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1. STRUCTURE

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

SECTION 1 GENERAL

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

SECTION 2 STRUCTURE AND FUNCTION

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

SECTION 3 HYDRAULIC SYSTEM

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

SECTION 4 ELECTRICAL SYSTEM

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

SECTION 5 MECHATRONICS SYSTEM

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

SECTION 6 TROUBLESHOOTING

This section explains the troubleshooting charts correlating problems to causes.

SECTION 7 MAINTENANCE STANDARD

This section gives the judgement standards when inspecting disassembled parts.

SECTION 8 DISASSEMBLY AND ASSEMBLY

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

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

2. HOW TO READ THE SERVICE MANUAL

Distribution and updating

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

Filing method

1. See the page number on the bottom of the page.
   File the pages in correct order.
2. Following examples shows how to read the page number.
   Example 1
   2 - 3
   - Item number (2. Structure and Function)
   - Consecutive page number for each item.
3. Additional pages : Additional pages are indicated by a hyphen (-) and number after the page number. File as in the example.
   8 - 4
   8 - 4 - 1 ⎤ Added pages
   8 - 4 - 2 ⎦
   8 - 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 50 in the vertical column at the left side, take this as ⓐ, then draw a horizontal line from ⓐ.

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

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

2. Convert 550 mm into inches.

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

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

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

Millimeters to inches

ⓑ

1 mm = 0.03937 in

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

Millimeters to inches

1mm = 0.03937in

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

Kilogram to Pound

1kg = 2.2046lb

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

Liter to U.S. Gallon

1 ℓ = 0.2642 U.S.Gal

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

Liter to U.K. Gallon

1 ℓ = 0.21997 U.K.Gal

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

kgf · m to lbf · ft

1kgf · m = 7.233lbf · ft

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

kgf/cm^2 to lbf/in^2

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

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

TEMPERATURE

Fahrenheit-Centigrade Conversion.

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

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

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

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

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

SECTION 1 GENERAL

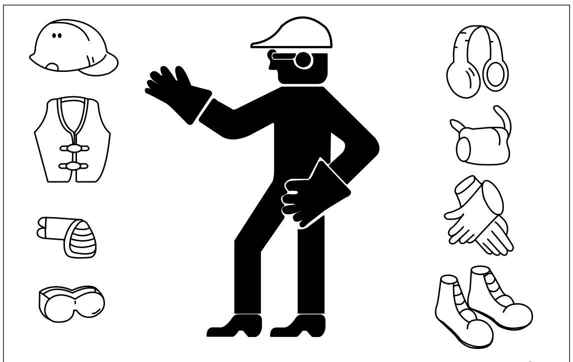
GROUP 1 SAFETY

FOLLOW SAFE PROCEDURE

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

WEAR PROTECTIVE CLOTHING

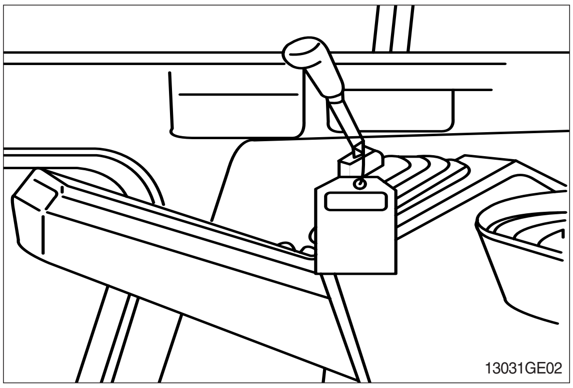
Wear close fitting clothing and safety equipment appropriate to the job.



13031GE01

WARN OTHERS OF SERVICE WORK

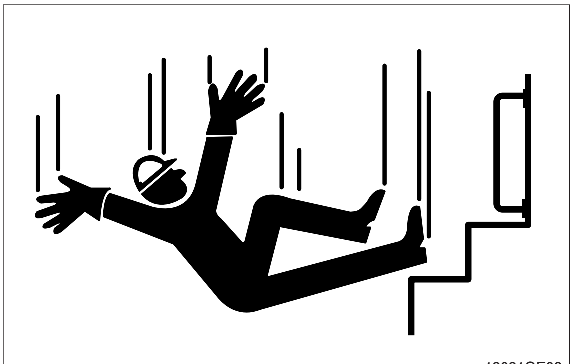
Unexpected machine movement can cause serious injury.
Before performing any work on the excavator, attach a「**Do Not Operate**」tag on the right side control lever.



13031GE02

USE HANDHOLDS AND STEPS

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



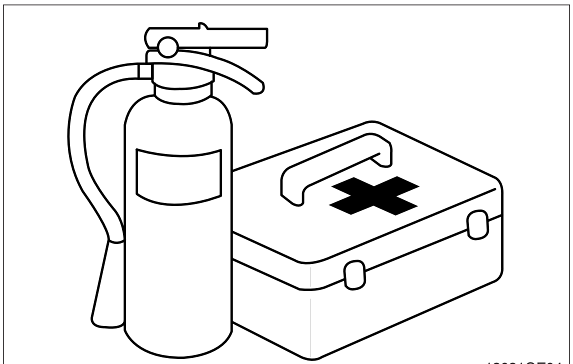
13031GE03

PREPARE FOR EMERGENCIES

Be prepared if a fire starts.

Keep a first aid kit and fire extinguisher handy.

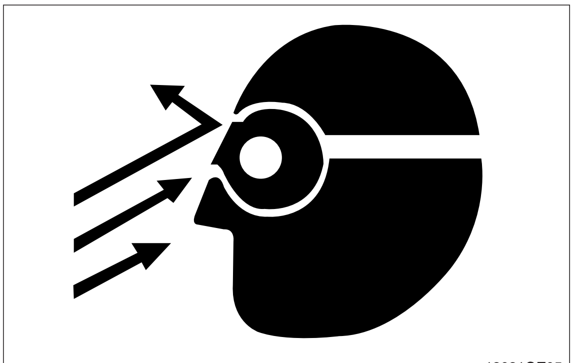
Keep emergency numbers for doctors, ambulance service, hospital, and fire department near your telephone.



13031GE04

PROTECT AGAINST FLYING DEBRIS

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

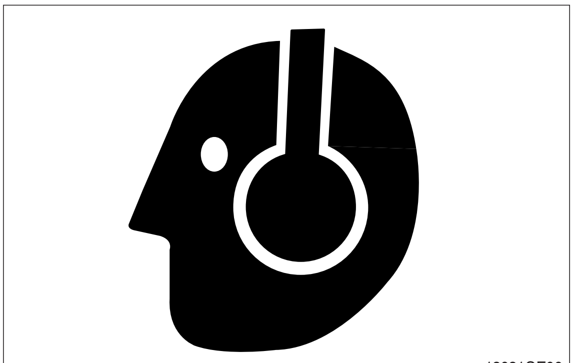


13031GE05

PROTECT AGAINST NOISE

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

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

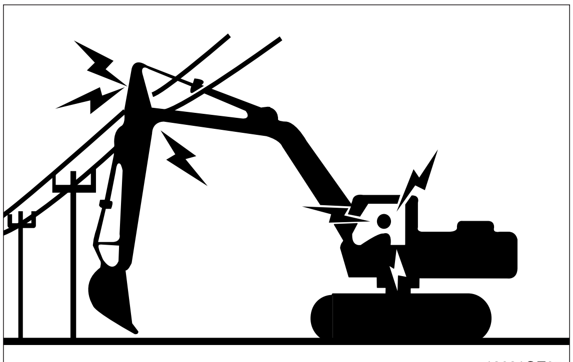


13031GE06

AVOID POWER LINES

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

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

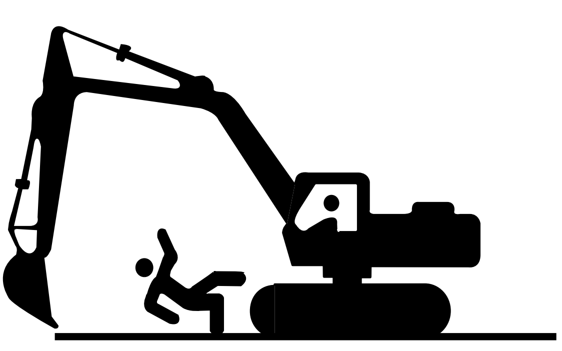


13031GE07

KEEP RIDERS OFF EXCAVATOR

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

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



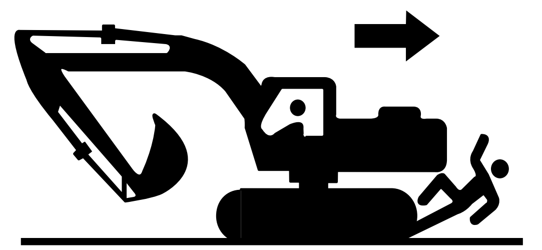
13031GE08

MOVE AND OPERATE MACHINE SAFELY

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

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

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

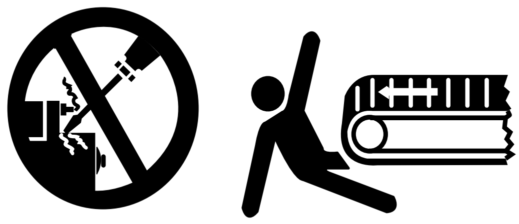


13031GE09

OPERATE ONLY FORM OPERATOR'S SEAT

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

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



13031GE26

PARK MACHINE SAFELY

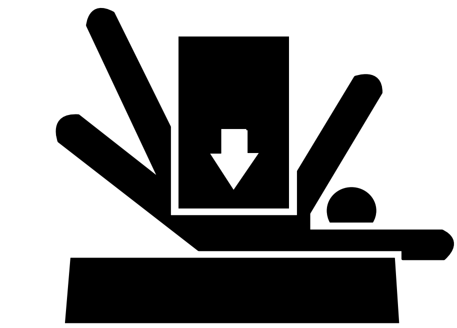
Before working on the machine:

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

SUPPORT MACHINE PROPERLY

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

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

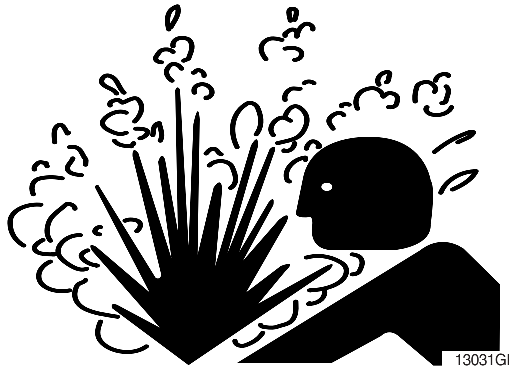


13031GE10

SERVICE COOLING SYSTEM SAFELY

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

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



13031GE11

HANDLE FLUIDS SAFELY-AVOID FIRES

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

13031GE12

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

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

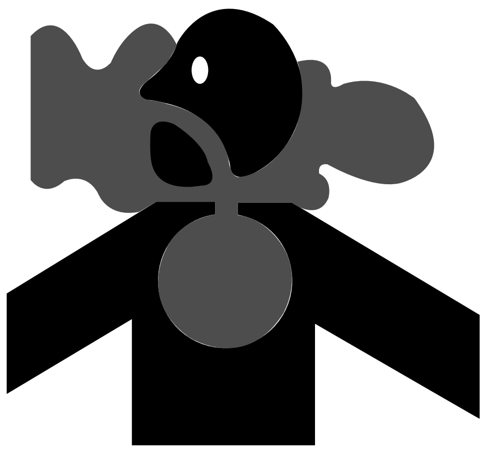
Do not store oily rags; They can ignite and burn spontaneously.

13031GE13

BEWARE OF EXHAUST FUMES

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

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



13031GE14

REMOVE PAINT BEFORE WELDING OR HEATING

Avoid potentially toxic fumes and dust.

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

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

Remove paint before welding or heating:

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

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

ILLUMINATE WORK AREA SAFELY

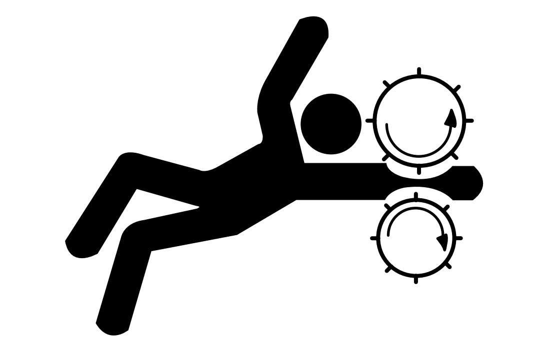
Illuminate your work area adequately but safely. Use a portable safety light for working inside or under the machine. Make sure the bulb is enclosed by a wire cage. The hot filament of an accidentally broken bulb can ignite spilled fuel or oil.

13031GE15

SERVICE MACHINE SAFELY

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

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

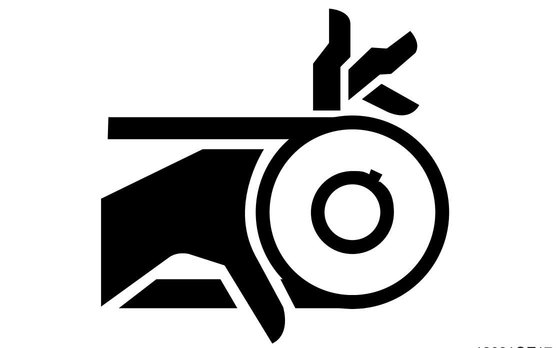


13031GE16

STAY CLEAR OF MOVING PARTS

Entanglements in moving parts can cause serious injury.

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



13031GE17

AVOID HIGH PRESSURE FLUIDS

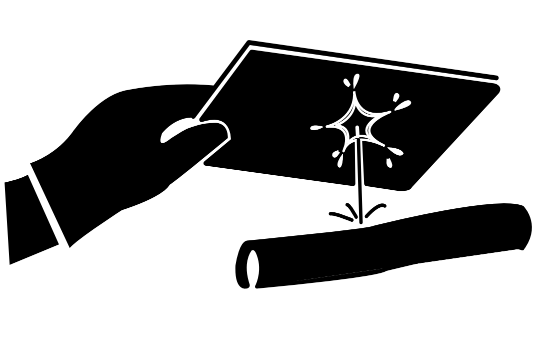
Escaping fluid under pressure can penetrate the skin causing serious injury.

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

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

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

13031GE18



13031GE19

AVOID HEATING NEAR PRESSURIZED FLUID LINES

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

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

13031GE20

PREVENT BATTERY EXPLOSIONS

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

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

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

13031GE21

PREVENT ACID BURNS

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

Avoid the hazard by:

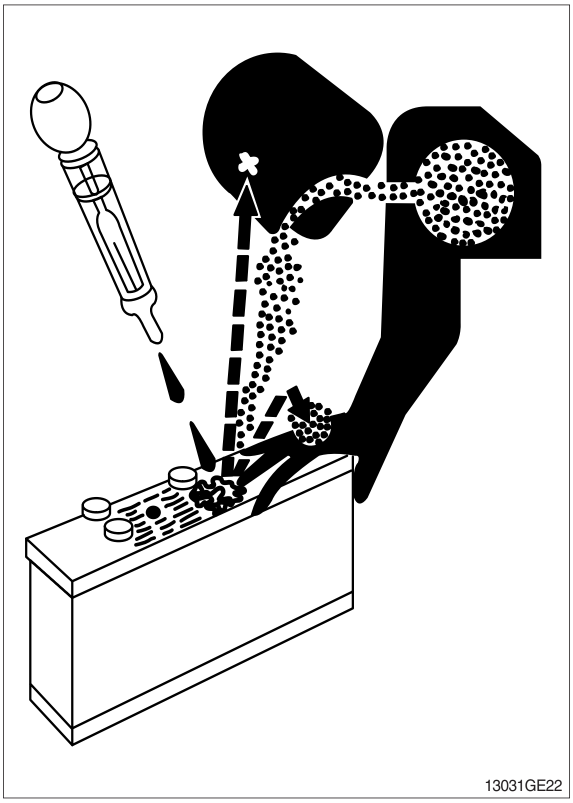
1. Filling batteries in a well-ventilated area.
2. Wearing eye protection and rubber gloves.
3. Avoiding breathing fumes when electrolyte is added.
4. Avoiding spilling of dripping electrolyte.
5. Use proper jump start procedure.

If you spill acid on yourself:

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

If acid is swallowed:

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



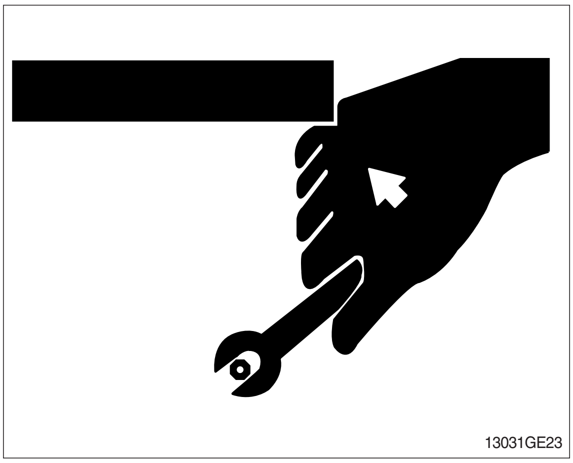
USE TOOLS PROPERLY

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

Use power tools only to loosen threaded tools and fasteners.

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

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

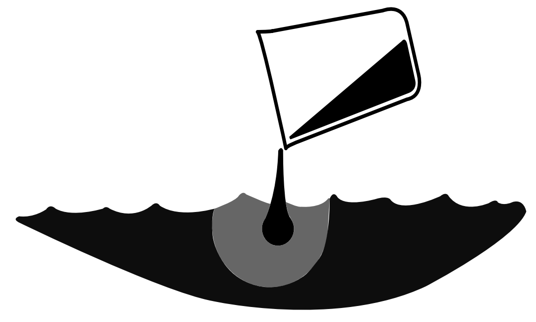


DISPOSE OF FLUIDS PROPERLY

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

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

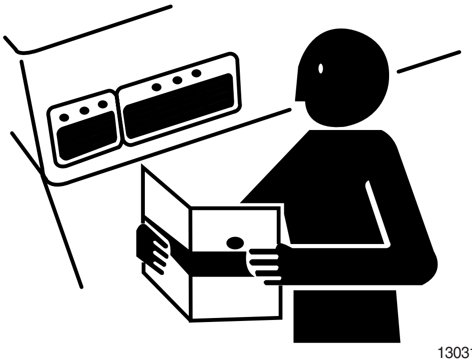
DO NOT pour oil into the ground, down a drain, or into a stream, pond, or lake. Observe relevant environmental protection regulations when disposing of oil, fuel, coolant, brake fluid, filters, batteries, and other harmful waste.



13031GE24

REPLACE SAFETY SIGNS

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



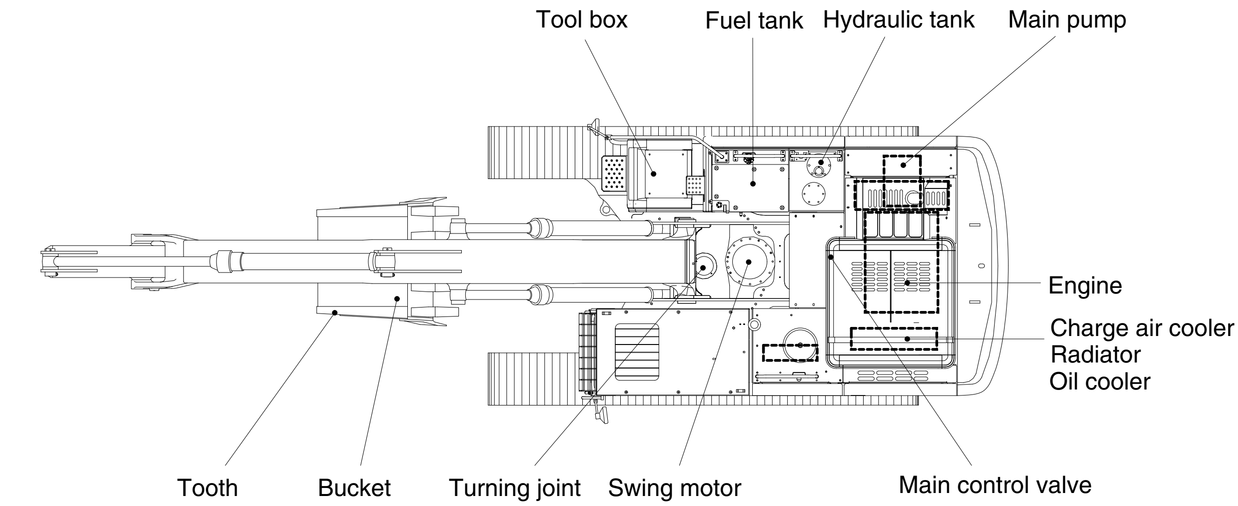
13031GE25

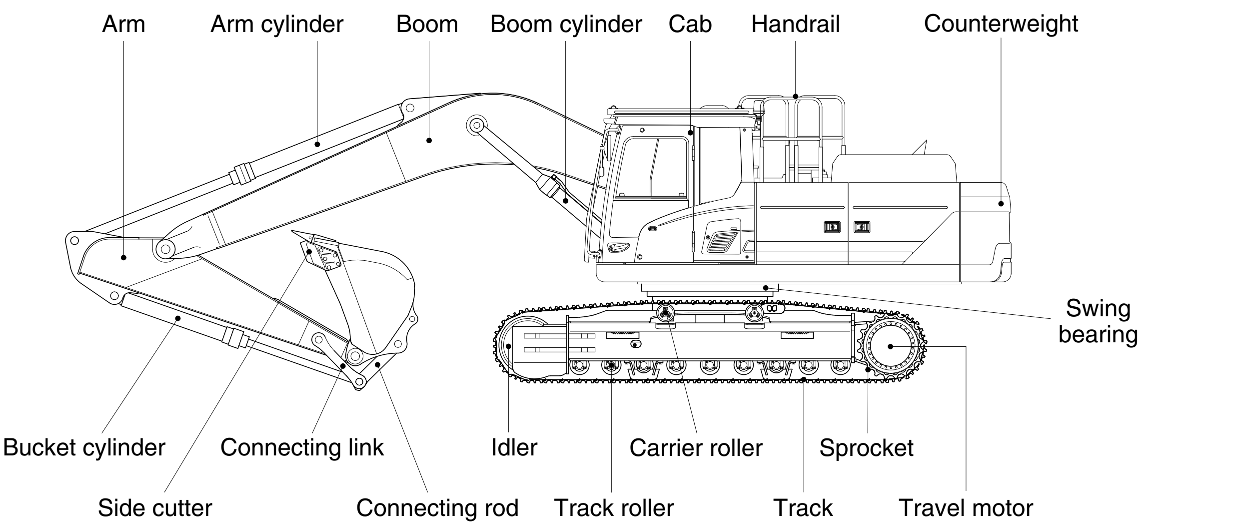
LIVE WITH SAFETY

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

GROUP 2 SPECIFICATIONS

1. MAJOR COMPONENT

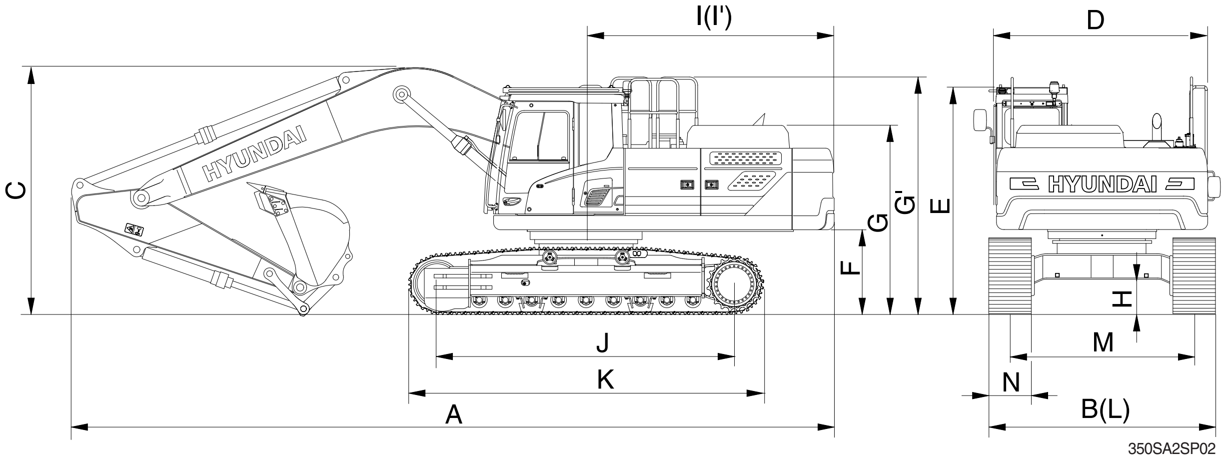




350SA2SP01

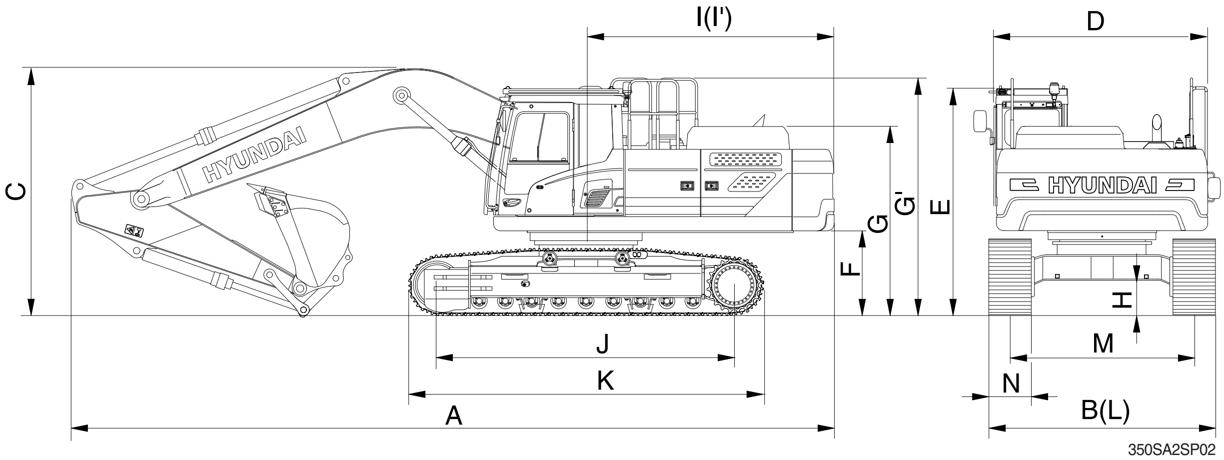
2. SPECIFICATIONS

1) HX350LT3, 6.45m (21' 2") BOOM



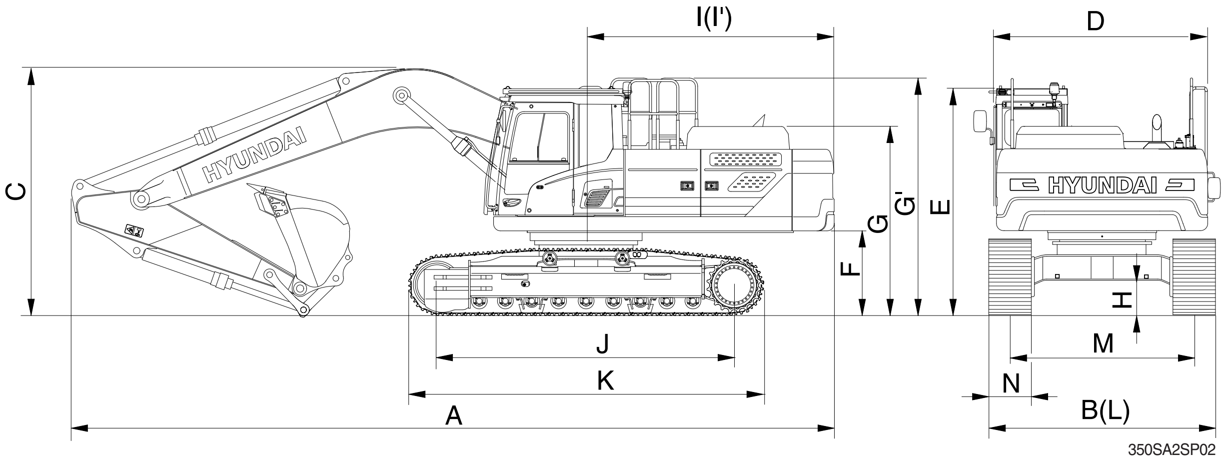
Description		Unit		Specification			
		m (ft-in)	Boom	6.45 (21' 2")			
			Arm	3.20 (10' 6")	2.20 (7' 3")	2.50 (8' 2")	4.05 (13' 3")
		mm (in)	Shoe	600 (24)			
Operating weight		kg (lb)		33680 (74096)	33460 (73612)	33570 (73854)	33900 (74580)
Bucket capacity (SAE heaped), standard		m^3 (yd^3)		1.44 (1.88)	1.44 (1.88)	1.44 (1.88)	1.44 (1.88)
Overall length	A	mm (ft-in)		11220 (36' 10")	11460 (37' 7")	11340 (37' 2")	11200 (36' 9")
Overall width	B			3280 (10' 9")	3280 (10' 9")	3280 (10' 9")	3280 (10' 9")
Overall height of boom	C			3360 (11' 0")	3630 (11' 11")	3540 (11' 7")	3880 (12' 9")
Superstructure width	D			2980 (9' 9")	2980 (9' 9")	2980 (9' 9")	2980 (9' 9")
Overall height of cab	E			3145 (10' 4")	3145 (10' 4")	3145 (10' 4")	3145 (10' 4")
Ground clearance of counterweight	F			1200 (3' 11")	1200 (3' 11")	1200 (3' 11")	1200 (3' 11")
Overall height of engine hood	G			2690 (8' 10")	2690 (8' 10")	2690 (8' 10")	2690 (8' 10")
Overall height of handrail	G'			3350 (11' 0")	3350 (11' 0")	3350 (11' 0")	3350 (11' 0")
Minimum ground clearance	H			500 (1' 8")	500 (1' 8")	500 (1' 8")	500 (1' 8")
Rear-end distance	I			3505 (11' 6")	3505 (11' 6")	3505 (11' 6")	3505 (11' 6")
Rear-end swing radius	I'			3570 (11' 9")	3570 (11' 9")	3570 (11' 9")	3570 (11' 9")
Distance between tumblers	J			4030 (13' 3")	4030 (13' 3")	4030 (13' 3")	4030 (13' 3")
Undercarriage length	K			4940 (16' 2")	4940 (16' 2")	4940 (16' 2")	4940 (16' 2")
Undercarriage width	L			3280 (10' 9")	3280 (10' 9")	3280 (10' 9")	3280 (10' 9")
Track gauge	M			2680 (8' 10")	2680 (8' 10")	2680 (8' 10")	2680 (8' 10")
Track shoe width, standard	N			600 (24")	600 (24")	600 (24")	600 (24")
Travel speed (low/high)		km/hr (mph)		3.5/6.4			
Swing speed		rpm		10.2			
Gradeability		Degree (%)		35 (70)			
Ground pressure		kgf/cm^2 (psi)		0.65 (9.22)	0.64 (9.16)	0.65 (9.19)	0.65 (9.28)
Max traction force		kg (lb)		27404 (60415)			

2) HX350LT3, 6.15m (20' 2") HD SHORT BOOM



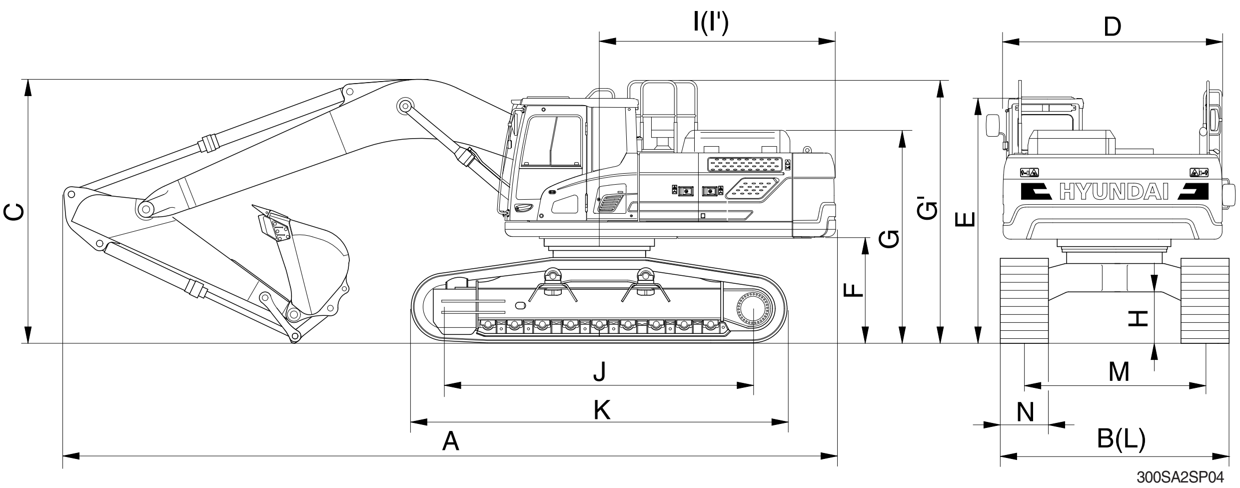
Description		Unit		Specification	
		m (ft-in)	Boom	6.15 (20' 2")	
			Arm	2.20 (7' 3")	2.50 (8' 2")
		mm (in)	Shoe	600 (24)	
Operating weight		kg (lb)		33410 (73502)	33520 (73744)
Bucket capacity (SAE heaped), standard		m^3 (yd^3)		1.44 (1.88)	1.44 (1.88)
Overall length	A	mm (ft-in)		11230 (36' 3")	11080 (36' 4")
Overall width	B			3280 (10' 9")	3280 (10' 9")
Overall height of boom	C			3720 (12' 2")	3620 (11' 11")
Superstructure width	D			2960 (9' 9")	2960 (9' 9")
Overall height of cab	E			3145 (10' 4")	3145 (10' 4")
Ground clearance of counterweight	F			1200 (3' 11")	1200 (3' 11")
Overall height of engine hood	G			2690 (8' 10")	2690 (8' 10")
Overall height of handrail	G'			3350 (11' 0")	3350 (11' 0")
Minimum ground clearance	H			500 (1' 8")	500 (1' 8")
Rear-end distance	I			3505 (11' 6")	3505 (11' 6")
Rear-end swing radius	I'			3570 (11' 9")	3570 (11' 9")
Distance between tumblers	J			4030 (13' 3")	4030 (13' 3")
Undercarriage length	K			4940 (16' 2")	4940 (16' 2")
Undercarriage width	L			3280 (10' 9")	3280 (10' 9")
Track gauge	M			2680 (8' 10")	2680 (8' 10")
Track shoe width, standard	N			600 (24")	600 (24")
Travel speed (low/high)		km/hr (mph)		3.5/6.4	
Swing speed		rpm		10.2	
Gradeability		Degree (%)		35 (70)	
Ground pressure		kgf/cm^2 (psi)		0.64 (9.15)	0.65 (9.18)
Max traction force		kg (lb)		27404 (60415)	

3) HX350LT3, 6.45m (21' 2") HD BOOM

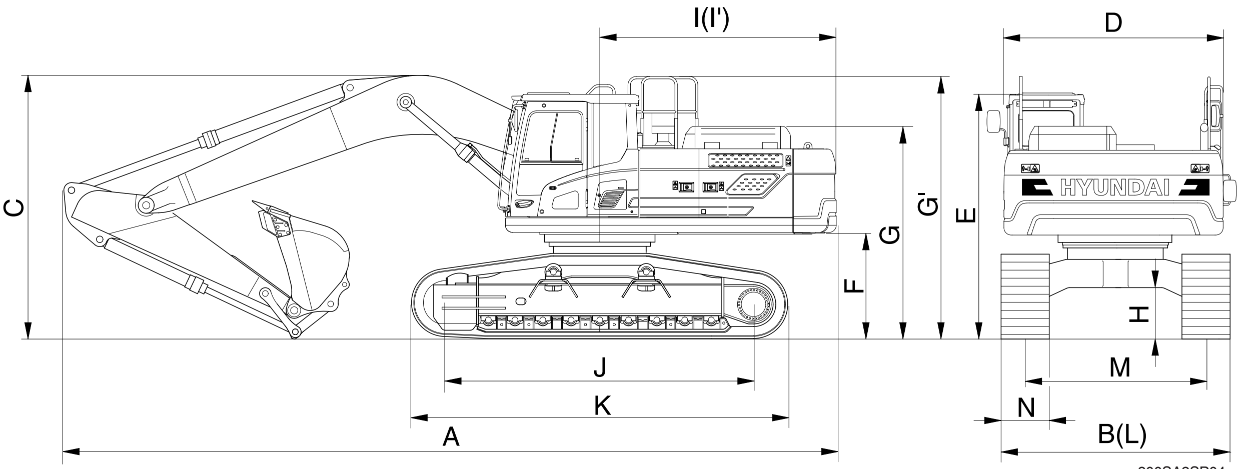


Description		Unit		Specification			
		m (ft-in)	Boom	6.45 (21' 2")			
			Arm	3.20 (10' 6")	2.20 (7' 3")	2.50 (8' 2")	4.05 (13' 3")
		mm (in)	Shoe	600 (24)			
Operating weight		kg (lb)		33680 (74096)	33460 (73612)	33570 (73854)	33900 (74580)
Bucket capacity (SAE heaped), standard		m^3 (yd^3)		1.44 (1.88)	1.44 (1.88)	1.44 (1.88)	1.44 (1.88)
Overall length	A	mm (ft-in)		11220 (36' 10")	11530 (37' 10")	11390 (37' 4")	11210 (36' 9")
Overall width	B			3280 (10' 9")	3280 (10' 9")	3280 (10' 9")	3280 (10' 9")
Overall height of boom	C			3420 (11' 3")	3680 (12' 1")	3580 (11' 9")	3900 (12' 1")
Superstructure width	D			2980 (9' 9")	2980 (9' 9")	2980 (9' 9")	2980 (9' 9")
Overall height of cab	E			3145 (10' 4")	3145 (10' 4")	3145 (10' 4")	3145 (10' 4")
Ground clearance of counterweight	F			1200 (3' 11")	1200 (3' 11")	1200 (3' 11")	1200 (3' 11")
Overall height of engine hood	G			2690 (8' 10")	2690 (8' 10")	2690 (8' 10")	2690 (8' 10")
Overall height of handrail	G'			3350 (11' 0")	3350 (11' 0")	3350 (11' 0")	3350 (11' 0")
Minimum ground clearance	H			500 (1' 8")	500 (1' 8")	500 (1' 8")	500 (1' 8")
Rear-end distance	I			3505 (11' 6")	3505 (11' 6")	3505 (11' 6")	3505 (11' 6")
Rear-end swing radius	I'			3570 (11' 9")	3570 (11' 9")	3570 (11' 9")	3570 (11' 9")
Distance between tumblers	J			4030 (13' 3")	4030 (13' 3")	4030 (13' 3")	4030 (13' 3")
Undercarriage length	K			4940 (16' 2")	4940 (16' 2")	4940 (16' 2")	4940 (16' 2")
Undercarriage width	L			3280 (10' 9")	3280 (10' 9")	3280 (10' 9")	3280 (10' 9")
Track gauge	M			2680 (8' 10")	2680 (8' 10")	2680 (8' 10")	2680 (8' 10")
Track shoe width, standard	N			600 (24")	600 (24")	600 (24")	600 (24")
Travel speed (low/high)		km/hr (mph)		3.5/6.4			
Swing speed		rpm		10.2			
Gradeability		Degree (%)		35 (70)			
Ground pressure		kgf/cm^2 (psi)		0.65 (9.22)	0.64 (9.16)	0.65 (9.19)	0.65 (9.28)
Max traction force		kg (lb)		27404 (60415)			

4) HX350LT3 HW, 6.45 m (21' 2") BOOM



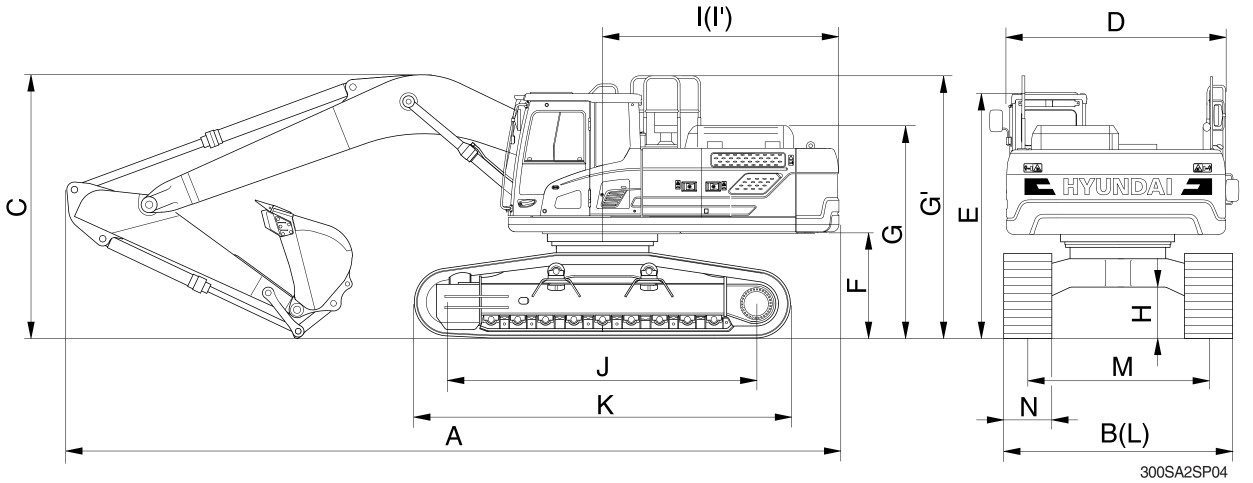
Description		Unit		Specification			
		m (ft-in)	Boom	6.45 (21' 2")			
			Arm	3.20 (10' 6")	2.20 (7' 3")	2.50 (8' 2")	4.05 (13' 3")
		mm (in)	Shoe	700 (28")			
Operating weight		kg (lb)		37100 (81620)	36890 (81158)	37000 (81400)	37330 (82126)
Bucket capacity (SAE heaped), standard		m^3 (yd^3)		1.44 (1.88)	1.44 (1.88)	1.44 (1.88)	1.44 (1.88)
Overall length	A	mm (ft-in)		11150 (36' 7")	11460 (37' 7")	11340 (37' 2")	11240 (36' 11")
Overall width	B			3570 (11' 9")	3570 (11' 9")	3570 (11' 9")	3570 (11' 9")
Overall height of boom	C			3360 (11' 0")	3740 (12' 3")	3760 (12' 4")	3810 (12' 6")
Superstructure width	D			2980 (9' 9")	2980 (9' 9")	2980 (9' 9")	2980 (9' 9")
Overall height of cab	E			3480 (11' 5")	3480 (11' 5")	3480 (11' 5")	3480 (11' 5")
Ground clearance of counterweight	F			1535 (5' 0")	1535 (5' 0")	1535 (5' 0")	1535 (5' 0")
Overall height of engine hood	G			2990 (9' 10")	2990 (9' 10")	2990 (9' 10")	2990 (9' 10")
Overall height of handrail	G'			3650 (12' 0")	3650 (12' 0")	3650 (12' 0")	3650 (12' 0")
Minimum ground clearance	H			800 (2' 7")	800 (2' 7")	800 (2' 7")	800 (2' 7")
Rear-end distance	I			3505 (11' 6")	3505 (11' 6")	3505 (11' 6")	3505 (11' 6")
Rear-end swing radius	I'			3570 (11' 9")	3570 (11' 9")	3570 (11' 9")	3570 (11' 9")
Distance between tumblers	J			4100 (13' 5")	4100 (13' 5")	4100 (13' 5")	4100 (13' 5")
Undercarriage length	K			5010 (16' 5")	5010 (16' 5")	5010 (16' 5")	5010 (16' 5")
Undercarriage width	L			3570 (11' 9")	3570 (11' 9")	3570 (11' 9")	3570 (11' 9")
Track gauge	M			2870 (9' 5")	2870 (9' 5")	2870 (9' 5")	2870 (9' 5")
Track shoe width, standard	N			700 (28")	700 (28")	700 (28")	700 (28")
Travel speed (low/high)		km/hr (mph)		3.5/6.4			
Swing speed		rpm		10.2			
Gradeability		Degree (%)		35 (70)			
Ground pressure		kgf/cm^2 (psi)		0.61 (8.69)	0.64 (8.64)	0.61 (8.66)	0.62 (8.86)
Max traction force		kg (lb)		27404 (60415)			



300SA2SP04

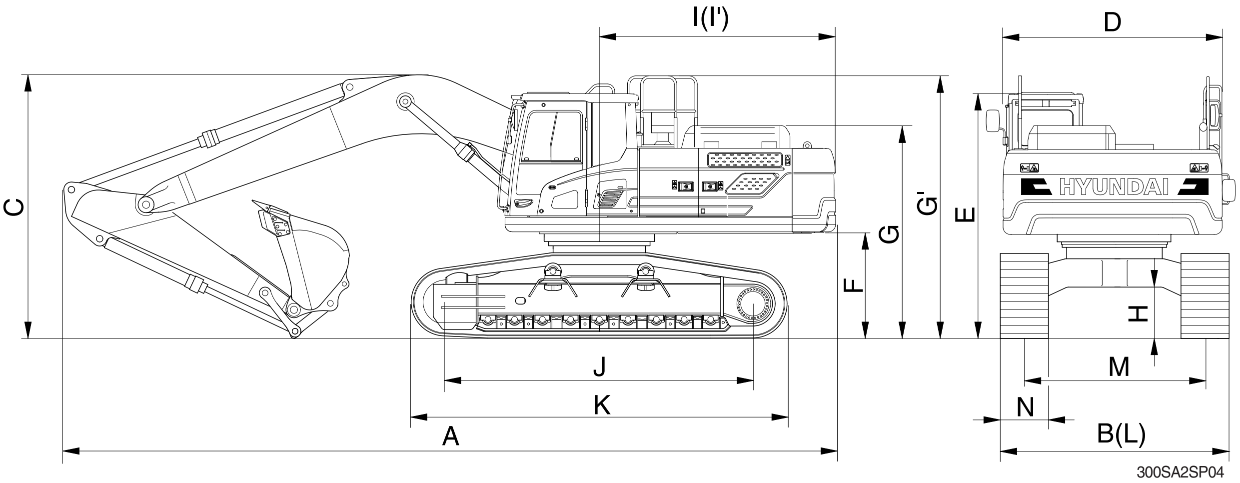
Description		Unit		Specification			
		m (ft-in)	Boom	6.45 (21' 2")			
			Arm	3.20 (10' 6")	2.20 (7' 3")	2.50 (8' 2")	4.05 (13' 3")
		mm (in)	Shoe	600 (24")			
Operating weight		kg (lb)		35540 (78350)	35330 (77890)	35440 (78130)	35770 (78860)
Bucket capacity (SAE heaped), standard		m^3 (yd^3)		1.44 (1.88)	1.44 (1.88)	1.44 (1.88)	1.44 (1.88)
Overall length	A	mm (ft-in)		11150 (36' 7")	11460 (37' 7")	11340 (37' 2")	11240 (36' 10")
Overall width	B			3470 (11' 5")	3470 (11' 5")	3470 (11' 5")	3470 (11' 5")
Overall height of boom	C			3360 (11' 0")	3740 (12' 3")	3760 (12' 4")	3810 (12' 6")
Superstructure width	D			2980 (9' 9")	2980 (9' 9")	2980 (9' 9")	2980 (9' 9")
Overall height of cab	E			3480 (11' 5")	3480 (11' 5")	3480 (11' 5")	3480 (11' 5")
Ground clearance of counterweight	F			1535 (5' 0")	1535 (5' 0")	1535 (5' 0")	1535 (5' 0")
Overall height of engine hood	G			2990 (9' 10")	2990 (9' 10")	2990 (9' 10")	2990 (9' 10")
Overall height of handrail	G'			3650 (12' 0")	3650 (12' 0")	3650 (12' 0")	3650 (12' 0")
Minimum ground clearance	H			800 (2' 7")	800 (2' 7")	800 (2' 7")	800 (2' 7")
Rear-end distance	I			3505 (11' 6")	3505 (11' 6")	3505 (11' 6")	3505 (11' 6")
Rear-end swing radius	I'			3570 (11' 9")	3570 (11' 9")	3570 (11' 9")	3570 (11' 9")
Distance between tumblers	J			4030 (13' 3")	4030 (13' 3")	4030 (13' 3")	4030 (13' 3")
Undercarriage length	K			4940 (16' 2")	4940 (16' 2")	4940 (16' 2")	4940 (16' 2")
Undercarriage width	L			3470 (11' 5")	3470 (11' 5")	3470 (11' 5")	3470 (11' 5")
Track gauge	M			2870 (9' 5")	2870 (9' 5")	2870 (9' 5")	2870 (9' 5")
Track shoe width, standard	N			600 (24")	600 (24")	600 (24")	600 (24")
Travel speed (low/high)		km/hr (mph)		3.5/6.4			
Swing speed		rpm		10.2			
Gradeability		Degree (%)		35 (70)			
Ground pressure		kgf/cm^2 (psi)		0.68 (9.73)	0.68 (9.67)	0.68 (9.70)	0.69 (9.80)
Max traction force		kg (lb)		27404 (60415)			

5) HX350LT3 HW, 6.15m (20' 2") HD SHORT BOOM

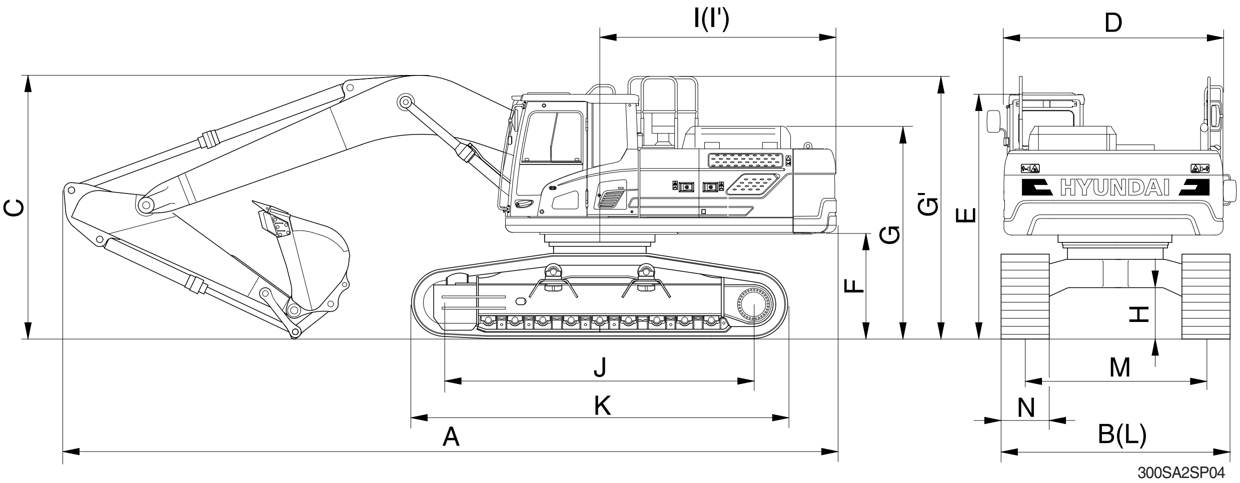


Description		Unit		Specification			
		m (ft-in)	Boom	6.15 (20' 2")			
			Arm	2.20 (7' 3")		2.50 (8' 2")	
		mm (in)	Shoe	700 (28")	600 (24")	700 (28")	600 (24")
Operating weight		kg (lb)		36840 (81048)	35280 (77780)	36950 (81290)	35390 (78022)
Bucket capacity (SAE heaped), standard		m^3 (yd^3)		1.44 (1.88)	1.44 (1.88)	1.44 (1.88)	1.44 (1.88)
Overall length	A	mm (ft-in)		11230 (36' 10")	11230 (36' 10")	11020 (36' 2")	11020 (36' 2")
Overall width	B			3570 (11' 9")	3470 (11' 5")	3570 (11' 9")	3470 (11' 5")
Overall height of boom	C			3820 (12' 6")	3820 (12' 6")	3690 (12' 1")	3690 (12' 1")
Superstructure width	D			2980 (9' 9")	2980 (9' 9")	2980 (9' 9")	2980 (9' 9")
Overall height of cab	E			3480 (11' 5")	3480 (11' 5")	3480 (11' 5")	3480 (11' 5")
Ground clearance of counterweight	F			1200 (3' 11")	1200 (3' 11")	1200 (3' 11")	1200 (3' 11")
Overall height of engine hood	G			2990 (9' 10")	2990 (9' 10")	2990 (9' 10")	2990 (9' 10")
Overall height of handrail	G'			3650 (12' 0")	3650 (12' 0")	3650 (12' 0")	3650 (12' 0")
Minimum ground clearance	H			800 (2' 7")	800 (2' 7")	800 (2' 7")	800 (2' 7")
Rear-end distance	I			3505 (11' 6")	3505 (11' 6")	3505 (11' 6")	3505 (11' 6")
Rear-end swing radius	I'			3570 (11' 9")	3570 (11' 9")	3570 (11' 9")	3570 (11' 9")
Distance between tumblers	J			4100 (13' 5")	4030 (13' 3")	4100 (13' 5")	4030 (13' 3")
Undercarriage length	K			5010 (16' 5")	4940 (16' 2")	5010 (16' 5")	4940 (16' 2")
Undercarriage width	L			3570 (11' 9")	3470 (11' 5")	3570 (11' 9")	3470 (11' 5")
Track gauge	M			2870 (9' 5")	2870 (9' 5")	2870 (9' 5")	2870 (9' 5")
Track shoe width, standard	N			700 (28")	600 (24")	700 (28")	600 (24")
Travel speed (low/high)		km/hr (mph)		3.5/6.4	3.5/6.4	3.5/6.4	3.5/6.4
Swing speed		rpm		10.2	10.2	10.2	10.2
Gradeability		Degree (%)		35 (70)	35 (70)	35 (70)	35 (70)
Ground pressure		kgf/cm^2 (psi)		0.61 (8.62)	0.68 (9.66)	0.61 (8.69)	0.68 (9.73)
Max traction force		kg (lb)		27404 (60415)	27404 (60415)	27404 (60415)	27404 (60415)

6) HX350LT3 HW, 6.45 m (21' 2") HD BOOM



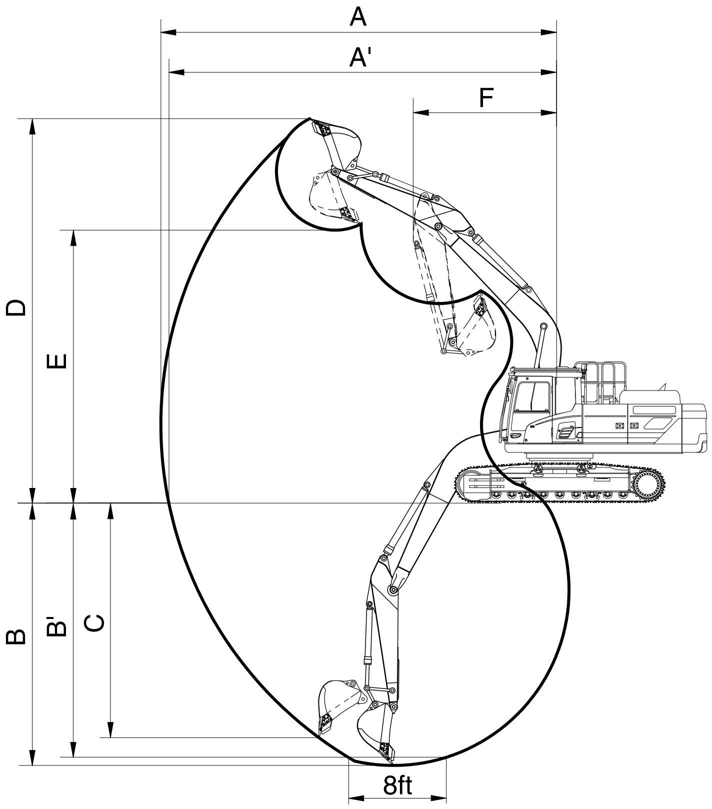
Description		Unit		Specification			
		m (ft-in)	Boom	6.45 (21' 2")			
			Arm	3.20 (10' 6")	2.20 (7' 3")	2.50 (8' 2")	4.05 (13' 3")
		mm (in)	Shoe	700 (28")			
Operating weight		kg (lb)		37100 (81620)	36890 (81158)	37000 (81400)	37330 (82126)
Bucket capacity (SAE heaped), standard		m^3 (yd^3)		1.44 (1.88)	1.44 (1.88)	1.44 (1.88)	1.44 (1.88)
Overall length	A	mm (ft-in)		11150 (36' 7")	11530 (37' 10")	11340 (37' 2")	11230 (36' 10")
Overall width	B			3570 (11' 9")	3570 (11' 9")	3570 (11' 9")	3570 (11' 9")
Overall height of boom	C			3540 (11' 4")	3780 (12' 5")	3650 (12' 0")	3840 (12' 7")
Superstructure width	D			2980 (9' 9")	2980 (9' 9")	2980 (9' 9")	2980 (9' 9")
Overall height of cab	E			3480 (11' 5")	3480 (11' 5")	3480 (11' 5")	3480 (11' 5")
Ground clearance of counterweight	F			1535 (5' 0")	1535 (5' 0")	1535 (5' 0")	1535 (5' 0")
Overall height of engine hood	G			2990 (9' 10")	2990 (9' 10")	2990 (9' 10")	2990 (9' 10")
Overall height of handrail	G'			3650 (12' 0")	3650 (12' 0")	3650 (12' 0")	3650 (12' 0")
Minimum ground clearance	H			800 (2' 7")	800 (2' 7")	800 (2' 7")	800 (2' 7")
Rear-end distance	I			3505 (11' 6")	3505 (11' 6")	3505 (11' 6")	3505 (11' 6")
Rear-end swing radius	I'			3570 (11' 9")	3570 (11' 9")	3570 (11' 9")	3570 (11' 9")
Distance between tumblers	J			4100 (13' 5")	4100 (13' 5")	4100 (13' 5")	4100 (13' 5")
Undercarriage length	K			5010 (16' 5")	5010 (16' 5")	5010 (16' 5")	5010 (16' 5")
Undercarriage width	L			3570 (11' 9")	3570 (11' 9")	3570 (11' 9")	3570 (11' 9")
Track gauge	M			2870 (9' 5")	2870 (9' 5")	2870 (9' 5")	2870 (9' 5")
Track shoe width, standard	N			700 (28")	700 (28")	700 (28")	700 (28")
Travel speed (low/high)		km/hr (mph)		3.5/6.4			
Swing speed		rpm		10.2			
Gradeability		Degree (%)		35 (70)			
Ground pressure		kgf/cm^2 (psi)		0.61 (8.69)	0.61 (8.64)	0.61 (8.66)	0.62 (8.86)
Max traction force		kg (lb)		27404 (60415)			



Description		Unit		Specification			
		m (ft-in)	Boom	6.45 (21' 2")			
			Arm	3.20 (10' 6")	2.20 (7' 3")	2.50 (8' 2")	4.05 (13' 3")
		mm (in)	Shoe	600 (24")			
Operating weight		kg (lb)		35540 (78350)	35330 (77890)	35440 (78130)	35770 (78860)
Bucket capacity (SAE heaped), standard		m^3 (yd^3)		1.44 (1.88)	1.44 (1.88)	1.44 (1.88)	1.44 (1.88)
Overall length	A	mm (ft-in)		11150 (36' 7")	11530 (37' 10")	11340 (37' 2")	11230 (36' 10")
Overall width	B			3470 (11' 5")	3470 (11' 5")	3470 (11' 5")	3470 (11' 5")
Overall height of boom	C			3450 (11' 4")	3780 (12' 5")	3650 (12' 0")	3840 (12' 7")
Superstructure width	D			2980 (9' 9")	2980 (9' 9")	2980 (9' 9")	2980 (9' 9")
Overall height of cab	E			3480 (11' 5")	3480 (11' 5")	3480 (11' 5")	3480 (11' 5")
Ground clearance of counterweight	F			1535 (5' 0")	1535 (5' 0")	1535 (5' 0")	1535 (5' 0")
Overall height of engine hood	G			2990 (9' 10")	2990 (9' 10")	2990 (9' 10")	2990 (9' 10")
Overall height of handrail	G'			3650 (12' 0")	3650 (12' 0")	3650 (12' 0")	3650 (12' 0")
Minimum ground clearance	H			800 (2' 7")	800 (2' 7")	800 (2' 7")	800 (2' 7")
Rear-end distance	I			3505 (11' 6")	3505 (11' 6")	3505 (11' 6")	3505 (11' 6")
Rear-end swing radius	I'			3570 (11' 9")	3570 (11' 9")	3570 (11' 9")	3570 (11' 9")
Distance between tumblers	J			4030 (13' 3")	4030 (13' 3")	4030 (13' 3")	4030 (13' 3")
Undercarriage length	K			4940 (16' 2")	4940 (16' 2")	4940 (16' 2")	4940 (16' 2")
Undercarriage width	L			3470 (11' 5")	3470 (11' 5")	3470 (11' 5")	3470 (11' 5")
Track gauge	M			2870 (9' 5")	2870 (9' 5")	2870 (9' 5")	2870 (9' 5")
Track shoe width, standard	N			600 (24")	600 (24")	600 (24")	600 (24")
Travel speed (low/high)		km/hr (mph)		3.5/6.4			
Swing speed		rpm		10.2			
Gradeability		Degree (%)		35 (70)			
Ground pressure		kgf/cm^2 (psi)		0.68 (9.73)	0.68 (9.67)	0.68 (9.70)	0.69 (9.80)
Max traction force		kg (lb)		27404 (60415)			

3. WORKING RANGE AND DIGGING FORCE

1) HX350LT3, 6.45m (21' 2") BOOM

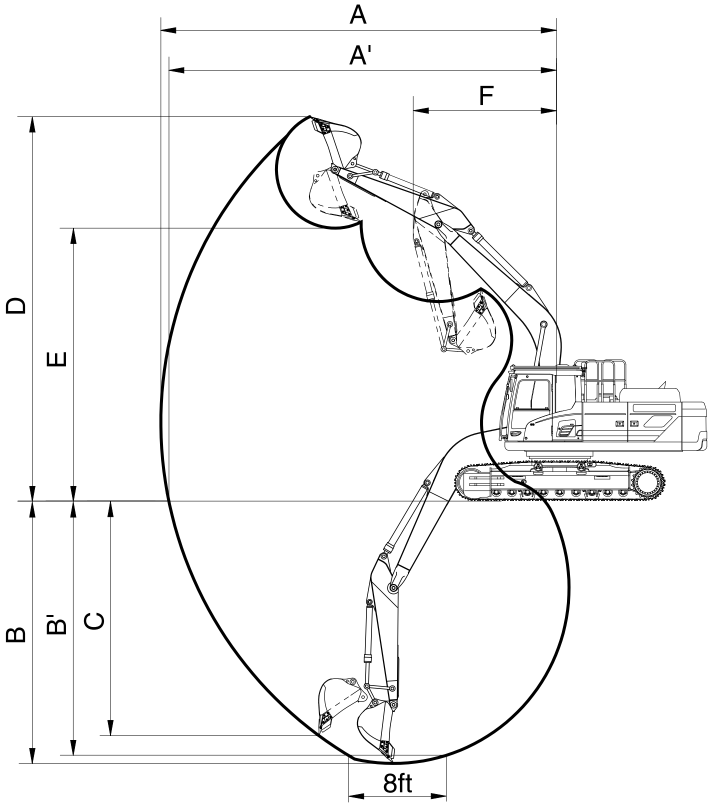


350SA2SP10

Description	m (ft-in)	Boom	6.45 (21' 2")		
		Arm	3.20 (10' 6")	2.5 (8' 2")	4.05 (13' 3")
Max digging reach	mm (ft-in)	A	11150 (36' 7")	10500 (34' 5")	11950 (39' 2")
Max digging reach on ground		A'	10950 (35'11")	10290 (33' 9")	11770 (38' 7")
Max digging depth		B	7360 (24' 2")	6660 (21'10")	8210 (26'11")
Max digging depth (8 ft level)		B'	7200 (23' 7")	6450 (21' 2")	8080 (26' 6")
Max vertical wall digging depth		C	6330 (20' 9")	5660 (18' 7")	7240 (23' 9")
Max digging height		D	10360 (34' 0")	10050 (33' 0")	10780 (35' 4")
Max dumping height		E	7260 (23' 10")	6950 (22' 10")	7670 (25' 2")
Min swing radius		F	4360 (14' 4")	4440 (14' 7")	4290 (14' 1")
Bucket digging force	kN	SAE	188.3 [204.5]	187.3 [203.4]	189.3 [205.5]
	kgf		19200 [20850]	19100 [20740]	19300 [20950]
	lbf		42330 [45970]	42110 [45720]	42550 [46190]
	kN	ISO	216.7 [235.3]	215.7 [234.3]	217.7 [236.3]
	kgf		22100 [23990]	22000 [23890]	22200 [24100]
	lbf		48720 [52890]	48500 [52670]	48940 [53130]
Arm digging force	kN	SAE	140.2 [152.3]	175.5 [190.5]	118.7 [128.9]
	kgf		14300 [15530]	17900 [19430]	12100 [13140]
	lbf		31530 [34240]	39460 [42840]	26680 [28970]
	kN	ISO	145.1 [157.6]	184.4 [200.2]	123.6 [134.2]
	kgf		14800 [16070]	18800 [20410]	12600 [13680]
	lbf		32630 [35430]	41450 [45000]	27780 [30160]

[ ] : Power boost

2) HX350LT3, 6.15m (20' 2") HD SHORT BOOM

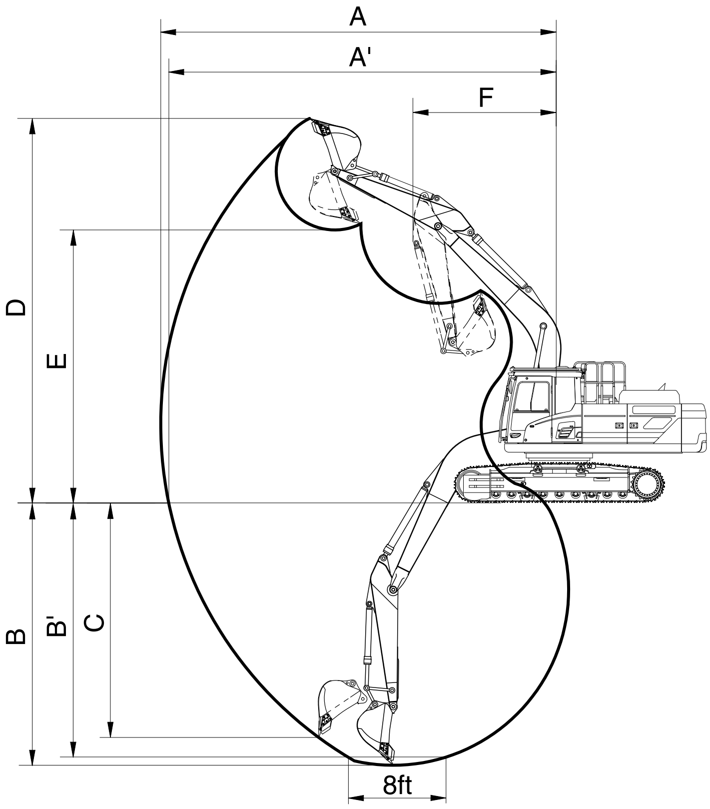


350SA2SP10

Description	m (ft-in)	Boom	6.15 (20' 2")	
		Arm	2.20 (7' 3")	2.50 (8' 2")
Max digging reach	mm (ft-in)	A	10020 (32' 10")	10190 (33' 5")
Max digging reach on ground		A'	9810 (32' 2")	9980 (32' 9")
Max digging depth		B	6150 (20' 2")	6450 (21' 2")
Max digging depth (8 ft level)		B'	5950 (19' 6")	6230 (20' 5")
Max vertical wall digging depth		C	5700 (18' 8")	5420 (17' 9")
Max digging height		D	9980 (32' 9")	9760 (32' 0")
Max dumping height		E	6790 (22' 3")	6670 (21' 11")
Min swing radius		F	4450 (14' 7")	4290 (14' 1")
Bucket digging force	kN	SAE	200.1 [217.2]	187.3 [203.4]
	kgf		20400 [22150]	19100 [20740]
	lbf		44970 [48830]	42110 [45720]
	kN	ISO	230.5 [250.2]	215.7 [234.3]
	kgf		23500 [25510]	22000 [23890]
	lbf		51810 [56240]	48500 [52670]
Arm digging force	kN	SAE	220.7 [239.6]	198.1 [215.1]
	kgf		22500 [24430]	20200 [21930]
	lbf		49600 [53860]	44530 [48350]
	kN	ISO	231.4 [251.3]	207.9 [225.8]
	kgf		23600 [25620]	21200 [23020]
	lbf		52030 [56480]	46740 [50750]

[ ] : Power boost

3) HX350LT3, 6.45m (21' 2") HD BOOM

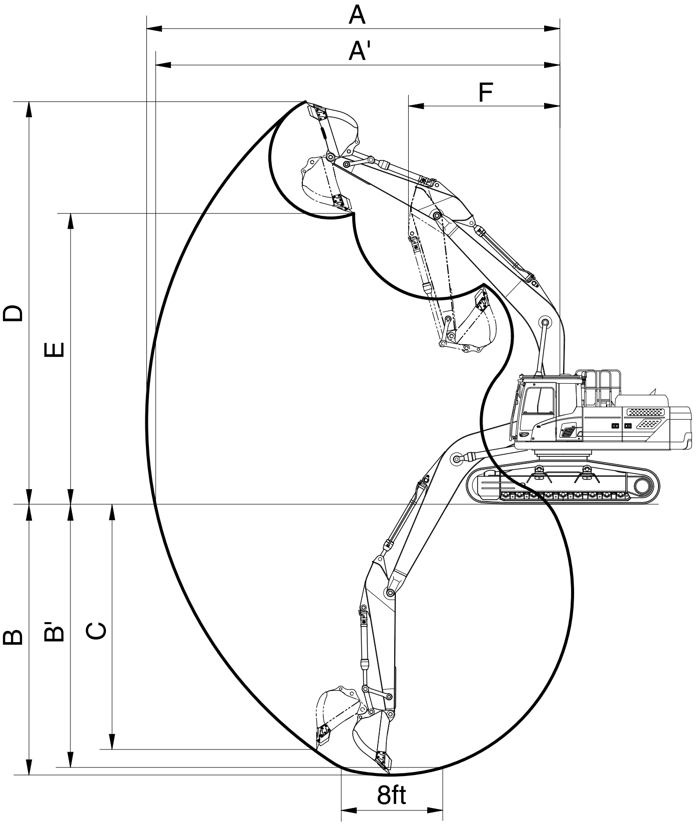


350SA2SP10

Description	m (ft-in)	Boom	6.45 (21' 2")	
		Arm	2.20 (7' 3")	2.50 (8' 2")
Max digging reach	mm (ft-in)	A	10300 (33' 11")	10500 (34' 5")
Max digging reach on ground		A'	10120 (33' 2")	10290 (33' 9")
Max digging depth		B	6360 (20' 10")	6660 (21' 10")
Max digging depth (8 ft level)		B'	6170 (20' 3")	6450 (21' 2")
Max vertical wall digging depth		C	5970 (19' 7")	5660 (18' 7")
Max digging height		D	10260 (33' 8")	10050 (33' 0")
Max dumping height		E	7060 (23' 2")	6950 (22' 10")
Min swing radius		F	4630 (15' 2")	4440 (14' 7")
Bucket digging force	kN	SAE	200.1 [217.2]	187.3 [203.4]
	kgf		20400 [22150]	19100 [20740]
	lbf		44970 [48830]	42110 [45720]
	kN	ISO	230.5 [250.2]	215.7 [234.3]
	kgf		23500 [25510]	22000 [23890]
	lbf		51810 [56240]	48500 [52670]
Arm digging force	kN	SAE	220.7 [239.6]	198.1 [215.1]
	kgf		22500 [24430]	20200 [21930]
	lbf		49600 [53860]	44530 [48350]
	kN	ISO	231.4 [251.3]	207.9 [225.8]
	kgf		23600 [25620]	21200 [23020]
	lbf		52030 [56480]	46740 [50750]

[ ] : Power boost

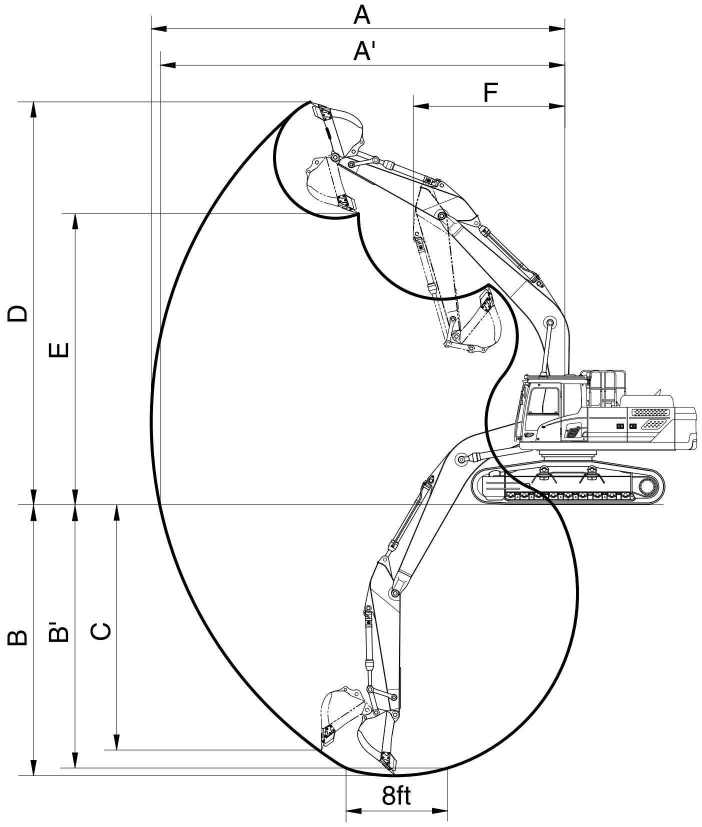
4) HX350LT3 HW, 6.45m (21' 2") BOOM



Description	m (ft-in)	Boom	6.45 (21' 2")		
		Arm	3.20 (10' 6")	2.50 (8' 2")	4.05 (13' 3")
Max digging reach	mm (ft-in)	A	11150 (36' 7")	10500 (34' 5")	11950 (39' 2")
Max digging reach on ground		A'	10890 (35' 9")	10220 (33' 6")	11710 (38' 5")
Max digging depth		B	7060 (23' 2")	6360 (20' 10")	7910 (25' 11")
Max digging depth (8 ft level)		B'	6890 (22' 7")	6140 (20' 2")	7780 (25' 6")
Max vertical wall digging depth		C	6030 (19' 9")	5350 (17' 7")	6940 (22' 9")
Max digging height		D	10670 (35' 0")	10350 (33' 11")	11090 (36' 5")
Max dumping height		E	7570 (24' 10")	7260 (23' 10")	7970 (26' 2")
Min swing radius		F	4360 (14' 4")	4440 (14' 7")	4290 (14' 1")
Bucket digging force	kN	SAE	188.3 [204.5]	187.3 [203.4]	189.3 [205.5]
	kgf		19200 [20850]	19100 [20740]	19300 [20950]
	lbf		42330 [45970]	42110 [45720]	42550 [46190]
	kN	ISO	216.7 [235.3]	215.7 [234.3]	217.7 [236.3]
	kgf		22100 [23990]	22000 [23890]	22200 [24100]
	lbf		48720 [52890]	48500 [52670]	48940 [53130]
Arm digging force	kN	SAE	140.2 [152.3]	175.5 [190.5]	118.7 [128.9]
	kgf		14300 [15530]	17900 [19430]	12100 [13140]
	lbf		31530 [34240]	39460 [42840]	26680 [28970]
	kN	ISO	145.1 [157.6]	184.4 [200.2]	123.6 [134.2]
	kgf		14800 [16070]	18800 [20410]	12600 [13680]
	lbf		32630 [35430]	41450 [45000]	27780 [30160]

[ ] : Power boost

5) HX350LT3 HW, 6.15m (20' 2") HD SHORT BOOM

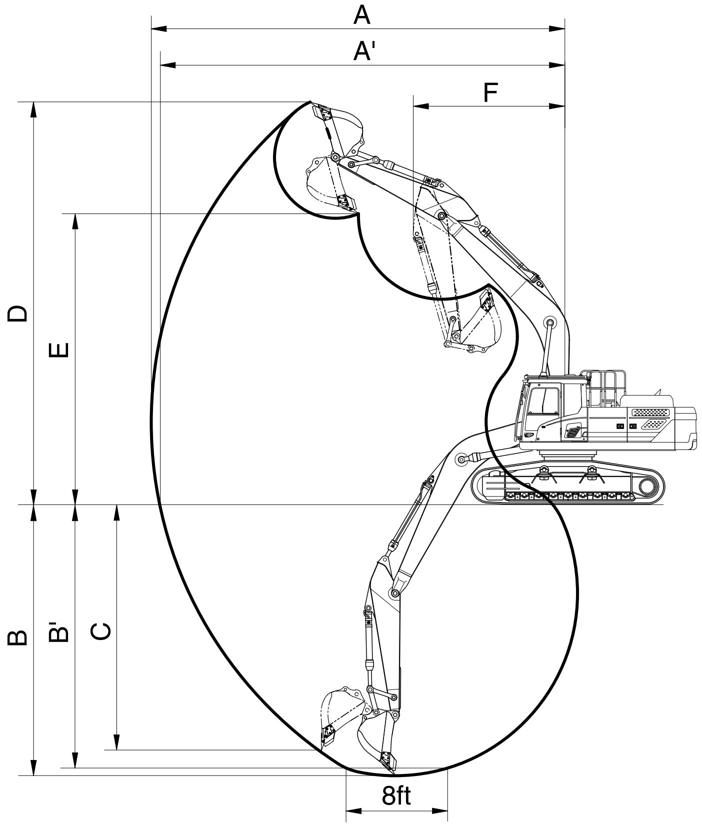


350SA2SP13

Description	m (ft-in)	Boom	6.15 (20' 2")	
		Arm	2.20 (7' 3")	2.50 (8' 2")
Max digging reach	mm (ft-in)	A	10020 (32' 10")	10190 (33' 5")
Max digging reach on ground		A'	9740 (31' 11")	9910 (32' 6")
Max digging depth		B	5850 (19' 2")	6150 (20' 2")
Max digging depth (8 ft level)		B'	5650 (18' 6")	5920 (19' 5")
Max vertical wall digging depth		C	5400 (17' 9")	5110 (16' 9")
Max digging height		D	10280 (33' 9")	10070 (33' 0")
Max dumping height		E	7100 (23' 4")	6980 (22' 11")
Min swing radius		F	4450 (14' 7")	4290 (14' 1")
Bucket digging force	kN	SAE	200.1 [217.2]	187.3 [203.4]
	kgf		20400 [22150]	19100 [20740]
	lbf		44970 [48830]	42110 [45720]
	kN	ISO	230.5 [250.2]	215.7 [234.3]
	kgf		23500 [25510]	22000 [23890]
	lbf		51810 [56240]	48500 [52670]
Arm digging force	kN	SAE	220.7 [239.6]	198.1 [215.1]
	kgf		22500 [24430]	20200 [21930]
	lbf		49600 [53860]	44530 [48350]
	kN	ISO	231.4 [251.3]	207.9 [225.8]
	kgf		23600 [25620]	21200 [23020]
	lbf		52030 [56480]	46740 [50750]

[ ] : Power boost

6) HX350LT3 HW, 6.45m (21' 2") HD BOOM



350SA2SP13

Description	m (ft-in)	Boom	6.45 (21' 2")	
		Arm	2.20 (7' 3")	2.50 (8' 2")
Max digging reach	mm (ft-in)	A	10330 (33' 11")	10500 (34' 5")
Max digging reach on ground		A'	10050 (33' 0")	10220 (33' 6")
Max digging depth		B	6060 (19' 11")	6360 (20' 10")
Max digging depth (8 ft level)		B'	5860 (19' 3")	6140 (20' 2")
Max vertical wall digging depth		C	5660 (18' 7")	5350 (17' 7")
Max digging height		D	10560 (34' 8")	10350 (33' 11")
Max dumping height		E	7370 (24' 2")	7260 (23' 10")
Min swing radius		F	4630 (15' 2")	4440 (14' 7")
Bucket digging force	kN	SAE	200.1 [217.2]	187.3 [203.4]
	kgf		20400 [22150]	19100 [20740]
	lbf		44970 [48830]	42110 [45720]
	kN	ISO	230.5 [250.2]	215.7 [234.3]
	kgf		23500 [25510]	22000 [23890]
	lbf		51810 [56240]	48500 [52670]
Arm digging force	kN	SAE	220.7 [239.6]	198.1 [215.1]
	kgf		22500 [24430]	20200 [21930]
	lbf		49600 [53860]	44530 [48350]
	kN	ISO	231.4 [251.3]	207.9 [225.8]
	kgf		23600 [25620]	21200 [23020]
	lbf		52030 [56480]	46740 [50750]

[ ] : Power boost

4. WEIGHT

Item	HX350LT3		HX350LT3 HW	
	kg	lb	kg	lb
Upperstructure assembly				
· Main frame weld assembly	2,839	6,259	2,839	6,259
· Engine assembly	590	1,301	590	1,301
· Aftertreatment assy	40	88	40	88
· Main pump assembly	181	399	181	399
· Main control valve assembly	220	485	220	485
· Swing motor assembly	345	761	345	761
· Hydraulic oil tank WA	205	451	205	451
· Fuel tank WA	235	518	235	518
· Counterweight	6,000	13,230	7,000	15,432
· Cab assembly	570	1,257	570	1,257
Lower chassis assembly				
· Track frame weld assembly	3,875	8,543	3,875	8,543
· Swing bearing	468	1,030	468	1,030
· Travel motor assembly (2EA)	886	1,954	886	1,954
· Turning joint	54	117	54	117
· Sprocket (2EA)	141	310	166 / ★141	370 / ★310
· Track recoil spring (2EA)	450	990	450	990
· Idler (2EA)	499	1,100	499	1,100
· Upper roller (4EA)	139	310	227 / ★216	500 / ★476
· Lower roller (18EA)	973	2140	1020 / ★973	2249 / ★2140
· Track-chain assembly (600 mm triple grouser shoe) (2EA)	3,759	8,290	3,759	8,290
· Track-chain assembly (700 mm triple grouser shoe) (2EA)	4,327	9,540	-	-
· Track-chain assembly (700 mm double grouser shoe) (2EA)	-	-	5,237	11,550
· Track-chain assembly (800 mm triple grouser shoe) (2EA)	4,706	10,380	-	-
Front attachment assembly				
· 6.45 m boom assembly	2,400	5,291	2,400	5,291
· 6.15 m boom assembly	3,150	6,944	3,150	6,944
· 3.20 m arm assembly	1,070	2,359	1,070	2,359
· 1.44 m³ SAE heaped bucket	1,130	2,491	1,130	2,491
· Boom cylinder assembly (2EA)	540	1,190	540	1,190
· Arm cylinder assembly	360	793	360	793
· Bucket cylinder assembly	220	485	140	308
· Bucket control linkage total	280	617	130	287

★ : 600 mm triple grouser shoe

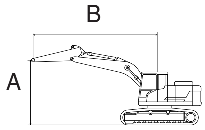
※ This information is different with operating and transportation weight because it is not including harness, pipe, oil, fuel so on.

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

5. LIFTING CAPACITIES

Model	Type	Boom	Arm	Counterweight	Shoe	Wheel	Dozer		Outtriger	
HX350LT3	MONO BOOM	Length [mm]	Length [mm]	weight [kg]	width [mm]	width [mm]	Front	Rear	Front	Rear
		6450	3200	6600	600	-	-	-	-	-

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



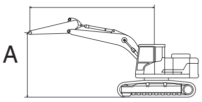
Lift-point height (A)		Lift-point radius (B)										At max. reach		
		3.0 m (9.8 ft)		4.5 m (14.8 ft)		6.0 m (19.7 ft)		7.5 m (24.6 ft)		9.0 m (29.5 ft)		Capacity		Reach
														m (ft)
7.5 m	kg							*6830	*6830			*5610	*5610	7.74
(24.6 ft)	lb							*15060	*15060			*12370	*12370	(25.4)
6.0 m	kg							*7860	7170			*5430	*5430	8.62
(19.7 ft)	lb							*17330	15810			*11970	*11970	(28.3)
4.5 m	kg			*11980	*11980	*9650	*9650	*8500	6960	*6660	5170	*5450	5010	9.17
(14.8 ft)	lb			*26410	*26410	*21270	*21270	*18740	15340	*14680	11400	*12020	11050	(30.1)
3.0 m	kg			*15520	14140	*11340	9280	*9380	6680	7540	5050	*5650	4670	9.44
(9.8 ft)	lb			*34220	31170	*25000	20460	*20680	14730	16620	11130	*12460	10300	(31.0)
1.5 m	kg			*17440	13250	*12840	8810	9730	6420	7400	4930	*6050	4560	9.47
(4.9 ft)	lb			*38450	29210	*28310	19420	21450	14150	16310	10870	*13340	10050	(31.1)
0.0 m	kg			*17250	12890	13360	8510	9530	6240	7300	4840	*6720	4650	9.25
(0.0 ft)	lb			*38030	28420	29450	18760	21010	13760	16090	10670	*14820	10250	(30.4)
-1.5 m	kg	*10800	*10800	*18880	12830	13220	8390	9440	6160			7560	4990	8.77
(-4.9 ft)	lb	*23810	*23810	*41620	28290	29150	18500	20810	13580			16670	11000	(28.8)
-3.0 m	kg	*17460	*17460	*17670	12960	13270	8430	9490	6210			8710	5740	7.98
(-9.8 ft)	lb	*38490	*38490	*38960	28570	29260	18580	20920	13690			19200	12650	(26.2)
-4.5 m	kg	*20570	*20570	*15170	13270	*11400	8650					*9590	7380	6.76
(-14.8 ft)	lb	*45350	*45350	*33440	29260	*25130	19070					*21140	16270	(22.2)

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

※ Lifting capacities are based upon a standard machine conditions.
Lifting capacities will vary with different work tools, ground conditions and attachments.
The difference between the weight of a work tool attachment must be subtracted.
Consult your HD Hyundai Construction Equipment 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 necessory for non-standard configurations.

Model	Type	Boom	Arm	Counterweight	Shoe	Wheel	Dozer		Outtriger	
HX350LT3	MONO BOOM	Length [mm]	Length [mm]	weight [kg]	width [mm]	width [mm]	Front	Rear	Front	Rear
		6450	2500	6600	600	-	-	-	-	-

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



Lift-point height (A)		Lift-point radius (B)								At max. reach		
		3.0 m (9.8 ft)		4.5 m (14.8 ft)		6.0 m (19.7 ft)		7.5 m (24.6 ft)		Capacity		Reach
												m (ft)
7.5 m	kg									*8810	8080	6.93
(24.6 ft)	lb									*19420	17810	(22.7)
6.0 m	kg					*9310	*9310	*8720	7040	*8720	6440	7.90
(19.7 ft)	lb					*20530	*20530	*19220	15520	*19220	14200	(25.9)
4.5 m	kg			*13720	*13720	*10620	9620	*9210	6860	8350	5620	8.49
(14.8 ft)	lb			*30250	*30250	*23410	21210	*20300	15120	18410	12390	(27.9)
3.0 m	kg					*12180	9110	9940	6620	7780	5210	8.79
(9.8 ft)	lb					*26850	20080	21910	14590	17150	11490	(28.8)
1.5 m	kg					*13440	8710	9690	6400	7640	5090	8.82
(4.9 ft)	lb					*29630	19200	21360	14110	16840	11220	(28.9)
0.0 m	kg			*15200	12900	13340	8500	9540	6260	7870	5220	8.58
(0.0 ft)	lb			*33510	28440	29410	18740	21030	13800	17350	11510	(28.2)
-1.5 m	kg			*18330	12960	13290	8460	9520	6240	8610	5690	8.06
(-4.9 ft)	lb			*40410	28570	29300	18650	20990	13760	18980	12540	(26.4)
-3.0 m	kg	*21480	*21480	*16620	13160	*12740	8570			*10120	6740	7.19
(-9.8 ft)	lb	*47360	*47360	*36640	29010	*28090	18890			*22310	14860	(23.6)
-4.5 m	kg			*13270	*13270					*10000	9380	5.80
(-14.8 ft)	lb			*29260	*29260					*22050	20680	(19.0)

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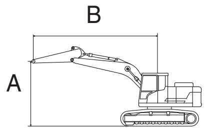
Make adjustments to the rated load as necessary for non-standard configurations.

Model	Type	Boom	Arm	Counterweight	Shoe	Wheel	Dozer		Outtriger	
HX350LT3	MONO BOOM	Length [mm]	Length [mm]	weight [kg]	width [mm]	width [mm]	Front	Rear	Front	Rear
		6450	4050	6600	600	-	-	-	-	-

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



Lift-point height (A)		Lift-point radius (B)												At max. reach		
		1.5 m (4.9 ft)		3.0 m (9.8 ft)		4.5 m (14.8 ft)		6.0 m (19.7 ft)		7.5 m (24.6 ft)		9.0 m (29.5 ft)		Capacity		Reach
																m (ft)
9.0 m	kg									*4710	*4710			*4520	*4520	7.55
(29.5 ft)	lb									*10380	*10380			*9960	*9960	(24.8)
7.5 m	kg													*4190	*4190	8.72
(24.6 ft)	lb													*9240	*9240	(28.6)
6.0 m	kg									*6800	*6800	*5820	5330	*4060	*4060	9.50
(19.7 ft)	lb									*14990	*14990	*12830	11750	*8950	*8950	(31.2)
4.5 m	kg									*7540	7050	*7120	5220	*4070	*4070	10.00
(14.8 ft)	lb									*16620	15540	*15700	11510	*8970	*8970	(32.8)
3.0 m	kg					*13310	*13310	*10100	9460	*8520	6740	7550	5050	*4200	4060	10.25
(9.8 ft)	lb					*29340	*29340	*22270	20860	*18780	14860	16640	11130	*9260	8950	(33.6)
1.5 m	kg					*16530	13520	*11840	8890	*9510	6420	7370	4880	*4450	3960	10.28
(4.9 ft)	lb					*36440	29810	*26100	19600	*20970	14150	16250	10760	*9810	8730	(33.7)
0.0 m	kg			*6350	*6350	*18370	12870	*13120	8480	9470	6180	7220	4740	*4880	4010	10.08
(0.0 ft)	lb			*14000	*14000	*40500	28370	*28920	18700	20880	13620	15920	10450	*10760	8840	(33.1)
-1.5 m	kg	*6460	*6460	*9880	*9880	*18900	12620	13100	8250	9310	6030	7130	4670	*5560	4250	9.64
(-4.9 ft)	lb	*14240	*14240	*21780	*21780	*41670	27820	28880	18190	20530	13290	15720	10300	*12260	9370	(31.6)
-3.0 m	kg	*10370	*10370	*14450	*14450	*18360	12630	13040	8210	9270	5990			*6720	4750	8.92
(-9.8 ft)	lb	*22860	*22860	*31860	*31860	*40480	27840	28750	18100	20440	13210			*14820	10470	(29.3)
-4.5 m	kg	*15020	*15020	*20810	*20810	*16690	12840	*12520	8320	9410	6120			*8750	5770	7.86
(-14.8 ft)	lb	*33110	*33110	*45880	*45880	*36800	28310	*27600	18340	20750	13490			*19290	12720	(25.8)
-6.0 m	kg			*18370	*18370	*13250	*13250	*9520	8690					*8860	8220	6.26
(-19.7 ft)	lb			*40500	*40500	*29210	*29210	*20990	19160					*19530	18120	(20.5)

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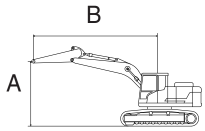
Model	Type	Boom	Arm	Counterweight	Shoe	Wheel	Dozer		Outtriger	
HX350LT3	HD MONO BOOM	Length [mm]	Length [mm]	weight [kg]	width [mm]	width [mm]	Front	Rear	Front	Rear
		6150	2200	6600	600	-	-	-	-	-

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



Lift-point height (A)		Lift-point radius (B)										At max. reach		
		3.0 m (9.8 ft)		4.5 m (14.8 ft)		6.0 m (19.7 ft)		7.5 m (24.6 ft)		9.0 m (29.5 ft)		Capacity		Reach
														m (ft)
7.5 m	kg					*9650	*9650			*9790	9330	6.31	*5610	7.74
(24.6 ft)	lb					*21270	*21270			*21580	20570	(20.7)	*12370	(25.4)
6.0 m	kg					*9850	*9850			*9550	7170	7.36	*5430	8.62
(19.7 ft)	lb					*21720	*21720			*21050	15810	(24.2)	*11970	(28.3)
4.5 m	kg					*10990	9660	*9700	6860	9180	6170	8.00	5010	9.17
(14.8 ft)	lb					*24230	21300	*21380	15120	20240	13600	(26.2)	11050	(30.1)
3.0 m	kg					*12450	9170	9980	6650	8500	5690	8.31	4670	9.44
(9.8 ft)	lb					*27450	20220	22000	14660	18740	12540	(27.3)	10300	(31.0)
1.5 m	kg					*13630	8790	9770	6450	8340	5550	8.34	4560	9.47
(4.9 ft)	lb					*30050	19380	21540	14220	18390	12240	(27.4)	10050	(31.1)
0.0 m	kg					13460	8590	9640	6340	8650	5730	8.10	4650	9.25
(0.0 ft)	lb					29670	18940	21250	13980	19070	12630	(26.6)	10250	(30.4)
-1.5 m	kg			*18190	13100	13440	8560	9680	6370	9610	6330	7.54	4990	8.77
(-4.9 ft)	lb			*40100	28880	29630	18870	21340	14040	21190	13960	(24.7)	11000	(28.8)
-3.0 m	kg	*20790	*20790	*16070	13340	*12130	8740			*10470	7740	6.59	5740	7.98
(-9.8 ft)	lb	*45830	*45830	*35430	29410	*26740	19270			*23080	17060	(21.6)	12650	(26.2)
-4.5 m	kg	*20570	*20570	*15170	13270	*11400	8650					*9590	7380	6.76
(-14.8 ft)	lb	*45350	*45350	*33440	29260	*25130	19070					*21140	16270	(22.2)

Note 1. Lifting capacity are based on ISO 10567.
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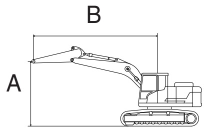
Model	Type	Boom	Arm	Counterweight	Shoe	Wheel	Dozer		Outtriger	
HX350LT3	HD MONO BOOM	Length [mm]	Length [mm]	weight [kg]	width [mm]	width [mm]	Front	Rear	Front	Rear
		6150	2500	6600	600	-	-	-	-	-



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

Lift-point height (A)		Lift-point radius (B)										At max. reach		
		3.0 m (9.8 ft)		4.5 m (14.8 ft)		6.0 m (19.7 ft)		7.5 m (24.6 ft)		9.0 m (29.5 ft)		Capacity		Reach
														m (ft)
7.5 m	kg					*9030	*9030			*9160	8910	6.53	*5610	7.74
(24.6 ft)	lb					*19910	*19910			*20190	19640	(21.4)	*12370	(25.4)
6.0 m	kg					*9380	*9380	*9030	7020	*9040	6940	7.55	*5430	8.62
(19.7 ft)	lb					*20680	*20680	*19910	15480	*19930	15300	(24.8)	*11970	(28.3)
4.5 m	kg			*13270	*13270	*10570	9730	*9350	6890	8900	5980	8.17	5010	9.17
(14.8 ft)	lb			*29260	*29260	*23300	21450	*20610	15190	19620	13180	(26.8)	11050	(30.1)
3.0 m	kg					*12080	9220	10000	6660	8250	5520	8.48	4670	9.44
(9.8 ft)	lb					*26630	20330	22050	14680	18190	12170	(27.8)	10300	(31.0)
1.5 m	kg					*13370	8790	9760	6440	8080	5370	8.51	4560	9.47
(4.9 ft)	lb					*29480	19380	21520	14200	17810	11840	(27.9)	10050	(31.1)
0.0 m	kg			*19180	12960	13430	8550	9600	6300	8350	5520	8.27	4650	9.25
(0.0 ft)	lb			*42280	28570	29610	18850	21160	13890	18410	12170	(27.1)	10250	(30.4)
-1.5 m	kg	*15260	*15260	*18460	12980	13370	8500	9590	6280	9210	6060	7.72	4990	8.77
(-4.9 ft)	lb	*33640	*33640	*40700	28620	29480	18740	21140	13850	20300	13360	(25.3)	11000	(28.8)
-3.0 m	kg	*22150	*22150	*16610	13200	*12560	8630			*10590	7310	6.81	5740	7.98
(-9.8 ft)	lb	*48830	*48830	*36620	29100	*27690	19030			*23350	16120	(22.3)	12650	(26.2)
-4.5 m	kg			*12680	*12680					*10380	*10380	5.31	7380	6.76
(-14.8 ft)	lb			*27950	*27950					*22880	*22880	(17.4)	16270	(22.2)

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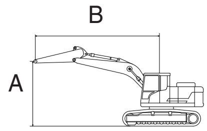
Model	Type	Boom	Arm	Counterweight	Shoe	Wheel	Dozer		Outtriger	
HX350LT3	HD MONO BOOM	Length [mm]	Length [mm]	weight [kg]	width [mm]	width [mm]	Front	Rear	Front	Rear
		6450	2200	6600	600	-	-	-	-	-



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

Lift-point height (A)		Lift-point radius (B) 3.0 m (9.8 ft) over-front	3.0 m (9.8 ft) over-side	4.5 m (14.8 ft) over-front	4.5 m (14.8 ft) over-side	6.0 m (19.7 ft) over-front	6.0 m (19.7 ft) over-side	7.5 m (24.6 ft) over-front	7.5 m (24.6 ft) over-side	9.0 m (29.5 ft) over-front	9.0 m (29.5 ft) over-side	At max. reach Capacity over-front	Capacity over-side	Reach m (ft)
7.5 m	kg					*9180	*9180			*9310	8400	6.71	*5610	7.74
(24.6 ft)	lb					*20240	*20240			*20530	18520	(22.0)	*12370	(25.4)
6.0 m	kg					*9670	*9670	*9060	6940	*9100	6610	7.71	*5430	8.62
(19.7 ft)	lb					*21320	*21320	*19970	15300	*20060	14570	(25.3)	*11970	(28.3)
4.5 m	kg					*10920	9510	*9430	6780	8560	5730	8.32	5010	9.17
(14.8 ft)	lb					*24070	20970	*20790	14950	18870	12630	(27.3)	11050	(30.1)
3.0 m	kg					*12400	8990	9870	6540	7970	5310	8.62	4670	9.44
(9.8 ft)	lb					*27340	19820	21760	14420	17570	11710	(28.3)	10300	(31.0)
1.5 m	kg					13480	8600	9640	6330	7820	5180	8.65	4560	9.47
(4.9 ft)	lb					29720	18960	21250	13960	17240	11420	(28.4)	10050	(31.1)
0.0 m	kg					13260	8410	9500	6200	8080	5330	8.41	4650	9.25
(0.0 ft)	lb					29230	18540	20940	13670	17810	11750	(27.6)	10250	(30.4)
-1.5 m	kg			*17770	12890	13250	8390	9510	6210	8900	5850	7.88	4990	8.77
(-4.9 ft)	lb			*39180	28420	29210	18500	20970	13690	19620	12900	(25.8)	11000	(28.8)
-3.0 m	kg	*19930	*19930	*15860	13120	*12230	8550			*9900	7020	6.98	5740	7.98
(-9.8 ft)	lb	*43940	*43940	*34970	28920	*26960	18850			*21830	15480	(22.9)	12650	(26.2)
-4.5 m	kg			*12060	*12060					*9290	*9290	5.54	7380	6.76
(-14.8 ft)	lb			*26590	*26590					*20480	*20480	(18.2)	16270	(22.2)

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

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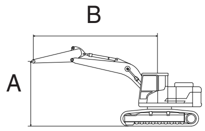
Make adjustments to the rated load as necessory for non-standard configurations.

Model	Type	Boom	Arm	Counterweight	Shoe	Wheel	Dozer		Outtriger	
HX350LT3	HD MONO BOOM	Length [mm]	Length [mm]	weight [kg]	width [mm]	width [mm]	Front	Rear	Front	Rear
		6450	2500	6600	600	-	-	-	-	-

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



Lift-point height (A)		Lift-point radius (B)										At max. reach		
		3.0 m (9.8 ft)		4.5 m (14.8 ft)		6.0 m (19.7 ft)		7.5 m (24.6 ft)		9.0 m (29.5 ft)		Capacity		Reach
														m (ft)
7.5 m	kg									*8740	8060	6.93	*5610	7.74
(24.6 ft)	lb									*19270	17770	(22.7)	*12370	(25.4)
6.0 m	kg					*9240	*9240	*8640	7000	*8630	6400	7.90	*5430	8.62
(19.7 ft)	lb					*20370	*20370	*19050	15430	*19030	14110	(25.9)	*11970	(28.3)
4.5 m	kg			*13590	*13590	*10510	9580	*9120	6810	8310	5570	8.49	5010	9.17
(14.8 ft)	lb			*29960	*29960	*23170	21120	*20110	15010	18320	12280	(27.9)	11050	(30.1)
3.0 m	kg					*12040	9030	*9850	6550	7730	5150	8.79	4670	9.44
(9.8 ft)	lb					*26540	19910	*21720	14440	17040	11350	(28.8)	10300	(31.0)
1.5 m	kg					*13280	8600	9630	6310	7580	5010	8.82	4560	9.47
(4.9 ft)	lb					*29280	18960	21230	13910	16710	11050	(28.9)	10050	(31.1)
0.0 m	kg			*17240	12700	13230	8370	9460	6160	7810	5140	8.58	4650	9.25
(0.0 ft)	lb			*38010	28000	29170	18450	20860	13580	17220	11330	(28.2)	10250	(30.4)
-1.5 m	kg			*18080	12750	13170	8320	9440	6140	8540	5600	8.06	4990	8.77
(-4.9 ft)	lb			*39860	28110	29030	18340	20810	13540	18830	12350	(26.4)	11000	(28.8)
-3.0 m	kg	*21320	*21320	*16370	12970	*12560	8440			*9980	6650	7.19	5740	7.98
(-9.8 ft)	lb	*47000	*47000	*36090	28590	*27690	18610			*22000	14660	(23.6)	12650	(26.2)
-4.5 m	kg			*13050	*13050					*9830	9270	5.80	7380	6.76
(-14.8 ft)	lb			*28770	*28770					*21670	20440	(19.0)	16270	(22.2)

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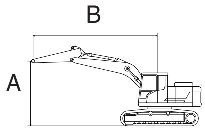
Model	Type	Boom	Arm	Counterweight	Shoe	Wheel	Dozer		Outtriger	
HX350LT3 HW	MONO BOOM	Length [mm]	Length [mm]	weight [kg]	width [mm]	width [mm]	Front	Rear	Front	Rear
		6450	2500	6000	700	-	-	-	-	-

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



Lift-point height (A)		Lift-point radius (B)										At max. reach		
		3.0 m (9.8 ft)		4.5 m (14.8 ft)		6.0 m (19.7 ft)		7.5 m (24.6 ft)		9.0 m (29.5 ft)		Capacity		Reach
														m (ft)
7.5 m	kg									*8780	8530	7.15	*5610	7.74
(24.6 ft)	lb									*19360	18810	(23.5)	*12370	(25.4)
6.0 m	kg					*9520	*9520	*8780	7820	*8730	6970	8.04	*5430	8.62
(19.7 ft)	lb					*20990	*20990	*19360	17240	*19250	15370	(26.4)	*11970	(28.3)
4.5 m	kg			*14410	*14410	*10910	10660	*9350	7620	8630	6190	8.57	5010	9.17
(14.8 ft)	lb			*31770	*31770	*24050	23500	*20610	16800	19030	13650	(28.1)	11050	(30.1)
3.0 m	kg					*12460	10150	*10110	7370	8140	5810	8.81	4670	9.44
(9.8 ft)	lb					*27470	22380	*22290	16250	17950	12810	(28.9)	10300	(31.0)
1.5 m	kg					*13610	9770	10160	7160	8060	5730	8.79	4560	9.47
(4.9 ft)	lb					*30000	21540	22400	15790	17770	12630	(28.9)	10050	(31.1)
0.0 m	kg			*16680	14720	14010	9590	10030	7040	8400	5950	8.51	4650	9.25
(0.0 ft)	lb			*36770	32450	30890	21140	22110	15520	18520	13120	(27.9)	10250	(30.4)
-1.5 m	kg	*12630	*12630	*18080	14800	*13740	9580	10040	7050	9310	6570	7.92	4990	8.77
(-4.9 ft)	lb	*27840	*27840	*39860	32630	*30290	21120	22130	15540	20530	14480	(26.0)	11000	(28.8)
-3.0 m	kg	*21020	*21020	*16140	15050	*12360	9740			*10150	7960	6.97	5740	7.98
(-9.8 ft)	lb	*46340	*46340	*35580	33180	*27250	21470			*22380	17550	(22.9)	12650	(26.2)
-4.5 m	kg			*12270	*12270					*9850	*9850	5.44	7380	6.76
(-14.8 ft)	lb			*27050	*27050					*21720	*21720	(17.9)	16270	(22.2)

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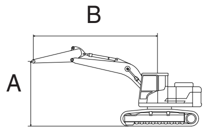
Model	Type	Boom	Arm	Counterweight	Shoe	Wheel	Dozer		Outtriger	
HX350LT3 HW	MONO BOOM	Length [mm]	Length [mm]	weight [kg]	width [mm]	width [mm]	Front	Rear	Front	Rear
		6450	3200	6000	700	-	-	-	-	-

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



Lift-point height (A)		Lift-point radius (B)										At max. reach		
		3.0 m (9.8 ft)		4.5 m (14.8 ft)		6.0 m (19.7 ft)		7.5 m (24.6 ft)		9.0 m (29.5 ft)		Capacity		Reach
														m (ft)
9.0 m	kg											*6000	*6000	6.70
(29.5 ft)	lb											*13230	*13230	(22.0)
7.5 m	kg							*7510	*7510			*5560	*5560	7.94
(24.6 ft)	lb							*16560	*16560			*12260	*12260	(26.1)
6.0 m	kg							*7950	7950			*5420	*5420	8.75
(19.7 ft)	lb							*17530	17530			*11950	*11950	(28.7)
4.5 m	kg			*12650	*12650	*9970	*9970	*8660	7710	*7170	5780	*5480	*5480	9.24
(14.8 ft)	lb			*27890	*27890	*21980	*21980	*19090	17000	*15810	12740	*12080	*12080	(30.3)
3.0 m	kg			*16150	15780	*11650	10310	*9550	7430	7910	5650	*5710	5220	9.47
(9.8 ft)	lb			*35600	34790	*25680	22730	*21050	16380	17440	12460	*12590	11510	(31.1)
1.5 m	kg			*16720	14980	*13070	9850	10190	7180	7770	5530	*6150	5150	9.45
(4.9 ft)	lb			*36860	33030	*28810	21720	22470	15830	17130	12190	*13560	11350	(31.0)
0.0 m	kg			*17920	14680	*13860	9590	10010	7010	7690	5450	*6890	5300	9.18
(0.0 ft)	lb			*39510	32360	*30560	21140	22070	15450	16950	12020	*15190	11680	(30.1)
-1.5 m	kg	*11970	*11970	*18720	14660	13920	9500	9940	6950			8140	5750	8.65
(-4.9 ft)	lb	*26390	*26390	*41270	32320	30690	20940	21910	15320			17950	12680	(28.4)
-3.0 m	kg	*18970	*18970	*17310	14820	*13100	9570	*10030	7040			*9440	6710	7.78
(-9.8 ft)	lb	*41820	*41820	*38160	32670	*28880	21100	*22110	15520			*20810	14790	(25.5)
-4.5 m	kg	*19520	*19520	*14460	*14460	*10740	9850					*9580	8920	6.46
(-14.8 ft)	lb	*43030	*43030	*31880	*31880	*23680	21720					*21120	19670	(21.2)

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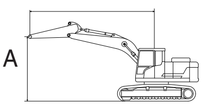
Model	Type	Boom	Arm	Counterweight	Shoe	Wheel	Dozer		Outtriger	
HX350LT3 HW	MONO BOOM	Length [mm]	Length [mm]	weight [kg]	width [mm]	width [mm]	Front	Rear	Front	Rear
		6450	4050	6000	700	-	-	-	-	-

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



Lift-point height (A)		Lift-point radius (B)												At max. reach		
		1.5 m (4.9 ft)		3.0 m (9.8 ft)		4.5 m (14.8 ft)		6.0 m (19.7 ft)		7.5 m (24.6 ft)		9.0 m (29.5 ft)		Capacity		Reach
																m (ft)
9.0 m	kg									*5410	*5410			*4440	*4440	7.81
(29.5 ft)	lb									*11930	*11930			*9790	*9790	(25.6)
7.5 m	kg													*4150	*4150	8.89
(24.6 ft)	lb													*9150	*9150	(29.2)
6.0 m	kg									*6920	*6920	*6120	5940	*4060	*4060	9.62
(19.7 ft)	lb									*15260	*15260	*13490	13100	*8950	*8950	(31.6)
4.5 m	kg							*8650	*8650	*7720	*7720	*7200	5820	*4090	*4090	10.07
(14.8 ft)	lb							*19070	*19070	*17020	*17020	*15870	12830	*9020	*9020	(33.0)
3.0 m	kg					*14000	*14000	*10450	*10450	*8710	7480	*7740	5650	*4240	*4240	10.27
(9.8 ft)	lb					*30860	*30860	*23040	*23040	*19200	16490	*17060	12460	*9350	*9350	(33.7)
1.5 m	kg					*17000	15200	*12130	9920	*9690	7170	7730	5480	*4520	4480	10.26
(4.9 ft)	lb					*37480	33510	*26740	21870	*21360	15810	17040	12080	*9960	9880	(33.7)
0.0 m	kg			*6950	*6950	*18570	14620	*13290	9540	9940	6940	7590	5340	*4980	4580	10.01
(0.0 ft)	lb			*15320	*15320	*40940	32230	*29300	21030	21910	15300	16730	11770	*10980	10100	(32.9)
-1.5 m	kg	*7190	*7190	*10660	*10660	*18870	14430	13770	9350	9800	6810	7530	5280	*5730	4890	9.52
(-4.9 ft)	lb	*15850	*15850	*23500	*23500	*41600	31810	30360	20610	21610	15010	16600	11640	*12630	10780	(31.2)
-3.0 m	kg	*11190	*11190	*15500	*15500	*18140	14480	*13490	9330	9790	6800			*7040	5540	8.75
(-9.8 ft)	lb	*24670	*24670	*34170	*34170	*39990	31920	*29740	20570	21580	14990			*15520	12210	(28.7)
-4.5 m	kg	*16070	*16070	*22390	*22390	*16210	14730	*12150	9480	*9020	6970			*8800	6860	7.60
(-14.8 ft)	lb	*35430	*35430	*49360	*49360	*35740	32470	*26790	20900	*19890	15370			*19400	15120	(24.9)
-6.0 m	kg					*12230	*12230							*8800	*8800	5.85
(-19.7 ft)	lb					*26960	*26960							*19400	*19400	(19.2)

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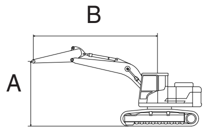
Model	Type	Boom	Arm	Counterweight	Shoe	Wheel	Dozer		Outtriger	
HX350LT3 HW	HD MONO BOOM	Length [mm]	Length [mm]	weight [kg]	width [mm]	width [mm]	Front	Rear	Front	Rear
		6150	2200	6000	700	-	-	-	-	-

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



Lift-point height (A)		Lift-point radius (B)										At max. reach		
		3.0 m (9.8 ft)		4.5 m (14.8 ft)		6.0 m (19.7 ft)		7.5 m (24.6 ft)		9.0 m (29.5 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	m (ft)
7.5 m	kg					*9570	*9570			*9710	*9710	6.55	*5610	7.74
(24.6 ft)	lb					*21100	*21100			*21410	*21410	(21.5)	*12370	(25.4)
6.0 m	kg					*10020	*10020	*9530	7760	*9540	7730	7.51	*5430	8.62
(19.7 ft)	lb					*22090	*22090	*21010	17110	*21030	17040	(24.6)	*11970	(28.3)
4.5 m	kg					*11260	10710	*9800	7630	9460	6770	8.08	5010	9.17
(14.8 ft)	lb					*24820	23610	*21610	16820	20860	14930	(26.5)	11050	(30.1)
3.0 m	kg					*12710	10220	*10430	7410	8880	6330	8.34	4670	9.44
(9.8 ft)	lb					*28020	22530	*22990	16340	19580	13960	(27.4)	10300	(31.0)
1.5 m	kg					*13780	9860	10240	7220	8800	6250	8.32	4560	9.47
(4.9 ft)	lb					*30380	21740	22580	15920	19400	13780	(27.3)	10050	(31.1)
0.0 m	kg					*14130	9690	10140	7130	9240	6540	8.01	4650	9.25
(0.0 ft)	lb					*31150	21360	22350	15720	20370	14420	(26.3)	10250	(30.4)
-1.5 m	kg			*17890	14960	*13590	9700			10430	7340	7.39	4990	8.77
(-4.9 ft)	lb			*39440	32980	*29960	21380			22990	16180	(24.3)	11000	(28.8)
-3.0 m	kg	*19990	*19990	*15460	15250	*11510	9940			*10430	9220	6.36	5740	7.98
(-9.8 ft)	lb	*44070	*44070	*34080	33620	*25380	21910			*22990	20330	(20.9)	12650	(26.2)

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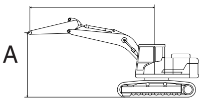
Make adjustments to the rated load as necessory for non-standard configurations.

Model	Type	Boom	Arm	Counterweight	Shoe	Wheel	Dozer		Outtriger	
HX350LT3 HW	HD MONO BOOM	Length [mm]	Length [mm]	weight [kg]	width [mm]	width [mm]	Front	Rear	Front	Rear
		6150	2500	6000	700	-	-	-	-	-

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

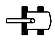


Lift-point height (A)		Lift-point radius (B)										At max. reach		
		3.0 m (9.8 ft)		4.5 m (14.8 ft)		6.0 m (19.7 ft)		7.5 m (24.6 ft)		9.0 m (29.5 ft)		Capacity		Reach
														m (ft)
7.5 m	kg					*9000	*9000			*9110	*9110	6.76	*5610	7.74
(24.6 ft)	lb					*19840	*19840			*20080	*20080	(22.2)	*12370	(25.4)
6.0 m	kg					*9560	*9560	*9030	7830	*9040	7480	7.70	*5430	8.62
(19.7 ft)	lb					*21080	*21080	*19910	17260	*19930	16490	(25.3)	*11970	(28.3)
4.5 m	kg			*13920	*13920	*10850	10770	*9470	7660	*9150	6570	8.25	5010	9.17
(14.8 ft)	lb			*30690	*30690	*23920	23740	*20880	16890	*20170	14480	(27.1)	11050	(30.1)
3.0 m	kg					*12370	10260	*10170	7420	8620	6140	8.51	4670	9.44
(9.8 ft)	lb					*27270	22620	*22420	16360	19000	13540	(27.9)	10300	(31.0)
1.5 m	kg					*13550	9860	10230	7210	8530	6050	8.49	4560	9.47
(4.9 ft)	lb					*29870	21740	22550	15900	18810	13340	(27.8)	10050	(31.1)
0.0 m	kg			*19120	14770	*14060	9650	10090	7080	8910	6300	8.19	4650	9.25
(0.0 ft)	lb			*42150	32560	*31000	21270	22240	15610	19640	13890	(26.9)	10250	(30.4)
-1.5 m	kg	*17520	*17520	*18200	14840	*13710	9620	10120	7110	9970	7010	7.58	4990	8.77
(-4.9 ft)	lb	*38620	*38620	*40120	32720	*30230	21210	22310	15670	21980	15450	(24.9)	11000	(28.8)
-3.0 m	kg	*21370	*21370	*16080	15100	*12090	9810			*10610	8680	6.57	5740	7.98
(-9.8 ft)	lb	*47110	*47110	*35450	33290	*26650	21630			*23390	19140	(21.6)	12650	(26.2)

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

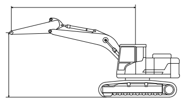
※ Lifting capacities are based upon a standard machine conditions.
Lifting capacities will vary with different work tools, ground conditions and attachments.
The difference between the weight of a work tool attachment must be subtracted.
Consult your HD Hyundai Construction Equipment dealer regarding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

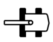
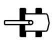
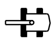
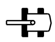
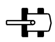
Model	Type	Boom	Arm	Counterweight	Shoe	Wheel	Dozer		Outtriger	
HX350LT3 HW	HD MONO BOOM	Length [mm]	Length [mm]	weight [kg]	width [mm]	width [mm]	Front	Rear	Front	Rear
		6450	2200	6000	700	-	-	-	-	-

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

B

A



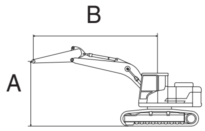
Lift-point height (A)		Lift-point radius (B)								At max. reach		
		3.0 m (9.8 ft)		4.5 m (14.8 ft)		6.0 m (19.7 ft)		7.5 m (24.6 ft)		Capacity		Reach
												m (ft)
9.0 m	kg									*9860	*9860	5.47
(29.5 ft)	lb									*21740	*21740	(18.0)
7.5 m	kg					*9190	*9190			*9240	8850	6.94
(24.6 ft)	lb					*20260	*20260			*20370	19510	(22.8)
6.0 m	kg					*9860	*9860	*9080	7740	*9090	7150	7.85
(19.7 ft)	lb					*21740	*21740	*20020	17060	*20040	15760	(25.8)
4.5 m	kg					*11200	10540	*9550	7550	8840	6310	8.40
(14.8 ft)	lb					*24690	23240	*21050	16640	19490	13910	(27.6)
3.0 m	kg					*12660	10020	*10230	7300	8320	5920	8.65
(9.8 ft)	lb					*27910	22090	*22550	16090	18340	13050	(28.4)
1.5 m	kg					*13660	9660	10110	7100	8250	5850	8.63
(4.9 ft)	lb					*30120	21300	22290	15650	18190	12900	(28.3)
0.0 m	kg					13940	9510	10000	6990	8630	6090	8.33
(0.0 ft)	lb					30730	20970	22050	15410	19030	13430	(27.3)
-1.5 m	kg			*17490	14740	*13450	9520	10040	7040	9640	6770	7.74
(-4.9 ft)	lb			*38560	32500	*29650	20990	22130	15520	21250	14930	(25.4)
-3.0 m	kg	*19290	*19290	*15330	15020	*11770	9730			*9870	8330	6.75
(-9.8 ft)	lb	*42530	*42530	*33800	33110	*25950	21450			*21760	18360	(22.2)
-4.5 m	kg			*13270	*13270					*10000	9380	5.80
(-14.8 ft)	lb			*29260	*29260					*22050	20680	(19.0)

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

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

Model	Type	Boom	Arm	Counterweight	Shoe	Wheel	Dozer		Outtriger	
HX350LT3 HW	HD MONO BOOM	Length [mm]	Length [mm]	weight [kg]	width [mm]	width [mm]	Front	Rear	Front	Rear
		6450	2500	6000	700	-	-	-	-	-

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



Lift-point height (A)		Lift-point radius (B)								At max. reach		
		3.0 m (9.8 ft)		4.5 m (14.8 ft)		6.0 m (19.7 ft)		7.5 m (24.6 ft)		Capacity		Reach
												m (ft)
7.5 m	kg									*8700	8510	7.15
(24.6 ft)	lb									*19180	18760	(23.4)
6.0 m	kg					*9440	*9440	*8690	7790	*8640	6930	8.04
(19.7 ft)	lb					*20810	*20810	*19160	17170	*19050	15280	(26.4)
4.5 m	kg			*14270	*14270	*10800	10610	*9250	7570	8580	6130	8.57
(14.8 ft)	lb			*31460	*31460	*23810	23390	*20390	16690	18920	13510	(28.1)
3.0 m	kg					*12320	10060	*9990	7310	8080	5740	8.81
(9.8 ft)	lb					*27160	22180	*22020	16120	17810	12650	(28.9)
1.5 m	kg					*13440	9660	10100	7080	8000	5660	8.79
(4.9 ft)	lb					*29630	21300	22270	15610	17640	12480	(28.8)
0.0 m	kg			*18780	14520	*13880	9460	9950	6950	8330	5870	8.51
(0.0 ft)	lb			*41400	32010	*30600	20860	21940	15320	18360	12940	(27.9)
-1.5 m	kg	*14350	*14350	*17830	14610	*13550	9450	9960	6950	9230	6480	7.92
(-4.9 ft)	lb	*31640	*31640	*39310	32210	*29870	20830	21960	15320	20350	14290	(26.0)
-3.0 m	kg	*20680	*20680	*15900	14860	*12180	9610			*10000	7860	6.97
(-9.8 ft)	lb	*45590	*45590	*35050	32760	*26850	21190			*22050	17330	(22.9)
-4.5 m	kg			*12050	*12050					*9680	*9680	5.44
(-14.8 ft)	lb			*26570	*26570					*21340	*21340	(17.9)

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

※ Lifting capacities are based upon a standard machine conditions.
Lifting capacities will vary with different work tools, ground conditions and attachments.
The difference between the weight of a work tool attachment must be subtracted.
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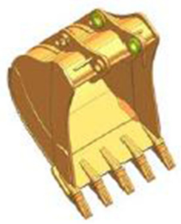
Failure to comply to the rated load can cause possible personal injury or property damage.
Make adjustments to the rated load as necessary for non-standard configurations.

6. BUCKET SELECTION GUIDE

1) HX350LT3

(1) 6000 kg counterweight


General bucket


Heavy duty
(without side cutter)


Rock heavy duty

Type	Capacity		Width	Weight	Tooth	MONO						
						Recommendation mm (ft-in)						
	SAE Heaped	CECE heaped				6.15 m (20' 2") HD Short Boom		6.45 m (21' 2") Boom			6.45 m (21' 2") HD Boom	
	m^3 (yd^3)	m^3 (yd^3)	mm (in)	kg (lb)	EA	2.2 m (7' 3") Arm	2.5 m (8' 2") Arm	2.5 m (8' 2") Arm	3.2 m (10' 6") Arm	4.05 m (13' 3") Arm	2.2 m (7' 3") Arm	2.5 m (8' 2") Arm
General bucket	1.44 (1.88)	1.25 (1.63)	1,380 (54.3")	1,150 (2,540)	5	●	●	●	●	◐	●	●
	1.74 (2.28)	1.50 (1.96)	1,620 (63.8")	1,260 (2,780)	6	●	●	◐	■	▲	◐	◐
	2.10 (2.75)	1.80 (2.35)	1,910 (75.2")	1,650 (3,640)	6	■	■	■	▲	X	■	■
Heavy duty	1.44 (1.88)	1.25 (1.63)	1,470 (57.9")	1,380 (3,040)	5	●	●	●	◐	■	●	●
	1.90 (2.49)	1.65 (2.16)	1,600 (63.0")	1,780 (3,920)	5	◐	◐	■	▲	X	■	■
Rock heavy duty	1.44 (1.88)	1.25 (1.63)	1,470 (57.9")	1,470 (3,240)	5	●	●	●	◐	-	●	●
	1.60 (2.09)	1.39 (1.82)	1,585 (62.4")	1,650 (3,640)	5	●	●	◐	■	-	●	◐
	1.73 (2.26)	1.50 (1.96)	1,710 (67.3")	1,650 (3,640)	5	●	◐	◐	■	-	◐	◐

●	Applicable for materials with density of 2100 kg/m^3 (3500 lb/yd^3) or less
◐	Applicable for materials with density of 1800 kg/m^3 (3000 lb/yd^3) or less
■	Applicable for materials with density of 1500 kg/m^3 (2500 lb/yd^3) or less
▲	Applicable for materials with density of 1200 kg/m^3 (2000 lb/yd^3) or less
X	Not recommended
-	Not available

※ These recommendations are for general conditions and average use.
Work tools and ground conditions have effects on machine performance.
Select an optimum combination according to the working conditions and the type of work that is being done.
Consult your HD Hyundai Construction Equipment dealer for information on selecting the correct boom−arm−bucket combination.

(2) 6600 kg counterweight

General bucket

Heavy duty
(without side cutter)

Rock heavy duty

Type	Capacity		Width	Weight	Tooth	MONO Recommendation mm (ft-in)						
	SAE Heaped	CECE heaped				6.15 m (20' 2") HD Short Boom		6.45 m (21' 2") Boom			6.45 m (21' 2") HD Boom	
	m³ (yd³)	m³ (yd³)	mm (in)	kg (lb)	EA	2.2 m (7' 3") Arm	2.5 m (8' 2") Arm	2.5 m (8' 2") Arm	3.2 m (10' 6") Arm	4.05 m (13' 3") Arm	2.2 m (7' 3") Arm	2.5 m (8' 2") Arm
General bucket	1.44 (1.88)	1.25 (1.63)	1,380 (54.3")	1,150 (2,540)	5	●	●	●	●	◐	●	●
	1.74 (2.28)	1.50 (1.96)	1,620 (63.8")	1,260 (2,780)	6	●	●	●	◐	■	●	●
	2.10 (2.75)	1.80 (2.35)	1,910 (75.2")	1,650 (3,640)	6	◐	◐	■	▲	X	■	■
Heavy duty	1.44 (1.88)	1.25 (1.63)	1,470 (57.9")	1,380 (3,040)	5	●	●	●	●	■	●	●
	1.90 (2.49)	1.65 (2.16)	1,600 (63.0")	1,780 (3,920)	5	◐	◐	◐	■	▲	◐	◐
Rock heavy duty	1.44 (1.88)	1.25 (1.63)	1,470 (57.9")	1,470 (3,240)	5	●	●	●	●	-	●	●
	1.60 (2.09)	1.39 (1.82)	1,585 (62.4")	1,650 (3,640)	5	●	●	●	◐	-	●	●
	1.73 (2.26)	1.50 (1.96)	1,710 (67.3")	1,650 (3,640)	5	●	●	◐	■	-	◐	◐

●	Applicable for materials with density of 2100 kg/m³ (3500 lb/yd³) or less
◐	Applicable for materials with density of 1800 kg/m³ (3000 lb/yd³) or less
■	Applicable for materials with density of 1500 kg/m³ (2500 lb/yd³) or less
▲	Applicable for materials with density of 1200 kg/m³ (2000 lb/yd³) or less
X	Not recommended
-	Not available

※ These recommendations are for general conditions and average use.
Work tools and ground conditions have effects on machine performance.
Select an optimum combination according to the working conditions and the type of work that is being done.
Consult your HD Hyundai Construction Equipment dealer for information on selecting the correct boom－arm－bucket combination.

2) HX350LT3, HW

(1) 6000 kg counterweight

General bucket

Heavy duty
(without side cutter)

Rock heavy duty

Type	Capacity		Width	Weight	Tooth	MONO Recommendation mm (ft-in)						
	SAE Heaped	CECE heaped				6.15 m (20' 2") HD Short Boom		6.45 m (21' 2") Boom			6.45 m (21' 2") HD Boom	
	m³ (yd³)	m³ (yd³)	mm (in)	kg (lb)	EA	2.2 m (7' 3") Arm	2.5 m (8' 2") Arm	2.5 m (8' 2") Arm	3.2 m (10' 6") Arm	4.05 m (13' 3") Arm	2.2 m (7' 3") Arm	2.5 m (8' 2") Arm
General bucket	1.44 (1.88)	1.25 (1.63)	1,380 (54.3")	1,150 (2,540)	5	●	●	●	●	●	●	●
	1.74 (2.28)	1.50 (1.96)	1,620 (63.8")	1,260 (2,780)	6	●	●	●	●	◐	●	●
	2.10 (2.75)	1.80 (2.35)	1,910 (75.2")	1,650 (3,640)	6	●	●	◐	■	▲	◐	◐
Heavy duty	1.44 (1.88)	1.25 (1.63)	1,470 (57.9")	1,380 (3,040)	5	●	●	●	●	●	●	●
	1.90 (2.49)	1.65 (2.16)	1,600 (63.0")	1,780 (3,920)	5	●	●	●	◐	■	●	●
Rock heavy duty	1.44 (1.88)	1.25 (1.63)	1,470 (57.9")	1,470 (3,240)	5	●	●	●	●	-	●	●
	1.60 (2.09)	1.39 (1.82)	1,585 (62.4")	1,650 (3,640)	5	●	●	●	●	-	●	●
	1.73 (2.26)	1.50 (1.96)	1,710 (67.3")	1,650 (3,640)	5	●	●	●	◐	-	●	●

●	Applicable for materials with density of 2100 kg/m³ (3500 lb/yd³) or less
◐	Applicable for materials with density of 1800 kg/m³ (3000 lb/yd³) or less
■	Applicable for materials with density of 1500 kg/m³ (2500 lb/yd³) or less
▲	Applicable for materials with density of 1200 kg/m³ (2000 lb/yd³) or less
X	Not recommended
-	Not available

※ These recommendations are for general conditions and average use.
Work tools and ground conditions have effects on machine performance.
Select an optimum combination according to the working conditions and the type of work that is being done.
Consult your HD Hyundai Construction Equipment dealer for information on selecting the correct boom−arm−bucket combination.

(2) 6600 kg counterweight

General bucket

Heavy duty
(without side cutter)

Rock heavy duty

Type	Capacity		Width	Weight	Tooth	MONO Recommendation mm (ft-in)						
	SAE Heaped	CECE heaped				6.15 m (20' 2") HD Short Boom		6.45 m (21' 2") Boom			6.45 m (21' 2") HD Boom	
	m³ (yd³)	m³ (yd³)	mm (in)	kg (lb)	EA	2.2 m (7' 3") Arm	2.5 m (8' 2") Arm	2.5 m (8' 2") Arm	3.2 m (10' 6") Arm	4.05 m (13' 3") Arm	2.2 m (7' 3") Arm	2.5 m (8' 2") Arm
General bucket	1.44 (1.88)	1.25 (1.63)	1,380 (54.3")	1,150 (2,540)	5	●	●	●	●	●	●	●
	1.74 (2.28)	1.50 (1.96)	1,620 (63.8")	1,260 (2,780)	6	●	●	●	●	◐	●	●
	2.10 (2.75)	1.80 (2.35)	1,910 (75.2")	1,650 (3,640)	6	●	●	●	◐	■	●	◐
Heavy duty	1.44 (1.88)	1.25 (1.63)	1,470 (57.9")	1,380 (3,040)	5	●	●	●	●	●	●	●
	1.90 (2.49)	1.65 (2.16)	1,600 (63.0")	1,780 (3,920)	5	●	●	●	◐	■	●	●
Rock heavy duty	1.44 (1.88)	1.25 (1.63)	1,470 (57.9")	1,470 (3,240)	5	●	●	●	●	-	●	●
	1.60 (2.09)	1.39 (1.82)	1,585 (62.4")	1,650 (3,640)	5	●	●	●	●	-	●	●
	1.73 (2.26)	1.50 (1.96)	1,710 (67.3")	1,650 (3,640)	5	●	●	●	●	-	●	●

●	Applicable for materials with density of 2100 kg/m³ (3500 lb/yd³) or less
◐	Applicable for materials with density of 1800 kg/m³ (3000 lb/yd³) or less
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※ These recommendations are for general conditions and average use.
Work tools and ground conditions have effects on machine performance.
Select an optimum combination according to the working conditions and the type of work that is being done.
Consult your HD Hyundai Construction Equipment dealer for information on selecting the correct boom－arm－bucket combination.

7. UNDERCARRIAGE

1) TYPES OF SHOES

Model	Description	Unit		Triple grouser								Double grouser	
	width	mm	(in)	600	(24)	700	(28)	800	(32)	900	(36)	700	(28)
HX350LT3	Operating weight	kg	(lb)	33680	(74096)	34260	(75372)	34650	(76230)	35040	(77088)	-	-
	Ground pressure	kgf/cm^2	(psi)	0.65	(9.22)	0.57	(8.04)	0.50	(7.11)	0.45	(6.39)	-	-
	Overall width	mm	(ft-in)	3280	(10' 9")	3380	(11' 1")	3480	(11' 5")	3580	(11' 9")	-	-
	Link quantity	EA		48		48		48		48		-	
HX350LT3 HW	Operating weight	kg	(lb)	35540	(78350)	-	-	-	-	-	-	37100	(81620)
	Ground pressure	kgf/cm^2	(psi)	0.68	(9.73)	-	-	-	-	-	-	0.61	8.69
	Overall width	mm	(ft-in)	3470	(11' 5")	-	-	-	-	-	-	3570	(11' 9")
	Link quantity	EA		48		-		-		-		48	

2) SELECTION OF TRACK SHOE

Suitable track shoes should be selected according to operating conditions.

Method of selecting shoes

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

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

Table 1

Track shoe	Specification	Category
600 mm triple grouser	Standard	A
700 mm triple grouser	Option	B
700 mm double grouser	Option	B
800 mm triple grouser	Option	C
900 mm triple grouser	Option	C

Table 2

Category	Applications	Precautions
A	Rocky ground, river beds, normal soil	· Travel at low speed on rough ground with large obstacles such as boulders or fallen trees or a wide range of general civil engineering work
B	Normal soil, soft ground	· These shoes cannot be used on rough ground with large obstacles such as boulders or fallen trees · Travel at high speed only on flat ground · Travel slowly at low speed if it is impossible to avoid going over obstacles
C	Extremely soft ground (swampy ground)	· Use the shoes only in the conditions that the machine sinks and it is impossible to use the shoes of category A or B · These shoes cannot be used on rough ground with large obstacles such as boulders or fallen trees · Travel at high speed only on flat ground · Travel slowly at low speed if it is impossible to avoid going over obstacles

8. SPECIFICATIONS FOR MAJOR COMPONENTS

1) ENGINE

Item	Specification
Model	Cummins QSC 8.3
Type	4-cycle, turbocharged, charge air cooled, electronic controlled diesel engine
Cooling method	Water cooled
Number of cylinders and arrangement	6 cylinders, in-line
Firing order	1-5-3-6-2-4
Combustion chamber type	Direct injection type
Cylinder bore × stroke	114× 135 mm (4.49" × 5.31")
Piston displacement	8.3 ℓ (506 cu in)
Compression ratio	16.5 : 1
Gross power	280 Hp (209 kW) at 2200 rpm
Net power	275 Hp (205 kW) at 2200 rpm
Maximum torque	138 kgf ·m (1000 lbf ·ft) at 1500 rpm
Engine oil quantity	35 ℓ (9.2 U.S. gal)
Wet weight	723 kg (1594 lb)
Starting motor	24 V-7.8 kW
Alternator	24 V-95 A

2) MAIN PUMP

Item	Specification
Type	Variable displacement tandem axis piston pumps
Capacity	2 × 175 cc/rev
Rated oil flow	2 × 306.3 ℓ/min (80.9 U.S. gpm / 67.4 U.K. gpm)
Rated speed	1750 rpm

3) GEAR PUMP

Item	Specification
Type	Fixed displacement gear pump single stage
Capacity	15 cc/rev
Maximum pressure	40 kgf/cm^2 (570 psi)
Rated oil flow	26.3 ℓ/min (6.9 U.S. gpm/5.8 U.K. gpm)

4) MAIN CONTROL VALVE

Item		Specification
Type		10 spools
Operating method		Hydraulic pilot system
Main relief valve pressure		350 kgf/cm^2 (4980 psi) [380 kgf/cm^2 (5400 psi)]
Port relief valve pressure	Boom	400 kgf/cm^2 (5690 psi)
	Arm	400 kgf/cm^2 (5690 psi)
	Bucket	400 kgf/cm^2 (5690 psi)

[ ] : Power boost

5) SWING MOTOR

Item	Specification
Type	Axial piston motor
Capacity	156.9 cc/rev
Relief pressure	300 kgf/cm^2 (4270 psi)
Braking system	Automatic, spring applied hydraulic released
Braking torque	84.4 kgf · m (610 lbf · ft) over
Brake release pressure	36.5 kgf/cm^2 (519 psi) below
Reduction gear type	2 - stage planetary

6) TRAVEL MOTOR

Item	Specification
Type	Variable displacement axial piston motor
Capacity	282.6/156.9 cc/rev
Relief pressure	350 kgf/cm^2 (4980 psi)
Braking system	Automatic, spring applied hydraulic released
Braking torque	134 kgf · m (969 lbf · ft)
Brake release pressure	13.2~17.0 kgf/cm^2 (188~242 psi)
Reduction gear type	2-stage planetary

7) CYLINDER

Item		Specification
Boom cylinder	Bore dia × Stroke	Ø150 × 1480 mm
	Cushion	Extend only
Arm cylinder	Bore dia × Stroke	Ø160 × 1685 mm Ø170 × 1685 mm (6.15 m, 6.45m HD boom only)
	Cushion	Extend and retract
Bucket cylinder	Bore dia × Stroke	Ø140 × 1285 mm Ø145 × 1285 mm (2.20 m arm only)
	Cushion	Extend only

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

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

9. RECOMMENDED OILS

HD Hyundai Construction Equipment genuine lubricating oils have been developed to offer the best performance and service life for your equipment. These oils have been tested according to the specifications of HD Hyundai Construction Equipment and, therefore, will meet the highest safety and quality requirements.
We recommend that you use only HD Hyundai Construction Equipment genuine lubricating oils and grease officially approved by HD Hyundai Construction Equipment.

Service point	Kind of fluid	Capacity ℓ (U.S. gal)	Ambient temperature ˚C(˚F) -50 (-58), -30 (-22), -20 (-4), -10 (14), 0 (32), 10 (50), 20 (68), 30 (86), 40 (104)
Engine oil pan	Engine oil	30 (7.9)	★SAE 5W-40 SAE 30 SAE 10W SAE 10W-30 SAE 15W-40
Swing drive	Gear oil	11 (2.91)	★SAE 75W-90
Final drive	Gear oil	7.8×2 (2.1×2)	SAE 80W-90
Hydraulic tank	Hydraulic oil	Tank : 210 (55.5) System : 414 (107)	★ISO VG 15 ISO VG 32 ISO VG 46 ISO VG 68
Fuel tank	Diesel fuel	600 (159)	★ASTM D975 NO.1 ASTM D975 NO.2
Fitting (grease nipple)	Grease	As required	★NLGI NO.1 NLGI NO.2
Radiator (reservoir tank)	Mixture of antifreeze and soft water★1	55 (14.5)	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

★ : Cold region
Russia, CIS, Mongolia

★1 : Soft water
City water or distilled water

※ Using any lubricating oils other than HD Hyundai Construction Equipment genuine products may lead to a deterioration of performance and cause damage to major components.
※ Do not mix HD Hyundai Construction Equipment genuine oil with any other lubricating oil as it may result in damage to the systems of major components.
※ For HD Hyundai Construction Equipment genuine lubricating oils and grease for use in regions with extremely low temperatures, please contact HD Hyundai Construction Equipment dealers.

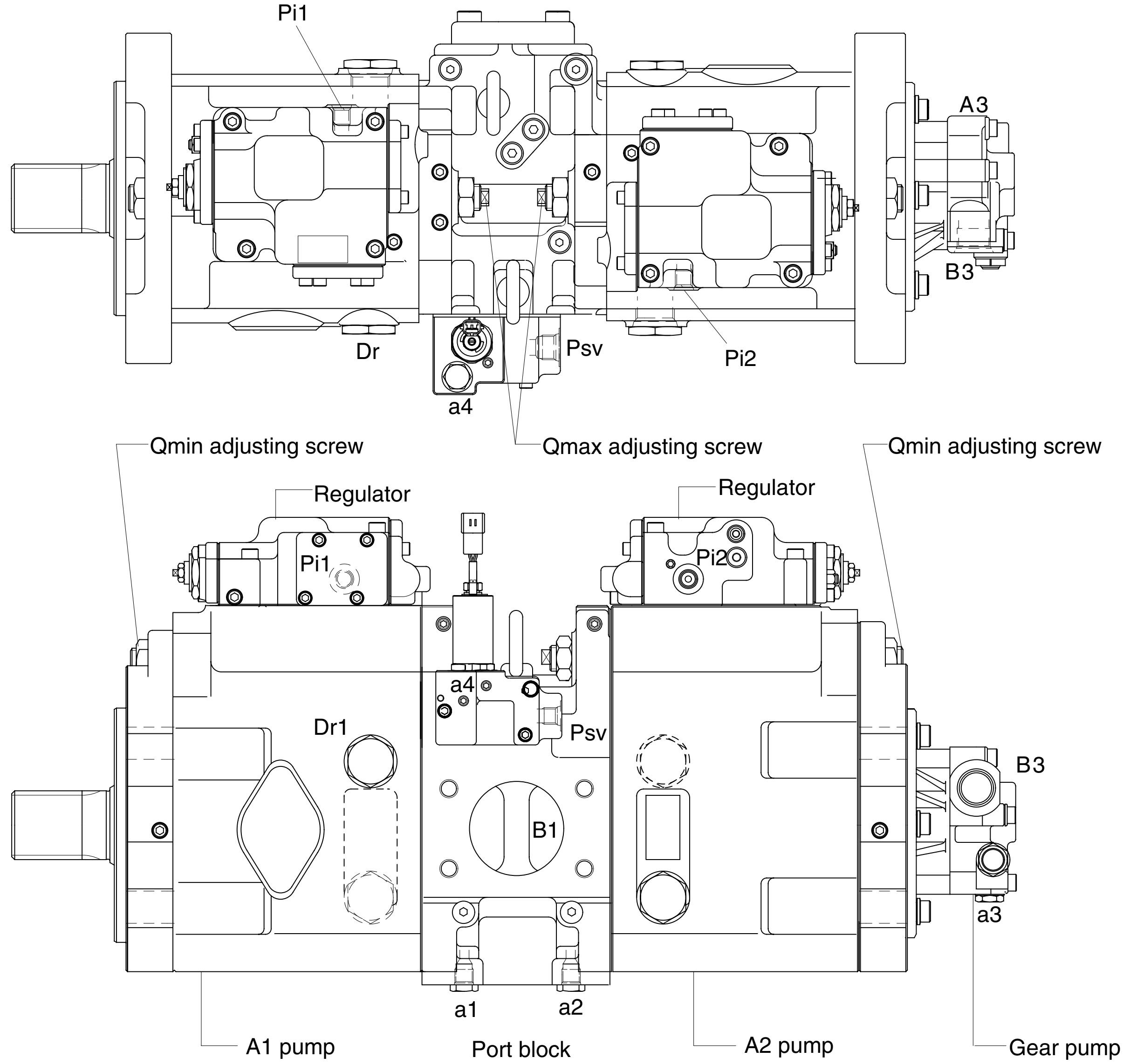
SECTION 2 STRUCTURE AND FUNCTION

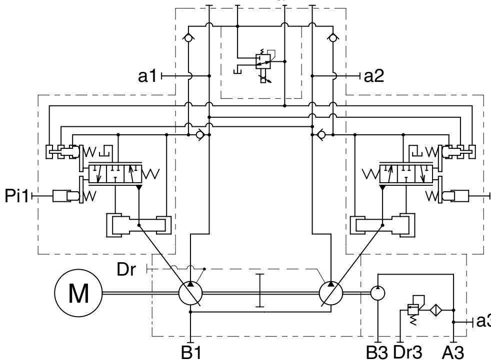
GROUP 1 PUMP DEVICE

1. STRUCTURE

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

1) OUTLINE (1/2) - WITHOUT PTO TYPE

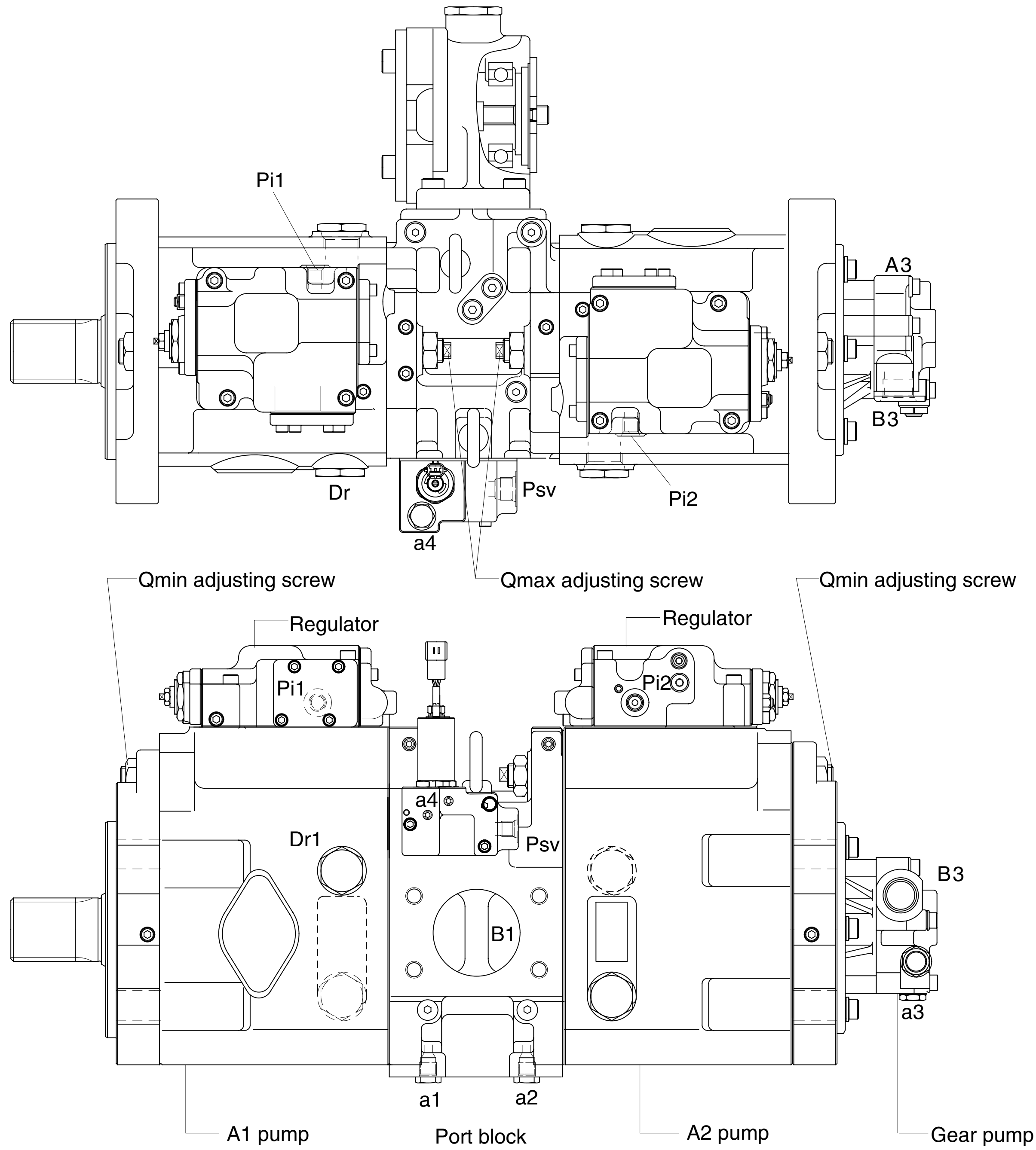


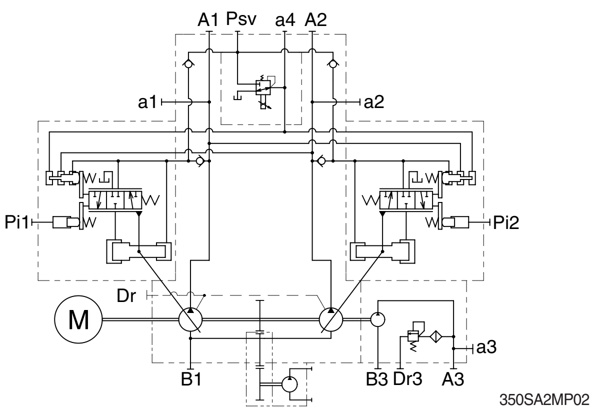


Port	Port name	Port size
A1, 2	Delivery port	SAE6000 psi 1"
B1	Suction port	SAE2000 psi 3"
Dr	Drain port	PF 3/4 - 23
Pi1, i2	Pilot port	PF 1/4 - 15
Psv	Servo assist port	PF 1/4 - 15
a1, 2, 4	Gauge port	PF 1/4 - 15
a3	Gauge port	PF 1/4 - 14
A3	Gear pump delivery port	PF 1/2 - 19
B3	Gear pump suction port	PF 3/4 - 20.5
Dr3	Gear pump drain port	PF 3/8 - 15

350SA2MP01

2) OUTLINE (2/2) - WITH PTO TYPE

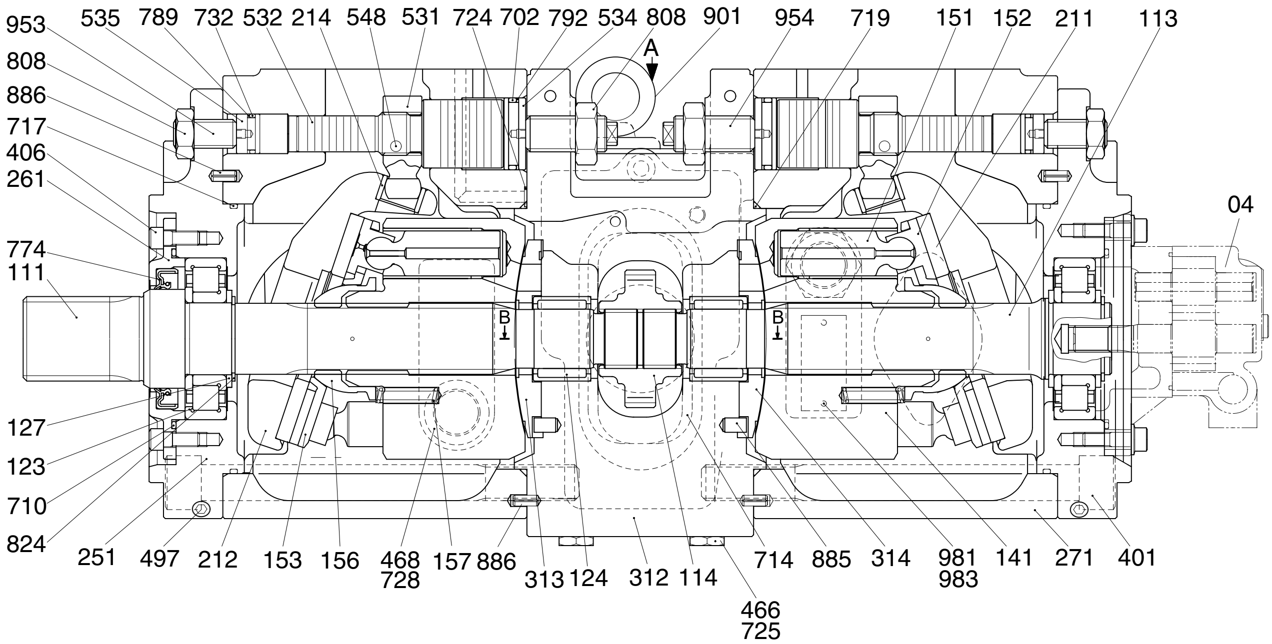




Port	Port name	Port size
A1, 2	Delivery port	SAE6000 psi 1"
B1	Suction port	SAE2000 psi 3"
Dr	Drain port	PF 3/4 - 23
Pi1, i2	Pilot port	PF 1/4 - 15
Psv	Servo assist port	PF 1/4 - 15
a1, 2, 4	Gauge port	PF 1/4 - 15
a3	Gauge port	PF 1/4 - 14
A3	Gear pump delivery port	PF 1/2 - 19
B3	Gear pump suction port	PF 3/4 - 20.5
Dr3	Gear pump drain port	PF 3/8 - 15

2) MAIN PUMP (1/3)

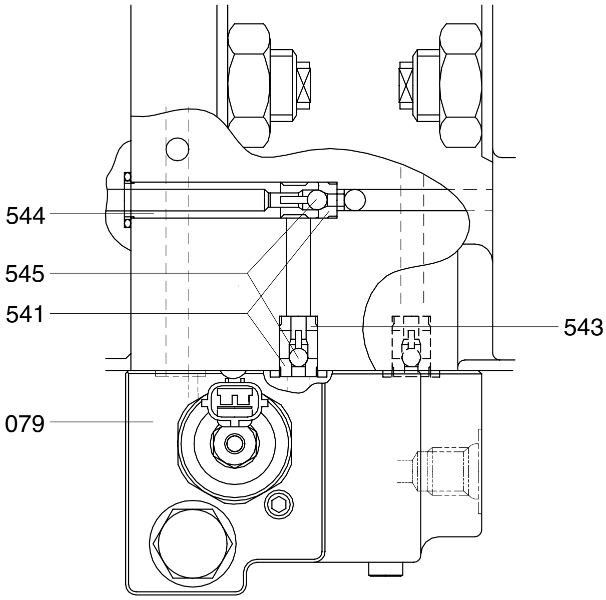
The main pump consists of two piston pumps (front & rear) and valve block.



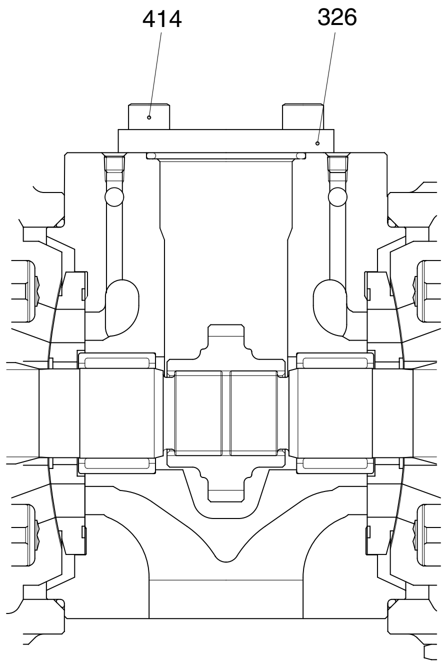
350SA2MP03

04	Gear pump
111	Drive shaft (F)
113	Drive shaft (R)
114	1st gear
123	Roller bearing
124	Needle bearing
127	Bearing spacer
141	Cylinder block
151	Piston
152	Shoe
153	Set plate
156	Spherical bushing
157	Cylinder spring
211	Shoe plate
212	Swash plate
214	Tilting bushing
251	Swash plate support
261	Seal cover (F)
271	Pump casing
312	Valve block
313	Valve plate (R)
314	Valve plate (L)
401	Hexagon socket bolt
406	Hexagon socket bolt
465	Plug
466	Plug
468	Plug
497	MH plug
531	Tilting pin
532	Servo piston
534	Stopper (L)
535	Stopper (S)
548	Feedback pin
702	O-ring
710	O-ring
714	O-ring
717	O-ring
719	O-ring
723	O-ring
724	Square ring
725	O-ring
728	O-ring
732	O-ring
774	Oil seal
789	Back up ring
792	Back up ring
808	Hexagon head nut
824	Snap ring
885	Valve plate pin
886	Spring pin
901	Eye bolt
953	Set screw
954	Set screw
981	Name plate
983	Pin

MAIN PUMP (2/3)



VIEW A

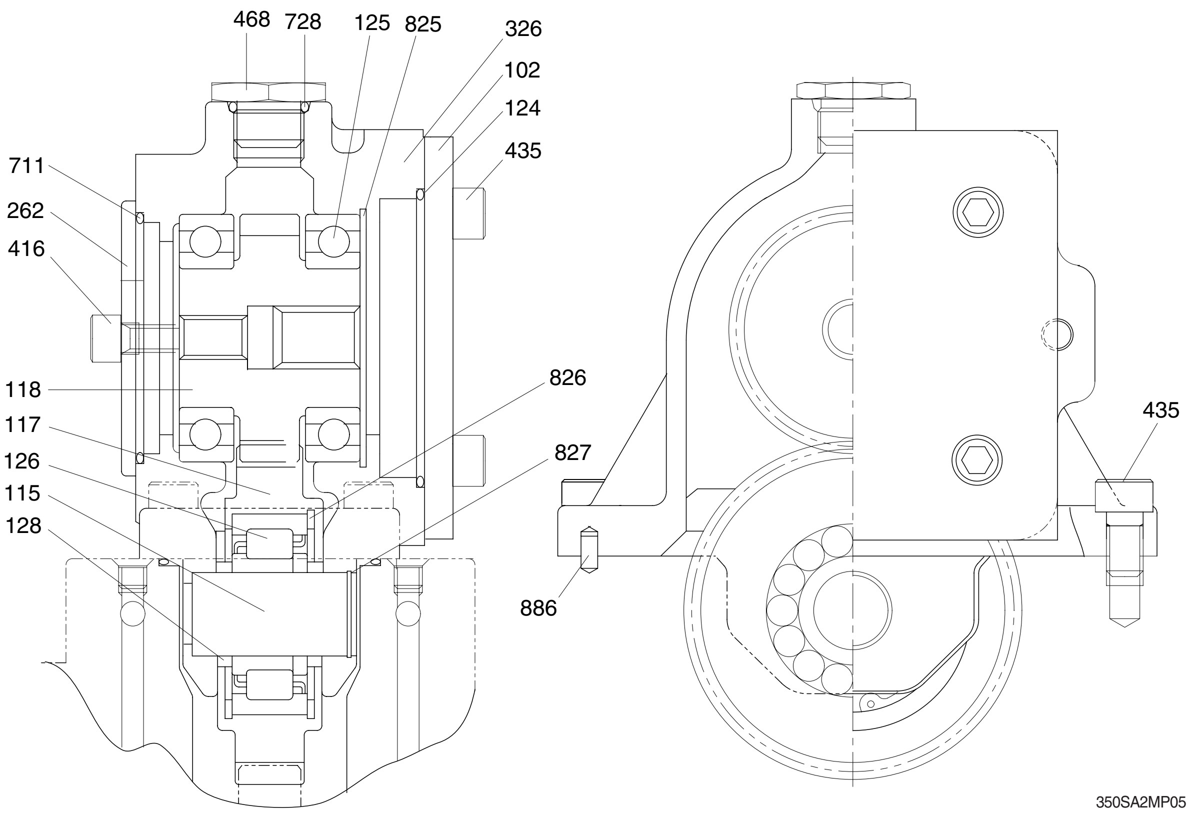


SECTION B-B

350SA2MP04

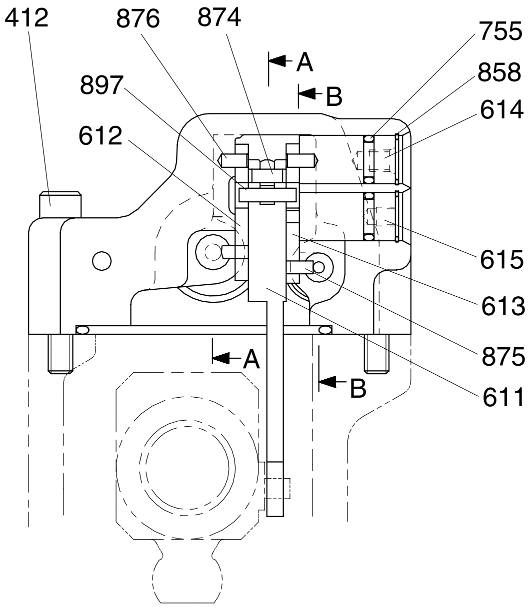
079	Proportional reducing valve	541	Seat	544	Stopper 2
326	Cover	543	Stopper 1	545	Steel ball
414	Hexagon socket bolt				

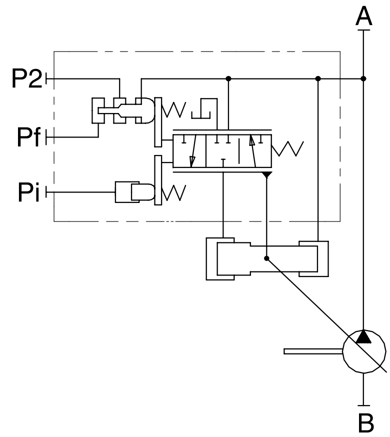
MAIN PUMP (3/3, WITH PTO TYPE)



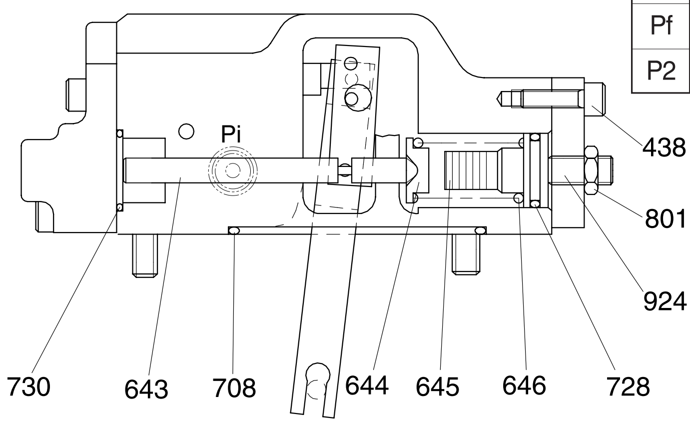
102	Cover (B)	262	Cover	724	O-ring
115	Idler shaft	326	Gear case	728	O-ring
117	2nd gear	416	Hex socket screw	825	Retainer ring
118	3rd gear	435	Hex socket screw	826	Retainer ring
125	Ball bearing	468	Plug	827	Retainer ring
126	Roller bearing	711	O-ring	886	Pin
128	Bearing spacer				

2) REGULATOR (1/2)

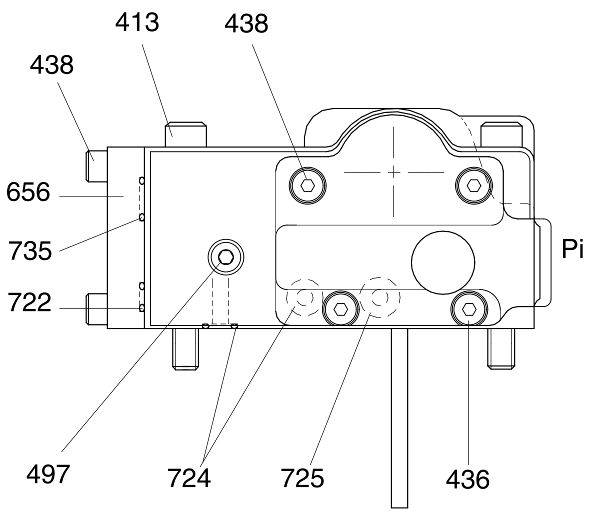




Port	Port name	Port size
A	Delivery port	SAE 6000 PSI 1"
B	Suction port	SAE 2000 PSI 3"
Pi	Pilot port	PF 1/4-15
Pf	Power shift pressure	-
P2	Companion delivery pressure	-



SECTION B-B

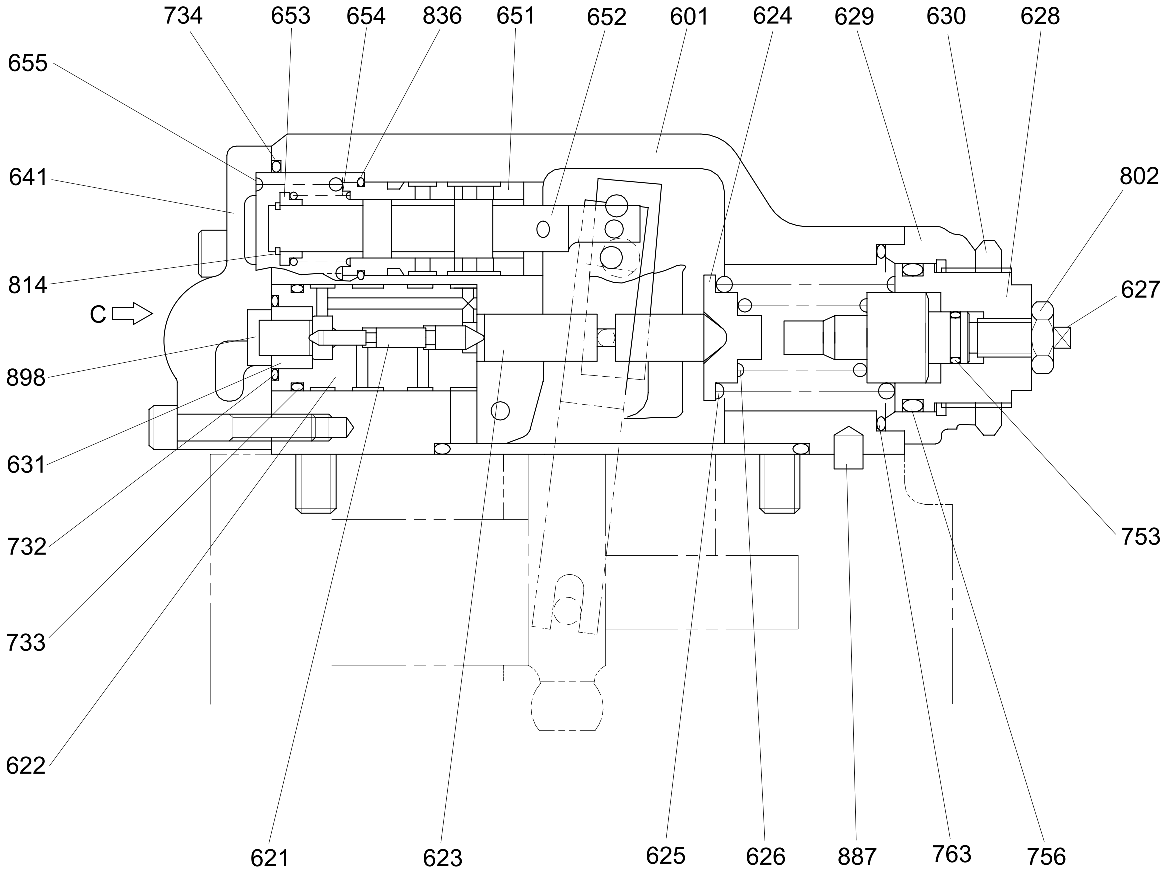


VIEW C

300S2MP06

412 Hexagon socket screw
413 Hexagon socket screw
436 Hexagon socket screw
438 Hexagon socket screw
497 Plug
611 Feed back lever
612 Lever (1)
613 Lever (2)
614 Center plug
615 Adjust plug
643 Pilot piston
644 Spring seat (Q)
645 Adjust stem (Q)
646 Pilot spring
656 Block cover
708 O-ring
722 O-ring
724 Square ring
725 O-ring
728 O-ring
730 O-ring
735 O-ring
755 O-ring
801 Nut
858 Snap ring
874 Pin
875 Pin
876 Pin
897 Pin
924 Set screw

REGULATOR (2/2)

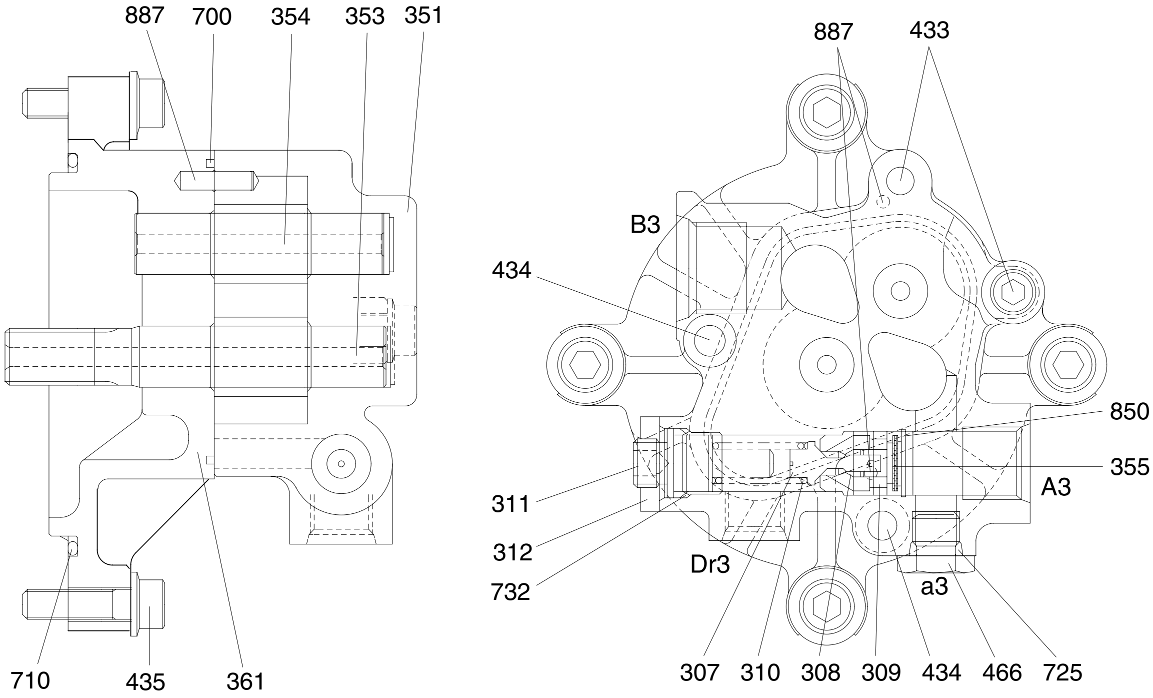


SECTION A-A

350SA2MP07

601	Casing	630	Lock nut	734	O-ring
621	Compensator piston	631	Sleeve, pf	753	O-ring
622	Piston case	641	Pilot cover	756	O-ring
623	Compensator rod	651	Sleeve	763	O-ring
624	Spring seat (C)	652	Spool	802	Nut
625	Outer spring	653	Spring seat	814	Snap ring
626	Inner spring	654	Return spring	836	Snap ring
627	Adjust stem (C)	655	Set spring	887	Pin
628	Adjust screw (C)	732	O-ring	898	Pin
629	Cover (C)	733	O-ring		

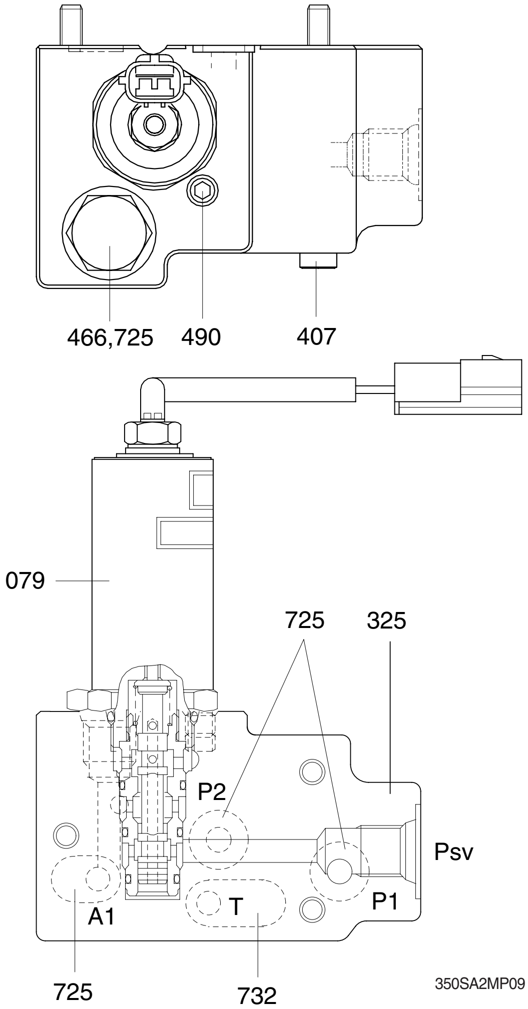
3) GEAR PUMP

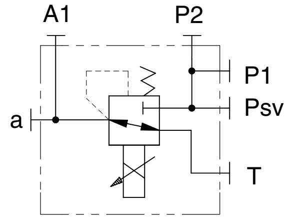


350SA2MP08

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

4) EPPR VALVE AND CASING SUB



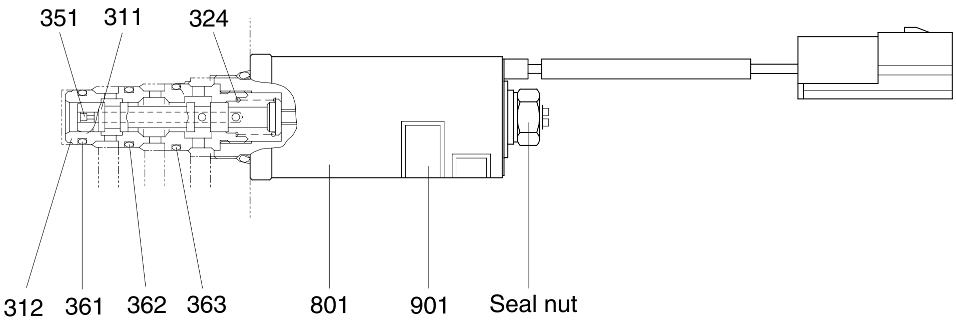


Hydraulic circuit

079 EPPR valve assy
325 Valve casing
407 Hexagon socket head screw
466 VP plug
490 Plug
725 O-ring
732 O-ring

Port	Port name	Port size
Psv	Servo assist port	PF 1/4-15
P1, P2	Internal assist port	-
A1	Power shift port	-
a	Gauge port	PF 1/4-15

5) EPPR VALVE ASSY



350SA2MP10

311	Spool	351	Orifice	363	O-ring
312	Sleeve	361	O-ring	801	Solenoid
324	Spring	362	O-ring	901	Name plate

2. FUNCTION

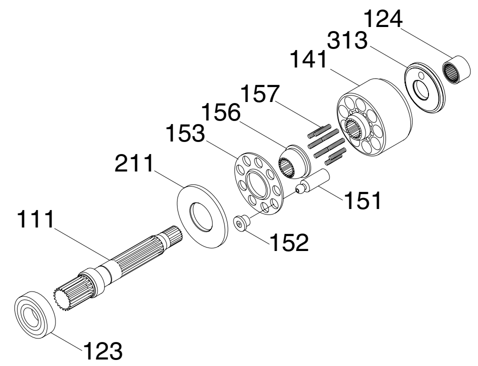
1) MAIN PUMP

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

(1) Rotary group

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

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



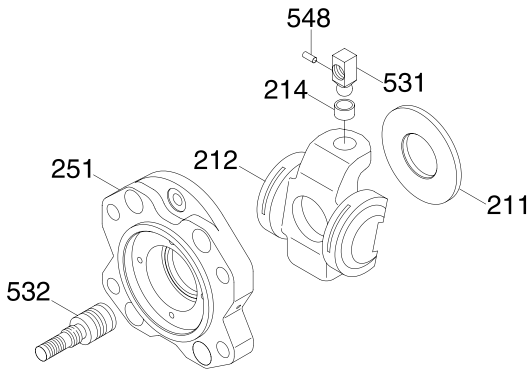
29092MP06

(2) Swash plate group

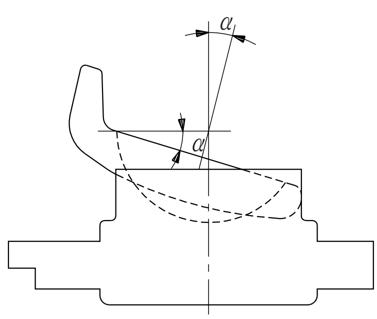
The swash plate group consists of swash plate (212), shoe plate (211), swash plate support (251), tilting bush (214), tilting pin (531) and servo piston (532).

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

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



29092MP07



2-7

(3) Valve block group

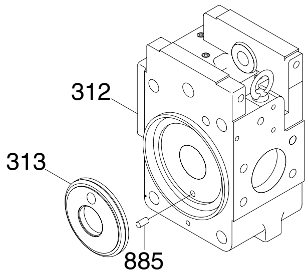
The valve block group consists of valve block (312), valve plate (313) and valve plate pin (885).

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

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

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

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



29092MP08

2) REGULATOR

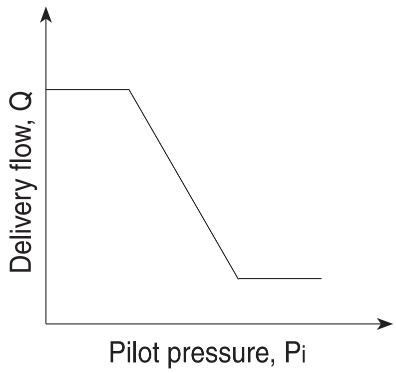
Regulator consists of the negative flow control, total horse power control and power shift control function.

(1) Negative flow control

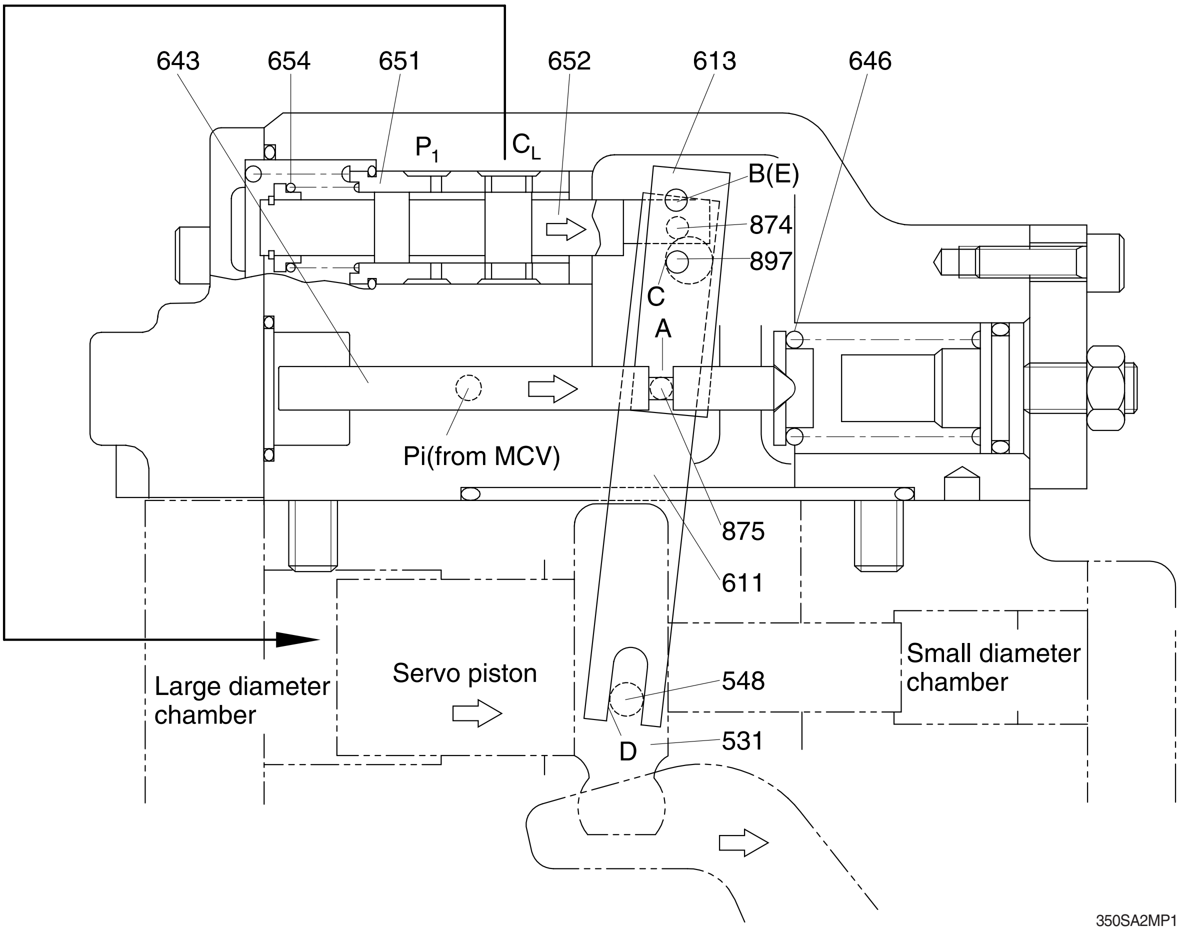
By changing the pilot pressure Pi, the pump tilting angle (delivery flow) is regulated arbitrarily, as shown in the figure.

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

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



① Flow reducing function



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

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

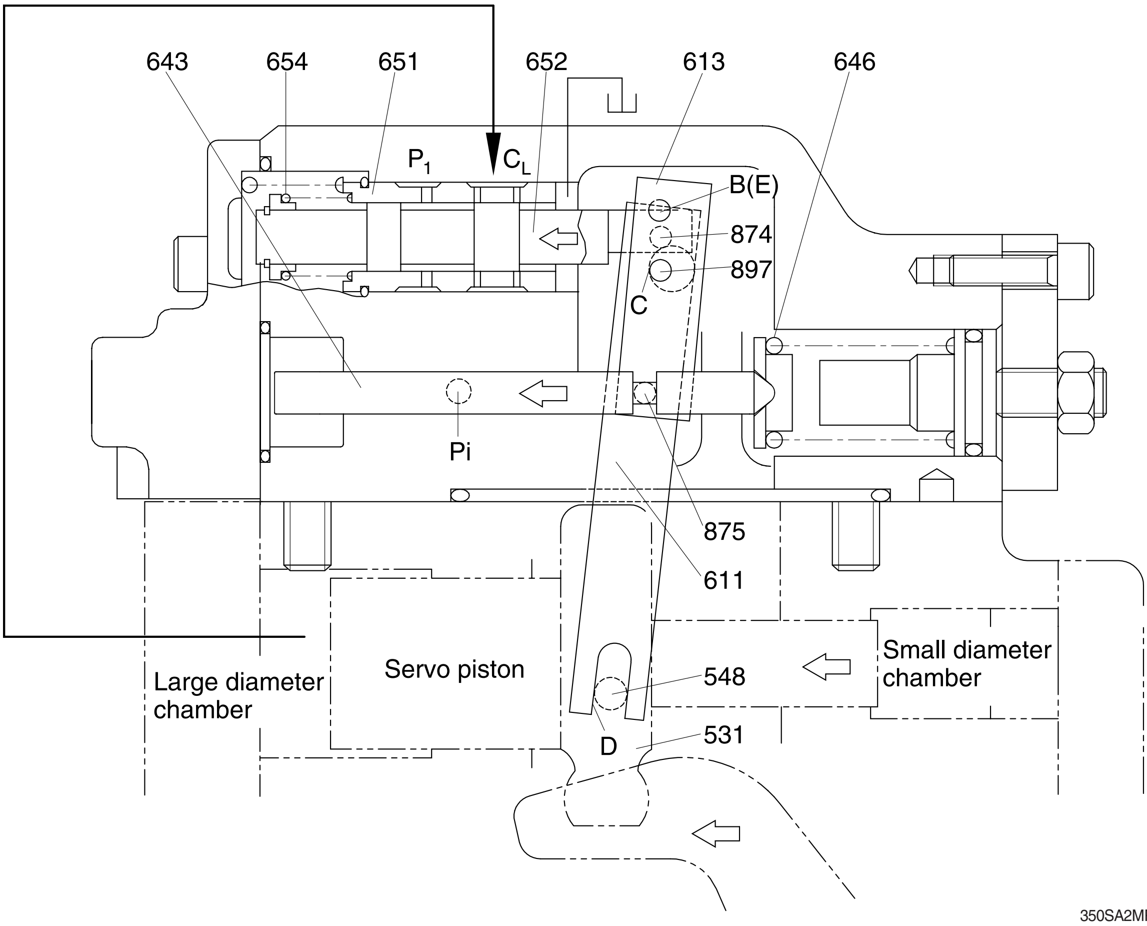
Since the feedback lever is connected with the spool (652) via the pin (874), the spool moves to the right.

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

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

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

② Flow increasing function



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

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

③ Adjustment of flow control characteristic

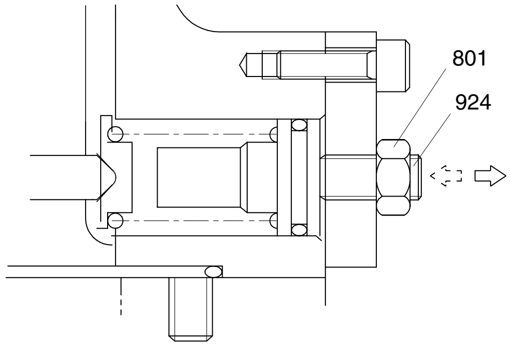
The flow control characteristic can be adjusted with the adjusting screw.

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

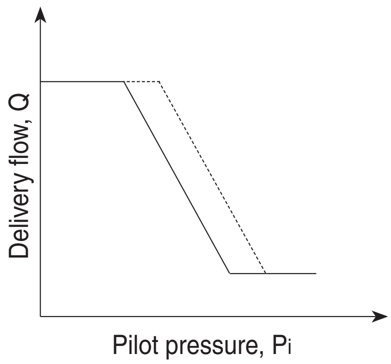
Tightening the screw shifts the control chart to the right as shown in the figure.

※ Adjusting values are shown in table.

Speed	Adjustment of flow control characteristic		
	Tightening amount of adjusting screw (924)	Flow control starting pressure change amount	Flow change amount
(min^{-1})	(Turn)	(kgf/cm^2)	(ℓ/min)
1800	+1/4	+1.5	+10.9



350SA2MP13



(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.

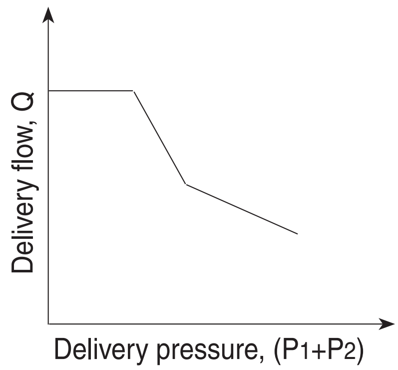
(The input horsepower is constant when the speed is constant.)

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.

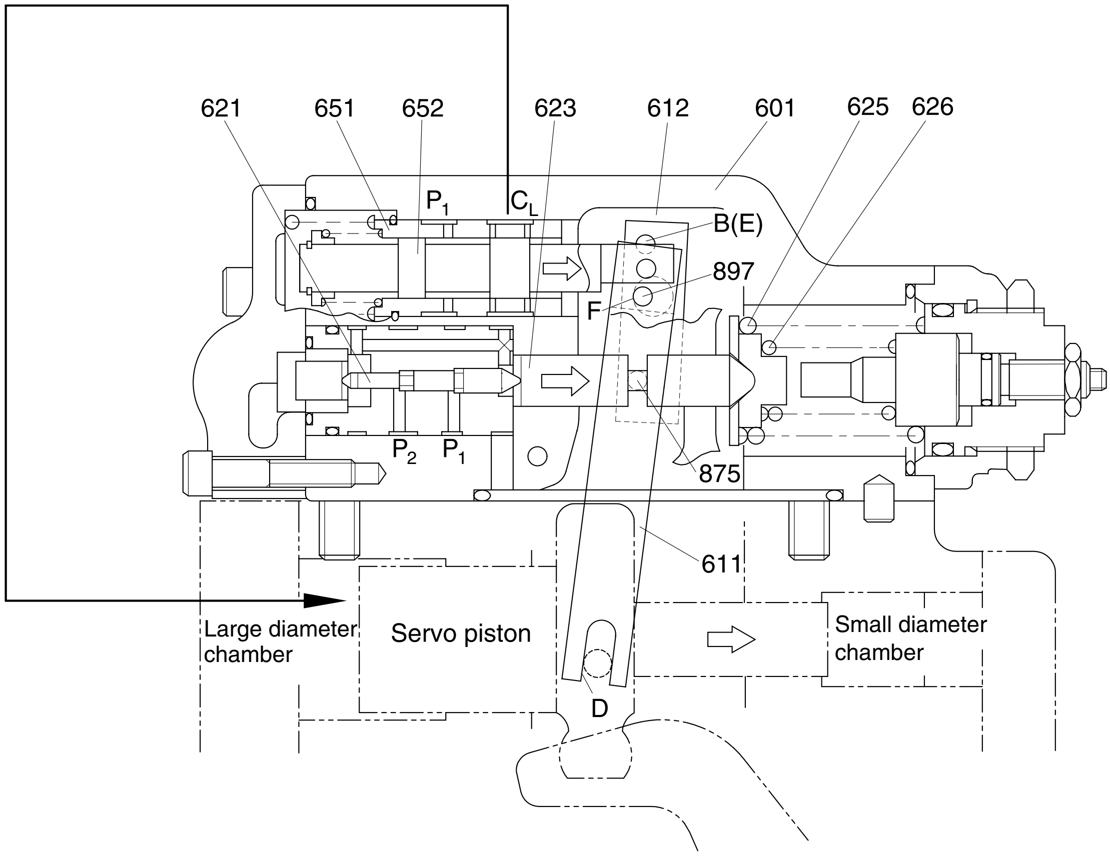
Since this regulator is of the simultaneous total horsepower type, it controls the tilting angles (displacement volumes) of the two pumps to the same value as represented by the following equation :

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

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



350SA2MP14

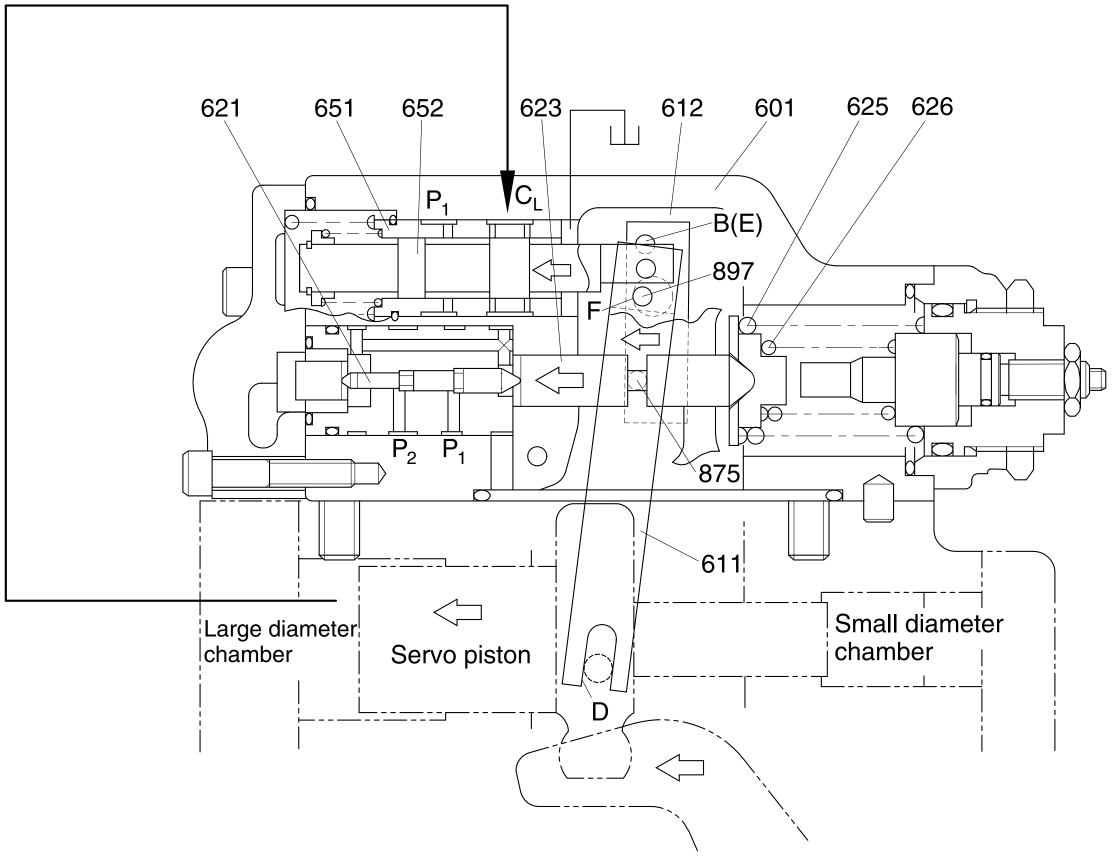
When the self pump delivery pressure P1 or the companion pump delivery pressure P2 rises, it acts on the stepped part of the compensating piston (621). It presses the compensating rod (623) to the right till the force of the outer spring (625) and inner spring (626) balances with the hydraulic force.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



350SA2MP15

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

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

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

③ Low tilting angle (low flow) command preferential function

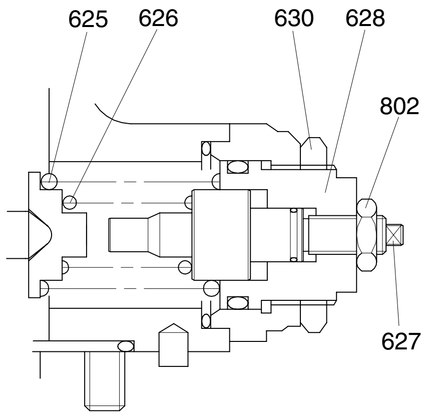
As mentioned above, flow control and horsepower control tilting angle commands are transmitted to the feedback lever and spool via the large-hole sections (C & F) of levers 1 and 2. However, since sections C and F have the pins (Ø4) protruding from the large hole (Ø8), only the lever lessening the tilting angle contacts the pin (897) ; the hole (Ø8) in the lever of a larger tilting angle command is freed without contacting the pin (897). Such a mechanical selection method permits preference of the lower tilting angle command of the flow control and horsepower control.

