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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
   8 - 4 - 2] Added pages
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Revised edition mark(①②③…)

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

Revisions

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

Symbols

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

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

3. CONVERSION TABLE

Method of using the Conversion Table

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

Example

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

   Convert 55mm into inches.

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

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

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

2. Convert 550mm into inches.

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

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

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

Millimeters to inches

ⓑ

1mm = 0.03937 in

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

Millimeters to inches

1mm = 0.03937in

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

Kilogram to Pound

1kg = 2.2046lb

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

Liter to U.S. Gallon

1 l = 0.2642 U.S.Gal

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

Liter to U.K. Gallon

1 l = 0.21997 U.K.Gal

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

kgf · m to lbf · ft

1kgf · m = 7.233lbf · ft

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

kgf/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

SECTION 1 GENERAL

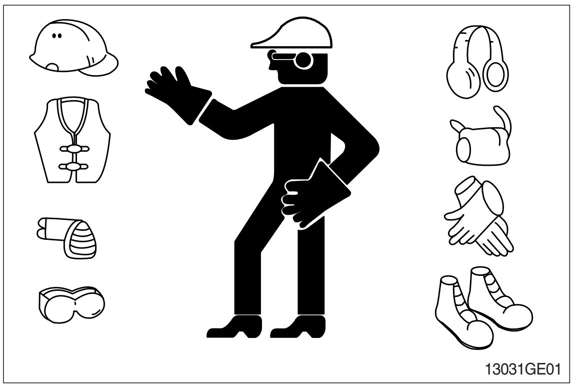
GROUP 1 SAFETY

FOLLOW SAFE PROCEDURE

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

WEAR PROTECTIVE CLOTHING

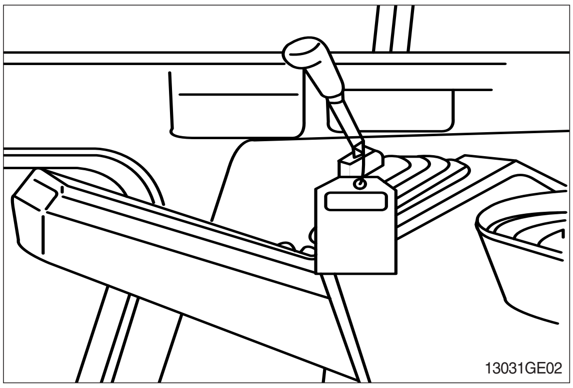
Wear close fitting clothing and safety equipment appropriate to the job.



13031GE01

WARN OTHERS OF SERVICE WORK

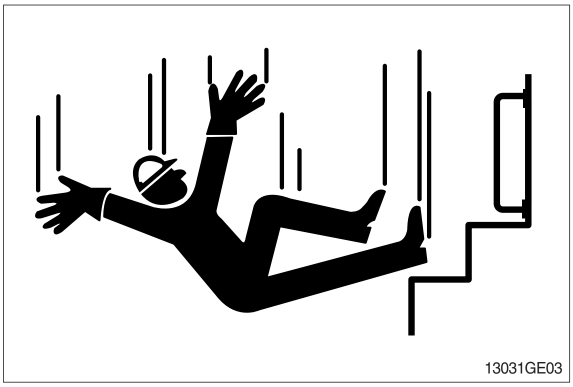
Unexpected machine movement can cause serious injury.
Before performing any work on the excavator, attach a 「**Do Not Operate**」 tag on the right side control lever.



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.



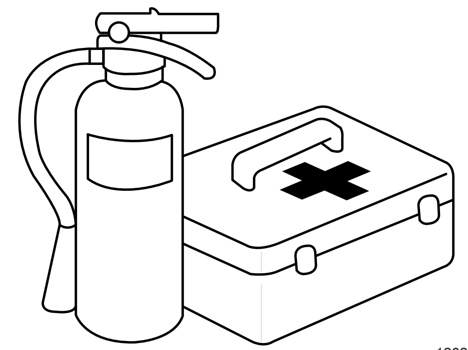
13031GE03

PREPARE FOR EMERGENCIES

Be prepared if a fire starts.

Keep a first aid kit and fire extinguisher handy.

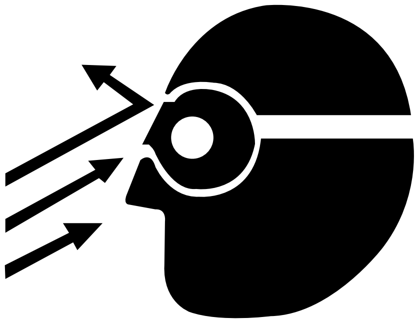
Keep emergency numbers for doctors, ambulance service, hospital, and fire department near your telephone.



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.

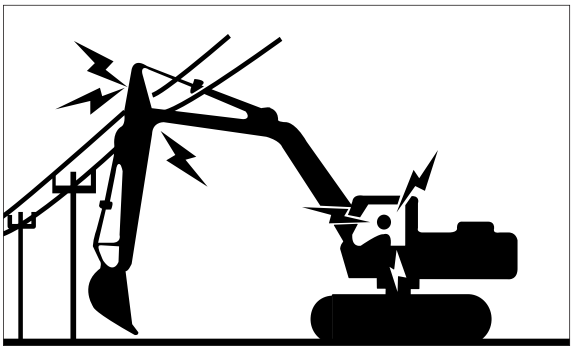
Wear a suitable hearing protective device such as earmuffs or earplugs to protect against objectionable or uncomfortable loud noises.

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.

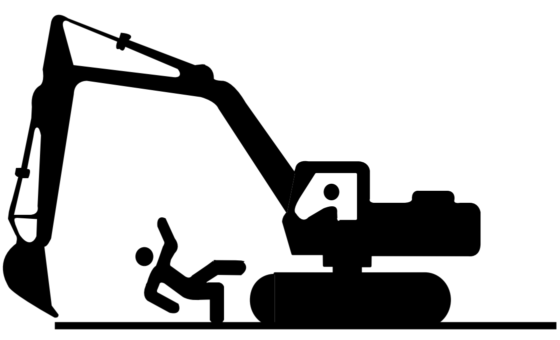


13031GE07

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.



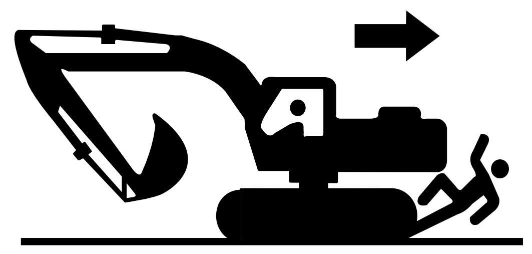
13031GE08

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.

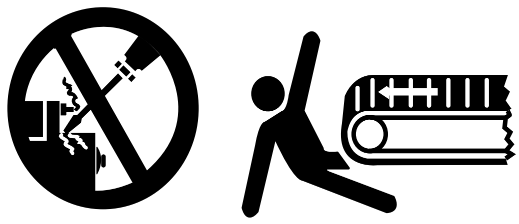


13031GE09

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 low idle speed without load for 5 minutes.
· Turn key switch to OFF to stop engine. Remove key from switch.
· Place safety lever to locked position.
· Allow engine to cool.

SUPPORT MACHINE PROPERLY

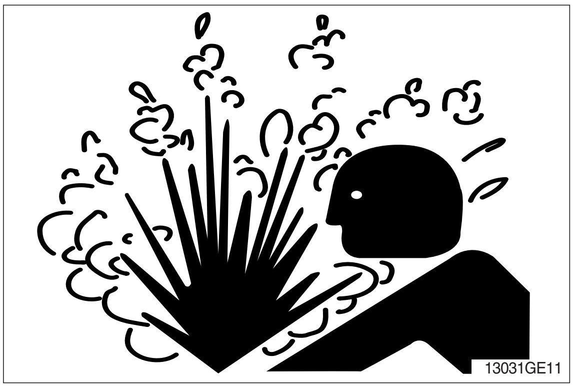
Always lower the attachment or implement to the ground before you work on the machine. If you must work on a lifted machine or attachment, securely support the machine or attachment.

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

SERVICE COOLING SYSTEM SAFELY

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

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



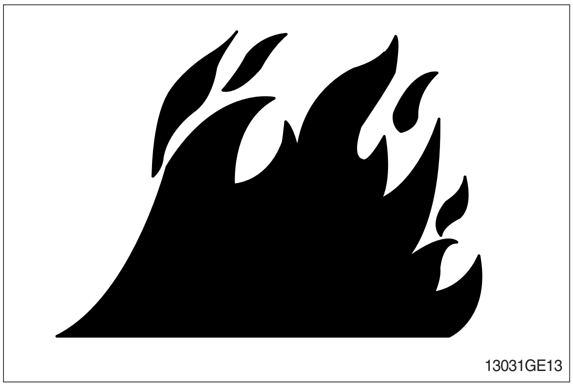
HANDLE FLUIDS SAFELY-AVOID FIRES

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

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

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

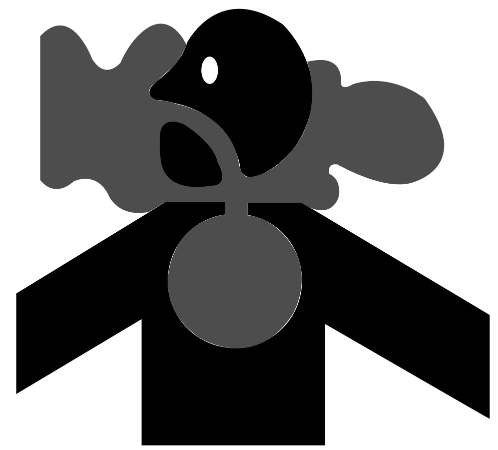
Do not store oily rags; They can ignite and burn spontaneously.



BEWARE OF EXHAUST FUMES

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

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



13031GE14

REMOVE PAINT BEFORE WELDING OR HEATING

Avoid potentially toxic fumes and dust.

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

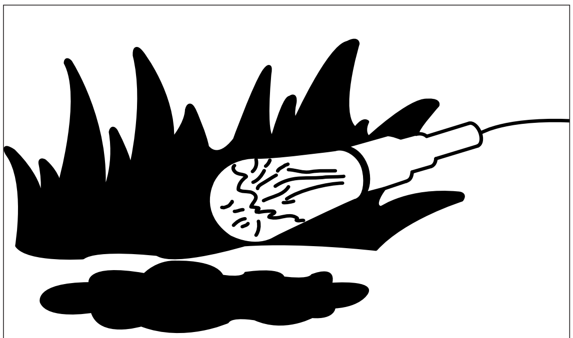
Do all work outside or in a well ventilated area. Dispose of paint and solvent properly.

Remove paint before welding or heating:

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

ILLUMINATE WORK AREA SAFELY

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

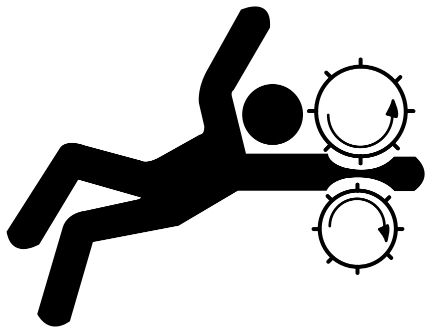


13031GE15

SERVICE MACHINE SAFELY

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

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

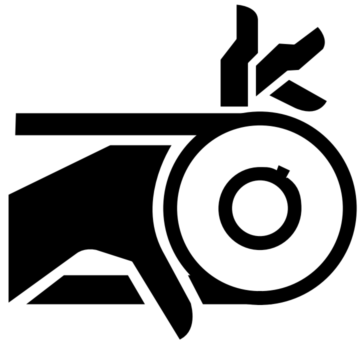


13031GE16

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

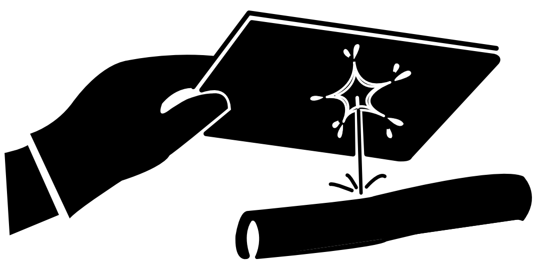
Escaping fluid under pressure can penetrate the skin causing serious injury.

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.

13031GE18

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.



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

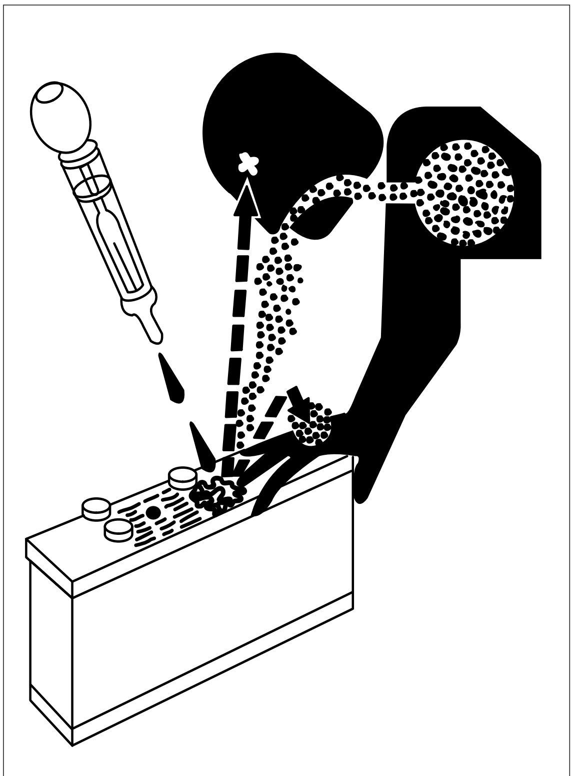
Keep sparks, lighted matches, and flame away from the top of battery.
Battery gas can explode.

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


13031GE22

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.

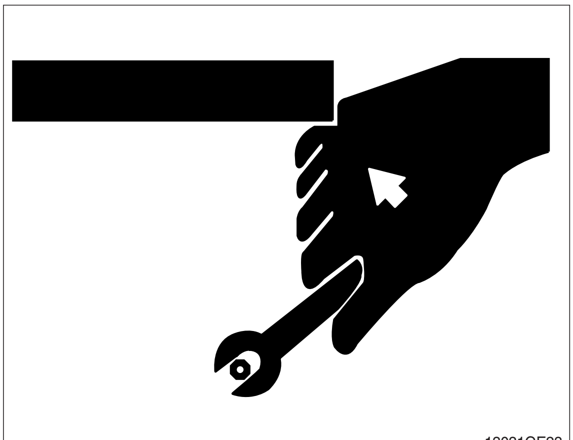
If you spill acid on yourself:

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 immediate-ly.

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


13031GE23

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.

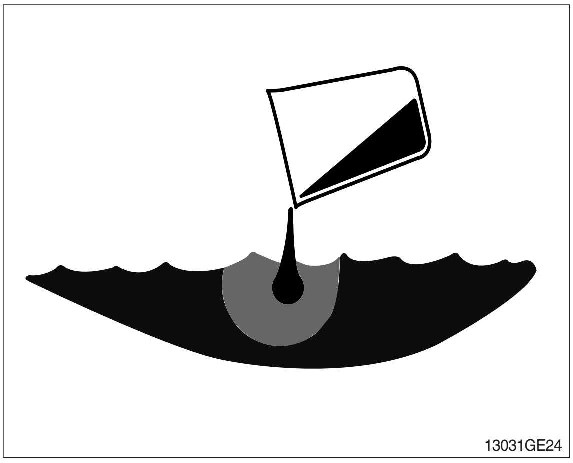
Use only recommended replacement parts. (See Parts manual.)

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.

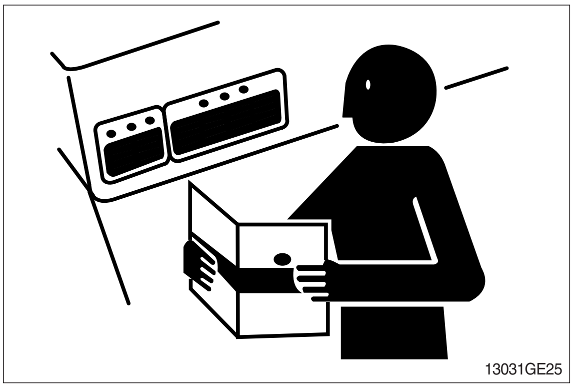
DO NOT pour oil into the ground, down a drain, or into a stream, pond, or lake. Observe relevant environmental protection regulations when disposing of oil, fuel, coolant, brake fluid, filters, batteries, and other harmful waste.



13031GE24

REPLACE SAFETY LABELS

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



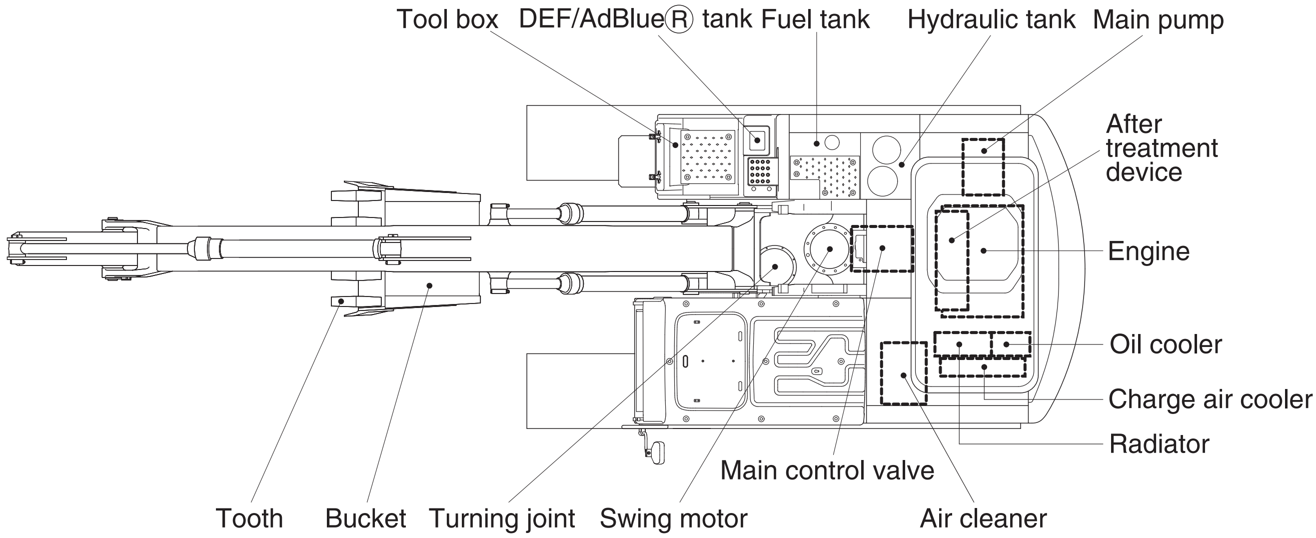
13031GE25

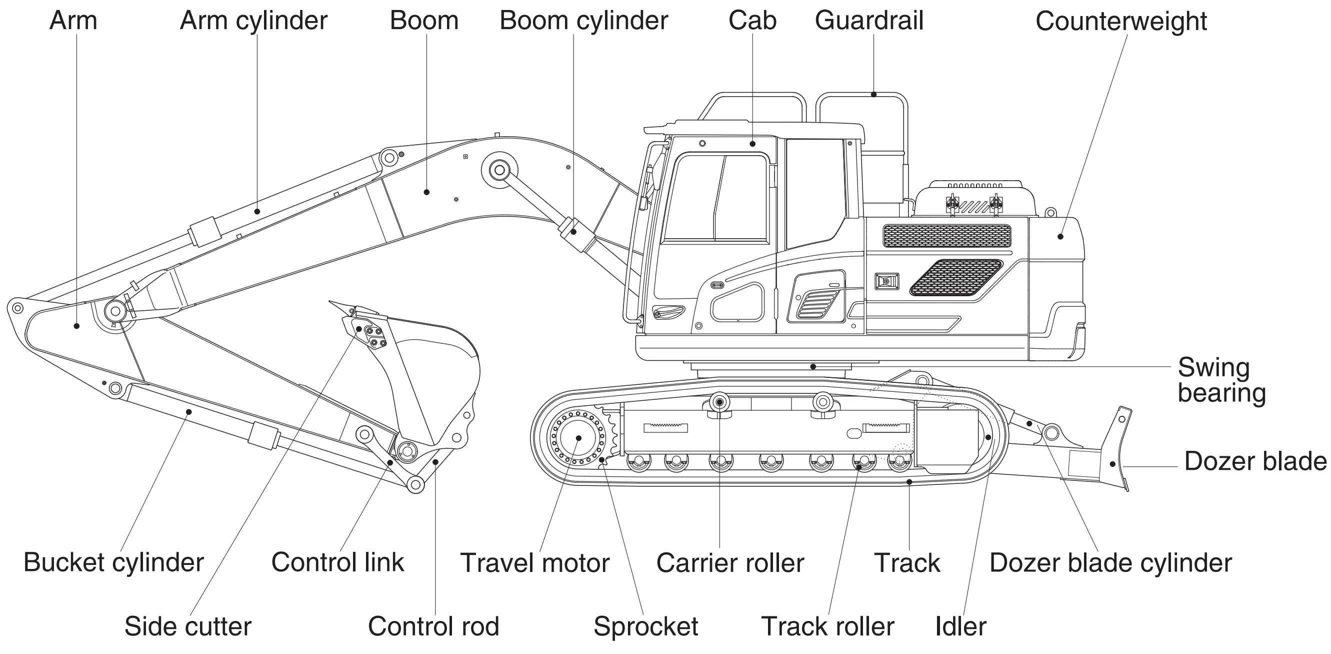
LIVE WITH SAFETY

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

GROUP 2 SPECIFICATIONS (HX160 L)

1. MAJOR COMPONENT



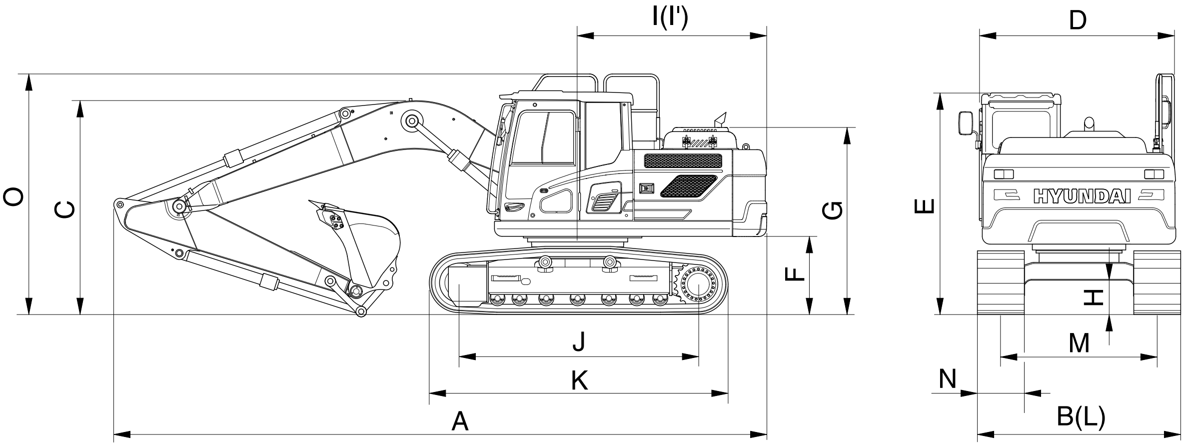


160F2SP01

2. SPECIFICATIONS

1) HX160 L

· 5.1 m (16' 9") BOOM and 2.6 m (8' 6") ARM

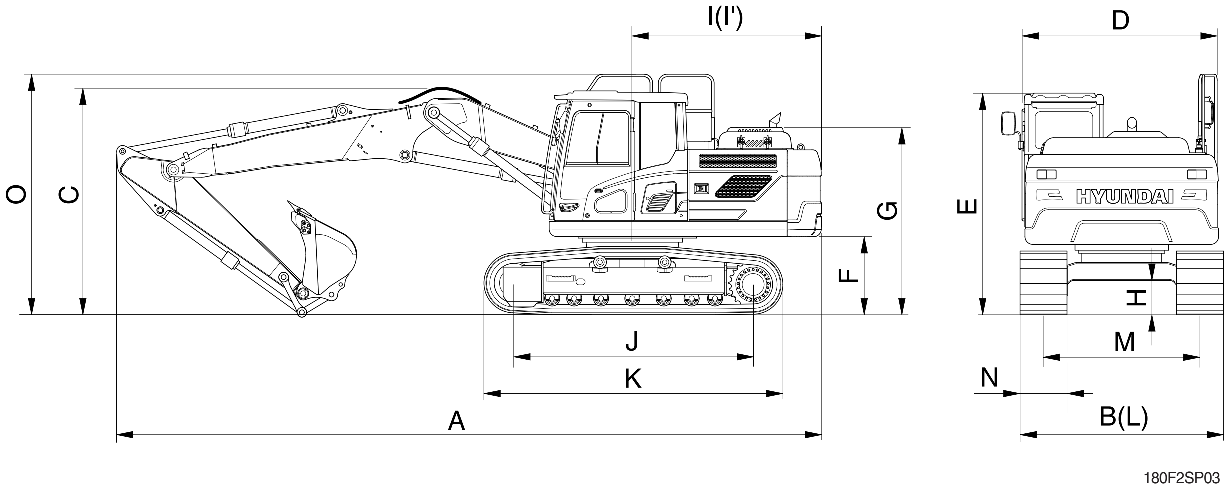


180F2SP02

Description		Unit	Specification
Operating weight		kg (lb)	18100 (39900)
Bucket capacity (SAE heaped), standard		m^3 (yd^3)	0.70 (0.92)
Overall length	A	mm (ft-in)	8650 (28' 5")
Overall width, with 600 mm shoe	B		2590 (8' 6")
Overall height of boom	C		2990 (9' 10")
Superstructure width	D		2475 (8' 1")
Overall height of cab	E		2980 (9' 9")
Ground clearance of counterweight	F		1055 (3' 6")
Engine cover height	G		2525 (8' 3")
Minimum ground clearance	H		460 (1' 6")
Rear-end distance	I		2480 (8' 2")
Rear-end swing radius	I'		2480 (8' 2")
Distance between tumblers	J		3170 (10' 5")
Undercarriage length	K		3926 (12' 11")
Undercarriage width	L		2590 (8' 6")
Track gauge	M		1990 (6' 6")
Track shoe width, standard	N		600 (24")
Overall height of guardrail	O		3220 (10' 6")
Travel speed (low/high)		km/hr (mph)	3.2/5.3 (2.0/3.3)
Swing speed		rpm	10.3
Gradeability		Degree (%)	35 (70)
Ground pressure (600 mm shoe)		kgf/cm^2(psi)	0.44 (6.26)
Max traction force		kg (lb)	17000 (37500)

2) HX160 L

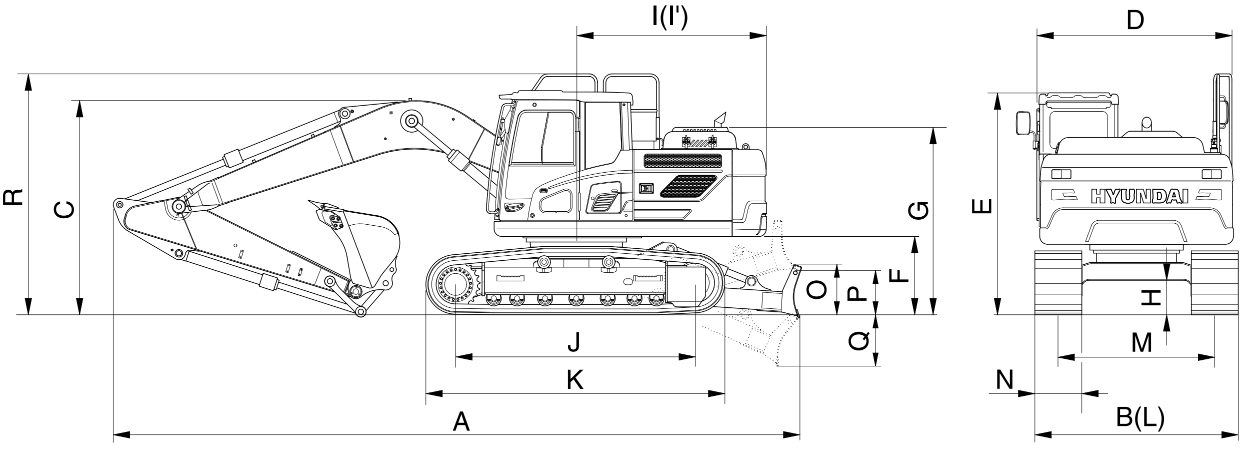
· 5.1 m (16' 9") HYDRAULIC ADJUSTABLE BOOM AND 2.6 m (8' 6") ARM



Description		Unit	Specification
Operating weight		kg (lb)	19000 (41890)
Bucket capacity (SAE heaped), standard		m^3 (yd^3)	0.70 (0.92)
Overall length	A	mm (ft-in)	8610 (28' 3")
Overall width, with 600 mm shoe	B		2590 (8' 6")
Overall height of boom	C		3060 (10' 0")
Superstructure width	D		2475 (8' 1")
Overall height of cab	E		2980 (9' 9")
Ground clearance of counterweight	F		1055 (3' 6")
Engine cover height	G		2525 (8' 3")
Minimum ground clearance	H		460 (1' 6")
Rear-end distance	I		2480 (10' 5")
Rear-end swing radius	I'		2480 (8' 2")
Distance between tumblers	J		3170 (10' 5")
Undercarriage length	K		3926 (12' 11")
Undercarriage width	L		2590 (8' 6")
Track gauge	M		1990 (6' 6")
Track shoe width, standard	N		600 (24")
Overall height of guardrail	O		3220 (10' 6")
Travel speed (low/high)		km/hr (mph)	3.2/5.3 (2.0/3.3)
Swing speed		rpm	10.3
Gradeability		Degree (%)	35 (70)
Ground pressure (600 mm shoe)		kgf/cm^2(psi)	0.46 (6.54)
Max traction force		kg (lb)	17000 (37500)

3) HX160 L

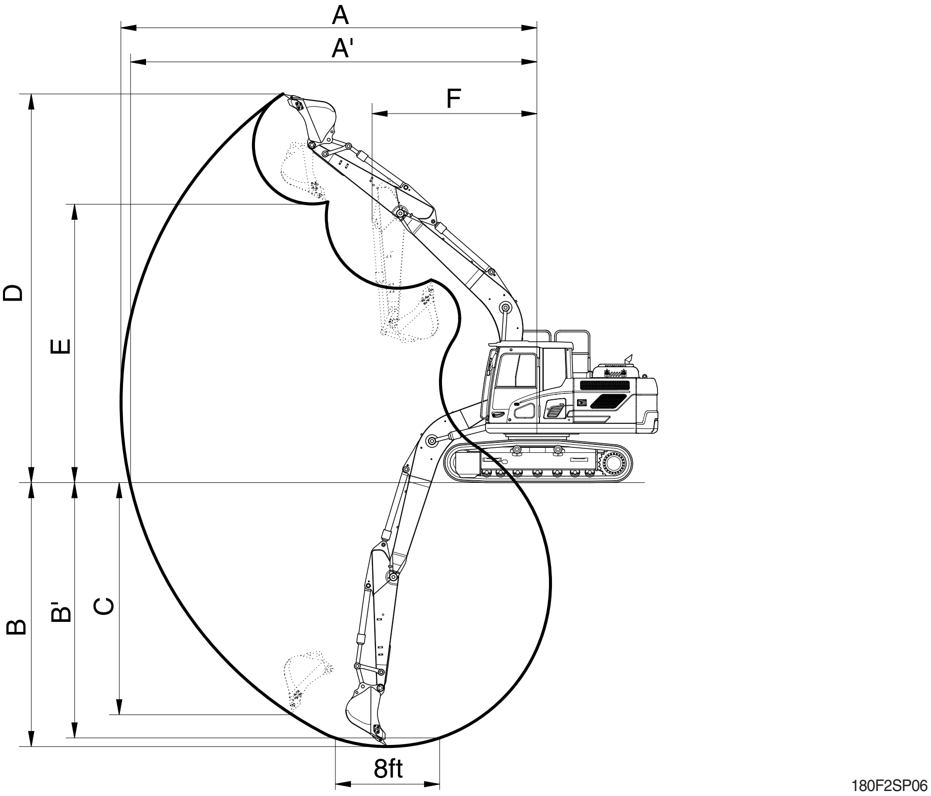
· 5.1 m (16' 9") BOOM and 2.6 m (8' 6") ARM WITH DOZER



Description		Unit	Specification
Operating weight		kg (lb)	18900 (41670)
Bucket capacity (SAE heaped), standard		m^3 (yd^3)	0.70 (0.92)
Overall length	A	mm (ft-in)	9100 (29' 10")
Overall width, with 600 mm shoe	B		2590 (8' 6")
Overall height of boom	C		2990 (9' 10")
Superstructure width	D		2475 (8' 1")
Overall height of cab	E		2980 (9' 9")
Ground clearance of counterweight	F		1055 (3' 6")
Engine cover height	G		2525 (8' 3")
Minimum ground clearance	H		460 (1' 6")
Rear-end distance	I		2480 (8' 2")
Rear-end swing radius	I'		2480 (8' 2")
Distance between tumblers	J		3170 (10' 5")
Undercarriage length	K		3926 (12' 11")
Undercarriage width	L		2590 (8' 6")
Track gauge	M		1990 (6' 6")
Track shoe width, standard	N		600 (24")
Height of blade	O		645 (2' 1")
Ground clearance of blade up	P		615 (2' 0")
Depth of blade down	Q		675 (2' 3")
Overall height of guardrail	R		3220 (10' 6")
Travel speed (low/high)		km/hr (mph)	3.2/5.3 (2.0/3.3)
Swing speed		rpm	10.3
Gradeability		Degree (%)	35 (70)
Ground pressure (600 mm shoe)		kgf/cm^2(psi)	0.46 (6.54)
Max traction force		kg (lb)	17000 (37500)

3. WORKING RANGE

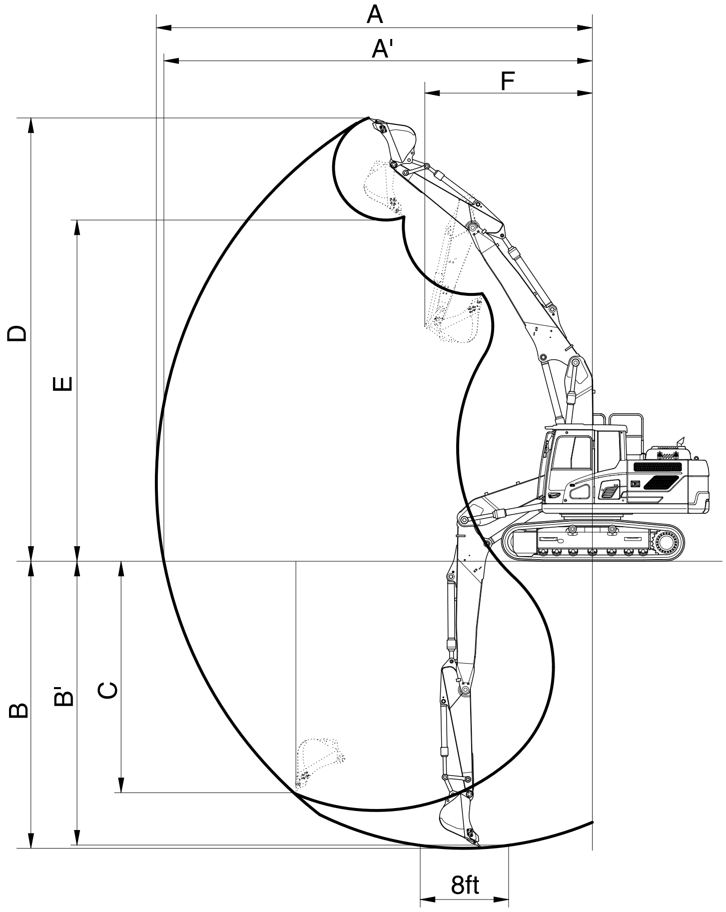
1) 5.1 m (16' 9") MONO BOOM



Description		2.2 m (7' 3") Arm	2.6 m (8' 6") Arm	3.1 m (10' 2") Arm
Max digging reach	A	8690 mm (28' 6")	9020 mm (29' 7")	9450 mm (31' 0")
Max digging reach on ground	A'	8530 mm (27'12")	8860 mm (29' 1")	9300 mm (30' 6")
Max digging depth	B	5660 mm (18' 7")	6060 mm (19'11")	6560 mm (21' 6")
Max digging depth (8ft level)	B'	5430 mm (17'10")	5850 mm (19' 2")	6370 mm (20'11")
Max vertical wall digging depth	C	5120 mm (16'10")	5380 mm (17' 8")	5710 mm (18' 9")
Max digging height	D	8750 mm (28' 8")	8840 mm (29' 0")	8980 mm (29' 6")
Max dumping height	E	6110 mm (20' 1")	6220 mm (20' 5")	6390 mm (21' 0")
Min swing radius	F	3180 mm (10' 5")	3170 mm (10' 5")	3170 mm (10' 5")
Bucket digging force	SAE	107.9 [117.2] kN	107.9 [117.2] kN	107.9 [117.2] kN
		11000 [11940] kgf	11000 [11940] kgf	11000 [11940] kgf
		24250 [26330] lbf	24250 [26330] lbf	24250 [26330] lbf
	ISO	123.6 [134.2] kN	123.6 [134.2] kN	123.6 [134.2] kN
		12600 [13680] kgf	12600 [13680] kgf	12600 [13680] kgf
		27780 [30160] lbf	27780 [30160] lbf	27780 [30160] lbf
Arm crowd force	SAE	87.2 [94.7] kN	77.3 [83.9] kN	69.0 [74.9] kN
		8890 [9650] kgf	7880 [8560] kgf	7030 [7630] kgf
		19600 [21280] lbf	17370 [18860] lbf	15500 [16830] lbf
	ISO	91.0 [98.8] kN	80.3 [87.2] kN	71.4 [77.5] kN
		9280 [10080] kgf	8190 [8890] kgf	7280 [7900] kgf
		20460 [22210] lbf	18060 [19600] lbf	16050 [17430] lbf

[ ] : Power boost

2) 5.1 m (16' 9") HYDRAULIC ADJUSTABLE BOOM



Description		2.2 m (7' 3") Arm	2.6 m (8' 6") Arm
Max digging reach	A	8760 mm (28' 9")	9110 mm (29'11")
Max digging reach on ground	A'	8590 mm (28' 2")	8950 mm (29' 4")
Max digging depth	B	5430 mm (17' 10")	5830 mm (19' 2")
Max digging depth (8ft level)	B'	5330 mm (17' 6")	5730 mm (18'10")
Max vertical wall digging depth	C	4630 mm (15' 2")	4980 mm (16' 4")
Max digging height	D	9420 mm (30' 11")	9610 mm (31' 6")
Max dumping height	E	6710 mm (22' 0")	6910 mm (22' 8")
Min swing radius	F	3100 mm (10' 2")	2970 mm (9' 9")
Bucket digging force	SAE	107.9 [117.2] kN	107.9 [117.2] kN
		11000 [11940] kgf	11000 [11940] kgf
		24250 [26330] lbf	24250 [26330] lbf
	ISO	123.6 [134.2] kN	123.6 [134.2] kN
		12600 [13680] kgf	12600 [13680] kgf
		27780 [30160] lbf	27780 [30160] lbf
Arm crowd force	SAE	87.2 [94.7] kN	77.3 [83.9] kN
		8890 [9650] kgf	7880 [8560] kgf
		19600 [21280] lbf	17370 [18860] lbf
	ISO	91.0 [98.8] kN	80.3 [87.2] kN
		9280 [10080] kgf	8190 [8890] kgf
		20460 [22210] lbf	18060 [19600] lbf

[ ] : Power boost

4. WEIGHT

Item	HX160 L		HX160 L (with dozer)	
	kg	lb	kg	lb
Upper structure assembly				
· Main frame weld assembly	1440	3170	←	
· Engine assembly	589	1300	←	
· Fan clutch assembly	45	100	←	
· Main pump assembly	89	200	←	
· Main control valve assembly	140	310	←	
· Swing motor assembly	250	550	←	
· Hydraulic oil tank assembly	150	330	←	
· Fuel tank assembly	130	290	←	
· Counterweight	2600	5730	←	
· Cab assembly	500	1100	←	
Lower chassis assembly				
· Track frame weld assembly	2290	5050	2270	5000
· Swing bearing	260	570	←	
· Travel motor assembly	300	660	←	
· Turning joint	60	130	←	
· Track recoil spring	132	290	←	
· Idler	151	330	←	
· Sprocket	54	120	←	
· Carrier roller	20	45	←	
· Track roller	40	90	←	
· Track-chain assembly (600 mm standard triple grouser shoe)	1180	2600	←	
Front attachment assembly				
· 5.1 m boom assembly	1060	2340	←	
· 2.6 m arm assembly	540	1190	←	
· 0.7 m^3 SAE heaped bucket	600	1320	←	
· Boom cylinder assembly	155	340	←	
· Arm cylinder assembly	180	400	←	
· Bucket cylinder assembly	125	280	←	
· Bucket control link assembly	120	265	←	
· Dozer blade assembly	-	-	655	1445
· Dozer blade cylinder assembly	-	-	66	146

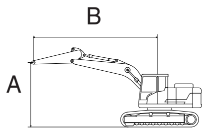
※ This information is different with operating and transportation weight because it is not including harness, pipe, oil, fuel so on.

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

5. LIFTING CAPACITIES

Model	Type	Boom	Arm	Counterweight	Shoe	Wheel	Dozer		Outtriger	
HX160 L	MONO BOOM	Length [mm]	Length [mm]	weight [kg]	width [mm]	width [mm]	Front	Rear	Front	Rear
		5100	2600	2600	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)		Capacity		Reach
														m (ft)
7.5 m	kg											*3400	*3400	4.85
(24.6 ft)	lb											*7500	*7500	(15.9)
6.0 m	kg							*3830	3420			*2960	*2960	6.27
(19.7 ft)	lb							*8440	7540			*6530	*6530	(20.6)
4.5 m	kg					*4890	*4890	*4450	3370			*2840	2550	7.10
(14.8 ft)	lb					*10780	*10780	*9810	7430			*6260	5620	(23.3)
3.0 m	kg			*9410	9100	*6140	4940	*4960	3240	*3100	2290	*2870	2270	7.54
(9.8 ft)	lb			*20750	20060	*13540	10890	*10930	7140	*6830	5050	*6330	5000	(24.7)
1.5 m	kg					*7420	4610	5040	3090	3610	2230	*3050	2160	7.66
(4.9 ft)	lb					*16360	10160	11110	6810	7960	4920	*6720	4760	(25.1)
0.0 m	kg			*5280	*5280	7610	4410	4910	2980			*3420	2200	7.47
(0.0 ft)	lb			*11640	*11640	16780	9720	10820	6570			*7540	4850	(24.5)
-1.5 m	kg	*5070	*5070	*9170	8030	7530	4350	4860	2930			3960	2420	6.95
(-4.9 ft)	lb	*11180	*11180	*20220	17700	16600	9590	10710	6460			8730	5340	(22.8)
-3.0 m	kg	*9350	*9350	*10230	8160	*7160	4400	4930	2990			4910	2980	6.01
(-9.8 ft)	lb	*20610	*20610	*22550	17990	*15790	9700	10870	6590			10820	6570	(19.7)
-4.5 m	kg			*6920	*6920							*4590	*4590	4.39
(-14.8 ft)	lb			*15260	*15260							*10120	*10120	(14.4)

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.

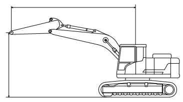
※ Lifting capacities are based upon a standard machine conditions.
Lifting capacities will vary with different work tools, ground conditions and attachments.
The difference between the weight of a work tool attachment must be subtracted.
Consult your HD Hyundai Construction Equipment dealer regarding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

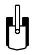
⚠ Failure to comply to the rated load can cause possible personal injury or property damage.
Make adjustments to the rated load as necessary for non-standard configurations.

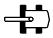
Model	Type	Boom	Arm	Counterweight	Shoe	Wheel	Dozer		Outtriger	
HX160 L	MONO BOOM	Length [mm]	Length [mm]	weight [kg]	width [mm]	width [mm]	Front	Rear	Front	Rear
		5100	2200	2600	600	-	-	-	-	-

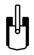
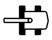
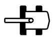
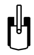
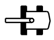
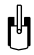
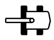
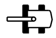
B

A



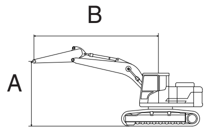
·  : Rating over-front

·  : 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									*3790	*3790	4.35
(24.6 ft)	lb									*8360	*8360	(14.3)
6.0 m	kg									*3140	*3140	5.90
(19.7 ft)	lb									*6920	*6920	(19.4)
4.5 m	kg			*5320	5180	*4740	3320			*2940	2710	6.77
(14.8 ft)	lb			*11730	11420	*10450	7320			*6480	5970	(22.2)
3.0 m	kg			*6530	4860	5160	3200			*2930	2390	7.23
(9.8 ft)	lb			*14400	10710	11380	7050			*6460	5270	(23.7)
1.5 m	kg			*7690	4550	5010	3060			*3070	2280	7.36
(4.9 ft)	lb			*16950	10030	11050	6750			*6770	5030	(24.1)
0.0 m	kg	*3900	*3900	7570	4380	4900	2960			*3410	2340	7.16
(0.0 ft)	lb	*8600	*8600	16690	9660	10800	6530			*7520	5160	(23.5)
-1.5 m	kg	*9210	8060	7530	4350	4880	2940			*4080	2600	6.62
(-4.9 ft)	lb	*20300	17770	16600	9590	10760	6480			*8990	5730	(21.7)
-3.0 m	kg	*9400	8230	*6720	4430					*4890	3310	5.62
(-9.8 ft)	lb	*20720	18140	*14820	9770					*10780	7300	(18.5)

Model	Type	Boom	Arm	Counterweight	Shoe	Wheel	Dozer		Outtriger	
HX160 L	MONO BOOM	Length [mm]	Length [mm]	weight [kg]	width [mm]	width [mm]	Front	Rear	Front	Rear
		5100	3100	2600	600	-	-	-	-	-

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



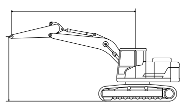
Lift-point height (A)		Lift-point radius (B)										At max. reach		
		1.5 m (4.9 ft)		3.0 m (9.8 ft)		4.5 m (14.8 ft)		6.0 m (19.7 ft)		7.5 m (24.6 ft)		Capacity		Reach
														m (ft)
7.5 m	kg											*2690	*2690	5.51
(24.6 ft)	lb											*5930	*5930	(18.1)
6.0 m	kg							*3680	3470			*2410	*2410	6.79
(19.7 ft)	lb							*8110	7650			*5310	*5310	(22.3)
4.5 m	kg							*4040	3400	*2550	2340	*2330	2300	7.56
(14.8 ft)	lb							*8910	7500	*5620	5160	*5140	5070	(24.8)
3.0 m	kg			*7980	*7980	*5570	5020	*4610	3260	3680	2290	*2370	2060	7.97
(9.8 ft)	lb			*17590	*17590	*12280	11070	*10160	7190	8110	5050	*5220	4540	(26.2)
1.5 m	kg			*6730	*6730	*6970	4660	5050	3090	3600	2210	*2520	1970	8.09
(4.9 ft)	lb			*14840	*14840	*15370	10270	11130	6810	7940	4870	*5560	4340	(26.5)
0.0 m	kg			*6140	*6140	7610	4400	4890	2950	3530	2150	*2810	1990	7.91
(0.0 ft)	lb			*13540	*13540	16780	9700	10780	6500	7780	4740	*6190	4390	(25.9)
-1.5 m	kg	*4780	*4780	*8740	7920	7480	4290	4810	2880			*3360	2160	7.42
(-4.9 ft)	lb	*10540	*10540	*19270	17460	16490	9460	10600	6350			*7410	4760	(24.3)
-3.0 m	kg	*8060	*8060	*11010	8010	7490	4310	4830	2900			4270	2580	6.56
(-9.8 ft)	lb	*17770	*17770	*24270	17660	16510	9500	10650	6390			9410	5690	(21.5)
-4.5 m	kg			*8340	8260	*5690	4450					*4680	3750	5.11
(-14.8 ft)	lb			*18390	18210	*12540	9810					*10320	8270	(16.8)

Model	Type	Boom	Arm	Counterweight	Shoe	Wheel	Dozer		Outtriger	
HX160 L	2-PIECE BOOM	Length [mm]	Length [mm]	weight [kg]	width [mm]	width [mm]	Front	Rear	Front	Rear
		5100	2200	3250	600	-	-	-	-	-

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

B

A



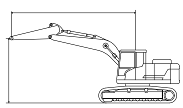
Lift-point height (A)		Lift-point radius (B)						At max. reach		
		3.0 m (9.8 ft)		4.5 m (14.8 ft)		6.0 m (19.7 ft)		Capacity		Reach
										m (ft)
7.5 m	kg							*4040	*4040	4.46
(24.6 ft)	lb							*8910	*8910	(14.6)
6.0 m	kg			*4490	*4490			*3260	*3260	5.98
(19.7 ft)	lb			*9900	*9900			*7190	*7190	(19.6)
4.5 m	kg			*5090	*5090	*4540	3630	*2980	2910	6.84
(14.8 ft)	lb			*11220	*11220	*10010	8000	*6570	6420	(22.5)
3.0 m	kg			*6250	5310	*4980	3500	*2910	2580	7.30
(9.8 ft)	lb			*13780	11710	*10980	7720	*6420	5690	(23.9)
1.5 m	kg			*7410	4970	5440	3350	*3000	2480	7.42
(4.9 ft)	lb			*16340	10960	11990	7390	*6610	5470	(24.3)
0.0 m	kg			*7990	4790	5330	3250	*3240	2540	7.23
(0.0 ft)	lb			*17610	10560	11750	7170	*7140	5600	(23.7)
-1.5 m	kg	*8220	*8220	*7850	4770	5310	3240	*3760	2830	6.69
(-4.9 ft)	lb	*18120	*18120	*17310	10520	11710	7140	*8290	6240	(21.9)

Model	Type	Boom	Arm	Counterweight	Shoe	Wheel	Dozer		Outtriger	
HX160 L	2-PIECE BOOM	Length [mm]	Length [mm]	weight [kg]	width [mm]	width [mm]	Front	Rear	Front	Rear
		5100	2600	3250	600	-	-	-	-	-

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

B

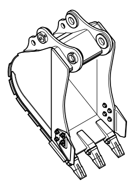
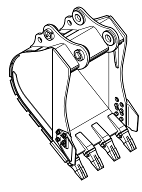
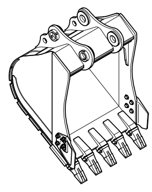
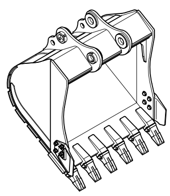
A



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)
7.5 m	kg			*4310	*4310					*3560	*3560	5.00
(24.6 ft)	lb			*9500	*9500					*7850	*7850	(16.4)
6.0 m	kg					*4130	3740			*3040	*3040	6.39
(19.7 ft)	lb					*9110	8250			*6700	*6700	(21.0)
4.5 m	kg			*4680	*4680	*4250	3690			*2860	2720	7.20
(14.8 ft)	lb			*10320	*10320	*9370	8140			*6310	6000	(23.6)
3.0 m	kg			*5880	5400	*4750	3540	*3650	2510	*2840	2440	7.63
(9.8 ft)	lb			*12960	11900	*10470	7800	*8050	5530	*6260	5380	(25.0)
1.5 m	kg			*7140	5040	*5340	3380	3930	2450	*2960	2330	7.75
(4.9 ft)	lb			*15740	11110	*11770	7450	8660	5400	*6530	5140	(25.4)
0.0 m	kg			*7900	4830	5340	3260	*3830	2410	*3240	2380	7.56
(0.0 ft)	lb			*17420	10650	11770	7190	*8440	5310	*7140	5250	(24.8)
-1.5 m	kg	*8270	*8270	*7970	4760	5290	3220			*3790	2620	7.05
(-4.9 ft)	lb	*18230	*18230	*17570	10490	11660	7100			*8360	5780	(23.1)
-3.0 m	kg			*7220	4830							
(-9.8 ft)	lb			*15920	10650							

6. BUCKET SELECTION GUIDE

1) GENERAL AND HEAVY DUTY BUCKET

			
0.39 m^3 SAE heaped bucket	0.50 m^3 SAE heaped bucket	0.64, ※0.70, 0.76 m^3 SAE heaped bucket	0.89, 1.05 m^3 SAE heaped bucket

Capacity		Width		Weight	Recommendation				
					5.1 m (16' 9") Mono boom			5.1 m (16' 9") Hyd adjustable boom	
SAE heaped	CECE heaped	Without side cutter	With side cutter		2.2 m arm (7' 3")	2.6 m arm (8' 6")	3.1 m arm (10' 2")	2.2 m arm (7' 3")	2.6 m arm (8' 6")
0.39 m^3 (0.51 yd^3)	0.34 m^3 (0.44 yd^3)	620 mm (24.4")	740 mm (29.1")	410 kg (900 lb)	○	○	○	○	○
0.50 m^3 (0.65 yd^3)	0.44 m^3 (0.58 yd^3)	760 mm (29.9")	880 mm (34.6")	470 kg (1040 lb)	○	○	○	○	○
0.64 m^3 (0.84 yd^3)	0.55 m^3 (0.72 yd^3)	920 mm (36.2")	1040 mm (40.9")	510 kg (1120 lb)	○	○	⊙	○	⊙
※0.70 m^3 (0.92 yd^3)	0.60 m^3 (0.78 yd^3)	990 mm (39.0")	1110 mm (43.7")	600 kg (1320 lb)	○	⊙	●	⊙	●
0.76 m^3 (0.99 yd^3)	0.65 m^3 (0.35 yd^3)	1060 mm (41.7")	1180 mm (46.5")	620 kg (1370 lb)	⊙	●		⊙	●
0.89 m^3 (1.16 yd^3)	0.77 m^3 (1.01 yd^3)	1220 mm (48.0")	1340 mm (52.8")	610 kg (1340 lb)	⊙	●		●	
1.05 m^3 (1.37 yd^3)	0.90 m^3 (1.18 yd^3)	1400 mm (55.1")	1520 mm (59.8")	680 kg (1500 lb)	●			●	

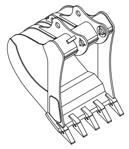
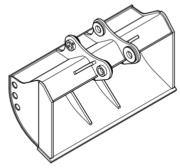
※ : Standard bucket

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

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

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

2) HEAVY DUTY BUCKET

	
◈ 0.69, 0.72, 0.87 m^3 SAE heaped bucket	⊙ 0.75 m^3 SAE heaped bucket

Capacity		Width		Weight	Recommendation				
					5.1 m (16' 9") Mono boom			5.1 m (16' 9") Hyd adjustable boom	
SAE heaped	CECE heaped	Without side cutter	With side cutter		2.2 m arm (7' 3")	2.6 m arm (8' 6")	3.1 m arm (10' 2")	2.2 m arm (7' 3")	2.6 m arm (8' 6")
◈0.69 m^3 (0.90 yd^3)	0.62 m^3 (0.81 yd^3)	990 mm (39.0")	-	720 kg (1590 lb)	○	⊙	●	⊙	●
◈0.72 m^3 (0.94 yd^3)	0.65 m^3 (0.85 yd^3)	940 mm (37.0")	985 mm (38.8")	640 kg (1410 lb)	○	⊙	●	⊙	●
⊙0.75 m^3 (0.98 yd^3)	0.65 m^3 (0.85 yd^3)	1820 mm (71.7")	-	540 kg (1190 lb)	○	⊙	●	○	⊙
◈0.87 m^3 (1.18 yd^3)	0.78 m^3 (1.02 yd^3)	1090 mm (42.9")	1140 mm (44.9")	680 kg (1500 lb)	⊙	●		●	

◈ : Heavy duty bucket

⊙ : Ditch cleaning bucket

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

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

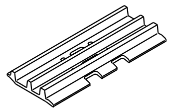
● Applicable for materials with density of 1100 kg/m^3 (1850 lb/yd^3) or less

7. UNDERCARRIAGE

1) TRACKS

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

2) TYPES OF SHOES

Model	Shapes		Triple grouser		
					
HX160 L	Shoe width	mm (in)	500 (20)	※600 (24)	700 (28)
	Operating weight	kg (lb)	17855 (39360)	18100 (39900)	18345 (40440)
	Ground pressure	kgf/cm^2 (psi)	0.52 (7.39)	0.44 (6.26)	0.38 (5.40)
	Overall width	mm (ft-in)	2490 (8' 2")	2590 (8' 6")	2690 (8' 10")
HX160 L (with dozer)	Shoe width	mm (in)	500 (20)	※600 (24)	700 (28)
	Operating weight	kg (lb)	18655 (41130)	18900 (41670)	19145 (42210)
	Ground pressure	kgf/cm^2 (psi)	0.55 (7.82)	0.46 (6.54)	0.40 (5.69)
	Overall width	mm (ft-in)	2490 (8' 2")	2590 (8' 6")	2690 (8' 10")

※ : Standard

3) NUMBER OF ROLLERS AND SHOES ON EACH SIDE

Item	Quantity
Carrier rollers	2 EA
Track rollers	7 EA
Track shoes	49 EA

4) SELECTION OF TRACK SHOE

Suitable track shoes should be selected according to operating conditions.

