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SECTION 6 TROUBLESHOOTING

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SECTION 8 DISASSEMBLY AND ASSEMBLY

1. STRUCTURE

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

SECTION 1 GENERAL

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

SECTION 2 STRUCTURE AND FUNCTION

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

SECTION 3 HYDRAULIC SYSTEM

This section explains the hydraulic circuit, single and combined operation.

SECTION 4 ELECTRICAL SYSTEM

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

SECTION 5 MECHATRONICS SYSTEM

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

SECTION 6 TROUBLESHOOTING

This section explains the troubleshooting charts correlating problems to causes.

SECTION 7 MAINTENANCE STANDARD

This section gives the judgement standards when inspecting disassembled parts.

SECTION 8 DISASSEMBLY AND ASSEMBLY

This section explains the order to be followed when removing, installing, disassembling or assembling each component, as well as precautions to be taken for these operations.

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

2. HOW TO READ THE SERVICE MANUAL

Distribution and updating

Any additions, amendments or other changes will be sent to HYUNDAI distributors.
Get the most up-to-date information before you start any work.

Filing method

1. See the page number on the bottom of the page.
   File the pages in correct order.
2. Following examples shows how to read the page number.
   Example 1
   2 - 3
   - 2: Item number(2. Structure and Function)
   - 3: Consecutive page number for each item.
3. Additional pages : Additional pages are indicated by a hyphen(-) and number after the page number. File as in the example.

   10 - 4
   10 - 4 - 1 ⎤
   10 - 4 - 2 ⎦ Added pages
   10 - 5

Revised edition mark(①②③···)

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

Revisions

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

Symbols

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

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

3. CONVERSION TABLE

Method of using the Conversion Table

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

Example

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

Convert 55mm into inches.

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

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

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

2. Convert 550mm into inches.

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

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

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

Millimeters to inches

1mm = 0.03937 in

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

Millimeters to inches

1mm = 0.03937in

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

Kilogram to Pound

1kg = 2.2046lb

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

Liter to U.S. Gallon

1 ℓ = 0.2642 U.S.Gal

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

Liter to U.K. Gallon

1 ℓ = 0.21997 U.K.Gal

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

kgf · m to lbf · ft

1kgf · m = 7.233lbf · ft

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

kgf/cm² to lbf/in²

1kgf / cm² = 14.2233lbf / in²

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

TEMPERATURE

Fahrenheit-Centigrade Conversion.

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

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

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

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

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

SECTION 1 GENERAL

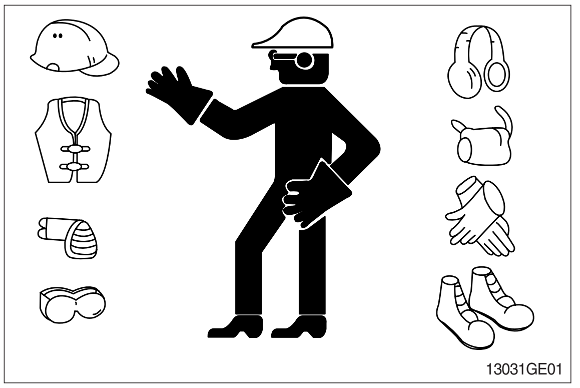
GROUP 1 SAFETY

FOLLOW SAFE PROCEDURE

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

WEAR PROTECTIVE CLOTHING

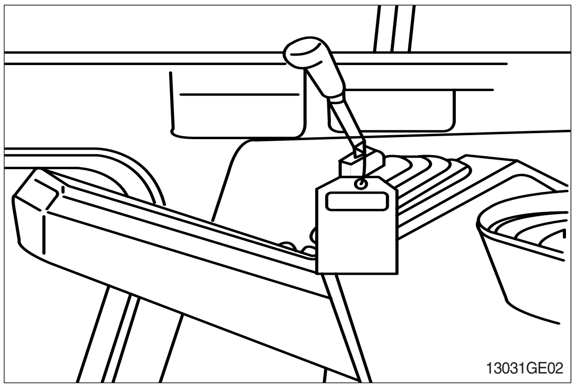
Wear close fitting clothing and safety equipment appropriate to the job.



13031GE01

WARN OTHERS OF SERVICE WORK

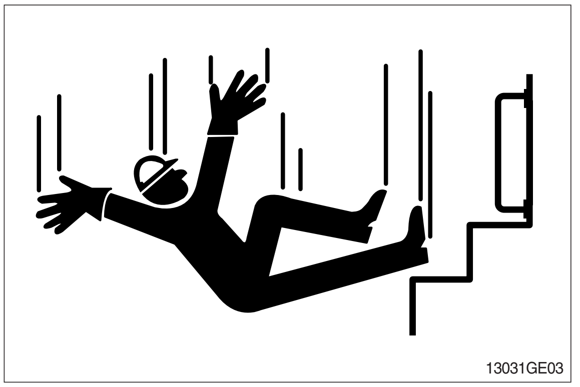
Unexpected machine movement can cause serious injury.
Before performing any work on the excavator, attach a 「**Do Not Operate**」 tag on the right side control lever.



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.



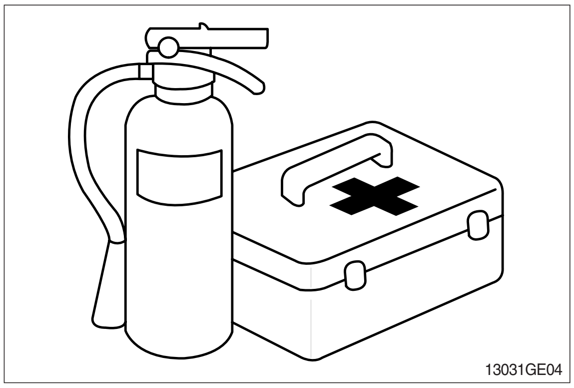
13031GE03

PREPARE FOR EMERGENCIES

Be prepared if a fire starts.

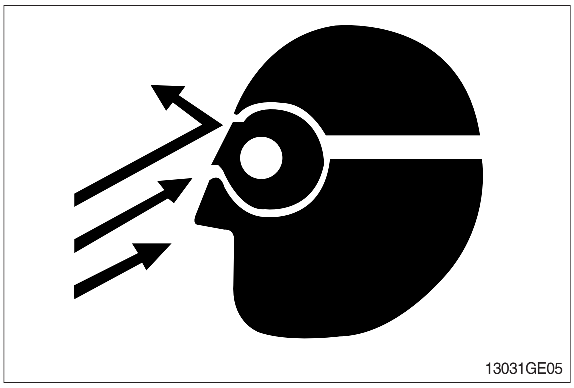
Keep a first aid kit and fire extinguisher handy.

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



PROTECT AGAINST FLYING DEBRIS

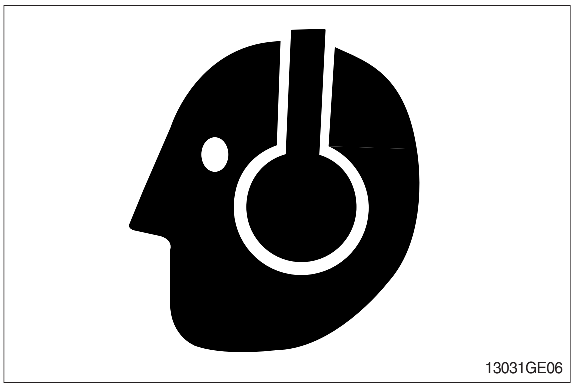
Guard against injury from flying pieces of metal or debris; Wear goggles or safety glasses.



PROTECT AGAINST NOISE

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

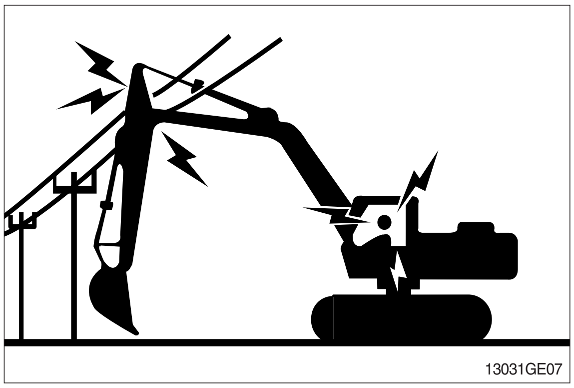
Wear a suitable hearing protective device such as earmuffs or earplugs to protect against objectionable or uncomfortable loud noises.



AVOID POWER LINES

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

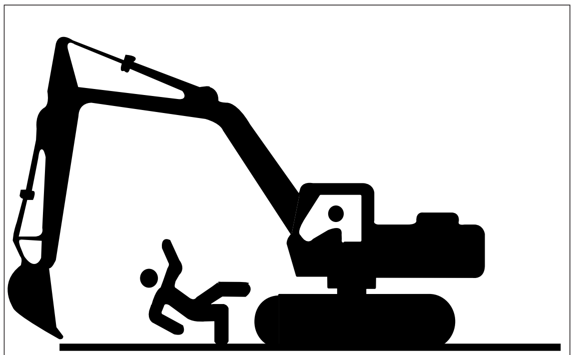
Never move any part of the machine or load closer to electric line than 3m(10ft) plus twice the line insulator length.



KEEP RIDERS OFF EXCAVATOR

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

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



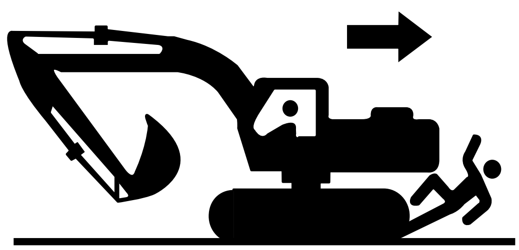
13031GE08

MOVE AND OPERATE MACHINE SAFELY

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

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

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

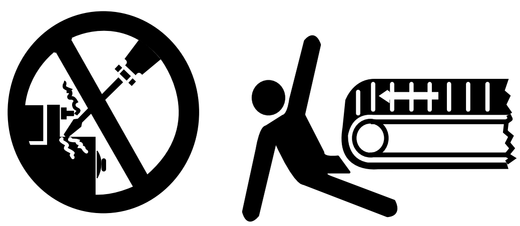


13031GE09

OPERATE ONLY FORM OPERATOR'S SEAT

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

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



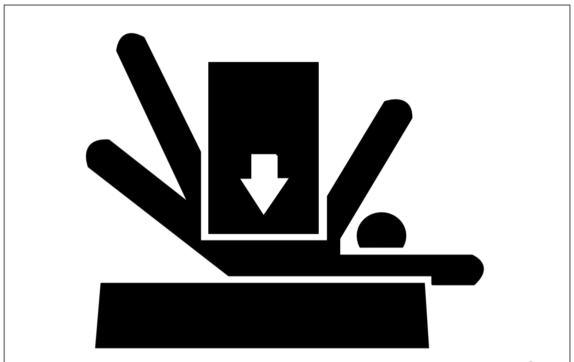
13031GE26

PARK MACHINE SAFELY

Before working on the machine:

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

SUPPORT MACHINE PROPERLY

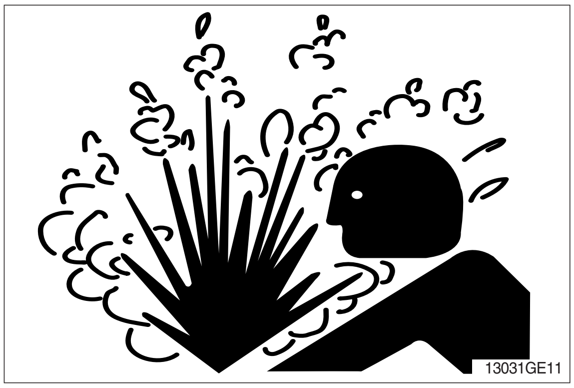

13031GE10

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

Do not support the machine on cinder blocks, hollow tiles, or props that may crumble under continuous load.

Do not work under a machine that is supported solely by a jack. Follow recommended procedures in this manual.

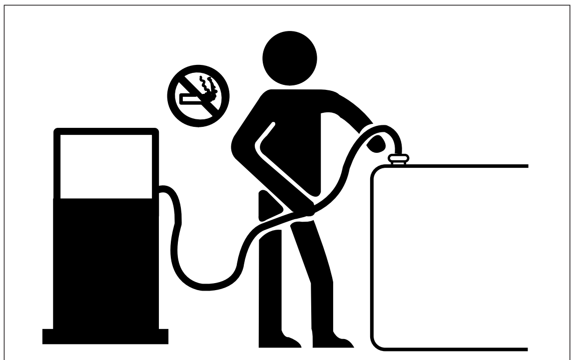
SERVICE COOLING SYSTEM SAFELY


13031GE11

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

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

HANDLE FLUIDS SAFELY-AVOID FIRES


13031GE12

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.


13031GE13

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

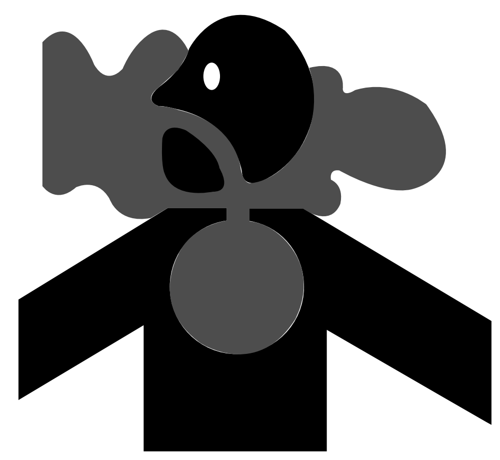
Make sure machine is clean of trash, grease, and debris.

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

BEWARE OF EXHAUST FUMES

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

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



13031GE14

REMOVE PAINT BEFORE WELDING OR HEATING

Avoid potentially toxic fumes and dust.

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

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

Remove paint before welding or heating:

· If you sand or grind paint, avoid breathing the dust.
Wear an approved respirator.

· If you use solvent or paint stripper, remove stripper with soap and water before welding. Remove solvent or paint stripper containers and other flammable material from area. Allow fumes to disperse at least 15 minutes before welding or heating.

ILLUMINATE WORK AREA SAFELY

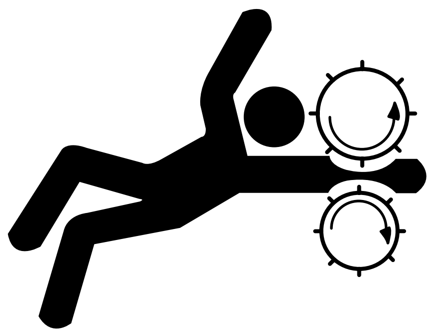
Illuminate your work area adequately but safely. Use a portable safety light for working inside or under the machine. Make sure the bulb is enclosed by a wire cage. The hot filament of an accidentally broken bulb can ignite spilled fuel or oil.

13031GE15

SERVICE MACHINE SAFELY

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

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

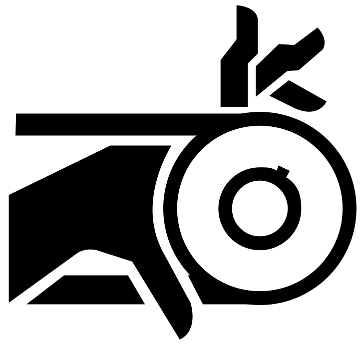


13031GE16

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

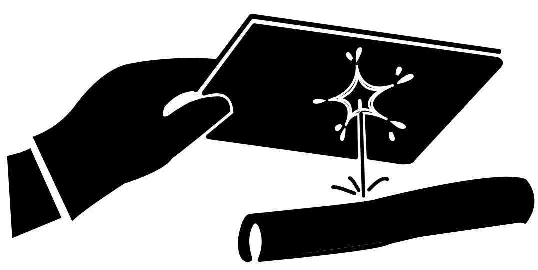
Escaping fluid under pressure can penetrate the skin causing serious injury.

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

13031GE20

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

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

PREVENT BATTERY EXPLOSIONS

13031GE21

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

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

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

PREVENT ACID BURNS

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

Avoid the hazard by:

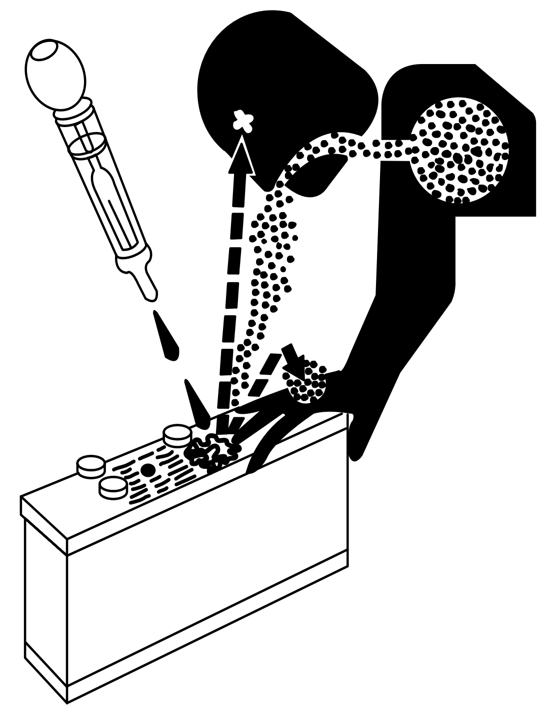
1. Filling batteries in a well-ventilated area.
2. Wearing eye protection and rubber gloves.
3. Avoiding breathing fumes when electrolyte is added.
4. Avoiding spilling of dripping electrolyte.
5. Use proper jump start procedure.

If you spill acid on yourself:

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

If acid is swallowed:

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



13031GE22

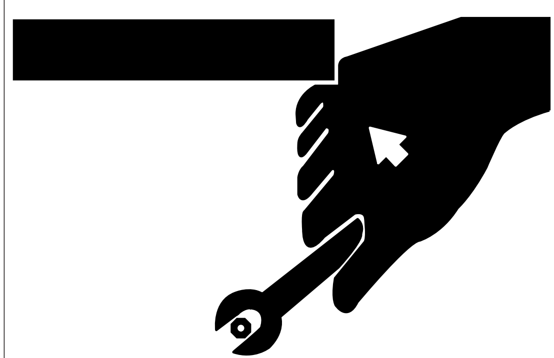
USE TOOLS PROPERLY

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.)



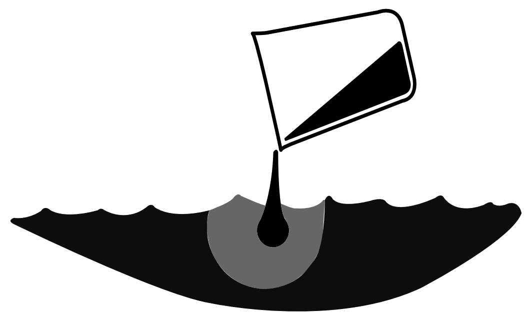
13031GE23

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.

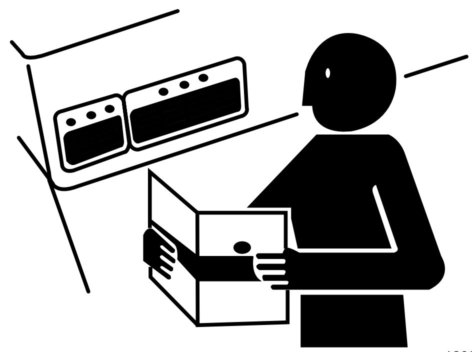
DO NOT pour oil into the ground, down a drain, or into a stream, pond, or lake. Observe relevant environmental protection regulations when disposing of oil, fuel, coolant, brake fluid, filters, batteries, and other harmful waste.



13031GE24

REPLACE SAFETY SIGNS

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

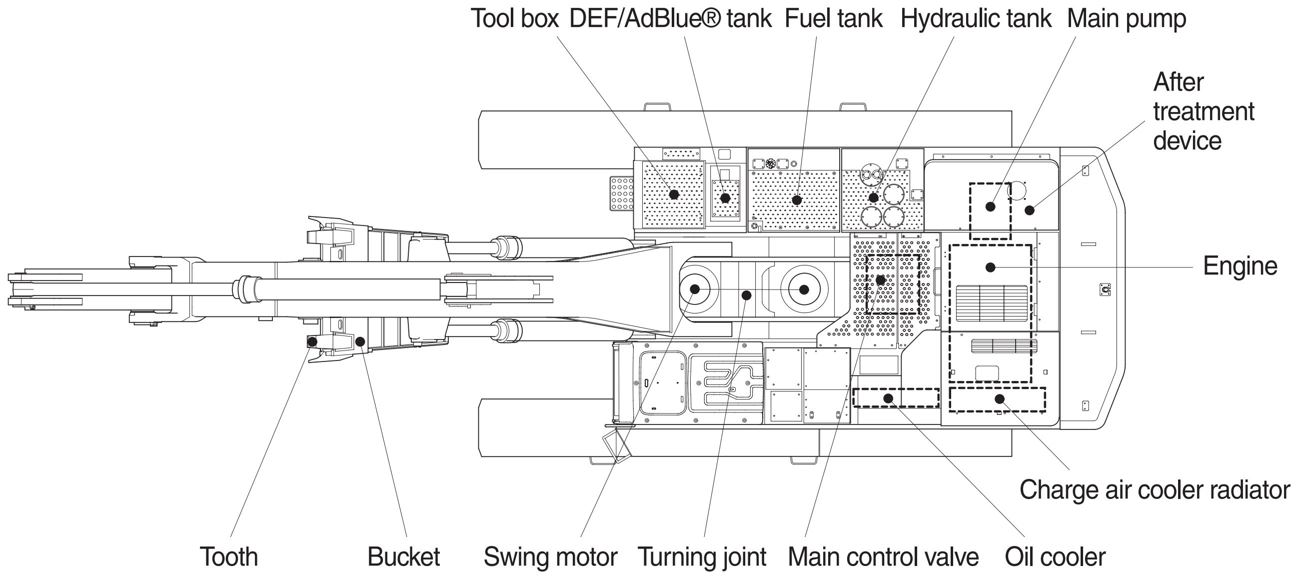


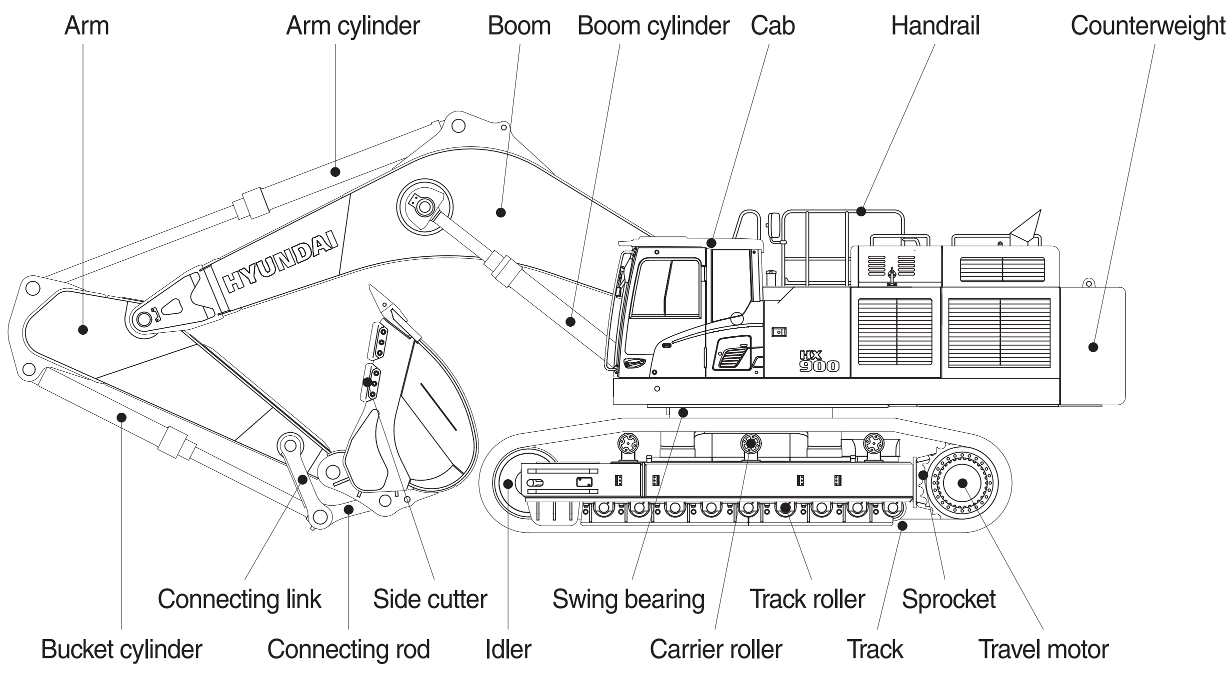
13031GE25

LIVE WITH SAFETY

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

1. MAJOR COMPONENT

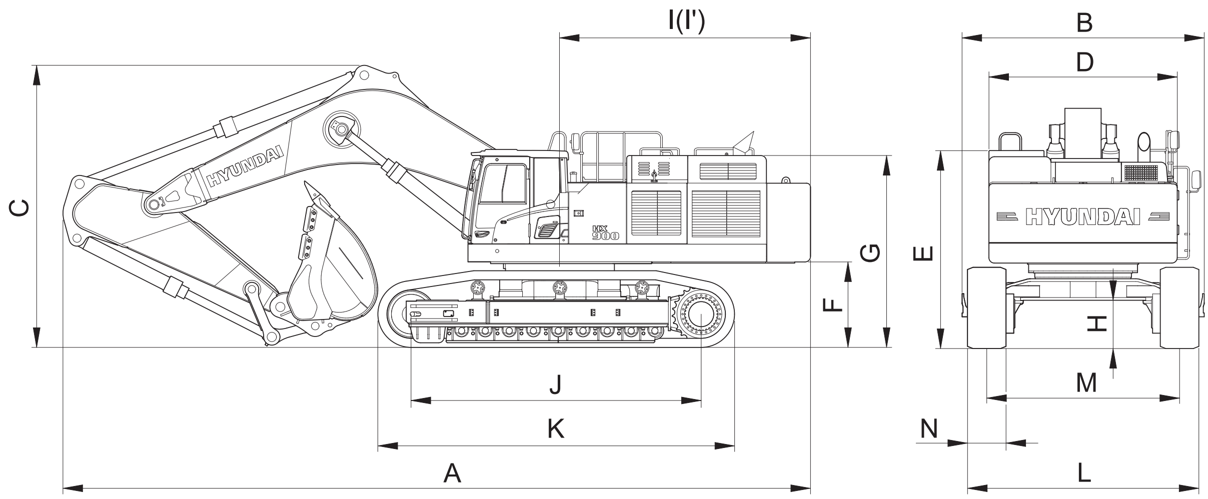




900F2SP01

2. SPECIFICATIONS

1) 7.20 m (23' 7") BOOM, 2.95 m (9' 8") ARM

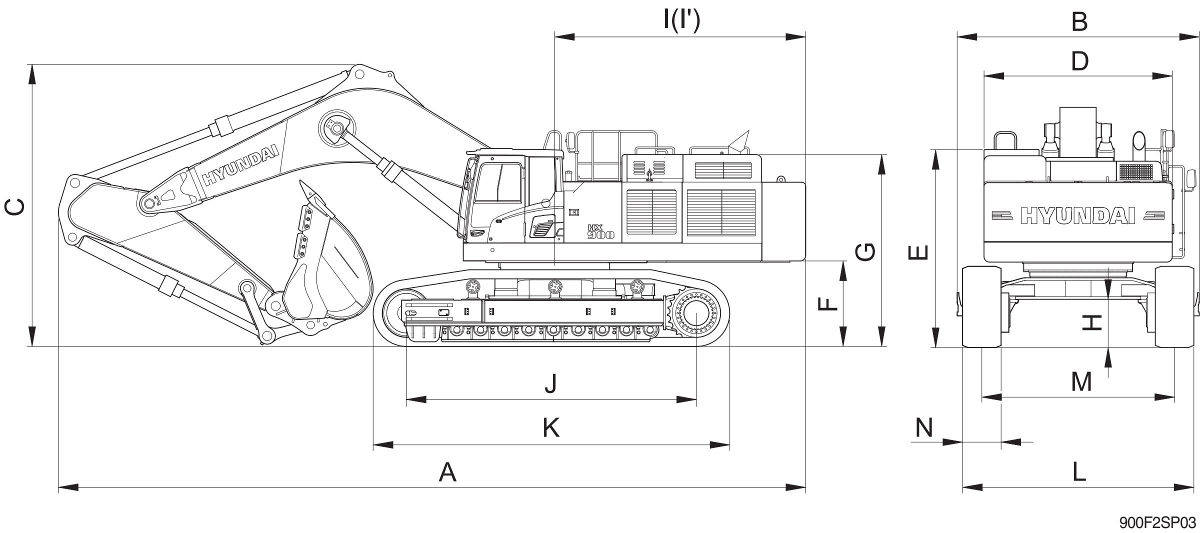


900F2SP03

Description		Unit	Specification
Operating weight		kg (lb)	88800 (195770) <89400 (197090)>
Bucket capacity (SAE heaped), standard		m^3 (yd^3)	4.85 (6.34)
Overall length	A	mm (ft-in)	13580 (44' 7")
Overall width, with 700 mm shoe	B		3775/4495 (12' 5"/14' 9")
Overall height	C		5380 (17' 8")
Superstructure width	D		3420 (11' 3")
Overall height of cab	E		3620 (11' 11") <4630 (15' 2")>
Ground clearance of counterweight	F		1615 (5' 4")
Engine cover height	G		3500 (11' 6")
Minimum ground clearance	H		925 (3' 0")
Rear-end distance	I		4550 (14' 11")
Rear-end swing radius	I'		4645 (15' 3")
Distance between tumblers	J		5130 (16' 10")
Undercarriage length	K		6445 (21' 2")
Undercarriage width	L		4200 (13' 9")
Track gauge	M		3500 (11' 6")
Track shoe width, standard	N		700 (28")
Travel speed (low/high)		km/hr (mph)	2.4/3.5 (1.5/2.2)
Swing speed		rpm	6.2
Gradeability		Degree (%)	35 (70)
Ground pressure (700 mm shoe)		kgf/cm^2 (psi)	1.14 (16.3)
Max traction force		kg (lb)	66800 (147270)

< > : Cabin riser

2) 8.20 m (26' 11") BOOM, 3.60 m (11' 10") ARM

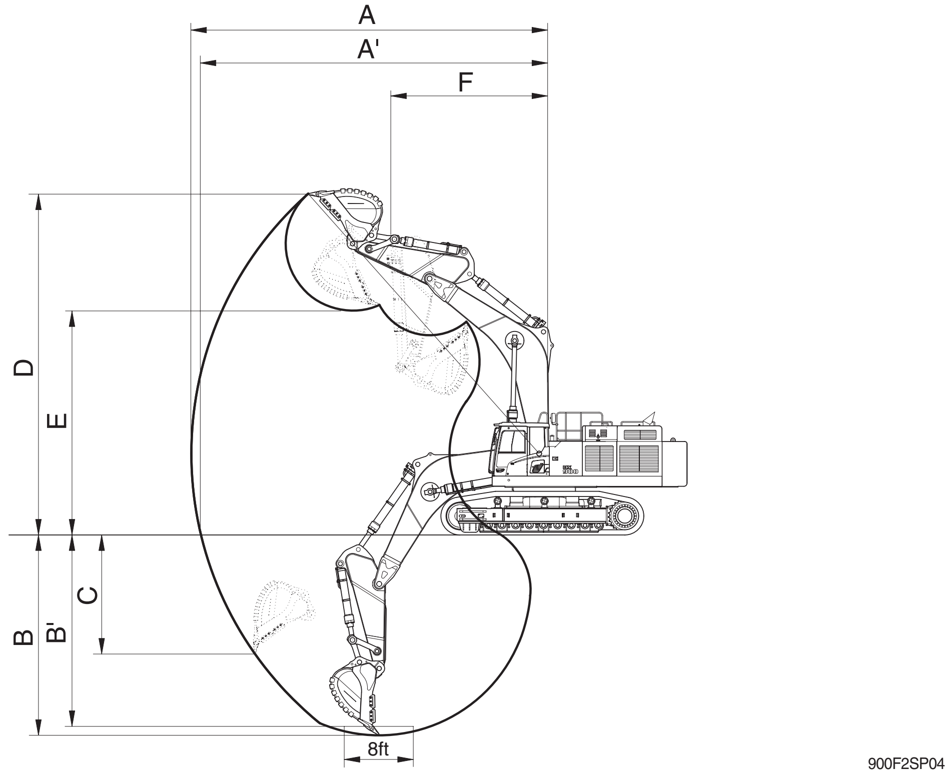


Description		Unit	Specification
Operating weight		kg (lb)	88900 (195990) <89500 (197310)>
Bucket capacity (SAE heaped), standard		m^3 (yd^3)	3.6 (4.71)
Overall length	A	mm (ft-in)	14380 (47' 2")
Overall width, with 700 mm shoe	B		3775/4495 (12' 5"/14' 9")
Overall height	C		5180 (17' 0")
Superstructure width	D		3420 (11' 3")
Overall height of cab	E		3620 (11' 11") <4630 (15' 2")>
Ground clearance of counterweight	F		1615 (5' 4")
Engine cover height	G		3500 (11' 6")
Minimum ground clearance	H		925 (3' 0")
Rear-end distance	I		4550 (14' 11")
Rear-end swing radius	I'		4645 (15' 3")
Distance between tumblers	J		5130 (16' 10")
Undercarriage length	K		6445 (21' 2")
Undercarriage width	L		4200 (13' 9")
Track gauge	M		3500 (11' 6")
Track shoe width, standard	N		700 (28")
Travel speed (low/high)		km/hr (mph)	2.4/3.5 (1.5/2.2)
Swing speed		rpm	6.2
Gradeability		Degree (%)	35 (70)
Ground pressure (700 mm shoe)		kgf/cm^2 (psi)	1.14 (16.3)
Max traction force		kg (lb)	66800 (147270)

< > : Cabin riser

3. WORKING RANGE

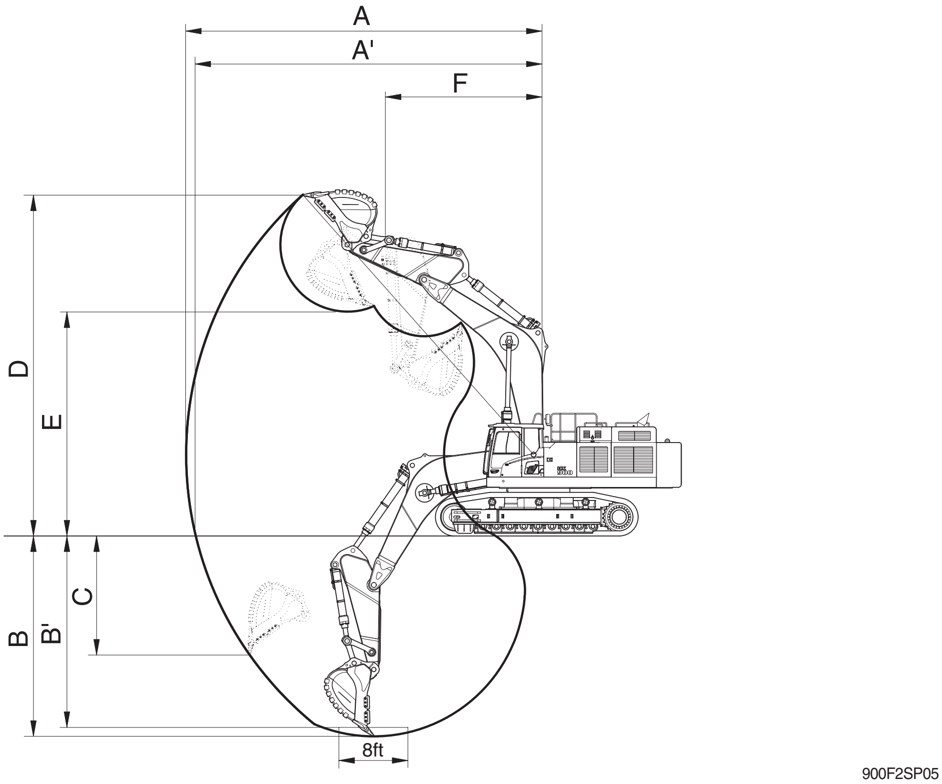
1) 7.20 m (23' 7") BOOM



Description		2.95 m (9' 8") Arm
Max digging reach	A	12300 mm (40' 4")
Max digging reach on ground	A'	12020 mm (39' 5")
Max digging depth	B	7230 mm (23' 9")
Max digging depth (8ft level)	B'	7090 mm (23' 3")
Max vertical wall digging depth	C	4370 mm (14' 4")
Max digging height	D	11910 mm (39' 1")
Max dumping height	E	7800 mm (25' 7")
Min swing radius	F	5100 mm (16' 9")
Bucket digging force	SAE	385.4 [420.4] kN
		39300 [42870] kgf
		86640 [94510] lbf
	ISO	439.3 [479.3] kN
		44800 [48870] kgf
		98770 [107740] lbf
Arm crowd force	SAE	372.7 [406.5] kN
		38000 [41450] kgf
		83780 [91380] lbf
	ISO	387.4 [422.6] kN
		39500 [43090] kgf
		87080 [95000] lbf

[ ] : Power boost

2) 8.20 m (26' 11") BOOM



Description		2.95 m (9' 8") Arm	3.60 m (11' 10") Arm	4.40 m (14' 5") Arm
Max digging reach	A	13360 mm (43' 10")	13920 mm (45' 8")	14670 mm (48' 2")
Max digging reach on ground	A'	13090 mm (42' 11")	13670 mm (44' 10")	14430 mm (47' 4")
Max digging depth	B	8160 mm (26' 9")	8810 mm (28' 11")	9610 mm (31' 6")
Max digging depth (8ft level)	B'	8020 mm (26' 4")	8680 mm (28' 6")	9500 mm (31' 2")
Max vertical wall digging depth	C	5250 mm (17' 3")	6000 mm (19' 8")	6670 mm (21' 11")
Max digging height	D	12630 mm (41' 5")	12780 mm (41' 11")	13190 mm (43' 3")
Max dumping height	E	8490 mm (27' 10")	8690 mm (28' 6")	9030 mm (29' 8")
Min swing radius	F	5930 mm (19' 5")	5970 mm (19' 7")	5970 mm (19' 7")
Bucket digging force	SAE	385.4 [420.4] kN	334.4 [364.8] kN	334.4 kN
		39300 [42870] kgf	34100 [37200] kgf	34100 kgf
		86640 [94510] lbf	75180 [82010] lbf	75180 lbf
	ISO	439.3 [479.3] kN	381.5 [416.2] kN	381.5 kN
		44800 [48870] kgf	38900 [42440] kgf	38900 kgf
		98770 [107740] lbf	85760 [93560] lbf	85760 lbf
Arm crowd force	SAE	372.7 [406.5] kN	307.9 [335.9] kN	266.7 kN
		38000 [41450] kgf	31400 [34250] kgf	27200 kgf
		83780 [91380] lbf	69230 [75510] lbf	59970 lbf
	ISO	387.4 [422.6] kN	319.7 [348.7] kN	274.6 kN
		39500 [43090] kgf	32600 [35560] kgf	28000 kgf
		87080 [95000] lbf	71870[78400] lbf	61730 lbf

[ ] : Power boost

4. WEIGHT

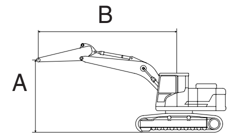
Item	HX900 L	
	kg	lb
Upperstructure assembly	30630	67530
Main frame weld assembly	7548	16640
Engine assembly	1490	3280
Main pump assembly	300	660
Main control valve assembly	424	930
Swing motor assembly	548	1210
Hydraulic oil tank assembly	706	1556
Fuel tank assembly	600	1323
Counterweight	13600	29980
Cab assembly	490	1080
Cab riser assy	600	1320
Lower chassis assembly	34790	76700
Track frame weld assembly	12809	28240
Swing bearing	1304	2875
Travel motor assembly	935	2060
Turning joint	75	165
Track recoil spring and tension body	742	1636
Idler	567	1250
Sprocket	240	530
Carrier roller	75	165
Track roller	199	439
Track-chain assembly (700 mm standard triple grouser shoe)	5038	11110
Front attachment assembly (7.20 m boom, 2.95 m arm, 4.85 m^3 SAE heaped bucket)	23380	51540
7.20 m boom assembly	7650	16870
8.20 m boom assembly	8220	18120
2.95 m arm assembly	3430	7560
3.60 m arm assembly	3770	8310
3.60 m^3 SAE heaped bucket	4620	10190
4.85 m^3 SAE heaped bucket	5420	11950
Boom cylinder assembly	862	1906
Arm cylinder assembly	1087	2400
Bucket cylinder assembly	754	1662
Bucket control linkage total	480	1060

5. LIFTING CAPACITIES

Unit : mm

Model	Boom	Boom	Arm	Counterweight	Shoe	Dozer		Outrigger	
	Type	Length	Length	Weight (kg)	Width	Front	Rear	Front	Rear
HX900 L	Mono	7200	2950	13600	700	-	-	-	-

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



Lift-point height (A)		Lift-point radius (B)										At max. reach		
		3.0m (9.8ft)		4.5m (14.8ft)		6.0m (19.7ft)		7.5m (24.6ft)		9.0m (29.5ft)		Capacity		Reach
														m (ft)
9.0 m	kg							*22440	*22440			*20960	*20960	7.63
29.5 ft	lb							*49470	*49470			*46210	*46210	(25.0)
7.5 m	kg							*23970	*23970			*20020	19150	8.68
24.6 ft	lb							*52840	*52840			*44140	42220	(28.5)
6.0 m	kg			*38200	*38200	*29660	*29660	*24980	23980	*22110	17750	*19840	16520	9.38
19.7 ft	lb			*84220	*84220	*65390	*65390	*55070	52870	*48740	39130	*43740	36420	(30.8)
4.5 m	kg					*32700	32410	*26400	22960	*22560	17270	*20240	15040	9.79
14.8 ft	lb					*72090	71450	*58200	50620	*49740	38070	*44620	33160	(32.1)
3.0 m	kg					*35050	30510	*27590	21940	*22980	16720	*20640	14300	9.96
9.8 ft	lb					*77270	67260	*60830	48370	*50660	36860	*45500	31530	(32.7)
1.5 m	kg					*35620	29250	*28010	21130	*22900	16250	*20260	14160	9.90
4.9 ft	lb					*78530	64490	*61750	46580	*50490	35830	*44670	31220	(32.5)
0.0 m	kg					*34230	28650	*27230	20640	*21890	15960	*19740	14610	9.60
0.0 ft	lb					*75460	63160	*60030	45500	*48260	35190	*43520	32210	(31.5)
-1.5 m	kg			*37480	*37480	*31020	28520	*24890	20490	*19060	15960	*18860	15870	9.04
-4.9 ft	lb			*82630	*82630	*68390	62880	*54870	45170	*42020	35190	*41580	34990	(29.7)
-3.0 m	kg			*30370	*30370	*25700	*25700	*20210	*20210			*17140	*17140	8.17
-9.8 ft	lb			*66950	*66950	*56660	*56660	*44560	*44560			*37790	*37790	(26.8)
-4.5 m	kg			*19940	*19940	*16840	*16840					*13310	*13310	6.86
-14.8 ft	lb			*43960	*43960	*37130	*37130					*29340	*29340	(22.5)

※ 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 lift-point is bucket pivot mounting pin on the arm (without bucket mass).
4. *indicates load limited by hydraulic capacity.

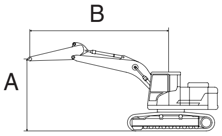
※ Lifting capacities are based upon a standard machine conditions.
Lifting capacities will vary with different work tools, ground conditions and attachments.
The difference between the weight of a work tool attachment must be subtracted.
Consult your Hyundai dealer regarding the lifting capacities for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

⚠ Failure to comply to the rated load can cause possible personal injury or property damage.
Make adjustments to the rated load as necessary for non-standard configurations.

Unit : mm

Model	Boom	Boom	Arm	Counterweight	Shoe	Dozer		Outrigger	
	Type	Length	Length	Weight (kg)	Width	Front	Rear	Front	Rear
HX900 L	Mono	8200	2950	13600	700	-	-	-	-

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

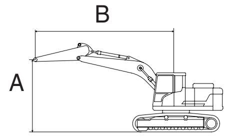


Lift-point height (A)		Lift-point radius (B)														At max. reach		
		3.0 m (10.0 ft)		4.5 m (15.0 ft)		6.0 m (20.0ft)		7.5 m (25.0 ft)		9.0 m (30.0 ft)		10.5 m (34.0 ft)		12.0 m (39.0 ft)		Capacity		Reach
																		m (ft)
10.5 m	kg							*21570	*21570							*21500	*21500	7.67
34.4 ft	lb							*47550	*47550							*47400	*47400	(25.2)
9.0 m	kg															*19770	18110	8.98
29.5 ft	lb															*43590	39930	(29.5)
7.5 m	kg							*21980	*21980	*19660	17890					*18850	15090	9.89
24.6 ft	lb							*48460	*48460	*43340	39440					*41560	33270	(32.4)
6.0 m	kg					*28820	*28820	*23450	23140	*20270	17330					*18290	13330	10.50
19.7 ft	lb					*63540	*63540	*51700	51010	*44690	38210					*40320	29390	(34.4)
4.5 m	kg							*25090	21870	*21060	16630	*18440	13030			*17920	12280	10.87
14.8 ft	lb							*55310	48220	*46430	36660	*40650	28730			*39510	27070	(35.7)
3.0 m	kg							*26350	20720	*21720	15950	*18600	12660			*17650	11730	11.02
9.8 ft	lb							*58090	45680	*47880	35160	*41010	27910			*38910	25860	(36.2)
1.5 m	kg							*26780	19910	*21950	15400	*18450	12350			*17400	11600	10.96
4.9 ft	lb							*59040	43890	*48390	33950	*40680	27230			*38360	25570	(36.0)
0.0 m	kg							*26210	19460	*21510	15060	*17640	12180			*17070	11880	10.70
0.0 ft	lb							*57780	42900	*47420	33200	*38890	26850			*37630	26190	(35.1)
-1.5 m	kg					*29630	27100	*24560	19330	*20120	14960					*16540	12690	10.20
-4.9 ft	lb					*65320	59750	*54150	42620	*44360	32980					*36460	27980	(33.5)
-3.0 m	kg			*28720	*28720	*25840	*25840	*21630	19500	*17200	15150					*15550	14290	9.44
-9.8 ft	lb			*63320	*63320	*56970	*56970	*47690	42990	*37920	33400					*34280	31500	(31.0)
-4.5 m	kg			*22220	*22220	*20270	*20270	*16600	*16600							*13570	*13570	8.33
-14.8 ft	lb			*48990	*48990	*44690	*44690	*36600	*36600							*29920	*29920	(27.3)
-6.0 m	kg																	
-19.7 ft	lb																	

Unit : mm

Model	Boom	Boom	Arm	Counterweight	Shoe	Dozer		Outrigger	
	Type	Length	Length	Weight (kg)	Width	Front	Rear	Front	Rear
HX900 L	Mono	8200	3600	13600	700	-	-	-	-

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

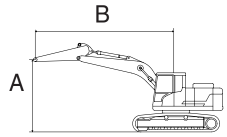


Lift-point height (A)		Lift-point radius (B)														At max. reach		
		3.0 m (10.0 ft)		4.5 m (15.0 ft)		6.0 m (20.0ft)		7.5 m (25.0 ft)		9.0 m (30.0 ft)		10.5 m (34.0 ft)		12.0 m (39.0 ft)		Capacity		Reach
																		m (ft)
10.5 m	kg															*14300	*14300	8.47
34.4 ft	lb															*31530	*31530	(27.8)
9.0 m	kg									*17910	*17910					*13440	*13440	9.67
29.5 ft	lb									*39480	*39480					*29630	*29630	(31.7)
7.5 m	kg									*18750	18280	*13220	*13220			*13070	*13070	10.51
24.6 ft	lb									*41340	40300	*29150	*29150			*28810	*28810	(34.5)
6.0 m	kg					*27270	*27270	*22480	*22480	*19540	17690	*17600	13630			*13040	12320	11.09
19.7 ft	lb					*60120	*60120	*49560	*49560	*43080	39000	*38800	30050			*28750	27160	(36.4)
4.5m	kg					*30770	*30770	*24320	22430	*20510	16960	*18000	13240			*13300	11420	11.44
14.8 ft	lb					*67840	*67840	*53620	49450	*45220	37390	*39680	29190			*29320	25180	(37.5)
3.0 m	kg					*33410	29230	*25890	21200	*21390	16230	*18380	12820			*13850	10930	11.59
9.8 ft	lb					*73660	64440	*57080	46740	*47160	35780	*40520	28260			*30530	24100	(38.0)
1.5 m	kg					*34260	27890	*26730	20260	*21890	15610	*18500	12440			*14740	10790	11.53
4.9 ft	lb					*75530	61490	*58930	44670	*48260	34410	*40790	27430			*32500	23790	(37.8)
0.0 m	kg					*33450	27280	*26620	19660	*21790	15180	*18130	12180			*16110	11000	11.28
0.0 ft	lb					*73740	60140	*58690	43340	*48040	33470	*39970	26850			*35520	24250	(37.0)
-1.5 m	kg			*23630	*23630	*31380	27120	*25470	19400	*20860	14960	*16900	12090			*15970	11640	10.81
-4.9 ft	lb			*52100	*52100	*69180	59790	*56150	42770	*45990	32980	*37260	26650			*35210	25660	(35.5)
-3.0 m	kg	*24830	*24830	*33260	*33260	*28120	27280	*23140	19430	*18760	15000					*15350	12900	10.09
-9.8 ft	lb	*54740	*54740	*73330	*73330	*61990	60140	*51010	42840	*41360	33070					*33840	28440	(33.1)
-4.5 m	kg			*26990	*26990	*23290	*23290	*19160	*19160	*14380	*14380					*14080	*14080	9.07
-14.8ft	lb			*59500	*59500	*51350	*51350	*42240	*42240	*31700	*31700					*31040	*31040	(29.8)
-6.0m	kg					*15890	*15890	*11750	*11750							*11240	*11240	7.62
-19.7ft	lb					*35030	*35030	*25900	*25900							*24780	*24780	(25.0)

Unit : mm

Model	Boom	Boom	Arm	Counterweight	Shoe	Dozer		Outrigger	
	Type	Length	Length	Weight (kg)	Width	Front	Rear	Front	Rear
HX900 L	Mono	8200	4400	16500	700	-	-	-	-

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

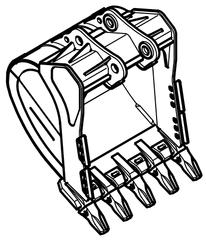
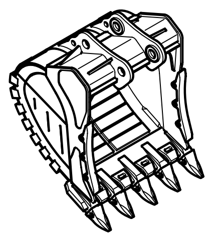
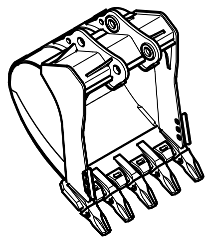
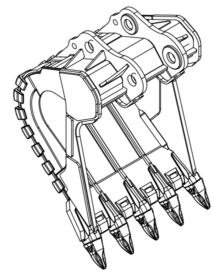


Lift-point height (A)		Lift-point radius (B)														At max. reach		
		3.0 m (10.0 ft)		4.5 m (15.0 ft)		6.0 m (20.0ft)		7.5 m (25.0 ft)		9.0 m (30.0 ft)		10.5 m (34.0 ft)		12.0 m (39.0 ft)		Capacity		Reach
		over-front	over-side	over-front	over-side	over-front	over-side	over-front	over-side	over-front	over-side	over-front	over-side	over-front	over-side	over-front	over-side	m (ft)
10.5m	kg															*14300	*14300	8.47
34.4ft	lb															*31530	*31530	(27.8)
9.0m	kg									*17910	*17910					*13440	*13440	9.67
29.5ft	lb									*39480	*39480					*29630	*29630	(31.7)
7.5m	kg									*18750	18280	*13220	*13220			*13070	*13070	10.51
24.6ft	lb									*41340	40300	*29150	*29150			*28810	*28810	(34.5)
6.0m	kg					*27270	*27270	*22480	*22480	*19540	17690	*17600	13630			*13040	12320	11.09
19.7ft	lb					*60120	*60120	*49560	*49560	*43080	39000	*38800	30050			*28750	27160	(36.4)
4.5m	kg					*30770	*30770	*24320	22430	*20510	16960	*18000	13240			*13300	11420	11.44
14.8ft	lb					*67840	*67840	*53620	49450	*45220	37390	*39680	29190			*29320	25180	(37.5)
3.0m	kg					*33410	29230	*25890	21200	*21390	16230	*18380	12820			*13850	10930	11.59
9.8ft	lb					*73660	64440	*57080	46740	*47160	35780	*40520	28260			*30530	24100	(38.0)
1.5m	kg					*34260	27890	*26730	20260	*21890	15610	*18500	12440			*14740	10790	11.53
4.9ft	lb					*75530	61490	*58930	44670	*48260	34410	*40790	27430			*32500	23790	(37.8)
0.0m	kg					*33450	27280	*26620	19660	*21790	15180	*18130	12180			*16110	11000	11.28
0.0ft	lb					*73740	60140	*58690	43340	*48040	33470	*39970	26850			*35520	24250	(37.0)
-1.5m	kg			*23630	*23630	*31380	27120	*25470	19400	*20860	14960	*16900	12090			*15970	11640	10.81
-4.9ft	lb			*52100	*52100	*69180	59790	*56150	42770	*45990	32980	*37260	26650			*35210	25660	(35.5)
-3.0m	kg	*24830	*24830	*33260	*33260	*28120	27280	*23140	19430	*18760	15000					*15350	12900	10.09
-9.8ft	lb	*54740	*54740	*73330	*73330	*61990	60140	*51010	42840	*41360	33070					*33840	28440	(33.1)
-4.5m	kg			*26990	*26990	*23290	*23290	*19160	*19160	*14380	*14380					*14080	*14080	9.07
-14.8ft	lb			*59500	*59500	*51350	*51350	*42240	*42240	*31700	*31700					*31040	*31040	(29.8)
-6.0m	kg					*15890	*15890	*11750	*11750							*11240	*11240	7.62
-19.7ft	lb					*35030	*35030	*25900	*25900							*24780	*24780	(25.0)

6. BUCKET SELECTION GUIDE

1) HX900 L

(1) HEAVY DUTY AND ROCK-HEAVY DUTY BUCKET

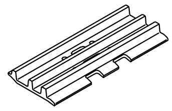
			
◇ Heavy duty	◈ Rock-heavy duty	◆ Light-heavy duty	★ Rock-special heavy duty (Cubic marble handling)

Capacity		Width	Weight	Tooth	Recommendation			
					7.2 m (23' 7") boom	8.2 m (26' 11") boom		
SAE heaped	CECE heaped				2.95 m (9' 8") arm	2.95 m (9' 8") arm	3.6 m (11' 10") arm	4.4 m (14' 5") arm
◇3.70 m³ (4.84 yd³)	3.30 m³ (4.32 yd³)	1845 mm (72.6")	4370 kg (9630 lb)	4 EA	●	◐	■	■
◇4.25 m³ (5.56 yd³)	3.75 m³ (4.90 yd³)	2045 mm (80.5")	4730 kg (10430 lb)	5 EA	●	■	▲	▲
◇4.85 m³ (6.34 yd³)	4.25 m³ (5.56yd³)	2245mm (88.4")	5000 kg (11020 lb)	5 EA	◐	▲	▲	▲
◇5.40 m³ (7.06 yd³)	4.75 m³ (6.21 yd³)	2445mm (96.3")	5275 kg (11630 lb)	5 EA	■			
◇5.80 m³ (7.59 yd³)	5.05 m³ (6.61 yd³)	2585mm (101.8")	5555 kg (12250 lb)	6 EA	▲			
◈3.70 m³ (4.84 yd³)	3.30 m³ (4.32 yd³)	1845mm (72.6")	4850 kg (10690 lb)	4 EA	●	◐	■	■
◈4.25 m³ (5.56 yd³)	3.75 m³ (4.90 yd³)	2045mm (80.5")	5235 kg (11540 lb)	5 EA	◐	■	▲	▲
◈4.85 m³ (6.34 yd³)	4.25 m³ (5.56 yd³)	2245mm (88.4")	5530 kg (12190 lb)	5 EA	■	▲		
◈5.40 m³ (7.06 yd³)	4.75 m³ (6.21 yd³)	2445mm (96.3")	5830 kg (12850 lb)	5 EA	■			
◆4.25 m³ (5.56 yd³)	3.75 m³ (4.90 yd³)	2045mm (80.5")	4150 kg (9150 lb)	5 EA	●	■	■	■
★3.60 m³ (4.71 yd³)	3.10 m³ (4.05 yd³)	1920mm (75.6")	4600 kg (10140 lb)	5 EA	●	◐	■	■

▲	Applicable for materials with density of 1200 kg/m³ (2000 lb/yd³) or less
■	Applicable for materials with density of 1500 kg/m³ (2500 lb/yd³) or less
◐	Applicable for materials with density of 1800 kg/m³ (3000 lb/yd³) or less
●	Applicable for materials with density of 2100 kg/m³ (3500 lb/yd³) or less

7. UNDERCARRIAGE

1) TRACKS

Model	Shapes		Double grouser		
					
HX900 L	Shoe width	mm (in)	700 (28)	800 (32)	900 (36)
	Operating weight	kg (lb)	88900 (195990)	89720 (197800)	90540 (199610)
	Ground pressure	kgf/cm^2 (psi)	1.14 (16.3)	1.01 (14.4)	0.91 (12.9)
	Overall width	mm (in)	4200 (13' 9")	4300 (14' 1")	4400 (14' 5")

2) NUMBER OF ROLLERS AND SHOES ON EACH SIDE

Item	Quantity
Carrier rollers	3 EA
Track rollers	9 EA
Track shoes	52 EA

3) 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
700 mm triple grouser	Option	A
800 mm triple grouser	Option	B
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	Scania DC16 084A
Type	Eco-friendly, 4-cycle turbocharged charger air cooled diesel engine
Cooling method	Water cooling
Number of cylinders and arrangement	8 cylinders
Firing order	1-5-4-2-6-3-7-8
Combustion chamber type	Direct injection type
Cylinder bore × stroke	130 × 154 mm (5.12" × 6.1")
Piston displacement	16400 cc (1000 cu in)
Compression ratio	17.4 : 1
Rated horse power	641 Hp at 2100 rpm (478 kW at 2100 rpm)
Maximum torque	321 kgf · m (2322 lbf · ft) at 1350 rpm
Engine oil quantity	49 ℓ (12.9 U.S. gal)
Dry weight	1490 kg (3280 lb)
Low idling speed	850 ± 100 rpm
High idling speed	1750 ± 50 rpm
Rated fuel consumption	155 g/Hp · hr at 1800 rpm
Starting motor	24V-7kW
Alternator	24V-100A
Battery	4 × 12V × 160Ah

2) MAIN PUMP

Item	Specification
Type	Variable displacement axial piston pumps
Capacity	2 × 280 cc/rev
Maximum pressure	330 kgf/cm² (4690 psi) [360 kgf/cm² (5120 psi)]
Rated oil flow	2 × 504 ℓ/min (133.1 U.S. gpm / 110.9 U.K. gpm)
Rated speed	1800 rpm

[ ] : Power boost

3) GEAR PUMP

Item	Specification
Type	Fixed displacement gear pump single stage
Capacity	15 cc/rev
Maximum pressure	40 kgf/cm² (570 psi)
Rated oil flow	27 ℓ/min (7.1 U.S. gpm/5.9 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)]
Port relief valve pressure	380 kgf/cm² (5400 psi)

[ ] : Power boost

5) SWING MOTOR

Item	Specification
Type	Fixed displacement axial piston motor
Capacity	250cc/rev
Relief pressure	300 kgf/cm² (3360 psi)
Braking system	Automatic, spring applied hydraulic released
Braking torque	165.2 kgf · m (1195 lbf · ft) over
Brake release pressure	33.7~50 kgf/cm² (479~711 psi)
Reduction gear type	2 - stage planetary

6) TRAVEL MOTOR

Item	Specification
Type	Axial piston motor
Relief pressure	350 kgf/cm² (4980 psi)
Capacity (max / min)	337.2/228.6 cc/rev
Reduction gear type	3-stage planetary
Braking system	Automatic, spring applied hydraulic released
Brake release pressure	18 kgf/cm² (256 psi) below
Braking torque	114 kgf · m (825 lbf · ft) over

7) CYLINDER

Item		Specification
Boom cylinder	Bore dia × Rod dia × Stroke	Ø215 × Ø150 × 1935 mm
	Cushion	Extend only
Arm cylinder	Bore dia × Rod dia × Stroke	Ø225 × Ø160 × 2290 mm
	Cushion	Extend and retract
Bucket cylinder	Bore dia × Rod dia × Stroke	Ø215 × Ø150 × 1593 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
HX900 L	Standard	★700 mm (28")	1.14 kgf/cm^2 (16.3 psi)	52	4200 mm (13' 9")
	Option	★800 mm (32")	1.01 kgf/cm^2 (14.4 psi)	52	4300 mm (14' 1")
		★900 mm (36")	0.91 kgf/cm^2 (12.9 psi)	52	4400 mm (14' 5")

★ : Double grouser

9) BUCKET

Item	Capacity		Tooth quantity	Width
	SAE heaped	CECE heaped		
HX900 L	◇3.70 m^3 (4.84 yd^3)	3.30 m^3 (4.32 yd^3)	4	1845 mm (72.6")
	◇4.25 m^3 (5.56 yd^3)	3.75 m^3 (4.90 yd^3)	5	2045 mm (80.5")
	◇4.85 m^3 (6.34 yd^3)	4.25 m^3 (5.56 yd^3)	5	2245mm (88.4")
	◇5.40 m^3 (7.06 yd^3)	4.75 m^3 (6.21 yd^3)	5	2445mm (96.3")
	◇5.80 m^3 (7.59 yd^3)	5.05 m^3 (6.61 yd^3)	6	2585mm (101.8")
	◈3.70 m^3 (4.84 yd^3)	3.30 m^3 (4.32 yd^3)	4	1845mm (72.6")
	◈4.25 m^3 (5.56 yd^3)	3.75 m^3 (4.90 yd^3)	5	2045mm (80.5")
	◈4.85 m^3 (6.34 yd^3)	4.25 m^3 (5.56 yd^3)	5	2245mm (88.4")
	◈5.40 m^3 (7.06 yd^3)	4.75 m^3 (6.21 yd^3)	5	2445mm (96.3")
	◆4.25 m^3 (5.56 yd^3)	3.75 m^3 (4.90 yd^3)	5	2045mm (80.5")
	★3.60 m^3 (4.71 yd^3)	3.10 m^3 (4.05 yd^3)	5	1920mm (75.6")

◇ : Heavy duty
◈ : Rock-heavy duty
◆ : Light-heavy duty
★ : Rock-special heavy duty (Cubic marble handling)

9. RECOMMENDED OILS

HYUNDAI genuine lubricating oils have been developed to offer the best performance and service life for your equipment. These oils have been tested according to the specifications of HYUNDAI and, therefore, will meet the highest safety and quality requirements.

We recommend that you use only HYUNDAI genuine lubricating oils and grease officially approved by HYUNDAI.

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	49 (12.9)	★SAE 5W-40 SAE 30 SAE 10W SAE 10W-30 SAE 15W-40
DEF/AdBlue® tank	Mixture of urea and deionized water	69 (18.2)	ISO 22241, High-purity urea + deionized water (32.5:67.5)
Swing drive	Gear oil	14×2 (3.7×2)	★SAE 85W-140 (GL-4)
Final drive	Gear oil	20×2 (5.3×2)	SAE 80W-90 (GL-5)
Hydraulic tank	Hydraulic oil	Tank : 450 (119) System : 940 (248)	★ISO VG 15 ISO VG 32 ISO VG 46, HBHO★3 ISO VG 68
Fuel tank	Diesel fuel★1	1110 (293)	★ASTM D975 NO.1 ASTM D975 NO.2
Track roller	Gear oil	1.56 (0.41)	★SAE 75W-90 SAE 85W-140
Carrier roller	Gear oil	0.6 (0.16)	
Idler	Gear oil	1.1 (0.29)	
Fitting (grease nipple)	Grease	As required	★NLGI NO.1 NLGI NO.2
Radiator (reservoir tank)	Mixture of antifreeze and soft water★2	70 (18.5)	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
UTTO : Universal Tractor Transmission Oil
DEF : Diesel Exhaust Fluid, DEF compatible with AdBlue®

★ : Cold region
Russia, CIS, Mongolia
★1 : Ultra low sulfur diesel
- sulfur content ≤ 15 ppm
★2 : Soft water
City water or distilled water
★3 : Hyundai Bio Hydraulic Oil
- For more information, contact HYUNDAI dealers.

※ Using any lubricating oils other than HYUNDAI genuine products may lead to a deterioration of performance and cause damage to major components.

※ Do not mix HYUNDAI genuine oil with any other lubricating oil as it may result in damage to the systems of major components.

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

※ For HYUNDAI genuine lubricating oils and grease for use in regions with extremely low temperatures, please contact HYUNDAI dealers.

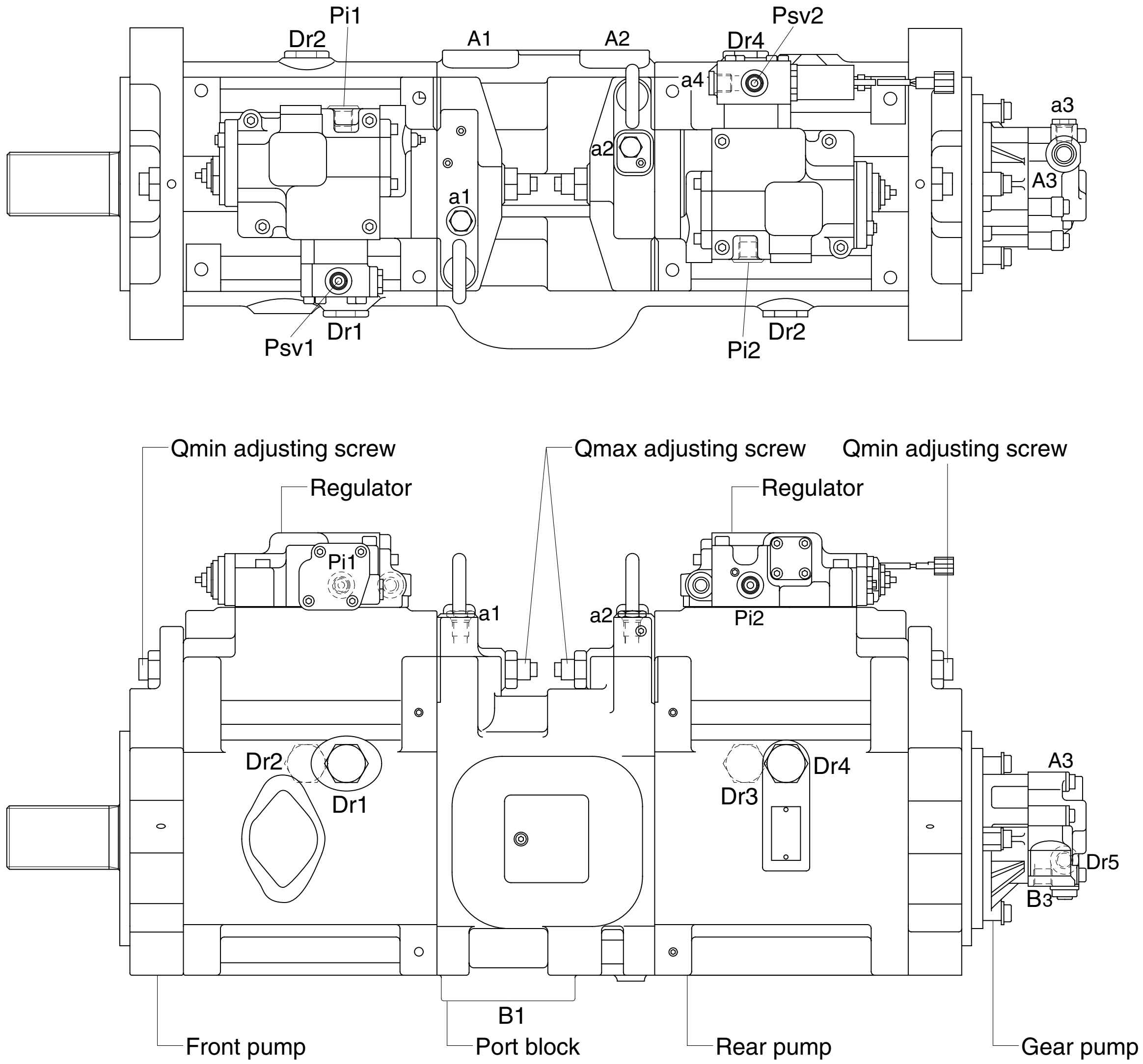
SECTION 2 STRUCTURE AND FUNCTION

SECTION 2 STRUCTURE AND FUNCTION

GROUP 1 PUMP DEVICE

1. STRUCTURE

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



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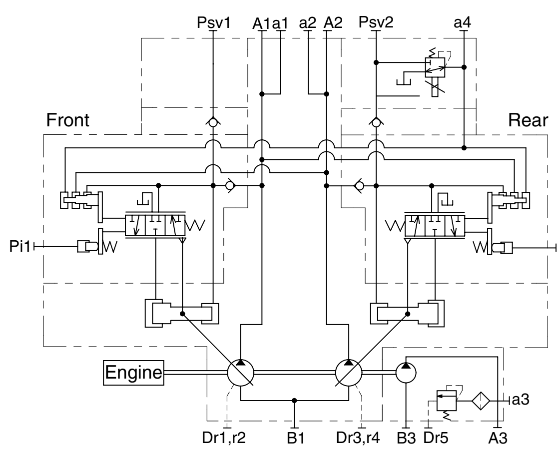
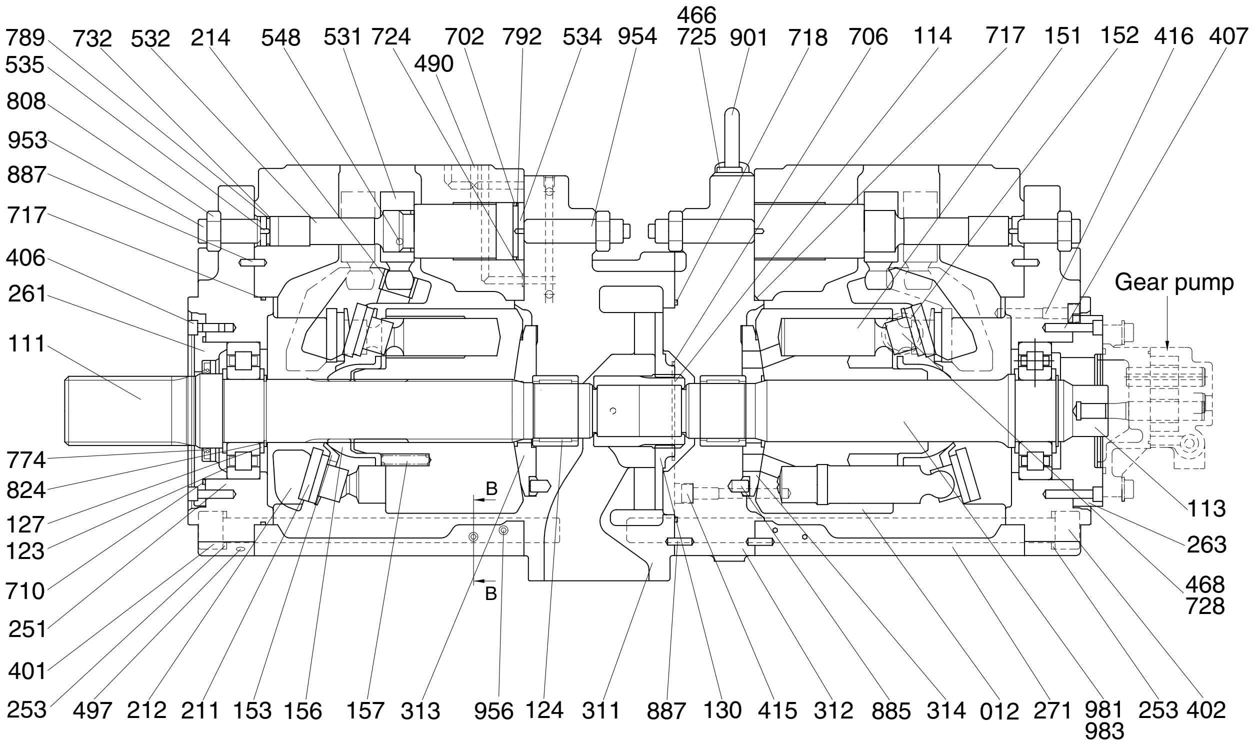
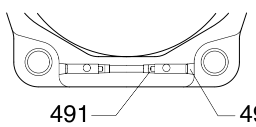


Port	Port name	Port size
A1,A2	Delivery port	SAE6000 psi 1 1/4"
B1	Suction port	SAE2500 psi 3 1/2"
Dr1~Dr4	Drain port	PF 3/4 - 23
Pi1,Pi2	Pilot port	PF 1/4 - 15
Psv1, Psv2	Servo assist port	PF 1/4 - 15
a1, a2	Gauge port	PF 1/4 - 15
a3	Gauge port	PF 1/4 - 14
a4	Gauge port	PF 1/4 - 13
A3	Gear delivery port	PF 1/2 - 19
B3	Gear suction port	PF 3/4 - 20.5
Dr5	Drain port	PF 3/8 - 15

1) **MAIN PUMP** (1/2)

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



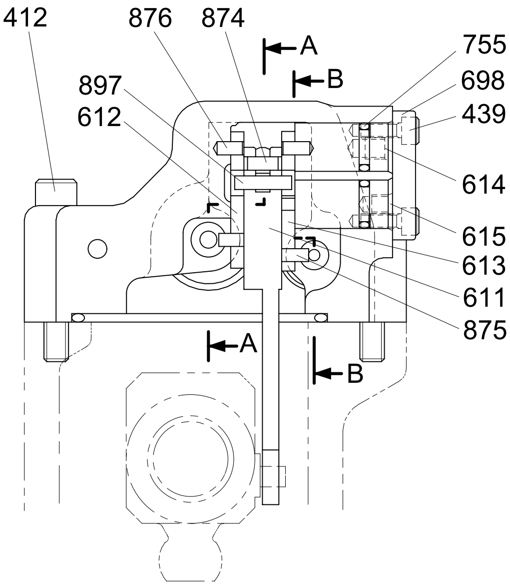


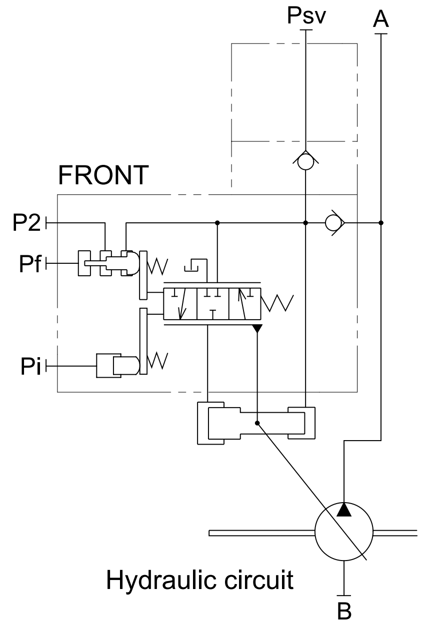
Section B - B

80092MP07

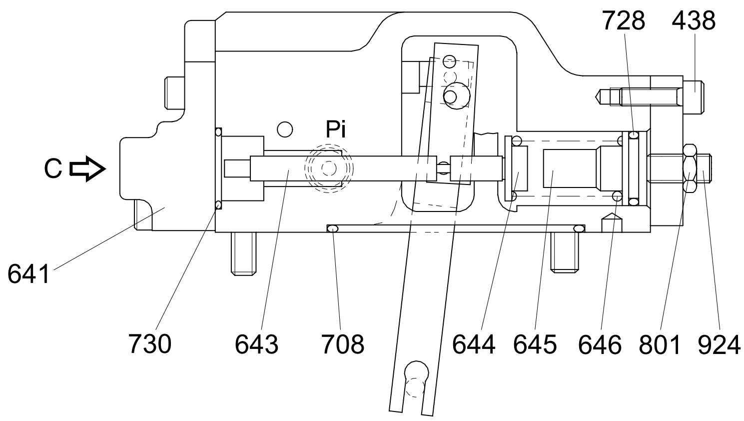
012	Cylinder block	311	Valve cover (F)	702	O-ring
111	Drive shaft (F)	312	Valve cover (R)	706	O-ring
113	Driven shaft (R)	313	Valve plate (R)	710	O-ring
114	Coupling	314	Valve plate (L)	717	O-ring
123	Roller bearing	401	Hexagon socket bolt	718	O-ring
124	Needle bearing	402	Hexagon socket bolt	724	O-ring
127	Spacer	406	Hexagon socket bolt	725	O-ring
130	Booster	407	Hexagon socket bolt	728	O-ring
151	Piston	415	Hexagon socket bolt	732	O-ring
152	Shoe	416	Hexagon socket bolt	774	Oil seal
153	Plate	466	VP Plug	789	Back up ring
156	Bushing	468	VP Plug	792	Back up ring
157	Cylinder spring	490	VP Plug	808	Hexagon head nut
211	Shoe plate	491	Restrictor	824	Snap ring
212	Swash plate	492	VP Plug	885	Pin
214	Bushing	497	VP Plug	887	Spring pin
251	Support plate	531	Tilting pin	901	Eye bolt
253	Washer	532	Servo piston	953	Set screw
261	Seal cover (F)	534	Stopper (L)	954	Set screw
263	Seal cover (R)	535	Stopper (S)	956	Set screw
271	Pump casing	548	Feed back pin		

2) FRONT REGULATOR (1/2)

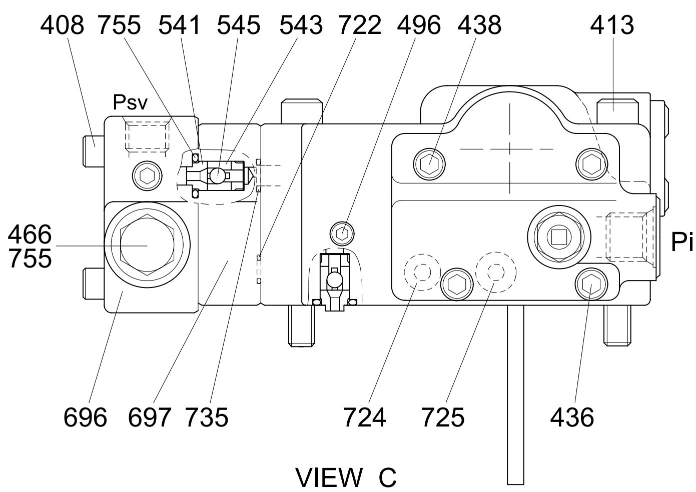




Hydraulic circuit



SECTION B-B



VIEW C

Port	Port name	Port size
Pi	Pilot port	PF 1/4 - 15
Psv	Servo assist port	PF 1/4 - 15
P2	Companion delivery pressure	-
Pf	Powershift pressure	-

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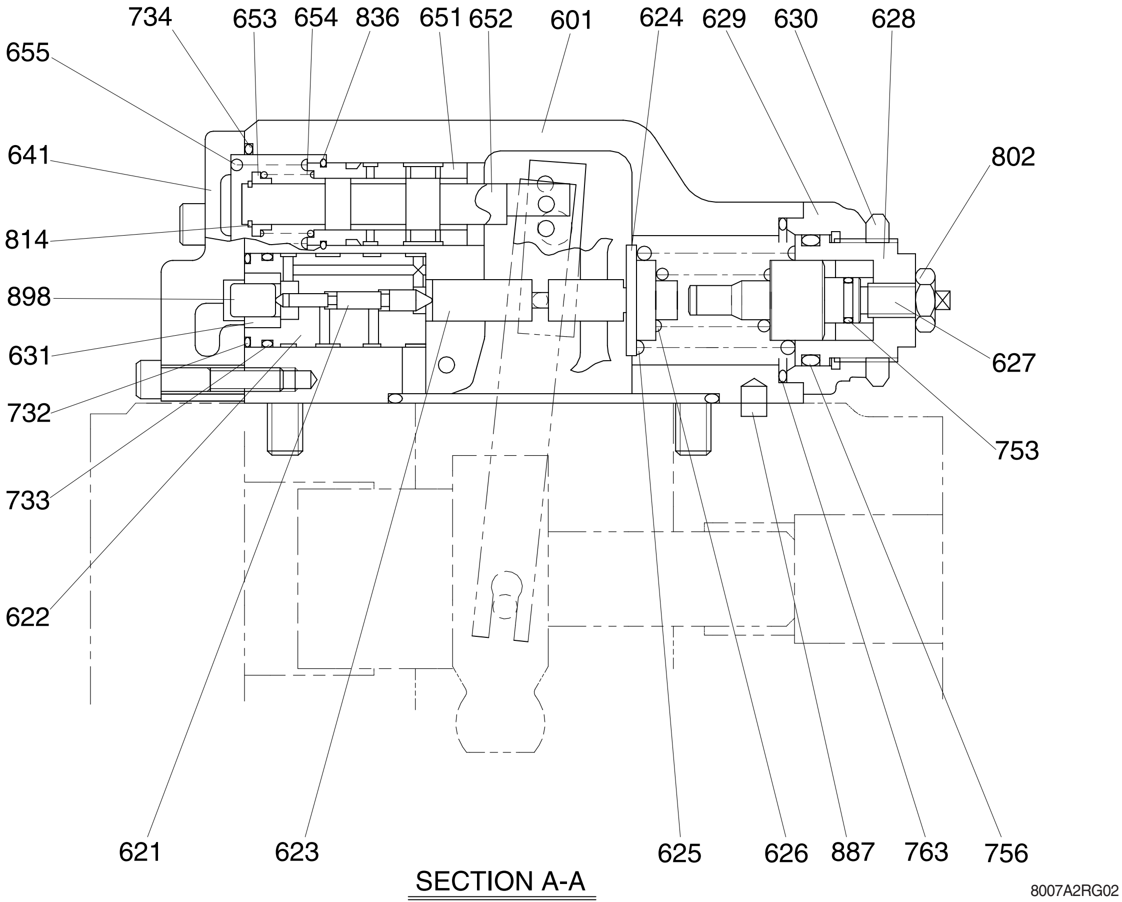
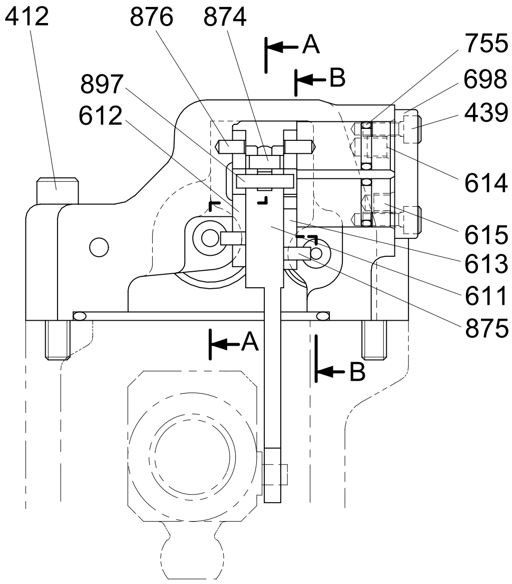
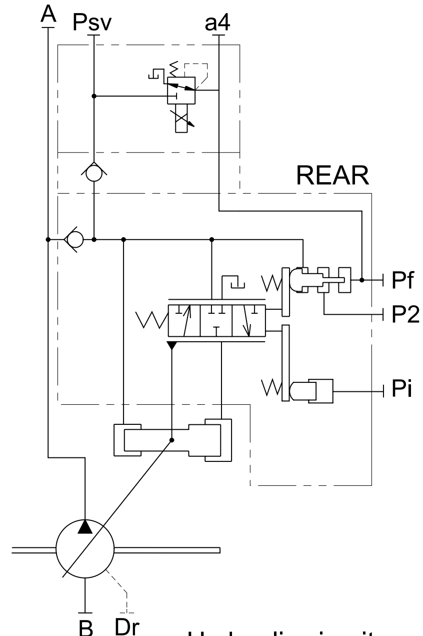
FRONT REGULATOR (2/2)



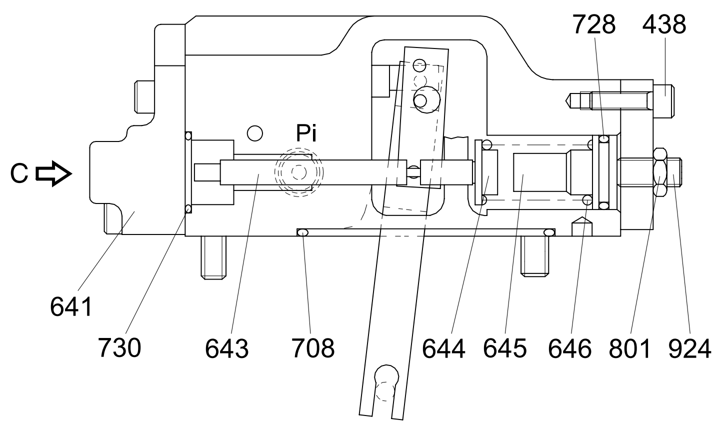
408	Hexagon socket screw	626	Inner spring	725	O-ring
412	Hexagon socket screw	627	Adjust stem(C)	728	O-ring
413	Hexagon socket screw	628	Adjust screw(C)	730	O-ring
436	Hexagon socket screw	629	Cover(C)	732	O-ring
438	Hexagon socket screw	630	Lock nut	733	O-ring
439	Hexagon socket screw	631	Sleeve, pf	734	O-ring
466	Plug	641	Pilot cover	735	O-ring
496	Plug	643	Pilot piston	753	O-ring
541	Seat	644	Spring seat(Q)	755	O-ring
543	Stopper 1	645	Adjust stem(Q)	756	O-ring
545	Steel ball	646	Pilot spring	763	O-ring
601	Casing	651	Sleeve	801	Nut
611	Feed back lever	652	Spool(A)	802	Nut
612	Lever(1)	653	Spring seat	814	Snap ring
613	Lever(2)	654	Return spring	836	Snap ring
614	Center plug	655	Set spring	874	Spring pin
615	Adjust plug	696	Port cover	875	Pin
621	Compensator piston	697	Check valve plate	876	Pin
622	Piston case	698	Cover	887	Pin
623	Compensator rod	708	O-ring	897	Pin
624	Spring seat(C)	722	O-ring	898	Pin
625	Outer spring	724	O-ring	924	Set screw

3) REAR REGULATOR (1/2)

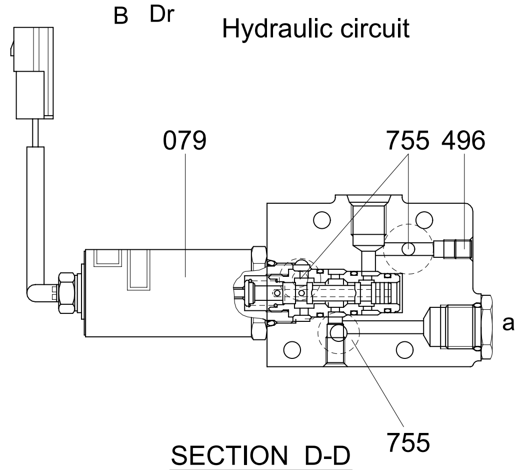




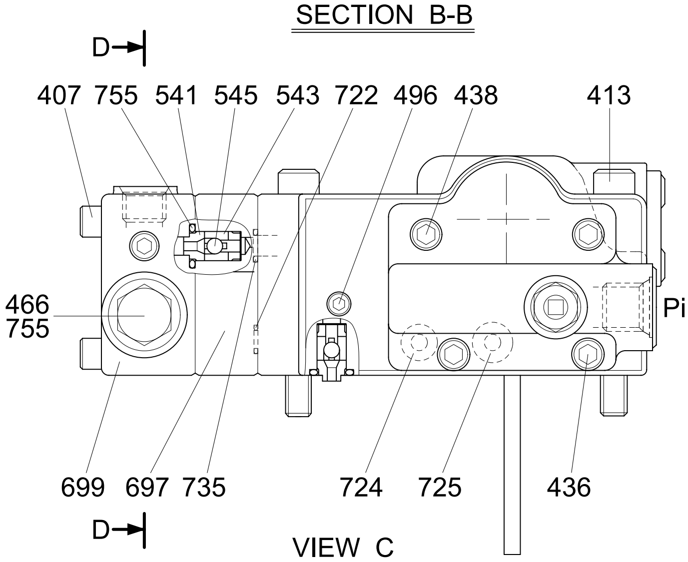
Hydraulic circuit



SECTION B-B



SECTION D-D



VIEW C

Port	Port name	Port size
Pi	Pilot port	PF 1/4 - 15
Psv	Servo assist port	PF 1/4 - 15
P2	Companion delivery pressure	-
Pf	Powershift pressure	-
a4	Gauge port	PF 1/4 - 13

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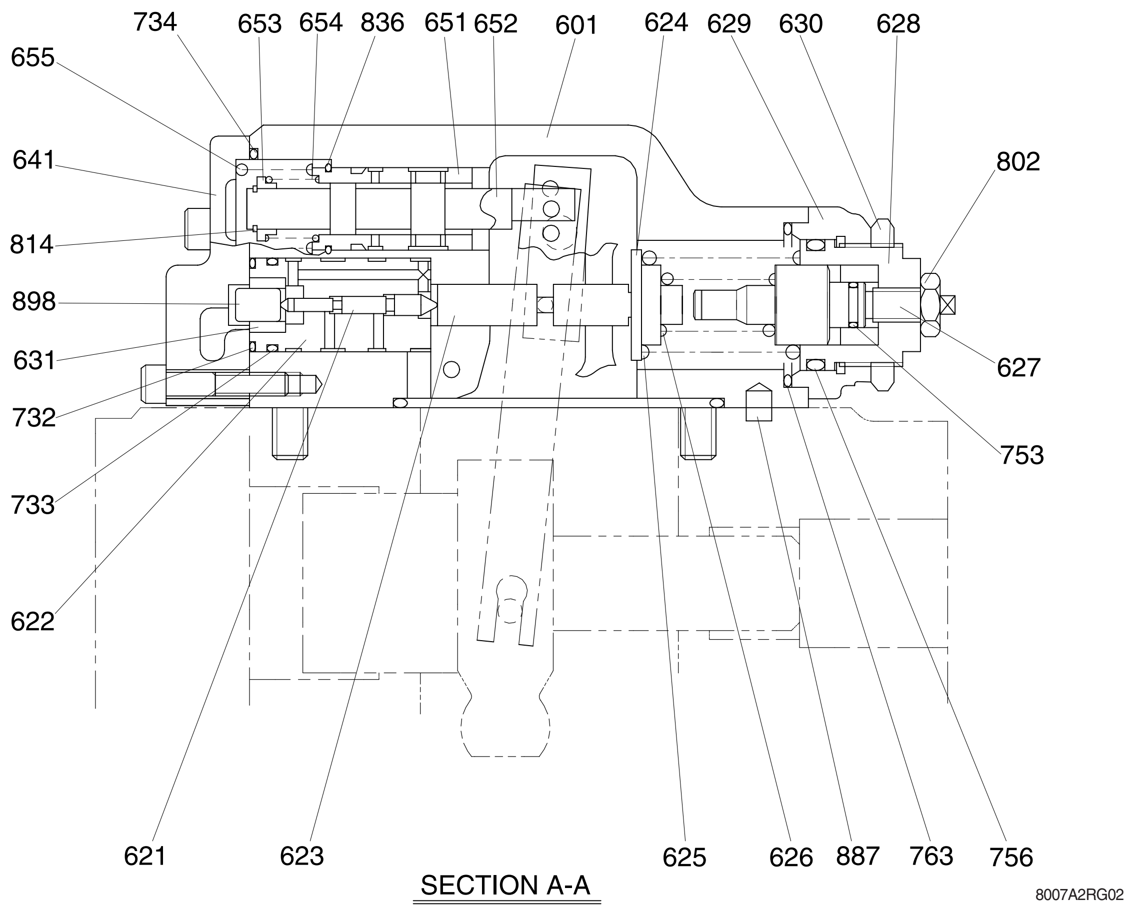
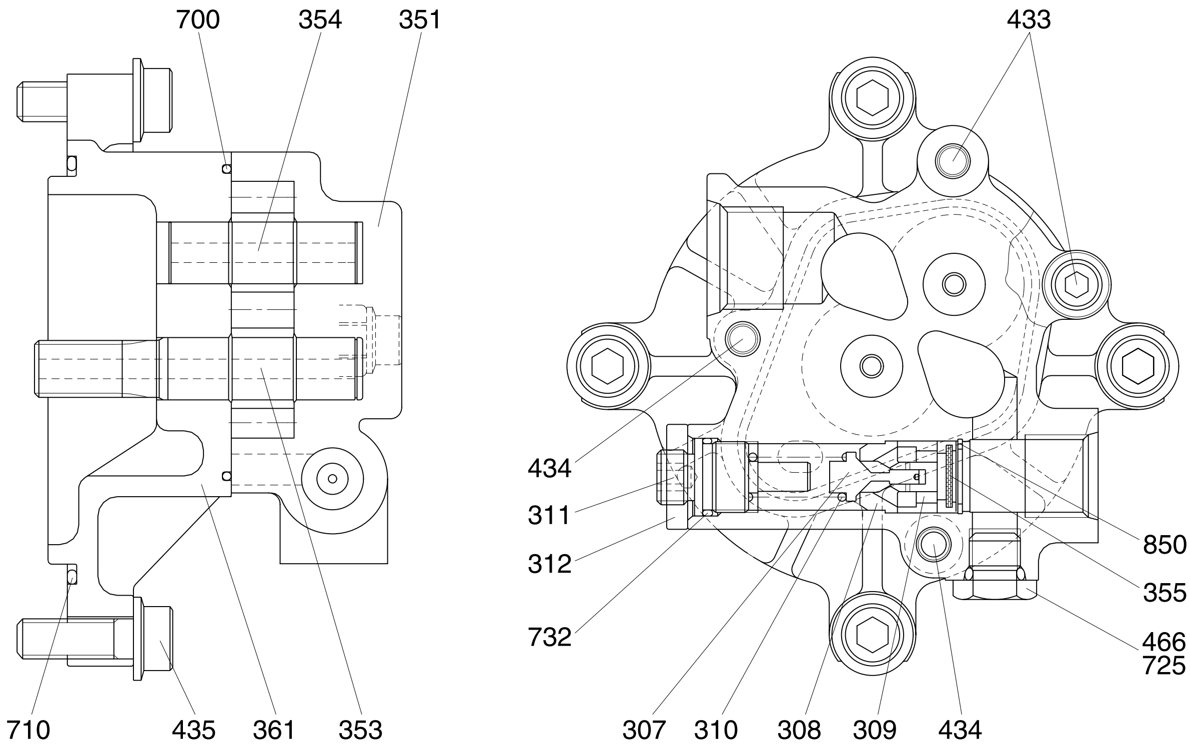
REAR REGULATOR (2/2)



079	EPPR valve	626	Inner spring	728	O-ring
407	Hexagon socket screw	627	Adjust stem (C)	730	O-ring
412	Hexagon socket screw	628	Adjust screw (C)	732	O-ring
413	Hexagon socket screw	629	Cover (C)	733	O-ring
436	Hexagon socket screw	630	Lock nut	734	O-ring
438	Hexagon socket screw	631	Sleeve, pf	735	O-ring
439	Hexagon socket screw	641	Pilot cover	753	O-ring
466	Plug	643	Pilot piston	755	O-ring
496	Plug	644	Spring seat (Q)	756	O-ring
541	Seat	645	Adjust stem (Q)	763	O-ring
543	Stopper	646	Pilot spring	801	Nut
545	Steel ball	651	Sleeve	802	Nut
601	Casing	652	Spool (A)	814	Snap ring
611	Feed back lever	653	Spring seat	836	Snap ring
612	Lever (1)	654	Return spring	858	Snap ring
613	Lever (2)	655	Set spring	874	Pin
614	Center plug	697	Check valve plate	875	Pin
615	Adjust plug	698	Cover	876	Pin
621	Compensator piston	699	Port cover	887	Pin
622	Piston case	708	O-ring	897	Pin
623	Compensator rod	722	O-ring	898	Pin
624	Spring seat (C)	724	O-ring	924	Set screw
625	Outer spring	725	O-ring		

4) GEAR PUMP



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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 socket	725	O-ring
311	Screw	433	Flange socket	732	O-ring
312	Lock nut	434	Flange socket	850	Snap ring
351	Gear case	435	Flange socket		

2. FUNCTION

1) MAIN PUMP

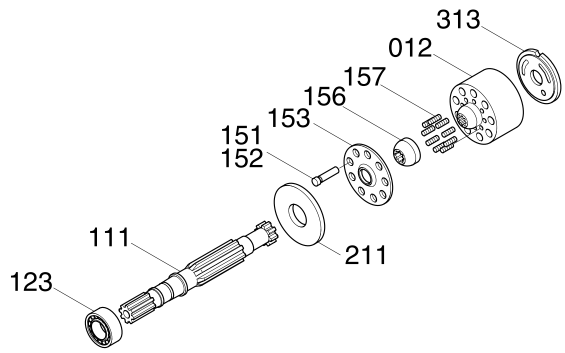
The pumps may classified roughly into the rotary group performing a rotary motion and working as the major part of the whole pump function: the swash plate group that varies the delivery rates: and the valve cover group that changes over oil suction and discharge.

(1) Rotary group

The rotary group consists of drive shaft (F)(111), cylinder block (012), piston shoes (151,152), set plate (153), spherical bush (156), and cylinder spring (157).

The drive shaft is supported by bearing (123,124) at its both ends.

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



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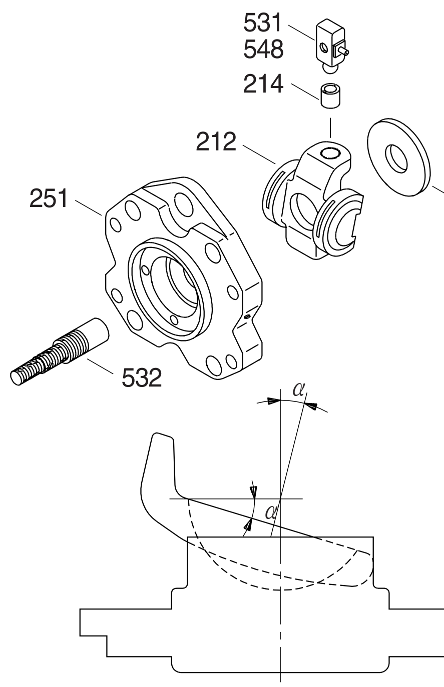
(2) Swash plate group

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

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

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



2-7 (210-7)

(3) Valve cover group

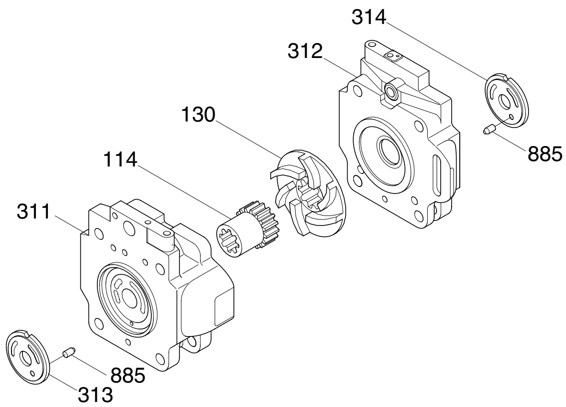
The valve cover group consists of valve cover (F, 311), valve cover (R, 312), valve plate (313, 314), spline coupling (114), booster (130) and valve plate pin (885).

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

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

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.



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2) REGULATOR

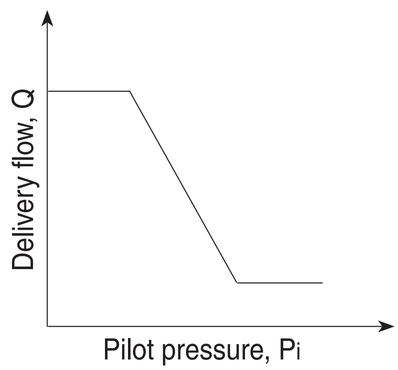
Regulator consists of the negative flow control, total horse power control and power shift control function.

(1) Negative flow control

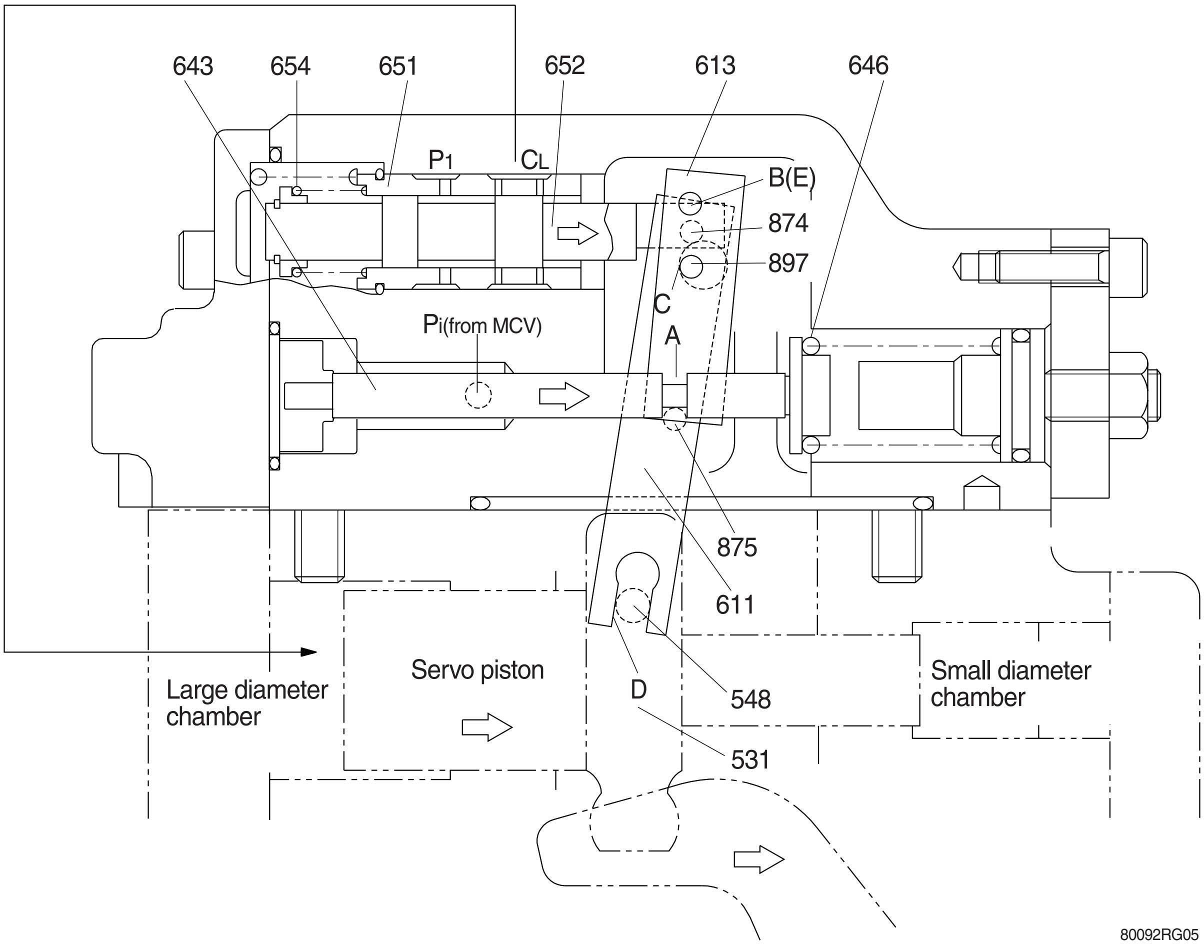
By changing the pilot pressure Pi, the pump tilting angle (delivery flow) is regulated arbitrarily, as shown in the figure.

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.

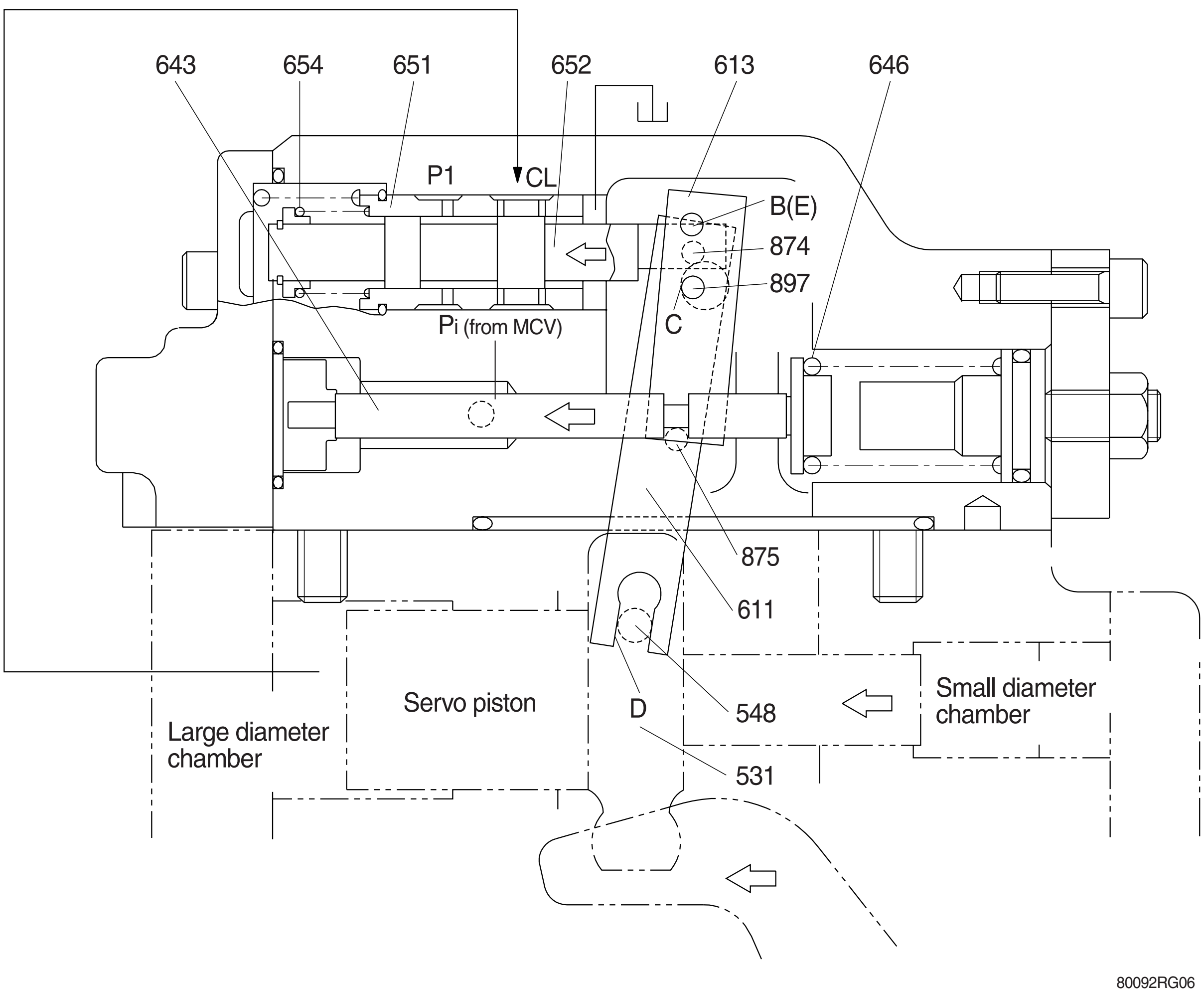
Since the feedback lever is connected with the spool (652) via the pin (874), the spool moves to the right.

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

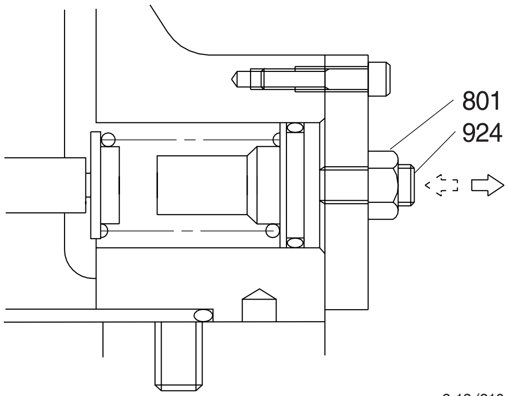
The flow control characteristic can be adjusted with the adjusting screw.

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

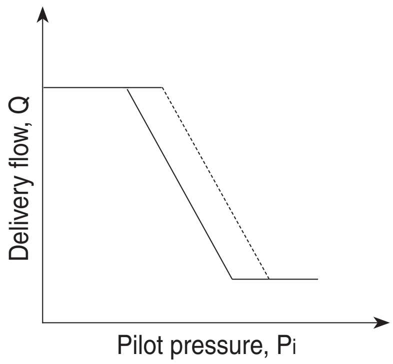
Tightening the screw shifts the control chart to the right as shown in the figure.

※ 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/cm2)	(ℓ/min)
1800	+1/4	+1.3	+30.2



2-12 (210-7)



(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.

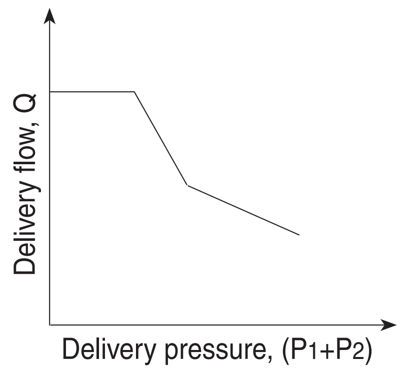
(The input horsepower is constant when the speed is constant.)

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.

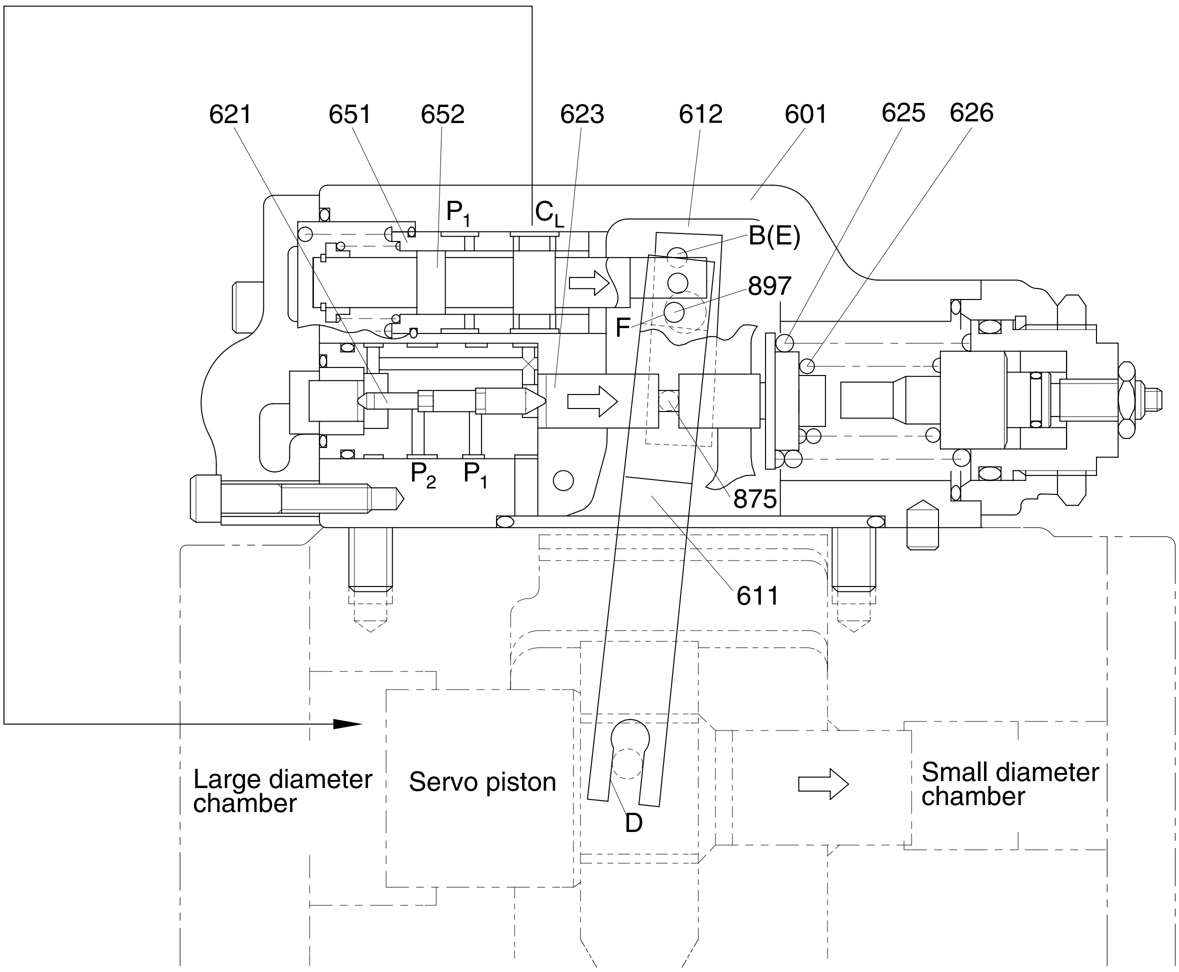
Since this regulator is of the simultaneous total horsepower type, it controls the tilting angles (displacement volumes) of the two pumps to the same value as represented by the following equation :

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

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



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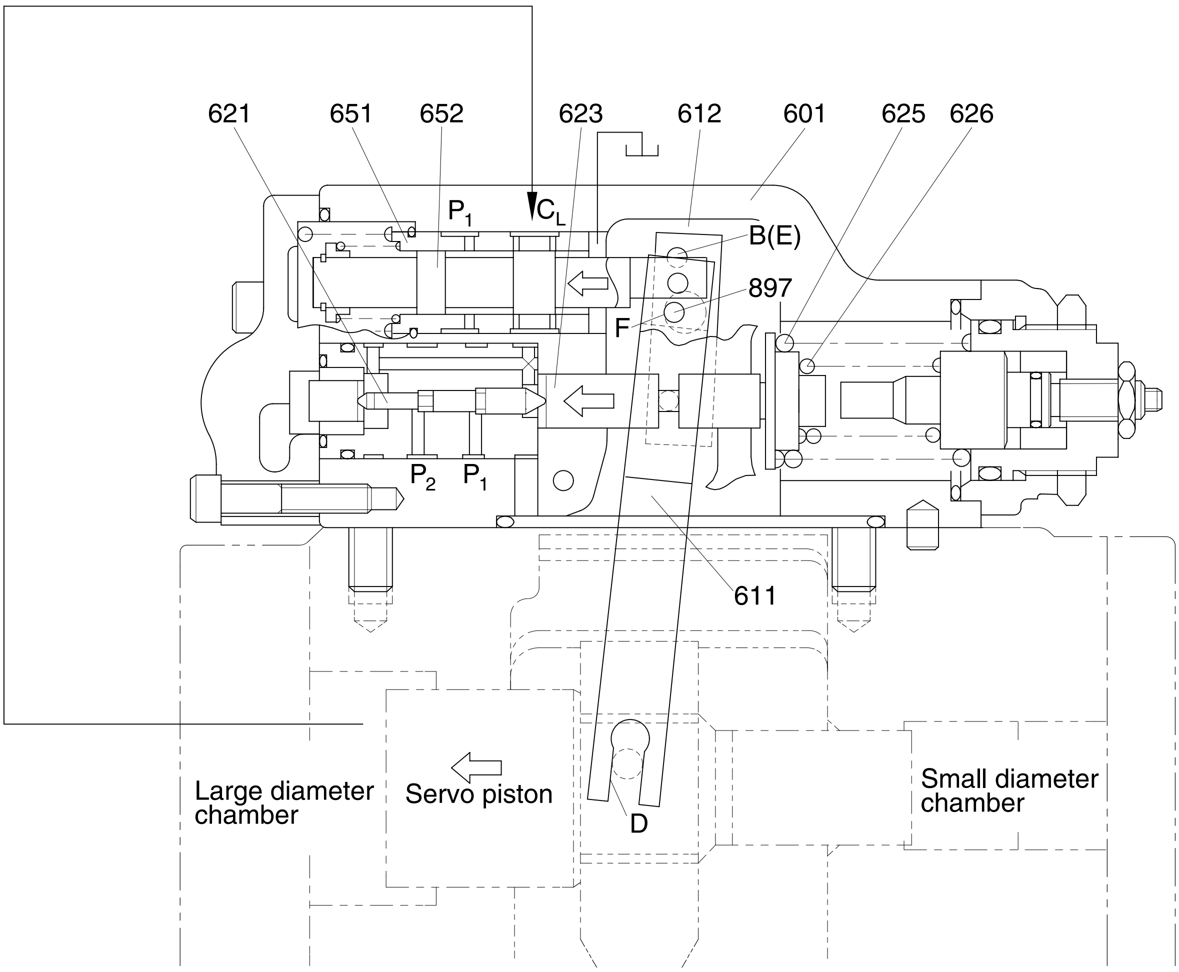
When the self pump delivery pressure P1 or the companion pump delivery pressure P2 rises, it acts on the stepped part of the compensating piston (621). It presses the compensating rod (623) to the right till the force of the outer spring (625) and inner spring (626) balances with the hydraulic force.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

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

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

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

② Flow reset function



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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.

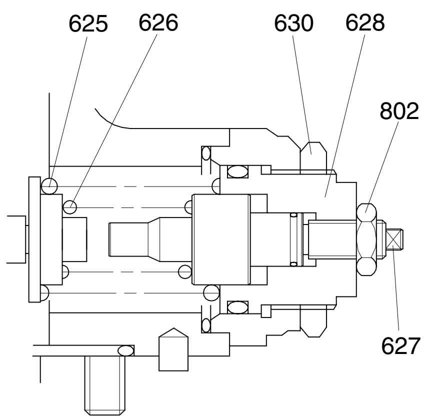
④ Adjustment of input horsepower

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).

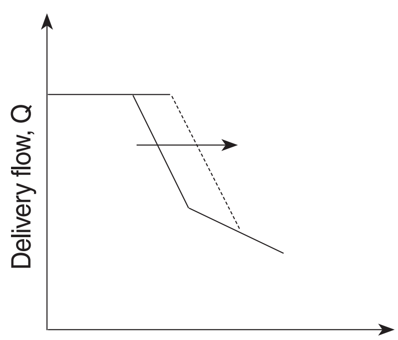
Tightening the screw shifts the control chart to the right and increases the input horse-power as shown in the figure. Since turning the adjusting screw C by N turns changes the setting of the inner spring (626), return the adjusting stem QI (627) by N×A turns at first. (A=1.81)



8007A2MP03

※ Adjusting values are shown in table.

Speed	Adjustment of outer spring		
	Tightening amount of adjusting screw (C) (928)	Compens-ating control starting pressure change amount	Flow change amount
(min $^{-1}$)	(Turn)	(kgf/cm^2)	(ℓ/min)
1800	+1/4	+17.7	+14.2



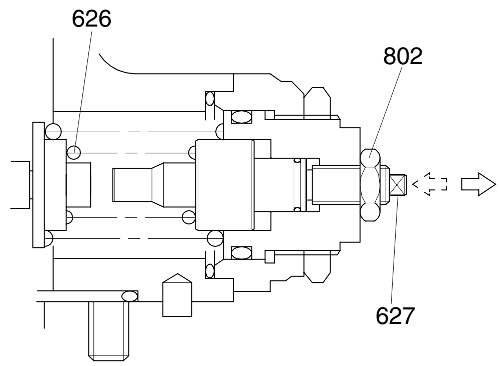
b. Adjustment of inner spring

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

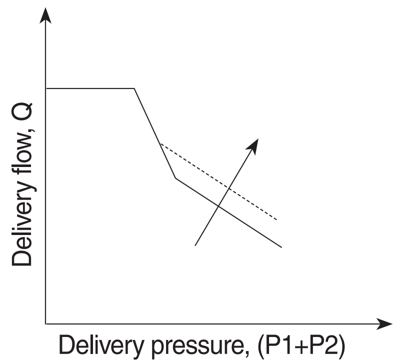
Tightening the screw increases the flow and then the input horsepower as shown in the figure.

※ Adjusting valves are shown in table.

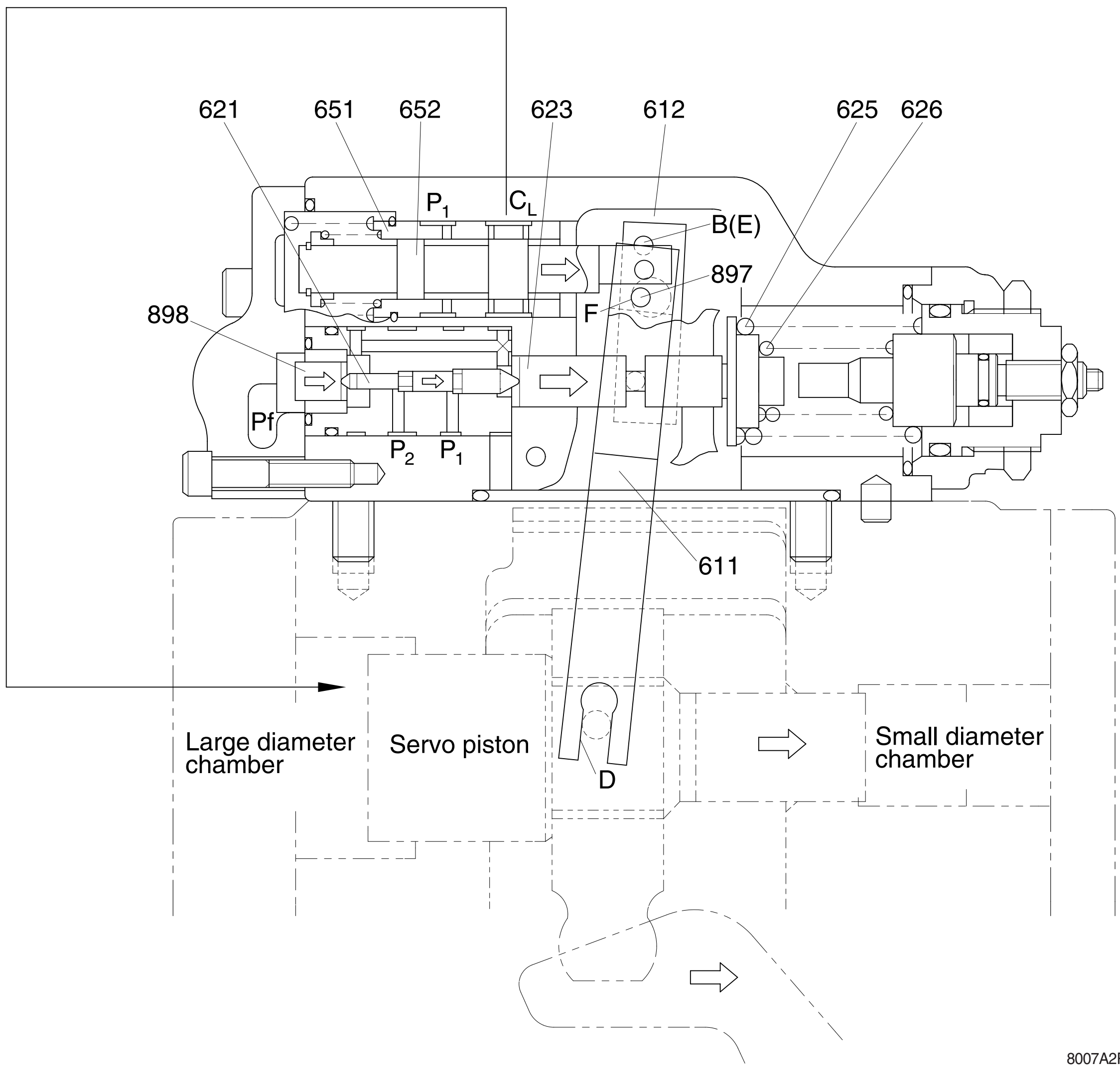
Speed	Adjustment of outer spring		
	Tightening amount of adjusting stem (QI) (627)	Flow change amount	Input torque change amount
(min -1)	(Turn)	(kgf/cm2)	(ℓ/min)
1800	+1/4	+22.8	+11.4



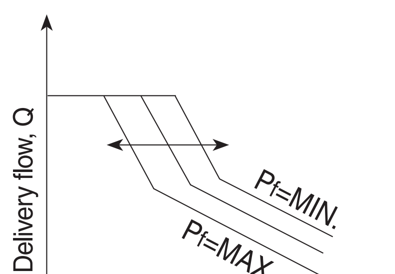
8007A2MP04



(3) Power shift control



8007A2RG06



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).

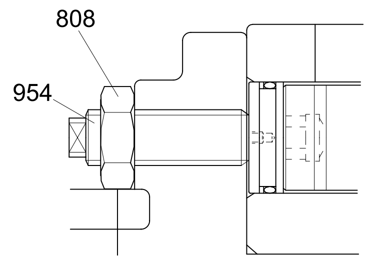
This decreases the pump tilting angle and then the set horsepower in the same way as explained in the overload preventive function of the horsepower control. On the contrary, the set horsepower rises as the power shift pressure Pf falls.

(4) Adjustment of maximum and minimum flows

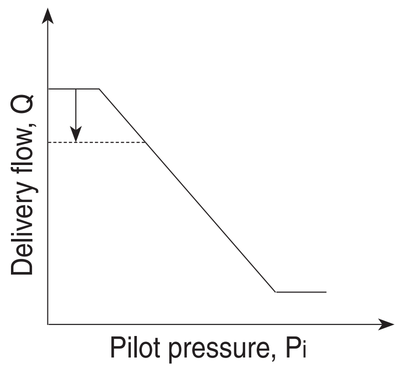
① Adjustment of maximum flow

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.



8007A2MP06



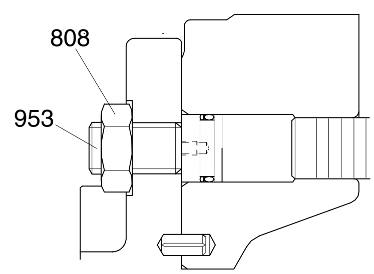
Speed	Adjustment of max flow	
	Tightening amount of adjusting screw (954)	Flow change amount
(min $^{-1}$)	(Turn)	(ℓ /min)
1800	+1/4	-9.2

② Adjustment of minimum flow

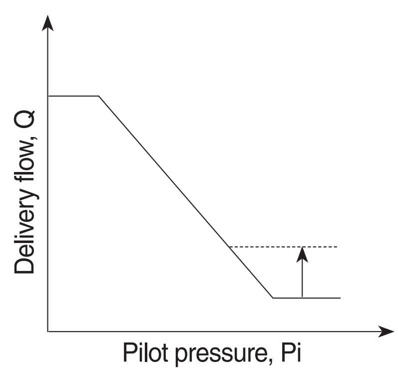
Adjust it by loosening the hexagon nut (808) and by tightening(or loosening) the hexagonal socket head set screw (953).

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.

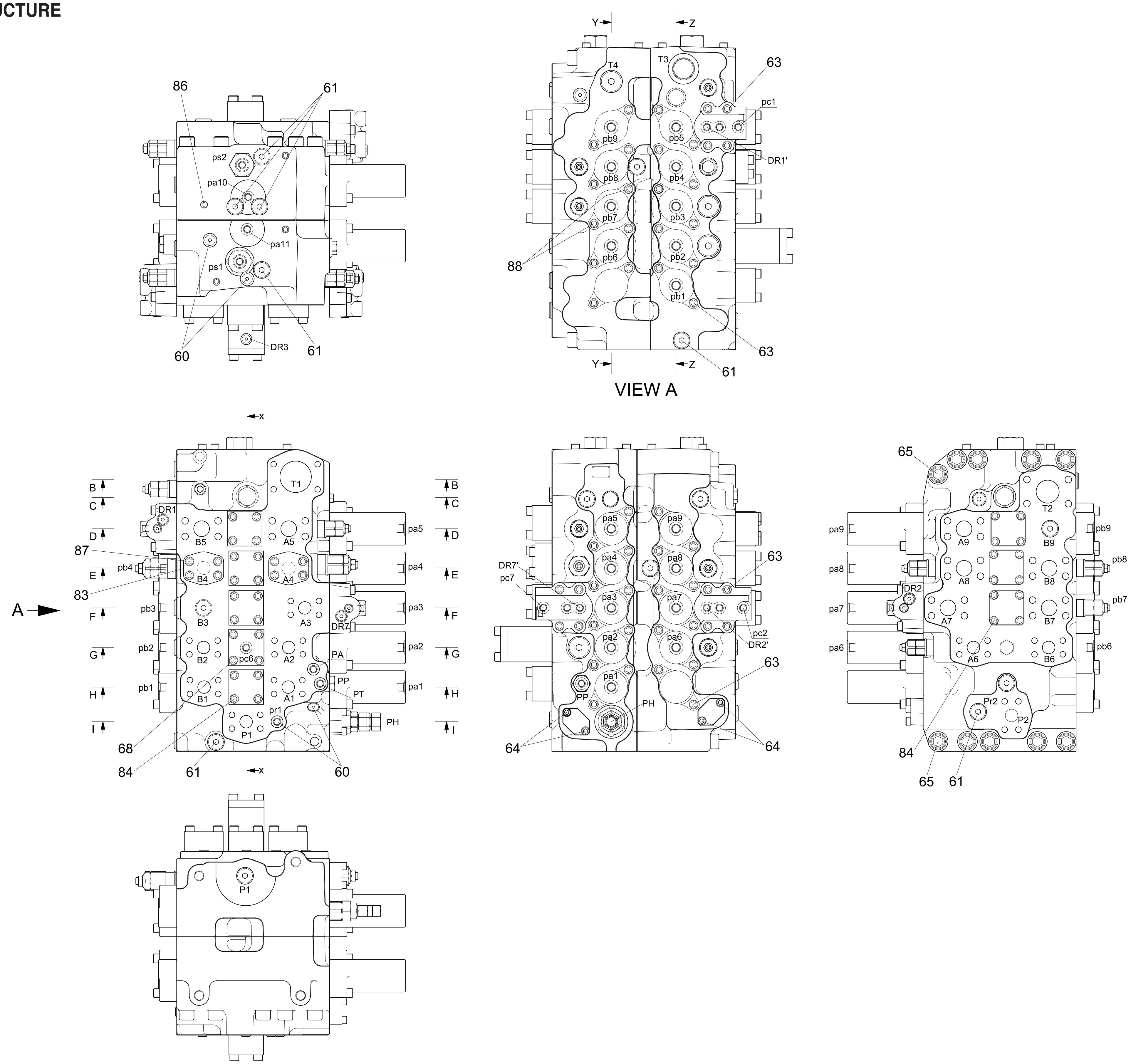


8007A2MP05



Speed	Adjustment of min flow	
	Tightening amount of adjusting screw (953)	Flow change amount
(min $^{-1}$)	(Turn)	(ℓ /min)
1800	+1/4	+9.2

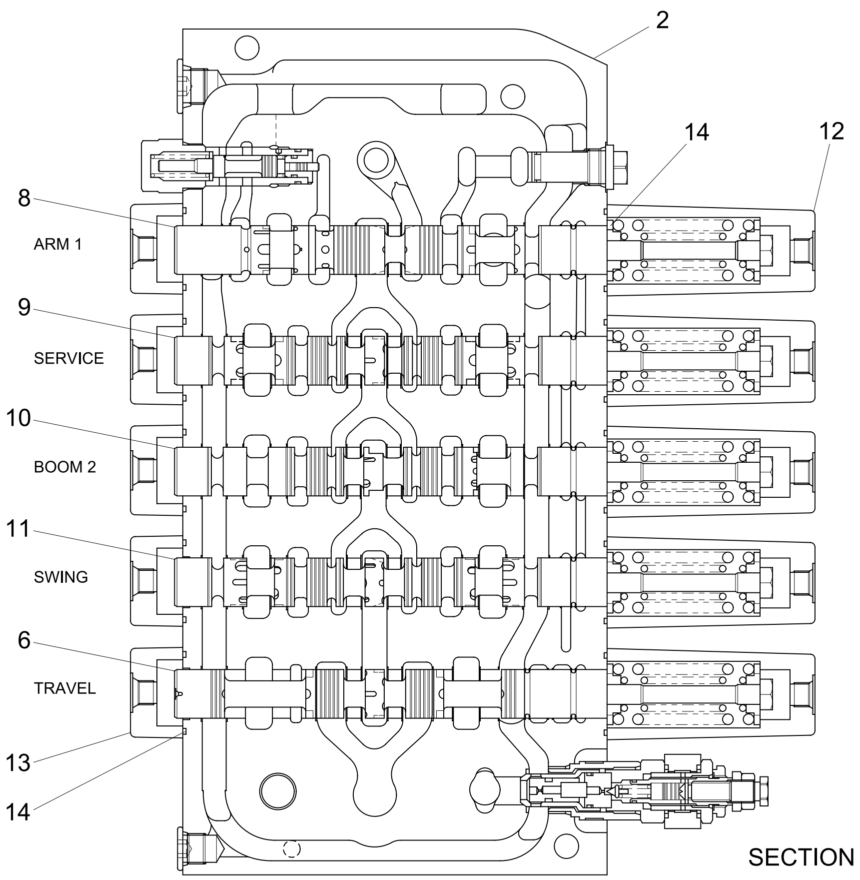
1. STRUCTURE



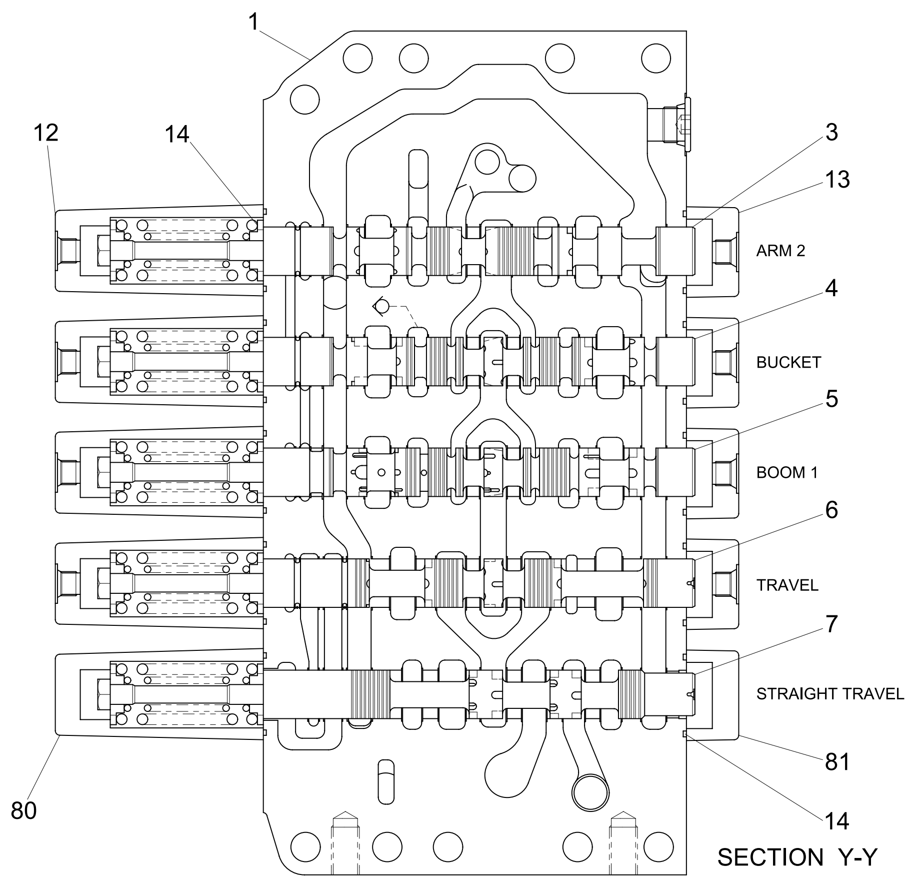
8007A2MC01

Mark	Port size	Thread depth (mm)
DR1, DR2, DR3, DR1', DR2', DR7', pr1, ps1, ps2, pc1, pc2, pc6, pc7, pa10, pa11, PA, PP, PH	PF 1/4	12
pa1~pa9, pb1~pb9	PF 3/8	14
pr2	PF 1/2	16
T3, T4	PF 3/4	17

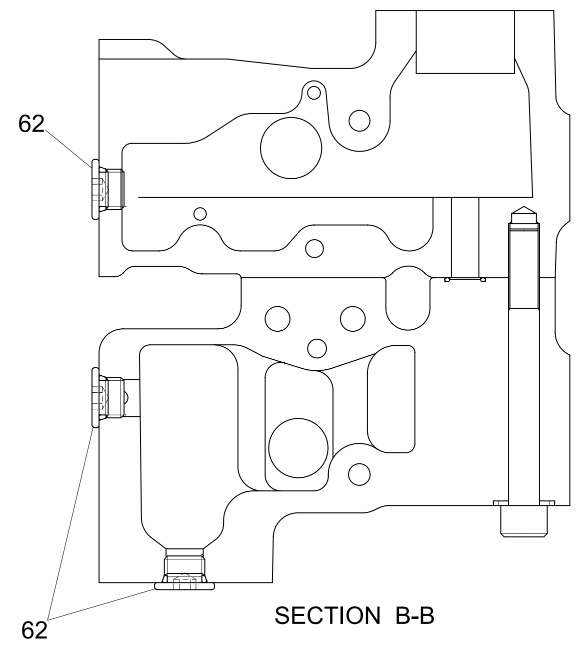
1 Valve housing
2 Valve housing
3 Spool assy(AM2)
4 Spool assy(BKT)
5 Spool assy(BM1)
6 Spool assy(TR)
7 Spool assy(S/TR)
8 Spool assy(AM1)
9 Spool assy(SER)
10 Spool assy(BM2)
11 Spool assy(SW)
12 Cap
13 Cap
14 O-ring
15 Poppet
16 Spring
17 Spacer
18 O-ring
19 Back up ring
20 Spool assy
21 Spring seat(A)
22 Spring
23 Plug
24 Spool assy
25 Spring
26 O-ring
27 Plug
28 Poppet
29 Spring
30 Poppet
31 Poppet
32 Poppet
33 Spring
34 Flange
35 O-ring
36 Poppet assy
37 Spring
38 Sleeve
39 Piston
40 O-ring
41 Back up ring
42 Body
43 Piston
44 Flange
45 O-ring
46 Poppet
47 Body assy
48 Relief valve kit
49 Relief valve kit
50 Relief valve assy
51 Plug assy
52 Poppet
53 Spring
54 Plug
55 O-ring
56 Flange
58 Plug assy
59 Plug assy
60 Plug assy
61 Plug assy
62 Plug assy
63 Socket head bolt
64 Socket head bolt
65 Socket head bolt
68 Socket head bolt
69 Poppet
72 Relief valve kit
73 Relief valve kit
76 O-ring
77 O-ring
78 O-ring
79 O-ring
80 Cap
81 Cap
82 Steel ball
84 Socket head bolt
86 Socket head bolt
87 Socket head bolt
92 Flange
93 O-ring



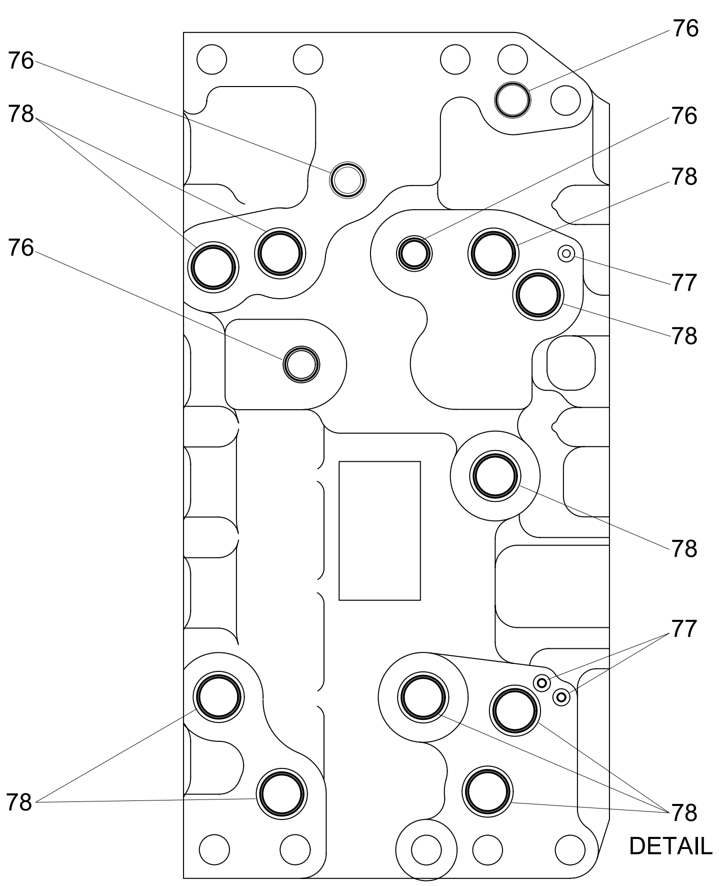
SECTION Z-Z



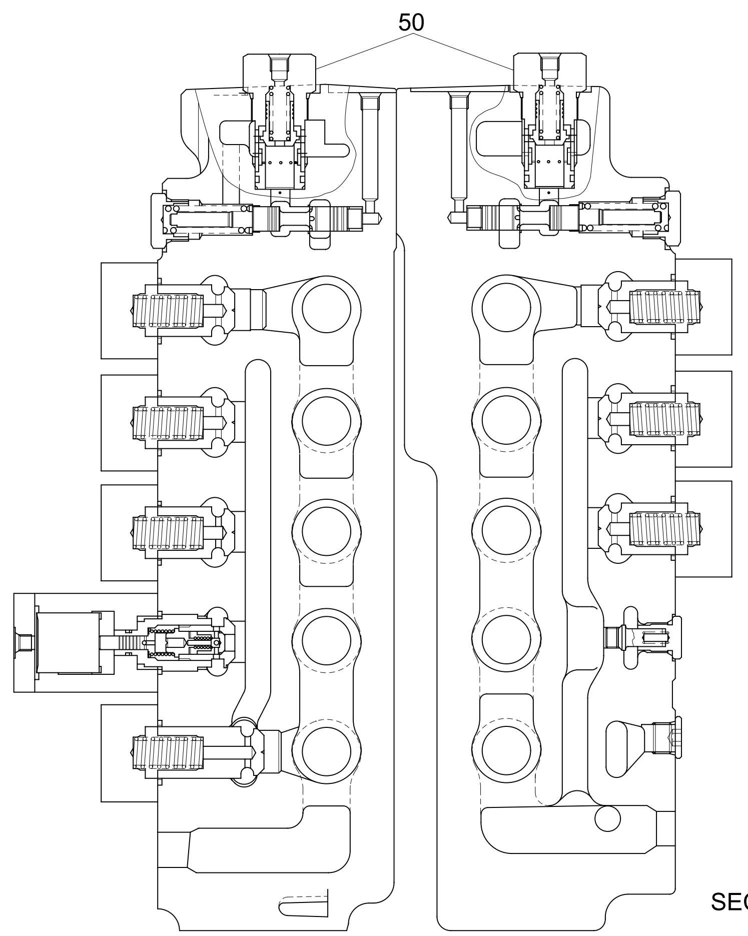
SECTION Y-Y



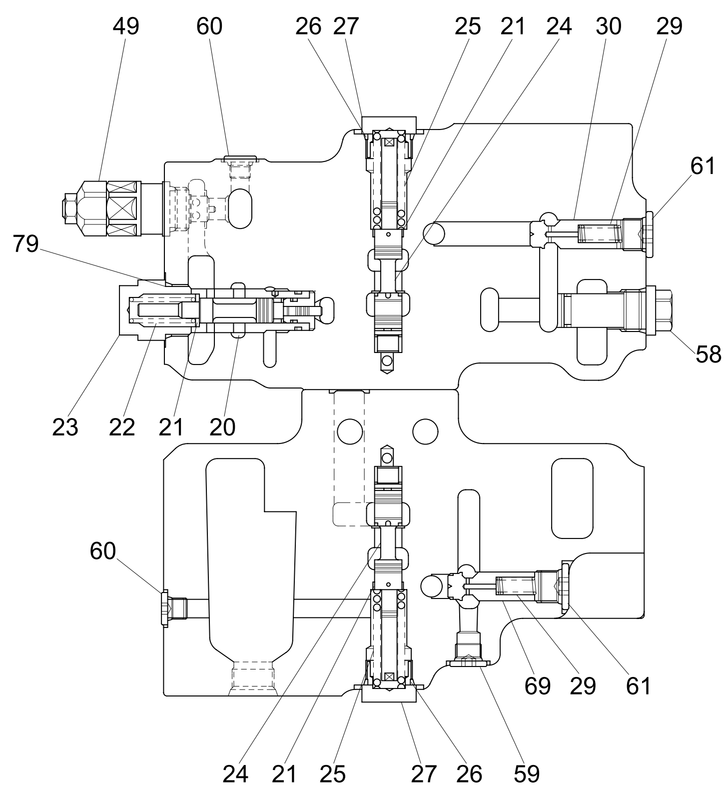
SECTION B-B



DETAIL OF COMBINED PLANE

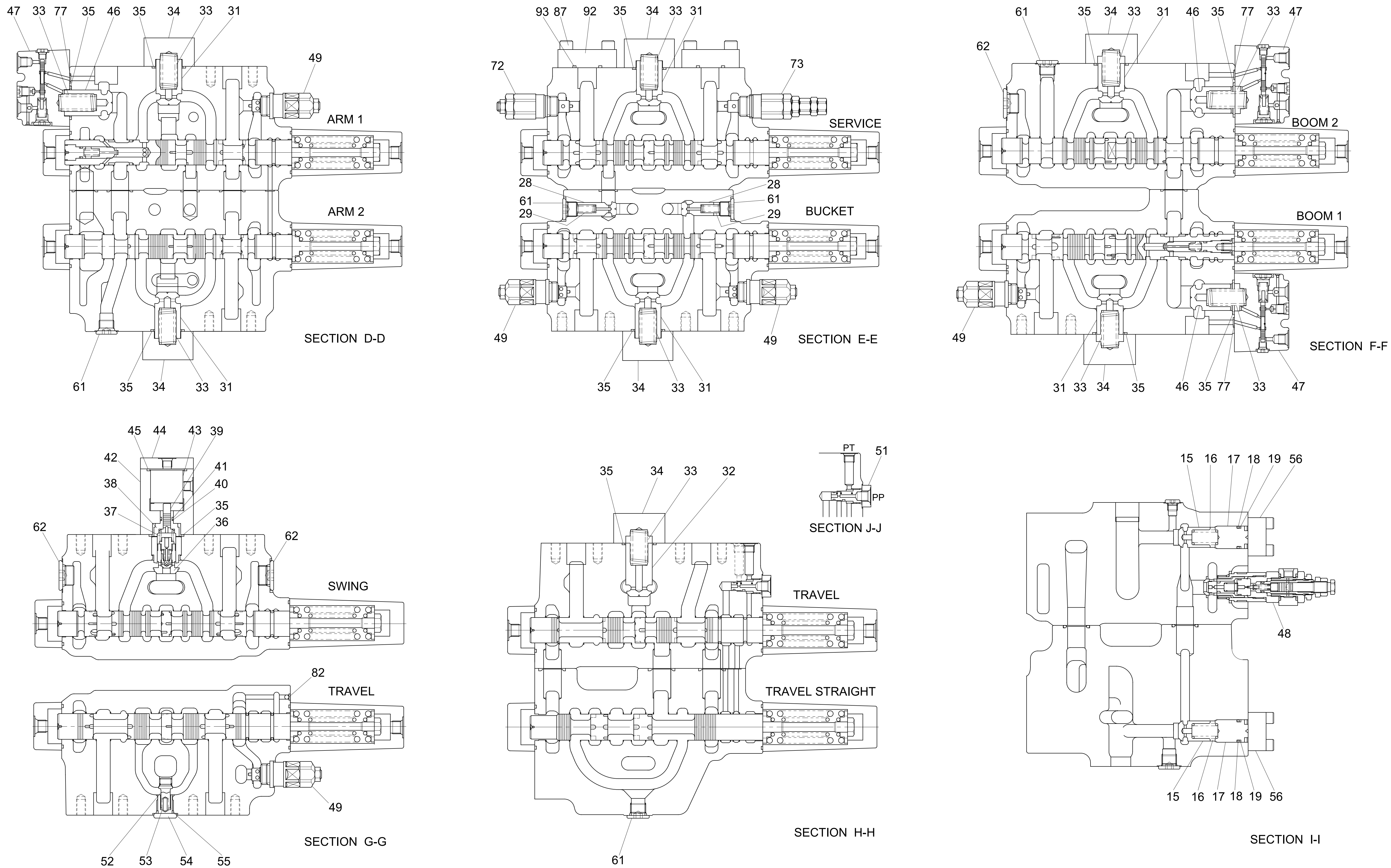


SECTION X-X



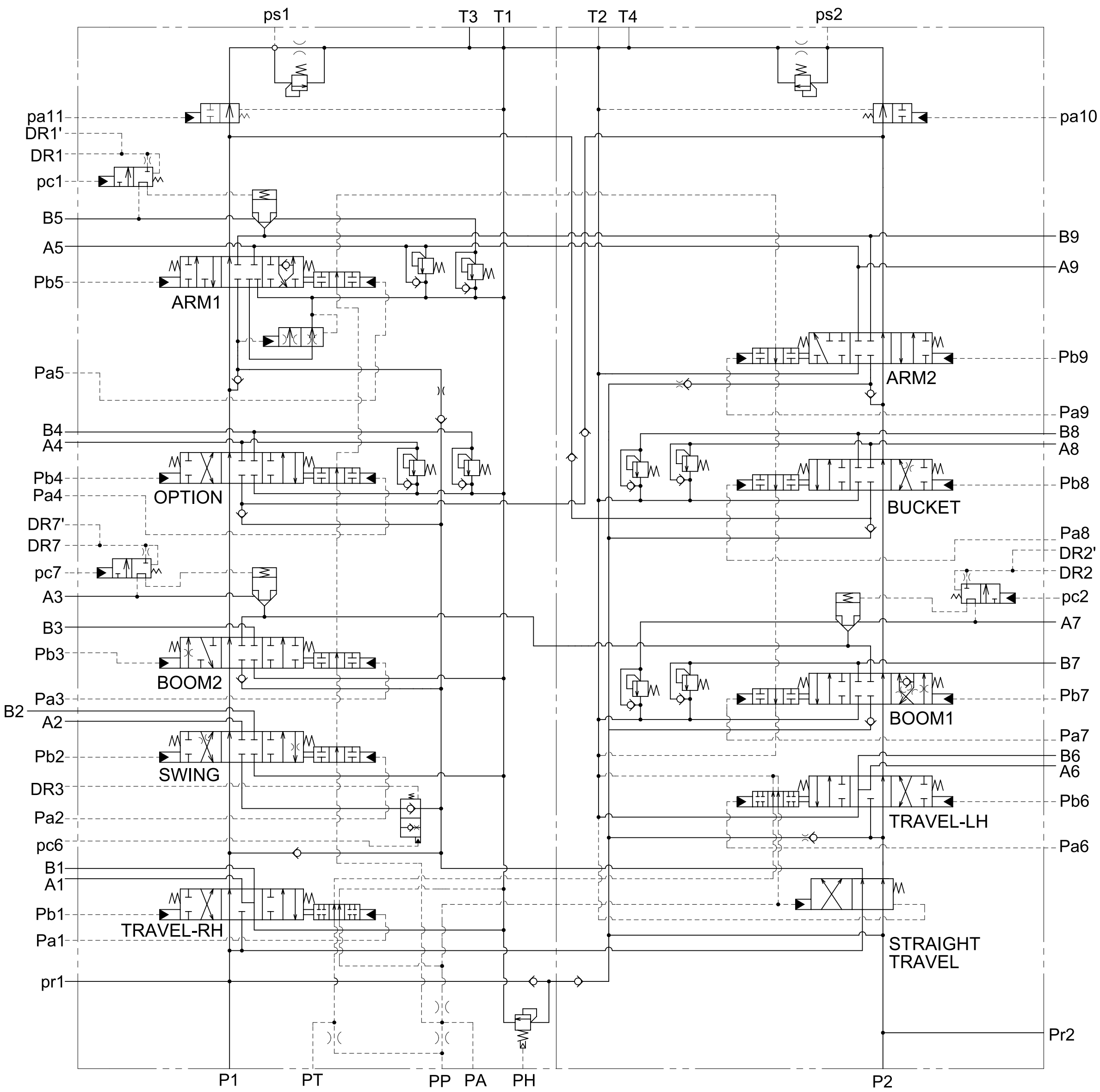
SECTION C-C

8007A2MC02


47 33 77 35 46 35 34 33 31
49
ARM 1
ARM 2
SECTION D-D
61 35 34 33 31
93 87 92 35 34 33 31
72
73
SERVICE
28 61 29
28 61 29
BUCKET
49
49
SECTION E-E
35 34 33 31
61 35 34 33 31 46 35 77 33 47
62
BOOM 2
BOOM 1
49
SECTION F-F
31 33 34 35 46 35 77 33 47
45 44 43 39
42 41 38 40 37 35 36
62
62
SWING
82
TRAVEL
49
SECTION G-G
52 53 54 55
35 34 33 32
TRAVEL
TRAVEL STRAIGHT
SECTION H-H
61
PT
51
PP
SECTION J-J
15 16 17 18 19 56
48
15 16 17 18 19 56
SECTION I-I

900L2MC03

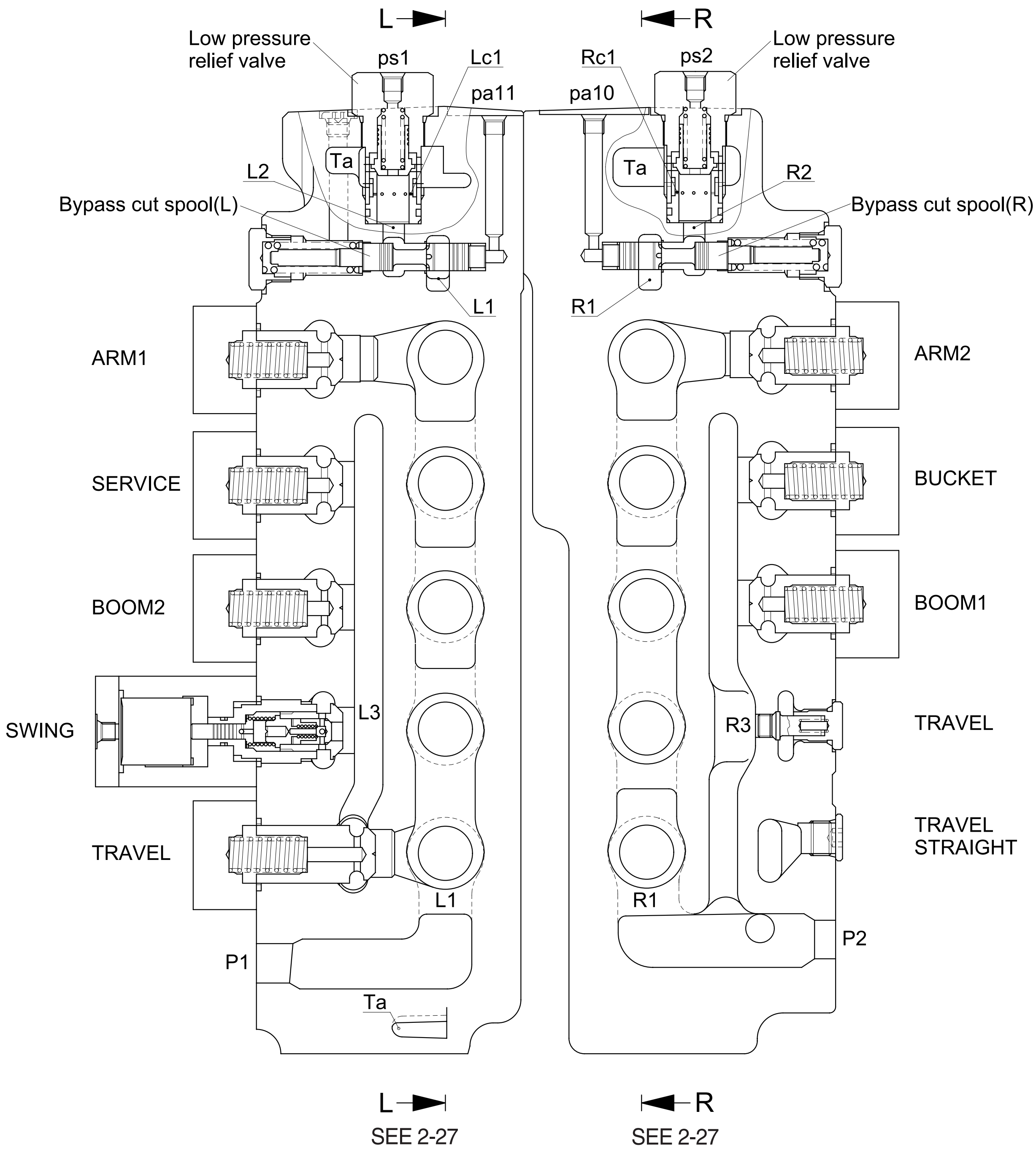
2. HYDRAULIC CIRCUIT



8007A2MC04

3. OPERATION

1) ALL SPOOL NEUTRAL



45071MC01

(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.

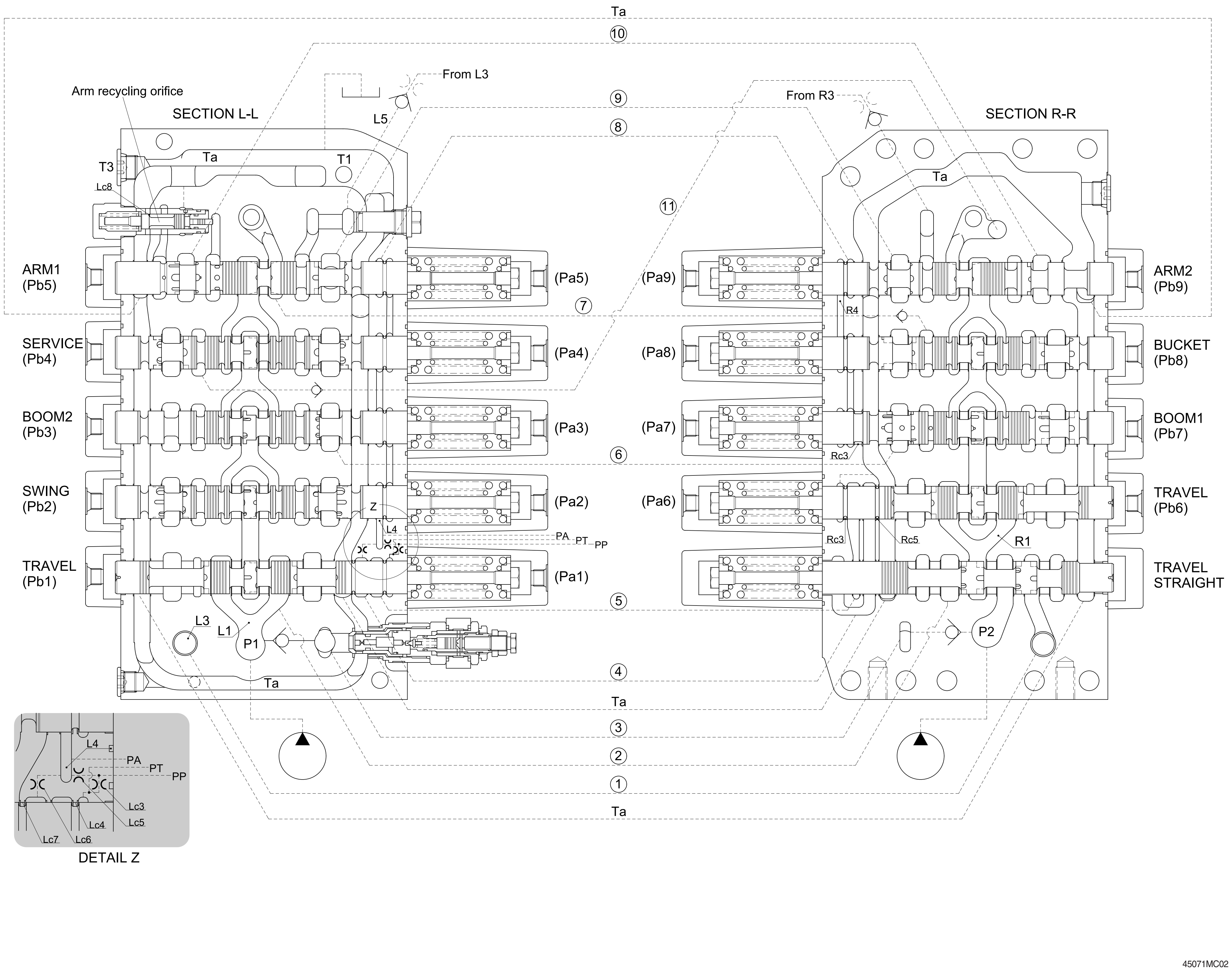
④ When a large amount of oil flows the neutral passage, the low pressure relief valves is operated. As a result, the shock pressure of port ps1, ps2 is prevented.

(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.



2) SINGLE OPERATION

(1) Travel spool

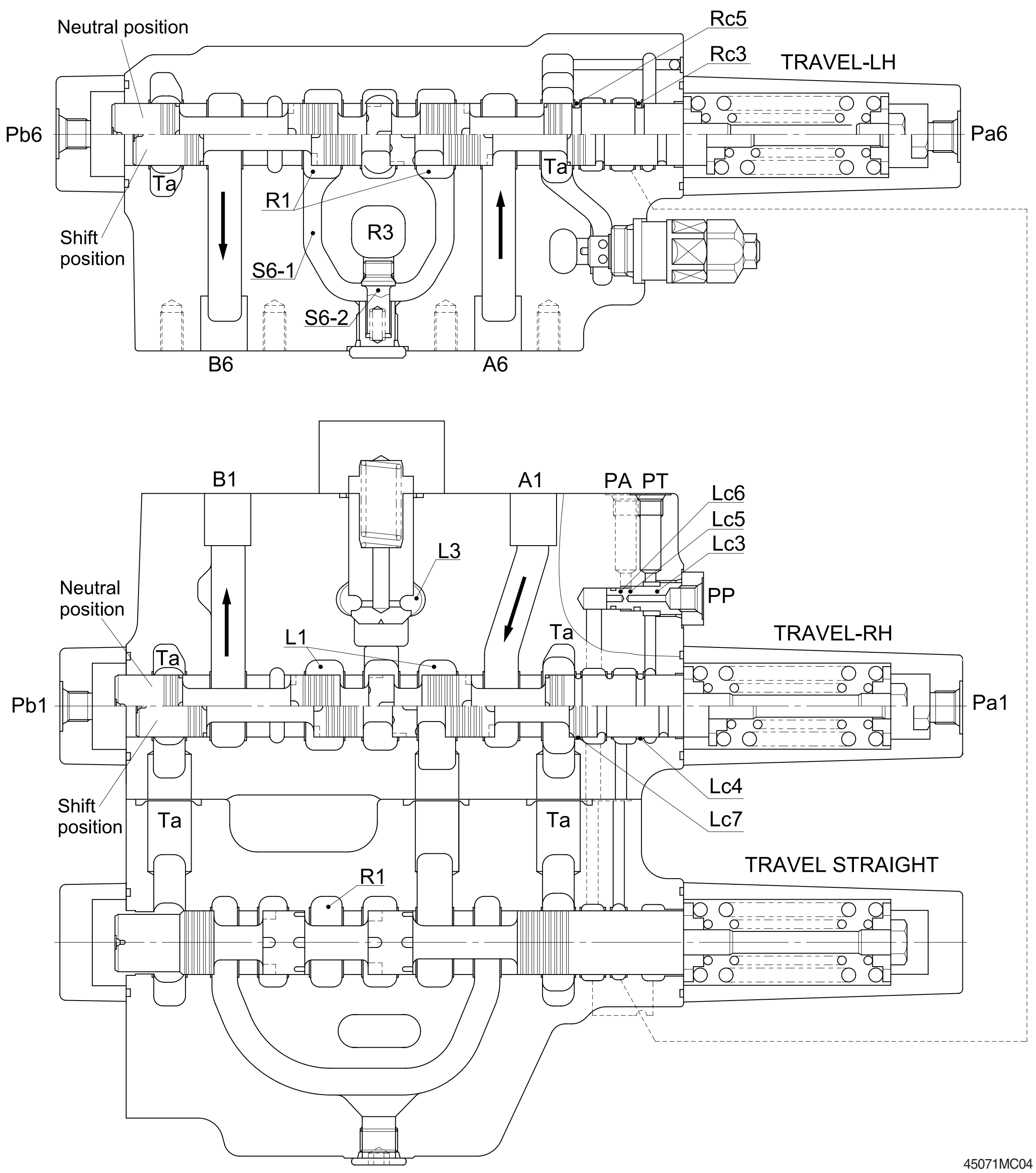
When the RH travel spool is pushed to right by the pilot pressure of port Pb1 the oil discharged from P1 port flows from the neutral passage (L1) to B1 port.

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).

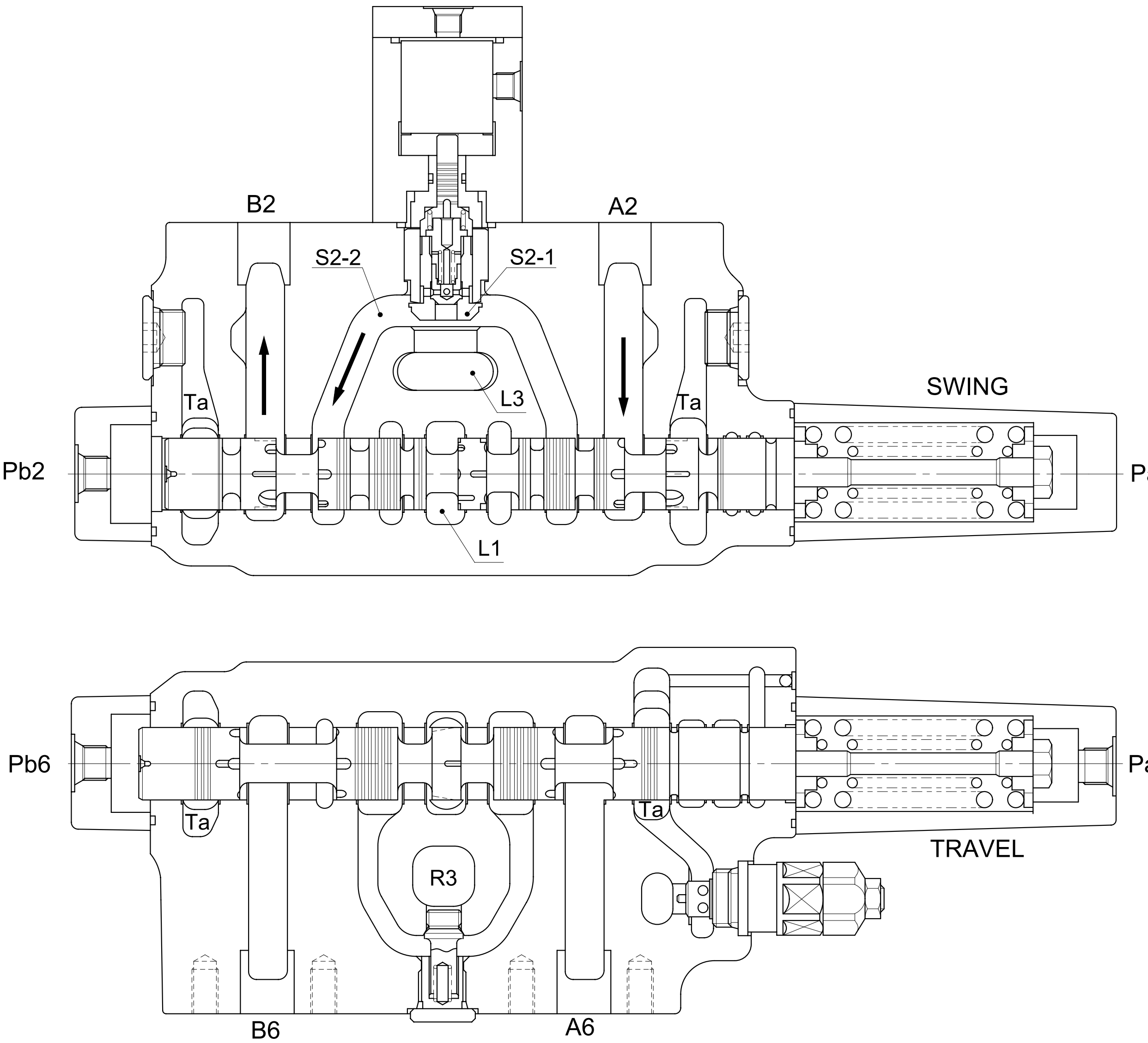
When the travel spool is pushed to the right by the pilot pressure, the land (Lc4, Rc3) is closed and the tank passage of the oil discharged from port PP is closed, and then the pressure of PT port is increased.



(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).

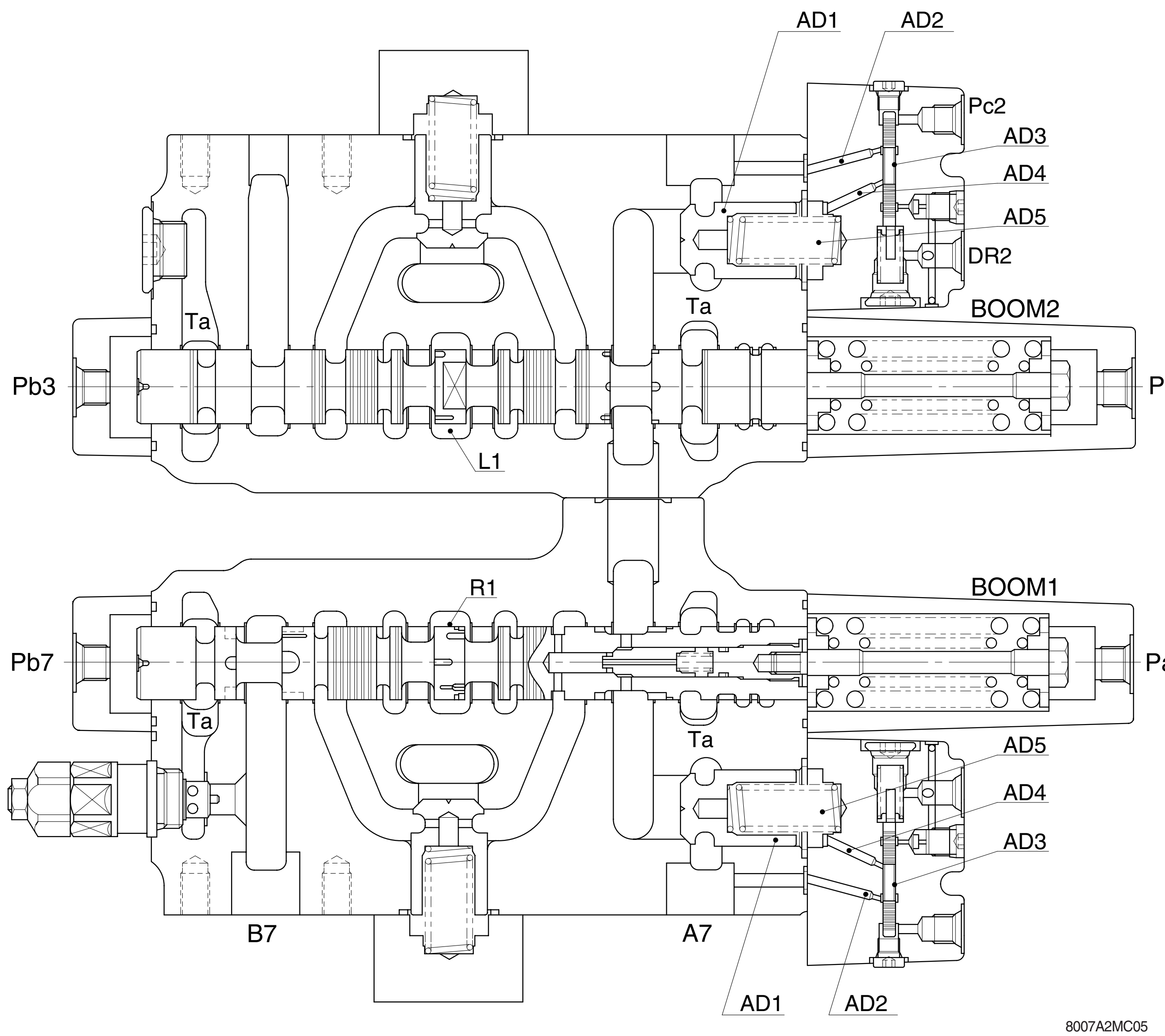


45071MC05

3) BOOM SPOOL

(1) Neutral

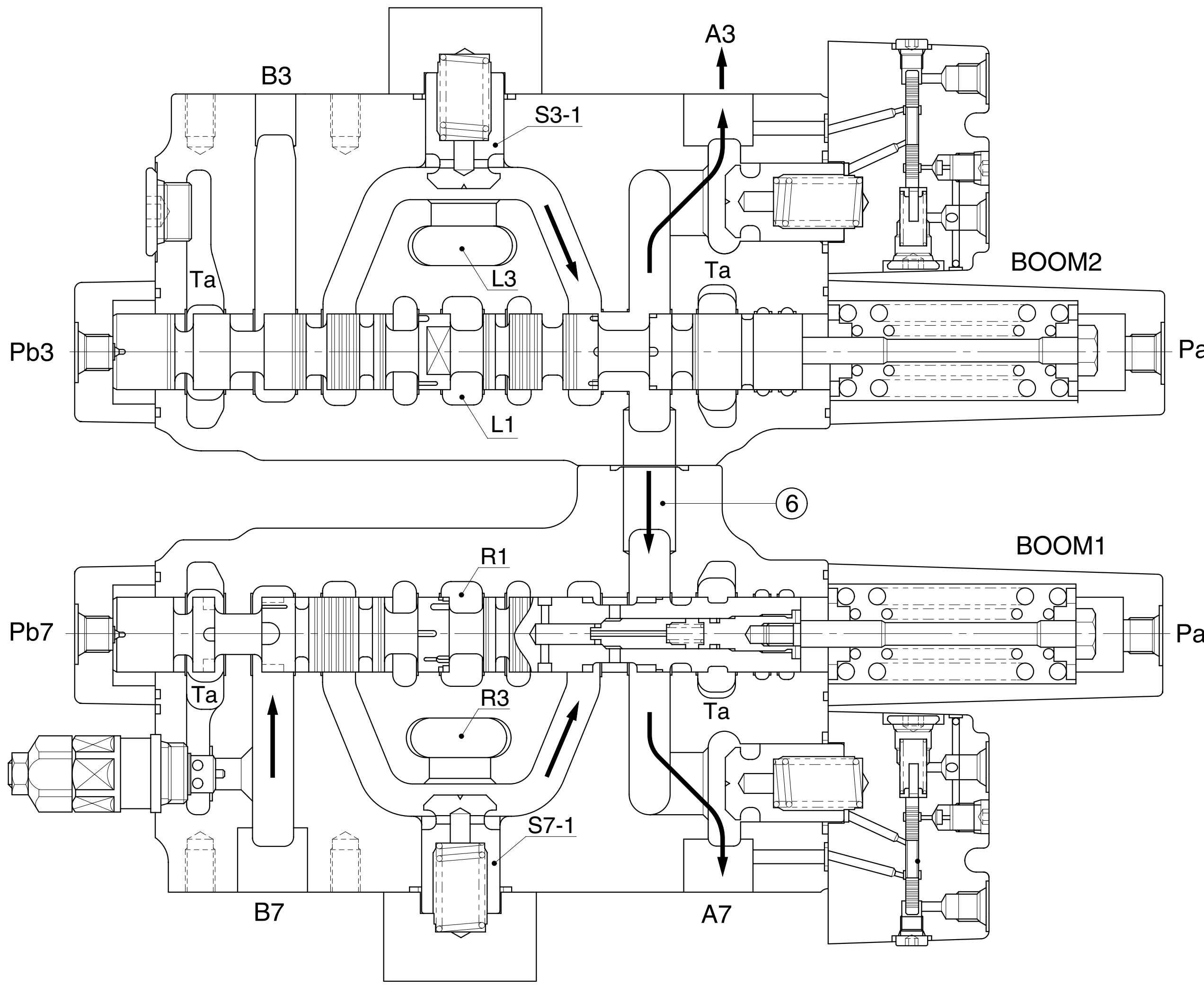
This valve is providing the anti-drift valve on the cylinder bottom side of boom 1 and boom 2 section. In neutral, the poppet (AD1) is seated by the pressure of spring chamber (AD5) because the oil from the port A7 is connection with spring chamber (AD5) via passage (AD2), spool (AD3) and passage (AD4).



(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) and external piping (A3).

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

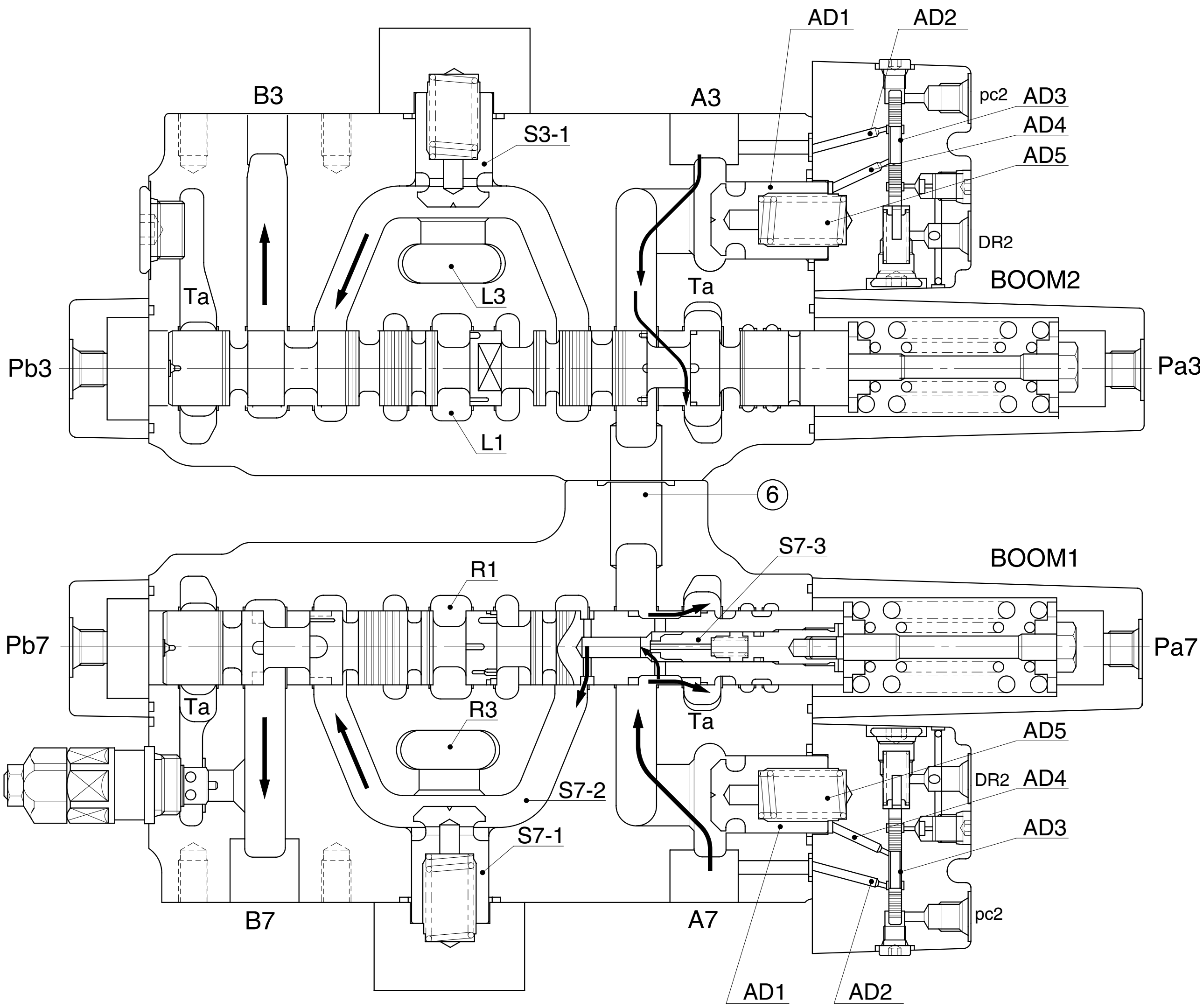


8007A2MC06

(3) Boom down (recycling)

When the boom 1 and 2 spool is pushed to the right by the pilot pressure of port Pb3 and Pb7, the neutral passage (R1, L1) is closed, the oil discharged from pump P2 flows into the port B3 and B7 via parallel passage (R3, L3) and the load check valve (S3-1, 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 A3 and 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.



8007A2MC07

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).

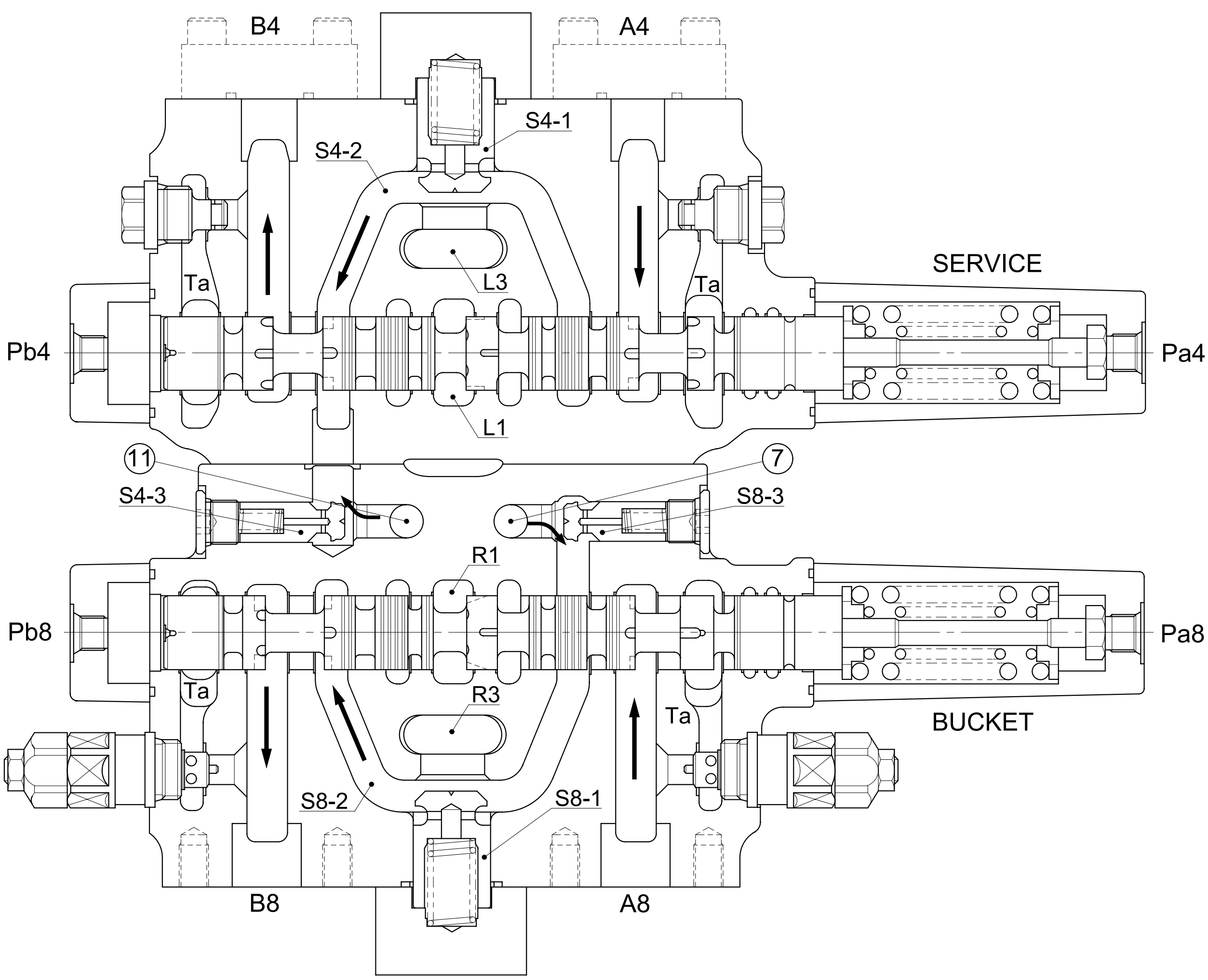
At the same time, as the port pa10 (see 2-24 page) is pressurizing and the bypass cut spool (R) is pushed, the oil discharged from pump P2 flows together into the port B7 via passage (11), poppet (S4-3). The oil returned from port A4 flows into the tank via the tank passage (Ta).

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).



45071MC09

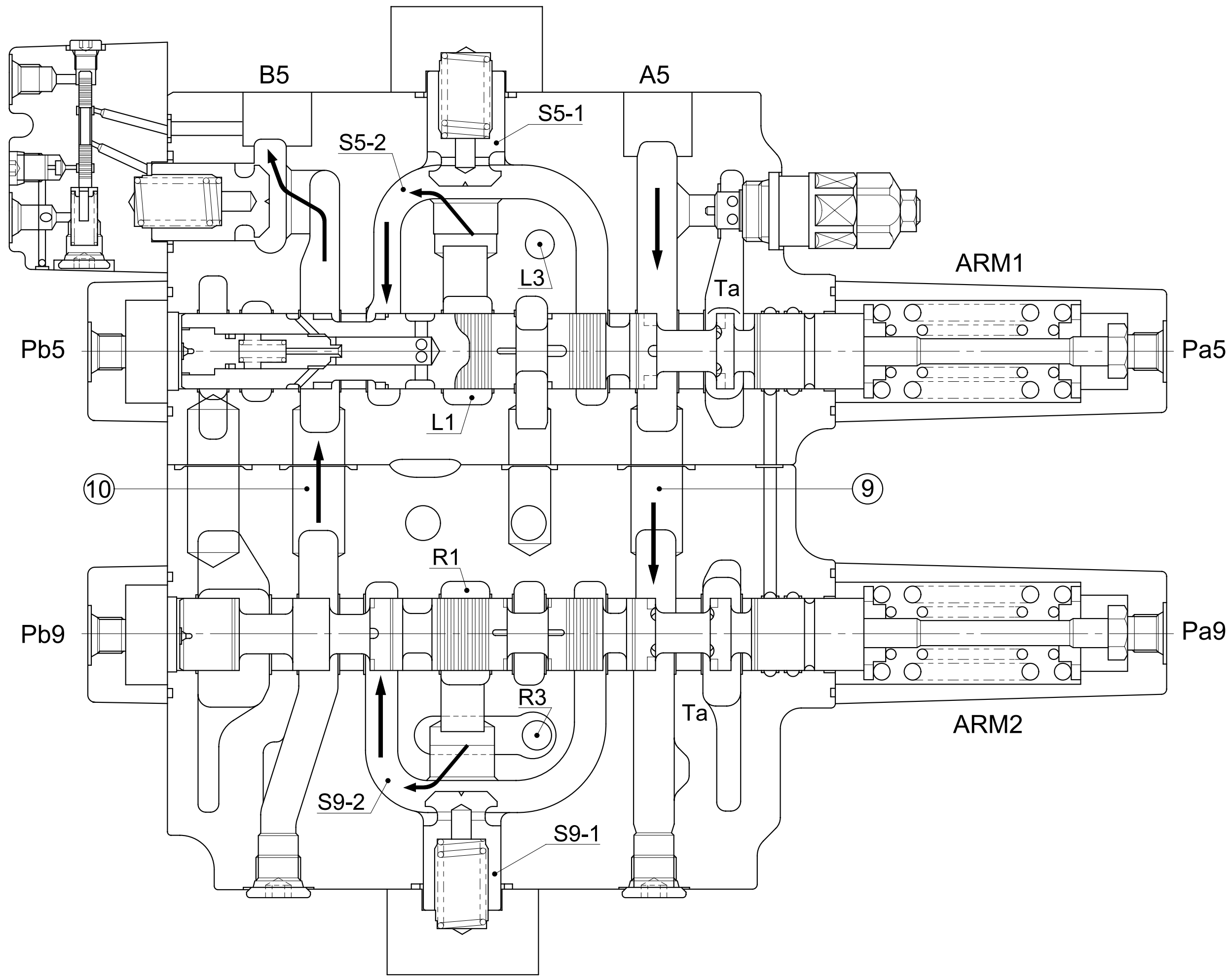
6) ARM SPOOL

(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 (⑩) 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).



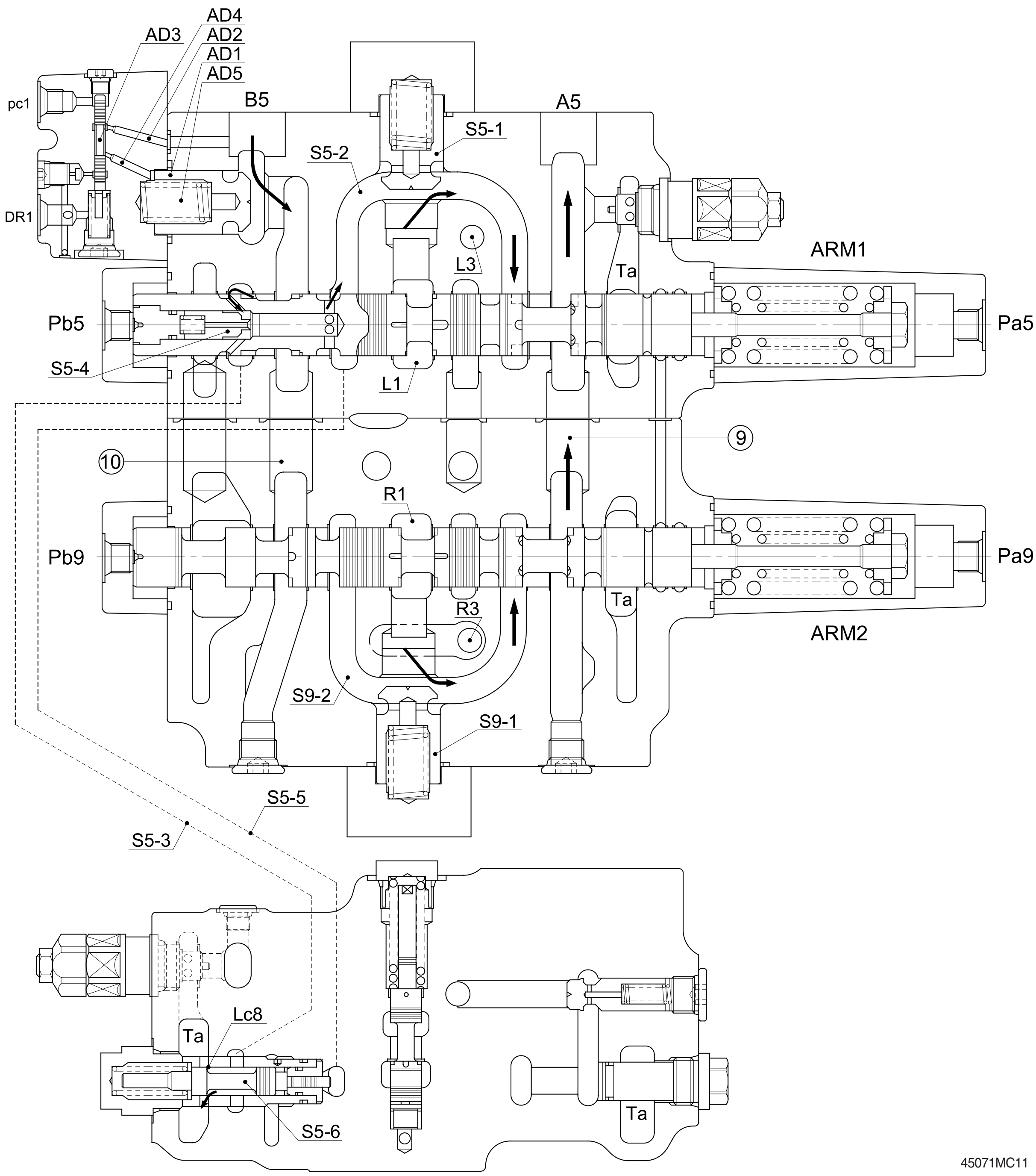
45071MC10

(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.

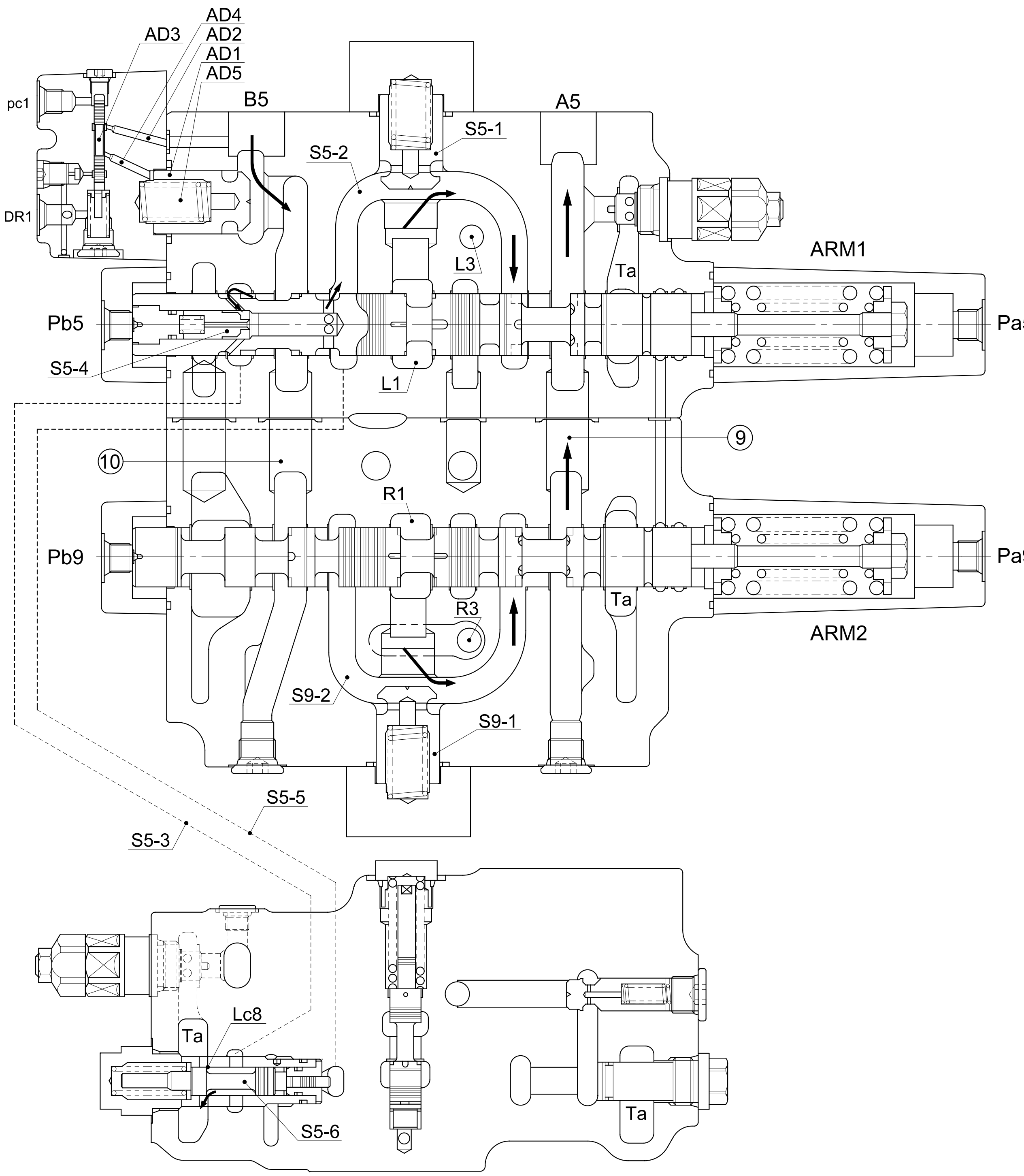


(3) Arm recycling (arm in)

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

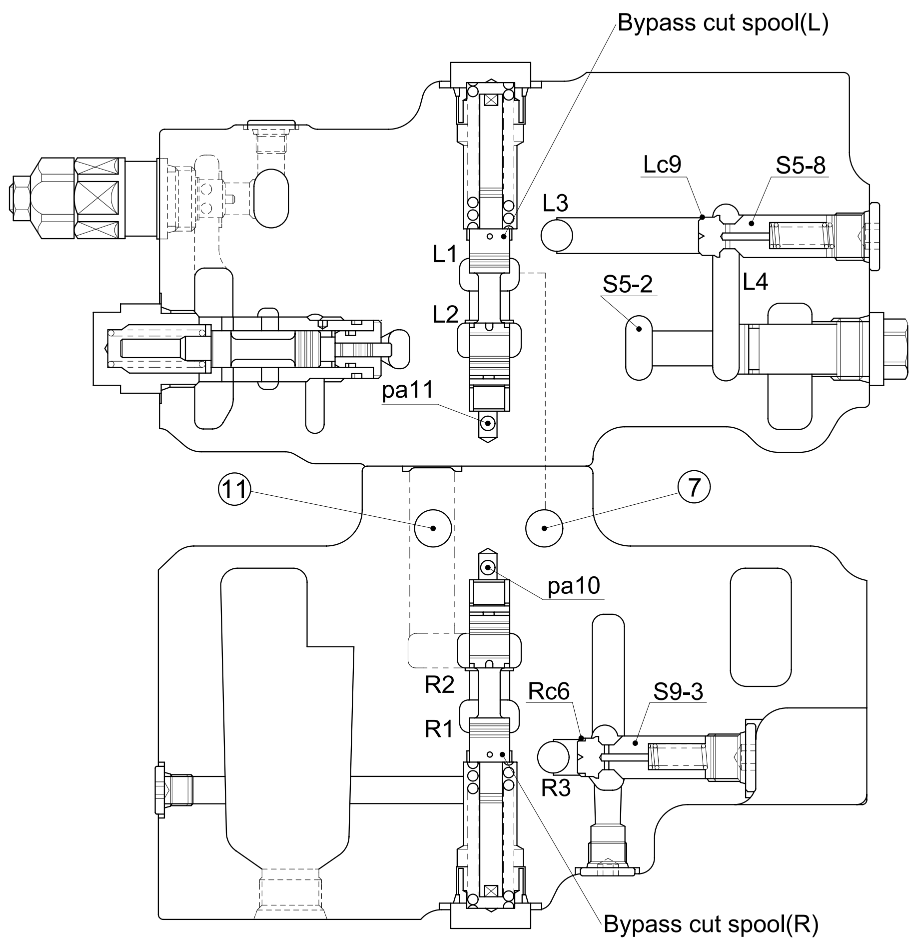
This valve is providing the bypass cut spool at the lowest stream of (upper stream of the low pressure relief valve) the neutral passage (L1, R1).