④ Adjustment of input horsepower

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

a. Adjustment of outer spring

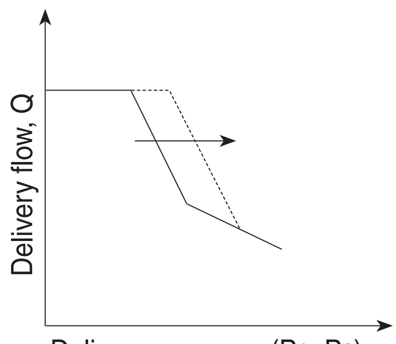
Adjust it by loosening the hexagon nut (630) and by tightening (or loosening) the adjusting screw C (628). Tightening the screw shifts the control chart to the right and increases the input horsepower as shown in the figure. Since turning the adjusting screw C by N turns changes the setting of the inner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



350SA2MP16

※ Adjusting values are shown in table.

Speed	Adjustment of outer spring		
	Tightening amount of adjusting screw (C) (628)	Compensating control starting pressure change amount	Input torque change amount
(min^{-1})	(Turn)	(kgf/cm^2)	(kgf · m)
1800	+1/4	+17.5	+6.1



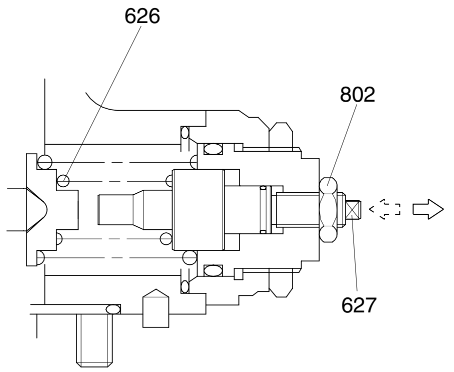
b. Adjustment of inner spring

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

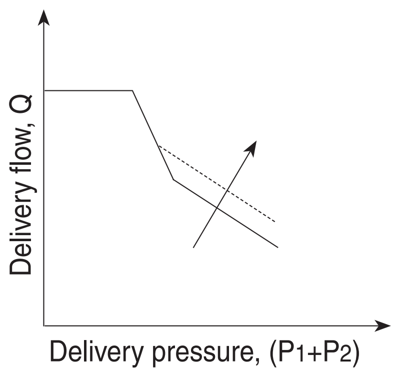
Tightening the screw increases the flow and then the input horsepower as shown in the figure.

※ Adjusting valves are shown in table.

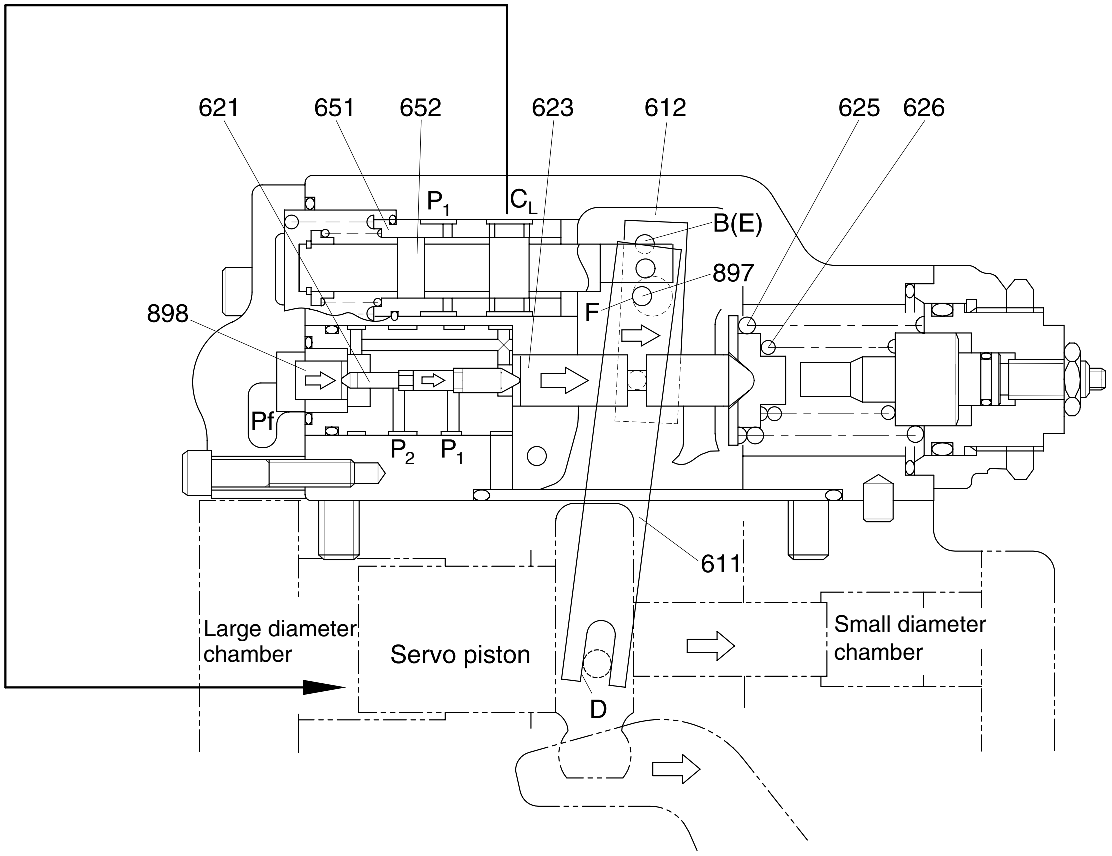
Speed	Adjustment of inner spring		
	Tightening amount of adjusting screw (QI) (627)	Flow change amount	Input torque change amount
(min^{-1})	(Turn)	(kgf/cm^2)	(kgf · m)
1800	+1/4	+16.7	+6.6



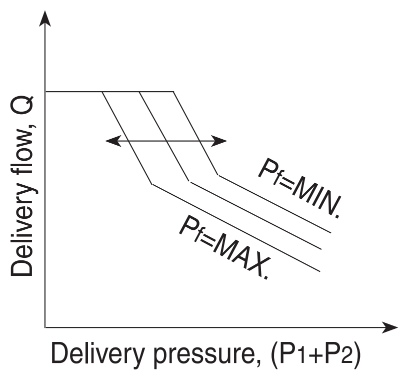
350SA2MP17



(3) Power shift control



350SA2MP18



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).

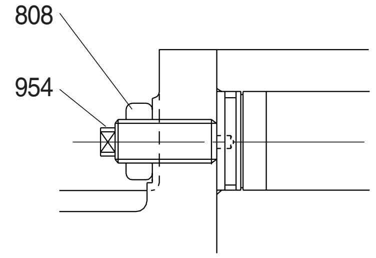
This decreases the pump tilting angle and then the set horsepower in the same way as explained in the overload preventive function of the horsepower control. On the contrary, the set horsepower rises as the power shift pressure Pf falls.

(4) Adjustment of maximum and minimum flows

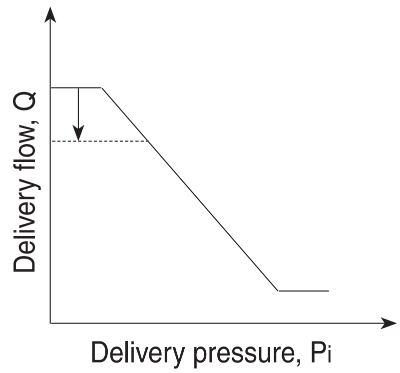
① **Adjustment of maximum flow**

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.



2-19(1)

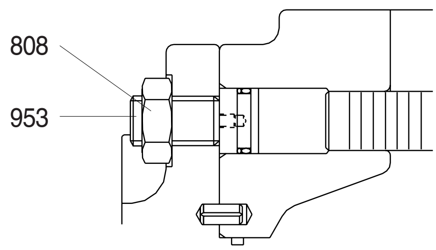


Speed	Adjustment of max flow	
	Tightening amount of adjusting screw (954)	Flow change amount
(min $^{-1}$)	(Turn)	(ℓ /min)
1800	+1/4	-6.9

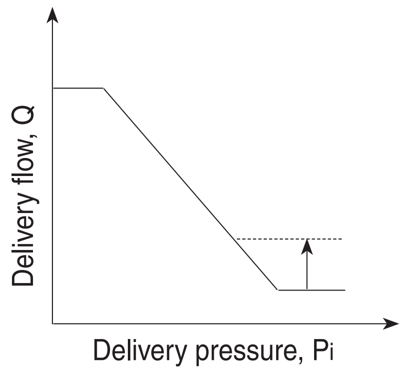
② **Adjustment of minimum flow**

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.



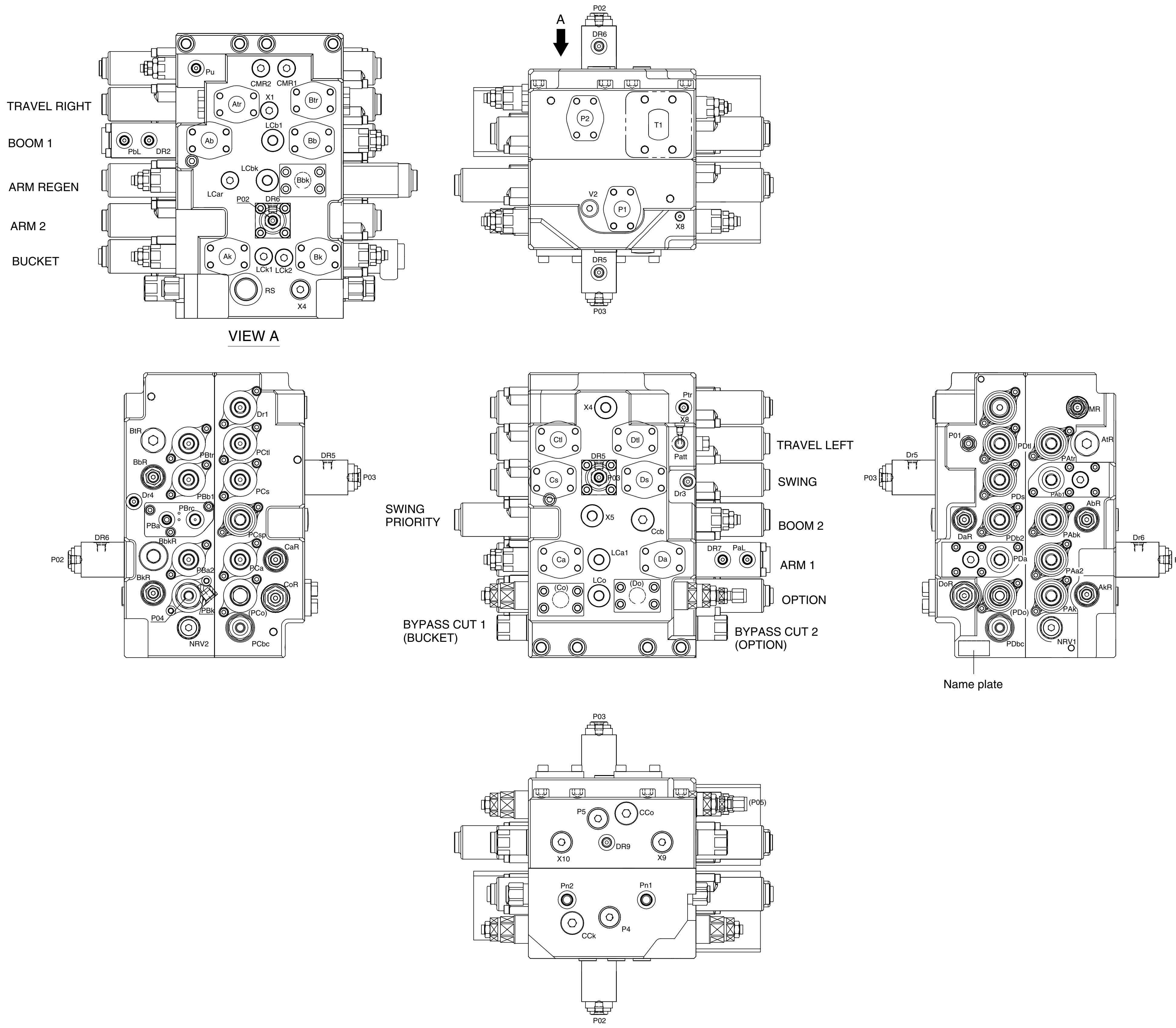
2-19(2)



Speed	Adjustment of min flow	
	Tightening amount of adjusting screw (953)	Flow change amount
(min $^{-1}$)	(Turn)	(ℓ /min)
1800	+1/4	+6.9

GROUP 2 MAIN CONTROL VALVE

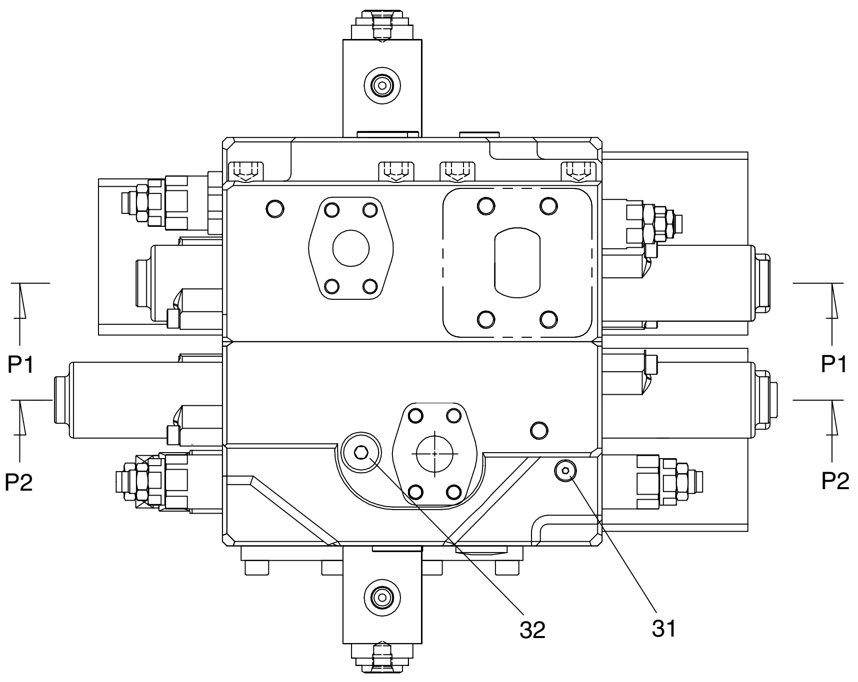
1. STRUCTURE (1/8)



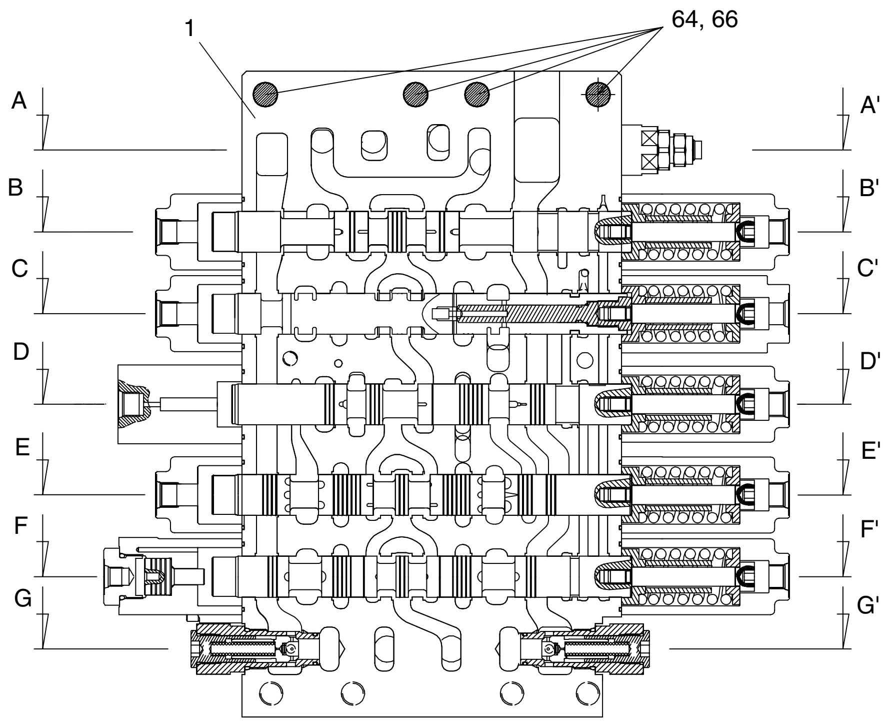
350SA2MC01

Mark	Port name	Port size	Tightening torque
Rs	Make up for swing motor	PF1	20~25 kgf · m (145~180 lbf · ft)
Patt	Auto idle signal-attachment	PF1/4	3.5~4.0 kgf · m (25.3~28.9 lbf · ft)
PbL	Lock valve pilot port (boom)		
PCbc	Bucket in confluence pilot port		
PDbc	Option confluence pilot port		
PBa	Arm in regen-cut signal selector port		
P01	Pilot signal port		
P02	Pilot signal port		
P03	Swing logic pilot port		
P04	Bucket parallel orifice pilot port		
(P05)	Option B confluence pilot port		
PaL	Lock valve pilot port (arm)		
Ptr	Auto idle signal-travel		
Pu	Power boost		
DR1	Drain port		
DR2	Drain port		
DR3	Drain port		
DR4	Drain port		
DR5	Drain port		
DR6	Drain port		
DR7	Drain port		
DR9	Drain port		
(P4)	-	PF1/2	10~12 kgf · m (72.3~86.8 lbf · ft)
(P5)	-		
PAtr	Travel pilot port-RH (FW)	PF3/8	7~8 kgf · m (50.6~57.8 lbf · ft)
PBtr	Travel pilot port-RH (BW)		
PCtl	Travel pilot port-LH (BW)		
PDtl	Travel pilot port-LH (FW)		
PAb1	Boom up pilot port		
PDb2	Boom up confluence pilot port		
PBb1	Boom down pilot port		
PCs	Swing pilot port (LH)		
PDs	Swing pilot port (RH)		
PBa2	Arm in confluence pilot port		
PCsp	Swing priority pilot port		
PAbk	Option A pilot port (breaker)		
PBrc	Arm in regeneration cut port		
PCa	Arm in pilot port		
PDa	Arm out pilot port		
PAa2	Arm out confluence pilot port		
PAk	Bucket in pilot port		
PBk	Bucket out pilot port		
(PCo)	Option B pilot port		
(PDo)	Option B pilot port		
Pn1	Negative control signal port (A2 pump side)		
Pn2	Negative control signal port (A1 pump side)		
V2	Carry-over port		
Atr	Travel motor port-LH (FW)	M10	5.0~6.5 kgf · m (36.2~47.0 lbf · ft)
Btr	Travel motor port-LH (BW)		
Ctl	Travel motor port-RH (BW)		
Dtl	Travel motor port-RH (FW)		
Ab	Boom up port		
Bb	Boom down port		
Cs	Swing motor port (LH)		
Ds	Swing motor port (RH)		
(Bbk)	Option A port (breaker)		
Ca	Arm in port		
Da	Arm out port		
Ak	Bucket in port		
Bk	Bucket out port		
(Co)	Option B port		
(Do)	Option B port		
P1	Pump port (A2 pump side)		
P2	Pump port (A1 pump side)		
T1	Return port	M12	8.0~11.0 kgf · m (57.9~79.6 lbf · ft)

STRUCTURE (2/8)



TOP VIEW

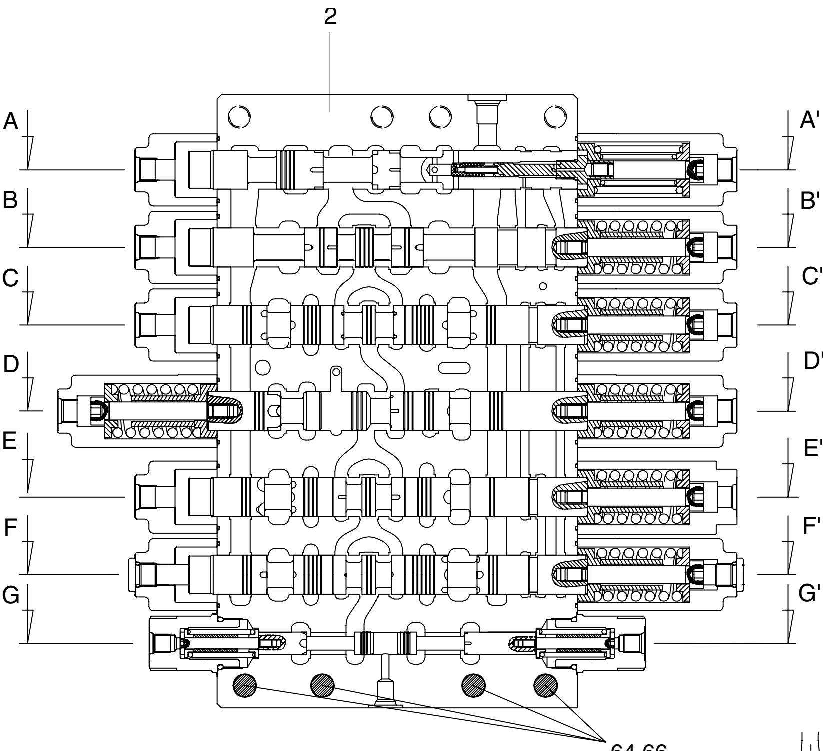


1	Housing P1
31	Plug
32	Plug
64	Hex socket head bolt
66	Spring washer

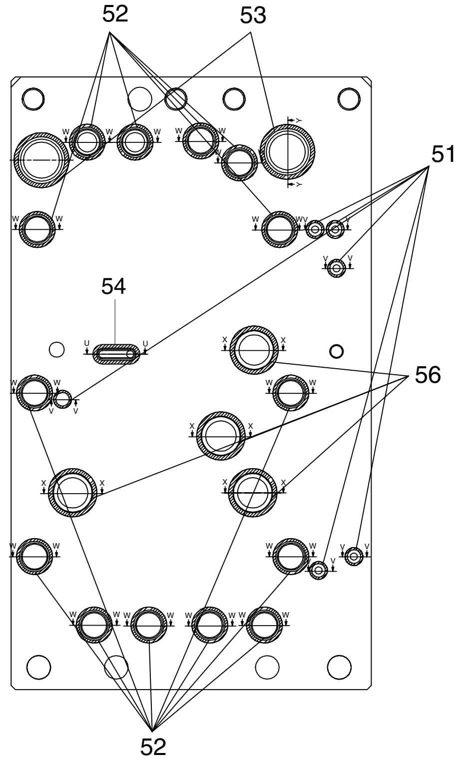
P1 BLOCK SPOOL SECTION

350SA2MC02

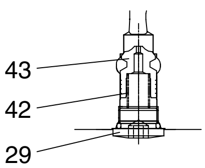
STRUCTURE (3/8)



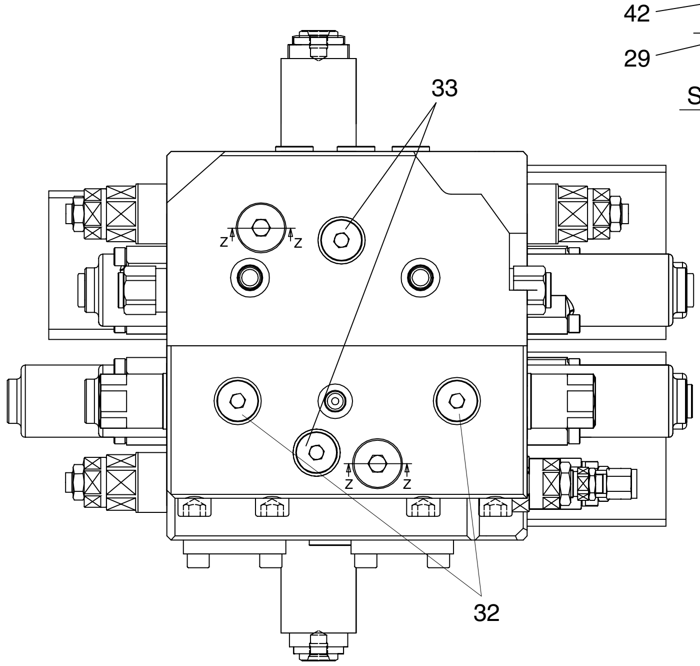
P2 BLOCK SPOOL SECTION



CONTACT FACE



SECTION Z-Z

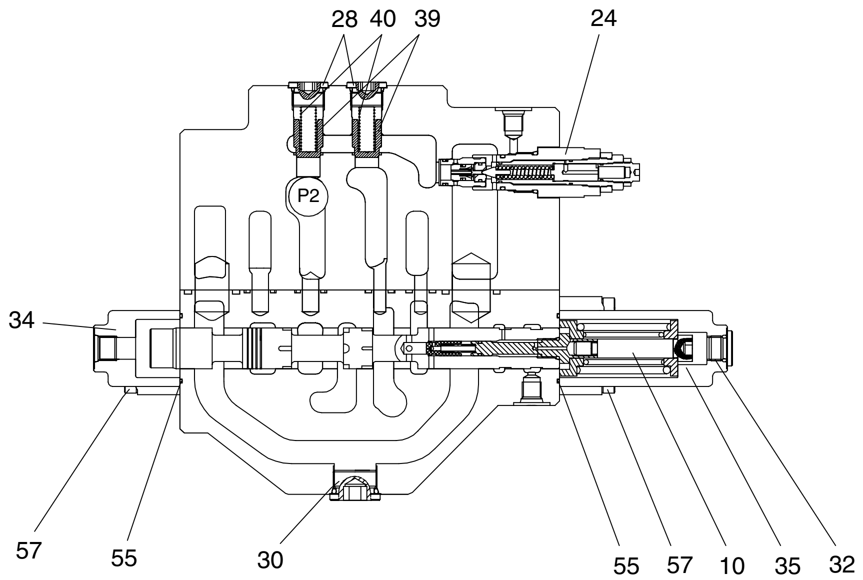


350SA2MC03

BOTTOM VIEW

2 Housing P2
32 Plug
33 Plug
51 O-ring
52 O-ring
53 O-ring
54 O-ring
56 O-ring
64 Hex socket head bolt
66 Spring washer

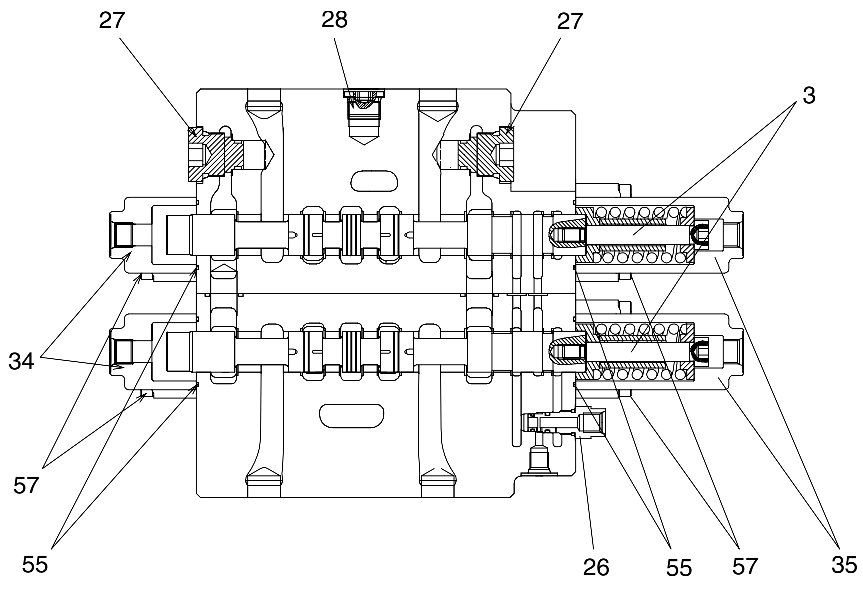
STRUCTURE (4/8)



A-A' (STRAIGHT TRAVEL AND SUPPLY)

350SA2MC04

10 Travel straight spool kit
24 Main relief valve
28 Plug
30 Plug
32 Plug
34 Pilot cover A
35 Pilot cover B
39 Check valve poppet 2
40 Check valve spring 2
55 O-ring
57 Hex socket head bolt

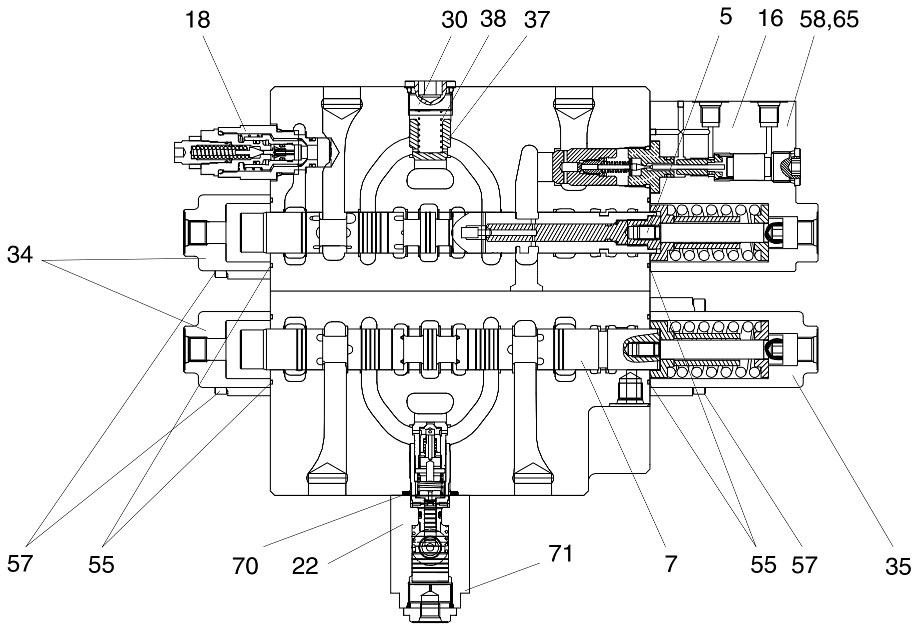


B-B' (TRAVEL RIGHT AND LEFT)

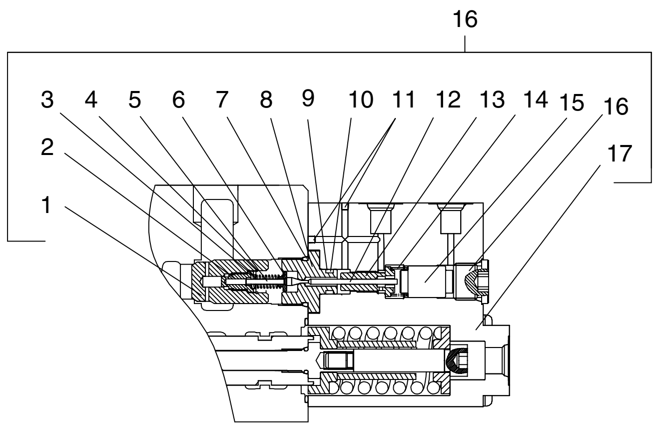
220S2MC05

3 Travel spool kit
26 Orifice signal plug
27 ORV plug
28 Plug
34 Pilot cover A
35 Pilot cover B
55 O-ring
57 Hex socket head bolt

STRUCTURE (5/8)



C-C' (SWING AND BOOM 1)

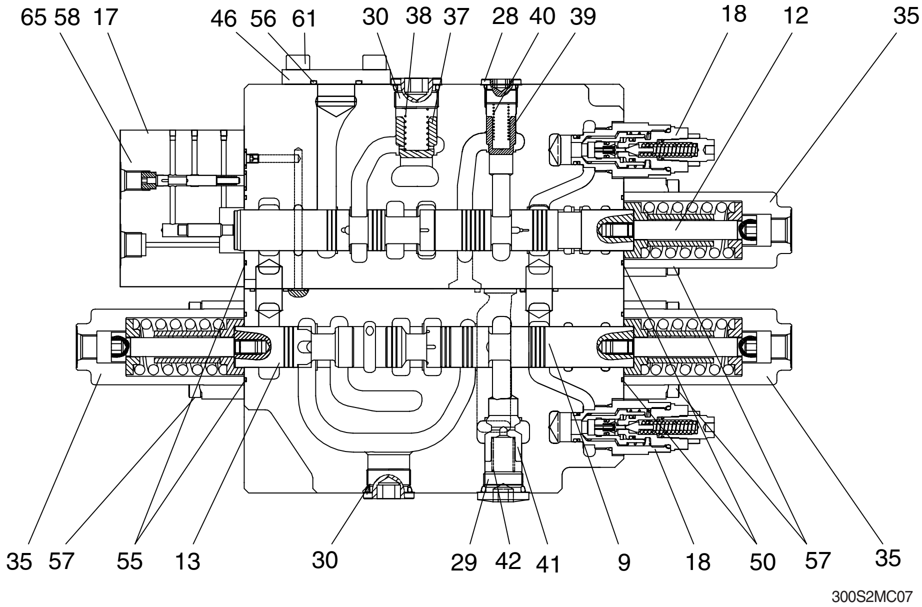


HOLDING VALVE

350SA2MC06

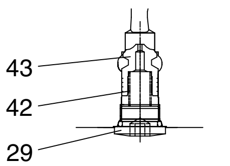
5	Boom 1 spool kit	16-9	Back up ring	30	Plug
7	Swing spool kit	16-10	O-ring	34	Pilot cover A
16	Holding valve assy	16-11	Plug	35	Pilot cover B
16-1	Main poppet	16-12	Pilot piston	37	Check valve poppet 1
16-2	Restrictor	16-13	Piston guide	38	Check valve spring 1
16-3	Pilot spring	16-14	Spring	55	O-ring
16-4	C-ring	16-15	Main piston	57	Hex socket head bolt
16-5	Pilot poppet	16-16	Plug	58	Hex socket head bolt
16-6	Poppet guide	16-17	Block	65	Spring washer
16-7	O-ring	18	Overload relief valve	70	O-ring
16-8	Poppet seat	22	Swing logic valve	71	Hex socket head bolt

STRUCTURE (6/8)

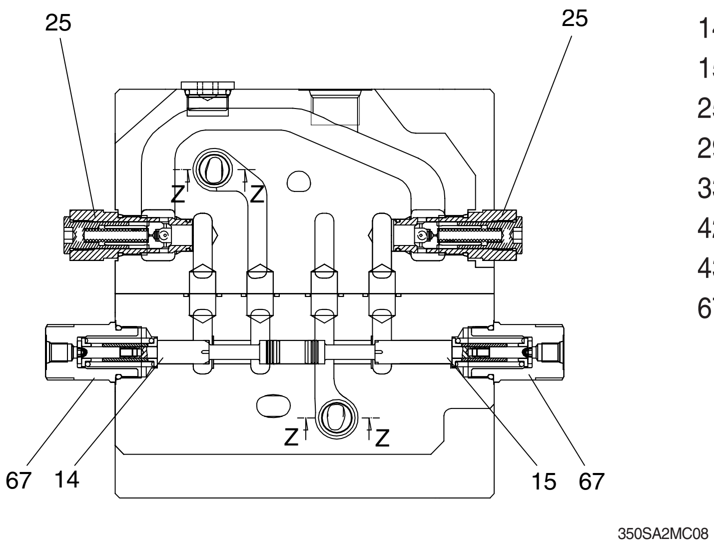


D-D' (SWING PRI, BOOM 2 & ARM REGEN)

9	Boom 2 spool kit
12	Arm regen spool kit
13	Swing priority spool kit
17	Regen valve
18	Overload relief valve
28	Plug
29	Plug
30	Plug
35	Pilot cover B
37	Check valve poppet 1
38	Check valve spring 1
39	Check valve poppet 2
40	Check valve spring 2
41	Check valve poppet 3
42	Check valve spring 3
46	Flange
50	Gasket 3
55	O-ring
56	O-ring
57	Hex socket head bolt
58	Hex socket head bolt
61	Hex socket head bolt
65	Spring washer



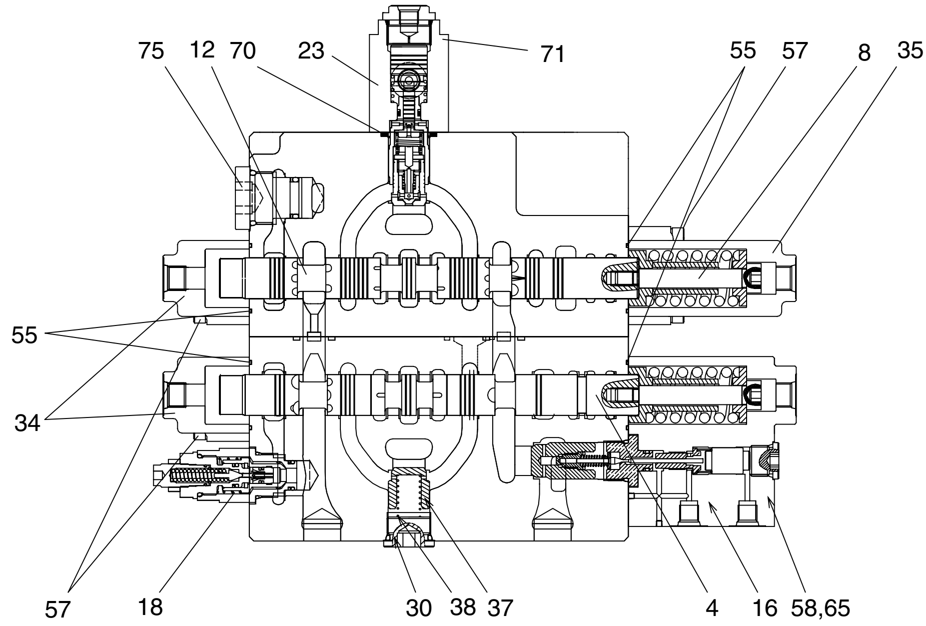
SECTION Z-Z



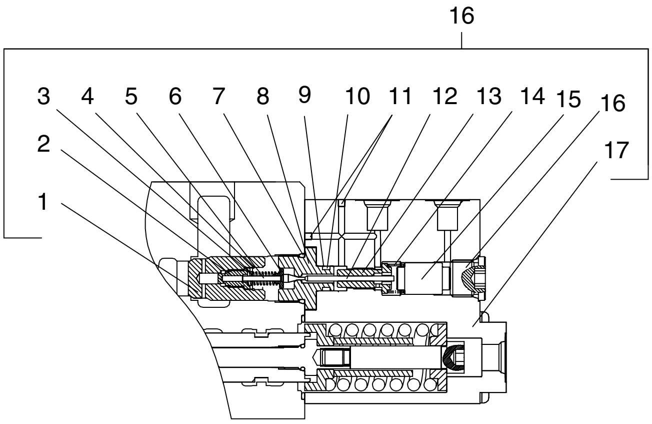
G-G' (BYPASS CUT & NEGATIVE CONTROL)

14	Bypass cut 1 spool kit (bucket)
15	Bypass cut 2 spool kit (option)
25	Negacon valve
29	Plug
33	Plug
42	Check valve spring 3
43	Check valve poppet 4
67	Bypass cut plug

STRUCTURE (7/8)



E-E' (ARM 1 & ARM 2)

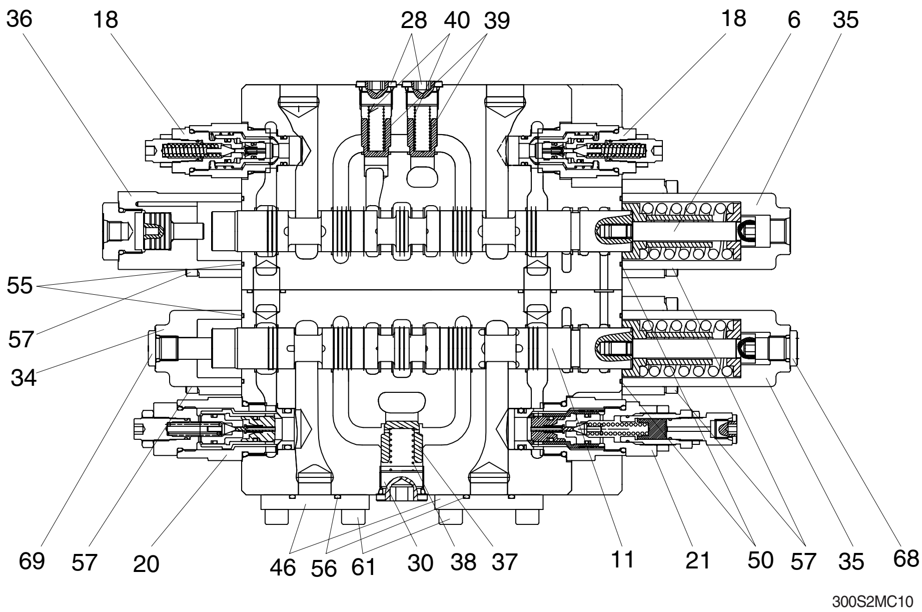


HOLDING VALVE

350SA2MC09

4	Arm 1 spool kit	16-9	Back up ring	34	Pilot cover A
8	Arm 2 spool kit	16-10	O-ring	35	Pilot cover B
12	Arm regen spool kit	16-11	Plug	37	Check valve poppet 1
16	Holding valve assy	16-12	Pilot piston	38	Check valve spring 1
16-1	Main poppet	16-13	Piston guide	55	O-ring
16-2	Restrictor	16-14	Spring	57	Hex socket head bolt
16-3	Pilot spring	16-15	Main piston	58	Hex socket head bolt
16-4	C-ring	16-16	Plug	65	Spring washer
16-5	Pilot poppet	16-17	Block	70	O-ring
16-6	Poppet guide	18	Overload relief valve	71	Hex socket head bolt
16-7	O-ring	23	Arm 2 logic valve	75	Plug
16-8	Poppet seat	30	Plug		

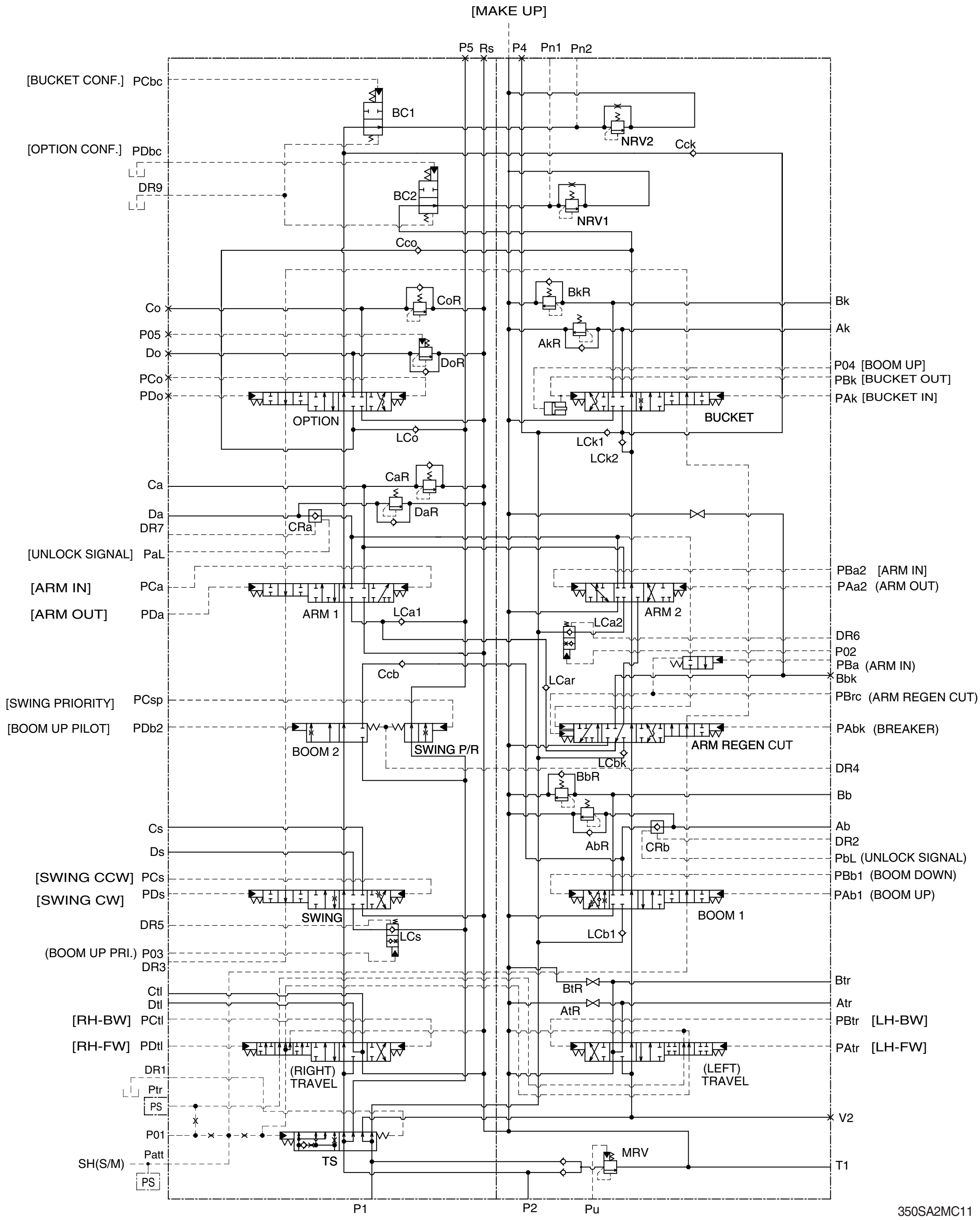
STRUCTURE (8/8)



F-F' (OPTION & BUCKET)

6	Bucket spool kit
11	Option spool kit
18	Overload relief valve
20	Overload relief valve
21	Overload relief valve
28	Plug
30	Plug
34	Pilot cover A
35	Pilot cover B
36	Pilot cover (stroke limit)
37	Check valve poppet 1
38	Check valve spring 1
39	Check valve poppet 2
40	Check valve spring 2
46	Flange
50	Gasket 3
55	O-ring
56	O-ring
57	Hex socket head bolt
61	Hex socket head bolt
68	Plug kit 1
69	Plug kit 2

2. HYDRAULIC CIRCUIT



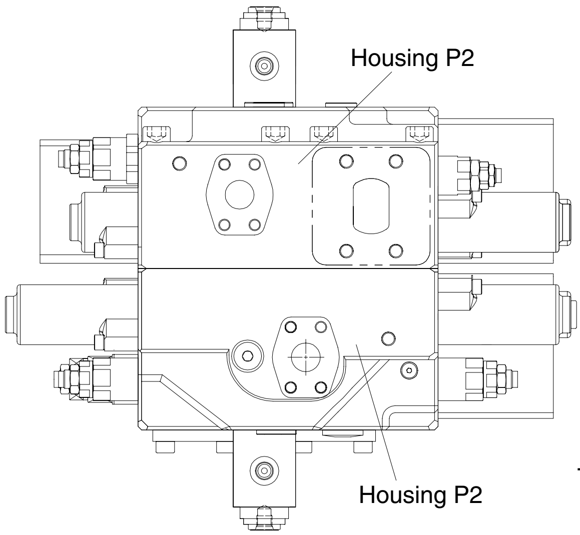
3. FUNCTION

1) CONTROL IN NEUTRAL POSITION

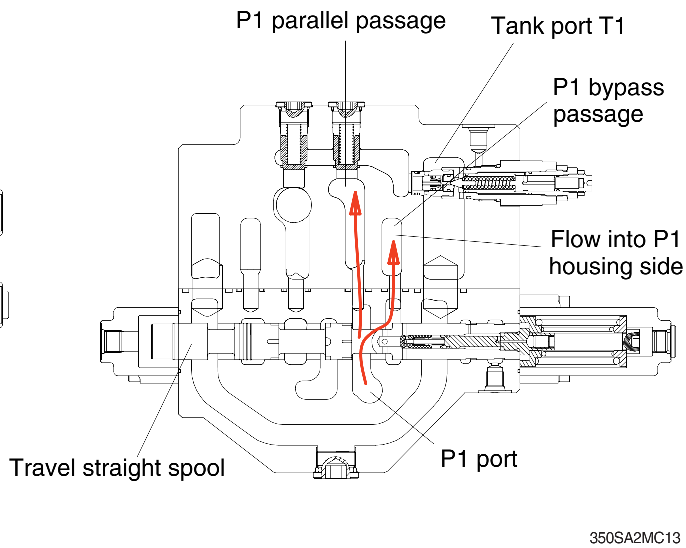
(1) P1 housing side

The pressurized oil discharged from hydraulic pump flows into the main control valve through the inlet port P1 and pass the land of the straight travel spool into the P1 bypass passage and P1 parallel passage.

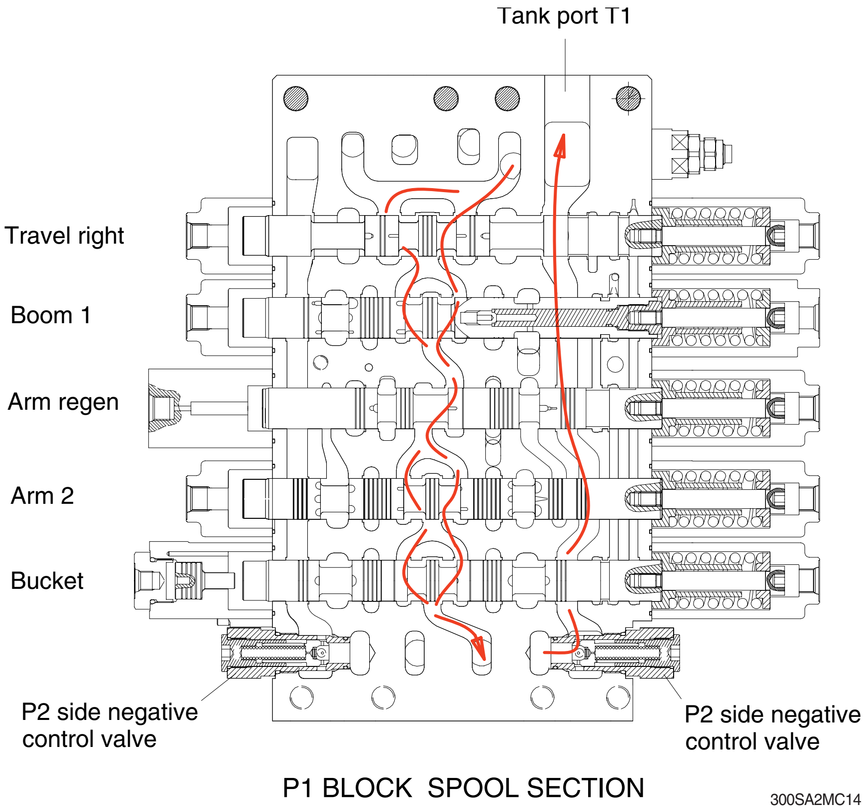
When the straight travel spool is neutral, the P1 side bypass passage is not cut-off and the pressurized oil is directed to the tank port T1 through the bypass passage of spools (travel right -> boom 1 -> arm regeneration -> arm 2 -> bucket), the negative control valve of P1 and tank passage.



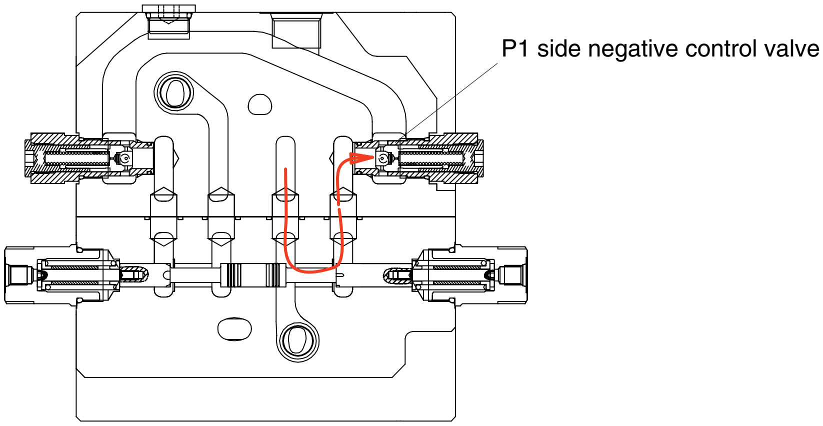
TOP VIEW



A-A' (STRAIGHT TRAVEL AND SUPPLY)



P1 BLOCK SPOOL SECTION

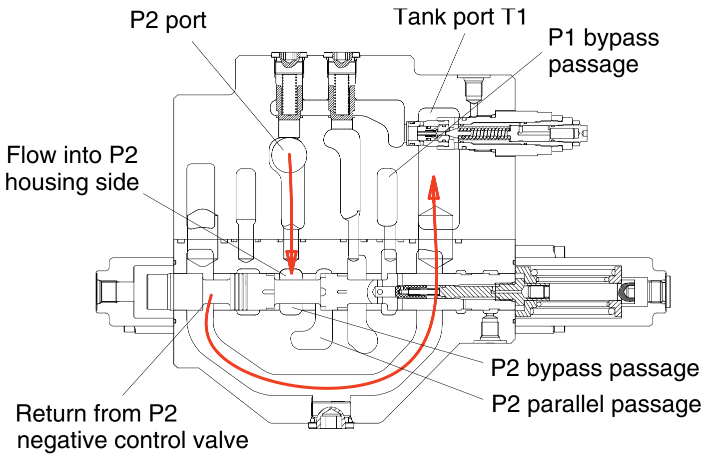


G-G' (BYPASS CUT & NEGATIVE CONTROL)

300SA2MC15

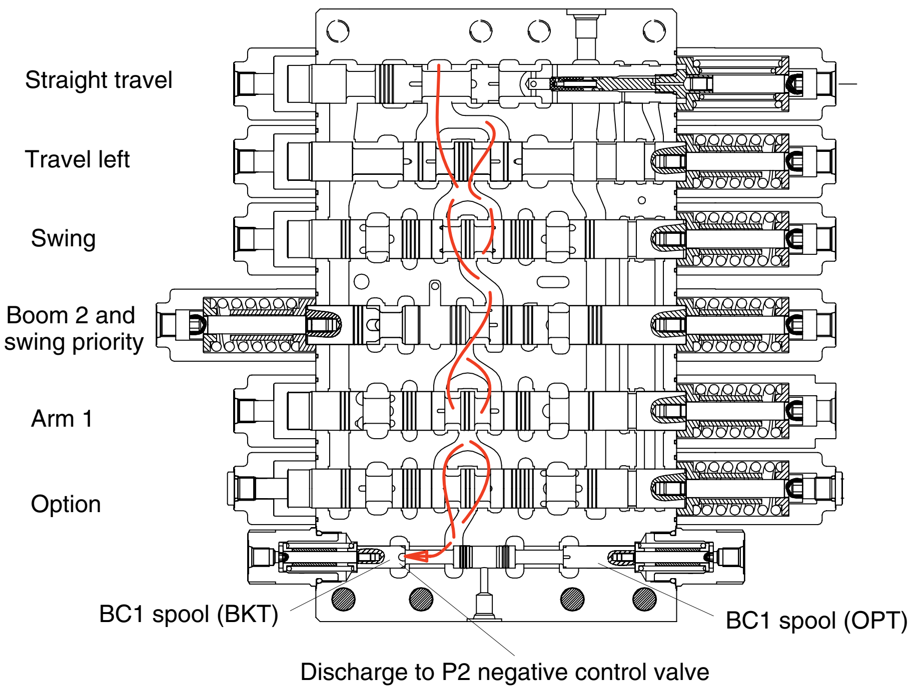
(2) P2 housing side

The pressurized oil discharged from hydraulic pump flows into the main control valve through the inlet port P2 and pass the land of the straight travel spool into the P2 bypass passage and P2 parallel passage.
When the straight travel spool is neutral, the P2 side bypass passage is not cut-off and the pressurized oil is directed to the tank port T1 through the bypass passage of spools (travel left -> swing -> boom 2 and swing priority -> arm 1 -> option), the negative control valve of P2 and tank passage.



A-A' (STRAIGHT TRAVEL AND SUPPLY)

220S2MC16



P2 BLOCK SPOOL SECTION

220S2MC17

2) TRAVEL OPERATION

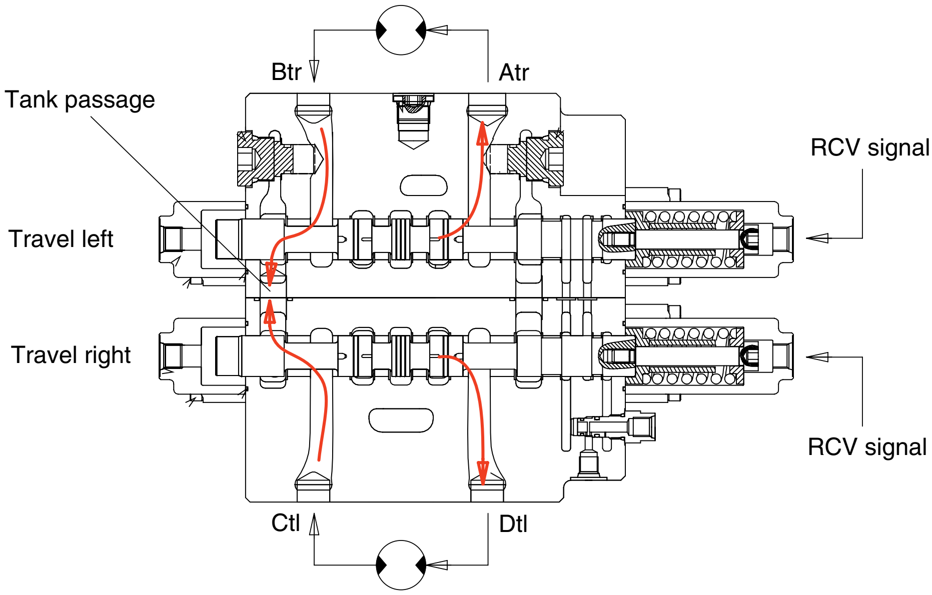
(1) Travel forward operation

During the travel forward operation, the pilot secondary pressure from the remote control valve is supplied to the spring side of pilot port and it shifts travel spools to the left direction.

The pressurized oil from the pump flows into the bypass passage of the travel spools through the land of the straight travel spool.

When the travel spools is shifted and the bypass passage is shut-off. The pressurized oil flowed into bypass passage is supplied to the travel motors through opened port Atr and Dtl.

On the other hand, the return oil from the travel motors flows into main control valve inside through the port Btr and Ctl and return to the tank passage.



B-B' (TRAVEL RIGHT AND LEFT)

220S2MC18

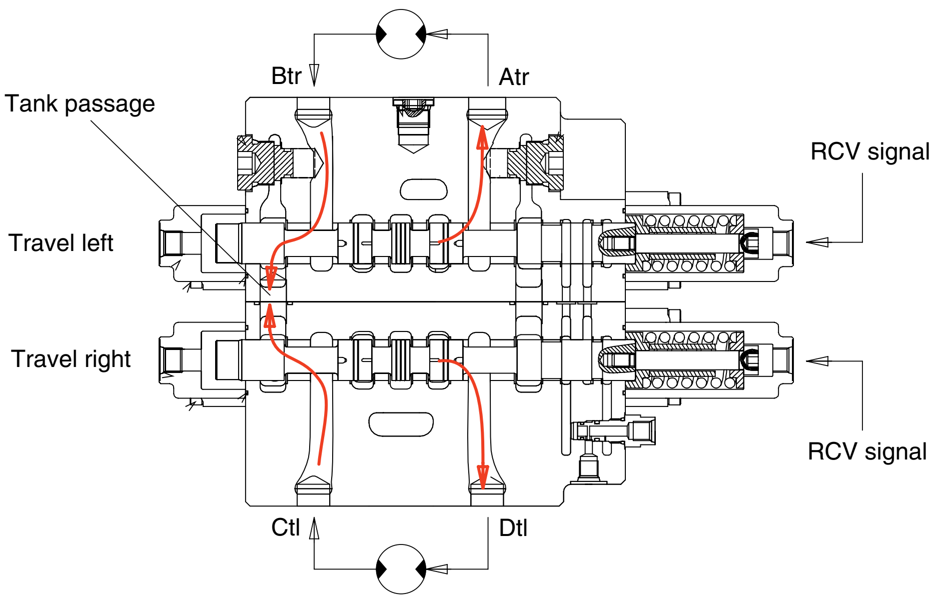
(2) Travel backward operation

During the travel backward operation, the pilot secondary pressure from the remote control valve is supplied to the against pilot port of the spring side and it shifts travel spools to the right direction.

The pressurized oil from the pump flows into the bypass passage of the travel spools through the land of the straight travel spool.

When the travel spools are shifted and the bypass passage is shut-off. The pressurized oil flowed into bypass passage is supplied to the travel motors through opened port Btr and Ctl.

On the other hand, the return oil from the travel motors flows into main control valve inside through the port Atr and Dtl and return to the tank passage.



B-B' (TRAVEL RIGHT AND LEFT)

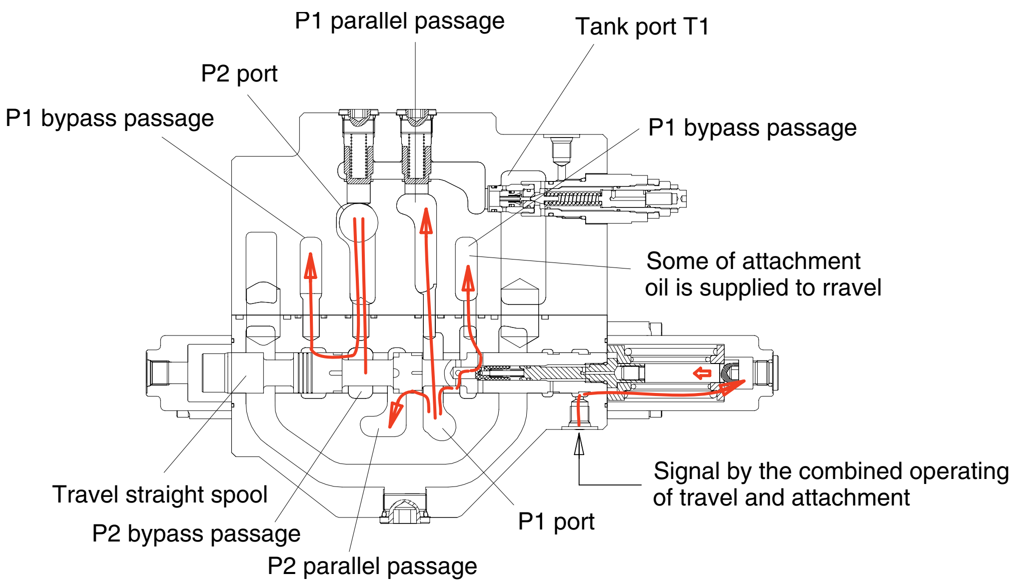
220S2MC19

(3) Travel straight function

This function keeps straight travel in case of simultaneous operation of other actuators (boom, arm, bucket, swing etc) during a straight travel.

In normal conditions, travel straight spool keeps neutral conditions, the pressurized oil of the P1 and P2 pumps is supplied to each passage independently.

When the attachment spool is operated under the travel operation of both sides, the pilot pressure is supplied to the spring side port of the travel straight spool and then the travel straight spool is shifted to the left direction.



A-A' (STRAIGHT TRAVEL AND SUPPLY)

After changeover of the travel straight spool, the pressurized oil discharged from the P1 pump is connected with P2 port oil and is supplied to the attachment line through both parallel passage of the P1 and P2.

Also, some of the pressurized oil open the check valve of the spool inside through side of the travel straight spool and is connected with the bypass passage of the P2 side.

On the other hand, the pressurized oil discharged from the P2 pump is connected with P1 port oil and is supplied to the travel line through both parallel passage of the P1 and P2.

Accordingly the attachment spool is operated under the travel operation of both sides, the pressurized oil discharged from P2 pump is mainly supplied to left and right travel line and the pressurized oil discharged from P1 pump is mainly supplied to attachment line.

As a result, simultaneous operation of both travel spools and attachment is not influenced to the travel operation of the both sides and the machine keeps straight travel.

3) BOOM OPERATION

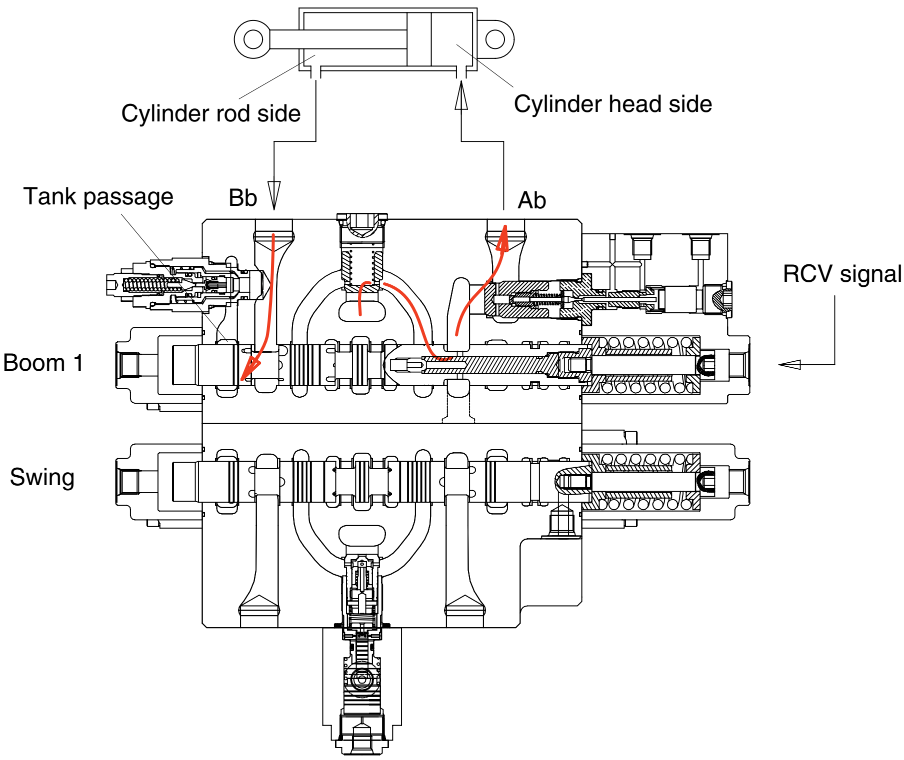
(1) Boom up operation

During the boom up operation, the pilot secondary pressure from the RCV is supplied to the port of the spring side and shifts the boom 1 spool to the left direction. The P1 bypass passage is shut off by the movement of the boom 1 spool and the pressurized oil from P2 port is entered P1 parallel passage and then passes through the load check valve, bridge passage and boom holding valve then flows into the head side of the boom cylinder via Ab port. (In this case, the boom holding valve is free flow condition)

At the same time, the pilot secondary pressure from RCV is supplied to the port of the spring side of boom 2 and shifts the boom 2 spool. The bypass passage is shut off by the movement of the boom 2 spool and the pressurized oil from P2 port entered boom summation passage via the P2 parallel passage, notch of the boom 2 spool, the check valve.

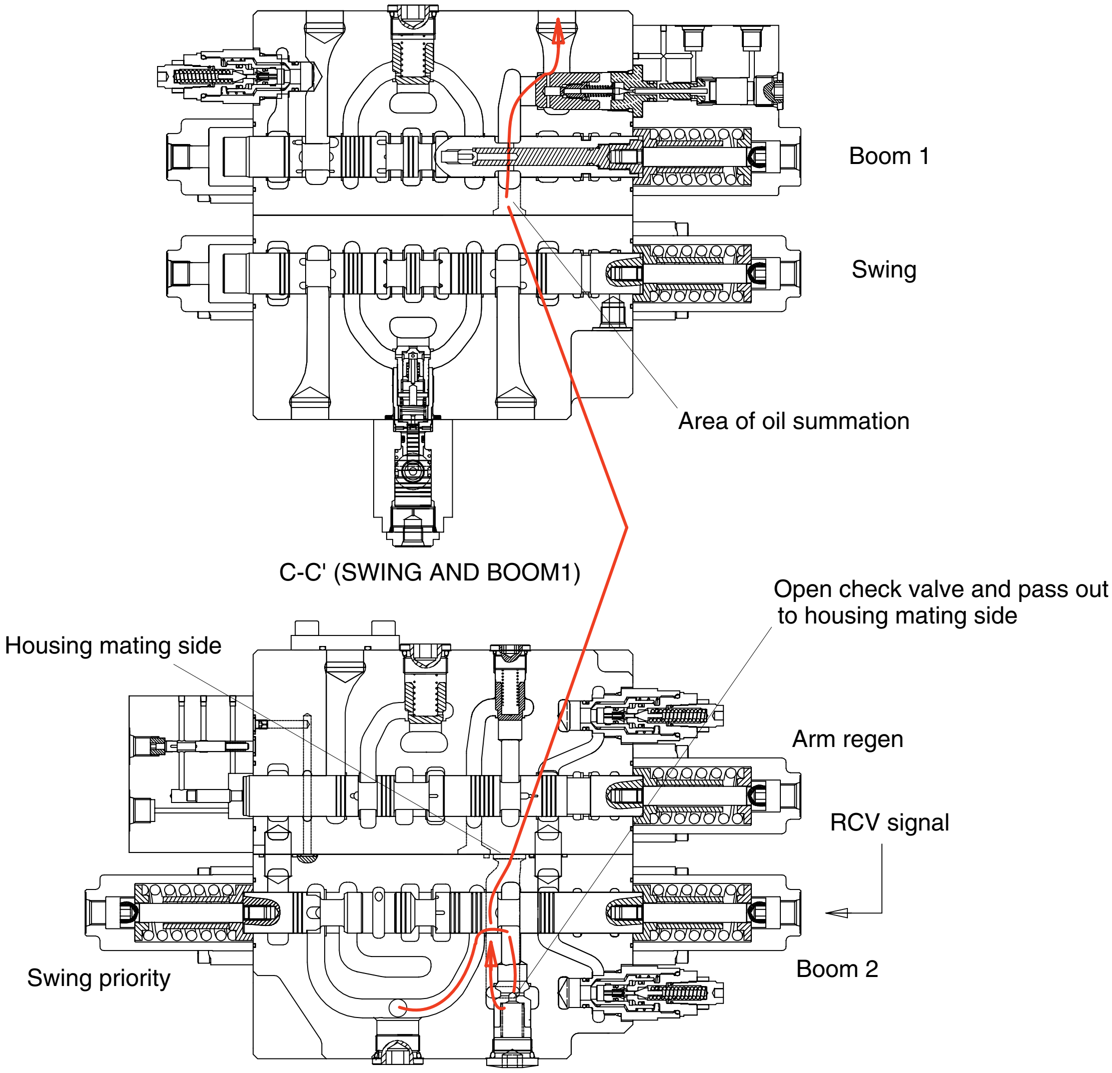
The oil from boom 2 spool combined with the boom 1 spool oil and is supplied Ab port.

At the same time, the return oil from rod side of the boom cylinders flows the boom 1 spool through the Bb port and return to the hydraulic oil tank through the tank passage.



C-C' (SWING AND BOOM 1)

350SA2MC21



C-C' (SWING AND BOOM1)

D-D' (SWING PRI, BOOM 2 & ARM REGEN)

300SA2MC22

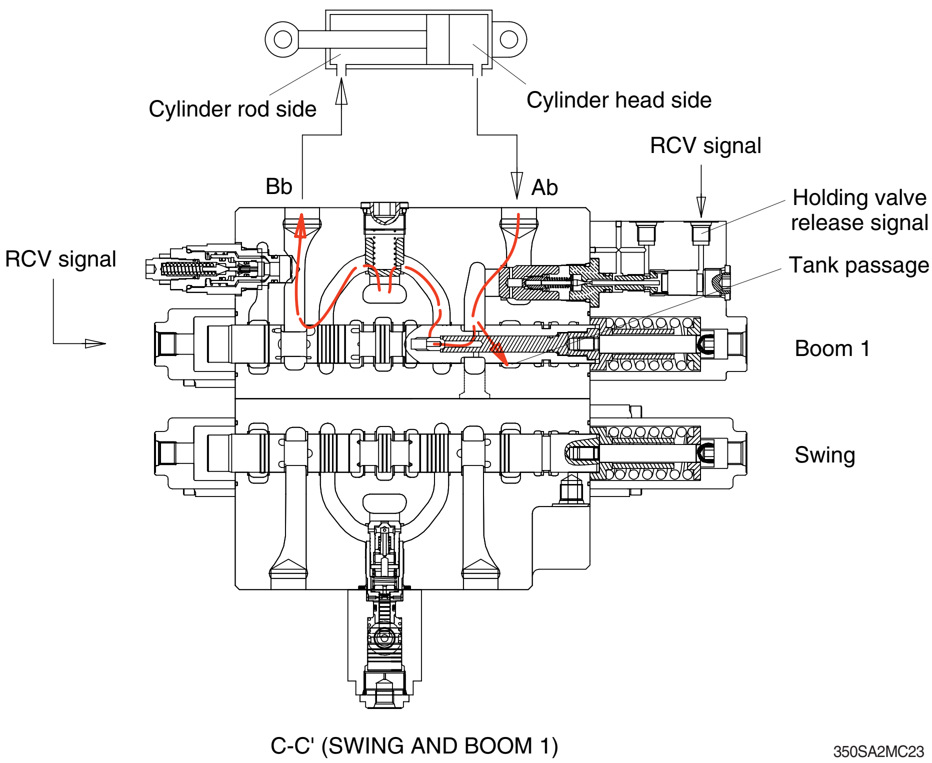
(2) Boom down operation

During the boom down operation, the pilot secondary pressure from the RCV is supplied to the against port of the spring side and shifts the boom 1 spool to the right direction. The P1 bypass passage is shut off by the movement of the boom 1 spool and the pressurized oil from P1 port is entered P1 parallel passage and then passes through the load check valve and bridge passage then flows into the rod side of the boom cylinder via Bb port.

At the same time, the return oil from head side of the boom cylinders flows the boom 1 spool through the Ab port and the boom holding valve and return to the hydraulic oil tank through the tank passage.

At this time, some of the return oil from the boom head side passes to the connected passage of the boom 1 spool inside and flows into the P1 parallel passage. (Boom spool inside regeneration function). At this time, the boom holding valve is open status and the operation principles are described following page.

During the boom down operation, the flow is not combined.



C-C' (SWING AND BOOM 1)

4) HOLDING VALVE OPERATION

(1) Holding operation

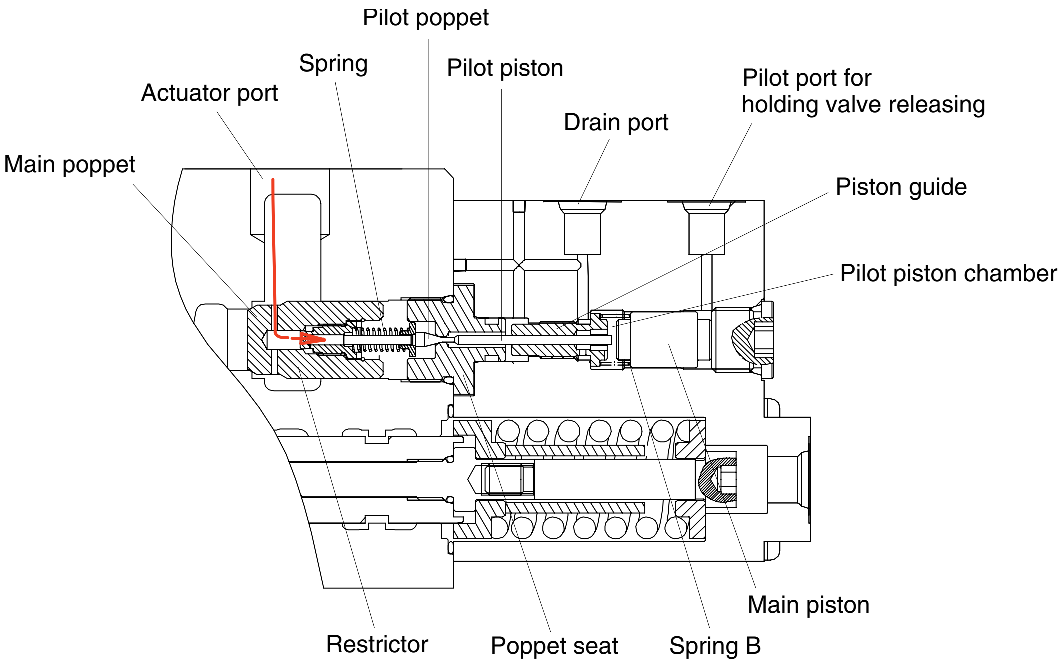
At neutral condition, the pilot piston chamber is connected to drain port through the pilot port.

And the main piston is seated by the spring B.

Also, the pressurized oil from the actuator entered to inside of the holding valve through the periphery hole of the main poppet, crevice of the main poppet and the restrictor and the periphery hole of the restrictor.

Then, this pressured oil pushed the pilot poppet to the poppet seat and the main poppet to the seat of body.

So the pressurized oil from the holding side of the actuator is not escaped and the actuator is not moved.



HOLDING VALVE BLOCK SECTION

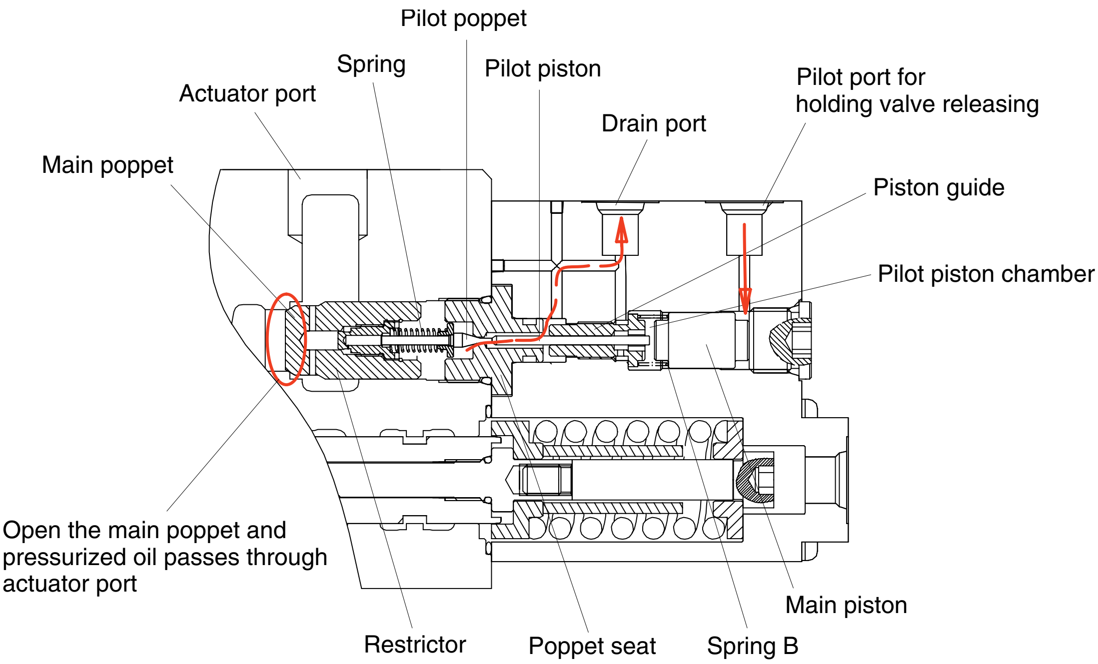
220S2MC24

(2) Releasing holding operation

The pilot pressure is supplied to the pilot port for releasing holding valve and shifts the main piston to the left direction against the spring B and shifts the pilot poppet to the left direction through the pilot piston and open the passage for the drain.

At same time, the return oil from actuator returns to the drain port through the periphery hole of main poppet, crevice of the main poppet and the restrictor, the periphery hole of the restrictor, inside of holding valve, crevice of the pilot poppet and the drain passage of the holding valve.

After above operation, pressure of inside of holding valve is decreased and the main poppet is opened by the return oil of the actuator and the return oil from actuator returns to the tank passage through the notch of spool.



HOLDING VALVE BLOCK SECTION

220S2MC25

5) BUCKET OPERATION

(1) Bucket in operation

① Bucket operation only

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

The P1 bypass passage is shut off by the movement of the bucket spool and the pressurized oil from P1 port entered P1 parallel passage and is directed to the Ak port through the check valve 2.

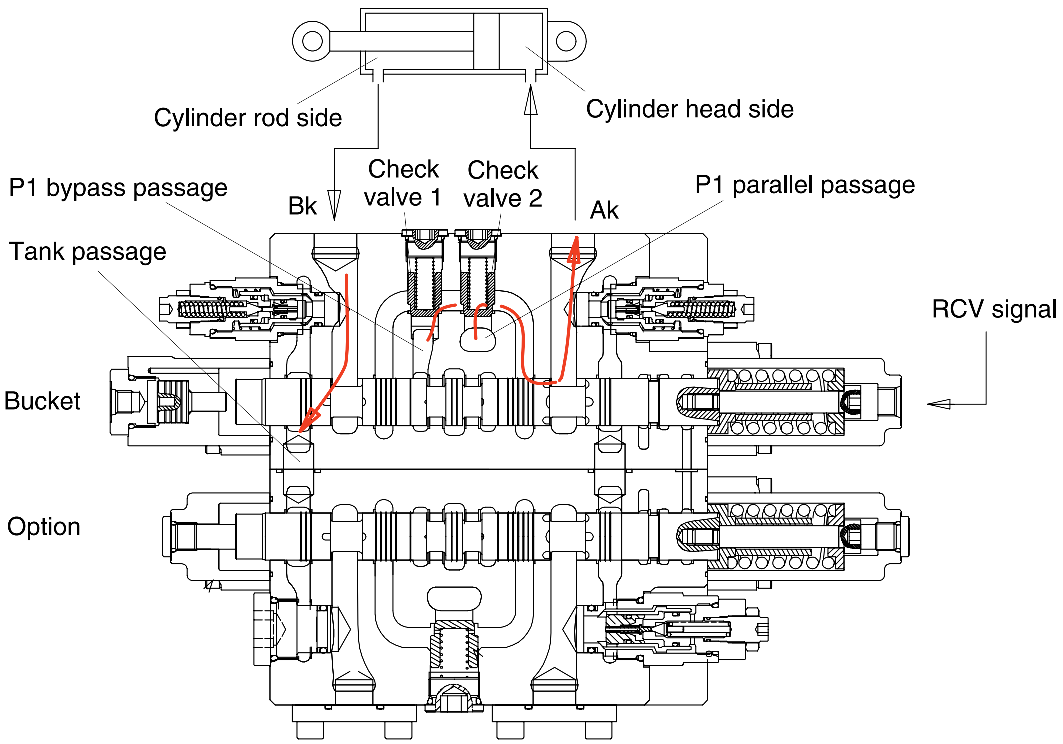
At the same time, the pressurized oil from P1 bypass passage is directed to the AK port through the check valve 1.

The return oil from the rod side of the bucket cylinder (Bk port) returns to the hydraulic oil tank through the tank passage.

② Combined operation

When combined operation of the bucket and other actuators, mostly same as above operation but the fluid from P1 bypass passage is empty by the upstream operation such as the arm or boom operation.

So only the fluid from P1 parallel passage is supplied to the Ak port.



F-F' (OPTION AND BUCKET)

(2) Bucket slow operation (incase bucket in)

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

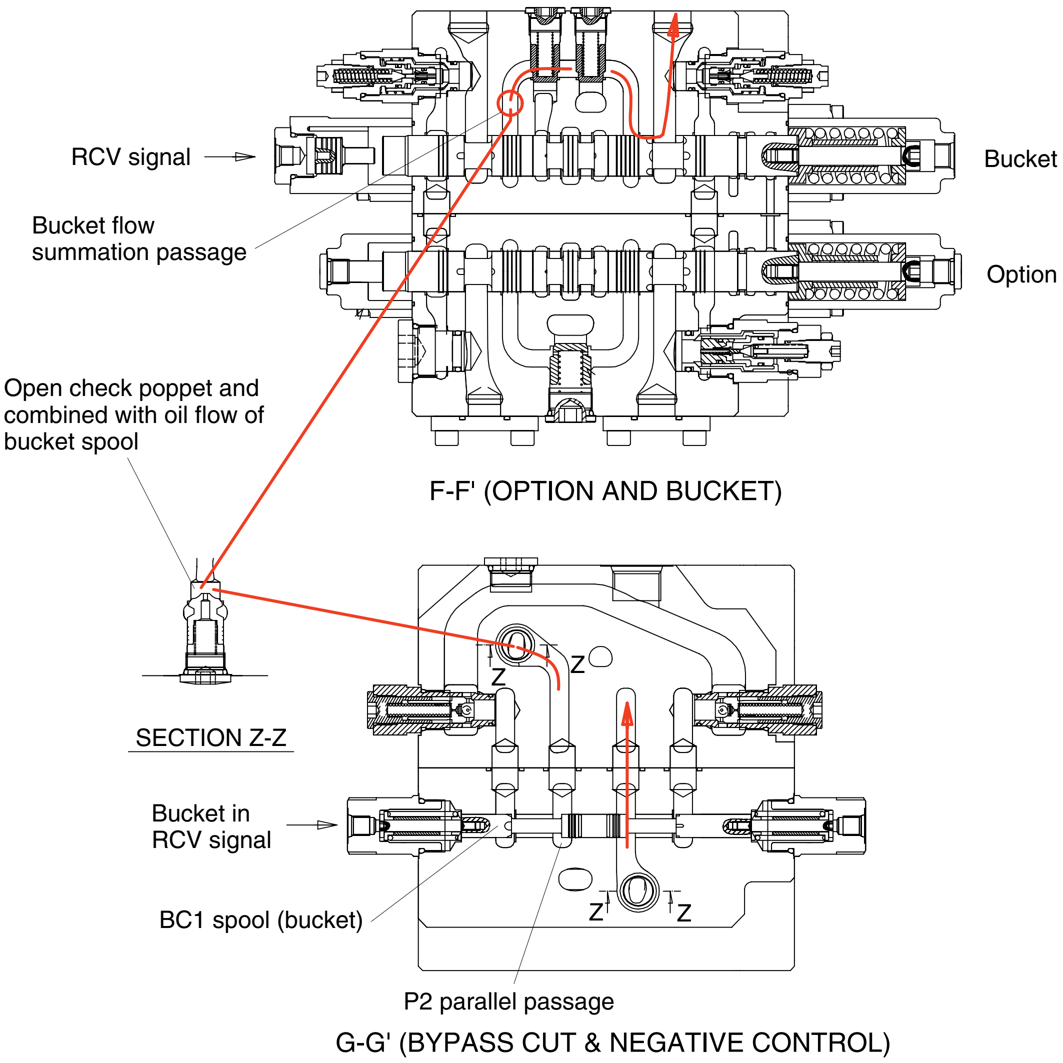
The bucket slow pilot pressure is supplied the pilot port of the BC1 spool and the piston is shifted to the right and then the bucket spool stroke is limited and the oil passage from P1 to the bucket cylinder is reduced and the oil flow of the bucket spool is reduced.

Bucket flow summation function, bypass cut-off 1 spool

During the bucket in operation, the pilot secondary pressure from the RCV is supplied to port of the spring side and shifts the BC1 (bucket) spool to the right direction.

The P2 parallel passage is shut off by the movement of the BC1 spool and the pressurized oil from P2 port opens the check poppet and combined with the flow of the bucket spool.

(Only bucket in operation)



FLOW SUMMATION BY THE SHIFTING OF THE BC1 SPOOL

300SA2MC27

(3) Bucket out operation

① Bucket operation only

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

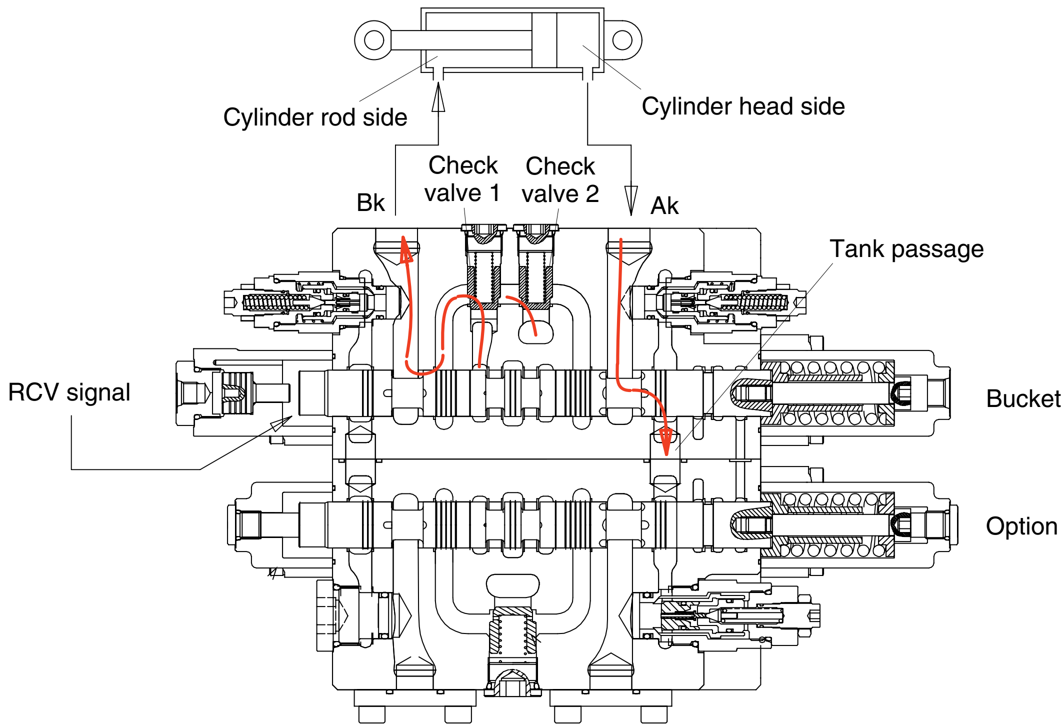
The P1 bypass passage is shut off by the movement of the bucket spool and the pressurized oil from P1 port entered P1 parallel passage and is directed to the Bk port through the check valve 2.

At the same time, the pressurized oil from P1 bypass passage is directed to the Bk port through the check valve 1.

The return oil from the head side of the bucket cylinder (Ak port) returns to the hydraulic oil tank through the tank passage.

② Combined operation

When combined operation of the bucket and other actuators, exactly same as above operation.



F-F' (OPTION AND BUCKET)

6) SWING OPERATION

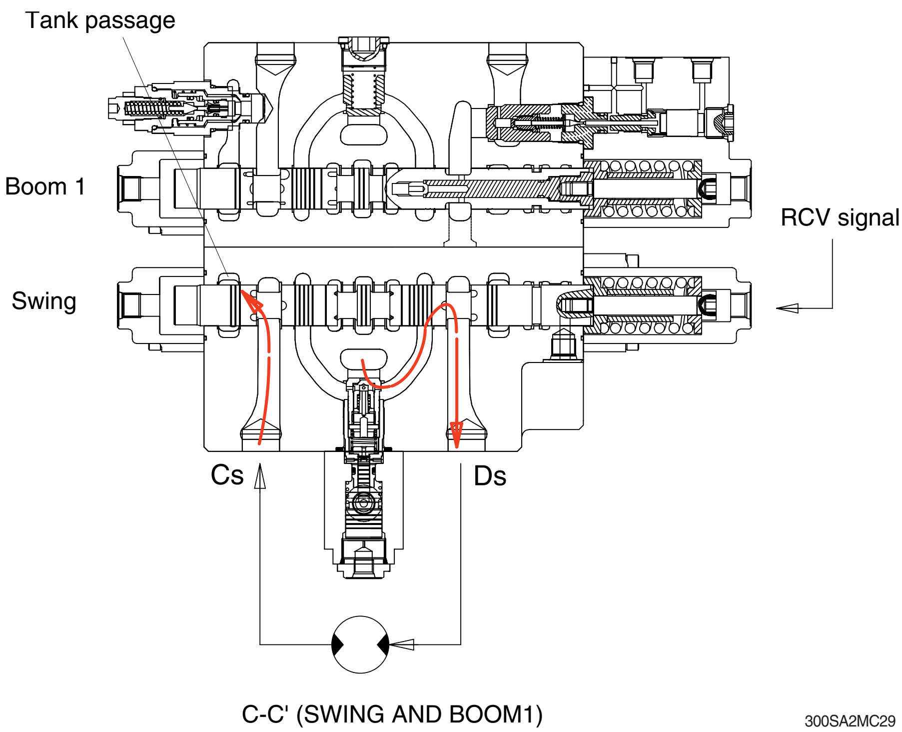
(1) Swing left and right operation

During the swing left operation, the pilot secondary pressure from the RCV is supplied to the port of the spring side and shifts the swing spool in left direction. The P2 bypass passage is shut off by the movement of the swing spool and the pressurized oil from P2 port flows into the P2 parallel passage and open the load check valve and is supplied to swing motor through the Ds port.

As the result, the return oil from the swing motor flows into the main control inside through Cs port and returns to the hydraulic oil tank through the swing spool and the tank passage.

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

Accordingly, the pressurized oil from P2 parallel passage flows into swing motor through the Cs port and returns to the hydraulic oil tank through the Ds port and the tank passage.



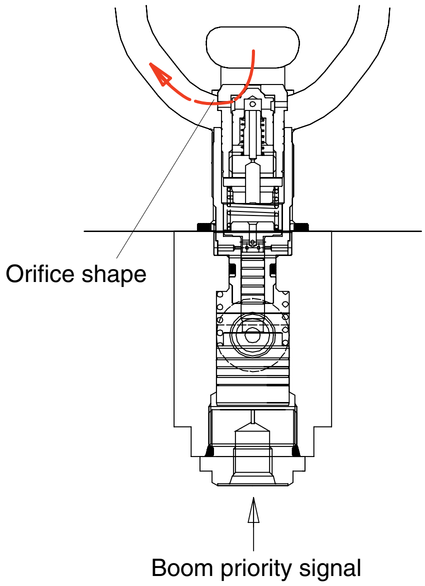
C-C' (SWING AND BOOM1)

(2) Boom priority function

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

The boom priority signal is supplied the pilot port and the poppet of the swing logic valve is closed and then the pressurized oil from P2 port is reduced by the oil leaking through the orifice.

As a result, the swing speed is slowed.



SWING LOGIC VALVE

220S2MC30

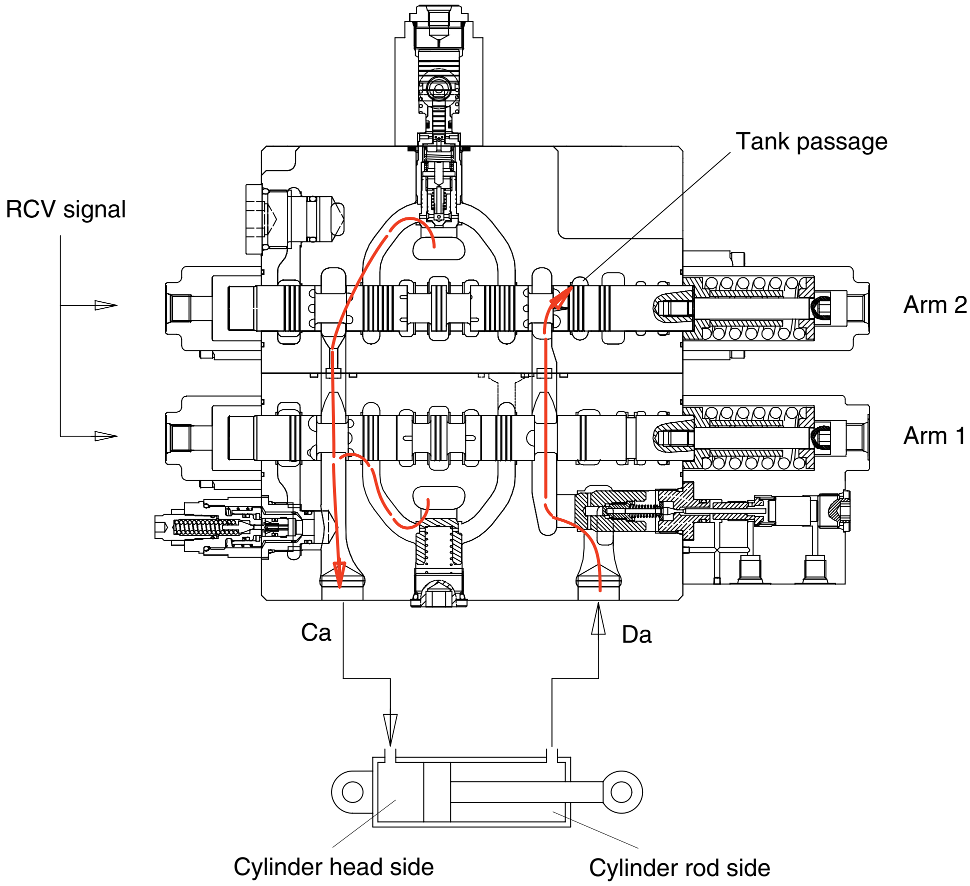
7) ARM OPERATION

(1) Arm in operation

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

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

At the same time, the pilot secondary pressure from the RCV is supplied to the port of spring opposite side and shifts the arm 2 spool in the right direction. The P2 bypass passage is shut off by the movement of the arm 2 spool and the pressurized oil from the P1 port flows into the arm summation passage through P1 parallel passage, the check valve and the notch of the arm 2 spool.



E-E' (ARM 1 AND ARM 2)   350SA2MC31

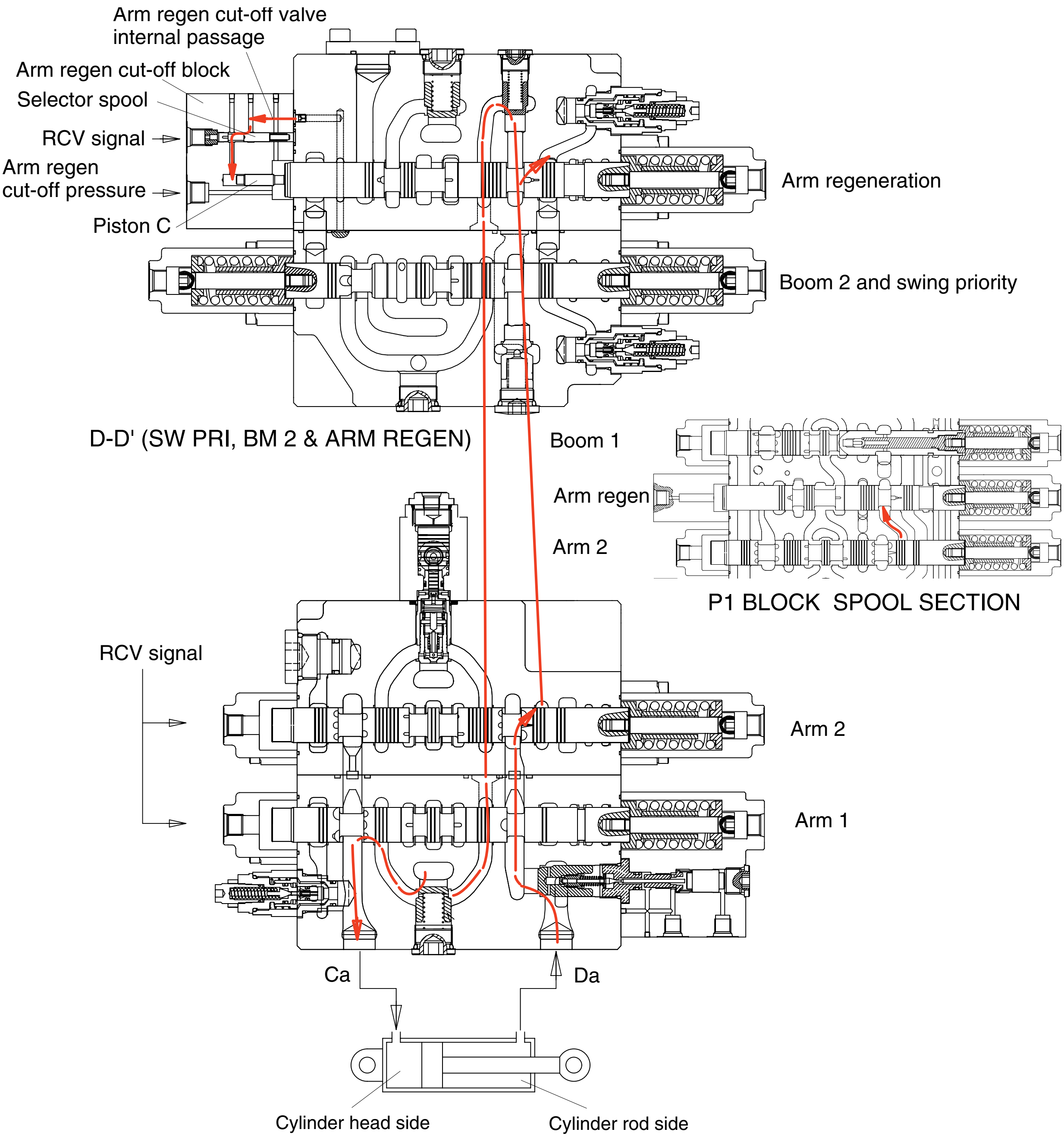
ARM REGENERATION

The return oil from the arm cylinder rod side passes the arm holding valve (open condition) through the Da port and the notch of the arm 1 and arm 2, and swing priority spool. And some of the oil return to the tank passage through the notch of the arm regeneration spool and most of the oil is supplied to the head side of the arm cylinder through internal summation passage.

This is called the arm regeneration function.

The amount of regeneration fluid is changed by movement of the arm regeneration spool. A few fluids of the oil that is supplied to the head side of the arm cylinder passes the selector spool (in this case, the selector spool is opened by the arm in pilot pressure) built in the arm regeneration block through internal passage and is pushed the piston C.
The amount of the regeneration oil from the rod side of the arm cylinder to the tank passage is increased by the movement of the piston C and the arm regeneration spool to the right direction and the arm regeneration flow is decreased as much increased oil.
The pressure of the arm cylinder head increases, then, the arm regeneration flow decreases.

Furthermore, the arm regeneration cut-off pressure is supplied to the port of the spring opposite side and the arm regeneration spool is moved to the right direction fully. The flow from the arm cylinder rod to the tank passage is maximum condition.



ARM REGENERATION PASSAGE

350SA2MC32

(2) Arm out operation

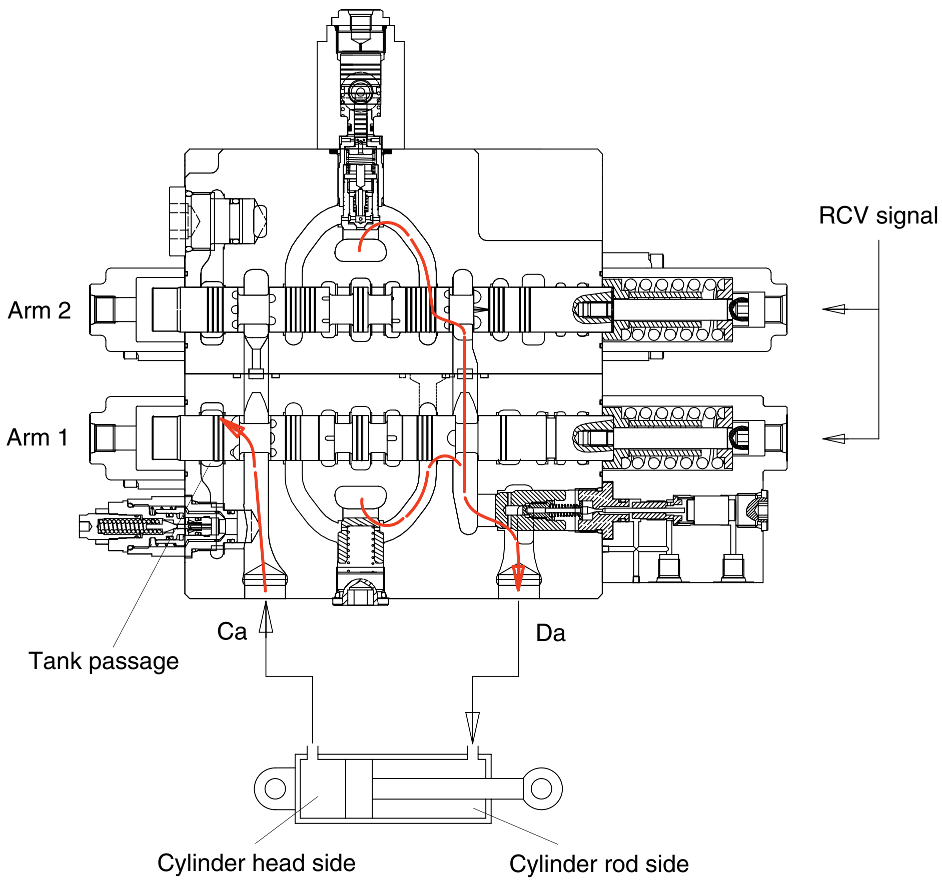
During arm out operation, the pilot secondary pressure from the RCV is supplied to the port of the spring side and shifts the arm 1 spool to the left direction.

The bypass passage is shut off by the movement of the arm 1 spool and the pressurized oil from the P2 port flows into arm 1 spool through the P2 parallel passage. Then it enters into the arm cylinder rod side through the load check, bridge passage, arm holding valve (oped status) and the port Da.

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

The bypass passage is shut off by the movement of the arm 2 spool and the pressurized oil from the P2 port through the P2 parallel passage. Then it combined with the flow of the arm 1 passage through P1 parallel passage, the check valve, bridge passage, the notch of the arm 1 and the arm holding valve (open status).

On the other hand, the return flow from the arm cylinder head side returns to the hydraulic tank through the port Ca, the notch of the arm 1 spool and tank passage.



E-E' (ARM 1 AND ARM 2)

350SA2MC33

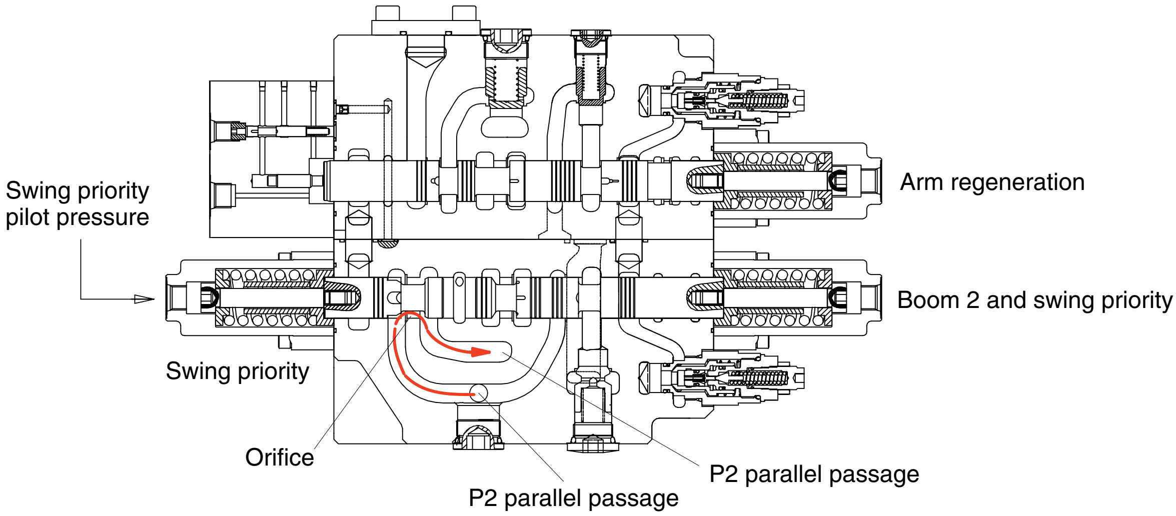
8) OPERATION OF SWING PRIORITY SPOOL

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

The pressurized oil from the P2 port flows into the P2 parallel passage through the notch of the swing priority spool.

When the swing priority spool is neutral condition, the passage is same as normal condition. But due to shifting of the swing priority spool, the orifice is formed between the notch of the swing priority spool and the land of the block housing and then the fluid to the swing side more then the downstream of the swing spool such as the arm 1 and option spool.

As a result, the flow is supplied to the swing operation most preferential.



D-D' (SWING PRI, BOOM 2 & ARM REGENERATION)

220S2MC34

9) OPERATION OF OPTION SPOOL

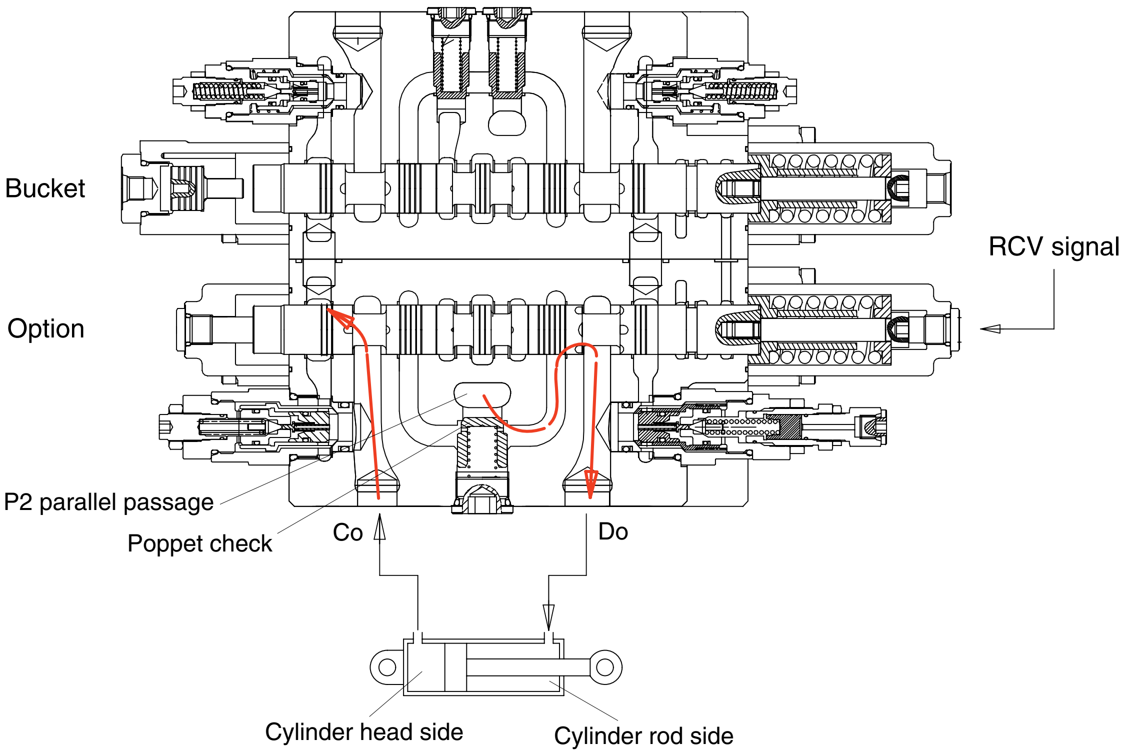
(1) 1-way operation

※ The pilot pressure is supplied to the port of the spring side and shifts spool to the left direction. The pilot secondary pressure from the RCV is supplied to the port of the spring opposite side of the option spool, the P2 bypass passage is shut off by the movement of the option spool and the pressurized oil from the P2 port flows into the actuator through the P2 parallel passage, the check valve, bridge passage and the Do port.

(2) 2-way operation

※ Shifts spool to the left and right direction.

- When the spool shifts to the left, same as 1-way operation.
- When the spool shifts to the right, the pressurized oil from the P2 port flows into the actuator through the P2 parallel passage, the check valve, bridge passage and the Co port.



F-F' (OPTION AND BUCKET)

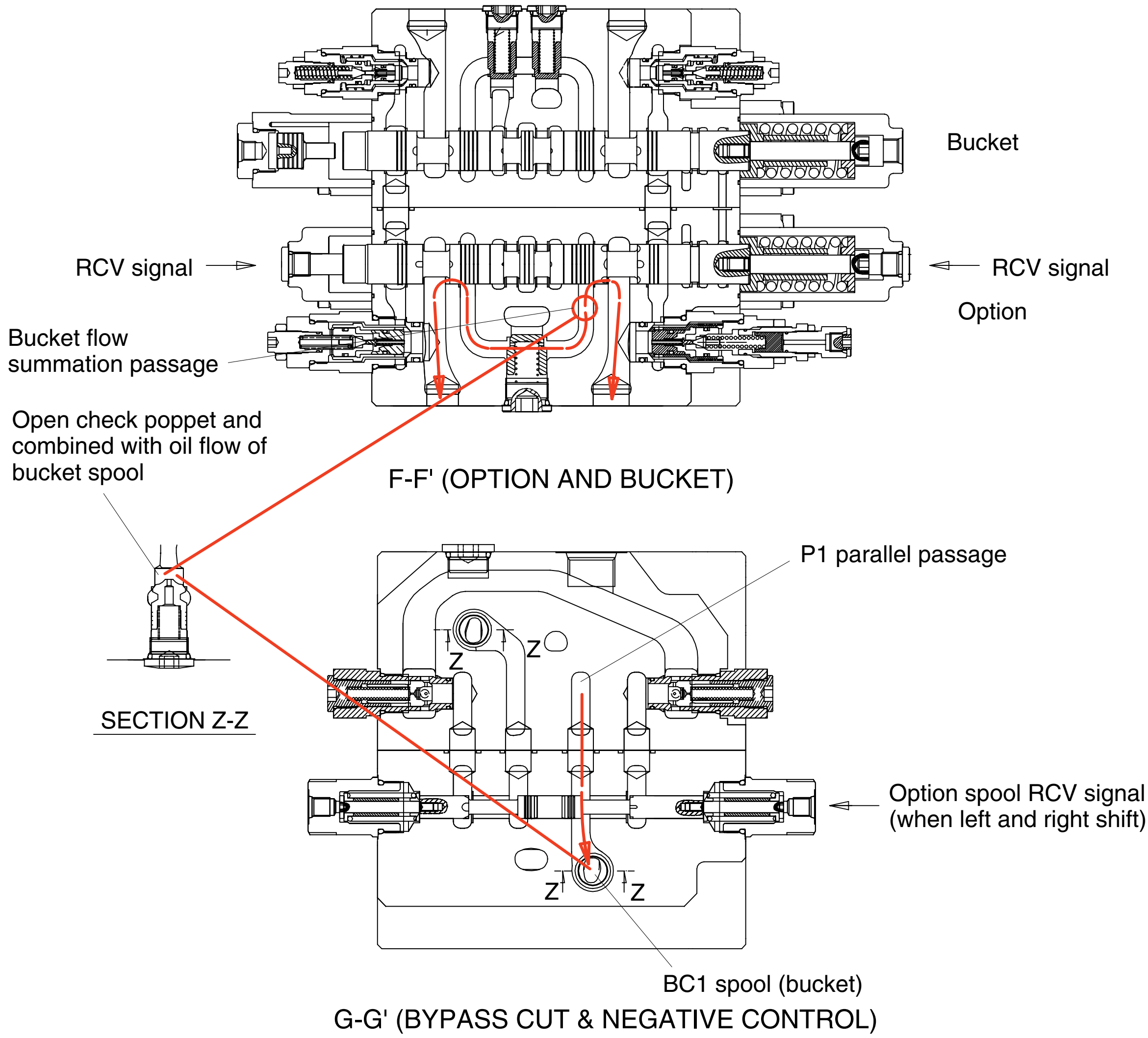
350SA2MC35

Option flow summation function, bypass cut-off 2 spool

During the 2-way option operation, the pilot secondary pressure from the RCV is supplied to port of the spring side and shifts the BC2 (option) spool.

The P1 parallel passage is shut off by the movement of the BC2 spool and the pressurized oil from P1 port opens the check poppet and combined with flow of the option spool.

(Only bucket in operation)



FLOW SUMMATION BY THE SHIFTING OF THE BC2 SPOOL

300SA2MC36

10) OPERATION OF NEGATIVE CONTROL VALVE

When no function is being actuated on P1 side, the hydraulic fluid from the P2 port, flows into the tank passage through the P1 bypass passage and the orifice of the negative control valve.

The negative control pressure caused by this operation is transferred to the regulator of the piston pump through the Pn1 port.

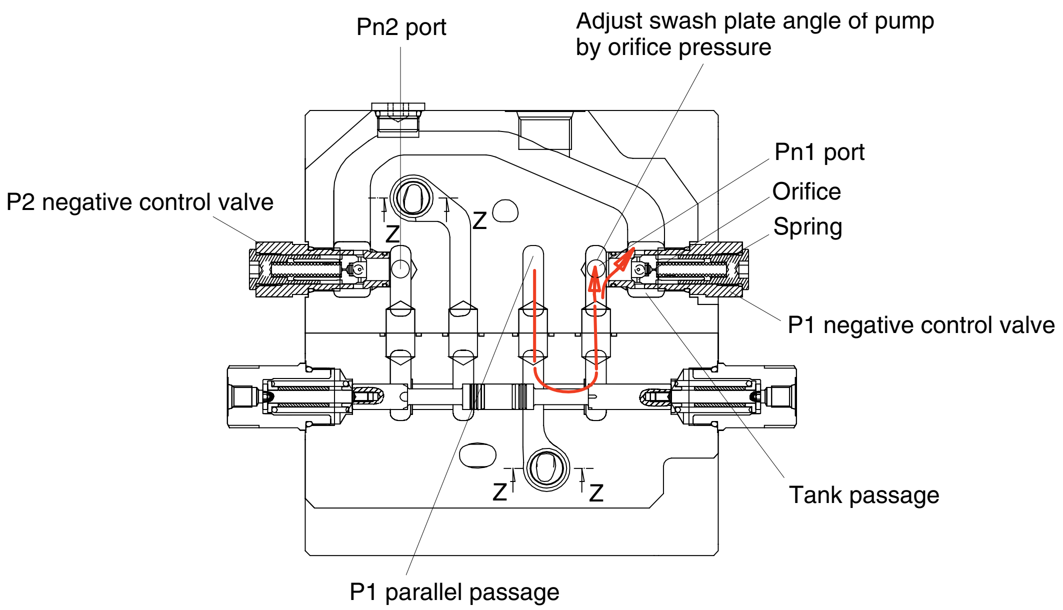
This pressure controls the swash plate angle of the pump to the minimum and minimize the flow of the P1 side.

When one or more spools are shifted, the P1 bypass passage is shut-off and the flow is almost zero.

Accordingly, the negative control pressure that is supplied to the pump through Pn1 port is lowered and the swash plate angle becomes maximum and the flow of the P1 side becomes maximum.

On the other hand, the negative control pressure is increased and high than the setting pressure of the spring, the negative control valve is opened and the flow passes to the hydraulic tank and functions as a relief valve.

The operation of the negative control valve of the P2 side is same as that of the P1 side.



OPERATION OF NEGATIVE CONTROL VALVE

300SA2MC37

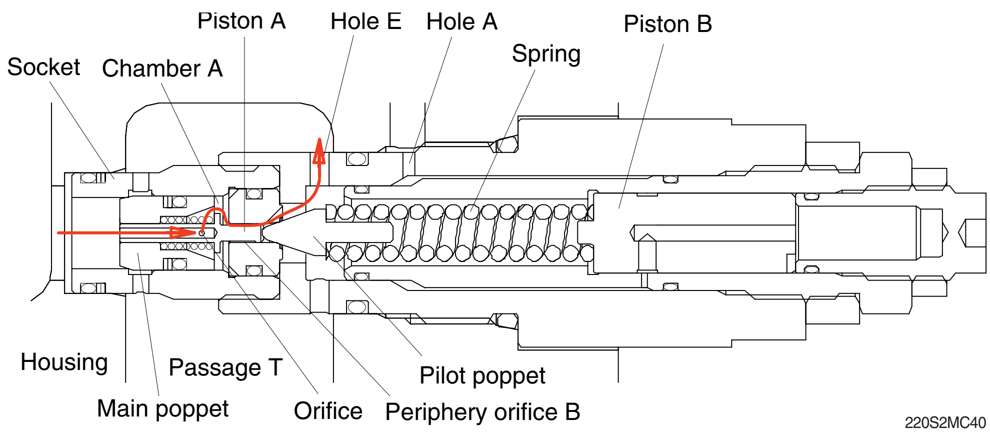
11) OPERATION OF MAIN RELIEF VALVE

(1) Neutral

The pressurized oil passes through the internal passage of the piston A, fitted in the main poppet and the orifice A and is filled up in the chamber A of the inside and seats the main poppet against socket and socket against the housing securely.

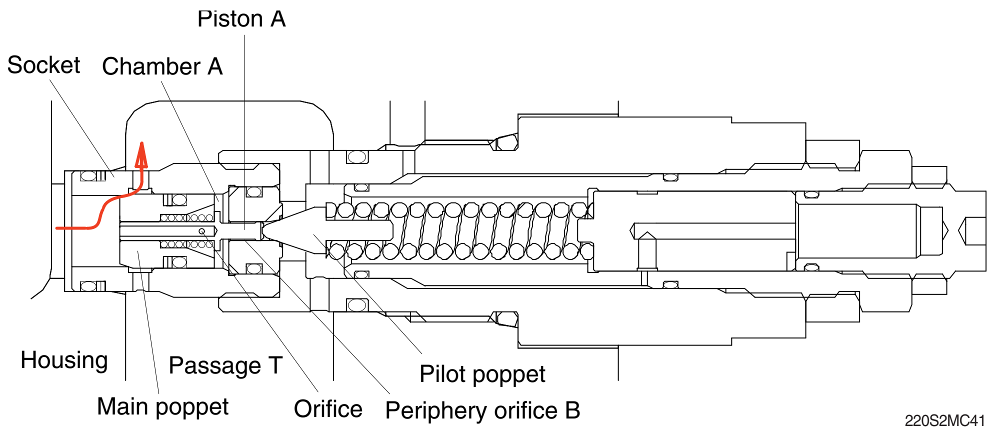
(2) When operation (relief)

① When the pressurized oil flowed in the chamber A through the orifice becomes equal to the set pressure of the spring, the hydraulic oil apply to the main poppet through the piston and pushes open the pilot poppet and flows to tank passage through the piston A internal passage, orifice A, chamber A, periphery orifice B and the hole E.



OPERATION 1 OF MAIN RELIEF VALVE

② The pressure in chamber A is lowered by moving of the pilot poppet and the main poppet is opened. As a result, the pressurized oil flows out to the tank passage through the hole of the socket side.



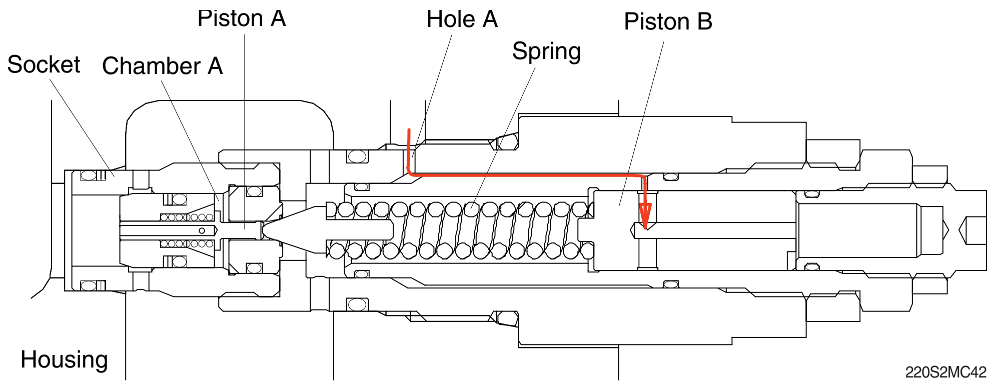
OPERATION 2 OF MAIN RELIEF VALVE

(3) When retraction (return)

On the other hand, the pressure of the pressurized oil becomes lower than set pressure of the spring, the main poppet is seated by spring force. Then the pressure of the chamber A becomes equal to the pressure of the P port and the main poppet is seated to the seat of the socket. The valve returns to the initial condition.

Power boost function

During power boost operation, the pilot pressure for the power boost enters inside of the piston B through the hole A, the crevice passage and the side hole of the piston B.
It pushes the piston to the left direction and the set pressure of the spring is increased.

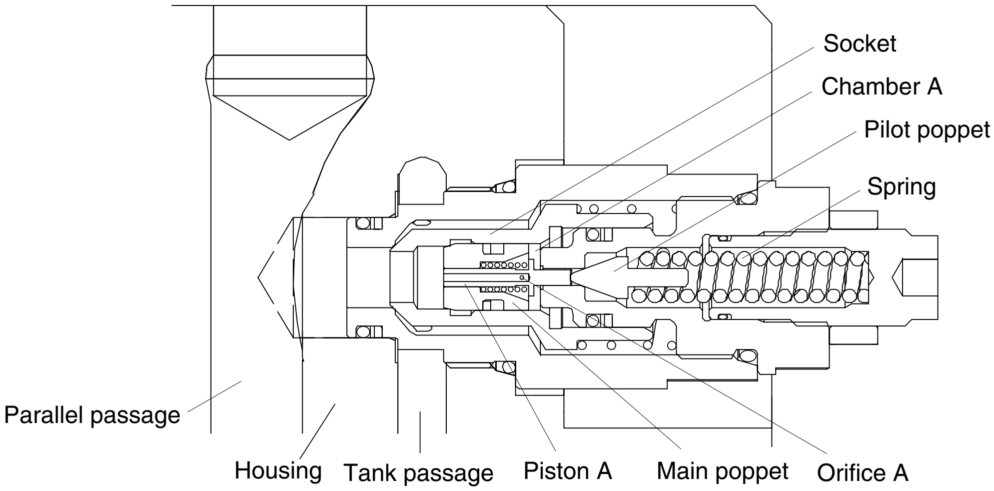


OPERATION 3 OF MAIN RELIEF VALVE

12) OPERATION OF PORT RELIEF VALVE

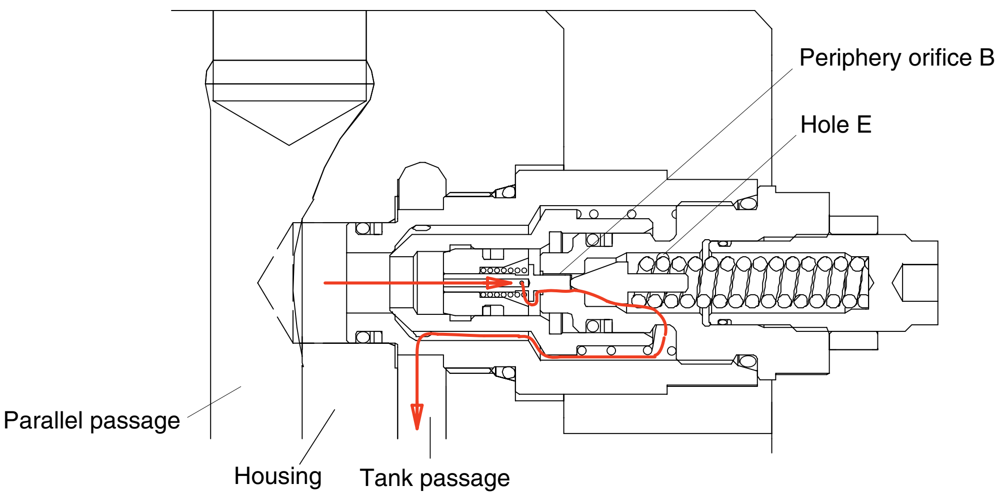
(1) Function as relief valve

① The pressurized oil passes through the internal passage of the piston A, fitted in the main poppet and the orifice A and is filled up in the chamber A of the inside and seats the main poppet against socket and socket against the housing securely.



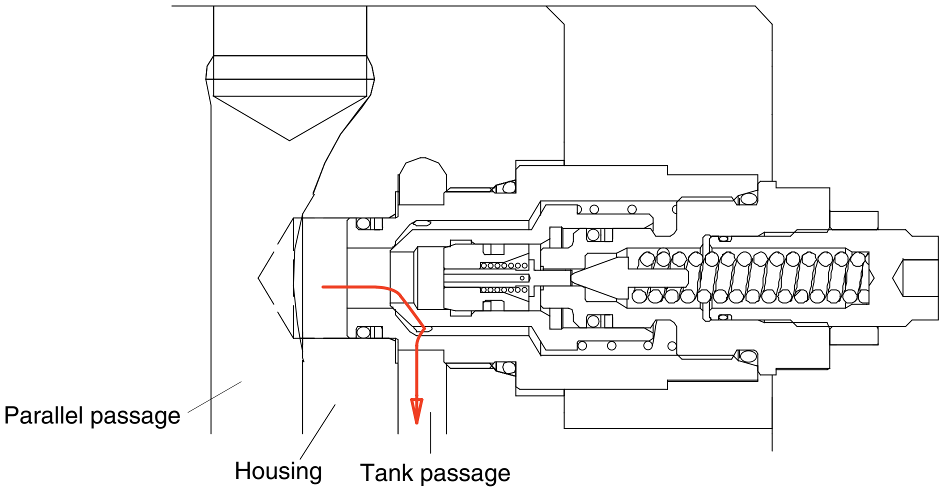
PORT RELIEF VALVE

② When the pressurized oil from the actuators becomes equal to the set pressure of the spring, the hydraulic oil apply to the pilot poppet and pushes the pilot poppet to the right direction and flows to tank passage through the piston A internal passage, orifice A, chamber A, periphery orifice B and the hole E.



OPERATION 1 OF PORT RELIEF VALVE

③ The pressure in chamber A is lowered by moving of the pilot poppet and the main poppet is opened. As a result, the pressurized oil from the actuator port flows out to the tank passage through the hole of the socket side.

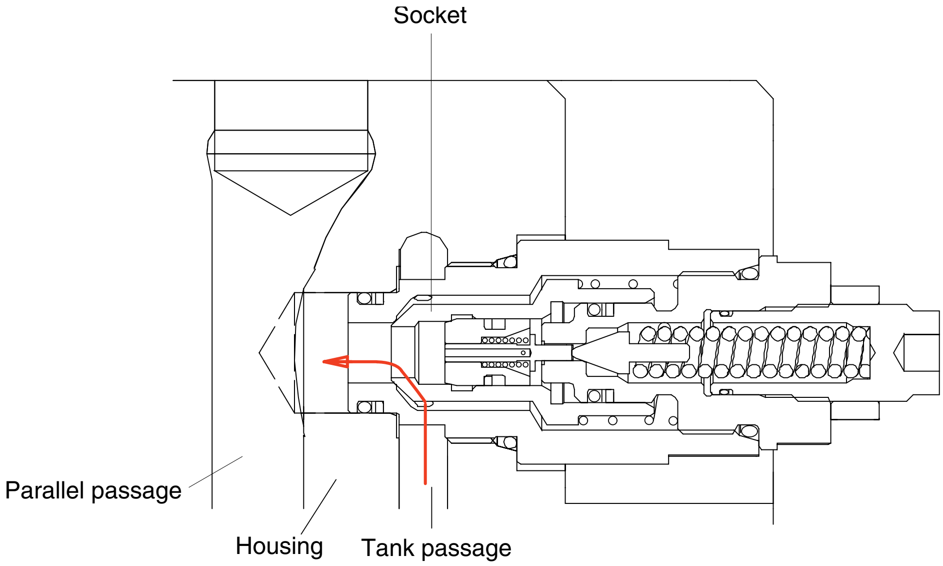


OPERATION 2 OF PORT RELIEF VALVE 220S2MC45

④ On the other hand, the pressure of the actuator becomes lower than set pressure of the spring, the pilot poppet is seated by spring force. Then the pressure of the chamber A becomes equal to the pressure of the actuator port and the main poppet is seated to the seat of the socket. The valve returns to the initial condition.

Make up function

When negative pressure exists at the actuator port, the oil is supplied through tank passage. When the pressure at tank passage becomes higher than that of at the actuator port, it pushed the socket moves in the right direction. Then, the gap between the housing and socket is opened and pressurized oil from the tank passage flows into parallel passage side.

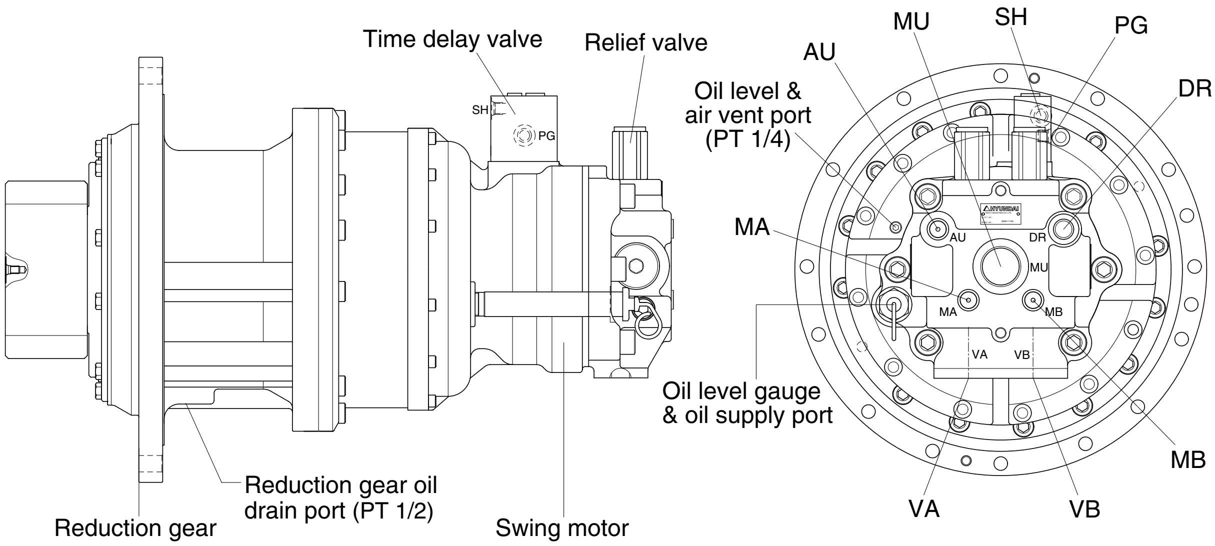


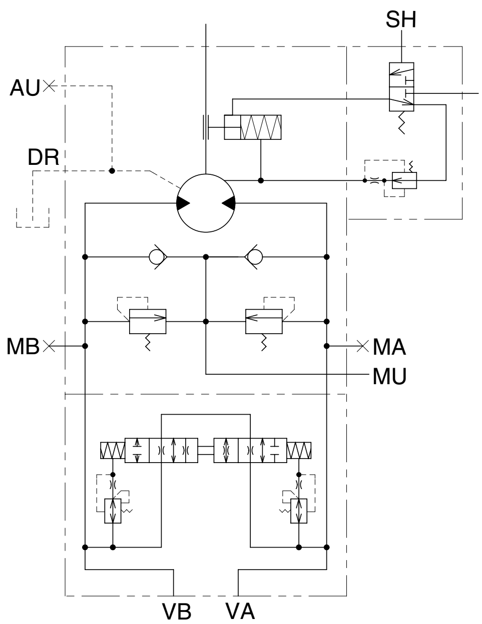
MAKE UP FUNCTION OF PORT RELIEF VALVE 220S2MC46

1. STRUCTURE

Swing device consists swing motor, swing reduction gear.

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



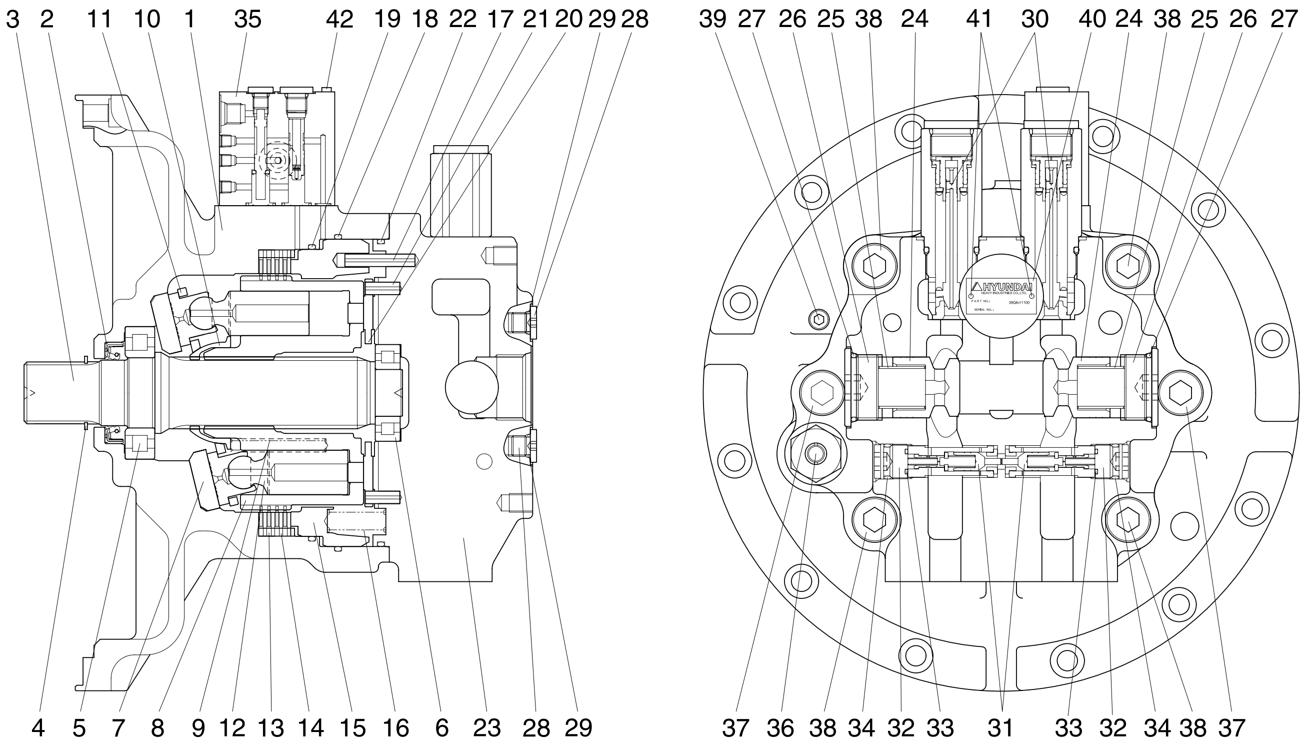


Hydraulic circuit

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

300L2SM01

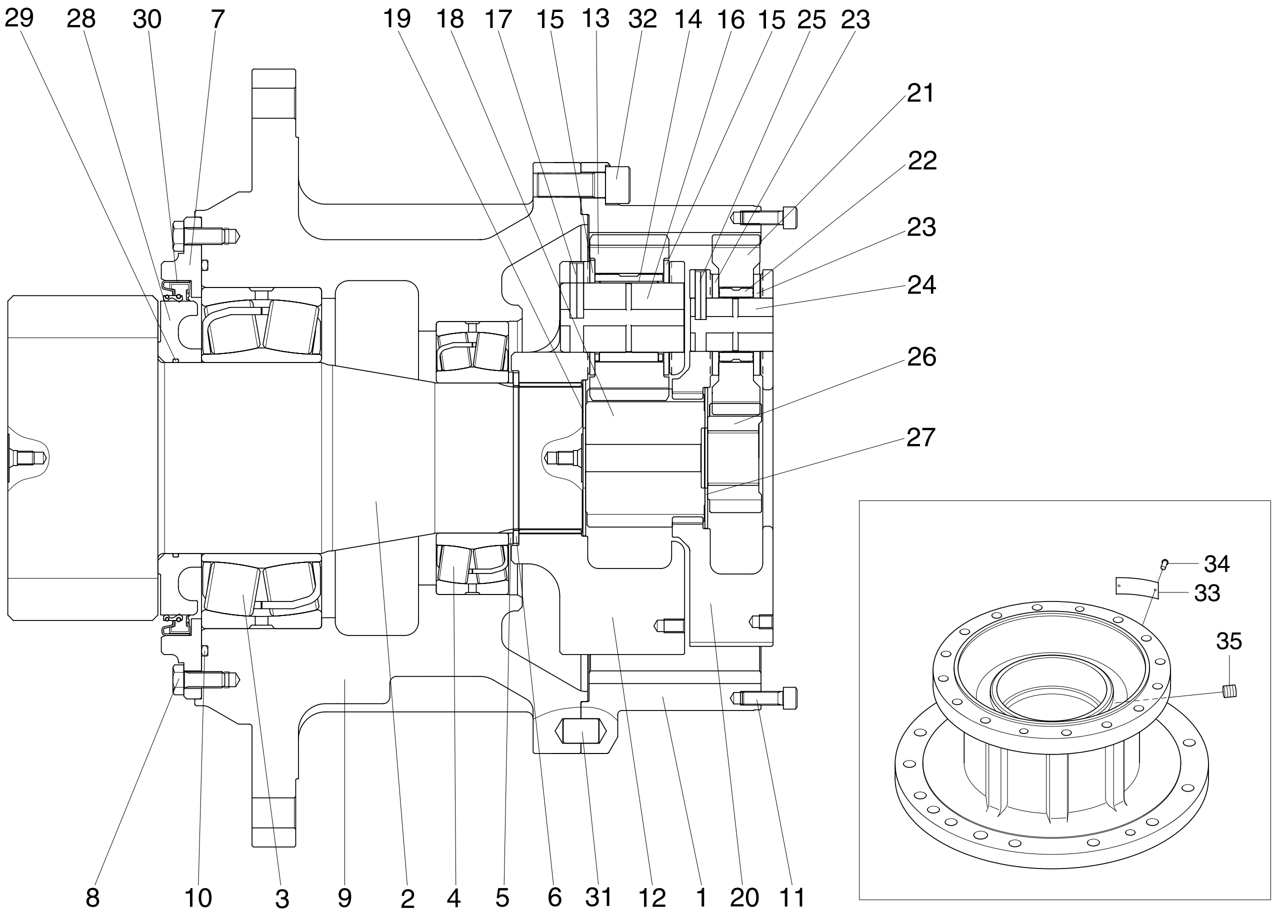
1) SWING MOTOR



300L2SM02

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

2) REDUCTION GEAR



300L2SM03

1	Ring gear	13	Planetary gear 2	25	Spring pin 1
2	Drive shaft	14	Needle bearing 2	26	Sun gear 1
3	Bearing	15	Thrust washer 2	27	Thrust plate 1
4	Bearing	16	Carrier pin 2	28	Sleeve
5	Thrust plate	17	Spring pin 2	29	O-ring
6	Snap ring	18	Sun gear 2	30	Oil seal
7	Cover	19	Thrust plate 2	31	Parallel pin
8	Hex head bolt	20	Carrier 1	32	Hex socket head bolt
9	Casing	21	Planetary gear 1	33	Name plate
10	O-ring	22	Needle bearing 1	34	Rivet
11	Hex socket head bolt	23	Thrust washer 1	35	Plug
12	Carrier 2	24	Carrier pin 1		

2. PRINCIPLE OF DRIVING

2.1 Generating the turning force

The high hydraulic supplied from a hydraulic pump flows into a cylinder block (8) through valve casing of motor (1), and valve plate (20).

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

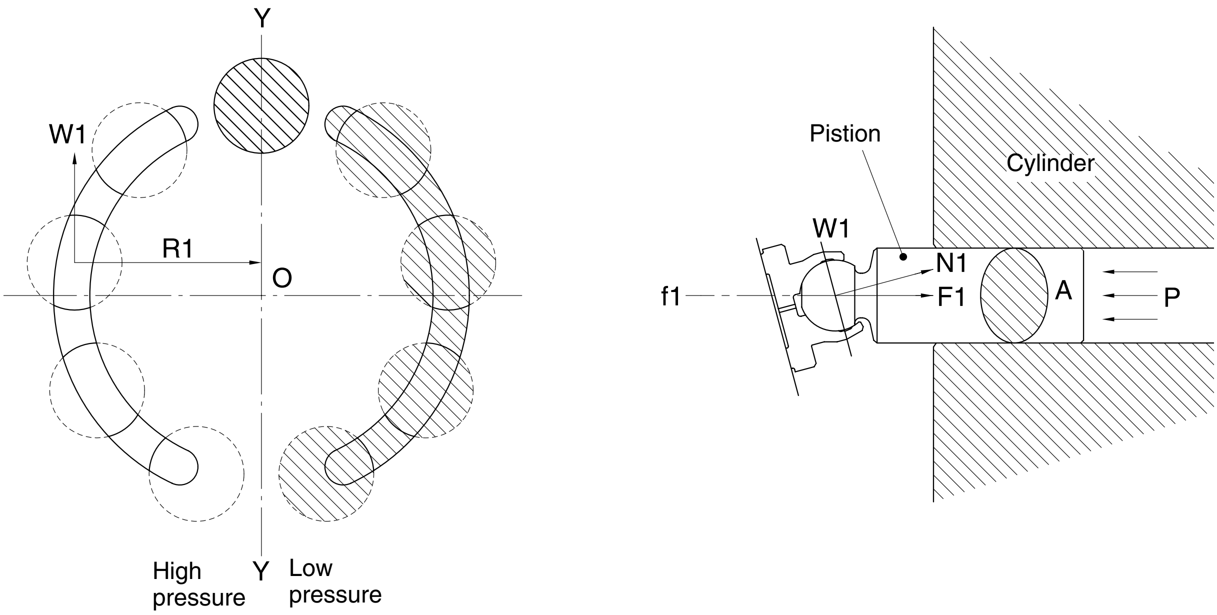
The high hydraulic can generate the force, F1=P×A (P : supplied pressure, A : water pressure area), like following pictures, working on a piston.

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

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

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

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



21078TM05

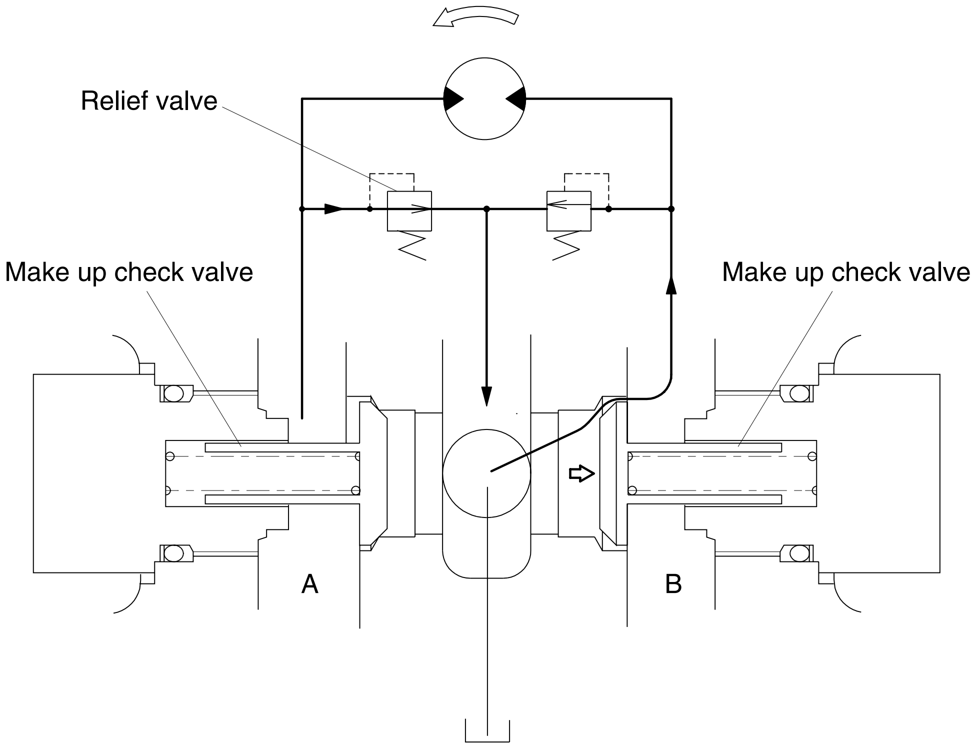
2) MAKE UP VALVE

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

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

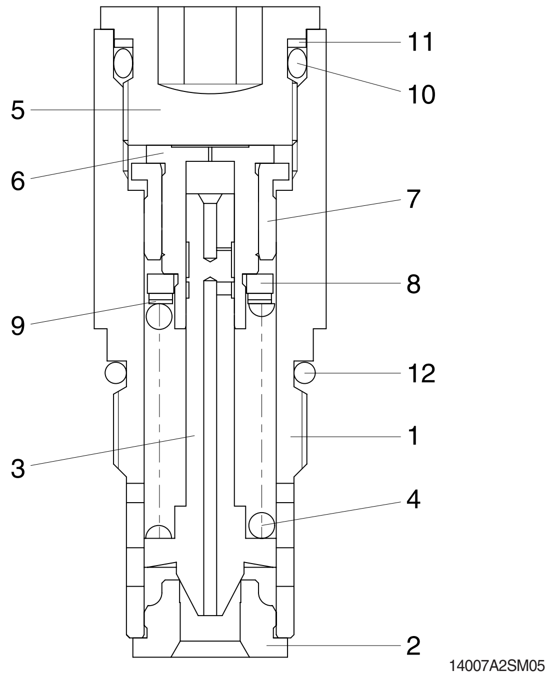
Pressurized oil into the port B, the motor rotate counterclockwise.

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



21092SM04

3) RELIEF VALVE



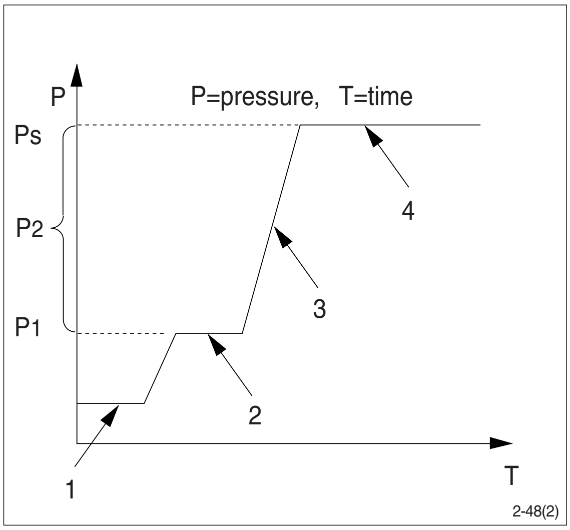
1	Body
2	Seat
3	Plunger
4	Spring
5	Adjusting screw
6	Piston
7	Bushing
8	Spring seat
9	Shim
10	O-ring
11	Back up ring
12	O-ring

(1) Construction of relief valve

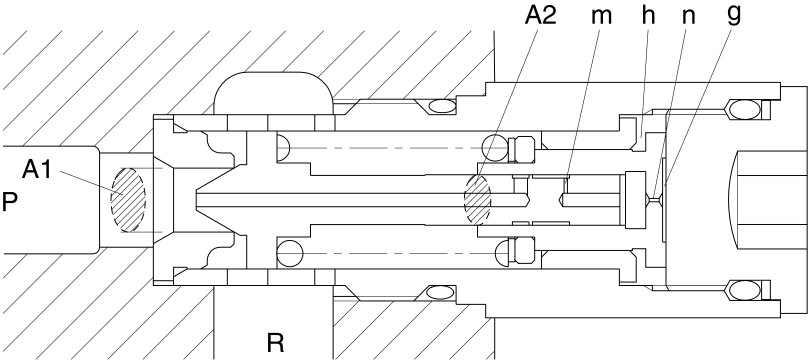
The valve casing contains two cartridge type relief valves that stop the regular and reverse rotations of the hydraulic motor. The relief valves relieve high pressure at start or at stop of swing motion and can control the relief pressure in two steps, high and low, in order to insure smooth operation.

(2) Function of relief valve

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



① Ports (P,R) at tank pressure.

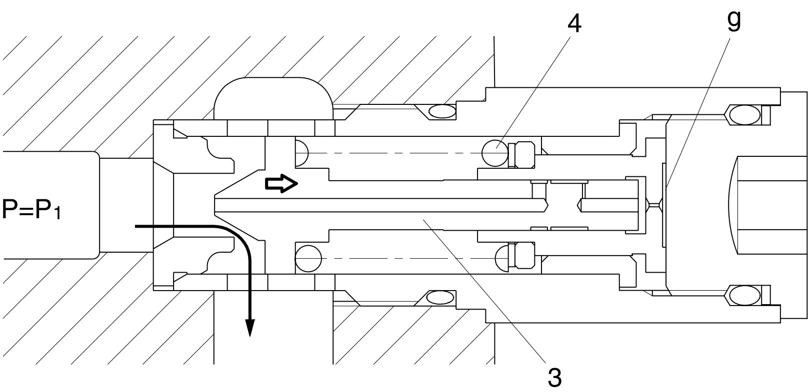


14007A2SM06

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

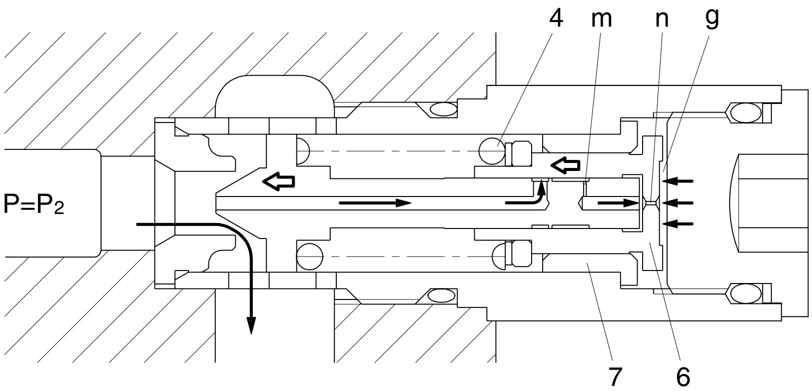
$P_1 \times A_1 = Fsp + Pg \times A_2$

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



14007A2SM07

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

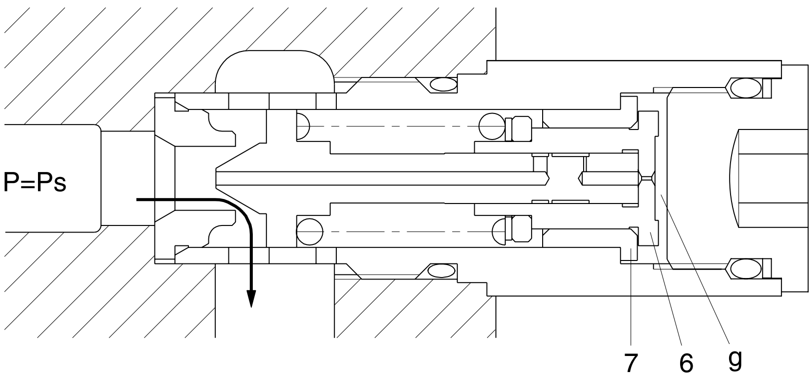


14007A2SM08

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

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

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



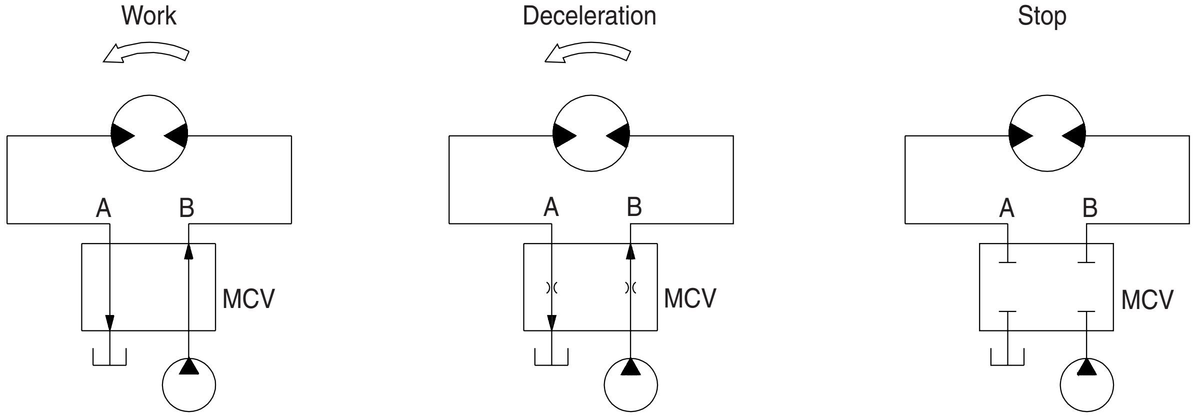
14007A2SM09

4) BRAKE SYSTEM

(1) Control valve swing brake system

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

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



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

2-48(1)

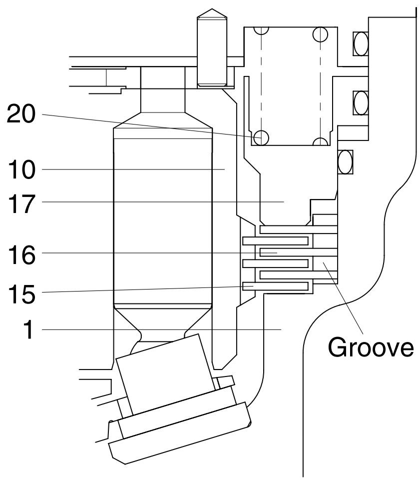
(2) Mechanical swing parking brake system

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

① Brake assembly

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

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

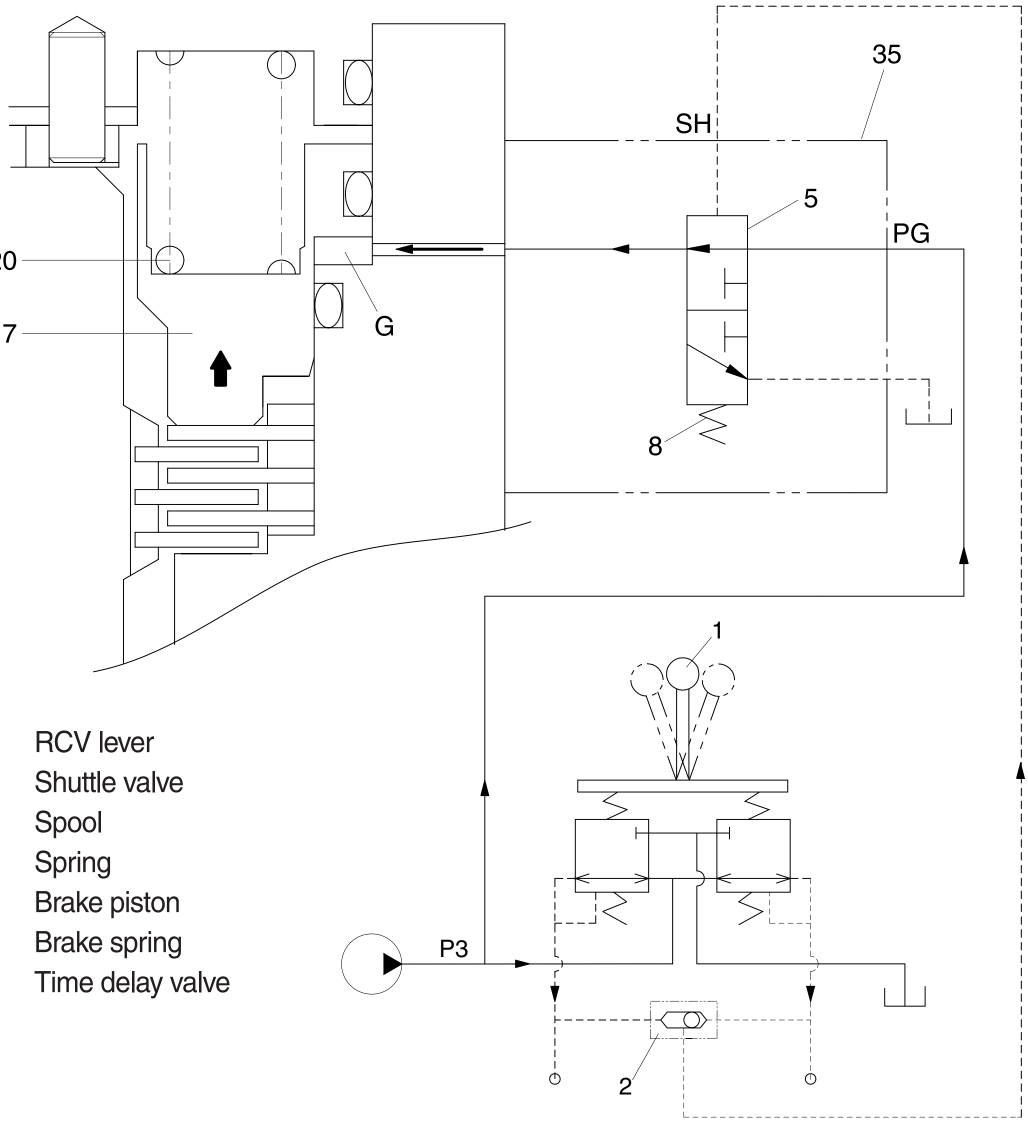


21092SM15

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

② Operating principle

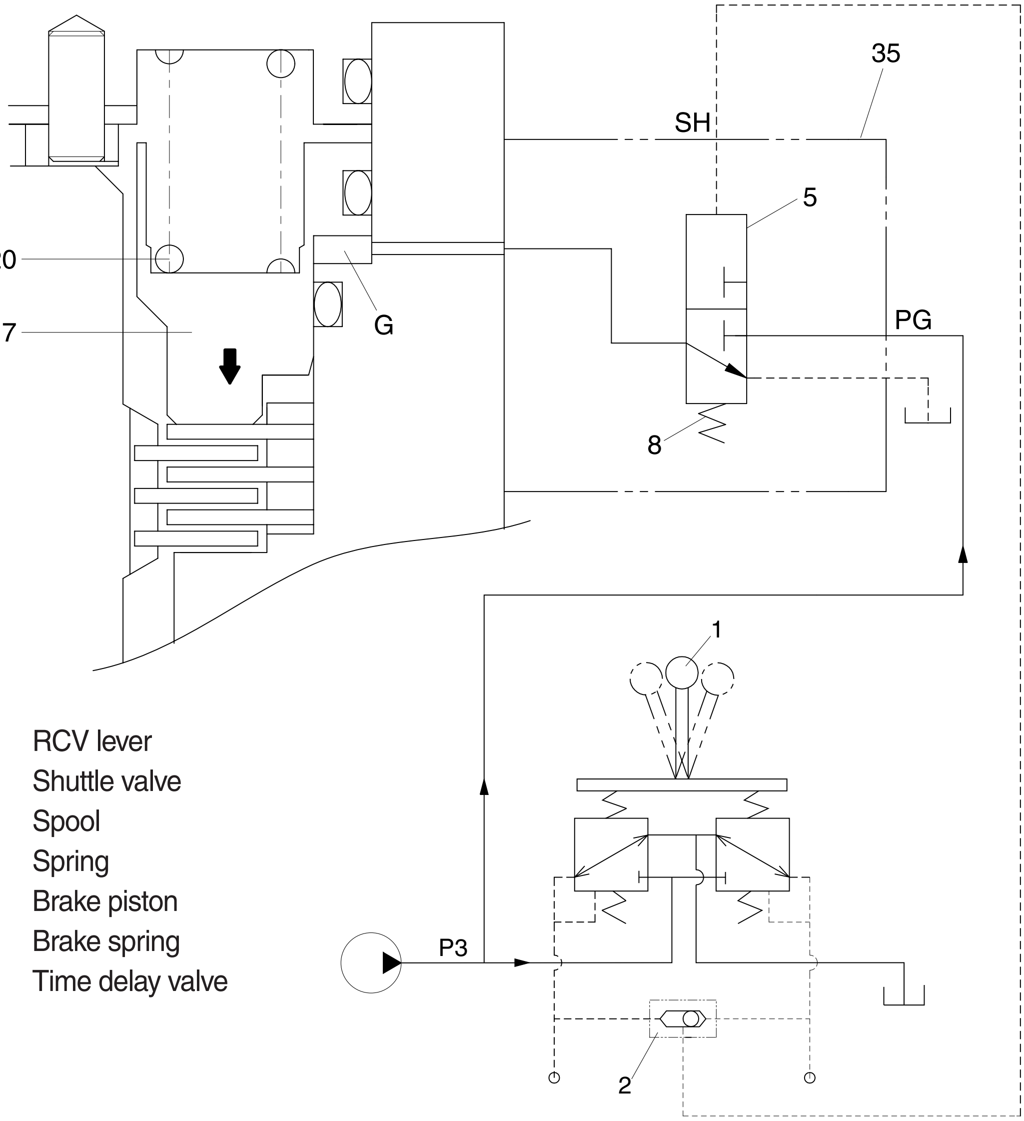
a. When the RCV lever (1) is set to the swing or arm in operating position, the pilot oil go to SH of the time delay valve (35).
   This pressure moves spool (5) to the leftward against the force of the spring(8), so pilot pump charged oil (P3) goes to the chamber G through port PG.
   This pressure is applied to move the piston (17) to the upward against the force of the spring (20). Thus, it releases the brake force.



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

300L2SM04

b. When all of the RCV lever (1) are set the neutral position, the spool (5) returns to the top.
Then, the brake piston (17) is moved lower by spring force and the return oil from the chamber G flows back to tank port.
At this time, the brake works.



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

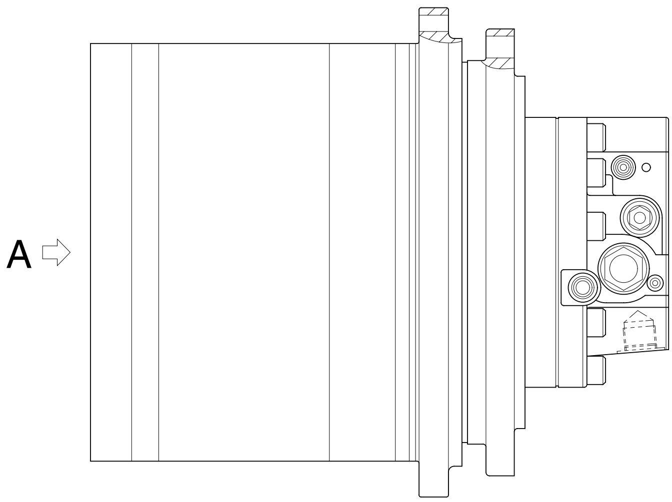
300L2SM05

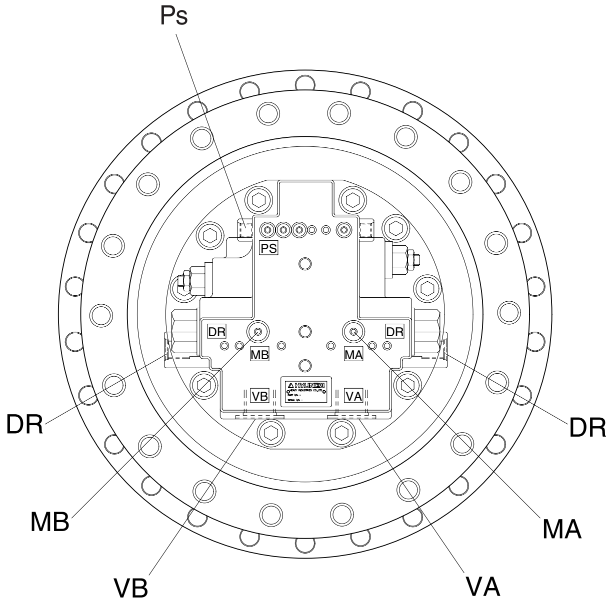
GROUP 4 TRAVEL DEVICE (TYPE 1 & 2)

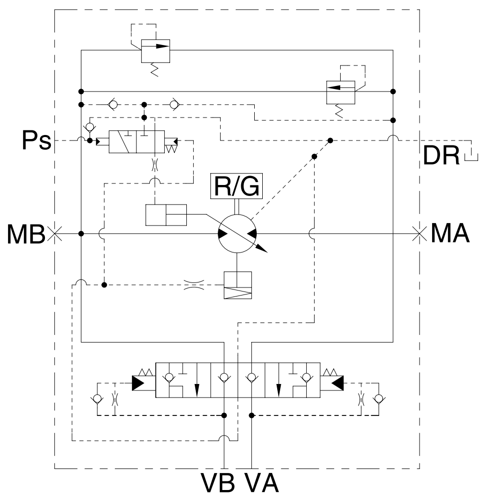
1. CONSTRUCTION

Travel device consists travel motor and gear box.

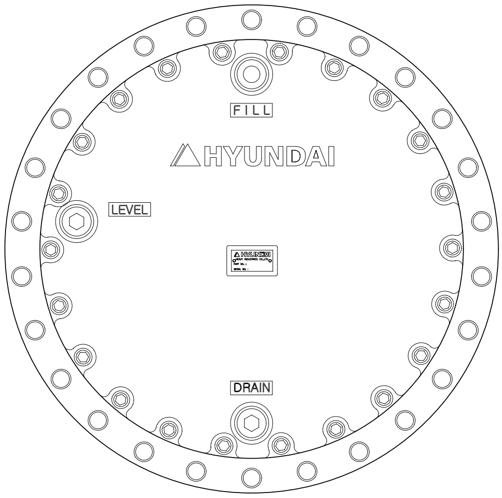
Travel motor includes brake valve, parking brake and high/low speed changeover mechanism.







HYDRAULIC CIRCUIT



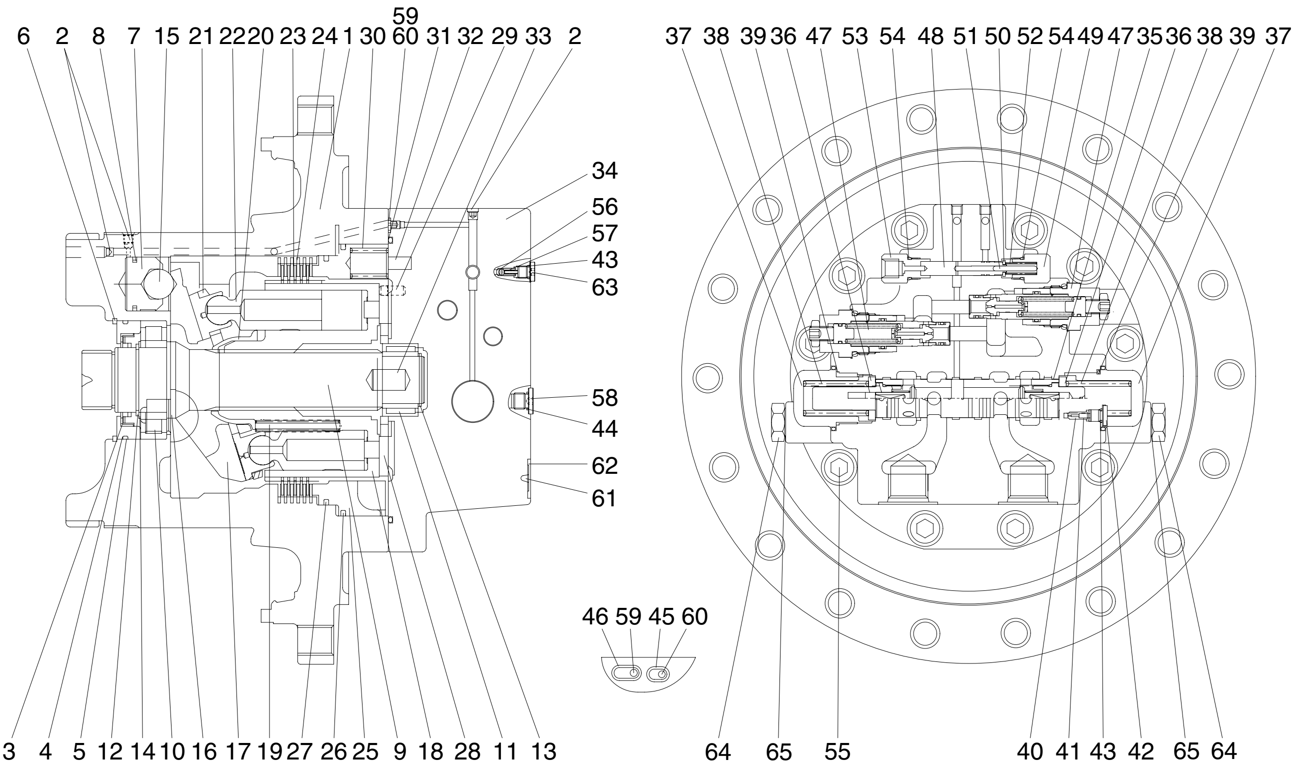
VIEW A

300L2TM01

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

2. SPECIFICATION

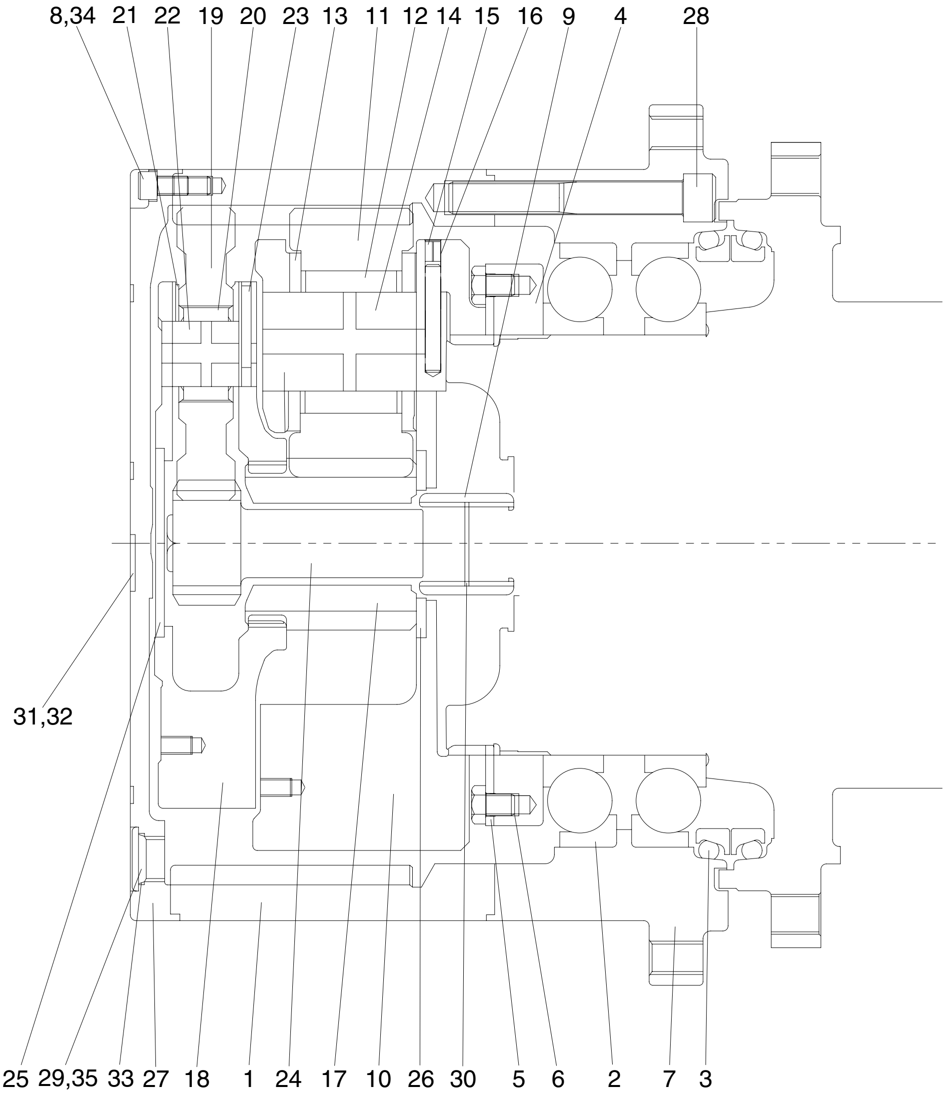
1) TRAVEL MOTOR



300L2TM02

1	Casing	23	Friction plate	45	O-ring
2	Plug	24	Separate plate	46	O-ring
3	Oil seal	25	Parking piston	47	Relief valve assy
4	Thrust block	26	D-ring	48	Spool
5	O-ring	27	D-ring	49	Plug
6	Snap ring	28	Valve plate	50	Spring seat
7	Piston	29	Parallel pin	51	Parallel pin
8	Piston seal	30	Spring	52	Spring
9	Shaft	31	O-ring	53	Connector
10	Cylinder roller bearing	32	Spring pin	54	O-ring
11	Needle bearing	33	Parallel pin	55	Hexagon socket head bolt
12	Snap ring	34	Rear cover	56	Check valve
13	Snap ring	35	Main spool assy	57	Spring
14	Thrust plate	36	Spring seat	58	Plug
15	Steel ball	37	Plug	59	Restrictor
16	Pivot	38	Spring	60	Restrictor
17	Swash plate	39	O-ring	61	Name plate
18	Cylinder block	40	Restrictor	62	Rivet
19	Spring	41	Spring	63	Plug
20	Ball guide	42	Plug	64	Plug
21	Retainer plate	43	O-ring	65	O-ring
22	Piston assy	44	O-ring		

2) TRAVEL REDUCTION GEAR



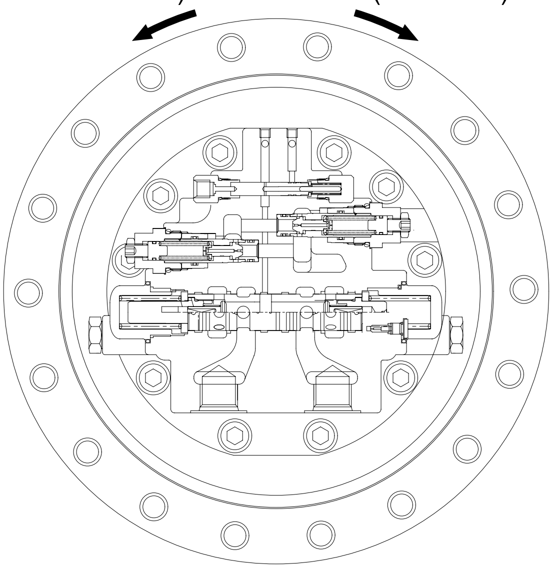
300S2TM03

1	Gear ring	13	Thrust washer 2	25	Thrust plate
2	Ball bearing	14	Carrier pin 2	26	Thrust plate
3	Floating seal assy	15	Spring pin 2	27	Cover
4	Nut ring	16	Solid pin 2	28	Hexagon socket head bolt
5	Lock plate	17	Sun gear 2	29	Plug
6	Hexagon socket head bolt	18	Carrier 1	30	Snap ring
7	Housing	19	Planetary gear 1	31	Name plate
8	Hexagon socket head bolt	20	Needle bearing 1	32	Rivet
9	Coupling	21	Thrust washer 1	33	O-ring
10	Carrier 2	22	Carrier pin 1	34	Rubber cap
11	Planetary gear 2	23	Spring pin 1	35	Rubber cap
12	Needle bearing 2	24	Sun gear 1		

3. OPERATION

1) MOTOR

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



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

300L2TM04

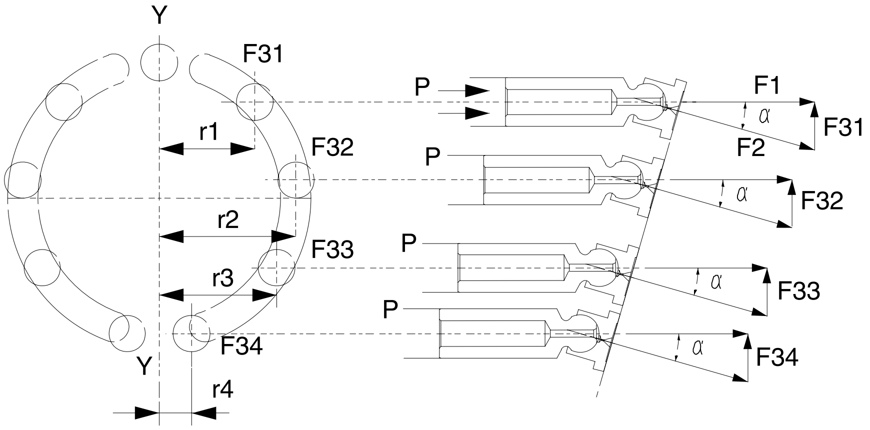
As shown in below figure, high pressure oil is supplied to the pistons which are on one side of the line Y-Y that connects upper and lower dead points and produces force F1.

F1 = P × A (P : pressure, A : area of piston section)

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

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

This drive torque is transmitted via cylinder block (18) to driving shaft (9).

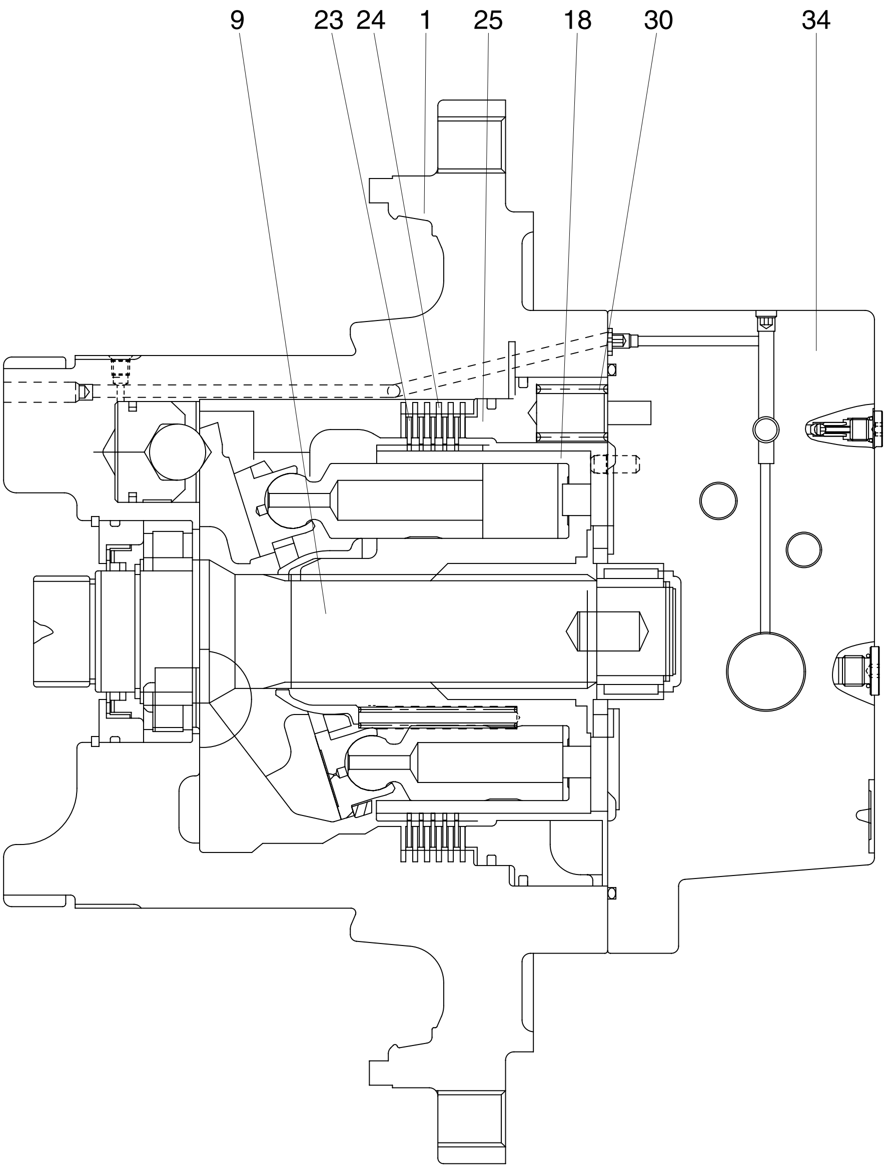


29092TM07

2) PARKING BRAKE

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

This braking torque is generated by the friction between the separated plates (24), inserted into the casing (1), and friction plates (23), coupled to cylinder block (18) by the outer splines.
When no pressure is activated on the parking piston (25), it is pushed by the brake springs (30) and it pushes friction plates (23) and separated plates (24) towards casing (1) and generates the friction force which brakes the rotation of cylinder block (18) and hence the shaft (9).



2609A2TM05

3) CAPACITY CONTROL MECHANISM

Figure typically shows the capacity control mechanism.

When high speed pilot line is charged with the pressure P_A that overcome the spring (52), the spring (52) is compressed and spool (48) shifts to the right to connect the port P and port C.

Then, the highest pressure is selected by the check valve (56) from inlet and outlet pressure of the motor and high speed pilot line pressure and pushes shifter piston (7). As a result, swash plate (17) turns around the line L which connect the two pivots (16) as shown by dotted lines. The turn stops at the stopper (1-1) of casing and swash plate (17) keeps the position.

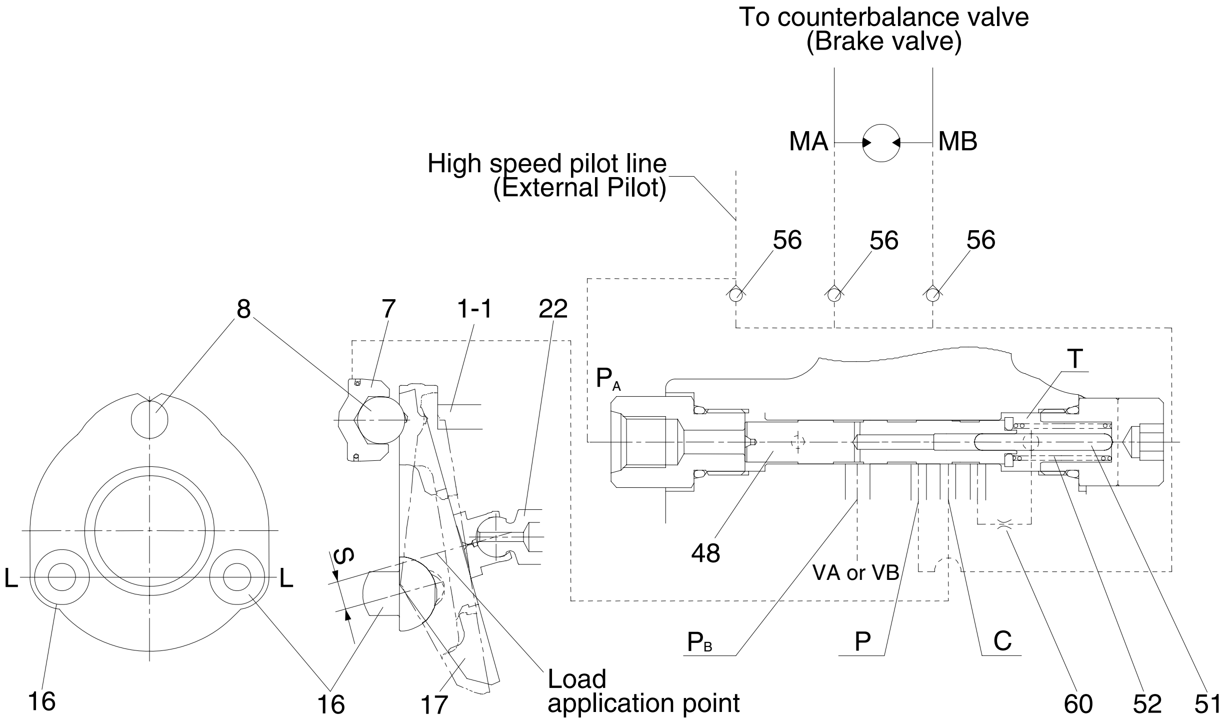
In this case, the piston stroke become shorter and motor capacity become smaller and motor rotates faster, around 1.60 times, by the same volume of oil.