Method of selecting shoes

Confirm the category from the list of applications in **table 2**, then use **table 1** to select the shoe. Wide shoes (categories B) 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
500 mm triple grouser	Option	A
700 mm triple grouser	Option	B

※ Table 2

Category	Applications	Applications
A	Rocky ground, river beds, normal soil	· Travel at low speed on rough ground with large obstacles such as boulders or fallen trees
B	Normal soil, soft ground	· These shoes cannot be used on rough ground with large obstacles such as boulders or fallen trees · Travel at high speed only on flat ground · Travel slowly at low speed if it is impossible to avoid going over obstacles

8. SPECIFICATIONS FOR MAJOR COMPONENTS

1) ENGINE

Item	Specification
Model	Perkins 1204F
Type	4-cycle turbocharged charge air cooled diesel engine
Cooling method	Water cooling
Number of cylinders and arrangement	4 cylinders, in-line
Firing order	1-3-4-2
Combustion chamber type	Direct injection type
Cylinder bore × stroke	105 × 127 mm (4.1" × 5.0")
Piston displacement	4400 cc (268.5 cu in)
Compression ratio	16.5 : 1
Roted net horse power (SAE J1349)	128Hp (96 kW) at 2050 rpm
Rated gross horse power (SAE J1995)	137Hp (102.1 kW) at 2050 rpm
Maximum torque	57.1 kgf · m (413 lbf · ft) at 1400 rpm
Engine oil quantity	10.5 ℓ (2.8 U.S. gal)
Dry weight	589 kg (1300 lb)
High idling speed	2100 ± 50 rpm
Low idling speed	800 ± 100 rpm
Rated fuel consumption	164 g/Hp · hr at 2050 rpm
Starting motor	24 V-4.5 kW
Alternator	24 V-100 A
Battery	2 × 12 V × 100 Ah

2) MAIN PUMP

Item	Specification
Type	Variable displacement tandem axis piston pumps
Capacity	2 × 80 cc/rev
Maximum pressure	350 kgf/cm^2 (4980 psi) [380 kgf/cm^2 (5400 psi)]
Rated oil flow	2 × 164 ℓ/min (43.3 U.S. gpm / 36.1 U.K. gpm)
Maximum speed	2100 rpm

[ ] : Power boost

3) GEAR PUMP

Item	Specification
Type	Fixed displacement gear pump single stage
Capacity	15cc/rev
Maximum pressure	40 kgf/cm^2 (570 psi)
Rated oil flow	31.5 l/min (8.3 U.S. gpm / 6.9 U.K. gpm)

4) MAIN CONTROL VALVE

Item	Specification
Type	11 spools two-block
Operating method	Hydraulic pilot system
Main relief valve pressure	350 kgf/cm^2 (4980 psi) [380 kgf/cm^2 (5400 psi)]
Overload relief valve pressure	400 kgf/cm^2 (5690 psi)

[ ] : Power boost

5) SWING MOTOR

Item	Specification
Type	Axial pistons motor
Capacity	142.8 cc/rev
Relief pressure	285 kgf/cm^2 (4053 psi)
Braking system	Automatic, spring applied hydraulic released
Braking torque	66.5 kgf · m (481 lbf · ft)
Brake release pressure	22.3~36.6 kgf/cm^2 (317~521 psi)
Reduction gear type	2 - stage planetary

6) TRAVEL MOTOR

Item	Specification
Type	Two speed axial pistons motor with brake valve and parking brake
Relief pressure	350 kgf/cm^2 (4980 psi)
Reduction gear type	Planetary & differential type
Braking system	Automatic, spring applied hydraulic released
Brake release pressure	11 kgf/cm^2 (156 psi)
Braking torque	49.3 kgf · m (357 lbf · ft)

7) CYLINDER

Item		Specification
Boom cylinder	Bore dia × Rod dia × Stroke	ø 115 × ø 80 × 1090 mm
	Cushion	Extend only
Arm cylinder	Bore dia × Rod dia × Stroke	ø 120 × ø 85 × 1355 mm
	Cushion	Extend and retract
Bucket cylinder	Bore dia × Rod dia × Stroke	ø 110 × ø 75 × 995 mm
	Cushion	Extend only
Adjust cylinder(opt)	Bore dia × Rod dia × Stroke	ø 160 × ø 85 × 650 mm
	-	-
Adjust boom cylinder(opt)	Bore dia × Rod dia × Stroke	ø 115 × ø 80 × 960 mm
	-	-
Dozer cylinder(opt)	Bore dia × Rod dia × Stroke	ø 110 × ø 85 × 320 mm
	-	-

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

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

8) SHOE

Item		Width	Ground pressure	Link quantity	Overall width
HX160 L	Option	500 mm (20")	0.52 kgf/cm^2 (7.39 psi)	49	2490 mm (8' 2")
	Standard	600 mm (24")	0.44 kgf/cm^2 (6.26 psi)	49	2590 mm (8' 6")
	Option	700 mm (28")	0.38 kgf/cm^2 (5.40 psi)	49	2690 mm (8' 10")

9) BUCKET

Item	Capacity		Tooth quantity	Width	
	SAE heaped	CECE heaped		Without side cutter	With side cutter
HX160 L	0.39 m^3 (0.51 yd^3)	0.34 m^3 (0.44 yd^3)	3	620 mm (24.4")	740 mm (29.1")
	0.50 m^3 (0.65 yd^3)	0.44 m^3 (0.58 yd^3)	4	760 mm (29.9")	880 mm (34.6")
	0.64 m^3 (0.84 yd^3)	0.55 m^3 (0.72 yd^3)	5	920 mm (36.2")	1040 mm (40.9")
	0.70 m^3 (0.92 yd^3)	0.60 m^3 (0.78 yd^3)	5	990 mm (39.0")	1110 mm (43.7")
	0.76 m^3 (0.99 yd^3)	0.65 m^3 (0.85 yd^3)	5	1060 mm (41.7")	1180 mm (46.5")
	0.89 m^3 (1.16 yd^3)	0.77 m^3 (1.01 yd^3)	6	1220 mm (48.0")	1340 mm (52.8")
	1.05 m^3 (1.37 yd^3)	0.90 m^3 (1.18 yd^3)	6	1400 mm (55.1")	1520 mm (59.8")
	◈0.69 m^3 (0.90 yd^3)	0.62 m^3 (0.81 yd^3)	5	990 mm (39.0")	-
	★0.75 m^3 (0.98 yd^3)	0.65 m^3 (0.85 yd^3)	-	1820 mm (71.7")	-

◈ : Heavy duty bucket

★ : Ditch cleaning bucket

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	10.5 (2.8)	★SAE 5W-40 SAE 30 SAE 10W SAE 10W-30 SAE 15W-40
DEF/ AdBlue® Tank	Mixture of urea and deionized water	19.0 (5.0)	ISO 22241, High-purity urea + deionized water (32.5:67.5)
Swing drive	Gear oil	TYPE 1 : 5.0 (1.32) TYPE 2 : 6.2 (1.64)	★SAE 75W-90 SAE 80W-90
Final drive		5.8×2 (1.5×2)	
Hydraulic tank	Hydraulic oil	Tank : 125 (33.0) System : 240 (63.4)	★ISO VG 15 ISO VG 32 ISO VG 46, HBHO VG 46★3 ISO VG 68
Fuel tank	Diesel fuel★1	290 (76.6)	★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★2	27.5 (7.3)	Ethylene glycol base permanent type (50 : 50) ★Ethylene glycol base permanent type (60 : 40)

SAE : Society of Automotive Engineers
API : American Petroleum Institute
ISO : International Organization for Standardization
NLGI : National Lubricating Grease Institute
ASTM : American Society of Testing and Material
UTTO : Universal Tractor Transmission Oil
DEF : Diesel Exhaust Fluid, DEF compatible with AdBlue®

★ : Cold region
Russia, CIS, Mongolia
★1 : Ultra low sulfur diesel
- sulfur content ≤ 15 ppm
★2 : Soft water
City water or distilled water
★3 : HD Hyundai Construction Equipment Bio Hydarulic Oil

※ 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.

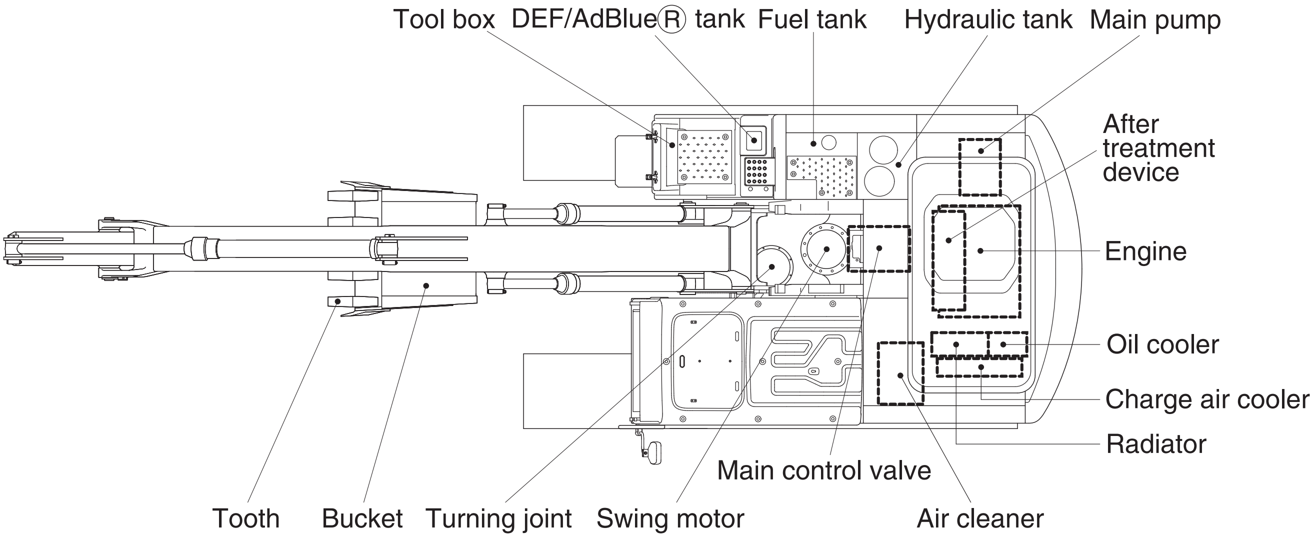
※ Do not mix HD Hyundai Construction Equipment genuine oil with any other lubricating oil as it may result in damage to the systems of major components.

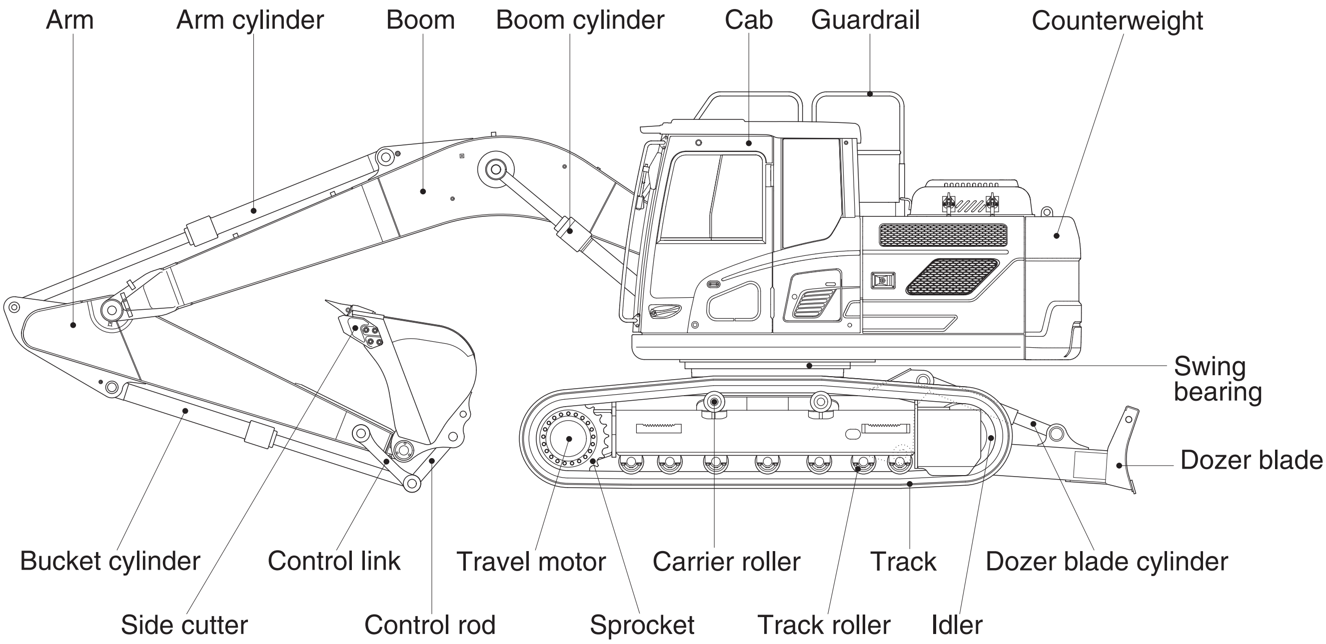
※ Do not use any engine oil other than that specified above, as it may clog the diesel particulate filter(DPF).

※ 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.

GROUP 3 SPECIFICATIONS (HX180 L)

1. MAJOR COMPONENT



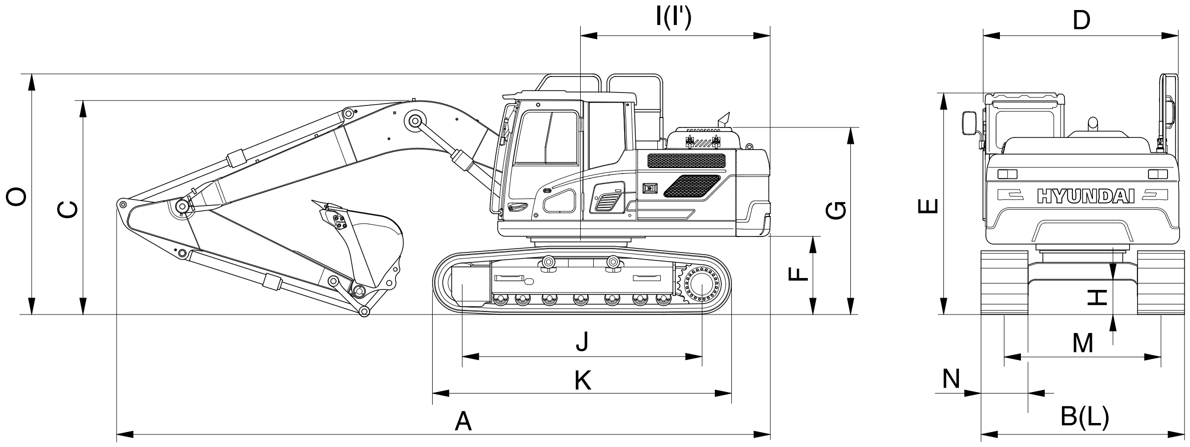


180F2SP01

2. SPECIFICATIONS

1) HX180 L

· 5.1 m (16' 9") BOOM and 2.6 m (8' 6") ARM

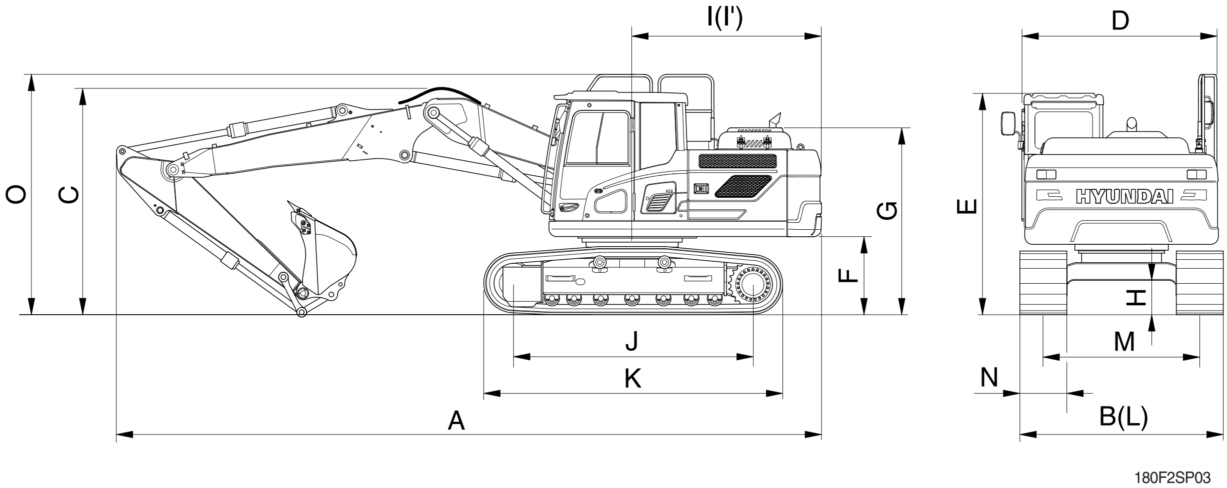


180F2SP02

Description		Unit	Specification
Operating weight		kg (lb)	18800 (41450)
Bucket capacity (SAE heaped), standard		m^3 (yd^3)	0.76 (0.99)
Overall length	A	mm (ft-in)	8650 (28' 5")
Overall width, with 600 mm shoe	B		2850 (9' 4")
Overall height of boom	C		2990 (9' 10")
Superstructure width	D		2475 (8' 1")
Overall height of cab	E		2980 (9' 9")
Ground clearance of counterweight	F		1055 (3' 6")
Engine cover height	G		2525 (8' 3")
Minimum ground clearance	H		460 (1' 6")
Rear-end distance	I		2480 (8' 2")
Rear-end swing radius	I'		2480 (8' 2")
Distance between tumblers	J		3360 (11' 0")
Undercarriage length	K		4116 (13' 6")
Undercarriage width	L		2850 (9' 4")
Track gauge	M		2250 (7' 5")
Track shoe width, standard	N		600 (24")
Overall height of guardrail	O		3220 (10' 6")
Travel speed (low/high)		km/hr (mph)	3.2/5.3 (2.0/3.3)
Swing speed		rpm	10.3
Gradeability		Degree (%)	35 (70)
Ground pressure (600 mm shoe)		kgf/cm^2(psi)	0.43 (6.11)
Max traction force		kg (lb)	17000 (37500)

2) HX180 L

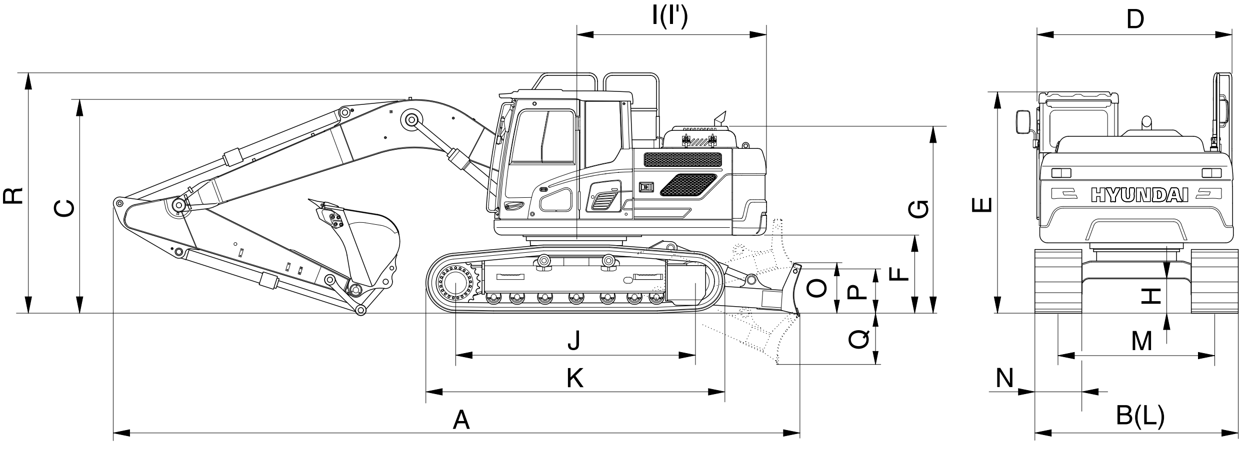
· 5.1 m (16' 9") HYDRAULIC ADJUSTABLE BOOM AND 2.6 m (8' 6") ARM



Description		Unit	Specification
Operating weight		kg (lb)	19700 (43430)
Bucket capacity (SAE heaped), standard		m^3 (yd^3)	0.76 (0.99)
Overall length	A	mm (ft-in)	8610 (28' 3")
Overall width, with 600 mm shoe	B		2850 (9' 4")
Overall height of boom	C		3060 (10' 0")
Superstructure width	D		2475 (8' 1")
Overall height of cab	E		2980 (9' 9")
Ground clearance of counterweight	F		1055 (3' 6")
Engine cover height	G		2525 (8' 3")
Minimum ground clearance	H		460 (1' 6")
Rear-end distance	I		2480 (8' 2")
Rear-end swing radius	I'		2480 (8' 2")
Distance between tumblers	J		3360 (11' 0")
Undercarriage length	K		4116 (13' 6")
Undercarriage width	L		2850 (9' 4")
Track gauge	M		2250 (7' 5")
Track shoe width, standard	N		600 (24")
Overall height of guardrail	O		3220 (10' 6")
Travel speed (low/high)		km/hr (mph)	3.2/5.3 (2.0/3.3)
Swing speed		rpm	10.3
Gradeability		Degree (%)	35 (70)
Ground pressure (600 mm shoe)		kgf/cm^2(psi)	0.45 (6.40)
Max traction force		kg (lb)	17000 (37500)

3) HX180 L

· 5.1 m (16' 9") BOOM and 2.6 m (8' 6") ARM WITH DOZER

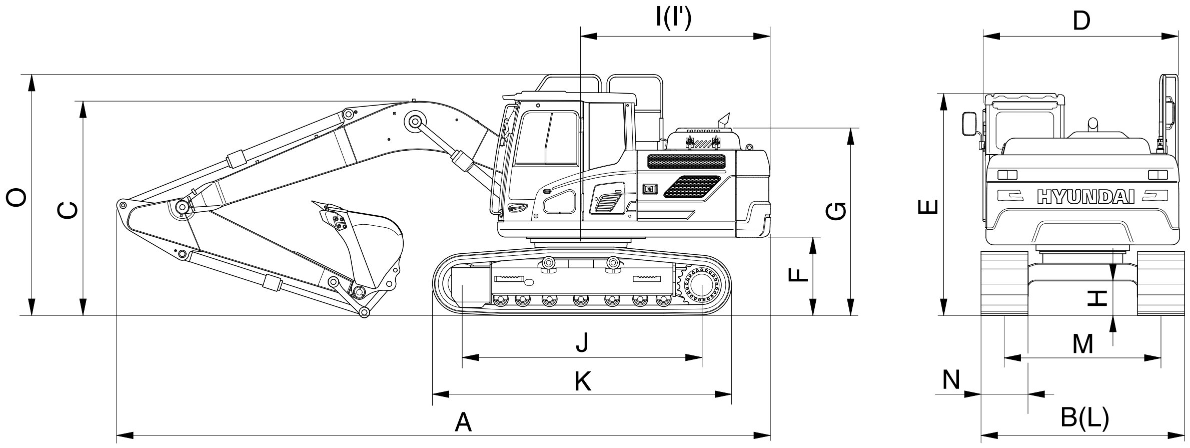


180F2SP04A

Description		Unit	Specification
Operating weight		kg (lb)	19700 (43430)
Bucket capacity (SAE heaped), standard		m^3 (yd^3)	0.76 (0.99)
Overall length	A	mm (ft-in)	9100 (29' 10")
Overall width, with 600 mm shoe	B		2850 (9' 4")
Overall height of boom	C		2990 (9' 10")
Superstructure width	D		2475 (8' 1")
Overall height of cab	E		2980 (9' 9")
Ground clearance of counterweight	F		1055 (3' 6")
Engine cover height	G		2525 (8' 3")
Minimum ground clearance	H		460 (1' 6")
Rear-end distance	I		2480 (8' 2")
Rear-end swing radius	I'		2480 (8' 2")
Distance between tumblers	J		3360 (11' 0")
Undercarriage length	K		4116 (13' 6")
Undercarriage width	L		2850 (9' 4")
Track gauge	M		2250 (7' 5")
Track shoe width, standard	N		600 (24")
Height of blade	O		645 (2' 1")
Ground clearance of blade up	P		615 (2' 0")
Depth of blade down	Q		675 (2' 3")
Overall height of guardrail	R		3220 (10' 6")
Travel speed (low/high)		km/hr (mph)	3.2/5.3 (2.0/3.3)
Swing speed		rpm	10.3
Gradeability		Degree (%)	35 (70)
Ground pressure (600 mm shoe)		kgf/cm^2(psi)	0.45 (6.40)
Max traction force		kg (lb)	17000 (37500)

4) HX180 NL

· 5.1 m (16' 9") BOOM and 2.6 m (8' 6") ARM

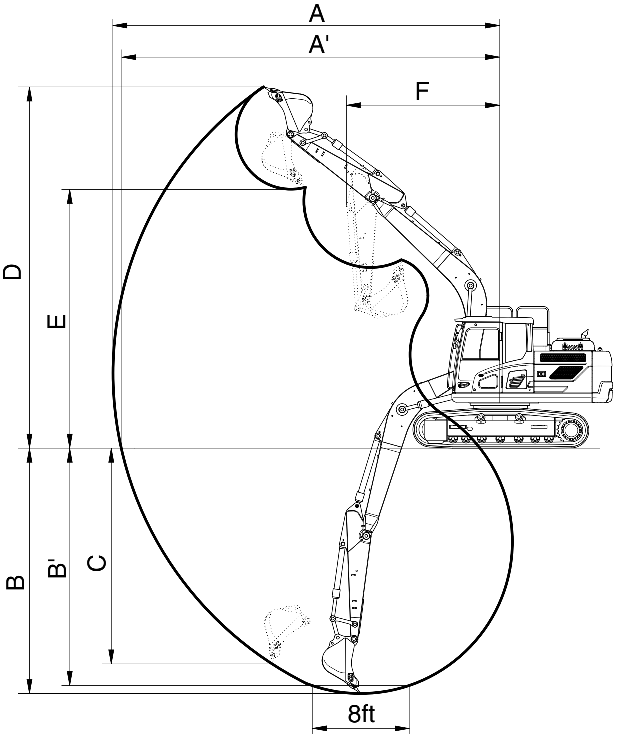


180F2SP02

Description		Unit	Specification
Operating weight		kg (lb)	18700 (41230)
Bucket capacity (SAE heaped), standard		m^3 (yd^3)	0.76 (0.99)
Overall length	A	mm (ft-in)	8650 (28' 5")
Overall width, with 600 mm shoe	B		2600 (8' 6")
Overall height of boom	C		2990 (9' 10")
Superstructure width	D		2475 (8' 1")
Overall height of cab	E		2980 (9' 9")
Ground clearance of counterweight	F		1055 (3' 6")
Engine cover height	G		2525 (8' 3")
Minimum ground clearance	H		460 (1' 6")
Rear-end distance	I		2480 (8' 2")
Rear-end swing radius	I'		2480 (8' 2")
Distance between tumblers	J		3360 (11' 0")
Undercarriage length	K		4116 (13' 6")
Undercarriage width	L		2600 (8' 6")
Track gauge	M		2000 (6' 7")
Track shoe width, standard	N		600 (24")
Overall height of guardrail	O		3220 (10' 6")
Travel speed (low/high)		km/hr (mph)	3.2/5.3 (2.0/3.3)
Swing speed		rpm	10.3
Gradeability		Degree (%)	35 (70)
Ground pressure (600 mm shoe)		kgf/cm^2(psi)	0.43 (6.11)
Max traction force		kg (lb)	17000 (37500)

3. WORKING RANGE

1) 5.1 m (16' 9") MONO BOOM

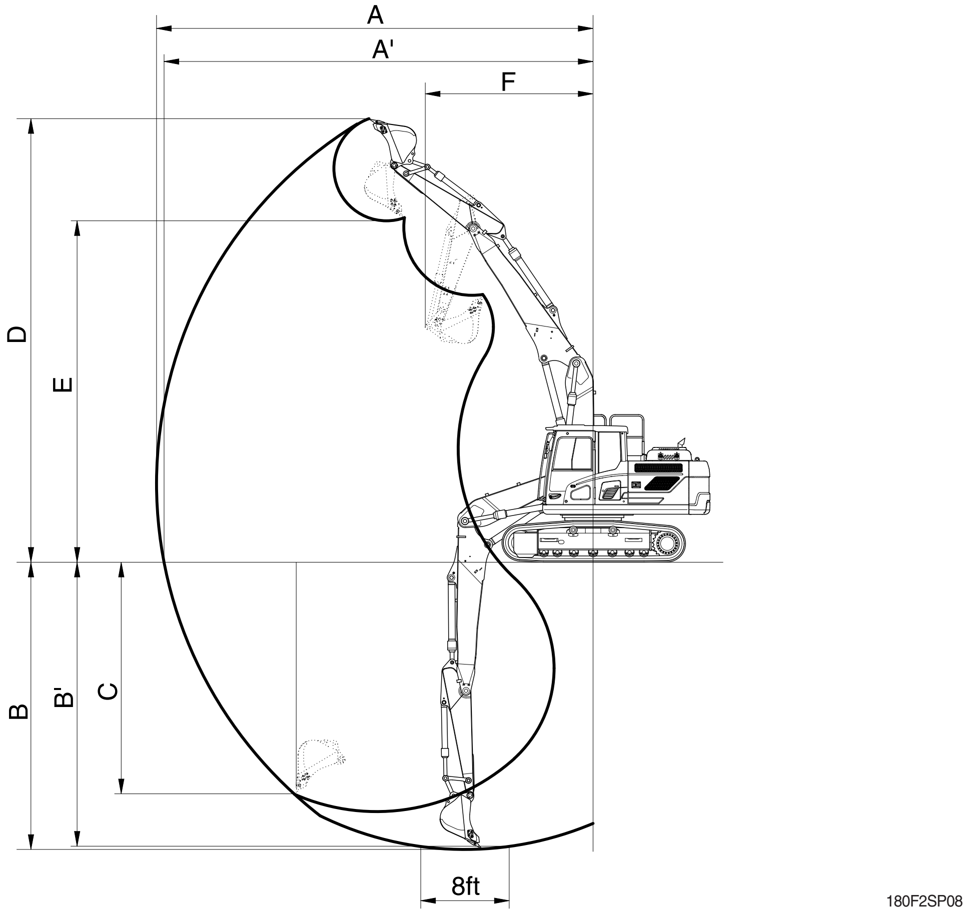


180F2SP06

Description		2.2 m (7' 3") Arm	2.6 m (8' 6") Arm	3.1 m (10' 2") Arm
Max digging reach	A	8690 mm (28' 6")	9020 mm (29' 7")	9450 mm (31' 0")
Max digging reach on ground	A'	8530 mm (27'12")	8860 mm (29' 1")	9300 mm (30' 6")
Max digging depth	B	5660 mm (18' 7")	6060 mm (19'11")	6560 mm (21' 6")
Max digging depth (8ft level)	B'	5430 mm (17'10")	5850 mm (19' 2")	6370 mm (20'11")
Max vertical wall digging depth	C	5120 mm (16'10")	5380 mm (17' 8")	5710 mm (18' 9")
Max digging height	D	8750 mm (28' 8")	8840 mm (29' 0")	8980 mm (29' 6")
Max dumping height	E	6110 mm (20' 1")	6220 mm (20' 5")	6390 mm (21' 0")
Min swing radius	F	3180 mm (10' 5")	3170 mm (10' 5")	3170 mm (10' 5")
Bucket digging force	SAE	107.9 [117.2] kN	107.9 [117.2] kN	107.9 [117.2] kN
		11000 [11940] kgf	11000 [11940] kgf	11000 [11940] kgf
		24250 [26330] lbf	24250 [23660] lbf	24250 [26330] lbf
	ISO	123.6 [134.2] kN	123.6 [134.2] kN	123.6 [134.2] kN
		12600 [13680] kgf	12600 [13680] kgf	12600 [13680] kgf
		27780 [30160] lbf	27780 [30160] lbf	27780 [30160] lbf
Arm crowd force	SAE	87.2 [94.7] kN	77.3 [83.9] kN	69.0 [74.9] kN
		8890 [9650] kgf	7880 [8560] kgf	7030 [7630] kgf
		19600 [21280] lbf	17370 [18860] lbf	15500 [16830] lbf
	ISO	91.0 [98.8] kN	80.3 [87.2] kN	71.4 [77.5] kN
		9280 [10080] kgf	8190 [8890] kgf	7280 [7900] kgf
		20460 [22210] lbf	18060 [19600] lbf	16050 [17430] lbf

[ ] : Power boost

2) 5.1 m (16' 9") HYDRAULIC ADJUSTABLE BOOM



Description		2.2 m (7' 3") Arm	2.6 m (8' 6") Arm
Max digging reach	A	8760 mm (28' 9")	9110 mm (29'11")
Max digging reach on ground	A'	8590 mm (28' 2")	8950 mm (29' 4")
Max digging depth	B	5430 mm (17' 10")	5830 mm (19' 2")
Max digging depth (8ft level)	B'	5330 mm (17' 6")	5730 mm (18'10")
Max vertical wall digging depth	C	4630 mm (15' 2")	4980 mm (16' 4")
Max digging height	D	9420 mm (30' 11")	9610 mm (31' 6")
Max dumping height	E	6710 mm (22' 0")	6910 mm (22' 8")
Min swing radius	F	3100 mm (10' 2")	2970 mm (9' 9")
Bucket digging force	SAE	107.9 [117.2] kN	107.9 [117.2] kN
		11000 [11940] kgf	11000 [11940] kgf
		24250 [26330] lbf	24250 [26330] lbf
	ISO	123.6 [134.2] kN	123.6 [134.2] kN
		12600 [13680] kgf	12600 [13680] kgf
		27780 [30160] lbf	27780 [30160] lbf
Arm crowd force	SAE	87.2 [94.7] kN	77.3 [83.9] kN
		8890 [9650] kgf	7880 [8560] kgf
		19600 [21280] lbf	17370 [18860] lbf
	ISO	91.0 [98.8] kN	80.3 [87.2] kN
		9280 [10080] kgf	8190 [8890] kgf
		20460 [22210] lbf	18060 [19600] lbf

[ ] : Power boost

4. WEIGHT

Item	HX180 L		HX180 L (with dozer)		HX180 NL	
	kg	lb	kg	lb	kg	lb
Upper structure assembly						
· Main frame weld assembly	1440	3170	←		←	
· Engine assembly	589	1300	←		←	
· Fan clutch assembly	45	100	←		←	
· Main pump assembly	89	200	←		←	
· Main control valve assembly	140	310	←		←	
· Swing motor assembly	250	550	←		←	
· Hydraulic oil tank assembly	150	330	←		←	
· Fuel tank assembly	130	290	←		←	
· Counterweight	2900	6390	←		←	
· Cab assembly	500	1100	←		←	
Lower chassis assembly						
· Track frame weld assembly	2130	4700	2370	5230	1980	4370
· Swing bearing	260	570	←		←	
· Travel motor assembly	300	660	←		←	
· Turning joint	60	130	←		←	
· Track recoil spring	132	290	←		←	
· Idler	151	330	←		←	
· Sprocket	54.4	120	←		←	
· Carrier roller	20	45	←		←	
· Track roller	40	90	←		←	
· Track-chain assembly (600 mm standard triple grouser shoe)	1230	2710	←		←	
Front attachment assembly						
· 5.1 m boom assembly	1060	2340	←		←	
· 2.6 m arm assembly	540	1190	←		←	
· 0.76 m^3 SAE heaped bucket	620	1370	←		←	
· Boom cylinder assembly	155	340	←		←	
· Arm cylinder assembly	180	400	←		←	
· Bucket cylinder assembly	125	260	←		←	
· Bucket control link assembly	120	265	←		←	
· Dozer blade assembly	-	-	715	1575	-	-
· Dozer blade cylinder assembly	-	-	66	146	-	-

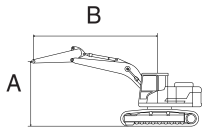
※ This information is different with operating and transportation weight because it is not including harness, pipe, oil, fuel so on.

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

5. LIFTING CAPACITIES

Model	Type	Boom	Arm	Counterweight	Shoe	Wheel	Dozer		Outrigger	
HX180 L	MONO BOOM	Length [mm]	Length [mm]	weight [kg]	width [mm]	width [mm]	Front	Rear	Front	Rear
		5100	2600	2900	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)		Capacity		Reach
														m (ft)
7.5 m	kg											*3400	*3400	4.85
(24.6 ft)	lb											*7500	*7500	(15.9)
6.0 m	kg							*3830	*3830			*2960	*2960	6.27
(19.7 ft)	lb							*8440	*8440			*6530	*6530	(20.6)
4.5 m	kg					*4890	*4890	*4450	4170			*2840	*2840	7.10
(14.8 ft)	lb					*10780	*10780	*9810	9190			*6260	*6260	(23.3)
3.0 m	kg			*9410	*9410	*6140	*6140	*4960	4030	*3100	2870	*2870	2850	7.54
(9.8 ft)	lb			*20750	*20750	*13540	*13540	*10930	8880	*6830	6330	*6330	6280	(24.7)
1.5 m	kg					*7420	5830	*5550	3880	*4030	2820	*3050	2730	7.66
(4.9 ft)	lb					*16360	12850	*12240	8550	*8880	6220	*6720	6020	(25.1)
0.0 m	kg			*5280	*5280	*8120	5610	5790	3760			*3420	2790	7.47
(0.0 ft)	lb			*11640	*11640	*17900	12370	12760	8290			*7540	6150	(24.5)
-1.5 m	kg	*5070	*5070	*9170	*9170	*8060	5550	5740	3720			*4130	3060	6.95
(-4.9 ft)	lb	*11180	*11180	*20220	*20220	*17770	12240	12650	8200			*9110	6750	(22.8)
-3.0 m	kg	*9350	*9350	*10230	*10230	*7160	5600	*4940	3780			*4920	3770	6.01
(-9.8 ft)	lb	*20610	*20610	*22550	*22550	*15790	12350	*10890	8330			*10850	8310	(19.7)
-4.5 m	kg			*6920	*6920							*4590	*4590	4.39
(-14.8 ft)	lb			*15260	*15260							*10120	*10120	(14.4)

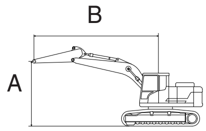
Note 1. Lifting capacity are based on ISO 10567.
2. Lifting capacity of the HX series does not exceed 75% of tipping load with the machine on firm, level ground or 87% of full hydraulic capacity.
3. The Lift-point is bucket pivot mounting pin on the arm (without bucket mass).
4. *Indicates load limited 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		Outrigger	
HX180 L	MONO BOOM	Length [mm]	Length [mm]	weight [kg]	width [mm]	width [mm]	Front	Rear	Front	Rear
		5100	2200	2900	600	-	-	-	-	-

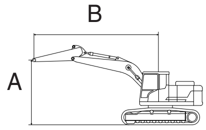
· : Rating over-front · : Rating over-side or 360 degree



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)		Capacity		Reach
										m (ft)
7.5 m	kg							*3790	*3790	4.35
(24.6 ft)	lb							*8360	*8360	(14.3)
6.0 m	kg							*3140	*3140	5.90
(19.7 ft)	lb							*6920	*6920	(19.4)
4.5 m	kg			*5320	*5320	*4740	4120	*2940	*2940	6.77
(14.8 ft)	lb			*11730	*11730	*10450	9080	*6480	*6480	(22.2)
3.0 m	kg			*6530	6080	*5190	3990	*2930	*2930	7.23
(9.8 ft)	lb			*14400	13400	*11440	8800	*6460	*6460	(23.7)
1.5 m	kg			*7690	5750	*5700	3850	*3070	2880	7.36
(4.9 ft)	lb			*16950	12680	*12570	8490	*6770	6350	(24.1)
0.0 m	kg	*3900	*3900	*8180	5580	5770	3750	*3410	2960	7.16
(0.0 ft)	lb	*8600	*8600	*18030	12300	12720	8270	*7520	6530	(23.5)
-1.5 m	kg	*9210	*9210	*7910	5550	5750	3730	*4080	3290	6.62
(-4.9 ft)	lb	*20300	*20300	*17440	12240	12680	8220	*8990	7250	(21.7)
-3.0 m	kg	*9400	*9400	*6720	5640			*4890	4170	5.62
(-9.8 ft)	lb	*20720	*20720	*14820	12430			*10780	9190	(18.5)

Model	Type	Boom	Arm	Counterweight	Shoe	Wheel	Dozer		Outrigger	
HX180 L	MONO BOOM	Length [mm]	Length [mm]	weight [kg]	width [mm]	width [mm]	Front	Rear	Front	Rear
		5100	3100	2900	600	-	-	-	-	-

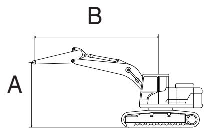
· : Rating over-front · : Rating over-side or 360 degree



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)		Capacity		Reach
														m (ft)
7.5 m	kg											*2690	*2690	5.51
(24.6 ft)	lb											*5930	*5930	(18.1)
6.0 m	kg							*3680	*3680			*2410	*2410	6.79
(19.7 ft)	lb							*8110	*8110			*5310	*5310	(22.3)
4.5 m	kg							*4040	*4040	*2550	*2550	*2330	*2330	7.56
(14.8 ft)	lb							*8910	*8910	*5620	*5620	*5140	*5140	(24.8)
3.0 m	kg			*7980	*7980	*5570	*5570	*4610	4050	*3770	2880	*2370	*2370	7.97
(9.8 ft)	lb			*17590	*17590	*12280	*12280	*10160	8930	*8310	6350	*5220	*5220	(26.2)
1.5 m	kg			*6730	*6730	*6970	5870	*5270	3880	4230	2800	*2520	2500	8.09
(4.9 ft)	lb			*14840	*14840	*15370	12940	*11620	8550	9330	6170	*5560	5510	(26.5)
0.0 m	kg			*6140	*6140	*7890	5610	*5770	3740	4160	2740	*2810	2540	7.91
(0.0 ft)	lb			*13540	*13540	*17390	12370	*12720	8250	9170	6040	*6190	5600	(25.9)
-1.5 m	kg	*4780	*4780	*8740	*8740	*8090	5500	5690	3670			*3360	2750	7.42
(-4.9 ft)	lb	*10540	*10540	*19270	*19270	*17840	12130	12540	8090			*7410	6060	(24.3)
-3.0 m	kg	*8060	*8060	*11010	10490	*7510	5510	*5400	3680			*4500	3280	6.56
(-9.8 ft)	lb	*17770	*17770	*24270	23130	*16560	12150	*11900	8110			*9920	7230	(21.5)
-4.5 m	kg			*8340	*8340	*5690	5660					*4680	*4680	5.11
(-14.8 ft)	lb			*18390	*18390	*12540	12480					*10320	*10320	(16.8)

Model	Type	Boom	Arm	Counterweight	Shoe	Wheel	Dozer		Outrigger	
HX180 L	2-PIECE BOOM	Length [mm]	Length [mm]	weight [kg]	width [mm]	width [mm]	Front	Rear	Front	Rear
		5100	2200	3250	600	-	-	-	-	-

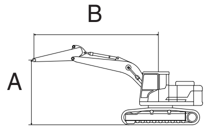
· : Rating over-front · : Rating over-side or 360 degree



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)		Capacity		Reach
										m (ft)
7.5 m	kg							*4040	*4040	4.46
(24.6 ft)	lb							*8910	*8910	(14.6)
6.0 m	kg			*4490	*4490			*3260	*3260	5.98
(19.7 ft)	lb			*9900	*9900			*7190	*7190	(19.6)
4.5 m	kg			*5090	*5090	*4540	4300	*2980	*2980	6.84
(14.8 ft)	lb			*11220	*11220	*10010	9480	*6570	*6570	(22.5)
3.0 m	kg			*6250	*6250	*4980	4160	*2910	*2910	7.30
(9.8 ft)	lb			*13780	*13780	*10980	9170	*6420	*6420	(23.9)
1.5 m	kg			*7410	5990	*5500	4010	*3000	2970	7.42
(4.9 ft)	lb			*16340	13210	*12130	8840	*6610	6550	(24.3)
0.0 m	kg			*7990	5810	*5840	3910	*3240	3050	7.23
(0.0 ft)	lb			*17610	12810	*12870	8620	*7140	6720	(23.7)
-1.5 m	kg	*8220	*8220	*7850	5780	*5730	3890	*3760	3400	6.69
(-4.9 ft)	lb	*18120	*18120	*17310	12740	*12630	8580	*8290	7500	(21.9)

Model	Type	Boom	Arm	Counterweight	Shoe	Wheel	Dozer		Outrigger	
HX180 L	2-PIECE BOOM	Length [mm]	Length [mm]	weight [kg]	width [mm]	width [mm]	Front	Rear	Front	Rear
		5100	2600	3250	600	-	-	-	-	-

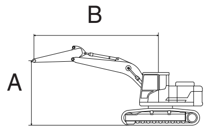
· : Rating over-front · : Rating over-side or 360 degree



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			*4310	*4310					*3560	*3560	5.00
(24.6 ft)	lb			*9500	*9500					*7850	*7850	(16.4)
6.0 m	kg					*4130	*4130			*3040	*3040	6.39
(19.7 ft)	lb					*9110	*9110			*6700	*6700	(21.0)
4.5 m	kg			*4680	*4680	*4250	*4250			*2860	*2860	7.20
(14.8 ft)	lb			*10320	*10320	*9370	*9370			*6310	*6310	(23.6)
3.0 m	kg			*5880	*5880	*4750	4210	*3650	2990	*2840	*2840	7.63
(9.8 ft)	lb			*12960	*12960	*10470	9280	*8050	6590	*6260	*6260	(25.0)
1.5 m	kg			*7140	6070	*5340	4040	4420	2930	*2960	2800	7.75
(4.9 ft)	lb			*15740	13380	*11770	8910	9740	6460	*6530	6170	(25.4)
0.0 m	kg			*7900	5840	*5770	3920	*3830	2890	*3240	2860	7.56
(0.0 ft)	lb			*17420	12870	*12720	8640	*8440	6370	*7140	6310	(24.8)
-1.5 m	kg	*8270	*8270	*7960	5780	*5820	3880			*3790	3140	7.05
(-4.9 ft)	lb	*18230	*18230	*17550	12740	*12830	8550			*8360	6920	(23.1)
-3.0 m	kg			*7220	5850							
(-9.8 ft)	lb			*15920	12900							

Model	Type	Boom	Arm	Counterweight	Shoe	Wheel	Dozer		Outrigger	
HX180 NL	MONO BOOM	Length [mm]	Length [mm]	weight [kg]	width [mm]	width [mm]	Front	Rear	Front	Rear
		5100	2200	2900	600	-	-	-	-	-

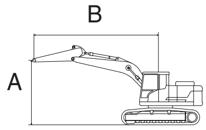
· : Rating over-front · : Rating over-side or 360 degree