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 2-31 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 2-31 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 2-34) 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 2-34) through orifice (Lc9) in the edge of the poppet (S5-8) from the parallel passage (L3).



45071MC12

9) RELIEF VALVE

(1) Main relief valve

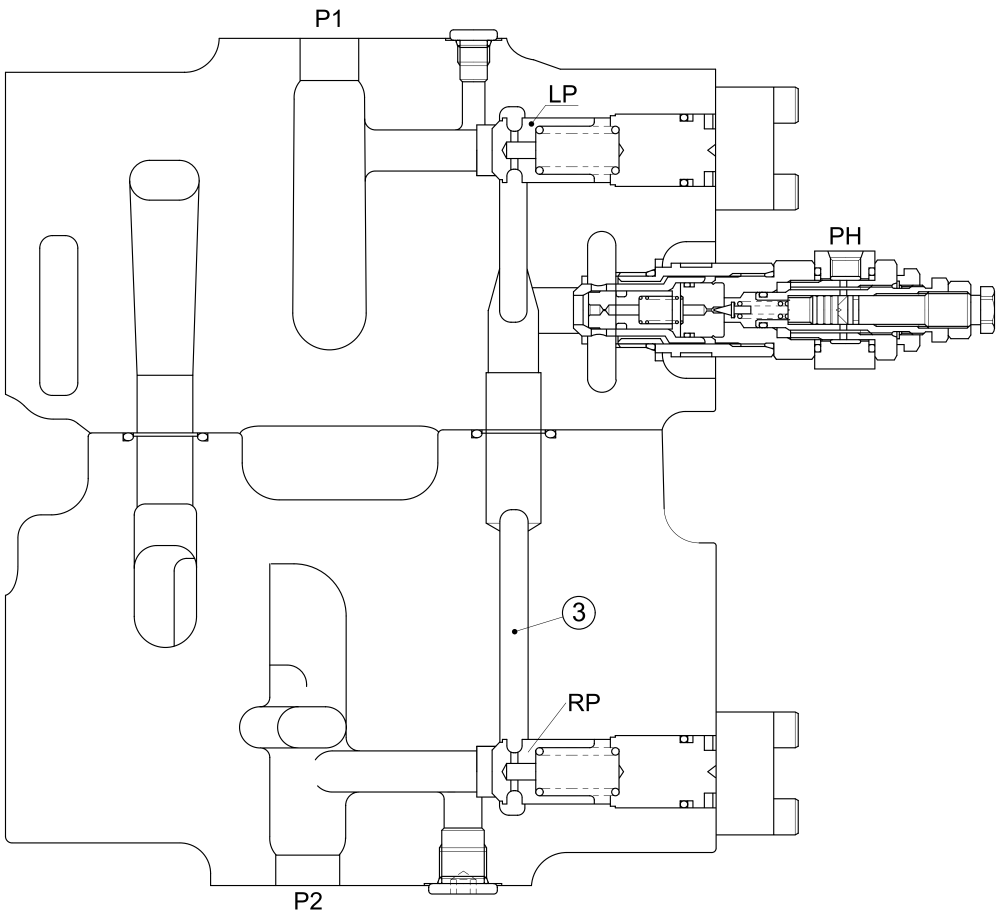
The oil discharged from P1 port via the poppet (LP) and the oil discharged from P2 port via the poppet (RP) flow into the main relief valve through the passage (3).

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.

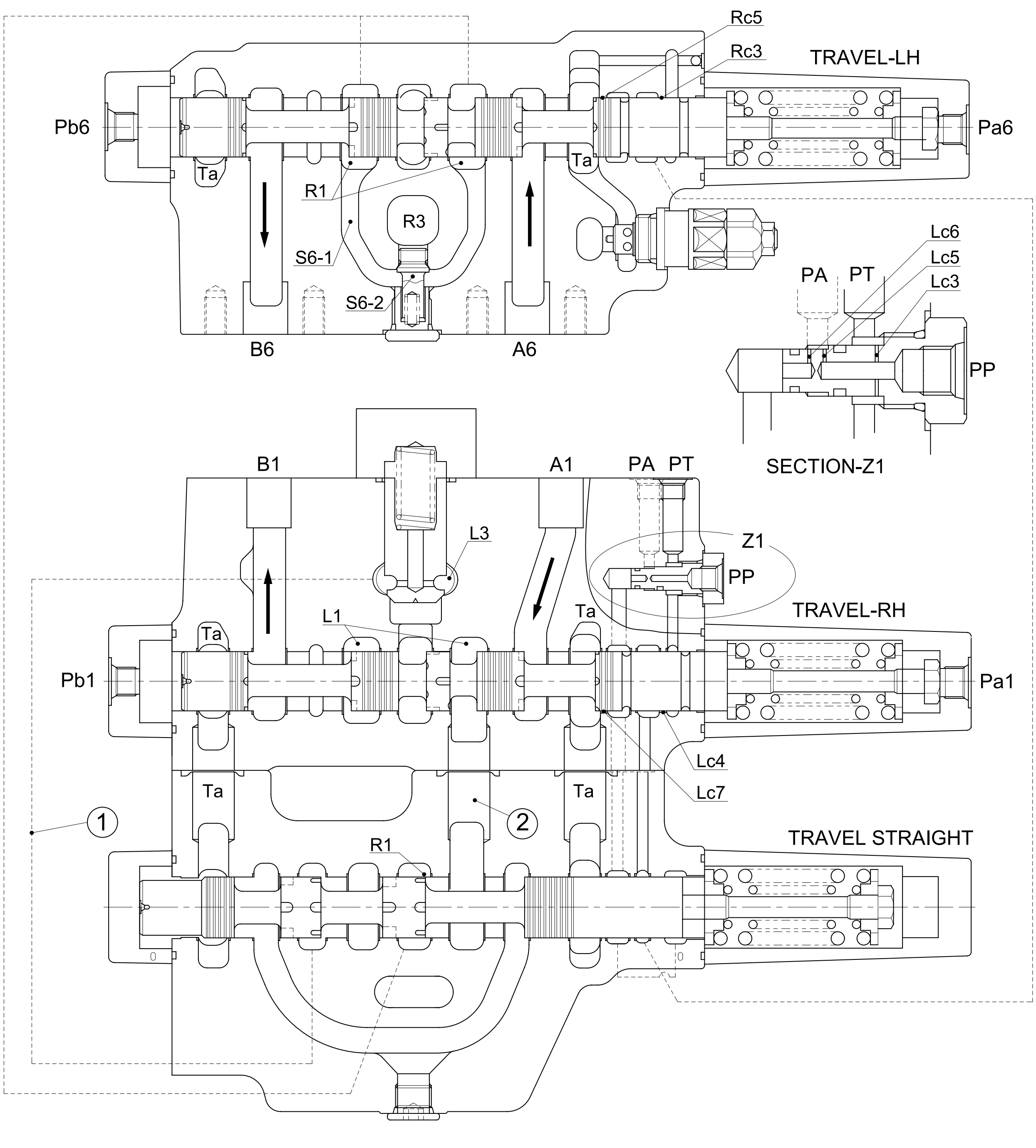


45071MC13

4. COMBINED OPERATION

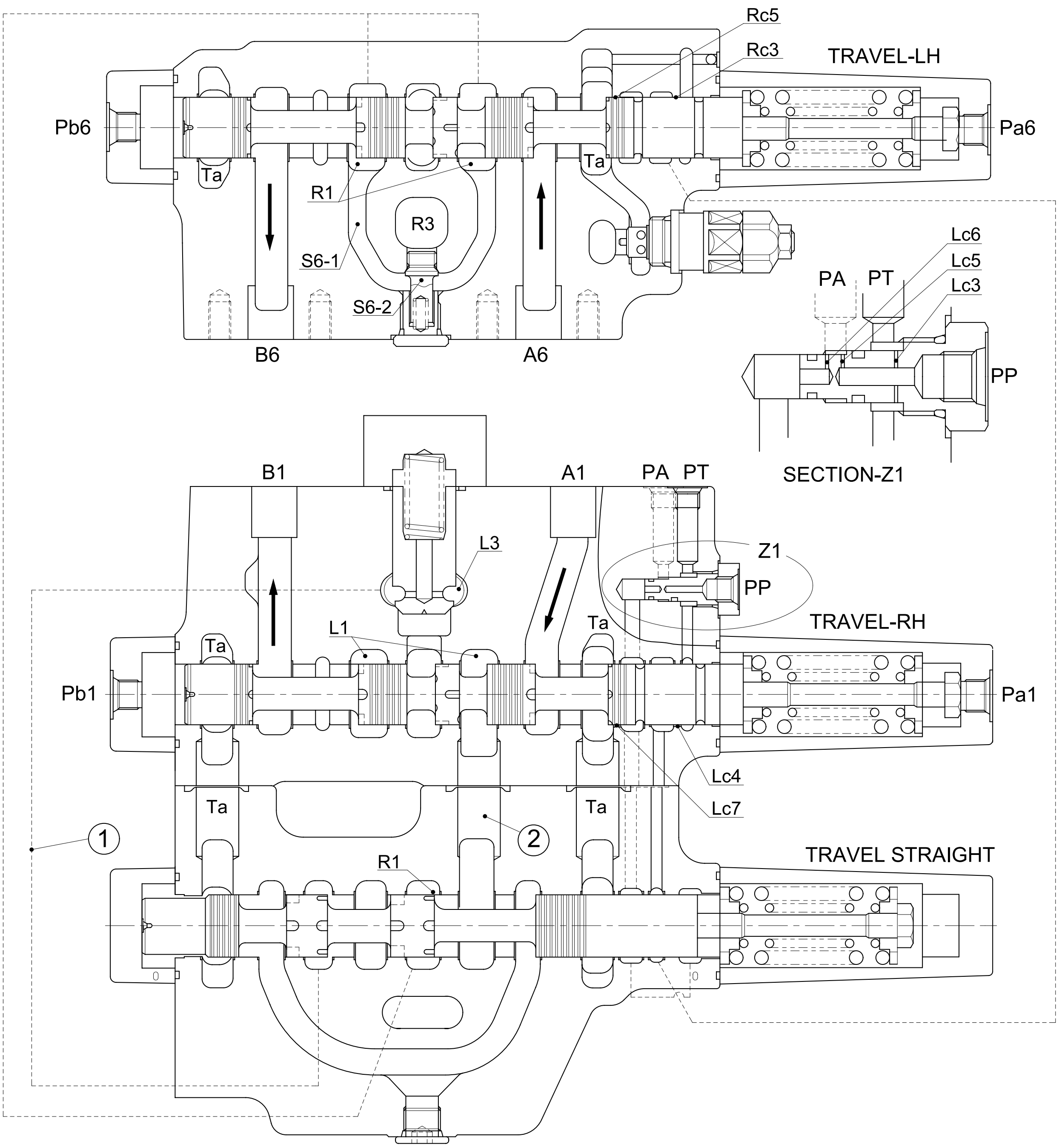
1) TRAVEL COMBINED OPERATION

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.



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.

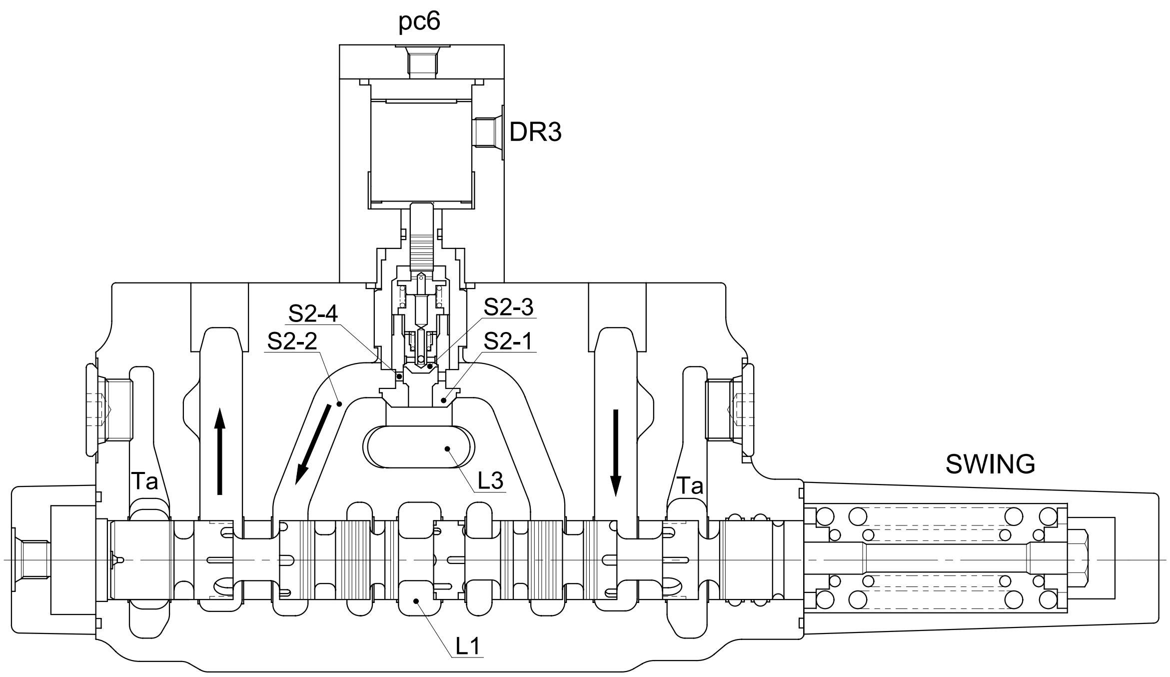


45071MC14

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.



45071MC15

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

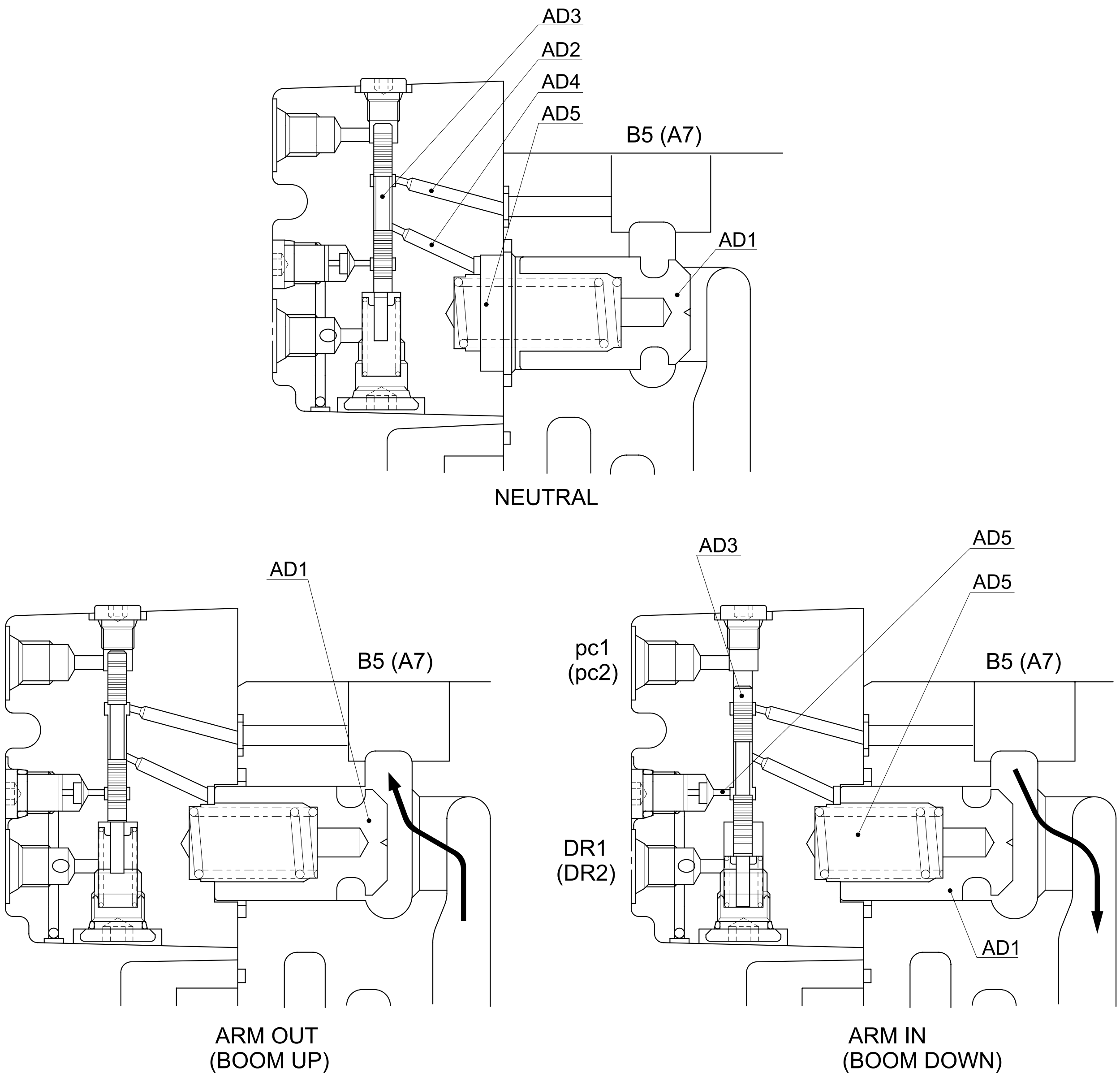
The oil from pump flows into cylinder by pushes open the poppet (AD1).

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).

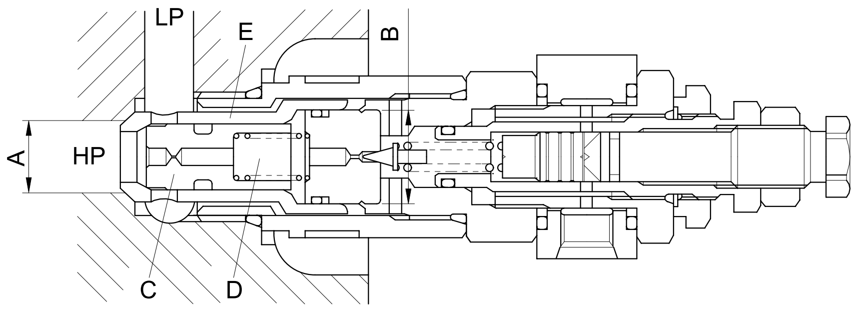


45071MC16

6. RELIEF VALVE OPERATION

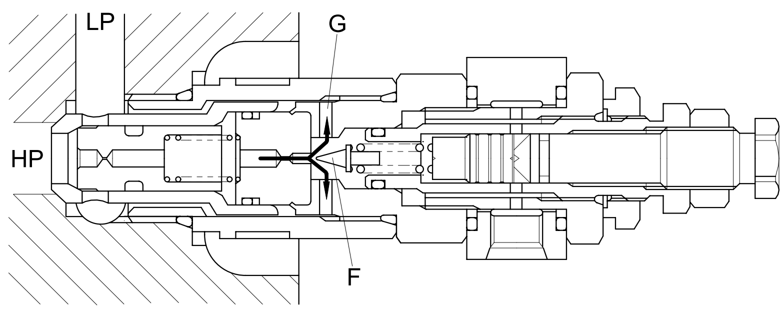
1) MAIN RELIEF VALVE

(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.



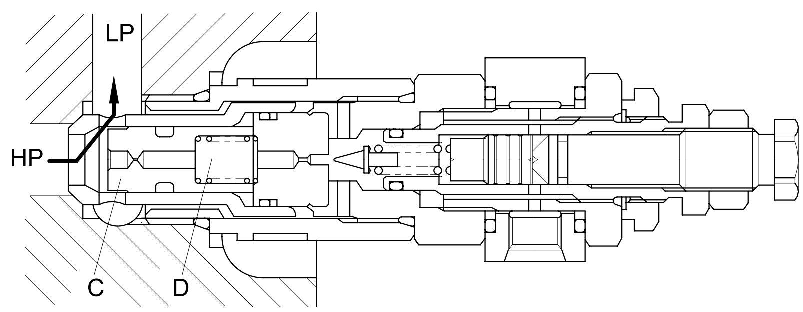
45071MC17

(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).



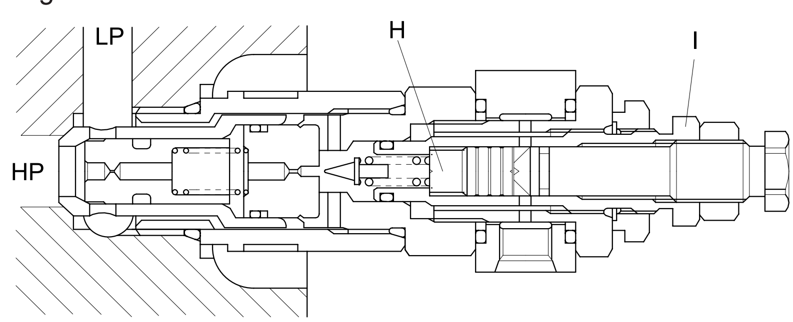
45071MC17-1

(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).



45071MC17-2

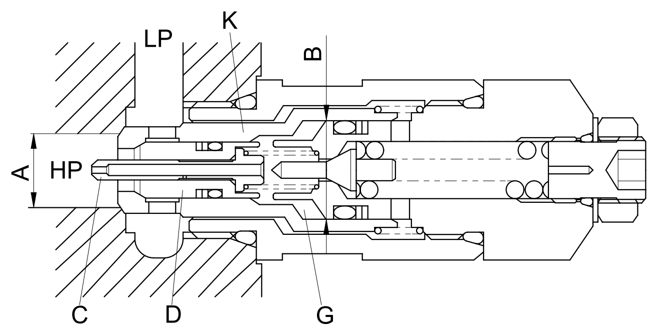
(4) High pressure setting pilot signal (Pi) : ON
The piston (H) moves to left by pilot pressure (Pi); set pressure of spring rises, making high pressure setting.



45071MC17-3

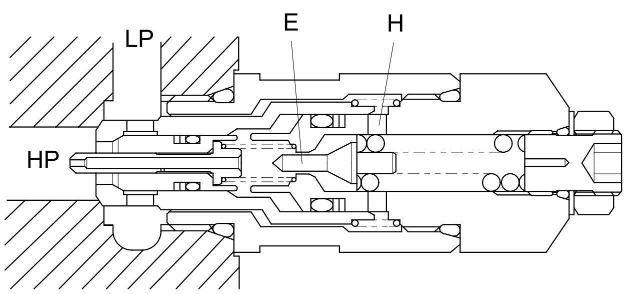
2) OVERLOAD RELIEF VALVE

(1) This relief valve is built-in the cylinder port (HP) and the low pressure (LP), and the pressure oil fills up camber (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.



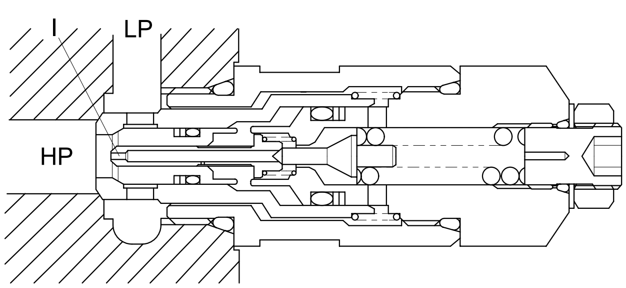
45071MC18

(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).



45071MC18-1

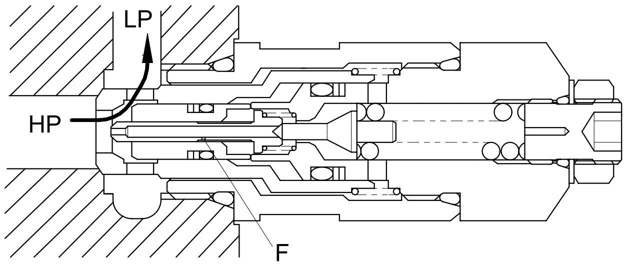
(3) When above flow is formed, the pilot poppet (E) is opened.
The pressure drops before and behind orifice (I); piston (C) moves to right and the piston (C) is seated at the tip of poppet (E).



45071MC18-2

(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).

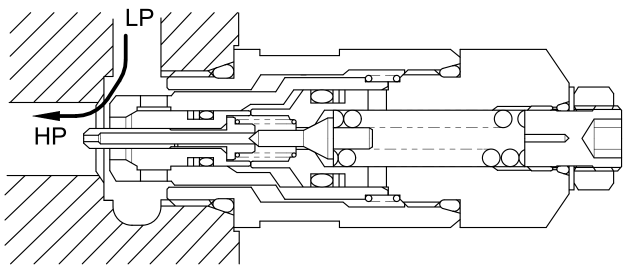


45071MC18-3

(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 camber (G) inside via hole of piston (C).

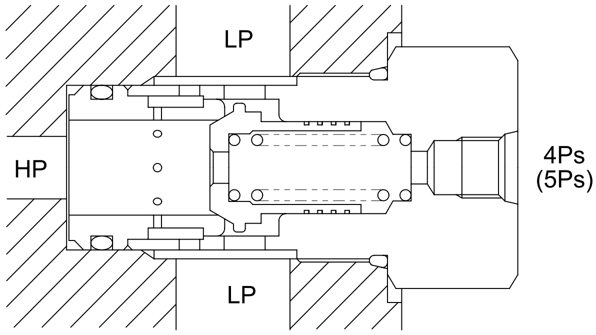
Thus the sleeve (K) and the main poppet (D) are securely seated by difference area of A and B.



45071MC18-4

3) LOW PRESSURE RELIEF VALVE

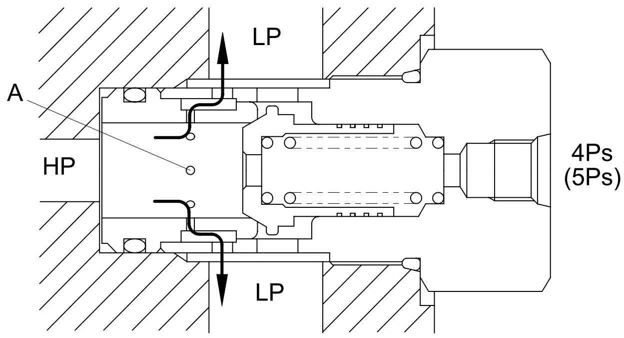
(1) When pump does not operational



45071MC19

(2) When spool neutral

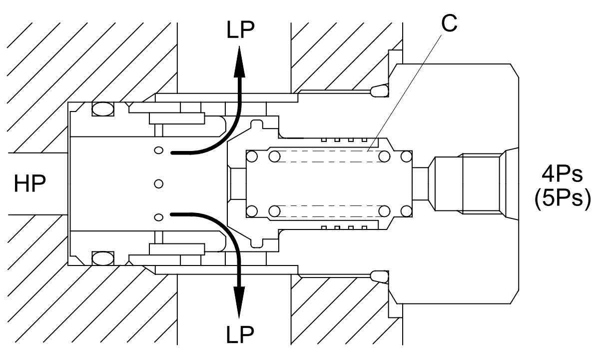
The neutral passage (HP) oil flows into the low pressure passage (LP) via signal orifice (S).
The signal port 4Ps (5Ps) pressure is raise by negative control orifice (A).



45071MC19-1

(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.



45071MC19-2

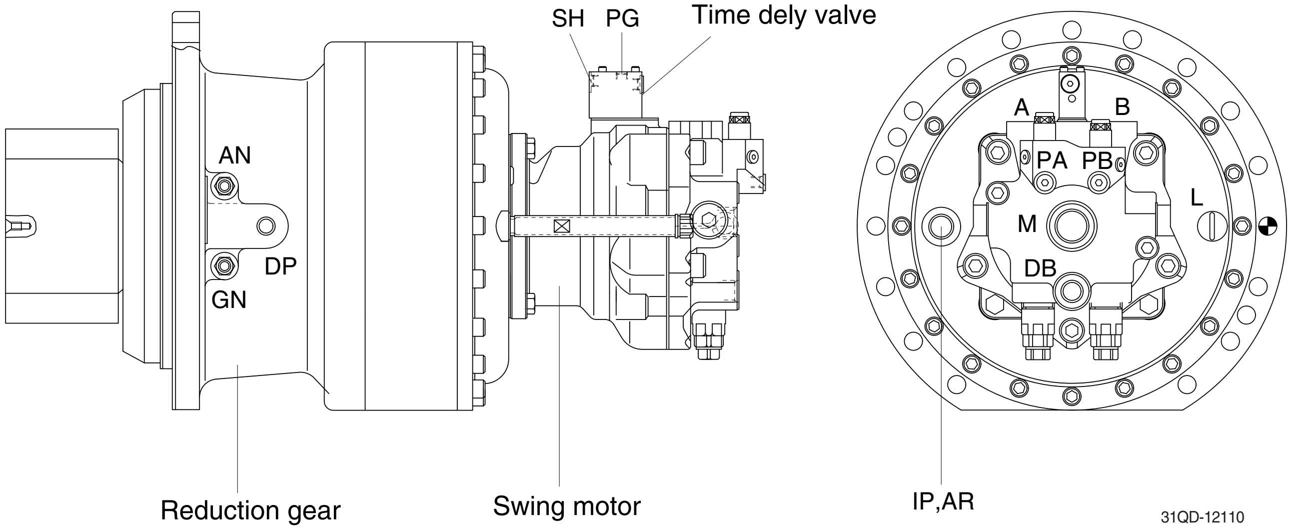
GROUP 3 SWING DEVICE

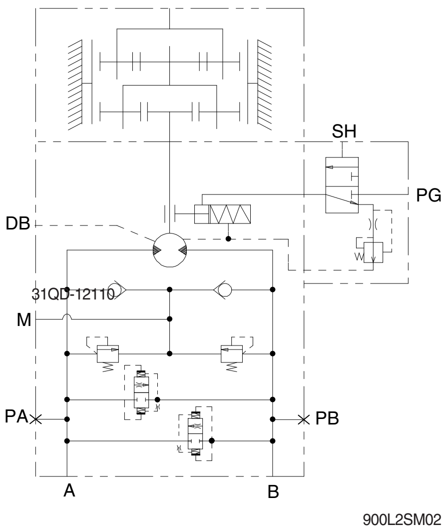
1. STRUCTURE

Swing device consists swing motor, swing reduction gear.

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

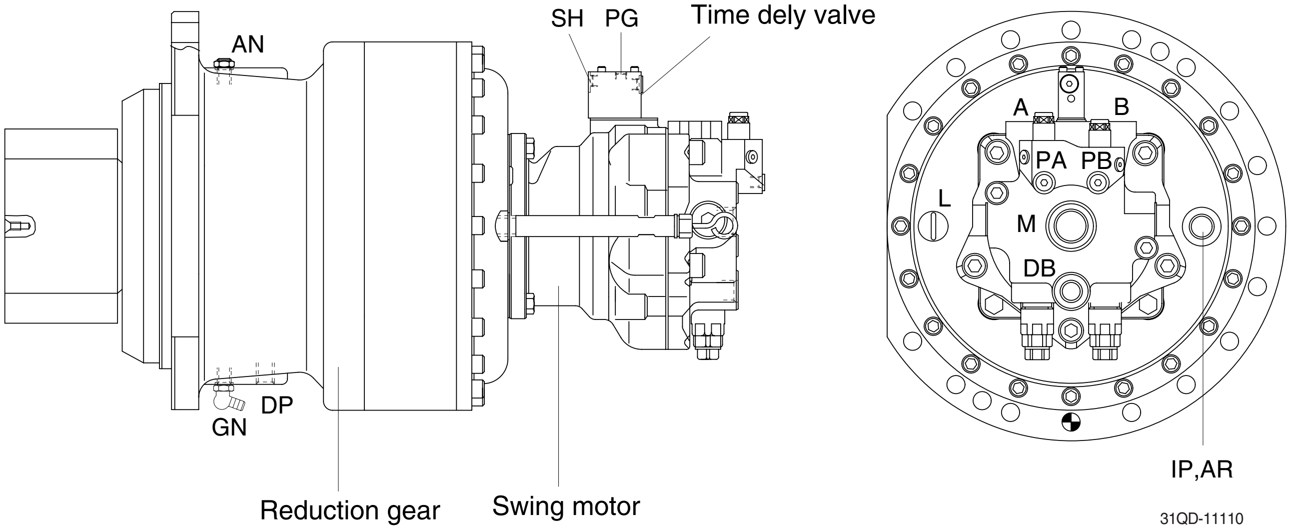
· FRONT



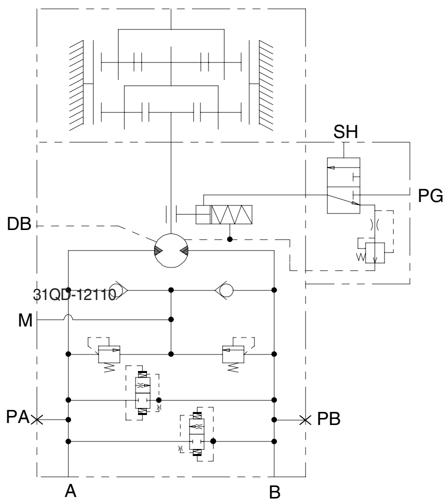


Port	Port name	Port size
A, B	Main port	SAE 1"
DB	Drain port	PF 3/4
M	Make up port	PF 1 1/4
PG	Brake release stand by port	PF 1/4
SH	Brake release pilot port	PF 1/4
IP,AR	Motor gear oil inlet air bleed port	PT 3/4
PA,PB	Gauge port	-
GN	Reduction gear grease fill port	PT 1/4
AN	Reduction gear air vent port	-
DP	Reduction gear drain port	PT 1/2
L	Level bar port	PT 1/2

· REAR



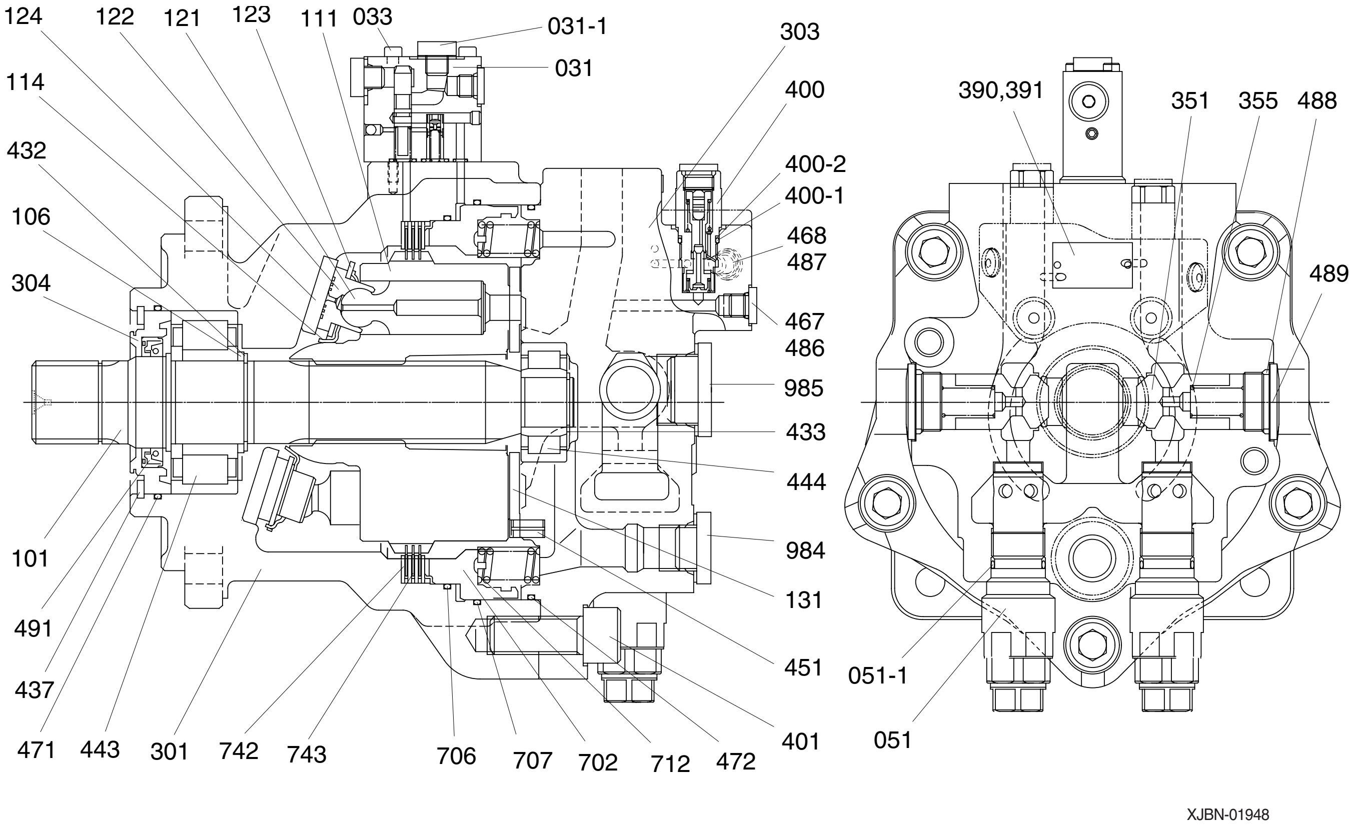
31QD-11110



900L2SM02

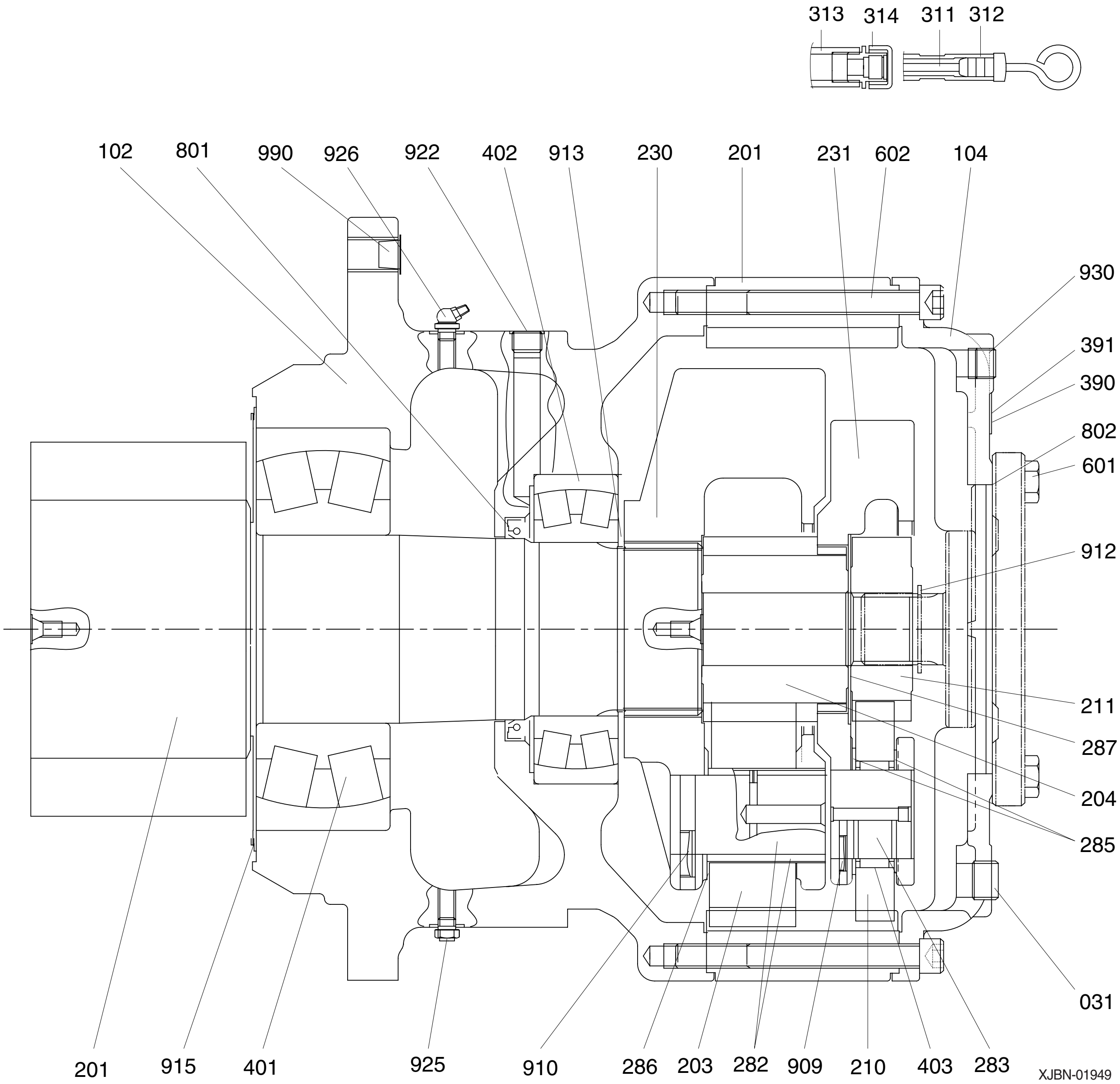
Port	Port name	Port size
A, B	Main port	SAE 1"
DB	Drain port	PF 3/4
M	Make up port	PF 1 1/4
PG	Brake release port	PF 1/4
SH	Brake pilot port	PF 1/4
IP,AR	Motor gear oil inlet air bleed port	PT 3/4
PA,PB	Gauge port	-
GN	Reduction gear grease fill port	PT 1/4
AN	Reduction gear air vent port	-
DP	Reduction gear drain port	PT 1/2
L	Level bar port	PT 1/2

1) SWING MOTOR



031	Time delay valve	304	Front cover	469	Plug bolt
0311	Masking plug	351	Plunger	471	O-ring
033	Hex screw	355	Spring	472	O-ring
051	Relief valve	390	Name plate	486	O-ring
0511	O-ring	391	Pin	487	O-ring
101	Drive shaft	400	Swing valve	488	O-ring
106	Spacer	4001	O-ring	491	Oil seal
111	Cylinder	4002	Back up ring	702	Brake piston
114	Shoe plate	401	Hex screw	706	O-ring
121	Piston	432	Snap ring	707	O-ring
122	Shoe	433	W clip	712	Brake spring
123	Set plate	437	Snap ring	742	Friction plate
124	Shoe plate	443	Roller bearing	743	Separator plate
131	Valve plate	444	Roller bearing	984	Making plug
301	Casing B	467	Plug	985	Masking plug
303	Valve casing	468	Plug		

2) REDUCTION GEAR



104 Rear casing
201 Drive shaft
202 Ring gear
203 Planet gear B No.2
204 Sun gear B No.2
210 Planet gear B No.1
211 Sun gear B No.1
230 Carrier No.2
231 Carrier B No.1
282 Pin A No.2
283 Pin No.1
285 Side plate
286 Thrust washer
287 Thrust plate
311 Level bar
312 Y pipe
313 Oiling pipe
314 Oiling pipe
390 Name plate
391 Pin
401 Spherical roller bearing
402 Spherical roller bearing
403 Needle cage
601 Hex head bolt
602 Hex head screw
801 Oil seal
802 O-ring
909 Spring pin
910 Spring pin
912 Snap ring
913 Stop ring
915 Bearing seal C
922 Plug
925 Relief fitting
926 Grease nipple
930 Plug
931 Plug
990 Plug

2. FUNCTION

1) HYDRAULIC MOTOR SECTION

When high-pressure oil passes thought the inlet port (a) of the valve plate (1) and flows into the cylinder as shown in figure, the oil pressure acts upon the piston to generate the axial force "F".

This force "F" is divided into two vector forces thought the shoe (2) : namely, the force "F1" vertical to the swash plate (3) and the force "F2" perpendicular to the shaft. This force "F2" is transmitted to the cylinder block (4) via the piston and generates a couple of forces that turn the output shaft.

In the cylinder block nine pistons are equally spaced, and the pintons connected to the high pressure oil inlet ports give their rotating torque to the output shaft sequentially.

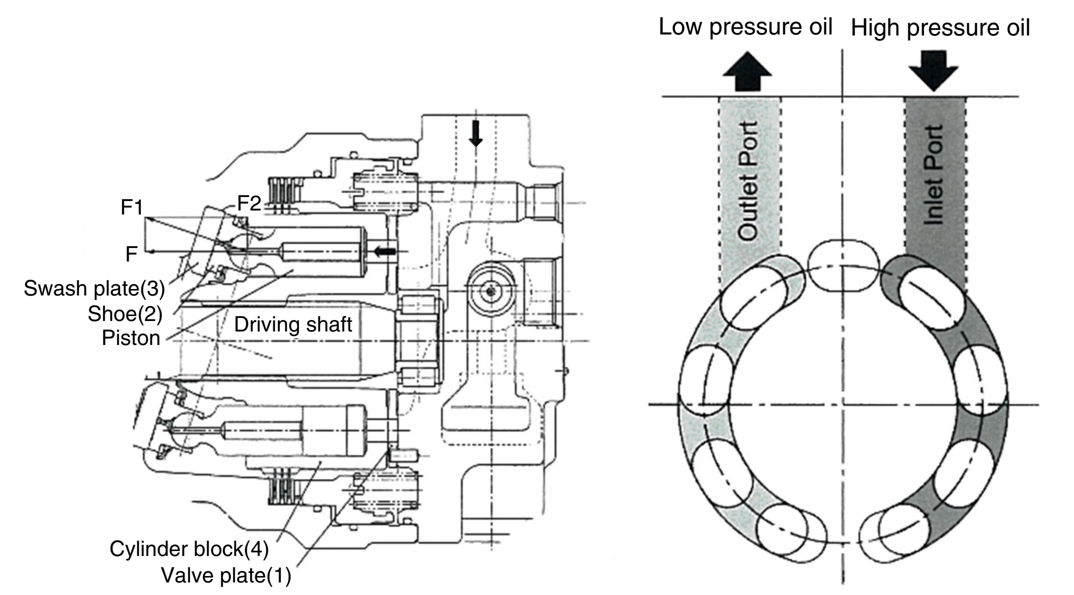
When the oil inflow/outflow direction are reversed, the rotating direction of the output shaft is reversed.

The theoretical output torque "T" is given by the following formula:

$$T = \frac{p \times q}{2 \times \pi} \cdot \frac{1}{100} \quad \text{N-m}$$

Where p : Effective pressure difference MPa

q : Displacement per revolution cm^3



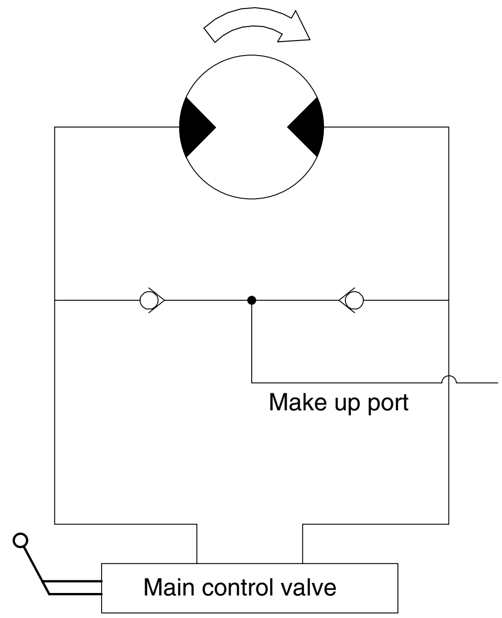
900L2SM10

2) VALVE CASING SECTION

(1) Anti-cavitation check valve section

Some systems using motors of this type have no valves of counterbalance functions, and so the motors may be turned beyond their supplied oil flows.

In order to prevent cavitation due to oil shortage, check valves are fitted to suck short oil flows.



900L2SM11

(2) Relief valve

In acceleration or braking, the relief valve works and the pressure is kept at the set value. The relief valve provides a small shork less piston, and it works at the start of relief action and keeps the pressure low value for a short time. So smooth acceleration or braking with small shock is possible.

(3) Anti-reaction valve

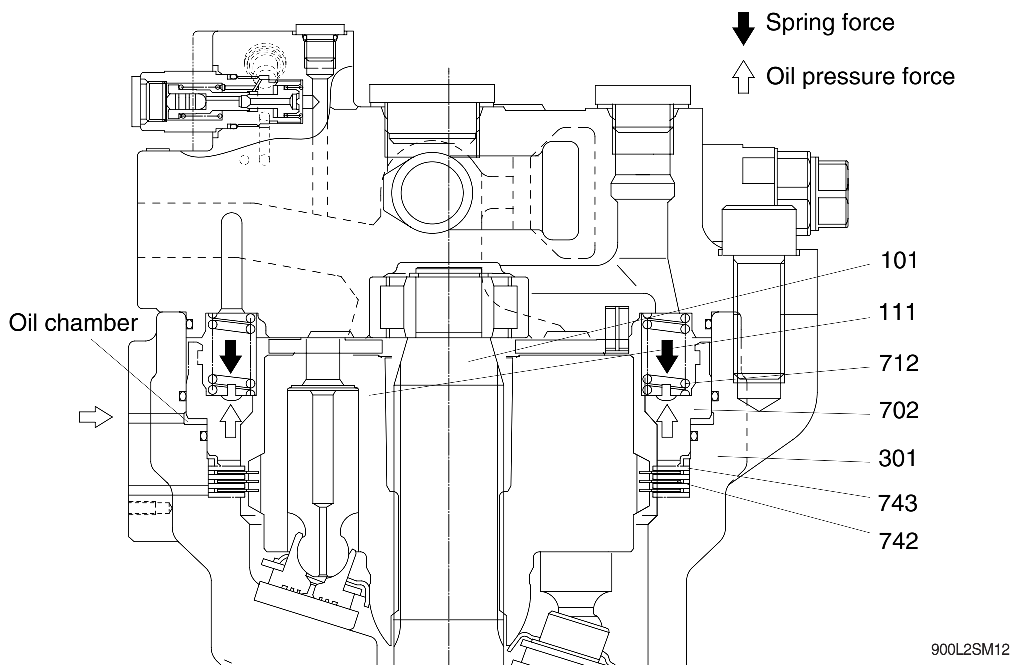
Right after braking, the high pressure remains a lttle at outlet port to make a motor swing back. Anti-reaction valves make oil passage from outlet side to inlet side in a moment to release the remained pressure. Therefore the swing back of the motor can be prevented.

3) BRAKE SECTION

The cylinder (111) is connected to the drive shaft (101) with a gear. In addition, the separator plate (743) is restrained from circumferentially - rotating by an arc groove cut on the casing (301).

When the friction plate (742) connected with a gear to the external periphery of the cylinder is pressed to the casing (301) by the brake spring (712) via the separator plate (743) and brake piston (702), friction force is generated among the friction plate, casing, separator plate and brake piston. This friction force restrains the driving gear and the brake is applied.

On the other hand, when the release pressure is applied to the oil chamber formed between the brake piston and casing and this pressure force overcomes the spring force, the brake piston moves and the fricrtion plate are not pushed to the casing and so the brake is released.



4) PARKING BRAKE

(1) PARKING BRAKE ON

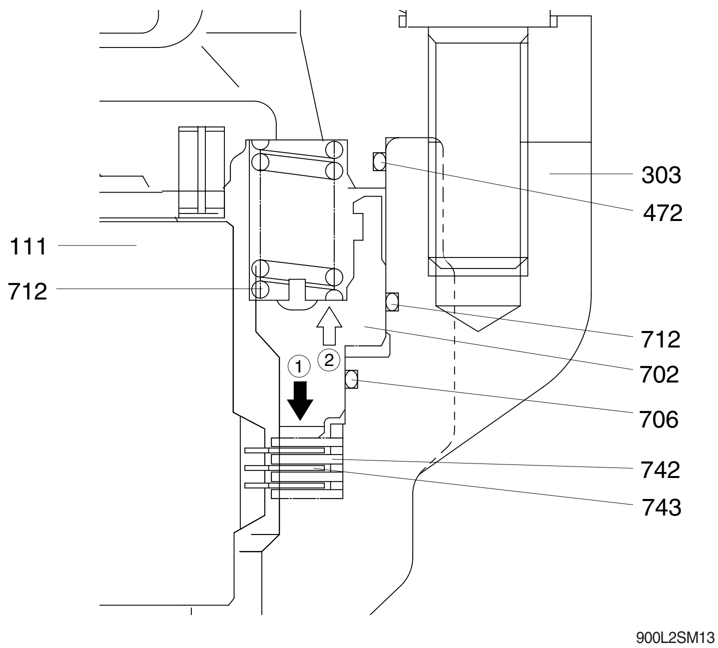
When the swing motor stops the parking brake is normally kept being fixed by mechanical force. When the brake release pressure is blocked, brake piston (702) is pushed by spring (712) force according to the arrow direction ①.

Consequently, friction plate (742) which is fixed to cylinder block (111) and separate plate (743) which is assembled to casing (303) are pressed. And then swing motor stops.

(2) PARKING BRAKE OFF

When the brake releases pressure-supply, the oil flows into room (G). Oil pressure is pressing the spring (712) force, and then brake piston (702) is pushed according to the arrow direction ②.

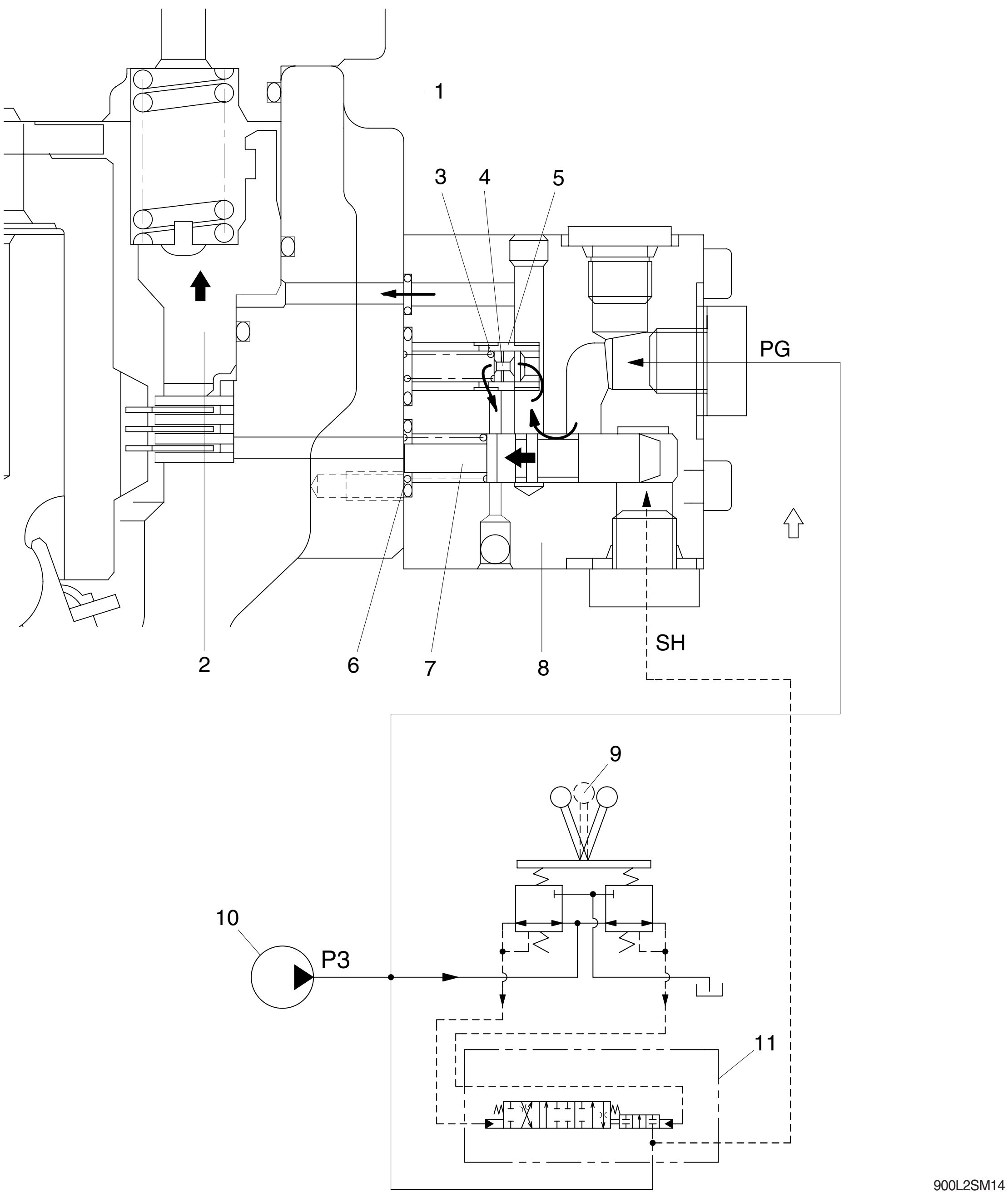
The pressure of friction plate (742) and separate plate (743) is released. Following this procedure the cylinder block (111) is rotating.



111	Cylinder block
303	Casing
472	O-ring
702	Brake piston
706	O-ring
707	O-ring
712	Spring
742	Friction plate
743	Separate plate

5) TIME DELAY VALVE

When the swing motor stops, time delay valve delays the parking brake function for a while.
For the parking brake works all of a sudden it may break the swing motor parts. When the swing control lever (9) sets up to the swing position, the pilot oil goes to the swing control valve (11) and to SH of the time delay valve (8) through the main control valve.
The oil pressure moves to the piston (2) to the upward against the force of the spring (1).
Thus the brake force is released.



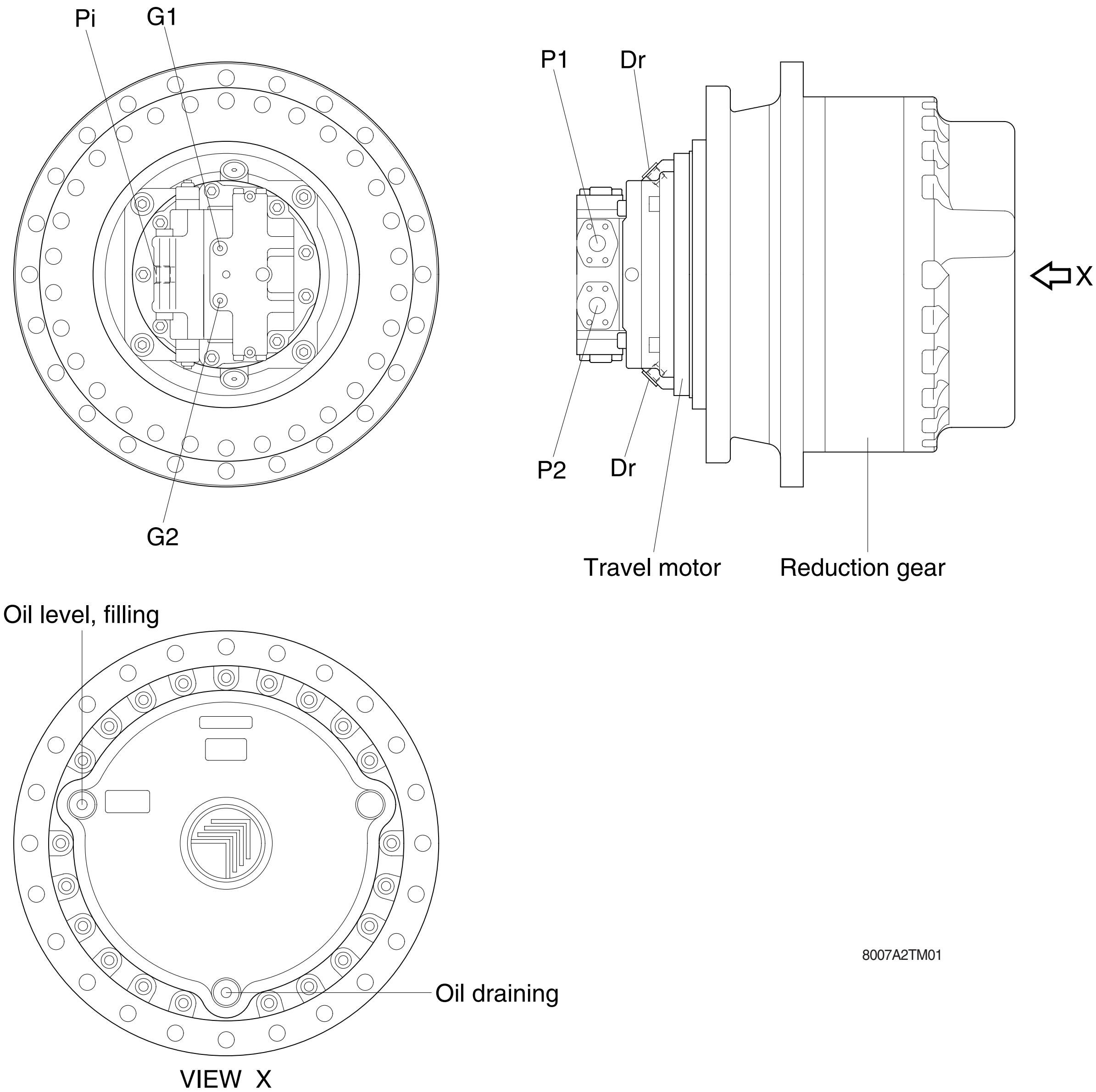
1	Spring	5	Poppet	9	Swing control lever
2	Piston	6	Spring	10	Pilot pump
3	Spring	7	Spool	11	Main control valve
4	Orifice	8	Time delay valve		

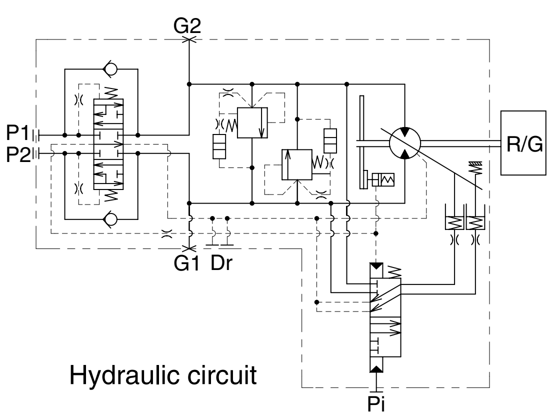
GROUP 4 TRAVEL DEVICE

1. CONSTRUCTION

Travel device consists travel motor and gear box.

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

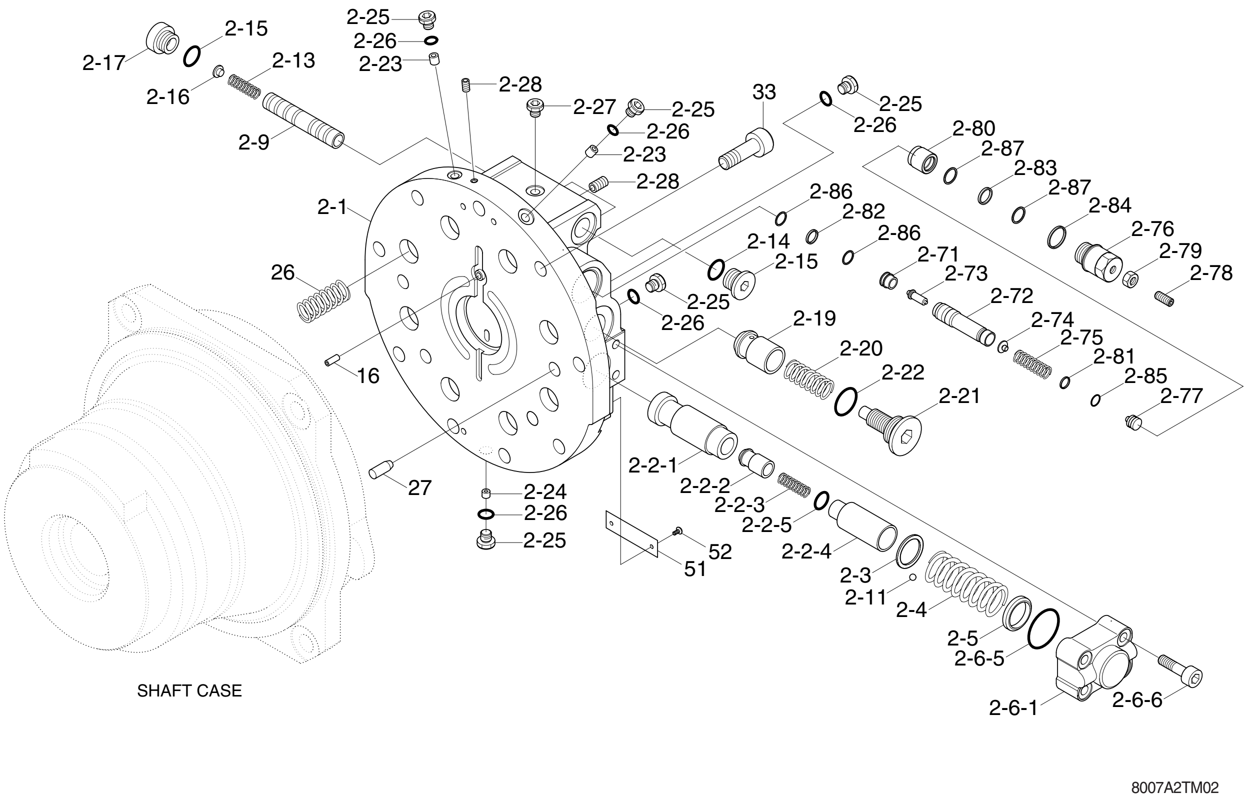




Hydraulic circuit

Port	Port name	Port size
P1	Main port	SAE 1"
P2	Main port	SAE 1"
G1, G2	Gauge port	PF 1/4
Dr	Drain port	PF 3/4
Pi	2 speed control port	PF 1/4

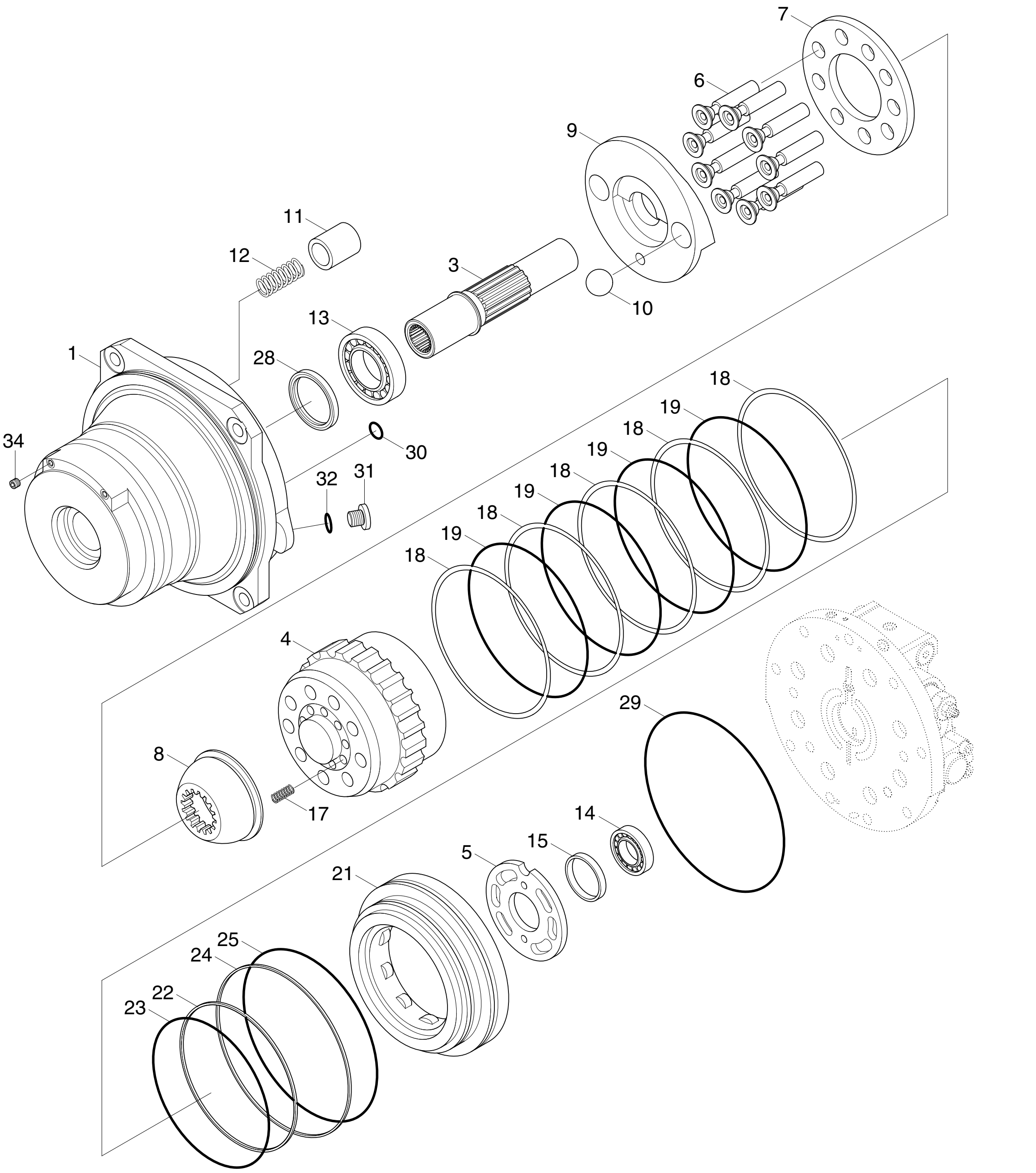
1) TRAVEL MOTOR (1/2)



2-1	Base plate	2-7-5	Spring	2-15	O-ring
2-2	Spool assy	2-7-6	Plug	2-16	Spring guide
2-2-1	Spool	2-7-7	Spring guide	2-17	Plug
2-2-2	Check valve	2-7-8	Set screw	2-19	Check valve
2-2-3	Spring	2-7-9	Nut	2-20	Spring
2-2-4	Plug	2-80	Free piston	2-21	Plug
2-2-5	O-ring	2-81	O-ring	2-22	O-ring
2-3	Spring seat	2-82	O-ring	2-23	Orifice
2-4	Spring	2-83	O-ring	2-24	Orifice
2-5	Spring seat	2-84	O-ring	2-25	Plug
2-6	Cap assy	2-85	Back up ring	2-26	O-ring
2-6-1	Cap	2-86	Back up ring	2-27	Shipping plug
2-6-5	O-ring	2-87	Back up ring	2-28	Plug
2-6-6	Bolt	2-9	Valve assy	16	Pin
2-7	Relief valve assy	2-9-1	Spool	26	Spring
2-7-1	Poppet seat	2-9-2	Spool-C	27	Pin
2-7-2	Relief housing	2-11	Orifice	33	Socket bolt
2-7-3	Poppet	2-13	Spring	51	Name plate
2-7-4	Spring seat	2-14	Plug	52	Drive screw

TRAVEL MOTOR (2/2)

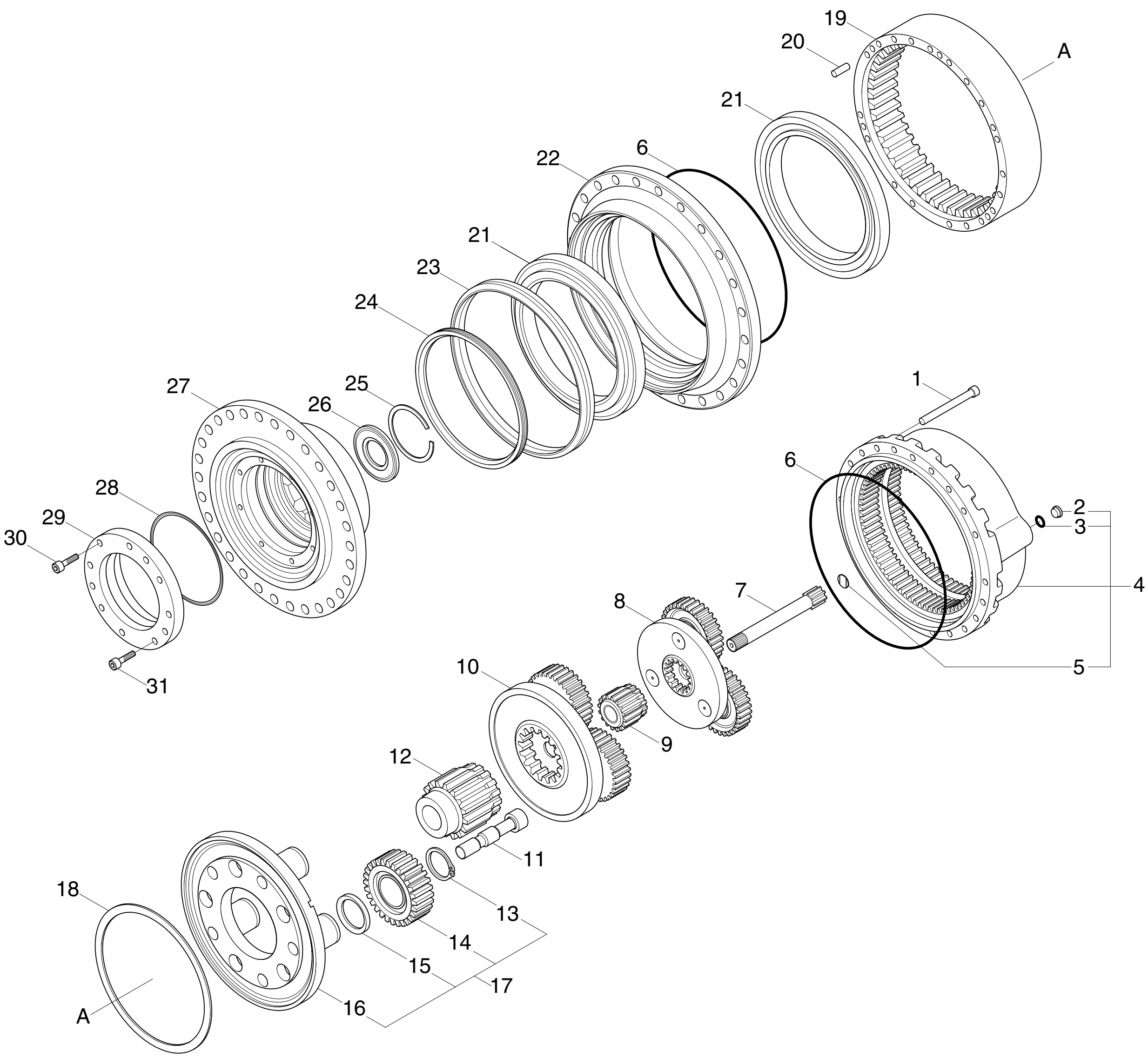
· Control part



8007A2TM03

1	Case	12	Spring	24	O-ring
3	Shaft	13	Roller bearing	25	Back up ring
4	Cylinder block	14	Roller bearing	28	Oil seal
5	Valve plate	15	Collar	29	O-ring
6	Piston assy	17	Spring	30	O-ring
7	Retainer plate	18	Friction plate	31	Plug
8	Plate holder	19	Disc plate	32	O-ring
9	Swash plate	21	Brake piston	34	Plug
10	Steel ball	22	O-ring		
11	Piston assy	23	Back up ring		

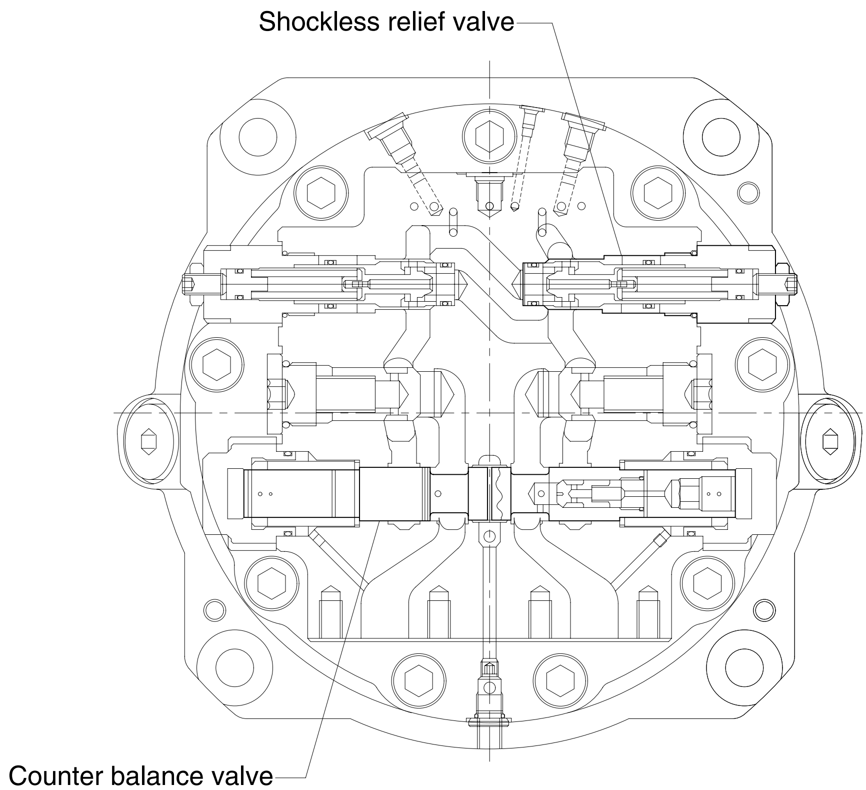
2) REDUCTION GEAR

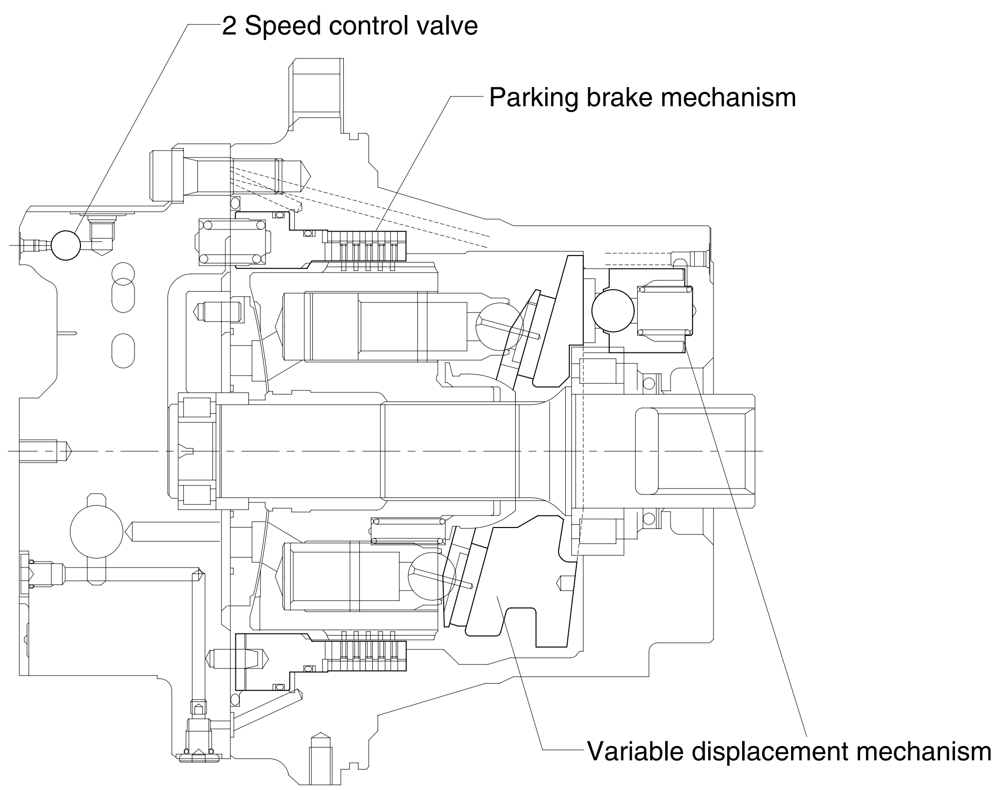


8007A2TM04

1	Screw	12	Sun gear	23	Life time seal
2	Oil breather plug	13	Circlip	24	Spacer
3	Washer	14	Planetary assy	25	Circlip
4	Cover assy	15	Spacer	26	Discs retainer
5	Pad	16	Planetary carrier	27	Hub
6	O-ring	17	Gear assy (3rd)	28	O-ring
7	Sun gear	18	Spacer	29	Motor adaptor
8	Gear assy(1st)	19	Toothed ring	30	Screw
9	Sun gear	20	Pin	31	Screw
10	Gear assy(2nd)	21	Bearing		
11	Screw	22	Gear box housing		

3) BASIC STRUCTURE

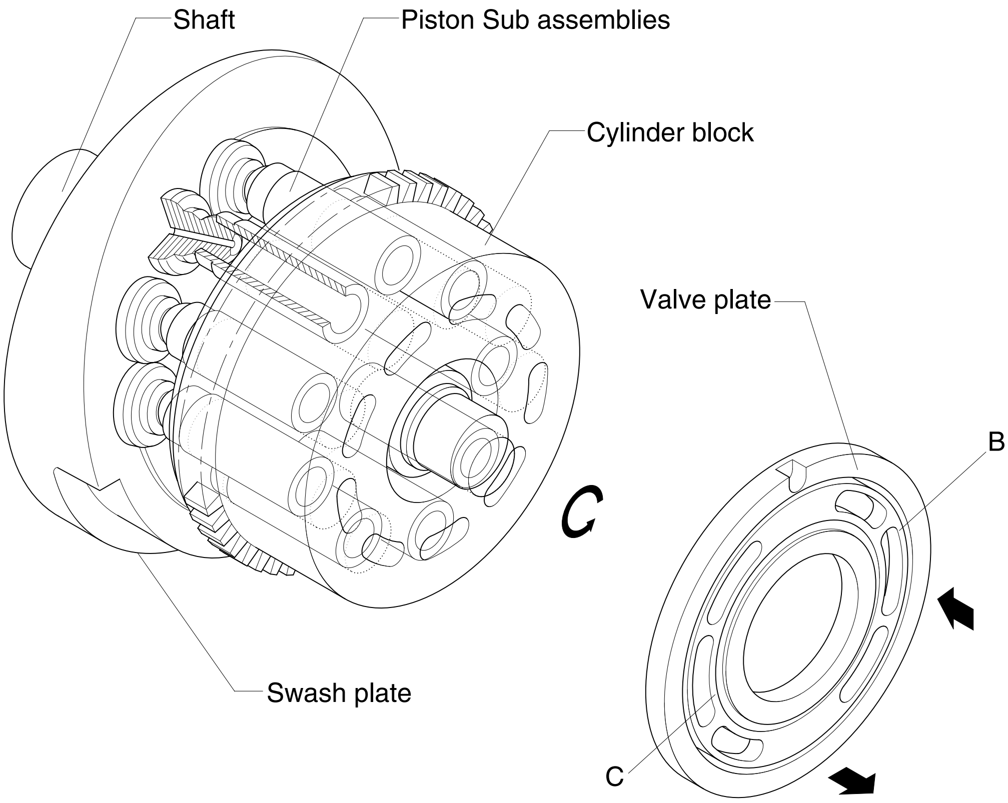




8007A2TM05

2. FUNCTION

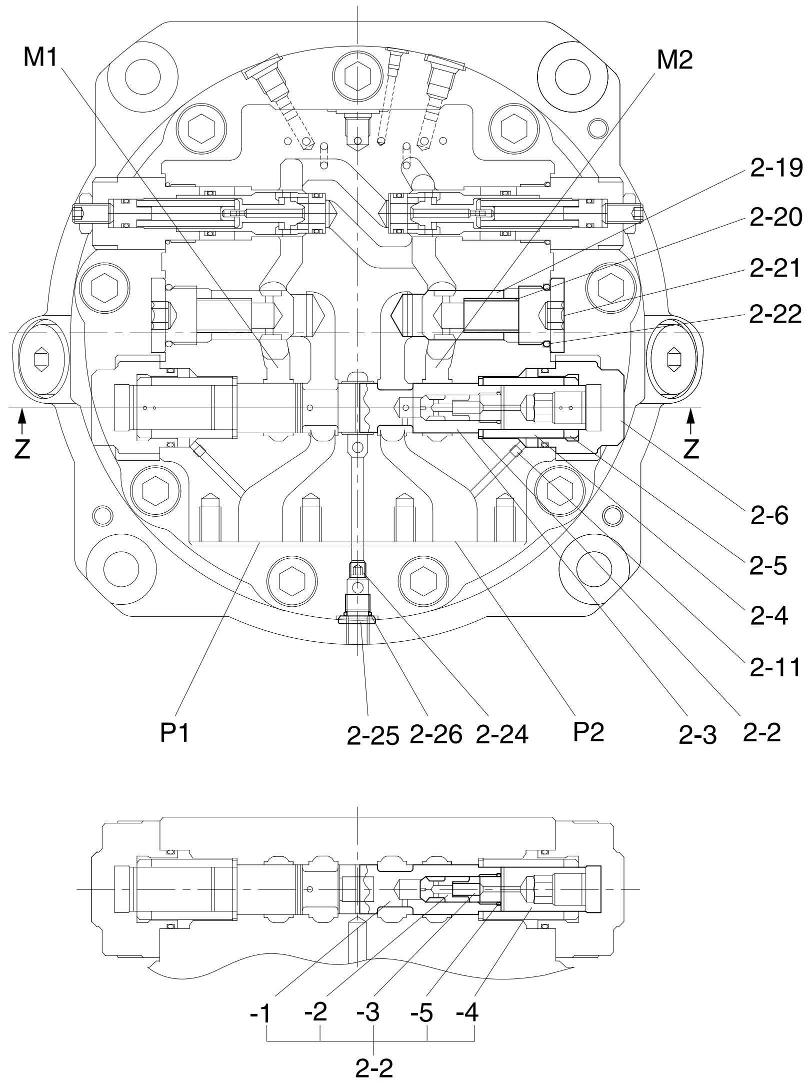
1) HYDRAULIC MOTOR



8007A2TM06

Nine piston sub assemblies are assembled in cylinder block. The end face of cylinder block is in contact with valve plate having two half moon shaped ports, B and C (high and low pressure ports).
When supplying pressure fluid (pressure P) to B port, swash plate is pushed by the force of piston sub assemblies having F = P · A (A: Piston pressure area). Piston sub assemblies receive the reaction force against it, and produce the reaction force (Ft) in rotating direction. The total force of high-pressure side piston sub assemblies in rotating direction produces a rotating force in the cylinder block, and the torque is transmitted to shaft through the spline resulting in the rotation of the shaft.

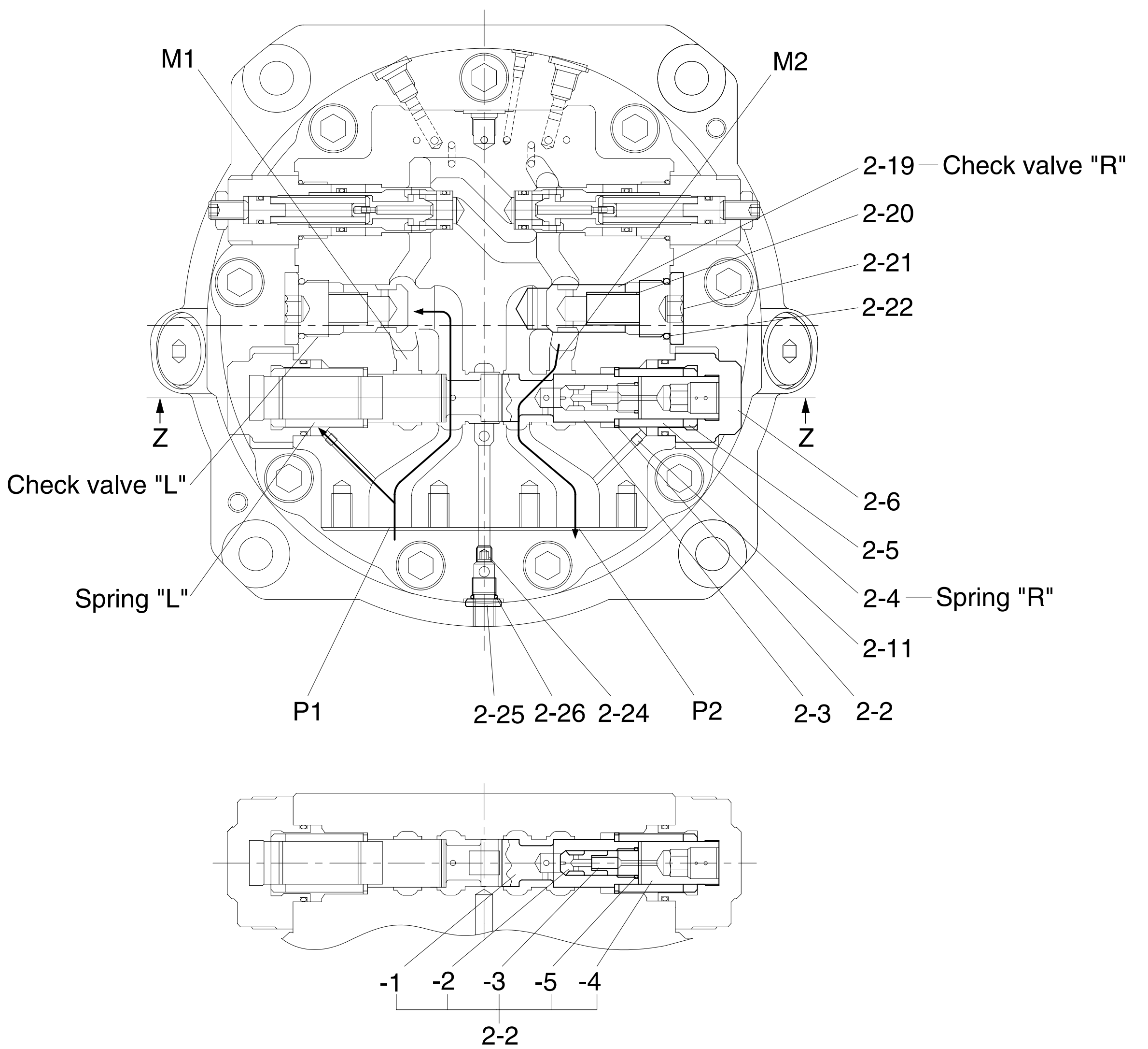
2) COUNTER BALANCE VALVE



8007A2TM07

The counter balance valve is provided to stop the axial piston motor and to prevent overrun. When the control valve is set to the neutral position, there is no pressure in the ports P1 and P2, and ports M1 and M2 are blocked by spool (2-2-1) and check valve (2-19), consequently the motor does not start rotating.

(1) COUNTER BALANCE VALVE WORK



When the fluid is supplied from pump to counter balance valve port P1 through control valve, the fluid flows into piston motor through check valve "L" (2-19), and rotate the piston motor.

On the other hand, the return fluid from the piston motor flows into the counter balance valve through port M2, but the fluid is interrupted by check valve "R" (2-19), and consequently the pump delivery pressure will increase.

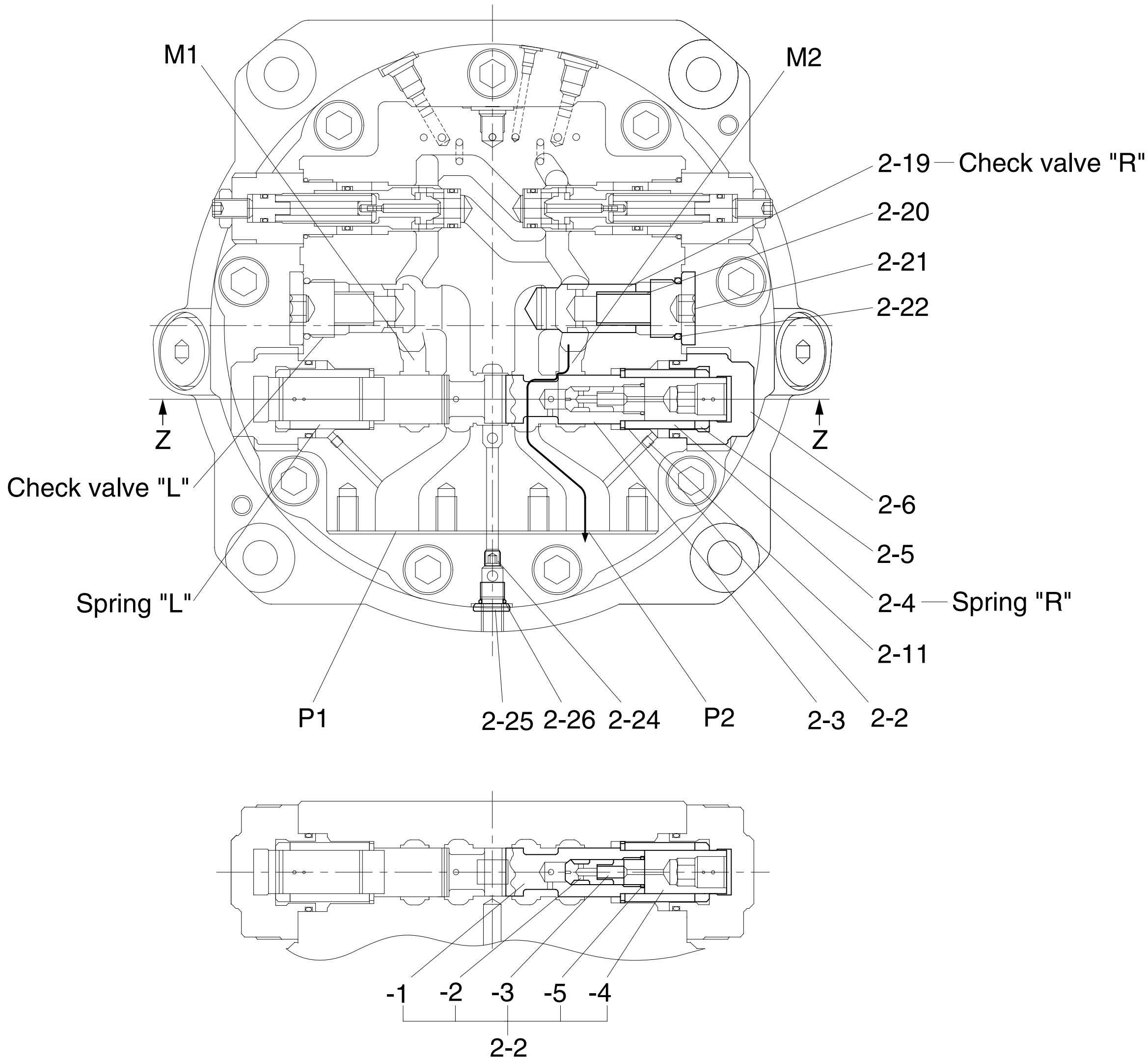
The high-pressure oil at port P1 passes through orifices "L" (2-11) pushes the end of face of spool assy (2-2) and pushes the plunger rightward against spring "R" (2-4) on the opposite side with the force proportional to the pressure.

When the hydraulic pressure rises to a certain pressure, spool assy (2-2) starts moving rightward, and the fluid in port M2 passes through the notch machined outer circular of spool assy (2-2) and flows into the port P2, producing a back pressure on the port M2, finally returning into the tank through a control valve.

And when the pump delivery pressure rises, the throttling aperture of the notch in spool assy (2-2) becomes larger, and consequently the backpressure of the port M2 becomes lower.

This way, the throttling aperture of the notch in spool assy (2-2) automatically adjusts the area of a return side passage in order to rotate the piston motor with the appropriate speed for Port P1 side flow rate (inlet flow).

(2) BRAKE WORK



8007A2TM09

Then, when the control valve returns to the neutral position, the pressurized oil from the pump is shut off and the pressures of the ports P1 and P2 become equal. Spool assy (2-2) tries to be returned to neutral position by force of spring "R" (2-4).

When spool assy (2-2) moves, the throttle opening of plunger becomes small.

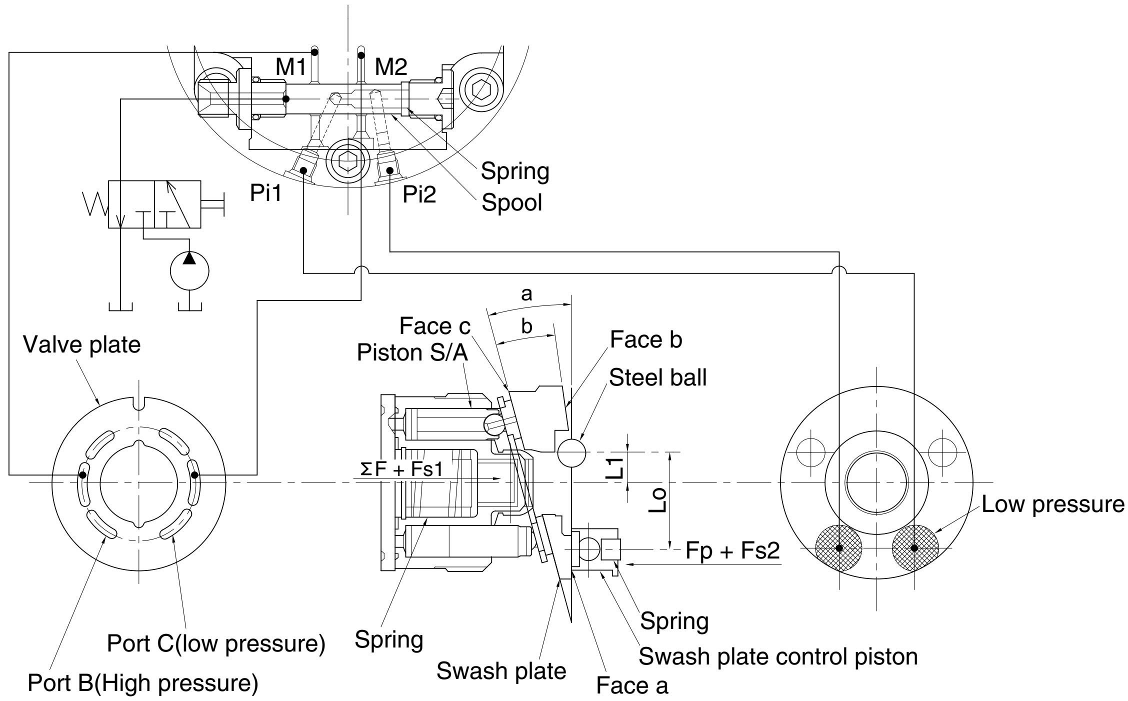
Piston motor tries to rotate with inertia energy (pumping action of motor) and the pressure rises on port M2.

With the movement of spool assy (2-2), the oil of spring "L" room flows out through orifices "L" (2-11) and controls the speed of spool assy (2-2).

By this movement, the shock pressure due to the inertia energy on the port M2 is absorbed, simultaneously preventing the cavitation on the port M1.

3) TWO SPEED CHANGE MECHANISM

(1) When running at 1st speed (low speed)



8007A2TM10

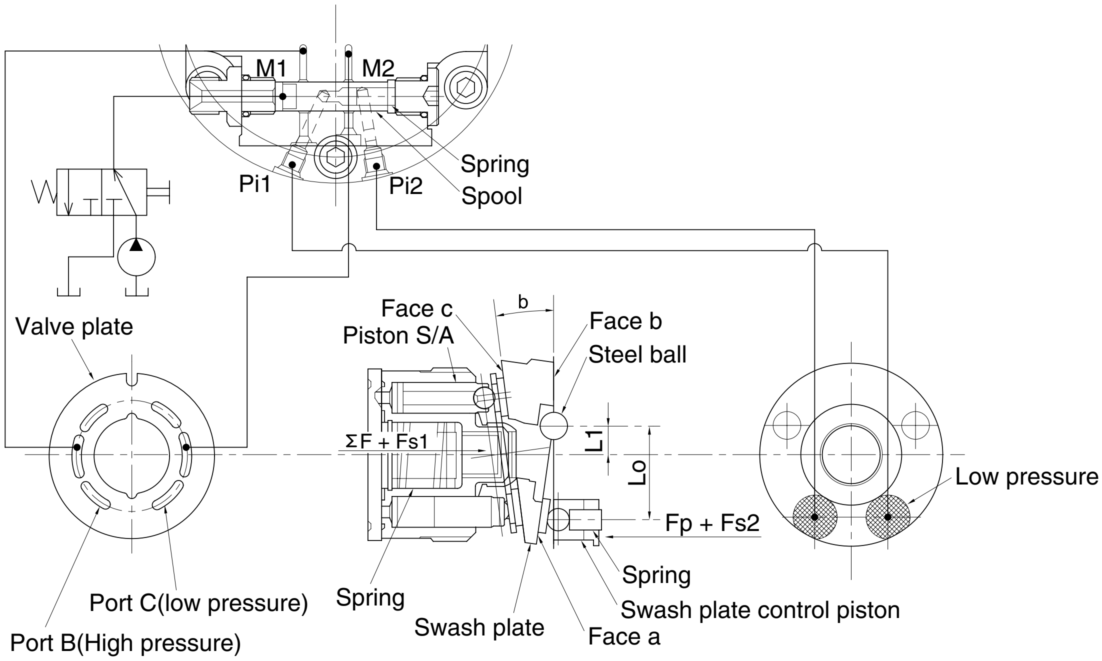
Swash plate has three faces, from "a" to "c", as shown in the figure, and installed in the flange holder with two steel balls in the condition where it can be tilted.

When the control valve is set to the 1st speed position, spool is placed in the position shown in upper figure by the force of spring, and the passage of swash plate control piston passes across the Pi1 and Pi2 port positions and led to the tank port. Therefore, the force pushing up the swash plate does not act on swash plate control piston.

$Fp=(Ap \times P)=0$

Fp : Swash plate control piston thrust
Ap : Swash plate control piston pressure receiving area
P : Pressure

(2) **When running at 2nd speed** (high speed)



8007A2TM11

When control valve is set to the 2nd speed position, the pressure oil delivered by the pump is led to spool, and spool is switched to the position shown in the figure.

And the pressurized oil flows into each ports Pi1 and Pi2 through ports M1 and M2 and the motor driving pressure (P1: high pressure and P2: low pressure) is led to each swash plate control piston. Therefore the force pushing up the swash plate acts on swash plate control piston.

$Fp1=Ap \times P1$ $\quad\quad$ $Fp2=Ap \times P2$

When steel ball is placed on the tilting center, the balance of moment acting on swash plate is in the condition of $(\Sigma F+Fs1)\times L1<(Fp+Fs2)\times Lo$ depending on the total ΣF of driving force of piston S/A.

The face "b" of swash plate stabilizes and the swash plate angle becomes "β" angle, consequently the motor speed is the 2nd speed (high speed).

While the engine is stopped, spool is returned to the 1st speed position by the force of spring since pressurized oil does not flow. When steel ball is placed on the tilting center, the balance of moment acting on swash plate is in the condition of $Fs\times L1>Fp\times Lo$, the face "a" of swash plate stabilizes and the swash plate angle becomes "α" angle, consequently the motor speed at starting is always the 1st speed.

4) AUTO TWO SPEED CHANGE MECHANISM

Auto two-speed control mechanism consists of two spools and spring. This valve automatically changes motor displacement in portion to motor pressure. This valve works while the pilot port "Ps" is pressurized.

(1) Motor pressure is low.

The motor displacement is small (high speed displacement) as shown figure.

When the two-speed spool is on the right position. Motor pressure Pm1 and Pm2 are connected to each side of chamber of two speed piston. So swash plate is moved to high-speed position by two-speed piston and motor displacement is kept on high-speed position.

Pilot pressure is applied on the area "Ap" when Ps port is pressurized. Then the pressure of Ps pushes the spool to the right direction on figure. At the same time,

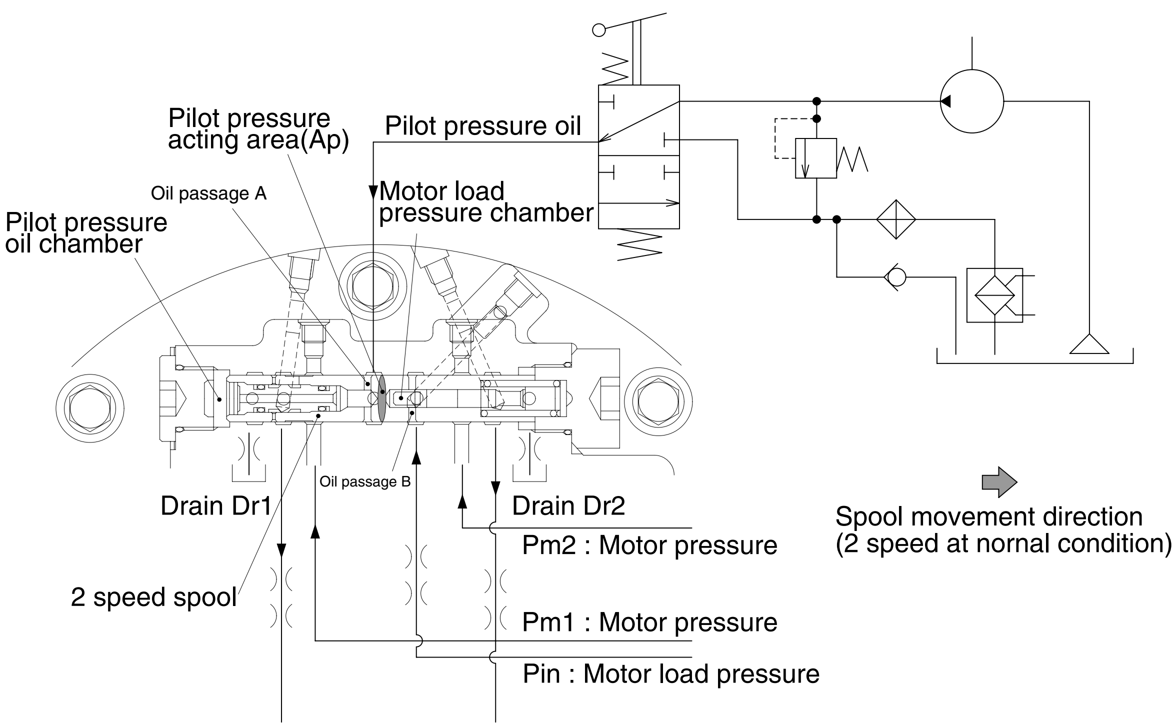
Motor inlet pressure is applied on the area "Am". So, the spool is also applied to the left direction by Am pressure. According to above, if the motor pressure is lower and keeps the following condition, the spool stays on the right position.

$$Ps \times Ap > Am \times Pin + Kx$$

Kx : Spring force

AP : Swash plate control piston pressure receiving area

Ps : Pilot pressure



8007A2TM12

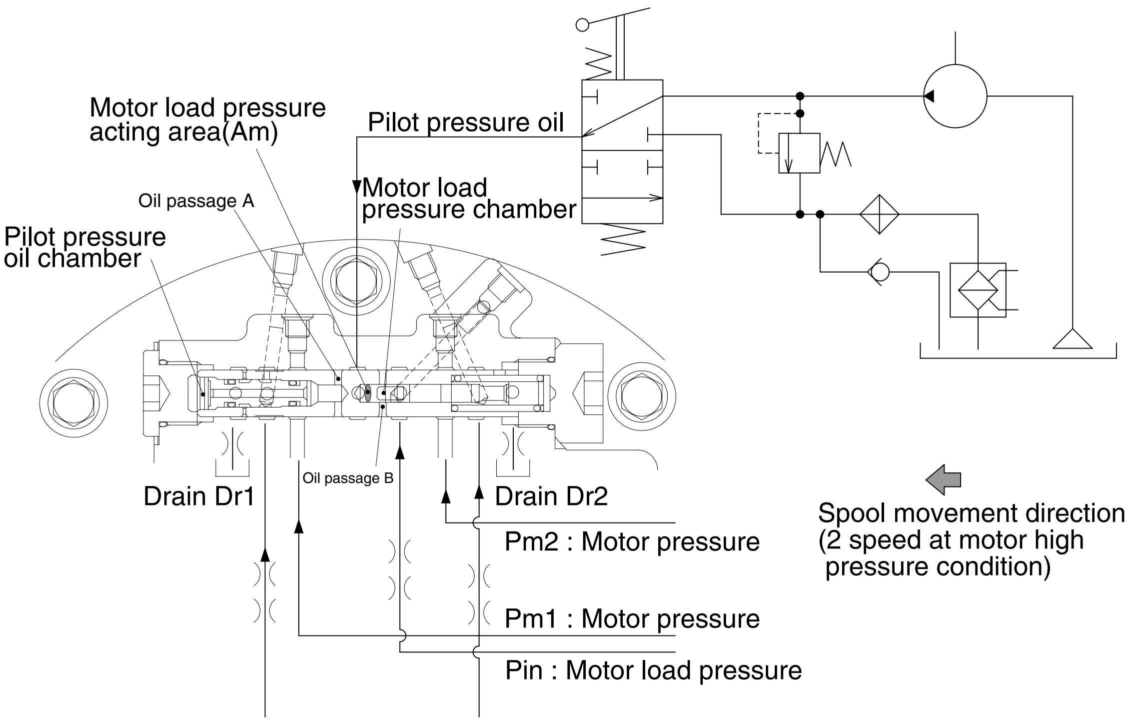
(2) Motor pressure is low.

The motor displacement is large (low speed displacement) as shown figure.

The two-speed spool is on the left position if Pin pressure is high. Then, Pm1 and Pm2 are shuttled by the spool.

If the motor pressure is higher and keeps the following condition, the spool stays on the left position.

$$Ps \times Ap < Am \times Pin + Kx$$



8007A2TM13

5) RELIEF VALVE

The relief valves determine the drive force and the brake force for hydraulic excavator travel and are installed in the main port M1 and M2 lines.

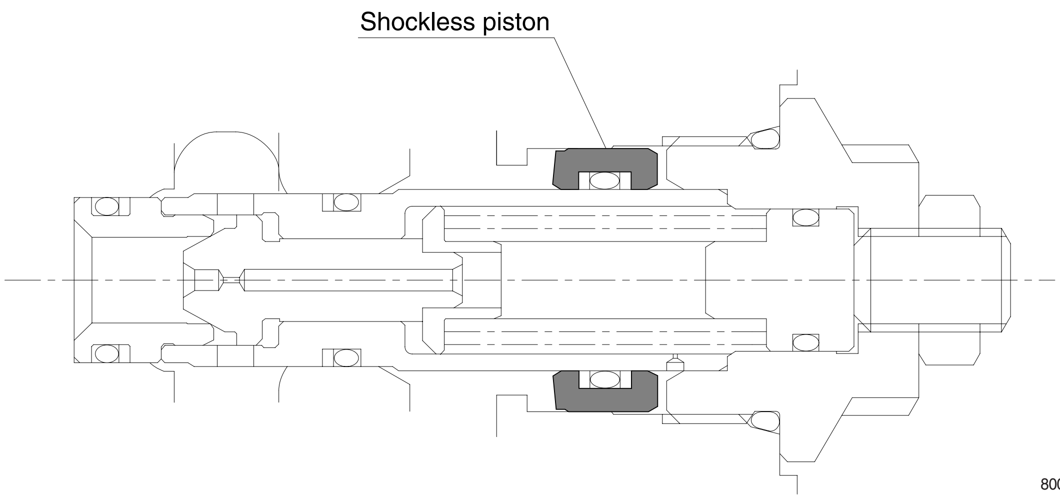
A shock less function is also incorporated to reduce shock produced at the start of both acceleration and deceleration.

(1) The construction of the relief valve.

① A direct-acting differential area type relief valve

② A shockless piston

The installation of a shockless type relief valve helps reduce.



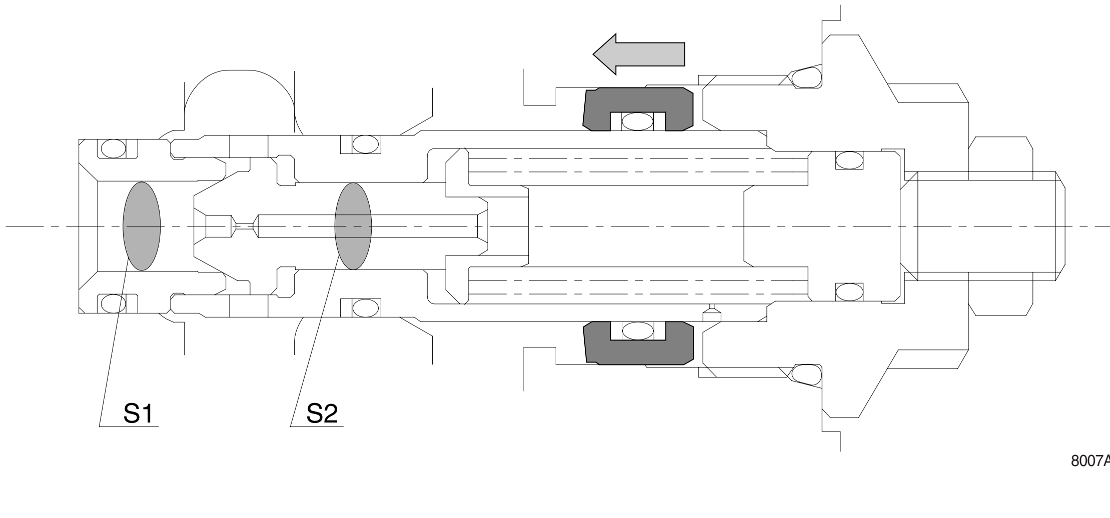
8007A2TM16

(2) The relief valve operates in two stages as follows.

① First stage

At the start of operation, the shockless piston moves to maintain the spring chamber at a low pressure. Thus, the pressure receiving area of the poppet becomes the poppet seat area (S1), a considerably larger area than the pressure receiving area (S1- S2) at the specified relief setting. For this reason, the relief operating pressure is kept at a low pressure until the shockless piston completes its movement.

The low pressure holding time depends on the poppet orifice diameter, the free piston pressure receiving area and the free piston stroke.

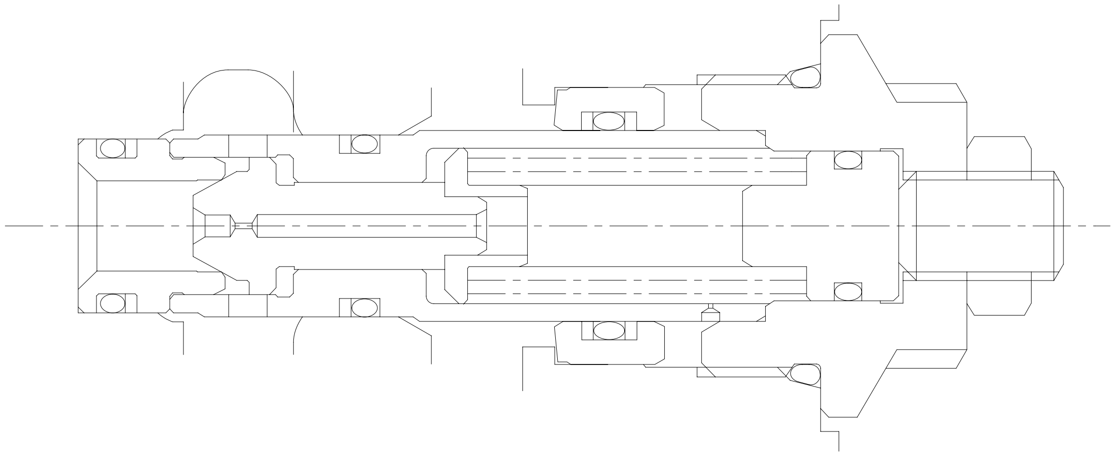


8007A2TM15

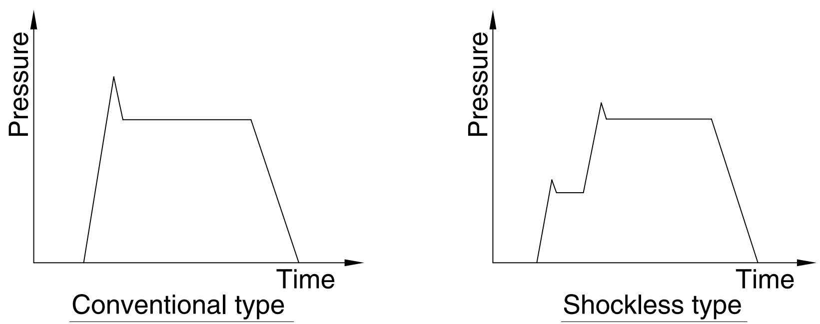
② Second stage

When the shockless piston completes its movement, the pressure inside the spring chamber increases to make the pressures before and after the poppet equal.

Then the relief valve operates at the specified set pressure.

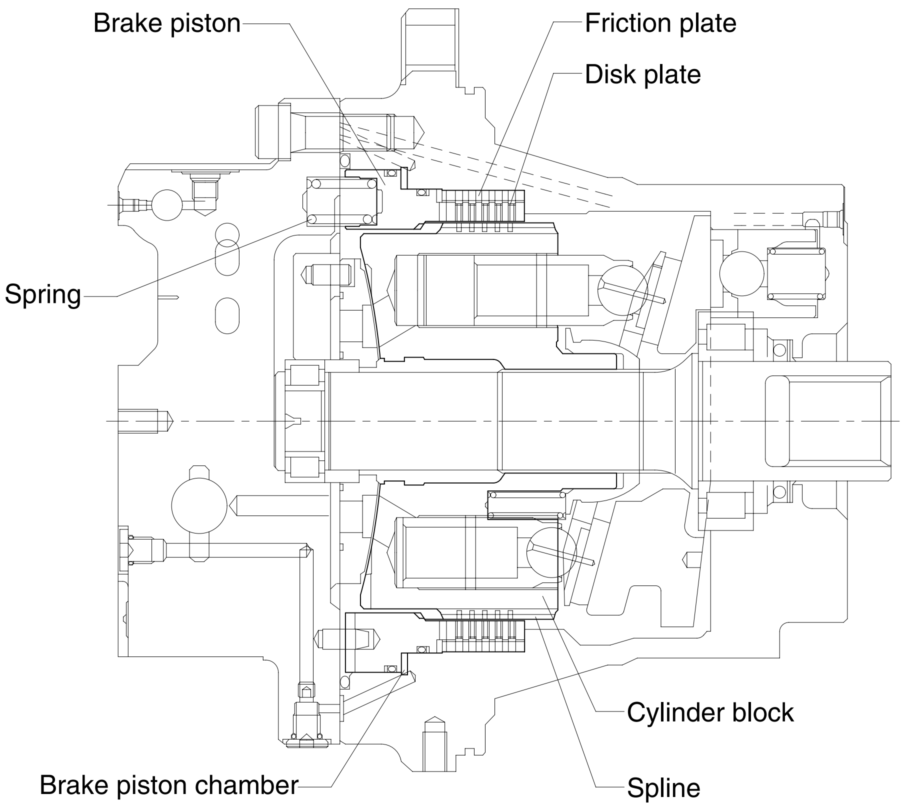


8007A2TM14



8007A2TM17

6) PARKING BRAKE



8007A2TM18A

The parking brake is a kind of negative brake which consist of disk, brake piston, friction plate and spring.

The cylinder block and disk are combined with a spline, and friction material is bonded on both sides of disk.

The disk generates frictional force between the case, the friction plate and the brake piston by the force of spring and restricts the rotating force of the motor, achieving the best performance of the parking brake.

When the pressurized oil flows into the motor, the plunger moves and the parking brake release port is opened.

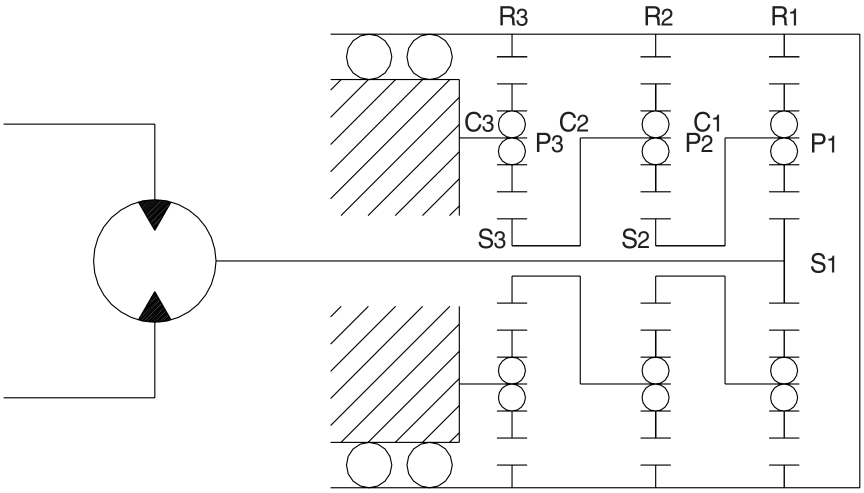
After the oil flows into brake piston chamber, the thrust "F" is generated, corresponding to the pressure receiving surface of brake piston and the thrust "F" becomes larger than the force of spring "f", consequently the brake piston moves toward right.

Then, the disk rotates freely between the flange holder and brake piston, and parking brake is released.

When the motor is stopped, the plunger returns to the neutral position and the parking brake release port is closed. Consequently the pressurized oil in brake piston chamber flows into motor case, the parking brake acts by the force of spring.

7) 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.



R290TM08(1)

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 gears (R3).
Therefore, the rotating case is driven by the overall driving torque of numbers.
1,2 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.

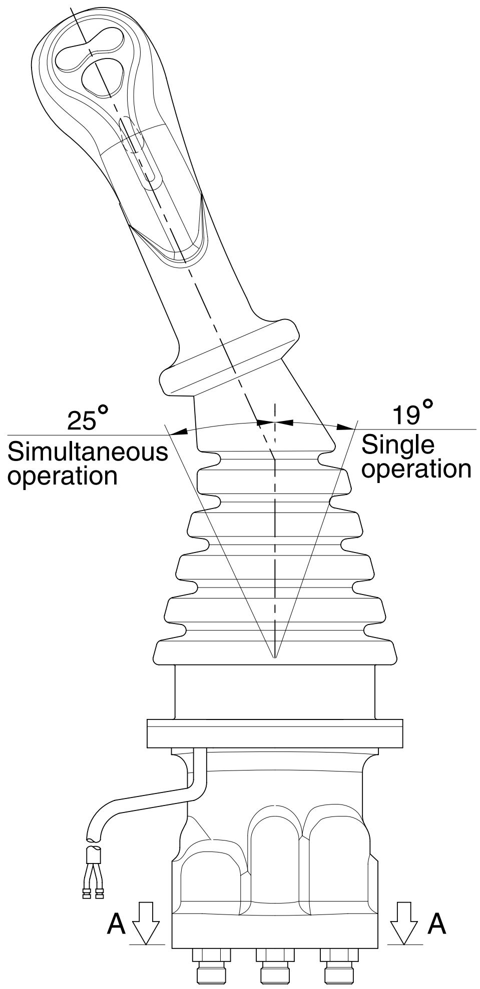
GROUP 5 RCV LEVER

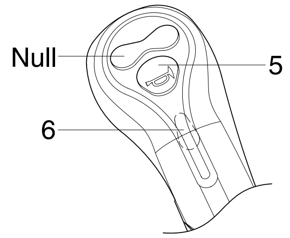
1. STRUCTURE

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

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

1) TYPE L1, L3, L10

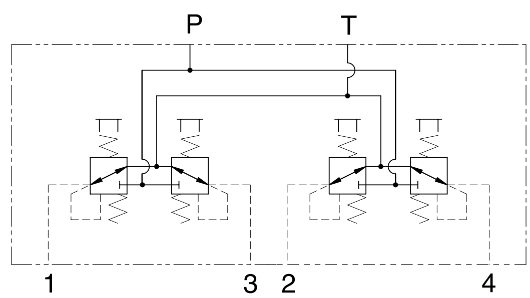




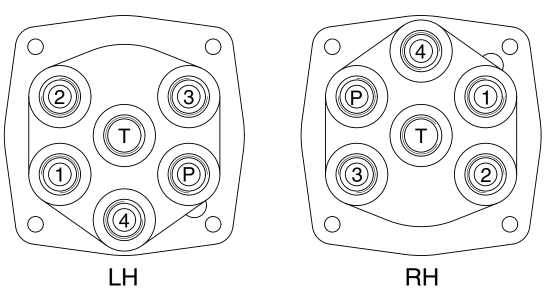
TYPE L1, L3, L10

Switches

Type	No.	LH	RH
L1, L3, L10	5	One touch decel	Horn
	6	Power boost	Breaker



Hydraulic circuit



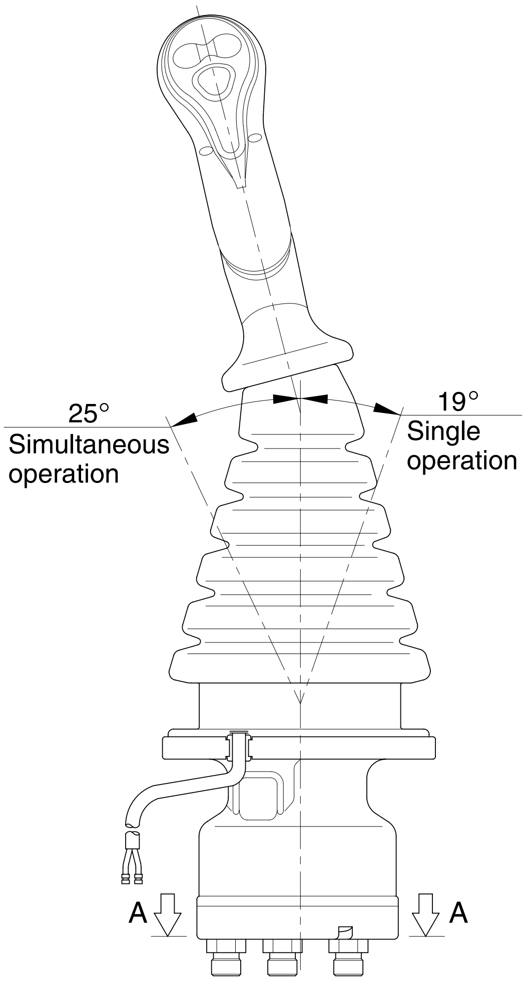
VIEW A-A

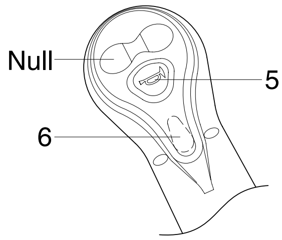
Pilot ports

Port	LH	RH	Port size
P	Pilot oil inlet port	Pilot oil inlet port	PF 3/8
T	Pilot oil return port	Pilot oil return port	
1	Left swing port	Bucket out port	
2	Arm out port	Boom up port	
3	Right swing port	Bucket in port	
4	Arm in port	Boom down port	

300L2RaL101

2) TYPE L2, L4, L9

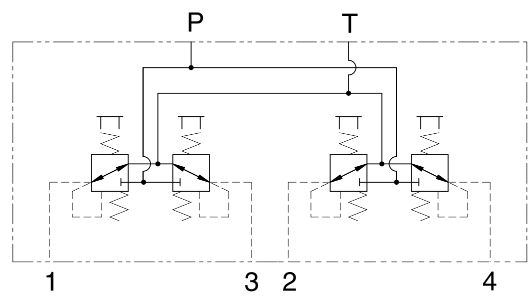




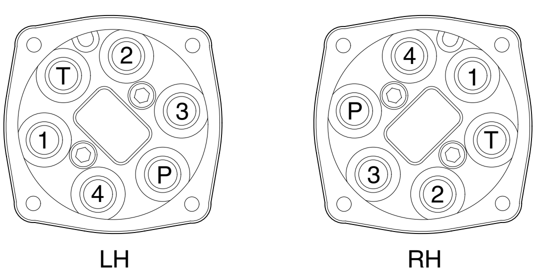
TYPE L2, L4, L9

Switches

Type	No.	LH	RH
L2, L4, L9	5	One touch decel	Horn
	6	Power boost	Breaker



Hydraulic circuit



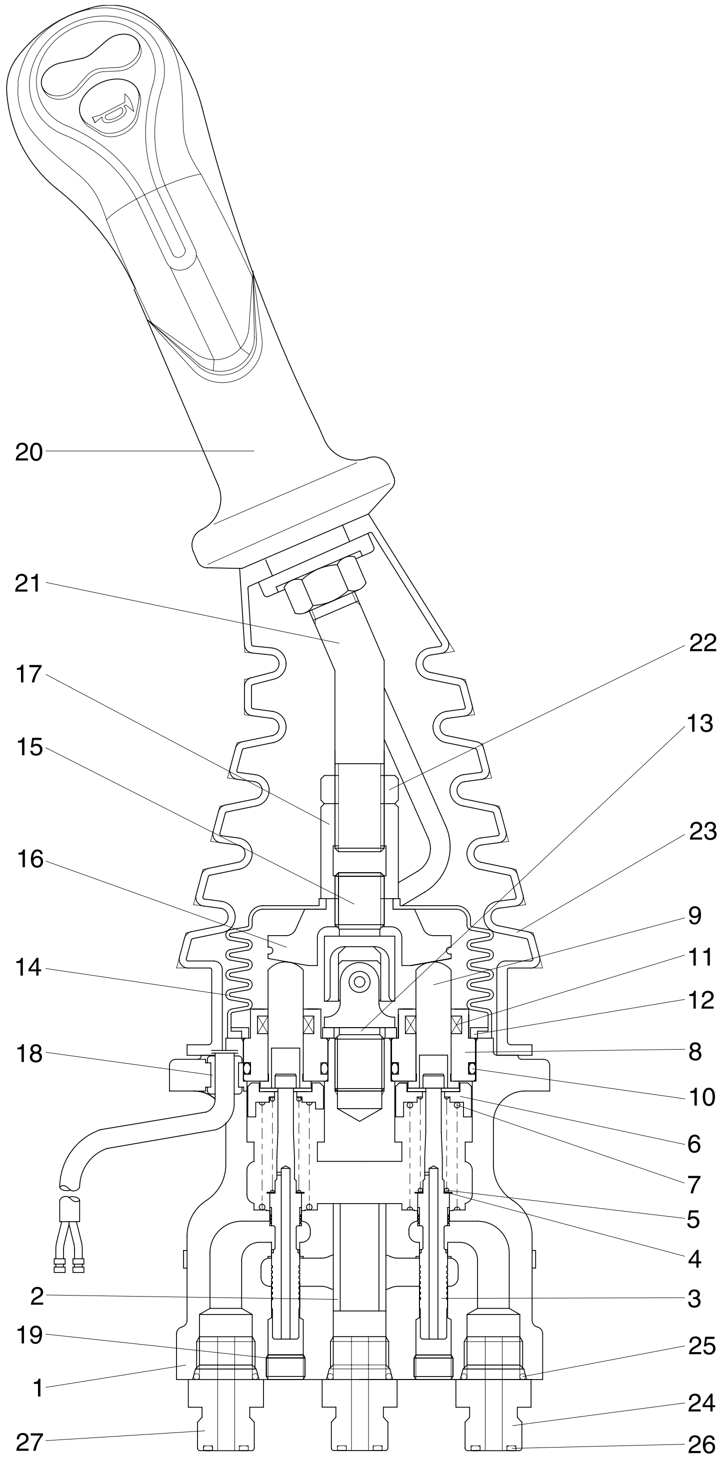
VIEW A-A

Pilot ports

Port	LH	RH	Port size
P	Pilot oil inlet port	Pilot oil inlet port	PF 3/8
T	Pilot oil return port	Pilot oil return port	
1	Left swing port	Bucket out port	
2	Arm out port	Boom up port	
3	Right swing port	Bucket in port	
4	Arm in port	Boom down port	

900L2RL105

3) CROSS SECTION



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

300L2RL06

Item numbers are based on the type L1.

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

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

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

2. FUNCTIONS

1) FUNDAMENTAL FUNCTIONS

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

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

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

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

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

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

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

2) FUNCTIONS OF MAJOR SECTIONS

Item numbers are based on the type L1.

The functions of the spool (3) are to receive the supply oil pressure from the hydraulic pump at its port P, and to change over oil paths to determine whether the pressure oil of port P is led to output ports 1, 2, 3 & 4 or the output port pressure oil to tank port T.

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

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

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

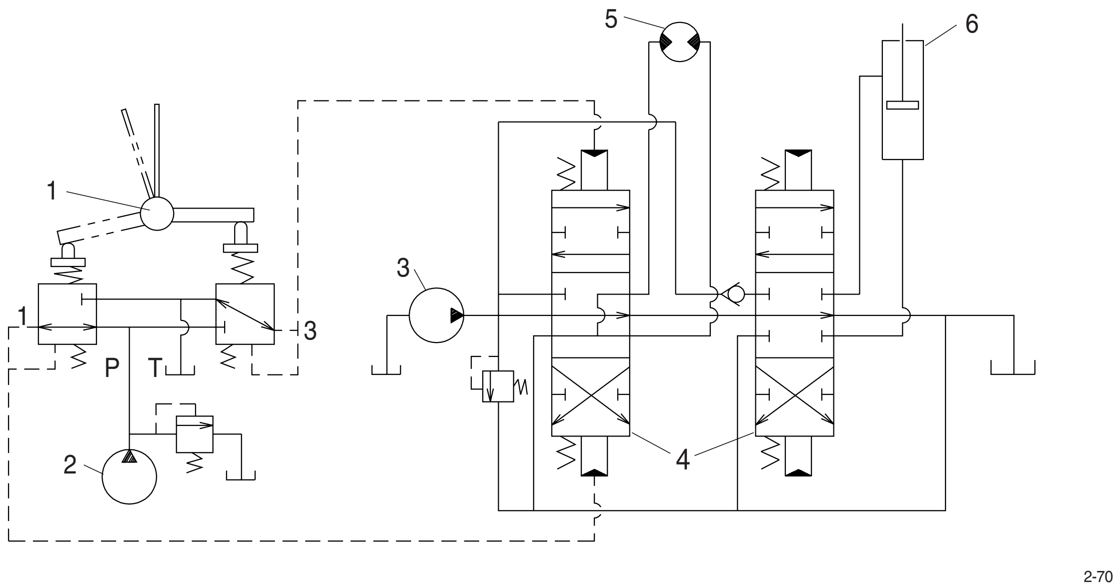
The spring (7) works on the case (1) and spring seat (6) and tries to return the push rod (9) to the zero-displacement position irrespective of the output pressure, securing its resetting to the center position.

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

3) OPERATION

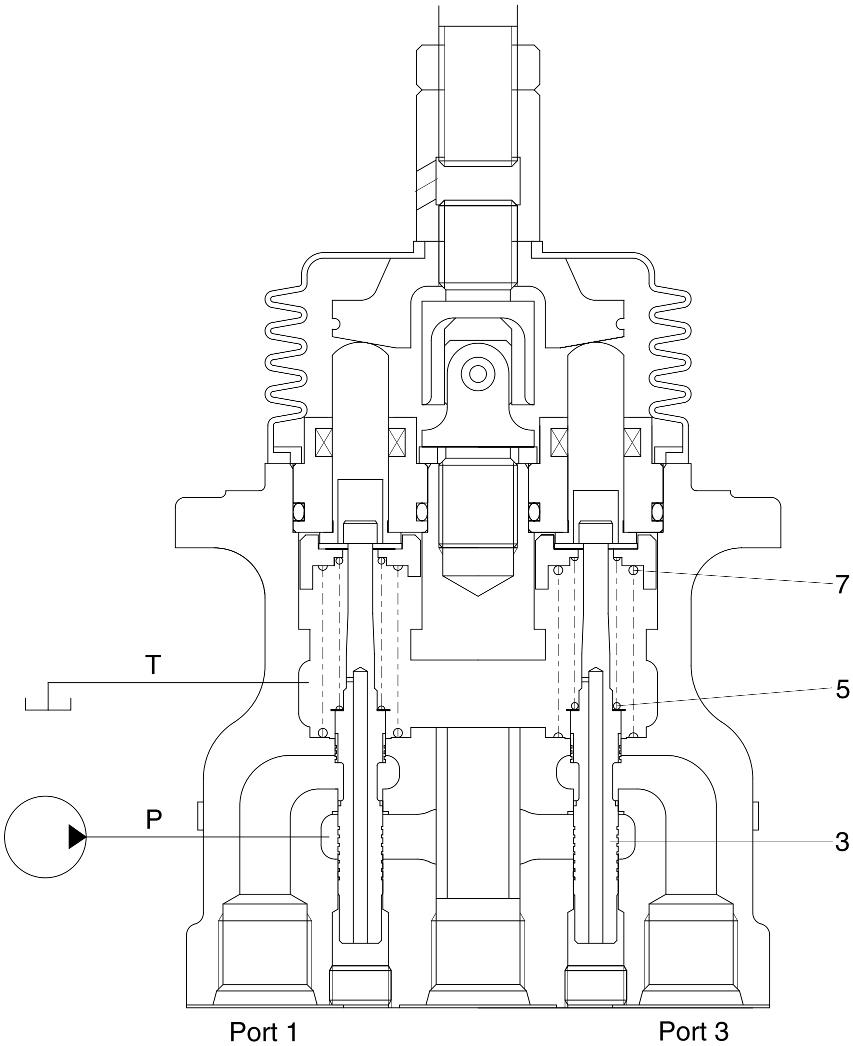
The operation of the pilot valve will be described on the basis of the hydraulic circuit diagram shown below and the attached operation explanation drawing.

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



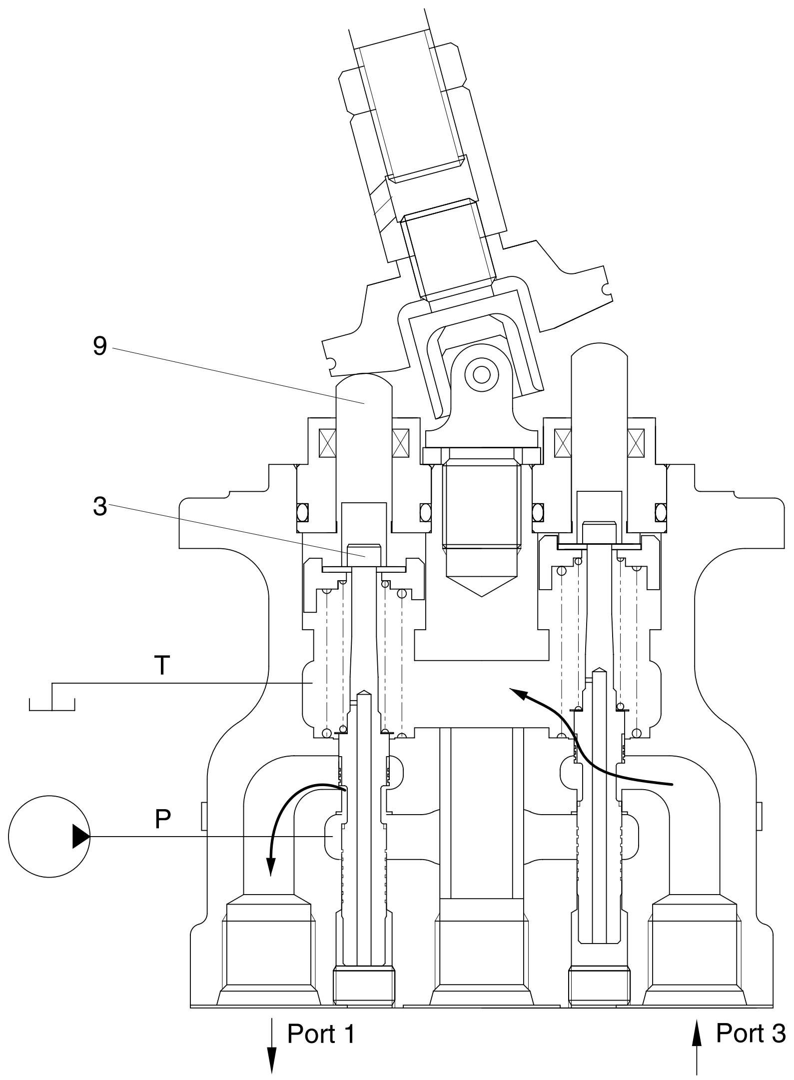
1	Pilot valve	3	Main pump	5	Hydraulic motor
2	Pilot pump	4	Main control valve	6	Hydraulic cylinder

(1) Case where handle is in neutral position



The force of the spring (5) that determines the output pressure of the pilot valve is not applied to the spool (3). Therefore, the spool is pushed up by the spring (7) to the position of port (1, 3) in the operation explanation drawing. Then, since the output port is connected to tank port T only, the output port pressure becomes equal to tank pressure.

(2) Case where handle is tilted



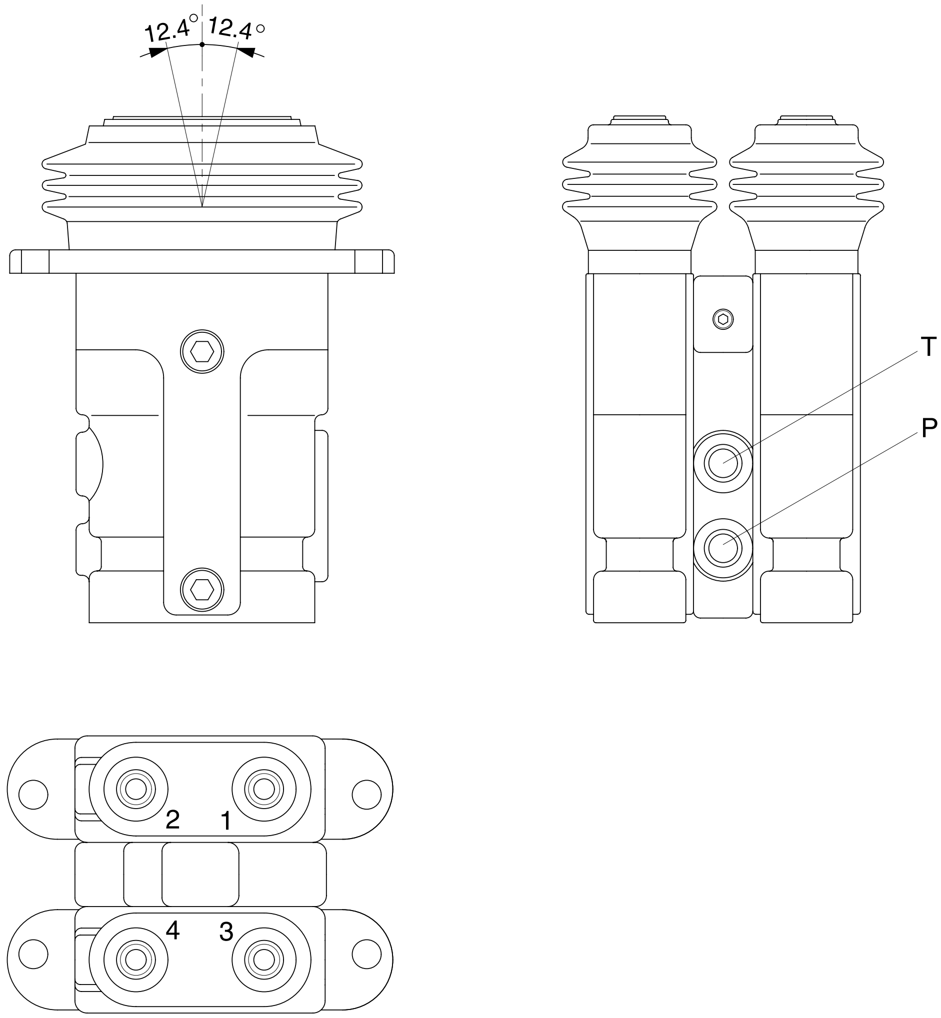
300L2RL04

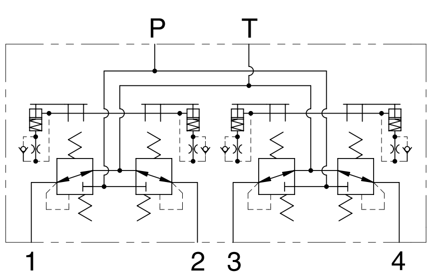
When the push rod (9) is stroked, the spool (3) moves downwards.
Then port P is connected with port (1) and the oil supplied from the pilot pump flows through port (1) to generate the pressure.
When the pressure at port (1) increases to the value corresponding to the spring force set by tilting the handle,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

GROUP 6 RCV PEDAL (-#0003)

1. STRUCTURE

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





Hydraulic circuit

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

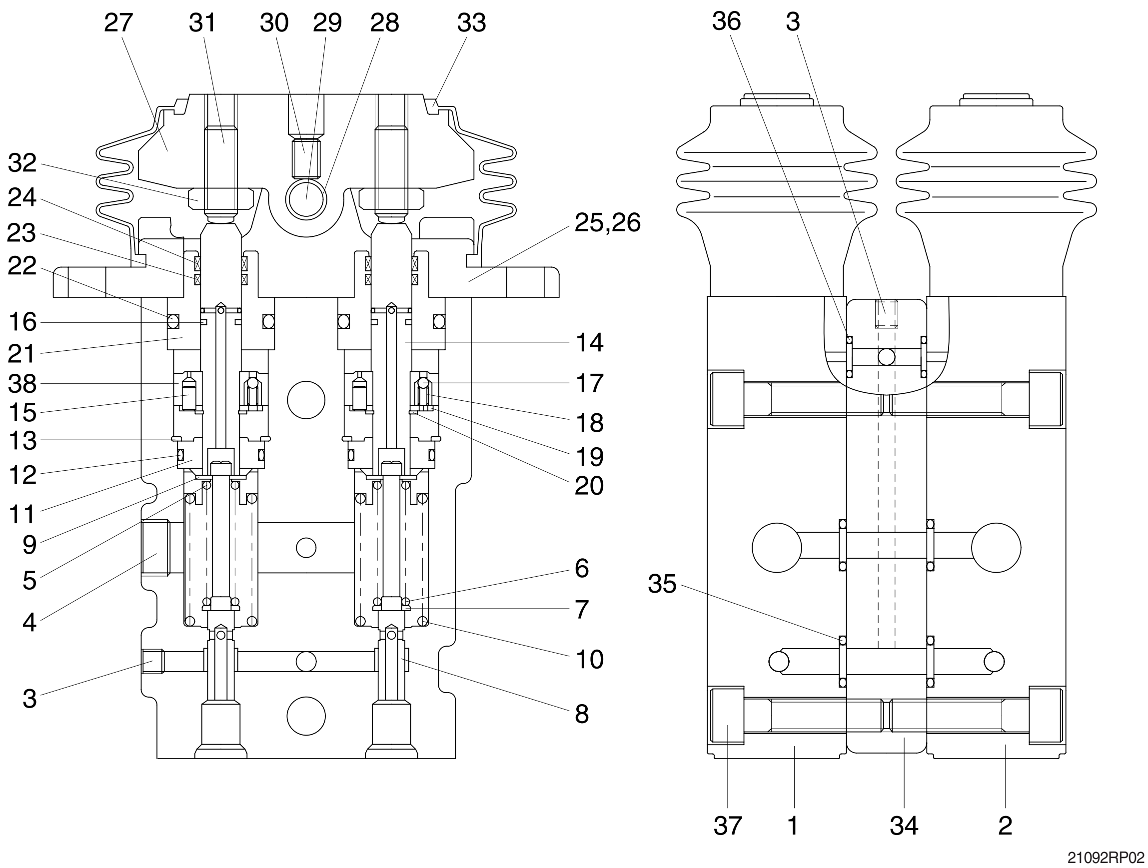
21092RP01

CROSS SECTION

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

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

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



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

2. FUNCTION

1) FUNDAMENTAL FUNCTIONS

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

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

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

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

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

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

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

2) FUNCTIONS OF MAJOR SECTIONS

The functions of the spool (8) are to receive the supply oil pressure from the hydraulic pump at its port P, and to change over oil paths to determine whether the pressure oil of port P is led to output ports 1, 2, 3 & 4 or the output spool to determine the output pressure.

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

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

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

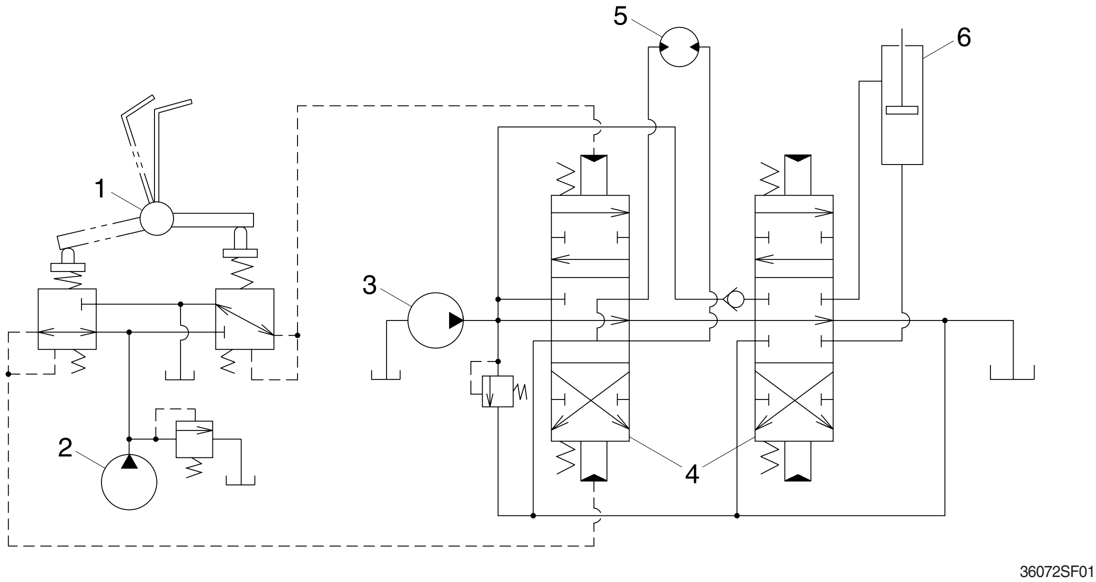
The spring (10) works on the casing (1) and spring seat (7) and tries to return the push rod (14) to the zero-displacement position irrespective of the output pressure, securing its resetting to the center position.

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

3) OPERATION

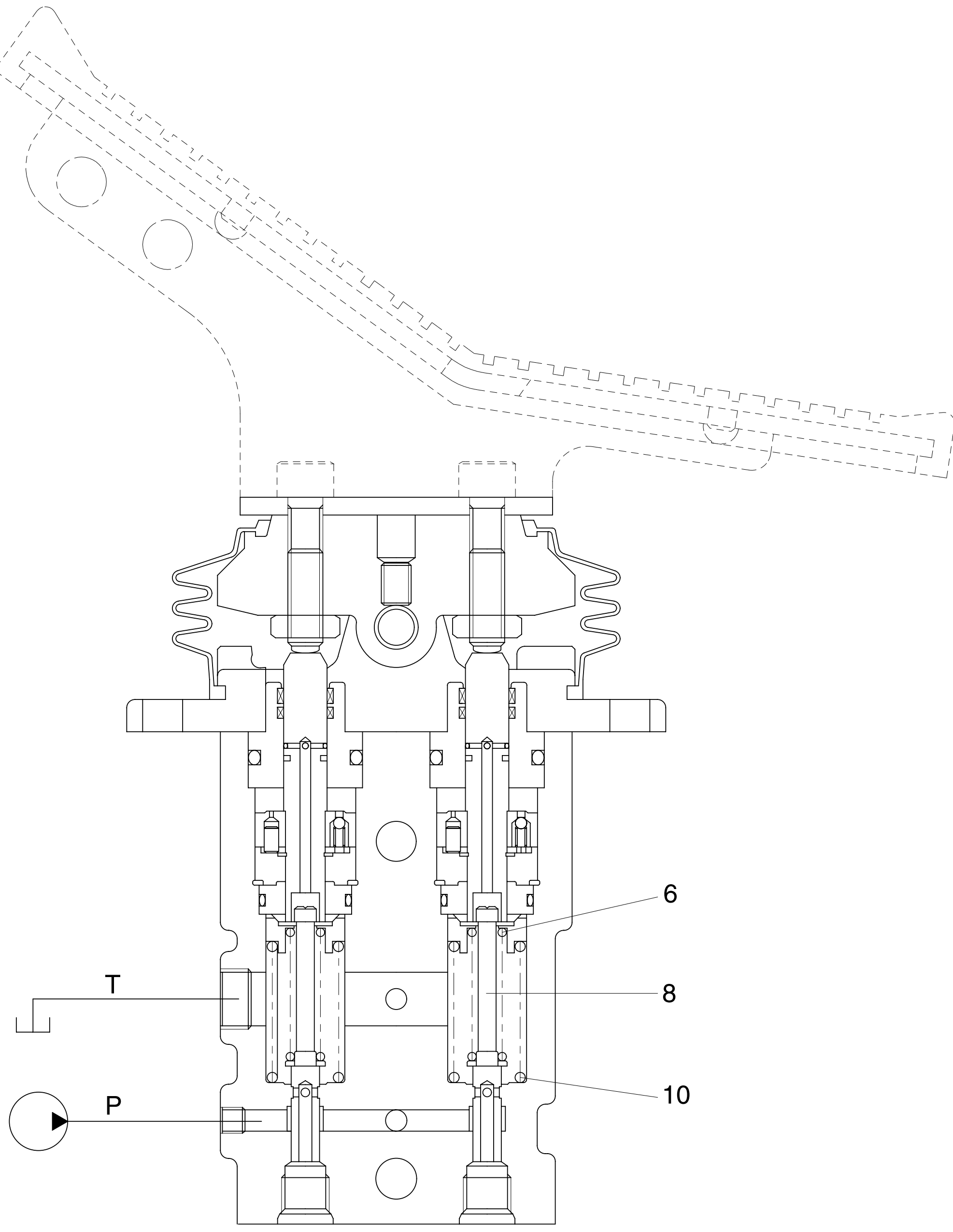
The operation of the pilot valve will be described on the basis of the hydraulic circuit diagram shown below ant the attached operation explanation drawing.

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



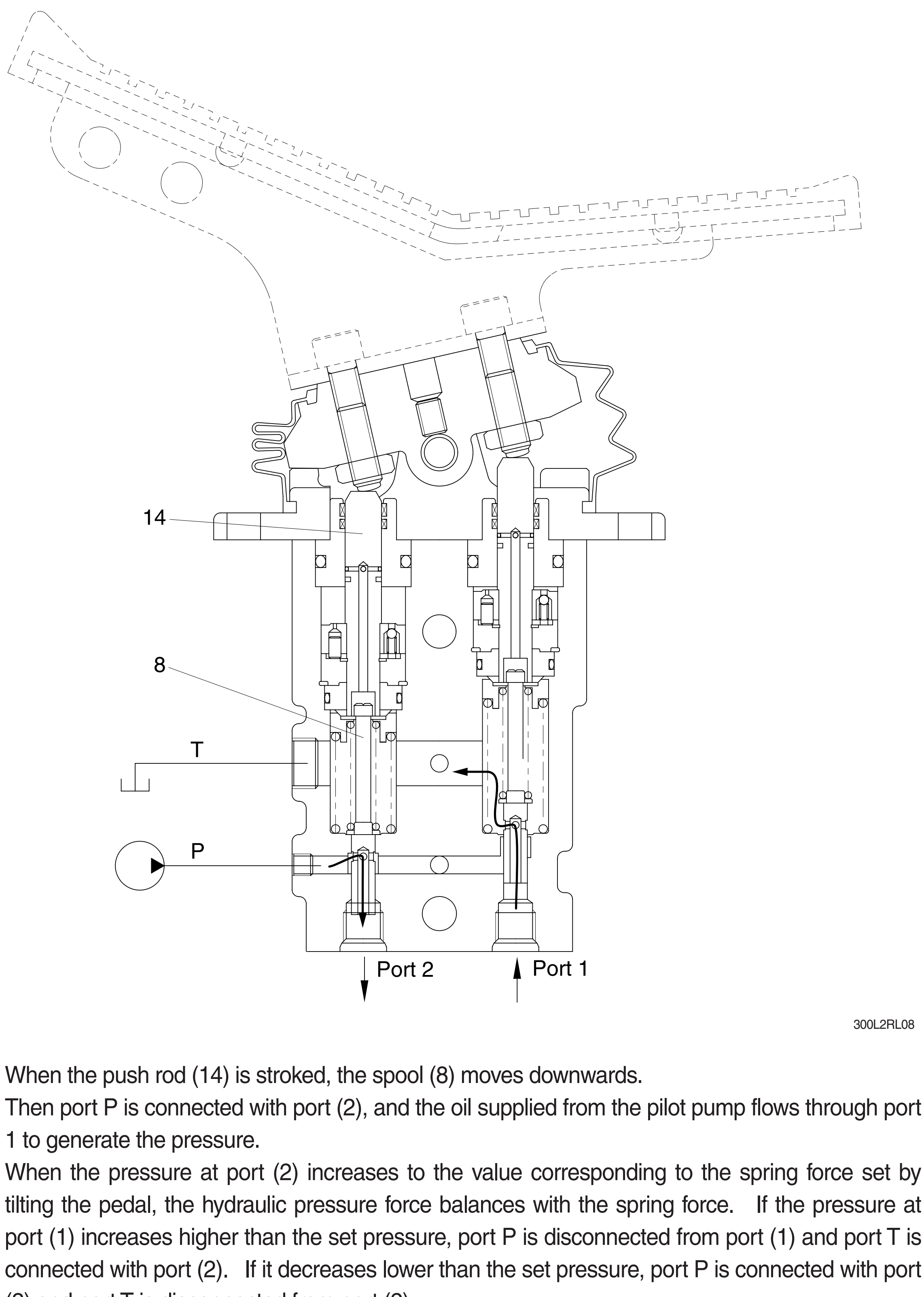
1	Pilot valve	3	Main pump	5	Hydraulic motor
2	Pilot pump	4	Main control valve	6	Hydraulic cylinder

(1) Case where pedal is in neutral position



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 (2), and the oil supplied from the pilot pump flows through port 1 to generate the pressure.

When the pressure at port (2) increases to the value corresponding to the spring force set by tilting the pedal, 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 (2). If it decreases lower than the set pressure, port P is connected with port (2) and port T is disconnected from port (2).

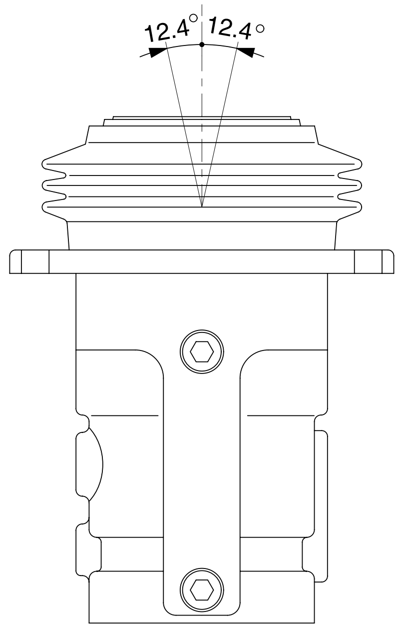
In this manner the secondary pressure is kept at the constant value.

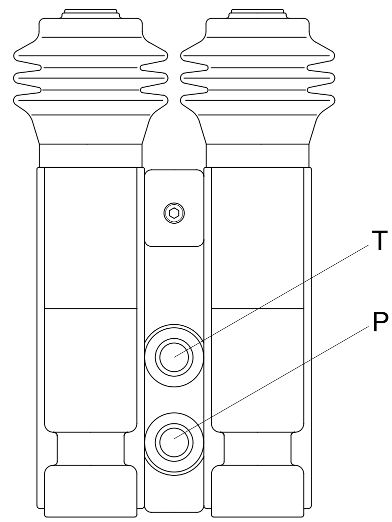
Besides, in some type, when the pedal is tilted more than a certain angle, the upper end of the spool contacts with inside bottom of the push rod and the output pressure is left to be connected with port P.

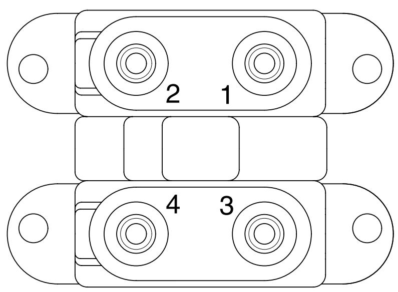
RCV PEDAL (#0004-)

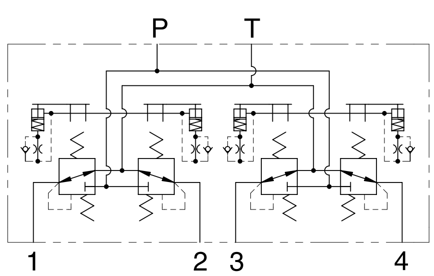
1. STRUCTURE

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









Hydraulic circuit

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

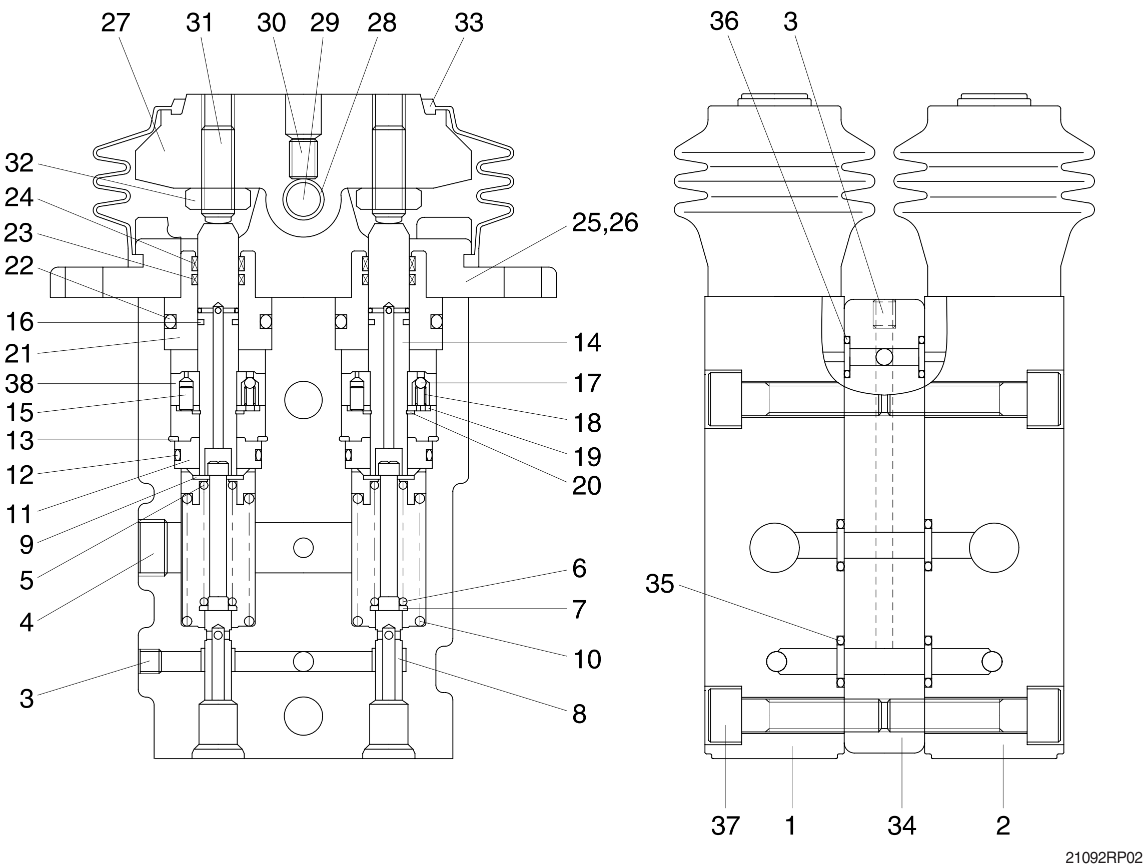
21092RP01

CROSS SECTION

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

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

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



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

2. FUNCTION

1) FUNDAMENTAL FUNCTIONS

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

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

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

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

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

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

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

2) FUNCTIONS OF MAJOR SECTIONS

The functions of the spool (8) are to receive the supply oil pressure from the hydraulic pump at its port P, and to change over oil paths to determine whether the pressure oil of port P is led to output ports 1, 2, 3 & 4 or the output spool to determine the output pressure.

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

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

For the purpose of changing the 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.

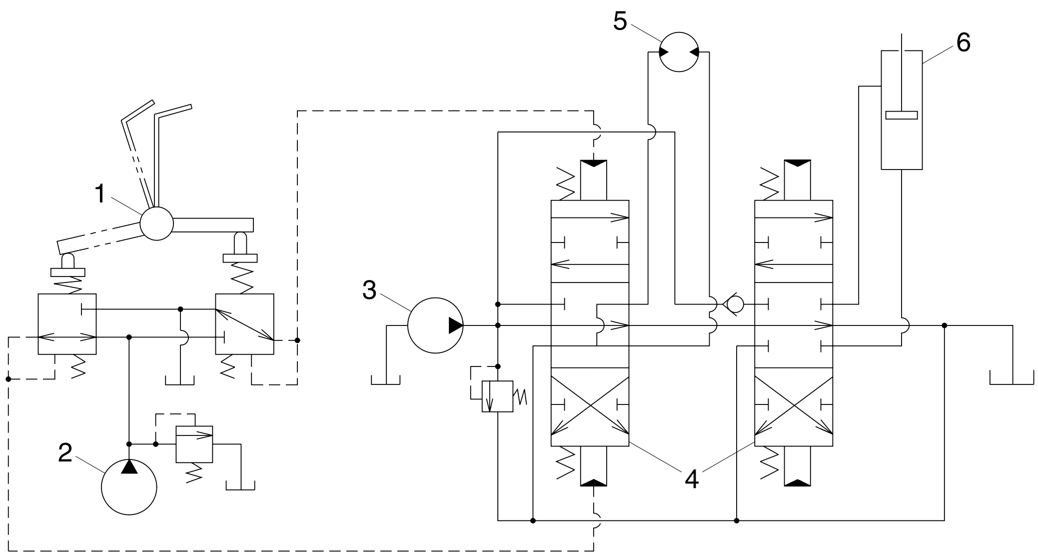
The spring (10) works on the casing (1) and spring seat (7) and tries to return the push rod (14) to the zero-displacement position irrespective of the output pressure, securing its resetting to the center position.

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.

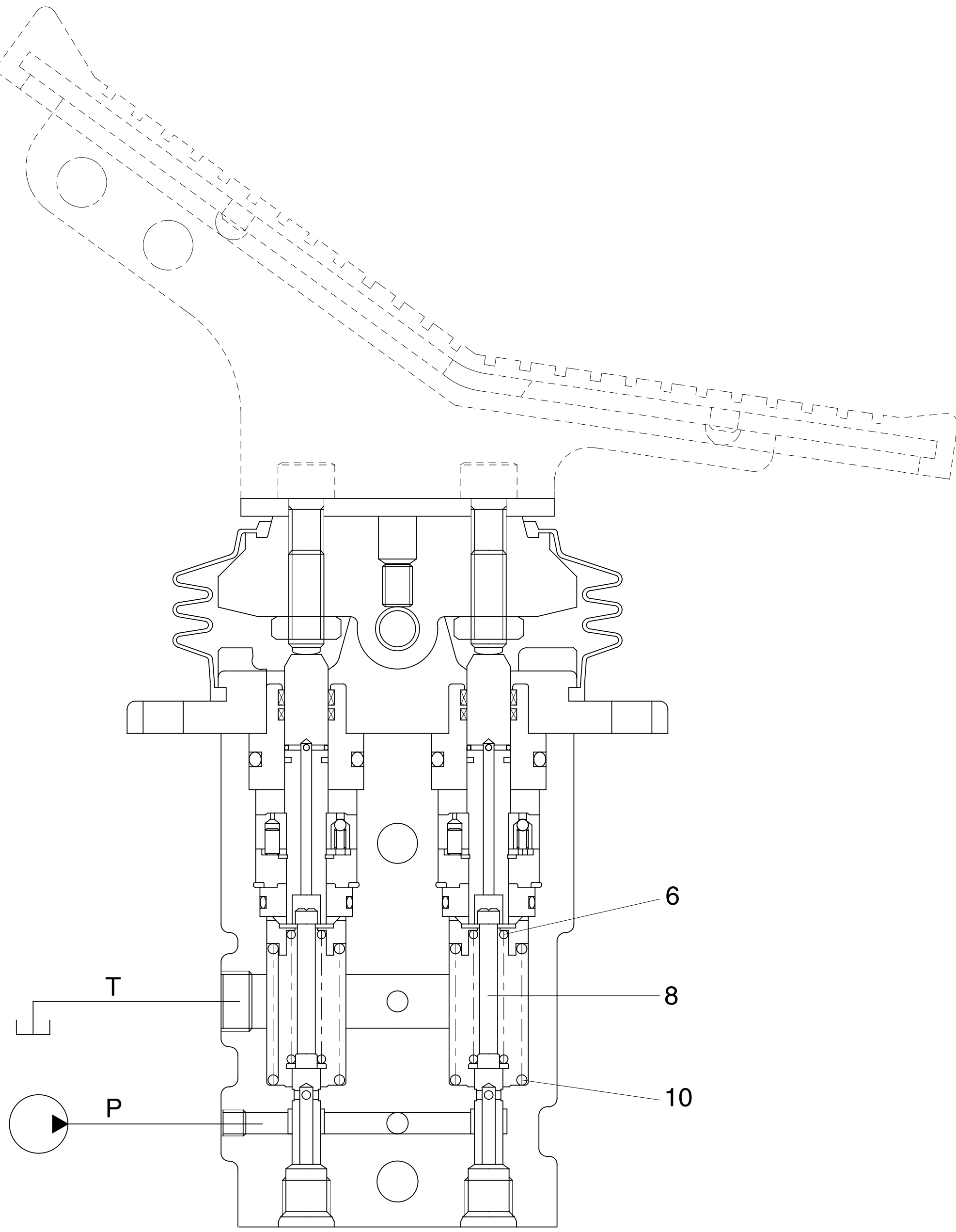
The diagram shown below is the typical application example of the pilot valve.



36072SF01

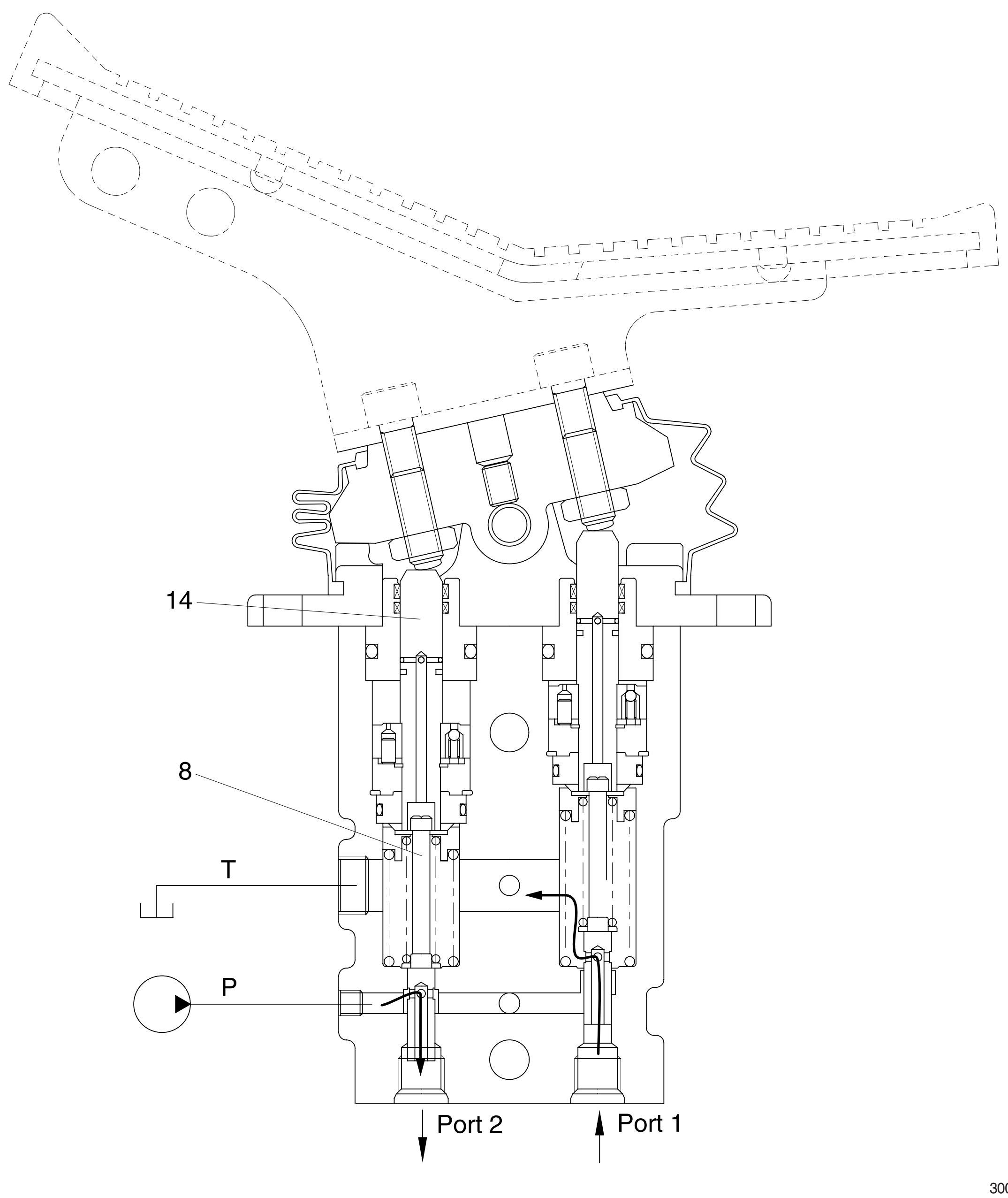
1	Pilot valve	3	Main pump	5	Hydraulic motor
2	Pilot pump	4	Main control valve	6	Hydraulic cylinder

(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

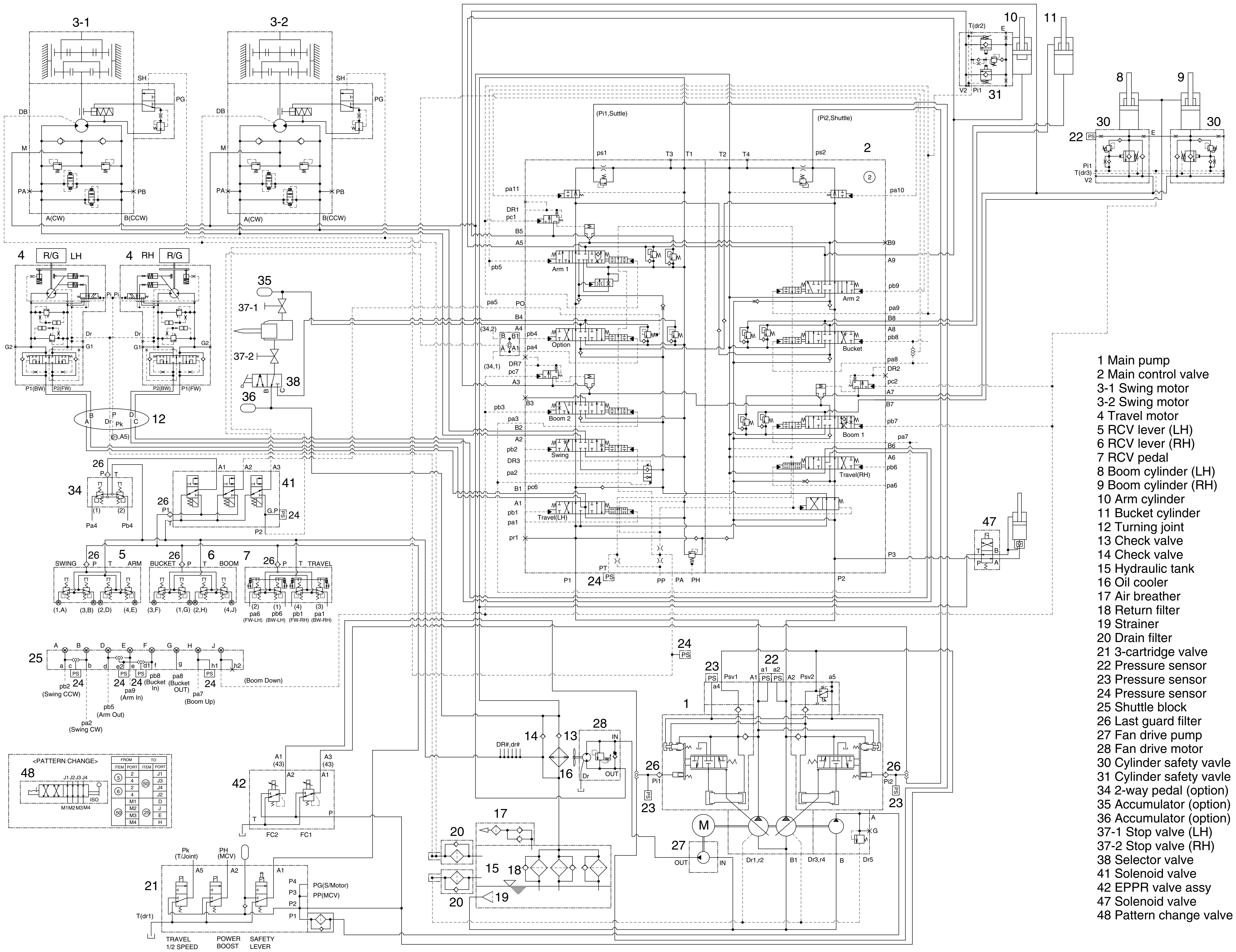


300L2RL08

When the push rod (14) is stroked, the spool (8) moves downwards.
Then port P is connected with port (2), and the oil supplied from the pilot pump flows through port 1 to generate the pressure.
When the pressure at port (2) increases to the value corresponding to the spring force set by tilting the pedal, 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 (2). If it decreases lower than the set pressure, port P is connected with port (2) and port T is disconnected from port (2).
In this manner the secondary pressure is kept at the constant value.
Besides, in some type, when the pedal is tilted more than a certain angle, the upper end of the spool contacts with inside bottom of the push rod and the output pressure is left to be connected with port P.

SECTION 3 HYDRAULIC SYSTEM

GROUP 1 HYDRAULIC CIRCUIT



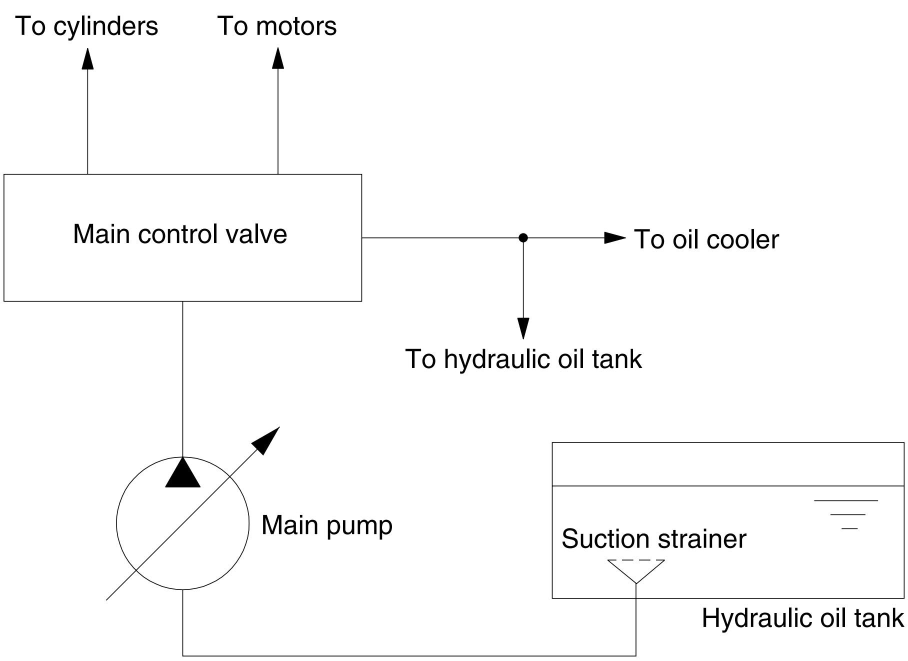
1 Main pump
2 Main control valve
3-1 Swing motor
3-2 Swing motor
4 Travel motor
5 RCV lever (LH)
6 RCV lever (RH)
7 RCV pedal
8 Boom cylinder (LH)
9 Boom cylinder (RH)
10 Arm cylinder
11 Bucket cylinder
12 Turning joint
13 Check valve
14 Check valve
15 Hydraulic tank
16 Oil cooler
17 Air breather
18 Return filter
19 Strainer
20 Drain filter
21 3-cartridge valve
22 Pressure sensor
23 Pressure sensor
24 Pressure sensor
25 Shuttle block
26 Last guard filter
27 Fan drive pump
28 Fan drive motor
30 Cylinder safety vavle
31 Cylinder safety vavle
34 2-way pedal (option)
35 Accumulator (option)
36 Accumulator (option)
37-1 Stop valve (LH)
37-2 Stop valve (RH)
38 Selector valve
41 Solenoid valve
42 EPPR valve assy
47 Solenoid valve
48 Pattern change valve

30KD-17100-01

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 main control valve, two swing motors, 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.

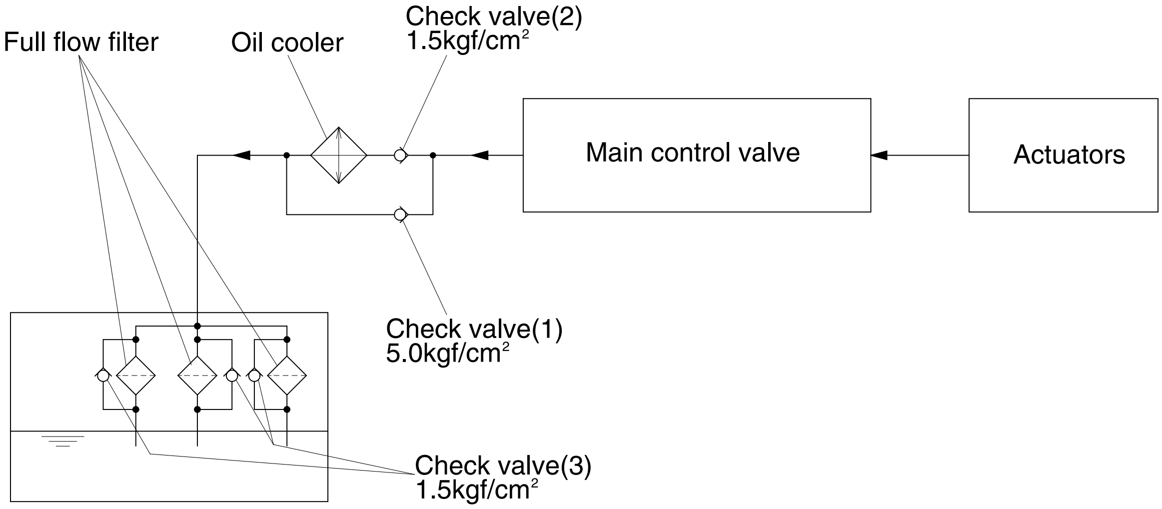
1. SUCTION AND DELIVERY CIRCUIT



140L3CI01

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

2. RETURN CIRCUIT



8007A3CI01

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

The bypass check valves are provided in the return circuit.

The setting pressure of bypass check valves are 1.5 kgf/cm^2 (21 psi) and 5.0 kgf/cm^2 (71 psi). Usually, oil returns to the hydraulic tank from the left side of control valve through oil cooler.

When oil temperature is low, viscosity becomes higher and flow resistance increases when passing through the oil cooler. The oil pressure exceeds 5.0 kgf/cm^2 (71 psi), the oil returns directly to the hydraulic tank, resulting in the oil temperature being raised quickly at an appropriate level.

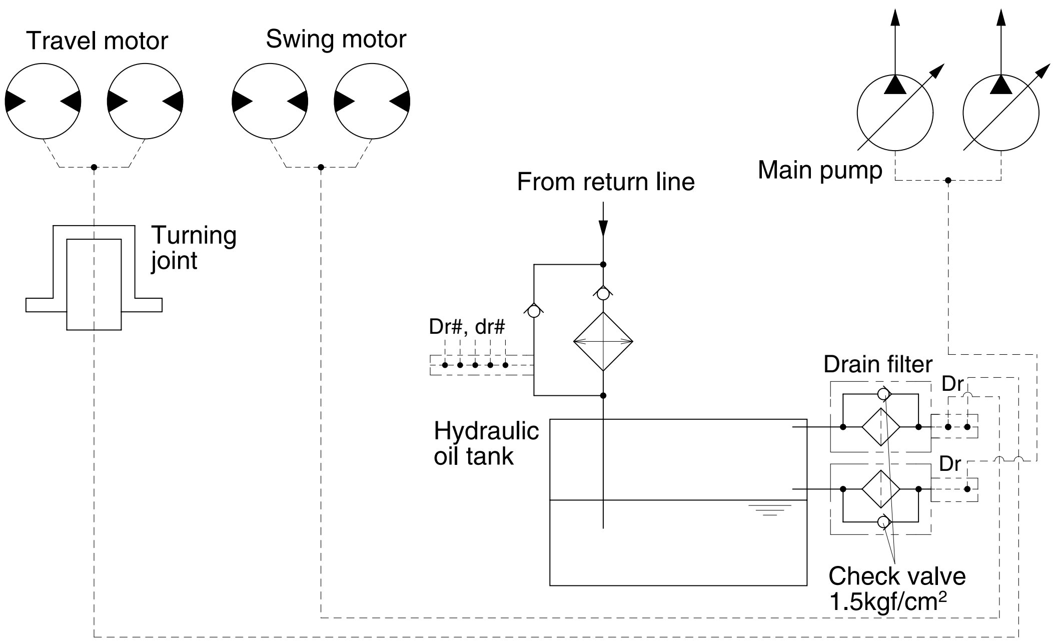
When the oil cooler is clogged, the oil returns directly to the hydraulic tank through bypass check valve (1).

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

The oil from right and left side of control valve is combined and filtered by the return filter. A bypass relief valve is provided in the full-flow filter.

When the filter element is clogged, the bypass relief valve opens at 1.5 kgf/cm^2 (21 psi) differential pressure.

3. DRAIN CIRCUIT



900L3CI02

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

1) TRAVEL MOTOR 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 passing though a drain filter.

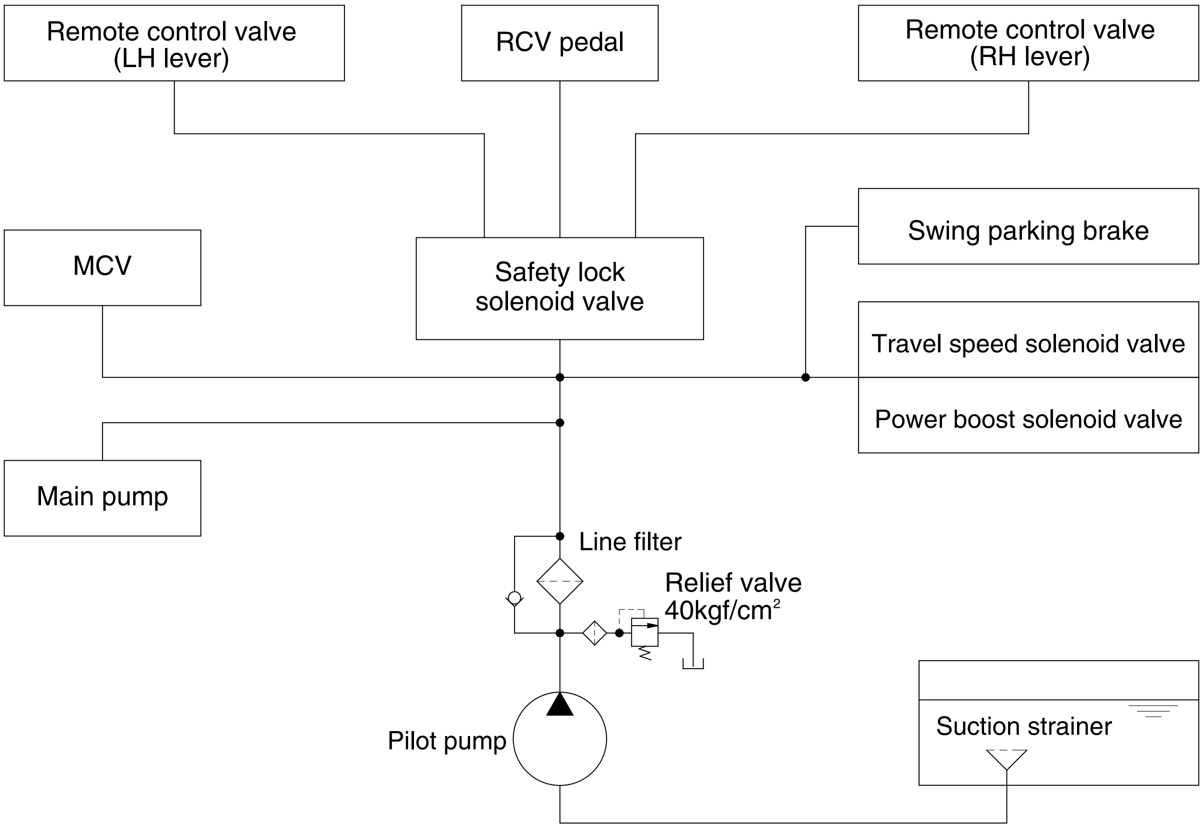
2) SWING MOTOR DRAIN CIRCUIT

Oil leaking from the front and rear swing motors come out of the drain ports provided in the respective motor casing and join with each other and return to the hydraulic tank passing through a drain filter.

3) MAIN PUMP DRAIN CIRCUIT

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

GROUP 3 PILOT CIRCUIT



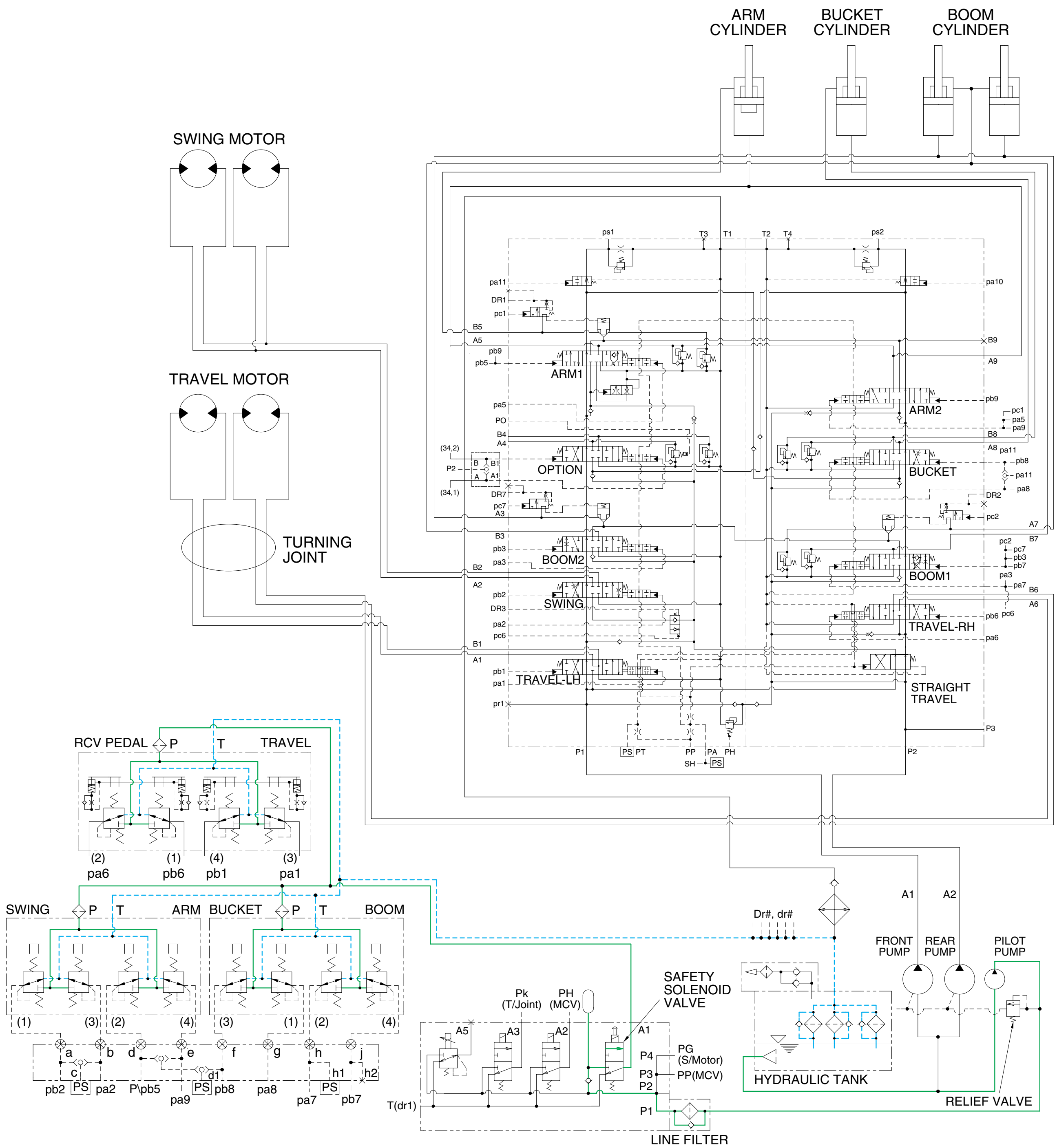
900L3CI03

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

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

The discharged oil from the pilot pump flows to the remote control valve, EPPR valve, solenoid valve assemblies, swing parking brake, main control valve and safety lock solenoid valve through line filter.