When no pressure is in the high speed pilot line P_A, spool (35) is pushed back by the spring (52) and pressure that pressed the shifter piston (7) is released to the hydraulic tank through restrictor (60).

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

When the power demand exceeds the engine power, such as in steep slope climbing or turning at high speed mode, the system step down to the low speed automatically. The mechanism is that: pump pressure is led to the port P_B and this pressure activate on pin (51). When the pressure at P_B exceeds predetermined value, spool (48) returns to the left by the counter-pressure against pin (51) and the pressure on the shifter piston (7) through port C is released to the tank and the motor comes to low speed.

When P_B goes down, the spool (48) moves to the right and the speed become high.

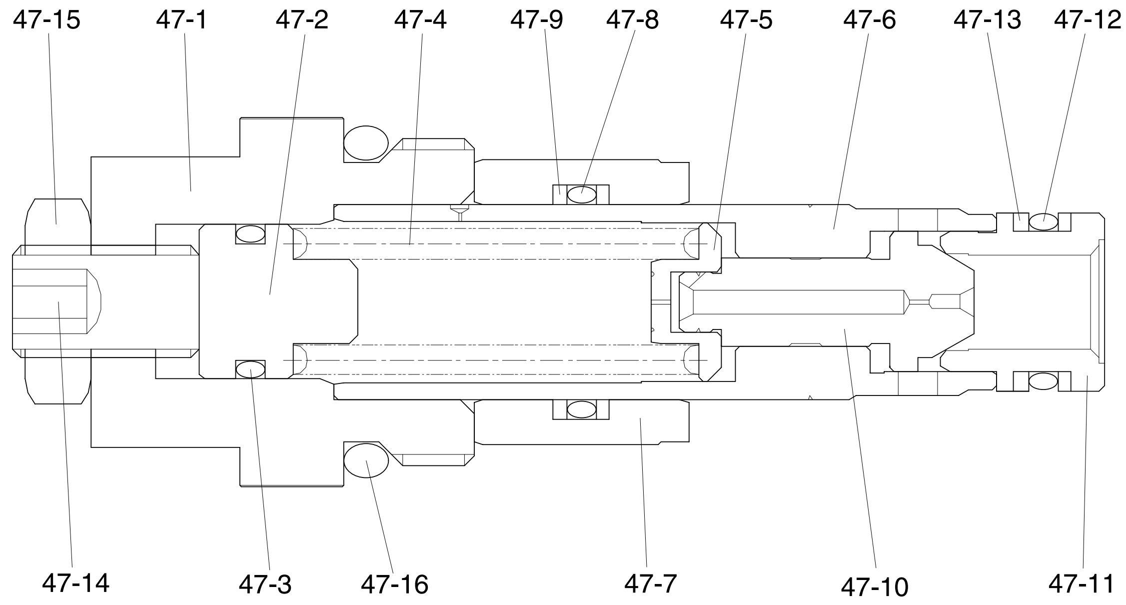


2609A2TM06

4) OVERLOAD RELIEF VALVE

(1) Structure

This valve is screwed in the motor rear cover (34) and consists of : plug (47-1) that is screwed and fixed in the rear cover (34), poppet (47-10) and supports the poppet seat (47-11), spring (47-4) that is operating relief valve setting pressure and supports the spring seat (47-5), that is inserted in the sleeve (47-6), screw (47-14) that is adjust the spring force, nut (47-15) that fix screw (47-14), piston (47-7) that reduce the shock.



2609A2TM07

47-1	Plug	47-7	Piston	47-12	O-ring
47-2	Guide	47-8	O-ring	47-13	Back-up ring
47-3	O-ring	47-9	Back-up ring	47-14	Socket screw
47-4	Spring	47-10	Poppet	47-15	Hexagon nut
47-5	Spring seat	47-11	Poppet seat	47-16	O-ring
47-6	Sleeve				

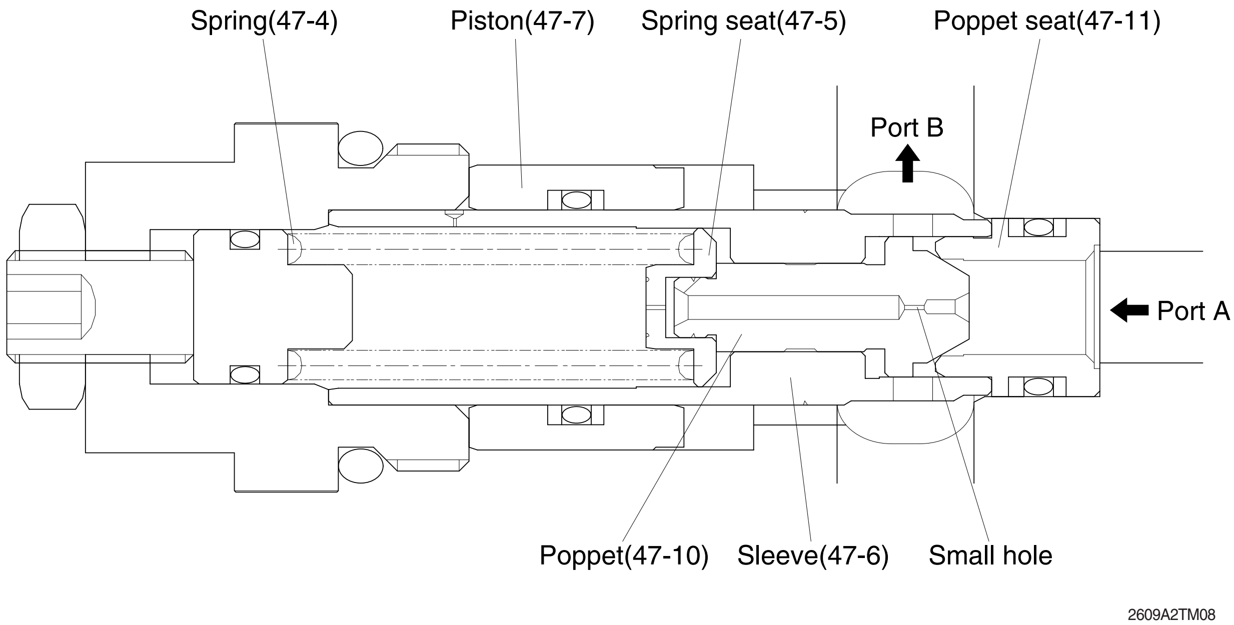
(2) Operation

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

① When hydraulic motor starts, keep the driving pressure below predetermined value and while accelerating, bypasses surplus oil to return line.
② When stopping the motor, keep the brake pressure, that develops on the outlet side of motor, under the predetermined value to stop the inertial force.
③ To accelerate sharply while starting, and to mitigate the braking shock while stopping. For these purposes, the developed pressure is kept comparatively low for a short period, then keep the line pressure as normal value. While the pressure is low, meshing of reduction gears, crawler and sprocket etc. can be smoothly done and the shock are absorbed.

When starting, "A" port pressure of overload valve increases, this pressure is applied to the effective diameter of poppet (47-10) which seats on the poppet seat (47-11) and, at the same time, is delivered, via small hole, to the spring seat (47-5) located inside the sleeve (47-6) and the seat bore pressure increases up to "A" port pressure. The poppet (47-10) opposes to spring (47-4) by the force of the pressure exerted on the area difference between poppet seat's effective diameter and spring seat bore and keep the predetermined pressure.

When hydraulically braking, the piston (47-7) is at the left position by the driving pressure, and when "A" port pressure increases, the pressure is applied also to the piston (47-7) through the small hole in the poppet (47-10) and piston (47-7) moves rightward until it touches the stopper in rear cover. In this while, the poppet (47-10) maintains "A" port pressure at comparatively low against the spring (47-4) force and exhaust oil to "B" port side. After the piston reached to the plug, the valve acts the same as at starting.



5) BRAKE VALVE

(1) Structure

The brake valve portion mainly consists of the following parts:

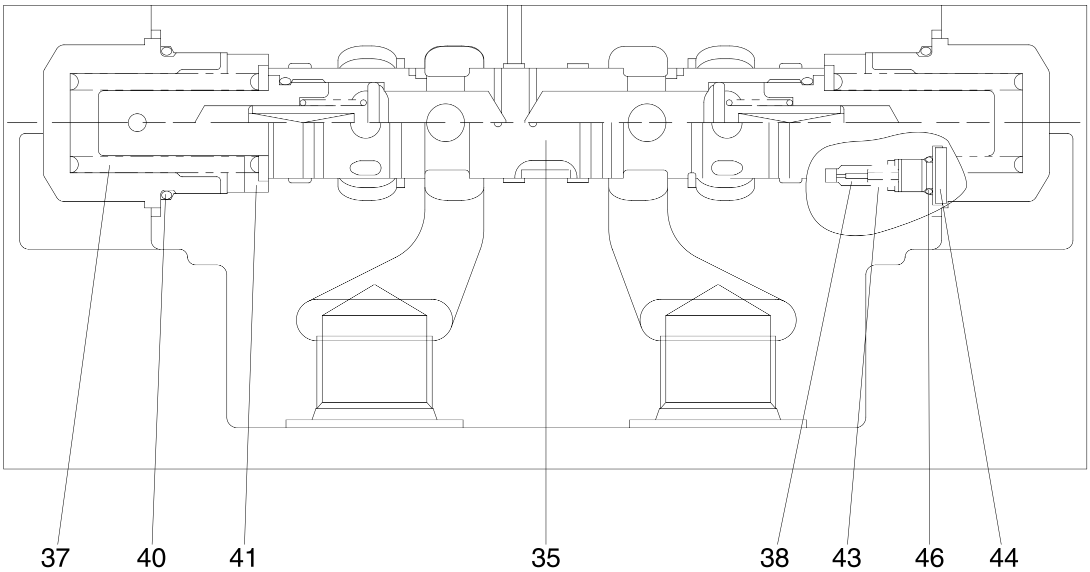
① Spool

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

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

② Check valve (built in the spool)

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



2609A2TM09

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

(2) Operation

① Holding operation

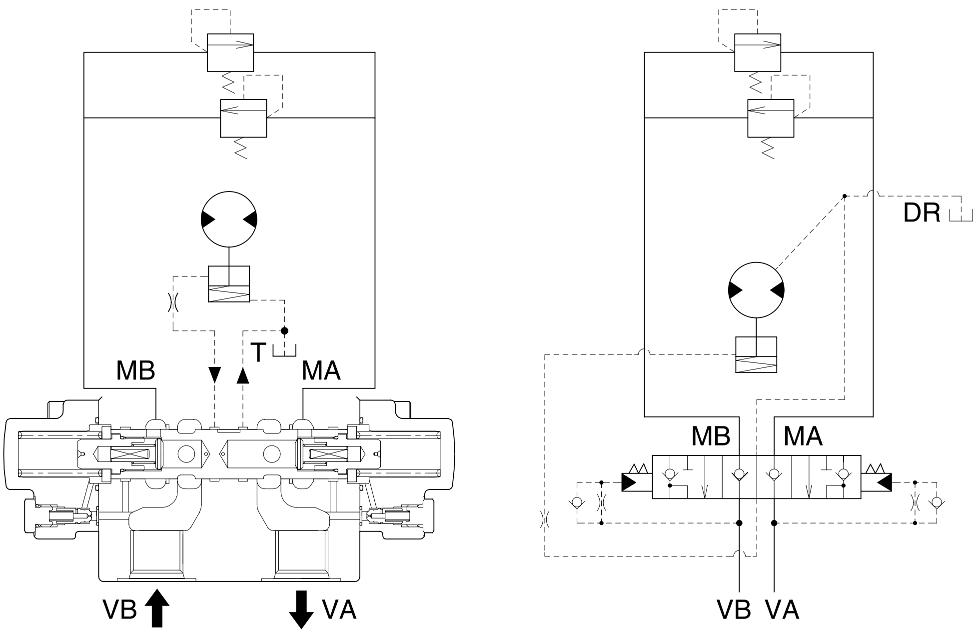
When the control valve is at neutral position, VA and VB ports are connected to the tank, and the spring (38) located on both spool ends holds the spool (35) at central position.

Therefore, the passages from VA to MA and VB to MB are closed, which result in closing MA and MB ports connected to hydraulic motor.

Since the passage to parking brake is connected to the tank line, the brake cylinder pressure is equal to the tank pressure and the brake is applied by the springs. Thus, the rotation of the motor is mechanically prevented.

If external torque is exerted on the motor shaft, the motor would not rotate as usual by this negative parking brake.

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



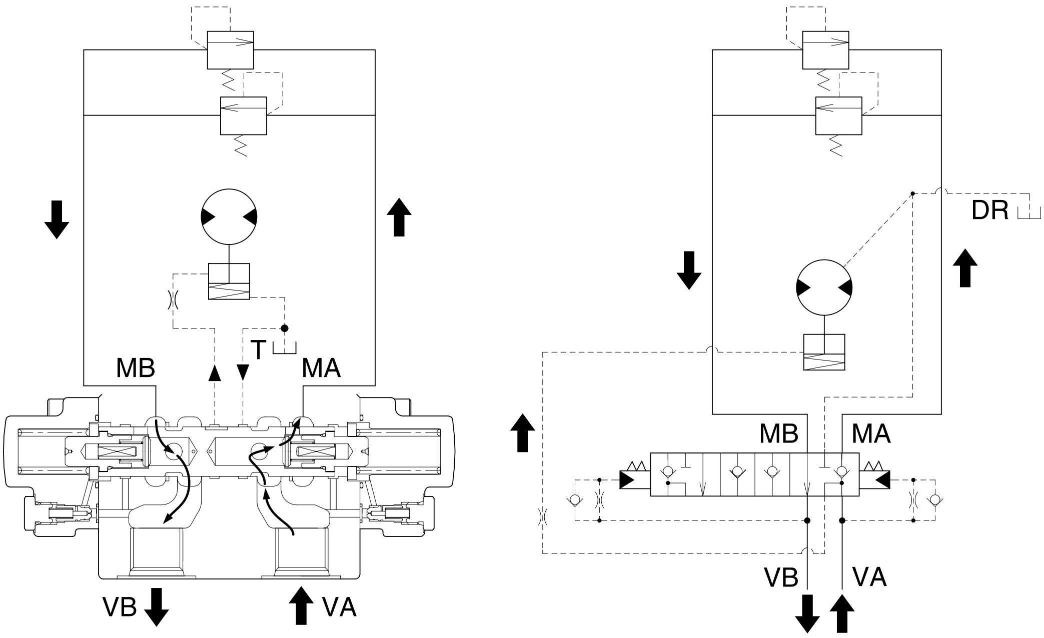
25092TM29

② Accelerating operation

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

Therefore, the pressure increases and negative brake is released by the pressure supplied from pump. At the same time, the pressure of pilot chamber increases to push and move the spool (35) leftwards, overcoming the spring (38) force. Thus, the return line from MB to VB opens to rotate the motor.

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



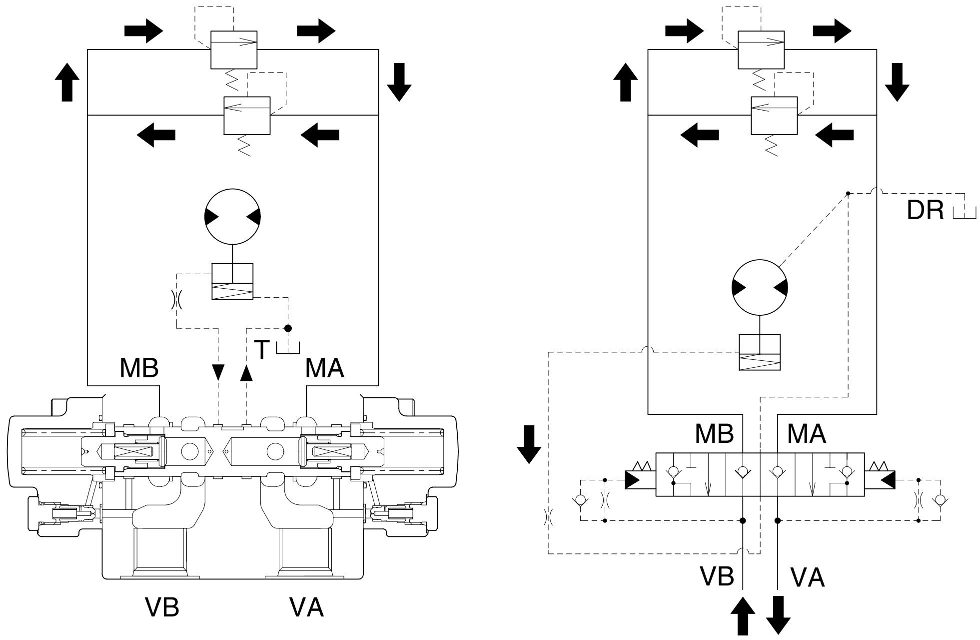
25092TM30

③ Stopping operation

Returning the control valve to neutral position while running the motor, the oil supply is cut off and VA and VB ports are connected to the tank line. Then the pressure of the pilot chamber located on both spool ends become equal, and the spool (35) returns to the neutral position by spring (38) force. Thus, the passage from MA to VA is closed.

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

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



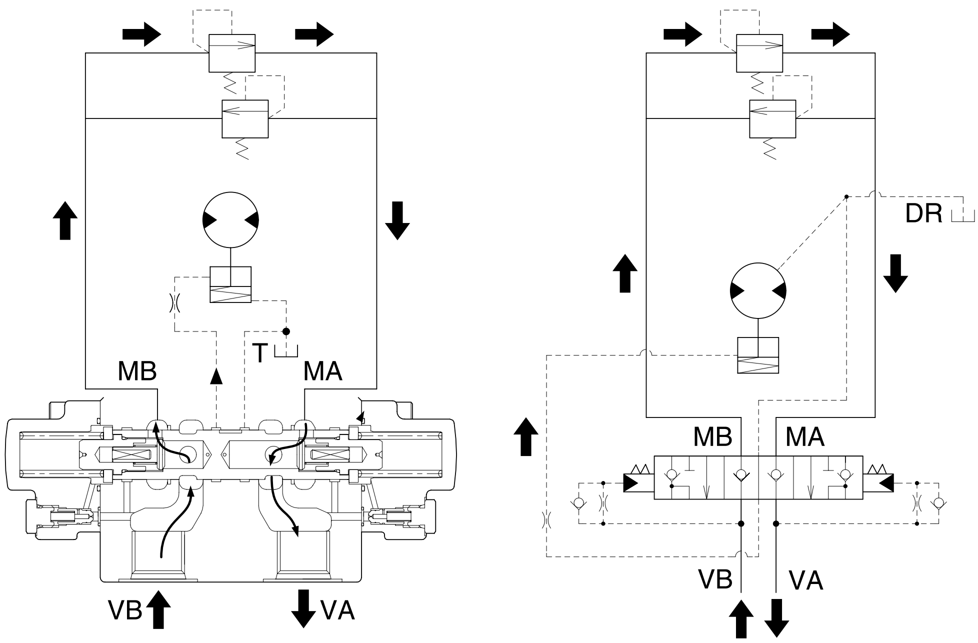
25092TM31

④ Counterbalance operation

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

In case the hydraulic oil is gradually decreased from pump to VB port, the drive shaft of hydraulic motor tends to rotate faster than that matched to the volume of oil supply.
Consequently, the pilot chamber pressure on MB to VB side decreases and the spring (38) force moves the spool (35) leftwards towards neutral position.
Therefore, the area of passage from MA to VA becomes smaller and the pressure on MA side rises due to increased resistance in the passage and the motor receives hydraulic braking effect.

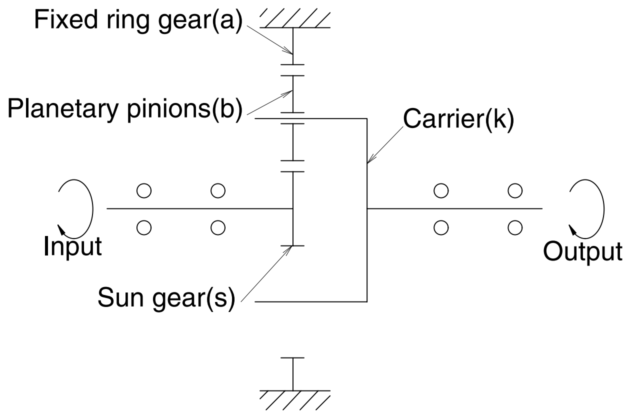
If the motor rotates slower than that matched to the volume of supplied oil, the pilot chamber pressure on VB port increases, and spool (35) moves rightwards to enlarge the area of passage from MA to VA. Therefore the braking effect becomes smaller and the rotational speed of motor is controlled to correspond to the volume of supplied oil.
In order to give stable counterbalance operation, the restrictors (40) are set in the pilot chamber to damp the spool (35) movement.
The parking brake is released during pressure adjusting action of the spool (35).



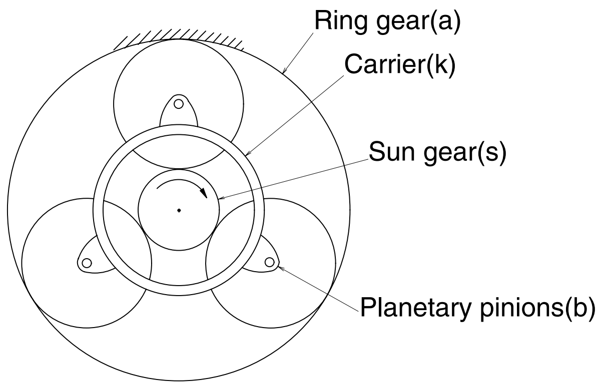
25092TM32

6) REDUCTION GEAR

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

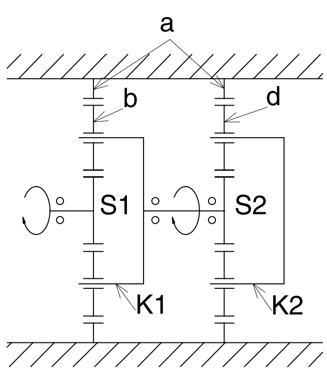


29072TM10



29072TM11

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



29072TM12

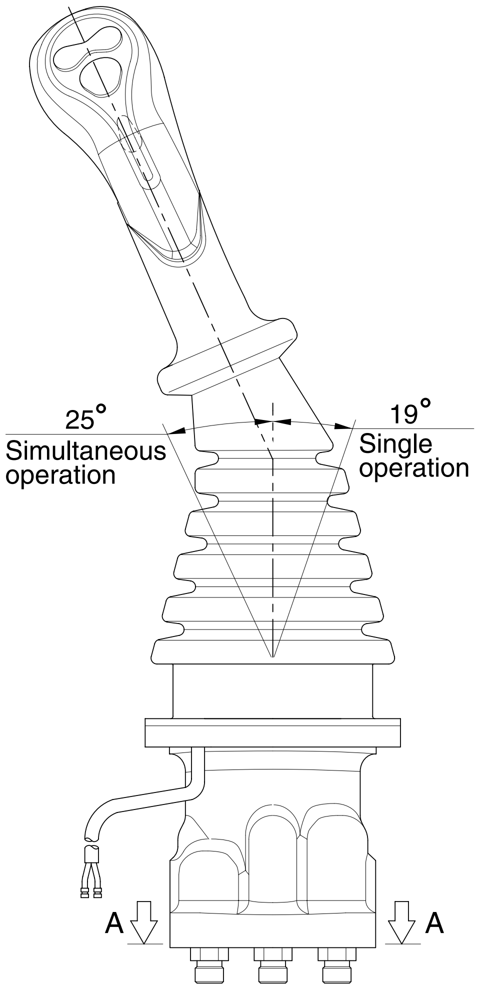
GROUP 5 RCV LEVER

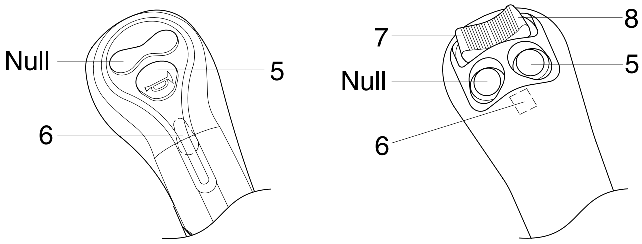
1. STRUCTURE

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

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

1) TYPE L11, L12, L15

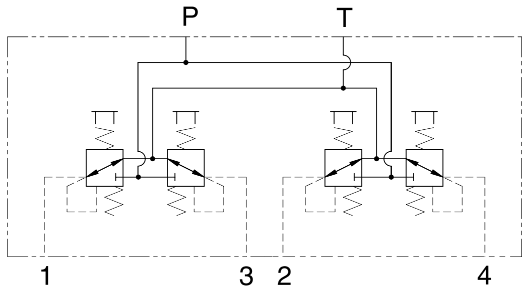




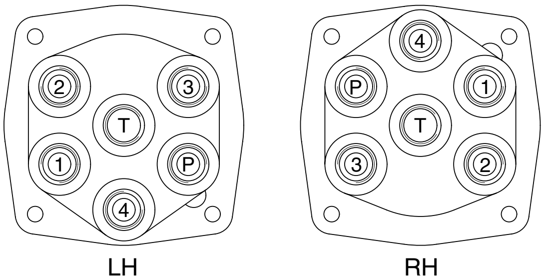
Switches

Type	No.	LH	RH
L11, L12	5	One touch decel	Horn
	6	Power boost	Breaker
L15	5	One touch decel	Horn
	6	Power boost	Null
	7	CCW rotation	Close
	8	CW rotation	Open

※ Number 7 and 8 : Option attachment



Hydraulic circuit



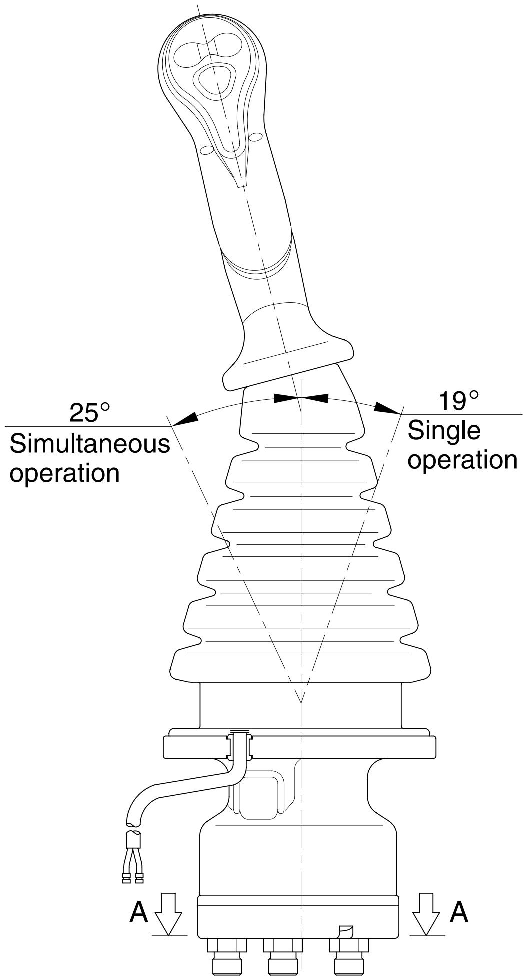
VIEW A-A

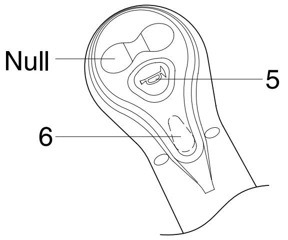
Pilot ports

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

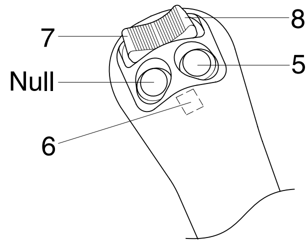
350SA2RL01

2) TYPE L13, L14, L16





TYPE L13, L14

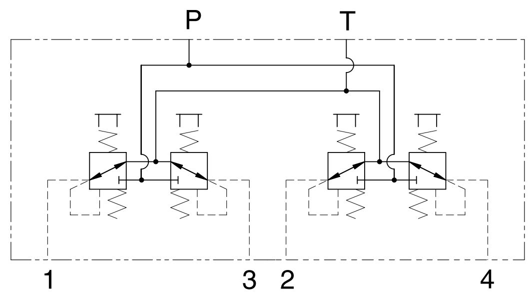


TYPE L16

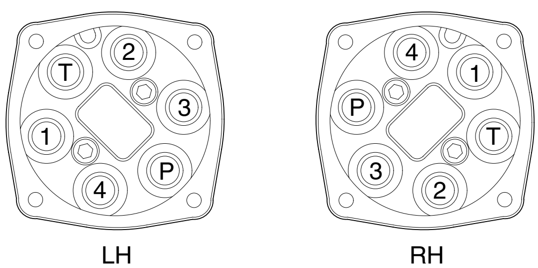
Switches

Type	No.	LH	RH
L13, L14	5	One touch decel	Horn
	6	Power boost	Breaker
L16	5	One touch decel	Horn
	6	Power boost	Null
	7	CCW rotation	Close
	8	CW rotation	Open

※ Number 7 and 8 : Option attachment



Hydraulic circuit



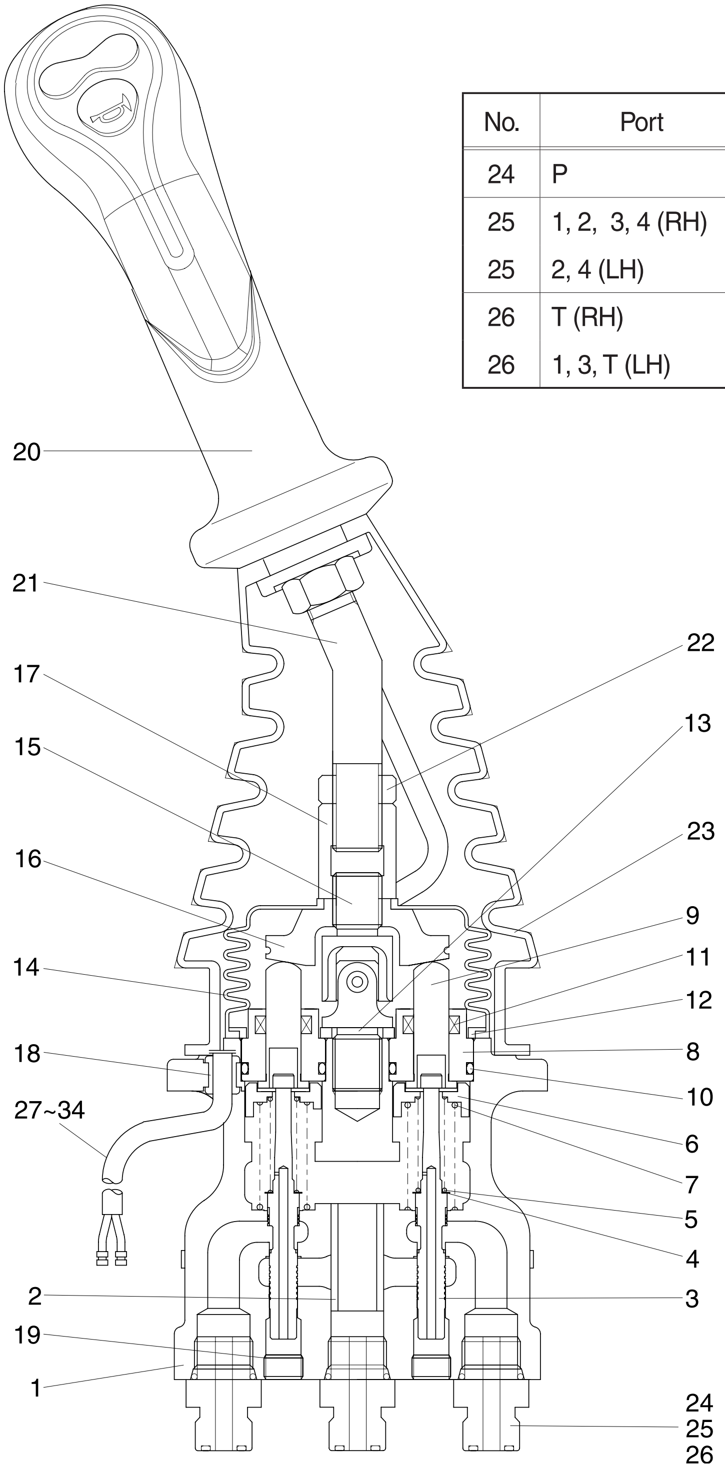
VIEW A-A

Pilot ports

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

350SA2RL05

3) CROSS SECTION



No.	Port
24	P
25	1, 2, 3, 4 (RH)
25	2, 4 (LH)
26	T (RH)
26	1, 3, T (LH)

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

210S2RL06

Item numbers are based on the type L11.
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 L11.

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

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

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

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

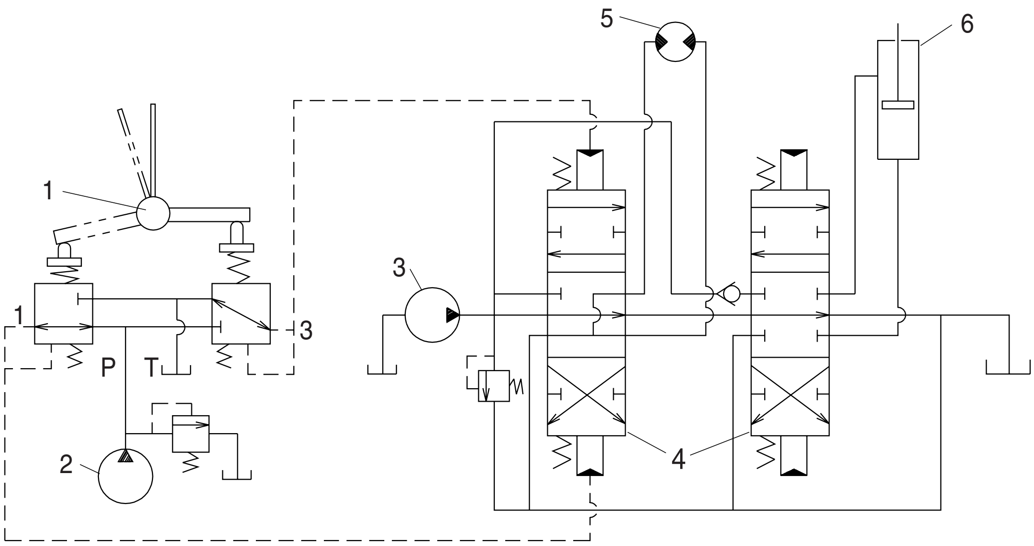
The spring (7) works on the case (1) and spring seat (6) and tries to return the push rod (9) to the zero-displacement position irrespective of the output pressure, securing its resetting to the center position.

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

3) OPERATION

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

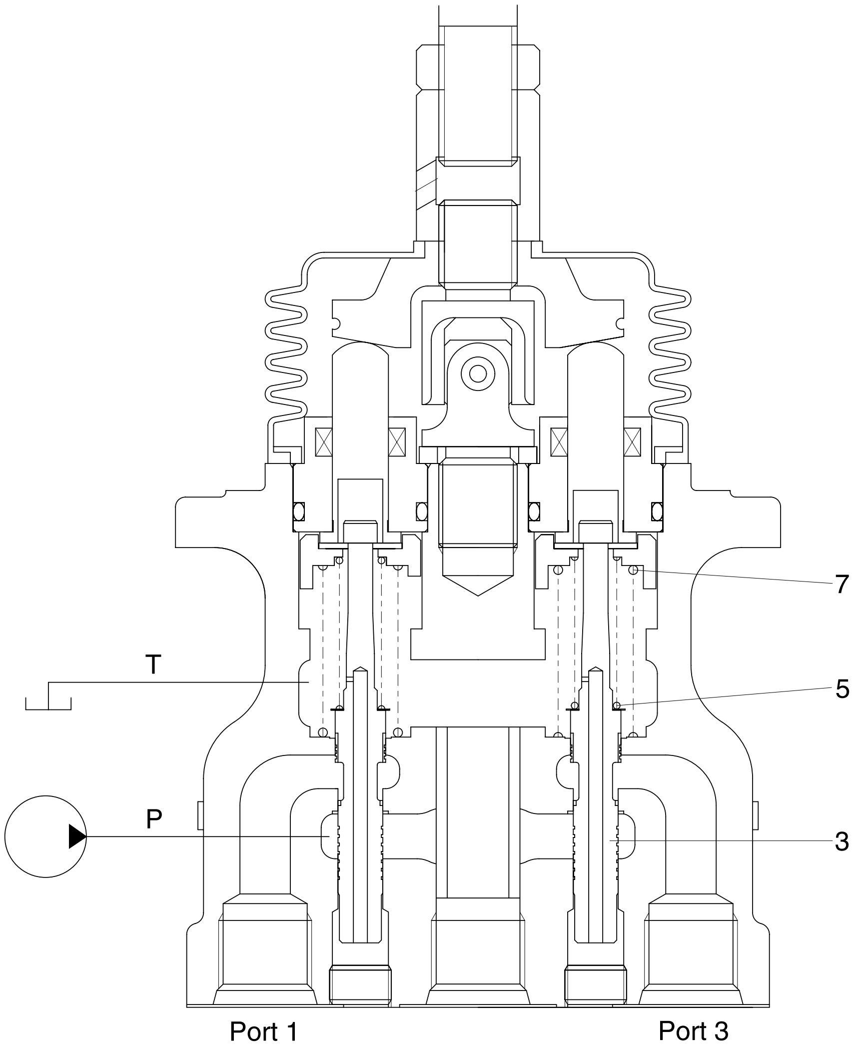
The diagram shown below is the typical application example of the pilot valve.



2-70

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

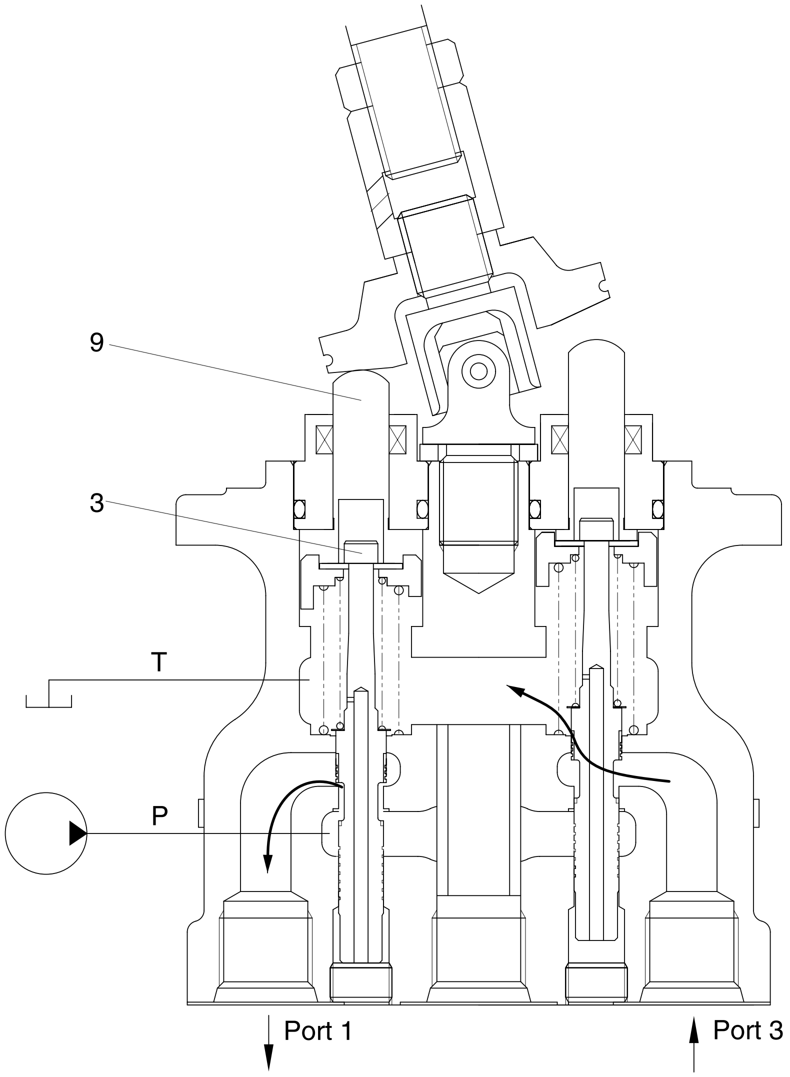
(1) Case where handle is in neutral position



300L2RL03

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

(2) Case where handle is tilted



300L2RL04

When the push rod (9) is stroked, the spool (3) moves downwards.

Then port P is connected with port (1) and the oil supplied from the pilot pump flows through port (1) to generate the pressure.

When the pressure at port (1) increases to the value corresponding to the spring force set by tilting the handle, the hydraulic pressure force balances with the spring force. If the pressure at port (1) increases higher than the set pressure, port P is disconnected from port (1) and port T is connected with port (1). If it decreases lower than the set pressure, port P is connected with port (1) and port T is disconnected from port 1.

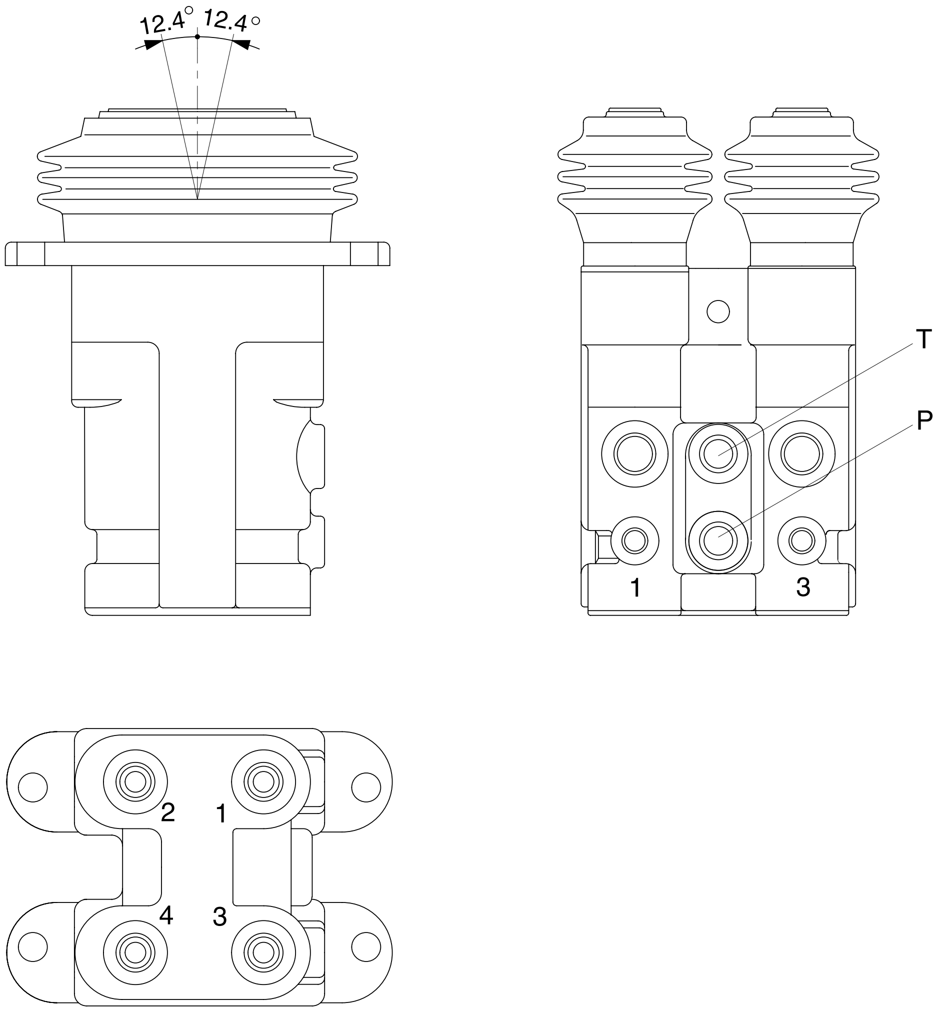
In this manner the secondary pressure is kept at the constant value.

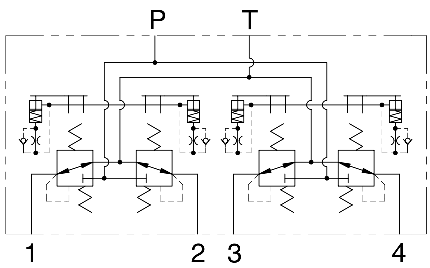
Besides, in some type, when the handle is tilted more than a certain angle, the upper end of the spool contacts with the inside bottom of the push rod and the output pressure is left to be connected with port P.

GROUP 6 RCV PEDAL

1. STRUCTURE

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





Hydraulic circuit

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

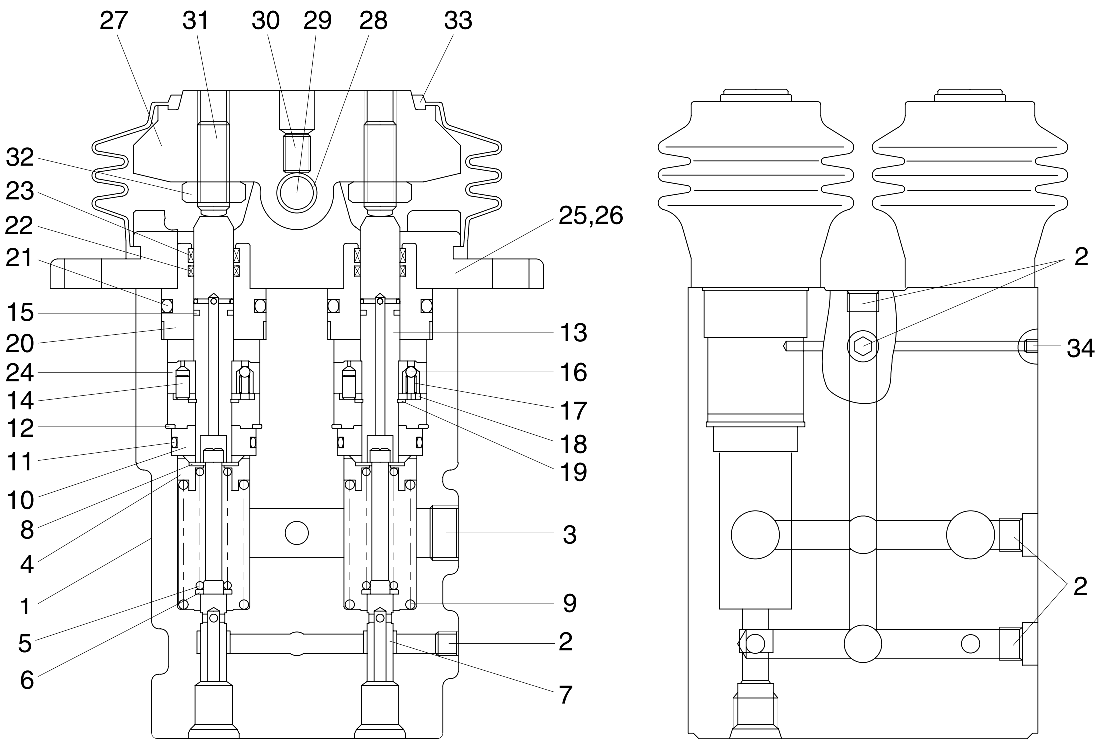
130ZF2RP01

CROSS SECTION

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

The pressure reducing section is composed of the spool (7), spring (5) for setting secondary pressure, return spring (9), stopper (8), and spring seat (6). The spring for setting the secondary pressure has been generally so preset that the secondary pressure is 6.3±1 to 24.9±1.5 kgf/cm^2 (depending on the type). The spool is pushed against the push rod (13) by the return spring.

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



130ZF2RP02

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

2. FUNCTION

1) FUNDAMENTAL FUNCTIONS

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

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

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

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

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

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

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

2) FUNCTIONS OF MAJOR SECTIONS

The functions of the spool (7) are to receive the supply oil pressure from the hydraulic pump at its port P, and to change over oil paths to determine whether the pressure oil of port P is led to output ports 1, 2, 3 & 4 or the output spool to determine the output pressure.

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

The change the deflection of this spring, the push rod (13) is inserted and can slide in the plug (20).

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

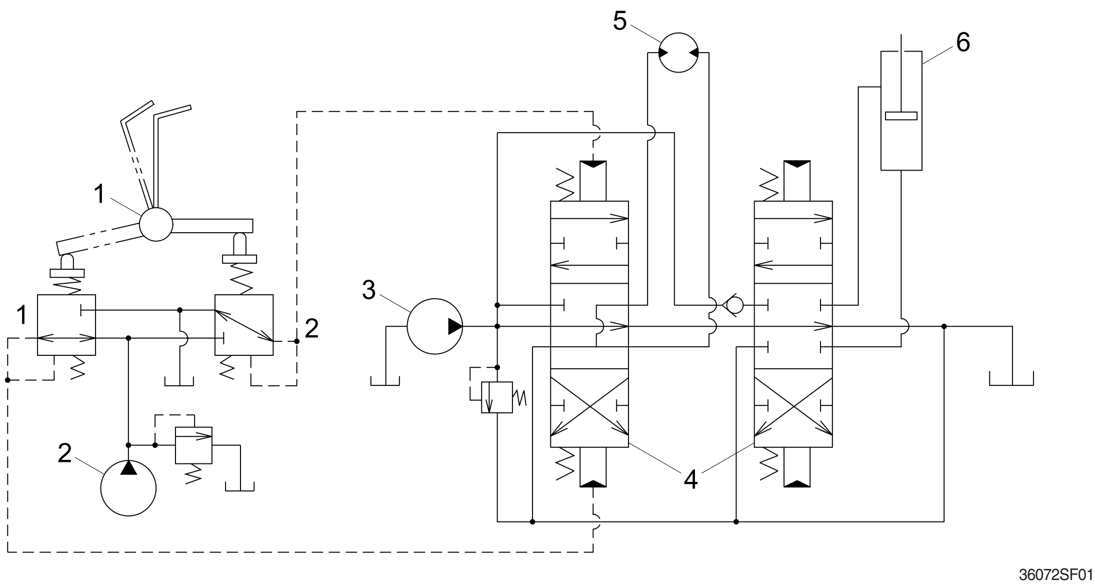
The spring (9) works on the body (1) and spring seat (6) and tries to return the push rod (13) to the zero-displacement position irrespective of the output pressure, securing its resetting to the center position.

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

3) OPERATION

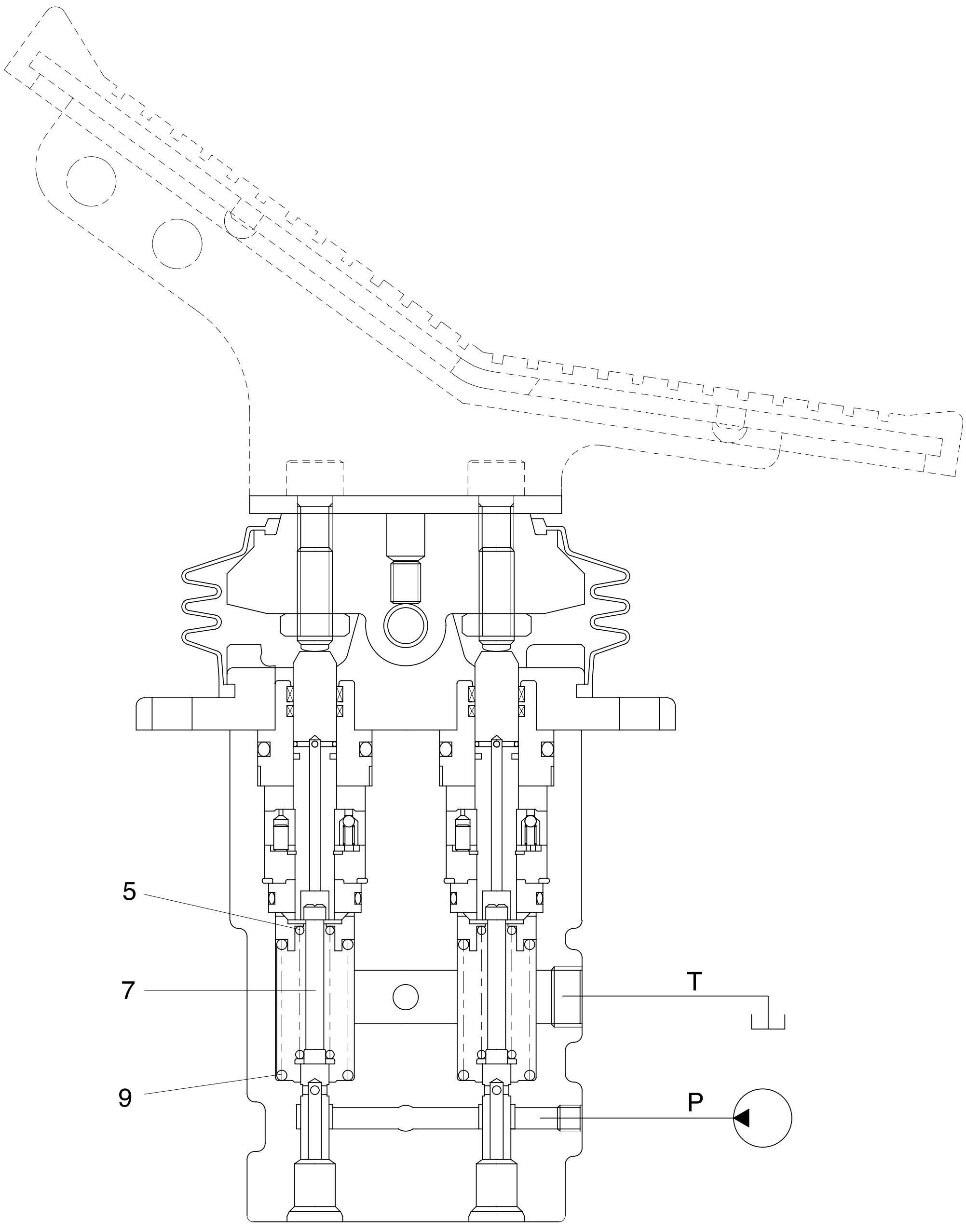
The operation of the pilot valve will be described on the basis of the hydraulic circuit diagram shown below and the attached operation explanation drawing.

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



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

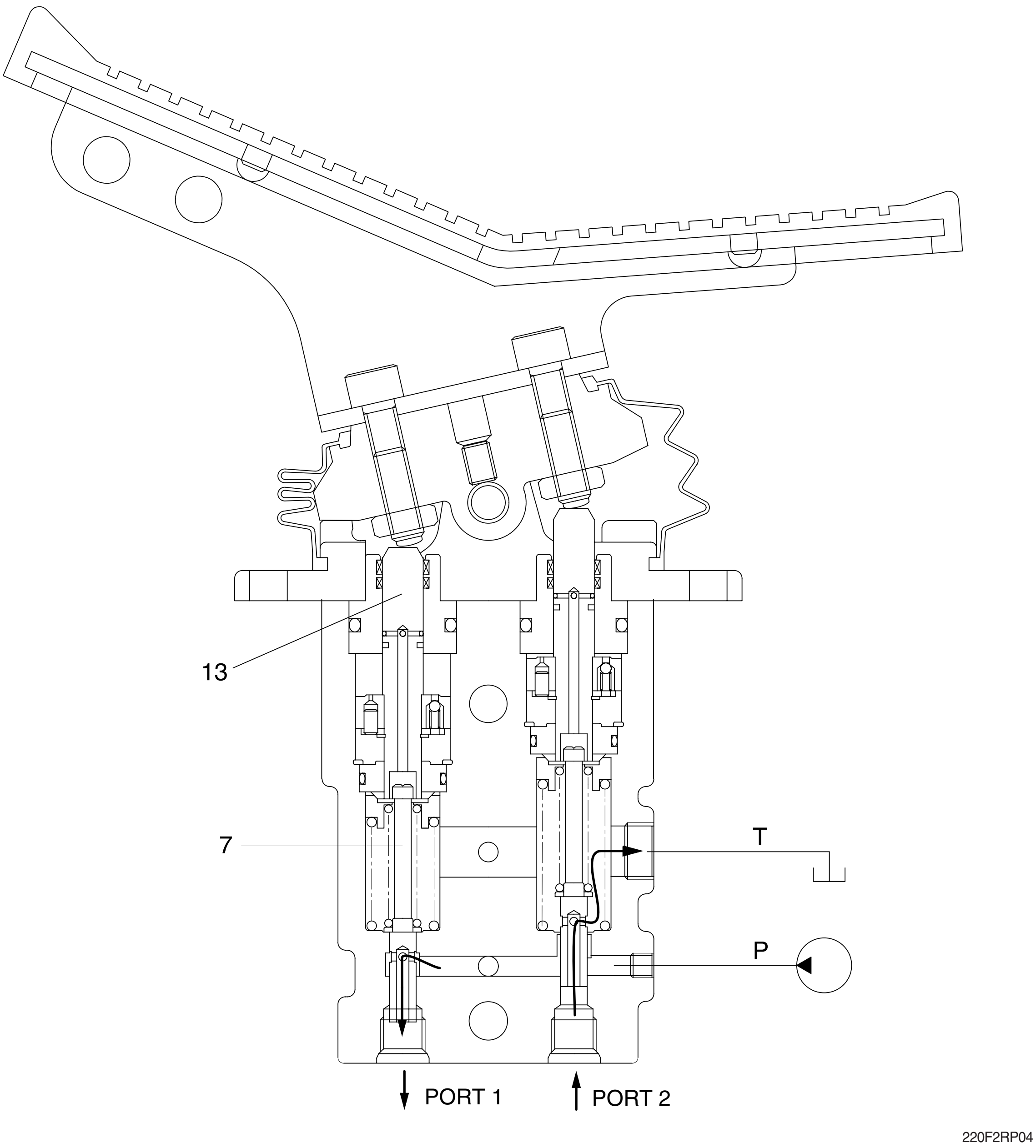
(1) Case where pedal is in neutral position



130ZF2RP03

The force of the spring (5) that determines the output pressure of the pilot valve is not applied to the spool (7). Therefore, the spool is pushed up by the spring (9) to the position of 1 and port 2. Then, since the output port is connected to tank port T only, the output port pressure becomes equal to tank pressure.

(2) Case where pedal is tilted



When the push rod (13) is stroked, the spool (7) moves downwards.

Then port P is connected with port 1, and the oil supplied from the pilot pump flows through port 1 to generate the pressure.

When the pressure at port 1 increases to the value corresponding to the spring force set by tilting the handle, the hydraulic pressure force balances with the spring force. If the pressure at port 1 increases higher than the set pressure, port P is disconnected from port 1 and port T is connected with port 1. If it decreases lower than the set pressure, port P is connected with port 1 and port T is disconnected from port 1.

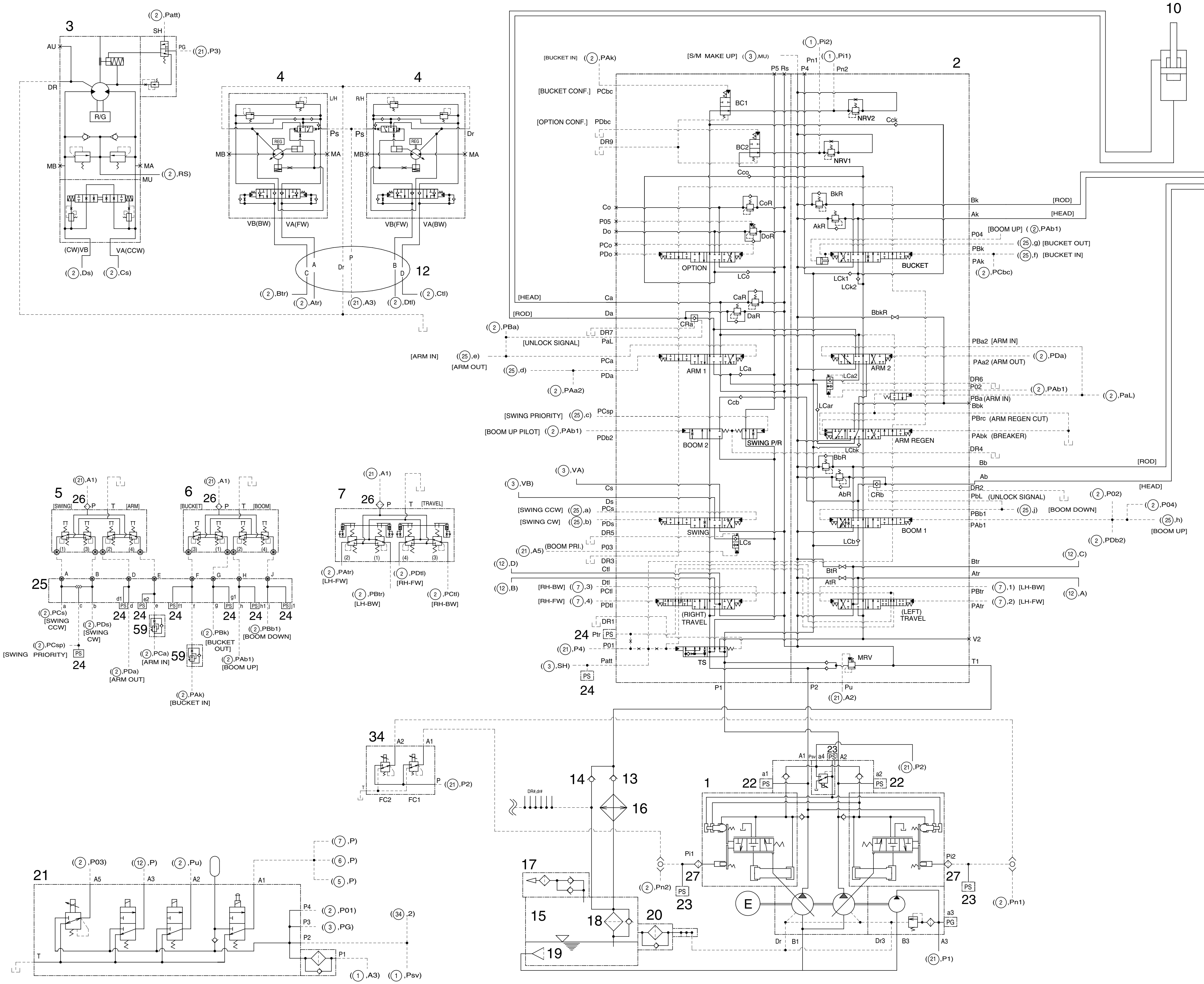
In this manner the secondary pressure is kept at the constant value.

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

SECTION 3 HYDRAULIC SYSTEM

GROUP 1 HYDRAULIC CIRCUIT

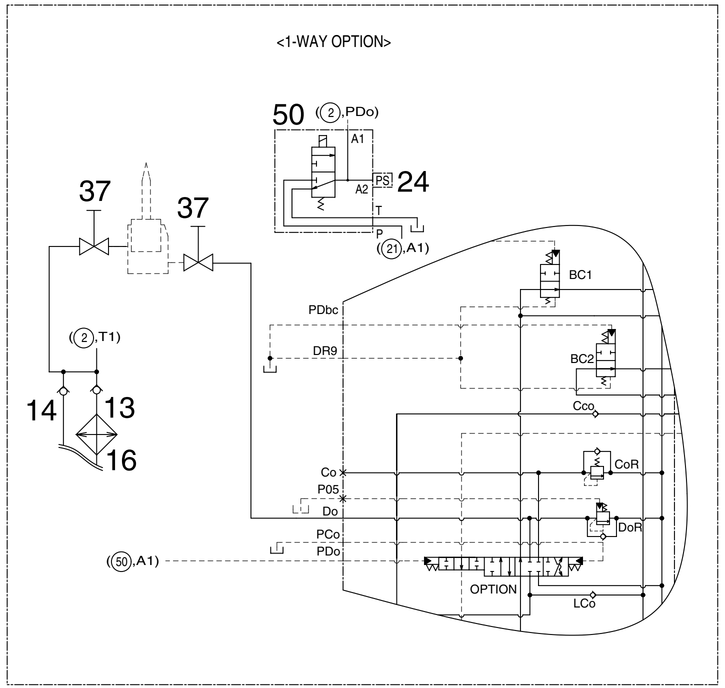
1. HYDRAULIC CIRCUIT (1/2)

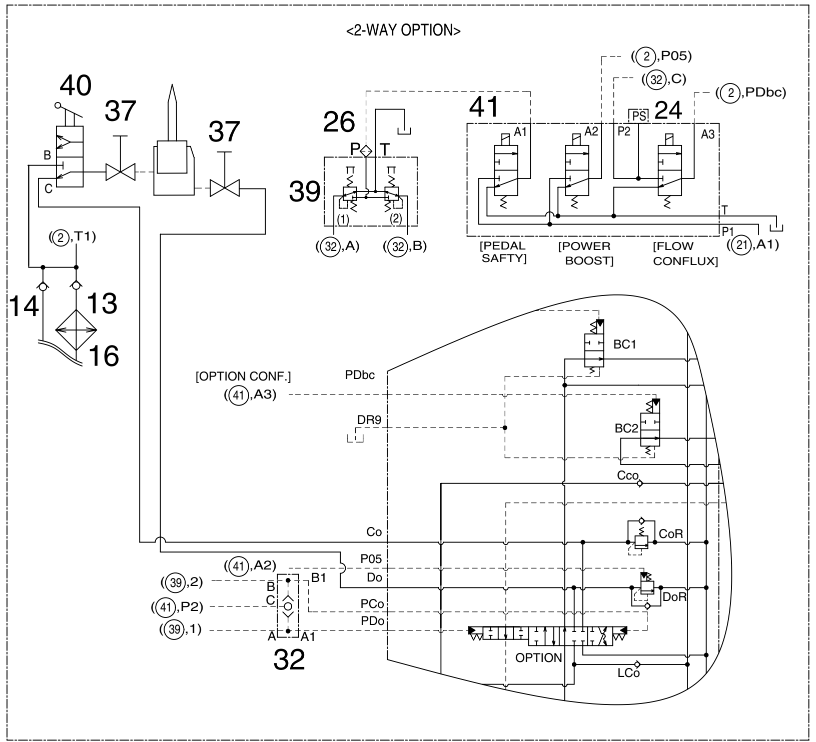


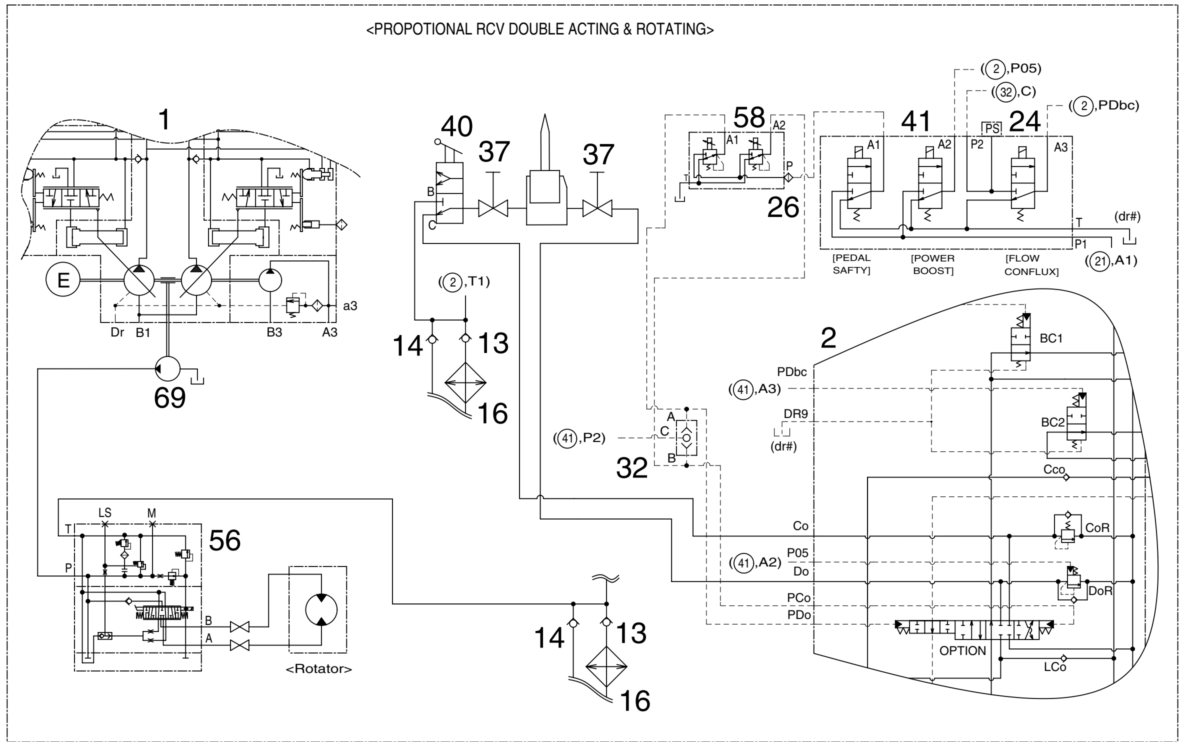
1 Main pump
2 Main control valve
3 Swing unit
4 Travel unit
5 RCV lever (LH)
6 RCV lever (RH)
7 RCV pedal
8 Boom cylinder (LH)
9 Boom cylinder (RH)
10 Arm cylinder
11 Bucket cylinder
12 Turning joint
13 Check valve
14 Check valve
15 Hydraulic tank
16 Oil cooler
17 Air breather
18 Return filter w/bypass valve
19 Strainer
20 Drain filter
21 4-cartridge valve
22 Pressure sensor
23 Pressure sensor
24 Pressure sensor
25 Terminal block
26 Last guard filter
27 Lasr guard filter
34 2-EPPR valve
59 Shockless valve

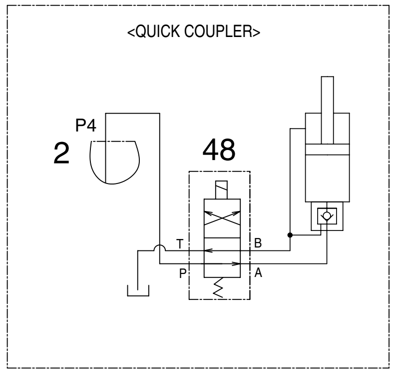
30K9-37100-01 1OF2

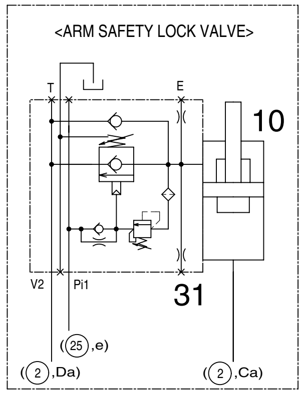
2. HYDRAULIC CIRCUIT (2/2)

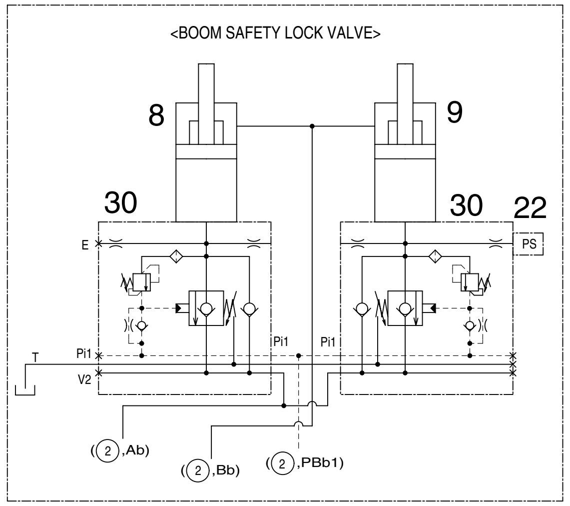


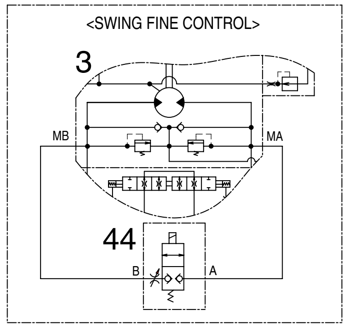




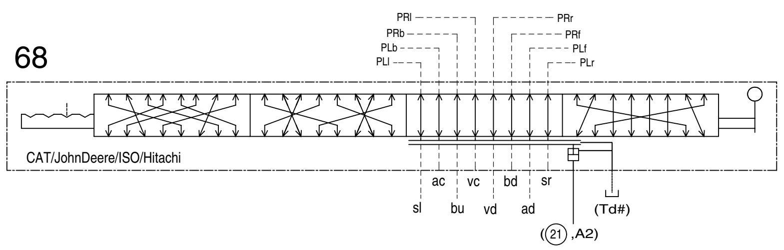








<4-PATTERN CHANGE>



FROM		TO	
ITEM	PORT	ITEM	PORT
5	1	68	PLl
	2		PLf
	3		PLr
	4		PLb
68	sl	25	A
	ad		D
	sr		B
	ac		E
6	1	68	PRr
	2		PRb
	3		PRl
	4		PRf
68	vd	25	G
	bu		H
	vc		F
	bd		J

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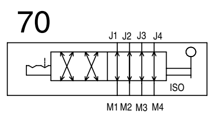
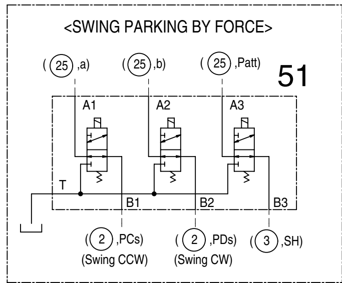


FROM		TO	
ITEM	PORT	ITEM	PORT
5	2	50	J1
	4		J3
6	2		J4
	4		J2
50	M1	25	D
	M2		J
	M3		E
	M4		H



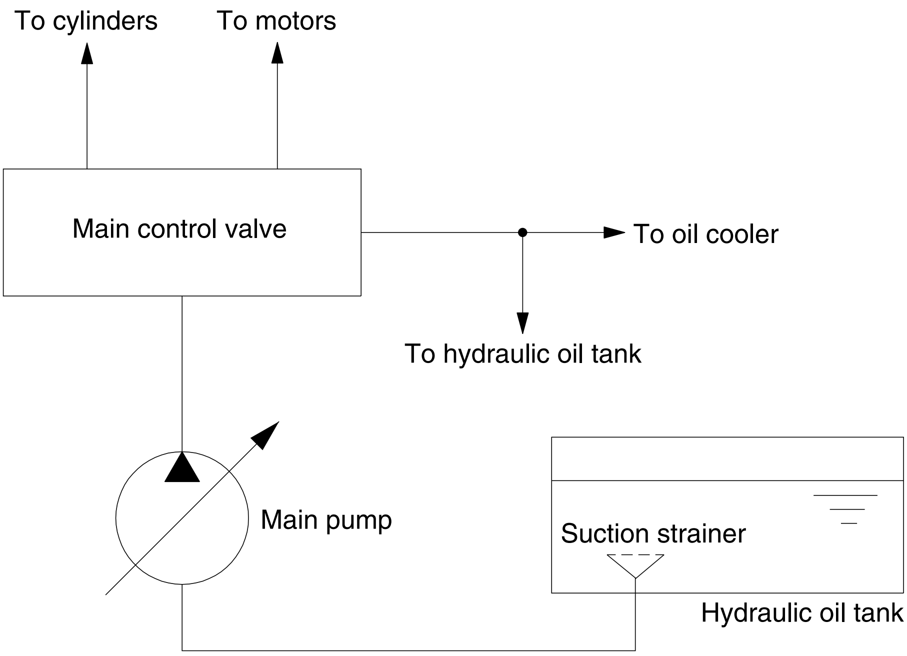
1 Main pump
2 Main control valve
3 Swing unit
8 Boom cylinder (LH)
9 Boom cylinder (RH)
10 Arm cylinder
13 Check valve
14 Check valve
16 Oil cooler
22 Pressure sensor
24 Pressure sensor
26 Last guard filter
30 Boom safety lock valve (LH, RH, option)
32 Arm safety lock valve (option)
33 Shuttle valve (option)
37 Stop valve (option)
39 2-way pedal (option)
40 3-way joint (option)
41 Solenoid valve (option)
44 Solenoid valve (option)
48 Solenoid valve (option)
50 Solenoid valve (option)
51 Solenoid valve (option)
56 Proportional valve (option)
58 2-EPPR valve (option)
68 Pattern change valve (option)
69 Gear pump (option)
70 Pattern change valve (option)

30K9-37100-01 2OF2

GROUP 2 MAIN CIRCUIT

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

1. SUCTION AND DELIVERY CIRCUIT

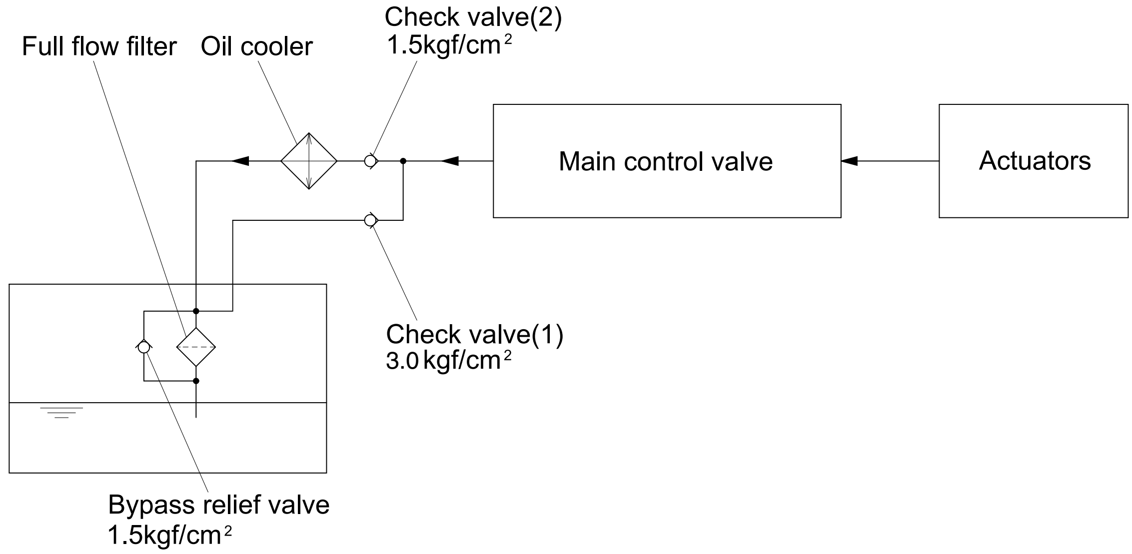


140L3CI01

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

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

2. RETURN CIRCUIT

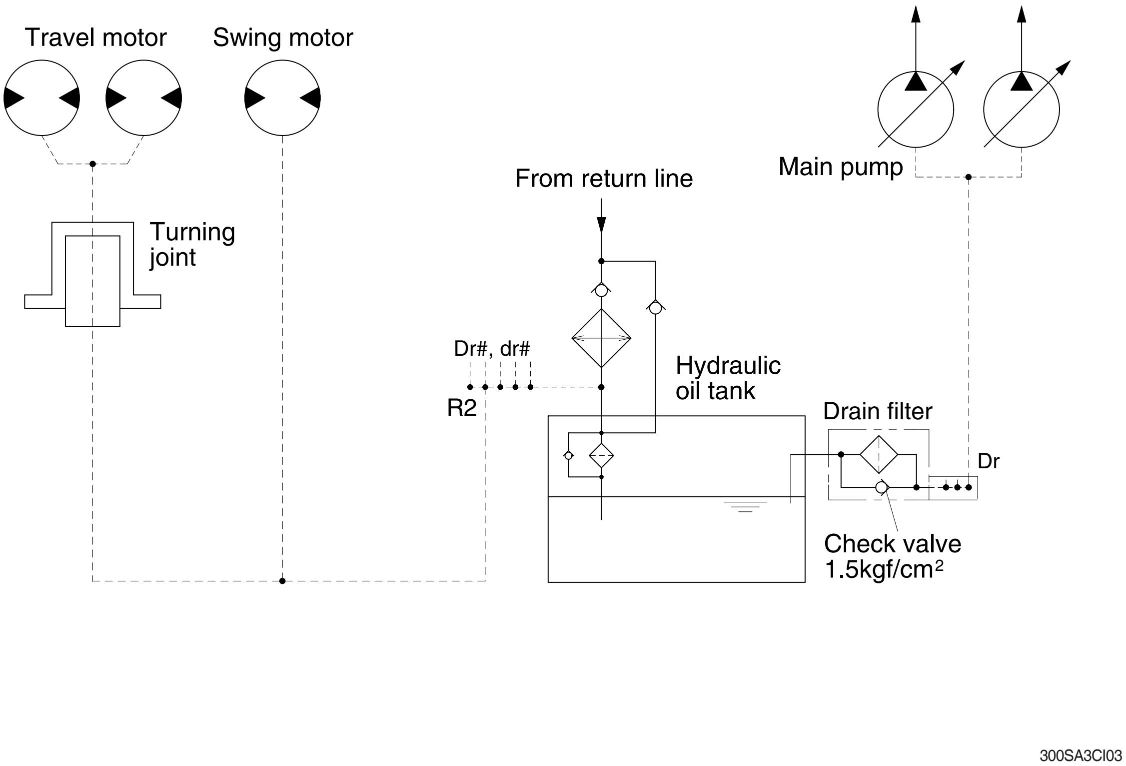


220F3CI01

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

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

3. DRAIN CIRCUIT



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

1) TRAVEL AND SWING MOTOR DRAIN CIRCUIT

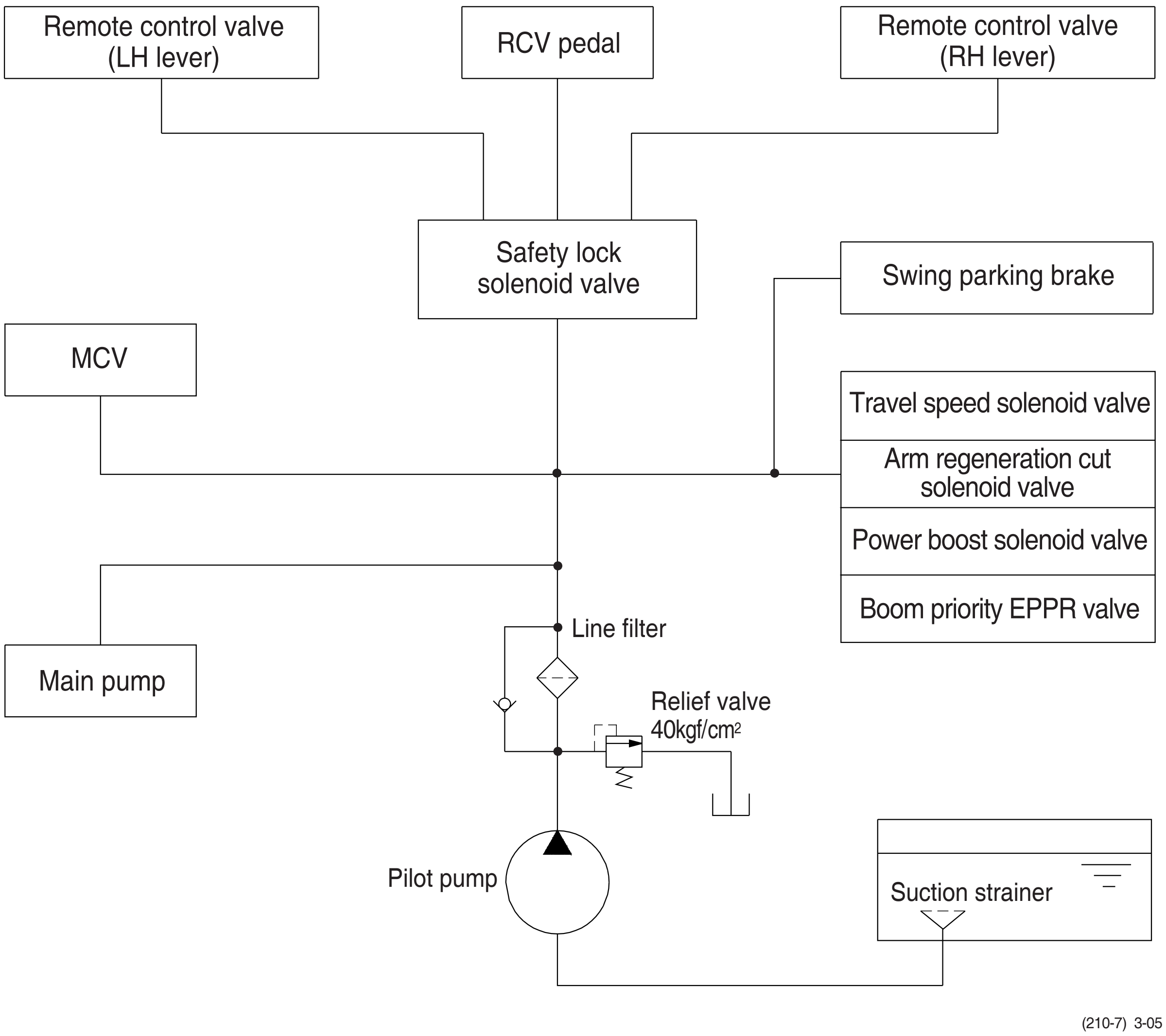
Oil leaking from the right and left travel motors comes out of the drain ports provided in the respective motor casing and join with each other. These oils pass through the turning joint and join with oil leak line of the swing motor and return to the hydraulic tank after being filtered by return filter.

2) MAIN PUMP DRAIN CIRCUIT

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

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

GROUP 3 PILOT CIRCUIT



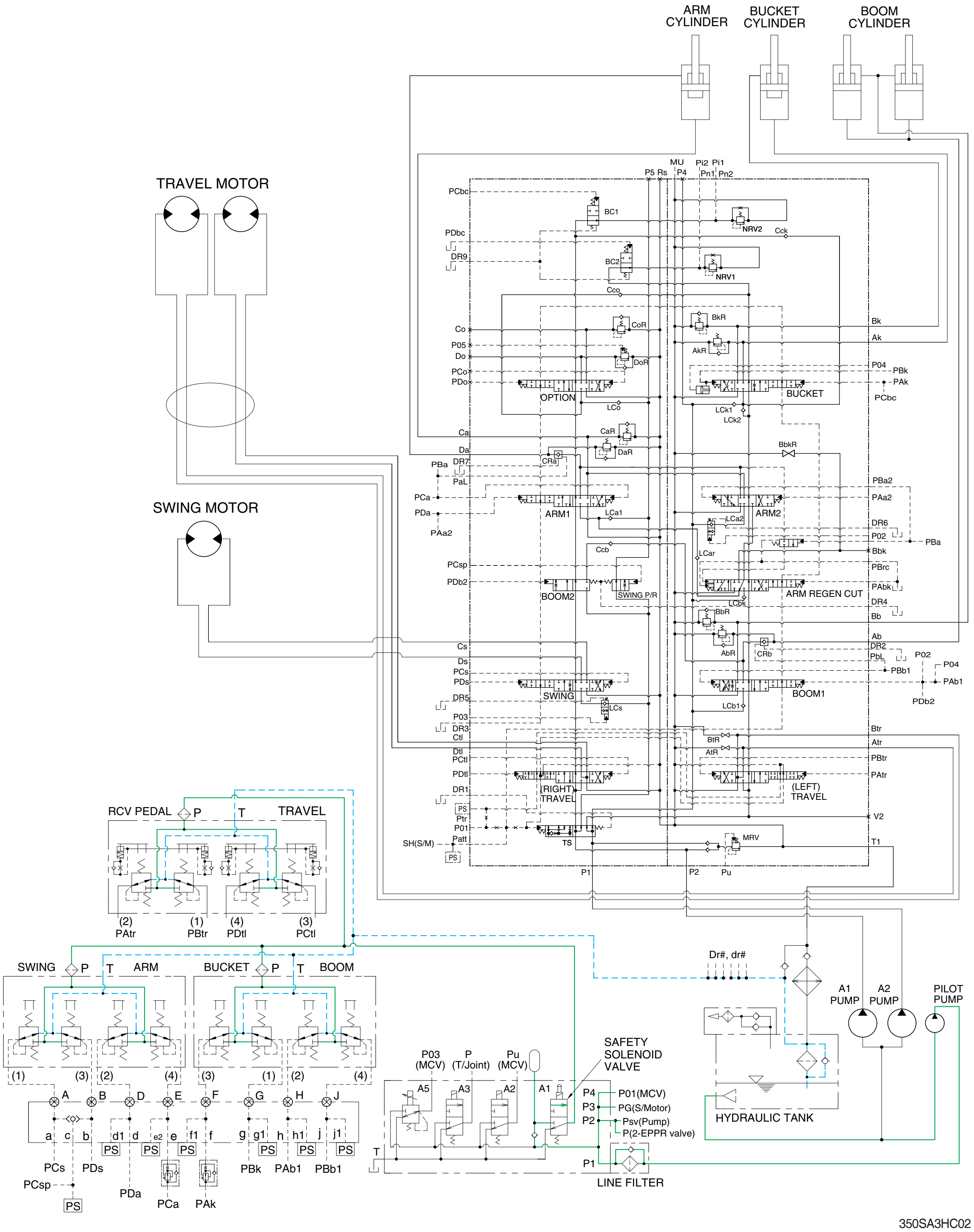
The pilot circuit consists of suction circuit, delivery circuit and return circuit.

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

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

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

1. SUCTION, DELIVERY AND RETURN CIRCUIT



350SA3HC02

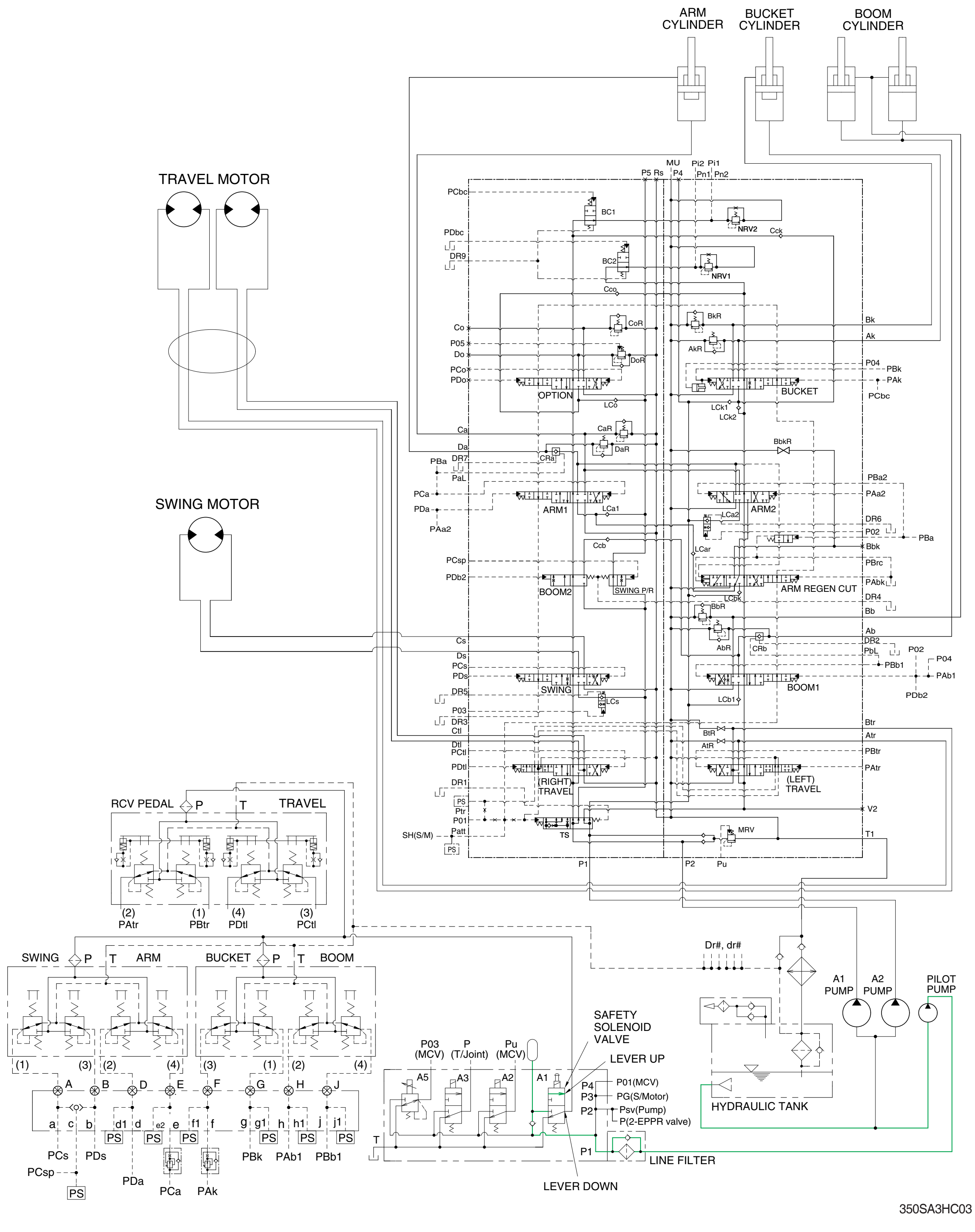
The pilot pump receive oil from the hydraulic tank. The discharged oil from the pilot pump flows to the safety solenoid valve through the line filter. The oil is filtered by the line filter. The pilot relief valve is provided in the pilot pump for limiting the pilot circuit pressure.

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

The return oil flow into the hydraulic tank through return filter.

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

2. SAFETY VALVE (SAFETY LEVER)

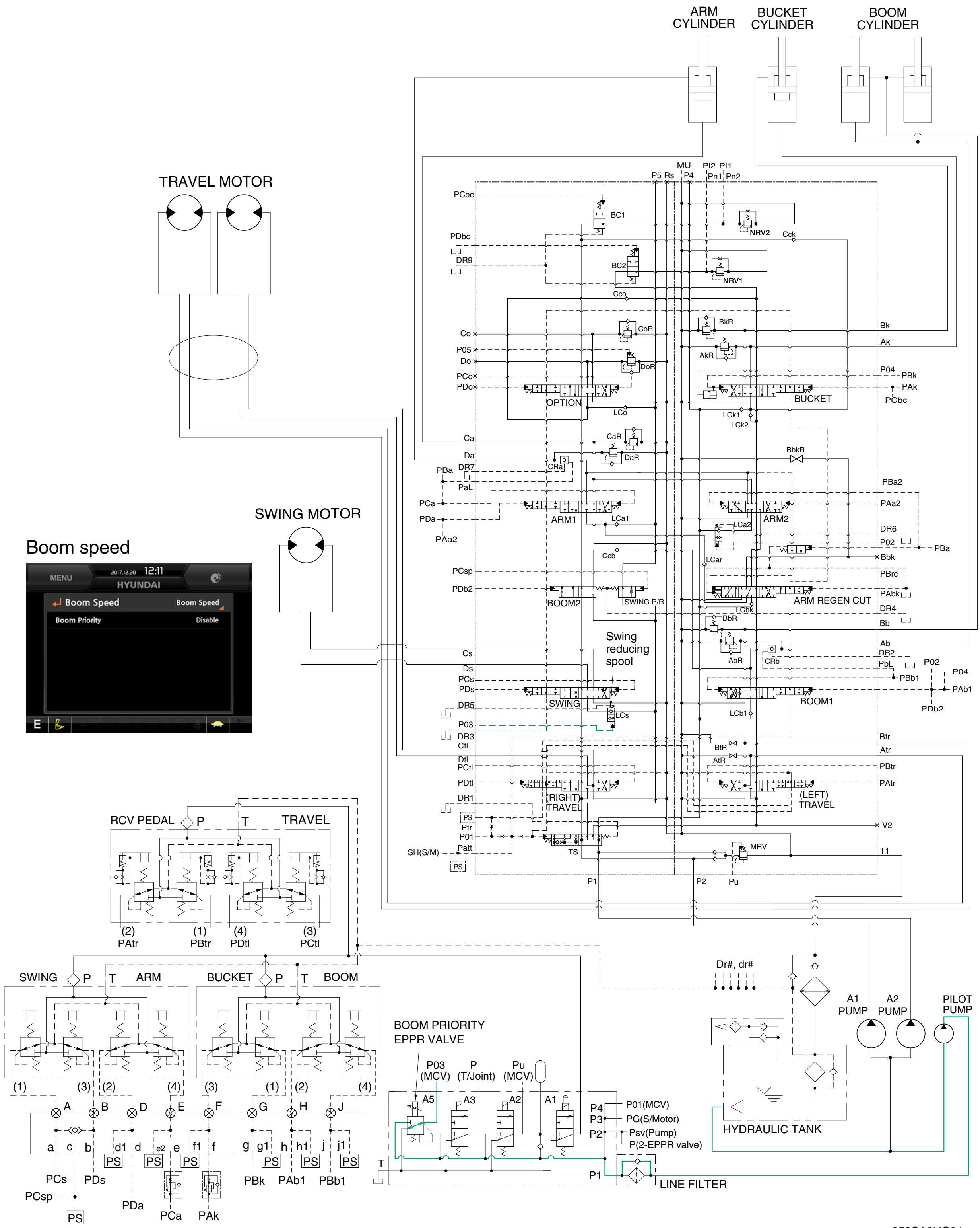


When the lever of the safety solenoid valve is moved upward, oil flows into the remote control valve through solenoid valve and line filter.

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

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

3. BOOM PRIORITY SYSTEM



350SA3HC04

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

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

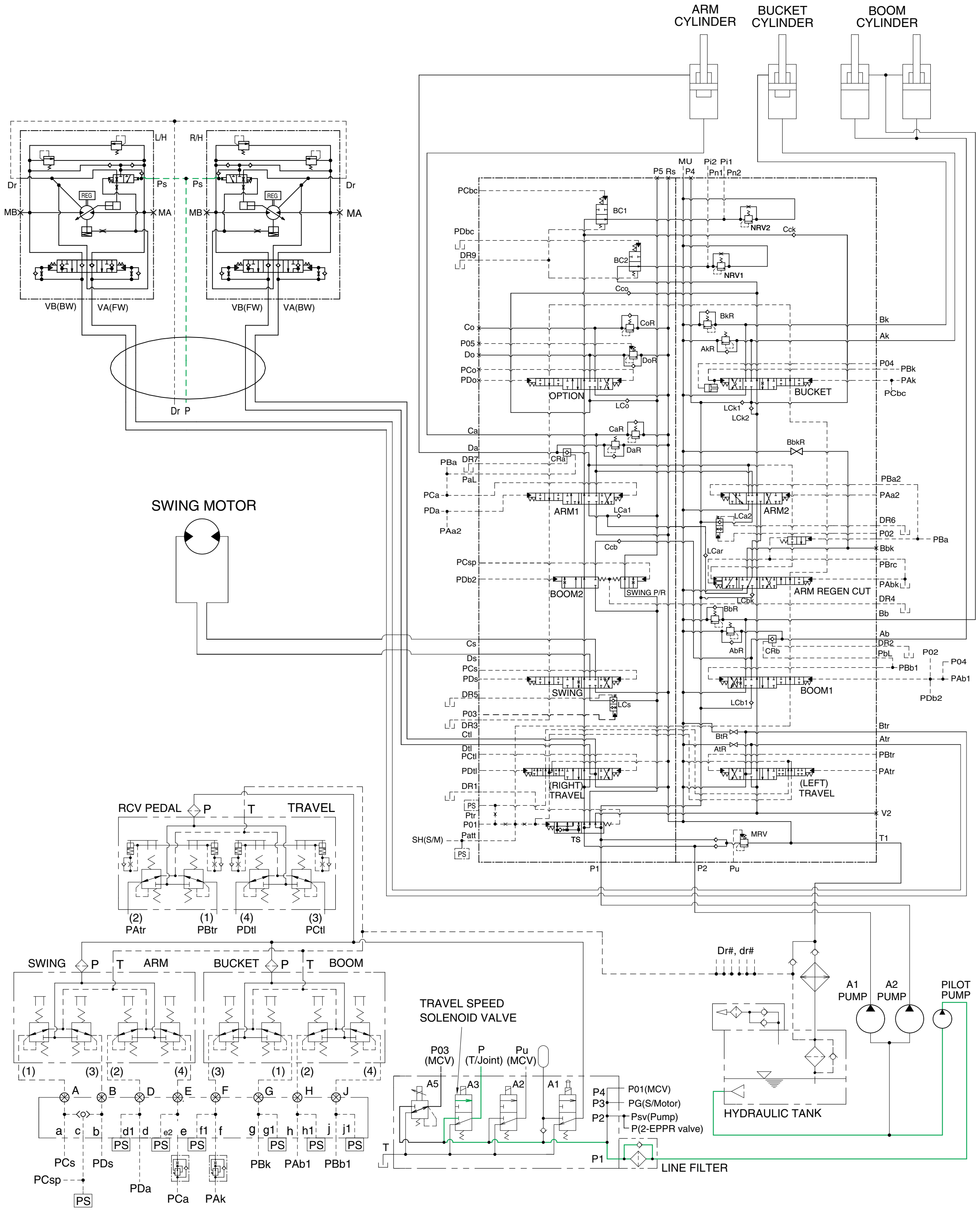
The pilot oil from pilot pump flow into P03 port in main control valve through boom priority EPPR valve. P03 oil pressure moves swing reducing spool to lower position and oil flow rate to the swing motor decreased.

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

The boom up speed can be adjusted by the cluster. Refer to page 3-19 of the operator's manual.

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

4. TRAVEL SPEED CONTROL SYSTEM



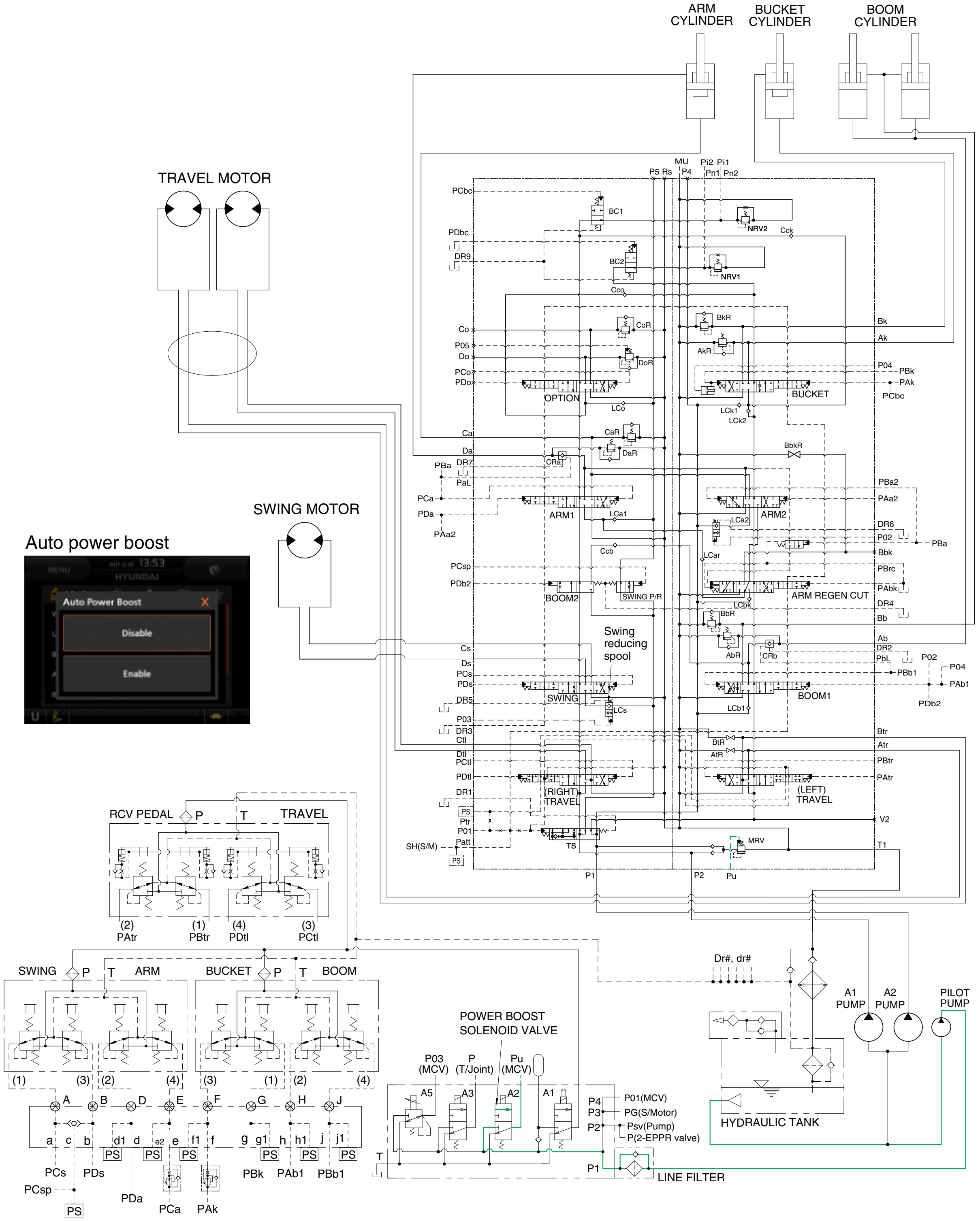
350SA3HC05

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

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

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

5. MAIN RELIEF PRESSURE CHANGE SYSTEM



350SA3HC06

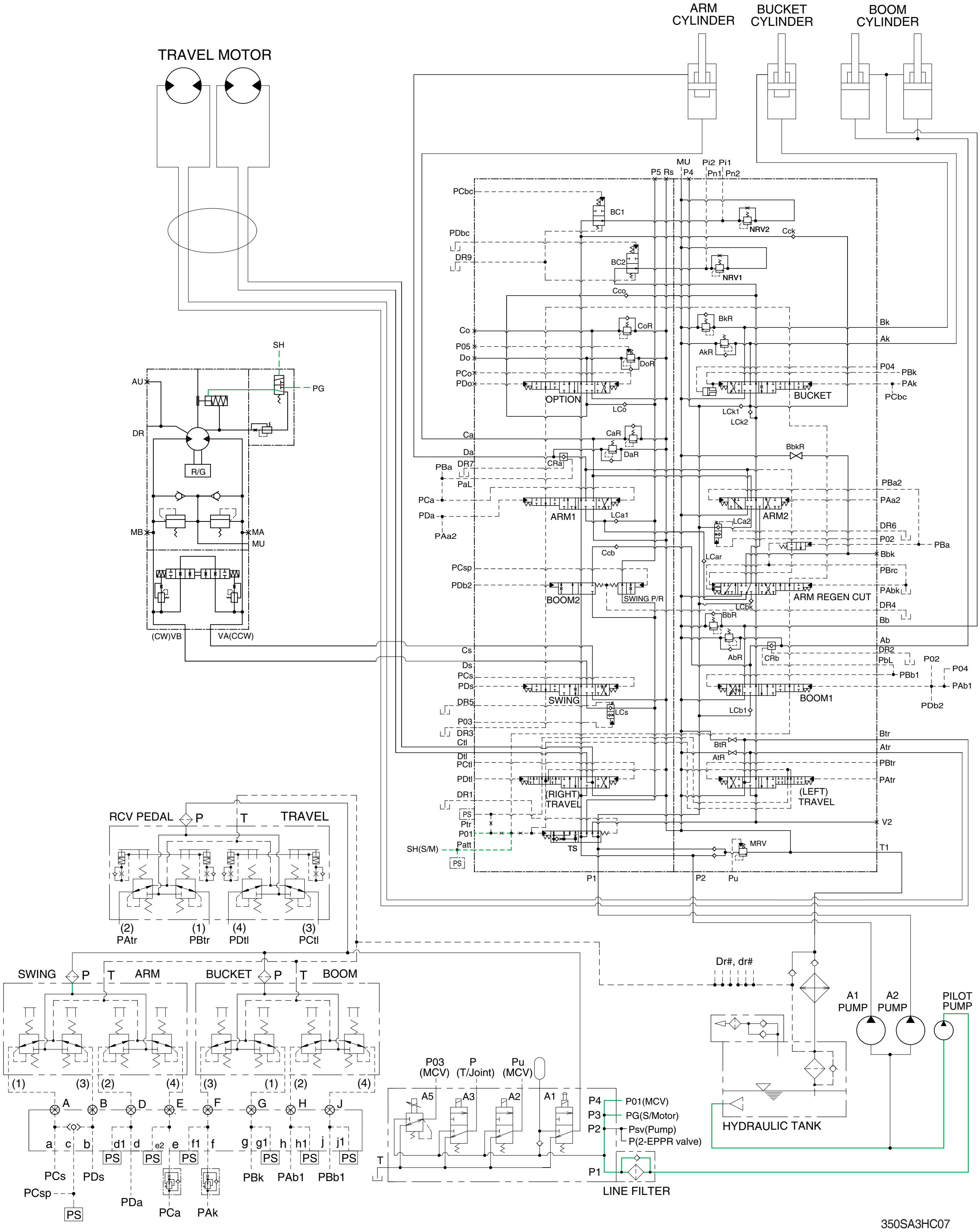
When the power boost switch on the left control lever is pushed ON, the power boost solenoid valve is actuated, the discharged oil from the pilot pump flows into Pu port of the main relief valve of main control valve; then the setting pressure of the main relief valve is raised from 350 kgf/cm² (4980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

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

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

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

6. SWING PARKING BRAKE RELEASE



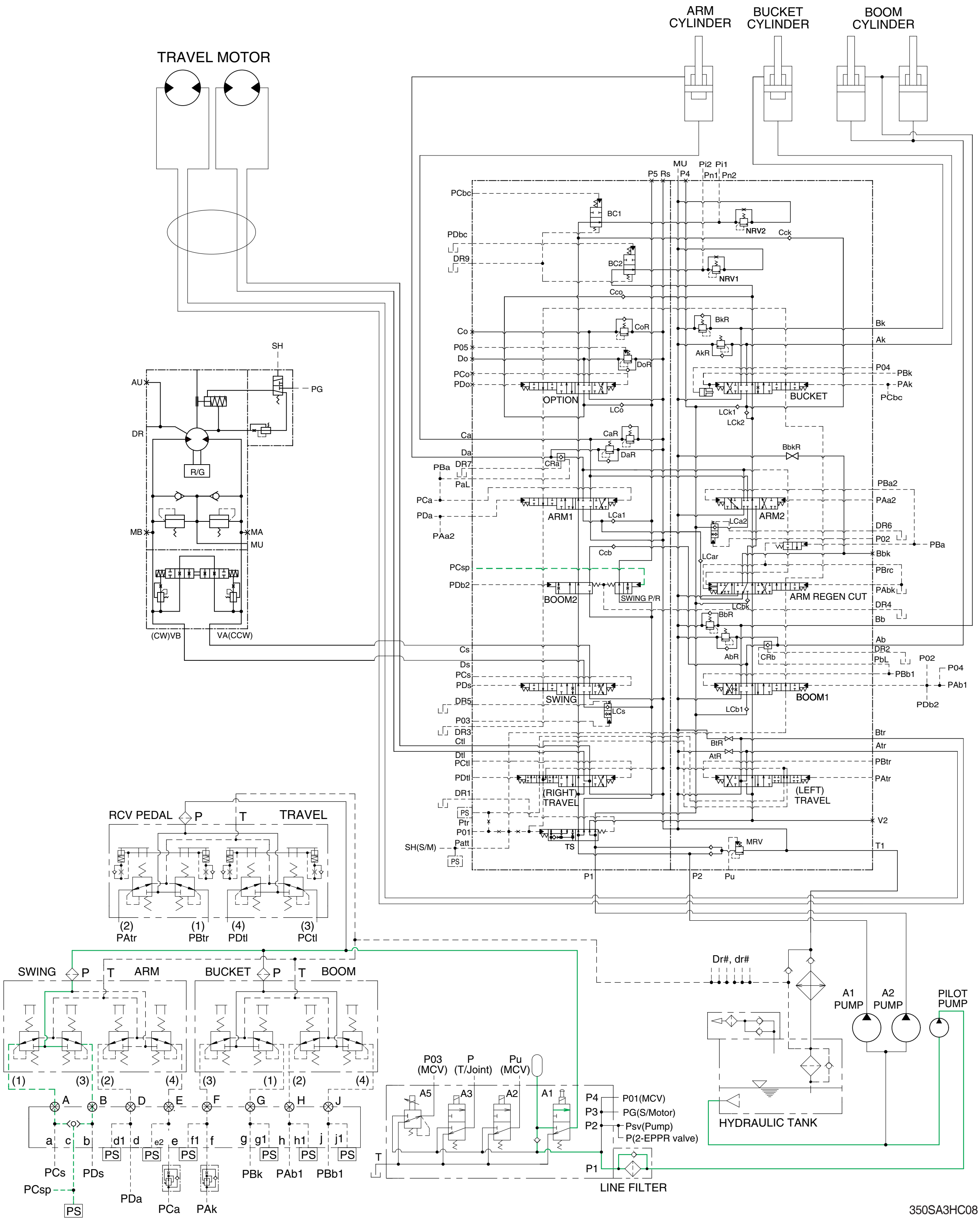
When one of the RCV lever (except travel lever) is tilted, the pilot oil flows into SH port through main control valve.

This pressure moves spool of the swing brake valve 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 (except travel lever) are set in the neutral position, oil in the swing motor disc cylinder is drained, thus the brake is applied.

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

7. SWING PRIORITY SYSTEM



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

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

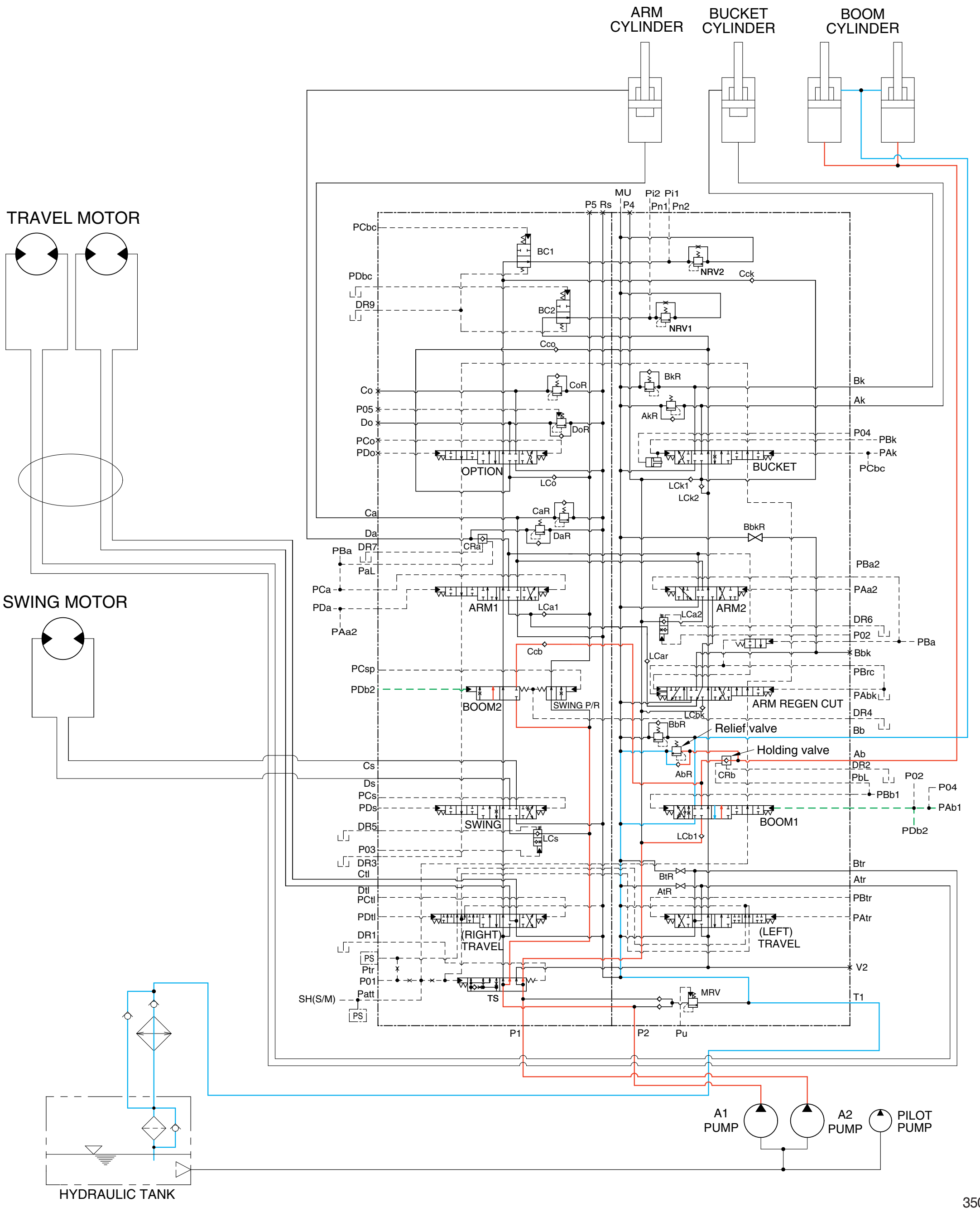
This is called the swing priority system.

For details, refer to page 2-51.

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

GROUP 4 SINGLE OPERATION

1. BOOM UP OPERATION



350SA3HC09

When the right control lever is pulled back, the boom spools in the main control valve are moved to the up position by the pilot oil pressure (PAb1, PDb2) from the remote control valve.

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

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

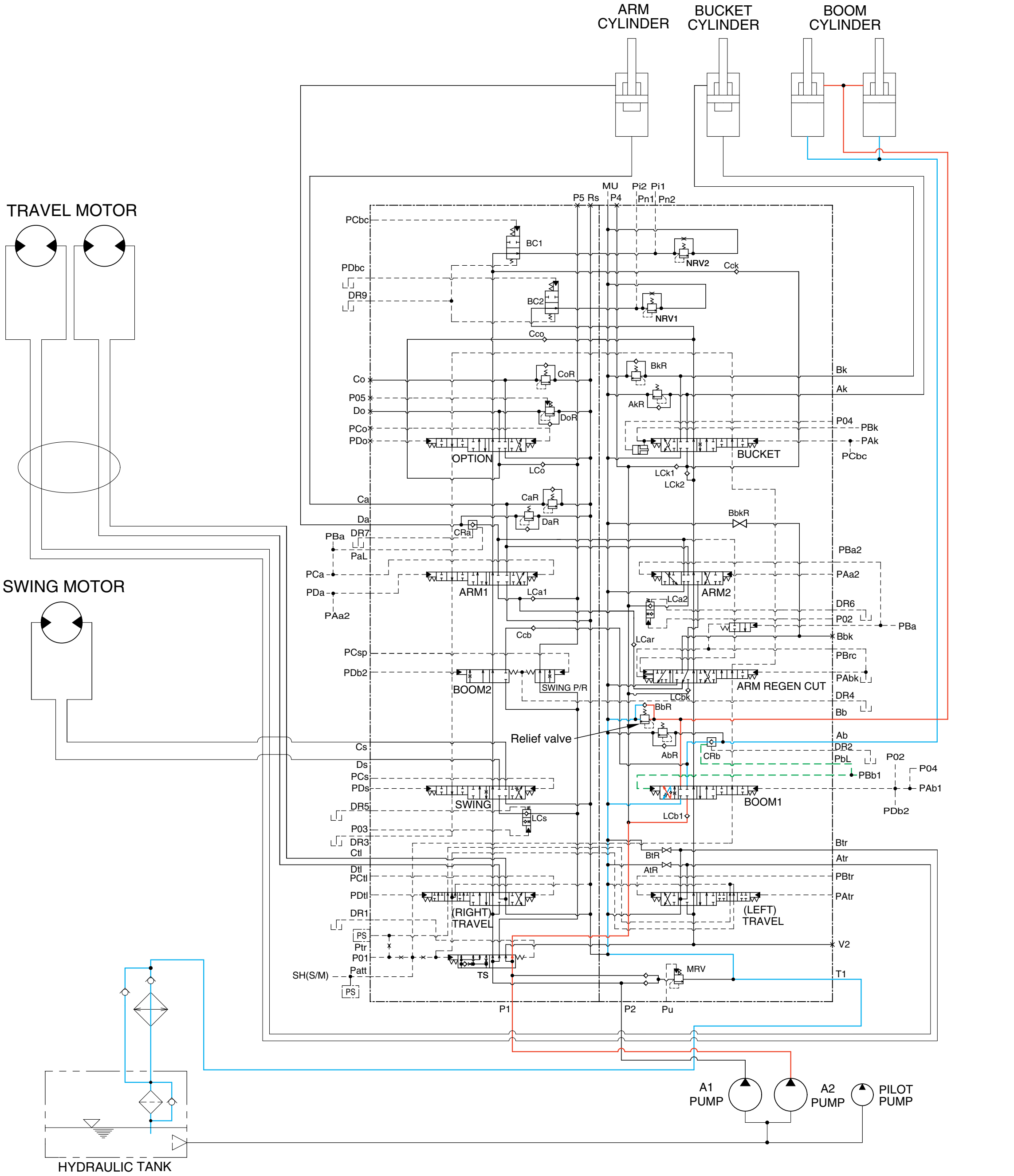
The excessive pressure in the boom cylinder head side is prevented by relief valve.

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

This prevents the hydraulic drift of boom cylinder.

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

2. BOOM DOWN OPERATION



350SA3HC10

When the right control lever is pushed forward, the boom 1 spool in the main control valve is moved to the down position by the pilot oil pressure (PBb1) from the remote control valve.

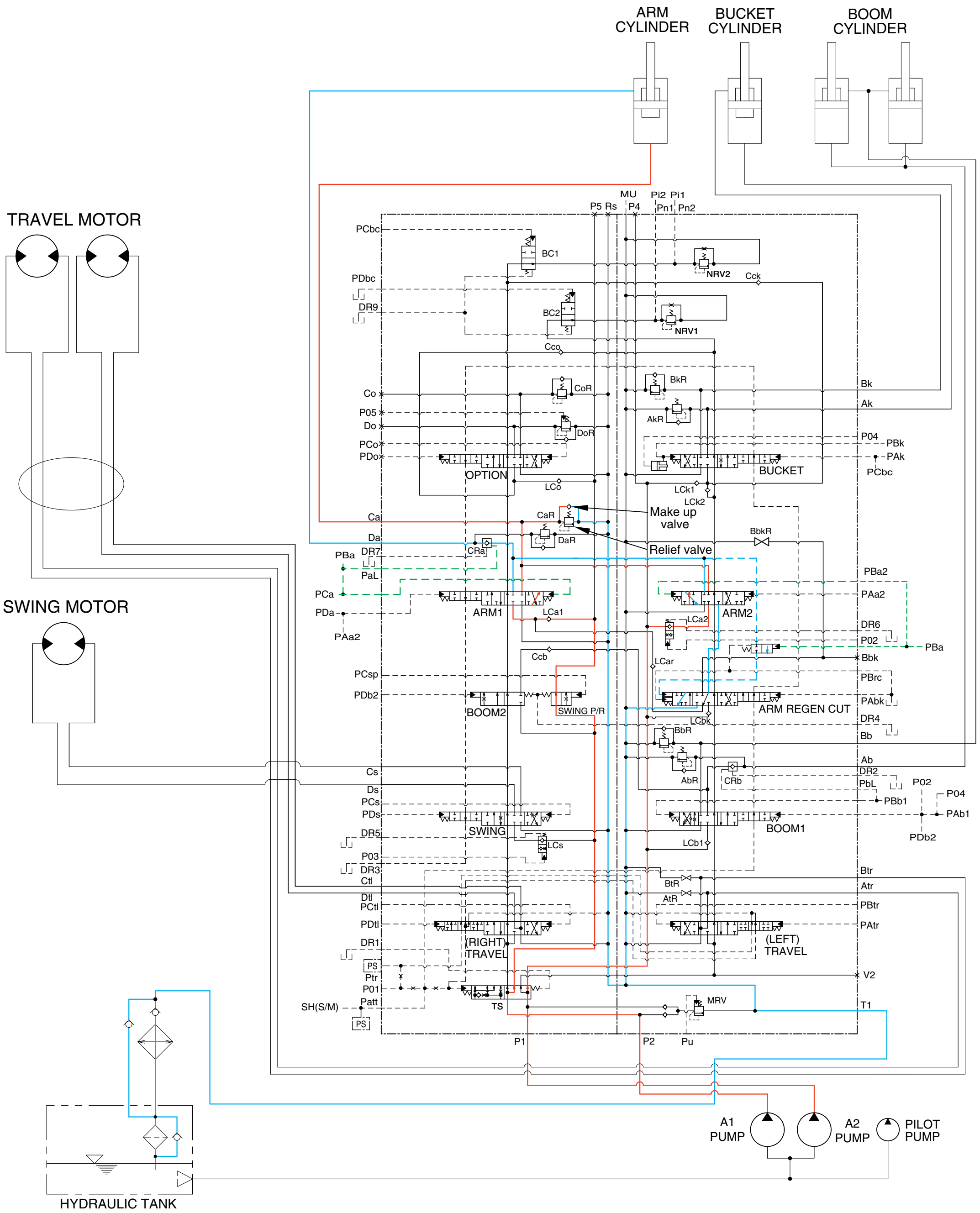
The oil from the A2 pump flows into the main control valve and then goes to the small chamber of boom cylinders. At the same time, the oil from the large chamber of boom cylinders returns to the hydraulic tank through the boom 1 spool in the main control valve.

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

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

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

3. ARM IN OPERATION



350SA3HC11

When the left control lever is pulled back, the arm spools in the main control valve are moved to the roll in position by the pilot oil pressure (PBa2, PCa) 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.

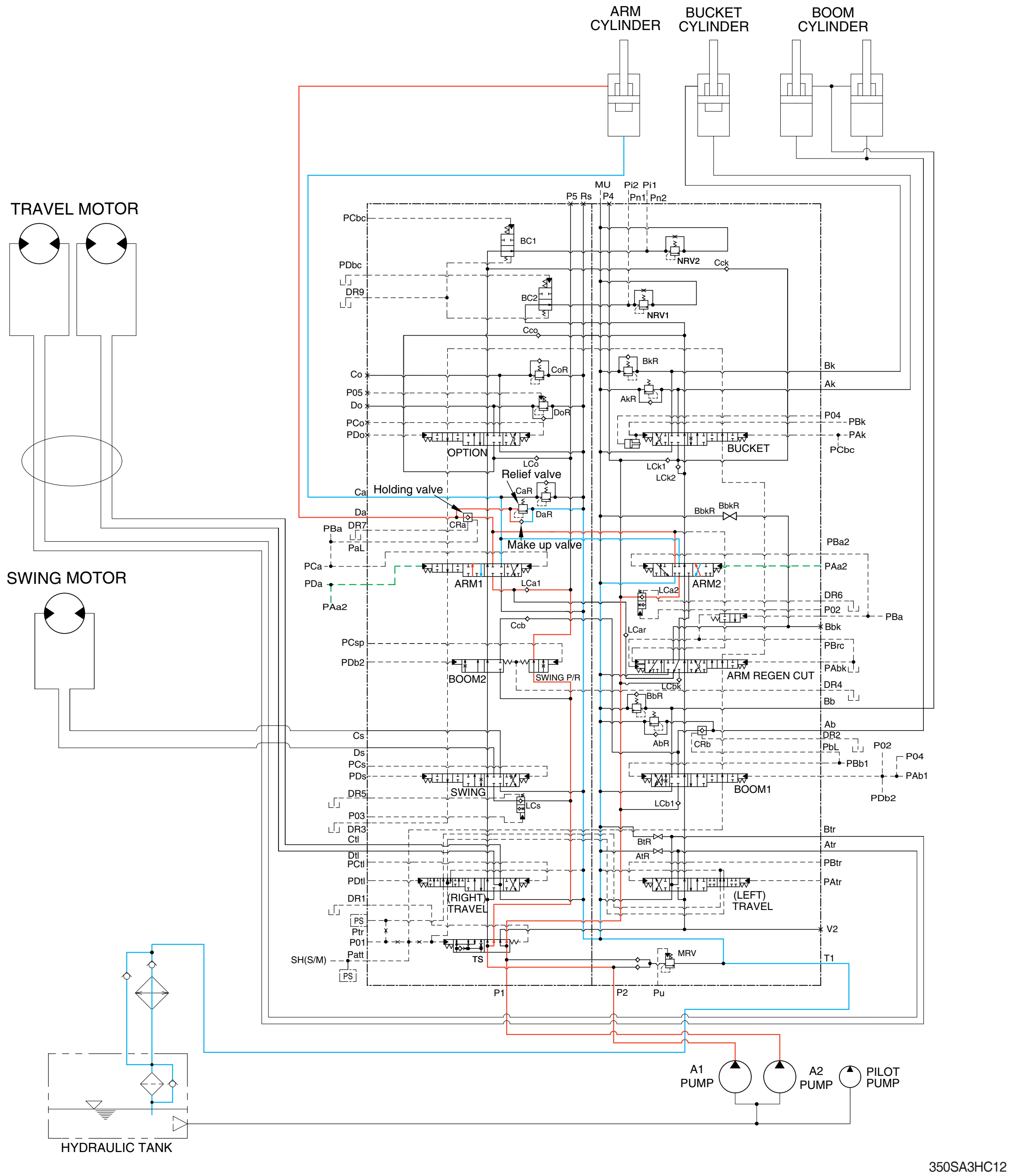
At the same time, the oil from small chamber of arm cylinder returns to the hydraulic oil tank through the arm 2 spool in the main control valve. When this happens, the arm rolls in.

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

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

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

4. ARM OUT OPERATION



When the left control lever is pushed forward, the arm spools in the main control valve are moved to the roll out position by the pilot oil pressure (PAa2, PDa) from the remote control valve.

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

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

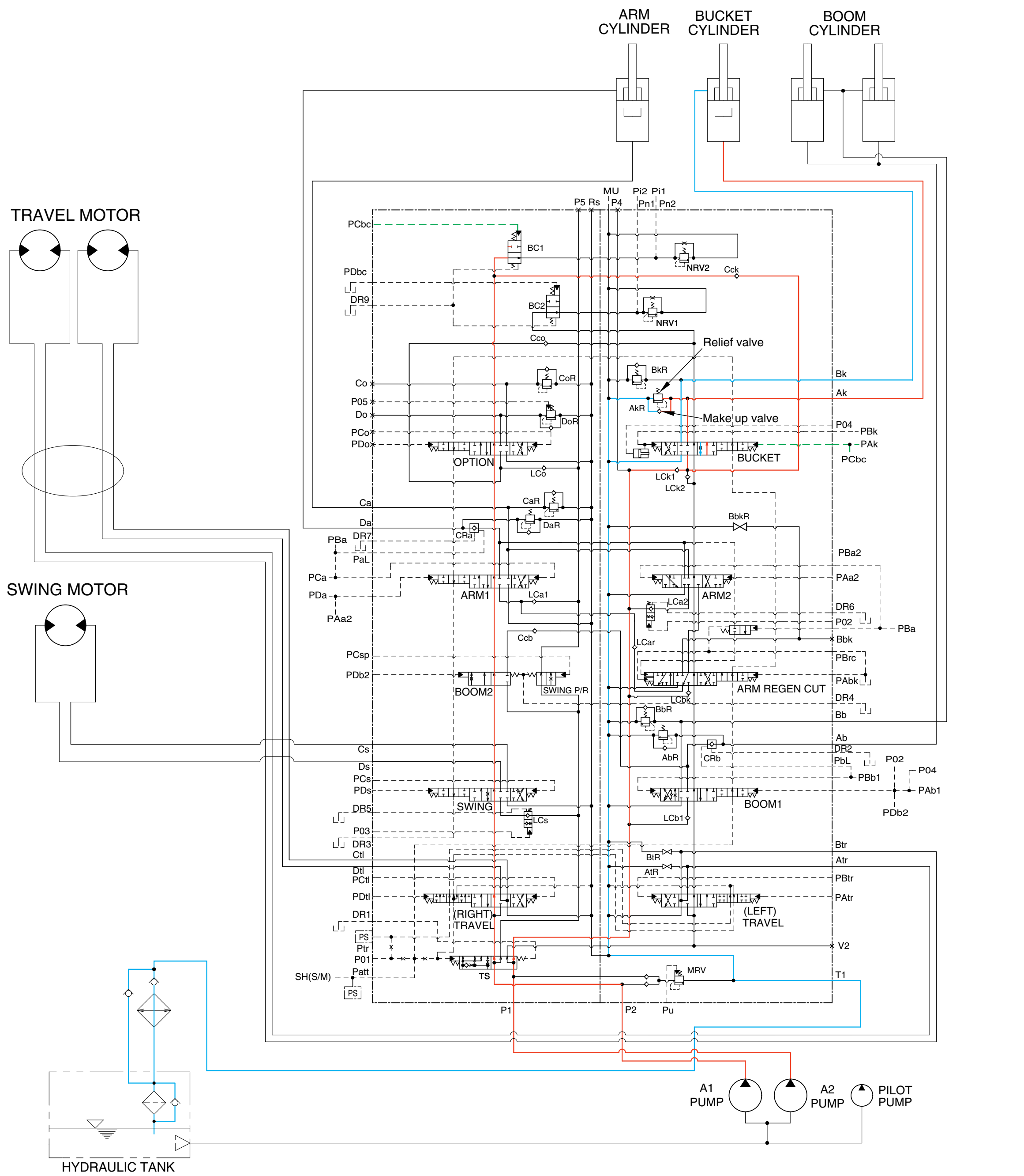
The excessive pressure in the arm cylinder rod side is prevented by relief valve.

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

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

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

5. BUCKET IN OPERATION



350SA3HC13

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

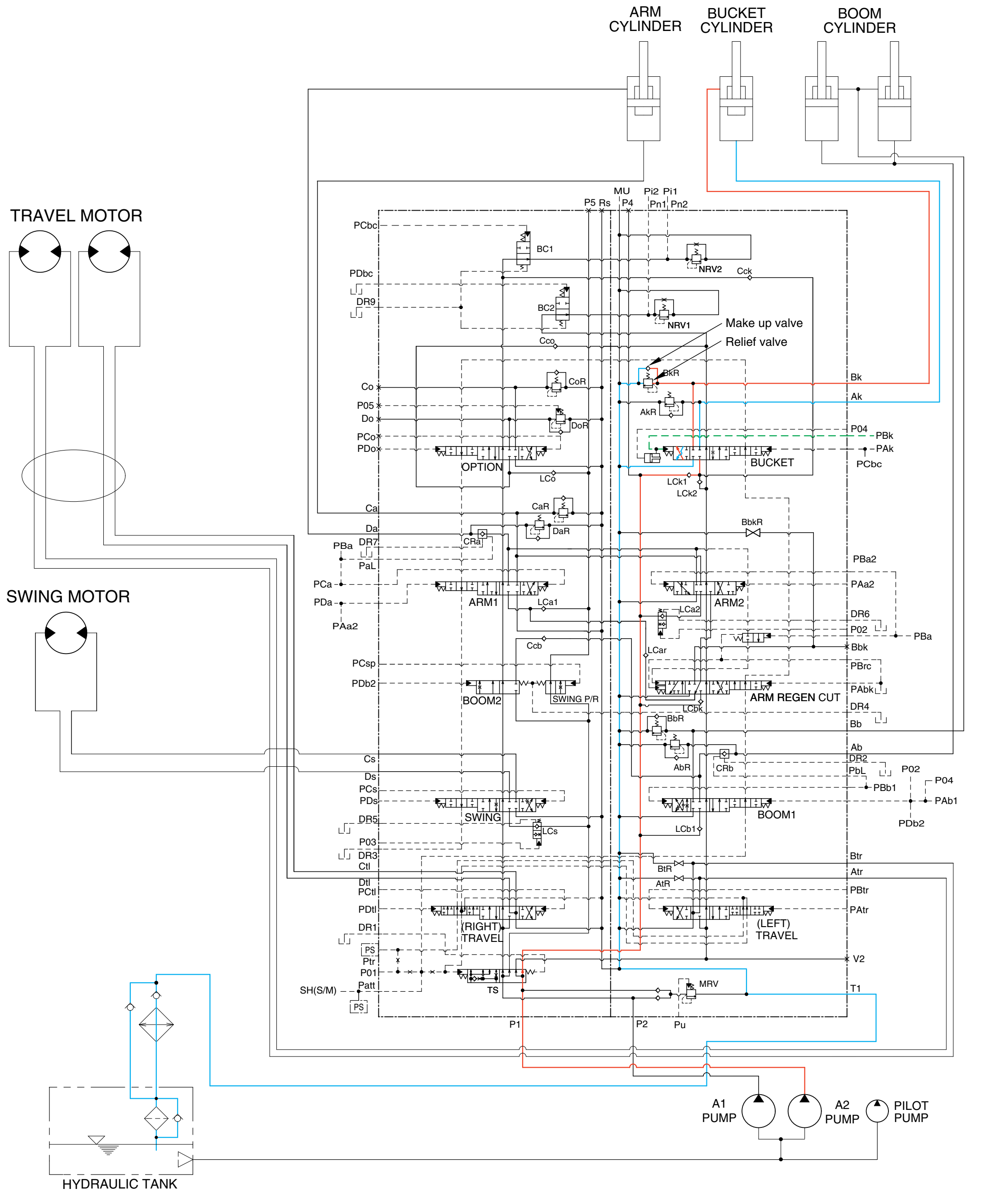
At the same time, the oil from the small chamber of bucket cylinder returns to the hydraulic oil tank through the bucket spool in the main control valve. When this happens, the bucket rolls in.

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

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

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

6. BUCKET OUT OPERATION



350SA3HC14

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

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

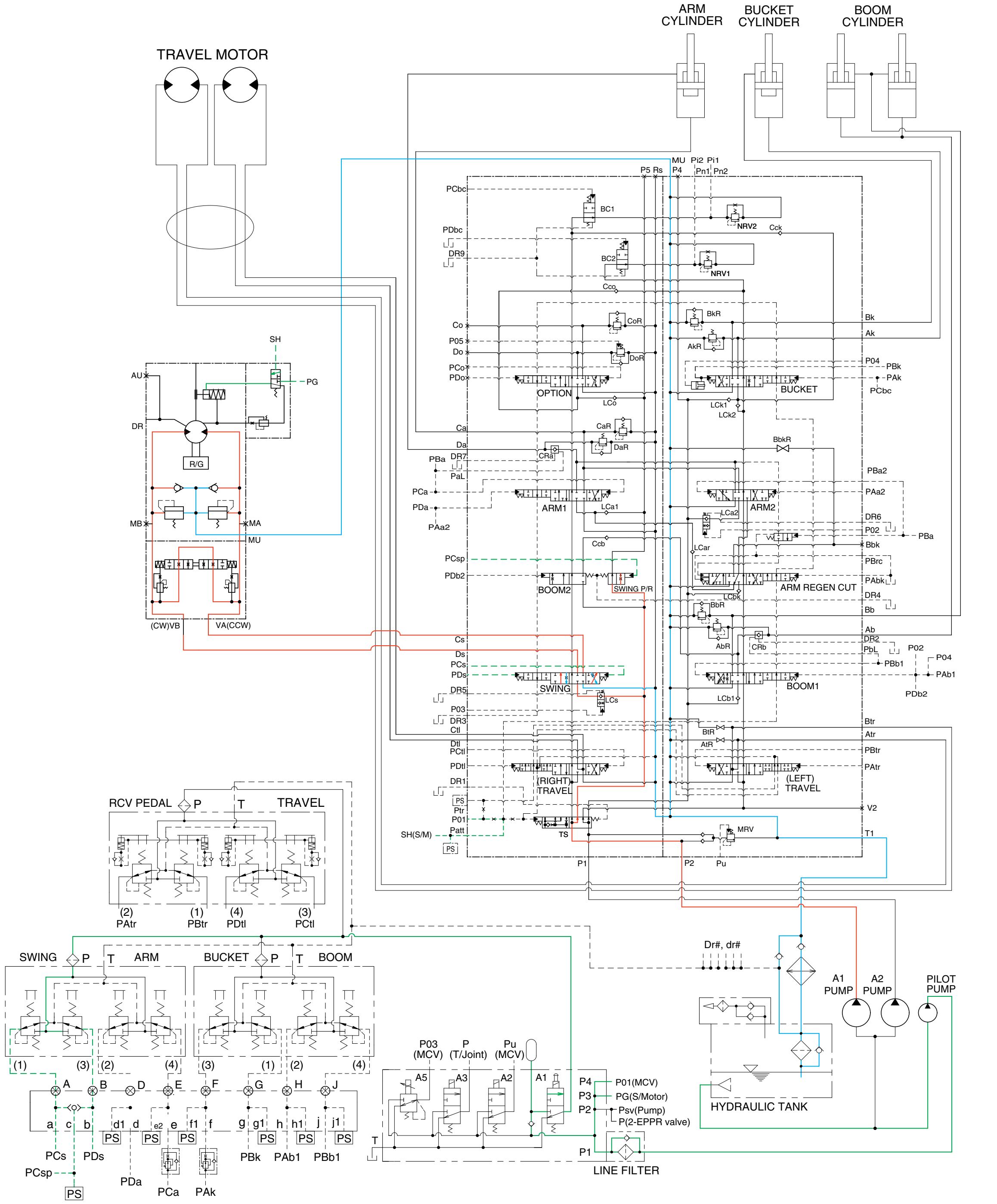
At the same time, the oil from the large chamber of bucket cylinder returns to the hydraulic oil tank through the bucket spool in the main control valve. When this happens, the bucket rolls out.

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

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

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

7. SWING OPERATION



350SA3HC15

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

Also the swing operation preference function is operated by the pilot pressure PCsp (refer to page 2-51).

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

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

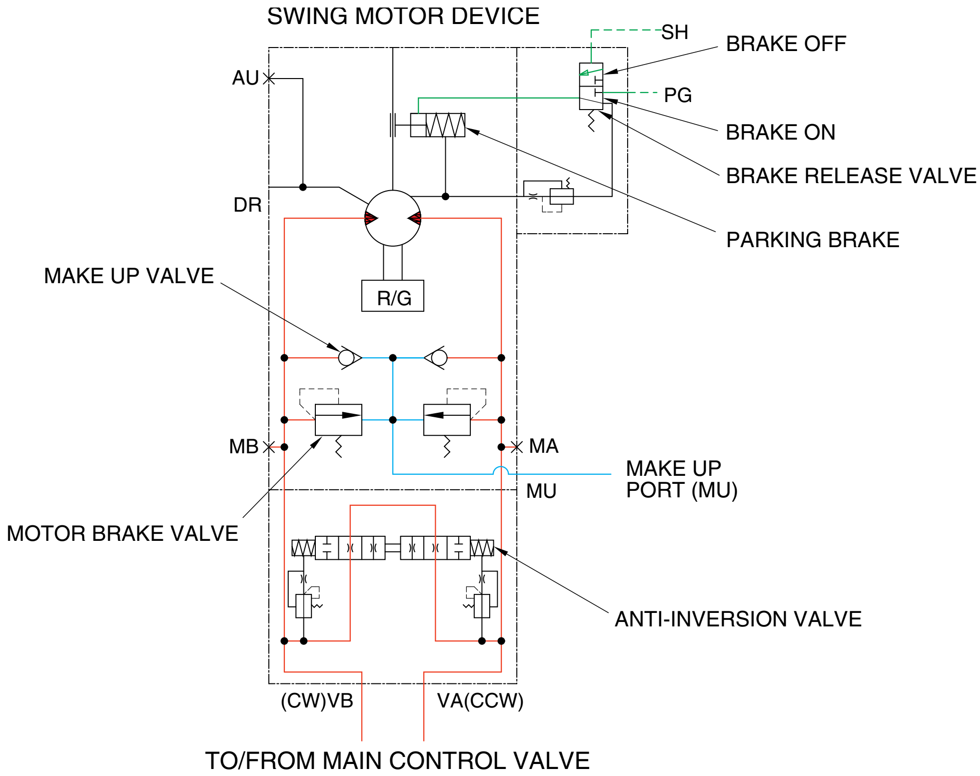
When this happens, the upper structure swings to the left or right.

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

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

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

SWING CIRCUIT OPERATION



220S3HC15A

1) MOTOR BRAKE VALVE

Motor brake valve for the swing motor limits to cushion the starting and stopping pressure of swing operation and controls the swing motor operating pressure to 300 kgf/cm² (4270 psi).

2) MAKE UP VALVE

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

3) PARKING BRAKE

This is function as a parking brake only when the swing control lever and arm in control lever are not operated.

PARKING BRAKE "OFF" OPERATION

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

When the swing control lever or arm in control lever placed in the operating position, the pilot oil flows into SH port through the MCV. This pressure transferred to the brake release valve and the brake release valve is change over. Then the pilot oil pressure PG lift the brake piston and release the parking brake.

PARKING BRAKE "ON" OPERATION

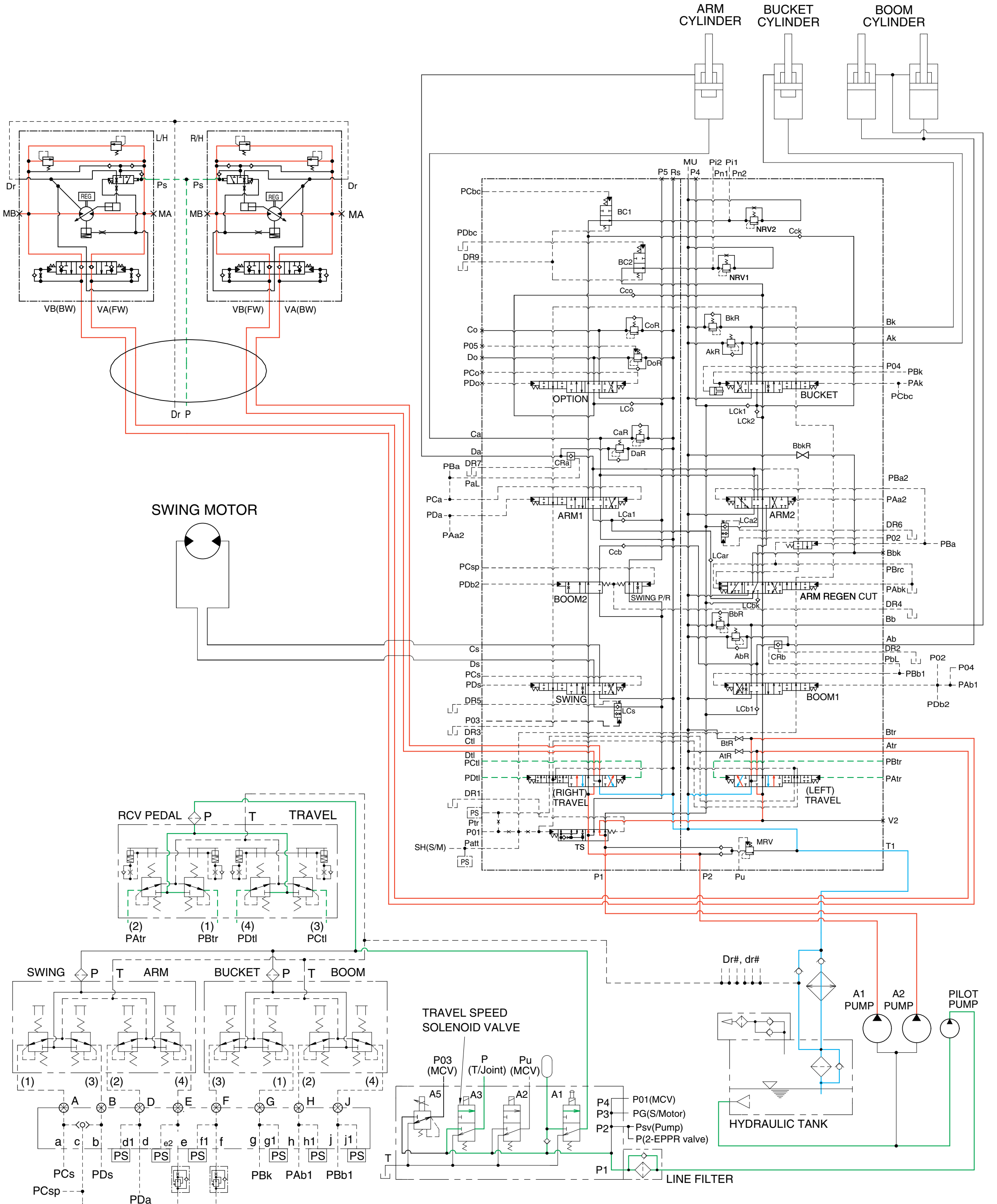
When the swing control lever and arm in control lever placed in the neutral position, the pressure of the pilot oil passage down. Then the brake release valve returned to the neutral position and the oil is returned from the brake piston to the tank. And the brake is set to "ON".

4) ANTI-INVERSION VALVE

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

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

8. TRAVEL FORWARD AND REVERSE OPERATION



350SA3HC16

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 (PAtr, PBtr, PCtl, PDtl) from the remote control valve.

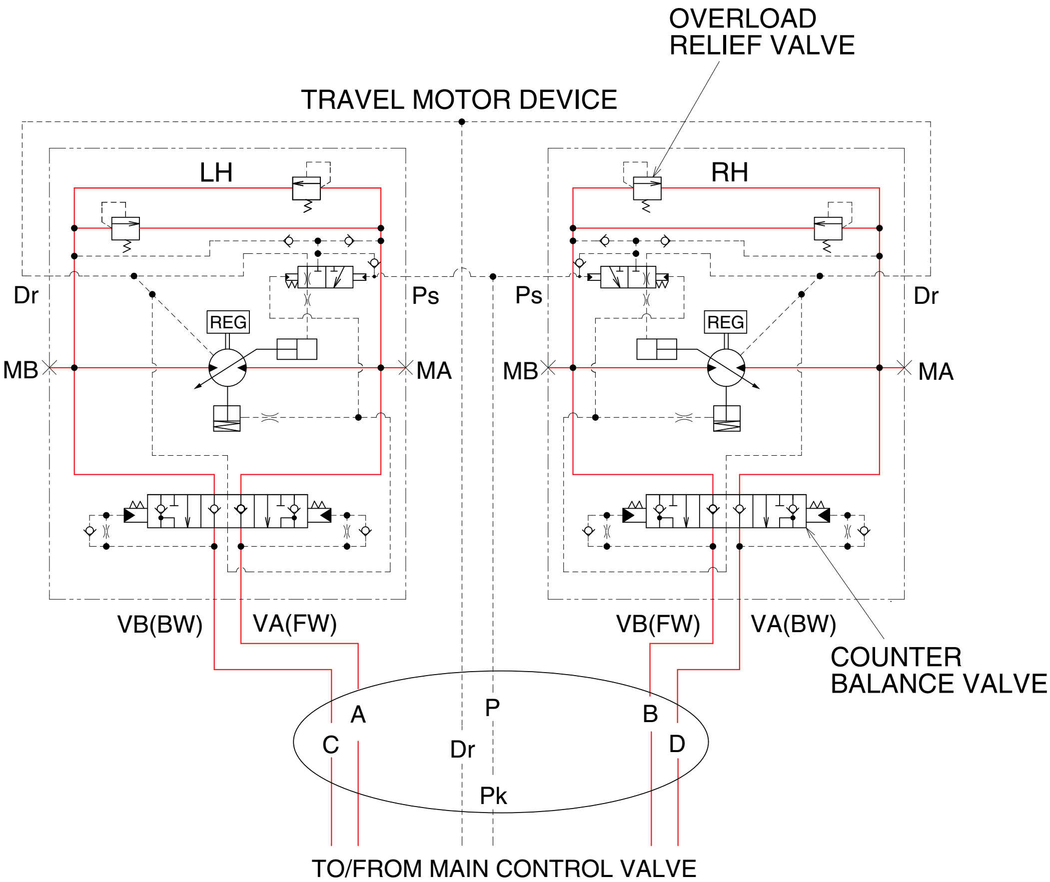
The oil from the each pump flows into the main control valve and then goes to the each travel motor through the turning joint.

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

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

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

TRAVEL CIRCUIT OPERATION



260L3HC16A

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

1) COUNTER BALANCE VALVE

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

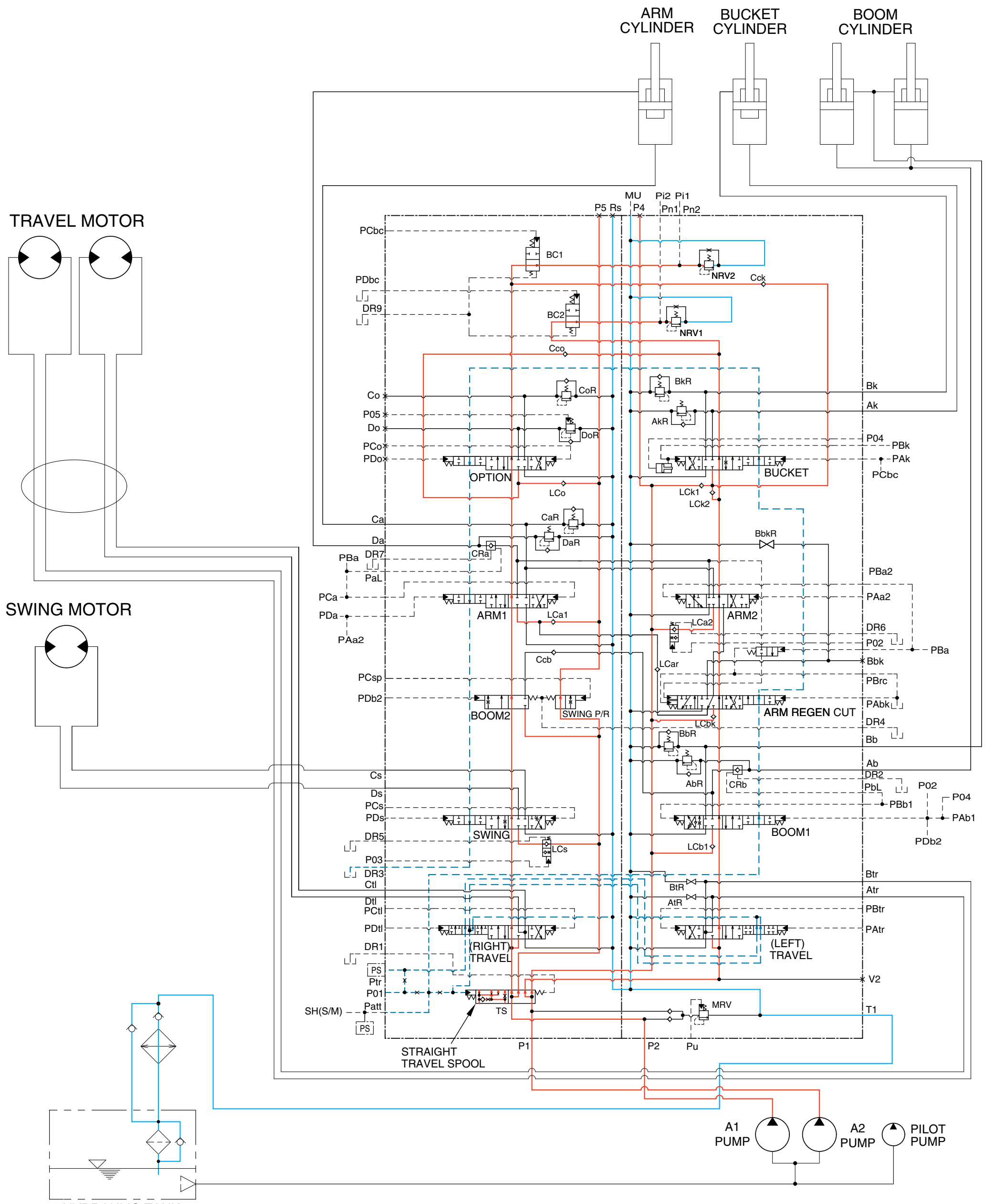
2) OVERLOAD RELIEF VALVE

Relief valve limit the circuit pressure below 350 kgf/cm2 (4980 psi) to prevent high pressure generated at a time of stopping the machine. Stopping the motor, this valve sucks the oil from lower pressure passage for preventing the negative pressure and the cavitation of the motor.

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

GROUP 5 COMBINED OPERATION

1. OUTLINE



350SA3HC17

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

STRAIGHT TRAVEL SPOOL

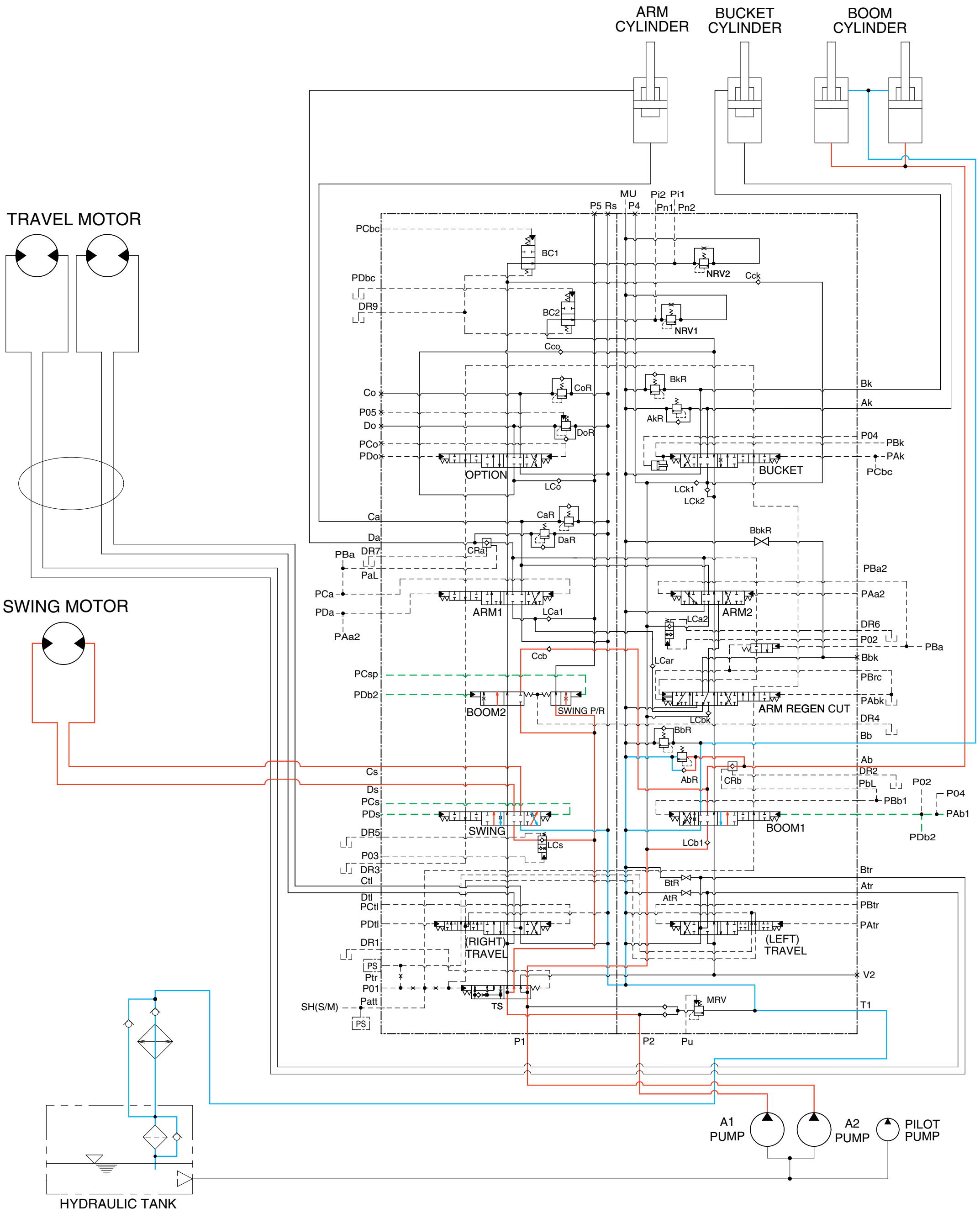
This straight travel spool for straight travel is provided in the main control valve.

If any actuator is operated when traveling, the straight travel spool is pushed to the right by the pilot oil pressure (P01).

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

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

2. COMBINED SWING AND BOOM UP OPERATION



350SA3HC18

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 (PCs, PDs, PAb1, PDb2) from the remote control valve.

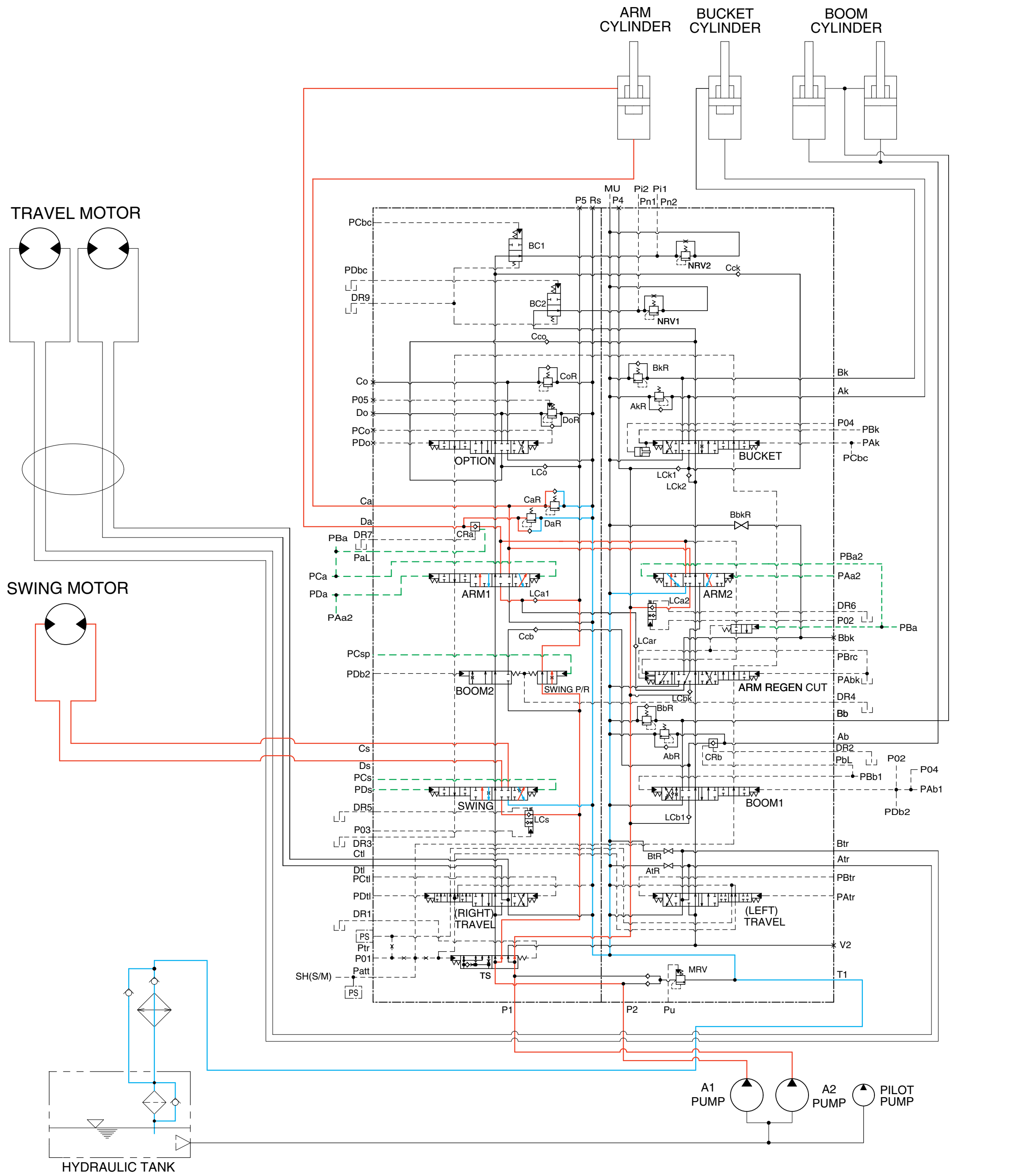
The oil from the A1 pump flows into the swing motor through swing spool and the boom cylinder through boom 2 spool.

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 3-9 for the boom priority system.

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

3. COMBINED SWING AND ARM OPERATION



350SA3HC19

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 (PCs, PDs, PAa2, PBa2, PCa, PDa) from the remote control valve.

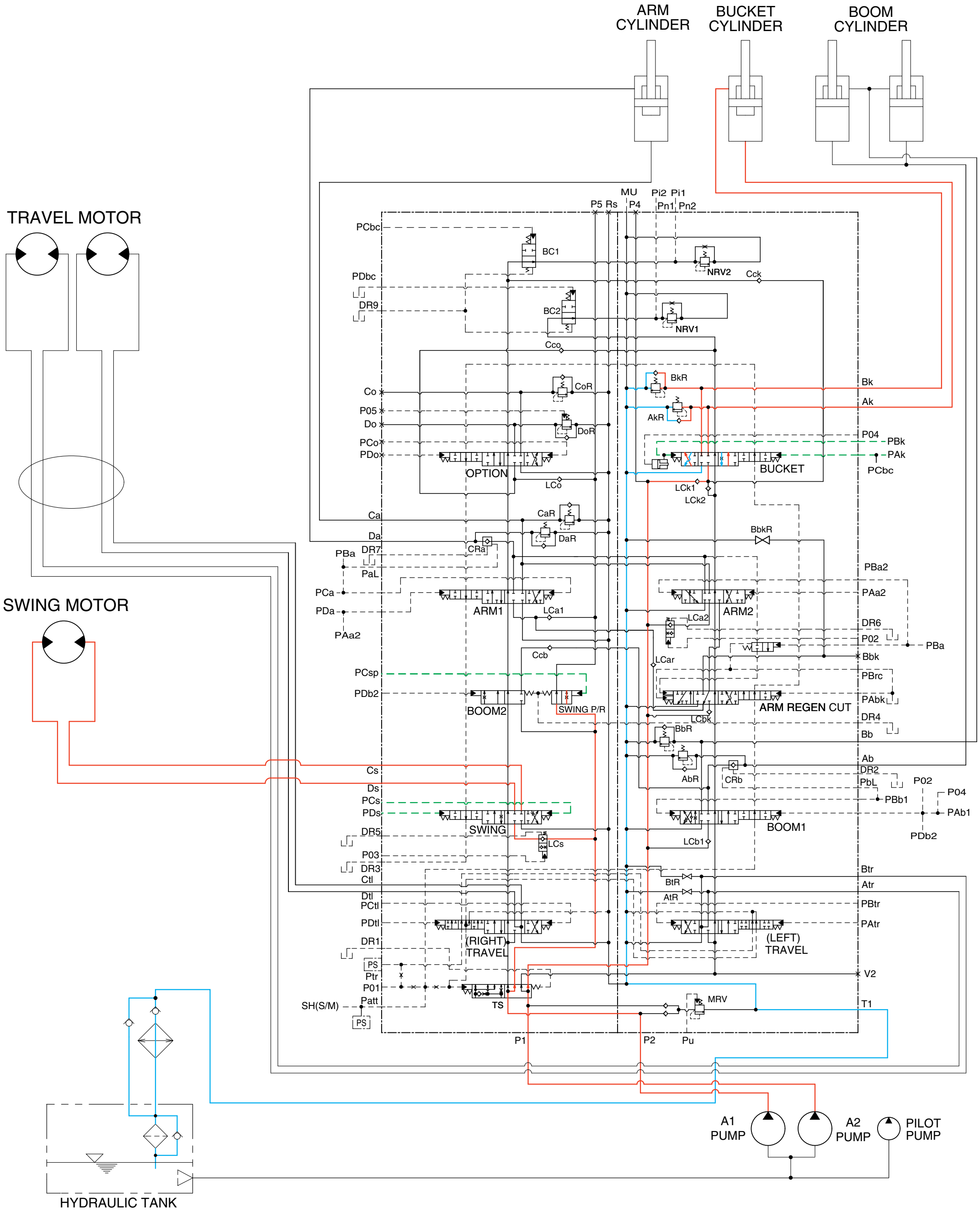
The oil from the A1 pump flows into the swing motor through swing spool and the arm cylinder through arm 1 spool.

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

Refer to page 2-51 for the swing operation preference function.

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

4. COMBINED SWING AND BUCKET OPERATION



350SA3HC20

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 (PCs, PDs, PAk, PBk) from the remote control valve.

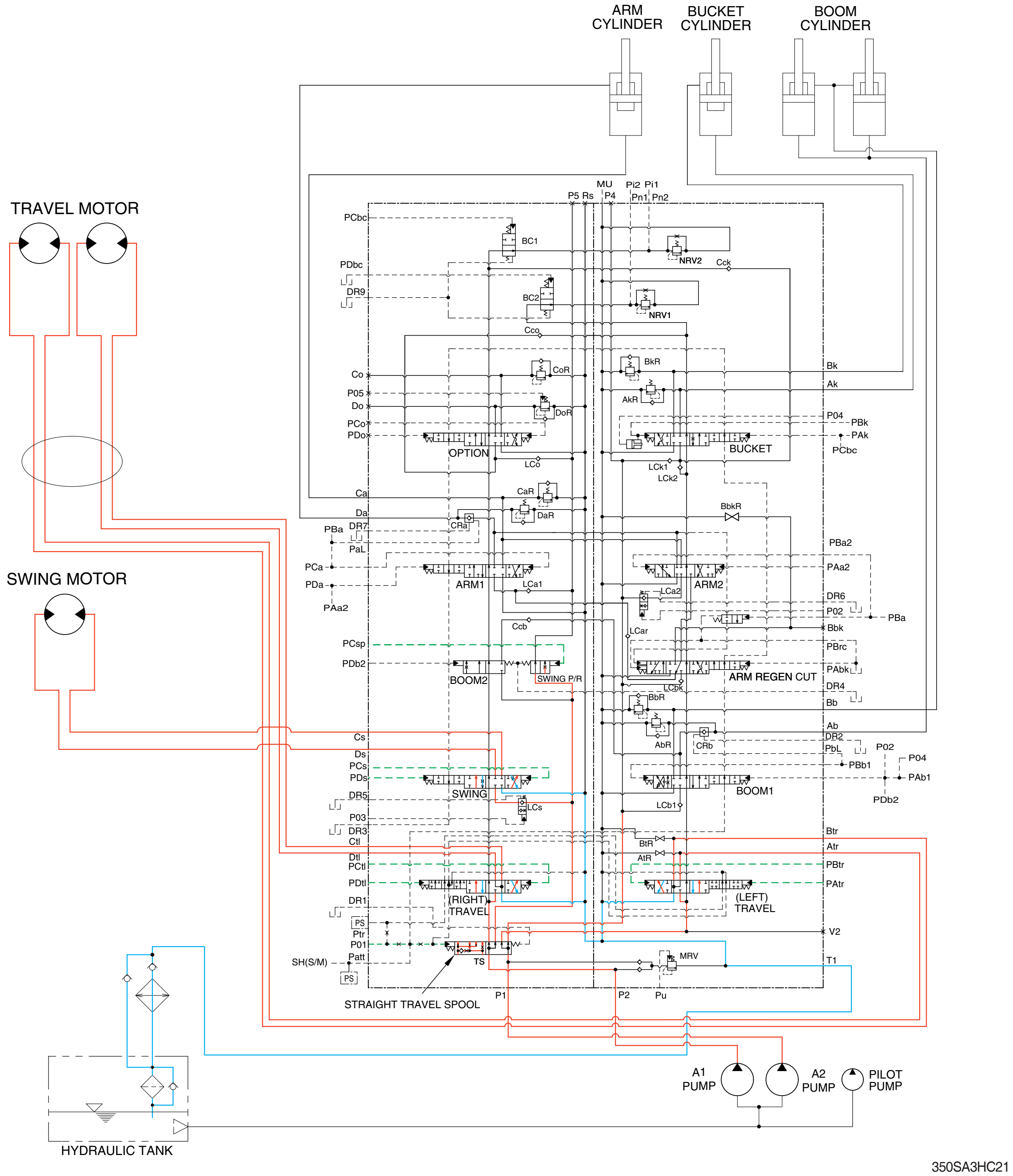
The oil from the A1 pump flows into the swing motor through the swing spool in the left control valve.

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

The upper structure swings and the bucket is operated.

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

5. COMBINED SWING AND TRAVEL OPERATION



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

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

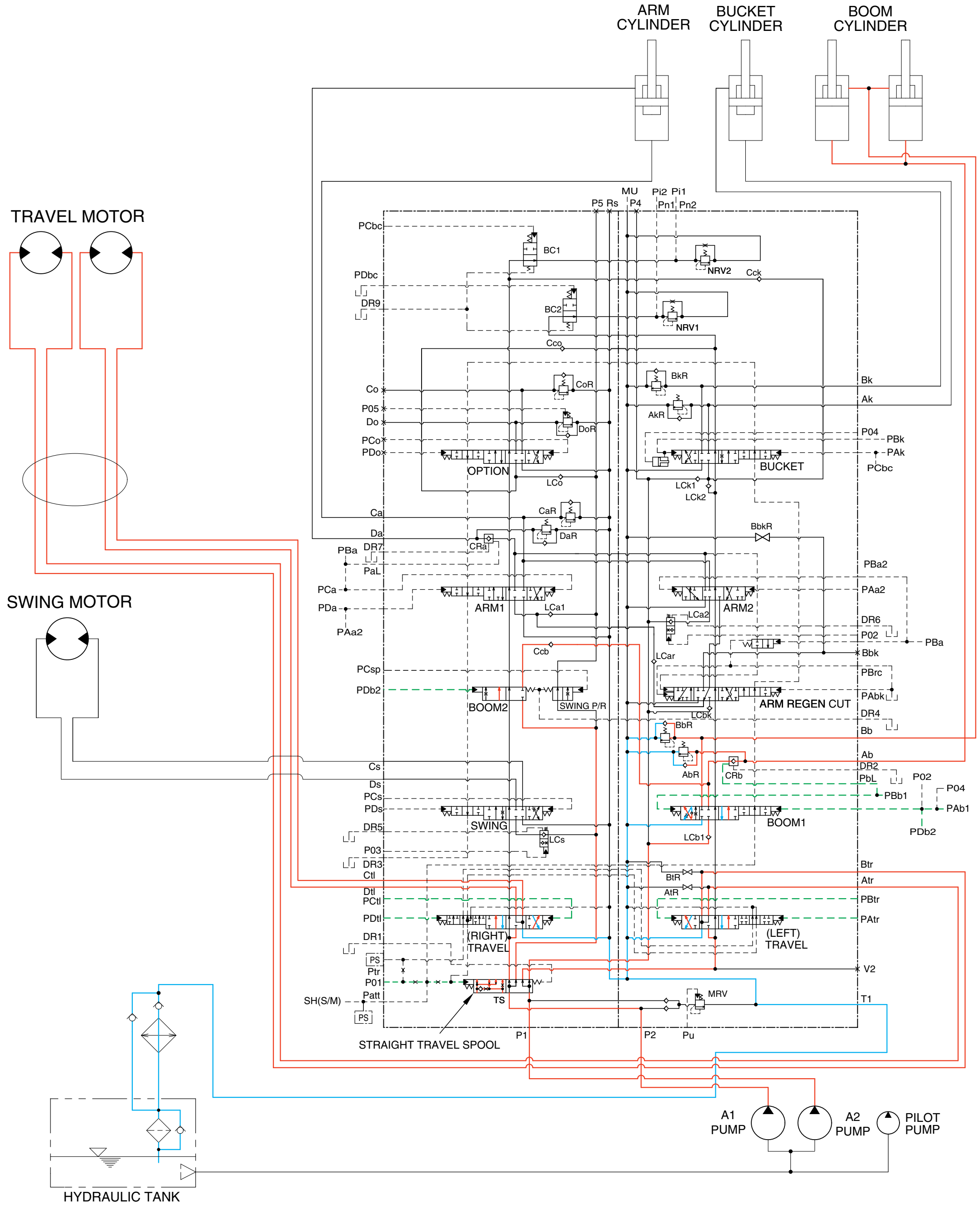
The oil from the A2 pump flows into the swing motor in the straight travel spool.

When the pressure of the travel motors is lower than the pressure of the swing motor, some oil from the A2 pump flows into the travel motors through the check valve and orifice in the straight travel spool. This prevents the rapid slowdown of the travel.

The upper structure swings and the machine travels straight.

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

6. COMBINED BOOM AND TRAVEL OPERATION



350SA3HC22

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 (PCs, PDs, PAtr, PBtr, PAb1, PBb1, PDb2) from the remote control valve and the straight travel spool is pushed to the right by the oil pressure from pilot pump.

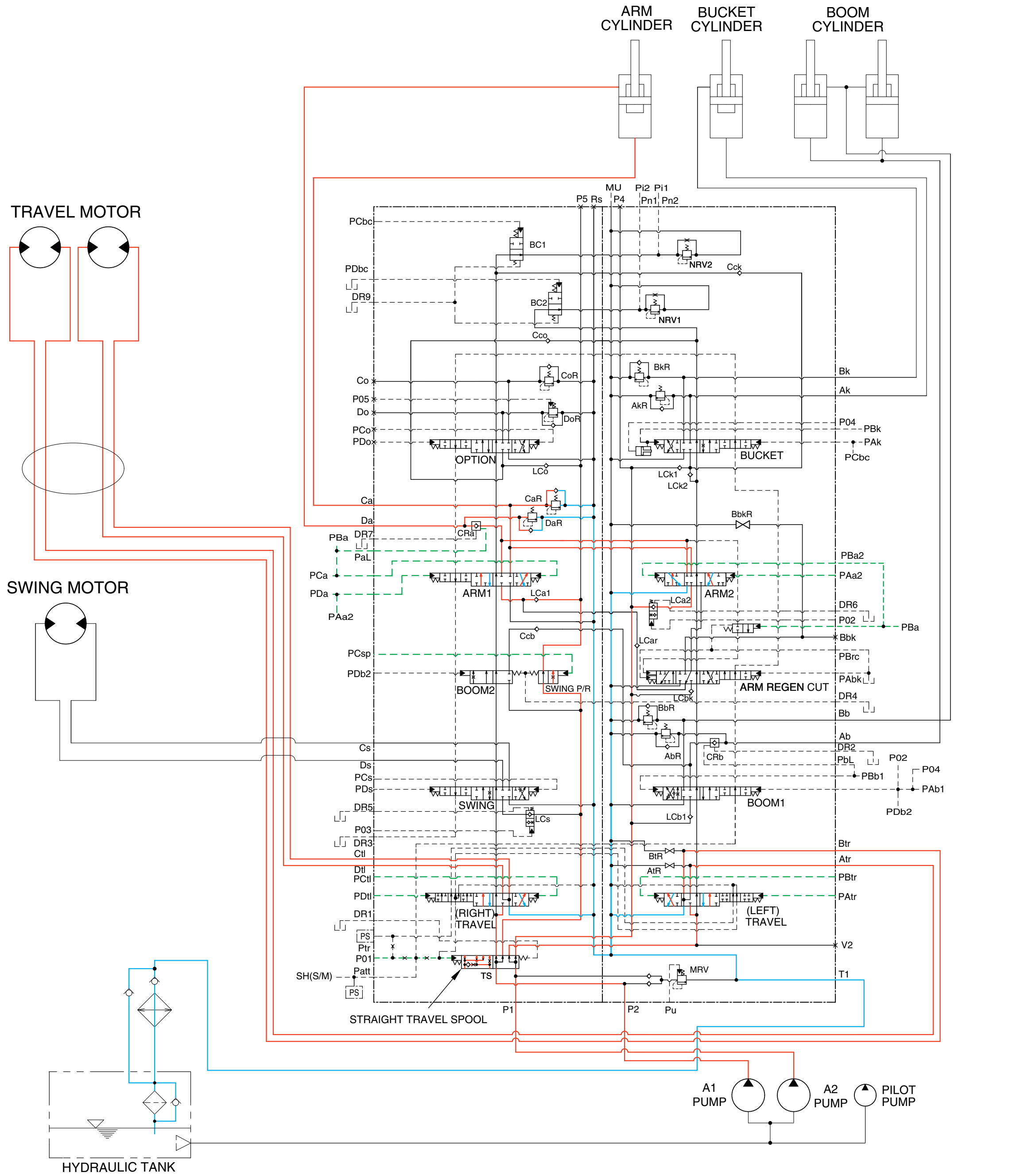
The oil from the A1 pump flows into the travel motors through the RH travel spool of the left control valve and the LH travel spool of the right control valve via the straight travel spool.

The oil from the A2 pump flows into the boom cylinders through the boom 2 spool and boom 1 spool via the parallel and confluence oil passage in case boom up operation. When the pressure of the travel motors is lower than the pressure of the boom cylinders, some oil from the A2 pump flows into the travel motors through the check valve and orifice in the straight travel spool. This prevents the rapid slowdown of the travel.

The boom is operated and the machine travels straight.

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

7. COMBINED ARM AND TRAVEL OPERATION



350SA3HC23

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 (PCs, PDs, PAtr, PBtr, PCa, PDa, PAa2, PBa2) from the remote control valve and the straight travel spool is pushed to the right by the oil pressure from pilot pump.

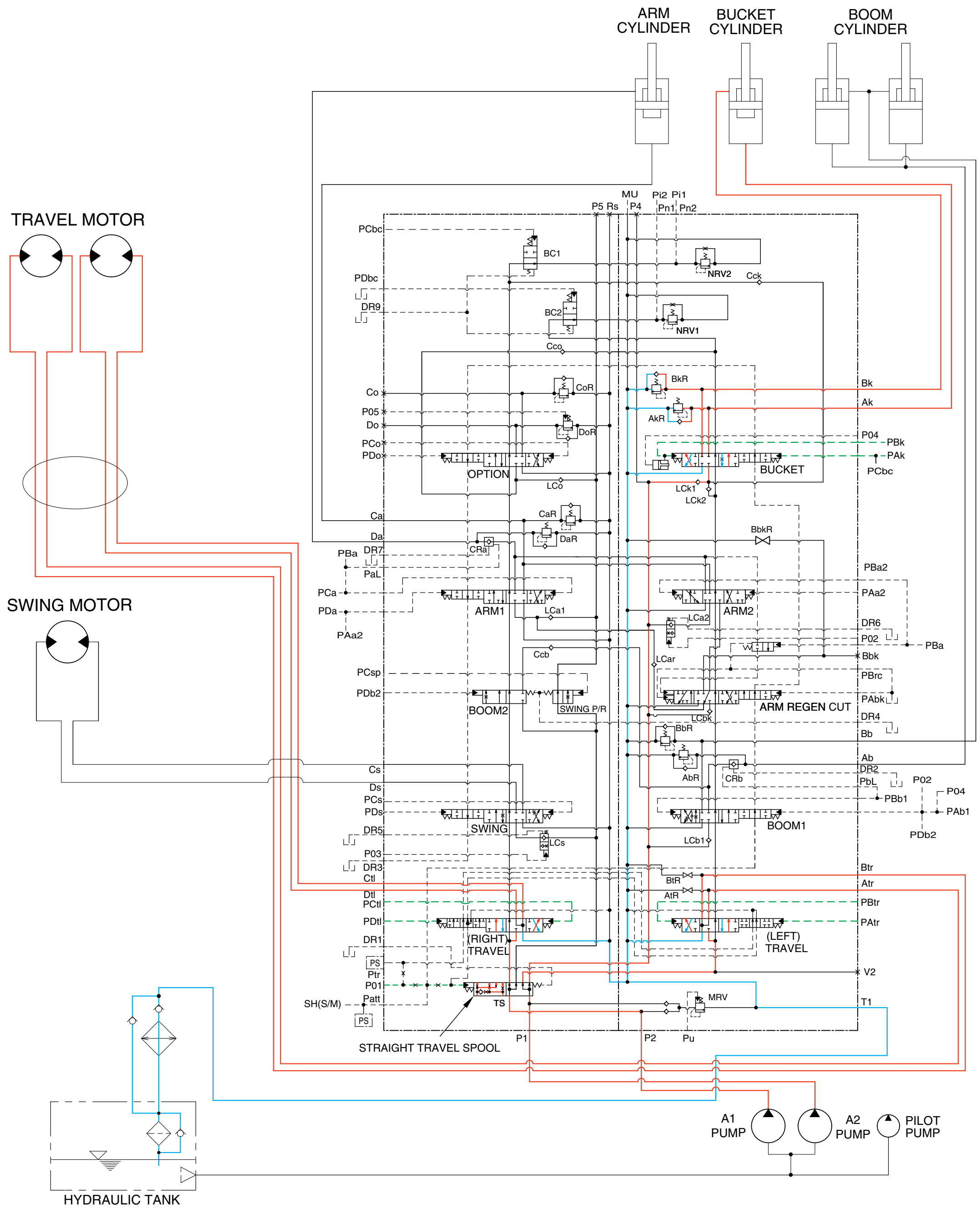
The oil from the A1 pump flows into the travel motors through the RH travel spool of the left control valve and the LH travel spool of the right control valve via the straight travel spool.

The oil from the A2 pump flows into the arm cylinders through the arm 1 spool and arm 2 spool via the parallel and confluence oil passage. When the pressure of the travel motors is lower than the pressure of the arm cylinder, some oil from the A2 pump flows into the travel motors through the check valve and orifice in the straight travel spool. This prevents the rapid slowdown of the travel.

The arm is operated and the machine travels straight.

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

8. COMBINED BUCKET AND TRAVEL OPERATION



350SA3HC24

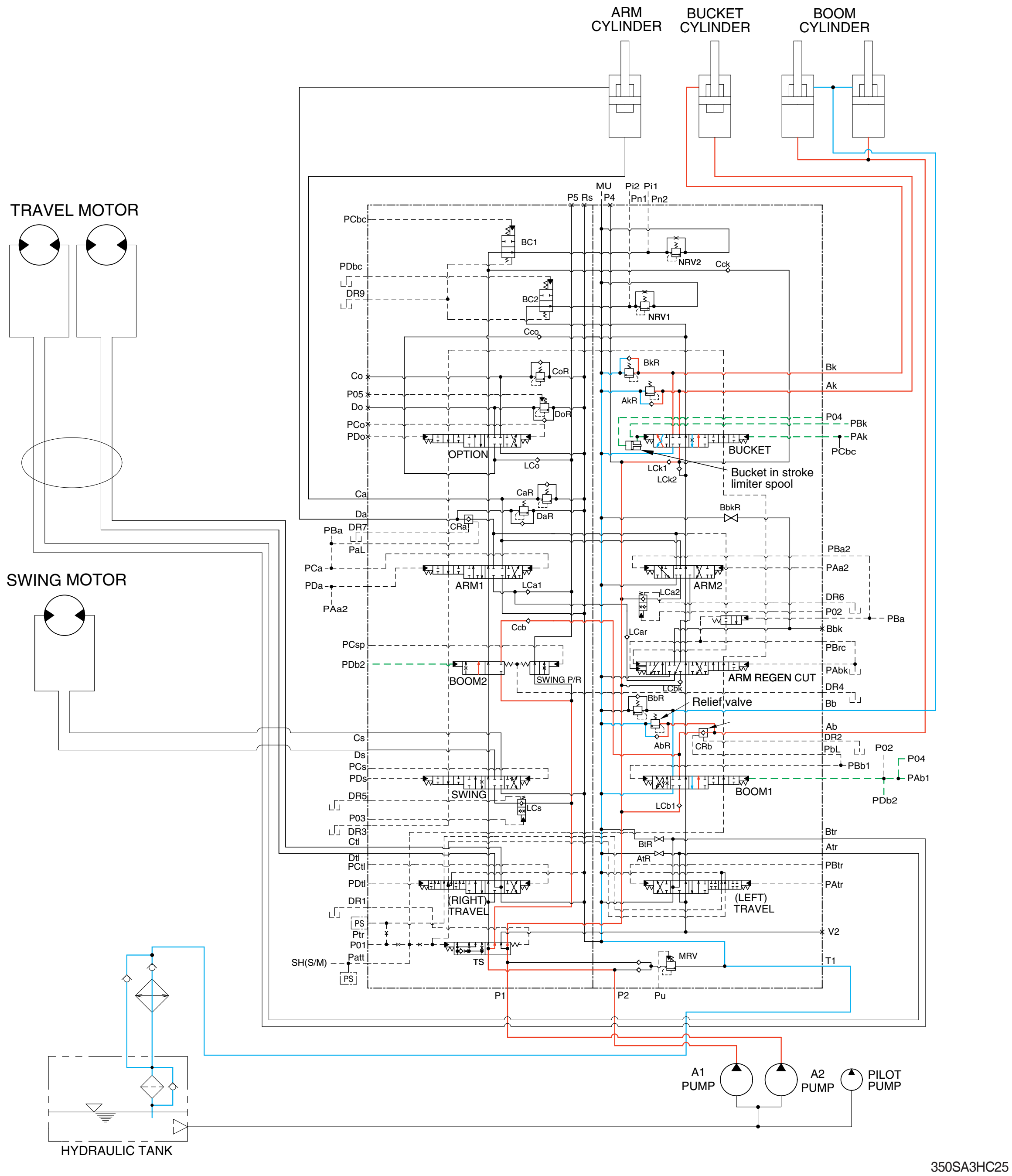
When the bucket and travel functions are operated, simultaneously the bucket spool and travel spools in the main control valve are moved to the functional position by the pilot oil pressure (PCs, PDs, PAtr, PBtr, PAk, PBk) from the remote control valve, and the straight travel spool is pushed to the right by the oil pressure from pilot pump. The oil from the A1 pump flows into the travel motors through the RH travel spool of the left control valve and the LH travel spool of the right control valve via the straight travel spool of the control valve.

The oil from the A2 pump flows into the bucket cylinder through the bucket spool via the confluence oil passage. When the pressure of the travel motors is lower than the pressure of the bucket cylinder, some oil from the A2 pump flows into the travel motors through the check valve and orifice in the straight travel spool. This prevents the rapid slowdown of the travel.

The bucket is operated and the machine travels straight.

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

9. COMBINED BOOM UP AND BUCKET OPERATION



When the boom up and bucket functions are operated, simultaneously each spool in the main control valve is moved to the functional position by the pilot oil pressure (PAb1, PDb2, PAk, PBk) from the remote control valve.