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)		Capacity		Reach
										m (ft)
7.5 m	kg							*3790	*3790	4.35
(24.6 ft)	lb							*8360	*8360	(14.3)
6.0 m	kg							*3140	*3140	5.90
(19.7 ft)	lb							*6920	*6920	(19.4)
4.5 m	kg			*5320	*5320	*4740	3500	*2940	2870	6.77
(14.8 ft)	lb			*11730	*11730	*10450	7720	*6480	6330	(22.2)
3.0 m	kg			*6530	5120	*5190	3380	*2930	2540	7.23
(9.8 ft)	lb			*14400	11290	*11440	7450	*6460	5600	(23.7)
1.5 m	kg			*7690	4810	5590	3240	*3070	2420	7.36
(4.9 ft)	lb			*16950	10600	12320	7140	*6770	5340	(24.1)
0.0 m	kg	*3900	*3900	*8180	4640	5480	3140	*3410	2480	7.16
(0.0 ft)	lb	*8600	*8600	*18030	10230	12080	6920	*7520	5470	(23.5)
-1.5 m	kg	*9210	8540	*7910	4610	5460	3120	*4080	2760	6.62
(-4.9 ft)	lb	*20300	18830	*17440	10160	12040	6880	*8990	6080	(21.7)
-3.0 m	kg	*9400	8700	*6720	4700			*4890	3500	5.62
(-9.8 ft)	lb	*20720	19180	*14820	10360			*10780	7720	(18.5)

Model	Type	Boom	Arm	Counterweight	Shoe	Wheel	Dozer		Outrigger	
HX180 NL	MONO BOOM	Length [mm]	Length [mm]	weight [kg]	width [mm]	width [mm]	Front	Rear	Front	Rear
		5100	2600	2900	600	-	-	-	-	-

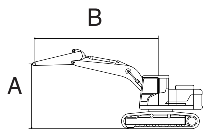
· : Rating over-front · : Rating over-side or 360 degree



Lift-point height (A)		Lift-point radius (B) 1.5 m (4.9 ft) over-front	1.5 m (4.9 ft) over-side	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	At max. reach Capacity over-front	Capacity over-side	Reach m (ft)
7.5 m	kg											*3400	*3400	4.85
(24.6 ft)	lb											*7500	*7500	(15.9)
6.0 m	kg							*3830	3600			*2960	*2960	6.27
(19.7 ft)	lb							*8440	7940			*6530	*6530	(20.6)
4.5 m	kg					*4890	*4890	*4450	3550			*2840	2700	7.10
(14.8 ft)	lb					*10780	*10780	*9810	7830			*6260	5950	(23.3)
3.0 m	kg			*9410	*9410	*6140	5210	*4960	3420	*3100	2420	*2870	2400	7.54
(9.8 ft)	lb			*20750	*20750	*13540	11490	*10930	7540	*6830	5340	*6330	5290	(24.7)
1.5 m	kg					*7420	4880	*5550	3270	4020	2370	*3050	2300	7.66
(4.9 ft)	lb					*16360	10760	*12240	7210	8860	5220	*6720	5070	(25.1)
0.0 m	kg			*5280	*5280	*8120	4670	5490	3160			*3420	2340	7.47
(0.0 ft)	lb			*11640	*11640	*17900	10300	12100	6970			*7540	5160	(24.5)
-1.5 m	kg	*5070	*5070	*9170	8510	*8060	4610	5440	3110			*4130	2570	6.95
(-4.9 ft)	lb	*11180	*11180	*20220	18760	*17770	10160	11990	6860			*9110	5670	(22.8)
-3.0 m	kg	*9350	*9350	*10230	8640	*7160	4660	*4940	3170			*4920	3160	6.01
(-9.8 ft)	lb	*20610	*20610	*22550	19050	*15790	10270	*10890	6990			*10850	6970	(19.7)
-4.5 m	kg			*6920	*6920							*4590	*4590	4.39
(-14.8 ft)	lb			*15260	*15260							*10120	*10120	(14.4)

Model	Type	Boom	Arm	Counterweight	Shoe	Wheel	Dozer		Outrigger	
HX180 NL	MONO BOOM	Length [mm]	Length [mm]	weight [kg]	width [mm]	width [mm]	Front	Rear	Front	Rear
		5100	3100	2900	600	-	-	-	-	-

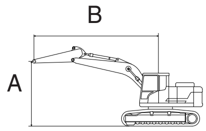
· : Rating over-front · : Rating over-side or 360 degree



Lift-point height (A)		Lift-point radius (B) 1.5 m (4.9 ft) over-front	1.5 m (4.9 ft) over-side	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	At max. reach Capacity over-front	Capacity over-side	Reach m (ft)
7.5 m	kg											*2690	*2690	5.51
(24.6 ft)	lb											*5930	*5930	(18.1)
6.0 m	kg							*3680	3650			*2410	*2410	6.79
(19.7 ft)	lb							*8110	8050			*5310	*5310	(22.3)
4.5 m	kg							*4040	3580	*2550	2480	*2330	*2330	7.56
(14.8 ft)	lb							*8910	7890	*5620	5470	*5140	*5140	(24.8)
3.0 m	kg			*7980	*7980	*5570	5280	*4610	3440	*3770	2430	*2370	2190	7.97
(9.8 ft)	lb			*17590	*17590	*12280	11640	*10160	7580	*8310	5360	*5220	4830	(26.2)
1.5 m	kg			*6730	*6730	*6970	4920	*5270	3270	4010	2350	*2520	2090	8.09
(4.9 ft)	lb			*14840	*14840	*15370	10850	*11620	7210	8840	5180	*5560	4610	(26.5)
0.0 m	kg			*6140	*6140	*7890	4660	5470	3130	3940	2290	*2810	2120	7.91
(0.0 ft)	lb			*13540	*13540	*17390	10270	12060	6900	8690	5050	*6190	4670	(25.9)
-1.5 m	kg	*4780	*4780	*8740	8390	*8090	4560	5390	3060			*3360	2300	7.42
(-4.9 ft)	lb	*10540	*10540	*19270	18500	*17840	10050	11880	6750			*7410	5070	(24.3)
-3.0 m	kg	*8060	*8060	*11010	8490	*7510	4570	*5400	3080			*4500	2750	6.56
(-9.8 ft)	lb	*17770	*17770	*24270	18720	*16560	10080	*11900	6790			*9920	6060	(21.5)
-4.5 m	kg			*8340	*8340	*5690	4710					*4680	3970	5.11
(-14.8 ft)	lb			*18390	*18390	*12540	10380					*10320	8750	(16.8)

Model	Type	Boom	Arm	Counterweight	Shoe	Wheel	Dozer		Outrigger	
HX180 NL	2-PIECE BOOM	Length [mm]	Length [mm]	weight [kg]	width [mm]	width [mm]	Front	Rear	Front	Rear
		5100	2200	3250	600	-	-	-	-	-

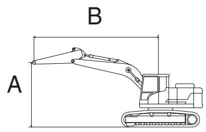
· : Rating over-front · : Rating over-side or 360 degree



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)		Capacity		Reach
										m (ft)
7.5 m	kg							*4040	*4040	4.46
(24.6 ft)	lb							*8910	*8910	(14.6)
6.0 m	kg			*4490	*4490			*3260	*3260	5.98
(19.7 ft)	lb			*9900	*9900			*7190	*7190	(19.6)
4.5 m	kg			*5090	*5090	*4540	3660	*2980	2930	6.84
(14.8 ft)	lb			*11220	*11220	*10010	8070	*6570	6460	(22.5)
3.0 m	kg			*6250	5350	*4980	3530	*2910	2610	7.30
(9.8 ft)	lb			*13780	11790	*10980	7780	*6420	5750	(23.9)
1.5 m	kg			*7410	5010	*5500	3380	*3000	2500	7.42
(4.9 ft)	lb			*16340	11050	*12130	7450	*6610	5510	(24.3)
0.0 m	kg			*7990	4830	5720	3280	*3240	2560	7.23
(0.0 ft)	lb			*17610	10650	12610	7230	*7140	5640	(23.7)
-1.5 m	kg	*8220	*8220	*7850	4810	5710	3260	*3760	2860	6.69
(-4.9 ft)	lb	*18120	*18120	*17310	10600	12590	7190	*8290	6310	(21.9)

Model	Type	Boom	Arm	Counterweight	Shoe	Wheel	Dozer		Outrigger	
HX180 NL	MONO BOOM	Length [mm]	Length [mm]	weight [kg]	width [mm]	width [mm]	Front	Rear	Front	Rear
		5100	2600	3250	600	-	-	-	-	-

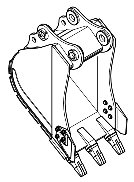
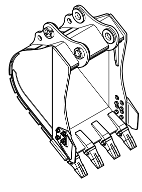
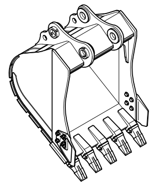
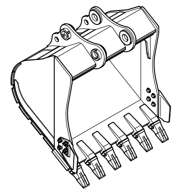
· : Rating over-front · : Rating over-side or 360 degree



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			*4310	*4310					*3560	*3560	5.00
(24.6 ft)	lb			*9500	*9500					*7850	*7850	(16.4)
6.0 m	kg					*4130	3770			*3040	*3040	6.39
(19.7 ft)	lb					*9110	8310			*6700	*6700	(21.0)
4.5 m	kg			*4680	*4680	*4250	3720			*2860	2740	7.20
(14.8 ft)	lb			*10320	*10320	*9370	8200			*6310	6040	(23.6)
3.0 m	kg			*5880	5450	*4750	3570	*3650	2530	*2840	2460	7.63
(9.8 ft)	lb			*12960	12020	*10470	7870	*8050	5580	*6260	5420	(25.0)
1.5 m	kg			*7140	5080	*5340	3410	4200	2470	*2960	2350	7.75
(4.9 ft)	lb			*15740	11200	*11770	7520	9260	5450	*6530	5180	(25.4)
0.0 m	kg			*7900	4870	5740	3290	*3830	2430	*3240	2400	7.56
(0.0 ft)	lb			*17420	10740	12650	7250	*8440	5360	*7140	5290	(24.8)
-1.5 m	kg	*8270	*8270	*7960	4800	5690	3250			*3790	2640	7.05
(-4.9 ft)	lb	*18230	*18230	*17550	10580	12540	7170			*8360	5820	(23.1)
-3.0 m	kg			*7220	4870							
(-9.8 ft)	lb			*15920	10740							

6. BUCKET SELECTION GUIDE

1) GENERAL BUCKET

			
0.39 m^3 SAE heaped bucket	0.50 m^3 SAE heaped bucket	0.64, 0.70, 0.76 m^3 SAE heaped bucket	0.89, 1.05 m^3 SAE heaped bucket

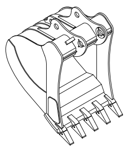
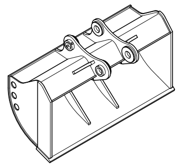
Capacity		Width		Weight	Recommendation				
					5.1 m (16' 9") Mono boom			5.1 m (16' 9") Hyd adjustable boom	
SAE heaped	CECE heaped	Without side cutter	With side cutter		2.2 m arm (7' 3")	2.6 m arm (8' 6")	3.1 m arm (10' 2")	2.2 m arm (7' 3")	2.6 m arm (8' 6")
0.39 m^3 (0.51 yd^3)	0.34 m^3 (0.44 yd^3)	620 mm (24.4")	740 mm (29.1")	410 kg (900 lb)	○	○	○	○	○
0.50 m^3 (0.65 yd^3)	0.44 m^3 (0.58 yd^3)	760 mm (29.9")	880 mm (34.6")	470 kg (1040 lb)	○	○	○	○	○
0.64 m^3 (0.84 yd^3)	0.55 m^3 (0.72 yd^3)	920 mm (36.2")	1040 mm (40.9")	510 kg (1120 lb)	○	○	⊙	○	○
0.70 m^3 (0.92 yd^3)	0.60 m^3 (0.78 yd^3)	990 mm (39.0")	1110 mm (43.7")	600 kg (1320 lb)	○	○	⊙	○	⊙
0.76 m^3 (0.99 yd^3)	0.65 m^3 (0.85 yd^3)	1060 mm (41.7")	1180 mm (46.5")	620 kg (1370 lb)	○	⊙	●	⊙	●
0.89 m^3 (1.16 yd^3)	0.77 m^3 (1.01 yd^3)	1220 mm (48.0")	1340 mm (52.8")	610 kg (1340 lb)	⊙	●		⊙	●
1.05 m^3 (1.37 yd^3)	0.90 m^3 (1.18 yd^3)	1400 mm (55.1")	1520 mm (59.8")	680 kg (1500 lb)	●	●		●	

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

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

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

2) HEAVY DUTY AND DITCH CLEANING BUCKET

	
◈ 0.69, 0.72, 0.87 m^3 SAE heaped bucket	⊙ 0.75 m^3 SAE heaped bucket

Capacity		Width		Weight	Recommendation				
					5.1 m (16' 9") Mono boom			5.1 m (16' 9") Hyd adjustable boom	
SAE heaped	CECE heaped	Without side cutter	With side cutter		2.2 m arm (7' 3")	2.6 m arm (8' 6")	3.1 m arm (10' 2")	2.2 m arm (7' 3")	2.6 m arm (8' 6")
◈0.69 m^3 (0.90 yd^3)	0.62 m^3 (0.81 yd^3)	990 mm (39.0")	-	720 kg (1590 lb)	○	⊙	●	⊙	●
◈0.72 m^3 (0.94 yd^3)	0.65 m^3 (0.85 yd^3)	940 mm (37.0")	985 mm (38.8")	640 kg (1410 lb)	○	⊙	●	⊙	●
◈0.87 m^3 (1.18 yd^3)	0.78 m^3 (1.02 yd^3)	1090 mm (42.9")	1140 mm (44.9")	680 kg (1500 lb)	⊙	●		●	
⊙0.75 m^3 (0.98 yd^3)	0.65 m^3 (0.85 yd^3)	1820 mm (71.7")	-	540 kg (1190 lb)	○	⊙	⊙	○	⊙

◈ : Heavy duty bucket ⊙ : Ditch cleaning bucket

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

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

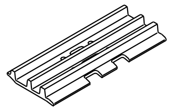
● Applicable for materials with density of 1100 kg/m^3 (1850 lb/yd^3) or less

7. UNDERCARRIAGE

1) TRACKS

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

2) TYPES OF SHOES

Model	Shapes		Triple grouser 			
HX180 L	Shoe width	mm (in)	500 (20)	600 (24)	700 (28)	800 (32)
	Operating weight	kg (lb)	18545 (40880)	18800 (41450)	18795 (41480)	19050 (42000)
	Ground pressure	kgf/cm^2 (psi)	0.51 (7.25)	0.43 (6.11)	0.37 (5.26)	0.33 (4.69)
	Overall width	mm (ft-in)	2750 (9' 0")	2850 (9' 4")	2950 (9' 8")	3050 (10' 0")
HX180 L (with dozer)	Shoe width	mm (in)	500 (20)	600 (24)	700 (28)	800 (32)
	Operating weight	kg (lb)	19445 (42870)	19700 (43430)	19950 (43980)	20205 (44540)
	Ground pressure	kgf/cm^2 (psi)	0.54 (7.68)	0.45 (6.40)	0.39 (5.55)	0.35 (4.98)
	Overall width	mm (ft-in)	2750 (9' 0")	2850 (9' 4")	2950 (9' 8")	3050 (10' 0")

3) NUMBER OF ROLLERS AND SHOES ON EACH SIDE

Item	Quantity
Carrier rollers	2 EA
Track rollers	7 EA
Track shoes	51 EA

4) SELECTION OF TRACK SHOE

Suitable track shoes should be selected according to operating conditions.

Method of selecting shoes

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

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

※ Table 1

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

※ Table 2

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

8. SPECIFICATIONS FOR MAJOR COMPONENTS

1) ENGINE

Item	Specification
Model	Perkins 1204F
Type	4-cycle turbocharged charge air cooled diesel engine
Cooling method	Water cooling
Number of cylinders and arrangement	4 cylinders, in-line
Firing order	1-3-4-2
Combustion chamber type	Direct injection type
Cylinder bore × stroke	105 × 127 mm (4.1" × 5.0")
Piston displacement	4400 cc (268.5 cu in)
Compression ratio	16.5 : 1
Roted net horse power (SAE J1349)	128Hp (96 kW) at 2050 rpm
Rated gross horse power (SAE J1995)	137Hp (102.1 kW) at 2050 rpm
Maximum torque	57.1 kgf · m (413 lbf · ft) at 1400 rpm
Engine oil quantity	10.5 l (2.8 U.S. gal)
Dry weight	589 kg (1300 lb)
High idling speed	2100 ± 50 rpm
Low idling speed	800 ± 100 rpm
Rated fuel consumption	164 g/Hp · hr at 2050 rpm
Starting motor	24 V-4.5 kW
Alternator	24 V-100 A
Battery	2 × 12 V × 100 Ah

2) MAIN PUMP

Item	Specification
Type	Variable displacement tandem axis piston pumps
Capacity	2 × 80 cc/rev
Maximum pressure	350 kgf/cm^2 (4980 psi) [380 kgf/cm^2 (5400 psi)]
Rated oil flow	2 × 164 l/min (43.3 U.S. gpm / 36.1 U.K. gpm)
Maximum speed	2100 rpm

[ ] : Power boost

3) GEAR PUMP

Item	Specification
Type	Fixed displacement gear pump single stage
Capacity	15cc/rev
Maximum pressure	40 kgf/cm^2 (570 psi)
Rated oil flow	31.5 ℓ/min (8.3 U.S. gpm / 6.9 U.K. gpm)

4) MAIN CONTROL VALVE

Item	Specification
Type	11 spools two-block
Operating method	Hydraulic pilot system
Main relief valve pressure	350 kgf/cm^2 (4980 psi)[380 kgf/cm^2 (5400 psi)]
Overload relief valve pressure	400 kgf/cm^2 (5690 psi)

[ ] : Power boost

5) SWING MOTOR

Item	Specification
Type	Axial pistons motor
Capacity	142.8 cc/rev
Relief pressure	285 kgf/cm^2 (4053 psi)
Braking system	Automatic, spring applied hydraulic released
Braking torque	66.5 kgf · m (481 lbf · ft)
Brake release pressure	22.3~36.6 kgf/cm^2 (317~521 psi)
Reduction gear type	2 - stage planetary

6) TRAVEL MOTOR

Item	Specification
Type	Two speed axial pistons motor with brake valve and parking brake
Relief pressure	350 kgf/cm^2 (4980 psi)
Reduction gear type	Planetary & differential type
Braking system	Automatic, spring applied hydraulic released
Brake release pressure	11 kgf/cm^2 (156 psi)
Braking torque	49.3 kgf · m (357 lbf · ft)

7) CYLINDER

Item		Specification
Boom cylinder	Bore dia × Rod dia × Stroke	ø 115 × ø 80 × 1090 mm
	Cushion	Extend only
Arm cylinder	Bore dia × Rod dia × Stroke	ø 120 × ø 85 × 1355 mm
	Cushion	Extend and retract
Bucket cylinder	Bore dia × Rod dia × Stroke	ø 110 × ø 75 × 995 mm
	Cushion	Extend only
Adjust cylinder(opt)	Bore dia × Rod dia × Stroke	ø 160 × ø 85 × 650 mm
	-	-
Adjust boom cylinder(opt)	Bore dia × Rod dia × Stroke	ø 115 × ø 80 × 960 mm
	-	-
Dozer cylinder(opt)	Bore dia × Rod dia × Stroke	ø 110 × ø 85 × 320 mm
	-	-

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

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

8) SHOE

Item		Width	Ground pressure	Link quantity	Overall width
HX180 L	Option	500 mm (20")	0.51 kgf/cm² (7.25 psi)	51	2750 mm (9' 0")
	Standard	600 mm (24")	0.43 kgf/cm² (6.11 psi)	51	2850 mm (9' 4")
	Option	700 mm (28")	0.37 kgf/cm² (5.26 psi)	51	2950 mm (9' 8")
	Option	800 mm (32")	0.33 kgf/cm² (4.69 psi)	51	3050 mm (10' 0")

9) BUCKET

Item	Capacity		Tooth quantity	Width	
	SAE heaped	CECE heaped		Without side cutter	With side cutter
HX180 L	0.76 m³ (0.99 yd³)	0.65 m³ (0.85 yd³)	5	1060 mm (41.7")	1180 mm (46.5")
	0.39 m³ (0.51 yd³)	0.34 m³ (0.44 yd³)	3	620 mm (24.4")	740 mm (29.1")
	0.50 m³ (0.65 yd³)	0.44 m³ (0.58 yd³)	4	760 mm (29.9")	880 mm (34.6")
	0.64 m³ (0.84 yd³)	0.55 m³ (0.72 yd³)	5	920 mm (36.2")	1040 mm (40.9")
	0.70 m³ (0.92 yd³)	0.60 m³ (0.78 yd³)	5	990 mm (39.0")	1110 mm (43.7")
	0.89 m³ (1.16 yd³)	0.77 m³ (1.01 yd³)	6	1220 mm (48.0")	1340 mm (52.8")
	1.05 m³ (1.37 yd³)	0.90 m³ (1.18 yd³)	6	1400 mm (55.1")	1520 mm (59.8")
	◈0.69 m³ (0.90 yd³)	0.62 m³ (0.81 yd³)	5	990 mm (39.0")	-
	★0.75 m³ (0.98 yd³)	0.65 m³ (0.85 yd³)	-	1820 mm (71.7")	-

◈ : Heavy duty bucket ★ : Ditch cleaning bucket

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	10.5 (2.8)	★SAE 5W-40 SAE 30 SAE 10W SAE 10W-30 SAE 15W-40
DEF/ AdBlue® Tank	Mixture of urea and deionized water	19.0 (5.0)	ISO 22241, High-purity urea + deionized water (32.5:67.5)
Swing drive	Gear oil	TYPE 1 : 5.0 (1.32) TYPE 2 : 6.2 (1.64)	★SAE 75W-90 SAE 80W-90
Final drive	Gear oil	5.8×2 (1.5×2)	★SAE 75W-90 SAE 80W-90
Hydraulic tank	Hydraulic oil	Tank : 125 (33.0) System : 240 (63.4)	★ISO VG 15 ISO VG 32 ISO VG 46, HBHO VG 46★3 ISO VG 68
Fuel tank	Diesel fuel★1	290 (76.6)	★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★2	27.5 (7.3)	Ethylene glycol base permanent type (50 : 50) ★Ethylene glycol base permanent type (60 : 40)

SAE : Society of Automotive Engineers
API : American Petroleum Institute
ISO : International Organization for Standardization
NLGI : National Lubricating Grease Institute
ASTM : American Society of Testing and Material
UTTO : Universal Tractor Transmission Oil
DEF : Diesel Exhaust Fluid, DEF compatible with AdBlue®

★ : Cold region
Russia, CIS, Mongolia
★1 : Ultra low sulfur diesel
- sulfur content ≤ 15 ppm
★2 : Soft water
City water or distilled water
★3 : HD Hyundai Construction Equipment Bio Hydraulic Oil

※ 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.

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

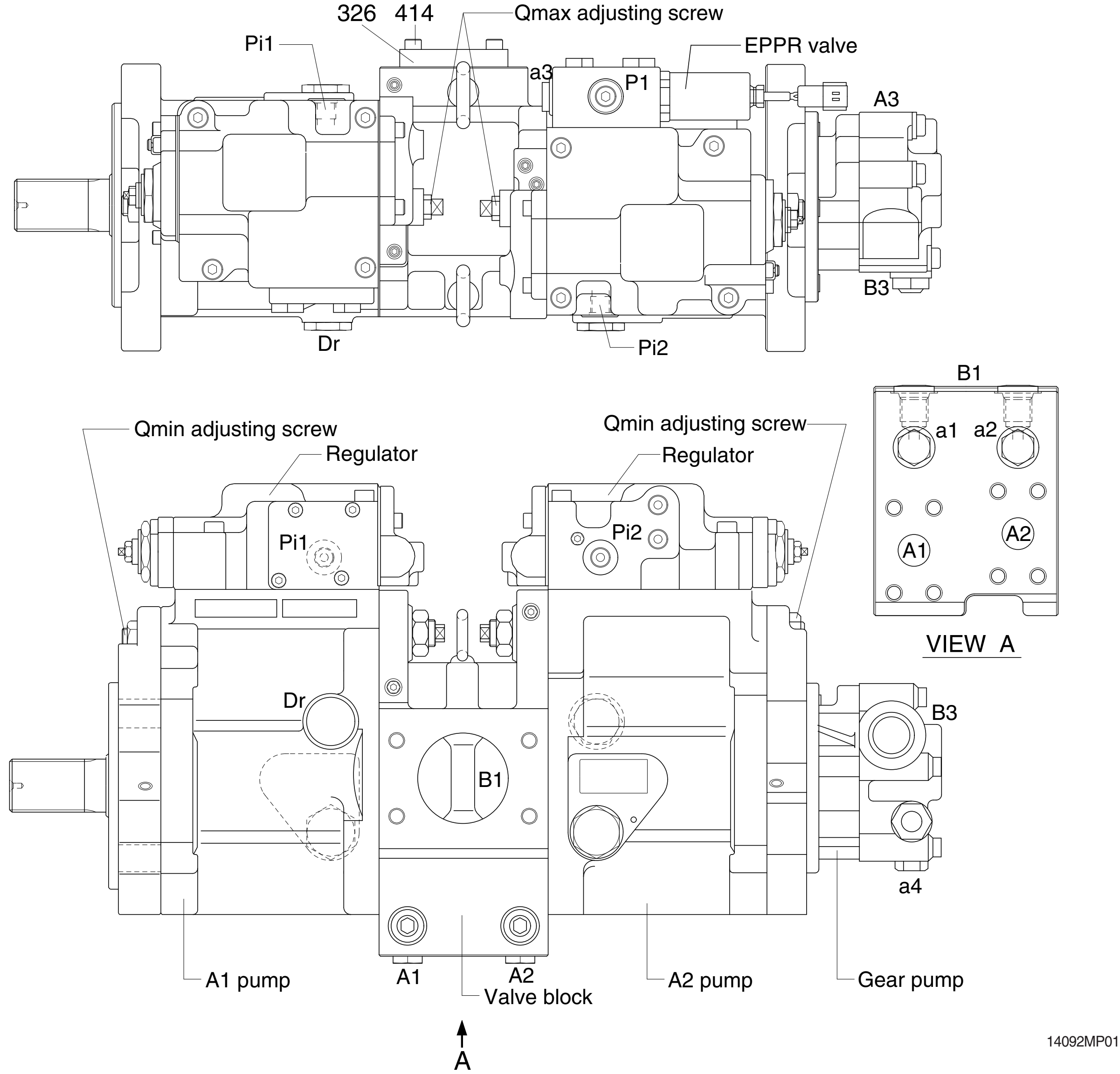
※ For HD Hyundai Construction Equipment genuine lubricating oils and grease for use in regions with extremely low temperatures, please contact HD Hyundai Construction Equipment dealers.

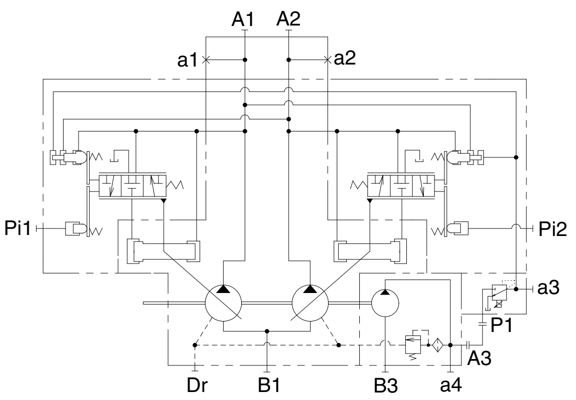
SECTION 2 STRUCTURE AND FUNCTION

GROUP 1 PUMP DEVICE

1. STRUCTURE

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



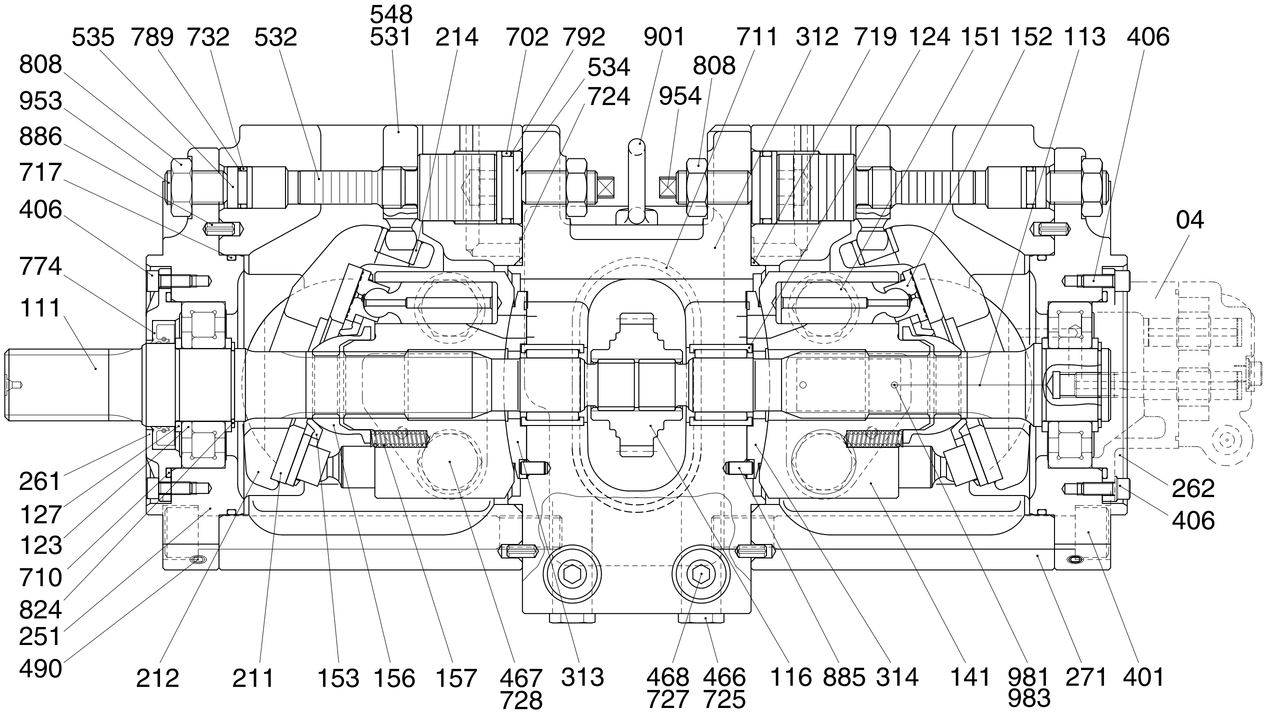


Hydraulic circuit

Port	Port name	Port size
A1, A2	Delivery port	SAE6000 psi 3/4"
B1	Suction port	SAE2500 psi 2 1/2"
Dr	Drain port	PF 1/2 - 19
Pi1, Pi2	Pilot port	PF 1/4 - 15
P1	EPPR port	PF 1/4 - 15
a1, a2, a3	Gauge port	PF 1/4 - 15
a4	Gauge port	PF 1/4-14
A3	Gear pump delivery port	PF 1/2 - 19
B3	Gear pump suction port	PF 3/4 - 20.5

1) MAIN PUMP (1/2)

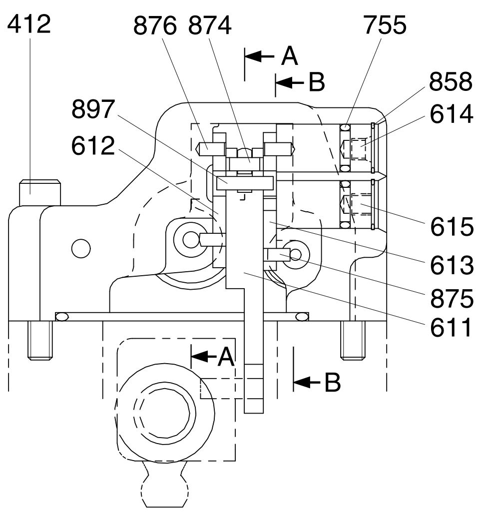
The main pump consists of two piston pumps (front & rear) and valve block.

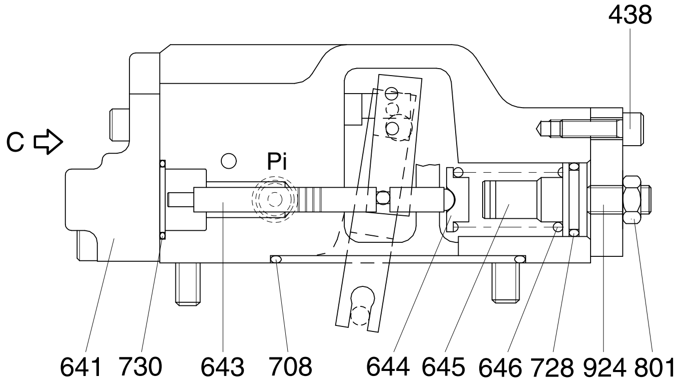


14092MP02

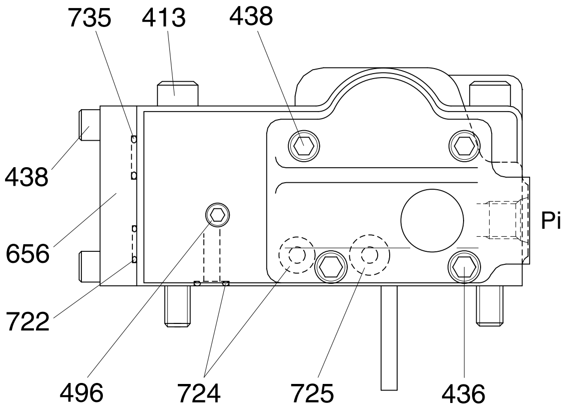
04	Gear pump	312	Valve block	717	O-ring
111	Drive shaft (F)	313	Valve plate (R)	719	O-ring
113	Drive shaft (R)	314	Valve plate (L)	724	O-ring
116	1st Gear	326	Cover	725	O-ring
123	Roller bearing	401	Hexagon socket bolt	727	O-ring
124	Needle bearing	406	Hexagon socket bolt	728	O-ring
127	Bearing spacer	414	Hexagon socket bolt	732	O-ring
141	Cylinder block	466	Plug	774	Oil seal
151	Piston	467	plug	789	Back up ring
152	Shoe	468	Plug	792	Back up ring
153	Set plate	490	Plug	808	Hexagon head nut
156	Bushing	531	Tilting pin	824	Snap ring
157	Cylinder spring	532	Servo piston	885	Pin
211	Shoe plate	534	Stopper (L)	886	Spring pin
212	Swash plate	535	Stopper (S)	901	Eye bolt
214	Bushing	548	Pin	953	Set screw
251	Support	702	O-ring	954	Set screw
261	Seal cover (F)	710	O-ring	981	Plate
271	Pump casing	711	O-ring	983	Pin

2) REGULATOR (1/2)

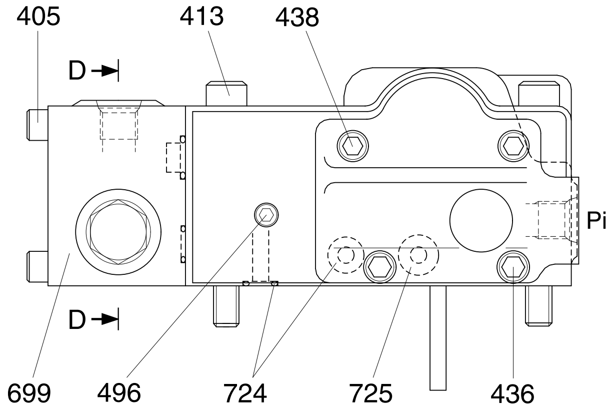




SECTION B-B

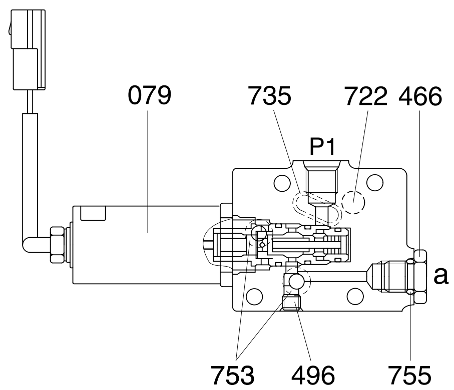


VIEW C (FRONT)

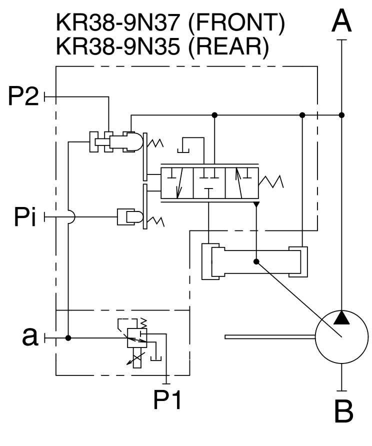


VIEW C (REAR)

16092MP04

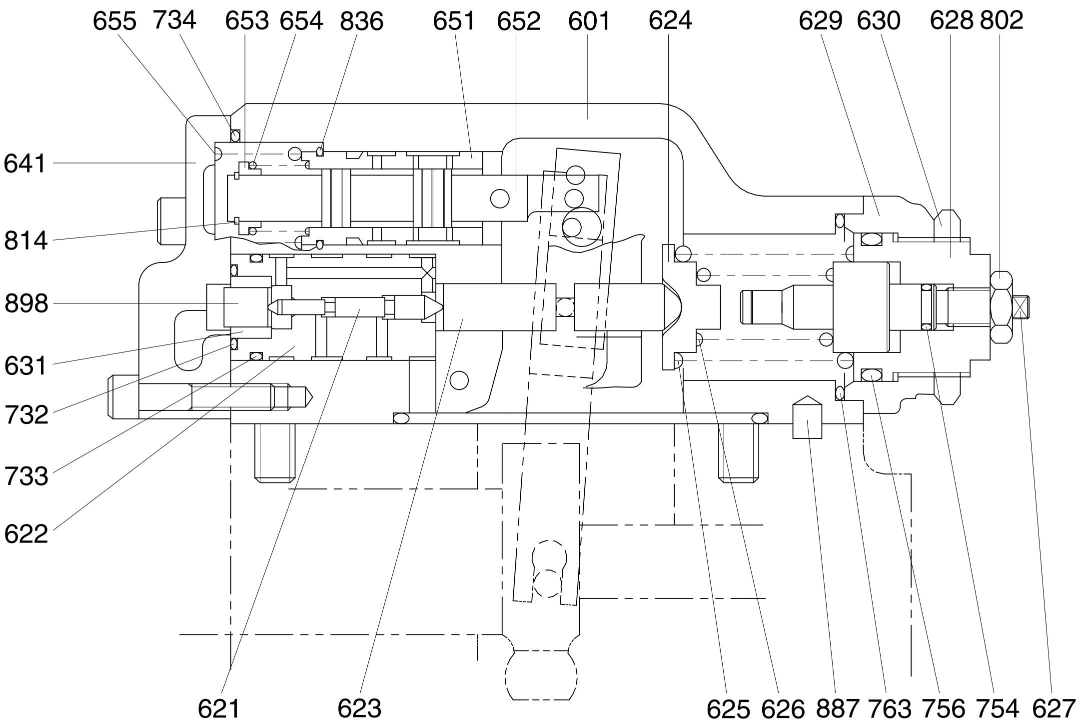


SECTION D-D(REAR)



Port	Port name	Port size
A	Delivery port	SAE6000 psi 3/4"
B	Suction port	SAE2500 psi 2 1/2"
Pi	Pilot port	PF 1/4-15

REGULATOR (2/2)

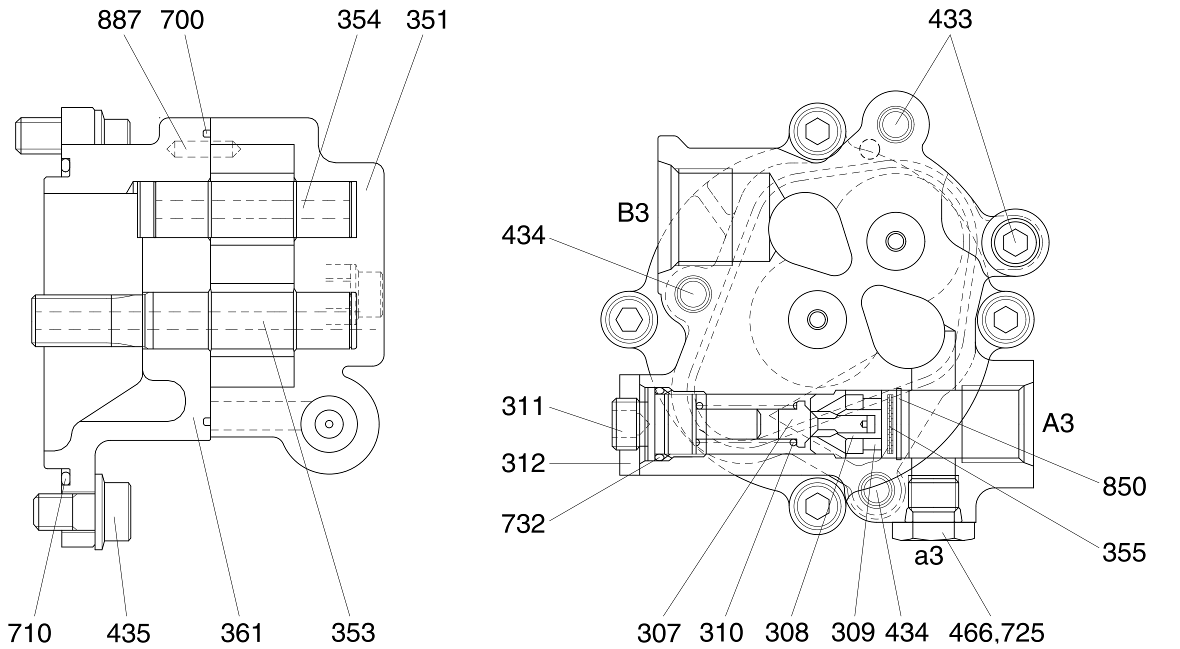


SECTION A-A

14W92MP05

079	EPPR valve assembly	629	Cover (C)	733	O-ring
405	Hexagon socket screw (R)	630	Lock nut	734	O-ring
412	Hexagon socket screw	631	Sleeve, Pf	735	O-ring
413	Hexagon socket screw	641	Pilot cover	753	O-ring (R)
436	Hexagon socket screw	643	Pilot piston	754	O-ring
438	Hexagon socket screw	644	Spring seat (Q)	755	O-ring
466	Plug (R)	645	Adjust stem (Q)	756	O-ring
496	Plug	646	Pilot spring	763	O-ring
601	Casing	651	Sleeve	801	Nut
611	Feed back lever	652	Spool	802	Nut
612	Lever (1)	653	Spring seat	814	Snap ring
613	Lever (2)	654	Return spring	836	Snap ring
614	Center plug	655	Set spring	858	Snap ring
615	Adjust plug	656	Block cover (F)	874	Pin
621	Compensator piston	699	Valve casing (R)	875	Pin
622	Piston case	708	O-ring	876	Pin
623	Compensator rod	722	O-ring	887	Pin
624	Spring seat (C)	724	O-ring	897	Pin
625	Outer spring	725	O-ring	898	Pin
626	Inner spring	728	O-ring	924	Set screw
627	Adjust stem (C)	730	O-ring		
628	Adjust screw (C)	732	O-ring		

3) GEAR PUMP



14092MP06

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

2. FUNCTION

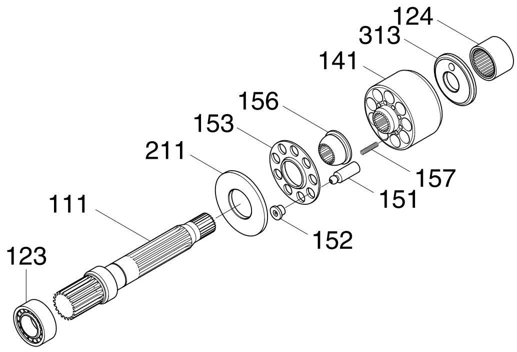
1) MAIN PUMP

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

(1) Rotary group

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

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



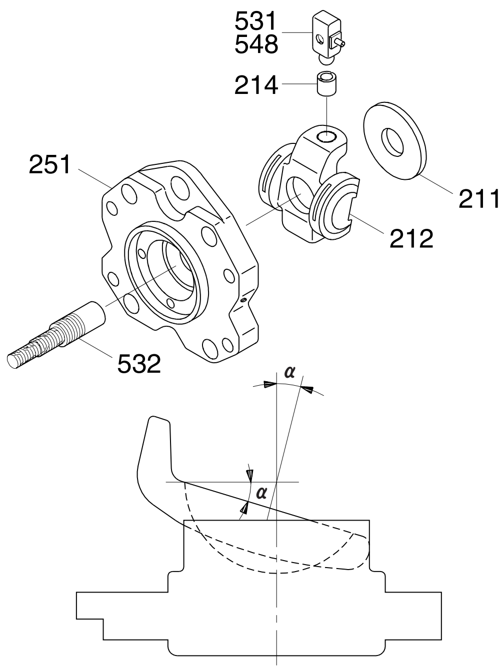
21092MP06

(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)



2507A2MP14

(3) Valve block group

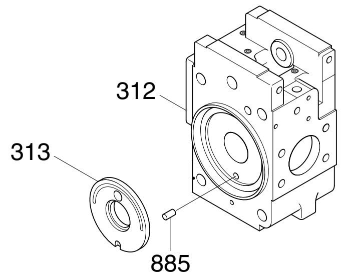
The valve block group consists of valve block (312), valve plate (313) and valve plate pin(885).

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 istons arranged in the cylinder block make a reciprocating motion with respect to the cylinder block, while they revolve with the cylinder block.

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



21092MP07

2) REGULATOR

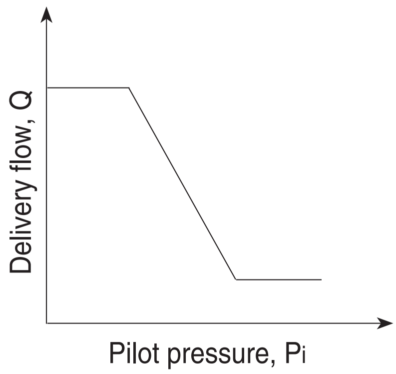
Regulator consists of the negative flow control, total horse power control and power shift control function.

(1) Negative flow control

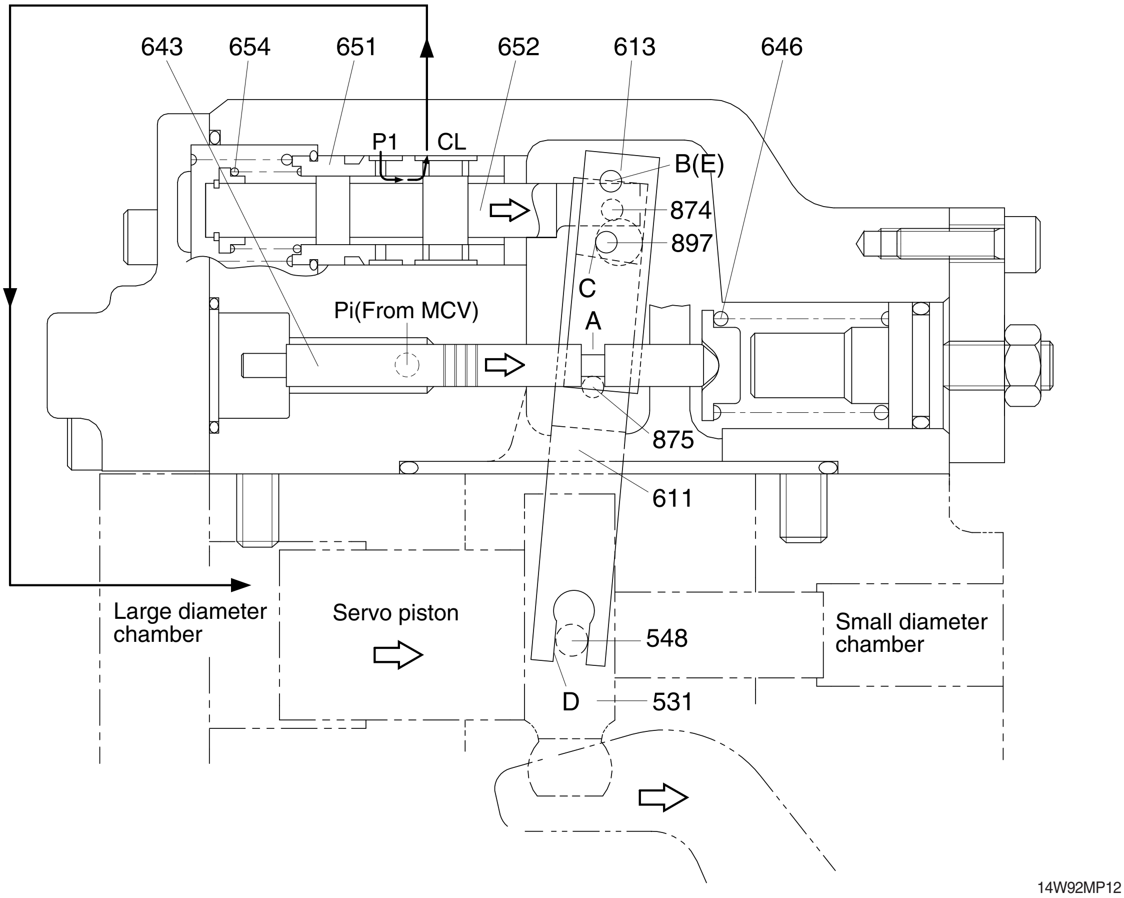
By changing the pilot pressure Pi, the pump tilting angle (delivery flow) is regulated arbitrarily, as shown in the figure.

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

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



① Flow reducing function



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

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

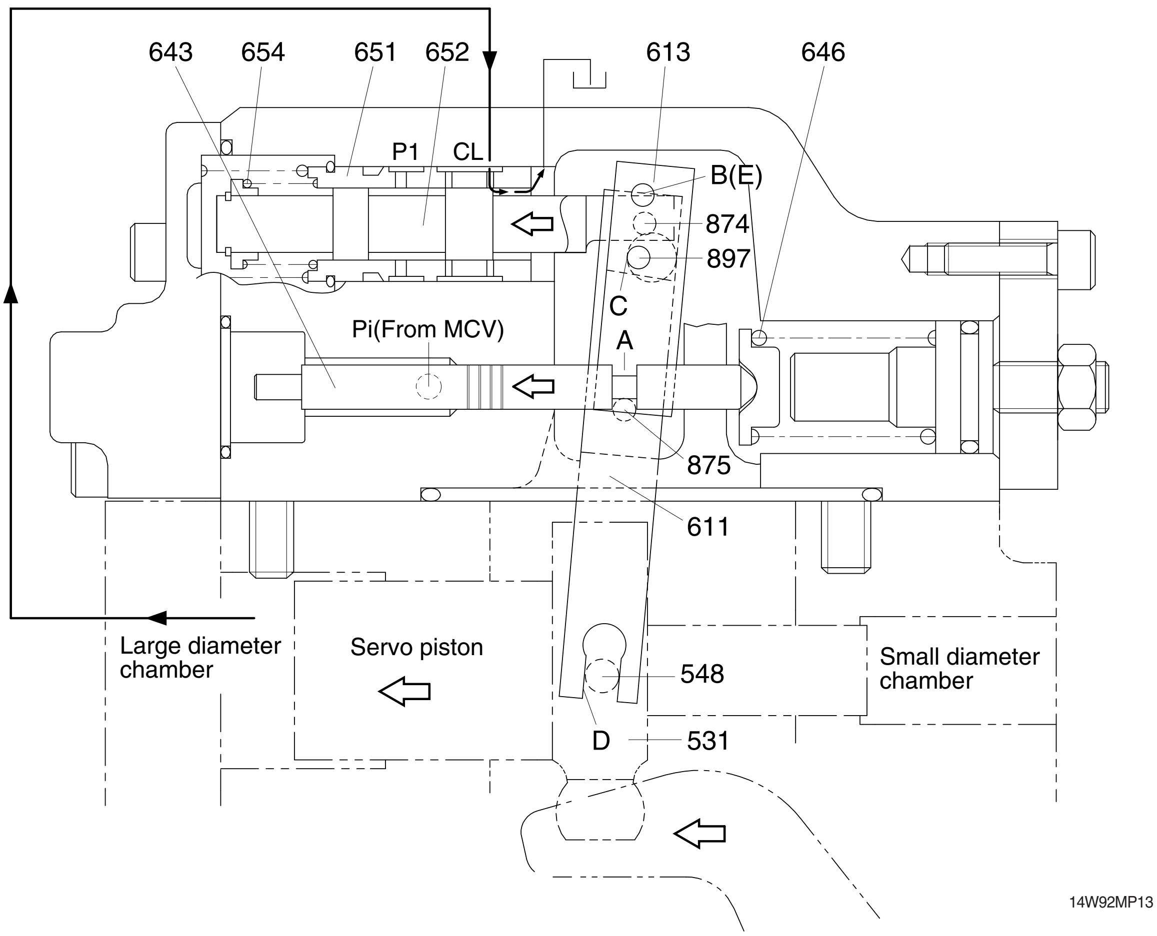
Since the feedback lever is connected with the spool (652) via the pin (874), the spool moves to the right.