1. SUCTION, DELIVERY AND RETURN CIRCUIT



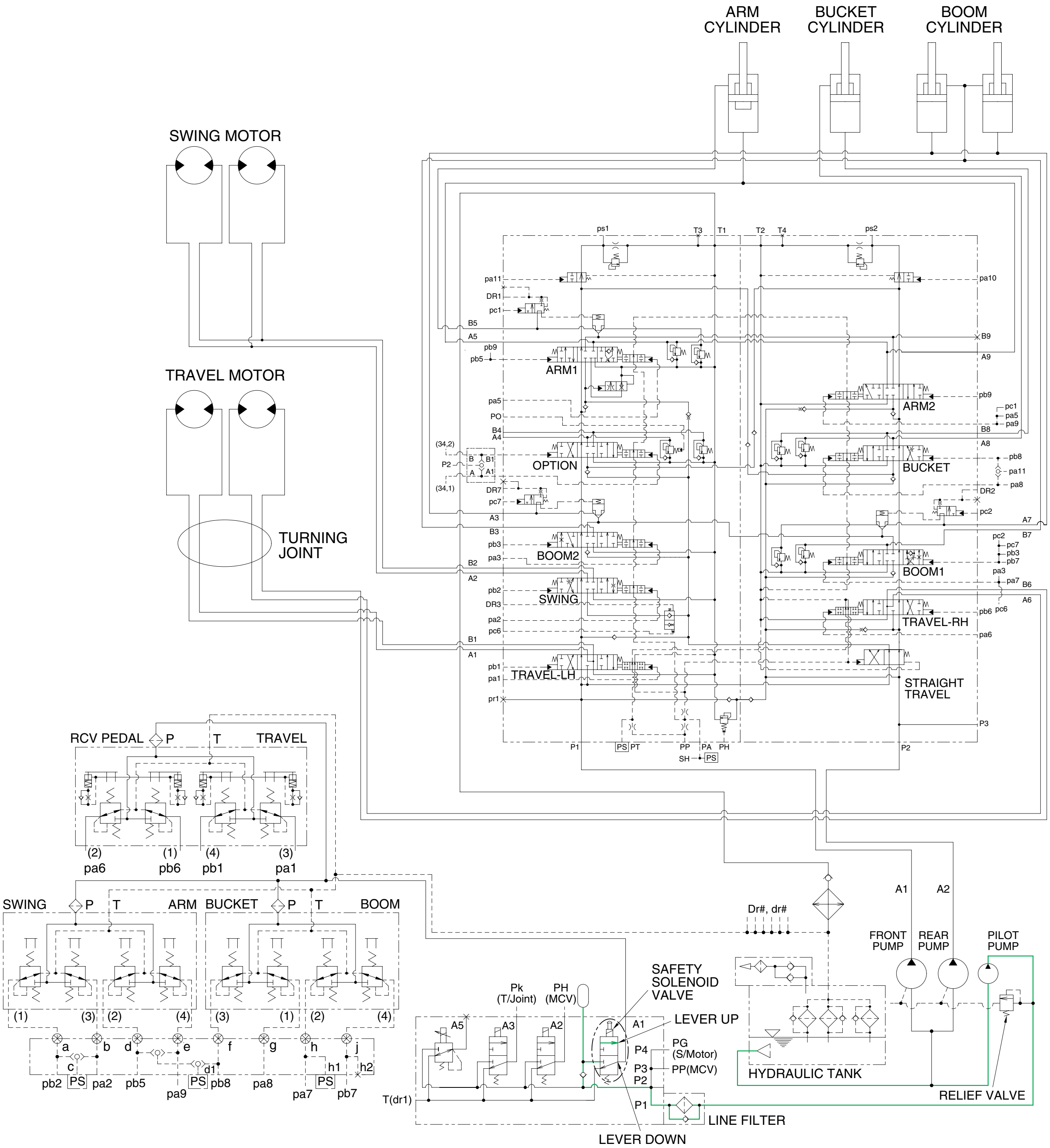
900L3HC02

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)

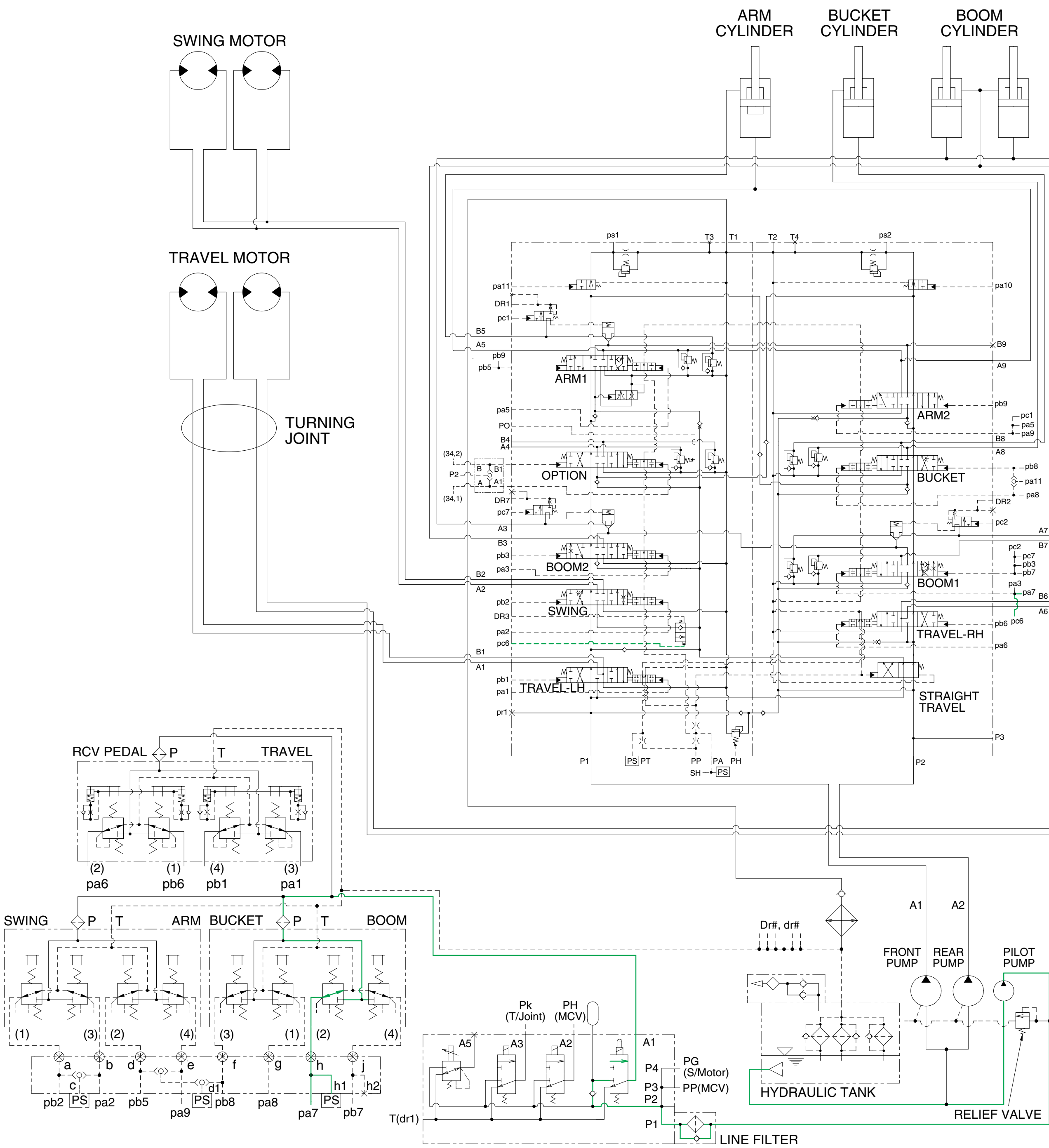


900L3HC03

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

When the lever of the safety solenoid valve moved downward, oil does not flows into the remote control valve, because of blocked by the spool. So, all hydraulic functions are not disabled.

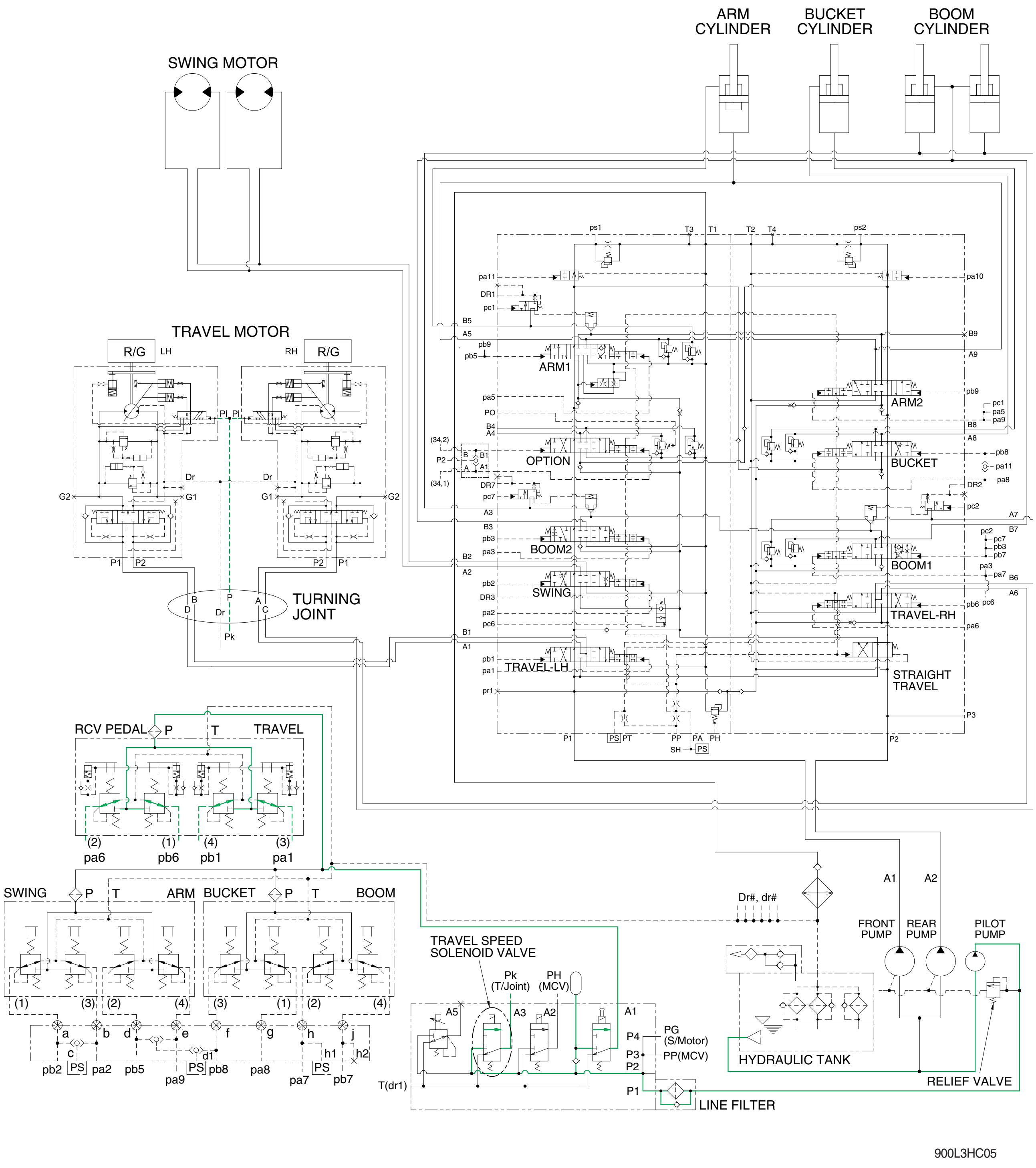
3. BOOM PRIORITY SYSTEM



900L3HC04

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.
When the RH control lever is pulled back to the boom up position, the pilot oil from pilot pump flow into Pc6 port in main control valve through pa7 port. Pc6 oil pressure moves swing reducing spool to upper direction and oil flow rate to the swing motor decreased.
Then, the boom up speed is increased. This is called the boom priority system.

4. TRAVEL SPEED CONTROL SYSTEM



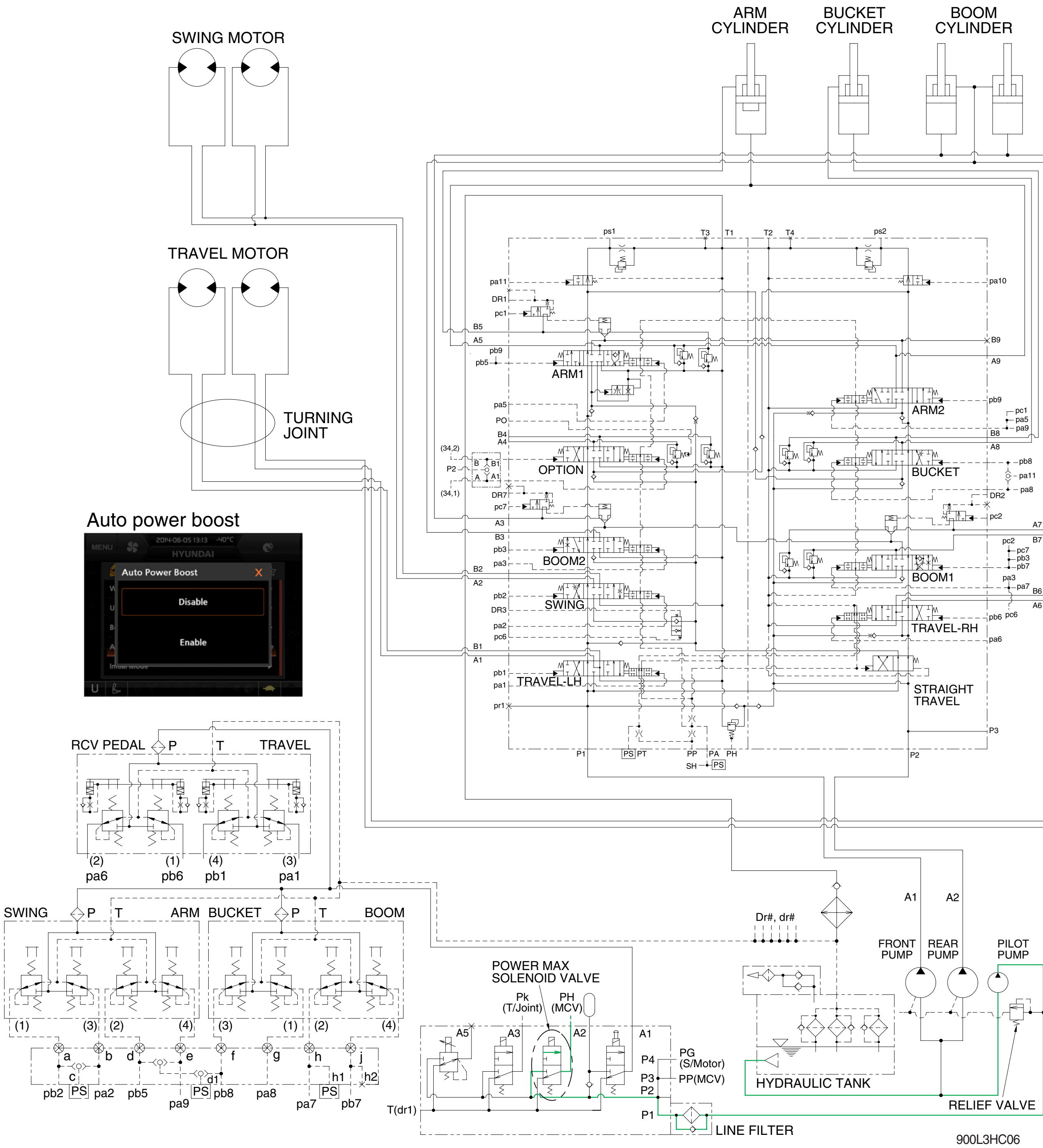
When the travel speed switch is pushed, the travel speed solenoid valve is actuated and the discharged oil from the pilot pump flows to the **Pi** port of pilot valve in the travel motors.

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.

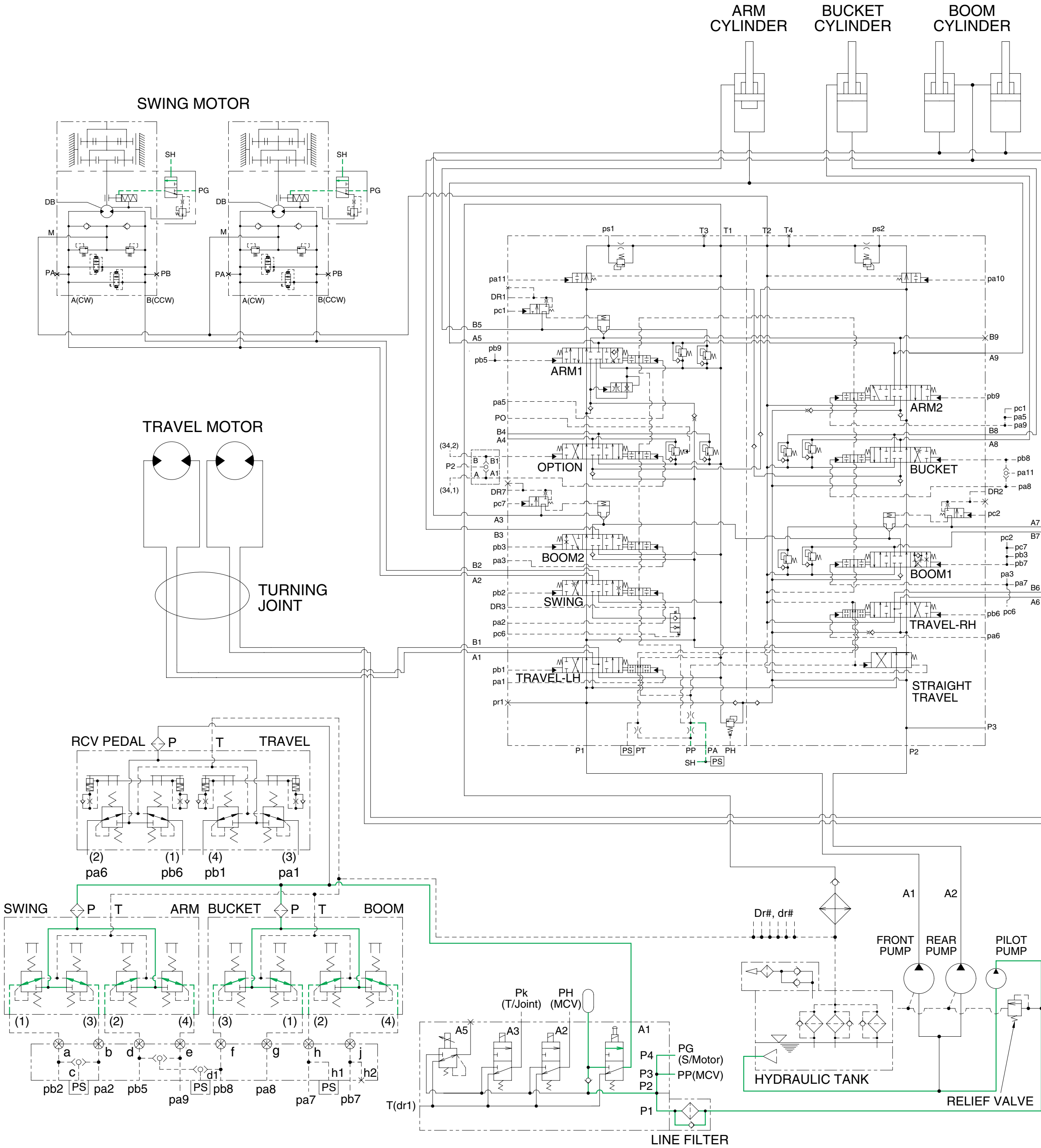
5. MAIN RELIEF PRESSURE CHANGE CIRCUIT



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 (4690 psi) to 360 kgf/cm^2 (5120 psi) 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 360 kgf/cm^2 (5120 psi) as working condition by the MCU. It is also operated maximum 8 seconds.

6. SWING PARKING BRAKE RELEASE



900L3HC07

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

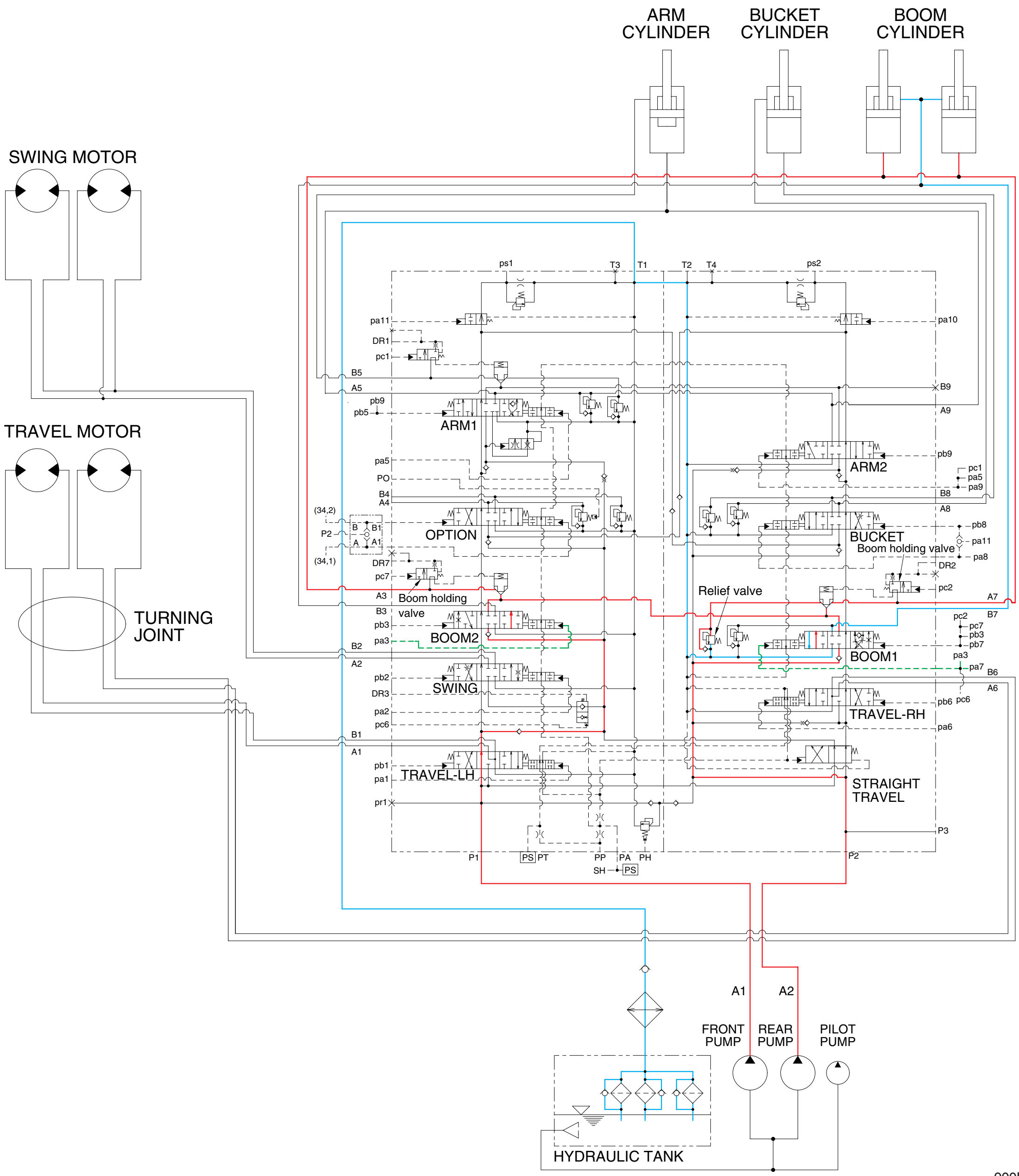
This pressure moves spool so, discharged oil from pilot valve flows to swing motor PG port.

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



900L3HC10

When the RH control lever is pulled back, the boom 1 and boom 2 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.

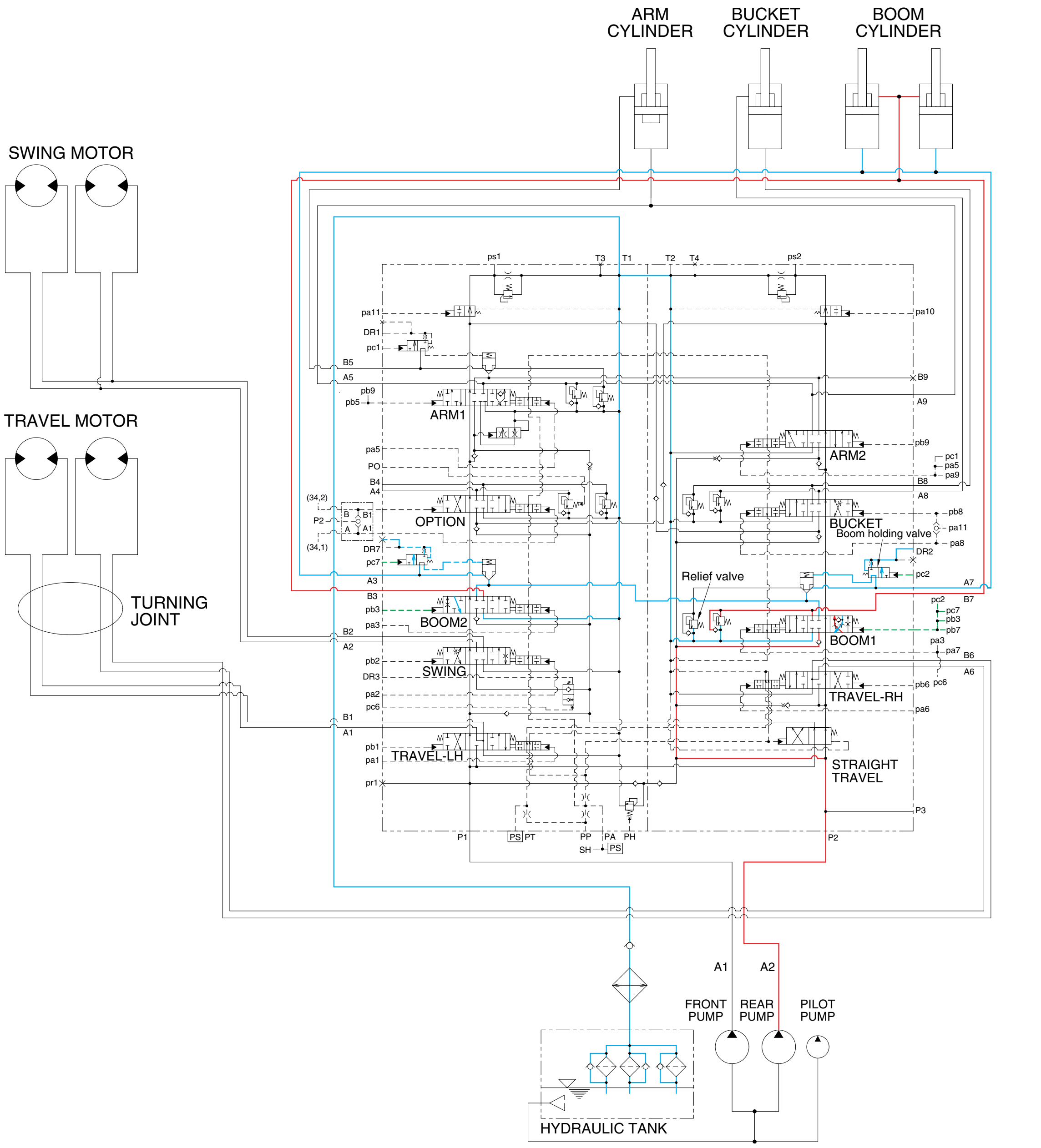
At the same time, the oil from the small chamber of boom cylinders returns to the hydraulic oil tank through the boom 1 spool in the main control valve. When this happens, the boom goes up.

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

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

This prevents the hydraulic drift of boom cylinder.

2. BOOM DOWN OPERATION



900L3HC11

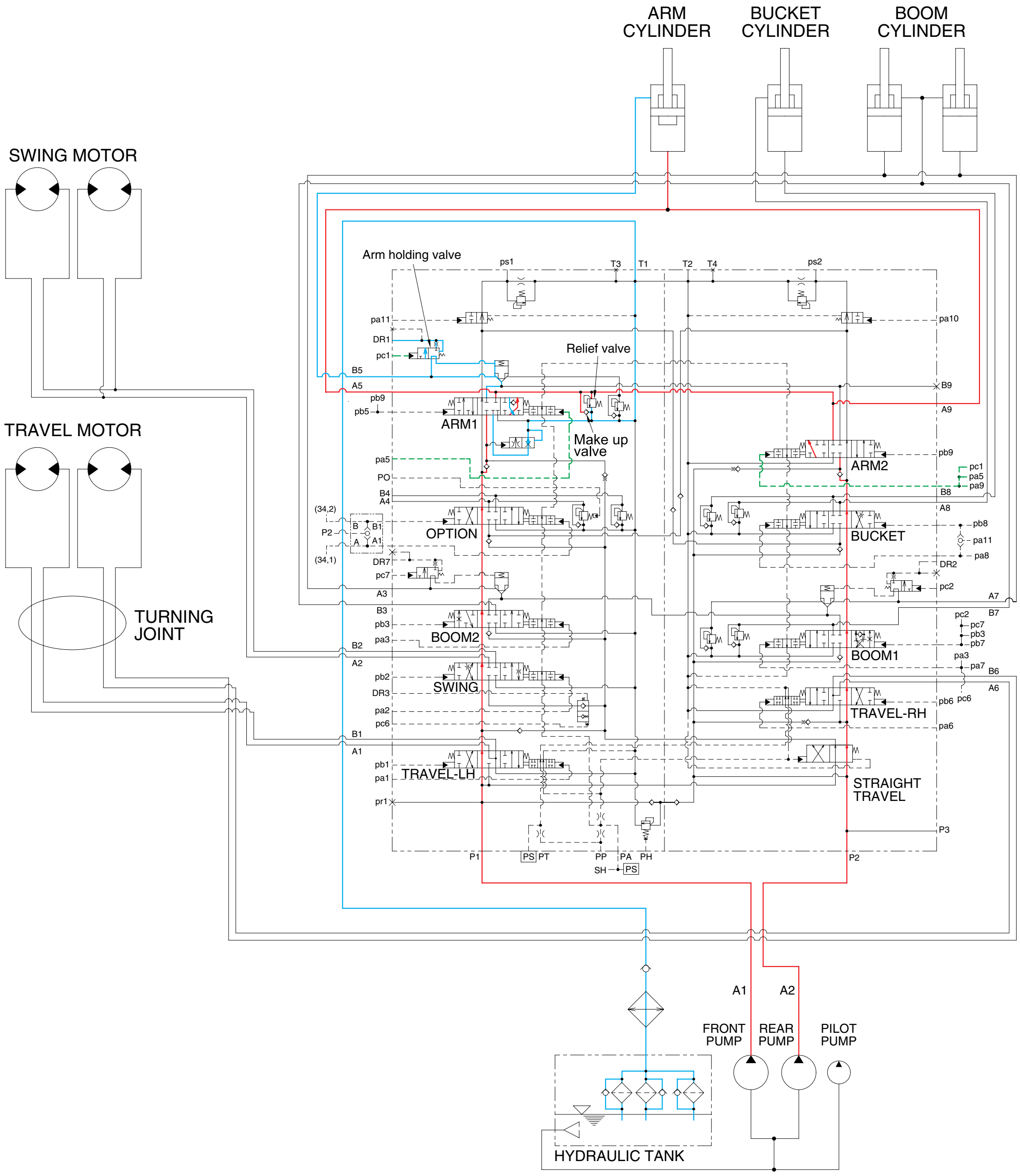
When the RH control lever is pushed forward, the boom 1 and boom 2 spools in the main control valve are moved to the down position by the pilot oil pressure from the remote control valve.

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 and boom 2 spools 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



900L3HC12

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.

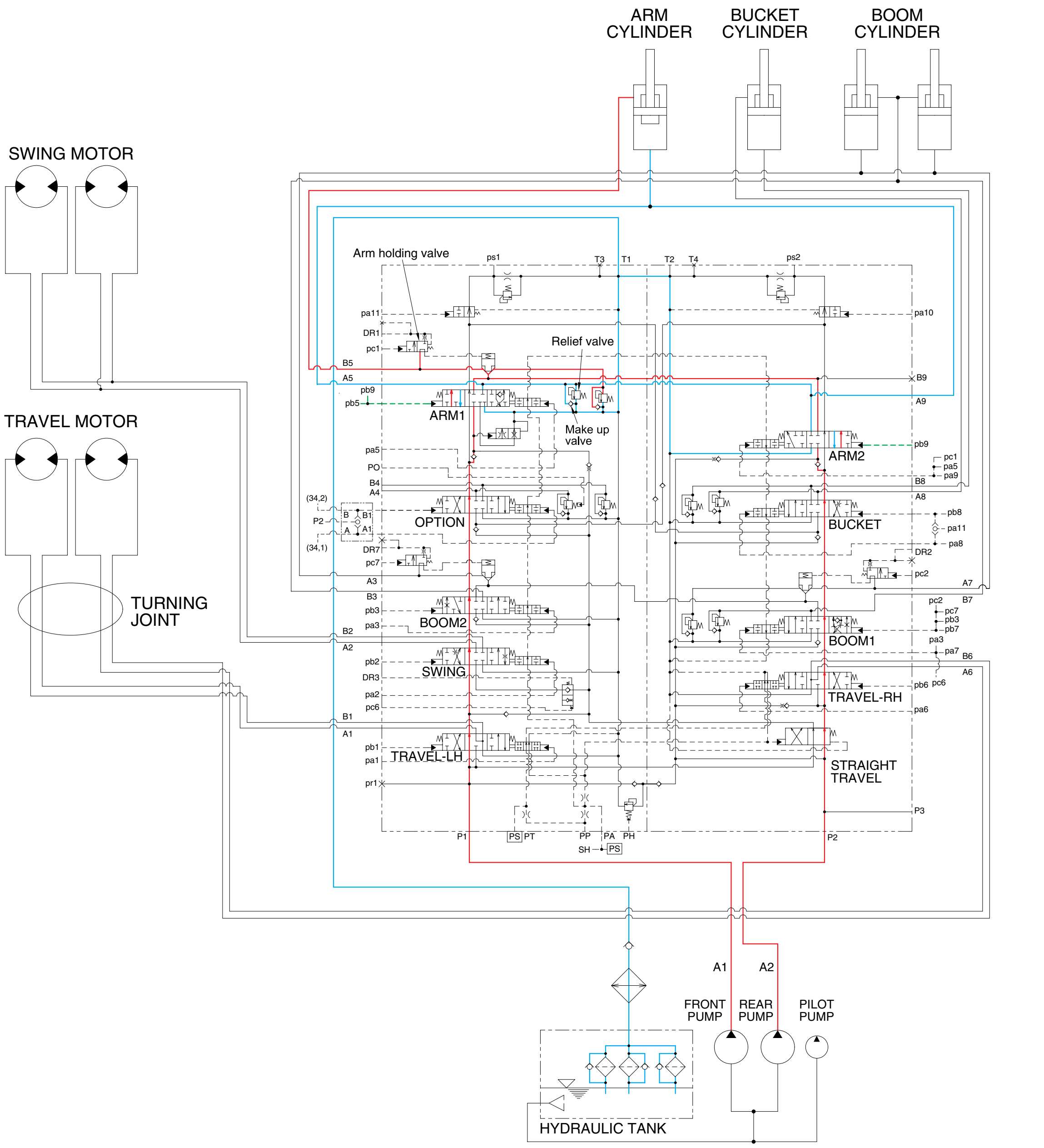
The oil from the A1 and A2 pump flows into the main control valve and then goes to the large chamber of arm cylinder.

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

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

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

4. ARM OUT OPERATION



900L3HC13

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.

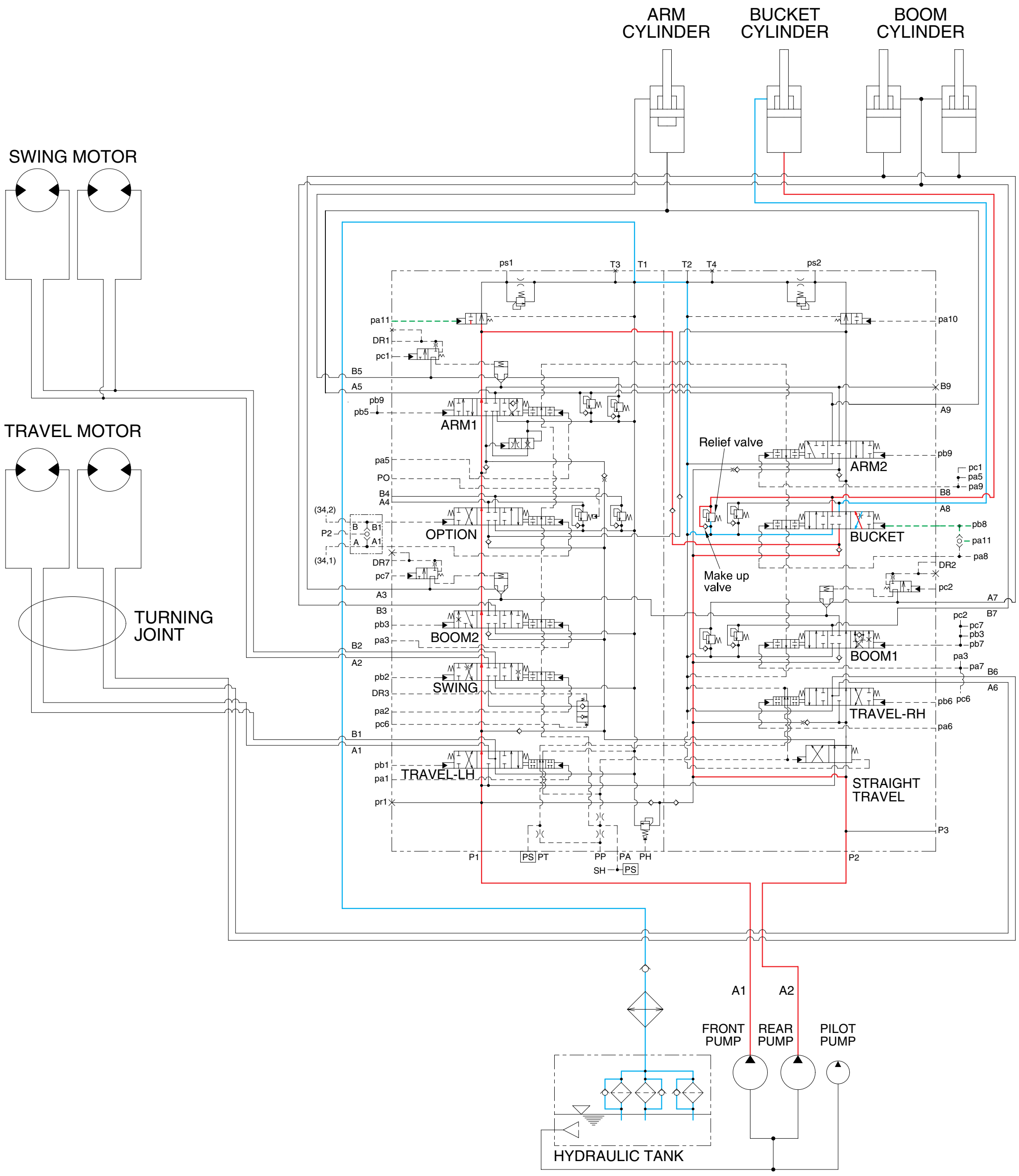
At the same time, the oil from the large chamber of arm cylinder returns to the hydraulic oil tank through the arm spools in the main control valve. When this happens, the arm rolls out.

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



900L3HC14

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.

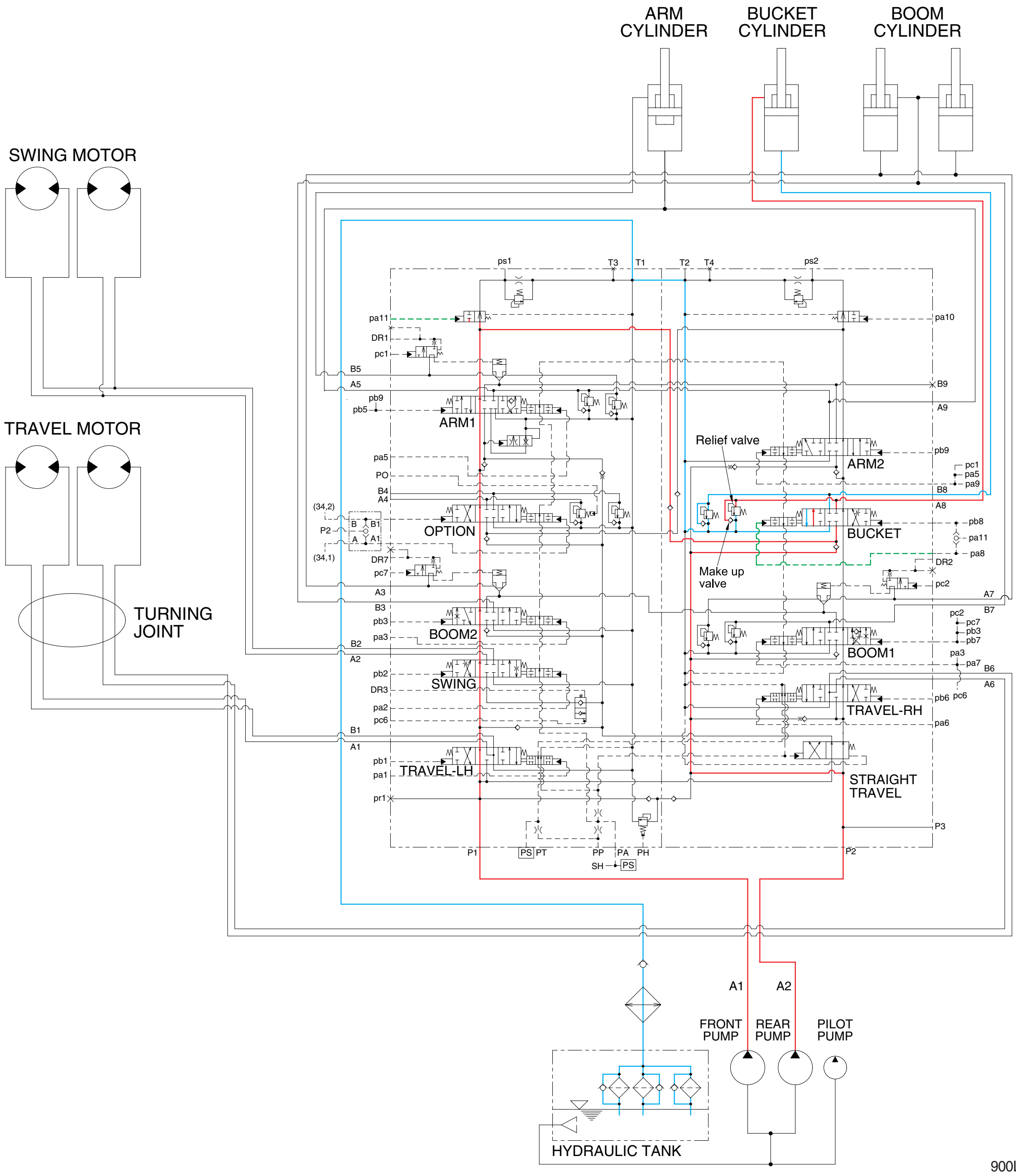
The oil from the A2 pump flows into the main control valve and then goes to the large chamber of bucket cylinder. The oil form the A1 pump flows into the large chamber of bucket cylinder through confluence oil passage in the main control valve by bypass cut pilot pressure (pa11).

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



900L3HC15

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.

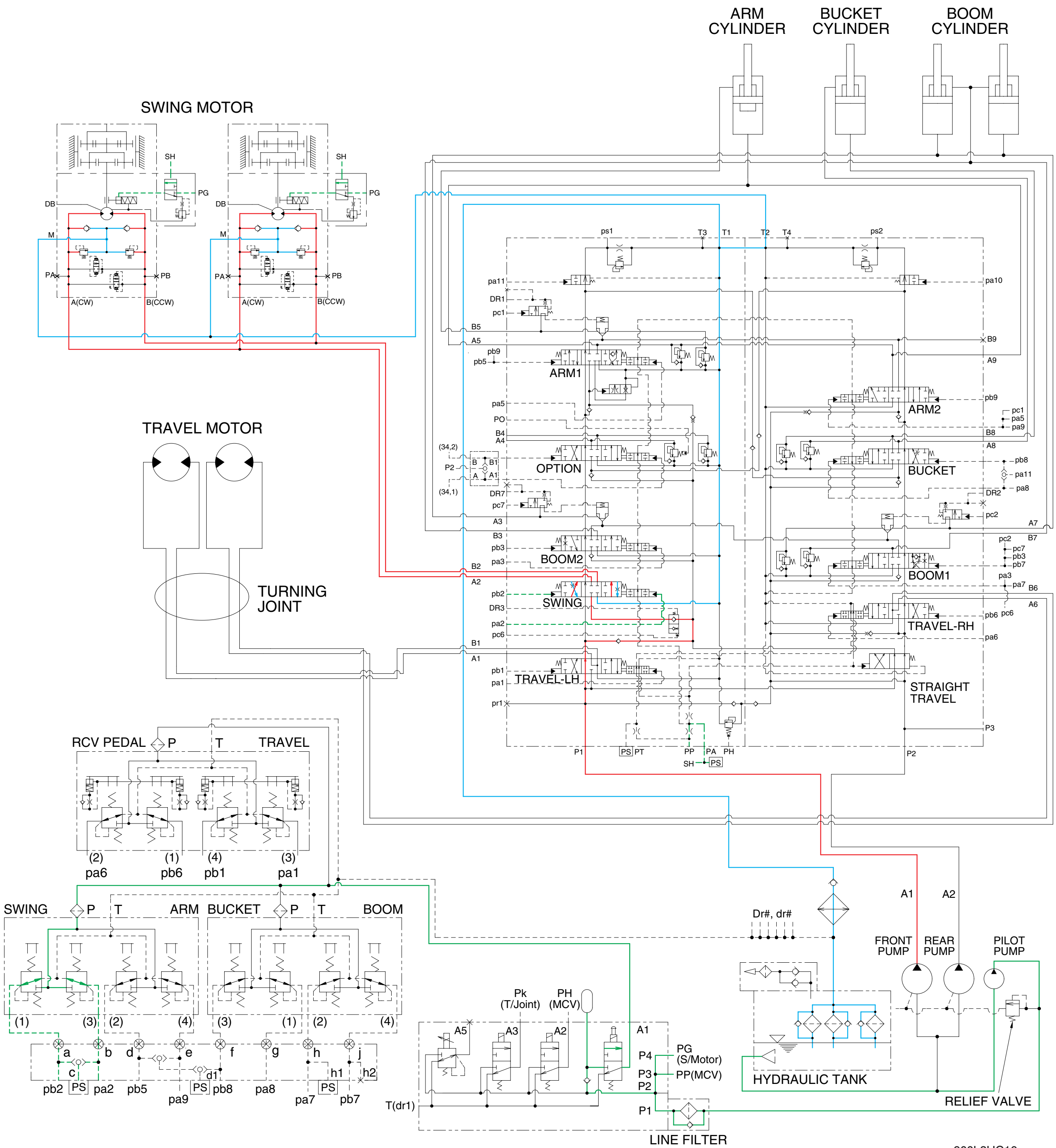
The oil from the A1 pump flows into the large chamber of bucket cylinder though confluence oil passage in the main conrtol valve by bypass cut pilot pressure (pa11).

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



900L3HC16

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.

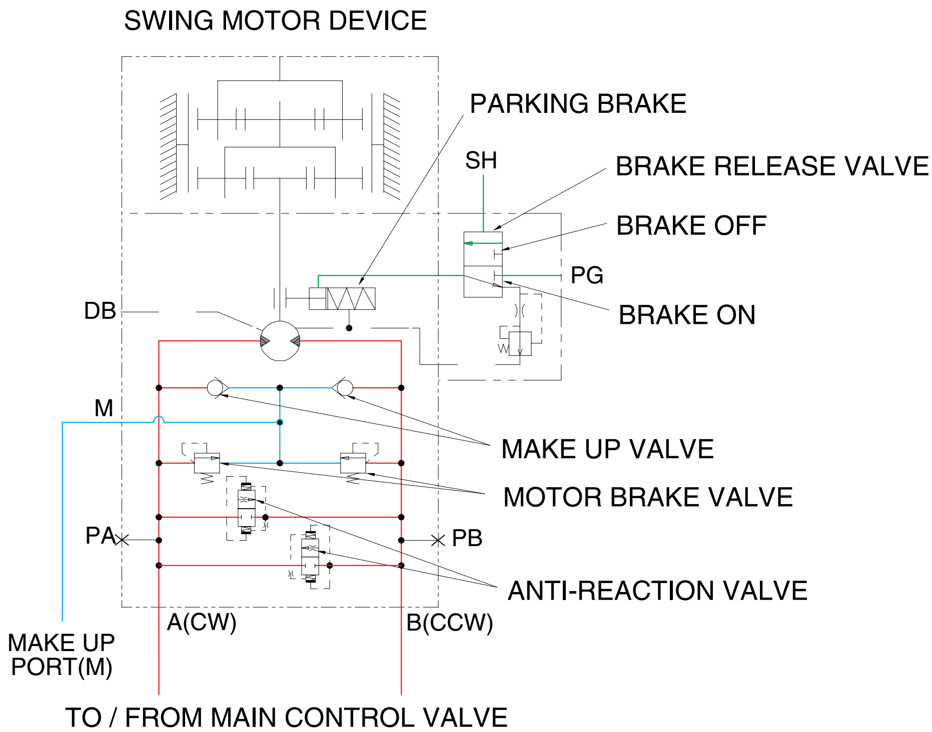
The oil from the A1 pump flows into the main control valve and then goes to the swing motor.

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



900L3HC17

1) MOTOR BRAKE VALVE

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

2) MAKE UP VALVE

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

3) PARKING BRAKE

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

PARKING BRAKE "OFF" OPERATION

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

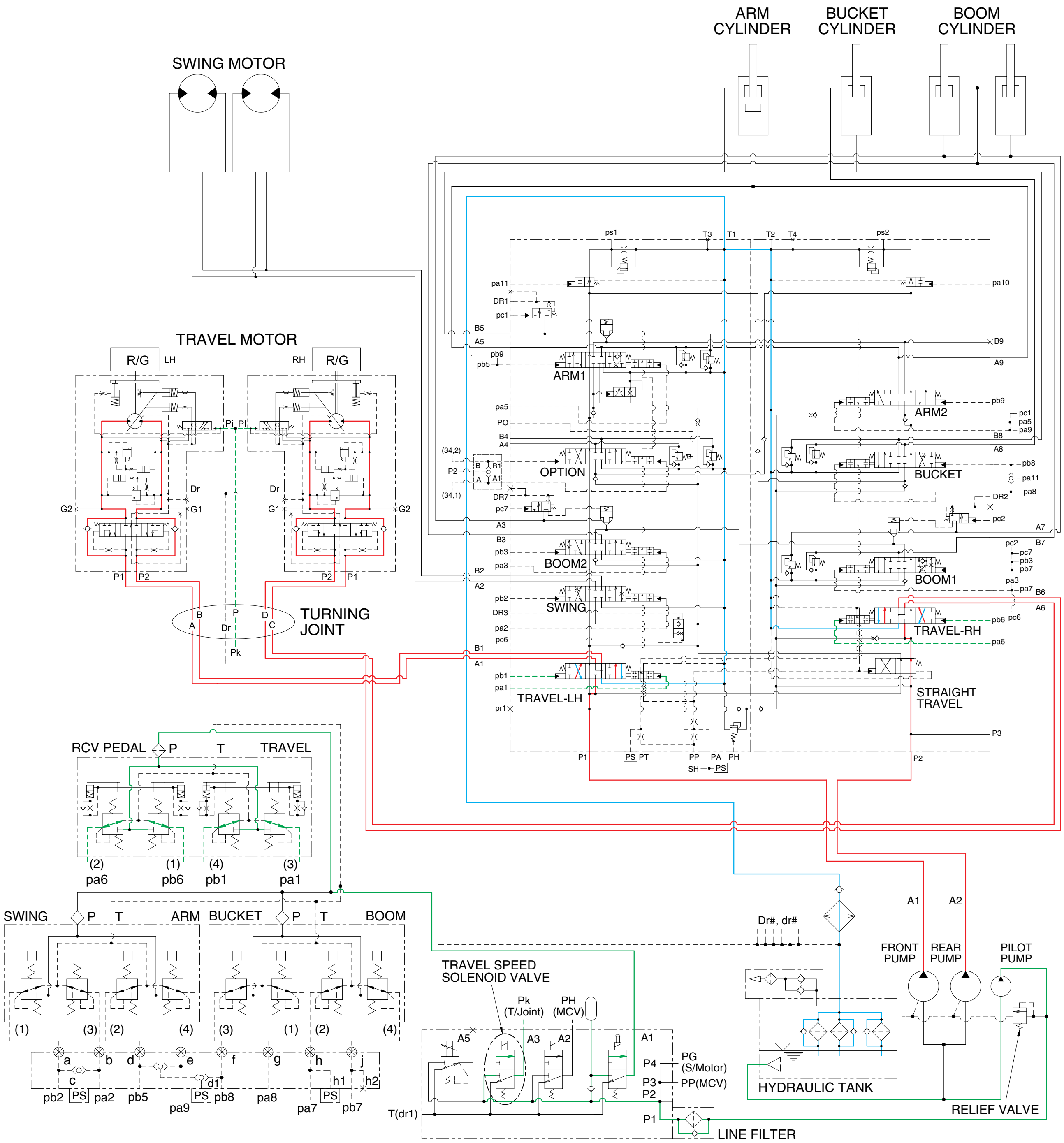
PARKING BRAKE "ON" OPERATION

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

4) ANTI-REACTION VALVE

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

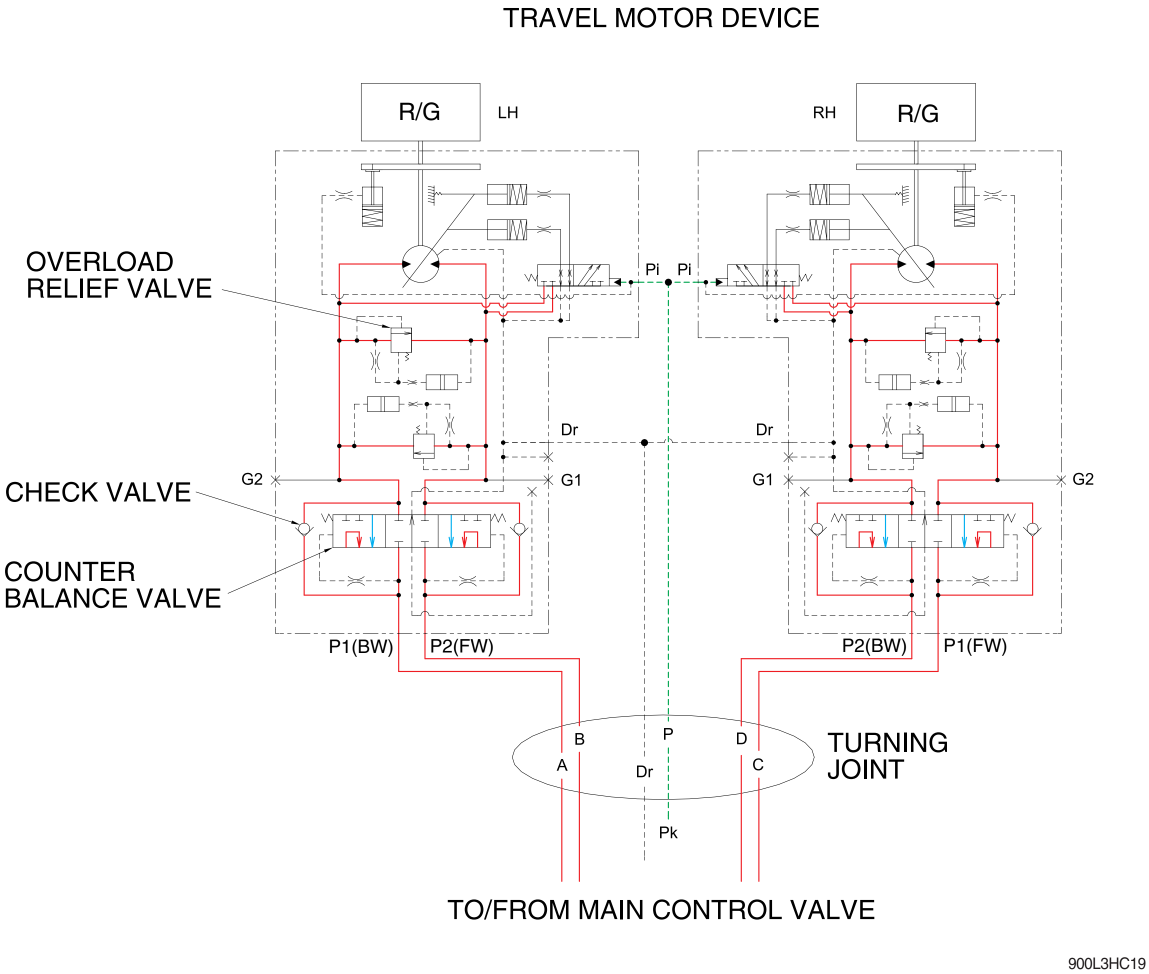
8. TRAVEL FORWARD AND REVERSE OPERATION



900L3HC18

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) CHECK VALVE

Stopping the motor, this valve sucks the oil from lower pressure passage for prevention the negative pressure and the cavitation of the motor.

2) COUNTER BALANCE VALVE

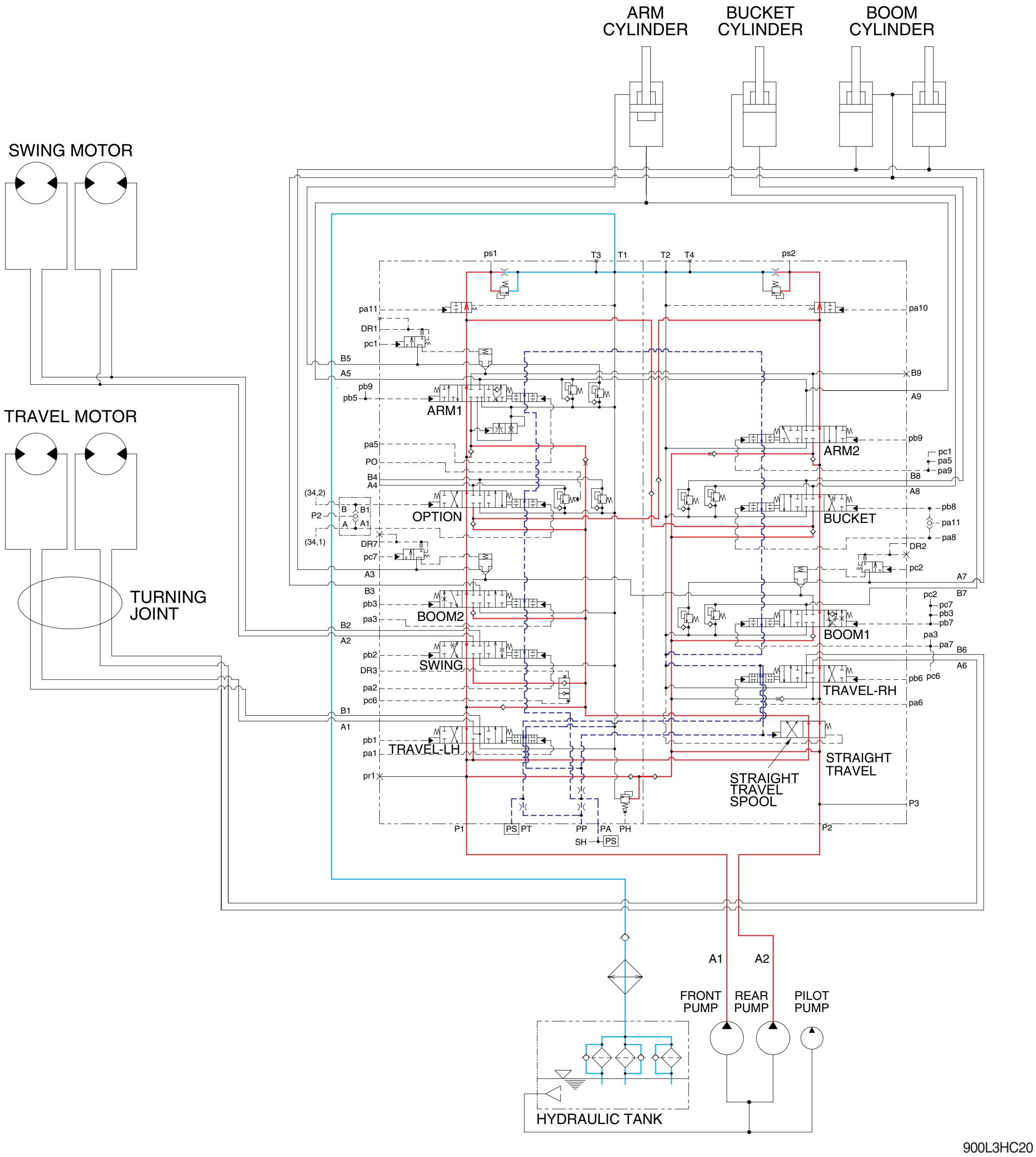
When stopping the motor of slope descending, this valve to prevent the motor over run.

3) OVERLOAD RELIEF VALVE

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

GROUP 5 COMBINED OPERATION

1. OUTLINE



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.

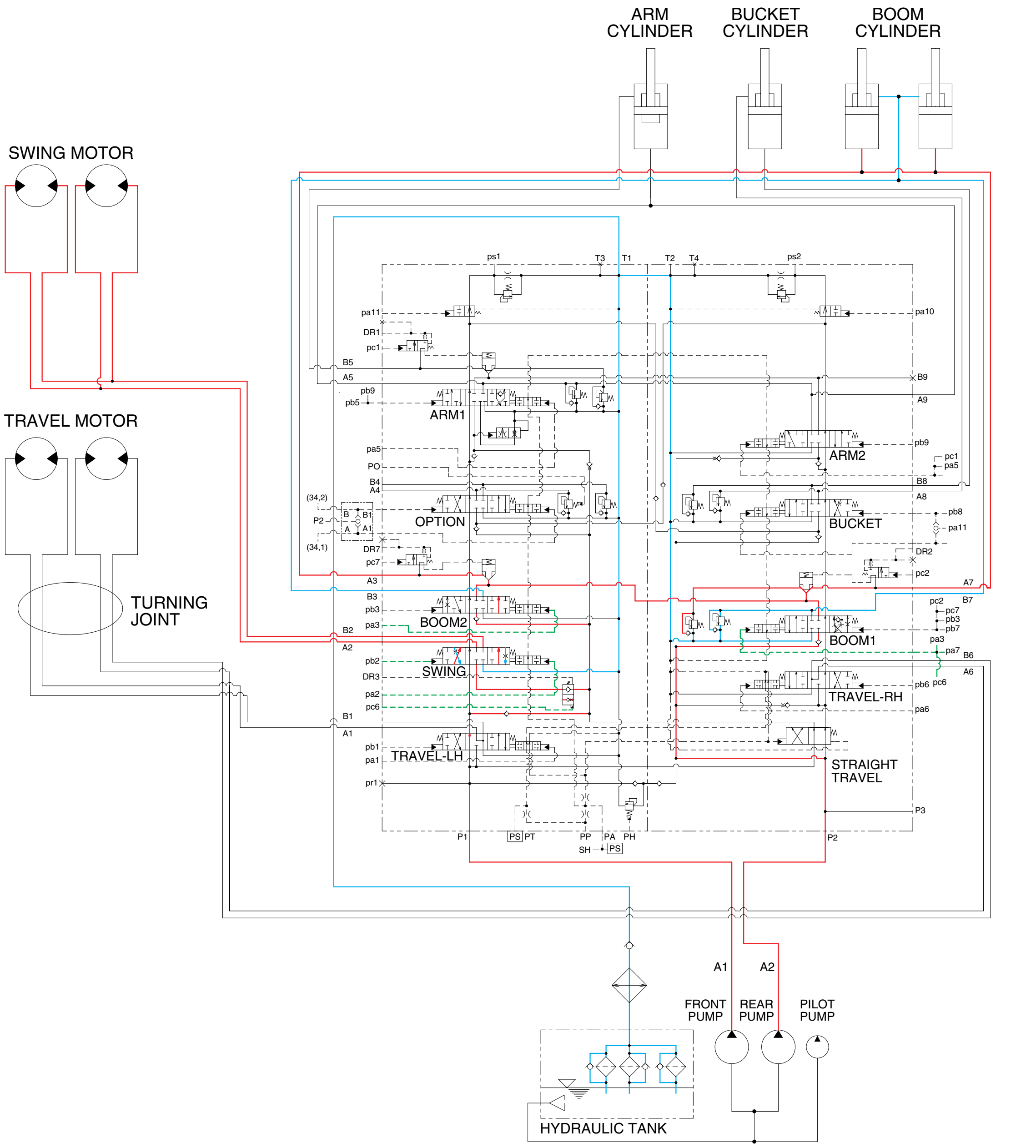
STRAIGHT TRAVEL SPOOL

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



900L3HC21

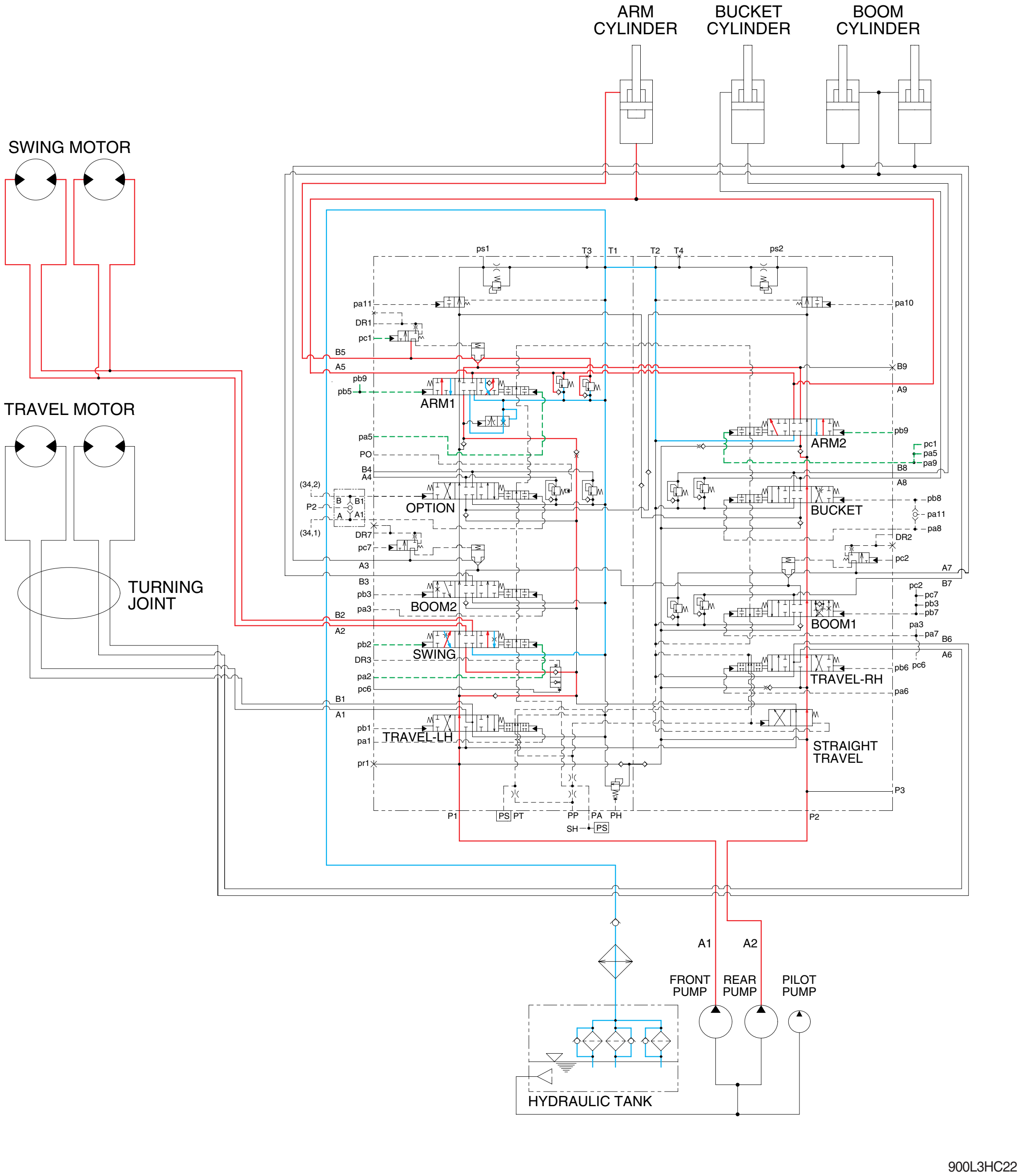
When the swing and boom up functions are operated simultaneously, the swing spool and boom spools in the main control valve are moved to the functional position by the pilot oil pressure from the remote control valve.

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

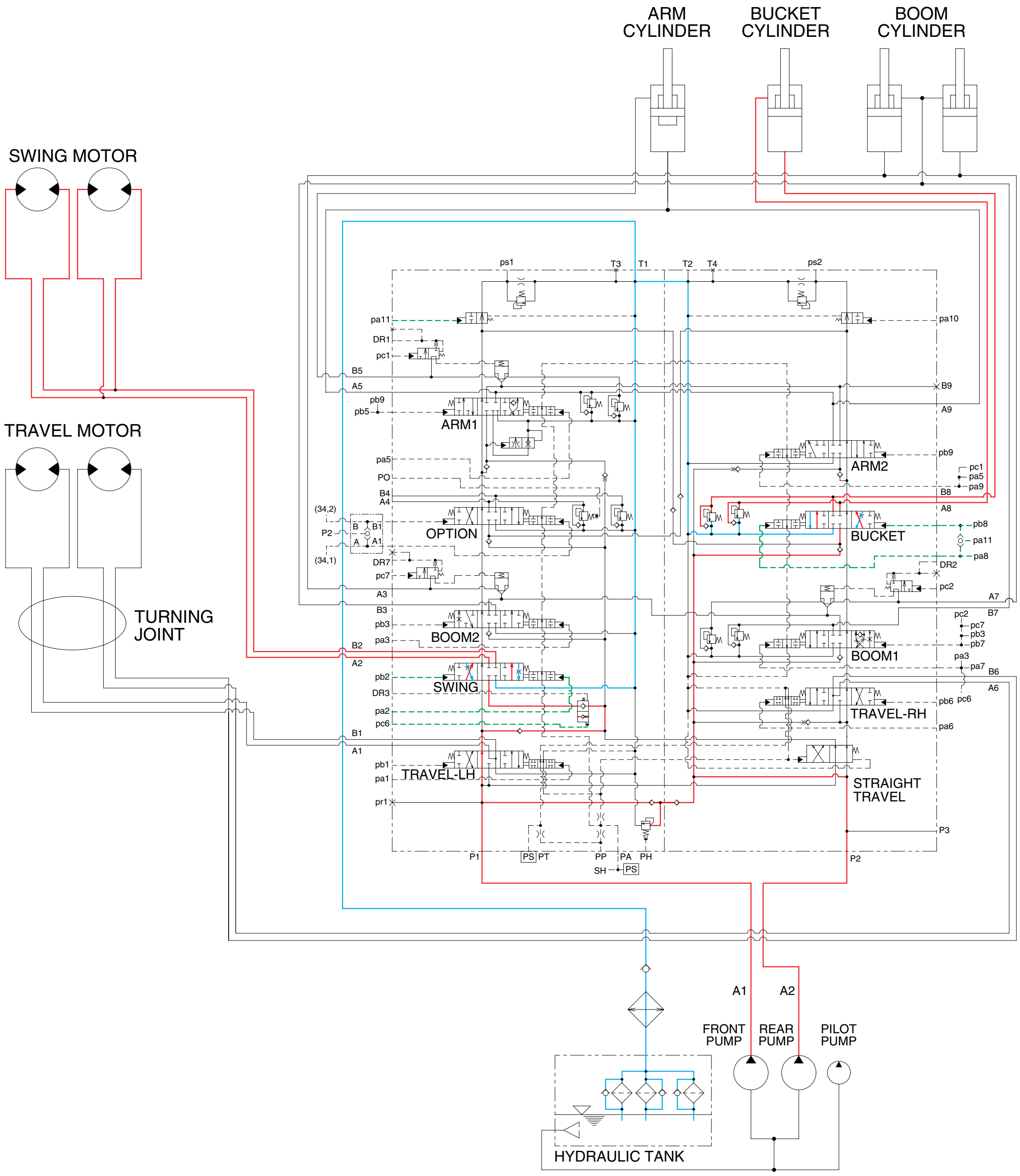


When the swing and arm functions are operated simultaneously, the swing spool and arm spools in the main control valve are moved to the functional position by the pilot oil pressure from the remote control valve.

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.

4. COMBINED SWING AND BUCKET OPERATION



900L3HC23

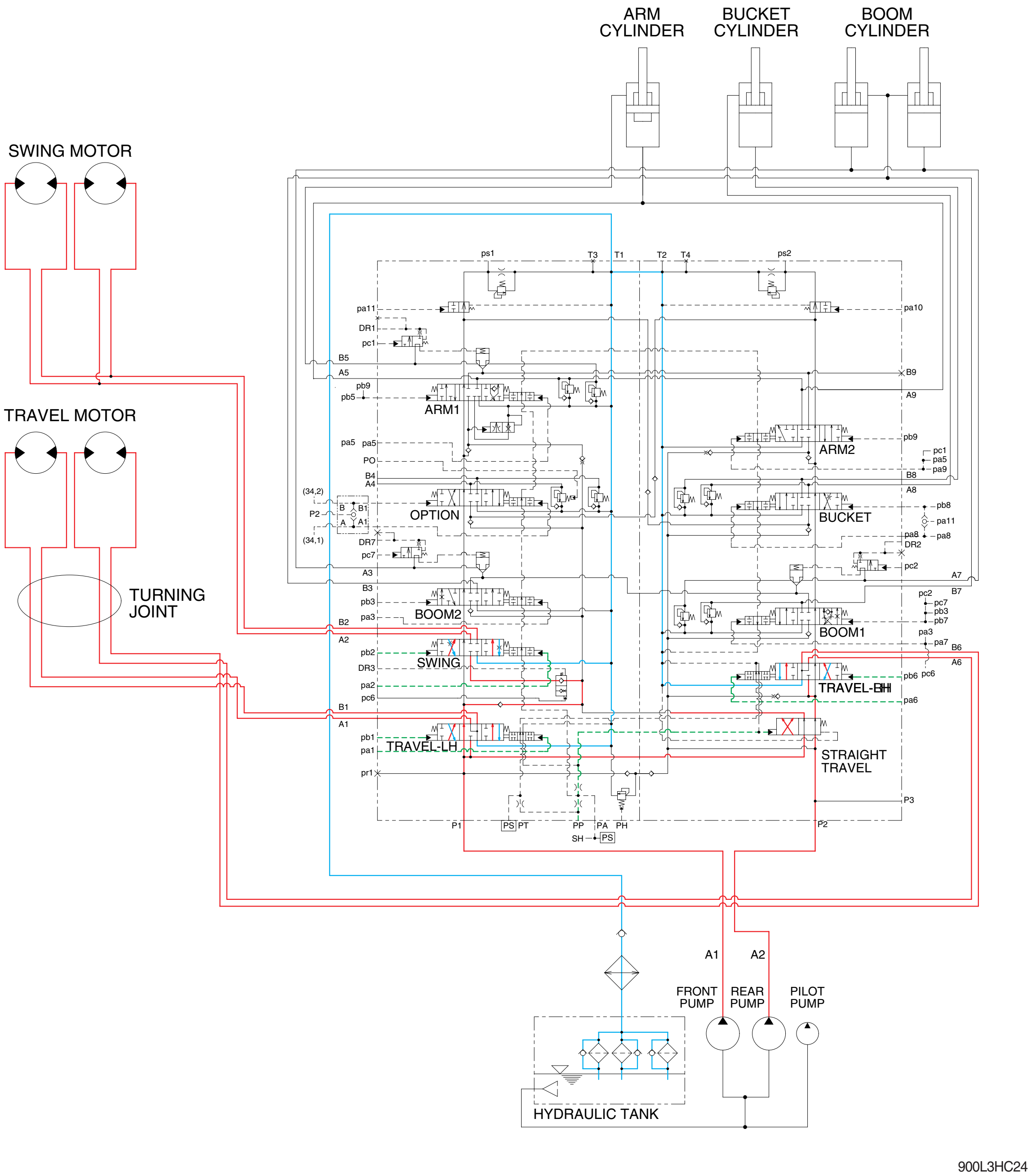
When the swing and bucket functions are operated simultaneously, the swing spool and bucket spool in the main control valve are moved to the functional position by the pilot oil pressure from the remote control valve.

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



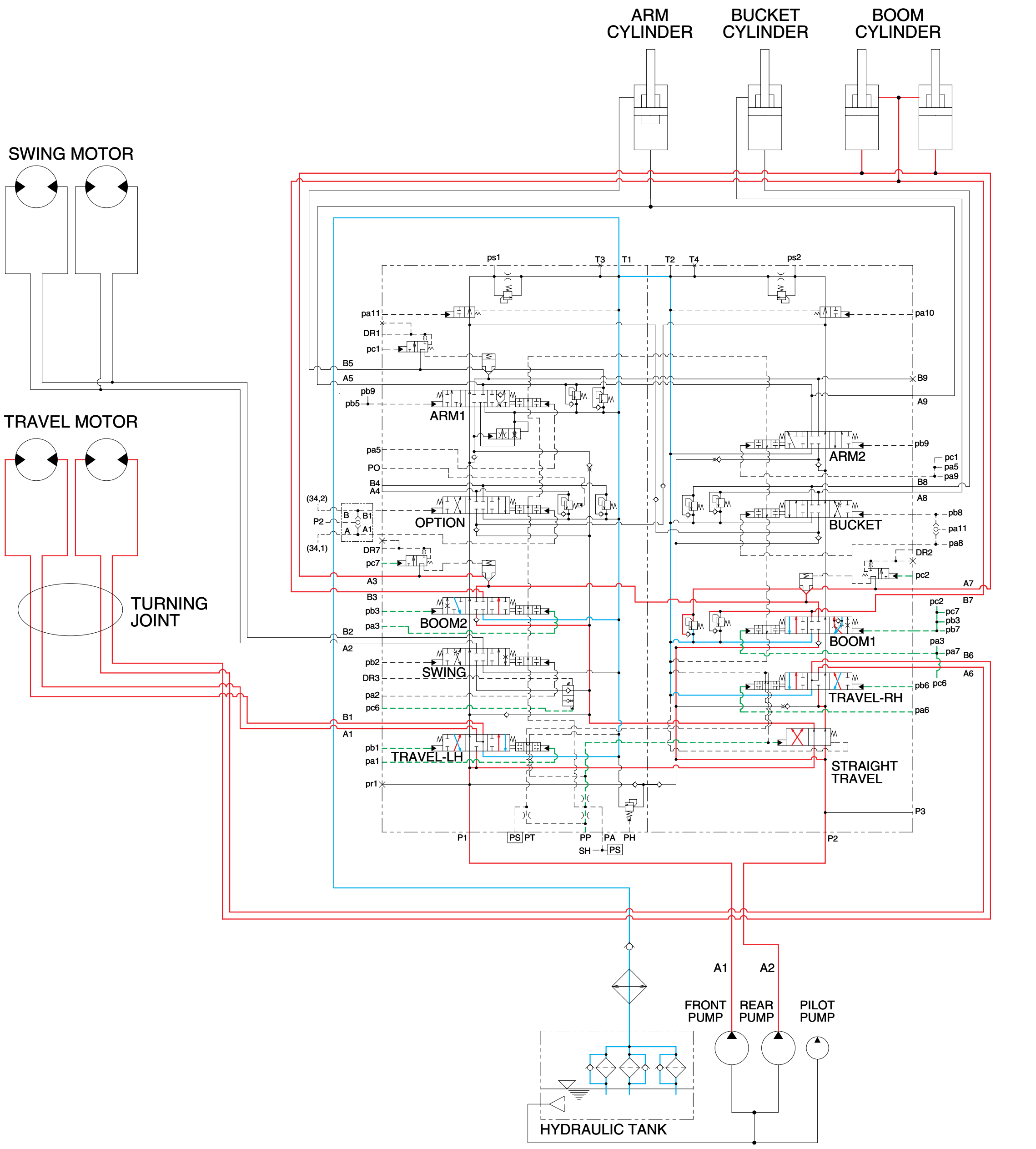
When the swing and travel functions are operated simultaneously, the swing spool and travel spools in the main control valve are moved to the functional position by the pilot oil pressure from the remote control valve and straight travel spool is pushed to the right by the pilot oil pressure from the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

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

The upper structure swings and the machine travels straight.

6. COMBINED BOOM AND TRAVEL OPERATION



900L3HC25

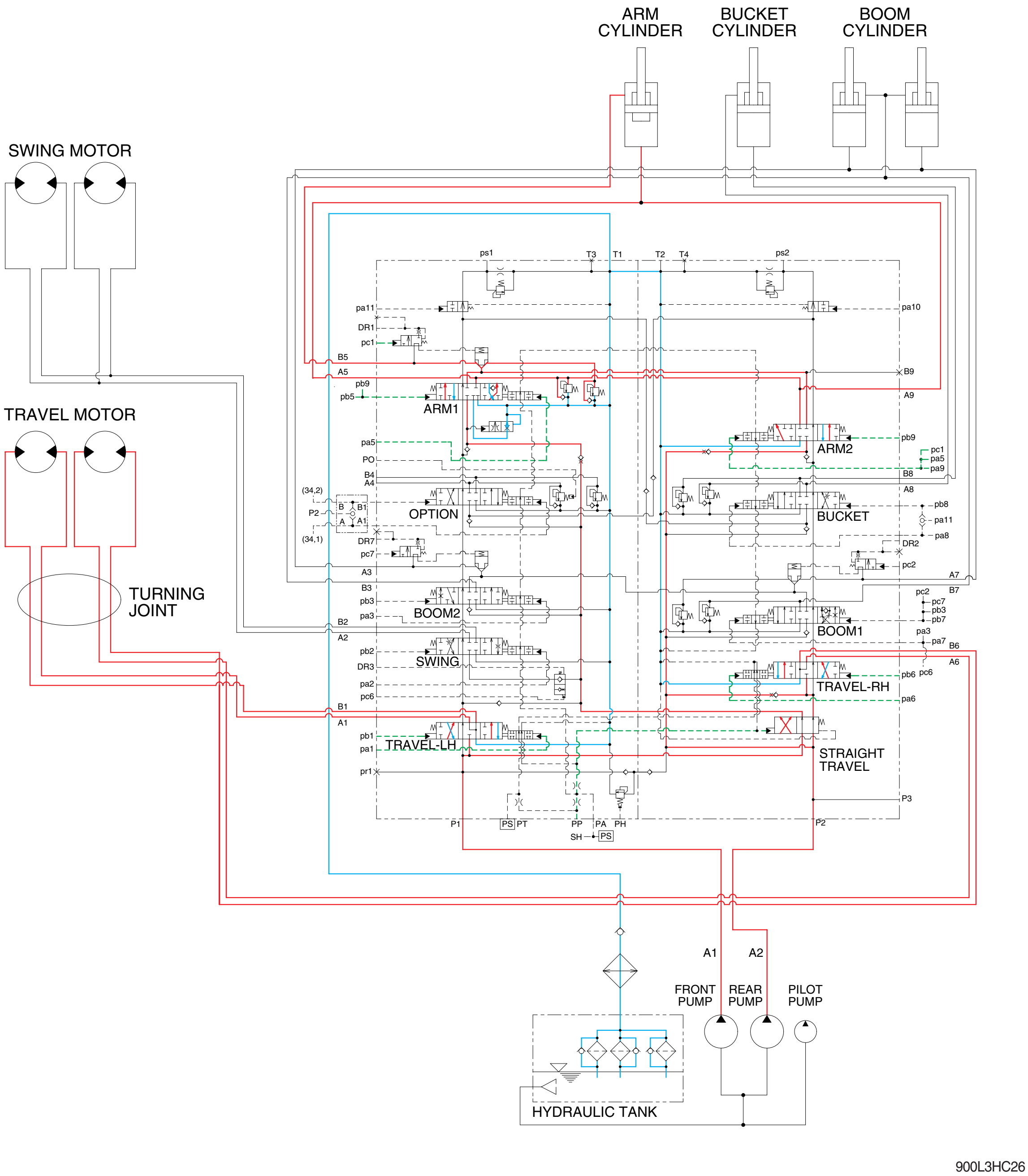
When the boom and travel functions are operated simultaneously, the boom spools and travel spools in the main control valve are moved to the functional position by the pilot oil pressure from the remote control valve and the straight travel spool is pushed to the right by the oil pressure from pilot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

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



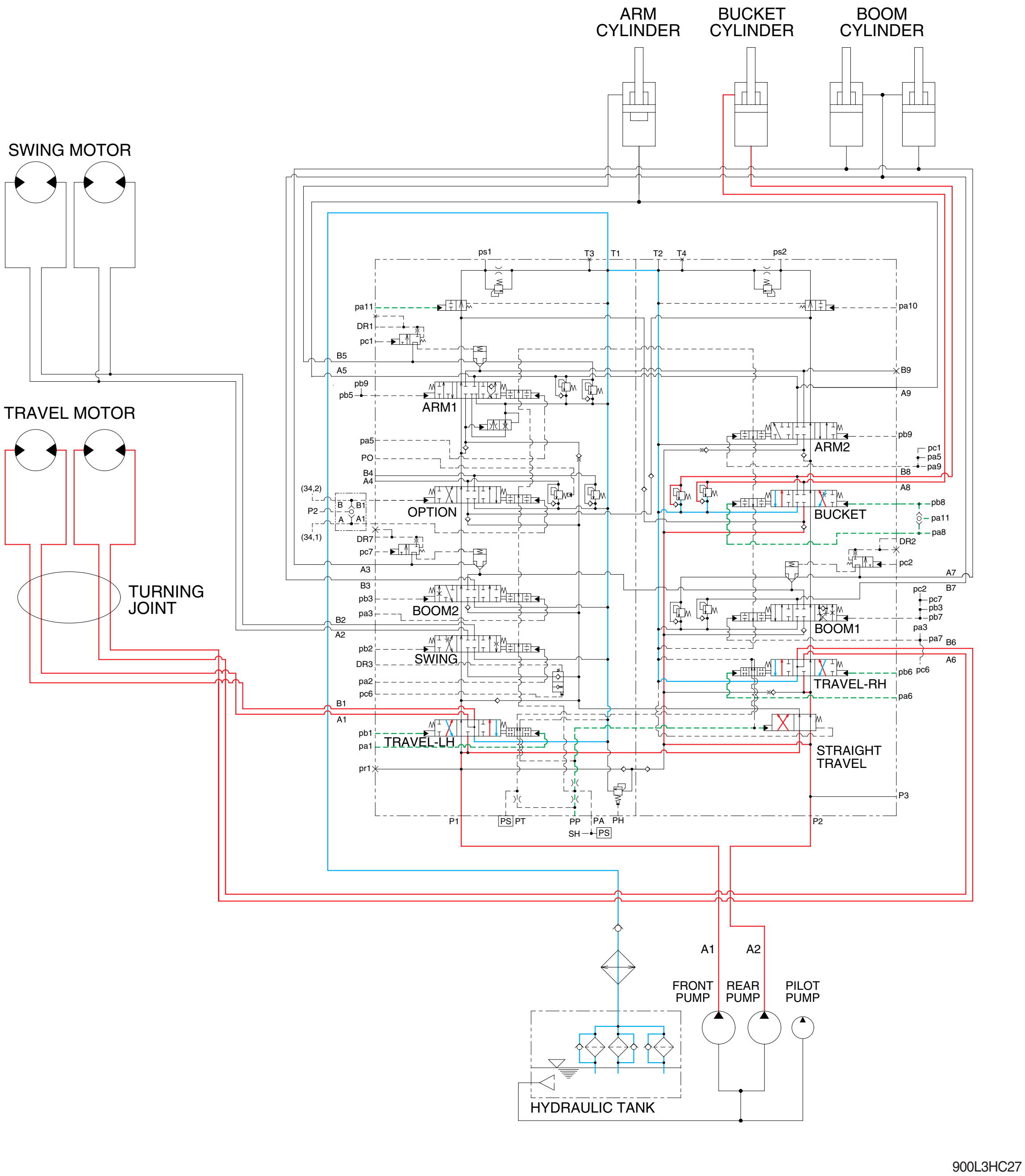
When the arm and travel functions are operated simultaneously, the arm spools and travel spools in the main control valve are moved to the functional position by the pilot oil pressure from the remote control valve and the straight travel spool is pushed to the right by the oil pressure from pilot pump.

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

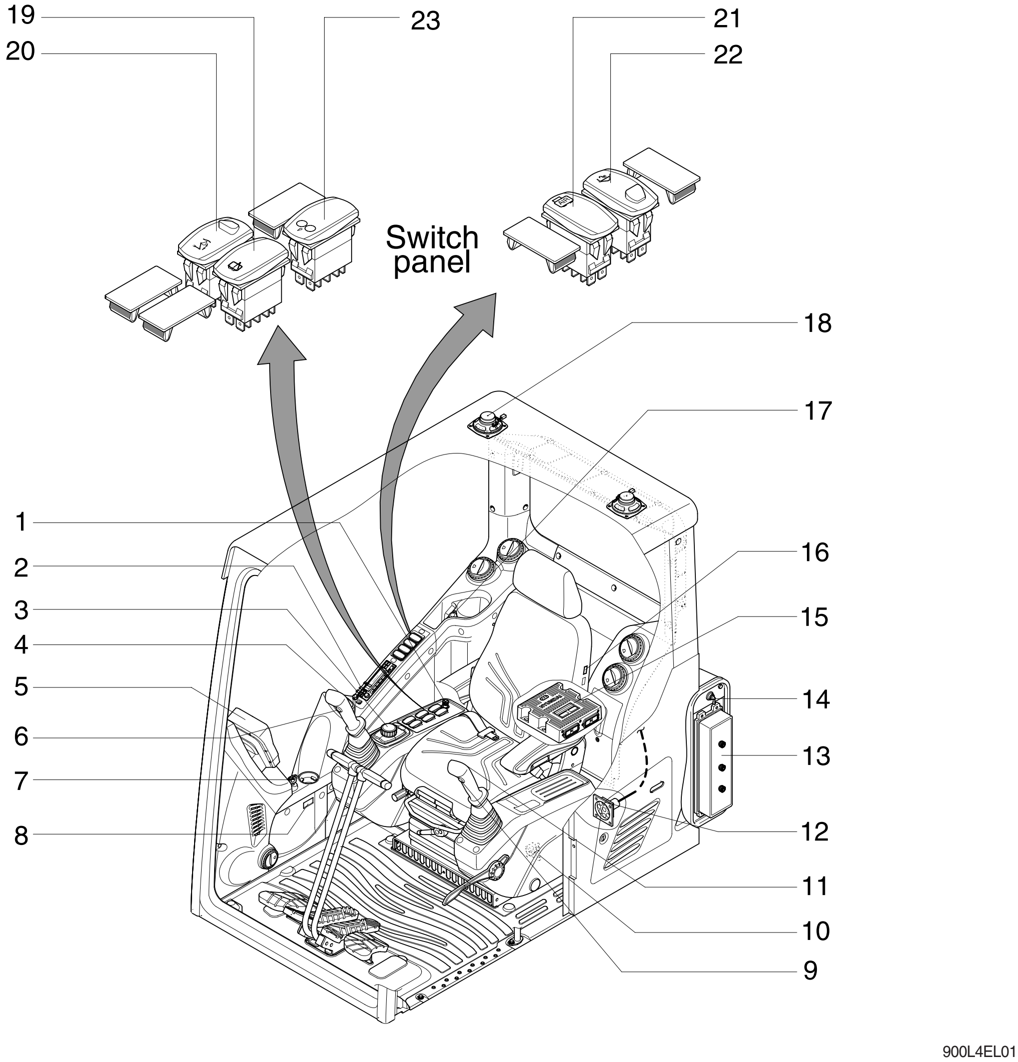
The oil from the A2 pump flows into the bucket cylinder through the bucket spool via the confluence oil passage.

The bucket is operated and the machine travels straight.

SECTION 4 ELECTRICAL SYSTEM

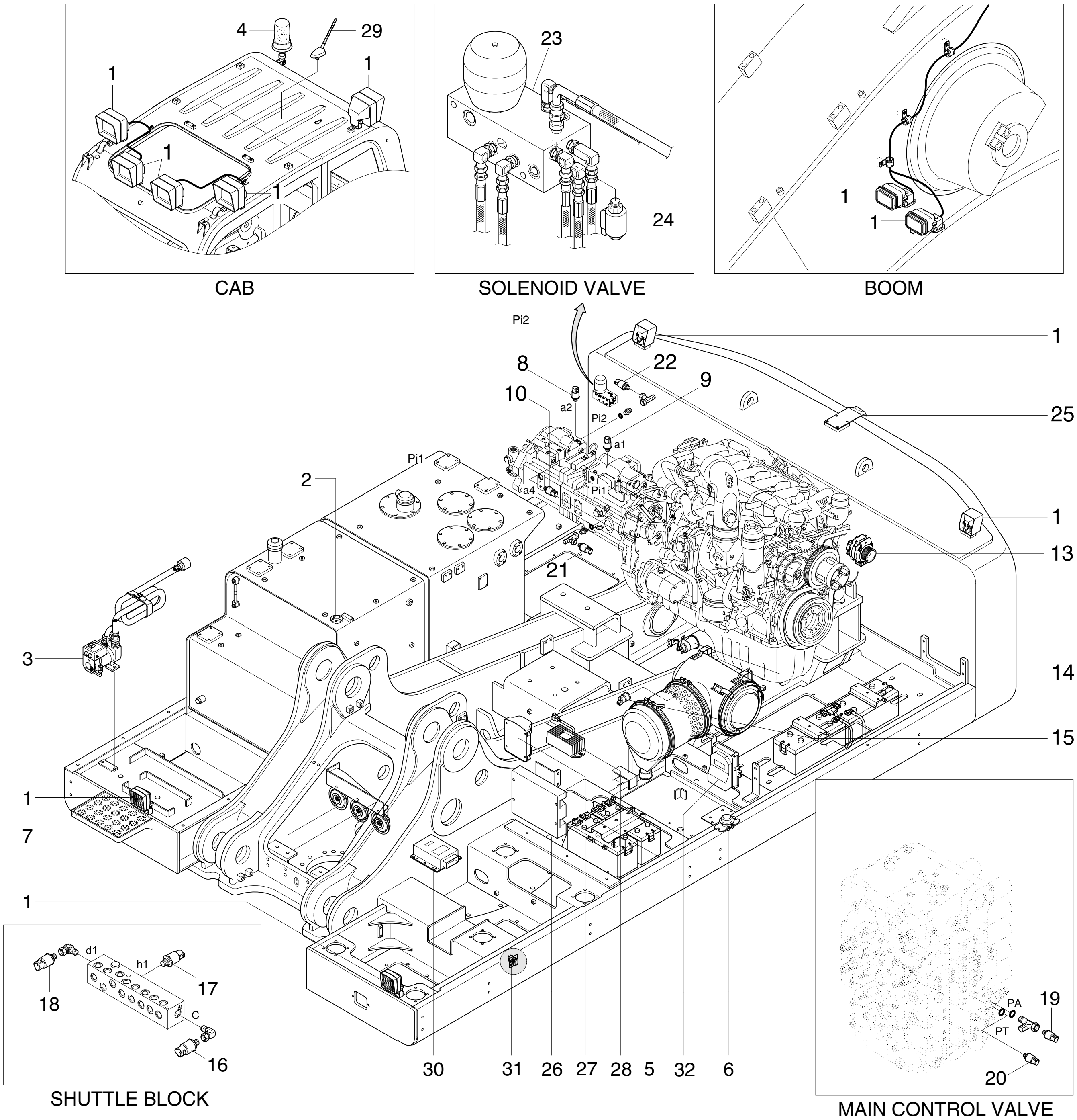
GROUP 1 COMPONENT LOCATION

1. LOCATION 1



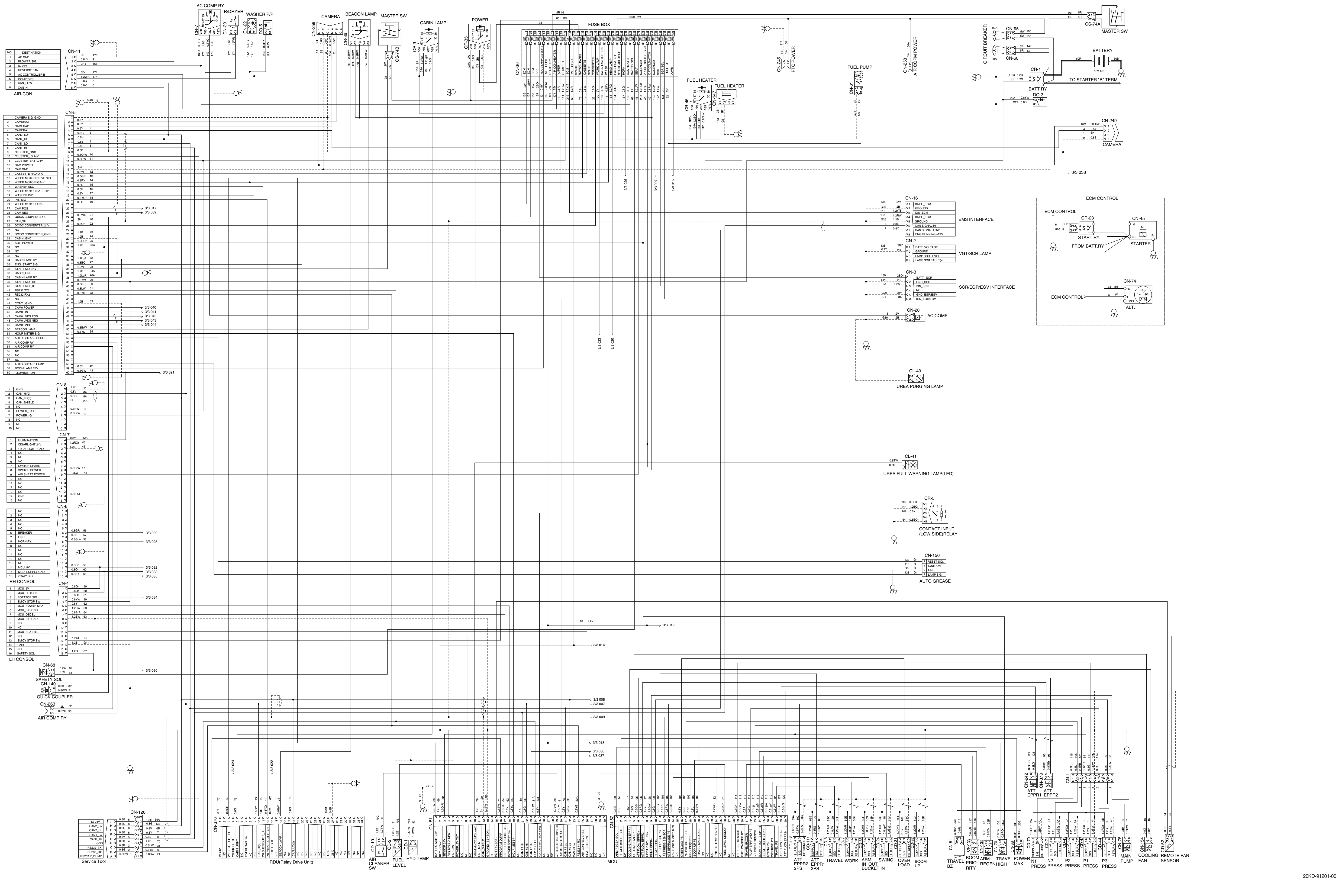
1	Cigar lighter	9	Power max switch	17	Service socket
2	Radio & USB player	10	Emergency engine stop switch	18	Speaker
3	Haptic controller	11	One touch decel switch	19	Lower wiper & washer switch
4	Horn switch	12	RS232 & J1939 service socket	20	Boom floating switch
5	Cluster	13	Fuse & relay box	21	Air compressor switch
6	Breaker operation switch	14	Master switch	22	Quick clamp switch
7	Starting switch	15	Machine control unit	23	Central grease lubrication switch
8	Service meter	16	Seat heater switch		

2. LOCATION 2

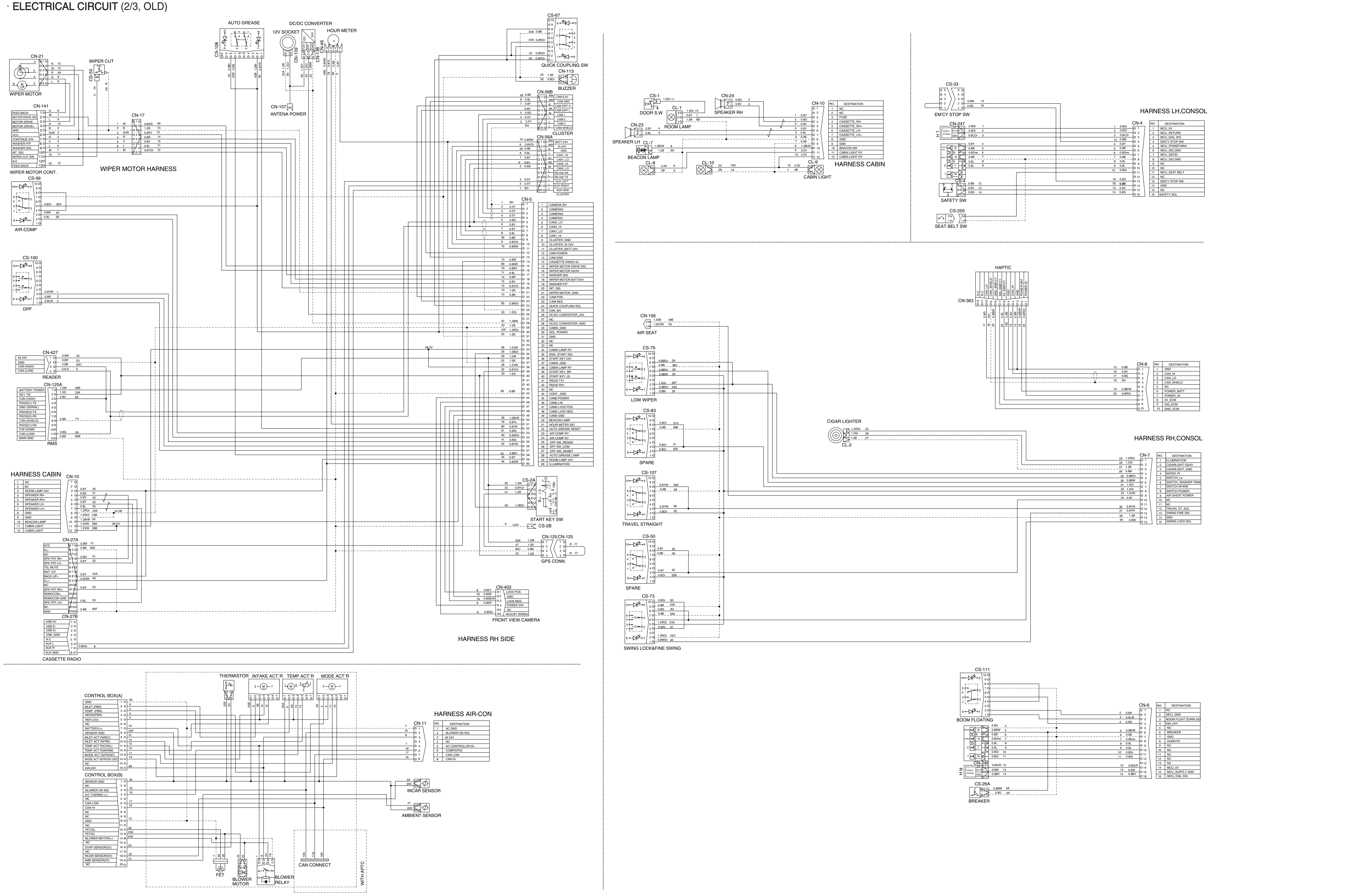


1	Lamp	13	Alternator	23	Solenoid valve
2	Fuel sender	14	Travel alarm buzzer	24	Boom priority EPPR valve
3	Fuel filler pump	15	Air cleaner switch	25	Rear view camera
4	Beacon lamp	16	Swing pressure sensor	26	MCU
5	Battery	17	Boom down pressure sensor	27	RMCU
6	Battery relay	18	Arm out/Bucket in pressure sensor	28	Converter
7	Horn	19	Attach pressure sensor	29	Antenna
8	P1 pressure sensor	20	Travel pressure sensor	30	Attachment MCU
9	P2 pressure sensor	21	Nega control 1 pressure sensor	31	Engine emergency stop switch
10	EPPR sensor	22	Nega control 2 pressure sensor	32	Relay drive unit

· ELECTRICAL CIRCUIT (1/3, OLD)

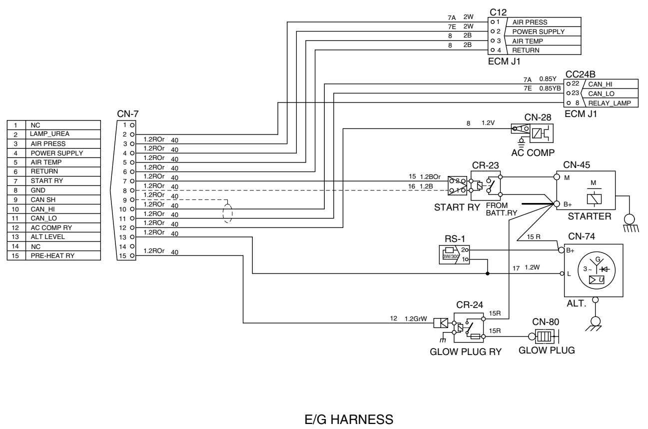


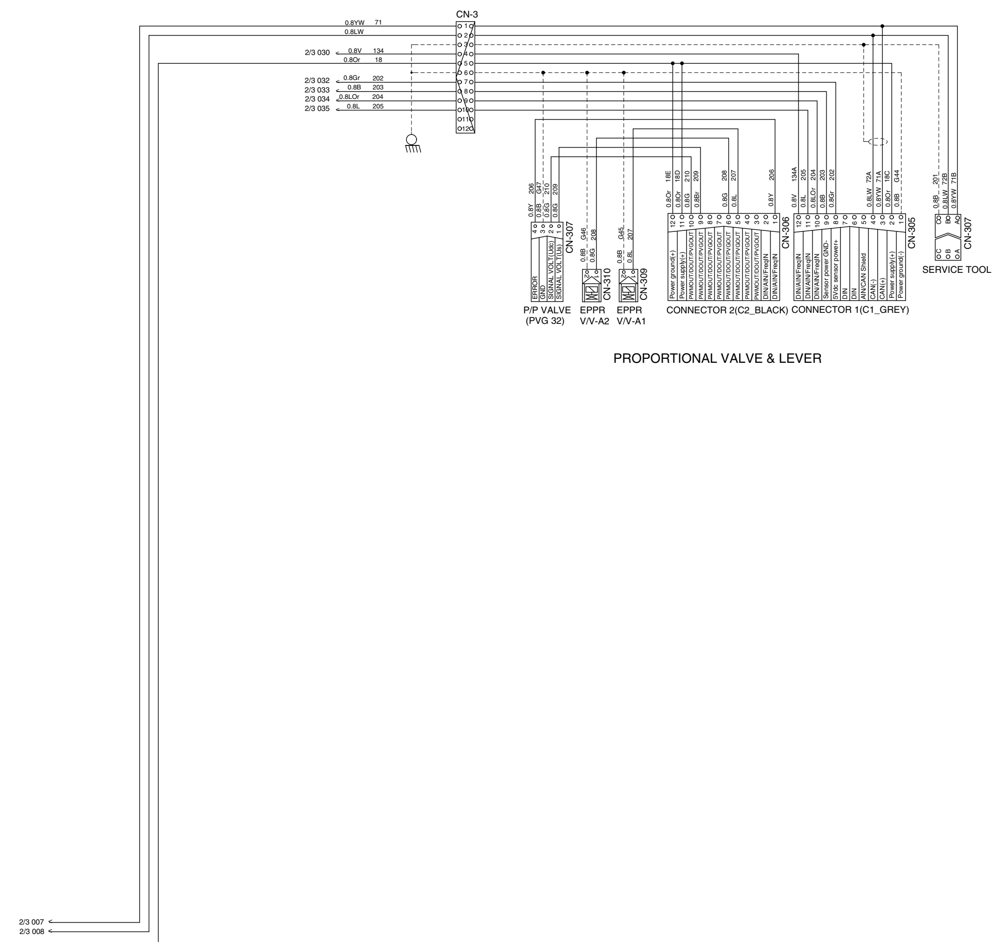
· ELECTRICAL CIRCUIT (2/3, OLD)

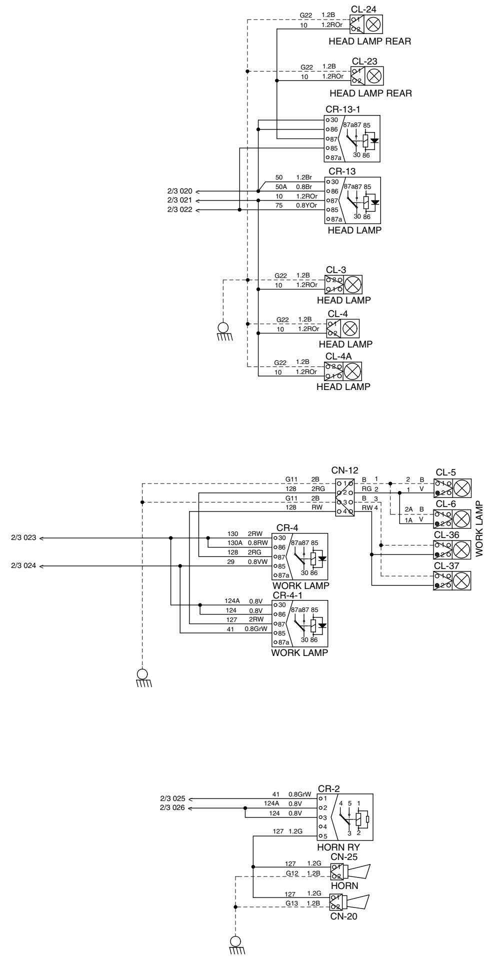


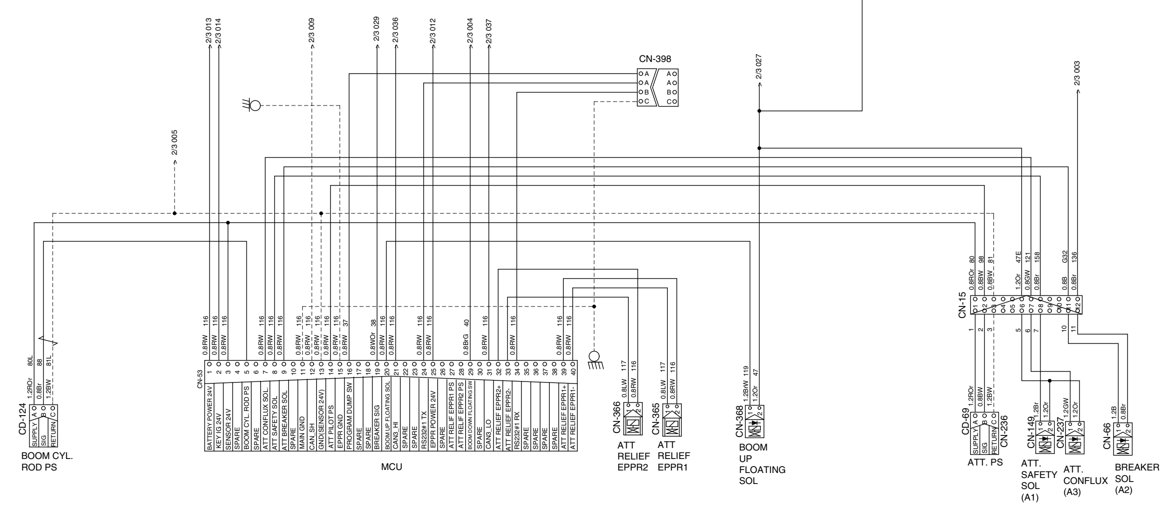
20KD-91101-00

· ELECTRICAL CIRCUIT (3/3, OLD)



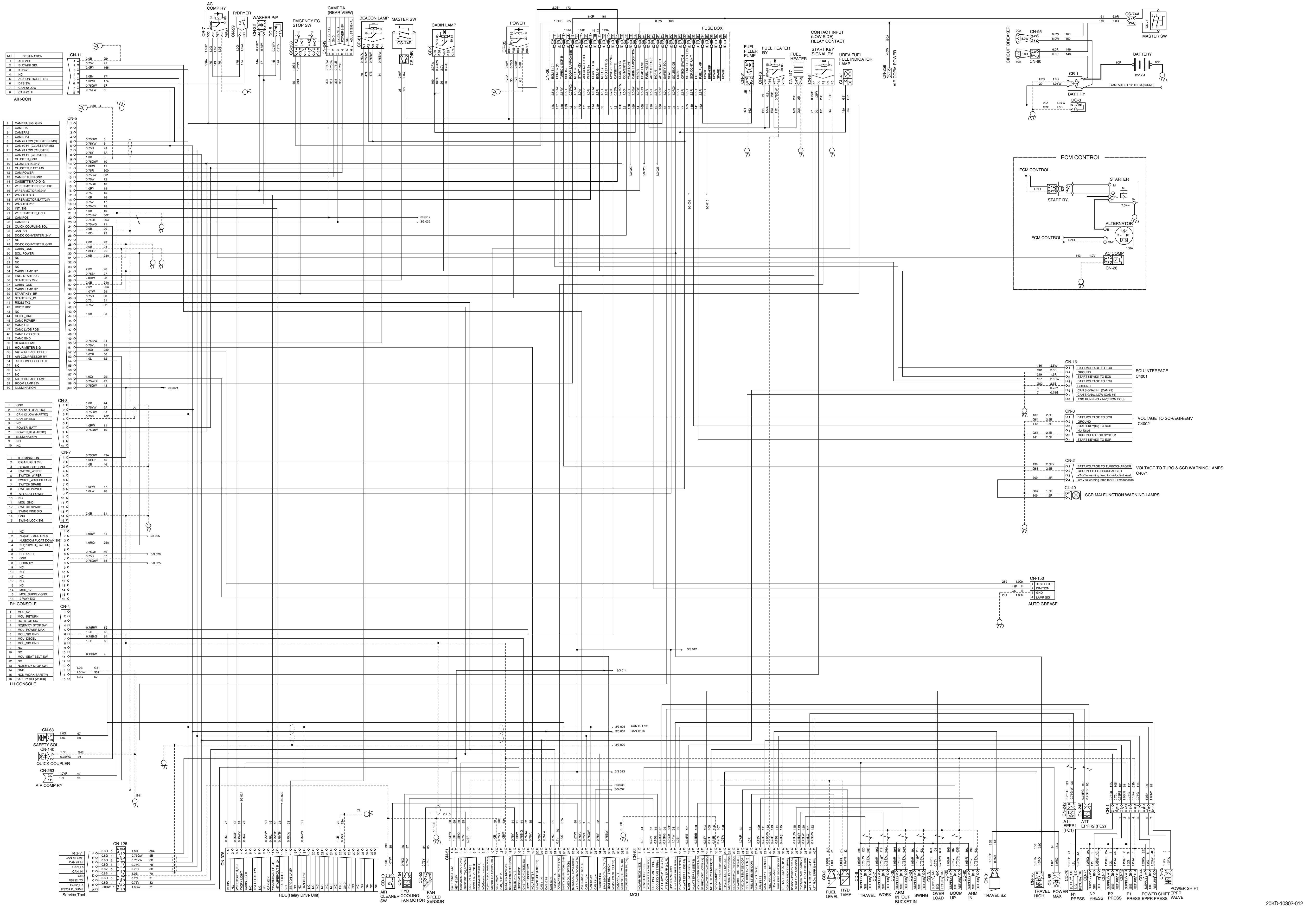




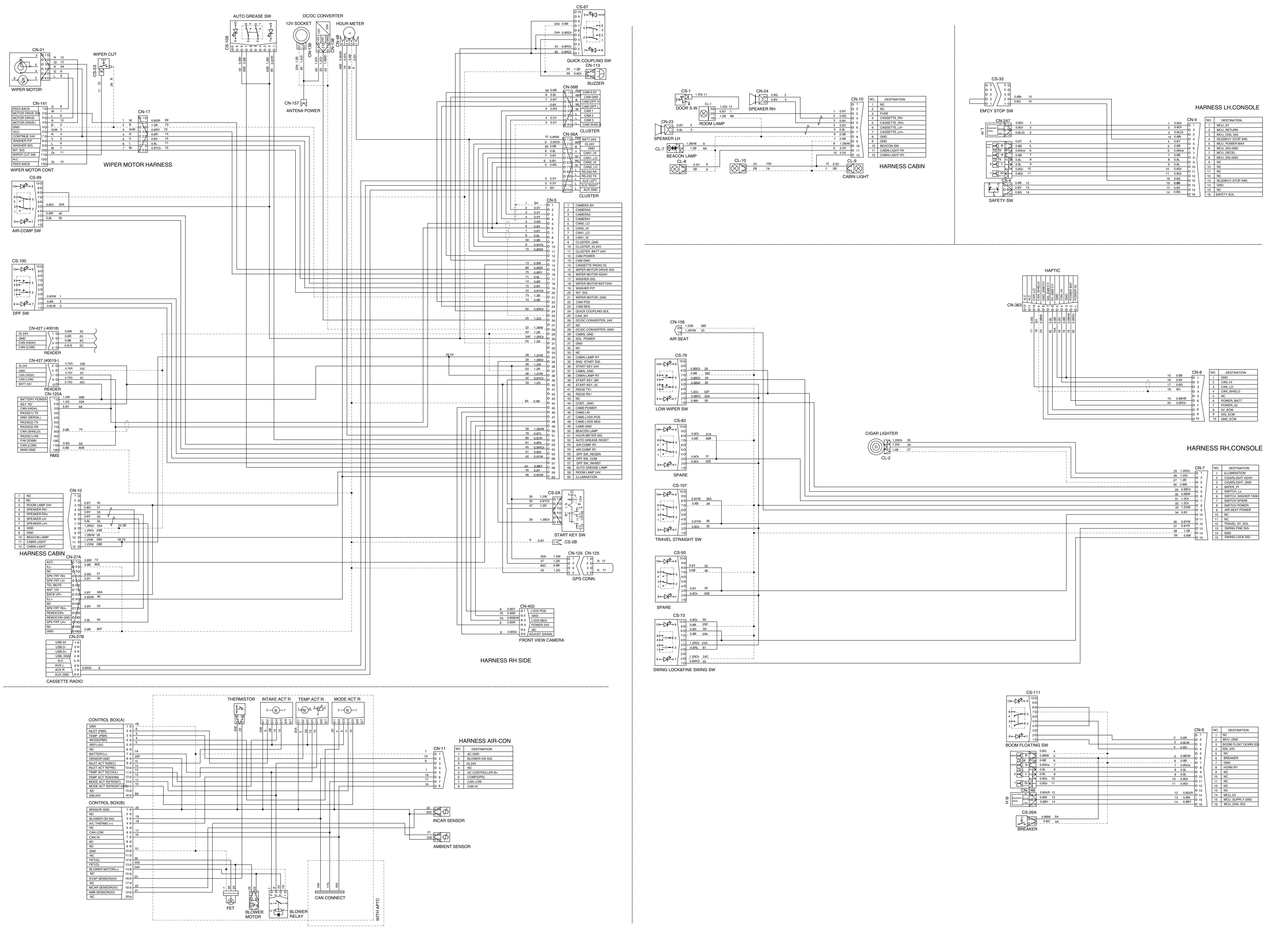


20KD-91300-00

· ELECTRICAL CIRCUIT (1/3, NEW)

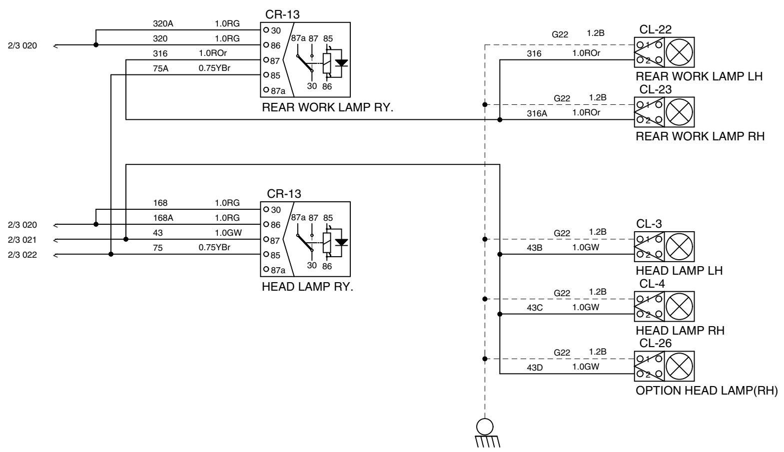


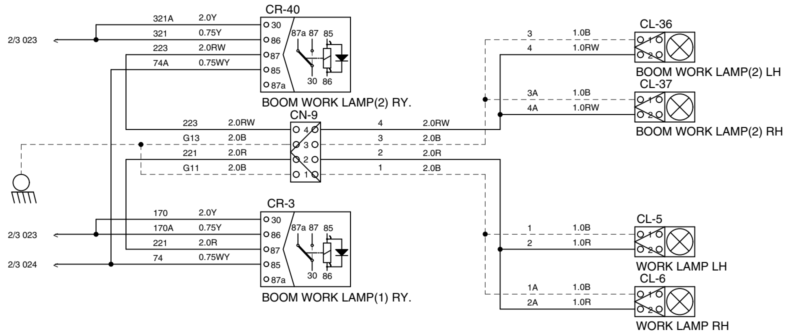
· ELECTRICAL CIRCUIT (2/3, NEW)

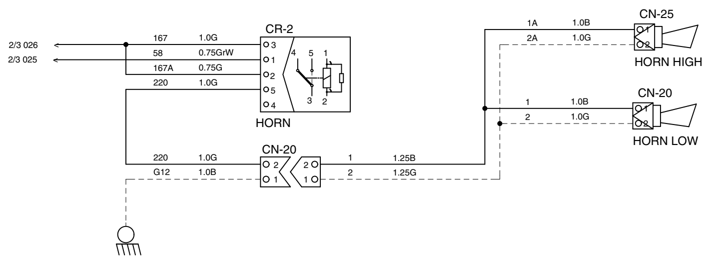


20KD-91102-00

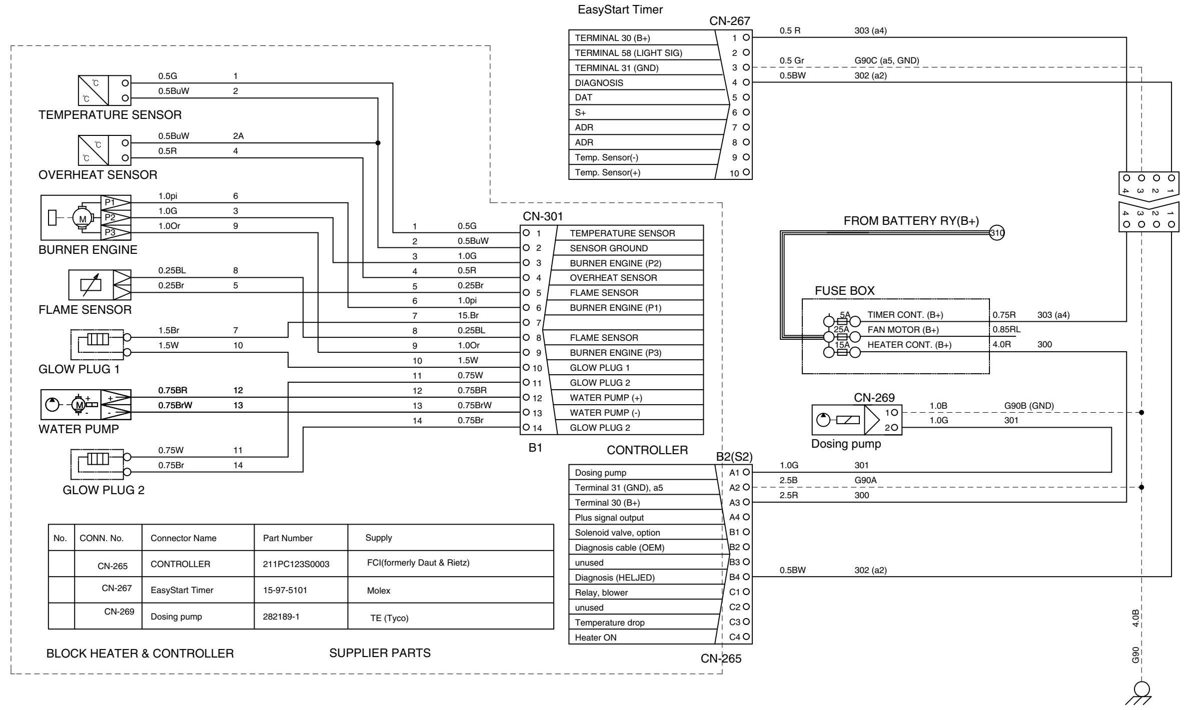
· ELECTRICAL CIRCUIT (3/3, NEW)



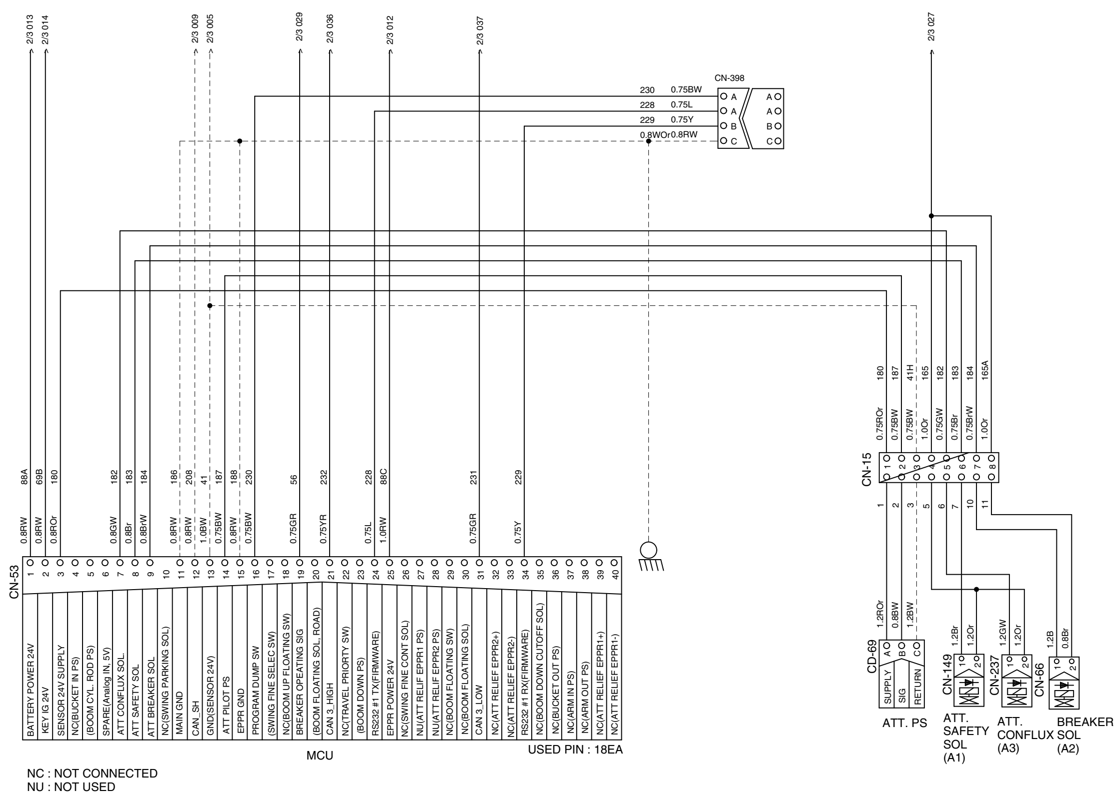




Engine Block Heater



No.	CONN. No.	Connector Name	Part Number	Supply
	CN-265	CONTROLLER	211PC123S0003	FCI(formerly Daut & Rietz)
	CN-267	EasyStart Timer	15-97-5101	Molex
	CN-269	Dosing pump	282189-1	TE (Tyco)



NC : NOT CONNECTED
NU : NOT USED

20KD-10302-003

MEMORANDUM

1. POWER CIRCUIT

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 → Circuit breaker [CN-60] → Master switch [CS-74A]

- → Fuse box [No.1] → Engine EMS interface [CN-16 (1)]
- → Fuse box [No.2] → Engine EMS interface [CN-16 (4)]
- → Fuse box [No.3] → Engine VGT/SCR lmap [CN-2 (1)]
- → Fuse box [No.4] → Engine SCR/EGR interface [CN-3 (1)]
- → Fuse box [No.5] → I/conn [CN-5 (59)]
  - → I/conn [CN-10 (3)] → Room lamp [CL-1 (2)]
    - → Door switch [CS-1]
  - → Radio & USB player [CN-27A (8)]
- → Fuse box [No.6]
  - → MCU [CN-51 (1)]
  - → MCU [CN-52 (8)]
  - → MCU [CN-53 (1), (25)]
- → Fuse box [No.7]
  - → Master switch [CS-74B] → I/conn [CN-5 (36)]
    - → Start switch [CS-2A (1)]
    - → RMS [CN-125A(1)]
    - → RMS connection [CN-125 (1)]
  - → Power relay [CR-35 (30)]
- → Fuse box [No.8] → I/conn [CN-11 (5)]
  - → AC & Heater controller A (7)
  - → Blower relay (4)
- → Fuse box [No.9] → I/conn [CN- 5 (18)] → I/conn [CN -17 (5)]
  - → Wiper motor controller [CN-141 (7)]
  - → Wiper motor [CN-21 (4)]
- → Fuse box [No.10]
  - → I/conn [CN-5 (11)]
    - → Cluster [CN -56 (1)]
    - → Hour meter [CN-48 (1)]
  - → I/conn [CN-8 (6)] → Haptic [CN-363 (2)]

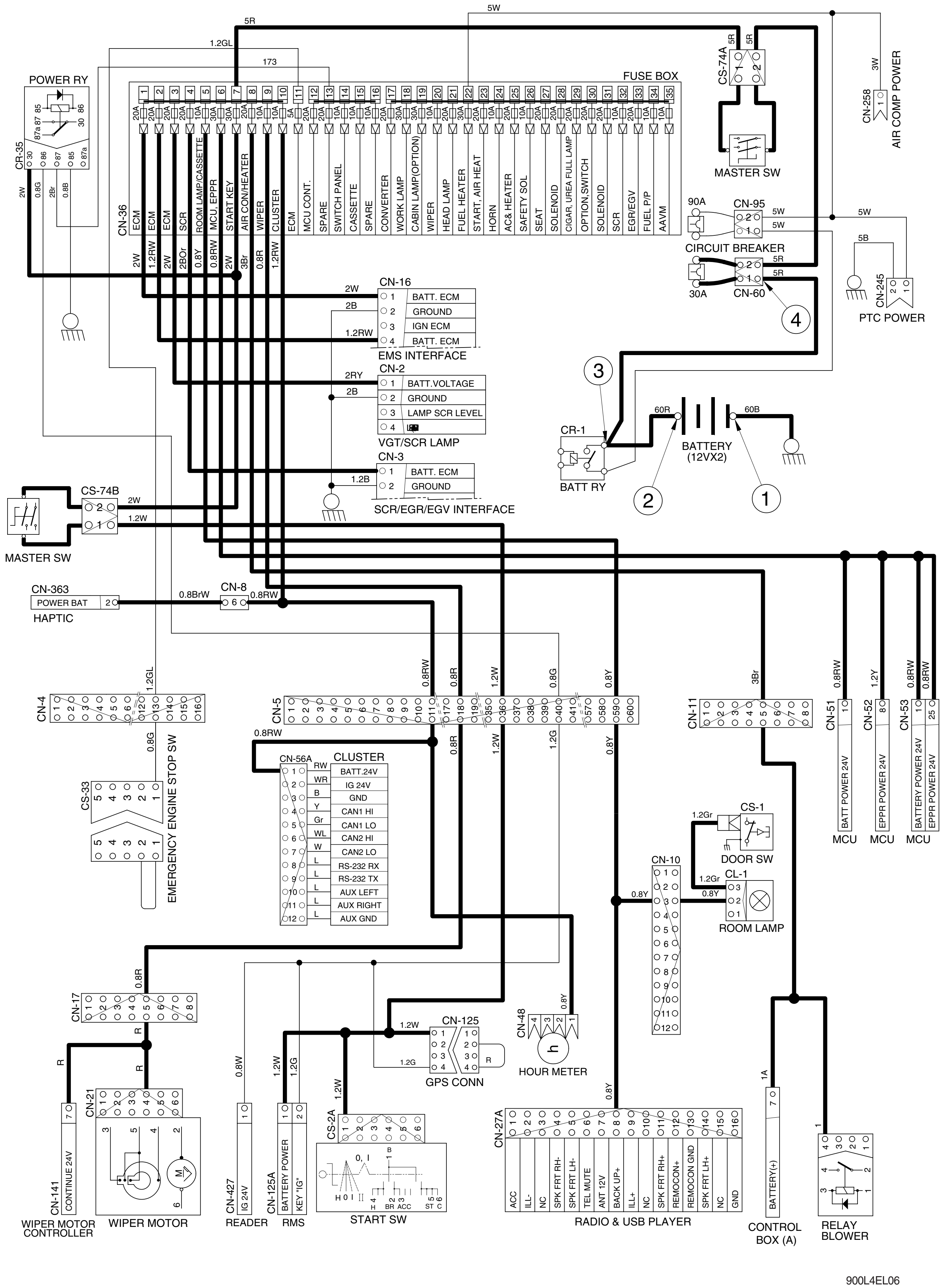
※ I/conn : Intermediate connector

2) CHECK POINT

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

※ GND : Ground

POWER CIRCUIT



2. STARTING CIRCUIT

1) OPERATING FLOW

Battery (+) terminal → Battery relay [CR-1] → Circuit breaker [CN-60] → Master switch [CS-74A] → Fuse box [No.7] → Master switch [CS-74B] → I/conn [CN-5(36)] → Start switch [CS-2A(1)]

(1) When start key switch is in ON position

→ Start switch ON [CS-2A (2)] → I/conn [CN-5 (39)]
  → Battery relay [CR-1] → Battery relay operating (all power is supplied with the electric component)
  → I/conn [CN-4 (4)] → Emergency engine stop sw [CS-33 (2)→(1)] → I/conn [CN-4 (13)]
    → Fuse box [No. 11] → Engine EMS interface [CS-16 (3)]
→ Start switch ON [CS-2A (3)] → RMS conn [CN-125 (2)→(4)]
  → I/conn [CN-5 (40)] → Power relay [CR-35 (86)→(87)]
    → Fuse box [No.12] → MCU [CN-51 (2)]
  → I/conn [CN-427 (1)]
  → I/conn [CN-125A (2)]

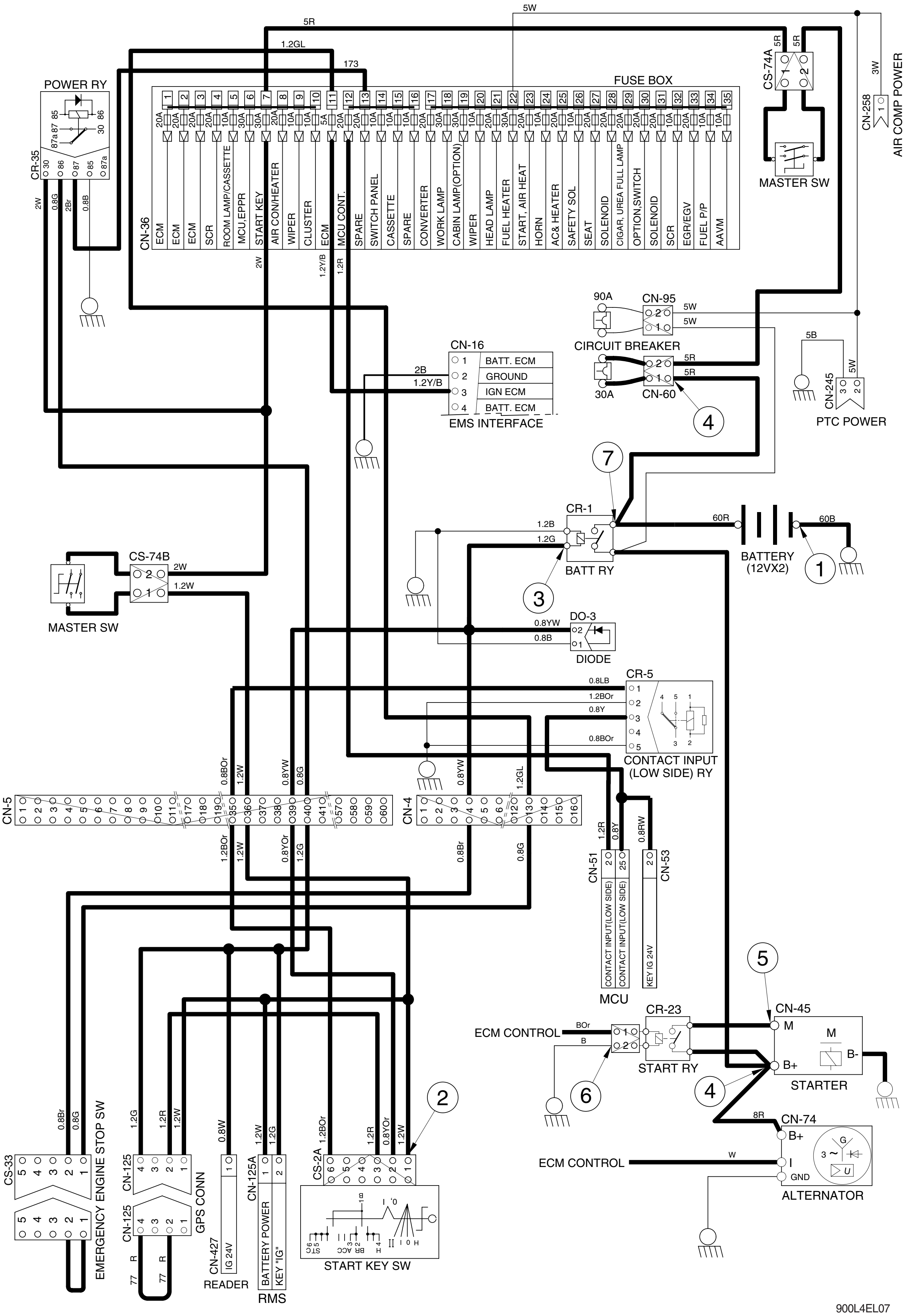
(2) When start key switch is in START position

Start switch START [CS-2A (6)] → I/conn [CN-5 (35)] → Coutact input relay [CR-5 (1)→(3)] → MCU [CN-51 (25)] → ECM control → Start relay [CR-23(1)] → Starter operating

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

STARTING CIRCUIT



3. CHARGING CIRCUIT

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

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

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

1) OPERATING FLOW

(1) Warning flow

Alternator "I" terminal → ECM control
→ Cluster charging warning lamp (Via serial interface)

(2) Charging flow

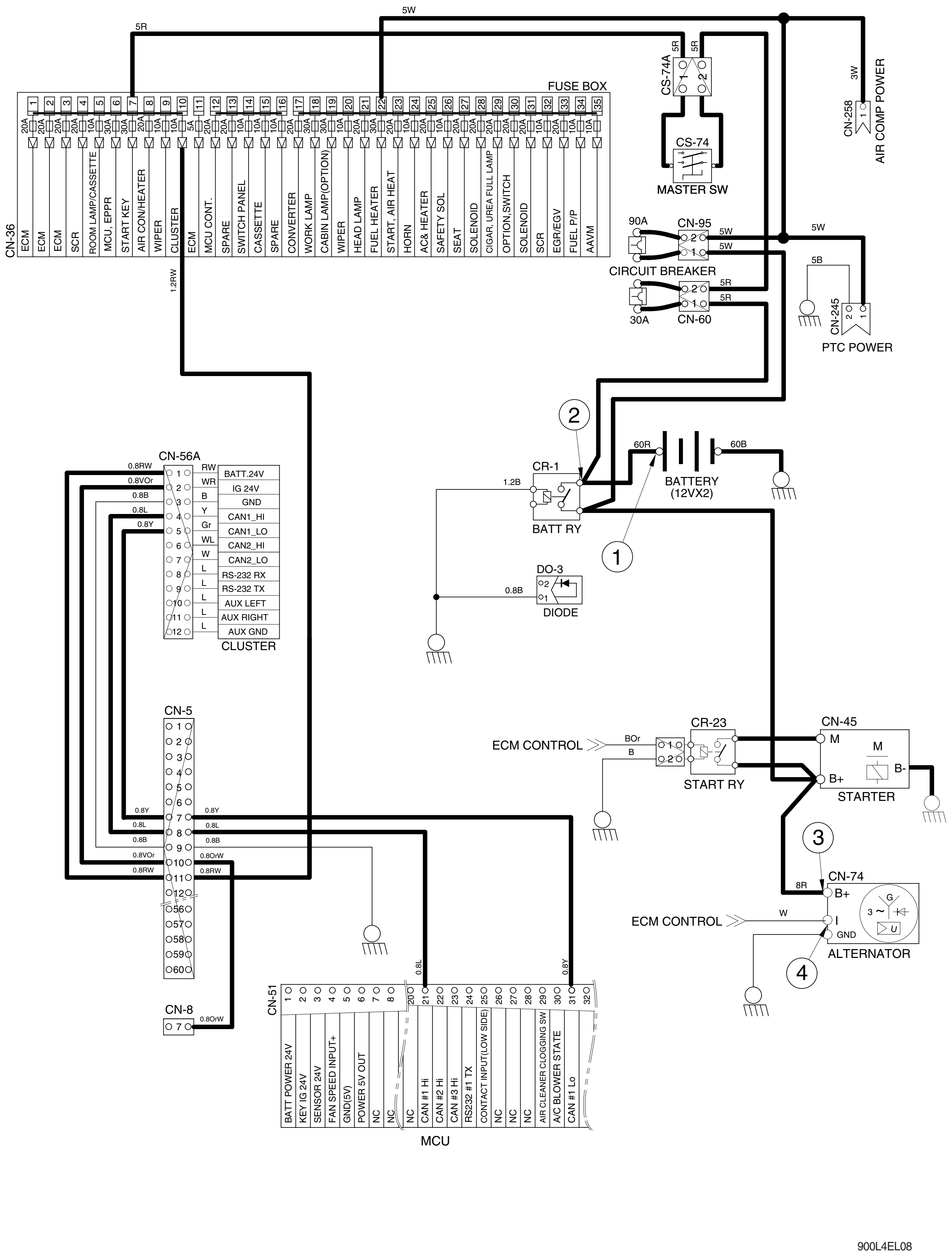
Alternator "B^+" terminal → Battery relay(M8)
- → Battery (+) terminal
- → Circuit breaker [CN-60] → Master switch [CS-74A] → Fuse box [No. 1~10]
- → Circuit breaker [CN-60] → Fuse box [No. 17~35]

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)	20~25V

※ GND : Ground

CHARGING CIRCUIT



4. HEAD AND WORK LIGHT CIRCUIT

1) OPERATING FLOW

Fuse box (No.21) → Head light relay [CR-13 (30, 86)]
→ Head light relay [CR-13-1 (30, 86)]

Fuse box (No.18) → Work light relay [CR-4 (30, 86)]
→ Work light relay [CR-4-1 (30, 86)]

Fuse box (No.14) → Relay drive unit [CN-376(1)]

(1) Head light switch ON

Head light switch ON [CN-376 (13)] → Head light relay [CR-13 (85) → (87)]
→ Head light ON [CL-3 (1), CL-4 (2), CL-4A (1)]
→ I/conn [CN-7 (1)] → Cigar light [CL-2]
→ I/conn [CN-5 (60)] → Radio & USB player illumination ON [CN-27A (9)]
→ Hour meter [CN-84 (4)]
→ Head light relay [CL-13-1 (86) → (87)]
→ Head light ON [CL-23 (2), CL-24(2)]

(2) Work light switch ON

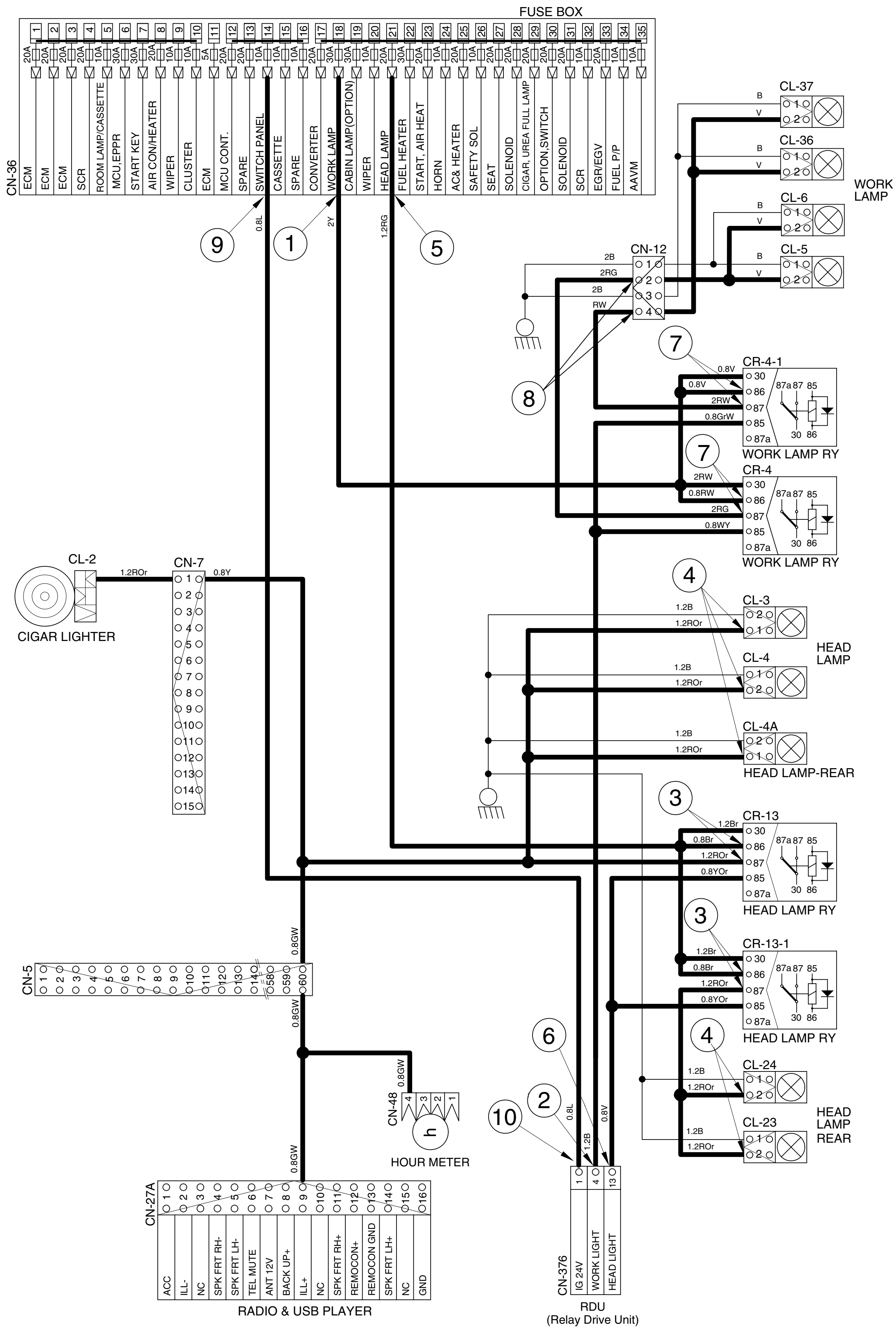
Work light switch ON [CN-376 (4)] → Work light relay [CR-4 (85) → (87)]
→ I/conn [CN-12 (2)] → Work light ON [CL-5 (2), CL-6 (2)]
→ Work light relay [CR-4 (1) → (87)]
→ I/conn [CN-12 (4)] → Work light ON [CL-36 (2), CL-37 (2)]

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) ⑨ - GND (fuse box) ⑩ - GND (relay drive unit power input)	20~25V

※ GND : Ground

HEAD AND WORK LIGHT CIRCUIT



900L4EL09

5. BEACON LAMP AND CAB LIGHT CIRCUIT

1) OPERATING FLOW

Fuse box (No.30) → Beacon lamp relay [CR-36 (2, 3)]
Fuse box (No.19) → Cab light relay [CR-9 (30, 86)]
Fuse box (No.14) → Relay drive unit [CN-376 (1)]

(1) Beacon lamp switch ON

Beacon lamp switch ON [CN-376 (15)] → Beacon lamp relay [CR-36 (1)→(5)]
→ I/conn [CN-5 (50)] → I/conn [CN-10 (10)] → Beacon lamp ON [CL-7]

(2) Cab light switch ON

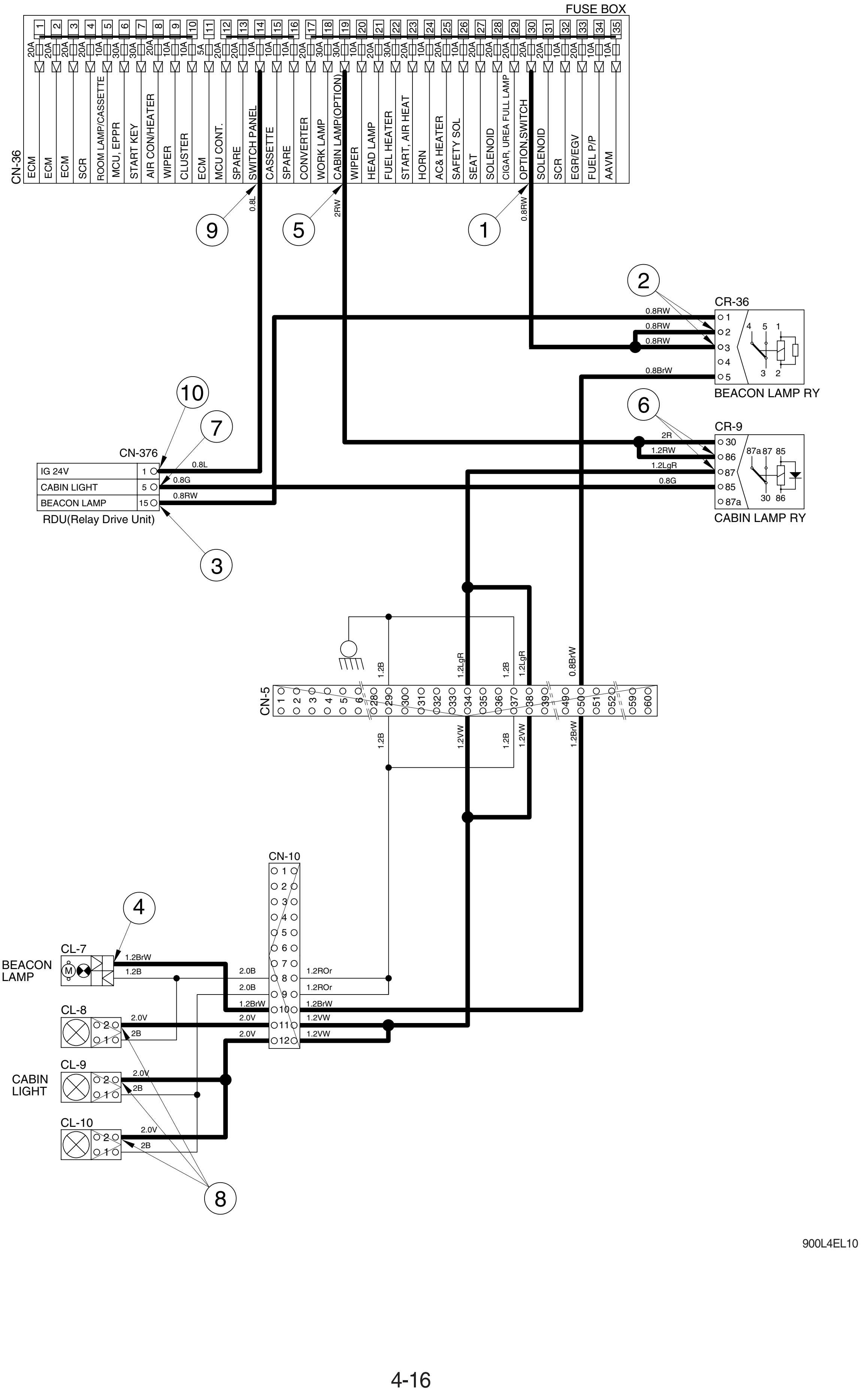
Cab light switch ON [CN-376 (5)] → Cab lamp relay [CR-9 (85)→(87)]
→ I/conn [CN-5 (34, 38)] ┌→ I/conn [CN-10 (11)] → Cab light ON [CL-8 (2)]
└→ I/conn [CN-10 (12)] → Cab light ON [CL-9 (2), CL-10 (2)]

2) CHECK POINT

Engine	Start switch	Check point	Voltage
STOP	ON	① - GND (fuse box) ② - GND (beacon lamp relay) ③ - GND (switch power output) ④ - GND (beacon lamp) ⑤ - GND (fuse box) ⑥ - GND (cabin light relay) ⑦ - GND (switch power output) ⑧ - GND (cab light) ⑨ - GND (fuse box) ⑩ - GND (relay drive unit power input)	20~25V

※ GND : Ground

BEACON LAMP AND CAB LIGHT CIRCUIT



6. WIPER AND WASHER CIRCUIT

1) OPERATING FLOW

(1) Key switch ON

Fuse box (No.14) → Relay drive unit [CN-376 (1)]

Fuse box (No.9) → I/conn [CN-5 (18)] → I/conn [CN-17 (5)] ┬→ Wiper motor controller [CN-141(7)]
└→ Wiper motor [CN-21(4)]

Fuse box (No.20) ┬→ I/conn [CN-5 (16)] → I/conn [CN-17 (4)] → Wiper motor controller [CN-141 (6)]
└→ Washer pump [CN-22 (2)]

(2) Intermittent wiper switch ON

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

(3) Wiper switch ON

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

(4) Washer switch ON

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

(5) Auto parking (when switch OFF)

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

2) OPERATING FLOW (LOW WIPER)

(1) Key switch ON

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

(2) Wiper switch ON (1st)

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

(3) Wiper switch ON (2nd)

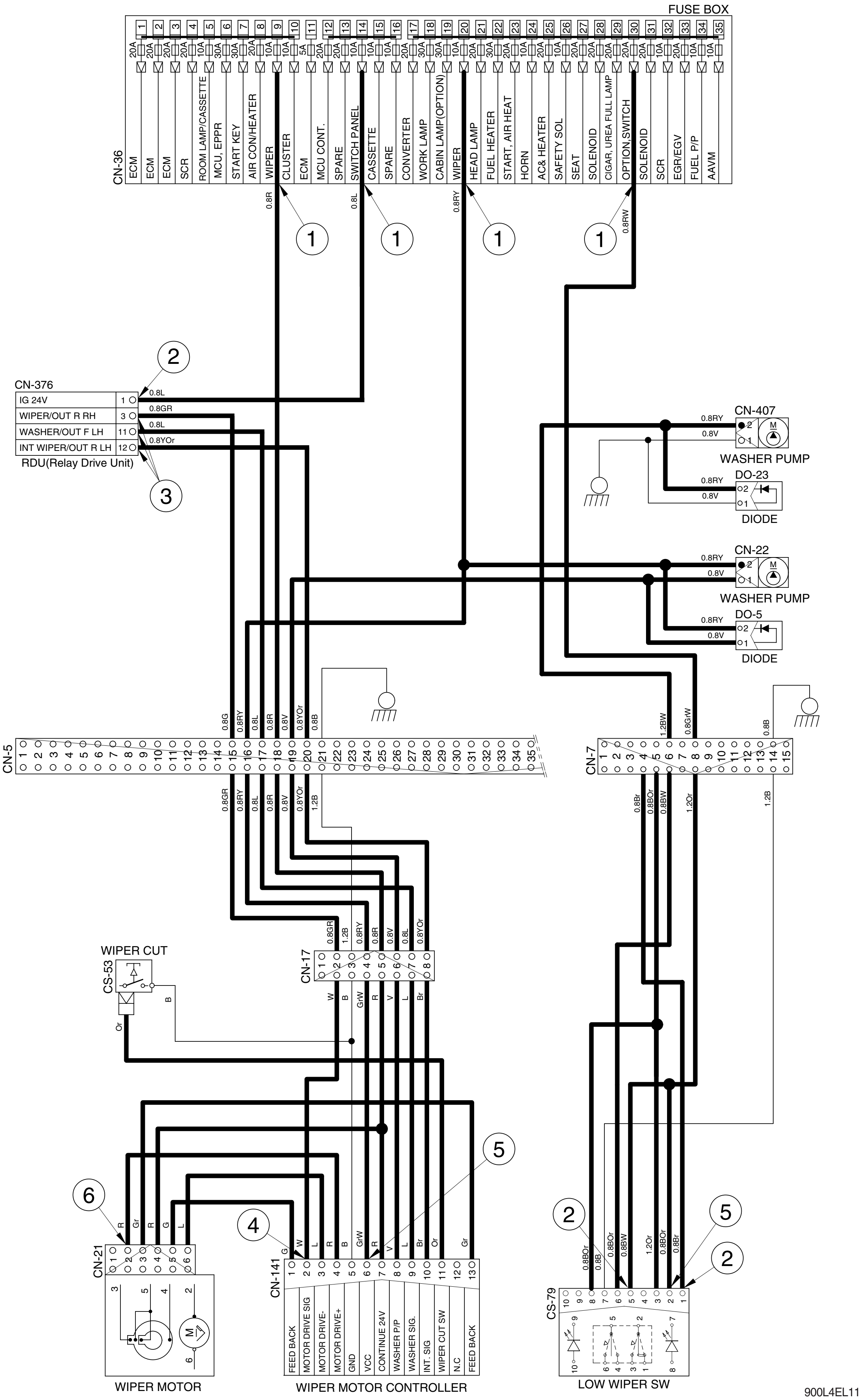
Wiper switch ON [CS-79 (5 → 4)] → I/conn [CN-7 (6)] → Washer pump [CN-407 (2)] → Washer operating

3) CHECK POINT

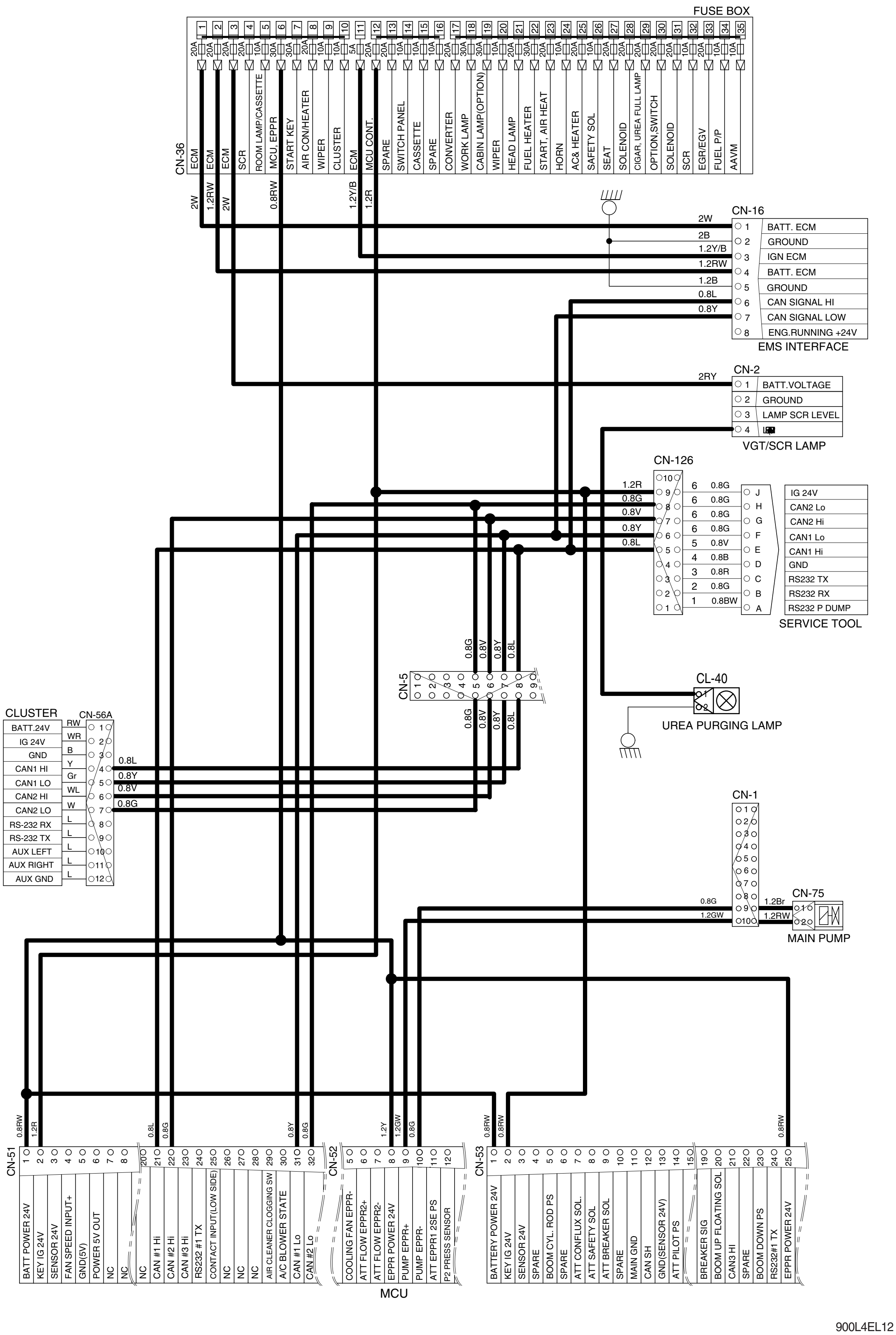
Engine	Start switch	Check point	Voltage
STOP	ON	① - GND (fuse box) ② - GND (switch power input)	20~25V
		③ - GND (switch power output) ④ - GND (wiper power input)	0 ~ 5V
		⑤ - GND (wiper power output)	24V
		⑥ - GND (wiper motor)	0 or 24V

※ GND : Ground

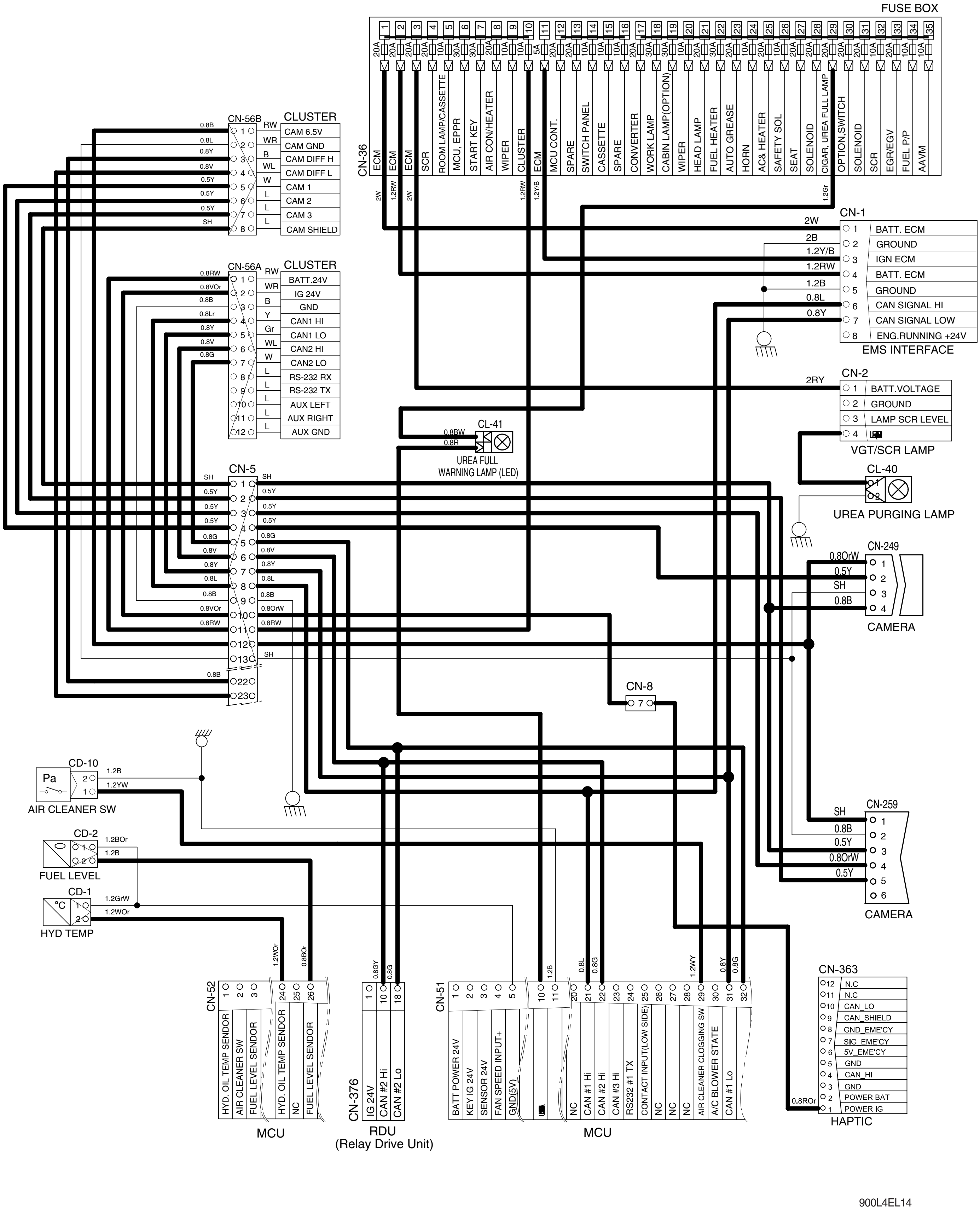
WIPER AND WASHER CIRCUIT



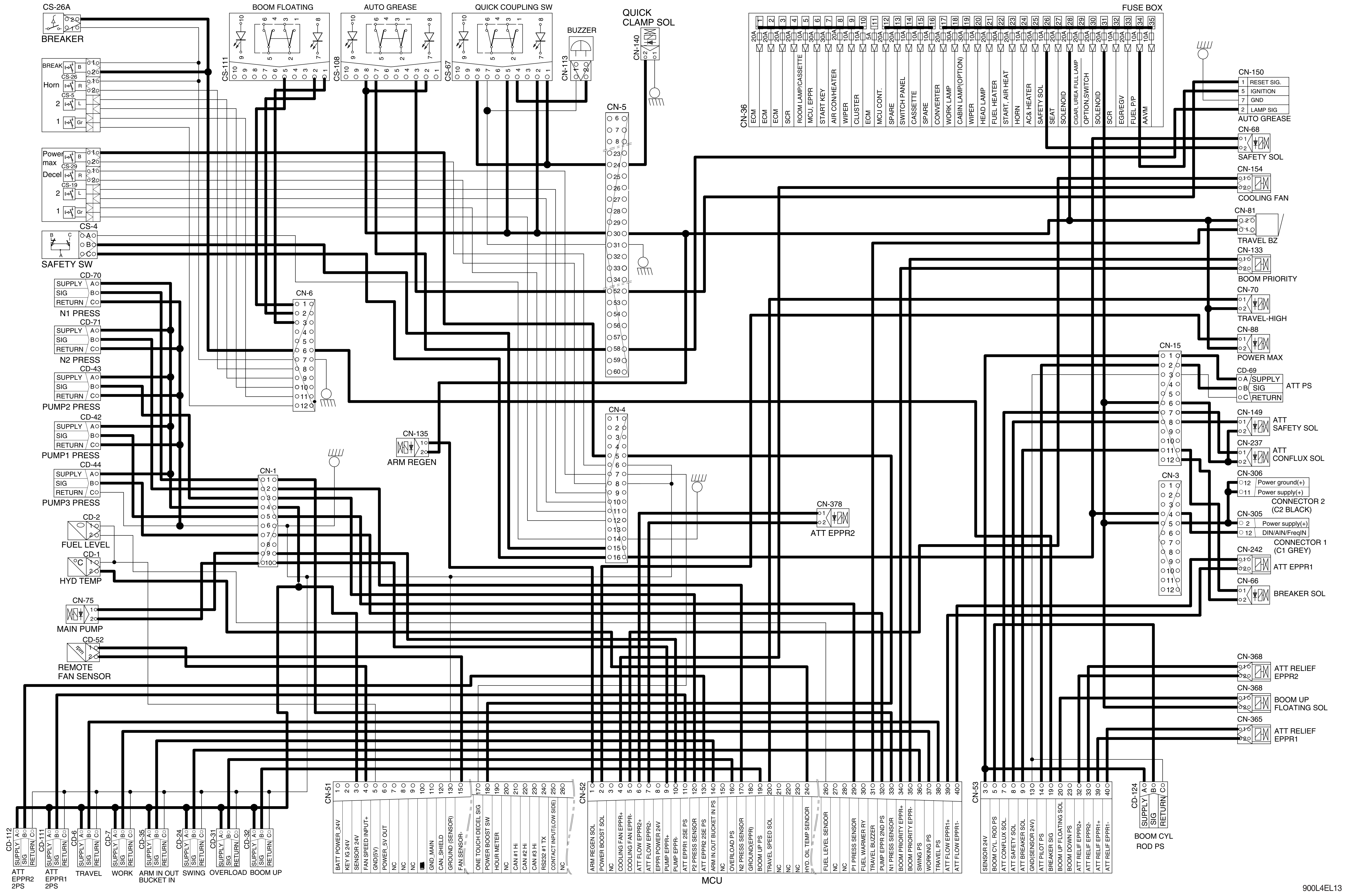
CONTROLLER CIRCUIT



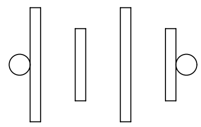
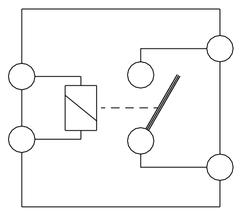
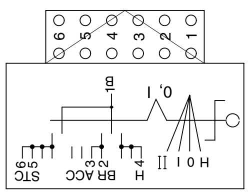
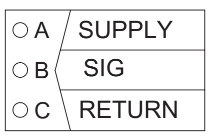
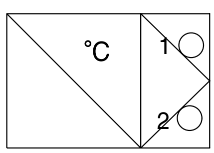
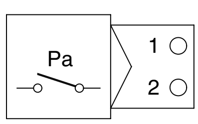
MONITORING CIRCUIT

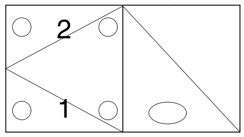
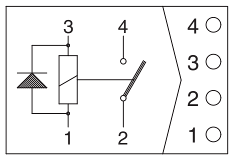
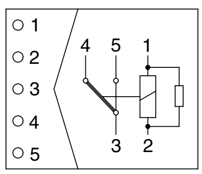
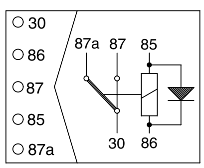
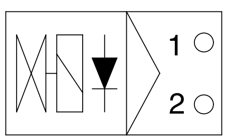
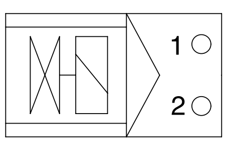


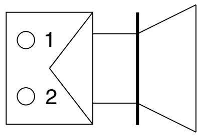
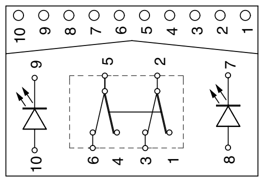
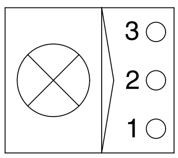
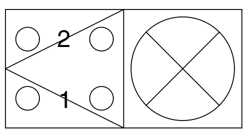
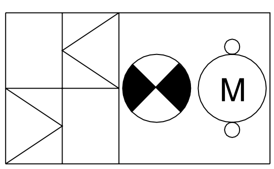
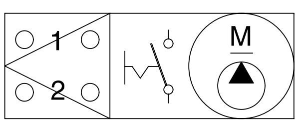
ELECTRIC CIRCUIT FOR HYDRAULIC

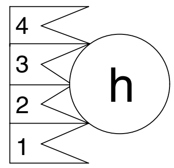
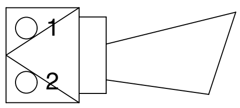
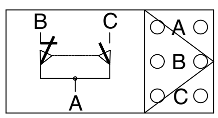
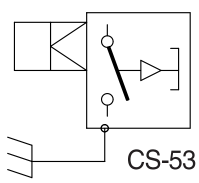
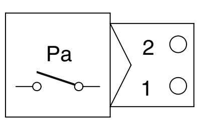
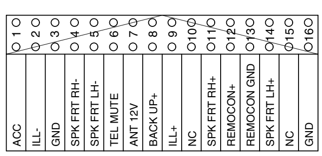


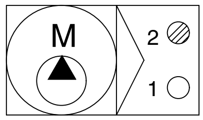
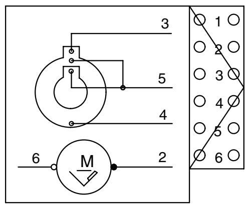
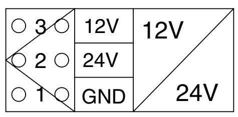
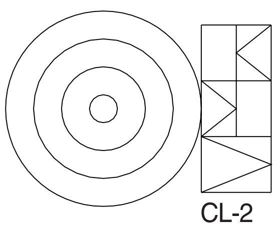
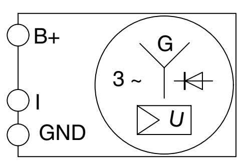
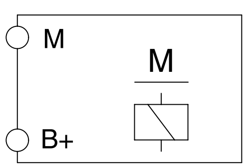
GROUP 3 ELECTRICAL COMPONENT SPECIFICATION

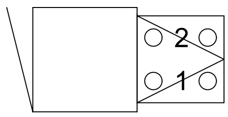
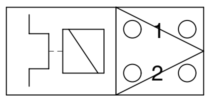
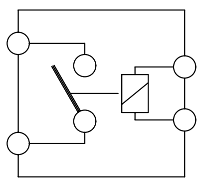
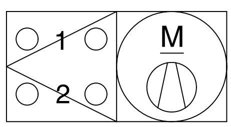
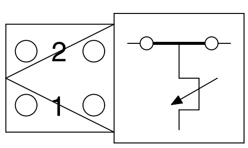
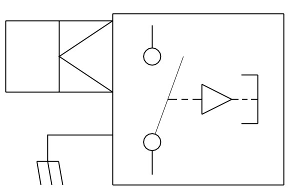
Part name	Symbol	Specifications	Check
Battery		12V × 160Ah (4EA)	※ Check specific gravity 1.280 over : Over charged 1.280 ~ 1.250 : Normal 1.250 below : Recharging
Battery relay	 CR-1	Rated load : 100A (continuity) 1000A (30seconds)	※ Check coil resistance(M4 to M4) Normal : About 50Ω ※ Check contact Normal : ∞Ω
Start switch	 CS-2A	B-BR : 24V 1A B-ACC : 24V 10A B-ST : 24V 40A	※ Check contact OFF : ∞Ω (for each terminal) ON : 0Ω (for terminal 1-3 and 1-2) START : 0Ω (for terminal 1-5)
Pressure sensor	 CD-6 CD-7 CD-24 CD-31 CD-32 CD-35 CD-42 CD-43 CD-44 CD-69 CD-70 CD-71 CD-111 CD-112 CD-124	8~30V	※ Check contact Normal : 0.1Ω
Temperature sensor (hydraulic)	 CD-1	-	※ 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

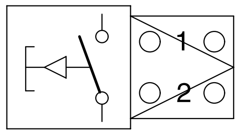
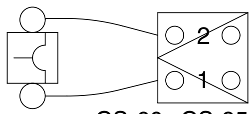
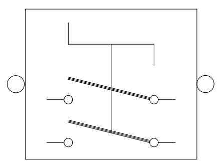
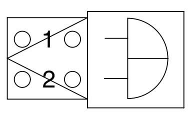
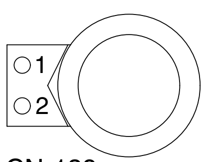
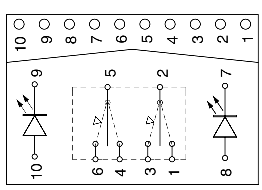
Part name	Symbol	Specifications	Check
Fuel level sender	 CD-2	-	※ Check resistance Full : 50Ω 6/12 : 350Ω 11/12 : 100Ω 5/12 : 400Ω 10/12 : 150Ω 4/12 : 450Ω 9/12 : 200Ω 3/12 : 500Ω 8/12 : 250Ω 2/12 : 550Ω 7/12 : 300Ω 1/12 : 600Ω Empty warning : 700Ω
Relay (air con blower)		24V 20A	※ Check resistance Normal : About 200Ω (for terminal 1-3) 0 Ω (for terminal 2-4)
Relay	 CR-2 CR-5 CR-36	24V 16A	※ Check resistance Normal : About 160 Ω (for terminal 1-2) 0Ω (for terminal 3-4) ∞Ω (for terminal 3-5)
Relay	 CR-4 CR-4-1 CR-7 CR-9 CR-13 CR-13-1 CR-35 CR-46	24V 16A	※ Check resistance Normal : About 160 Ω (for terminal 85-86) 0Ω (for terminal 30-87a) ∞Ω (for terminal 30-87)
Solenoid valve	 CN-66 CN-68 CN-70 CN-88 CN-135 CN-140 CN-149 CN-237 CN-367 CN-368	24V 1A	※ Check resistance Normal : 15~25Ω (for terminal 1-2)
EPPR valve	 CN-75 CN-133 CN-154 CN-242 CN-309 CN-310 CN-365 CN-366 CN-378	700mA	※ Check resistance Normal : 15~25Ω (for terminal 1-2)

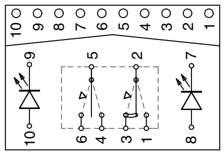
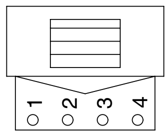
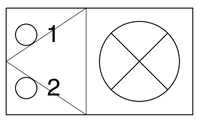
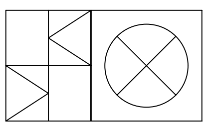
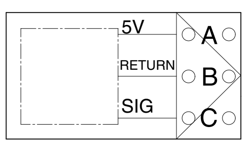
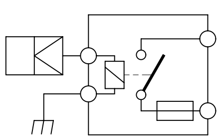
Part name	Symbol	Specifications	Check
Speaker	 CN-23(LH) CN-24(RH)	20W	※ Check resistance Normal : A few Ω
Switch (locking type)	 CS-50 CS-67 CS-83 CS-99 CS-107 CS-108 CS-111	24V 1.5A	※ Check contact Normal ON : 0 Ω (for terminal 2-3,) ∞ Ω (for terminal 2-1) OFF : ∞ Ω (for terminal 2-3) 0 Ω (for terminal 2-1)
Room lamp	 CL-1	24V 10W	※ Check disconnection Normal : 1.0Ω ON : 0Ω (For terminal 1-2) ∞ Ω (For terminal 1-3) OFF : ∞ Ω (For terminal 1-2) 0Ω (For terminal 1-3)
Head lamp, Work lamp, Cab lamp	 CL-3 CL-4 CL-4A CL-5 CL-6 CL-8 CL-9 CL-10 CL-23 CL-24 CL-36 CL-37	24V 65W (H3 Type)	※ Check disconnection Normal : 1.2Ω
Beacon lamp	 CL-7	24V 70W (H1 Type)	※ Check disconnection Normal : A few Ω
Fuel filler pump	 CN-61	24V 10A 35 ℓ /min	※ Check resistance Normal : 1.0Ω

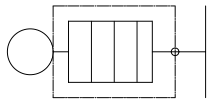
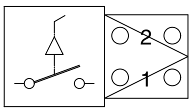
Part name	Symbol	Specifications	Check
Hour meter	 CN-48	16~32V	※ Check operation Supply power (24V) to terminal No.2 and connect terminal No.1 and ground
Horn	 CN-20 CN-25	DC22~28V 2A	※ Check operation Supply power (24V) to each terminal and connect ground.
Safety switch	 CS-4	24V 15A (N.C TYPE)	※ Check contact Normal : 0Ω (for terminal 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 player	 CL-27A	24V 2A	※ Check voltage 20~25V (for terminal 1-3, 3-8)

Part name	Symbol	Specifications	Check
Washer pump	 CN-22	24V 3.8A	※ Check contact Normal : 10.7Ω (for terminal 1-2)
Wiper motor	 CN-21	24V 2A	※ Check disconnection Normal : 7Ω (for terminal 2-6)
DC/DC Converter	 CN-138	12V 3A	※ Check voltage 24V (for terminal 1-2) 12V (for terminal 1-3)
Cigar lighter	 CL-2	24V 5A 1.4W	※ Check coil resistance Normal : About 1MΩ ※ Check contact Normal : ∞Ω Operating time : 5~15sec
Alternator		24V 100A	※ Check contact Normal : 0Ω (for terminal B^+-I) Normal : 24~27.5V
Starter	 CN-45	24V 7kW	※ Check contact Normal : 0.1Ω

Part name	Symbol	Specifications	Check
Travel alarm	 CN-81	24V 0.5A	※ Check contact Normal : 5.2Ω
Aircon compressor	 CN-28	24V 79W	※ Check contact Normal : 13.4Ω
Start relay	 CR-23	24V 300A	※ Check contact Normal : 0.94Ω (for terminal 1-2)
Air conditioner blower motor		24V 9.5A	※ Check resistance Normal : 2.5Ω (for terminal 1-2)
Air conditioner 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

Part name	Symbol	Specifications	Check
Switch (power max, one touch decel, horn, breaker)	 CS-5 CS-19 CS-26 CS-29	24V 6A	※ Check resistance Normal : ∞Ω
Circuit breaker	 CS-60 CS-95	CN-60 : 30A CN-95 : 90A	※ Check disconnection Normal : 0Ω (connect ring terminal and check resist between terminal 1 and 2)
Master switch	 CS-74A, CS-74B	6-36V	※ Check disconnection Normal : 0.1Ω
Quick clamp buzzer	 CN-113	24V 200mA 107±4dB	
Socket	 CN-139	12V 10A	
Switch	 CS-73 CS-100	24V 8A	※ Check contact Normal OFF : ∞Ω (for terminal 2-1, 2-3, 5-4, 5-6) 0Ω (for terminal 7-9, 8-10)

Part name	Symbol	Specifications	Check
Switch	 CS-79	24V 8A	※ Check contact Normal OFF : ∞Ω (for terminal 2-1, 5-4, 5-6)
Fuel heater	 CN-147	-	
DEF/AdBlue® fill up warning lamp (LED)	 CL-40	-	
DEF/AdBlue® full warning lamp (LED)	 CL-41	-	
Proportional valve sensor	 CN-246 CN-247	-	
Glow plug relay	 CR-24	24V 200A	※ Check disconnection Normal : 0.942A (for terminal - GND)

Part name	Symbol	Specifications	Check
Glow plug	 CN-80	24V -200A	※ Check resistance Normal : 0.25~0.12Ω
Breaker switch	 CS-26A	-	

GROUP 4 CONNECTORS

1. CONNECTOR DESTINATION

Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CN-1	AMP	10	I/conn (Frame harness-Pump PS harness)	S816-010002	S816-110002
CN-2	DEUTSCH	4	I/conn (Frame harness-Engine harness)	DT06-4S-EP06	DT06-4P-E005
CN-3	DEUTSCH	6	I/conn (Frame harness-Engine harness)	DT06-6S-EP06	DT06-6P-E005
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	DRB12-60P-L018
CN-6	AMP	16	I/conn (Console harness RH-Frame harness)	368047-1	368050-1
CN-7	AMP	15	I/conn (Console harness RH-Frame harness)	2-85262-1	368301-1
CN-8	AMP	10	I/conn (Console harness RH-Frame harness)	S816-010002	S816-110002
CN-10	DEUTSCH	12	I/conn (Cab harness-Side harness RH)	DT06-12S-EP06	DT04-12PA-P021
CN-11	DEUTSCH	8	I/conn (Frame harness-Aircon harness)	DT06-8S-EP06	-
CN-12	DEUTSCH	4	I/conn (Frame harness-Boom wire harness)	DT06-4S-P012	DT04-4P-E005
CN-15	AMP	8	I/conn (Frame harness-Breaker sol)	S816-008002	S816-108002
CN-16	DEUTSCH	8	I/conn (Frame harness-Engine harness)	DT06-8S-EP06	-
CN-17	AMP	8	I/conn (Side harness RH-Wiper harness)	S816-008002	S816-108002
CN-20	TYCO	2	Horn	174352-2	174354-2
CN-21	AMP	6	Wiper motor	S810-006202	-
CN-22	KET	2	Washer pump	MG640605	-
CN-23	KET	2	Speaker-LH	MG610070	-
CN-24	KET	2	Speaker-RH	MG610070	-
CN-25	DEUTSCH	2	Horn	DT06-2S-EP06	-
CN-27A	KUM	16	Radio & USB player	PK145-16017	-
CN-27B	AMP	8	Radio & USB player	-	174984-2
CN-28	DEUTSCH	2	Aircon compressor	-	DT04-2P-E005
CN-29	KET	2	Receiver dryer	MG640795	-
CN-36	-	-	Fuse & relay box	21Q7-10910	-
CN-45	RING-TERM	-	Starter motor B^+	S820-108000	-
CN-48	KET	1	Hour meter	2-520193-2	-
CN-51	DEUTSCH	40	MCU	DRC26-40SA	-
CN-52	DEUTSCH	40	MCU	DRC26-40SB	-
CN-53	DEUTSCH	40	MCU	DRC26-40SA	-
CN-56A	AMP	12	Cluster	-	174663-2
CN-56B	AMP	8	Cluster	-	174984-2
CN-60	KET	2	Circuit breaker	-	MG620558-5
CN-61	DEUTSCH	2	Fuel filler pump	DT06-2S-EP06	DT04-2P-E005
CN-66	DEUTSCH	2	Breaker solenoid	DT06-2S-EP06	-

Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CN-68	DEUTSCH	2	Safety solenoid	DT06-2S-EP06	-
CN-70	DEUTSCH	2	Travel high solenoid	DT06-2S-EP06	-
CN-74	RING-TERM	1	Alternator "I" terminal	S820-108000	-
CN-75	AMP	2	Pump EPPR	S816-002002	-
CN-81	DEUTSCH	2	Travel buzzer solenoid	DT06-2S-EP06	-
CN-88	DEUTSCH	2	Power max solenoid	DT06-2S-EP06	-
CN-95	YAZAKI	2	Circuit breaker	-	7222-4220-30
CN-113	KET	2	Buzzer	MG651205-5	-
CN-125	Econoseal J	4	GPS connector	S816-004002	S816-104002
CN-125A	DEUTSCH	12	RMS	DT06-12S-P021	DT04-12PA-P021
CN-126	AMP	10	Service tool	S816-010002	S816-110002
CN-133	DEUTSCH	2	Boom priority solenoid	DT06-2S-EP06	-
CN-138	FASTEN	3	DC/DC Converter	S810-003202	-
CN-139	FASTEN	2	12V socket	172434-2	-
CN-140	DEUTSCH	2	Quick clamp solenoid	DT06-2S-EP06	DT04-2P-E005
CN-141	AMP	13	Wiper motor controller	172498-1	-
CN-147	AMP	4	Fuel heater	2-967325-3	-
CN-149	DEUTSCH	2	Attach safety solenoid	DT06-2S-EP06	-
CN-150	TYCO	4	Auto grease	174257-2	174259-2
CN-154	DEUTSCH	2	Cooling fan	DT06-2S-EP06	DT04-2P-E005
CN-156	DEUTSCH	2	Air seat	DT06-2S	DT04-2P
CN-157	AMP	1	Antena power	S822-014002	-
CN-236	DEUTSCH	2	Attach pressure switch	DT06-2S-EP06	-
CN-237	DEUTSCH	2	Attach conflux solenoid	DT06-2S-EP06	-
CN-242	DEUTSCH	2	Attach EPPR 1	DT06-2S-EP06	DT04-2P-E005
CN-243	DEUTSCH	2	Attach EPPR 2	DT06-2S-EP06	-
CN-245	KET	4	PTC power	MG610557-5	MG620558-5
CN-246	DEUTSCH	3	Proportional valve-RH	DT06-3S	DT04-3P
CN-247	DEUTSCH	3	Proportional valve-LH	DT06-3S	DT04-3P
CN-249	DEUTSCH	6	Rear view camera	DT06-6S-EP06	DT04-6P-E005
CN-258	KET	1	Air compressor power	MG640944-5	MG650943-5
CN-259	DEUTSCH	6	Camera	DT06-6S-EP06	DT04-6P-E005
CN-263	DEUTSCH	2	Air compressor relay	DT06-2S-EP06	DT04-2P-E005
CN-305	DEUTSCH	12	Proportional-Connector-1	DTM06-12SA	-
CN-306	DEUTSCH	12	Proportional-Connector-2	DTM06-12SB	-
CN-307	DEUTSCH	3	Proportional-Service tool	DT06-3S-E006	DT04-3P-E005
CN-308	AMP	4	Proportional-PVG32	2-967056-1	-
CN-309	DEUTSCH	2	Proportional-EPPR valve-A1	DT06-2S-EP06	-
CN-310	DEUTSCH	2	Proportional-EPPR valve-A2	DT06-2S-EP06	-

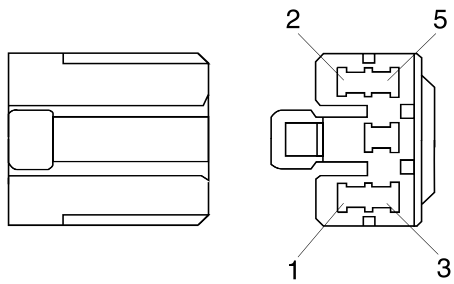
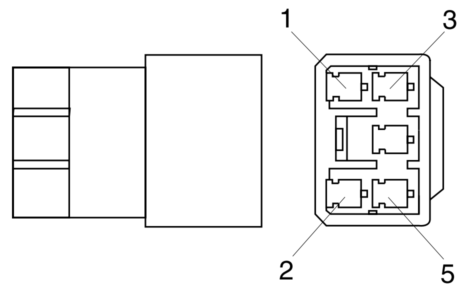
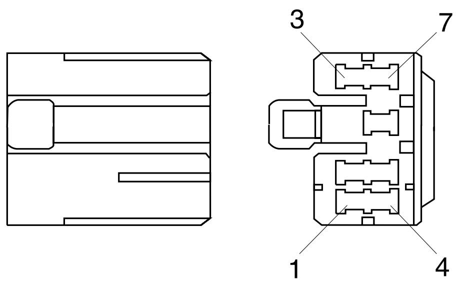
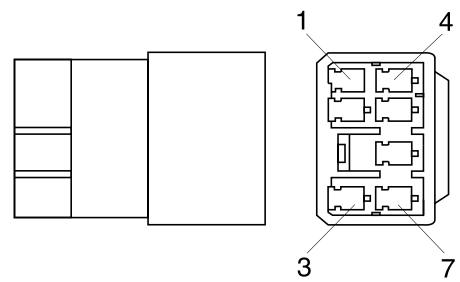
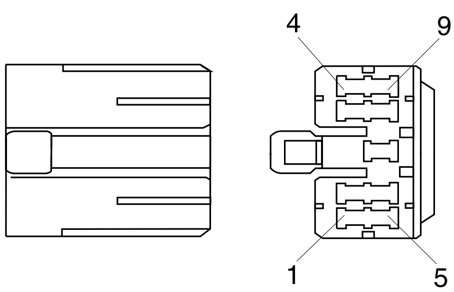
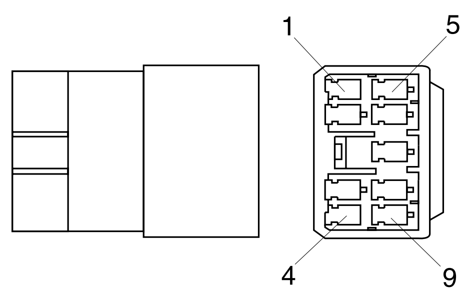
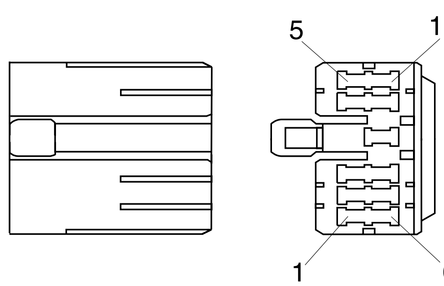
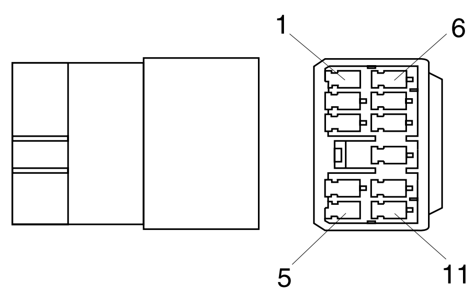
Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CN-363	AMP	12	Haptic controller	174045-2	-
CN-365	DEUTSCH	2	Attach EPPR valve1	DT06-2S-EP06	DT04-2P-E005
CN-366	DEUTSCH	2	Attach EPPR valve2	DT06-2S-EP06	DT04-2P-E005
CN-367	DEUTSCH	2	Boom down floating solenoid	DT06-2S-EP06	DT04-2P-E005
CN-368	DEUTSCH	2	Boom up floating solenoid	DT06-2S-EP06	DT04-2P-E005
CN-369	DEUTSCH	2	Boom down cut off solenoid	DT06-2S-EP06	DT04-2P-E005
CN-376	TYCO	34	Relay drive unit	4-1437290-1	-
CN-378	DEUTSCH	2	Attach EPPR 2	DT06-2S-EP06	-
CN-398	DEUTSCH	4	RS232	DT06-4S-EP06	DT04-4P-E005
CN-399	TYCO	4	DEF/AdBlue® tank level sensor	1-967325-1	-
CN-402	DEUTSCH	6	Front view camera	DT06-6S-P021	DT04-6P-P021
CN-403	DEUTSCH	6	Rear view camera	DT06-6S-EP06	DT04-6P-EP14
CN-404	DEUTSCH	6	RH view camera	DT06-6S-EP06	DT04-6P-EP14
CN-405	DEUTSCH	6	LH view camera	DT06-6S-EP06	DT04-6P-EP14
CN-406	DEUTSCH	3	RS232	DT06-3S-EP06	DT06-3P-E005
CN-407	FCI	4	Low wiper motor	180900-0	-
CN-408	FCI	4	Washer tank	MG640795	-
CN-427	MOLEX	4	Reader-RMS	039012040	026013096
		12		5557-12R	5559-12P
· Relay					
CR-1	KET	1	Battery relay	ST710289-2	-
CR-2	-	5	Horn relay	-	-
CR-4	-	5	Work lamp relay	-	-
CR-4-1	-	5	Contact input relay	-	-
CR-5	-	5	Anti restart relay	-	-
CR-7	-	5	Aircon compressor relay	-	-
CR-9	-	5	Cabin lamp relay	-	-
CR-13	-	5	Head lamp relay	-	-
CR-13-1	-	5	Head lamp relay - rear	-	-
CR-23	KET	2	Start relay	S814-002001	S814-102001
CR-24	-	2	Glow plug relay	-	-
CR-35	-	5	Power relay	-	-
CR-36	-	5	Beacon relay	-	-
CR-46	-	5	Fuel warmer relay	-	-
· Switch					
CS-1	SHUR	1	Door switch	S822-014002	S822-114002
CS-2A	WP	6	Start switch	S814-006100	-
CS-2B	DEUTSCH	3	Reader	DT06-3S-EP06	DT04-2P-E005
CS-4	DEUTSCH	3	Safety switch	DT06-3S-EP06	-
CS-5	DEUTSCH	2	Horn switch	DT06-3S-EP06	DT04-2P

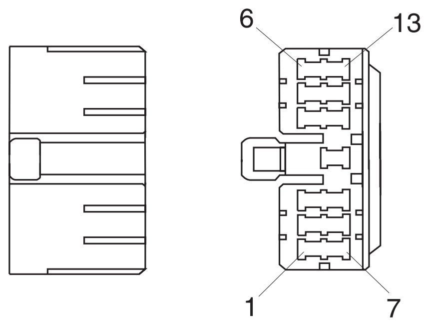
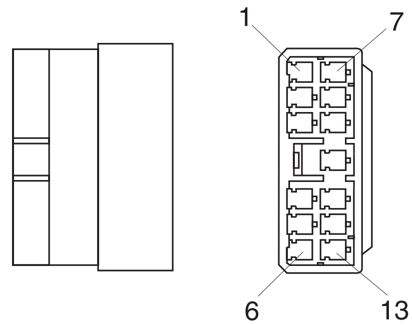
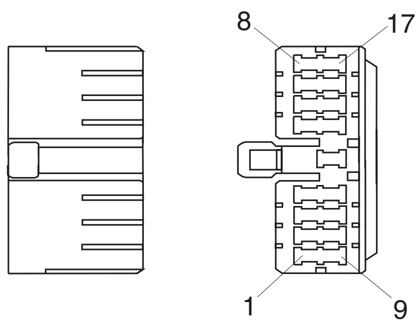
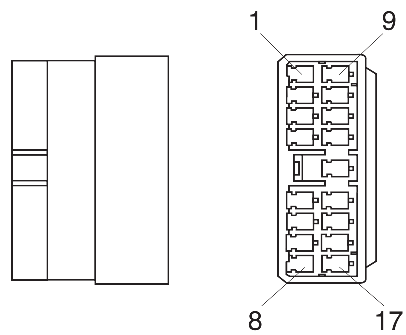
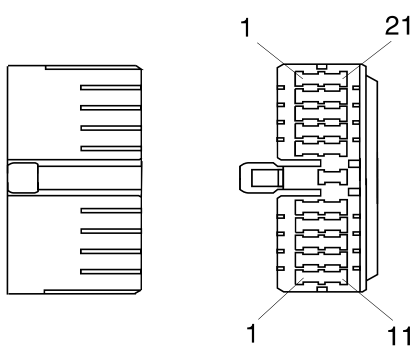
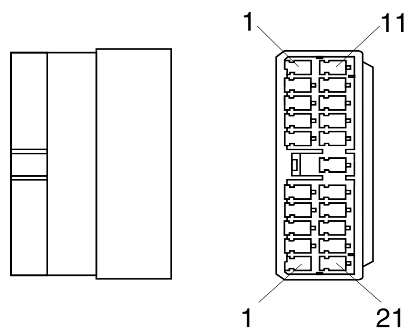
Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CS-19	DEUTSCH	2	One touch decel switch	DT06-3S-EP06	DT04-2P-E005
CS-26	DEUTSCH	2	Breaker switch	DT06-2S	DT04-2P-E005
CS-26A	AMP	2	Breaker pedal switch	S816-002002	S816-102002
CS-29	DEUTSCH	2	Power max switch	DT06-2S-EP06	DT04-2P-E005
CS-33	AMP	6	Emergency engine stop switch	S816-006002	S816-106002
CS-50	CARLING	10	Travel priority switch	VC2-01	-
CS-53	AMP	1	Wiper cut switch	S822-014002	-
CS-67	CARLING	10	Quick clamp switch	VC2-01	-
CS-73	CARLING	10	Swing lock & fine switch	VC2-01	-
CS-73A	CARLING	10	Swing fine switch	VC2-01	-
CS-74A	KET	2	Master switch	MG610557-5	S813-130201
	DEUTSCH	2		-	DT04-2P-E005
CS-74B	DEUTSCH	2	Master switch	DT06-2S-EP06	DT04-2P-E005
CS-79	CARLING	10	Lower wiper switch	VC2-01	-
CS-83	CARLING	10	Spare switch	VC2-01	-
CS-99	CARLING	10	Air compressor switch	VC2-01	-
CS-100	CARLING	10	SCR system cleaning switch	VC2-01	-
CS-107	CARLING	10	Travel straight switch	VC2-01	-
CS-108	CARLING	10	Auto grease switch	VC2-01	-
CS-111	CARLING	10	Boom floating switch	VC2-01	-
· Light					
CL-1	KET	3	Room lamp	MG651032	-
CL-2	AMP	1	Cigar lighter	S822-014002	S822-114002
				S810-001202	-
CL-3	DEUTSCH	2	Head lamp-LH	DT06-2S-EP06	DT04-2P-E005
CL-4	DEUTSCH	2	Head lamp-RH	DT06-2S-EP06	DT04-2P-E005
CL-4A	DEUTSCH	2	Head lamp-RH	DT06-2S-EP06	DT04-2P-E005
CL-5	DEUTSCH	2	Work lamp-LH	DT06-2S-EP06	DT04-2P-E005
CL-6	DEUTSCH	2	Work lamp-RH	DT06-2S-EP06	DT04-2P-E005
CL-7	SHUR	1	Beacon lamp	S822-014002	S822-114002
CL-8	DEUTSCH	2	Cab light-LH	DT06-2S-EP06	DT04-2P
CL-9	DEUTSCH	2	Cab light-RH	DT06-2S-EP06	DT04-2P
CL-10	DEUTSCH	2	Cab light-RH	DT06-2S-EP06	DT04-2P
CL-23	DEUTSCH	2	Head lamp	DT06-2S-EP06	-
CL-24	DEUTSCH	2	Head lamp-rear	DT06-2S-EP06	DT04-2P-E005
CL-36	DEUTSCH	2	Work lamp-LH	DT06-2S-EP06	DT04-2P-E005
CL-37	DEUTSCH	2	Work lamp-RH	DT06-2S-EP06	DT04-2P-E005
CL-40	DEUTSCH	2	DEF/AdBlue® lamp	DT06-2S-EP06	DT04-2P-E005
CL-41	-	2	DEF/AdBlue® full warming lamp	-	-