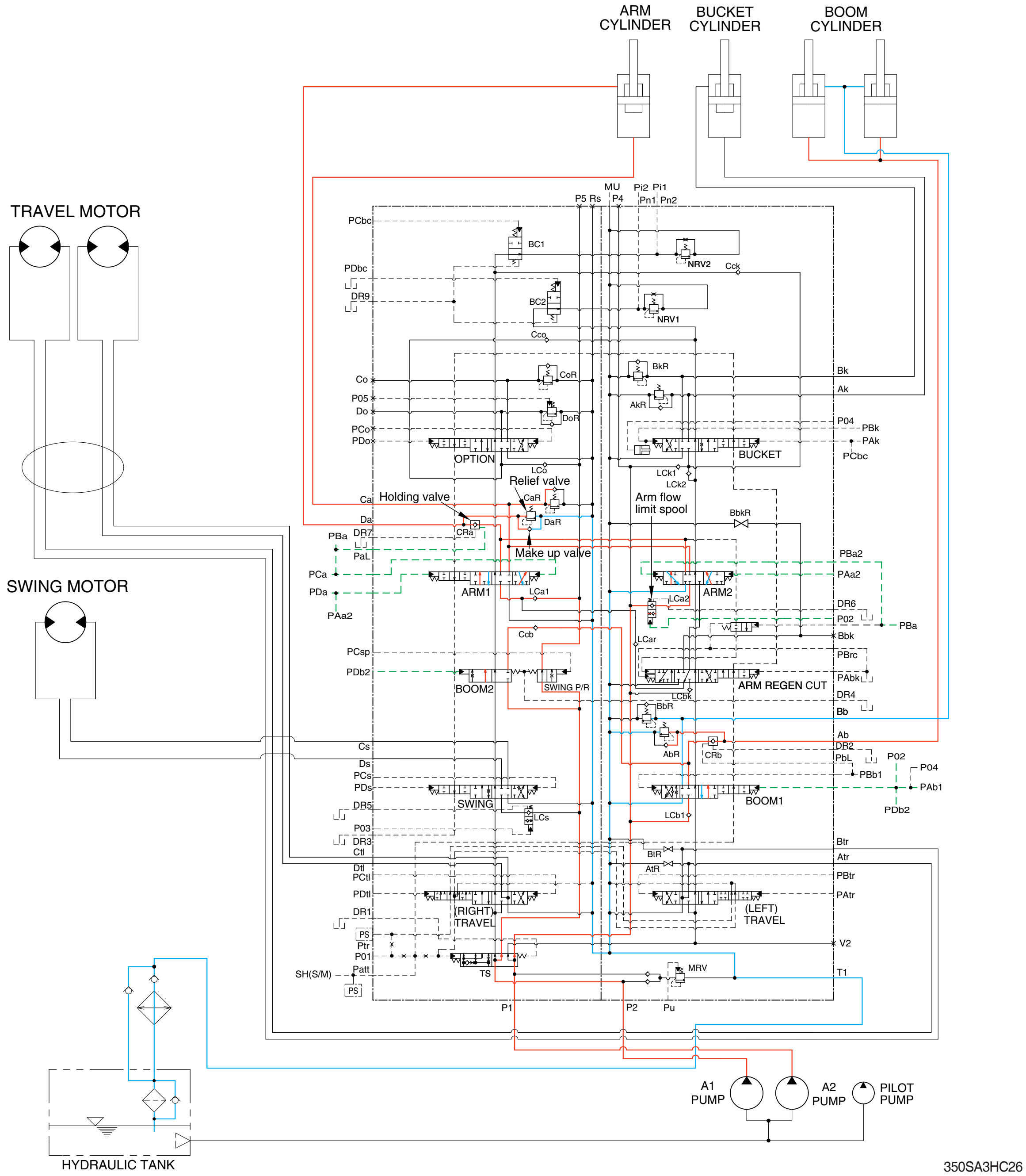
The oil from the A1 pump flows into the boom cylinders through the boom 2 spool in the left control valve. The oil from the A2 pump flows into the boom cylinders and bucket cylinder through the boom 1 spool, bucket spool and the parallel and confluence oil passage in the right control valve.

Also, when the boom up and bucket in functions are operated simultaneously, the boom up operation preference function is operated by the pilot pressure P04 and then the bucket spool transfers in the half stroke not full stroke (refer to page 2-43). Therefore, the most of pressurized oil flows into boom 1 spool than the bucket spool to make the boom up operation more preferential.

The boom and bucket are operated.

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

10. COMBINED BOOM UP AND ARM OPERATION



350SA3HC26

When the boom up and arm functions are operated, simultaneously each spool in the main control valve is moved to the functional position by the pilot oil pressure (PAb1, PDb2, PCa, PDa, PAa2, PBa2) from the remote control valve.

The oil from the A1 pump flows into the boom cylinders and arm cylinder through the boom 2 spool and arm 1 spool in the left control valve. The oil from the A2 pump flows into the boom cylinders and arm cylinder through the boom 1 spool, arm 2 spool and the parallel and confluence oil passage in the right control valve.

Also, when the boom up and arm in functions are operated simultaneously, the boom up operation preference function is operated by the pilot pressure P02 and then the flow into arm 2 spool is reduced by shifting of the arm in flow limit spool. Therefore, the most of pressurized oil flows into boom 1 spool than the arm 2 spool to make the boom up operation more preferential.

The boom and arm are operated.

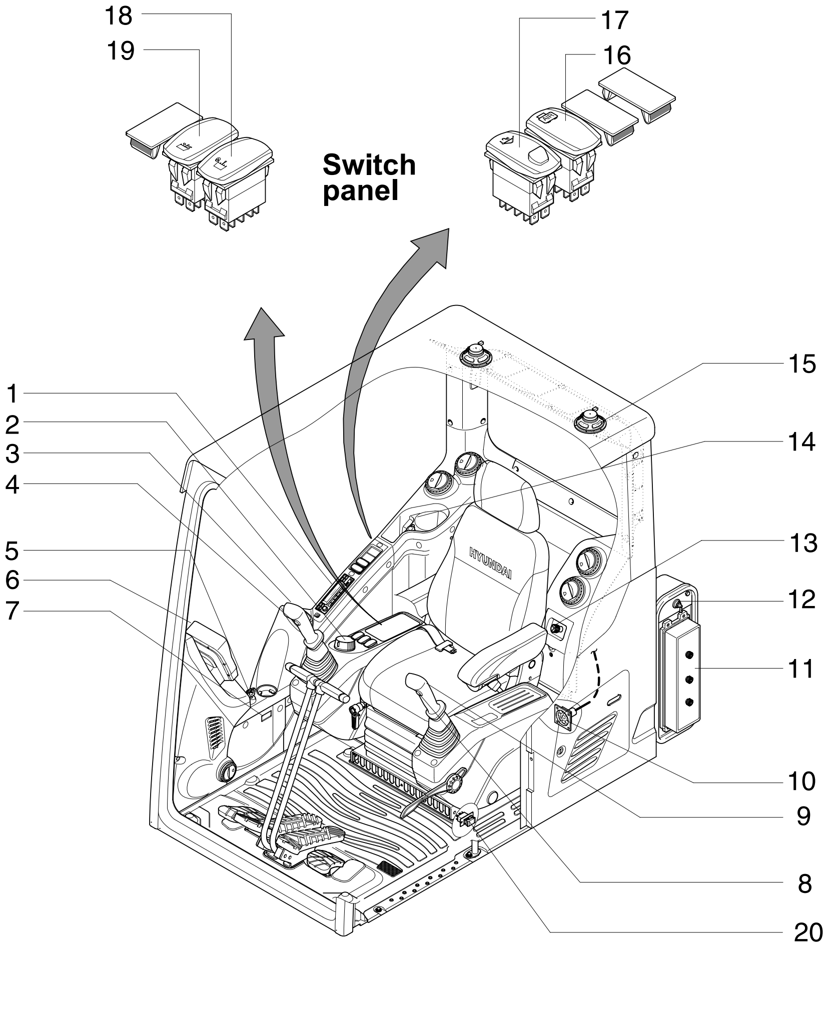
※ The circuit diagram may differ from the equipment, so please check before a repair.

SECTION 4 ELECTRICAL SYSTEM

SECTION 4 ELECTRICAL SYSTEM

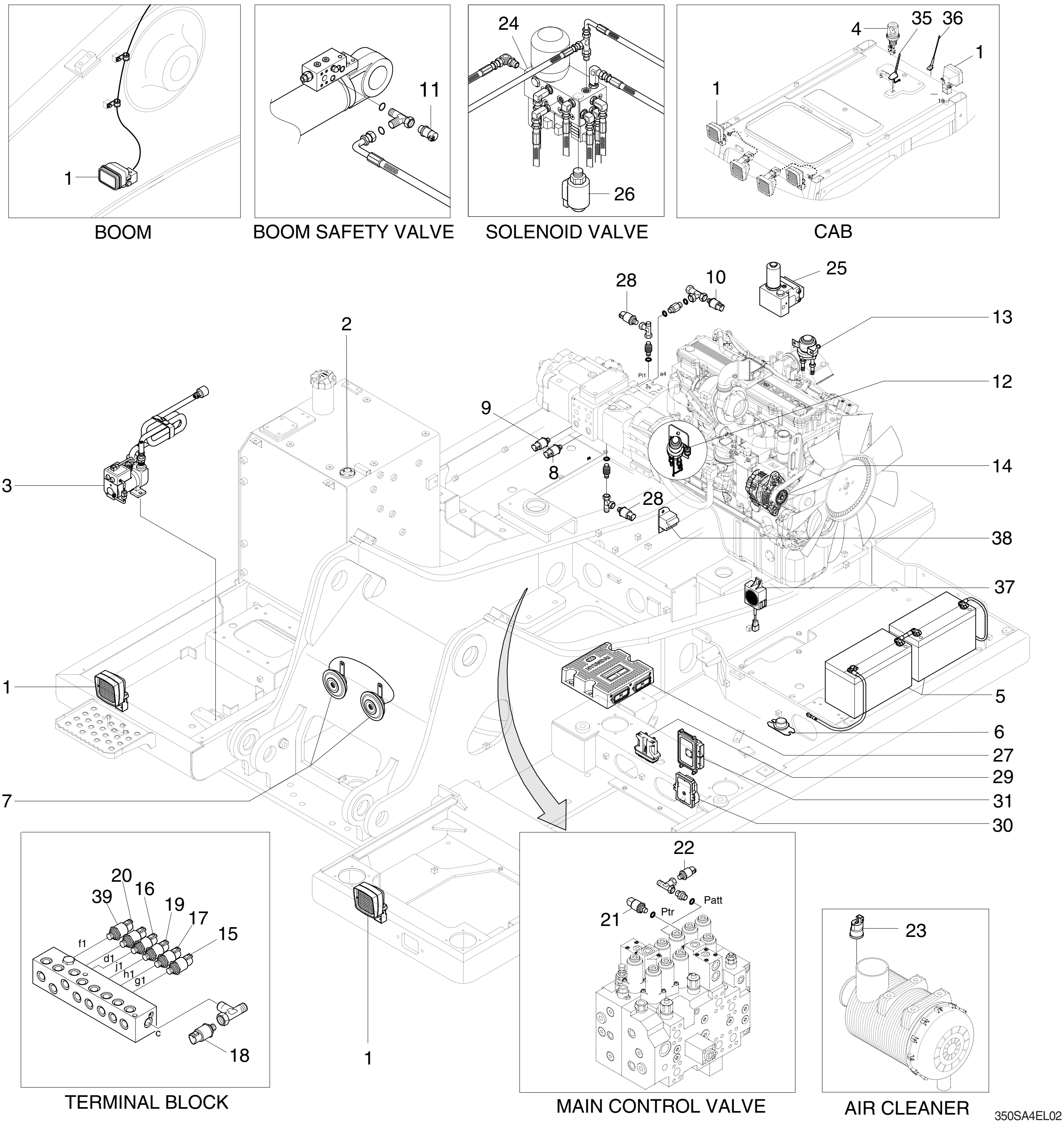
GROUP 1 COMPONENT LOCATION

1. LOCATION 1



1	Radio & USB player	8	Power max switch	15	Speaker
2	Accel dial	9	One touch decel switch	16	Air compressor switch
3	Horn switch	10	RS232 service socket	17	Quick clamp switch
4	Breaker operation switch	11	Fuse & relay box	18	Swing lock switch
5	Starting switch	12	Master switch	19	Fine swing switch
6	Cluster	13	Cigar lighter	20	Emergency engine stop switch
7	Service meter	14	12V socket		

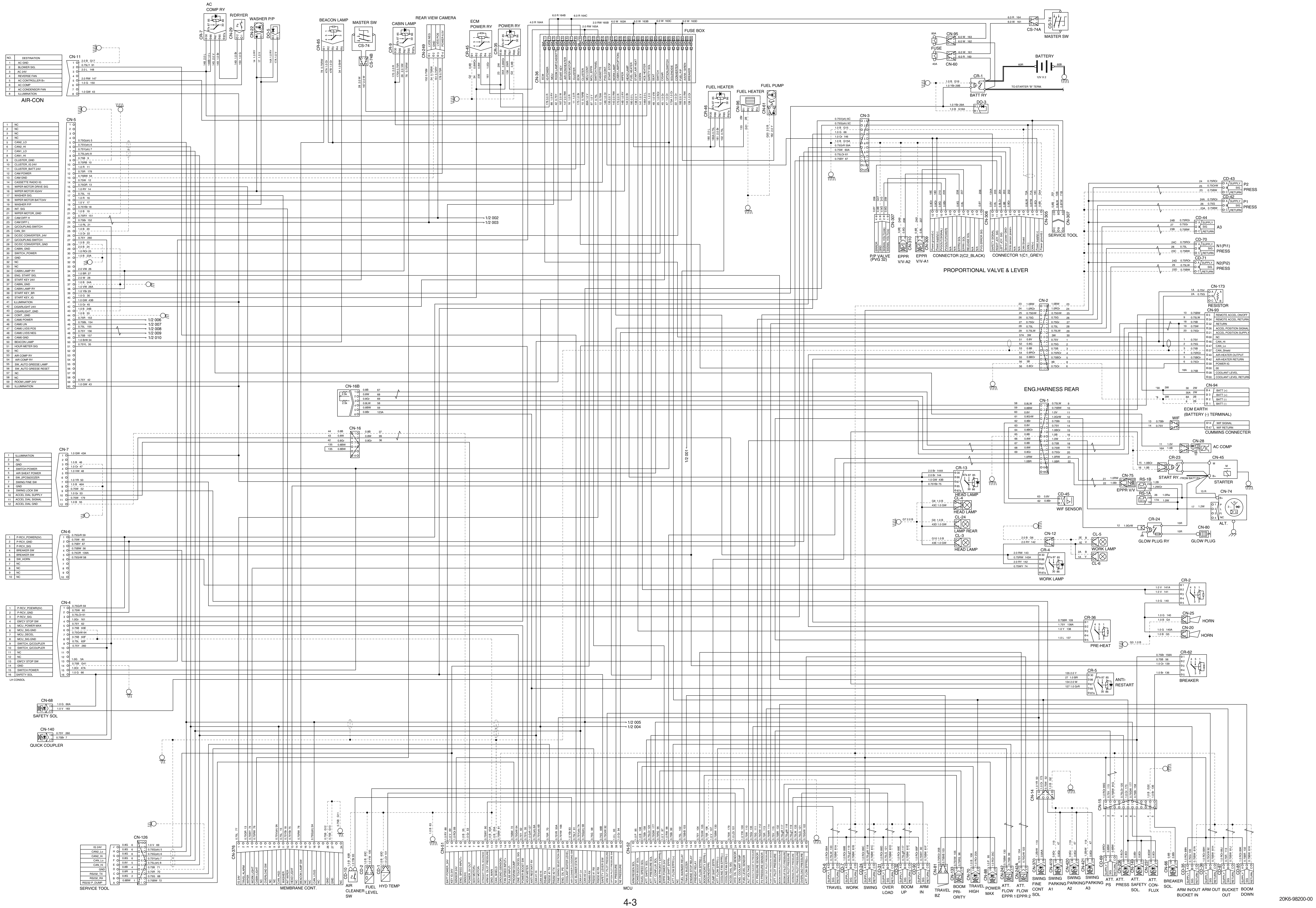
2. LOCATION 2



1	Lamp	13	Heater relay	25	Pump EPPR valve
2	Fuel sender	14	Alternator	26	Boom priority EPPR valve
3	Fuel filler pump	15	Bucket out pressure sensor	27	MCU
4	Beacon lamp	16	Arm out pressure sensor	28	Pliot pressure sensor
5	Battery	17	Boom up pressure sensor	29	PVG32 controller
6	Battery relay	18	Swing pressure sensor	30	Relay drive unit
7	Horn	19	Boom down pressure sensor	31	Around view controller
8	A1 pump pressure sensor	20	Arm in pressure sensor	35	Integrated antenna
9	A2 pump pressure sensor	21	Attach pressure sensor	36	Satellite antenna
10	EPPR pressure sensor	22	Travel pressure sensor	37	Warning buzzer
11	Overload pressure sensor	23	Air cleaner sensor	38	Travel alarm buzzer
12	Start relay	24	4 cartridge valve	39	Bucket in pressure sensor

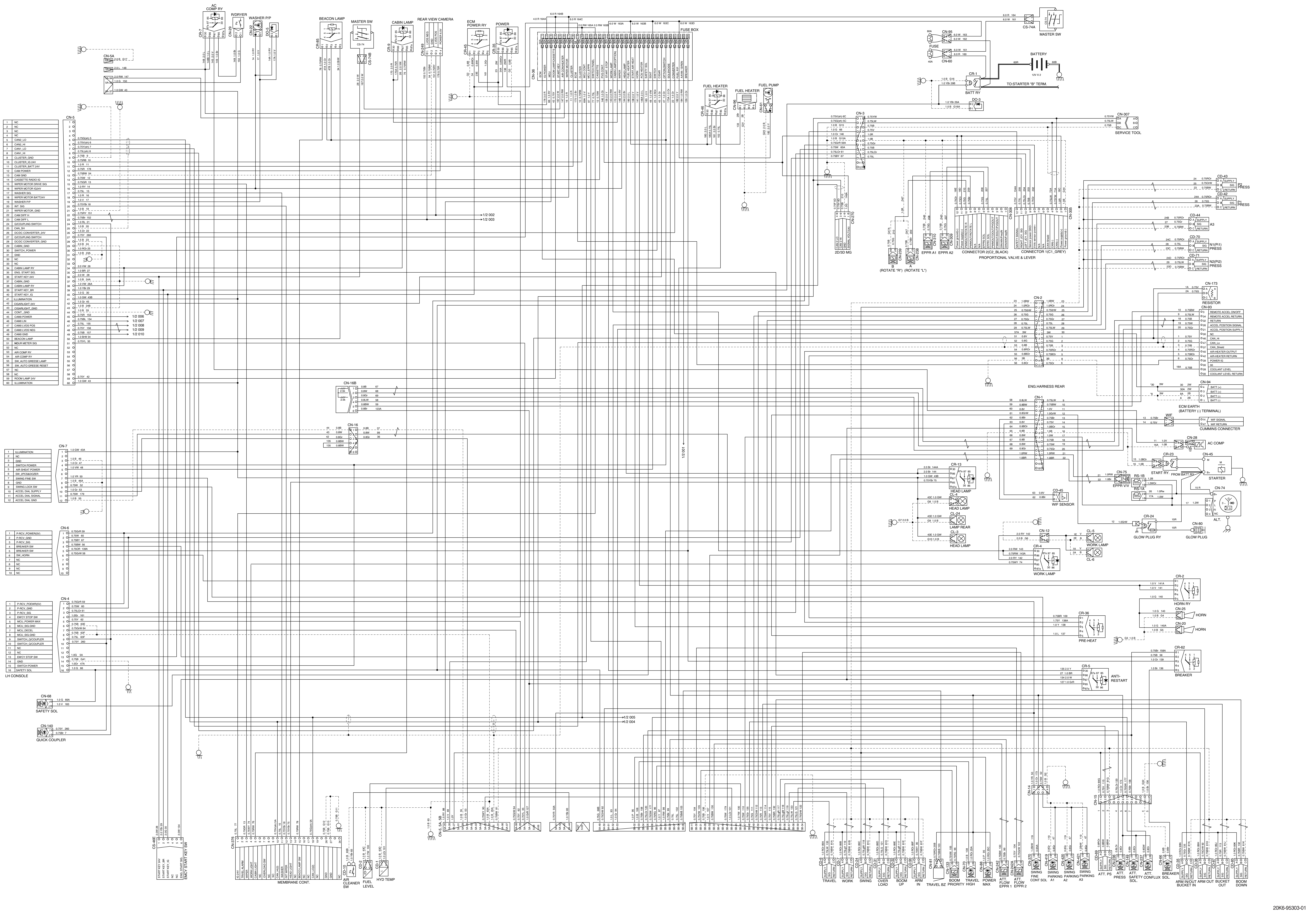
· ELECTRICAL CIRCUIT (1/2)

- MACHINE SERIAL NO. : -#00138

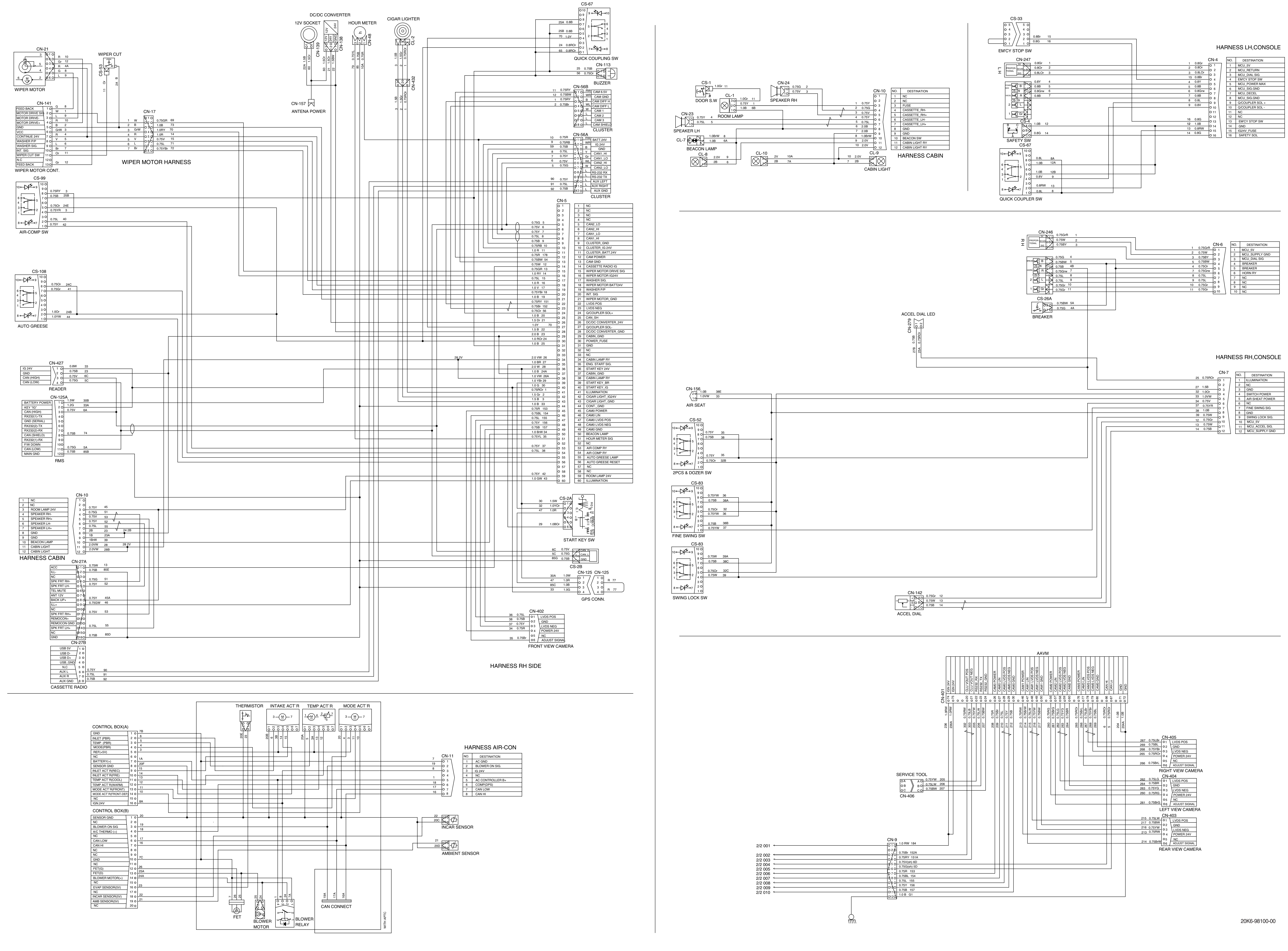


20K6-98200-00

- MACHINE SERIAL NO. : #00139-



· ELECTRICAL CIRCUIT (2/2)



MEMORANDUM

1. POWER CIRCUIT

The negative terminal of battery is grounded to the machine chassis directly.

When the start switch is in the OFF position, the current flows from the positive battery terminal as shown below.

1) OPERATING FLOW

Battery → Battery relay [CR-1] → Circuit breaker [CN-60] → Master switch [CS-74A]

- → Fuse box [No.1] → I/conn [CN-2 (8)] → ECM [CN-94 (3, 4)]
- → Fuse box [No.2] → Power relay [CR-35 (30)]
  - → ECM power relay [CR-45 (3)]
- → Fuse box [No.3] → MCU [CN-51 (1)]
- → Fuse box [No.4] → 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.5] → Master switch [CS-74B] → I/conn [CN-5 (36)] → Start switch [CS-2A (1)]
  - → RMS [CN-125A (1)]
  - → GPS connection [CN-125 (1)]
- → Fuse box [No.6] → I/conn [CN-11 (5)] → AC & Heater controller box (A)
  - → Blower relay (4)
- → Fuse box [No.7] → I/conn [CN - 5 (18)] → I/conn [CN -17 (5)] → Wiper motor controller [CN-141 (7)]
  - → Wiper motor [CN-21 (4)]
- → Fuse box [No.8] → I/conn [CN - 5 (11)] → Cluster [CN -56A (1)]
  - → Hour meter [CN-48 (1)]

※ I/conn : Intermediate connector

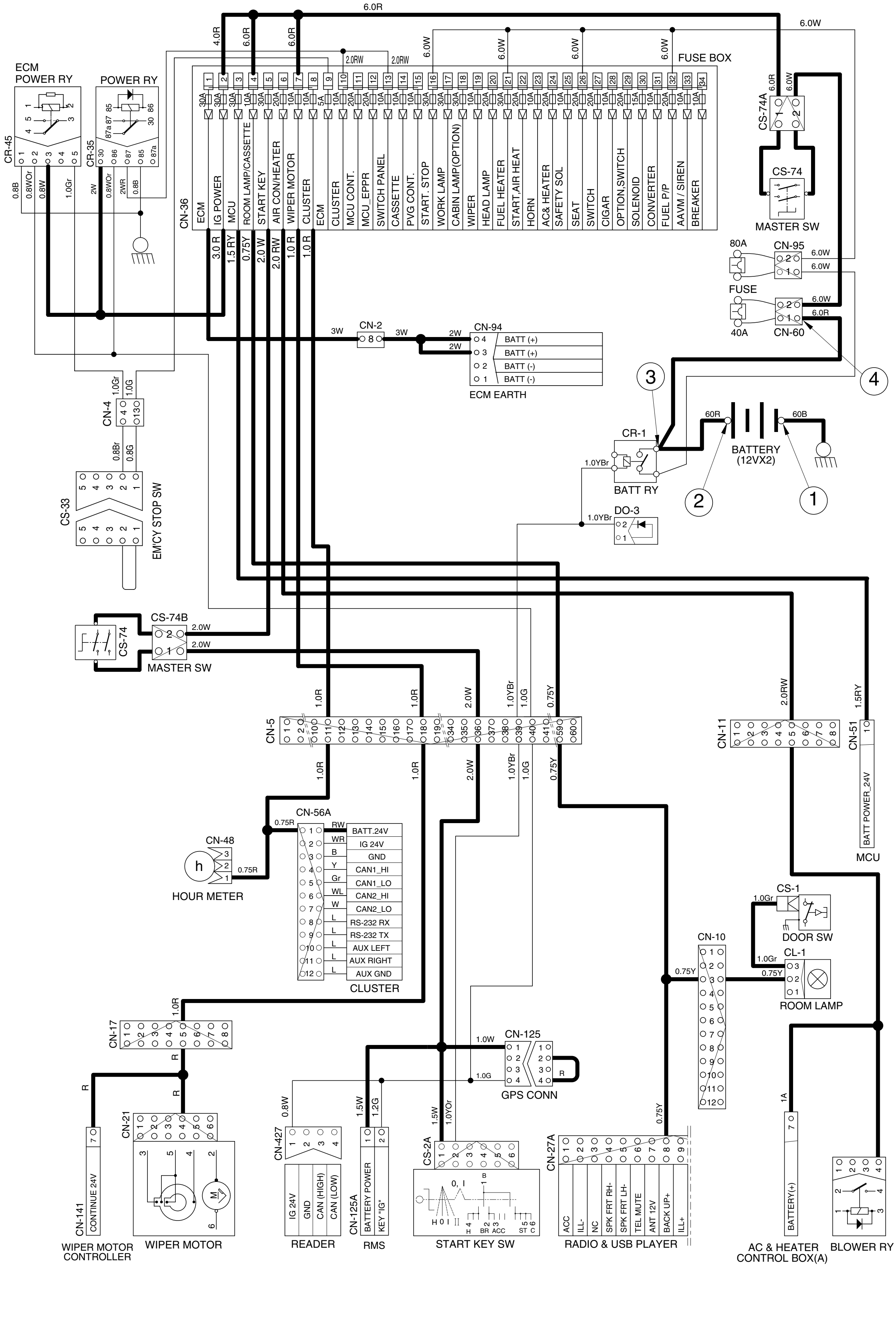
2) CHECK POINT

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

※ GND : Ground

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

POWER CIRCUIT



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

2. STARTING CIRCUIT

1) OPERATING FLOW

Battery (+) terminal → Battery relay [CR-1] → Circuit breaker [CN-60] → Master switch [CS-74A]
→ Fuse box [No.5] → Master switch [CS-74B] → I/conn [CN-5 (36)] → Start switch [CS-2A (1)]
→ Fuse box [No.2] → Power relay [CR-35 (30)]
→ ECM power relay [CR-45 (3)]

(1) When start switch is in ON position

→ Start switch ON [CS-2A (2)] → I/conn [CN-5 (39)]
→ Battery relay [CR-1] → Battery relay operating (all power is supplied with the electric component)
→ Start switch ON [CS-2A (3)] → GPS conn [CN-125 (2) → (4)]
→ I/conn [CN-5 (40)] → Power relay [CR-35 (86) → (87)]
→ Fuse box [No.11] → MCU [CN-51 (2)]
→ ECM Power relay [CR-45 (2) → (5)] → I/conn [CN-4 (4)]
→ Emergency engine stop sw [CS-33 (2)→(1)] → I/conn [CN-4 (13)]
→ Fuse box [No. 9] → I/conn [CN-2 (15)]
→ Engine ECM [CN-93 (39)]
→ Reader [CN-427 (1)]
→ RMS [CN-125A (2)]

(2) When start switch is in START position

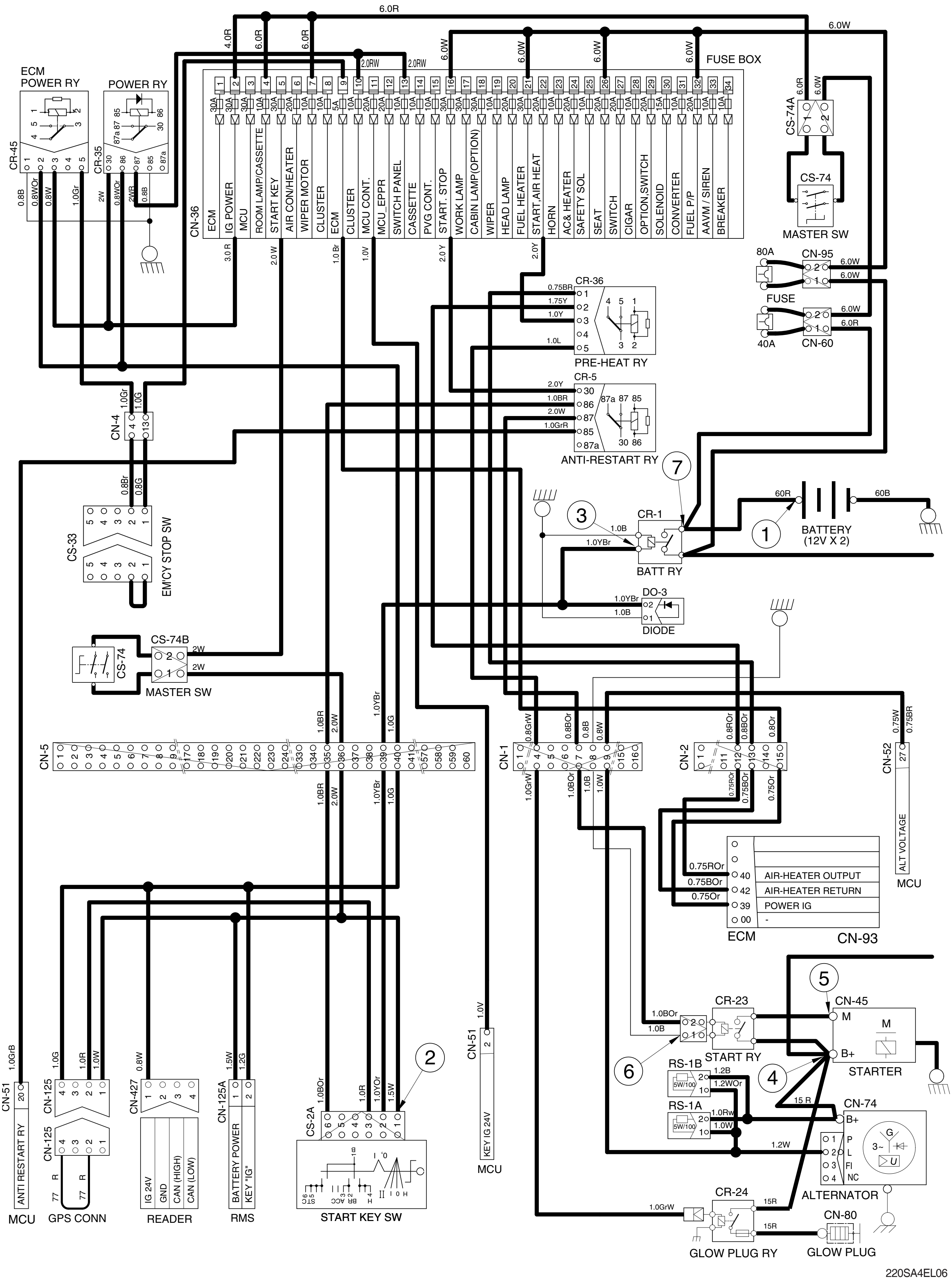
Start switch START [CS-2A (6)] → I/conn [CN-5 (35)] → Anti-restart relay [CR-5 (86) → (87)]
→ I/conn CN-1 (7) → Start relay [CR-23] → Starter motor operating

2) CHECK POINT

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

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

STARTING CIRCUIT



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

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 [CN-74 (2)] → I/conn [CN-1 (9)] → MCU alternator voltage [CN-52 (27)]
→ Cluster charging warning lamp (Via CANbus interface)

(2) Charging flow

Alternator [CN-74 (B^+)] → Battery relay (M8)
→ Battery (+) terminal
→ Fuse [CN-60] → Master switch [CS-74A] → Fuse box [No.1~8]
→ Fuse [CN-95] → Fuse box [No.16~34]

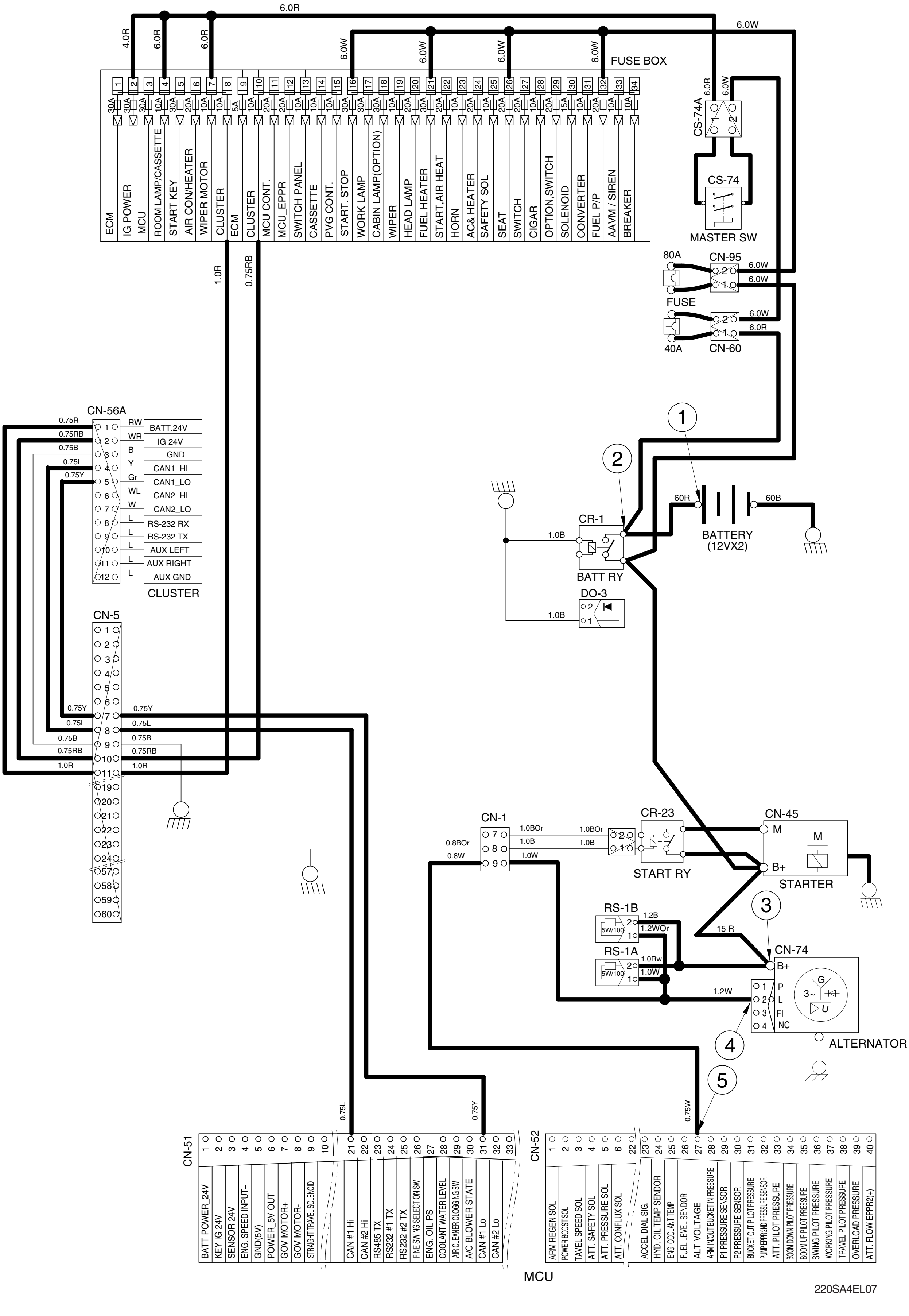
2) CHECK POINT

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

※ GND : Ground

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

CHARGING CIRCUIT



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

4. HEAD AND WORK LIGHT CIRCUIT

1) OPERATING FLOW

Fuse box (No.20) → Head light relay [CR-13 (30, 86)]
Fuse box (No.17) → Work light relay [CR-4 (30, 86)]
Fuse box (No.13) → Membrane controller [CN-376 (1)]

(1) Head light switch ON

Head light switch ON [CN-376 (13)] → Head light relay [CR-13 (85) → (87)]
→ Head light ON [CL-3 (2), CL-4 (1), CL-24 (2)]
→ I/conn [CN-5 (41)] → I/conn [CN-432 (1)] → Cigar lighter [CL-2]
→ I/conn [CN-5 (60)] → Radio & USB player illumination ON [CN-27A (9)]
→ I/conn [CN-7 (1)] → Accel dial LED [CN-279 (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)]

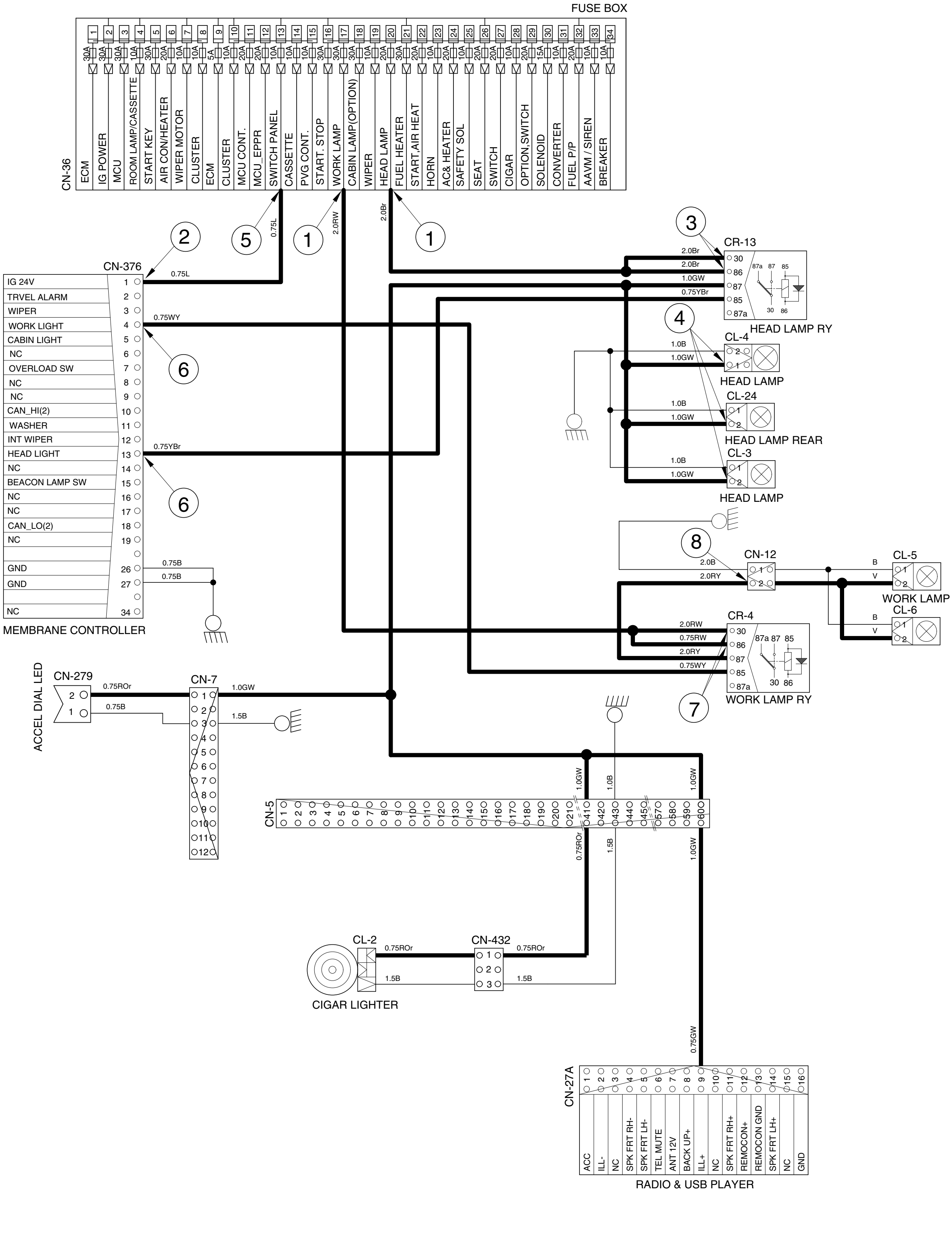
2) CHECK POINT

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

※ GND : Ground

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

HEAD AND WORK LIGHT CIRCUIT



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

5. BEACON LAMP AND CAB LIGHT CIRCUIT

1) OPERATING FLOW

Fuse box (No.29) → Beacon lamp relay [CR-36 (2, 3)]
Fuse box (No.18) → Cab light relay [CR-9 (30, 86)]
Fuse box (No.13) → Membrane controller [CN-376 (1)]

(1) Beacon lamp switch ON

Beacon lamp switch ON [CN-376 (15)] → Beacon lamp relay [CR-85 (1)→(5)]
→ I/conn [CN-5 (50)] → I/conn [CN-10 (10)] → Beacon lamp ON [CL-7]

(2) Cab light switch ON

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

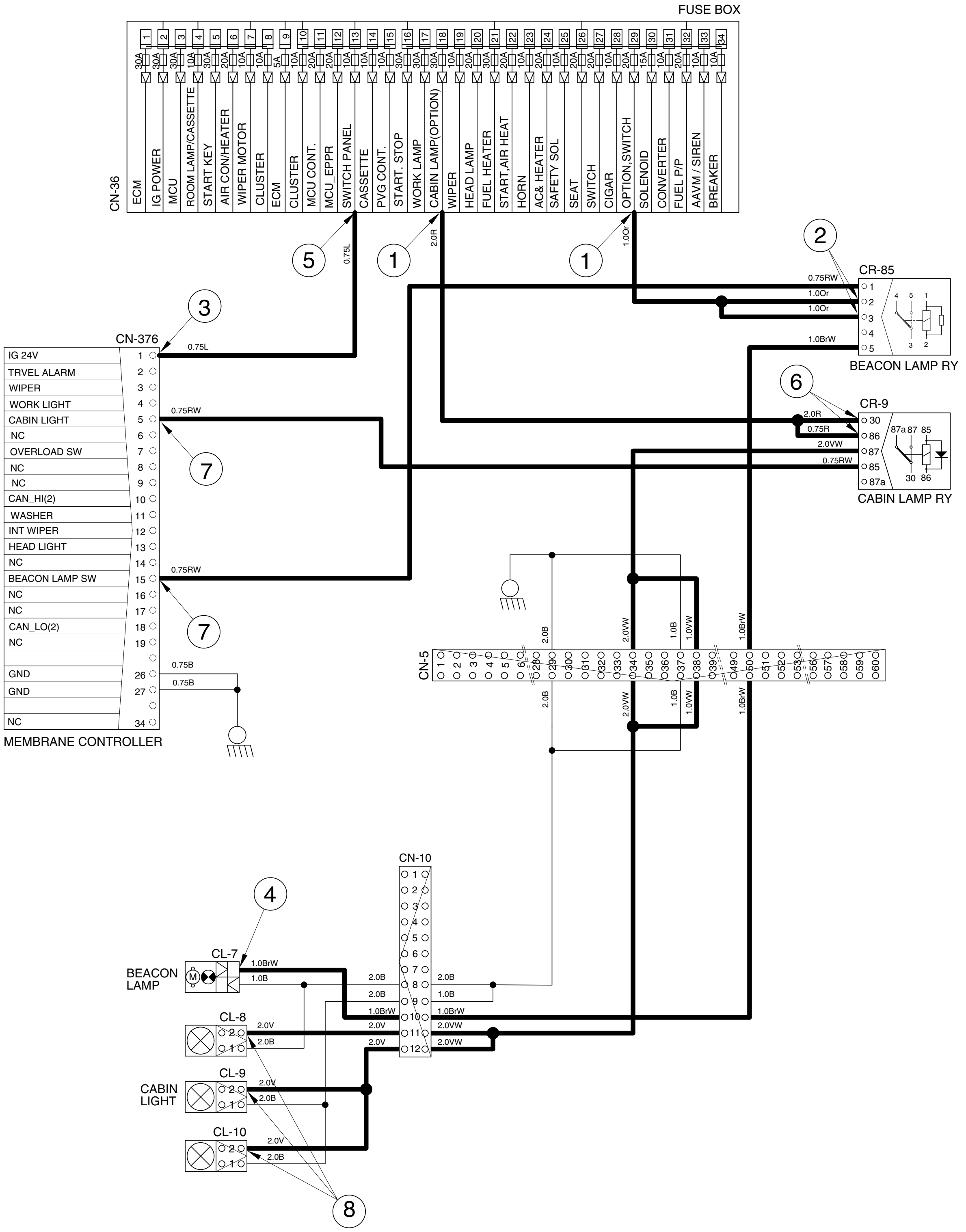
2) CHECK POINT

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

※ GND : Ground

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

BEACON LAMP AND CAB LIGHT CIRCUIT



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

6. WIPER AND WASHER CIRCUIT

1) OPERATING FLOW

(1) Start switch ON

Fuse box (No.13) → RDU membrance controller [CN-376 (1)]

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

Fuse box (No.19) → I/conn [CN-5 (16)] → I/conn [CN-17 (4)] → Wiper motor controller [CN-141 (6)]
→ Wiper pump [CN-22 (2)]

(2) Wiper switch ON (Intermittent)

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

(3) Wiper switch ON (continual)

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

(4) Washer switch ON

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

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

(5) Auto parking (when switch OFF)

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

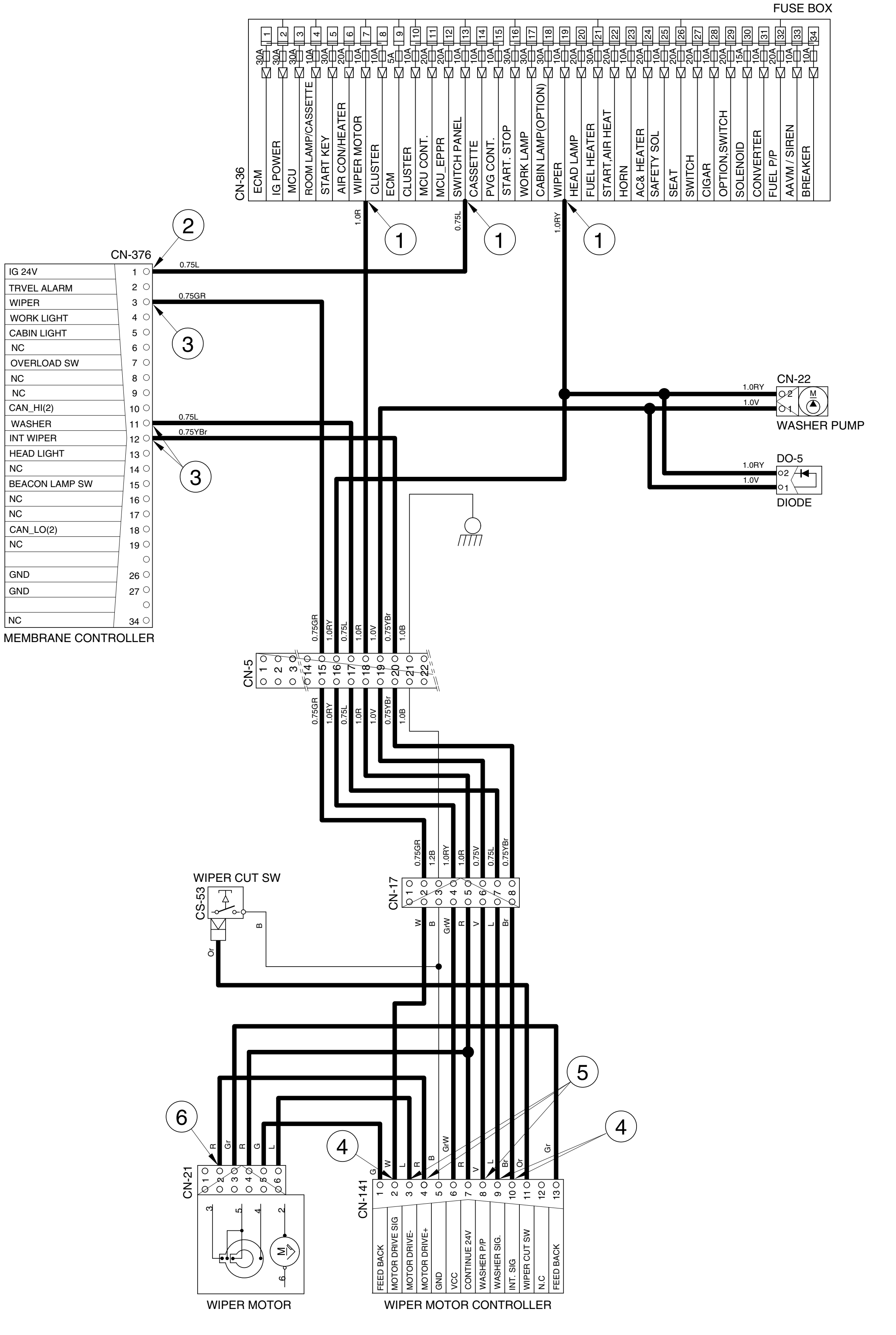
3) CHECK POINT

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 switch power input)	0 ~ 5V
		⑤ - GND (wiper power output)	24V
		⑥ - GND (wiper motor)	0 or 24V

※ GND : Ground

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

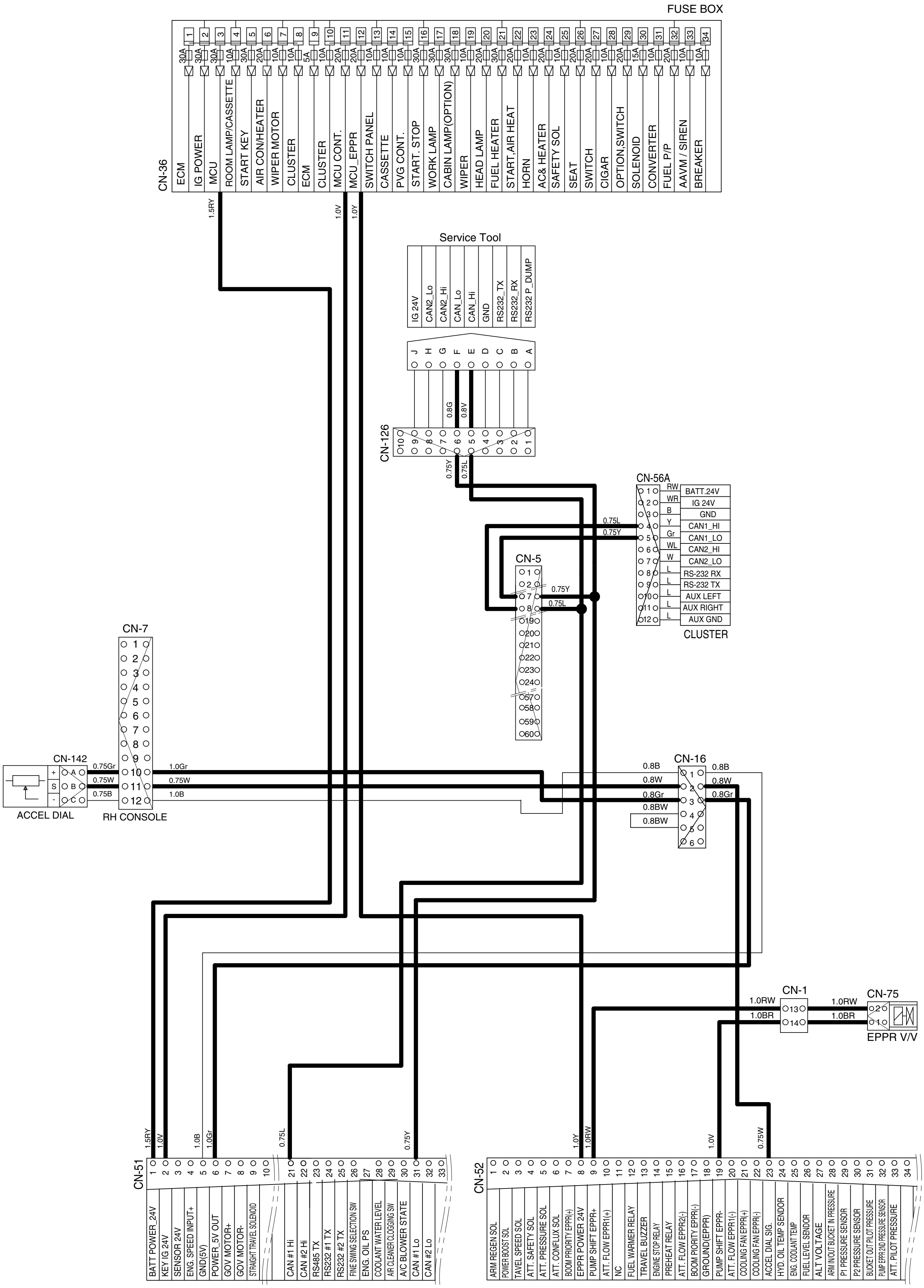
WIPER AND WASHER CIRCUIT



220SA4EL10

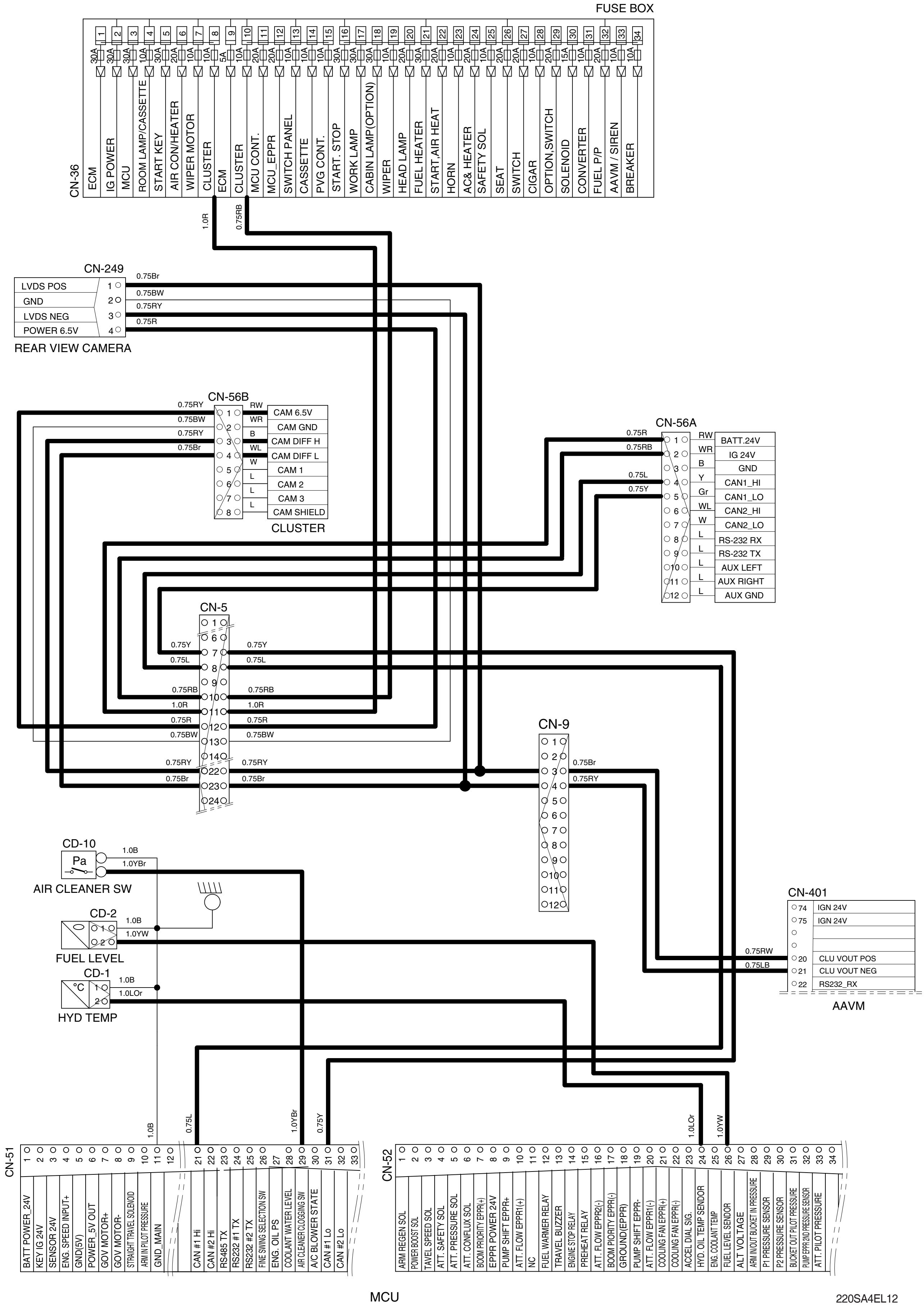
※ The circuit diagram may differ from the equipment, so please check before a repair.

CONTROLLER CIRCUIT



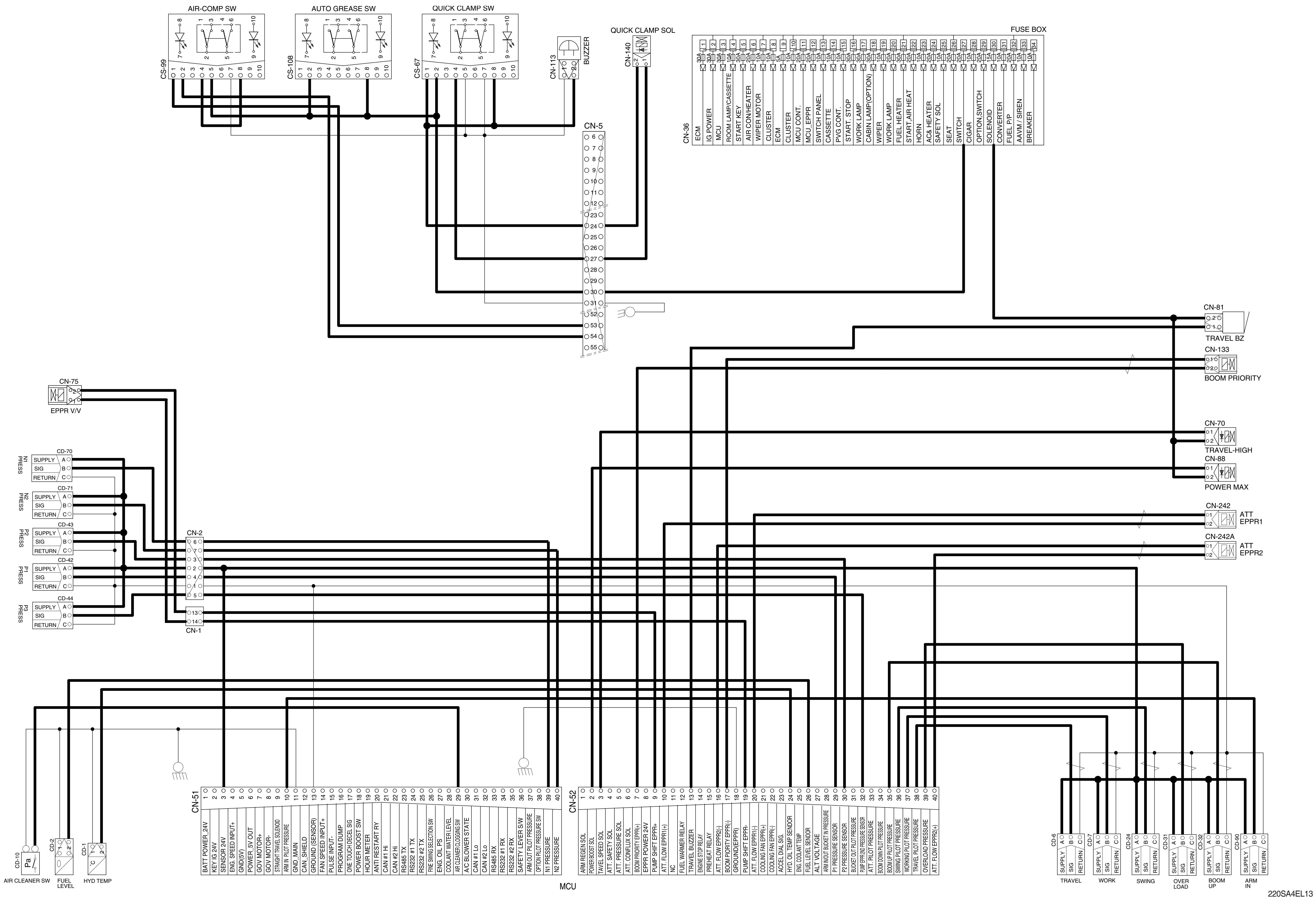
※ The circuit diagram may differ from the equipment, so please check before a repair.

MONITORING CIRCUIT



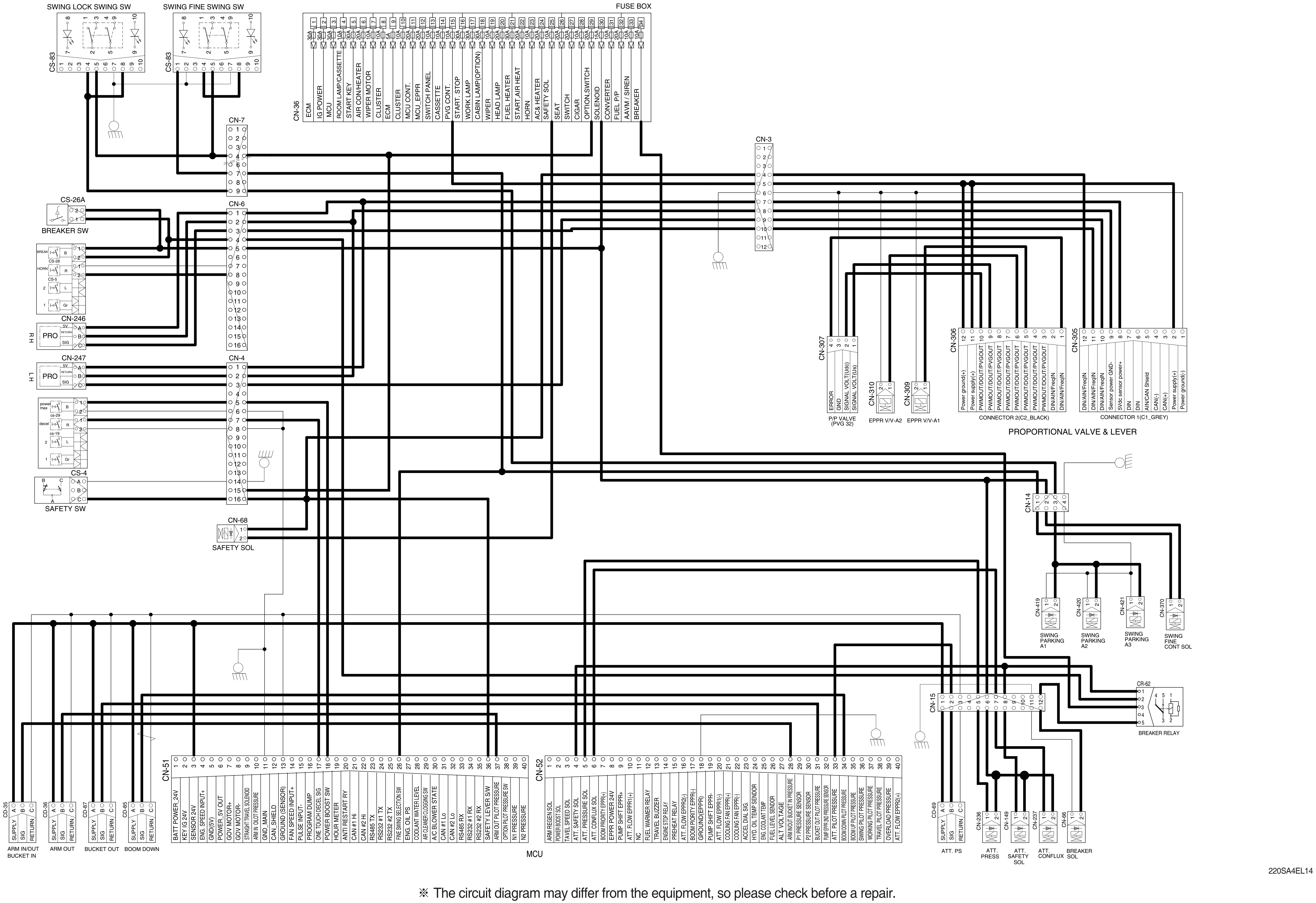
※ The circuit diagram may differ from the equipment, so please check before a repair.

ELECTRIC CIRCUIT FOR HYDRAULIC (1/2)



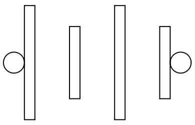
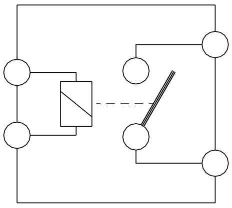
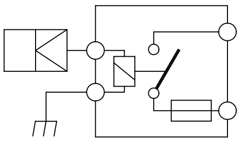
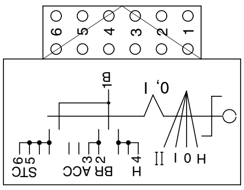
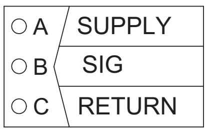
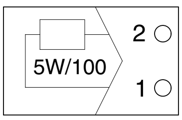
※ The circuit diagram may differ from the equipment, so please check before a repair.

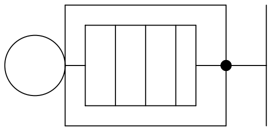
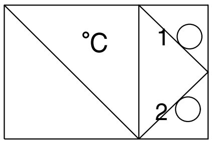
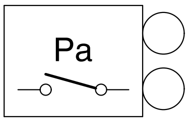
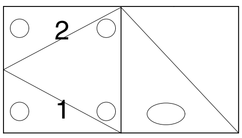
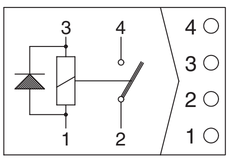
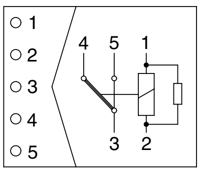
ELECTRIC CIRCUIT FOR HYDRAULIC (2/2)

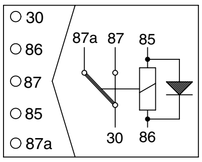
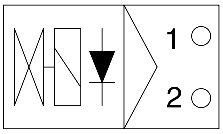
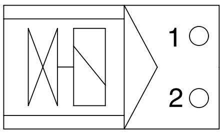
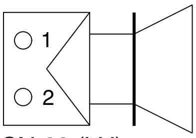
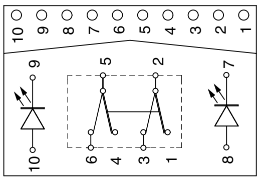
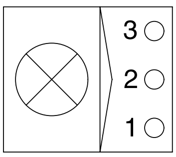


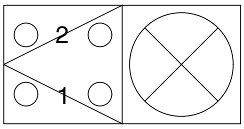
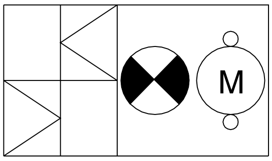
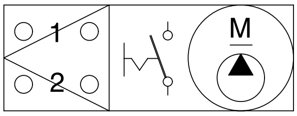
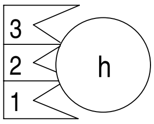
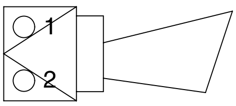
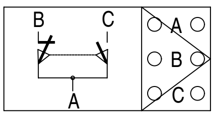
※ The circuit diagram may differ from the equipment, so please check before a repair.

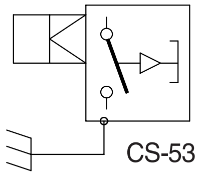
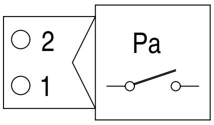
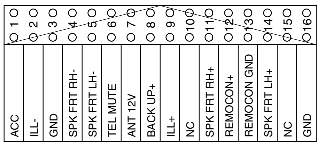
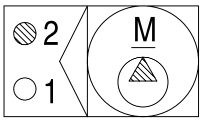
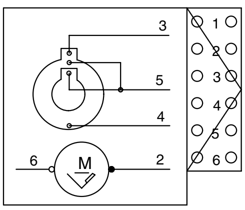
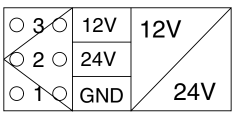
GROUP 3 ELECTRICAL COMPONENT SPECIFICATION

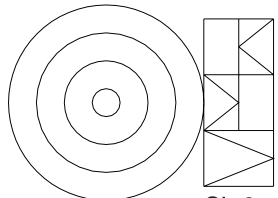
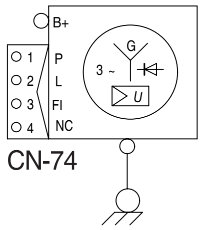
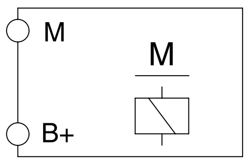
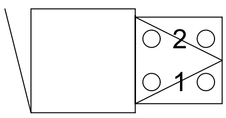
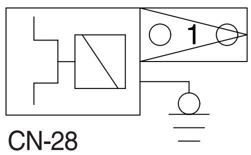
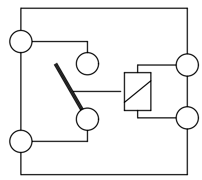
Part name	Symbol	Specifications	Check
Battery		12V×100Ah (2EA)	※ Check specific gravity 1.280 over : Over charged 1.280 ~ 1.250 : Normal 1.250 below : Recharging
Battery relay	 CR-1	Rated load : 24V 100A (continuity) 1000A (30seconds)	※ Check coil resistance(M4 to M4) Normal : About 50Ω ※ Check contact Normal : ∞Ω
Glow plug relay	 CR-24	24V 200A	※ Check contact Normal : 0.942Ω (For terminal 1-GND)
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 1-6)
Pressure sensor	 CD-6 CD-7 CD-24 CD-31 CD-32 CD-35 CD-36 CD-42 CD-43 CD-44 CD-69 CD-70 CD-71 CD-85 CD-87 CD-90	8~30V	※ Check contact Normal : 0.1Ω
Resistor	 RS-1A RS-1B	5W 100Ω	※ Check resistance Normal : 100Ω (For terminal 1-2)

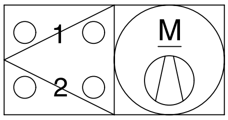
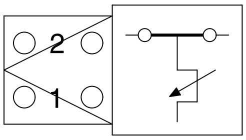
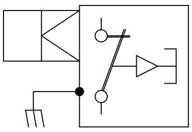
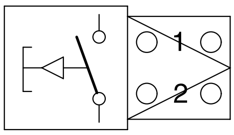
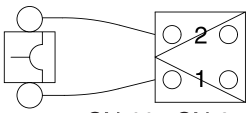
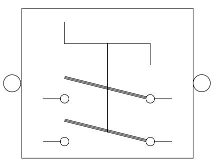
Part name	Symbol	Specifications	Check
Glow plug	 CN-80	24V 200A	※ Check resistance 0.25~0.12Ω
Temperature sensor (hydraulic)	 CD-1	-	※ Check resistance 50˚C : 804Ω 80˚C : 310Ω 100˚C : 180Ω
Air cleaner pressure switch	 CD-10	N.O TYPE	※ Check contact High level : ∞Ω Low level : 0Ω
Fuel level sender	 CD-2	-	※ Check resistance Full : 50Ω 6/12 : 350Ω 11/12 : 100Ω 5/12 : 400Ω 10/12 : 150Ω 4/12 : 450Ω 9/12 : 200Ω 3/12 : 500Ω 8/12 : 250Ω 2/12 : 550Ω 7/12 : 300Ω 1/12 : 600Ω Empty warning : 700Ω
Relay (air con blower)		24V 20A	※ Check resistance Normal : About 200Ω (for terminal 1-3) ∞Ω (for terminal 2-4)
Relay	 CR-2 CR-36 CR-45 CR-62 CR-85	24V 16A	※ Check resistance Normal : About 160 Ω (for terminal 1-2) 0Ω (for terminal 3-4) ∞Ω (for terminal 3-5)

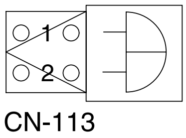
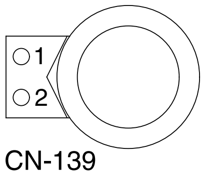
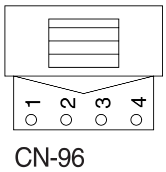
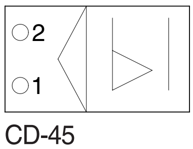
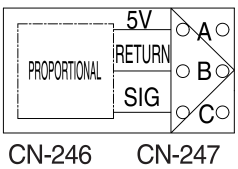
Part name	Symbol	Specifications	Check
Relay	 CR-4 CR-5 CR-7 CR-9 CR-13 CR-35 CR-46	24V 16A	※ Check resistance Normal : About 160 Ω (for terminal 85-86) 0Ω(for terminal 30-87a) ∞Ω(for terminal 30-87)
Solenoid valve	 CN-66 CN-68 CN-70 CN-88 CN-140 CN-149 CN-236 CN-237 CN-370 CN-419 CN-420 CN-421	24V 1A	※ Check resistance Normal : 15~25Ω (for terminal 1-2)
EPPR valve	 CN-75 CN-133 CN-242 CN-242A CN-309 CN-310	700mA	※ Check resistance Normal : 15~25Ω (for terminal 1-2)
Speaker	 CN-23 (LH) CN-24 (RH)	20W	※ Check resistance Normal : A fewΩ
Switch (locking type)	 CS-52 CS-67 CS-83 CS-99 CS-108	24V 8A	※ Check contact Normal ON : 0 Ω(for terminal 2-3, 5-6) ∞Ω(for terminal 1-2, 4-5) OFF : ∞Ω(for terminal 2-3, 5-6) 0 Ω(for terminal 1-2, 4-5)
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)

Part name	Symbol	Specifications	Check
Head lamp, Work lamp, Cab lamp	 CL-3 CL-4 CL-5 CL-6 CL-8 CL-9 CL-10 CL-24	24V 65W (H3 Type)	※ Check disconnection Normal : 1.2Ω
Beacon lamp	 CL-7	21V 70W (H1 Type)	※ Check disconnection Normal : A fewΩ
Fuel filler pump	 CN-61	24V 10A 35 ℓ /min	※ Check resistance Normal : 1.0Ω
Hour meter	 CN-48	16~32V	※ Check operation Supply power(24V) to terminal No.2 and connect terminal No.1 and ground
Horn	 CN-20 CN-25	DC22~28V 2A	※ Check operation Supply power(24V) to each terminal and connect ground.
Safety switch	 CS-4	24V 15A (N.C TYPE)	※ Check contact Normal : 0Ω(for terminal A-B) ∞Ω(for terminal A-C) Operating : ∞Ω(for terminal A-B) 0Ω(for terminal A-C)

Part name	Symbol	Specifications	Check
Wiper cut switch	 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	 CN-27A	24V 2A	※ Check voltage 20~25V (for terminal 1-3, 3-8)
Washer pump	 CN-22	24V 3.8A	※ Check contact Normal : 10.7Ω (for terminal 1-2)
Wiper motor	 CN-21	24V 2A	※ Check disconnection Normal : 7Ω (for terminal 2-6)
DC/DC Converter	 CN-138	12V 3A	※ Check voltage 24V (for terminal 1-2) 12V (for terminal 1-3)

Part name	Symbol	Specifications	Check
Cigar lighter	 CL-2	24V 5A 1.4W	※ Check coil resistance Normal : About 1MΩ ※ Check contact Normal : ∞Ω Operating time : 5~15sec
Alternator	 CN-74	Denso 24V 95A	※ Check contact Normal : 0Ω (for terminal B+-L) Normal : 24~27.5V
Starter	 CN-45	24V 4.5kW	※ Check contact Normal : 0.1Ω
Travel alarm	 CN-81	24V 0.5A	※ Check contact Normal : 5.2Ω
Aircon compressor	 CN-28	24V 79W	※ Check contact Normal : 13.4Ω
Start relay	 CR-23	24V 300A	※ Check contact Normal : 0.94Ω(for terminal 1-2)

Part name	Symbol	Specifications	Check
Blower motor		24V 9.5A	※ Check resistance Normal : 2.5Ω (for terminal 1-2)
Thermistor		1˚C OFF 4˚C ON	※ Check resistance Normal : 0Ω (for terminal 1-2), the atmosphere temp : Over 4˚C
Door switch	 CS-1	24V 2W	※ Check resistance Normal : About 5MΩ
Switch (power max, one touch decel, horn, breaker)	 CS-5 CS-19 CS-26 CS-29	24V 6A	※ Check resistance Normal : ∞ Ω
Fuse	 CN-60 CN-95	CN-60 : 40A CN-95 : 80A	※ Check disconnection Normal : 0Ω (connect ring terminal and check resist between terminal 1 and 2)
Master switch	 CS-74	6-36V	※ Check disconnection Normal : 0.1Ω

Part name	Symbol	Specifications	Check
Quick clamp buzzer		24V 200mA 107±4dB	-
Socket		12V 10A	-
Fuel heater		-	-
WIF sensor		-	-
Proportional valve sensor		-	-

GROUP 4 CONNECTORS

1. CONNECTOR DESTINATION

Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CN-1	TE/AMP	16	I/conn (Frame harness-Engine harness)	368047-1	368051-1
CN-2	TE/AMP	15	I/conn (Frame harness-Engine harness)	2-85262-1	368301-1
CN-3	TYCO	12	I/conn (Frame harness-Pro vlv harness)	174661-2	368537-1
CN-4	AMP/TE	16	I/conn (Console harness LH-Frame harness)	368047-1	368050-1
CN-5	DEUTSCH	60	I/conn (Side harness RH-Frame harness)	DRB16-60SAE-L018	DRB14-60PAE-L018
CN-6	AMP	10	I/conn (Console harness RH-Frame harness)	S816-010002	174655-2
CN-7	AMP	12	I/conn (Console harness RH-Frame harness)	S816-012002	S816-112002
CN-9	DEUTSCH	12	I/conn (Frame harness-AAVM harness)	DT06-12SA-P021	DT04-12PA-P021
CN-10	DEUTSCH	12	I/conn (Cab harness-Side harness RH)	DT06-12S-EP06	DT04-12PA-P021
CN-11	DEUTSCH	8	I/conn (Frame harness-Aircon harness)	DT06-8S-EP06	-
CN-12	DEUTSCH	2	I/conn (Frame harness-Boom wire harness)	DT06-2S-EP06	DT04-2P-E005
CN-14	TE	4	I/conn (Fream harness-Swing parking & fine control)	174257-2	174259-2
CN-15	AMP	12	I/conn (Frame harness-Breaker sol)	174661-2	S816-112002
CN-16	TYCO	6	Emergency engine start & speed control	-	174661-2
CN-16A	-	6	Emergency engine start & speed control	965687-1	-
CN-16B	-	6	Emergency engine start & speed control	965687-1	-
CN-17	AMP	8	I/conn (Side harness RH-Wiper harness)	S816-008002	S816-108002
CN-20	MOLEX	2	Horn	DT06-2S-EP06	-
CN-21	AMP	6	Wiper motor	S810-006202	-
CN-22	KET	2	Washer tank 1	MG640605	-
CN-23	KET	2	Speaker-LH	MG610070	-
CN-24	KET	2	Speaker-RH	MG610070	-
CN-25	MOLEX	2	Horn	35825-0211	-
CN-27A	KUM	16	Radio & USB player	PK145-16017	-
CN-27B	AMP	8	Radio & USB player	-	174984-2
CN-28	KET	2	Aircon compressor	MG610320	-
CN-29	KET	2	Receiver dryer	MG640795	-
CN-36	-	-	Fuse & relay box	21Q7-10910	-
CN-45	RING-TERM	-	Starter motor B^+	S820-108000	-
CN-48	KET	3	Hour meter	2-520193-2	-
CN-51	DEUTSCH	40	MCU	DRC26-40SA	-
CN-52	DEUTSCH	40	MCU	DRC26-40SB	-
CN-56A	AMP	12	Cluster	-	174663-2
CN-56B	AMP	8	Cluster	-	174984-2
CN-60	R/TERM/-	2	Fuse maxi	ST710285-2	31K9-03270
CN-61	DEUTSCH	2	Fuel filler pump	DT06-2S-EP06	-

Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CN-66	DEUTSCH	2	Breaker solenoid	DT06-2S-EP06	-
CN-68	DEUTSCH	2	Safety solenoid	DT06-2S-EP06	-
CN-70	DEUTSCH	2	Travel high solenoid	DT06-2S-EP06	-
CN-74	-	4	Alternator terminal	1218 6568	-
CN-75	AMP	2	Pump EPPR	174352-2	-
CN-80	RING-TERM	-	Glow plug	S820-306000	-
CN-81	DEUTSCH	2	Travel buzzer solenoid	DT06-2S-EP06	-
CN-88	DEUTSCH	2	Power max solenoid	DT06-2S-EP06	-
CN-93	DEUTSCH	50	ECM	DRC26-50S-04	-
CN-94	DEUTSCH	4	ECM earth	DTP06-4S-EP06	-
CN-95	R/TERM/-	2	Fuse maxi	ST710285-2	31K9-03270
CN-96	AMP	4	Fuel warmer	-	2-967402-2
CN-96A	AMP	3	Fuel warmer	368523-1	-
CN-96B	AMP	4	Fuel warmer	2-967325-2	-
CN-113	KET	2	Buzzer	MG651205-5	-
CN-125	Econoseal J	4	RMS connector	S816-004002	S816-104002
CN-125A	DEUTSCH	12	RMS	DT06-12S-P021	DT04-12PA-P021
CN-126	AMP	10	Service tool	174259-2	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-142	DEUTSCH	3	Accel dial switch	DT06-3S	-
CN-147	AMP	4	Fuel heater	2-967325-1	2-967402-1
CN-149	DEUTSCH	2	Attach safety solenoid	DT06-2S-EP06	-
CN-156	DEUTSCH	2	Seat heat	DT06-2S-EP06	DT04-2P
CN-157	AMP	1	Antena power	S822-014002	-
CN-173	DEUTSCH	3	Resistor	DT06-3S-EP06	-
CN-236	DEUTSCH	2	Attach pressure solenoid	DT06-2S-EP06	-
CN-237	DEUTSCH	2	Attach conflux solenoid	DT06-2S-EP06	-
CN-242	DEUTSCH	2	Attach EPPR 1 (A1)	DT06-2S-EP06	DT04-2P-E0005
CN-242A	DEUTSCH	2	Attach EPPR 2 (A2)	DT06-2S-EP06	DT04-2P-E0005
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	4	Rear view camera	DT06-4S-EP06	DT04-4P-E005
CN-279	AMP	2	Accel dial LED	S816-002002	-
CN-305	DEUTSCH	12	Proportional-connector 1	DTM06-12SA	-
CN-306	DEUTSCH	12	Proportional-connector 2	DTM06-12SB	-

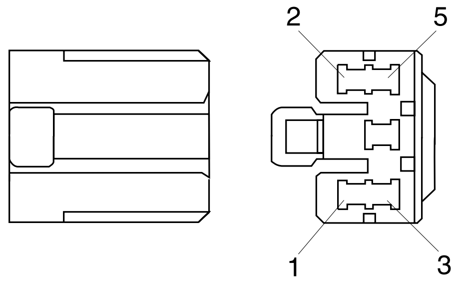
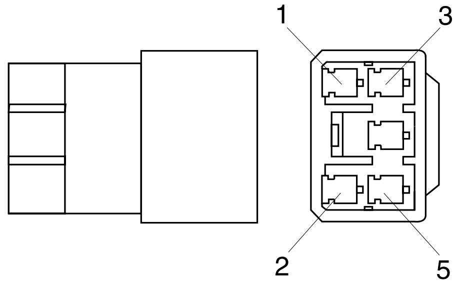
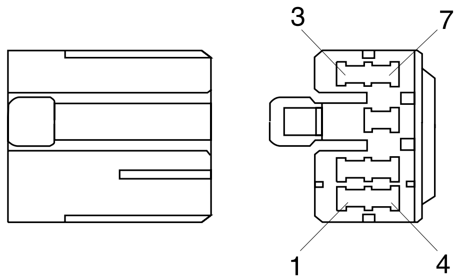
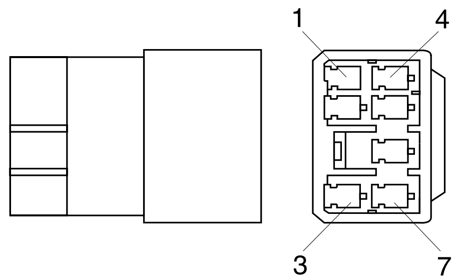
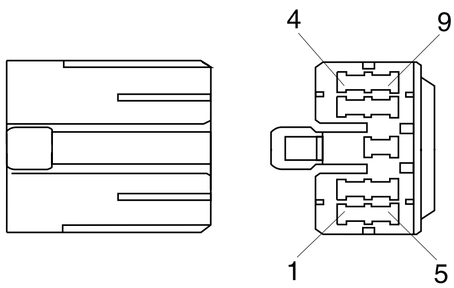
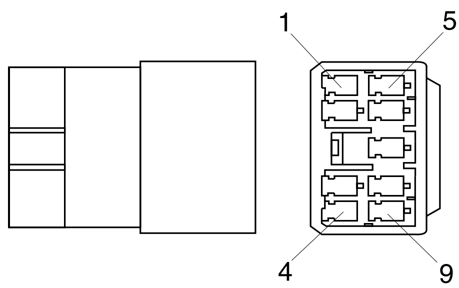
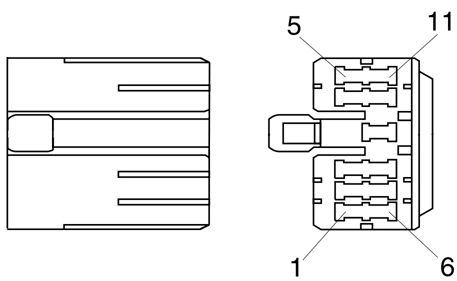
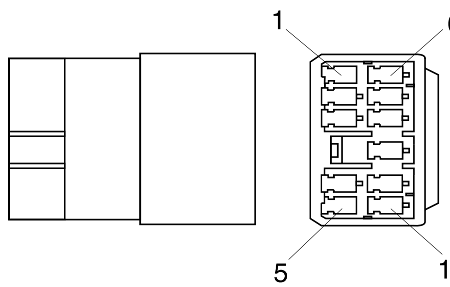
Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CN-307	DEUTSCH	3	Proportional-Service tool	DT06-3S-EP06	DT04-3P-E005
CN-307	DEUTSCH	4	Proportional-PVG32	DT06-4S	DT04-4P-E005
CN-307	DEUTSCH	4	PVG32 EPPR	DT06-4S	-
CN-307A	DEUTSCH	4	PVG32 rotating harness	2-967059-1	-
CN-309	DEUTSCH	2	Proportional-EPPR valve A1	DT06-2S-EP06	-
CN-310	DEUTSCH	2	Proportional-EPPR valve A2	DT06-2S-EP06	-
CN-370	DEUTSCH	2	Swing fine control solenoid	DT06-2S-EP06	-
CN-376	TYCO	33	Membrane controller	7706087-2	-
CN-401	TE	35	AAVM controller	776164-1	-
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	LH view camera	DT06-6S-EP06	DT04-6P-EP14
CN-405	DEUTSCH	6	RH view camera	DT06-6S-EP06	DT04-6P-EP14
CN-406	DEUTSCH	3	RS 232	DT06-3S-EP06	DT04-3P-E005
CN-419	DEUTSCH	2	Swing parking-A1	DT06-2S-EP06	-
CN-420	DEUTSCH	2	Swing parking-A2	DT06-2S-EP06	-
CN-421	DEUTSCH	2	Swing parking-A3	DT06-2S-EP06	-
CN-427	MOLEX	4	Reader-RMS	039012040	026013096
CN-432	AMP	3	Cigar lighter	174357-2	174359-2
· Relay					
CR-1	RING-TERM	-	Battery relay	ST710289-2	-
CR-2	-	5	Horn relay	-	-
CR-4	-	5	Working lamp relay	-	-
CR-5	-	5	Anti restart relay	-	-
CR-7	-	5	Aircon compressor relay	-	-
CR-9	-	5	Cabin lamp relay	-	-
CR-13	-	5	Head lamp relay	-	-
CR-23	KET	2	Start relay	MG610320	MG640322
CR-24	RING TERM	1	Preheat relay	S822-014000	-
CR-35	-	5	Power relay	-	-
CR-36	-	5	Preheat relay	-	-
CR-45	-	5	ECM power relay	-	-
CR-46	-	5	Fuel warmer relay	-	-
CR-62	-	5	Breaker relay	-	-
CR-85	-	5	Beacon lamp relay	-	-
· Switch					
CS-1	SHUR	1	Door switch	S822-014002	S822-114002
CS-2A	WP	6	Start key switch	S814-006100	-
CS-2B	DEUTSCH	3	BKCU	DT06-3S-EP06	DT04-3P-E005

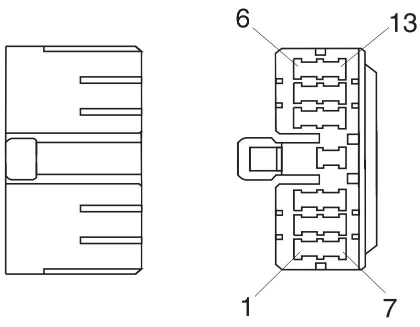
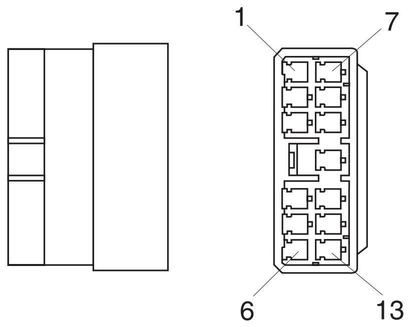
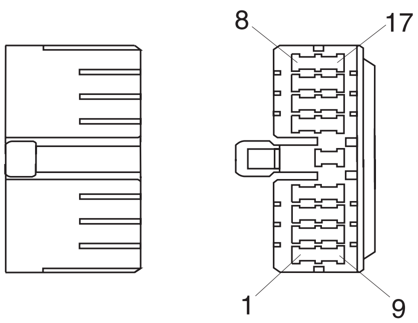
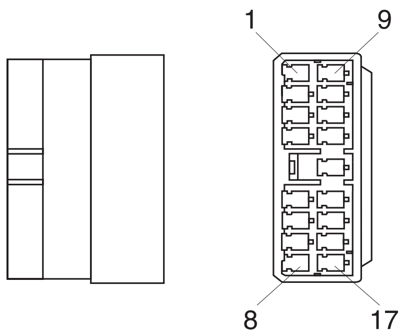
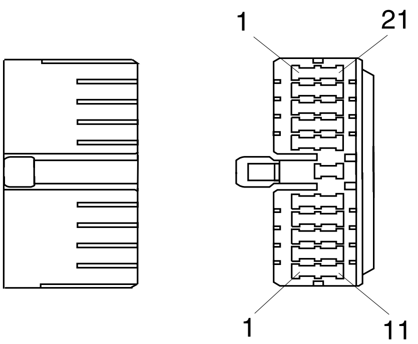
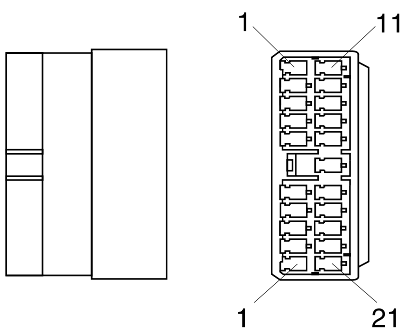
Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CS-4	DEUTSCH	3	Safety switch	DT06-3S	-
CS-5	DEUTSCH	2	Horn switch	-	DT04-2P
CS-19	DEUTSCH	2	One touch decel switch	-	DT04-2P
CS-26	DEUTSCH	2	Breaker switch	DT06-2S	-
CS-26A	AMP	2	Breaker pedal switch	S816-002002	S816-102002
CS-29	DEUTSCH	2	Power max switch	DT06-2S	-
CS-33	AMP	6	Emergency engine stop switch	S816-006002	S816-106002
CS-52	CARLING	10	2 pcs dozer 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	Fine swing switch	VC2-01	-
CS-74A	DEUTSCH	2	Master switch	DT06-2S-EP06	-
CS-74B	DEUTSCH	2	Master switch	DT06-2S-EP06	-
CS-83	CARLING	10	Swing lock switch	VC2-01	-
CS-99	CARLING	10	Air compressor switch	VC2-01	-
CS-108	CARLING	10	Auto grease switch	VC2-01	-
· Light					
CL-1	KET	3	Room lamp	MG651032	-
CL-2	AMP	1	Cigar lighter	S822-014002	S822-114002
CL-3	DEUTSCH	2	Head lamp-LH	DT06-2S-EP06	-
CL-4	DEUTSCH	2	Head lamp-RH	DT06-2S-EP06	-
CL-5	DEUTSCH	2	Work lamp-LH	DT06-2S-EP06	-
CL-6	DEUTSCH	2	Work lamp-RH	DT06-2S-EP06	-
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 lighter	DT06-2S-EP06	DT04-2P
CL-24	DEUTSCH	2	Head lamp-rear	DT06-2S-EP06	DT04-2P-E005
CL-36	DEUTSCH	2	Work lamp-LH	DT06-2S-EP06	-
CL-37	DEUTSCH	2	Work lamp-RH	DT06-2S-EP06	-
· Sensor, sendor					
CD-1	AMP	2	Hydraulic oil temp sender	85202-1	-
CD-2	DEUTSCH	2	Fuel sender	DT06-2S-EP06	-
CD-6	DEUTSCH	3	Travel pressure switch	DT06-3S-EP06	-
CD-7	DEUTSCH	3	Working pressure switch	DT06-3S-EP06	-
CD-10	AMP	2	Air cleaner switch	85202-1	-
CD-24	DEUTSCH	3	Swing pressure sensor	DT06-3S-EP06	-
CD-31	DEUTSCH	3	Overload pressure sensor	DT06-3S-EP06	DT04-3P-E005
CD-32	DEUTSCH	3	Boom up pressure sensor	DT06-3S-EP06	-

Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CD-35	DEUTSCH	3	Bucket in pressure sensor	DT06-3S-EP06	-
CD-36	DEUTSCH	3	Arm out pressure sensor	DT06-3S-EP06	-
CD-42	DEUTSCH	3	P1 pump pressure sensor	DT06-3S-EP06	-
CD-43	DEUTSCH	3	P2 pump pressure sensor	DT06-3S-EP06	-
CD-44	DEUTSCH	3	A4 pump pressure sensor	DT06-3S-EP06	-
CD-45	DEUTSCH	2	WIF sensor	DT06-2S-EP06	DT04-2P-E005
CD-69	DEUTSCH	3	Attach pressure sensor	DT06-3S-EP06	-
CD-70	DEUTSCH	3	N1 pressure sensor	DT06-3S-EP06	-
CD-71	DEUTSCH	3	N2 pressure sensor	DT06-3S-EP06	-
CD-85	DEUTSCH	3	Boom down pressure sensor	DT06-3S-EP06	-
CD-87	DEUTSCH	3	Bucket out pressure sensor	DT06-3S-EP06	-
CD-90	DEUTSCH	3	Arm in pressure sensor	DT06-3S-EP06	-

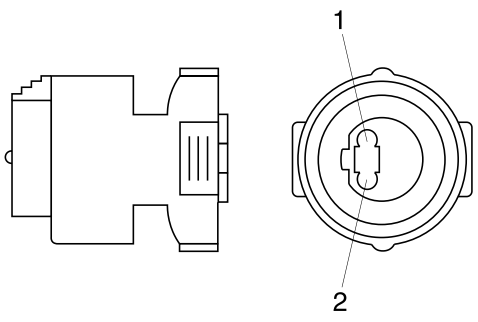
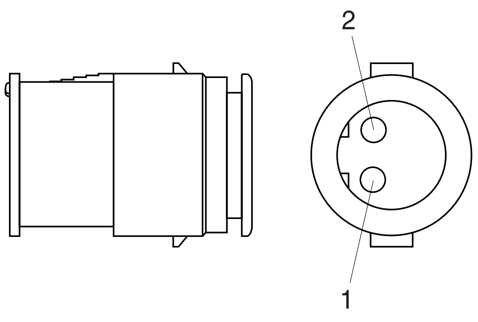
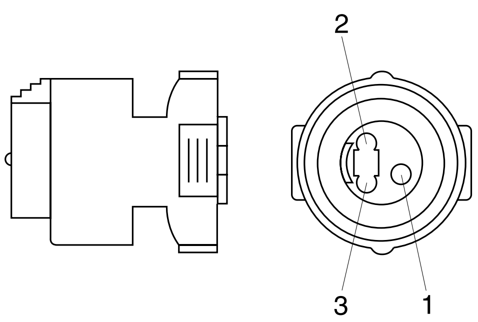
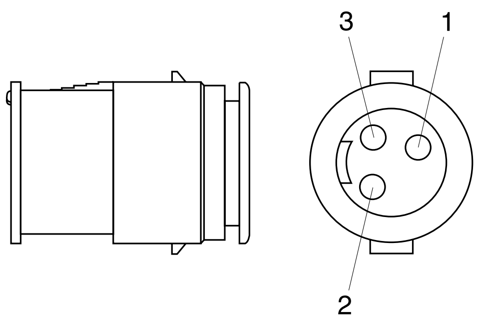
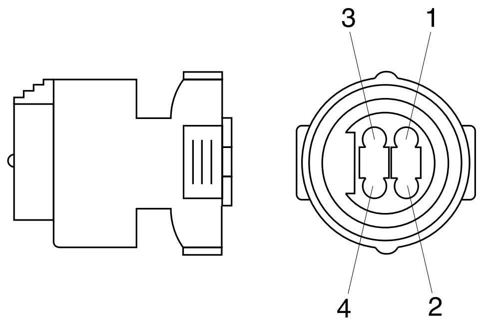
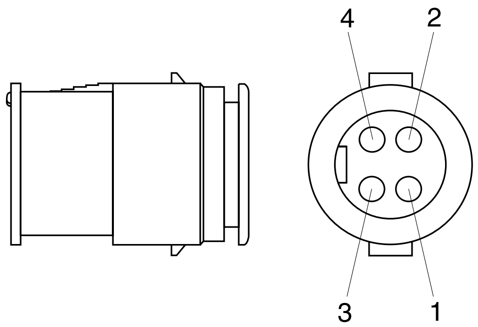
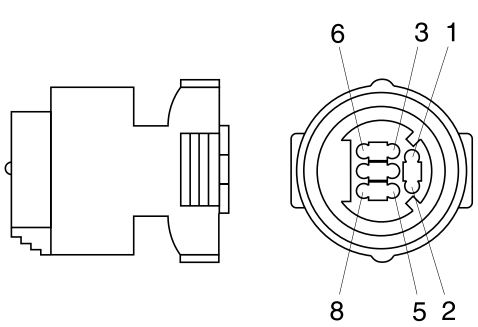
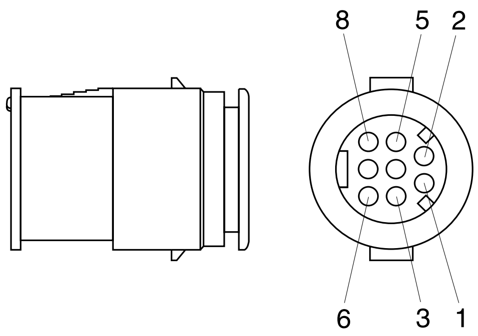
2. CONNECTION TABLE FOR CONNECTORS

1) PA TYPE CONNECTOR

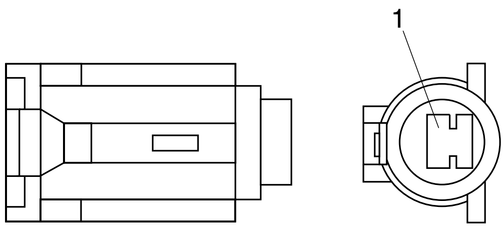
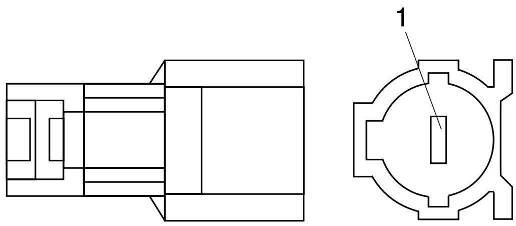
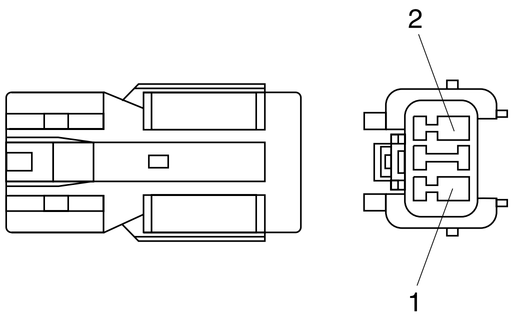
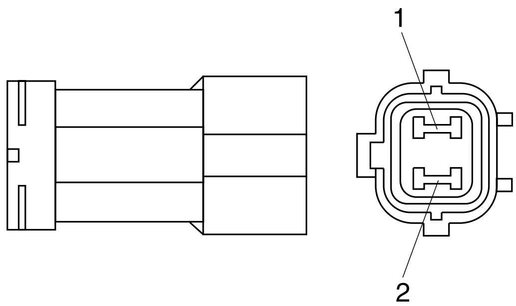
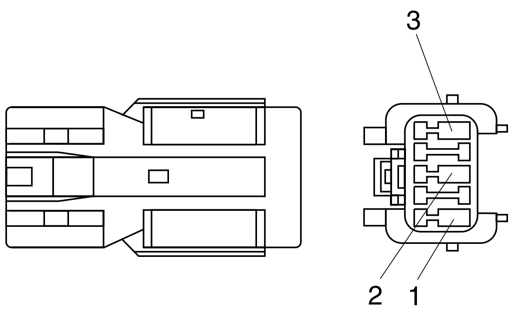
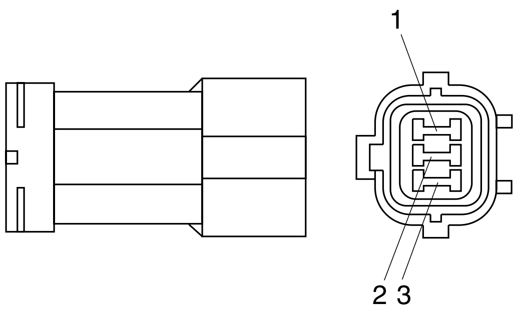
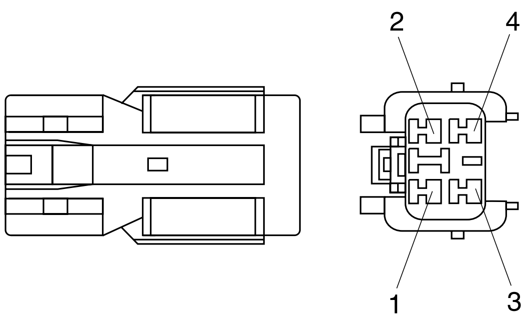
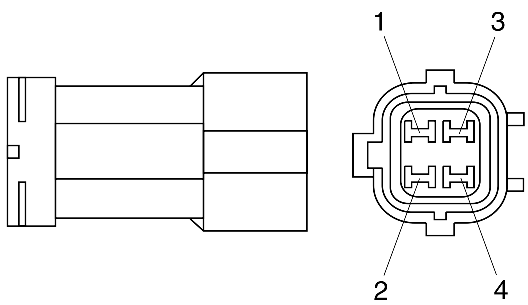
No. of pin	Receptacle connector (female)	Plug connector (male)
5	 S811-005002	 S811-105002
7	 S811-007002	 S811-107002
9	 S811-009002	 3S811-109002
11	 S811-011002	 S811-111002

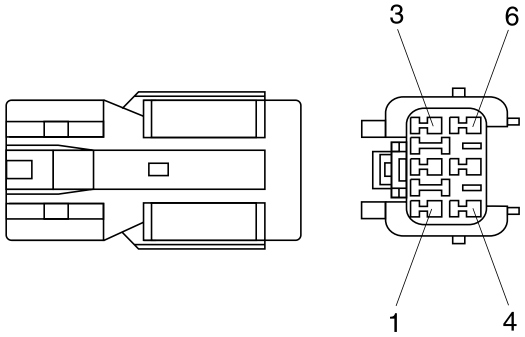
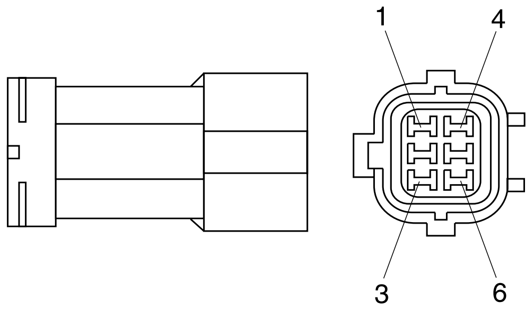
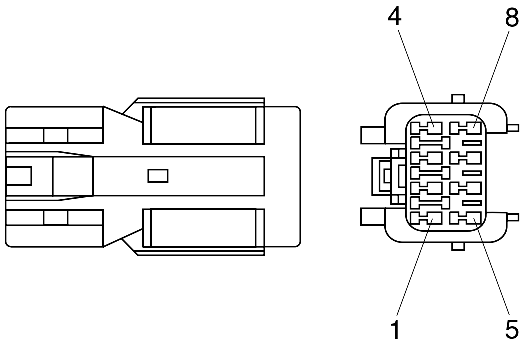
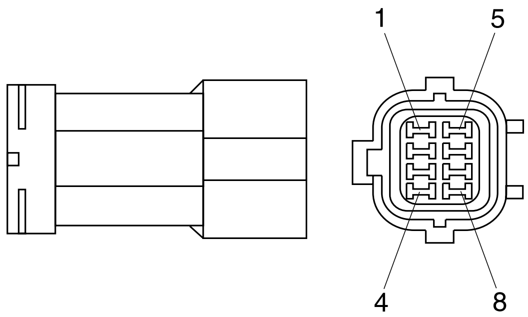
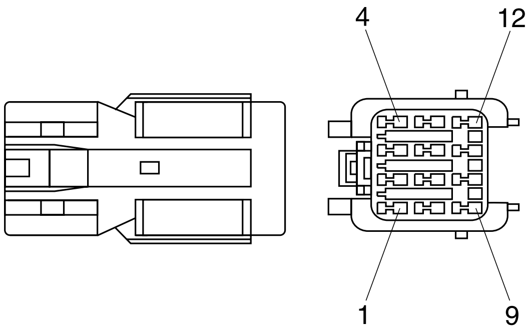
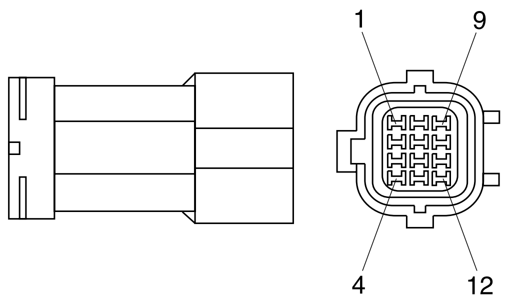
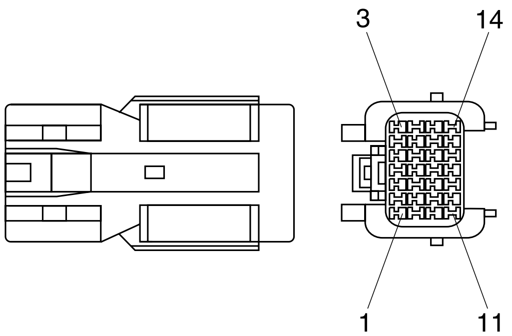
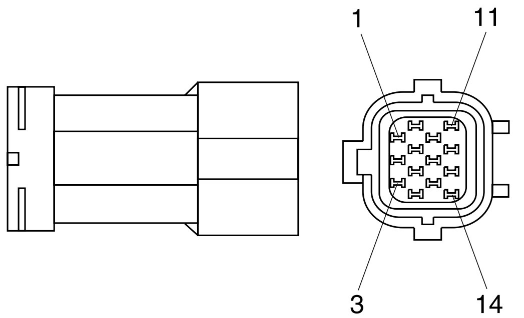
No. of pin	Receptacle connector (female)	Plug connector (male)
13	 S811-013002	 S811-113002
17	 S811-017002	 S811-117002
21	 S811-021002	 S811-121002

2) J TYPE CONNECTOR

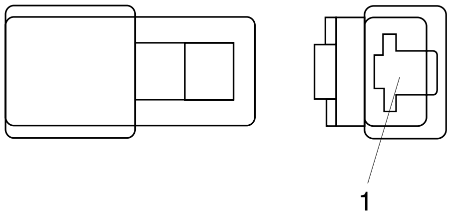
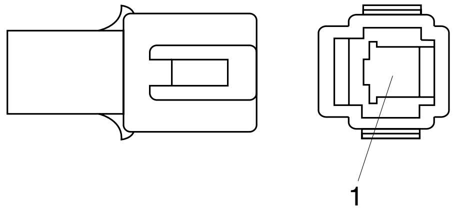
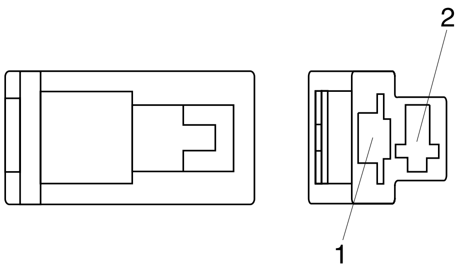
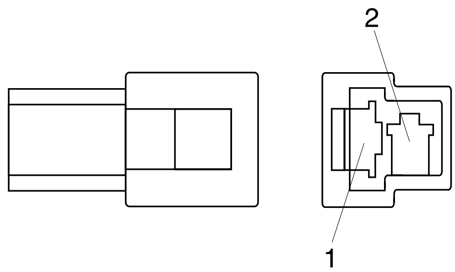
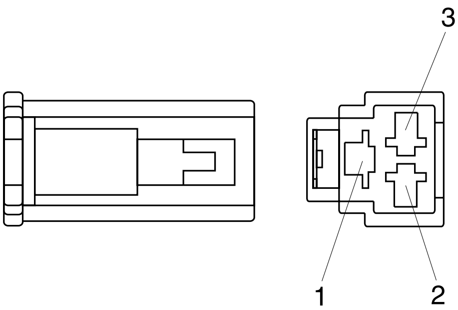
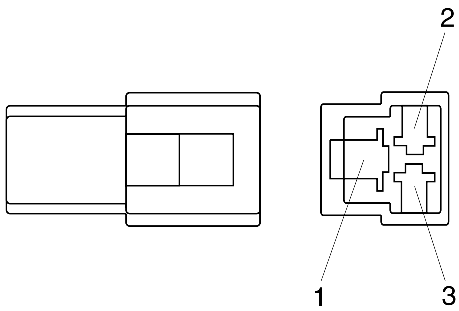
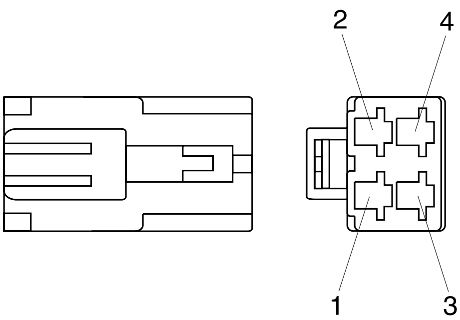
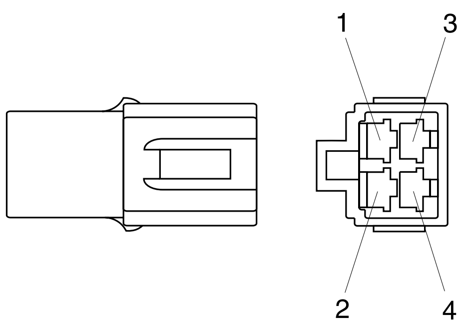
No. of pin	Receptacle connector (female)	Plug connector (male)
2	 S816-002001	 S816-102001
3	 S816-003001	 S816-103001
4	 S816-004001	 S816-104001
8	 S816-008001	 S816-108001

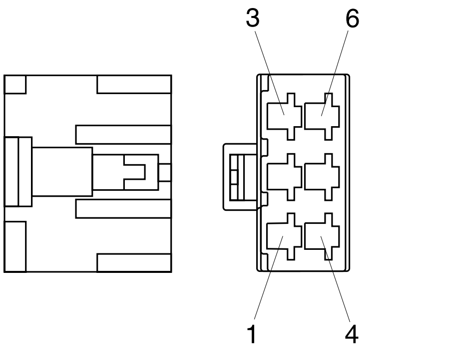
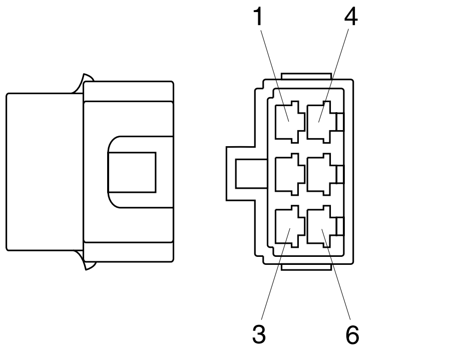
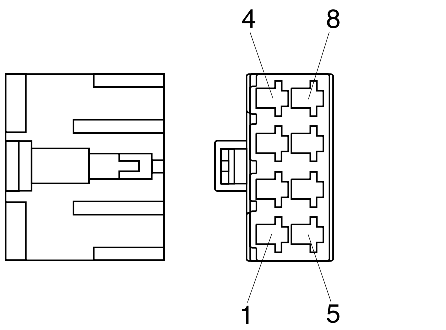
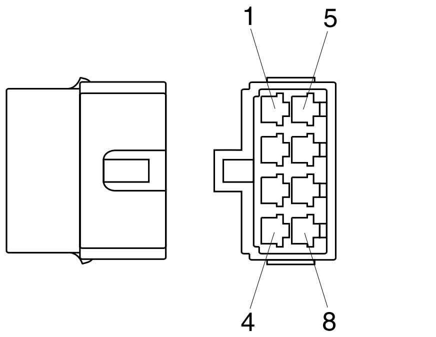
3) SWP TYPE CONNECTOR

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

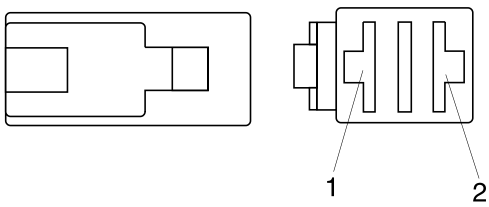
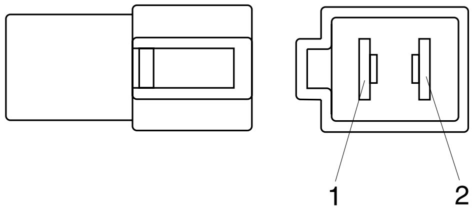
No. of pin	Receptacle connector (female)	Plug connector (male)
6	 S814-006000	 S814-106000
8	 S814-008000	 S814-108000
12	 S814-012000	 S814-112000
14	 S814-014000	 S814-114000

4) CN TYPE CONNECTOR

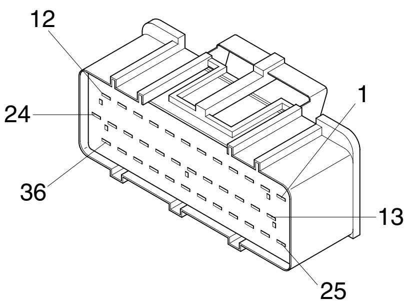
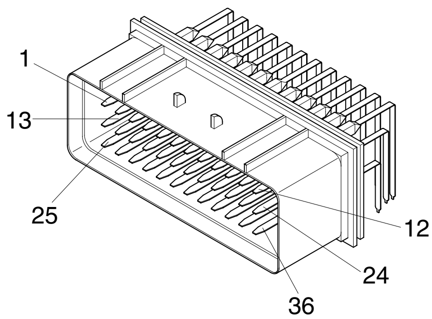
No. of pin	Receptacle connector (female)	Plug connector (male)
1	 S810-001202	 S810-101202
2	 S810-002202	 S810-102202
3	 S810-003202	 S810-103202
4	 S810-004202	 S810-104202

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

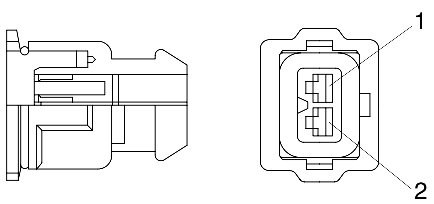
5) 375 FASTEN TYPE CONNECTOR

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

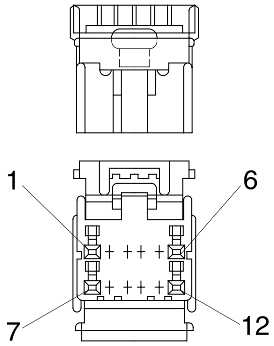
6) AMP ECONOSEAL CONNECTOR

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

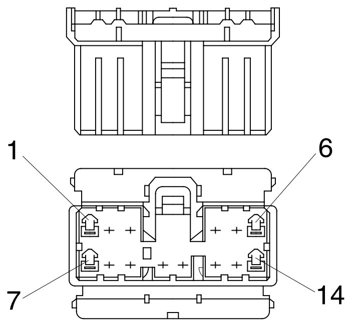
7) AMP TIMER CONNECTOR

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

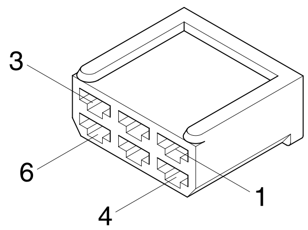
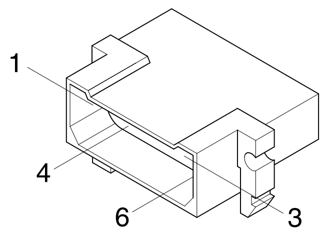
8) AMP 040 MULTILOCK CONNECTOR

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

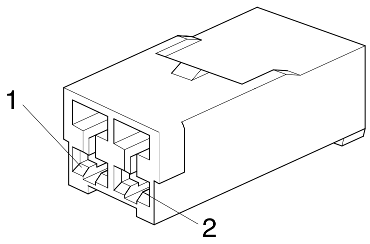
9) AMP 070 MULTILOCK CONNECTOR

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

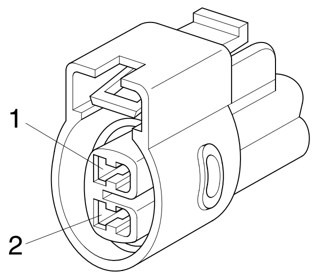
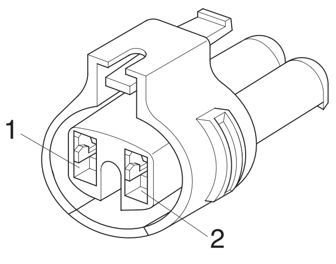
10) AMP FASTIN - FASTON CONNECTOR

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

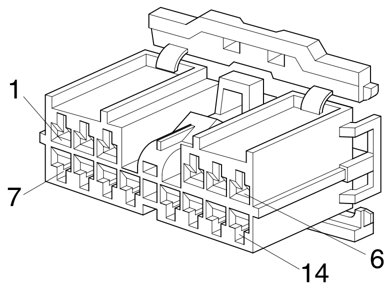
11) KET 090 CONNECTOR

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

12) KET 090 WP CONNECTORS

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

13) KET SDL CONNECTOR

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

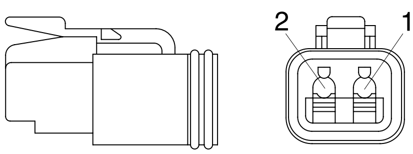
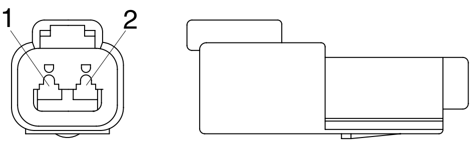
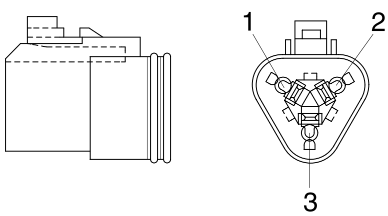
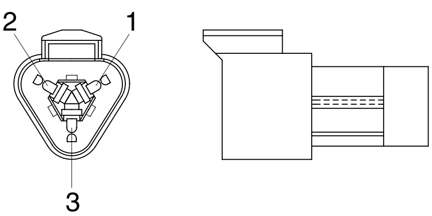
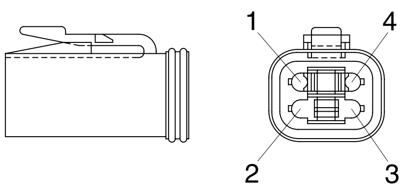
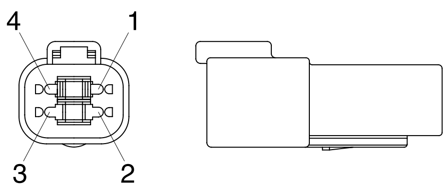
14) DEUTSCH DT CONNECTORS

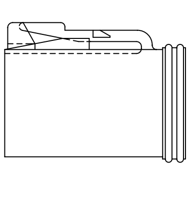
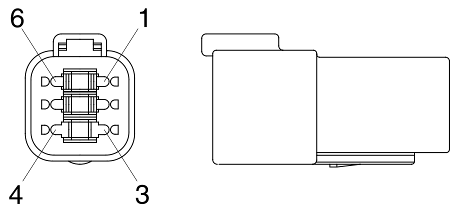
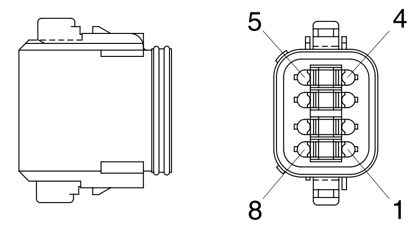
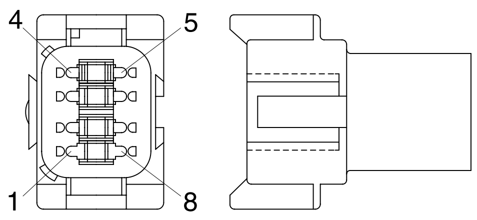
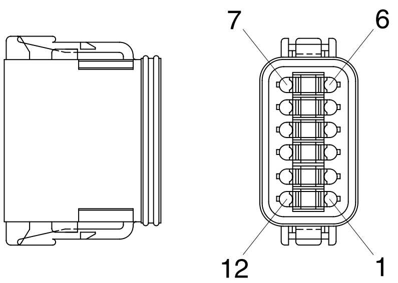
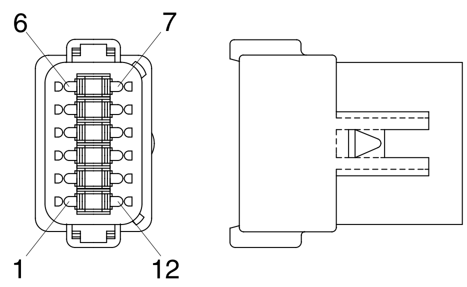
DT 06 - 3S - ★★★★

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

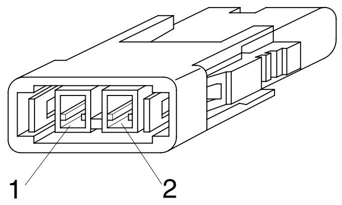
※ Modification

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

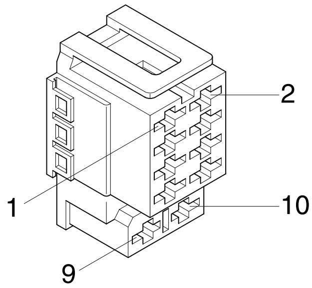
No. of pin	Receptacle connector (female)	Plug connector (male)
2	 DT06-2S	 DT04-2P
3	 DT06-3S	 DT04-3P
4	 DT06-4S	 DT04-4P

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

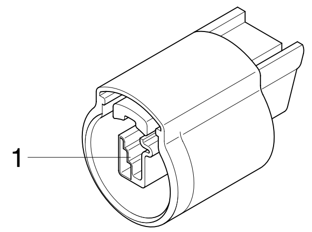
15) MOLEX 2CKTS CONNECTOR

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

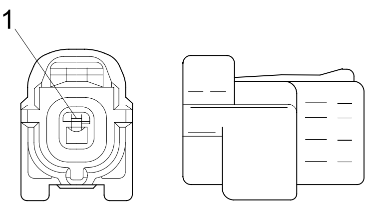
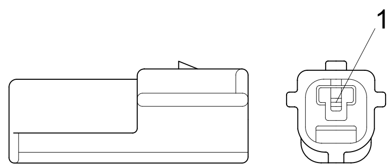
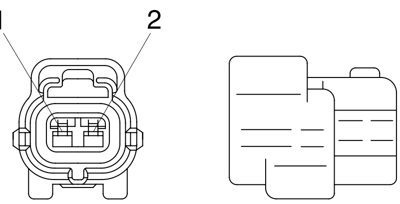
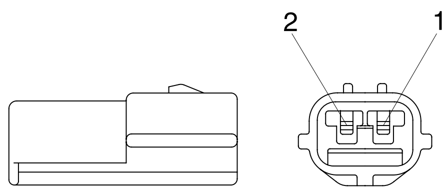
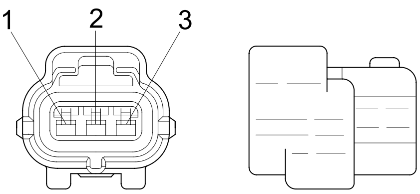
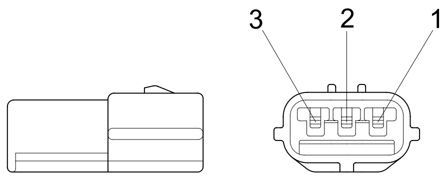
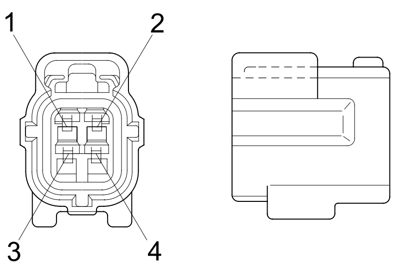
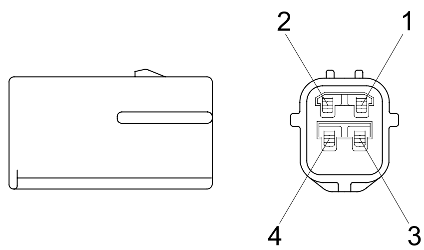
16) ITT SWF CONNECTOR

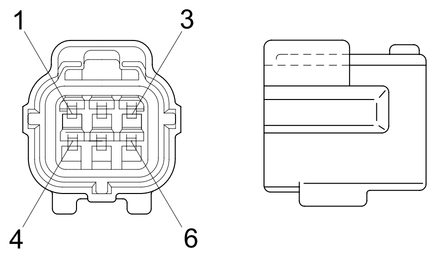
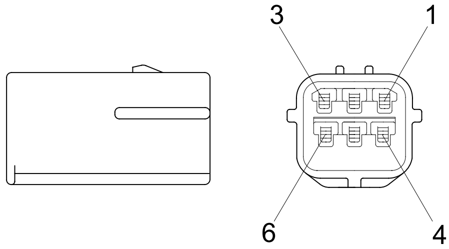
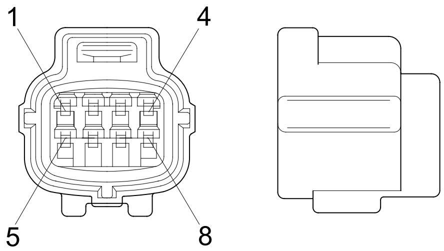
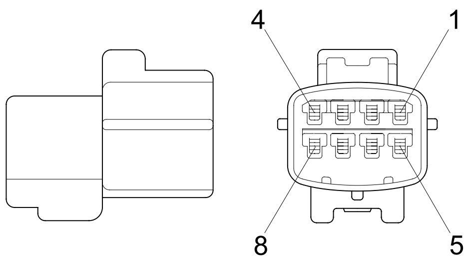
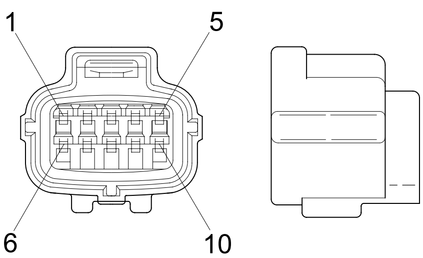
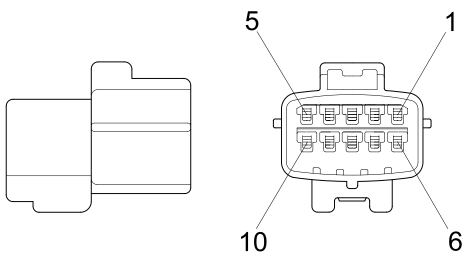
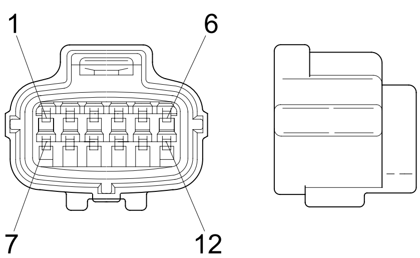
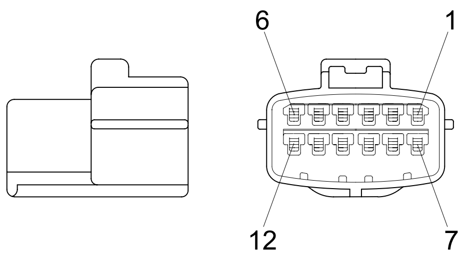
No. of pin	Receptacle connector (female)	Plug connector (male)
10	 SWF593757	

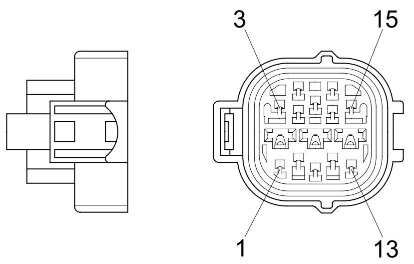
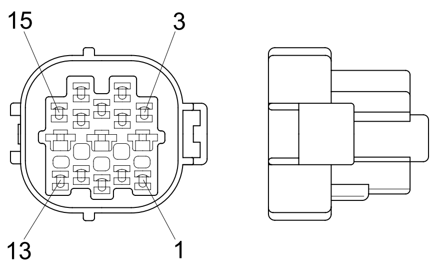
17) MWP NMWP CONNECTOR

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

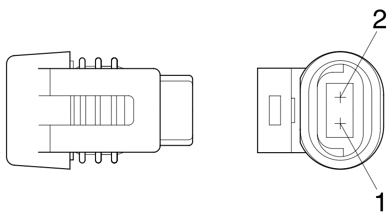
18) ECONOSEAL J TYPE CONNECTORS

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

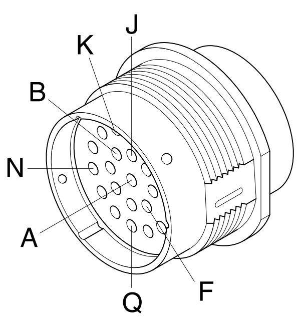
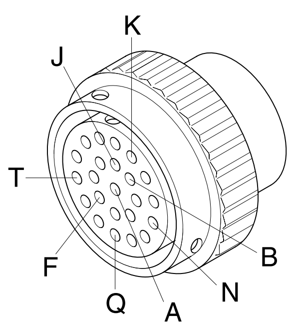
No. of pin	Receptacle connector (female)	Plug connector (male)
6	 S816-006002	 S816-106002
8	 S816-008002	 S816-108002
10	 S816-010002	 S816-110002
12	 S816-012002	 S816-112002

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

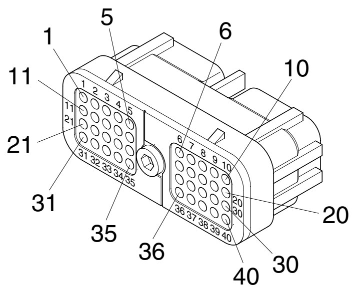
19) METRI-PACK TYPE CONNECTOR

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

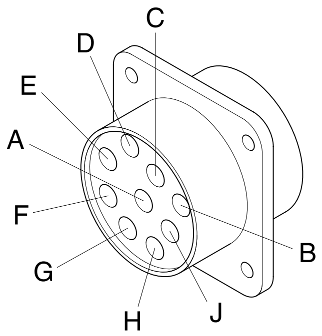
20) DEUTSCH HD30 CONNECTOR

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

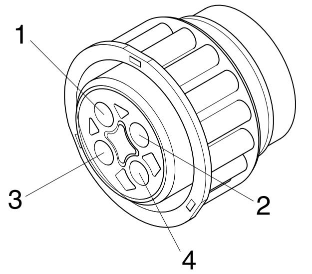
21) DEUTSCH MCU CONNECTOR

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

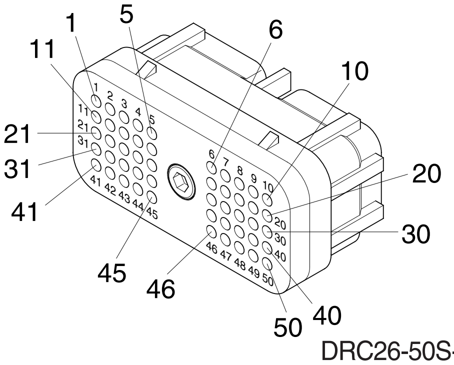
22) DEUTSCH SERVICE TOOL CONNECTOR

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

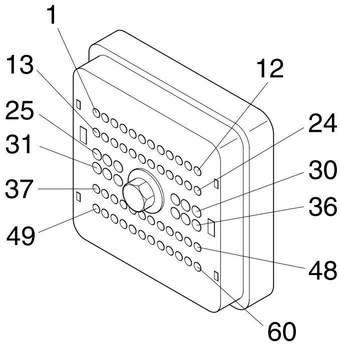
23) AMP FUEL WARMER CONNECTOR

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

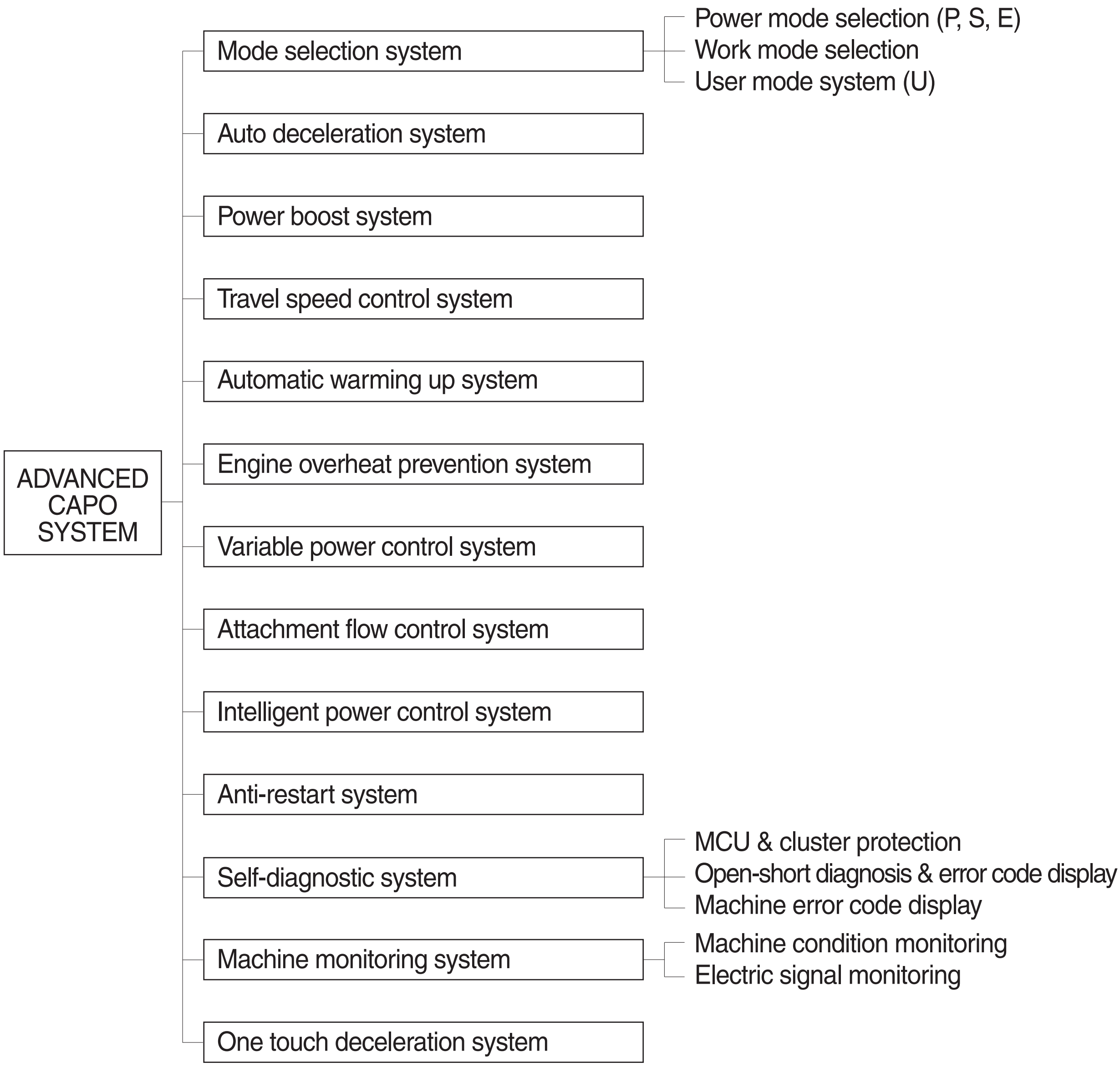
No. of pin	Receptacle connector (Female)	Plug connector (Male)
60	DRB16-60SAE-L018	

SECTION 5 MECHATRONICS SYSTEM

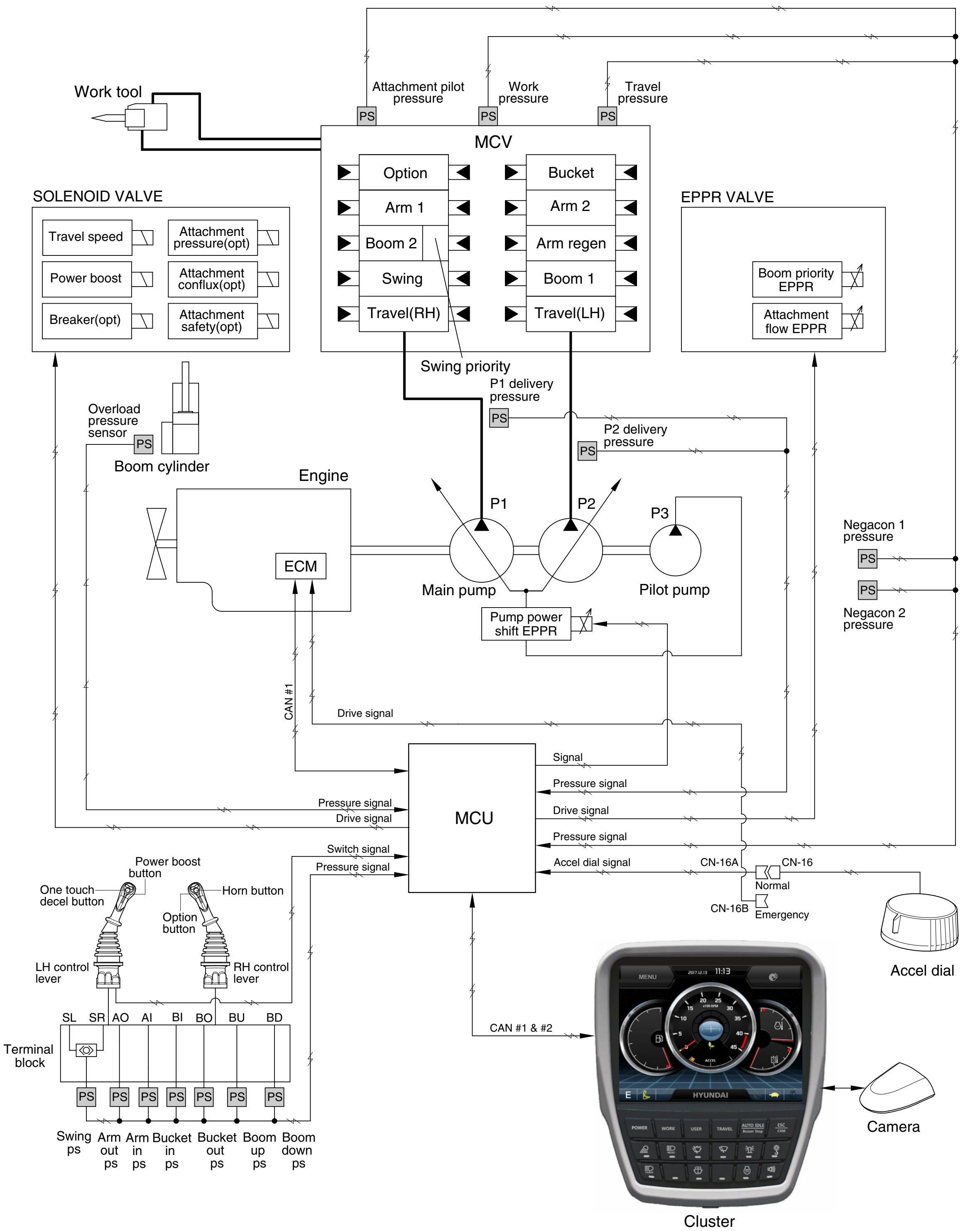
SECTION 5 MECHATRONICS SYSTEM

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.

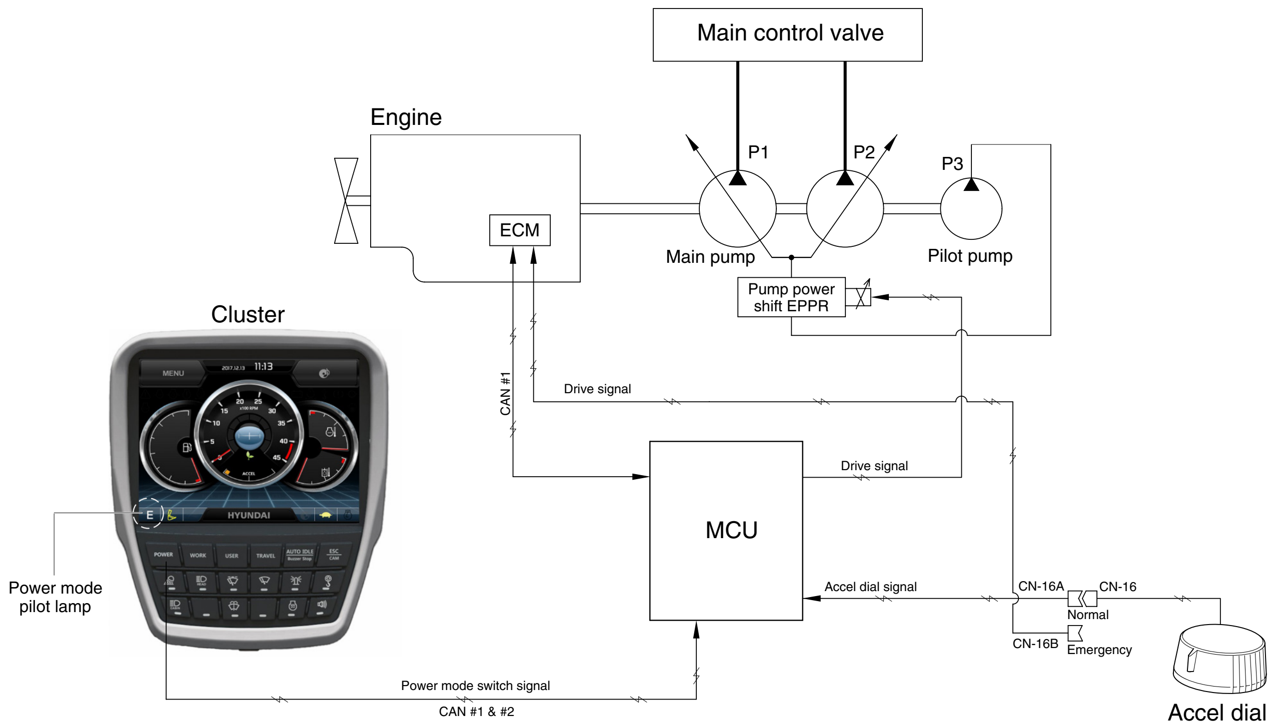


SYSTEM DIAGRAM



350SA5MS01

1. POWER MODE SELECTION SYSTEM



220SA5MS02

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.

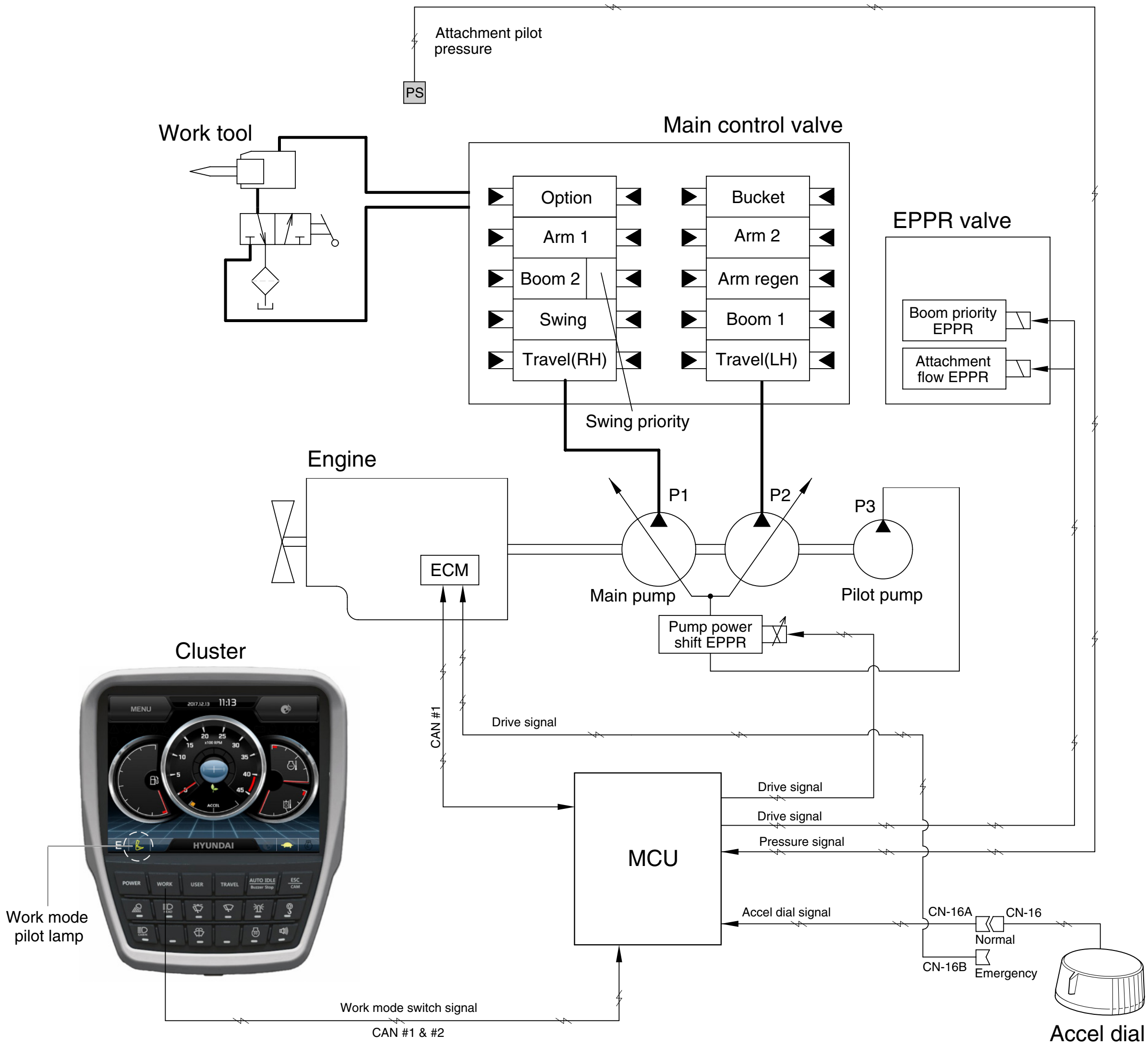
Power mode	Application	Engine rpm				Power shift by EPPR valve			
		Standard		Option		Standard		Option	
		Unload	Load	Unload	Load	Current (mA)	Pressure (kgf/cm^2)	Current (mA)	Pressure (kgf/cm^2)
P	Heavy duty power	1650±50	1750±50	1850±50	1850±50	340±30	10 (~5)	340±30	10 (~5)
S	Standard power	1550±50	1650±50	1750±50	1750±50	400±30	15 (~10)±3	400±30	15 (~10)±3
E	Economy operation	1450±50	1550±50	1650±50	1650±50	425±30	17 (~10)±3	425±30	17 (~10)±3
AUTO DECEL	Engine deceleration	1000±100	-	1000±100	-	700±30	38±3	700±30	38±3
One touch decel	Engine quick deceleration	900±100	-	900±100	-	700±30	38±3	700±30	38±3
KEY START	Key switch start position	900±100	-	900±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).



220SA5MS03

1) GENERAL WORK MODE (bucket)

This mode is used to general digging work.

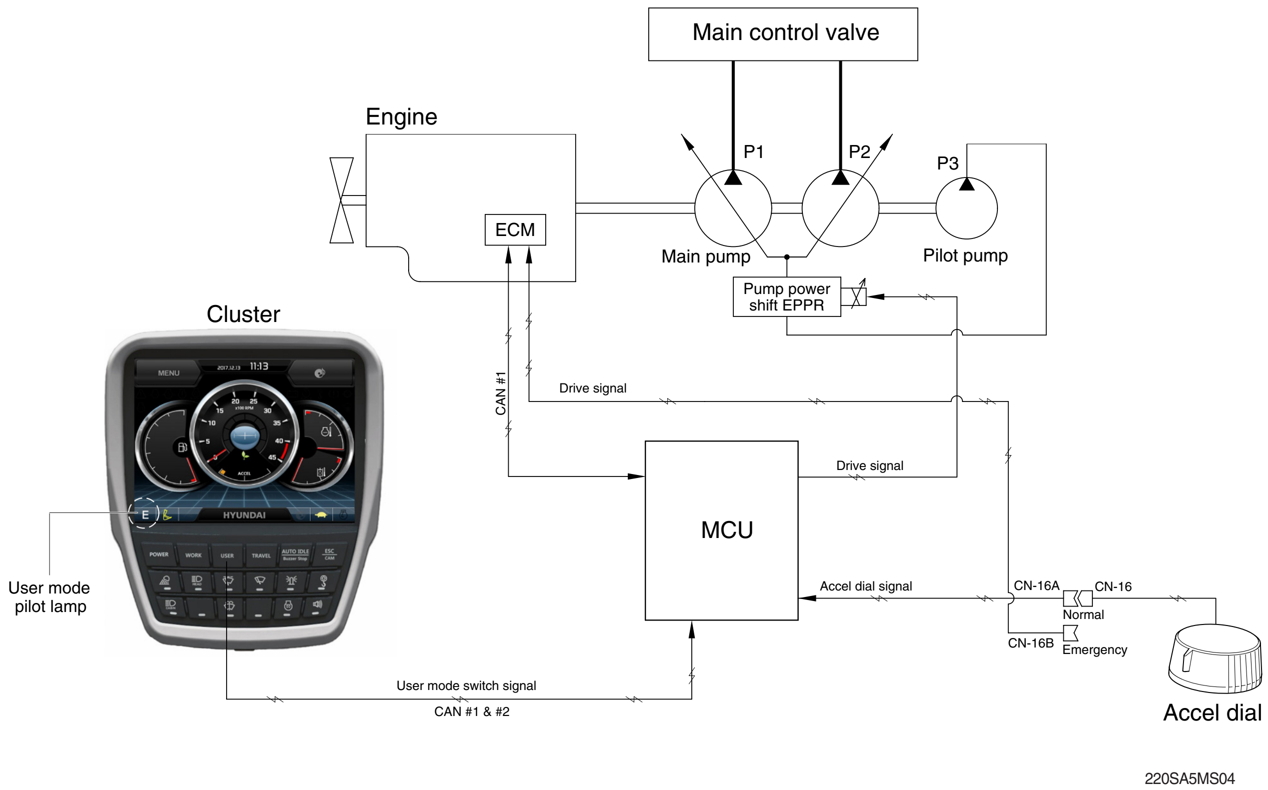
2) ATT WORK MODE (breaker, crusher)

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

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

★ When breaker operating button is pushed.

3. USER MODE SELECTION SYSTEM

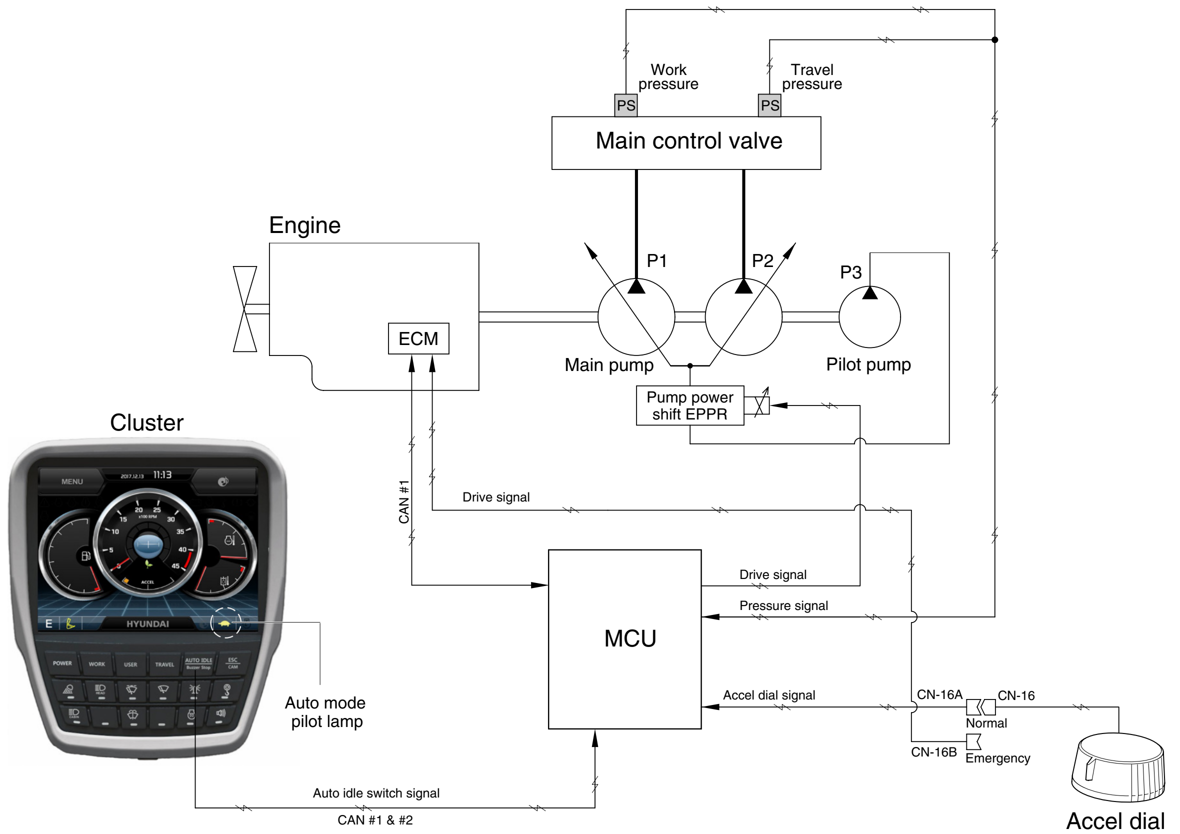


1) High idle rpm, auto idle rpm and EPPR pressure can be adjusted and memorized in the U-mode.

2) LCD segment vs parameter setting

Step (▮)	Engine speed (rpm)	Idle speed (rpm)	Power shift (bar)
1	1300	800	0
2	1400	850	3
3	1450	900	6
4	1500	950	9
5	1550	1000 (auto decel)	12
6	1600	1050	16
7	1650	1100	20
8	1700	1150	26
9	1750	1200	32
10	1800	1250	38

GROUP 3 AUTOMATIC DECELERATION SYSTEM

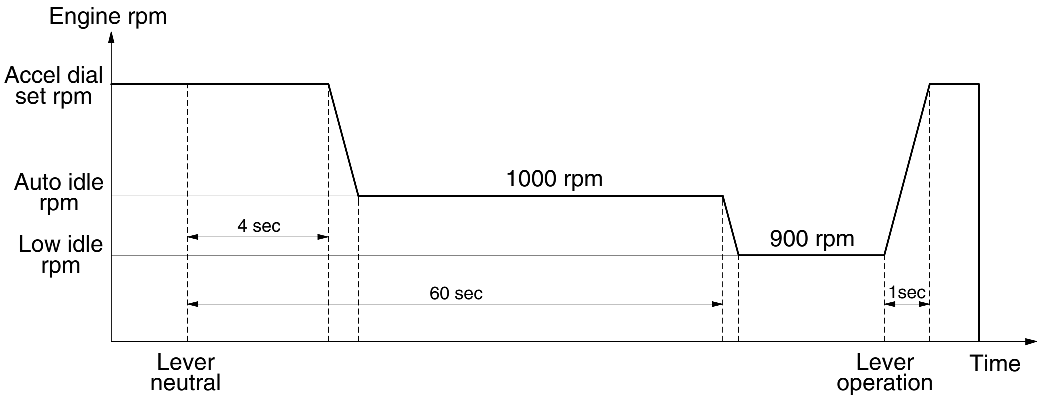


220S5MS05

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 drive the governor moter to reduce the engine speed to 1000 rpm. If the control levers are at neutral for 1 minute, MCU reduces the engine speed to 900 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.



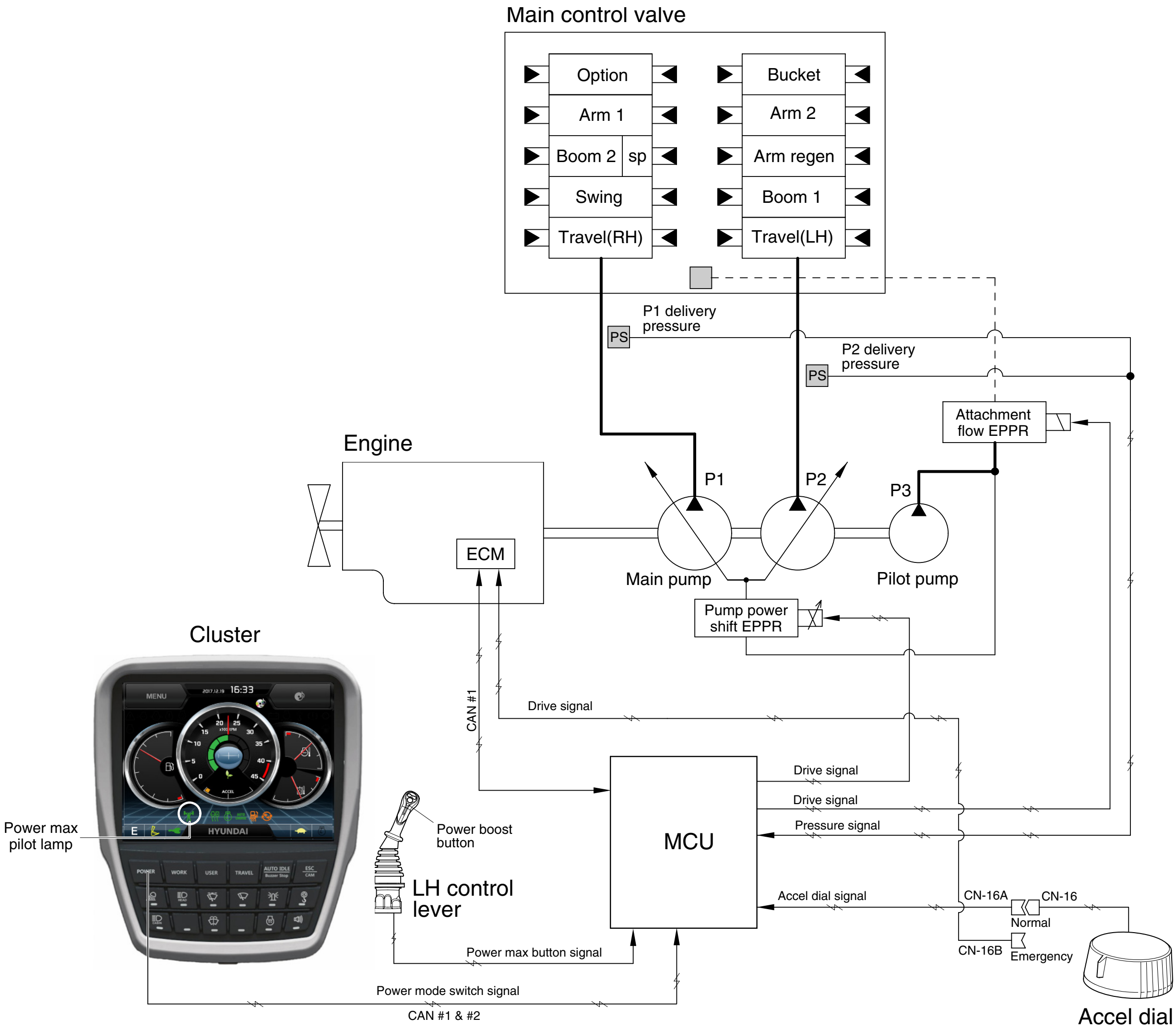
350SA5MS56

2. WHEN AUTO IDLE PILOT LAMP OFF

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

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

GROUP 4 POWER BOOST SYSTEM



220SA5MS06

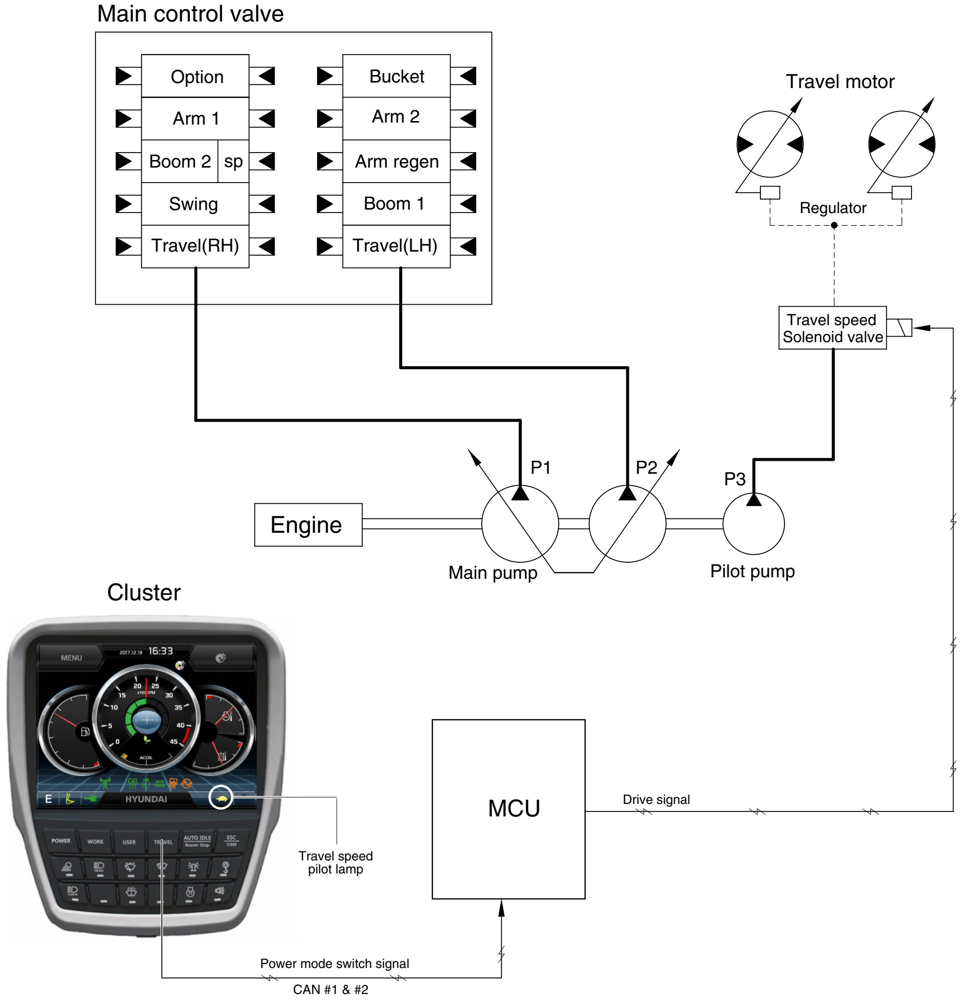
· When the power boost switch on the left control lever knob is pushed ON, the power mode is set P mode and maximum digging power is increased by 10 %.

· 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



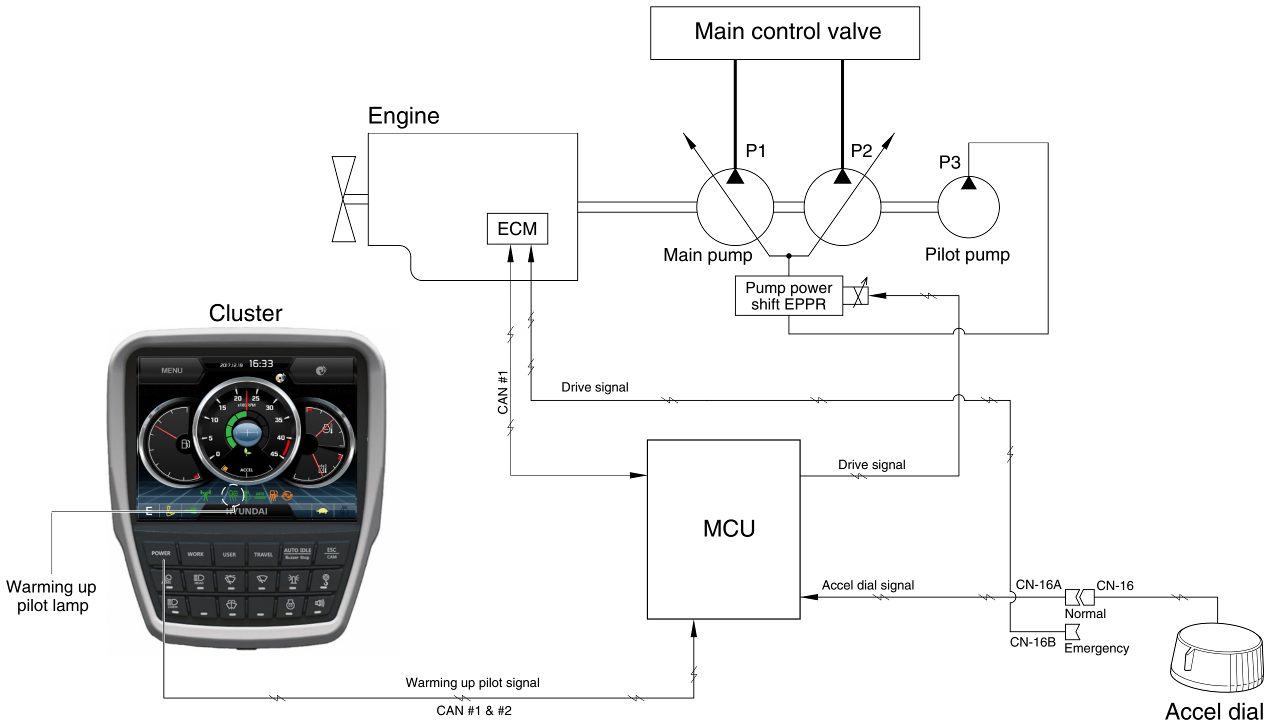
220SA5MS10

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



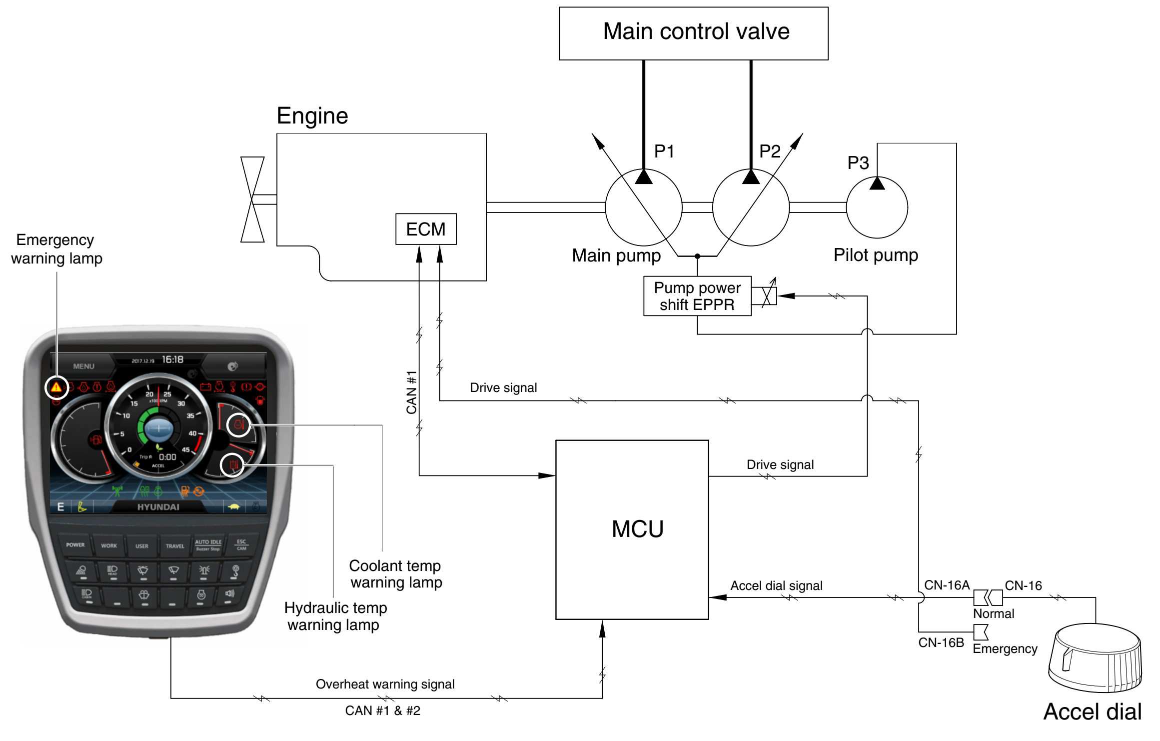
220SA5MS07

1. The MCU receives the engine coolant temperature thought the temperature sensor, and if the coolant temperature is below 30˚C, it increases the engine speed from key start rpm to 1200 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



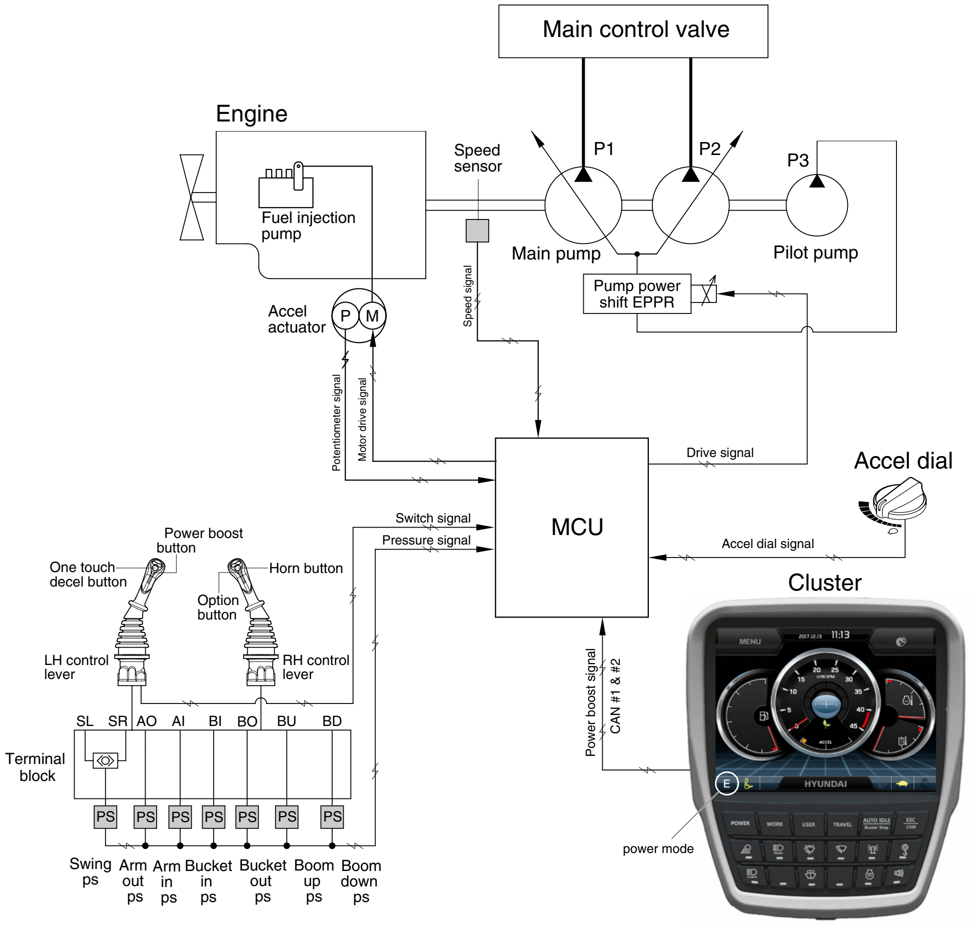
220SA5MS08

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

2. LOGIC TABLE

Description		Condition	Function
First step warning	Activated	- Coolant temperature : Above 100˚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 100˚C	- Return to pre-set the pump absorption torque.
Second step warning	Activated	- Coolant temperature : Above 113˚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 100˚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



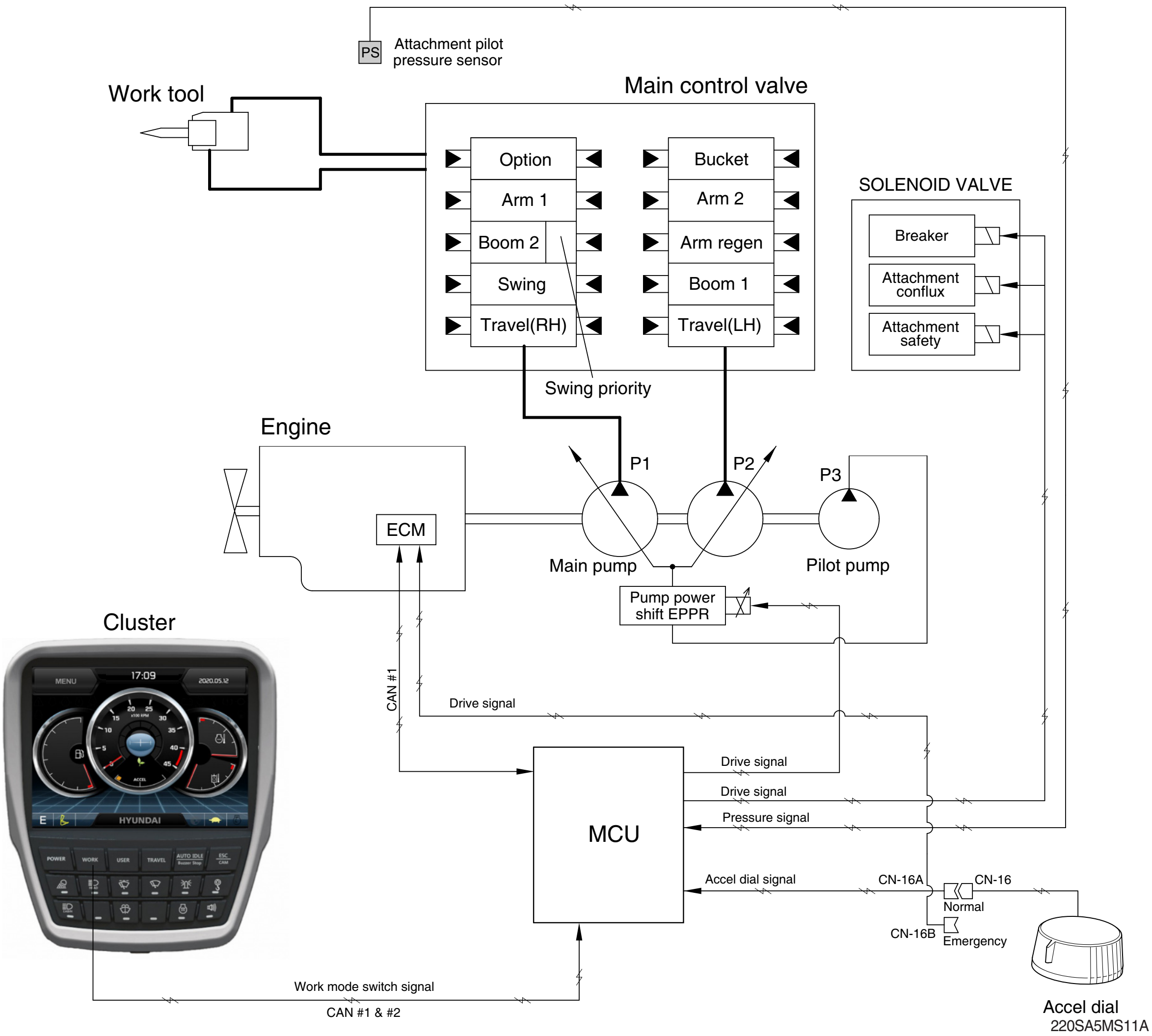
350SA5MS09

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

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

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

GROUP 9 ATTACHMENT FLOW CONTROL SYSTEM



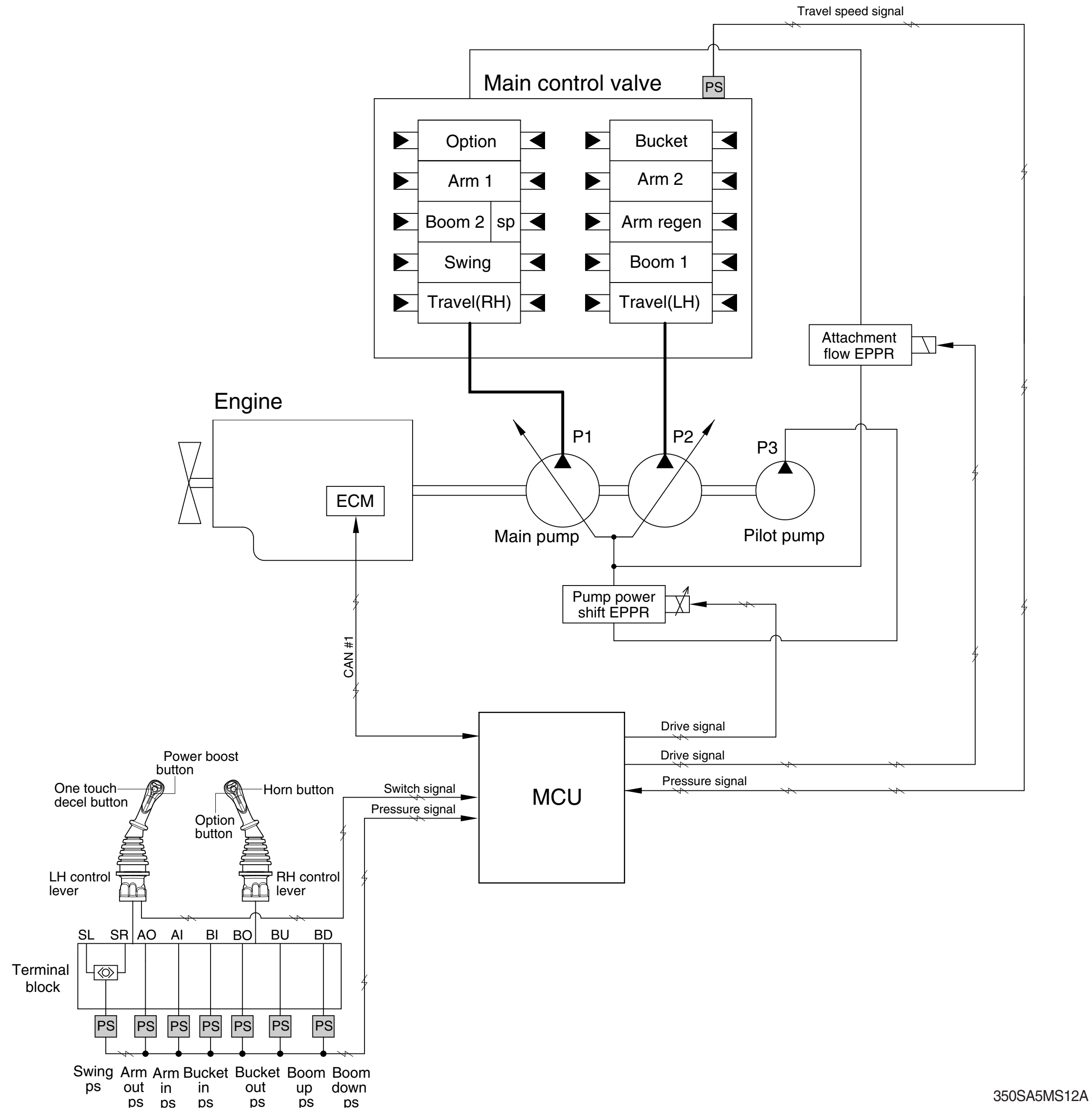
· The system is used to control the pump delivery flow according to set of the work tool on the cluster by the attachment flow EPPR valve.

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

※ Refer to the page 5-79 for the attachment kinds and max flow.

★ When breaker operating button is pushed.

GROUP 10 INTELLIGENT POWER CONTROL SYSTEM



1. When the requirement of pump flow rate is low, IPC mode controls pump flow rate to improve fuel efficiency.

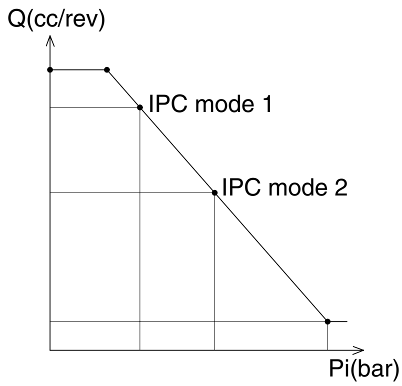
Condition★1	Function
IPC mode : ON★2 Boom up Arm in Not travel motion Not swing motion	Limitation of pump flow rate : Activated
None of upper condition	Limitation of pump flow rate : Canceled

★1 AND condition

★2 IPC mode ON/OFF is selected at "Mode setup > IPC mode". See next page.

2. IPC MODE SELECTION

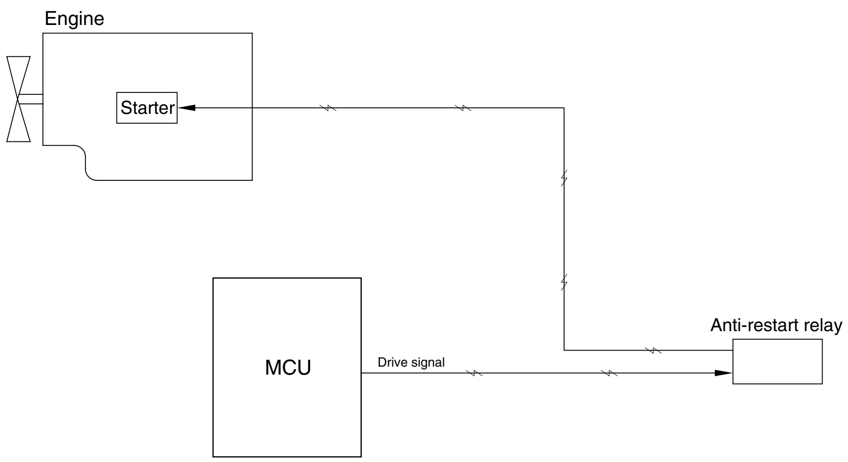
IPC mode ON/OFF and the levels of flow rate limit can be selected at "Mode setup > IPC mode"



220S5MS19

IPC mode	Description
Balance mode (default)	IPC mode ON, limit level 1
Efficiency mode	IPC mode ON, limit level 2
Speed mode	IPC mode OFF

GROUP 11 ANTI-RESTART SYSTEM



220S5MS18

1. ANTI-RESTART FUNCTION

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

GROUP 12 SELF-DIAGNOSTIC SYSTEM

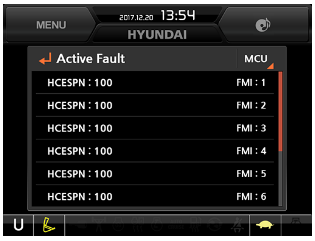
1. OUTLINE

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

220S3CD120

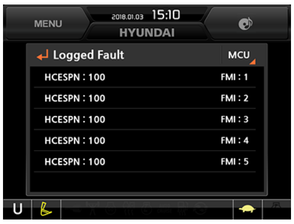


220S3CD125

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

2) Logged fault

220S3CD128

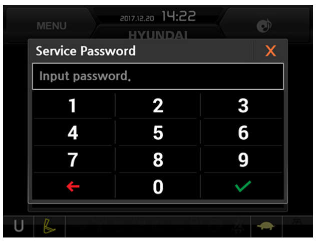


220S3CD124

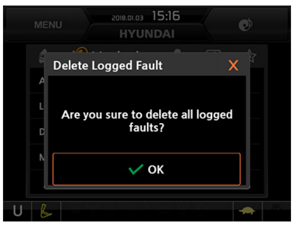
· The logged faults of the MCU, can be checked by this menu.