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

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

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

② Flow increasing function



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

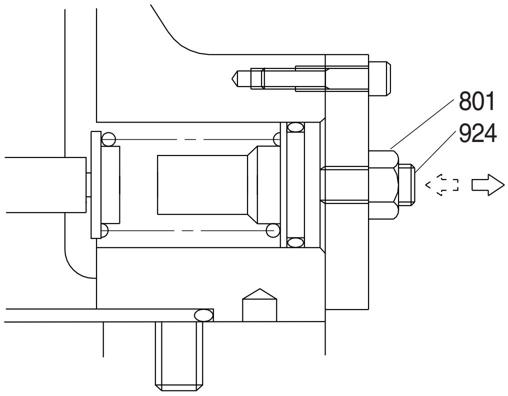
As the servo piston moves, point D also moves to the left, the feedback lever rotates around the fulcrum of point C, and the spool moves to the right till the opening between the spool and sleeve is closed.

③ Adjustment of flow control characteristic

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

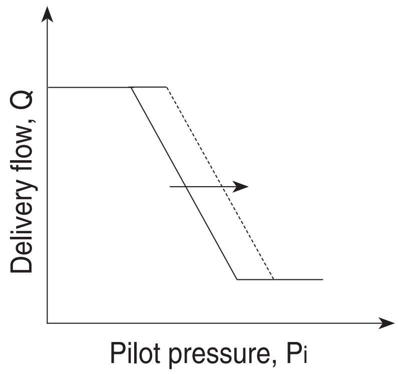
Adjust it by loosening the hexagon nut (801) and by tightening (or loosening) the hexagonal socket head screw (924).

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



※ Adjusting value

Speed	Adjustment of flow control characteristic		
	Tightening amount of adjusting screw (924)	Flow control starting pressure change amount	Flow change amount
(min -1)	(Turn)	(kgf/cm2)	(l/min)
2000	+1/4	+1.5	+9.5



(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.)

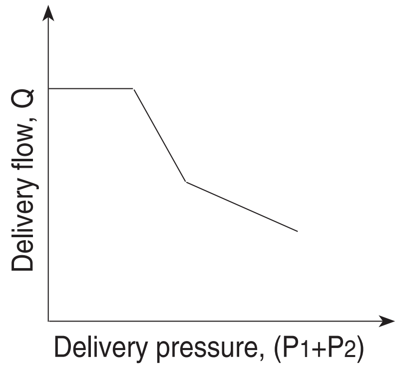
Since the regulator is of the simultaneous total horsepower type that operates by the sum of load pressures of the two pumps in the tandem double-pump system, the prime mover is automatically prevented from being overloaded, irrespective of the load condition of the two pumps, when horsepower control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

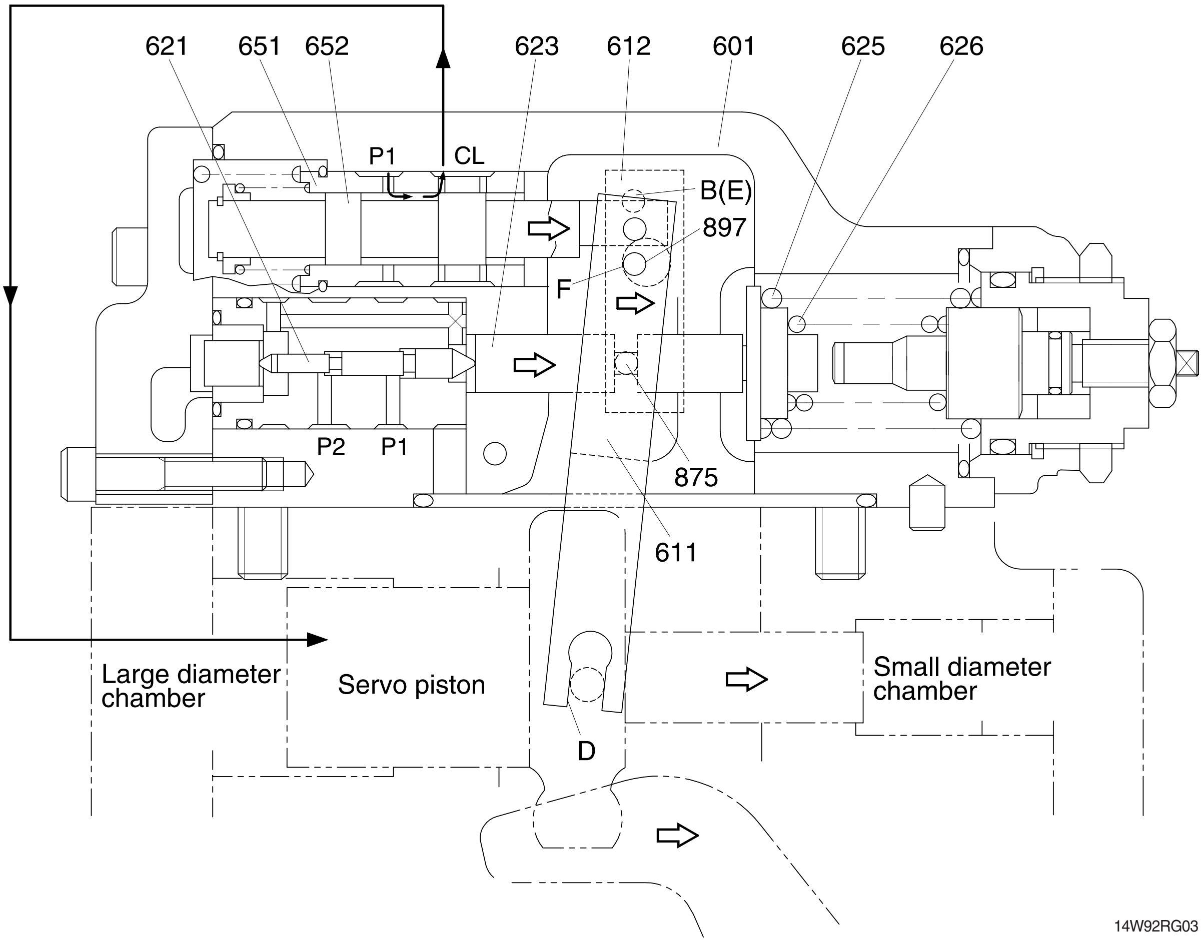
$T_{in} = P1 \times q/2\pi + P2 \times q/2\pi$

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

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



① Overload preventive function

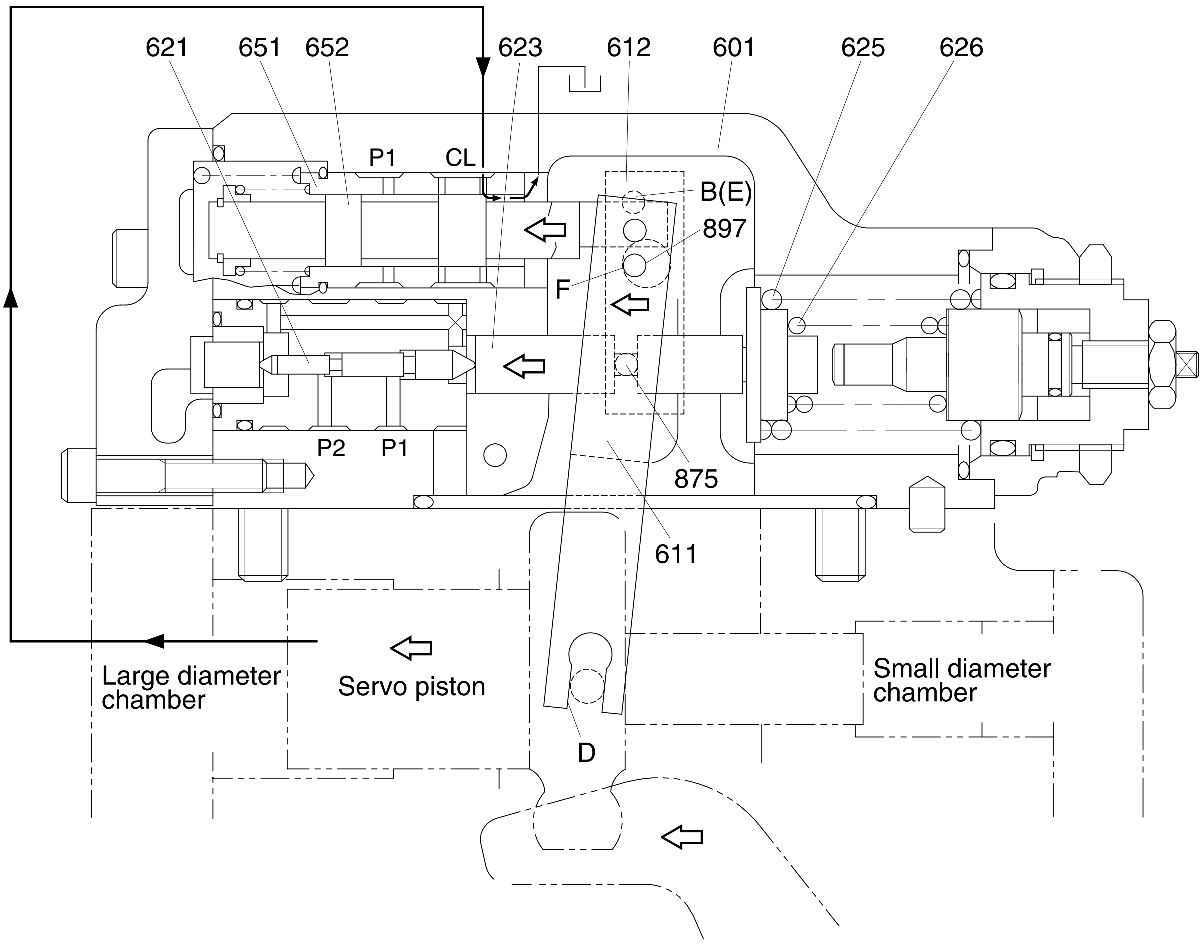


When the self pump delivery pressure P1 or the companion pump delivery pressure P2 rises, it acts on the stepped part of the compensating piston (621). It presses the compensating rod (623) to the right till the force of the outer spring (625) and inner spring (626) balances with the hydraulic force.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

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

Since the large hole section (F) of lever 1 contains a protruding pin (897) fixed to the feedback lever (611), the feedback lever rotates around the fulcrum of point D as lever 1 rotates, and then the spool (652) is shifted to the right. As the spool moves, the delivery pressure P1 is admitted to the large diameter section of the servo piston via port CL, causes the servo piston move to the right, reduces the pump delivery, flow rate, and prevents the prime mover from being overloaded. The movement of the servo piston is transmitted to the feedback lever via point D. Then the feedback lever rotates around the fulcrum of point F and the spool is shifted to the left. The spool moves till the opening between the spool (652) and sleeve (651) is closed.

② Flow reset function



14W92RG04

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.

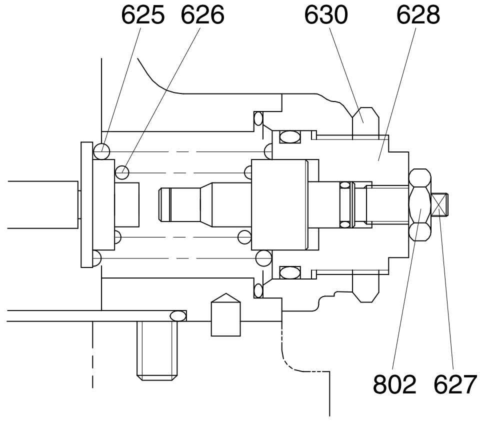
④ **Adjustment of input horsepower**

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 (628) by N turns changes the setting of the inner spring (626), return the adjusting stem C (627) by N×A turns at first. (A=1.85)



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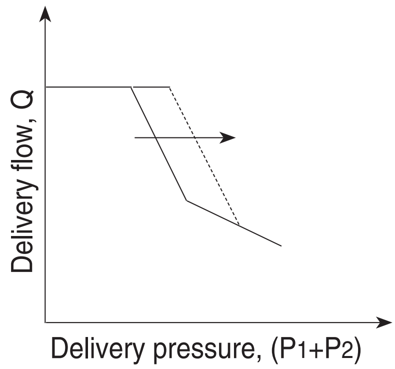
※ **Adjusting value**

Speed	Adjustment of input horsepower		
	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)
2000	+1/4	+17.7	+3.5



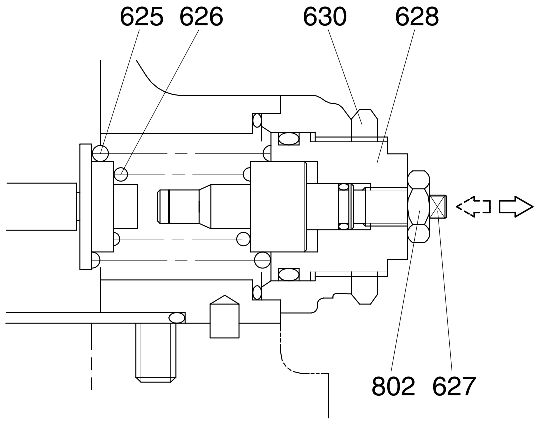
b. Adjustment of inner spring

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

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

※ Adjusting value

Speed	Adjustment of input horsepower		
	Tightening amount of adjusting stem (C) (627)	Flow change amount	Input torque change amount
(min^{-1})	(Turn)	(l/min)	(kgf · m)
2000	+1/4	+8.4	+3.8



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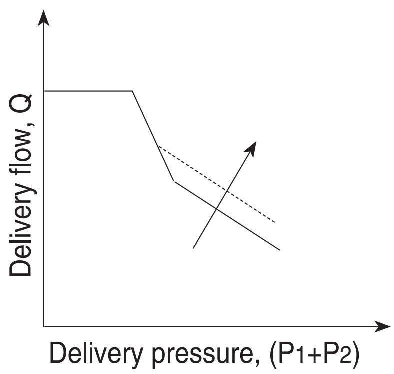
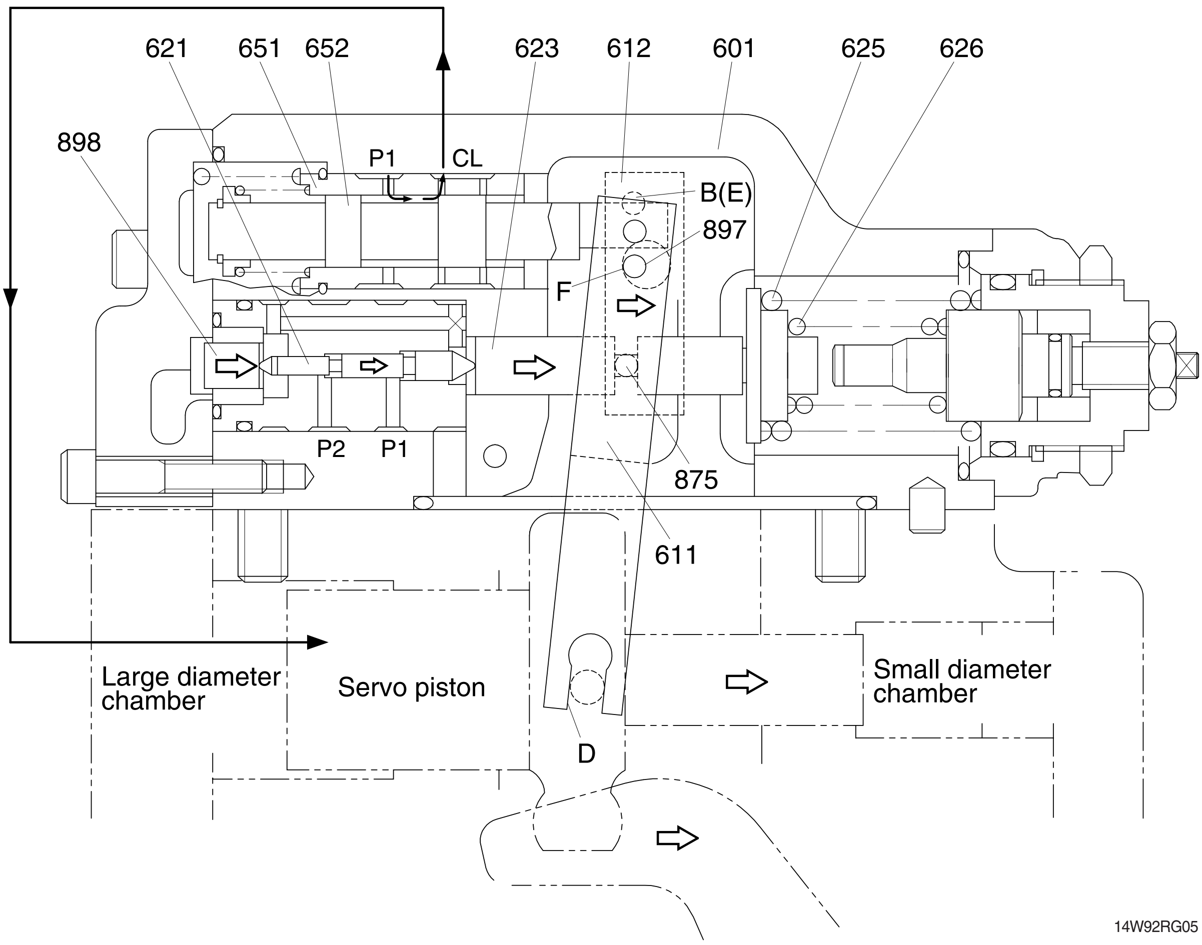


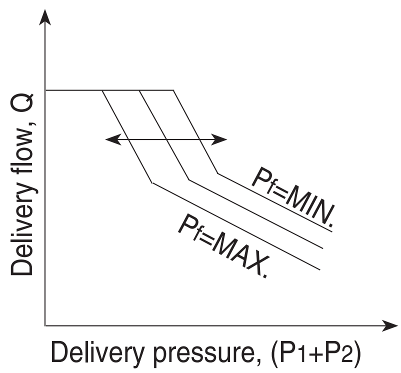
(3) Power shift control



The set horsepower valve is shifted by varying the command current level of the proportional pressure reducing valve attached to the pump.

Only one proportional pressure reducing valve is provided.

However, the secondary pressure Pf (power shift pressure) is admitted to the horsepower control section of each pump regulator through the pump's internal path to shift it to the same set horsepower level.



This function permits arbitrary setting of the pump output power, thereby providing the optimum power level according to the operating condition.

The power shift pressure Pf controls the set horsepower of the pump to a desired level, as shown in the figure.

As the power shift pressure Pf rises, the compensating rod (623) moves to the right via the pin (898) and compensating piston (621).

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

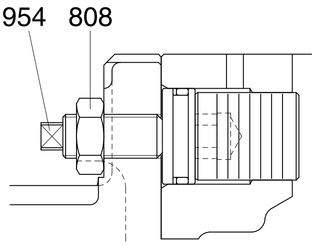
(4) Adjustment of maximum and minimum flows

① Adjustment of maximum flow

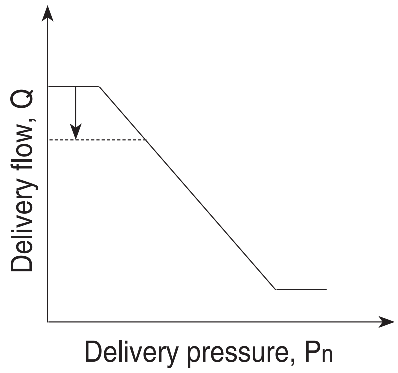
Adjust it by loosening the hexagon nut (808) and by tightening (or loosening) the set screw (954).

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

Speed	Adjustment of max flow	
	Tightening amount of adjusting screw (954)	Flow change amount
(min^{-1})	(Turn)	(l/min)
2000	+1/4	-3.2



14W92MP23

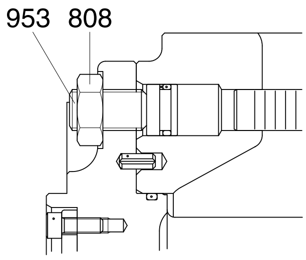


② Adjustment of minimum flow

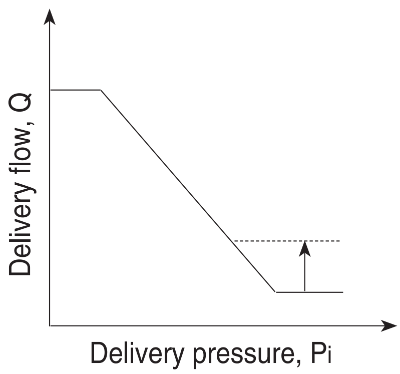
Adjust it by loosening the hexagon nut (808) and by tightening (or loosening) the hexagonal socket head set screw (953). Similarly to the adjustment of the maximum flow, other characteristics are not changed.

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

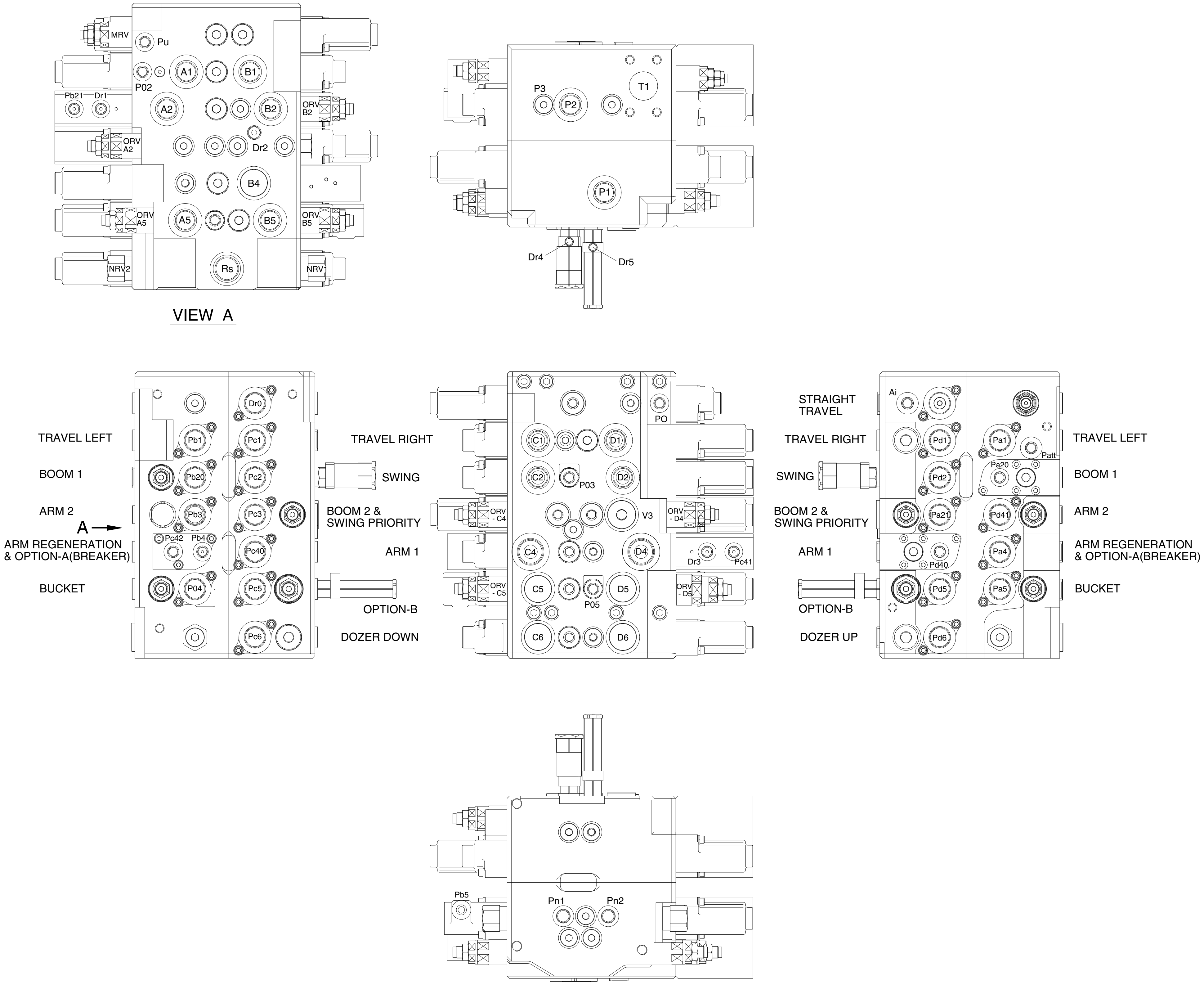
Speed	Adjustment of min flow	
	Tightening amount of adjusting screw (953)	Flow change amount
(min^{-1})	(Turn)	(l/min)
2000	+1/4	+3.2



14W92MP24

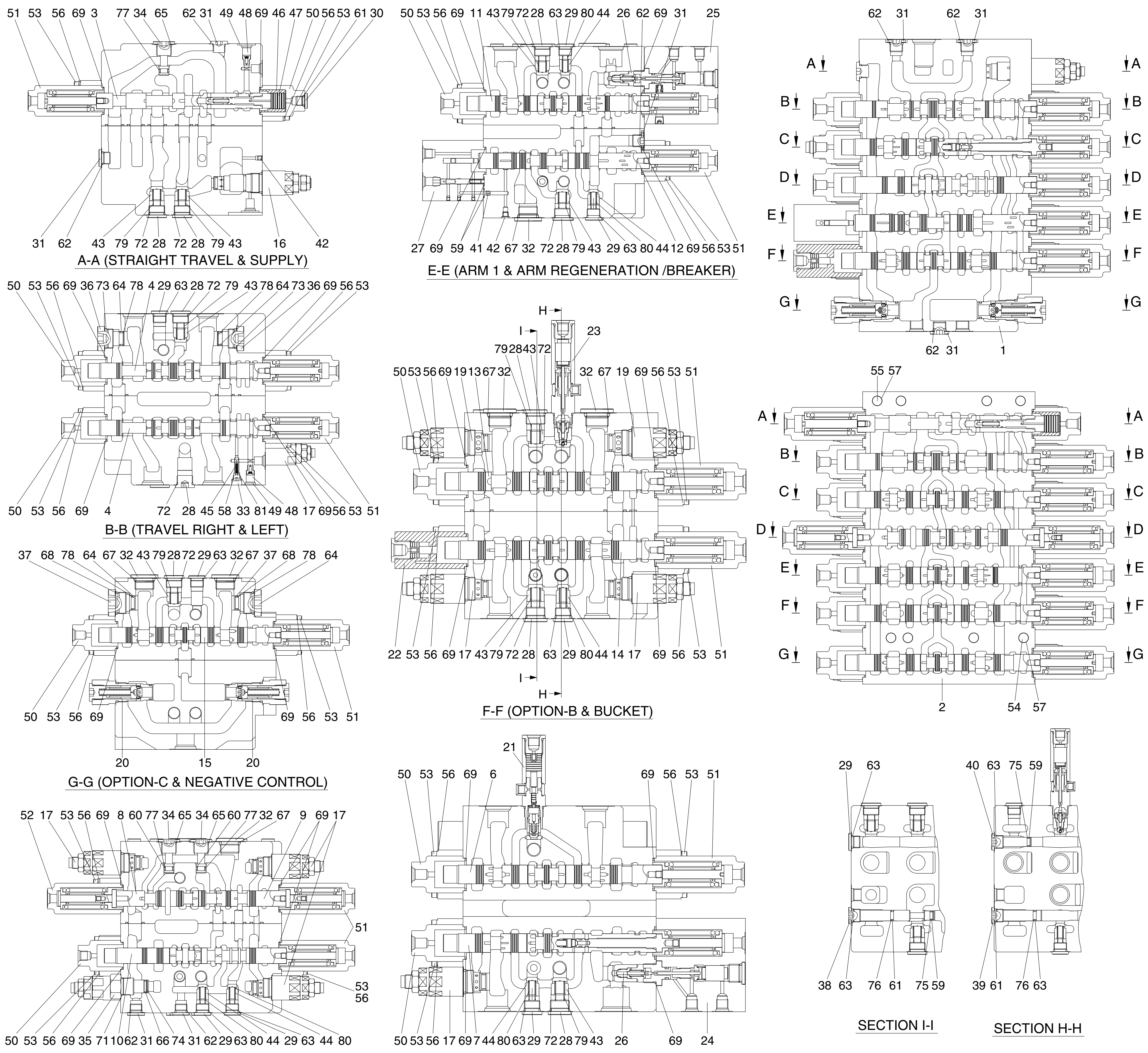


1. STRUCTURE



160F2MC01

Mark	Port name	Port size	Tightening torque
Rs	Make up for swing motor	UNF 1 3/16	18 kgf · m (130 lbf · ft)
Pd0	Straight travel pilot port	PF 1/4	3.5~3.9 kgf · m (25.3~28.2 lbf · ft)
Pa1	Travel left pilot port (BW)		
Pb1	Travel left pilot port (FW)		
Pc1	Travel right pilot port (FW)		
Pd1	Travel right pilot port (BW)		
Pa20	Boom up pilot port		
Pa21	Boom up confluence pilot port		
Pb20	Boom down pilot port		
Pb21	Lock valve pilot port (boom)		
Pc2	Swing pilot port (RH)		
Pd2	Swing pilot port (LH)		
Pb3	Arm in confluence pilot port		
Pc3	Swing priority pilot port		
Pa4	Option A pilot port (breaker)		
Pb4	Arm in regeneration cut port		
Pc40	Arm in pilot port		
Pc41	Lock valve pilot port (arm)		
Pc42	Arm in regen-cut signal selector port		
Pd40	Arm out pilot port		
Pd41	Arm out confluence pilot port		
Pa5	Bucket in pilot port		
Pb5	Bucket out pilot port		
Pc5	Option B pilot port		
Pd5	Option B pilot port		
Pc6	Option C pilot port (dozer blade down)		
Pd6	Option C pilot port (dozer blade up)		
P0	Pilot pressure port		
Pu	Main relief pressure up pilot port		
Ai	Auto idle signal port		
Patt	Auto idle signal-attachment		
P02	Pilot signal port		
P03	Boom priority pilot port		
P04	Boom parallel orifice pilot port		
P05	Breaker summation pilot port		
Dr0	Drain port (travel straight)		
Dr1	Drain port (boom holding valve)		
Dr2	Drain port (boom 2 & swing priority)		
Dr3	Drain port (arm holding valve)		
Pn1	Negative control signal port (P1 port side)	PF 3/8	7~8 kgf · m (50.6~57.8 lbf · ft)
Pn2	Negative control signal port (P2 port side)		
P3	Quick clamp port		
A1	Travel motor left side port (BW)	PF 3/4	15~18 kgf · m (109~130 lbf · ft)
B1	Travel motor left side port (FW)		
C1	Travel motor right side port (FW)		
D1	Travel motor right side port (BW)		
B2	Boom rod side port		
C2	Swing motor port (RH)		
D2	Swing motor port (LH)		
B4	Option A port (breaker)		
A5	Bucket head side port		
B5	Bucket rod side port		
C5	Option B port		
D5	Option B port		
C6	Option C pilot port (dozer down port)		
D6	Option C pilot port (dozer up port)		
P1	Pump port (P1 side)		
P2	Pump port (P2 side)		
A2	Boom head side port	PF 1	20~25 kgf · m (115~180 lbf · ft)
C4	Arm head side port		
D4	Arm rod side port		
Dr4	Drain port (swing logic valve)	PF 1/8	1.5~1.9 kgf · m (10.8~13.7 lbf · ft)
Dr5	Drain port (flow summation)		
T1	Return port	SAE3000, 1 1/2 (M12×1.75)	8.5~11.5 kgf · m (61.5~83.1 lbf · ft)



A-A (STRAIGHT TRAVEL & SUPPLY)

E-E (ARM 1 & ARM REGENERATION /BREAKER)

B-B (TRAVEL RIGHT & LEFT)

F-F (OPTION-B & BUCKET)

G-G (OPTION-C & NEGATIVE CONTROL)

D-D (SWING PRIORITY & BOOM 2 & ARM 2)

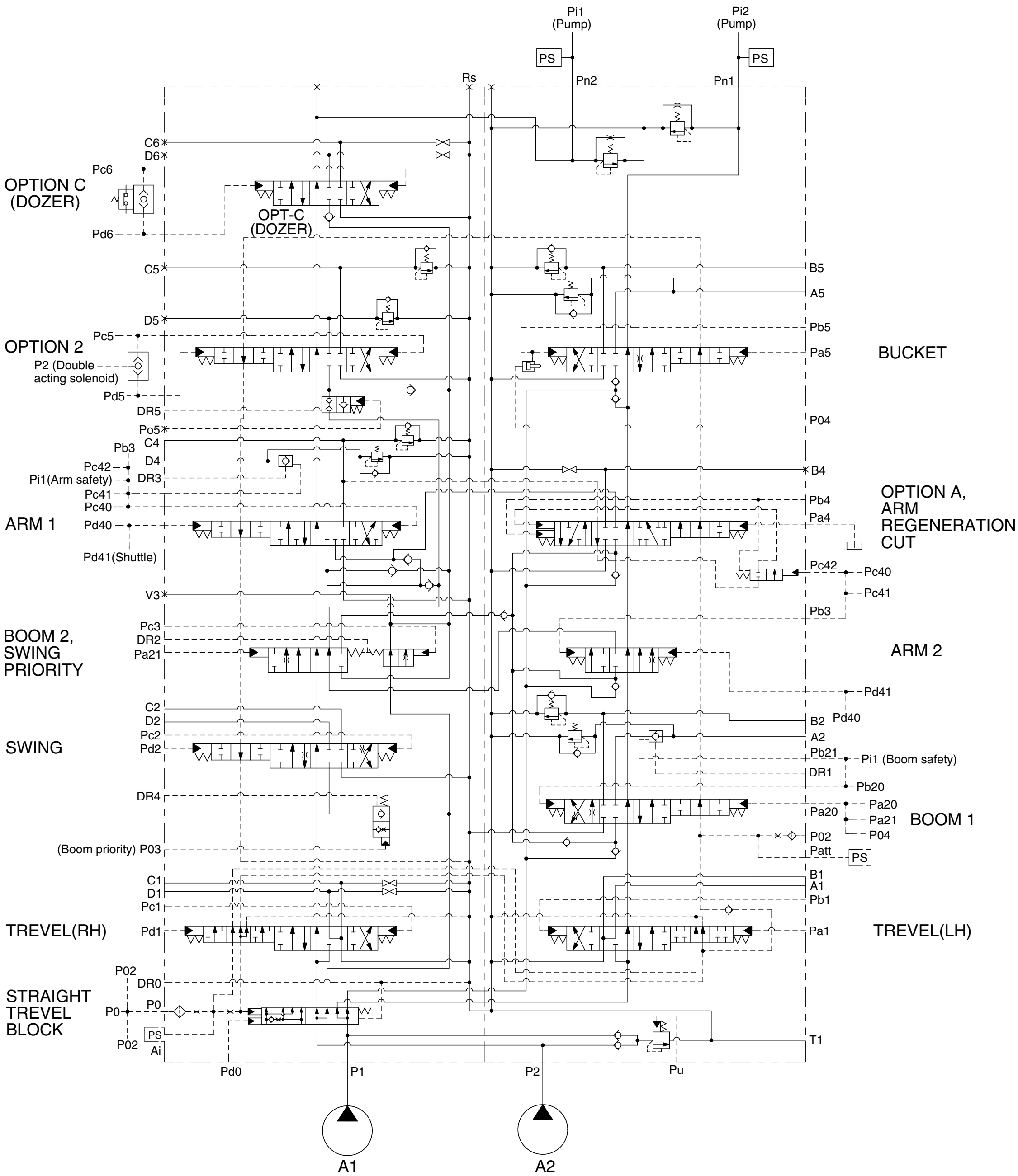
C-C (SWING & BOOM 1)

SECTION I-I

SECTION H-H

1	Housing-P1	43	Load check poppet
2	Housing-P2	44	Load check poppet
3	Spool-straight travel	45	Signal poppet
4	Spool-travel (LH, RH)	46	Travel straight sleeve
6	Spool-swing	47	Travel straight piston
7	Spool-boom 1	48	Orifice signal
8	Spool-swing priority	49	Coin type filter
9	Spool-boom 2	50	Pilot cap
10	Spool-arm 2	51	Pilot cap
11	Spool-arm 1	52	Pilot cap
12	Spool-arm regeneration	53	Socket bolt
13	Spool-option B	54	Socket bolt
14	Spool-bucket	55	Socket bolt
15	Spool-option C (dozer)	56	Washer
16	Main relief valve	57	Spring washer
17	Overload relief valve	58	O-ring
19	Overload relief valve	59	O-ring
20	Negacon relief valve	60	O-ring
21	Swing logic valve	61	O-ring
22	Bucket strock limiter	62	O-ring
23	Option on-off valve	63	O-ring
24	Holding valve kit A1	64	O-ring
25	Holding valve kit A2	65	O-ring
26	Holding valve kit B	66	O-ring
27	Regeneration block	67	O-ring
28	Plug	68	O-ring
29	Plug	69	O-ring
30	Plug	70	O-ring
31	Plug	71	O-ring
32	Plug	72	O-ring
33	Plug	73	O-ring
34	Plug-parallel	74	Back-up ring
35	Plug-relief cat	75	Back-up ring
36	Plug-relief cat	76	Back-up ring
37	Plug-relief cat	77	Back-up ring
38	Plug-bucket	78	Back-up ring
39	Plug-bucket parallel	79	Load check spring
40	Plug-option	80	Load check spring
41	Plug-orifice	81	Poppet signal spring
42	Plug	82	Pin

2. HYDRAULIC CIRCUIT



160F2MC05

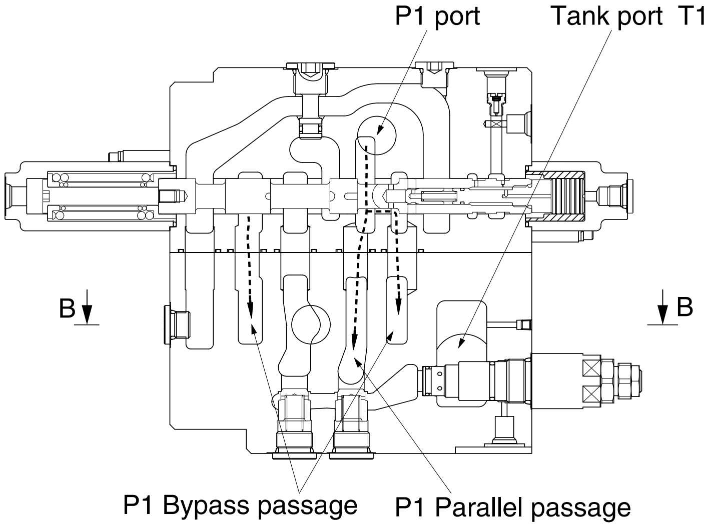
3. FUNCTION

1) CONTROL IN NEUTRAL

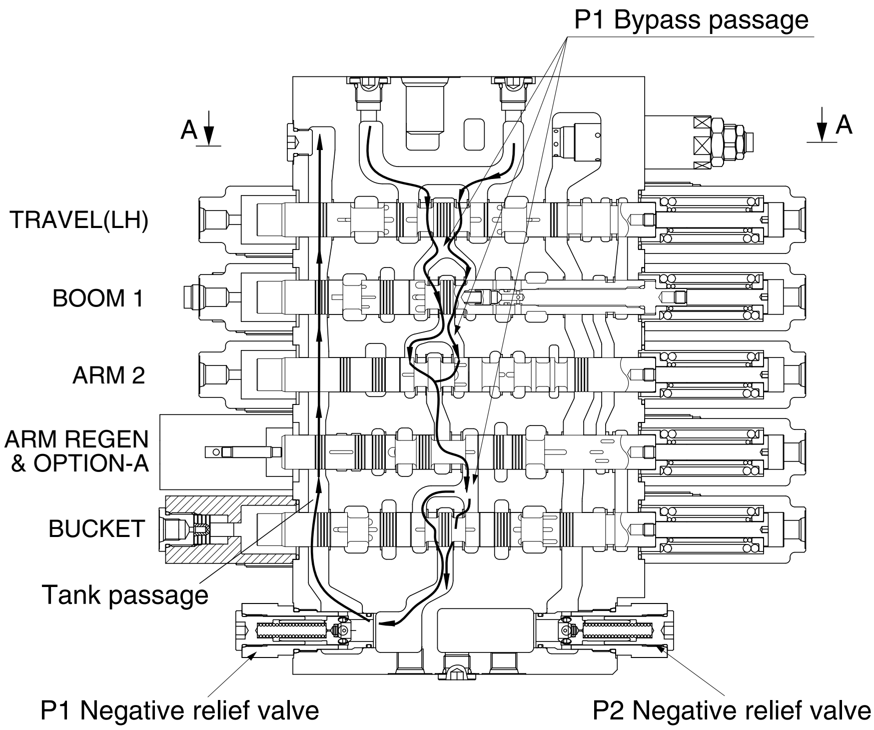
(1) P1 SIDE

The hydraulic fluid from pump A2 flows into the main control valve through the inlet port "P1", pass the straight travel spool into the P1 bypass passage and P1parallel passage.

The hydraulic fluid from the pump A2 is directed to the tank through the bypass passage of spools : travel left, boom 1, arm 2, arm regeneration & option A and bucket, the negative relief valve of P1, tank passage, and the tank port "T1"



SECTION A-A



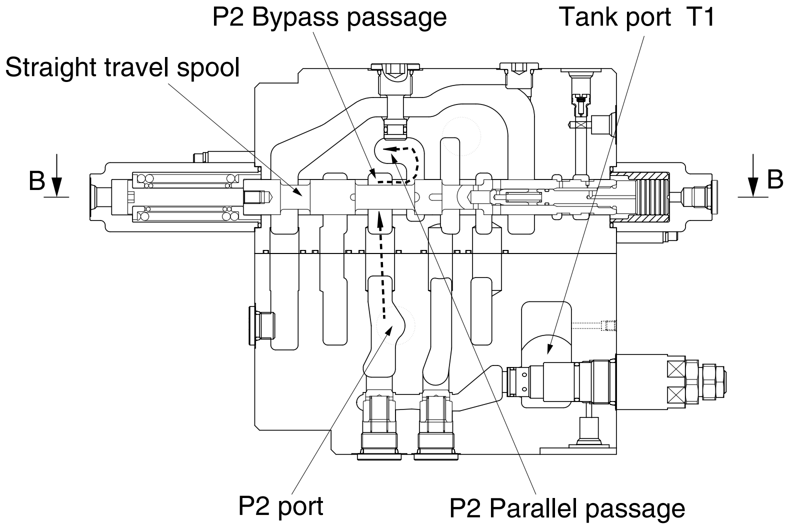
SECTION B-B

1609A2MC11

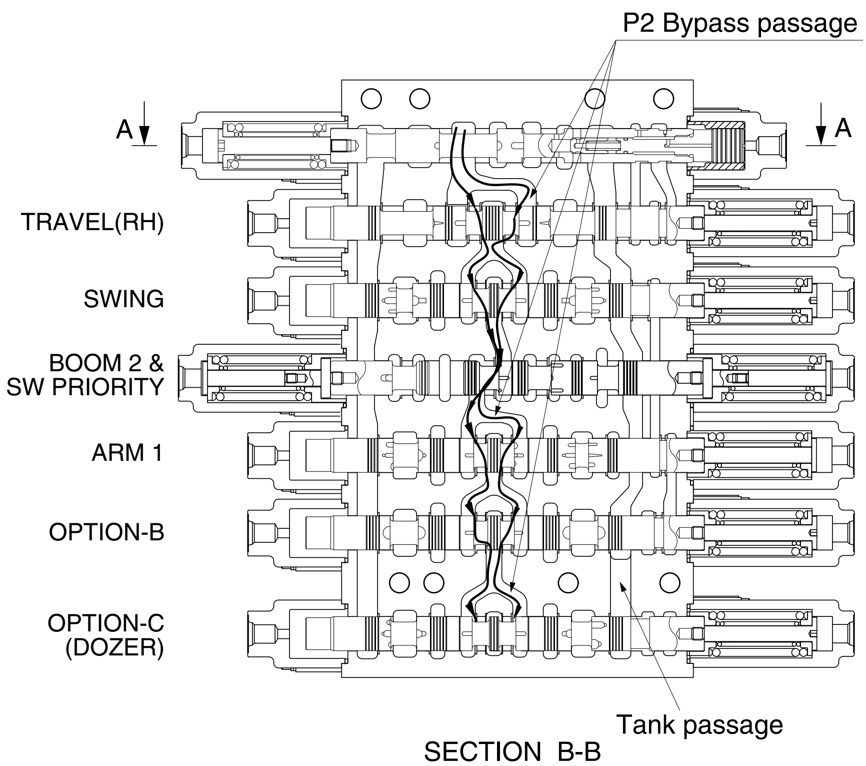
(2) P2 SIDE

The hydraulic fluid from pump A1 flows into the main control valve through the inlet port "P2", into the P2 bypass passage and P2 parallel passage.

The hydraulic fluid from the pump A1 is directed to the tank through the bypass passage of spools : travel right, swing, boom 2 & swing priority, arm 1, option "B" and option "C" (dozer), the negative relief valve of P2, tank passage and the tank port "T1".



SECTION A-A

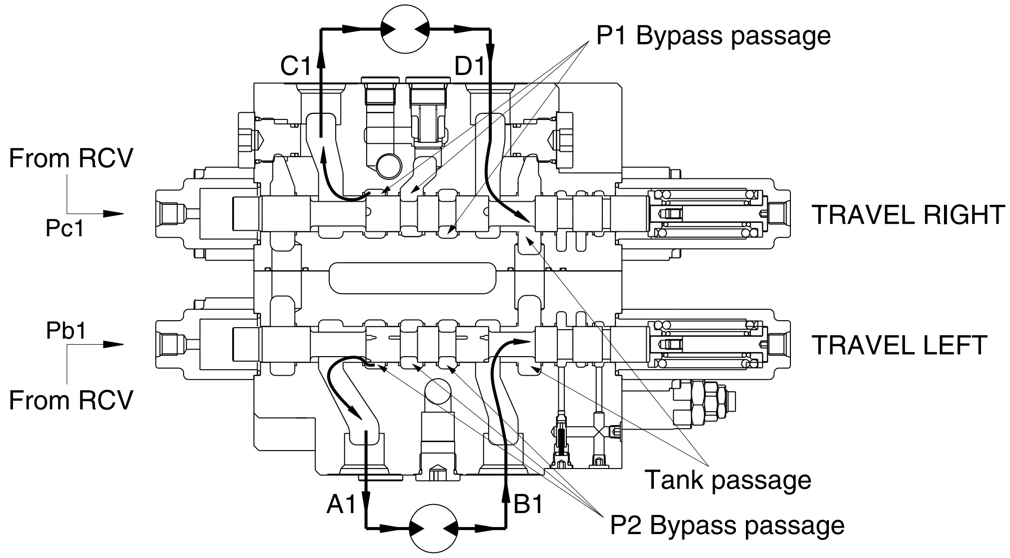


SECTION B-B

1609A2MC12

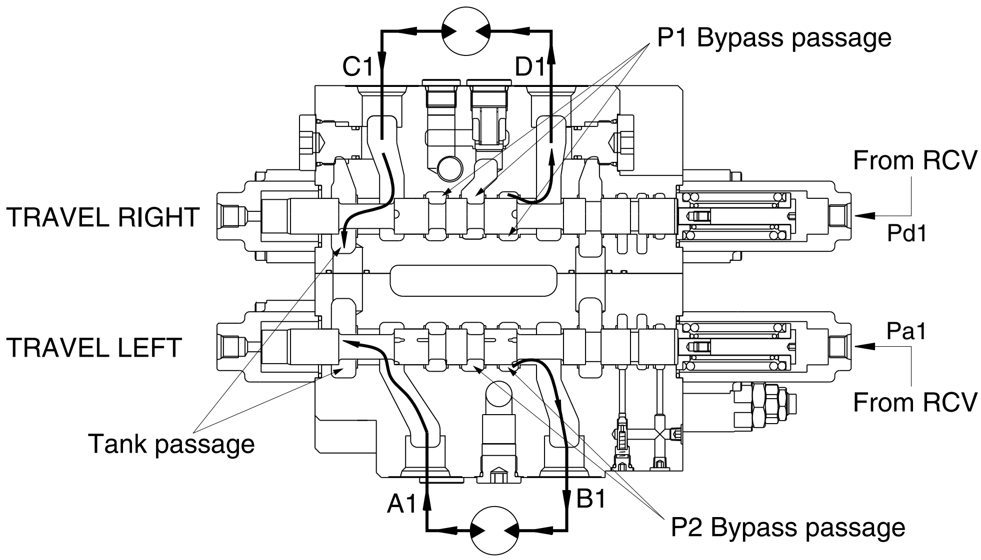
2) TRAVEL OPERATION

(1) TRAVEL FORWARD OPERATION



14092MC18

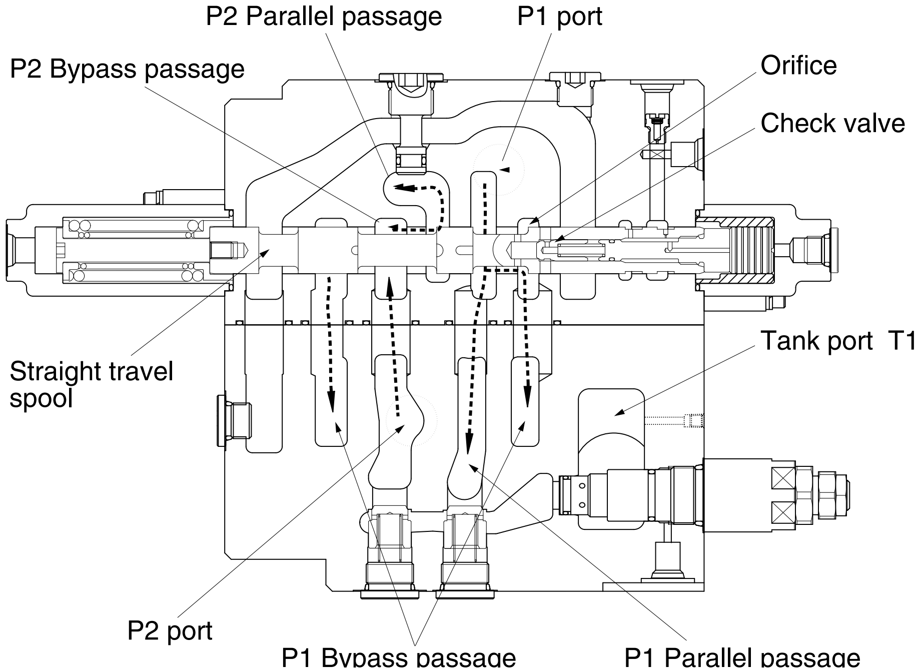
(2) TRAVEL BACKWARD OPERATION



14092MC17

During the travel forward operation, the hydraulic fluid of the pump A2 is supplied to the travel left motor and the hydraulic fluid of the pump A1 is supplied to the other travel right motor.
The pilot pressure from the pilot control valve is supplied to the spring side of pilot port (pb1, pc1).
And it shifts travel right and left spools in the left direction against springs. Hydraulic fluid from the pump A1 flow into the travel right spool through the bypass passage and hydraulic fluid from the pump A2 flow into the travel left spool through the bypass passage.
Then they are directed to the each travel motor through port A1 and C1. As a result, the travel motors turn and hydraulic fluid returns to the tank passage through the travel spools.
In case of the reverse operation, the operation is similar.