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	DT06-4P-E005
CD-6	DEUTSCH	3	Travel pressure switch	DT06-3S-EP06	DT06-4P-E005
CD-7	DEUTSCH	3	Working pressure switch	DT06-3S-EP06	DT06-4P-E005
CD-10	AMP	2	Air cleaner switch	85202-1	-
CD-24	DEUTSCH	3	Swing pressure sensor	DT06-3S-EP06	DT06-4P-E005
CD-31	DEUTSCH	3	Overload pressure sensor	DT06-3S-EP06	DT06-4P-E005
CD-32	DEUTSCH	3	Boom up pressure sensor	DT06-3S-EP06	DT06-4P-E005
CD-35	DEUTSCH	3	Arm & bucket in pressure sensor	DT06-3S-EP06	DT06-4P-E005
CD-42	DEUTSCH	3	Pump pressure 1	DT06-3S-EP06	DT06-4P-E005
CD-43	DEUTSCH	3	Pump pressure 2	DT06-3S-EP06	DT06-4P-E005
CD-44	DEUTSCH	3	Pump pressure 3	DT06-3S-EP06	DT06-4P-E005
CD-52	AMP	2	Fan speed sensor	S816-002002	-
CD-69	DEUTSCH	3	Attach pressure sensor	DT06-3S-EP06	DT06-4P-E005
CD-70	DEUTSCH	3	N1 pressure sensor	DT06-3S-EP06	DT06-4P-E005
CD-71	DEUTSCH	3	N2 pressure sensor	DT06-3S-EP06	DT06-4P-E005
CD-85	DEUTSCH	3	Boom down pressure sensor	DT06-3S-EP06	DT06-3P-E005
CD-90	DEUTSCH	3	Arm in pressure sensor	DT06-3S-EP06	DT06-3P-E005
CD-111	DEUTSCH	3	Attach EPPR 1 pressure sensor	DT06-3S-EP06	DT06-4P-E005
CD-112	DEUTSCH	3	Attach EPPR 2 pressure sensor	DT06-3S-EP06	DT06-4P-E005
CD-124	DEUTSCH	3	Boom cylinder rod pressure snensor	DT06-3S-EP06	DT06-3P-E005

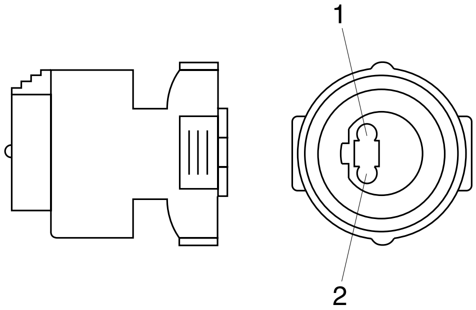
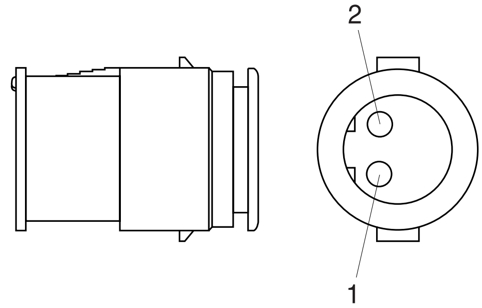
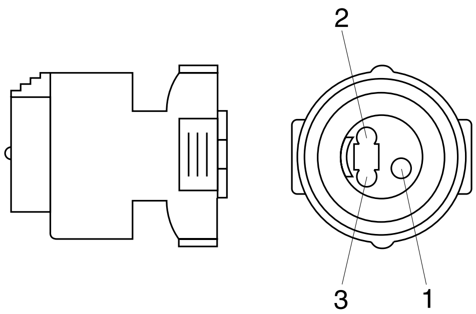
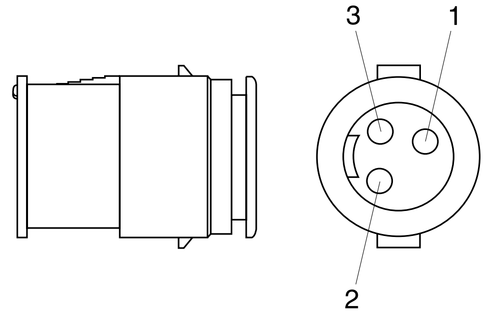
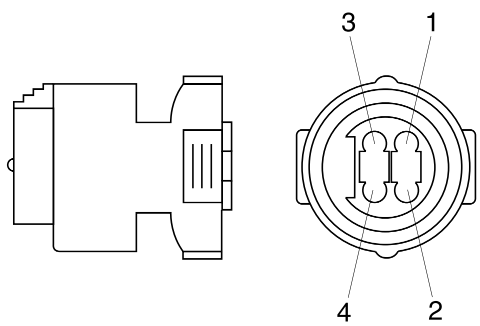
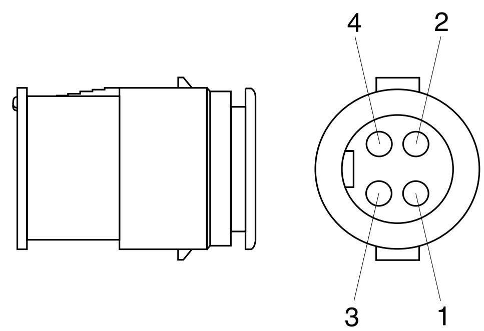
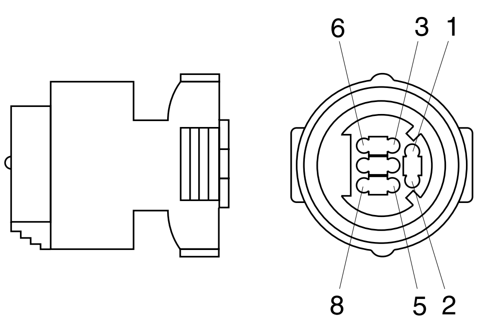
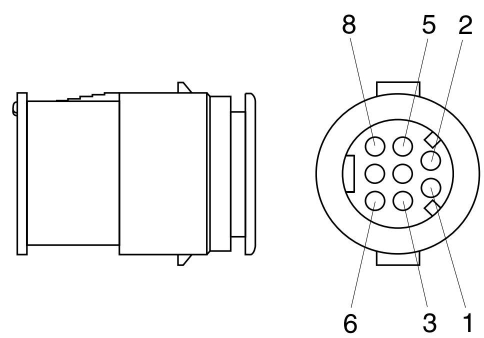
2. CONNECTION TABLE FOR CONNECTORS

1) PA TYPE CONNECTOR

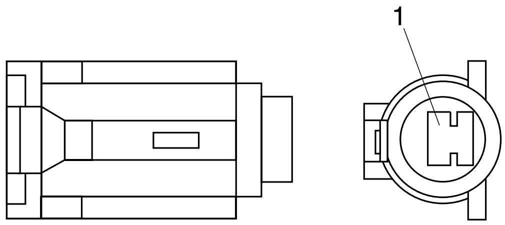
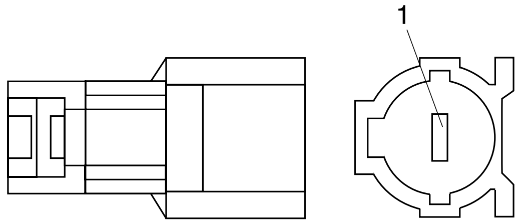
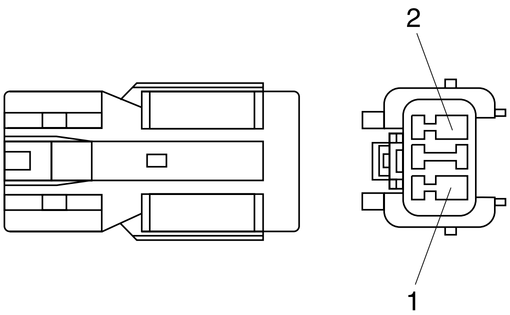
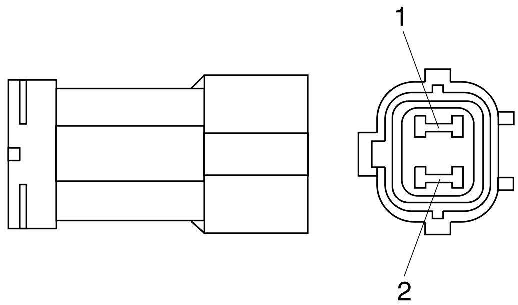
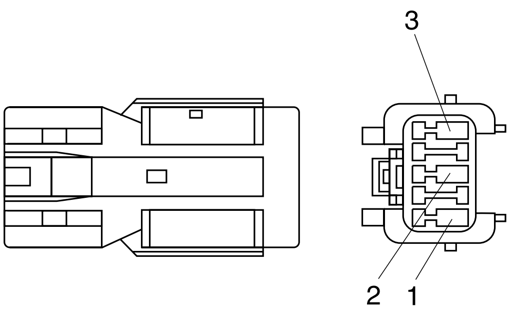
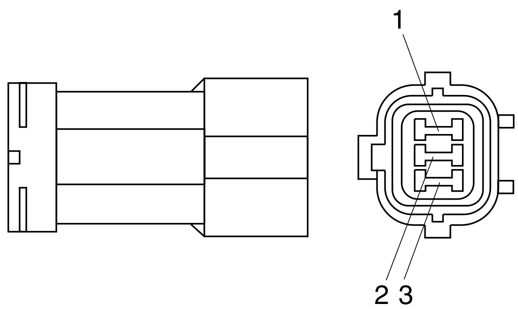
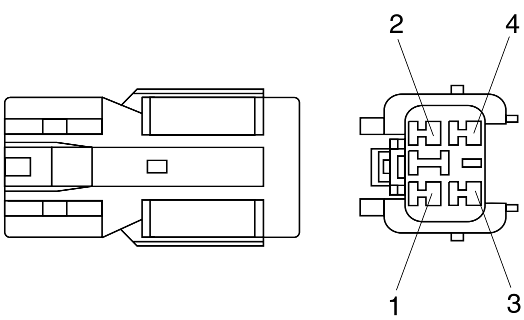
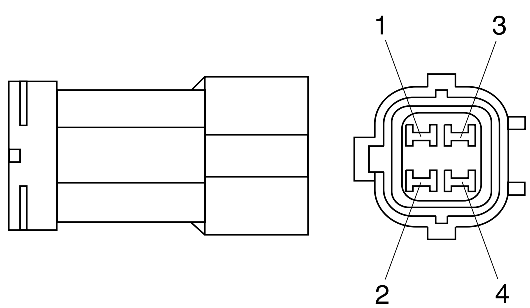
No. of pin	Receptacle connector (female)	Plug connector (male)
5	 S811-005002	 S811-105002
7	 S811-007002	 S811-107002
9	 S811-009002	 3S811-109002
11	 S811-011002	 S811-111002

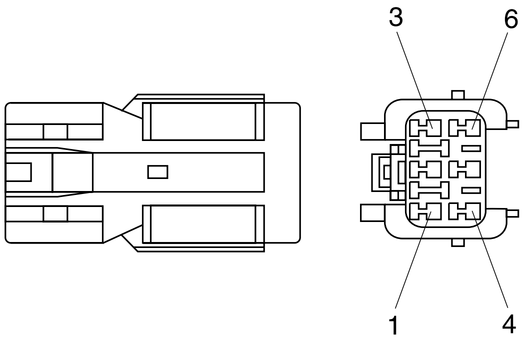
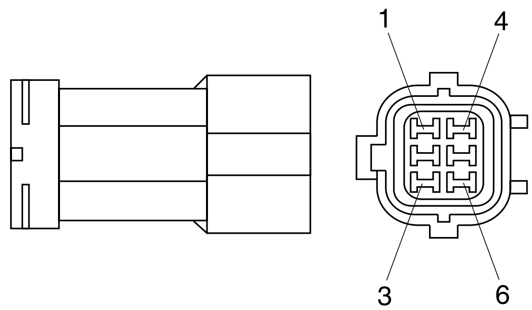
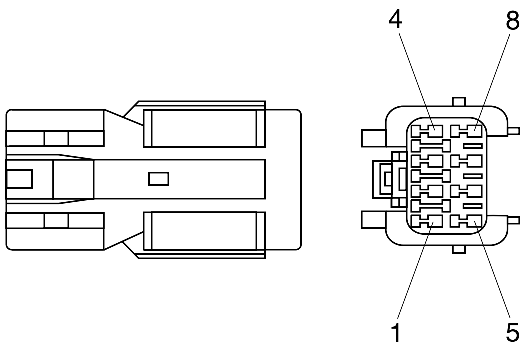
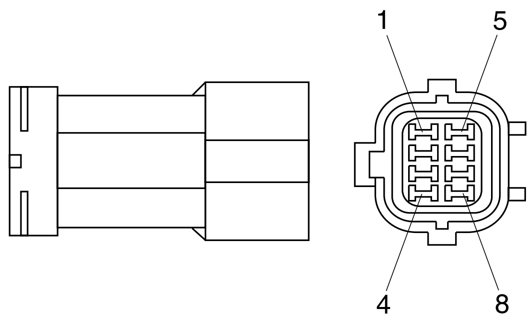
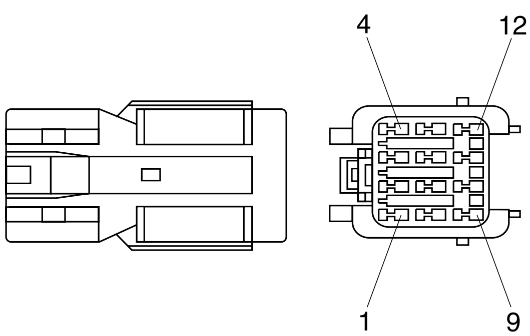
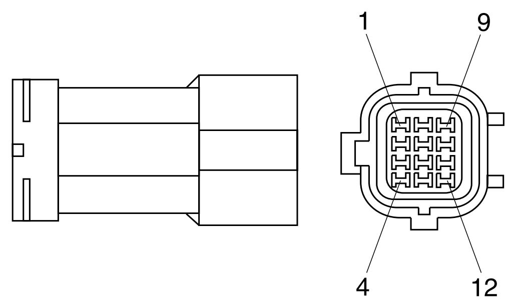
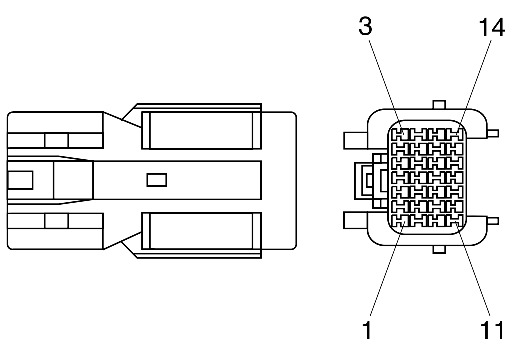
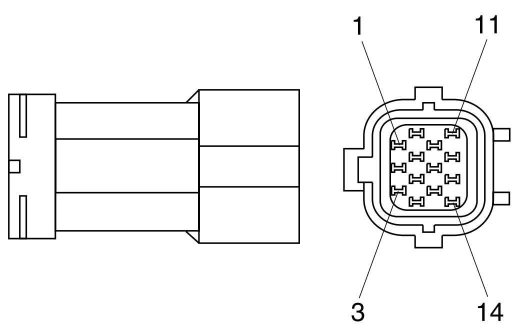
No. of pin	Receptacle connector (female)	Plug connector (male)
13	 S811-013002	 S811-113002
17	 S811-017002	 S811-117002
21	 S811-021002	 S811-121002

2) J TYPE CONNECTOR

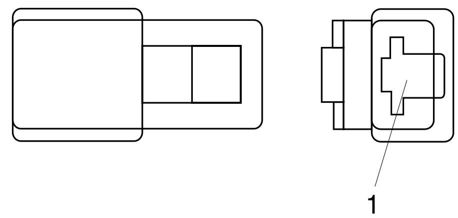
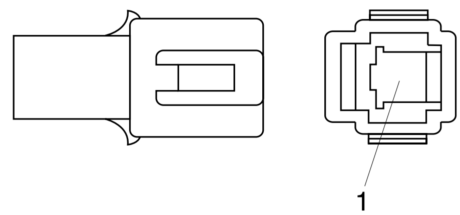
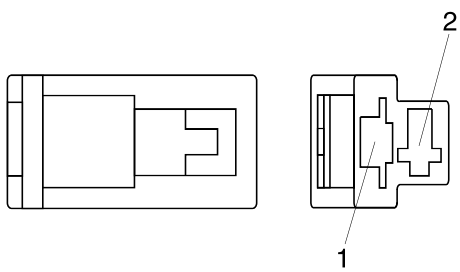
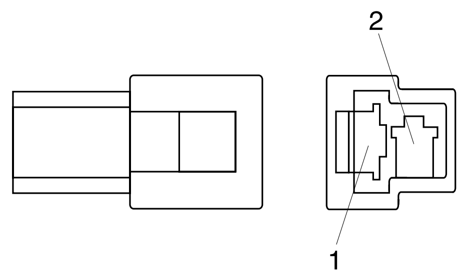
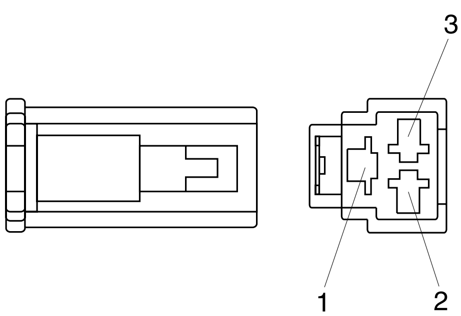
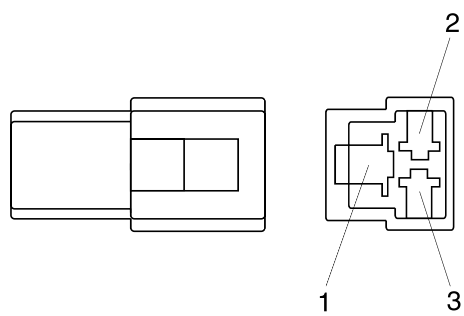
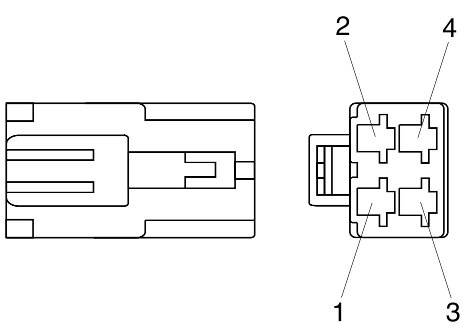
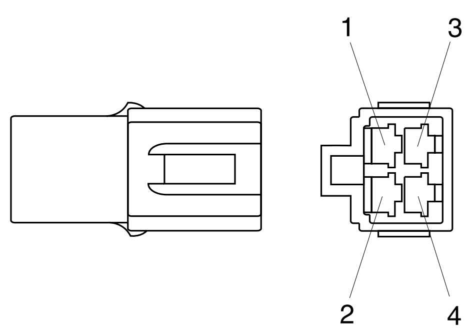
No. of pin	Receptacle connector (female)	Plug connector (male)
2	 S816-002001	 S816-102001
3	 S816-003001	 S816-103001
4	 S816-004001	 S816-104001
8	 S816-008001	 S816-108001

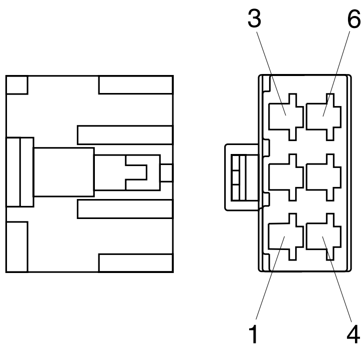
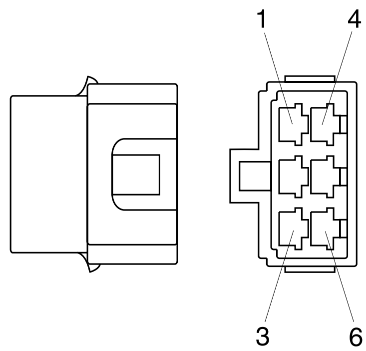
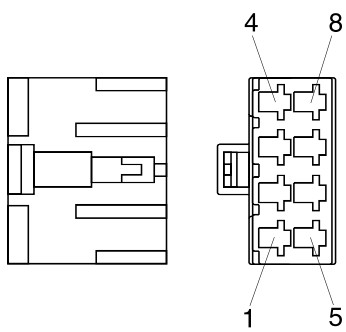
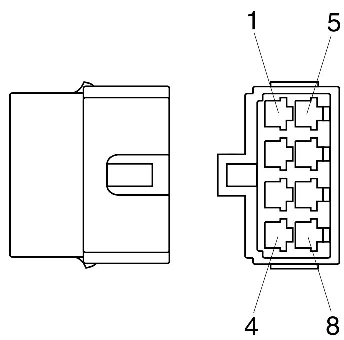
3) SWP TYPE CONNECTOR

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

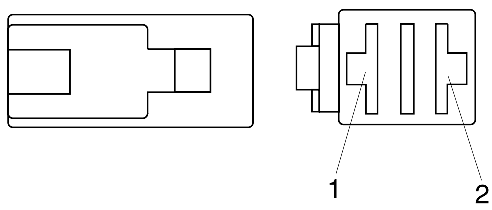
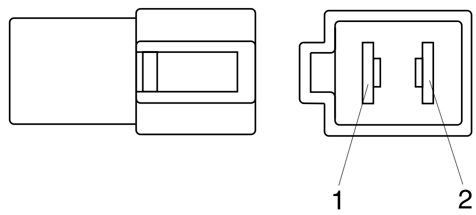
No. of pin	Receptacle connector (female)	Plug connector (male)
6	 S814-006000	 S814-106000
8	 S814-008000	 S814-108000
12	 S814-012000	 S814-112000
14	 S814-014000	 S814-114000

4) CN TYPE CONNECTOR

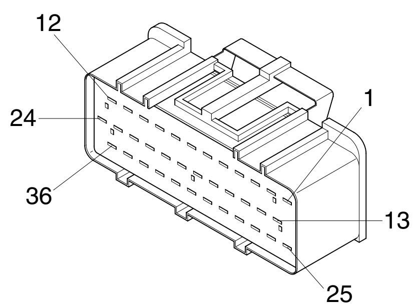
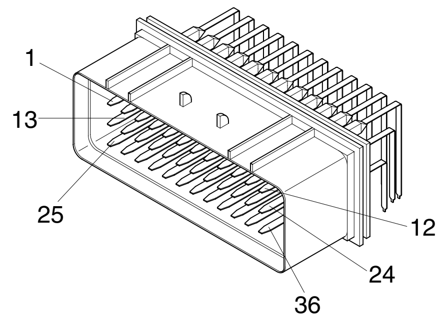
No. of pin	Receptacle connector (female)	Plug connector (male)
1	 S810-001202	 S810-101202
2	 S810-002202	 S810-102202
3	 S810-003202	 S810-103202
4	 S810-004202	 S810-104202

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

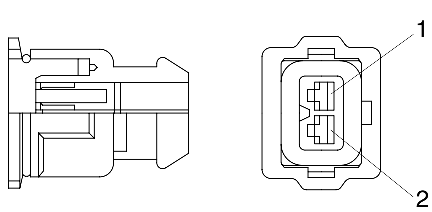
5) 375 FASTEN TYPE CONNECTOR

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

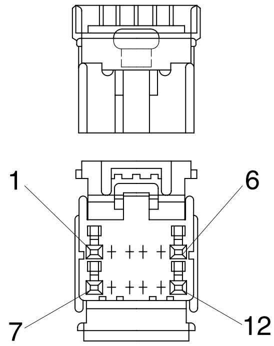
6) AMP ECONOSEAL CONNECTOR

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

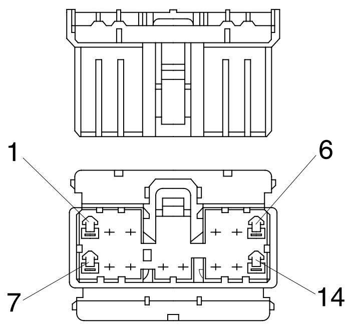
7) AMP TIMER CONNECTOR

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

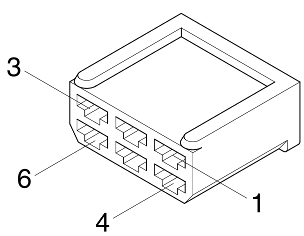
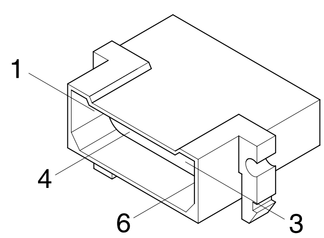
8) AMP 040 MULTILOCK CONNECTOR

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

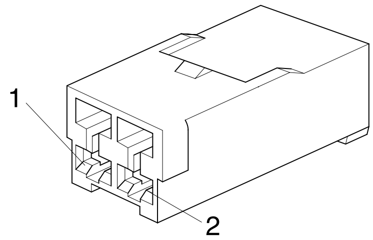
9) AMP 070 MULTILOCK CONNECTOR

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

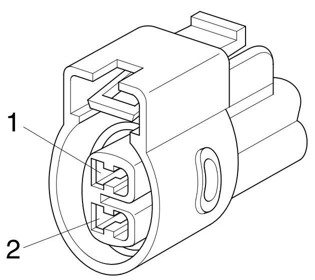
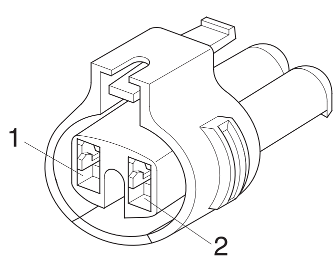
10) AMP FASTIN - FASTON CONNECTOR

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

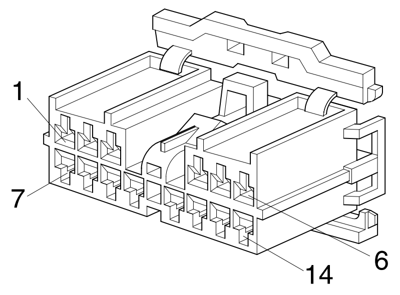
11) KET 090 CONNECTOR

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

12) KET 090 WP CONNECTORS

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

13) KET SDL CONNECTOR

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

14) DEUTSCH DT CONNECTORS

DT 06 - 3S - ★★★★

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

※ Modification

E003 : Standard end cap - gray

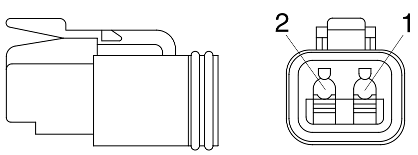
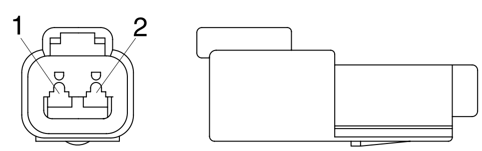
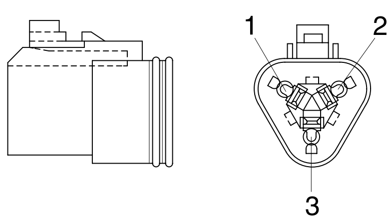
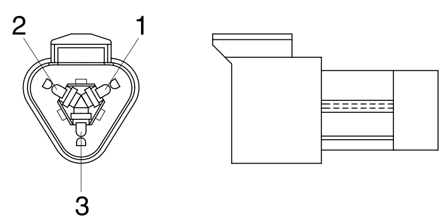
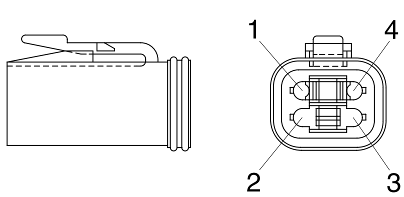
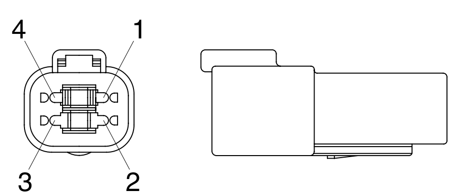
E004 : Color of connector to be black

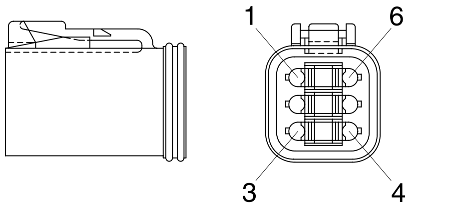
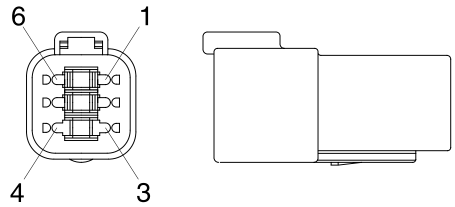
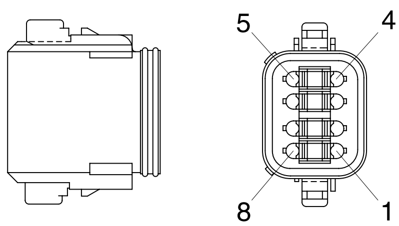
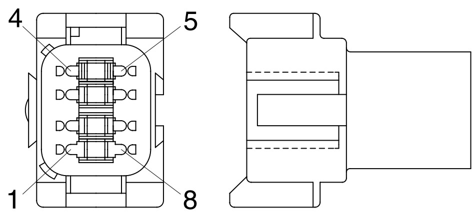
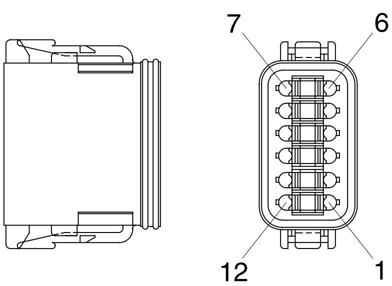
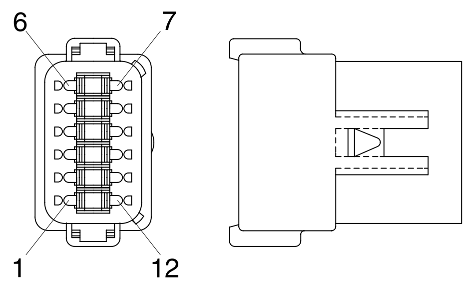
E005 : Combination - E004 & E003

EP04 : End cap

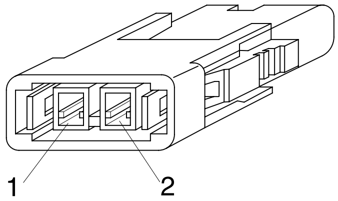
EP06 : Combination P012 & EP04

P012 : Front seal enhancement - connectors color to black for 2, 3, 4 & 6pin

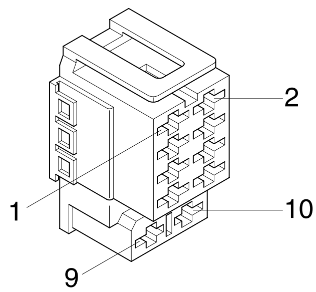
No. of pin	Receptacle connector (female)	Plug connector (male)
2	 DT06-2S	 DT04-2P
3	 DT06-3S	 DT04-3P
4	 DT06-4S	 DT04-4P

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

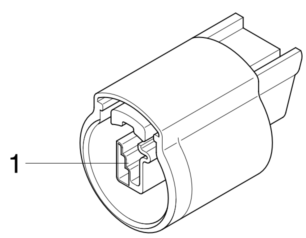
15) MOLEX 2CKTS CONNECTOR

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

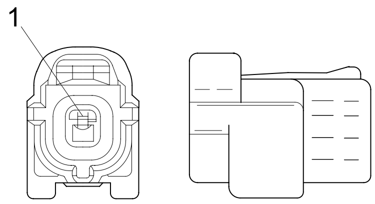
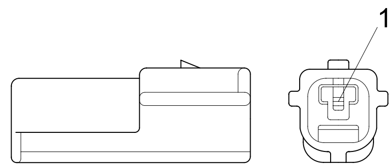
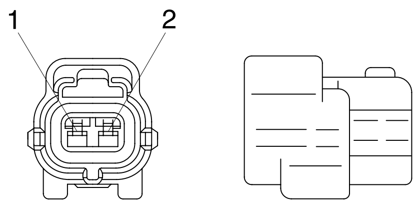
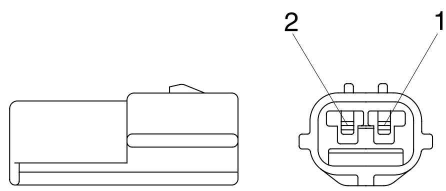
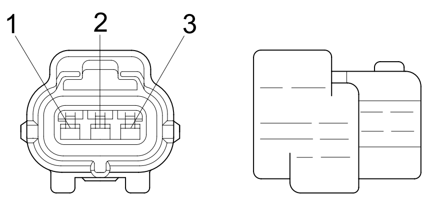
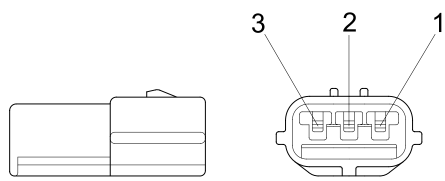
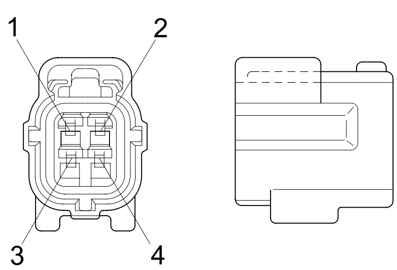
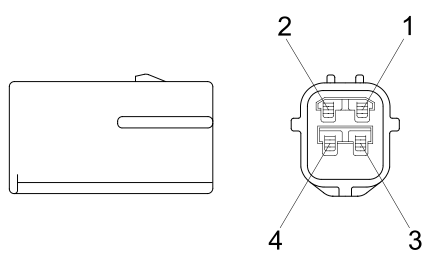
16) ITT SWF CONNECTOR

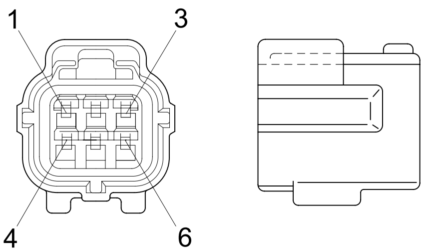
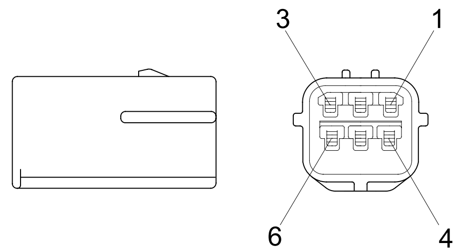
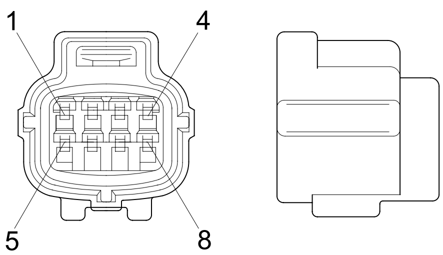
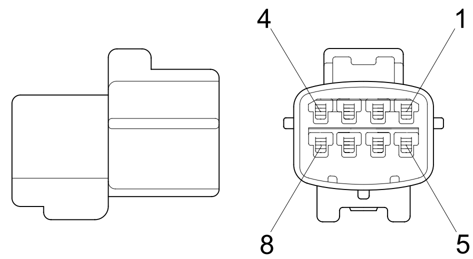
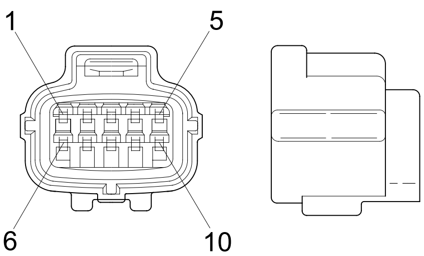
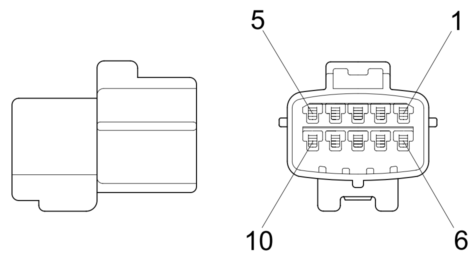
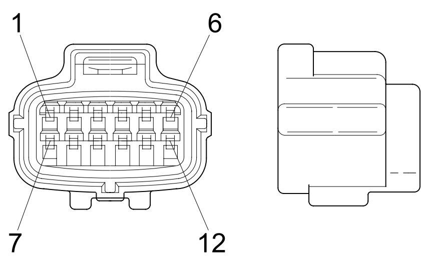
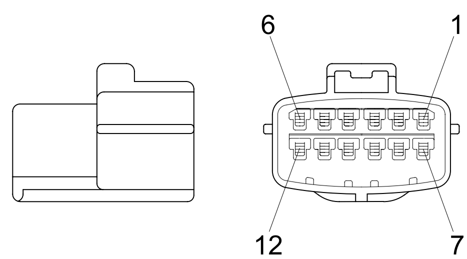
No. of pin	Receptacle connector (female)	Plug connector (male)
10	 SWF593757	

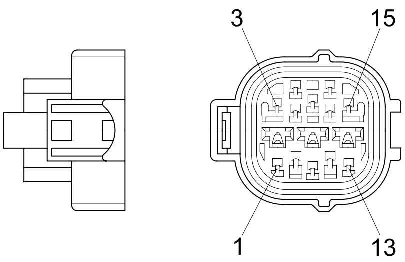
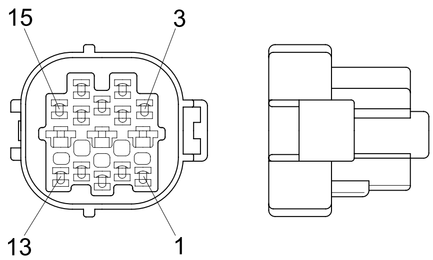
17) MWP NMWP CONNECTOR

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

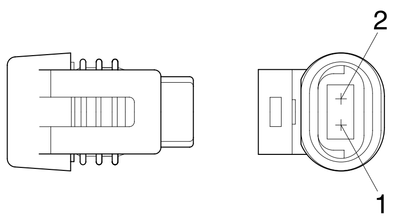
18) ECONOSEAL J TYPE CONNECTORS

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

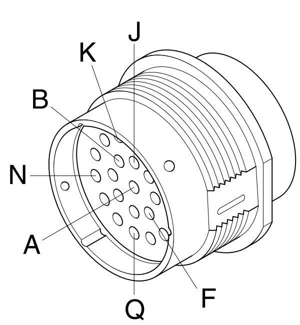
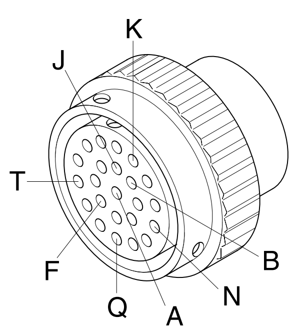
No. of pin	Receptacle connector (female)	Plug connector (male)
6	 S816-006002	 S816-106002
8	 S816-008002	 S816-108002
10	 S816-010002	 S816-110002
12	 S816-012002	 S816-112002

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

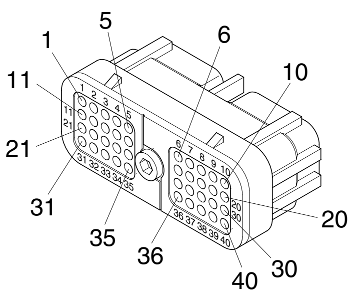
19) METRI-PACK TYPE CONNECTOR

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

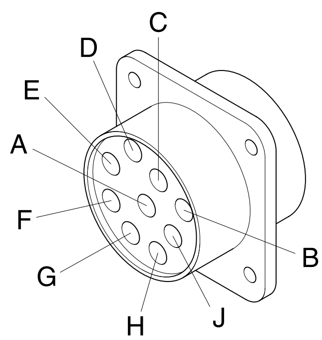
20) DEUTSCH HD30 CONNECTOR

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

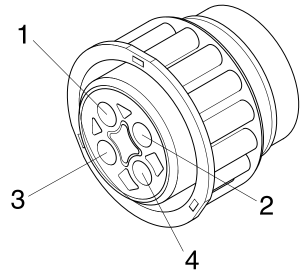
21) DEUTSCH MCU CONNECTOR

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

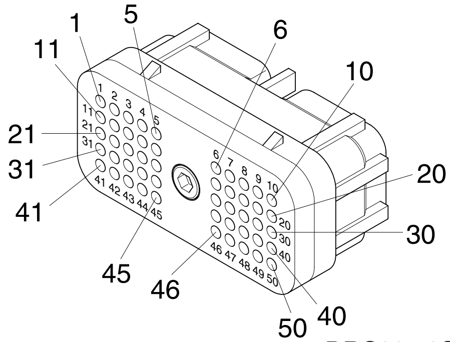
22) DEUTSCH SERVICE TOOL CONNECTOR

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

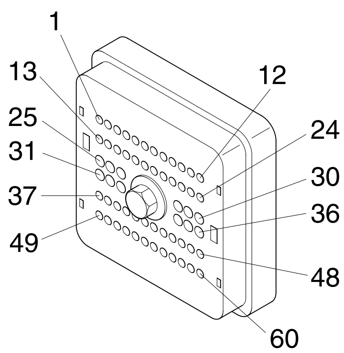
23) AMP FUEL WARMER CONNECTOR

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

24) DEUTSCH ENGINE ECM CONNECTOR

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

25) DEUTSCH INTERMEDIATE CONNECTOR

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

SECTION 5 MECHATRONICS SYSTEM

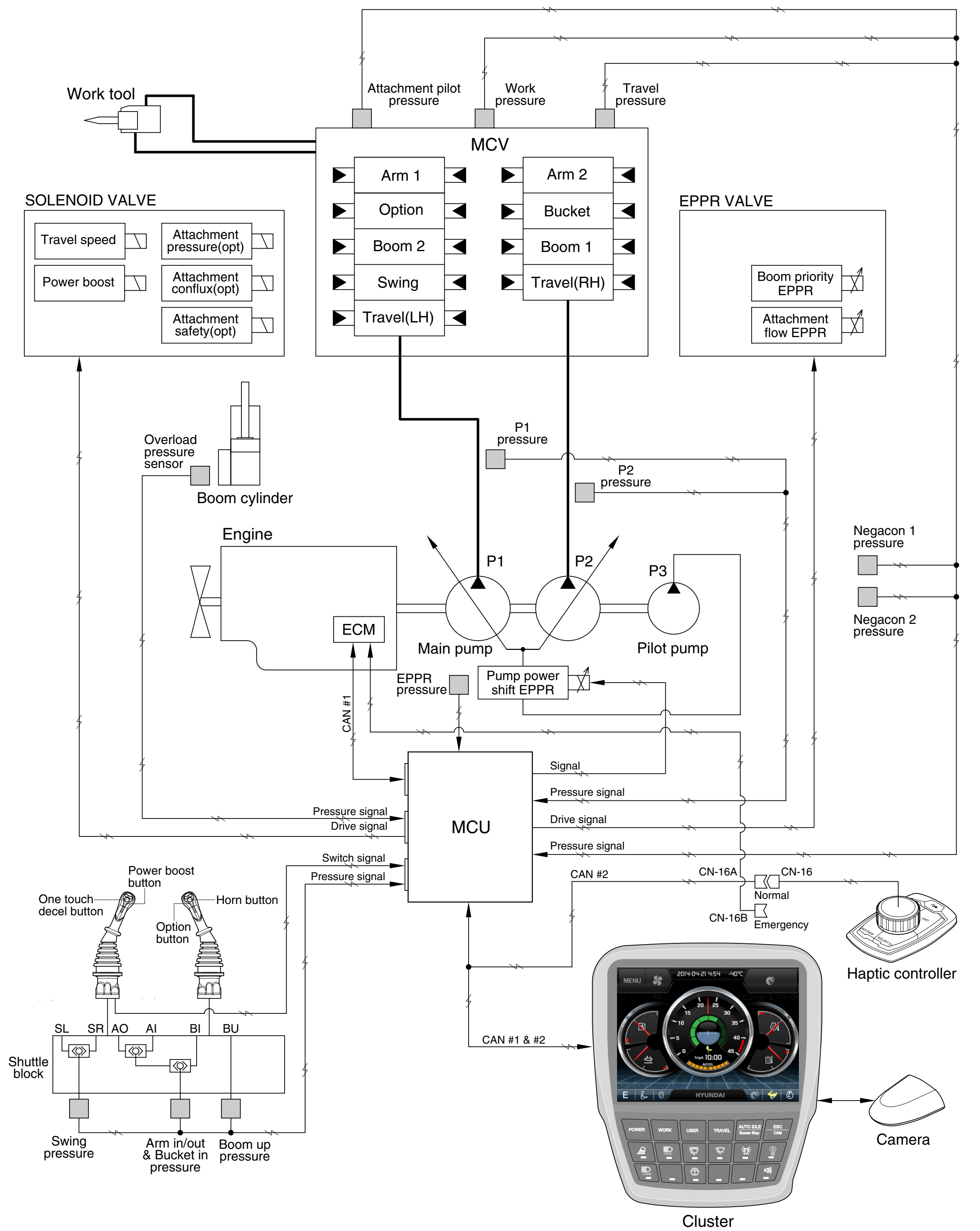
SECTION 5 MECHATRONICS SYSTEM

GROUP 1 OUTLINE

The ADVANCED CAPO (Computer Aided Power Optimization) system controls engine and pump mutual power at an optimum and less fuel consuming state for the selected work by mode selection, auto-deceleration, power boost function, etc. It monitors machine conditions, for instance, engine speed, coolant temperature, hydraulic oil temperature, and hydraulic oil pressure, etc.
It consists of a MCU, a cluster, an ECM, EPPR valves, and other components. The MCU and the cluster protect themselves from over-current and high voltage input, and diagnose malfunctions caused by short or open circuit in electric system, and display error codes on the cluster.

- ADVANCED CAPO SYSTEM
  - Mode selection system
    - Power mode selection (P, S, E)
    - Work mode selection
    - User mode system (U)
  - Auto deceleration system
  - 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 & ECM fault code display
  - Machine monitoring system
    - Machine condition monitoring
    - Electric signal monitoring
  - One touch deceleration system

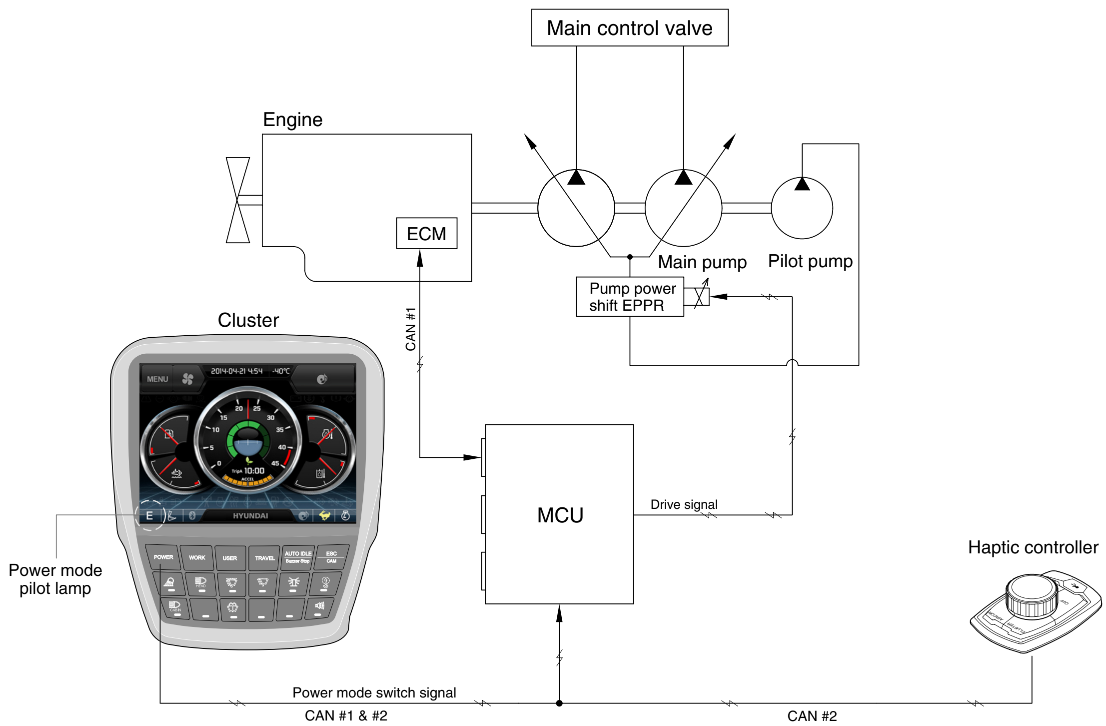
SYSTEM DIAGRAM



900L5MS01

GROUP 2 MODE SELECTION SYSTEM

1. POWER MODE SELECTION SYSTEM



900L5MS14

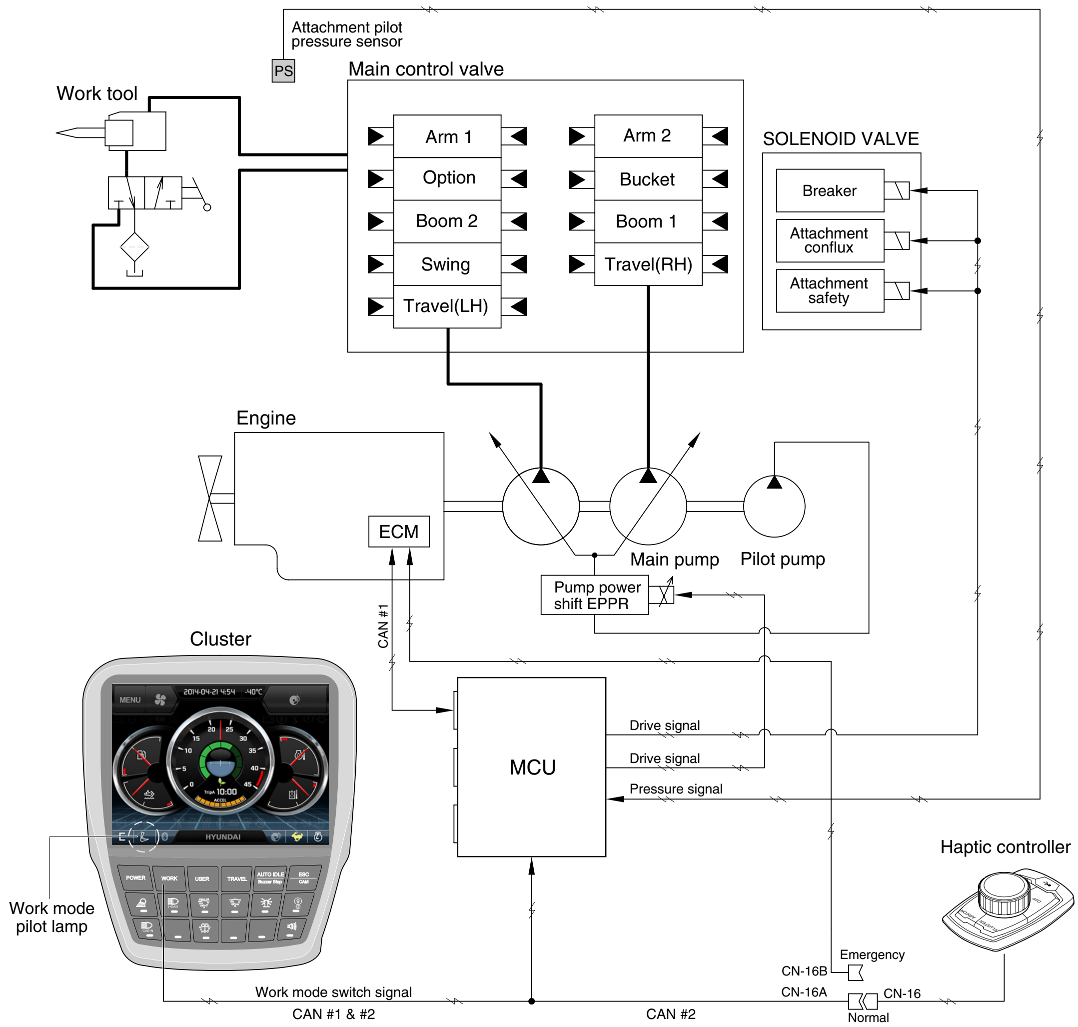
Mode selection system (micro computer based electro-hydraulic pump and engine mutual control system) optimizes the engine and pump performance.
The combination of 3 power modes (P, S, E) and acceleration mode (10 set) of haptic controller makes it possible to use the engine and pump power more effectively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

Power mode	Application	Engine rpm				Power shift by EPPR valve			
		Standard		Option		Standard		Option	
		Unload	Load	Unload	Load	Current (mA)	Pressure (kgf/cm²)	Current (mA)	Pressure (kgf/cm²)
P	Heavy duty power	1750±50	1850±50	1850±50	1850±50	280±30	8 (~3)	230±30	0 (0)
S	Standard power	1650±50	1750±50	1800±50	1800±50	305±30	10 (~5)±3	260±30	0 (0)
E	Economy operation	1550±50	1650±50	1600±50	1750±50	340±30	13 (~8)±3	340±30	5±3 (0)
AUTO DECEL	Engine deceleration	1000±100	-	1000±100	-	700±30	38±3	700±30	38±3
One touch decel	Engine quick deceleration	850±100	-	850±100	-	700±30	38±3	700±30	38±3
KEY START	Key switch start position	850±100	-	850±100	-	700±30	38±3	700±30	38±3

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

2. WORK MODE SELECTION SYSTEM

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



900L5MS02

1) GENERAL WORK MODE (bucket)

This mode is used to general digging work.

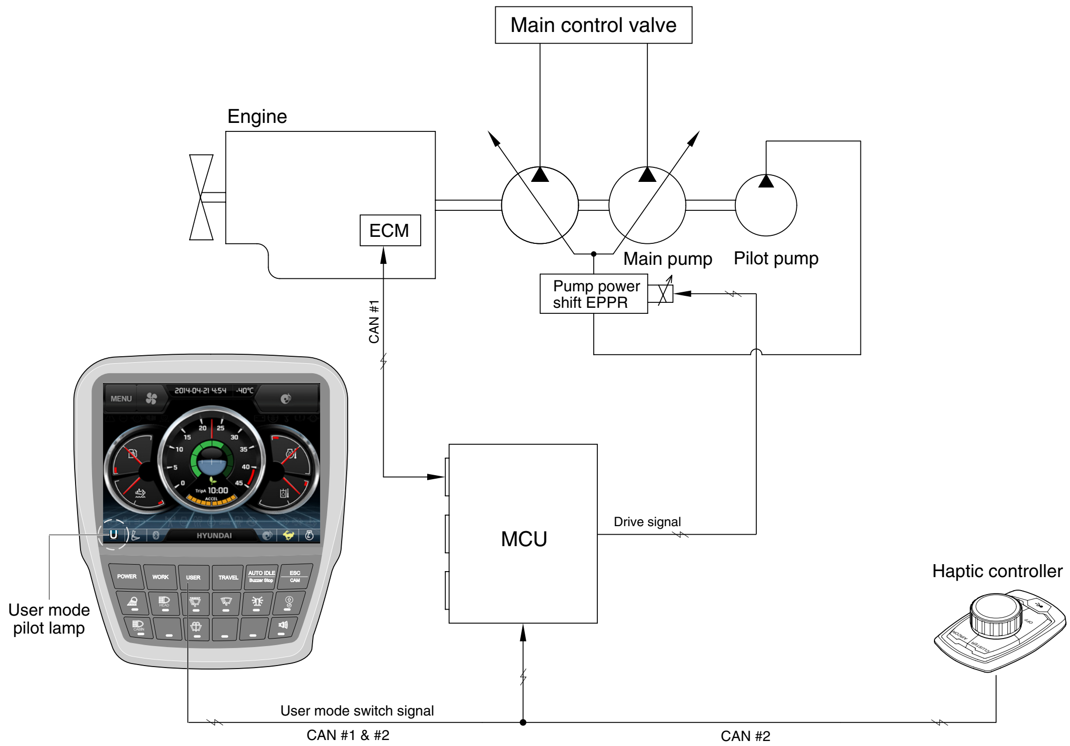
2) ATT WORK MODE (breaker, crusher)

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

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

★ When breaker operating button is pushed.

3. USER MODE SELECTION SYSTEM



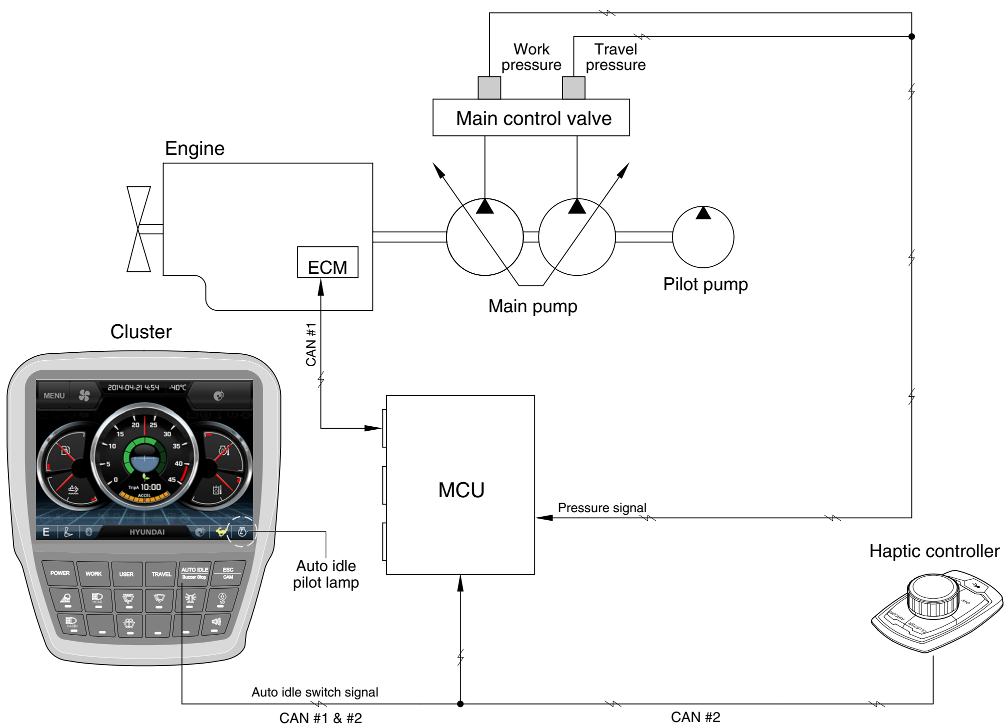
900L5MS15

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	800	0
2	1500	850	3
3	1600	900	6
4	1700	950	9
5	1750	1000 (auto decel)	12
6	1800	1050	16
7	1850	1100	20
8	1900	1150	26
9	1950	1180	32
10	2000	1200	38

GROUP 3 AUTOMATIC DECELERATION SYSTEM

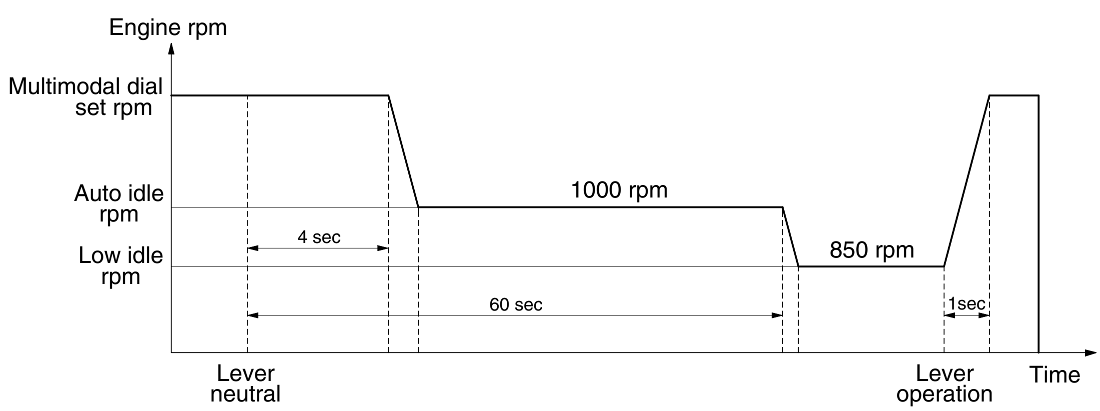


900L5MS16

1. WHEN AUTO IDLE PILOT LAMP ON

When all of the work equipment control levers including swing and travel levers are at neutral for 4 seconds, MCU sends throttle command to ECM to reduce the engine speed to 1000 rpm. If the control levers are at neutral for 1 minute, MCU reduces the engine speed to 850 rpm. As the result of reducing the engine speed, fuel consumption and noise are effectively cut down during non-operation of the control levers.

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



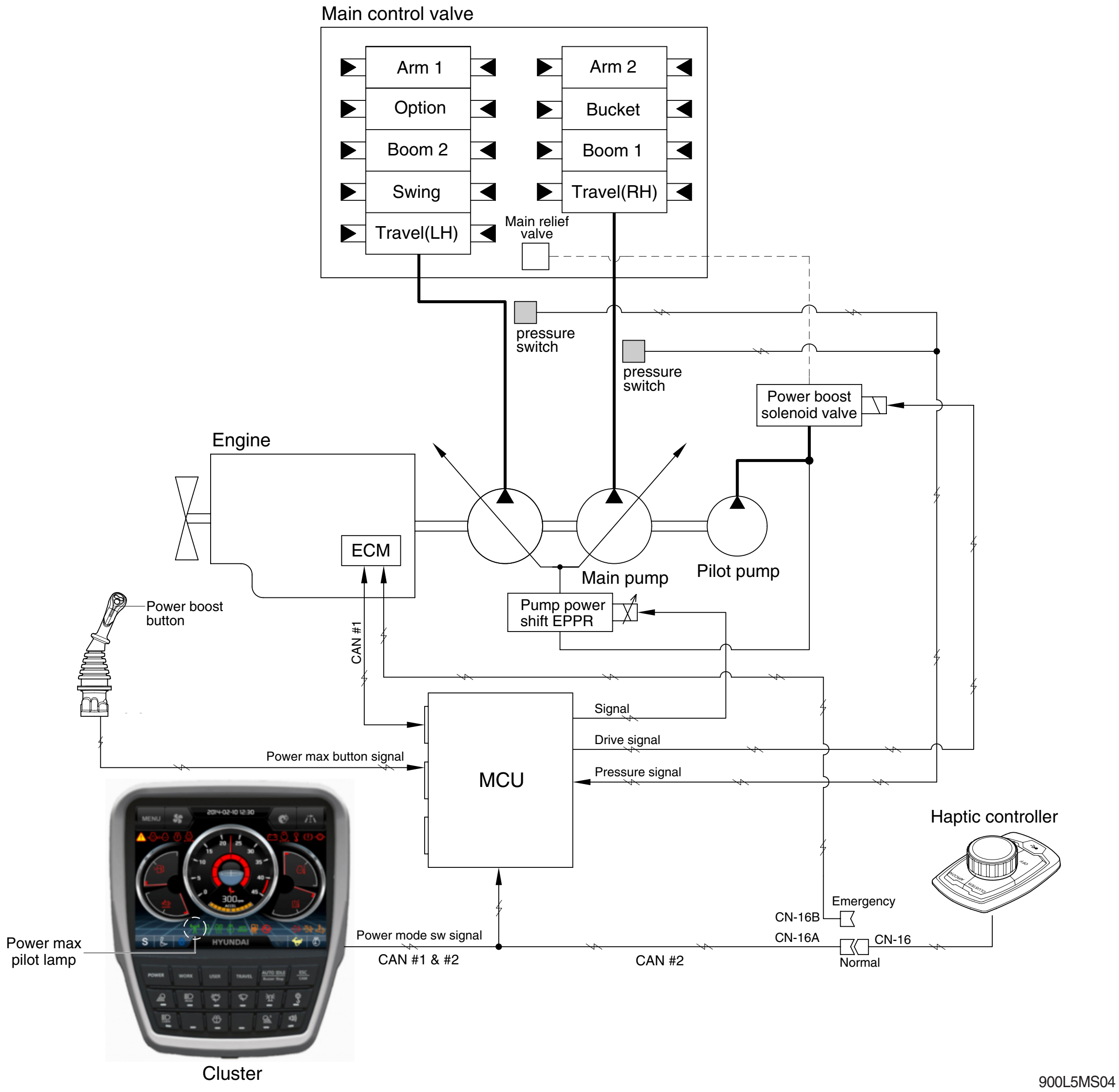
900L5MS03

2. WHEN AUTO IDLE PILOT LAMP OFF

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

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

GROUP 4 POWER BOOST SYSTEM



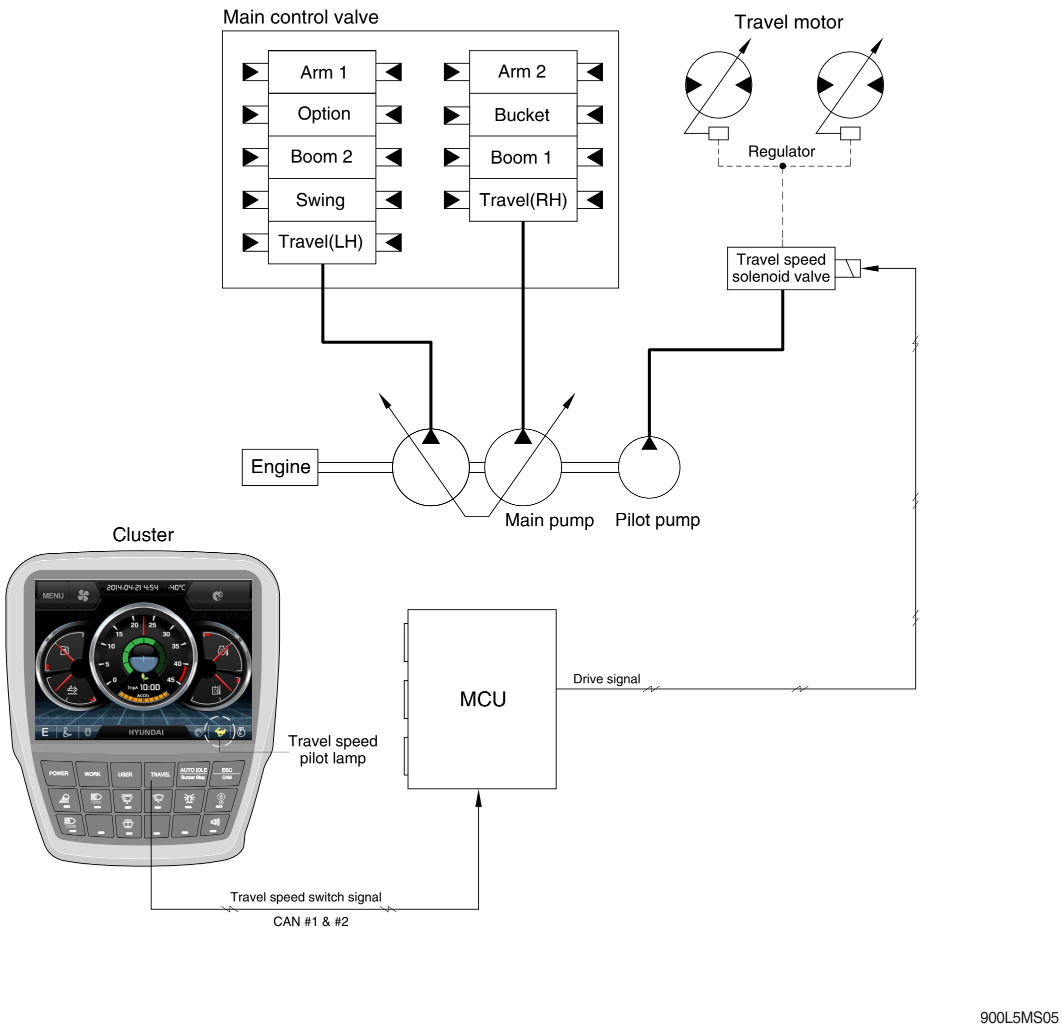
· When the power boost switch on the left control lever knob is pushed ON, the power mode is set P mode and maximum digging power is increased by 10 %.

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

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

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

GROUP 5 TRAVEL SPEED CONTROL SYSTEM

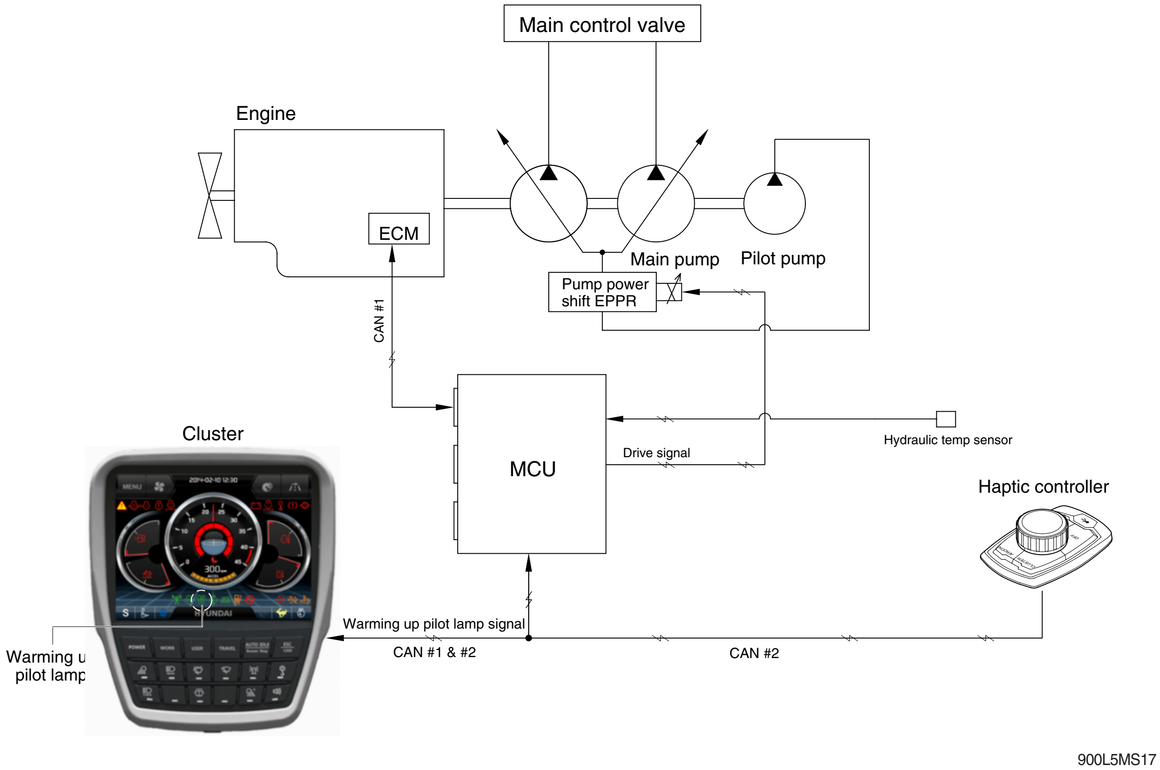


Travel speed can be switched manually by pressing the travel speed switch on the cluster.

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

※ Default : Turtle (Low)

GROUP 6 AUTOMATIC WARMING UP SYSTEM



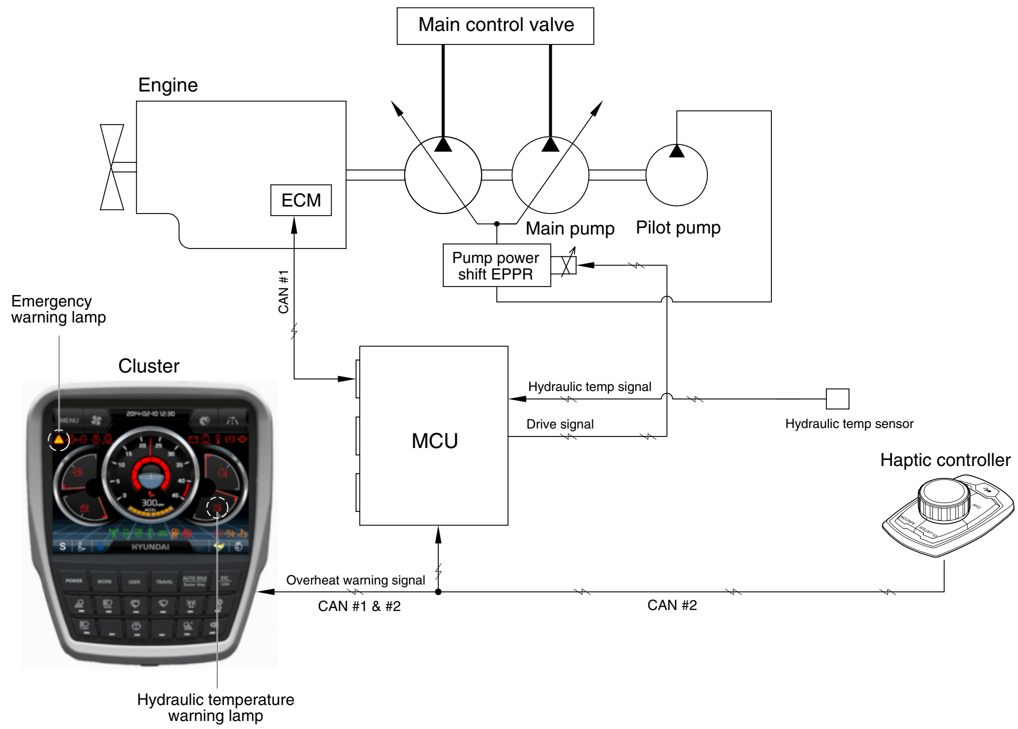
1. The MCU receives the engine coolant temperature from the ECM, and if the coolant temperature is below 30˚C, it increases the engine speed from key start rpm to 1000 rpm. At this time the mode does not change. If the coolant temperature sensor has fault, the hydraulic oil temperature signal is substituted.

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

3. LOGIC TABLE

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

GROUP 7 ENGINE OVERHEAT PREVENTION SYSTEM



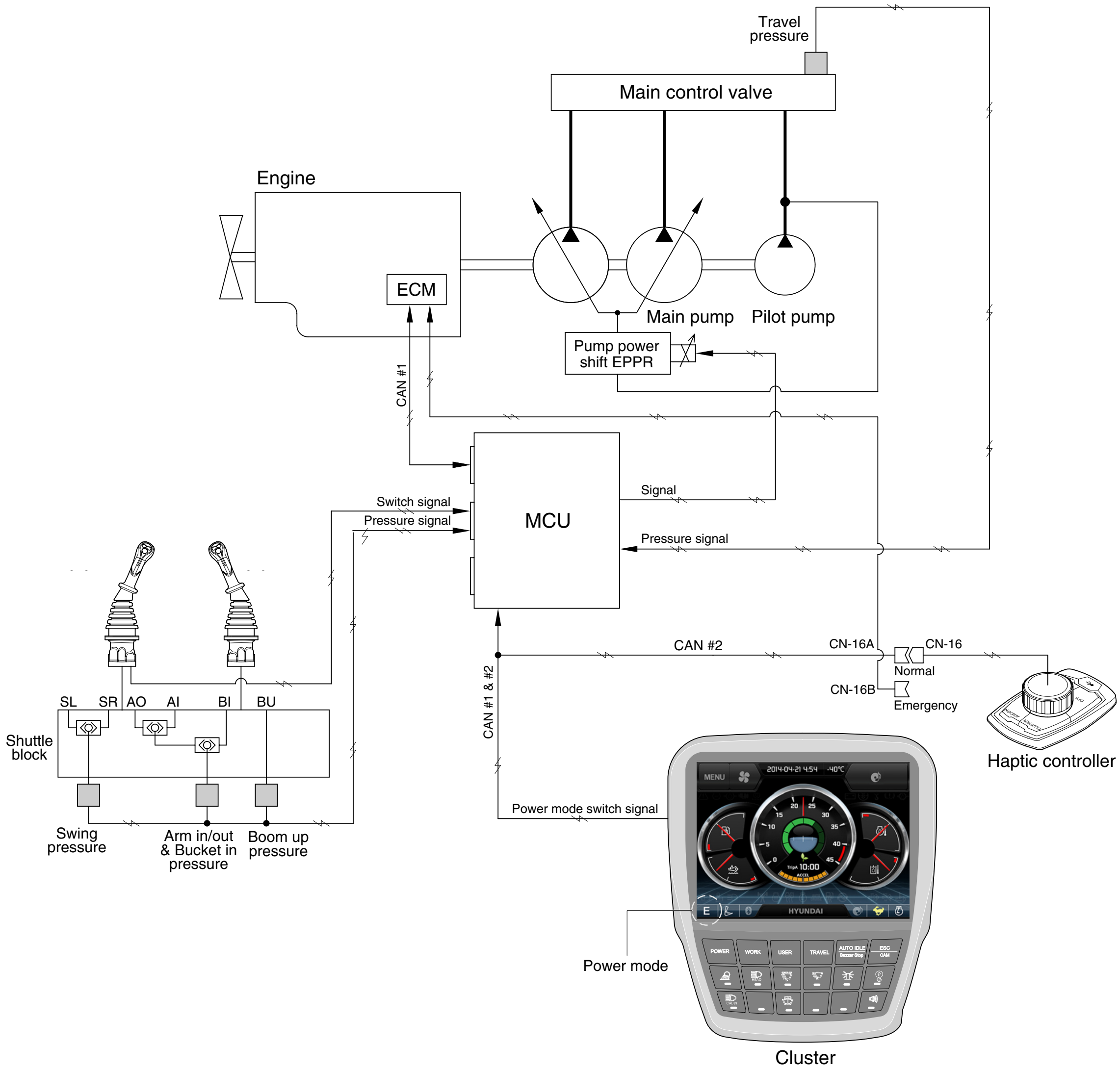
900L5MS18

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

2. LOGIC TABLE

Description		Condition	Function
First step warning	Activated	- Coolant temperature : Above 103˚C - Hydraulic oil temperature : Above 100˚C	- Warning lamp : ON , buzzer : OFF - Pump input torque is reduced.
			- Warning lamp & buzzer : ON - Pump input torque is reduced.
	Canceled	- Coolant temperature : Less than 100˚C - Hydraulic oil temperature : Less than 95˚C	- Return to pre-set the pump absorption torque.
Second step warning	Activated	- Coolant temperature : Above 107˚C - Hydraulic oil temperature : Above 105˚C	- Emergency warning lamp pops up on the center of LCD and the buzzer sounds. - Engine speed is reduced after 10 seconds.
	Canceled	- Coolant temperature : Less than 103˚C - Hydraulic oil temperature : Less than 100˚C	- Return to pre-set the engine speed. - Hold pump absorption torque on the first step warning.

GROUP 8 VARIABLE POWER CONTROL SYSTEM



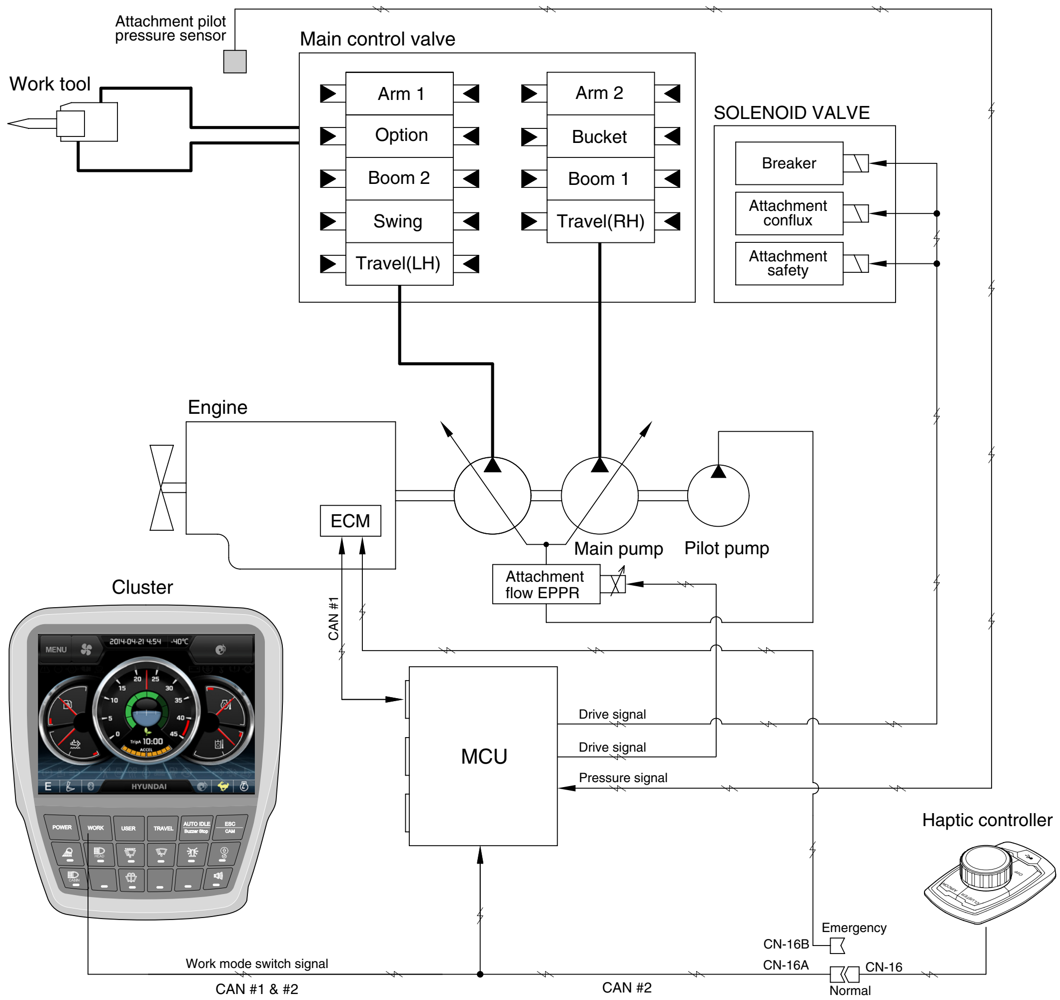
900L5MS06

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

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

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

GROUP 9 ATTACHMENT FLOW CONTROL SYSTEM



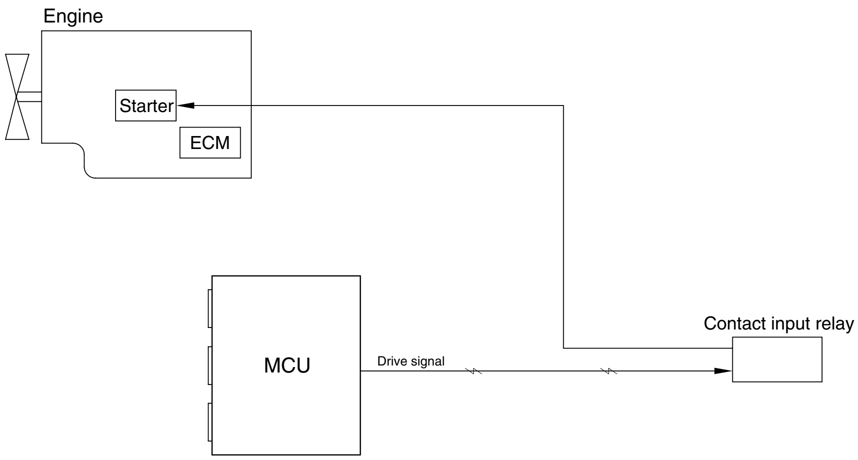
· The system is used to control the pump delivery flow according to set of the work tool on the cluster by the attachment flow EPPR valve.

Description	Work tool	
	Breaker	Crusher
Flow level	100 ~ 420 lpm	100 ~ 760 lpm
Attach safety solenoid	-	ON
Attach conflux solenoid	ON/OFF	ON/OFF
Breaker solenoid★	ON	-

※ Refer to the page 5-99 for the attachment kinds and max flow.

★ When breaker operating button is pushed.

GROUP 10 ANTI-RESTART SYSTEM



900L5MS12

1. ANTI-RESTART FUNCTION

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

GROUP 11 SELF-DIAGNOSTIC SYSTEM

1. OUTLINE

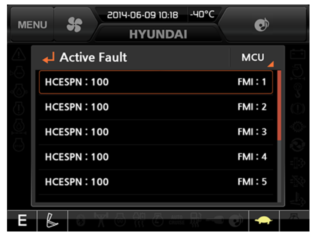
When any abnormality occurs in the ADVANCED CAPO system caused by electric parts malfunction and by open or short circuit, the MCU diagnoses the problem and sends the error codes to the cluster and also stores them in the memory.

2. MONITORING

1) Active fault

290F3CD120

290F3CD121

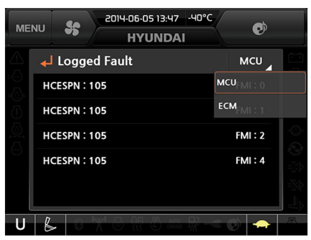


290F3CD125

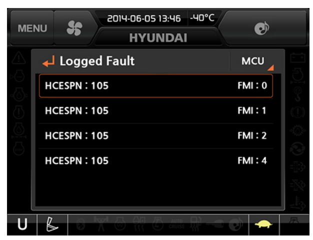
· The active faults of the MCU, engine ECM or air conditioner can be checked by this menu.

2) Logged fault

290F3CD128



290F3CD123

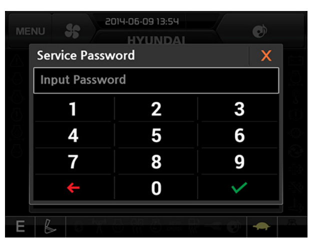


290F3CD124

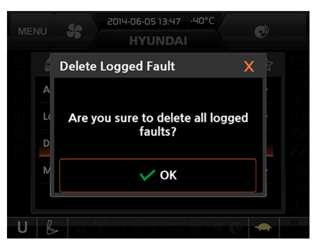
· The logged faults of the MCU, engine ECM or air conditioner can be checked by this menu.

3) Delete logged fault

290F3CD134



290F3CD126



290F3CD127

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

3. MACHINE ERROR CODES TABLE

DTC		Diagnostic Criteria	Application		
HCESPN	FMI		G	C	W
101	3	10 seconds continuous, Hydraulic Oil Temp. Measurement Voltage > 3.8V	●		
	4	10 seconds continuous, Hydraulic Oil Temp. Measurement Voltage < 0.3V	●		
	(Results / Symptoms) 1. Monitor – Hydraulic oil temperature display failure 2. Control Function – Fan revolutions control failure (Checking list) 1. CD-1 (#2) - CN-52 (#24) Checking Open/Short 2. CD-1 (#1) - CN-51 (#5) Checking Open/Short				
105	0	10 seconds continuous, Working Press. Sensor Measurement Voltage > 5.2V	●		
	1	10 seconds continuous, 0.3V≤ Working Press. Sensor Measurement Voltage < 0.8V	●		
	4	10 seconds continuous, Working Press. Sensor Measurement Voltage < 0.3V	●		
	(Results / Symptoms) 1. Monitor – Working Press. display failure 2. Control Function – Auto Idle operation failure, Engine variable horse power control operation failure (Checking list) 1. CD-7 (#B) – CN-52 (#37) Checking Open/Short 2. CD-7 (#A) – CN-51 (#3) Checking Open/Short 3. CD-7 (#C) – CN-51 (#13) Checking Open/Short				
108	0	10 seconds continuous, Travel Oil Press. Sensor Measurement Voltage > 5.2V		●	
	1	10 seconds continuous, 0.3V ≤ Travel Oil Press. Sensor Measurement Voltage < 0.8V	●		
	4	10 seconds continuous, Travel Oil Press. Sensor Measurement Voltage < 0.3V	●		
	(Results / Symptoms) 1. Monitor – Travel Oil Press. display failure 2. Control Function – Auto Idle operation failure, Engine variable horse power control operation failure, IPC operation failure, Driving alarm operation failure (Checking list) 1. CD-6 (#B) – CN-52 (#38) Checking Open/Short 2. CD-6 (#A) – CN-51 (#3) Checking Open/Short 3. CD-6 (#C) – CN-51 (#13) Checking Open/Short				

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

DTC		Diagnostic Criteria	Application		
HCESPN	FMI		G	C	W
120	0	10 seconds continuous, Main Pump 1 (P1) Press. Sensor Measurement Voltage > 5.2V	●		
	1	10 seconds continuous, 0.3V ≤ Main Pump 1 (P1) Press. Sensor Measurement Voltage < 0.8V	●		
	4	10 seconds continuous, Main Pump 1 (P1) Press. Sensor Measurement Voltage < 0.3V	●		
	(Results / Symptoms) 1. Monitor – Main Pump 1 (P1) Press. display failure 2. Control Function – Automatic voltage increase operation failure, Overload at compensation control failure (Checking list) 1. CD-42 (#B) – CN-52 (#29) Checking Open/Short 2. CD-42 (#A) – CN-51 (#3) Checking Open/Short 3. CD-42 (#C) – CN-51 (#13) Checking Open/Short				
121	0	10 seconds continuous, Main Pump 2 (P2) Press. Sensor Measurement Voltage > 5.2V	●		
	1	10 seconds continuous, 0.3V≤ Main Pump 2 (P2) Press. Sensor Measurement Voltage < 0.8V	●		
	4	10 seconds continuous, Main Pump 2 (P2) Press. Sensor Measurement Voltage < 0.3V	●		
	(Results / Symptoms) 1. Monitor – Main Pump 2 (P2) Press. display failure 2. Control Function – Automatic voltage increase operation failure, Overload at compensation control failure (Checking list) 1. CD-43 (#B) – CN-52 (#12) Checking Open/Short 2. CD-43 (#A) – CN-51 (#3) Checking Open/Short 3. CD-43 (#C) – CN-51 (#13) Checking Open/Short				
122	1	(when you had conditions mounting pressure sensor) 10 seconds continuous, 0.3V ≤ Overload Press. Sensor Measurement Voltage < 0.8V	●		
	4	(when you had conditions mounting pressure sensor) 10 seconds continuous, Overload Press. Sensor Measurement Voltage < 0.3V	●		
	(Results / Symptoms) 1. Monitor – Overload Press. display failure 2. Control Function – Overload warning alarm failure (Checking list) 1. CD-31 (#B) – CN-52 (#16) Checking Open/Short 2. CD-31 (#A) – CN-51 (#3) Checking Open/Short 3. CD-31 (#C) – CN-51 (#13) Checking Open/Short				

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

<table>
<tr><th colspan="2">DTC</th><th rowspan="2">Diagnostic Criteria</th><th colspan="3">Application</th></tr>
<tr><th>HCESPN</th><th>FMI</th><th>G</th><th>C</th><th>W</th></tr>
<tr><td rowspan="4">123</td><td>0</td><td>10 seconds continuous, Negative 1 Press. Sensor Measurement Voltage > 5.2V</td><td>●</td><td></td><td></td></tr>
<tr><td>1</td><td>10 seconds continuous, 0.3V≤ Negative 1 Press. Sensor Measurement Voltage < 0.8V</td><td>●</td><td></td><td></td></tr>
<tr><td>4</td><td>10 seconds continuous, Negative 1 Press. Sensor Measurement Voltage < 0.3V</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Monitor – Negative 1 Press. display failure
2. Control Function – IPC operation failure, Option attachment flow control operation failure
(Checking list)
1. CD-70 (#B) – CN-52 (#33) Checking Open/Short
2. CD-70 (#A) – CN-51 (#3) Checking Open/Short
3. CD-70 (#C) – CN-51 (#13) Checking Open/Short</td></tr>
<tr><td rowspan="4">124</td><td>0</td><td>10 seconds continuous, Negative 2 Press. Sensor Measurement Voltage > 5.2V</td><td>●</td><td></td><td></td></tr>
<tr><td>1</td><td>10 seconds continuous, 0.3V≤ Negative 2 Press. Sensor Measurement Voltage < 0.8V</td><td>●</td><td></td><td></td></tr>
<tr><td>4</td><td>10 seconds continuous, Negative 2 Press. Sensor Measurement Voltage < 0.3V</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Monitor – Negative 2 Press. display failure
2. Control Function – Option attachment flow control operation failure
(Checking list)
1. CD-71 (#B) – CN-52 (#17) Checking Open/Short
2. CD-71 (#A) – CN-51 (#3) Checking Open/Short
3. CD-71 (#C) – CN-51 (#13) Checking Open/Short</td></tr>
<tr><td rowspan="4">127</td><td>0</td><td>10 seconds continuous, Boom Up Pilot Press. Sensor Measurement Voltage > 5.2V</td><td>●</td><td></td><td></td></tr>
<tr><td>1</td><td>10 seconds continuous, 0.3V≤ Boom Up Pilot Press. Sensor Measurement Voltage < 0.8V</td><td>●</td><td></td><td></td></tr>
<tr><td>4</td><td>10 seconds continuous, Boom Up Pilot Press. Sensor Measurement < 0.3V</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Monitor – Boom Up Pilot Press. display failure
2. Control Function – Engine/Pump variable horse power control operation failure, IPC operation failure, Boom first operation failure
(Checking list)
1. CD-32 (#B) – CN-52 (#19) Checking Open/Short
2. CD-32 (#A) – CN-51 (#3) Checking Open/Short
3. CD-32 (#C) – CN-51 (#13) Checking Open/Short</td></tr>
</table>

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

<table>
<tr><th colspan="2">DTC</th><th rowspan="2">Diagnostic Criteria</th><th colspan="3">Application</th></tr>
<tr><th>HCESPN</th><th>FMI</th><th>G</th><th>C</th><th>W</th></tr>
<tr><td rowspan="4">128</td><td>0</td><td>(when you had conditions mounting pressure sensor)
10 seconds continuous, Boom Down Pilot Press. Sensor Measurement Voltage > 5.2V</td><td>●</td><td></td><td></td></tr>
<tr><td>1</td><td>(when you had conditions mounting pressure sensor)
10 seconds continuous, 0.3V≤ Boom Down Pilot Press. Sensor Measurement Voltage < 0.8V</td><td>●</td><td></td><td></td></tr>
<tr><td>4</td><td>(when you had conditions mounting pressure sensor)
10 seconds continuous, Boom Down Pilot Press. Sensor Measurement Voltage < 0.3V</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Monitor – Boom Down Pilot Press. display failure
2. Control Function – Boom floating operation failure
(Checking list)
1. CD-85 (#B) – CN-53 (#23) Checking Open/Short
2. CD-85 (#A) – CN-53 (#3) Checking Open/Short
3. CD-85 (#C) – CN-53 (#13) Checking Open/Short</td></tr>
<tr><td rowspan="4">129</td><td>0</td><td>10 seconds continuous, Arm In Pilot Press. Sensor Measurement Voltage > 4.8V</td><td>●</td><td></td><td></td></tr>
<tr><td>1</td><td>10 seconds continuous, 0.3V≤ Arm In Pilot Press. Sensor Measurement Voltage < 0.8V</td><td>●</td><td></td><td></td></tr>
<tr><td>4</td><td>10 seconds continuous, Arm In Pilot Press. Sensor Measurement Voltage < 0.3V</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Monitor – Arm In Pilot Press. display failure
2. Control Function – IPC operation failure
(Checking list)
1. CD-90 (#B) – CN-52 (#28) Checking Open/Short
2. CD-90 (#A) – CN-51 (#3) Checking Open/Short
3. CD-90 (#C) – CN-51 (#13) Checking Open/Short</td></tr>
<tr><td rowspan="4">133</td><td>0</td><td>10 seconds continuous,
Arm In/Out & Bucket In Pilot Press. Sensor Measurement Voltage > 5.2V</td><td>●</td><td></td><td></td></tr>
<tr><td>1</td><td>10 seconds continuous,
0.3V≤ Arm In/Out & Bucket In Pilot Press. Sensor Measurement Voltage < 0.8V</td><td>●</td><td></td><td></td></tr>
<tr><td>4</td><td>10 seconds continuous,
Arm In/Out & Bucket In Pilot Press. Sensor Measurement Voltage < 0.3V</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Monitor – Arm In/Out & Bucket In Pilot Press. display failure
2. Control Function – Engine variable horse power control operation failure
(Checking list)
1. CD-35 (#B) – CN-52 (#14) Checking Open/Short
2. CD-35 (#A) – CN-51 (#3) Checking Open/Short
3. CD-35 (#C) – CN-51 (#13) Checking Open/Short</td></tr>
</table>

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G : General C : Crawler Type W : Wheel Type

<table>
<tr><th colspan="2">DTC</th><th rowspan="2">Diagnostic Criteria</th><th colspan="3">Application</th></tr>
<tr><th>HCESPN</th><th>FMI</th><th>G</th><th>C</th><th>W</th></tr>
<tr><td rowspan="4">135</td><td>0</td><td>10 seconds continuous, Swing Pilot Press. Sensor Measurement Voltage > 5.2V</td><td>●</td><td></td><td></td></tr>
<tr><td>1</td><td>10 seconds continuous, 0.3V≤ Swing Pilot Press. Sensor Measurement Voltage < 0.8V</td><td>●</td><td></td><td></td></tr>
<tr><td>4</td><td>10 seconds continuous, Swing Pilot Press. Sensor Measurement Voltage < 0.3V</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Monitor – Swing Pilot Press. display failure
2. Control Function – IPC operation, Boom first operation failure
(Checking list)
1. CD-24 (#B) – CN-52 (#36) Checking Open/Short
2. CD-24 (#A) – CN-51 (#3) Checking Open/Short
3. CD-24 (#C) – CN-51 (#13) Checking Open/Short</td></tr>
<tr><td rowspan="4">138</td><td>0</td><td>Monitor – Select Attachment(breaker / crusher)
10 seconds continuous, Attachment Pilot Press. Sensor Measurement Voltage > 5.2V</td><td>●</td><td></td><td></td></tr>
<tr><td>1</td><td>Monitor – Select Attachment(breaker / crusher)
10 seconds continuous, 0.3V≤ Attachment Pilot Press. Sensor Measurement Voltage < 0.8V</td><td>●</td><td></td><td></td></tr>
<tr><td>4</td><td>Monitor – Select Attachment(breaker / crusher)
10 seconds continuous, Attachment Pilot Press. Sensor Measurement Voltage < 0.3V</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Monitor – Attachment Pilot Press. display failure
2. Control Function – Option attachment flow control operation failure
(Checking list)
1. CD-69 (#B) – CN-53 (#14) Checking Open/Short
2. CD-69 (#A) – CN-53 (#3) Checking Open/Short
3. CD-69 (#C) – CN-53 (#13) Checking Open/Short</td></tr>
<tr><td rowspan="3">139</td><td>1</td><td>10 seconds continuous, 0.3V≤ Option Pilot Press. Sensor Measurement Voltage < 0.8V</td><td></td><td></td><td>●</td></tr>
<tr><td>4</td><td>10 seconds continuous, Option Pilot Press. Sensor Measurement Voltage < 0.3V</td><td></td><td></td><td>●</td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Monitor – Option Pilot Press. display failure
2. Control Function – Auto Idle operation failure
(Checking list)
1. CD-100 (#B) – CN-52 (#21) Checking Open/Short
2. CD-100 (#A) – CN-51 (#3) Checking Open/Short
3. CD-100 (#C) – CN-1 (#6) Checking Open/Short</td></tr>
</table>

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G : General C : Crawler Type W : Wheel Type

<table>
<tr><th colspan="2">DTC</th><th rowspan="2">Diagnostic Criteria</th><th colspan="3">Application</th></tr>
<tr><th>HCESPN</th><th>FMI</th><th>G</th><th>C</th><th>W</th></tr>
<tr><td rowspan="3">140</td><td>5</td><td>(Detection)
(When Main Pump EPPR Current is more than 10 mA)
10 seconds continuous, Pump EPPR drive current < 0 mA
(Cancellation)
(When Main Pump EPPR Current is more than 10 mA)
3 seconds continuous, Main Pump EPPR drive current ≥10 mA</td><td>●</td><td></td><td></td></tr>
<tr><td>6</td><td>(Detection)
10 seconds continuous, Main Pump EPPR drive current > 1.0A
(Cancellation)
3 seconds continuous, Main Pump EPPR drive current ≤ 1.0 A</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Control Function – Pump horse power setting specification difference
(Fuel efficiency/speed specification failure)
(Checking list)
1. CN-75 (#2) – CN-52 (#9) Checking Open/Short
2. CN-75 (#1) – CN-52 (#10) Checking Open/Short</td></tr>
<tr><td rowspan="3">141</td><td>5</td><td>(Model Parameter) mounting Boom Priority EPPR
(Detection)
(When Boom Priority EPPR Current is more than 10 mA)
10 seconds continuous, Boom Priority EPPR drive current < 0 mA
(Cancellation)
(When Boom Priority EPPR Current is more than 10 mA)
3 seconds continuous, Boom Priority EPPR drive current ≥ 10 mA</td><td>●</td><td></td><td></td></tr>
<tr><td>6</td><td>(Detection)
10 seconds continuous, Boom Priority EPPR drive current > 1.0 A
(Cancellation)
3 seconds continuous, Boom Priority EPPR drive current ≤ 1.0 A</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Control Function – Boom first control operation failure
(Checking list)
1. CN-133 (#2) – CN-52 (#34) Checking Open/Short
2. CN-133 (#1) – CN-52 (#35) Checking Open/Short</td></tr>
</table>

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G : General C : Crawler Type W : Wheel Type

DTC		Diagnostic Criteria	Application		
HCESPN	FMI		G	C	W
143	5	(Detection) (When Travel EPPR Current is more than 10 mA) 10 seconds continuous, Travel EPPR drive current = 0 mA (Cancellation) (When Travel EPPR Current is more than 100 mA) 3 seconds continuous, Travel EPPR drive current ≥ 10 mA			●
	6	(Detection) 10 seconds continuous, Travel EPPR drive current > 1.0 A (Cancellation) 3 seconds continuous, Travel EPPR drive current ≤ 1.0 A			●
	(Results / Symptoms) 1. Control Function – cruise control operation failure (Checking list) 1. CN-246 (#B) – CN-306 (#9) Checking Open/Short 2. CN-246 (#A) – CN-306 (#8) Checking Open/Short 3. CN-246 (#C) – CN-306 (#11) Checking Open/Short				
145	5	(Model Parameter) mounting Remote Cooling Fan EPPR (Detection) (When Remote Cooling Fan EPPR Current is more than 10 mA) 10 seconds continuous, Remote Cooling Fan EPPR drive current = 0 mA (Cancellation) (When Remote Cooling Fan EPPR Current is more than 10 mA) 3 seconds continuous, Remote Cooling Fan EPPR drive current ≥ 10 mA	●		
	6	(Detection) 10 seconds continuous, Remote Cooling Fan EPPR drive current > 1.0 A (Cancellation) 3 seconds continuous, Remote Cooling Fan EPPR drive current ≤ 1.0 A	●		
	(Results / Symptoms) 1. Control Function – Remote fan control operation failure (Checking list) 1. CD-52 (#1) – CN-154 (#5) Checking Open/Short 2. CD-52 (#2) – CN-154 (#4) Checking Open/Short				

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G : General C : Crawler Type W : Wheel Type

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

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

DTC		Diagnostic Criteria	Application		
HCESPN	FMI		G	C	W
167	4	(Detection) (When Travel Speed Solenoid is Off) 10 seconds continuous, Travel Speed Solenoid drive unit Measurement Voltage ≤ 3.0V (Cancellation) (When Travel Speed Solenoid is Off) 3 seconds continuous, Travel Speed Solenoid drive unit Measurement Voltage > 3.0V		●	
		(When Parking mode is not) (Detection) (When Travel Speed Solenoid is Off) 10 seconds continuous, Travel Speed Solenoid drive unit Measurement Voltage ≤ 3.0V (Cancellation) (When Travel Speed Solenoid is Off) 3 seconds continuous, Travel Speed Solenoid drive unit Measurement Voltage > 3.0V			●
	6	(Detection) (When Travel Speed Solenoid is On) 10 seconds continuous, Travel Speed Solenoid drive current > 4.5 A (Cancellation) (When Travel Speed Solenoid is On) 3 seconds continuous, Travel Speed Solenoid drive current ≤ 4.5 A	●		
	(Results / Symptoms) 1. Control Function – driving in 1/2 transmission operation failure (Checking list) 1. CN-70 (#1) – CN-52 (#20) Checking Open/Short 2. CN-70 (#2) – Fuse box (#28) Checking Open/Short				

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

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<tr><th colspan="2">DTC</th><th rowspan="2">Diagnostic Criteria</th><th colspan="3">Application</th></tr>
<tr><th>HCESPN</th><th>FMI</th><th>G</th><th>C</th><th>W</th></tr>
<tr><td rowspan="3">169</td><td>4</td><td>Monitor – Selecting attachment(breaker / crusher)
(Detection)
(When Attachment Conflux Solenoid is Off)
10 seconds continuous, Attachment Conflux Solenoid drive unit Measurement Voltage ≤ 3.0V
(Cancellation)
(When Attachment Conflux Solenoid is Off)
3 seconds continuous, Attachment Conflux Solenoid drive unit Measurement Voltage > 3.0V</td><td>●</td><td></td><td></td></tr>
<tr><td>6</td><td>(Detection)
(When Attachment Conflux Solenoid is On)
10 seconds continuous, Attachment Conflux Solenoid drive Current > 6.5 A
(Cancellation)
(When Attachment Conflux Solenoid is On)
3 seconds continuous, Attachment Conflux Solenoid drive Current ≤ 6.5 A</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(Results / symptoms)
1. Control Function – Option attachment flow control – Joining operation failure
(Eco breaker mode, crusher mode)
(Checking list)
1. CN-237 (#1) – CN-53 (#7) Checking Open/Short
2. CN-237 (#2) – Fuse box (#31) Checking Open/Short</td></tr>
<tr><td rowspan="3">170</td><td>4</td><td>(Model Parameter) mounting Arm Regenerating Solenoid
(Detection)
(When Arm Regeneration Solenoid is Off)
10 seconds continuous, Arm Regeneration Solenoid drive unit Measurement Voltage ≤ 3.0V
(Cancellation)
(When Arm Regeneration Solenoid is Off)
3 seconds continuous, Arm Regeneration Solenoid drive unit Measurement Voltage > 3.0V</td><td>●</td><td></td><td></td></tr>
<tr><td>6</td><td>(Detection)
(When Arm Regeneration Solenoid is On)
10 seconds continuous, Arm Regeneration Solenoid drive current > 4.5 A
(Cancellation)
(When Arm Regeneration Solenoid is On)
3 seconds continuous, Arm Regeneration Solenoid drive current ≤ 4.5 A</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(Results / symptoms)
1. Control Function – Arm regeneration operation failure
(Checking list)
1. CN-135 (#1) – CN-52 (#07) Checking Open/Short
2. CN-135 (#2) – Fuse box (#28) Checking Open/Short</td></tr>
</table>

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G : General C : Crawler Type W : Wheel Type

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<tr><th colspan="2">DTC</th><th rowspan="2">Diagnostic Criteria</th><th colspan="3">Application</th></tr>
<tr><th>HCESPN</th><th>FMI</th><th>G</th><th>C</th><th>W</th></tr>
<tr><td rowspan="3">171</td><td>4</td><td>Monitor – Selecting attachment(crusher)
(Detection)
(When Attachment Safety Solenoid is Off)
10 seconds continuous, Attachment Safety Solenoid drive unit Measurement Voltage ≤ 3.0V
(Cancellation)
(When Attachment Safety Solenoid is Off)
3 seconds continuous, Attachment Safety Solenoid drive unit Measurement Voltage > 3.0V</td><td>●</td><td></td><td></td></tr>
<tr><td>6</td><td>(Detection)
(When Attachment Safety Solenoid is On)
10 seconds continuous, Attachment Safety Solenoid drive current > 6.5 A
(Cancellation)
(When Attachment Safety Solenoid is On)
3 seconds continuous, Attachment Safety Solenoid drive current ≤ 6.5 A</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Control Function – Option attachment flow control – Option spool pilot pressure cut off failure (crusher mode)
(Checking list)
1. CN-149 (#1) – CN-53 (#8) Checking Open/Short
2. CN-149 (#2) – Fuse box (#31) Checking Open/Short</td></tr>
<tr><td rowspan="3">179</td><td>4</td><td>Monitor – Selecting attachment(breaker / crusher)
(Detection)
(When Breaker Operating Solenoid is Off)
10 seconds continuous, Attachment Safety Solenoid drive unit Measurement Voltage ≤ 3.0V
(Cancellation)
(When Breaker Operating Solenoid is Off)
3 seconds continuous, Attachment Safety Solenoid drive unit Measurement Voltage > 3.0V</td><td>●</td><td></td><td></td></tr>
<tr><td>6</td><td>(Detection)
(When Breaker Operating Solenoid is On)
10 seconds continuous, Attachment Safety Solenoid drive current > 6.5 A
(Cancellation)
(When Breaker Operating Solenoid is On)
3 seconds continuous, Attachment Safety Solenoid drive current ≤ 6.5 A</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Control Function – Option attachment flow control – Breaker operation failure (breaker mode)
(Checking list)
1. CN-66 (#1) – CN-53 (#9) Checking Open/Short
2. CN-66 (#2) – Fuse box (#28) Checking Open/Short</td></tr>
</table>

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G : General C : Crawler Type W : Wheel Type

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<tr><th colspan="2">DTC</th><th rowspan="2">Diagnostic Criteria</th><th colspan="3">Application</th></tr>
<tr><th>HCESPN</th><th>FMI</th><th>G</th><th>C</th><th>W</th></tr>
<tr><td rowspan="3">181</td><td>4</td><td>(Model Parameter) mounting Reverse Cooling Fan Solenoid
(Detection)
(When Reverse Cooling Fan Solenoid is Off)
10 seconds continuous, Reverse Cooling Fan Solenoid drive unit Measurement Voltage ≤ 3.0V
(Cancellation)
(When Reverse Cooling Fan Solenoid is Off)
3 seconds continuous, Reverse Cooling Fan Solenoid drive unit Measurement Voltage > 3.0V</td><td>●</td><td></td><td></td></tr>
<tr><td>6</td><td>(Detection)
(When Reverse Cooling Fan Solenoid is On)
10 seconds continuous, Reverse Cooling Fan Solenoid drive current > 4.5 A
(Cancellation)
(When Reverse Cooling Fan Solenoid is On)
3 seconds continuous, Reverse Cooling Fan Solenoid drive current ≤ 4.5 A</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Control Function – Cooling Fan reverse control operation failure
(Check list)
1. CN-52 (#1) – CN-51 (#4) Checking Open/Short
2. CN-52 (#2) – CN-51 (#15) Checking Open/Short</td></tr>
<tr><td rowspan="3">188</td><td>5</td><td>(Detection)
(When Attachment Flow EPPR 1 current is equal or more than 300 mA)
10 seconds continuous, Attachment Flow EPPR drive current < 100 mA
(Cancellation)
(When Attachment Flow EPPR 1 current is equal or more than 300 mA)
3 seconds continuous, Attachment Flow EPPR drive current ≥ 100 mA</td><td>●</td><td></td><td></td></tr>
<tr><td>6</td><td>(Detection)
10 seconds continuous, Attachment Flow EPPR 1 drive current > 1.0 A
(Cancellation)
3 seconds continuous, Attachment Flow EPPR 1 drive current ≤ 1.0 A</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Control Function – IPC operation failure, Option attachment flow control operation failure
(Checking list)
1. CN-242 (#2) – CN-52 (#39) Checking Open/Short
2. CN-242 (#1) – CN-52 (#40) Checking Open/Short</td></tr>
</table>

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

DTC		Diagnostic Criteria	Application		
HCESPN	FMI		G	C	W
189	5	(Detection) (When Attachment Flow EPPR 2 current is equal or more than 300 mA) 10 seconds continuous, Attachment Flow EPPR drive current < 100 mA (Cancellation) (When Attachment Flow EPPR 2 current is equal or more than 300 mA) 3 seconds continuous, Attachment Flow EPPR drive current ≥ 100 mA	●		
	6	(Detection) 10 seconds continuous, Attachment Flow EPPR 2 drive current > 1.0 A (Cancellation) 3 seconds continuous, Attachment Flow EPPR 2 drive current ≤ 1.0 A	●		
	(Results / Symptoms) 1. Control Function – Option attachment flow control operation failure (Checking list) 1. CN-378 (#2) – CN-52 (#6) Checking Open/Short 2. CN-378 (#1) – CN-52 (#7) Checking Open/Short				
196	0	HW145 10 seconds continuous, Attachment flow control EPPR 1 press. Sensor Measurement Voltage > 5.2V			
	1	HW145 10 seconds continuous, 0.3V≤ Attachment flow control EPPR 1 press. Sensor Measurement Voltage < 0.8V			
	4	HW145 10 seconds continuous, Attachment flow control EPPR 1 press. Sensor Measurement Voltage < 0.3V			
	(Results / Symptoms) 1. Control Function – Driving second pump joining function operation failure (Checking list) 1. CD-93 (#B) – CN-52 (#11) Checking Open/Short 2. CD-93 (#A) – CN-51 (#3) Checking Open/Short 3. CD-93 (#C) – CN-51 (#13) Checking Open/Short				
200	0	10 seconds continuous, Pump EPPR Press. Sensor Measurement Voltage > 5.2V	●		
	1	10 seconds continuous, 0.3V≤ Pump EPPR Press. Sensor Measurement Voltage < 0.8V	●		
	4	10 seconds continuous, Pump EPPR Press. Sensor Measurement Voltage < 0.3V	●		
	(Results / Symptoms) 1. Monitor – Pump EPPR Press. display failure 2. Control Function – Pump input horse power control failure, Overload at compensation control operation failure (Fuel efficiency/speed performance failure) (Checking list) 1. CD-44 (#B) – CN-52 (#32) Checking Open/Short 2. CD-44 (#A) – CN-51 (#3) Checking Open/Short 3. CD-44 (#C) – CN-51 (#13) Checking Open/Short				

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

<table>
<tr><th colspan="2">DTC</th><th rowspan="2">Diagnostic Criteria</th><th colspan="3">Application</th></tr>
<tr><th>HCESPN</th><th>FMI</th><th>G</th><th>C</th><th>W</th></tr>
<tr><td rowspan="4">205</td><td>0</td><td>(Mounting pressure sensor)
10 seconds continuous, Boom Cylinder Rod Press. Sensor Measurement Voltage > 5.2V</td><td>●</td><td></td><td></td></tr>
<tr><td>1</td><td>(Mounting pressure sensor)
10 seconds continuous, 0.3V≤ Boom Cylinder Rod Press. Sensor Measurement Voltage < 0.8V</td><td>●</td><td></td><td></td></tr>
<tr><td>4</td><td>(Mounting pressure sensor)
10 seconds continuous, Boom Cylinder Rod Press. Sensor Measurement Voltage < 0.3V</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Monitor – Boom Cylinder Rod Press. display failure
2. Control Function – Boom floating control operation failure
(Checking list)
1. CD-124 (#B) – CN-53 (#5) Checking Open/Short
2. CD-124 (#A) – CN-53 (#3) Checking Open/Short
3. CD-124 (#C) – CN-53 (#13) Checking Open/Short</td></tr>
<tr><td rowspan="3">218</td><td>4</td><td>Mounting pressure sensor (HCESPN128 or HCESPN 205)
(Detection)
(When Boom Up Floating Solenoid is Off)
10 seconds continuous, Boom Up Floating Solenoid drive unit Measurement Voltage ≤ 3.0V
(Cancellation)
(When Boom Up Floating Solenoid is Off)
3 seconds continuous, Boom Up Floating Solenoid drive unit Measurement Voltage > 3.0V</td><td>●</td><td></td><td></td></tr>
<tr><td>6</td><td>(Detection)
(When Boom Up Floating Solenoid is On)
10 seconds continuous, Boom Up Floating Solenoid drive current > 6.5 A
(Cancellation)
(When Boom Up Floating Solenoid is On)
3 seconds continuous, Boom Up Floating Solenoid drive current ≤ 6.5 A</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Control Function – Boom floating control operation failure
(Checking list)
1. CN-368 (#1) – CN-53 (#20) Checking Open/Short
2. CN-368 (#2) – Fuse box (#31) Checking Open/Short</td></tr>
</table>

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

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

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

DTC		Diagnostic Criteria	Application		
HCESPN	FMI		G	C	W
222	5	Monitor – Selecting attachment(crusher) (Detection) (When ATT Relief Setting EPPR 2 Current is equal or more than 10 mA) 10 seconds continuous, ATT Relief Setting EPPR 2 drive current = 0 mA (Cancellation) (When ATT Relief Setting EPPR 2 Current is equal or more than 10 mA) 3 seconds continuous, ATT Relief Setting EPPR 2 drive current ≥ 10mA	●		
	6	(Detection) 10 seconds continuous, ATT Relief Setting EPPR 2 drive current > 1.0 A (Cancellation) 3 seconds continuous, ATT Relief Setting EPPR 2 drive current ≤ 1.0 A	●		
	(Results / Symptoms) 1. Control Function – Option attachment flow control – P2 relief pressure setting failure (Checking list) 1. CN-366 (#2) – CN-53 (#32) Checking Open/Short 2. CN-366 (#1) – CN-53 (#33) Checking Open/Short				
301	3	10 seconds continuous, Fuel Level Measurement Voltage > 3.8V	●		
	4	10 seconds continuous, Fuel Level Measurement Voltage < 0.3V	●		
	(Results / Symptoms) 1. Monitor – Fuel remaining display failure (Checking list) 1. CD-2 (#2) – CN-52 (#26) Checking Open/Short 2. CD-2 (#1) – CN-51 (#5) Checking Open/Short				
325	4	(Model Parameter) mounting Fuel Warmer Relay (Detection) (When Fuel Warmer Relay is Off) 10 seconds continuous, Fuel Warmer Relay drive unit Measurement Voltage ≤ 3.0V (Cancellation) (When Fuel Warmer Relay is Off) 3 seconds continuous, Fuel Warmer Relay drive unit Measurement Voltage > 3.0V	●		
	6	(Detection) (When Fuel Warmer Relay is On) 10 seconds continuous, Fuel Warmer Relay drive current > 4.5 A (Cancellation) (When Fuel Warmer Relay is On) 3 seconds continuous, Fuel Warmer Relay drive current ≤ 4.5 A	●		
	(Results / Symptoms) 1. Control Function – Fuel warmer operation failure (Checking list) 1. CR-46 (#85) – CN-52 (#30) Checking Open/Short 2. CR-46 (#86) – Fuse box (#22) Checking Open/Short				

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

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

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

<table>
<tr><th colspan="2">DTC</th><th rowspan="2">Diagnostic Criteria</th><th colspan="3">Application</th></tr>
<tr><th>HCESPN</th><th>FMI</th><th>G</th><th>C</th><th>W</th></tr>
<tr><td rowspan="3">514</td><td>4</td><td>(Detection)
(When Parking Relay is Off)
10 seconds continuous, Parking Relay drive unit
Measurement Voltage ≤ 3.0V
(Cancellation)
(When Parking Relay is Off)
3 seconds continuous, Parking Relay drive unit
Measurement Voltage > 3.0V</td><td></td><td></td><td>●</td></tr>
<tr><td>6</td><td>(Detection)
(When Parking Relay is On)
10 seconds continuous, Parking Relay drive current > 6.5 A
(Cancellation)
(When Parking Relay is On)
3 seconds continuous, Parking Relay drive current ≤ 6.5 A</td><td></td><td></td><td>●</td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Control Function – Parking Relay operation failure
(Checking list)
1. CR-66 (#1) – CN-54 (#20) Checking Open/Short
2. CR-66 (#2) – Fuse box (#30) Checking Open/Short</td></tr>
<tr><td rowspan="3">517</td><td>4</td><td>(Detection)
(When Traveling Cutoff Relay is Off)
10 seconds continuous, Traveling Cutoff Relay drive unit Measurement Voltage ≤ 3.0V
(Cancellation)
(When Traveling Cutoff Relay is Off)
3 seconds continuous, Traveling Cutoff Relay drive unit Measurement Voltage > 3.0V</td><td></td><td></td><td>●</td></tr>
<tr><td>6</td><td>(Detection)
(When Traveling Cutoff Relay is On)
10 seconds continuous, Traveling Cutoff Relay drive current > 6.5 A
(Cancellation)
(When Traveling Cutoff Relay is On)
3 seconds continuous, Traveling Cutoff Relay drive current ≤ 6.5 A</td><td></td><td></td><td>●</td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Control Function – Traveling Cutoff Relay operation failure
(Checking list)
1. CR-47 (#85) – CN-54 (#9) Checking Open/Short
2. CR-47 (#86) – Fuse box (#28) Checking Open/Short</td></tr>
</table>

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

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

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

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

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

DTC HCESPN	DTC FMI	Diagnostic Criteria	Application G	Application C	Application W
714	3	(Model Parameter) Mounting Acc. Dial 10 seconds continuous, Acc. Dial Measurement Voltage > 5.2V	●		
	4	(Model Parameter) Mounting Acc. Dial 10 seconds continuous, Acc. Dial Measurement Voltage < 0.3V	●		
		(Results / Symptoms) 1. Monitor – Acc. Dial Voltage display failure 2. Control Function – Engine rpm control failure (Checking list) 1. CN-7 (#15) – CN-52 (#23) Checking Open/Short			
722	4	(Detection) (When Travel Alarm (Buzzer) Sound is Off) 10 seconds continuous, Travel Alarm (Buzzer) Sound Relay drive unit Measurement Voltage ≤ 3.0V (Cancellation) (When Travel Alarm (Buzzer) Sound Relay is Off) 3 seconds continuous, Travel Alarm (Buzzer) Sound Relay drive unit Measurement Voltage > 3.0V	●		
	6	(Detection) (When Travel Alarm (Buzzer) Sound is On) 10 seconds continuous, Travel Alarm (Buzzer) Sound Relay drive current > 4.5 A (Cancellation) (When Travel Alarm (Buzzer) Sound is On) 3 seconds continuous, Travel Alarm (Buzzer) Sound Relay drive current ≤ 4.5 A	●		
		(Results / Symptoms) 1. Control Function – Driving alarm operation failure (Checking list) 1. CN-81 (#1) – CN-52 (#31) Checking Open/Short 2. CN-81 (#2) – Fuse box (#28) Checking Open/Short			
831	2	(When mounting the A/C Controller) 60 seconds continuous, A/C Controller Communication Data Error	●		
		(Results / Symptoms) 1. Control Function – A/C Controller operation failure (Checking list) 1. CN-11 (#8) – CN-51 (#22) Checking Open/Short 2. CN-11 (#7) – CN-51 (#32) Checking Open/Short			
840	2	60 seconds continuous, Cluster Communication Data Error	●		
		(Results / Symptoms) 1. Control Function – Cluster operation failure (Checking list) 1. CN-56A (#7) – CN-51 (#22) Checking Open/Short 2. CN-56A (#6) – CN-51 (#32) Checking Open/Short			

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

<table>
<tr><th colspan="2">DTC</th><th rowspan="2">Diagnostic Criteria</th><th colspan="3">Application</th></tr>
<tr><th>HCESPN</th><th>FMI</th><th>G</th><th>C</th><th>W</th></tr>
<tr><td rowspan="2">841</td><td>2</td><td>10 seconds continuous, ECM Communication Data Error</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Control Function – ECM operation failure
(Checking list)
1. CN-16 (#6) – CN-51 (#21) Checking Open/Short
2. CN-16 (#7) – CN-51 (#31) Checking Open/Short</td></tr>
<tr><td rowspan="2">845</td><td>2</td><td>(When mounting the I/O Controller 1)
60 seconds continuous, I/O Controller 1 Communication Data Error</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Control Function – I/O Controller 1 operation failure
(Checking list)
1. CN-53 (#21) – CN-51 (#23) Checking Open/Short
2. CN-53 (#31) – CN-51 (#33) Checking Open/Short</td></tr>
<tr><td rowspan="2">848</td><td>2</td><td>(When mounting the Haptic Controller)
60 seconds continuous, Haptic Controller Communication Data Error</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Control Function – Haptic Controller operation failure
(Checking list)
1. CN-8 (#2) – CN-51 (#22) Checking Open/Short
2. CN-8 (#3) – CN-51 (#32) Checking Open/Short</td></tr>
<tr><td rowspan="2">850</td><td>2</td><td>(When mounting the RMCU)
60 seconds continuous, RMCU communication Data Error</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(Resuluts / Symptoms)
1. Control Function – RMCU operation failure
(Checking list)
1. CN-125A (#3) – CN-51 (#22) Checking Open/Short
2. CN-125A (#11) – CN-51 (#32) Checking Open/Short</td></tr>
<tr><td rowspan="2">861</td><td>2</td><td>(When mounting the I/O Controller 2)
60 seconds continuous, I/O Controller 2 communication Data Error</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Control Function – I/O Controller 2 operation failure
(Checking list)
1. CN-53 (#21) – CN-51 (#23) Checking Open/Short
2. CN-53 (#31) – CN-51 (#33) Checking Open/Short</td></tr>
</table>

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

DTC		Diagnostic Criteria	Application		
HCESPN	FMI		G	C	W
866	2	(When mounting the AAVM) 60 seconds continuous, AAVM communication Data Error	●		
	(Results / Symptoms) 1. Control Function – AAVM operation failure (Checking list) 1. CN-401 (#86) – CN-51 (#22) Checking Open/Short 2. CN-401 (#87) – CN-51 (#32) Checking Open/Short				
867	2	60 seconds continuous, RDU communication Data Error	●		
	(Results / Symptoms) 1. Control Function – RDU operation failure (Checking list) 1. CN-376 (#10) – CN-51 (#22) Checking Open/Short 2. CN-376 (#18) – CN-51 (#32) Checking Open/Short				
868	2	60 seconds continuous, Switch Controller communication Data Error	●		
	(Results / Symptoms) 1. Control Function – Switch Controller operation failure (Checking list) 1. CN-56A (#7) – CN-51 (#22) Checking Open/Short 2. CN-56A (#6) – CN-51 (#32) Checking Open/Short				
869	2	(When mounting the BKCU) 60 seconds continuous, BKCU communication Data Error	●		
	(Results / Symptoms) 1. Control Function – BKCU operation failure (Checking list) 1. CS-2B (#A) – CN-51 (#22) Checking Open/Short 2. CS-2B (#B) – CN-51 (#32) Checking Open/Short				

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

4. ENGINE FAULT CODE

Fault code J1939 SPN J1939 FMI	Name	Description
12D1 46 1	Pnuematic supply pressure	Low air pressure signal from APS
12D4 46 19	Pnuematic supply pressure	CAN message timeout from APS
2123 51 3	Engine throttle valve position	Throttle Position Sensor 1, short circuit to +24
2122 51 4	Engine throttle valve position	Throttle Position Sensor 1, short circuit to ground
2121 51 7	Engine throttle valve position	Throttle Position Sensor, not plausible
1091 51 8	Engine throttle valve position	Endpoints of throttle position sensor are out of range
2138 51 9	Engine throttle valve position	Throttle Position Sensor, correlation error
16C9 91 2	Accelerator pedal position	Auxiliary accelerator pedal is used due to other fault
16C8 91 9	Accelerator pedal position	Accelerator pedal faulty or error via can
D415 91 10	Accelerator pedal position	Accelerator pedal not plausible, faulty
D414 91 19	Accelerator pedal position	Accelerator pedal value out of range via CAN
1100 94 0	Engine fuel deliver pressure	Accumulator pressure is too high
250A 98 2	Engine oil level	Oil level sensor, faulty
250D 98 3	Engine oil level	Oil level sensor, short circuit to +24V
250C 98 4	Engine oil level	Oil level sensor, short circuit to ground
1715 98 10	Engine oil level	Oil level sensor stuck

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Name	Description
0524 100 1	Engine oil pressure	Oil pressure sensor, pressure too low
0521 100 2	Engine oil pressure	Oil pressure sensor, faulty
0523 100 3	Engine oil pressure	Oil pressure sensor, short circuit to +24V
0522 100 4	Engine oil pressure	Oil pressure sensor, short circuit to ground
1522 100 13	Engine oil pressure	Oil pressure sensor, pressure not plausible
1520 100 16	Engine oil pressure	Oil pressure sensor, pressure above normal
134F 100 17	Engine oil pressure	Oil pressure sensor, pressure too low and engine protective action
1521 100 18	Engine oil pressure	Oil pressure sensor, pressure below normal
0234 102 0	Engine intake manifold pressure	Boost pressure higher than reference
0299 102 1	Engine intake manifold pressure	Boost pressure lower than reference
0108 102 3	Engine intake manifold pressure	Boost pressure sensor, short circuit to +24V
0107 102 4	Engine intake manifold pressure	Boost pressure sensor, short circuit to ground
2262 102 7	Engine intake manifold pressure	Boost pressure, too low
1081 102 8	Engine intake manifold pressure	Boost pressure sensor, faulty
107C 102 9	Engine intake manifold pressure	Boost pressure, not plausible
006C 102 10	Engine intake manifold pressure	Boost pressure sensor, faulty

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Name	Description
006B 102 15	Engine intake manifold pressure	Boost pressure sensor and exhaust pressure sensor do not correlate
1234 102 16	Engine intake manifold pressure	Boost pressure above normal
1299 102 18	Engine intake manifold pressure	Boost pressure, lower than reference at part load
1066 102 20	Engine intake manifold pressure	Boost pressure, too high not plausible
1067 102 21	Engine intake manifold pressure	Boost pressure, too low not plausible
1683 103 0	Engine turbocharger speed	Turbine excessive overspeed
2579 103 2	Engine turbocharger speed	Turbine speed sensor, faulty
2581 103 3	Engine turbocharger speed	Turbine speed sensor, short circuit to +24V
2580 103 4	Engine turbocharger speed	Turbine speed sensor, short circuit to ground
2578 103 5	Engine turbocharger speed	Turbine speed sensor, open load
150B 103 9	Engine turbocharger speed	Turbine speed not plausible
1506 103 20	Engine turbocharger speed	Turbine speed sensor above model, not plausible
1504 103 21	Engine turbocharger speed	Turbine speed sensor below model, not plausible
16EA 105 0	Engine intake manifold temperature	Boost temp sensor excessive high
16EB 105 1	Engine intake manifold temperature	Boost temp sensor excessive low
0096 105 2	Engine intake manifold temperature	Boost temp sensor, faulty

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Name	Description
0098 105 3	Engine intake manifold temperature	Boost temp sensor, short circuit to +24V
0097 105 4	Engine intake manifold temperature	Boost temp sensor, short circuit to ground
16EE 105 9	Engine intake manifold temperature	Boost temperature above ambient, not plausible
16F3 105 15	Engine intake manifold temperature	Boost temperature to high for longer period
16C3 105 16	Engine intake manifold temperature	Boost temperature above normal
16EF 105 17	Engine intake manifold temperature	Boost temperature below ambient, not plausible
16F0 105 20	Engine intake manifold temperature	Boost temperature to high, not plausible
16F1 105 21	Engine intake manifold temperature	Boost temperature to low, not plausible
1422 107 1	Engine air filter pressure	Air filter clogged
1423 107 2	Engine air filter pressure	Air filter control switch broken
2226 108 2	Barometric pressure	Ambient Pressure Sensor Error via CAN
16DB 108 3	Barometric pressure	Ambient Pressure Sensor, short circuit to +24V
16DA 108 4	Barometric pressure	Ambient Pressure Sensor, short circuit to ground
106C 108 15	Barometric pressure	Ambient Pressure Sensor and Exhaust Pressure Sensor do not correlate
006D 108 16	Barometric pressure	Ambient Pressure above normal
1064 108 20	Barometric pressure	Ambient Pressure too high, not plausible

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Name	Description
1065 108 21	Barometric pressure	Ambient Pressure too low, not plausible
1133 110 0	Engine coolant temperature	Engine temperature, excessive high
1128 110 1	Engine coolant temperature	Engine temperature too low
1136 110 2	Engine coolant temperature	Engine temp sensor fault
0118 110 3	Engine coolant temperature	Engine temp sensor, short circuit to +24V
0117 110 4	Engine coolant temperature	Engine temp sensor, short circuit to ground
0115 110 8	Engine coolant temperature	Engine temp sensor, stuck
0116 110 9	Engine coolant temperature	Engine temp sensor, faulty
1135 110 10	Engine coolant temperature	Engine temperature is not plausble
1132 110 16	Engine coolant temperature	Engine temperature, too high
1130 110 17	Engine coolant temperature	Engine temp sensor, temp below normal or VGT-temp above normal
1131 110 18	Engine coolant temperature	Engine temp sensor, temp above normal or VGT-temp below normal
0217 110 20	Engine coolant temperature	Engine Coolant Water Temperature Too High
0128 110 21	Engine coolant temperature	Coolant Temperature Below Thermostat Regulating Temperature
2560 111 1	Engine coolant level	Coolant level too low
2556 111 3	Engine coolant level	Coolant level sensor, short circuit to +24

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Name	Description
2558 111 4	Engine coolant level	Coolant level sensor, short circuit to ground
107D 131 2	Engine exhaust back pressure	Exhaust pressure sensor, not plausible
0473 131 3	Engine exhaust back pressure	Exhaust pressure sensor, short circuit to +24V
0472 131 4	Engine exhaust back pressure	Exhaust pressure sensor, short circuit to ground or open load
106B 131 7	Engine exhaust back pressure	Exhaust pressure sensor and boost pressure sensor do not correlate
1078 131 8	Engine exhaust back pressure	Exhaust pressure sensor, faulty
16CC 131 9	Engine exhaust back pressure	Exhaust pressure sensor, stuck
106D 131 10	Engine exhaust back pressure	Exhaust pressure sensor and ambient pressure sensor do not correlate
1414 131 15	Engine exhaust back pressure	Exhaust pressure, high exhaust pressure during normal fueling
1413 131 16	Engine exhaust back pressure	Exhaust pressure, high exhaust pressure during motoring, no fueling
1415 131 18	Engine exhaust back pressure	Exhaust pressure, low exhaust pressure during exhaust brake
1068 131 20	Engine exhaust back pressure	Exhaust pressure too high, not plausible
106A 131 21	Engine exhaust back pressure	Exhaust pressure too low, not plausible
0103 132 0	Engine intake air mass flow rate	Mass flow sensor, short circuit to +24V
0102 132 1	Engine intake air mass flow rate	Mass flow sensor, short circuit to ground or open load
0101 132 2	Engine intake air mass flow rate	Mass flow sensor, faulty

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Name	Description
1187 132 3	Engine intake air mass flow rate	Mass flow sensor, supply
1189 132 4	Engine intake air mass flow rate	Mass flow sensor, adaptation under low threshold
1188 132 5	Engine intake air mass flow rate	Mass flow sensor, adaptation over high threshold
0100 132 7	Engine intake air mass flow rate	Mass flow sensor, stuck
0088 156 0	Engine injector timing rail pressure	Fuel rail pressure is excessively above command
0087 156 1	Engine injector timing rail pressure	Fuel rail pressure is excessively below command
0191 156 2	Engine injector timing rail pressure	Fuel rail pressure sensor, faulty
0193 156 3	Engine injector timing rail pressure	Fuel rail pressure sensor, short circuit to +24V or open load
0192 156 4	Engine injector timing rail pressure	Fuel rail pressure sensor, short circuit to ground
0190 156 8	Engine injector timing rail pressure	Fuel rail pressure sensor, stuck
1090 156 9	Engine injector timing rail pressure	Fuel rail pressure is lagging
1087 156 18	Engine injector timing rail pressure	Fuel rail pressure is too low during cranking
1060 167 2	Charging system potential	Alternator actuator, faulty
1063 167 3	Charging system potential	Alternator actuator, short circuit to +24V
1062 167 4	Charging system potential	Alternator actuator, short circuit to ground
1061 167 5	Charging system potential	Alternator actuator, open load

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Name	Description
063A 167 9	Charging system potential	Alternator 1, signal not plausible
160B 167 10	Charging system potential	Alternator 2, signal not plausible
1565 168 0	Battery potential	Battery voltage above 47 V for 1 s
1564 168 1	Battery potential	Battery voltage below 9 V for 0.5 s
1507 168 4	Battery potential	Battery voltage 1 for engine control unit is low
1509 168 5	Battery potential	Battery voltage 2 for engine control unit is low
2064 168 15	Battery potential	Battery voltage too high for SCR main unit
0563 168 16	Battery potential	Battery voltage above 32 V
2063 168 17	Battery potential	Battery voltage too low for SCR main unit
0562 168 18	Battery potential	Battery voltage below 21 V
1074 171 0	Ambient air temperature	Ambient temperature sensors correlation error
1271 171 1	Ambient air temperature	Ambient temperature low or boost temperature high
11B0 171 2	Ambient air temperature	Ambient temperature sensor, faulty
1073 171 3	Ambient air temperature	Ambient temperature sensor error via CAN
1075 171 4	Ambient air temperature	Ambient temperature sensor error via CAN
1077 171 7	Ambient air temperature	Ambient temperature sensor stuck

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Name	Description
D104 171 9	Ambient air temperature	CAN message AMBIENT CONDITION from coordinator timeout
1076 171 15	Ambient air temperature	Ambient temperature sensors correlation error
1270 171 16	Ambient air temperature	Ambient temperature high or boost temperature low
1071 171 17	Ambient air temperature	Ambient temperature sensors correlation error
1072 171 18	Ambient air temperature	Ambient temperature sensors correlation error
1070 171 19	Ambient air temperature	Ambient temperature sensor signal defect
0070 171 20	Ambient air temperature	Temperature sensor before compressor low or ambient temperature sensor high
0071 171 21	Ambient air temperature	Temperature sensor before compressor high or ambient temperature sensor low
0111 172 2	Engine air intake temperature	Air inlet temp sensor, faulty
0113 172 3	Engine air intake temperature	Air inlet temp sensor, short circuit to +24V
0112 172 4	Engine air intake temperature	Air inlet temp sensor, short circuit to ground
0114 172 7	Engine air intake temperature	Air inlet temp sensor, stuck
0198 175 3	Engine oil temperature	Oil temp sensor, short circuit to +24V
0197 175 4	Engine oil temperature	Oil temp sensor, short circuit to ground
0195 175 11	Engine oil temperature	Oil temp sensor, faulty
16C2 188 14	Engine speed at idle	Idle due to other fault

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Name	Description
1205 190 0	Engine speed	Severe overspeed has occured
1201 190 10	Engine speed	Overspeed protection, fast over speed
1321 190 15	Engine speed	Engine speed has been above the limit
1202 190 16	Engine speed	Overspeed protection, over speed
0219 190 20	Engine speed	Engine overspeed, value to high
C10F 234 2	Software identification	The EMS and EEC control units are incompatible
D10B 234 19	Software identification	Wrong CAN version transmitted by COO
16C1 532 14	Engine speed at high idle	Increased idle due to other fault
D109 558 2	Accelerator pedal - low idle switch	Low idle switch error state from coordinator
D107 559 2	Accelerator pedal kickdown switch	Kickdown signal defect via CAN
1550 559 9	Accelerator pedal kickdown switch	Accelerator pedal kickdown CAN message, faulty
D418 559 10	Accelerator pedal kickdown switch	Accelerator pedal/kick down switch, EMS and coordinator do not agree
D105 597 2	Brake switch	Brake pedal signal defect via CAN
D106 598 2	Clutch switch	Clutch pedal signal defect via CAN
0811 598 7	Clutch switch	Excessive clutch slip
D10D 598 19	Clutch switch	CAN-signal or engine shut-down command from OPC for automatic clutch failure, timeout

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Name	Description
1214 636 1	Engine position sensor	Camshaft position sensor, faulty
0344 636 2	Engine position sensor	Camshaft position sensor, intermittent fault
0343 636 3	Engine position sensor	Camshaft position sensor, short circuit to +24V
0342 636 4	Engine position sensor	Camshaft position sensor, short circuit to ground
0340 636 5	Engine position sensor	Camshaft position sensor, open circuit
0016 636 7	Engine position sensor	Engine speed detected by flywheel sensor, but no signal from camshaft sensor
0341 636 8	Engine position sensor	Camshaft Pulse Pattern, Gap or Sync Error or other fault
16E7 641 2	Engine turbocharger actuator	VGT internal temperature sensor stuck
1686 641 4	Engine turbocharger actuator	VGT voltage supply open load
16B5 641 5	Engine turbocharger actuator	VGT internal temperature sensor open circuit
168B 641 7	Engine turbocharger actuator	VGT motion limited or restricted
168E 641 8	Engine turbocharger actuator	VGT reference or position not found
1134 641 9	Engine turbocharger actuator	VGT temperature sensor value not plausible
168C 641 10	Engine turbocharger actuator	VGT motion error, span too large
1689 641 11	Engine turbocharger actuator	VGT actuator faulty
1693 641 12	Engine turbocharger actuator	VGT internal fault

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Name	Description
16DF 641 13	Engine turbocharger actuator	VGT actuator installation procedure was not completed
1685 641 15	Engine turbocharger actuator	VGT error
1684 641 16	Engine turbocharger actuator	VGT temperature too high
1690 641 19	Engine turbocharger actuator	VGT timeout on CAN
D101 645 19	Engine tachometer	CAN message TCO1 from tachograph timeout
11A1 651 1	Engine injector cylinder 1	Two or more injectors with the same trim code, injector cyl. 1
1178 651 2	Engine injector cylinder 1	Injector trim code, checksum error injector cyl. 1
0261 651 4	Engine injector cylinder 1	Injector 1 cable short circuit to ground
0201 651 5	Engine injector cylinder 1	Injector cyl. 1 cable/injector open load
115F 651 6	Engine injector cylinder 1	Injector cyl. 1 cable/injector short circuit
1150 651 7	Engine injector cylinder 1	Injection error, physical cylinder 1
118F 651 8	Engine injector cylinder 1	Injector cyl. 1, over or under fueling
12C0 651 10	Engine injector cylinder 1	Fault with sensors/actuators for the particulate filter
1199 651 13	Engine injector cylinder 1	Injector trim code version error, injector cyl. 1
11E0 651 15	Engine injector cylinder 1	Cylinder 1 torque error
11D0 651 16	Engine injector cylinder 1	Cylinder 1 injector fault, high torque

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Name	Description
11D8 651 18	Engine injector cylinder 1	Cylinder 1 injector fault, low torque
0263 651 20	Engine injector cylinder 1	Cylinder 1 balancing min or max
11E8 651 21	Engine injector cylinder 1	Cylinder balancing, not plausible
11A2 652 1	Engine injector cylinder 2	Two or more injectors with the same trim code, injector cyl. 2
1179 652 2	Engine injector cylinder 2	Injector trim code, checksum error injector cyl. 2
0264 652 4	Engine injector cylinder 2	Injector 2 cable short circuit to ground
0202 652 5	Engine injector cylinder 2	Injector cyl. 2 cable/injector open load
1161 652 6	Engine injector cylinder 2	Injector cyl. 2 cable/injector short circuit
1151 652 7	Engine injector cylinder 2	Injection error, physical cylinder 2
1190 652 8	Engine injector cylinder 2	Injector cyl. 2, over or under fueling
12C1 652 10	Engine injector cylinder 2	Fault with sensors/actuators for the particulate filter
119A 652 13	Engine injector cylinder 2	Injector trim code version error, injector cyl. 2
11E1 652 15	Engine injector cylinder 2	Cylinder 2 torque error
11D1 652 16	Engine injector cylinder 2	Cylinder 2 injector fault, high torque
11D9 652 18	Engine injector cylinder 2	Cylinder 2 injector fault, low torque
0266 652 20	Engine injector cylinder 2	Cylinder 2 balancing min or max

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Name	Description
11A3 653 1	Engine injector cylinder 3	Two or more injectors with the same trim code, injector cyl. 3
117A 653 2	Engine injector cylinder 3	Injector trim code, checksum error injector cyl. 3
0267 653 4	Engine injector cylinder 3	Injector 3 cable short circuit to ground
0203 653 5	Engine injector cylinder 3	Injector cyl. 3 cable/injector open load
1164 653 6	Engine injector cylinder 3	Injector cyl. 3 cable/injector short circuit
1152 653 7	Engine injector cylinder 3	Injection error, physical cylinder 3
1191 653 8	Engine injector cylinder 3	Injector cyl. 3, over or under fueling
12C2 653 10	Engine injector cylinder 3	Fault with sensors/actuators for the particulate filter
119B 653 13	Engine injector cylinder 3	Injector trim code version error, injector cyl. 3
11E2 653 15	Engine injector cylinder 3	Cylinder 3 torque error
11D2 653 16	Engine injector cylinder 3	Cylinder 3 injector fault, high torque
11DA 653 18	Engine injector cylinder 3	Cylinder 3 injector fault, low torque
0269 653 20	Engine injector cylinder 3	Cylinder 3 balancing min or max
11A4 654 1	Engine injector cylinder 4	Two or more injectors with the same trim code, injector cyl. 4
117B 654 2	Engine injector cylinder 4	Injector trim code, checksum error injector cyl. 4
0270 654 4	Engine injector cylinder 4	Injector 4 cable short circuit to ground

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Name	Description
0204 654 5	Engine injector cylinder 4	Injector cyl. 4 cable/injector open load
1167 654 6	Engine injector cylinder 4	Injector cyl. 4 cable/injector short circuit
1153 654 7	Engine injector cylinder 4	Injection error, physical cylinder 4
1192 654 8	Engine injector cylinder 4	Injector cyl. 4, over or under fueling
12C3 654 10	Engine injector cylinder 4	Fault with sensors/actuators for the particulate filter
119C 654 13	Engine injector cylinder 4	Injector trim code version error, injector cyl. 4
11E3 654 15	Engine injector cylinder 4	Cylinder 4 torque error
11D3 654 16	Engine injector cylinder 4	Cylinder 4 injector fault, high torque
11DB 654 18	Engine injector cylinder 4	Cylinder 4 injector fault, low torque
0272 654 20	Engine injector cylinder 4	Cylinder 4 balancing min or max
11A5 655 1	Engine injector cylinder 5	Two or more injectors with the same trim code, injector cyl. 5
117C 655 2	Engine injector cylinder 5	Injector trim code, checksum error injector cyl. 5
0273 655 4	Engine injector cylinder 5	Injector 5 cable short circuit to ground
0205 655 5	Engine injector cylinder 5	Injector cyl. 5 cable/injector open load
116E 655 6	Engine injector cylinder 5	Injector cyl. 5 cable/injector short circuit
1154 655 7	Engine injector cylinder 5	Injection error, physical cylinder 5

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Name	Description
1193 655 8	Engine injector cylinder 5	Injector cyl. 5, over or under fueling
12C4 655 10	Engine injector cylinder 5	Fault with sensors/actuators for the particulate filter
119D 655 13	Engine injector cylinder 5	Injector trim code version error, injector cyl. 5
11E4 655 15	Engine injector cylinder 5	Cylinder 5 torque error
11D4 655 16	Engine injector cylinder 5	Cylinder 5 injector fault, high torque
11DC 655 18	Engine injector cylinder 5	Cylinder 5 injector fault, low torque
0275 655 20	Engine injector cylinder 5	Cylinder 5 balancing min or max
11A6 656 1	Engine injector cylinder 6	Two or more injectors with the same trim code, injector cyl. 6
117D 656 2	Engine injector cylinder 6	Injector trim code, checksum error injector cyl. 6
0206 656 5	Engine injector cylinder 6	Injector cyl. 6 cable/injector open load
1171 656 6	Engine injector cylinder 6	Injector cyl. 6 cable/injector short circuit
1155 656 7	Engine injector cylinder 6	Injection error, physical cylinder 6
1194 656 8	Engine injector cylinder 6	Injector cyl. 6, over or under fueling
119E 656 13	Engine injector cylinder 6	Injector trim code version error, injector cyl. 6
11E5 656 15	Engine injector cylinder 6	Cylinder 6 torque error
11D5 656 16	Engine injector cylinder 6	Cylinder 6 injector fault, high torque

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Name	Description
11DD 656 18	Engine injector cylinder 6	Cylinder 6 injector fault, low torque
0278 656 20	Engine injector cylinder 6	Cylinder 6 balancing min or max
11A7 657 1	Engine injector cylinder 7	Two or more injectors with the same trim code, injector cyl. 7
117E 657 2	Engine injector cylinder 7	Injector trim code, checksum error injector cyl. 7
0207 657 5	Engine injector cylinder 7	Injector cyl. 7 cable/injector open load
1174 657 6	Engine injector cylinder 7	Injector cyl. 7 cable/injector short circuit
1156 657 7	Engine injector cylinder 7	Injection error, physical cylinder 7
1195 657 8	Engine injector cylinder 7	Injector cyl. 7, over or under fueling
119F 657 13	Engine injector cylinder 7	Injector trim code version error, injector cyl. 7
11E6 657 15	Engine injector cylinder 7	Cylinder 7 torque error
11D6 657 16	Engine injector cylinder 7	Cylinder 7 injector fault, high torque
11DE 657 18	Engine injector cylinder 7	Cylinder 7 injector fault, low torque
0281 657 20	Engine injector cylinder 7	Cylinder 7 balancing min or max
11A8 658 1	Engine injector cylinder 8	Two or more injectors with the same trim code, injector cyl. 8
117F 658 2	Engine injector cylinder 8	Injector trim code, checksum error injector cyl. 8
0208 658 5	Engine injector cylinder 8	Injector cyl. 8 cable/injector open load

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Name	Description
1177 658 6	Engine injector cylinder 8	Injector cyl. 8 cable/injector short circuit
1157 658 7	Engine injector cylinder 8	Injection error, physical cylinder 8
1196 658 8	Engine injector cylinder 8	Injector cyl. 8, over or under fueling
11A0 658 13	Engine injector cylinder 8	Injector trim code version error, injector cyl. 8
11E7 658 15	Engine injector cylinder 8	Cylinder 8 torque error
11D7 658 16	Engine injector cylinder 8	Cylinder 8 injector fault, high torque
11DF 658 18	Engine injector cylinder 8	Cylinder 8 injector fault, low torque
0284 658 20	Engine injector cylinder 8	Cylinder 8 balancing min or max
160D 677 0	Engine starter motor relay	Unintentional starter activation while moving or idling
160C 677 2	Engine starter motor relay	Starter actuator, faulty
1645 677 3	Engine starter motor relay	Starter actuator, short circuit to +24V
1646 677 4	Engine starter motor relay	Starter actuator, short circuit to ground
0512 677 5	Engine starter motor relay	Starter actuator, open load
1670 677 7	Engine starter motor relay	Starter actuator, blind start
D108 677 19	Engine starter motor relay	Starter motor demand defect via CAN
1319 723 2	Engine speed	Engine position sensor 2, faulty

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Name	Description
1312 723 4	Engine speed	Engine position sensor 2, too weak signal
1212 723 7	Engine speed	Engine position sensor 2, faulty
1330 723 8	Engine speed	Engine position sensor 2, Gap Puls or Sync error
1318 723 9	Engine speed	Engine position sensor 2, Time out
1311 723 10	Engine speed	Engine position sensor 2, position diff
1317 723 14	Engine speed	Engine position sensor 2 error torque limit
16C6 974 0	Remote accelerator pedal position	Signal level from redundant gas pedal above high limit
16C5 974 1	Remote accelerator pedal position	Signal level from redundant gas pedal below low limit
1602 986 2	Requested % fan speed	Fan actuator, faulty
0692 986 3	Requested % fan speed	Fan actuator, short circuit to +24V
0691 986 4	Requested % fan speed	Fan actuator, short circuit high to ground
0480 986 5	Requested % fan speed	Fan actuator, open load
1603 986 7	Requested % fan speed	Fan coupling unit, bad performance
12D3 1086 2	Parking and/or trailer pressure	Electrical fault on the parking brake pressure sensor
16C0 1108 14	Engine protection system timer override	Overridden due to other fault
16BF 1110 14	Engine protection system has shutdown engine	Engine Stop due to other fault

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Name	Description
0094 1239 7	Engine fuel leakage	Fuel Rail pressure, small volume leak
0300 1322 7	Engine misfire for multiple cylinders	Random/Multiple Cylinder Misfire Detected
0301 1323 7	Engine misfire cylinder 1	Cylinder 1 Misfire Detected
0302 1324 7	Engine misfire cylinder 2	Cylinder 2 Misfire Detected
0303 1325 7	Engine misfire cylinder 3	Cylinder 3 Misfire Detected
0304 1326 7	Engine misfire cylinder 4	Cylinder 4 Misfire Detected
0305 1327 7	Engine misfire cylinder 5	Cylinder 5 Misfire Detected
1183 1442 2	Engine fuel valve position	Inlet metering valve 1, faulty
1184 1442 3	Engine fuel valve position	Inlet metering valve 1, short circuit to +24V
1182 1442 5	Engine fuel valve position	Inlet metering valve 1, short circuit to ground
11B8 1442 7	Engine fuel valve position	Inlet metering valve 1, stuck
11B1 1442 8	Engine fuel valve position	Inlet metering valve 1, plausible leakage
118E 1442 10	Engine fuel valve position	Inlet metering valve 1, calculated resistance error
1080 1443 1	Engine fuel valve position	Mechanical dump valve, opened
118B 1443 6	Engine fuel valve position	Mechanical dump valve, tripped
1605 1483 2	Source address of engine control device	EMS internal error

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Name	Description
1606 1483 2	Source address of engine control device	EMS Memory Error
1610 1483 2	Source address of engine control device	EMS Memory Error
1607 1483 8	Source address of engine control device	EMS Memory or TPU Error
160F 1483 8	Source address of engine control device	EMS memory or TPU error
16D7 1483 9	Source address of engine control device	Camshaft TPU Supervision Error
160A 1483 11	Source address of engine control device	Software Watchdog Reset
1604 1483 12	Source address of engine control device	Hardware watchdog error
D100 1484 9	Other control are reporting faults affecting the engine	CAN message DLN1 from coordinator timeout
D102 1484 10	Other control are reporting faults affecting the engine	CAN message CRUISE CONTROL/ VEHICLE SPEED from coordinator timeout
D113 1484 16	Other control are reporting faults affecting the engine	CAN message from EMSX, invalid data
D112 1484 18	Other control are reporting faults affecting the engine	CAN message from EMSX, invalid data
D103 1484 19	Other control are reporting faults affecting the engine	CAN message DLN6 from coordinator timeout
D111 1484 20	Other control are reporting faults affecting the engine	CAN message timout from EMSX
D110 1484 21	Other control are reporting faults affecting the engine	CAN message timout from EMSX
20EA 1485 16	ECM main relay	SCR main unit, power switched off too early
20EB 1485 18	ECM main relay	SCR main unit, power switched off too late

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Name	Description
16BE 1569 14	Engine protection torque derate	Torque reduction due to other fault
16F9 1639 3	Fan speed	Fan speed sensor, short circuit to +24V
0526 1639 4	Fan speed	Fan speed sensor supply too low
0528 1639 8	Fan speed	Fan speed sensor circuit no signal
D10F 1675 2	Engine starter mode	Immobiliser - EMS and EMSX
C426 1675 9	Engine starter mode	Invalid Data Received From Vehicle Control Module
D10A 1675 12	Engine starter mode	Immobiliser error
C326 1675 13	Engine starter mode	Software Incompatibility With Vehicle Immoblilizer Control Module
C167 1675 19	Engine starter mode	Lost Communication With Vehicle Immobilizer Control Module
1704 1761 1	After treatment diesel exhaust fluid level	Reductant tank, empty
203C 1761 2	After treatment diesel exhaust fluid level	Reductant tank level sensor, short circuit to ground
203A 1761 3	After treatment diesel exhaust fluid level	Reductant tank level sensor, short circuit to +24V
203D 1761 5	After treatment diesel exhaust fluid level	Reductant tank level sensor, open circuit
203F 1761 18	After treatment diesel exhaust fluid level	Reductant tank, low level
1600 2609 2	Cab A/C outlet pressure	AC compressor actuator, faulty
2521 2609 3	Cab A/C outlet pressure	AC compressor actuator, short circuit to +24V

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Name	Description
2520 2609 4	Cab A/C outlet pressure	AC compressor actuator, short circuit to ground
2519 2609 5	Cab A/C outlet pressure	AC compressor actuator, open load
042F 2791 2	Engine EGR valve control	EGR actuator, control error
0490 2791 3	Engine EGR valve control	EGR actuator, short circuit to +24V
0489 2791 4	Engine EGR valve control	EGR actuator, short circuit to ground
1400 2791 5	Engine EGR valve control	EGR actuator, stuck open
0488 2791 7	Engine EGR valve control	EGR actuator, stuck close
1424 2791 8	Engine EGR valve control	The EGR valve is responding too slow
2BAB 2791 10	Engine EGR valve control	NOx Exceedence - Incorrect EGR Flow
0400 2791 11	Engine EGR valve control	EGR system faulty
2BAC 2791 16	Engine EGR valve control	NOx Exceedence - Deactivation of EGR
0402 2791 20	Engine EGR valve control	EGR higher than desired
0401 2791 21	Engine EGR valve control	EGR lower than desired
115D 2797 2	Engine injector group 1	Injector group A, short circuit to other bank
115C 2797 3	Engine injector group 1	Injector group A, short circuit to +24V
115B 2797 4	Engine injector group 1	Injector group A, short circuit to ground

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Name	Description
1692 2797 5	Engine injector group 1	Injector drive voltage, faulty
115A 2797 8	Engine injector group 1	Injector group A, injection error
116D 2798 2	Engine injector group 2	Injector group B, short circuit to other bank
116C 2798 3	Engine injector group 2	Injector group B, short circuit +24V
116B 2798 4	Engine injector group 2	Injector group B, short circuit ground
116A 2798 8	Engine injector group 2	Injection error, group B
1608 2858 13	Machine data config. 1	EMS, Default EOL Data in E2
1609 2859 13	Machine data config. 2	EMS, Default Barcoding Data in E2
1697 2860 13	Machine data config. 3	EMS internal software error
1613 2861 13	Machine data config. 4	EMS Configuration for Automatic Clutch Faulty
9999 2862 13	Machine data config. 5	Internal software error
1038 3031 0	After treatment diesel exhaust fluid tank temperature	SCR main unit, high temperature low limit exceedence
2215 3216 4	After treatment - intake Nox	NOx sensor upstream, internal fault or open circuit
2213 3216 5	After treatment - intake Nox	NOx sensor upstream, open circuit
2214 3216 7	After treatment - intake Nox	NOx sensor upstream, internal fault
100B 3216 8	After treatment - intake Nox	NOx sensor upstream of catalytic converter

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Name	Description
100E 3216 9	After treatment - intake Nox	NOx sensor upstream of catalytic converter
16CF 3216 10	After treatment - intake Nox	NOx sensor upstream, stuck
16F4 3216 17	After treatment - intake Nox	NOx sensor upstream, low signal
16D8 3216 18	After treatment - intake Nox	NOx sensor upstream, too low value
12CA 3216 19	After treatment - intake Nox	NOx sensor upstream error via CAN
16FA 3216 20	After treatment - intake Nox	NOx sensor upstream, not plausible
2202 3226 4	After treatment - outlet Nox	NOx sensor downstream, internal fault or open circuit
2200 3226 5	After treatment - outlet Nox	NOx sensor downstream, open circuit
2201 3226 7	After treatment - outlet Nox	NOx sensor downstream, internal fault
12C9 3226 8	After treatment - outlet Nox	NOx sensor downstream error via CAN
100F 3226 9	After treatment - outlet Nox	NOx sensor downstream of the SCR catalytic converter
16CE 3226 10	After treatment - outlet Nox	NOx sensor downstream, stuck
16F2 3226 17	After treatment - outlet Nox	NOx sensor downstream, low signal
16D9 3226 18	After treatment - outlet Nox	NOx sensor downstream, too low value
100A 3226 19	After treatment - outlet Nox	NOx sensor downstream of the catalytic converter
16FB 3226 20	After treatment - outlet Nox	NOx sensor downstream, not plausible

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Name	Description
0426 3241 2	After treatment - exhaust gas temperature	Upstream catalyst temperature sensor not plausible.
104D 3241 3	After treatment - exhaust gas temperature	Upstream catalyst temperature sensor not plausible, too high
0427 3241 4	After treatment - exhaust gas temperature	Upstream catalyst temperature sensor not plausible, short circuit
0425 3241 5	After treatment - exhaust gas temperature	Upstream catalyst temperature sensor not plausible, open circuit
104F 3241 8	After treatment - exhaust gas temperature	Upstream catalyst temperature sensor not plausible, too high
16CD 3241 10	After treatment - exhaust gas temperature	Upstream catalyst temperature sensor not plausible.
20ED 3241 16	After treatment - exhaust gas temperature	Upstream catalyst temperature too high
104E 3241 18	After treatment - exhaust gas temperature	Upstream catalyst temperature sensor not plausible, too low
16FF 3241 19	After treatment - exhaust gas temperature	CAN Error from Exhaust Temperature Sensors
1803 3242 0	After treatment - DPF intake gas temp.	Upstream DPF temperature sensor, too high
16FC 3242 7	After treatment - DPF intake gas temp.	Upstream DPF temperature sensor, not plausible
2080 3242 9	After treatment - DPF intake gas temp.	Upstream DPF temperature sensor, not plausible
200F 3242 10	After treatment - DPF intake gas temp.	Upstream DPF temperature too high during normal condition
200E 3242 16	After treatment - DPF intake gas temp.	Upstream DPF temperature too high during regeneration
12CF 3245 19	After treatment - exhaust gas temperature	Auxiliary Temperature Sensor Error on CAN
12CB 3246 2	After treatment - DPF outlet gas temp.	Downstream DPF temperature sensor error

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Name	Description
042C 3246 3	After treatment - DPF outlet gas temp.	Exhaust temperature sensor after SCR catalytic converter, short circuit
042D 3246 4	After treatment - DPF outlet gas temp.	Exhaust temperature sensor after SCR catalytic converter, open circuit
242B 3246 9	After treatment - DPF outlet gas temp.	Downstream exhaust temperature sensor, not plausible
200D 3246 15	After treatment - DPF outlet gas temp.	Downstream DPF temperature too high during normal condition
200C 3246 16	After treatment - DPF outlet gas temp.	Downstream DPF temperature too high during regeneration
16E3 3251 2	After treatment - DPF differential pressure	Particulate filter is missing
16D6 3251 7	After treatment - DPF differential pressure	Differential pressure sensor over particulate filter, faulty
16E4 3251 7	After treatment - DPF differential pressure	Particulate filter is damaged or cracked
12D2 3251 8	After treatment - DPF differential pressure	Differential pressure sensor not plausible
16D5 3251 9	After treatment - DPF differential pressure	Differential pressure sensor over particulate filter, not plausible
16ED 3340 1	Engine CAC intake pressure	Intercooler temperature, too low
1111 3340 3	Engine CAC intake pressure	Intercooler pressure sensor, short circuit to ground
1112 3340 4	Engine CAC intake pressure	Intercooler pressure sensor, short circuit to +24V
1079 3340 7	Engine CAC intake pressure	Intercooler pressure sensor, stuck
107E 3340 9	Engine CAC intake pressure	Intercooler pressure sensor, not plausible
107F 3340 10	Engine CAC intake pressure	Intercooler pressure sensor, not plausible

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Name	Description
106F 3340 15	Engine CAC intake pressure	Intercooler pressure, above normal
106E 3340 16	Engine CAC intake pressure	Intercooler pressure, above normal
107A 3340 20	Engine CAC intake pressure	Intercooler pressure too high
107B 3340 21	Engine CAC intake pressure	Intercooler pressure too low
16DD 3360 0	After treatment - Diesel exhaust fluid controller	SCR system adaptation have reached max values
16DE 3360 1	After treatment - Diesel exhaust fluid controller	SCR system adaptation have reached min values
12C7 3360 2	After treatment - Diesel exhaust fluid controller	EEC3 System has demanded "SCR Hazardous major functional failure" actions
20A3 3360 3	After treatment - Diesel exhaust fluid controller	SCR main unit, ventilation valve test, short to battery
1033 3360 4	After treatment - Diesel exhaust fluid controller	SCR main unit, internal supply voltage low
20A0 3360 5	After treatment - Diesel exhaust fluid controller	SCR main unit, ventilation valve test, open load
1047 3360 6	After treatment - Diesel exhaust fluid controller	SCR main unit, system voltage error
1022 3360 7	After treatment - Diesel exhaust fluid controller	SCR main unit, ignition switch plausible error
12C6 3360 9	After treatment - Diesel exhaust fluid controller	EEC3 has demanded "SCR Major functional failure reductant dosing stopped" actions
12C8 3360 10	After treatment - Diesel exhaust fluid controller	EEC3 System has demanded "SCR minor functional failure" actions
16AA 3360 12	After treatment - Diesel exhaust fluid controller	SCR main unit, error
1032 3360 16	After treatment - Diesel exhaust fluid controller	SCR main unit, internal supply voltage high

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Name	Description
100C 3360 19	After treatment - Diesel exhaust fluid controller	SCR main unit, communication error
2049 3361 3	After treatment - Diesel exhaust fluid dosing unit	SCR reductant dosing valve, short circuit to battery
2047 3361 5	After treatment - Diesel exhaust fluid dosing unit	SCR reductant dosing valve, open circuit
208E 3361 10	After treatment - Diesel exhaust fluid dosing unit	SCR main unit, reductant pressure not plausible
202D 3362 2	After treatment - Diesel exhaust fluid dosing unit input lines	SCR reductant pressure, error
20C0 3363 0	After treatment - Diesel exhaust fluid tank heater	SCR main unit, reductant heater, circuit high
20BD 3363 2	After treatment - Diesel exhaust fluid tank heater	SCR main unit, reductant heater, open load
20C4 3363 3	After treatment - Diesel exhaust fluid tank heater	SCR main unit, internal heating pump, short circuit to battery
2044 3363 4	After treatment - Diesel exhaust fluid tank heater	SCR main unit, reductant temperature sensor circuit low
20C1 3363 5	After treatment - Diesel exhaust fluid tank heater	SCR main unit, internal heating pump, open load
20BE 3363 8	After treatment - Diesel exhaust fluid tank heater	SCR main unit, reductant heater, circuit performance
1054 3363 15	After treatment - Diesel exhaust fluid tank heater	SCR reagent tank temperature too high
101A 3363 16	After treatment - Diesel exhaust fluid tank heater	SCR main unit, high temperature high limit exceeded
209F 3363 17	After treatment - Diesel exhaust fluid tank heater	SCR reductant tank temperature too low
2045 3363 18	After treatment - Diesel exhaust fluid tank heater	SCR main unit, low temperature limit exceeded
0638 3464 2	Engine throttle actuator control command	Throttle, control error

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Name	Description
2103 3464 3	Engine throttle actuator control command	Throttle Actuator, short circuit to +24V
2102 3464 4	Engine throttle actuator control command	Throttle Actuator, short circuit
2101 3464 5	Engine throttle actuator control command	Throttle Actuator, slow response
2106 3464 6	Engine throttle actuator control command	Throttle Actuator Control System - Forced Limited Power
2111 3464 7	Engine throttle actuator control command	Throttle, stuck in open position
2112 3464 8	Engine throttle actuator control command	Throttle, stuck in closed position
20CA 3485 1	After treatment - supply air pressure	SCR main unit, air pressure too low
209A 3485 2	After treatment - supply air pressure	SCR main unit, air pressure sensor after orifice circuit supply
209D 3485 3	After treatment - supply air pressure	SCR main unit, air pressure sensor after orifice circuit high
209C 3485 4	After treatment - supply air pressure	SCR main unit, air pressure sensor after orifice circuit low
1014 3485 7	After treatment - supply air pressure	SCR, air circuit blocked
209B 3485 9	After treatment - supply air pressure	SCR main unit, air pressure sensor after orifice performance
1045 3485 18	After treatment - supply air pressure	EEC, air supply low
209E 3485 20	After treatment - supply air pressure	SCR main unit, air pressure sensor after orifice plausible error
1082 3563 11	Engine intake manifold pressure	Boost pressure sensor and ambient pressure sensor do not correlate
1069 3563 15	Engine intake manifold pressure	Boost pressure sensor and ambient pressure sensor do not correlate

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Name	Description
0069 3563 17	Engine intake manifold pressure	Boost pressure sensor and ambient pressure sensor do not correlate
F001 3607 2	Engine emergency shutdown	Incorrect EMS shutdown
2128 3673 3	Engine throttle valve position	Throttle Position Sensor 2, short circuit to +24V
2127 3673 4	Engine throttle valve position	Throttle Position Sensor 2, short circuit to ground
0406 3822 3	Engine EGR valve position	EGR position sensor, short circuit to +24V
0405 3822 4	Engine EGR valve position	EGR position sensor, short circuit to ground
1405 3822 7	Engine EGR valve position	EGR SRA reports a warning during Learn Stops.
049D 3822 8	Engine EGR valve position	EGR position sensor, outside the permitted range
1404 3822 12	Engine EGR valve position	EGR SRA reports it has a continuous fault.
1705 3822 13	Engine EGR valve position	EGR position sensor, not plausible
1406 3822 16	Engine EGR valve position	EGR SRA reports a running conditions warning for high temp or low voltage.
1402 3822 19	Engine EGR valve position	EGR CAN timeout
1813 3822 20	Engine EGR valve position	EGR position sensor, voltage shows large variation in open position
1814 3822 21	Engine EGR valve position	EGR position sensor, voltage shows large variation in closed position
244B 3936 2	After treatment - DPF filter	Particulate filter, clogged
242F 3936 6	After treatment - DPF filter	Particulate filter, ash level too high

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Name	Description
1802 3936 10	After treatment - DPF filter	Exhaust temperature sensors, not plausible
1049 4090 0	Nox limit exceeded	NOx level after catalytic converter too high
2BAD 4090 11	Nox limit exceeded	NOx Exceedence - Root Cause Unknown
20EE 4090 16	Nox limit exceeded	SCR main unit, NOx level too high
2BA8 4095 2	Nox limit exceeded	NOx Exceedence - Interruption of Reagent Dosing Activity
2BA7 4096 2	Nox limit exceeded	NOx Exceedence - Empty Reagent Tank
1309 4201 2	Engine speed	Engine position sensor 1, faulty
1302 4201 4	Engine speed	Engine position sensor 1, too weak signal
1213 4201 7	Engine speed	Engine position sensor 1, faulty
1303 4201 8	Engine speed	Engine position sensor 1, Gap Puls or Sync error
1308 4201 9	Engine speed	Engine position sensor 1, time out
1301 4201 10	Engine speed	Engine position sensor 1, position diff
0726 4202 2	Engine speed	Engine speed sensor faulty
2BAE 4225 2	Nox limit exceeded	Failure in the NOx control monitoring system
1040 4334 0	After treatment Diesel exhaust fluid pressure	SCR reductant pressure error
12C5 4334 1	After treatment Diesel exhaust fluid pressure	EEC3 has demanded "SCR Hazardous functional failure reductant dosing stopped" actions

Fault code J1939 SPN J1939 FMI	Name	Description
103D 4334 2	After treatment Diesel exhaust fluid pressure	Urea pressure sensor, plausible error during start-up
204D 4334 3	After treatment Diesel exhaust fluid pressure	Urea pressure sensor, SCR high
204C 4334 4	After treatment Diesel exhaust fluid pressure	Urea pressure sensor, SCR low
204B 4334 8	After treatment Diesel exhaust fluid pressure	Urea pressure sensor, pressure too high not plausible
1031 4374 0	After treatment - Diesel exhaust fluid pump	Reductant pump fault, pump speed too high
1030 4374 1	After treatment - Diesel exhaust fluid pump	Reductant pump fault, pump speed too low
16AC 4782 0	DPF soot density	Particulate filter is clogged, hazardous
16AB 4782 16	DPF soot density	Particulate filter is clogged, major
12CC 4809 2	After treatment - DOC intake temp.	Upstream exhaust temperature sensor error
16E0 4809 7	After treatment - DOC intake temp.	Upstream exhaust temperature sensor, stuck
12CE 4809 8	After treatment - DOC intake temp.	Upstream exhaust temperature sensor error
16FD 4809 9	After treatment - DOC intake temp.	Upstream exhaust temperature sensor, not plausible
1700 4809 16	After treatment - DOC intake temp.	Upstream exhaust temperature sensor, above limit
1701 4809 18	After treatment - DOC intake temp.	Upstream exhaust temperature sensor, below limit
16B1 4810 9	After treatment - DOC outlet temp	Particulate filter, temperature drop not plausible
2423 4810 18	After treatment - DOC outlet temp	Upstream exhaust temperature too low during regeneration

Fault code J1939 SPN J1939 FMI	Name	Description
2601 4814 2	Engine coolant pump	Coolant water pump actuator, faulty
2603 4814 3	Engine coolant pump	Coolant water pump actuator, short circuit on high side
2602 4814 4	Engine coolant pump	Coolant water pump actuator, short circuit on low side
1811 4814 7	Engine coolant pump	Coolant pump speed sensor, stuck
00B7 4814 8	Engine coolant pump	Electrically controlled coolant pump
1810 4814 10	Engine coolant pump	Coolant pump speed sensor, no signal
16EC 5285 1	Engine CAC efficiency	Boost temperature to high, not plausible
245B 5401 2	Engine Turbocharger Turbine Bypass Actuator	EGR bypass actuator, faulty
245D 5401 3	Engine Turbocharger Turbine Bypass Actuator	EGR bypass actuator, short circuit high to +24V
245C 5401 4	Engine Turbocharger Turbine Bypass Actuator	EGR bypass actuator, short circuit high to ground
245A 5401 5	Engine Turbocharger Turbine Bypass Actuator	EGR bypass actuator, open load
1717 5419 2	Engine Throttle Actuator	Throttle M42, CAN interface fault
1707 5419 3	Engine Throttle Actuator	Throttle M42, supply voltage fault
1716 5419 5	Engine Throttle Actuator	Throttle M42, current limited
170A 5419 6	Engine Throttle Actuator	Throttle M42, overload
1708 5419 9	Engine Throttle Actuator	Throttle M42 has detected a CAN timeout

Fault code J1939 SPN J1939 FMI	Name	Description
170B 5419 10	Engine Throttle Actuator	Throttle M42, control error
1710 5419 11	Engine Throttle Actuator	Throttle M42, internal fault
1711 5419 12	Engine Throttle Actuator	Throttle M42, software execution error
170D 5419 13	Engine Throttle Actuator	Throttle M42, unsuccessful learning of the reference position
1709 5419 14	Engine Throttle Actuator	Throttle M42 has detected a CAN timeout
1706 5419 16	Engine Throttle Actuator	Throttle M42, too high temperature
1714 5419 19	Engine Throttle Actuator	Throttle M42, CAN timeout
170F 5419 31	Engine Throttle Actuator	Throttle M42, service mode enabled
1426 5421 3	Engine Turbocharger Wastegate Actuator	Wastegate actuator, short circuit to +24V
0249 5421 4	Engine Turbocharger Wastegate Actuator	Wastegate actuator, short circuit
1425 5421 5	Engine Turbocharger Wastegate Actuator	Wastegate actuator, short circuit to ground
0247 5421 6	Engine Turbocharger Wastegate Actuator	Wastegate actuator, short circuit
1407 5543 2	Engine Exhaust Brake Actuator Command	Exhaust brake actuator, control fault
0478 5543 3	Engine Exhaust Brake Actuator Command	Exhaust brake actuator, short circuit to +24V
0477 5543 4	Engine Exhaust Brake Actuator Command	Exhaust brake actuator, short circuit to ground
1427 5543 5	Engine Exhaust Brake Actuator Command	Exhaust brake actuator, stuck in open position

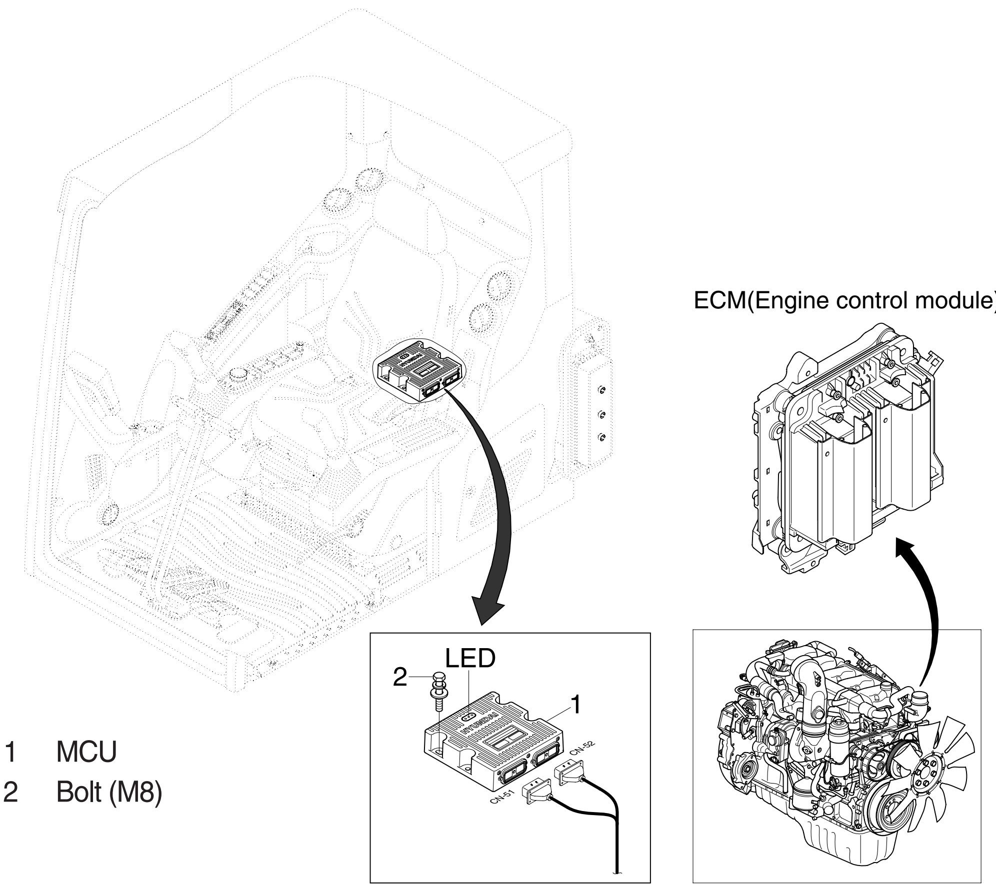
Fault code J1939 SPN J1939 FMI	Name	Description
0475 5543 6	Engine Exhaust Brake Actuator Command	Exhaust brake actuator, faulty
1411 5543 7	Engine Exhaust Brake Actuator Command	Exhaust brake actuator, stuck in closed position
1428 5543 12	Engine Exhaust Brake Actuator Command	Exhaust brake actuator, control fault
1408 5543 13	Engine Exhaust Brake Actuator Command	Exhaust brake actuator, fault with stop position
1409 5543 16	Engine Exhaust Brake Actuator Command	Exhaust brake actuator, over temperature
1403 5543 19	Engine Exhaust Brake Actuator Command	Exhaust brake actuator, CAN timeout
0476 5543 21	Engine Exhaust Brake Actuator Command	Exhaust brake actuator, error
205B 5743 2	Aftertreatment SCR Temperature	Reductant tank temperature sensor, not plausible
205C 5743 4	Aftertreatment SCR Temperature	Reductant tank temperature sensor, short circuit
205A 5743 5	Aftertreatment SCR Temperature	Reductant tank temperature sensor, open load
202C 5745 3	Aftertreatment Diesel Exhaust Fluid Dosing Unit Heater	SCR water valve, short circuit to battery
202A 5745 5	Aftertreatment Diesel Exhaust Fluid Dosing Unit Heater	SCR water valve, open load
207F 5841 1	Diesel Exhaust Fluid Quality Malfunction	SCR main unit, reductant quality too low

5. AAVM FAULT CODE

Fault Code	Description
A01	AAVM Communication Error -AAVM
A02	AAVM Communication Error -Front Camera
A03	AAVM Communication Error -Rear Camera
A04	AAVM Communication Error -Left Camera
A05	AAVM Communication Error -Right Camera
A06	Manual Setting Fail
A07	No MCU CID
A08	MCU CID Format Error
A09	AAVM Hardware Error -AAVM
A10	AAVM Hardware Error -Front Camera
A11	AAVM Hardware Error -Rear Camera
A12	AAVM Hardware Error -Left Camera
A13	AAVM Hardware Error -Right Camera
A14	MCU CID Model is not registered
A15	MCU CID Model can’t be applied

GROUP 12 ENGINE CONTROL SYSTEM

1. MCU and Engine ECM (Electronic Control Module)



1 MCU
2 Bolt (M8)

480F5MS10

2. MCU ASSEMBLY

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

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

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

G : green, R : red, Y : yellow

GROUP 13 EPPR VALVE

1. PUMP EPPR VALVE

1) COMPOSITION

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

(1) Electro magnet valve

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

(2) Spool valve

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

(3) Pressure and electric current value for each mode

Mode		Pressure		Electric current (mA)	Engine rpm (at accel dial 10)
		kgf/cm^2	psi		
Standard	P	8	114	280 ± 30	1750 ± 50
	S	10 ± 3	142 ± 40	305 ± 30	1650 ± 50
	E	13 ± 3	185 ± 40	340 ± 30	1550 ± 50
Option	P	0	0	230 ± 30	1850 ± 50
	S	0	0	260 ± 30	1800 ± 50
	E	5 ± 3	71 ± 40	340 ± 30	1600 ± 50

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

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

- Management
  - · Service menu

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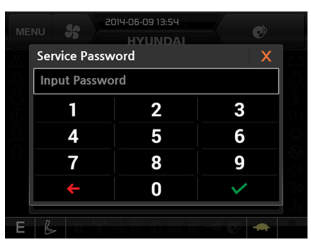

Enter the password

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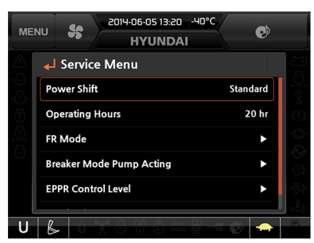

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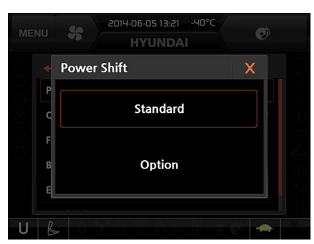

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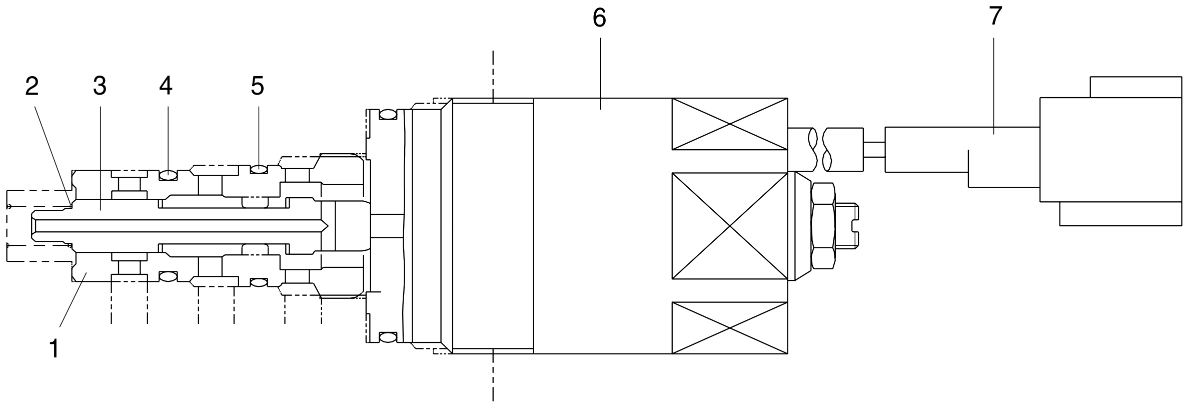
· Power shift (standard/option) : Power shift pressure can be set by option menu.

3) OPERATING PRINCIPLE (pump EPPR valve)

(1) Structure



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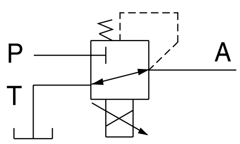
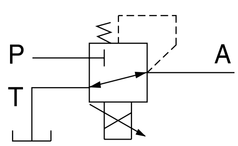
1	Sleeve	4	O-ring	6	Solenoid valve
2	Spring	5	O-ring	7	Connector
3	Spool				

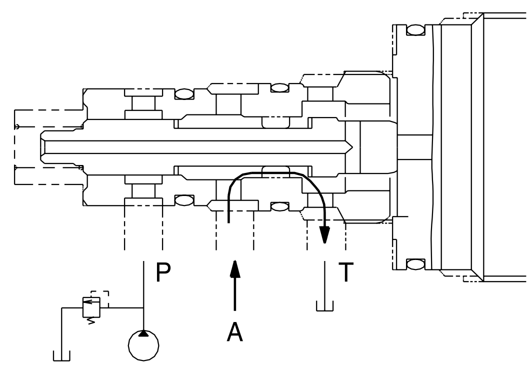


P Pilot oil supply line (pilot pressure)
T Return to tank
A Secondary pressure to flow regulator at main pump

(2) Neutral

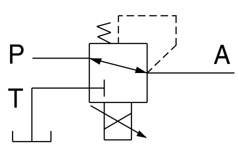
Pressure line is blocked and A oil returns to tank.

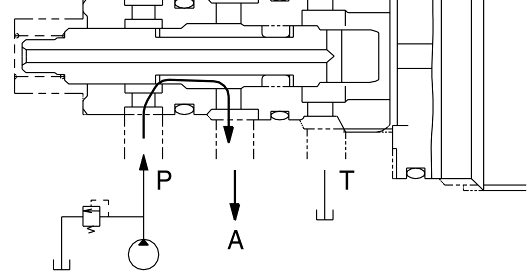




(3) Operating

Secondary pressure enters into A.





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4) EPPR VALVE CHECK PROCEDURE

(1) Check electric current value at EPPR valve

① Disconnect connector CN-75 from EPPR valve.

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

③ Start engine.

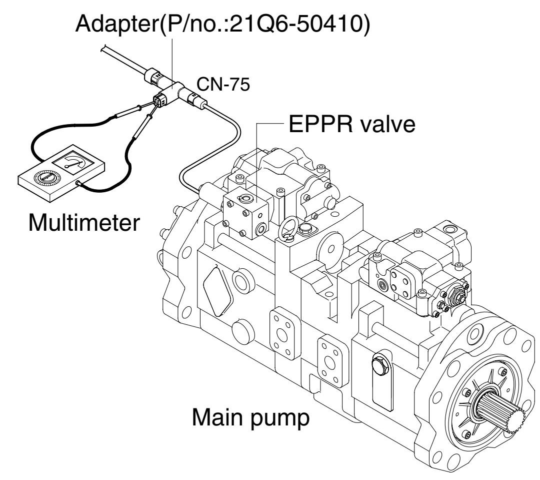
④ Set S-mode and cancel auto decel mode.

⑤ Position the multimodal dial at 10.

⑥ If rpm display show approx 1650±50 rpm check electric current at bucket circuit relief position.

⑦ Check electric current at bucket circuit relief position.

Spec : 100~700 mA



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(2) Check pressure at EPPR valve

① Remove plug and connect pressure gauge as figure.

· Gauge capacity : 0 to 50 kgf/cm² (0 to 725 psi)

② Start engine.

③ Set S-mode and cancel auto decel mode.

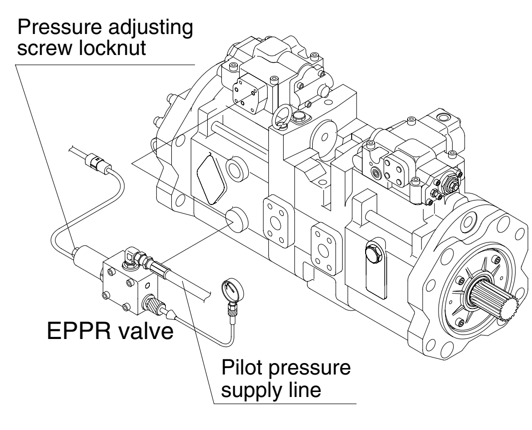
④ Position the multimodal dial at 10.

⑤ If tachometer show approx 1650±50 rpm check pressure at relief position of bucket circuit by operating bucket control lever.

⑥ If pressure is not correct, adjust it.

⑦ After adjust, test the machine.

Spec : 2~25 kgf/cm² (30~350 psi)



900L5MS22

2. BOOM PRIORITY EPPR VALVE

1) COMPOSITION

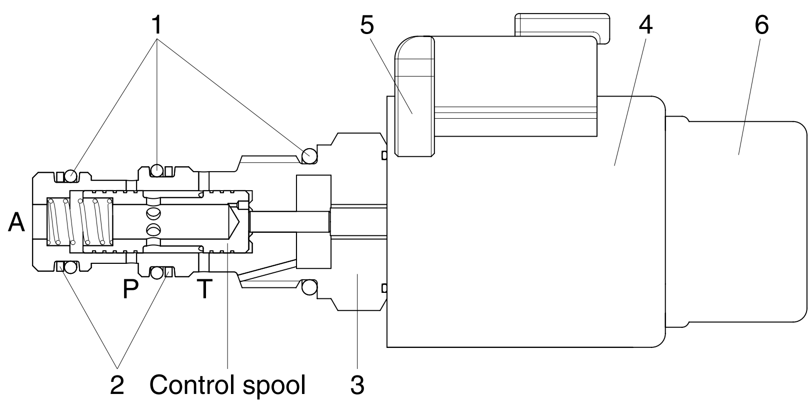
The boom priority EPPR valve is built in a manifold and mainly consisting of valve body and coil.
This EPPR valve installed under the solenoid valve.

2) CONTROL

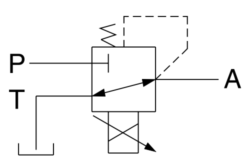
The boom priority EPPR valve has to be controlled by a specific electronic amplifier card, which is supplying the coil with a current 580 mA at 30Ω and 24 V.

3) OPERATING PRINCIPLE

(1) Structure



21095MS14



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

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

(2) Operation

In de-energized mode the inlet port (P) is closed and the outlet port (A) is connected to tank port (T).
In energized mode the solenoid armature presses onto the control spool with a force corresponding to the amount of current. This will set a reduced pressure at port A. The setting is proportional to the amount of current applied.

(3) Maximum pressure relief

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

2) EPPR VALVE CHECK PROCEDURE

(1) Check electric current value at EPPR valve

① Disconnect connector CN-133 from EPPR valve.

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

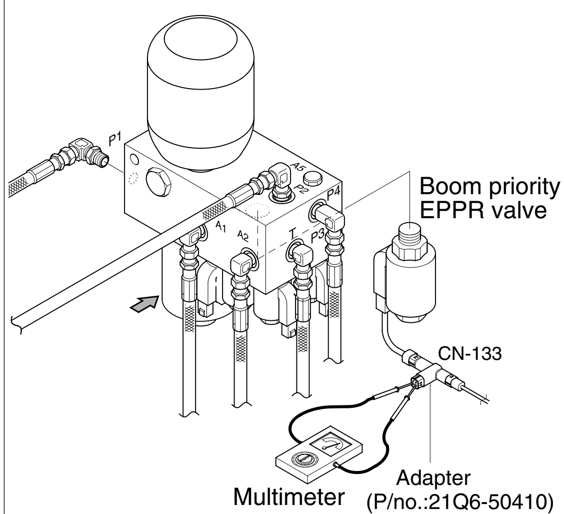
③ Start engine.

④ Set S-mode and cancel auto decel mode.

⑤ If rpm display approx 1650±50 rpm disconnect one wire harness from EPPR valve.

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

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



900L5MS23

(2) Check pressure at EPPR valve

① Remove hose from A5 port and connect pressure gauge as figure.

· Gauge capacity : 0 to 50 kgf/cm^2 (0 to 725 psi)

② Start engine.

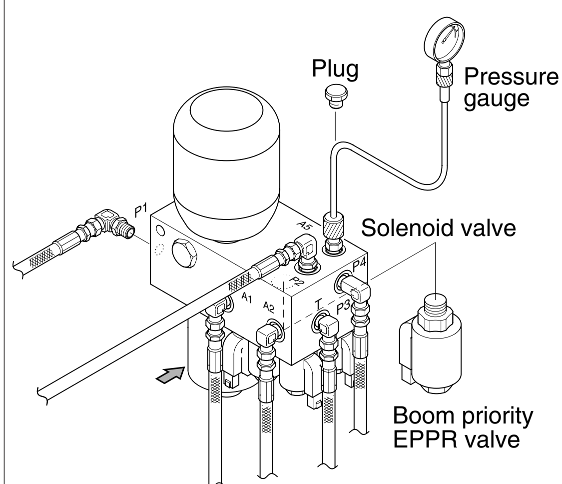
③ Set S-mode and cancel auto decel mode.

④ If rpm display approx 1650±50 rpm check pressure (In case of combined boom up and swing operation).

⑤ If pressure is not correct, adjust it.

⑥ After adjust, test the machine.

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



900L5MS24

GROUP 14 MONITORING SYSTEM

1. OUTLINE

Monitoring system consists of the monitor part and switch part.
The monitor part gives warnings when any abnormality occurs in the machine and informs the condition of the machine.
Various select switches are built into the monitor panel, which act as the control portion of the machine control system.

2. CLUSTER

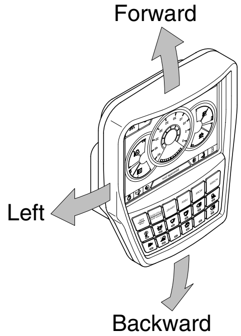
1) MONITOR PANEL

900L5MS13

※ The warning lamp pops up and/or blinks and the buzzer sounds when the machine has a problem.
The warning lamp blinks until the problem is cleared. Refer to page 5-86 for details.

※ This cluster is adjustable.

· Vertical (forward/backward) : each 15°
· Horizontal (left only) : 8°



290F3CD47

2) CLUSTER CHECK PROCEDURE

(1) Start key : ON

① Check monitor

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

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

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

a. Engine rpm display : 0 rpm

b. Engine coolant temperature gauge : White range

c. Hydraulic oil temperature gauge : White range

d. Fuel level gauge : White range

③ Indicating lamp state

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

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

c. Travel speed pilot lamp : Low (turtle)

(2) Start of engine

① Check machine condition

a. RPM display indicates at present rpm

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

※ When normal condition : All warning lamp OFF

c. Work mode selection : General work

d. Power mode selection : E mode or U mode

e. Travel speed pilot lamp : Low (turtle)

② When warming up operation

a. Warming up pilot lamp : ON

b. After engine started, engine speed increases to1000 rpm.

※ Others same as above.

③ When abnormal condition

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

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

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

3. CLUSTER CONNECTOR

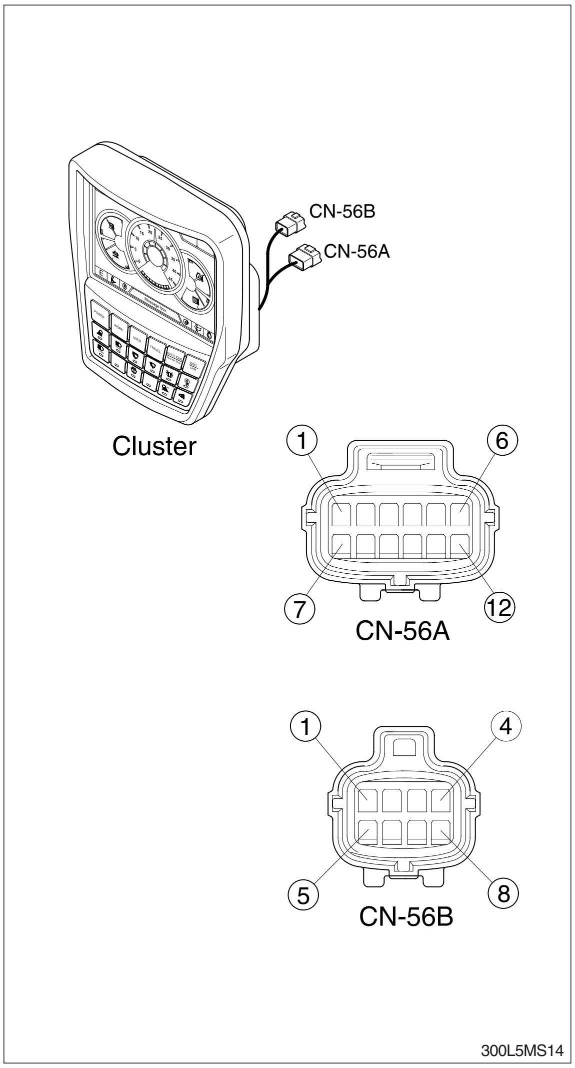
1) CN-56A

No.	Name	Signal
1	Battery 24V	20~32V
2	Power IG (24V)	20~32V
3	GND	-
4	CAN 1 (H)	0~5V
5	CAN 1 (L)	0~5V
6	CAN 2 (H)	20~32V
7	CAN 2 (L)	20~32V
8	RS-232 (RX)	±15V
9	RS-232 (TX)	±15V
10	Aux left	0~5V
11	Aux right	0~5V
12	Aux GND	-

CN-56B

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

NTSC : National Television System Committee

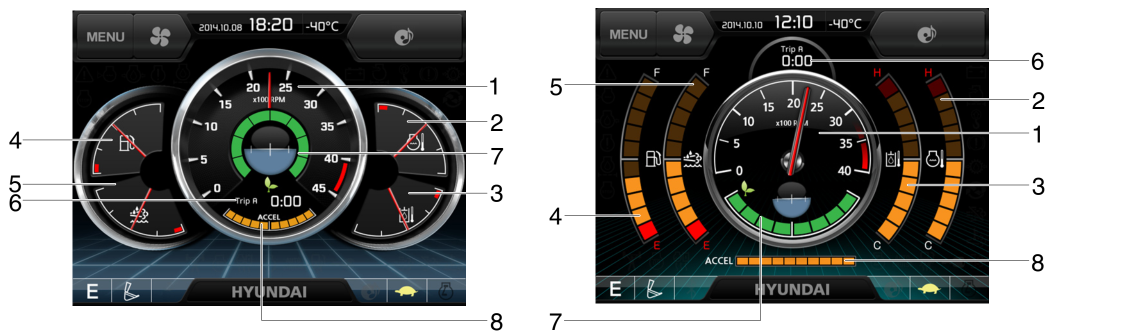


2) GAUGE

(1) Operation screen

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

Default　　　　　　　　　　　　　　　　Option



290F3CD51

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

※ Operation screen type can be set by the screen type menu of the display.
Refer to page 5-108 for details.