3) Delete logged fault

220S3CD134



220S3CD126



220S3CD127

· The logged faults of the MCU, 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 (#11) 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

<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">120</td><td>0</td><td>10 seconds continuous, Main Pump 1 (P1) Press. Sensor Measurement Voltage > 5.2V</td><td>●</td><td></td><td></td></tr>
<tr><td>1</td><td>10 seconds continuous, 0.3V ≤ Main Pump 1 (P1) Press. Sensor Measurement Voltage < 0.8V</td><td>●</td><td></td><td></td></tr>
<tr><td>4</td><td>10 seconds continuous, Main Pump 1 (P1) Press. Sensor Measurement Voltage < 0.3V</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(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</td></tr>
<tr><td rowspan="4">121</td><td>0</td><td>10 seconds continuous, Main Pump 2 (P2) Press. Sensor Measurement Voltage > 5.2V</td><td>●</td><td></td><td></td></tr>
<tr><td>1</td><td>10 seconds continuous, 0.3V≤ Main Pump 2 (P2) Press. Sensor Measurement Voltage < 0.8V</td><td>●</td><td></td><td></td></tr>
<tr><td>4</td><td>10 seconds continuous, Main Pump 2 (P2) Press. Sensor Measurement Voltage < 0.3V</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(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 (#30) Checking Open/Short
2. CD-43 (#A) – CN-51 (#3) Checking Open/Short
3. CD-43 (#C) – CN-51 (#13) Checking Open/Short</td></tr>
<tr><td rowspan="3">122</td><td>1</td><td>(when you had conditions mounting pressure sensor)
10 seconds continuous, 0.3V ≤ Overload 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, Overload Press. Sensor Measurement Voltage < 0.3V</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Monitor – Overload Press. display failure
2. Control Function – Overload warning alarm failure
(Checking list)
1. CD-31 (#B) – CN-52 (#39) Checking Open/Short
2. CD-31 (#A) – CN-51 (#3) Checking Open/Short
3. CD-31 (#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">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-51 (#39) 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-51 (#40) 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 (#35) Checking Open/Short
2. CD-32 (#A) – CN-51 (#3) Checking Open/Short
3. CD-32 (#C) – CN-5 1(#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-52 (#34) Checking Open/Short
2. CD-85 (#A) – CN-51 (#3) Checking Open/Short
3. CD-85 (#C) – CN-51 (#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-51 (#10) 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 (#28) 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>

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

DTC		Diagnostic Criteria	Application		
HCESPN	FMI		G	C	W
135	0	10 seconds continuous, Swing Pilot Press. Sensor Measurement Voltage > 5.2V	●		
	1	10 seconds continuous, 0.3V≤ Swing Pilot Press. Sensor Measurement Voltage < 0.8V	●		
	4	10 seconds continuous, Swing Pilot Press. Sensor Measurement Voltage < 0.3V	●		
		(Results / Symptoms) 1. Monitor – Swing Pilot Press. display failure 2. Control Function – IPC operation, Boom first operation failure (Checking list) 1. CD-24 (#B) – CN-52 (#36) Checking Open/Short 2. CD-24 (#A) – CN-51 (#3) Checking Open/Short 3. CD-24 (#C) – CN-51 (#13) Checking Open/Short			
138	0	Monitor – Select Attachment(breaker / crusher) 10 seconds continuous, Attachment Pilot Press. Sensor Measurement Voltage > 5.2V	●		
	1	Monitor – Select Attachment(breaker / crusher) 10 seconds continuous, 0.3V≤ Attachment Pilot Press. Sensor Measurement Voltage < 0.8V	●		
	4	Monitor – Select Attachment(breaker / crusher) 10 seconds continuous, Attachment Pilot Press. Sensor Measurement Voltage < 0.3V	●		
		(Results / Symptoms) 1. Monitor – Attachment Pilot Press. display failure 2. Control Function – Option attachment flow control operation failure (Checking list) 1. CD-69 (#B) – CN-52 (#33) Checking Open/Short 2. CD-69 (#A) – CN-51 (#3) Checking Open/Short 3. CD-69 (#C) – CN-51 (#13) Checking Open/Short			
139 (NA)	1	10 seconds continuous, 0.3V≤ Option Pilot Press. Sensor Measurement Voltage < 0.8V			●
	4	10 seconds continuous, Option Pilot Press. Sensor Measurement Voltage < 0.3V			●
		(Results / Symptoms) 1. Monitor – Option Pilot Press. display failure 2. Control Function – Auto Idle operation failure (Checking list) 1. CD-100 (#B) – CN-52 (#21) Checking Open/Short 2. CD-100 (#A) – CN-51 (#3) Checking Open/Short 3. CD-100 (#C) – CN-1 (#6) Checking Open/Short			

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

<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 Pump EPPR Current is more than 10 mA)
10 seconds continuous, Pump EPPR drive current < 0 mA
(Cancellation)
(When Pump EPPR Current is more than 10 mA)
3 seconds continuous, Pump EPPR drive current ≥10 mA</td><td>●</td><td></td><td></td></tr>
<tr><td>6</td><td>(Detection)
10 seconds continuous, Pump EPPR drive current > 1.0A
(Cancellation)
3 seconds continuous, 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 (#19) 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 (#7) Checking Open/Short
2. CN-133 (#1) – CN-52 (#17) 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
143 (NA)	5	(Detection) (When Travel EPPR Current is more than 10 mA) 10 seconds continuous, Travel EPPR drive current = 0 mA (Cancellation) (When Travel EPPR Current is more than 100 mA) 3 seconds continuous, Travel EPPR drive current ≥ 10 mA			●
	6	(Detection) 10 seconds continuous, Travel EPPR drive current > 1.0 A (Cancellation) 3 seconds continuous, Travel EPPR drive current ≤ 1.0 A			●
	(Results / Symptoms) 1. Control Function – cruise control operation failure (Checking list) 1. CN-246 (#2) – CN-54 (#39) Checking Open/Short 2. CN-246 (#1) – CN-51 (#40) Checking Open/Short				
145 (NA)	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-385 (#3) – CN-51 (#9) Checking Open/Short 2. CD-385 (#1) – CN-51 (#14) 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="3">164
(NA)</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 (#30) 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 (#3) Checking Open/Short 2. CN-70 (#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
169	4	Monitor – Selecting attachment(breaker / crusher) (Detection) (When Attachment Conflux Solenoid is Off) 10 seconds continuous, Attachment Conflux Solenoid drive unit Measurement Voltage ≤ 3.0V (Cancellation) (When Attachment Conflux Solenoid is Off) 3 seconds continuous, Attachment Conflux Solenoid drive unit Measurement Voltage > 3.0V	●		
	6	(Detection) (When Attachment Conflux Solenoid is On) 10 seconds continuous, Attachment Conflux Solenoid drive Current > 6.5 A (Cancellation) (When Attachment Conflux Solenoid is On) 3 seconds continuous, Attachment Conflux Solenoid drive Current ≤ 6.5 A	●		
	(Results / symptoms) 1. Control Function – Option attachment flow control – Joining operation failure (Eco breaker mode, crusher mode) (Checking list) 1. CN-237 (#1) – CN-52 (#6) Checking Open/Short 2. CN-237 (#2) – Fuse box (#30) Checking Open/Short				
170 (NA)	4	(Model Parameter) mounting Arm Regenerating Solenoid (Detection) (When Arm Regeneration Solenoid is Off) 10 seconds continuous, Arm Regeneration Solenoid drive unit Measurement Voltage ≤ 3.0V (Cancellation) (When Arm Regeneration Solenoid is Off) 3 seconds continuous, Arm Regeneration Solenoid drive unit Measurement Voltage > 3.0V	●		
	6	(Detection) (When Arm Regeneration Solenoid is On) 10 seconds continuous, Arm Regeneration Solenoid drive current > 4.5 A (Cancellation) (When Arm Regeneration Solenoid is On) 3 seconds continuous, Arm Regeneration Solenoid drive current ≤ 4.5 A	●		
	(Results / symptoms) 1. Control Function – Arm regeneration operation failure (Checking list) 1. CN-135 (#1) – CN-52 (#1) Checking Open/Short 2. CN-135 (#2) – Fuse box (#28) Checking Open/Short				

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

<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">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-52 (#4) Checking Open/Short
2. CN-149 (#2) – Fuse box (#30) 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-15 (#11) Checking Open/Short
2. CN-66 (#2) – CR-62 (#5) 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
181 (NA)	4	(Model Parameter) mounting Reverse Cooling Fan Solenoid (Detection) (When Reverse Cooling Fan Solenoid is Off) 10 seconds continuous, Reverse Cooling Fan Solenoid drive unit Measurement Voltage ≤ 3.0V (Cancellation) (When Reverse Cooling Fan Solenoid is Off) 3 seconds continuous, Reverse Cooling Fan Solenoid drive unit Measurement Voltage > 3.0V	●		
	6	(Detection) (When Reverse Cooling Fan Solenoid is On) 10 seconds continuous, Reverse Cooling Fan Solenoid drive current > 4.5 A (Cancellation) (When Reverse Cooling Fan Solenoid is On) 3 seconds continuous, Reverse Cooling Fan Solenoid drive current ≤ 4.5 A	●		
		(Results / Symptoms) 1. Control Function – Cooling Fan reverse control operation failure (not applicable)			
188	5	(Detection) (When 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	●		
	6	(Detection) 10 seconds continuous, Attachment Flow EPPR 1 drive current > 1.0 A (Cancellation) 3 seconds continuous, Attachment Flow EPPR 1 drive current ≤ 1.0 A	●		
		(Results / Symptoms) 1. Control Function – IPC operation failure, Option attachment flow control operation failure (Checking list) 1. CN-242 (#2) – CN-52 (#10) Checking Open/Short 2. CN-242 (#1) – CN-52 (#20) Checking Open/Short			

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

DTC		Diagnostic Criteria	Application		
HCESPN	FMI		G	C	W
189	5	(Detection) (When 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-242A (#2) – CN-52 (#40) Checking Open/Short 2. CN-242A (#1) – CN-52 (#16) Checking Open/Short				
196 (NA)	0	HW145 10 seconds continuous, Attachment flow control EPPR 1 press. Sensor Measurement Voltage > 5.2V			
	1	HW145 10 seconds continuous, 0.3V≤ Attachment flow control EPPR 1 press. Sensor Measurement Voltage < 0.8V			
	4	HW145 10 seconds continuous, Attachment flow control EPPR 1 press. Sensor Measurement Voltage < 0.3V			
	(Results / Symptoms) 1. Control Function – Driving second pump joining function operation failure (Checking list) 1. CD-93 (#B) – CN-52 (#34) Checking Open/Short 2. CD-93 (#A) – CN-51 (#32) Checking Open/Short 3. CD-93 (#C) – CN-51 (#31) Checking Open/Short				
200	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
(NA)</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
(NA)</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 (#17) 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">220
(NA)</td><td>4</td><td>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</td><td>●</td><td></td><td></td></tr>
<tr><td>6</td><td>(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</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-369 (#1) – CN-53 (#35) Checking Open/Short
2. CN-369 (#2) – Fuse box (#17) Checking Open/Short</td></tr>
<tr><td rowspan="3">221
(NA)</td><td>5</td><td>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</td><td>●</td><td></td><td></td></tr>
<tr><td>6</td><td>(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</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(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</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">222
(NA)</td><td>5</td><td>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</td><td>●</td><td></td><td></td></tr>
<tr><td>6</td><td>(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</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(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</td></tr>
<tr><td rowspan="3">301</td><td>3</td><td>10 seconds continuous, Fuel Level Measurement Voltage > 3.8V</td><td>●</td><td></td><td></td></tr>
<tr><td>4</td><td>10 seconds continuous, Fuel Level Measurement Voltage < 0.3V</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(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 (#11) Checking Open/Short</td></tr>
<tr><td rowspan="3">325</td><td>4</td><td>(Model Parameter) mounting Fuel Heater Relay
(Detection)
(When Fuel Heater Relay is Off)
10 seconds continuous, Fuel Heater Relay drive unit
Measurement Voltage ≤ 3.0V
(Cancellation)
(When Fuel Heater Relay is Off)
3 seconds continuous, Fuel Heater Relay drive unit
Measurement Voltage > 3.0V</td><td>●</td><td></td><td></td></tr>
<tr><td>6</td><td>(Detection)
(When Fuel Heater Relay is On)
10 seconds continuous, Fuel Heater Relay drive current > 4.5 A
(Cancellation)
(When Fuel Heater Relay is On)
3 seconds continuous, Fuel Heater Relay drive current ≤ 4.5 A</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Control Function – Fuel heater operation failure
(Checking list)
1. CR-46 (#85) – CN-52 (#12) Checking Open/Short
2. CR-46 (#30, #86) – Fuse box (#21) 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">501
(NA)</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
(NA)</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
(NA)</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
(NA)</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
(NA)</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 (NA)	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 (NA)	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 (NA)	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 (NA)	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

<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">714</td><td>3</td><td>(Model Parameter) Mounting Acc. Dial
10 seconds continuous, Acc. Dial Measurement Voltage > 5.2V</td><td>●</td><td></td><td></td></tr>
<tr><td>4</td><td>(Model Parameter) Mounting Acc. Dial
10 seconds continuous, Acc. Dial Measurement Voltage < 0.3V</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Monitor – Acc. Dial Voltage display failure
2. Control Function – Engine rpm control failure
(Checking list)
1. CN-142 (#B) – CN-52 (#23) Checking Open/Short</td></tr>
<tr><td rowspan="3">722</td><td>4</td><td>(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</td><td>●</td><td></td><td></td></tr>
<tr><td>6</td><td>(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</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Control Function – Driving alarm operation failure
(Checking list)
1. CN-81 (#1) – CN-52 (#13) Checking Open/Short
2. CN-81 (#2) – Fuse box (#30) Checking Open/Short</td></tr>
<tr><td rowspan="2">831</td><td>2</td><td>(When mounting the A/C Controller)
60 seconds continuous, A/C Controller Communication Data Error</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(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</td></tr>
<tr><td rowspan="2">840</td><td>2</td><td>60 seconds continuous, Cluster Communication Data Error</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Control Function – Cluster operation failure
(Checking list)
1. CN-56A (#7) – CN-51 (#32) Checking Open/Short
2. CN-56A (#6) – CN-51 (#22) 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
841 (NA)	2	10 seconds continuous, ECM Communication Data Error	●		
	(Results / Symptoms) 1. Control Function – ECM operation failure (Checking list) 1. CN-93 (#17) – CN-51 (#21) Checking Open/Short 2. CN-93 (#18) – CN-51 (#31) Checking Open/Short				
845 (NA)	2	(When mounting the I/O Controller 1) 60 seconds continuous, I/O Controller 1 Communication Data Error	●		
	(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				
848 (NA)	2	(When mounting the Haptic Controller) 60 seconds continuous, Haptic Controller Communication Data Error	●		
	(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				
850	2	(When mounting the RMCU) 60 seconds continuous, RMCU communication Data Error	●		
	(Resuluts / Symptoms) 1. Control Function – RMCU operation failure (Checking list) 1. CN-125A (#3) – CN-51 (#22) Checking Open/Short 2. CN-125A (#11) – CN-51 (#32) Checking Open/Short				
861 (NA)	2	(When mounting the I/O Controller 2) 60 seconds continuous, I/O Controller 2 communication Data Error	●		
	(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				

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<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">866</td><td>2</td><td>(When mounting the AAVM)
60 seconds continuous, AAVM communication Data Error</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(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</td></tr>
<tr><td rowspan="2">867</td><td>2</td><td>60 seconds continuous, RDU communication Data Error</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(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</td></tr>
<tr><td rowspan="2">868</td><td>2</td><td>60 seconds continuous, Switch Controller communication Data Error</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Control Function – Switch Controller operation failure
(Checking list)
1. CN-56 (#7) – CN-51 (#32) Checking Open/Short
2. CN-56 (#6) – CN-51 (#22) Checking Open/Short</td></tr>
<tr><td rowspan="2">869</td><td>2</td><td>(When mounting the BKCU)
60 seconds continuous, BKCU communication Data Error</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(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</td></tr>
</table>

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

4. ENGINE FAULT CODE

Fault code	J1939 SPN	J1939 FMI	Item	Description
111	629	12	Controller #1	Engine control module critical internal failure - bad intelligent device or component
115	612	2	System diagnostic code # 2	Engine speed/position sensor circuit lost both of two signals from the magnetic pickup sensor - data erratic, intermittent, or incorrect
122	102	3	Boost pressure	Intake manifold pressure sensor circuit – voltage above normal, or shorted to high source
123	102	4	Boost pressure	Intake manifold pressure sensor circuit – voltage below normal, or shorted to low source
124	102	16	Boost pressure	Intake manifold 1 pressure - data valid but above normal operational range - moderately severe level
131	91	3	Accelerator pedal position	Accelerator pedal or lever position sensor circuit - voltage above normal, or shorted to high source
132	91	4	Accelerator pedal position	Accelerator pedal or lever position sensor circuit - voltage below normal, or shorted to low source
133	974	3	Remote accelerator	Remote accelerator pedal or lever position sensor circuit – voltage above normal, or shorted to high source
134	974	4	Remote accelerator	Remote accelerator pedal or lever position sensor circuit – voltage below normal, or shorted to low source
135	100	3	Engine oil pressure	Oil pressure sensor circuit - voltage above normal, or shorted to high source
141	100	4	Engine oil pressure	Oil pressure sensor circuit - voltage below normal, or shorted to low source
143	100	18	Engine oil pressure	Oil pressure low – data valid but below normal operational range - moderately severe level
144	110	3	Engine coolant temperature	Coolant temperature sensor circuit – voltage above normal, or shorted to high source
145	110	4	Engine coolant temperature	Coolant temperature sensor circuit – voltage below normal, or shorted to low source
146	110	16	Engine coolant temperature	Coolant temperature high - data valid but above normal operational range - moderately severe level
147	91	1	Accelerator pedal position	Accelerator pedal or lever position sensor circuit – abnormal frequency, pulse width, or period
148	91	0	Accelerator pedal position	Accelerator pedal or lever position sensor circuit – abnormal frequency, pulse width, or period
151	110	0	Engine coolant temperature	Coolant temperature high - data valid but above normal operational range - most severe level
153	105	3	Intake manifold #1 temp	Intake manifold air temperature sensor circuit - voltage above normal, or shorted to high source
154	105	4	Intake manifold #1 temp	Intake manifold air temperature sensor circuit - voltage below normal, or shorted to low source
155	105	0	Intake manifold #1 temp	Intake manifold air temperature high – data valid but above normal operational range - most severe level

※ Some fault codes are not applied to this machine.

Fault code	J1939 SPN	J1939 FMI	Item	Description
187	3510	4	5 Volts dc supply	Sensor supply voltage #2 circuit – voltage below normal, or shorted to low source
193	520199	3	Cruise control	Cruise control (resistive) signal circuit - voltage above normal, or shorted to high source
194	520199	4	Cruise control	Cruise control (resistive) signal circuit - voltage below normal, or shorted to low source
195	111	3	Coolant level	Coolant level sensor circuit - voltage above normal, or shorted to high source
196	111	4	Coolant level	Coolant level sensor circuit - voltage below normal, or shorted to low source
197	111	18	Coolant level	Coolant level - data valid but below normal operational range - moderately severe level
199	1661	4	Engine automatic start lamp	Engine automatic start lamp driver circuit - voltage above normal, or shorted to high source
211	1484	31	J1939 error	Additional auxiliary diagnostic codes logged - condition exists
212	175	3	Oil temperature	Engine oil temperature sensor 1 circuit - voltage above normal, or shorted to high source
213	175	4	Oil temperature	Engine oil temperature sensor 1 circuit - voltage below normal, or shorted to low source
214	175	0	Oil temperature	Engine oil temperature - data valid but above normal operational range - most severe level
221	108	3	Barometric pressure	Barometric pressure sensor circuit – voltage above normal, or shorted to high source
222	108	4	Barometric pressure	Barometric pressure sensor circuit – voltage below normal, or shorted to low source
227	3510	3	5 Volts dc supply	Sensor supply voltage #2 circuit – voltage above normal, or shorted to high source
231	109	3	Coolant pressure	Coolant pressure sensor circuit - voltage above normal, or shorted to high source
232	109	4	Coolant pressure	Coolant pressure sensor circuit - voltage below normal, or shorted to low source
233	109	18	Coolant pressure	Coolant pressure - data valid but below normal operational range - moderately severe level
234	190	0	Engine speed	Engine speed high - data valid but above normal operational range - most severe level
235	111	1	Coolant level	Coolant level low - data valid but below normal operational range - most severe level
237	644	2	External speed input	External speed input (multiple unit synchronization) - data erratic, intermittent, or incorrect
238	3511	4	System diagnostic code # 1	Sensor supply voltage #3 circuit – voltage below normal, or shorted to low source
239	3511	3	System diagnostic code #2	Sensor supply voltage #3 circuit - voltage above normal, or shorted to high source
241	84	2	Wheel-based vehicle speed	Vehicle speed sensor circuit - data erratic, intermittent, or incorrect
242	84	10	Wheel-based vehicle speed	Vehicle speed sensor circuit tampering has been detected – abnormal rate of change

※ Some fault codes are not applied to this machine.

Fault code	J1939 SPN	J1939 FMI	Item	Description
244	623	4	Red stop lamp	Red stop lamp driver circuit - voltage below normal, or shorted to low source
245	647	4	Fan clutch output device driver	Fan control circuit - voltage below normal, or shorted to low source
249	171	3	Ambient air temperature	Ambient air temperature sensor circuit - voltage above normal, or shorted to high source
256	171	4	Ambient air temperature	Ambient air temperature sensor circuit - voltage below normal, or shorted to low source
261	174	16	Fuel temperature	Engine fuel temperature - data valid but above normal operational range - moderately severe level
263	174	3	Fuel temperature	Engine fuel temperature sensor 1 circuit - voltage above normal, or shorted to high source
265	174	4	Fuel temperature	Engine fuel temperature sensor 1 circuit - voltage below normal, or shorted to low source
268	94	2	Fuel delivery pressure	Fuel pressure sensor circuit - data erratic, intermittent, or incorrect
271	1347	4	Fuel pump pressurizing assembly #1	High fuel pressure solenoid valve circuit – voltage below normal, or shorted to low source
272	1347	3	Fuel pump pressurizing assembly #1	High fuel pressure solenoid valve circuit – voltage above normal, or shorted to high source
281	1347	7	Fuel pump pressurizing assembly #1	High fuel pressure solenoid valve #1 – mechanical system not responding properly or out of adjustment
285	639	9	Sae J1939 datalink	SAE J1939 multiplexing pgn timeout error - abnormal update rate
286	639	13	Sae J1939 datalink	SAE J1939 multiplexing configuration error – out of calibration
287	91	19	Accelerator pedal position	SAE J1939 multiplexing accelerator pedal or lever sensor system error - received network data in error
288	974	19	Remote accelerator	SAE J1939 multiplexing remote accelerator pedal or lever data error - received network data in error
292	441	14	Auxiliary temperature 1	Auxiliary temperature sensor input 1 - special instructions
293	441	3	OEM Temperature	Auxiliary temperature sensor input # 1 circuit - voltage above normal, or shorted to high source
294	441	4	OEM Temperature	Auxiliary temperature sensor input # 1 circuit - voltage below normal, or shorted to low source
295	108	2	Barometric pressure	Barometric pressure sensor circuit - data erratic, intermittent, or incorrect
296	1388	14	Auxiliary pressure	Auxiliary pressure sensor input 1 - special instructions
297	1388	3	Auxiliary pressure	Auxiliary pressure sensor input # 2 circuit - voltage above normal, or shorted to high source
298	1388	4	Auxiliary pressure	Auxiliary pressure sensor input # 2 circuit - voltage below normal, or shorted to low source
319	251	2	Real time clock power	Real time clock power interrupt - data erratic, intermittent, or incorrect

※ Some fault codes are not applied to this machine.

Fault code	J1939 SPN	J1939 FMI	Item	Description
322	651	5	Injector cylinder #01	Injector solenoid cylinder #1 circuit – current below normal, or open circuit
323	655	5	Injector cylinder #05	Injector solenoid cylinder #5 circuit – current below normal, or open circuit
324	653	5	Injector cylinder #03	Injector solenoid cylinder #3 circuit – current below normal, or open circuit
325	656	5	Injector cylinder #06	Injector solenoid cylinder #6 circuit – current below normal, or open circuit
331	652	5	Injector cylinder #02	Injector solenoid cylinder #2 circuit – current below normal, or open circuit
332	654	5	Injector cylinder #04	Injector solenoid cylinder #4 circuit – current below normal, or open circuit
334	110	2	Engine coolant temperature	Coolant temperature sensor circuit – data erratic, intermittent, or incorrect
338	1267	3	Vehicle accessories relay driver	Idle shutdown vehicle accessories relay driver circuit - voltage above normal, or shorted to high source
339	1267	4	Vehicle accessories relay driver	Idle shutdown vehicle accessories relay driver circuit - voltage below normal, or shorted to low source
342	630	13	Calibration memory	Electronic calibration code incompatibility - out of calibration
343	629	12	Controller #1	Engine control module warning internal hardware failure - bad intelligent device or component
349	191	16	Transmission output shaft speed	Transmission output shaft speed - data valid but above normal operational range - moderately severe level
351	3597	12	Controller #1	Injector power supply - bad intelligent device or component
352	3509	4	5 volts DC supply	Sensor supply voltage #1 circuit – voltage below normal, or shorted to low source
386	3509	3	5 volts DC supply	Sensor supply voltage #1 circuit – voltage above normal, or shorted to high source
415	100	1	Engine oil pressure	Oil pressure low – data valid but below normal operational range - most severe level
418	97	15	Water in fuel indicator	Water in fuel indicator high - data valid but above normal operational range – least severe level
422	111	2	Coolant level	Coolant level - data erratic, intermittent, or incorrect
425	175	2	Oil temperature	Engine oil temperature - data erratic, intermittent, or incorrect
428	97	3	Water in fuel indicator	Water in fuel sensor circuit - voltage above normal, or shorted to high source
429	97	4	Water in fuel indicator	Water in fuel sensor circuit - voltage below normal, or shorted to low source
431	558	2	Accelerator pedal low idle switch	Accelerator pedal or lever idle validation circuit - data erratic, intermittent, or incorrect
432	558	13	Accelerator pedal low idle switch	Accelerator pedal or lever idle validation circuit - out of calibration

※ Some fault codes are not applied to this machine.

Fault code	J1939 SPN	J1939 FMI	Item	Description
435	100	2	Engine oil pressure	Oil pressure sensor circuit - data erratic, intermittent, or incorrect
441	168	18	Electrical potential (voltage)	Battery #1 voltage low - data valid but below normal operational range – moderately severe level
442	168	16	Electrical potential (voltage)	Battery #1 voltage high - data valid but above normal operational range – moderately severe level
449	157	0	Injector metering rail 1 pressure	Fuel pressure high - data valid but above normal operational range – moderately severe level
451	157	3	Injector metering rail 1 pressure	Injector metering rail #1 pressure sensor circuit - voltage above normal, or shorted to high source
452	157	4	Injector metering rail 1 pressure	Injector metering rail #1 pressure sensor circuit - voltage below normal, or shorted to low source
488	105	16	Intake manifold	Intake manifold 1 temperature - data valid but above normal operational range - moderately severe level
489	191	18	Transmission output shaft speed	Transmission output shaft speed - data valid but below normal operational range - moderately severe level
497	1377	2	Switch circuit	Multiple unit synchronization switch circuit - data erratic, intermittent, or incorrect
523	611	2	System diagnostic code # 1	OEM Intermediate (PTO) speed switch validation - data erratic, intermittent, or incorrect
527	702	3	Circuit - voltage	Auxiliary input/output 2 circuit - voltage above normal, or shorted to high source
528	93	2	Switch - data	Auxiliary alternate torque validation switch - data erratic, intermittent, or incorrect
529	703	3	Circuit - voltage	Auxiliary input/output 3 circuit - voltage above normal, or shorted to high source
546	94	3	Fuel delivery pressure	Fuel delivery pressure sensor circuit - voltage above normal, or shorted to high source
547	94	4	Fuel delivery pressure	Fuel delivery pressure sensor circuit - voltage below normal, or shorted to low source
551	558	4	Accelerator pedal low idle switch	Accelerator pedal or lever idle validation circuit - voltage below normal, or shorted to low source
553	157	16	Injector metering rail 1 pressure	Injector metering rail #1 pressure high – data valid but above normal operational range - moderately severe level
554	157	2	Injector metering rail 1 pressure	Fuel pressure sensor error - data erratic, intermittent, or incorrect
559	157	18	Injector metering rail 1 pressure	Injector metering rail #1 pressure low – data valid but below normal operational range - moderately severe level
584	677	3	Starter solenoid lockout relay driver circuit	Starter relay circuit - voltage above normal, or shorted to high source
585	677	4	Starter solenoid lockout relay driver circuit	Starter relay circuit - voltage below normal, or shorted to low source
595	103	16	Turbocharger 1 speed	Turbocharger #1 speed high - data valid but above normal operational range – moderately severe level

※ Some fault codes are not applied to this machine.

Fault code	J1939 SPN	J1939 FMI	Item	Description
596	167	16	Alternate potential (voltage)	Electrical charging system voltage high – data valid but above normal operational range - moderately severe level
597	167	18	Alternate potential (voltage)	Electrical charging system voltage low – data valid but below normal operational range - moderately severe level
598	167	1	Alternate potential (voltage)	Electrical charging system voltage low – data valid but below normal operational range - most severe level
599	640	14	Engine external protection input	Auxiliary commanded dual output shutdown - special instructions
649	1378	31	Engine oil change interval	Change lubricating oil and filter – condition exists
687	103	18	Turbocharger 1 speed	Turbocharger #1 speed low - data valid but below normal operational range – moderately severe level
689	190	2	Engine speed	Primary engine speed sensor error – data erratic, intermittent, or incorrect
691	1172	3	Turbocharger #1compressor inlet temperature	Turbocharger #1 compressor inlet temperature sensor circuit – voltage above normal, or shorted to high source
692	1172	4	Turbocharger #1compressor inlet temperature	Turbocharger #1 compressor inlet temperature sensor circuit – voltage below normal, or shorted to low source
697	1136	3	Sensor circuit - voltage	ECM internal temperature sensor circuit - voltage above normal, or shorted to high source
698	1136	4	Sensor circuit - voltage	Ecm internal temperature sensor circuit - voltage below normal, or shorted to low source
719	22	3	Crankcase pressure	Extended crankcase blow-by pressure circuit - voltage above normal, or shorted to high source
729	22	4	Crankcase pressure	Extended crankcase blow-by pressure circuit - voltage below normal, or shorted to low source
731	723	7	Engine speed sensor #2	Engine speed/position #2 mechanical misalignment between camshaft and crankshaft sensors - mechanical system not responding properly or out of adjustment
757	2802	31	Electronic control module	Electronic control module data lost - condition exists
778	723	2	Engine speed sensor #2	Engine speed sensor (camshaft) error – data erratic, intermittent, or incorrect
779	703	11	Auxiliary equipment sensor input	Warning auxiliary equipment sensor input # 3 (OEM switch) - root cause not known
951	166	2	Cylinder power	Cylinder power imbalance between cylinders - data erratic, intermittent, or incorrect
1117	3597	2	Power supply	Power lost with ignition on - data erratic, intermittent, or incorrect
1139	651	7	Injector cylinder # 01	Injector cylinder #1 - mechanical system not responding properly or out of adjustment
1141	652	7	Injector cylinder # 02	Injector cylinder #2 - mechanical system not responding properly or out of adjustment
1142	653	7	Injector cylinder # 03	Injector cylinder #3 - mechanical system not responding properly or out of adjustment

※ Some fault codes are not applied to this machine.

Fault code	J1939 SPN	J1939 FMI	Item	Description
1143	654	7	Injector cylinder # 04	Injector cylinder #4 - mechanical system not responding properly or out of adjustment
1144	655	7	Injector cylinder # 05	Injector cylinder #5 - mechanical system not responding properly or out of adjustment
1145	656	7	Injector cylinder # 06	Injector cylinder #6 - mechanical system not responding properly or out of adjustment
1239	2623	3	Accelerator pedal position	Accelerator pedal or lever position sensor 2 circuit - voltage above normal, or shorted to high source
1241	2623	4	Accelerator pedal position	Accelerator pedal or lever position sensor 2 circuit - voltage below normal, or shorted to low source
1242	91	2	Accelerator pedal position	Accelerator pedal or lever position sensor 1 and 2 - data erratic, intermittent, or incorrect
1256	1563	2	Control module identification input state	Control module identification input state error - data erratic, intermittent, or incorrect
1257	1563	2	Control module identification input state	Control module identification input state error - data erratic, intermittent, or incorrect
1852	97	16	Water in fuel indicator	Water in fuel indicator - data valid but above normal operational range - moderately severe level
1911	157	0	Injector metering rail	Injector metering rail 1 pressure - data valid but above normal operational range - most severe level
2111	52	3	Coolant temperature	Coolant temperature 2 sensor circuit - voltage above normal, or shorted to high source
2112	52	4	Coolant temperature	Coolant temperature 2 sensor circuit - voltage below normal, or shorted to low source
2113	52	16	Coolant temperature	Coolant temperature 2 - data valid but above normal operational range - moderately severe level
2114	52	0	Coolant temperature	Coolant temperature 2 - data valid but above normal operational range - most severe level
2115	2981	3	Coolant pressure	Coolant pressure 2 circuit - voltage above normal, or shorted to high source
2116	2981	4	Coolant pressure	Coolant pressure 2 circuit - voltage below normal, or shorted to low source
2117	2981	18	Coolant pressure	Coolant pressure 2 - data valid but below normal operational range - moderately severe level
2182	1072	3	Engine brake output # 1	Engine brake actuator driver 1 circuit - voltage above normal, or shorted to high source
2183	1072	4	Engine brake output # 1	Engine brake actuator driver 1 circuit - voltage below normal, or shorted to low source
2185	3512	3	System diagnostic code # 1	Sensor supply voltage #4 circuit – voltage above normal, or shorted to high source
2186	3512	4	System diagnostic code # 1	Sensor supply voltage #4 circuit – voltage below normal, or shorted to low source
2195	703	14	Auxiliary equipment sensor	Auxiliary equipment sensor input 3 engine protection critical - special instructions
2215	94	18	Fuel delivery pressure	Fuel pump delivery pressure - data valid but below normal operational range - moderately severe level
2216	94	16	Fuel delivery pressure	Fuel pump delivery pressure - data valid but above normal operational range – moderately severe level

※ Some fault codes are not applied to this machine.

Fault code	J1939 SPN	J1939 FMI	Item	Description
2217	630	31	Calibration memory	ECM program memory (RAM) corruption - condition exists
2249	157	1	Injector metering rail 1 pressure	Injector metering rail 1 pressure - data valid but below normal operational range - most severe level
2261	94	15	Fuel delivery pressure	Fuel pump delivery pressure - data valid but above normal operational range - least severe level
2262	94	17	Fuel delivery pressure	Fuel pump delivery pressure - data valid but below normal operational range - least severe level
2263	1800	16	Battery temperature	Battery temperature - data valid but above normal operational range - moderately severe level
2264	1800	18	Battery temperature	Battery temperature - data valid but below normal operational range - moderately severe level
2265	1075	3	Electric lift pump for engine fuel	Fuel priming pump control signal circuit – voltage above normal, or shorted to high source
2266	1075	4	Electric lift pump for engine fuel	Fuel priming pump control signal circuit – voltage below normal, or shorted to low source
2292	611	16	Fuel inlet meter device	Fuel inlet meter device - data valid but above normal operational range - moderately severe level
2293	611	18	Fuel inlet meter device	Fuel inlet meter device flow demand lower than expected - data valid but below normal operational range - moderately severe level
2311	633	31	Fuel control valve #1	Fueling actuator #1 circuit error – condition exists
2321	190	2	Engine speed	Engine speed / position sensor #1 - data erratic, intermittent, or incorrect
2322	723	2	Engine speed sensor #2	Engine speed / position sensor #2 - data erratic, intermittent, or incorrect
2345	103	10	Turbocharger 1 speed	Turbocharger speed invalid rate of change detected - abnormal rate of change
2346	2789	15	System diagnostic code #1	Turbocharger turbine inlet temperature (calculated) - data valid but above normal operational range – least severe level
2347	2629	15	System diagnostic code #1	Turbocharger compressor outlet temperature (calculated) - data valid but above normal operational range – least severe level
2363	1073	4	Engine compression brake output # 2	Engine brake actuator circuit #2 – voltage below normal, or shorted to low source
2365	1112	4	Engine brake output # 3	Engine brake actuator driver output 3 circuit - voltage below normal, or shorted to low source
2367	1073	3	Engine compression brake output # 2	Engine brake actuator circuit #2 – voltage above normal, or shorted to high source
2368	1112	3	Engine brake output # 3	Engine brake actuator driver 3 circuit - voltage above normal, or shorted to high source
2372	95	16	Engine fuel filter differential pressure	Fuel filter differential pressure - data valid but above normal operational range - moderately severe level
2373	1209	3	Exhaust gas pressure	Exhaust gas pressure sensor circuit - voltage above normal, or shorted to high source
2374	1209	4	Exhaust gas pressure	Exhaust gas pressure sensor circuit - voltage below normal, or shorted to low source

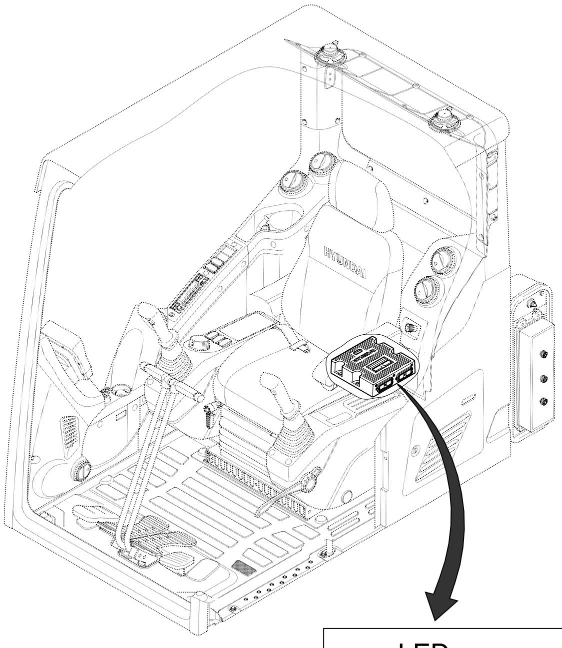
※ Some fault codes are not applied to this machine.

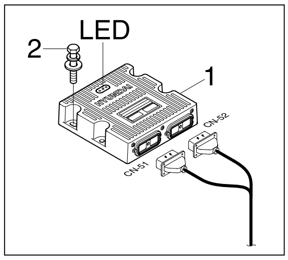
Fault code	J1939 SPN	J1939 FMI	Item	Description
2375	412	3	Exhaust gas recirculation temperature	Exhaust gas recirculation temperature sensor circuit - voltage above normal, or shorted to high source
2376	412	4	Exhaust gas recirculation temperature	Exhaust gas recirculation temperature sensor circuit - voltage below normal, or shorted to low source
2377	647	3	Fan clutch output device driver	Fan control circuit - voltage above normal, or shorted to high source
2425	730	4	Intake air heater # 2	Intake air heater 2 circuit - voltage below normal, or shorted to low source
2426	730	3	Intake air heater # 2	Intake air heater 2 circuit - voltage above normal, or shorted to high source
2448	111	17	Coolant level	Coolant level - data valid but below normal operating range - least severe level
2555	729	3	Inlet air heater driver #1	Intake air heater #1 circuit - voltage above normal, or shorted to high source
2556	729	4	Inlet air heater driver #1	Intake air heater #1 circuit - voltage below normal, or shorted to low source
2557	697	3	Auxiliary PWM driver #1	Auxiliary PWM driver #1 - voltage above normal, or shorted to high source
2558	697	4	Auxiliary PWM driver #1	Auxiliary PWM driver #1 - voltage below normal, or shorted to low source
2963	110	15	Engine coolant temperature	Engine coolant temperature high - data valid but above normal operational range - least severe level
2973	102	2	Boost pressure	Intake manifold pressure sensor circuit - data erratic, intermittent, or incorrect

※ Some fault codes are not applied to this machine.

GROUP 13 ENGINE CONTROL SYSTEM

1. MCU (Machine Control Unit)





1 MCU
2 Mounting bolt (M8)

220S5MS13

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 14 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 (Stage : 1.0)	P	10 ± 3	142 ± 42.7	340 ± 30	1650 ± 50
	S	15 ± 3	213 ± 42.7	400 ± 30	1550 ± 50
	E	17 ± 3	242 ± 42.7	425 ± 30	1450 ± 50
Option (Stage : 2.0)	P	10 ± 3	142 ± 42.7	340 ± 30	1850 ± 50
	S	15 ± 3	213 ± 42.7	400 ± 30	1750 ± 50
	E	17 ± 3	242 ± 42.7	425 ± 30	1650 ± 50

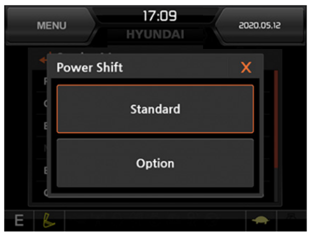
2) HOW TO SWITCH THE STAGE (1.0 ↔ 2.0) ON THE CLUSTER

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

- Management
  · Service menu

220S3CD149A

Enter the password 220S3CD150B

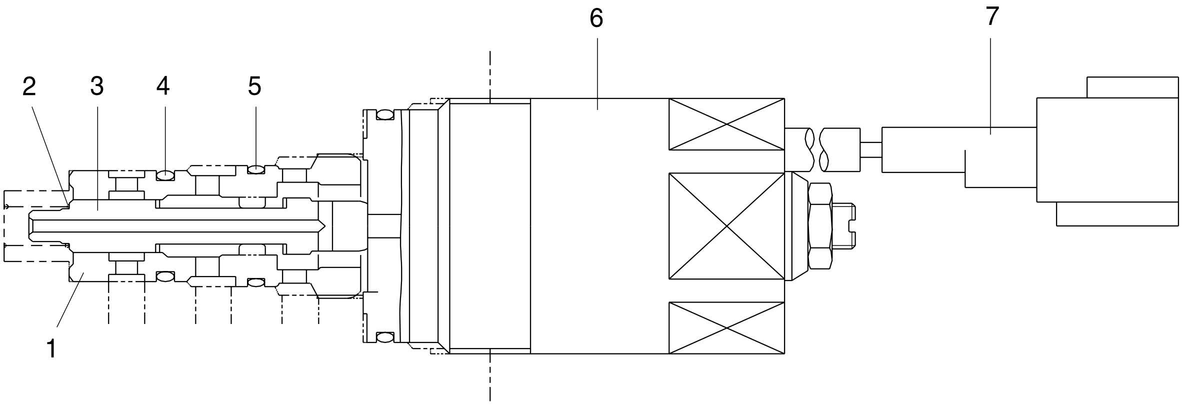


220S3CD251A

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

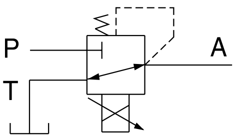
3) OPERATING PRINCIPLE (pump EPPR valve)

(1) Structure



5-22(1)

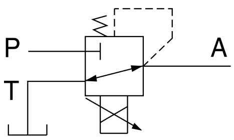
1	Sleeve	4	O-ring	6	Solenoid valve
2	Spring	5	O-ring	7	Connector
3	Spool				

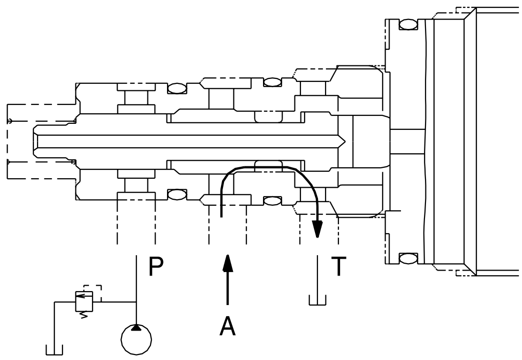


P Pilot oil supply line (pilot pressure)
T Return to tank
A Secondary pressure to flow regulator at main pump

(2) Neutral

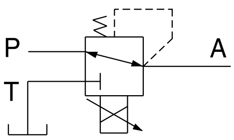
Pressure line is blocked and A oil returns to tank.

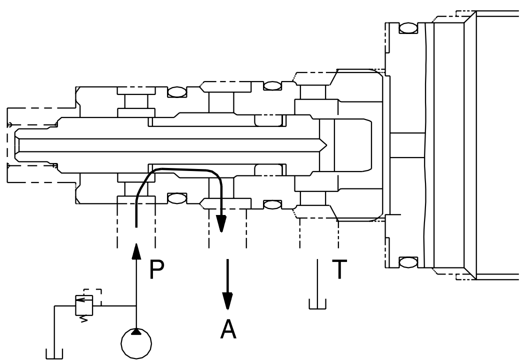




(3) Operating

Secondary pressure enters into A.





5-22(2)

4) EPPR VALVE CHECK PROCEDURE

(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.

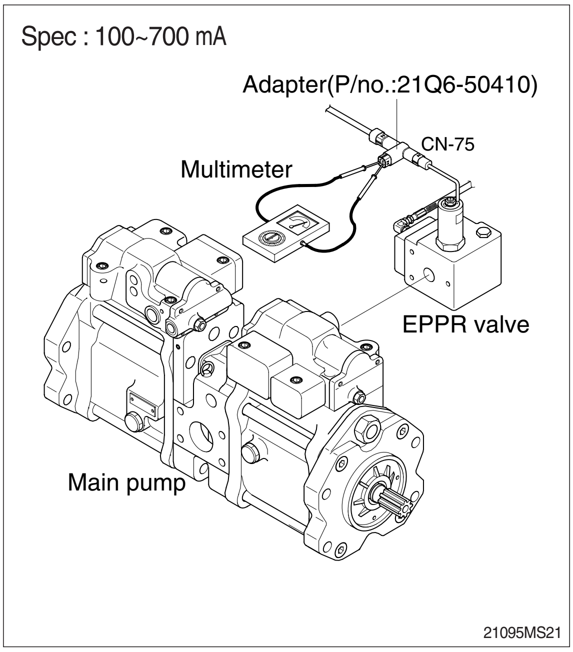
③ Start engine.

④ Set S-mode and cancel auto decel mode.

⑤ Position the multimodal dial at 10.

⑥ If rpm display show approx 1550±50 rpm check electric current at bucket circuit relief position.

⑦ Check electric current at bucket circuit relief position.



(2) Check pressure at EPPR valve

① Remove plug and connect pressure gauge as figure.

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

② Start engine.

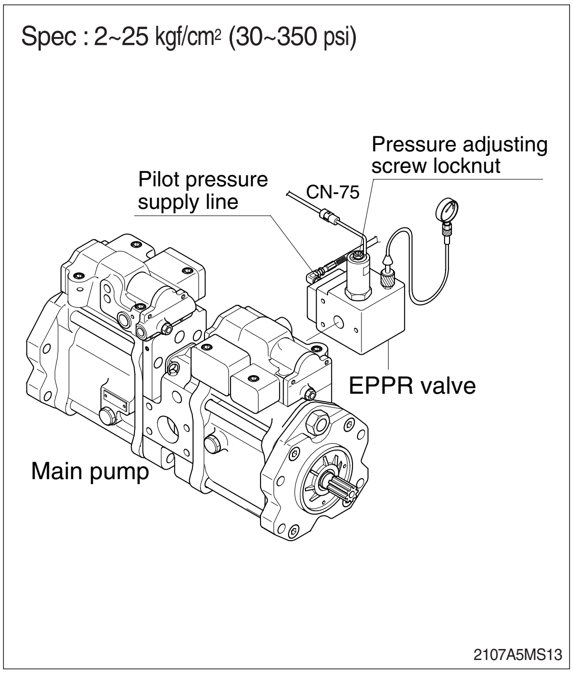
③ Set S-mode and cancel auto decel mode.

④ Position the multimodal dial at 10.

⑤ If tachometer show approx 1550±50 rpm check pressure at relief position of bucket circuit by operating bucket control lever.

⑥ If pressure is not correct, adjust it.

⑦ After adjust, test the machine.



2. BOOM PRIORITY EPPR VALVE

1) COMPOSITION

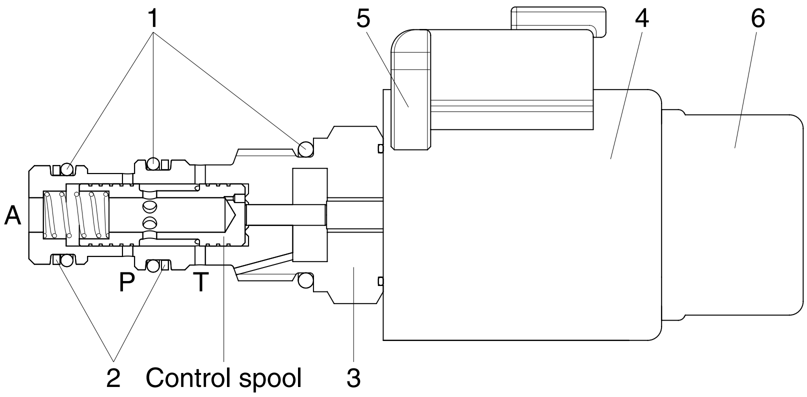
The boom priority EPPR valve is built in a manifold and mainly consisting of valve body and coil.
This EPPR valve installed under the solenoid valve.

2) CONTROL

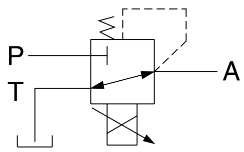
The boom priority EPPR valve has to be controlled by a specific electronic amplifier card, which is supplying the coil with a current 580 mA at 30Ω and 24 V.

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.

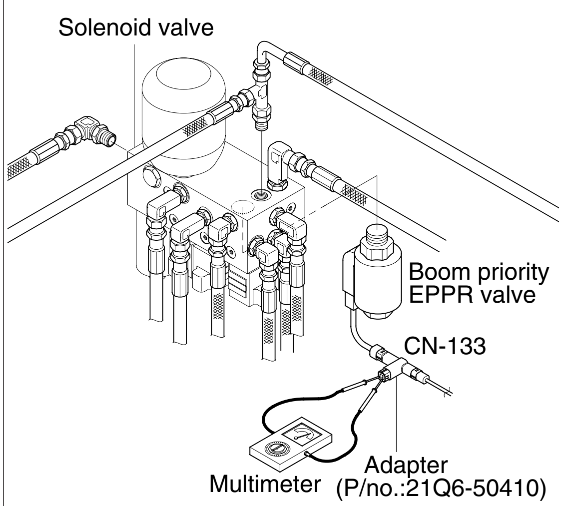
③ Start engine.

④ Set S-mode and cancel auto decel mode.

⑤ If rpm display approx 1550±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)



350SA5MS15

(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.

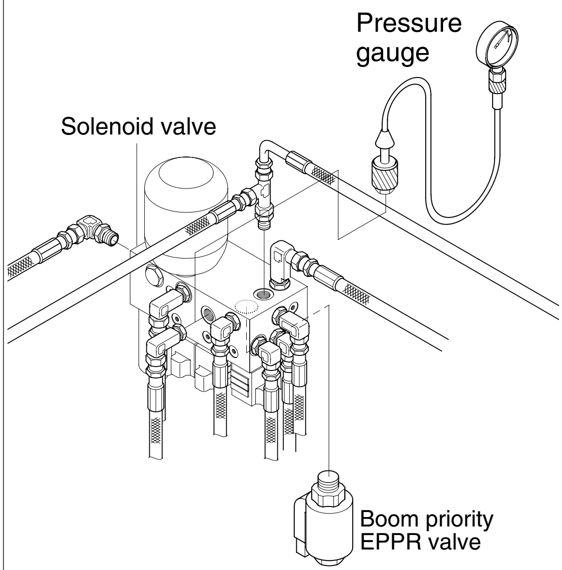
③ Set S-mode and cancel auto decel mode.

④ If rpm display approx 1550±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)



350SA5MS16

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

Normal type

300SA3CD50B

Premium type

300SA3CD51B

※ 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 3-62 for details.

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 to1200 rpm.
※ Others same as above.

③ When abnormal condition

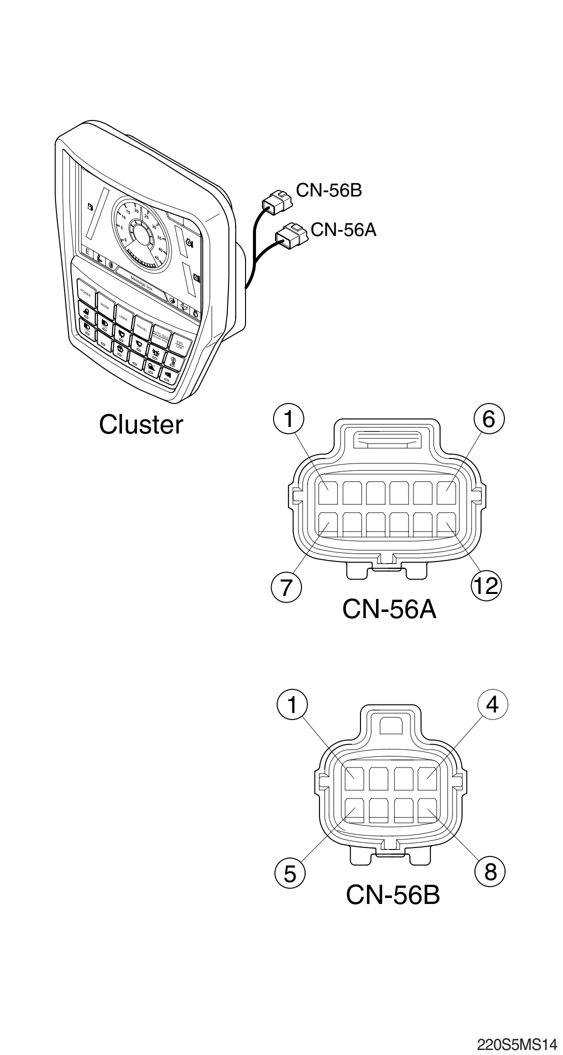
a. The warning lamp lights up and the buzzer sounds.
b. If BUZZER STOP switch is pressed, buzzer sound is canceled but the lamp warning lights up until normal condition.
※ The pop-up warning lamp moves to the original position and blink when the buzzer stop switch is pushed. Also the buzzer stops.

3. CLUSTER CONNECTOR

1) NORMAL TYPE

(1) CN-56A

No.	Name	Signal
1	Battery 24V	20~32Vdc
2	Power IG {24V}	20~32Vdc
3	GND	-
4	N.C	-
5	N.C	-
6	CAN 2 (H)	0~5Vdc
7	CAN 2 (L)	dc
8	N.C	-
9	N.C	-
10	N.C	-
11	N.C	-
12	N.C	-



(2) CN-56B

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

NTSC : National Television System Committee

2) PREMIUM TYPE

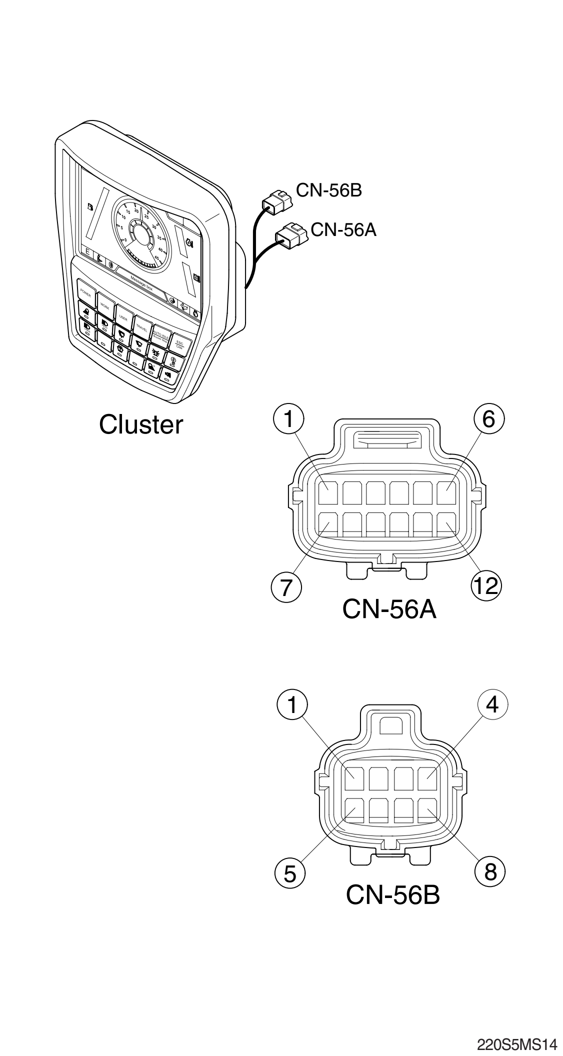
(1) CN-56A

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

(2) CN-56B

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

NTSC : National Television System Committee



3) GAUGE

(1) Operation screen

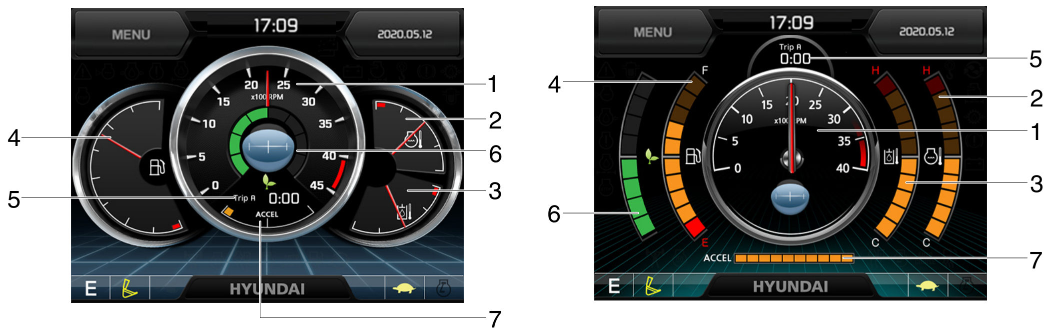
When you first turn starting switch ON, the operation screen will appear.

Normal type

235SA3CD551

Premium type

Default　　　　　　　　　　Option



220S3CD151A

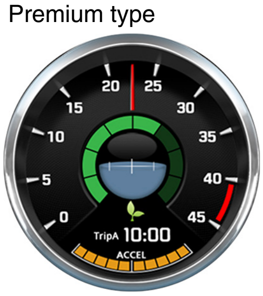
1	RPM / Speed gauge	5	Tripmeter display
2	Engine coolant temperature gauge	6	Eco guage
3	Hydraulic oil temperature gauge	7	Accel dial gauge
4	Fuel level gauge		

※ Operation screen type can be set by the screen type menu of the display (premium type). Refer to page 5-85 for details.

(2) RPM / Speed gauge

Normal type

Premium type



235SA3CD549

① This display the engine speed.

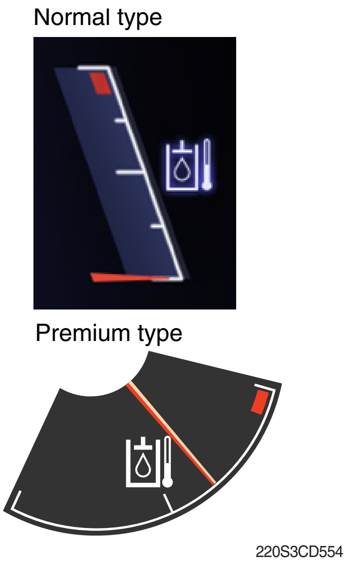
(3) Engine coolant temperature gauge

① This gauge indicates the temperature of coolant.
- White range : 40-113˚C (104-235˚F)
- Red range : Above 113˚C (235˚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



① This gauge indicates the temperature of hydraulic oil.
- White range : 40-100˚C (104-212˚F)
- Red range : Above 100˚C (212˚F)

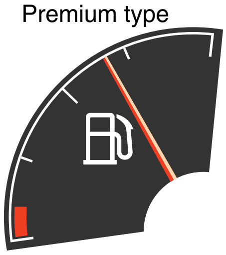
② If the indicator is in the red range or lamp pops up and the buzzer sounds reduce the load on the system. If the gauge stays in the red range, stop the machine and check the cause of the problem.

※ 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

Normal type

Premium type



220S3CD555

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) Tripmeter display

290F3CD56

① This displays the engine the tripmeter.
※ Refer to page 5-87 for details.

(7) 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.

(8) Accel dial gauge

290F3CD59

① This gauge indicates the level of accel dial.

4) WARNING LAMPS

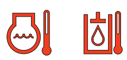
Normal type

400SA3CD503

Premium type

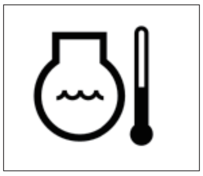
400SA3CD03

※ 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  is pushed - the lamp of the LCD is touched
	Warning lamp pops up on the center of the LCD and the buzzer sounds	· Cluster displays this pop-up when it has communication error with MCU. · If communication with MCU become normal state, it will dis-appear automatically.
	Warning lamp pops up on the center of the LCD and the buzzer sounds	※ Refer to page 5-62 for details.

※ Refer to page 5-69 for the buzzer stop switch  .

(1) Engine coolant temperature warning lamp



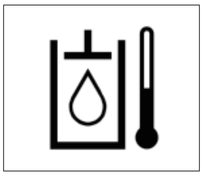
290F3CD61

① Engine coolant temperature warning is indicated two steps.
- 100˚C over : The lamp pops up and the buzzer sounds.
- 113˚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



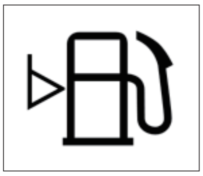
290F3CD62

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 69 ℓ (18.2 U.S. gal).

② Fill the fuel immediately when the lamp blinks.

(4) Emergency warning lamp

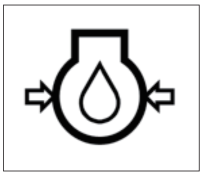
290F3CD64

① This warning lamp pops up and the buzzer sounds when each of the below warnings is happened.
- Engine coolant overheating (over 113˚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.

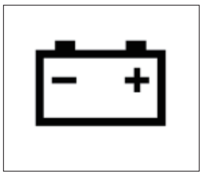
(5) Engine oil pressure warning lamp



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.

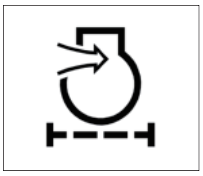
(6) Battery charging warning lamp



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.

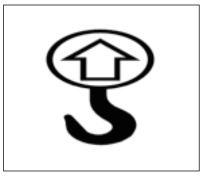
(7) Air cleaner warning lamp



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.

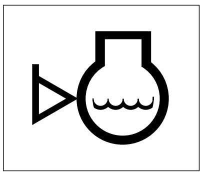
(8) Overload warning lamp (opt)



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.

(9) Coolant level warning lamp



760F3CD58

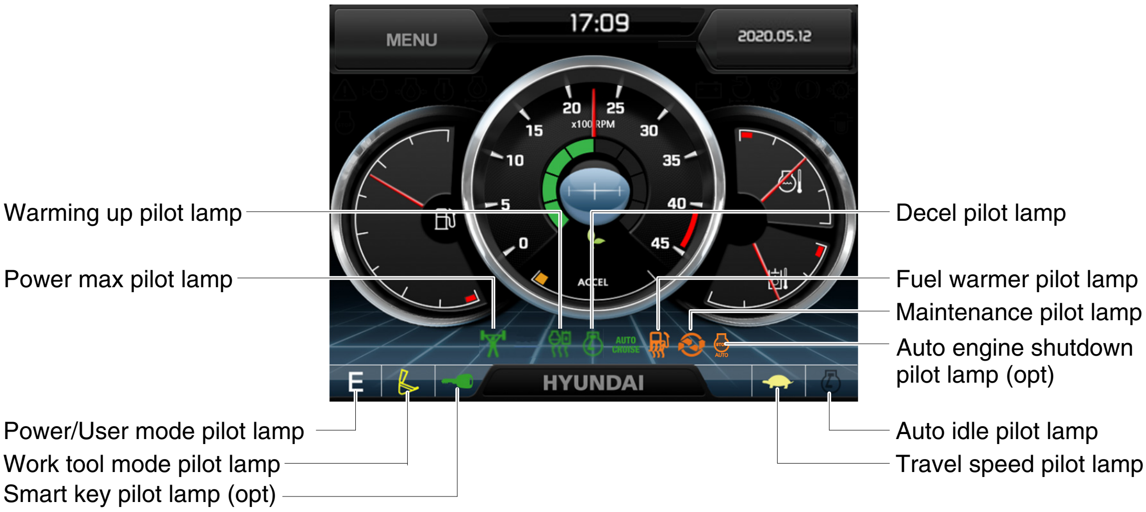
① This warning lamp indicates lack of coolant.
② Check and refill coolant.

5) PILOT LAMPS

Normal type

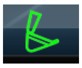
235SA3CD574

Premium type



220S3CD74B

(1) Mode pilot lamps

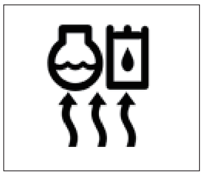
No	Mode	Pilot lamp	Selected mode
1	Power mode	P S E	Heavy duty power work mode Standard power mode Economy power mode
2	User mode	U	User preferable power mode
3	Work tool mode	    	General operation - IPC speed mode General operation - IPC balance mode General operation - IPC efficiency mode Breaker operation mode Crusher operation mode
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 manaul page 3-36 for power max function.**

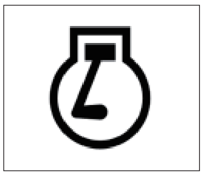
(3) Warming up pilot lamp



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.

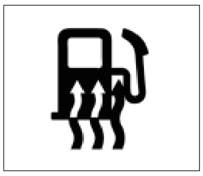
(4) Decel pilot lamp



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 manaul page 3-36.

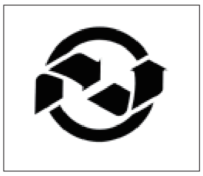
(5) Fuel warmer pilot lamp



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.

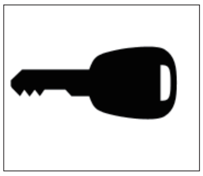
(6) Maintenance pilot lamp



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 page 5-80.

(7) Smart key pilot lamp (premium type, 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 page 5-81.

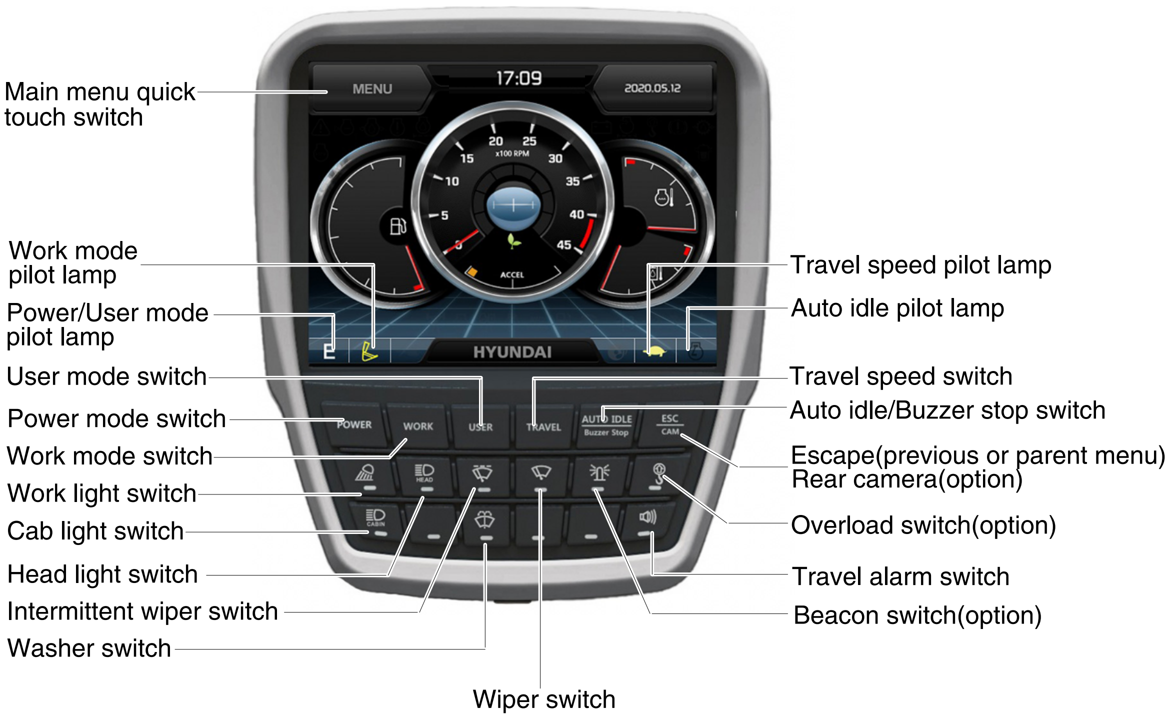
(8) Auto engine shutdown pilot lamp (premium type, opt)

① This lamp is turned ON when the auto engine shutdown is activated
※ Refer to page 5-77.

6) SWITCHES

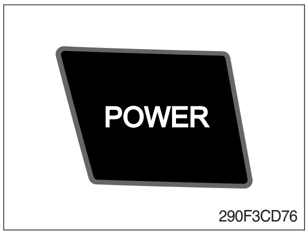
Normal type

Premium type



※ When some of the switches are selected, the pilot lamps are displayed on the LCD. Refer to page 5-65for 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.

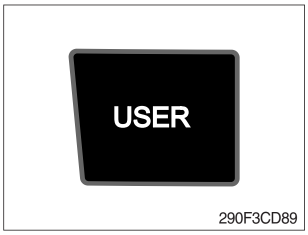
(2) Work mode switch

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 manaul page 2-7 for details.**

(3) User mode switch



290F3CD89

① This switch is used to select between user mode and general power mode.
- · U : User mode
- · P/S/E : General power mode

② Refer to page 5-75 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.

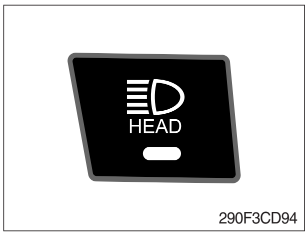
(6) Escape/Camera switch

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 5-87 for the camera.
③ If the camera is not installed, this switch is used only ESC function.

(7) Work light switch

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

(8) Head light switch



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

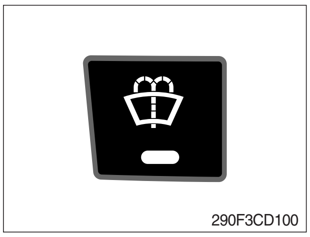
(9) Intermittent wiper switch

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

(10) Wiper switch

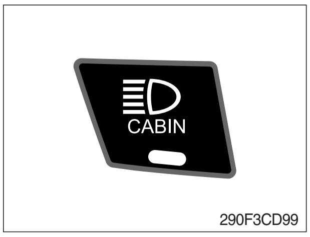
① This switch is used to operate the window wiper.
② Note that the wiper will self-park when switched off.
③ The pilot lamp is turned ON when operating the switch.
※ If the wiper does not operate with the switch in ON position, turn the switch OFF immediately. Check the cause.
If the switch remains ON,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

(11) Washer switch



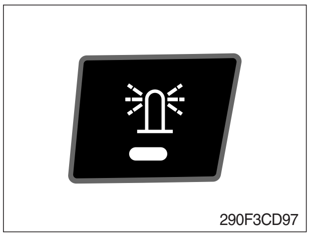
① The washer liquid is sprayed and the wiper is operated only while pressing this switch.
② The pilot lamp is turned ON when operating the switch.

(12) Cab light switch



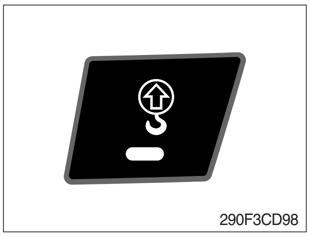
① This switch turns ON the cab light on the cab.
② The pilot lamp is turned ON when operating the switch.

(13) Beacon switch (opt)



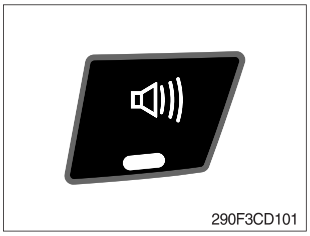
① This switch turns ON the rotary light on the cab.
② The pilot lamp is turned ON when operating the switch.

(14) Overload switch (opt)



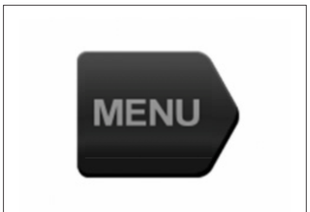
① When this switch turned ON, buzzer makes sound and overload warning lamp comes ON in case that the machine is overload.
② When it turned OFF, buzzer stops and warning lamp goes out.
⚠ **Overloading the machine could impact the machines stability which could result in tipover hazard. A tipover hazard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

(15) Travel alarm switch



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) Main menu quick touch switch



220S3CD217

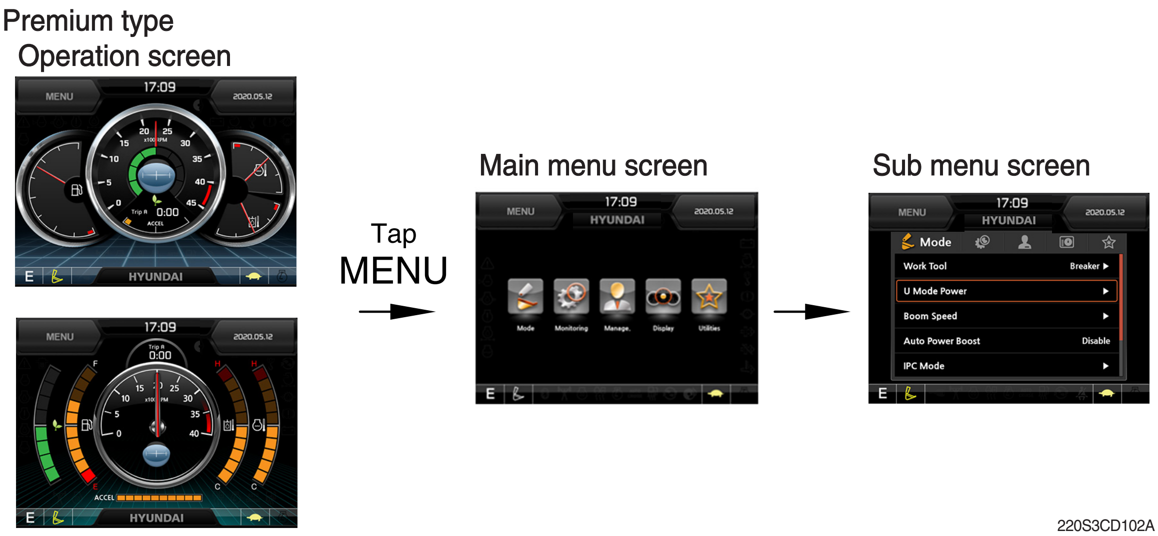
① This switch is to activate the main menu in the cluster.

※ Refer to page 5-74.

7) MAIN MENU

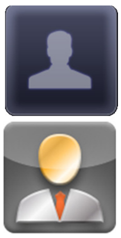
※ On the operation screen, tap MENU to access the main menu screen.
On the sub menu screen, you can tap the menu bar to access functions or applications.

235SA3CD502



220S3CD102A

(1) Structure

No	Main menu	Sub menu	Description
1	 Mode 220S3CD103	Work tool U mode power Boom/Arm speed Auto power boost IPC mode Auto engine shutdown (opt) Initial mode Emergency mode	Breaker, Crusher, Not installed User mode only Boom speed Enable, Disable Speed mode, Balance mode, Efficiency mode One time, Always, Disable Key on initial mode / initial work mode Switch function
2	 Monitoring 220S3CD104	Active fault Logged fault Delete logged fault Monitoring	MCU, AAVM (opt) MCU, AAVM (opt) All logged fault delete, Initialization canceled Machine information, Switch status, Output status,
3	 Management 220S3CD105	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 RMCU, Relay drive unit, AAVM (opt) A/S phone number, A/S phone number change Power shift, Operating hour, Breaker mode pump acting, EPPR current level, Overload pressure Clinometer setting Cluster, ETC device
4	 Display 220S3CD106	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 220S3CD107	Tripmeter Camera setting AUX Manual	3 kinds (A, B, C) Number of active, Display order, AAVM (opt)★

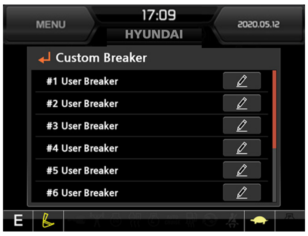
★ : premium type

(2) Mode setup

※ Illustrations are based on the premium type cluster.

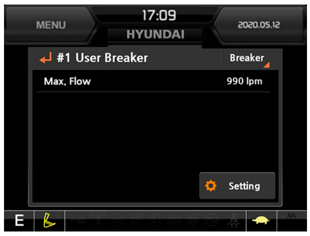
① Work tool

220S3CD108A



220S3CD253A

A



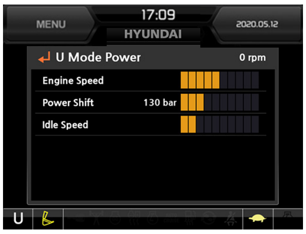
220S3CD254A

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.

② U mode power

220S3CD111A



220S3CD112A

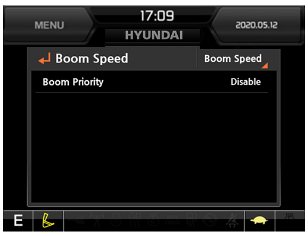
Step (▮)	Engine speed (rpm)	Idle speed (rpm)	Power shift (bar)
1	1300	800	0
2	1400	850	3
3	1450	900	6
4	1500	950	9
5	1550	1000 (auto decel)	12
6	1600	1050	16
7	1650	1100	20
8	1700	1150	26
9	1750	1200	32
10	1800	1250	38

※One touch decel & low idle : 900 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 Boom speed

220S3CD113A



220S3CD115A

· Boom speed
  - Boom priority function can be activated or cancelled
    Enable - Boom up speed is automatically adjusted as working conditions by the MCU.
    Disable - Normal operation

④ Auto power boost

220S3CD118A

220S3CD117A

· The power boost function can be activated or cancelled.
Enable - The digging power is automatically increased as working conditions by the MCU.
It is operated max 8 seconds.
Disable - Not operated.

⑤ IPC mode

220S3CD310A

220S3CD311A

220S3CD304A

220S3CD312A

220S3CD305A

220S3CD313A

220S3CD306A

· The IPC mode can be selected by this menu.
- Speed mode
- Balance mode (default)
- Efficiency mode

⑥ Automatic engine shutdown (option)

220S3CD91A

220S3CD92A

220S3CD93A

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

⑦ Initial mode

220S3CD122A

220S3CD119A

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

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

⑧ Emergency mode

220S3CD248A

220S3CD249A

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

(3) Monitoring

① Active fault

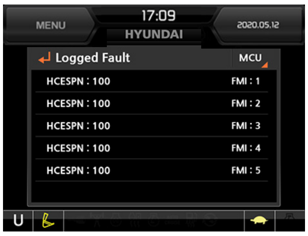
220S3CD120A

220S3CD125A

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

② Logged fault

220S3CD128A

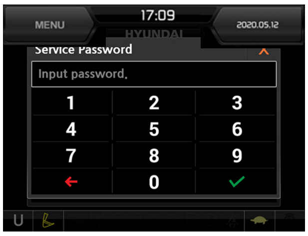


220S3CD124A

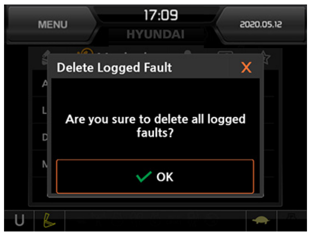
· The logged faults of the MCU can be checked by this menu.

③ Delete logged fault

220S3CD134A



220S3CD126A

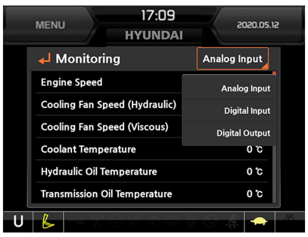


220S3CD127A

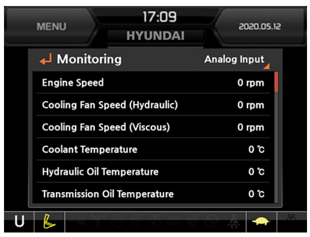
· The logged faults of the MCU can be deleted by this menu.

④ Monitoring

220S3CD172A



220S3CD188A



220S3CD189A

· 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

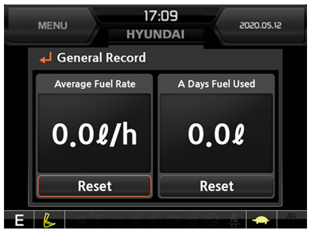
220S3CD14A

220S3CD15A

· 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).

A



220S3CD16A

· 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".

B

220S3CD17A

· 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".

C

220S3CD18A

· Mode record (D)

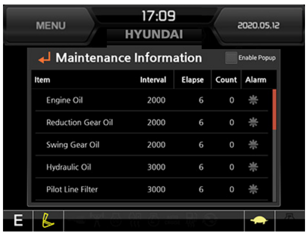
- Average fuel rate for each power mode/accel dial (at least 7) from "Reset" to now.
- No record during idle.
- All mode records deletion by "Reset".

D

220S3CD19A

② Maintenance information

220S3CD131A



220S3CD132A

220S3CD133A

· 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 30 hours.

※ **Refer to the maintenance chart for further information of maintenance interval.**

③ Machine security

220S3CD190A

220S3CD135A

220S3CD136A

220S3CD137A

220S3CD138A

· 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.

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

220S3CD190A

220S3CD140A

220S3CD135A

Enter the current password

220S3CD143A

Enter the new password again

220S3CD142A

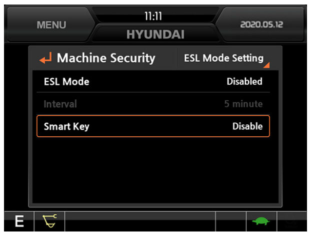
Enter the new password

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

- Smart key

220S3CD190A

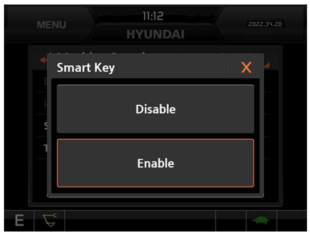
220S3CD135A



235F3CD001

· 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.

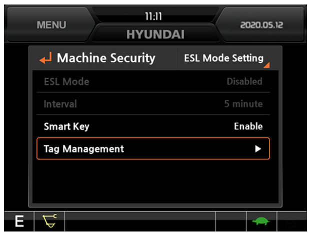


235F3CD002

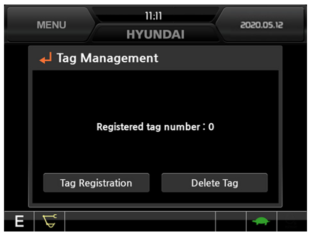
- Tag management

· 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.

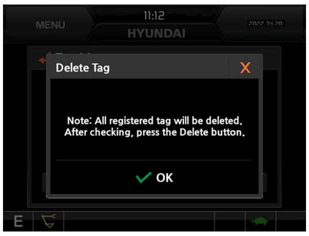


235F3CD003



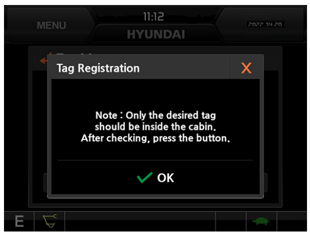
235F3CD004

Deleting



235F3CD006

Registering



235F3CD005

※ Engine Starting Condition

Case	ESL Mode	Smart Key	Condition
1	Disable	Disable	- With registered tag : Engine can be started without password input. - Without registered tag : Engine can be started without password input.
2	Disable	Enable	If Smart Key is enabled, ESL Mode is automatically enabled. This Case 2 work the same as the Case 4.
3	Enable	Disable	- With registered tag : Engine can be started with password input. - Without registered tag : Engine can be started with password input.
4	Enable	Enable	- With registered tag : Engine can be started without password input. - Without registered tag : Engine can be started with password input.

④Machine Information

220S3CD144A

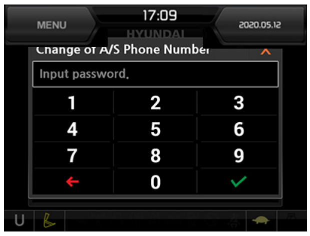
220S3CD145A

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

⑤ Contact (A/S phone number)

220S3CD146A

220S3CD147A



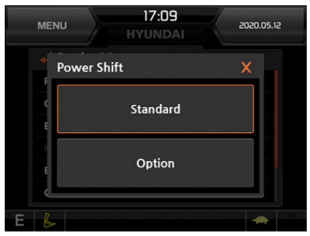
220S3CD148A

Enter the new A/S phone number

⑥ Service menu

220S3CD149A

220S3CD150B



220S3CD251A

· Power shift (standard/option) : Power shift pressure can be set by option menu.
· Operating hours : Operating hours since the machine line out can be checked by this menu.
· Breaker mode pump acting (null)
· EPPR current level (attach flow EPPR 1 & 2)
· Overload pressure : 100 ~ 350 bar

⑦ Clinometer

220S3CD152A

220S3CD153A

· 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.

⑧ Update (cluster & ETC devices)

220S3CD67A

220S3CD135A

220S3CD280A

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

220S3CD290A

220S3CD281A

220S3CD291A

220S3CD282A

220S3CD299A

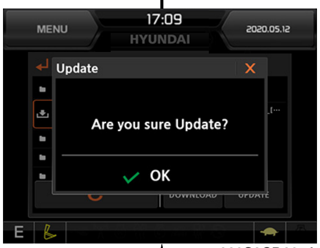
220S3CD292A

220S3CD283A

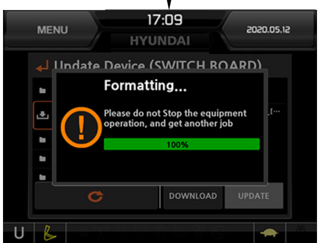
220S3CD298A

220S3CD293A

220S3CD284A



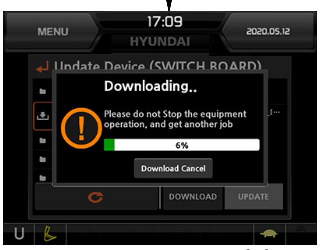
220S3CD297A



220S3CD294A

220S3CD285A

220S3CD296A



220S3CD295A

(5) Display

① Display item

220S3CD154A

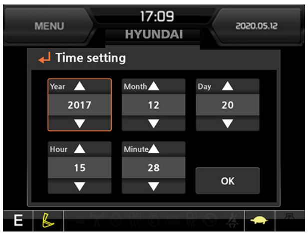
220S3CD155A

220S3CD156A

· 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

220S3CD157A

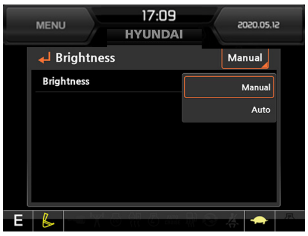


220S3CD158A

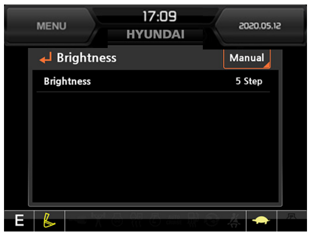
· The first line's three spots "**/**/****" represent Year/Month/Day each.
· The second line shows the current time. (0:00~23:59)

③ Brightness

220S3CD159A



220S3CD160A



220S3CD139A

220S3CD141A

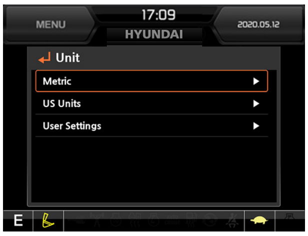
220S3CD191A

220S3CD192A

· 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

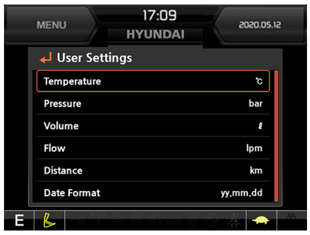
220S3CD161A



220S3CD182A

220S3CD183A

220S3CD186A



220S3CD162A

- 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

220F3CD193A

⑤ Language

220S3CD163A

220S3CD164A

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

⑥ Screen type (premium type)

220S3CD165A

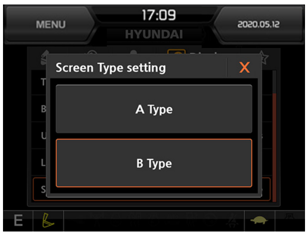
→

A Type (Default) 220S3CD166A

→

220S3CD156A

↓



B Type (Option) 220S3CD174A

→

220S3CD167A

(6) Utilites

① Tripmeter

220S3CD168A

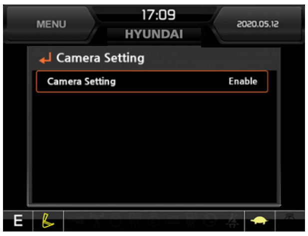
220S3CD169A

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

② Camera setting

- If the rear camera is not installed on the machine, set disable.
- If the rear camera installed on the machine, set enable.

220S3CD225A



220S3CD255A

220S3CD256A

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

220S3CD222A

290F3CD221

③ AAVM (Advanced Around View Monitoring, premium type, opt)

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

220S3CD244A

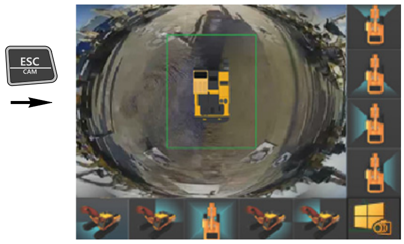
- Escape switch

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

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

220S3CD156A

Home screen

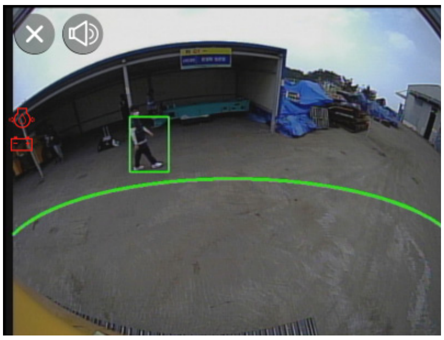


AAVM mode 235SA3CD222A

- Buzzer stop switch

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

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


220A3CD246

· When a worker/pedestrian reaches the green line, which is an external danger area equipped on the cluster, warning buzzer sounds and it displays a green rectangular box recognizing the worker/pedestrian.
Stop work immediately. Stop the buzzer by pressing the buzzer stop switch. Then resume work after you confi rm that the area is safe and clear of workers/objects.


220A3CD247

· When a worker/pedestrian reaches the red line, which is an external danger area equipped on the cluster, warning buzzer sounds and it displays a red rectangular box recognizing the worker/pedestrian.
Stop work immediately. Stop the buzzer by pressing the buzzer stop switch. Then resume work after you confirm that the area is safe and clear of workers/objects.

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

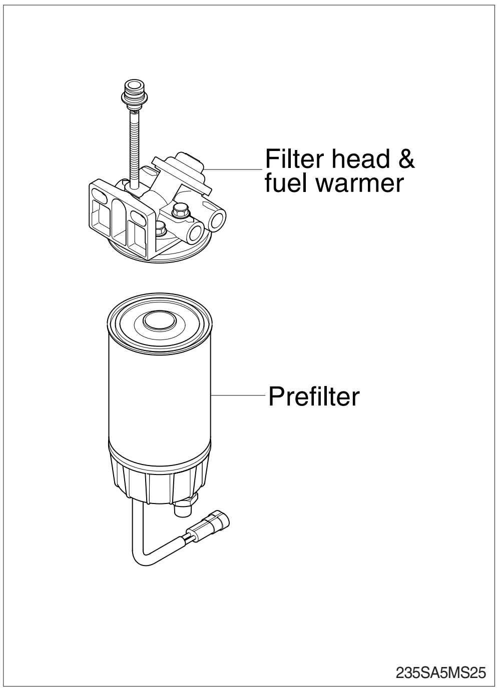
※ In AAVM mode, a touch screen of the LCD is available only.

1. SPECIFICATION

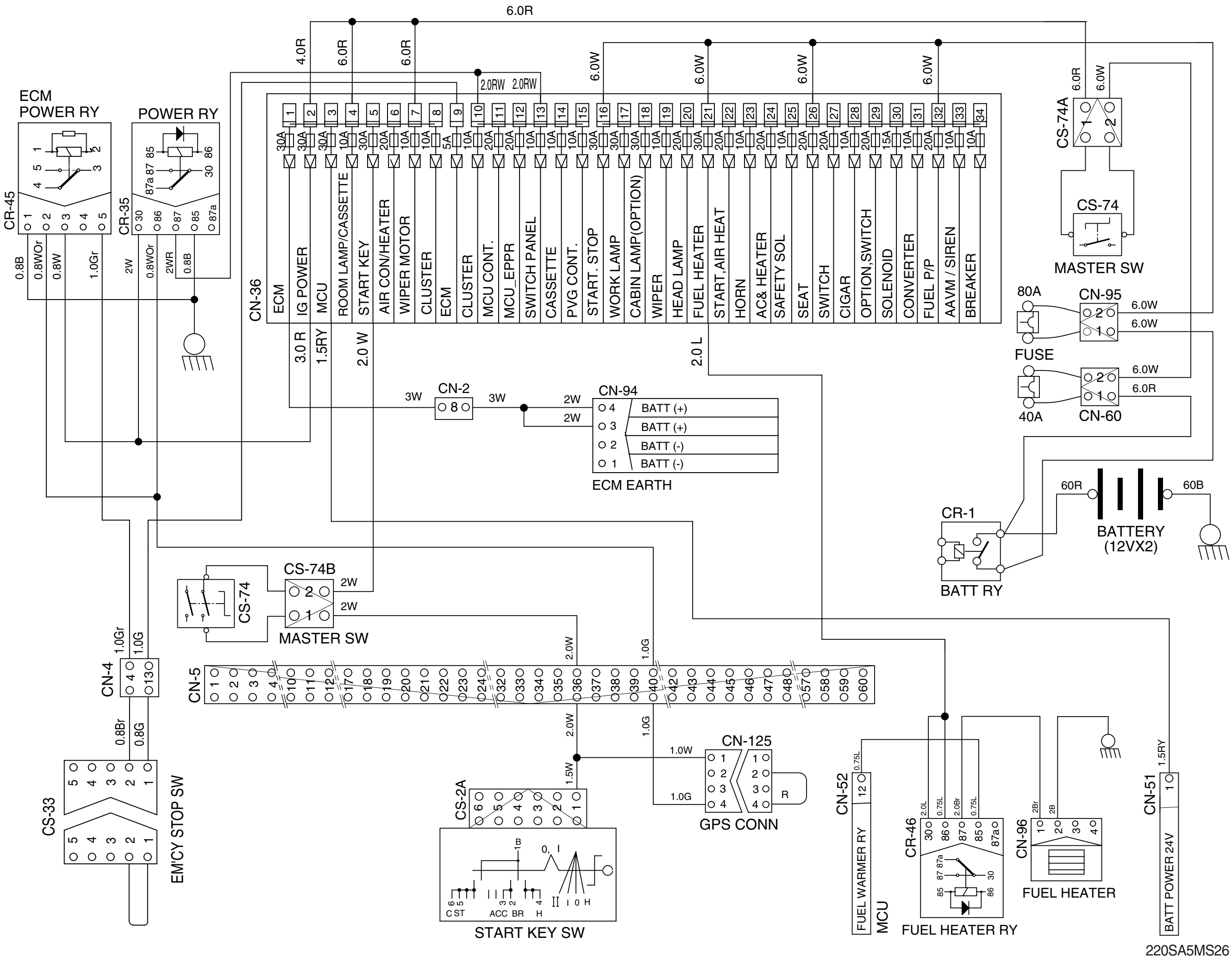
1) Operating voltage : 24±4 V
2) Power : 350±50 W
3) Current : 15 A

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

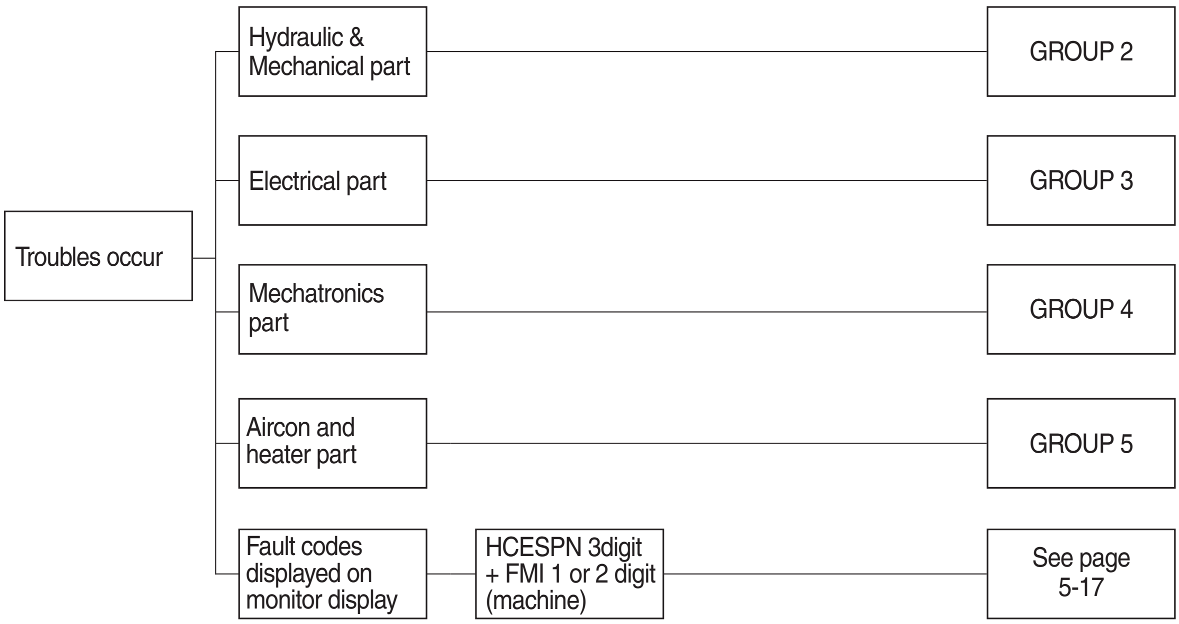
GROUP 1 BEFORE TROUBLESHOOTING

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

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

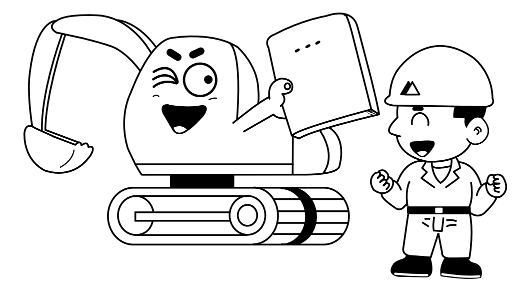


2. DIAGNOSING PROCEDURE

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

STEP 1. Study the machine system

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

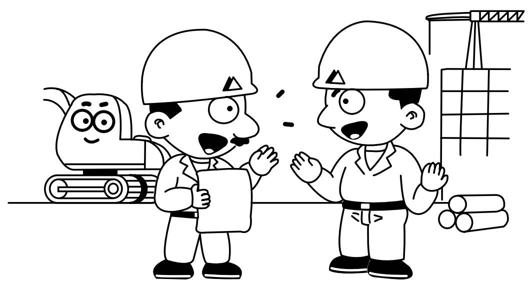


13031SH02

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.

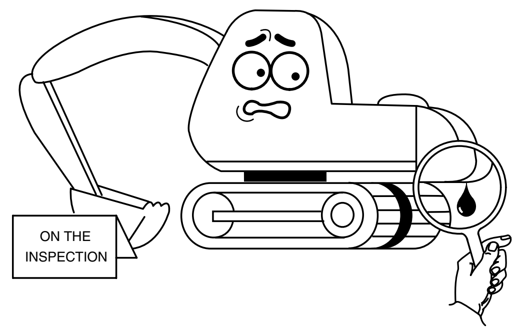


13031SH03

STEP 3. Inspect the machine

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

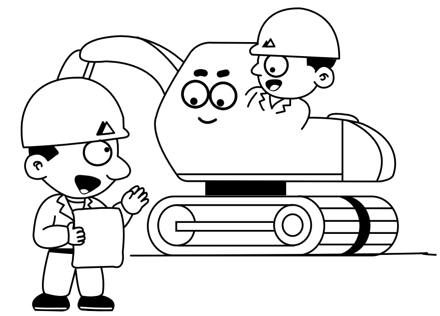
And also check the electrical system including batteries, as the troubles in the electrical system such as low battery voltage, loose connections and blown out fuses will result in malfunction of the controllers causing total operational failures of the machine.



(210-7) 6-2(3)

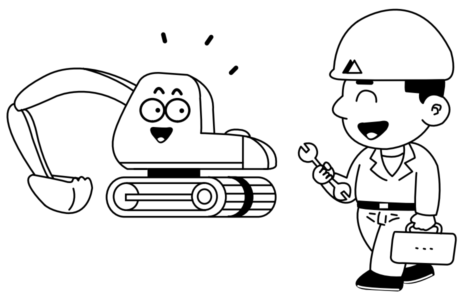
STEP 4. Inspect the trouble actually on the machine

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

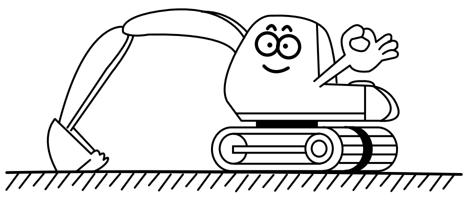
According to where the trouble parts are located, hydraulic & mechanical system part or electrical system part or mechatronics system part, perform troubleshooting the machine refer to the each system part's troubleshooting process diagram.


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.

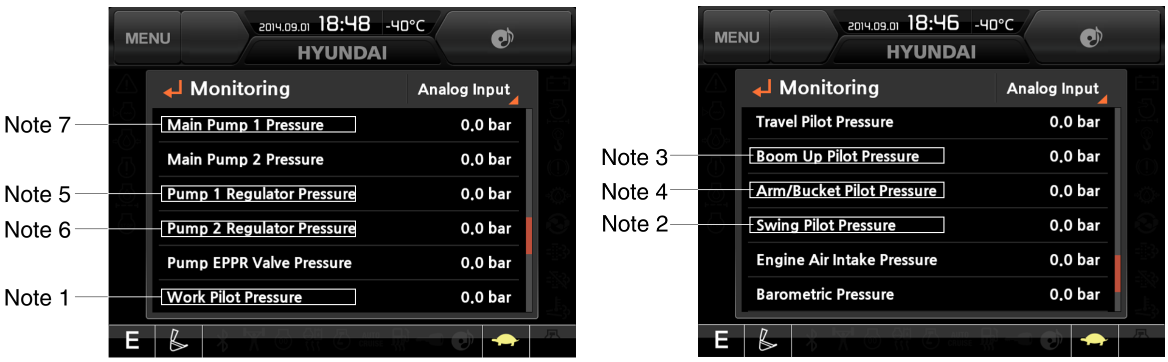
(3) When carrying out troubleshooting, do not hurry to disassemble the components.
It will become impossible to find the cause of the problem.

(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.



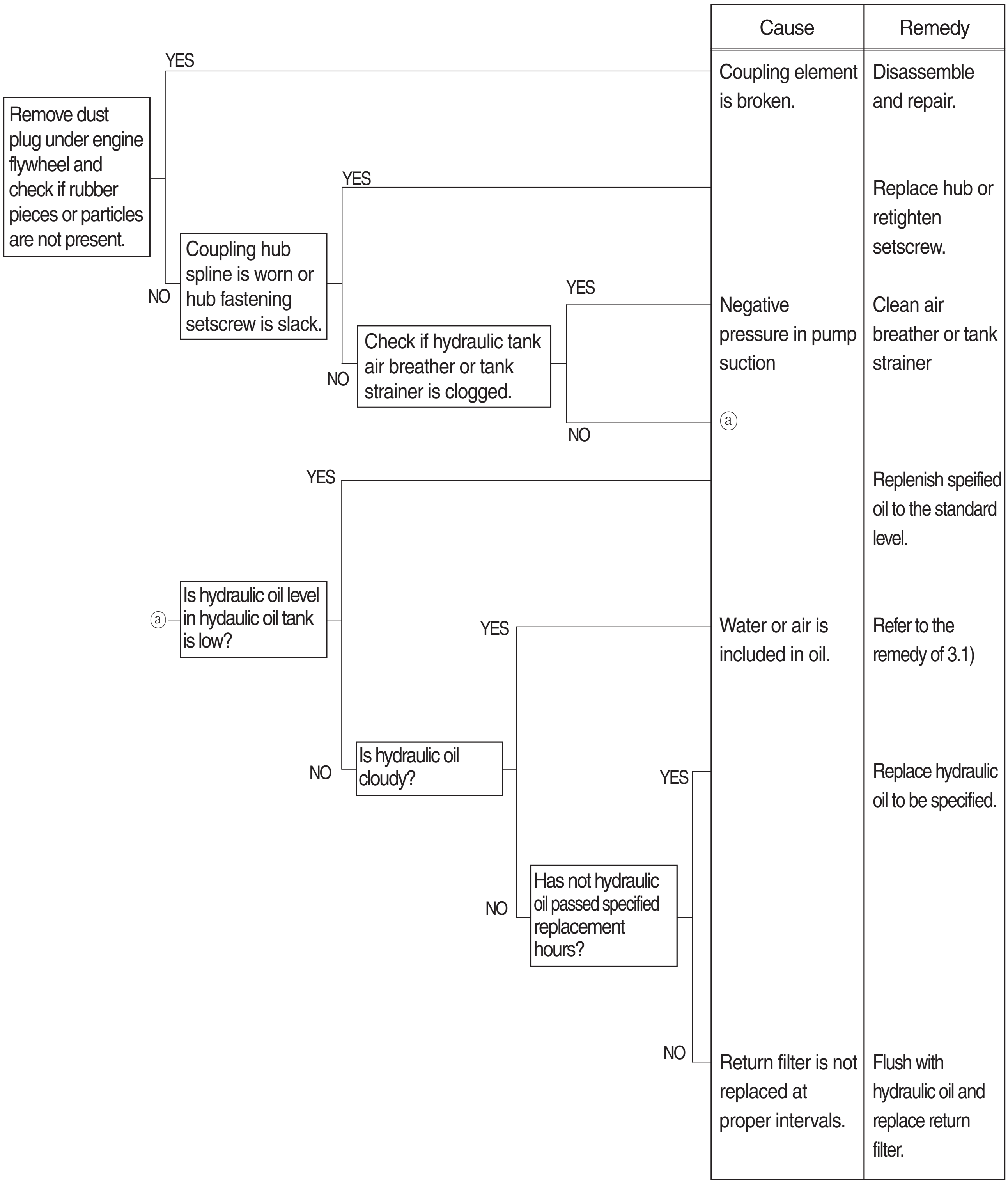
Analog 1 Analog 2 220S6HS01

(2) Specification

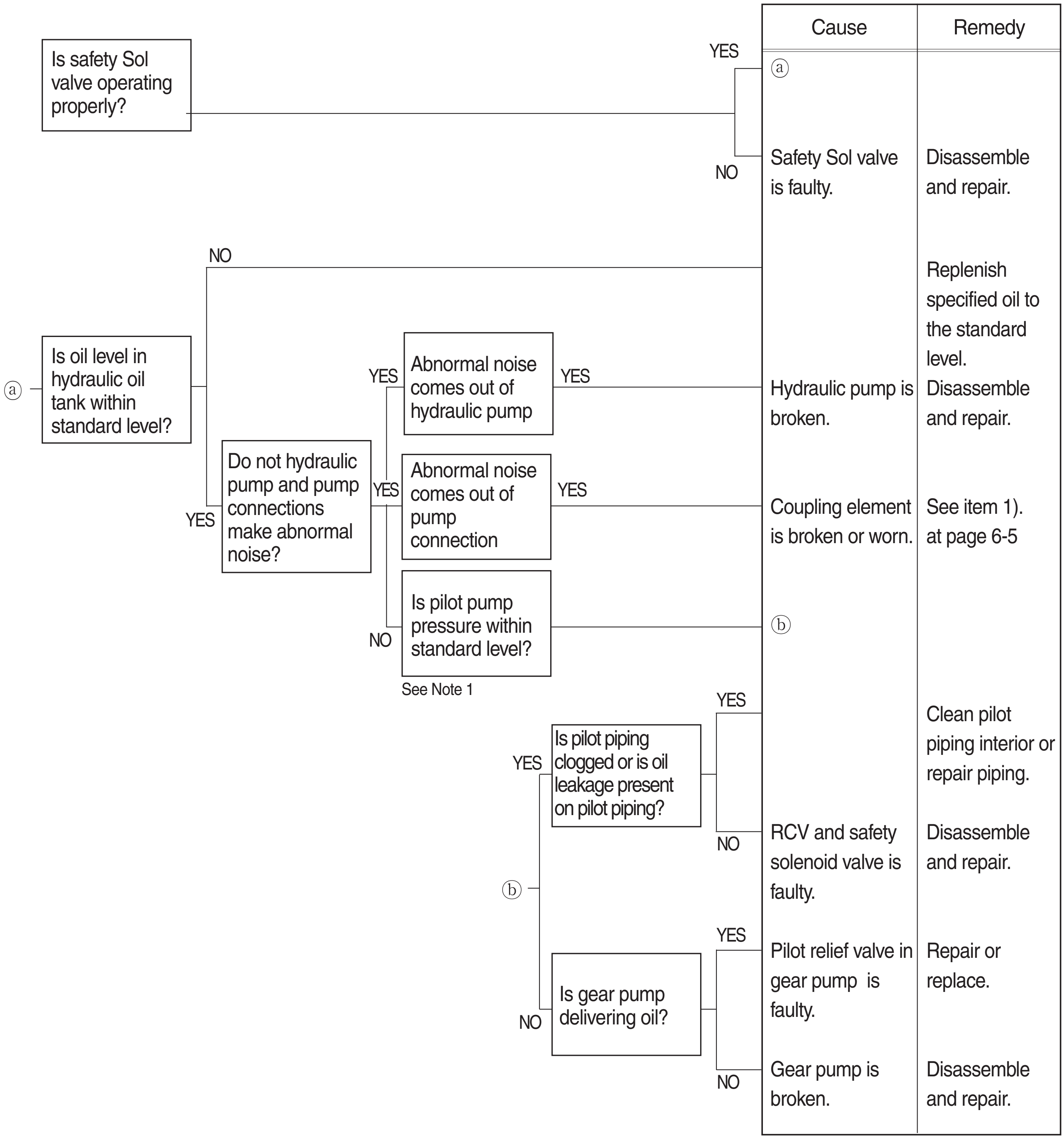
No.	Description	Specification
Note 1	Work pilot pressure	40^{+2}_{0} bar
Note 2	Swing pilot pressure	0~40 bar
Note 3	Boom up pilot pressure	0~40 bar
Note 4	Arm/bucket pilot pressure	0~40 bar
Note 5	Pump 1 regulator pressure	0~50 bar
Note 6	Pump 2 regulator pressure	0~50 bar
Note 7	Pump 1 pressure	350 bar

2. DRIVE SYSTEM

1) UNUSUAL NOISE COMES OUT OF PUMP CONNECTION

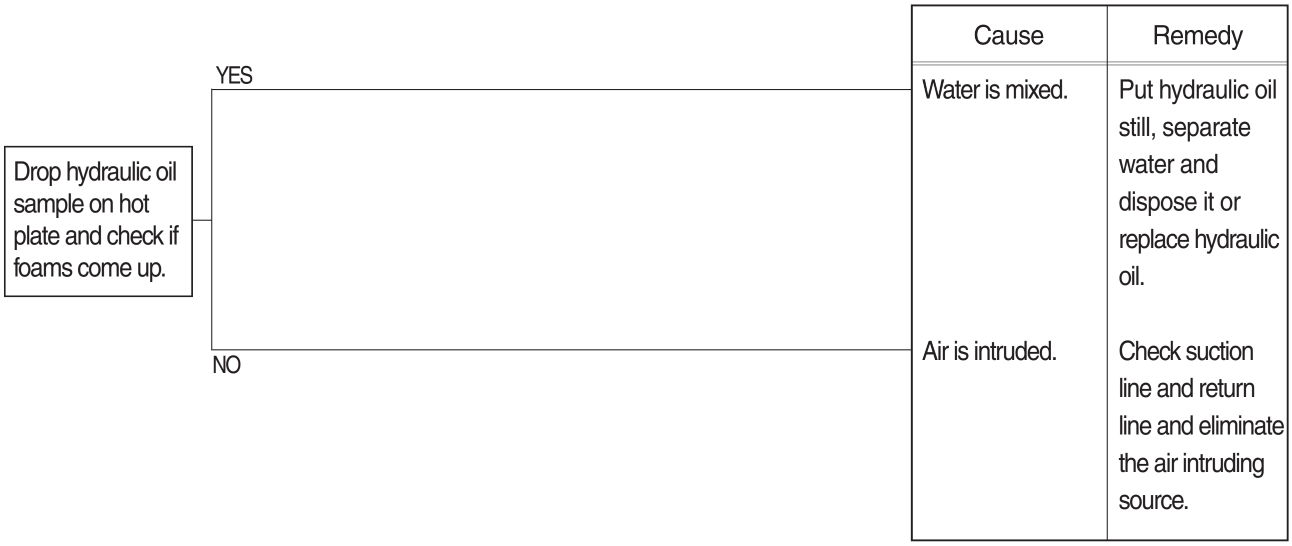


2) ENGINE STARTS BUT MACHINE DOES NOT OPERATE AT ALL

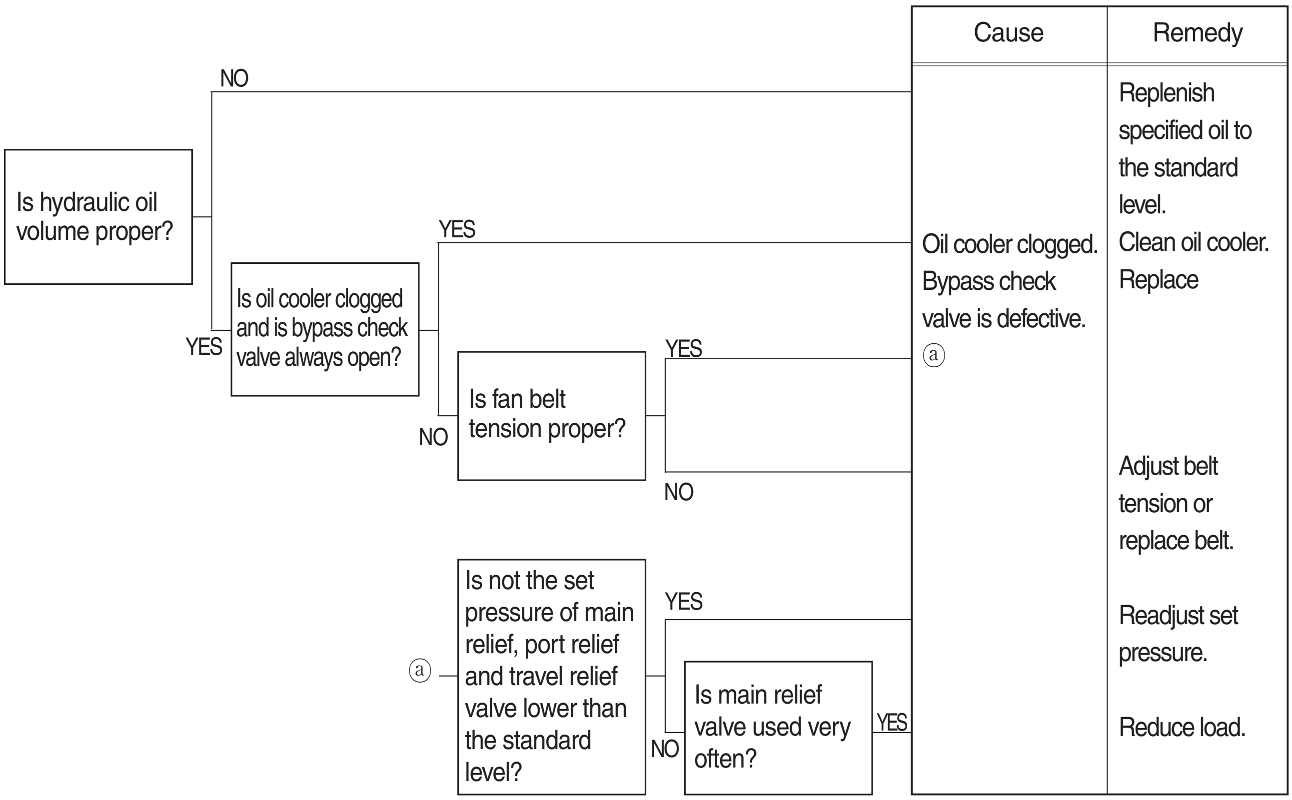


3. HYDRAULIC SYSTEM

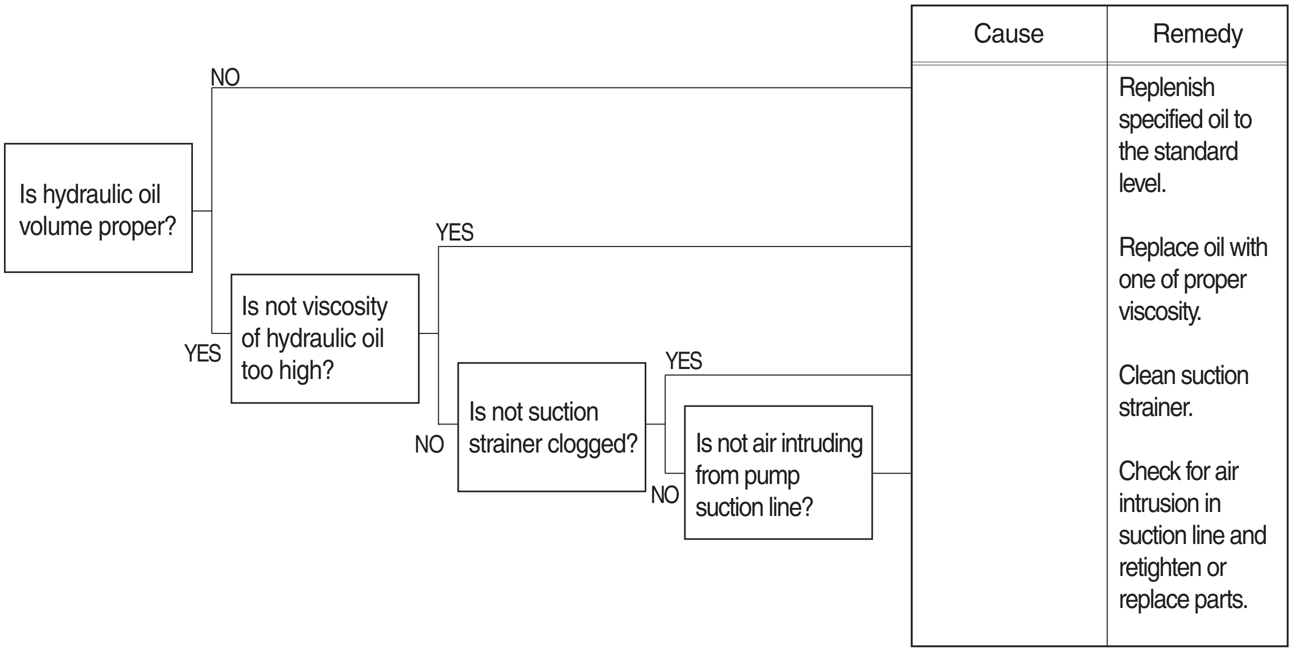
1) HYDRAULIC OIL IS CLOUDY



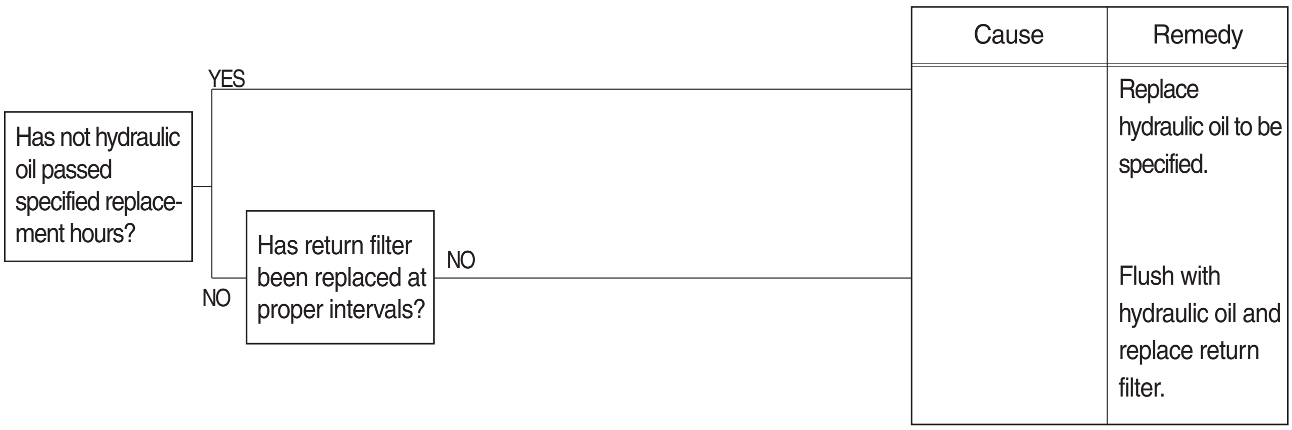
2) HYDRAULIC OIL TEMPERATURE HAS RISEN ABNORMALLY



3) CAVITATION OCCURS WITH PUMP

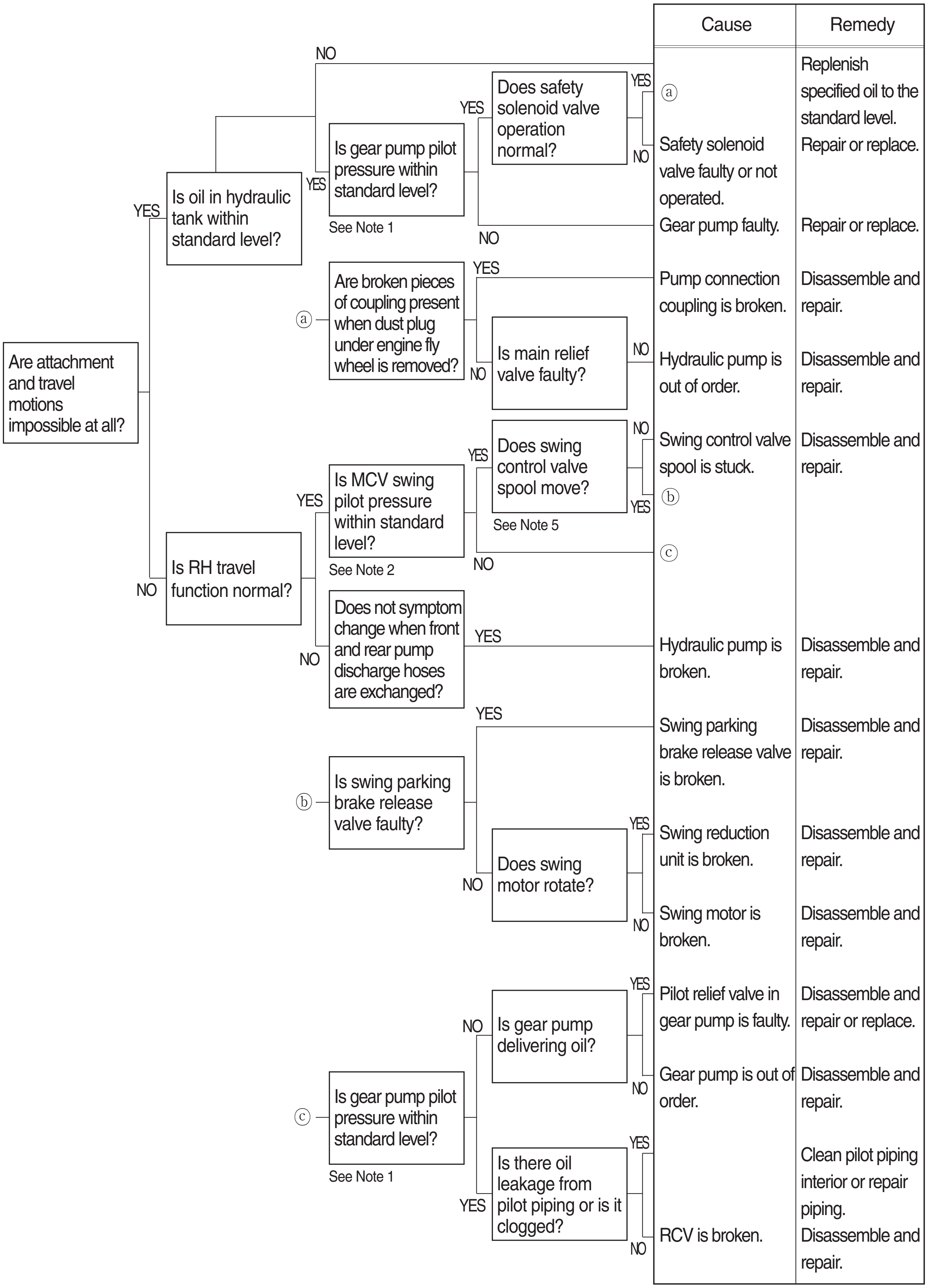


4) HYDRAULIC OIL IS CONTAMINATED

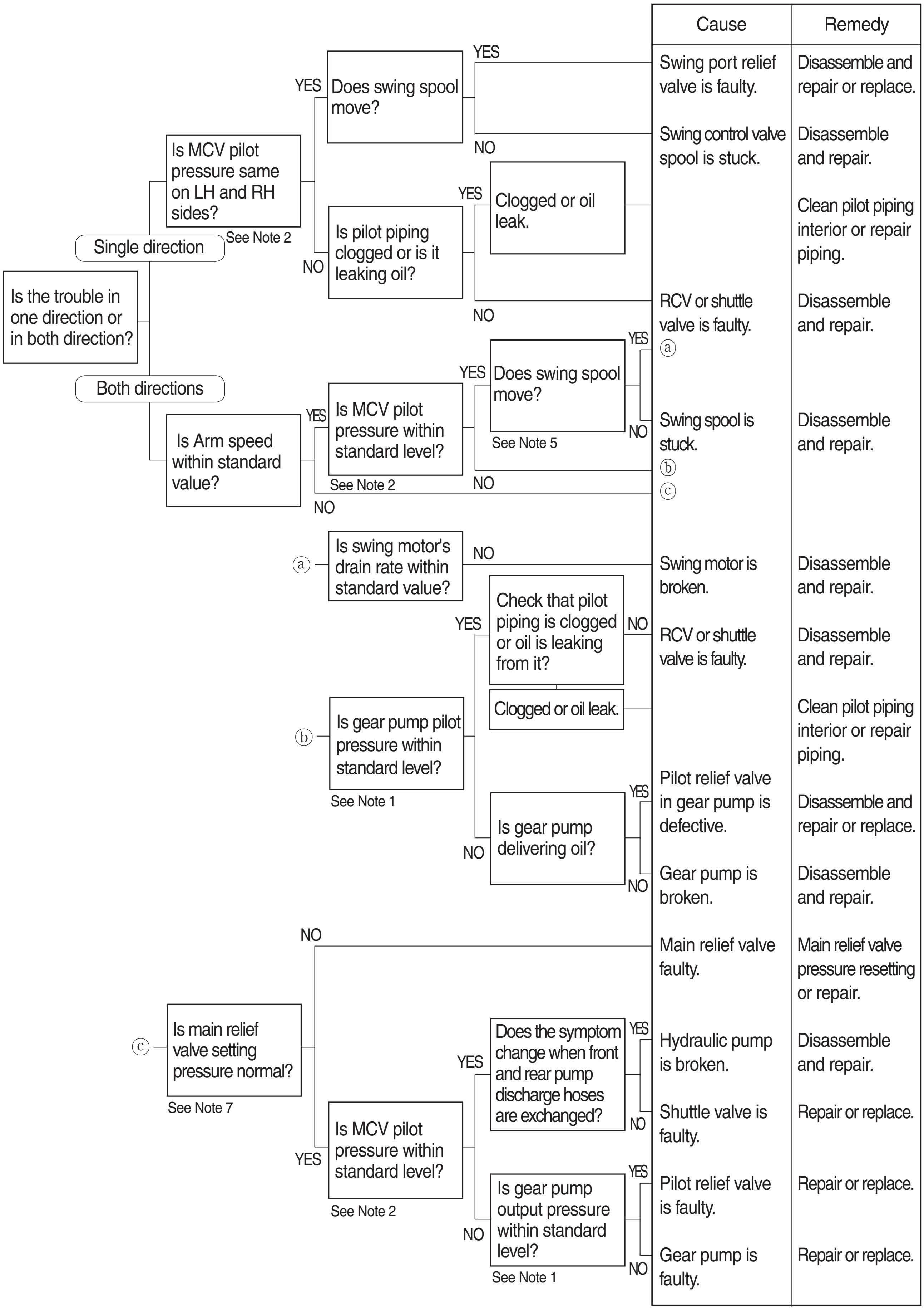


4. SWING SYSTEM

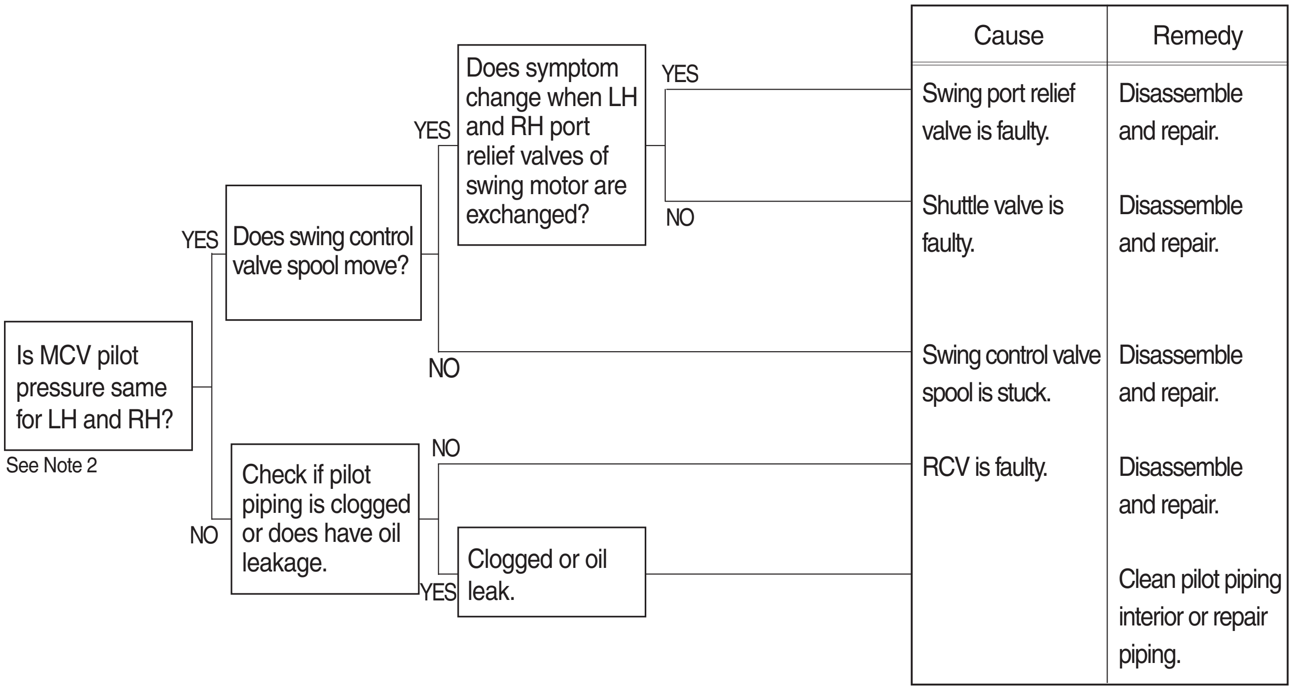
1) BOTH LH AND RH SWING ACTIONS ARE IMPOSSIBLE



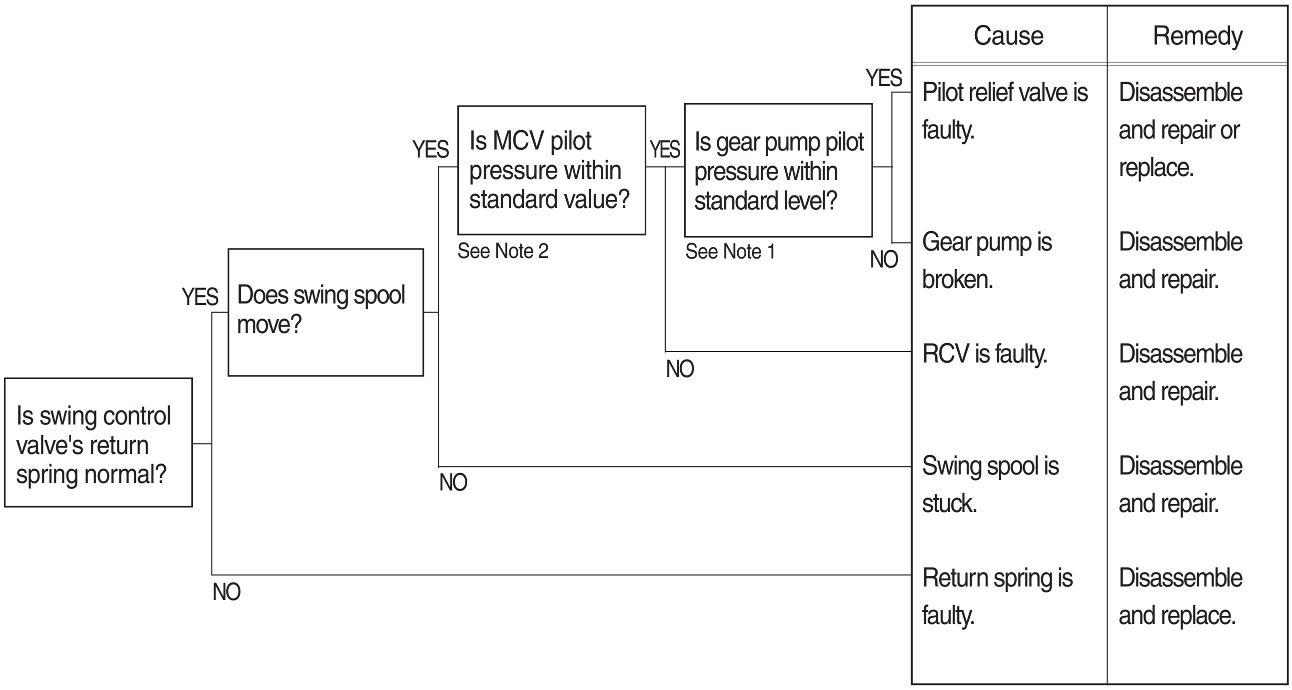
2) SWING SPEED IS LOW



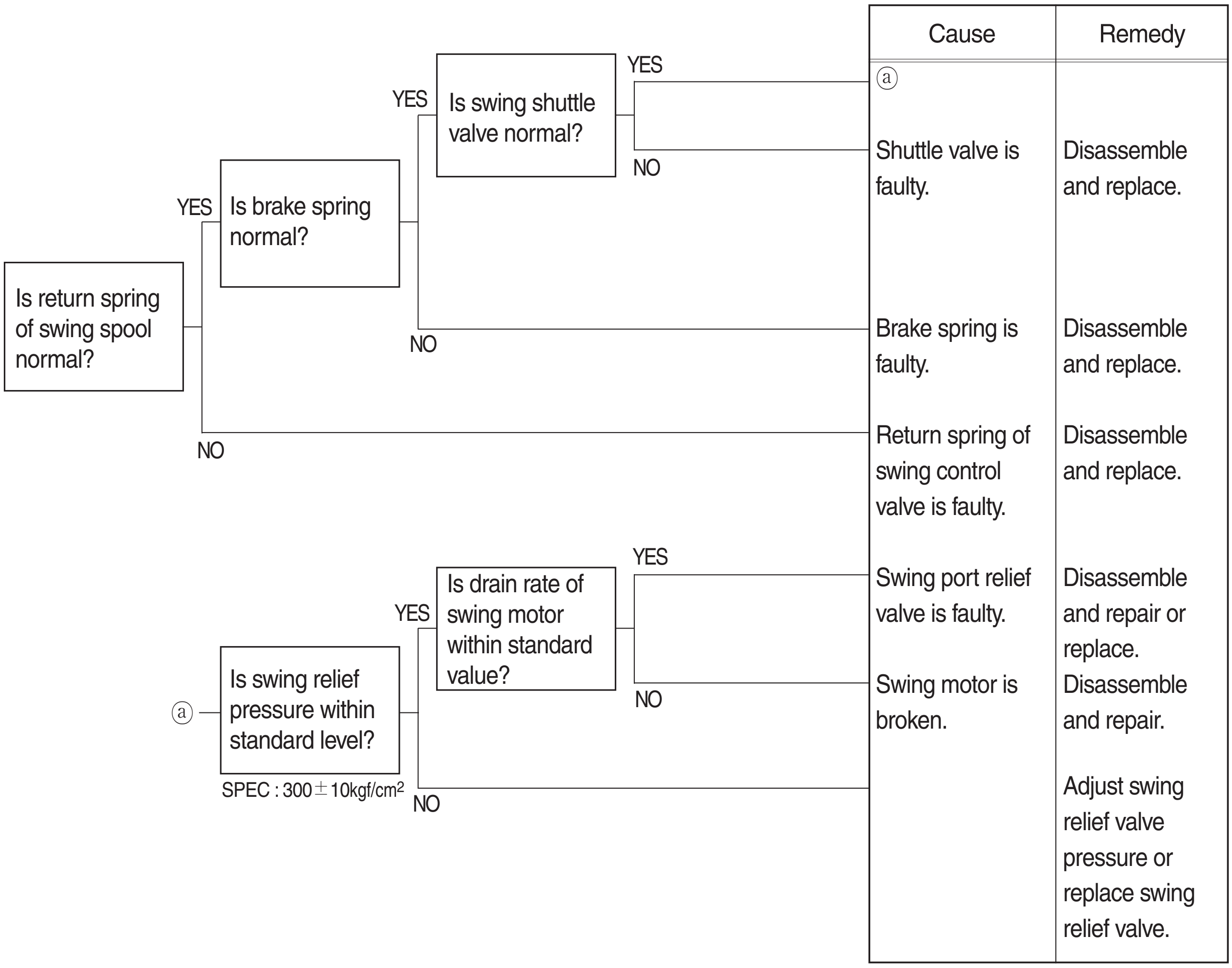
3) SWING MOTION IS IMPOSSIBLE IN ONE DIRECTION



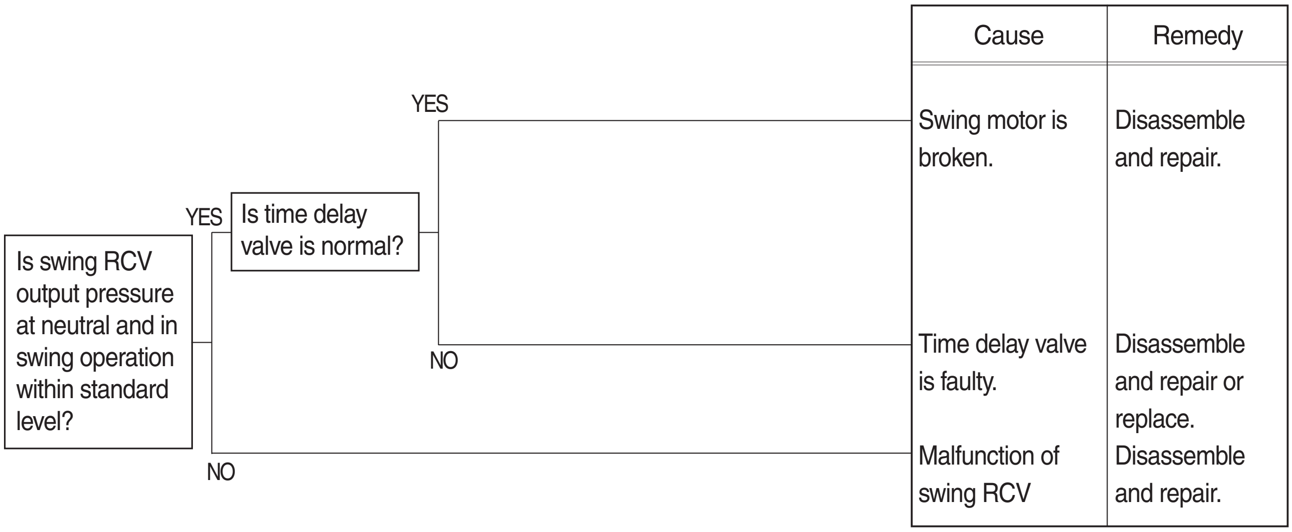
4) MACHINE SWINGS BUT DOES NOT STOP



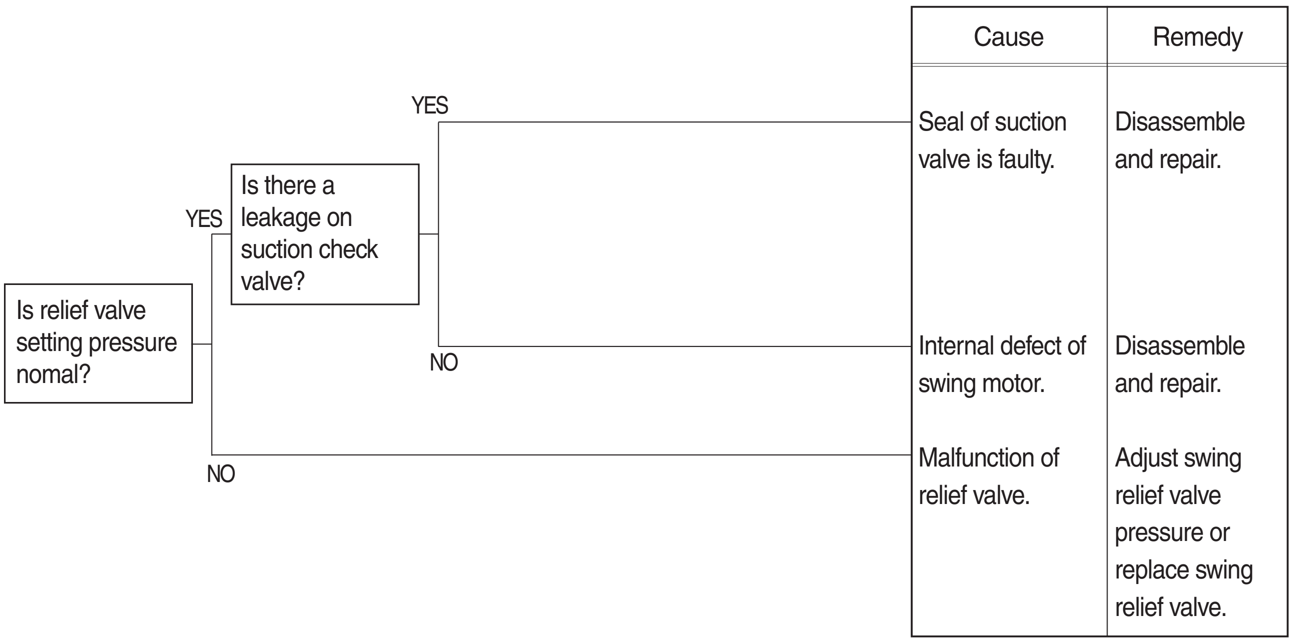
5) THE SWING UNIT DRIFTS WHEN THE MACHINE IS AT REST ON A SLOPE



6) LARGE SHOCK OCCURS WHEN STOP SWINGING

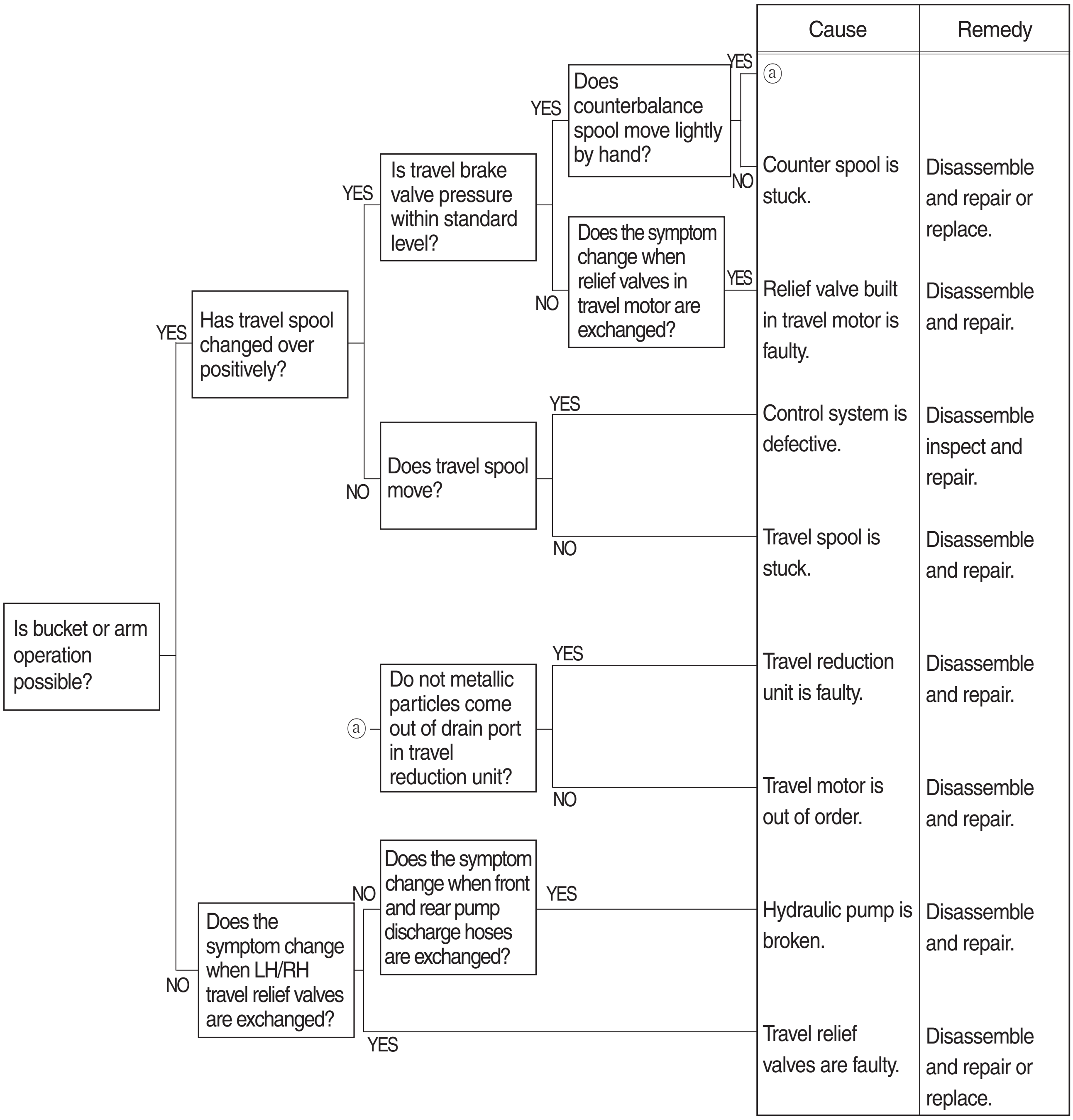


7) LARGE SOUND OCCURS WHEN STOP SWINGING

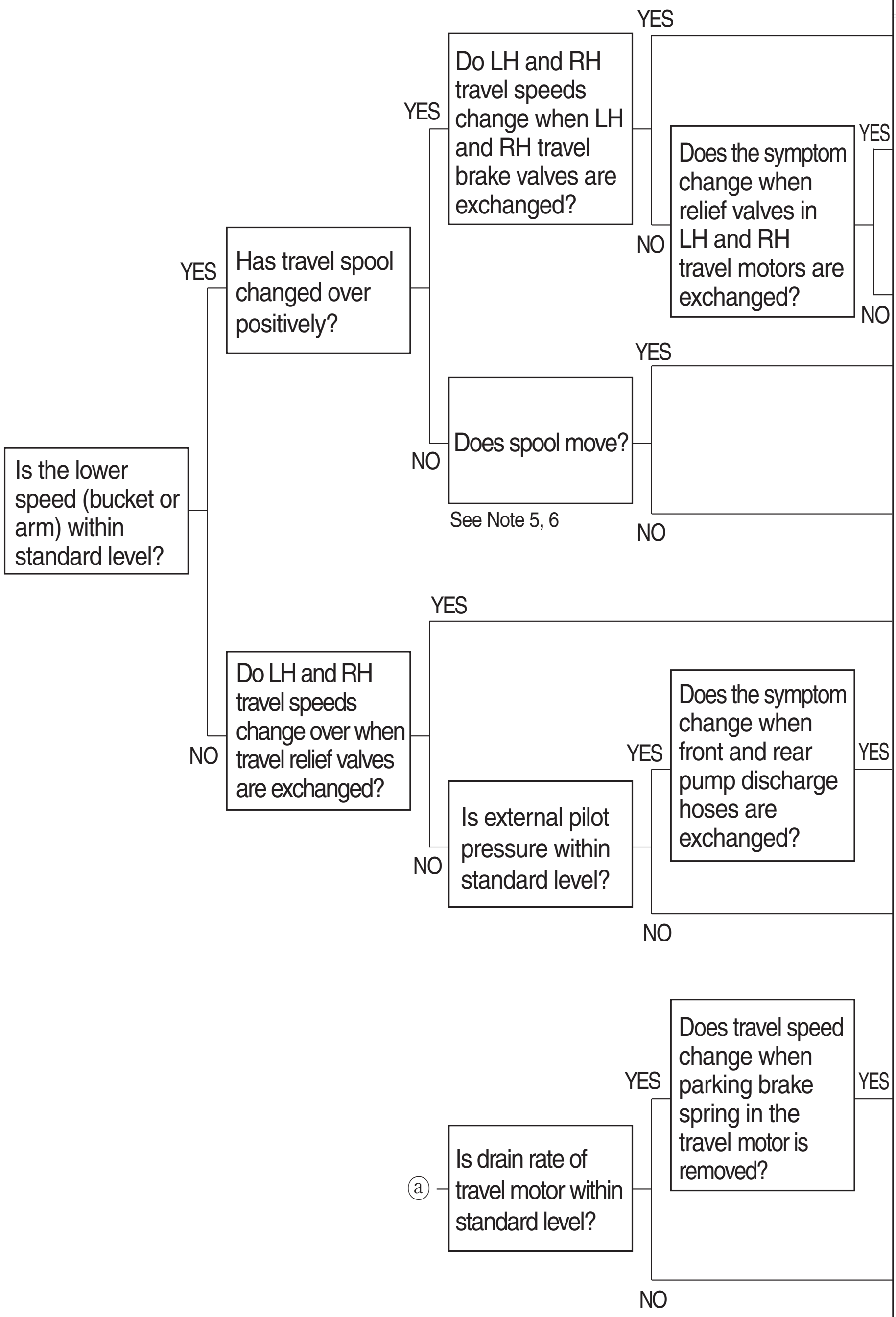


5. TRAVEL SYSTEM

1) TRAVEL DOES NOT FUNCTION AT ALL ON ONE SIDE



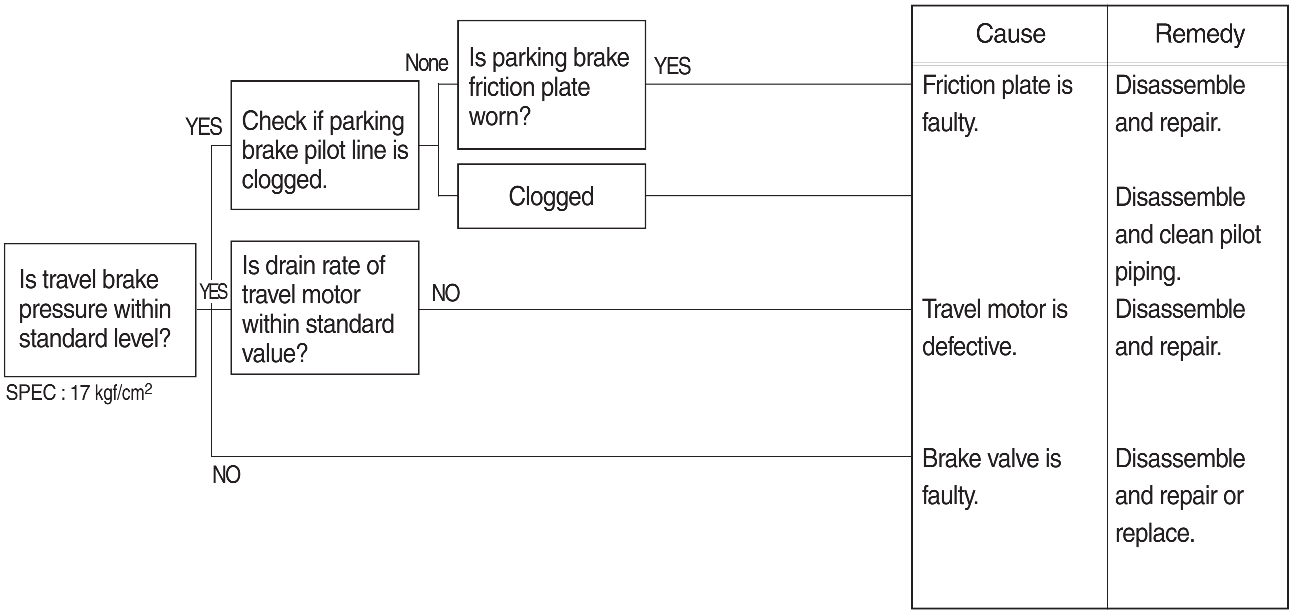
2) SPEED ON ONE SIDE FALLS AND THE MACHINE CURVES



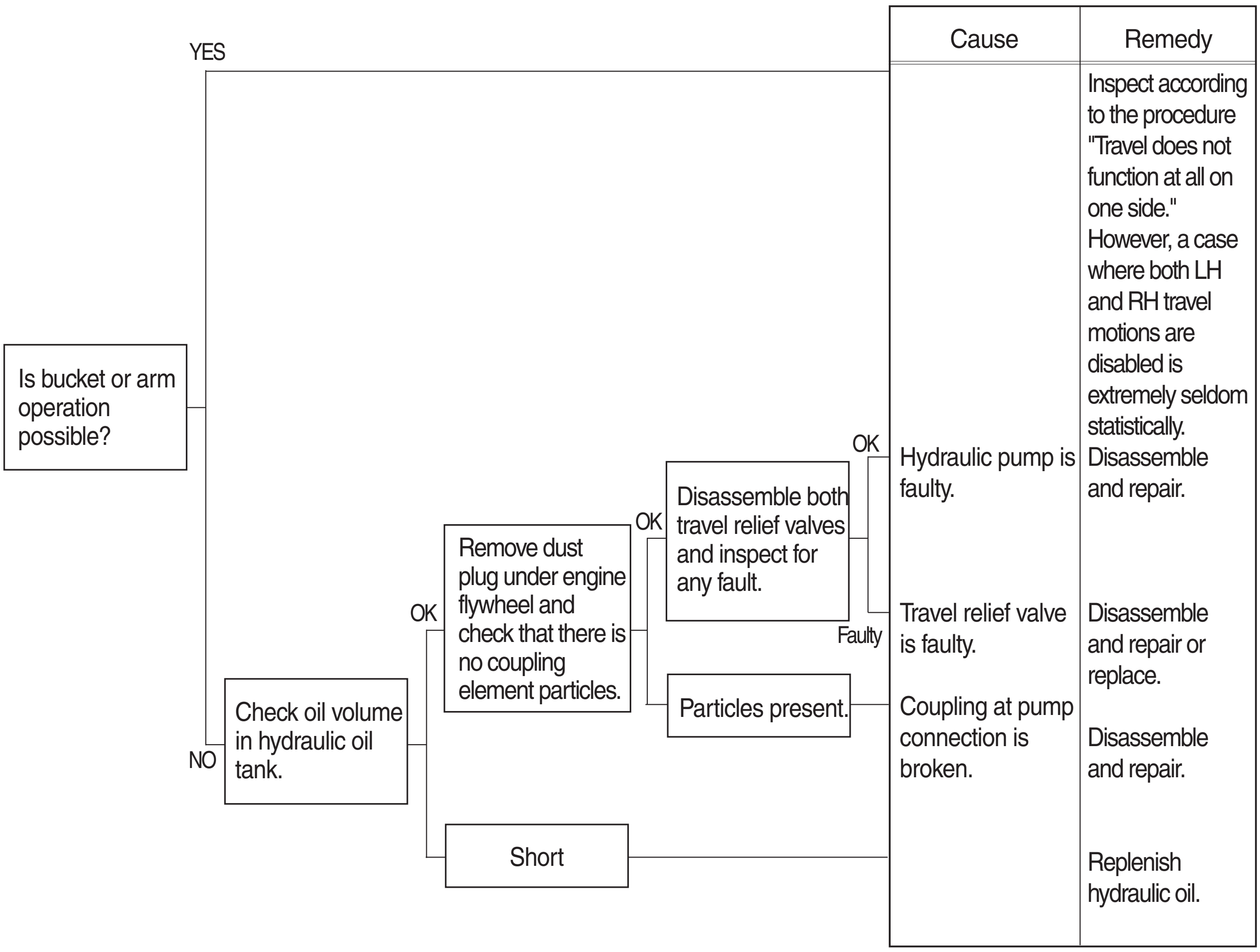
Cause	Remedy
Brake valve is defective.	Disassemble and repair or replace.
Relief valve built in travel motor is faulty.	Disassemble and repair.
Control system is faulty .	Disassemble, inspect and repair.
Control valve spool is stuck.	Disassemble and repair.
Travel relief valve is faulty.	Disassemble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

3) MACHINE DOES NOT STOP ON A SLOPE

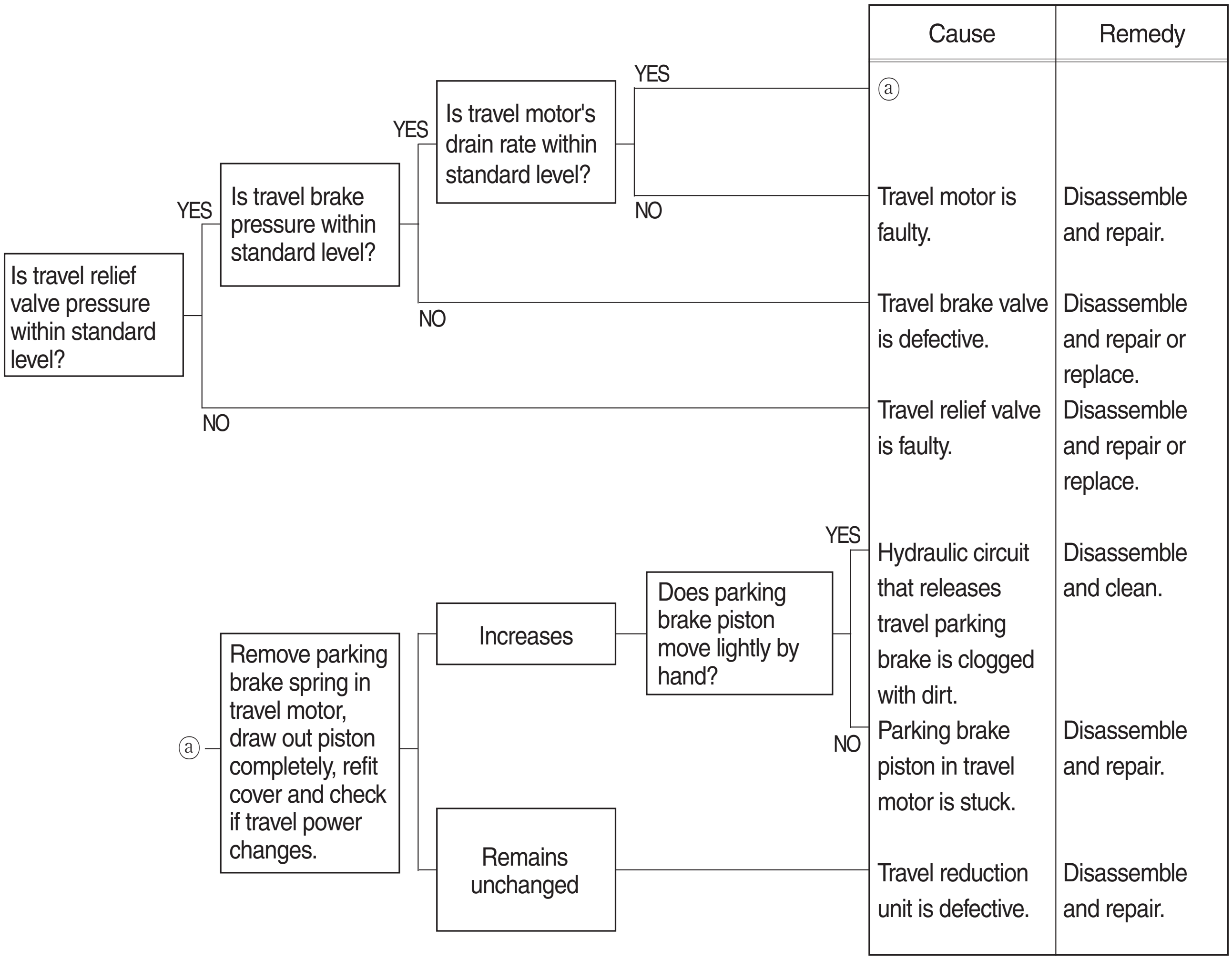
Machine is pulled forward as sprocket rotates during digging operation.



4) LH AND RH TRAVEL MOTIONS ARE IMPOSSIBLE

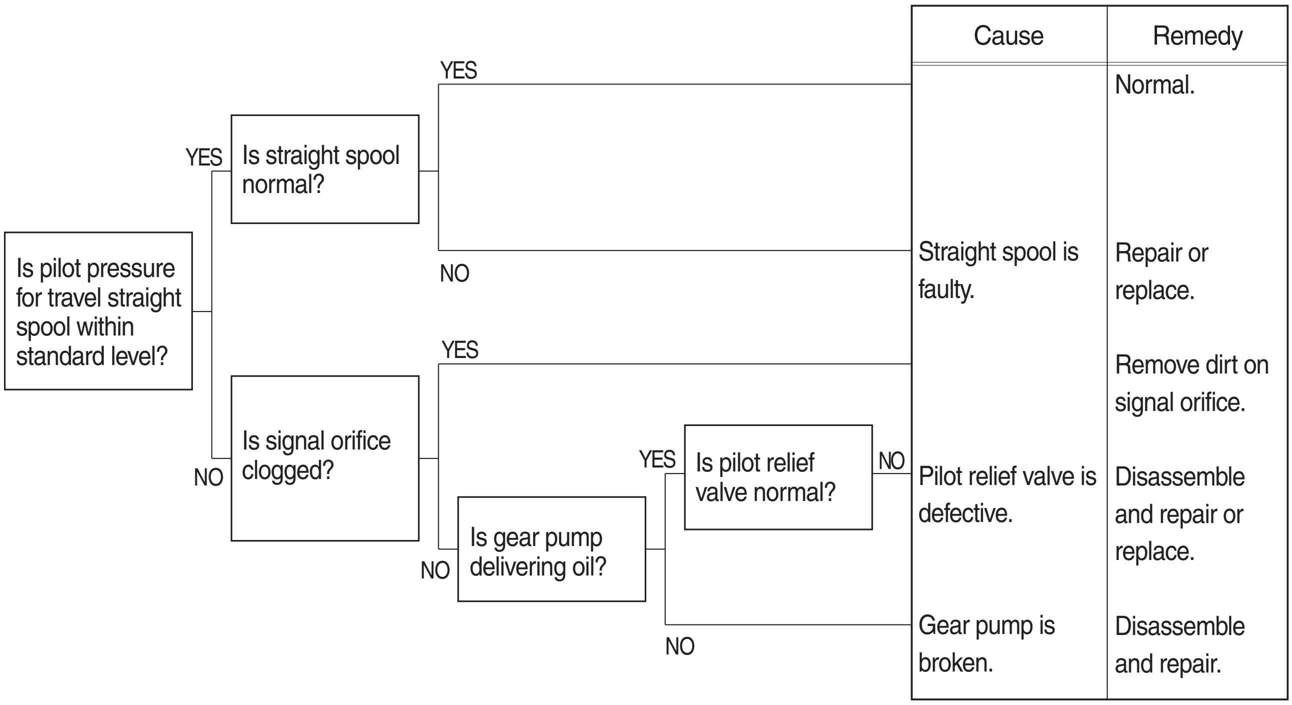


5) TRAVEL ACTION IS POWERLESS (travel only)



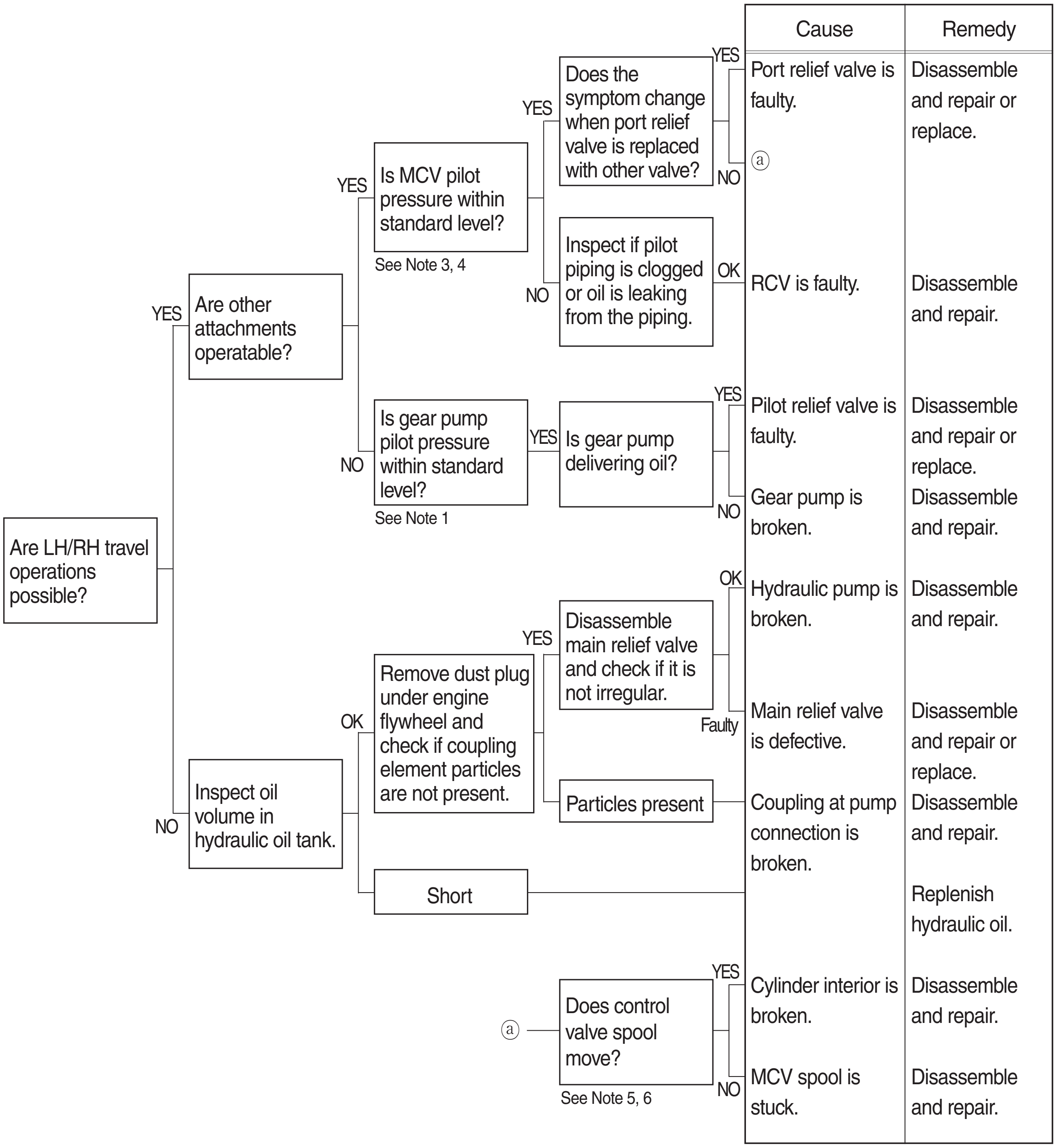
6) MACHINE RUNS RECKLESSLY ON A SLOPE

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

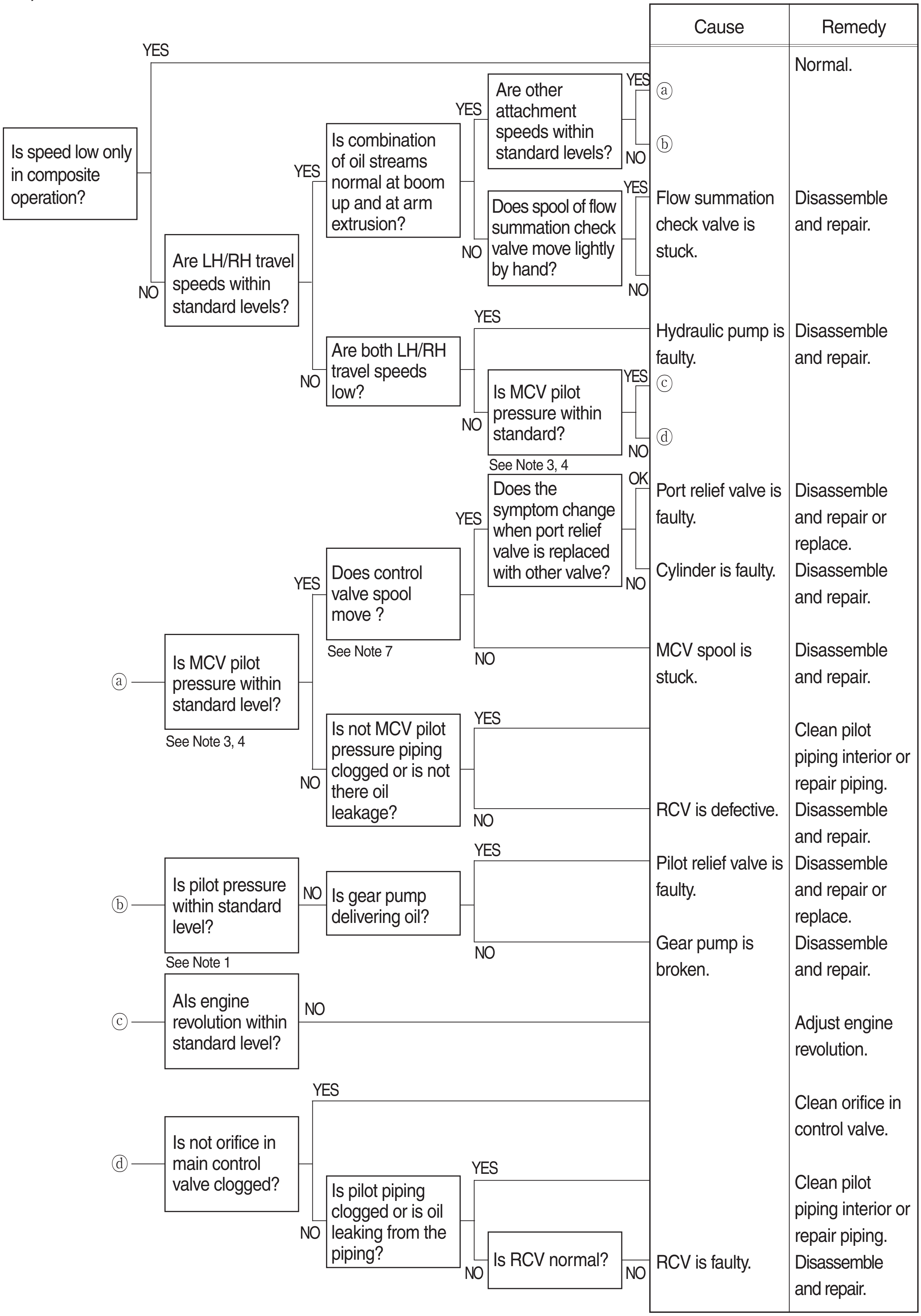


6. ATTACHMENT SYSTEM

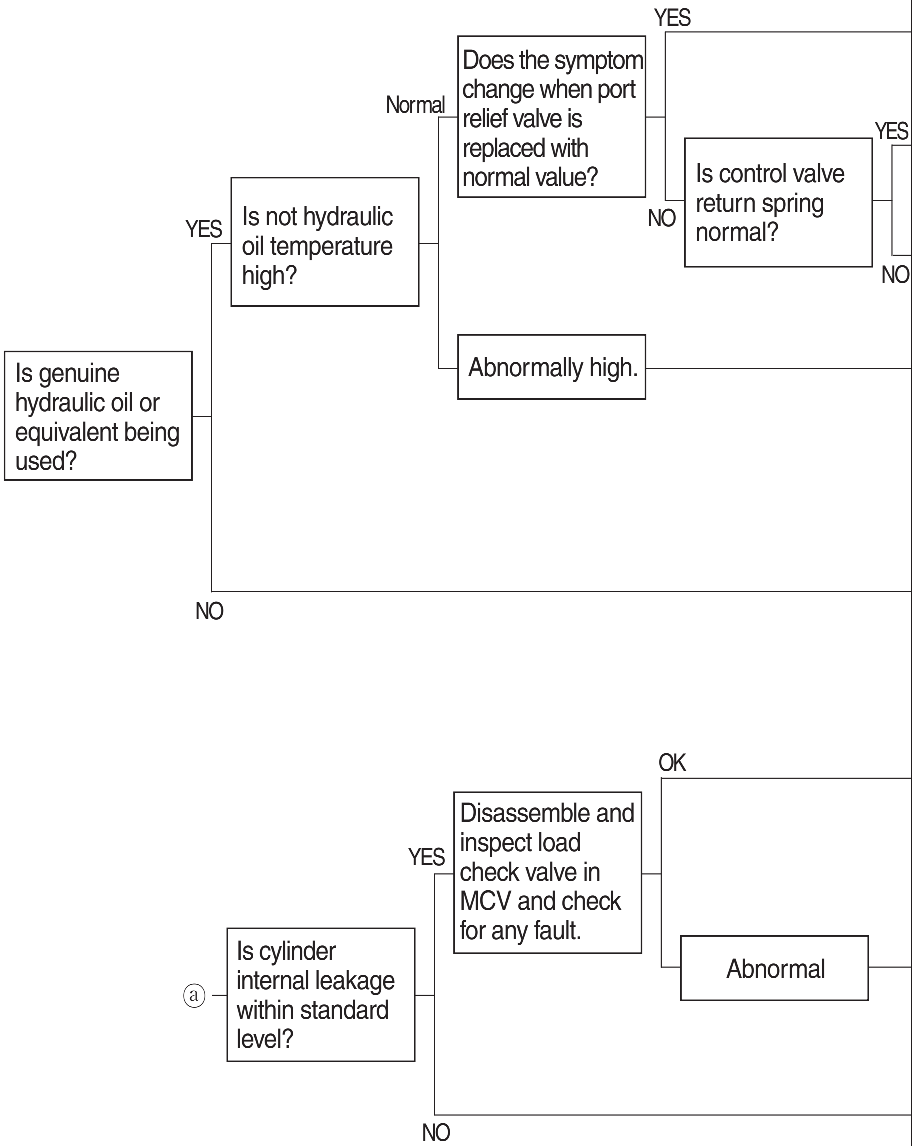
1) BOOM OR ARM ACTION IS IMPOSSIBLE AT ALL



2) BOOM, ARM OR BUCKET SPEED IS LOW

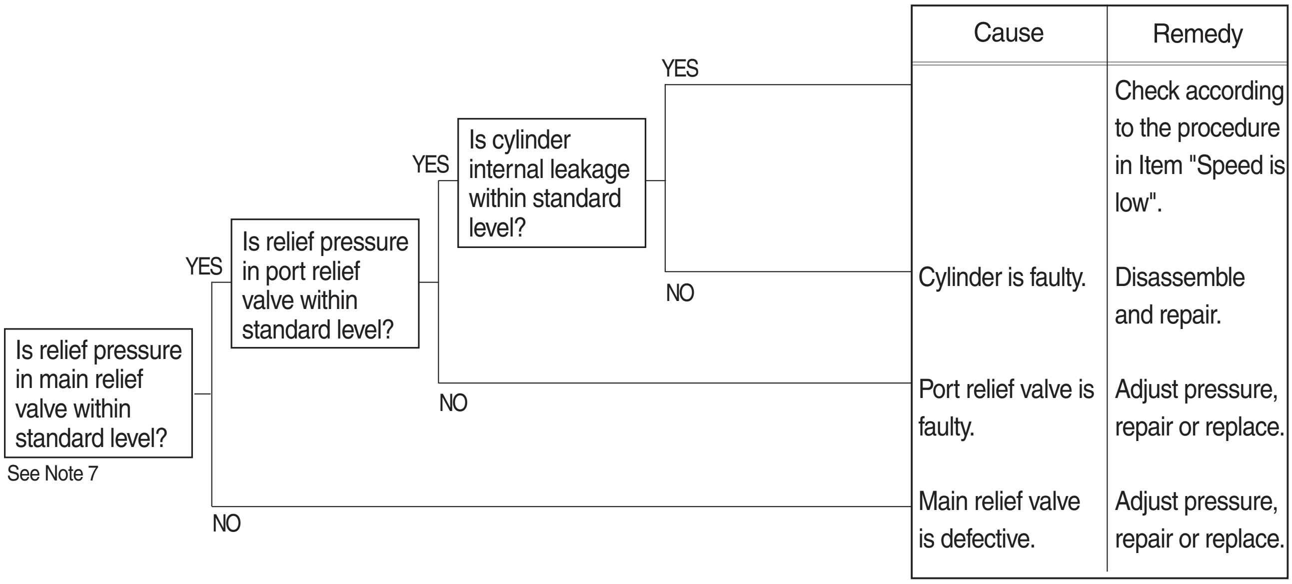


3) BOOM, ARM OR BUCKET CYLINDER EXTENDS OR CONTRACTS ITSELF AND ATTACHMENT FALLS

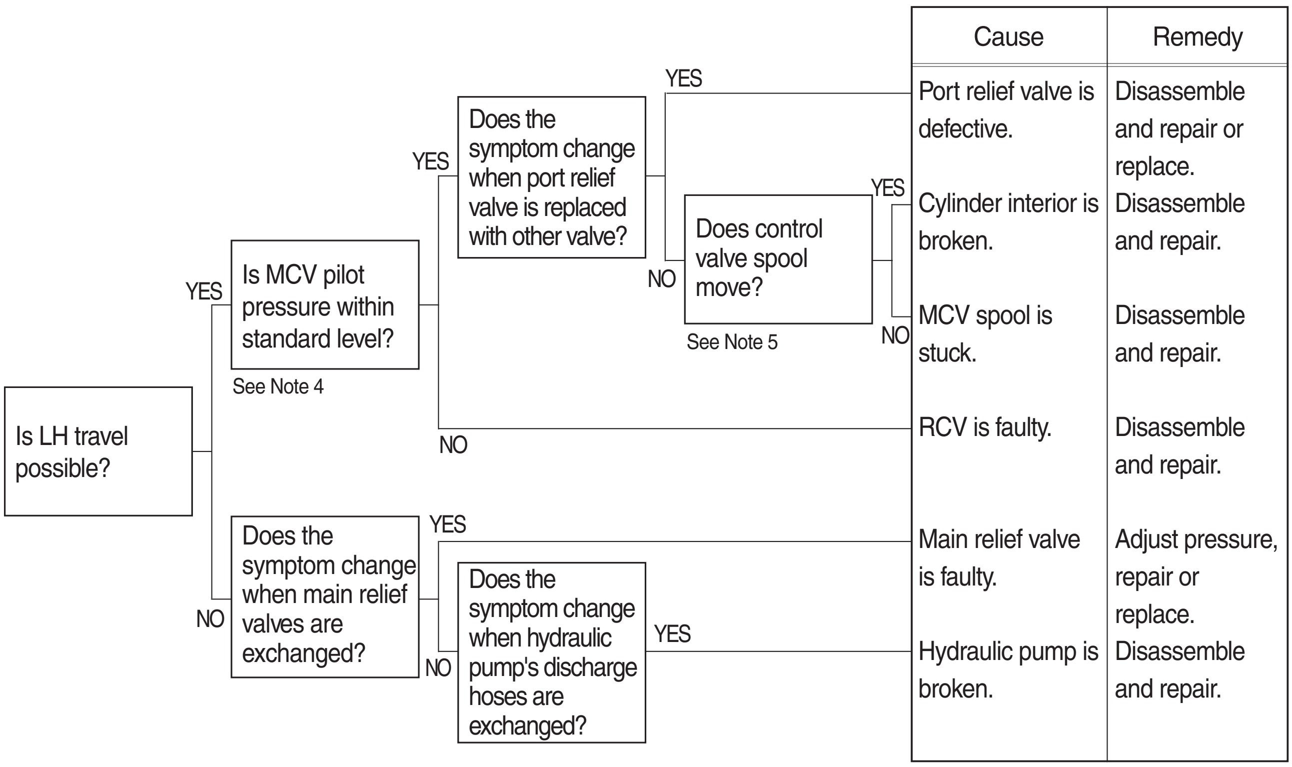


Cause	Remedy
Port relief valve is faulty.	Disassemble and repair or replace.
Control valve's return spring is faulty.	Disassemble and replace.
	Locate the cause of hydraulic oil temperature rise and lower it to proper level.
	Replace with genuine hydraulic oil or equivalent.
Pressure tightness between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

4) BOOM, ARM OR BUCKET POWER IS WEAK



5) ONLY BUCKET OPERATION IS TOTALLY IMPOSSIBLE



6) BOOM MAKES A SQUEAKING NOISE WHEN BOOM IS OPERATED

Is boom foot pin greased sufficiently?

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

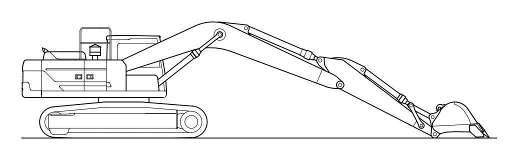
7) TIME LAG OF MACHINE WORKING IS LARGE.

Is overload relief valve for each spool working properly?

	Cause	Remedy
YES		Refer to 2)
NO	Overload relief valve is faulty.	Disassemble and repair.

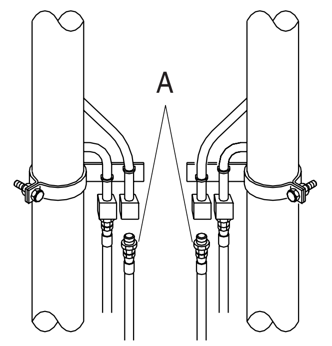
※ HOW TO CHECK INTERNAL BOOM CYLINDER LEAKAGE

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



300L6TS01

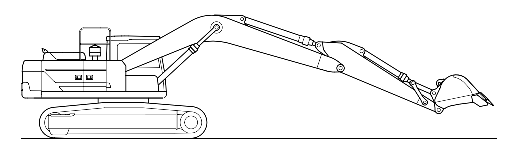
2. Disconnect hose (A) from rod side of boom cylinder and drain oil from cylinders and hose. (put cups on piping and hose ends)



(210-7) 6-20(2)

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

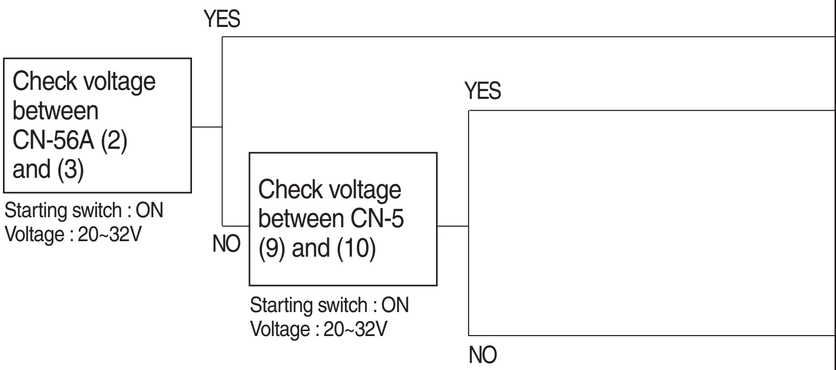
   If oil leaks from piping side and boom cylinder rod is retracted there is an internal leak in the cylinder.
   If no oil leaks from piping side and boom cylinder rod is retracted, there is an internal leak in the control valve.



300L6TS02

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

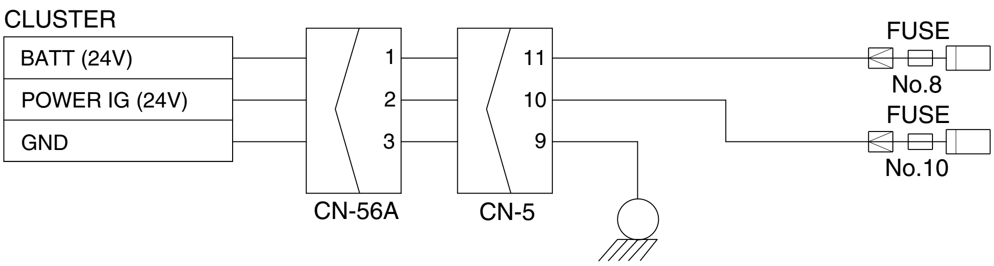
· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted and short of fuse No. 8, 10.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.



Cause	Remedy
Defective cluster	Replace
Disconnection in wiring harness or poor contact between CN-5-CN-56A	Repair or replace (after clean)
Disconnection in wiring harness or poor contact between CN-5 (9) -GND or fuse No. 8, 10	Repair or replace (after clean)

Check voltage

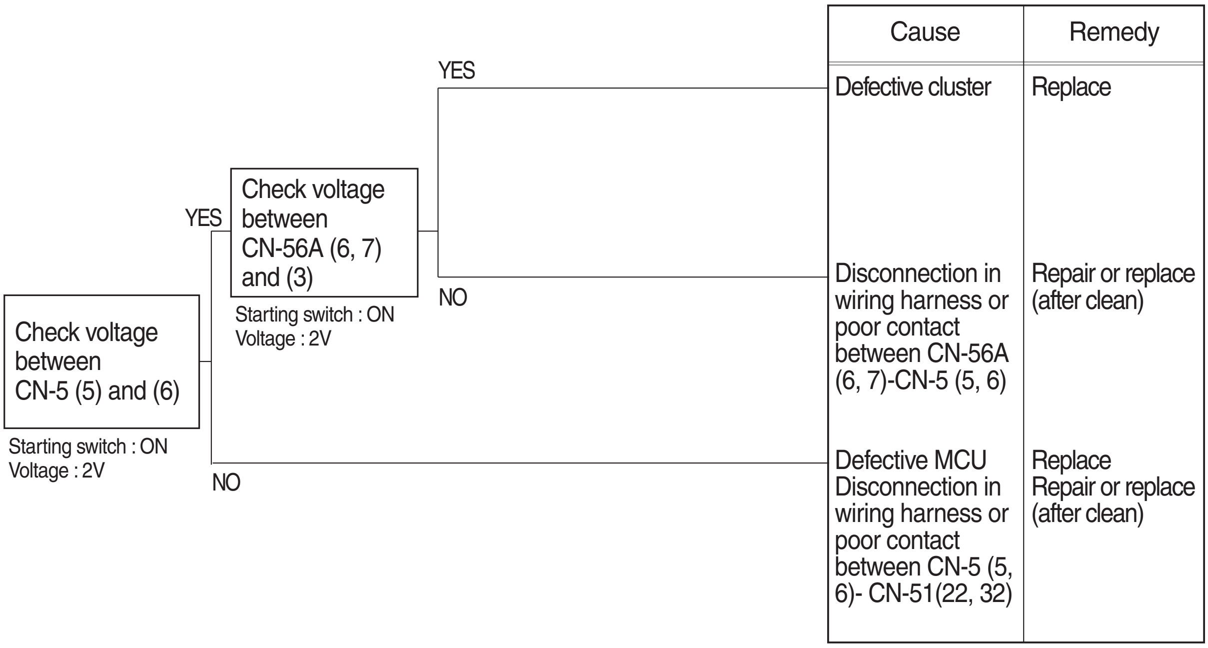
YES	20~32V
NO	0V



220S6ES01

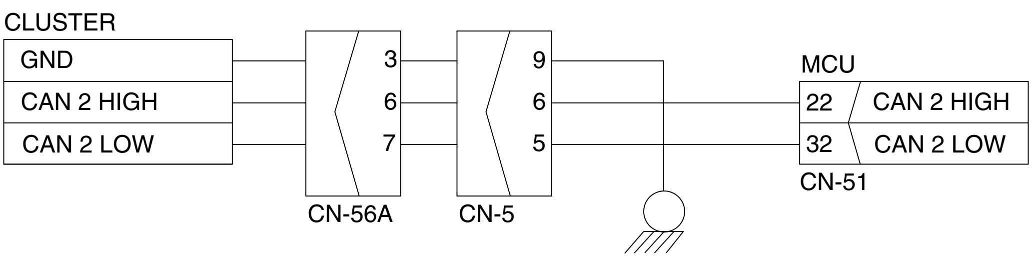
2. COMMUNICATION ERROR FLASHES ON THE CLUSTER (HCESPN 840, FMI 2)

· 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

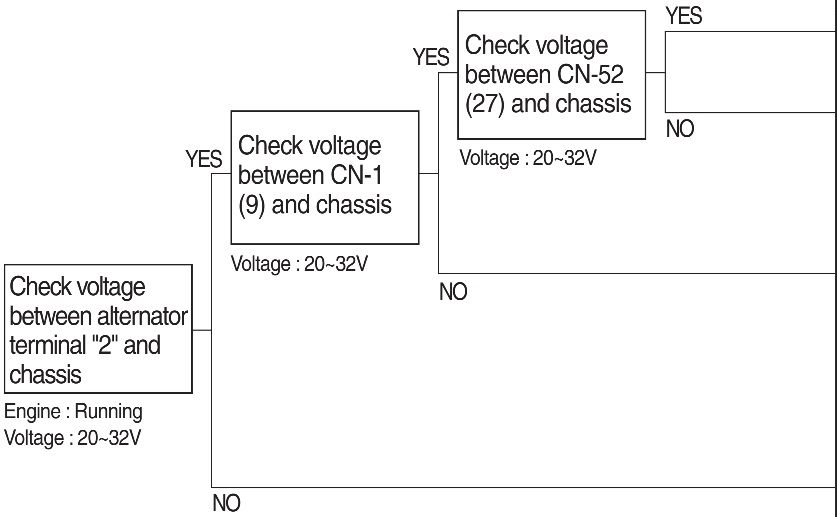
YES	2V
NO	0V



300L6ES02

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

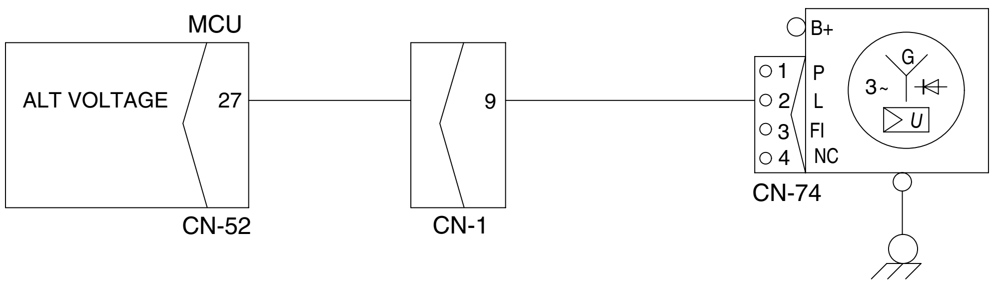
· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.