(3) TRAVEL STRAIGHT FUNCTION



14092MC19

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

① **During travel only :**

The hydraulic fluid of the pump A1 is supplied to the travel right motor and the pump A2 is supplied to the travel left motor.

Thus, the machine keep travel straight.

② **The other actuator operation during straight travel operation :**

When the other actuator spool (s) is selected under straight travel operation, the straight travel spool is moved.

The hydraulic fluid from pump A2 is supplied actuator through P2 and P1 parallel pass and travel motors through orifice at side of straight travel spool.

The hydraulic oil fluid from pump A1 is supplied to travel motors (left/right).

Therefore, the other actuator operation with straight travel operation, hydraulic oil fluid from pump A2 is mainly supplied to actuator, and the hydraulic oil fluid form pump A1 is mainly supplied to travel motors (left/right).

Then the machine keeps straight travel.

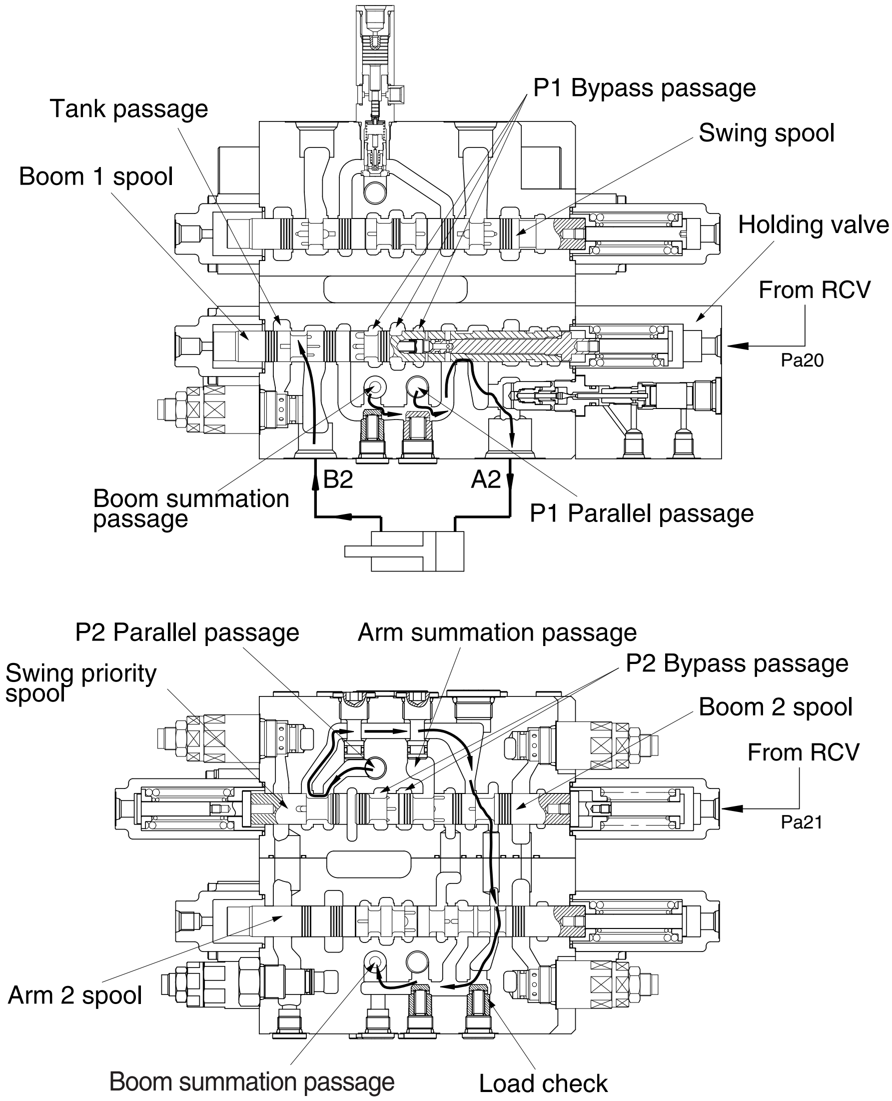
3) BOOM OPERATION

(1) BOOM UP OPERATION

During boom up operation, the pilot secondary pressure from RCV is supplied to the port Pa20 of the spring side and shifts the boom 1 spool in the left direction. The bypass passage is shut off by the movement of the boom 1 spool and the hydraulic oil fluid from pump A2 is entered P1 parallel passage and then passes through the load check, bridge passage and boom holding valve then flows into the port A2. Following this it flows into the head side of the boom cylinder. (In this case, the boom holding valve is free flow condition)

At the same time, the pilot pressure from RCV is supplied to the port Pa21 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 hydraulic oil fluid from pump A1 entered boom summation passage via the P2 parallel passage, the land of the swing priority spool, notch of the boom 2 spool, arm 2 spool and the check. The flows combine in passage and are directed to port A2 and head side of boom cylinder.

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



160F2MC24

(2) BOOM DOWN OPERATION

During the boom lowing operation, the pilot pressure from RCV is supplied to the port Pb20 of the spring opposite side and shifts the boom 1 spool in the right direction.

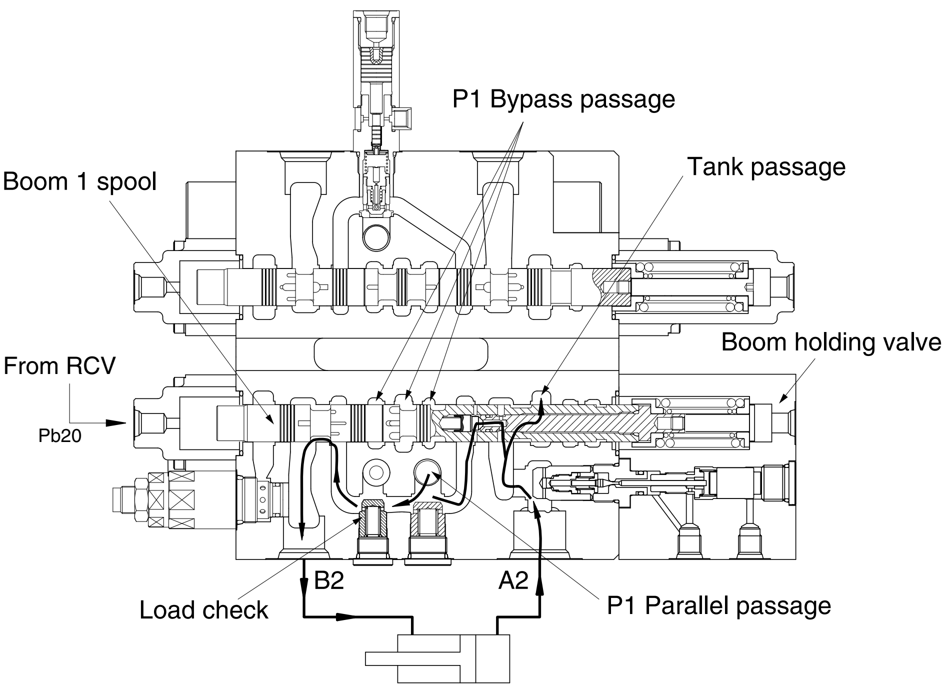
The bypass passage is shut off by the movement of the boom 1 spool and the hydraulic fluid from the pump A2 enters the parallel passage and is directed to the port B2 through the load check. Following this, it flows into the rod side of the boom cylinder.

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

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

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

During the boom lowering operation, the fluid from A1 pump is not summation.



160F2MC26

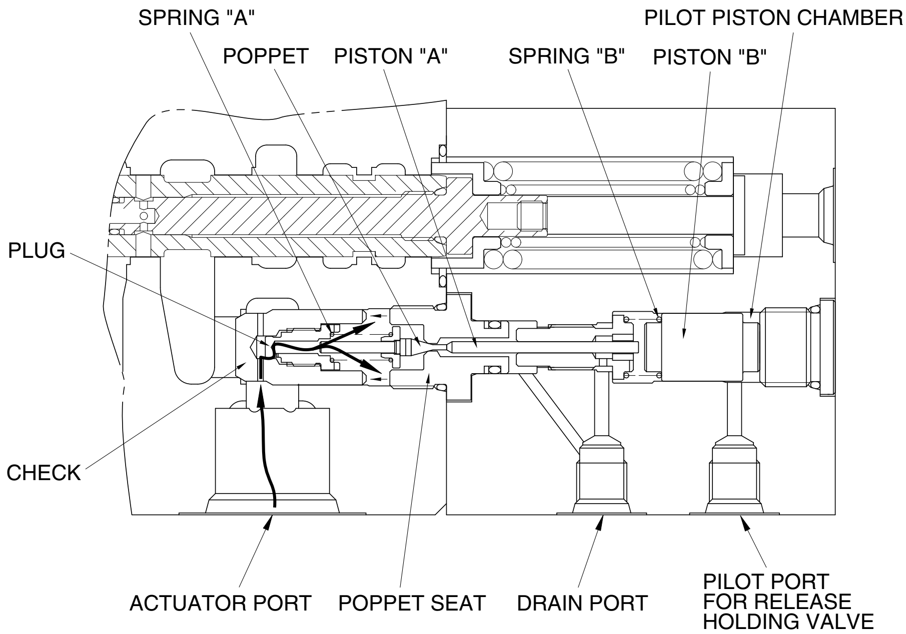
4) HOLDING VALVE OPERATION

(1) HOLDING OPERATION

At neutral condition, the pilot piston chamber is connected to drain port through the pilot port. And the piston "B" is supported with spring "B".

Also, the pressured fluid from actuator entered to inside of the holding valve through the periphery hole of check, crevice of the check and the plug and the periphery hole of plug.

Then, this pressured oil pushed the poppet to the poppet seat and the check to the seat of body. So the hydraulic fluid from actuator is not escaped and the actuator is not moved.



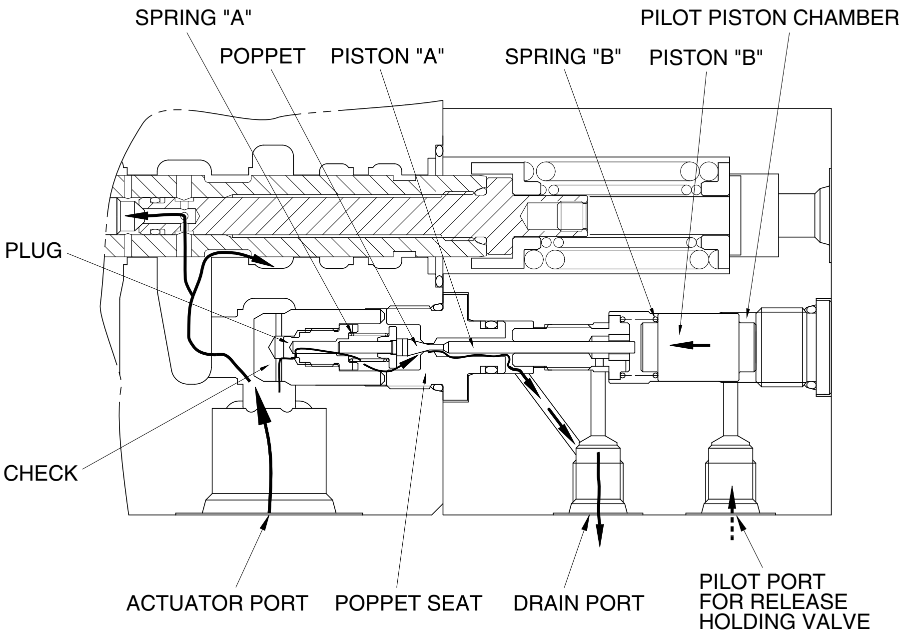
160F2MC15

(2) RELEASE HOLDING OPERATION

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

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

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



160F2MC16

5) BUCKET OPERATION

(1) BUCKET IN OPERATION

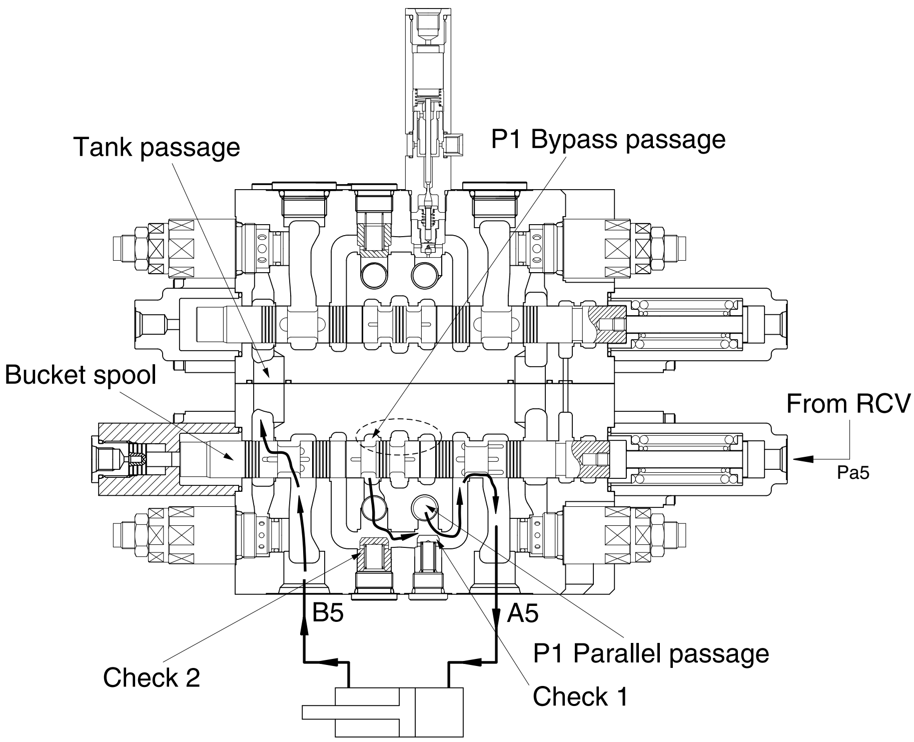
During the bucket in operation, the pilot secondary pressure from RCV is supplied to port Pa5 of the spring side and shifts the bucket spool in the left direction.

The bypass passage is shut off by the movement of the bucket spool and the hydraulic fluid from pump A2 entered P1 parallel passage and is directed to the port A5 through the check 1.

At the same time, the hydraulic fluid from P1 bypass passage is directed to the port A5 through the check 2.

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

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



160F2MC34

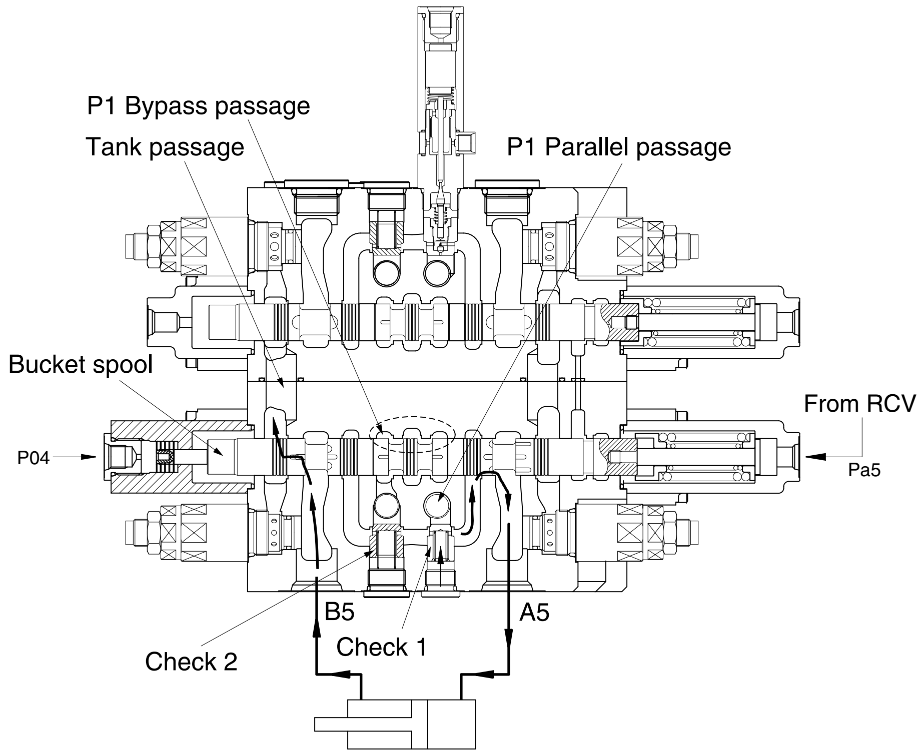
(2) BUCKET OUT OPERATION

During the bucket out operation, the pilot secondary pressure from RCV is supplied to port Pb5 of the spring opposite side and shifts the bucket spool in the right direction.

The bypass passage is shut off by the movement of the bucket spool and the hydraulic fluid from pump A2 entered P1 parallel passage and is directed to the port B5 through the check 1.

At the same time, the hydraulic fluid from P1 bypass passage is directed to the port B5 through the check 2.

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



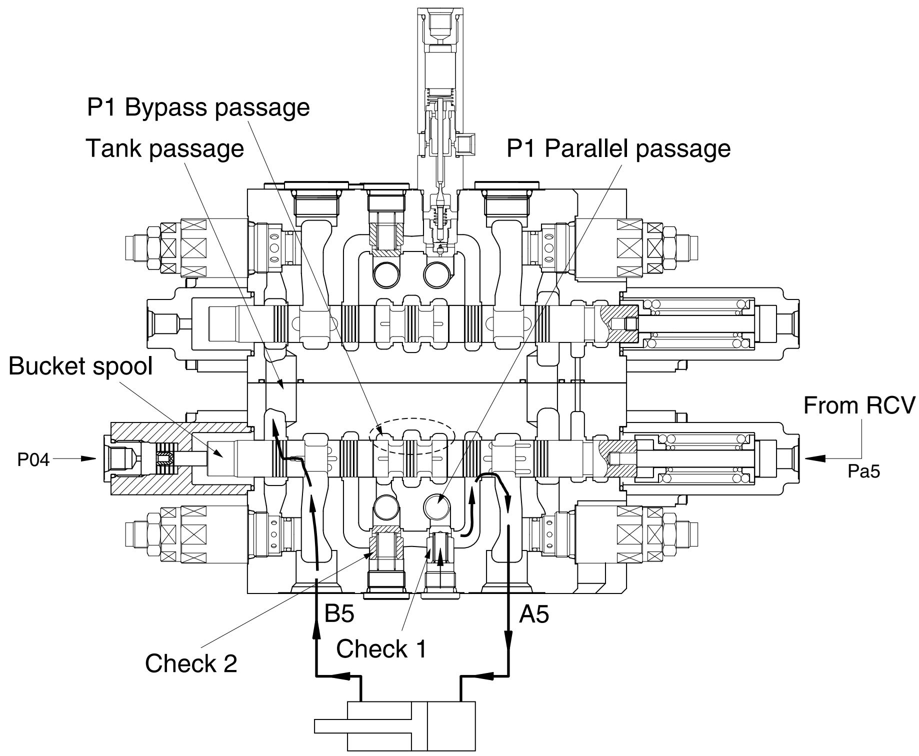
160F2MC35

(3) BUCKET IN OPERATION WITH BOOM UP OPERATION

When combined operation, mostly same as previous page.

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

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



160F2MC29

6) SWING OPERATION

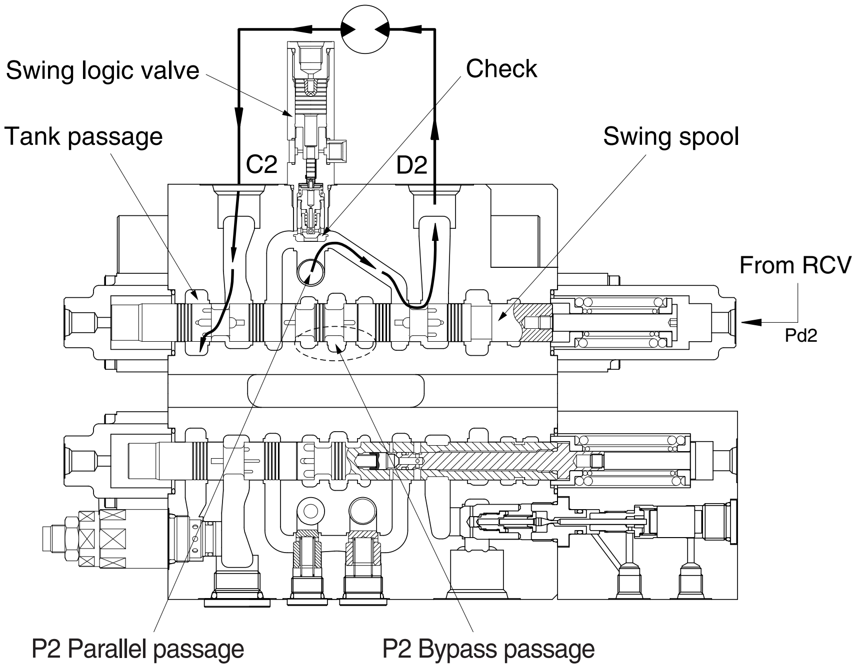
(1) SWING LEFT & RIGHT OPERATION

During the swing left operation, the pilot secondary pressure from the RCV is supplied to the port Pd2 of the spring side and shift the swing spool in left direction. The bypass passage is shut off by the movement of the swing spool and the hydraulic fluid from pump A1 flows into swing spool through the P2 parallel passage. Then it is directed to swing motor through the port D2.

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

In case of swing right operation, the operation is similar to swing left operation but the pilot secondary pressure from the RCV is supplied to the port Pc2 of the spring opposite side.

Accordingly, the hydraulic fluid from pump A1 flows into swing motor through the port C2 and returns to the hydraulic oil tank through the port D2 and the tank passage.

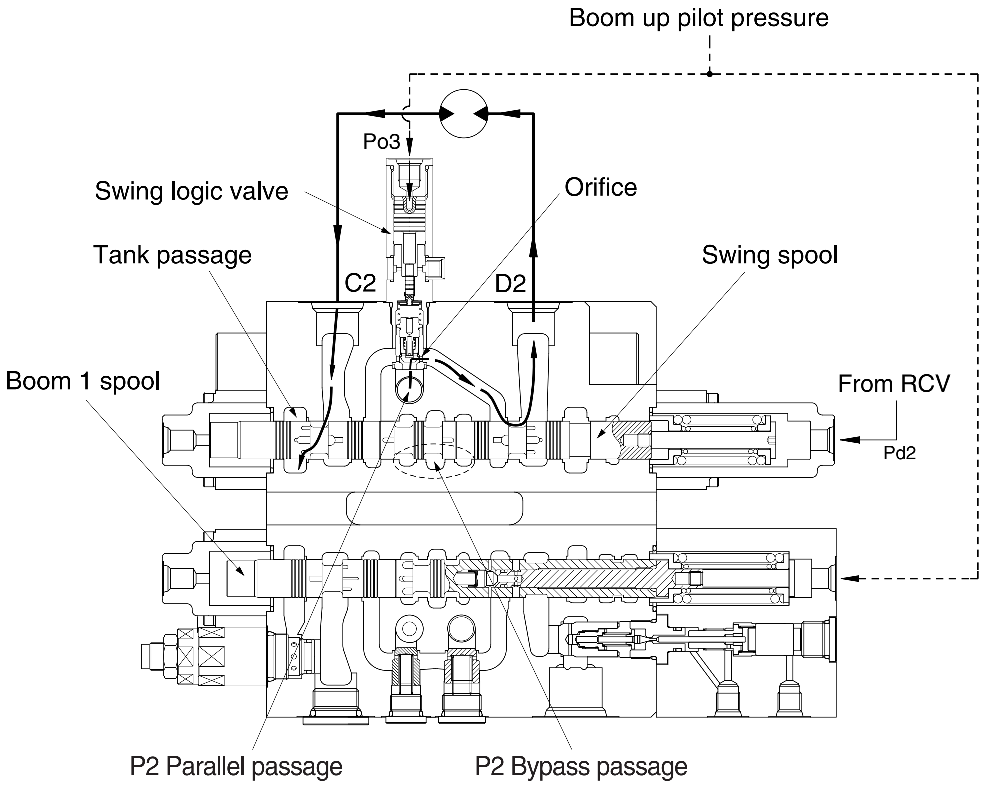


160F2MC32

(2) SWING LEFT OPERATION WITH ARM OR BOOM OPERATION

When combined operation, mostly same as previous page but the fluid from P2 bypass passage is empty.

So only the fluid from parallel passage is supplied to the swing motor. Also, parallel passage is installed the orifice of swing logic valve for supplying the fluid from pump A1 to the boom or the arm operation prior to the swing operation. In case of the swing right operation with arm or boom operation, operation is similar.



160F2MC20

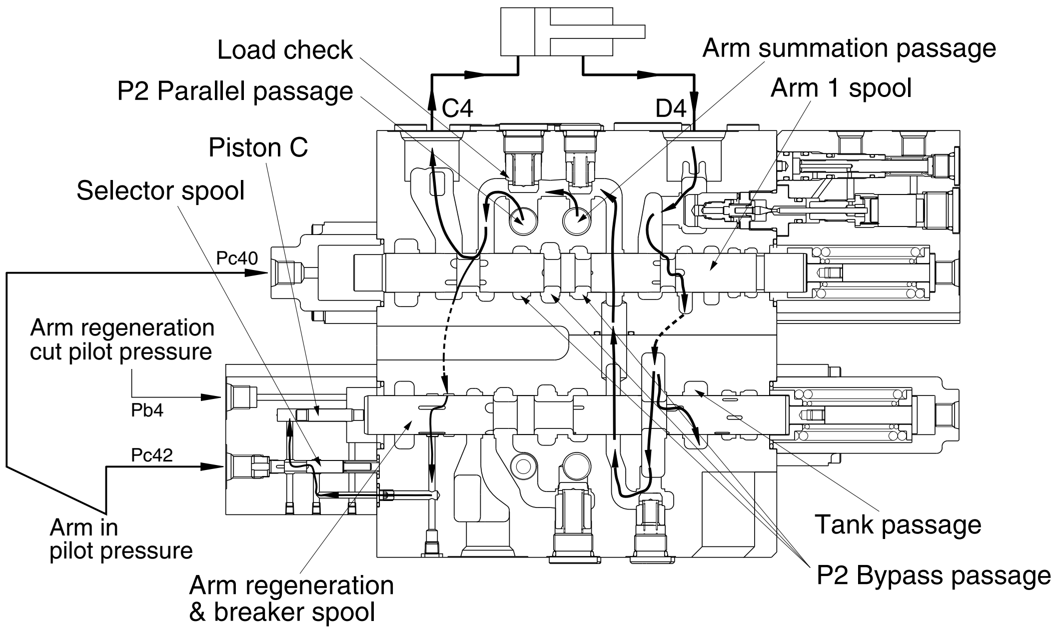
7) ARM OPERATION

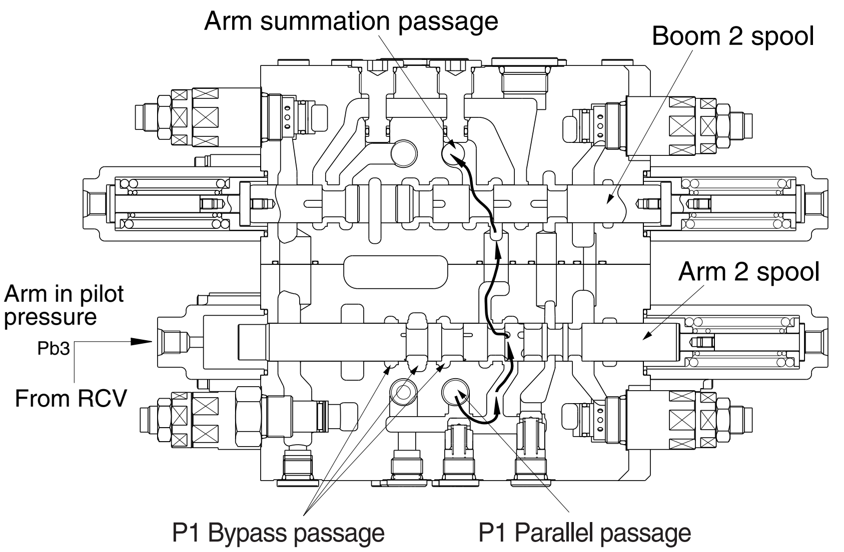
(1) ARM IN OPERATION

During arm in operation, the pilot secondary pressure from the RCV is supplied to the port Pc40 of spring opposite side and shifts arm 1 spool in the right direction.

The bypass passage is shut off by the movement of the arm 1 spool and the hydraulic oil from the pump A1 flows into the arm cylinder head side through P2 parallel passage, the load check valve, bridge passage and the port C4.

At same time, the pilot secondary pressure from the RCV is supplied to the port Pb3 of spring opposite side and shifts arm 2 spool in the right direction. The bypass passage is shut off by the movement of the arm 2 spool and the hydraulic fluid from the pump A2 flows into the arm summation passage through P1 parallel passage, the check valve, the arm 2 spool and the boom 2 spool. Then it entered the arm cylinder head side with hydraulic fluid from arm 1 spool.





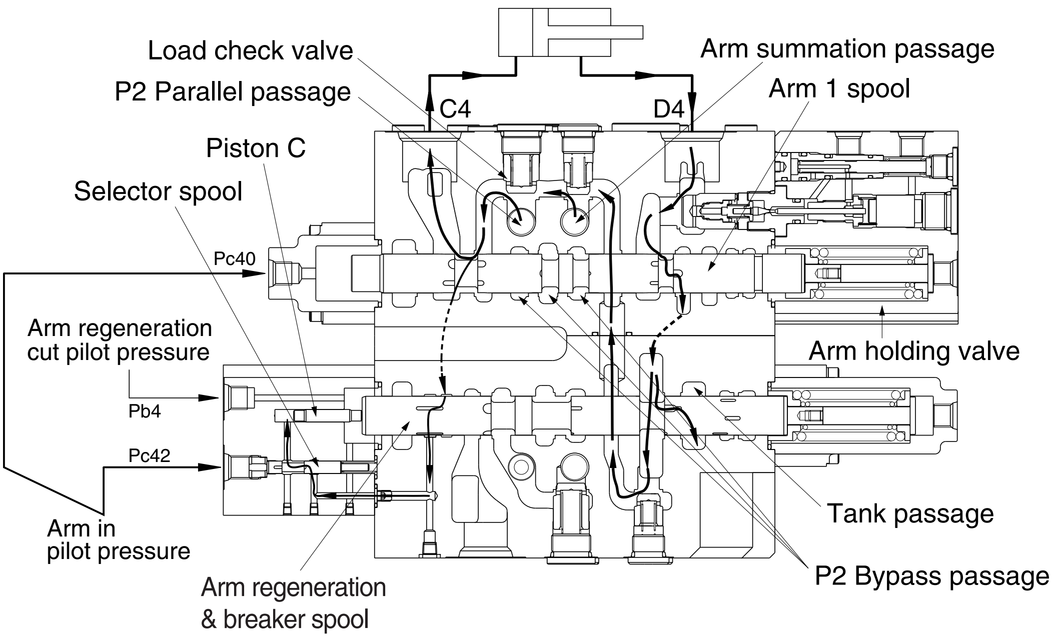
1609A2MC21

ARM REGENERATION

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

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

Furthermore, the arm regeneration cut pressure is supplied to the port Pb4 of spring opposite side and arm regeneration spool is move into the right direction fully. The flow from the arm cylinder rod is returned to the hydraulic oil tank and regeneration function is not activated. (The return fluid is maximum condition)



1609A2MC22

(2) ARM OUT OPERATION

During arm out operation, the pilot secondary pressure from RCV is supplied to the port Pd40 of spring side and shifts arm 1 spool in the left direction.

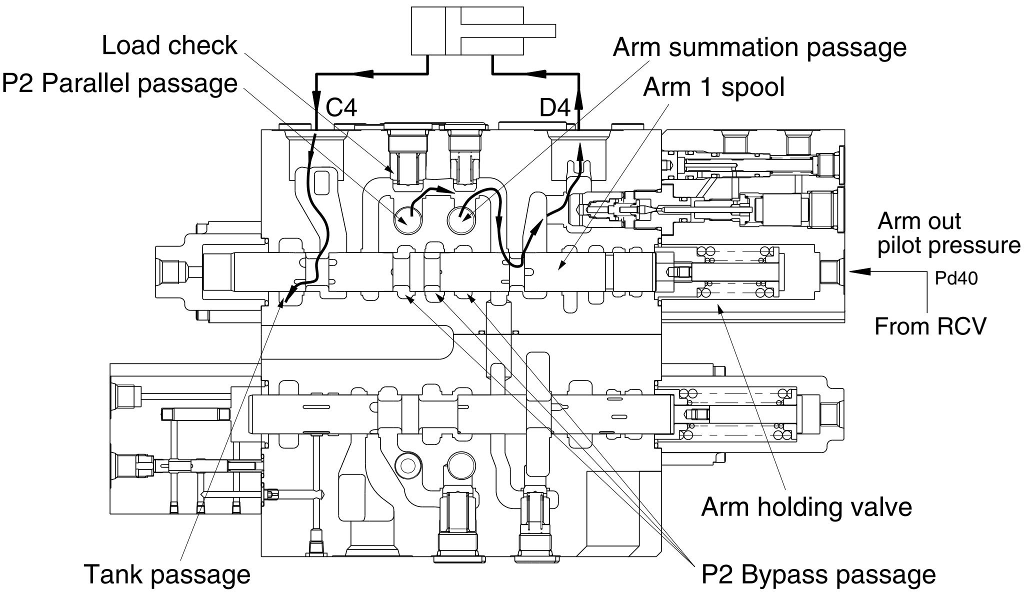
The bypass passage is shut off by the movement of the arm 1 spool and the hydraulic fluid from pump A1 flows into arm 1 spool through the P2 parallel passage. Then it enters into the arm cylinder rod side through the load check, bridge passage, arm holding valve and the port D4.

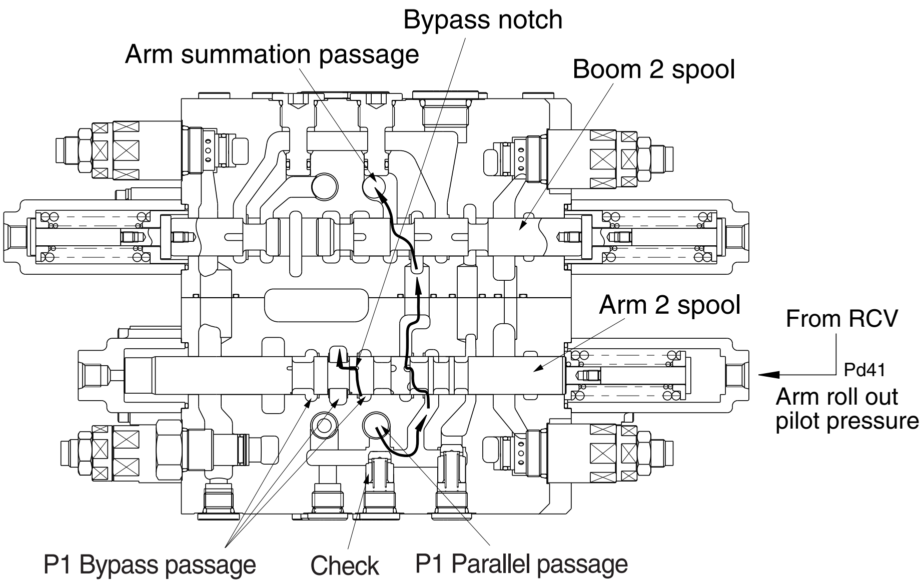
Also, the pilot secondary pressure from RCV is supplied to the port Pd41 of spring side and shifts arm 2 spool in the left direction.

The bypass passage is shut off by the movement of the arm 2 spool and some of the hydraulic fluid from pump A2 bypassed through bypass notch. The rest of hydraulic fluid from pump A2 flows into the arm summation passage through P1 parallel passage, the check valve, arm 2 spool and boom 2 spool.

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

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





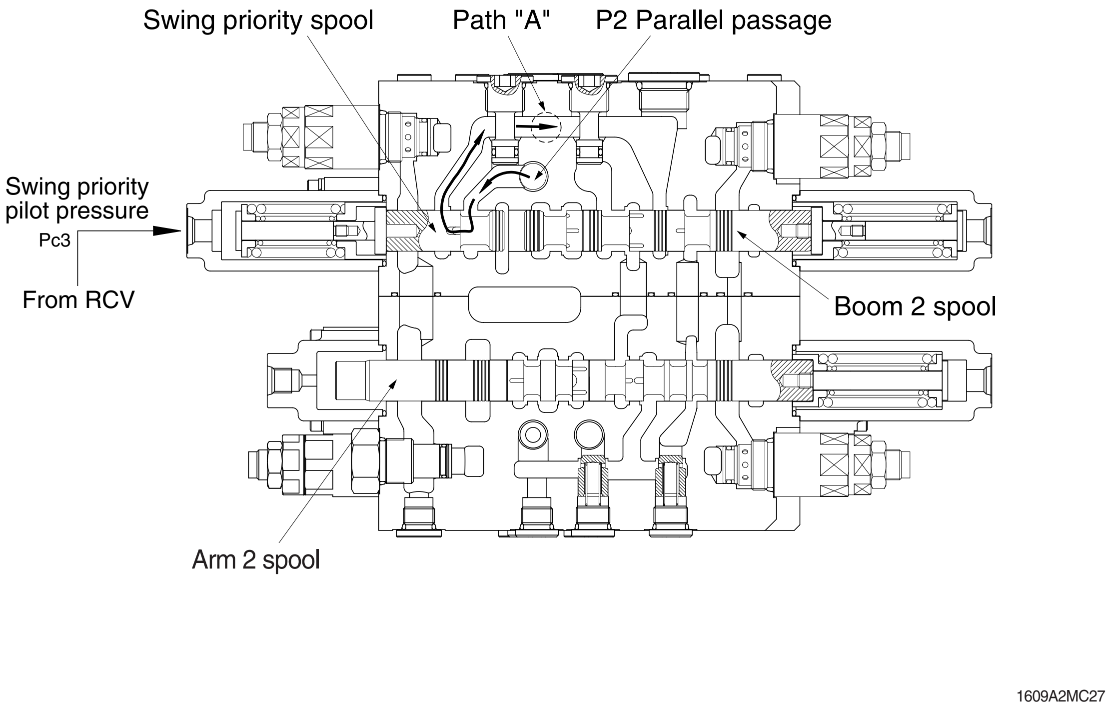
1609A2MC23

8) SWING PRIORITY FUNCTION

During swing priority operation, the pilot secondary pressure is supplied to the port Pc3 of the spring side of the swing priority spool and shift swing priority spool in the right direction.

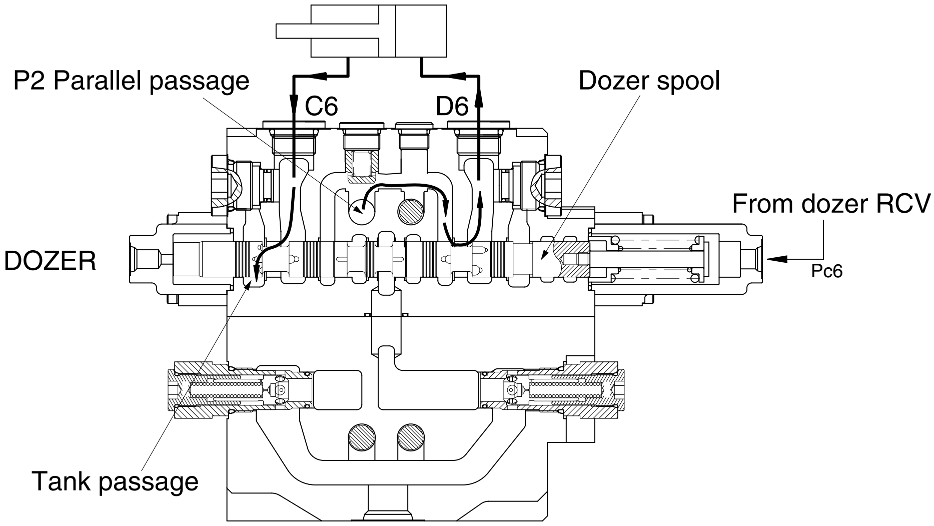
The hydraulic fluid from P2 parallel passage flows into the parallel passage of arm 1 side through swing priority spool and the path "A" and also flows into the boom 2 spool.

When the swing priority spool is neutral condition, the passage is same as normal condition. But due to shifting of the swing priority spool, the fluid from pump A1 flows to swing side more then the boom 2, arm 1, option B and dozer spools to make the swing operation most preferential.



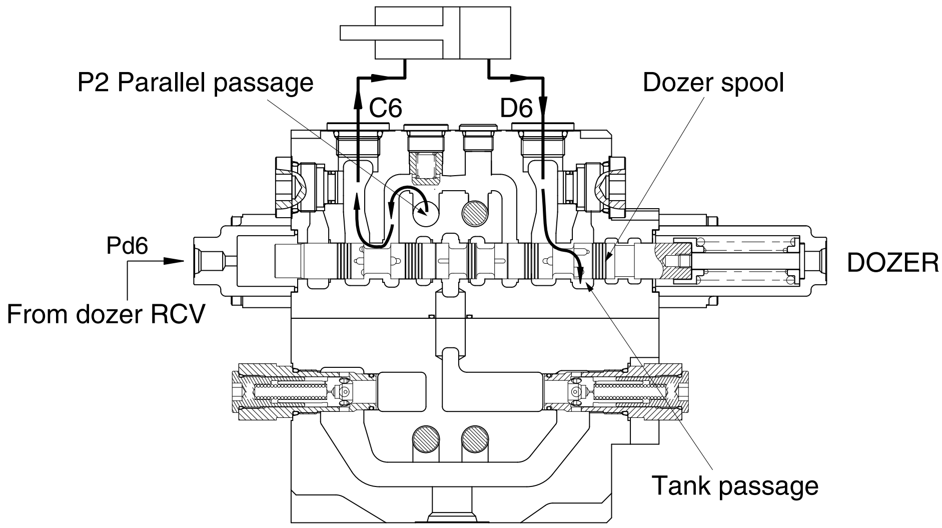
9) DOZER OPERATION

(1) Dozer down operation



14W92MC30

(2) Dozer up operation



14W92MC31

During the dozer down operation, the pilot pressure from the dozer control valve is supplied into the port Pc6 of the spring side and it shifts the dozer spool in the left direction.
The hydraulic fluid from the pump A1 enters the parallel passage and is direction to the head side of the dozer cylinder through port D6.
The return flow from the rod side of the dozer cylinder returns to the dozer spool through C6 port. Thereafter it is directed to the hydraulic tank through tank passage.
In case of the dozer up operation, operation is similar.

10) NEGATIVE RELIEF VALVE OPERATION

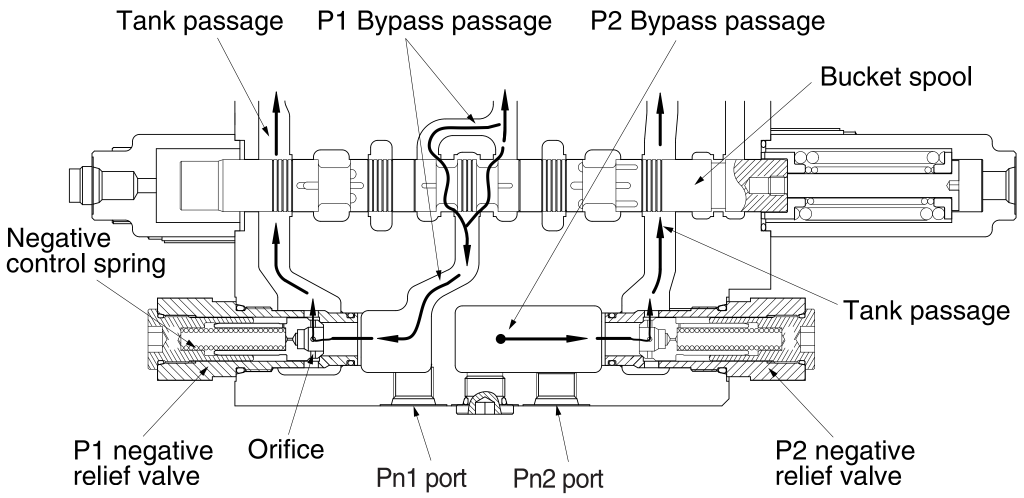
When no function is being actuated on P1 side, the hydraulic fluid from the pump A2, flows into the tank passage through the P1 bypass passage and orifice. The restriction caused by this orifice thereby pressurizes. This pressure is transferred as the negative control signal pressure Pn1 to the pump A2 regulator.

It controls the pump regulator so as to minimize the discharge of the pump A2.

The bypass passage is shut off when the shifting of one or more spools and the flow through bypass passage became zero. The pressure of negative control signal becomes zero and the discharge of the pump A2 becomes maximum.

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

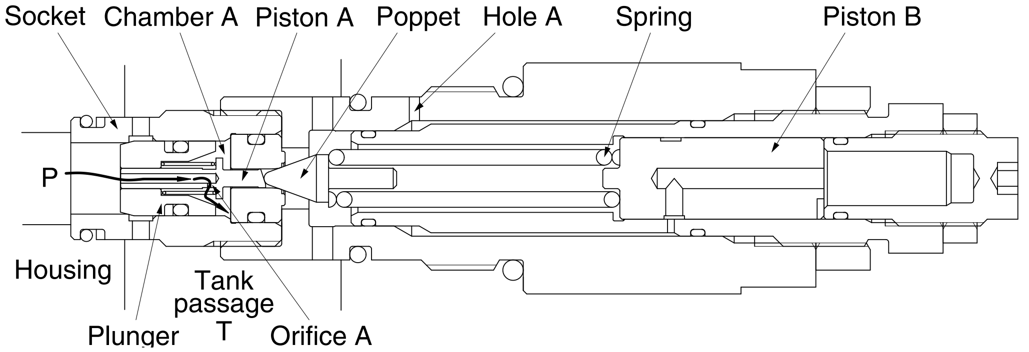
For the pump A1 the same negative control principle.



14W92MC28

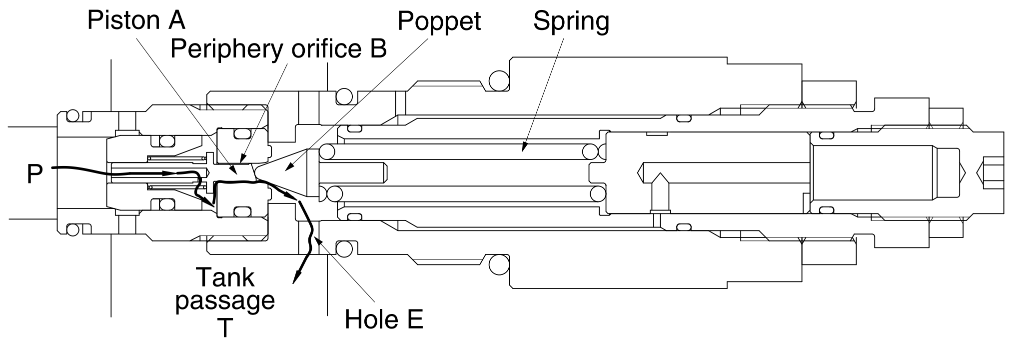
11) OPERATION OF MAIN RELIEF VALVE

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



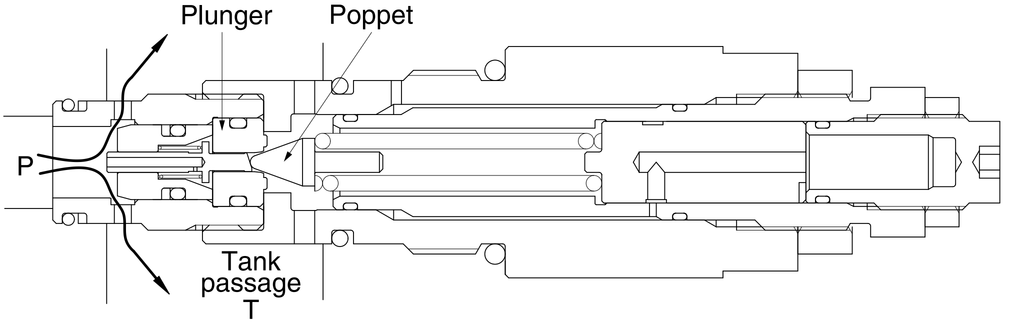
14W92MC36

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



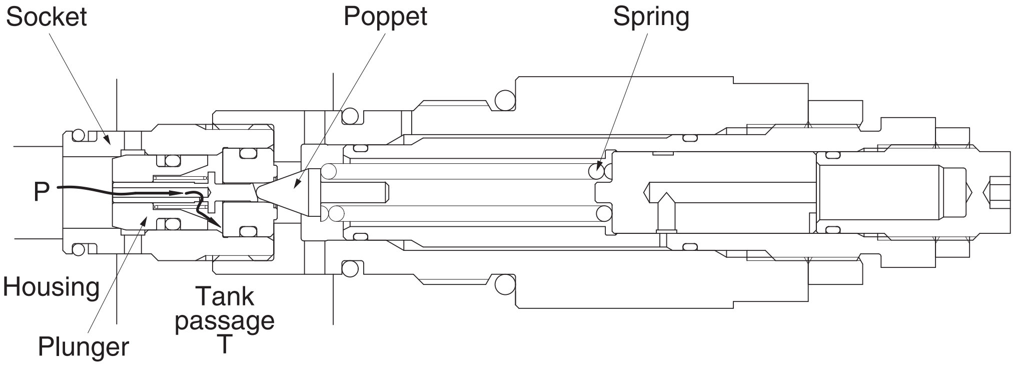
14W92MC37

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



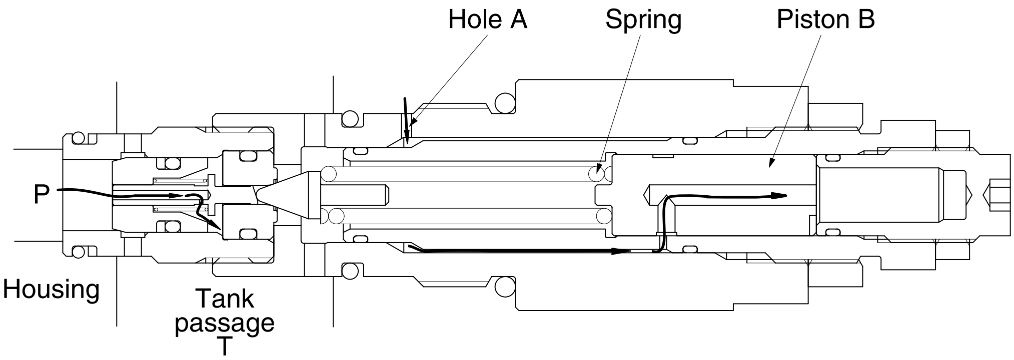
14W92MC38

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



14W92MC39

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

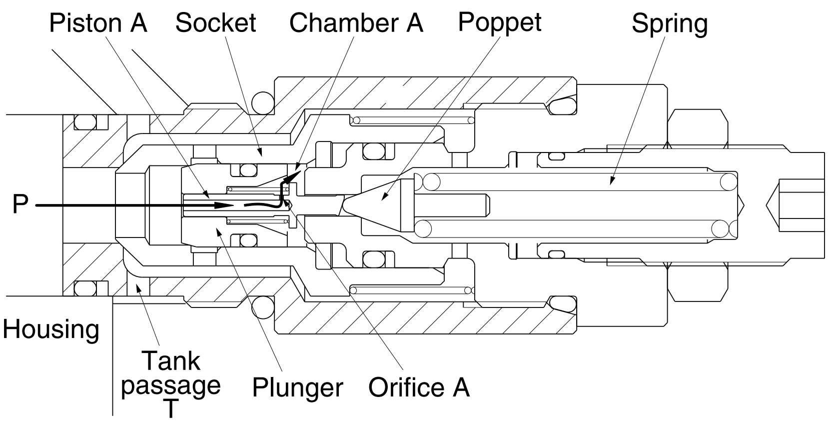


14W92MC40

12) OPERATION OF OVERLOAD RELIEF VALVE

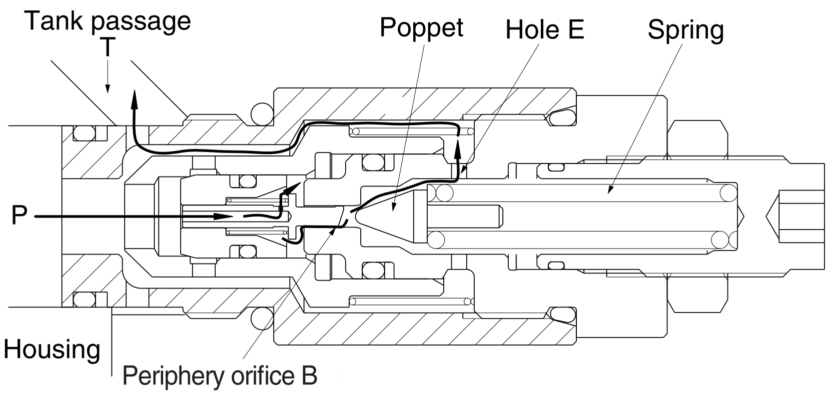
FUNCTION AS RELIEF VALVE

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



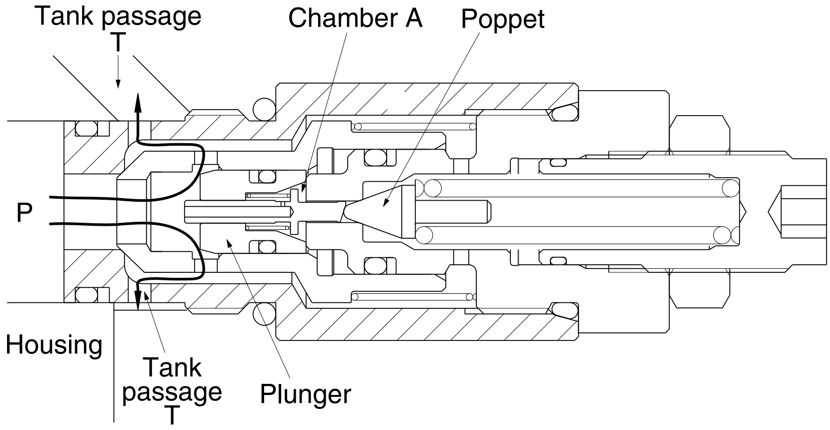
14W92MC41

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



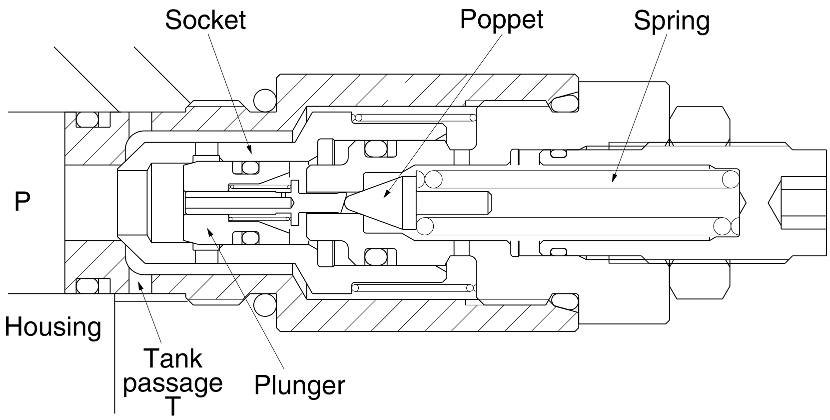
14W92MC42

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



14W92MC43

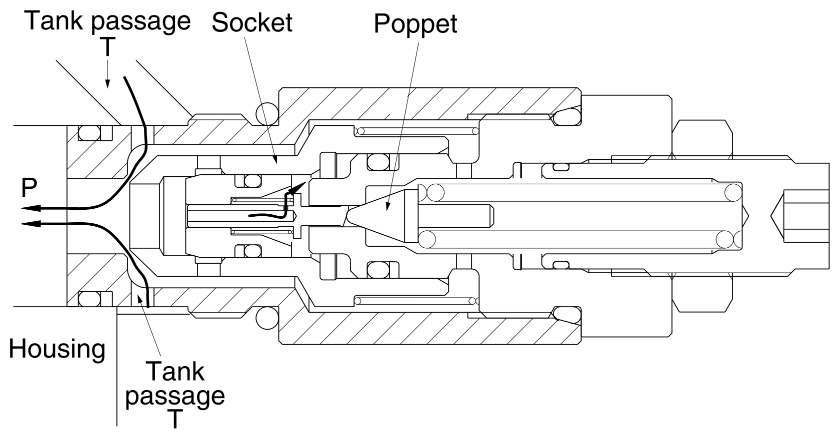
(4) The pressure at port P becomes lower than set pressure of the spring, the poppet is seated by spring force. Then the pressure at port P becomes equal to set pressure of the spring and the plunger is seated to the socket.