(2) RPM / Speed gauge

290F3CD49

① This display the engine speed.

(3) Engine coolant temperature gauge

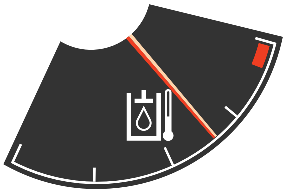
290F3CD53

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

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

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

(4) Hydraulic oil temperature gauge



290F3CD54

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

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

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

(5) Fuel level gauge

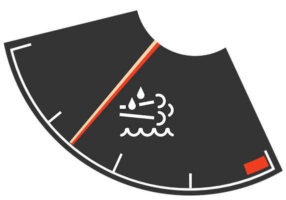
290F3CD55

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

② Fill the fuel when the red range, or lamp pops up and the buzzer sounds.

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

(6) DEF/AdBlue® Level gauge



290F3CD57

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

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

③ Do not pour DEF/AdBlue® any more when the DEF/AdBlue® fill up warning lamp lights ON.

※ Refer to page 5-90.

※ 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.

(7) Tripmeter display

290F3CD56

① This displays the engine the tripmeter.

※ Refer to page 5-110 for details.

(8) Eco gauge

290F3CD58

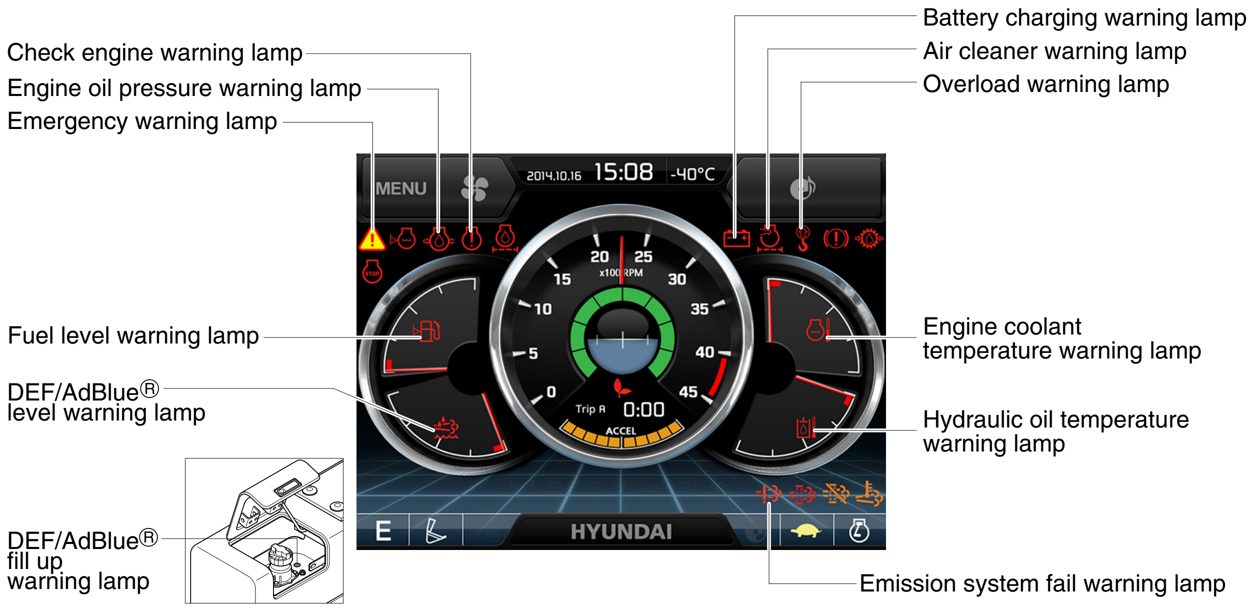
① This gauge indicates the fuel consumption rate and machine load status. So that operators can be careful with fuel economy.
② The fuel consumption rate or machine load is higher, the number of segment is increased.
③ The color of Eco gauge indicates operation status.
- White : Idle operation
- Green : Economy operation
- Yellow : Non-economy operation at a medium level.
- Red : Non-economy operation at a high level.

(9) Accel dial gauge

290F3CD59

① This gauge indicates the level of accel dial.

3) WARNING LAMPS



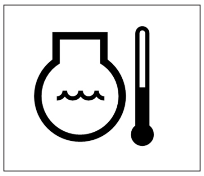
480F3CD60

※ Warning lamps and buzzer

Warnings	When error happened	Lamps and buzzer
All warning lamps except below	Warning lamp pops up on the center of the LCD and the buzzer sounds	· The pop-up warning lamp moves to the original position and blinks, and the buzzer stops when ; - the buzzer stop switch (AUTO IDLE Buzzer Stop) is pushed - the knob of the haptic controller is pushed - the lamp of the LCD is touched
	Warning lamp pops up on the center of the LCD and the buzzer sounds	· The pop-up warning lamp moves to the original position and light ON or blinks, and the buzzer stops when ; - the buzzer stop switch (AUTO IDLE Buzzer Stop) is pushed - the knob of the haptic controller is pushed - the lamp of the LCD is touched **※ Refer to page 5-90 for details.**
	Warning lamp pops up on the center of the LCD and the buzzer sounds	**※ Refer to page 5-87 for details.**

※ Refer to page 5-95 for the buzzer stop switch (AUTO IDLE Buzzer Stop) and operator's manual page 3-57 for the haptic controller.

(1) Engine coolant temperature warning lamp



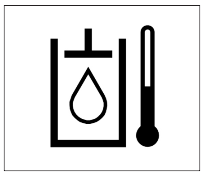
290F3CD61

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

② The pop-up , lamps move to the original position and blinks when the buzzer stop switch AUTO IDLE Buzzer Stop is pushed. And the buzzer stops and , lamps keep blink.

③ Check the cooling system when the lamps keep blink.

(2) Hydraulic oil temperature warning lamp



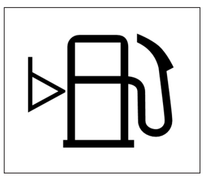
290F3CD62

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

② The pop-up , lamps move to the original position and blinks when the buzzer stop switch AUTO IDLE Buzzer Stop is pushed. And the buzzer stops and , lamps keep blink.

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

(3) Fuel level warning lamp



290F3CD63

① This warning lamp pops up and the buzzer sounds when the level of fuel is below 210 ℓ (55.5 U.S. gal).

② Fill the fuel immediately when the lamp blinks.

(4) Emergency warning lamp

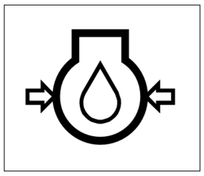
290F3CD64

① This warning lamp pops up and the buzzer sounds when each of the below warnings is happened.
- Engine coolant overheating (over 107˚C)
- Hydraulic oil overheating (over 105˚C)
- MCU input voltage abnormal
- Cluster communication data error
- Engine ECM communication data error

※ **The pop-up warning lamp moves to the original position and blinks when the buzzer stop switch AUTO IDLE Buzzer Stop is pushed. And the buzzer stops.**

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

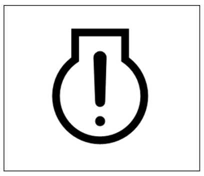
(5) Engine oil pressure warning lamp



290F3CD65

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

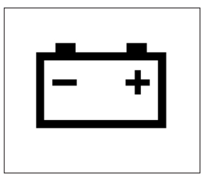
(6) Check engine warning lamp



290F3CD66

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

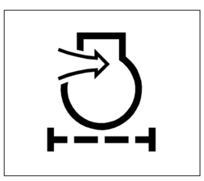
(7) Battery charging warning lamp



290F3CD67

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

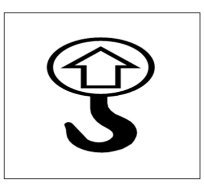
(8) Air cleaner warning lamp



290F3CD68

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

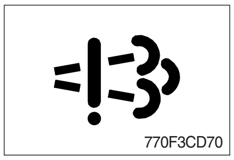
(9) Overload warning lamp (opt)



290F3CD69

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

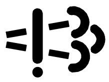
(10) Emission system fail warning lamp



① This warning lamp lights ON if there are faults on the SCR system.

※ In the case of some faults, the torque is reduced.

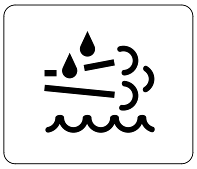
※ Please contact your Hyundai service center or local dealer.

Warning lamp		Torque reduction
	Time	
On	Fault detected	-
Blink	After 30 minutes	· Torque is reduced by 1% per minute to 70% of the highest torque.
Blink rapidly	After 4 hours	· Torque is reduced by to 0% (low idling) within 2~10 minutes.

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

※ If a new fault occurs within 40 hours of operation since the first fault, the warning lamp will come ON. After 30 minutes of operation, the warning lamp will blink rapidly and torque will be reduced to 0% (low idling) within 30 minutes.

(11) DEF/AdBlue® level warning lamp



290F3CD257

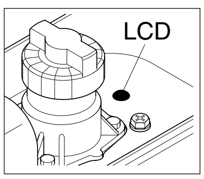
① This warning lamp indicates when ON or blinking, that the DEF/AdBlue® level is low as table below.

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

※ The engine resumes normal torque after DEF/AdBlue® has been filled to a level of at least 20%.

Warning lamp		Description
	DEF/AdBlue® level	
On	20%	· The DEF/AdBlue® level has fallen below the initial warning level (20%).
Blink	10%	· The DEF/AdBlue® level has fallen below the critical warning level (10%). · Torque is reduced by 1% per minute to 70% of the highest torque.
Blink rapidly	0%	· This is happened when 30 minutes elapsed with empty conditions (0%) of the DEF/AdBlue® tank. · Torque is reduced by to 0% (low idling) within 2~10 minutes.

(12) DEF/AdBlue® fill up warning lamp



290F3CD272

① This lamp lights ON when the DEF/AdBlue® tank is completely filled with DEF/AdBlue®.

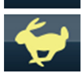
※ Fill the tank with the DEF/AdBlue® after start switch ON and then turn OFF the start switch.

※ Do not pour DEF/AdBlue® any more when this lamp lights ON. Otherwise DEF/AdBlue® tank may freeze and burst in winter season.

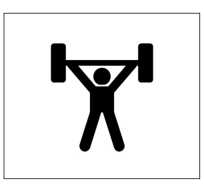
4) PILOT LAMPS

290F3CD74A

(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

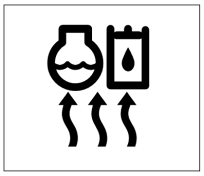
(2) Power max pilot lamp



290F3CD78

① The lamp will be ON when pushing power max switch on the LH RCV lever.
② The power max function is operated maximum 8 seconds.
※ Refer to the operator's manual page 3-37 for power max function.

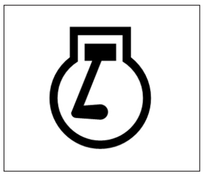
(3) Warming up pilot lamp



290F3CD80

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.

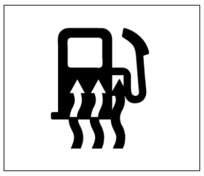
(4) Decel pilot lamp



290F3CD81

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 3-36.

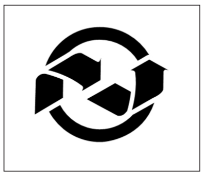
(5) Fuel warmer pilot lamp



290F3CD82

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, and the hydraulic oil temperature is above 45˚C since the start switch was ON position.

(6) Maintenance pilot lamp



290F3CD83

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.
※ Refer to the page 5-103.

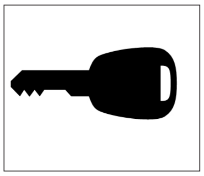
(7) Entertainment pilot lamp

290F3CD84

① This lamp is on when audio or video files are playing.

※ Refer to the page 5-109.

(8) Smart key pilot lamp (opt)



290F3CD214

① This lamp is ON when the engine is started by the start button.

② This lamp is red when the a authentication fails, green when succeeds.

※ Refer to the page 5-104.

5) SWITCHES

290F3CD86

※ When some of the switches are selected, the pilot lamps are displayed on the LCD. Refer to the page 5-91 for details.

(1) Power mode switch

290F3CD76

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.

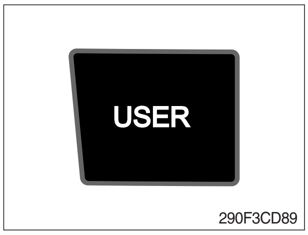
(2) Work mode switch

290F3CD88

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

※ Refer to the operator's manual page 4-7 for details.

(3) User mode switch



290F3CD89

① This switch is used to memorize the current machine operating status in the MCU and activate the memorized user mode.
  · Memory : Automatically saved after key OFF.
  · Action : Push this switch.
  · Cancel : Push this switch once more.

② Refer to the page 5-99 for another set of user mode.

(4) Travel speed switch

290F3CD91

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

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

⚠ Personal injury can result from sudden changes in machine stability.

(5) Auto idle/ buzzer stop switch

290F3CD90

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

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

(6) Escape/Camera switch

290F3CD92

① This switch is used to return to the previous menu or parent menu.

② In the operation screen, pushing this switch will display the view of the camera on the machine (if equipped).
Please refer to page 5-110 for the camera.

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

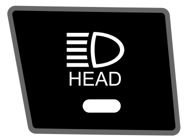
(7) Work light switch

290F3CD93

① This switch is used to operate the work light.

② The pilot lamp is turned ON when operating the switch.

(8) Head light switch



290F3CD94

① This switch is used to operate the head light.
② The pilot lamp is turned ON when operating the switch.

(9) Intermittent wiper switch

290F3CD95

① This switch is used to wipe operates intermittently.
② The pilot lamp is turned ON when operating the switch.

(10) Wiper switch

290F3CD96

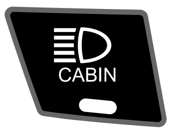
① This switch is used to operate the window wiper.
② Note that the wiper will self-park when switched off.
③ The pilot lamp is turned ON when operating the switch.
※ **If the wiper does not operate with the switch in ON position, turn the switch OFF immediately. Check the cause. If the switch remains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

(11) Washer switch

290F3CD100

① The washer liquid is sprayed and the wiper is operated only while pressing this switch.
② The pilot lamp is turned ON when operating the switch.

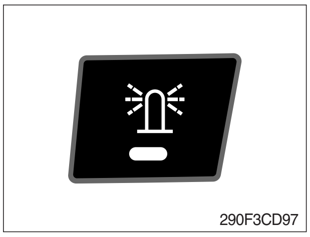
(12) Cab light switch



290F3CD99

① This switch turns ON the cab light on the cab.
② The pilot lamp is turned ON when operating the switch.

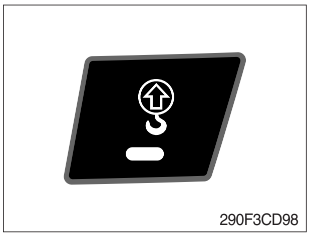
(13) Beacon switch



290F3CD97

① This switch turns ON the rotary light on the cab.
② The pilot lamp is turned ON when operating the switch.

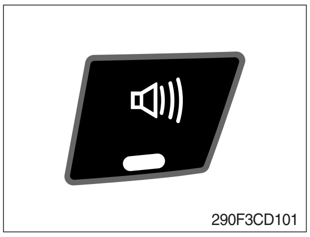
(14) Overload switch



290F3CD98

① When this switch turned ON, buzzer makes sound and overload warning lamp comes ON in case that the machine is overload.
② When it turned OFF, buzzer stops and warning lamp goes out.
⚠ **Overloading the machine could impact the machines stability which could result in tipover hazard. A tipover hazard could result in serious injury or death. Always activate the overload warning device before you handle or lift objects.**

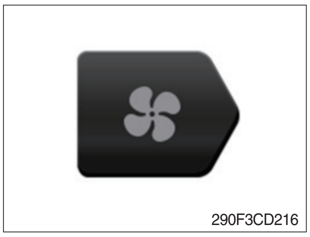
(15) Travel alarm switch



290F3CD101

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

(16) Air conditioner quick touch switch



290F3CD216

① This switch used to select air conditioner control mode.
※ Refer to the page 5-112.

(17) Main menu quick touch switch

290F3CD217

① This switch is to activate the main menu in the cluster.
※ Refer to the page 5-98.

(18) Entertainment quick touch switch

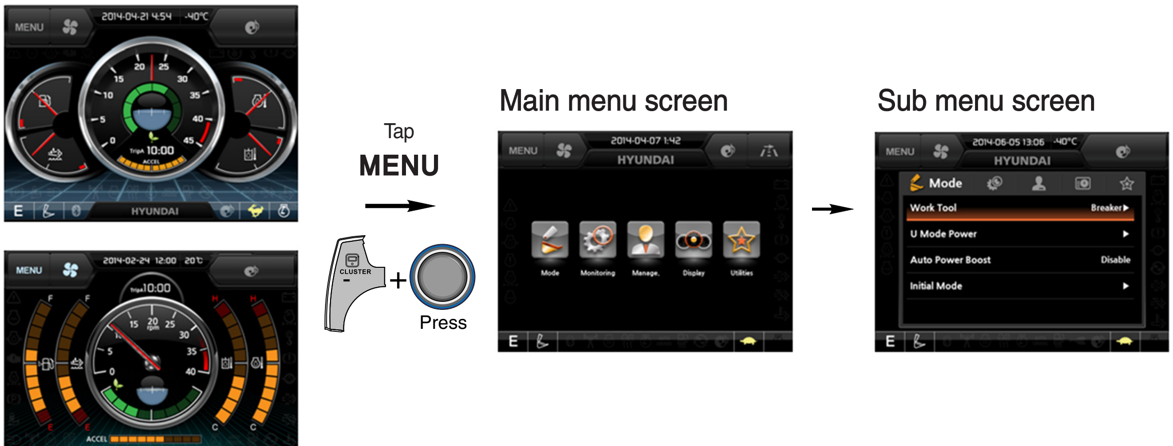
290F3CD218

① This switch is to activate the entertainment control menu in the cluster.
※ Refer to the page 5-109.

6) MAIN MENU

※ You can select or set the menu by the haptic controller or touch screen.
On the operation screen, tap MENU to access the main menu screen.
On the sub menu screen, you can tap the menu bar to access functions or applications.

· Operation screen



290F3CD102

※ Please refer to the haptic controller, operator's manual page 3-57 for selection and change of menu and input value.

(1) Structure

No	Main menu	Sub menu	Description
1	 Mode 290F3CD103	Work tool U mode power Boom/Arm speed Auto power boost Auto engine shutdown (option) Initial mode Emergency mode	Breaker, Crusher, Not installed User mode only Boom speed, Arm speed Enable, Disable One time, Always, Disable Key on initial mode, Accel initial mode / step Switch function
2	 Monitoring 290F3CD104	Active fault Logged fault Delete logged fault Monitoring	MCU, Engine ECM MCU, Engine ECM All logged fault delete, Initialization canceled Machine information, Switch status, Output status,
3	 Management 290F3CD105	Fuel rate information Maintenance information Machine security Machine information Contact Service menu Clinometer Update	General record, Hourly, Daily, Mode record Replacement, Change interval oils and filters ESL mode setting, Password change Model, MCU, Monitor, Haptic / switch controller, RMCU, Relay drive unit, FATC, AAVM (opt) A/S phone number, A/S phone number change Power shift, Operating hour, IPC mode, Breaker mode pump acting, EPPR current level, Overload pressure Clinometer setting Cluster, ETC device
4	 Display 290F3CD106	Display item Clock Brightness Unit setup Language selection Screen type	Engine speed, Tripmeter A, Tripmeter B, Tripmeter C Clock Manual, Auto Temperature, Pressure, Flow, Distance, Date format Korean, English, Chinese, ETC A type, B type
5	 Utilities 290F3CD107	Entertainment Tripmeter Camera	Play Video, Audio, Smart terminal. 3 kinds (A, B, C) Number of active, Display order, AAVM (opt)

(2) Mode setup

① Work tool

210WF3CD108

290F3CD253

A

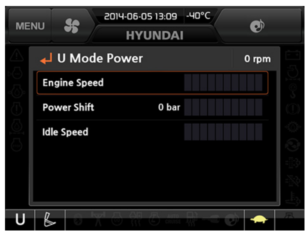
290F3CD254

B

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

② U mode power

210WF3CD111



290F3CD112

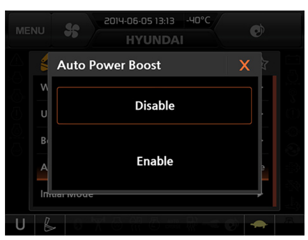
Step (▮)	Engine speed (rpm)	Idle speed (rpm)	Power shift (bar)
1	1450	800	0
2	1500	850	3
3	1600	900	6
4	1700	950	9
5	1750	1000 (auto decel)	12
6	1800	1050	16
7	1850	1100	20
8	1900	1150	26
9	1950	1180	32
10	2000	1200	38

※One touch decel & low idle : 850 rpm

· 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.

③ Auto power boost

210WF3CD118



290F3CD117

· 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.

④ Automatic engine shutdown (option)

210WF3CD11

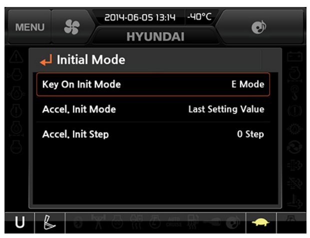
210WF3CD12

210WF3CD13

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

⑤ Initial mode

210WF3CD122



290F3CD119

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

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

· Accel initial step
  - 0~9 step

⑥ Emergency mode

210WF3CD248

290F3CD249

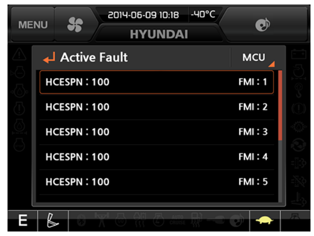
· This mode can be use when the switches are abnormal on the cluster.
· The cluster switches will be selected by touched each icon.

(3) Monitoring

① Active fault

290F3CD120

290F3CD121

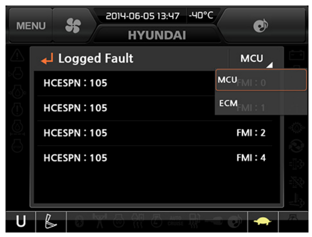


290F3CD125

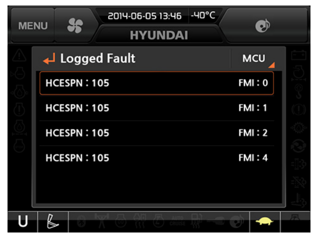
· The logged faults of the MCU, engine ECM or air conditioner can be checked by this menu.

② Logged fault

290F3CD128



290F3CD123

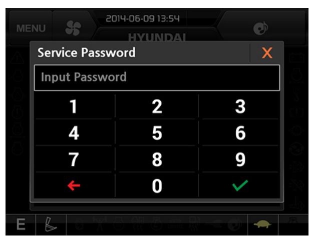


290F3CD124

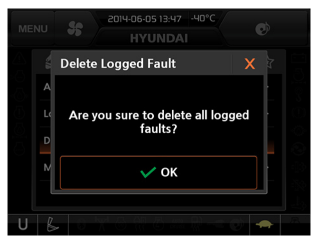
· The logged faults of the MCU, engine ECM or air conditioner can be checked by this menu.

③ Delete logged fault

290F3CD134



290F3CD126



290F3CD127

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

④ Monitoring

290F3CD172

290F3CD188

290F3CD189

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

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

· The activated switch or output pilot lamps ● are light ON.

(4) Management

① Fuel rate information

210WF3CD14

210WF3CD15

A

· General record (A)

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

B

· Hourly record (B)

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

C

· Daily record (C)

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

D

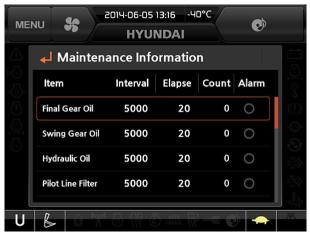
210WF3CD16

· Mode record (D)

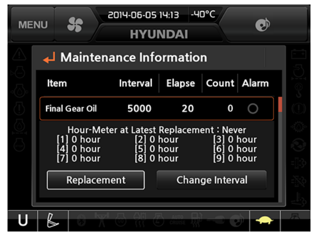
- Average fuel rate for each power mode/accel dial (at least 7) from "Reset" to now.
- No record during idle.
- All mode records deletion by "Reset".

② Maintenance information

210WF3CD131



290F3CD132



290F3CD133

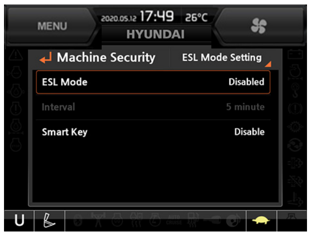
· Alarm lamp (●) is ON when oil or filter needs to be changed or replaced.
· Replacement : The elapsed time will be reset to zero (0).
· Change interval : The change or replace interval can be changed in the unit of 50 hours.
· Change or relpace interval

No	Item	Interval
1	Engine oil	500
2	Final gear oil	1000
3	Swing gear oil	1000
4	Hydraulic oil	5000
5	Pilot line filter	1000
6	Drain filter	1000
7	Hydraulic oil return filter	1000
8	Engine oil filter	500
9	Fuel filter	1000
10	Fuel tank breather filter	4000
11	Pre-filter	1000
12	Hydraulic tank breather	1000
13	Air cleaner (inner & outer)	4000
14	Radiator coolant	2000
15	Swing gear pinion grease	1000
16	DEF/AdBlue® supply module filter	1000

③ Machine security

210WF3CD190B

290F3CD135B



290F3CD136A

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

    Disable : ESL function is disabled and password is not required to start engine.

    Enable (always) : The password is required whenever the operator starts engine.
  - Interval : The password is required when the operator starts engine first. But the operator can restart the engine within the interval time without inputting the password. The interval time can be set to a maximum 4 hours.

    ※Default password : 00000 + ✓

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

290F3CD137A

290F3CD138A

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

210WF3CD190A

290F3CD140B

290F3CD135C

Enter the current password

290F3CD143B

Enter the new password again

290F3CD142B

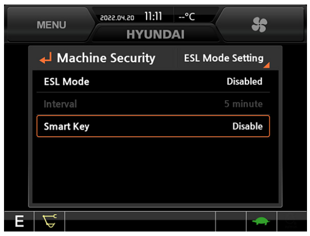
Enter the new password

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

- Smart key

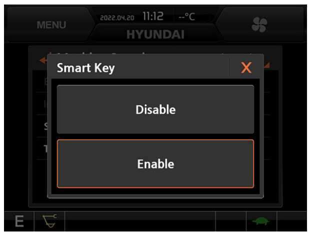
210WF3CD190A

290F3CD135C



290F3CD001

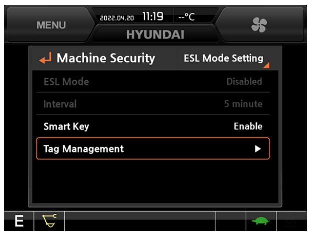
- Smart key is registered when equipped with optional smart key. If smart key is not inside of the cabin, authentication process fails and the password is needed.
- Tag management menu is activated when the Smart key menu is Enabled.
  You can register and delete the tags.



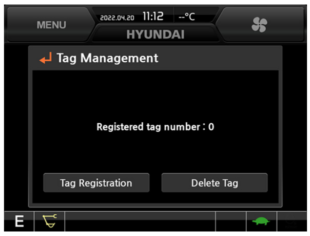
290F3CD002

- Tag management

- When registering a tag : Only the tag you want to register must be in the cabin.
- When deleting a tag : All registered tags are deleted.

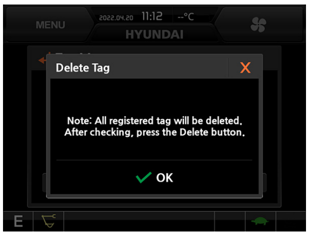


290F3CD003



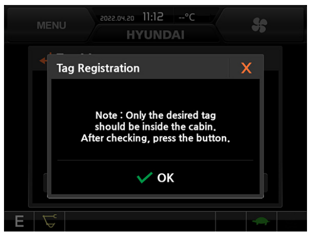
290F3CD004

Deleting



290F3CD006

Registering



290F3CD005

④ Machine Information

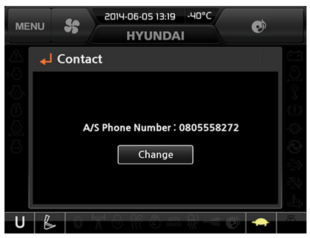
290F3CD144

290F3CD145

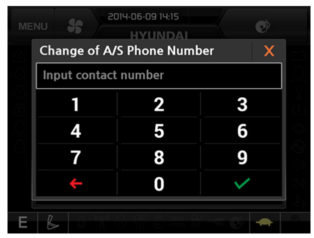
· This can confirm the identification of the model information (ECU), MCU, monitor, haptic controller, switch controller, RMCU, relay driver unit, FATC (air conditioner controller), AAVM (opt).

⑤ Contact (A/S phone number)

290F3CD146



290F3CD147



290F3CD148

Enter the new A/S phone number

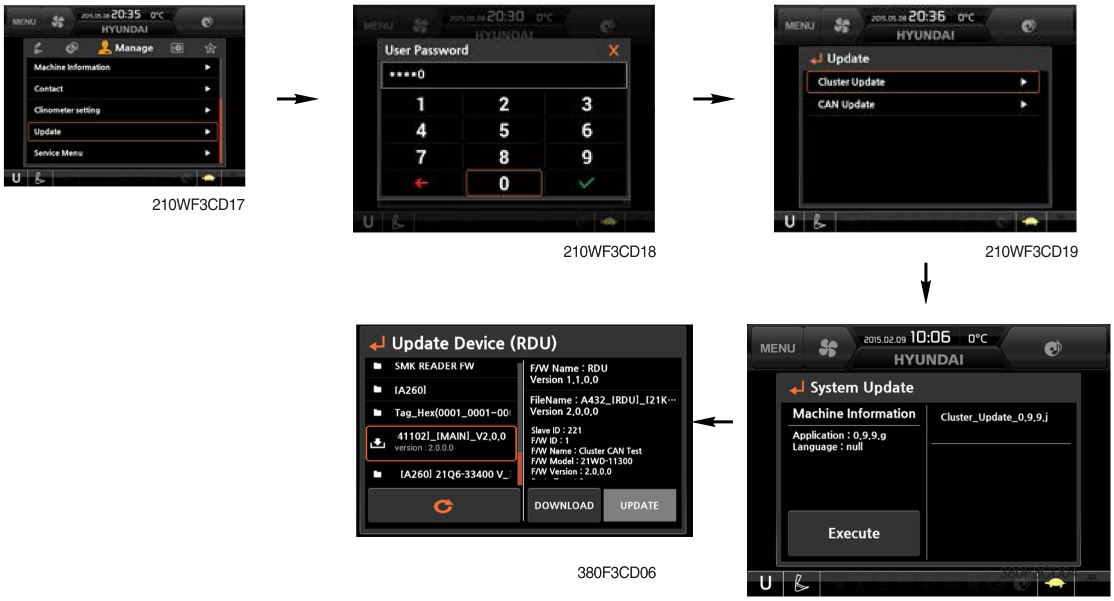
⑥ Clinometer

290F3CD152

290F3CD153

· When the machine is on the flatland, if tap the "initialization", the values of X, Y reset "0".
· You can confirm tilt of machine in cluster's operating screen.

⑦ Update (cluster & ETC devices)



210WF3CD17

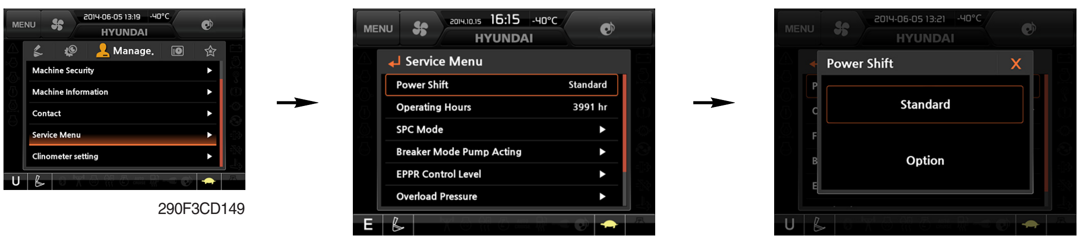
210WF3CD18

210WF3CD19

380F3CD06

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

⑧ Service menu



290F3CD149

290F3CD250

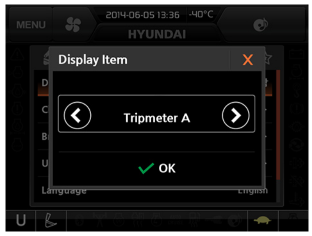
290F3CD151

· Power shift (standard/option) : Power shift pressure can be set by option menu.
· Operating hours : Operating hours since the machine line out can be checked by this menu.
· IPC mode : IPC mode 1, IPC mode 2, Not used.
· Breaker mode pump acting (1 pump/2 pump)
· EPPR current level (attach flow EPPR 1 & 2, boom priority EPPR, attach relief pressure EPPR 1& 2)
· Overload pressure : 100 ~ 350 bar

(5) Display

① Display item

290F3CD154



290F3CD155

290F3CD156

· 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

290F3CD157

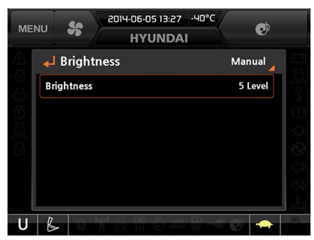
290F3CD158

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

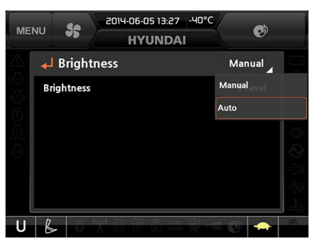
③ Brightness

290F3CD159

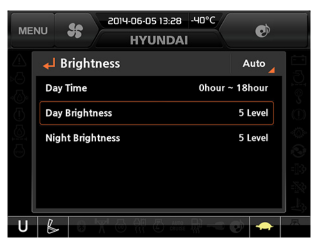
290F3CD160



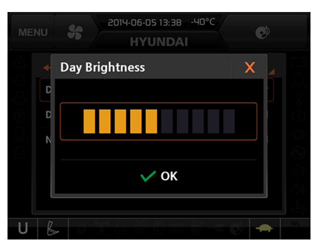
290F3CD139



290F3CD141



290F3CD191



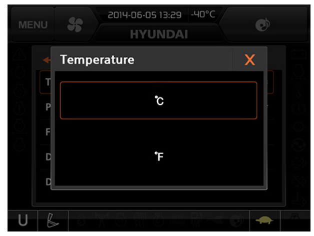
290F3CD192

· 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, white area represents night time while orange shows day time)

④ Unit

290F3CD161

210WF3CD162



290F3CD193

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

⑤ Language

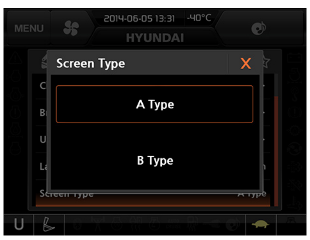
290F3CD163

290F3CD164

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

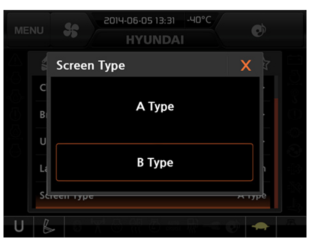
⑥ Screen type

290F3CD165



A Type (Default) 290F3CD166

290F3CD156A

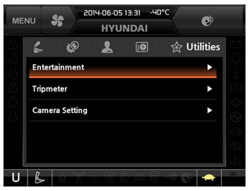


B Type (Option) 290F3CD194

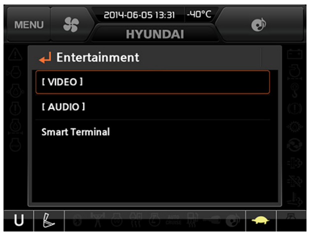
290F3CD167A

(6) Utilities

① Entertainment



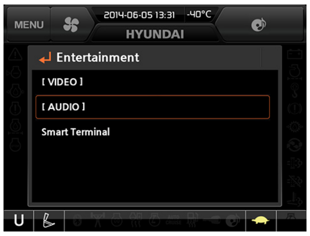
290F3CD195



A

290F3CD196

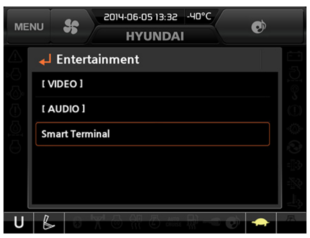
210WF3CD219



B

290F3CD197

210WF3CD220



C

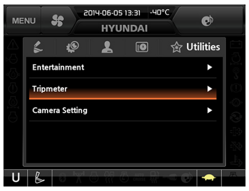
290F3CD198

210WF3CD199

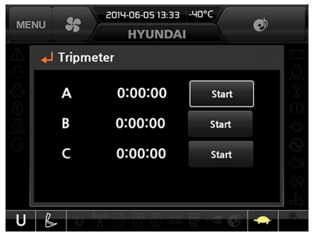
210WF3CD22

- Video (A) : This menu operates the video play function.
  mp4, mkv, avi files and so on.
- Audio (B) : This menu operates the play music.
  mp3, mp4 files and so on.
- Smart terminal (C) : The menu features a smartphone and operates the miracast.

② Tripmeter



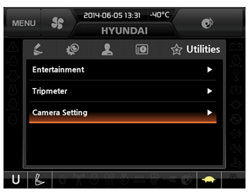
290F3CD168



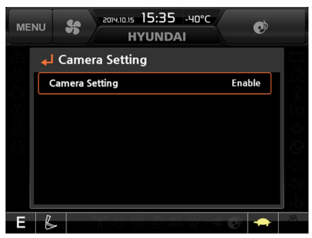
290F3CD169

· 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.

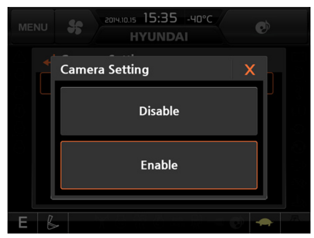
③ Camera setting
· If the rear camera is not installed on the machine, set disable.
· If the rear camera installed on the machine, set enable.



290F3CD200



290F3CD255



290F3CD256

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

290F3CD156

290F3CD221

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

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

290F3CD244

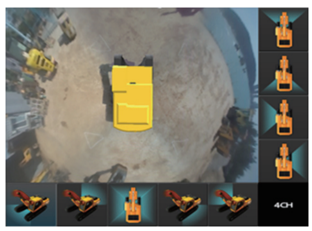
- **Escape button**

· It will enter into the AAVM mode from the beginning screen if the AAVM is installed.

· While in the AAVM mode, select the ESC button to return to the beginning screen.

290F3CD156

The beginning screen



AAVM mode

290F3CD222

- **Buzzer stop button**

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

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

290F3CD246

· When the worker or pedestrian go to the blue line (radius 5 m), an external danger area of equipping on the cluster screen, the warning buzzer sounds and it displays the blue rectangular box for the recognition of the worker and pedestrian.
At this time, the operator should stop work immediately, and stop the buzzer by pressing the buzzer stop button. And then, please work after you check whether the danger factors are solved.

290F3CD247

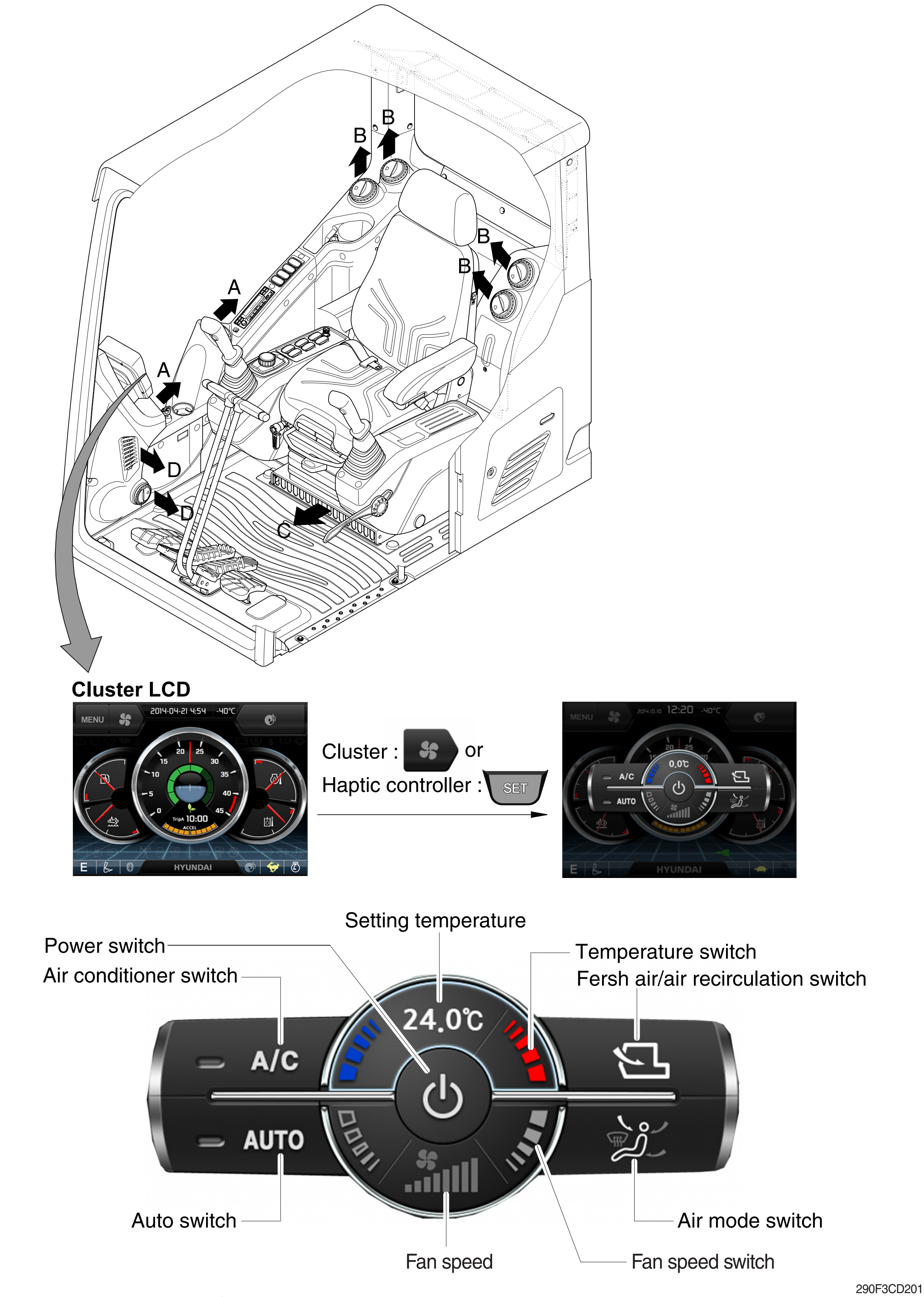
· When the worker or pedestrian go inside of red line (radius 3 m), an internal danger area of equipping on the cluster screen, the warning buzzer sounds and it displays the red rectangular box for the recognition of the worker and pedestrian.
At this time, the operator should stop work immediately, and stop the buzzer by pressing the buzzer stop button. And then, please work after you check whether the danger factors are solved.

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

7) AIR CONDITIONER AND HEATER

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

· Location of air flow ducts



※ Haptic controller : Refer to operator's manual page 3-57.

(1) Power switch

290F3CD251

① This switch makes the system ON/OFF.
Just before the power OFF, set values are stored.

② Default setting values

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

(2) Air conditioner switch

290F3CD203

① This switch turns the compressor ON/OFF.

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

(3) Auto switch

290F3CD223

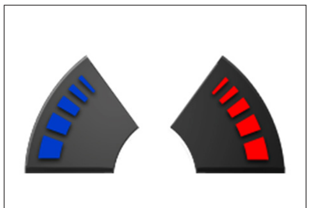
① Auto air conditiner and heater system automatically keeps the optimum condition in accordance with operator's temperature configuration sensing ambient and cabin inside temperature.

(4) Setting temperature

290F3CD224

① Display the temperature setting out.

(5) Temperature switch



290F3CD225

① Setting temperature indication
· Lo (17˚C), 17.5~31.5˚C, Hi (32˚C)

② Max cool and max warm beeps 5 times.

③ The max cool or the max warm position operates as following table.

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

④ Temperature unit can be changed between celsius (˚C) and fahrenheit (˚F)

a. Default status (˚C)

b. Push Up/Down temperature switch simultaneously more than 5 second displayed temperature unit change (˚C → ˚F)

(6) Fan speed switch

290F3CD226

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

(7) Fan speed

290F3CD227

① Steps 1 through 8 to display the amount of wind.

(8) Fresh air/air recirculation switch

290F3CD228

① It is possible to change the air-inlet method.
 a. Fresh air ( )
  Inhaling air from the outside.
 b. Air recirculation ( )
  It recycles the heated or cooled air to increase the energy efficiency.
 ※ Change air occasionally when using recirculation for a long time.
 ※ Check out the fresh air filter and the recirculation filter periodically to keep a good efficiency.

(9) Air mode switch

290F3CD229

① Operating this switch, it beeps and displays symbol of each mode in order. (Face → Face/Rear → Face/Rear/Foot → Foot → Def/Foot)

Mode switch		Face	Face/Rear	Face/Rear/Foot	Foot	Def/Foot
Outlet	A	●	●	●		
	B		●	●		
	C			●	●	●
	D					●

② When defroster mode operating, FRESH AIR/AIR RECIRCULATION switch turns to FRESH AIR mode and air conditioner switch turns ON.

8) SELF DIAGNOSIS FUNCTION

(1) Diagnostic methods : Diagnostic information window, select

(2) Diagnostic indication (Displays fault)

Fault code	Description	Fail safe function
F01	Ambient temperature sensor open	20˚C alternate value control
F02	Ambient temperature sensor short	
F03	Cab inside temperature sensor open	25˚C alternate value control
F04	Cab inside temperature sensor short	
F05	Evaporate temperature sensor open	0˚C alternate value control
F06	Evaporate temperature sensor short	
F07	Null	-
F08	Null	-
F09	Mode 1 actuator open/short	The alternate value is face
F10	Mode 1 actuator drive circuit malfunction	If not, the alternate value is Def/Foot
F11	Intake actuator open/short	The alternate value is air recirculation
F12	Intake actuator drive circuit malfunction	The alternate fresh air
F13	Temperature actuator open/short	If opening amount is 0 %, the alternate value is 0 %
F14	Temperature actuator drive circuit malfunction	If not, the alternate value is 100 %
F15	Null	-
F16	Null	-

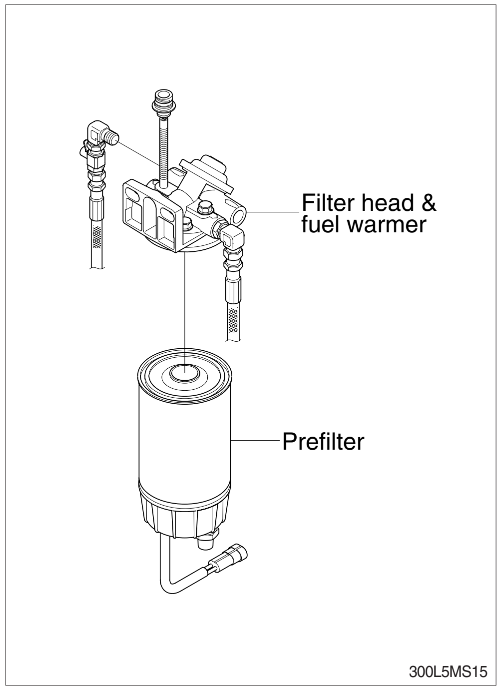
GROUP 15 FUEL WARMER SYSTEM

1. SPECIFICATION

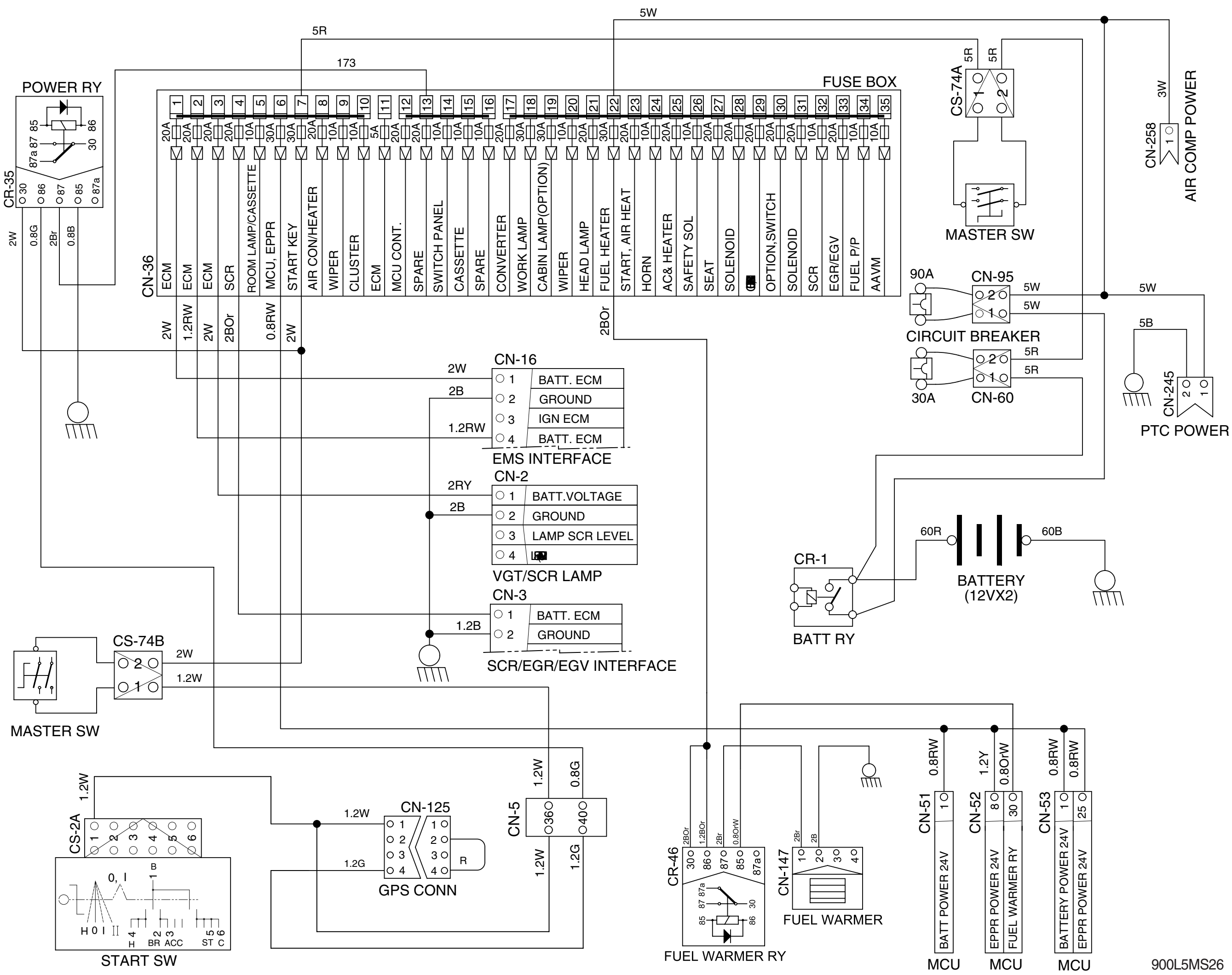
1) Operating voltage : 24±4 V
2) Power : 350±50 W
3) Current : 15 A

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

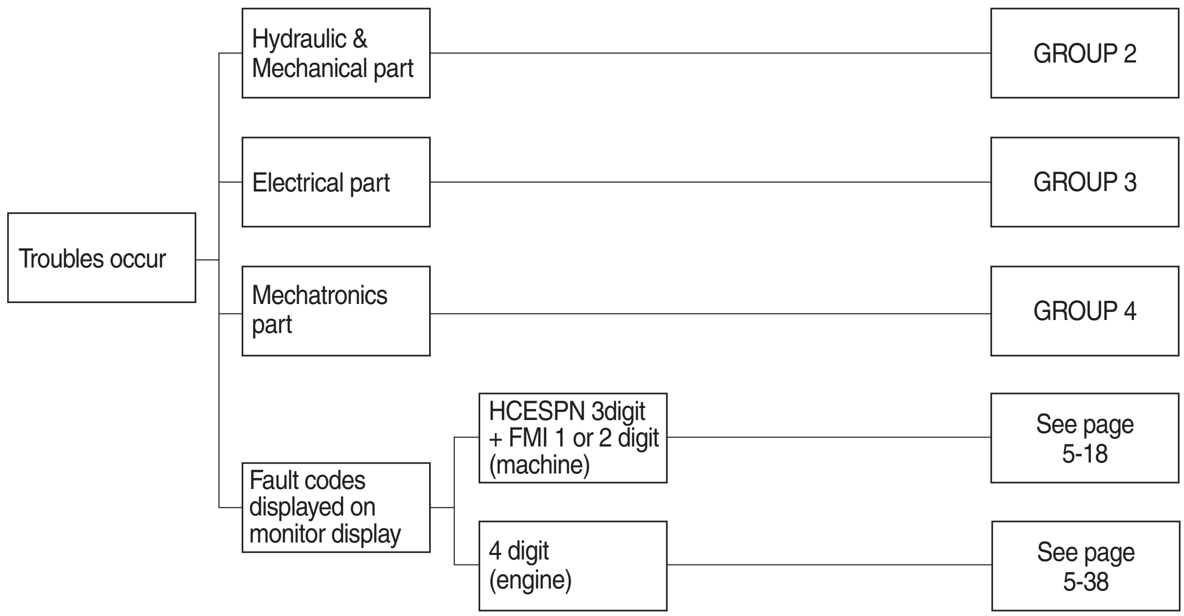
GROUP 1 BEFORE TROUBLESHOOTING

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.

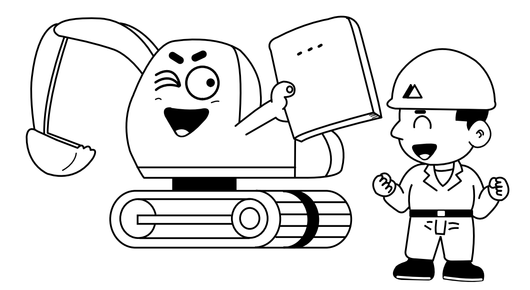


2. DIAGNOSING PROCEDURE

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.

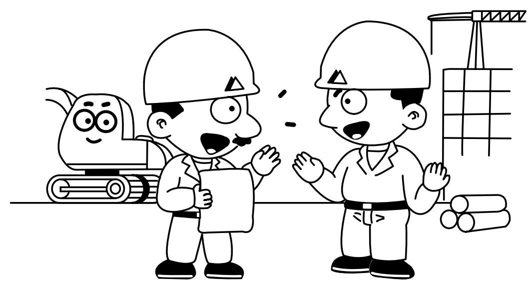


13031SH02

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.

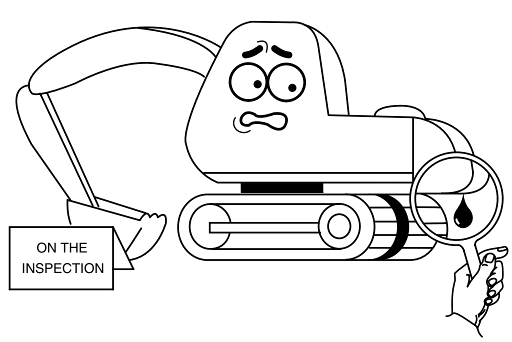


13031SH03

STEP 3. Inspect the machine

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

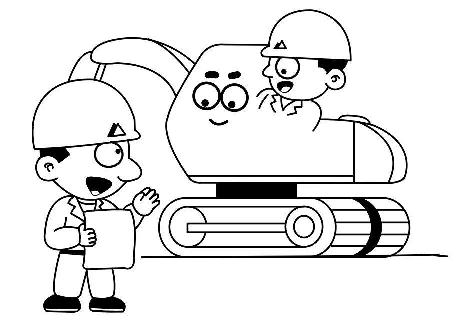
And also check the electrical system including batteries, as the troubles in the electrical system such as low battery voltage, loose connections and blown out fuses will result in malfunction of the controllers causing total operational failures of the machine.



(210-7) 6-2(3)

STEP 4. Inspect the trouble actually on the machine

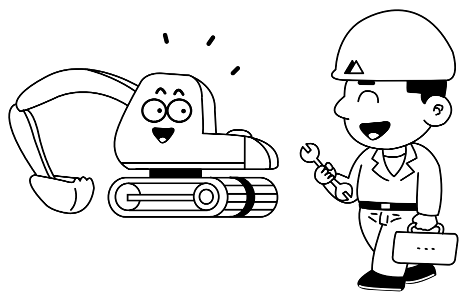
In case that some trouble cannot be confirmed, obtain the details of the malfunction from the operator.
Also, check if there are any in complete connections of the wire harnesses are or not.



(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.

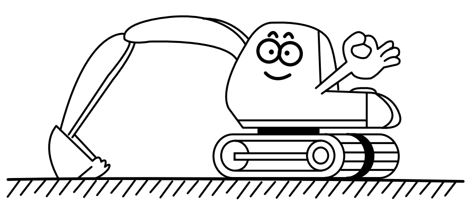


13031SH05

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

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

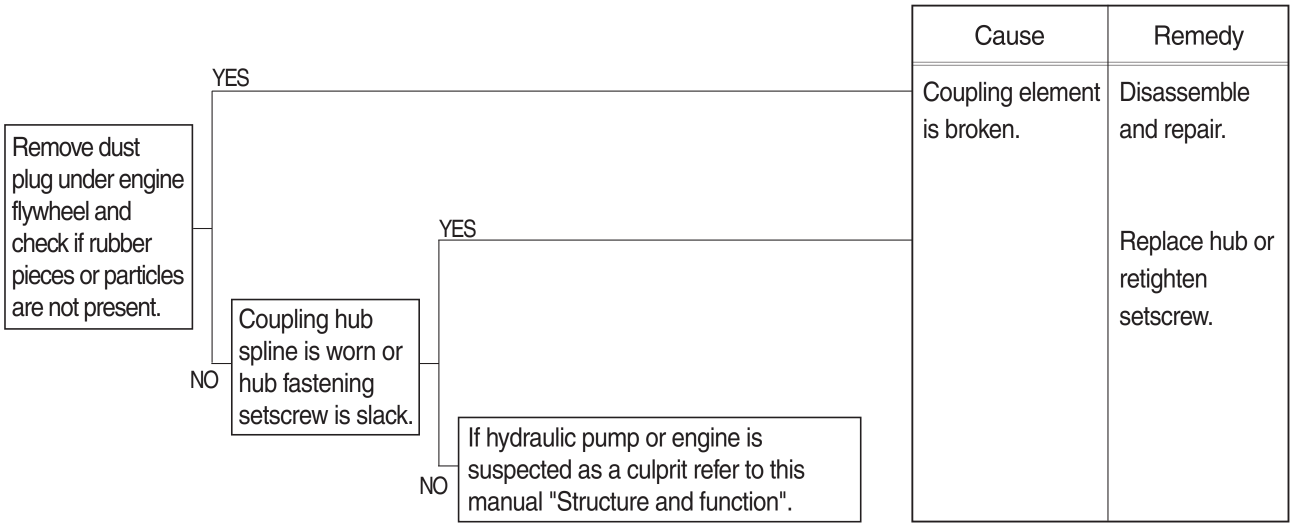
300L6HS01

(2) Specification

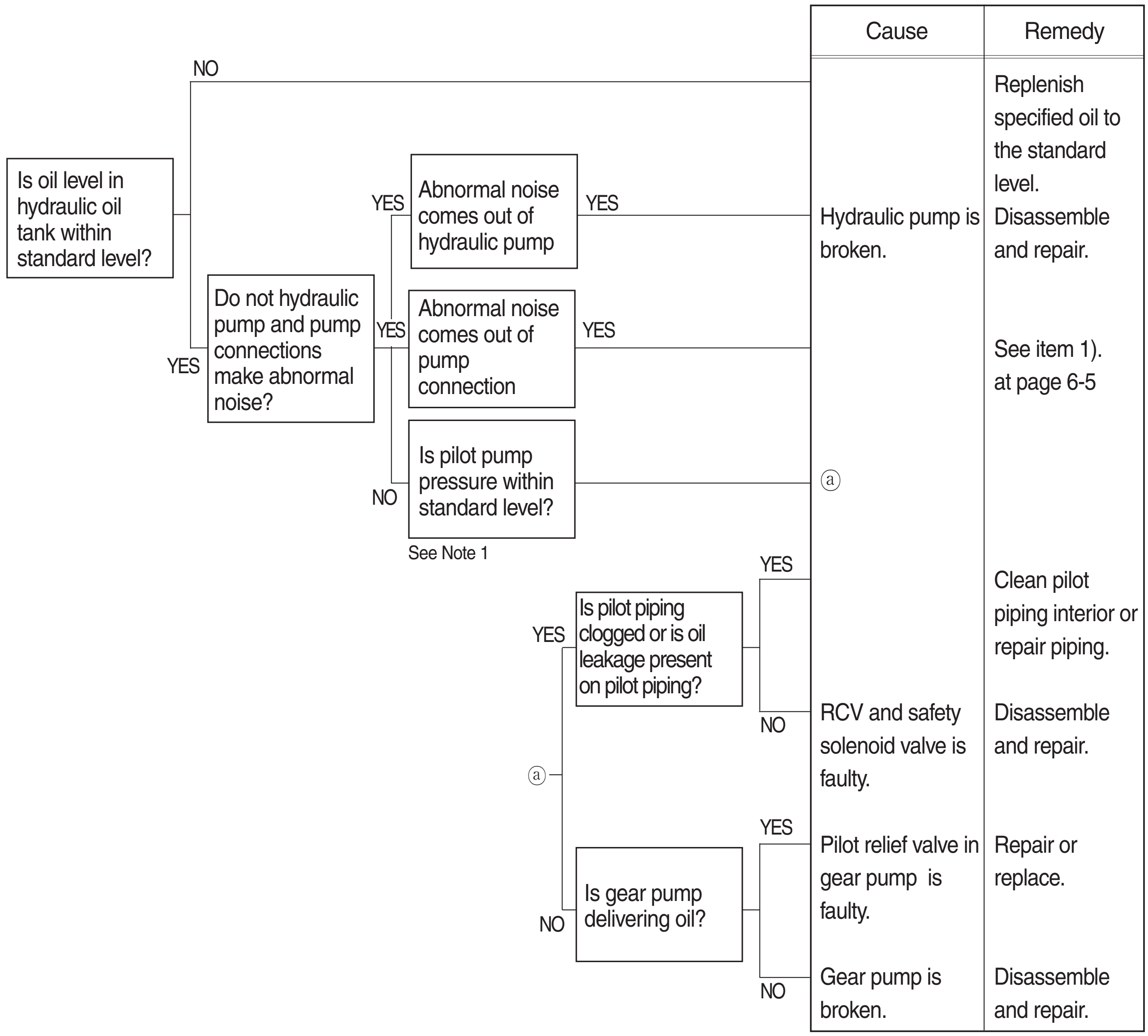
No.	Description	Specification
Note 1	Work pilot pressure	40^{+2}_{0} bar
Note 2	Swing pilot pressure	0~40 bar
Note 3	Boom up pilot pressure	0~40 bar
Note 4	Arm/bucket pilot pressure	0~40 bar
Note 5	Pump 1 regulator pressure	0~50 bar
Note 6	Pump 2 regulator pressure	0~50 bar
Note 7	Pump 1 pressure	330 bar

2. DRIVE SYSTEM

1) UNUSUAL NOISE COMES OUT OF PUMP CONNECTION

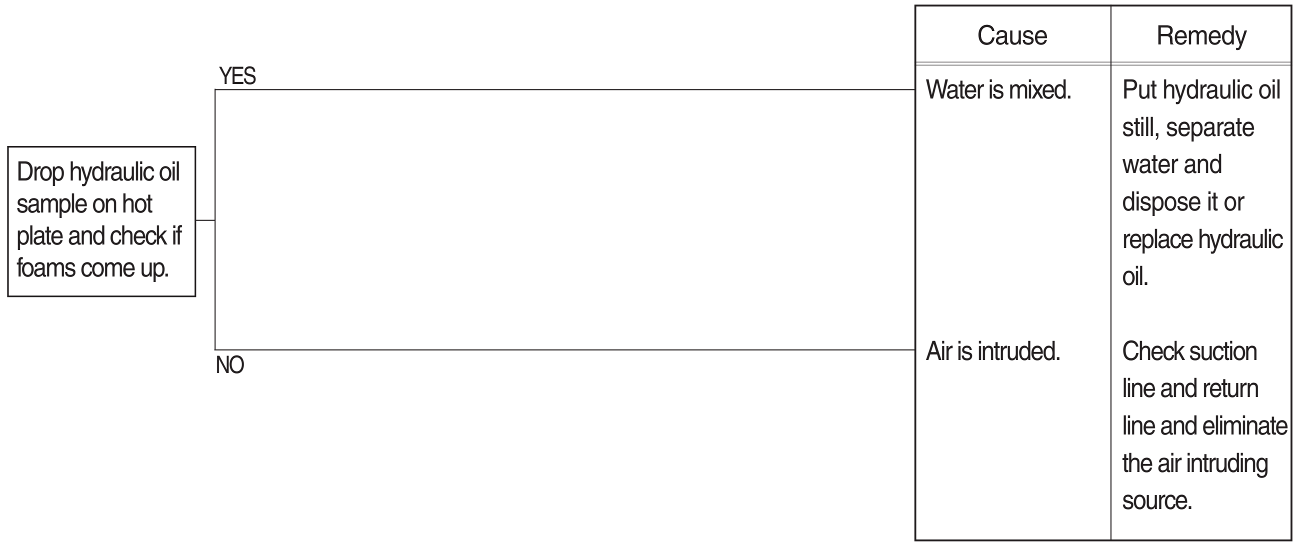


2) ENGINE STARTS BUT MACHINE DOES NOT OPERATE AT ALL

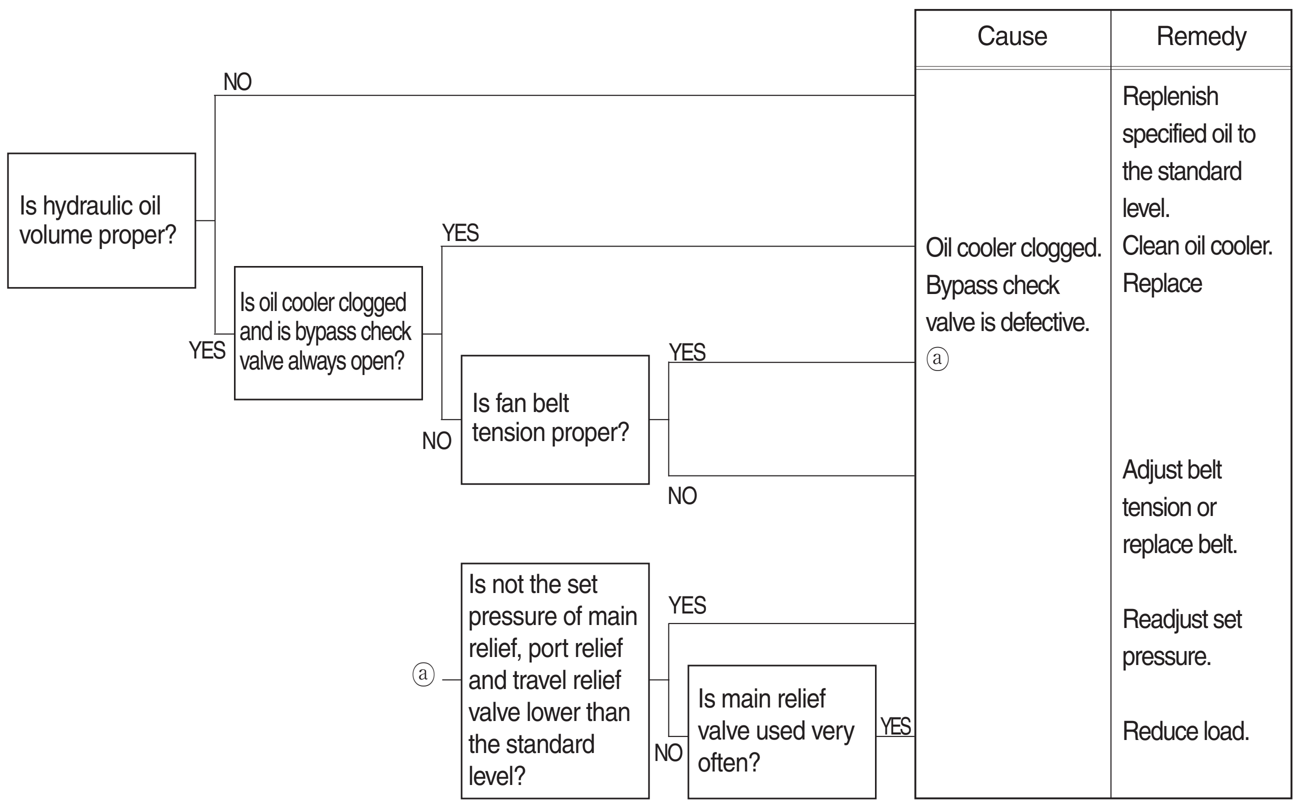


3. HYDRAULIC SYSTEM

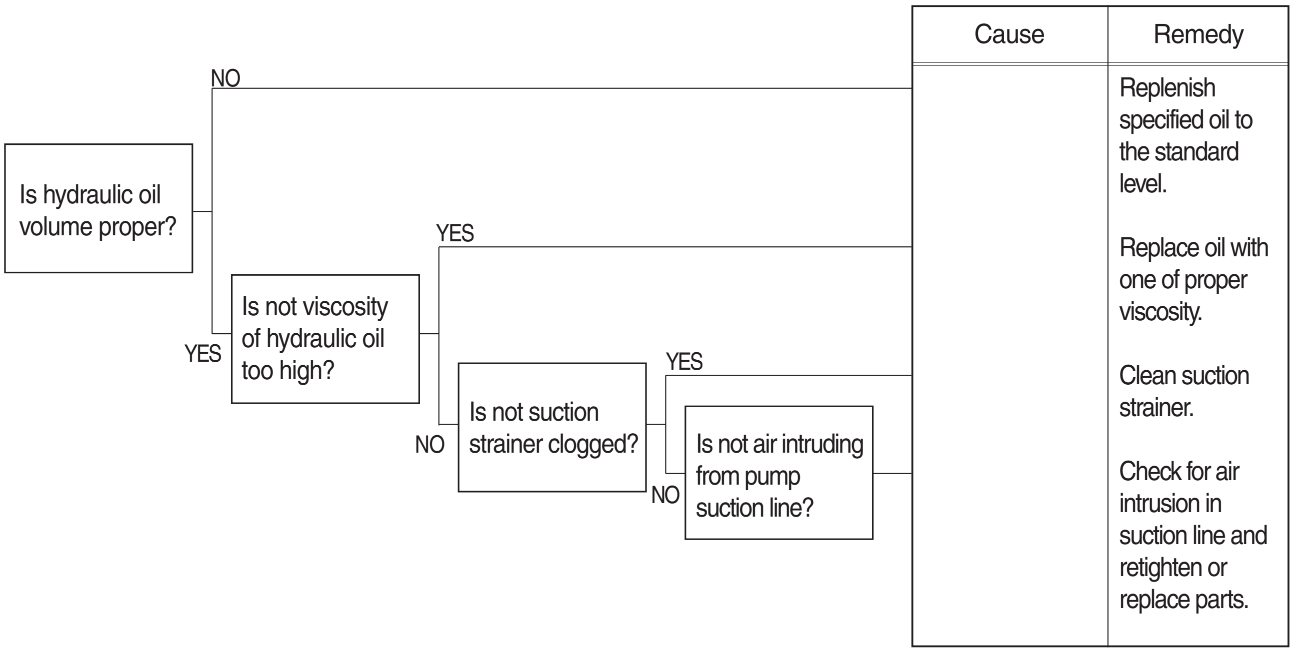
1) HYDRAULIC OIL IS CLOUDY



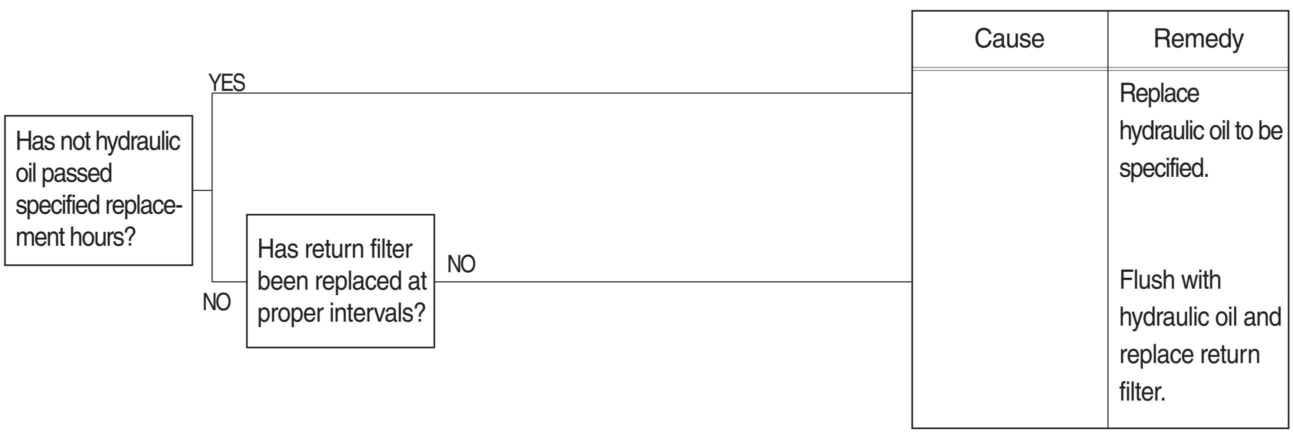
2) HYDRAULIC OIL TEMPERATURE HAS RISEN ABNORMALLY



3) CAVITATION OCCURS WITH PUMP

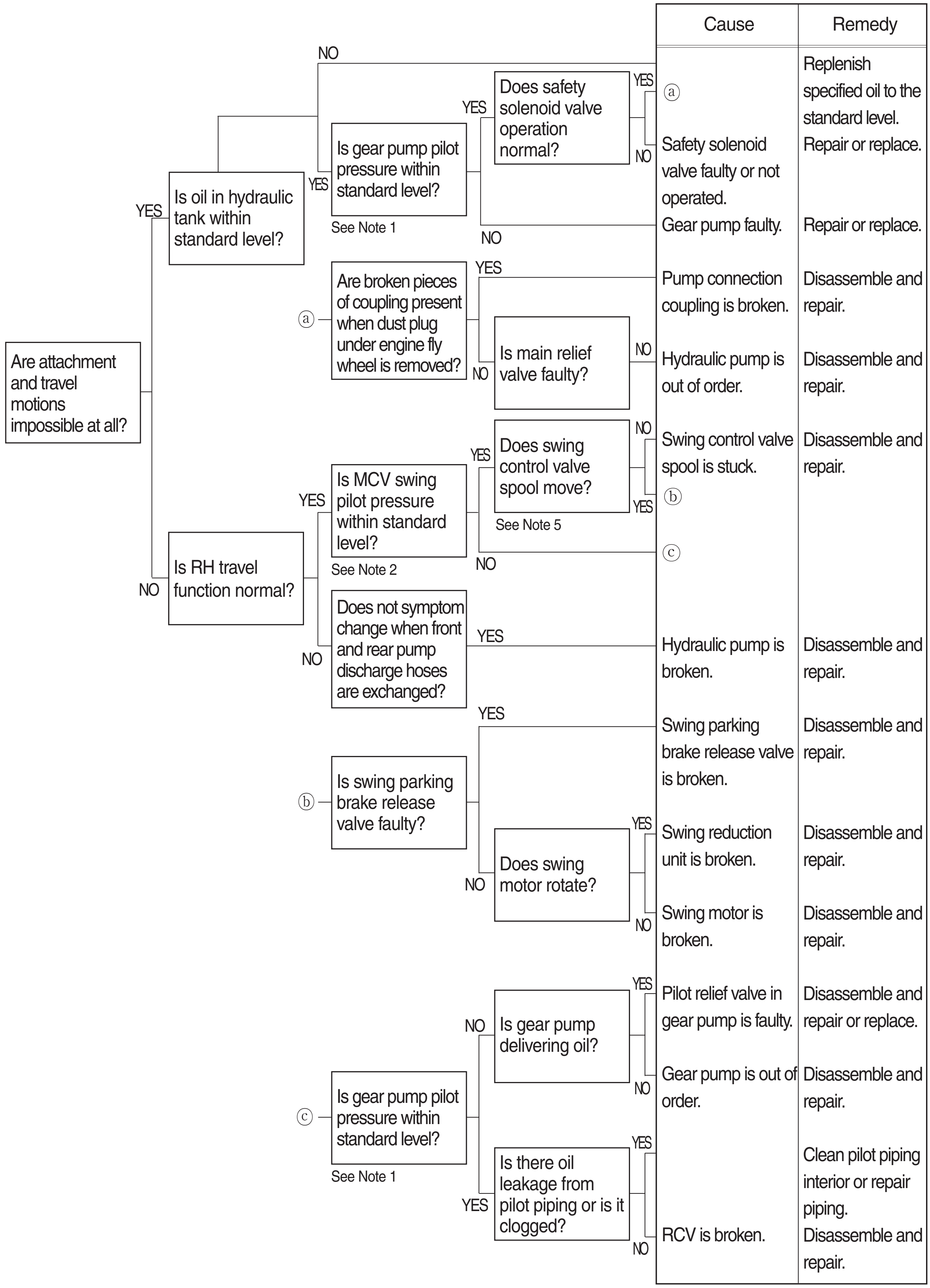


4) HYDRAULIC OIL IS CONTAMINATED

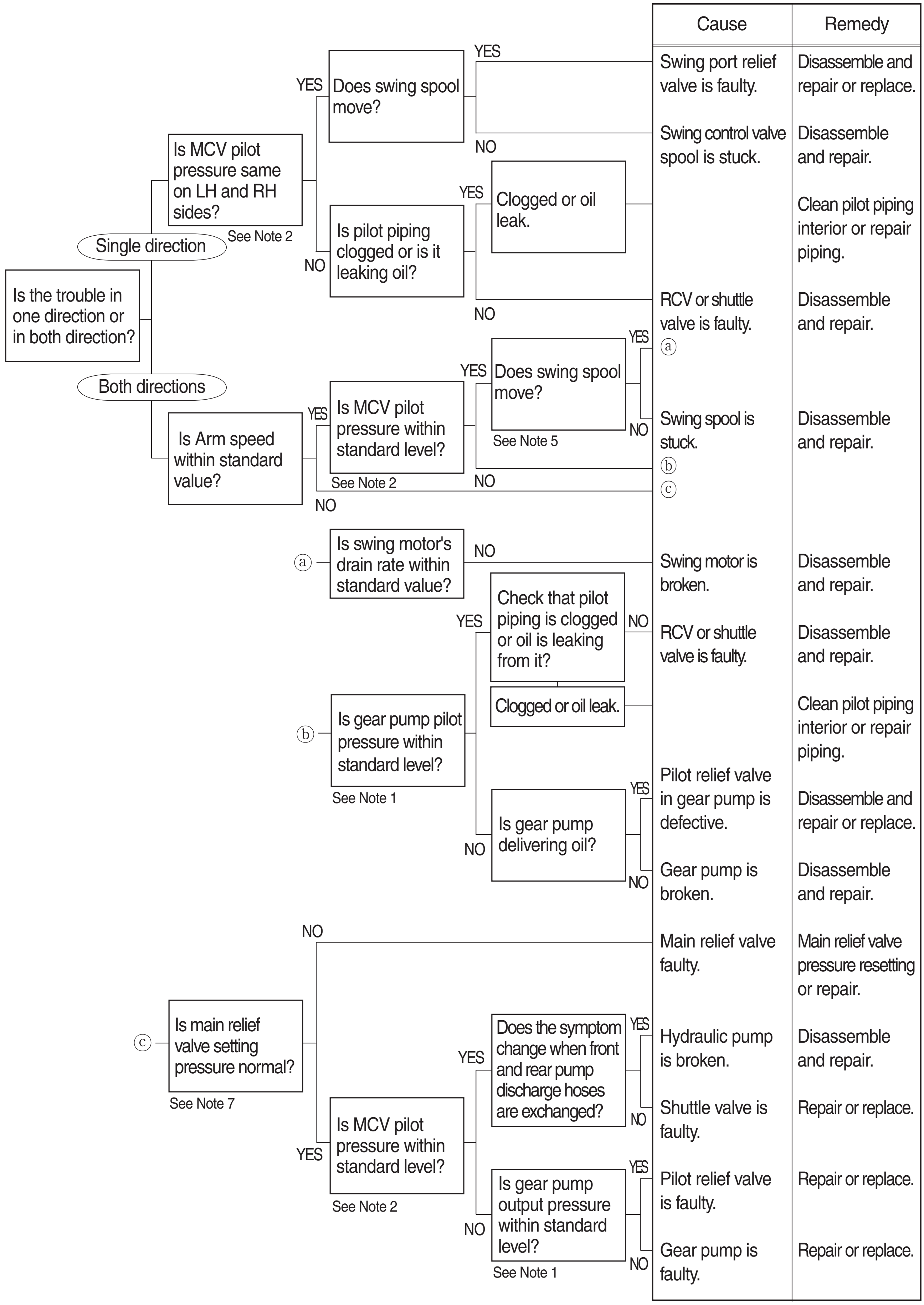


4. SWING SYSTEM

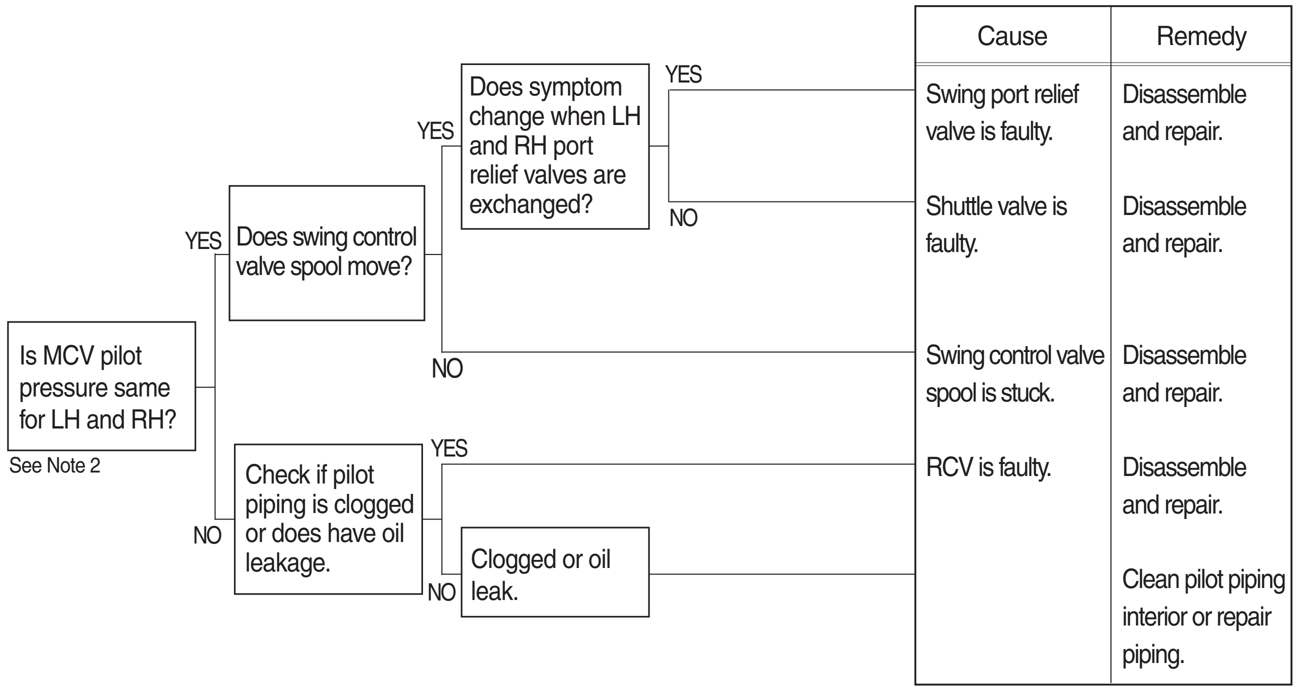
1) BOTH LH AND RH SWING ACTIONS ARE IMPOSSIBLE



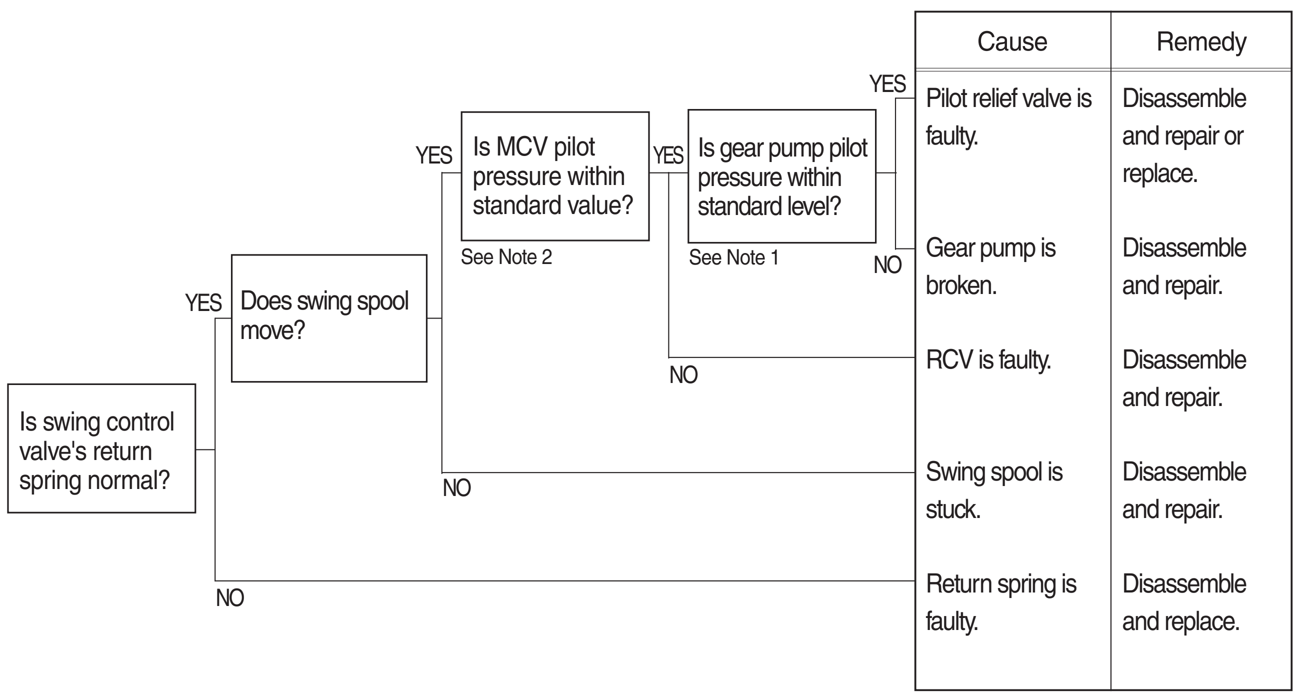
2) SWING SPEED IS LOW



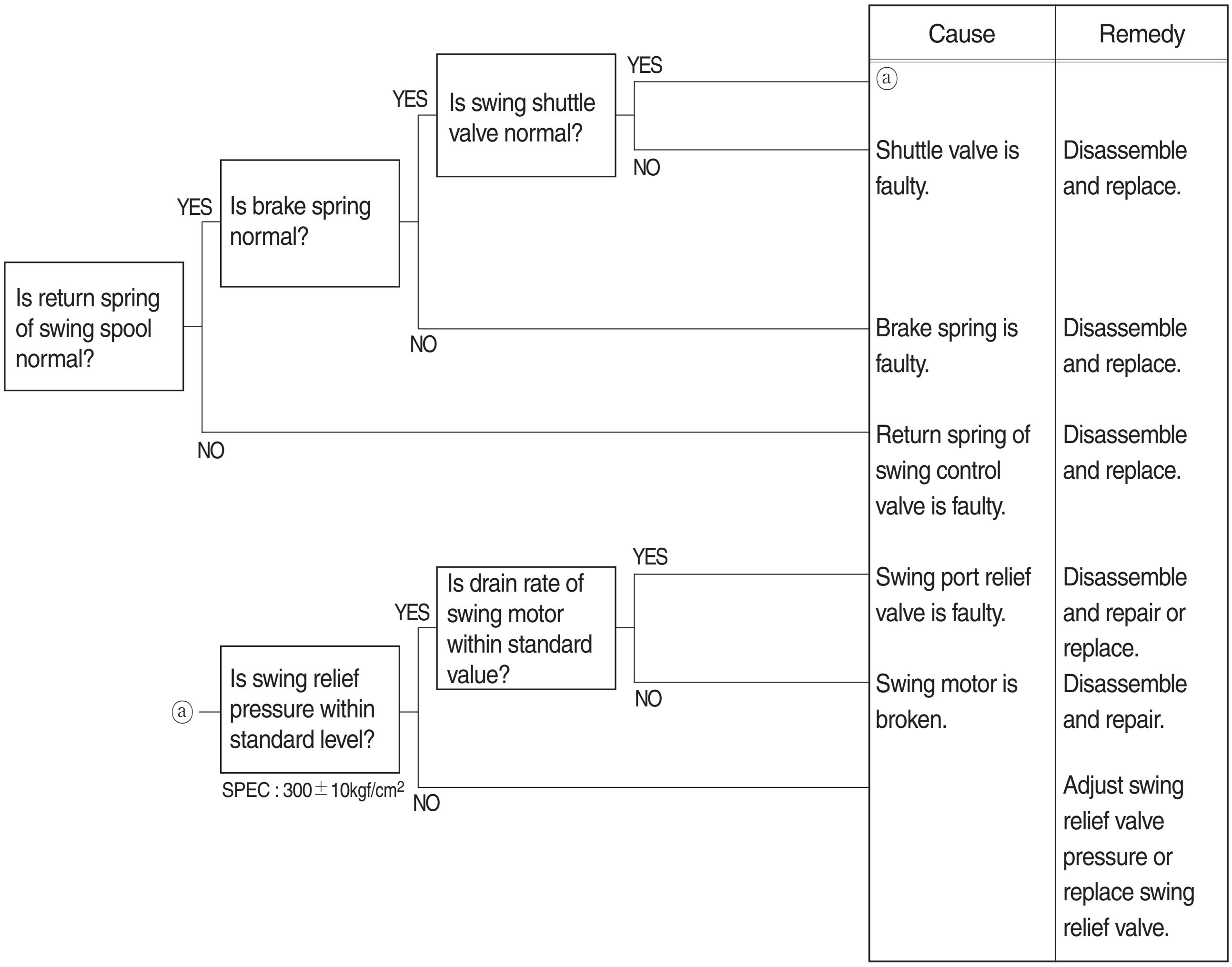
3) SWING MOTION IS IMPOSSIBLE IN ONE DIRECTION



4) MACHINE SWINGS BUT DOES NOT STOP

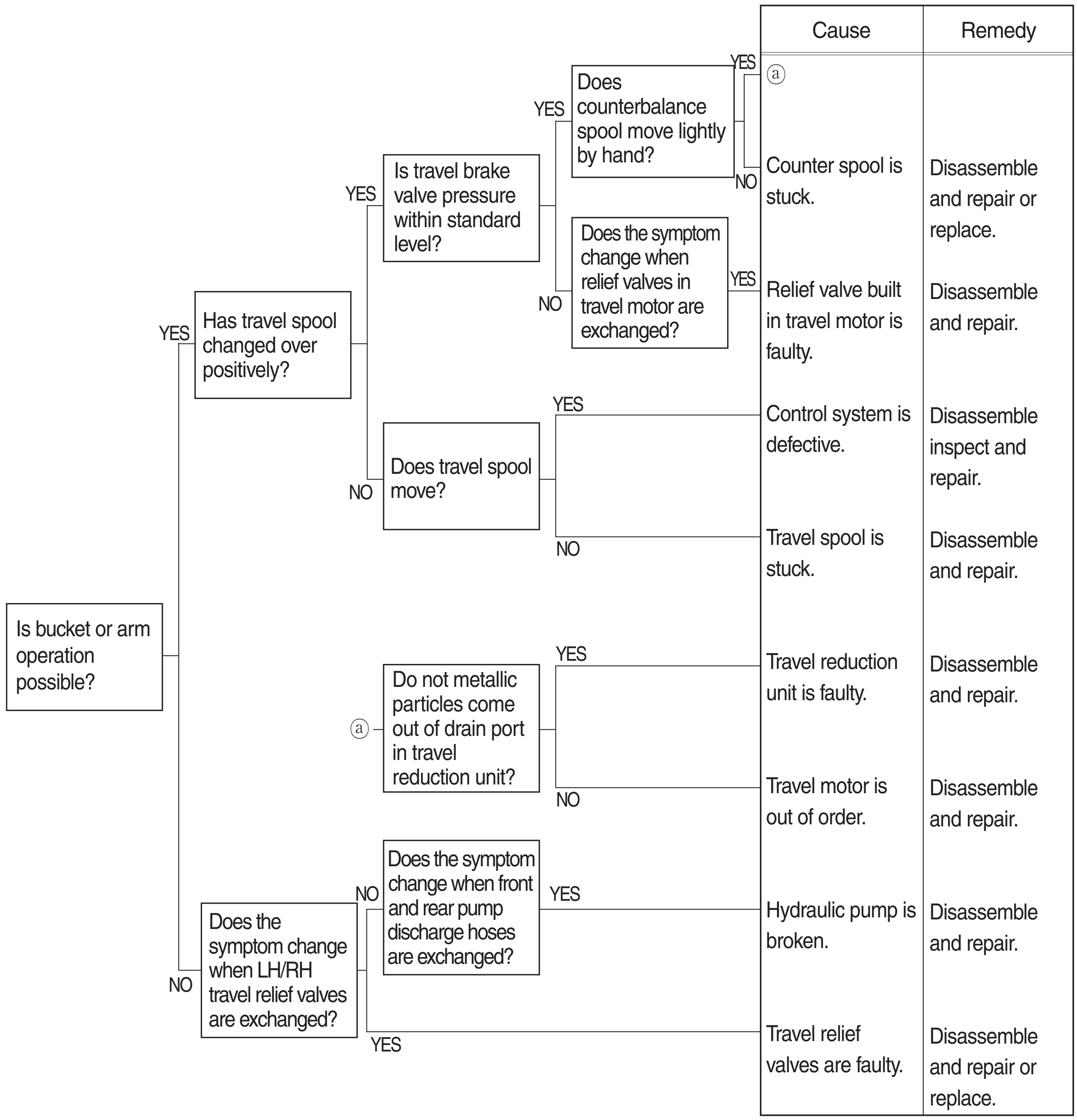


5) THE SWING UNIT DRIFTS WHEN THE MACHINE IS AT REST ON A SLOPE

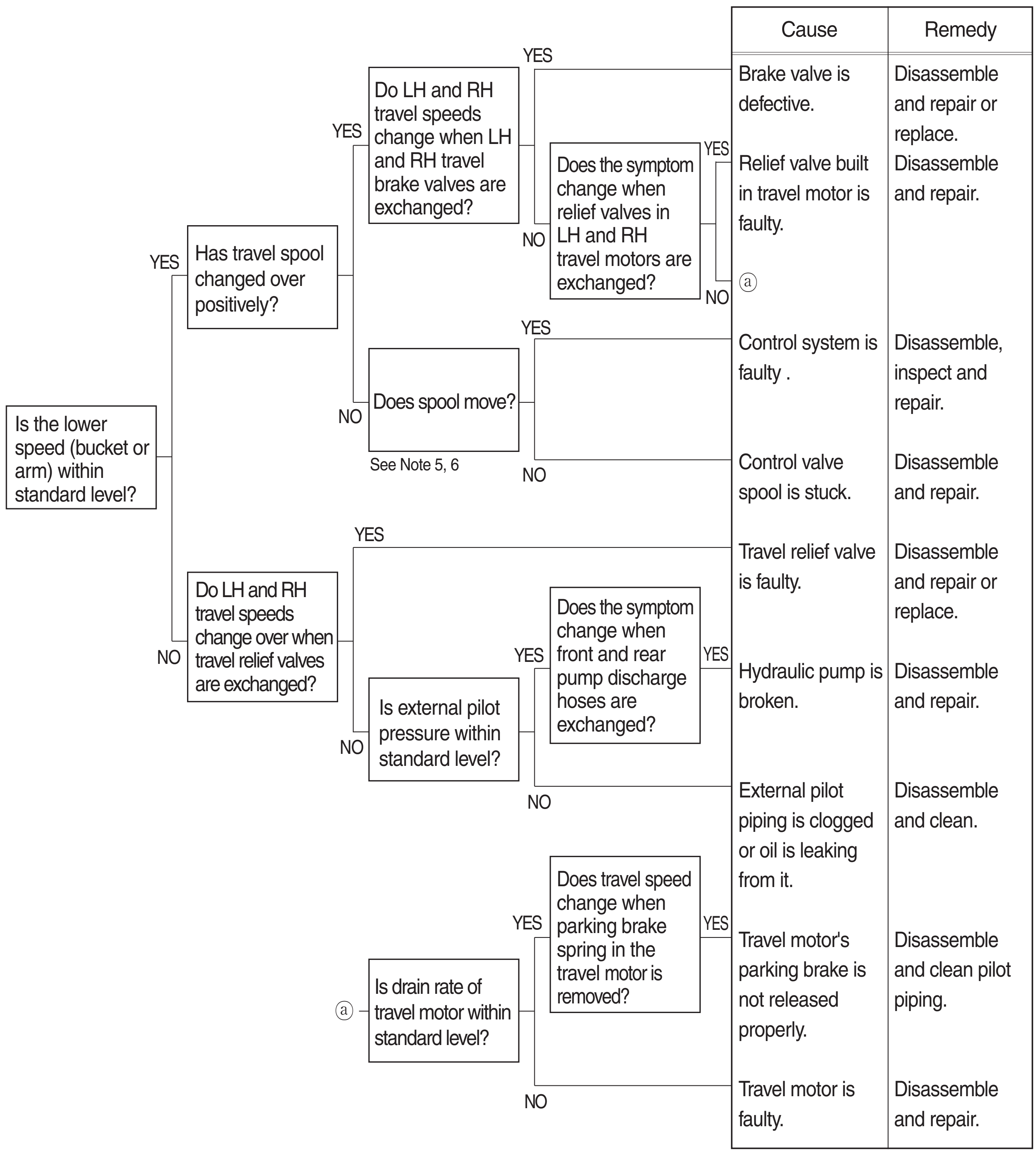


5. TRAVEL SYSTEM

1) TRAVEL DOES NOT FUNCTION AT ALL ON ONE SIDE

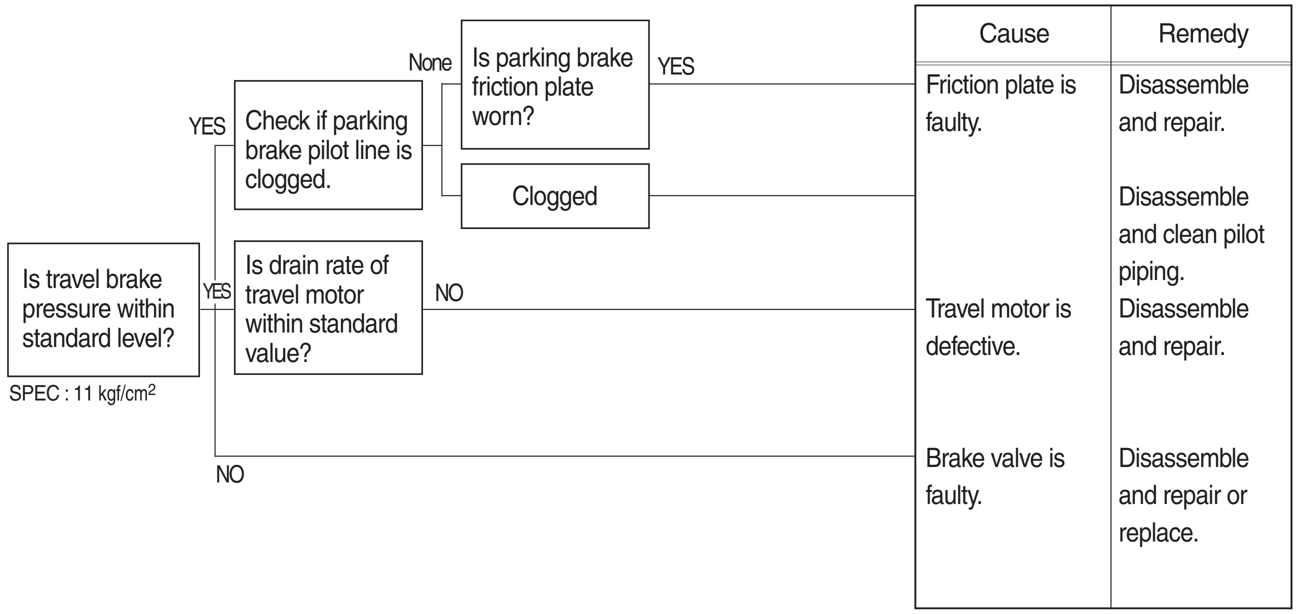


2) SPEED ON ONE SIDE FALLS AND THE MACHINE CURVES

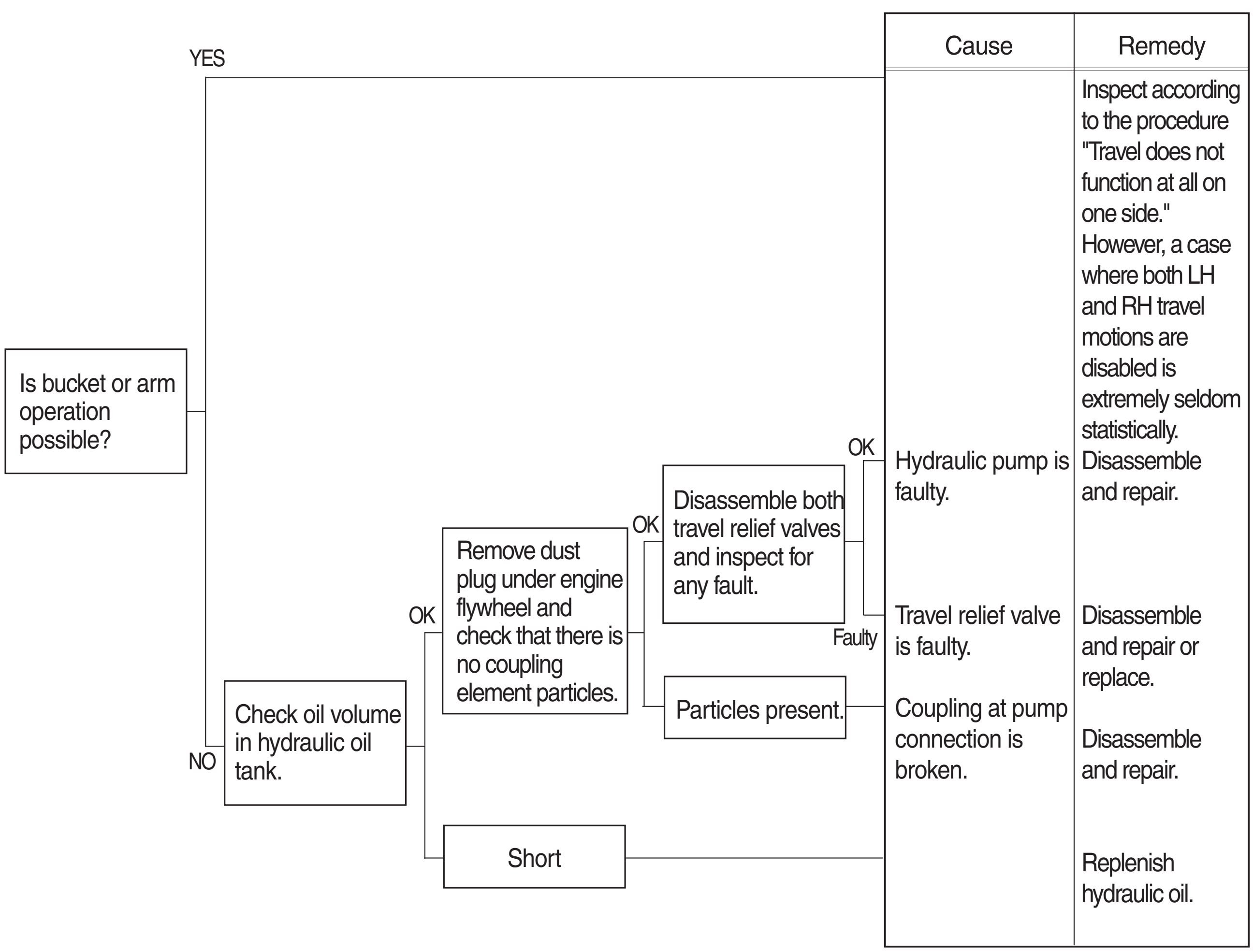


3) MACHINE DOES NOT STOP ON A SLOPE

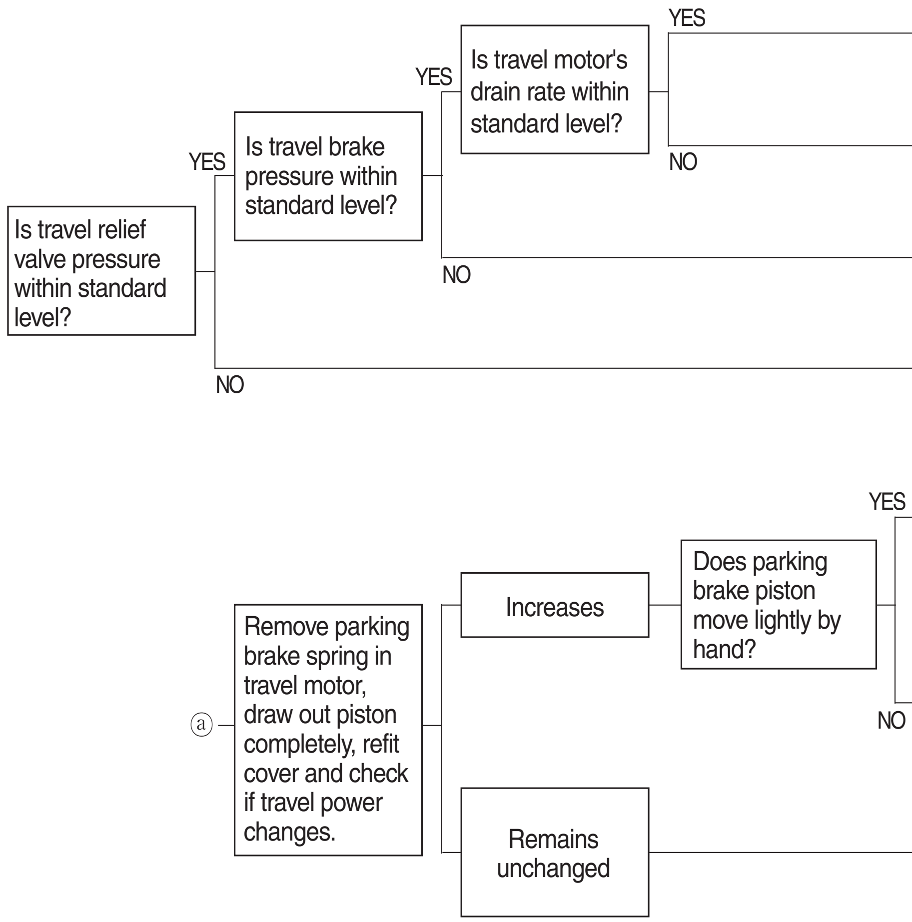
Machine is pulled forward as sprocket rotates during digging operation.



4) LH AND RH TRAVEL MOTIONS ARE IMPOSSIBLE



5) TRAVEL ACTION IS POWERLESS (travel only)



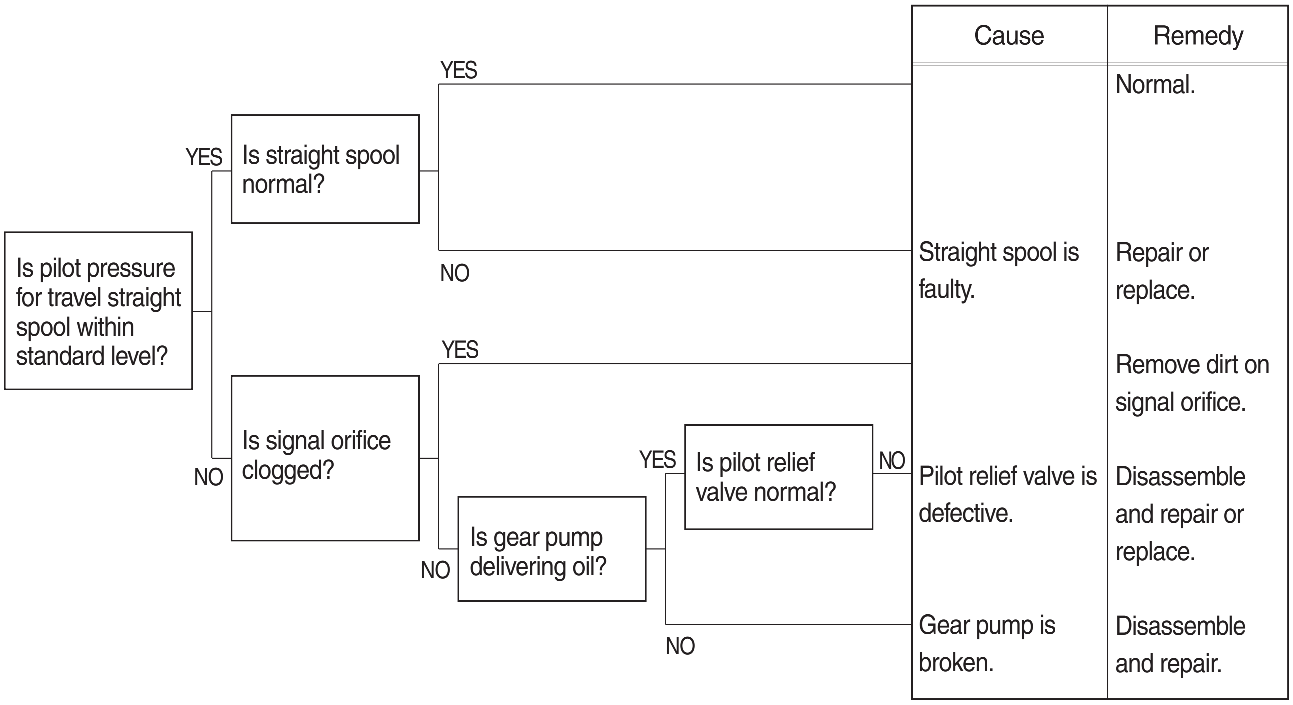
Cause	Remedy
ⓐ	
Travel motor is faulty.	Disassemble and repair.
Travel brake valve is defective.	Disassemble and repair or replace.
Travel relief valve is faulty.	Disassemble and repair or replace.
Hydraulic circuit that releases travel parking brake is clogged with dirt.	Disassemble and clean.
Parking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

6) MACHINE RUNS RECKLESSLY ON A SLOPE

Travel brake valve (counterbalance valve) is faulty.

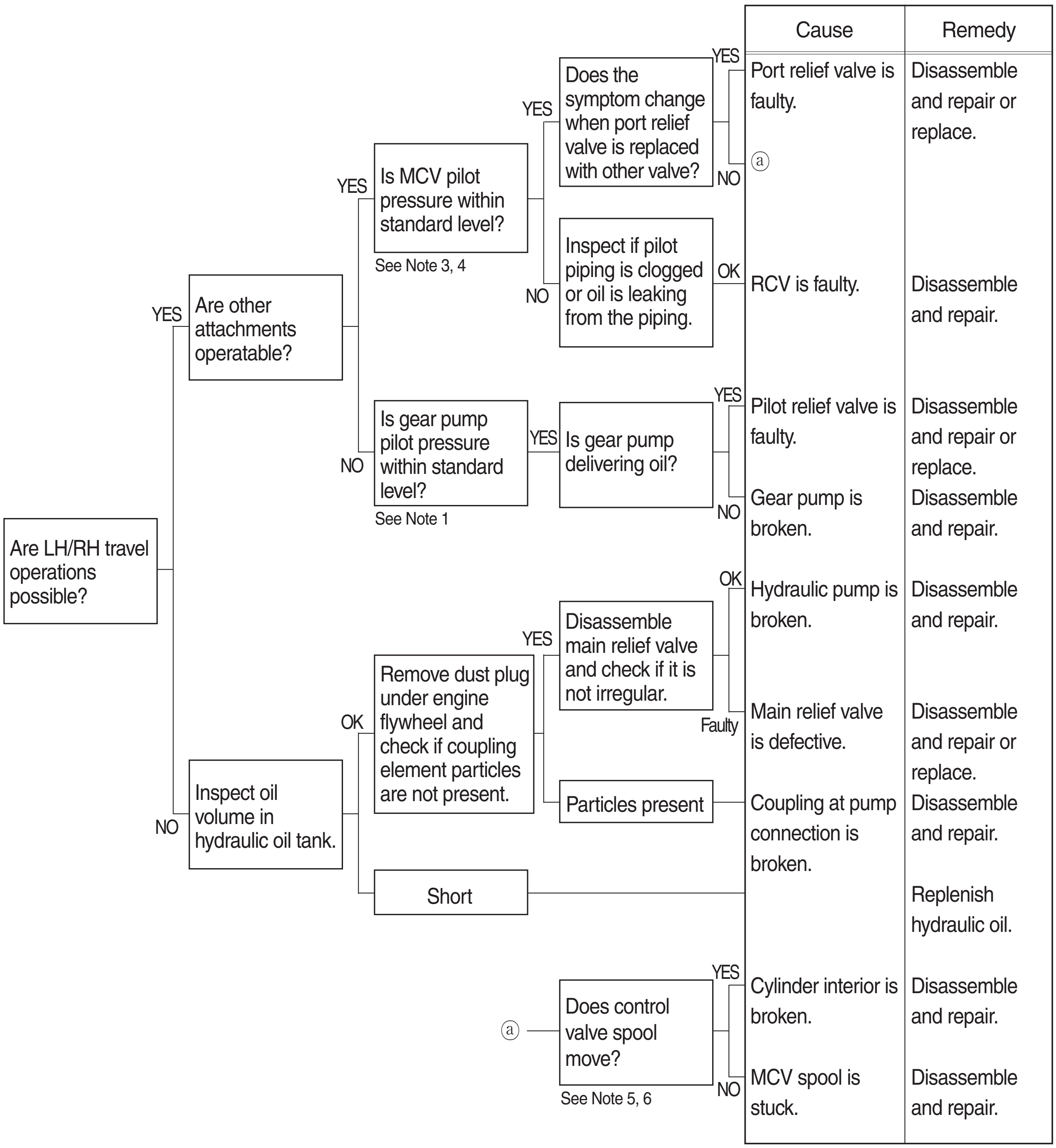
Cause	Remedy
	Disassemble and repair or replace.

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

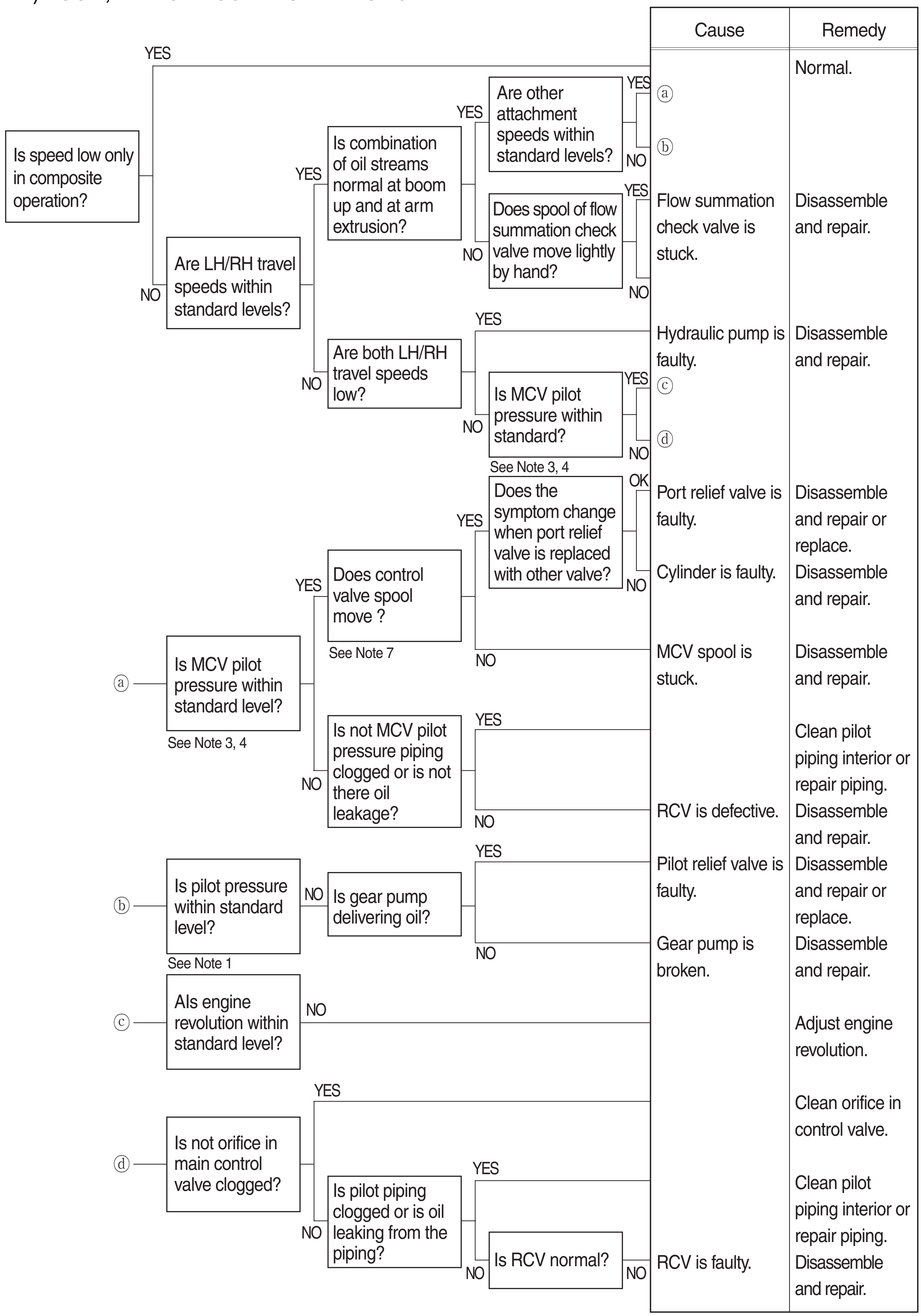


6. ATTACHMENT SYSTEM

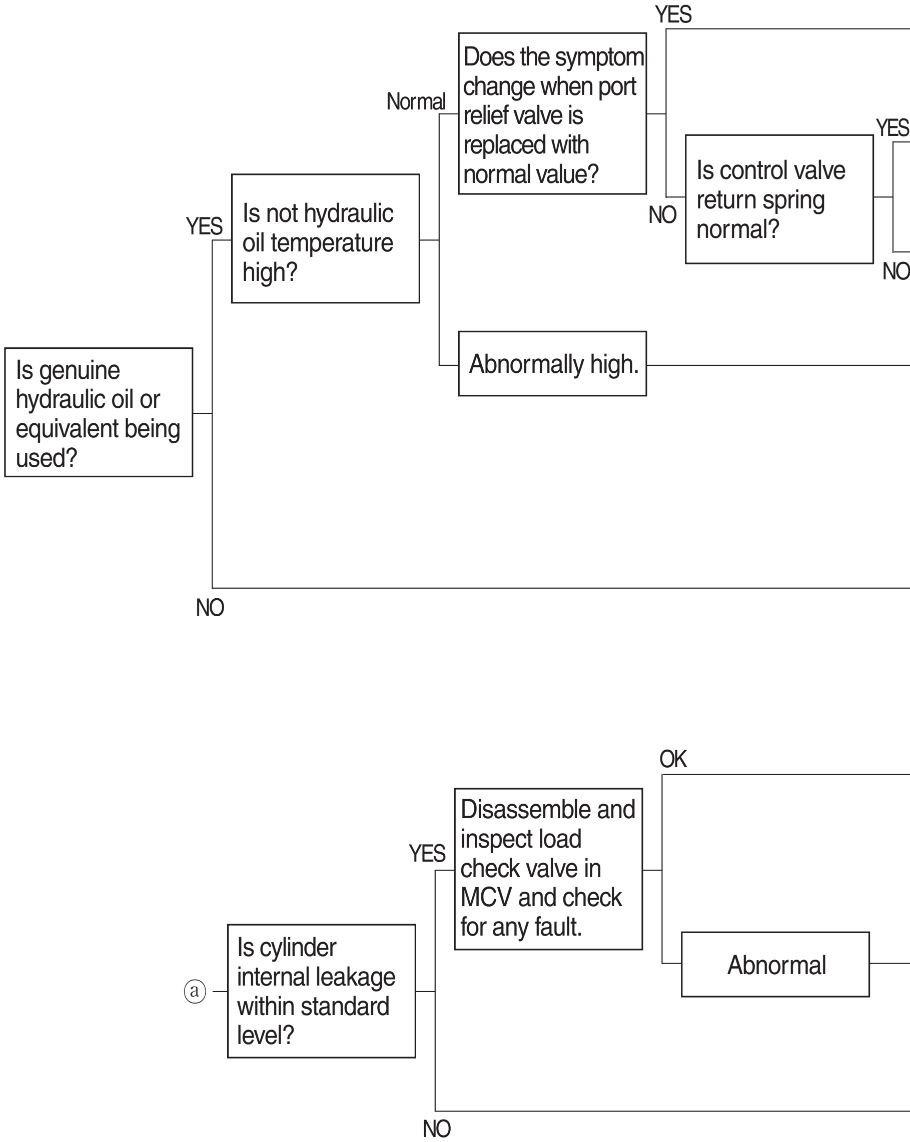
1) BOOM OR ARM ACTION IS IMPOSSIBLE AT ALL



2) BOOM, ARM OR BUCKET SPEED IS LOW

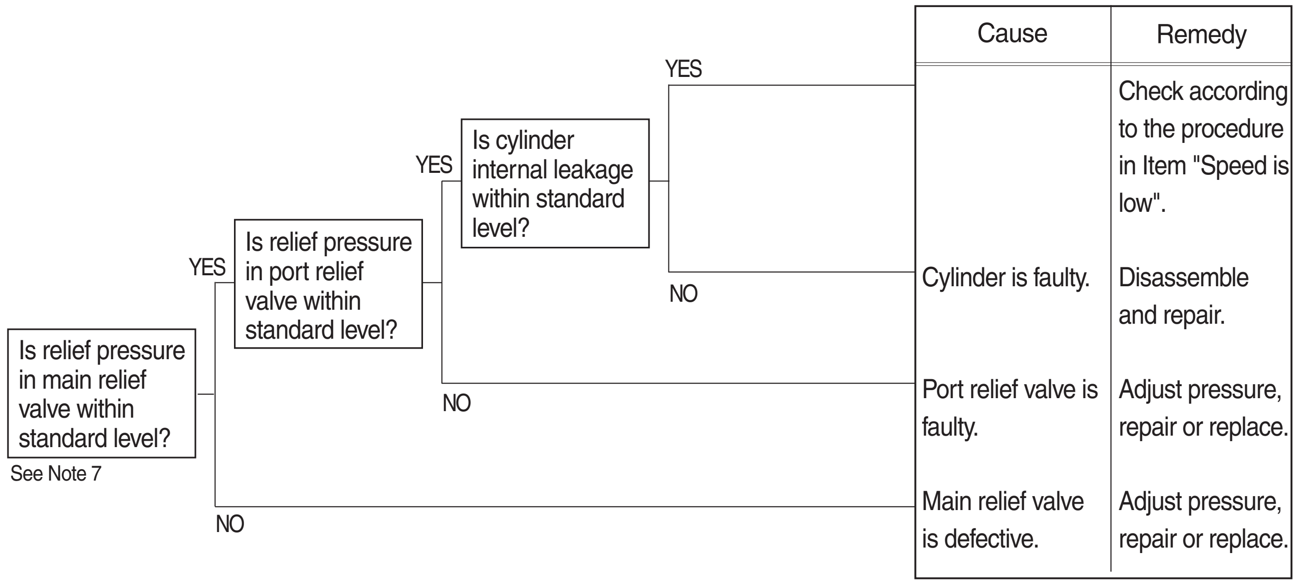


3) BOOM, ARM OR BUCKET CYLINDER EXTENDS OR CONTRACTS ITSELF AND ATTACHMENT FALLS

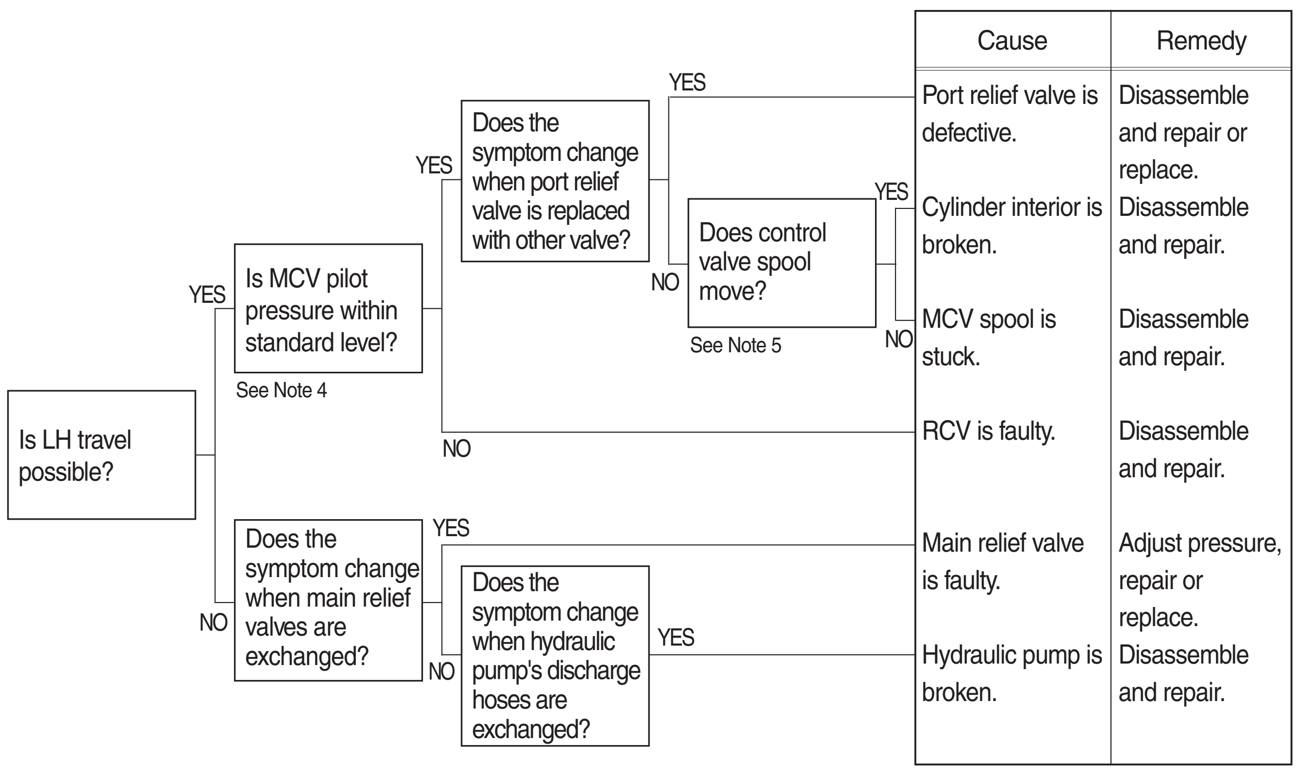


Cause	Remedy
Port relief valve is faulty.	Disassemble and repair or replace.
Control valve's return spring is faulty.	Disassemble and replace.
	Locate the cause of hydraulic oil temperature rise and lower it to proper level.
	Replace with genuine hydraulic oil or equivalent.
Pressure tightness between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

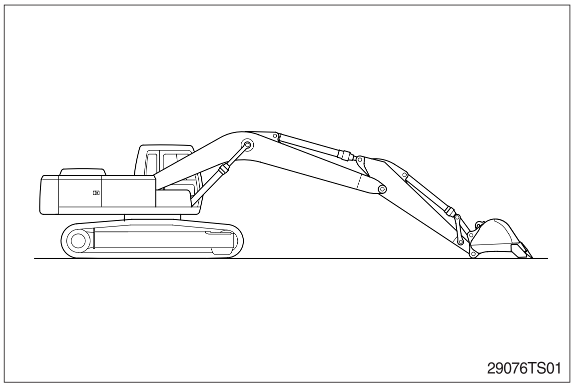


6) BOOM MAKES A SQUEAKING NOISE WHEN BOOM IS OPERATED

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

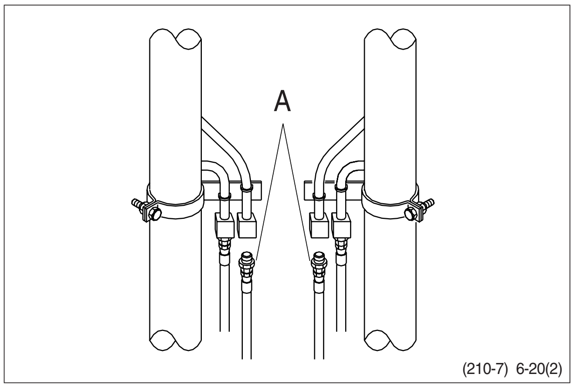
※ HOW TO CHECK INTERNAL BOOM CYLINDER LEAKAGE

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



29076TS01

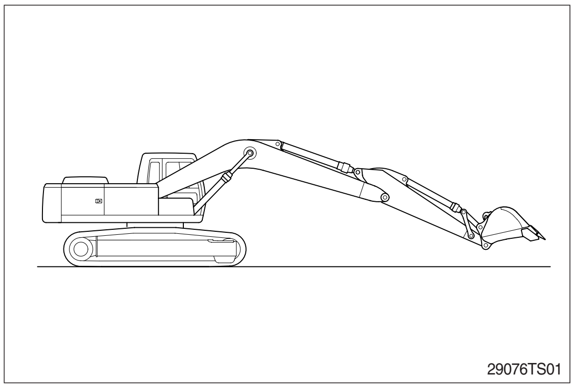
2. Disconnect hose (A) from rod side of boom cylinder and drain oil from cylinders and hose. (put cups on piping and hose ends)



(210-7) 6-20(2)

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

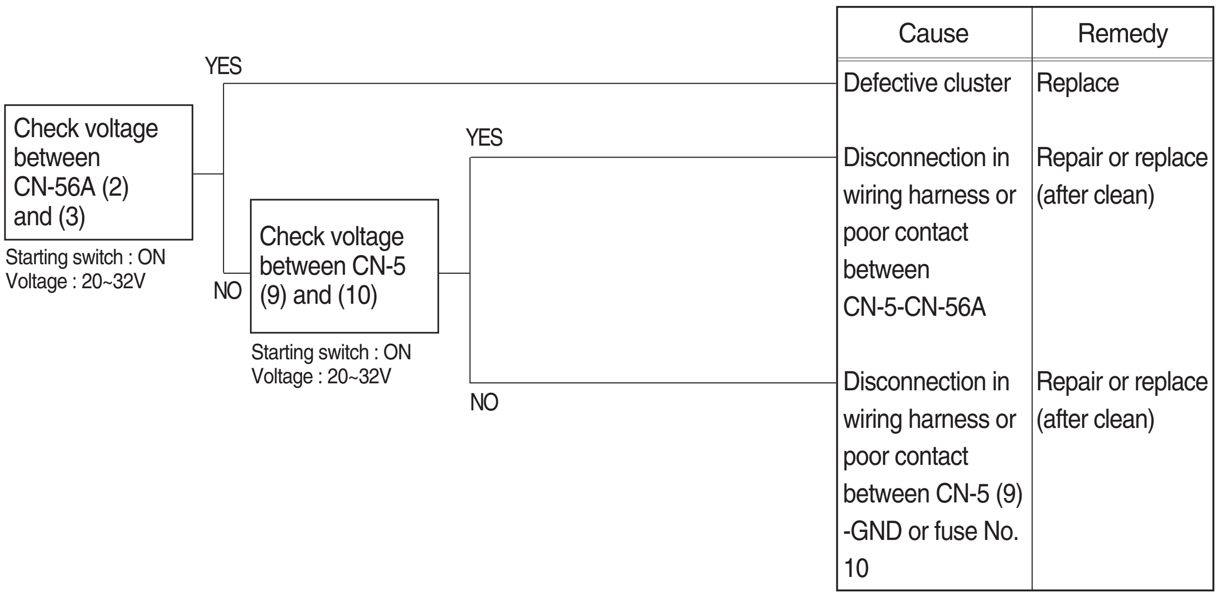
   If oil leaks from piping side and boom cylinder rod is retracted there is an internal leak in the cylinder.
   If no oil leaks from piping side and boom cylinder rod is retracted, there is an internal leak in the control valve.



29076TS01

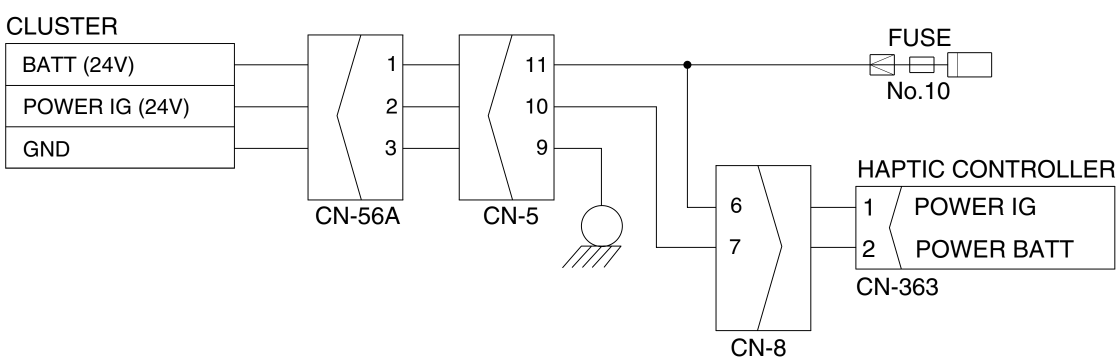
1. WHEN STARTING SWITCH IS TURNED ON, CLUSTER DISPLAY DOES NOT APPEAR

- Before disconnecting the connector, always turn the starting switch OFF.
- Before carrying out below procedure, check all the related connectors are properly inserted and short of fuse No. 10.
- After checking, insert the disconnected connectors again immediately unless otherwise specified.



Check voltage

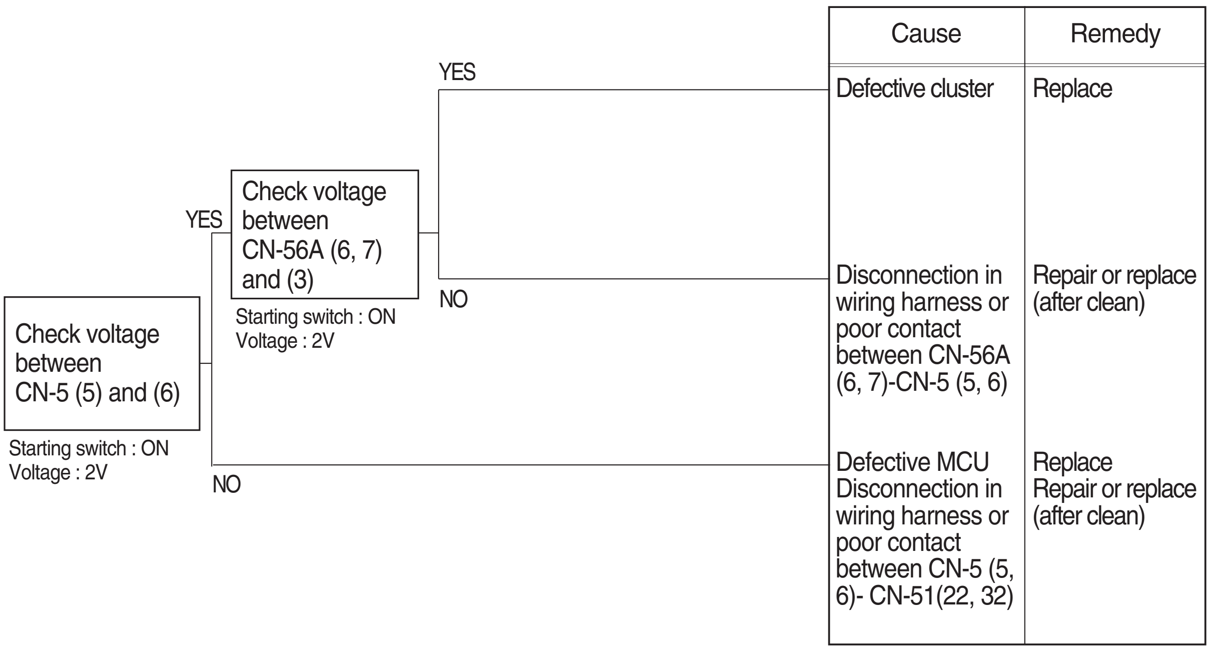
YES	20~32V
NO	0V



900L6ES01

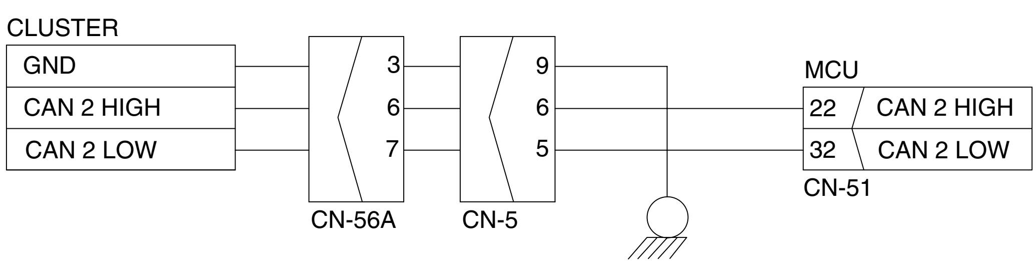
2. COMMUNICATION ERROR FLASHES ON THE CLUSTER (HCESPN 840, FMI 2)

· 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.



Check voltage

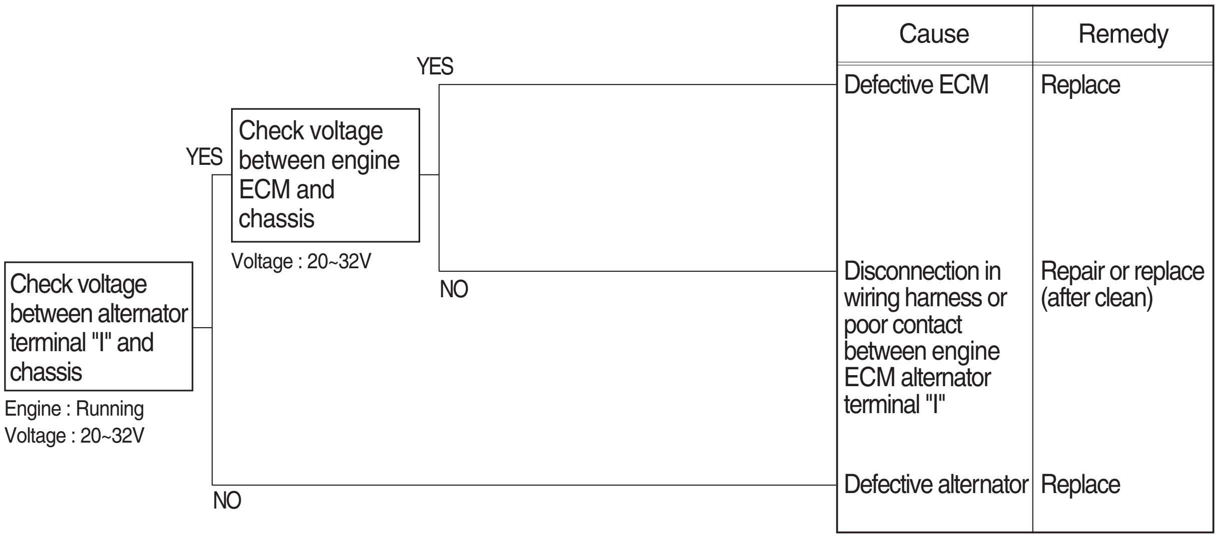
YES	2V
NO	0V



300L6ES02

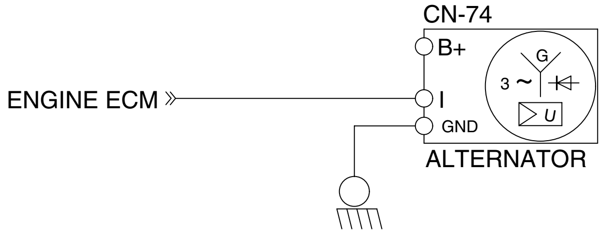
3. BATTERY CHARGING WARNING LAMP LIGHTS UP (Starting switch : ON)

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



Check voltage

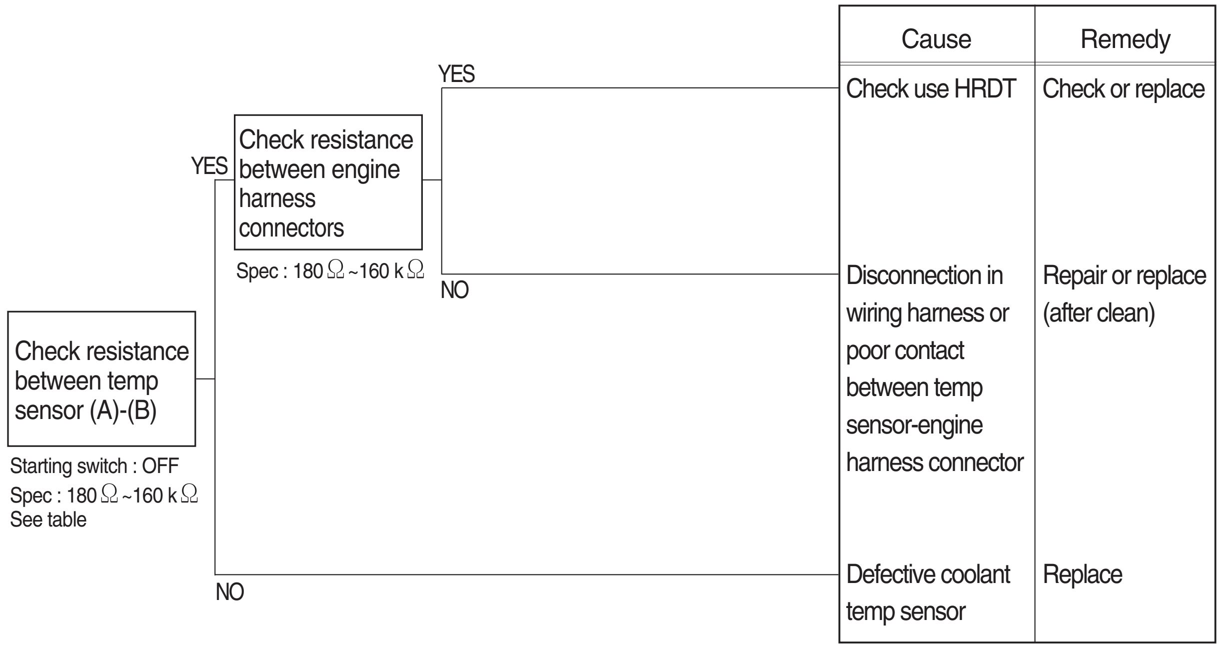
YES	20~32V
NO	0V



900L6ES09

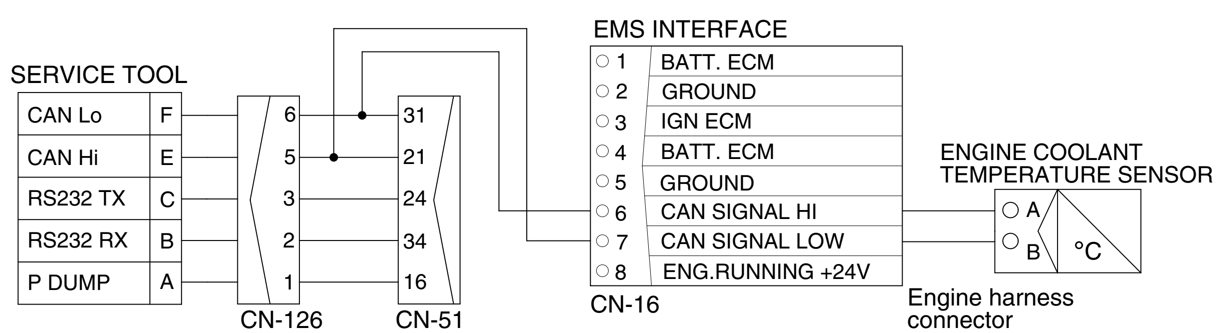
4. WHEN COOLANT OVERHEAT WARNING LAMP LIGHTS UP (engine is started)

· 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

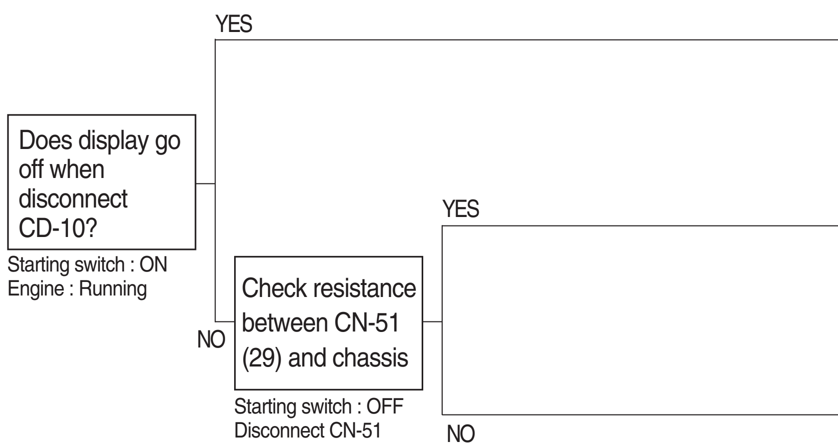
Temperature (˚C)	0	25	50	80	95
Resistance (kΩ)	30~37	9.3~10.7	3.2~3.8	1.0~1.3	0.7~0.8



900L6ES02

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

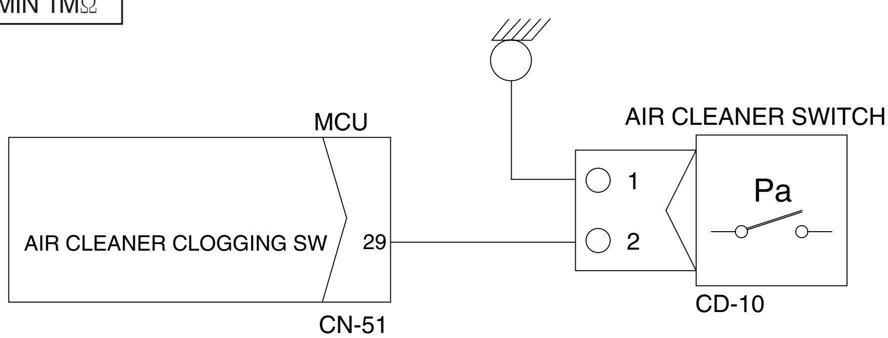
· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.



Cause	Remedy
Clogged air filter or defective switch	Check filter or replace switch
Short circuit in wiring harness between CD-10-CN-51 (29)	Repair or replace (After clean)
Defective MCU	Replace

Check resistance

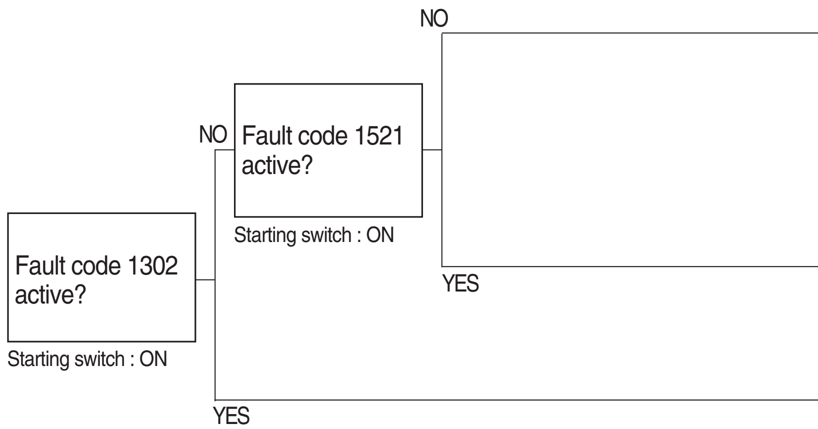
YES	MAX 1Ω
NO	MIN 1MΩ



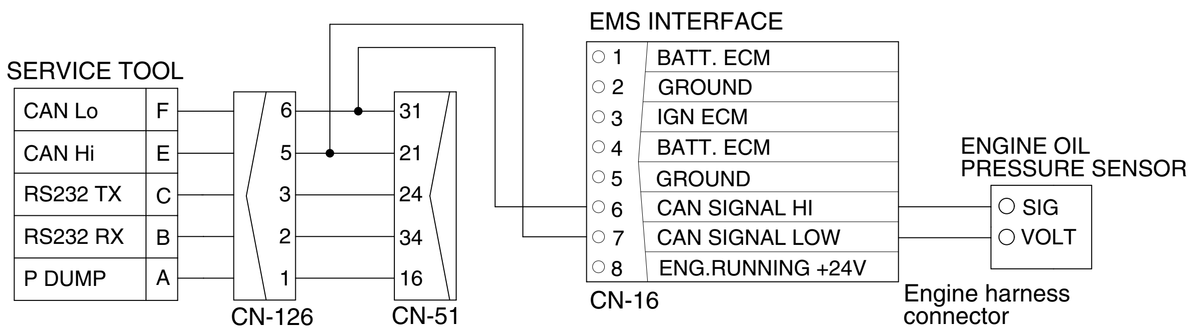
900L6ES06

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

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



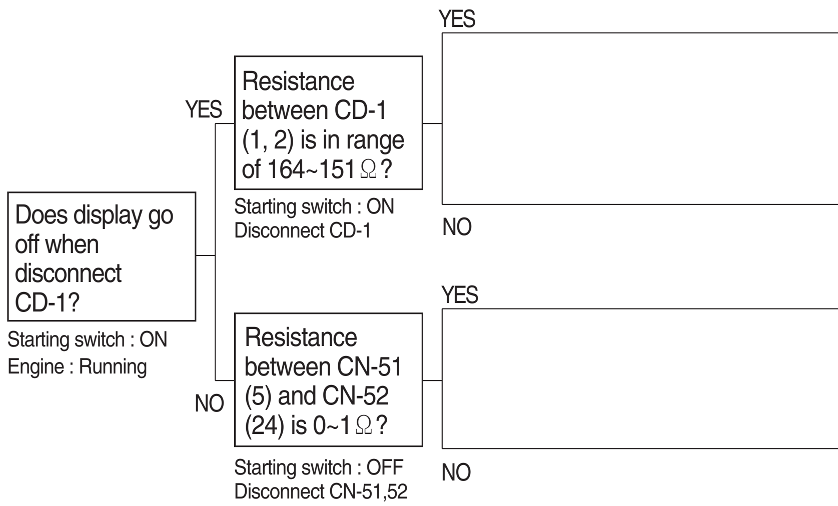
Cause	Remedy
Defective circuit, sensor or ECM.	Contact Cummins.
Voltage above normal or shorted to high source	Refer to engine fault code 1521
Voltage above normal or shorted to high source	Refer to engine fault code 1302



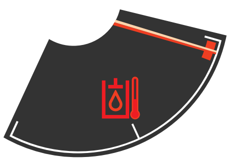
900L6ES20

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.

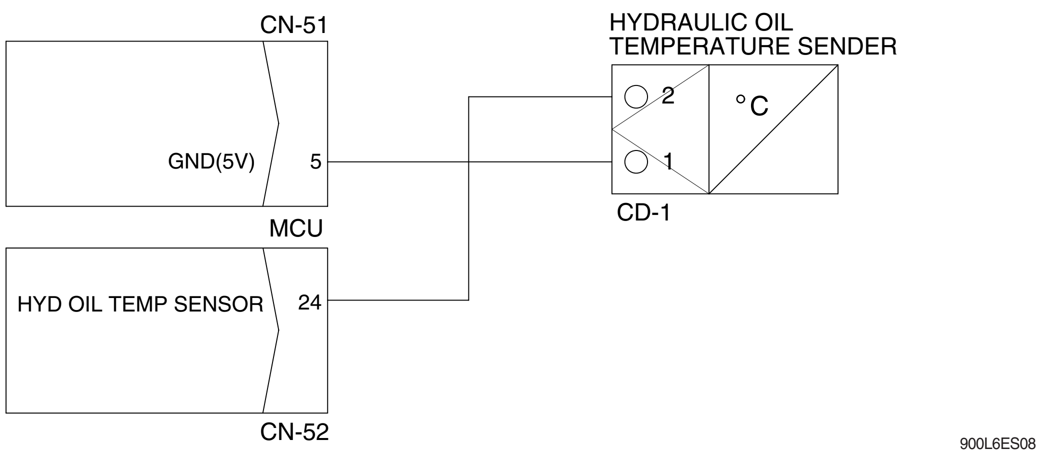


Cause	Remedy
High temperature	Check hydraulic system
Defective temp sensor	Replace
Short circuit between temp sensor and MCU	Repair or replace
Defective MCU	Replace



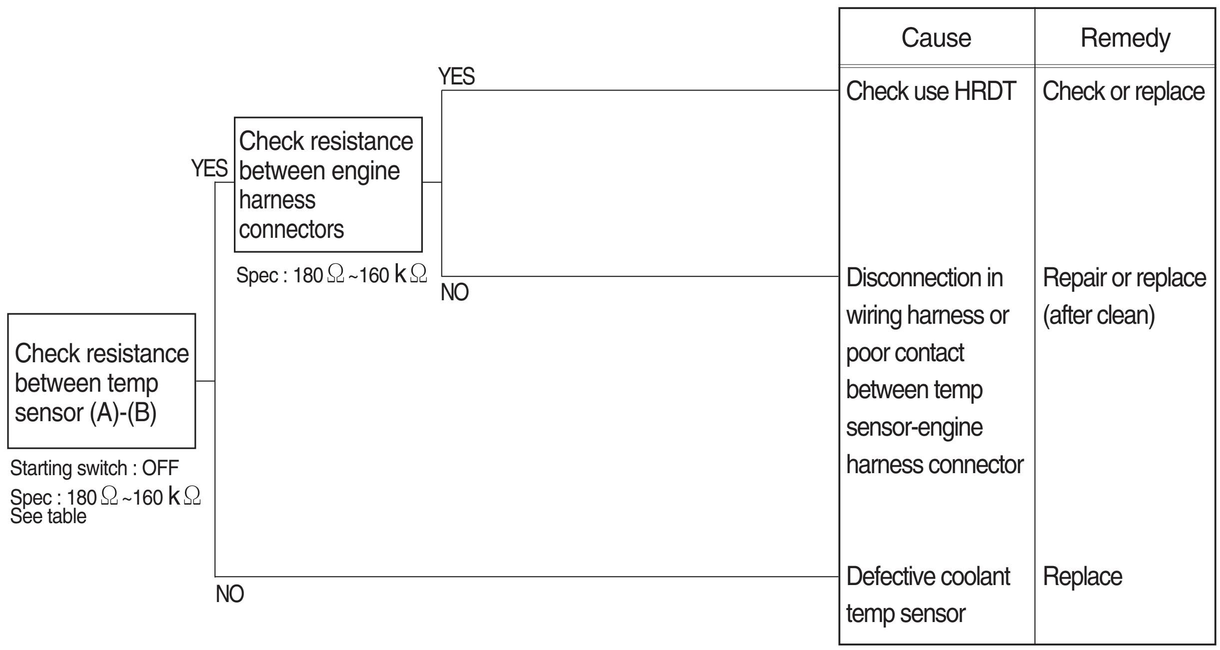
Check Table

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



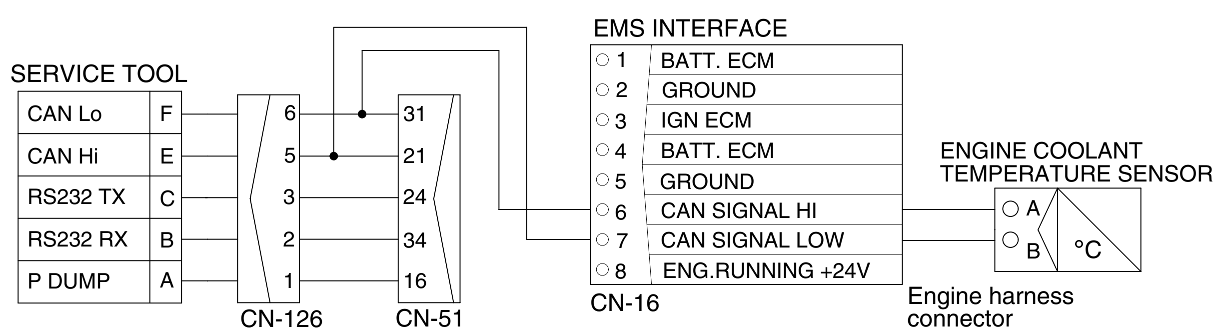
8. WHEN COOLANT TEMPERATURE GAUGE DOES NOT OPERATE

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



Check Table

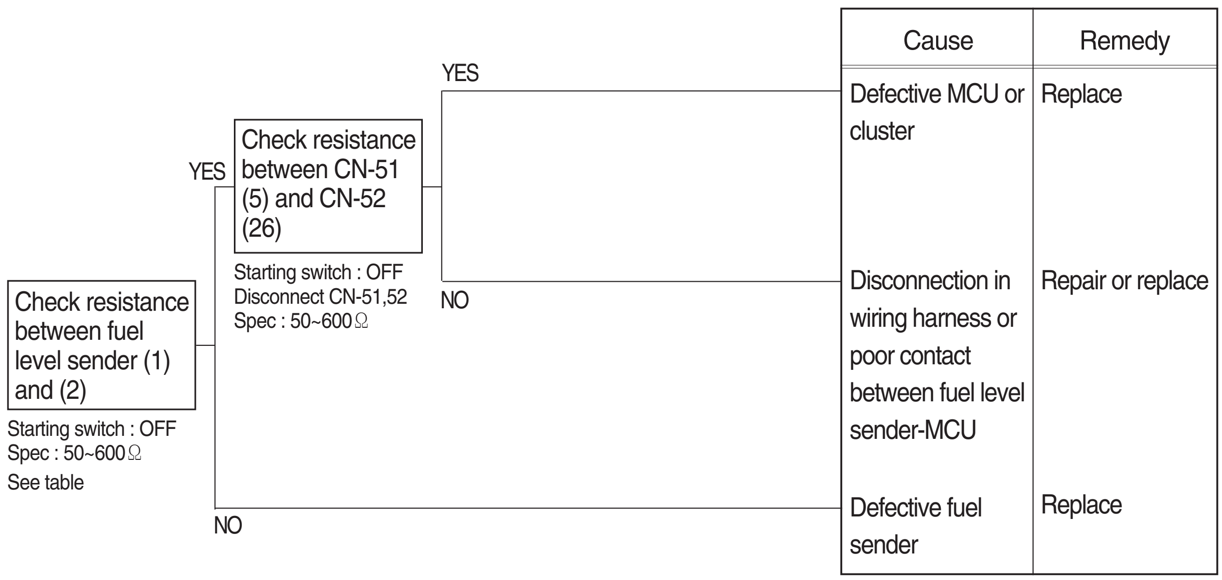
Temperature (˚C)	0	25	50	80	95
Resistance (kΩ)	30~37	9.3~10.7	3.2~3.8	1.0~1.3	0.7~0.8

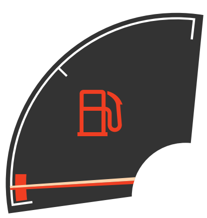


900L6ES02

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

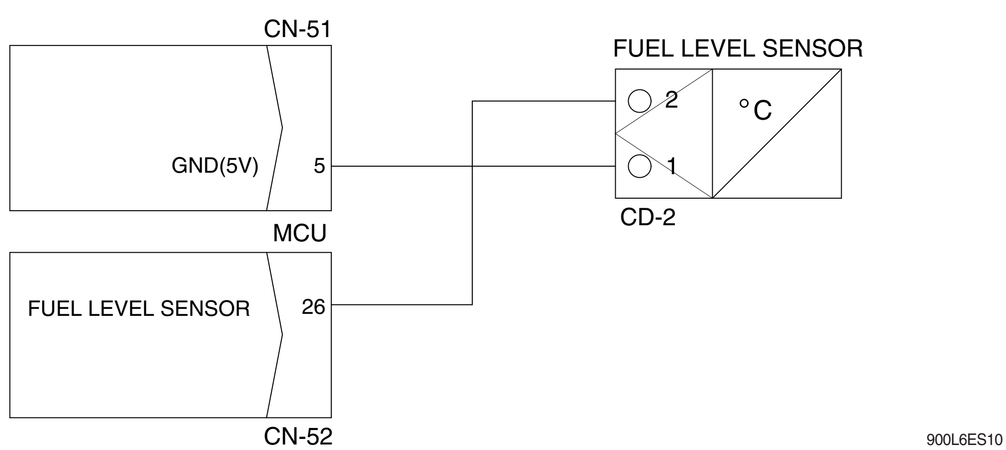
- Before disconnecting the connector, always turn the starting switch OFF.
- Before carrying out below procedure, check all the related connectors are properly inserted.
- After checking, insert the disconnected connectors again immediately unless otherwise specified.





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	-	-

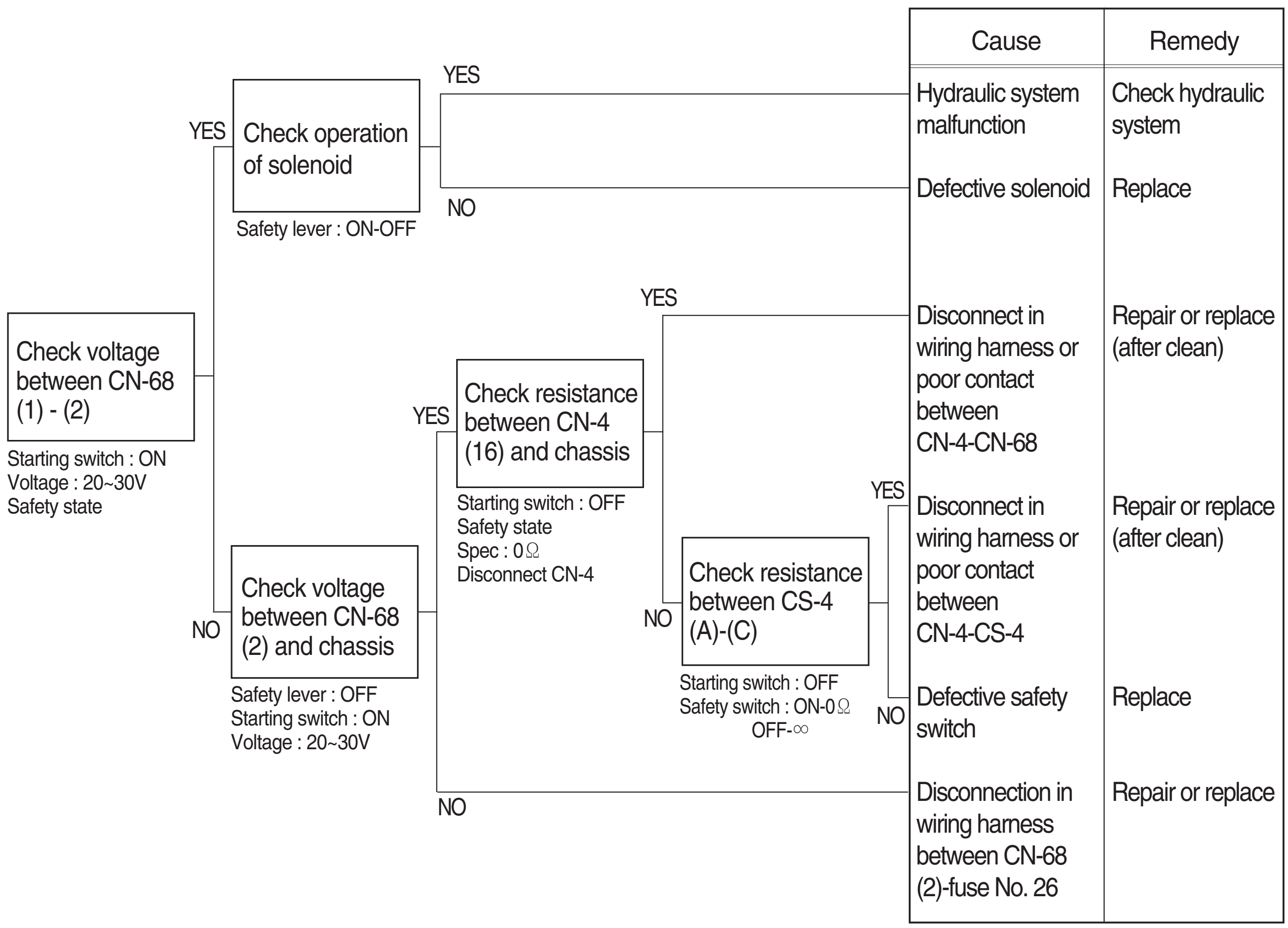


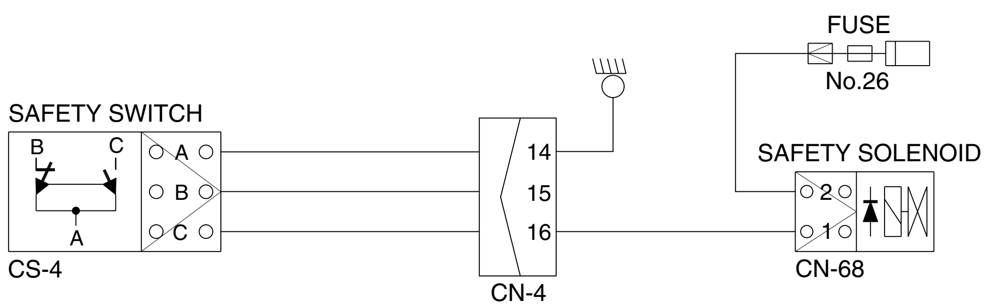
10. WHEN SAFETY SOLENOID DOES NOT OPERATE

· 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. 26.

· After checking, insert the disconnected connectors again immediately unless otherwise specified.

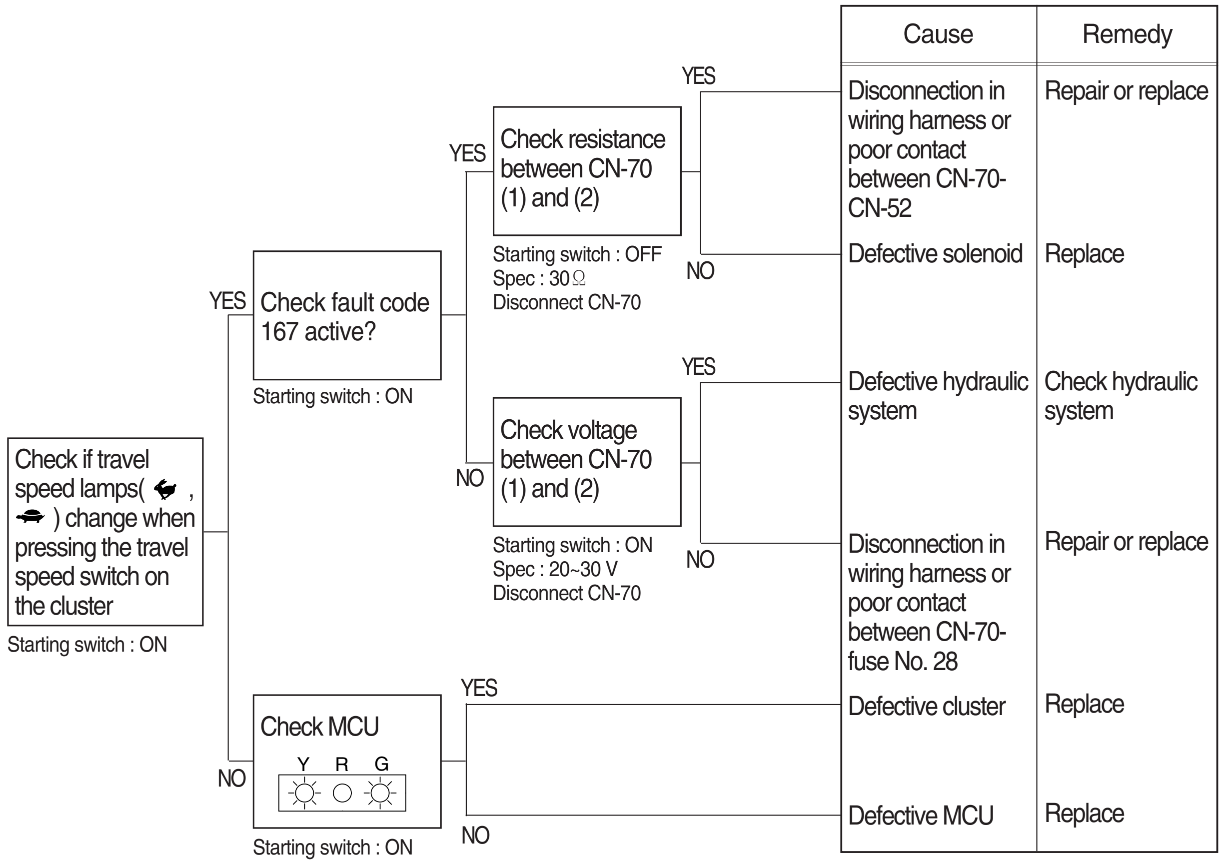


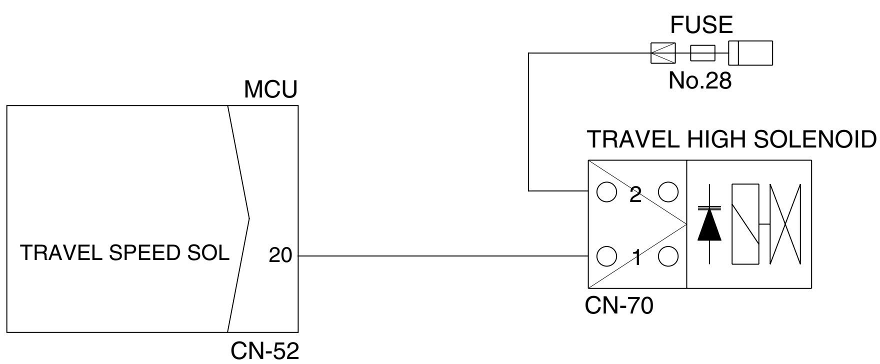


900L6ES03

11. WHEN TRAVEL SPEED 1, 2 DOES NOT OPERATE (HCESPN 167, FMI 4 or 6)

- Before disconnecting the connector, always turn the starting switch OFF.
- Before carrying out below procedure, check all the related connectors are properly inserted and short of fuse No. 28.
- After checking, insert the disconnected connectors again immediately unless otherwise specified.

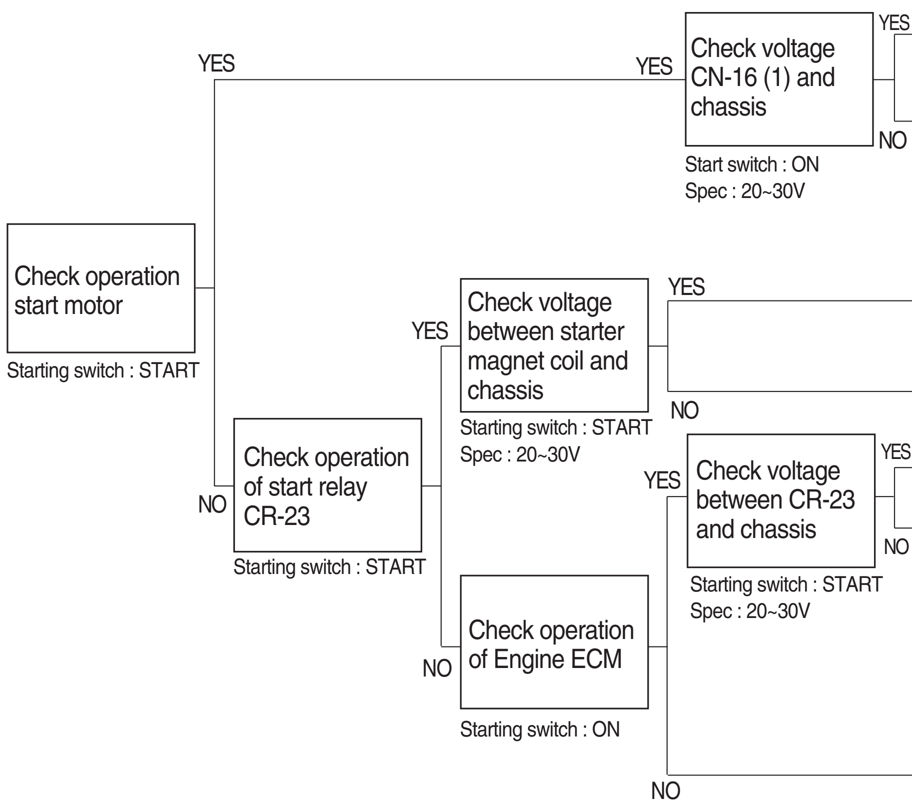




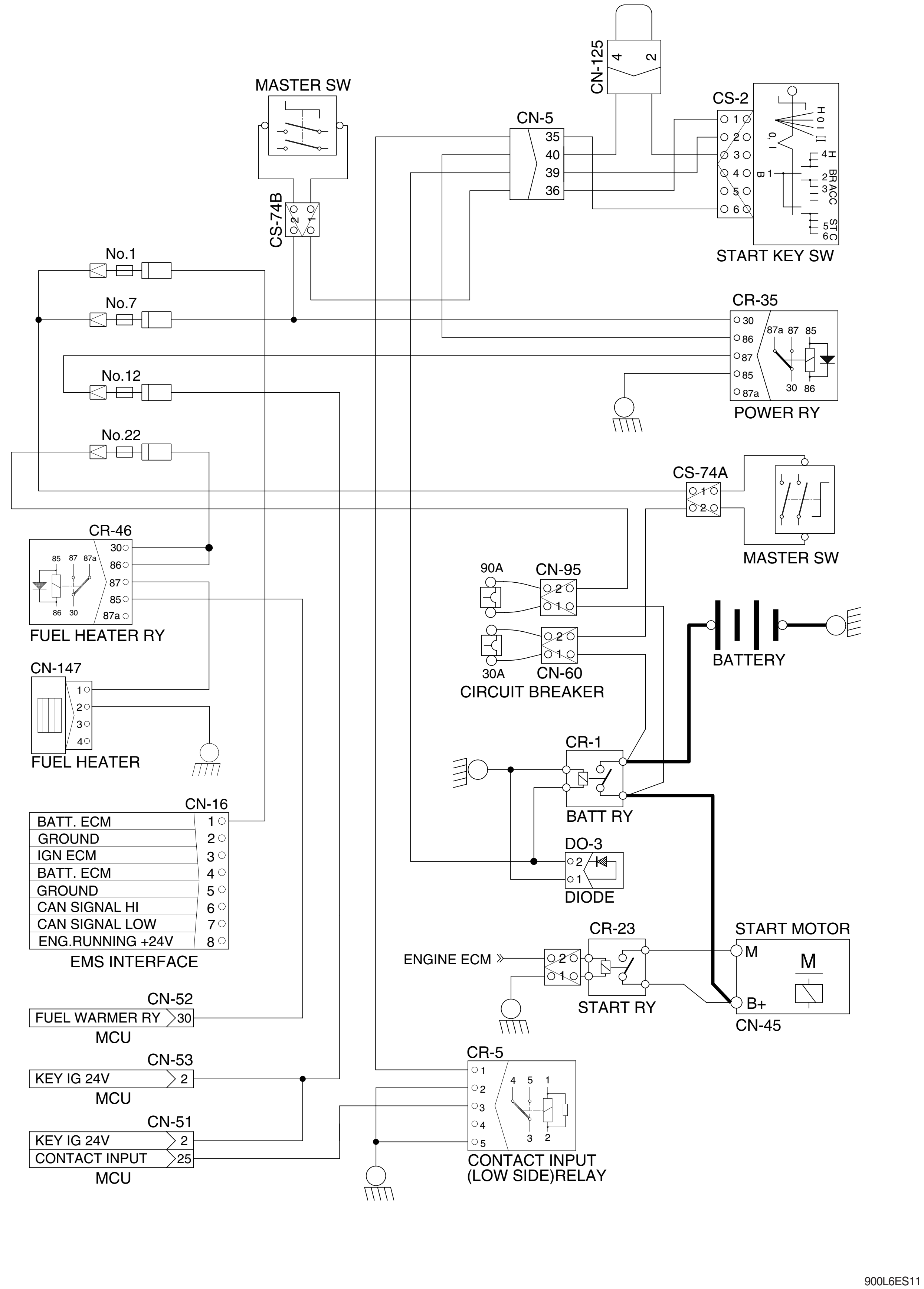
900L6ES04

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, 7, 12, 22.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.



Cause	Remedy
Defective ECM or battery	Replace
Disconnection in wiring harness or poor contact between CR-35 (30) -CN-16 (1)	Repair or replace
Defective magnet of start motor	Replace
Defective start relay	Replace
Defective start relay	Replace
Disconnection in wiring harness or poor contact between CR-23 -Engine ECM	Repair or replace
Defective engine ECM	Replace

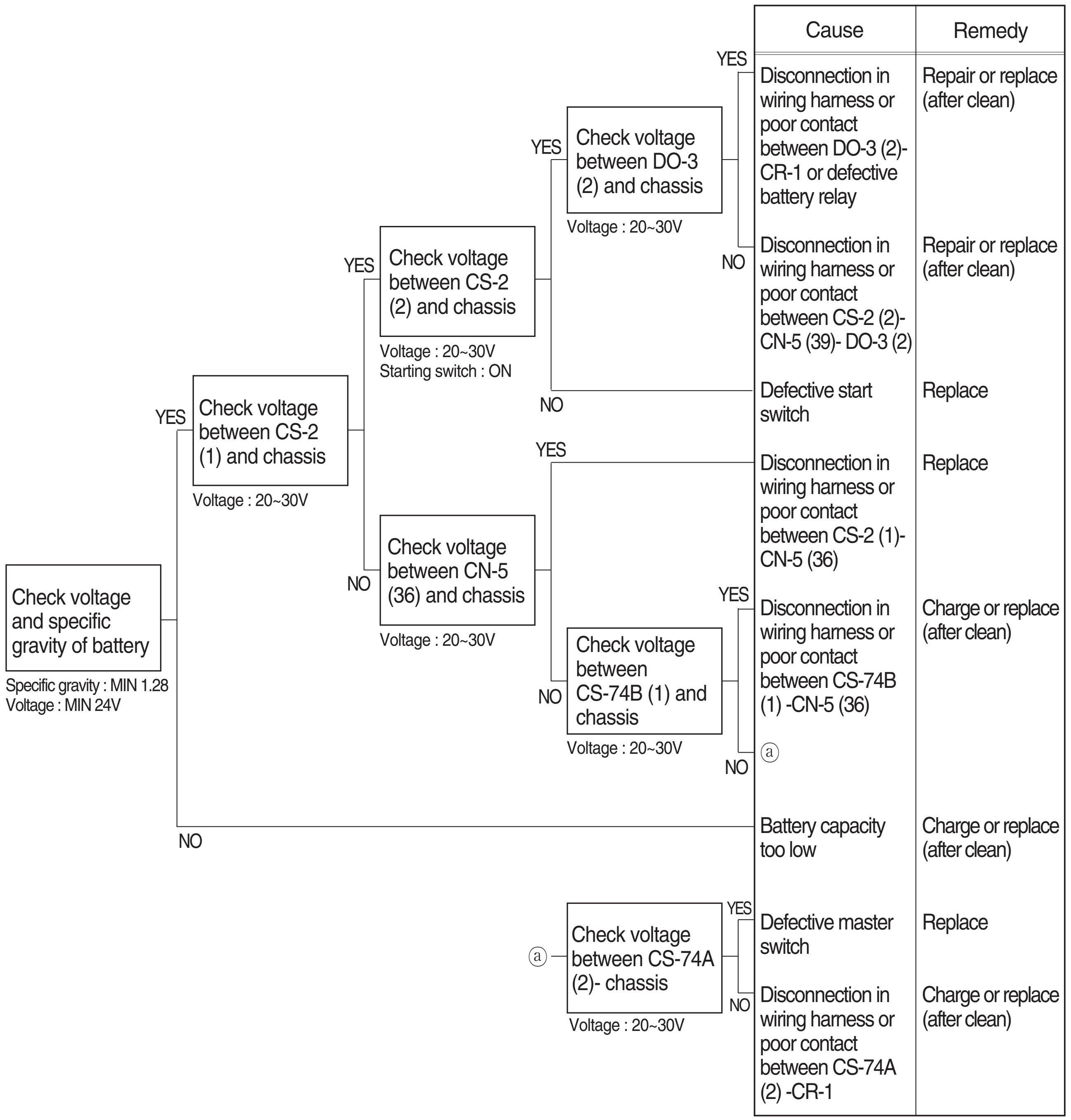


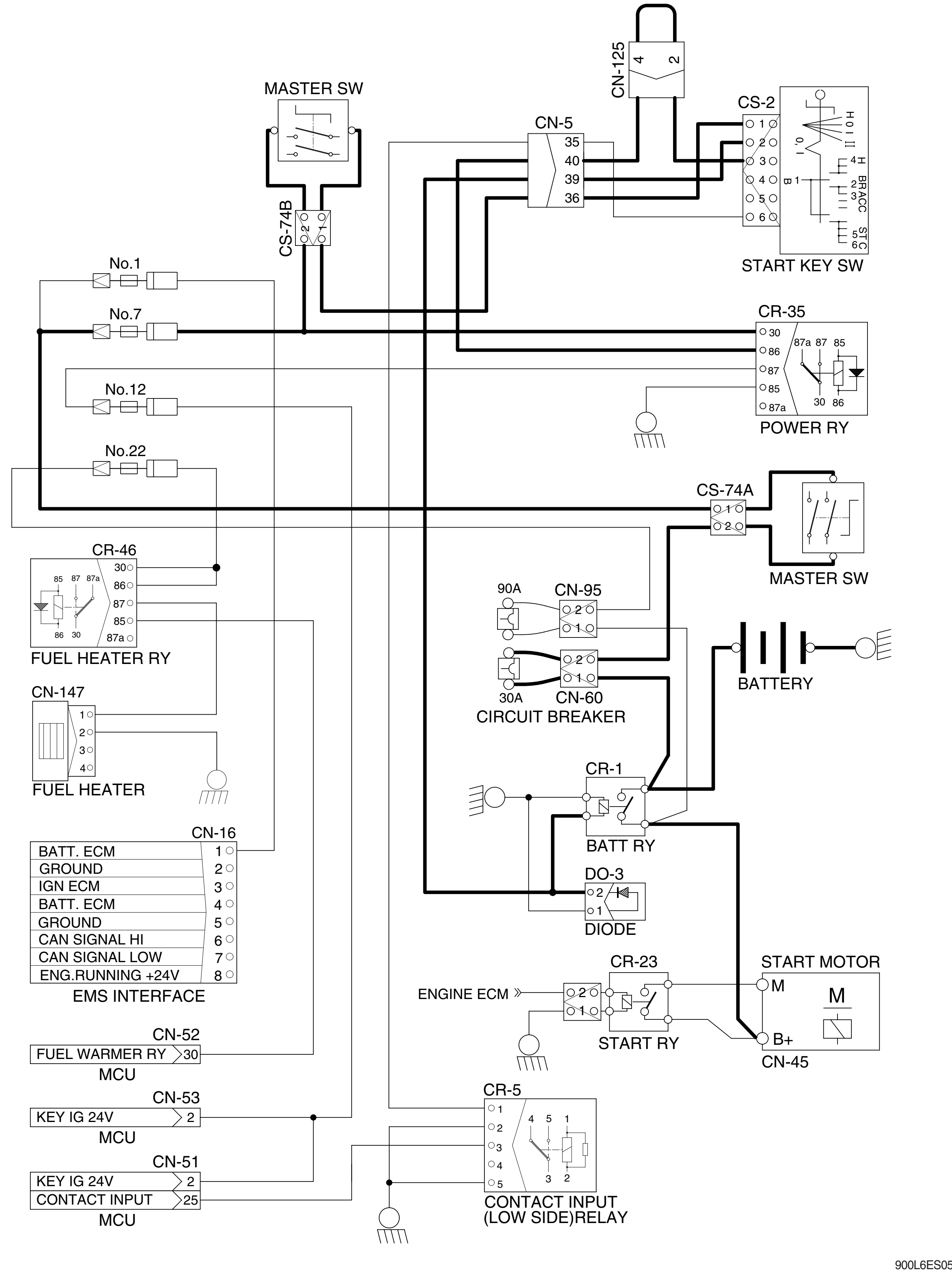
13. WHEN STARTING SWITCH ON DOES NOT OPERATE

· 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).

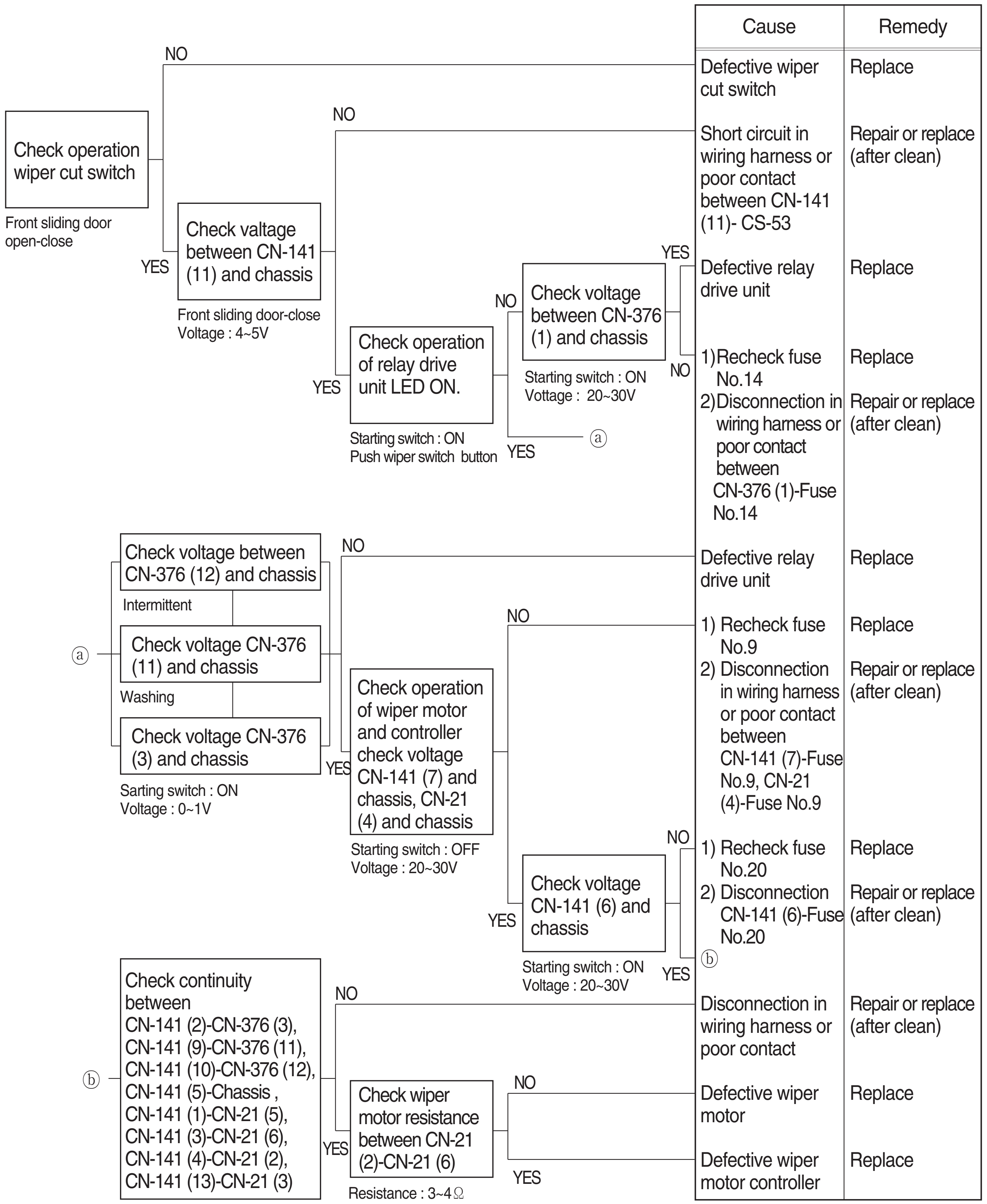
· After checking, insert the disconnected connectors again immediately unless otherwise specified.

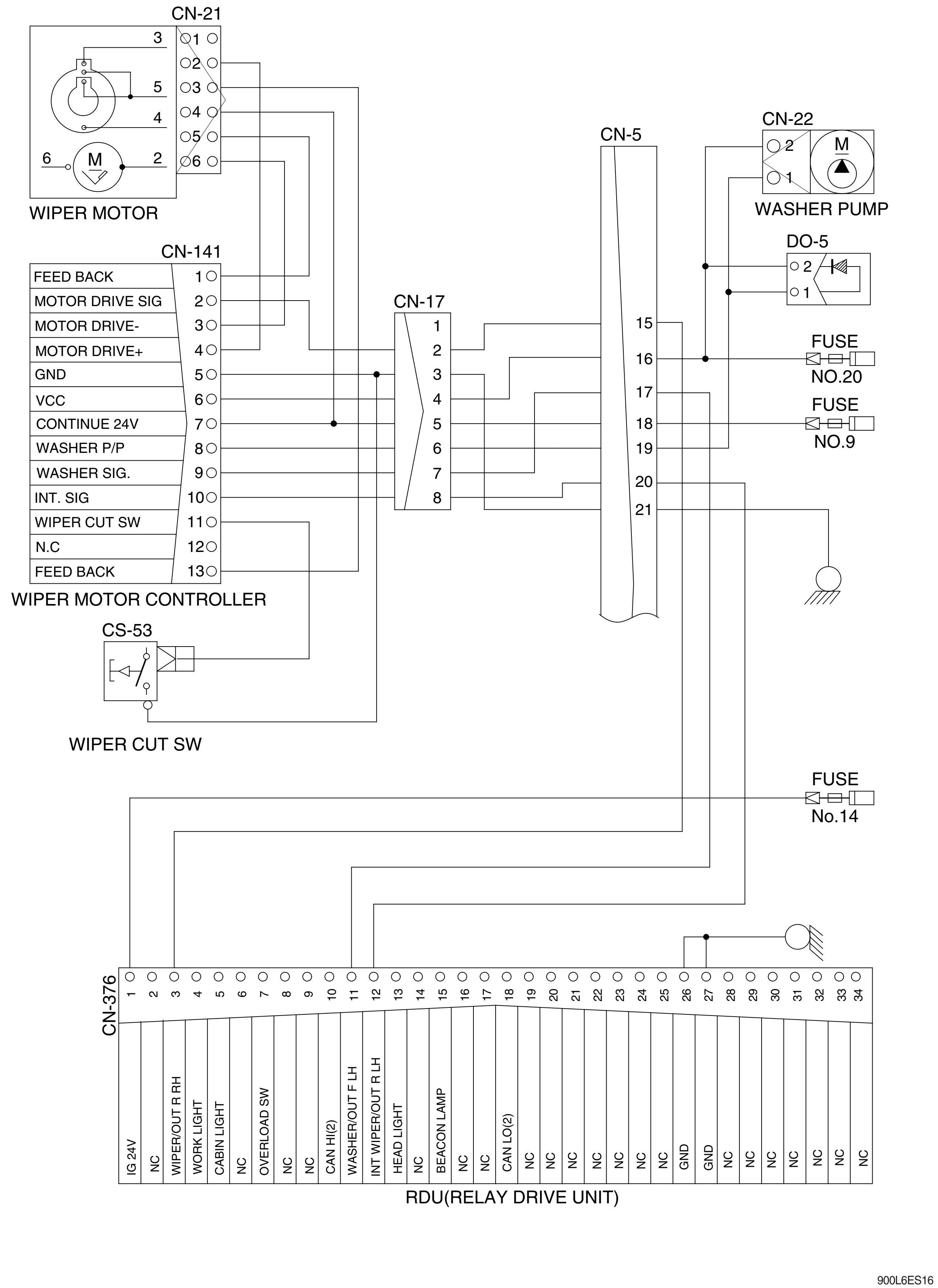




14. WHEN STARTING SWITCH IS TURNED ON, WIPER MOTOR DOES NOT OPERATE

· 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. 9, 14 and 20 are not blown out.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.