Cause	Remedy
Defective MCU	Replace
Disconnection in wiring harness or poor contact between CN-52 (27)-CN-1 (9)	Repair or replace (after clean)
Disconnection in wiring harness or poor contact between CN-1 (9) -alternator terminal "2"	Repair or replace (after clean)
Defective alternator	Replace

Check voltage

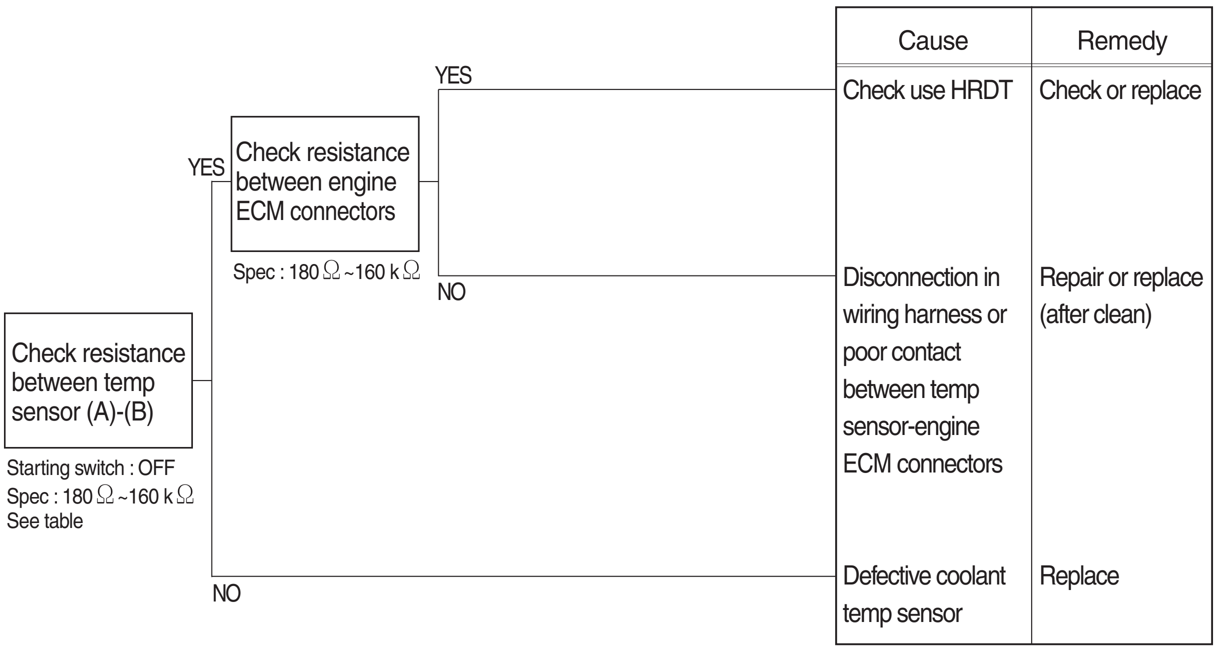
YES	20~32V
NO	0V



220SA6ES03

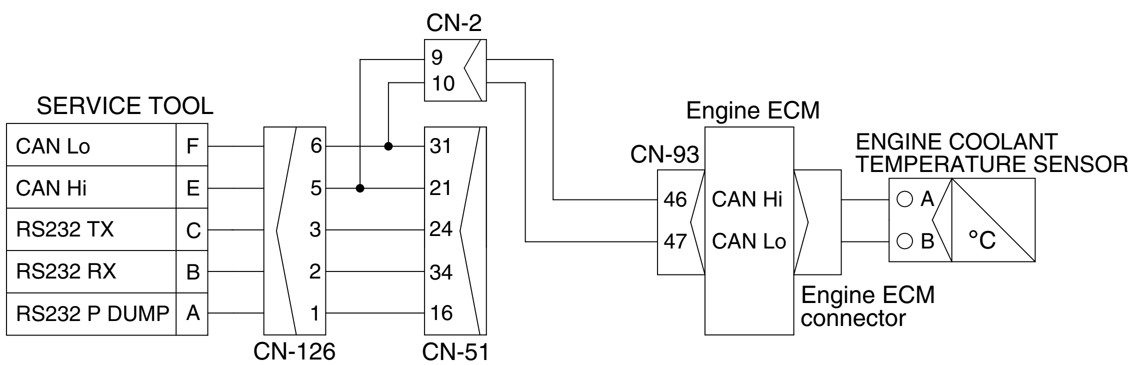
4. WHEN COOLANT OVERHEAT WARNING LAMP LIGHTS UP (engine is started)

· 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

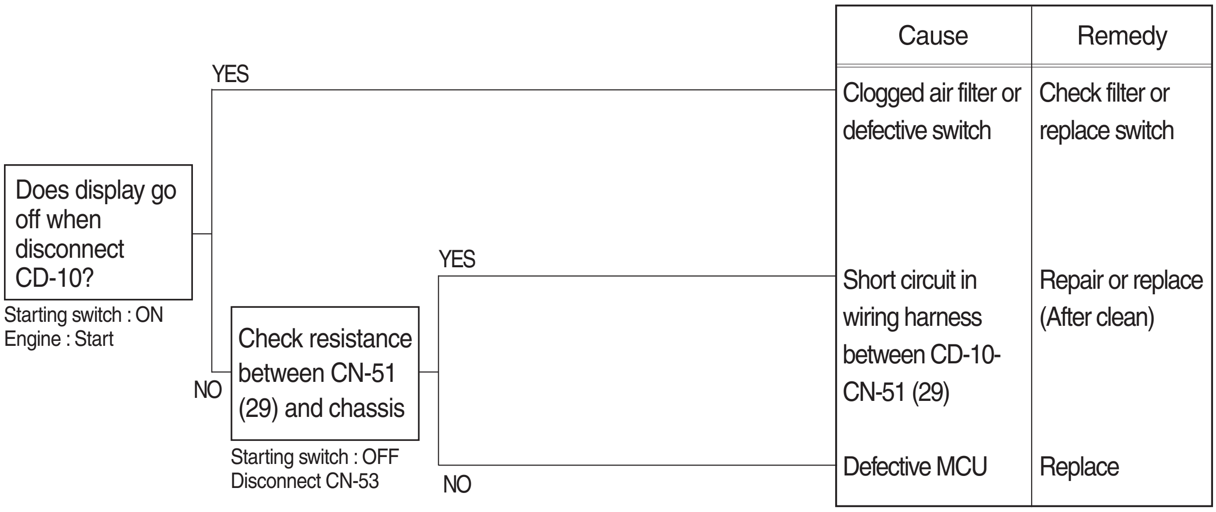
Temperature (˚C)	0	25	50	80	95
Resistance (kΩ)	30~37	9.3~10.7	3.2~3.8	1.0~1.3	0.7~0.8



220SA6ES04

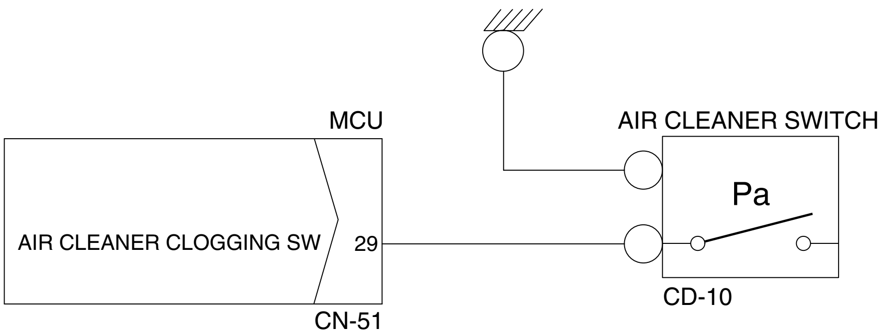
5. WHEN AIR CLEANER WARNING LAMP LIGHTS UP (engine is started)

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



Check resistance

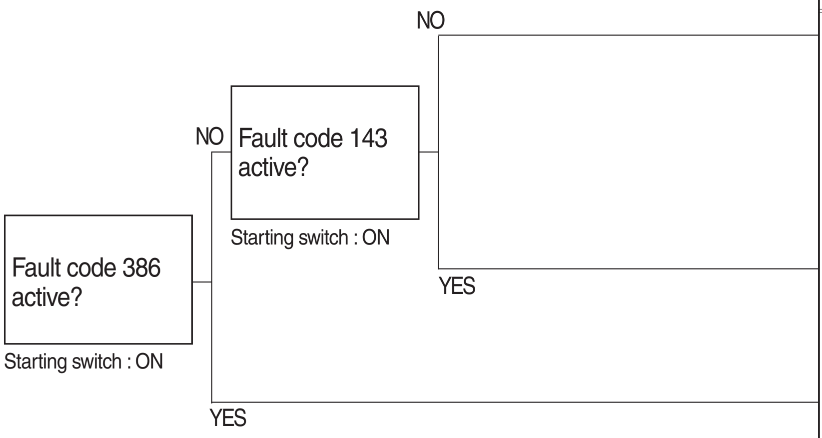
YES	MAX 1Ω
NO	MIN 1MΩ



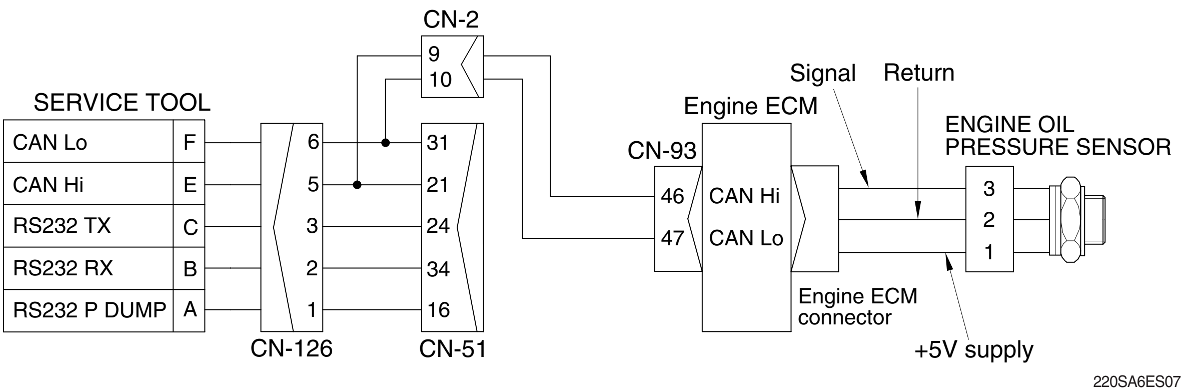
220S6ES05

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.

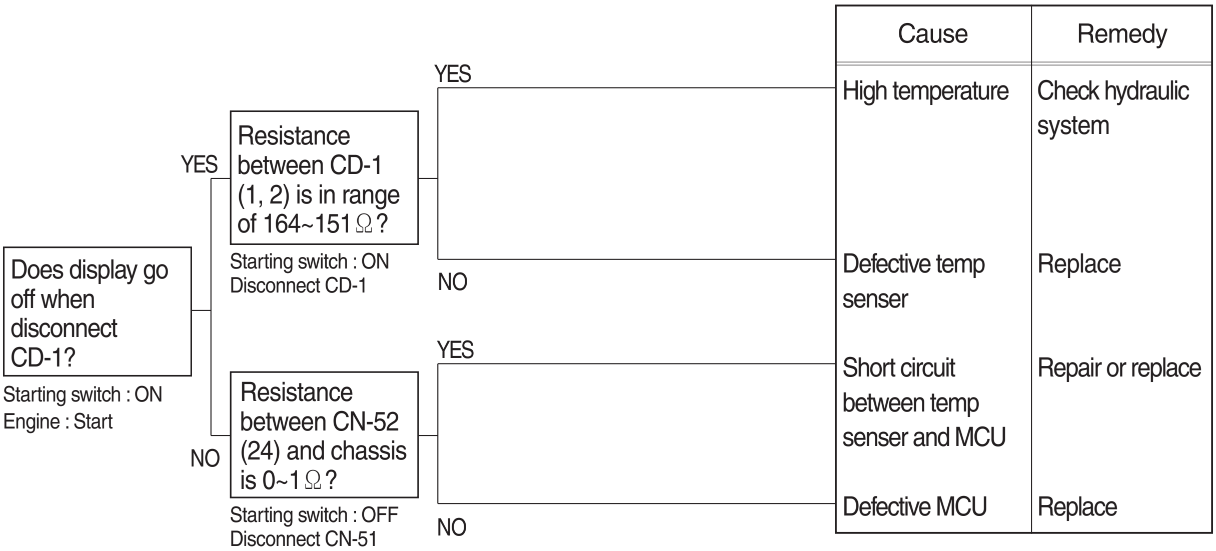


Cause	Remedy
Defective circuit, sensor or ECM.	Contact Cummins.
Voltage above normal or shorted to high source	Refer to engine fault code 143
Voltage above normal or shorted to high source	Refer to engine fault code 386



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.

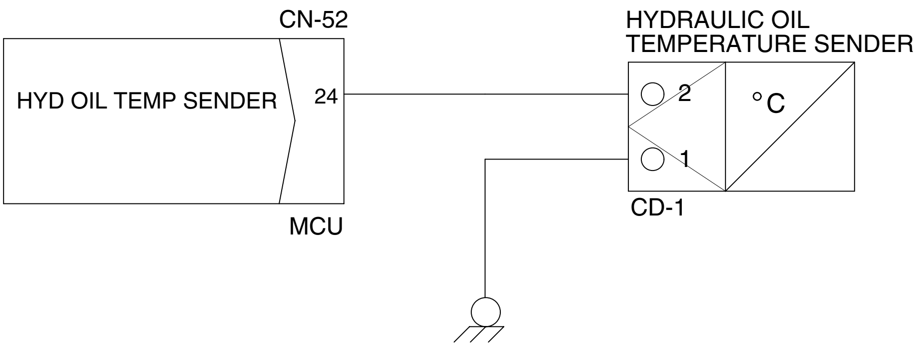


Normal type

Premium type

Check Table

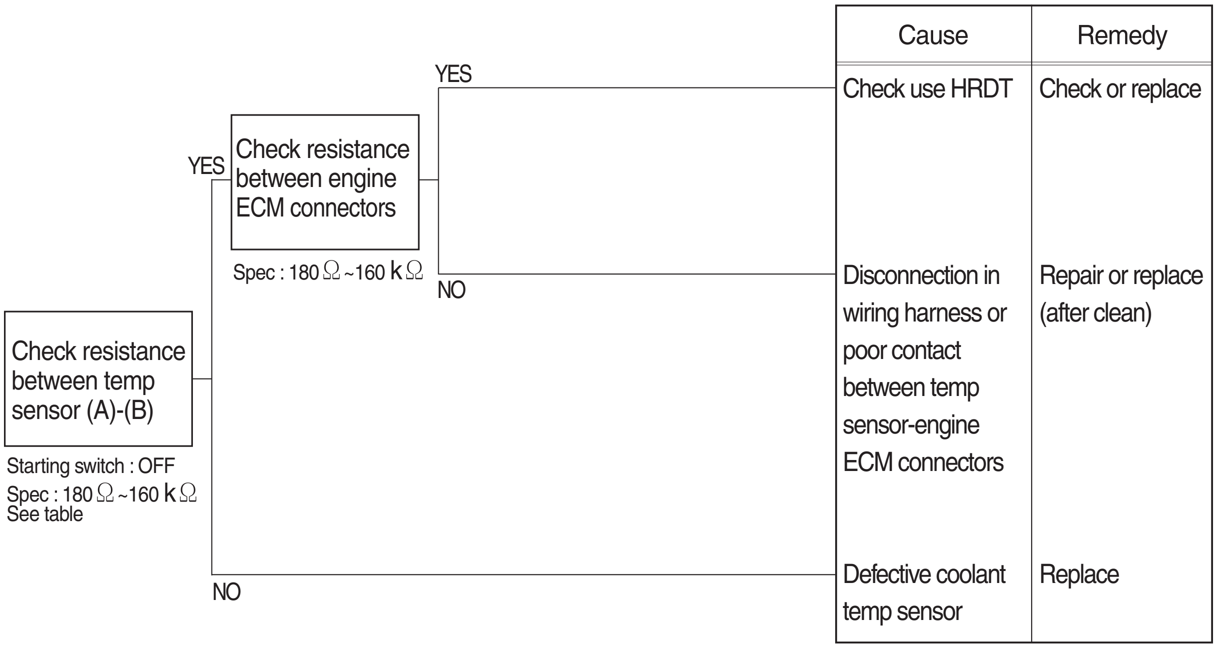
Temperature (˚C)	~ -30	~ -10	~ 0	~ 40	~ 70	~ 80	~ 90	~ 100	105~
Resistance (kΩ)	22.22 ~31.78	8.16 ~10.74	5.18 ~ 6.6	1.06 ~1.28	0.39 ~0.476	0.322 ~0.298	0.243 ~0.219	0.185 ~0.167	0.164 0.151



220SA6ES08

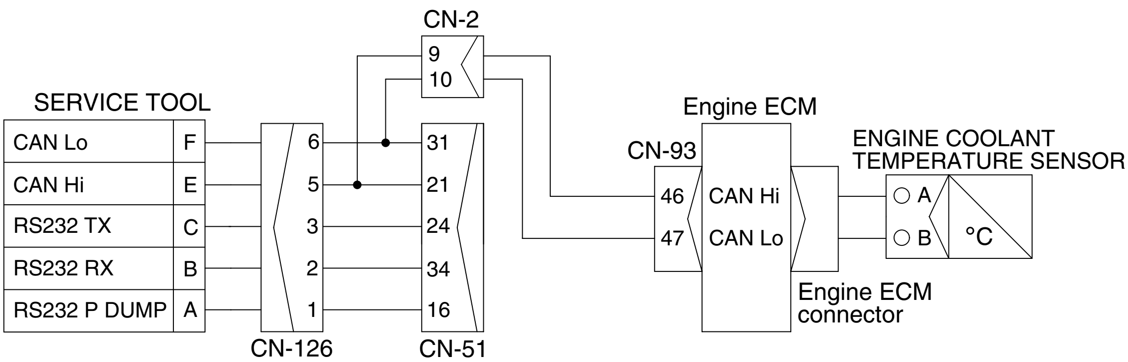
8. WHEN COOLANT TEMPERATURE GAUGE DOES NOT OPERATE (HCESPN 304, FMI 3 or 4) GAUGE DOES NOT OPERATE

· 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

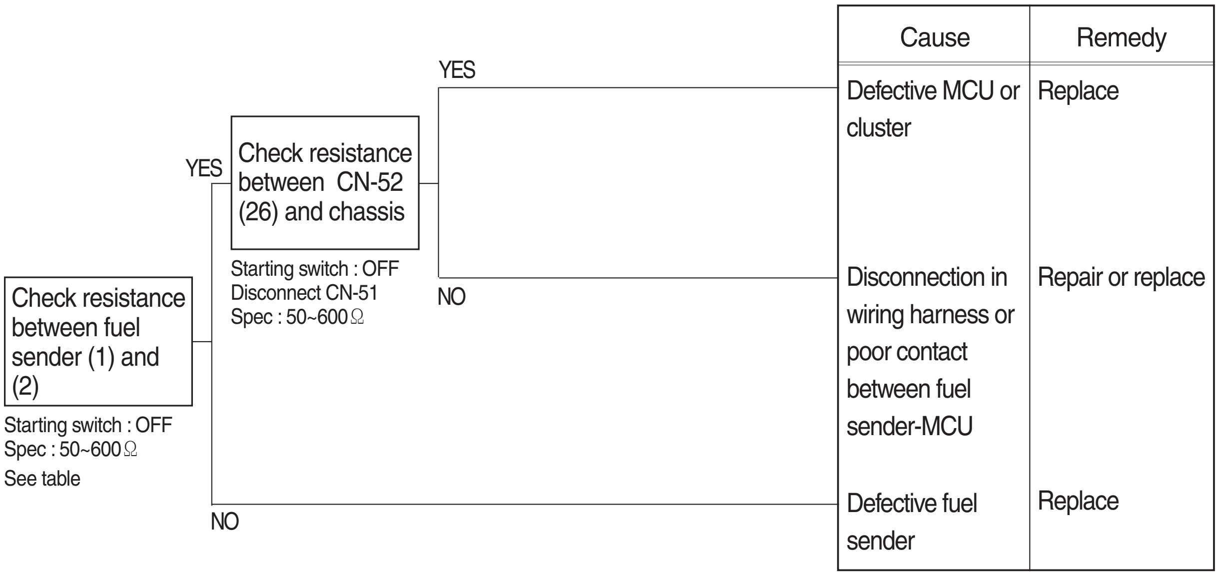
Temperature (˚C)	0	25	50	80	95
Resistance (kΩ)	30~37	9.3~10.7	3.2~3.8	1.0~1.3	0.7~0.8



220SA6ES04

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.

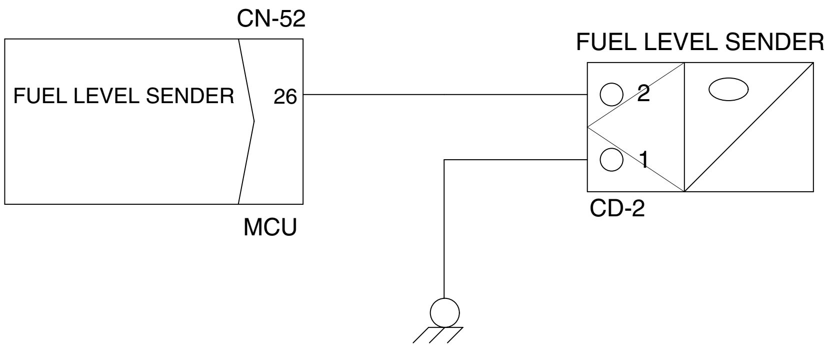


Normal type

Premium type

Check Table

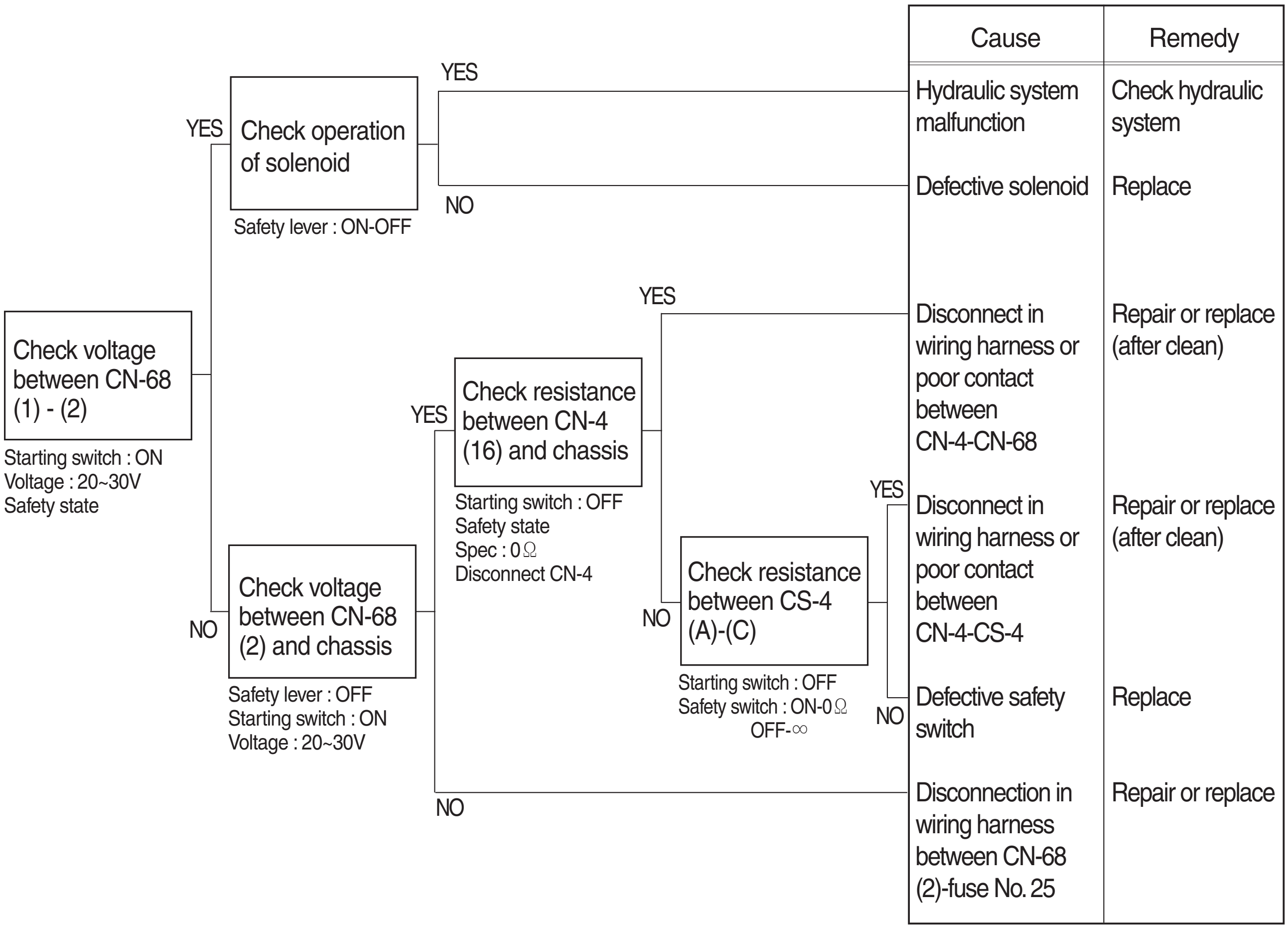
Range	Resistance (Ω)	Range	Resistance (Ω)
Full	50	5/12	400
11/12	100	4/12	450
10/12	150	3/12	500
9/12	200	2/12	550
8/12	250	1/12	600
7/12	300	Empty warning	700
6/12	350	-	-

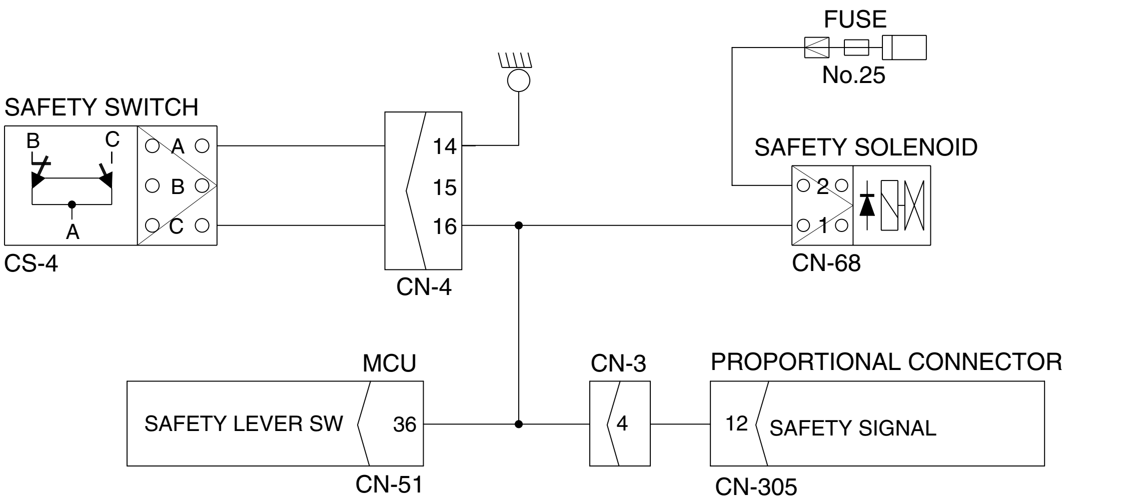


220SA6ES10

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. 25.
- After checking, insert the disconnected connectors again immediately unless otherwise specified.

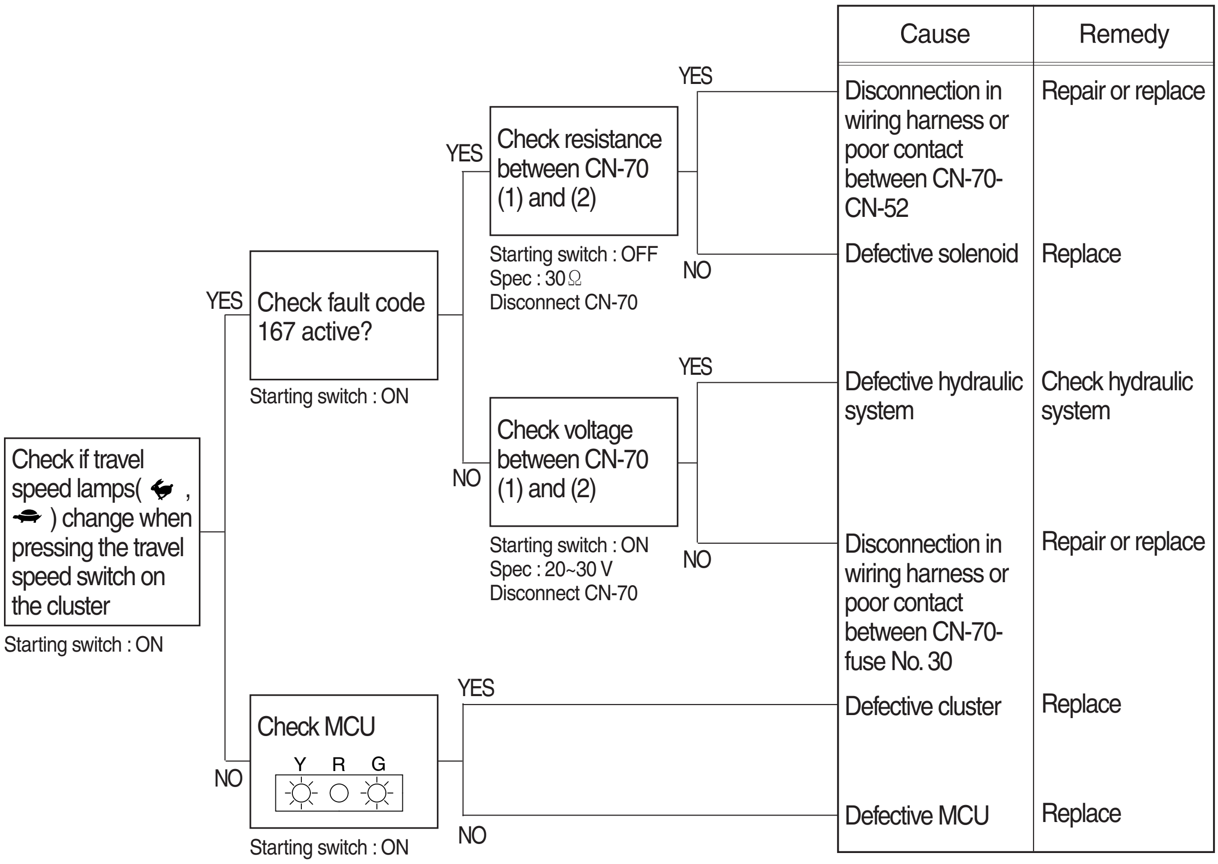


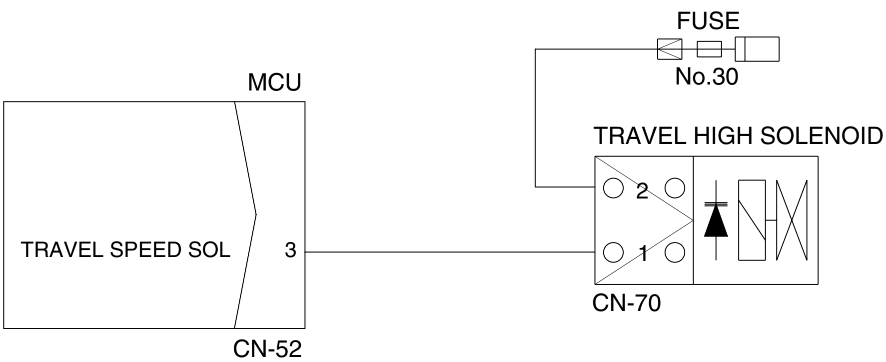


220SA6ES12

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. 30.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.





220S6ES13

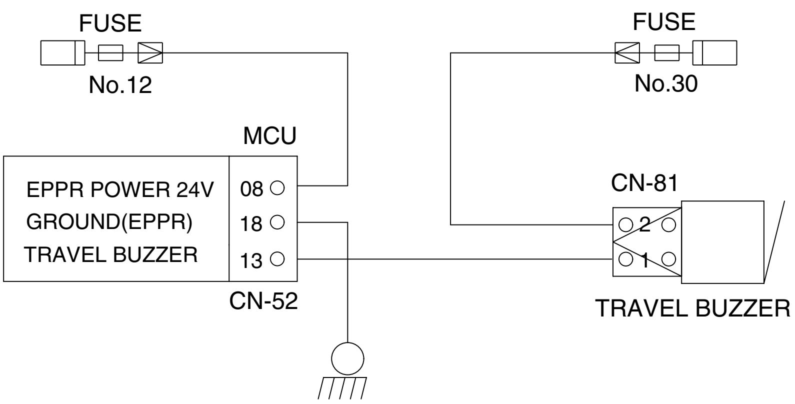
12. TRAVEL ALARM DOES NOT SOUND OR DOES NOT STOP SOUNDING

Check the fuse for travel alarm inside fuse box whether fuse is blown or not

- YES → The fuse is blown
- NO → Check the signal of MCU's pin for back buzzer whether ground signal (DO) generate or not when machine travel mode.
  - YES → The travel alarm signal of united MCU is defective
  - NO → * Prepare with starting switch OFF, then turn start engine and carry out troubleshooting : Between CN-81 (2) - chassis ground : 20-30 voltage . Between CN-81 (1) - chassis ground : Max 1 Ω (resistance) Is the above value normal?

    ** Note : Since voltage value , connector number and pin number varies with each model, should refer to the electric circuit of each model.
    - YES → The travel buzzer is defective
    - NO → * Prepare with starting switch OFF, then carry out trouble-shooting without turning starting switch ON : 1. Disconnection in wiring or defective contact in connector between CN-81 (2) inline connector-end connector : Max 1 Ω (resistance) 2. Short circuit with ground circuit between CN-81 (2) inline connector-end connector - chassis ground : Min 1MΩ (resistance)
      - NO → In case of the value of resistance, disconnection in wiring or defective contact in connector or short circuit with ground circuit

Cause	Remedy
The fuse is blown	Replace the fuse
The travel alarm signal of united MCU is defective	Check the united MCU program
The travel buzzer is defective	Replace the travel buzzer
In case of the value of resistance, disconnection in wiring or defective contact in connector or short circuit with ground circuit	Replace connector Connect the wire



220SA6ES25

13. HORN DOES NOT SOUND

Check the fuse for horn inside fuse box whether fuse is blown or not

YES → The fuse is blown → Replace the fuse

NO → After replacing the relay for horn, check the horn operate

YES → The relay is broken → Replace the relay

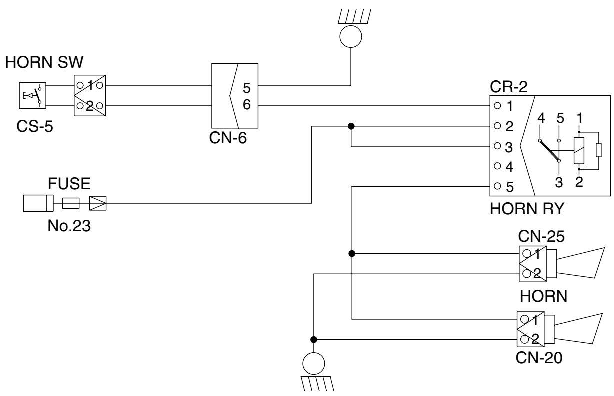
NO → * Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting : Between CN-20 (1) or CN-25 (1) - chassis ground (with horn switch turned ON) : 20-30 voltage
* Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON : Between CN-20 (2) or CN-25 (2)- chassis ground : Max 1 Ω (resistance)
Is the above value normal?
** Note : Since voltage value , connector number and pin number varies with each model, should refer to the wiring diagram of each model.
<CN-20 (1)/ CN-25 (1) : Horn connector (+) terminal CN-20 (2) /CN-25 (2) : Horn connector (-) terminal>

YES → The horn is defective → Replace the horn

NO → * Prepare with starting switch OFF, then carry out trouble-shooting without turning starting switch ON :
1. Disconnection in wiring or defective contact in connector between CN-20 (1) or CN-25 (1) - inline connector-end connector : Max 1 Ω (resistance)
2. Short circuit with ground circuit between CN-20 (1) or CN-25 (1) - inline connector-end connector - chassis ground : Min 1M Ω (resistance)

NO → In case of the value of resistance, disconnection in wiring or defective contact in connector or short circuit with ground circuit → Replace connector. Connect the wire

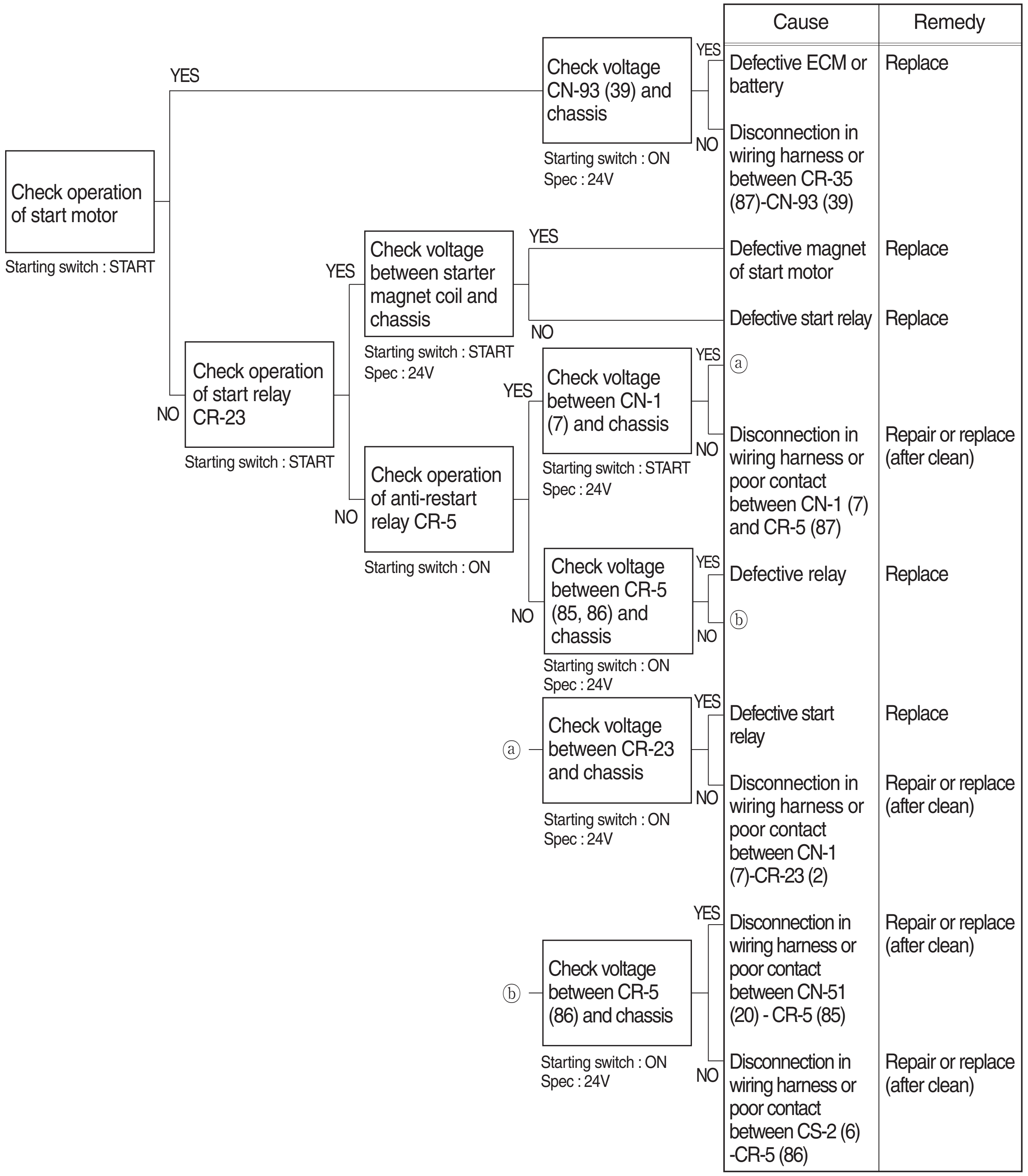
Cause	Remedy
The fuse is blown	Replace the fuse
The relay is broken	Replace the relay
The horn is defective	Replace the horn
In case of the value of resistance, disconnection in wiring or defective contact in connector or short circuit with ground circuit	Replace connector. Connect the wire

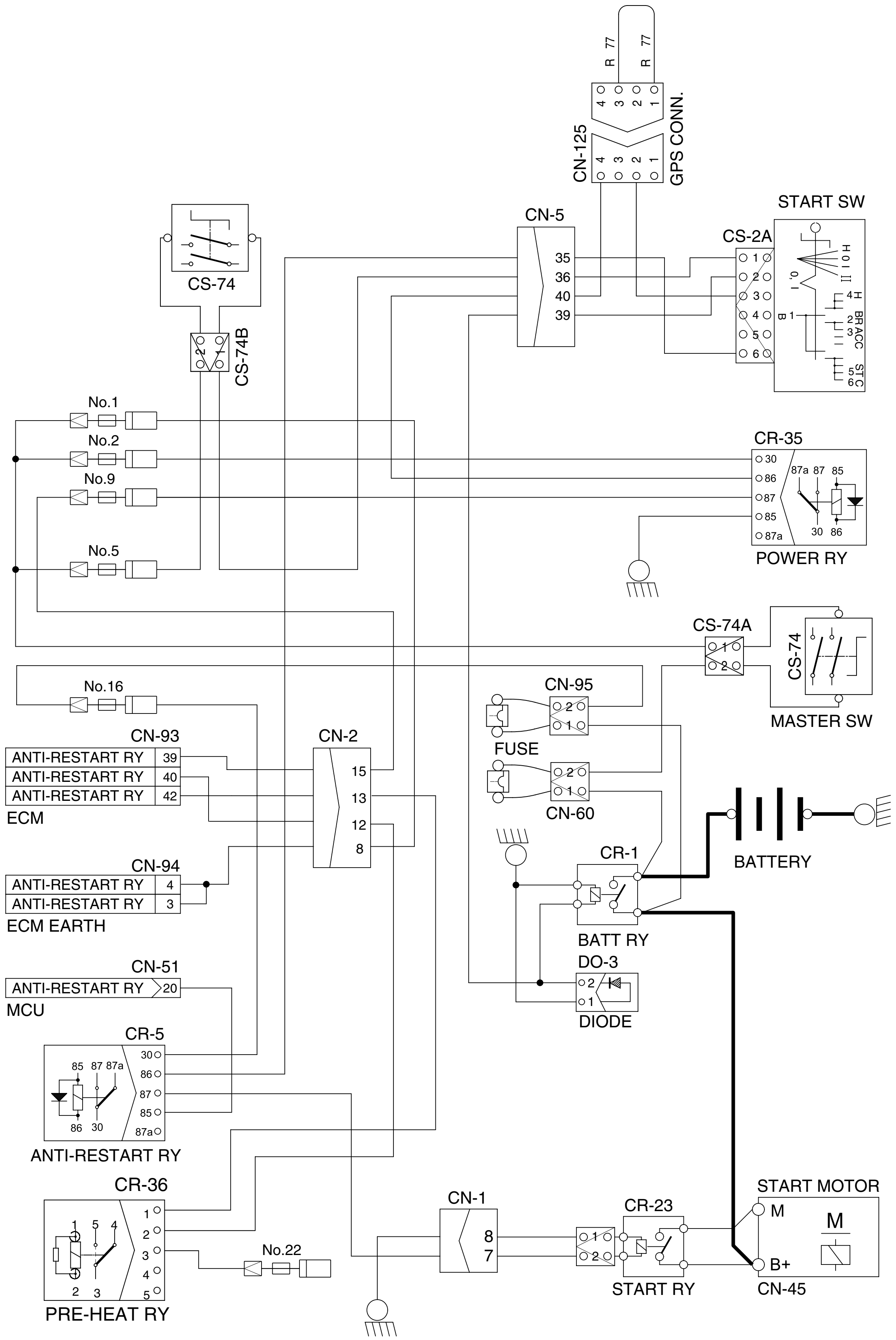


220SA6ES26

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

· Check supply of the power at engine stop solenoid while starting switch is ON.
· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted and fuse No. 1, 2, 5, 9 and 16 burnt out.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.

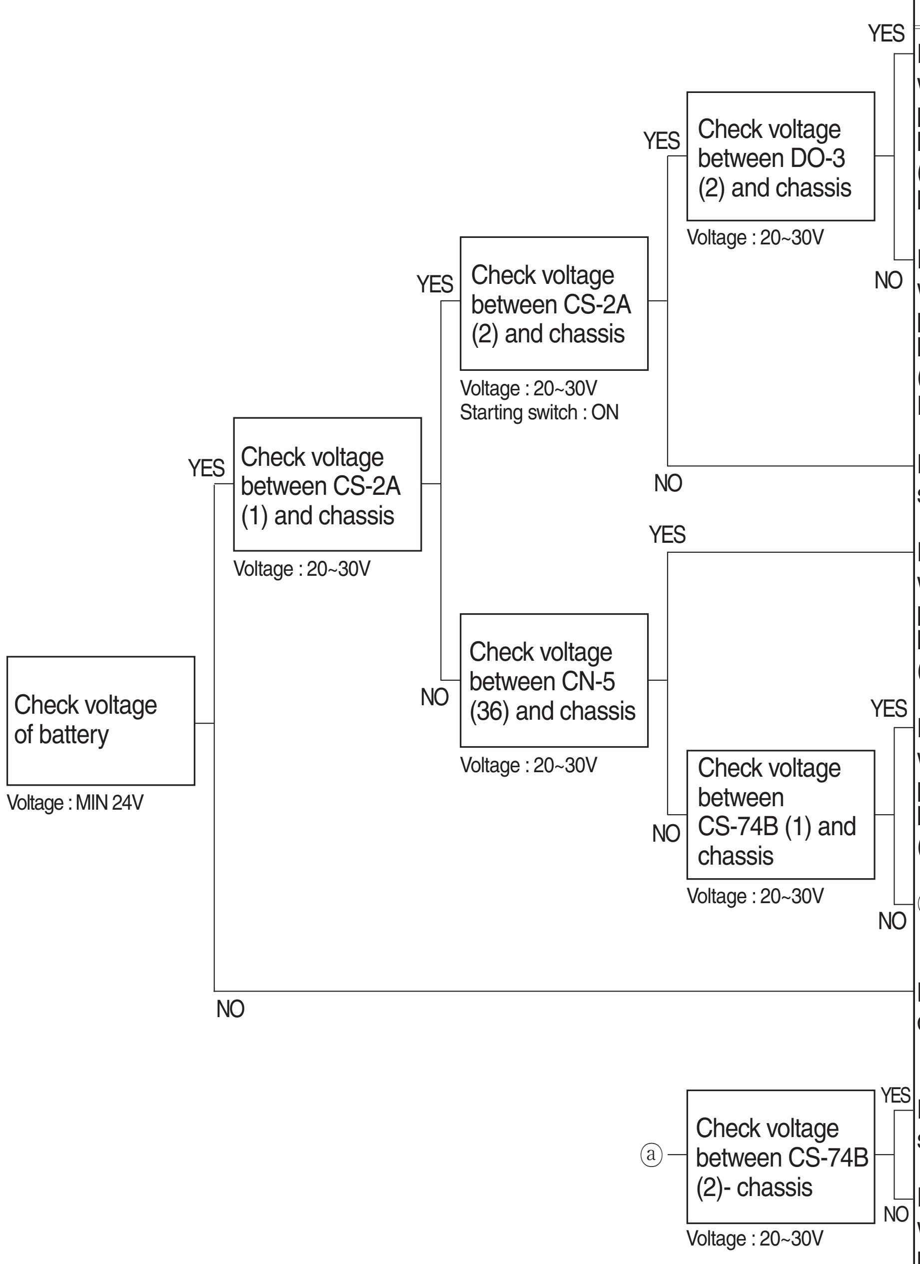




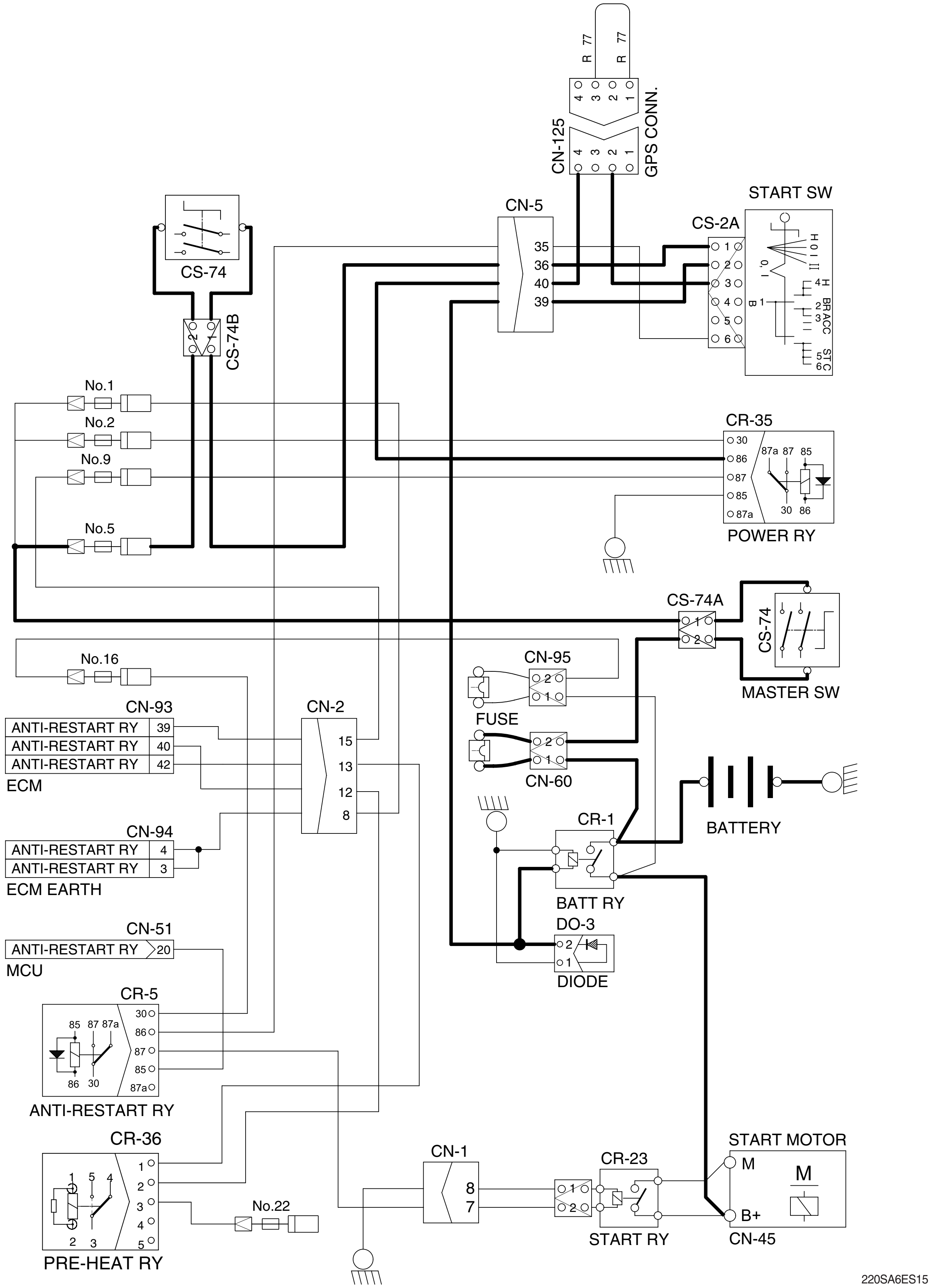
220SA6ES14

15. 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 blown out of the fuse (CN-60).
· After checking, insert the disconnected connectors again immediately unless otherwise specified.

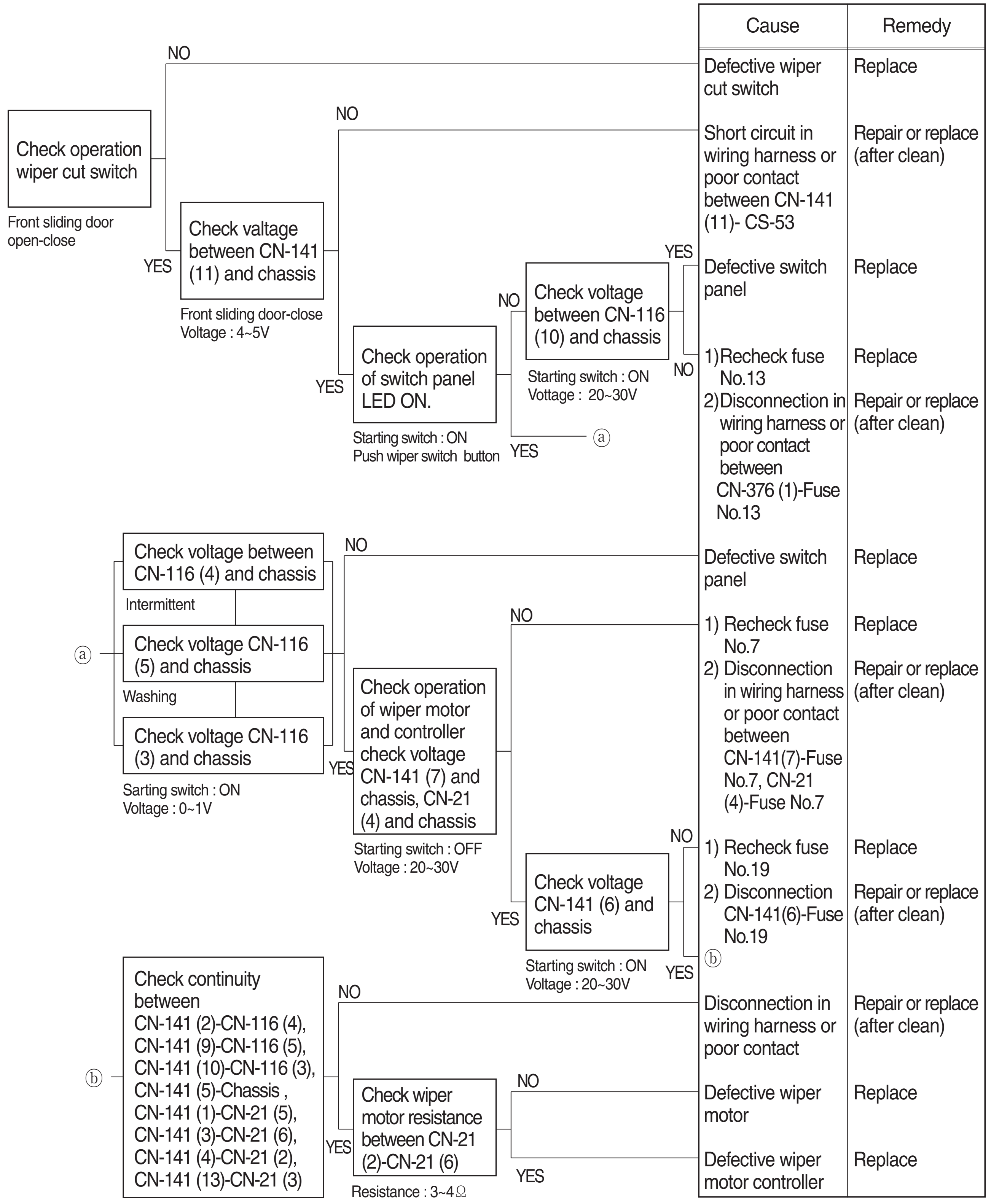


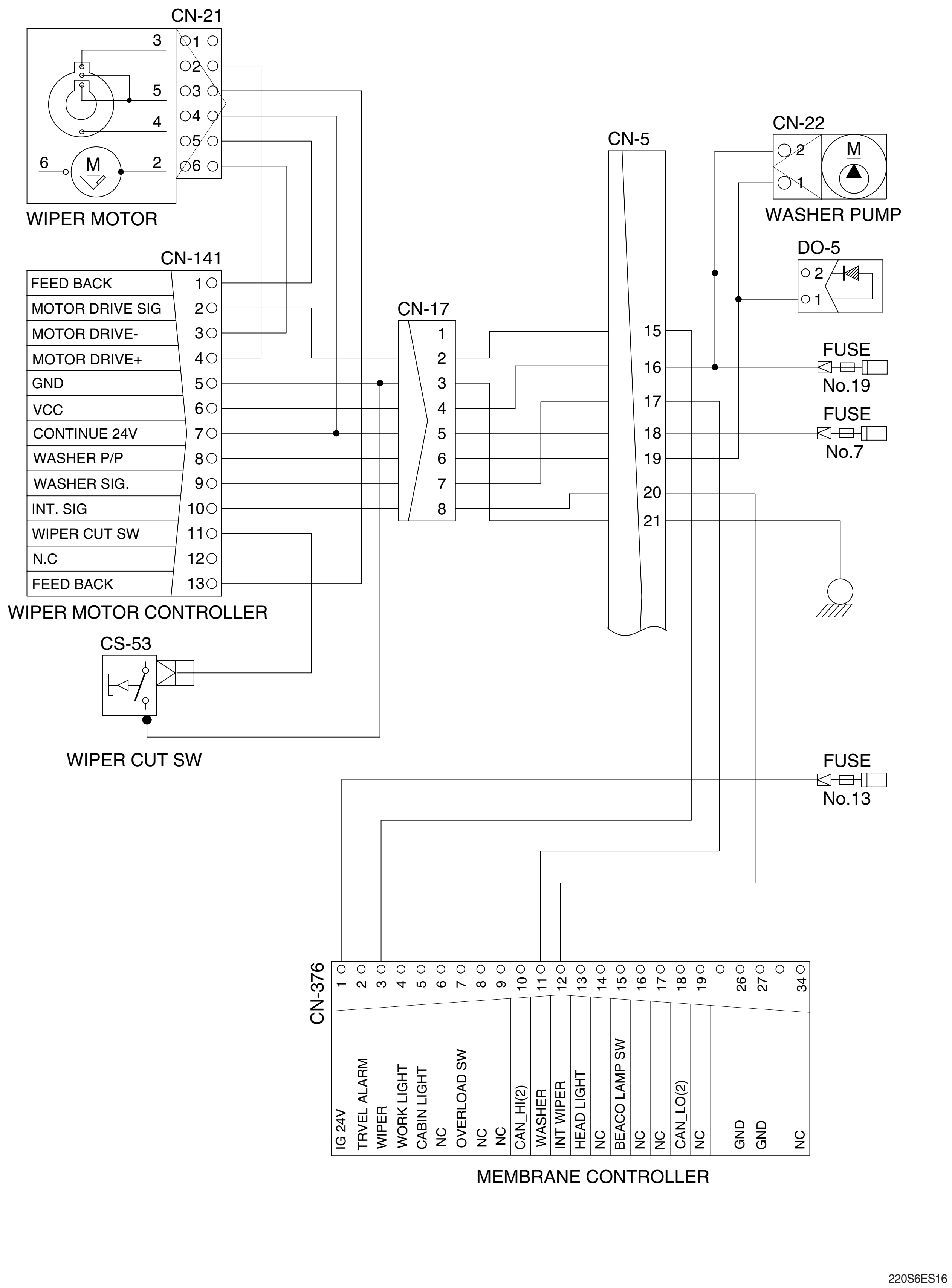
Cause	Remedy
Disconnection in wiring harness or poor contact between DO-3 (2)-CR-1 or defective battery relay	Repair or replace (after clean)
Disconnection in wiring harness or poor contact between CS-2A (2)-CN-5 (39)-DO-3 (2)	Repair or replace (after clean)
Defective start key switch	Replace
Disconnection in wiring harness or poor contact between CS-2A (1)-CN-5 (36)	Replace
Disconnection in wiring harness or poor contact between CS-74B (1) -CN-5 (36)	Charge or replace (after clean)
Battery discharged	Replace
Defective master switch	Replace
Disconnection in wiring harness or poor contact between CS-74B (2) -CR-1	Charge or replace (after clean)



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

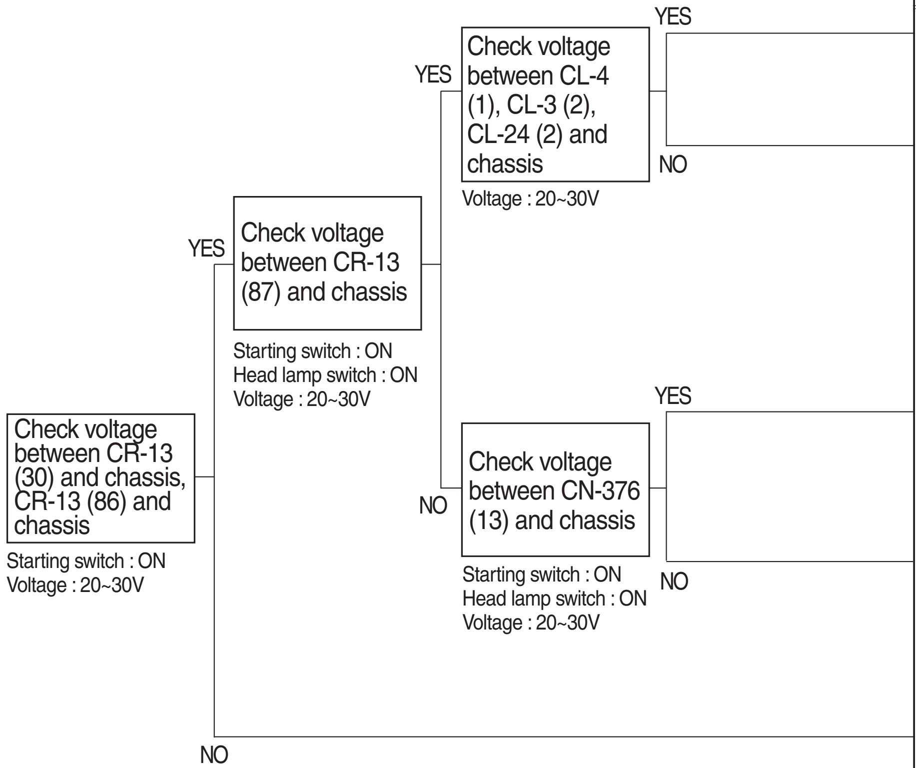
· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted and fuse No. 7, 13 and 19 is not blown out.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.



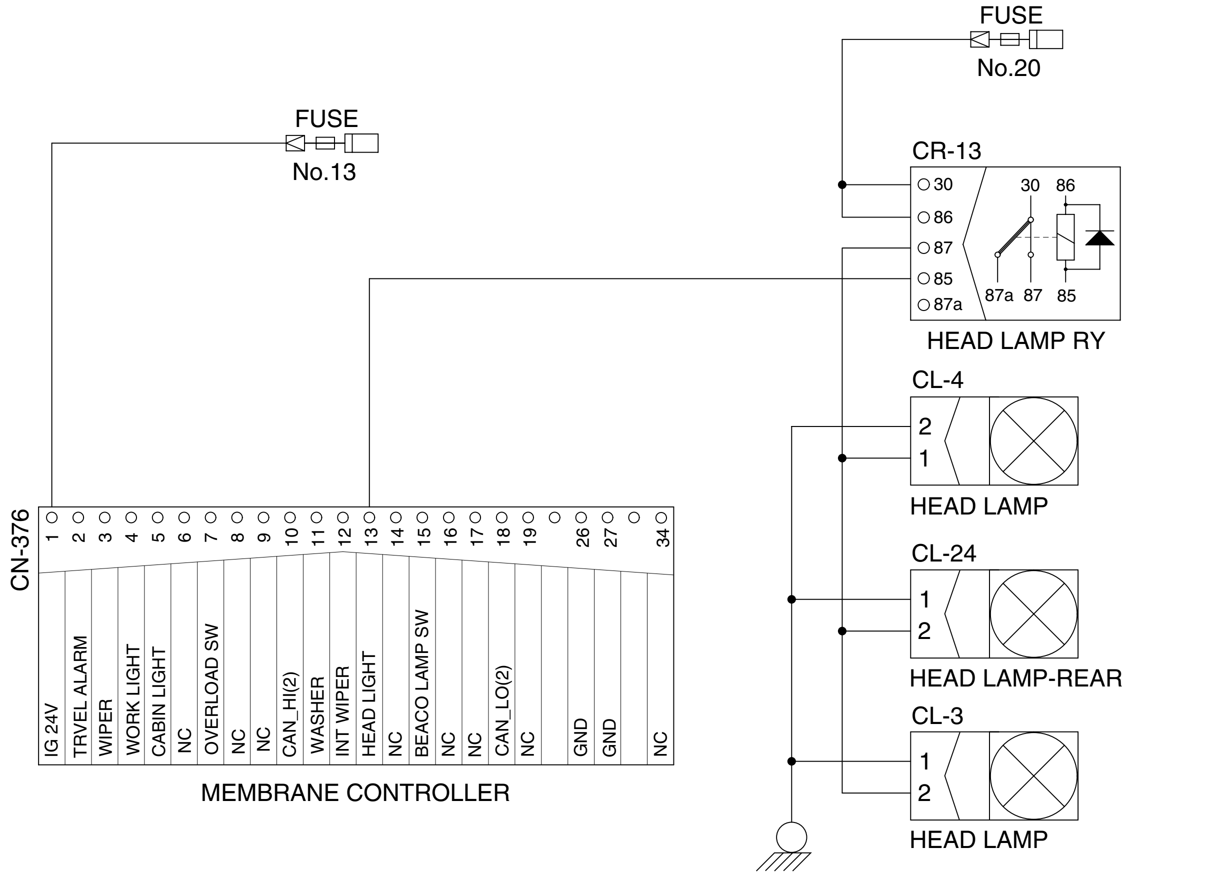


17. WHEN STARTING SWITCH IS TURNED ON, HEAD LAMP DOES NOT LIGHTS UP

· 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.13 and 20.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.



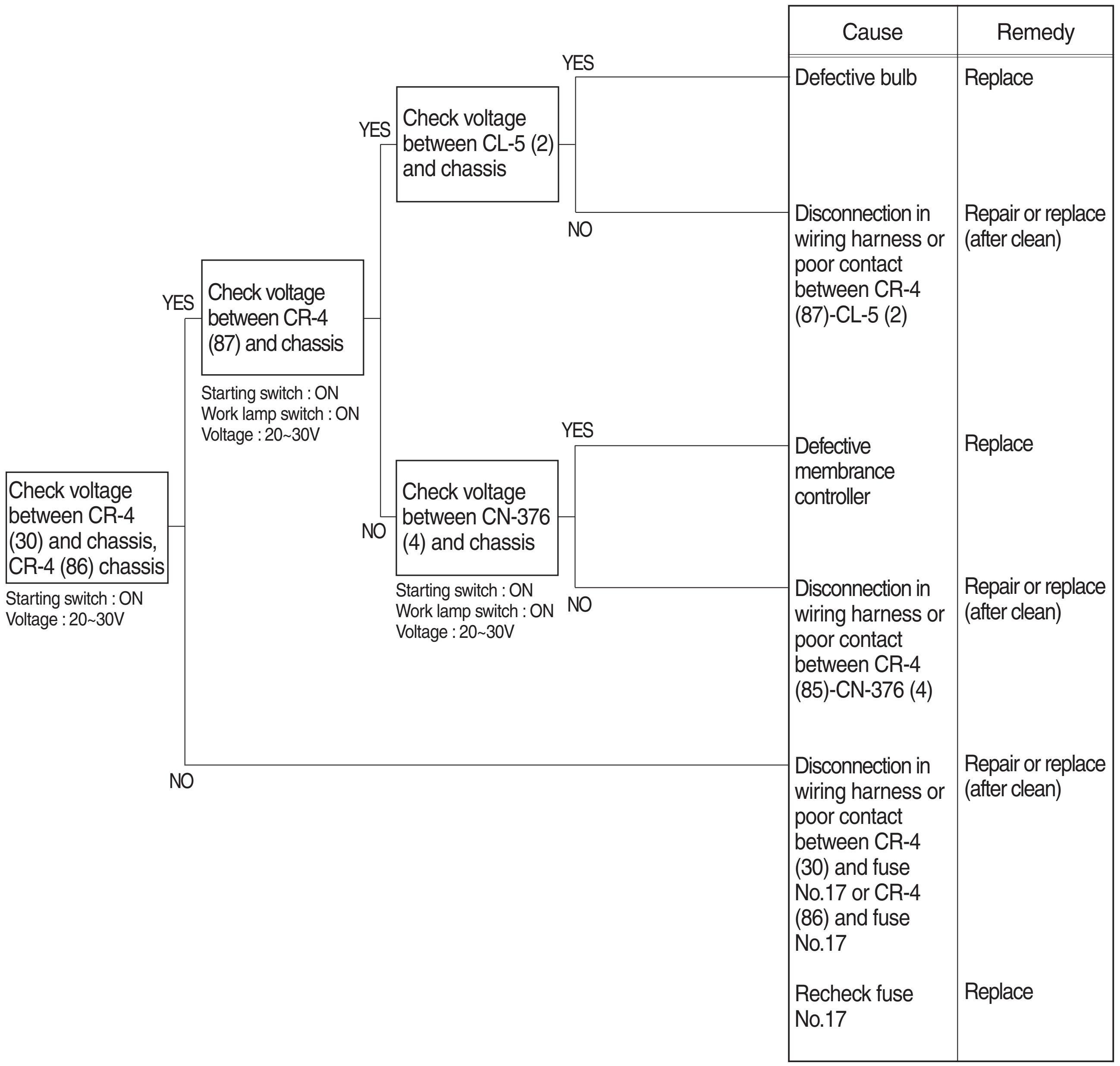
Cause	Remedy
Defective bulb	Replace
Disconnection in wiring harness or poor contact between CR-13 (87)-CL-4 (1) or CR-13 (87)-CL-3 (2) or CR-13 (87)-CL-24 (2)	Repair or replace (after clean)
Defective membrance controller	Replace
Disconnection in wiring harness or poor contact between CN-376 (13)-CR-13 (85)	Repair or replace (after clean)
Disconnection in wiring harness or poor contact between CR-13 (30) and fuse No.20 or CR-13 (86) - fuse No.20	Repair or replace (after clean)
Recheck fuse No. 20	Replace

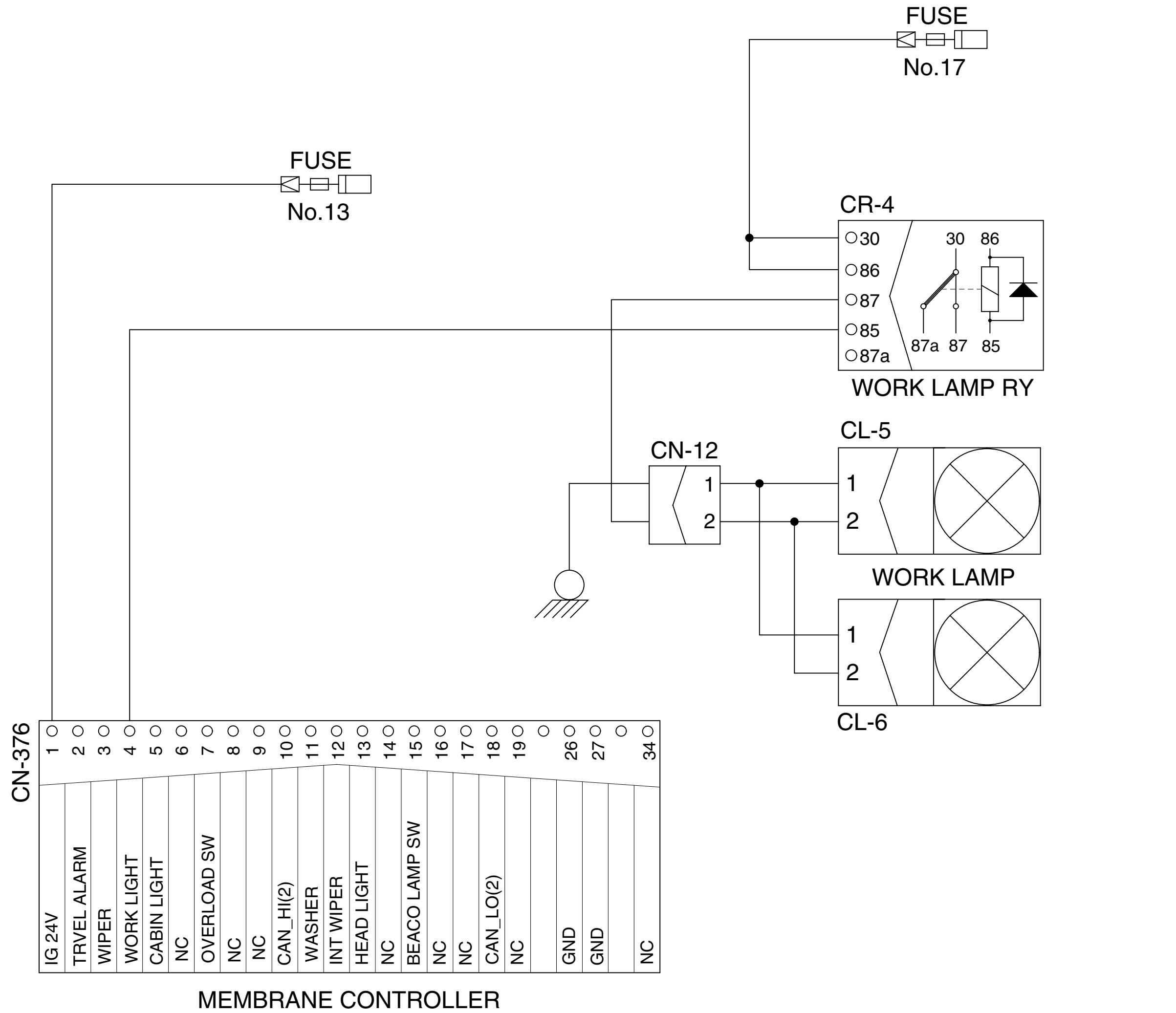


220S6ES17

18. 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 13 and 17.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.





220S6ES18

GROUP 4 MECHATRONICS SYSTEM

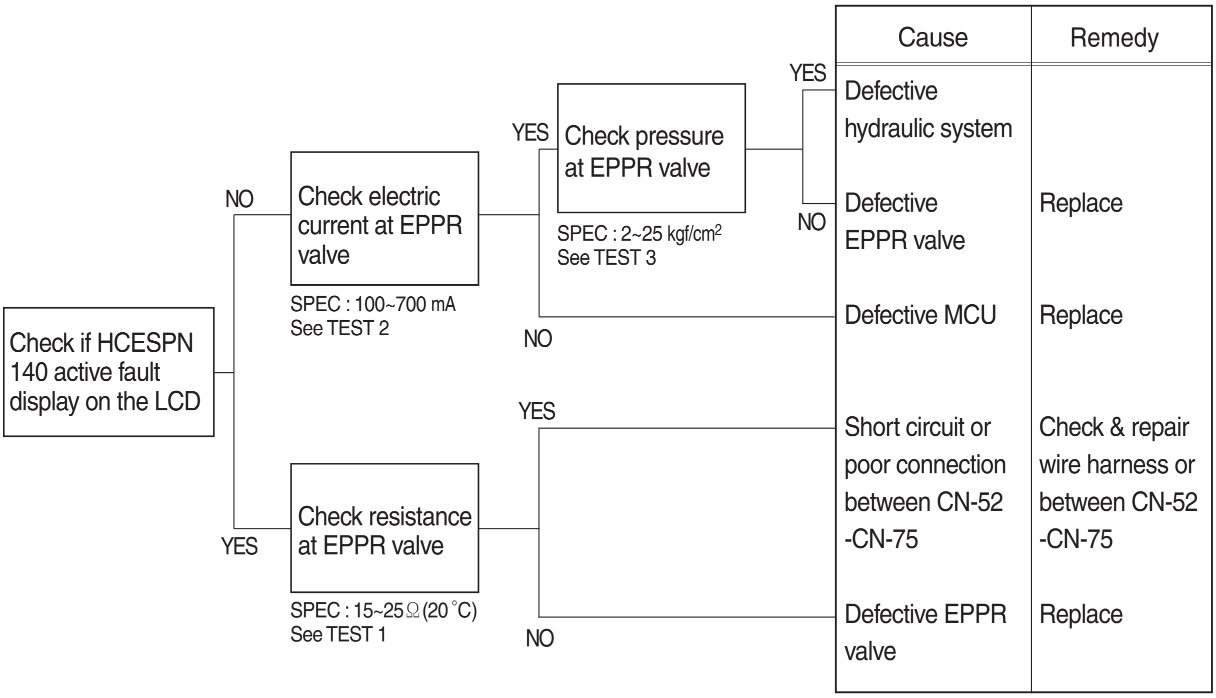
1. ALL ACTUATORS SPEED ARE SLOW

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

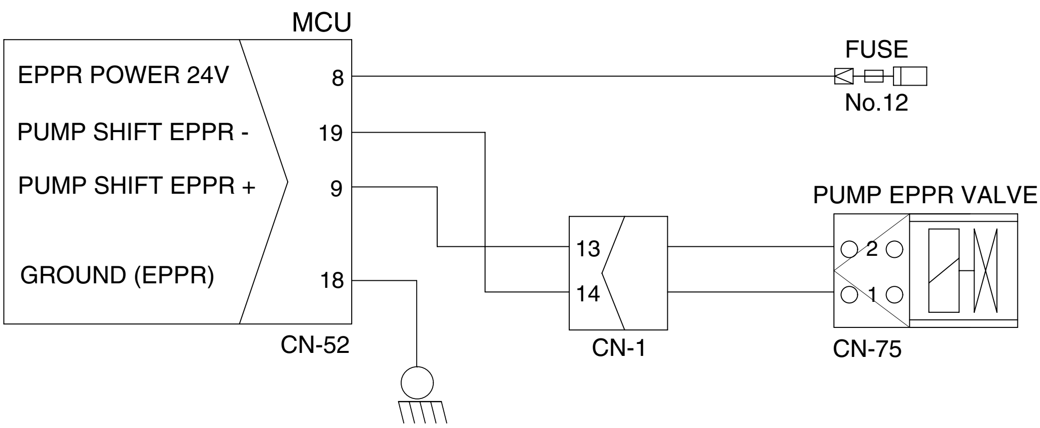
※ Spec : P-mode 1650 ± 50 rpm S -mode 1550 ± 50 rpm E-mode 1450 ± 50 rpm

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

1) INSPECTION PROCEDURE



Wiring diagram



220SA6MS01

2) TEST PROCEDURE

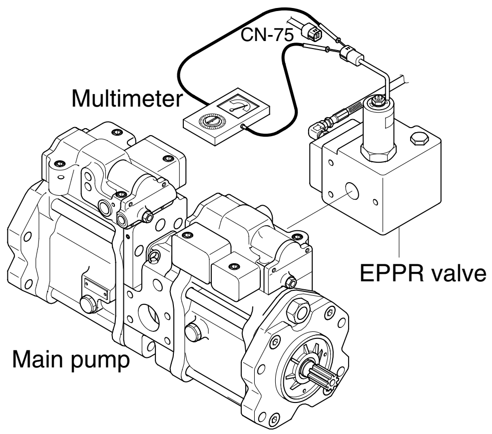
(1) **Test 1** : Check resistance at connector CN-75.

① Starting key OFF.

② Disconnect connector CN-75 from EPPR valve at main hydraulic pump.

③ Check resistance between 2 lines as figure.

SPEC : 15~25Ω (20˚C)



2107A5MS15

(2) **Test 2** : Check electric current at EPPR valve.

① Disconnect connector CN-75 from EPPR valve.

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

③ Start engine.

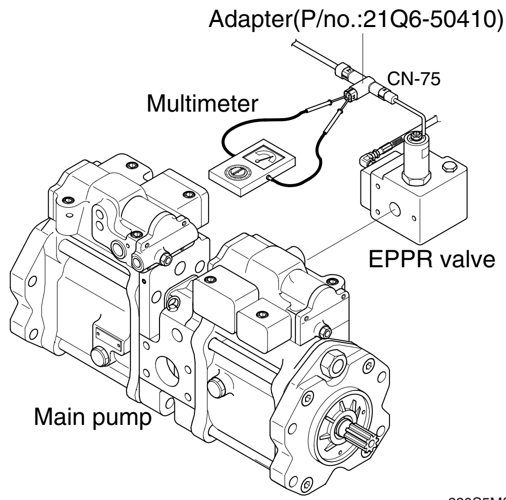
④ Set S-mode and cancel auto decel mode.

⑤ Position the accel dial at 10.

⑥ If tachometer show approx 1550±50 rpm disconnect one wire harness from EPPR valve.

⑦ Check electric current at bucket circuit relief position.

Spec : 100~700 mA



220S5MS21

(3) **Test 3** : Check pressure at EPPR valve.

① Remove plug and connect pressure gauge as figure.

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

② Start engine.

③ Set S-mode and cancel auto decel mode.

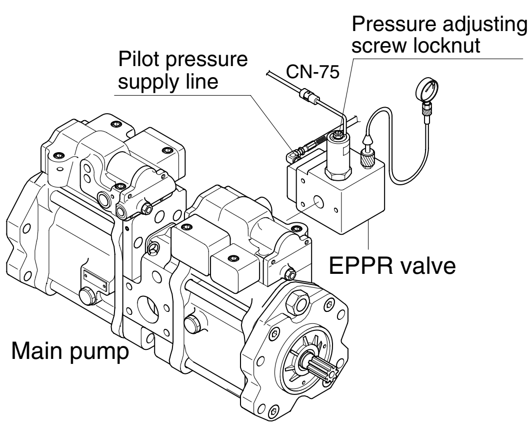
④ Position the accel dial at 10.

⑤ If tachometer show approx 1550±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/cm^2 (30~350 psi)

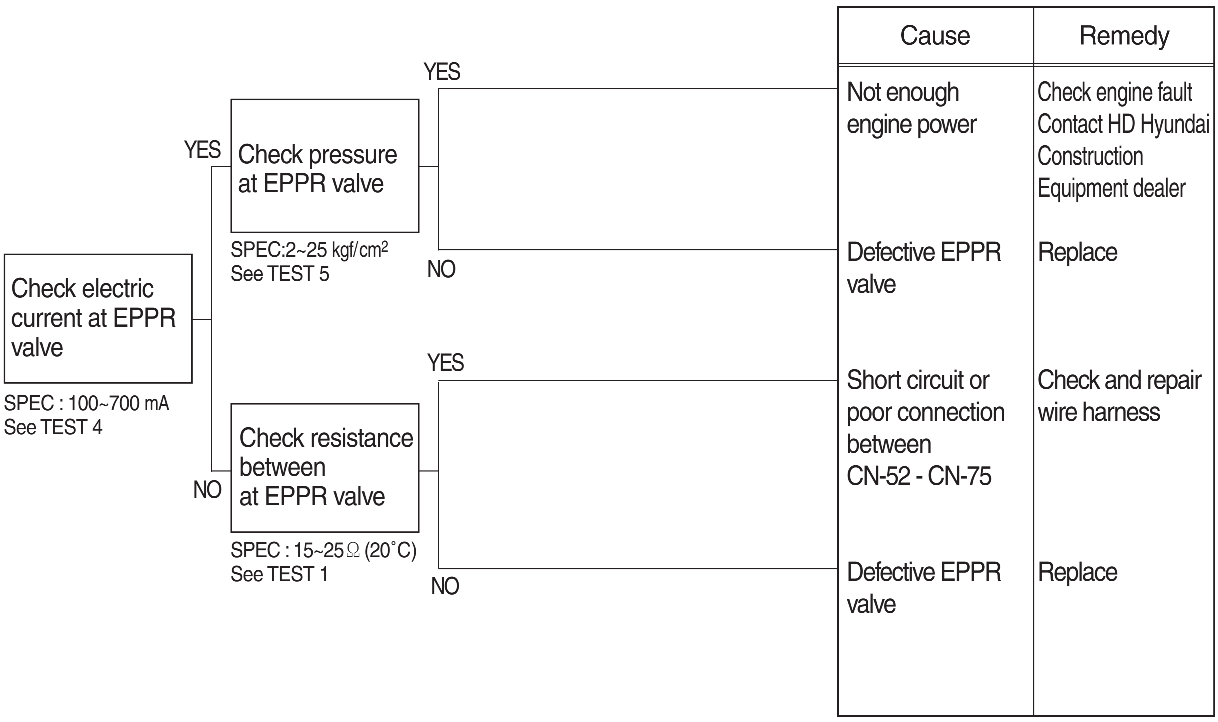


220S5MS22

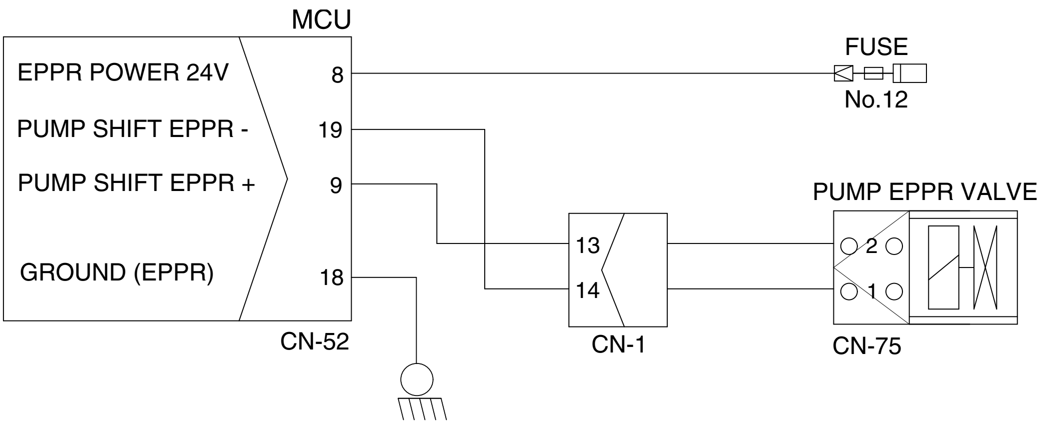
2. ENGINE STALL

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

1) INSPECTION PROCEDURE



Wiring diagram



220SA6MS01

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.

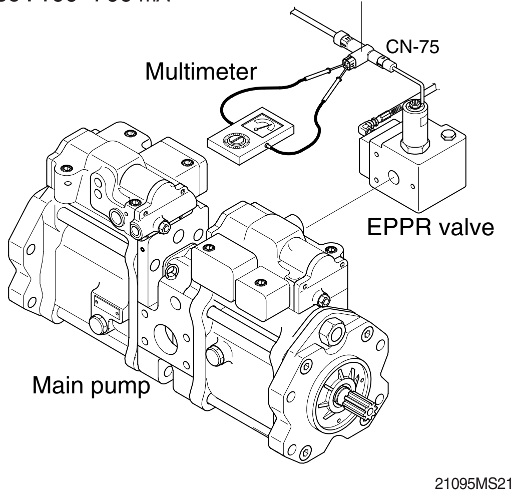
④ Set S-mode and cancel auto decel mode.

⑤ Position the accel dial at 10.

⑥ If rpm show approx 1550±50 rpm disconnect one wire harness from EPPR valve.

⑦ Check electric current at bucket circuit relief position.

Spec : 100~700 mA



(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.

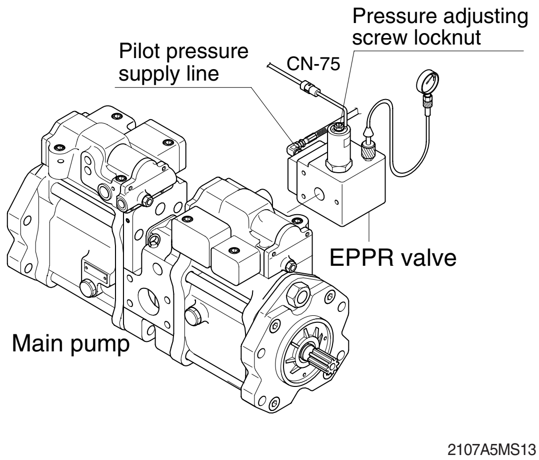
④ Position the accel dial at 10.

⑤ If rpm show approx 1550±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.

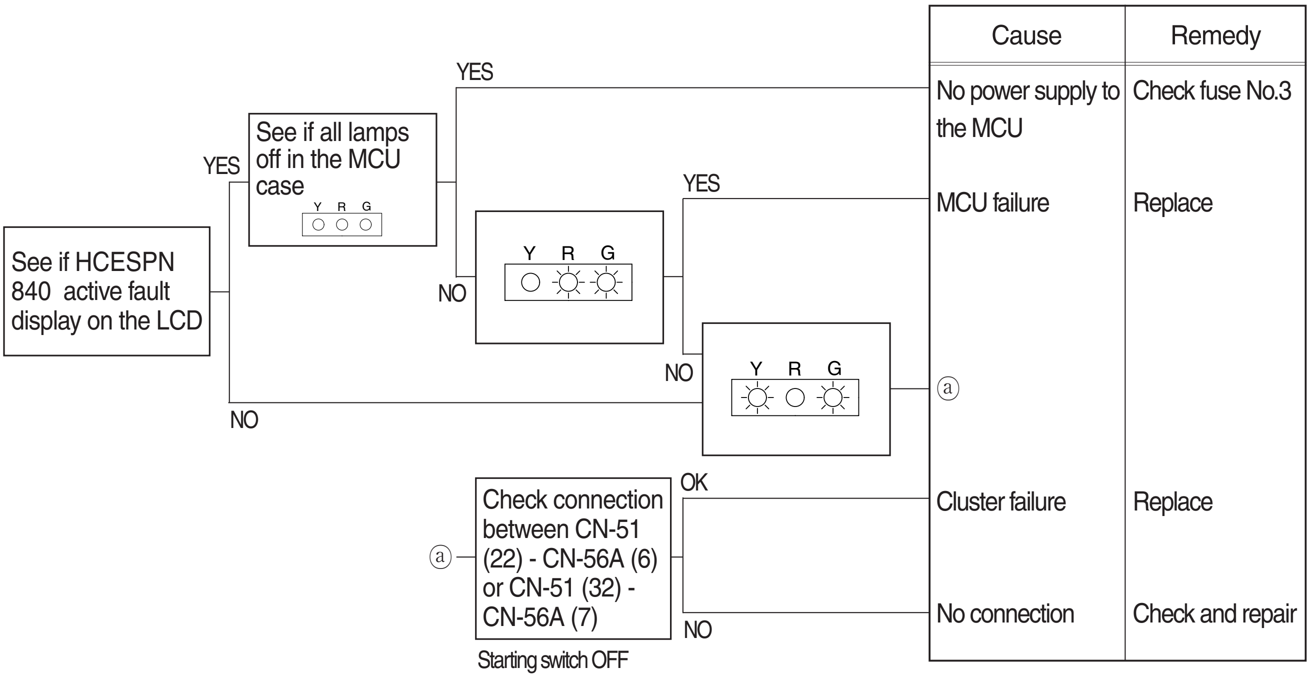
SPEC : 2~25 kgf/cm^2 (30~350 psi)



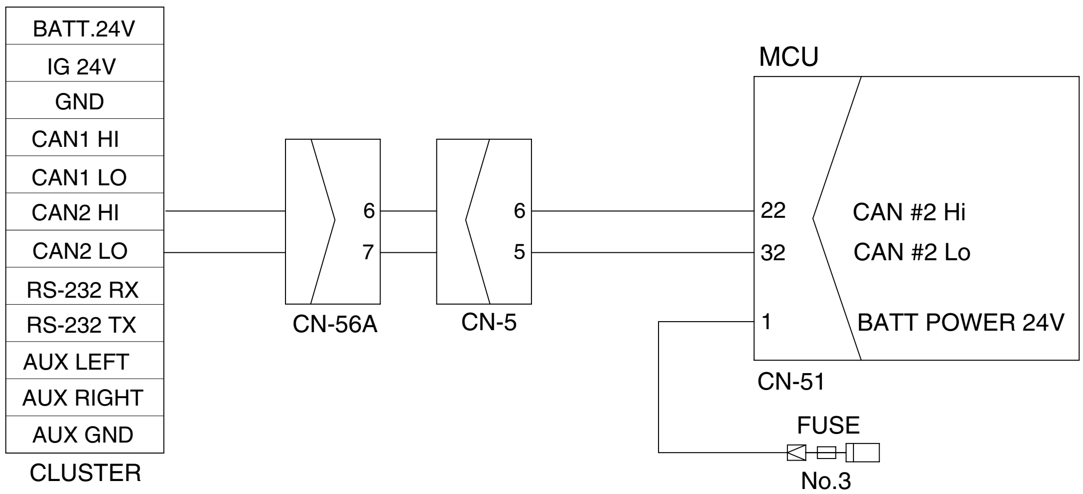
3. MALFUNCTION OF CLUSTER OR MODE SELECTION SYSTEM

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

1) INSPECTION PROCEDURE



Wiring diagram



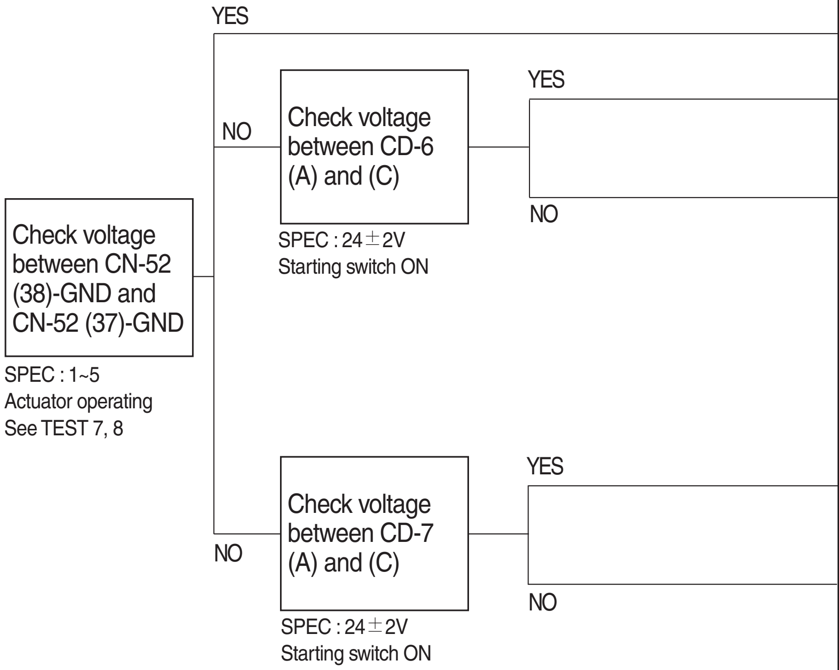
220S6MS02

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)

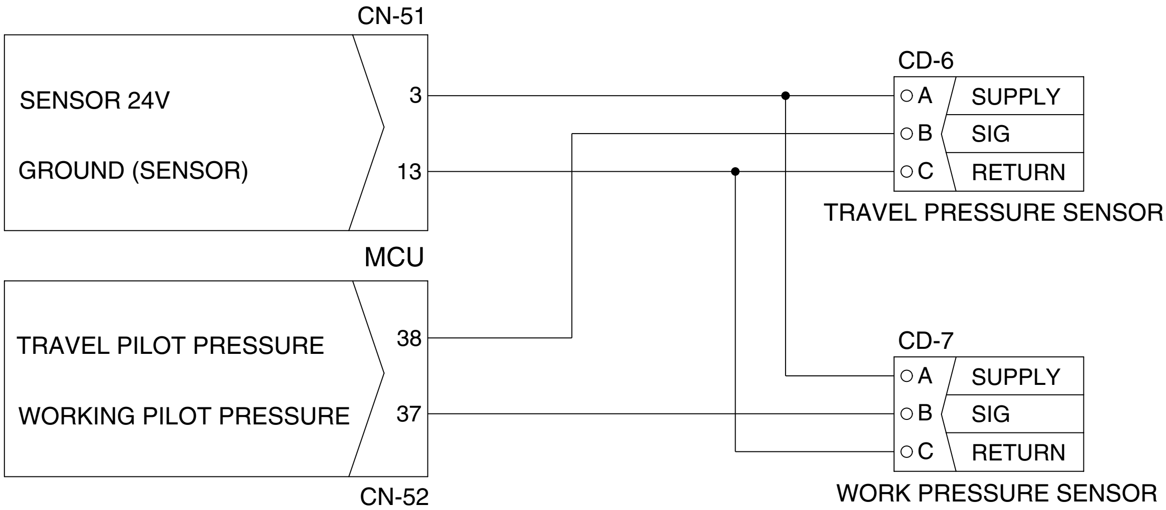
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective MCU	Replace
Defective travel pressure sensor	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



220S6MS03

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 key ON.

④ Check voltage as figure.

(2) Test 8 : Check voltage at CN-52 (37) and ground.

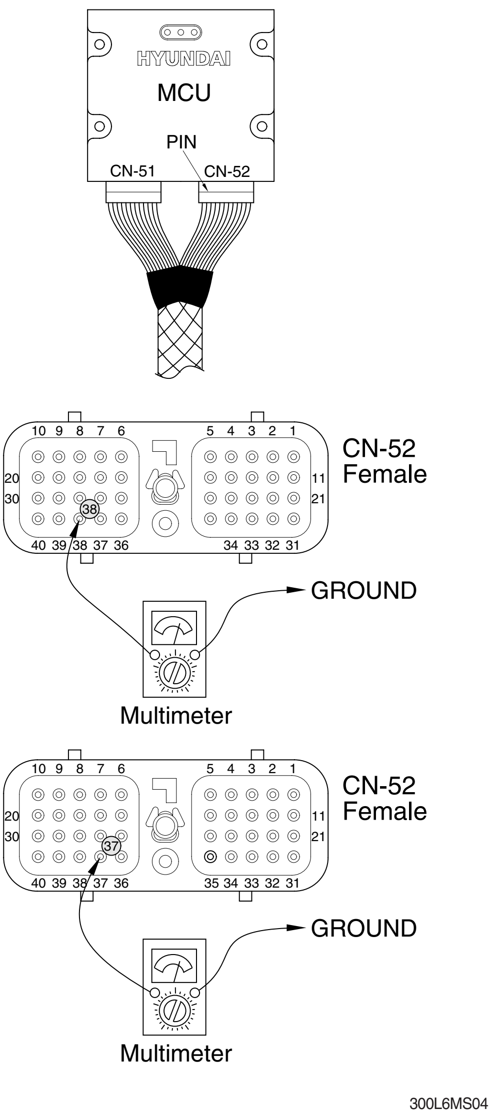
① Prepare 1 piece of thin sharp pin, steel or copper

② Insert prepared pin to rear side of connectors : One pin to (37) of CN-52.

③ Starting switch ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V

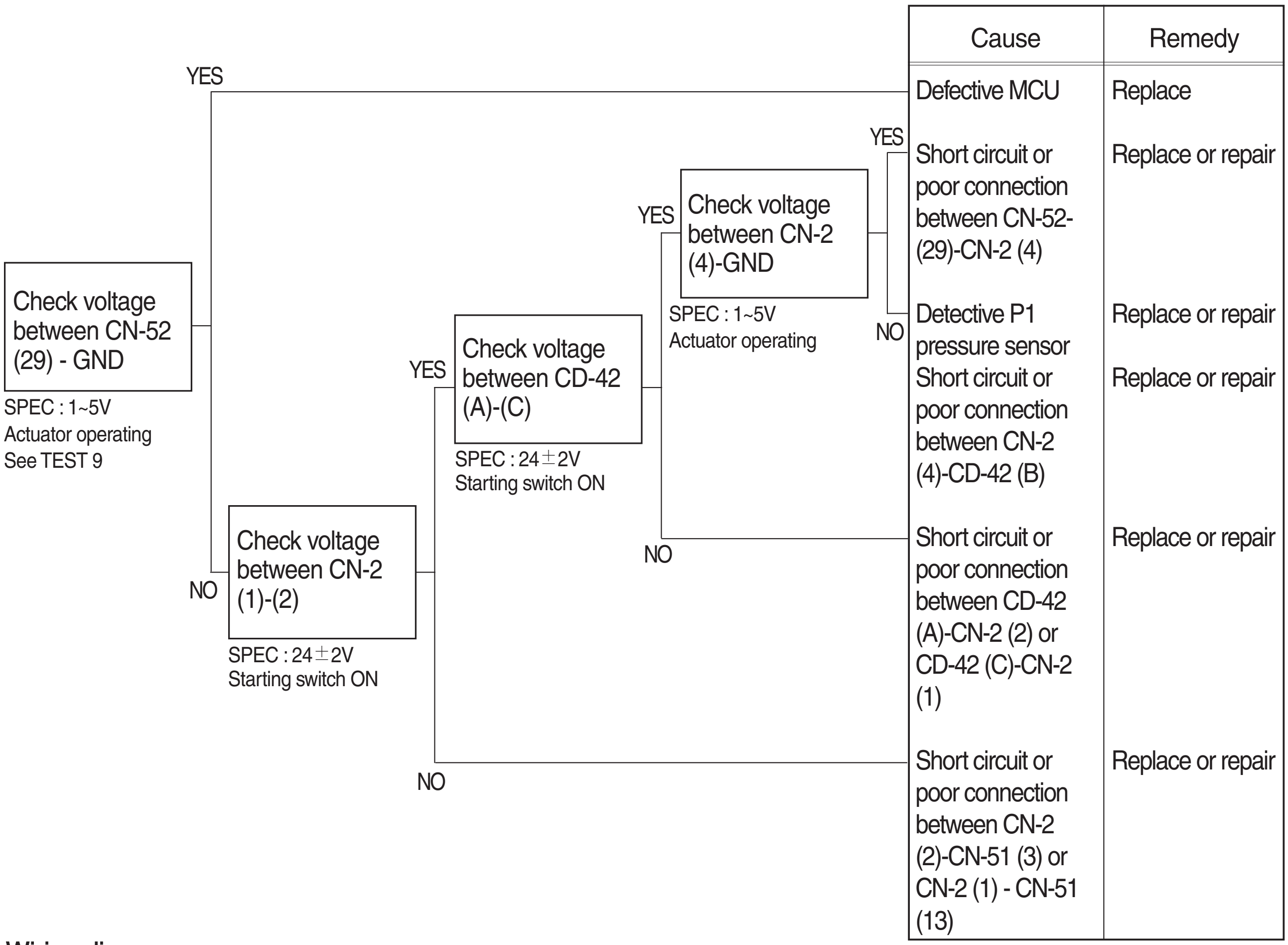


5. MALFUNCTION OF PUMP 1 PRESSURE SENSOR

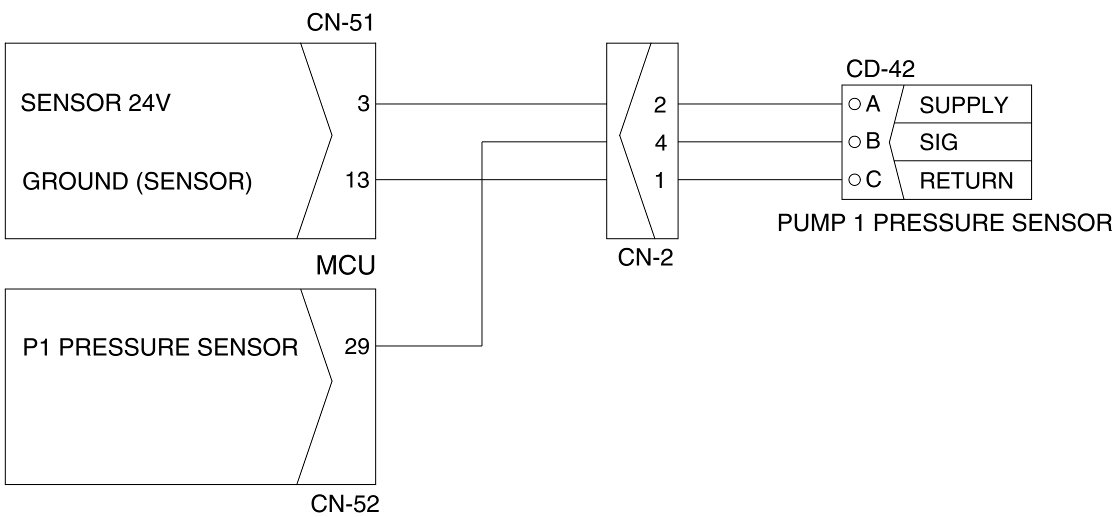
· Fault code : HCESPN 120, FMI 0~4

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

1) INSPECTION PROCEDURE



Wiring diagram



220S6MS05

2) TEST PROCEDURE

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

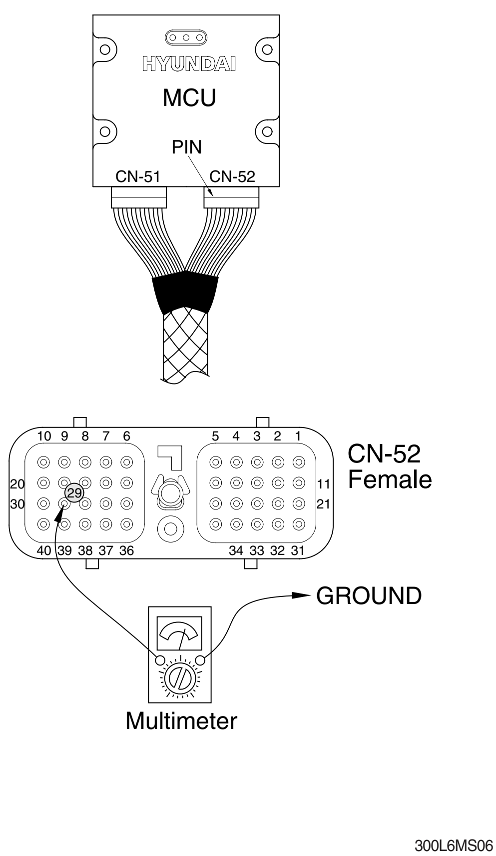
① Prepare 1 piece of thin sharp pin, steel or copper.

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

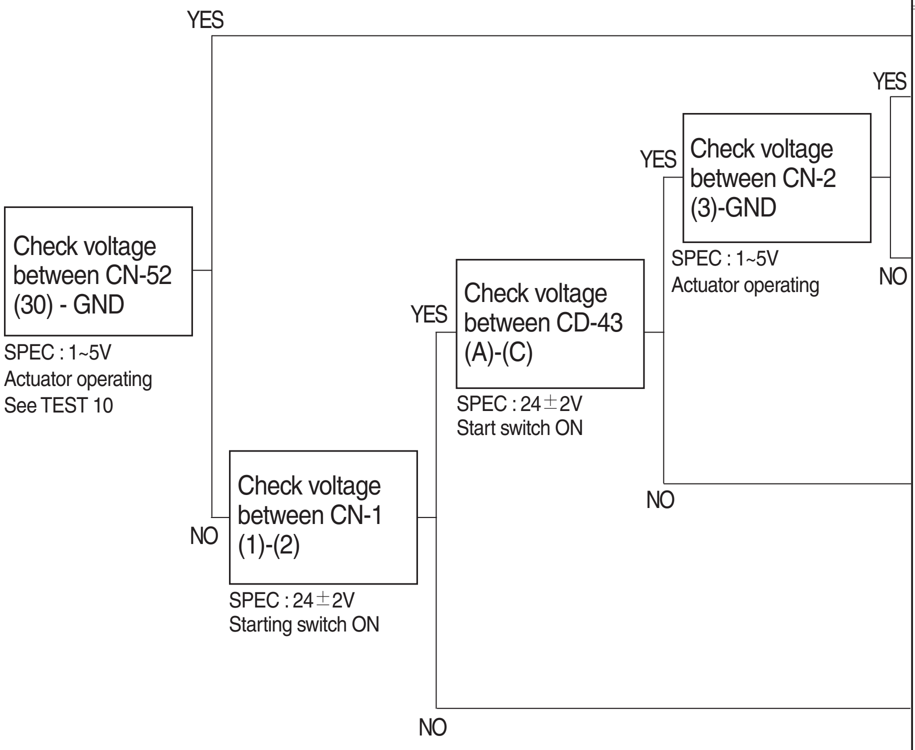


6. MALFUNCTION OF PUMP 2 PRESSURE SENSOR

· Fault code : HCESPN 121, FMI 0~4

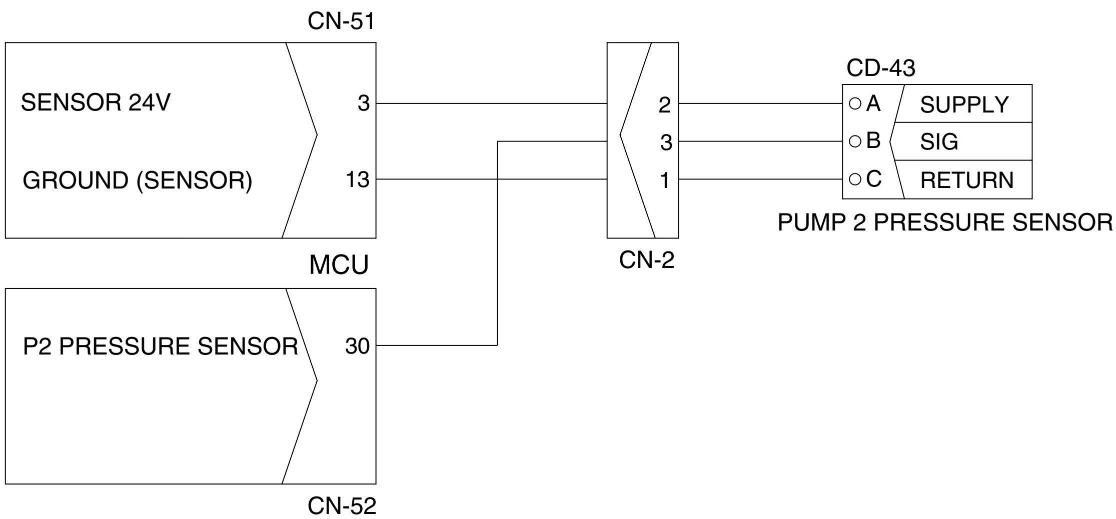
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective MCU	Replace
Short circuit or poor connection between CN-52-(30)-CN-2 (3)	Replace or repair
Detective P2 pressure sensor	Replace or repair
Short circuit or poor connection between CN-2 (3)-CD-43 (B)	Replace or repair
Short circuit or poor connection between CD-43 (A)-CN-2 (2) or CD-43 (C)-CN-2 (1)	Replace or repair
Short circuit or poor connection between CN-2 (2)-CN-51 (3) or CN-2 (1) - CN-51 (13)	Replace or repair

Wiring diagram



220S6MS07

2) TEST PROCEDURE

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

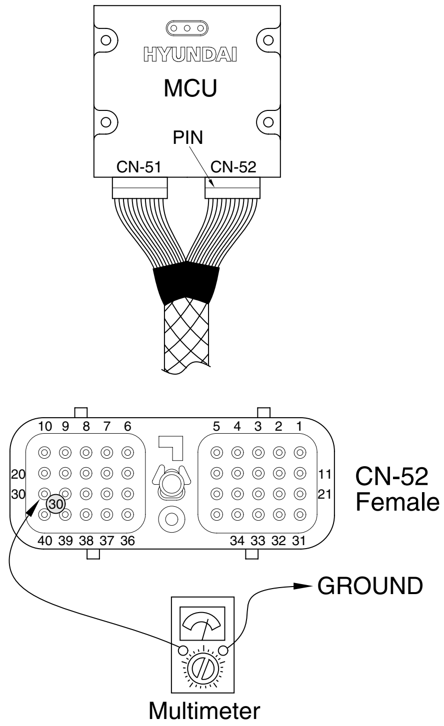
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (30) of CN-52.

③ Starting switch ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V



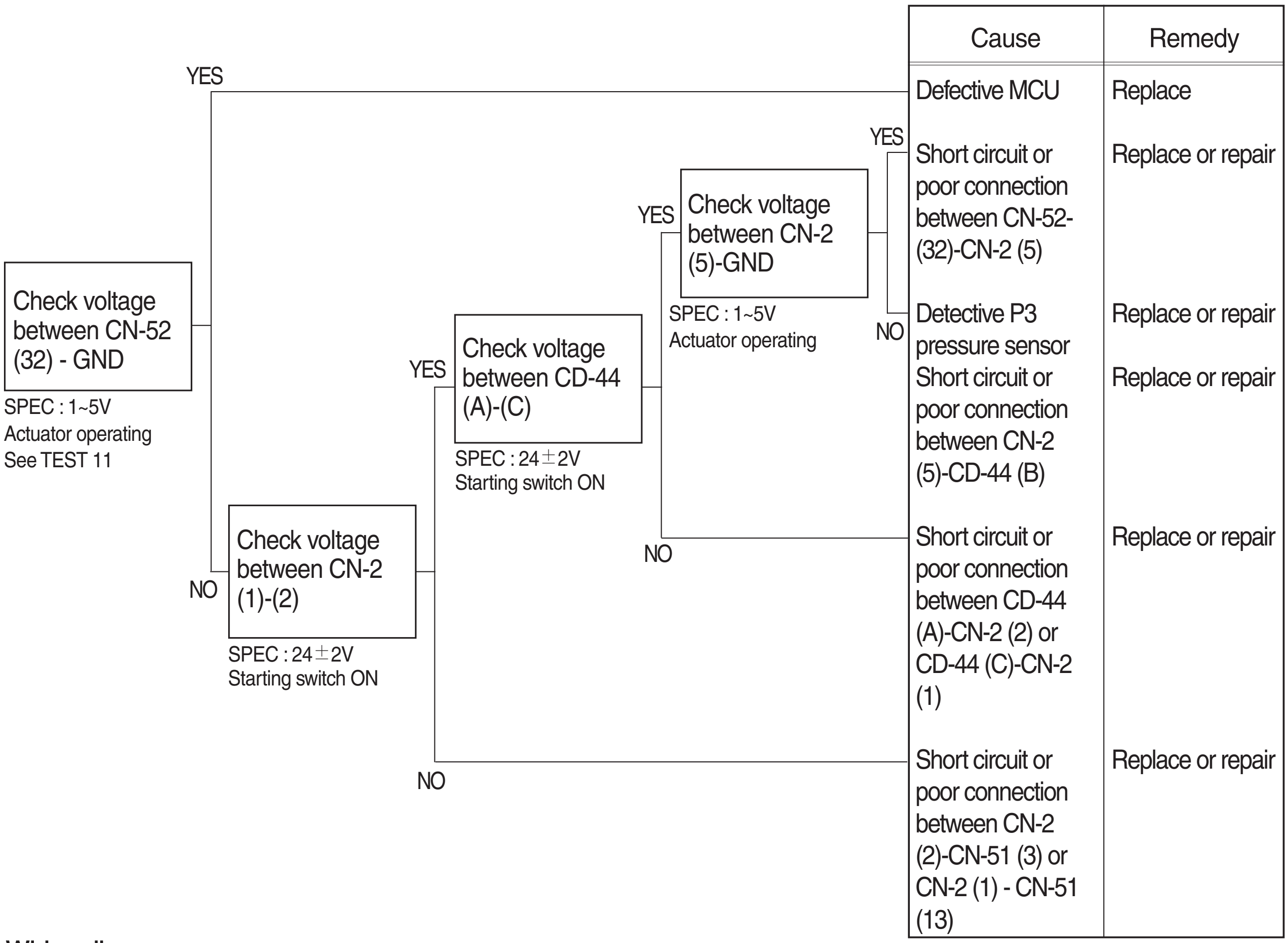
220S6MS08

7. MALFUNCTION OF PUMP 3 PRESSURE SENSOR

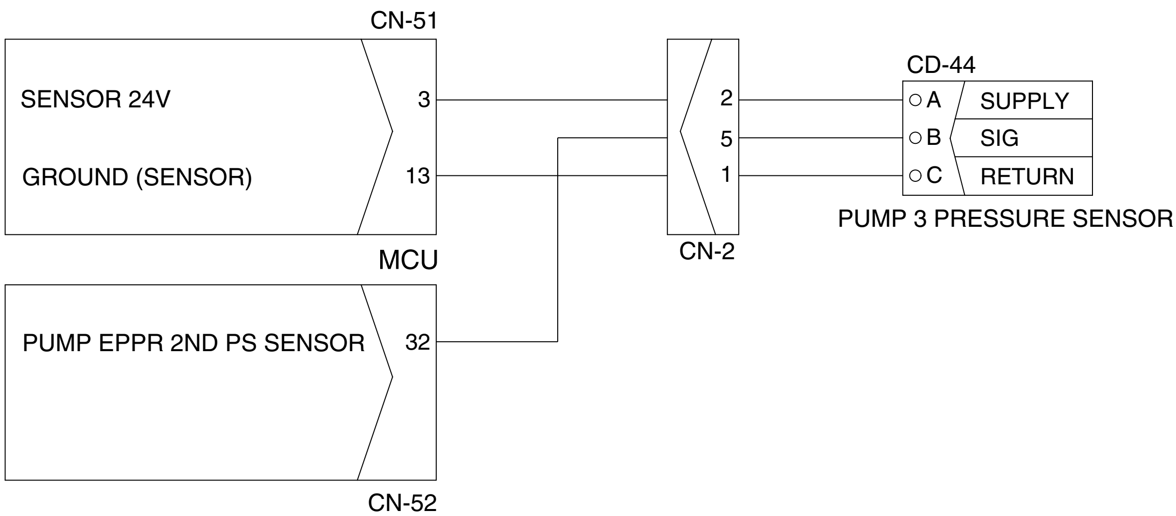
· Fault code : HCESPN 125, FMI 0~4

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

1) INSPECTION PROCEDURE



Wiring diagram



220S6MS09

2) TEST PROCEDURE

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

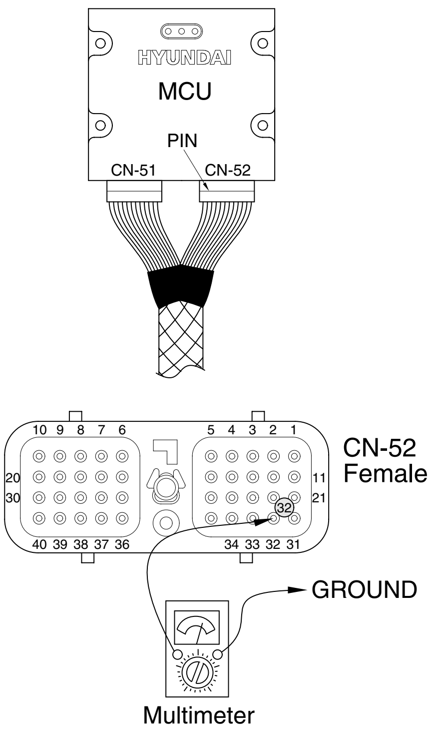
① Prepare 1 piece of thin sharp pin, steel or copper.

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



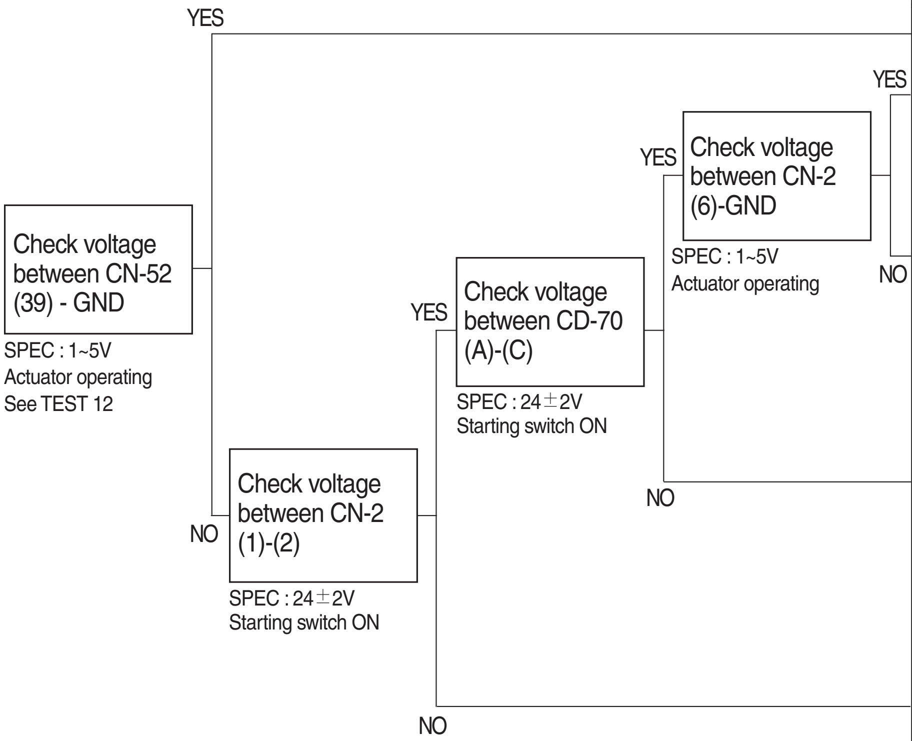
300L6MS10

8. MALFUNCTION OF NEGATIVE 1 PRESSURE SENSOR

· Fault code : HCESPN 123, FMI 0~4

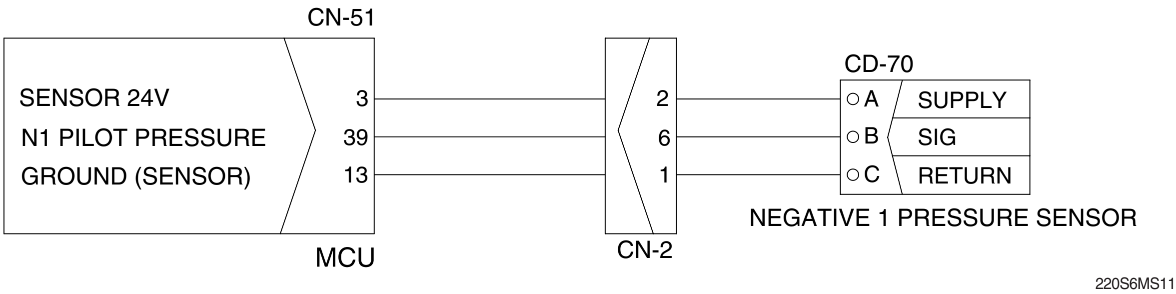
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective MCU	Replace
Short circuit or poor connection between CN-52-(39)-CN-2 (6)	Replace or repair
Detective N1 pressure sensor	Replace or repair
Short circuit or poor connection between CN-2 (6)-CD-70 (B)	Replace or repair
Short circuit or poor connection between CD-70 (A)-CN-2 (2) or CD-70 (C)-CN-2 (1)	Replace or repair
Short circuit or poor connection between CN-2 (2)-CN-51 (3) or CN-2 (1) - CN-51 (13)	Replace or repair

Wiring diagram



2) TEST PROCEDURE

(1) Test 12 : Check voltage at CN-52 (39) and ground.

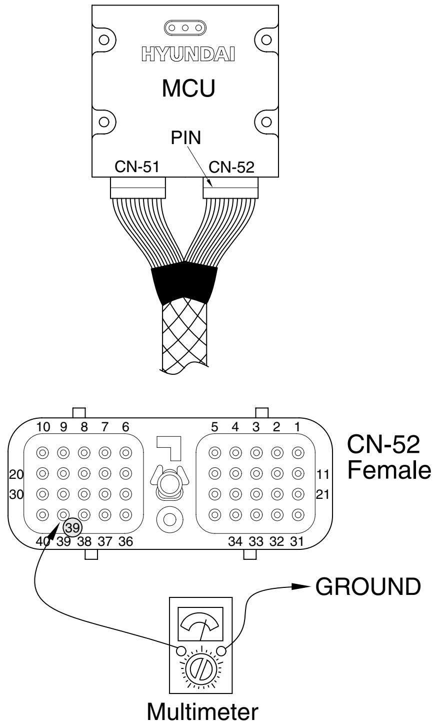
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (39) of CN-52.

③ Starting switch ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V



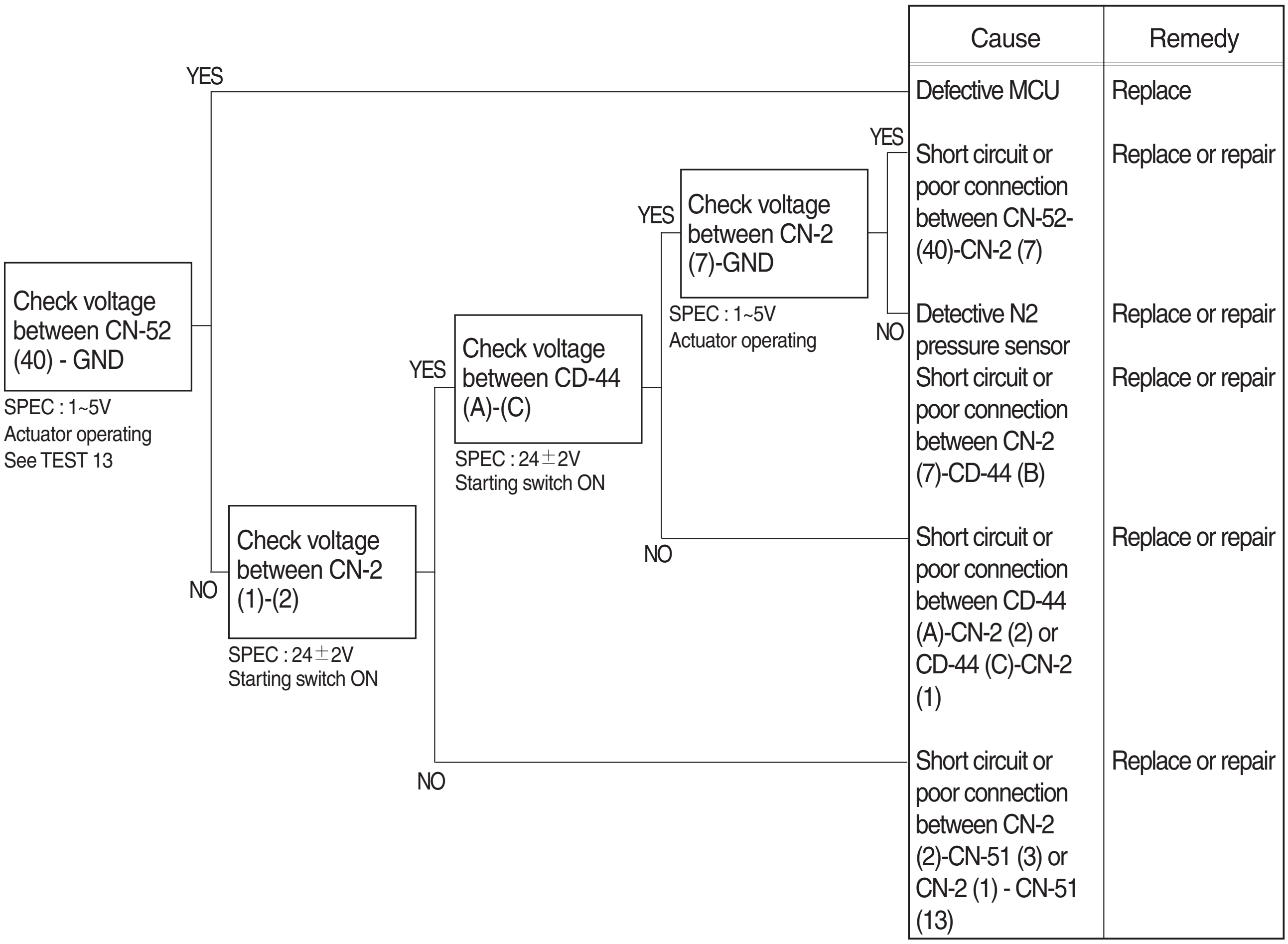
220S6MS12

9. MALFUNCTION OF NEGATIVE 2 PRESSURE SENSOR

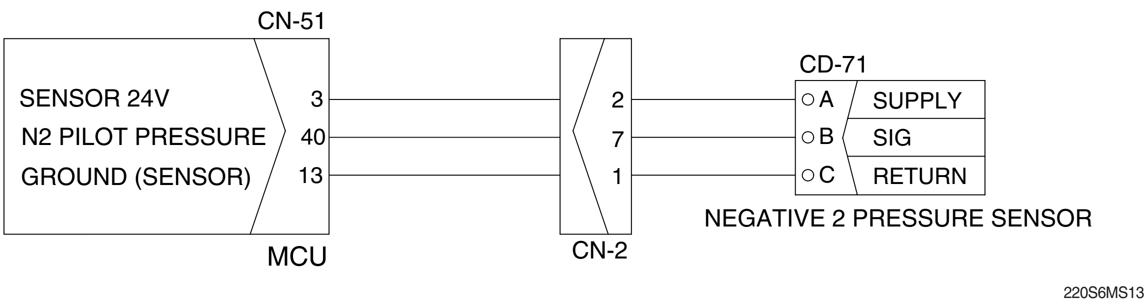
· Fault code : HCESPN 124, FMI 0~4

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

1) INSPECTION PROCEDURE



Wiring diagram



2) TEST PROCEDURE

(1) Test 13 : Check voltage at CN-52 (40) and ground.

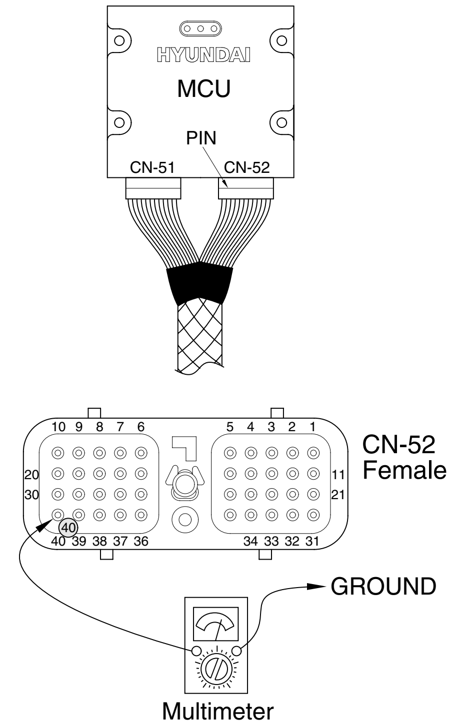
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (40) of CN-52.

③ Starting switch ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V



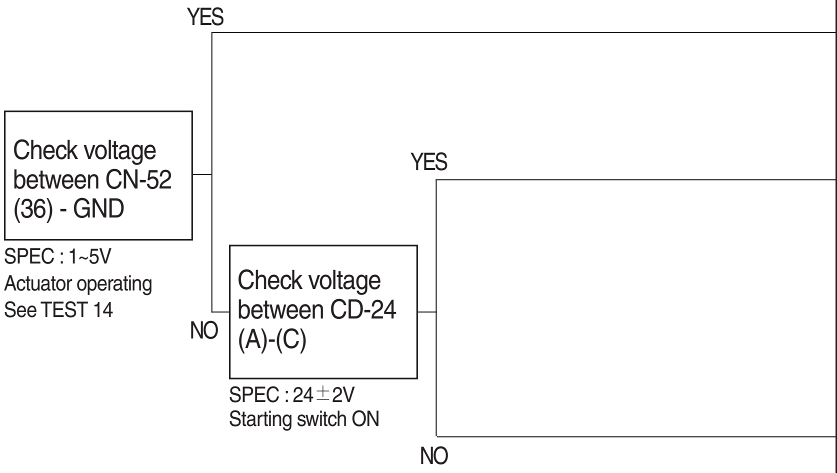
220S6MS14

10. MALFUNCTION OF SWING PRESSURE SENSOR

· Fault code : HCESPN 135, FMI 0~4

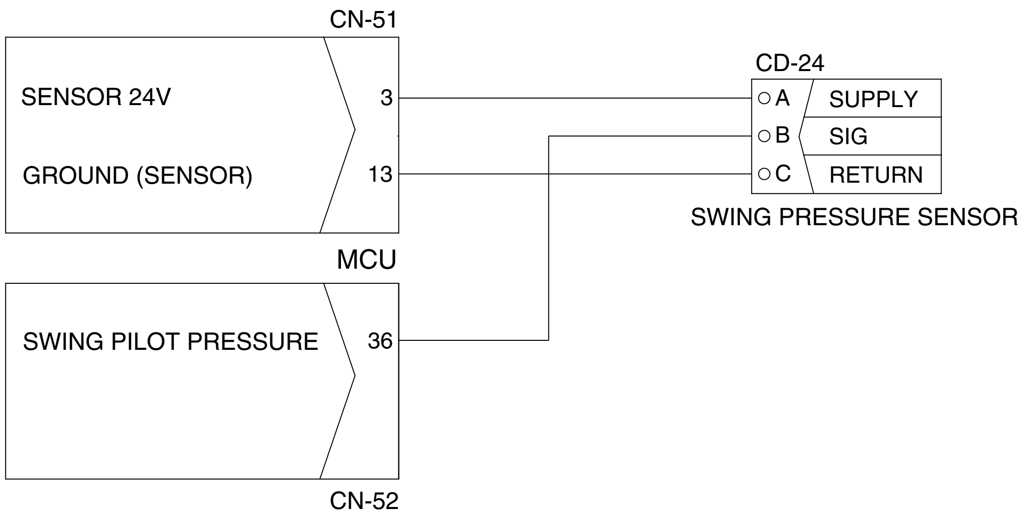
※ Before carrying out below procedure, check all the related connectors are properly inserted.

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



220S6MS15

2) TEST PROCEDURE

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

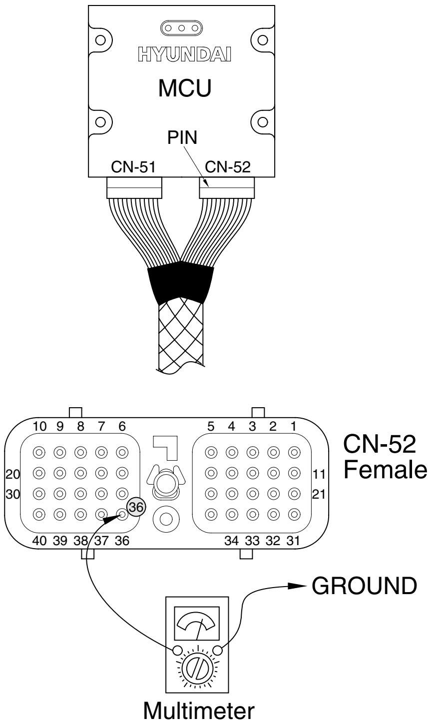
① Prepare 1 piece of thin sharp pin, steel or copper.

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



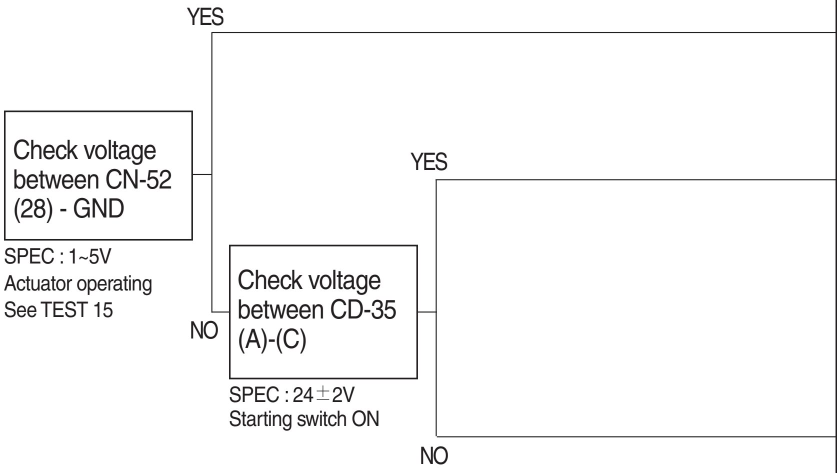
300L6MS16

11. MALFUNCTION OF ARM IN/OUT & BUCKET IN PRESSURE SENSOR

· Fault code : HCESPN 133, FMI 0~4

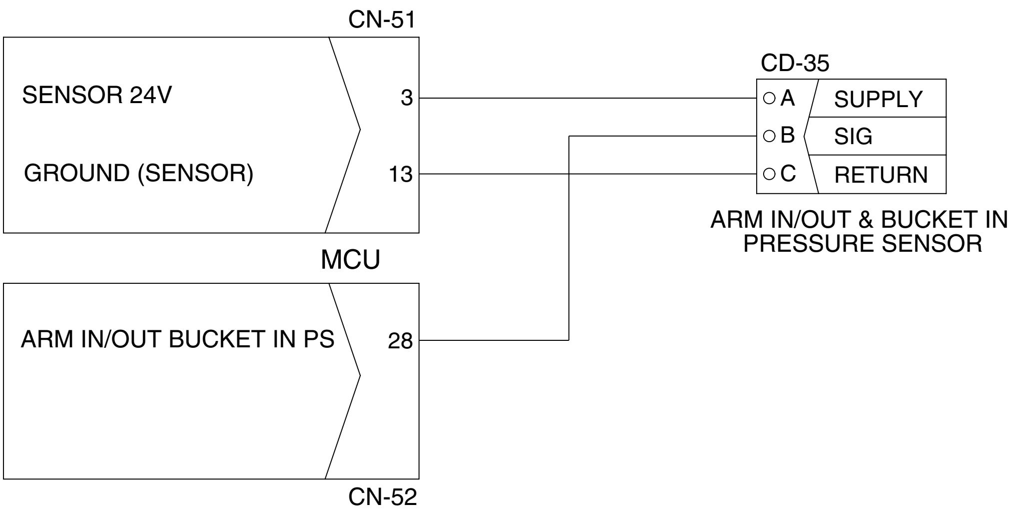
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective MCU	Replace
Detective arm in/out & bucket in pressure sensor	Replace or repair
Short circuit or poor connection between CN-52 (35)-CD-35 (B)	Replace or repair
Short circuit or poor connection between CD-35 (A)-CN-51 (3) or CD-35 (C)- CN-51 (13)	Replace or repair

Wiring diagram



220S6MS17

2) TEST PROCEDURE

(1) Test 15 : Check voltage at CN-52 (28) and ground.

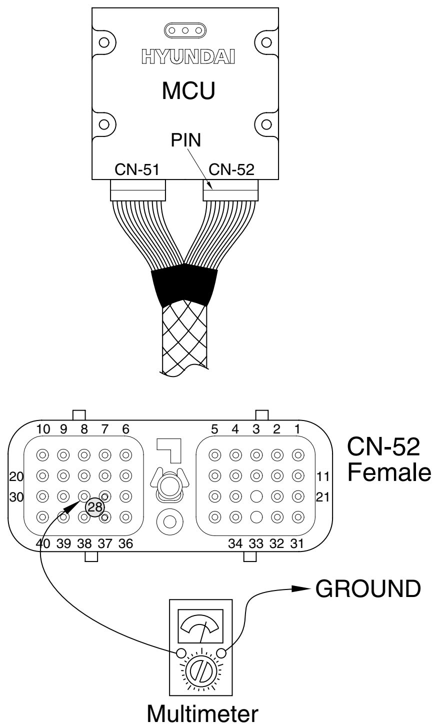
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (28) of CN-52.

③ Starting key ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V



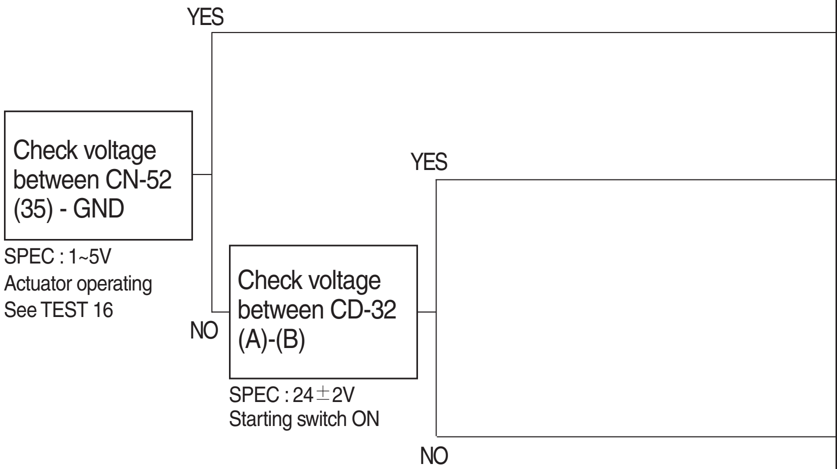
220S6MS18

12. MALFUNCTION OF BOOM UP PRESSURE SENSOR

· Fault code : HCESPN 127, FMI 0~4

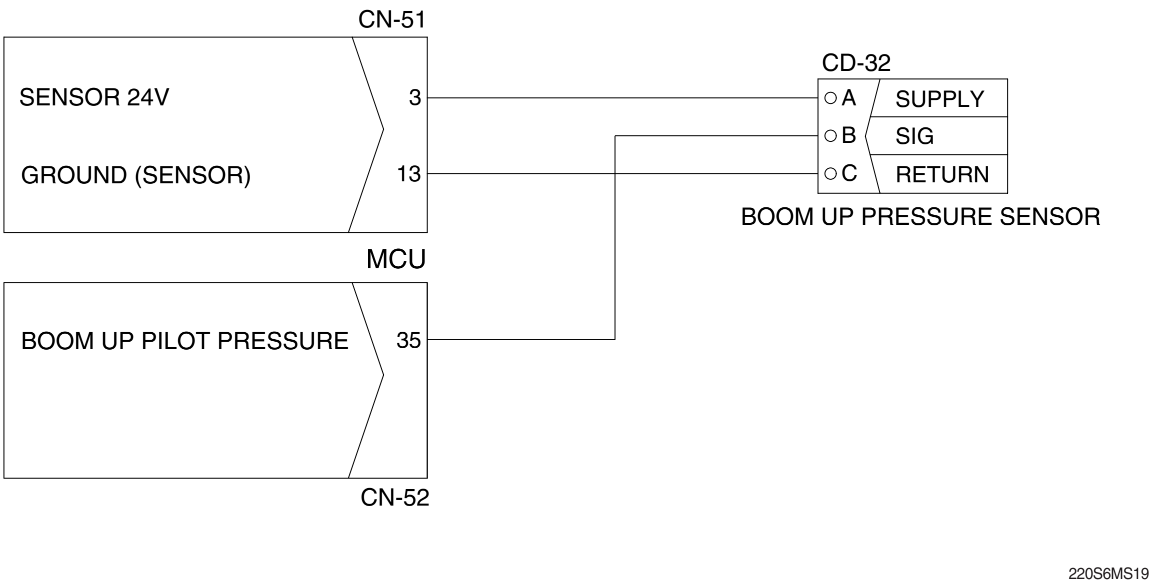
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



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

Wiring diagram

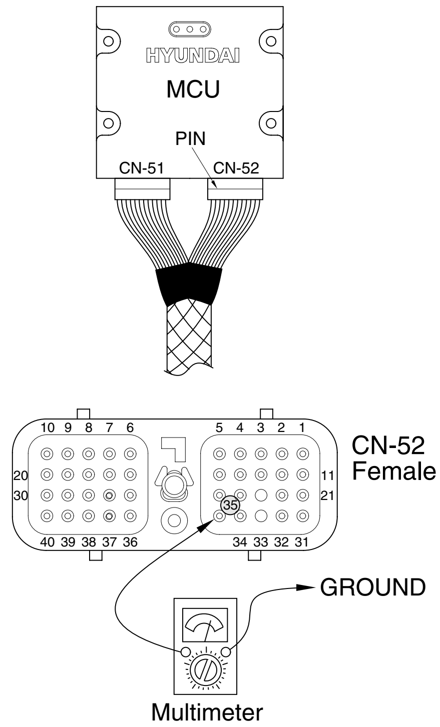


2) TEST PROCEDURE

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

① Prepare 1 piece of thin sharp pin, steel or copper.
② Insert prepared pin to rear side of connectors : One pin to (35) of CN-52.
③ Starting switch ON.
④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V



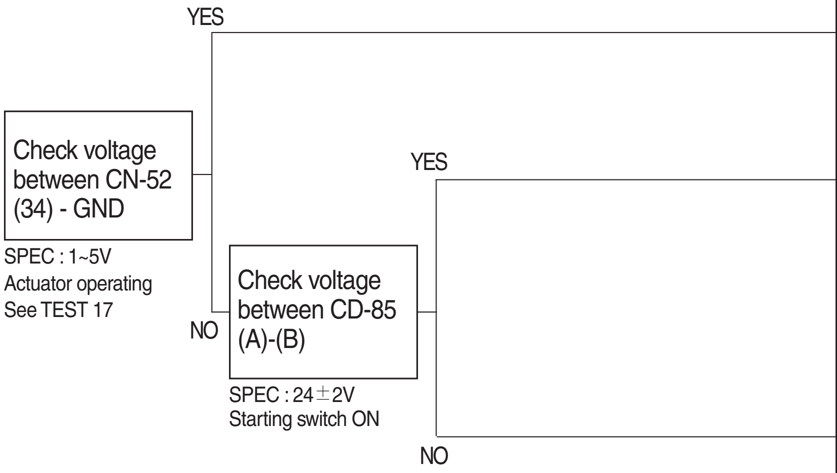
220S6MS20

13. MALFUNCTION OF BOOM DOWN PRESSURE SENSOR

· Fault code : HCESPN 128, FMI 0~4

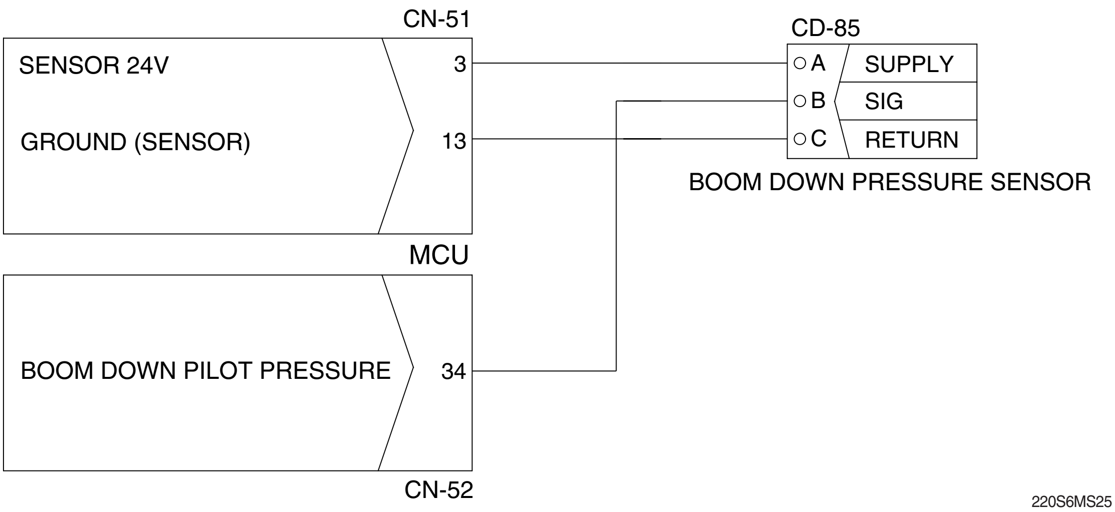
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective MCU	Replace
Detective boom up pressure sensor	Replace or repair
Short circuit or poor connection between CN-52 (34)-CD-85 (B)	Replace or repair
Short circuit or poor connection between CD-85 (A)-CN-51 (3) or CD-85 (C)- CN-51 (13)	Replace or repair

Wiring diagram



2) TEST PROCEDURE

(1) Test 17 : Check voltage at CN-52 (34) and ground.

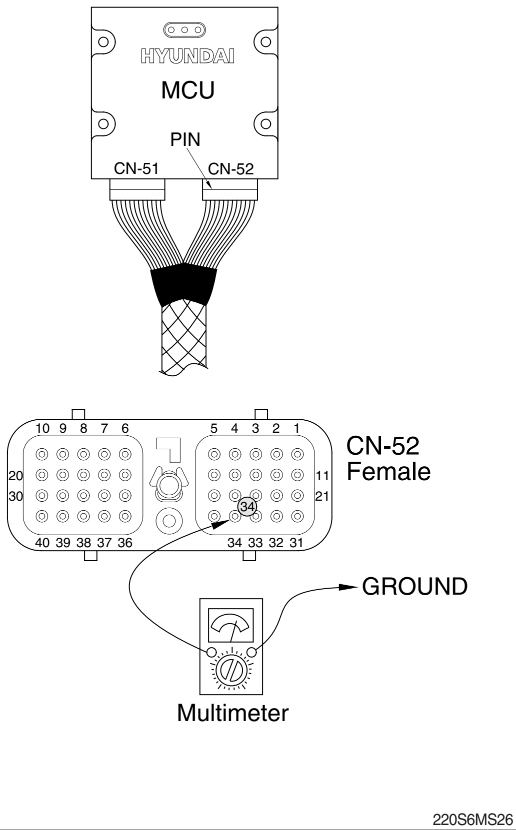
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (34) of CN-52.

③ Starting switch ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V

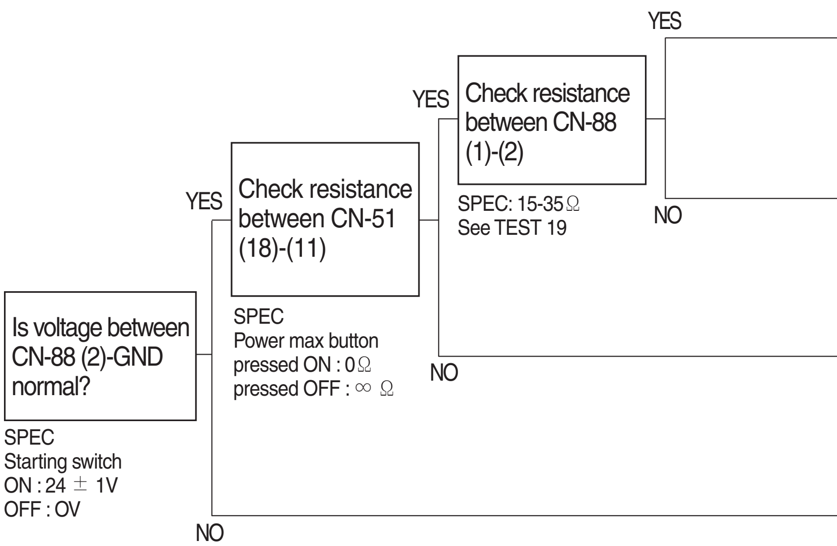


14. MALFUNCTION OF POWER MAX

· Fault code : HCESPN 166, FMI 4 or 6

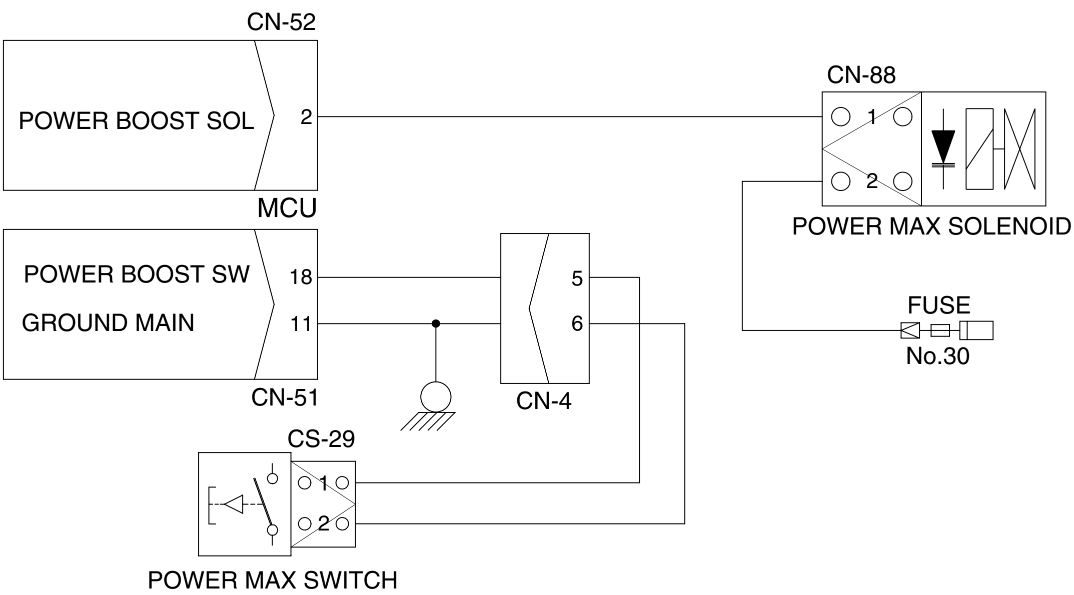
※ Before carrying out below procedure, check all the related connectors are properly inserted.

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. 30	Repair or replace

Wiring diagram

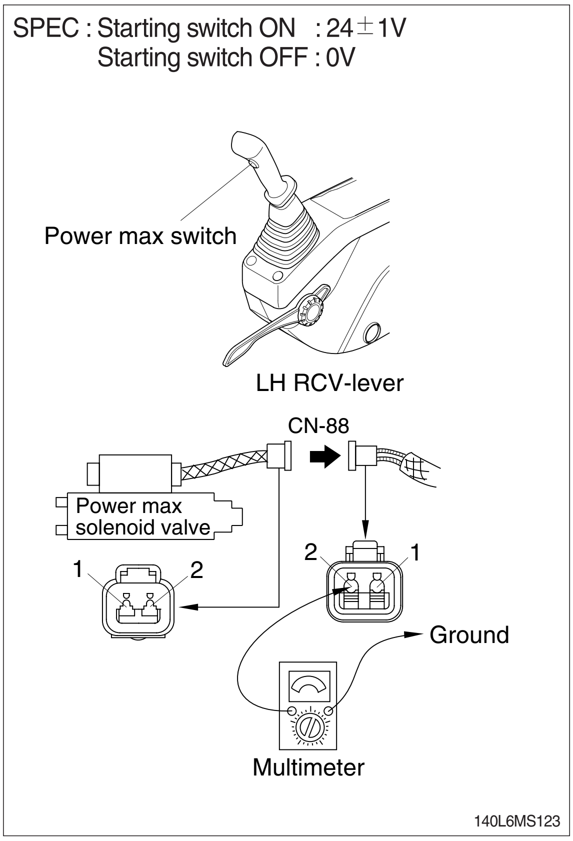


220S6MS21

2) TEST PROCEDURE

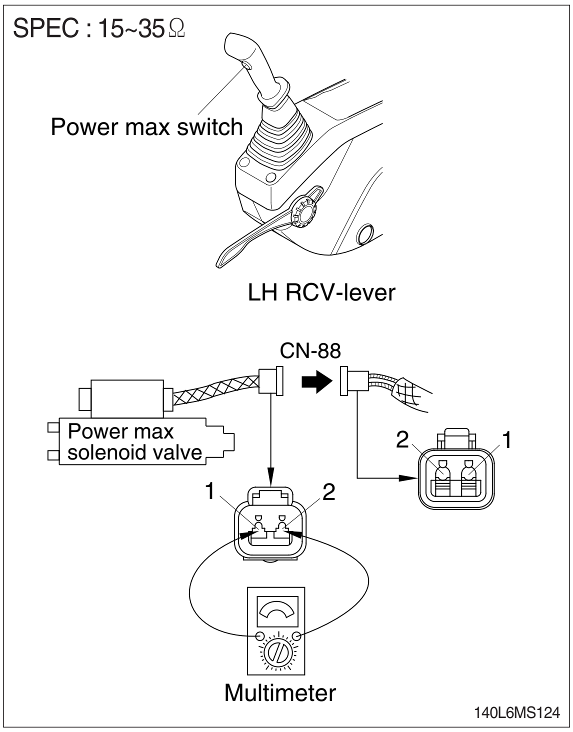
(1) Test 18: Check voltage between connector CN-88 (2) - GND.

① Disconnect connector CN-88 from power max solenoid valve.
② Start switch ON.
③ Check voltage as figure.



(2) Test 19: Check resistance of the solenoid valve between CN-88 (1)-(2).

① Starting switch OFF.
② Disconnect connector CN-88 from power max solenoid valve.
③ Check resistance as figure.



15. 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.

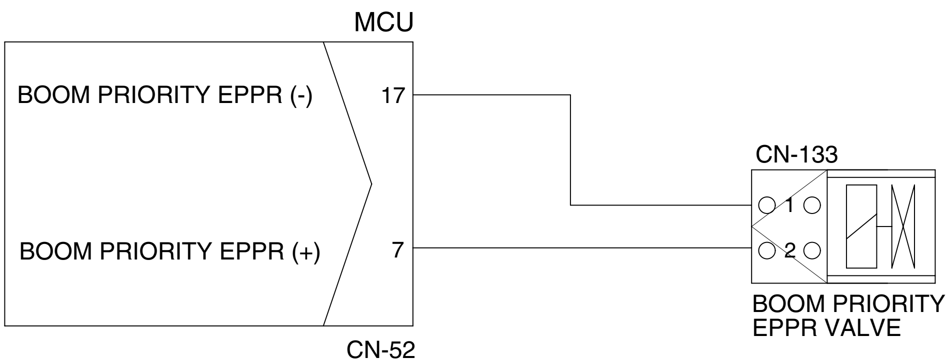
1) INSPECTION PROCEDURE

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

SPEC : 20~30V
Starting switch : ON

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

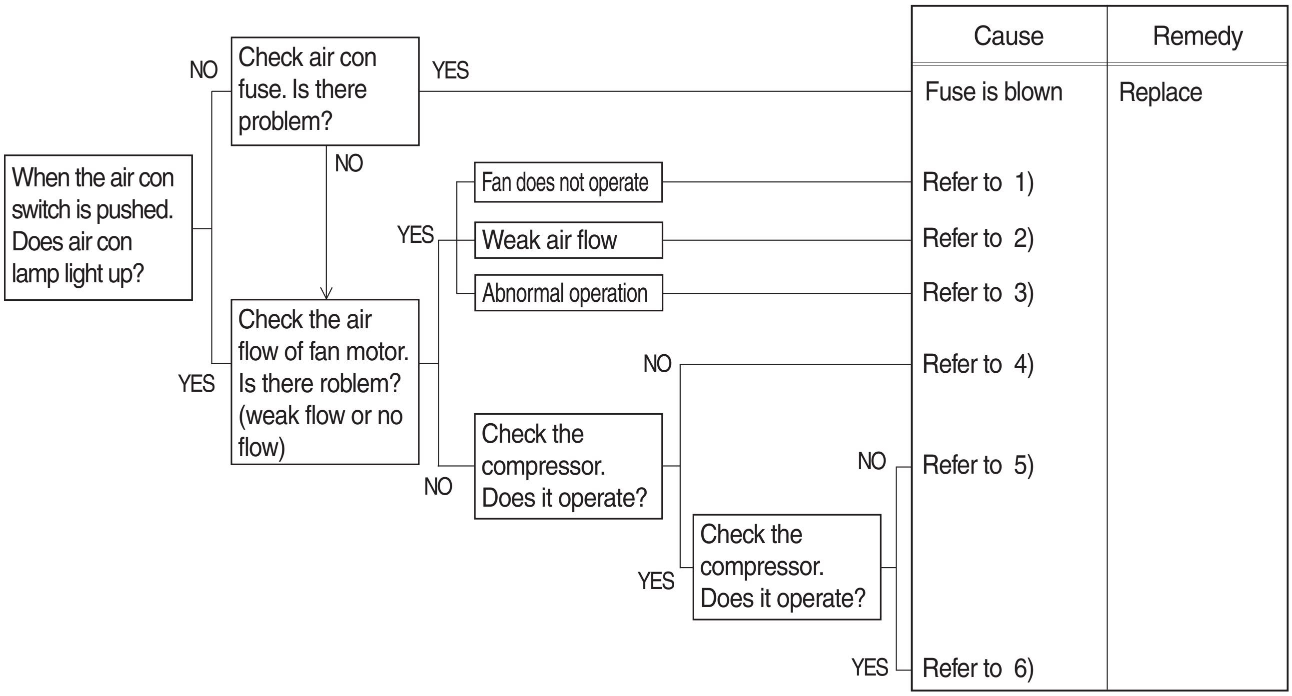
Wiring diagram



220S6MS23

GROUP 5 AIR CONDITIONER AND HEATER SYSTEM

1. AIR CONDITIONER DOES NOT OPERATE



1) FAN DOES NOT OPERATE

Cause	Check	Remedy
Fuse is blown or abnormal relay operation	* Fuse * Does relay normally operate?	Replace
Harness short or poor contact	Check any harness short or abnormal contact of connnector	Repair shortage
Fan motor failure	Supply 24V to 2 lead wire from motor and check the operation	Replace
Resistor is broken	Check current flow of resistor with tester	Replace
Fan switch failure	Push fan switch by turn and check the operation	Replace

2) WEAK AIR FLOW FROM FAN MOTOR

Cause	Check	Remedy
Clogged evaporator or obstacles around air inlet	Check if evaporator is contaminated	Clean
Leakage of air flow	Check HVAC case assembly	Adjust
Duct sensor failure	Check if evaporator is frozen	Replace

3) ABNORMAL OPERATION OF FAN MOTOR

Cause	Check	Remedy
Abnormal operation of each step of control	4 step only operate	Replace resistor
	1 or 2 step does not operate	Replace control
	3 or 4 step does not operate	Replace relay

4) COMPRESSOR DOES NOT ROTATE OR HARDLY ROTATE

Cause	Check	Remedy
Loose belt	Belt shaking is severe	Adjust tension
Failure of compressor itself	Belt slip	Repair or Replace
Low voltage of battery	Slip when rotate	Charge battery
Fieldcoil short	Slip when rotate	Replace magnetic clutch
Oily clutch face	Contamination around clutch	Replace magnetic clutch, clean
Fieldcoil is broken	Magnetic clutch does not operate or "∞" resistance	Replace compressor
Leakage of refrigerant or oil inside	Check if wet with oil	Replace compressor Charge refrigerant

5) COMPRESSOR OPERATE NORMALLY AND AIR FLOW IS NORMAL

Cause	Check	Remedy
Shortage of refrigerant	When air con operate during 5~10 min small temperature difference between high and low pressure pipes.	Repair leakage joint Charge refrigerant
Overcharge of refrigerant	*Magnetic clutch on/off rapidly *High pressure over specification *Lukewarm air from nozzle	Recharge refrigerant following specification
Lower pressure than normal condition at low side	Shortage of refrigerant	Make up refrigerant
	Clogged receive dryer	Replace receive dryer
	Clogged expansion valve	Replace expansion valve
	Clogged or crushed pipe	Replace pipe or clean
	Failure of duct sensor	Replace duct sensor

6) COMPRESSOR OPERATE NORMALLY AND AIR FLOW IS NORMAL

Cause	Check	Remedy
Lower pressure than normal condition at low side	Failure of duct sensor Magnetic clutch off before air temperature sufficiently down	Replace duct sensor or adjust location
	Defective compressor gasket When compressor off, high and low pressure balance immediatly	Repair compressor or Replace
Higher pressure than normal condition at high side	Failure of condensing Contamination on condenser or insufficient air flow from fan	Clean the condenser Repair fan
	Overcharge of refrigerant	Adjust refrigerant
	Entrained air	Vacuum and recharge
Lower pressure than normal condition at high side	Shortage of refrigerant	Make up refrigerant

SECTION 7 MAINTENANCE STANDARD

GROUP 1 OPERATIONAL PERFORMANCE TEST

1. PURPOSE

Performance tests are used to check :

1) OPERATIONAL PERFORMANCE OF A NEW MACHINE

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

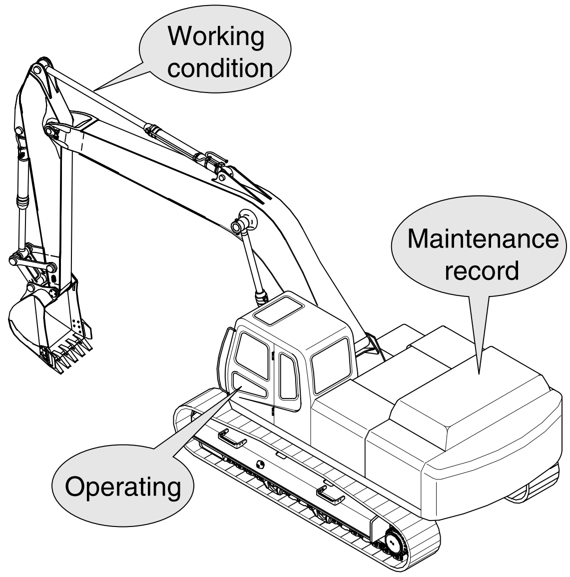
2) OPERATIONAL PERFORMANCE OF A WORKING MACHINE

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

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

3) OPERATIONAL PERFORMANCE OF A REPAIRED MACHINE

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

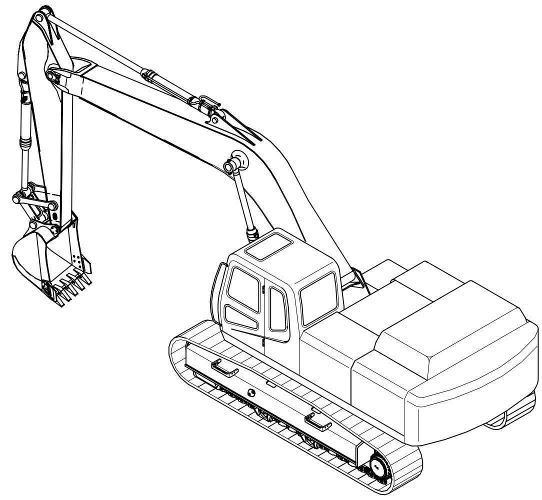


21077MS01

2. TERMINOLOGY

1) STANDARD

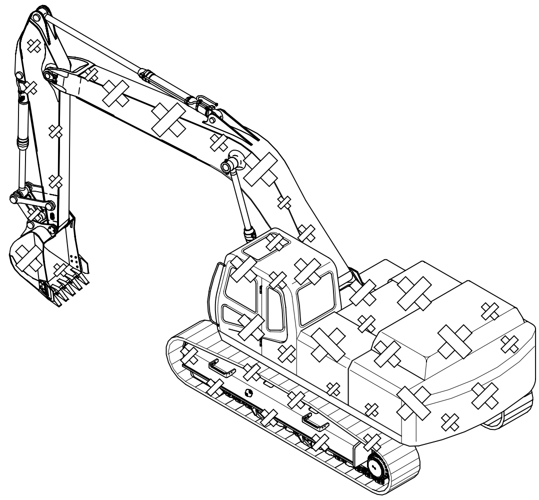
Specifications applied to the brand-new machine, components and parts.



21077MS02

2) SERVICE LIMIT

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



21077MS03

3. OPERATION FOR PERFORMANCE TESTS

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

(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.

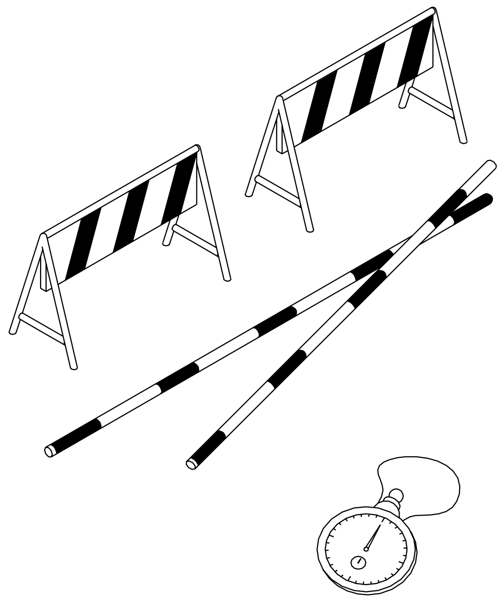
④ Avoid polluting the machine and the ground with leaking oil. Use oil pans to catch escaping oil. Pay special attention to this when removing hydraulic pipings.

(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

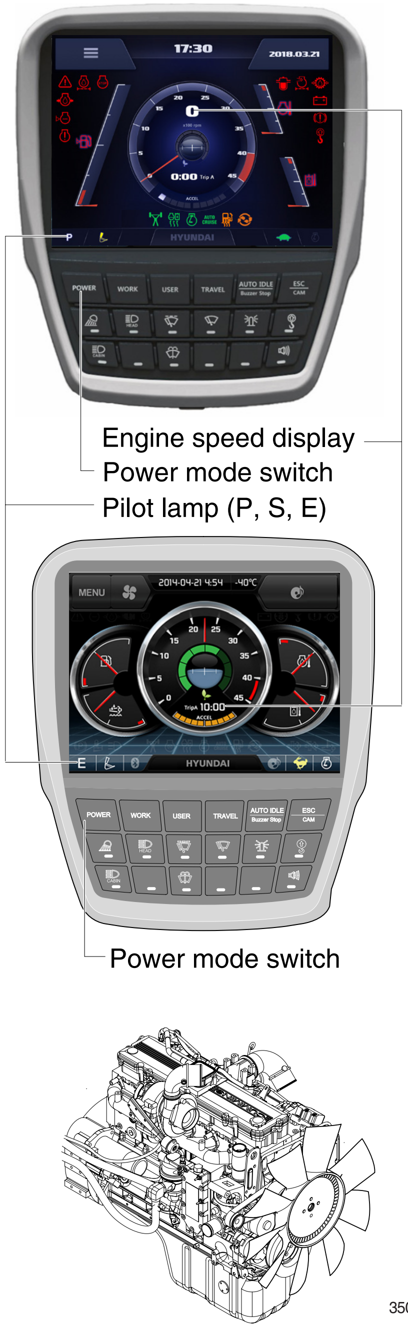
① Start the engine. The engine will run at start idle speed. Measure engine speed with a engine rpm display.

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.



350SA7MS01

(4) Evaluation

The measured speeds should meet the following specifications.

Unit : rpm

Model	Engine speed	Standard	Remarks
HX350LT3	Start idle	900±100	
	P mode	1650±50	
	S mode	1550±50	
	E mode	1450±50	
	Auto decel	1000±100	
	One touch decel	900±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 ㎙ test track.

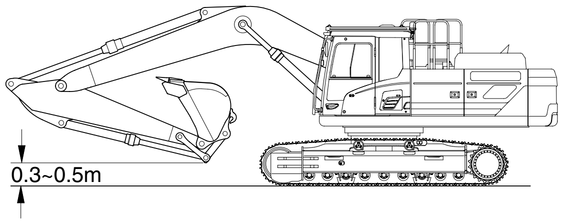
(2) Preparation

① Adjust the tension of both tracks to be equal.

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

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

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



350SA7MS02

(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.

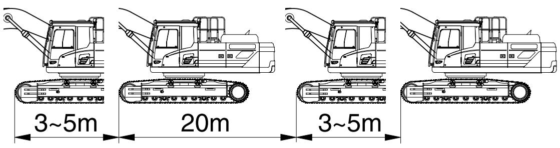
· Power mode switch : P mode

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.



350SA7MS03

(4) Evaluation

The average measured time should meet the following specifications.

Unit : Seconds / 20 ㎙

Model	Travel speed	Standard	Maximum allowable	Remarks
HX350LT3	1 Speed	20.3±2.0	26.4	
	2 Speed	11.3±1.0	15.7	

4) TRACK REVOLUTION SPEED

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

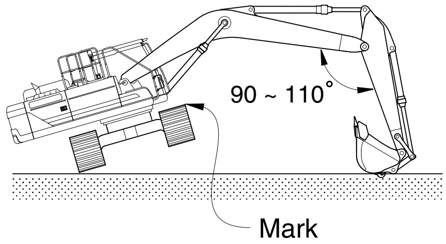
(2) Preparation

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

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

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

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



350SA7MS04

(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
HX350LT3	1 Speed	30.8±2.0	40.3
	2 Speed	17.5±2.0	24.0

5) TRAVEL DEVIATION

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

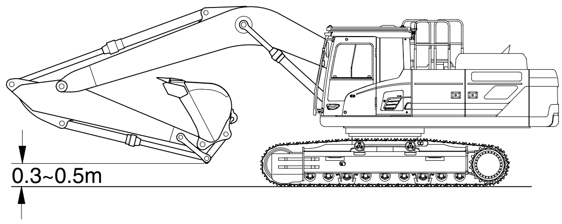
(2) Preparation

① Adjust the tension of both tracks to be equal.

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

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

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



350SA7MS02

(3) Measurement

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

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

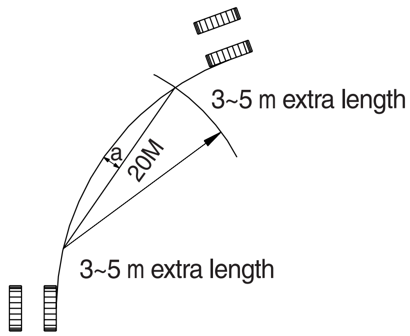
· Power mode switch : P mode

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

④ Measure the distance between a straight 20 ㎙ 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.



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(4) Evaluation

Mistrack should be within the following specifications.

Unit : ㎜ / 20 ㎙

Model	Standard	Maximum allowable	Remarks
HX350LT3	200 below	250	-

6) SWING SPEED

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

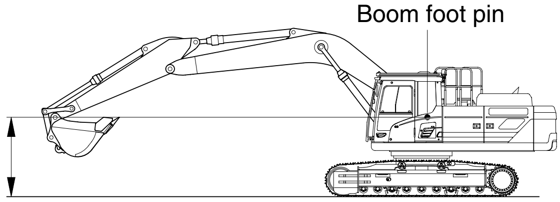
(2) Preparation

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.



350SA7MS05

(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
HX350LT3	P mode	17.6±1.5	21.5

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.

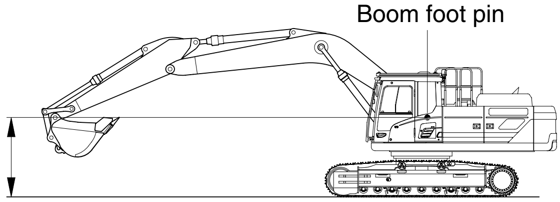
② Place the machine on flat, solid ground with ample space for swinging. Do not conduct this test on slopes.

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.



350SA7MS05

(3) Measurement

① Conduct this test in the M mode.

② Select the following switch positions.

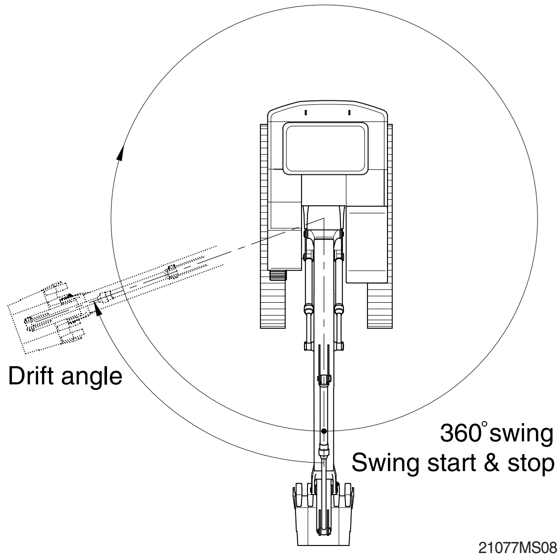
· Power mode switch : P mode

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

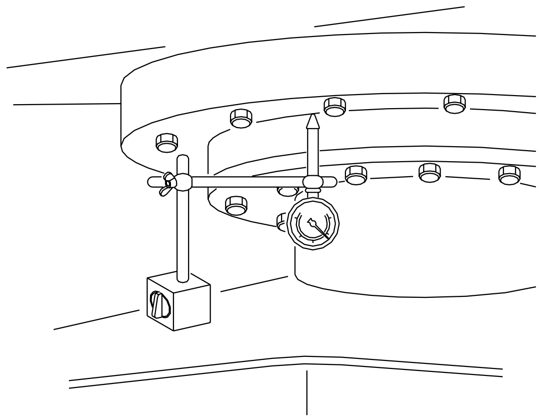
The measured drift angle should be within the following specifications.

Unit : Degree

Model	Power mode switch	Standard	Maximum allowable	Remarks
HX350LT3	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.

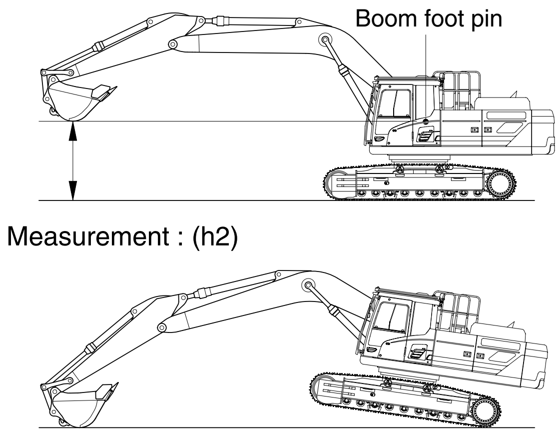
⑥ Bucket should be empty.

(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



350SA7MS06

(4) Evaluation

The measured drift should be within the following specifications.

Unit : mm

Model	Standard	Maximum allowable	Remarks
HX350LT3	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.

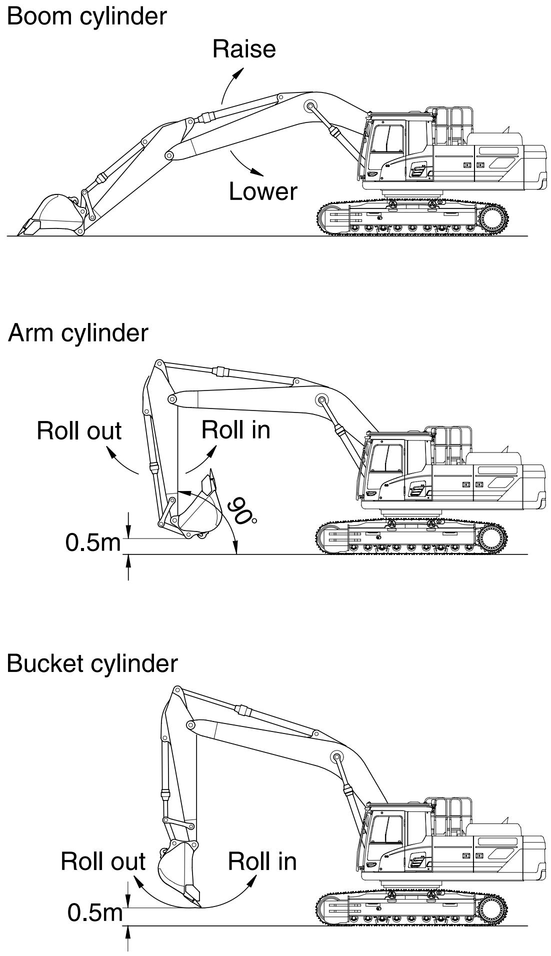
(2) Preparation

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.



350SA7MS07

(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

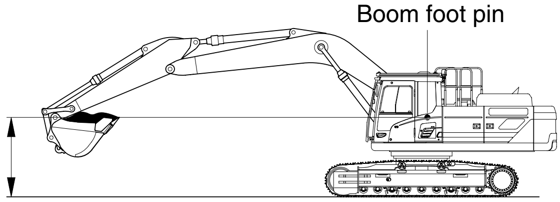
The average measured time should meet the following specifications.

Unit : Seconds

Model	Function		Standard	Maximum allowable	Remarks
HX350LT3	Boom raise		3.7±0.4	4.1	
	Boom lower		3.2±0.4	3.3	
	Arm in	Regen ON	3.0±0.4	3.6	
	Arm out		3.1±0.3	3.5	
	Bucket load		2.5±0.4	3.1	
	Bucket dump		2.6±0.3	2.8	

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.



350SA7MS08

(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.

(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
HX350LT3	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
HX350LT3	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
HX350LT3	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.

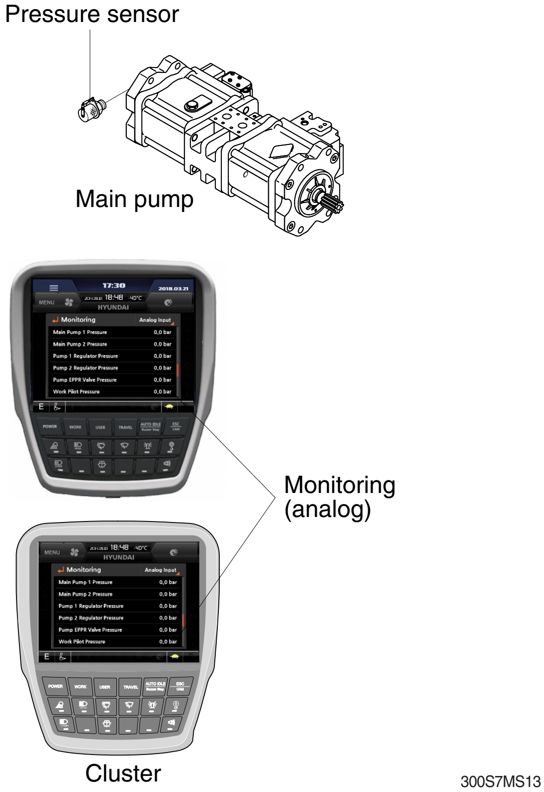
(2) Measurement

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.



(3) Evaluation

The average measured pressure should meet the following specifications:

Unit : kgf / cm2

Model	Engine speed	Standard	Allowable limits	Remarks
HX350LT3	P mode	40^{+2}_{0}	-	

14) FOR TRAVEL SPEED SELECTING PRESSURE:

(1) Preparation

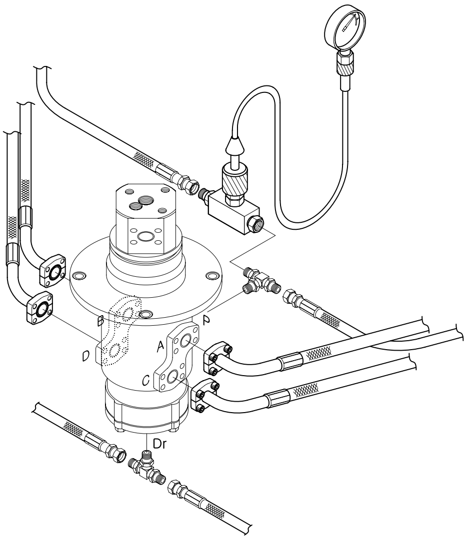
① Stop the engine.

② Loosen the cap and relieve the pressure in the tank by pushing the top of the air breather.

③ To measure the speed selecting pressure: Install a connector and pressure gauge assembly to turning joint P port as shown.

④ Start the engine and check for on leakage from the adapter.

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



21077MS13

(2) Measurement

① Select the following switch positions.

- 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.

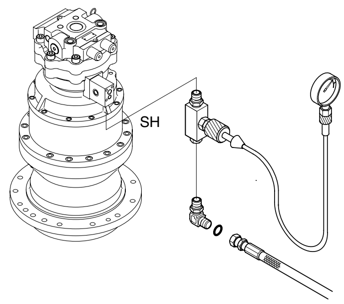
Unit : kgf / cm^2

Model	Travel speed mode	Standard	Maximum allowable	Remarks
HX350LT3	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.



350SA7MS15

(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
HX350LT3	Brake disengaged	40	31~49	
	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).

300S7MS16

(3) Evaluation

The average measured pressure should meet the following specifications.

Unit : kgf / cm^2

Model	Engine speed	Standard	Allowable limits	Remarks
HX350LT3	High idle	33±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.

300S7MS16

(3) Evaluation

The average measured pressure should be within the following specifications.

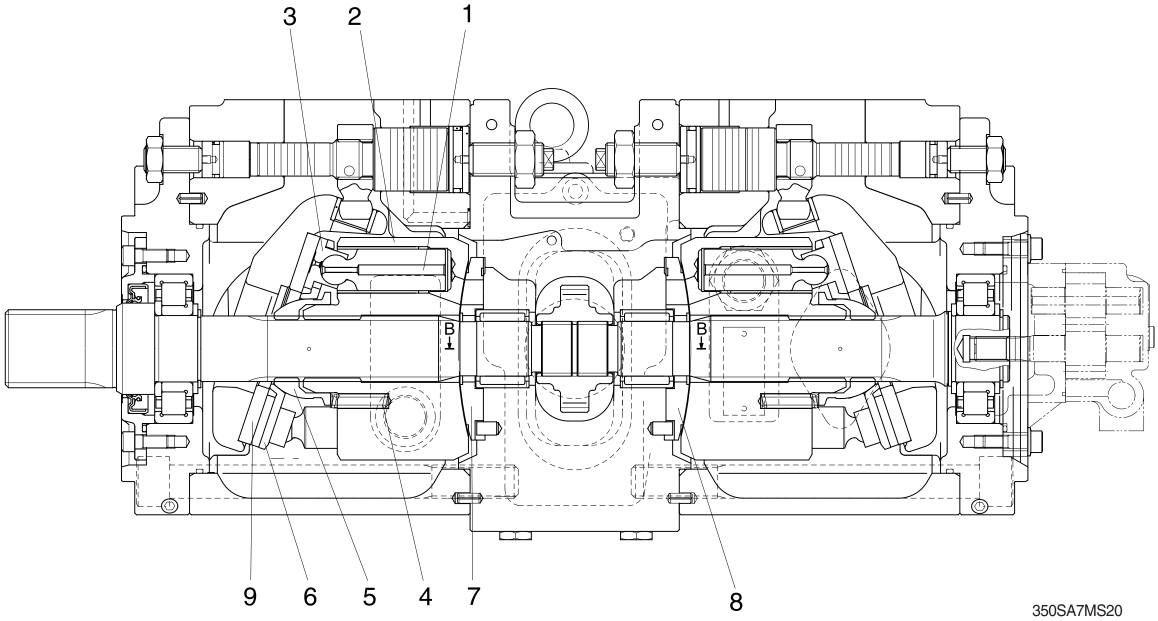
Unit : kgf / cm^2

Model	Function to be tested	Standard	Port relief setting
HX350LT3	Boom, Arm, Bucket	350 (380)±10	390±10
	Travel	350±10	-
	Swing	300±10	-

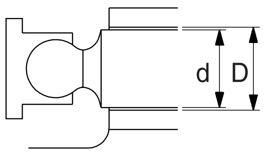
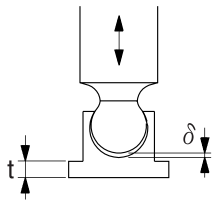
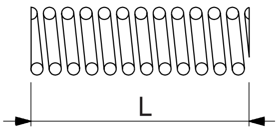
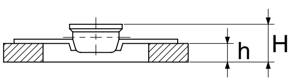
(　) : Power boost

GROUP 2 MAJOR COMPONENT

1. MAIN PUMP



350SA7MS20

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		

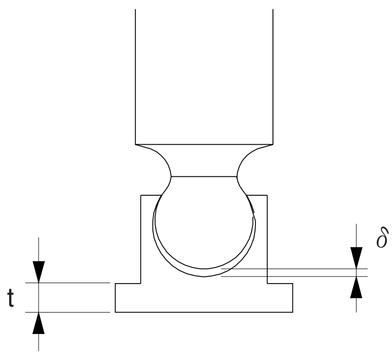
2. MAIN CONTROL VALVE

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) WEARING PARTS

Inspection item	Standard dimension	Recommended replacement value	Counter measures
Clearance between piston and cylinder block bore	0.041	0.060	Replace piston or cylinder block
Thickness of valve plate	6	5.88	Replace
Play between piston and shoe caulking section (δ)	0.025	0.1	Replace assembly of piston and shoe
Thickness of shoe (t)	6.6	6.5	Replace assembly of piston and shoe
Combined height of retainer plate and spherical bushing (H-h)	17.6	17.3	Replace set of retainer plate and sperical bushing
Thickness of friction plate	2.94	2.7	Replace



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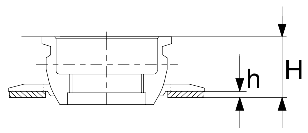

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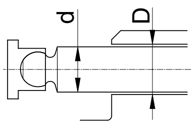
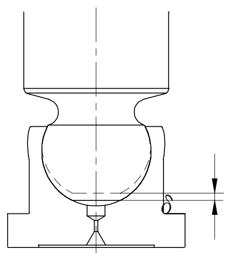
2) SLIDING PARTS

Part name	Standard roughness	Allowable roughness	Remark
Shoe	Rmax=1S (Ra=0.2a) (LAPPING)	4S (Ra=0.1a)	
Shoe plate	Rmax=0.4S (Ra=0.1a) (LAPPING)	3S (Ra=0.8a)	
Cylinder	Rmax=0.4S (Ra=0.1a) (LAPPING)	3S (Ra=0.8a)	
Valve plate	Rmax=0.4S (Ra=0.1a) (LAPPING)	2S (Ra=0.5a)	

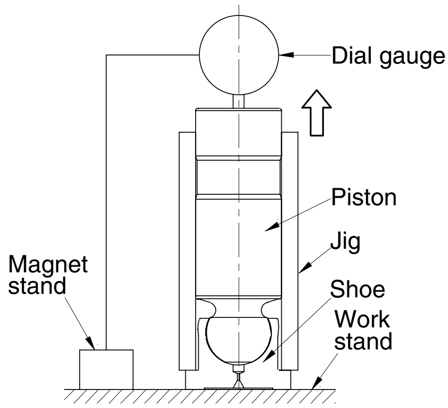
4. TRAVEL MOTOR

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

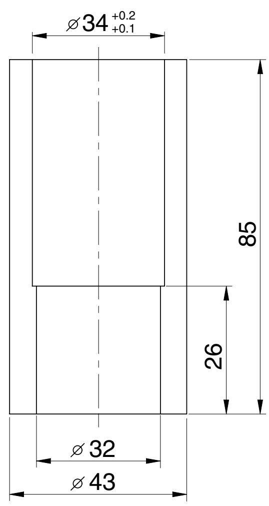
Check item		Measuring method	Criteria	Allowable	Remedy
Sliding surface of cylinder block, valve plate and swash plate	Surface roughness of cylinder block, valve plate and swas plate	Measure the surface roughness by roughness tester	Below 0.4 Zμ	Below 3.0 Zμ	Replace or repair ※ Lap together the surfaces of both cylinder block and valve plate to remedy their roughness (# 1200 power)
	Swash plate - hardness of sliding surface	Measure the surface hardness of swash plate by hardness tester	Over HS78	HS74	Replace
Clearance between piston and cylinder block	Outer dia of piston d max - d min	Measure outer dia of piston and bore of cylinder block at least 3 places in the longitudinal direction with micrometer and obtain : max outer dia = d max min outer dia = d min max inner dia = D max min inner dia = D min	0.01 mm	0.05 mm	Replace piston or cylinder block ※ In exchanging pistons, replace all of nine pistons at the same time
	Inner dia of cylinder bore D max - D min		0.01 mm	0.022 mm	
Measurement position	Clearance D-d		0.037~ 0.047 mm	0.065 mm	
Play between piston and shoe	Play between calked piston and shoe (δ)	With the jig, hold down the shoe on work stand and pull up the piston vertical direction to measure the play between piston and shoe	0~0.1 mm	0.3 mm	Replace piston



Play



Method



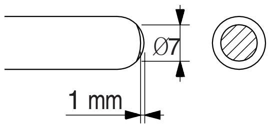
Jig for measuring play

29097MS10

Check item	Measuring method	Criteria	Allowable	Remedy
Parking brake torque	After completion of assembly, set the torque wrench on the shaft end, and measure the braking torque generated when the shaft starts to rotate	92.6 kgf · m (670 lbf · ft)	82.8 kgf · m (599 lbf · ft)	Replace all of separator, friction plates and springs
Standard of replacing friction and separating plate. When measuring parking brake torque, it needs to disassemble traveling unit to motor and reduction gear portion, and it's so hard. The right allowable value is a standard of replacing friction and separating plate. If it is impossible to disassemble traveling unit, refer to the right value.	Measure the total thickness of 4 pieces of friction plate and 5 pieces of separating plate.	22.76 mm	Thickness : 21.3 mm	Replace all separating and friction plates and springs.