14W92MC44

MAKE-UP FUNCTION

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



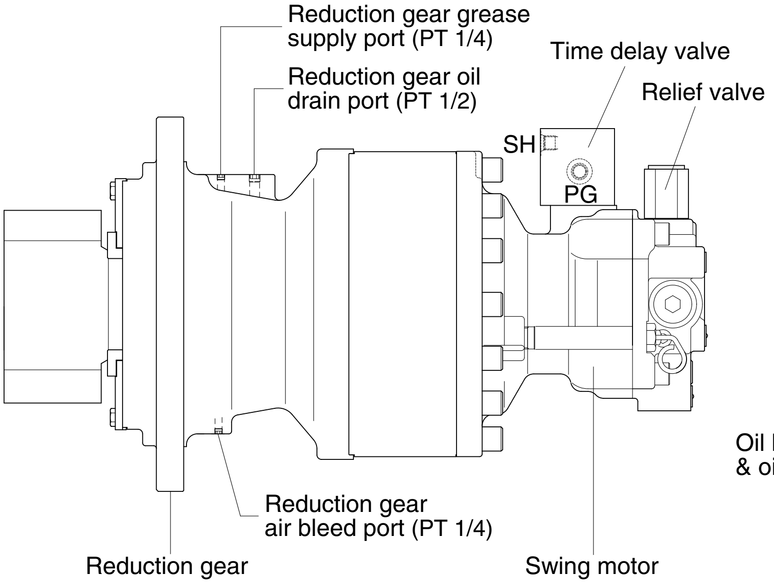
14W92MC45

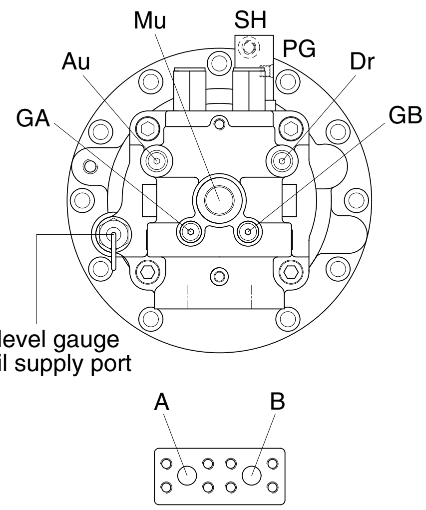
GROUP 3 SWING DEVICE (TYPE 1)

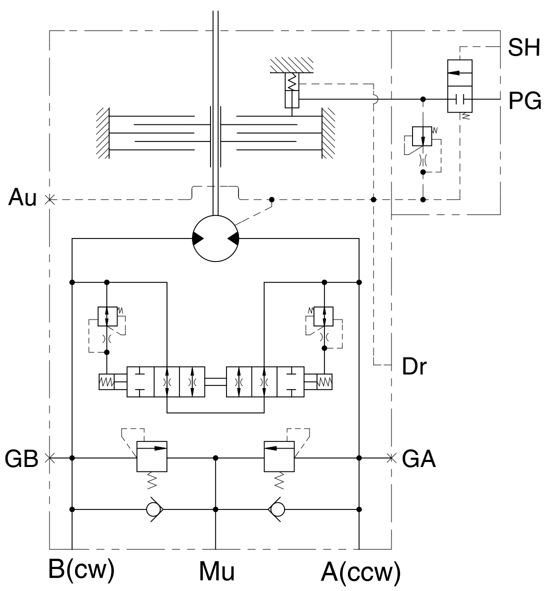
1. STRUCTURE

Swing device consists swing motor, swing reduction gear.

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





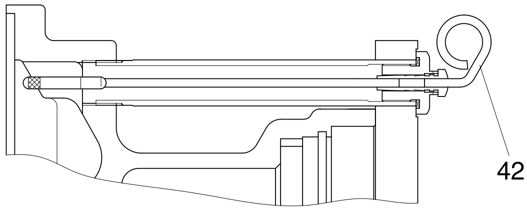


Hydraulic circuit

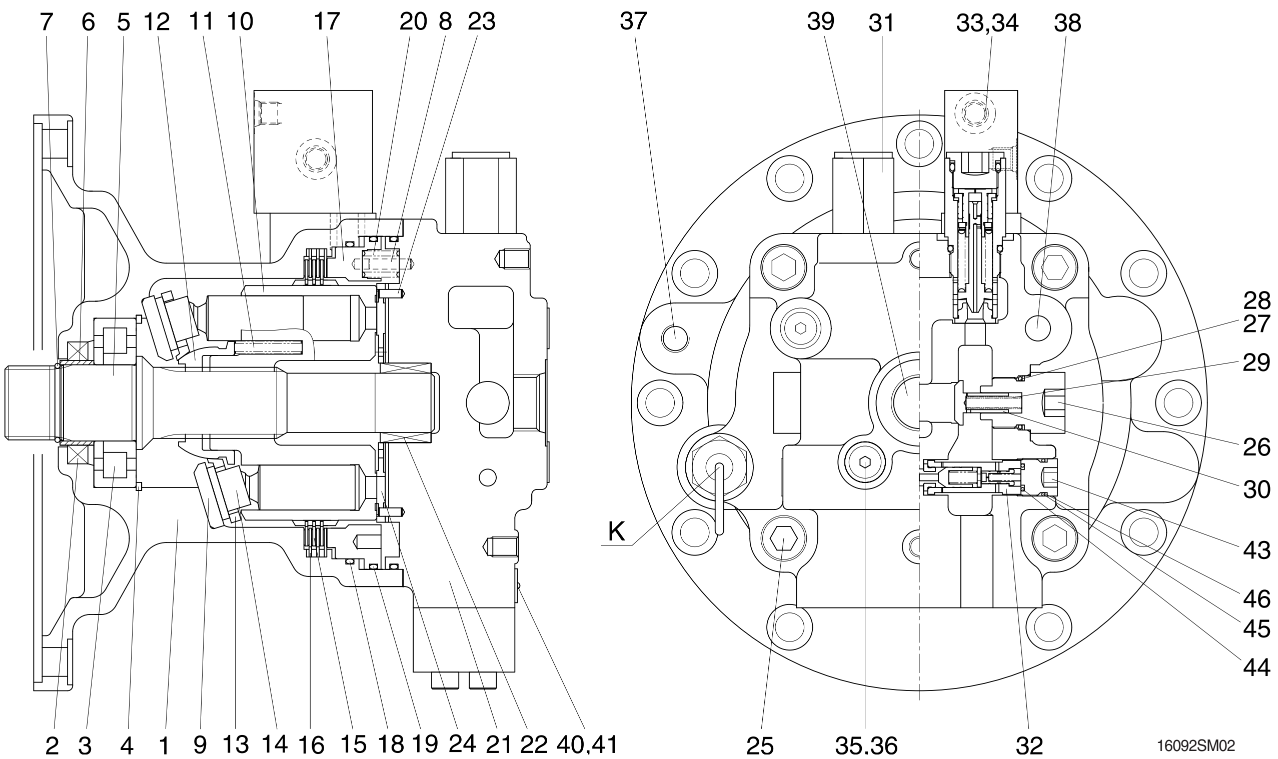
Port	Port name	Port size
A	Main port	ø 20
B	Main port	ø 20
Dr	Drain port	PF 1/2
Mu	Make up port	PF 1
PG	Brake release stand byport	PF 1/4
SH	Brake release pilot port	PF 1/4
GA, GB	Gauge port	PF 1/4
Au	Air vent port	PF 1/4

16092SM01

1) SWING MOTOR

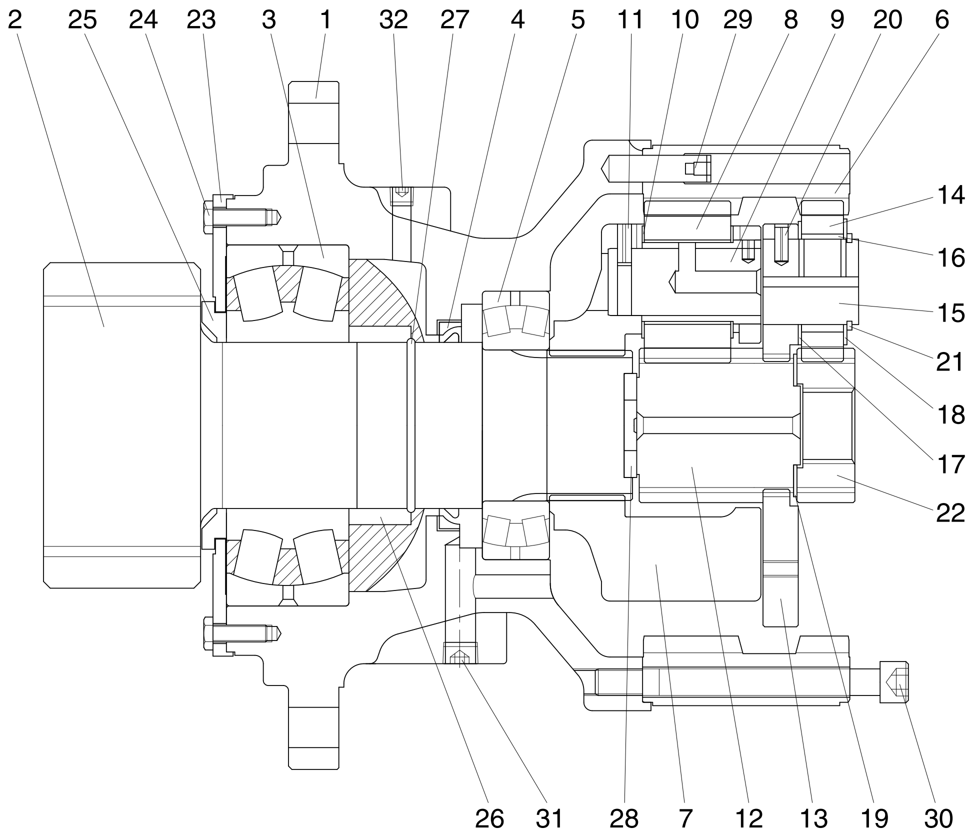


DETAIL K



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

2) REDUCTION GEAR



160F2SM05

1	Casing	12	Sun gear 2	23	Cover plate
2	Drive shaft	13	Carrier 1	24	Hexagon bolt
3	Roller bearing	14	Planet gear 1	25	Spacer
4	Oil seal	15	Pin 1	26	Spacer pipe
5	Roller bearing	16	Needle cage	27	Wire
6	Ring gear	17	Side plate 1	28	Thrust plate
7	Carrier 2	18	Side plate 2	29	Knock pin
8	Planet gear 2	19	Side plate 3	30	Socket bolt
9	Pin 2	20	Spring pin	31	Plug
10	Thrust washer	21	Stop ring	32	Plug
11	Spring pin	22	Sun gear 1		

2. PRINCIPLE OF DRIVING

2.1 Generating the turning force

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

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

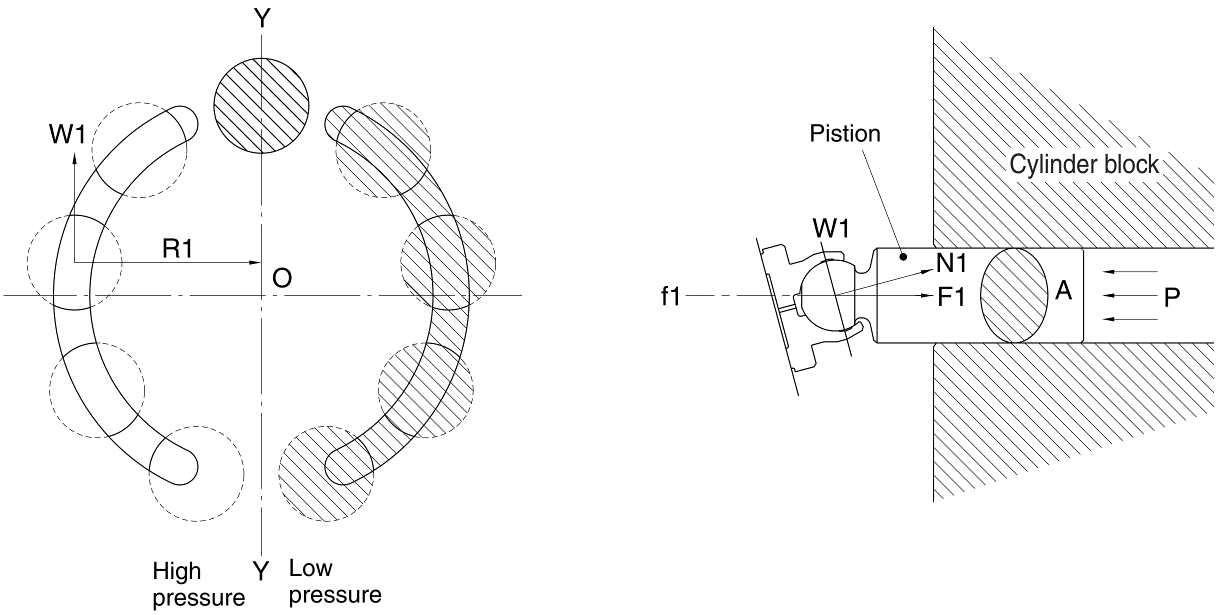
The high hydraulic can generate the force, F1=P×A (P : supplied pressure, A : water pressure area), like following pictures, working on a piston.

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

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

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

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



21078TM05

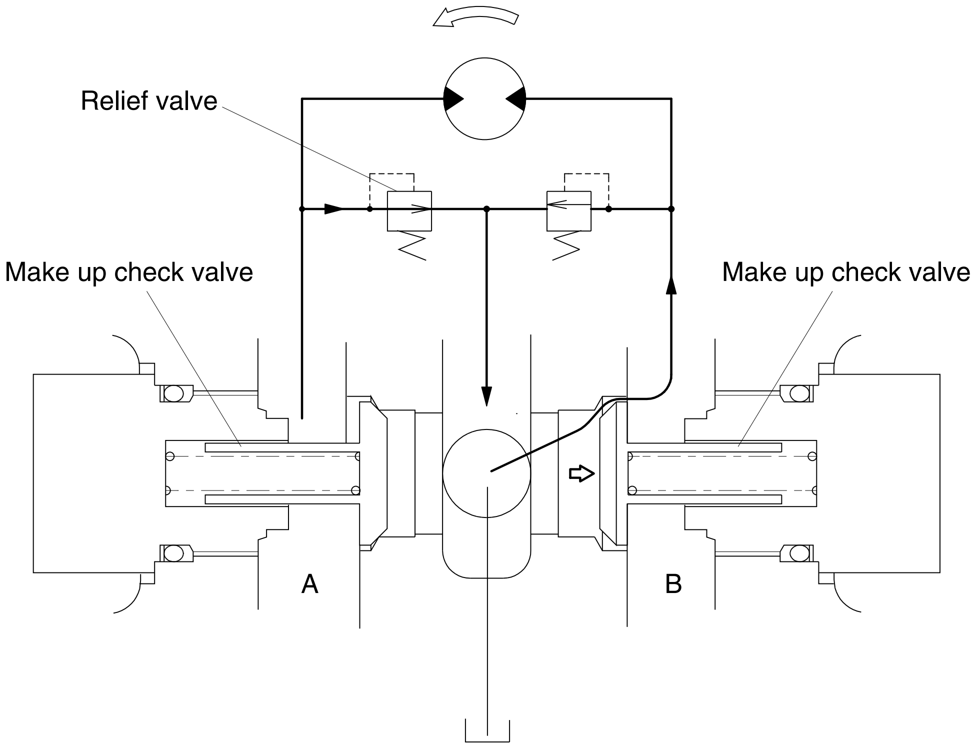
2) MAKE UP VALVE

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.

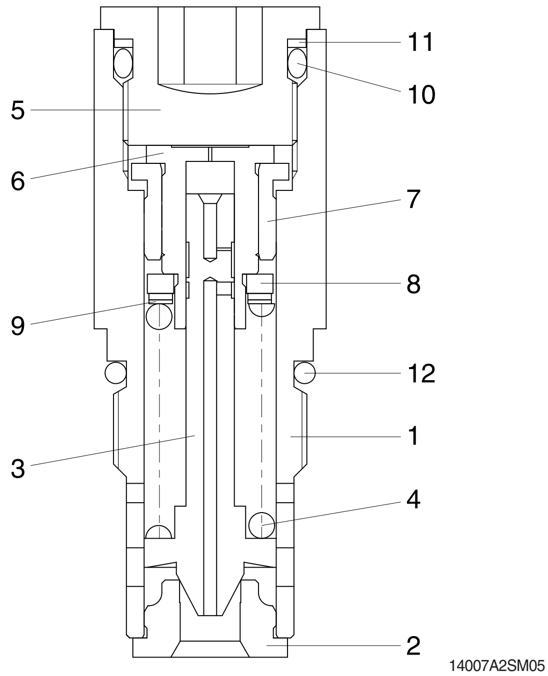
Pressurized oil into the port B, the motor rotate counterclockwise.

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



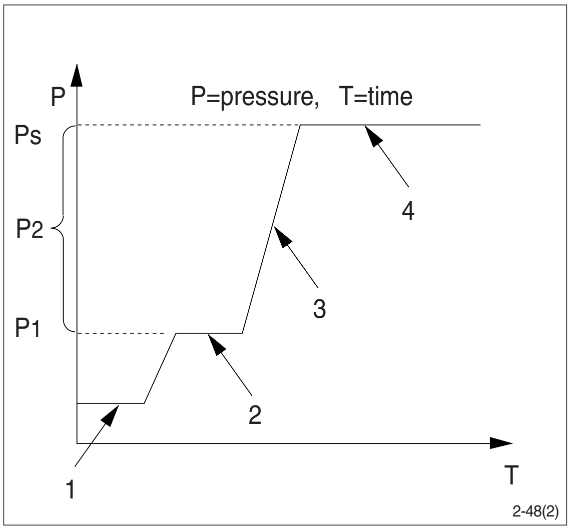
1	Body
2	Seat
3	Plunger
4	Spring
5	Adjusting screw
6	Piston
7	Bushing
8	Spring seat
9	Shim
10	O-ring
11	Back up ring
12	O-ring

(1) Construction of relief valve

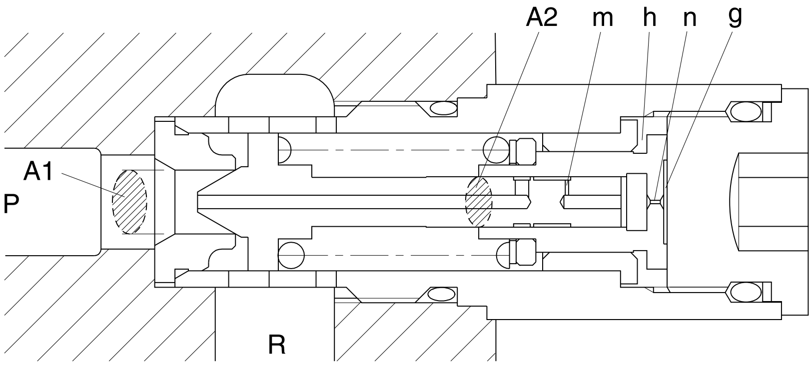
The valve casing contains two cartridge type relief valves that stop the regular and reverse rotations of the hydraulic motor. The relief valves relieve high pressure at start or at stop of swing motion and can control the relief pressure in two steps, high and low, in order to insure smooth operation.

(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.

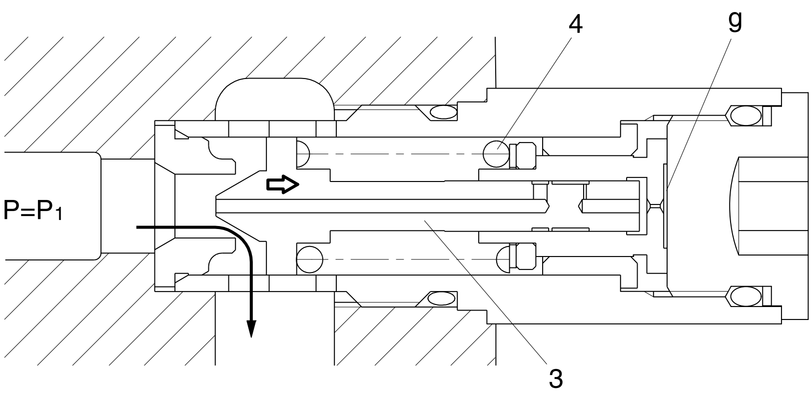


14007A2SM06

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.

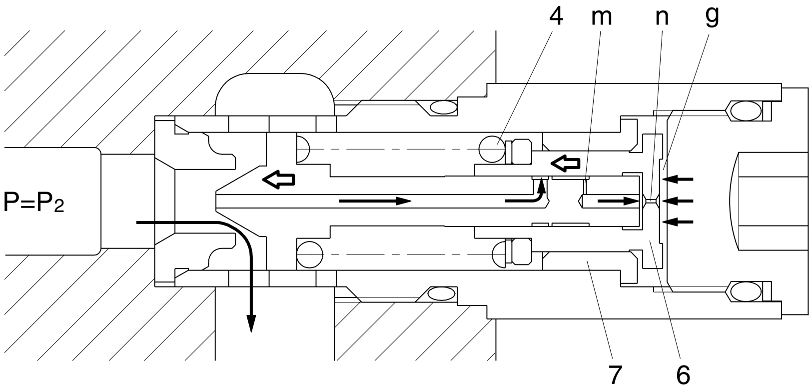
$P_1 \times A_1 = Fsp + Pg \times A_2$

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



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).

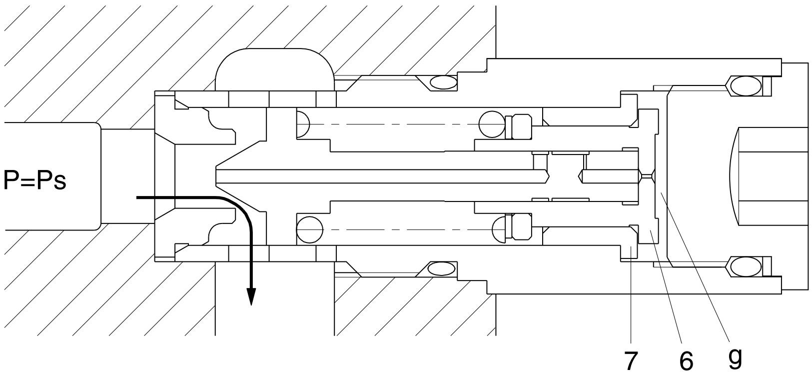


14007A2SM08

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).

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

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



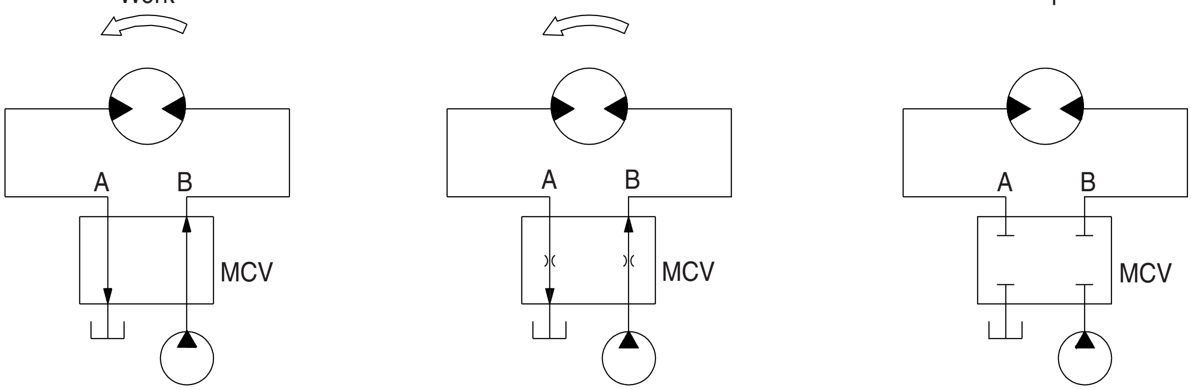
14007A2SM09

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.



2-48(1)

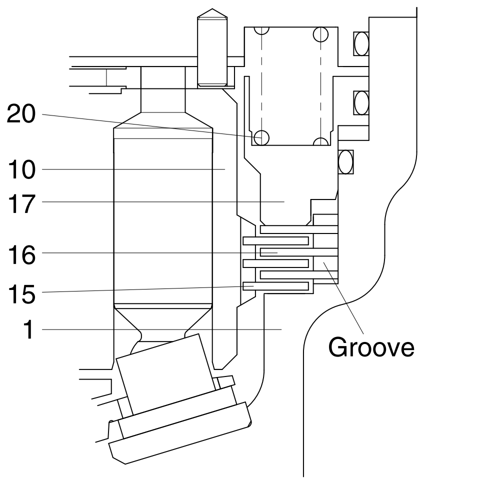
(2) Mechanical swing parking brake system

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

① Brake assembly

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

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

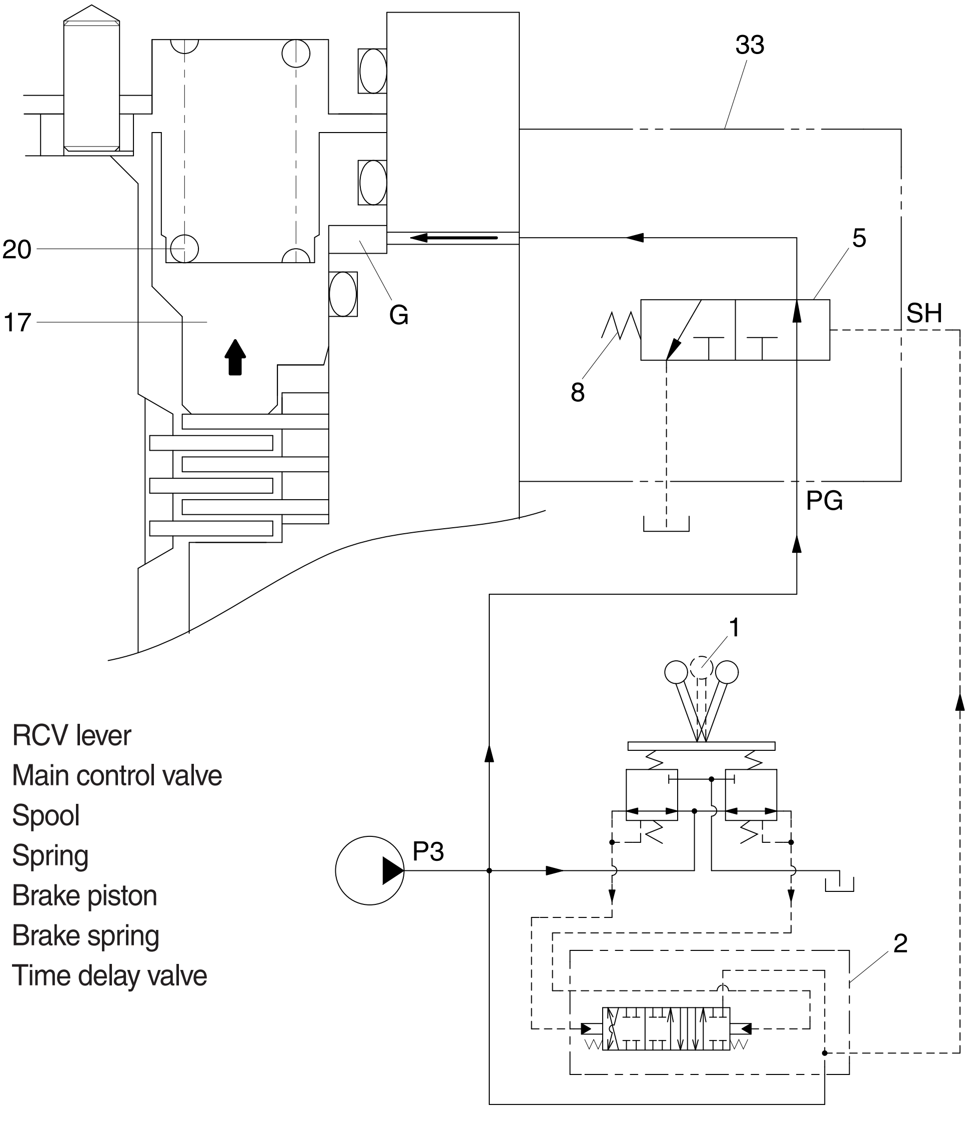


21092SM15

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

② Operating principle

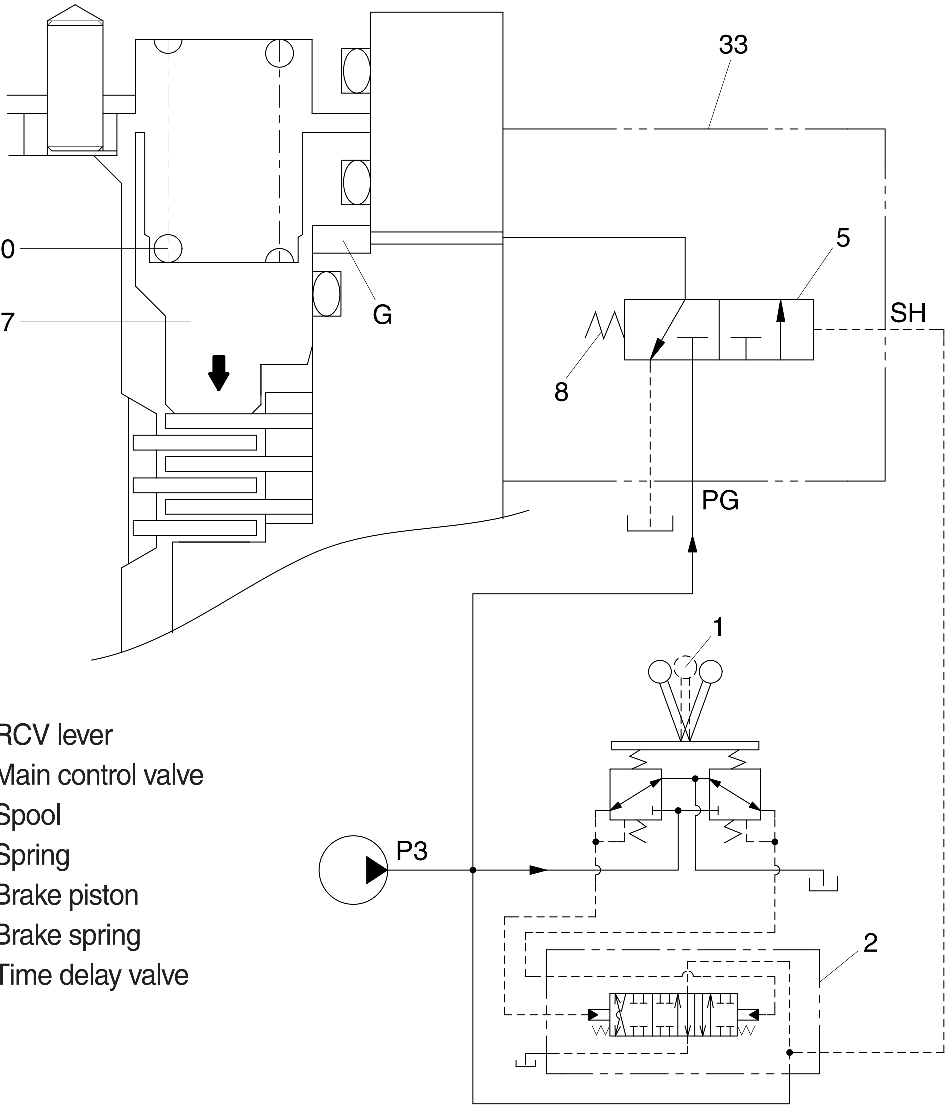
a. When one of the RCV lever (1) is set to the operation position, the each spool is shifted to left or right and the pilot oil flow is blocked. Then the pilot oil go to SH of the time delay valve (33).
   This pressure moves spool (5) to the leftward against the force of the spring(8), so pilot pump charged oil (P3) goes to the chamber G through port PG.
   This pressure is applied to move the piston (17) to the upward against the force of the spring (20). Thus, it releases the brake force.



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

16092SM16

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



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

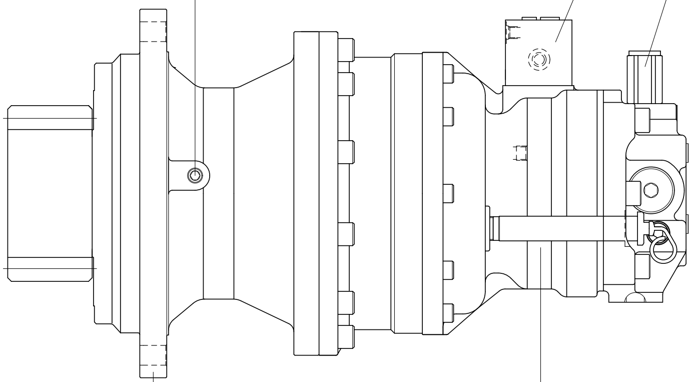
16092SM17

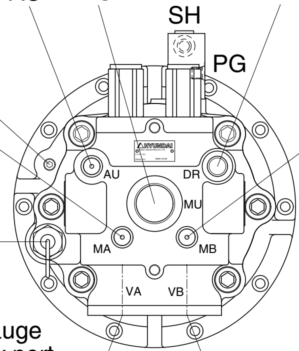
GROUP 3 SWING DEVICE (TYPE 2)

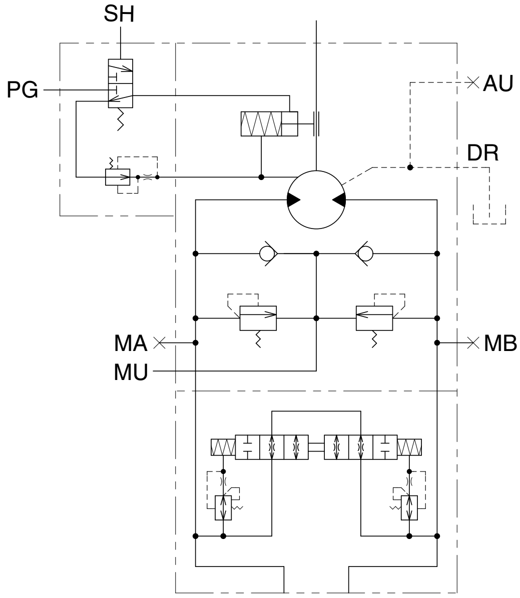
1. STRUCTURE

Swing device consists swing motor, swing reduction gear.

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





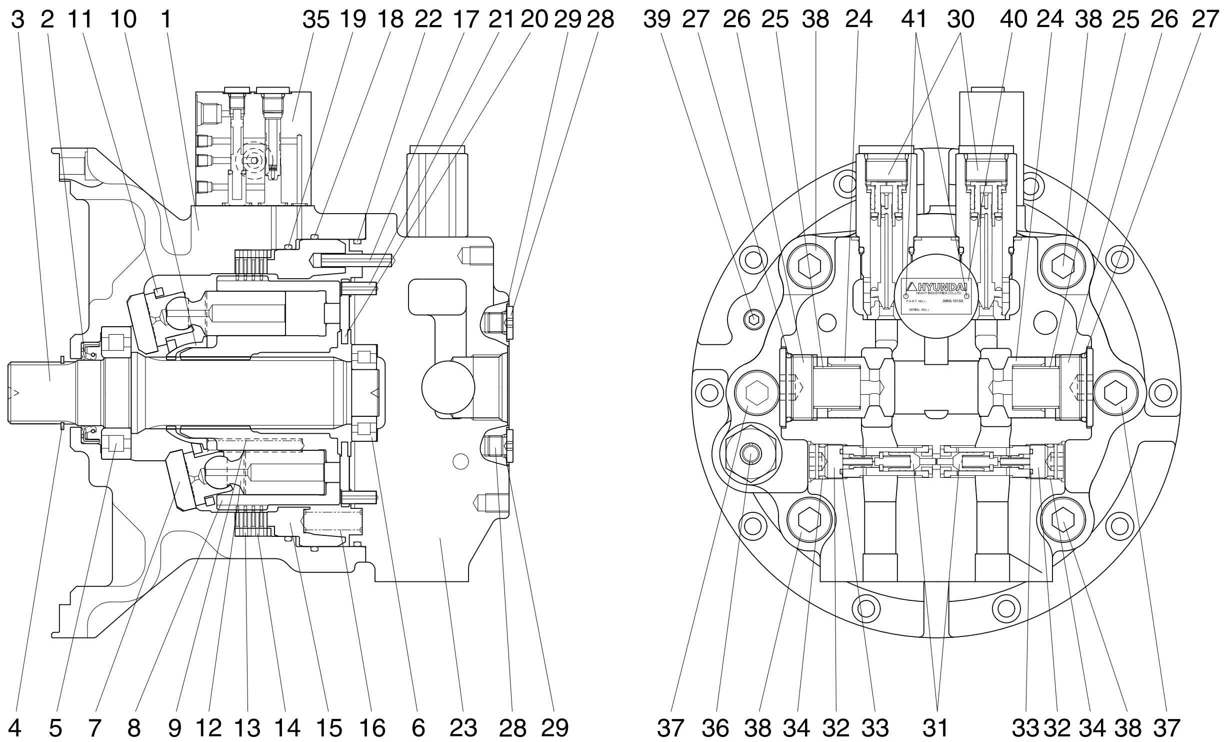


Hydraulic circuit

Port	Port name	Port size
VA	Main port	ø 20
VB	Main port	ø 20
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

220L2SM01

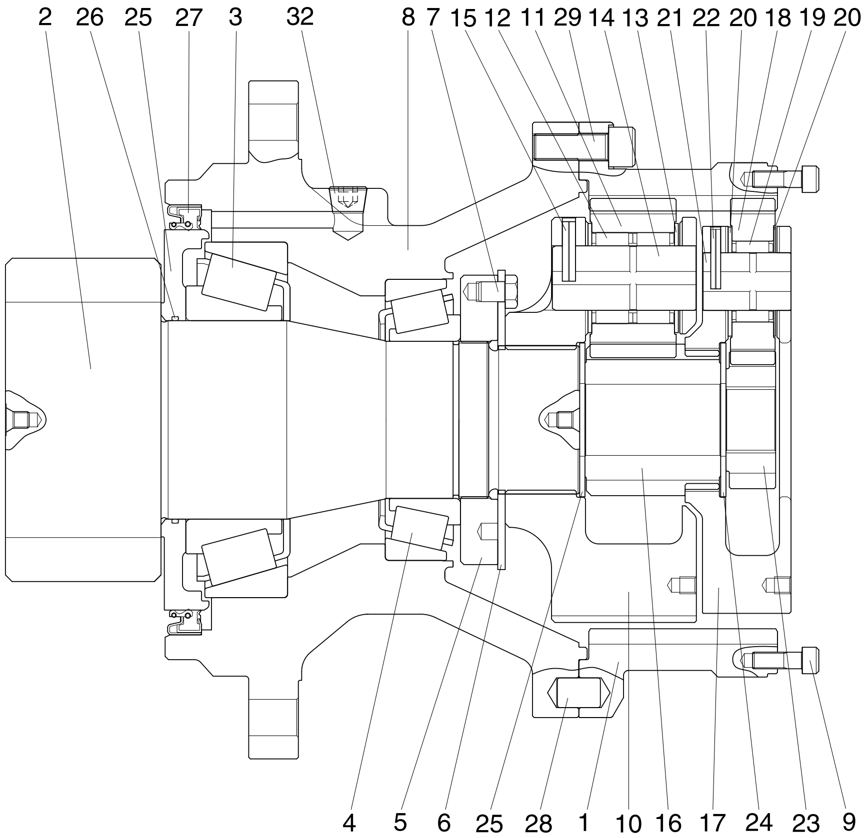
1) SWING MOTOR



220L2SM02

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		

2) REDUCTION GEAR



160F2SM03

1	Ring gear	11	Planetary gear 2	21	Carrier pin 1
2	Drive shaft	12	Needle bearing 2	22	Spring pin 1
3	Taper bearing	13	Thrust washer 2	23	Sun gear 1
4	Taper bearing	14	Carrier pin 2	24	Thrust plate
5	Ring nut	15	Spring pin 2	25	Sleeve
6	Lock plate	16	Sun gear 2	26	O-ring
7	Hexagon bolt	17	Carrier 1	27	Oil seal
8	Casing	18	Planetary gear 1	28	Parallel pin
9	Socket bolt	19	Needle bearing 1	29	Socket bolt
10	Carrier 2	20	Thrust washer 1	32	Plug

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 (23), 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).

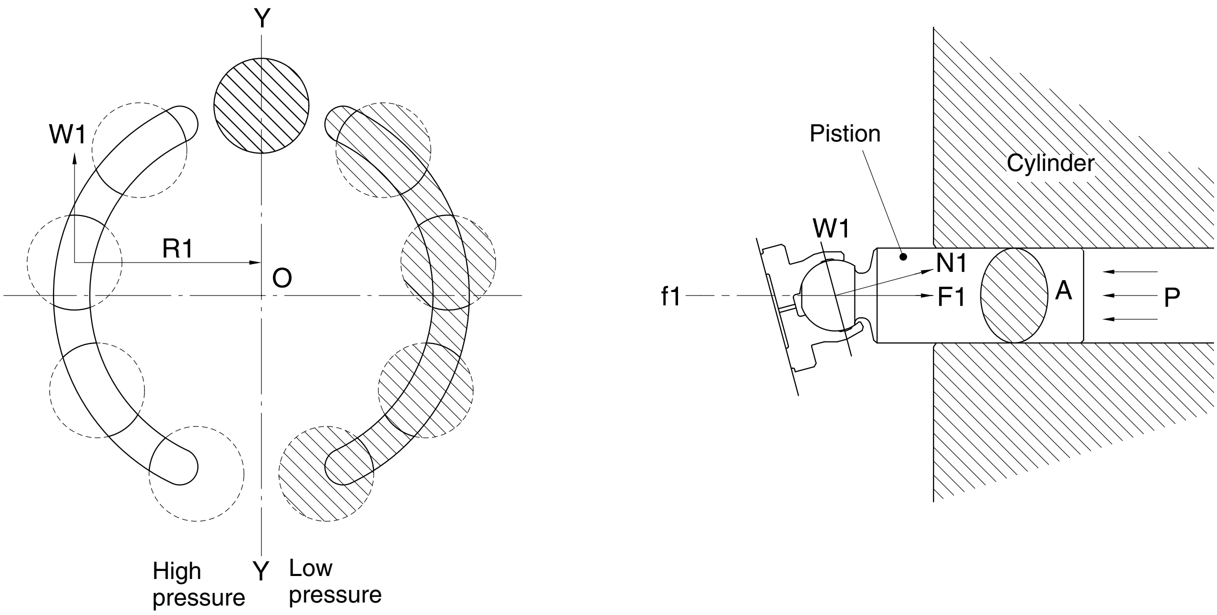
The high hydraulic can generate the force, $F1=P \times A$ (P : supplied pressure, A : water pressure area), like following pictures, working on a piston.

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, $T=W1 \times R1$, for Y-Y line connected by the upper and lower sides of the piston as following pictures.

The sum of torque ($\Sigma W1 \times R1$), 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

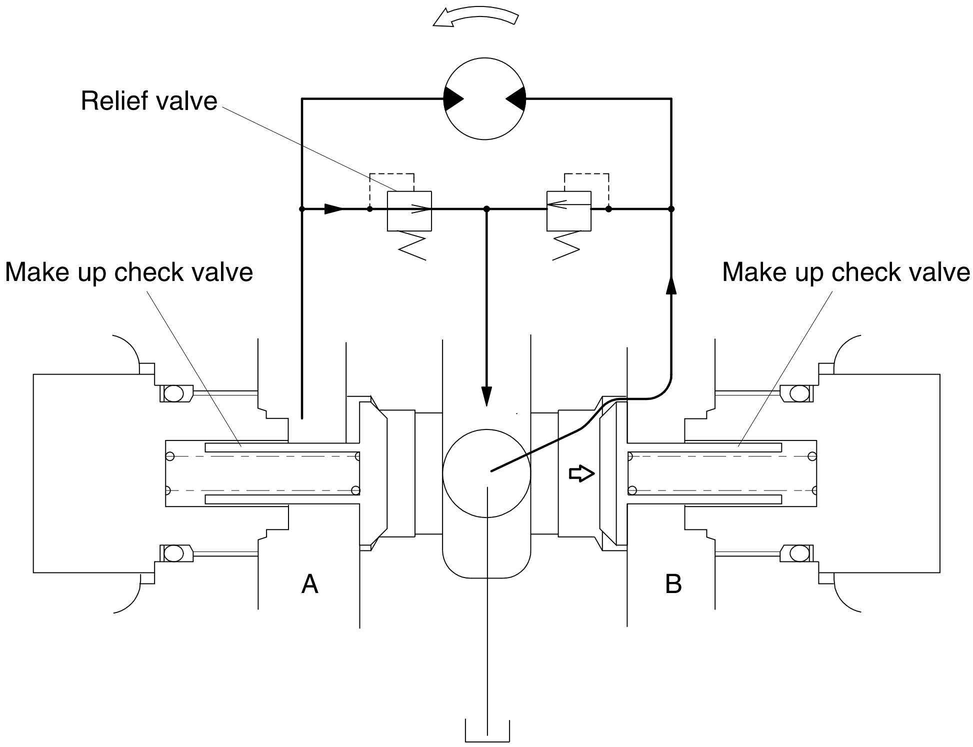
2) MAKE UP VALVE

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.

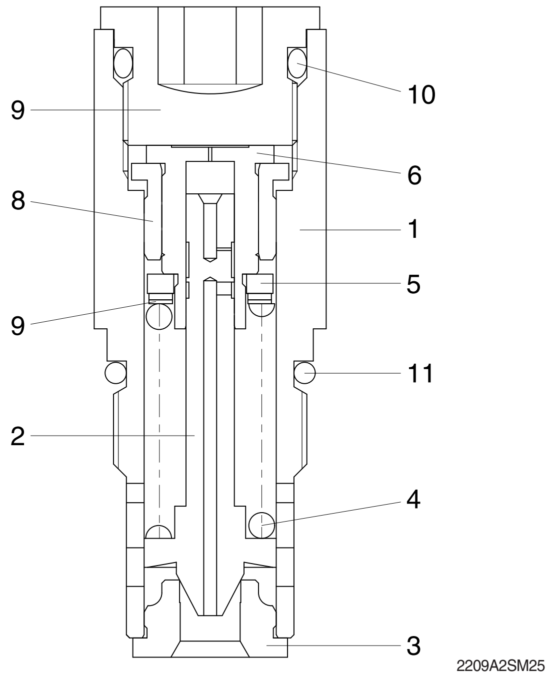
Pressurized oil into the port B, the motor rotate counterclockwise.