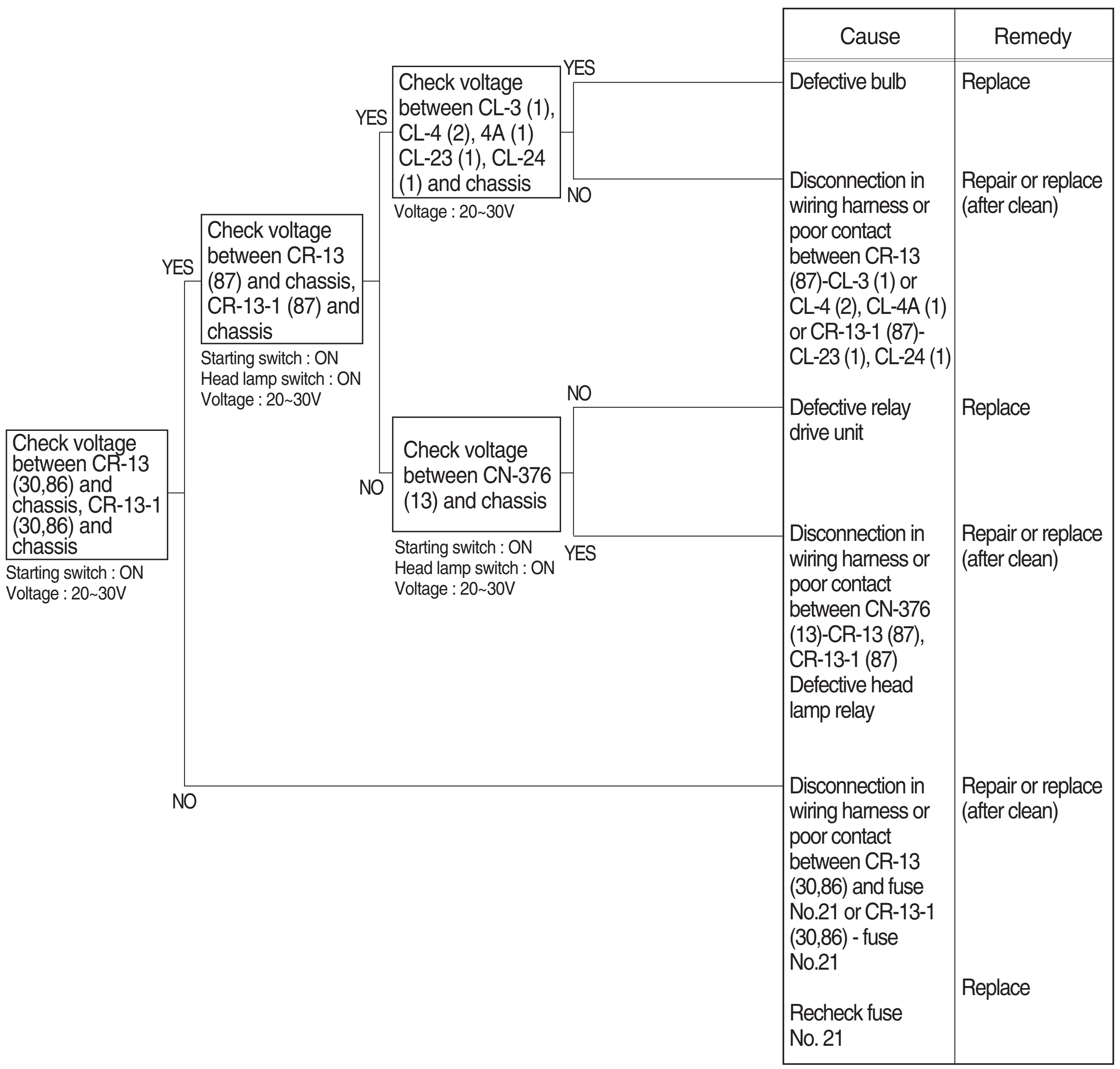


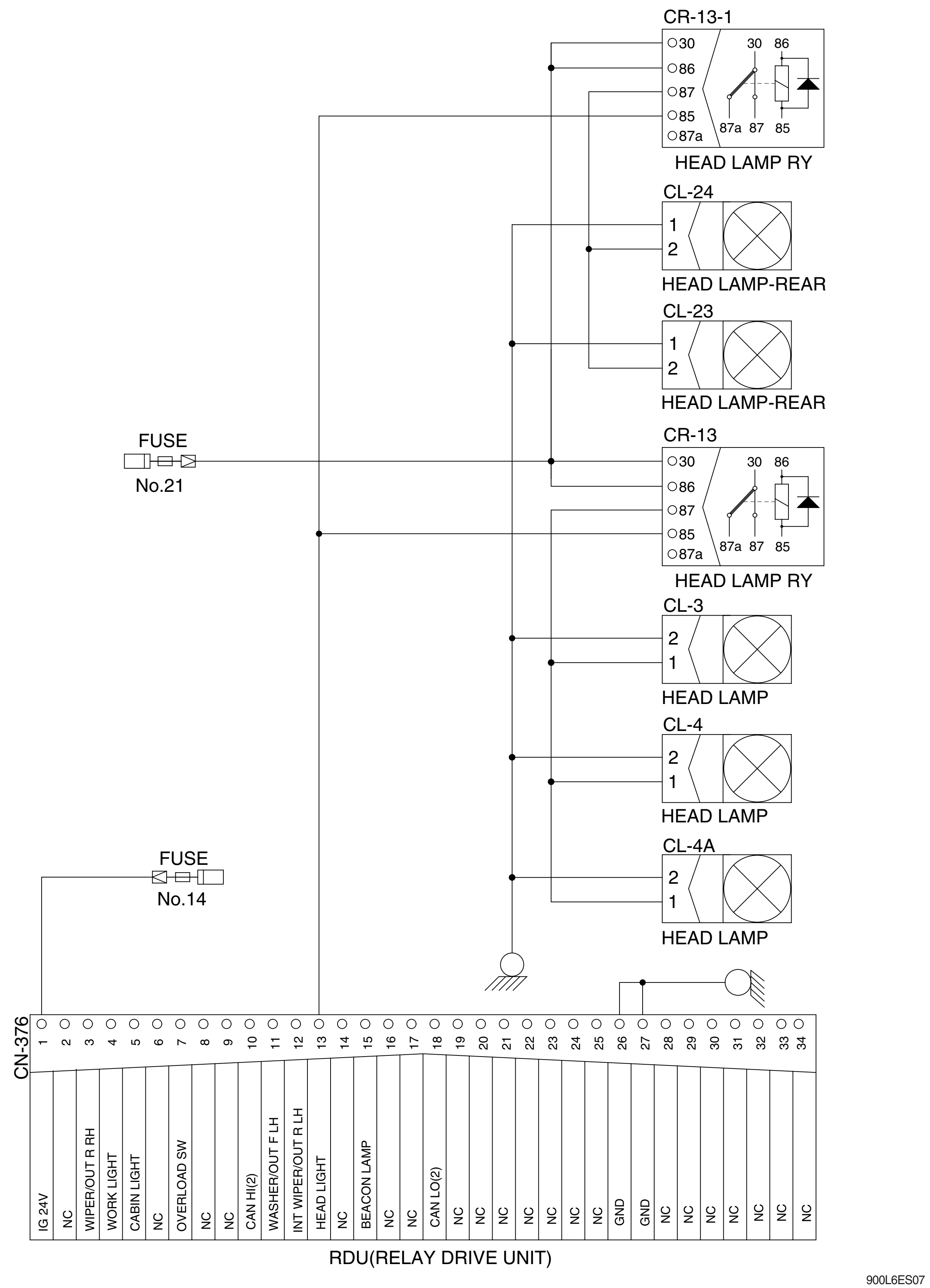
15. WHEN STARTING SWITCH IS TURNED ON, HEAD LAMP DOES NOT LIGHTS UP

· 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.14 and 21.

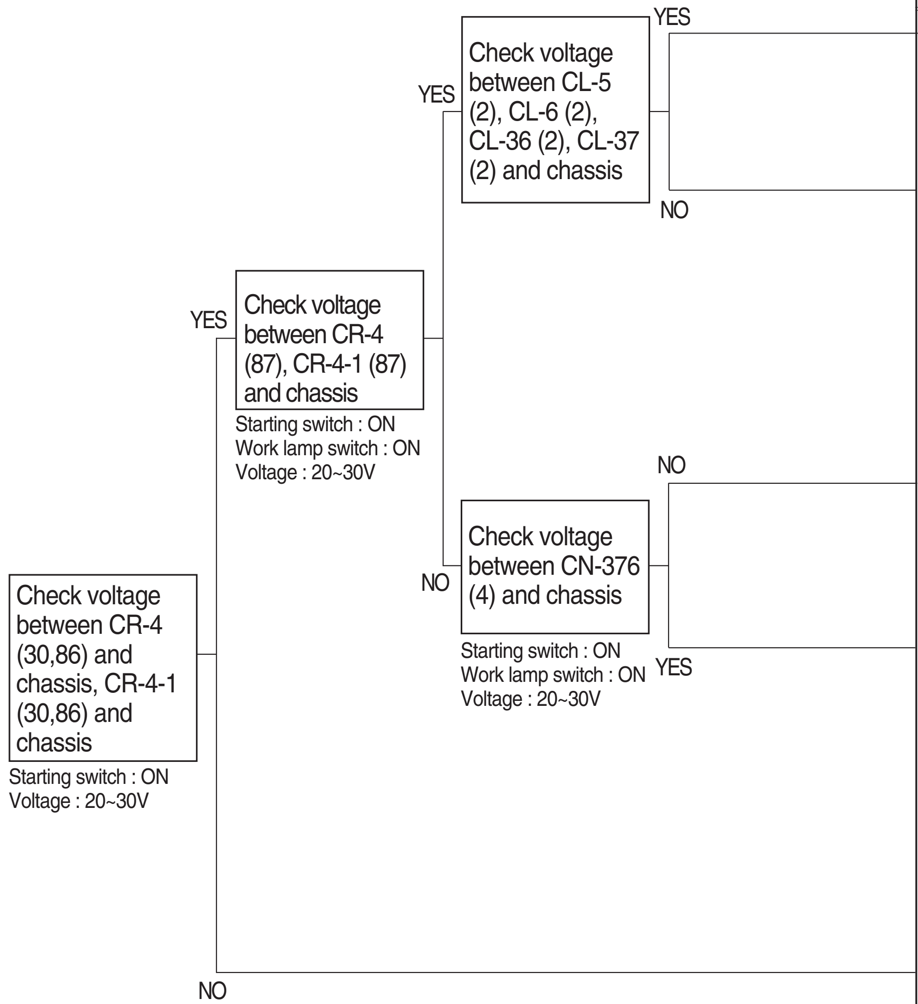
· After checking, insert the disconnected connectors again immediately unless otherwise specified.



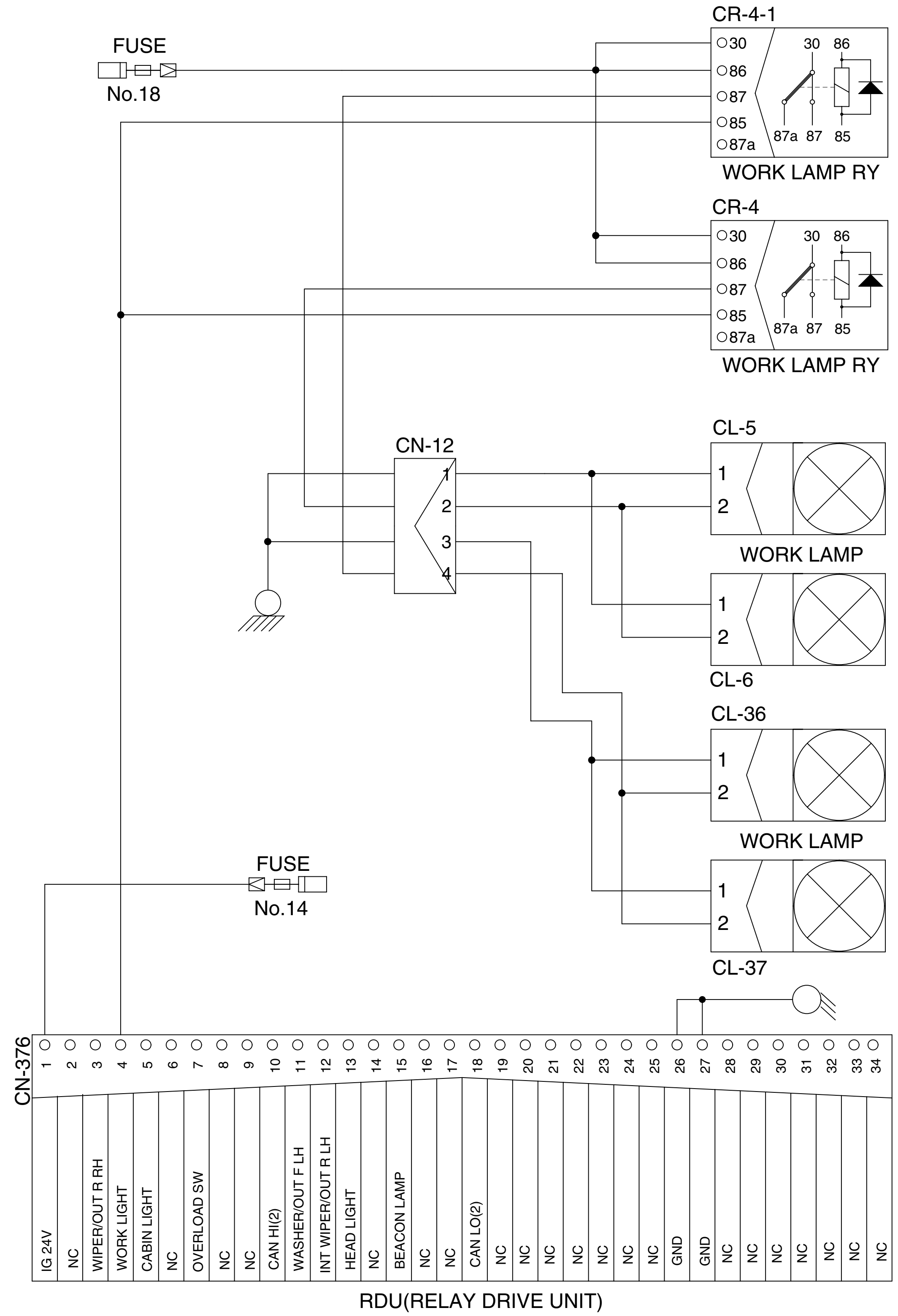


16. WHEN STARTING SWITCH IS TURNED ON, WORK LAMP DOES NOT LIGHTS UP

· 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.14 and 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-4 (87)-CL-5 (2), CL-6 (2) or CR-4-1 (87) - CL-36 (2), CL-37 (2)	Repair or replace (after clean)
Defective relay drive unit	Replace
Disconnection in wiring harness or poor contact between CR-4 (85)-CN-376 (4) or CR-4-1 (85) - CN-376 (4) Detective work lamp relay	Repair or replace (after clean)
Disconnection in wiring harness or poor contact between CR-4 (30) and fuse No.18 or CR-4 (86) and fuse No.18	Repair or replace (after clean)
Recheck fuse No.18	Replace



900L6ES18

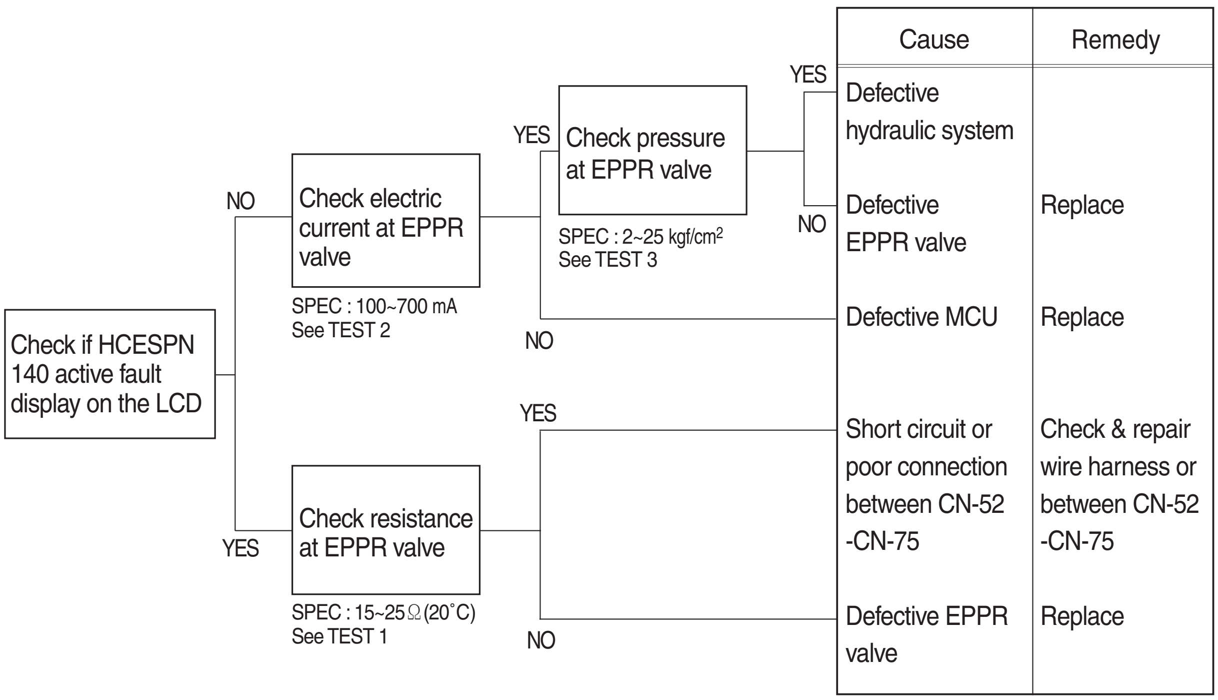
1. ALL ACTUATORS SPEED ARE SLOW

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

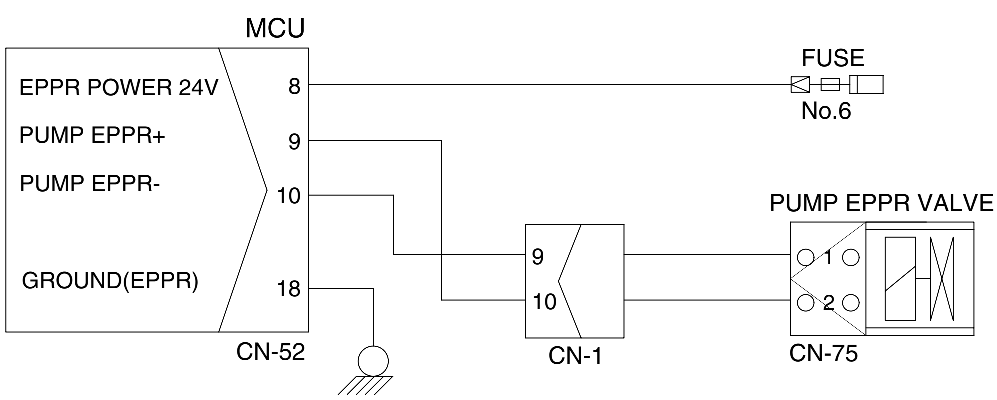
※ Spec : P-mode 1750 ± 50 rpm S -mode 1650 ± 50 rpm E-mode 1550 ± 50 rpm

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

1) INSPECTION PROCEDURE



Wiring diagram



900L6MS01

2) TEST PROCEDURE

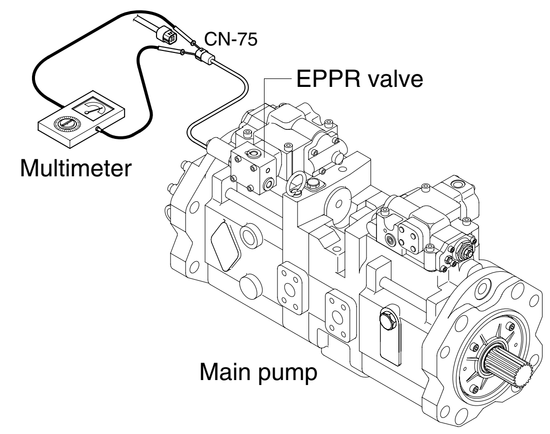
(1) Test 1 : Check resistance at connector CN-75.

① Starting switch OFF.

② Disconnect connector CN-75 from EPPR valve at main hydraulic pump.

③ Check resistance between 2 lines as figure.

SPEC : 15~25Ω (20˚C)



900L6MS02

(2) Test 2 : Check electric current at EPPR valve.

① Disconnect connector CN-75 from EPPR valve.

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

③ Start engine.

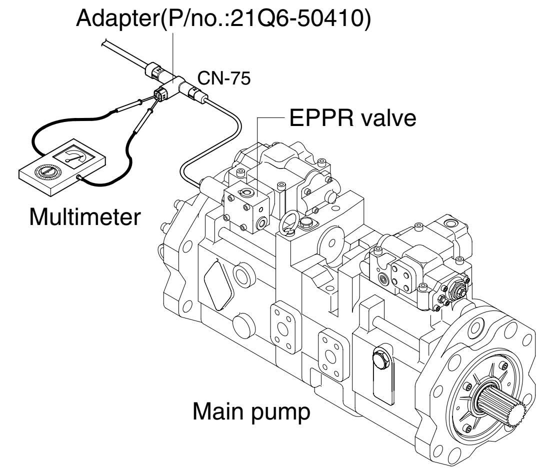
④ Set S-mode and cancel auto decel mode.

⑤ Position the multimodal dial at 10.

⑥ If tachometer show approx 1650±50 rpm disconnect one wire harness from EPPR valve.

⑦ Check electric current at bucket circuit relief position.

Spec : 100~700 mA



900L5MS21

(3) Test 3 : Check pressure at EPPR valve.

① Remove plug and connect pressure gauge as figure.

 · Gauge capacity : 0 to 50 kgf/cm² (0 to 725 psi)

② Start engine.

③ Set S-mode and cancel auto decel mode.

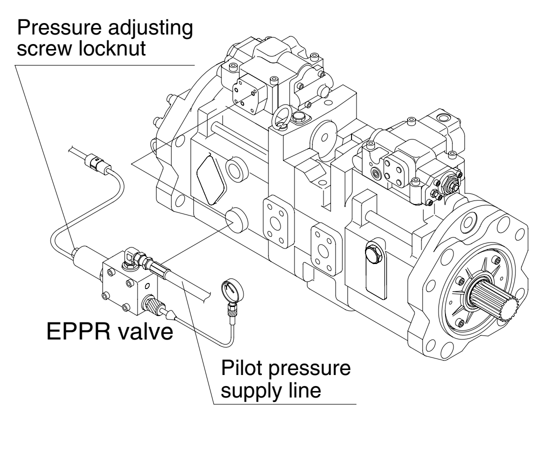
④ Position the multimodal dial at 10.

⑤ If tachometer show approx 1650±50 rpm check pressure at relief position of bucket circuit by operating bucket control lever.

⑥ If pressure is not correct, adjust it.

⑦ After adjust, test the machine.

Spec : 2~25 kgf/cm² (30~350 psi)

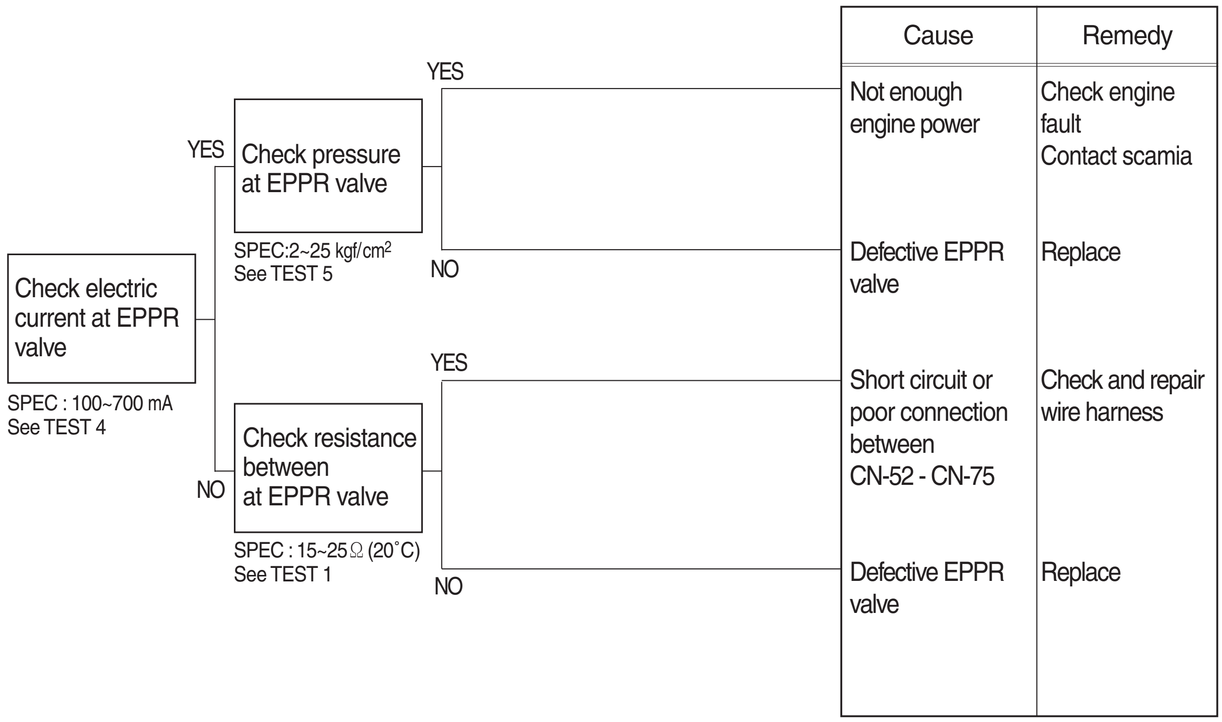


900L5MS22

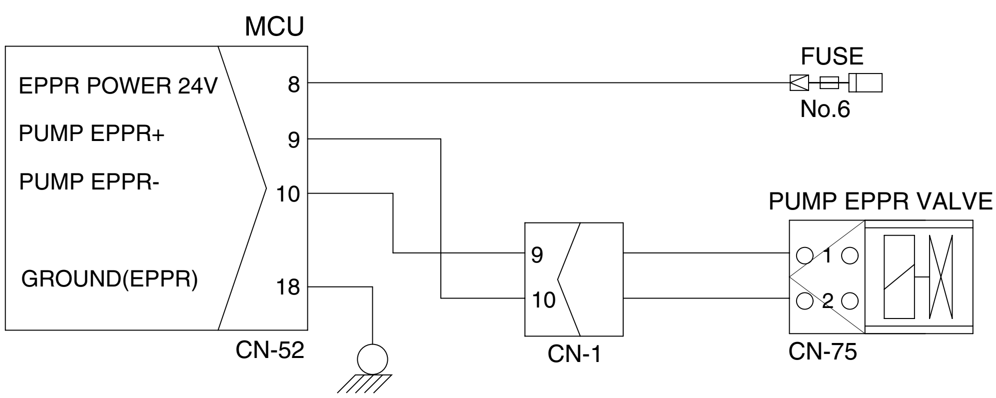
2. ENGINE STALL

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

1) INSPECTION PROCEDURE



Wiring diagram

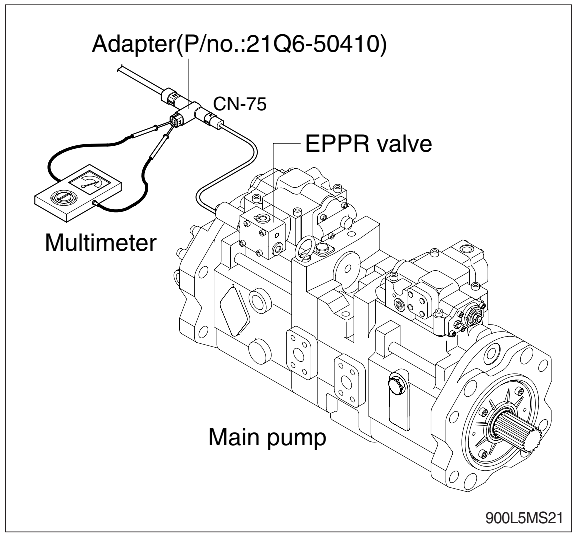


900L6MS01

2) TEST PROCEDURE

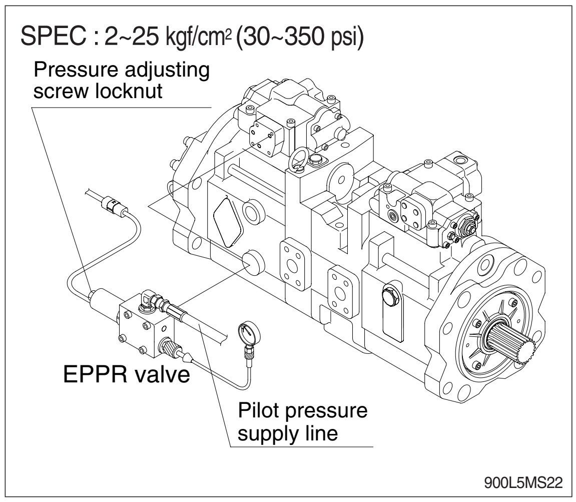
(1) Test 4 : Check electric current at EPPR valve.

① Disconnect connector CN-75 from EPPR valve.
② Insert the adapter to CN-75 and install multimeter as figure.
③ Start engine.
④ Set S-mode and cancel auto decel mode.
⑤ Position the accel dial at 10.
⑥ If rpm show approx 1650±50 rpm disconnect one wire harness from EPPR valve.
⑦ Check electric current at bucket circuit relief position.



(2) Test 5 : Check pressure at EPPR valve.

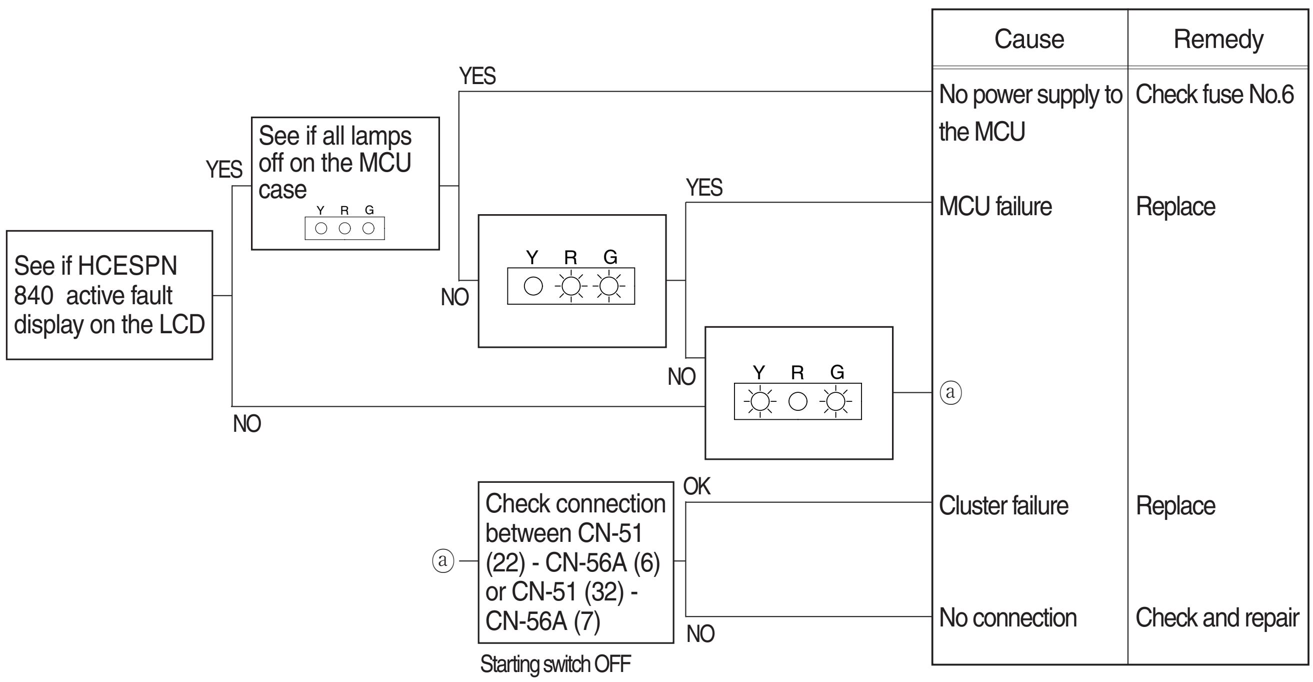
① Remove plug and connect pressure gauge as figure.
 · Gauge capacity : 0 to 50 kgf/cm^2 (0 to 725 psi)
② Start engine.
③ Set S-mode and cancel auto decel mode.
④ Position the accel dial at 10.
⑤ If rpm show approx 1650±50 rpm check pressure at relief position of bucket circuit by operating bucket control lever.
⑥ If pressure is not correct, adjust it.
⑦ After adjust, test the machine.



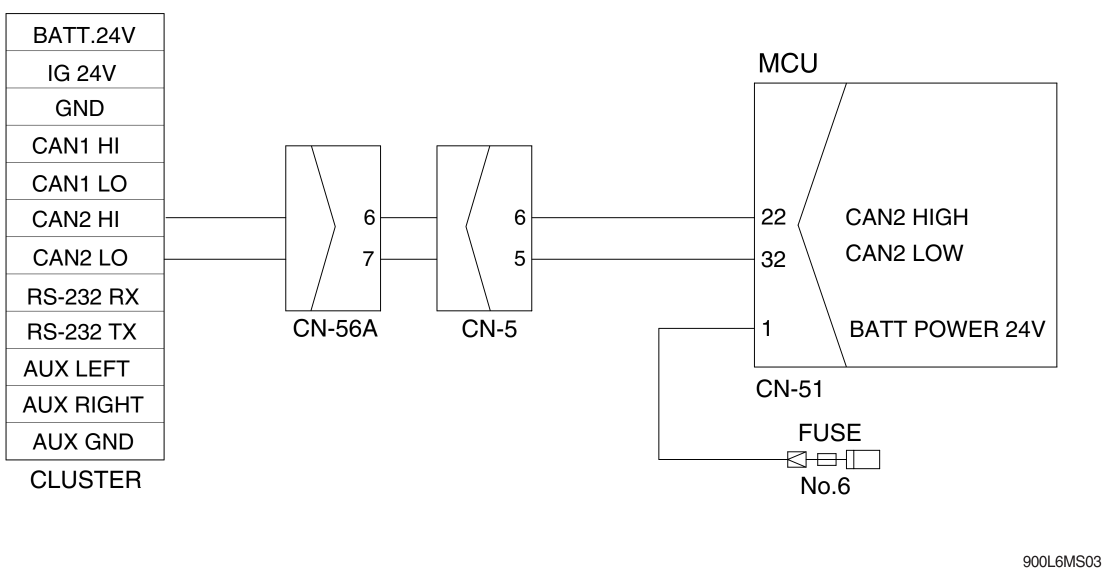
3. MALFUNCTION OF CLUSTER OR MODE SELECTION SYSTEM

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

1) INSPECTION PROCEDURE



Wiring diagram

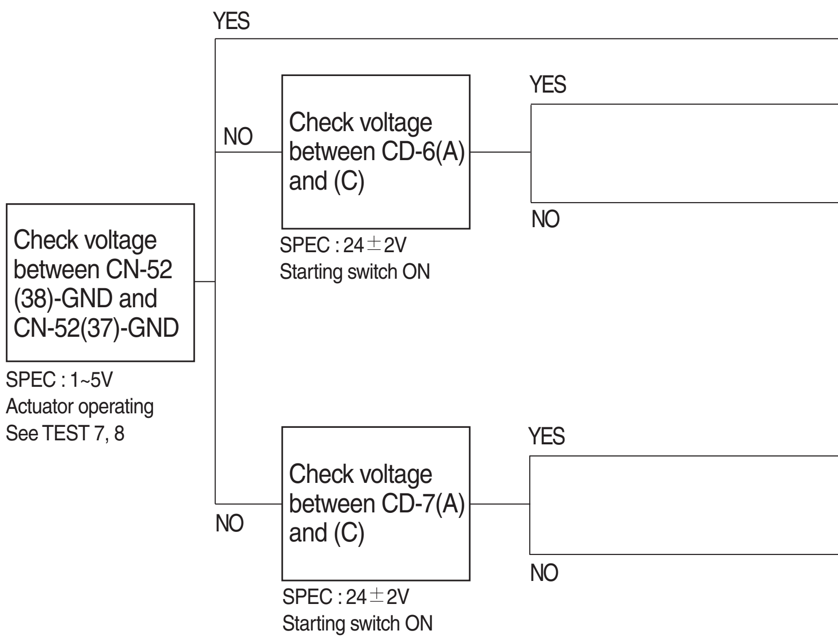


4. AUTO DECEL SYSTEM DOES NOT WORK

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

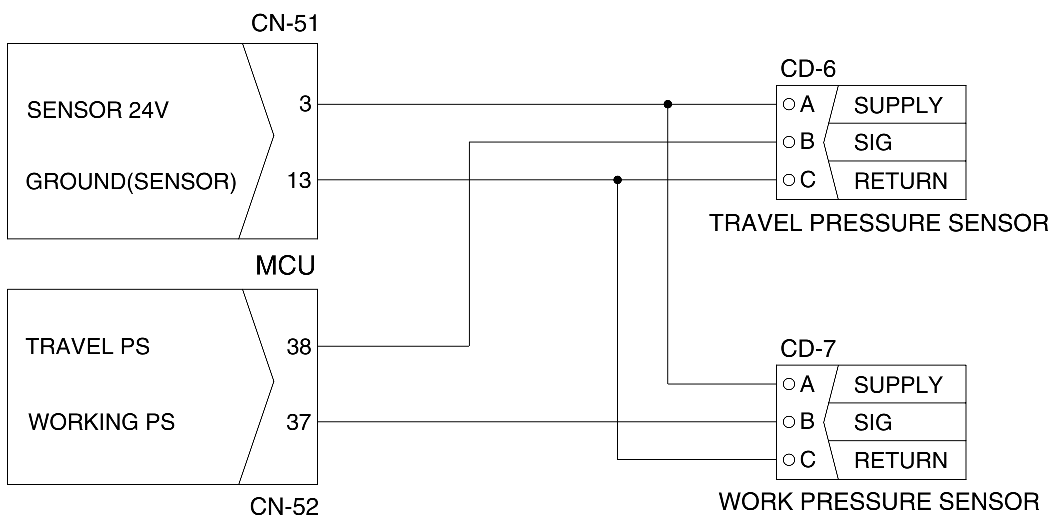
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective MCU	Replace
Defective travel pressure switch	Replace
Short circuit or poor connection between CN-51 (3) -CD-6 (A) and / or CN-51 (13)-CD-6 (C) (fault code 108 displayed)	Replace or repair
Defective work pressure sensor	Replace
Short circuit or poor connection between CN-51 (3)-CD-7 (A) and / or CN-51 (13)-CD -7 (C) (fault code 105 displayed)	Replace or repair

Wiring diagram



900L6MS33

2) TEST PROCEDURE

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

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

② Insert prepared pin to rear side of connectors : One pin to (38) of CN-52.

③ Starting switch ON.

④ Check voltage as figure.

(2) Test 8 : Check voltage at CN-52 (37) and ground.

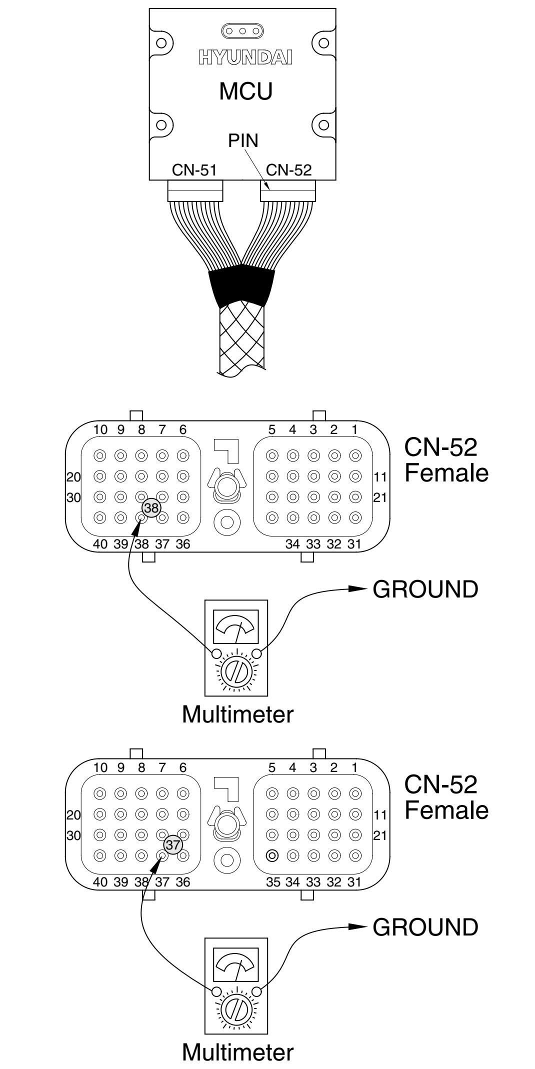
① Prepare 1 piece of thin sharp pin, steel or copper

② Insert prepared pin to rear side of connectors : One pin to (37) of CN-52.

③ Starting switch ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V



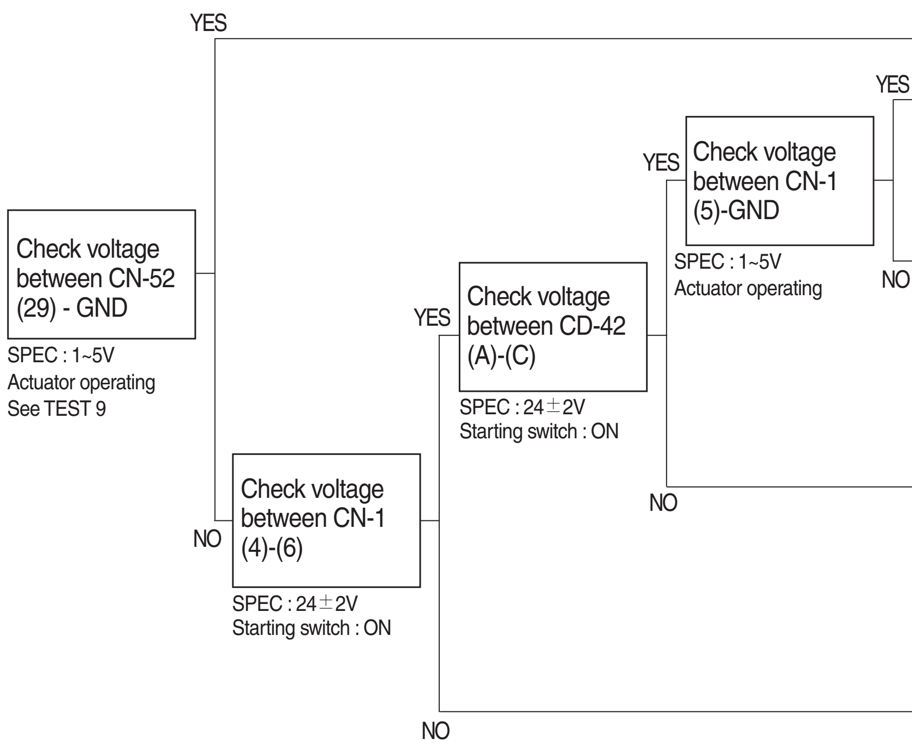
300L6MS04

5. MALFUNCTION OF PUMP 1 PRESSURE SENSOR

· Fault code : HCESPN 120, FMI 0~4

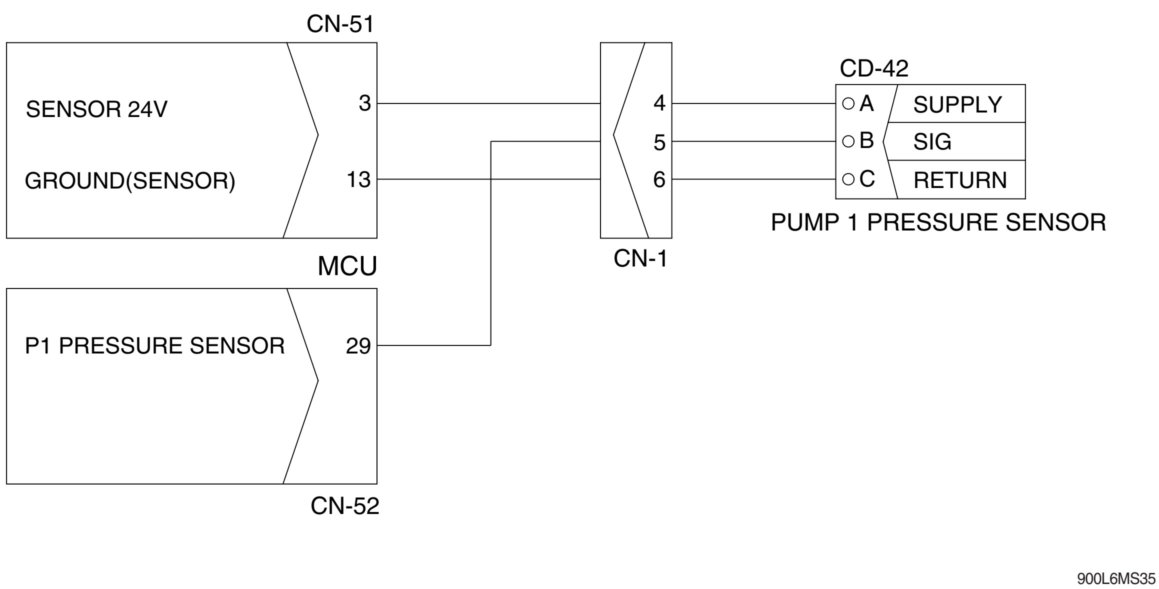
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective MCU	Replace
Short circuit or poor connection between CN-52-(29)-CN-1 (5)	Replace or repair
Detective P1 pressure sensor	Replace or repair
Short circuit or poor connection between CN-1 (5)-CD-42 (B)	Replace or repair
Short circuit or poor connection between CD-42 (A)-CN-1 (4) or CD-42 (C)-CN-1 (6)	Replace or repair
Short circuit or poor connection between CN-1 (4)-CN-51 (3) or CN-1 (6) - CN-51 (13)	Replace or repair

Wiring diagram



2) TEST PROCEDURE

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

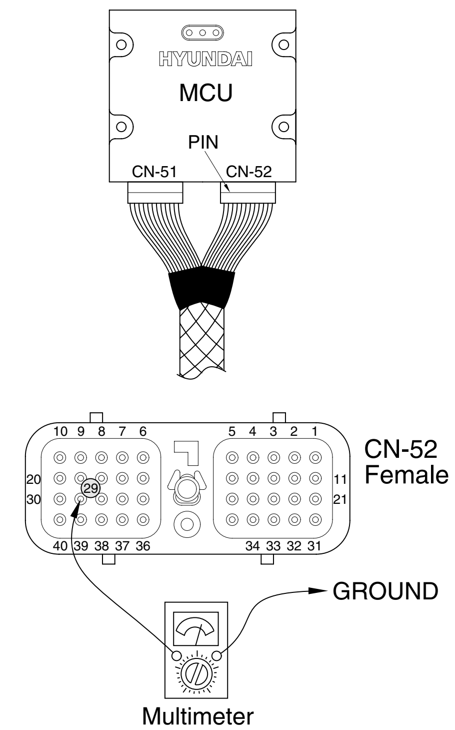
① Prepare 1 piece of thin sharp pin, steel or copper.

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

③ Starting switch ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V



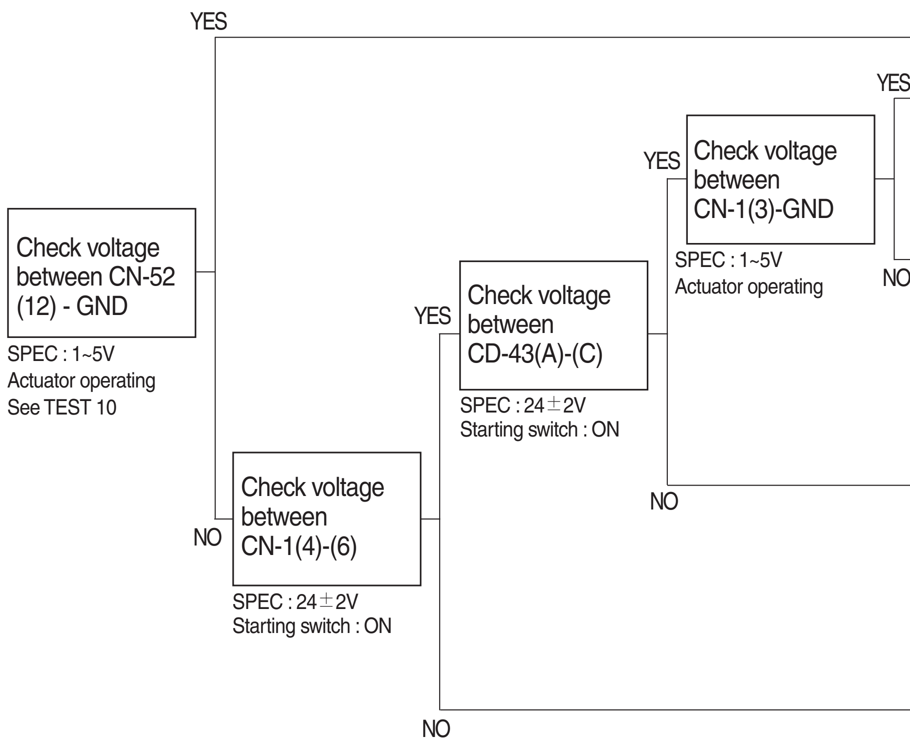
300L6MS06

6. MALFUNCTION OF PUMP 2 PRESSURE SENSOR

· Fault code : HCESPN 121, FMI 0~4

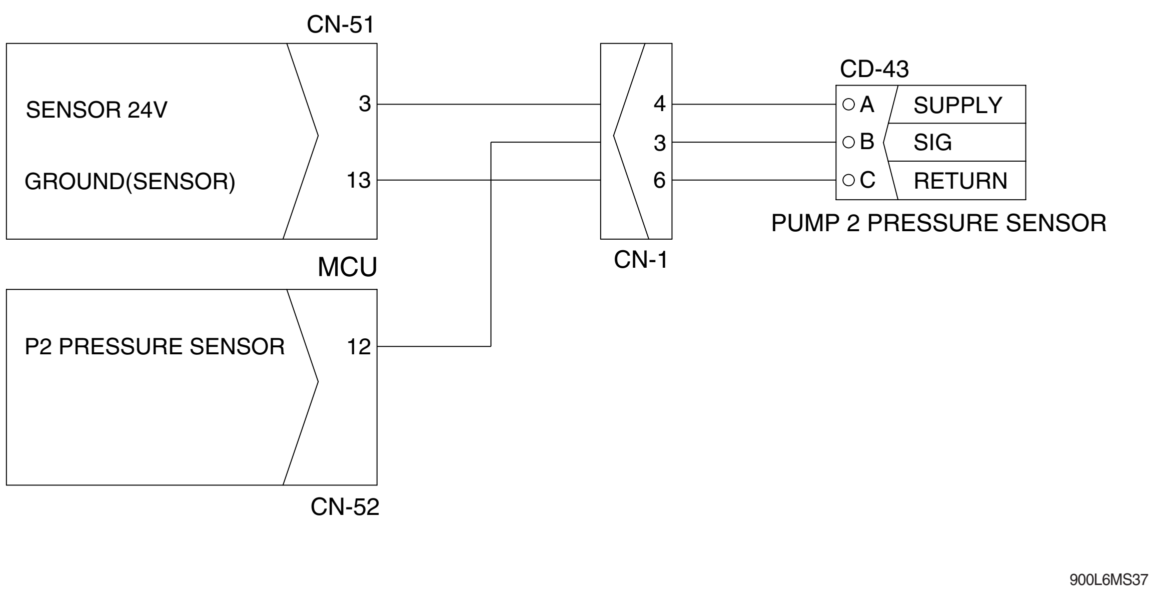
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective MCU	Replace
Short circuit or poor connection between CN-52-(12)-CN-1 (3)	Replace or repair
Detective P2 pressure sensor	Replace or repair
Short circuit or poor connection between CN-1 (3)-CD-43 (B)	Replace or repair
Short circuit or poor connection between CD-43 (A)-CN-1 (4) or CD-43 (C)-CN-1 (6)	Replace or repair
Short circuit or poor connection between CN-1 (4) -CN-51 (3) or CN -1 (6) - CN-51 (13)	Replace or repair

Wiring diagram



2) TEST PROCEDURE

(1) Test 10 : Check voltage at CN-52 (12) and ground.

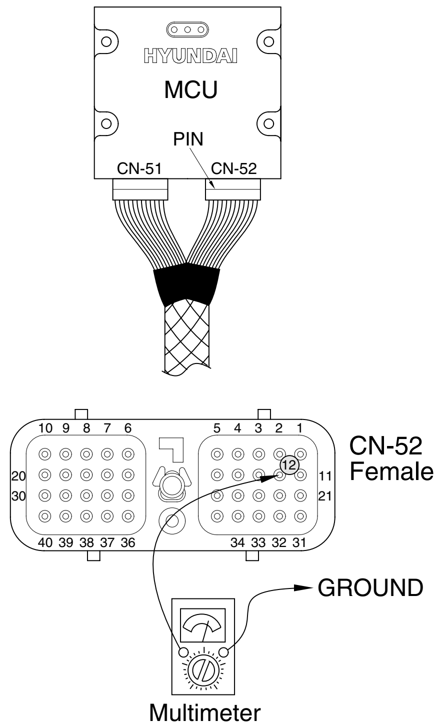
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (12) of CN-52.

③ Starting switch ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V

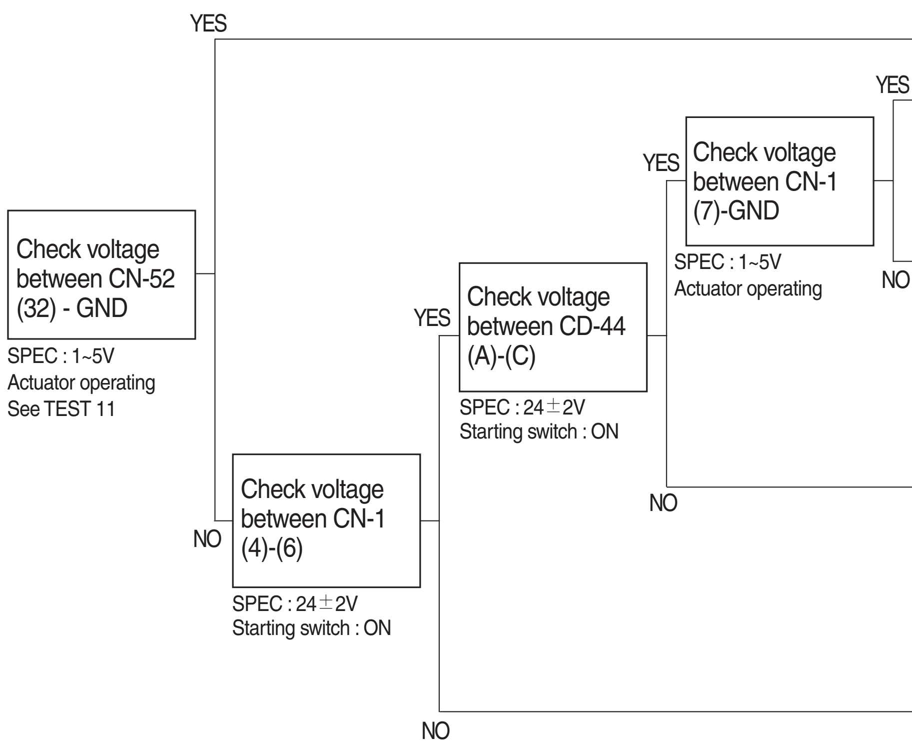


300L6MS08

7. MALFUNCTION OF PUMP 3 PRESSURE SENSOR

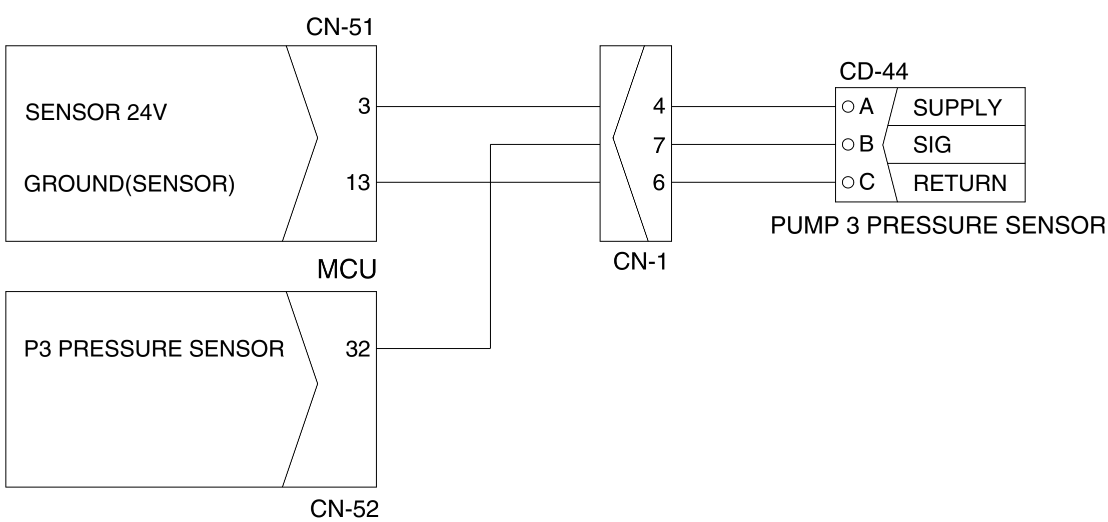
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective MCU	Replace
Short circuit or poor connection between CN-52-(32)-CN-1 (7)	Replace or repair
Detective P3 pressure sensor	Replace or repair
Short circuit or poor connection between CN-1 (7)-CD-44 (B)	Replace or repair
Short circuit or poor connection between CD-44 (A)-CN-1 (4) or CD-44 (C)-CN-1 (6)	Replace or repair
Short circuit or poor connection between CN-1 (4)-CN-51 (3) or CN-1 (6) - CN-51 (13)	Replace or repair

Wiring diagram



2) TEST PROCEDURE

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

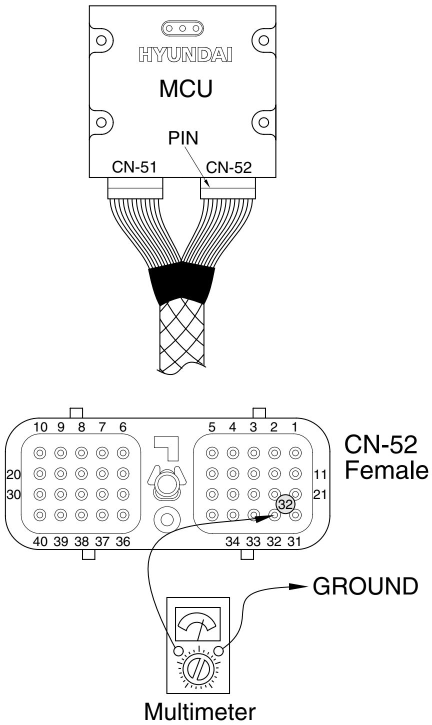
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (32) of CN-52.

③ Starting switch ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V



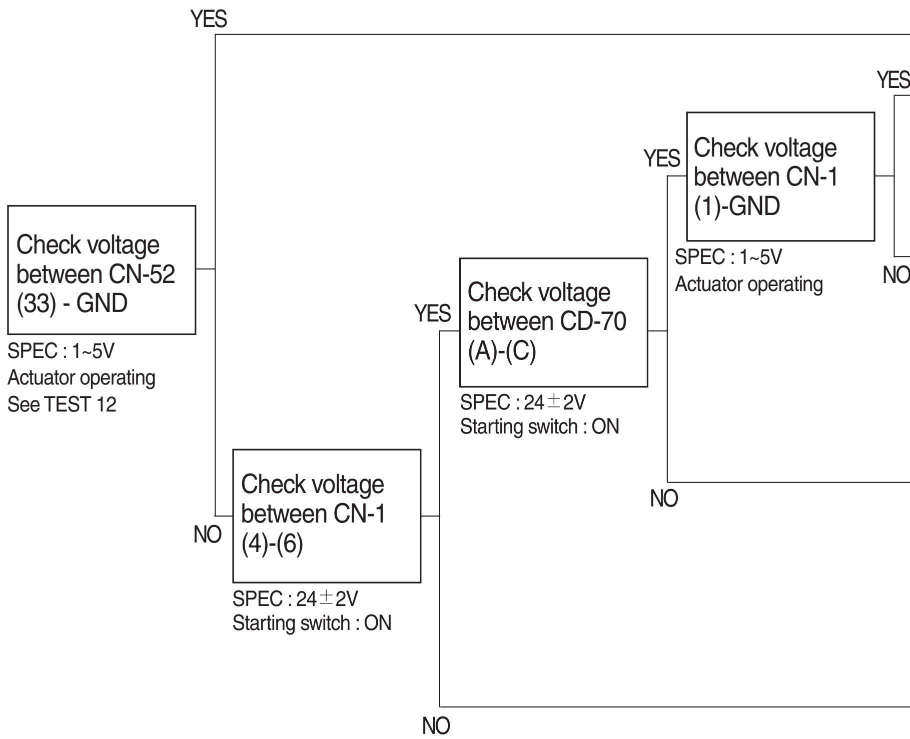
300L6MS10

8. MALFUNCTION OF NEGATIVE 1 PRESSURE SENSOR

· Fault code : HCESPN 123, FMI 0~4

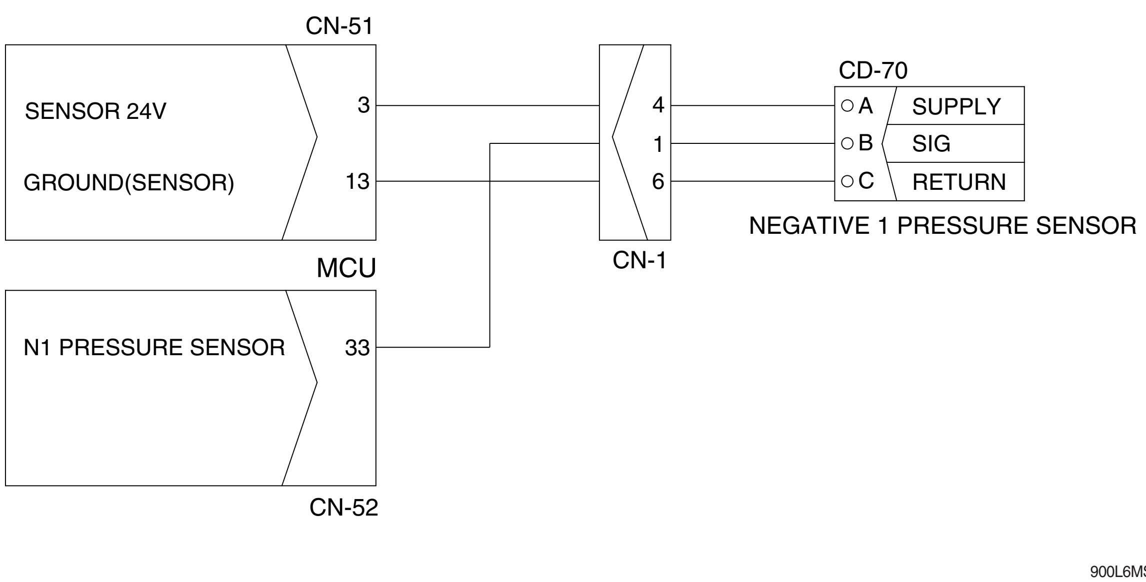
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective MCU	Replace
Short circuit or poor connection between CN-52-(33)-CN-1 (1)	Replace or repair
Detective N1 pressure sensor	Replace or repair
Short circuit or poor connection between CN-1 (1)-CD-70 (B)	Replace or repair
Short circuit or poor connection between CD-70 (A)-CN-1 (4) or CD-70 (C)-CN-1 (6)	Replace or repair
Short circuit or poor connection between CN-1 (4)-CN-51 (3) or CN-1 (6) - CN-51 (13)	Replace or repair

Wiring diagram



2) TEST PROCEDURE

(1) Test 12 : Check voltage at CN-52 (33) and ground.

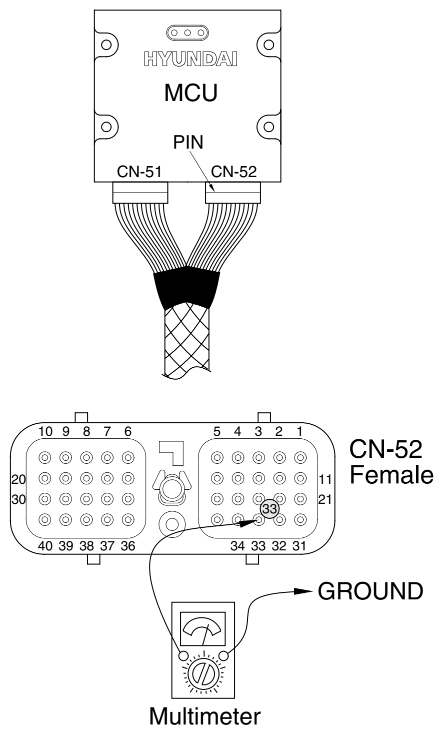
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (33) of CN-52.

③ Starting switch ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V



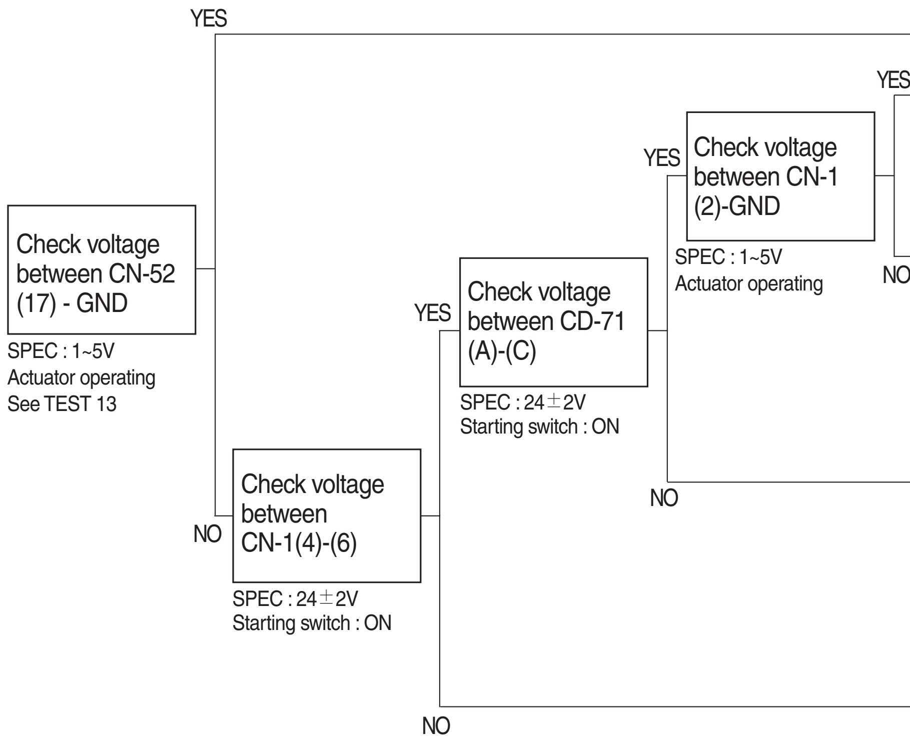
300L6MS12

9. MALFUNCTION OF NEGATIVE 2 PRESSURE SENSOR

· Fault code : HCESPN 124, FMI 0~4

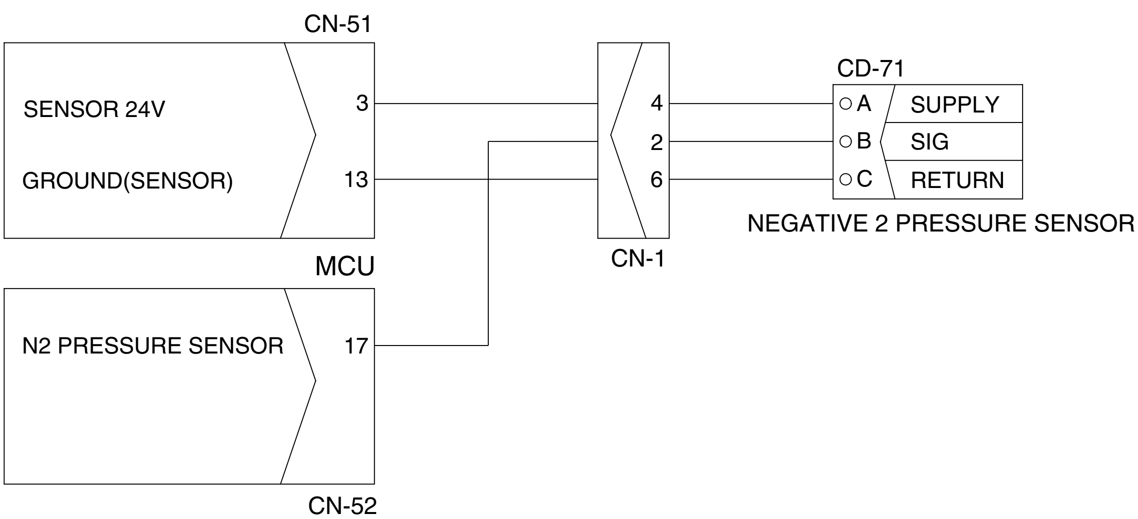
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective MCU	Replace
Short circuit or poor connection between CN-52-(17)-CN-1 (2)	Replace or repair
Detective N2 pressure sensor	Replace or repair
Short circuit or poor connection between CN-1 (2)-CD-71 (B)	Replace or repair
Short circuit or poor connection between CD-71 (A)-CN-1 (4) or CD-71 (C)-CN-1 (6)	Replace or repair
Short circuit or poor connection between CN-1 (4)-CN-51 (3) or CN-1 (6) - CN-51 (13)	Replace or repair

Wiring diagram



900L6MS43

2) TEST PROCEDURE

(1) Test 13 : Check voltage at CN-52 (17) and ground.

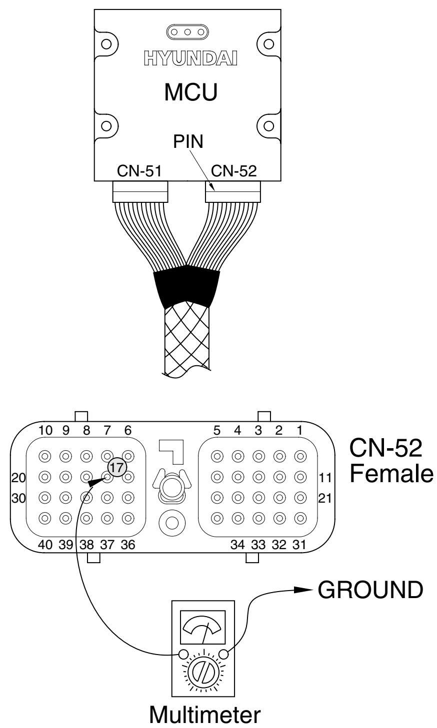
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (17) of CN-52.

③ Starting switch ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V



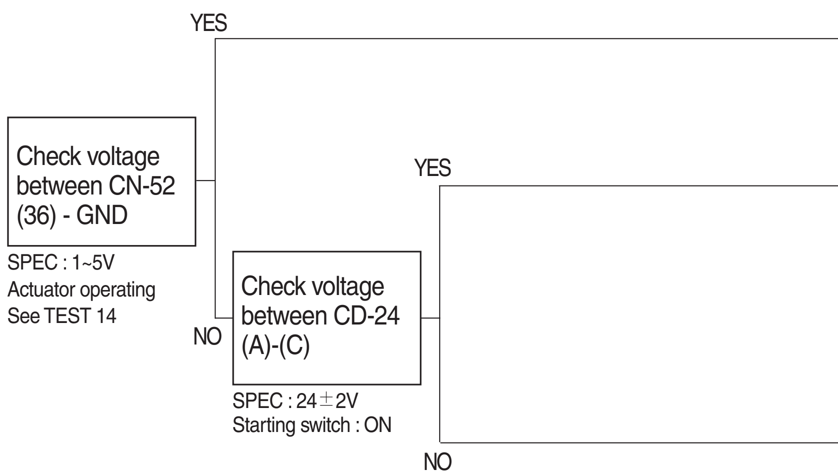
300L6MS14

10. MALFUNCTION OF SWING PRESSURE SENSOR

· Fault code : HCESPN 135, FMI 0~4

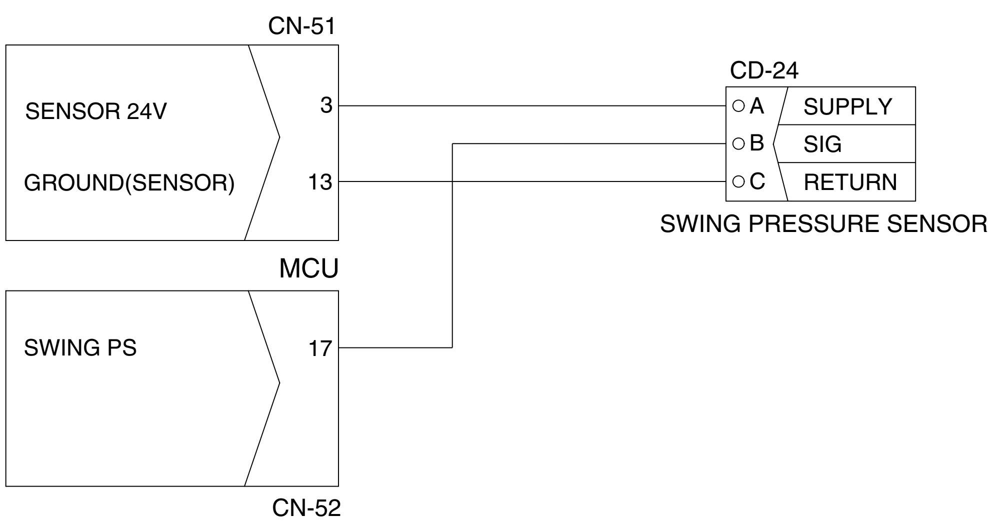
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective MCU	Replace
Detective swing pressure sensor	Replace or repair
Short circuit or poor connection between CN-52 (36)-CD-24 (B)	Replace or repair
Short circuit or poor connection between CD-24 (A)-CN-51 (3) or CD-24 (C)- CN-51 (13)	Replace or repair

Wiring diagram



900L6MS45

2) TEST PROCEDURE

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

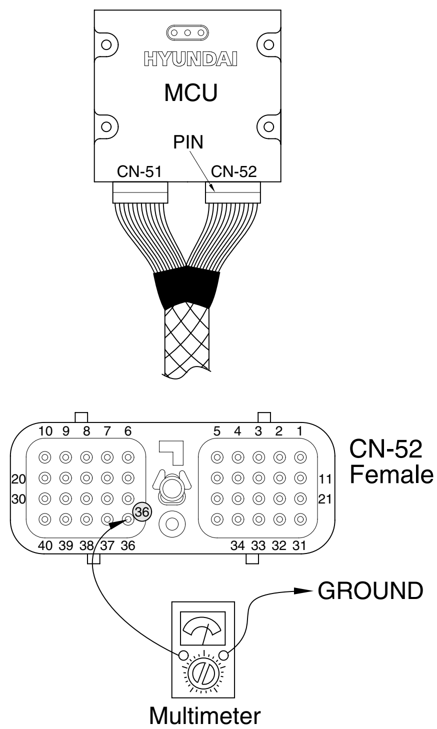
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (36) of CN-52.

③ Starting switch ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V



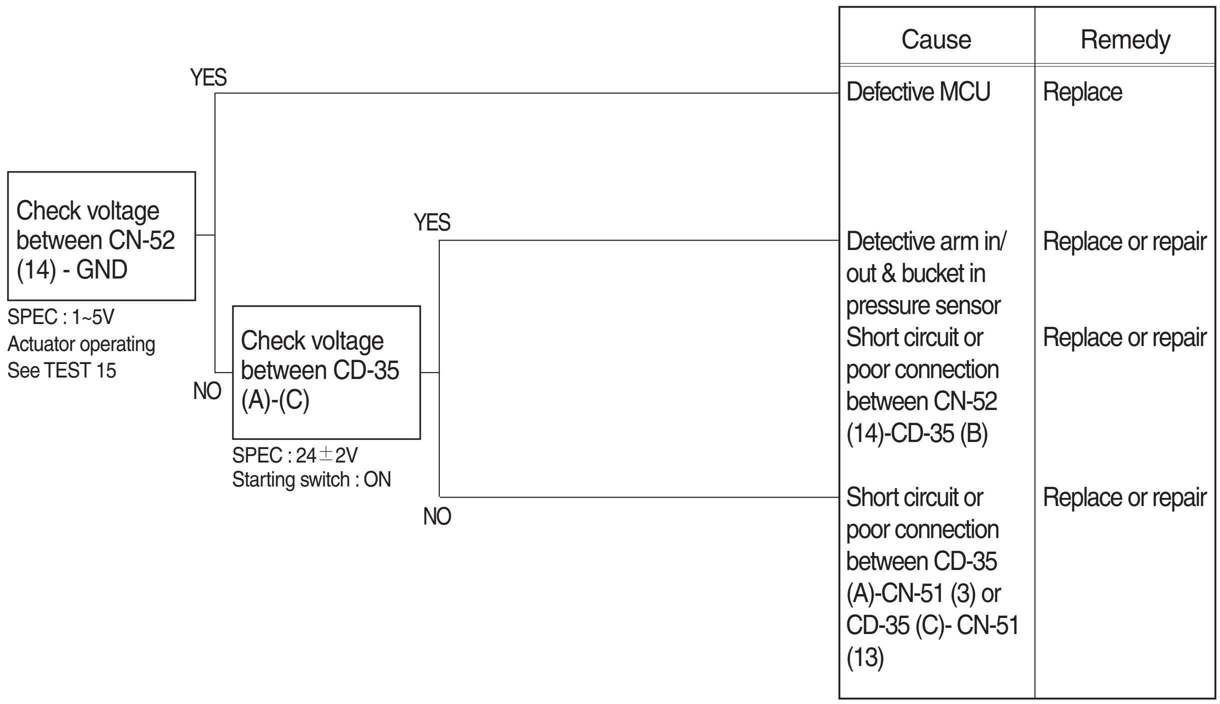
300L6MS16

11. MALFUNCTION OF ARM IN/OUT & BUCKET IN PRESSURE SENSOR

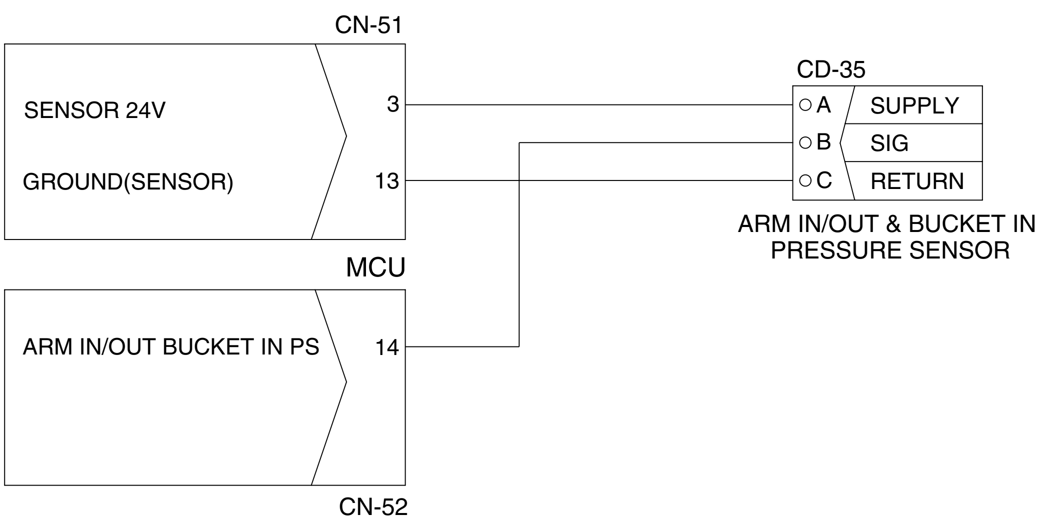
· Fault code : HCESPN 133, FMI 0~4

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

1) INSPECTION PROCEDURE



Wiring diagram



900L6MS47

2) TEST PROCEDURE

(1) Test 15 : Check voltage at CN-52 (14) and ground.

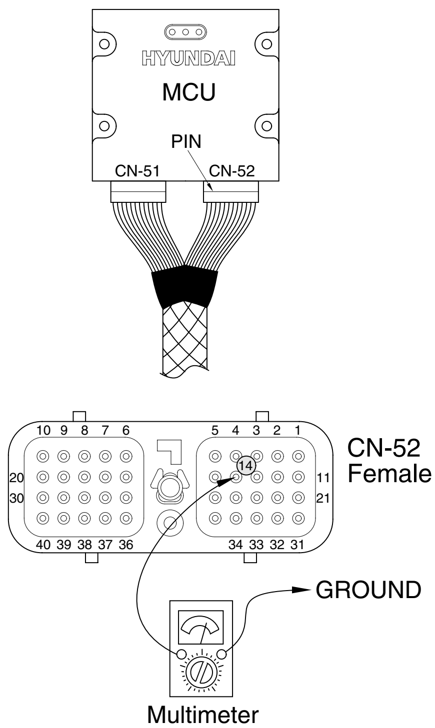
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (14) of CN-52.

③ Starting switch ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V



300L6MS18

12. MALFUNCTION OF BOOM UP PRESSURE SENSOR

· Fault code : HCESPN 127, FMI 0~4

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

1) INSPECTION PROCEDURE

Check voltage between CN-52 (19) - GND

SPEC : 1~5V
Actuator operating
See TEST 16

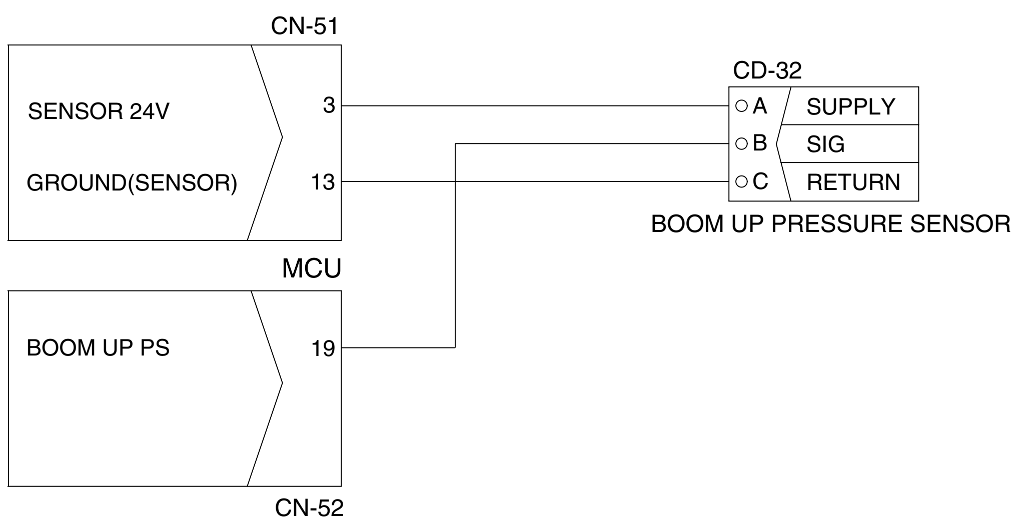
- YES → Defective MCU
- NO → Check voltage between CD-32 (A)-(B)

SPEC : 24±2V
Starting switch : ON

- YES → Detective boom up pressure sensor; Short circuit or poor connection between CN-52 (19)-CD-32 (B)
- NO → Short circuit or poor connection between CD-32 (A)-CN-51 (3) or CD-32 (C)- CN-51 (13)

Cause	Remedy
Defective MCU	Replace
Detective boom up pressure sensor	Replace or repair
Short circuit or poor connection between CN-52 (19)-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



900L6MS49

2) TEST PROCEDURE

(1) Test 16 : Check voltage at CN-52 (19) and ground.

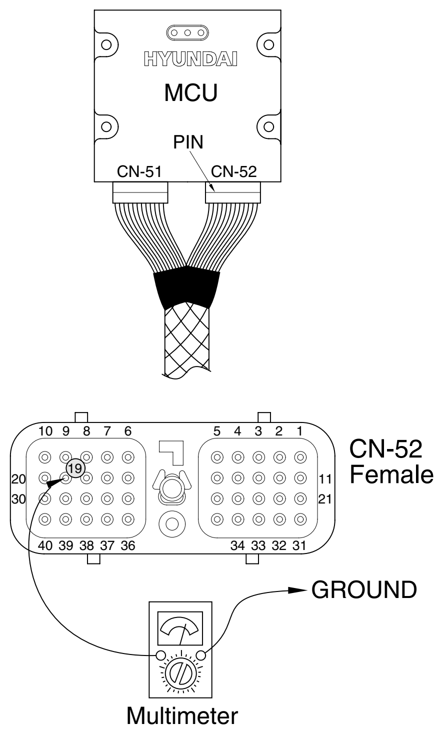
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (19) of CN-52.

③ Starting switch ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V



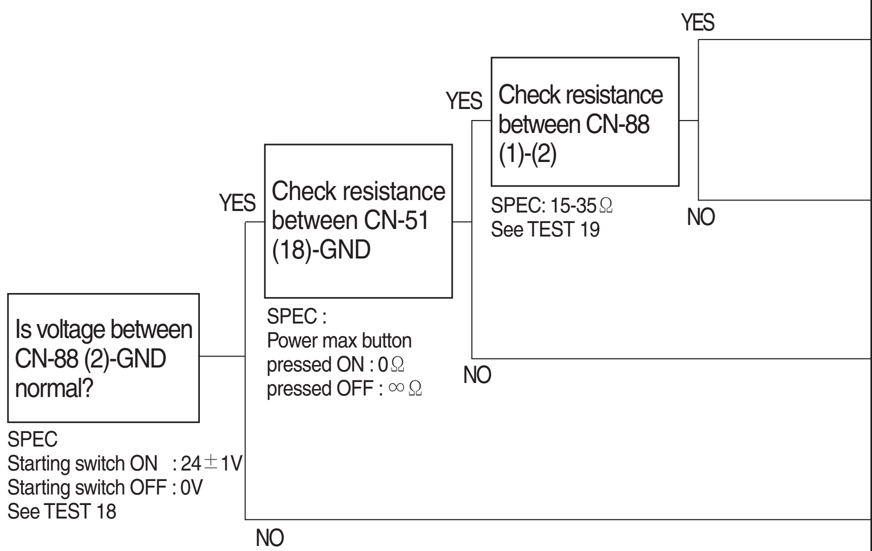
300L6MS20

13. MALFUNCTION OF POWER MAX

· Fault code : HCESPN 166, FMI 4 or 6

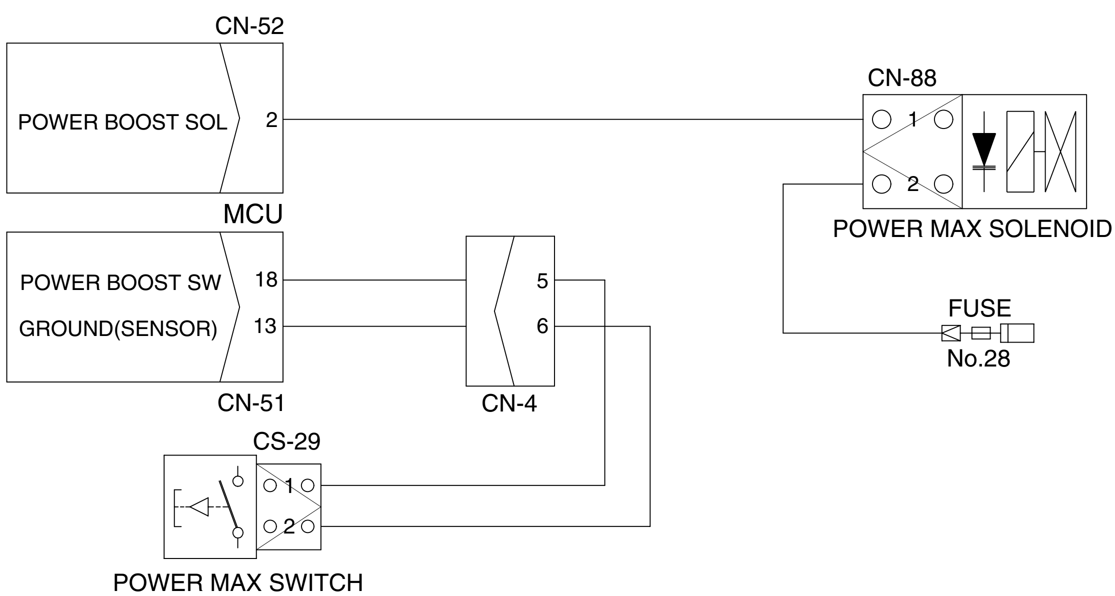
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Short circuit or poor connection between CN-88 (1)-CN-52 (2)	Repair or replace
Defective power max. solenoid valve Check hydraulic system	Repair or replace
Short circuit or poor connection between CN-51 (18)-CS-29 (1)	Repair or replace
Short circuit or poor connection between CN-88 (2)-Fuse No. 28	Repair or replace

Wiring diagram

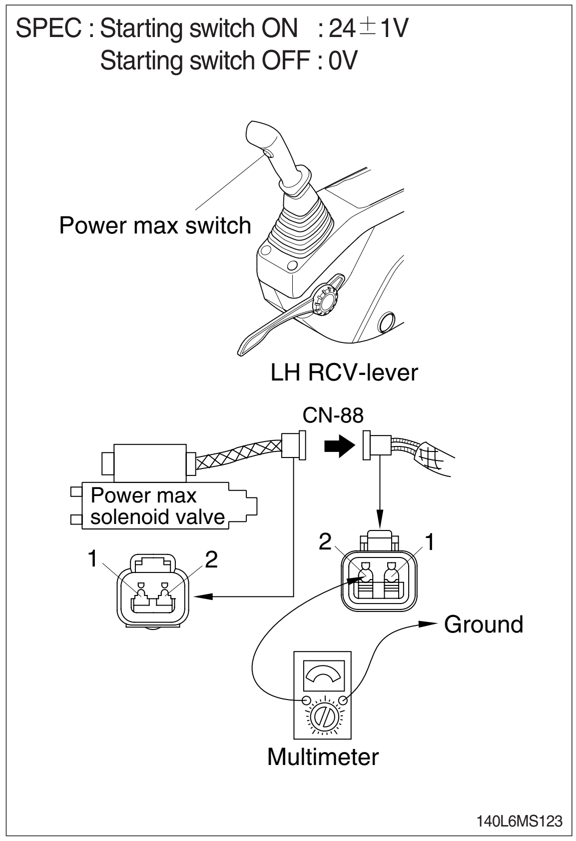


900L6MS54

2) TEST PROCEDURE

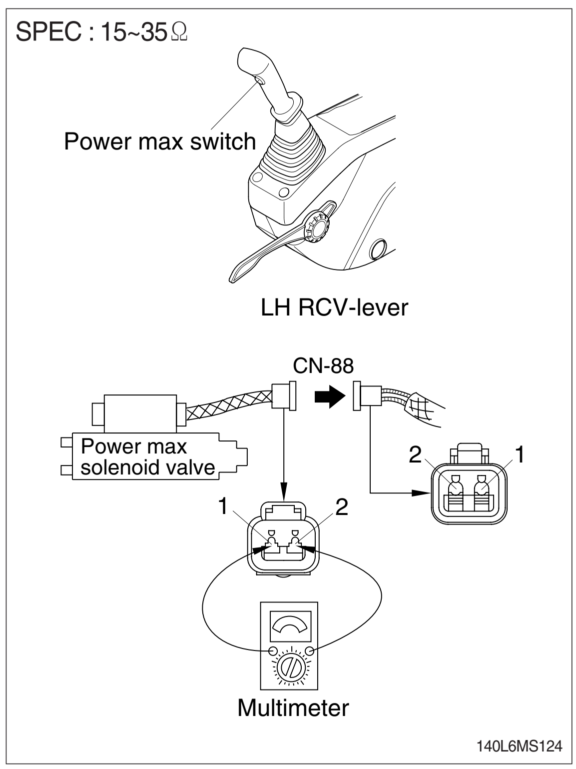
(1) Test 18: Check voltage between connector CN-88 (2) - GND.

① Disconnect connector CN-88 from power max solenoid valve.
② Starting switch ON.
③ Check voltage as figure.



(2) Test 19: Check resistance of the solenoid valve between CN-88 (1)-(2).

① Starting switch OFF.
② Disconnect connector CN-88 from power max solenoid valve.
③ Check resistance as figure.



14. MALFUNCTION OF BOOM PRIORITY EPPR VALVE

· Fault code : HCESPN 141, FMI 5 or 6

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

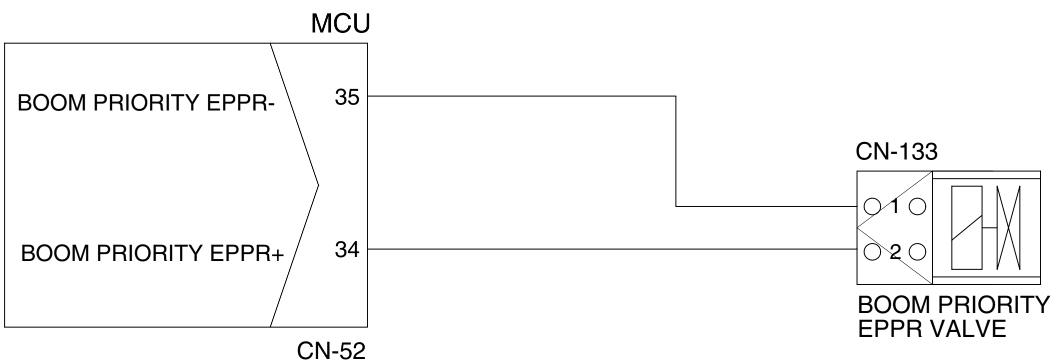
1) INSPECTION PROCEDURE

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

SPEC : 20~30V
Starting switch : ON

	Cause	Remedy
YES	Short circuit or poor connection between CN-52 (35)-CN-133 (1) or CN-52 (34)-CN-133 (2)	Repair or replace
NO	Defective EPPR valve	Repair or replace

Wiring diagram



900L6MS53

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.

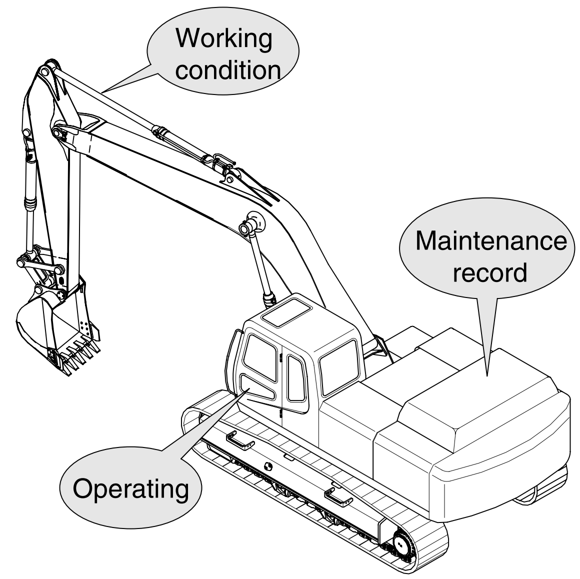
2) OPERATIONAL PERFORMANCE OF A WORKING MACHINE

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.

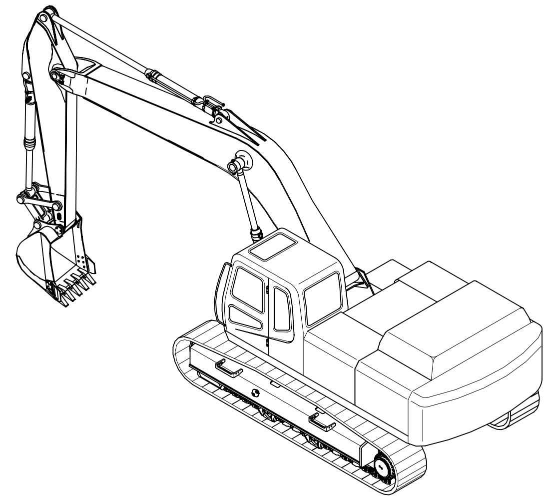


21077MS01

2. TERMINOLOGY

1) STANDARD

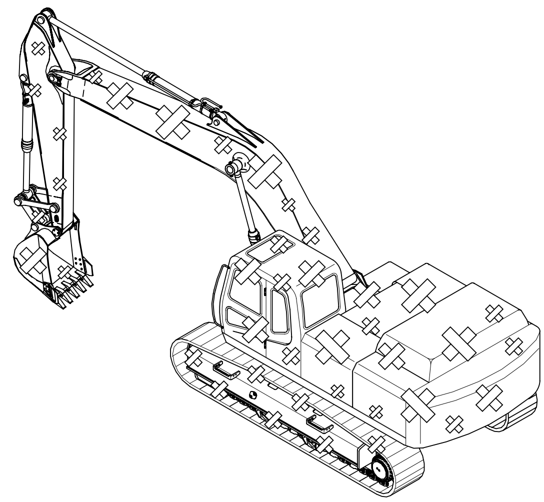
Specifications applied to the brand-new machine, components and parts.



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.

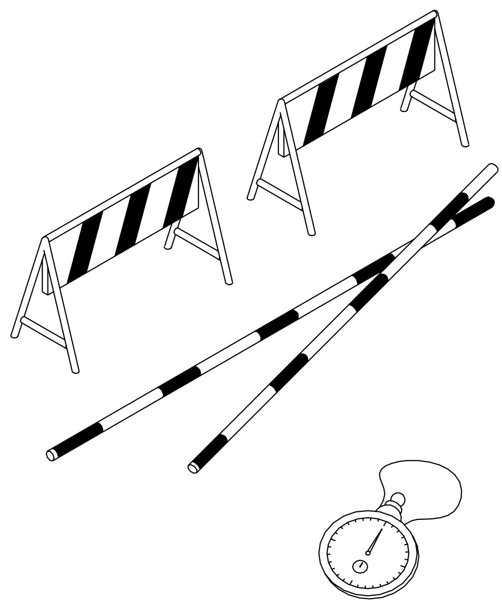
④ Avoid polluting the machine and the ground with leaking oil. Use oil pans to catch escaping oil. Pay special attention to this when removing hydraulic pipings.

(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.



(210-7) 7-3

2) ENGINE SPEED

(1) Measure the engine speed at each power mode

※ The engine speed at each power mode must meet standard RPM; if not, all other operational performance data will be unreliable. It is essential to perform this test first.

(2) Preparation

① Warm up the machine, until the engine coolant temperature reaches 50˚C or more, and the hydraulic oil is 50±5˚C.

② Set the accel dial at 10 (Max) position.

③ Measure the engine RPM.

(3) Measurement

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

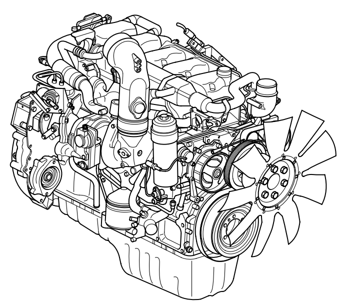
② Measure and record the engine speed at each mode (P, S, E).

③ Select the P-mode.

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

⑤ Measure and record the auto deceleration speed.

CLUSTER



480L7MS01

(4) Evaluation

The measured speeds should meet the following specifications.

Unit : rpm

Model	Engine speed	Standard	Remarks
HX900 L	Start idle	850±100	
	P mode	1750±50	
	S mode	1650±50	
	E mode	1550±50	
	Auto decel	1000±100	
	One touch decel	850±100	

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

3) TRAVEL SPEED

(1) Measure the time required for the excavator to travel a 20 m test track.

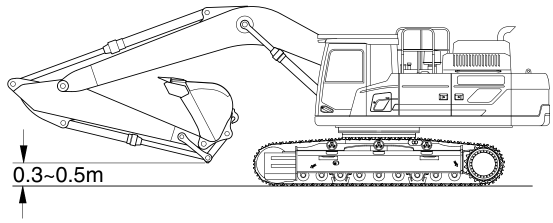
(2) Preparation

① Adjust the tension of both tracks to be equal.

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

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

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



480A7MS02

(3) Measurement

① Measure both the low and high speeds of the machine.

② Before starting either the low or high speed tests, adjust the travel mode switch to the speed to be tested, then select the following switch positions.

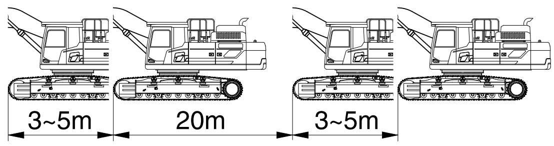
· Power mode switch : P mode

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

④ Measure the time required to travel 20 m.

⑤ After measuring the forward travel speed, turn the upperstructure 180˚ and measure the reverse travel speed.

⑥ Repeat steps ④ and ⑤ three times in each direction and calculate the average values.



480A7MS03

(4) Evaluation

The average measured time should meet the following specifications.

Unit : Seconds / 20 m

Model	Travel speed	Standard	Maximum allowable	Remarks
HX900 L	1 Speed	29.5±2.0	37.3	
	2 Speed	20.5±1.0	26.0	

4) TRACK REVOLUTION SPEED

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

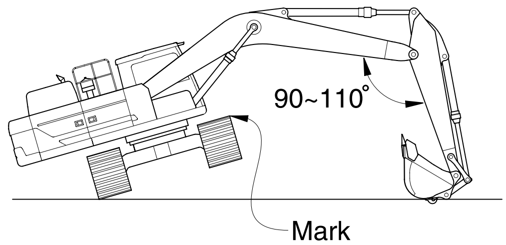
(2) Preparation

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.



480L7MS04

(3) Measurement

① Select the following switch positions.

· Travel mode switch : 1 or 2 speed
· Power mode switch : P mode
· Auto idle switch : OFF

② Operate the travel control lever of the raised track in full forward and reverse.

③ Rotate 1 turn, then measure time taken for next 3 revolutions.

④ Raise the other side of machine and repeat the procedure.

⑤ Repeat steps ③ and ④ three times and calculate the average values.

(4) Evaluation

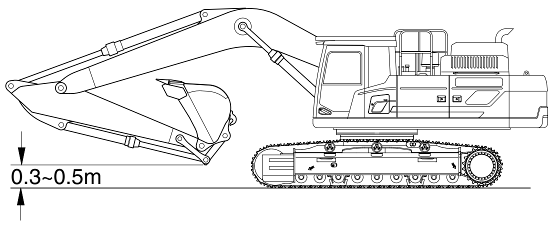
The revolution cycle time of each track should meet the following specifications.

Unit : Seconds / 3 revolutions

Model	Travel speed	Standard	Maximum allowable
HX900 L	1 Speed	59.0±2.0	72.5
	2 Speed	41.0±1.0	49.9

5) TRAVEL DEVIATION

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



480A7MS02

(2) Preparation

① Adjust the tension of both tracks to be equal.

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

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

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

(3) Measurement

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

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

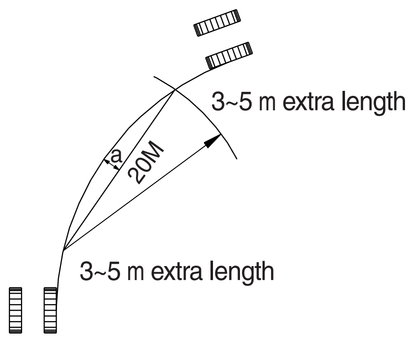
· Power mode switch : P mode

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

④ Measure the distance between a straight 20 m line and the track made by the machine. (Dimension a)

⑤ After measuring the tracking in forward travel, turn the upperstructure 180˚ and measure that in reverse travel.

⑥ Repeat steps ④ and ⑤ three times and calculate the average values.



(210-7) 7-7(2)

(4) Evaluation

Mistrack should be within the following specifications.

Unit : mm / 20 m

Model	Standard	Maximum allowable	Remarks
HX900 L	200 below	250	-

6) SWING SPEED

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

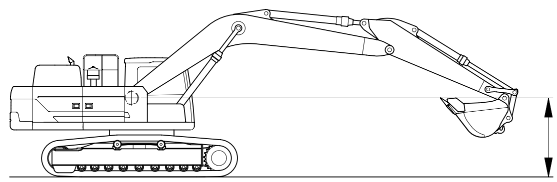
(2) Preparation

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.



480L7MS05

(3) Measurement

① Select the following switch positions.

· Power mode switch : P mode

② Operate swing control lever fully.

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

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

(4) Evaluation

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

Unit : Seconds / 3 revolutions

Model	Power mode switch	Standard	Maximum allowable
HX900 L	P mode	29±1.5	36.8

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.

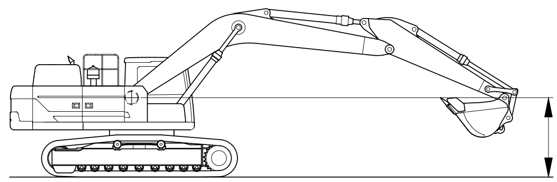
② Place the machine on flat, solid ground with ample space for swinging. Do not conduct this test on slopes.

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.



480L7MS05

(3) Measurement

① Conduct this test in the M mode.

② Select the following switch positions.

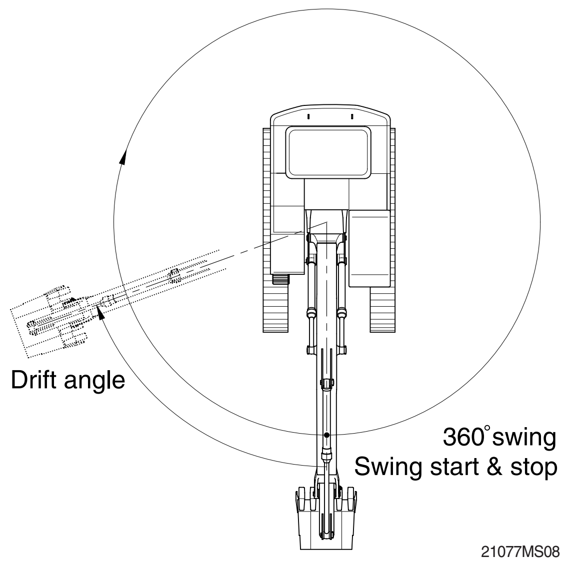
· Power mode switch : P mode

③ Operate the swing control lever fully and return it to the neutral position when the mark on the upperstructure aligns with that on track frame after swinging 360 ˚

④ Measure the distance between the two marks.

⑤ Align the marks again, swing 360 ˚, then test the opposite direction.

⑥ Repeat steps ④ and ⑤ three times each and calculate the average values.



21077MS08

(4) Evaluation

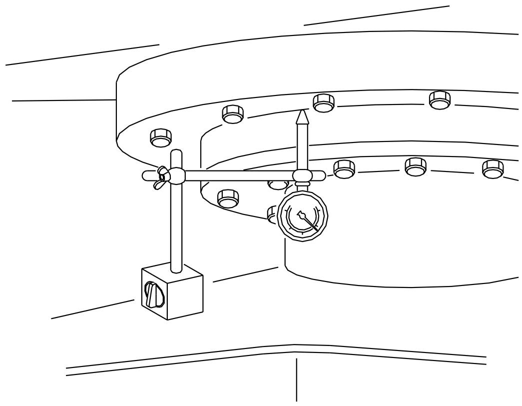
The measured drift angle should be within the following specifications.

Unit : Degree

Model	Power mode switch	Standard	Maximum allowable	Remarks
HX900 L	P mode	90 below	112.5	

8) SWING BEARING PLAY

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


(210-7) 7-10(1)

(2) Preparation

① Check swing bearing mounting cap screws for loosening.

② Check the lubrication of the swing bearing. Confirm that bearing rotation is smooth and without noise.

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

④ Position the upperstructure so that the boom aligns with the tracks facing towards the front idlers.

⑤ Position the dial gauge so that its needle point comes into contact with the bottom face of the bearing outer race.

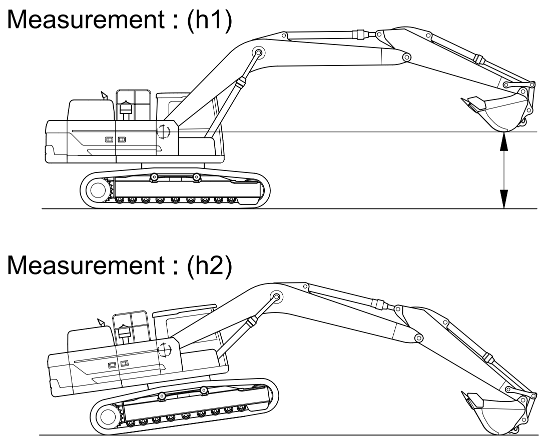
⑥ Bucket should be empty.

(3) Measurement

① With the arm rolled out and bucket rolled in, hold the bottom face of the bucket to the same height of the boom foot pin.
Record the dial gauge reading (h1).

② Lower the bucket to the ground and use it to raise the front idler 50 ㎝.
Record the dial gauge reading (h2).

③ Calculate bearing play (H) from this data (h1 and h2) as follows.
H=h2-h1



480L7MS06

(4) Evaluation

The measured drift should be within the following specifications.

Unit : mm

Model	Standard	Maximum allowable	Remarks
HX900 L	0.5 ~ 1.5	3.0	

9) HYDRAULIC CYLINDER CYCLE TIME

(1) Measure the cycle time of the boom, standard arm, and standard bucket cylinders.

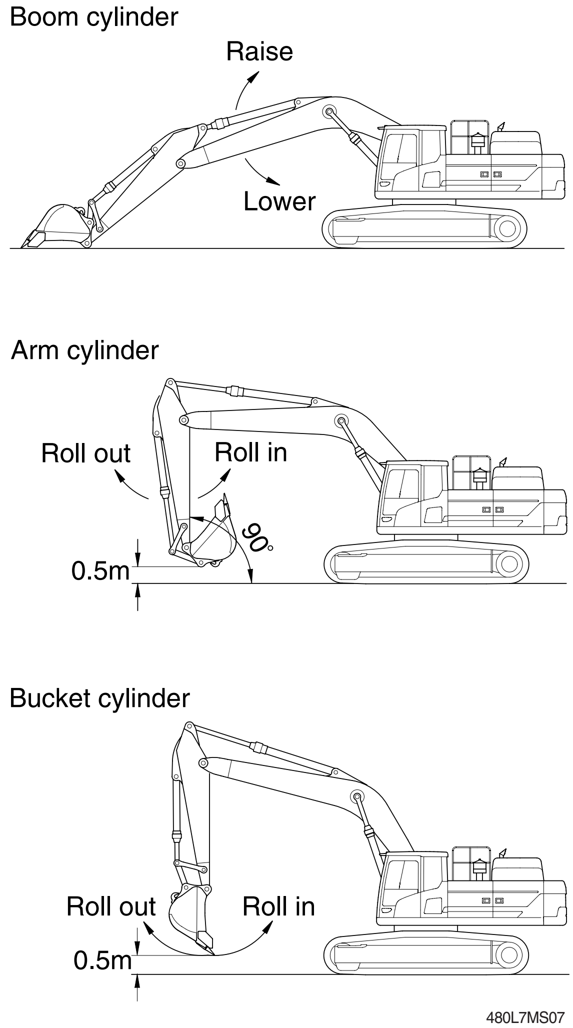
(2) Preparation

① To measure the cycle time of the boom cylinders:
With the arm rolled out and the empty bucket rolled out, lower the bucket to the ground, as shown.

② To measure the cycle time of the arm cylinder.
With the empty bucket rolled in, position the arm so that it is vertical to the ground. Lower the boom until the bucket is 0.5 m above the ground.

③ To measure the cycle time of the bucket cylinder.
The empty bucket should be positioned at midstroke between roll-in and roll-out, so that the sideplate edges are vertical to the ground.

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



(3) Measurement

① Select the following switch positions.
· Power mode switch : P mode

② To measure cylinder cycle times.

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

- 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
HX900 L	Boom raise	6.0±0.4	6.9	
	Boom lower	4.2±0.4	4.9	
	Arm in	4.0±0.4	5.1	
	Arm out	3.7±0.4	4.3	
	Bucket load	4.1±0.4	4.8	
	Bucket dump	3.1±0.4	3.8	

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)

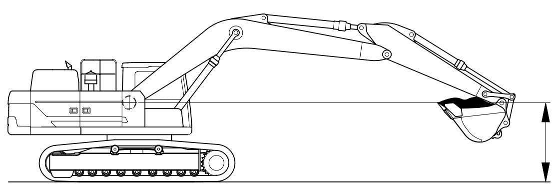
1.5 = Soil specific gravity

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.



480L7MS08

(3) Measurement

① Stop the engine.

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

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

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

Unit : mm / 5min

Model	Drift to be measured	Standard	Maximum allowable	Remarks
HX900 L	Boom cylinder	10 below	15	
	Arm cylinder	10 below	15	
	Bucket cylinder	40 below	50	

11) CONTROL LEVER OPERATING FORCE

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

(2) Preparation

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

(3) Measurement

① Start the engine.

② Select the following switch positions.

· Power mode switch : P mode

③ Operate each boom, arm, bucket and swing lever at full stroke and measure the maximum operating force for each.

④ Lower the bucket to the ground to raise one track off the ground. Operate the travel lever at full stroke and measure the maximum operating force required. When finished, lower the track and then jack-up the other track.

⑤ Repeat steps ③ and ④ three times and calculate the average values.

(4) Evaluation

The measured operating force should be within the following specifications.

Unit : kgf

Model	Kind of lever	Standard	Maximum allowable	Remarks
HX900 L	Boom lever	1.3 or below	1.7	
	Arm lever	1.3 or below	1.7	
	Bucket lever	1.3 or below	1.7	
	Swing lever	1.3 or below	1.7	
	Travel lever	2.1 or below	3.15	

12) CONTROL LEVER STROKE

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

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

(2) Preparation

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

(3) Measurement

① Stop the engine.

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

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

(4) Evaluation

The measured drift should be within the following specifications.

Unit : mm

Model	Kind of lever	Standard	Maximum allowable	Remarks
HX900 L	Boom lever	90±10	115	
	Arm lever	90±10	115	
	Bucket lever	90±10	115	
	Swing lever	90±10	115	
	Travel lever	142±10	178	

13) PILOT PRIMARY PRESSURE

(1) Preparation

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

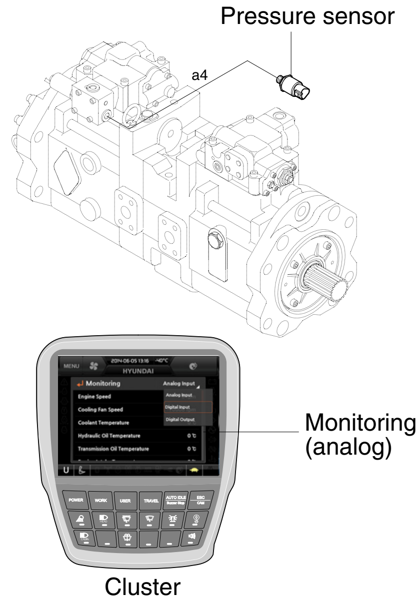
(2) Measurement

① Select the following switch positions.

· Power mode switch : P mode

· Auto decel switch : OFF

② Measure the primary pilot pressure by the monitoring menu of the cluster.



900L7MS09

(3) Evaluation

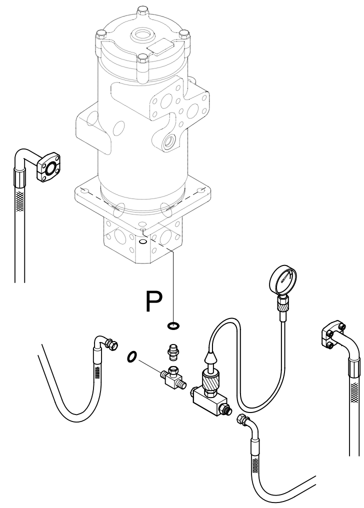
The average measured pressure should meet the following specifications:

Unit : kgf / cm^2

Model	Engine speed	Standard	Allowable limits	Remarks
HX900 L	P mode	40^{+2}_{0}	-	

14) FOR TRAVEL SPEED SELECTING PRESSURE:

(1) Preparation



900L7MS13

① Stop the engine.
② Loosen the cap and relieve the pressure in the tank by pushing the top of the air breather.
③ To measure the speed selecting pressure: Install a connector and pressure gauge
④ assembly to turning joint P port as shown. Start the engine and check for on leakage from the adapter.
⑤ Keep the hydraulic oil temperature at 50±5˚C.

(2) Measurement

① Select the following switch positions.
· Power mode switch : P mode
· Travel mode switch : 1 speed
2 speed
② Measure the travel speed selecting pressure in the Hi or Lo mode.
③ Lower the bucket to the ground to raise the track off the ground. Operate the travel lever at full stroke and measure the fast speed pressure.
④ Repeat steps ② and ③ three times and calculate the average values.

(3) Evaluation

The average measured pressure should be within the following specifications.

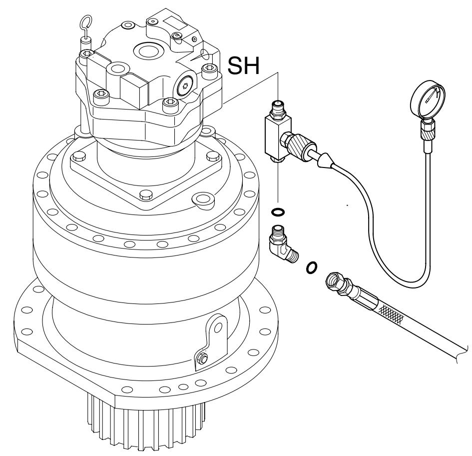
Unit : kgf / cm^2

Model	Travel speed mode	Standard	Maximum allowable	Remarks
HX900 L	1 Speed	0	-	
	2 Speed	40±5	-	

15) SWING PARKING BRAKE RELEASING PRESSURE

(1) Preparation

① Stop the engine.
② Loosen the cap and relieve the pressure in the tank by pushing the top of the air breather.
③ The pressure release L wrench to bleed air.
④ Install a connector and pressure gauge assembly to swing motor SH port, as shown.
⑤ Start the engine and check for oil leakage from the adapter.
⑥ Keep the hydraulic oil temperature at 50±5˚C.



900L7MS10

(2) Measurement

① Select the following switch positions.
· Power mode switch : P mode
② Operate the swing function or arm roll in function and measure the swing brake control pressure with the brake disengaged. Release the control lever to return to neutral and measure the control pressure when the brake is applied.
Repeat step ② three times and calculate the average values.

(3) Evaluation

The average measured pressure should be within the following specifications.

Unit : kgf / cm^2

Model	Description	Standard	Allowable limits	Remarks
HX900 L	Brake disengaged	40	31~42	
	Brake applied	0	-	

16) MAIN PUMP DELIVERY PRESSURE

(1) Preparation

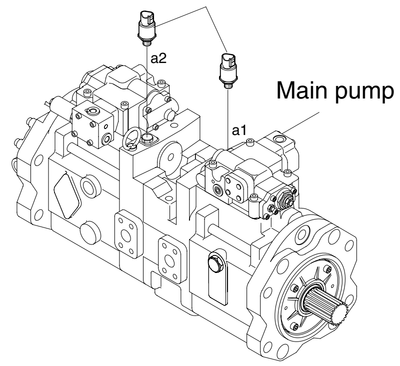
① Keep the hydraulic oil temperature at 50±5˚C.

(2) Measurement

① Select the following switch positions.

· Power mode switch : P mode

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



900L7MS11

(3) Evaluation

The average measured pressure should meet the following specifications.

Unit : kgf / cm^2

Model	Engine speed	Standard	Allowable limits	Remarks
HX900 L	High idle	40±5	-	

17) SYSTEM PRESSURE REGULATOR RELIEF SETTING

(1) Preparation

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

(2) Measurement

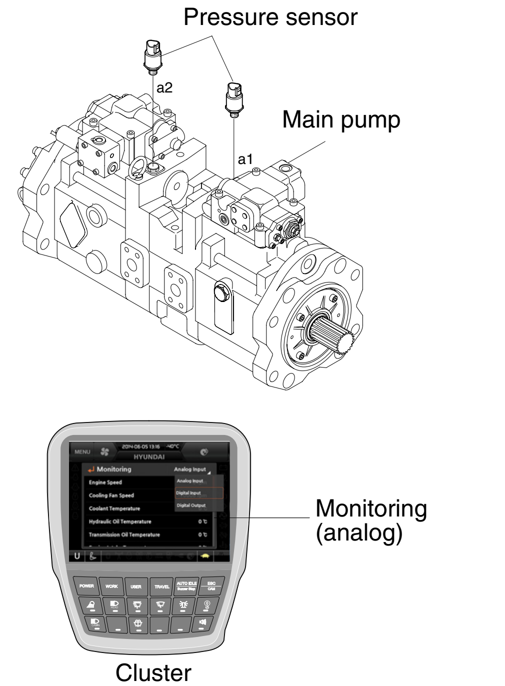
① Select the following switch positions.

· Power mode switch : P mode

② Slowly operate each control lever of boom, arm and bucket functions at full stroke over relief and measure the pressure.

③ In the swing function, place bucket against an immovable object and measure the relief pressure.

④ In the travel function, lock undercarriage with an immovable object and measure the relief pressure.



900L7MS11

(3) Evaluation

The average measured pressure should be within the following specifications.

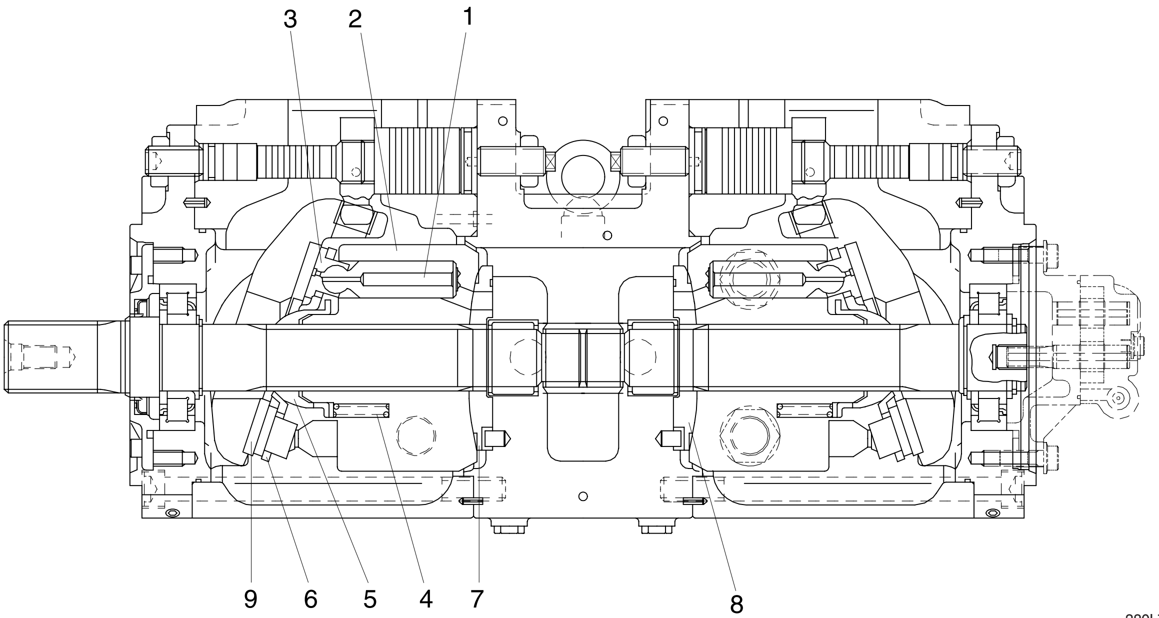
Unit : kgf / cm^2

Model	Function to be tested	Standard	Port relief setting
HX900 L	Boom	330(360)±10	380
	Arm	330(360)±10	380
	Bucket	330(360)±10	380
	Travel	350±10	350
	Swing	300±10	300

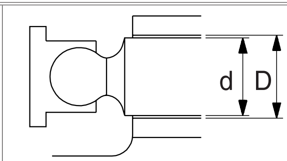
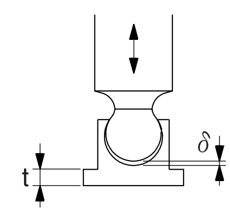
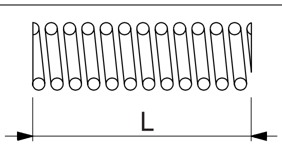
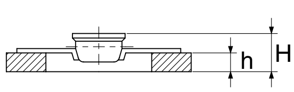
( ) : Power boost

GROUP 2 MAJOR COMPONENT

1. MAIN PUMP



380L7MS01

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 & negative control valve	· External rusting or damage. · Contacting face of valve seat. · Contacting face of poppet. · O-rings and back up rings.	· Replacement. · Replacement when damaged. · Replacement when damaged. · Replacement in principle.

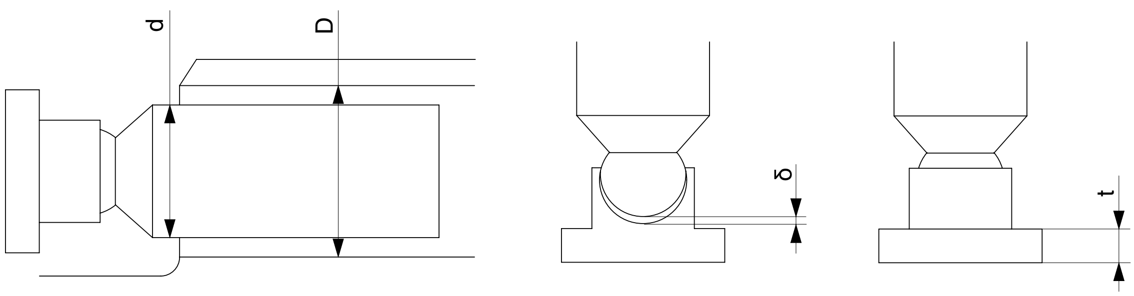
3. SWING DEVICE

1) HYDRAULIC MOTOR

(1) Service limit

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

Part name and inspection item	Standard dimension	Recommended value for replacement	Remedy
Clearance between piston & cylinder bore	D - d = 0.033 mm	D - d = 0.045 mm	Replace piston or cylinder block
Clearance caulked part between piston & shoe	δ = 0.0 mm	δ = 0.3 mm	Replace assembly of piston & shoe
Thickness of shoe	t = 7.0 mm	t = 6.8 mm	Replace assembly of piston & shoe
Thickness of friction plate	2.2 mm	2.1 mm	Replace friction plate



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(2) Renovation limit

If the face roughness is found exceed the renovation limit, renovate or replace the parts.

Part name	Normal face roughness	Renovation limit
Shoe	1.6-Z (Ra=0.4) (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)

※ 1. Renovate face of parts by lapping below normal face roughness.
2. If set plate and retainer's face is no good, replace those parts as an assembly.

(3) Causes of troubles and remedies

① The hydraulic motor not rotate

Phenomenon	Possible cause	Remedy
Pressure does not increase	· Safety valve in circuit is not correctly. · Relief valve does not function well. a) Sticking of plunger b) Clogging of plunger throttle. · Seat of plunger does not funtion well.	· Set valve at correct valvue. · a) Repair or replace stuck section. b) Disassemble and repair plunger. · Check seat section. Replace it, if damaged.
Pressure rises	· Overload. · Seizure of moving parts. · Brake is not applied with release perssure. · Brake piston sticks. · Spool sticks. · Fricrtion plate is seized.	· Remove load. · Check and repair. piston/shoes, cylinder, valve plate, etc. · a) Check and repair circuit. b) Check time delay valve for brake. · Disassemble and check it. · Disassemble and check it. · Disassemble and check it. Replace seized one.

② The motor rotates reversely

Phenomenon	Possible cause	Remedy
Motor rotates reversely.	· Motor is assembled to rotate reversely. · Piping is connected to inlet and outlet reversely	· Confirm this, and reassemble it · Correct piping.

③ The speed does not reach set value

Phenomenon	Possible cause	Remedy
Speed does not reach set value	· Oil flow rate is insufficient. · Oil temp is high and oil leaks abnormally. · Sliding parts are worn or damaged.	· Check pump's delivery flow and circuit to motor. · Reduce oil temp. · Replace damaged parts.

④ The braking torque is insufficient

Phenomenon	Possible cause	Remedy
Brake torque is insuffcient.	· Friction plate is worn. · Breke piston sticks. · Brake release pressure cannot be removed. · Spline for frition plate is damaged.	· Disassemble and check it. Replace it, if worn more than criterion. · Disassemble and check it. · a) Check and repair circuit. b) Check time delay valve for brake. · Disassemble and check it. Replace it, if damaged.

⑤ The hydraulic motor slips too much

Investigate the drain flow rate of the motor. If it is about 500 cm^3/min or lower, the motor is considered to be normal.

Phenomenon	Possible cause	Remedy
When external driving torque is applied to motor, it slips too much	· Relief valve does not function well. Same as item ① · Seat of plunger does not function well. · Anti-reaction valve don't function well.	· Replace it. Same as item ① · Replace it. · Replace it.

⑥ Oil leakage

a. Oil leaks from oil seal

Phenomenon	Possible cause	Remedy
Oil leaks from oil seal	· Lip catches particles of dirt and is damaged. · Shaft is scratched or worn. · Because of excessively-high casing internal pressure, lip of oil seal is turned up. · Shaft is rusted.	· Replace oil seal. · Shift lip/shaft contact position or replace them. · If drain piping is clogged, clean it out. · Disassemble and repair it.

b. Oil leaks through mating faces

Phenomenon	Possible cause	Remedy
Oil leaks through mating face.	· O-ring forgotten to be fitted. · O-ring is scratched. · Seal surface is scratched. · Bolts are loose or damaged.	· Fit it correctly and carry out reassembling. · Replace it. · Disassemble and repair it. · Tighten then with specified torque or replace them.

2) REDUCTION GEAR

(1) Causes of troubles and remedies

The troubles and remedies of the reduction gear are shown here mainly.
Therefore, in case of trouble, refer also to the hydraulic motor part.

① Reduction gear will not rotate

Phenomenon	Possible cause	Remedy
Hyd motor inlet pressure is sufficiently high	· Overload · Damage of reduction gear · Negative brake is ON	· Reduce load · Replace reduction gear · Inspect brake release pressure · Inspect brake pilot pressure · Inspect brake parts
Hyd motor inlet pressure is not sufficiently high Rotation noise is heard in hydraulic motor	· Motor shaft breakage · Damage of reduction gear	· Replace hydraulic motor · Replace reduction gear
No rotation noise is heard in hydraulic motor	· Abnormality in pump, valve or so on	· Check for abnormality and remedy

② Reduction gear will not rotate

Phenomenon	Possible cause	Remedy
Oil leakage through mating faces	· Careless omission to apply liquid packing · Mating faces has slipped due to insufficient tightening or loosening of bolts · Scratch on mating face	· Disassemble gear and re-apply it. · Disassemble them, re-apply liquid packing and reassemble them as specified · Replace parte
Leakage around shaft	· Oil seal is damaged	· Disassemble reduction gear and replace oil seal

③ Temperature is too high

Phenomenon	Possible cause	Remedy
Reduction gear casing temperature is too high	· Gear oil is insufficient · Grease is insufficient · Gear, bearing or so on is damaged	· Check level and supply oil to specified level · Supply grease · Replace reduction gear

(2) Simultaneously replaced parts

This reduction gear is so designed that the parts are few in quantity and the life-spans of section are balanced with each other. Therefore, many parts should be replaced simultaneously as combinations due to constructional or functional reason, though any parts can be supplied independently. These are shown in table below.

			Part to be replaced simultaneously														
			201	401	402	203	230	282	286	910	210	231	283	285	287	403	909
			Drive shaft	Spherical roller bearing	Spherical roller bearing	Planetary gear No.2	Carrier No.2	Pin No.2	Thrust washer	Spring pin	Planetary gear No.1	Carrier No.1	Pin No.1	Side plate	Thrust plate	Needle cage	Spring pin
Part to be replaced	201	Drive shaft	-	o	o												
	401	Spherical roller bearing	x	-	x												
	402	Spherical roller bearing	x	x	-												
	203	Planetary gear No.2				-	x	o	x	o							
	230	Carrier No.2				x	-	o	x	o							
	282	Pin No.2				x	x	-	x	o							
	286	Thrust washer				x	x	o	-	o							
	910	Spring pin				x	x	o	x	-							
	210	Planetary gear No.1									-	x	o	x	x	x	o
	231	Carrier No.1									x	-	o	x	x	x	o
	283	Pin No.1									x	x	-	x	x	x	o
	285	Side plate									x	x	o	-	x	x	o
	287	Thrust washer									x	x	o	x	-	x	o
	403	Needle cage									x	x	o	x	x	-	o
	909	Spring pin									x	x	o	x	x	x	-

※ 1. Mark "O" show the part that must be replaced simultaneously.
2. Mark "X" show the part that is desirable to be replaced simultaneously.

(3) Part inspection and replacement criteria

① Tooth faces of sun, planetary and ring gears:
When pitting is found, replace the gear.
(If the pit size is 1mm or larger in diameter, and the area ratio 5% or more))

② Oil Seal
When the lip face is damaged or worn away, replace the oil seal.
When the reduction gear is disassembled for inspection, it is recommended to replace oil seals without fail.

※ The following parts art those of the drive shaft assembly. Except case of any abnormality found, do not disassemble it and inspect it as assembly.

③ Bearing (the front side of the reduction gear)
Check the bearings without removing from the drive shaft, following the procedures mentioned below.

a. Check the outer race and rollers and confirm that they are free of pitting and flaking.
b. Since the inner race is behind the retainer and connot be seen, check it as follows:
   - Aren't there large wear particles in gear oil?
   - Don't large wear particles stick between the rollers and retainer?
   - Can the inner race be rotated smoothly by hand?

   If any abnormality is found during the above check, replace it. Any bearing removed from the shaft should not be reused.

④ Bearing (the rear side of the reduction gear)
When they are pitting or flaking on the outer race and rollers, replace the bearing.

⑤ Planetary gear No.2
Check the radial play of the planetary gear No.2
If this play is 0.5 mm or more, replace the pin.

⑥ Thrust washer, thrust plate
When sliding face of thrust washer and thrust plate is scratched considerably, replace them.

⑦ Needle cage and pin No.1
When they art pitting or flaking, replace the needle cage and pin No.1.

4. TRAVEL MOTOR

Wash all parts disassembly in treated oil and dry in the compressed air.

Perform maintenance including replacement or corrections in accordance with the following criterion.

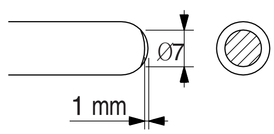
No.	Parts Name	Appearance	Allowance	Replacement parts
6	Piston sub assembly	When remarkable flaws or high surface roughness are found on each sliding surface	Roughness : 0.8a There should be no seizure and remarkable flaws (over 0.02 mm in thickness).	Cylinder block kit / Perform lapping (#1000). Replace if flaws cannot be completely removed.
		When remarkable flaws or high surface roughness are found on surface of piston.	Roughness : 1.2a There should be no seizure and remarkable flaws (over 0.02 mm in thickness).	
		When clearance between piston sub assembly and cylinder block bore is great.	Clearance : 0.060 mm	Cylinder block kit
		When looseness in shoe ball parts is great.	Looseness : 0.4 mm	
4	Cylinder Block	When remarkable flaws or high surface roughness are found on the surface with the valve plate.	Roughness : 0.8a	Cylinder block kit / Perform lapping(#1000). Replace if flaws cannot be completely removed.
		When wear inside bore is great.	Roughly : 1.6a	Cylinder block kit
		When clearance between piston sub assembly and cylinder block bore is great.	Looseness : 0.4 mm	
		When abnormal wear and breakage develop on mating teeth.		
5	Valve plate	When remarkable flaws or high surface roughness are found on each sliding surface	Roughness : 0.8 a There should be no seizure and remarkable flaws(over 0.02 mm in thickness).	Cylinder block kit
7 8	Retainer plate Retainer holder	When remarkable flaws or high surface roughness are found on each sliding surface.	Roughness : 0.8 a There should be no seizure and remarkable flaws(over 0.02 mm in thickness).	7 Retainer plate 8 Retainer holder

No.	Parts Name	Appearance	Allowance	Replacement parts
9	Swash plate	When remarkable flaws or high surface roughness are found on sliding surface with shoe.	Roughness : 0.8 a There should be no seizure and remarkable flaws(over 0.02 mm in thickness).	Swash plate / Perform lapping (#1000). Replace if flaws cannot be completely removed.
		When remarkable flaws or high surface roughness are found on sliding surface with steel ball.	Roughness : 1.6 a There should be no seizure and remarkable flaws(over 0.02 mm in thickness).	Swash plate
		When remarkable flaws or seizure are found on contact surface with steel balls.	Sphere depth : 19.06 mm	
3	Shaft	When remarkable flaws or high surface roughness are found on sliding surface of oil seal.	Roughness : 1.6 a There should be no seizure andremarkable flaws (over 0.02 mm in thickness).	Shaft
		When abnormal wear and breakage develop on mating teeth.		
21	Brake piston	When remarkable flaws or high surface roughness are found in each sliding surface	Height : 50.5 mm Roughness : 3.2 a There should be no seizure and remarkable flaws(over 0.02 mm in thickness).	Brake piston Friction plate
19	Disk plate	When remarkable flaws or abrasion are found on disks(friction material)	Thickness : 3.2 mm	Disk plate
13 14	Roller Bearing Roller Bearing	When flaking and abrasion develop on rolling surface.	-	Roller Bearing
		When indentation is found on rolling surface	-	
		When abnormality is found in rotation (abnormal noise, irregular rotation)	-	

No.	Parts Name	Appearance	Allowance	Replacement parts
11	Piston sub assembly	When remarkable flaws or high surface roughness are found on sliding surface with swash plate.	Roughness : 1.6 a There should be no seizure and remarkable flaws (over 0.02 mm in thickness).	Case kit / Perform lapping (#1000). Replace if flaws cannot be completely removed.
		When remarkable flaws or high surface roughness are found on surface with case.	Roughness : 1.2a There should be no seizure and remarkable flaws(over 0.02 mm in thickness).	Case kit
		When clearance between piston sub assembly and case bore is great.	Clearance : 0.030 mm	
		When looseness in shoe ball parts is great.	Looseness : 0.7 mm	
2-2	Spool Assy	When remarkable flaws or high surface roughness are found on each sliding surface	Roughness : 0.8 a There should be no seizure and remarkable flaws (over 0.02 mm in thickness).	Base plate sub assembly
		When clearance between piston sub assembly and case bore is great.	Clearance : 0.050 mm	
2-1	Base plate	When remarkable flaws or high surface roughness are found on each sliding surface with spool assy.	Roughness : 0.8 a There should be no seizure and remarkable flaws (over 0.02 mm in thickness).	Base plate sub assembly
		When clearance between spool assy and base plate bore is great.	Clearance : 0.050 mm	
		When remarkable flaws or high surface roughness are found on each sliding surface with valve assy.	Roughness : 0.8 a There should be no seizure and remarkable flaws (over 0.02 mm in thickness).	
		When clearance between valve assy and base plate bore is great.	Clearance : 0.040 mm	
		When remarkable flaws or high surface roughness are found on each sliding surface with spool assy.	There should be no seizure and remarkable flaws (over 0.02 mm in thickness).	

No.	Parts Name	Appearance	Allowance	Replacement parts
9	Valve assy	When remarkable flaws or high surface roughness are found on each sliding surface with spool assy.	Roughness : 0.8 a There should be no seizure and remarkable flaws (over 0.02 mm in thickness).	Base plate sub assembly
		When clearance between valve assy and base plate bore is great.	Clearance : 0.040 mm	
2-7-10	Free piston	When remarkable flaws or high surface roughness are found on each sliding surface with base plate.	There should be no seizure and remarkable flaws (over 0.02 mm in thickness).	Relief valve assy
2-7-2	Housing	When remarkable flaws or high surface roughness are found on each sliding surface with free piston.	There should be no seizure and remarkable flaws (over 0.02 mm in thickness).	

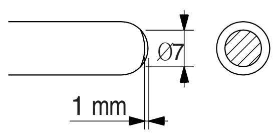
5. RCV LEVER

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

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

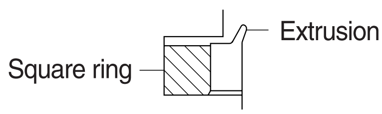
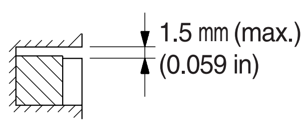
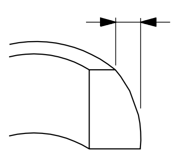
2. When loosening the hexagon socket head cap screw (125), replace the seal washers (121) without fail.

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

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

7. TURNING JOINT

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

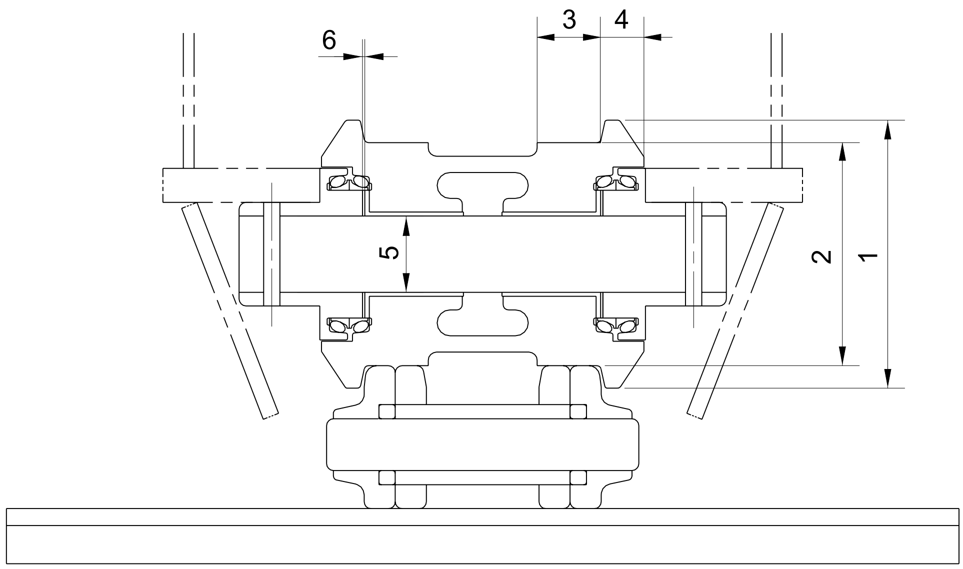
8. CYLINDER

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

GROUP 3 TRACK AND WORK EQUIPMENT

1. TRACK

1) TRACK ROLLER



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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 flange</td><td colspan="2">Standard size</td><td colspan="2">Repair limit</td><td rowspan="5">Rebuild or replace</td></tr>
<tr><td colspan="2">Ø320</td><td colspan="2">–</td></tr>
<tr><td>2</td><td>Outside diameter of tread</td><td colspan="2">Ø270</td><td colspan="2">Ø258</td></tr>
<tr><td>3</td><td>Width of tread</td><td colspan="2">73.5</td><td colspan="2">79.5</td></tr>
<tr><td>4</td><td>Width of flange</td><td colspan="2">49</td><td colspan="2">-</td></tr>
<tr><td rowspan="3">5</td><td rowspan="3">Clearance between shaft and bushing</td><td colspan="2">Standard size & tolerance</td><td rowspan="2">Standard clearance</td><td rowspan="2">Clearance limit</td><td rowspan="3">Replace bushing</td></tr>
<tr><td>Shaft</td><td>Hole</td></tr>
<tr><td>Ø115 $^{-0.25}_{-0.35}$</td><td>Ø115 $^{+0.15}_{+0.03}$</td><td>0.28 to 0.5</td><td>2.0</td></tr>
<tr><td rowspan="2">6</td><td rowspan="2">Side clearance of roller (Both side)</td><td colspan="2">Standard clearance</td><td colspan="2">Clearance limit</td><td rowspan="2">Replace</td></tr>
<tr><td colspan="2">0.34~1.678</td><td colspan="2">2.5</td></tr>
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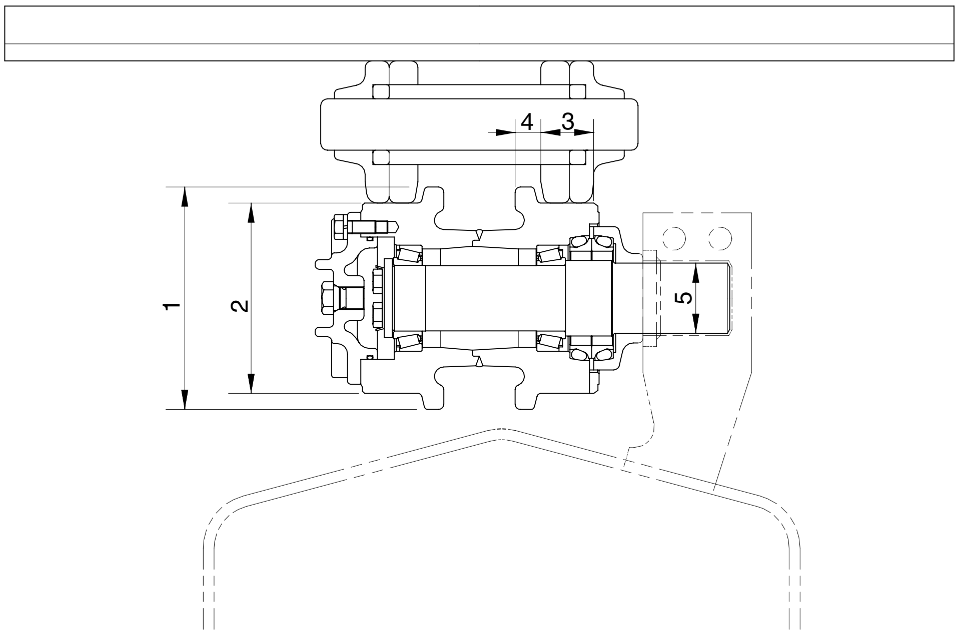
2) CARRIER ROLLER



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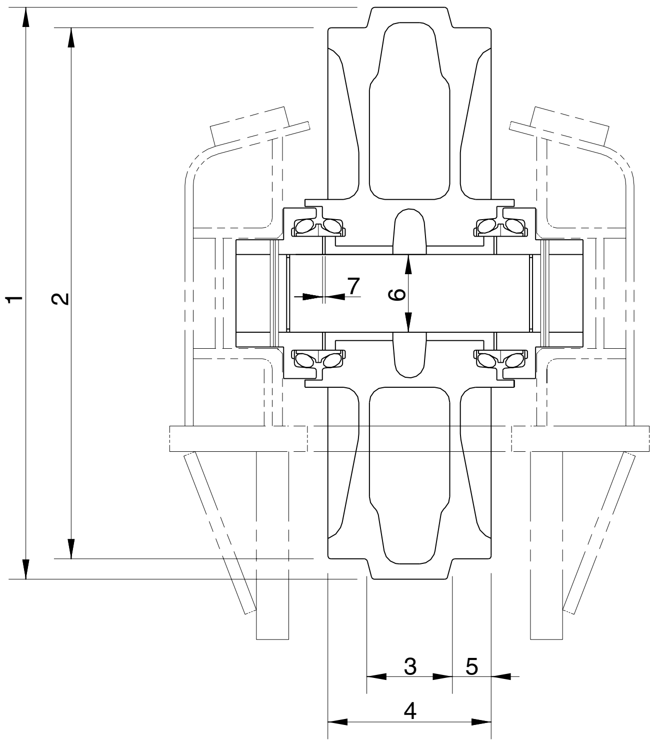
Unit : ㎜

<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 flange</td><td colspan="2">Standard size</td><td colspan="2">Repair limit</td><td rowspan="4">Rebuild or replace</td></tr>
<tr><td colspan="2">Ø250</td><td colspan="2">-</td></tr>
<tr><td>2</td><td>Outside diameter of tread</td><td colspan="2">Ø218</td><td colspan="2">Ø208</td></tr>
<tr><td>3</td><td>Width of tread</td><td colspan="2">71</td><td colspan="2">76</td></tr>
<tr><td>4</td><td>Width of flange</td><td colspan="2">23</td><td colspan="2">-</td><td></td></tr>
<tr><td>5</td><td>Clearance between shaft and bushing</td><td>Ø96 $^{0.036}_{-0.09}$</td><td>Ø96 $^{+0.3}_{+0.1}$</td><td>0.136~0.39</td><td>1.2</td><td>Replace</td></tr>
</table>

3) IDLER

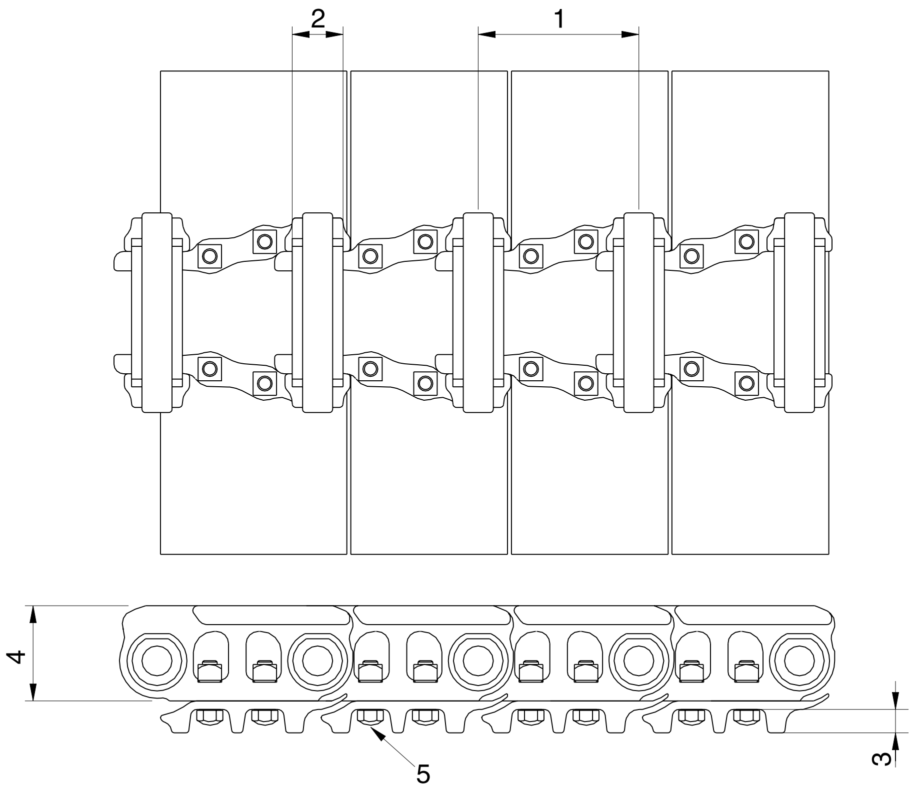


8007A7MS05

Unit : mm

<table>
<tr><th>No.</th><th>Check item</th><th colspan="4">Criteria</th><th>Remedy</th></tr>
<tr><td rowspan="2">1</td><td rowspan="2">Outside diameter of protrusion</td><td colspan="2">Standard size</td><td colspan="2">Repair limit</td><td rowspan="6">Rebuild or replace</td></tr>
<tr><td colspan="2">Ø875</td><td colspan="2">–</td></tr>
<tr><td>2</td><td>Outside diameter of tread</td><td colspan="2">Ø830</td><td colspan="2">Ø816</td></tr>
<tr><td>3</td><td>Width of protrusion</td><td colspan="2">127</td><td colspan="2">–</td></tr>
<tr><td>4</td><td>Total width</td><td colspan="2">266</td><td colspan="2">–</td></tr>
<tr><td>5</td><td>Width of tread</td><td colspan="2">69.5</td><td colspan="2">76.5</td></tr>
<tr><td rowspan="3">6</td><td rowspan="3">Clearance between shaft and bushing</td><td colspan="2">Standard size & tolerance</td><td rowspan="2">Standard clearance</td><td rowspan="2">Clearance limit</td><td rowspan="3">Replace bushing</td></tr>
<tr><td>Shaft</td><td>bushing</td></tr>
<tr><td>Ø120 $^{0}_{-0.03}$</td><td>Ø120 $^{+0.4}_{+0.35}$</td><td>0.35 to 0.43</td><td>2.0</td></tr>
<tr><td rowspan="2">7</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">0.4 to 1.4</td><td colspan="2">2.0</td></tr>
</table>

4) TRACK

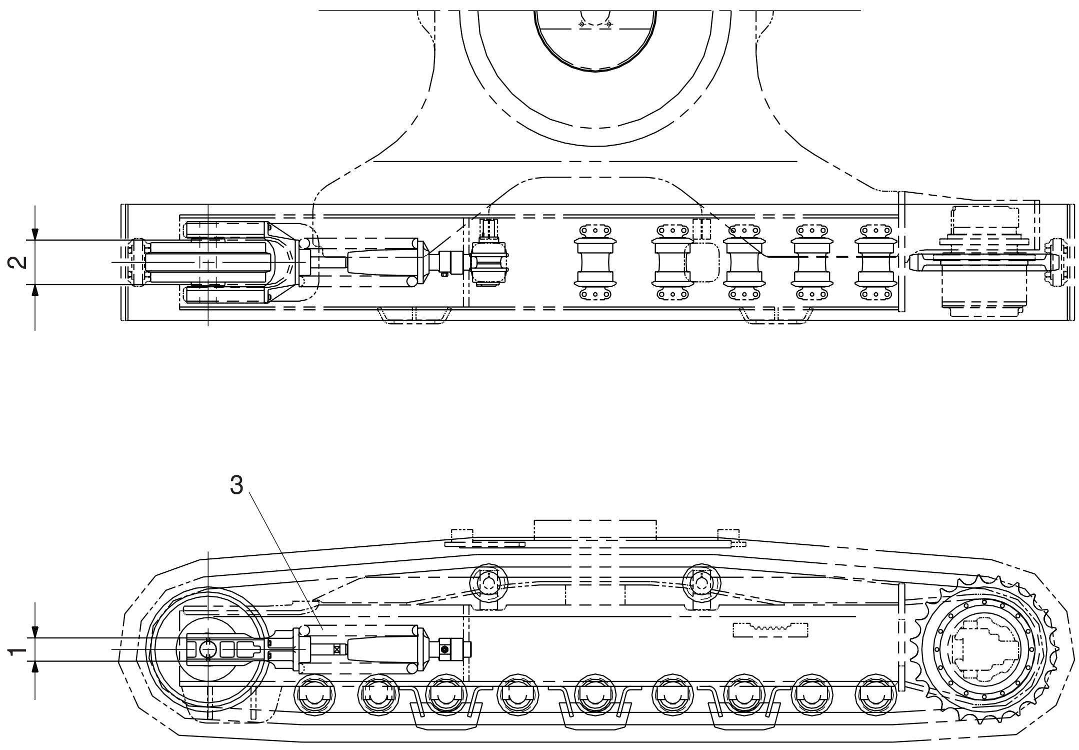


32077MS04

Unit : ㎜

No.	Check item	Criteria		Remedy
1	Link pitch	Standard size	Repair limit	Turn or replace
		260.35	265.75	
2	Outside diameter of bushing	Ø85.725	Ø73.725	Rebuild or replace
3	Height of grouser	52	28	
4	Height of link	155.5	141.5	
5	Tightening torque	Initial tightening torque : 180.3~212.2 kgf · m		Retighten

5) TRACK FRAME AND RECOIL SPRING

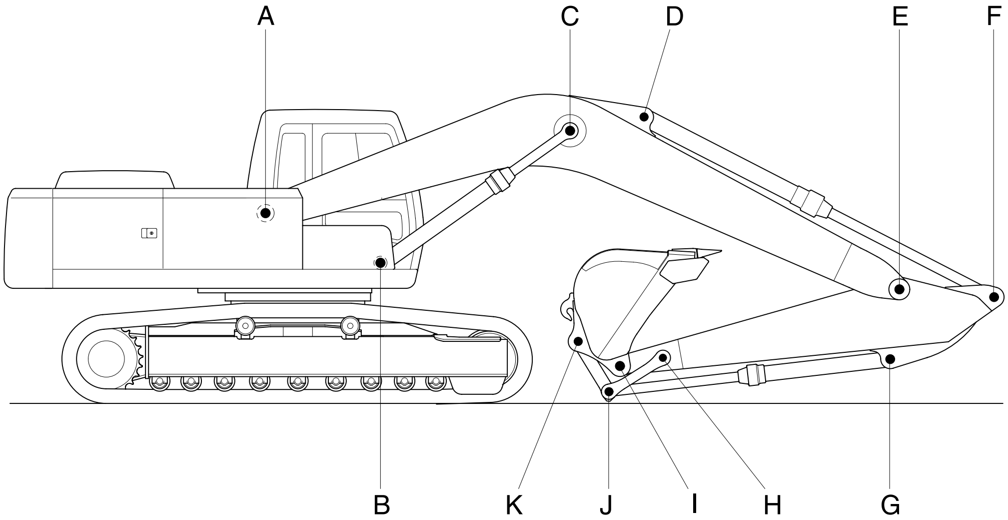


21073MS05

Unit : ㎜

<table>
<tr><th>No.</th><th>Check item</th><th colspan="6">Criteria</th><th>Remedy</th></tr>
<tr><td rowspan="3">1</td><td rowspan="3">Vertical width of idler guide</td><td colspan="2"></td><td>Standard size</td><td>Tolerance</td><td colspan="2">Repair limit</td><td rowspan="5">Rebuild or replace</td></tr>
<tr><td colspan="2">Track frame</td><td>193</td><td>+2
0</td><td colspan="2">197</td></tr>
<tr><td colspan="2">Idler support</td><td>190</td><td>0
-1.5</td><td colspan="2">186</td></tr>
<tr><td rowspan="2">2</td><td rowspan="2">Horizontal width of idler guide</td><td colspan="2">Track frame</td><td>342</td><td>+2
0</td><td colspan="2">346</td></tr>
<tr><td colspan="2">Idler support</td><td>340</td><td>-</td><td colspan="2">337</td></tr>
<tr><td rowspan="3">3</td><td rowspan="3">Recoil spring</td><td colspan="3">Standard size</td><td colspan="3">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 colspan="2">Installation load</td></tr>
<tr><td>310×1553</td><td>1290</td><td>49.986 ㎏</td><td>-</td><td colspan="2">39.990㎏</td></tr>
</table>

2. WORK EQUIPMENT



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	155	154	153.5	155.5	156	Replace
B	Boom Cylinder Head	130	129	128.5	130.5	131	
C	Boom Cylinder Rod	130	129	128.5	130.5	131	
D	Arm Cylinder Head	140	139	138.5	140.5	141	
E	Boom Front	150	149	148.5	150.5	151	
F	Arm Cylinder Rod	140	139	138.5	140.5	141	
G	Bucket Cylinder Head	130	129	128.5	130.5	131	
H	Arm Link	120	119	118.5	120.5	121	
I	Bucket and Arm Link	140	139	138.5	140.5	141	
J	Bucket Cylinder Rod	150	149	148.5	150.5	151	
K	Bucket Link	140	139	138.5	140.5	141	

SECTION 8 DISASSEMBLY AND ASSEMBLY

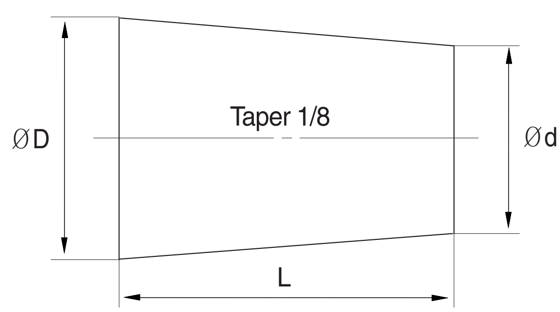
SECTION 8 DISASSEMBLY AND ASSEMBLY

GROUP 1 PRECAUTIONS

1. REMOVAL WORK

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

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



2. INSTALL WORK

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

2) Install the hoses without twisting or interference.

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

4) Bend the cotter pin or lock plate securely.

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

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

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

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

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

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

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

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

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

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

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

(2) Operate the control lever and actuate the hydraulic cylinder 4-5 times, stopping 100 mm 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 (FR, engine-bracket	M24 × 3.0	90±9.0	650±65.1
2		Engine mounting bolt (RR, engine-bracket)	M14 × 2.0	18±1.8	130±13.0
3		Engine mounting bolt (bracket-frame)	M24 × 3.0	90±9.0	651±65.1
4		Radiator mounting bolt	M10 × 1.5	55±5.0	398±36.1
5		Coupling mounting socket bolt	M24 × 3.0	87.5±2.5	633±108
6		Fuel tank mounting bolt	M20 × 2.5	58±6.0	420±43.4
7	Hydraulic system	Main pump housing mounting bolt	M10 × 1.5	6.7±1.0	48.4±7.2
8		Main pump mounting bolt	M24 × 3.0	80±8.0	579±57.9
9		Main control valve mounting nut	M20 × 2.5	69.5±10.5	503±76
10		Hydraulic oil tank mounting bolt	M20 × 2.5	58±6.0	420±43.4
11		Turning joint mounting bolt, nut	M16 × 2.0	29.7±4.5	215±32.5
12	Power train system	Swing motor mounting bolt	M24 × 3.0	120±18	868±130
13		Swing bearing upper part mounting bolt	M30 × 3.0	199±20	1439±145
14		Swing bearing lower part mounting bolt	M30 × 3.0	199±20	1439±145
15		Travel motor mounting bolt	M30 × 3.5	199±30	1439±217
16		Sprocket mounting bolt	M30 × 3.5	199±20	1439±144.7
17	Under carriage	Carrier roller mounting bolt, nut	M20 × 2.5	57.9±6.0	419±62.9
18		Track roller mounting bolt	M27 × 3.0	135±13	977±94
19		Track tension cylinder mounting bolt	M20 × 2.5	57.9±6.0	419±43.4
20		Track shoe mounting bolt, nut	1 1/8"-12UNF	196±15	1418±108.5
21		Track guard mounting bolt	M27 × 3.0	135±15	977±109
22	Others	Counterweight mounting bolt	M42 × 3.0	390±40	2821±289
23		Center frame support and lower track mtg bolt	M36 × 3.0	280±30	2025±21.7
24		Cab mounting bolt	M12 × 1.75	12.8±3.0	92.6±21.7
25		Operator's seat mounting bolt	M8 × 1.25	4.05±0.8	293±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	8.8T		10.9T		12.9T	
	kgf · m	lbf · ft	kgf · m	lbf · ft	kgf · m	lbf · ft
M 6×1.0	0.8 ~ 1.2	5.8 ~ 8.6	1.2 ~ 1.8	8.7 ~ 13.0	1.5 ~ 2.1	10.9 ~ 15.1
M 8×1.25	2.0 ~ 3.0	14.5 ~ 21.6	2.8 ~ 4.2	20.3 ~ 30.4	3.4 ~ 5.0	24.6 ~ 36.1
M10×1.5	4.0 ~ 6.0	29.0 ~ 43.3	5.6 ~ 8.4	40.5 ~ 60.8	6.8 ~ 10.0	49.2 ~ 72.3
M12×1.75	6.8 ~ 10.2	50.0 ~ 73.7	9.6 ~ 14.4	69.5 ~ 104	12.3 ~ 16.5	89.0 ~ 119
M14×2.0	10.9 ~ 16.3	78.9 ~ 117	16.3 ~ 21.9	118 ~ 158	19.5 ~ 26.3	141 ~ 190
M16×2.0	17.9 ~ 24.1	130 ~ 174	25.1 ~ 33.9	182 ~ 245	30.2 ~ 40.8	141 ~ 295
M18×2.5	24.8 ~ 33.4	180 ~ 241	34.8 ~ 47.0	252 ~ 340	41.8 ~ 56.4	302 ~ 407
M20×2.5	34.9 ~ 47.1	253 ~ 340	49.1 ~ 66.3	355 ~ 479	58.9 ~ 79.5	426 ~ 575
M22×2.5	46.8 ~ 63.2	339 ~ 457	65.8 ~ 88.8	476 ~ 642	78.9 ~ 106	570 ~ 766
M24×3.0	60.2 ~ 81.4	436 ~ 588	84.6 ~ 114	612 ~ 824	102 ~ 137	738 ~ 991
M30×3.5	120 ~161	868 ~ 1164	168 ~ 227	1216 ~ 1641	202 ~ 272	1461 ~ 1967

(2) Fine thread

Bolt size	8.8T		10.9T		12.9T	
	kgf · m	lbf · ft	kgf · m	lbf · ft	kgf · m	lbf · ft
M 8×1.0	2.1 ~ 3.1	15.2 ~ 22.4	3.0 ~ 4.4	21.7 ~ 31.8	3.6 ~ 5.4	26.1 ~ 39.0
M10×1.25	4.2 ~ 6.2	30.4 ~ 44.9	5.9 ~ 8.7	42.7 ~ 62.9	7.0 ~ 10.4	50.1 ~ 75.2
M12×1.25	7.3 ~ 10.9	52.8 ~ 78.8	10.3 ~ 15.3	74.5 ~ 110	13.1 ~ 17.7	94.8 ~ 128
M14×1.5	12.4 ~ 16.6	89.7 ~ 120	17.4 ~ 23.4	126 ~ 169	20.8 ~ 28.0	151 ~ 202
M16×1.5	18.7 ~ 25.3	136 ~ 182	26.3 ~ 35.5	191 ~ 256	31.6 ~ 42.6	229 ~ 308
M18×1.5	27.1 ~ 36.5	196 ~ 264	38.0 ~ 51.4	275 ~ 371	45.7 ~ 61.7	331 ~ 446
M20×1.5	37.7 ~ 50.9	273 ~ 368	53.1 ~ 71.7	384 ~ 518	63.6 ~ 86.0	460 ~ 622
M22×1.5	51.2 ~ 69.2	370 ~ 500	72.0 ~ 97.2	521 ~ 703	86.4 ~ 116	625 ~ 839
M24×2.0	64.1 ~ 86.5	464 ~ 625	90.1 ~ 121	652 ~ 875	108 ~ 146	782 ~ 1056
M30×2.0	129 ~ 174	933 ~ 1258	181 ~ 245	1310 ~ 1772	217 ~ 294	1570 ~ 2126

2) PIPE AND HOSE (FLARE type)

Thread size (PF)	Width across flat (mm)	kgf · m	lbf · ft
1/4"	19	4	28.9
3/8"	22	5	36.2
1/2"	27	9.5	68.7
3/4"	36	18	130
1"	41	21	152
1-1/4"	50	35	253

3) PIPE AND HOSE (ORFS type)

Thread size (UNF)	Width across flat (mm)	kgf · m	lbf · ft
9/16-18	19	4	28.9
11/16-16	22	5	36.2
13/16-16	27	9.5	68.7
1-3/16-12	36	18	130
1-7/16-12	41	21	152
1-11/16-12	50	35	253

4) FITTING

Thread size	Width across flat (mm)	kgf · m	lbf · ft
1/4"	19	4	28.9
3/8"	22	5	36.2
1/2"	27	9.5	68.7
3/4"	36	18	130
1"	41	21	152
1-1/4"	50	35	253

GROUP 3 PUMP DEVICE

1. REMOVAL AND INSTALL

1) REMOVAL

13031GE18

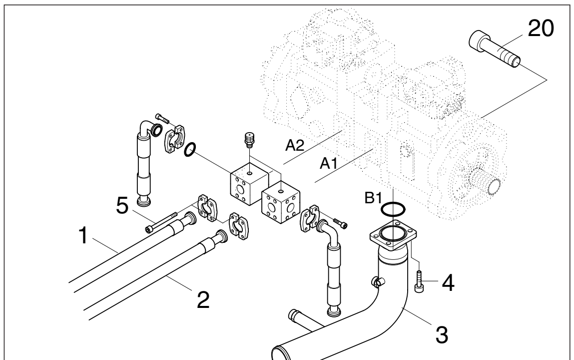
(1) Lower the work equipment to the ground and stop the engine.

(2) Loosen the breather slowly to release the pressure inside the hydraulic tank.

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

(3) Loosen the drain plug under the hydraulic tank and drain the oil from the hydraulic tank.

· Hydraulic tank quantity : 450 ℓ



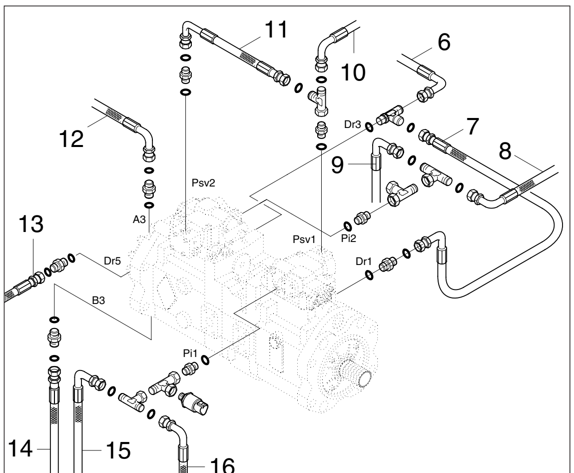
900L8MP01

(4) Remove socket bolts(5) and disconnect hose (1,2).

(5) Disconnect pilot line hoses (6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16).

(6) Remove 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.



900L8MP02

(7) Sling the pump assembly and remove the pump mounting bolts (20).

· Weight : 300 kg (660 lb)

· Tightening torque : 80±8.0 kgf · m (579±57.9 lbf · ft)

※ Pull out the pump assembly from housing. When removing the pump assembly, check that all the hoses have been disconnected.

2) INSTALL

(1) Carry out installation in the reverse order to removal

(2) Remove the suction strainer and clean it.

(3) Replace the return filter with a new one.

(4) Remove breather and clean it.

(5) After adding oil to the hydraulic tank to the specified level.

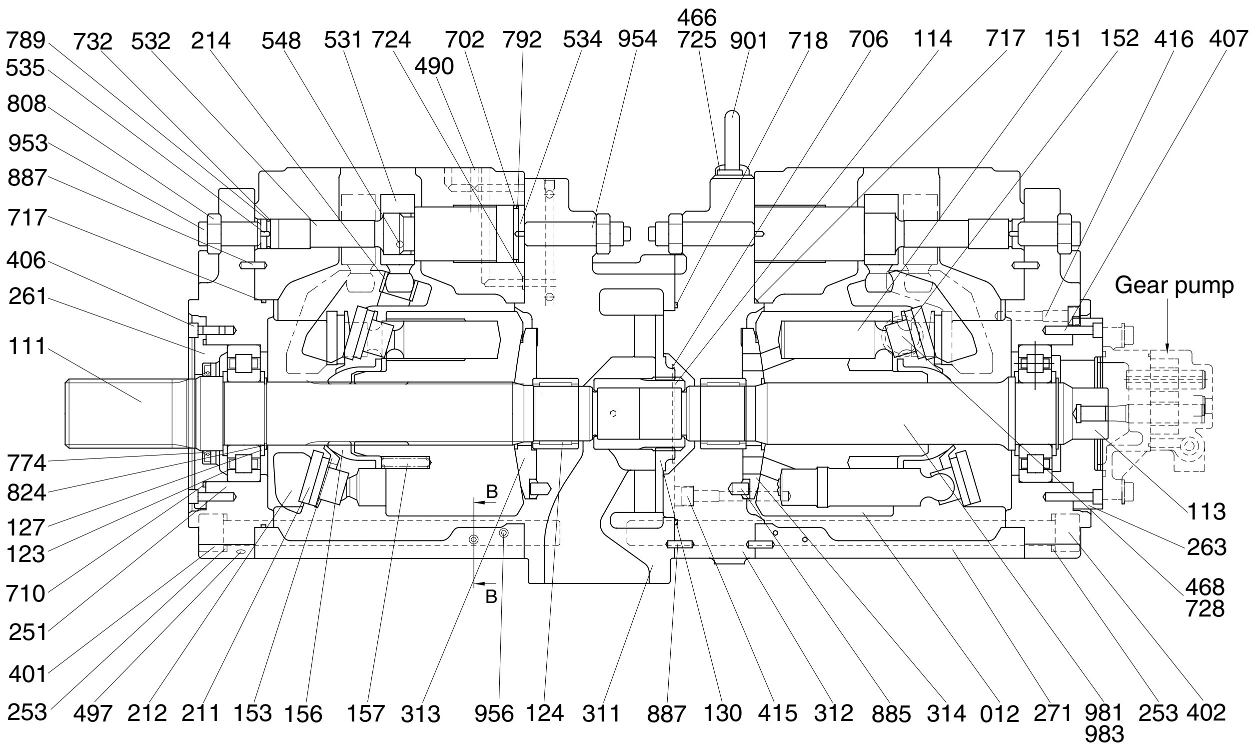
(6) Bleed the air from the hydraulic pump.
 ① Remove the air vent plug (2EA)
 ② Tighten plug lightly
 ③ Start the engine, run at low idling, and check oil come out from plug.
 ④ Tighten plug.

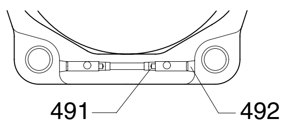
(7) Start the engine, run at low idling (3~5 minutes) to circulate the oil through the system.

(8) Confirmed the hydraulic oil level and check the hydraulic oil leaks or not.

2. MAIN PUMP (1/2)

1) STRUCTURE





Section B - B

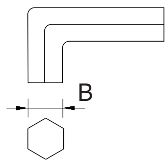
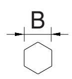
80092MP07

012	Cylinder block	311	Valve cover (F)	702	O-ring
111	Drive shaft (F)	312	Valve cover (R)	706	O-ring
113	Driven shaft (R)	313	Valve plate (R)	710	O-ring
114	Coupling	314	Valve plate (L)	717	O-ring
123	Roller bearing	401	Hexagon socket bolt	718	O-ring
124	Needle bearing	402	Hexagon socket bolt	724	O-ring
127	Spacer	406	Hexagon socket bolt	725	O-ring
130	Booster	407	Hexagon socket bolt	728	O-ring
151	Piston	415	Hexagon socket bolt	732	O-ring
152	Shoe	416	Hexagon socket bolt	774	Oil seal
153	Plate	466	VP Plug	789	Back up ring
156	Bushing	468	VP Plug	792	Back up ring
157	Cylinder spring	490	VP Plug	808	Hexagon head nut
211	Shoe plate	491	Restorictor	824	Snap ring
212	Swash plate	492	VP Plug	885	Pin
214	Bushing	497	VP Plug	887	Spring pin
251	Support plate	531	Tilting pin	901	Eye bolt
253	Washer	532	Servo piston	953	Set screw
261	Seal cover (F)	534	Stopper (L)	954	Set screw
263	Seal cover (R)	535	Stopper (S)	956	Set screw
271	Pump casing	548	Feed back pin		

2) TOOLS AND TIGHTENING TORQUE

(1) Tools

The tools necessary to disassemble/reassemble the pump are shown in the follow list.

Tool name & size		Part name			
Allen wrench 	B	Hexagon socket head bolt	PT plug (PT thread)	PO plug (PF thread)	Hexagon socket head setscrew
	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	-
Double ring spanner, socket wrench, double (Single) open end spanner 	-	Hexagon head bolt	Hexagon head bolt	VP plug (PF thread)	
	19	M12	M12	VP-1/4	
	24	M16	M16	-	
	27	M18	M18	VP-1/2	
	30	M20	M20	-	
	36	-	-	VP-3/4	
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	115.7	0.47	12
	M16	24.0	173.6	0.55	14
	M18	34.0	245.9	0.55	14
	M20	44.0	318.3	0.67	17
	M22	64.0	462.9	0.67	17
PT plug (Material : S45C) ※ Wind a seal tape 1 1/2 to 2 turns round the plug	PT 1/16	0.7	5.1	0.16	4
	PT 1/ 8	1.05	7.59	0.20	5
	PT 1/ 4	1.75	12.66	0.24	6
	PT 3/ 8	3.5	25.3	0.31	8
	PT 1/ 2	5.0	36.2	0.39	10
PF plug (Material : S45C)	PF 1/ 4	3.0	21.7	0.24	6
	PF 1/ 2	10.0	72.3	0.39	10
	PF 3/ 4	15.0	108.5	0.55	14
	PF 1	19.0	137.4	0.67	17
	PF 1 1/4	27.0	195.3	0.67	17
	PF 1 1/2	28.0	202.5	0.67	17

3) DISASSEMBLY

(1) Select place suitable to disassembling.

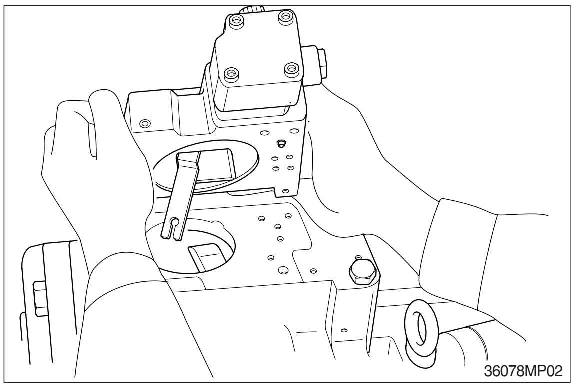
※ Select clean place.

※ Spread rubber sheet, cloth or so on on overhaul workbench top to prevent parts from being damaged.

(2) Remove dust, rust, etc, from pump surfaces with cleaning oil or so on.

(3) Remove drain port plug (468) and let oil out of pump casing (Front and rear pump).

(4) Remove hexagon socket head bolts (412, 413) and remove regulator.


36078MP02

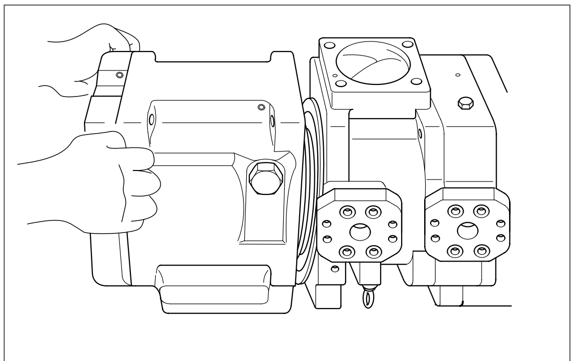
(5) Loosen hexagon socket head bolts (401) which tighten swash plate support (251), pump casing (271) and valve cover (F, 311).

※ If gear pump and so on are fitted to rear face of pump, remove them before starting this work.

(6) Loosen hexagon socket head bolts (402) which tighten swash plate support (251), pump casing (271) and valve cover (R, 312).

(7) Place pump horizontally on workbench with its regulator-fitting surface down, and separate pump casing (271) from valve cover (F, 311).

※ Before bringing this surface down, spread rubber sheet on workbench without fail to prevent this surface from being damaged.

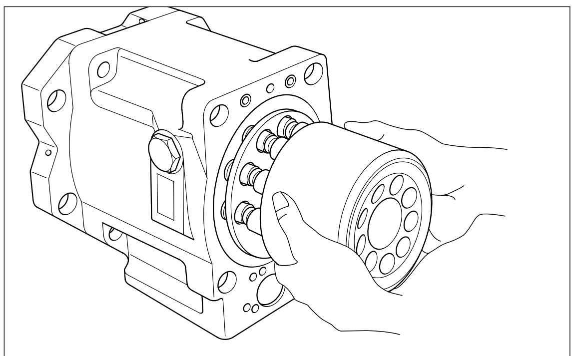


36078MP03

(8) Separate valve cover (F, 311) from valve cover (R, 312) and pull out booster (130), spline coupling (114).

(9) Separate valve cover (R, 312) from pump casing and then pull out the cylinder block (012) of pump casing (271) straightly over drive shaft (R, 113). Pull out also pistons (151), set plate (153), spherical bush(156) and cylinder springs (157) simultaneously.

※ Take care not to damage sliding surfaces of cylinder, spherical bushing, shoes, swash plate, etc.

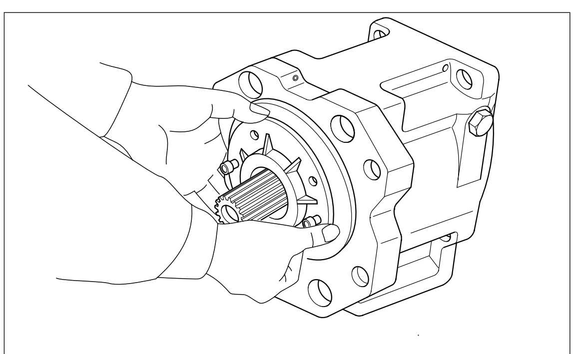


36078MP04

(10) Remove hexagon socket head bolts (406) and then seal cover (F, 261).

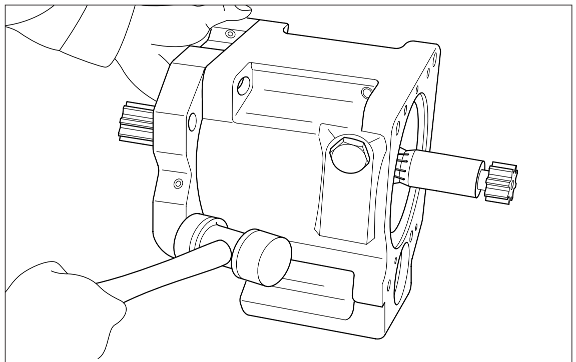
※ Fit bolt into pulling-out tapped hole of seal cover (F), and cover can be removed easily.

※ Since oil seal is fitted on seal cover (F), take care not to damage it when removing cover.



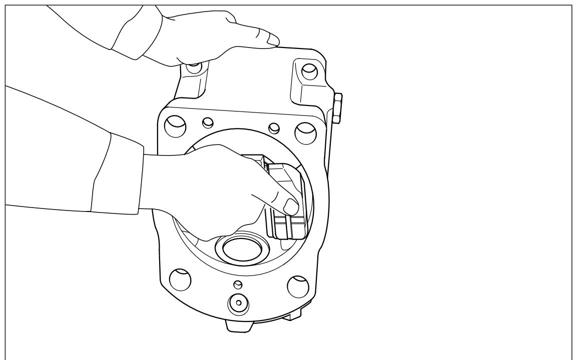
36078MP05

(11) Tapping lightly fitting flange section of swash plate support (251) on its pump casing side, separate swash plate support from pump casing.



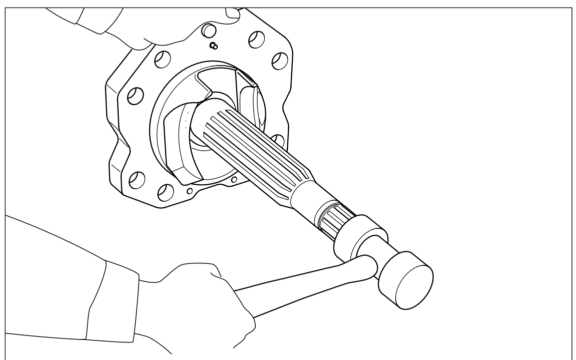
36078MP06

(12) Remove shoe plate (211) and swash plate (212) from pump casing (271).



36078MP07

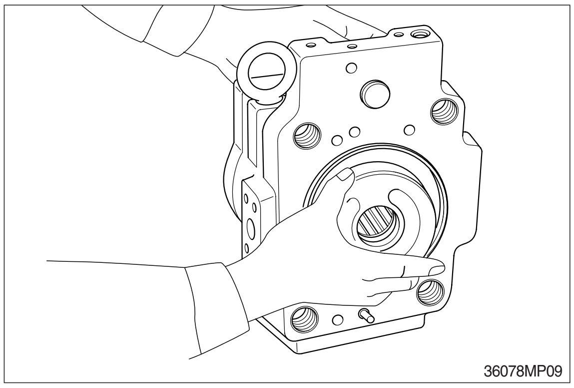
(13) Tapping lightly shaft ends of drive shafts (111, 113) with plastic hammer, take out drive shafts from swash plate supports.



36078MP08

(14) Remove valve plates (313, 314) from valve cover (311, 312).

※ These may be removed in work 7, 9.



36078MP09

(15) If necessary, remove stopper (L, 534), stopper (S, 535), servo piston (532) and tilting pin (531) from pump casing (271), and needle bearing (124) from valve cover (311, 312).

※ In removing tilting pin, use a protector to prevent pin head from being damaged.

※ Since loctite is applied to fitting areas of tilting pin and servo piston, take care not to damage servo piston.

※ Do not remove needle bearing as far as possible, except when it is considered to be out of its life span.

※ Do not loosen hexagon nuts of valve cover and swash plate support.
If loosened, flow setting will be changed.

(16) This is the end of disassembling procedures.

4) ASSEMBLY

(1) For reassembling reverse the disassembling procedures, paying attention to the following items.

① Do not fail to repair the parts damaged during disassembling, and prepare replacement parts in advance.

② Clean each part fully with cleaning oil and dry it with compressed air.

③ Do not fail to apply clean working oil to sliding sections, bearings, etc. before assembling them.

④ In principle, replace seal parts, such as O-rings, oil seals, etc.

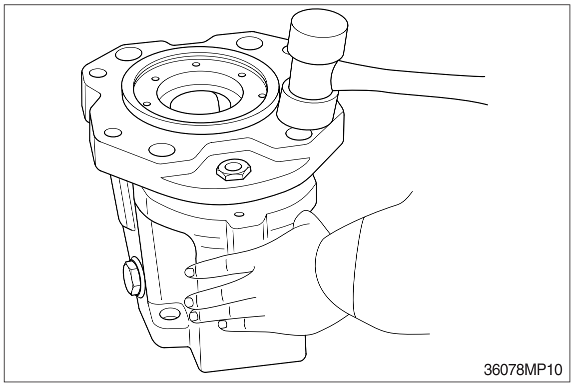
⑤ For fitting bolts, plug, etc., prepare a torque wrench or so on, and tighten them with torques shown in page 8-10, 11.

⑥ For the double-pump, take care not to mix up parts of the front pump with those of the rear pump.

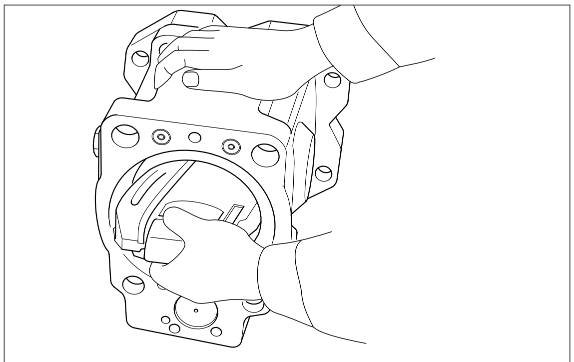
(2) Fit swash plate support (251) to pump casing (271), tapping the former lightly with a hammer.

※ After servo piston, tilting pin, stopper (L) and stopper (S) are removed, fit them soon to pump casing in advance for reassembling.

※ In tightening servo piston and tilting pin, use a protector to prevent tilting pin head and feedback pin from being damaged. In addition, apply loctite (Medium strength) to their threaded sections.

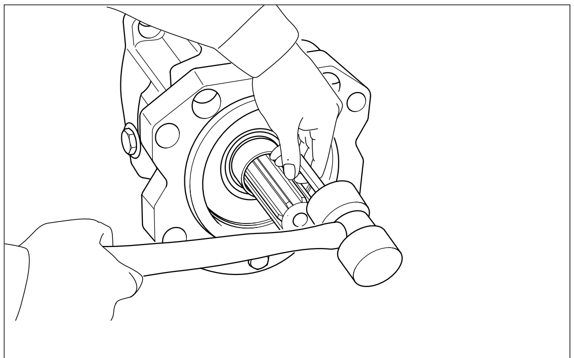

36078MP10

(3) Place pump casing with its regulator fitting surface down, fit tilting bush of swash plate to tilting pin (531) and fit swash plate (212) to swash plate support (251) correctly.
※ Confirm with fingers of both hands that swash plate can be removed smoothly.
※ Apply grease to sliding sections of swash plate and swash plate support, and drive shaft can be fitted easily.



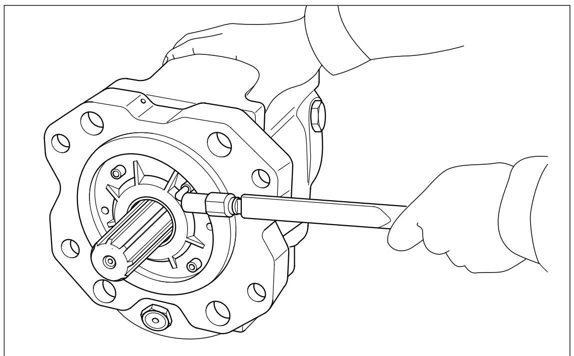
36078MP11

To (4) swash plate support (251), fit drive shaft (111) set with bearing (123), bearing spacer (127) and snap ring (824).
※ Do not tap drive shaft with hammer or so on.
※ Assemble them into support, tapping outer race of bearing lightly with plastic hammer.
Fit them fully, using steel bar or so on.



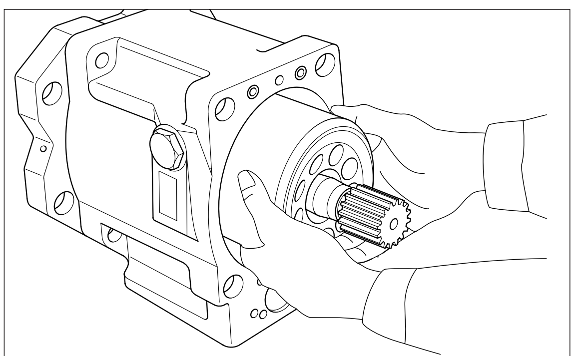
36078MP12

(5) Assemble seal cover (F, 261) to pump casing (271) and fix it with hexagon socket head bolts (406).
※ Apply grease lightly to oil seal in seal cover (F).
※ Assemble oil seal, taking full care not to damage it.
※ For tandem type pump, fit rear cover (263) and seal cover (262) similarly.



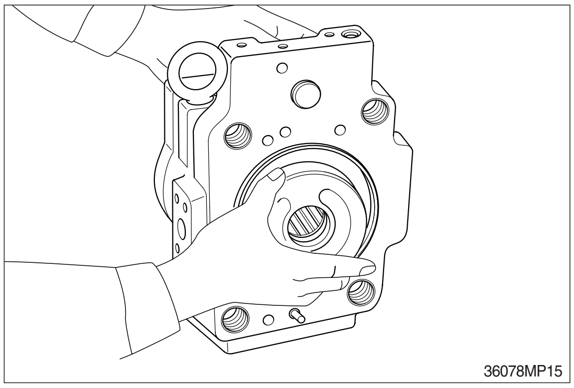
36078MP13

(6) Assemble piston cylinder subassembly [cylinder block (012), piston subassembly (151, 152), set plate (153), spherical bushing (156) and cylinder spring (157)].
Fit spline phases of retainer and cylinder.
Then, insert piston cylinder subassembly into pump casing (271).



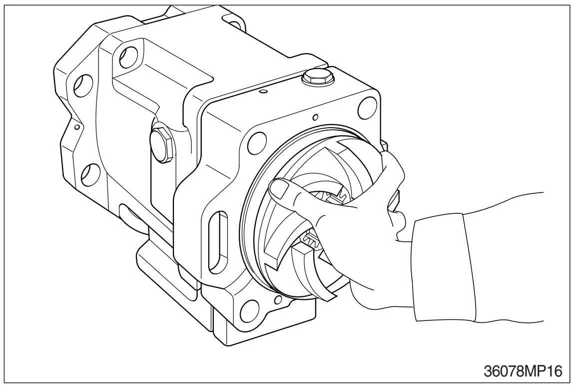
36078MP14

(7) Fit valve plate (313) to valve cover (F, 311), and fit valve plate (314) to valve cover (R, 312), entering pin into pin hole.
※ Take care not to mistake suction / delivery directions of valve plate.



36078MP15

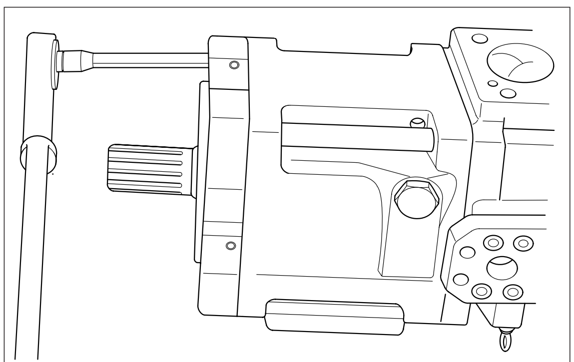
(8) Fit valve block (R, 312) to pump casing (271) and fit spline coupling (114) and booster (130) to shaft (R, 113).
※ Take care not to mistake direction of valve cover.
Fit valve cover with regulator up and with delivery flange left, viewed from front side.
※ Take care not to mistake direction of booster (130).
(Refer to the sectional drawing)



36078MP16

(9) Fit valve cover (F, 311) to valve cover (R) and tighten hexagon socket head bolts (402).

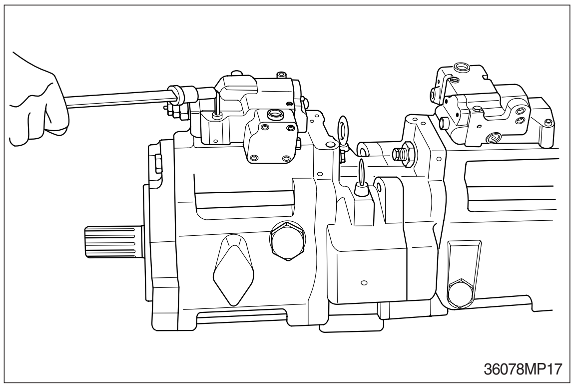
(10) Fit pump casing (271) with shaft (F, 111) to valve cover (F, 311) and tighten hexagon socket head bolts (401).
※ Mate spline phases of shaft (F) and spline coupling, with shaft (F) been rotating.



36078MP18

(11) Putting feedback pin of tilting pin into feedback lever of regulator, fit regulator and tighten hexagon socket head bolts (412,413).

※ Take care not to mistake regulator of front pump for that of rear pump.

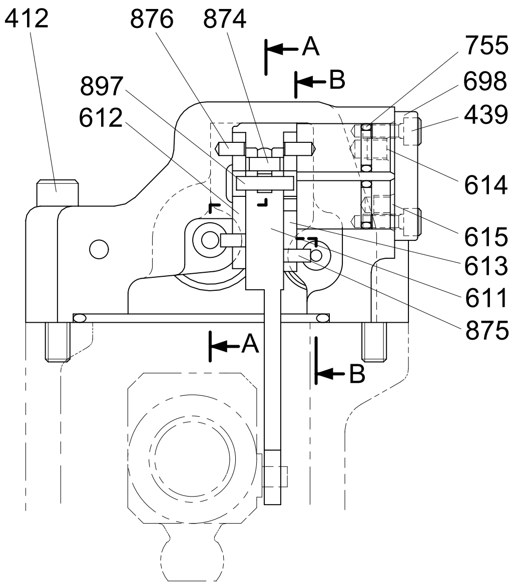


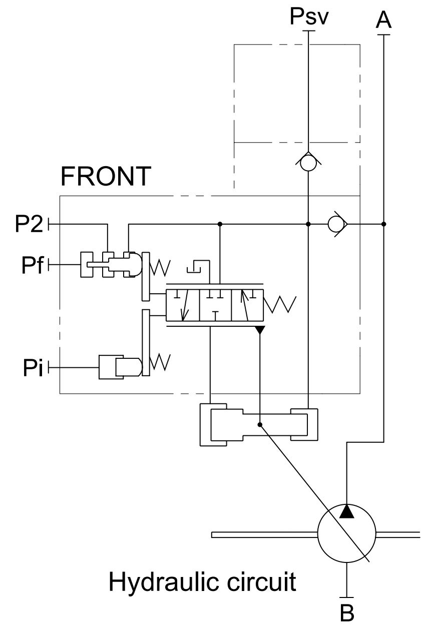
36078MP17

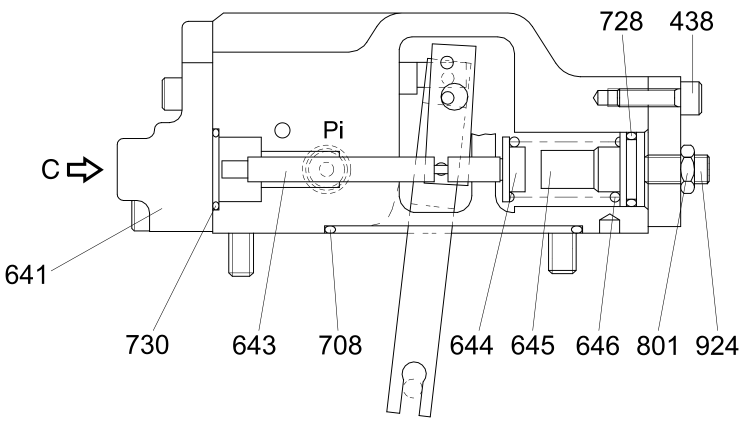
(12) Fit drain port plug (468).

This is the end of reassembling procedures.

5) REGULATOR (1/2)

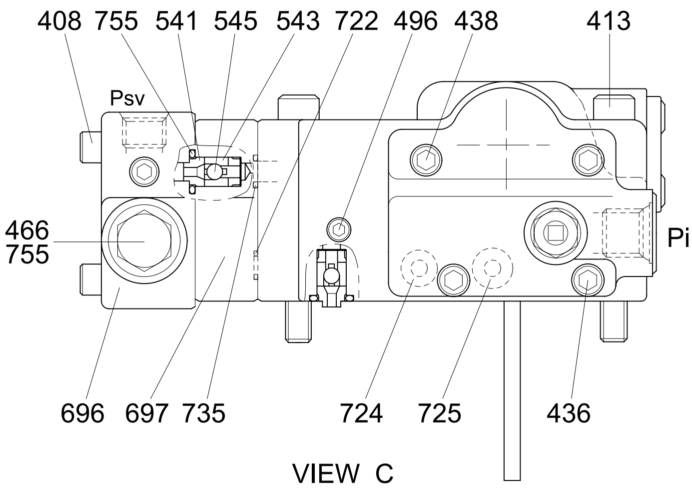






SECTION B-B

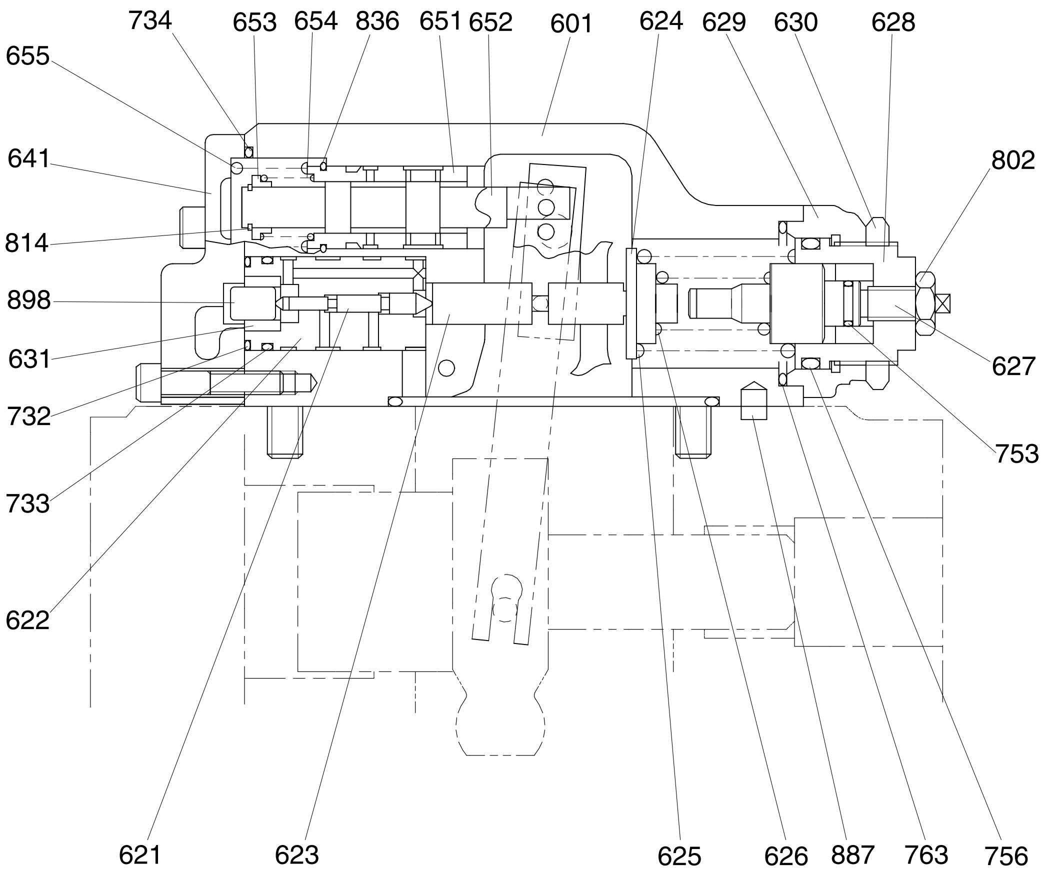
80092RG01



VIEW C

Port	Port name	Port size
Pi	Pilot port	PF 1/4 - 15
Psv	Servo assist port	PF 1/4 - 15
P2	Companion delivery pressure	-
Pf	Powershift pressure	-

REGULATOR (2/2)



SECTION A-A

8007A2RG02

408	Hexagon socket screw	627	Adjust stem(C)	725	O-ring
412	Hexagon socket screw	628	Adjust screw(C)	728	O-ring
413	Hexagon socket screw	629	Cover(C)	730	O-ring
436	Hexagon socket screw	630	Lock nut	732	O-ring
438	Hexagon socket screw	631	Sleeve, pf	733	O-ring
439	Hexagon socket screw	641	Pilot cover	734	O-ring
466	Plug	643	Pilot piston	735	O-ring
496	Plug	644	Spring seat(Q)	753	O-ring
541	Seat	645	Adjust stem(Q)	755	O-ring
543	Stopper 1	646	Pilot spring	756	O-ring
545	Steel ball	647	Stopper	763	O-ring
601	Casing	648	Piston(QMC)	801	Nut
611	Feed back lever	651	Sleeve	802	Nut
612	Lever(1)	652	Spool(A)	814	Snap ring
613	Lever(2)	653	Spring seat	836	Snap ring
614	Center plug	654	Return spring	874	Spring pin
615	Adjust plug	655	Set spring	875	Pin
621	Compensator piston	696	Port cover	876	Pin
622	Piston case	697	Check valve plate	887	Pin
623	Compensator rod	698	Cover	897	Pin
624	Spring seat(C)	708	O-ring	898	Pin
625	Outer spring	722	O-ring	924	Set screw
626	Inner spring	724	O-ring		

6) TOOLS AND TIGHTENING TORQUE

(1) Tools

The tools necessary to disassemble/reassemble the pump are shown in the follow list.