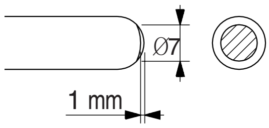
Check item	Measuring method	Judging criteria and remedy
Shaft	Measure the wear at contacting surface of oil seal (3) with the surface roughness tester	If the depth of shaft wear is less than 0.05 mm, the shaft is reusable. ※ In case of replacing the shaft (9), replace oil seal (3) at the same time.
Bearings	Replace bearings (10, 51) after decided hours	Replace bearings (10, 51) before hour meter of host machine indicates 10,000 hours. ※ In case replacing the bearings (10, 51), replace both inner and outer races at the same time. ※ Also the bearing shims (52) must be readjusted when replaced shaft (9) and/or bearings (10, 51). Contact dealers for jigs and tools required.
Splines	Replace if the wear of splines exceeds the allowable value	If the wear of splines is less than 0.3 mm, the spline is reusable.
Overload relief valve	Do not try to adjust the valve, since special hydraulic test bench is required for inspecting and adjusting the pressure	Replace relief valve part as an assembly each time the host machine works for 10,000 hours.

5. RCV LEVER

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

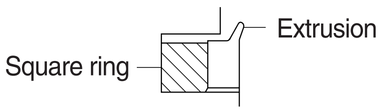
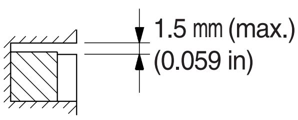
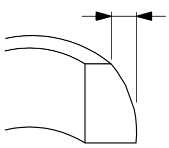
Notes 1. It is desirable to replace seal materials, such as O-rings, every disassembling. However, they may be reused, after being confirmed to be free of damage.
2. When loosening the hexagon socket head cap screw (125), replace the seal washers (121) without fail.

6. RCV PEDAL

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

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

7. TURNING JOINT

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

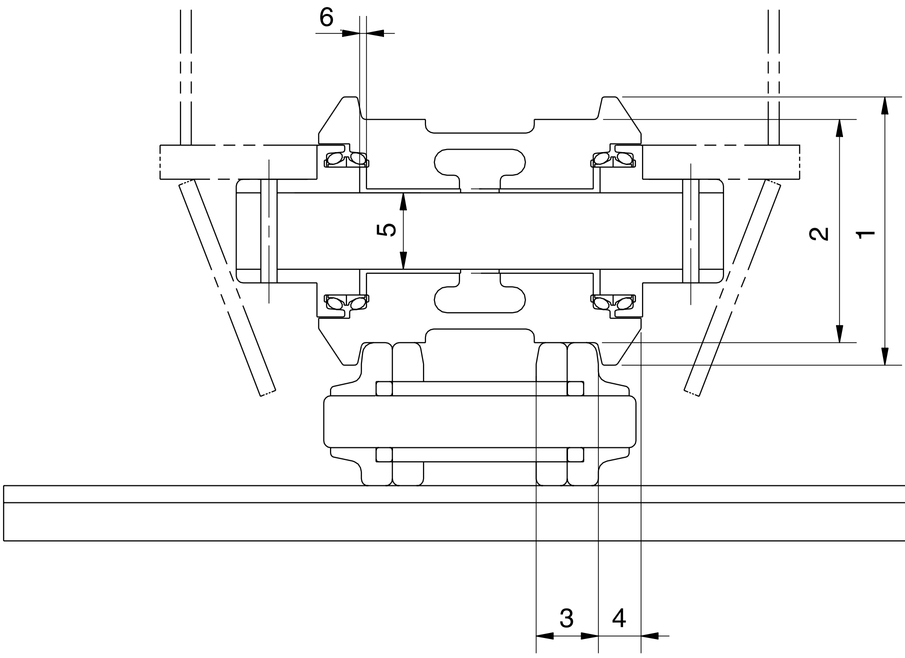
8. CYLINDER

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

GROUP 3 TRACK AND WORK EQUIPMENT

1. TRACK

1) TRACK ROLLER

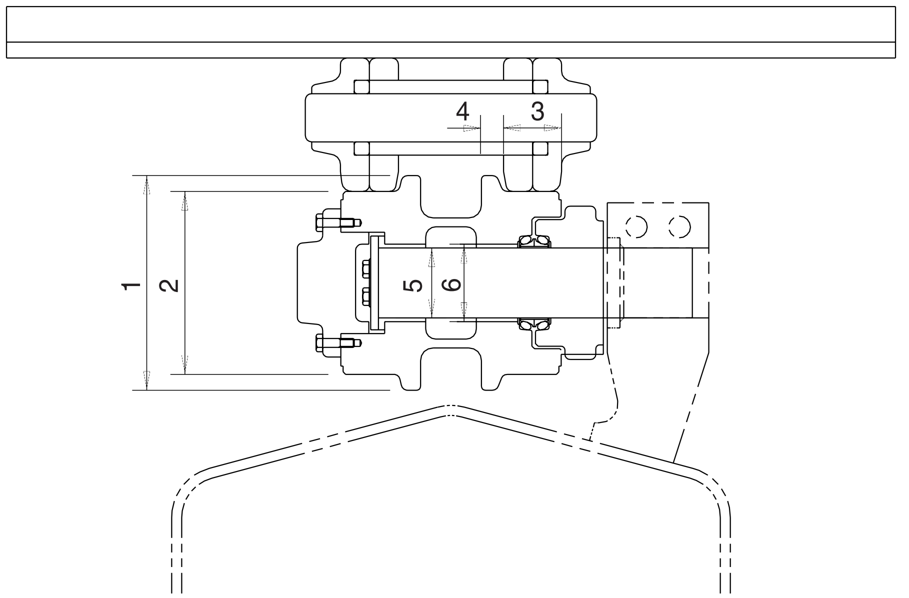


21037MS01

Unit : mm

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

2) CARRIER ROLLER

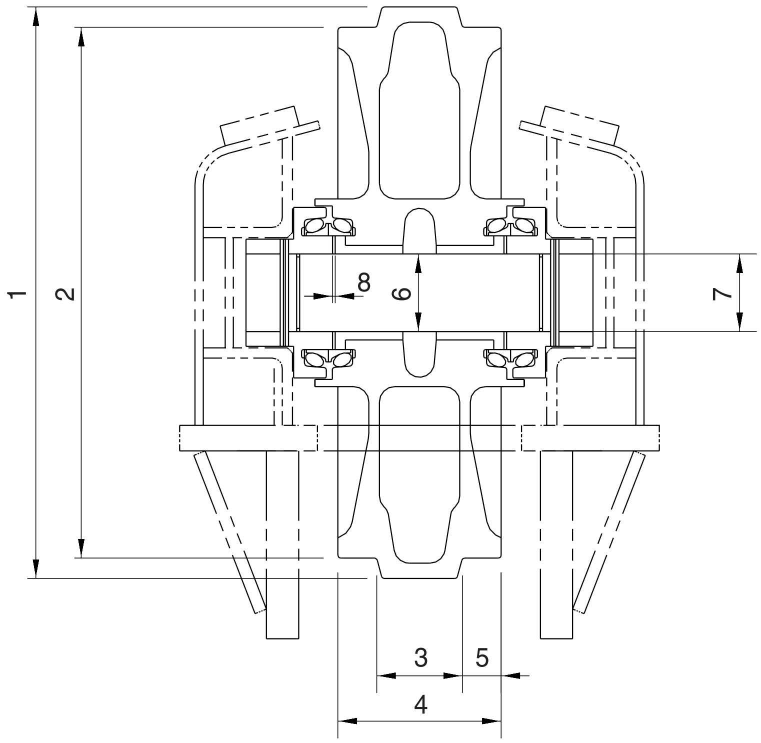


32037MA37

Unit : ㎜

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

3) IDLER

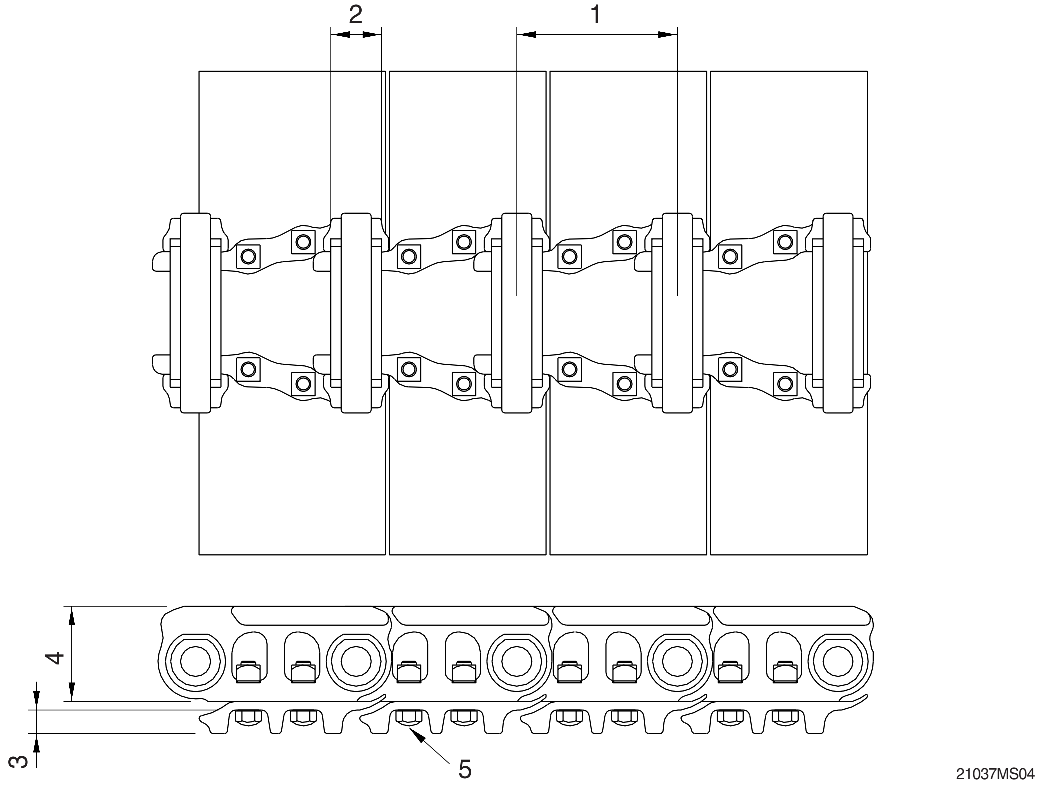


21037MS03

Unit : mm

<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">Ø646</td><td colspan="2">–</td></tr>
<tr><td>2</td><td>Outside diameter of tread</td><td colspan="2">Ø594</td><td colspan="2">Ø588</td></tr>
<tr><td>3</td><td>Width of protrusion</td><td colspan="2">102</td><td colspan="2">–</td></tr>
<tr><td>4</td><td>Total width</td><td colspan="2">203</td><td colspan="2">–</td></tr>
<tr><td>5</td><td>Width of tread</td><td colspan="2">50.5</td><td colspan="2">56.5</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>Hole</td></tr>
<tr><td>Ø90 $^{0}_{-0.035}$</td><td>Ø90.35 $^{+0.05}_{0}$</td><td>0.35 to 0.435</td><td>2.0</td></tr>
<tr><td>7</td><td>Clearance between shaft and support</td><td>Ø90 $^{0}_{-0.035}$</td><td>Ø90 $^{+0.09}_{+0.036}$</td><td>0.036 to 0.125</td><td>1.2</td><td>Replace</td></tr>
<tr><td>8</td><td>Side clearance of idler (both side)</td><td colspan="2">Standard clearance
0.4 to 1.2</td><td colspan="2">Clearance limit
2.0</td><td>Replace</td></tr>
</table>

4) TRACK



Unit : ㎜

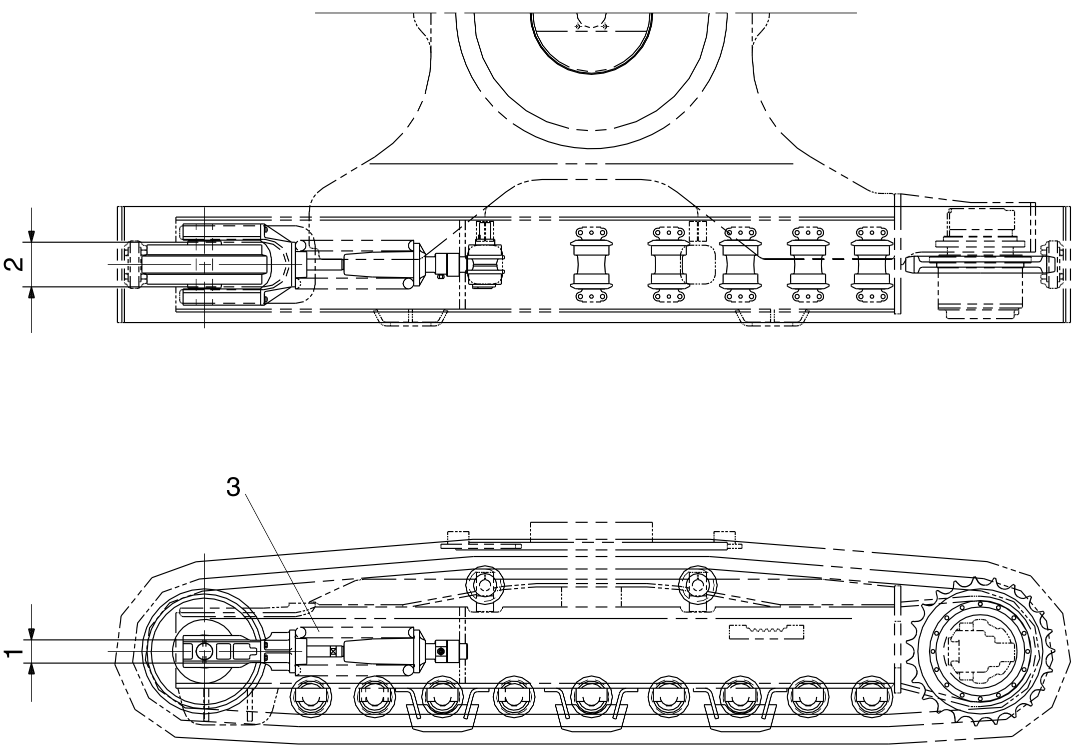
No.	Check item	Criteria		Remedy
1	Link pitch	Standard size	Repair limit	Turn or replace
		216	221	
2	Outside diameter of bushing	Ø66.5	Ø60.9	Rebuild or replace
3	Height of grouser	30	23	
4	Height of link	116	111	
5	Tightening torque	Initial tightening torque : 115±5 kgf · m		Retighten

(Mahcine Serial No. : #0145-)

Unit : ㎜

No.	Check item	Criteria		Remedy
1	Link pitch	Standard size	Repair limit	Turn or replace
		216	221	
2	Outside diameter of bushing	Ø66.9	Ø61.3	Rebuild or replace
3	Height of grouser	30	23	
4	Height of link	116	111	
5	Tightening torque (Tightening angle method)	Initial tightening torque : 50±5 kgf · m Additional tightening angle : 70±6°		Retighten

5) TRACK FRAME AND RECOIL SPRING



21037MS05

Unit : ㎜

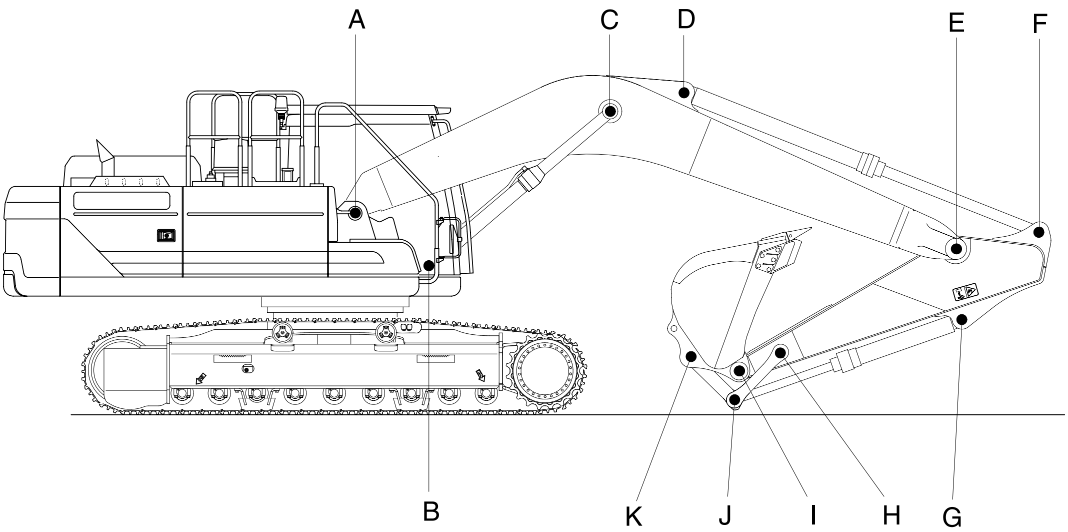
No.	Check item	Criteria					Remedy
1	Vertical width of idler guide			Standard size	Tolerance	Repair limit	Rebuild or replace
		Track frame		132	2.0 0	136	
		Idler support		130	0 -1.5	126	
2	Horizontal width of idler guide	Track frame		292	2.0 0	297	
		Idler support		290	–	288	
3	Recoil spring	Standard size			Repair limit		Replace
		Free length	Installation length	Installation load	Free length	Installation load	
		710	580	19012 ㎏	–	15210 ㎏	

(Mahcine Serial No. : #0145-)

Unit : ㎜

No.	Check item	Criteria					Remedy
1	Vertical width of idler guide			Standard size	Tolerance	Repair limit	Rebuild or replace
		Track frame		122	3.0 -1.0	126	
		Idler support		120	0 -0.5	116	
2	Horizontal width of idler guide	Track frame		238	3.0 -1.0	243	
		Idler support		235	–	233	
3	Recoil spring	Standard size			Repair limit		Replace
		Free length	Installation length	Installation load	Free length	Installation load	
		716	610	20857 ㎏	–	16686 ㎏	

2. WORK EQUIPMENT



350SA7MS21

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	110	109	108.5	110.5	111	Replace
B	Boom Cylinder Head	90	89	88.5	90.5	91	〃
C	Boom Cylinder Rod	100	99	98.5	100.5	101	〃
D	Arm Cylinder Head	90	89	88.5	90.5	91	〃
E	Boom Front	100	99	98.5	100.5	101	〃
F	Arm Cylinder Rod	90	89	88.5	90.5	91	〃
G	Bucket Cylinder Head	90	89	88.5	90.5	91	〃
H	Arm Link	80	79	78.5	80.5	81	〃
I	Bucket and Arm Link	90	89	88.5	90.5	91	〃
J	Bucket Cylinder Rod	80	79	78.5	80.5	81	〃
K	Bucket Link	90	89	88.5	90.5	91	〃

SECTION 8 DISASSEMBLY AND ASSEMBLY

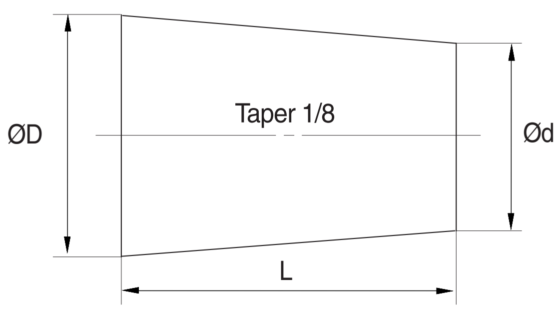
SECTION 8 DISASSEMBLY AND ASSEMBLY

GROUP 1 PRECAUTIONS

1. REMOVAL WORK

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

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



2. INSTALL WORK

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

2) Install the hoses without twisting or interference.

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

4) Bend the cotter pin or lock plate securely.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

※ If the hydraulic cylinder has been replaced, carry out this procedure before assembling the rod to
※ the work equipment.
Carry out the same operation on machines that have been in storage for a long time after completion of repairs.

3. COMPLETING WORK

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

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

3) If the piping or hydraulic equipment, such as hydraulic cylinders, pumps, or motors, have been removed for repair, always bleed the air from the system after reassembling the parts.

4) Add the specified amount of grease (molybdenum disulphied grease) to the work equipment related parts.

GROUP 2 TIGHTENING TORQUE

1. MAJOR COMPONENTS

No.	Descriptions		Bolt size	Torque	
				kgf · m	lbf · ft
1	Engine	Engine mounting bolt (engine-bracket)	M12 × 1.75	11.5 ± 1.0	83.2 ± 7.2
2		Engine mounting bolt (bracket-frame, FR)	M24 × 3.0	90 ± 9.0	651 ± 65.1
3		Engine mounting bolt (bracket-frame, RR)	M24 × 3.0	90 ± 9.0	651 ± 65.1
4		Radiator mounting bolt	M16 × 2.0	29.7 ± 4.5	215 ± 32.5
5		Coupling mounting socket bolt	M18 × 2.5	46.5 ±2.5	336 ±18.1
6		Fuel tank mounting bolt	M20 × 2.5	57.8 ± 5.8	418 ± 42.0
7	Hydraulic system	Main pump housing mounting bolt	M10 × 1.5	6.5 ± 0.7	47 ± 5.1
8		Main pump mounting socket bolt	M20 × 2.5	57.9 ± 8.7	419 ± 62.9
9		Main control valve mounting nut	M12 × 1.75	12.2 ± 1.3	88.2 ± 9.4
10		Hydraulic oil tank mounting bolt	M20 × 2.5	57.9 ± 5.8	419 ± 42
11		Turning joint mounting bolt, nut	M12 × 1.75	12.3 ± 1.3	89.0 ± 9.4
12	Power train system	Swing motor mounting bolt	M20 × 2.5	57.9 ± 5.8	419 ± 42
13		Swing bearing upper part mounting bolt	M24 × 3.0	100 ± 10	723 ± 72.3
14		Swing bearing lower part mounting bolt	M24 × 3.0	100 ± 10	723 ± 72.3
15		Travel motor mounting bolt	M24 × 3.0	84 ± 8.0	608 ± 57.9
16		Sprocket mounting bolt	M20 × 2.5	57.9 ± 6.0	419 ± 43.4
17	Under carriage	Upper roller mounting bolt, nut (STD)	M16 × 2.0	29.7 ± 3.0	215 ± 21.7
18		Upper roller mounting bolt, nut (H/WALKER)	M20 × 2.5	57.9 ± 6.0	419 ± 43.4
19		Lower roller mounting bolt	M20 × 2.5	57.9 ± 6.0	419 ± 43.4
20		Track tension cylinder mounting bolt	M16 × 2.0	29.7 ± 4.5	215 ± 32.5
21		Track shoe mounting bolt, nut	M22 × 1.5	78 ± 8.0	564 ± 57.9
22		Track guard mounting bolt	M20 × 2.5	57.9 ± 8.7	419 ± 62.9
23		Travel motor cover mounting bolt	M16 × 2.0	29.7 ± 4.5	215 ± 32.5
24	Others	Counterweight mounting bolt	M36 × 3.0	337 ± 33	2440 ± 239
25		Cab mounting bolt	M12 × 1.75	12.8 ± 3.0	92.6 ± 21.7
26		Operator's seat mounting bolt	M 8 × 1.25	4.05 ± 0.8	29.3 ± 5.8
27		Under cover mounting bolt	M12 × 1.75	12.8 ± 3.0	92.6 ± 21.7

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

2. TORQUE CHART

Use following table for unspecified torque.

1) BOLT AND NUT

(1) Coarse thread

Bolt size	8.8T		10.9T		12.9T	
	kgf · m	lbf · ft	kgf · m	lbf · ft	kgf · m	lbf · ft
M 6×1.0	0.8 ~ 1.2	5.8 ~ 8.6	1.2 ~ 1.8	8.7 ~ 13.0	1.5 ~ 2.1	10.9 ~ 15.1
M 8×1.25	2.0 ~ 3.0	14.5 ~ 21.6	2.8 ~ 4.2	20.3 ~ 30.4	3.4 ~ 5.0	24.6 ~ 36.1
M10×1.5	4.0 ~ 6.0	29.0 ~ 43.3	5.6 ~ 8.4	40.5 ~ 60.8	6.8 ~ 10.0	49.2 ~ 72.3
M12×1.75	6.8 ~ 10.2	50.0 ~ 73.7	9.6 ~ 14.4	69.5 ~ 104	12.3 ~ 16.5	89.0 ~ 119
M14×2.0	10.9 ~ 16.3	78.9 ~ 117	16.3 ~ 21.9	118 ~ 158	19.5 ~ 26.3	141 ~ 190
M16×2.0	17.9 ~ 24.1	130 ~ 174	25.1 ~ 33.9	182 ~ 245	30.2 ~ 40.8	141 ~ 295
M18×2.5	24.8 ~ 33.4	180 ~ 241	34.8 ~ 47.0	252 ~ 340	41.8 ~ 56.4	302 ~ 407
M20×2.5	34.9 ~ 47.1	253 ~ 340	49.1 ~ 66.3	355 ~ 479	58.9 ~ 79.5	426 ~ 575
M22×2.5	46.8 ~ 63.2	339 ~ 457	65.8 ~ 88.8	476 ~ 642	78.9 ~ 106	570 ~ 766
M24×3.0	60.2 ~ 81.4	436 ~ 588	84.6 ~ 114	612 ~ 824	102 ~ 137	738 ~ 991
M30×3.5	120 ~161	868 ~ 1164	168 ~ 227	1216 ~ 1641	202 ~ 272	1461 ~ 1967

(2) Fine thread

Bolt size	8.8T		10.9T		12.9T	
	kgf · m	lbf · ft	kgf · m	lbf · ft	kgf · m	lbf · ft
M 8×1.0	2.1 ~ 3.1	15.2 ~ 22.4	3.0 ~ 4.4	21.7 ~ 31.8	3.6 ~ 5.4	26.1 ~ 39.0
M10×1.25	4.2 ~ 6.2	30.4 ~ 44.9	5.9 ~ 8.7	42.7 ~ 62.9	7.0 ~ 10.4	50.1 ~ 75.2
M12×1.25	7.3 ~ 10.9	52.8 ~ 78.8	10.3 ~ 15.3	74.5 ~ 110	13.1 ~ 17.7	94.8 ~ 128
M14×1.5	12.4 ~ 16.6	89.7 ~ 120	17.4 ~ 23.4	126 ~ 169	20.8 ~ 28.0	151 ~ 202
M16×1.5	18.7 ~ 25.3	136 ~ 182	26.3 ~ 35.5	191 ~ 256	31.6 ~ 42.6	229 ~ 308
M18×1.5	27.1 ~ 36.5	196 ~ 264	38.0 ~ 51.4	275 ~ 371	45.7 ~ 61.7	331 ~ 446
M20×1.5	37.7 ~ 50.9	273 ~ 368	53.1 ~ 71.7	384 ~ 518	63.6 ~ 86.0	460 ~ 622
M22×1.5	51.2 ~ 69.2	370 ~ 500	72.0 ~ 97.2	521 ~ 703	86.4 ~ 116	625 ~ 839
M24×2.0	64.1 ~ 86.5	464 ~ 625	90.1 ~ 121	652 ~ 875	108 ~ 146	782 ~ 1056
M30×2.0	129 ~ 174	933 ~ 1258	181 ~ 245	1310 ~ 1772	217 ~ 294	1570 ~ 2126

2) PIPE AND HOSE (FLARE TYPE)

Thread size (PF)	Width across flat (mm)	kgf·m	lbf·ft
1/4"	19	4	28.9
3/8"	22	5	36.2
1/2"	27	9.5	68.7
3/4"	36	18	130.2
1"	41	21	151.9
1-1/4"	50	35	253.2

3) PIPE AND HOSE (ORFS TYPE)

Thread size (UNF)	Width across flat (mm)	kgf·m	lbf·ft
9/16-18	19	4	28.9
11/16-16	22	5	36.2
13/16-16	27	9.5	68.7
1-3/16-12	36	18	130.2
1-7/16-12	41	21	151.9
1-11/16-12	50	35	253.2

4) FITTING

Thread size	Width across flat (mm)	kgf·m	lbf·ft
1/4"	19	4	28.9
3/8"	22	5	36.2
1/2"	27	9.5	68.7
3/4"	36	18	130.2
1"	41	21	151.9
1-1/4"	50	35	253.2

GROUP 3 PUMP DEVICE

1. REMOVAL AND INSTALL

1) REMOVAL

(1) Lower the work equipment to the ground and stop the engine.

(2) Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

(3) Loosen the breather slowly to release the pressure inside the hydraulic tank.

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

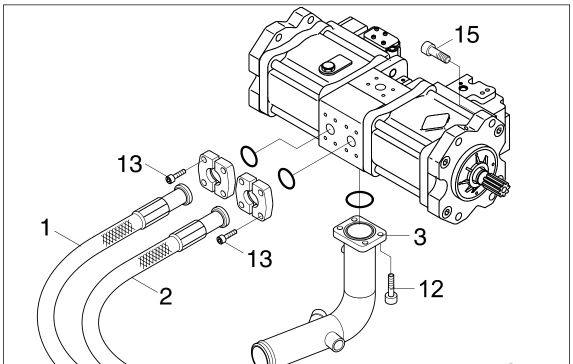
13031GE18

(4) Remove the wirings for the pressure sensors and so on.

(5) Loosen the drain plug under the hydraulic tank and drain the oil from the hydraulic tank.

· Hydraulic tank quantity : 190 ℓ

(6) Remove bolts (13) and disconnect horse (1,2).



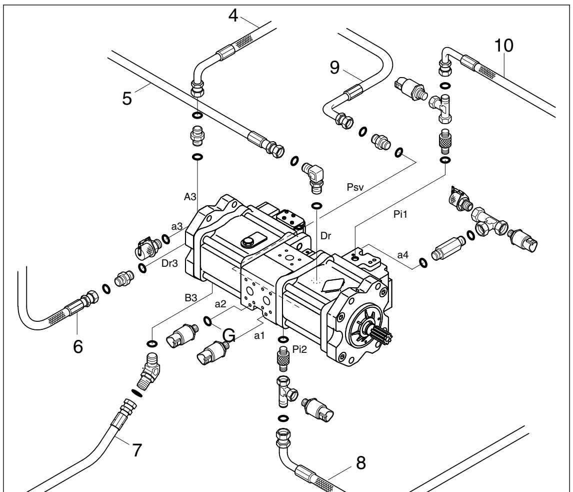
300S8MP01

(7) Disconnect pilot line hoses (4, 5, 6, 7, 8, 9, 10).

(8) Remove pressure switches and accessory items if necessary.

(9) Remove bolts(12) and disconnect pump suction tube (3).

※ **When pump suction tube is disconnected, the oil inside the piping will flow out, so catch it in oil pan.**



350SA8MP02

(10) Sling the pump assembly and remove the pump mounting bolts (15).

· Weight : 181 kg (399 lb)

· Tightening torque : 57.9±8.7 kgf·m (419±62.9 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.

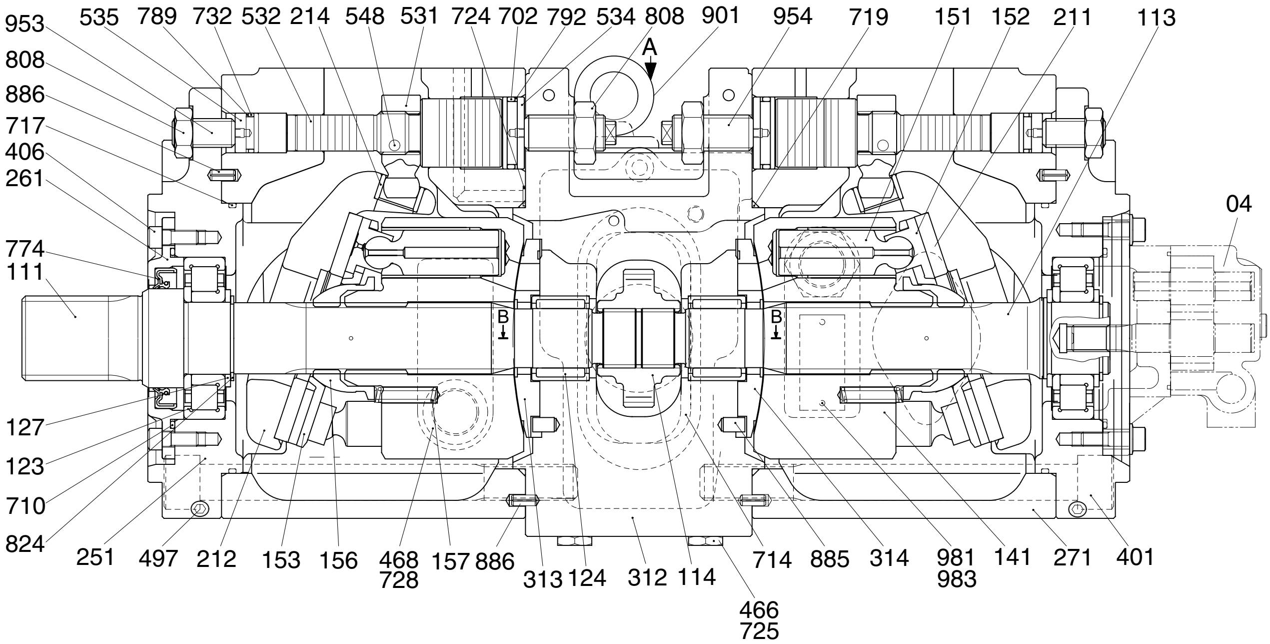
(6) Bleed the air from the hydraulic pump.
① Remove the air vent plug (2EA)
② Tighten plug lightly
③ Start the engine, run at low idling, and check oil come out from plug.
④ Tighten plug.

(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.

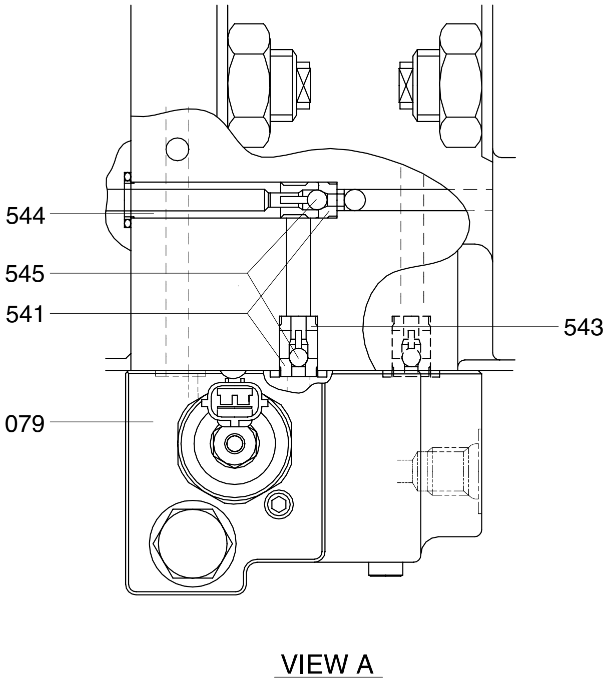
2. MAIN PUMP (1/2)

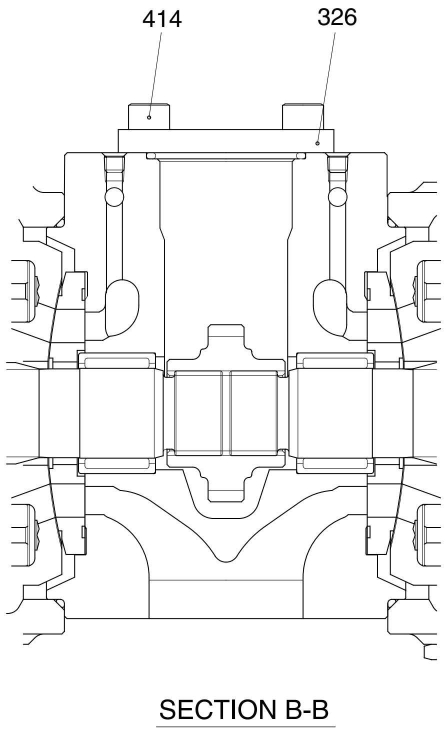
1) STRUCTURE



04	Gear pump	312	Valve block	723	O-ring
111	Drive shaft (F)	313	Valve plate (R)	724	Square ring
113	Drive shaft (R)	314	Valve plate (L)	725	O-ring
114	1st gear	401	Hexagon socket bolt	728	O-ring
123	Roller bearing	406	Hexagon socket bolt	732	O-ring
124	Needle bearing	465	Plug	774	Oil seal
127	Bearing spacer	466	Plug	789	Back up ring
141	Cylinder block	468	Plug	792	Back up ring
151	Piston	497	MH plug	808	Hexagon head nut
152	Shoe	531	Tilting pin	824	Snap ring
153	Set plate	532	Servo piston	885	Valve plate pin
156	Spherical bushing	534	Stopper (L)	886	Spring pin
157	Cylinder spring	535	Stopper (S)	901	Eye bolt
211	Shoe plate	548	Feedback pin	953	Set screw
212	Swash plate	702	O-ring	954	Set screw
214	Tilting bushing	710	O-ring	981	Name plate
251	Swash plate support	714	O-ring	983	Pin
261	Seal cover (F)	717	O-ring		
271	Pump casing	719	O-ring		

MAIN PUMP (2/3)





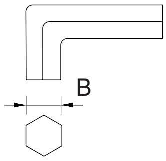
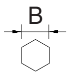
350SA2MP04

079	Proportional reducing valve	541	Seat	544	Stopper 2
326	Cover	543	Stopper 1	545	Steel ball
414	Hexagon socket bolt				

2) TOOLS AND TIGHTENING TORQUE

(1) Tools

The tools necessary to disassemble/reassemble the pump are shown in the follow list.

<table>
<tr><td colspan="2">Tool name & size</td><td colspan="12">Part name</td></tr>
<tr><td rowspan="6">Allen wrench

</td><td>B</td><td colspan="3">Hexagon socket head bolt</td><td colspan="3">PT plug (PT thread)</td><td colspan="3">PO plug (PF thread)</td><td colspan="3">Hexagon socket head setscrew</td></tr>
<tr><td>4</td><td colspan="3">M 5</td><td colspan="3">BP-1/16</td><td colspan="3">-</td><td colspan="3">M 8</td></tr>
<tr><td>5</td><td colspan="3">M 6</td><td colspan="3">BP1/ 8</td><td colspan="3">-</td><td colspan="3">M10</td></tr>
<tr><td>6</td><td colspan="3">M 8</td><td colspan="3">BP-1/ 4</td><td colspan="3">PO-1/4</td><td colspan="3">M12, M14</td></tr>
<tr><td>8</td><td colspan="3">M10</td><td colspan="3">BP-3/ 8</td><td colspan="3">PO-3/8</td><td colspan="3">M16, M18</td></tr>
<tr><td>17</td><td colspan="3">M20, M22</td><td colspan="3">BP-1</td><td colspan="3">PO-1, 1 1/4, 1 1/2</td><td colspan="3">-</td></tr>
<tr><td rowspan="6">Double ring spanner, socket wrench, double (single) open end spanner

</td><td>-</td><td colspan="4">Hexagon head bolt</td><td colspan="4">Hexagon head bolt</td><td colspan="4">VP plug (PF thread)</td></tr>
<tr><td>19</td><td colspan="4">M12</td><td colspan="4">M12</td><td colspan="4">VP-1/4</td></tr>
<tr><td>24</td><td colspan="4">M16</td><td colspan="4">M16</td><td colspan="4">-</td></tr>
<tr><td>27</td><td colspan="4">M18</td><td colspan="4">M18</td><td colspan="4">VP-1/2</td></tr>
<tr><td>30</td><td colspan="4">M20</td><td colspan="4">M20</td><td colspan="4">-</td></tr>
<tr><td>36</td><td colspan="4">-</td><td colspan="4">-</td><td colspan="4">VP-3/4</td></tr>
<tr><td colspan="2">Adjustable angle wrench</td><td colspan="12">Medium size, 1 set</td></tr>
<tr><td colspan="2">Screw driver</td><td colspan="12">Minus type screw driver, Medium size, 2 sets</td></tr>
<tr><td colspan="2">Hammer</td><td colspan="12">Plastic hammer, 1 set</td></tr>
<tr><td colspan="2">Pliers</td><td colspan="12">For snap ring, TSR-160</td></tr>
<tr><td colspan="2">Steel bar</td><td colspan="12">Steel bar of key material approx. 10×8×200</td></tr>
<tr><td colspan="2">Torque wrench</td><td colspan="12">Capable of tightening with the specified torques</td></tr>
</table>

(2) Tightening torque

Part name	Bolt size	Torque		Wrench size	
		kgf · m	lbf · ft	in	mm
Hexagon socket head bolt (material : SCM435)	M 5	0.7	5.1	0.16	4
	M 6	1.2	8.7	0.20	5
	M 8	3.0	21.7	0.24	6
	M10	5.8	42.0	0.31	8
	M12	10.0	72.3	0.39	10
	M14	16.0	115.7	0.47	12
	M16	24.0	173.6	0.55	14
	M18	34.0	245.9	0.55	14
	M20	44.0	318.3	0.67	17
PT plug (material : S45C) ※ Wind a seal tape 1 1/2 to 2 turns round the plug	PT 1/16	0.7	5.1	0.16	4
	PT 1/ 8	1.05	7.59	0.20	5
	PT 1/ 4	1.75	12.66	0.24	6
	PT 3/ 8	3.5	25.3	0.31	8
	PT 1/ 2	5.0	36.2	0.39	10
PF plug (material : S45C)	PF 1/ 4	3.0	21.7	0.24	6
	PF 1/ 2	10.0	72.3	0.39	10
	PF 3/ 4	15.0	108.5	0.55	14
	PF 1	19.0	137.4	0.67	17
	PF 1 1/4	27.0	195.3	0.67	17
	PF 1 1/2	28.0	202.5	0.67	17

3) DISASSEMBLY

(1) Select place suitable to disassembling.

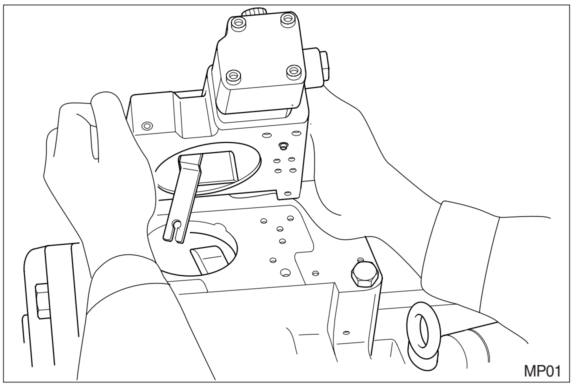
※ Select clean place.

※ Spread rubber sheet, cloth or so on, on overhaul workbench top to prevent parts from being damaged.

(2) Remove dust, rust, etc, from pump surfaces with cleaning oil or so on.

(3) Remove drain port plug (468) and let oil out of pump casing. (front and rear pump).

(4) Remove hexagon socket head bolts (412, 413) and remove regulator.
Remove flange socket bolts (435) and remove gear pump.

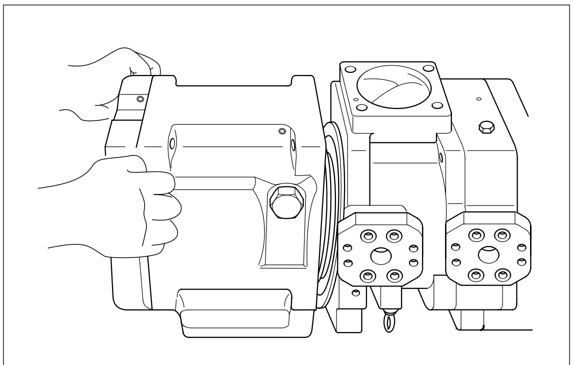


MP01

(5) Loosen hexagon socket head bolts (401) fixing swash plate support (251), pump casing (271) and valve block (312).

(6) Place pump horizontally on workbench with its regulator-fitting surface down, and separate pump casing (271) from valve block (312).

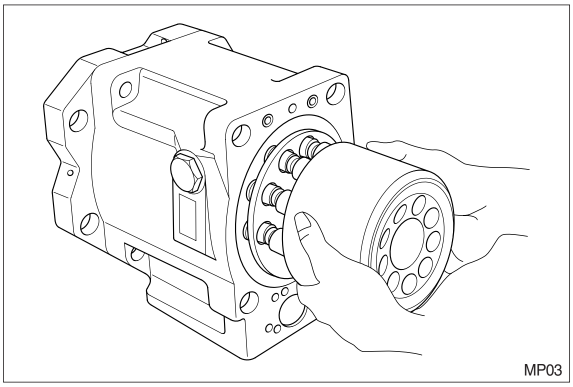
※ Before bringing this surface down, spread rubber sheet on workbench without failing to prevent this surface from being damaged.



MP02

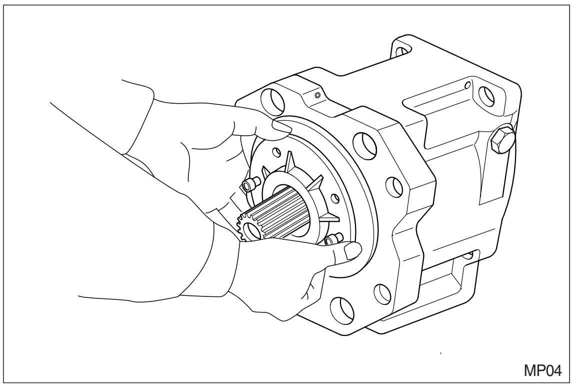
(7) Pull cylinder (141) out of pump casing (271) straightly over drive shaft (111). Pull out also pistons (151), set plate (153), spherical bush (156) and cylinder springs (157) simultaneously.

※ Take care not to damage sliding surfaces of cylinder, spherical bushing, shoes, swash plate, etc.



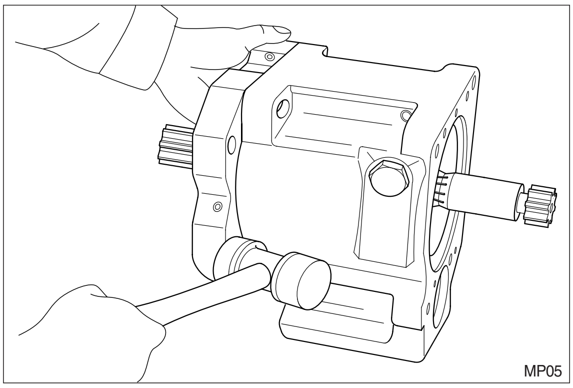
(8) Remove hexagon socket head bolts (406) and then seal cover (F) (261).
Fit bolt into pulling out tapped hole of seal cover (F), and cover can be removed easily.

※ Since oil seal is fitted on seal cover (F), take care not to damage it when removing cover.

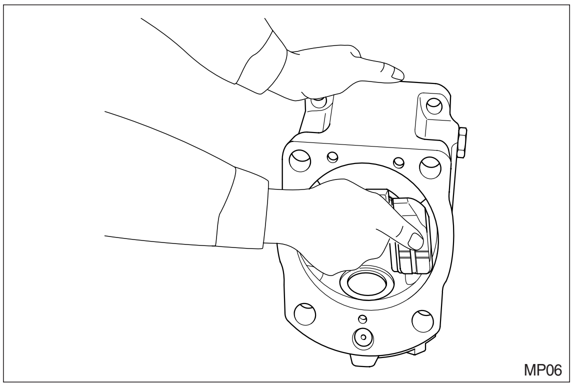


(9) Remove hexagon socket head bolts (408) and then seal cover (R, 262).
In case of fitting a gear pump, first, remove gear pump.

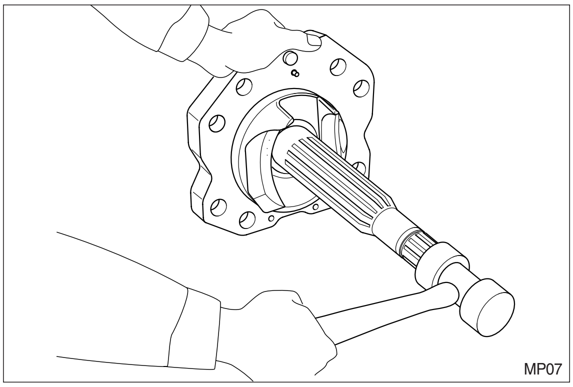
(10) Tapping lightly fitting flange section of swash plate support (251) on its pump casing side, separate swash plate support from pump casing.



(11) Remove shoe plate (211)and swash plate (212) from pump casing (271).

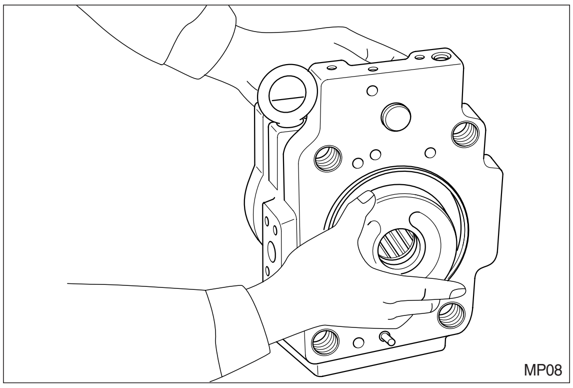


(12) Tapping lightly shaft's end of drive shafts (111, 113) with plastic hammer, take out drive shafts from swash plate supports.


MP07

(13) Remove valve plates (313, 314) from valve block (312).

※ These may be removed in work 6.


MP08

(14) If necessary, remove stopper (L, 534), stopper (S, 535), servo piston (532) and tilting pin(531) from pump casing (271), and needle bearing (124) and gear (114) from valve block (312).

※ In removing tilting pin, use a protector to prevent pin head from being damaged.

※ Since loctite is applied to fitting areas of tilting pin and servo piston, take care not to damage servo piston.

※ Do not remove needle bearing as far as possible, except when it is considered to be out of its life span.

※ Do not loosen hexagon nuts of valve block and swash plate support.
Once loosened, flow setting will be changed.

4) ASSEMBLY

(1) For reassembling reverse the disassembling procedures, paying attention to the following items.

① Do not fail to repair the parts damaged during disassembling, and prepare replacement parts in advance.

② Clean each part fully with cleaning oil and dry it with compressed air.

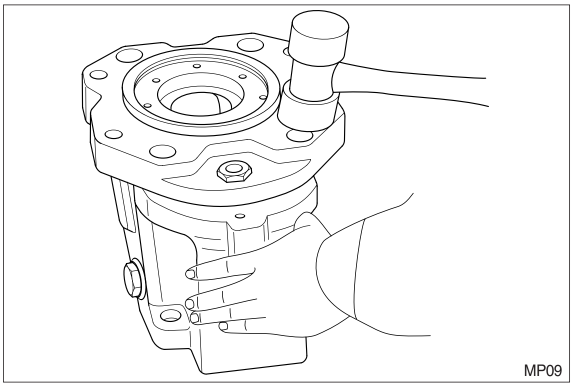
③ Do not fail to apply clean working oil to sliding sections, bearings, etc. before assembling them.

④ In principle, replace seal parts, such as O-rings, oil seals, etc.

⑤ For fitting bolts, plug, etc., prepare a torque wrench or so on, and tighten them with torques shown in Section 2-3.

⑥ For the double-pump, take care not to mix up parts of the front pump with those of the rear pump.

(2) Fit swash plate support (251) to pump casing (271), tapping the former lightly with a hammer.



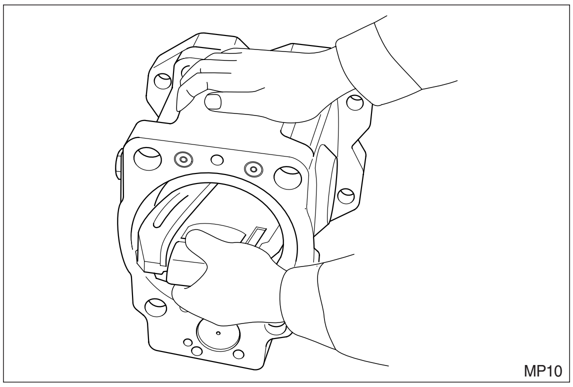
※ After servo piston, tilting pin, stopper (L) and stopper (S) are removed, fit them soon to pump casing in advance for reassembling.

※ In tightening servo piston and tilting pin, use a protector to prevent tilting pin head and feedback pin from being damaged. In addition, apply lock-tight (medium strength) to their threaded sections.

(3) Place pump casing with its regulator fitting surface down, fit tilting bush of swash plate to tilting pin (531), and fit swash plate (212) to swash plate support (251) correctly.

※ Confirm with fingers of both hands that swash plate can be removed smoothly.

※ Apply grease to sliding sections of swash plate and swash plate support, and drive shaft can be fitted easily.



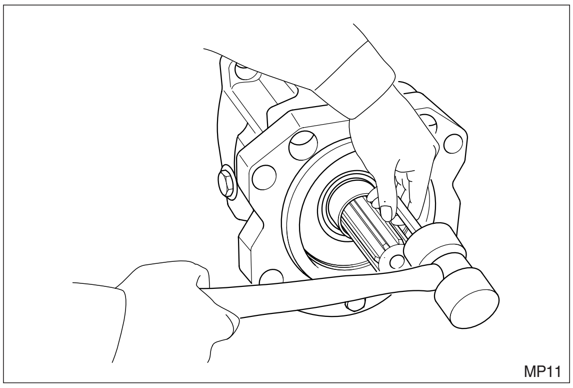
MP10

(4) To swash plate support (251), fit drive shaft (111) set with bearing (123), bearing spacer (127) and snap ring (824).

※ Do not tap drive shaft with hammer or so on.

※ Assemble them into support, tapping outer race of bearing lightly with plastic hammer.

※ Fit them fully, using steel bar or so on.



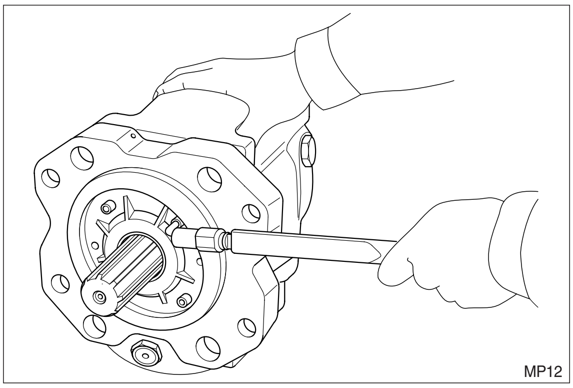
MP11

(5) Assemble seal cover (F, 261) to pump casing (271) and fix it with hexagon socket head bolts (406).

※ Apply grease lightly to oil seal in seal cover (F).

※ Assemble oil seal, taking full care not to damage it.

※ For tandem type pump, fit rear cover (263) and seal cover (262).

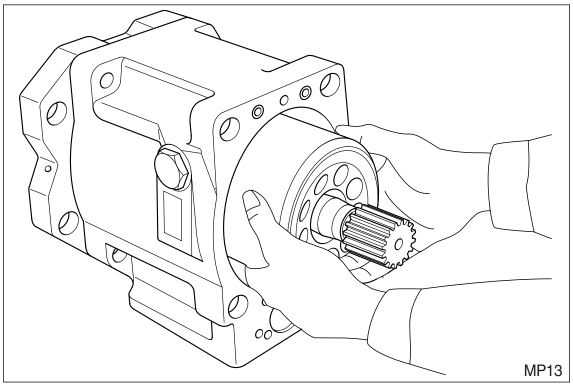


MP12

(6) Assemble piston cylinder subassembly 〔Cylinder (141), piston subassembly (151, 152), set plate (153), spherical bush (156), spacer (158) and cylinder spring (157).〕

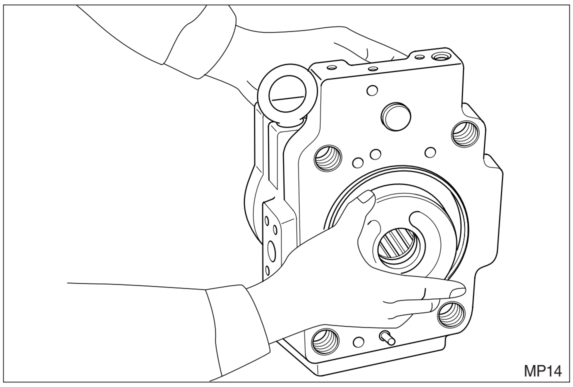
Fit spline phases of retainer and cylinder.

Then, insert piston cylinder subassembly into pump casing.

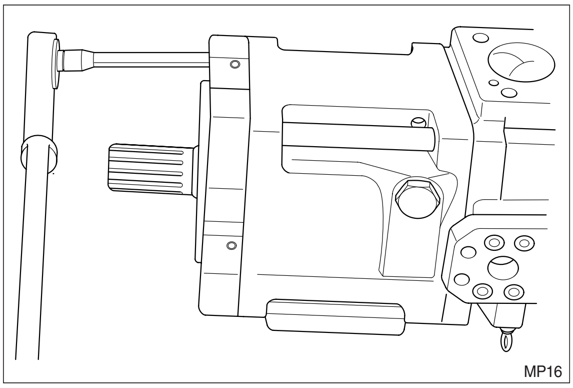


MP13

(7) Fit valve plate (313) to valve block (312), entering pin into pin hole.
※ Take care not to mistake suction / delivery directions of valve plate.

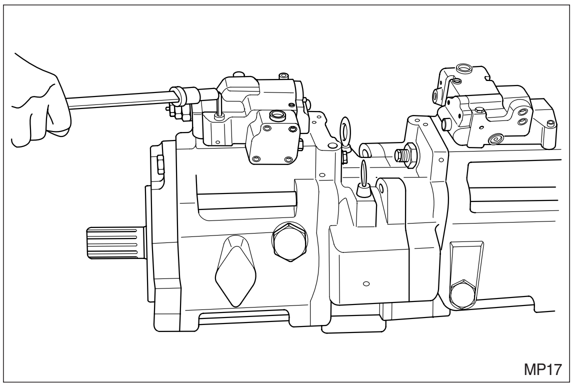


(8) Fit valve block (312) to pump casing (271) and tighten hexagon socket head bolts (401).
※ At first assemble this at rear pump side, and this work will be easy.
※ Take care not to mistake direction of valve block.



※ Clockwise rotation (viewed from input shaft side)
※ Fit block with regulator up and with delivery flange left, viewed from front side.

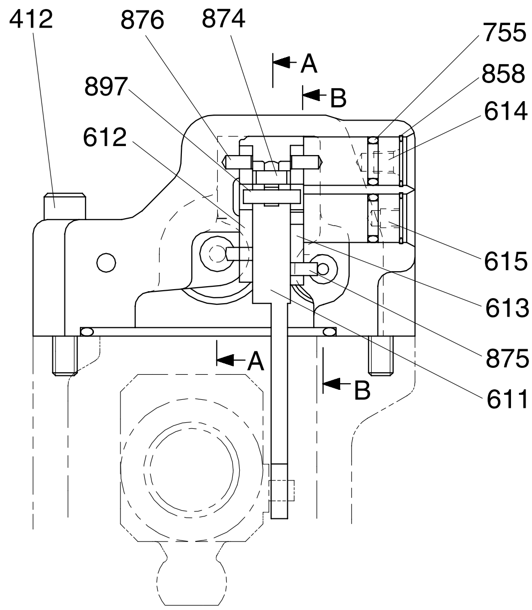
(9) Putting feedback pin of tilting pin into feedback lever of regulator, fit regulator and tighten hexagon socket head bolts (412, 413).
※ Take care not to mistake regulator of front pump for that of rear pump.

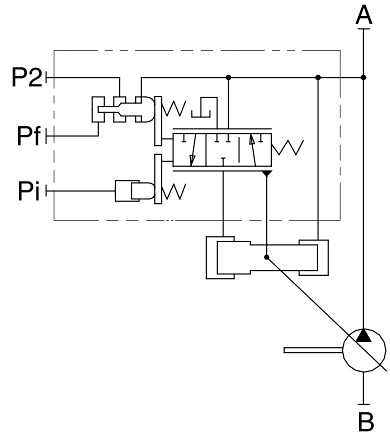


(10) Fit drain port plug (468).
This is the end of reassembling procedures.

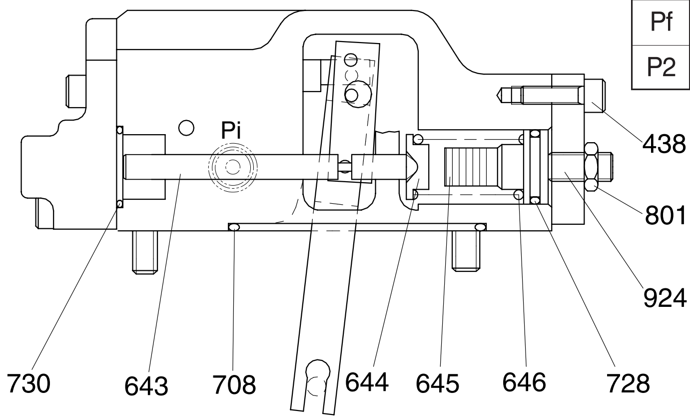
3. REGULATOR

1) STRUCTURE(1/2)

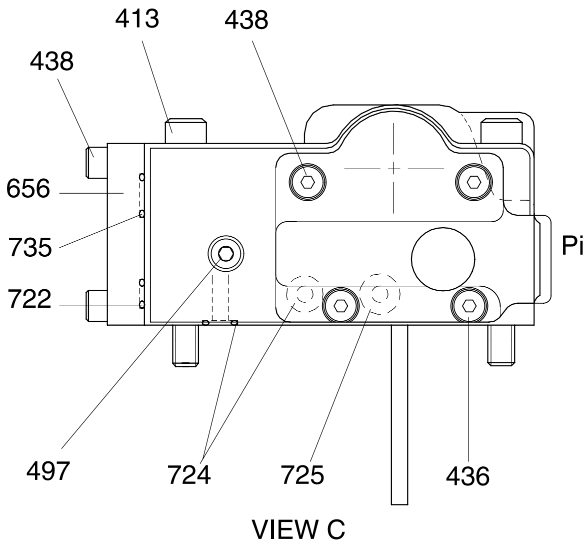




Port	Port name	Port size
A	Delivery port	SAE 6000 PSI 1"
B	Suction port	SAE 2000 PSI 3"
Pi	Pilot port	PF 1/4-15
Pf	Power shift pressure	-
P2	Companion delivery pressure	-



SECTION B-B

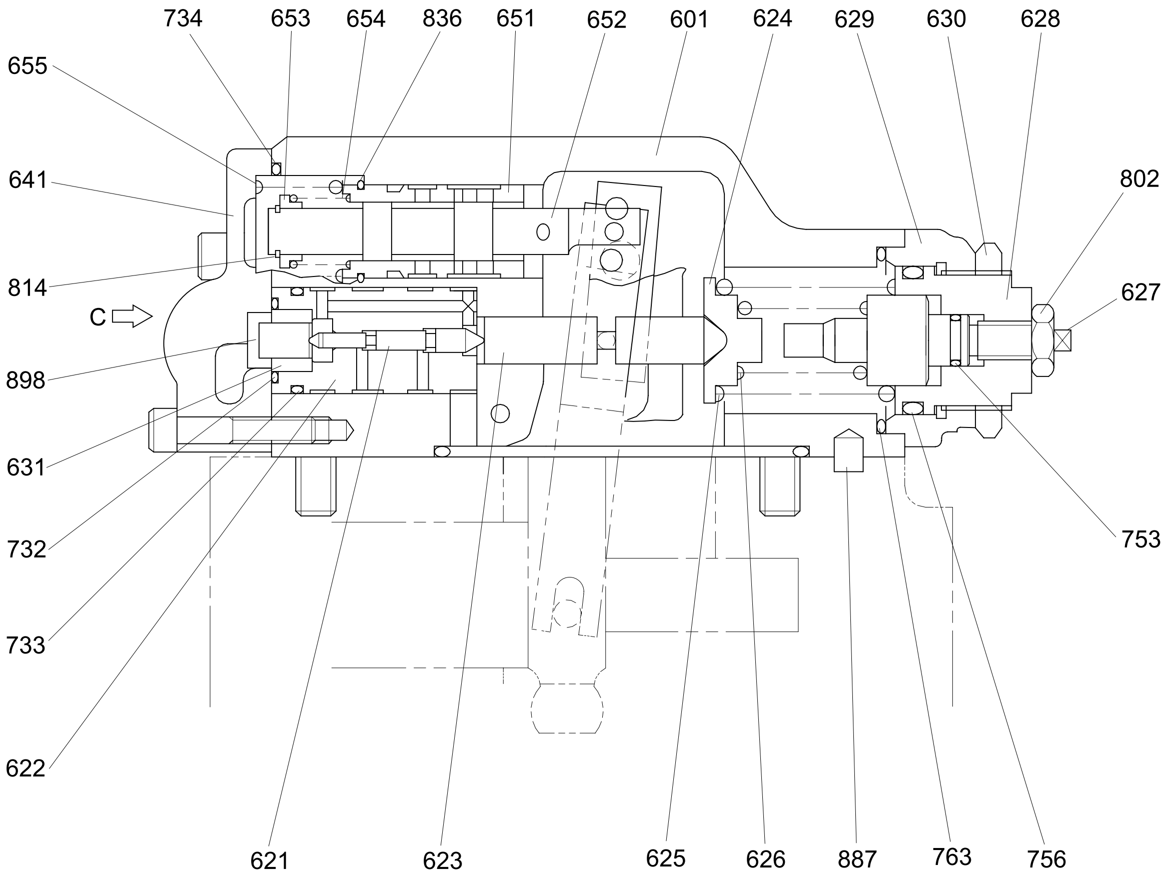


VIEW C

300S2MP06

412 Hexagon socket screw
413 Hexagon socket screw
436 Hexagon socket screw
438 Hexagon socket screw
497 Plug
611 Feed back lever
612 Lever (1)
613 Lever (2)
614 Center plug
615 Adjust plug
643 Pilot piston
644 Spring seat (Q)
645 Adjust stem (Q)
646 Pilot spring
656 Block cover
708 O-ring
722 O-ring
724 Square ring
725 O-ring
728 O-ring
730 O-ring
735 O-ring
755 O-ring
801 Nut
858 Snap ring
874 Pin
875 Pin
876 Pin
897 Pin
924 Set screw

REGULATOR (2/2)



SECTION A-A

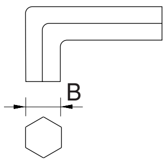
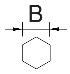
350SA2MP07

601	Casing	630	Lock nut	734	O-ring
621	Compensator piston	631	Sleeve, pf	753	O-ring
622	Piston case	641	Pilot cover	756	O-ring
623	Compensator rod	651	Sleeve	763	O-ring
624	Spring seat (C)	652	Spool	802	Nut
625	Outer spring	653	Spring seat	814	Snap ring
626	Inner spring	654	Return spring	836	Snap ring
627	Adjust stem (C)	655	Set spring	887	Pin
628	Adjust screw (C)	732	O-ring	898	Pin
629	Cover (C)	733	O-ring		

2) TOOLS AND TIGHTENING TORQUE

(1) Tools

The tools necessary to disassemble/reassemble the pump are shown in the follow list.

<table>
<tr><th colspan="2">Tool name & size</th><th colspan="12">Part name</th></tr>
<tr><td rowspan="4">Allen wrench </td><td>B</td><td colspan="3">Hexagon socket head bolt</td><td colspan="3">PT plug (PT thread)</td><td colspan="3">PO plug (PF thread)</td><td colspan="3">Hexagon socket head setscrew</td></tr>
<tr><td>4</td><td colspan="3">M 5</td><td colspan="3">BP-1/16</td><td colspan="3">-</td><td colspan="3">M 8</td></tr>
<tr><td>5</td><td colspan="3">M 6</td><td colspan="3">BP1/ 8</td><td colspan="3">-</td><td colspan="3">M10</td></tr>
<tr><td>6</td><td colspan="3">M 8</td><td colspan="3">BP-1/ 4</td><td colspan="3">PO-1/4</td><td colspan="3">M12, M14</td></tr>
<tr><td rowspan="2">Socket wrench,
double (single) open end </td><td>-</td><td colspan="4">Hexagon head bolt</td><td colspan="4">Hexagon nut</td><td colspan="4">VP plug (PF thread)</td></tr>
<tr><td>6</td><td colspan="4">M 8</td><td colspan="4">M 8</td><td colspan="4">-</td></tr>
<tr><td colspan="2">Adjustable angle wrench</td><td colspan="12">Small size, Max 36 mm</td></tr>
<tr><td colspan="2">Screw driver</td><td colspan="12">Minus type screw driver, Medium size, 2 sets</td></tr>
<tr><td colspan="2">Hammer</td><td colspan="12">Plastic hammer, 1 set</td></tr>
<tr><td colspan="2">Pliers</td><td colspan="12">For snap ring, TSR-160</td></tr>
<tr><td colspan="2">Steel bar</td><td colspan="12">Steel bar of key material approx. 10×8×200</td></tr>
<tr><td colspan="2">Torque wrench</td><td colspan="12">Capable of tightening with the specified torques.</td></tr>
<tr><td colspan="2">Pincers</td><td colspan="12">-</td></tr>
<tr><td colspan="2">Bolt</td><td colspan="12">M4, Length : 50 mm</td></tr>
</table>

(2) Tightening torque

Part name	Bolt size	Torque		Wrench size	
		kgf · m	lbf · ft	in	mm
Hexagon socket head bolt (material : SCM435)	M 5	0.7	5.1	0.16	4
	M 6	1.2	8.7	0.20	5
	M 8	3.0	21.7	0.24	6
	M10	5.8	42.0	0.31	8
	M12	10.0	72.3	0.39	10
	M14	16.0	115.7	0.47	12
PT plug (material : S45C) ※ Wind a seal tape 1 1/2 to 2 turns round the plug	PT 1/16	0.7	5.1	0.16	4
	PT 1/ 8	1.05	7.59	0.20	5
	PT 1/ 4	1.75	12.66	0.24	6
PF plug (material : S45C)	PT 1/ 4	3.0	21.7	0.24	6

3) DISASSEMBLY

Since the regulator consists of small precision finished parts, disassembly and assembly are rather complicated.

For this reason, replacement of a regulator assembly is not recommended, unless there is a special reason, but in case disassembly is necessary for an unavoidable reason, read through this manual to the end before starting disassembly.

(1) Choose a place for disassembly.

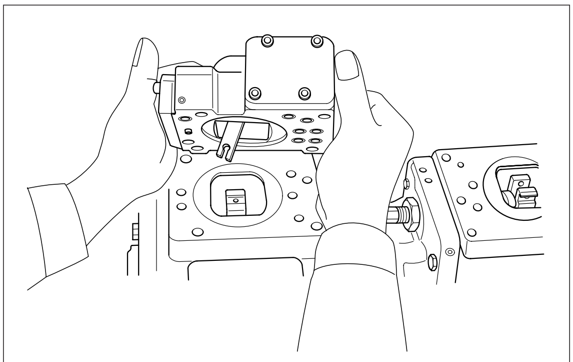
※ Choose a clean place.

※ Spread rubber sheet, cloth, or so on on top of work-bench to prevent parts from being damaged.

(2) Remove dust, rust, etc. from surfaces of regulator with clean oil.

(3) Remove hexagon socket head screw (412, 413) and remove regulator main body from pump main body.

※ Take care not to lose O-ring.



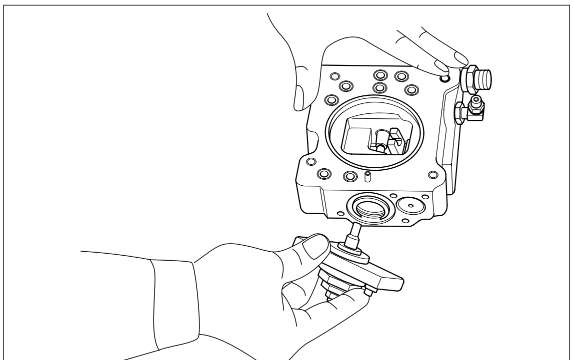
REG01

(4) Remove hexagon socket head screw (438) and remove cover (C, 629).

※ Cover (C) is fitted with adjusting screw (C, 628), adjusting stem (C, 627), lock nut (630), hexagon nut (801) and adjusting screw (924).

Do not loosen these screws and nuts.

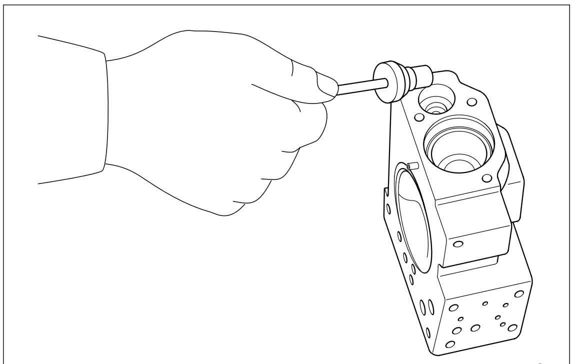
If they are loosened, adjusted pressure-flow setting will vary.



REG02

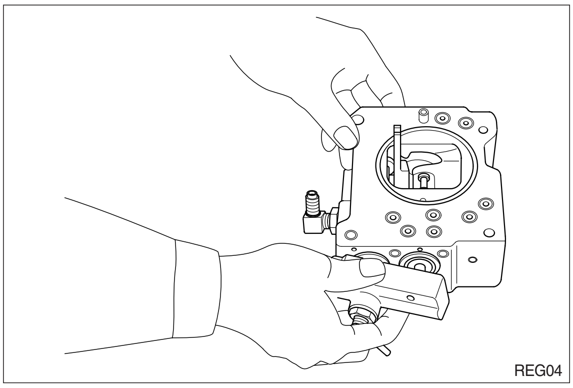
(5) After removing cover (C, 629) subassembly, take out outer spring (625), inner spring (626) and spring seat (C, 624) from compensating section.
Then draw out adjusting stem (Q, 645), pilot spring (646) and spring seat (644) from pilot section.

※ Adjusting stem (Q, 645) can easily be drawn out with M4 bolt.



REG03

(6) Remove hexagon socket head screws (436, 438) and remove pilot cover (641).
After removing pilot cover, take out set spring (655) from pilot section.

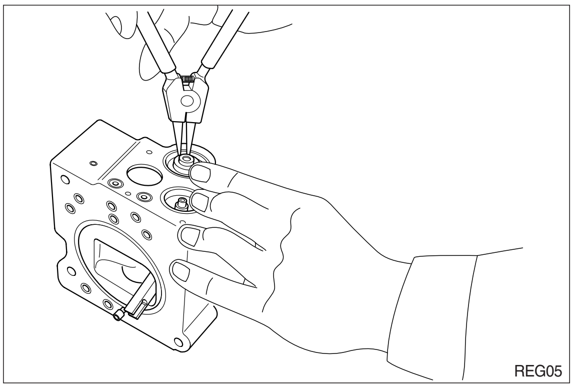


REG04

(7) Remove snap ring (814) and take out spring seat (653), return spring (654) and sleeve (651).
Sleeve (651) is fitted with snap ring (836).

※ When removing snap ring (814), return spring (654) may pop out.

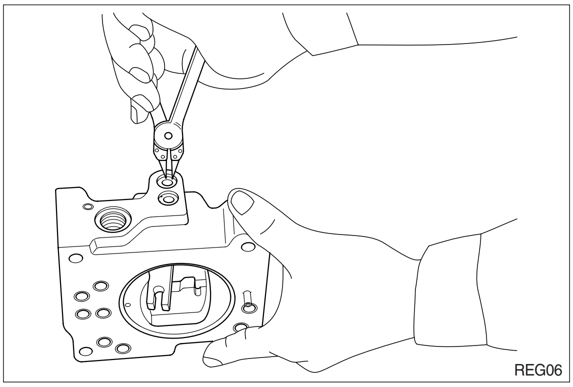
※ Take care not to lose it.



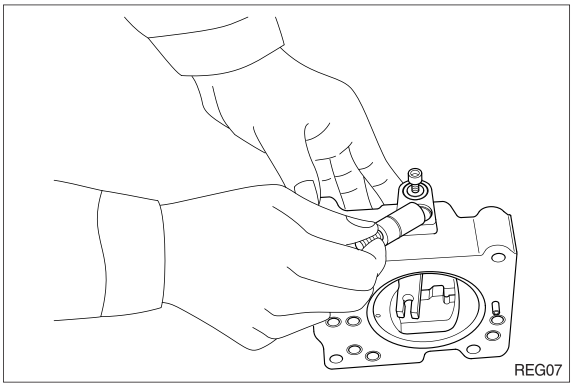
REG05

(8) Remove locking ring (858) and take out fulcrum plug (614) and adjusting plug (615).

※ Fulcrum plug (614) and adjusting plug (615) can easily be taken out with M6 bolt.

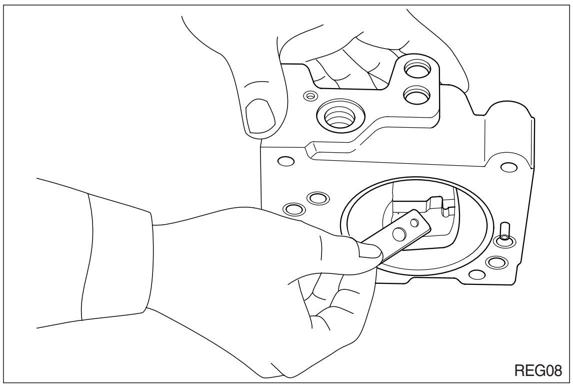


REG06



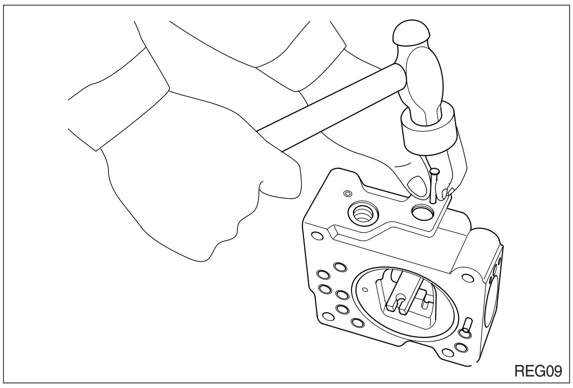
(9) Remove lever (2, 613). Do not draw out pin (875).

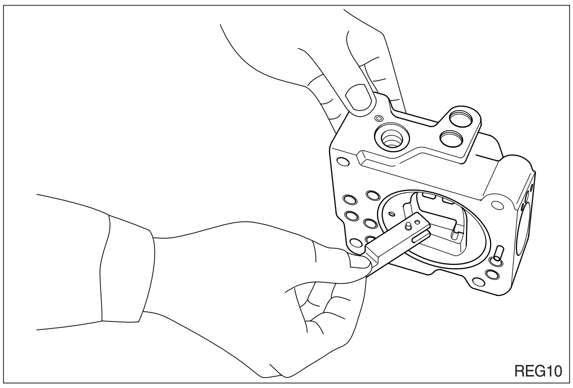
※ Work will be promoted by using pincers or so on.



(10) Draw out pin (874) and remove feedback lever (611).

※ Push out pin (874, 4 mm in dia.) from above with slender steel bar so that it may not interfere with lever (1, 612).





(11) Remove lever (1, 612). Do not draw out pin (875).

(12) Draw out pilot piston (643) and spool (652).

(13) Draw out piston case (622), compensating piston (621) and compensating rod (623).

※ Piston case (622) can be taken out by pushing compensating rod (623) at opposite side of piston case.

This completes operation.

4) ASSEMBLY

(1) For assembly, reverse disassembly procedures, but pay attention to the following items.

① Always repair parts that were scored at disassembly.
Get replacement parts ready beforehand.

② Mixing of foreign matter will cause malfunction.
Therefore, wash parts well with cleaning oil, let them dry with jet air and handle them in clean place.

③ Always tighten bolts, plugs, etc. to their specified torques.

④ Do not fail to coat sliding surfaces with clean hydraulic oil before assembly.

⑤ Replace seals such as O-ring with new ones as a rule.

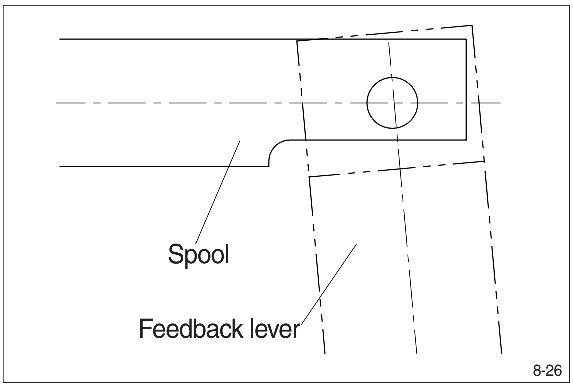
(2) Put compensating rod (623) into compensating hole of casing (601).

(3) Put pin force-fitted in lever (1, 612) into groove of compensating rod and fit lever (1) to pin force-fitted in casing.

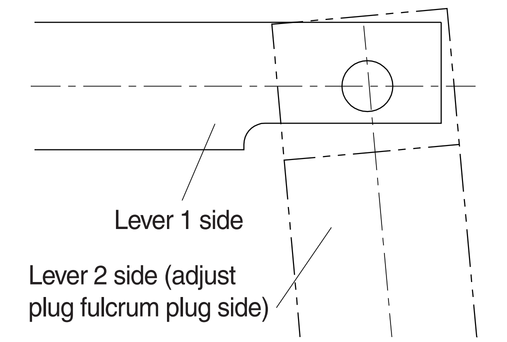
(4) Fit spool (652) and sleeve (651) into hole in spool of casing.

※ Confirm that spool and sleeve slide smoothly in casing without binding.

※ Pay attention to orientation of spool.



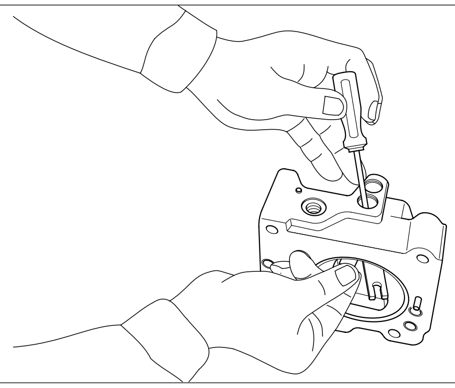
(5) Fit feedback lever (611), matching its pin hole with pin hole in spool.
Then insert pin (874).
※ Insert pin in feedback lever a little to ease operation.
※ Take care not to mistake direction of feedback lever.



8-27

(6) Put pilot piston (643) into pilot hole of casing.
※ Confirm that pilot piston slides smoothly without binding.

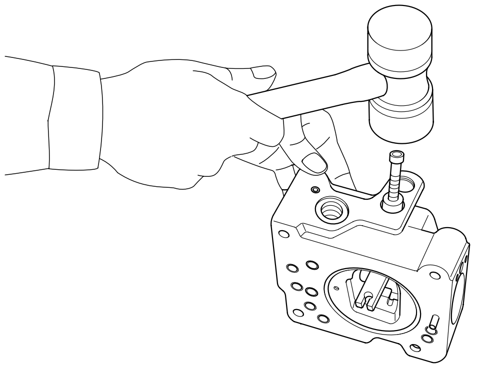
(7) Put pin force-fitted in lever (2, 613) into groove of pilot piston.
Then fix lever (2).



REG11

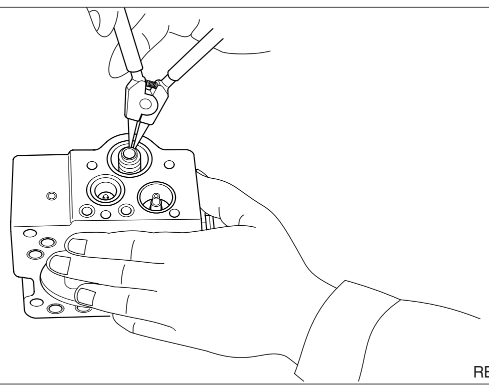
(8) Fit fulcrum plug (614) so that pin force-fitted in fulcrum plug(614) can be put into pin hole of lever (2).
Then fix locking ring (858).

(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.



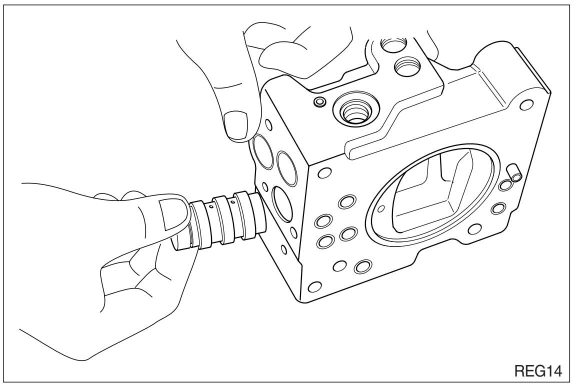
REG12

(10) Fit return spring (654) and spring seat (653) into spool hole and attach snap ring (814).



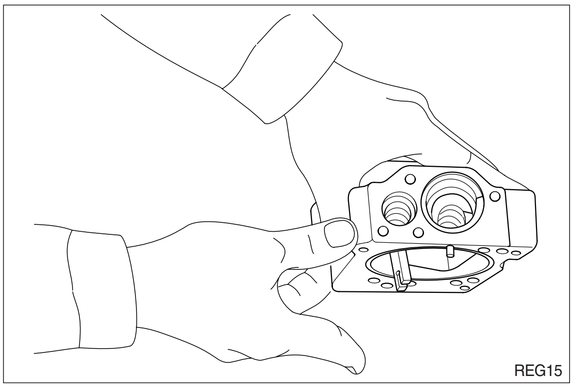
REG13

(11) Fit set spring (655) to spool hole and put compensating piston (621) and piston case (622) into compensating hole.
Fit pilot cover (641) and tighten it with hexagonal socket head screws (436, 438).



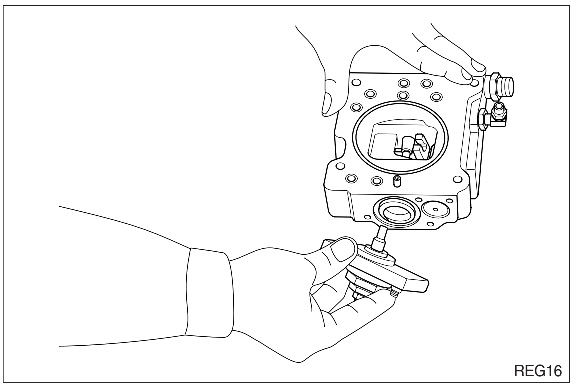
REG14

(12) Put spring seat (644), pilot spring (646) and adjusting stem (Q, 645) into pilot hole.
Then fix spring seat (624), inner spring (626) and outer spring (625) into compensating hole.
※ When fitting spring seat, take care not to mistake direction of spring seat.



REG15

(13) Install cover (C, 629) fitted with adjusting screws (628), adjusting stem (C, 627), lock nut (630), hexagon nut (802) and adjusting screw (924).
Then tighten them with hexagonal socket head screws (438).
This completes assembly.



REG16

GROUP 4 MAIN CONTROL VALVE

1. REMOVAL AND INSTALL OF MOTOR

1) REMOVAL

(1) Lower the work equipment to the ground and stop the engine.

(2) Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

13031GE18

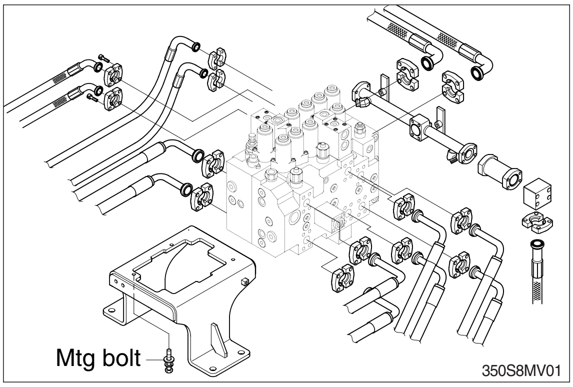
(3) Loosen the breather slowly to release the pressure inside the hydraulic tank.

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

※ When pipes and hoses are disconnected, the oil inside the piping will flow out, so catch it in oil pan.

(4) Remove the wirings for the pressure sensor and so on.

(5) Remove bolts and disconnect pipe.



350S8MV01

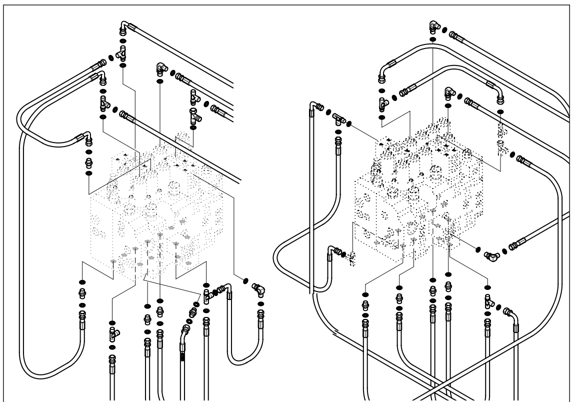
(6) Disconnect pilot line hoses.

(7) Disconnect pilot piping.

(8) Sling the control valve assembly and remove the control valve mounting bolt.

· Weight : 220 kg (485lb)

· Tightening torque : 12.3 ± 1.3 kgf·m (89.0 ± 9.4 lbf·ft)



350S8MV02

(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.

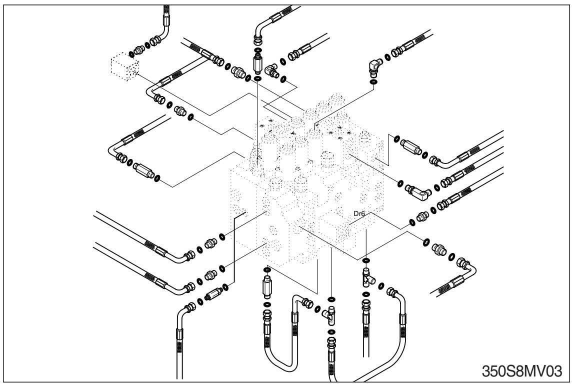
① Cylinder (boom, arm, bucket)

② Swing motor

③ Travel motor

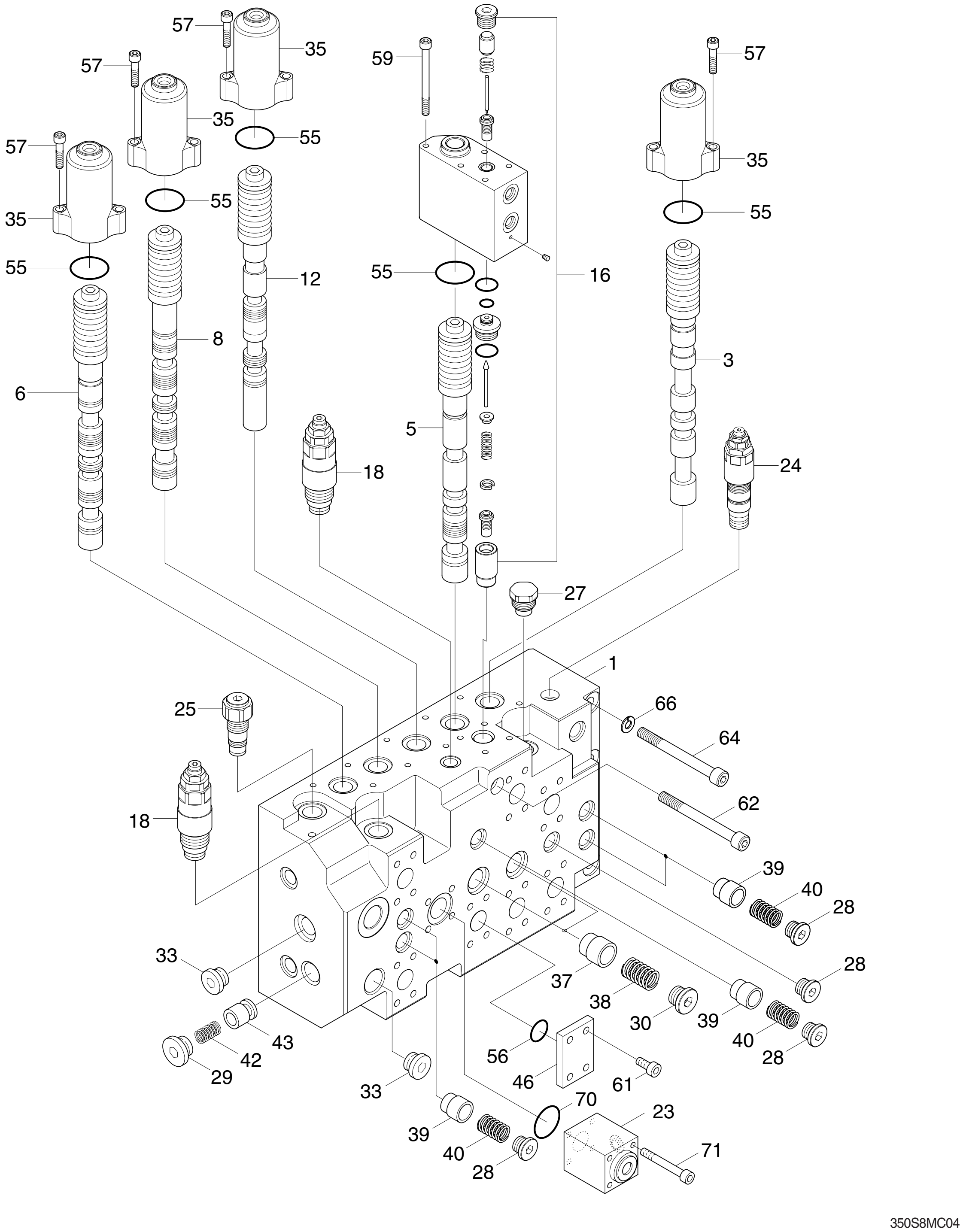
※ See each item removal and install.

(3) Confirm the hydraulic oil level and recheck the hydraulic oil leak or not.



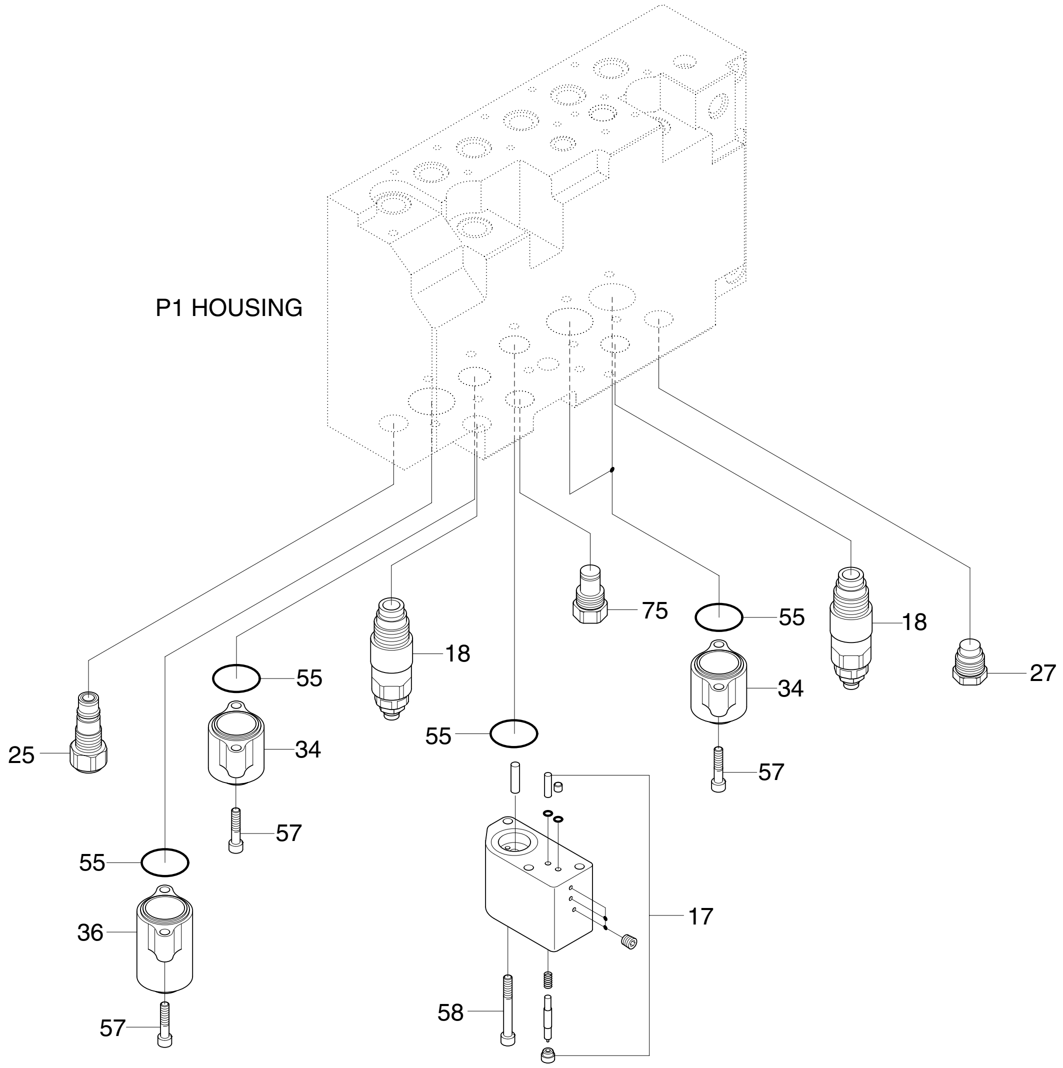
350S8MV03

2. STRUCTURE (1/5)



1	P1 housing	28	Load check Plug	55	O-ring
3	Travel spool kit	29	Plug kit	56	O-ring
5	Boom 1 spool kit	30	Load check plug	57	Socket bolt
6	Bucket spool kit	33	Plug kit	59	Socket bolt
8	Arm 2 spool kit	35	Spool cap	61	Socket bolt
12	Arm regen spool kit	37	L/C poppet 1	62	Socket bolt
16	Holding valve assy	38	L/C spring 1	64	Socket bolt
18	Port relief valve assy	39	L/C poppet 2	66	Spring washer
23	Arm 2 logic valve assy	40	L/C spring 2	70	O-ring
24	Main relief valve assy	42	L/C spring 3	71	Socket bolt
25	Negacon relief valve	43	L/C spring 4		
27	Overload plug	46	Port plug flange		

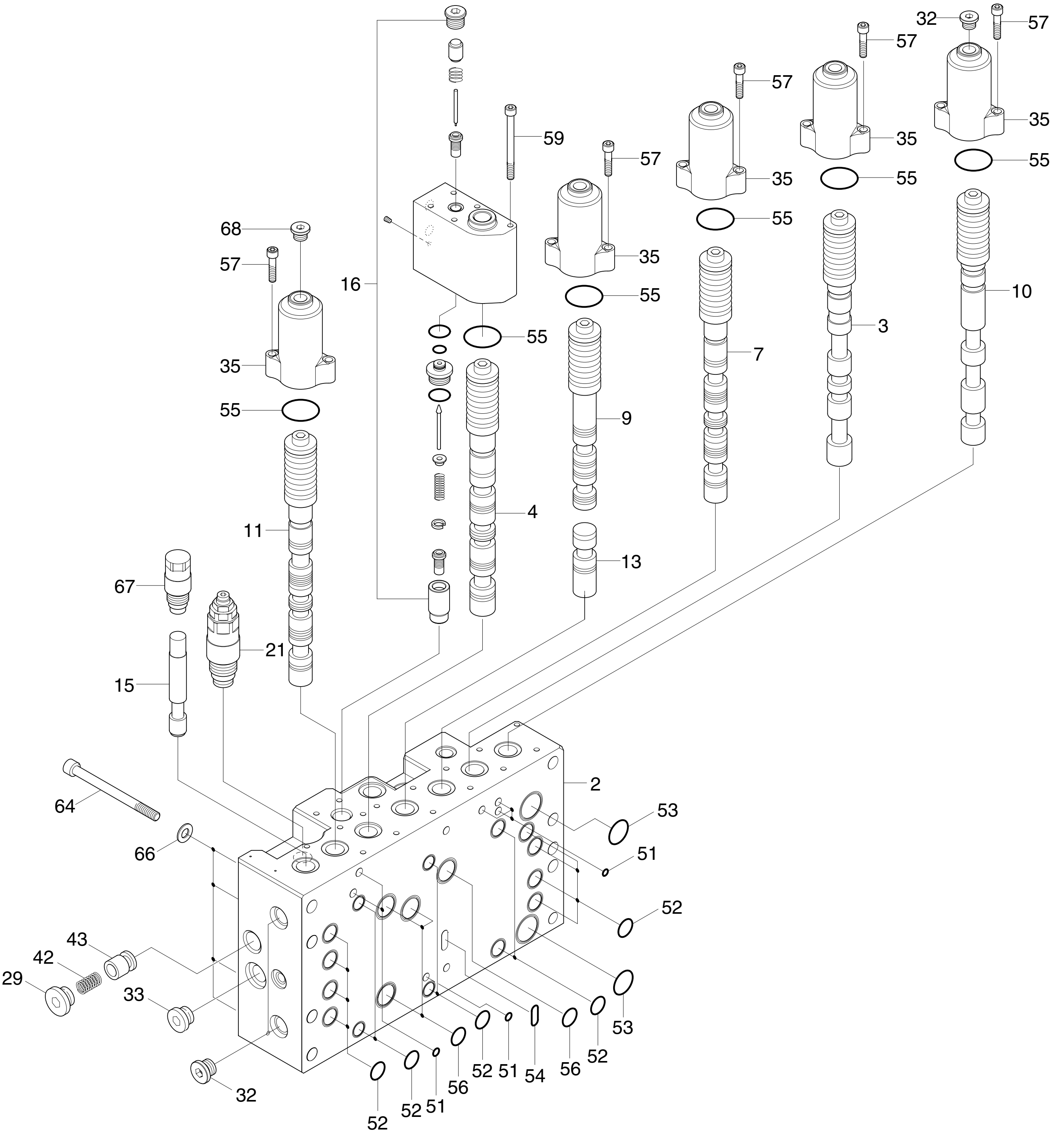
STRUCTURE (2/5)



350S8MC05

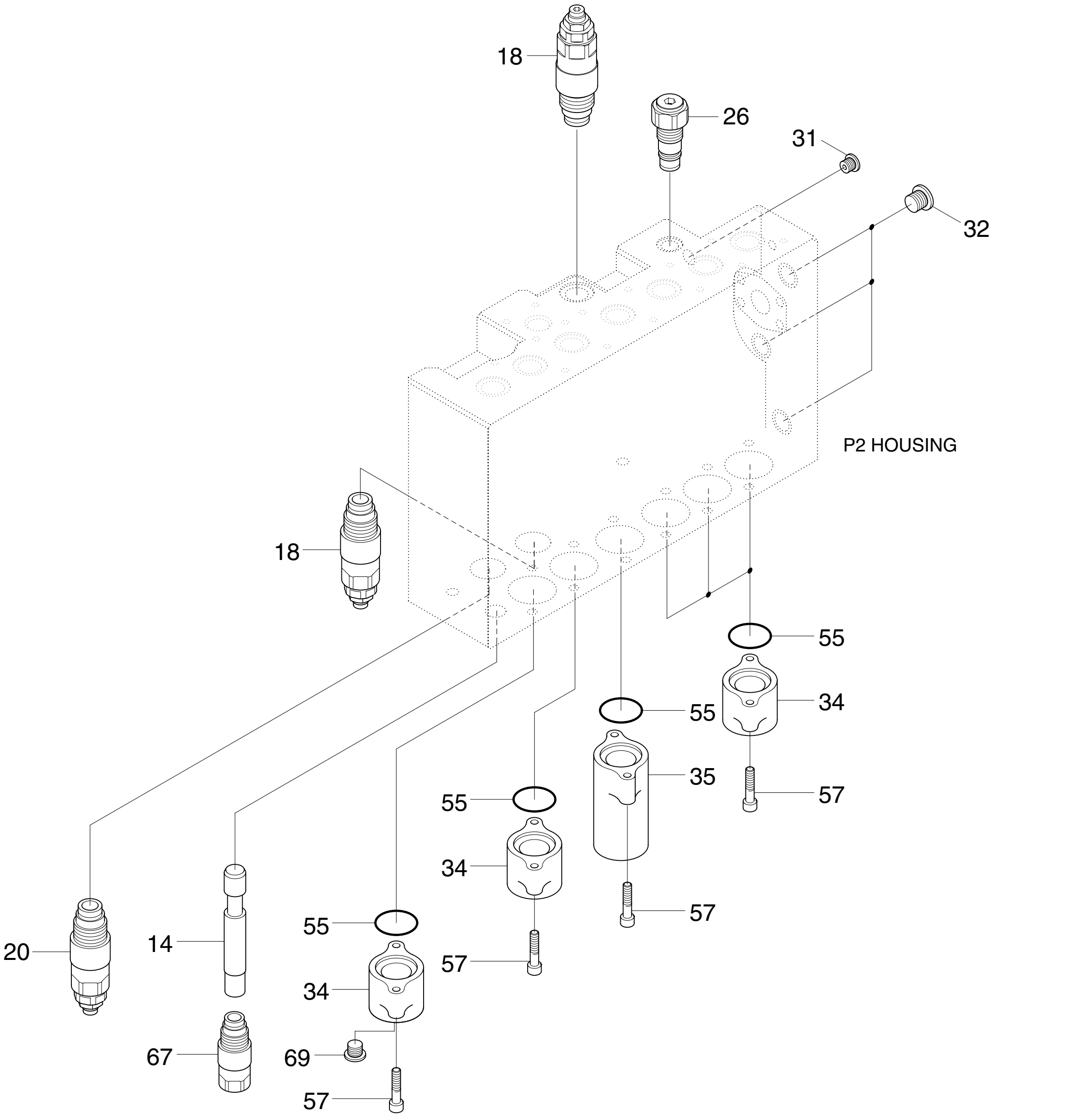
17	Regen valve assy	34	Spool cap	58	Socket bolt
18	Port relief valve assy	36	Bucket stroke limit	75	Plug kit
25	Negacon relief valve	55	O-ring		
27	Overload plug assy	57	Socket bolt		

STRUCTURE (3/5)



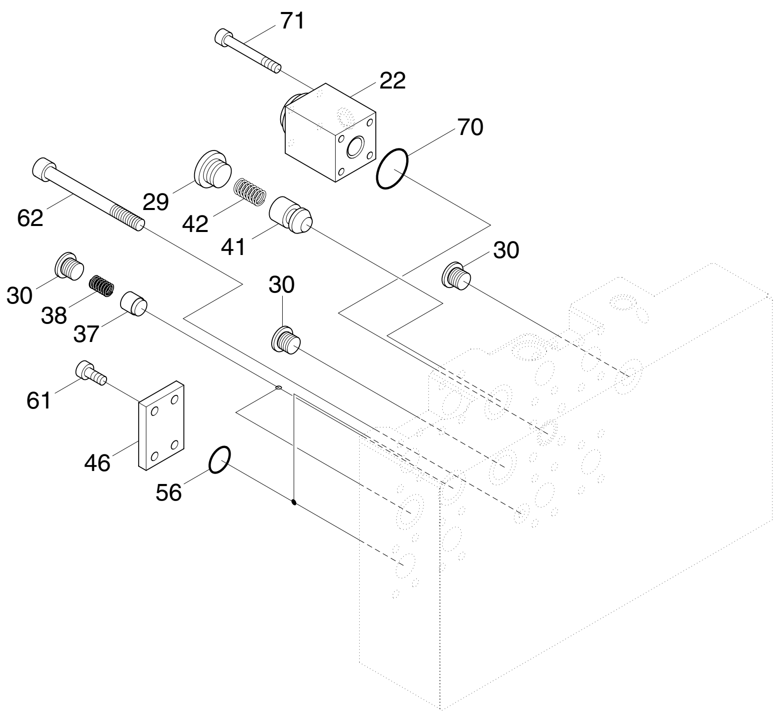
2	P2 housing	29	Plug kit	54	O-ring
3	Travel spool kit	32	Plug kit	55	O-ring
4	Arm 1 spool kit	33	Plug kit	56	O-ring
7	Swing spool kit	35	Cap spool	57	Socket bolt
9	Boom 2 spool kit	42	L/C spring 3	59	Socket bolt
10	Travel straight spool kit	43	L/C poppet 4	64	Socket bolt
11	Option spool kit	44	Name plate	66	Spring washer
13	Swing priority spool kit	45	Rivet	67	Bypass cut plug assy
15	Bypass cut 2 spool kit	51	O-ring	68	Opt stroke limit plug kit 1
16	Holding valve assy	52	O-ring		
21	Port relief valve assy	53	O-ring		

STRUCTURE (4/5)



14	Bypass cut 1 spool kit	31	Plug kit	55	O-ring
18	Port relief valve assy	32	Plug kit	57	Socket bolt
20	Port relief valve assy	34	Spool cap	67	Bypass cut plug assy
26	Orifice signal plug assy	35	Spool cap	69	Opt stroke limit plug kit 2

STRUCTURE (5/5)



P2 HOUSING

350S8MC08

22	Swing logic valve assy	41	L/C poppet 3	62	Socket bolt
29	Plug kit	42	L/C spring 3	70	O-ring
30	Load check valve	46	Port plug flange	71	Socket bolt
37	L/C poppet 1	56	O-ring		
38	L/C spring 1	61	Socket bolt		

3. 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.
In handling a control valve, pay full attention to prevent dust, sand, etc. from entering into it.

(2) When a control valve is to be removed from the machine, apply caps and masking seals to all ports. Before disassembling the valve, recheck that these caps and masking seals are fitted completely, and then clean the outside of the assembly. Use a proper bench for working. Spread paper or a rubber mat on the bench, and disassemble the valve on it.

(3) Support the body section carefully when carrying or transferring the control valve. Do not lift by the exposed spool, end cover section etc.

(4) After disassembling and assembling of the component it is desired to carry out various tests (for the relief characteristics, leakage, flow resistance, etc.), but hydraulic test equipment is necessary for these tests. Therefore, even when its disassembling can be carried out technically, do not disassemble such components that cannot be tested, adjusted, and so on. Additionally one should always prepare clean cleaning oil, hydraulic oil, grease, etc. beforehand.

2) TOOLS

Before disassembling the control valve, prepare the following tools beforehand.

Name of tool	Quantity	Size (mm)
Torque wrench	1	-
Extension bar	1	-
Hexagon bit socket	Each 1	6, 8, 10
Hex socket	1	36
Spanner	Each 1	32, 34, 38
Loctite #262	1	-

3) DISASSEMBLY

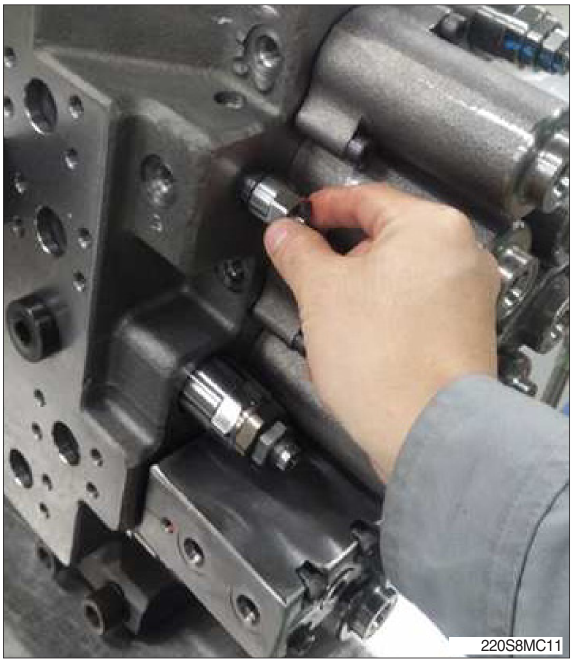
The figure in ( ) shown after the part name in explanation sentence shows its number in the construction figures (8-31)

(1) Place main control valve on working bench

※ Disassemble it in clean place and pay attention not to damage flange faces and plate faces.

(2) Disassembling of orifice signal plug

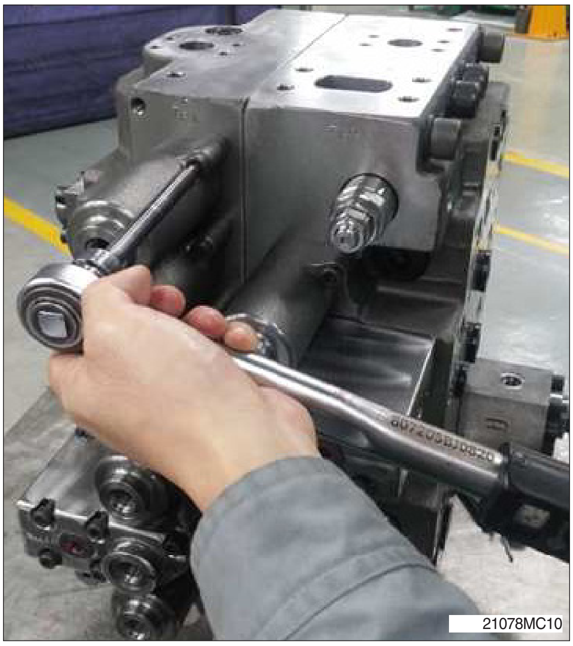
① Loosen and remove orifice signal plug (25).



(3) Disassembling of main spool assy 1 (Pilot cover B side) (Travel R/L (3), Swing (7), Boom 2 (9), Arm regen (12), Arm 2 (8), Bucket (6), Option (11))

① Loosen the hexagon socket head bolts (45) 2EA and remove the pilot cover B (33) and O-ring (43).
[Hexagon key wrench 6 mm]

② Pull out the main spool, spring, spring seat stopper and spacer bolt in the spool assembly condition from the housing P1 & P2.



(4) Disassembling of main spool assy 2 (Pilot cover B side)
(Boom 1 (5), Arm 1 (4))

① Loosen the hexagon socket head bolts (47) 5EA and remove the O-ring (44) and holding valve block assy (16)
[Hexagon key wrench : 6 mm]

② Pull out the main spool, spring, spring seat stopper and spacer bolt in the spool assembly condition from the housing P1 & P2.

※ When you disassemble holding valve block assy, pay attention not to miss the pilot poppet.

220S8MC13

(5) Disassembling of bypass cut spool (=BC)
(Bucket BC (14), Option BC (15))

① Loosen bypass cut plug assy
[36mm socket wrench]

② Pull out the bypass cut spool

※ Option BC spool (14) and bucket BC spool (15) are different lengths. So when you reassemble, be careful of length. (length : option BC > bucket BC)

220S8MC14

(6) Disassembling of pilot cover (Bucket stroke limiter)

① Loosen the hexagon socket head bolts (45) 2EA.
[Hexagon key wrench 6 mm]

② Remove the pilot cover (34) and O-ring (43).

(7) Disassembling of swing priority spool & pilot cover A
(Travel R/L (3), Swing (7), Boom1 (5), Arm 1 (4), Bucket (6), Option (11), Boom2 (9), Arm 2 (8))

① Loosen the hexagon socket head bolts (45) 2EA and remove the pilot cover A (32) and O-ring (43).

② Pull out the swing priority spool (13).

③ Remove the pilot cover A (32).

21078MC15

21078MC16

(8) Disassembling of regen valve block assy

① Loosen the hexagon socket head bolts (46) 3EA.
[Hexagon key wrench 6 mm]

② Remove plug (551) or (552) and take out poppet (511) or (515, 516) and spring (521) or (523).

③ When you disassemble regen valve block assy, pay attention not to miss the piston and O-ring (43).

220S8MC17

(9) Disassembling of main relief valve

① Loosen and remove the main relief valve (23).
[Spanner 32 mm]

220S8MC18

(10) Disassembling of port relief valve (Except the option side)

① Loosen and remove the port relief valve (18).
[Spanner 34 mm]

220S8MC19

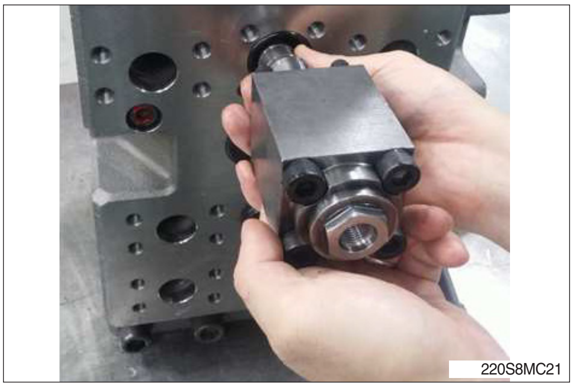
(11) Disassembling of port relief valve (Option side)
(1-stage (19), 2-stage (20))

① Loosen and remove the port relief valve.
[Spanner 38 mm]

220S8MC20

(12) Disassembling of logic valve
(Arm logic valve (22), Swing logic valve (21))

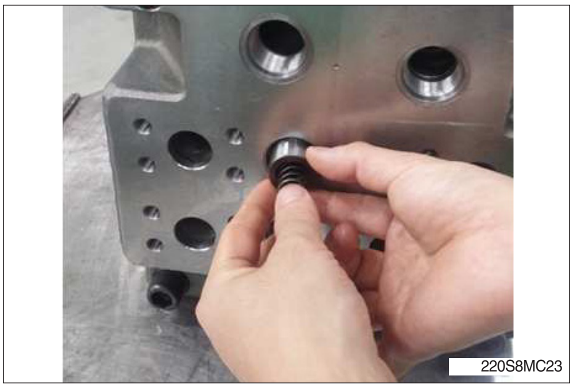
① Loosen the hexagon socket head bolts (56) 4EA and remove the logic valve.
[Hexagon key wrench 8 mm]


220S8MC21

② Remove the swing logic poppet.

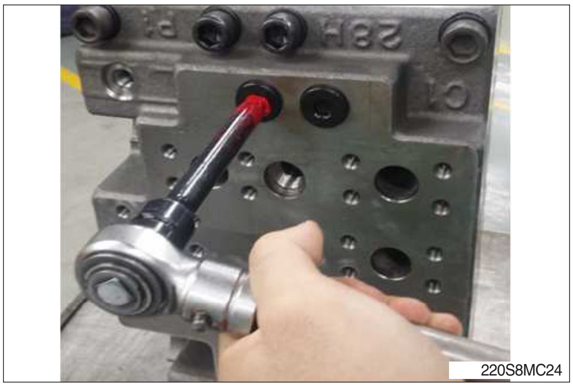

220S8MC22

③ Remove the Arm logic poppet and spring by same method.


220S8MC23

(13) Disassembling of check valve (Plug (27) 2EA)

① Loosen the plug (27) and remove the poppet (37), spring (38).
[Hexagon key wrench 10 mm]



220S8MC24

220S8MC25

(14) Main spool disassembly

① Fix the spool to the dedicated jig and take it apart.
(Spacer bolt, spring, stopper, spring seat)
[Hexagon key wrench 8 mm]

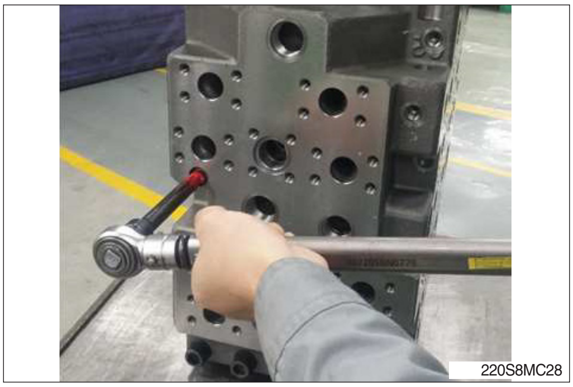
220S8MC26

220S8MC27

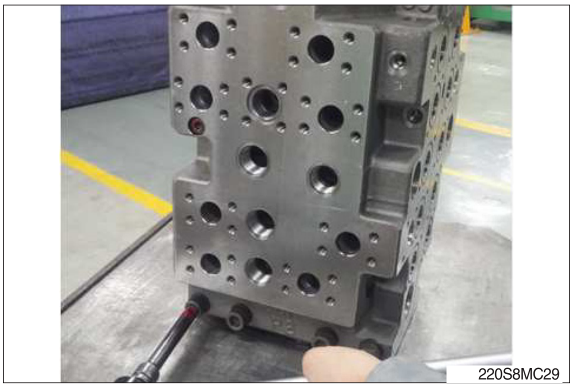
(15) Disassembling of housing

① Loosen the hexagon socket head bolts (49, 50) each 2EA, 8EA

※ Except when required specially, do not disassemble housing P1&P2 for sanitation.



220S8MC28



220S8MC29

(16) Inspection after disassembly

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 the seal groove faces of the housing and the covers are smooth and free of dust, dent, rust etc.
c. Correct dents and damages on check seat faces of housing, if any, by lapping.
※ Pay attention not to leave lapping agent in the housing.
d. Confirm that all sliding and fitting parts can be moved manually and that all grooves and paths are free from foreign matter.
e. If any spring is broken or deformed, replace it with new one.
f. When a relief valve does not function properly, repair it, following its inspection procedures.
g. Replace all the O-rings with new ones.

② Relief valve

a. Confirm that all seat faces at ends of all poppets and seats are free of defects and are uniform contact faces.
b. Confirm manually that main poppet and seat can slide lightly and smoothly.
c. Confirm that outside face of main poppet and inside face of seat are free from scratches and so on.
d. Confirm that orifices of the main poppet and seat section are not clogged with foreign matter.
e. Replace all O-rings with new ones.
f. When any light damage is found in above inspections, correct it by lapping.
g. When any abnormal part is found, replace it with a relief valve assembly.

GROUP 5 SWING DEVICE

1. REMOVAL AND INSTALL OF MOTOR

1) REMOVAL

(1) Lower the work equipment to the ground and stop the engine.

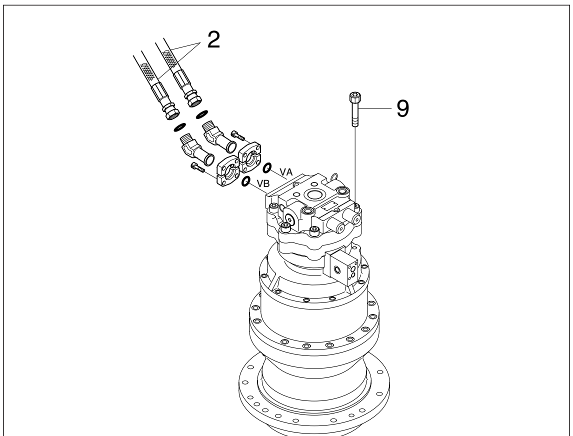
13031GE18

(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.



330S8SM21

(4) Disconnect hose assembly (2).

(5) Disconnect pilot line hoses (3, 4, 5, 6, 7, 8).

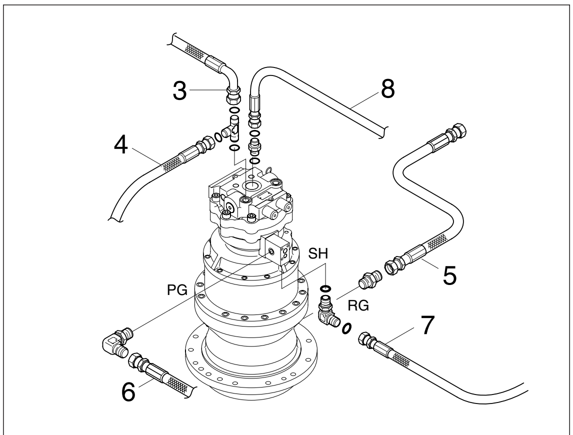
(6) Sling the swing motor assembly (1) and remove the swing motor mounting socket bolts (9).

· Motor device weight : 61 ㎏ (135 ㏐)

· Tightening torque : 57.9±5.8 kgf·m (419±42.0 lbf·ft)

(7) Remove the swing motor assembly.

※ When removing the swing motor assembly, check that all the piping have been disconnected.



350SA8SM22

2) INSTALL

(1) Carry out installation in the reverse order to removal.

(2) Bleed the air from the swing motor.

① Remove the air vent plug.

② Pour in hydraulic oil until it overflows from the port.

③ Tighten plug lightly.

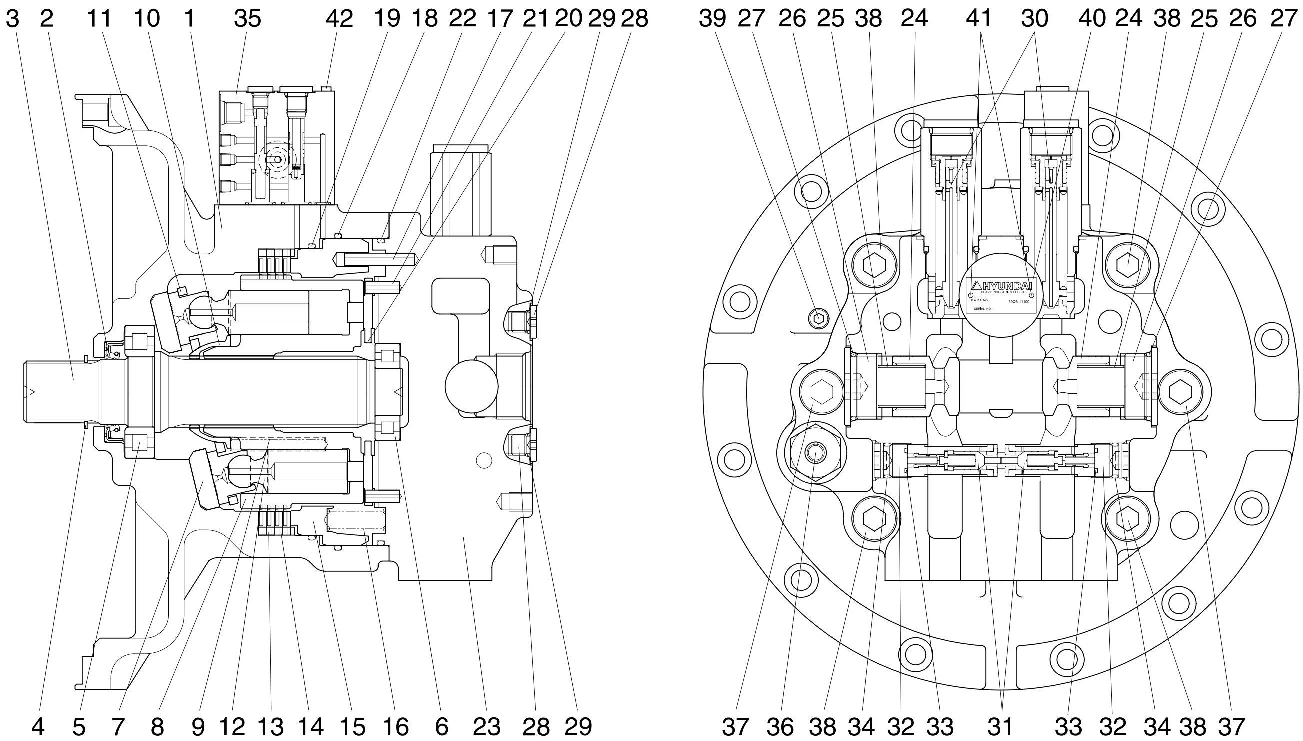
④ Start the engine, run at low idling and check oil come out from plug.

⑤ Tighten plug fully.

(3) Confirm the hydraulic oil level and check the hydraulic oil leak or not.

2. DISASSEMBLY AND ASSEMBLY OF SWING MOTOR

1) STRUCTURE



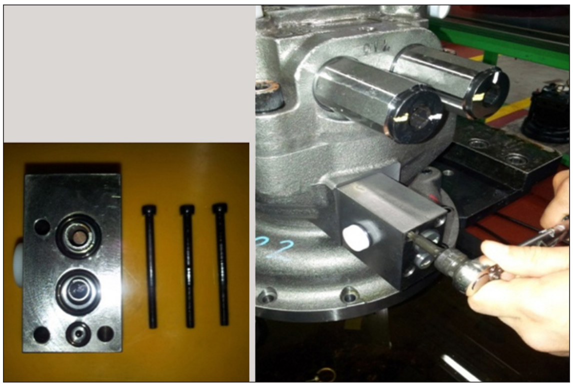
300L2SM02

1	Casing	15	Parking piston	29	O-ring
2	Oil seal	16	Brake spring	30	Relief valve assy
3	Shaft	17	Spring pin	31	Reactionless valve assy
4	Snap ring	18	O-ring	32	Plug
5	Roller bearing	19	O-ring	33	O-ring
6	Needle bearing	20	Valve plate	34	O-ring
7	Swash plate	21	Spring pin	35	Time delay valve assy
8	Cylinder block	22	O-ring	36	Level gauge
9	Spring	23	Valve casing	37	Socket bolt
10	Ball guide	24	Check valve	38	Socket bolt
11	Retainer plate	25	Spring	39	Plug
12	Piston assy	26	Plug	40	Name plate
13	Friction plate	27	O-ring	41	Rivet
14	Separate plate	28	Plug	42	Socket bolt

2) DISASSEMBLY

(1) Disassemble drive shaft

① Unloosing socket bolt (time delay valve, 42) and disassemble time delay valve assy (35) from casing (1).



2209A8SM51

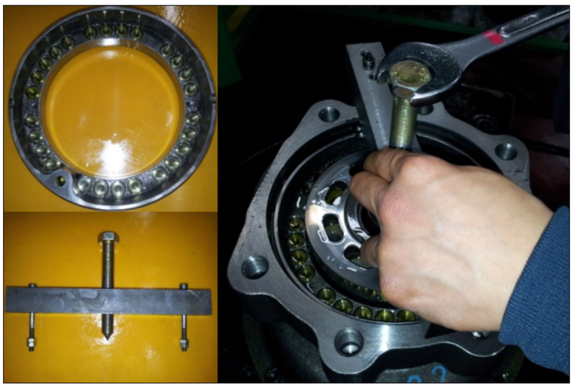
② Disassemble level gauge (36) from casing (1).

2209A8SM52

③ Hang valve casing (23) on hoist, unloose socket bolt (37, 38) and disassemble from casing (1).

2209A8SM53

④ Disassemble spring (16) and using a jig, disassemble parking piston (15) from casing (1).



2209A8SM54

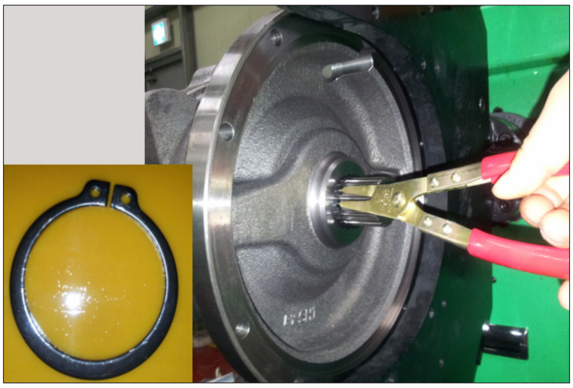
⑤ Disassemble respectively cylinder block sub (8), friction plate (13), separate plate (14) from casing (1).

2209A8SM55

⑥ Disassemble swash plate (7) from casing (1).

2209A8SM56

⑦ Using a plier jig, disassemble snap ring (4) from casing (1).



2209A8SM57

⑧ Disassemble shaft assy (3), oil seal (2) and O-ring (18, 22) from casing (1).

2209A8SM58

(2) Disassemble cylinder block sub

① Disassemble piston assy (12) from cylinder block (8).

2209A8SM59

② Disassemble ball guide (10) and spring (cylinder block, 9) from cylinder block (8).

· Ball guide × 1EA
· Spring × 9EA

2209A8SM60

(3) Disassemble valve casing sub

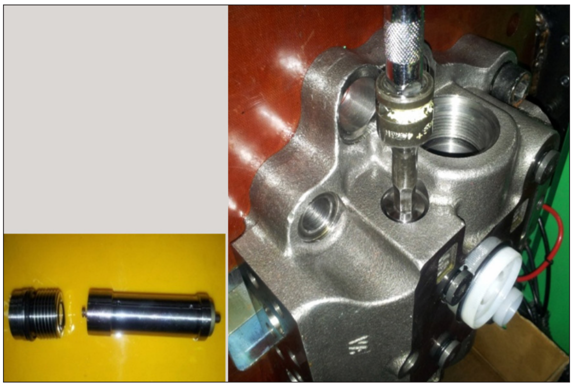
① Disassemble spring pin (17, 21), valve plate (20), O-ring (22) from valve casing (23).

2209A8SM61

② Using a torque wrench, disassemble relief valve (30) from valve casing (23).

2209A8SM62

③ Using a torque wrench, disassemble plug (32) from valve casing (23) and disassemble O-ring (33, 34) and reactionless valve assy (31).



2209A8SM63

④ Using a torque wrench, disassemble check valve (24) from valve casing (23).

2209A8SM64

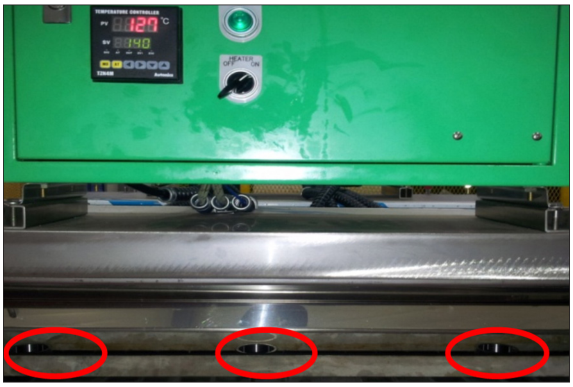
⑤ Disassemble plug (28), O-ring (29) from valve casing (23).

2209A8SM65

3) ASSEMBLING

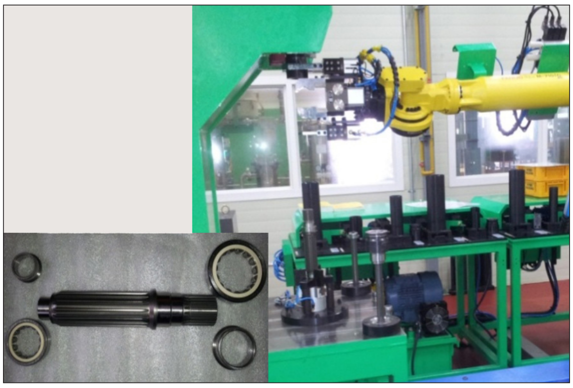
(1) Assemble shaft sub

① Put roller bearing (3) on preheater and provide heat to inner race.
(Temperature in conveyor : 120°C for 3~5 minutes)



2209A8SM66

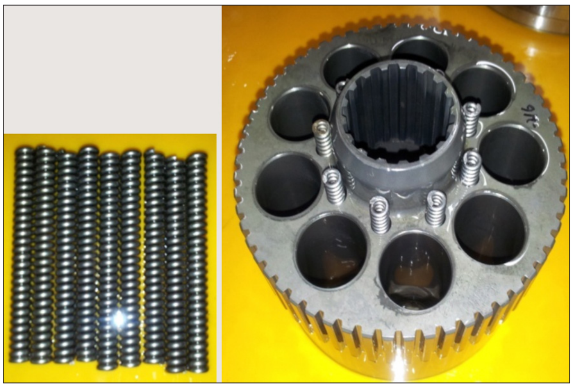
② Using a robot machine, assemble and press preheated roller bearing (3) into shaft (5).



2209A8SM67

(2) Assemble cylinder block sub

① Assemble 9 springs (cylinder block, 9) into cylinder block (8).
- Spring×9EA



2209A8SM68

② Assemble ball guide (10) into cylinder block (8).
- Ball guide×1EA

2209A8SM69

③ Assemble 9 piston assy (12) into retainer plate (11).

- Piston assy × 9EA
- Retainer plate × 1EA

2209A8SM70

④ Assemble parts of procedure ② and ③.

2209A8SM71

(3) Assemble valve casing sub

① **Assemble make up check valve sub**

Assemble check valve (24), O-ring (27), plug (26) in that order and then screw it torque wrench.

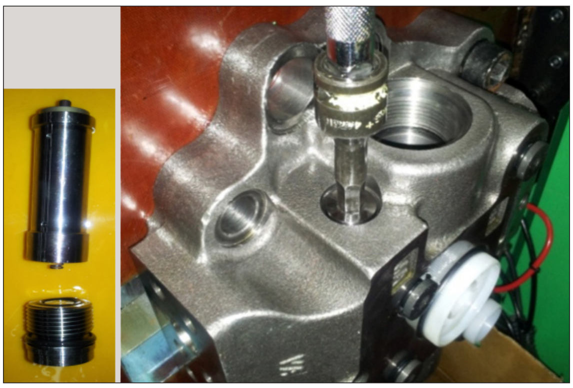
- Make up check valve × 2EA
- Spring × 2EA
- Plug × 2EA
- O-ring × 2EA
- Tightening torque : 38 ± 3.8 kgf · m (275 ± 27.5 lbf · ft)

2209A8SM72

② **Assemble reactionless valve assy**

Assemble reactionless valve assy (31), plug (32), O-ring (33, 34) in that order and then screw it a torque wrench.

- Reactionless valve assy (31) × 2EA
- Plug (32) × 2EA
- O-ring (33, 34) × 2EA
- Tightening torque : 22 ± 1.5 kgf · m (159 ± 11 lbf · ft)



2209A8SM73

③ Using a torque wrench, assemble relief valve (30) 2 sets into valve casing (23).

- Relief valve (30) × 2EA
- Tightening torque : 18 ± 1.8 kgf · m (130 ± 13 lbf · ft)

2209A8SM74

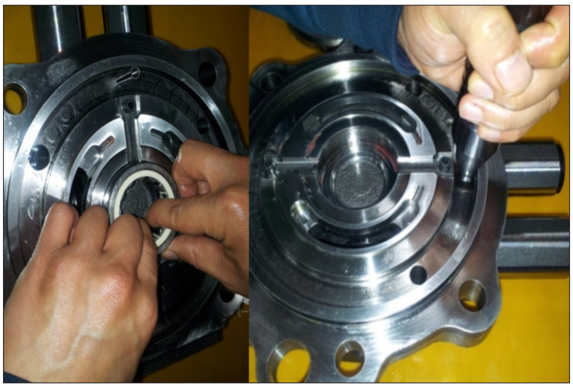
④ Assemble plug (28) and O-ring (27) into valve casing (23).

- Plug (28) × 3EA
- O-ring (27) × 3EA
- Tightening torque : 4.5 ± 0.4 kgf · m (32.5 ± 2.9 lbf · ft)

2209A8SM75

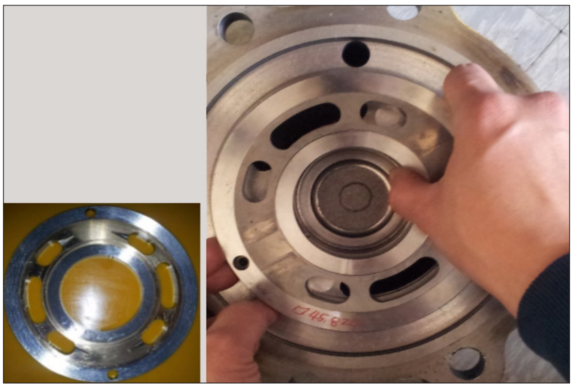
⑤ Assemble needle bearing (6) into valve casing (23) and assemble spring pin (17, 21) into valve casing (23).

- Needle bearing (6) × 1EA
- Spring pin (17, 21) × 1EA



2209A8SM76

⑥ Apply some grease valve plate (20) and assemble it into valve casing (23).



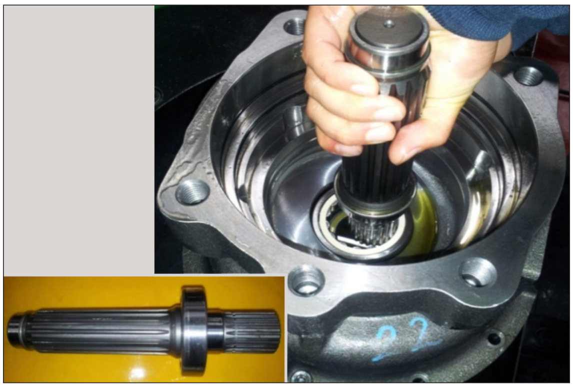
2209A8SM77

(4) Assemble drive shaft sub

① Using a jig, assemble oil sealing (2) into casing (1).

2209A8SM78

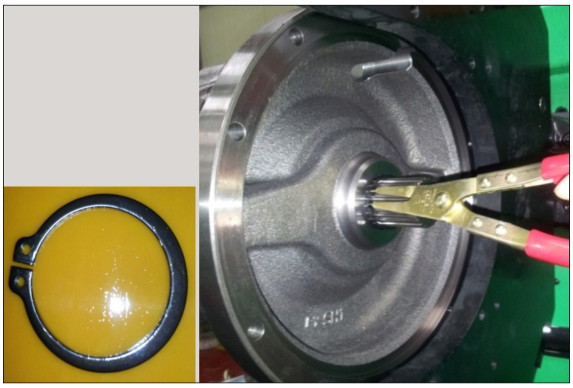
② Fit shaft sub (shaft+roller bearing) into casing (1).



2209A8SM79

③ Using a plier jig, assemble snap ring (4) to shaft (3).

· Snap ring×1EA



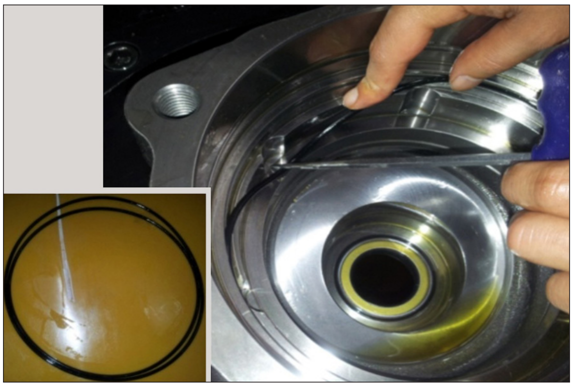
2209A8SM80

④ Apply some grease swash plate (7) and assemble it into casing (1).

· Swash plate×1EA

2209A8SM81

⑤ Insert O-ring (18, 19) into casing (1).
- O-ring (18) × 1EA
- O-ring (19) × 1EA


2209A8SM82

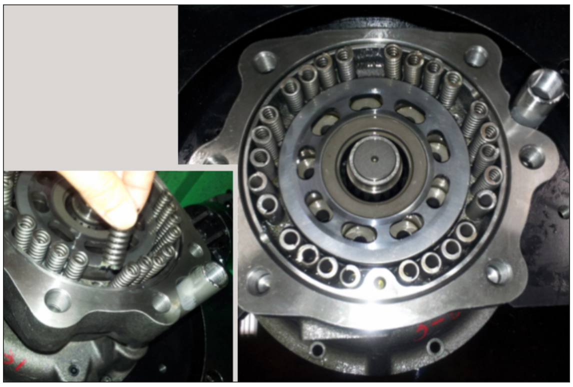
⑥ Assemble cylinder block (8) into casing (1).


2209A8SM83

⑦ Assemble separate plate (14) and friction plate (13) 4 sets into casing (1) and fit parking piston (15) into casing (1) by a jig or a press.
- Separate plate × 4EA
- Friction plate × 4EA
- Parking piston × 1EA

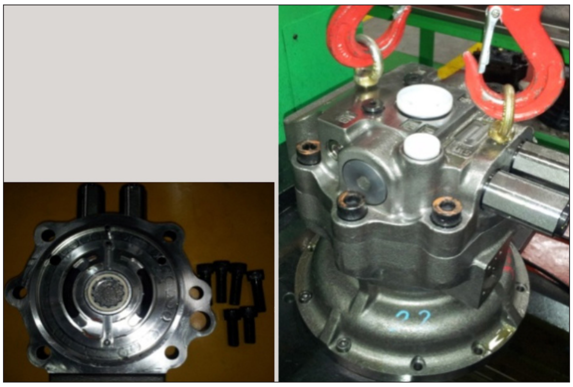

2209A8SM84

⑧ Assemble spring (parking piston, 16) into parking piston (15).
- Spring × 26EA


2209A8SM85

⑨ Lift up valve casing (23) on casing (1) by a crane and assemble it with socket bolts (37, 38).

· Tightening torque : 33±3.3 kgf · m
(239±23.9 lbf · ft)



2209A8SM86

⑩ Assemble level gauge (36) and plug (39) into casing (1).

· Tightening torque (36) : 15±1.0 kgf · m
(108.5±7.2 lbf · ft)
· Tightening torque (39) : 3±0.3 kgf · m
(21.7±2.2 lbf · ft)

2209A8SM87

⑪ Assemble time delay valve assy (35) into valve casing (23) with socket bolt (42).

· Time delay valve × 1EA
· Socket bolt × 3EA
· Tightening torque (42) : 1.3±0.1 kgf · m
(9.4±0.72 lbf · ft)

2209A8SM88

⑫ Air pressing test

Be sure of leakage, after press air into assembled motor and put it in water for 1 minute (pressure : 2 kgf/cm^2).

2209A8SM89

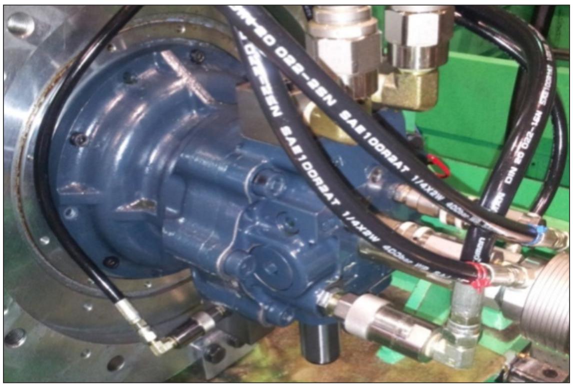
⑬ Leakage check

Place motor on a bench tester and after cleaning motor by color check No.1, paint No.3 and be sure of leakage.

2209A8SM90

⑭ Mount test bench

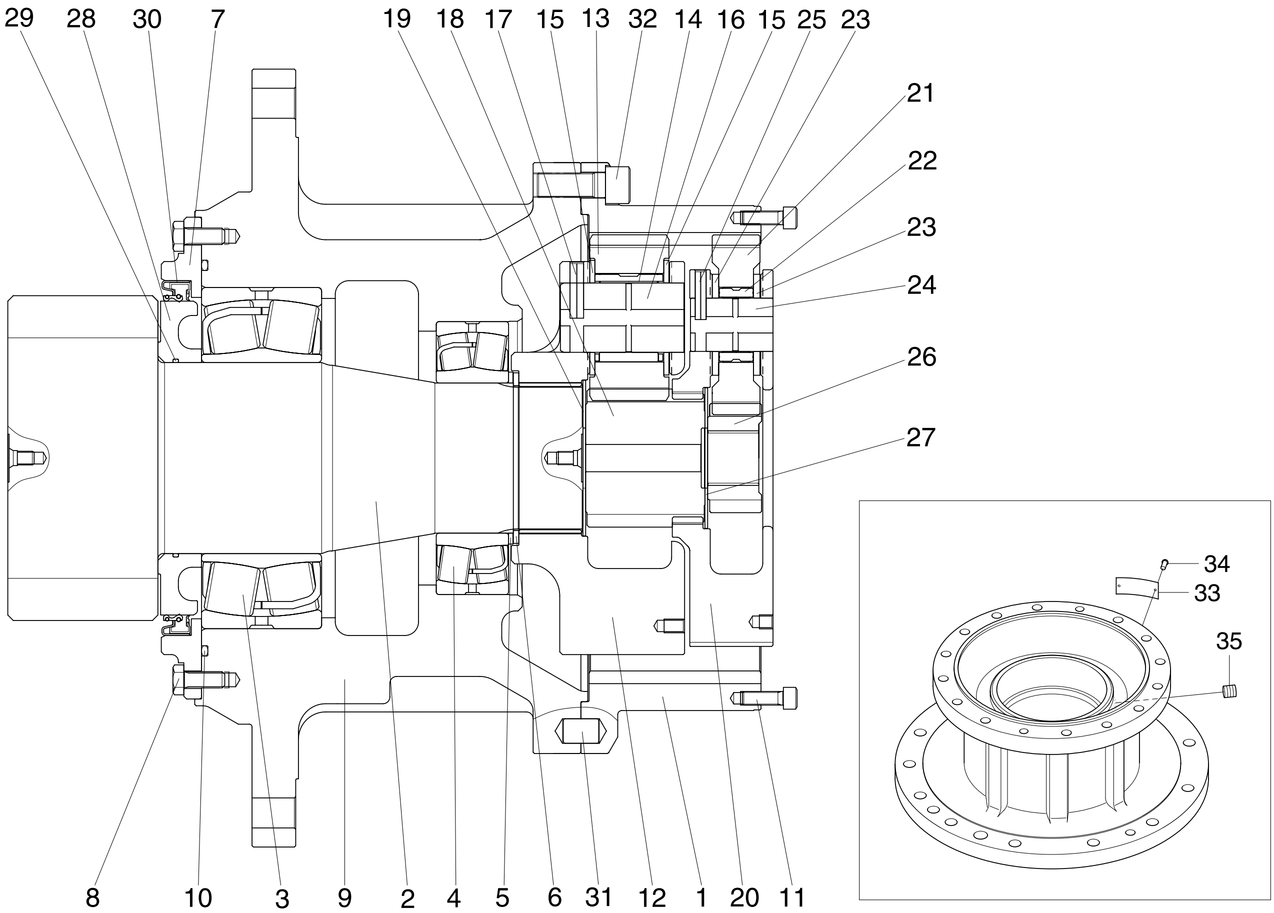
Mounting motor a test bench, test the availability of each part.



2209A8SM91

3. DISASSEMBLY AND ASSEMBLY OF REDUCTION GEAR

1) STRUCTURE



300L2SM03

1	Ring gear	13	Planetary gear 2	25	Spring pin 1
2	Drive shaft	14	Needle bearing 2	26	Sun gear 1
3	Bearing	15	Thrust washer 2	27	Thrust plate 1
4	Bearing	16	Carrier pin 2	28	Sleeve
5	Thrust plate	17	Spring pin 2	29	O-ring
6	Snap ring	18	Sun gear 2	30	Oil seal
7	Cover	19	Thrust plate 2	31	Parallel pin
8	Hex head bolt	20	Carrier 1	32	Hex socket head bolt
9	Casing	21	Planetary gear 1	33	Name plate
10	O-ring	22	Needle bearing 1	34	Rivet
11	Hex socket head bolt	23	Thrust washer 1	35	Plug
12	Carrier 2	24	Carrier pin 1		

2) DISASSEMBLY REDUCTION GEAR

(1) Preparation

① The reduction gear removed from machine is usually covered with mud.
Wash out side of reduction gear and dry it.
② Setting reduction gear on work stand for disassembling.
③ Mark for mating
Put marks on each mating parts when disassembling so as to reassemble correctly as before.
⚠ **Take great care not to pinch your hand between parts while disassembling not let fall parts on your foot while lifting them.**

(2) Disassemble the swing motor

① Loosen the hex wrench bolt (11, M10), and remove the swing motor.

300L8SR01

(3) Disassemble the carrier No.1 assy

① Disassemble gear-sun No.1 (26), tightening eye-bolt (M10) to screw holes for disassembly in carrier No.1 (20), then disassemble carrier No.1 assy.

300L8SR02

(4) Disassemble the carrier No.2 assy

① Disassemble gear-sun No.2 (18), tighten eye-bolt (M10) to screw holes for disassembly in carrier No.2 (12), then disassemble carrier No.2 assy.

300L8SR03

(5) Disassemble carrier No.1 assy

① Hold jig to spring pin No.1 (26), then tap jig with a hammer, so that place spring pin in the center of carrier pin No.1 (24).

※ Do not reuse spring pin.

※ Disassemble method of carrier No.2 assy is same.

300L8SR04

② Disassemble carrier pin No.1 (24), then disassemble planetary gear No.1 (21), thrust washer No.1 (23) from the carrier No.1 (20).

300L8SR05

(6) Disassemble the ring gear (1).

① Separate ring gear (1) from casing (9).

※ Separate casing (9) by using the groove area because loctite is spread on joining surface of ring gear (1) and casing (9) to prevent oil leakage.

300L8SR06

(7) Disassemble the drive shaft (2).

① Using the snapring plier, disassemble snap ring (6),then disassemble thrust plate (5).

300L8SR07

② Turn casing (9) over to face pinion gear upward. Then unscrew hex.head bolt (8) 12ea by using the tool.

300L8SR08

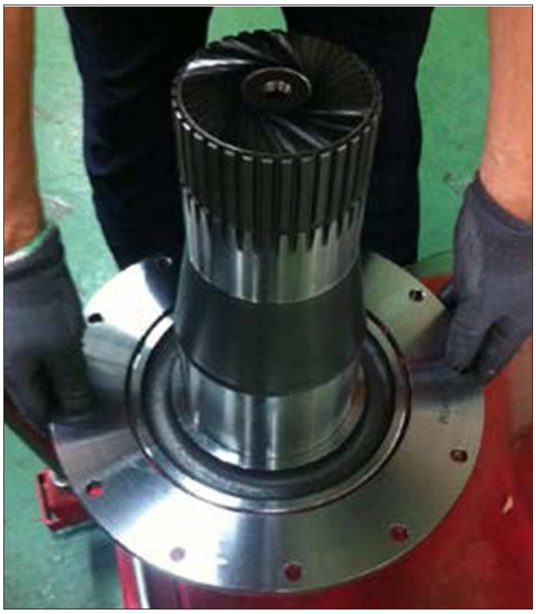
③ Disassemble drive shaft sub assy by using the press machine.

※ The drive shaft sub assy fall all together, so becareful when removing it.

300L8SR09

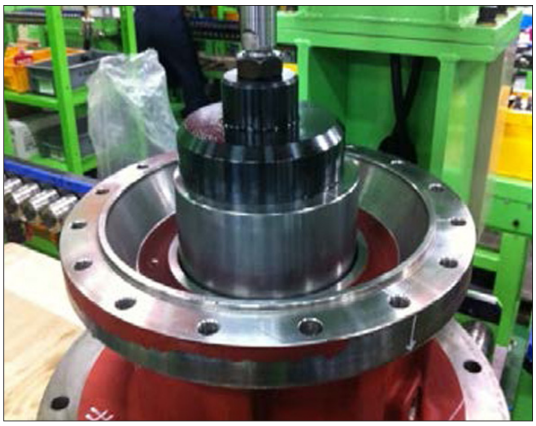
④ Disassemble sph. roller bearing (3), cover (7), oil seal (30), and sleeve (28) from the drive shaft (2).

※ Do not reuse oil seal (30).



300L8SR10

(8) Separate sph. roller bearing (4) from casing (9) by using the press machine.



300L8SR11

3) ASSEMBLY REDUCTION GEAR

(1) Even though assembly is accomplished by reversing disassembly steps, be careful of the following.

① Repair the damaged part when disassembling, prepare parts for the exchange in advance.

② All parts should be cleaned with cleaner, and dried with compressed air.

③ Sliding surface, O-ring, bearing and oil seal should be lubricated with clean hydraulic oil, prior to final assembly.

④ Replacement O-ring and oil seal with new parts is generally recommended.

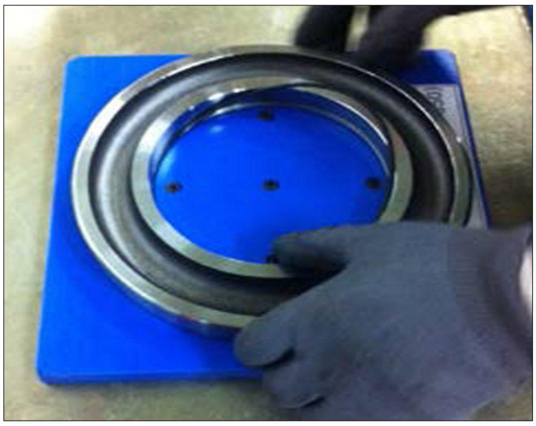
⑤ Use a torque wrench to make sure that assembly fasteners are tightened to specified values.

⑥ When assembling bolt, spread Loctite.

(2) Assemble drive shaft (2).

① After heating sleeve (28) for 5 minutes at 80 ~ 90˚C, assemble O-ring (29).

※ Apply grease to the O-ring (29) to prevent damage.



300L8SR12

② Apply grease to the oil seal (30), placed on the jig and then assemble it to cover (7) by using the press machine.

※ Apply grease to oil seal lip portion.
※ Be careful of damage of oil seal.

300L8SR13

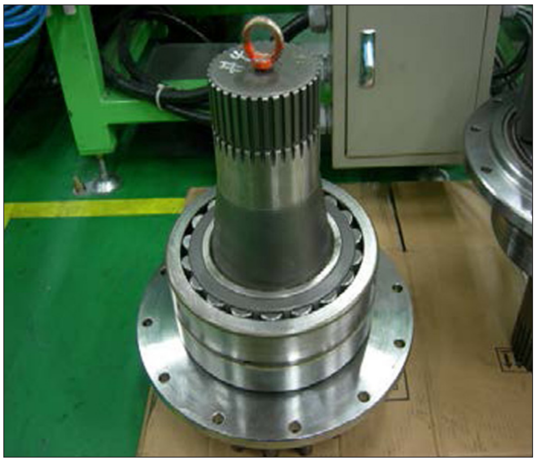
③ Assemble sleeve (28) and cover (7) to drive shaft (2).

※ Be careful of the direction of cover (7), sleeve (28).

※ Be careful of damage of oil seal.

300L8SR14

④ After heating sph. roller bearing (3) for 13 minutes at 80~90˚C and doing demagnetization, then assemble it to drive shaft (2).



300L8SR15

⑤ After assembling O-ring (10) on casing (9), assemble drive shaft sub assy by using a press machine.

300L8SR16

⑥ After spreading loctite #262 on hex.head bolt (8), screw them to fix casing (9) and cover (7).

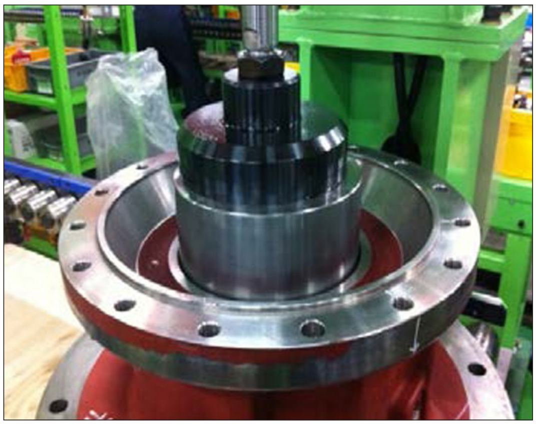
※ Tightening torque : 8.8±0.9 kgf · m
(63.7±6.51 lbf · ft)

※ Screwing when rust inhibitor is not remove.

300L8SR17

(3) Assemble sph. roller bearing (4).

① Assemble sph. roller bearing (4) to casing (9) by using the press machine.



300L8SR18

② After assembling thrust plate (5), assemble snap ring (6) to assembly groove of drive shaft (2).

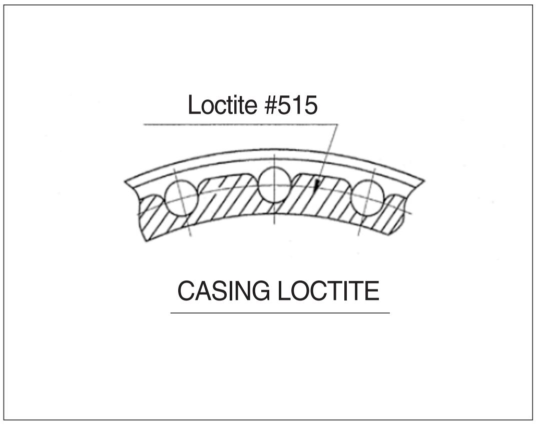
※ Assemble selected thrust plate (5) to make gap (0.1~0.3 mm) between snap ring (6) and sph. roller bearing (4).

300L8SR19

(4) Assemble ring gear (1).

① Spread the loctite #515 on the casing (9) with reference to the right detail view.

※ Loctite should not flow into casing (9).



300L8SR20

② After press-fitting parallel pin (31) with a hammer on the casing (9). Then spreading loctite #262 on hex.head bolt (32), screw them.

※ Tightening torque : 33±3.3 kgf · m
(239±23.9 lbf · ft)

※ Screwing when rust inhibitor is not removed.

300L8SR21

(5) Assemble carrier No.1 assy

① After assembling thrust plate No.1 (27) on carrier No.1 (20), assemble thrust washer No.1 (23), planetary gear No.1 (21), then assemble carrier pin No.1 (24) by using the hammer.

※ Assembly method of carrier No.2 assy is same.

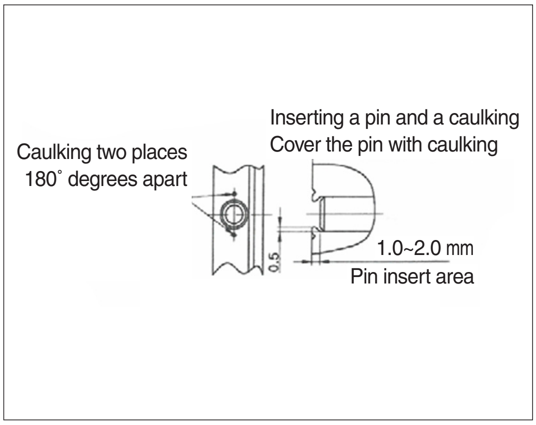
300L8SR22

② Assemble spring pin No.1 (25) to fix carrier No.1 (20) and spring pin No.1 (25) by using the jig.

300L8SR23

③ Caulking is performed on the assembled spring pin unit.

※ To cover pins, implement the caulking in two places that are located direction of 180 degrees around assembled spring pin No.1 (25).



300L8SR24

(6) Assemble carrier No.2 assy

① Lift pre-assembled carrier No.2 assy.
Shaking it from side to side, assemble it to ring gear (1) to engage with ring gear (1). Then, press-fit it with polyurethane hammer.

※ Check caulking and rotating state before assembly.

300L8SR25

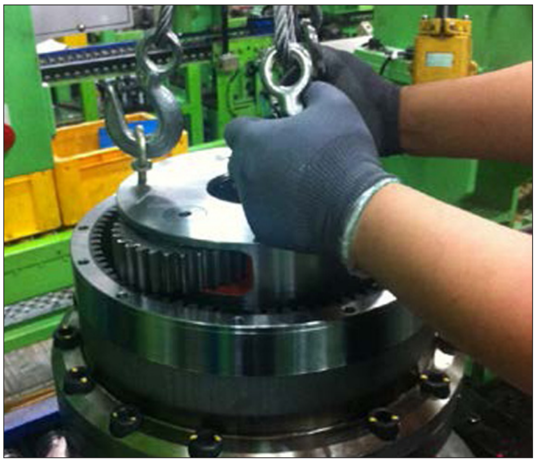
(7) Assemble sun gear No.2 (18).

① Shaking sun gear No.2 (18) from side to side, assemble it to carrier No.2 assy to engage with planetary gear No.2 (13).

300L8SR26

(8) Assemble carrier No.1 assy.
Lift carrier No.1 assy. Shaking it from side to side, assemble it to ring gear (1) to engage with ring gear (1).

※ Check rotating state before assembly.



300L8SR27

(9) Assemble sun gear No.1 (26).

① Shaking sun gear No.1 (26) from side to side, assembleit to engage planetary gear No.1 (21). Then fill with gear oil 11 liter.

300L8SR28

GROUP 6 TRAVEL DEVICE (TYPE 1 & 2)

1. REMOVAL AND INSTALL

1) REMOVAL

13031GE18

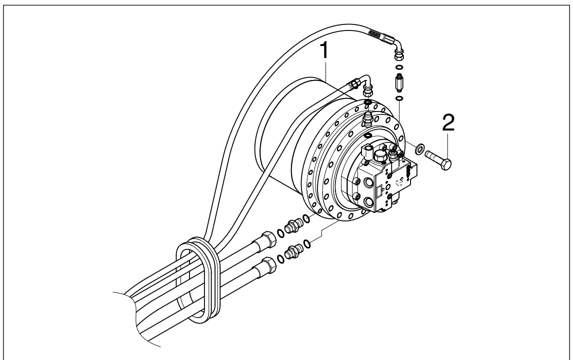
(1) Swing the work equipment 90° and lower it completely to the ground.

(2) Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

(3) Loosen the breather slowly to release the pressure inside the hydraulic tank.

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

※ When pipes and hoses are disconnected, the oil inside the piping will flow out, so catch it in oil pan.



300L8TM01

(4) Remove the track shoe assembly.
For details, see **removal of track shoe assembly.**

(5) Remove the cover.

(6) Remove the hoses.
※ Fit blind plugs to the disconnected hoses.

(7) Remove the bolts and the sprocket.

(8) Sling travel device assembly (1).

(9) Remove the mounting bolts (2), then remove the travel device assembly.
· Weight : 433 kg (977 lb)
· Tightening torque : 84 ± 8.0 kgf·m
(608 ± 57.9 lbf·ft)

2) INSTALL

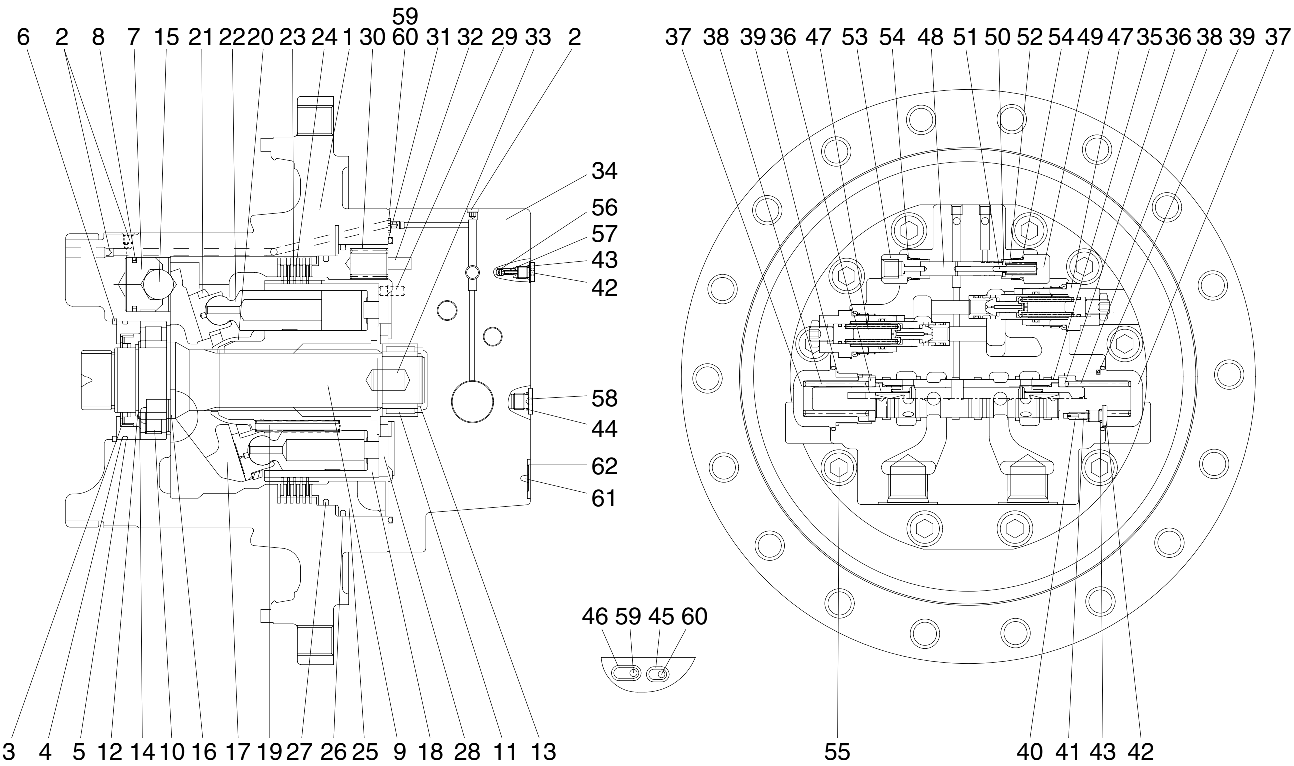
(1) Carry out installation in the reverse order to removal.

(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. SPECIFICATION

1) TRAVEL MOTOR



2609A2TM02

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

2) TOOL AND TIGHTENING TORQUE

(1) Tools

Name of tools	B-size	Name of part applied
Hexagonal L-Wrench	4	Plug (2), Orifice screw (3, 4, 38)
	8	Hex socket bolt (50), Lock screw (62, 72), Plug (65)
	10	Hex socket bolt (49)
	46	Hex (57)
Socket wrench/ spanner	19	Hp plug (54)
	24	Hex nut (63)
	27	Hp plug (56)
Snap-ring plier (for holes, axis)		Ring stop (14), Ring lock (74)
Solder hammer		Needle bearing (34), Pin (5, 6, 36)
Torque wrench		Size : 500, 3000
Jig for assembling oil seal		Oil seal (73)
Induction heating apparatus for bearing		Roller bearing (13)

(2) Tightening torque

NO.	Part name	Standard	Size	Torque	
				kgf · m	lbf · ft
2	Plug	NPTF 1/16	4	0.9±0.2	6.51±1.45
3, 4, 38	Orifice screw	NPTF 1/16	4	0.7	5.06
49	Hex socket bolt	M12	10	10	72.33
50	Hex socket bolt	M10	8	6.7	48.46
54	Plug	PF 1/4	19	3.7	26.76
56	Plug	PF 1/2	27	11	79.56
57	Relief valve	HEX 27	1 5/16	34±3.4	246±24.6
63	Nut	M16	24	24	173.59
65	Plug	PF 3/8	8	7.5	54.25
70, 72	Hex socket bolt	M16	14	24	173.59
71	Hex socket bolt	M16	14	24	173.59

3. DISASSEMBLING

1) GENERAL INSTRUCTIONS

⚠ Combustibles such as white kerosene are used for washing parts.
These combustibles are easily ignited, and could result in fire or injury.
Be very careful when using.

⚠ Internal parts are coated with hydraulic fluid during disassembling and are slippery.
If a part slips out of your hand and fails, it could result in bodily injury or could damage the park.
Be very careful when handling.

(1) Generally, hydraulic equipment is precisely manufactured and clearances between each parts are very narrow. Therefore, disassembling and assembling works should be performed on the clean place where dusts hardly gather. Tools and kerosene to wash parts should also be clean and handled with great care.

(2) When motor is removed from the host machine, wash around the ports sufficiently and put the plugs so that no dust and/or water may invade. Take off these plugs just before the piping works when re-attach it to the host machine.

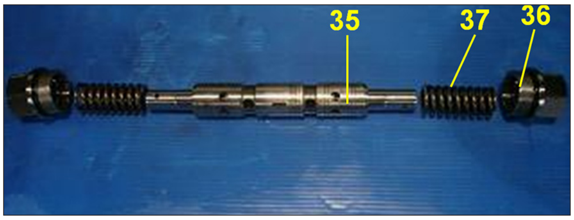
(3) Before disassembling, review the sectional drawing and prepare the required parts, depending on the purpose and the range of disassembling.
Seals, O-rings, etc., if once disassembled, are not reusable.
There are some parts that should be replaced as a subassembly.
Consult with the parts manual in advance.

(4) The piston can be inserted to whichever cylinder block for the initial assembling.
However, their combination should not be changed if they are once used. To reuse them, put the matching mark on both pistons and cylinder block before disassembling.

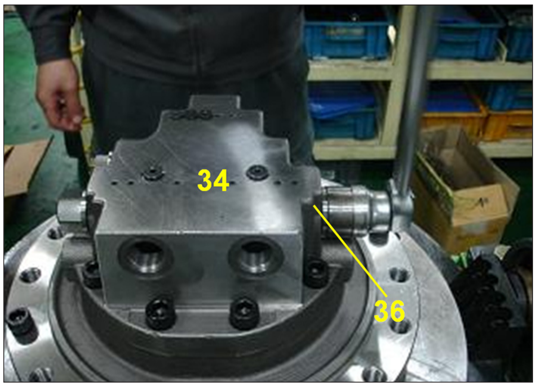
⚠ Take great care not to pinch your hand between parts while disassembling nor let fall parts on your foot while lifting them.

2) DISASSEMBLING TRAVEL MOTOR

(1) Disassemble main spool cover (36) into rear cover (34) using spanner and torque wrench and then disassemble spring (37), main spool assy (35).



2609A8TM02

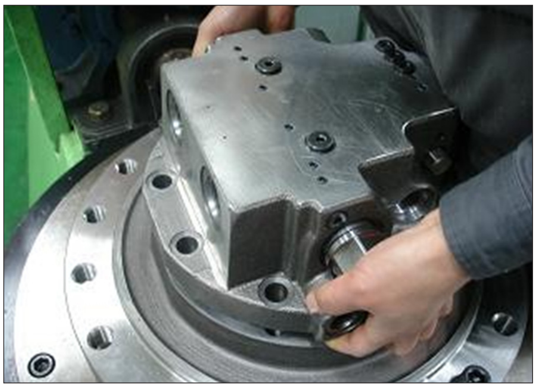


2609A8TM03

(2) Disassemble wrench bolt (54) using torque wrench.


2609A8TM04

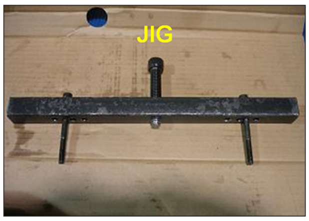
(3) Take out rear cover (34) into casing (1).


2609A8TM05

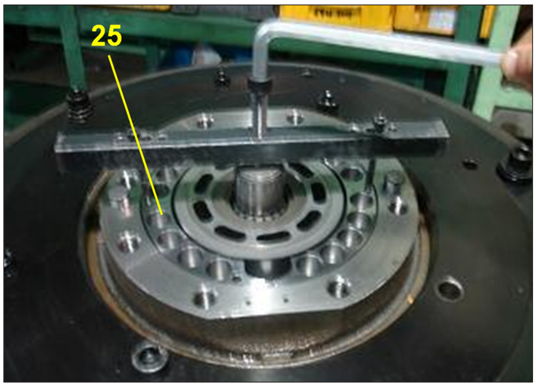
(4) Remove brake spring (30, 14EA)

2609A8TM06

(5) Disassemble parking piston (25) using jig.

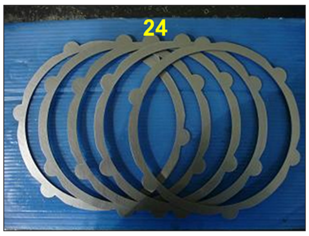


2609A8TM07



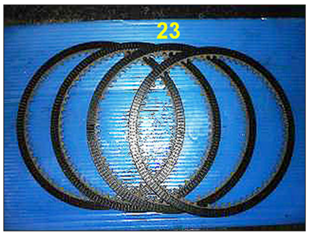
2609A8TM08

(6) Disassemble separate plate (24, 5EA) and friction plate (23, 4EA).

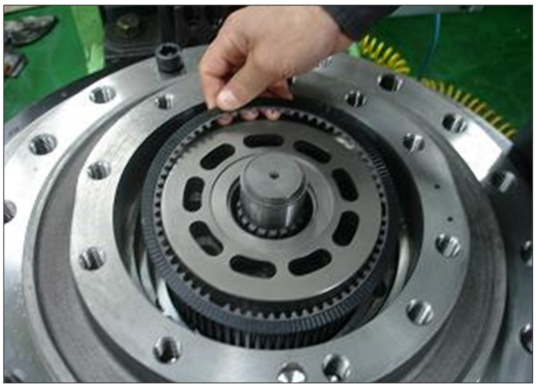


2609A8TM09

2609A8TM10

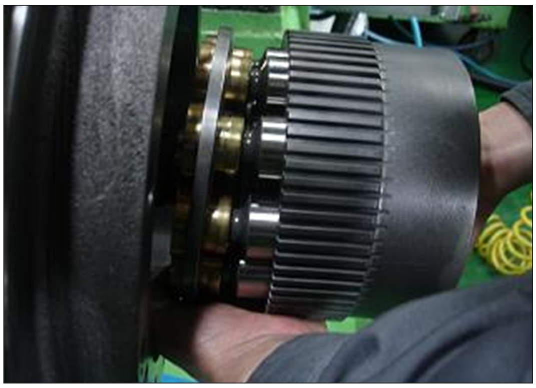


2609A8TM11



2609A8TM12

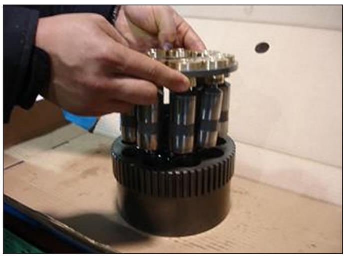
(7) Remove cylinder block kit.
It is easier to work by placing the casing (1) horizontal.



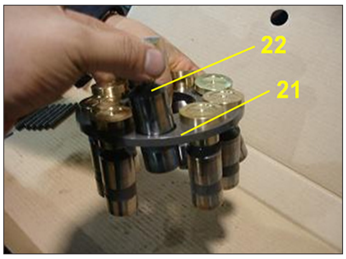
2609A8TM13

(8) Disassemble cylinder block (18), retainer plate (21), piston assy (22), ball guide (20) and spring (19) into cylinder block kit.

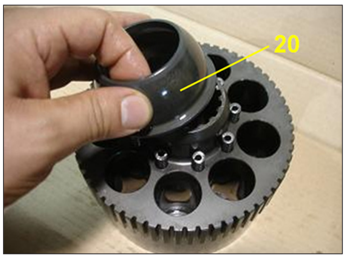
2609A8TM14



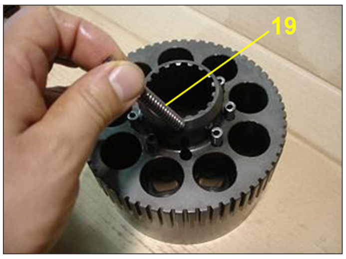
2609A8TM15



2609A8TM16



2609A8TM17



2609A8TM18

(9) Disassemble swash plate (17) into casing (1).

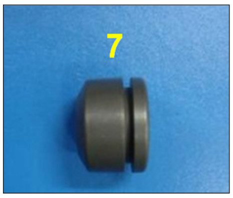
2609A8TM19

2609A8TM20

(10) Disassemble steel ball (15), swash piston (7) into casing (1).

※ Hole in the Casing(1) of two speed line is decomposed by injecting air.

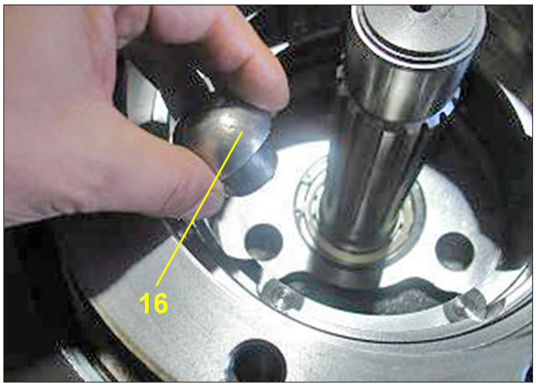
2609A8TM21



2609A8TM22

2609A8TM23

(11) Disassemble pivot (16, 2EA) into casing (1).

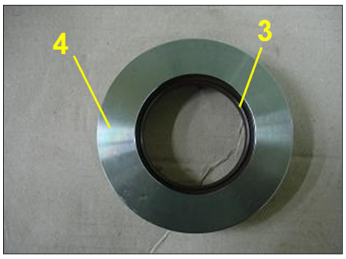


2609A8TM24

(12) Disassemble snap ring (6) using pliers.

2609A8TM25

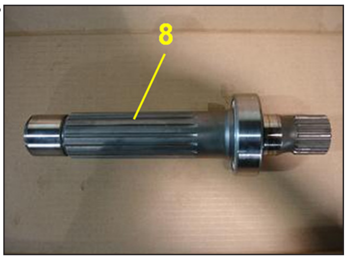
(13) Disassemble trust block (4) and oil-seal (3) into casing (1).



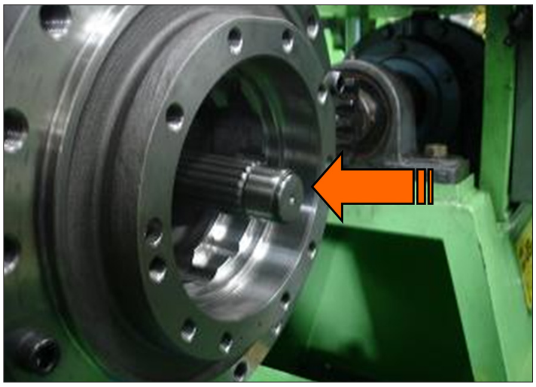
2609A8TM26

2609A8TM27

(14) In the casing (1), the arrow part of the shaft (8) using a rubber mallet taps and then disassemble the shaft (8) and bearing-roller (10) to the other side.

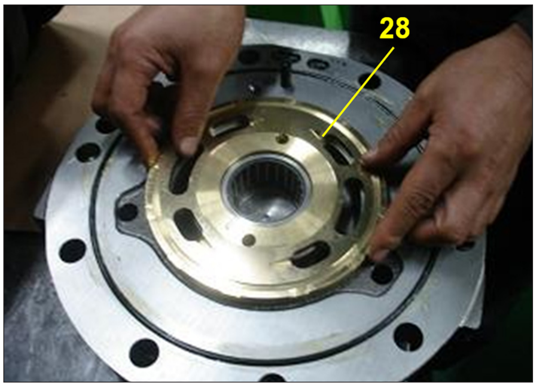


2609A8TM28



2609A8TM29

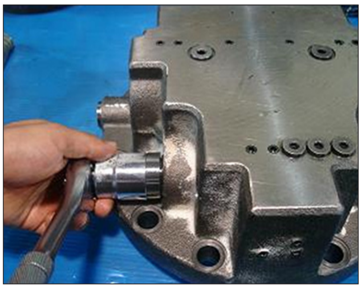
(15) Disassemble valve plate (28) into rear cover (34).

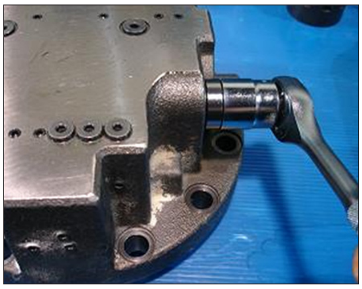


2609A8TM30

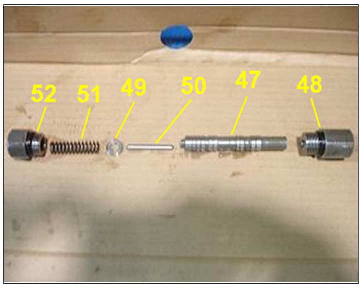
(16) Disassemble relief valve (46, 2EA) into rear cover (34) using the torque wrench.

2609A8TM31

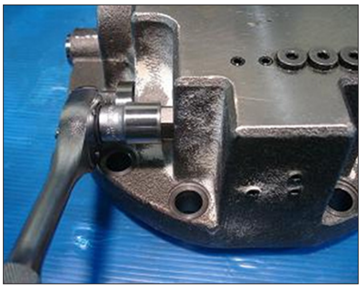

2609A8TM32

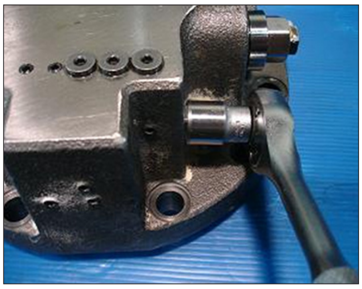

2609A8TM33

(17) Disassemble plug (48), connector (52) into rear cover (34) using the torque wrench and then disassemble spring (51), spring seat (49), parallel pin (50) and spool (47) in regular sequence.

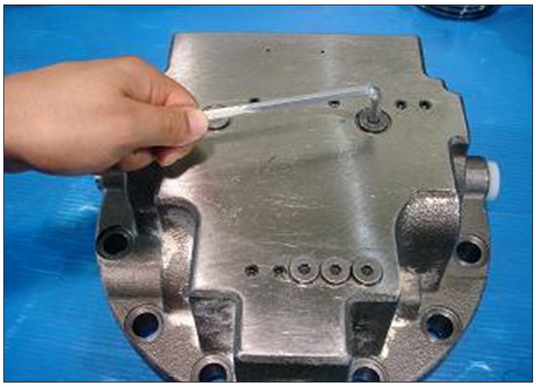


2609A8TM34


2609A8TM35

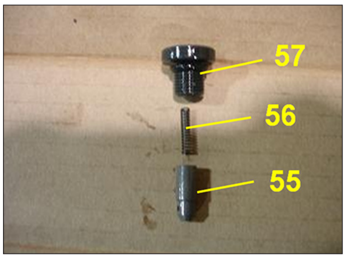

2609A8TM36

(18) Disassemble plug (57) into rear cover (34).

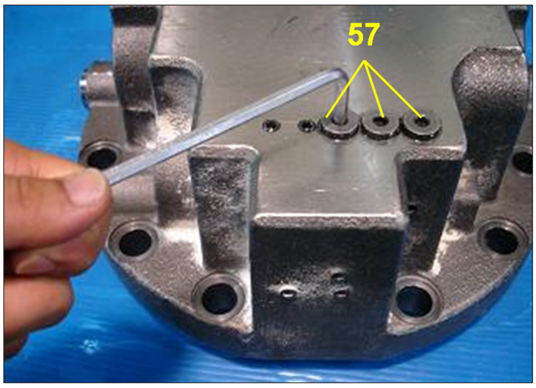


2609A8TM37

(19) Disassemble plug (57) into rear cover (34) and then disassemble spring (56), check valve (55) into rear cover (34) in regular sequence.



2609A8TM38



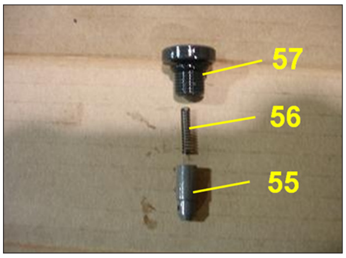
2609A8TM39

4. REASSEMBLING

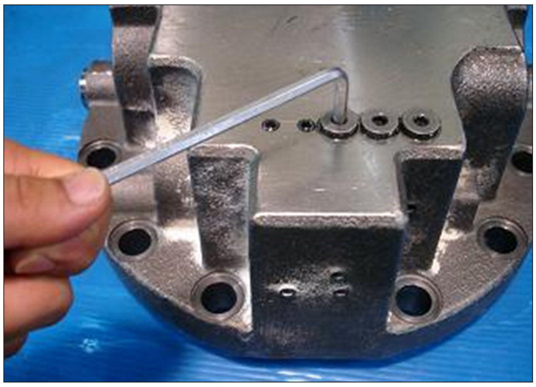
1) ASSEMBLING MOTOR

- REAR COVER ASSY

(1) Assemble check valve (55), spring (56) into rear cover (34) and then assemble plug (57) using L-wrench.

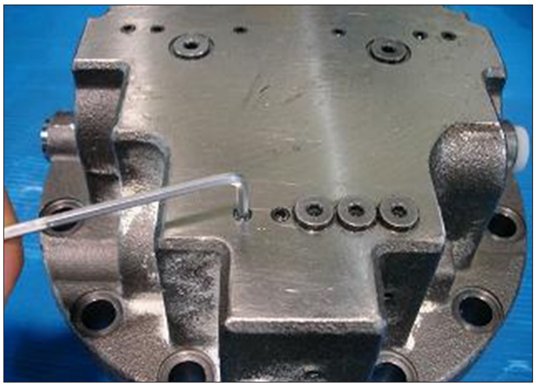


2609A8TM40

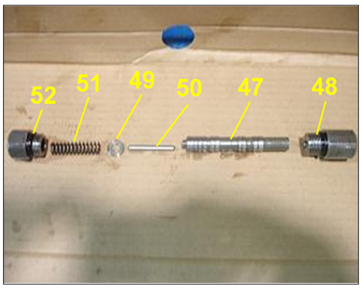

2609A8TM41

(2) Apply loctite #242 on the NPTF 1/16 plug (2) and then assemble 12-NPTF 1/16 Plug (2) into rear cover(34).