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



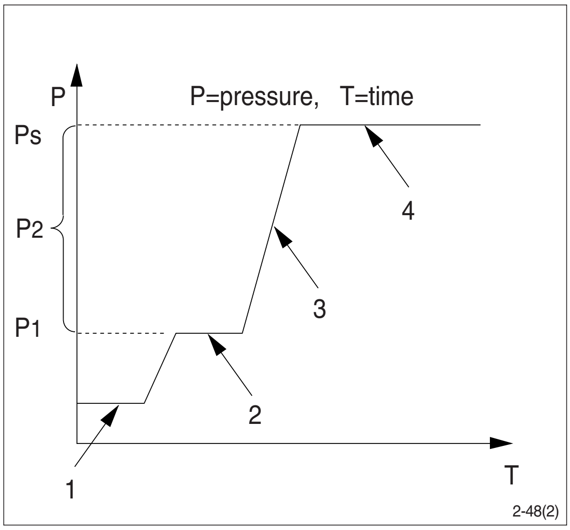
1	Sleeve
2	Poppet
3	Poppet seat
4	Spring
5	Spring seat
6	Shim
7	Piston
8	Stopper
9	Plug
10	O-ring
11	O-ring

(1) Construction of relief valve

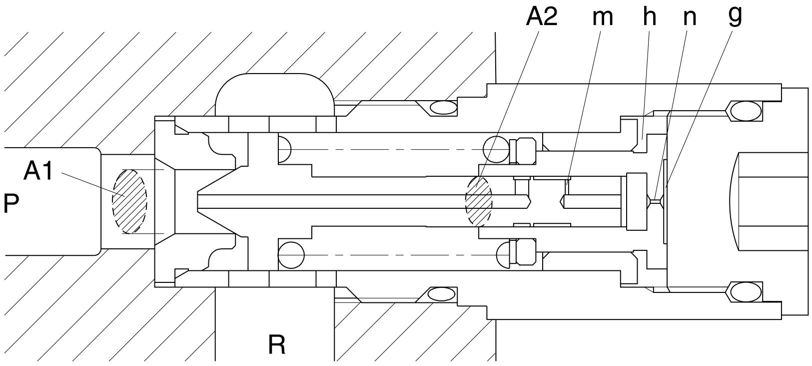
The valve casing contains two cartridge type relief valves that stop the regular and reverse rotations of the hydraulic motor. The relief valves relieve high pressure at start or at stop of swing motion and can control the relief pressure in two steps, high and low, in order to insure smooth operation.

(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.

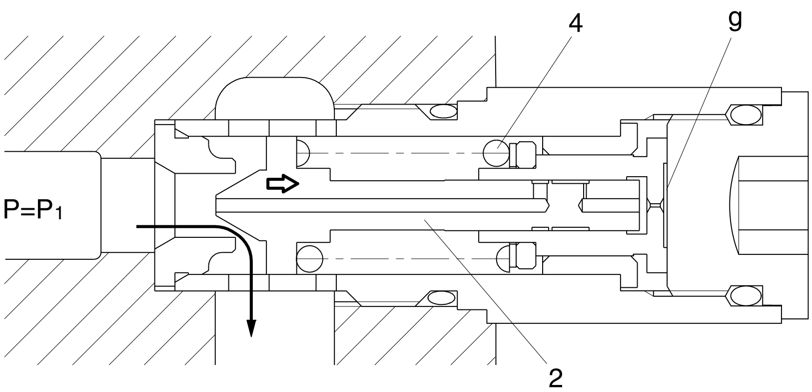


2209A2SM26

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

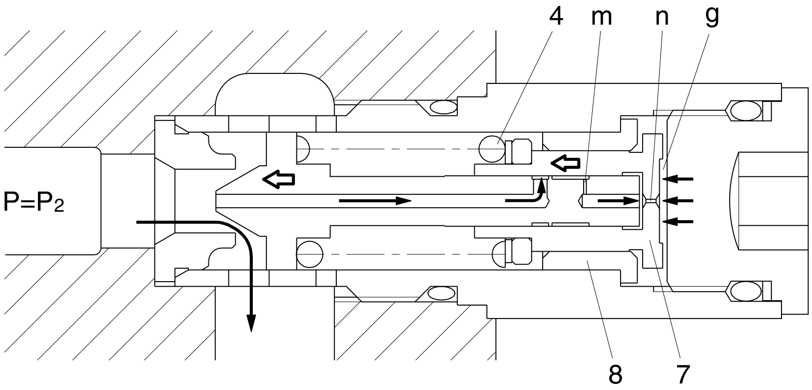
$P_1 \times A_1 = Fsp + Pg \times A_2$

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



2209A2SM27

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 (7) moves left and stop the piston (7) hits the bottom of bushing (8).

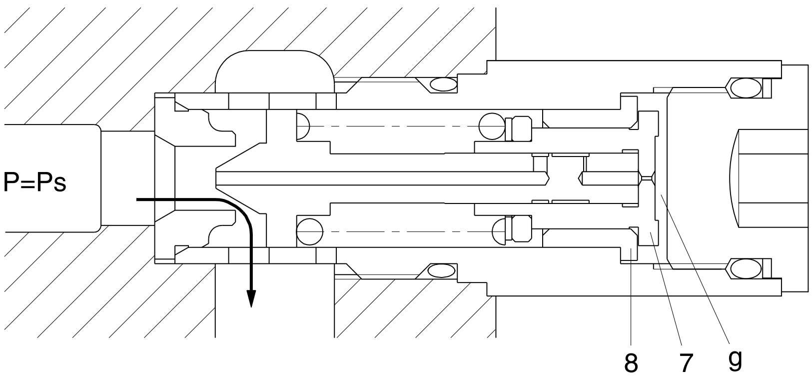


2209A2SM28

④ When piston (7) hits the bottom of bushing (8), it stops moving to the left any further. As the result, the pressure in chamber (g) equals (Ps).

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

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



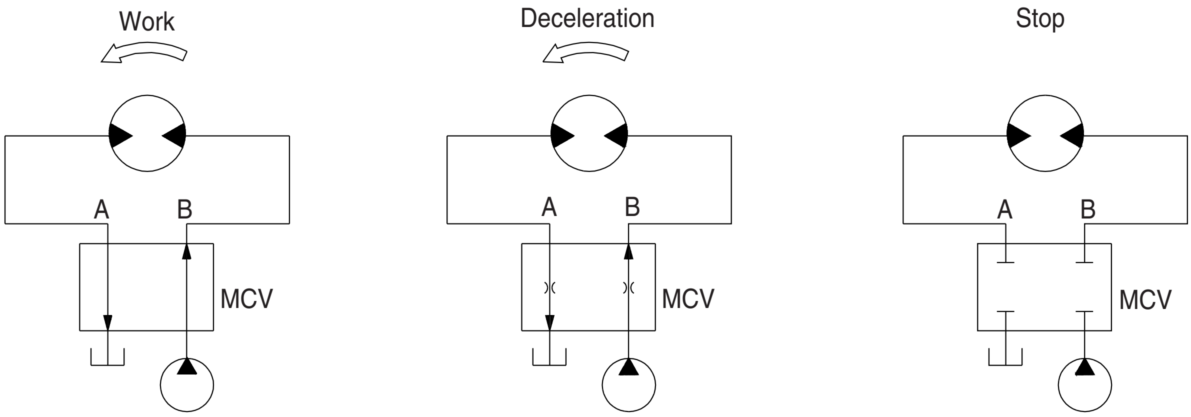
2209A2SM29

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.



2-48(1)

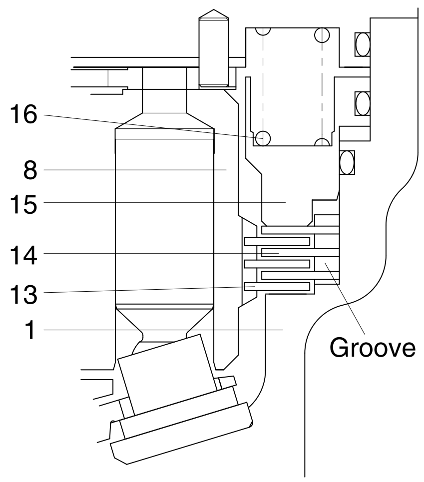
(2) Mechanical swing parking brake system

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 (14) is constrained by the groove located at casing (1). When housing is pressed down by brake spring (16) through friction plate (13), separate plate (14) and parking piston (15), friction force occurs there.

Cylinder block (8) is constrained by this friction force and brake acts, while brake releases when hydraulic force exceeds spring force.

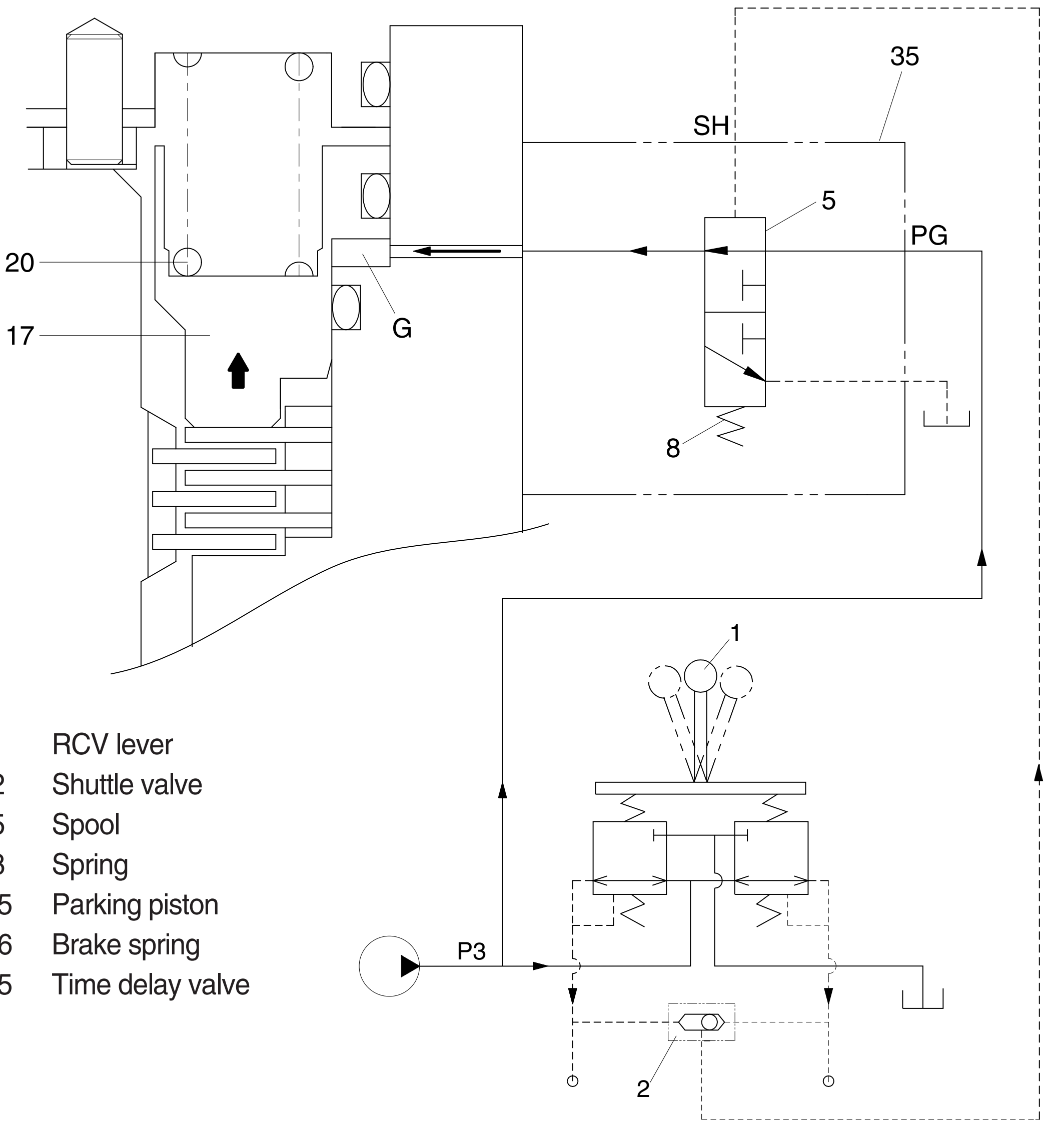


2209A2SM35

1	Casing	14	Separate plate
8	Cylinder block	15	Parking piston
13	Friction plate	16	Brake spring

② Operating principle

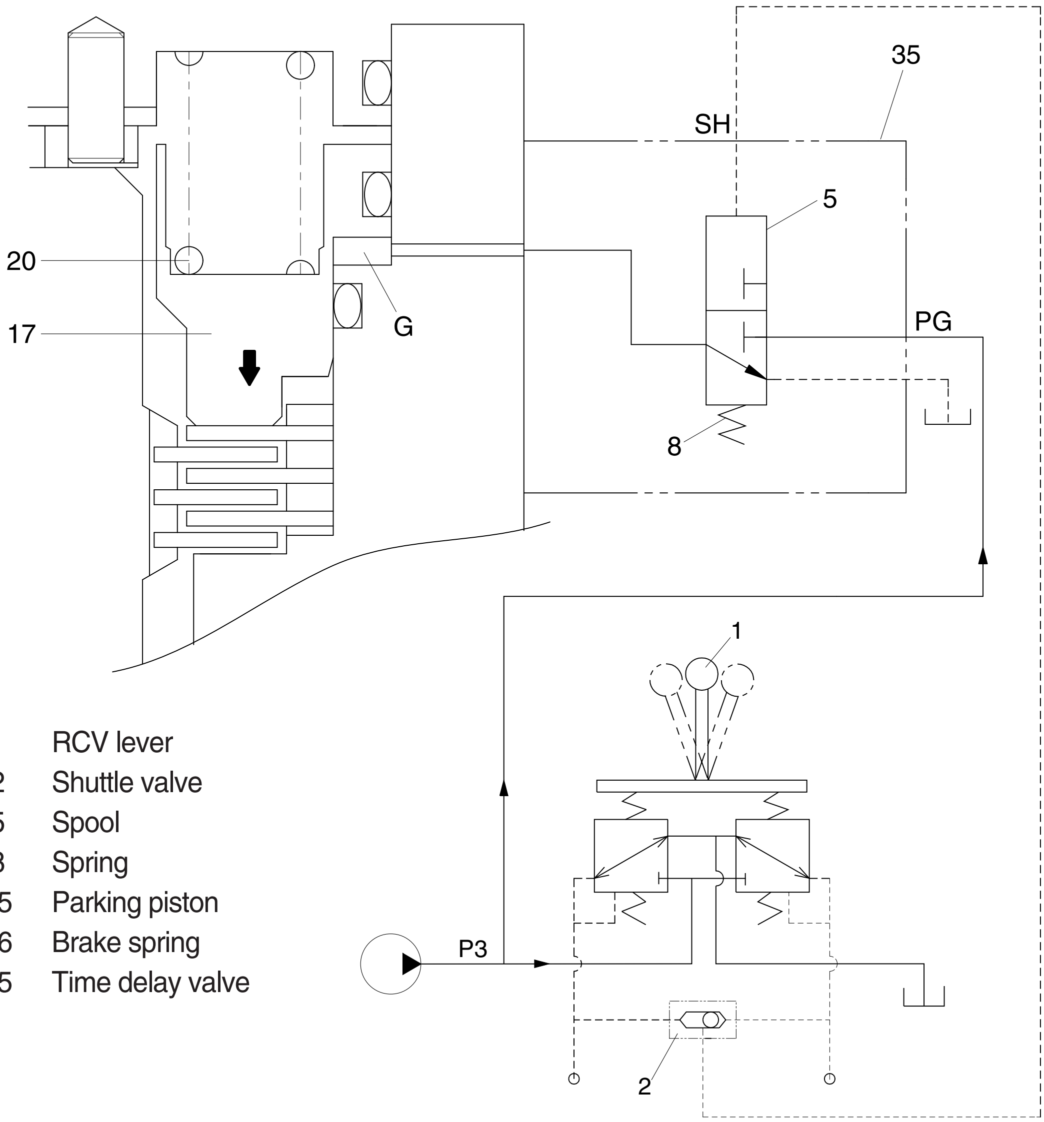
a. When the RCV lever (1) is set to the swing or arm in operating position, the pilot oil go to SH of the time delay valve (35).
This pressure moves spool (5) to the leftward against the force of the spring(8), so pilot pump charged oil (P3) goes to the chamber G through port PG.
This pressure is applied to move the parking piston (15) to the upward against the force of the brake spring (16). Thus, it releases the brake force.



1	RCV lever
2	Shuttle valve
5	Spool
8	Spring
15	Parking piston
16	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 parking piston (15) 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
15	Parking piston
16	Brake spring
35	Time delay valve

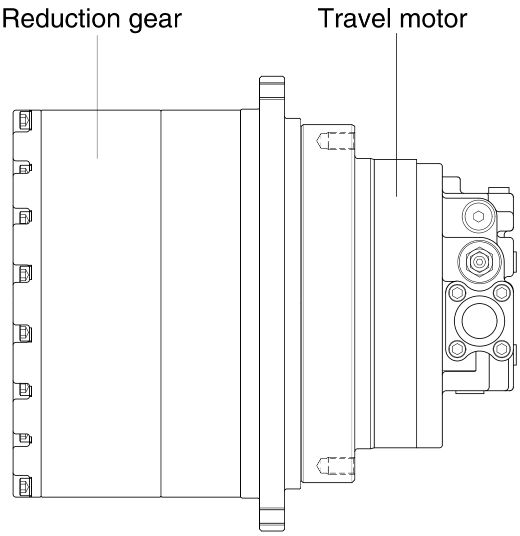
300L2SM05

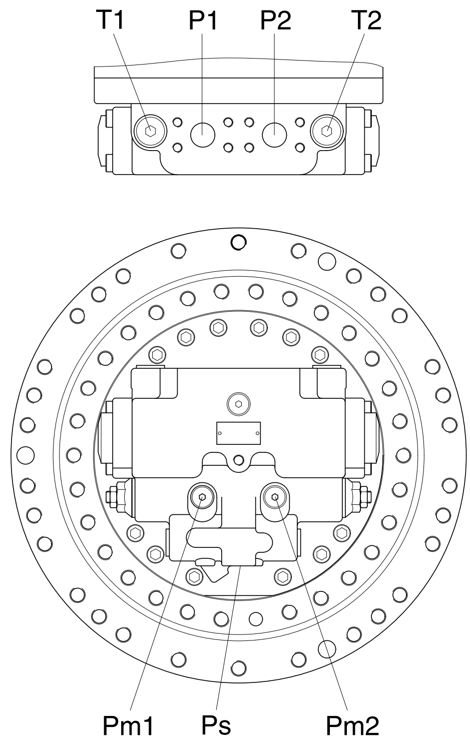
GROUP 4 TRAVEL DEVICE

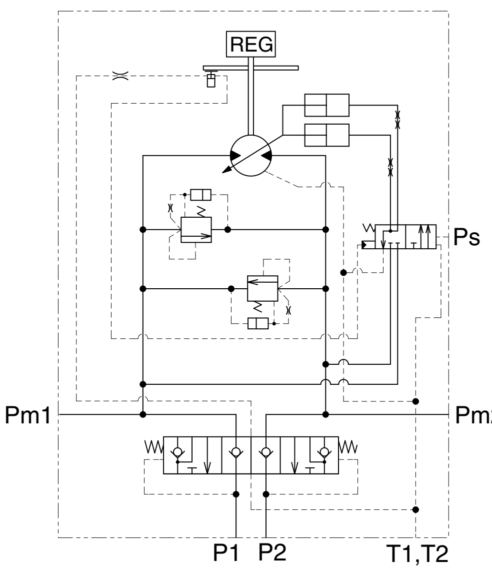
1. STRUCTURE

A Hydraulic motor includes followings.

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





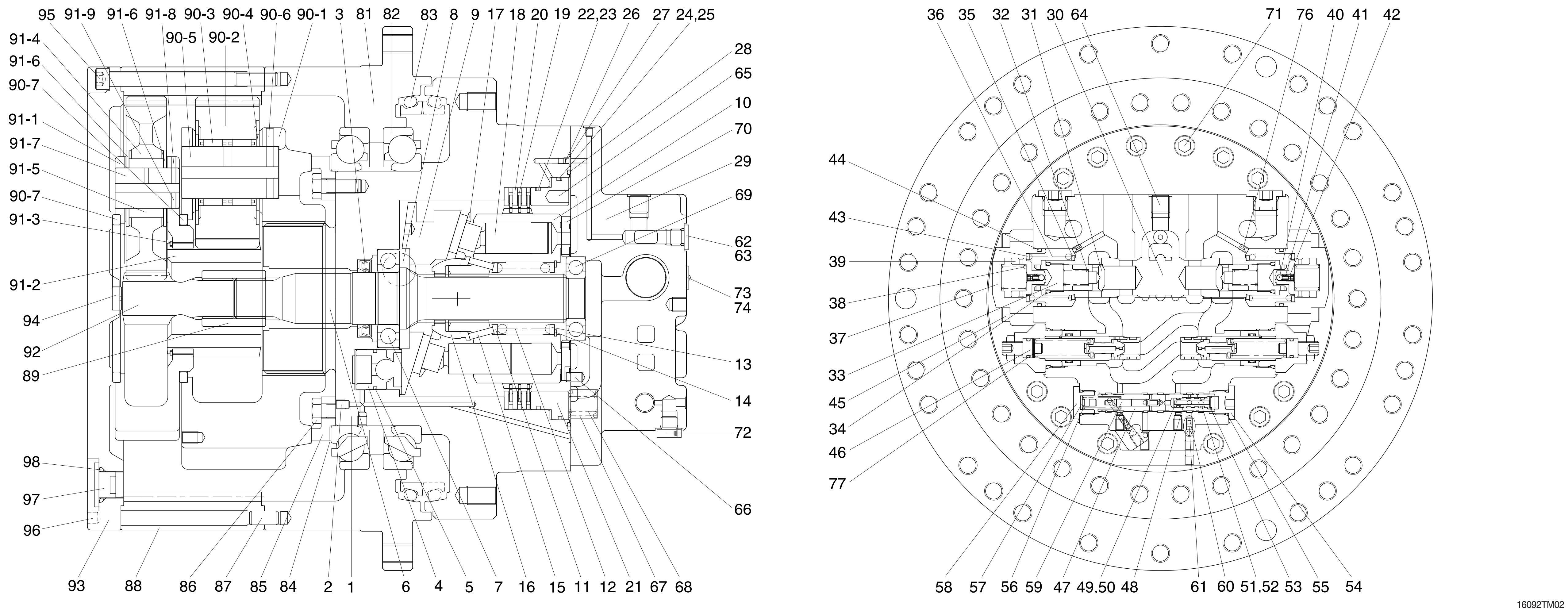


Hydraulic circuit

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

160F2TM01

1) STRUCTURE



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

2. PRINCIPLE OF DRIVING

2.1 Generating the turning force

The high hydraulic supplied from a hydraulic pump flows into a cylinder block (10) through rear cover (29) of motor, and valve plate (70).

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

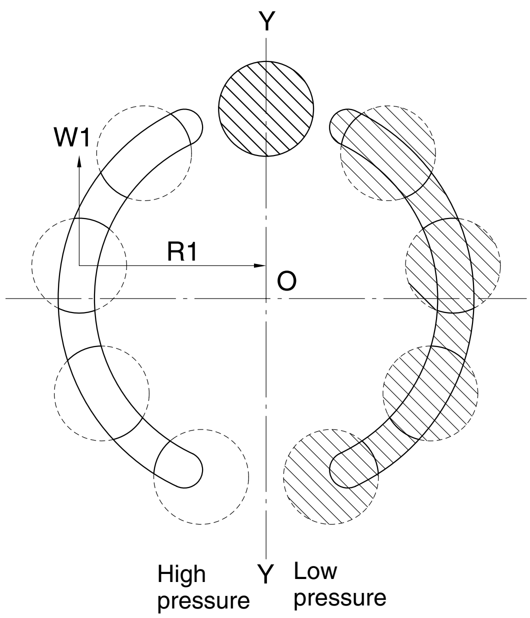
The high hydraulic can generate the force, $F1 = P \times A$ (P : supplied pressure, A : water pressure area), like following pictures, working on a piston.

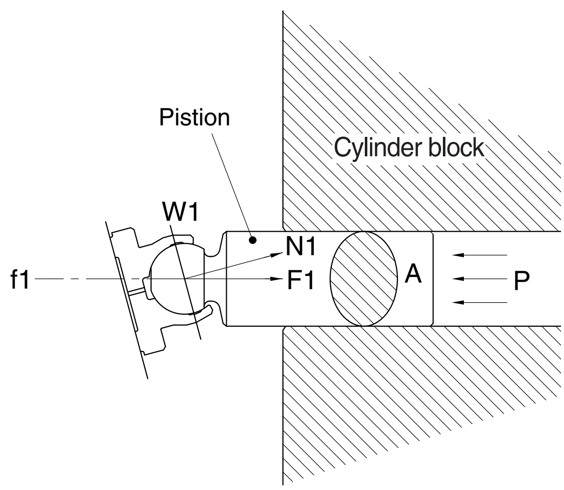
This force, F1, is divided as N1 thrust partial pressure and W1 radial partial pressure, in case of the plate (09) of a tilt angle, α .

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

The sum of torque ($\Sigma W1 \times R1$), 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 block (10) through a piston; because a cylinder block is combined with a turning axis and spline, a turning axis rotates and a turning force is sent.





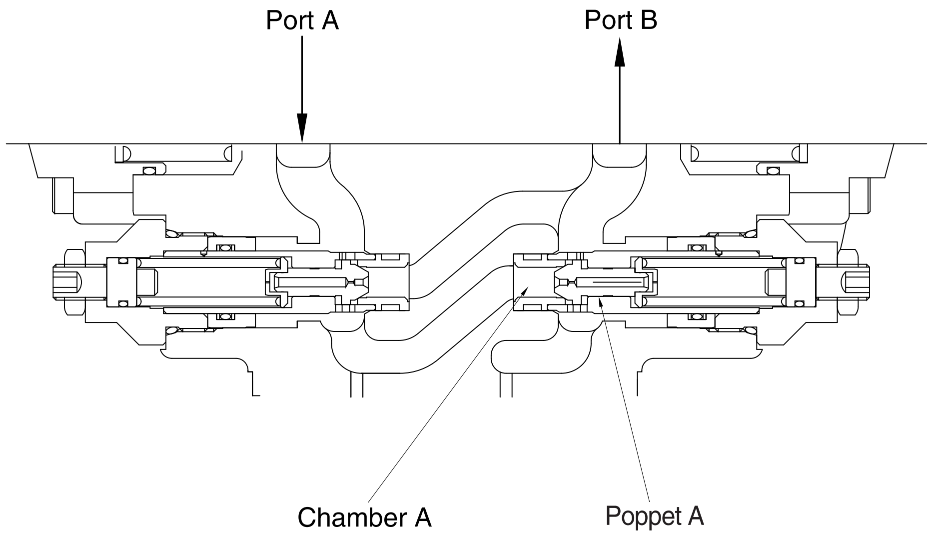
21078TM05

2.2 Working of relief valve

Relief valve carries on two functions of followings.

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

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



21078TM06A

2.3 Working of negative brake

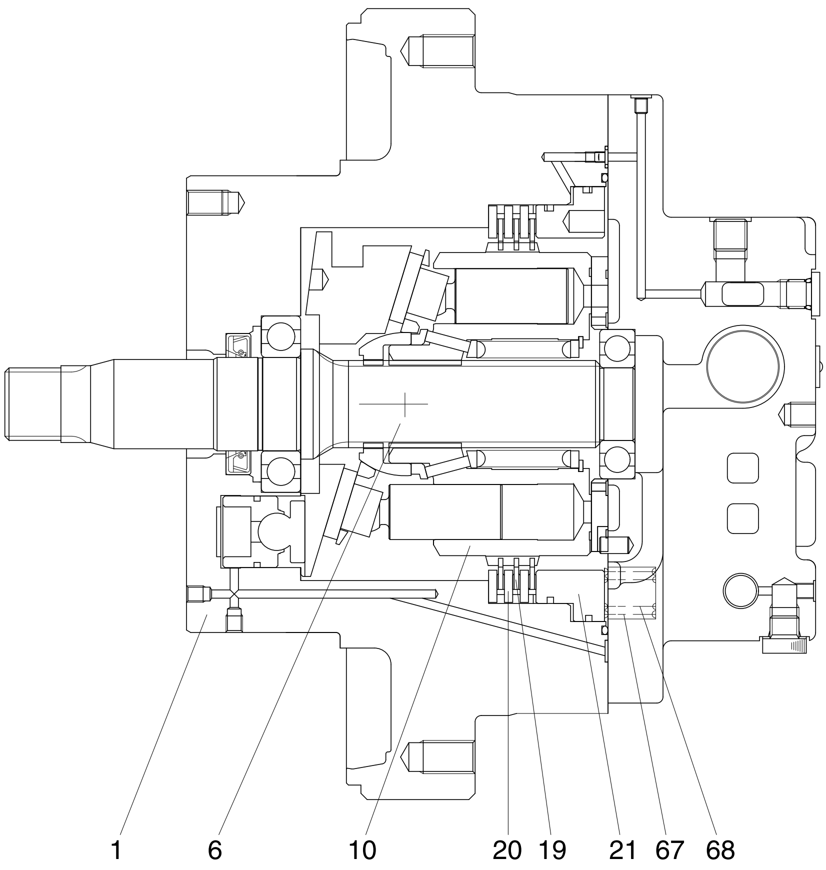
When the operating pressure is supplied to the brake piston (21) through the spool (simultaneous peripheral operation online) built in the shaft casing (1), the negative brake is released.

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

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

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

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

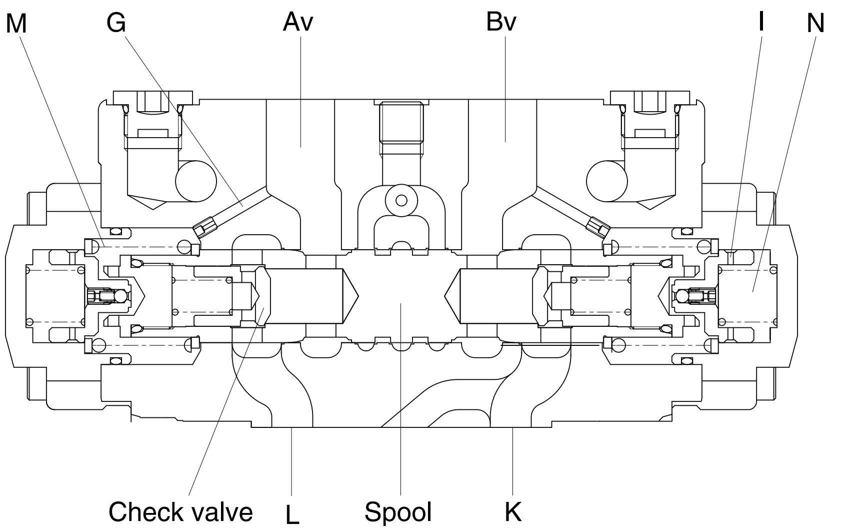


21092TM07

2.4 Counterbalance valve

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

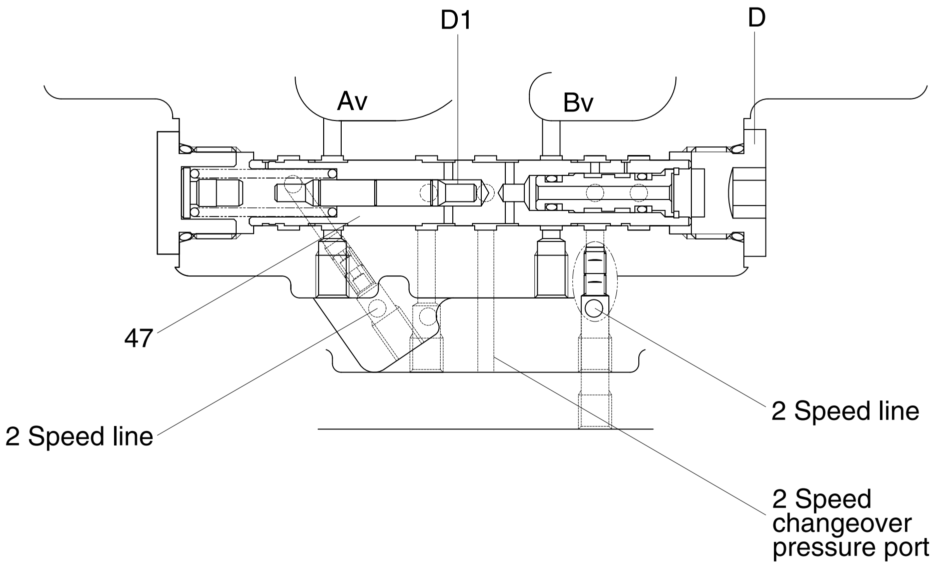
An oil supplied from a hydraulic pump presses check valve and flows into L port. It makes a hydraulic motor circulated. The oil pressure out of a pump is increased and transferred to spring room M through the path G because negative brake is working on. When the pressure of room M exceeds the force of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



21078TM08

2.5 Working description of automatic switch (at normal speed)

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



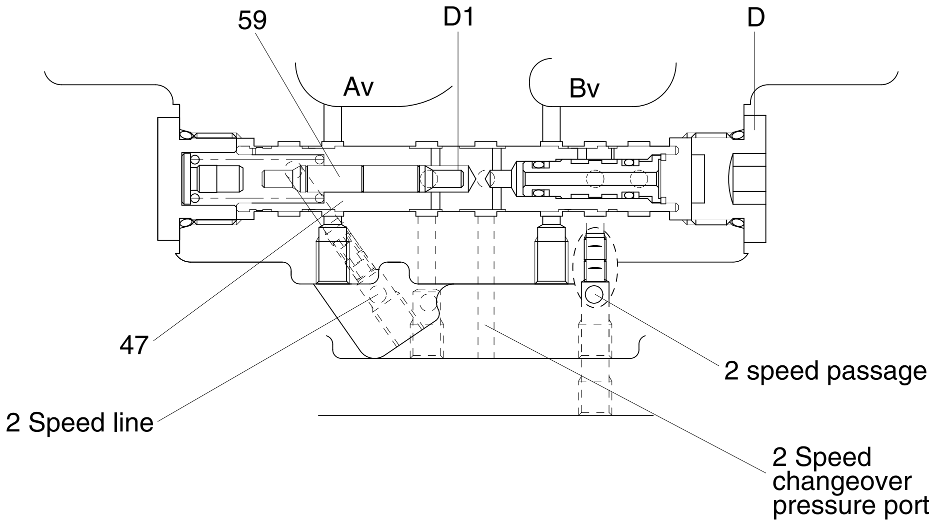
(Normal speed)

21078TM09

2.6 Working description of automatic switch (at high speed)

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

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



(High speed)

21078TM10

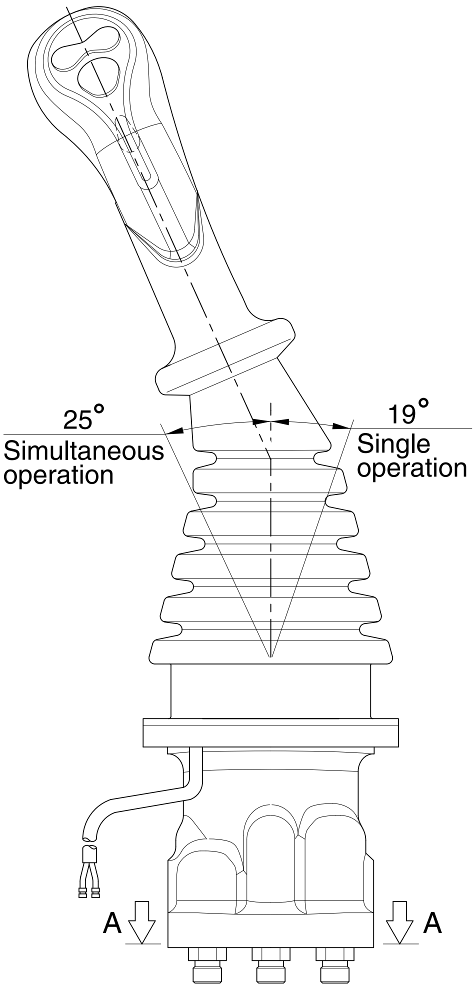
GROUP 5 RCV LEVER

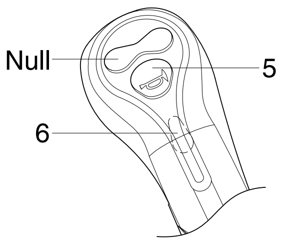
1. STRUCTURE

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

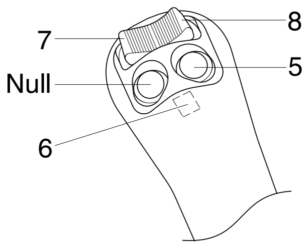
※ **Refer to the parts manual for the types of the RCV lever.**

1) TYPE M1, M3, M5, M10





TYPE M1, M3, M10

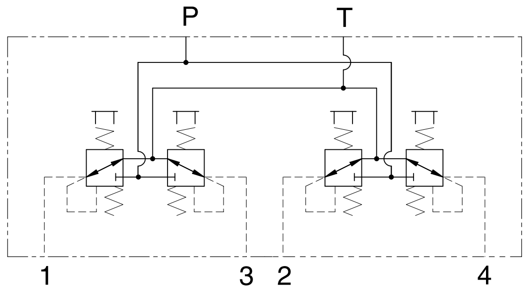


TYPE M5

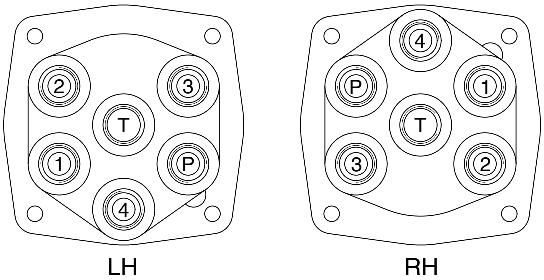
Switches

Type	No.	LH	RH
M1, M3, M10	5	One touch decel	Horn
	6	Power boost	Breaker
M5	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



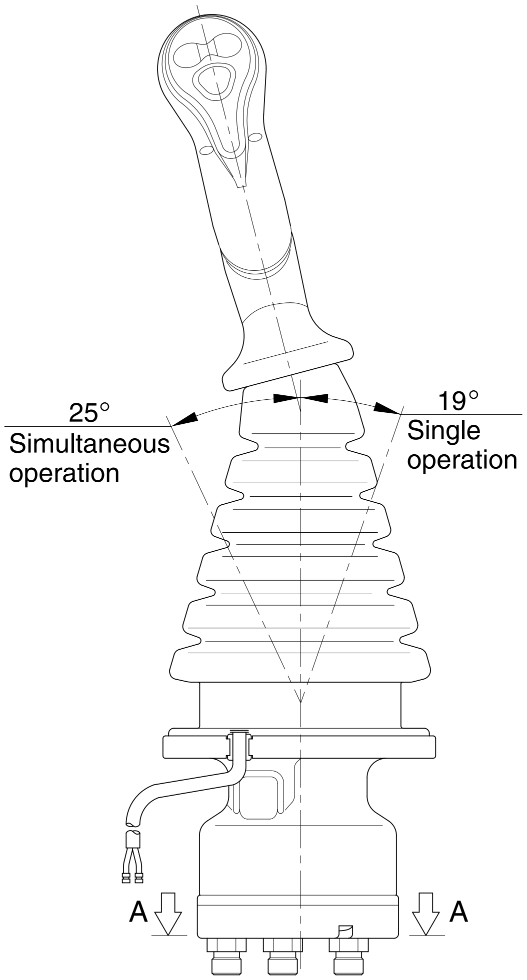
VIEW A-A

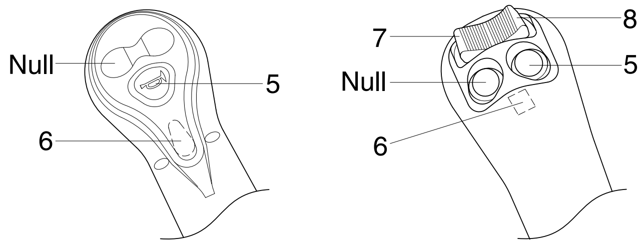
Pilot ports

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	

300L2RL01

2) TYPE M2, M4, M6, M9



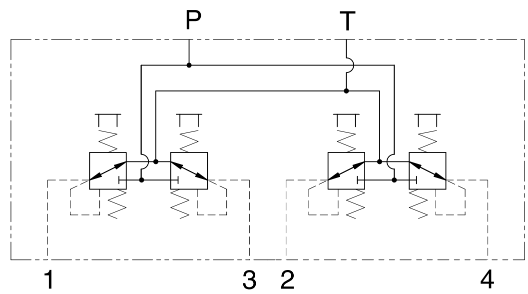


TYPE M2, M4, M9 TYPE M6

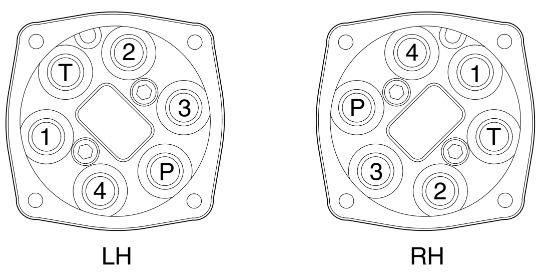
Switches

Type	No.	LH	RH
M2, M4, M9	5	One touch decel	Horn
	6	Power boost	Breaker
M6	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



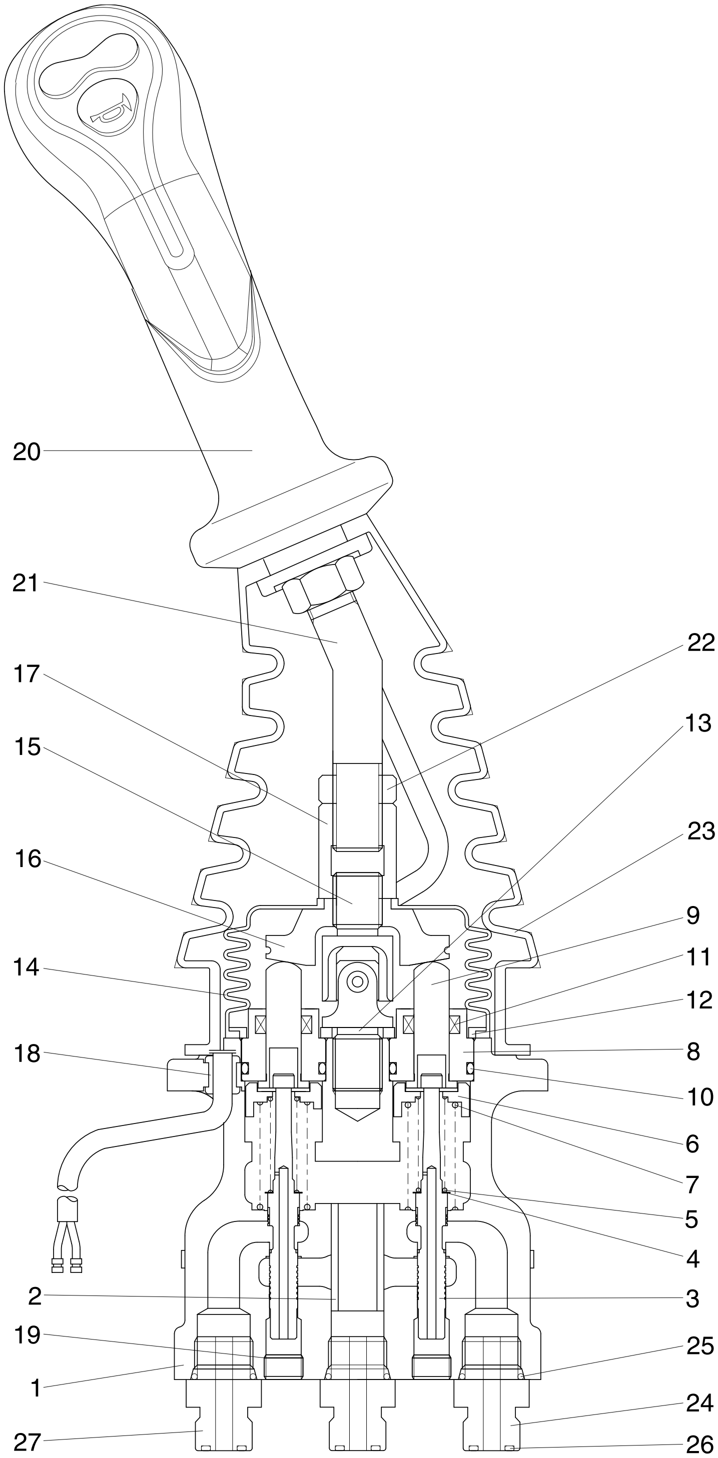
VIEW A-A

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	

300L2RL05

3) CROSS SECTION



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

300L2RL06

Item numbers are based on the type M1.

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 M1.

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.

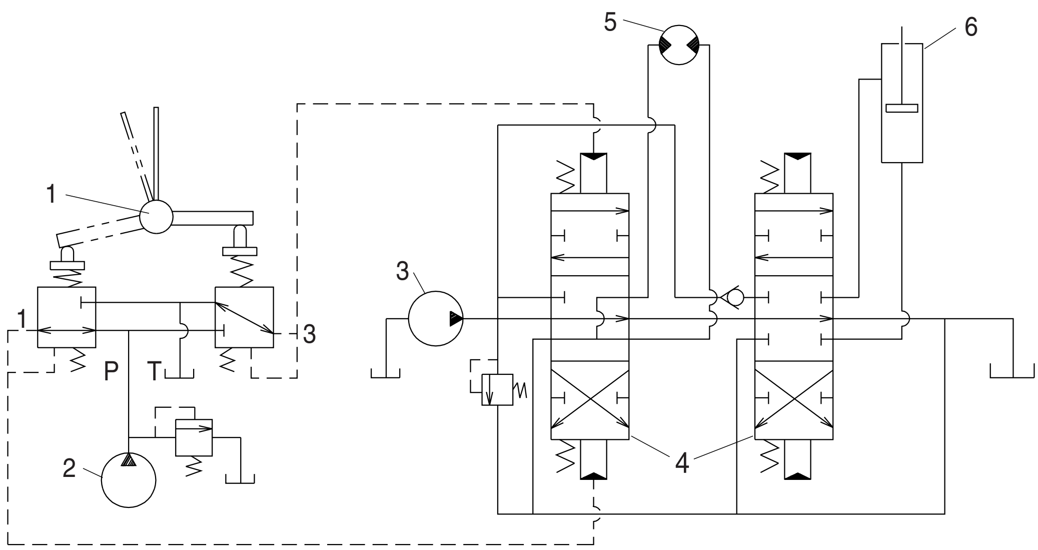
The spring (7) works on the case (1) and spring seat (6) and tries to return the push rod (9) to the zero-displacement position irrespective of the output pressure, securing its resetting to the center position.

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.

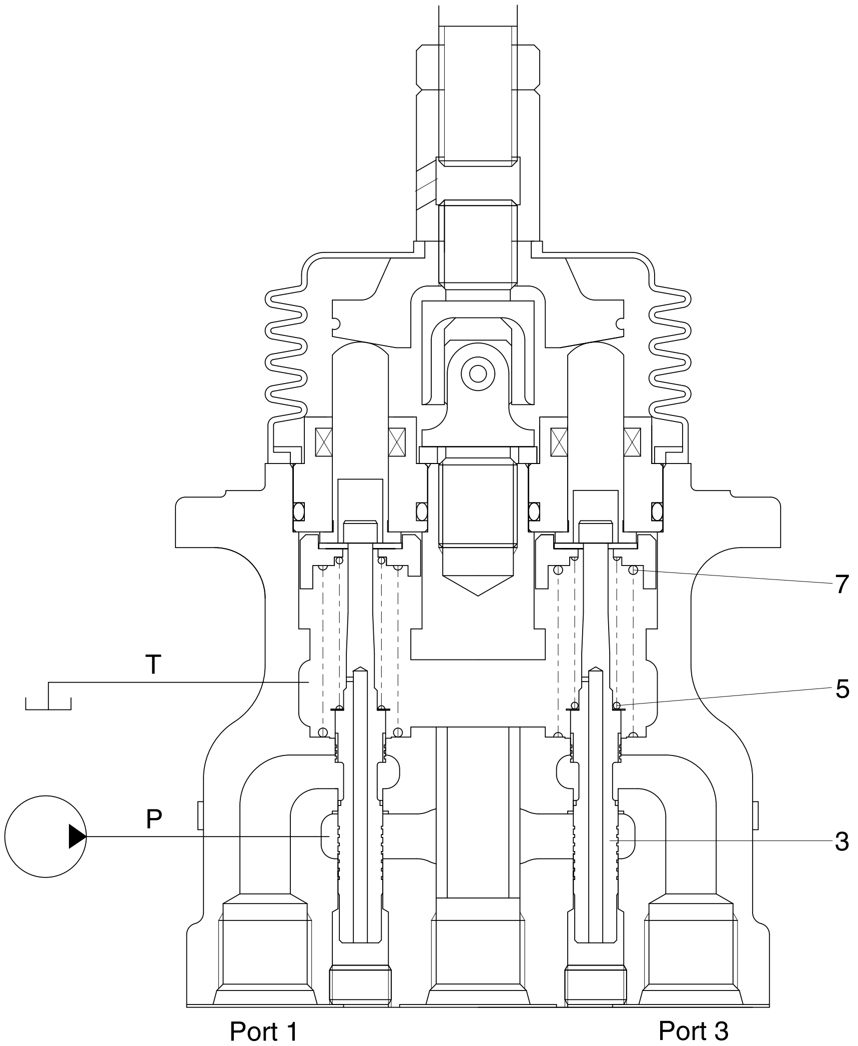
The diagram shown below is the typical application example of the pilot valve.



2-70

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

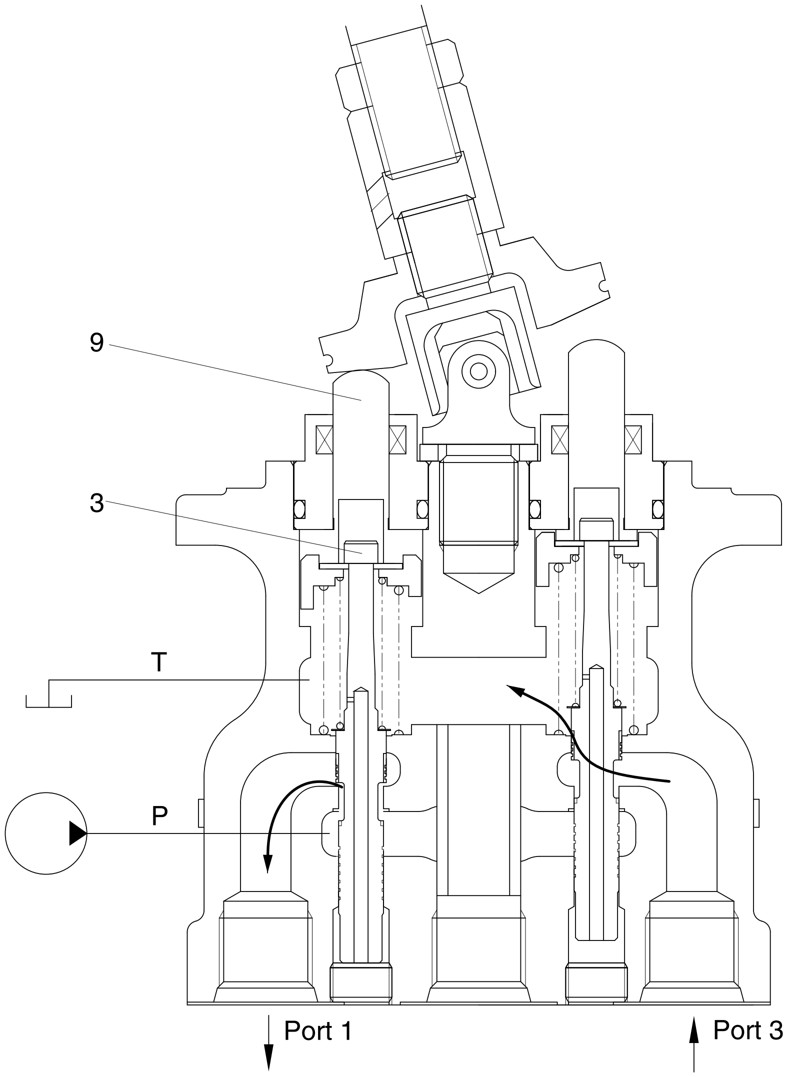
(1) Case where handle is in neutral position



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



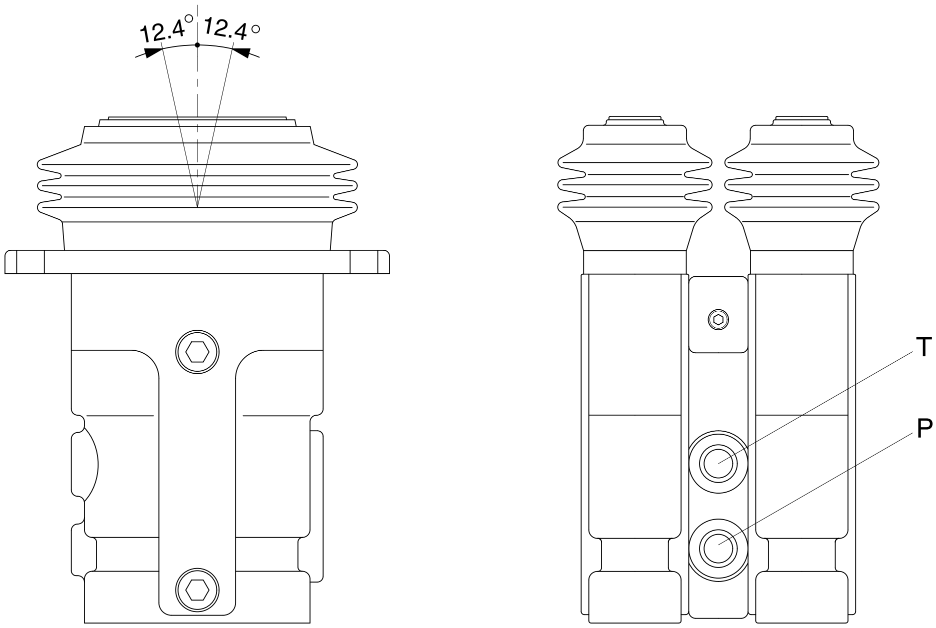
300L2RL04

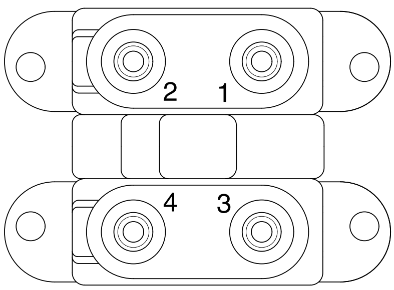
When the push rod (9) is stroked, the spool (3) moves downwards.
Then port P is connected with port (1) and the oil supplied from the pilot pump flows through port (1) to generate the pressure.
When the pressure at port (1) increases to the value corresponding to the spring force set by tilting the handle, 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.