<table>
<tr><td colspan="2">Tool name & size</td><td colspan="2"></td><td colspan="2">Part name</td></tr>
<tr><td>Name</td><td>B</td><td>Hexagon socket head bolt</td><td>PT plug (PT thread)</td><td>PO plug (PF thread)</td><td>Hexagon socket head setscrew</td></tr>
<tr><td rowspan="3">Allen wrench
B</td><td>4</td><td>M 5</td><td>BP-1/16</td><td>-</td><td>M 8</td></tr>
<tr><td>5</td><td>M 6</td><td>BP-1/8</td><td>-</td><td>M10</td></tr>
<tr><td>6</td><td>M 8</td><td>BP-1/4</td><td>PO-1/4</td><td>M12, M14</td></tr>
<tr><td rowspan="2">Double ring spanner, socket wrench, double (Single) open end spanner
B</td><td>-</td><td colspan="2">Hexagon head bolt</td><td>Hexagon nut</td><td>VP plug (PF thread)</td></tr>
<tr><td>6</td><td colspan="2">M 8</td><td>M 8</td><td>-</td></tr>
<tr><td colspan="2">Adjustable angle wrench</td><td colspan="4">Small size, Max 36mm</td></tr>
<tr><td colspan="2">Screw driver</td><td colspan="4">Minus type screw driver, Medium size, 2 sets</td></tr>
<tr><td colspan="2">Hammer</td><td colspan="4">Plastic hammer, 1 set</td></tr>
<tr><td colspan="2">Pliers</td><td colspan="4">For snap ring, TSR-160</td></tr>
<tr><td colspan="2">Steel bar</td><td colspan="4">4×100 mm</td></tr>
<tr><td colspan="2">Torque wrench</td><td colspan="4">Capable of tightening with the specified torques</td></tr>
<tr><td colspan="2">Pincers</td><td colspan="4">-</td></tr>
<tr><td colspan="2">Bolt</td><td colspan="4">M4, Length : 50 mm</td></tr>
</table>

(2) Tightening torque

Part name	Bolt size	Torque		Wrench size	
		kgf · m	lbf · ft	in	mm
Hexagon socket head bolt (Material : SCM435)	M 5	0.7	5.1	0.16	4
	M 6	1.2	8.7	0.20	5
	M 8	3.0	21.7	0.24	6
	M10	5.8	42.0	0.31	8
	M12	10.0	72.3	0.39	10
	M14	16.0	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.

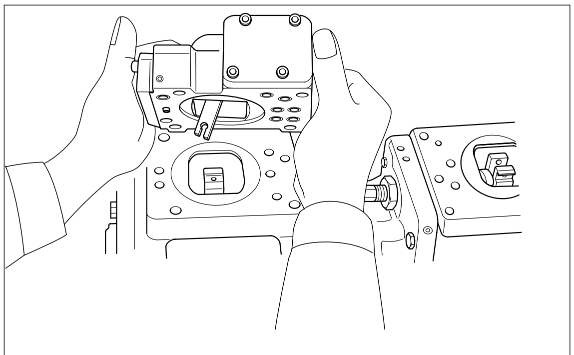
※ Choose a clean place.

※ 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.



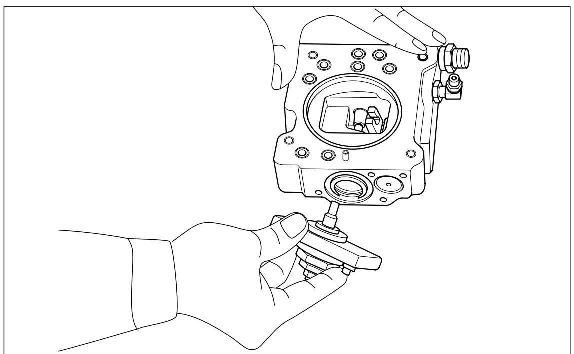
REG01 (210-7)

(4) Remove hexagon socket head screw (438) and remove cover (C,629)

※ Cover (C) is fitted with adjusting screw (C,QI) (628, 925), adjusting ring (C, 627), lock nut (630), hexagon nut (801) and adjusting screw (924).

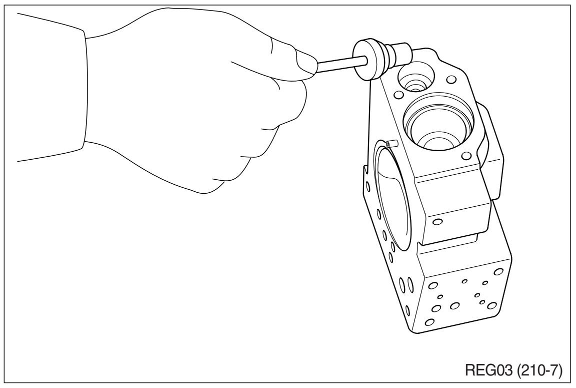
Do not loosen these screws and nuts.

If they are loosened, adjusted pressure-flow setting will vary.



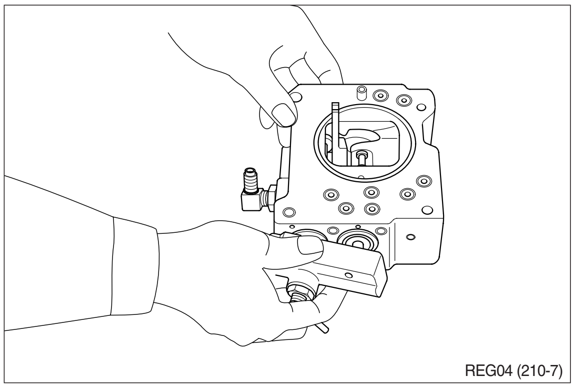
REG02 (210-7)

(5) After removing cover(C, 629) subassembly, take out outer spring (625), inner spring (626) and spring seat (C, 624) from compensating section.
Then draw out adjusting ring (Q, 645), pilot spring (646) and spring seat (644) from pilot section.
※ Adjusting ring (Q,645) can easily be drawn out with M4 bolt.



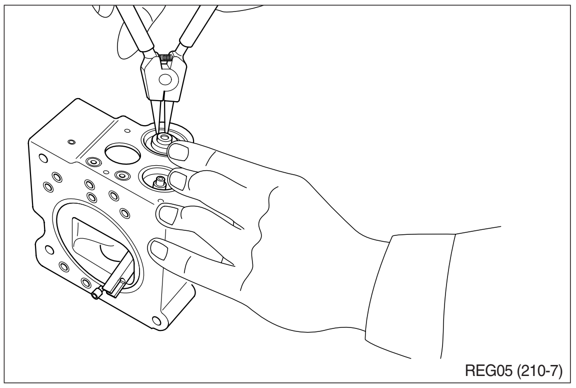
REG03 (210-7)

(6) Remove hexagon socket head screws (436, 438) and remove pilot cover (641).
After removing pilot cover, take out set spring (655) from pilot section.



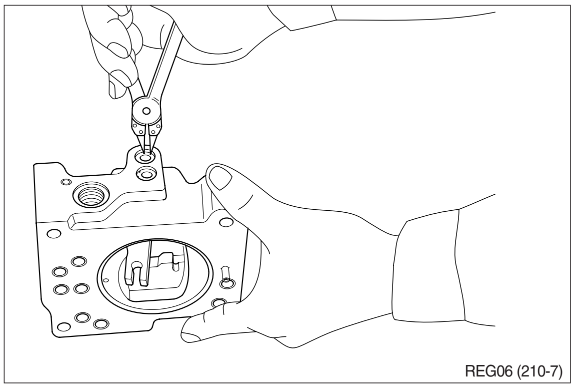
REG04 (210-7)

(7) Remove snap ring (814) and take out spring seat (653), return spring (654) and sleeve (651).
※ Sleeve (651) is fitted with snap ring (836).
※ When removing snap ring (814), return spring (654) may pop out.
Take care not to lose it.

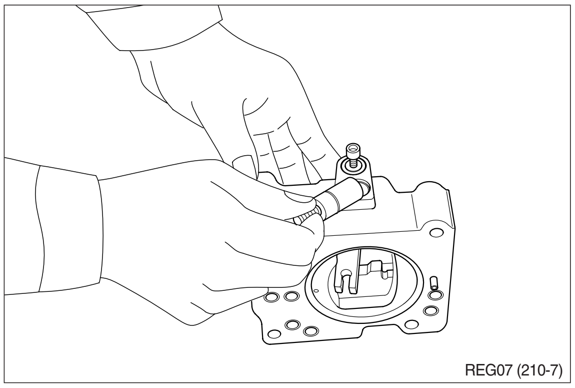


REG05 (210-7)

(8) Remove locking ring (858) and take out fulcrum plug (614) and adjusting plug (615).
※ Fulcrum plug (614) and adjusting plug (615) can easily be taken out with M6 bolt.



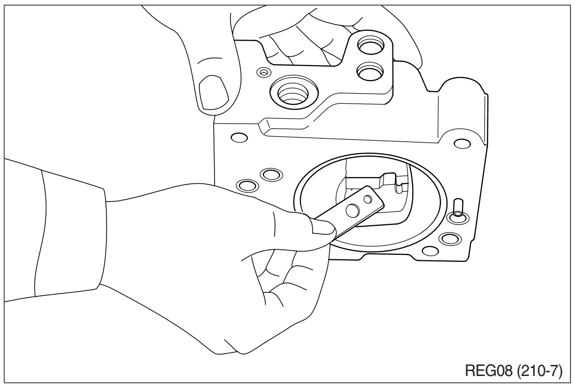
REG06 (210-7)



REG07 (210-7)

(9) Remove lever (2, 613). Do not draw out pin (875).

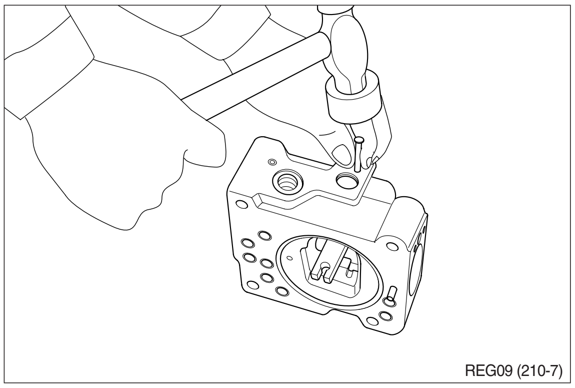
※ Work will be promoted by using pincers or so on.



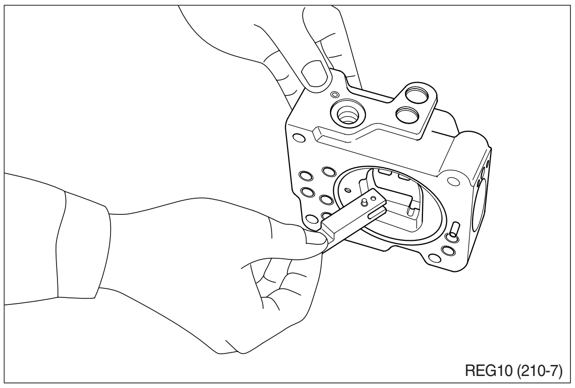
REG08 (210-7)

(10) Draw out pin (874) and remove feedback lever (611).

Push out pin (874, 4 mm in dia.) from above with slender steel bar so that it may not interfere with lever (1, 612).



REG09 (210-7)



REG10 (210-7)

(11) Remove lever(1, 612). Do not draw out pin (875).

(12) Draw out pilot piston(643) and spool(652).

(13) Draw out piston case(622), compensating piston(621) and compensating rod(623).

※ Piston case(622) can be taken out by pushing compensating rod(623) at opposite side of piston case.

This completes disassembly.

4) ASSEMBLY

(1) For assembly, reverse disassembly procedures, but pay attention to the following items.

① Always repair parts that were scored at disassembly.

② Get replacement parts ready beforehand.
Mixing of foreign matter will cause malfunction.
Therefore, wash parts well with cleaning oil, let them dry with jet air and handle them in clean place.

③ Always tighten bolts, plugs, etc. to their specified torques.

④ Do not fail to coat sliding surfaces with clean hydraulic oil before assembly.

⑤ Replace seals such as O-ring with new ones as a rule.

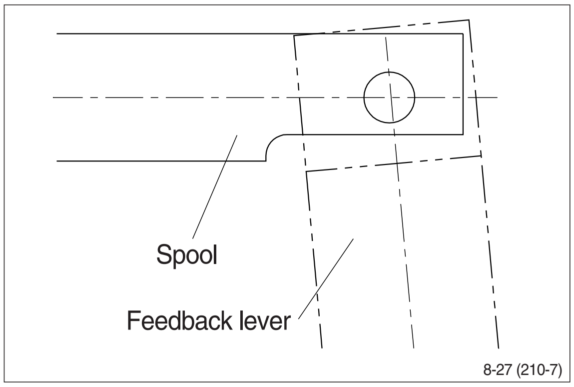
(2) Put compensating rod (623) into compensating hole of casing (601).

(3) Put pin force-fitted in lever (1, 612) into groove of compensating rod and fit lever (1) to pin force-fitted in casing.

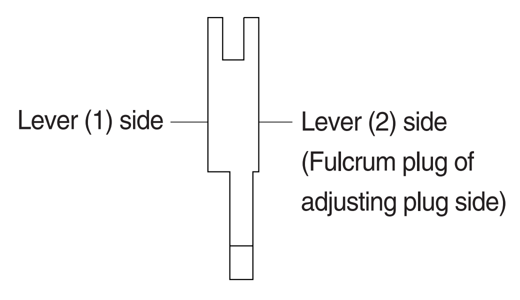
(4) Fit spool (652) and sleeve (651) into hole in spool of casing.

※ Confirm that spool and sleeve slide smoothly in casing without binding.

※ Pay attention to orientation of spool.



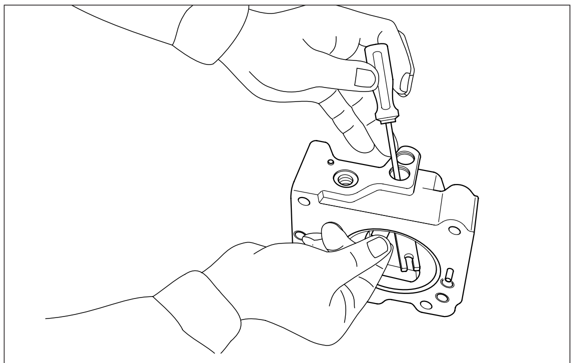
(5) Fit feedback lever (611), matching its pin hole with pin hole in spool.
Then insert pin (874).
※ Insert pin in feedback lever a little to ease operation.
※ Take care not to mistake direction of feedback lever.



8-28 (210-7)

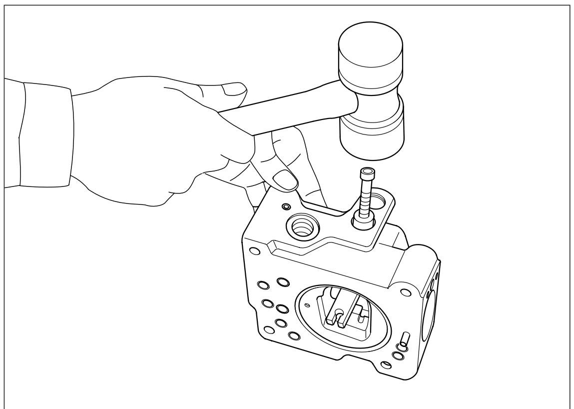
(6) Put pilot piston (643) into pilot hole of casing.
※ Confirm that pilot piston slides smoothly without binding.

(7) Put pin force-fitted in lever (2, 613) into groove of pilot piston.
Then fix lever (2).

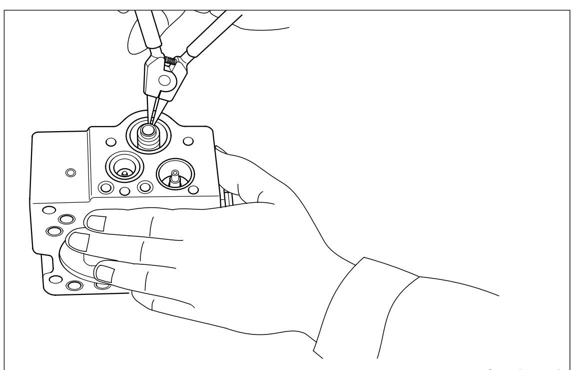

REG11 (210-7)

(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).

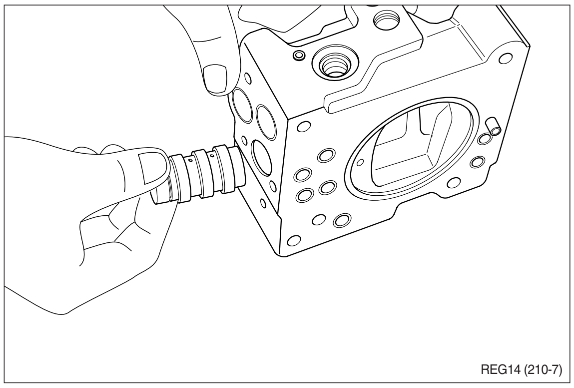
(9) Insert adjusting plug (615) and fit locking ring.
※ Take care not to mistake inserting holes for fulcrum plug and adjusting plug.
At this point in time move feedback lever to confirm that it has no large play and is free from binding.


REG12 (210-7)

(10) Fit return spring (654) and spring seat (653) into spool hole and attach snap ring (814).


REG13 (210-7)

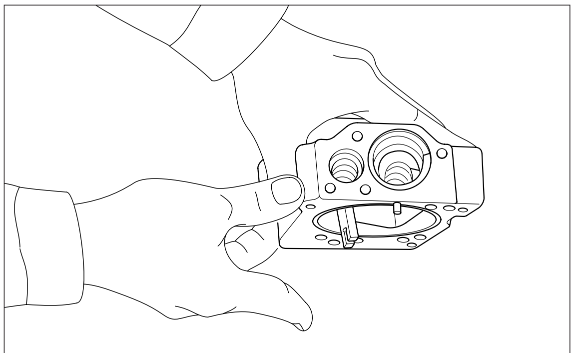
(11) Fit set spring (655) to spool hole and put compensating piston (621) and piston case (622) into compensating hole.
Fit pilot cover (641) and tighten it with hexagonal socket head screws (436, 438).



REG14 (210-7)

(12) Put spring seat (644), pilot spring (646) and adjusting ring (Q, 645) into pilot hole.
Then fix spring seat (624), inner spring (626) and outer spring (625) into compensating hole.

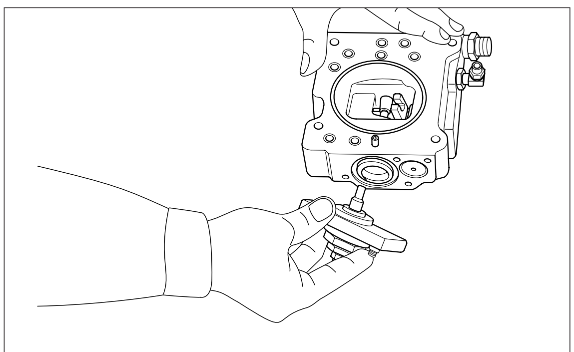
※ When fitting spring seat, take care not to mistake direction of spring seat.



REG15 (210-7)

(13) Install cover (C, 629) fitted with adjusting screws (628, 925), adjusting ring (C, 627), lock nut (630), hexagon nut (801) and adjusting screw (924).
Then tighten them with hexagonal socket head screws (438).

This completes assembly.



REG16 (210-7)

GROUP 4 MAIN CONTROL VALVE

1. REMOVAL AND INSTALL

1) REMOVAL

(1) Lower the work equipment to the ground and stop the engine.

(2) Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

(3) Loosen the breather slowly to release the pressure inside the hydraulic tank.

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

※ When pipes and hoses are disconnected, the oil inside the piping will flow out, so catch it in oil pan.

(4) Remove bolts and disconnect pipe.

Remove bolts and disconnect pipe.

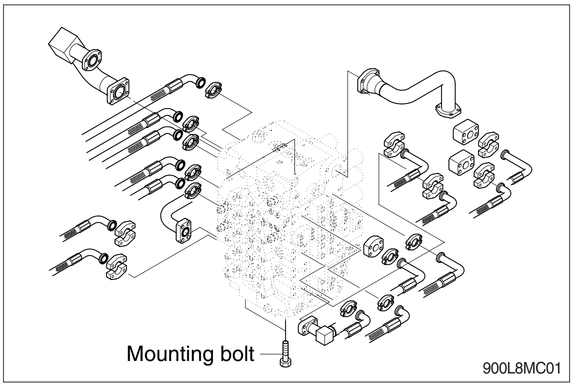
(5) Disconnect pilot line hoses.

(6) Disconnect pilot piping.

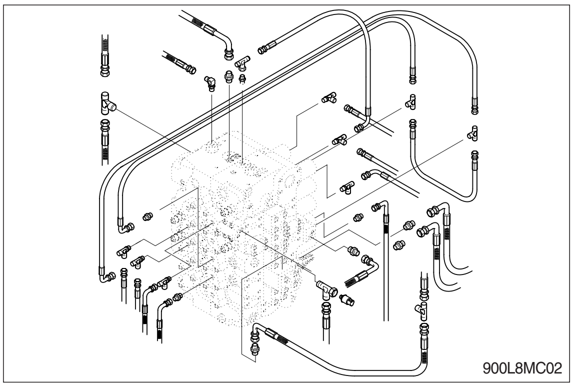
(7) Sling the control valve assembly and

(8) remove the control valve mounting bolt.

- Weight : 424 kg (935 lb)
- Tightening torque : 69.5±10.5 kgf · m (503±76 lbf · ft)



(9) Remove the control valve assembly. When removing the control valve assembly, check that all the piping have been disconnected.

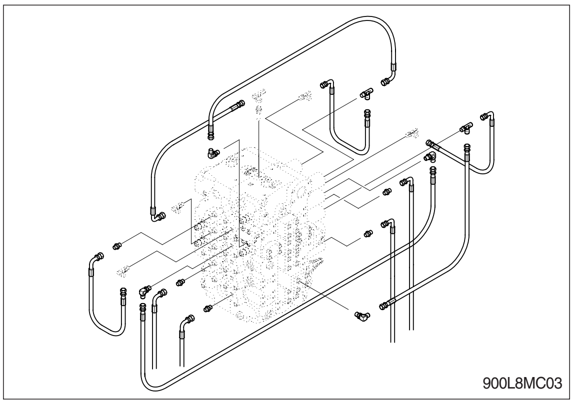


2) INSTALL

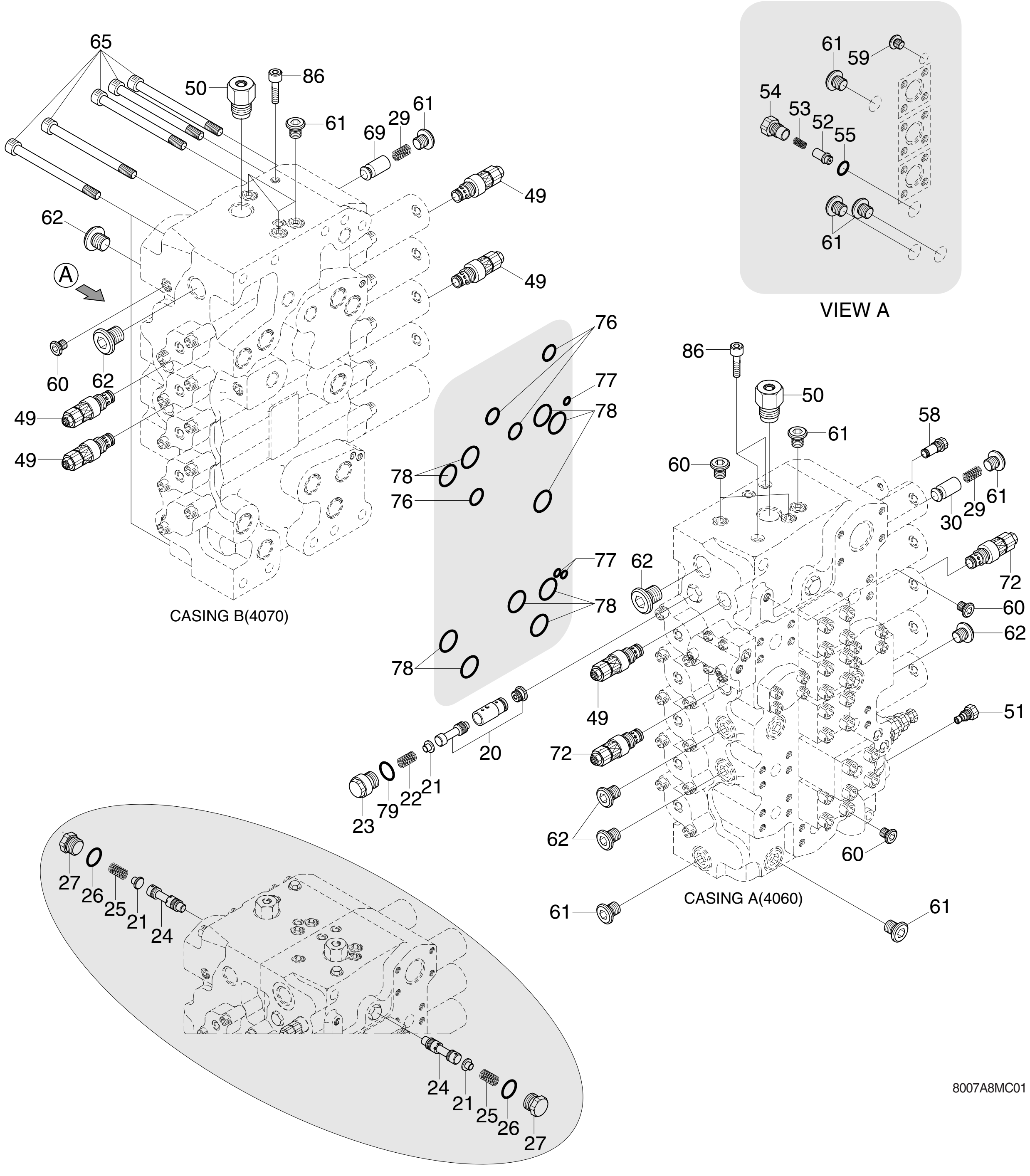
(1) Carry out installation in the reverse order to removal.

(2) Bleed the air from below items.
① Cylinder (boom, arm, bucket)
② Swing motor
③ Travel motor
※ See each item removal and install.

(3) Confirm the hydraulic oil level and recheck the hydraulic oil leak or not.

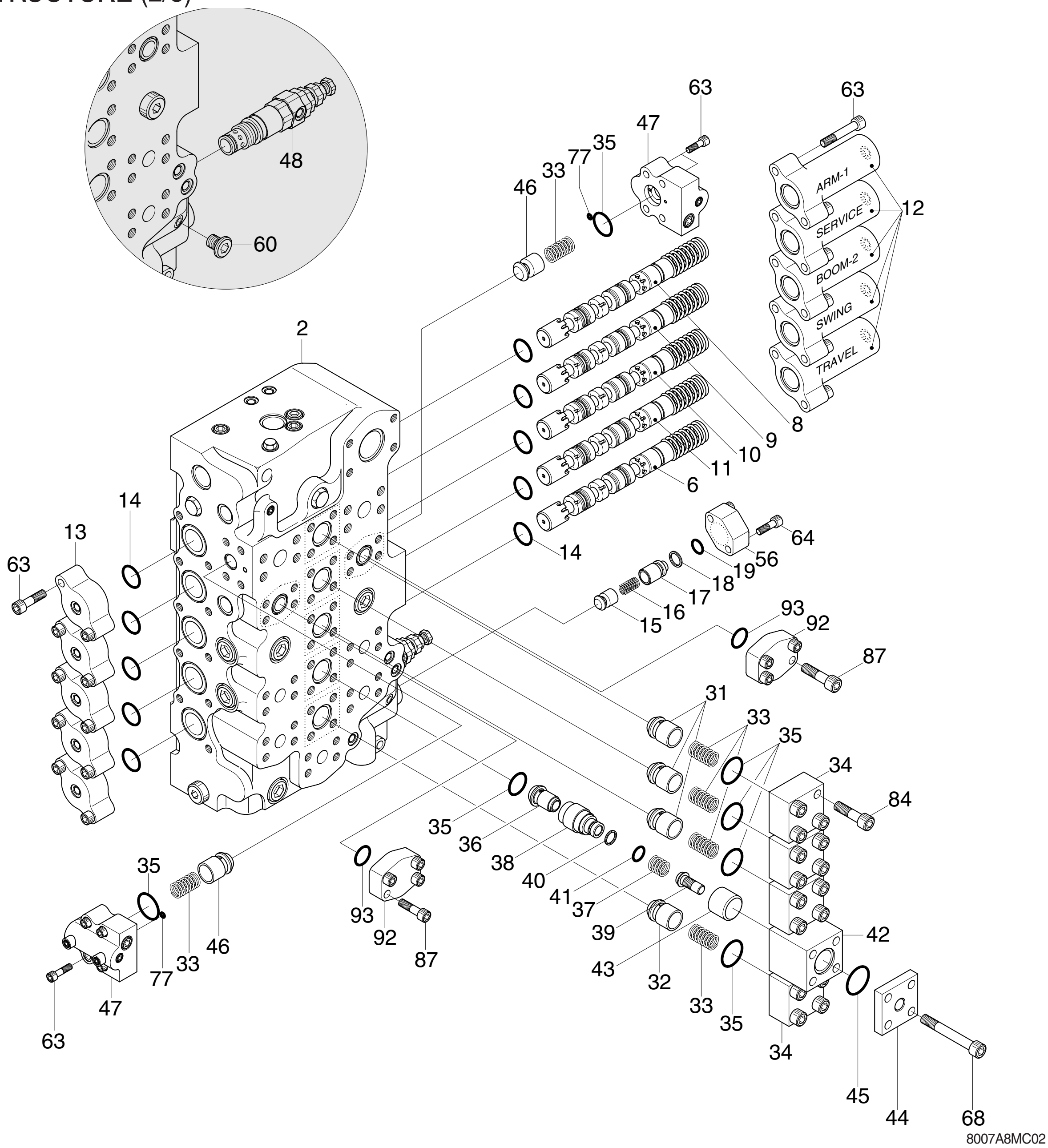


2. STRUCTURE (1/3)



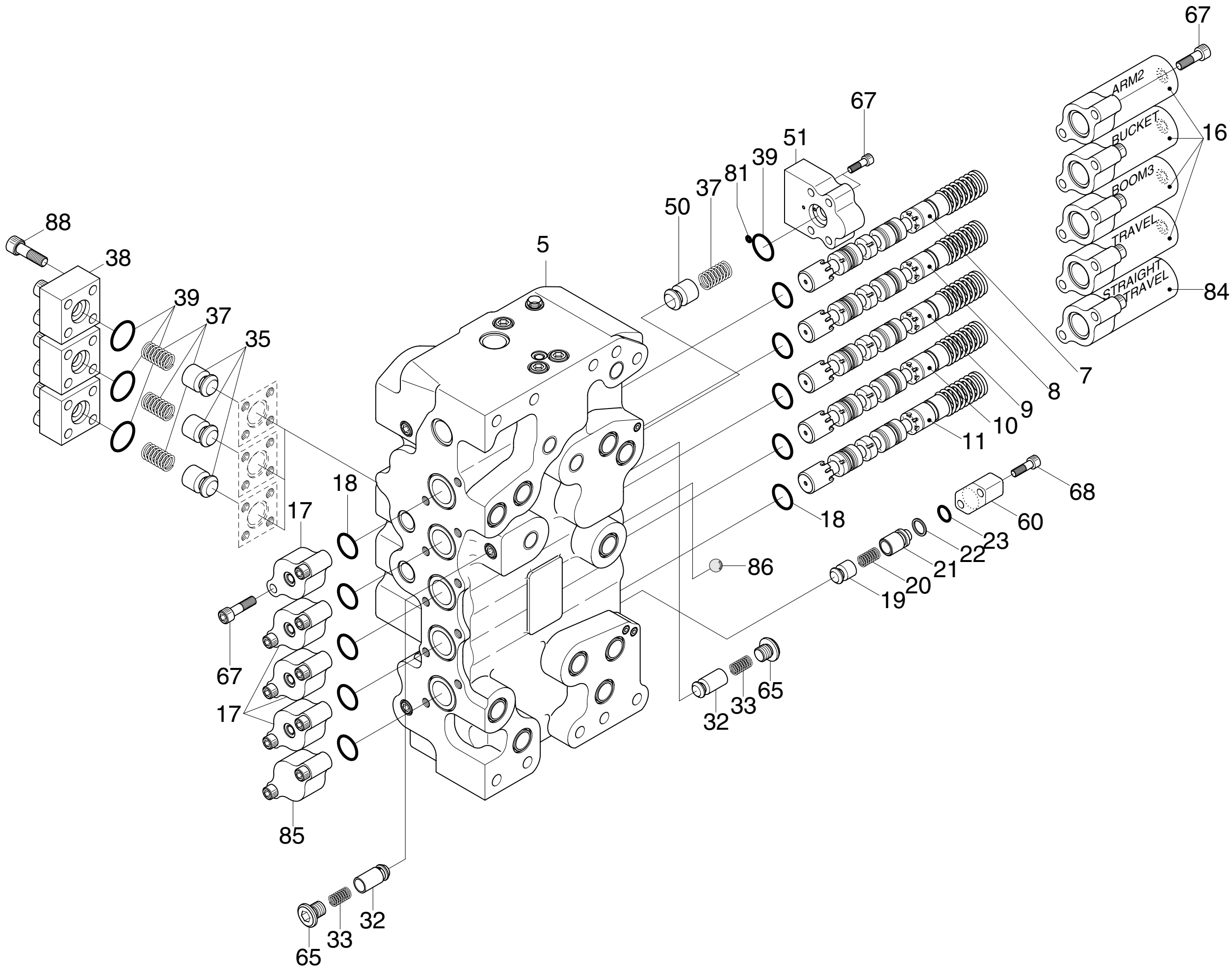
20	Spool assy	49	Relief valve kit	61	Plug assy
21	Spring seat	50	Relief valve assy	62	Plug assy
22	Spring	51	Plug assy	65	Bolt
23	Plug	52	Poppet	69	Poppet
24	O-ring	53	Spring	72	Relief valve kit
25	Spool assy	54	Plug	76	O-ring
26	O-ring	55	O-ring	77	O-ring
27	Plug	58	Plug assy	78	O-ring
29	Spring	59	Plug assy	79	O-ring
30	Poppet	60	Plug assy	86	Socket head bolt

STRUCTURE (2/3)



2	Housing	31	Flange	45	O-ring
6	Spool assy	32	Flange	46	Poppet
8	Spool assy	33	Poppet	47	Body assy
9	Spool assy	34	Poppet	48	Relief valve assy
10	Spool assy	35	Poppet	56	Flange
11	Spool assy	36	Poppet	63	Bolt
12	Cap	37	Spacer	64	Bolt
13	Cap	38	Spring	68	Bolt
14	O-ring	39	Spring	77	O-ring
15	Poppet	40	O-ring	84	Bolt
16	Spring	41	O-ring	87	Bolt
17	Spacer	42	O-ring	92	Flange
18	O-ring	43	O-ring	93	O-ring
19	Back up ring	44	O-ring		

STRUCTURE (3/3)

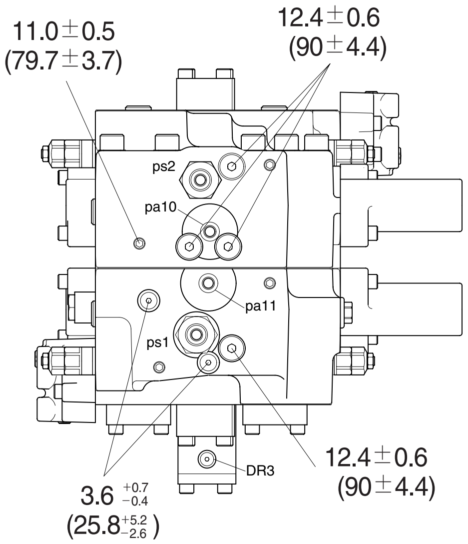


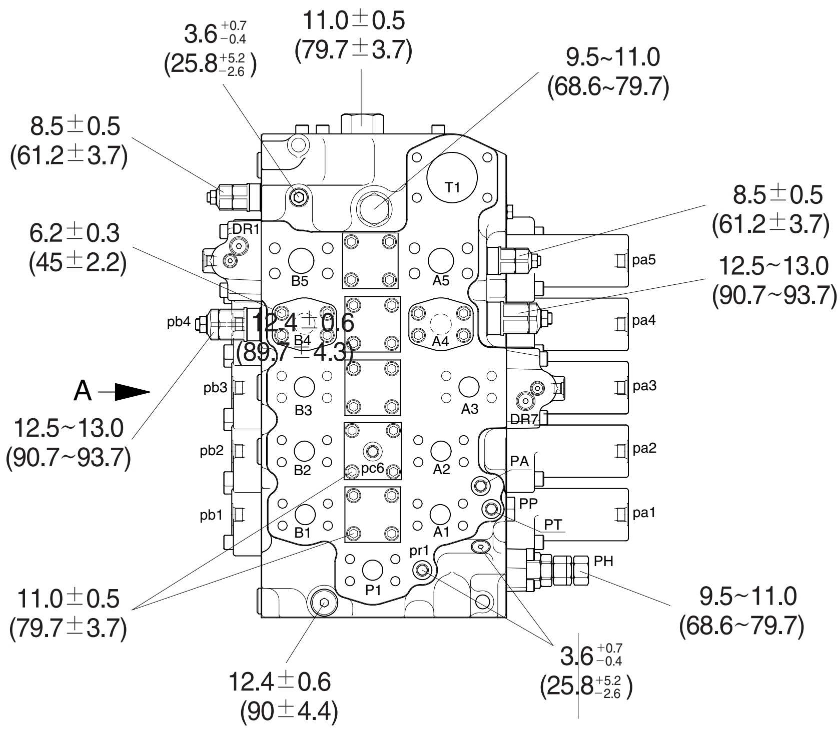
8007A8MC03

1	Housing	17	Spacer	47	Body assy
3	Spool assy	18	O-ring	56	Flange
4	Spool assy	19	Back up ring	61	Plug assy
5	Spool assy	28	Poppet	63	Bolt
6	Spool assy	29	Spring	64	Bolt
7	Spool assy	31	Poppet	77	O-ring
12	Cap	33	Spring	80	Cap
13	Cap	34	Flange	81	Cap
14	O-ring	35	O-ring	82	Steel ball
15	Poppet	46	Poppet	84	Bolt
16	Spring				

3. TIGHTENING TORQUE (1/2)

※ Unit : kgf · m (lbf · ft)

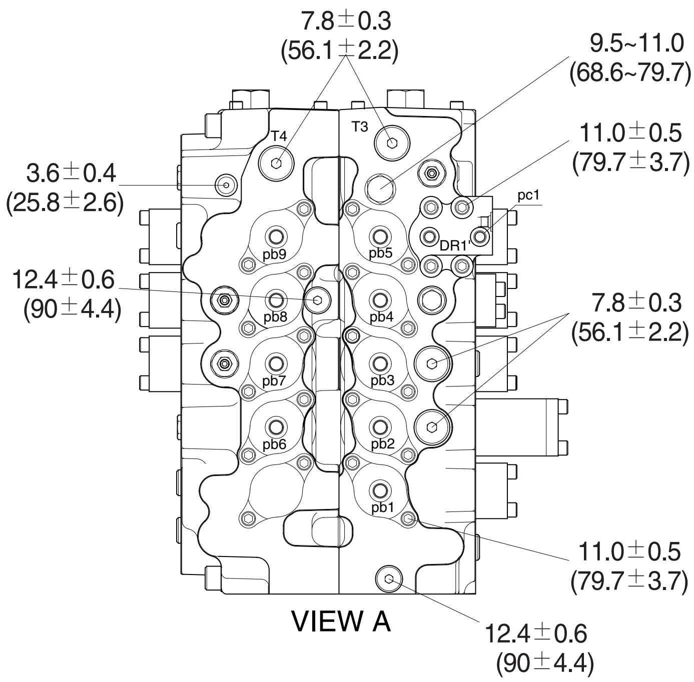


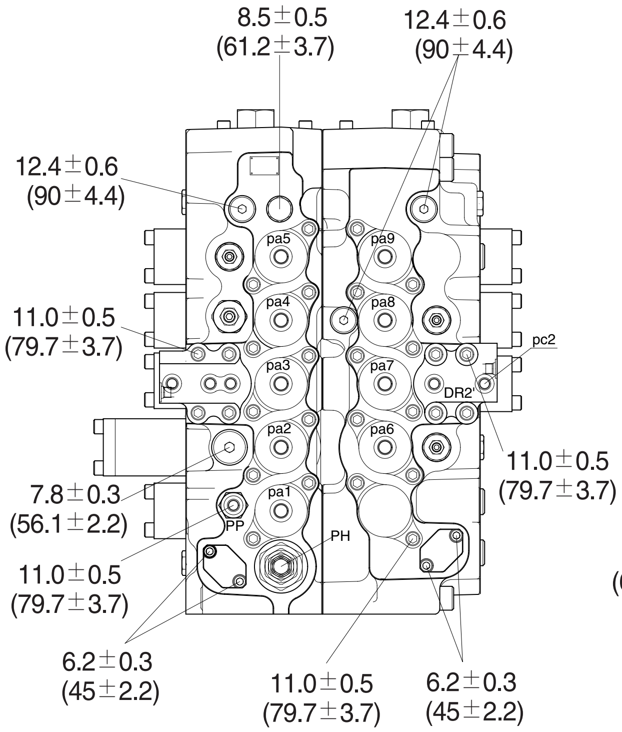


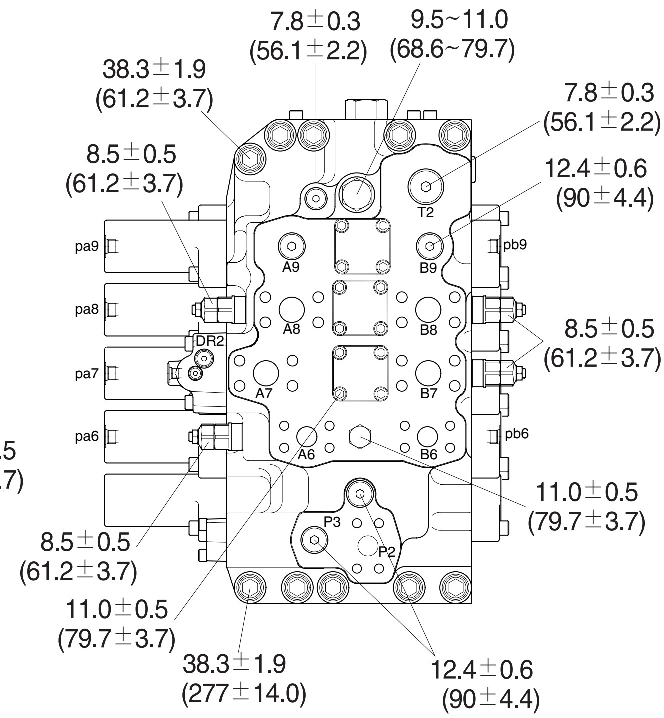
480L8MV07

TIGHTENING TORQUE (2/2)

※ Unit : kgf · m (lbf · ft)







8007A8MC05

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

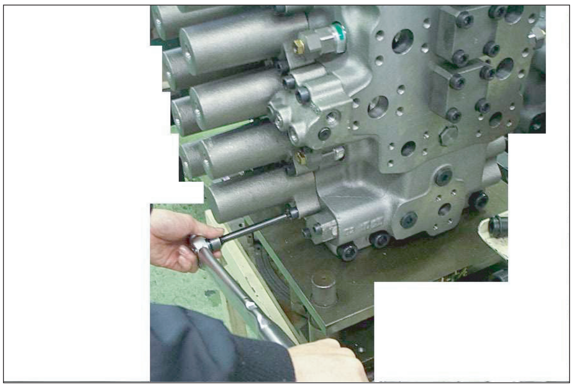
The figure in ( ) shown after the part name in explanation sentence shows its number in the construction figures.

(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

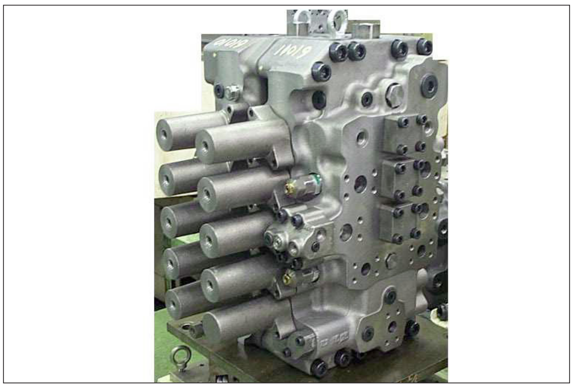
① Loosen socket head bolts (63) and remove the pilot cap (12, 80).
Pull out O-ring (14) from valve housing.



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)

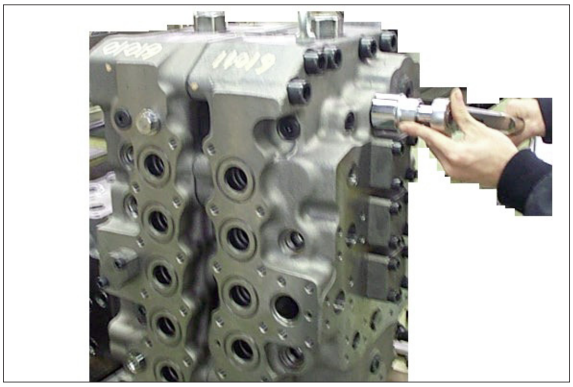
45078MC12

⑥ Loosen the socket head bolt (63) and remove the small pilot cap (13, 81). Pull out O-ring (14) from valve housing.

45078MC09

(3) Center bypass cut spool assy (24)

① Loosen the plug (27) and remove spring (25), spring seat (21) and the spool (24).

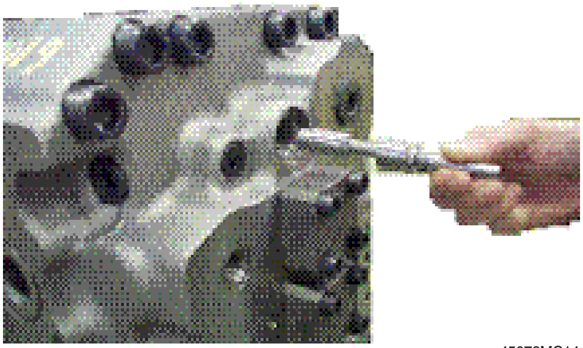


45078MC13

② Pull out O-ring(20).

※ When disassemble the spool assembly, fix the spool with vise. On this occasion attach wood between vise blades to prevent the spool from damaging.

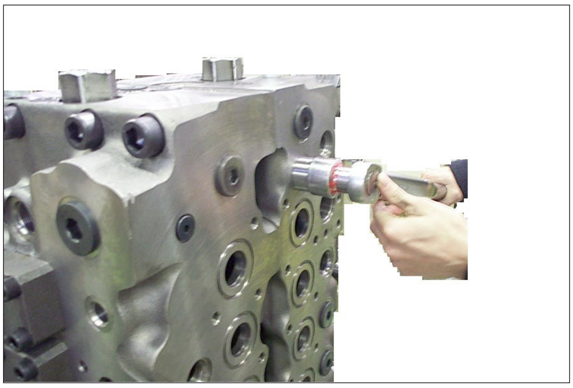
※ Heat the outer race of spool with industrial drier and then loosen easily. (Temperature : 200~250˚C)



45078MC14

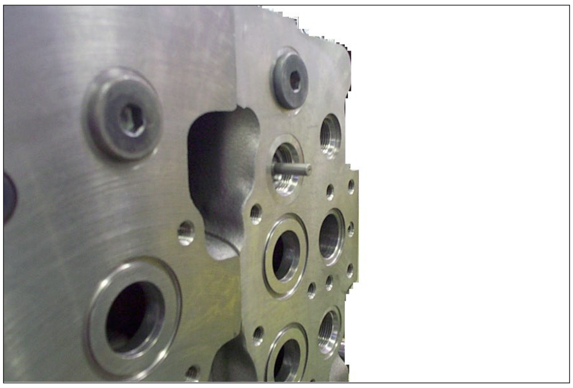
(4) Arm1 regeneration spool assy (20)

① Loosen the plug(23) and pull out Oring(79).



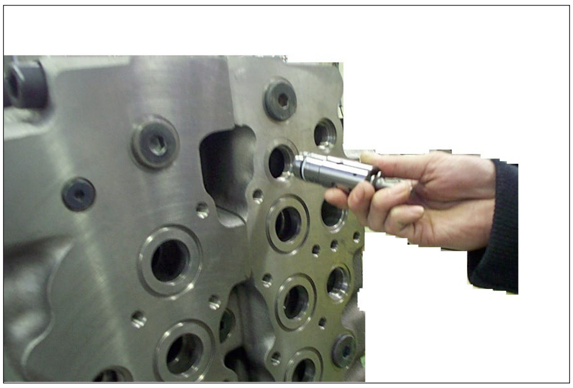
45078MC15

② Disassemble spring(22), spring seat(21) and spool(20).



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 understandi ng, 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 (24)

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) Loosen the breather slowly to release the pressure inside the hydraulic tank.

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

※ When pipes and hoses are disconnected, the oil inside the piping will flow out, so catch it in oil pan.


13031GE18

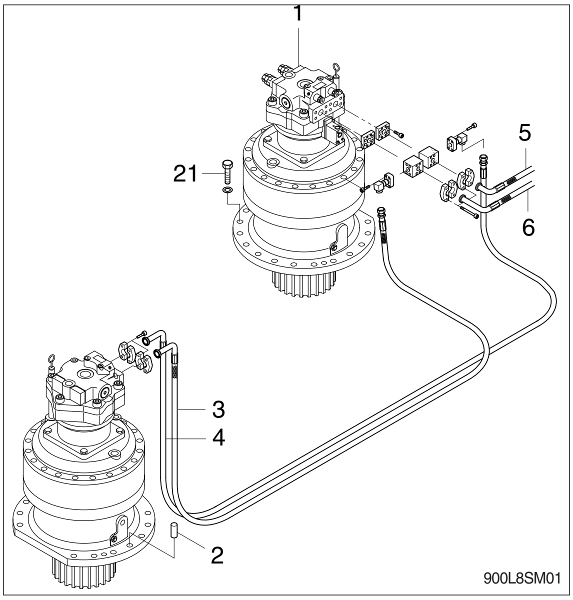
(3) Disconnect pilot line hoses (3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19).

(4) Sling the swing motor assembly (1)and remove the swing motor mounting bolts (21) and dowel pin (2).

- · Motor device weight : 90 ㎏ (200 ℔)
- · Tightening torque : 120±18 kgf · m (868±130 lbf · ft)

(5) Remove the swing motor assembly.

※ When removing the swing motor assembly, check that all the piping have been disconnected.



900L8SM01

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.

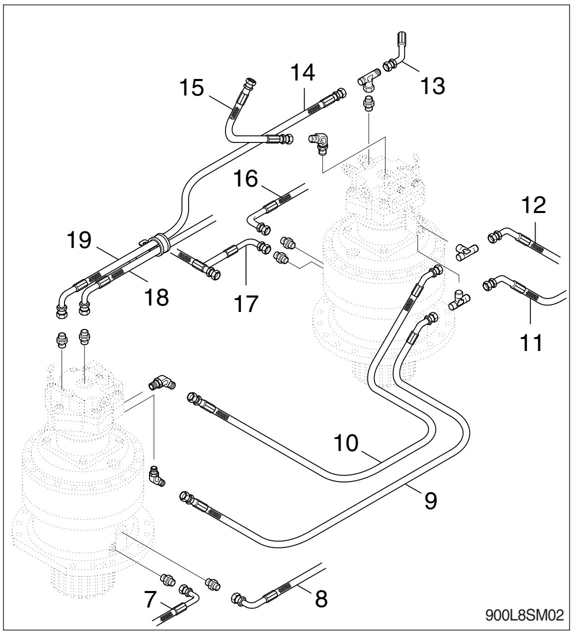
② Pour in hydraulic oil until it over flows from the port.

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.



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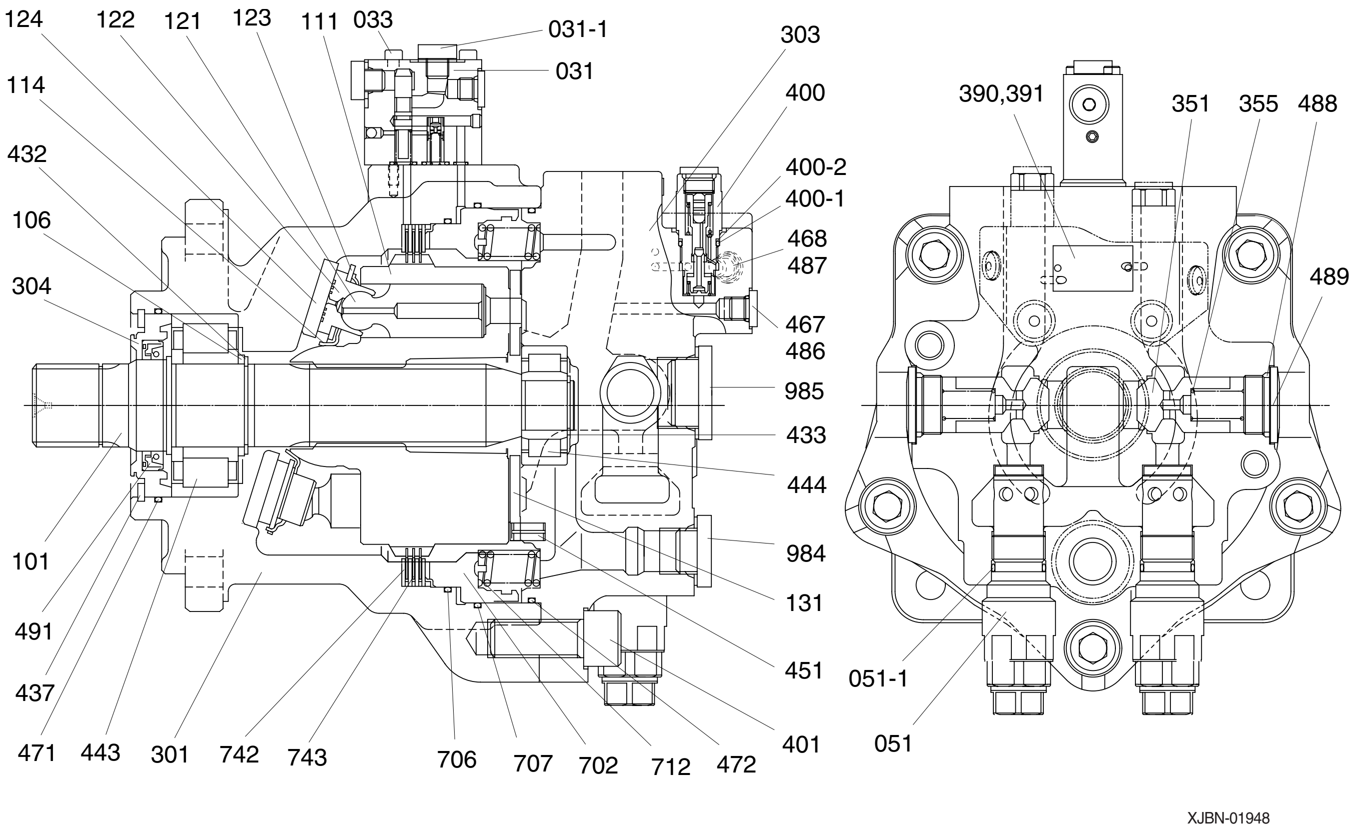
2. SWING MOTOR

1) STRUCTURE



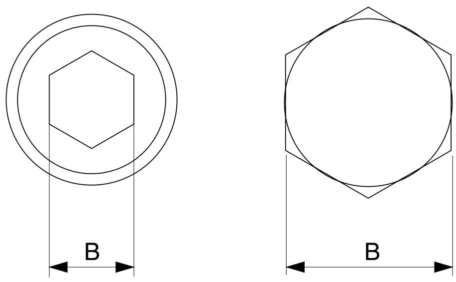
031	Time delay valve	304	Front cover	469	Plug bolt
0311	Masking plug	351	Plunger	471	O-ring
033	Hex screw	355	Spring	472	O-ring
051	Relief valve	390	Name plate	486	O-ring
0511	O-ring	391	Pin	487	O-ring
101	Drive shaft	400	Swing valve	488	O-ring
106	Spacer	4001	O-ring	491	Oil seal
111	Cylinder	4002	Back up ring	702	Brake piston
114	Shoe plate	401	Hex screw	706	O-ring
121	Piston	432	Snap ring	707	O-ring
122	Shoe	433	W clip	712	Brake spring
123	Set plate	437	Snap ring	742	Friction plate
124	Shoe plate	443	Roller bearing	743	Separator plate
131	Valve plate	444	Roller bearing	984	Making plug
301	Casing B	467	Plug	985	Masking plug
303	Valve casing	468	Plug		

2) TOOLS AND TIGHTENING TORQUE

(1) Necessary tools

The tool necessary for disassembling and reassembling and their dimensions are shown below.

Name of tools		Dimension B (mm)	Name of parts applied and remarks
Hexagon bar wrenches (JIS B 4686)		17	ROMH plug (469)
			Hexagon socket head cap screw (401)
Spanner, socket wrenches		19	Plug (468)
		24	Anti-reaction valve (400)
		41	Relief valve (051)
Hammers	Plastic hammer		Wooden hammer allowed.
	Iron hammer		Norminal 1 or so.
Steel rod approx. 10 x 8 x 200 mm			Bearing (443 & 444), Pin (451)
Torque wrench			5 to 10 N-m
			10 to 45 N-m
			40 to 275 N-m
			75 to 550 N-m
			100 to 1000 N-m
Screw driver			2 pieces
Bearing pliers			Bearings (443 & 444)
Plier			Snaping (437)
Brake piston removal tool			Brake piston (702)



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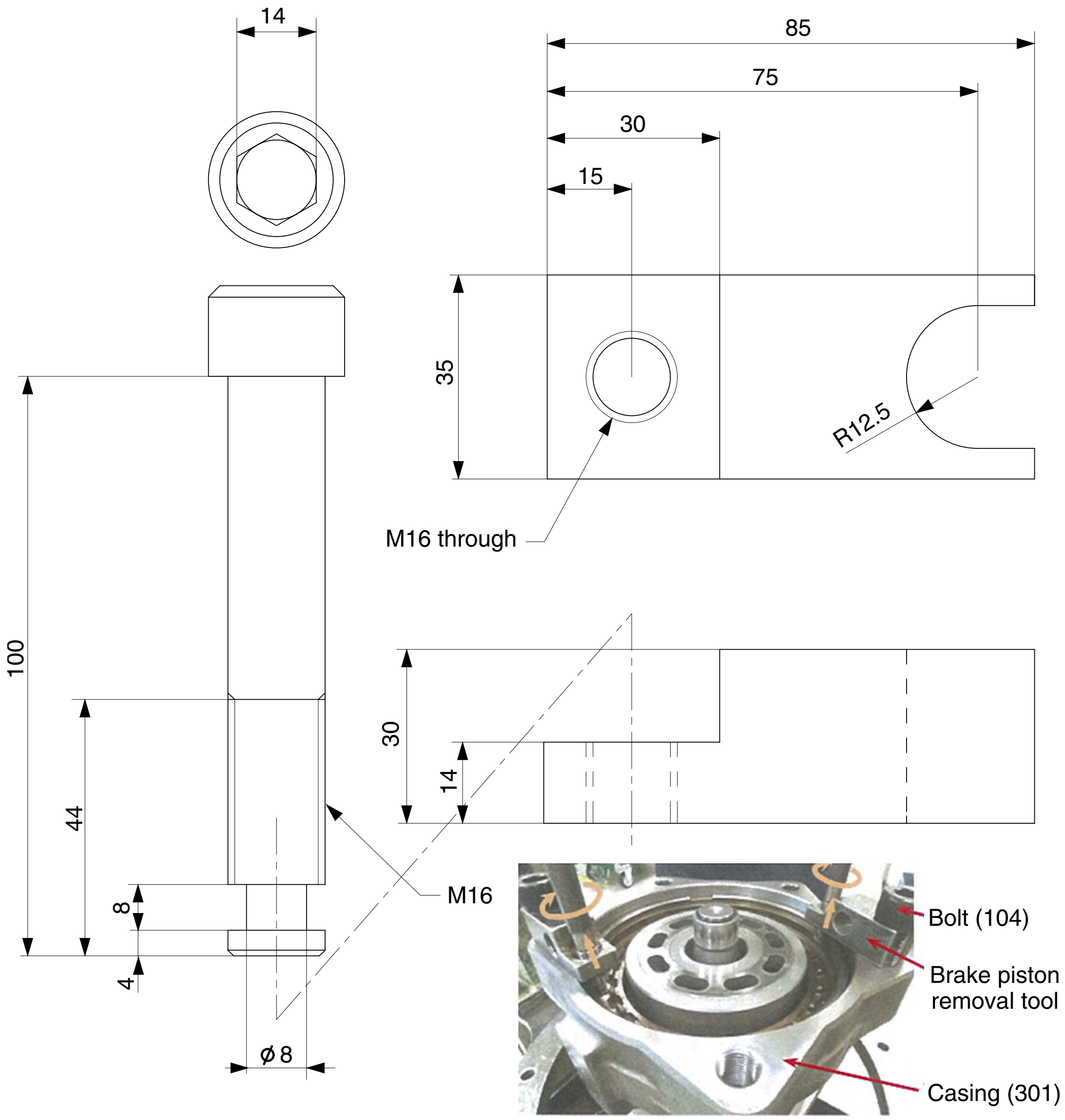
(2) Thread size used and tighting touque

Part name	Item No.	Sizes	Dimensions B (mm)	Torque	
				kgf · m	lbf · ft
Hexagon socket head cap screw	401	M22 (ISO724)	17	64.2	465
ROMH plug	469	M36 (ISO724)	17	55.0	398
Plug	468	9/16-18UNF-2B (SAE)	19	4.9	35.4
Anti-reaction valve	400	M22 (ISO724)	24	7.0	50.9
Relief valve	051	M33 (ISO724)	41	18.0	131

(3) Brake piston removal tool



900L8SM06

3) DISASSEMBLING

Disassemble the motor, following the procedures described below.

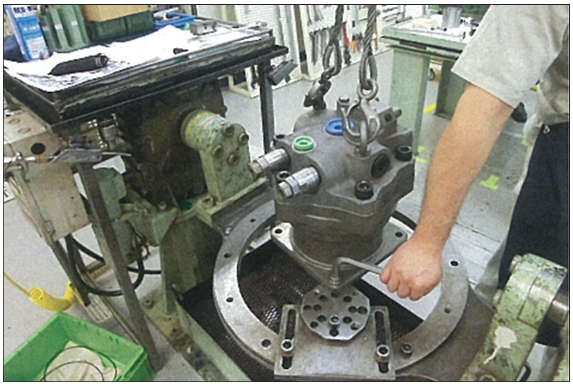
(1) Ensure that the motor is clean and free from dirt and debris to any disassembly.

※ All parts are to be plugged to prevent ingress of dirt during external cleaning.

(2) Remove the oil from drain port.

(3) Be sure to fix motor to the working bench and put identification marks on each parts to show its location in the motor.

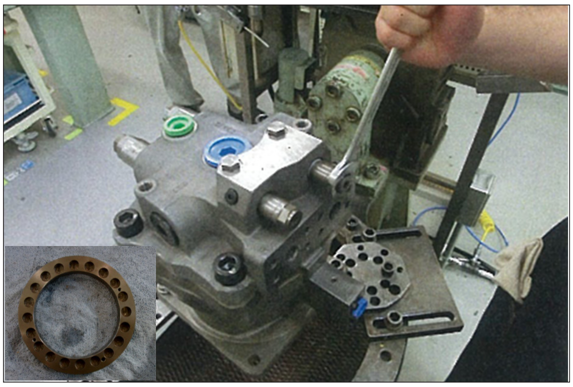
※ Prevent damage to disassembled parts, by keeping them protected and in a clean area.



900L8SM10

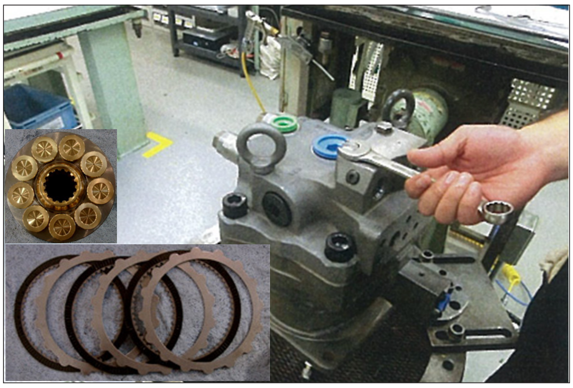
(4) Remove anti-reaction valve (400) from the valve casing (303).

※ Be careful not to lose the parts of anti-reaction valves since some parts of this valves can be easily pull out of its body.



900L8SM11

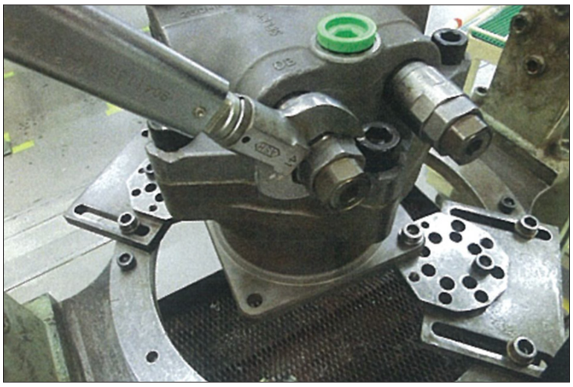
(5) Remove plug (468) from the valve casing (303).



900L8SM12

(6) Remove relief valves (051) from the valve casing (303).

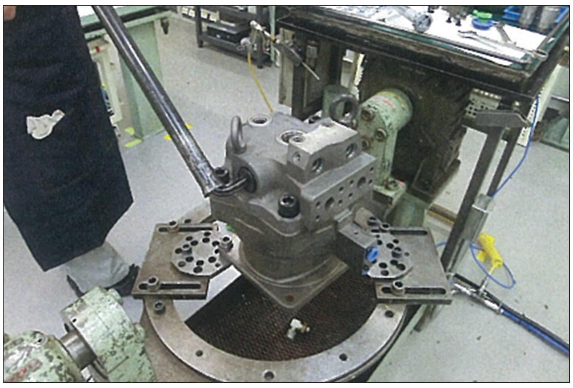
※ Be sure to replace O-rings of relief valves because they are frequently damaged during disassembly.



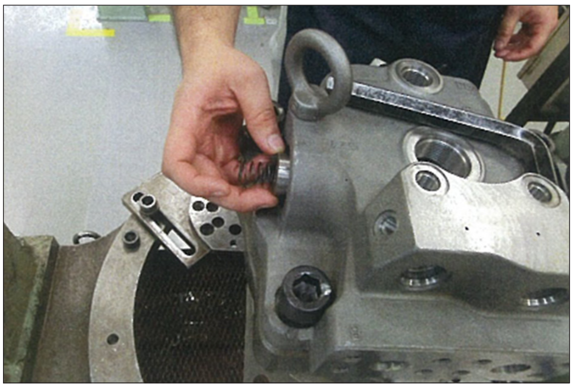
900L8SM13

(7) Remove ROMH plugs (469), spring (355) and plungers (351) from the valve casing (303).

※ Handle carefully to prevent damage to the seat on the plunger (351).



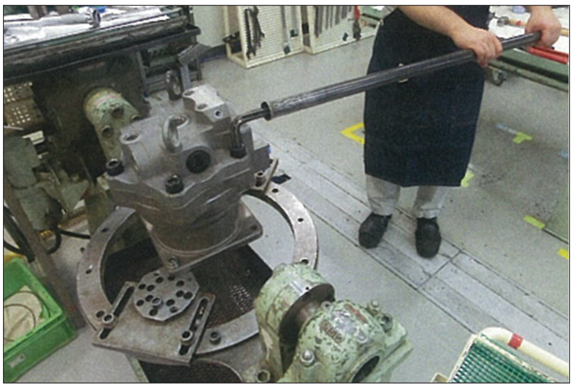
900L8SM14



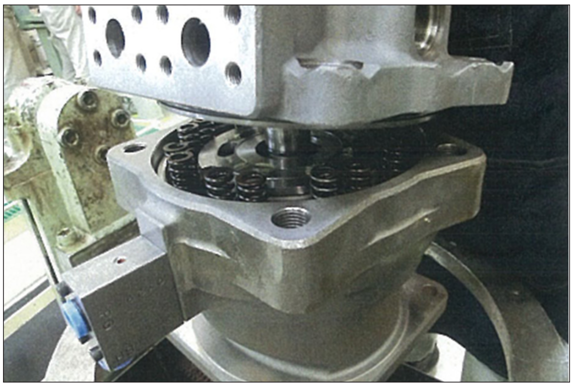
900L8SM15

(8) Remove socket head bolts (401) and remove valve casing (303) from casing (301) then remove valve plate (131).

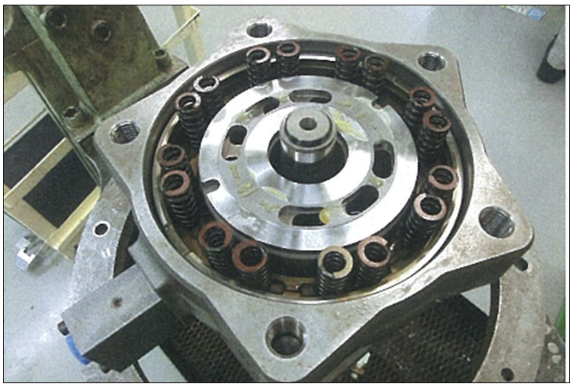
※ Valve plate (131) may often remain on cylinder (111).



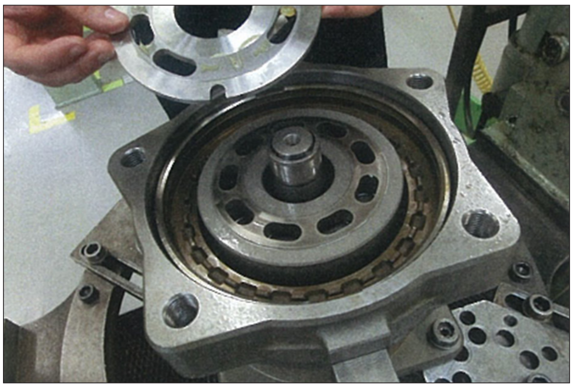
900L8SM16



900L8SM17

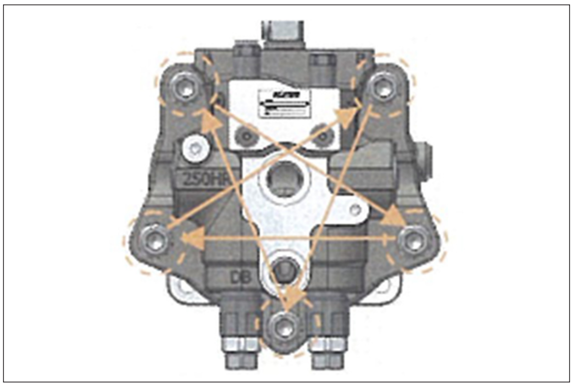


900L8SM18



900L8SM19

※ Be sure to loose the bolt (401) according to the following order so as not to damage the bearing (444).

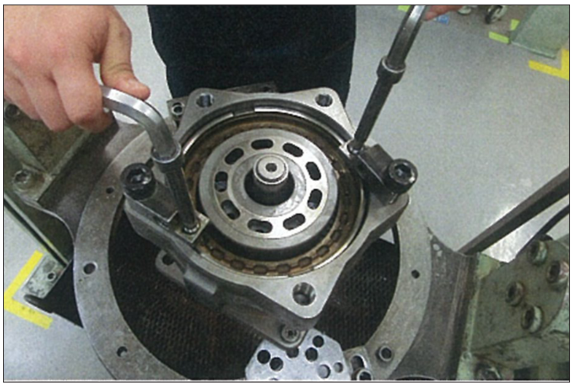


900L8SM20

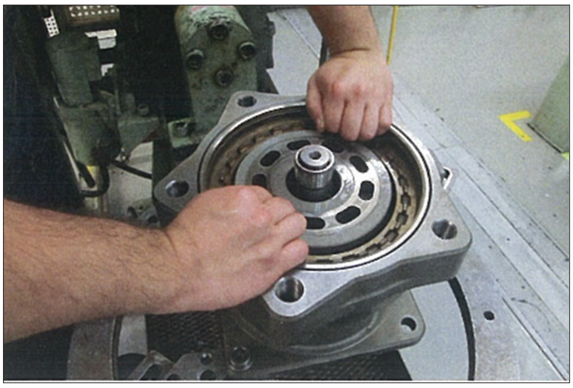
(9) Remove springs (712) from the brake piston (702).

(10) Remove brake piston (702) from casing (301) by using special tooling.

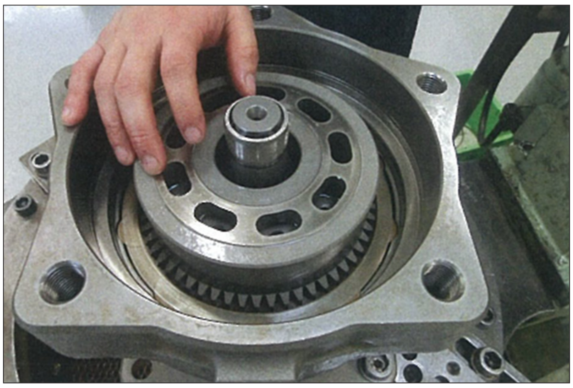
※ Pull brake piston vertically by using the special tooling.



900L8SM21



900L8SM22



900L8SM23

(11) Put the motor on its side as shown in figure. Remove rotation group from the drive shaft (101).

※ During the removal of the rotation group from the swing motor, do not let the pistons fall out of the cylinder.
All pistons in the rotation group must be re-installed in their original locations.

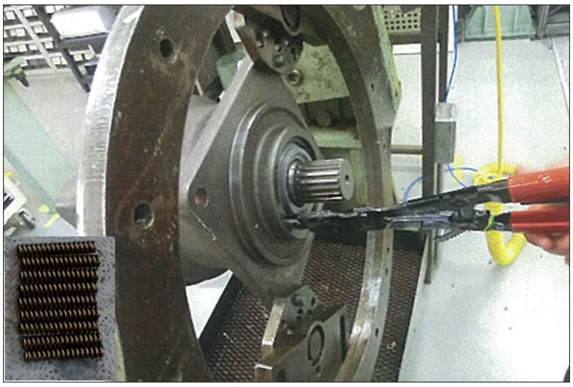
900L8SM24

(12) Disassemble rotation group as follows :
Put identification marks on nine pistons (121), showing their location in the plate (123) and the plate (123) as a unit from the cylinder.
Separate the piston assembles from the plate.
※ Handle carefully so as not to damage sliding face on the retainer (113) or shoes (122).

900L8SM25

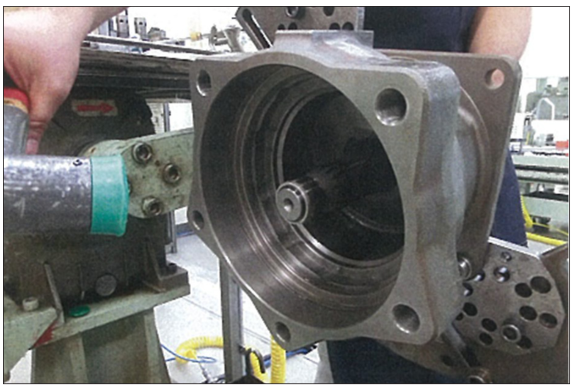
(13) Remove friction plates (742) and separator plates (743) from casing (301).
※ Pay attention to the position of friction and separator plates.

(14) Remove the snap ring (437) with a plier and then remove the front cover (304) and oil seal (491) from the casing (301).
※ Pay attention to the position of friction and separator plates.
※ Be sure to warp the output spline of driving shaft (101) with a cover or plastic tape to protect a lip of oil seal.



900L8SM26

(15) Remove shaft assembly from casing (301) with hammering at the other shaft end.
※ Be careful not to damage sliding face on the shaft.



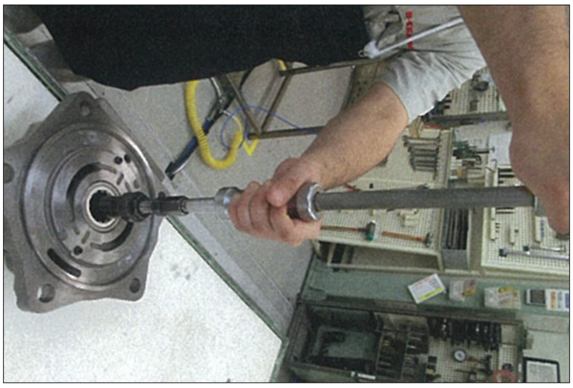
900L8SM27

(16) Remove bearing inner race (443) from the shaft (101) with press machine if necessary.

※ The bearing inner race (444) cannot be removed from the shaft (101).
Be careful not to damage sliding face on the shaft. If bearing center cone is removed do not use in re-assembly of motor.

(17) Remove bearing outer race (444) from the valve casing (303) with bearing pliers, only if necessary.

※ Do not use in re-assembly of motor if b earing is removed.



900L8SM28

※ That is all of disassembling work.

4) REASSEMBLING

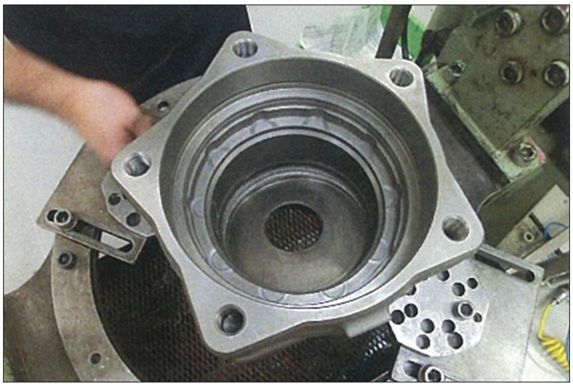
Cleanliness is a primary means of insuring satisfactory motor life, on either new or repaired units. Cleaning parts by using a solvent wash and air-drying is adequate, providing clean solvent is used. As with any precision equipment, the internal mechanism and related items must be kept free of foreign materials and chemicals.

Protect all exposed sealing surfaces and open cavities from damage and foreign material.

It is recommended that all oil seals and O-rings be replaced. Lightly lubricate all oil seals and O-rings with clean oil prior to assembly. Lubricate all sliding sections, bearings, and cylinders with clean oil prior to assembly.

Reassemble the motor, following the procedures described below.

(1) Place the motor in a vertical position with bell housing face down. Be sure to fix the motor casing (301) before assembling.



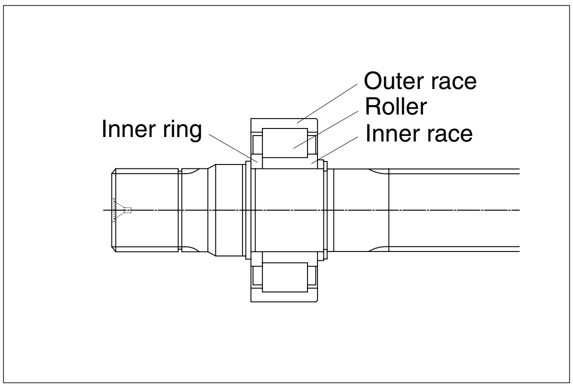
900L8SM30

(2) Heat the inner race of the bearing (443) (444) to 110 ℃ (230 °F) max and insert to the drive shaft.
And then attach the spacer (106) and the snap rings (432) (433) to the driving shaft (101).

⚠ **Do not exceed temperature 110℃ (230 °F).**

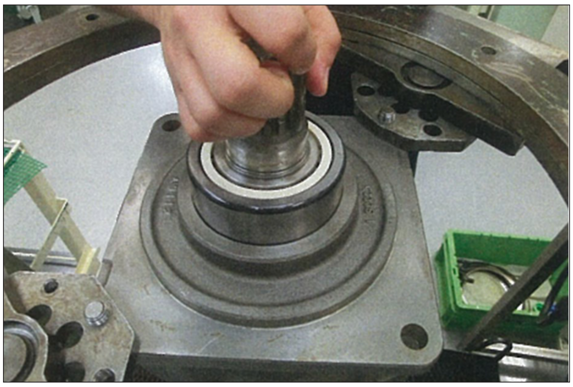
※ Be sure to assemble the bearing (443) According to the following direction.

※ Be sure to erase the inner race of the bearing (443) (444) before assembling.

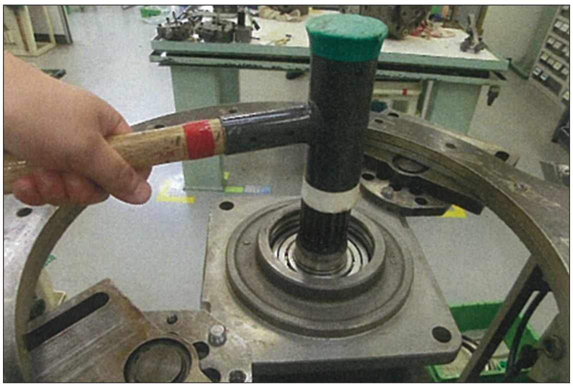


900L8SM31

(3) Insert the shaft assembly into the motor casing (301) by hammering at the shaft end.
※ Use the plastic hammer not to damage the driving shaft.



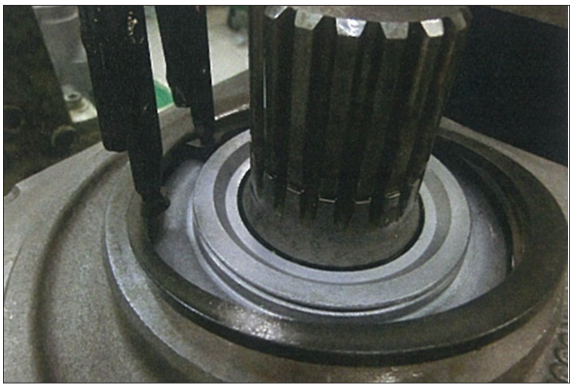
900L8SM32



900L8SM33

(4) Grease to the oil seal (491) and install it to the front cover (304).
Then, attach the O-ring (471) to the motor casing (301) and install the front cover and the snap ring (432) into the motor casing (301).
※ Be sure to warp the output spline of driving shaft (101) with a cover or plastic tape to protect a lip of oil seal.

900L8SM34



900L8SM35

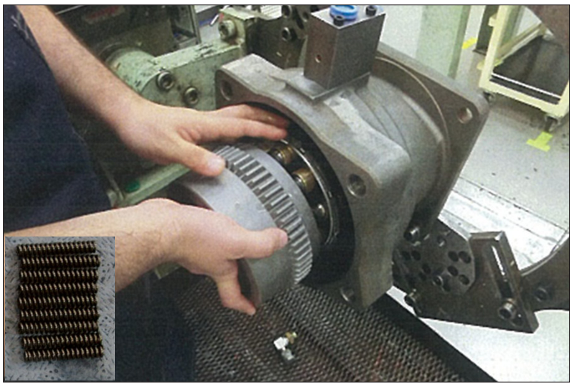
(5) Install shoe plate (124) into the motor casing (301).
※ Shoe plate to be fitted lapped side outwards.

900L8SM36

(6) Put set plate (123) on plate spring (114) and install assembly (121 & 122) into set plate (123).
※ Be sure to reassemble with identification marks on parts corresponding to each order.

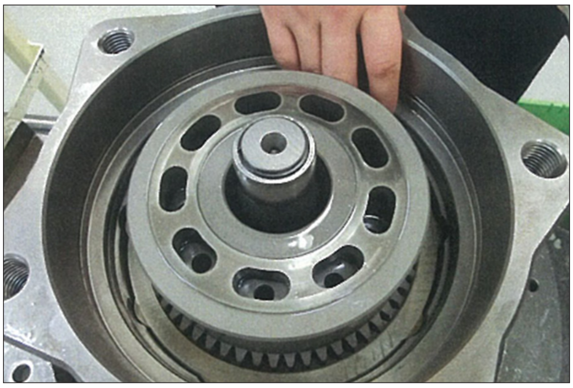
900L8SM37

(7) Insert piston assemblies into cylinder (111).
Install rotation group into casing (301).
※ Be sure to reassemble with identification marks on parts corresponding to each order.



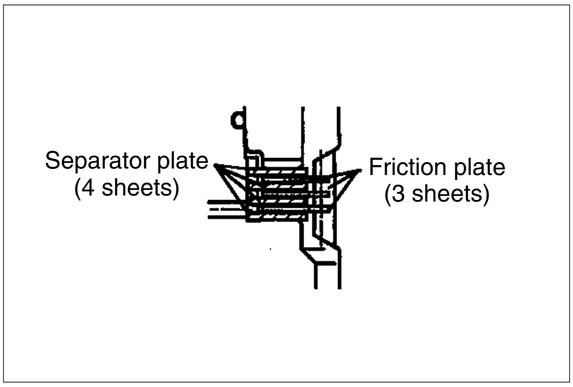
900L8SM38

(8) Place the motor in a vertical position with bell housing face down.
※ Be careful of the assembling order.



900L8SM39

※ At first, insert a separator plate (743), and then insert a friction plate (742) and separator plate alternately.



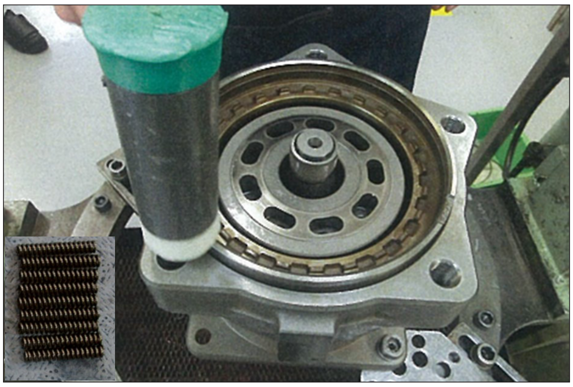
900L8SM40

(9) Install O-ring (707) and O-ring (706) into casing (301).

※ Ensure that the seal is lightly greased not to be cut.

900L8SM41

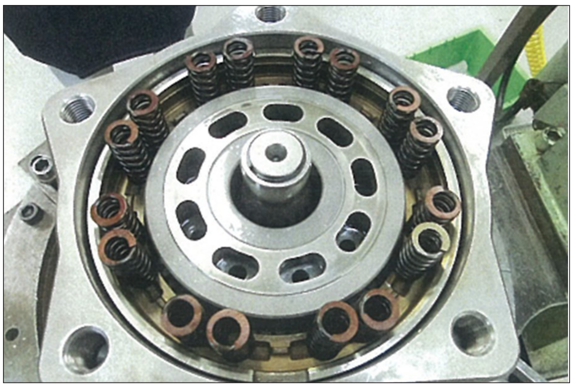
(10) Install brake piston (702) into casing (301) by tapping the piston into position using a plastic hammer, and then press to ensure brake piston is seated correctly.



900L8SM42

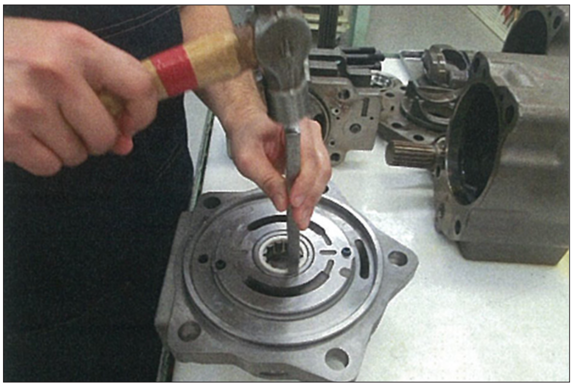
(11) Install spring (712) into the brake piston (702).

※ Be sure to place the spring according to the displacement described in cross section of the motor.



900L8SM43

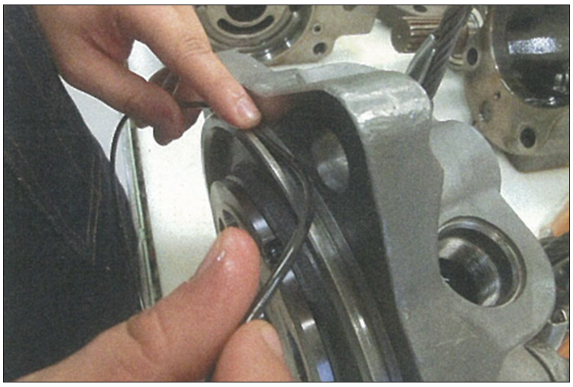
(12) Install the outer race of the bearing (444) into valve casing (303) by a hammer and a steel rod.
※ Insert to hit at the periphery of bearing evenly using steel rod and hammer.



900L8SM44

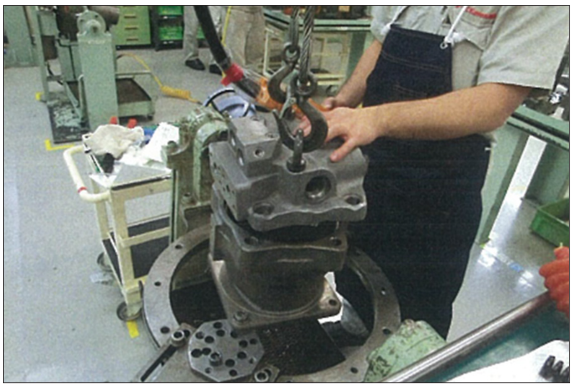
(13) Install valve plate (131) and O-ring (472) onto valve casing (303).
Brass face must be upwards.
※ Put multi purpose grease onto the face of the head to ensure contact.

900L8SM45

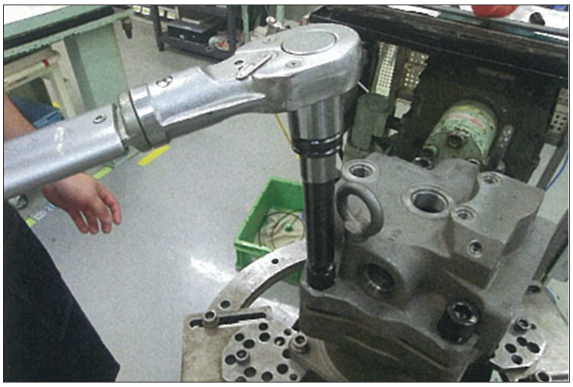


900L8SM46

(14) Install valve casing (303) and five socket head cap screw (401) into casing (301).

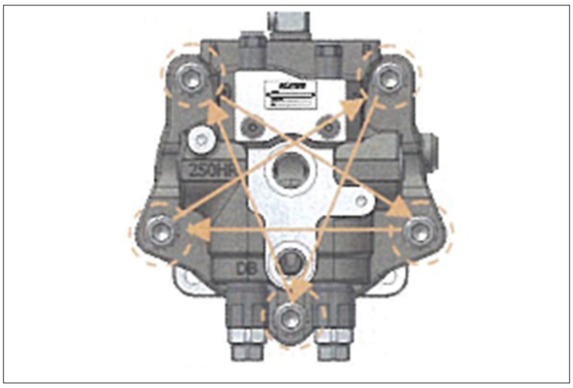


900L8SM47



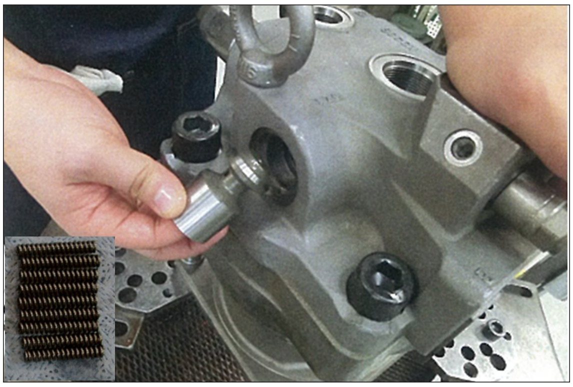
900L8SM48

※ Be sure to tighten the bolts (401) according to the following order so as not to damage the bearing (444).

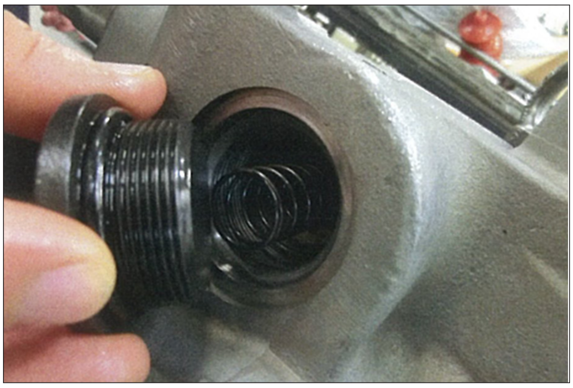


900L8SM20

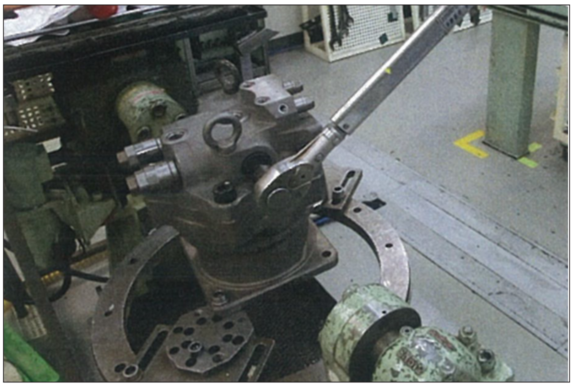
(10) Insert plunger (351) and spring (355) into valve casing (303) and install plug (469) with O-ring (488) in valve casing (303).
※ Check plunger (351) to move smoothly.
※ Be sure to reassemble with identification marks on parts corresponding to each other.



900L8SM49



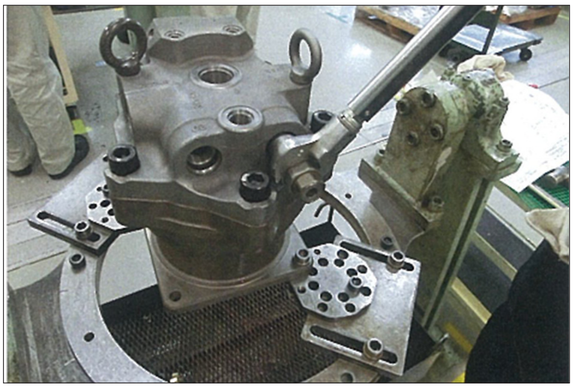
900L8SM50



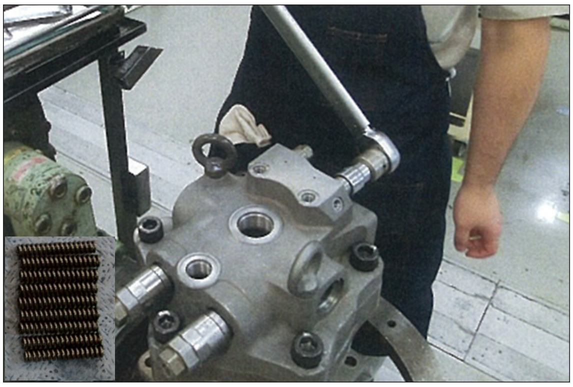
900L8SM51

(16) Put new O-ring on relief valve (051) and install relief valves (051) and anti-reaction valves (400) into valve casing (303).

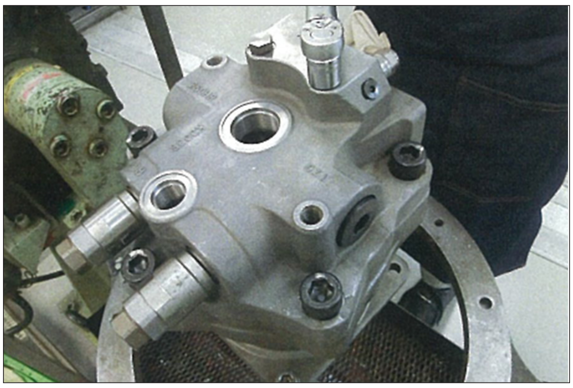
※ Be sure to reassemble with identification marks on parts corresponding to each other.



900L8SM52

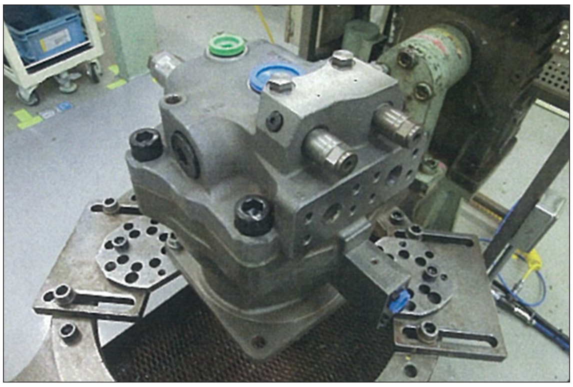


900L8SM53



900L8SM54

※ That is all of reassembling work.



900L8SM55

3. REMOVAL AND INSTALL OF REDUCTION GEAR

1) REMOVAL

(1) Remove the swing motor assembly.
For details, see removal of swing motor assembly.

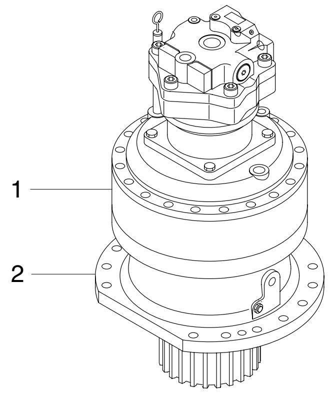
(2) Sling reduction gear assembly (1) and remove mounting bolts (2).

(3) Remove the reduction gear assembly.
· Reduction gear device weight :
270kg (600lb)

13031GE18

2) INSTALL

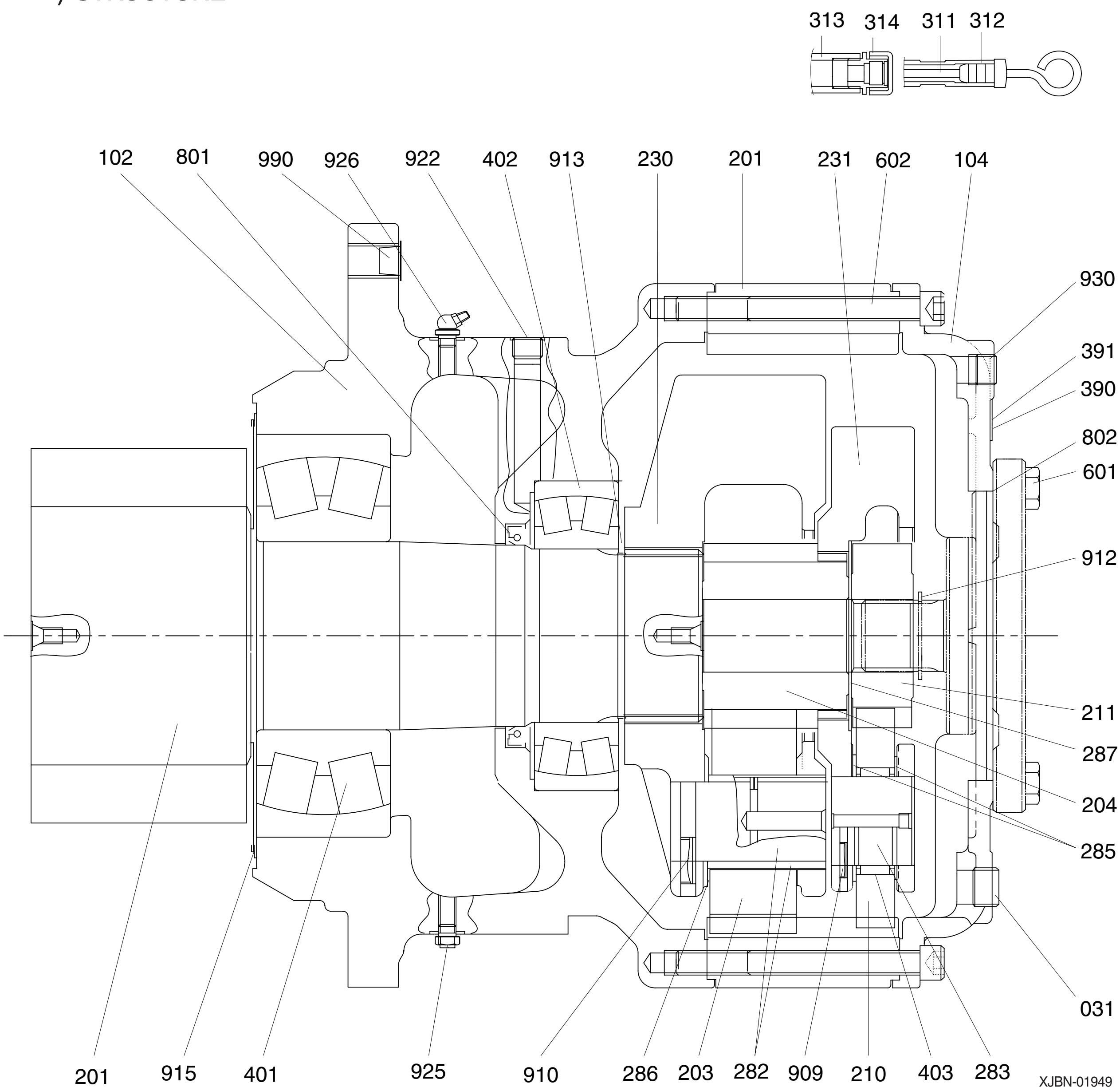
(1) Carry out installation in the reverse order to removal.
· Tightening torque : 100±15 kgf · m
(723±109 lbf · ft)



900L8SM03

4. REDUCTION GEAR

1) STRUCTURE



104	Rear casing	287	Thrust plate	802	O-ring
201	Drive shaft	311	Level bar	909	Spring pin
202	Ring gear	312	Y pipe	910	Spring pin
203	Planet gear B No.2	313	Oiling pipe	912	Snap ring
204	Sun gear B No.2	314	Oiling pipe	913	Stop ring
210	Planet gear B No.1	390	Name plate	915	Bearing seal C
211	Sun gear B No.1	391	Pin	922	Plug
230	Carrier No.2	401	Spherical roller bearing	925	Relief fitting
231	Carrier B No.1	402	Spherical roller bearing	926	Grease nipple
282	Pin A No.2	403	Needle cage	930	Plug
283	Pin No.1	601	Hex head bolt	931	Plug
285	Side plate	602	Hex head screw	990	Plug
286	Thrust washer	801	Oil seal		

2) TOOLS AND TIGHTENING TORQUE

(1) Thread size used and tightening torques

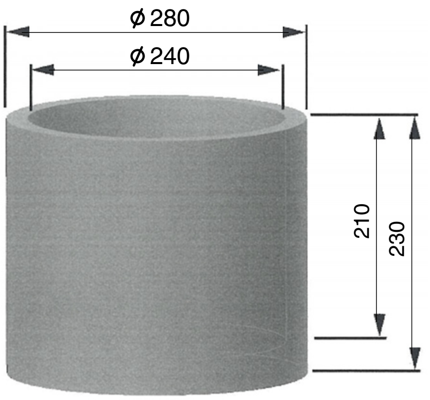
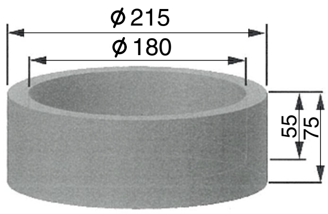
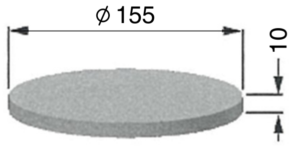
The thread sizes used in the reduction gear and their tightening torque is shown in table below.

No.	Part name	Size	Width across flat	Tightening torque	
				kgf · m	lbf · ft
601	Hex. head screw	M16 × 40	24 mm	24.0	173
602	Hex. socket head screw	M16 × 170	14 mm	24.0	173
922	Plug	PT 1/4	10 mm	6.6	47.9

(2) Tools used

① Allen wrench (width across flat : 24, 14, 10), socket wrench.
② Adjustable angle wrench, double (single) open-ended spanner.
③ Hammer, plastic hammer, screwdriver, punch, torque wrench & key.
④ Special jig, liquid panking (threebond no.1217).
⑤ Tank for shrinkage fit (80-100 degrees centigrade).

(3) Special jig

Detachment jig of spherical roller bearing (401)	Inserting jig of spherical roller bearing (402)	Inserting jig of oil seal
 900L8SM60	 900L8SM61	 900L8SM62

3) DISASSEMBLING

- Be careful not to damage parts.
- Before reassembling, check parts, according to the part inspection.
- Clean all parts with cleaning oil and dry them with compressed air.
- If liquid packing has been applied, remove it with a chambering knife or so on and finish surfaces with an oilstone.
- Follow the tightening torque.

Disassemble the reduction gear, following the procedures described below.

(1) Light up reduction gear with its drive shaft horizontal with crane and remove gear oil through oil drain port.

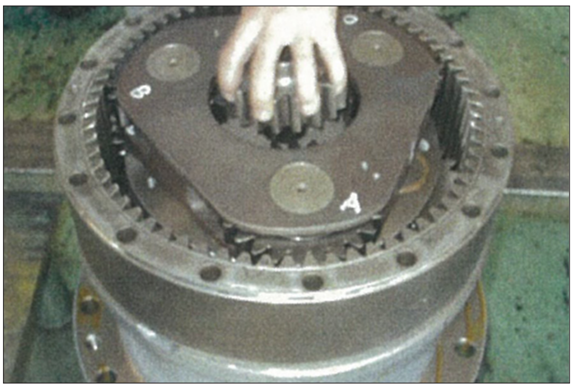
※ Receive gear oil with clean vessel and check oil for wear particles.

(2) Loosen hexagon head screws (601) and remove hydraulic motor

(3) Loosen hexagon socket head screws (602) and remove rear casing (104).

900L8SM70

(4) Remove No.1 sun gear (211).



900L8SM71

(5) Remove No.1 carrier assembly.

900L8SM72

(6) Disassembling of No.1 carrier assembly

※ During periodical inspection or so on, it is unnecessary to disassemble No.1 carrier assembly more.

In this state, check parts according to inspection shown in section 6.

As mentioned above, it is recommended to replace No.1 carrier assembly as set as far as possible.

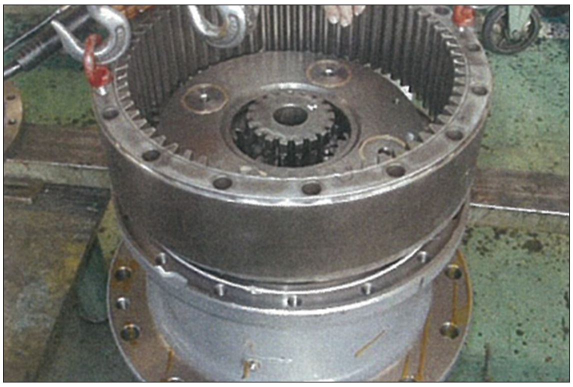
However, if partial replacement is inevitable, follow procedures mentioned below.

① Press spring pin (909) in the more inner part and pull out pin No.1 (283).

※ If pin No.1 (283) is removed do not use in reassembly of reduction gear.

② Remove No.1 planetary gear (210), needle cage (403), side plate (285).

(7) Lift up ring gear (202) to remove.



900L8SM73

(8) Remove No. 2 sun gear (204).

(9) Remove No.3 carrier assembly.

(10) Disassembling of carrier No.2

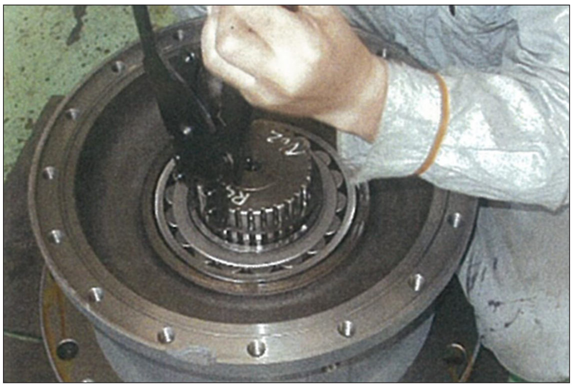
※ During periodical inspection or so on, it is unnecessary to disassemble No.2 carrier assembly more.
In this state, check parts according to inspection shown in section 6.
As mentioned above, it is recommended to replace No.2 carrier assembly as set as far as possible.
However, if partial replacement is inevitable, follow procedures mentioned below.

① Press spring pin (910) in the more inner part and pull out pin No.2 (282).

※ If pin No.2 (282) is removed do not use in reassembly of reduction gear.

② Pull out to remove planetary gear No.2 (203) and thrust washer (286).

(11) Remove snap ring (913) from driving shaft (201).



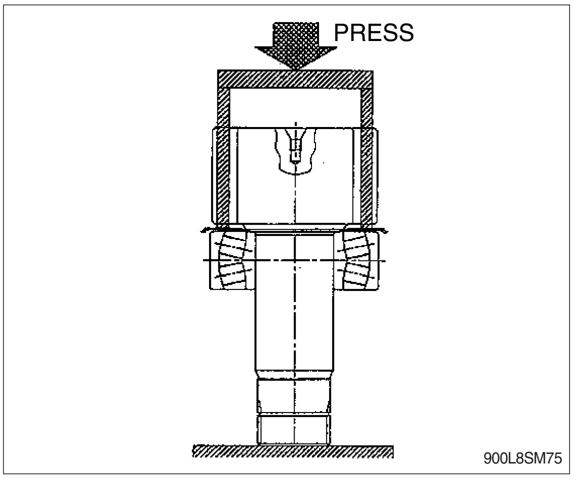
900L8SM74

(12) Place the reduction gear in a vertical with end of drive shaft, face down.

※ During periodical inspection or so on, it is unnecessary to disassemble drive shaft assembly more.
In this state, check parts according to inspection shown in section 6.
As mentioned above, it is recommended to replace drive shaft assembly as set as far as possible.
However, if partial replacement is inevitable, follow procedures mentioned below.

(13) Remove bearing seal (915) and spherical roller bearing (401) from driving shaft using press and jig as in right figure.

※ If bearing seal (915) and oil seal (801) is removed, do not use in reassembly of reduction gear.



(14) Remove oil seal (801) from casing (102)

4) REASSEMBLING

Reassemble the reduction gear, following the procedures described below.

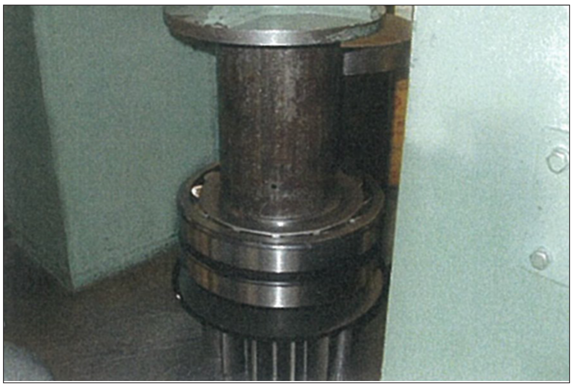
(1) Reassembling of drive shaft assembly

① Insert bearing seal (915) to shaft (201).

※ Take care not to damage sliding face of oil seal.

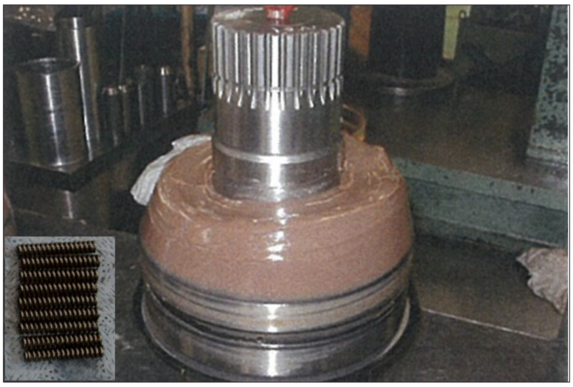
900L8SM76

② Put grease on the inside of bearing (401) and press to insert bearing.

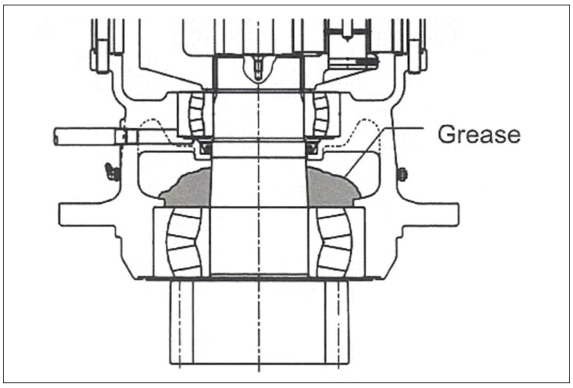


900L8SM77

※ Put grease on the bearing.



900L8SM78



900L8SM79

(2) Put down casing (102) on a level surface.

(3) Insert oil seal (801) into front casing (102) using jig.

900L8SM80

(4) Lift up drive shaft assembly using lift-up screw holes on the drive shaft, and insert it to casing.

(5) Place the reduction gear in a vertical position with end of drive shaft, face down.

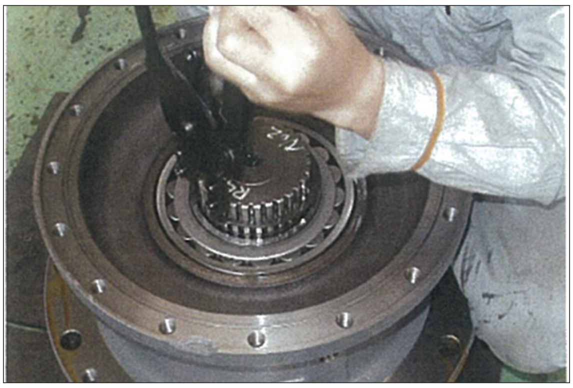
900L8SM81

(6) Insert bearing (402) using jig.

900L8SM82

(7) Insert snap ring (913).

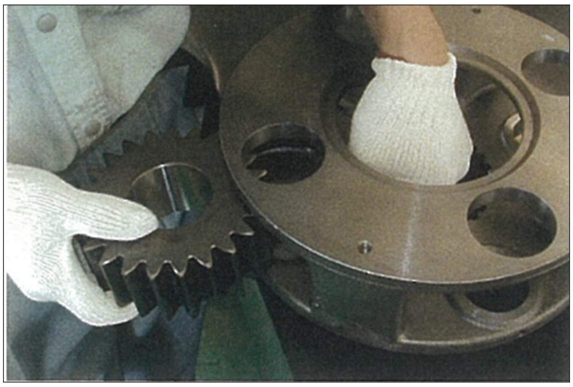
(8) Put grease into casing from inlet port of grease.



900L8SM83

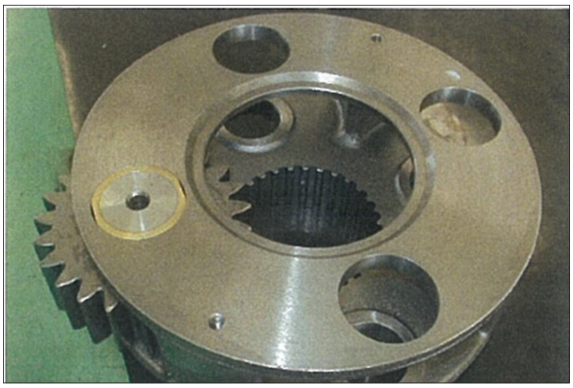
(9) Reassembling of carrier No.2 assembly

① Set thrust washer (286)
② Insert planetary gear (203).



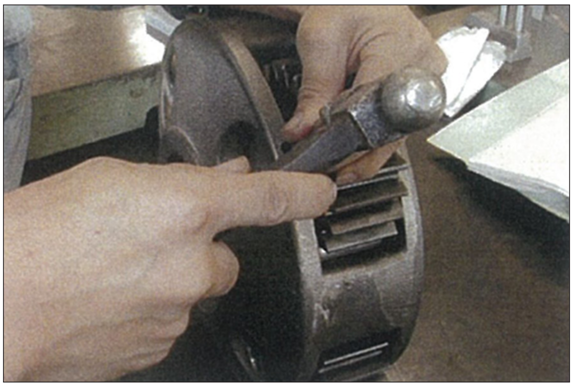
900L8SM84

③ Insert pin No.2 (282) while tapping lightly with plastic hammer.



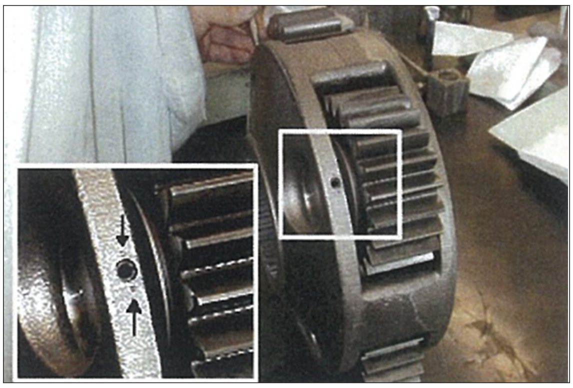
900L8SM85

④ Insert spring pin (910) and caulk carrier No.2 (230) both sides of spring pin with punch.



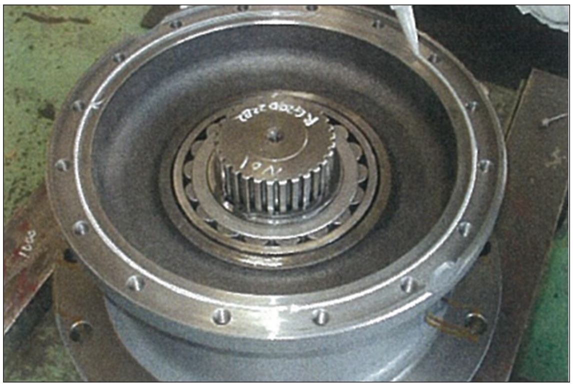
900L8SM86

※ Refer to "installation dimension".



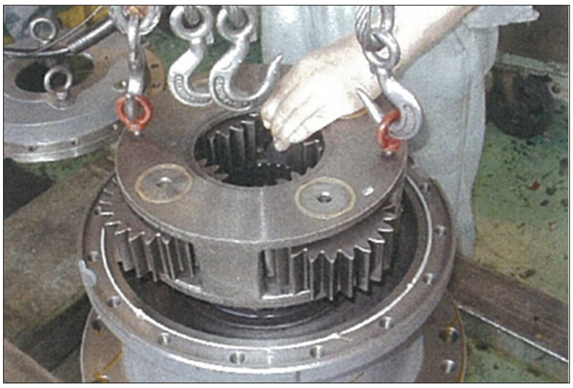
900L8SM87

(10) Apply liquid packing to casing (102).



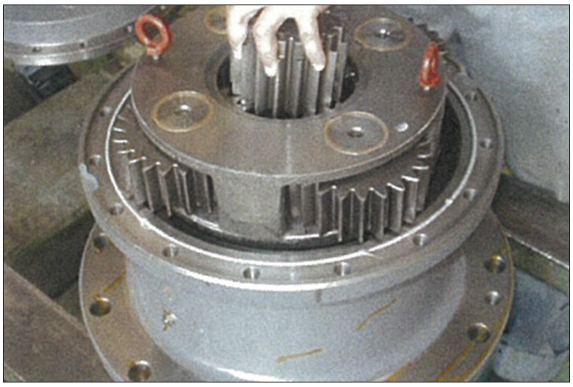
900L8SM88

(11) Install carrier No.2 assembly into casing (102).



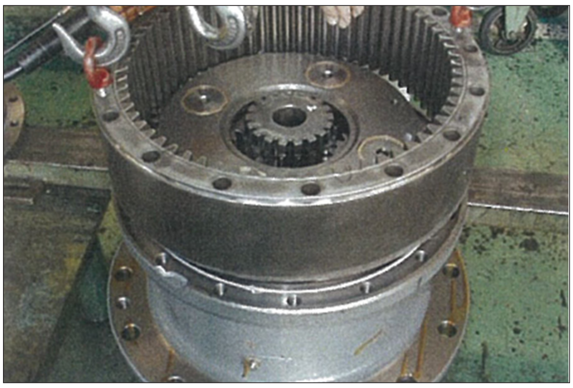
900L8SM89

(12) Install sun gear No.2 (204).



900L8SM90

(13) Install ring gear (202) to casing (102).
Install four socket head cap screw into casing temporarily using washer not to damage casing.



900L8SM91

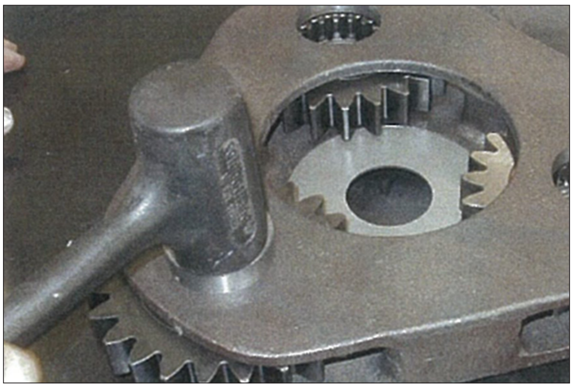
(14) Reassembling of carrier No.1 assembly

① Set thrust washer (231)

② Insert planetary gear (287).

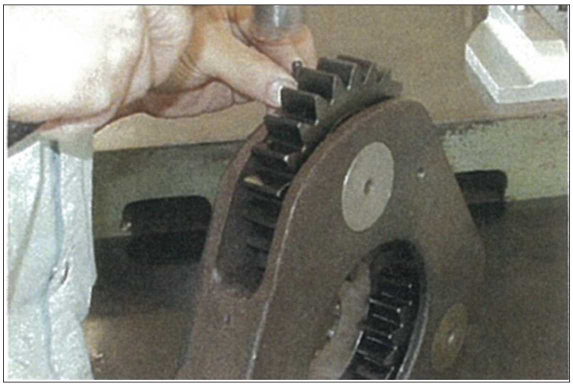
③ Install needle cage (403), planetary gear No.1 (210), side plate (285) into carrier No.1 (231).

④ Install pin No.1 (283) to carrier No.1 (231).

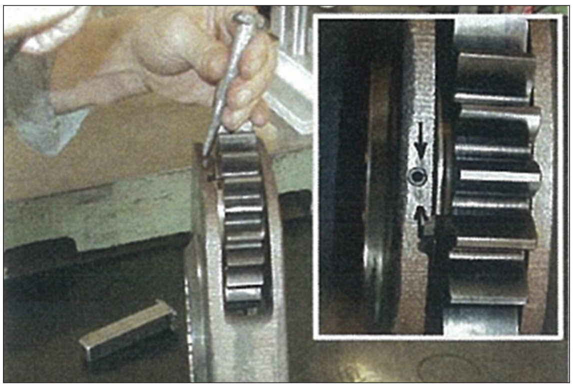


900L8SM92

⑤ Insert spring pin (909) and caulk carrier No.1 (231) both sides of spring pin with punch.

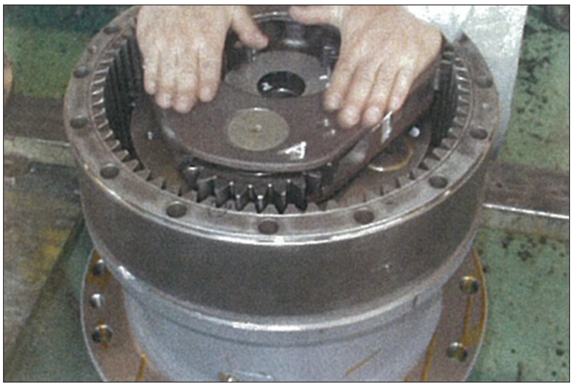


900L8SM93



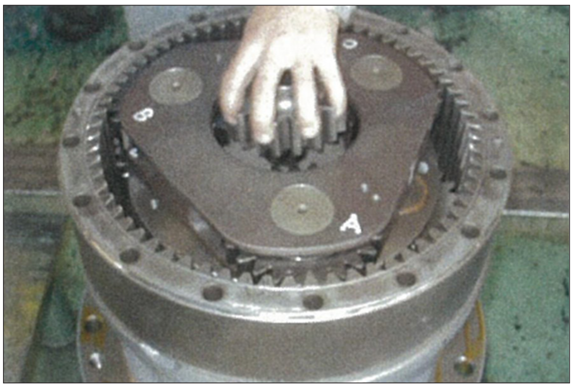
900L8SM94

(15) Install carrier No.1 assembly.



900L8SM95

(16) Install sun gear No.1 (211).



900L8SM96

(17) Remove temporary bolts and apply liquid packing to casing (102).

900L8SM97

(18) Install rear casing (104) to ring gear (202) and tighten hexagon socket head screws (602).

900L8SM98

(19) Install snap ring (912) and O-ring (802) to hydraulic motor, and then install hydraulic motor to reduction gear and tighten hexagon head screws (601).

(20) Fit plug (922) that is winded by seal tape to casing (102).

(21) Supply gear oil to inlet port of gear oil of reduction gear.

GROUP 6 TRAVEL DEVICE

1. REMOVAL AND INSTALL

1) REMOVAL

(1) Swing the work equipment 90° and lower it completely to the ground.

(2) Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

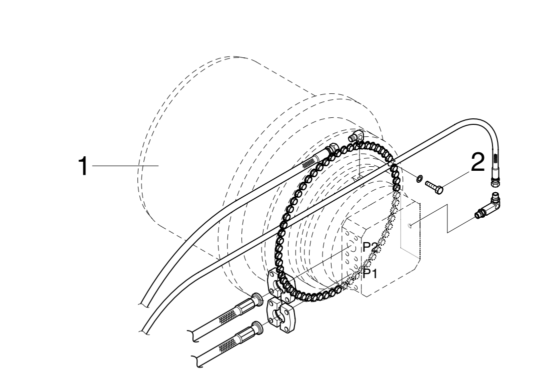
(3) Loosen the breather slowly to release the pressure inside the hydraulic tank.

13031GE18

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

※ When pipes and hoses are disconnected, the oil inside the piping will flow out, so catch it in oil pan.

(4) Remove the track shoe assembly.
For details, see removal of track shoe assembly.



8007A8TM01

(5) Remove the cover.

(6) Remove the hoses.
※ Fit blind plugs to the disconnected hoses.

(7) Remove the bolts and the sprocket.
· Tightening torque : 199±20 kgf · m
(1439±145 lbf · ft)

(8) Sling travel device assembly (1).

(9) Remove the mounting bolts (2), then remove the travel device assembly.
· Weight : 440 kg (970 lb)
· Tightening torque : 199±30 kgf · m
(1439±217 lbf · ft)

2) INSTALL

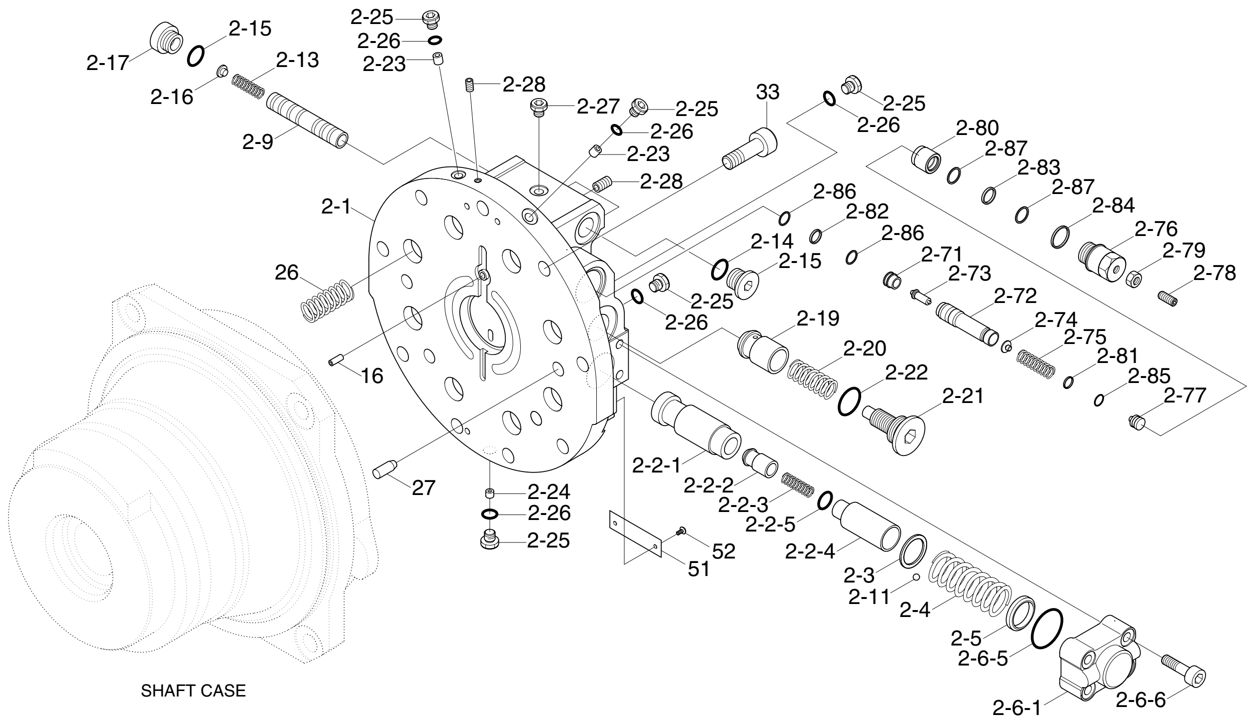
(1) Carry out installation in the reverse order to removal.

(2) Bleed the air from the travel motor.
① Remove the air vent plug.
② Pour in hydraulic oil until it overflows from the port.
③ Tighten plug lightly.
④ Start the engine, run at low idling, and check oil come out from plug.
⑤ Tighten plug fully.

(3) Confirm the hydraulic oil level and check the hydraulic oil leak or not.

2. TRAVEL MOTOR (1/2)

1) STRUCTURE

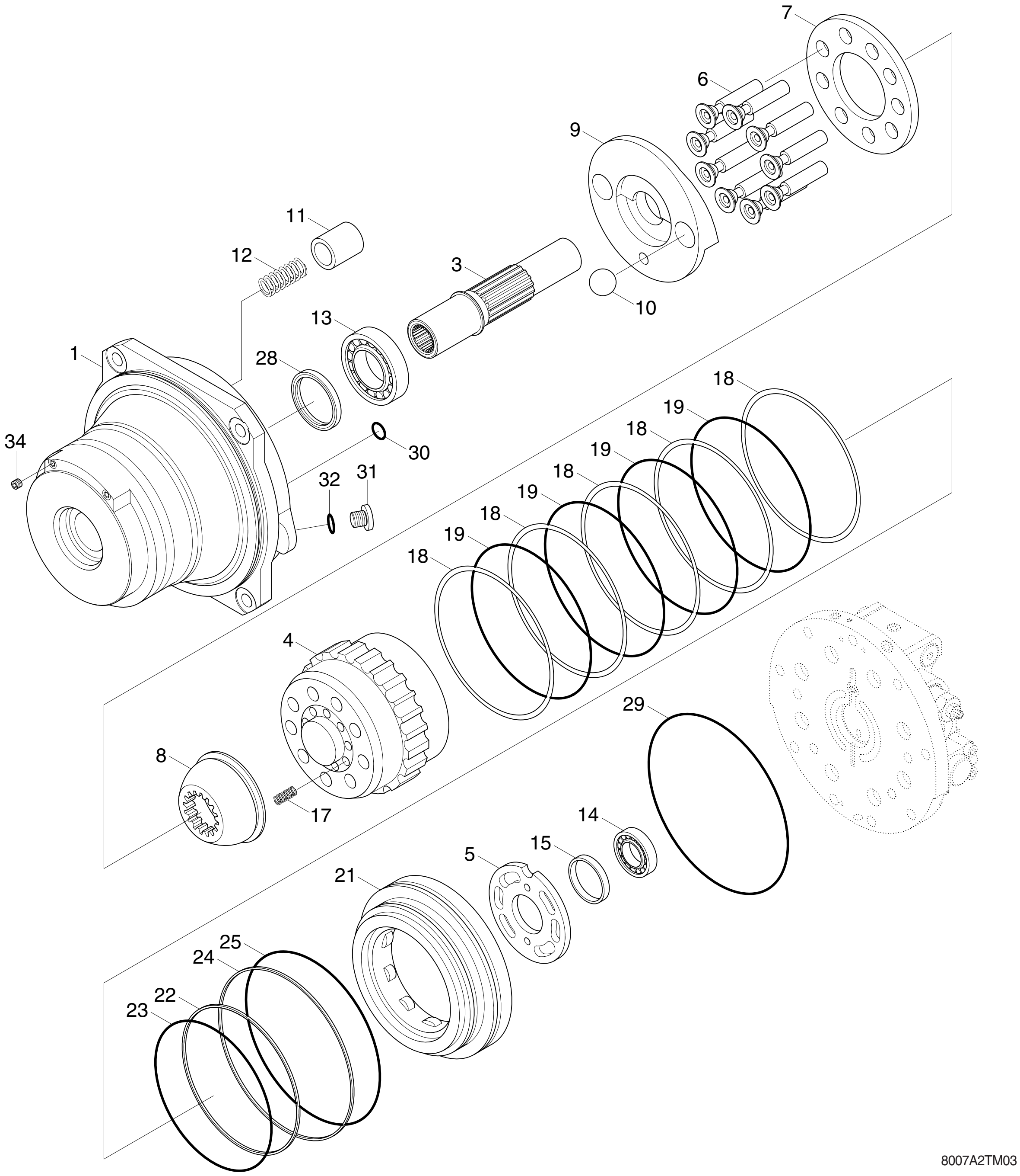


8007A2TM02

2-1	Base plate	2-7-5	Spring	2-15	O-ring
2-2	Spool assy	2-7-6	Plug	2-16	Spring guide
2-2-1	Spool	2-7-7	Spring guide	2-17	Plug
2-2-2	Check valve	2-7-8	Set screw	2-19	Check valve
2-2-3	Spring	2-7-9	Nut	2-20	Spring
2-2-4	Plug	2-80	Free piston	2-21	Plug
2-2-5	O-ring	2-81	O-ring	2-22	O-ring
2-3	Spring seat	2-82	O-ring	2-23	Orifice
2-4	Spring	2-83	O-ring	2-24	Orifice
2-5	Spring seat	2-84	O-ring	2-25	Plug
2-6	Cap assy	2-85	Back up ring	2-26	O-ring
2-6-1	Cap	2-86	Back up ring	2-27	Shipping plug
2-6-5	O-ring	2-87	Back up ring	2-28	Plug
2-6-6	Bolt	2-9	Valve assy	16	Pin
2-7	Relief valve assy	2-9-1	Spool	26	Spring
2-7-1	Poppet seat	2-9-2	Spool-C	27	Pin
2-7-2	Relief housing	2-11	Orifice	33	Socket bolt
2-7-3	Poppet	2-13	Spring	51	Name plate
2-7-4	Spring seat	2-14	Plug	52	Drive screw

TRAVEL MOTOR (2/2)

· Control part



1	Case	12	Spring	24	O-ring
3	Shaft	13	Roller bearing	25	Back up ring
4	Cylinder block	14	Roller bearing	28	Oil seal
5	Valve plate	15	Collar	29	O-ring
6	Piston assy	17	Spring	30	O-ring
7	Retainer plate	18	Friction plate	31	Plug
8	Plate holder	19	Disc plate	32	O-ring
9	Swash plate	21	Brake piston	34	Plug
10	Steel ball	22	O-ring		
11	Piston assy	23	Back up ring		

2) MAINTENANCE INSTRUCTION

(1) Tools for disassembly and reassembly

No.	Tool name	Specification	Applicable Components or Parts
1	Torque wrench	60 kgf · m (434 lbf · ft)	Orifice (2-11)
2		900 kgf · m (6510 lbf · ft)	Plug (2-2-4, 2-25), Nut (2-7-9), Orifice (2-23)
3		1800 kgf · m (13019 lbf · ft)	Bolt (2-6-6), Plug (2-14, 2-17)
4		5600 kgf · m (40505 lbf · ft)	Valve assy (2-7), Plug (2-21), Socket bolt (33)
5	Ratchet steering wheel for socket wrench	-	-
6	Hexagonal bit for torque wrench	Hex. 2.5	Orifice (2-11)
7		Hex. 4	Orifice (2-23, 2-24)
8		Hex. 5	-
9		Hex. 6	Set screw (2-7-8), Plug (2-25)
10		Hex. 10	Bolt (2-6-6), Plug (2-14, 2-17)
11		Hex. 12	Plug (31)
12		Hex. 14	Plug (2-2-4, 2-21), Socket bolt (33)
13	Socket	Hex. 21	-
14		Hex. 36	Relief valve assy (2-7)
15	Hexagon socket screw key	Hex. 2.5	Orifice (2-11)
16		Hex. 4	Orifice (2-23, 2-24)
17		Hex. 5	-
18		Hex. 6	Set screw (2-7-8), Plug (2-25)
19		Hex. 10	Bolt (2-6-6), Plug (2-14, 2-17)
20		Hex. 12	Plug (31)
21		Hex. 14	Plug (2-2-4, 2-21), Socket bolt (33)
22	Spanner	Hex. 19	Nut (2-7-9)
23		Hex. 21	-
24		Hex. 36	Relief valve assy (2-7)
25	Minus driver	6×100	Base plate assy (2), Valve plate (5)
26	Plastic hammer	#3	-
27	Punch	About 10 mm	-
28	Hand Press	200 kgf or more	-
29	Crane	For 400 kg	-
30	Eyebolt	M12	Case (1), Base plate assy (2), Base plate (2-1)
31	Chain string (wire)	-	-

3) DISASSEMBLY

(1) General precautions

① Before disassembling the motor, check the items to be inspected and, for remedy against trouble, closely examine the nature of the trouble, so that the motor can be disassembled effectively.

② To disassemble the motor, use the disassembling procedures described in section 2) and select a clean place.

③ Place a rubber or vinyl sheet or other such protective materials on your working bench to protect the surface of the motor to be serviced.

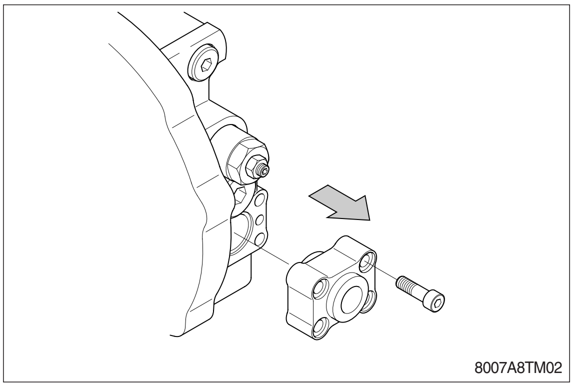
④ During disassembly, give a match mark to the mating surfaces of each part.

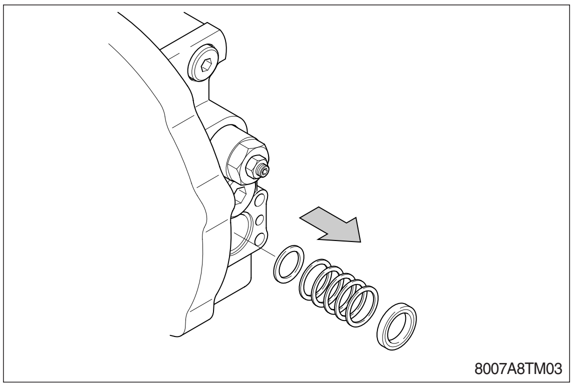
⑤ Arrange removed parts in order so that they will not become damaged or missing during disassembly.

⑥ Once seals have been disassembled, they should be replaced even if damage is not observed. Have replacement seals ready on hand before starting your disassembling job.

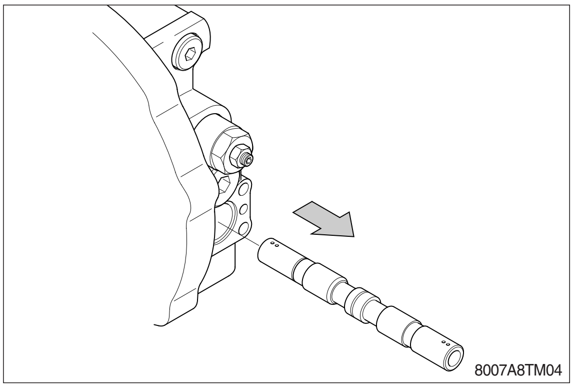
(2) DISASSEMBLY TRAVEL MOTOR

① Remove cap (2-6) and take out spring (37), spring seat (36).





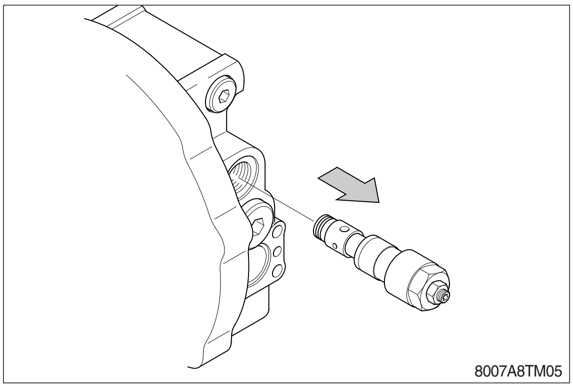
② Remove spool assy (2-2) turning slowly. Be careful not to damage around the spool assy.



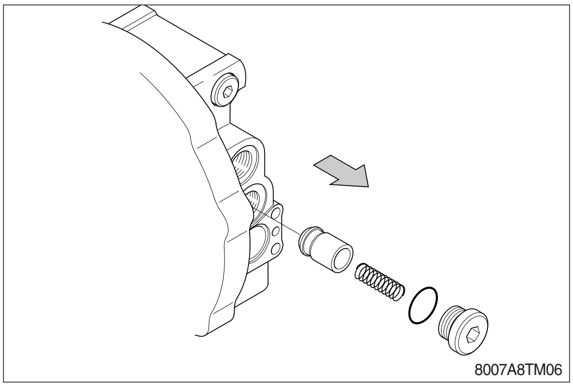
③ Loosen the plug (2-7-6) to remove the relief valve assembly (2-7).

※ Do not move the setscrew, nut. Otherwise, the set pressure will change.

※ Do not disassemble the relief valve assembly because it is a functional component.



④ Remove plug (2-21), spring (2-20) and check valve (2-19).



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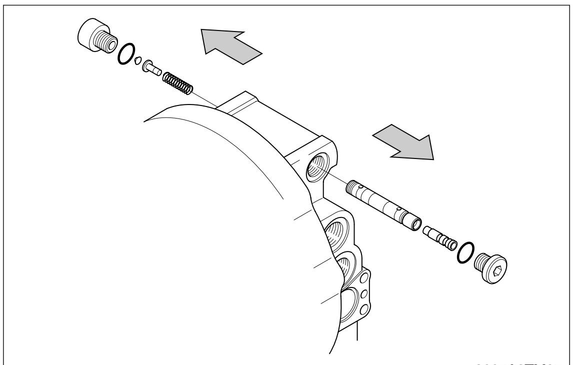
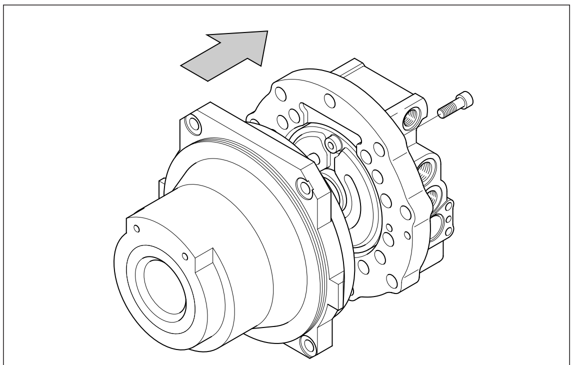
⑤ Remove Plugs (2-14, 2-17) remove spring (2-13) and spool assy (2-9).



8007A8TM07

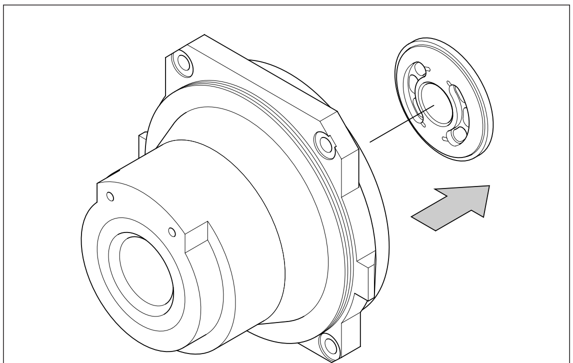
⑥ Remove socket head bolt (33).

- Points
  To disassemble the motor easily, socket head bolt (33) should be loosened evenly because base plate (1-2-1) lift up by the reactive force of springs (26).
  Remove base plate (1-2-1).
- Then, pay attention so that cylinder block does not come out. When it is difficult to remove, strike it by use of plastic hammer. If it is more difficult to remove, remove it by lightly prying with screwdriver.



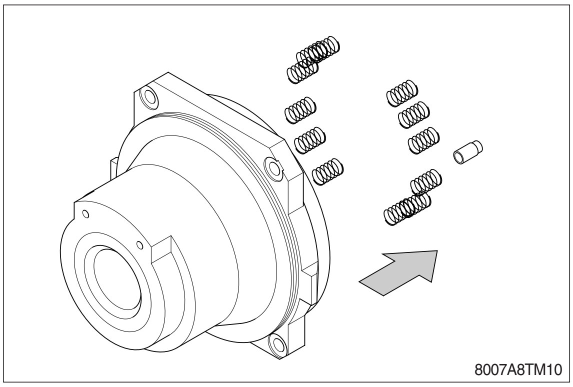
8007A8TM08

⑦ Remove valve plate (5) from base plate (1-2-1).

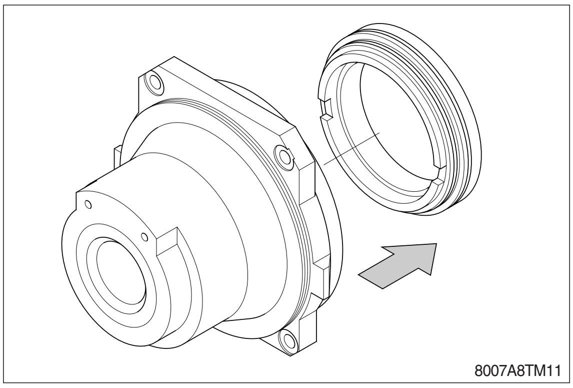


8007A8TM09

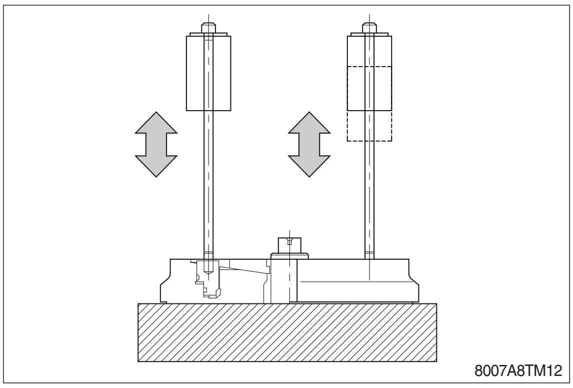
⑧ Remove O-rings (29)(30), pins (27) and springs (26).



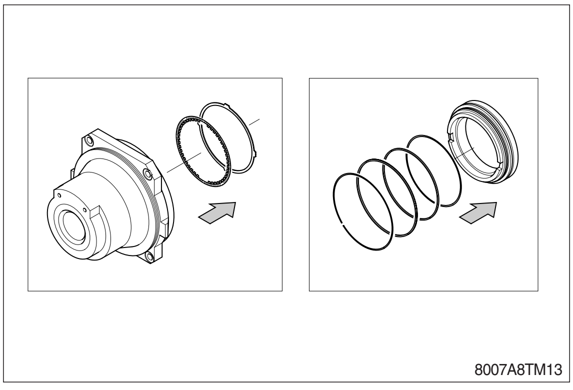
⑨ Remove brake piston (21).
Blow compressed air into parking brake-releasing port on case (1).



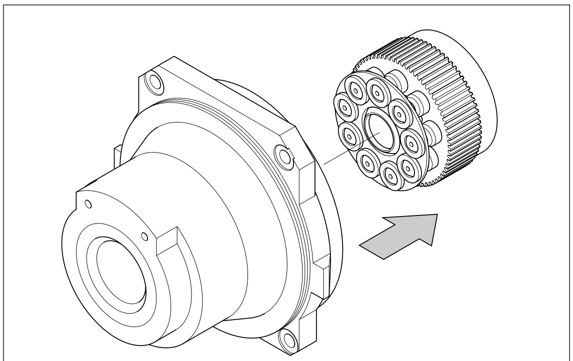
※ Before work, put rag on all surface of brake piston because brake piston fly out and oil flies off while at work.



※ After removing brake piston, remove disk (19), friction plate (18)(20). And then, removing O-rings (22)(24) and back up rings (23)(25).

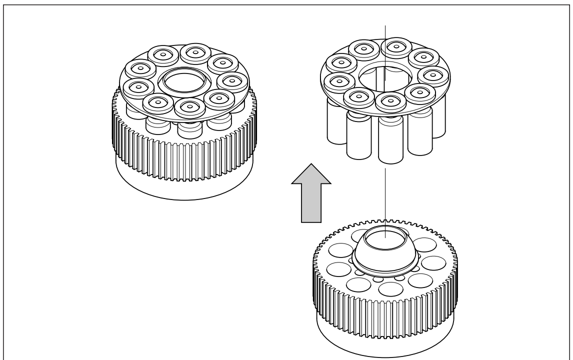


⑩ Remove cylinder block assy.

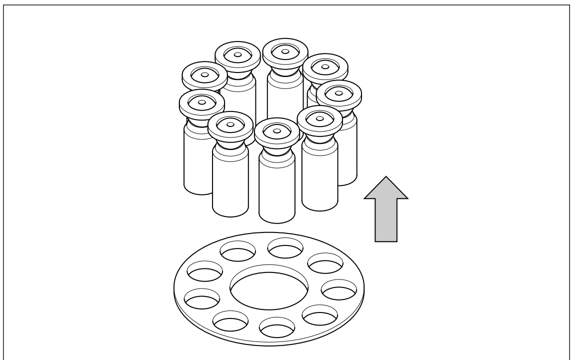

8007A8TM14

⑪ Disassemble cylinder block assy.

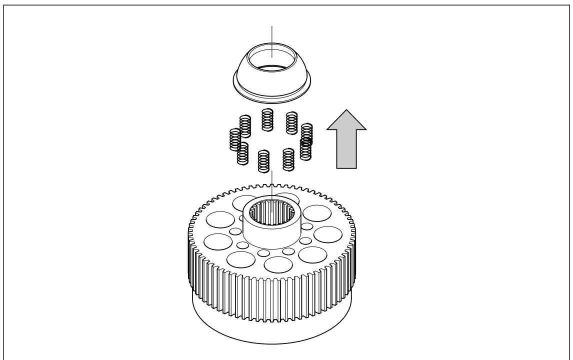
a. Remove piston assy (6) and retainer plate (7) from cylinder block (4).


8007A8TM15

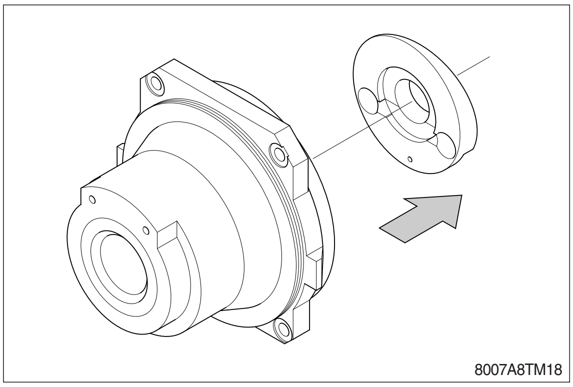
b. Remove piston assy (6) from retainer plate (7).


8007A8TM16

c. Remove retainer holder (8) from cylinder block (4).
And then, remove springs (17) from cylinder block (4).

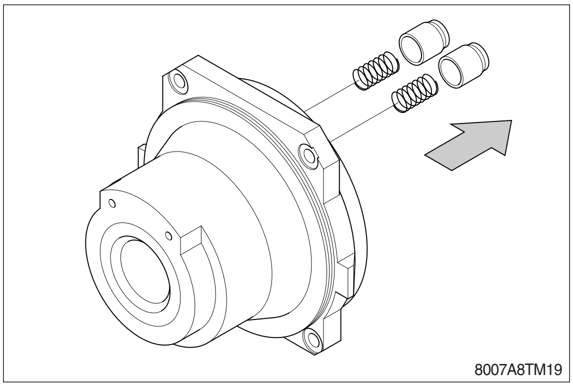

8007A8TM17

⑫ Remove swash plate (9).

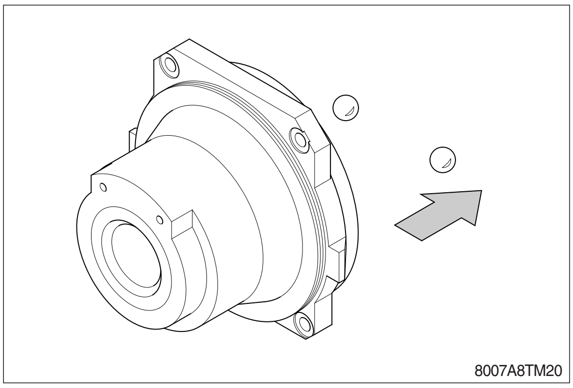


8007A8TM18

⑬ Remove piston assy (11) and spring (12).
And then remove steel ball (10).

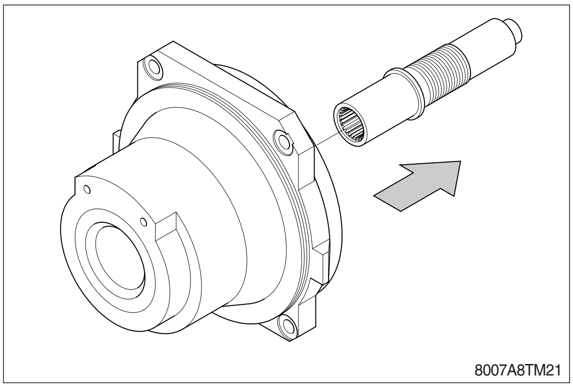


8007A8TM19



8007A8TM20

⑭ Remove shaft (3).



8007A8TM21

4) REASSEMBLY

(1) General precautions

① Reassemble in a work area that is clean and free from dust and grit.

② Handle parts with bare hands to keep them free of linty contaminates.

③ Repair or replace the damaged parts.
Each parts must be free of burrs its corners.

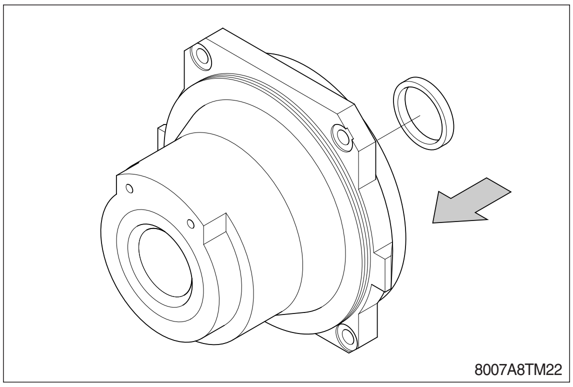
④ Do not reuse O-rings, oil seal and floating seal that were removed in disassembly.
Provide the new parts.

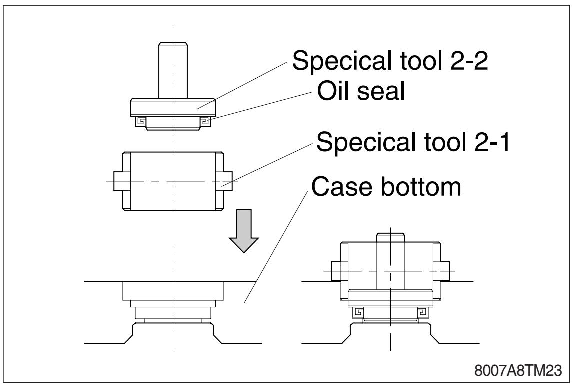
⑤ Wash all parts thoroughly in a suitable solvent.
Dry thoroughly with compressed air.
Do not use the cloths.

⑥ When reassembling oil motor components of motor, be sure to coat the sliding parts of the motor and valve with fresh hydraulic oil. (NAS class 9 or above)

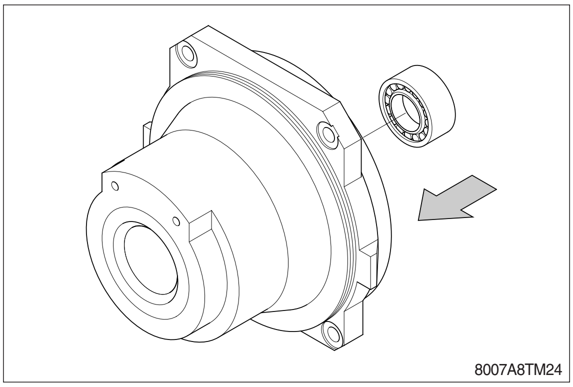
⑦ Use a torque wrench to tighten bolts and plugs, to the torque specified as follows.

① Apply grease to oil seal (28) and press fit it in case (1).



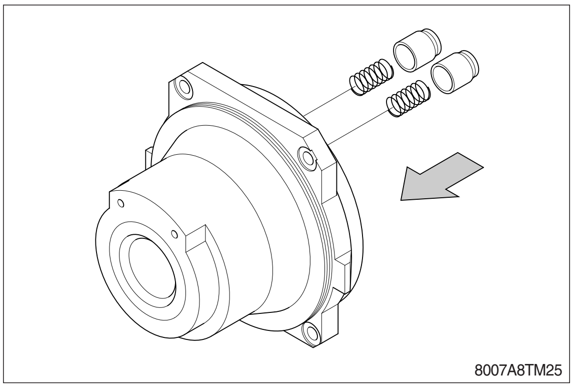


② Press fit the outer race of roller bearing (13) in case (1).



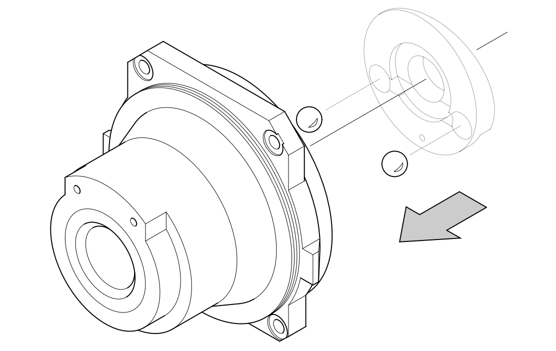
③ Install springs (12) and piston assy (11) on case (1).

※ Apply hydraulic oil to the sliding surface of the piston assy.



④ Install steel ball (10).

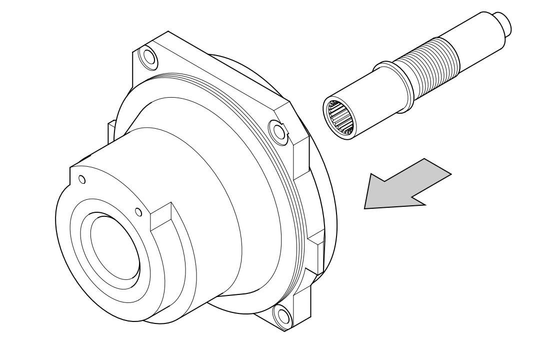
※ Apply hydraulic oil to the surface of the steel ball.



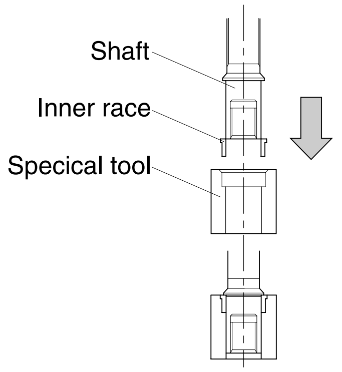
8007A8TM26

⑤ Press fit Inner race of roller bearing (13) on shaft (3).

And then, install shaft sub assy on case (1).



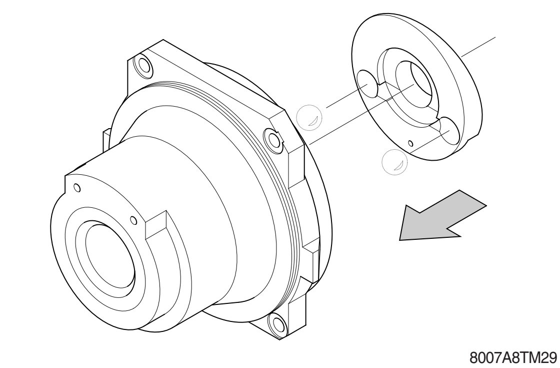
8007A8TM27



8007A8TM28

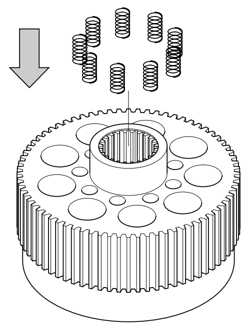
⑥ Install Swash plate (9).

※ Apply hydraulic oil to the surface of the steel ball.



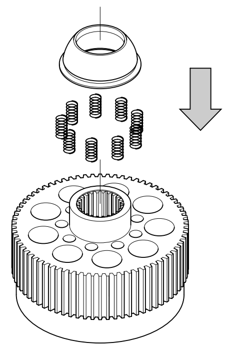
8007A8TM29

⑦ Install 9 springs (17) on cylinder block (4).



8007A8TM30

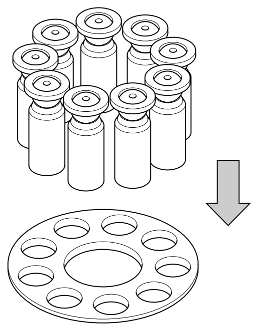
⑧ Install retainer holder (8) on cylinder block (4).



8007A8TM31

⑨ Install 9 piston assy (6) in each holes of retainer plate (7).

※ Be care for the direction of the retainer plate.

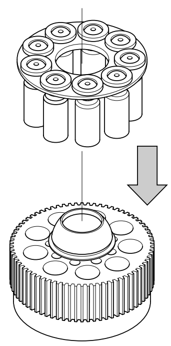


8007A8TM32

⑩ Install piston assy (6) and retainer plate (7) in cylinder block (4).

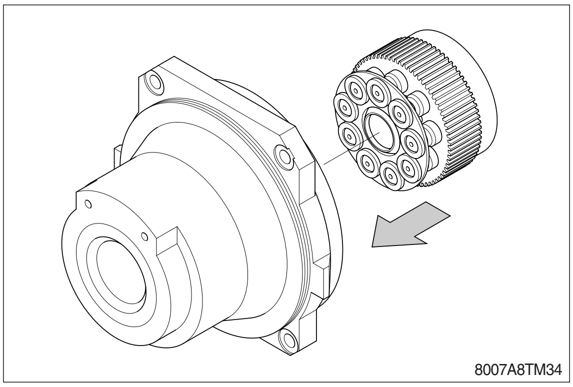
※ Apply hydraulic oil in 9 holes of cylinder block.

Apply hydraulic oil on the surface of retainer holder (8) and retainer plate (7).

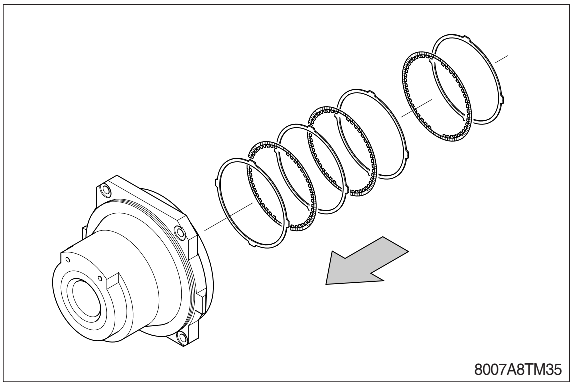


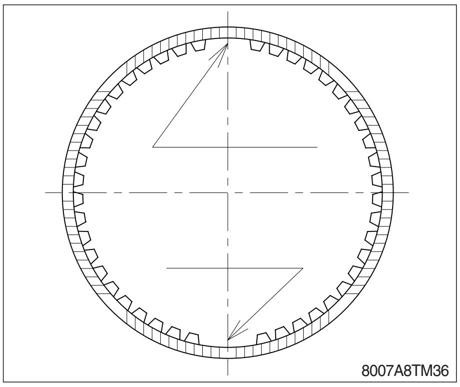
8007A8TM33

⑪ Install cylinder block assy.
※ Apply hydraulic oil on the surface of piston assemblies (6) and swash plate (9).


8007A8TM34

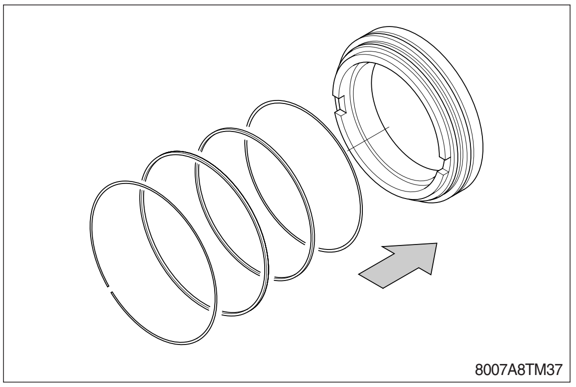
⑫ Install friction plates (18) and disk plates (19).
a. Apply enough hydraulic oil to disk plate.
b. The circular arc part of the friction plate is set to the cutting lack part of
c. the case.
There is a part where teeth are lacked in the spline of disk plate.
When assembling the disk plates, match the position of these each parts.


8007A8TM35

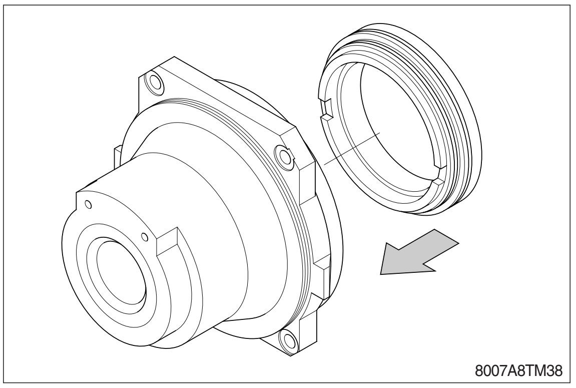

8007A8TM36

d. Refer to the sectional drawing for the combination of assembling friction plate and disk plate.

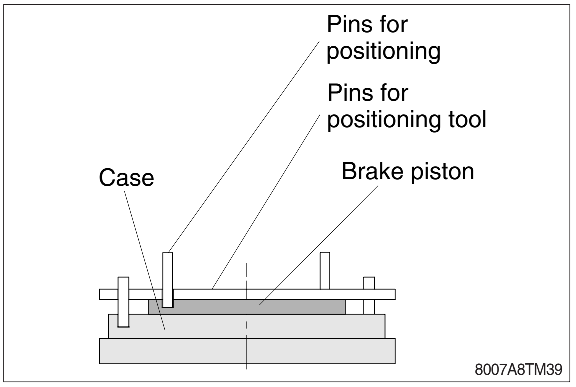
⑬ Apply grease to O-rings (22)(24), backup ring (23)(25), and install them to brake piston (21).
And install brake piston (21) to case (1) to align pins (27) installed on base plate in No.** with holes on brake piston (21).
When install it, beat on evenly outside of brake piston by using of plastic hammer.
a. Each backup rings should be set out side position.
b. Be careful of installing direction of brake piston.
c. Apply grease to outside of brake piston and inside of case (1).



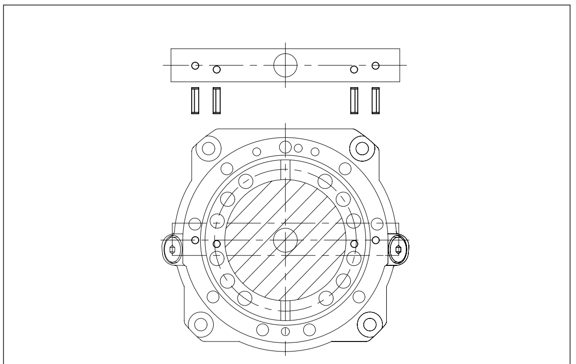
8007A8TM37



8007A8TM38

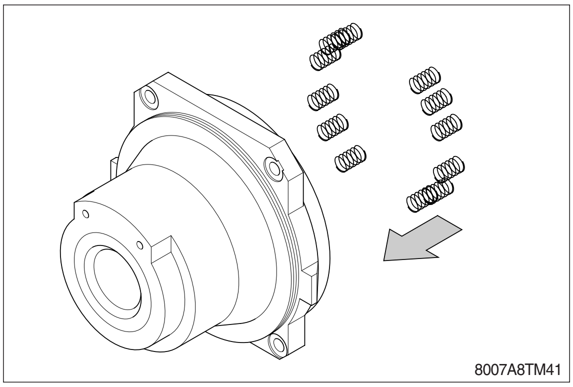


8007A8TM39

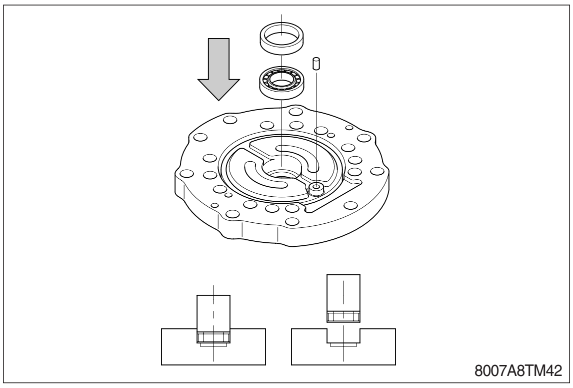


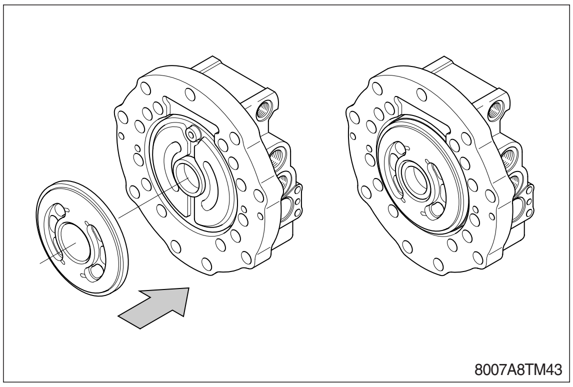
8007A8TM40

⑭ Install springs (26) in the holes of brake piston (21).



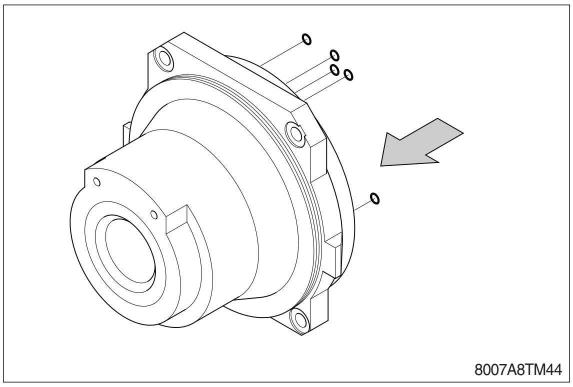
⑮ Press fit roller bearing (14) on base plate (2-1).
Install pins (16) and color (15) on base plate (2-1).
※ Apply grease to the surface of valve plate (25) and base plate (2-1).

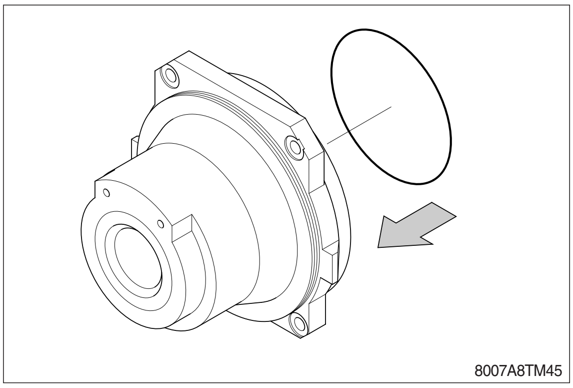


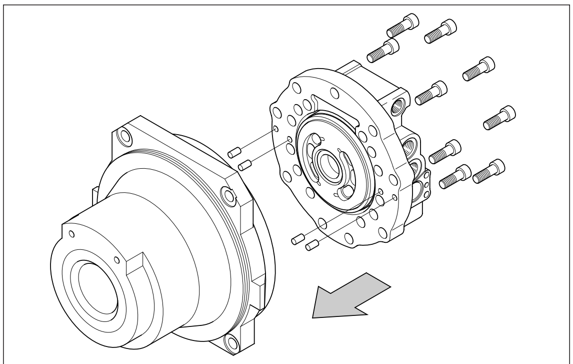


⑯ Install O-rings (29)(30) on case (1).
Install pins (27) on base plate (2-1).
Install base plate (2-1) and socket head bolt (9).

a. Apply grease to O-ring (25).
b. Do not apply grease to O-ring (30).
c. Be care for direction of pin (27).
d. Apply hydraulic oil to the surface between cylinder block (4) and valve Plate (5).
e. Be care for pilot line of base plate and case (1).
f. Tighten the bolts evenly, as base plate is pushed by spring.

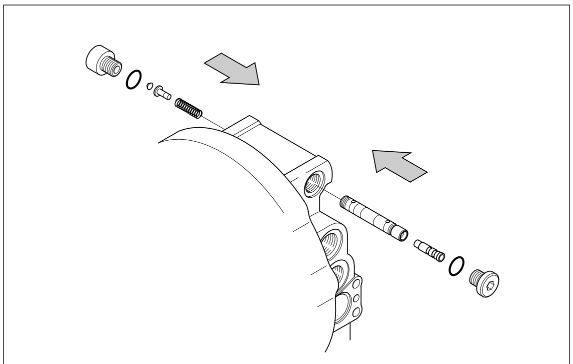

8007A8TM44


8007A8TM45

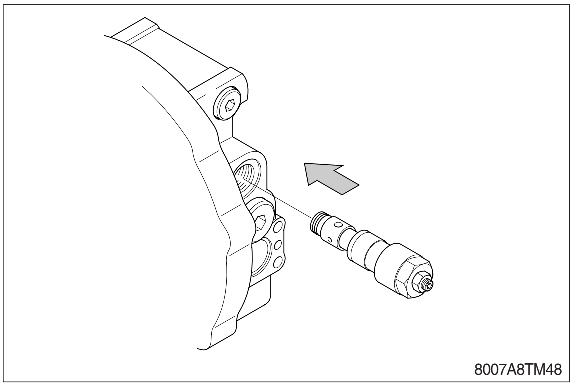

8007A8TM46

⑰ Place spring (2-13) on valve assy (2-9), and then install valve assy on base plate (2-1).
Tighten plug (2-14) with O-ring (2-15).
Place spring guide (2-16) and washer (2-18), and then tighten plug (2-17) with O-ring (2-15).

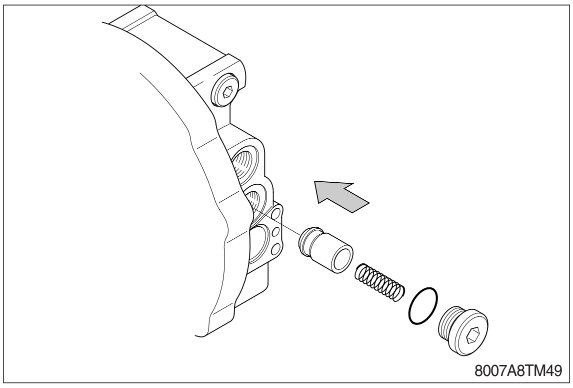
※ Apply hydraulic oil to valve assy before installation.
Apply slight grease to O-rings (2-15).


8007A8TM47

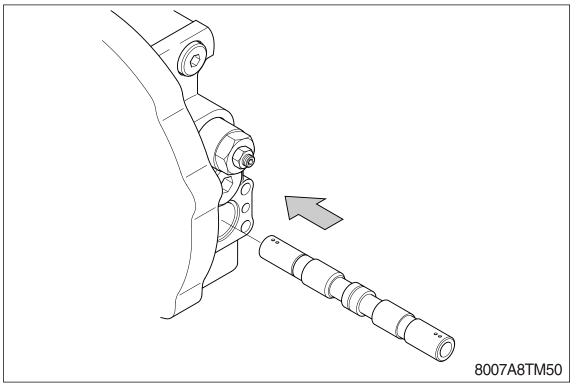
⑱ Tighten relief valve assemblies (2-7).
※ Apply slight grease to O-rings (2-7-12) and backup rings (2-7-16).



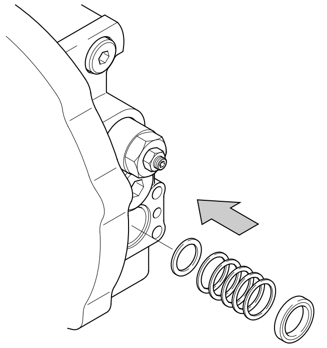
⑲ Place check valve (2-19) and springs (2-20).
Tighten plug (2-21) with O-ring (2-22).
※ Apply slight grease to the O-rings.



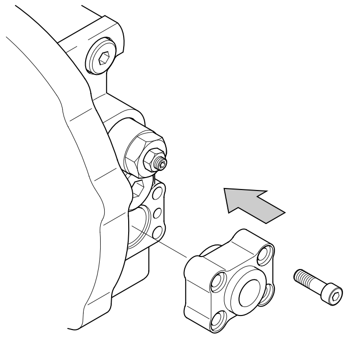
⑳ Install spool assy (2-2) on base plate (2-1).
Install it while turning to prevent it from sticking.
※ Apply hydraulic oil to spool assy before installation.



㉑ Place spring seats (2-3) and springs (2-4).
Install O-rings (2-10) on base plate (2-1).
Install O-rings (2-6-5) on cap assy (2-6).
Place spring seats (2-5) on cap assy (2-6), and then install them on base plate (2-1).
※ Tighten socket head bolts (2-6-6).
Apply grease to O-rings (2-6-5).



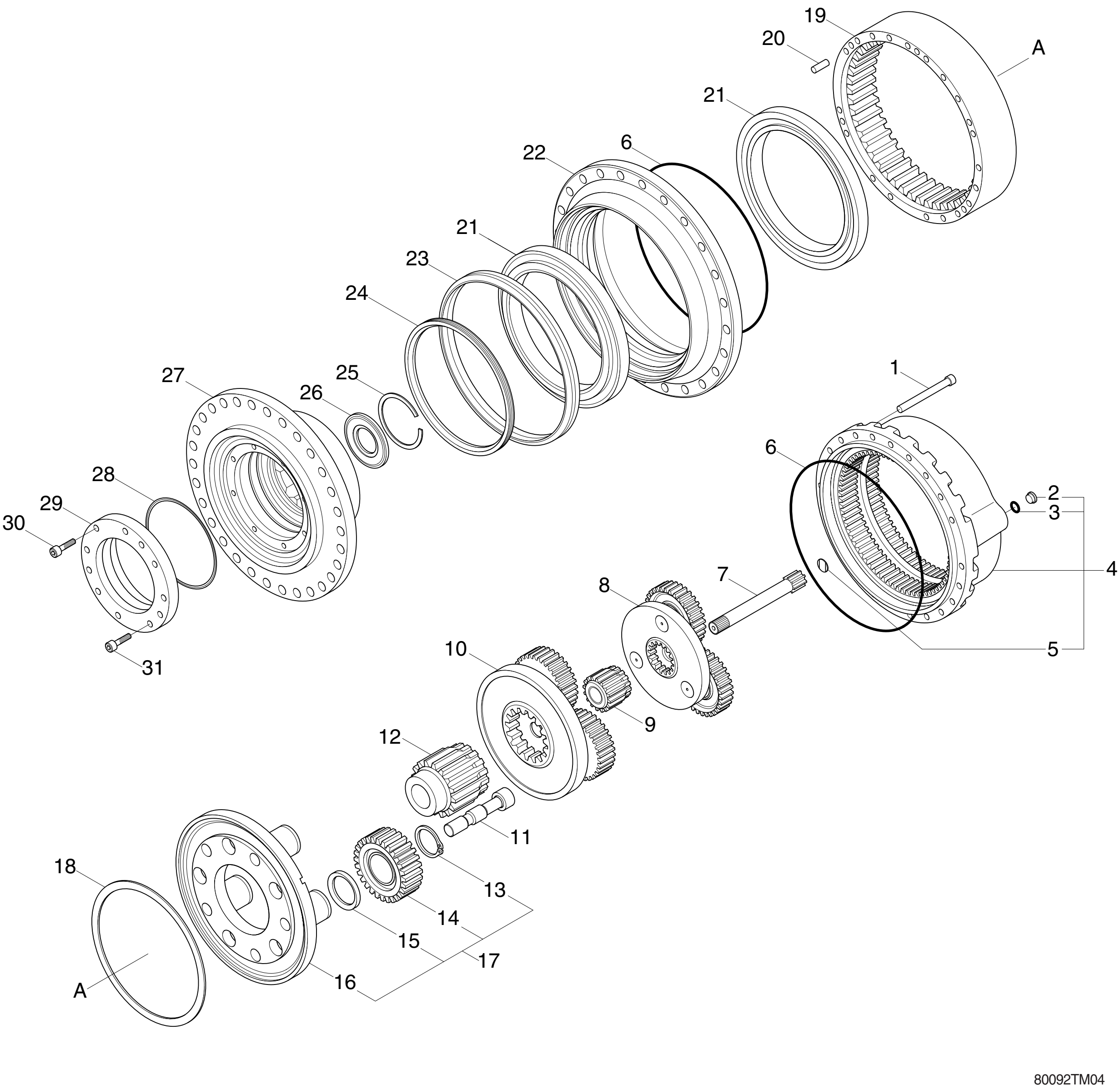
8007A8TM51



8007A8TM52

3. REDUCTION GEAR

1) STRUCTURE



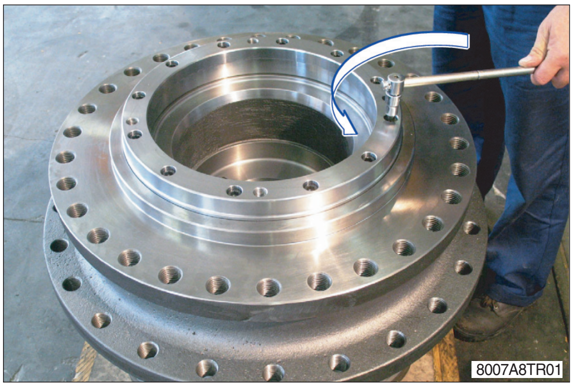
1	Screw	12	Sun gear	23	Lifetime seal
2	Oil breather plug	13	Circlip	24	Spacer
3	Washer	14	Planetary assy	25	Circlip
4	Cover assy	15	Spacer	26	Discs retainer
5	Pad	16	Planetary carrier	27	Hub
6	O-ring	17	Gear assy(3rd)	28	O-ring
7	Sun gear	18	Spacer	29	Motor adaptor
8	Gear assy(1st)	19	Toothed ring	30	Screw
9	Sun gear	20	Pin	31	Screw
10	Gear assy(2nd)	21	Bearing		
11	Screw	22	Gearbox housing		

2) DISASSEMBLING

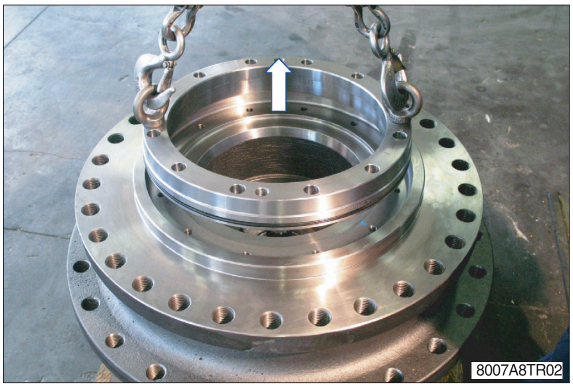
Initial inspection of the gears and the travel motor, can be made without disassembling the track and the gearmotor from the machine.

Prior to disassembling make sure that the oil is discharged, unscrew and remove the 4 screws (31), and remove the travel motor and the O-ring seal.

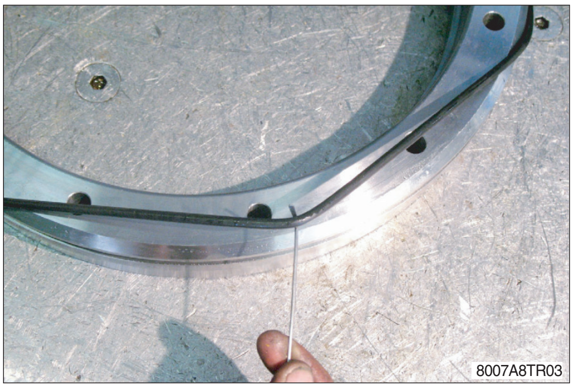
(1) Unscrew the 12 socket head screws (30) and remove the motor flange from the motor adapter (29).



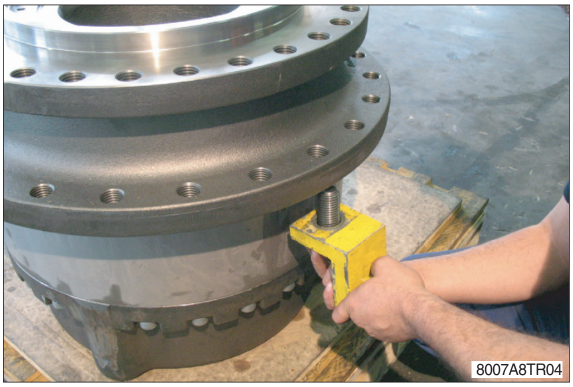
(2) By using a tackle remove the motor adapter (29).



(3) Remove the O-ring (28) from its seat in the motor adapter (29).

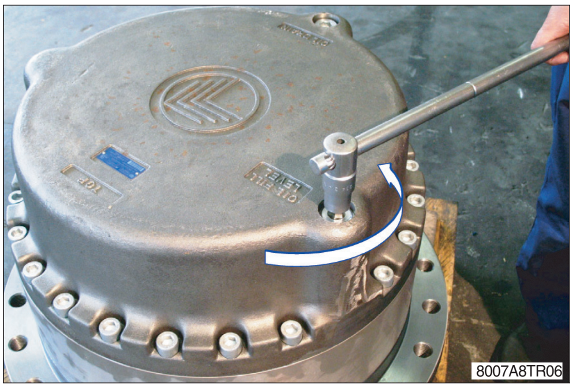


(4) Assemble the equipment on the gearbox housing (22).

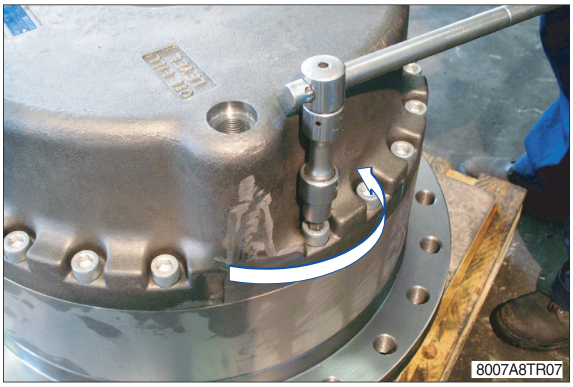


(5) By using a tackle and the equipment turn the gearbox upside down.

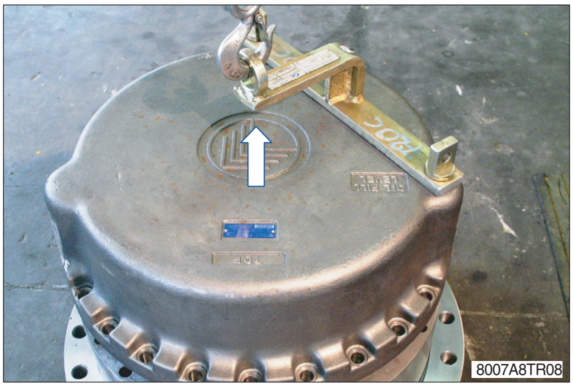
(6) Unscrew the 2 plugs (2) and the 2 washers (3) from the end cover (4).



(7) Unscrew the 21 socket head screws (1) from the end cover (4).

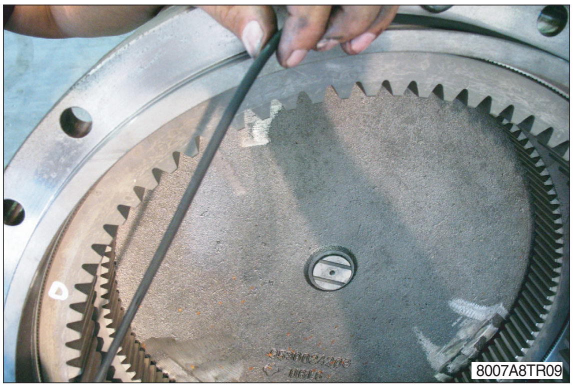


(8) By using a tackle and the equipment remove the end cover (4).



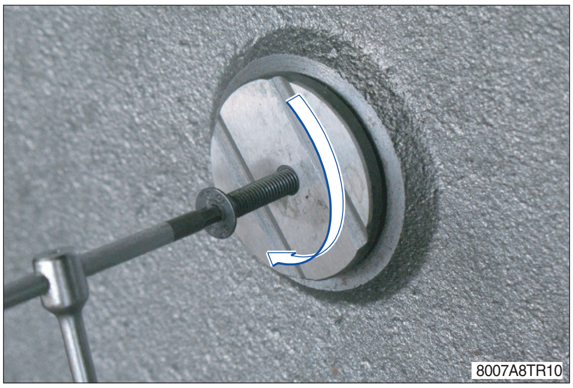
8007A8TR08

(9) Remove the O-ring (6) from its seat in the end cover (4).



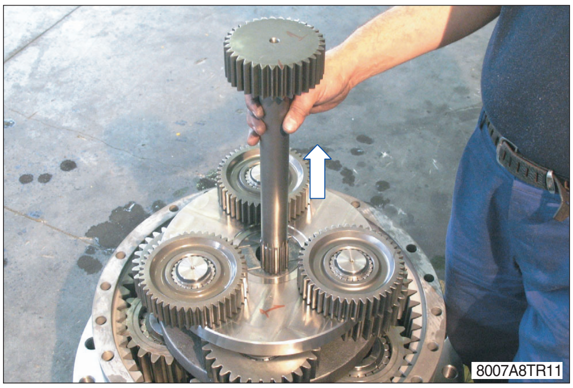
8007A8TR09

(10) Screw a socket head screw in the threaded hole of the pad (5) in order to remove it from the end cover (4).



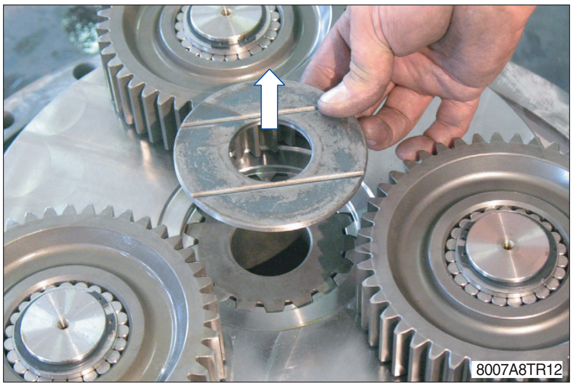
8007A8TR10

(11) Remove the 1st stage sun gear (7).

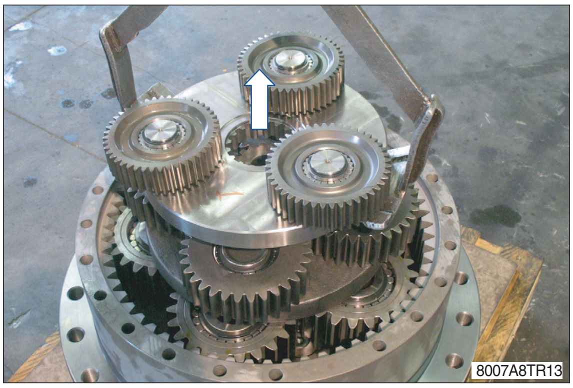


8007A8TR11

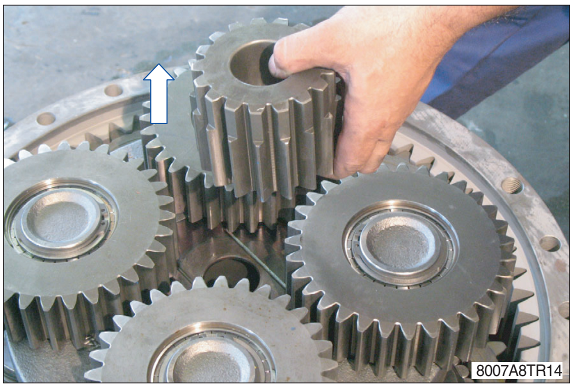
(12) Remove the centering ring.



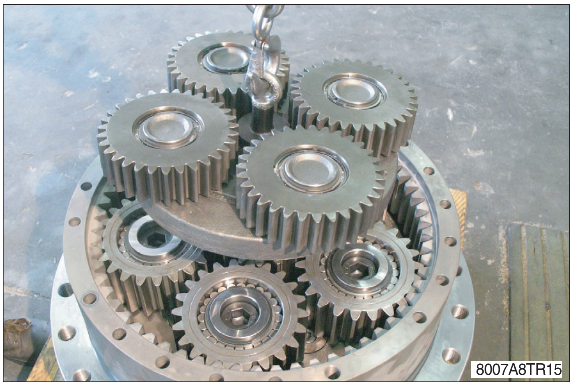
(13) By using a tackle and the equipment remove the 1st reduction assembly (8).



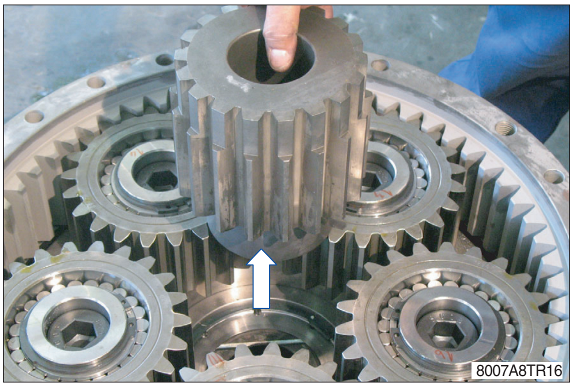
(14) Remove the 2nd stage sun gear (9).



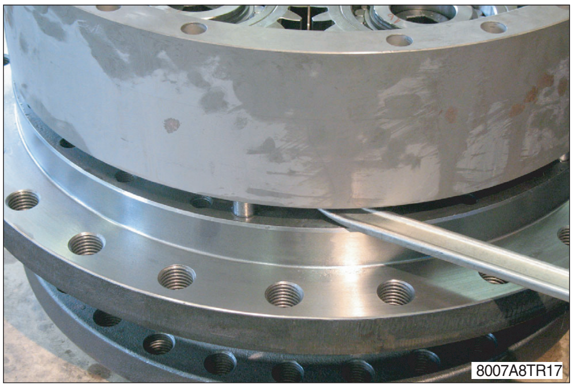
(15) By using a tackle and the equipment remove the 2nd reduction assembly (10).