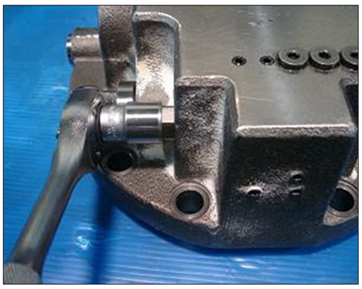
2609A8TM42

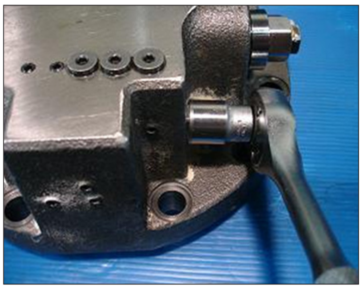

2609A8TM43

(3) Assemble spool (47), parallel pin (50), spring seat (49) and spring (51) into rear cover (34) in regular sequence and then assemble plug (48) and connector (52).



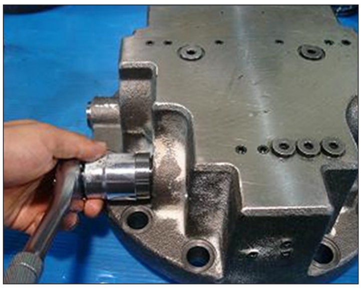
2609A8TM44

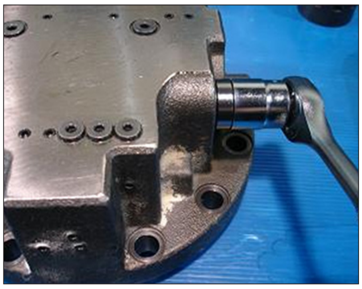

2609A8TM45


2609A8TM46

(4) Assemble relief valve (42, 2EA) into rear cover (34).

2609A8TM47


2609A8TM48


2609A8TM49

(5) Press needle bearing (11) into rear cover (34) using jig.

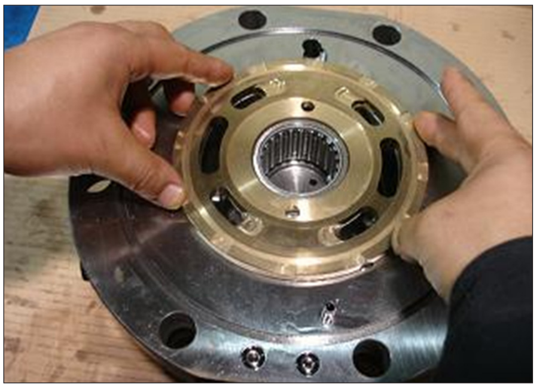
2609A8TM50

(6) Assemble spring pin (32) and parallel pin (29) using small hammer.

2609A8TM51

(7) Assemble valve plate (28) into rear cover (34).

※ Apply grease to the valve plate contact and then assemble valve plate into rear cover (34).

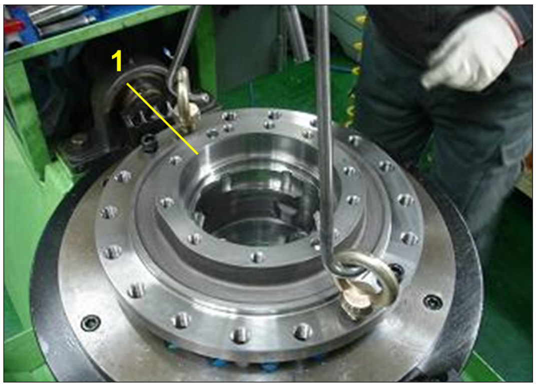


2609A8TM52

(8) Apply grease to the O-ring and then assemble O-ring into rear cover (34).

2609A8TM53

(9) Install casing (1) into assembling jig.



2609A8TM54

(10) Assemble the heated Roller Bearing(10) onto the Shaft(8).

① The temperature of the Roller Bearing : 100˚C.
Using tool : Heater.

※ Be careful not to damage the sliding surface for the Oil seal on the shaft.

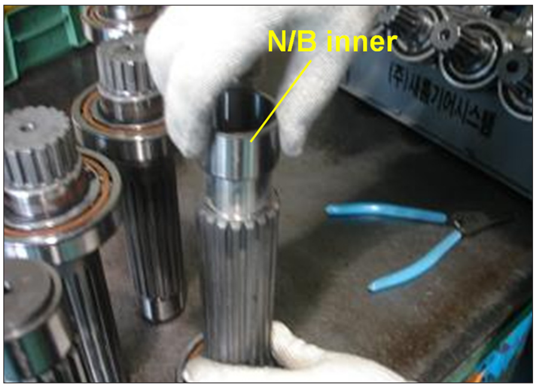

2609A8TM55


2609A8TM56


2609A8TM57

(11) Assemble the heated needle bearing inner ring on the shaft (8).


2609A8TM58

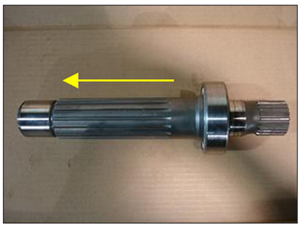


2609A8TM59

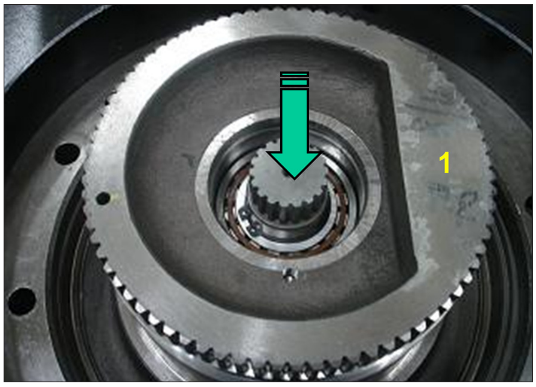
(12) Assemble snap ring (13) into Shaft (8) using pliers.


2609A8TM60

(13) Insert assembled shaft assy in the direction of the arrow into casing (1) using a rubber mallet.

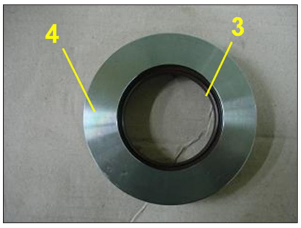


2609A8TM61

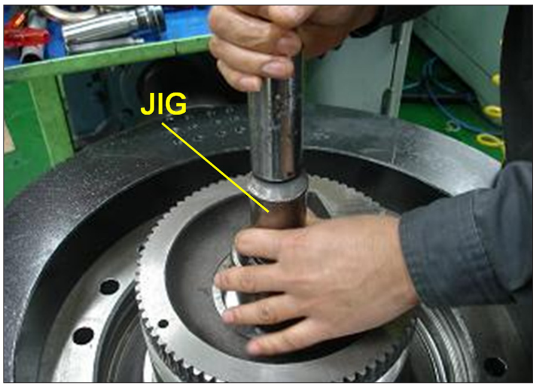


2609A8TM62

(14) Assemble oil seal(3) into trust block (4) with a assembling jig and press it into casing (1). Caution the direction of oil seal (3).



2609A8TM63



2609A8TM64

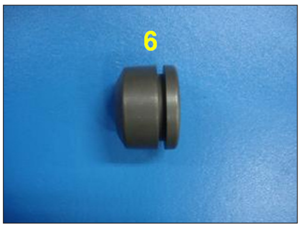
(15) Assemble snap ring(6) into casing(1) using pliers.

2609A8TM65

(16) Apply the grease to pivot (16, 2EA) and then assemble pivot (16) into casing(1).

2609A8TM66

(17) Warm piston seal (8) and assemble it on swash piston (7) and then bind the piston seal (8) with a bend for a minute.
Remove the bend and assemble it into casing (1).

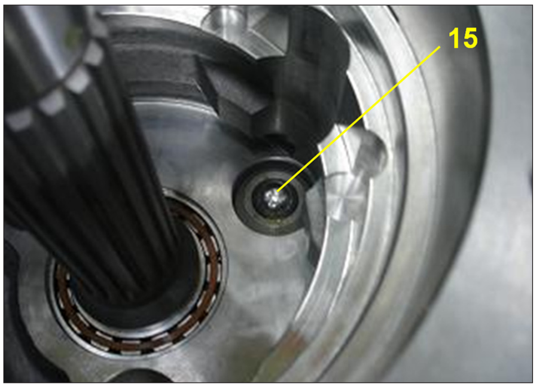


2609A8TM67


2609A8TM68

(18) Apply the grease to steel ball(15) and then assemble steel ball(15) into casing(1).

2609A8TM69



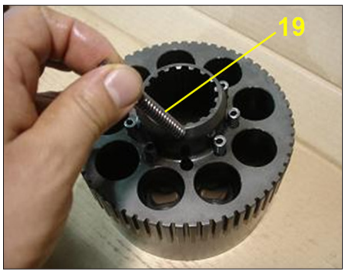
2609A8TM70

(19) Apply the grease to swash plate(17) and then assemble swash plate(17) into casing(1).

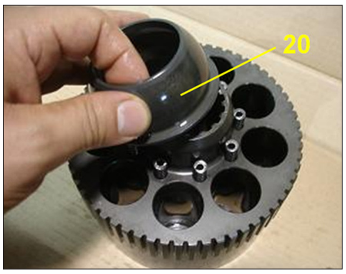
2609A8TM71


2609A8TM72

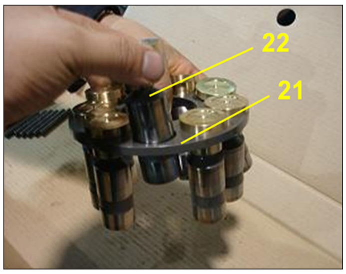
(20) Assemble spring (19), ball guide((20), retainer plate (21), piston assy (22) into cylinder block (18) in regular sequence.



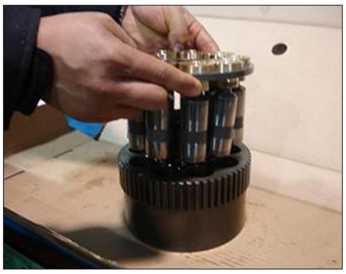
2609A8TM73



2609A8TM74



2609A8TM75

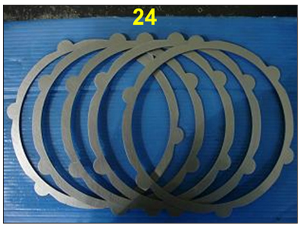

2609A8TM76


2609A8TM77

(21) Stant the casing (1) and then assemble cylinder block kit into casing (1).

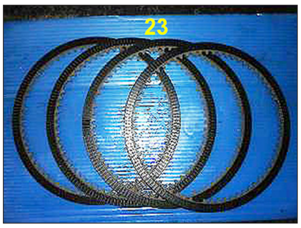

2609A8TM78

(22) Assemble separated plate (24), friction plate (23) into cylinder block in regular sequence.
Friction plate : 4EA
Separated plate : 5EA



2609A8TM79

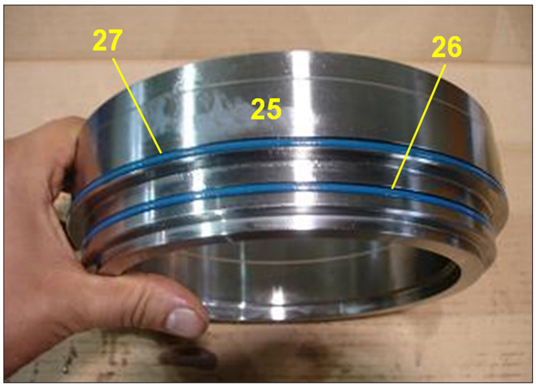

2609A8TM80



2609A8TM81

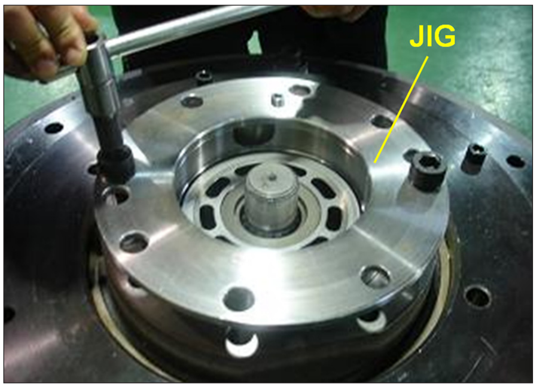
2609A8TM82

(23) Apply the grease to D-ring (26, 27) and then assemble D-ring (26, 27) into parking piston (25).



2609A8TM83

(24) Assemble parking piston into casing using jig.

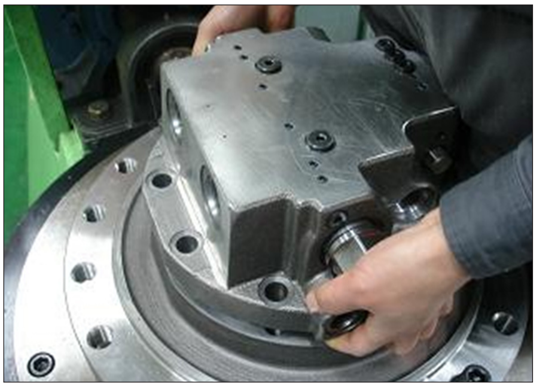


2609A8TM84

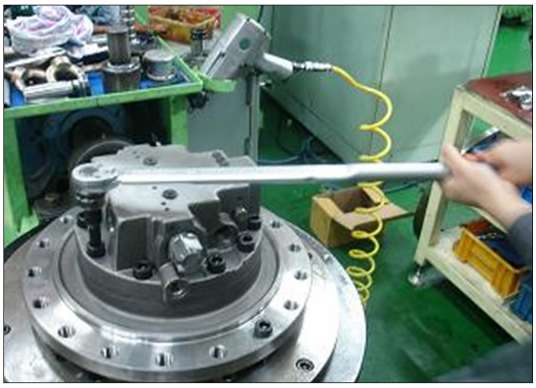
(25) Assemble brake spring (30, 18EA).

2609A8TM85

(26) Put on the rear cover (34) on the casing (1).

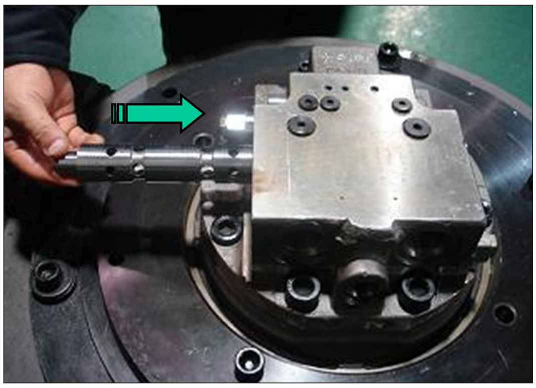

2609A8TM86

(27) Assemble rear cover (34) into casing (1) and then tighten the wrench bolt (54, 55) using torque wrench.


2609A8TM87

(28) Assemble main spool assy (35) into rear cover (34) after checking the direction to be correct.

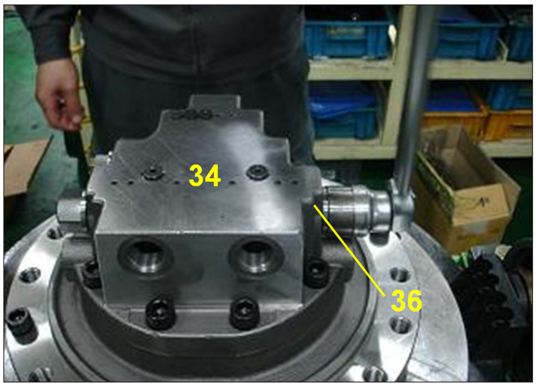

2609A8TM88


2609A8TM89

(29) Assemble spring (37), plug (36) into rear cover (34) in regular sequence and then plug (36) into rear cover (34) using torque wrench.

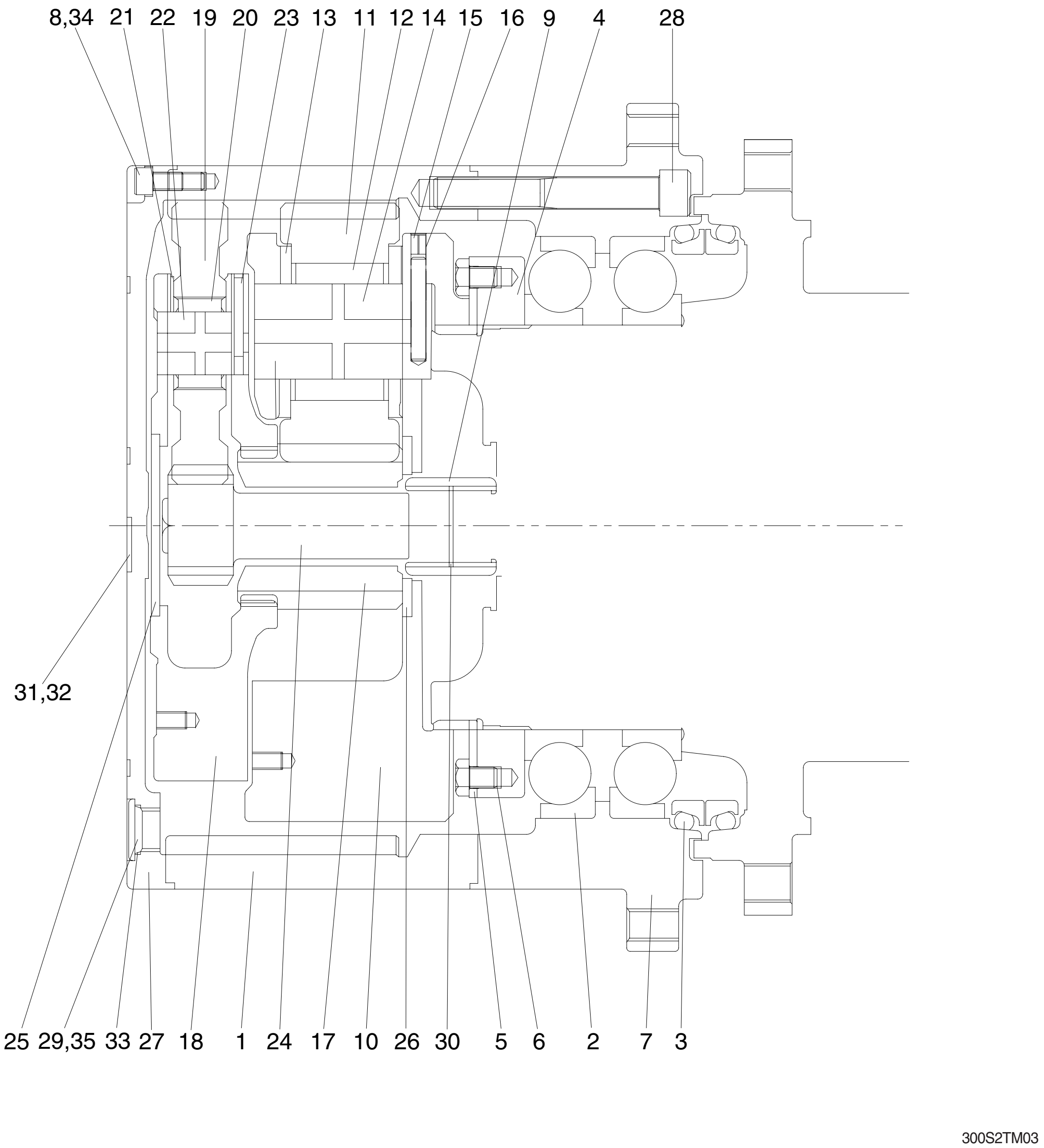

2609A8TM90


2609A8TM91



2609A8TM92

2) TRAVEL REDUCTION GEAR



1	Gear ring	13	Thrust washer 2	25	Thrust plate
2	Ball bearing	14	Carrier pin 2	26	Thrust plate
3	Floating seal assy	15	Spring pin 2	27	Cover
4	Nut ring	16	Solid pin 2	28	Hexagon socket head bolt
5	Lock plate	17	Sun gear 2	29	Plug
6	Hexagon socket head bolt	18	Carrier 1	30	Snap ring
7	Housing	19	Planetary gear 1	31	Name plate
8	Hexagon socket head bolt	20	Needle bearing 1	32	Rivet
9	Coupling	21	Thrust washer 1	33	O-ring
10	Carrier 2	22	Carrier pin 1	34	Rubber cap
11	Planetary gear 2	23	Spring pin 1	35	Rubber cap
12	Needle bearing 2	24	Sun gear 1		

6. DISASSEMBLING

1) GENERAL INSTRUCTIONS

⚠ Combustibles such as white kerosene are used for washing parts.
These combustibles are easily ignited, and could result in fire or injury.
Be very careful when using.

⚠ Internal parts are coated with gear oil during disassembling and are slippery.
If a part slips off from your hand and fails, it could result in bodily injury or could damage the park.
Be very careful when handling.

(1) Therefore, disassembling and assembling works should be performed on the clean place where dusts hardly gather.
Tools and kerosene to wash parts should also be clean and handled with great care.

(2) Bofore disassembling, review the sectional drawing and prepare the required parts, depending on the purpose and the range of disassembling.
Seals, O-rings, etc., if once disassembled, are not reusable.
There are some parts that should be replaced as a subassembly.
Consult with the parts manual in advance.

⚠ Take great care not to pinch your hand between parts while disassembling nor let fall parts on your foot while lifting them.

2) DISASSEMBLING TRAVEL REDUCTION GEAR

(1) Preparation for disassembling

① The reduction units removed from excavator are usually covered with mud. Wash outside of propelling unit and dry it.
② Locate reducer in order for drain port to be at the lowest level loosen taper screw plug of drain port, and drain oil from reduction gear.

※ While oil is still hot, inside of the unit may be pressurized.

▲ Take care of the hot oil gushing out of the unit when loosening the plug.

③ Mark for mating
Put marks on each mating parts when disassembling so as to reassemble correctly as before.

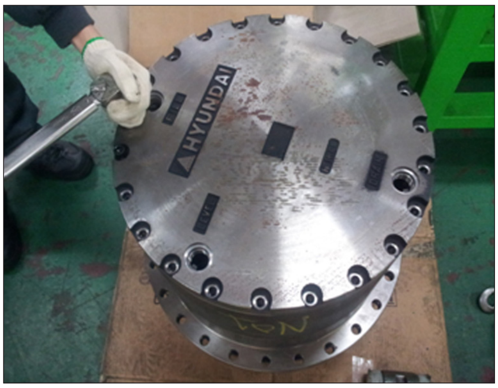
(2) Set the reduction unit on table

① Remove 7/16-14UNC hexagon socket head bolts at 3 places from cover almost equally apart each other, and then install 7/16-14UNC eye bolts.

▲ Take great care not to pinch your hand between parts while disassembling nor let fall parts on your foot while lifting them.

(3) Removing cover

① Remove 22 socket bolts (7/16-14UNC) those are attached to ring gear.
② Cover is stuck (27) to ring gear (1).
So use sharp chisel for removing cover (27) from ring gear (1).



2609A8TM02

(4) Removing sun gear No.1

Pull sun gear No.1 (24) vertically slow after removing thrust plate (25).

2609A8TM03

(5) Removing carrier No.1 sub assembly

Pull away carrier No.1 (18) with attached eye-bolt (M10) that is assembled to hole on carrier sub-assembly.

2609A8TM04

(6) Removing sun gear No.2

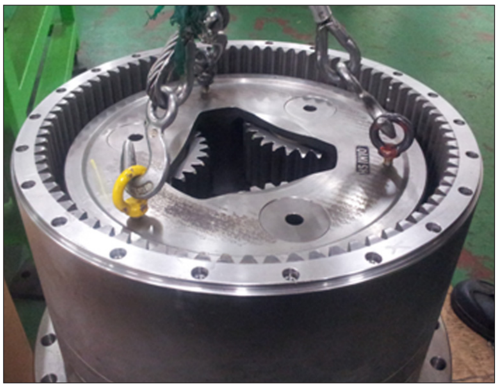
Pull away sun gear No.2 (17) for removing.

2609A8TM05

(7) Deassembleing carrier No.2 sub-assembly

Attach eye-bolt (M10) to the hole of carrier No.2 (10), and remove the carrier No.2 sub-assembly to lift up slowly.

※ Keep horizontal to ground and make sure the eye-bolts to be safe operation.



2609A8TM06

(8) Take away coupling

Take away the coupling (9) from casing (1).

2609A8TM07

(9) Lock plate

Release four hex head bolts (6, M12) and remove lock plate (5).

2609A8TM08

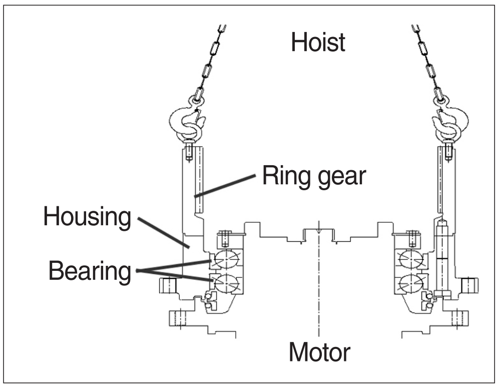
(10) Nut ring

Release nut ring with removing jig.

2609A8TM09

(11) Housing sub-assembly

Lift up housing part slowly with hoist after attaching eye-bolt (7/16-14UNC) on it If you hit softly the center of motor with hammer and particular jig, you can remove the device easily.



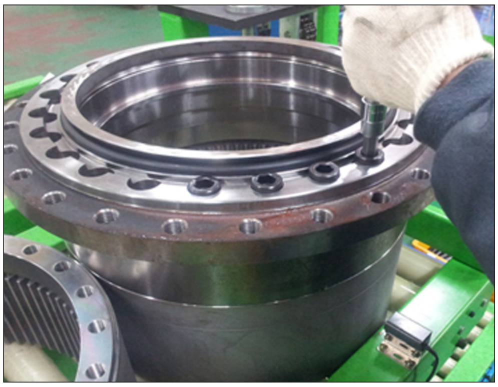
2609A8TM10

(12) Ring gear

① Reverse the housing sub-assembly part with machine, and remove floating seal (3) from the inside.

2609A8TM11

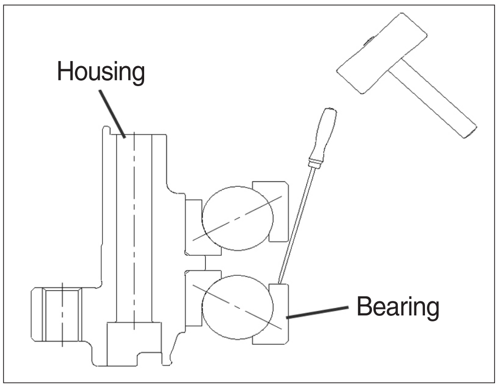
② Release 25 hex wrench bolts (28. M18) and remove ring gear (1) from housing (7).



2609A8TM12

(13) Angular Bearing

Put the housing sub-assembly (7) like this figure. And hit each opposite side of bearing with driver and hammer.



2609A8TM13

(14) Carrier No.1 sub-assembly

① Lay it on deassemblig jig. And remove pin No.1 (22) with press machine.

2609A8TM14

② Then remove planet gear No.1 (19) and thrust washer No.1 (21) from carrier No.1 (18).

2609A8TM15

(15) Carrier No.2 sub-assembly

Same as carrier No.1 (12) sub-asembly.

2609A8TM16

(16) Coupling

Remove snap ring (30) inside coupling (9) with nipper.

2609A8TM17

7. ASSEMBLY REDUTION UNIT

1) GENERAL NOTES

(1) Clean every part by kerosene and dry them by air blow.

(2) Surfaces to be applied by loctite must be decreased by solvent.

(3) Check every part for any abnormal.

(4) Each hexagon socket head bolt should be used with loctite No.242 applied on its threads.

(5) Apply gear oil slightly on each part before assembling.

⚠ Take great care not to pinch your hand between parts or tools while assembling nor let fall parts on your foot while lifting them.
Inspection before reassembling.

Thrust washer
· Check if there are seizure, abnormal wear or uneven wear.
· Check if wear is over the allowable limit.

Gear
· Check if there are pitting or seizure on the tooth surface.
· Check if there are cracks on the root of tooth by die check.

Bearing
· Rotate by hand to see if there are something unusual such as noise or uneven rotation.

Floating seal
· Check flaw or score on sliding surfaces or O-ring.

2) ASSEMBLING CARRIER 1 SUB-ASSY

(1) Put carrier No.1 (18) on the flat table.

(2) Insert needle bearing No.1 (20) in planet gear No.1 (20), and attach 2 thrust washers No.1 (21) on the both side of planet gear No.1. then assemble them in carrier No.1 (18).

※ When assembling thrust washer, rounded edge-side should be facing casting side of carrier.

2609A8TM18

(3) Insert pin No.1 (22) into pinhole of carrier correctly.

※ Insert careful the pin not to scratch thrust washer and needle bearing.

2609A8TM19

(4) Press spring pin No.1 (23) with jig and strike round spring pinhole (2 symmetrical point) with tool.

※ After striking, draw the line by marker pen.

※ Check swinging conditon of planet gears.

(5) Press two more pins and spring pins on the same way.

2609A8TM20

3) ASSEMBLING CARRIER 2 SUB-ASSY

(1) Put thrust plate (26) inside of carrier No.2 (10).

2609A8TM21

(2) Insert needle bearing No.2 (12) in planet gear No.2 (11) and attach 2 thrust washers No.2 (13) on the both side of planet gear No.2. Then assemble them in carrier No.2 (10).

※ When assembling thrust washer, rounded edge-side should be facing casting side of carrier.

(3) Insert pin No.2 (14) into pinhole of carrier No.2 correctly.

※ Insert careful pin No.2 not to scratch thrust washer and needle bearing.

2609A8TM22

(4) Insert solid pin No.2 (16) with pressing jig and insert spring pin No.2 (15) in the same position. When insertion is done, strike inner circle of spring pin (2 symmetrical point) with tool.

※ After striking, draw the line by marker pen.

※ Check the spining condition of planet gear.

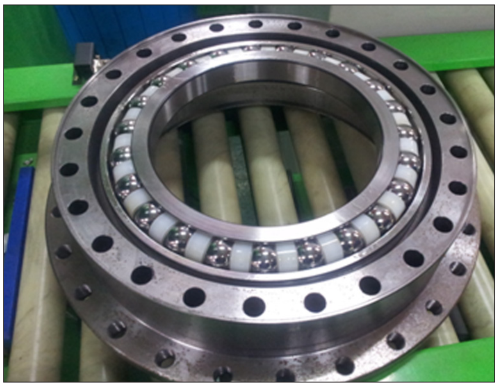
(5) Insert two more pins and spring pins on the same way.

2609A8TM23

4) ANGULAR BEARING

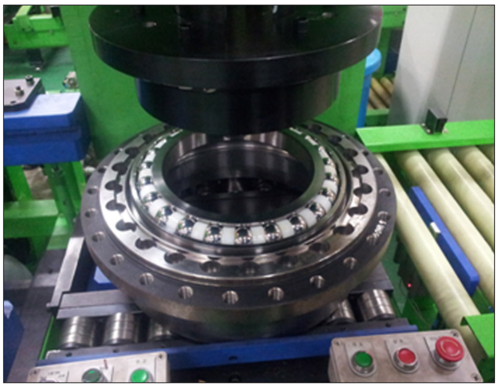
(1) Put the jig on housing (7) and insert angular bearing (2) into it with pressing machine, and turn down the upside of housing (7) by reversing machine.

※ Check the direction of bearing when inserting it.



2609A8TM24

(2) Insert angular bearing (2) into reversed housing (7) on the same way.



2609A8TM25

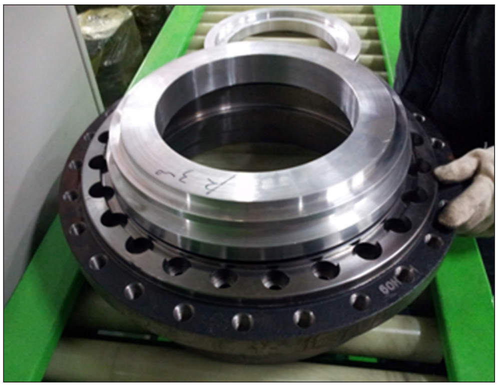
5) ASSEMBLING FLOATING SEAL

(1) Paint alchole on floating seal (3) and polish it.

2609A8TM26

(2) Put floating seal (3) on the right position of housing (3) and insert it by pressing jig.
After complete, check the condition by lifting with hand softly.

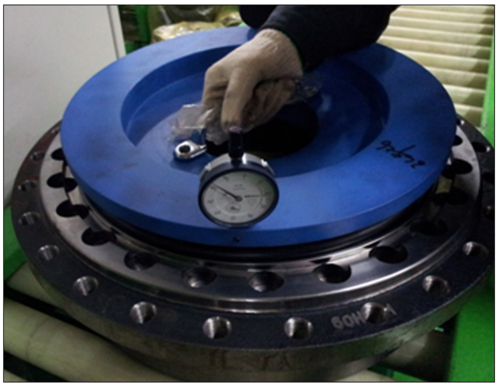
※ Keep clean on surface of floating seal while assembling.



2609A8TM27

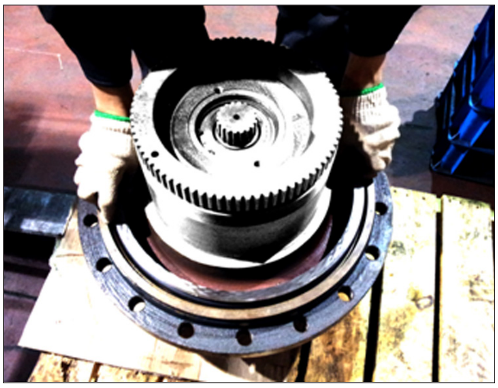
(3) Put the gauge for seal measurement on floating seal (3) and check the horizontal angle by gauge scale.

※ Two gauge scales should be same.
(pass inspection)



2609A8TM28

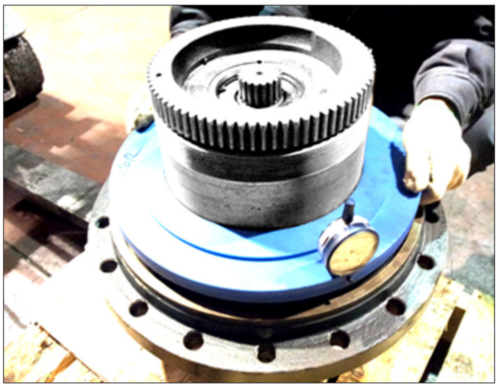
(4) Attach floating seal to motor that will be assembled with housing (on the same way to (1), (2))



2609A8TM29

(5) Put the measuring jig on floating seal (3) and check the horizontal angle condition with both gauge scale.

※ Two gauge scales should be same.
(pass inspection)



2609A8TM30

6) ASSEMBLING RING GEAR

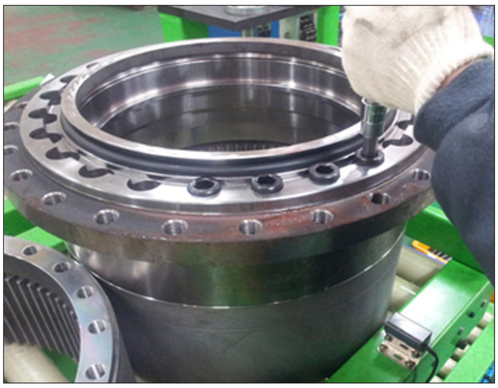
(1) Put ring gear (1) on contact surface (should be upside) of housing (7).

(2) Paint loctite #515 on ring gear (1) and put on housing (7). Then assemble 25 hexwrench bolts (28, M18)

※ Paint loctite #262 on hex-wrench bolts (28) before assembling.

※ Tightening torque : 38.5±3.8 kgf·m
(278.5±27.5 lbf·ft)

※ Bolts should be assembled with lust preventing oil.



2609A8TM31

7) ASSEMBLING NUT RING

(1) Put housing (7) sub-assembly upside down (ring gear side is up), and attach it to motor by lifting with hoist. (shaking it lightly)

(2) When housing (7) sub-assembly is set, put nut ring (4) on it, and assemble with jig.

※ Tightening torque for assembling nut ring : 66 ± 6.0 kgf·m (477.3 ± 43.3 lbf·ft)

※ Floating seal should not be damaged or separated while assembling.

2609A8TM32

8) ASSEMBLING LOCK PLATE

(1) Put lock plate (5) on nut ring (4) to fit to M12 bolt hole. Then assemble 4 he head bolts (6, M12)

※ Paint loctite #262 on hex-head bolts.

※ Tightening torque : 6.05 ± 0.6 kgf·m (43.8 ± 4.3 lbf·ft)

※ Bolts should be assembled with lust preventing oil.

2609A8TM33

9) ASSEMBLING COUPLING

(1) Attach snap ring (3) into coupling (9) with nipper.

2609A8TM34

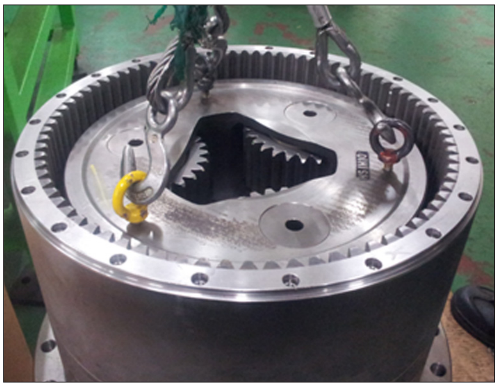
(2) Put coupling (9) on motor shaft to fit.

2609A8TM35

10) ASSEMBLING NO.2 CARRIER SUB-ASSY

(1) Lift carrier No.2 subassembly and put on ring gear (1), and fit it into internal side of ring gear (1). Then hit urethan hammer to fit.

※ Check turning and cocking condition before assembling.



2609A8TM36

11) ASSEMBLING NO.2 SUN GEAR

(1) Insert sun gear No.2 (17) in the middle of carrier No.2 sub assembly and make it fit in carrier No.2.

2609A8TM37

12) ASSEMBLING NO.1 CARRIER SUB-ASSY

(1) Lift carrier No.1 sub-assembly and put it into ring gear (1) and shake carrier No.1 to fit into ring gear.

※ Check turning and cocking condition before assembling.

2609A8TM38

13) SWINGING TORQUE INSPECTION

(1) Attach inspection jig before assembling sun gear No.1 (24).

2609A8TM39

(2) Attach torque wrench to the jig, check the torque when it swings.

※ Swinging torque : below 3.0 kgf·m (21.7 lbf·ft)

2609A8TM40

14) ASSEMBLING NO.1 SUN GEAR

(1) Remove the jig and wrench after torque inspection complete. And assemble sun gear No.1 (24) with pushing round to fix to the center of carrier No.1

2609A8TM41

15) ASSEMBLING THRUST PLATE

(1) Put thrust plate (25) on carrier No.1 sub assembly. And paint loctite #515 on flat side of ring gear (1).

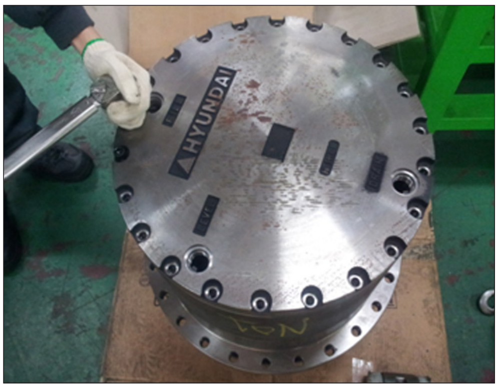
※ When assembling thrust washer, rounded edge-side should be facing casting side of carrier.

2609A8TM42

16) ASSEMBLING COVER

(1) Attach cover on ring gear (1) with assembling 22 hex-wrench bolts (8, 7/16-16UNC).

※ Paint loctite #262 on screw of hex bolts.
※ Tightening torque : 8.1±0.8 kgf·m
(58.6±5.8 lbf·ft)
※ Bolts should be assembled with lust preventing oil.



2609A8TM43

17) ASSEMBLING OIL INJECTION

(1) Inject the oil (10 ℓ) through PF3/4 hole on cover (27).

2609A8TM44

18) ASSEMBLING PLUG

(1) Assemble 3 plugs (29, PF3/4) after oil injection complete.

※ Tightening torque : 10±1.0 kgf·m
(72.3±7.2 lbf·ft)

2609A8TM45

GROUP 7 RCV LEVER

1. REMOVAL AND INSTALL

1) REMOVAL

(1) Lower the work equipment to the ground and stop the engine.

(2) Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

(3) Loosen the breather slowly to release the pressure inside the hydraulic tank.

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

13031GE18

(4) Loosen the socket bolt (1).

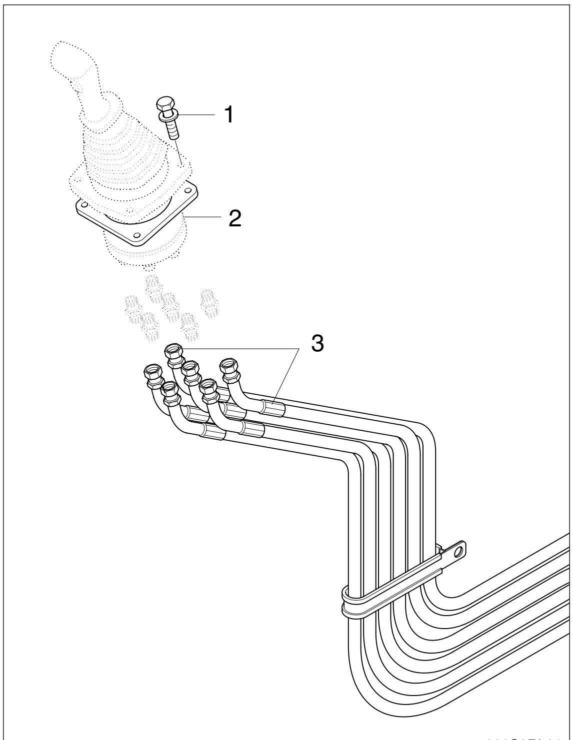
· Tightening torque : 1.05 ± 0.2 kgf·m
(7.6 ± 1.45 lbf·ft)

(5) Remove the cover of the console box.

(6) Disconnect pilot line hoses (3).

(7) Remove the pilot valve assembly (2).

※ When removing the pilot valve assembly, check that all the hoses have been disconnected.



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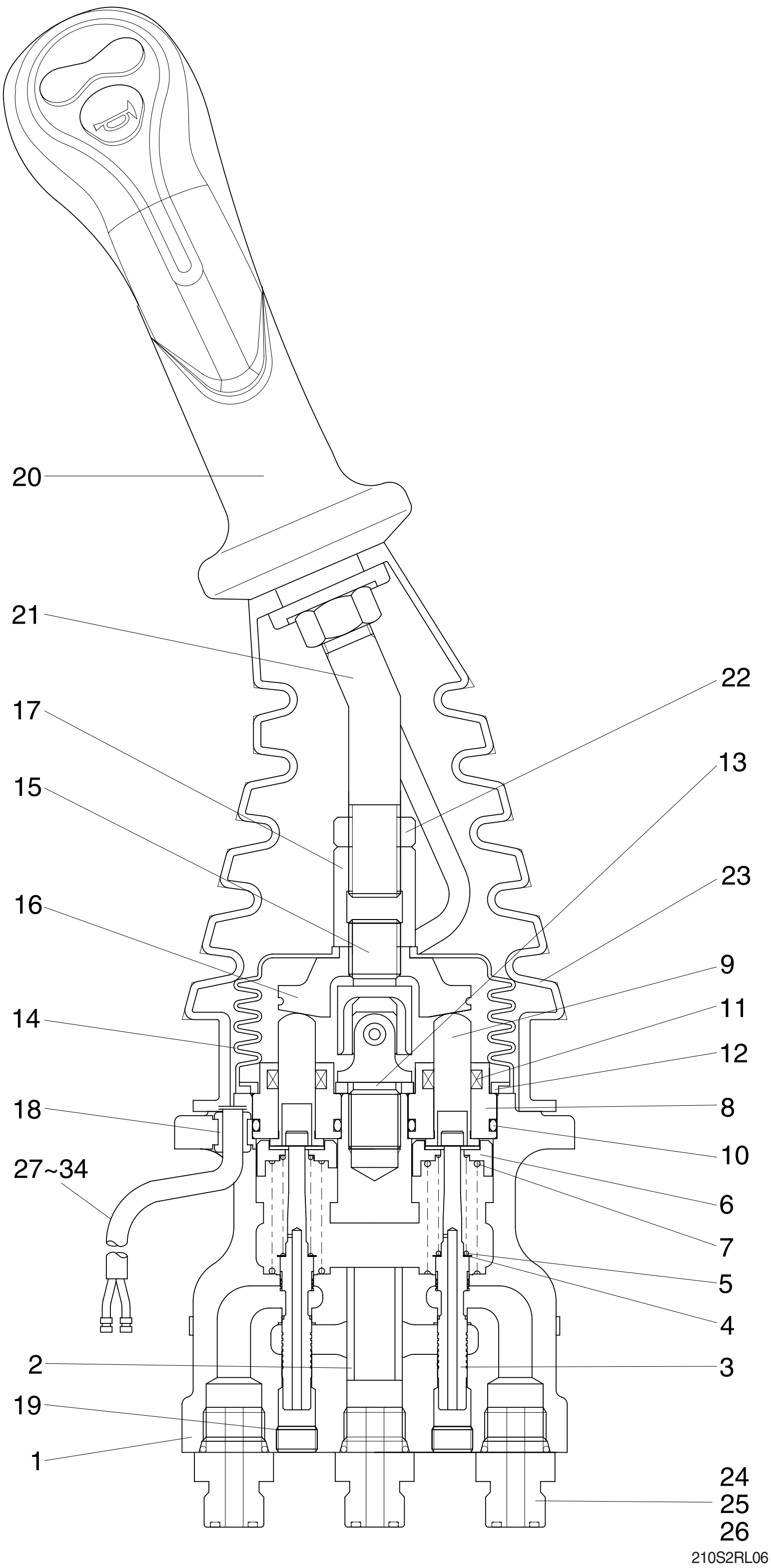
2) INSTALL

(1) Carry out installation in the reverse order to removal.

(2) Confirm the hydraulic oil level and check the hydraulic oil leak or not.

2. DISASSEMBLY AND ASSEMBLY

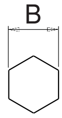
1) STRUCTURE



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

2) TOOLS AND TIGHTENING TORQUE

(1) Tools

Tool name	Remark	
Allen wrench	6	B 
Spanne	22	
	27	
(+) Driver	Length 150	
(-) Driver	Width 4~5	
Torque wrench	Capable of tightening with the specified torques	

(2) Tightening torque

Part name	Item	Size	Torque	
			kgf · m	lbf · ft
Joint	15	M14	3.8	27.5
Swash plate	16	M14	7.0±0.40	50.6±2.9
Adjusting nut	17	M14	7.0±0.40	50.6±2.9
Lock nut	22	M14	5.0±0.35	36.2±2.5

3) DISASSEMBLY

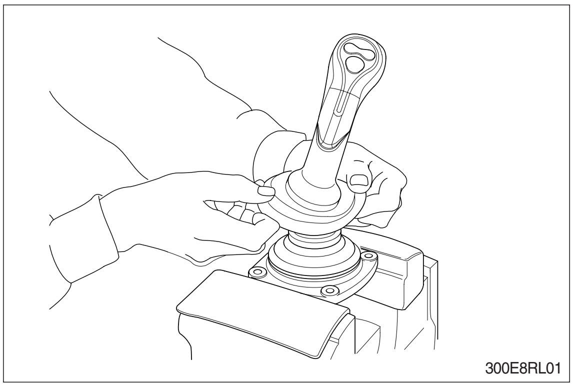
※ Procedures are based on the type L11.

(1) Clean pilot valve with kerosene.

※ Put blind plugs into all ports

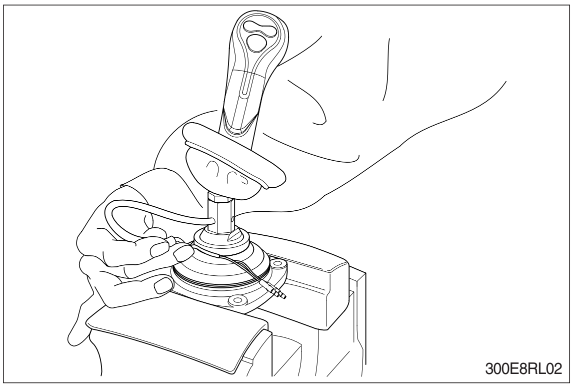
(2) Fix pilot valve in a vise with copper (or lead) sheets.

(3) Remove end of boot (23) from case (1) and take it out upwards.



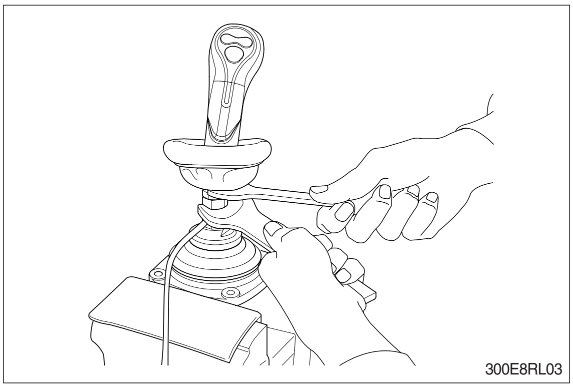
300E8RL01

※ For valve with switch, remove cord also through hole of casing.



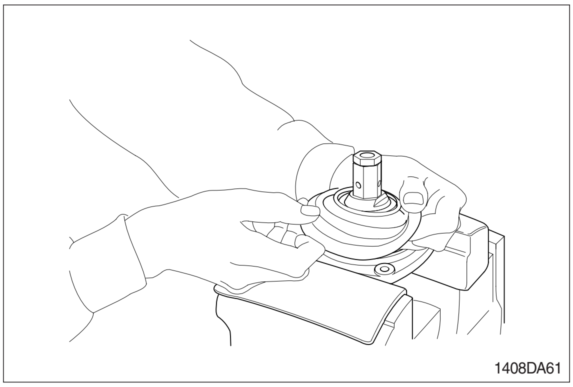
300E8RL02

(4) Loosen lock nut (22) and adjusting nut (17) with spanners on them respectively, and take out handle section as one body.



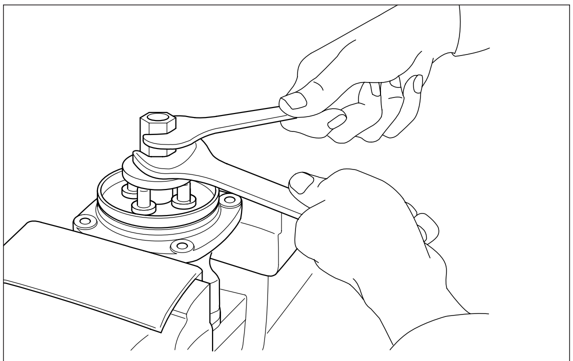
300E8RL03

(5) Remove the boot (14).

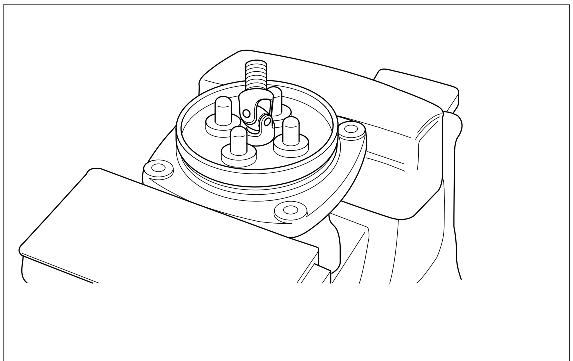


1408DA61

(6) Loosen adjusting nut (17) and swash plate (16) with spanners on them respectively, and remove them.



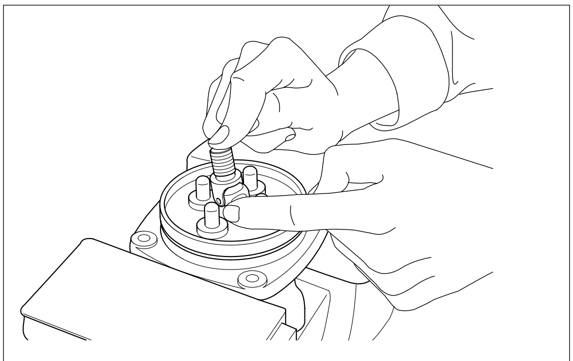
36078RL01



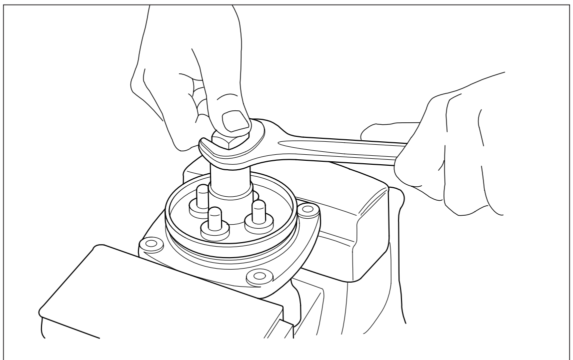
36078RL02

(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.

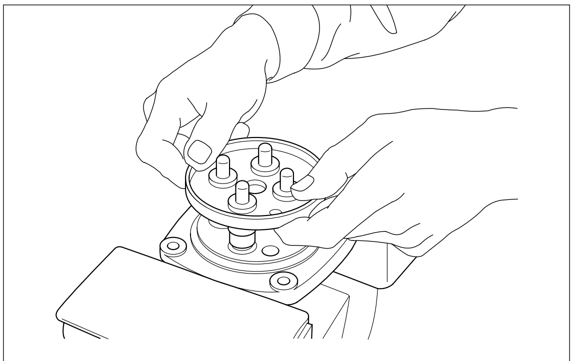


36078RL03



36078RL04

(8) Remove plate (12).

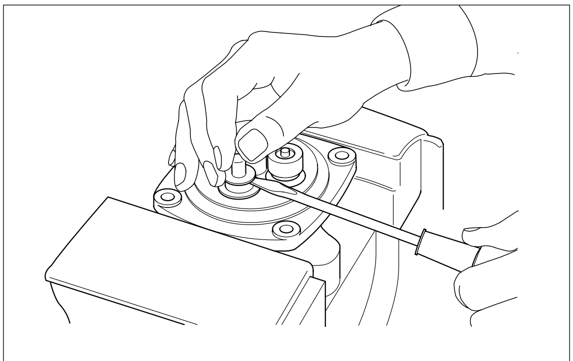


36078RL05

(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.

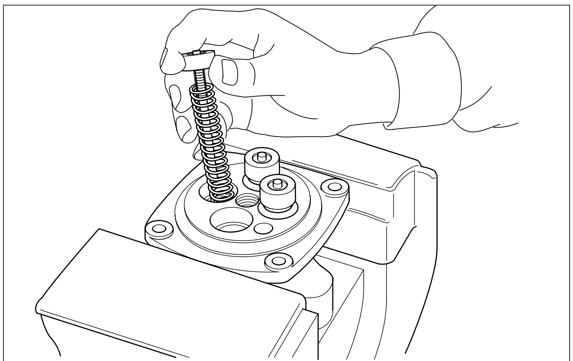
※ During taking out, plug may jump up due to return spring (7) force.
Pay attention to this.



36078RL06

(10) Remove reducing valve subassembly and return spring (7) out of casing.

※ Record relative position of reducing valve subassembly and return springs.



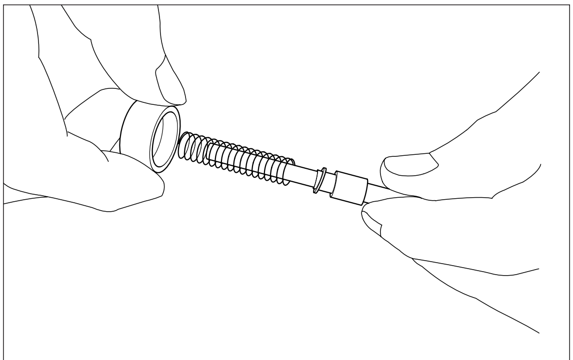
36078RL07

(11) Separate spool (3), spring seat (6), spring (5) and shim (4) individually.

※ Pay attention not to damage spool surface.

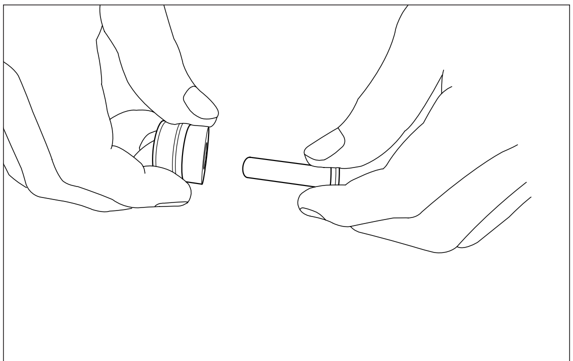
※ Record original position of spring seat (6).

※ Until being assembled, they should be handled as one subassembly group.



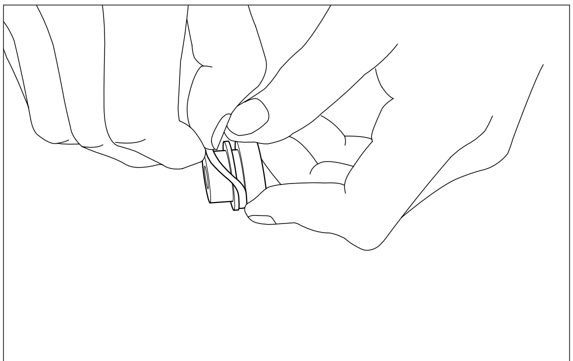
36078RL10

(12) Take push rod (9) out of plug (8).

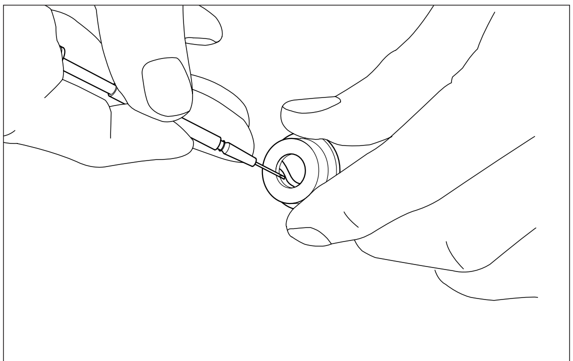


36078RL11

(13) Remove O-ring (10) and seal (11) from plug (8).
Use small minus screwdriver or so on to remove this seal.

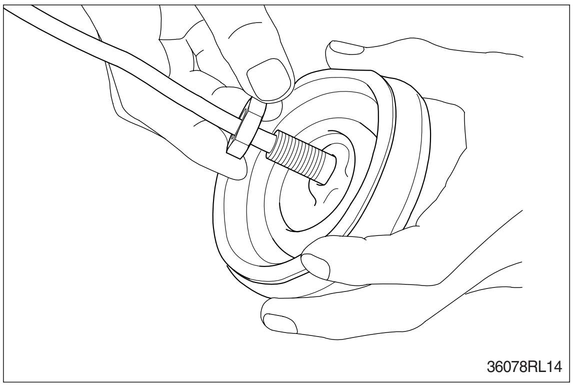


36078RL12

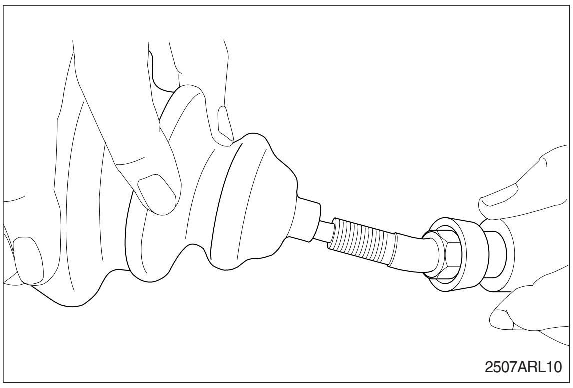


36078RL13

(14) Remove lock nut (22) and then boot (23).



36078RL14



2507ARL10

(15) Cleaning of parts

① Put all parts in rough cleaning vessel filled with kerosene and clean them (rough cleaning).

※ If dirty part is cleaned with kerosene just after putting it in vessel, it may be damaged. Leave it in kerosene for a while to loosen dust and dirty oil.

※ If this kerosene is polluted, parts will be damaged and functions of reassembled valve will be degraded.
Therefore, control cleanliness of kerosene fully.

② Put parts in final cleaning vessel filled with kerosene, turning it slowly to clean them even to their insides (finish cleaning).

※ Do not dry parts with compressed air, since they will be damaged and/or rusted by dust and moisture in air.

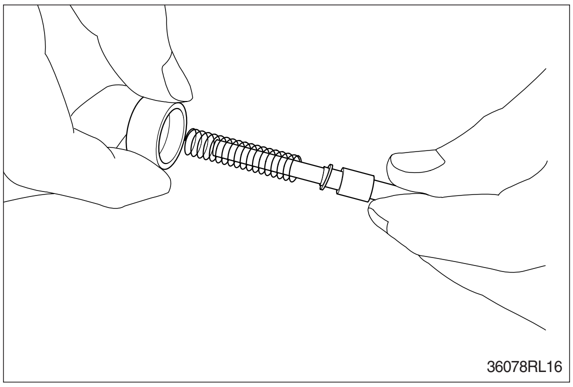
(16) Rust prevention of parts

Apply rust-preventives to all parts.

※ If left as they after being cleaned, they will be rusted and will not display their functions fully after being reassembled.

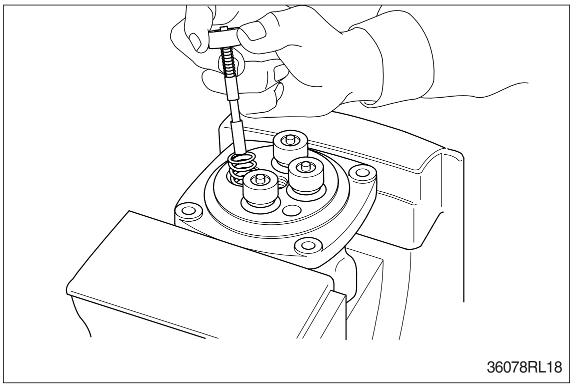
4) ASSEMBLY

(1) Put shim (4), springs (5) and spring seat (6) onto spool (3) in this order.

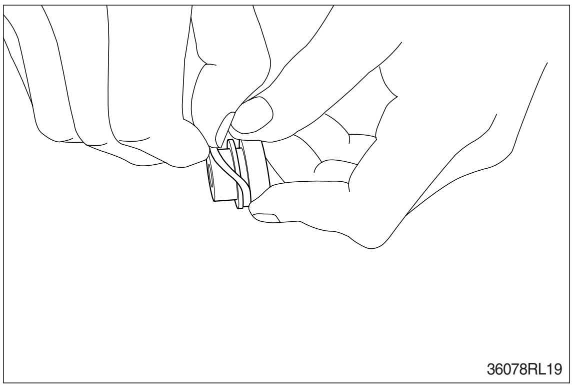


(2) Assemble spring (7) into casing (1). Assemble reducing valve subassembly into casing.

※ Assemble them to their original positions.

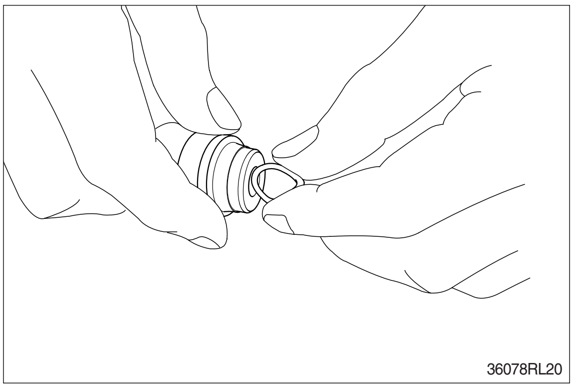


(3) Assemble O-ring (10) onto plug (8).

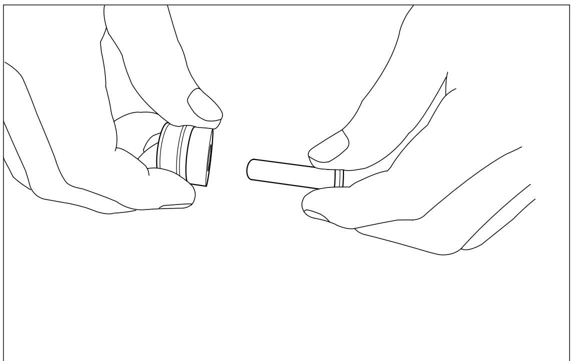


(4) Assemble seal (11) to plug (8).

※ Assemble seal in such lip direction as shown below.

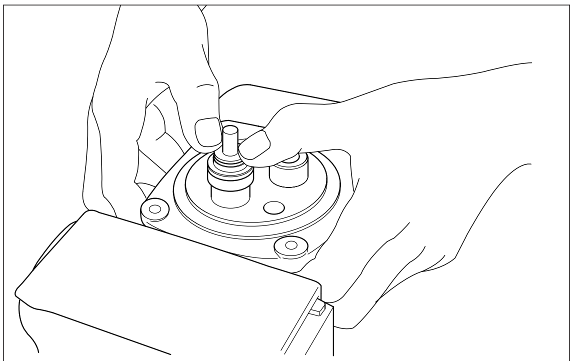


(5) Assemble push rod (9) to plug (8).
※ Apply working oil on push-rod surface.



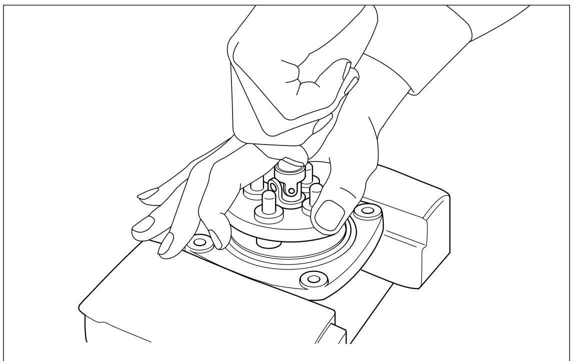
36078RL21

(6) Assemble plug subassembly to casing.
※ When return spring is weak in force, subassembly stops due to resistance of O-ring.



36078RL22

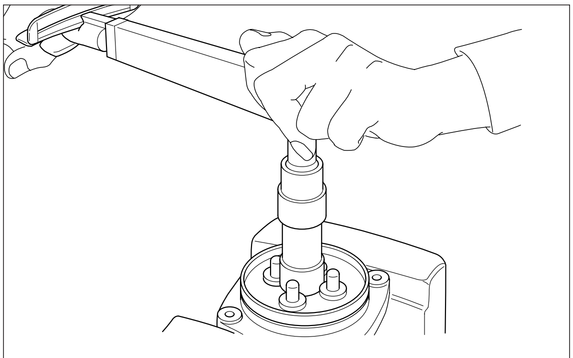
(7) When return spring is strong in force, assemble 4 sets at the same time, utilizing plate (12), and tighten joint (15) temporarily.



36078RL23

(8) Fit plate (12).

(9) Tighten joint (15) with the specified torque to casing, utilizing jig.

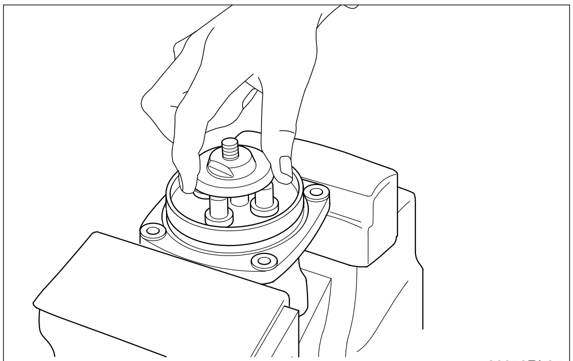


36078RL24

(10) Assemble swash plate (16) to joint (15).

※ Screw it to position that it contacts with 4 push rods evenly.

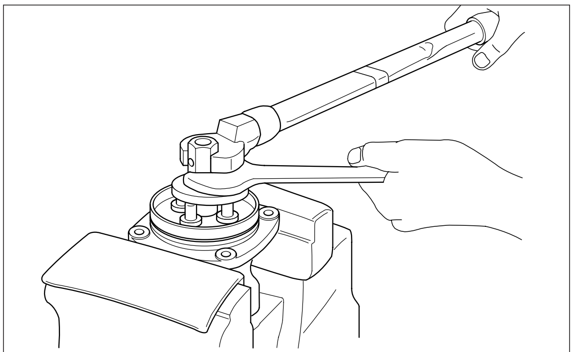
※ Do not screw it over.



36078RL25

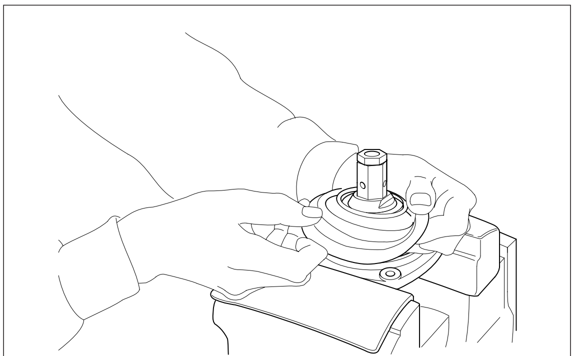
(11) Assemble adjusting nut (17), apply spanner to width across flat of plate (16) to fix it, and tighten adjusting nut to the specified torque.

※ During tightening, do not change position of disk.



36078RL26

(12) Fit boot (14) to plate.



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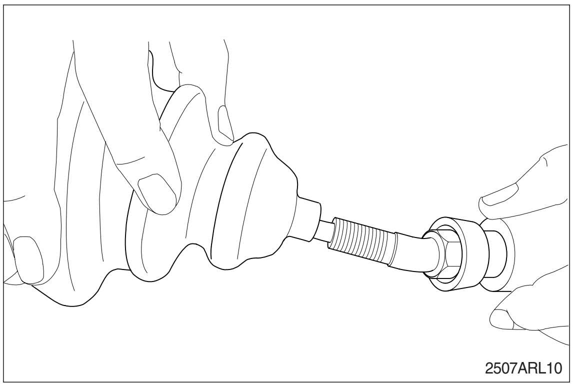
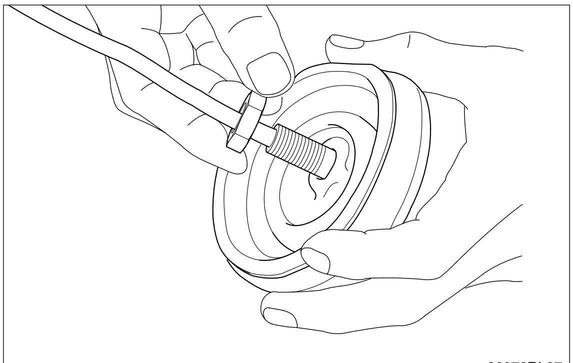
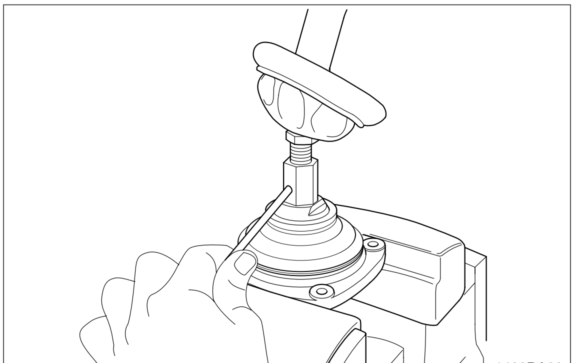
(13) Fit boot (23) and lock nut (22), and handle subassembly is assembled completely.


2507ARL10

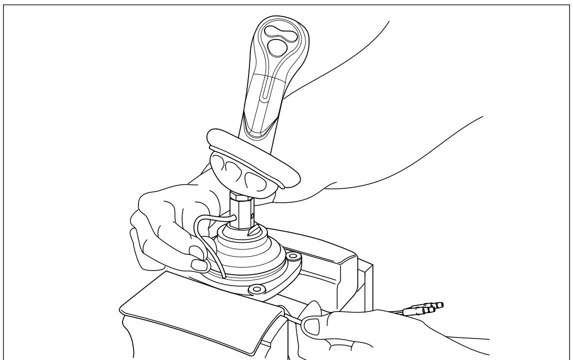

36078RL27

(14) Pull out cord and tube through adjusting nut hole provided in direction 60 ° to 120 ° from casing hole.

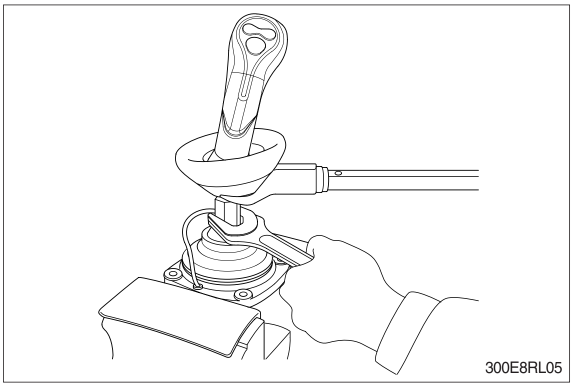

1408DA66

(15) Assemble bushing (18) to plate and pass cord and tube through it.

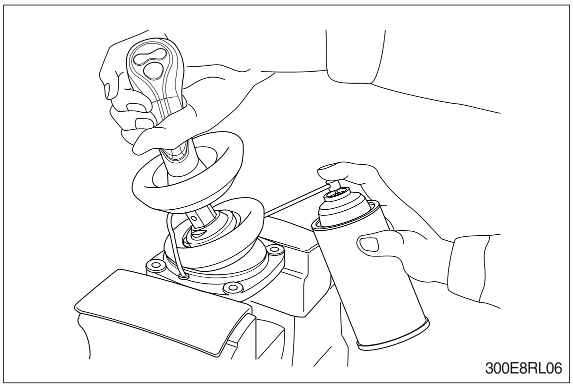
※ Provide margin necessary to operation.


300E8RL04

(16) Determine handle direction, tighten lock nut (22) to specified torque to fix handle.

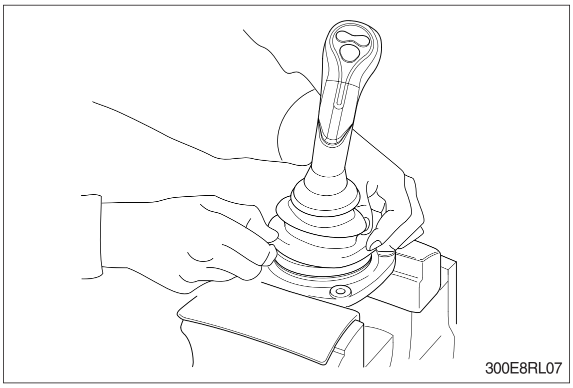


(17) Apply grease to rotating section of joint and contacting faces of disk and push rod.



(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) Sling the turning joint assembly (1) and remove the mounting bolt (2).

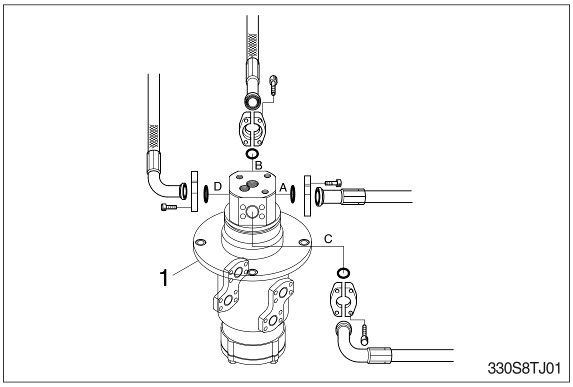
· Weight : 54 kg (117 lb)

· Tightening torque : 12.3±1.3 kgf · m (89±9.4 lbf · ft)

(6) Remove the turning joint assembly.

※ When removing the turning joint, check that all the hoses have been disconnected.

13031GE18



330S8TJ01

2) INSTALL

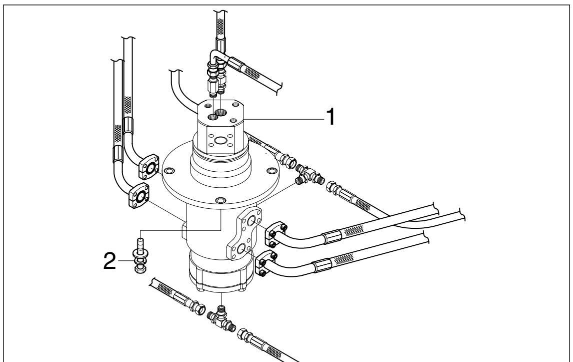
(1) Carry out installation in the reverse order to removal.

※ Take care of turning joint direction.

※ Assemble hoses to their original

※ positions.

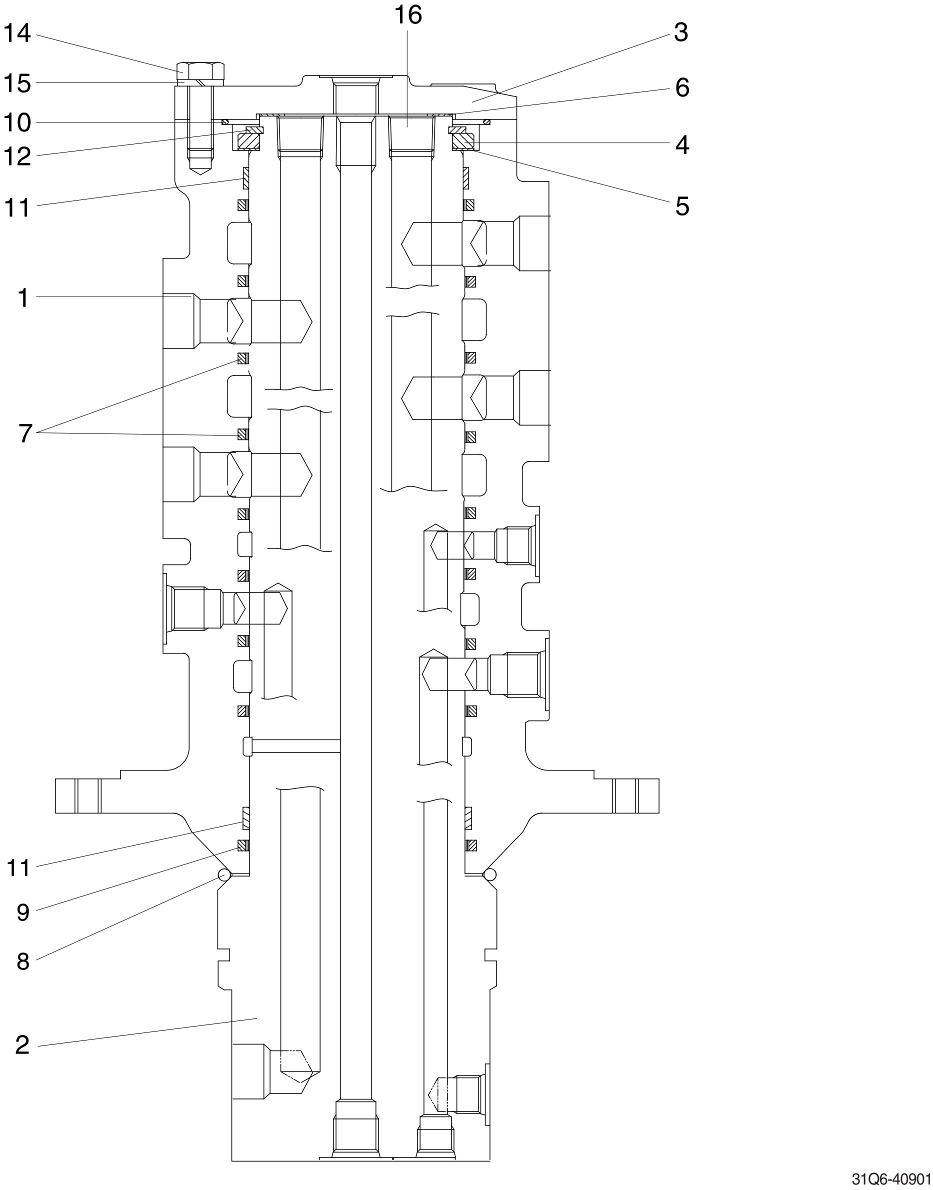
Confirm the hydraulic oil level and check the hydraulic oil leak or not.



350SA8DA08

2. DISASSEMBLY AND ASSEMBLY

1) STRUCTURE

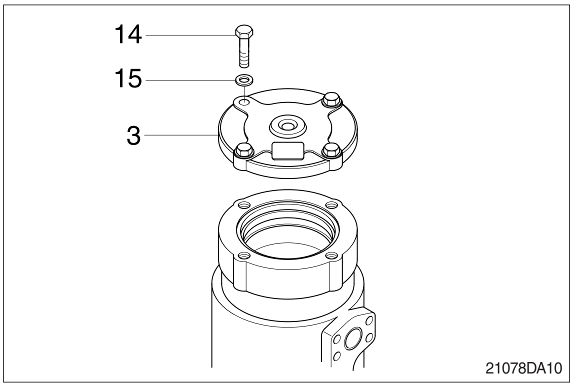


1	Hub	7	Slipper seal	13	Plug
2	Shaft	8	O-ring	14	Hexagon bolt
3	Cover	9	O-ring	15	Spring washer
4	Spacer	10	O-ring	16	Plug
5	Shim	11	Wear ring		
6	Shim	12	Retainer ring		

2) DISASSEMBLY

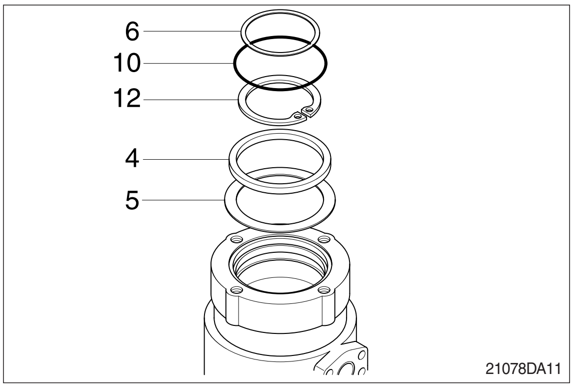
※ Before the disassembly, clean the turning joint.

(1) Remove bolts (14), washer (15) and cover (3).



(2) Remove shim (6) and O-ring (10).

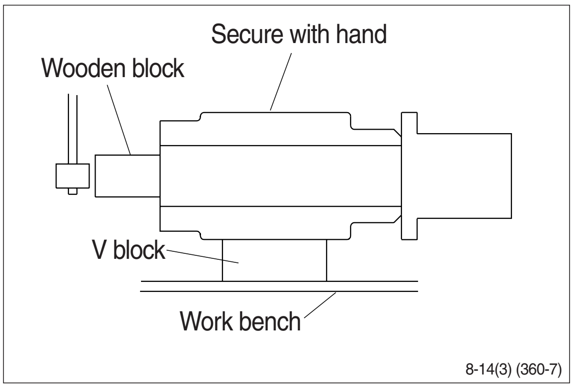
(3) Remove retainer ring (12), spacer (4) and shim (5).



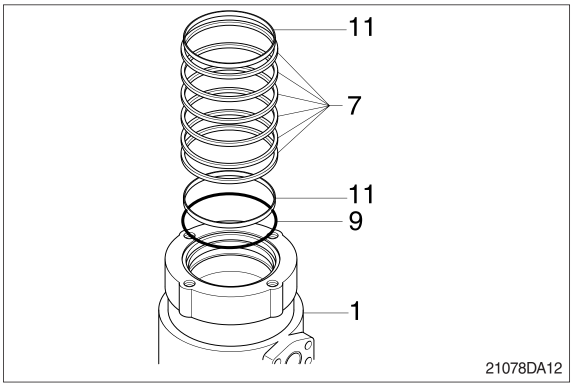
(4) Place hub (1) on a V-block and by using a wood buffer at the shaft end, hit out shaft (2) to about 1/2 from the body with a hammer.

※ Take care not to damage the shaft (2) when remove hub (1) or rest it sideway.

※ Put a fitting mark on hub (1) and shaft (2).



(5) Remove six slipper seals (7) and O-ring (9), two wear ring (11) from hub (1).

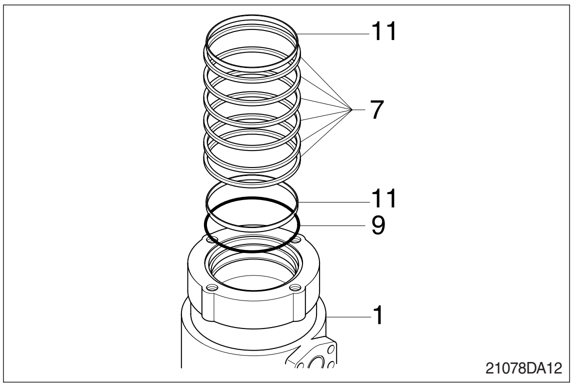


3) ASSEMBLY

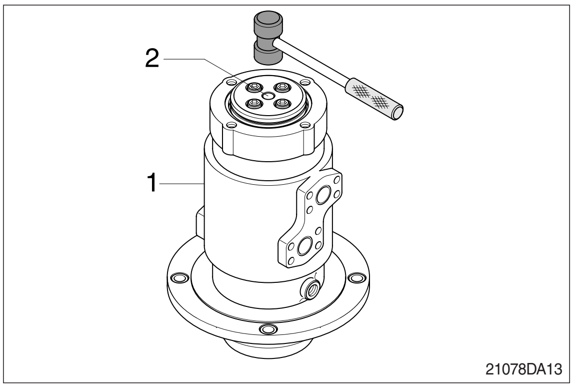
※ Clean all parts.
※ As a general rule, replace oil seals and O-ring.
※ Coat the sliding surfaces of all parts with engine oil or grease before installing.

(1) Fix seven slipper seal (7) and O-ring (9), two wear ring (11) to hub (1).

(2) Fit O-ring (8) to shaft (2).



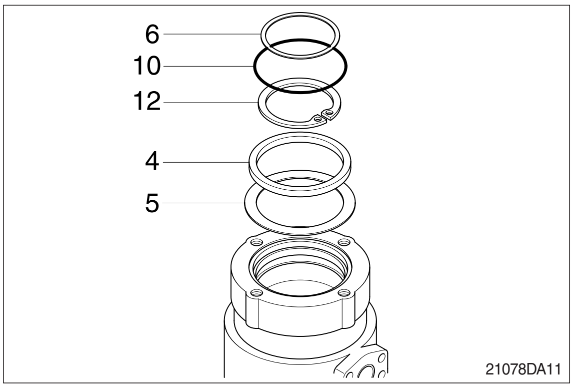
(3) Set shaft (2) on block, tap hub (1) with a plastic hammer to install.



(4) Fit shim (5), spacer (4) and retainer ring (12) to shaft (2).

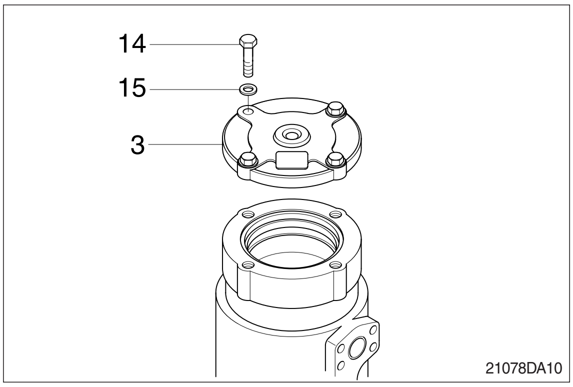
(5) Fit O-ring (10) to hub (1).

(6) Fit shim (6) to shaft (2).



(7) Install cover (3) to body (1) and tighten bolts (14).

· Torque : 10~12.5 kgf · m (72.3~90.4 lbf · ft)



GROUP 9 BOOM, ARM AND BUCKET CYLINDER

1. REMOVAL AND INSTALL

1) BUCKET CYLINDER

(1) Removal

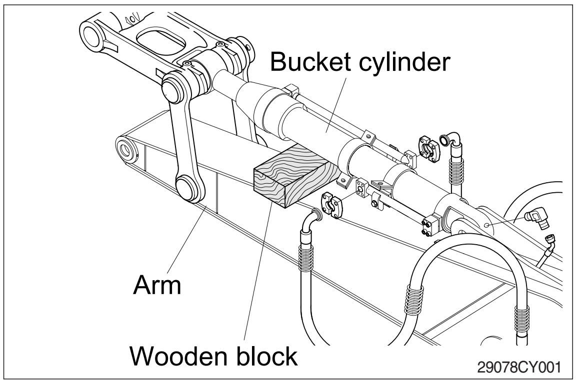
※ Expand the arm and bucket fully, lower the work equipment to the ground and stop the engine.

※ Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

⚠ **Loosen the breather slowly to release the pressure inside the hydraulic tank.**

※ Escaping fluid under pressure can penetrate the skin causing serious injury. Fit blind plugs in the hoses after disconnecting them, to prevent dirt or dust from entering.

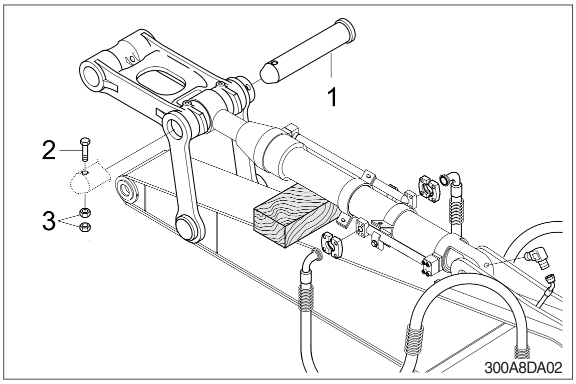
① Set block between bucket cylinder and arm.



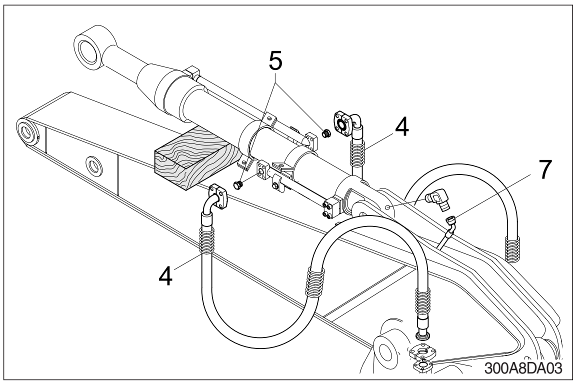
② Remove bolt (2), nut (3) and pull out pin (1).

※ Tie the rod with wire to prevent it from coming out.

· Tightening torque : 57.9 ± 8.7 kgf·m
(419 ± 62.9 lbf·ft)



③ Disconnect bucket cylinder hoses (4), grease line hose (7) and put plugs (5) on cylinder pipe.

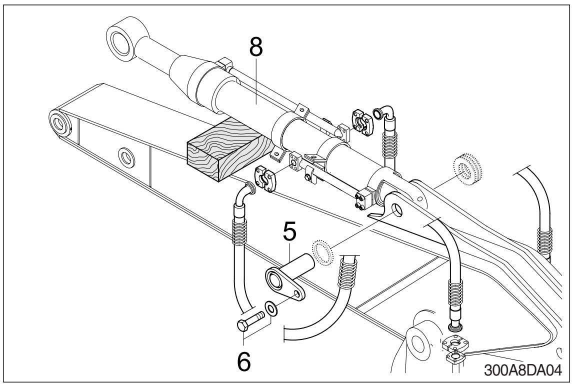


④ Sling bucket cylinder assembly (8) and remove bolt (6) then pull out pin (5).

⑤ Remove bucket cylinder assembly (8).

· Weight : 220 ㎏ (485 ℔)

· Tightening torque : 57.9 ± 8.7 kgf·m
(419 ± 62.9 lbf·ft)



(2) Install

① Carry out installation in the reverse order to removal.

▲ 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.

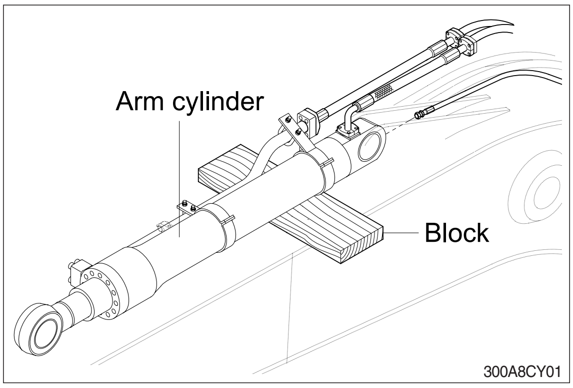
※ Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

⚠ **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



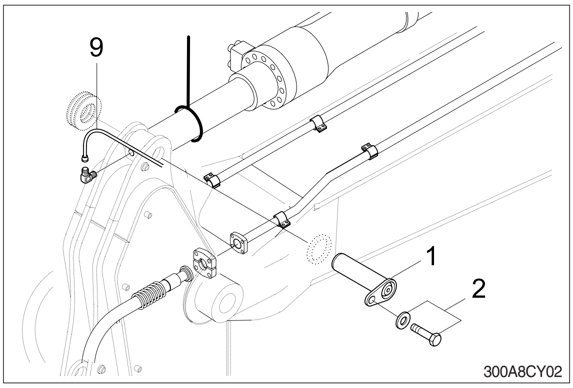
300A8CY01

② Disconnect grease line hose (9).

③ Remove bolt (2) and pull out pin (1).

※ Tie the rod with wire to prevent it from coming out.

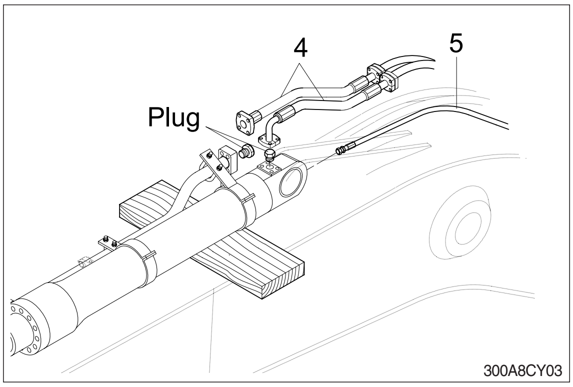
· Tightening torque : 57.9 ± 8.7 kgf·m (419 ± 62.9 lbf·ft)



300A8CY02

④ Disconnect arm cylinder hoses (4) and put plugs on cylinder pipe.

⑤ Disconnect greasing pipings (5).



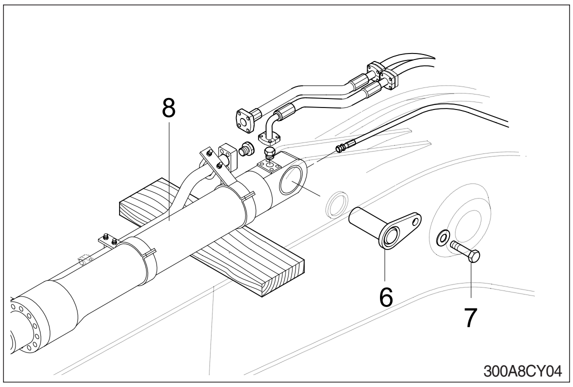
300A8CY03

⑥ Sling arm assembly (8) and remove bolt (7) then pull out pin (6).

⑦ Remove arm cylinder assembly (8).

· Weight : 360 ㎏ (790 ℔)

· Tightening torque : 57.9 ± 8.7 kgf·m (419 ± 62.9 lbf·ft)



(2) Install

① Carry out installation in the reverse order to removal.

▲ **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.

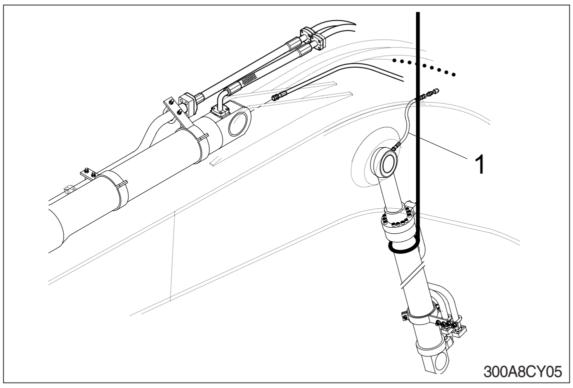
⚠ **Loosen the breather slowly to release the pressure inside the hydraulic tank.**

※ 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

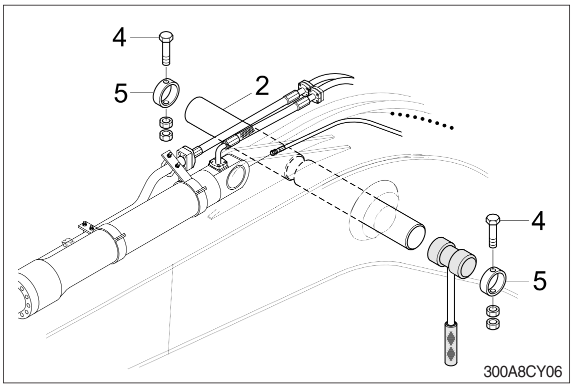


300A8CY05

③ Remove bolt (4), pin stopper (5) and pull out pin (2).

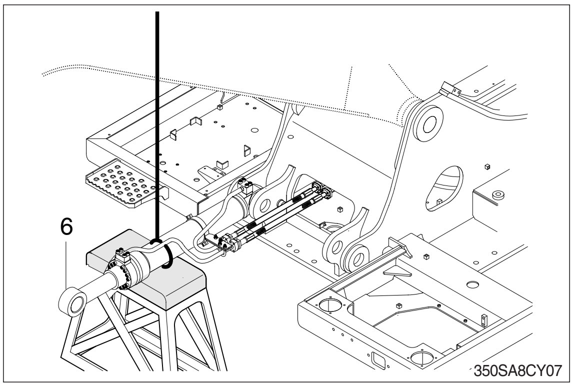
※ Tie the rod with wire to prevent it from coming out.

· Tightening torque : 29.7 ± 4.5 kgf·m (215 ± 32.5 lbf·ft)



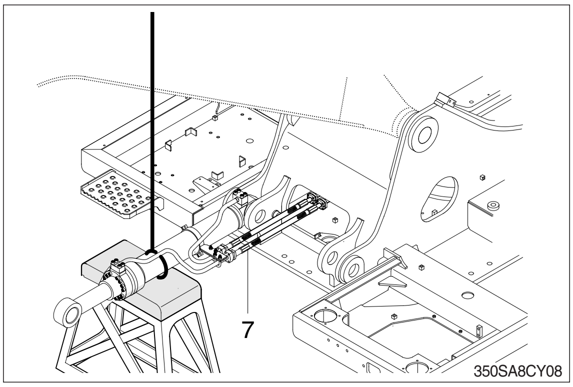
300A8CY06

④ Lower the boom cylinder assembly (6) on a stand.



350SA8CY07

⑤ Disconnect boom cylinder hoses (7) and put plugs on cylinder pipe.

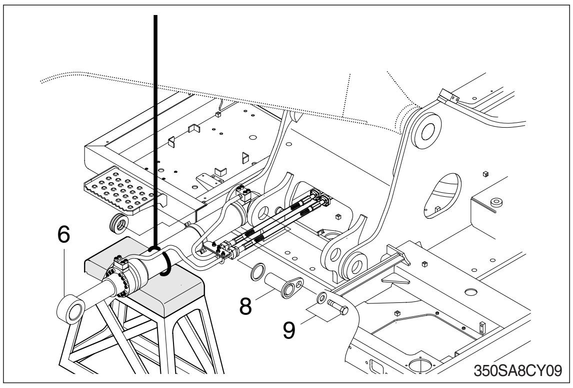


⑥ Remove bolt (9) and pull out pin (8).

⑦ Remove boom cylinder assembly (6).

· Weight : 280 kg (617 lb)

· Tightening torque : 57.9 ± 8.7 kgf·m (419 ± 62.9 lbf·ft)



(2) Install

① Carry out installation in the reverse order to removal.

⚠ **When aligning the mounting position of the pin, do not insert your fingers in the pin hole.**

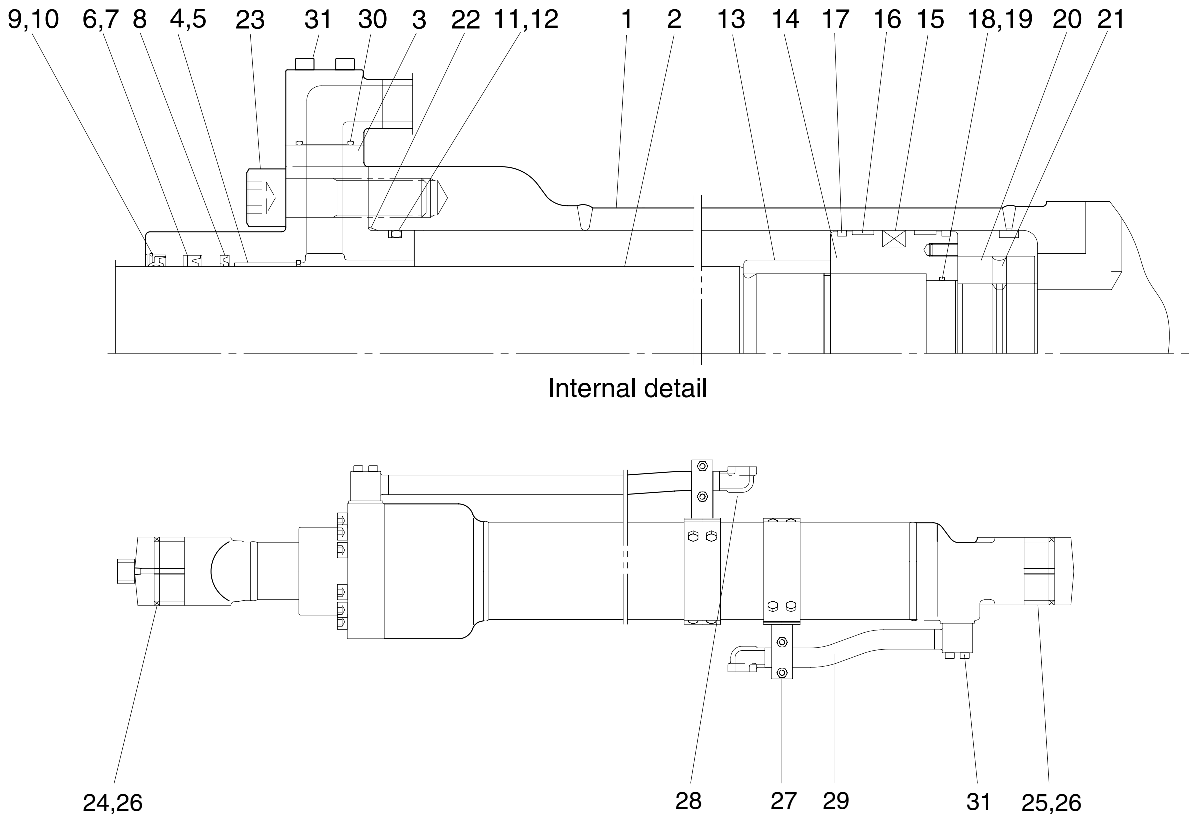
※ Bleed the air from the boom cylinder.

※ Conformed the hydraulic oil level and check the hydraulic oil leak or not.

2. DISASSEMBLY AND ASSEMBLY

1) STRUCTURE

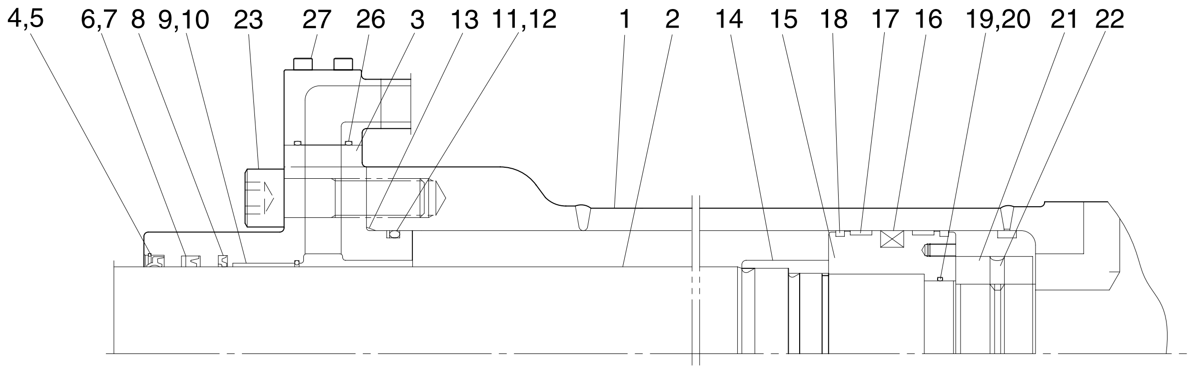
(1) Bucket cylinder (CHANGZHOU)



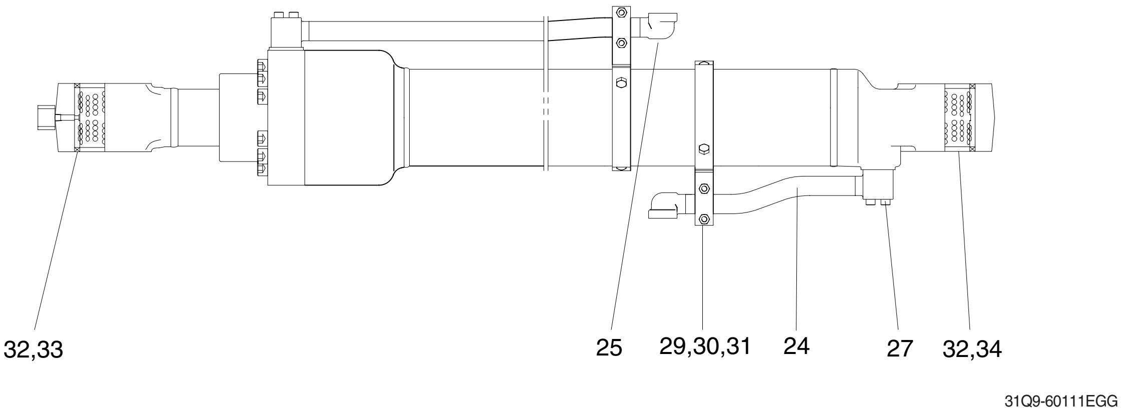
31Q9-60111GGC

1	Tube assembly	12	Back up ring	23	Hexagon socket head bolt
2	Rod assembly	13	Cushion ring	24	Dimple bushing
3	Gland	14	Piston	25	Dimple bushing
4	DD2 bushing	15	Piston seal	26	Dust seal
5	Snap ring	16	Wear ring	27	Band assembly
6	Rod seal	17	Dust ring	28	Pipe assembly-R
7	Back up ring	18	O-ring	29	Pipe assembly-B
8	Buffer ring	19	Back up ring	30	O-ring
9	Dust wiper	20	Lock nut	31	Hexagon socket head bolt
10	Snap ring	21	Hexagon socket set screw		
11	O-ring	22	O-ring		

Bucket cylinder (SHPAC)

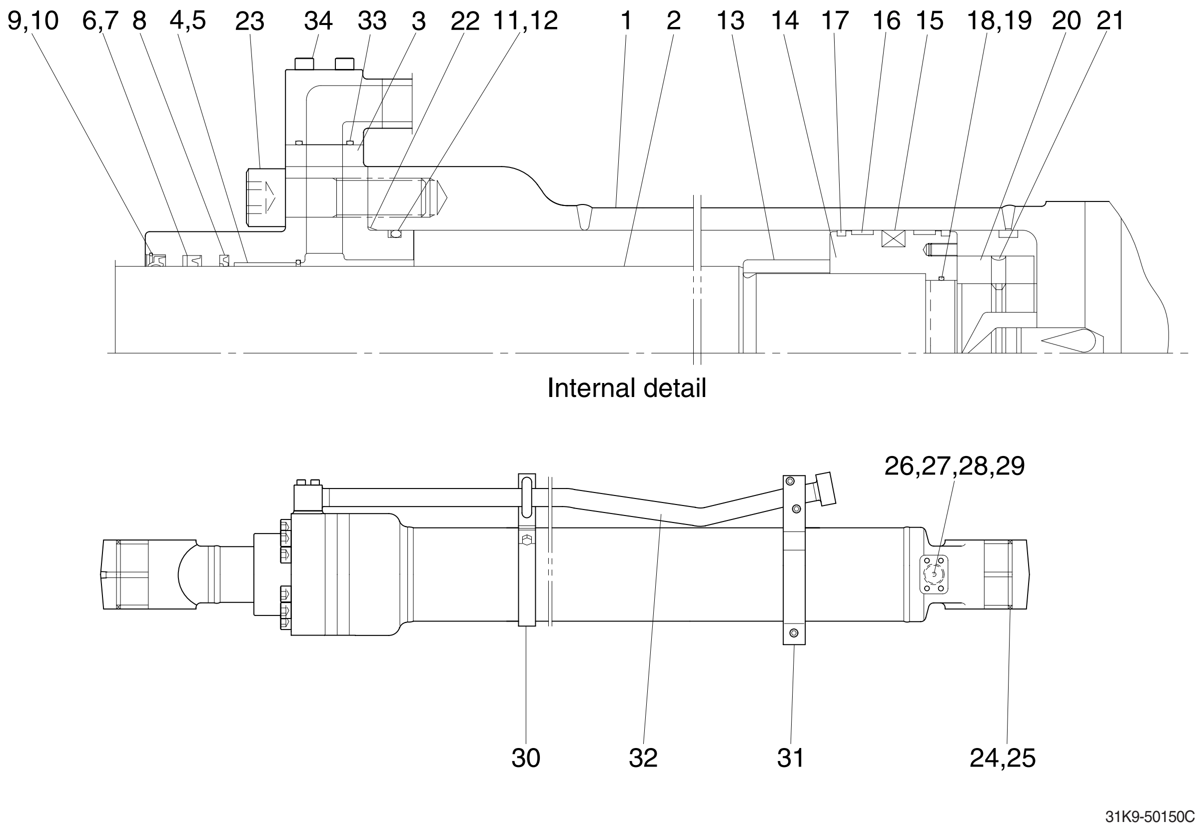


Internal detail



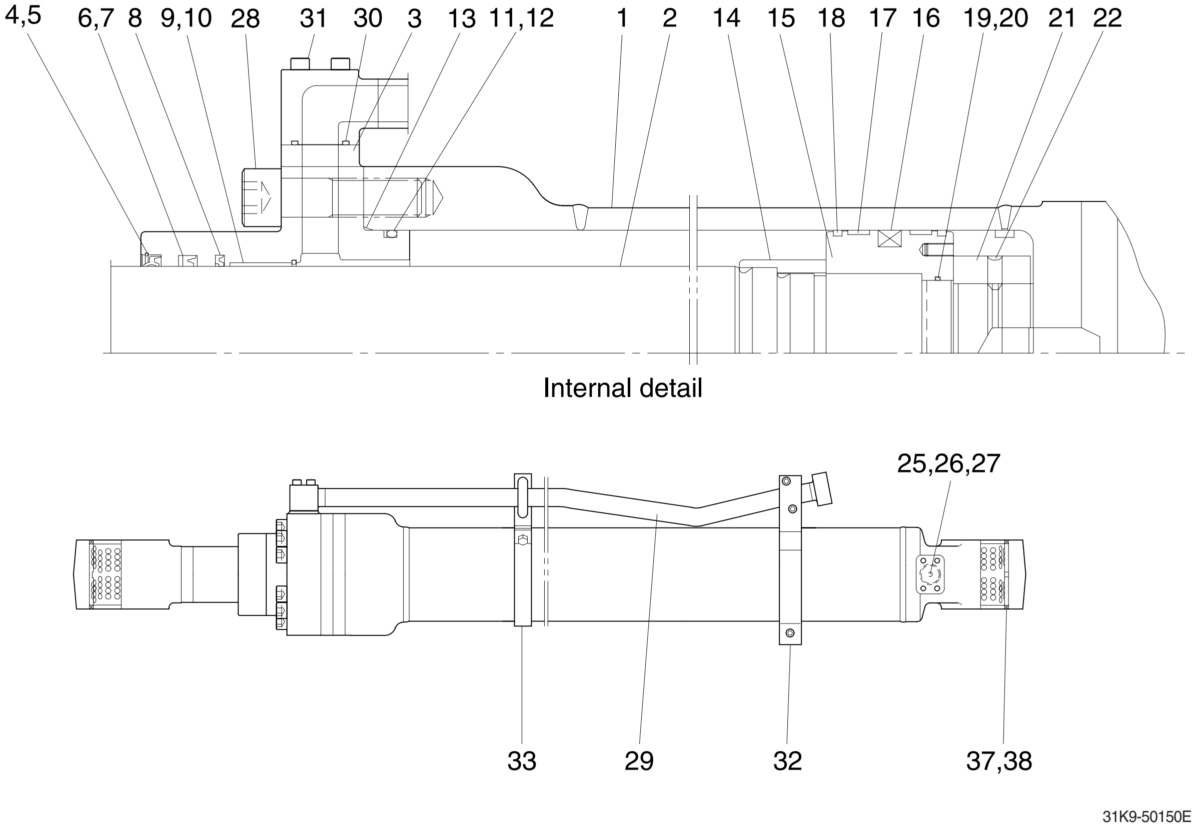
1 Tube assembly
2 Rod assembly
3 Gland
4 Dust wiper
5 Retaining ring
6 Rod seal
7 Back up ring
8 Buffer ring
9 Dry bearing
10 Retaining ring
11 O-ring
12 Back up ring
13 O-ring
14 Cushion ring
15 Piston
16 Piston seal
17 Wear ring
18 Dust ring
19 O-ring
20 Back up ring
21 Lock nut
22 Hexagon socket set screw
23 Hexagon socket head bolt
24 Pipe assembly-B
25 Pipe assembly-R
26 O-ring
27 Hexagon socket head bolt
28 Band assembly
29 U-bolt
30 Hexagon nut
31 Spring washer
32 Dimple bushing
33 Dust seal

(2) Arm cylinder (CHANGZHOU)



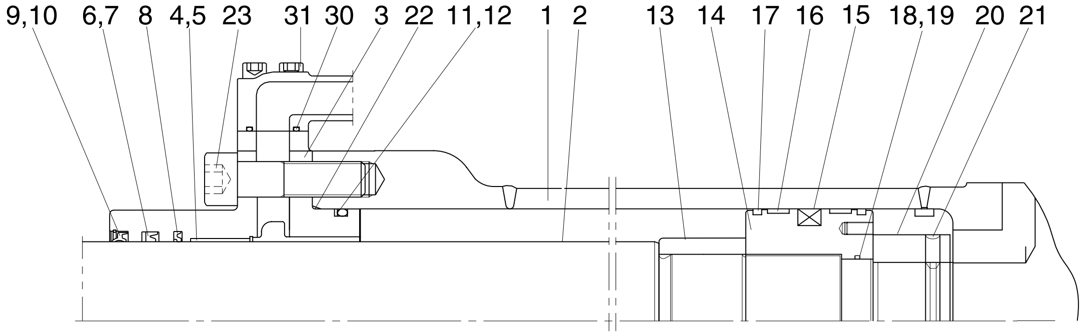
1	Tube assembly	13	Cushion ring	25	Dust seal
2	Rod assembly	14	Piston	26	Check valve
3	Gland	15	Piston seal	27	Coil spring
4	DD2 bushing	16	Wear ring	28	O-ring
5	Snap ring	17	Dust ring	29	Plug
6	Rod seal	18	O-ring	30	Band assembly-R
7	Back up ring	19	Back up ring	31	Band assembly-B
8	Buffer ring	20	Lock nut	32	Pipe assembly-R
9	Dust wiper	21	Hexagon socket set screw	33	O-ring
10	Snap ring	22	O-ring	34	Hexagon socket head bolt
11	O-ring	23	Hexagon socket head bolt		
12	Back up ring	24	Dimple bushing		

Arm cylinder (SHPAC)

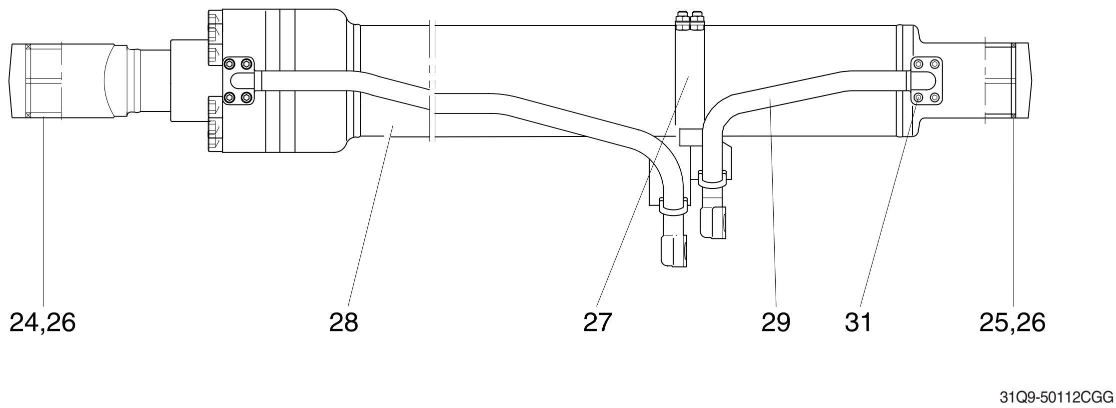


1 Tube assembly
2 Rod assembly
3 Gland
4 Dust wiper
5 Retaining ring
6 Rod seal
7 Back up ring
8 Buffer ring
9 Dry bearing
10 Retaining ring
11 O-ring
12 Back up ring
13 O-ring
14 Cushion ring
15 Piston
16 Piston seal
17 Wear ring
18 Dust ring
19 O-ring
20 Back up ring
21 Lock nut
22 Hexagon socket set screw
23 Cushion plunger
24 Stop ring
25 Check valve
26 Coil spring
27 Hexagon plug
28 Hexagon socket head bolt
29 Pipe assembly-R
30 O-ring
31 Hexagon socket head bolt
32 Band assembly-B
33 Band assembly-R
34 U-bolt
35 Hexagon nut
36 Spring washer
37 Dimple bushing
38 Dust seal

(3) Boom cylinder (CHANGZHOU)

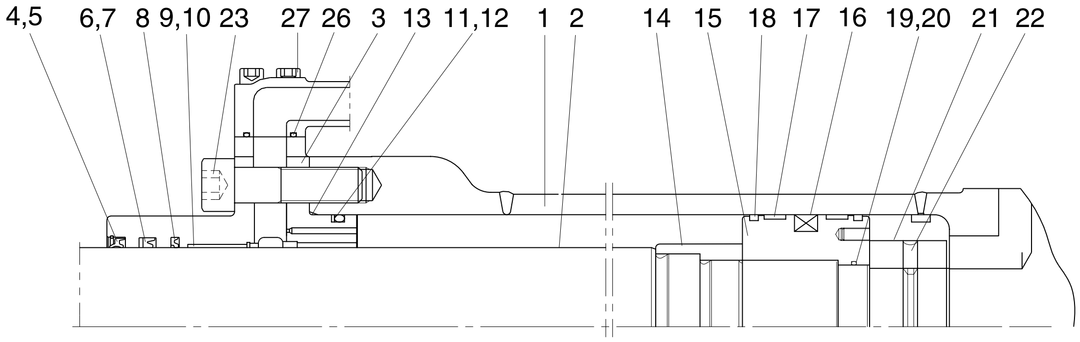


Internal detail

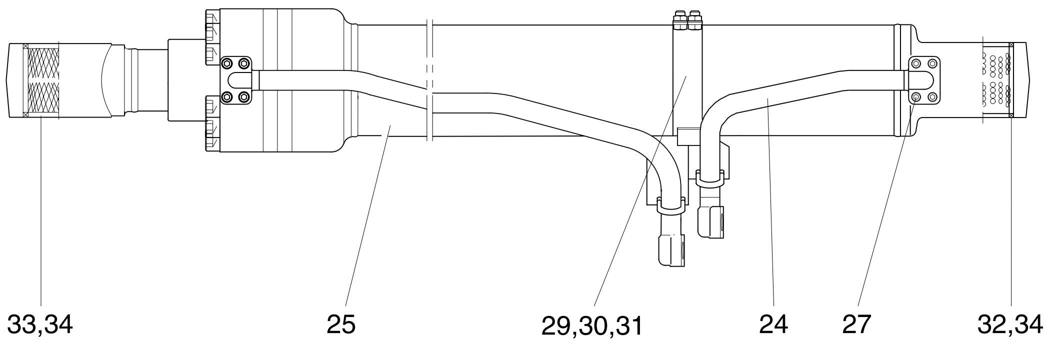


1	Tube assembly	12	Back up ring	23	Hexagon socket head bolt
2	Rod assembly	13	Cushion ring	24	Pin bushing
3	Gland	14	Piston	25	Pin bushing
4	DD2 bushing	15	Piston seal	26	Dust seal
5	Snap ring	16	Wear ring	27	Band assembly
6	Rod seal	17	Dust ring	28	Pipe assembly-R
7	Back up ring	18	O-ring	29	Pipe assembly-B
8	Buffer ring	19	Back up ring	30	O-ring
9	Dust wiper	20	Lock nut	31	Hexagon socket head bolt
10	Snap ring	21	Hexagon socket set screw		
11	O-ring	22	O-ring		

Boom cylinder (SHPAC)



Internal detail

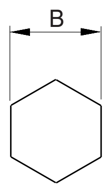


31Q9-50112EGG

1	Tube assembly	13	O-ring	25	Pipe assembly-R
2	Rod assembly	14	Cushion ring	26	O-ring
3	Gland	15	Piston	27	Hexagon socket head bolt
4	Dust wiper	16	Piston seal	28	Band assembly
5	Retaining ring	17	Wear ring	29	U-bolt
6	Rod seal	18	Dust ring	30	Hexagon nut
7	Back up ring	19	O-ring	31	Spring washer
8	Buffer ring	20	Back up ring	32	Pin bushing
9	Dry bearing	22	Lock nut	33	Pin bushing
10	Retaining ring	22	Hexagon socket set screw	34	Dust seal
11	O-ring	23	Hexagon socket head bolt		
12	Back up ring	24	Pipe assembly-B		

2) TOOLS AND TIGHTENING TORQUE

(1) Tools

Tools	Remark	
Allen wrench	6	
	8	
	10	
	12	
	14	
	17	
Spanner	7	
	8	
(-) Driver	Small and large sizes	
Torque wrench	Capable of tightening with the specified torques	

(2) Tightening torque

Part name		Item	Size	Torque	
				kgf · m	lbf · ft
Socket head bolt	Bucket cylinder (standard)	23★1★3 23★1★4	M18 M18	32.0±3.0 38.0±3.8	232±21.7 275±27.5
		31★3 27★4	M12 M12	9.4±1.0 11.3±1.1	68.0±7.2 81.7±8.0
	Boom cylinder	23★1★3 23★1★4	M20 M20	46.0±5.0 52.2±5.2	333±36.2 378±37.6
		31★3 27★4	M12 M12	9.4±1.0 11.3±1.1	68.0±7.2 81.7±8.0
	Arm cylinder	23★1★3 28★1★4	M22 M22	63.0±6.0 69.4±6.9	456±43.4 502±49.9
		34★3 31★4	M12 M12	9.4±1.0 11.3±1.1	68.0±7.2 81.7±8.0
Lock nut	Bucket cylinder (standard)	20★3 21★4	- M76	100±10.0 100±10.0	723±72.3 723±72.3
	Boom cylinder	20★3 21★4	- M76	100±10.0 100±10.0	723±72.3 723±72.3
	Arm cylinder	20★3 21★4	- M80	150±15.0 150±15.0	1085±108 1085±108

★1 : Apply loctite #243 on the thread of bolt.
★2 : Apply loctite #277 on the thread of bolt.
★3 : CHANGZHOU
★4 : SHPAC

Part name		Item	Size	Torque	
				kgf · m	lbf · ft
Piston	Bucket cylinder (standard)	14★3 15★4	- M90	150±15.0 150±15.0	1085±108 1085±108
	Boom cylinder	14★3 15★4	- M95	150±15.0 150±15.0	1085±108 1085±108
	Arm cylinder	14★3 15★4	- M100	200±20.0 200±20.0	1447±145 1447±145
Set screw	Bucket cylinder (standard)	21★3 22★4	M10 M10	5.4±0.5 2.5±0.3	39.1±3.6 18.1±2.2
	Boom cylinder	21★3 22★4	M10 M10	5.4±0.5 2.5±0.3	39.1±3.6 18.1±2.2
	Arm cylinder	21★3 22★4	M10 M10	5.4±0.5 2.5±0.3	39.1±3.6 18.1±2.

★1 : Apply loctite #243 on the thread of bolt.

★3 : CHANGZHOU

★4 : SHPAC

3) DISASSEMBLY

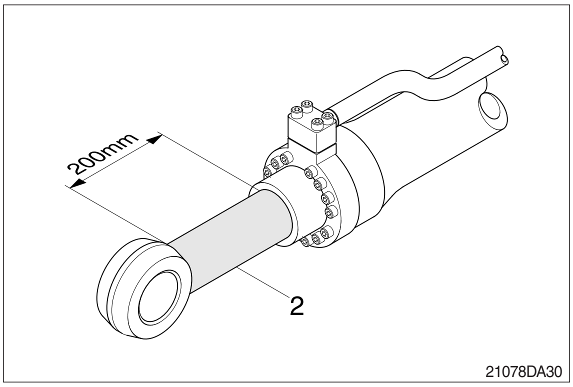
(1) Remove cylinder head and piston rod

※ Procedures are based on the bucket cylinder (CHANGZHOU type).

① Hold the clevis section of the tube in a vise.

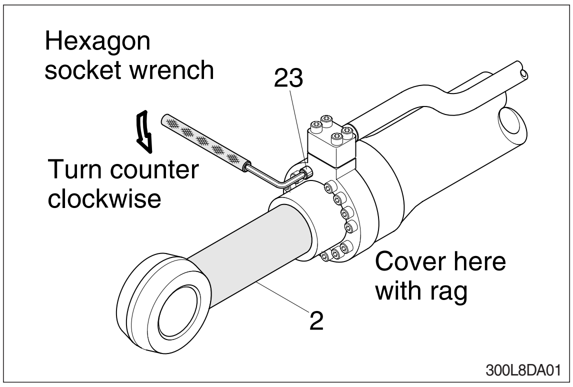
※ Use mouth pieces so as not to damage the machined surface of the cylinder tube. Do not make use of the outside piping as a locking means.

② Pull out rod assembly (2) about 200 mm (7.1 in). Because the rod assembly is rather heavy, finish extending it with air pressure after the oil draining operation.



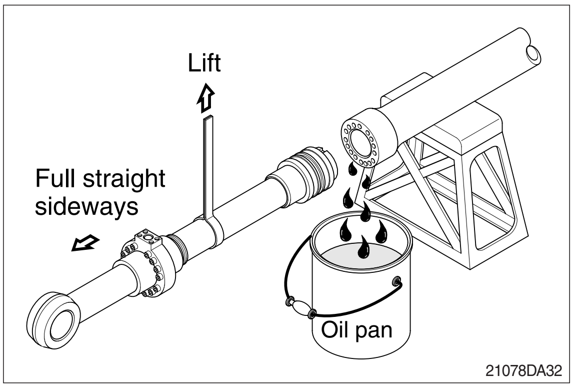
③ Loosen and remove socket bolts (23) of the gland in sequence.

※ Cover the extracted rod assembly (2) with rag to prevent it from being accidentally damaged during operation.



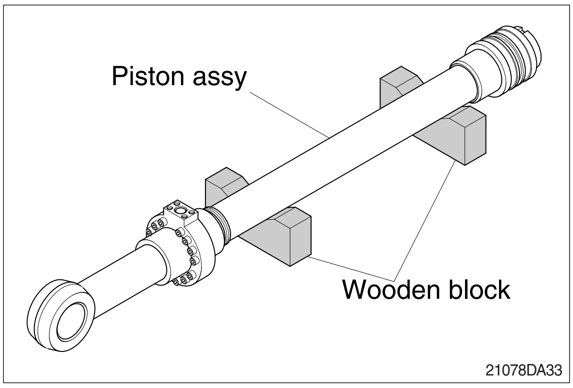
④ Draw out cylinder head and rod assembly together from tube assembly (1).

※ Since the rod assembly is heavy in this case, lift the tip of the rod assembly (2) with a crane or some means and draw it out. However, when rod assembly (2) has been drawn out to approximately two thirds of its length, lift it in its center to draw it completely.

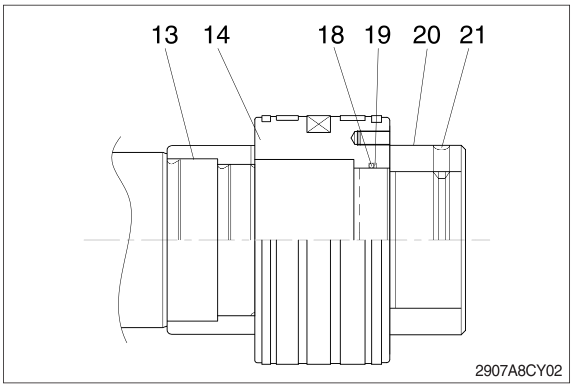


Note that the plated surface of rod assembly (2) is to be lifted. For this reason, do not use a wire sling and others that may damage it, but use a strong cloth belt or a rope.

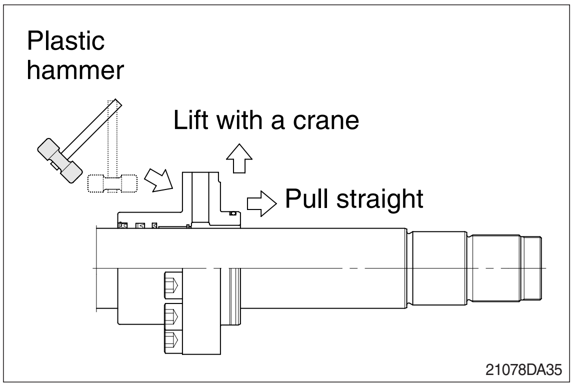
⑤ Place the removed rod assembly on a wooden V-block that is set level.
※ Cover a V-block with soft rag.



(2) Remove piston and cylinder head
① Remove set screw (21).
※ Since set screw (21) and lock nut (20) is tightened to a high torque, use a hydraulic and power wrench that utilizers a hydraulic cylinder, to remove the set screw (21) lock nut (20).
② Remove piston assembly (14), back up ring (19), and O-ring (18).



③ Remove the cylinder head assembly from rod assembly (2).
※ If it is too heavy to move, move it by striking the flanged part of cylinder head with a plastic hammer.
※ Pull it straight with cylinder head assembly lifted with a crane.
Exercise care so as not to damage the lip of rod bushing (4) and packing (5,6,7,8,9,10) by the threads of rod assembly (2).

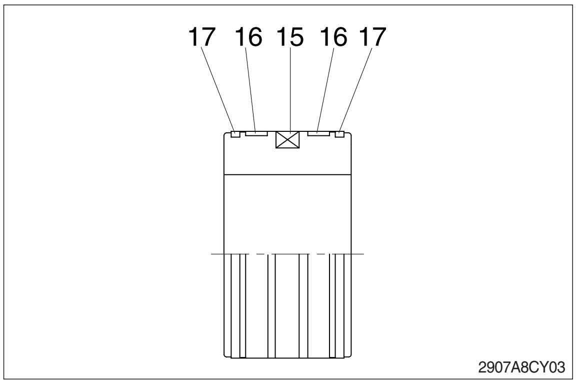


(3) Disassemble the piston assembly

① Remove wear ring (16).

② Remove dust ring (17) and piston seal (15).

※ Exercise care in this operation not to damage the grooves.



(4) Disassemble cylinder head assembly

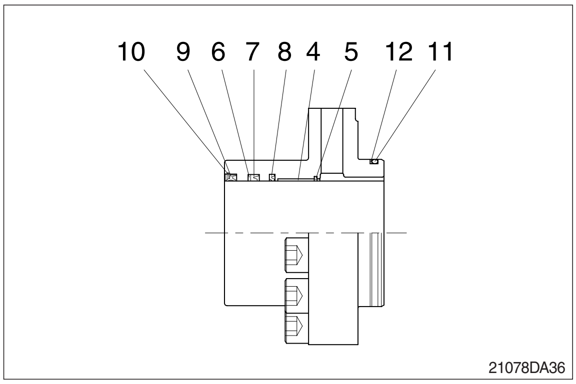
① Remove back up ring (12) and O-ring (11).

② Remove snap ring (10), dust wiper (9).

③ Remove back up ring (7), rod seal (6) and buffer ring (8).

※ Exercise care in this operation not to damage the grooves.

※ Do not remove seal and ring, if does not damaged.

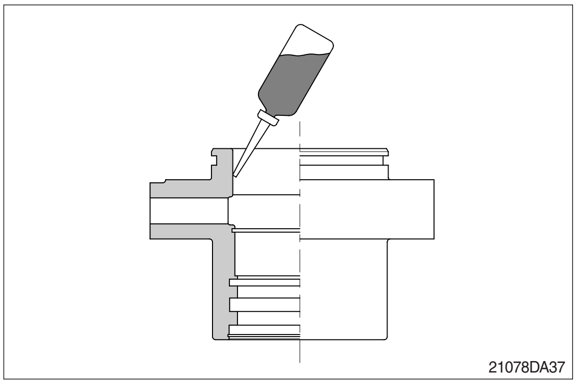


3) ASSEMBLY

(1) Assemble cylinder head assembly

※ Check for scratches or rough surfaces if found smooth with an oil stone.

① Coat the inner face of gland (3) with hydraulic oil.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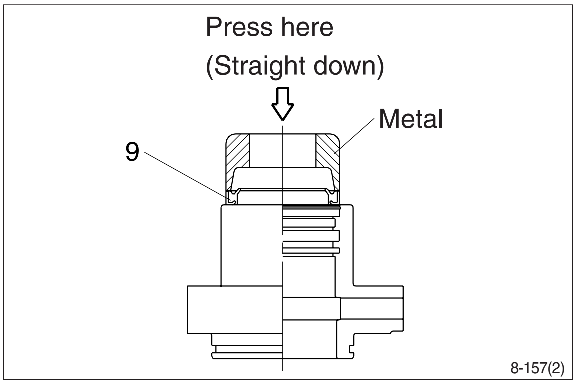
② Coat dust wiper (9) with grease and fit dust wiper (9) to the bottom of the hole of dust seal.
At this time, press a pad metal to the metal ring of dust seal.

③ Fit snap ring (10) to the stop face.

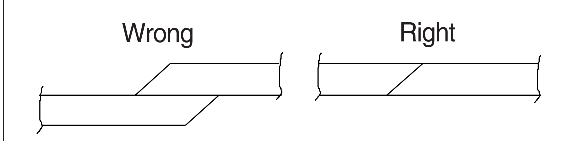


8-157(2)

④ Fit back up ring (7), rod seal (6) and buffer ring (8) to corresponding grooves, in that order.

※ Coat each packing with hydraulic oil before fitting it.

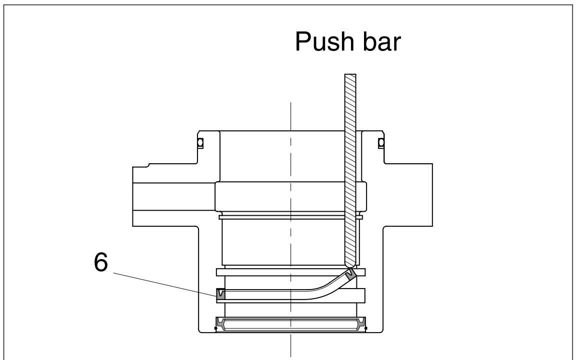
※ Insert the backup ring until one side of it is inserted into groove.



8-157(3)

※ Rod seal (6) has its own fitting direction. Therefore, confirm it before fitting them.

※ Fitting rod seal (6) upside down may damage its lip. Therefore check the correct direction that is shown in fig.



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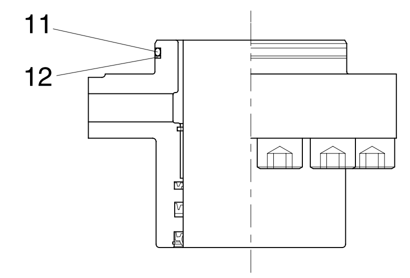
⑤ Fit back up ring (12) to gland (3).

※ Put the backup ring in the warm water of 30~50˚C.

⑥ Fit O-ring (11) to gland (3).



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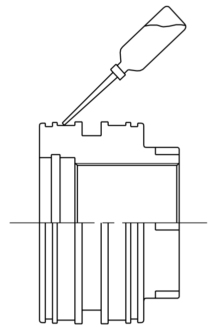
(2) Assemble piston assembly

※ Check for scratches or rough surfaces. If found smooth with an oil stone.

① Coat the outer face of piston (14) with hydraulic oil.

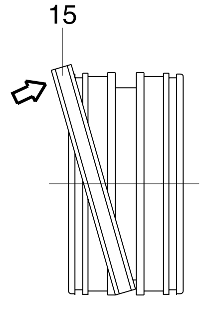


8-158(2)

② Fit piston seal (15) to piston.

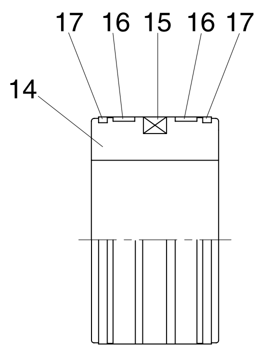
※ Put the piston seal in the warm water of 60~100˚C for more than 5 minutes.

※ After assembling the piston seal, press its outer diameter to fit in.



2907A8CY04

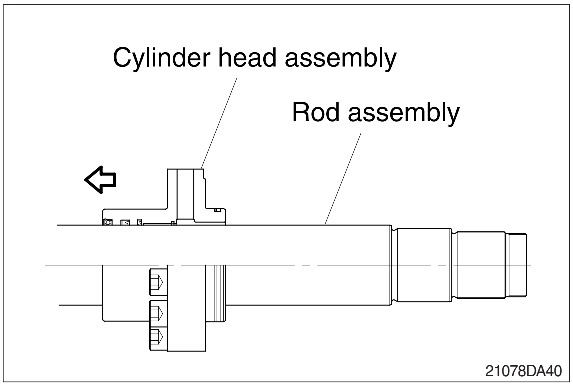
③ Fit wear ring (16) and dust ring (17) to piston (14).



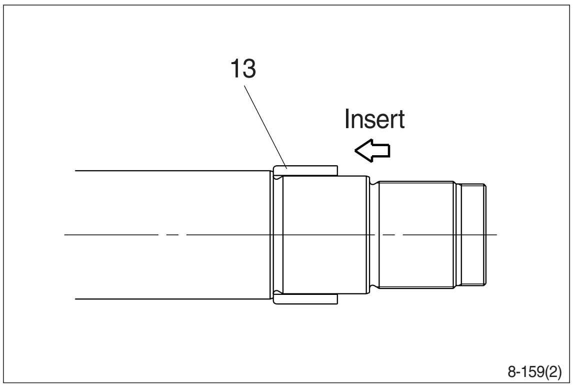
2907A8CY05

(3) Install piston and cylinder head

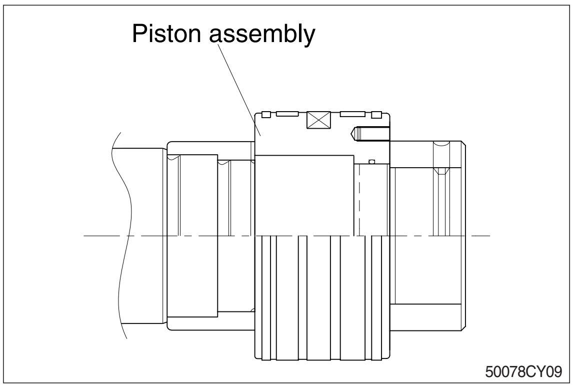
① Fix the rod assembly to the work bench.
② Apply hydraulic oil to the outer surface of rod assembly (2), the inner surface of piston and cylinder head.
③ Insert cylinder head assembly to rod assembly.



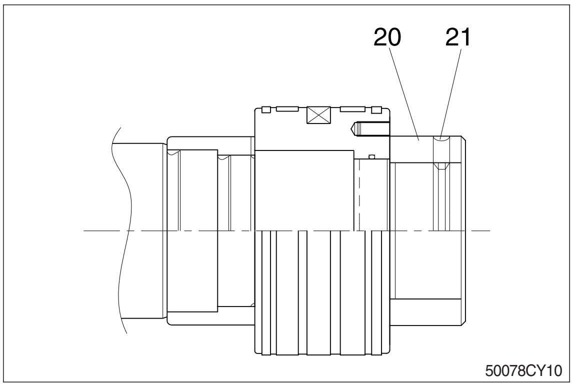
④ Insert cushion ring (13) to rod assembly.
※ Note that cushion ring (13) has a direction in which it should be fitted.



⑤ Fit piston assembly to rod assembly.
· Tightening torque : 150±15.0 kgf · m (1085±108 lbf · ft)
※ Refer to page 8-169.



⑥ Fit lock nut (20) and tighten the screw (21).
· Tightening torque :
Item 20 : 100±10.0 kgf·m (723±72.3 lbf·ft)
Item 21 : 5.4±0.5 kgf·m (39.1±3.6 lbf·ft)
※ Refer to page 8-169.



(3) Overall assemble

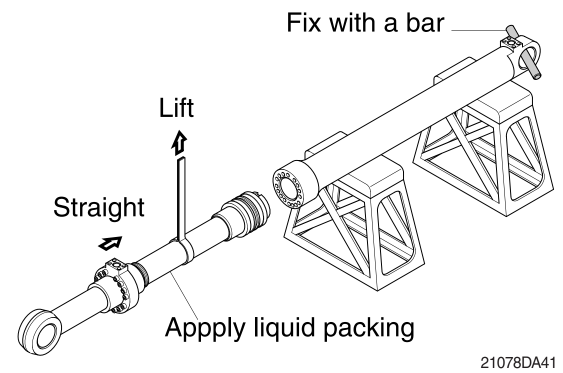
① Place a V-block on a rigid work bench. Mount the tube assembly (1) on it and fix the assembly by passing a bar through the clevis pin hole to lock the assembly.

② Insert the rod assembly in to the tube assembly, while lifting and moving the rod assembly with a crane.

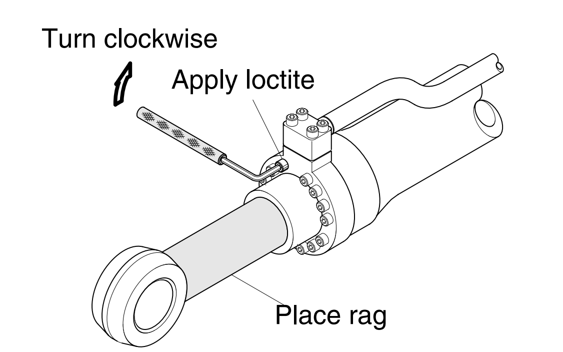
※ Be careful not to damage piston seal by thread of tube assembly.

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.



21078DA41



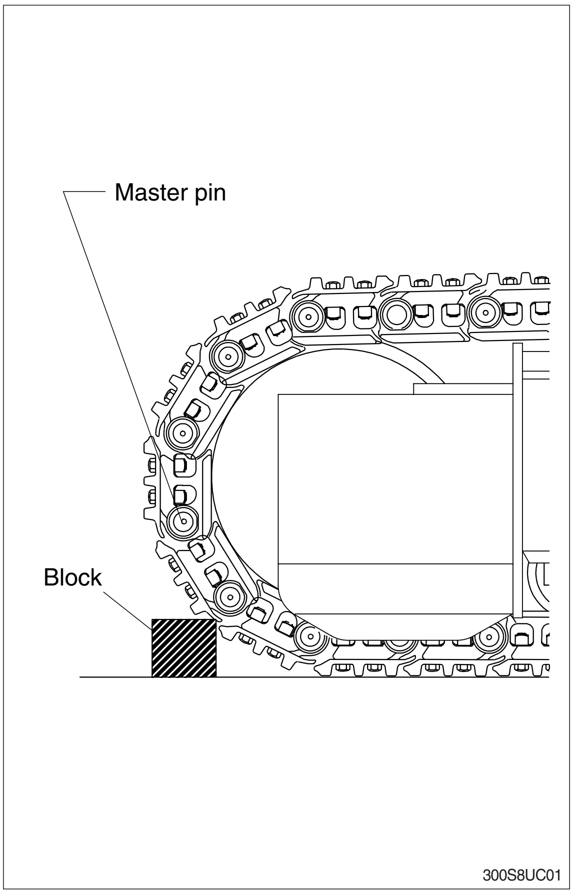
21078DA42

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.

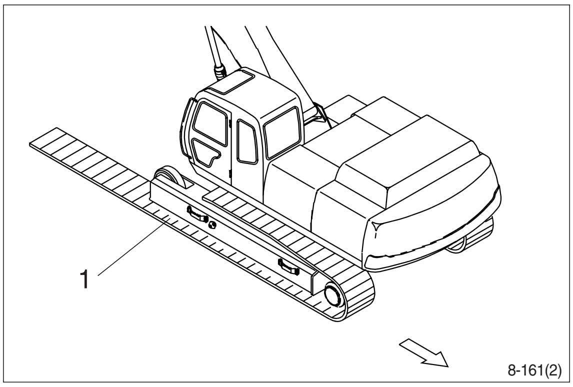
※ Unscrew the grease nipple after release the tension by pushing the poppet only when necessarily required.
Grease leaking hole is not existing. So, while unscrew the grease nipple, grease is not leaking until the grease nipple is completely coming out. If the tension is not released in advance, the grease nipple can be suddenly popped out by pressurized grease.

(3) Push out master pin by using a suitable tool.

(4) Move the machine slowly in reverse, and lay out track link assembly (1).

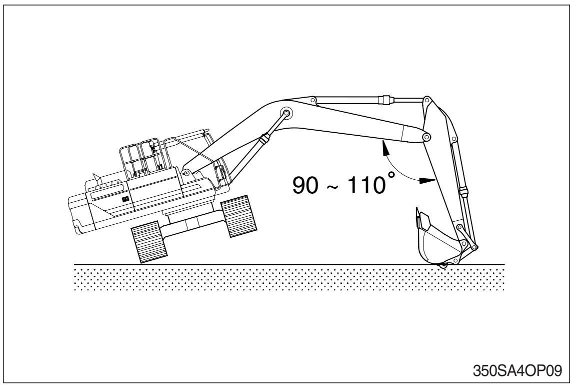
※ Jack up the machine and put wooden block under the machine.

※ Don't get close to the sprocket side as the track shoe plate may fall down on your feet.



2) INSTALL

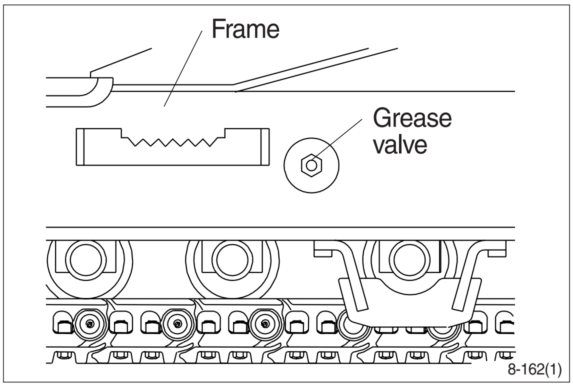
(1) Carry out installation in the reverse order to removal.
Adjust the tension of the track link.



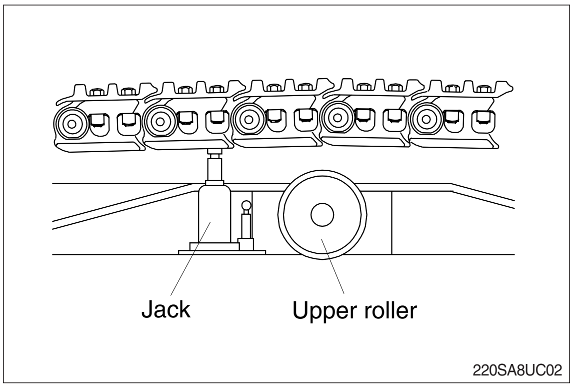
2. UPPER ROLLER

1) REMOVAL

(1) Loosen tension of the track link.



(2) Jack up the track link height enough to permit upper roller removal.

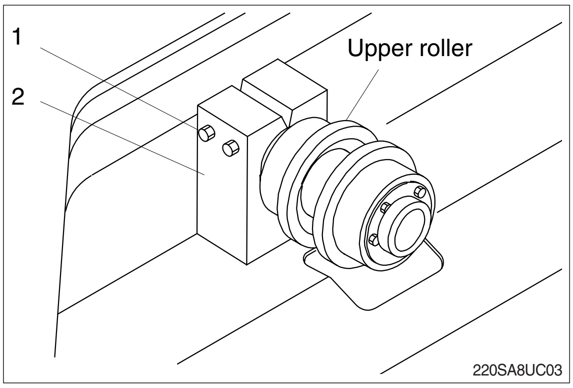


(3) Loosen the lock nut (1).

(4) Open bracket (2) with a screwdriver, push out from inside, and remove upper roller assembly.

· Weight : 70 kg (154 lb)

· Tightening torque : 29.7±4.5 kgf·m
(215±32.5 lbf·ft)



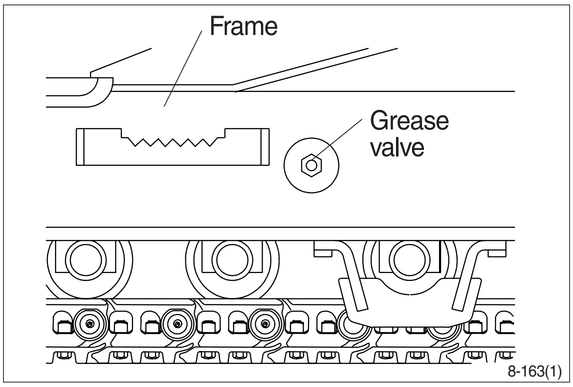
2) INSTALL

(1) Carry out installation in the reverse order to removal.

3. LOWER ROLLER

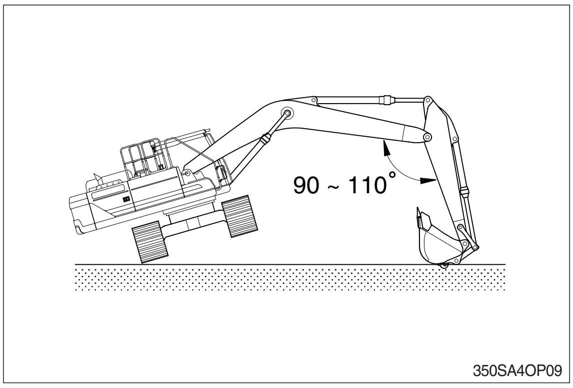
1) REMOVAL

(1) Loosen tension of the track link.



(2) Using the work equipment, push up track frame on side which is to be removed.

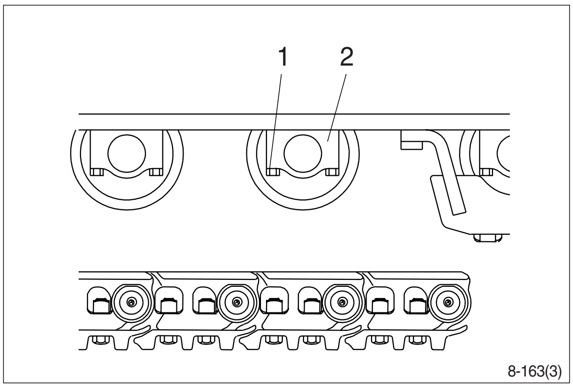
※ After jack up the machine, set a block under the unit.



(3) Remove the mounting bolt (1) and draw out the lower roller (2).

· Weight : 59.4 kg (131 lb)

· Tightening torque : 57.9±6.0 kgf·m (419±43.4 lbf·ft)



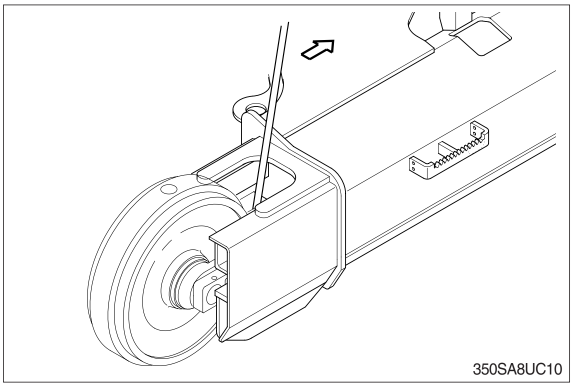
2) INSTALL

(1) Carry out installation in the reverse order to removal.

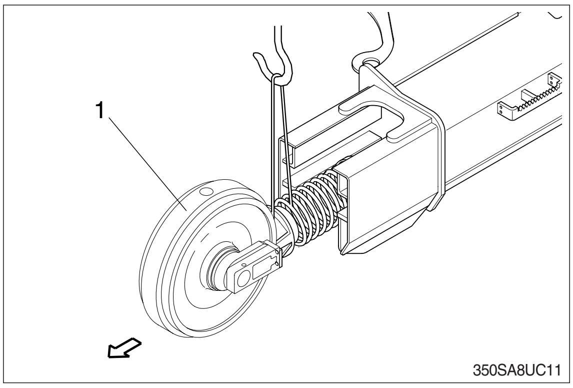
4. IDLER AND RECOIL SPRING

1) REMOVAL

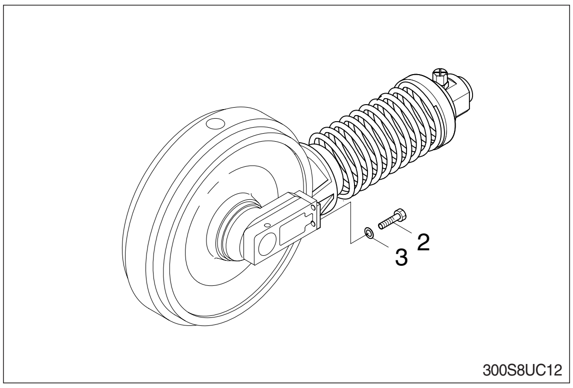
(1) Remove the track link.
For detail, see removal of track link.



(2) Sling the recoil spring (1) and pull out idler and recoil spring assembly from track frame, using a pry.
· Weight : 475 kg (1047 lb)



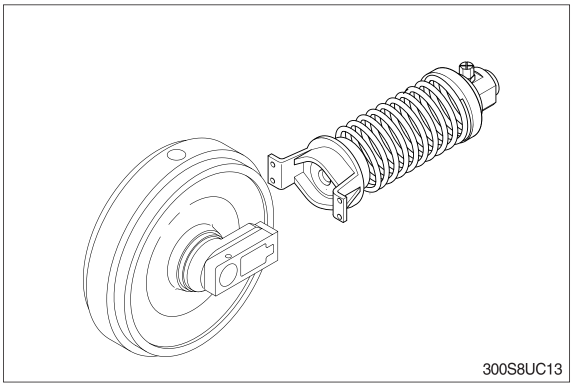
(3) Remove the bolts (2), washers (3) and separate idler from recoil spring.
· Tightening torque : 31.3±4.7 kgf·m
(226±34.0 lbf·ft)



2) INSTALL

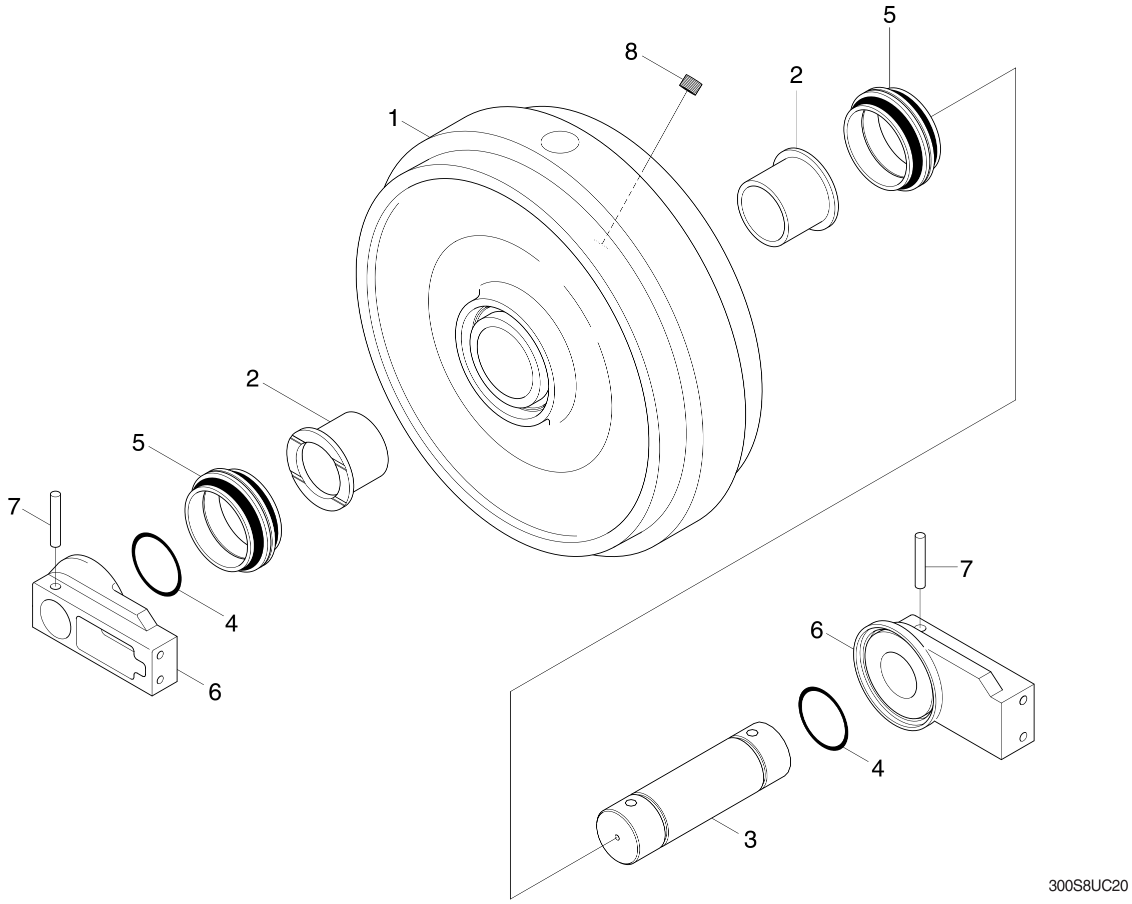
(1) Carry out installation in the reverse order to removal.

※ Make sure that the boss on the end face of the recoil cylinder rod is in the hole of the track frame.



3) DISASSEMBLY AND ASSEMBLY OF IDLER

(1) Structure

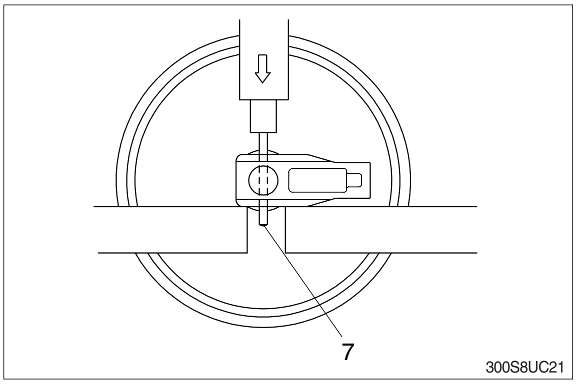


1	Shell	4	O-ring	7	Spring pin
2	Bushing	5	Seal assembly	8	Plug
3	Shaft	6	Bracket		

(2) Disassembly

① Remove plug and drain oil.

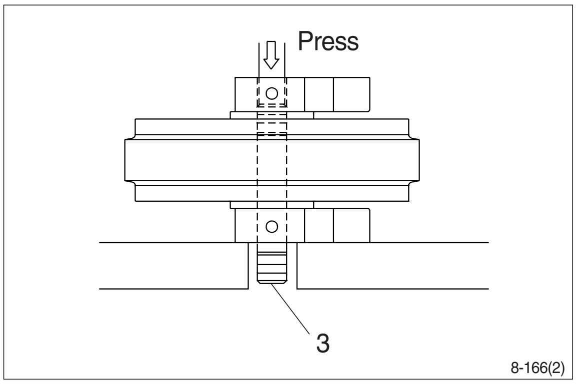
② Draw out the spring pin (7), using a press.



③ Pull out the shaft (2) with a press.

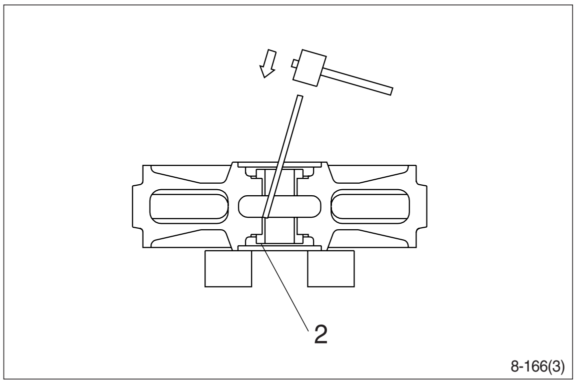
④ Remove seal (5) from shell (1) and bracket (6).

⑤ Remove O-ring (4) from shaft.



⑥ Remove the bushing (2) from idler, using a special tool.

※ Only remove bushing if replacement is necessity.

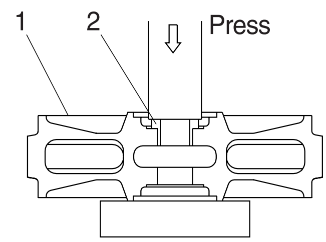


(3) Assembly

※ Before assembly, clean the parts.

※ Coat the sliding surfaces of all parts with oil.

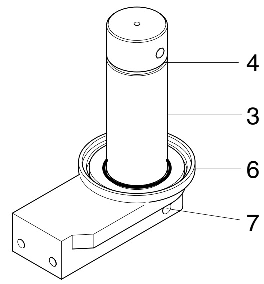
① Cool up bushing (2) fully by some dry ice and press it into shell (1).
Do not press it at the normal temperature, or not knock in with a hammer even after the cooling.



8-167(1)

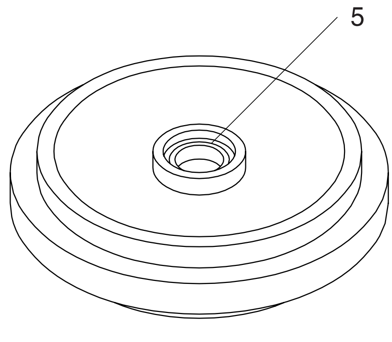
② Coat O-ring (4) with grease thinly, and install it to shaft (3).

③ Insert shaft (3) into bracket (6) and drive in the spring pin (7).



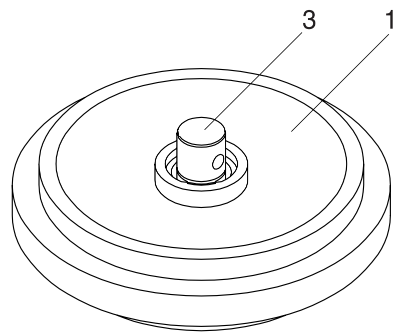
300S8UC22

④ Install seal (5) to shell (1) and bracket (6).



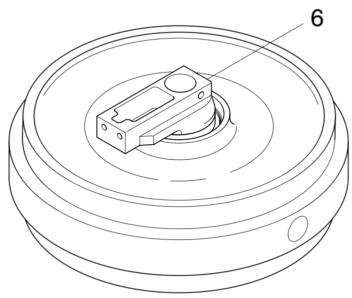
8-167(3)

⑤ Install shaft (3) to shell (1).



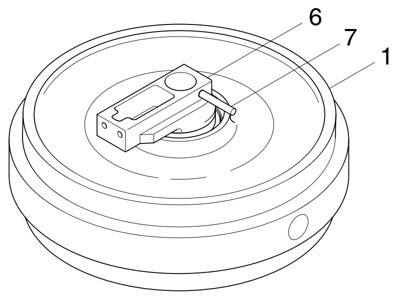
8-167(4)

⑥ Install bracket (6) attached with seal (5).



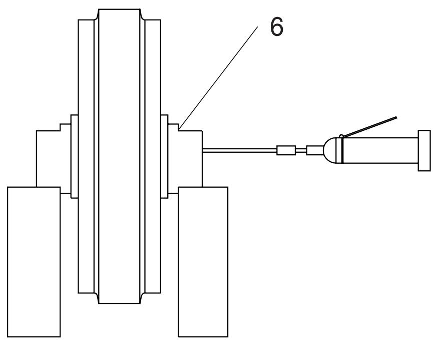
300S8UC23

⑦ Knock in the spring pin (7) with a hammer.



300S8UC24

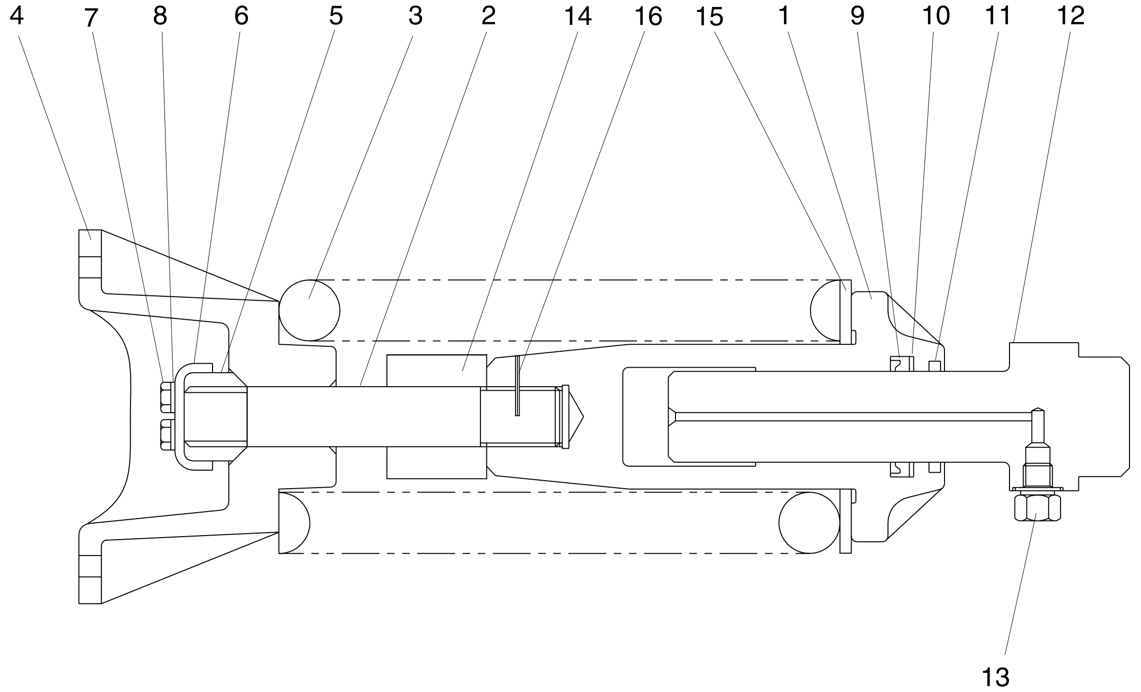
⑧ Lay bracket (6) on its side.
Supply engine oil to the specified level, and tighten plug.



8-168(3)

4) DISASSEMBLY AND ASSEMBLY OF RECOIL SPRING

(1) Structure



1	Body	6	Lock plate	11	Dust seal
2	Tie bar	7	Bolt	12	Adjust rod
3	Spring	8	Spring washer	13	Grease valve
4	Bracket	9	Rod seal	14	Stopper tube
5	Lock nut	10	Back up ring	15	Spacer
				16	Spring pin

(2) Disassembly

※ The illustrations are base on the type 1.

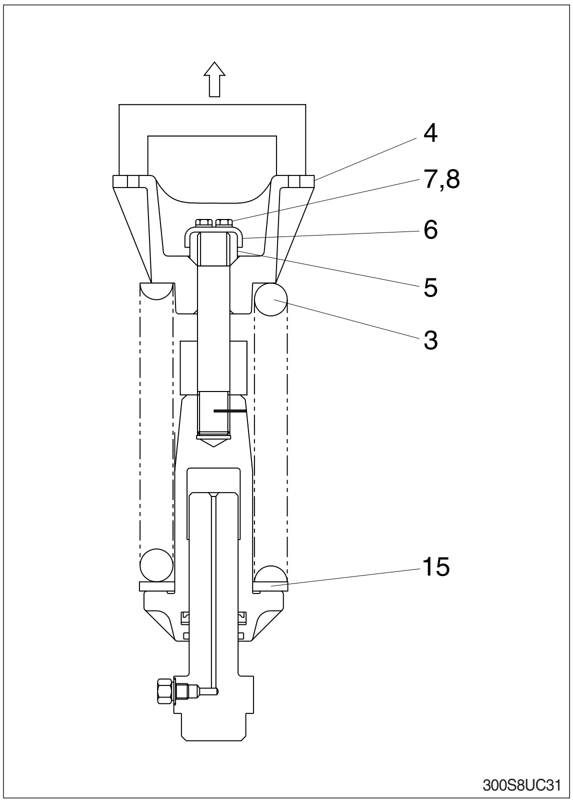
① Apply pressure on spring (3) with a press.

※ The spring is under a large installed load. This is dangerous, so be sure to set properly.

② Remove bolt (7), spring washer (8) and lock plate (6).

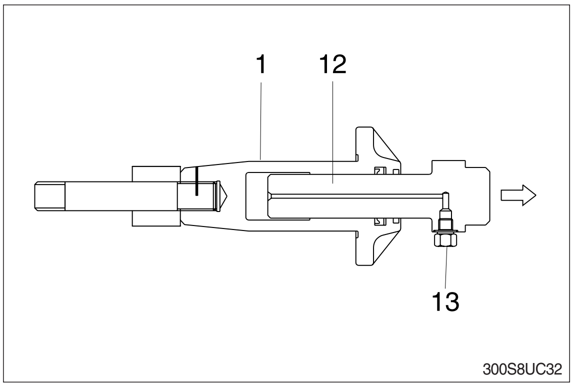
③ Remove lock nut (5).
Take enough notice so that the press which pushes down the spring, should not be slipped out in its operation.

④ Lighten the press load slowly and remove bracket (4), spring (3) and spacer (15).

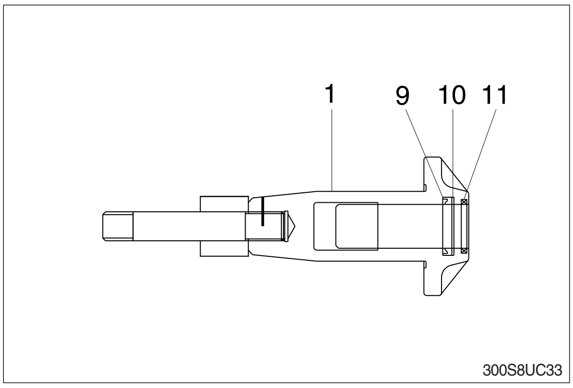


⑤ Remove rod (12) from body (1).

⑥ Remove grease valve (13) from rod (12).



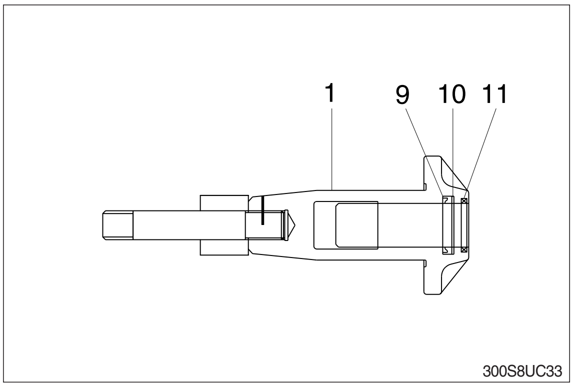
⑦ Remove rod seal (9), back up ring (10) and dust seal (11).



(3) Assembly

① Install dust seal (11), back up ring (10) and rod seal (9) to body (1).

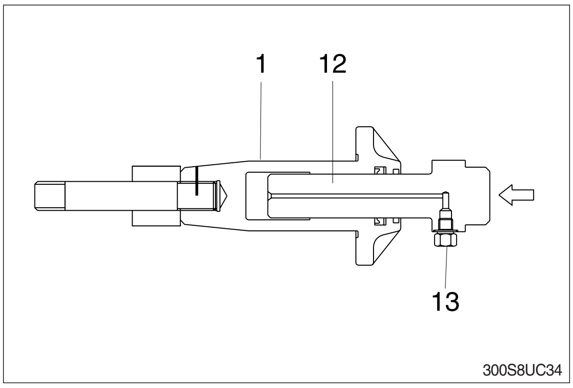
※ When installing dust seal (11) and rod seal (9), take full care so as not to damage the lip.



② Pour grease into body (1), then push in rod (12) by hand.
After take grease out of grease valve mounting hole, let air out.

※ If air letting is not sufficient, it may be difficult to adjust the tension of crawler.

③ Fit grease valve (13) to rod (12).
· Tightening torque : 13.0±1.0 kgf · m (94±7.2 lbf · ft)

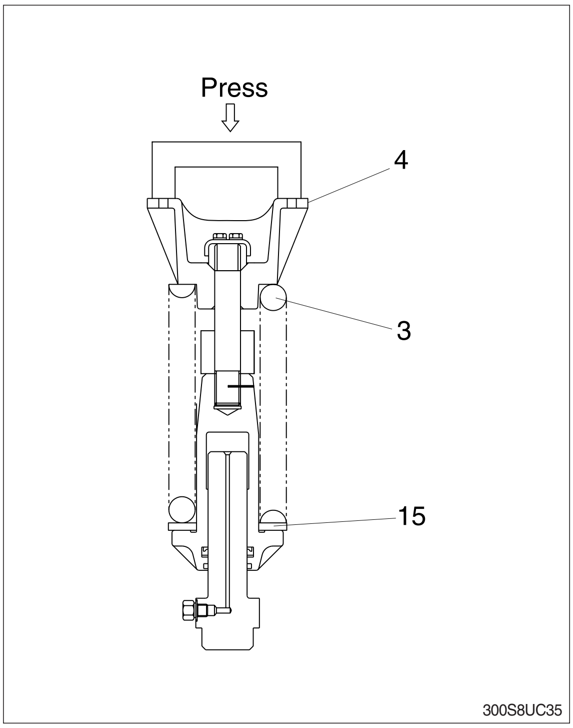


④ Install spacer (15), spring (3) and bracket (4) to body (1).

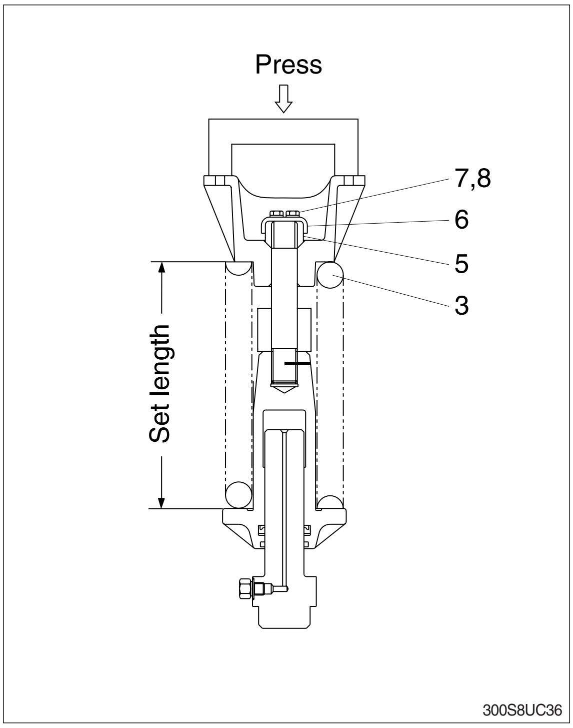
⑤ Apply pressure to spring (3) with a press and tighten lock nut (5).
· Spring set load
22285 kg (49130 lb)

※ Apply sealant before assembling.

※ During the operation, pay attention specially to prevent the press from slipping out.

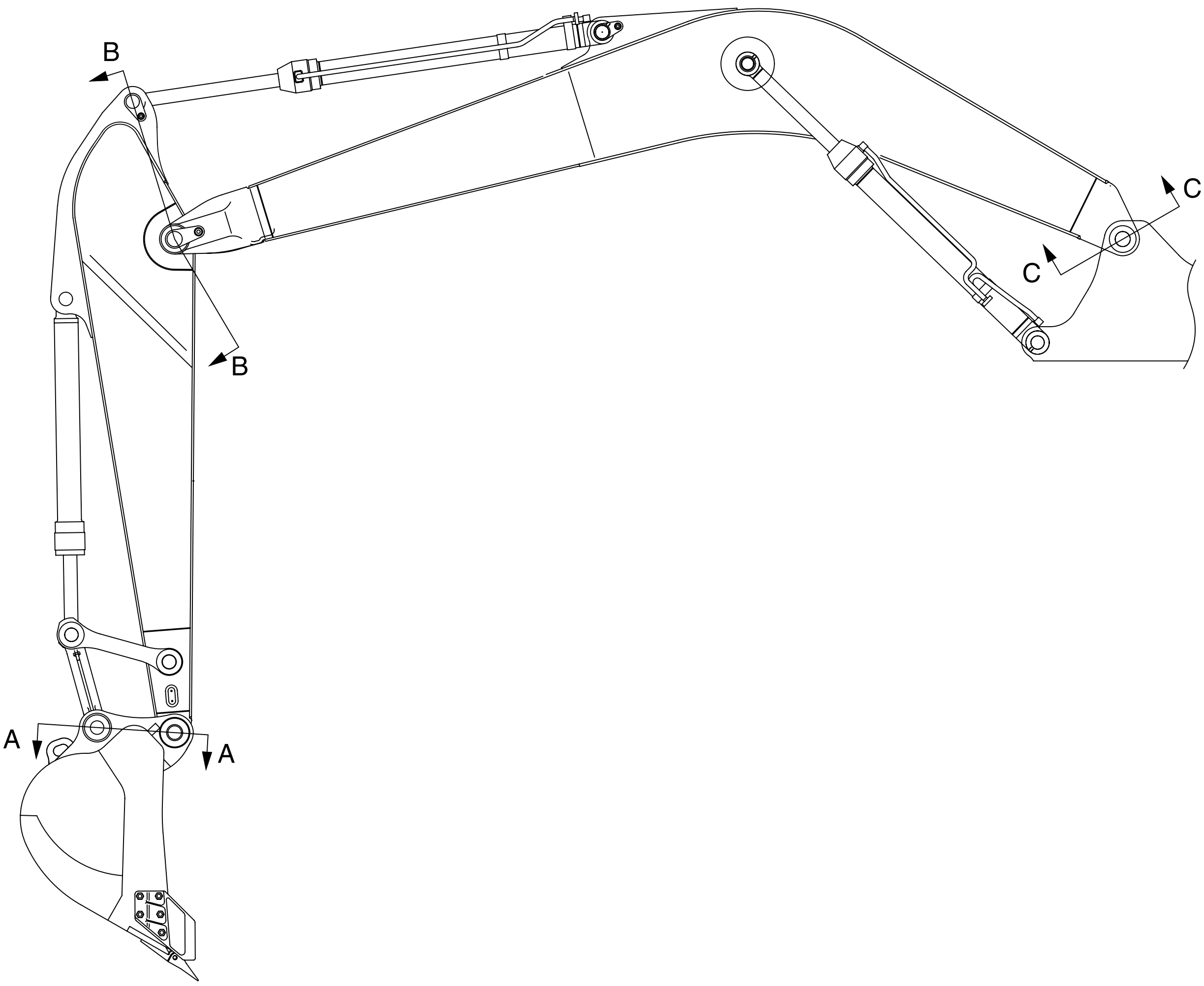


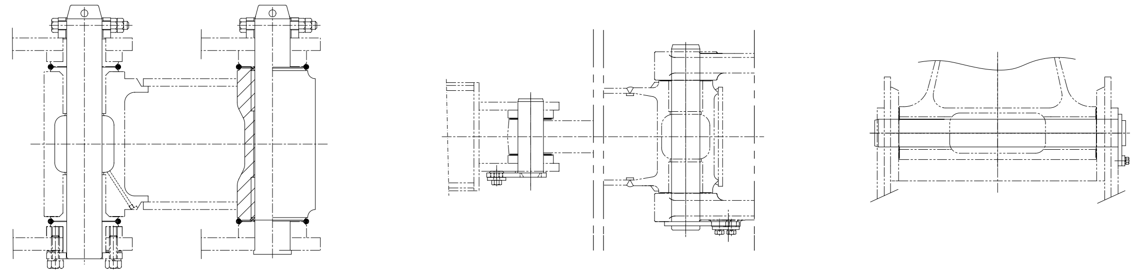
⑥ Lighten the press load and confirm the set length of spring (3).
·Set length : 565 ± 1.5 mm
After the setting of spring (3), install lock
⑦ plate (6), spring washer (8) and bolt (7).
·Tightening torque : 15±0.5 kgf·m
(108±3.6 lbf·ft)



GROUP 11 WORK EQUIPMENT

1. STRUCTURE





SECTION A SECTION B SECTION C

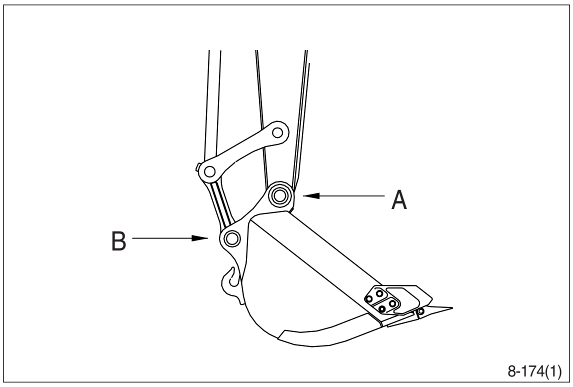
330A8WE01

2. REMOVAL AND INSTALL

1) BUCKET ASSEMBLY

(1) Removal

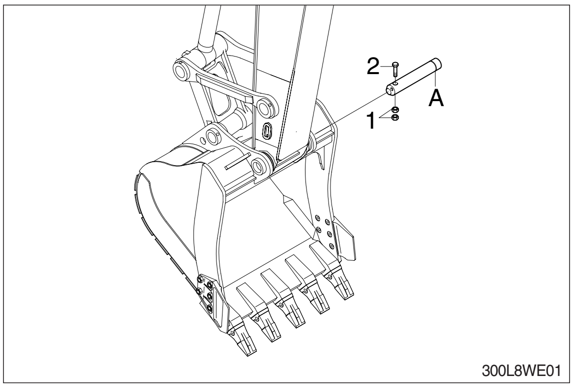
① Lower the work equipment completely to ground with back of bucket facing down.



8-174(1)

② Remove nut (1), bolt (2) and draw out the pin (A).

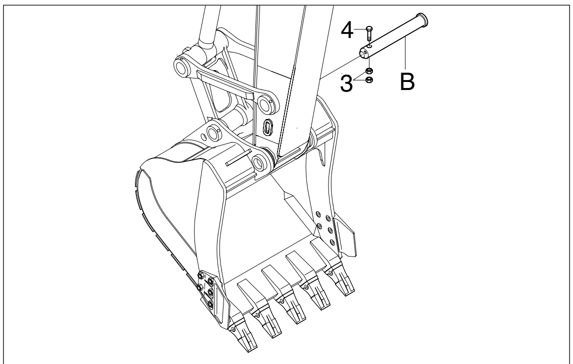
· Tightening torque : 57.9±8.7 kgf·m
(419±62.9 lbf·ft)



300L8WE01

③ Remove nut (3), bolt (4) and draw out the pin (B).

· Tightening torque : 57.9±8.7 kgf·m
(419±62.9 lbf·ft)



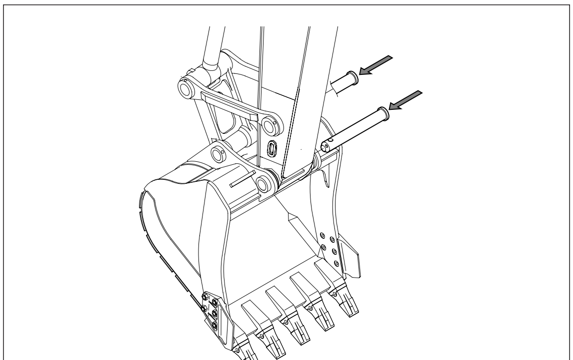
300L8WE02

(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.**



300A8WE03

2) ARM ASSEMBLY

(1) Removal

※ Loosen the breather slowly to release the pressure inside the hydraulic tank.

⚠ **Escaping fluid under pressure can penetrated the skin causing serious injury.**

① Remove bucket assembly.
For details, see **removal of bucket assembly.**

② Disconnect bucket cylinder hose (1).

⚠ **Fit blind plugs in the piping at the chassis end securely to prevent oil from spurting out when the engine is started.**

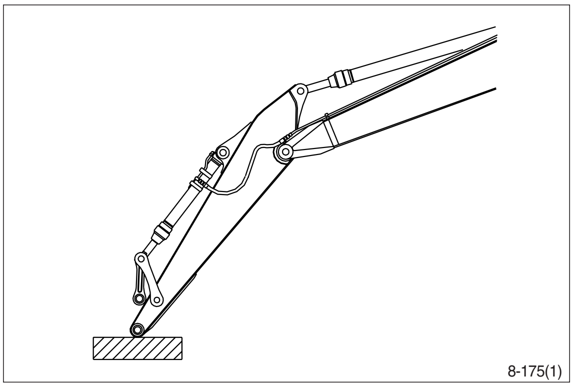
③ Sling arm cylinder assembly, remove spring, pin stopper and pull out pin.

※ Tie the rod with wire to prevent it from coming out.

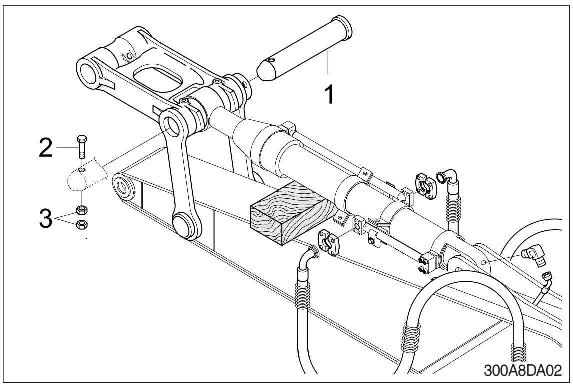
④ For details, see **removal of arm cylinder assembly.**
Place a wooden block under the cylinder and bring the cylinder down to it.

⑤ Remove bolt (2), plate (3) and pull out the pin (4) then remove the arm assembly.
- Weight : 1810 ㎏ (3990 ㏌)
- Tightening torque (2) : 57.9±8.7 kgf·m (419±62.9 lbf·ft)

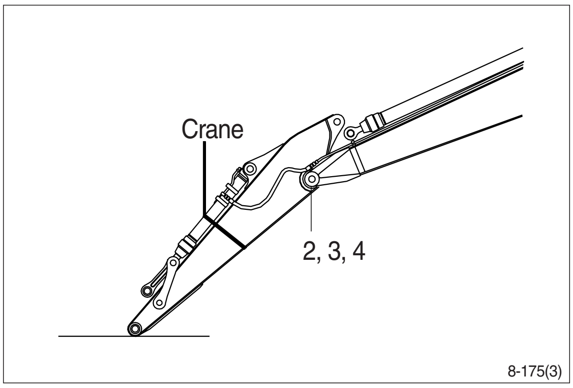
※ When lifting the arm assembly, always lift the center of gravity.



8-175(1)



300A8DA02



8-175(3)

(2) Install

① Carry out installation in the reverse order to removal.
When lifting the arm assembly, always lift the center of gravity.

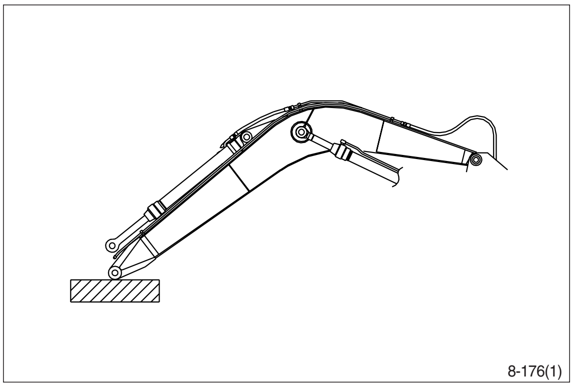
※ Bleed the air from the cylinder.

3) BOOM CYLINDER

(1) Removal

① Remove arm and bucket assembly.
For details, see **removal of arm and bucket assembly.**

② Remove boom cylinder assembly from boom.
For details, see **removal of arm cylinder assembly.**

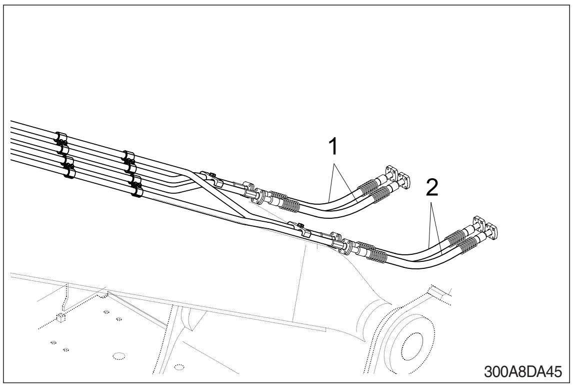


③ Disconnect head lamp wiring.

④ Disconnect bucket cylinder hose (2) and arm cylinder hose (1).

※ When the hose are disconnected, oil may spurt out.

⑤ Sling boom assembly (3).

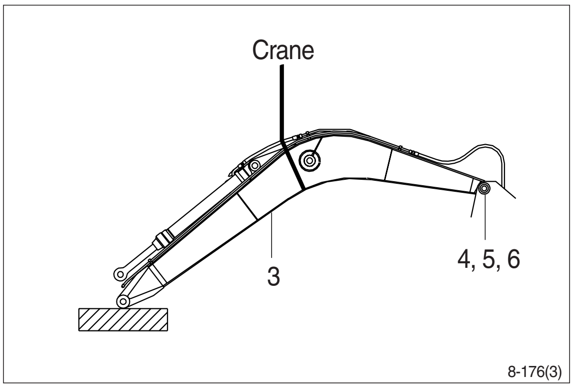


⑥ Remove bolt (4), plate (5) and pull out the pin (6) then remove boom assembly.

· Weight : 3060 ㎏ (6750 ㏈)

※ When lifting the boom assembly always lift the center of gravity.

· Tightening torque : 29.7±4.5 kgf·m (215±32.5 lbf·ft)



(2) Install

① Carry out installation in the reverse order to removal.

⚠ **When lifting the arm assembly, always lift the center of gravity.**

※ Bleed the air from the cylinder.