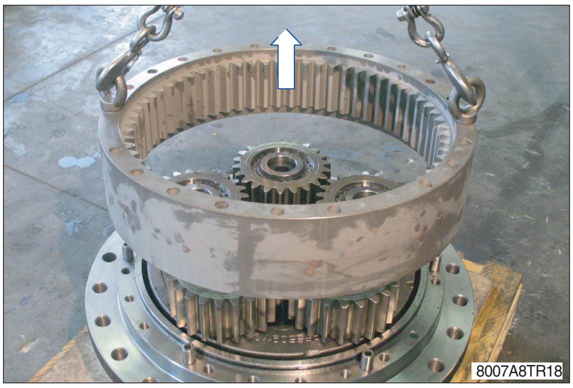
(16) Remove the 3rd stage sun gear (12).



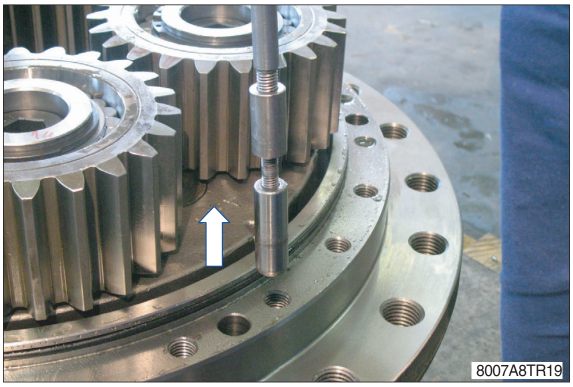
(17) By using a crowbar lift the toothed ring (19) from the gearbox housing (22).



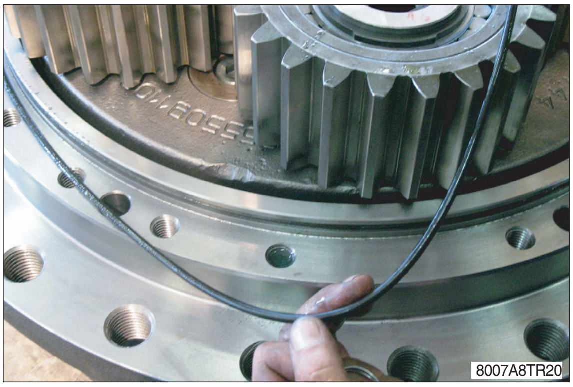
(18) Tighten 2 eye bolts on the toothed ring (19) and by using a tackle remove it from the gearbox housing (22).



(19) By using the puller remove the 6 pins (20) from the gearbox housing (22).

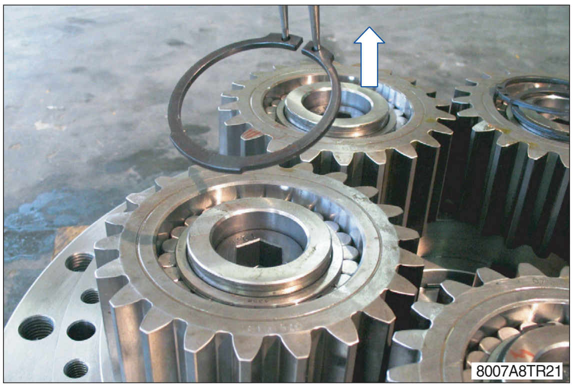


(20) Remove the O-ring (6) from its seat in the gearbox housing (22).



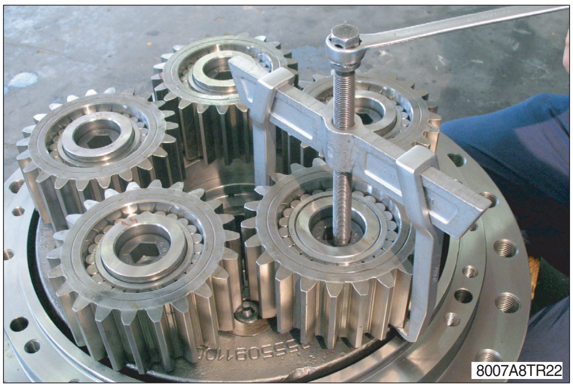
8007A8TR20

(21) By using pliers remove the circlips (13) from their seats placed in the planetary carrier's pins (16).



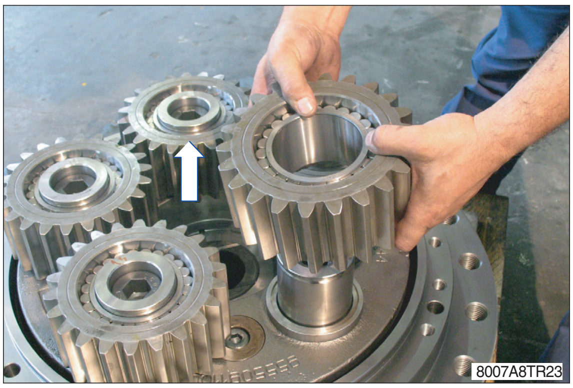
8007A8TR21

(22) By using a puller remove the planet assemblies of the 3rd reduction (14).



8007A8TR22

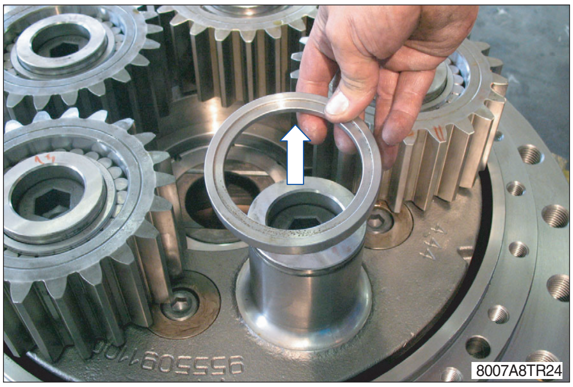
(23) Remove the planet assemblies of the 3rd reduction (14).



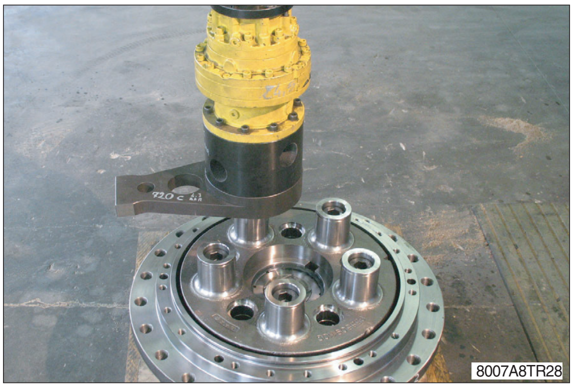
8007A8TR23

(24) Remove the spacer (15) from their seats placed in the planetary carrier's pins (16).

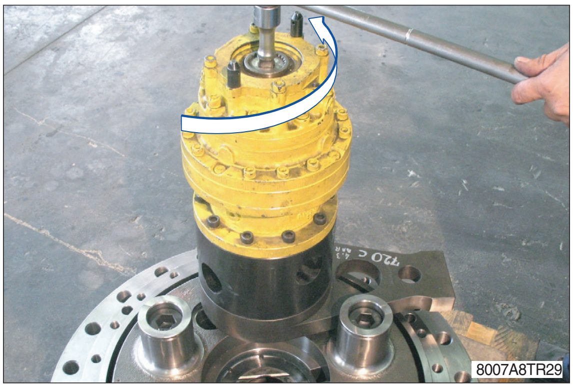
※ In order to proceed with the gearbox disassembly, it is now necessary to remove it from the machine and bring it to a properly equipped workshop.



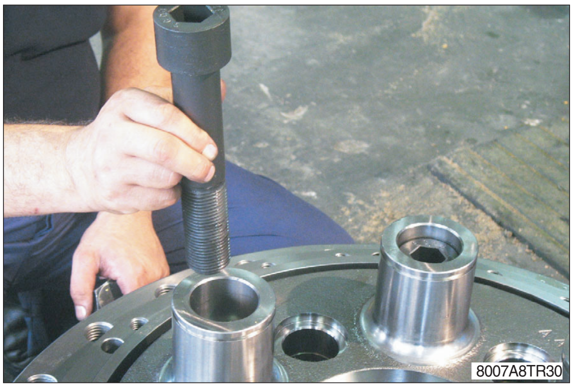
(25) By using a tackle palce the screwer on the planetary carrier's pins (16).



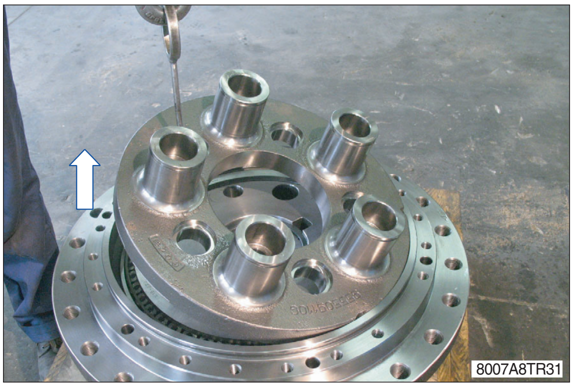
(26) By using the screwer tighten the 5 socket head screws (11) from the planetary carrier (16).



(27) Take out the nos. 5 socket head screws (11).

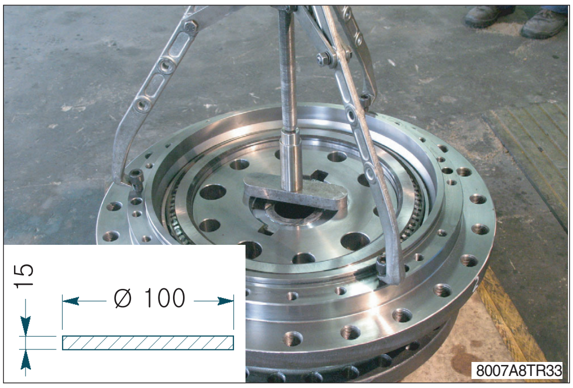


(28) By using a tackle remove the planetary carrier (16) from the gearbox housing (22).

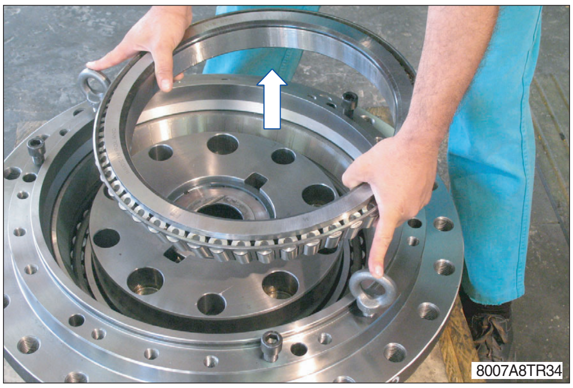


(29) By using a screwdriver, remove the spacer (18) from the planetary carrier (16).

(30) By using a puller and a metal stopper remove the flanged hub (27) from the gearbox housing (22).

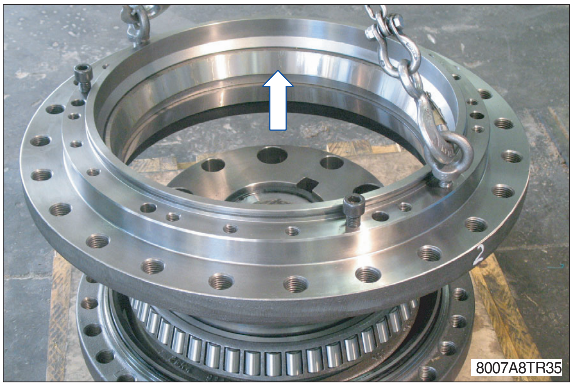


(31) Remove the bearing inner ring (21) from its seat in the gearbox housing (22).

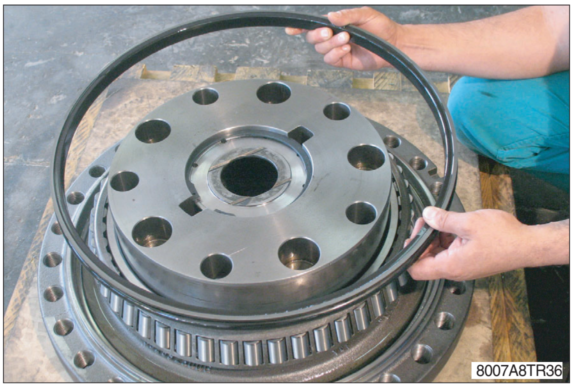


(32) Tighten 2 eye bolts on the gearbox housing (22) and by using a tackle remove it from the flanged hub (27).

※ In case of oil leakages, it might be necessary to check and eventually replace the lifetime seal (23), which means both the steel rings and the O-ring seals.

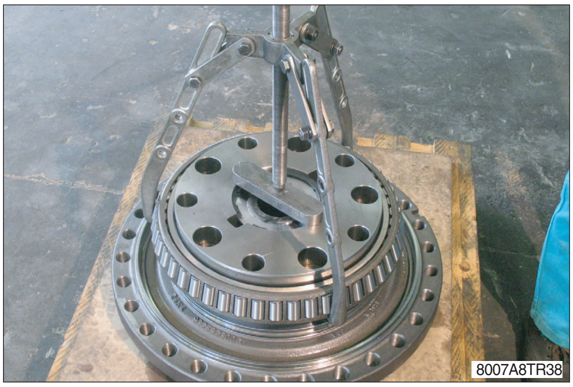


(33) Remove the half-seal (23) from the flanged hub (27).

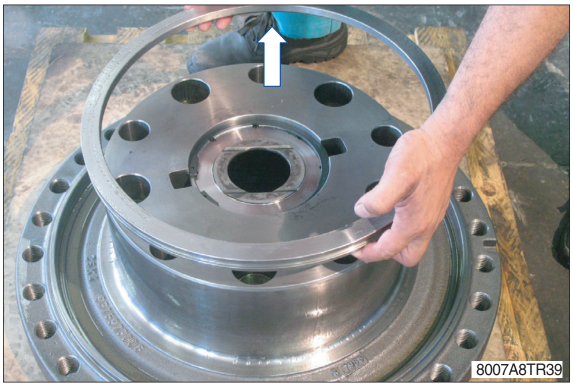


(34) Remove the half-seal (23) from the gearbox housing (22).

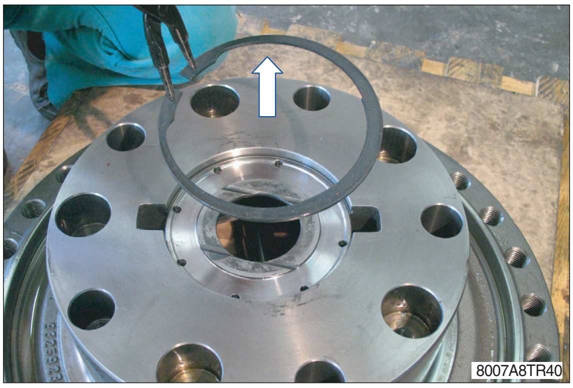
(35) By using a puller remove the bearing inner ring (21) from the flanged hub (27).



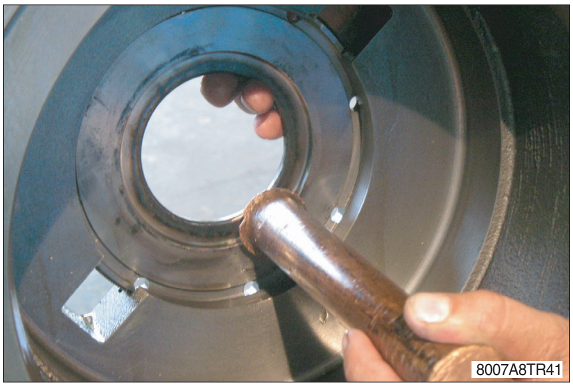
(36) Remove the spacer (24) from its seat in the flanged hub (27).



(37) By using pliers remove the circlip (25) from its seat in the flanged hub (27).

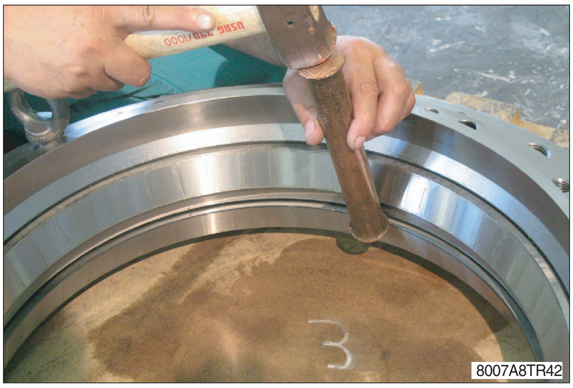


(38) By using a punch remove the discs retainer (26) from the flanged hub (27).



(39) By using a rubber hammer and a punch remove the bearing outer rings (21) from the gearbox housing (22).

※ The gearbox disassembly ends with the above operation. All the parts are now available for the necessary inspections.

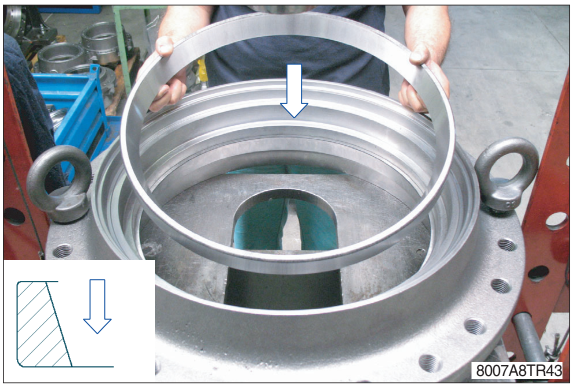


3) REASSEMBLY

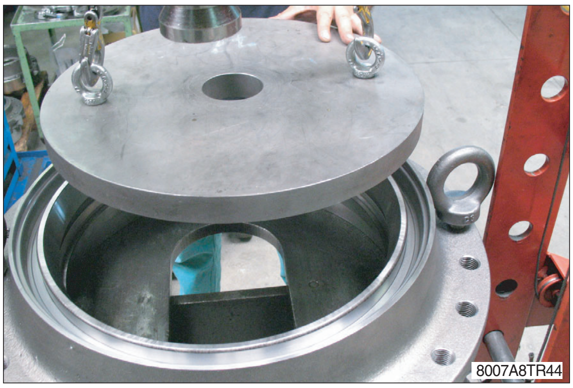
※ The pieces that are subject to general wear and tear are the following:
- Gears
- Bearings
- All the seals

※ Replace the used or irregular parts respecting the following steps:
- Accurately remove dirt, and in particular properly clean the seals, bearings and locking rings seating.
- Lubricate the parts before connecting them.
- In the case of damaged gears, for example a planetary, do not proceed to replace the individual gear but the entire reduction assembly.
- When reconnecting a part always replace all the seals involved. Add some grease on the seats and on the new seals to make easier the reassembly.

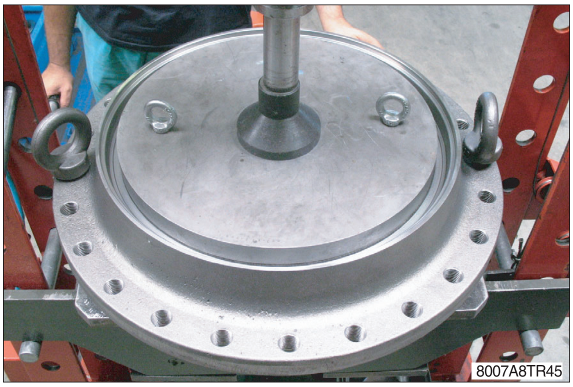
(1) Assemble the bearing inner ring (21) in the gearbox housing (22).



(2) Place the equipment on the bearing outer ring (21).



(3) By using a press and the stopper push the bearing outer ring (21) against the gearbox housing shoulder (22).



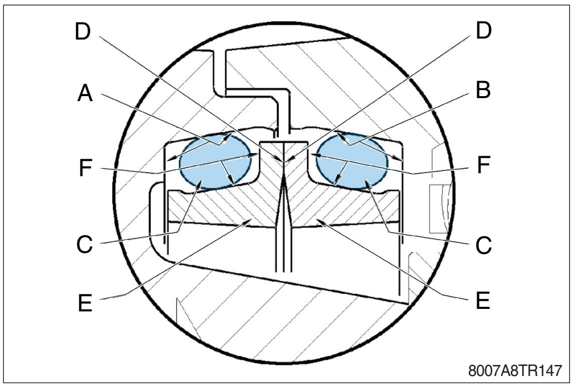
(4) Insert the spacer (24) on the flanged hub (27).

※ Make ready of the lifetime seal:

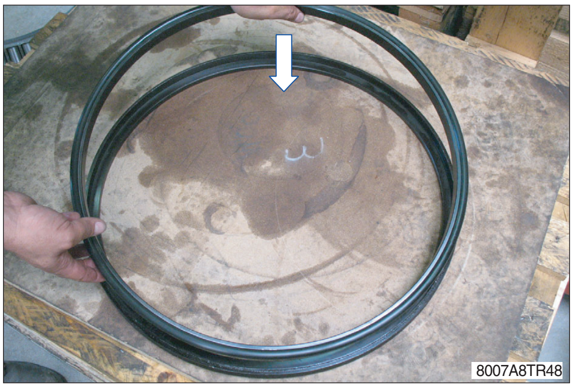
① Carefully clean the seats (A and B) using, if necessary, metallic brushes or solvent (surfaces in contact with or (c) must be perfectly clean and dry).

② Make sure that sealing surfaces (D) of metal rings (E) are free from scratches, dinges or foreign substances; metallic ring surfaces must be perfectly clean and dry. We suggest to dip the metallic rings in volatile solvent or industrial degreasing alcohol.

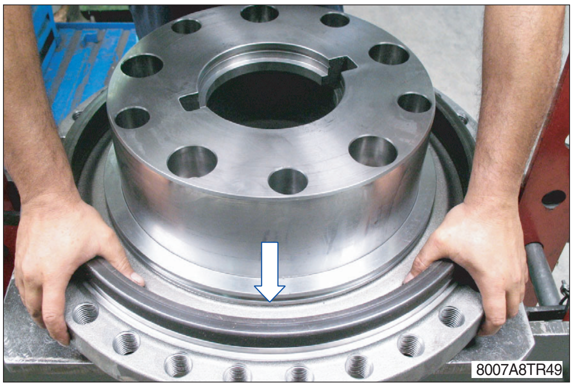
③ Carefully clean the lapped surface (D) of metal rings (E) and remove dust or fingerprints. Then lubrificate them with a thin oil film, taking care not to oil the other components.



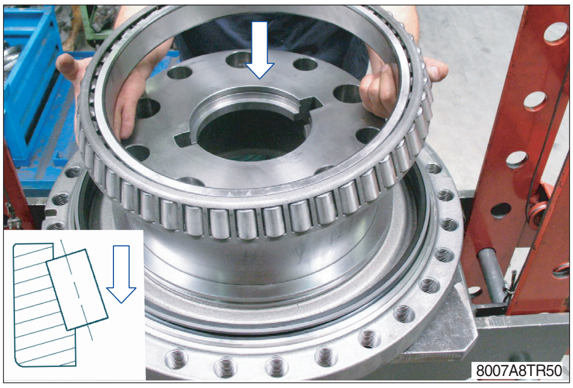
(5) Assemble the half seal (23) on the tool.



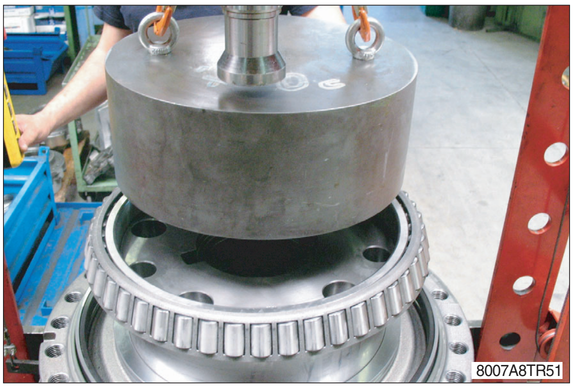
(6) Assemble the 1st half seal (23) in the flanged hub (27).



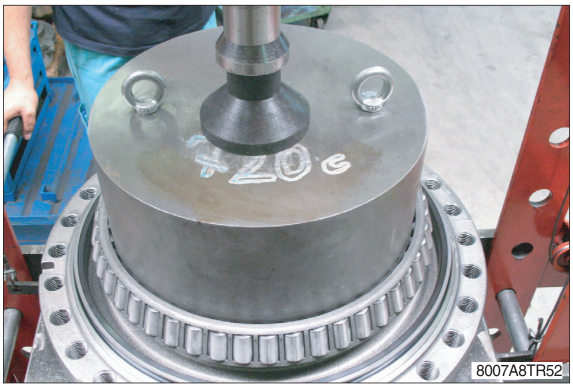
(7) Assemble the bearing inner ring (21) in the flanged hub (27).



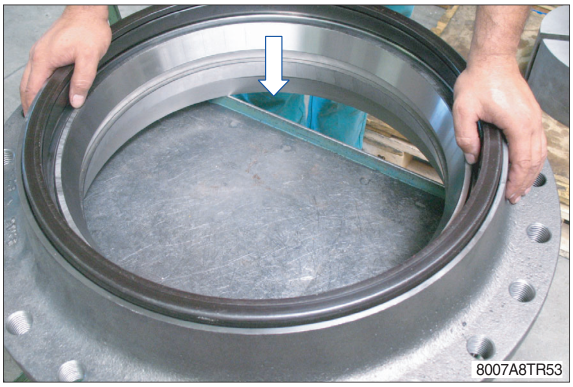
(8) Place the equipment on the bearing inner ring (21).



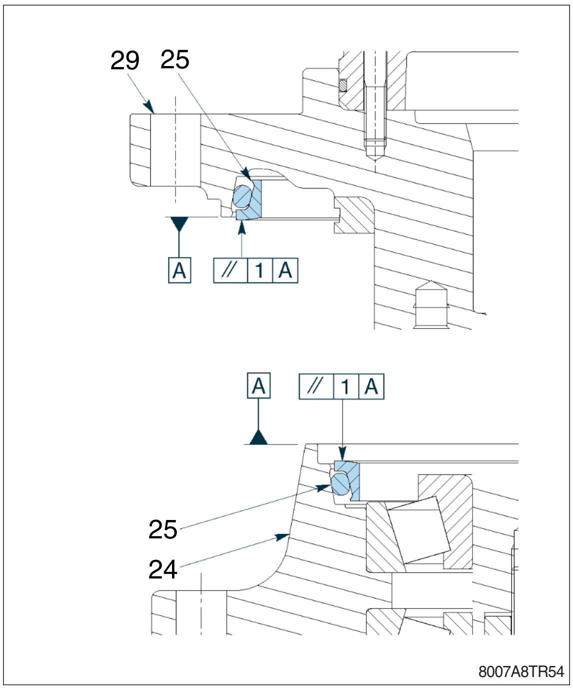
(9) By using a press and the stopper push the bearing inner ring (21) against the flanged hub shoulder (27).



(10) Insert the 1st reduction assembly (8).

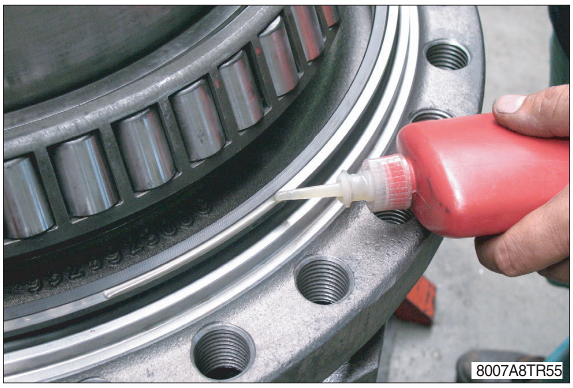


※ Correct lifetime seal (23) assembly check.

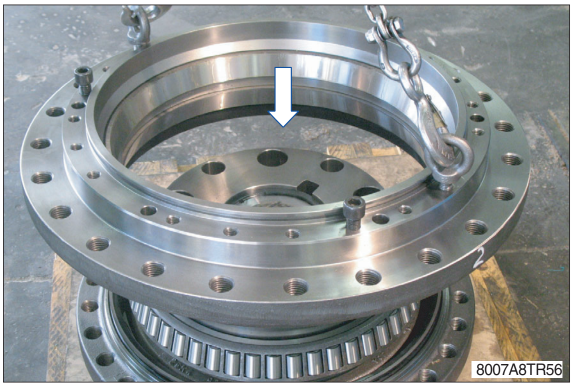


(11) Clean carefully the seal faces (23).

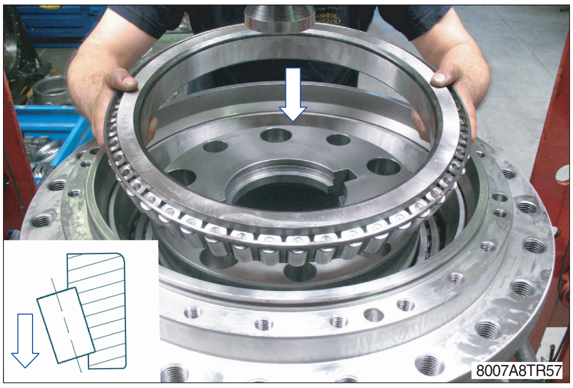
※ Apply a thin oil film on the entire metallic face of one or both seals. Oil must not contact surfaces other than the sealing faces.



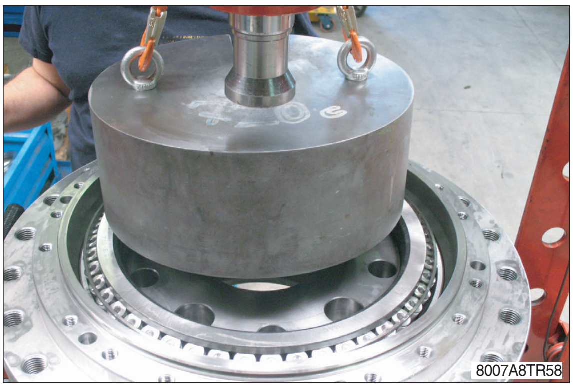
(12) By using a tackle place the gearbox housing (22) on the flanged hub (27).



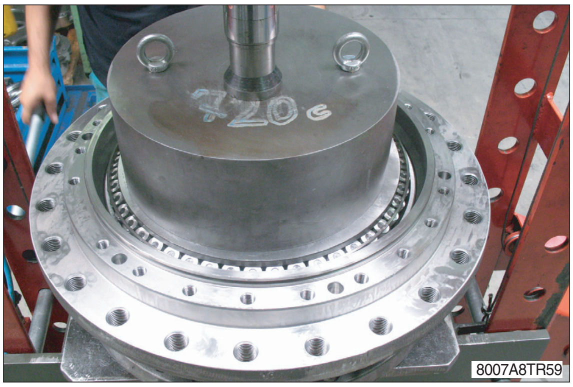
(13) Assemble the bearing inner ring (21) on the flanged hub (27).



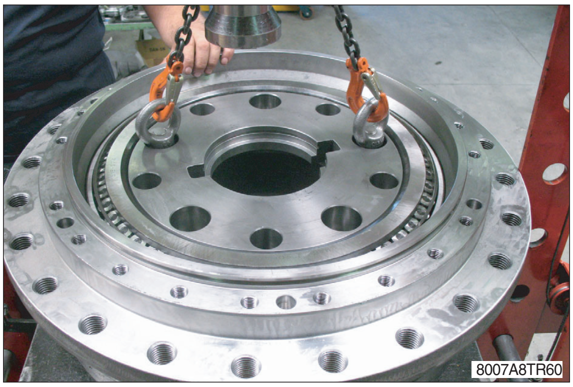
(14) Place the equipment on the bearing inner ring (21).



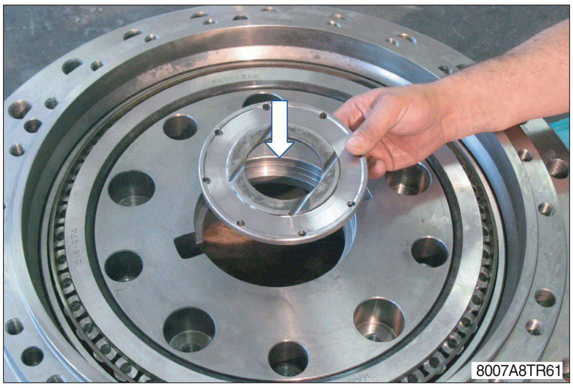
(15) By using a press and the stopper push the bearing inner ring (21) against the shoulder of the flanged hub (27) until assembling of the unit is complete.



(16) By using a tackle remove the gearbox by the press.

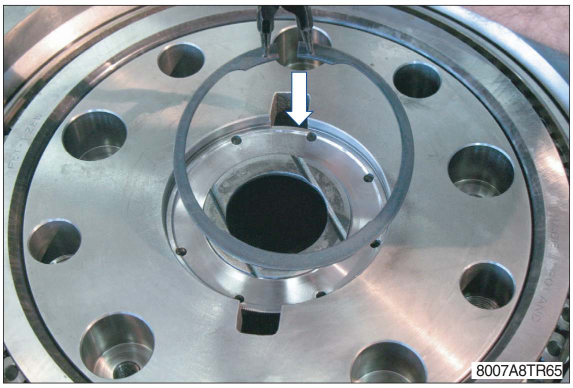


(17) Place the discs retainer (26).



(18) By using a rubber hammer push the discs retainer (26) against the shoulder until assembly is complete.

(19) By using pliers assemble the circlip (13) into its seat on the flanged hub (27).



※ In case of bearings (21), gearbox housing (22) or flanged hub (27) replacing, follow the steps here below before proceeding with reassembling.

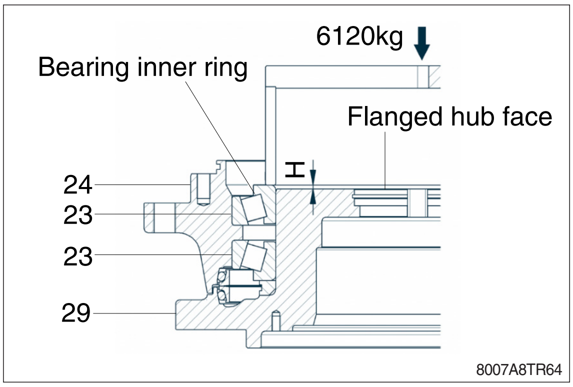
① Position the stopper on bearing (21).

② By using a press apply a load of 6120 kg (13500 lb) on the stopper.

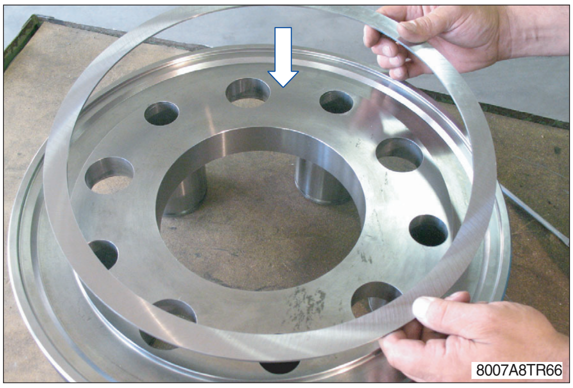
③ Measure the control value "H"

④ Reduce the thickness "S" of the spacer (18) flattening the bearing areas at the following value;
S = 10 - H - 0.1

⑤ Assemble the planet carrier (16) to the flanged hub (27) and by a dynamometric wrench find the necessary torque for the gearbox housing rotation (22).
8.2~12.2 kgf · m (59.3~88.2 lbf · ft)

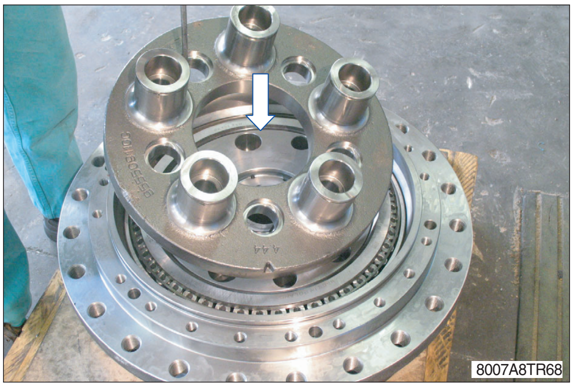


(20) Assemble the spacer (18) on the planetary carrier (16).

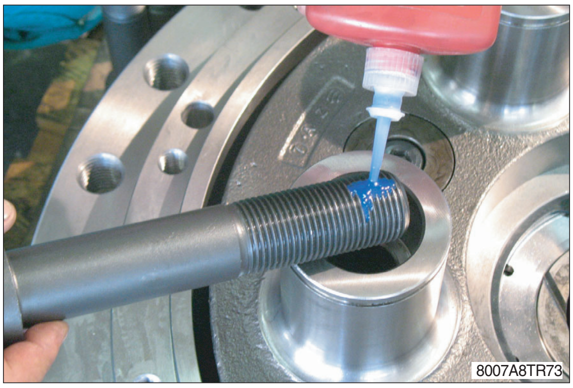


(21) By using a rubber hammer push the spacer (18) against the shoulder until assembly is completed.

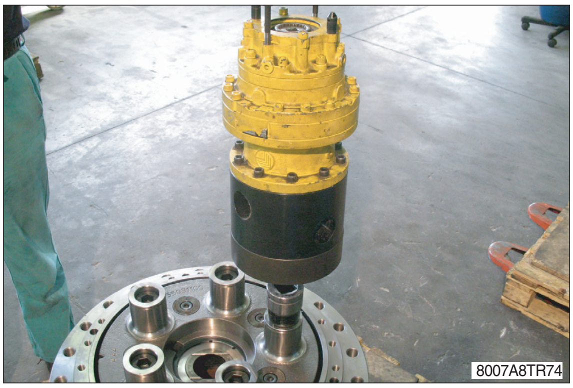
(22) By using a tackle place the planetary carrier (16) on the flanged hub (27).



(23) Apply LOCTITE type 243 on the 5 socket head screws (11).

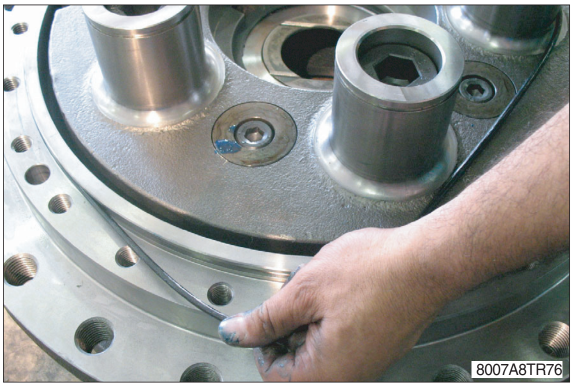


(24) By using a tackle place the screwer on the planetary carrier's pins (16).

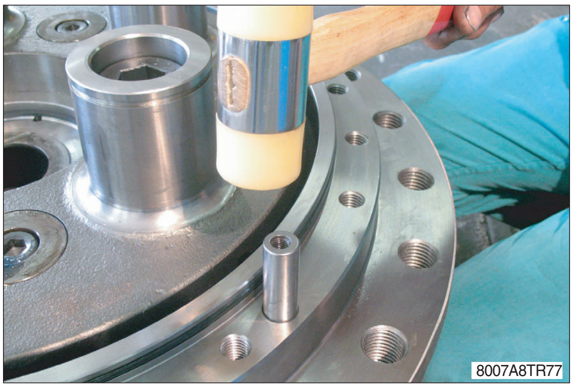


(25) By using the screwer tighten the socket head screws (11), by a torque wrench with an input multiplier torque of 6.7 kgf · m (48.5 lbf · ft) corresponding to an output multiplier torque of 342 kgf · m (2474 lbf · ft).

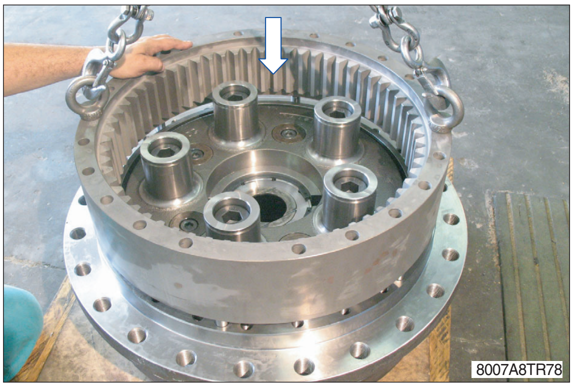
(26) Assemble the O-ring (6) into its seat in the gearbox housing (22).



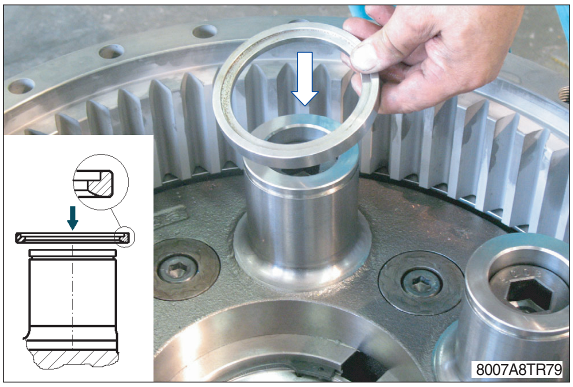
(27) By using a rubber hammer push the 6 pins (20) against the shoulder until assembly is completed.



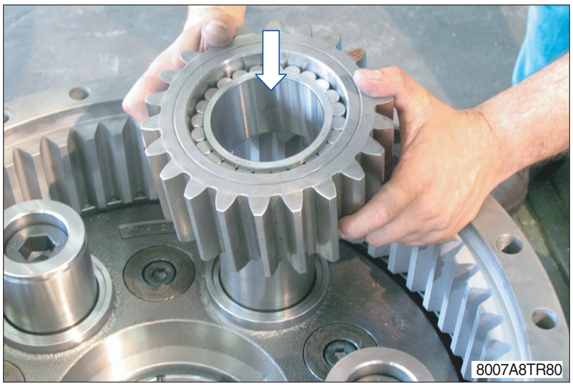
(28) By using a tackle assemble the toothed ring and, by using a rubber hammer, push it against the shoulder until assembly is completed.



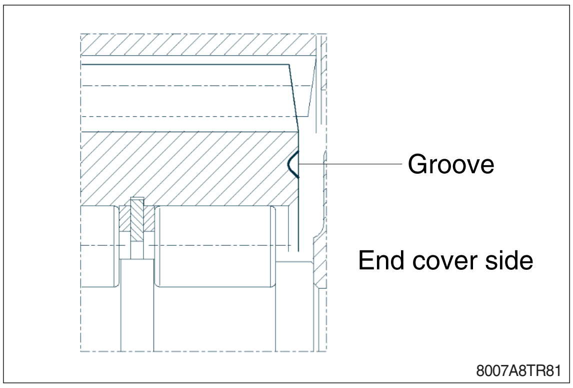
(29) Assemble correctly the spacers (15) on the pins of the planetary carrier (16).



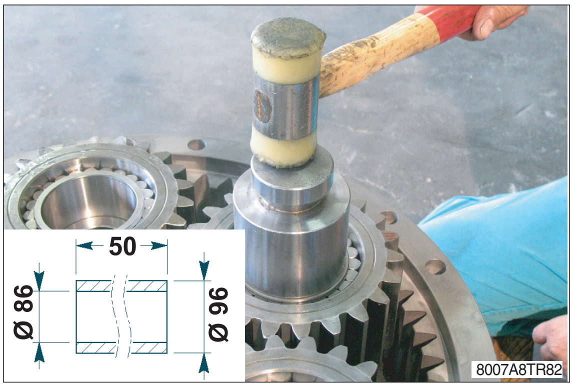
(30) Place the reduction planet assemblies of the 3rd reduction (14) on the pins of the planetary carrier (16).



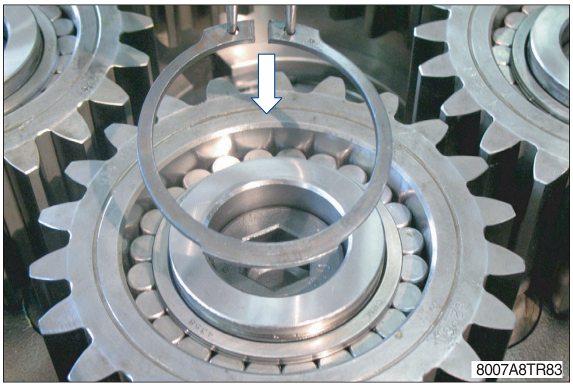
※ Place correctly the reduction planet assemblies checking that the groove is towards the end cover.



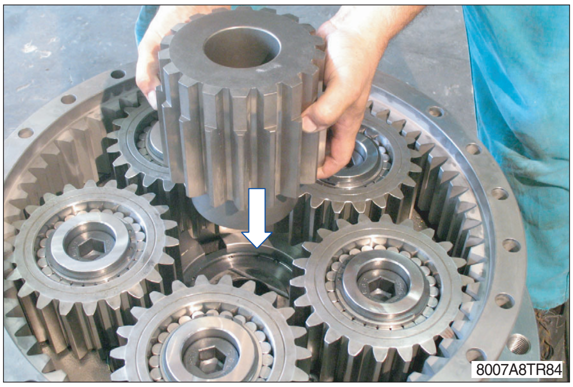
(31) By using a stopper and a rubber hammer push the planet assemblies of the 3rd reduction (16) against the shoulder until assembly is completed.



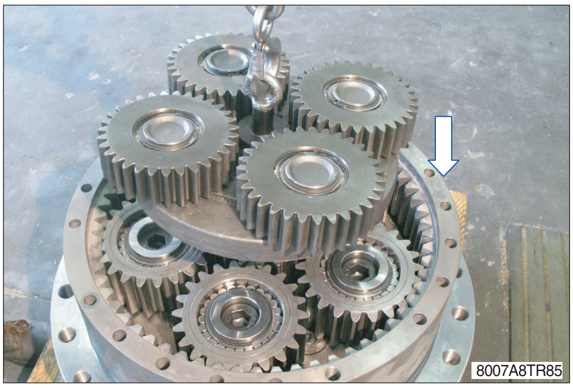
(32) By using pliers, assemble the circlips (13) in the planetary carrier pin seats (16).



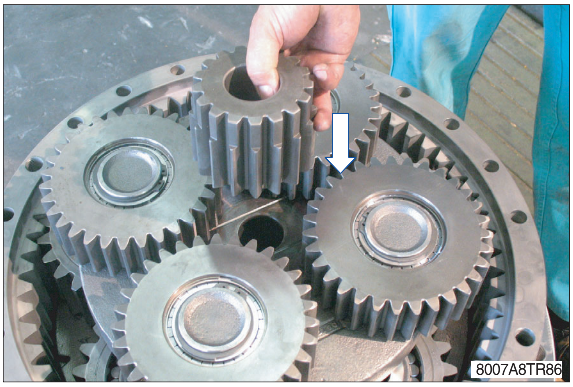
(33) Insert the 3rd stage sun gear (12).



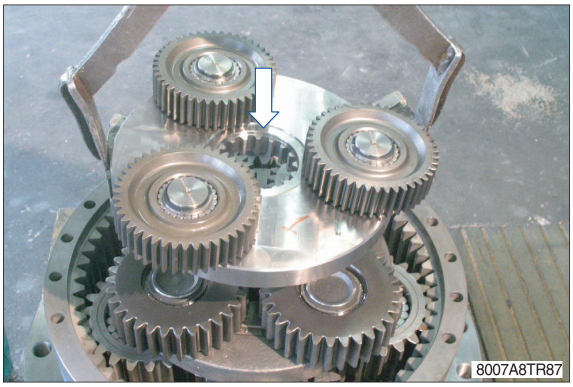
(34) By using a tackle and the equipment assemble the 2nd reduction assembly (10).



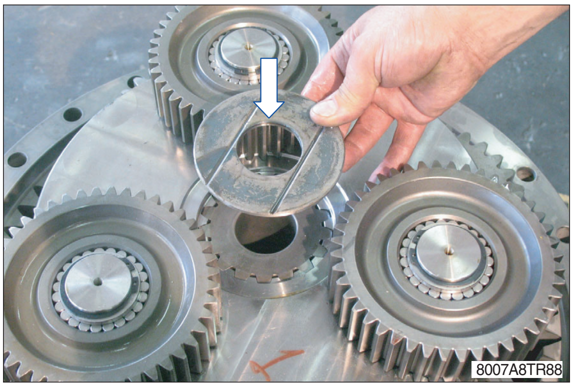
(35) Insert the 2nd stage sun gear (9).



(36) By using a tackle and the equipment assemble the 1st reduction assembly (8).

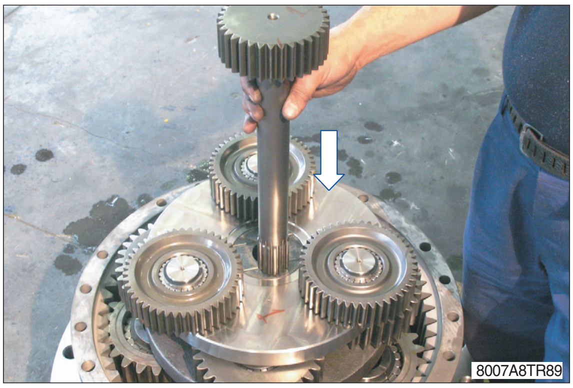


(37) Assemble the centering ring.



8007A8TR88

(38) Insert the 1st stage sun gear (7).

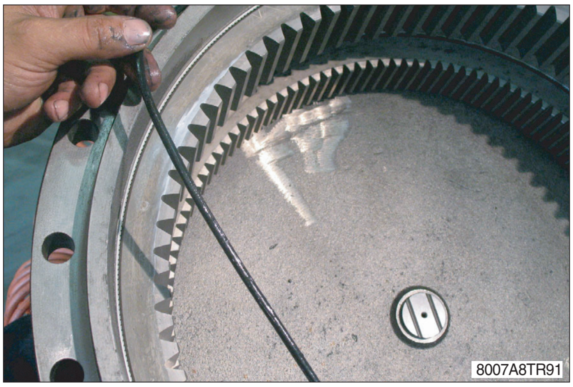


8007A8TR89

(39) By using a punch and a rubber hammer press the pad (5) against the shoulder of the end cover (4).

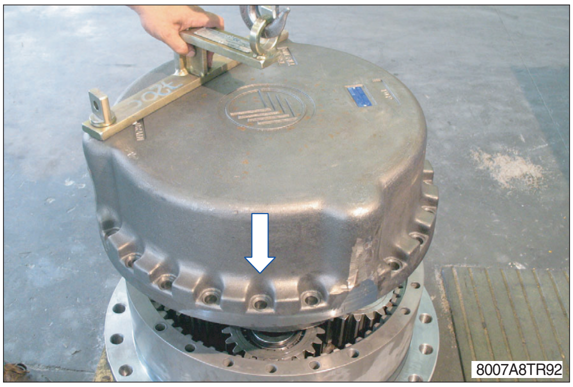
8007A8TR90

(40) Assemble the O-ring (6) into its seat in the end cover (4).



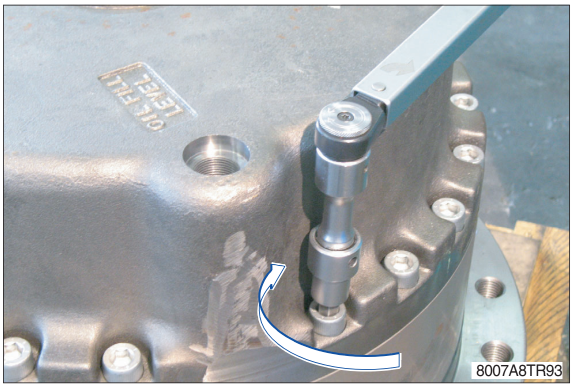
8007A8TR91

(41) By using a tackle and the equipment place the end cover (4) on the toothed ring (19).



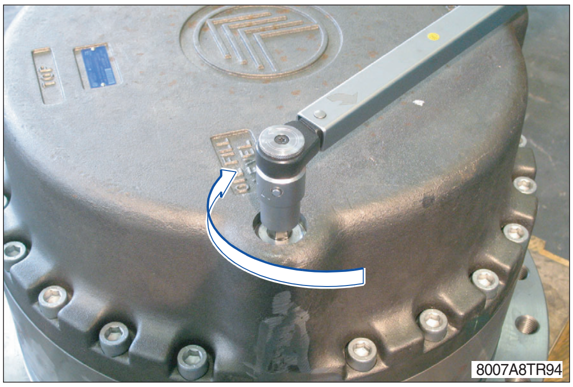
8007A8TR92

(42) Tighten the 21 socket head screws (1) by a torque wrench at 48.9 kgf · m (354 lbf · ft) torque.



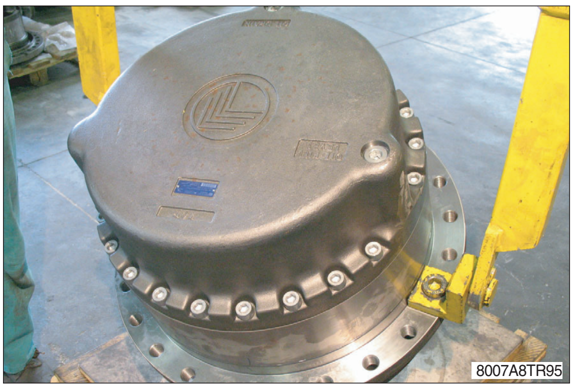
8007A8TR93

(43) Insert the washers (3) and the plugs (2) into the oil draing-filling holes of the end cover (4). Tighten the plugs by a torque wrench at 7.1±1.0 kgf · m (51.4±7.2 lbf · ft) torque.



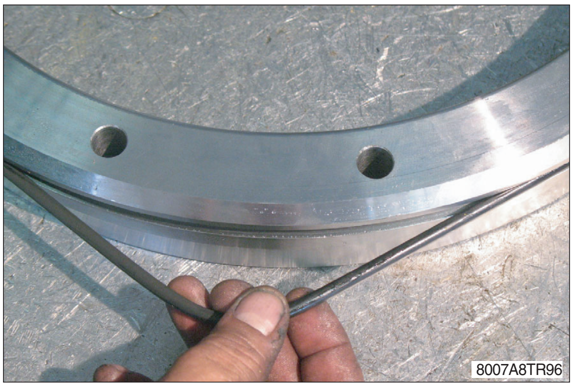
8007A8TR94

(44) By using a tackle and the equipment turn the gearbox upside down.

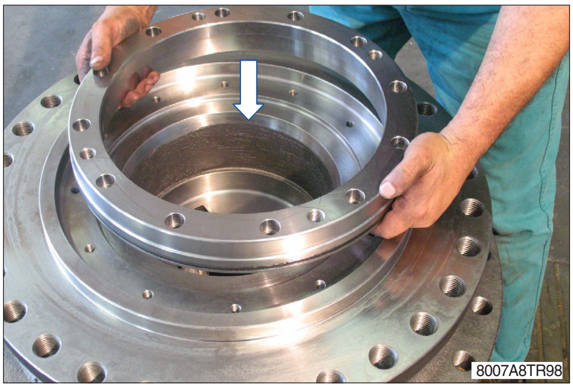


8007A8TR95

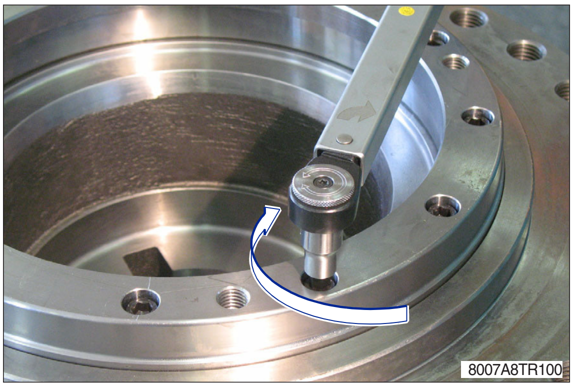
(45) Assemble the O-ring (28) into its seat in the motor adapter flange (29).



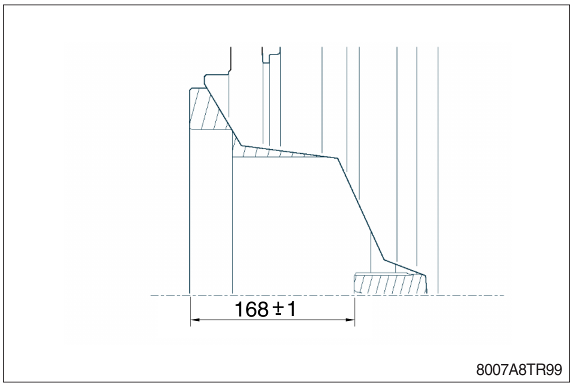
(46) Position the motor adapter flange (29) on the gearbox.



(47) Tighten the 12 socket head screws (30) by a torque wrench torque.



※ Before assembling the hydraulic motor, verify by a depth slide gauge the correct assembly of the unit checking the axial distance as shown in the figure.



GROUP 7 RCV LEVER

1. REMOVAL AND INSTALL

1) REMOVAL

(1) Lower the work equipment to the ground and stop the engine.

(2) Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

(3) Loosen the breather slowly to release the pressure inside the hydraulic tank.

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


13031GE18

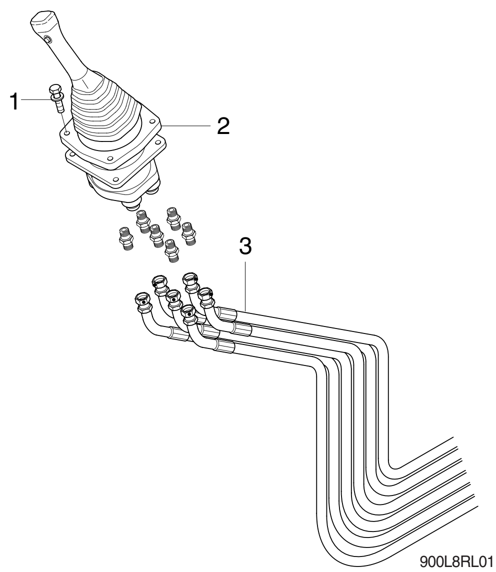
(4) Loosen the socket bolt (1).

(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.



900L8RL01

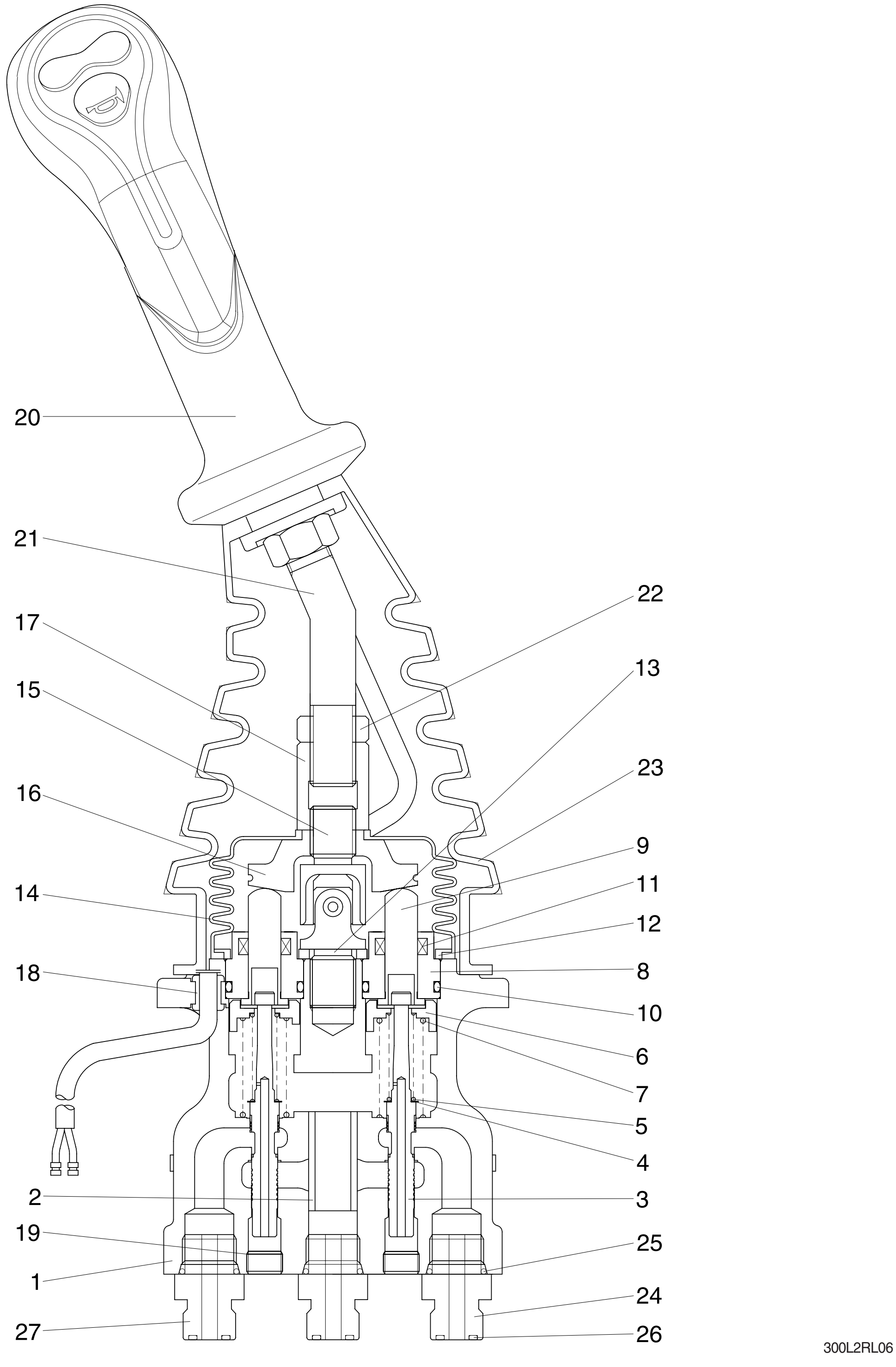
2) INSTALL

(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

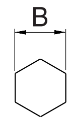
1) STRUCTURE



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

2) TOOLS AND TIGHTENING TORQUE

(1) Tools

Tool name	Remark	
Allen wrench	6	
Spanne	22	
	27	
(+) Driver	Length 150	
(-) Driver	Width 4~5	
Torque wrench	Capable of tightening with the specified torques	

(2) Tightening torque

Part name	Item	Size	Torque	
			kgf · m	lbf · ft
Joint	15	M14	3.5	25.3
Swash plate	16	M14	5.0±0.35	36.2±2.5
Adjusting nut	17	M14	5.0±0.35	36.2±2.5
Lock nut	22	M14	5.0±0.35	36.2±2.5

3) DISASSEMBLY

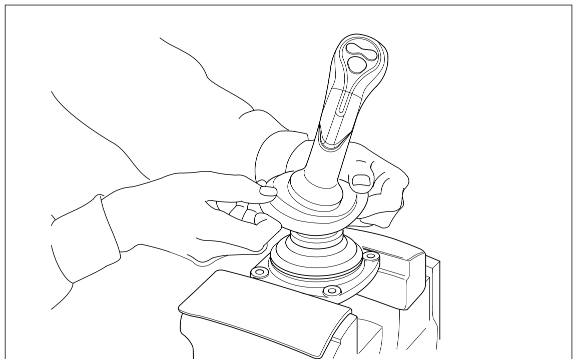
※ Procedures are based on the type L1.

(1) Clean pilot valve with kerosene.

※ Put blind plugs into all ports

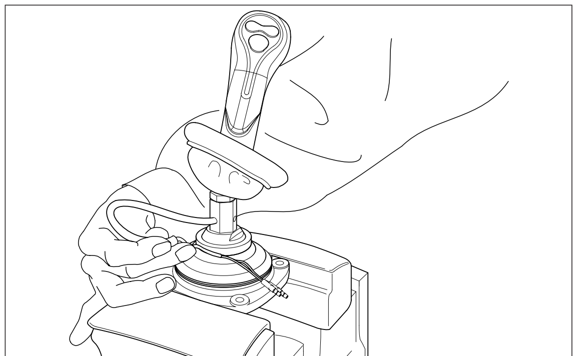
(2) Fix pilot valve in a vise with copper (or lead) sheets.

(3) Remove end of boot (23) from case (1) and take it out upwards.



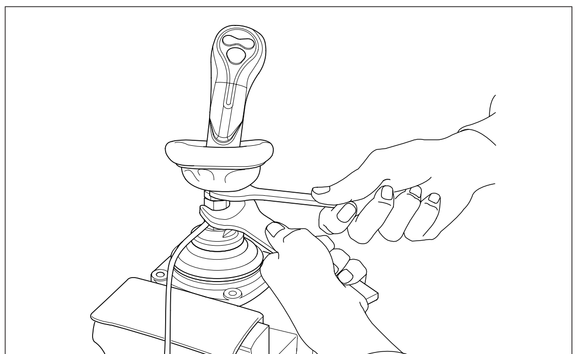
300E8RL01

※ For valve with switch, remove cord also through hole of casing.



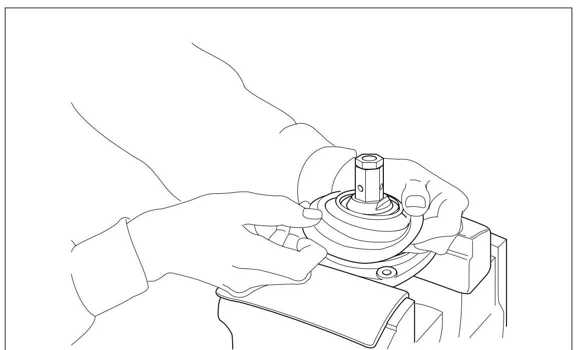
300E8RL02

(4) Loosen lock nut (22) and adjusting nut (17) with spanners on them respectively, and take out handle section as one body.



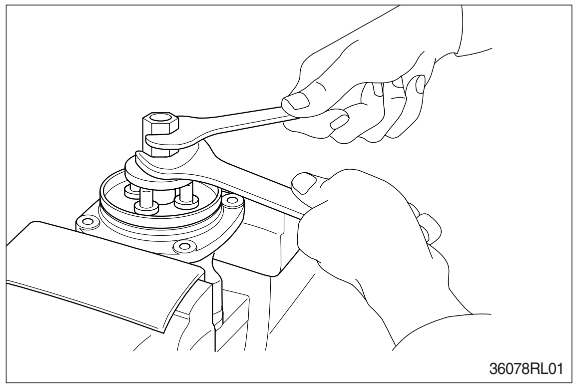
300E8RL03

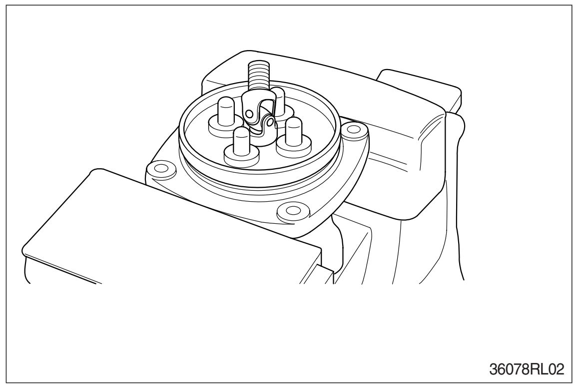
(5) Remove the boot (14).



1408DA61

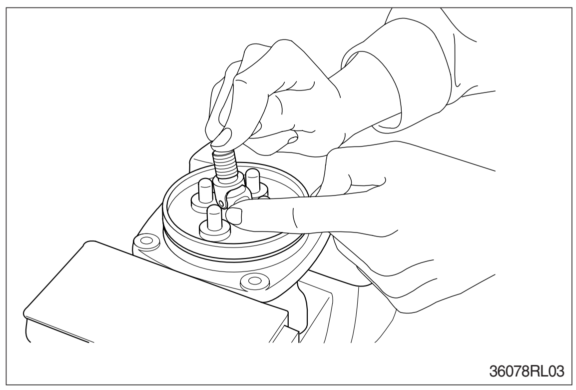
(6) Loosen adjusting nut (17) and swash plate (16) with spanners on them respectively, and remove them.

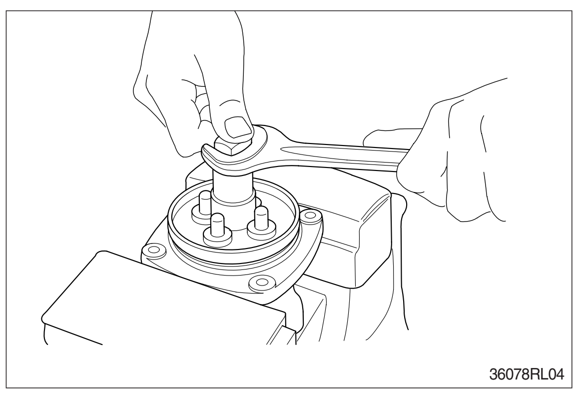




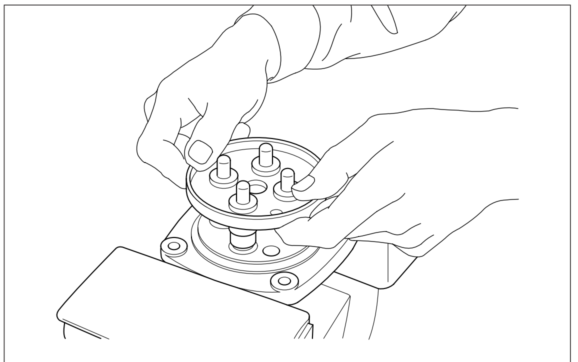
(7) Turn joint anticlockwise to loosen it, utilizing jig (Special tool).

※ When return spring (7) is strong in force, plate (12), plug (8) and push rod (9) will come up on loosening joint.
Pay attention to this.





(8) Remove plate (12).

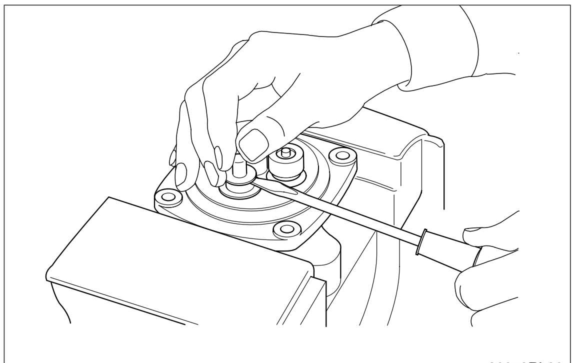


36078RL05

(9) When return spring (7) is weak in force, plug (8) stays in casing because of sliding resistance of O-ring.

※ Take it out with minus screwdriver.
Take it out, utilizing external periphery groove of plug and paying attention not to damage it by partial loading.

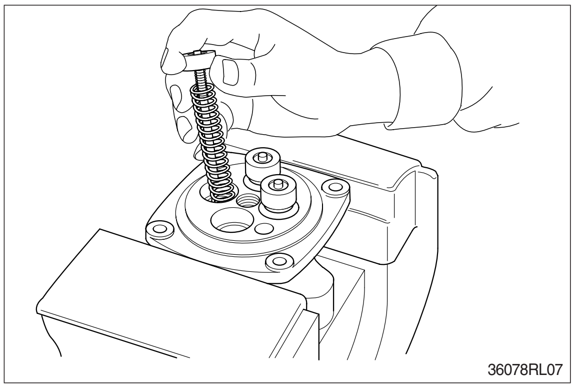
※ During taking out, plug may jump up due to return spring (7) force.
Pay attention to this.



36078RL06

(10) Remove reducing valve subassembly and return spring (7) out of casing.

※ Record relative position of reducing valve subassembly and return springs.



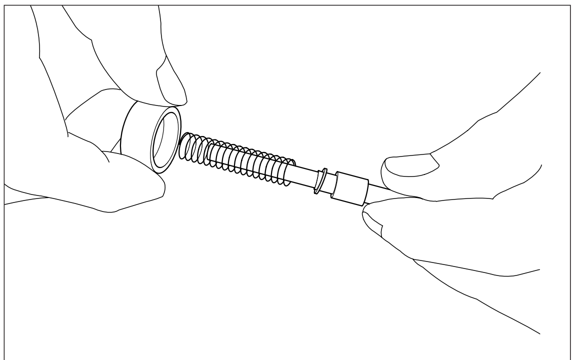
36078RL07

(11) Separate spool (3), spring seat (6), spring (5) and shim (4) individually.

※ Pay attention not to damage spool surface.

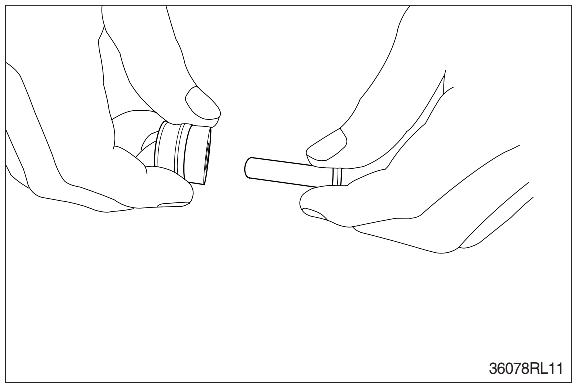
※ Record original position of spring seat (6).

※ Until being assembled, they should be handled as one subassembly group.

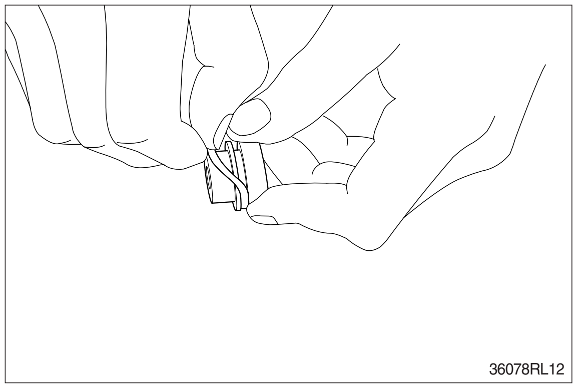


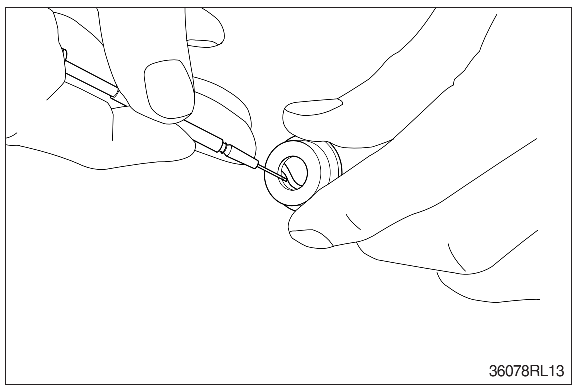
36078RL10

(12) Take push rod (9) out of plug (8).

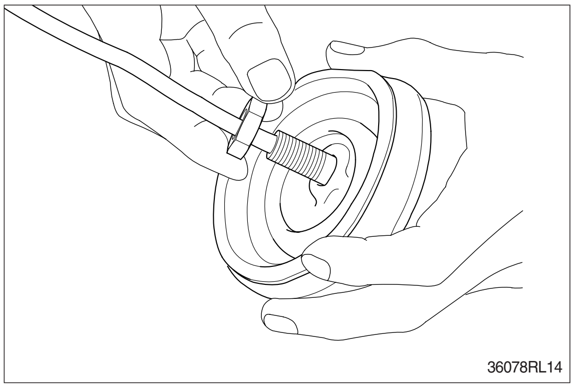

36078RL11

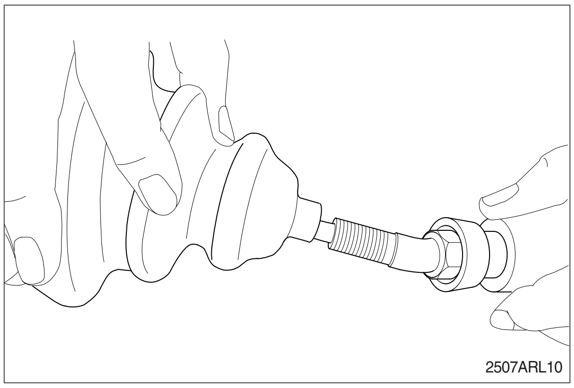
(13) Remove O-ring (10) and seal (11) from plug (8).
Use small minus screwdriver or so on to remove this seal.


36078RL12


36078RL13

(14) Remove lock nut (22) and then boot (23).





(15) Cleaning of parts

① Put all parts in rough cleaning vessel filled with kerosene and clean them (rough cleaning).

※ If dirty part is cleaned with kerosene just after putting it in vessel, it may be damaged. Leave it in kerosene for a while to loosen dust and dirty oil.

※ If this kerosene is polluted, parts will be damaged and functions of reassembled valve will be degraded.
Therefore, control cleanliness of kerosene fully.

② Put parts in final cleaning vessel filled with kerosene, turning it slowly to clean them even to their insides (finish cleaning).

※ Do not dry parts with compressed air, since they will be damaged and/or rusted by dust and moisture in air.

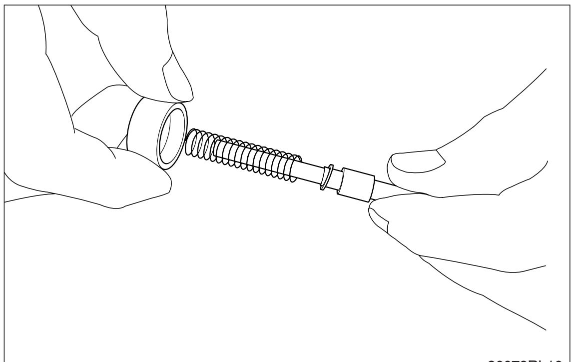
(16) Rust prevention of parts

Apply rust-preventives to all parts.

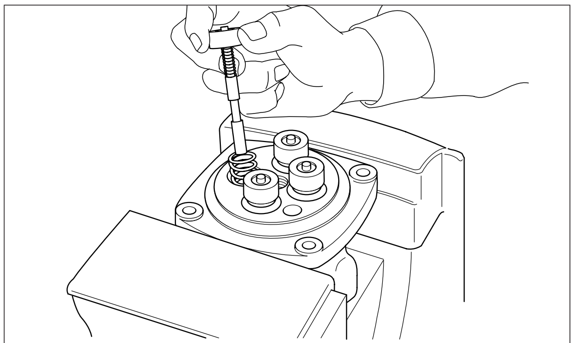
※ If left as they after being cleaned, they will be rusted and will not display their functions fully after being reassembled.

4) ASSEMBLY

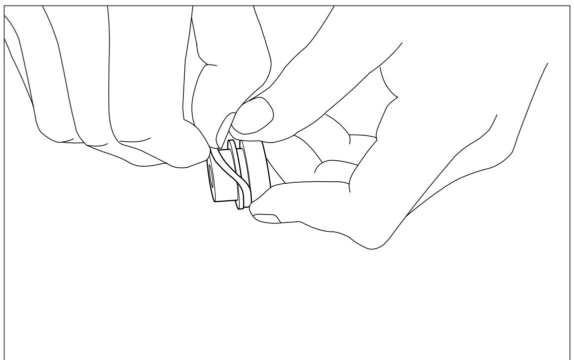
(1) Put shim (4), springs (5) and spring seat (6) onto spool (3) in this order.


36078RL16

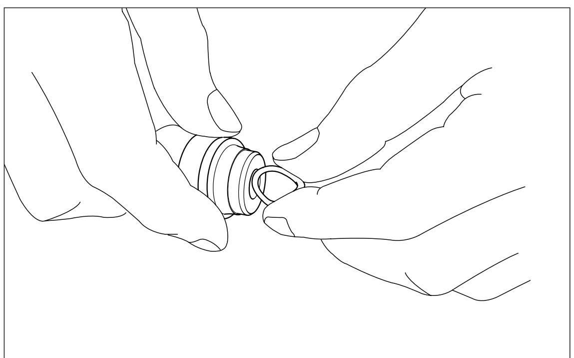
(2) Assemble spring (7) into casing (1).
Assemble reducing valve subassembly into casing.
※ Assemble them to their original positions.


36078RL18

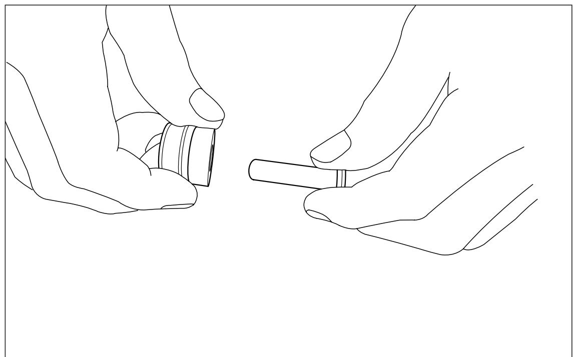
(3) Assemble O-ring (10) onto plug (8).


36078RL19

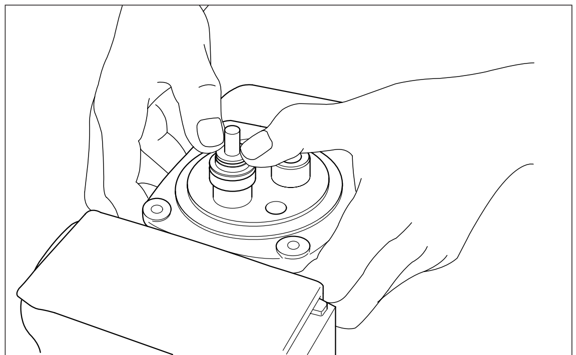
(4) Assemble seal (11) to plug (8).
※ Assemble seal in such lip direction as shown below.


36078RL20

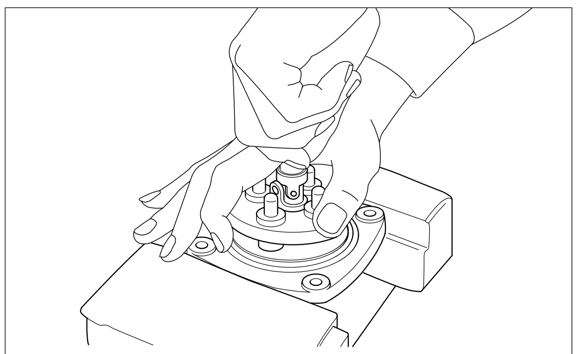
(5) Assemble push rod (9) to plug (8).
※ Apply working oil on push-rod surface.


36078RL21

(6) Assemble plug subassembly to casing.
※ When return spring is weak in force, subassembly stops due to resistance of O-ring.

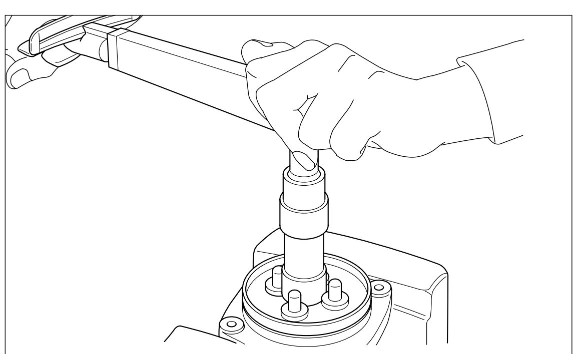

36078RL22

(7) When return spring is strong in force, assemble 4 sets at the same time, utilizing plate (12), and tighten joint (15) temporarily.

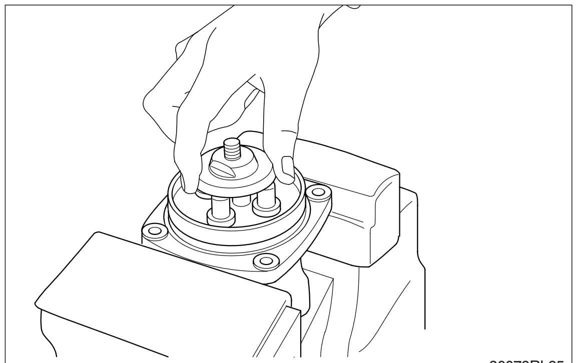

36078RL23

(8) Fit plate (12).

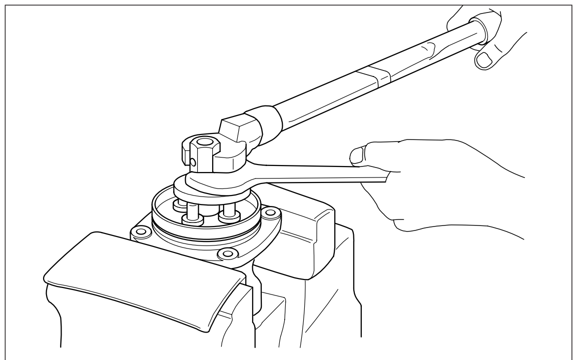
(9) Tighten joint (15) with the specified torque to casing, utilizing jig.


36078RL24

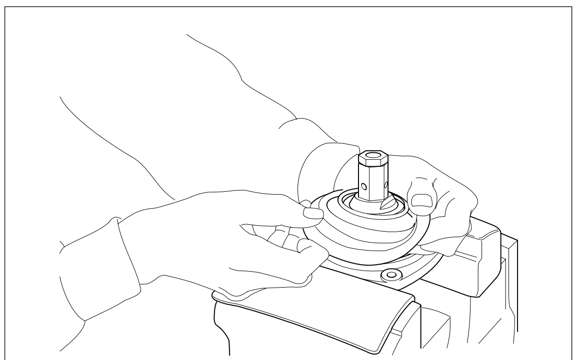
(10) Assemble swash plate (16) to joint (15).
※ Screw it to position that it contacts with 4 push rods evenly.
※ Do not screw it over.


36078RL25

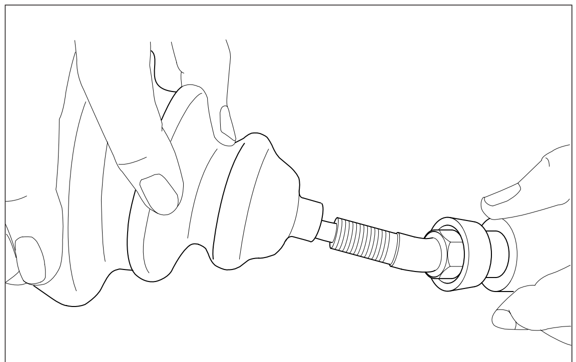
(11) Assemble adjusting nut (17), apply spanner to width across flat of plate (16) to fix it, and tighten adjusting nut to the specified torque.
※ During tightening, do not change position of disk.


36078RL26

(12) Fit boot (14) to plate.


1408DA61

(13) Fit boot (23) and lock nut (22), and handle subassembly is assembled completely.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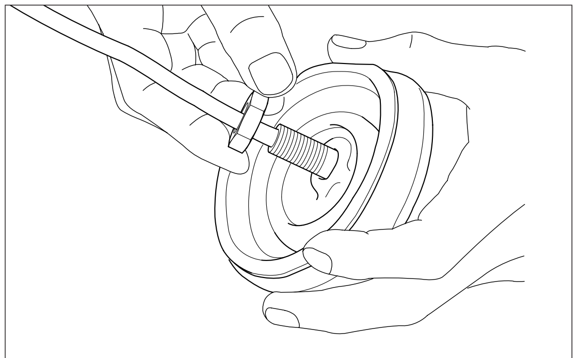
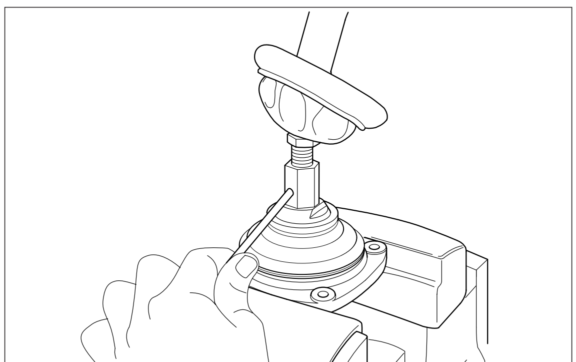
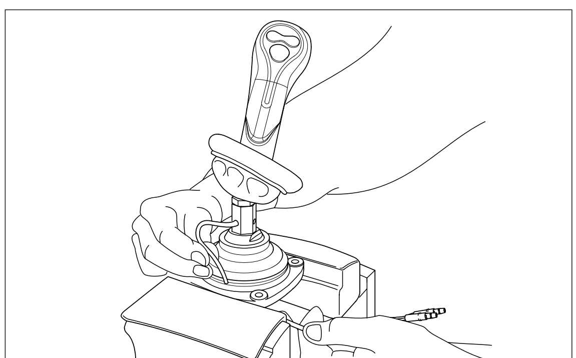

36078RL27

(14) Pull out cord and tube through adjusting nut hole provided in direction 60 °to 120 °from casing hole.

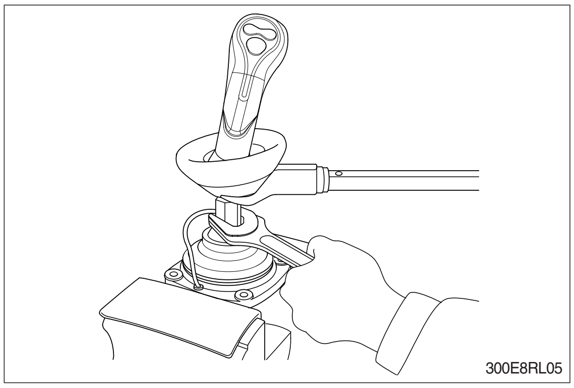

1408DA66

(15) Assemble bushing (18) to plate and pass cord and tube through it.

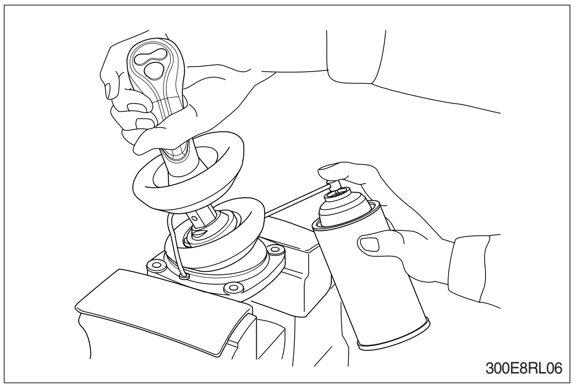
※ Provide margin necessary to operation.


300E8RL04

(16) Determine handle direction, tighten lock nut (22) to specified torque to fix handle.

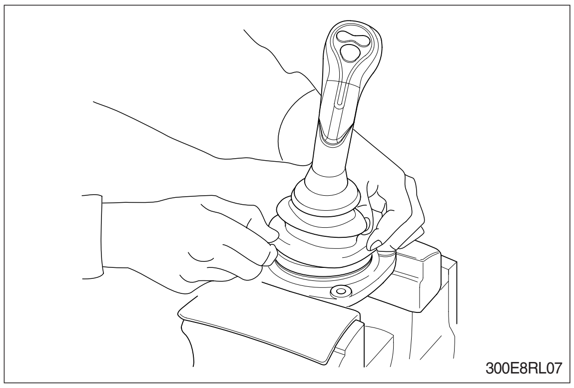


(17) Apply grease to rotating section of joint and contacting faces of disk and push rod.



(18) Assemble lower end of bellows to casing.

(19) Inject volatile rust-preventives through all ports and then put blind plugs in ports.



GROUP 8 TURNING JOINT

1. REMOVAL AND INSTALL

1) REMOVAL

(1) Lower the work equipment to the ground and stop the engine.

(2) Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

(3) Loosen the breather slowly to release the pressure inside the hydraulic tank.

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

※ When pipes and hoses are disconnected, the oil inside the piping will flow out, so catch it in oil pan.

(4) Disconnect all hoses.

(5) Unlock the split pin (4) and remove the pin (3).

(6) Sling the turning joint assembly (1) and remove the mounting bolt (2).
Weight : 75 kg (165 lb)
Tightening torque : 29.7±4.5 kgf · m
(215±32.5 lbf · ft)

(7) Remove the turning joint assembly.

※ When removing the turning joint, check that all the hoses have been disconnected.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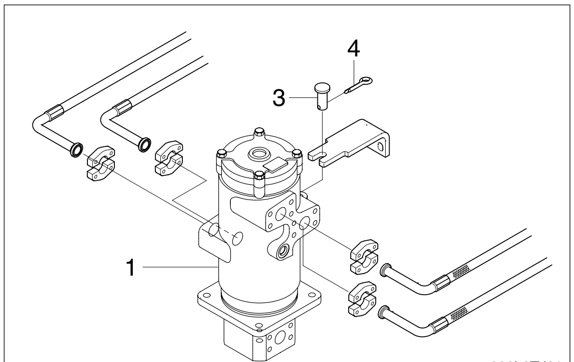
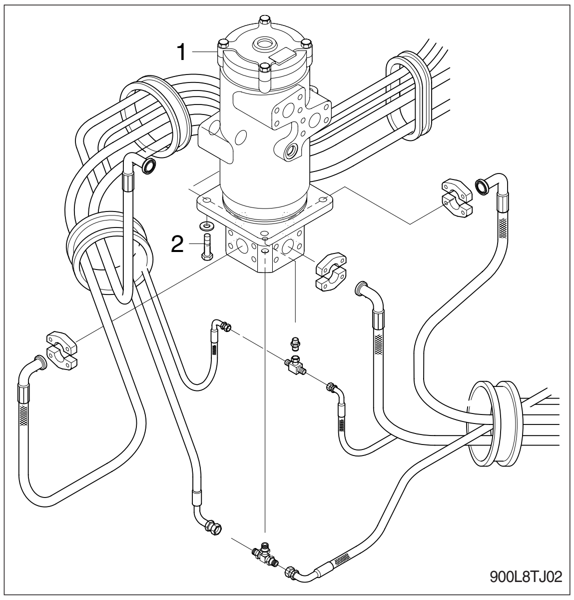


900L8TJ01



900L8TJ02

2) INSTALL

(1) Carry out installation in the reverse order to removal.

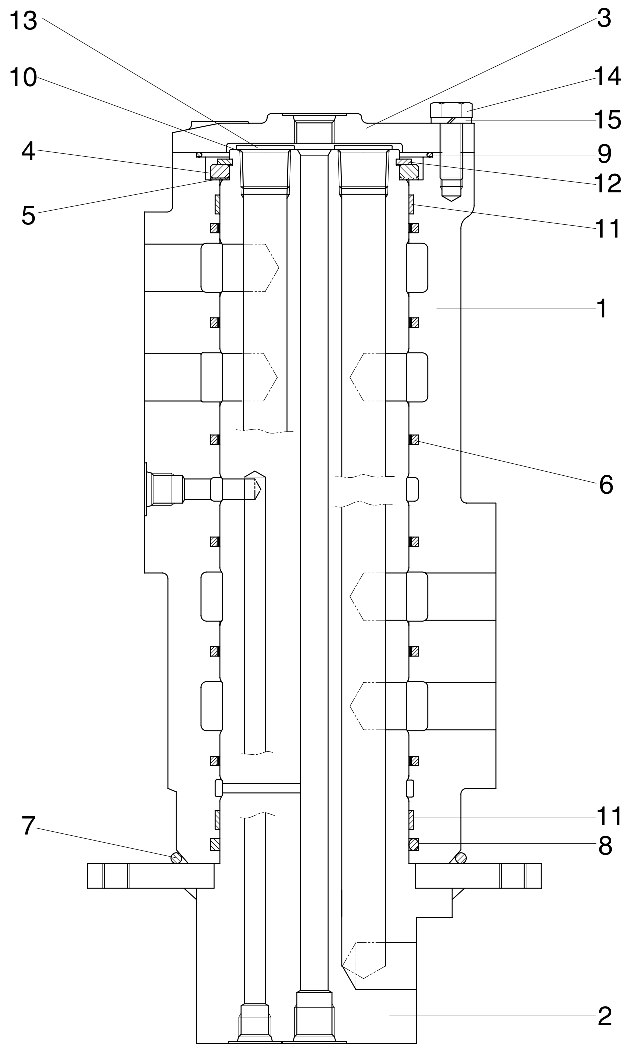
※ Take care of turning joint direction.

※ Assemble hoses to their original positions.

※ Confirm the hydraulic oil level and check the hydraulic oil leak or not.

2. DISASSEMBLY AND ASSEMBLY

1) STRUCTURE



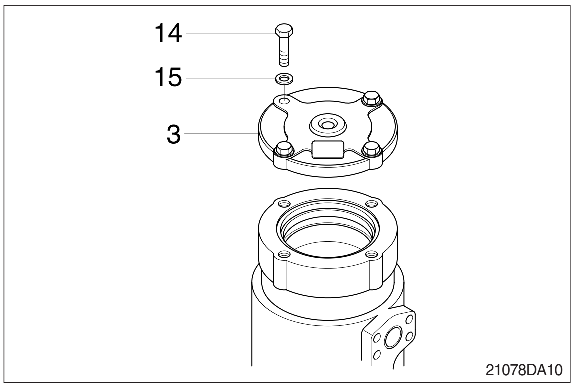
8007A8TJ03

1	Hub	6	Slipper seal	11	Wear ring
2	Shaft assembly	7	O-ring	12	Retaining ring
3	Cover	8	O-ring	13	Socket plug
4	Spacer	9	O-ring	14	Hexagon bolt
5	Shim	10	O-ring	15	Spring washer

2) DISASSEMBLY

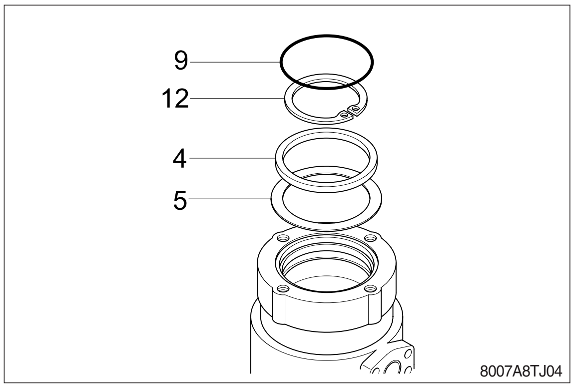
※ Before the disassembly, clean the turning joint.

(1) Remove bolts (14), washer (15) and cover (3).



(2) Remove O-ring (9).

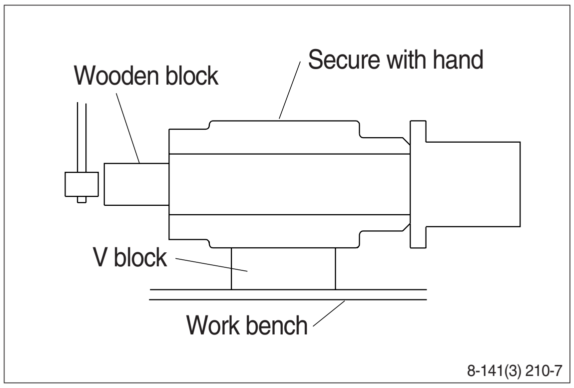
(3) Remove retainer ring (12), spacer (4) and shim (5).



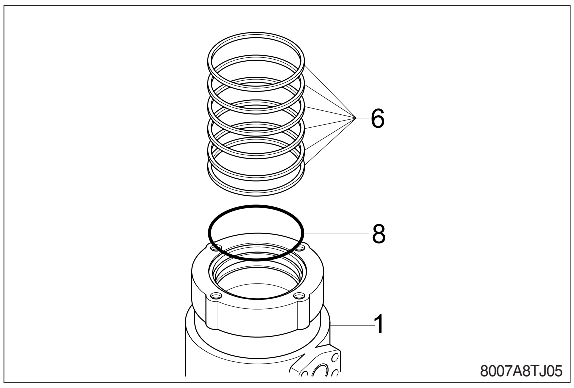
(4) Place body (1) on a V-block and by using a wood buffer at the shaft end, hit out shaft (2) to about 1/2 from the body with a hammer.

※ Take care not to damage the shaft (2) when remove body (1) or rest it sideway.

※ Put a fitting mark on body (1) and shaft (2).



(5) Remove six slipper seals (6) and O-ring (8), from body (1).



3) ASSEMBLY

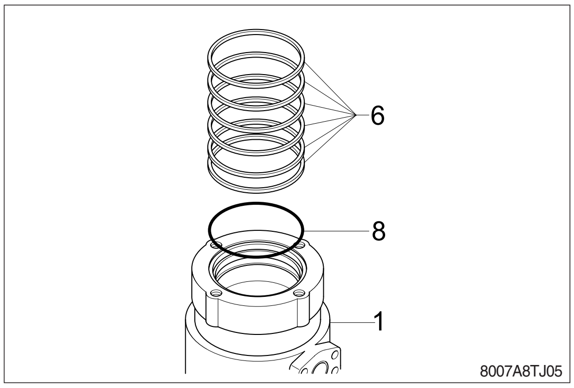
※ Clean all parts.

※ As a general rule, replace oil seals and O-ring.

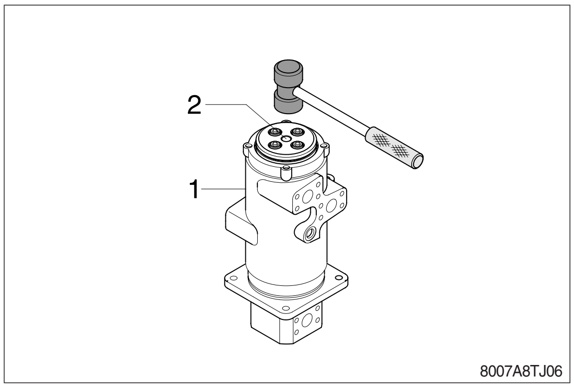
※ Coat the sliding surfaces of all parts with engine oil or grease before installing.

(1) Fix six slipper seal (6) and O-ring (8), to body (1).

(2) Fit O-ring (7) to shaft (2).

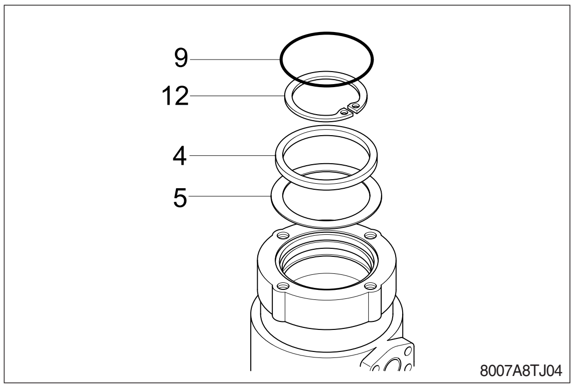


(3) Set shaft (2) on block, tap body (1) with a plastic hammer to install.

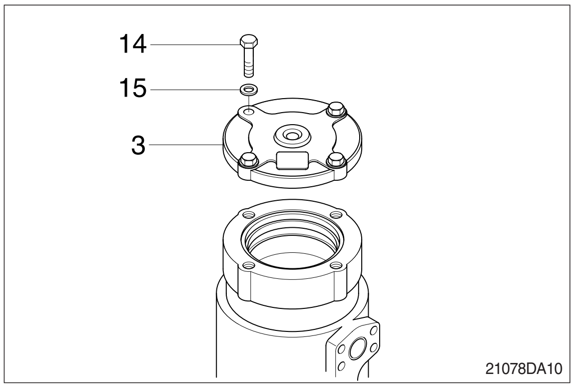


(4) Fit shim (5), spacer (4) and retainer ring (12) to shaft (2).

(5) Fit O-ring (9) to body (1).



(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

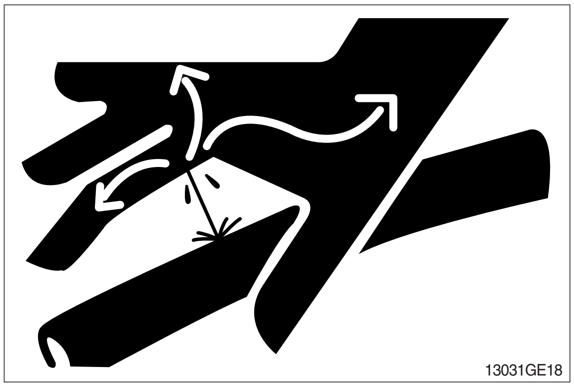
(1) Removal

※ Expand the arm and bucket fully, lower the work equipment to the ground and stop the engine.

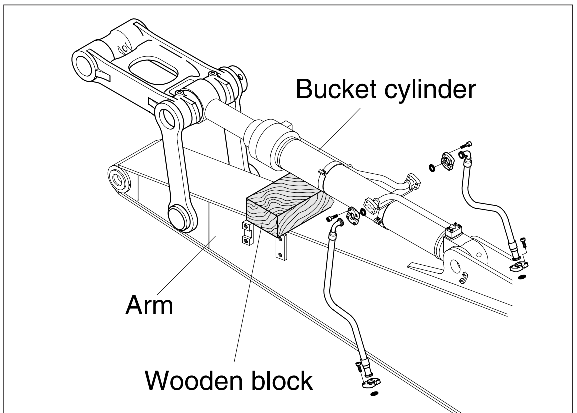
※ Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

⚠ **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.


13031GE18

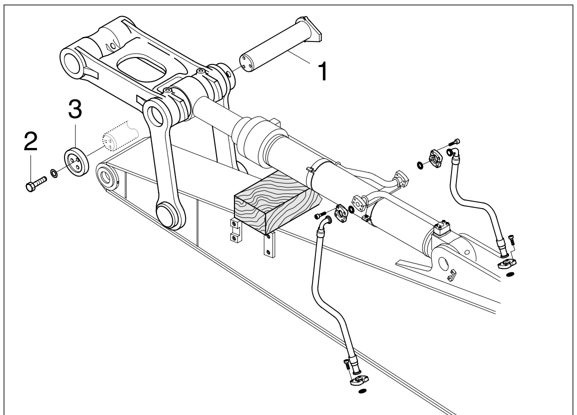
① Set block between bucket cylinder and arm.



900L8CY100

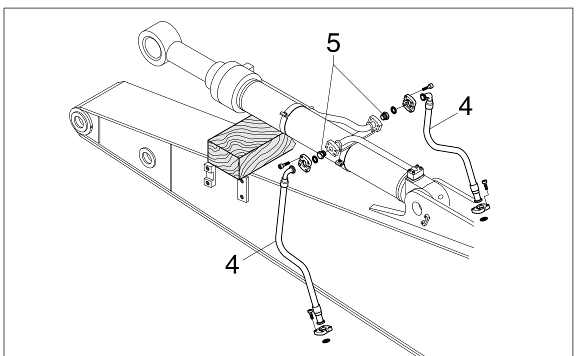
② Remove bolt (2), stopper (3) and pull out pin (1).

※ Tie the rod with wire to prevent it from coming out.



900L8CY101

③ Disconnect bucket cylinder hoses (4) and put plugs (5) on cylinder pipe.

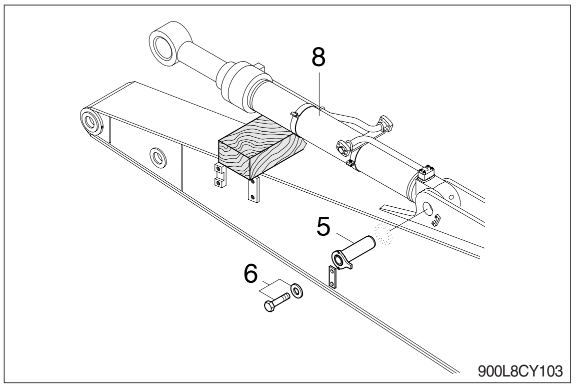


900L8CY102

④ Sling bucket cylinder assembly (8) and remove bolt (6) then pull out pin (5).

⑤ Remove bucket cylinder assembly (8).

· Weight : 754 ㎏ (1662 ㏈)



(2) Install

① Carry out installation in the reverse order to removal.

▲ When aligning the mounting position of the pin, do not insert your fingers in the pin hole.

※ Bleed the air from the bucket cylinder.

※ Confirm the hydraulic oil level and check the hydraulic oil leak or not.

2) ARM CYLINDER

(1) Removal

※ Expand the arm and bucket fully, lower the work equipment to the ground and stop the engine.

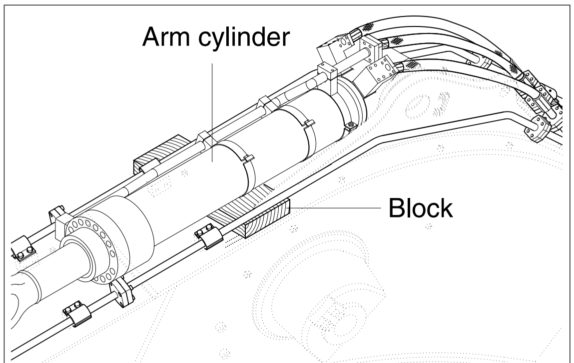
※ Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

⚠ **Loosen the breather slowly to release the pressure inside the hydraulic tank.**

※ Escaping fluid under pressure can penetrate the skin causing serious injury. Fit blind plugs in the hoses after disconnecting them, to prevent dirt or dust from entering.

① Set block between arm cylinder and boom.

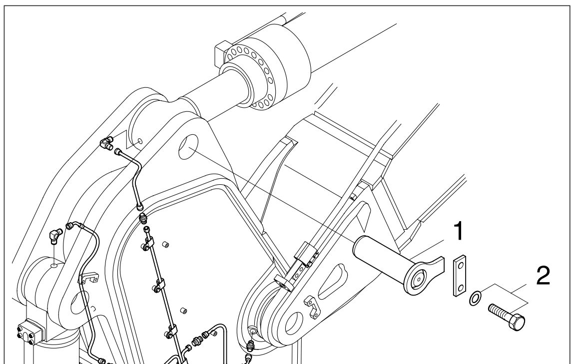

13031GE18



900L8CY110

② Remove bolt (2) and pull out pin (1).

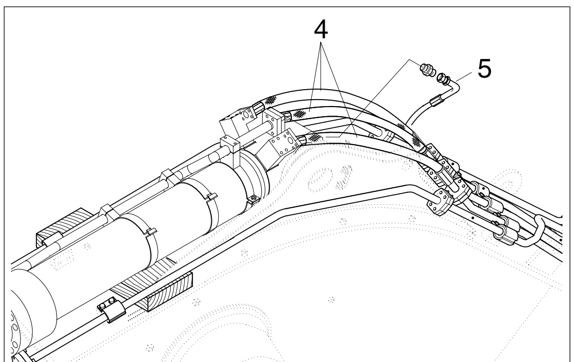
※ Tie the rod with wire to prevent it from coming out.



900L8CY111

③ Disconnect arm cylinder hoses (4) and put plugs on cylinder pipe.

④ Disconnect greasing pipings (5).

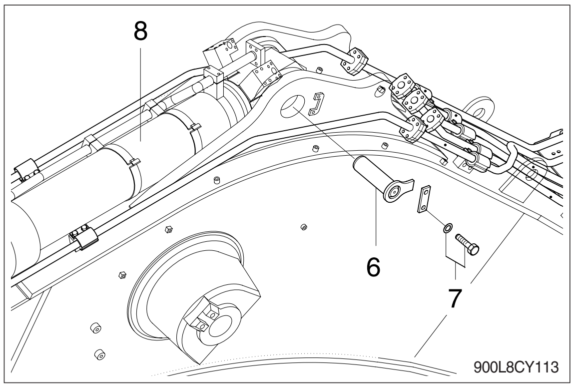


900L8CY112

⑤ Sling arm assembly (8) and remove bolt (7) then pull out pin (6).

⑥ Remove arm cylinder assembly (8).

· Weight : 1087 ㎏ (2400 ℔)



(2) Install

① Carry out installation in the reverse order to removal.

▲ **When aligning the mounting position of the pin, do not insert your fingers in the pin hole.**

※ Bleed the air from the arm cylinder.

※ Confirm the hydraulic oil level and check the hydraulic oil leak or not.

3) BOOM CYLINDER

(1) Removal

※ Expand the arm and bucket fully, lower the work equipment to the ground and stop the engine.

※ Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

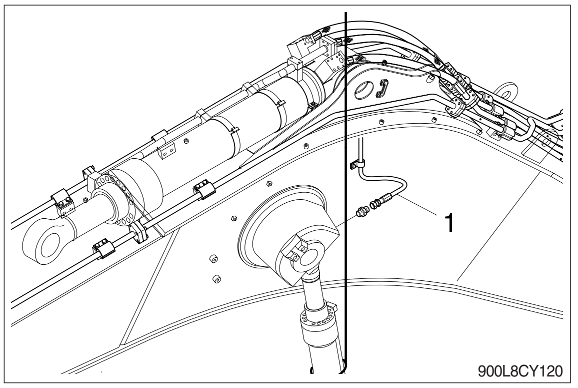
⚠ **Loosen the breather slowly to release the pressure inside the hydraulic tank.**

※ Escaping fluid under pressure can penetrate the skin causing serious injury. Fit blind plugs in the hoses after disconnecting them, to prevent dirt or dust from entering.

① Disconnect greasing hoses(1).

② Sling boom cylinder assembly.

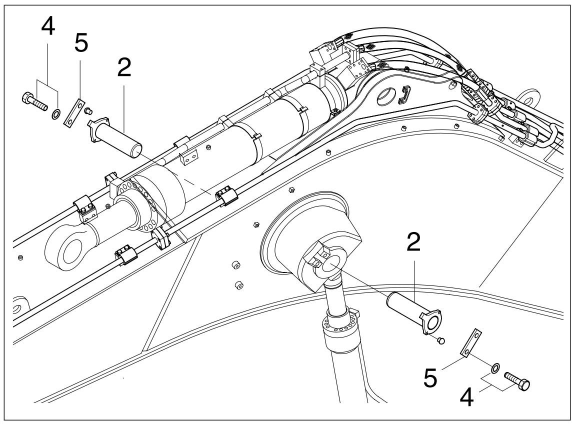
13031GE18



900L8CY120

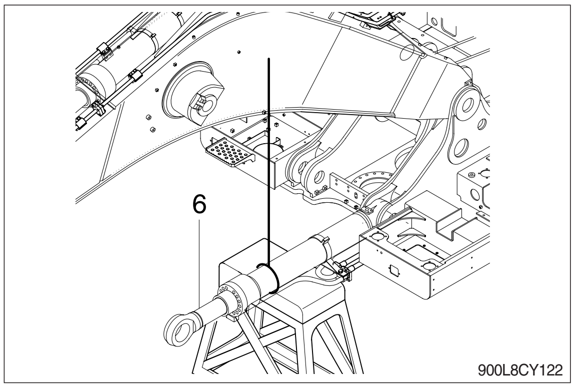
③ Remove bolt (4), pin stopper (5) and pull out pin (2).

※ Tie the rod with wire to prevent it from coming out.



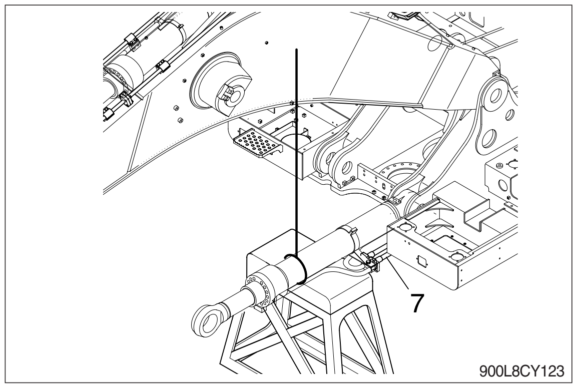
900L8CY121

④ Lower the boom cylinder assembly (6) on a stand.



900L8CY122

⑤ Disconnect boom cylinder hoses (7) and put plugs on cylinder pipe.

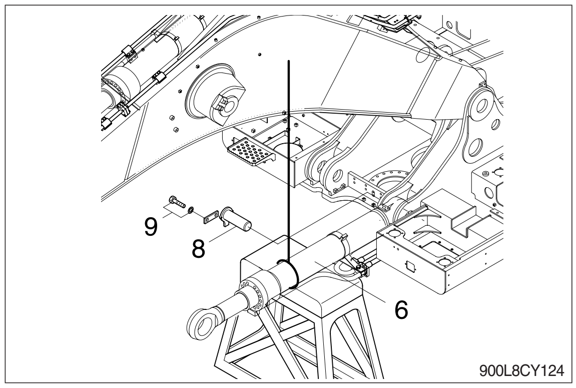


900L8CY123

⑥ Remove bolt (9) and pull out pin (8).

⑦ Remove boom cylinder assembly (6).

· Weight : 862 ㎏ (1906 ℔)



900L8CY124

(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.**

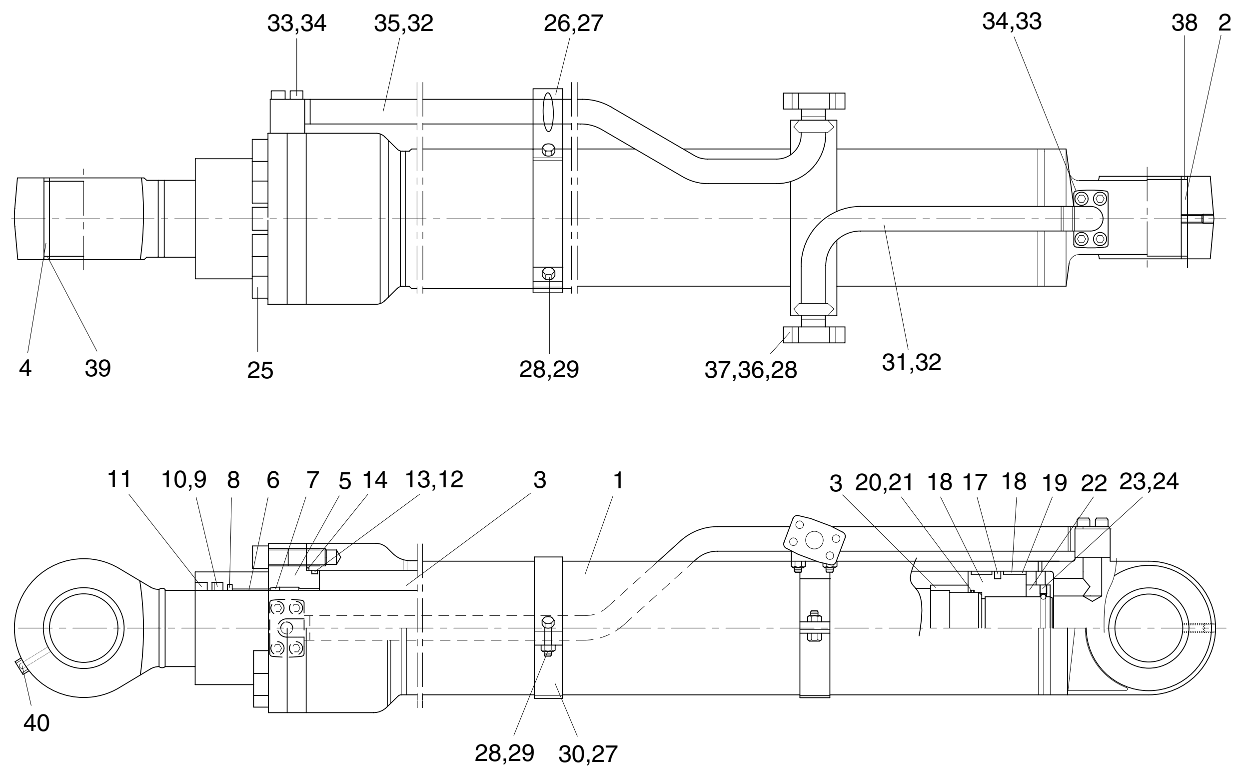
※ Bleed the air from the boom cylinder.

※ Confirm the hydraulic oil level and check the hydraulic oil leak or not.

2. DISASSEMBLY AND ASSEMBLY

1) STRUCTURE

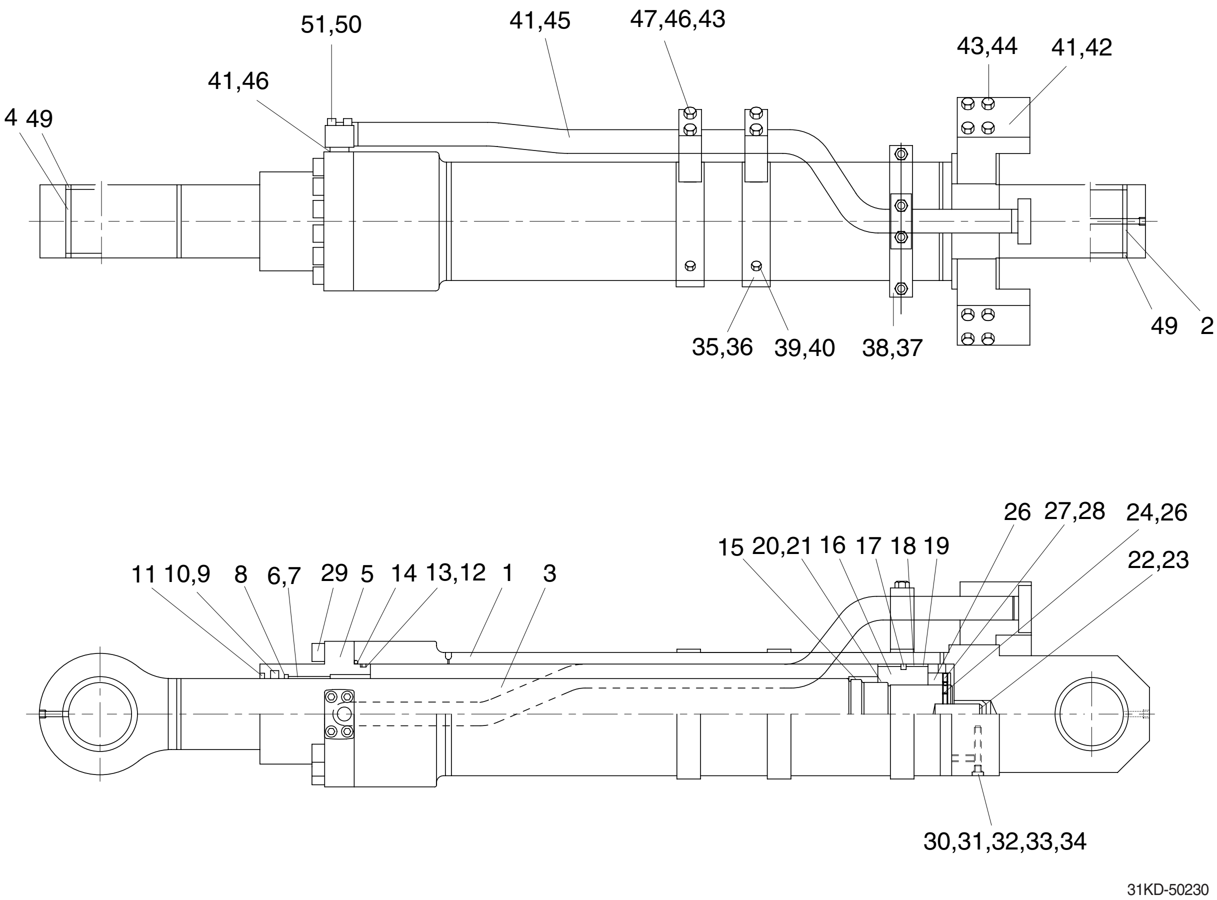
(1) Bucket cylinder



31KD-60010

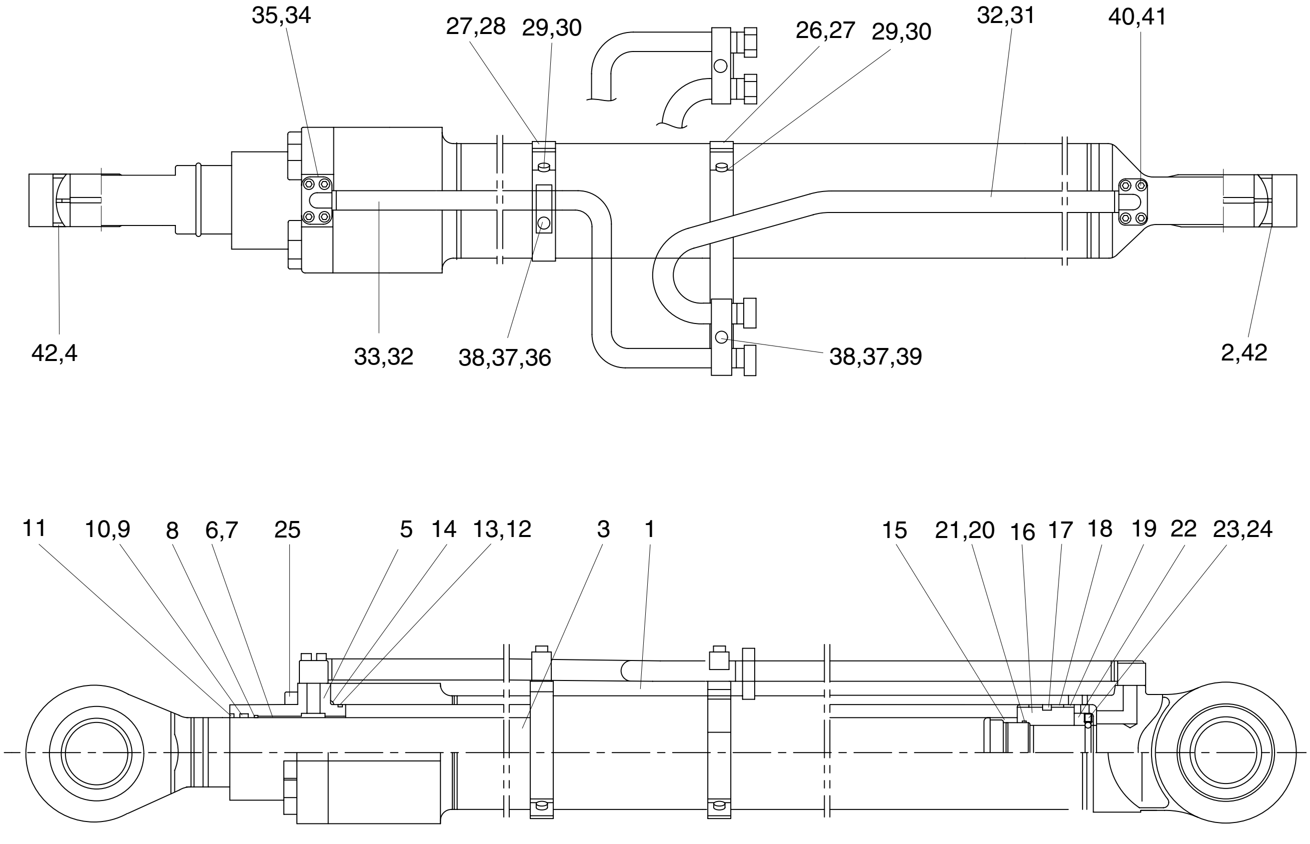
1	Tube assembly
2	Pin bushing
3	Rod assembly
4	Pin bushing
5	Rod cover
6	Rod bushing
7	Retaining ring
8	Buffer seal
9	U-packing
10	Back up ring
11	Dust wiper
12	O-ring
13	Back up ring
14	O-ring
15	Cushion ring
16	Piston
17	Pinton seal
18	Wear ring
19	Dust ring
20	O-ring
21	Back up ring
22	Piston nut
23	Steel ball
24	Set screw
25	Hex socket bolt
26	Pipe band assembly
27	Pipe band
28	Spring washer
29	Hex bolt
30	Pipe band assembly
31	Pipe band
32	O-ring
33	Hex socket bolt
34	Spring washer
35	Pipe assembly
36	U-bolt
37	Hex nut
38	Pin wiper
39	Pin wiper
40	Grease nipple

(2) Arm cylinder



1	Tube assembly	18	Wear ring	35	Pipe band assembly
2	Pin bushing	19	Slyd ring	36	Pipe band
3	Rod assembly	20	O-ring	37	Pipe band assembly
4	Pin bushing	21	Back up ring	38	Pipe band
5	Rod cover	22	Guide	39	Spring washer
6	Rod bushing	23	Cushion ring	40	Hex bolt
7	Retaining ring	24	Set screw	41	O-ring
8	Buffer seal	25	Set screw	42	Flange port
9	U-packing	26	Piston nut	43	Spring washer
10	Back up ring	27	Steel ball	44	Hex socket bolt
11	Dust wiper	28	Set screw	45	Pipe assembly
12	O-ring	29	Hex socket bolt	46	Pipe clamp
13	Back up ring	30	Check valve	47	Clamp
14	O-ring	31	Spring	48	Spacer
15	Cushion ring	32	Spring support	49	Pin wiper
16	Piston	33	O-ring	50	Spring washer
17	Slipper seal	34	Plug	51	Hex socket bolt

(3) Boom cylinder

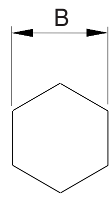


31KD-50210

1	Tube assembly	15	Cushion ring	29	Hex bolt
2	Spherical bearing	16	Piston	30	Spring washer
3	Rod assembly	17	Piston seal	31	Pipe assembly
4	Spherical bearing	18	Wear ring	32	O-ring
5	Rod cover	19	Dust ring	33	Pipe assembly
6	Rod bushing	20	O-ring	34	Hex socket bolt
7	Retaining ring	21	Back up ring	35	Spring washer
8	Buffer seal	22	Piston nut	36	Clamp
9	U-packing	23	Steel ball	37	Spring washer
10	Back up ring	24	Set screw	38	Hex bolt
11	Dust wiper	25	Hex socket bolt	39	Clamp
12	O-ring	26	Pipe band assembly	40	Spring washer
13	Back up ring	27	Band pipe	41	Hex socket bolt
14	O-ring	28	Pipe band assembly	42	Retaining ring

2) TOOLS AND TIGHTENING TORQUE

(1) Tools

Allen wrench	6	
	12	
	14	
	19	
	24	
	27	
(-) 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
Piston	Bucket cylinder	16	M120	190±19	1374±137
	Boom cylinder	16	M120	190±19	1374±137
	Arm cylinder	16	M120	190±19	1374±137
Piston nut	Bucket cylinder	22	M120	250±25	1808±181
	Boom cylinder	22	M120	250±25	1808±181
	Arm cylinder	26	M120	250±25	1808±181
Socket head bolt	Bucket cylinder	★1 25	M27	120~137	868~991
		33	M14	14~15	101~108
	Boom cylinder	★1 25	M27	120~137	868~991
		34	M14	14~15	101~108
	Arm cylinder	★1 29	M27	120~137	868~991
		51	M16	16~18	116~130
Set screw	Bucket cylinder	★1 24	M14	6.5	47.0
	Boom cylinder	★1 24	M14	6.5	47.0
	Arm cylinder	★1 28	M14	6.5	47.0

★1 Apply the loctite #243 on the thread before tightening.

3) DISASSEMBLY

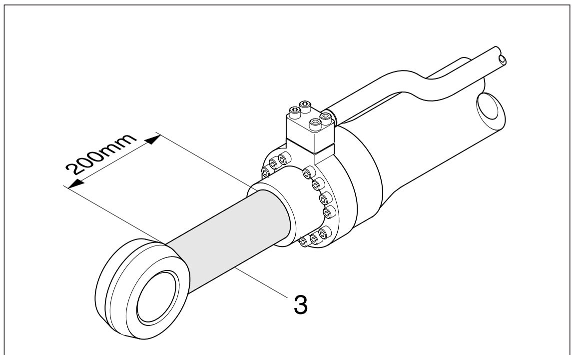
(1) Remove cylinder head and piston rod

※ 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.

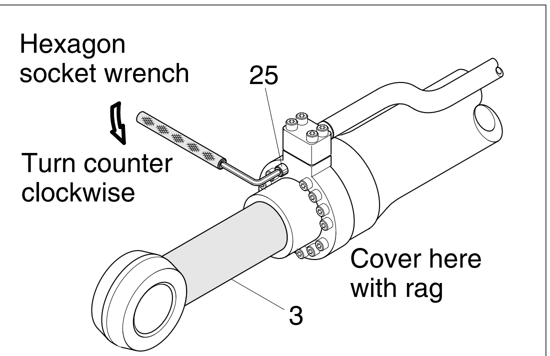
② Pull out rod assembly (3) about 200 mm (7.1 in). Because the rod assembly is rather heavy, finish extending it with air pressure after the oil draining operation.



900L8CY10

③ Loosen and remove socket bolts (25) of the rod cover in sequence.

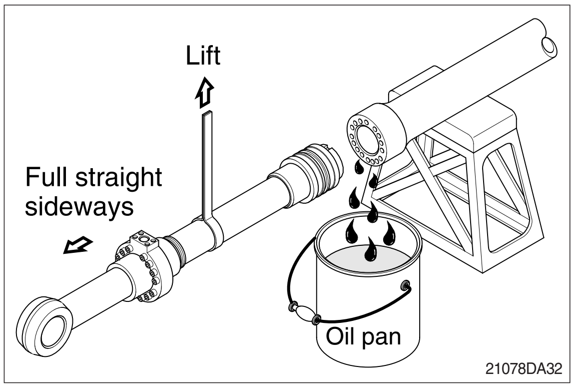
※ Cover the extracted rod assembly (3) with rag to prevent it from being accidentally damaged during operation.



900L8CY11

④ Draw out cylinder head and rod assembly together from tube assembly (1).

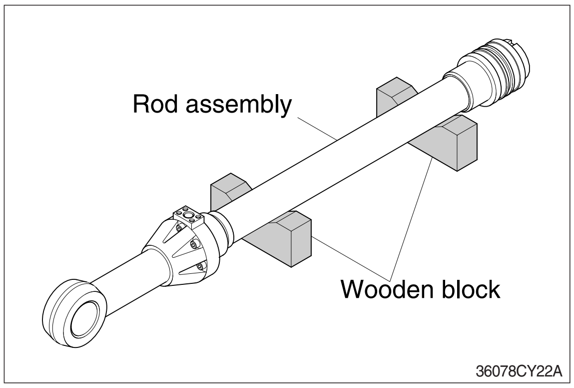
※ Since the rod assembly is heavy in this case, lift the tip of the rod assembly (3) with a crane or some means and draw it out. However, when rod assembly (3) has been drawn out to approximately two thirds of its length, lift it in its center to draw it completely.



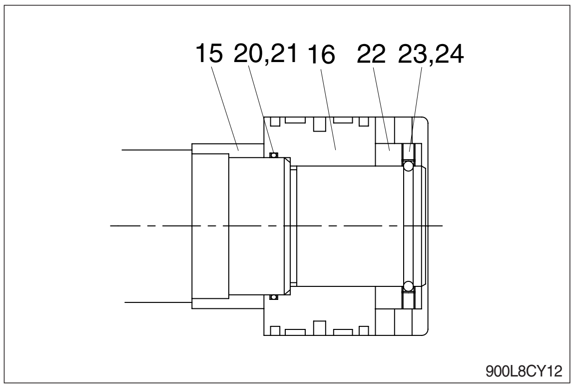
21078DA32

Note that the plated surface of rod assembly (3) 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.

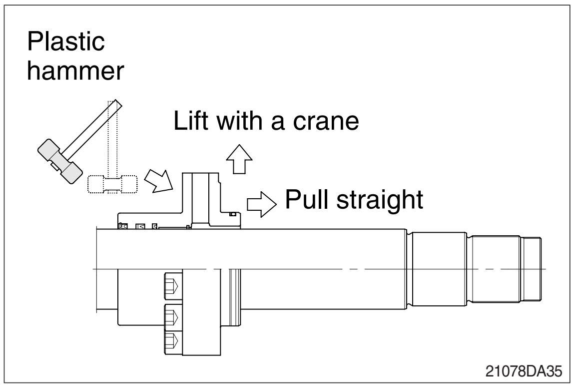
⑤ Place the removed rod assembly on a wooden V-block that is set level.
※ Cover a V-block with soft rag.



(2) Remove piston and cylinder head
① Loosen the set screw (24) and remove steel ball (23).
② Remove piston nut (22).
※ Since piston nut (22) and piston (16) are tightened to a high torque, use a hydraulic and power wrench that utilizers a hydraulic cylinder, to remove the piston nut (22) and piston (16).
③ Remove piston assembly (16), back up rings (21), and O-ring (20).
④ Remove the cushion ring (15)



⑤ Remove the cylinder head assembly from rod assembly (3).
※ 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 (6) and packing (7, 8, 9, 10,11) by the threads of rod assembly (3).

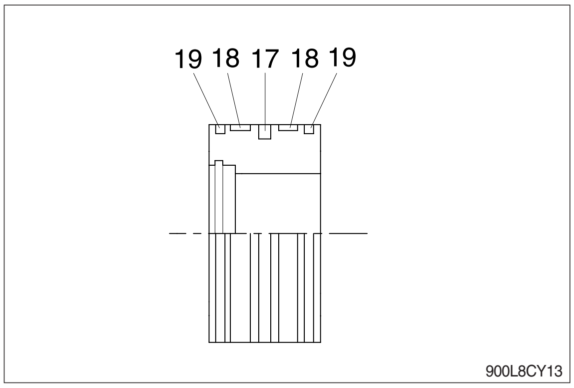


(3) Disassemble the piston assembly

① Remove wear ring (18).

② Remove dust ring (19) and piston seal (17).

※ Exercise care in this operation not to damage the grooves.



(4) Disassemble cylinder head assembly

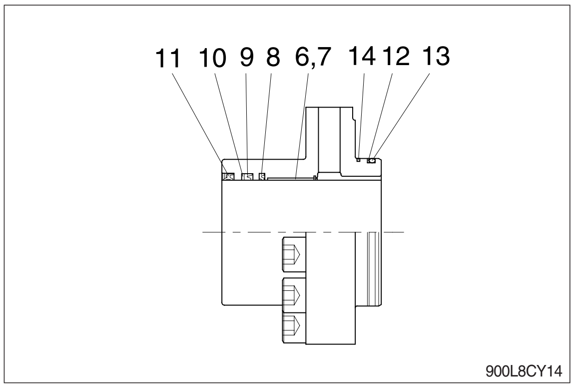
① Remove back up ring (13) and O-ring (12, 14).

② Remove dust wiper (11).

③ Remove back up ring (10), U-packing (9) and buffer seal (8).

※ Exercise care in this operation not to damage the grooves.

※ Do not remove seal and ring, if does not damaged.

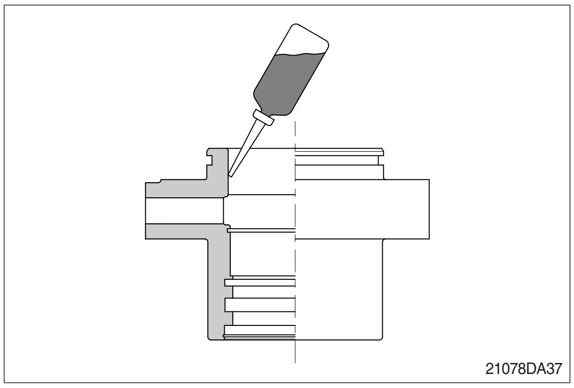


3) ASSEMBLY

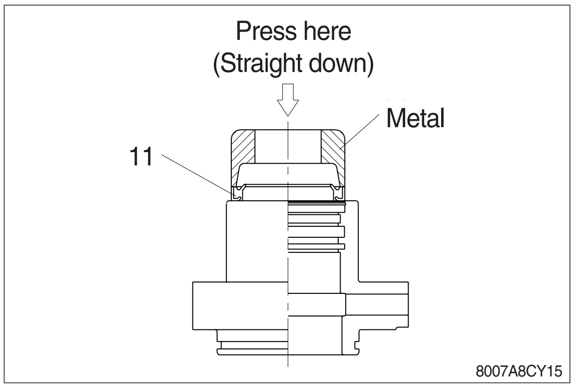
(1) Assemble cylinder head assembly

※ Check for scratches or rough surfaces if found smooth with an oil stone.

① Coat the inner face of rod cover (5) with hydraulic oil.



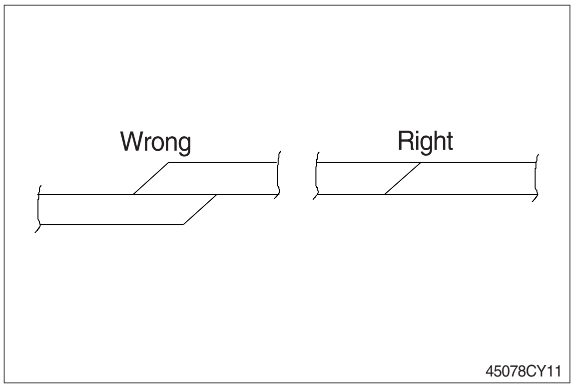
② Coat dust wiper (11) with grease and fit dust wiper (11) to the bottom of the hole of dust seal.
At this time, press a pad metal to the metal ring of dust seal.



③ Fit back up ring (10), U-packing (9) and buffer seal (8) to corresponding grooves, in that order.

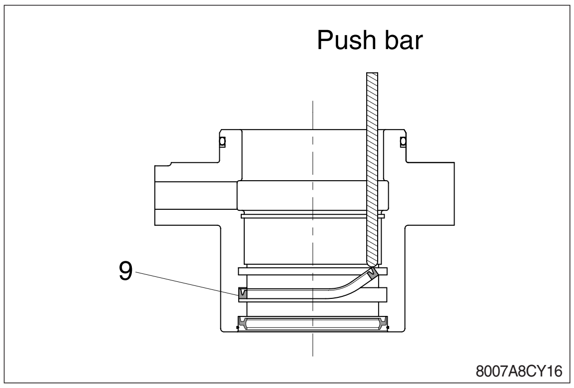
※ Coat each packing with hydraulic oil before fitting it.

※ Insert the backup ring until one side of it is inserted into groove.

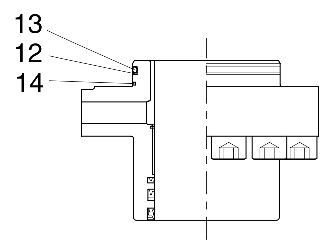


※ U-packing (9) has its own fitting direction. Therefore, confirm it before fitting them.

※ Fitting U-packing (9) upside down may damage its lip. Therefore check the correct direction that is shown in fig.

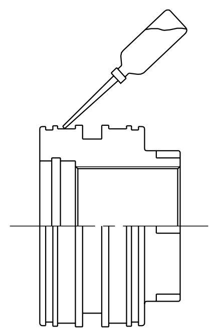


④ Fit back up ring (13) to rod cover (5).
※ Put the backup ring in the warm water of 30~50°C.
⑤ Fit O-ring (12, 14) to rod cover (5).



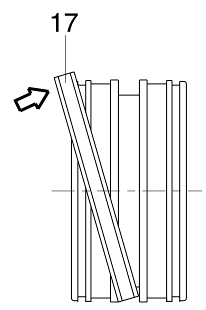
900L8CY17

(2) Assemble piston assembly
※ Check for scratches or rough surfaces. If found smooth with an oil stone.
① Coat the outer face of piston (16) with hydraulic oil.



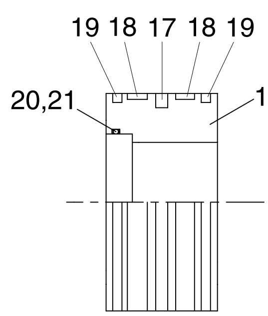
8-158(2)

② Fit piston seal (17) 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.



900L8CY18

③ Fit wear ring (18) and dust ring (19) to piston (16).
④ Fit back up rings (21) and O-ring (20) to piston (16).



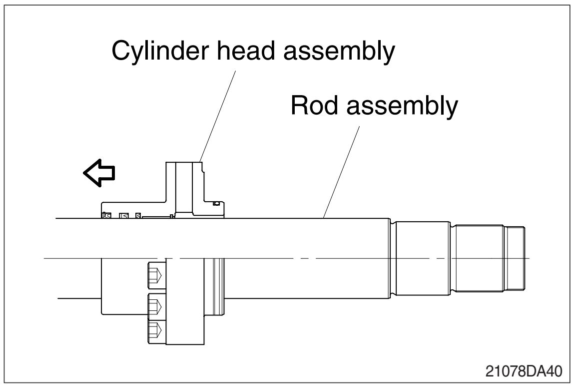
900L8CY19

(3) Install piston and cylinder head

① Fix the rod assembly to the work bench.

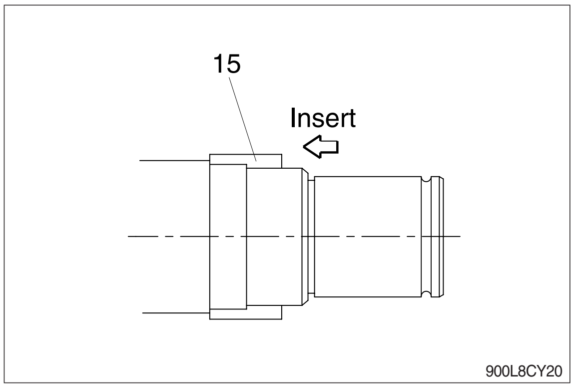
② Apply hydraulic oil to the outer surface of rod assembly (3), the inner surface of piston and cylinder head.

③ Insert cylinder head assembly to rod assembly.



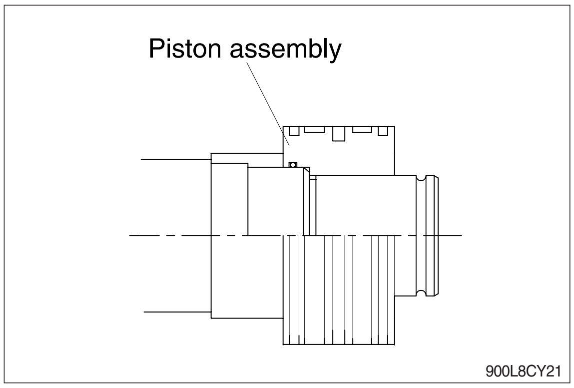
④ Insert cushion ring (15) to rod assembly.

※ Note that cushion ring (15) has a direction in which it should be fitted.



⑤ Fit piston assembly to rod assembly.

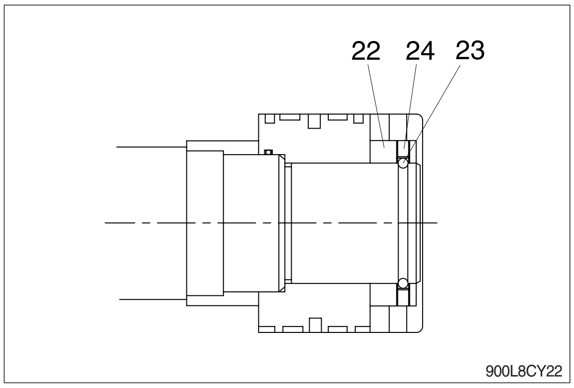
· Tightening torque : 190±19 kgf · m (1374±137 lbf · ft)



⑥ Fit piston nut (22) as specified torque.

· Tightening torque

Item		kgf · m	lbf · ft
Bucket	22	250±25	1808±181
Boom	22	250±25	1808±181
Arm	26	250±25	1808±181



⑦ Insert the steel ball (23) into hole and tighten the set screw (24).

· Tightening torque : 6.5 kgf · m (47.0 lbf · ft)

(3) Overall assemble

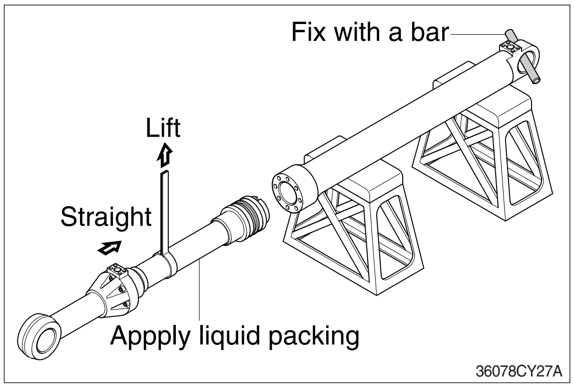
① Place a V-block on a rigid work bench. Mount the tube assembly (1) on it and fix the assembly by passing a bar through the clevis pin hole to lock the assembly.

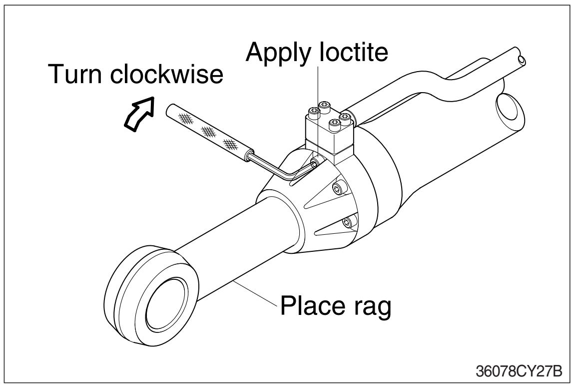
② Insert the rod assembly in to the tube assembly, while lifting and moving the rod assembly with a crane.

※ 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

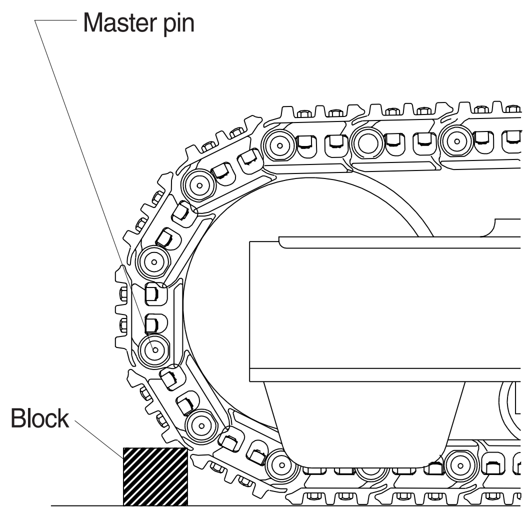
1) REMOVAL

(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.

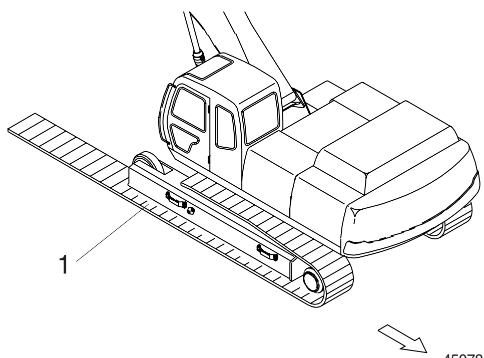


45078UC11

(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.

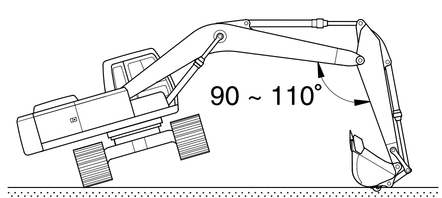


45078UC10

2) INSTALL

(1) Carry out installation in the reverse order to removal.

※ Adjust the tension of the track link.



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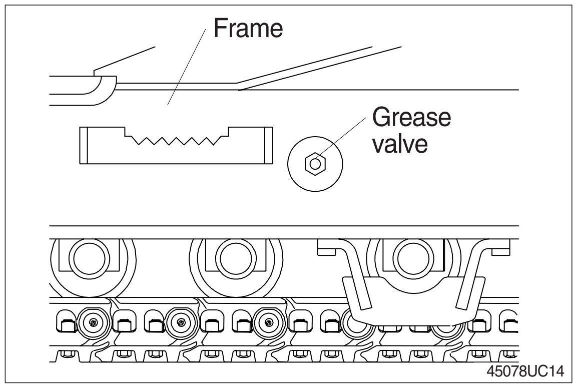
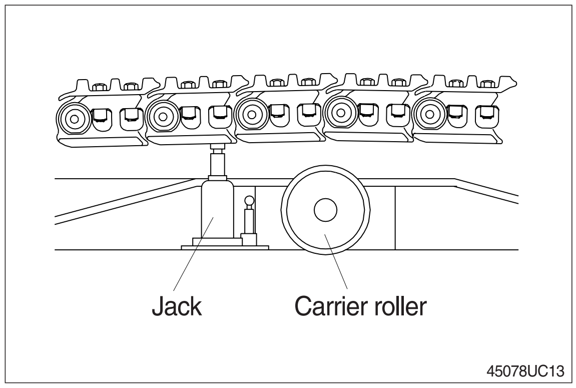
2. CARRIER ROLLER

1) REMOVAL

(1) Loosen tension of the track link.



(2) Jack up the track link height enough to permit carrier roller removal.

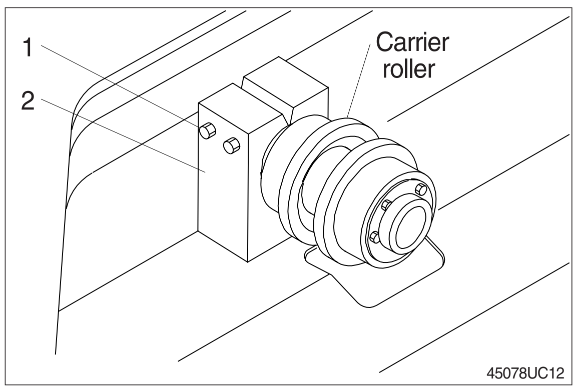


(3) Loosen the lock nut (1).

(4) Open bracket (2) with a screwdriver, push out from inside, and remove carrier roller assembly.

· Weight : 75 kg (165 lb)

· Tightening torque : 57.9±6.0 kgf · m
(419±43.4 lbf · ft)



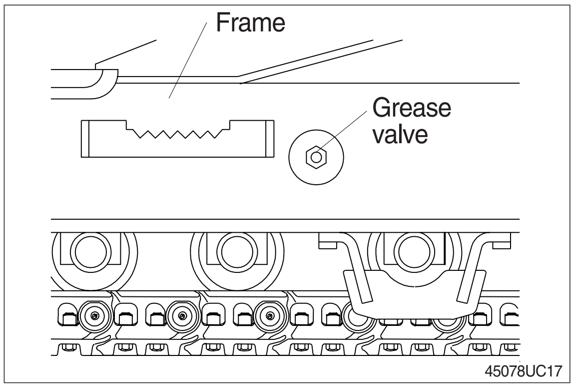
2) INSTALL

(1) Carry out installation in the reverse order to removal.

3. TRACK ROLLER

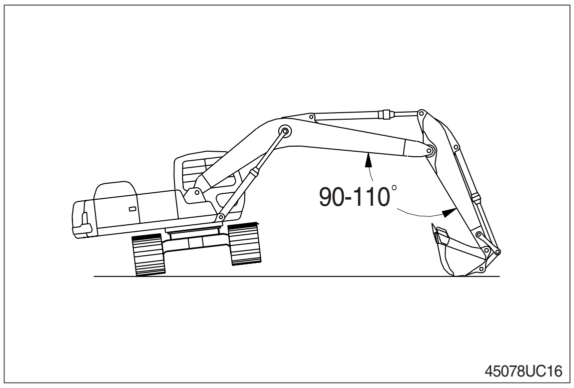
1) REMOVAL

(1) Loosen tension of the track link.



(2) Using the work equipment, push up track frame on side which is to be removed.

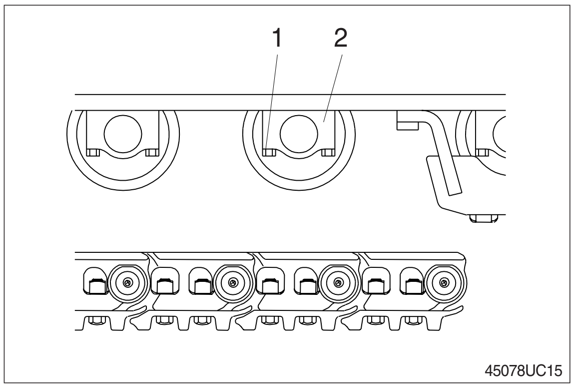
※ After jack up the machine, set a block under the unit.



(3) Remove the mounting bolt (1) and draw out the track roller (2).

· Weight : 185 kg (410 lb)

· Tightening torque : 135±13 kgf · m
(976±94.0 lbf · ft)



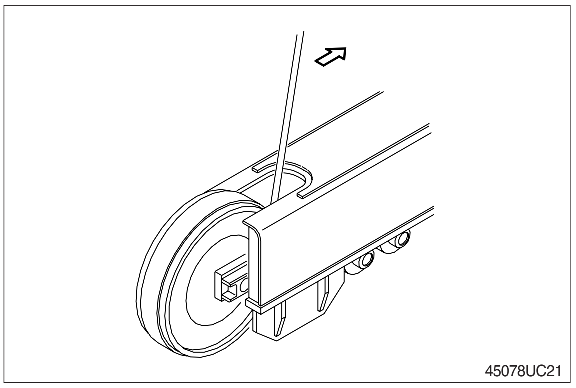
2) INSTALL

(1) Carry out installation in the reverse order to removal.

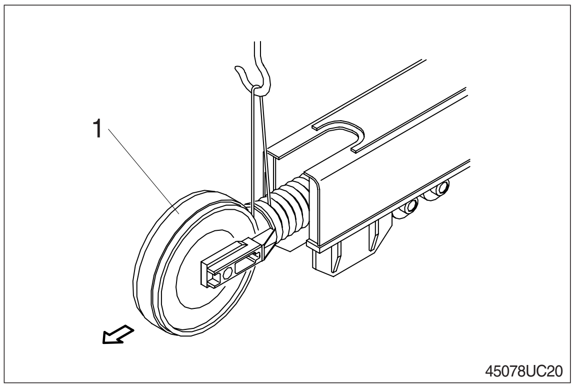
4. IDLER AND RECOIL SPRING

1) REMOVAL

(1) Remove the track link.
For detail, see **removal of track link.**

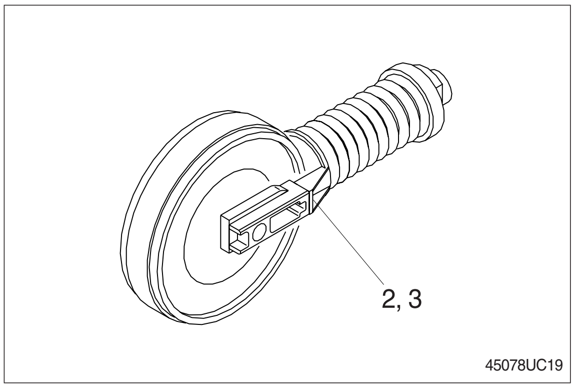

45078UC21

(2) Sling the recoil spring (1) and pull out idler and recoil spring assembly from track frame, using a pry.
· Weight : 550 ㎏ (1210 ℔)



45078UC20

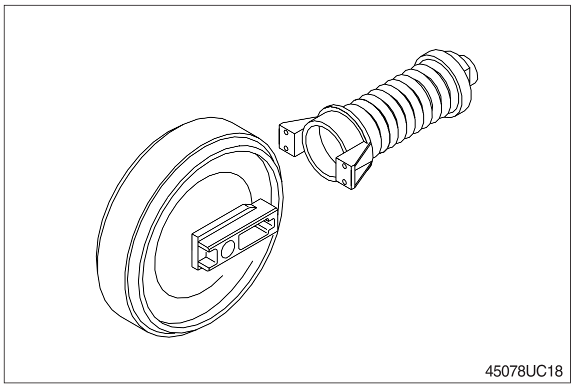
(3) Remove the bolts (2), washers (3) and separate idler from recoil spring.
· Tightening torque : 57.9±6.0 kgf · m
(419±43.4 lbf · ft)



45078UC19

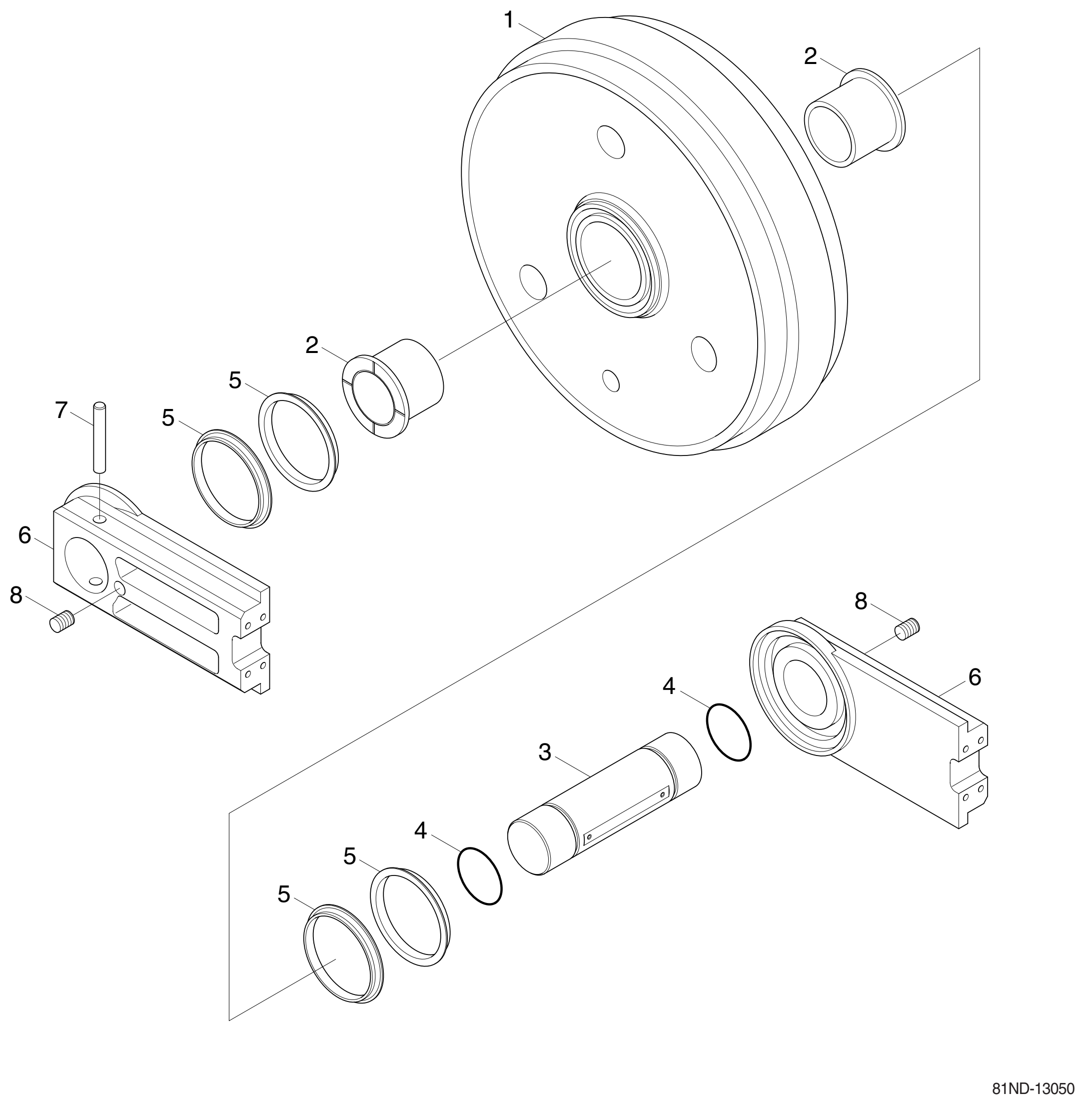
2) INSTALL

(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.


45078UC18

3) DISASSEMBLY AND ASSEMBLY OF IDLER

(1) Structure

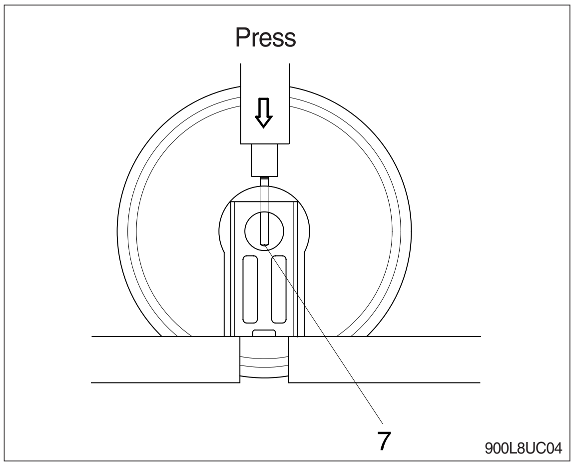


1	Shell	4	O-ring	7	Pin
2	Bushing	5	Seal assy	8	Plug
3	Shaft	6	Bracket		

(2) Disassembly

① Remove plug and drain oil.

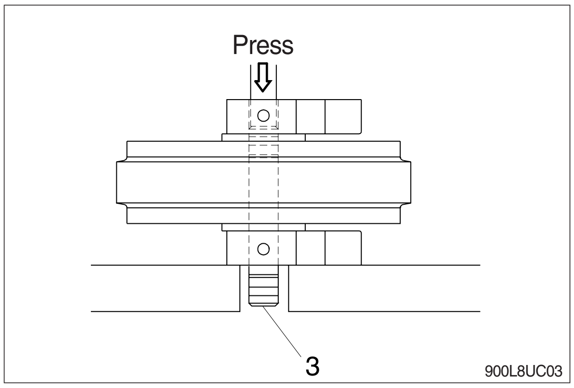
② Draw out the pin (7), using a press.



③ Pull out the shaft (3) with a press.

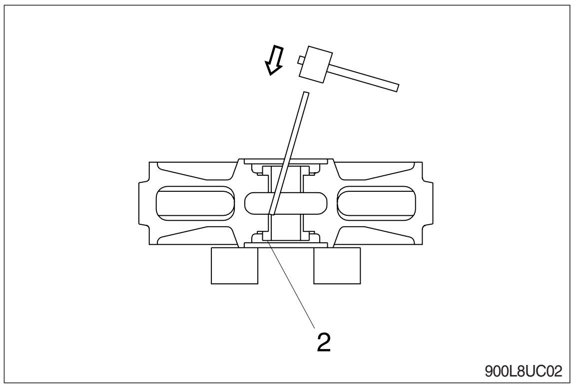
④ Remove seal (5) from shell (1) and bracket (6).

⑤ Remove O-ring (4) from shaft.



⑥ Remove the bushing (2) from idler, using a special tool.

※ Only remove bushing if replacement is necessity.

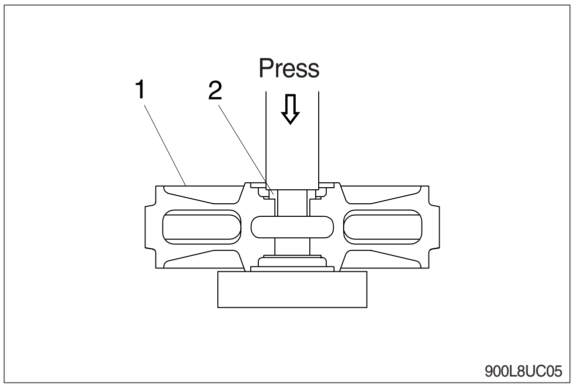


(3) Assembly

※ Before assembly, clean the parts.

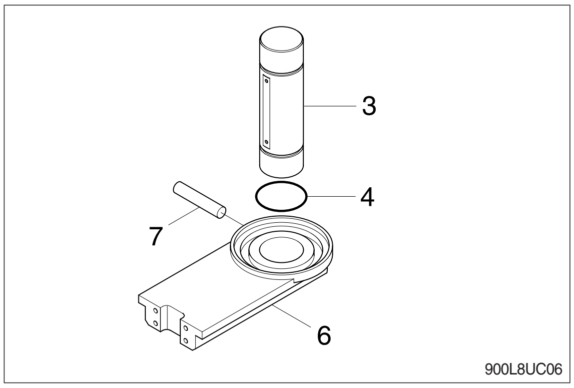
※ Coat the sliding surfaces of all parts with oil.

① Cool up bushing (2) fully by some dry ice and press it into shell (1).
Do not press it at the normal temperature, or not knock in with a hammer even after the cooling.

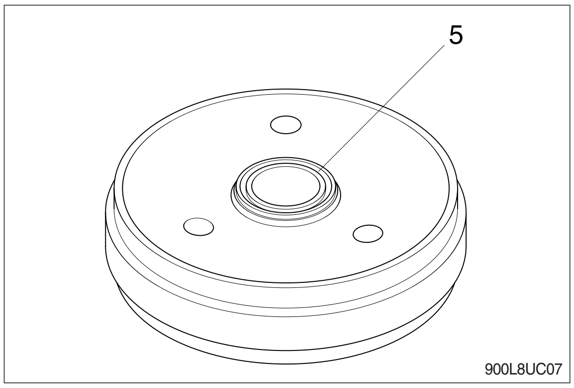


② Coat O-ring (4) with grease thinly, and install it to shaft (2).

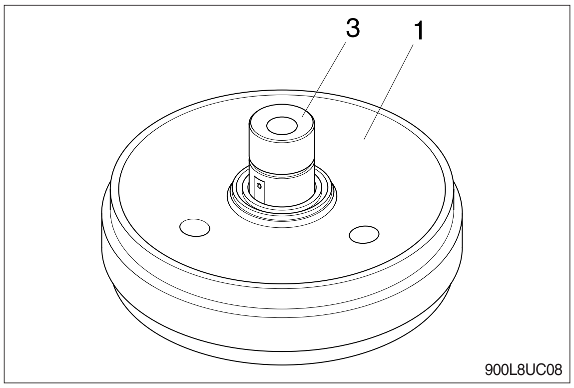
③ Insert shaft (2) into bracket (6) and drive in the taper pin (7).



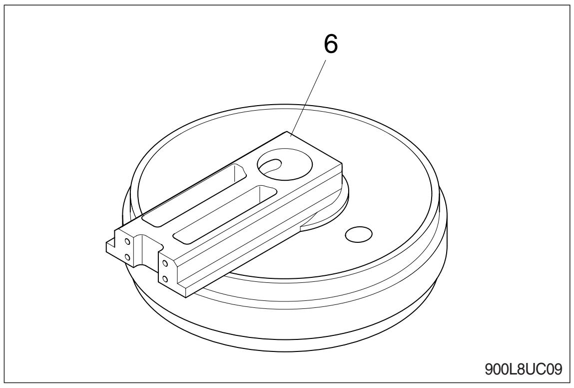
④ Install seal (5) to shell (1) and bracket (5).



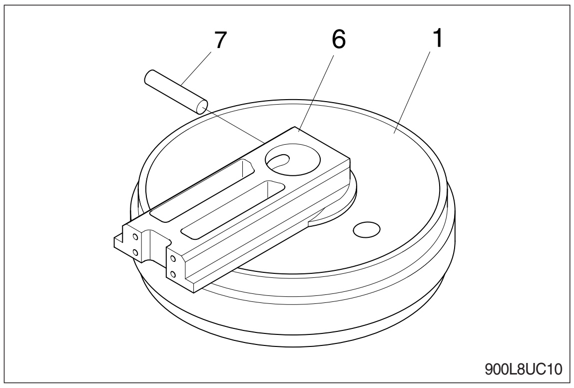
⑤ Install shaft (3) to shell (1).



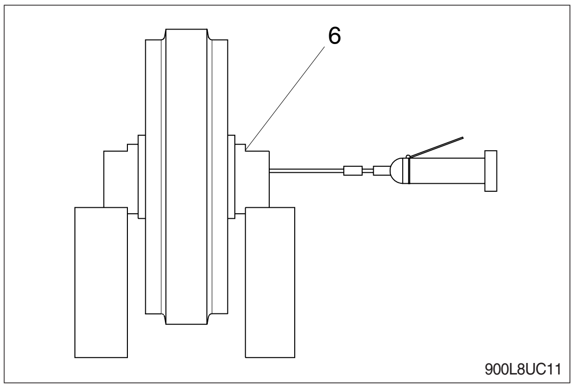
⑥ Install bracket (6) attached with seal (5).



⑦ Knock in the pin (7) with a hammer.

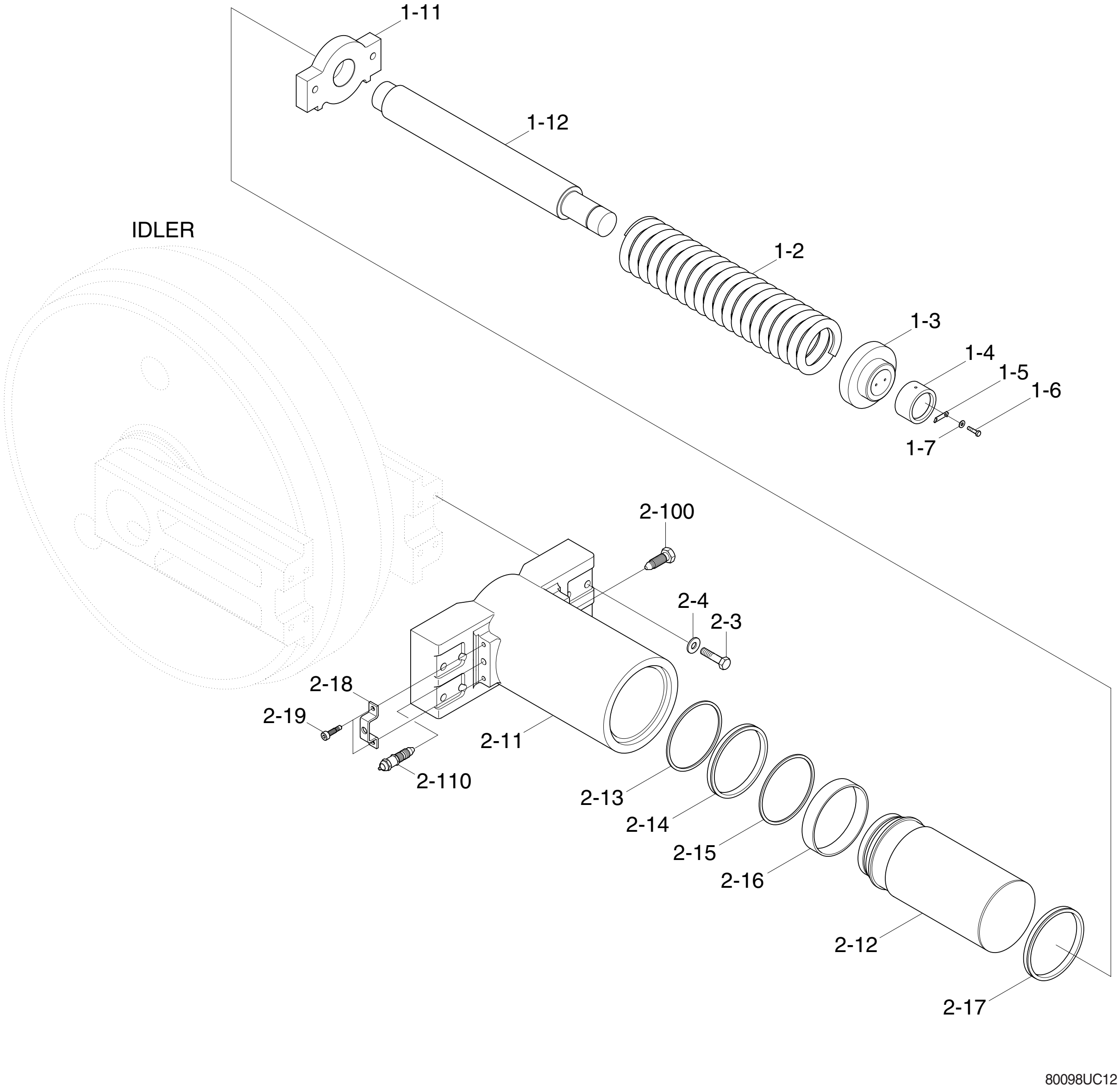


⑧ Lay bracket (6) on its side.
Supply engine oil to the specified level, and tighten plug.



4) DISASSEMBLY AND ASSEMBLY OF RECOIL SPRING

(1) Structure



1	T/Cylinder assembly	1-6	Bolt	2-16	Guide ring
1-1	Main rod assembly	1-7	Spring washer	2-17	Dust seal (wiper)
1-11	Front flange	2	Tension body assembly	2-18	Locking plate
1-12	Rod	2-11	Cylinder body	2-19	Socket bolt
1-2	Spring	2-12	Piston rod	2-100	Plug bolt
1-3	Rear flange	2-13	Lock ring	2-110	Grease valve
1-4	Locking ring	2-14	Seal (U-packing)	2-3	Hex bolt
1-5	Locking plate	2-15	Back up ring	2-4	Hardened washer

(2) Disassembly

① Apply pressure on spring (1-2) with a press.

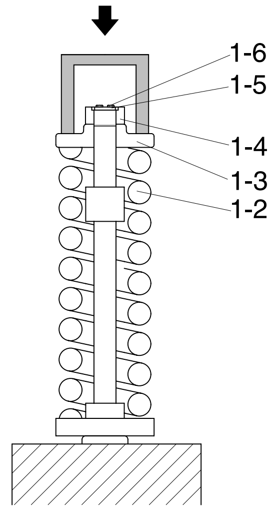
※ The spring is under a large installed load. This is dangerous, so be sure to set properly.

· Spring set load : 49986 ㎏ (110200 ㏁)

② Remove bolt (1-6), locking plate (1-5) and locking ring (1-4).

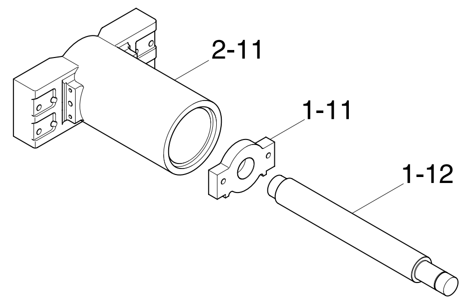
③ Take enough notice so that the press which pushes down the spring, should not be slipped out in its operation.

④ Lighten the press load slowly and remove rear flange (1-3) and spring (1-2).



80098UC14

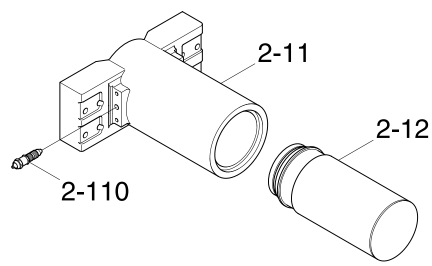
⑤ Remove rod (1-12) and front flange (1-11) from body (2-11).



80098UC15

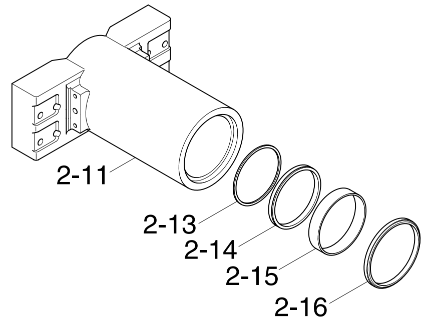
⑥ Remove grease valve (2-110) from body (2-11).

⑦ Remove rod (2-12) from body (2-11).



80098UC13

⑧ Remove guide ring (2-16), back up ring (2-15), packing seal (2-14) and lock ring (2-13).



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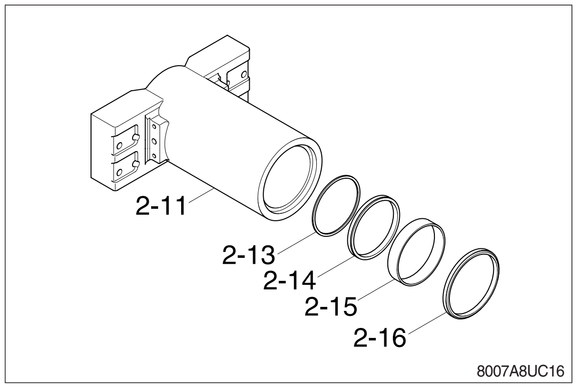
(3) Assembly

① Install lock ring (2-13), packing seal (2-14), back up ring (2-15) and guide ring (2-16).

※ When installing packing seal (2-14) take full care so as not to damage the lip.

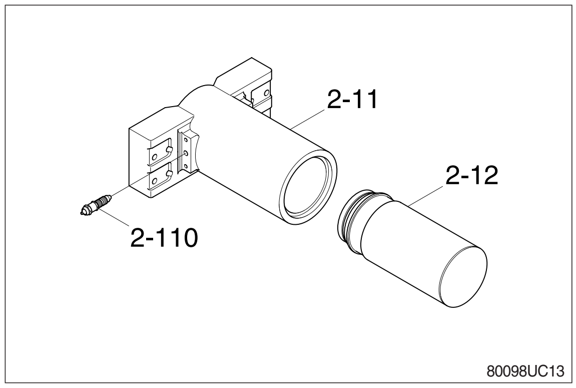


② Pour grease into body (2-11), then push in rod (2-12) by hand.
After take grease out of grease valve mounting hole, let air out.

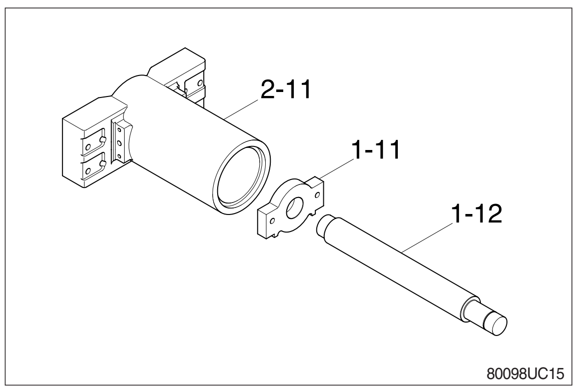
※ If air letting is not sufficient, it may be difficult to adjust the tension of crawler.

③ Fit grease valve (2-110) to body (2-11).

· Tightening torque : 7.0±1.0 kgf · m
(50.6±7.2 lbf · ft)



④ Install rod (1-12) and front flange (1-11) to body (2-11).

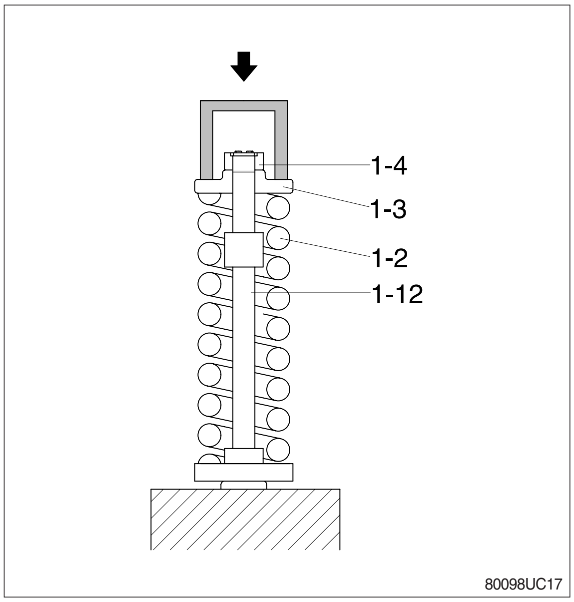


⑤ Install spring (1-2) and rear flange (1-3) to rod (1-12).

⑥ Apply pressure to spring (1-2) with a press and tighten locking ring (1-4).

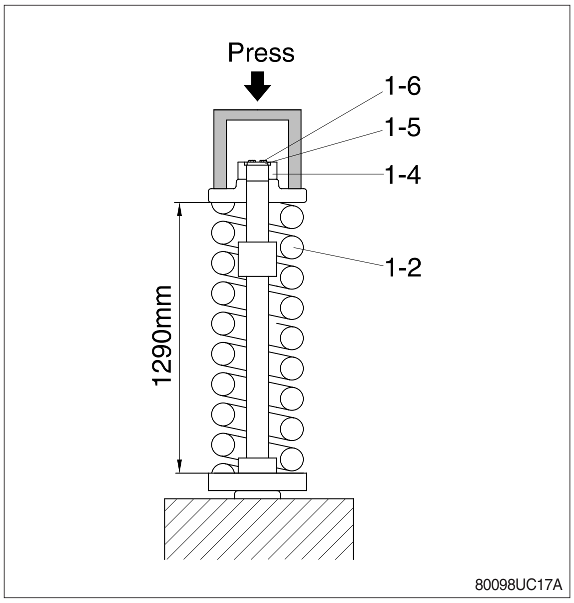
※ Apply sealant before assembling.

※ During the operation, pay attention specially to prevent the press from slipping out.

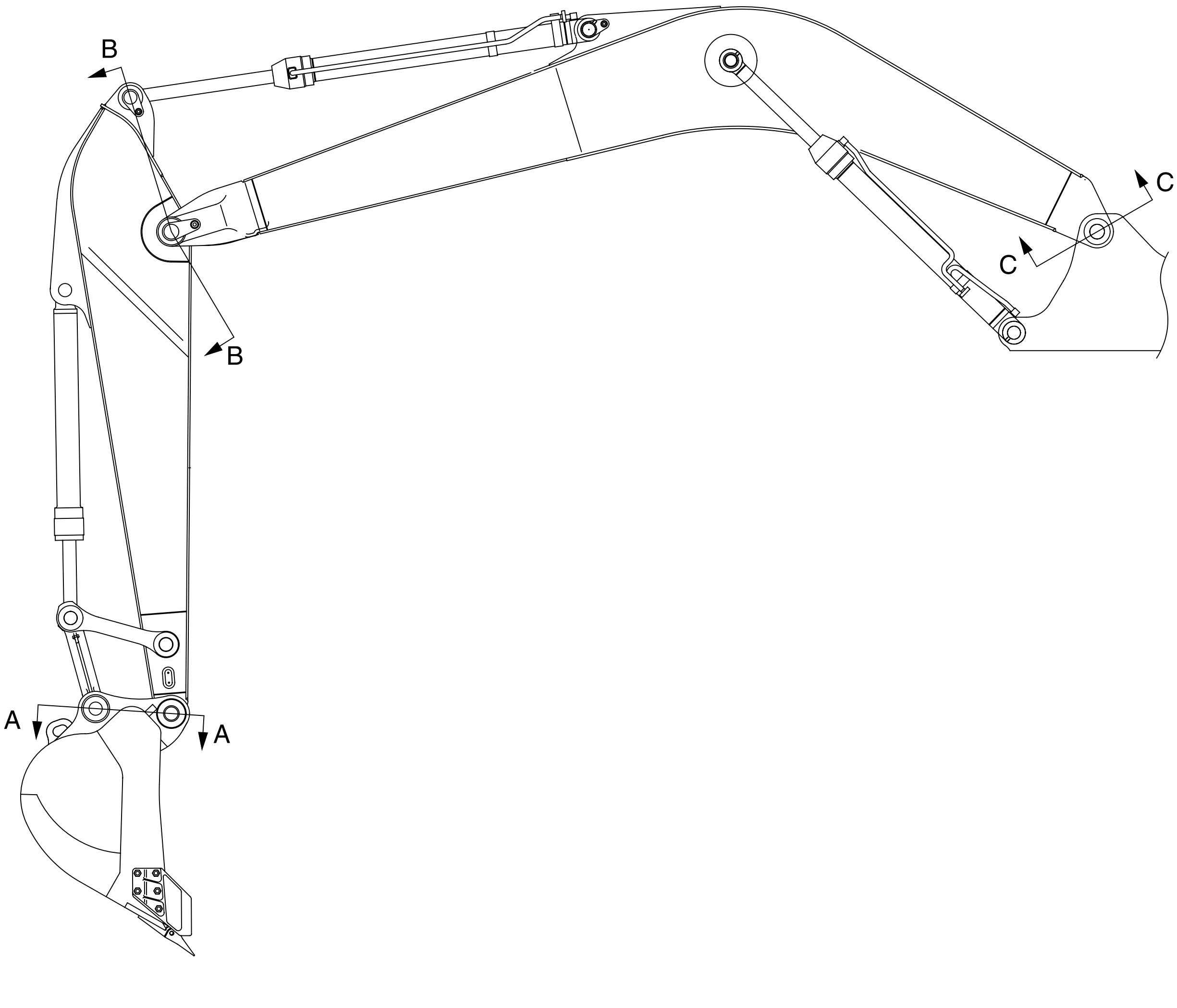


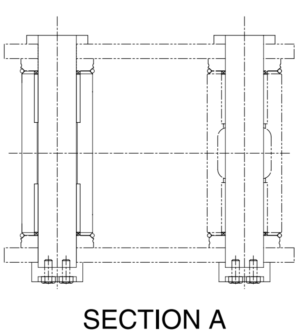
⑦ Lighten the press load and confirm the set length of spring (1-2).

⑧ After the setting of spring (1-2), install locking ring (1-4), locking plate (1-5) and bolt (1-6).

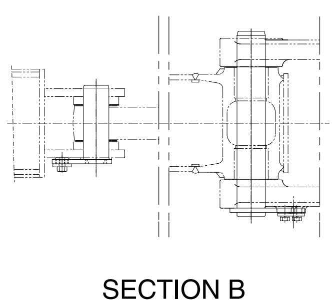


1. STRUCTURE

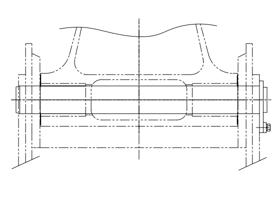




SECTION A



SECTION B



SECTION C

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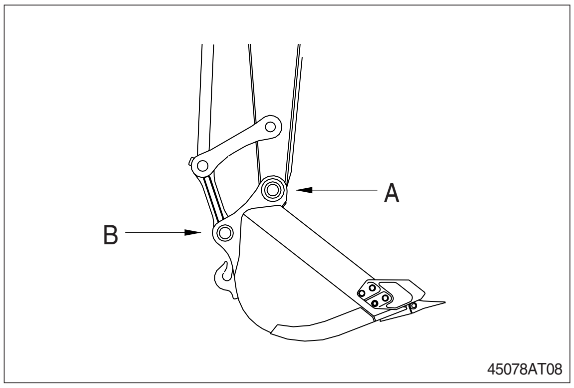
2. REMOVAL AND INSTALL

1) BUCKET ASSEMBLY

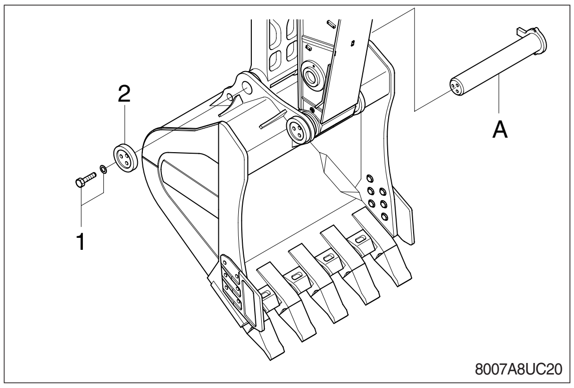
(1) Removal

① Lower the work equipment completely to ground with back of bucket facing down.



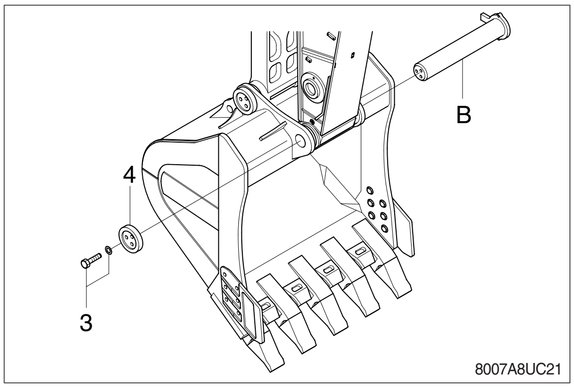
② Remove bolt (1), stopper (2) and draw out the pin (A).

· Tightening torque : 100±15 kgf · m (723±109 lbf · ft)



③ Remove bolt (3), stopper (4) and draw out the pin (B).

· Tightening torque : 100±15 kgf · m (723±109 lbf · ft)

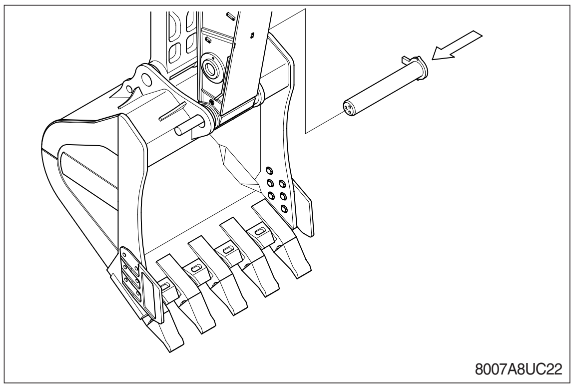


(2) Install

① Carry out installation in the reverse order to removal.

⚠ **When aligning the mounting position of the pin, do not insert your fingers in the pin hole.**

※ Adjust the bucket clearance.
For detail, see **operation manual.**

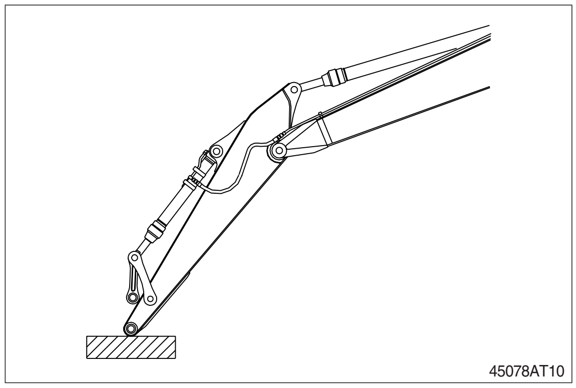


2) ARM ASSEMBLY

(1) Removal

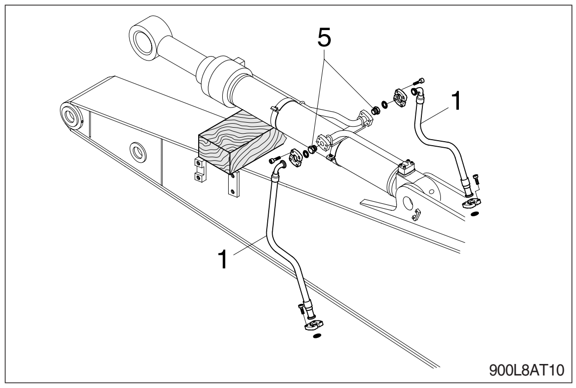
※ Loosen the breather slowly to release the pressure inside the hydraulic tank.

▲ **Escaping fluid under pressure can penetrated the skin causing serious injury.**



① Remove bucket assembly.
For details, see **removal of bucket assembly.**

② Disconnect bucket cylinder hoses (1) and put plugs (5) on cylinder pipes.



▲ **Fit blind plugs in the piping at the chassis end securely to prevent oil from spurting out when the engine is started.**

③ Sling arm cylinder assembly, remove spring, pin stopper and pull out pin.

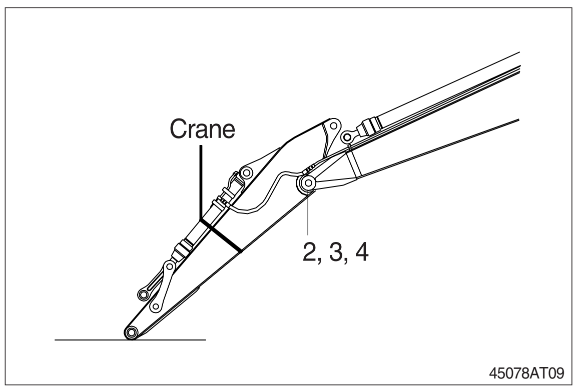
※ Tie the rod with wire to prevent it from coming out.

④ For details, see **removal of arm cylinder assembly.**
Place a wooden block under the cylinder and bring the cylinder down to it.

⑤ Remove bolt (2), plate (3) and pull out the pin (4) then remove the arm assembly.

· Weight : 4950 kg (10910 lb)

· Tightening torque (2) : 29.7±45 kgf · m (215±32.5 lbf · ft)



※ When lifting the arm assembly, always lift the center of gravity.

(2) Install

① Carry out installation in the reverse order to removal.

▲ **When lifting the arm assembly, always lift the center of gravity.**

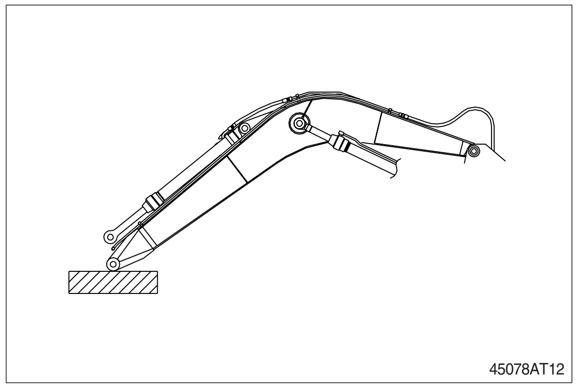
※ Bleed the air from the cylinder.

3) BOOM ASSEMBLY

(1) Removal

① Remove arm and bucket assembly.
For details, see **removal of arm and bucket assembly.**

② Remove boom cylinder assembly from boom.
For details, see **removal of boom cylinder assembly.**

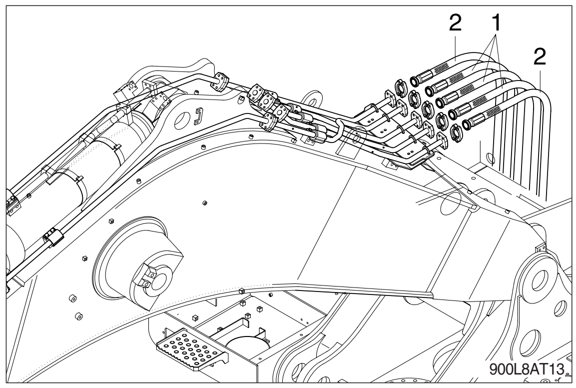


③ Disconnect head lamp wiring.

④ Disconnect bucket cylinder hose (2) and arm cylinder hose (1).

※ When the hose are disconnected, oil may spurt out.

⑤ Sling boom assembly (3).

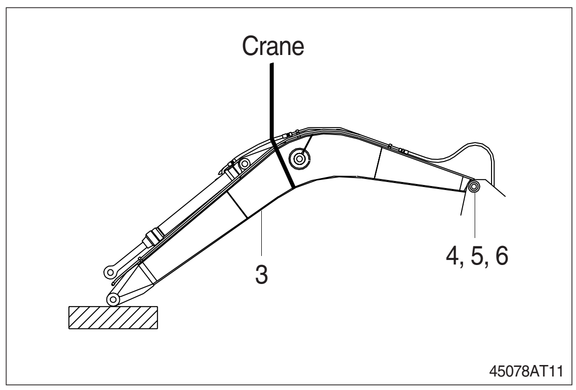


⑥ Remove bolt (4), plate (5) and pull out the pin (6) of both sides then remove boom assembly.

· Weight : 8810 kg (19420 lb)

· Tightening torque (2) : 29.7±45 kgf · m (215±32.5 lbf · ft)

※ When lifting the boom assembly always lift the center of gravity.



(2) Install

① Carry out installation in the reverse order to removal.

⚠ **When lifting the boom assembly, always lift the center of gravity.**

※ Bleed the air from the cylinder.