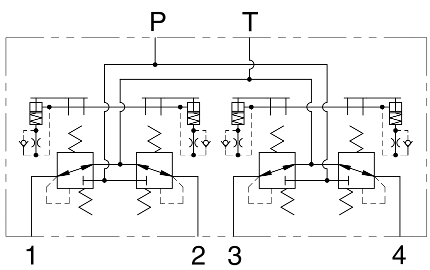
GROUP 6 RCV PEDAL

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)	

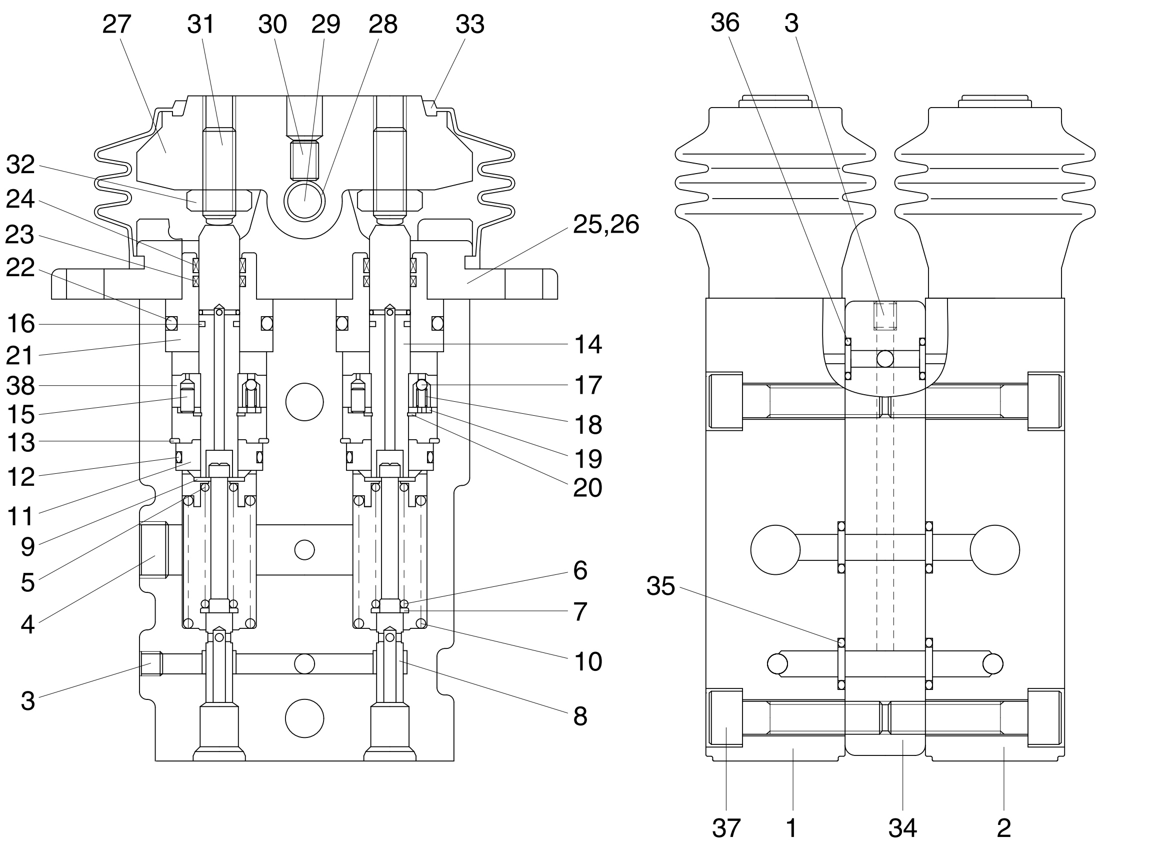
21092RP01

CROSS SECTION

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

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

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



21092RP02

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

2. FUNCTION

1) FUNDAMENTAL FUNCTIONS

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

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

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

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

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

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

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

2) FUNCTIONS OF MAJOR SECTIONS

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

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

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

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

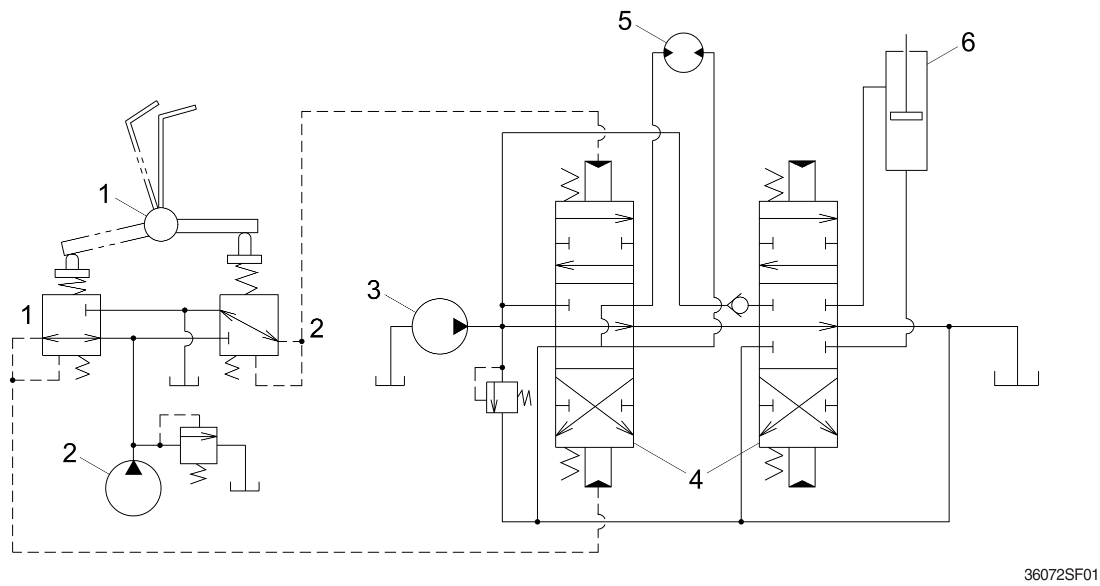
The spring (10) works on the body (1 & 2) and spring seat (7) and tries to return the push rod (14) to the zero-displacement position irrespective of the output pressure, securing its resetting to the center position.

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

3) OPERATION

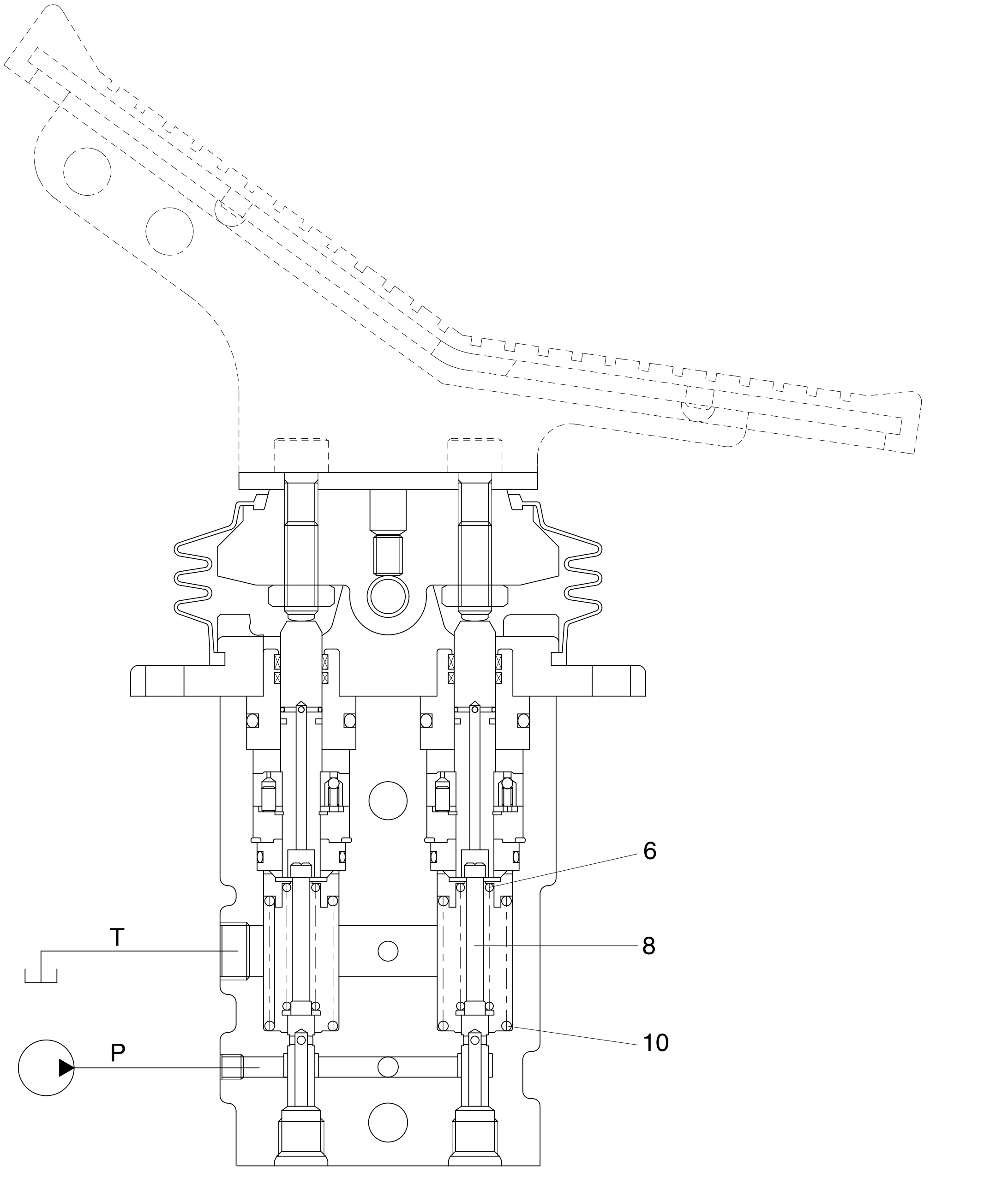
The operation of the pilot valve will be described on the basis of the hydraulic circuit diagram shown below and the attached operation explanation drawing.

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



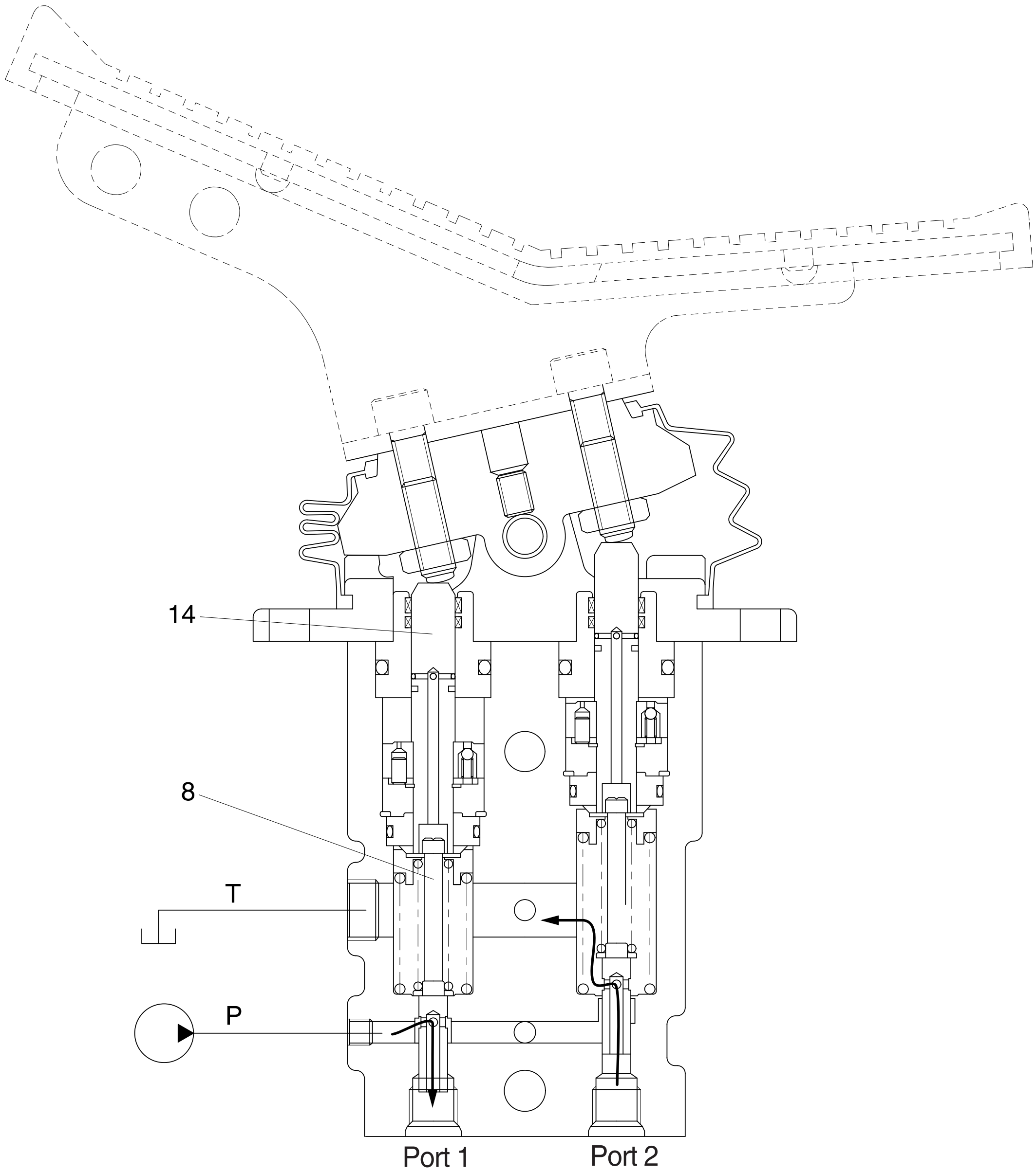
1	Pilot valve	3	Main pump	5	Hydraulic motor
2	Pilot pump	4	Main control valve	6	Hydraulic cylinder

(1) Case where pedal is in neutral position



The force of the spring (6) that determines the output pressure of the pilot valve is not applied to the spool (8). Therefore, the spool is pushed up by the spring (10) to the position of port 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



21092RP04

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

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

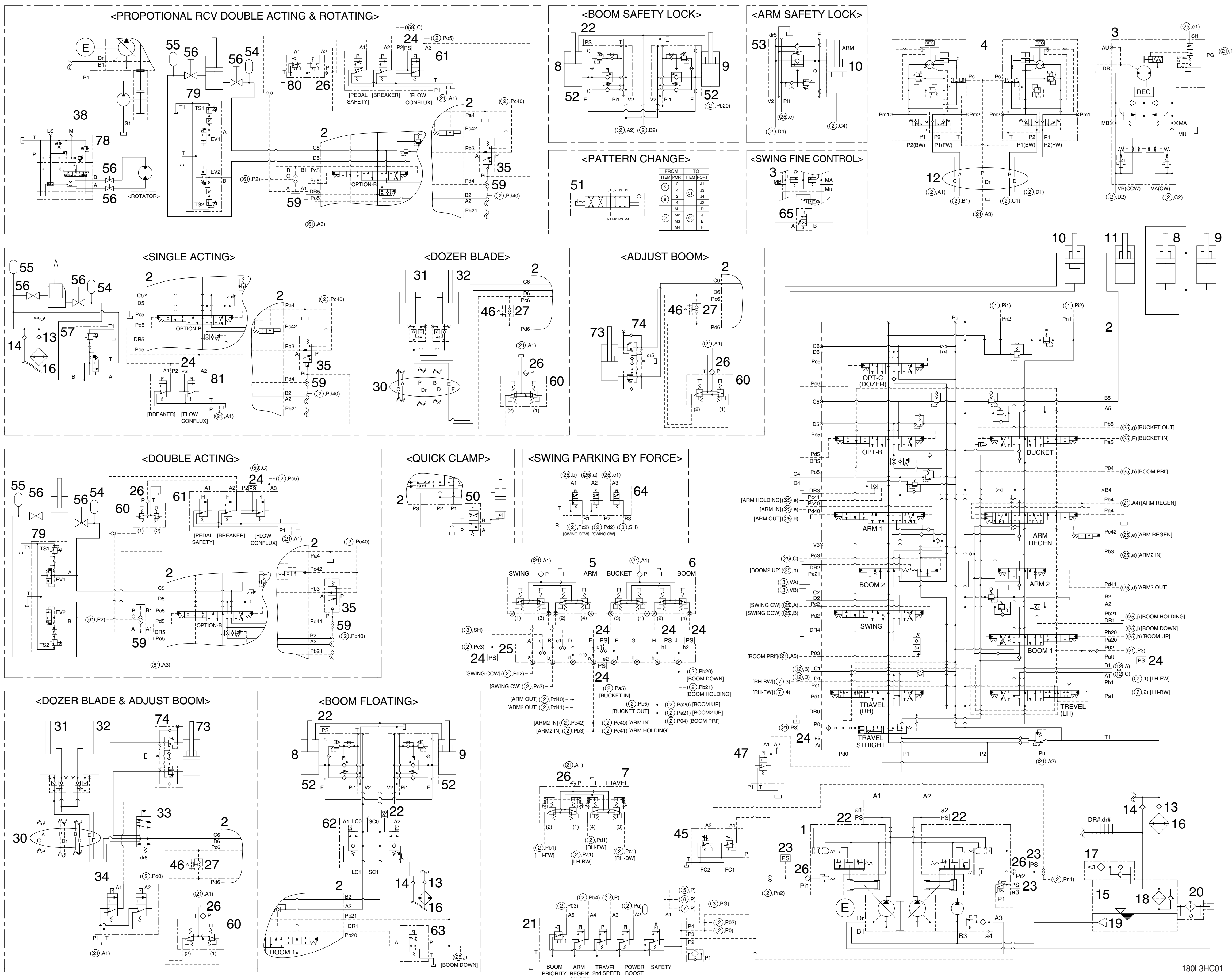
When the pressure at port 1 increases to the value corresponding to the spring force set by tilting the handle, the hydraulic pressure force balances with the spring force. If the pressure at port 1 increases higher than the set pressure, port P is disconnected from port 1 and port T is connected with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

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

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

SECTION 3 HYDRAULIC SYSTEM

GROUP 1 HYDRAULIC CIRCUIT

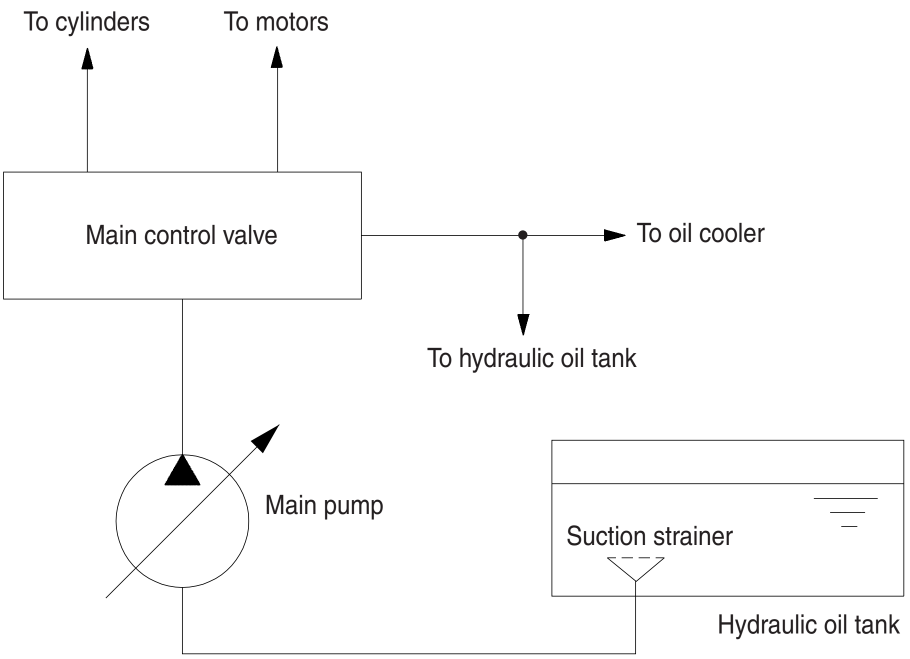


1 Main pump
2 Main control valve
3 Swing motor
4 Travel motor
5 RCV lever(LH)
6 RCV lever(RH)
7 RCV pedal
8 Boom cylinder(LH)
9 Boom cylinder(RH)
10 Arm cylinder
11 Bucket cylinder
12 Turning joint
13 Check valve
14 Check valve
15 Hydraulic tank
16 Oil cooler
17 Air breather
18 Return filter
19 Suction strainer
20 Drain filter
21 5 cartridge valve
22 Pressure sensor
23 Pressure sensor
24 Pressure sensor
25 Shuttle block
26 Last guard filter
27 Shuttle valve(option)
30 Turning joint(option)
31 Dozer cylinder(LH, option)
32 Dozer cylinder(RH, option)
33 Selector valve(option)
34 Solenoid valve(option)
35 Pilot selector valve(option)
38 Fan drive pump(option)
45 2 EPPR cartridge valve
46 Pressure switch(option)
47 Solenoid valve
50 Solenoid valve(option)
51 Pattern change valve(option)
52 Boom safety valve(option)
53 Arm safety valve(option)
54 Accumulator(option)
55 Accumulator(option)
56 Stop valve(option)
57 Proportional relief valve(option)
59 Shuttle valve(option)
60 2 way pedal(option)
61 Solenoid valve(option)
62 Float cartridge valve(option)
63 Solenoid valve(option)
64 Solenoid valve(option)
65 Solenoid valve(option)
73 Adjust boom cylinder(option)
74 Adjust boom safety valve(option)
78 Proportional valve(option)
79 Proportional relief valve(option)
80 2 EPPR valve(option)
81 Solenoid valve(option)

GROUP 2 MAIN CIRCUIT

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

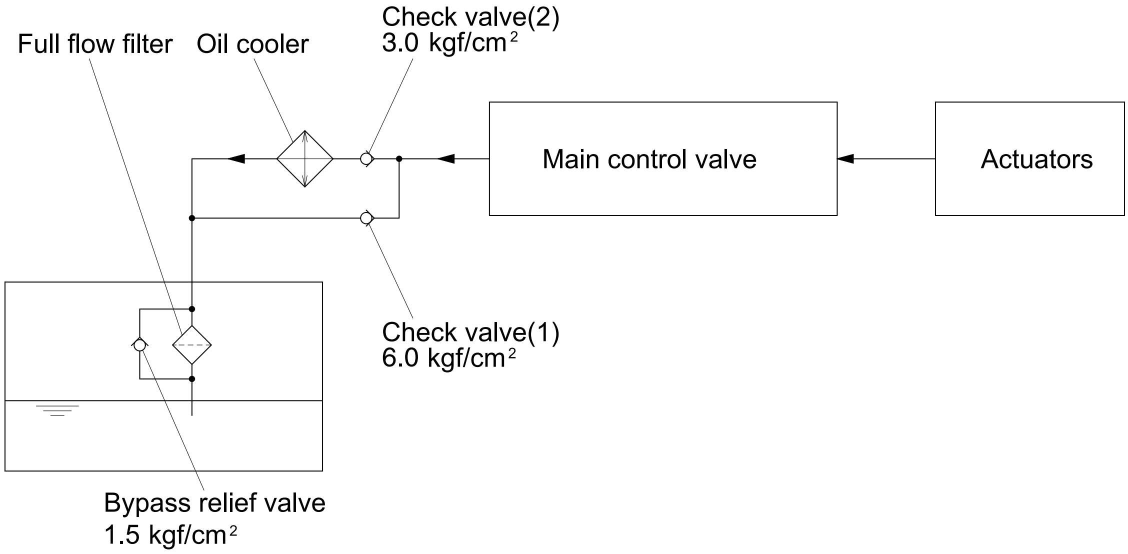
1. SUCTION AND DELIVERY CIRCUIT



(210-7) 3-03

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 main control valve.
The main control valve controls the hydraulic functions.
The return oil from the actuators flows to the hydraulic tank through the main control valve and the oil cooler.

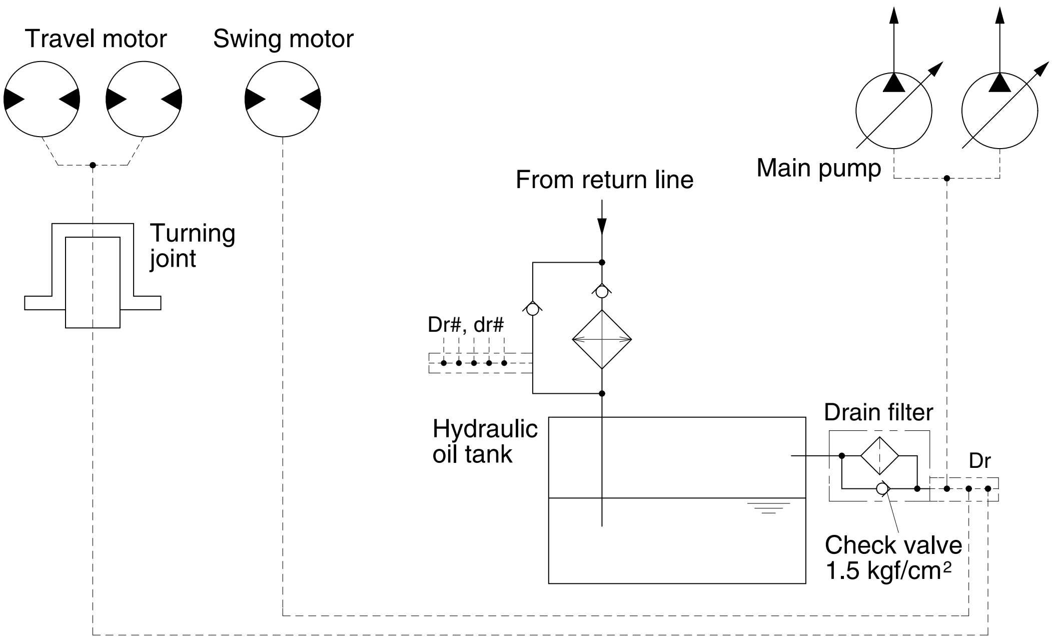
2. RETURN CIRCUIT



140L3CI02

All oil returned from each actuator returns to the hydraulic tank through the main control valve.
The bypass check valves are provided in the return circuit.
The setting pressure of bypass check valves are 3.0 kgf/cm^2 (43 psi) and 6.0 kgf/cm^2 (85 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. When the oil pressure exceeds 6.0 kgf/cm^2 (85 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 returned from right and left side of control valve is combined and filtered by the full-flow filter. A bypass relief valve is provided in the full-flow filter.
When the filter element is clogged, the bypass relief valve opens at 1.5 kgf/cm^2 (21 psi) differential pressure.

3. DRAIN CIRCUIT



220NL3CI02

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

1) TRAVEL MOTOR DRAIN CIRCUIT

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

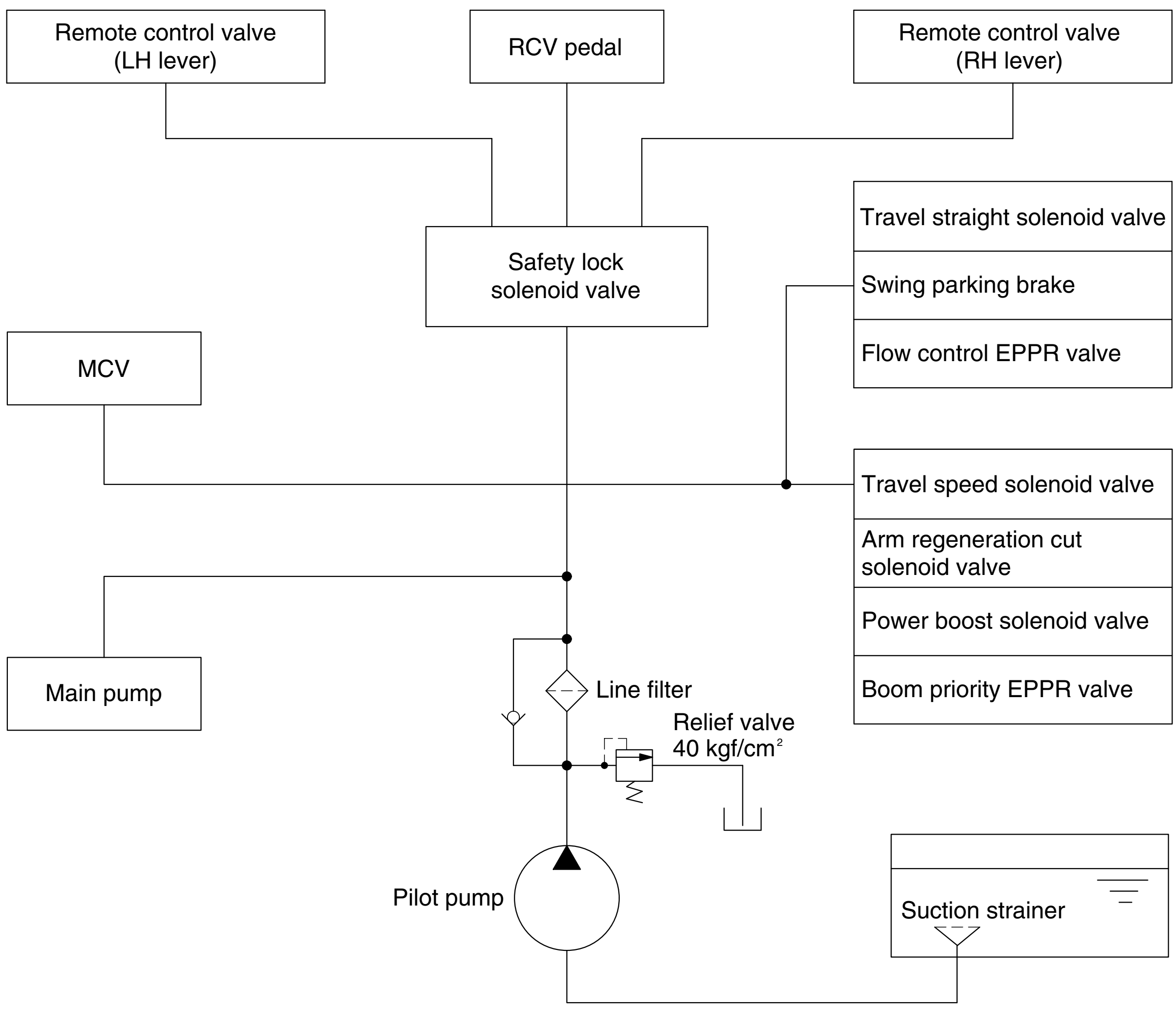
2) SWING MOTOR DRAIN CIRCUIT

Oil leaked from the swing motor returns to the hydraulic tank passing through a drain filter.

3) MAIN PUMP DRAIN CIRCUIT

Oil leaked from main pump returns to the hydraulic tank passing through drain filter.

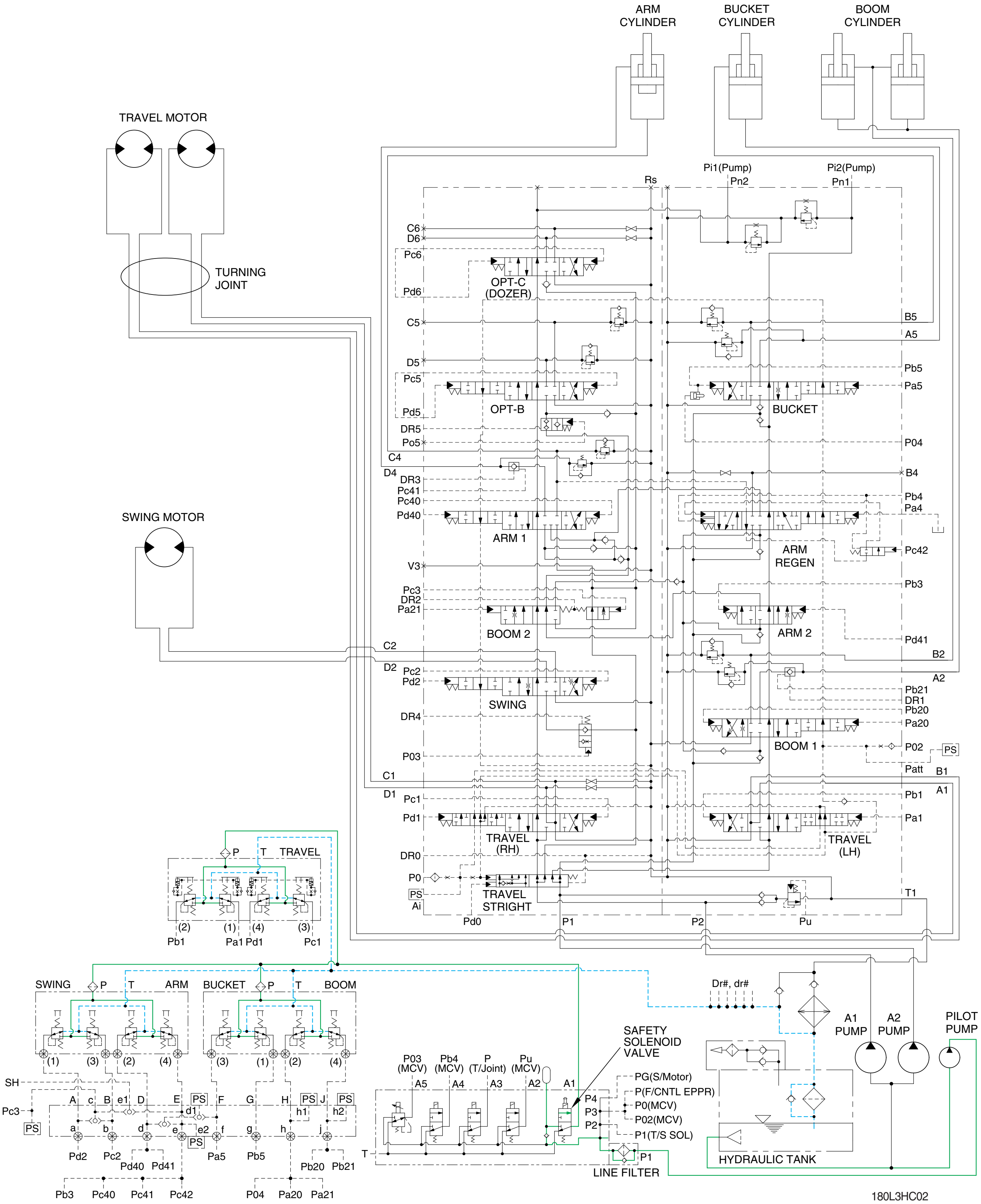
GROUP 3 PILOT CIRCUIT



180L3PC01

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.

1. SUCTION, DELIVERY AND RETURN CIRCUIT

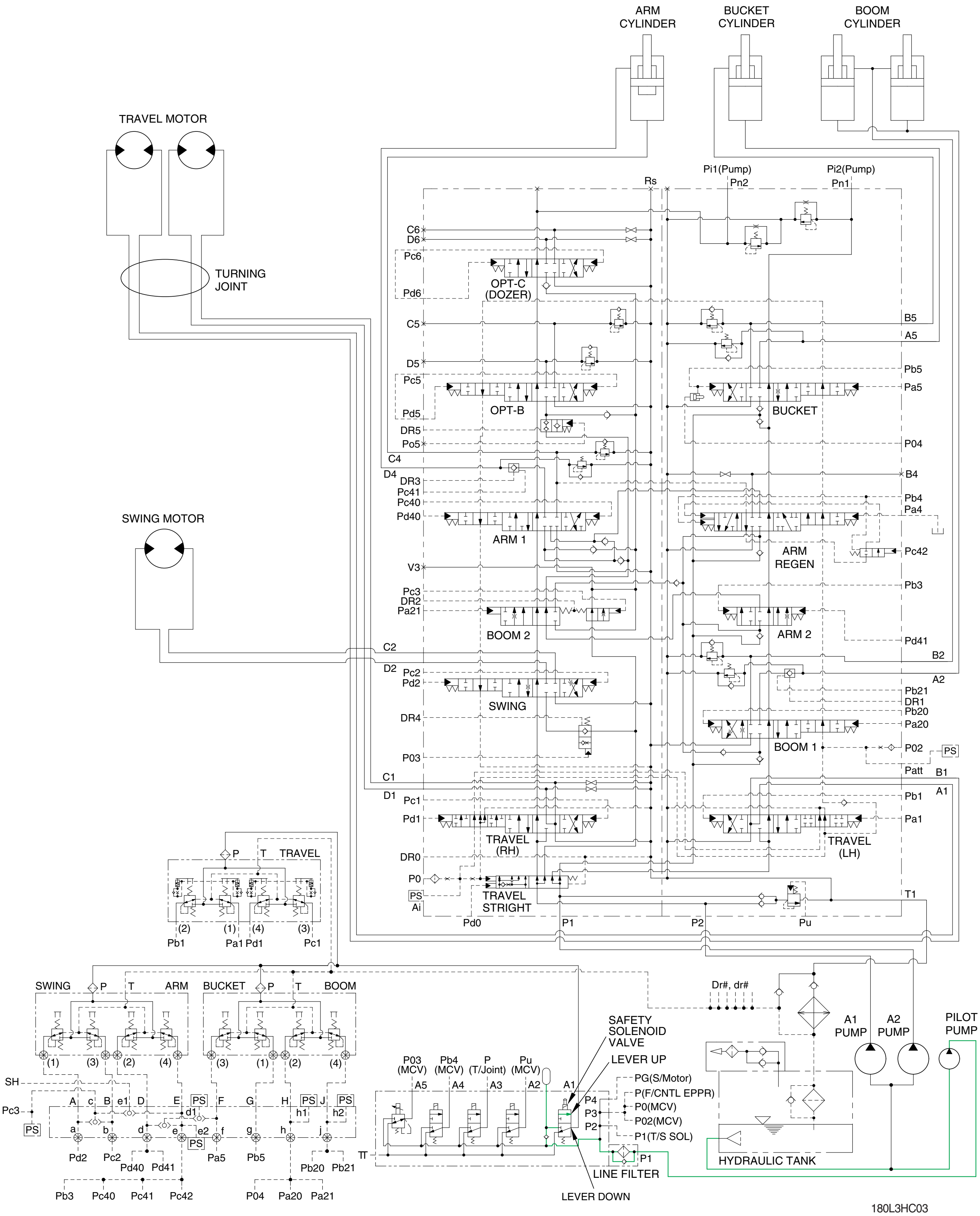


The pilot pump receive oil from the hydraulic tank. The discharged oil from the pilot pump flows to the safety solenoid valve through the line filter. The oil is filtered by the line filter. The pilot relief valve is provided in the pilot pump for limiting the pilot circuit pressure.

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

The return oil flow into the hydraulic tank.

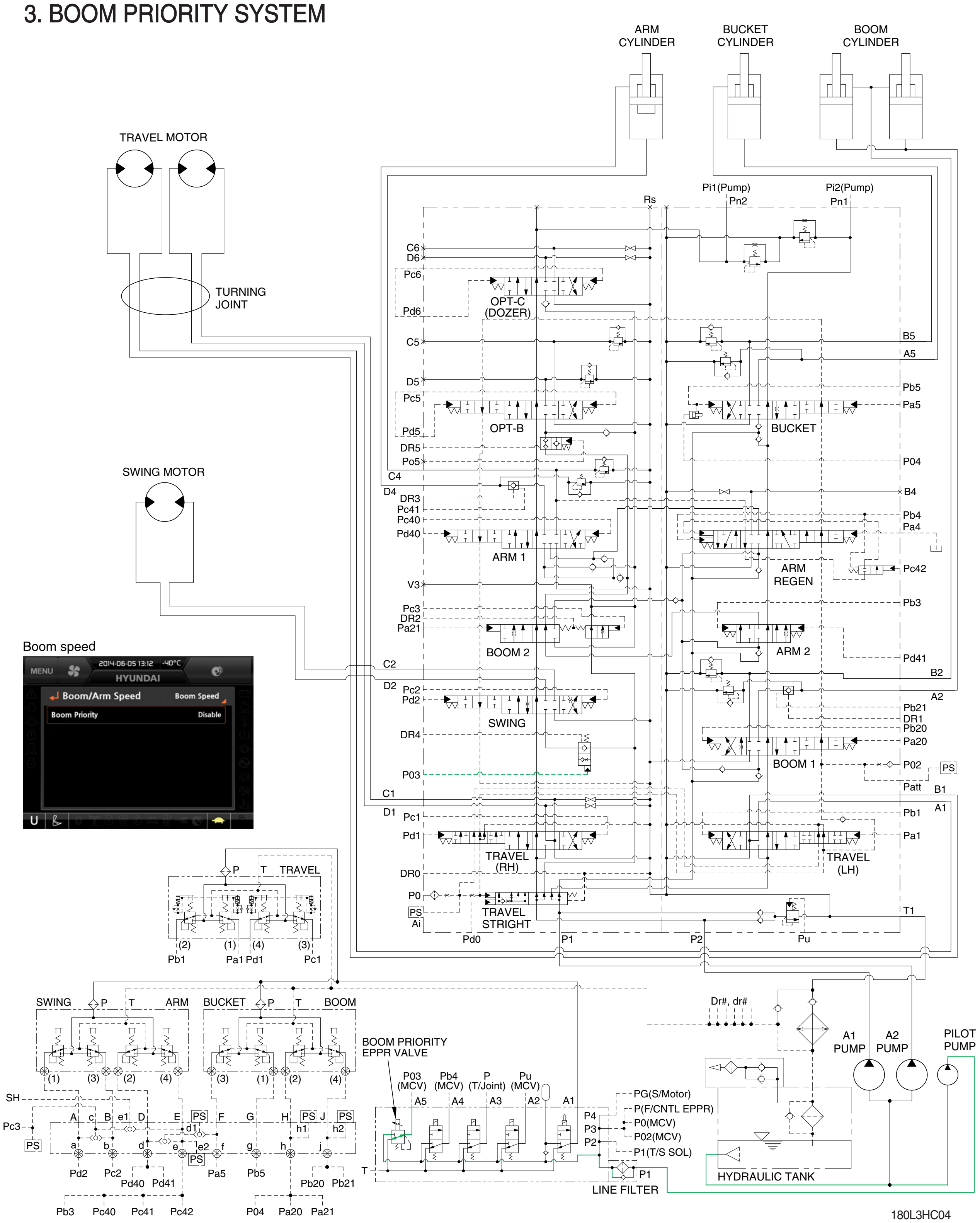
2. SAFETY VALVE (SAFETY LEVER)



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

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

3. BOOM PRIORITY SYSTEM



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

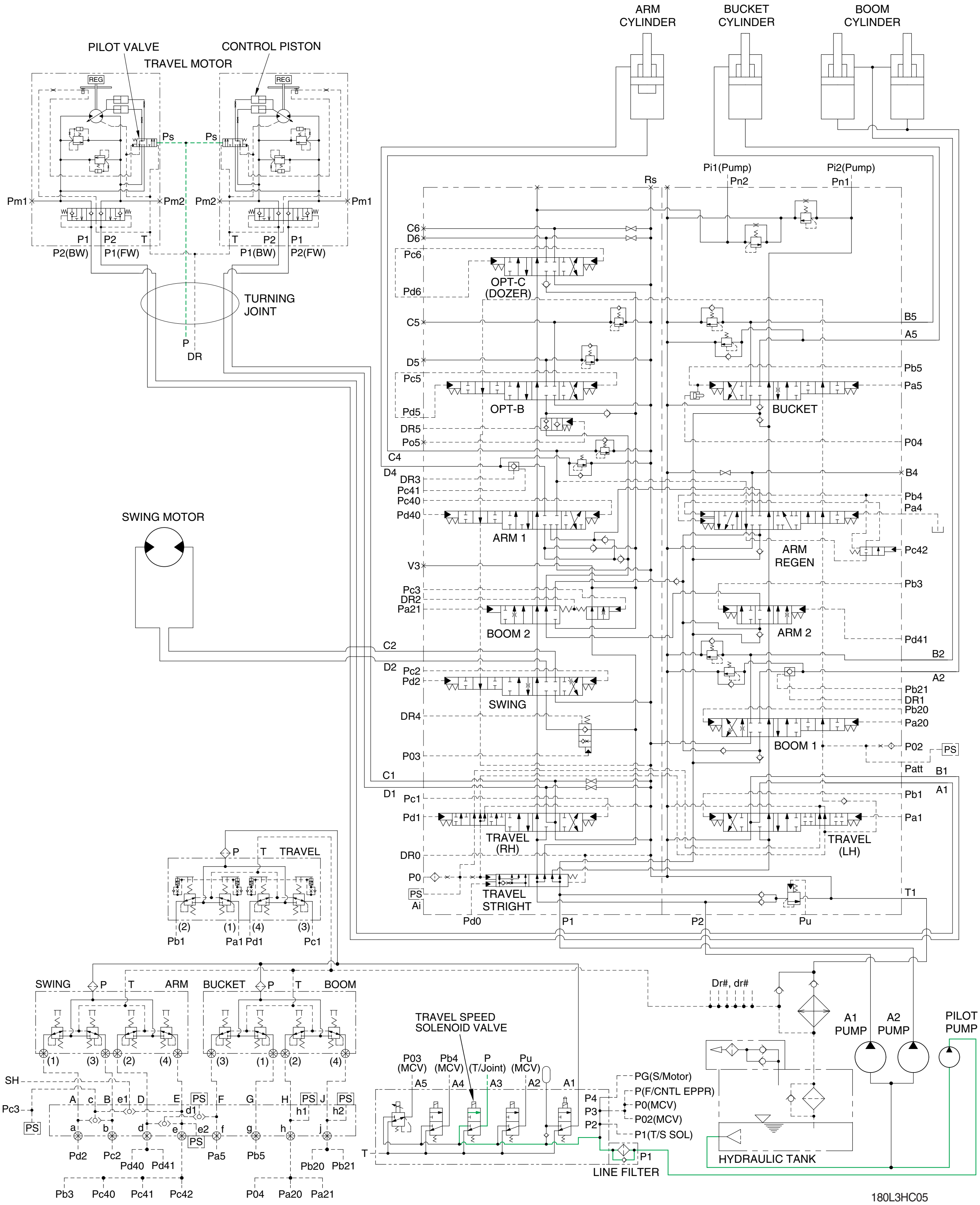
To increase working efficiency, swing speed reducing system is used.

The pilot oil from pilot pump flow into 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 3-20 of the operator's manual.

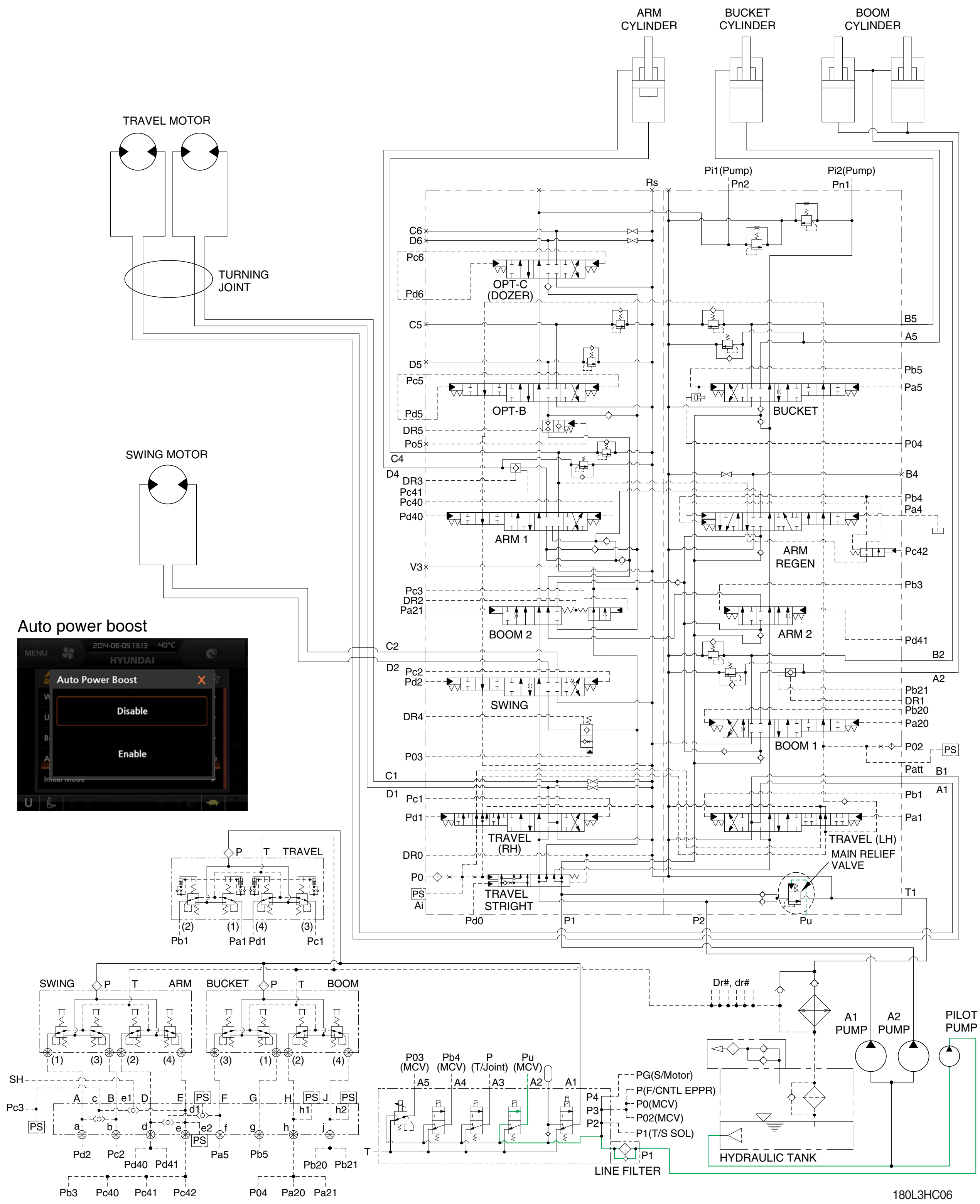
4. TRAVEL SPEED CONTROL SYSTEM



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

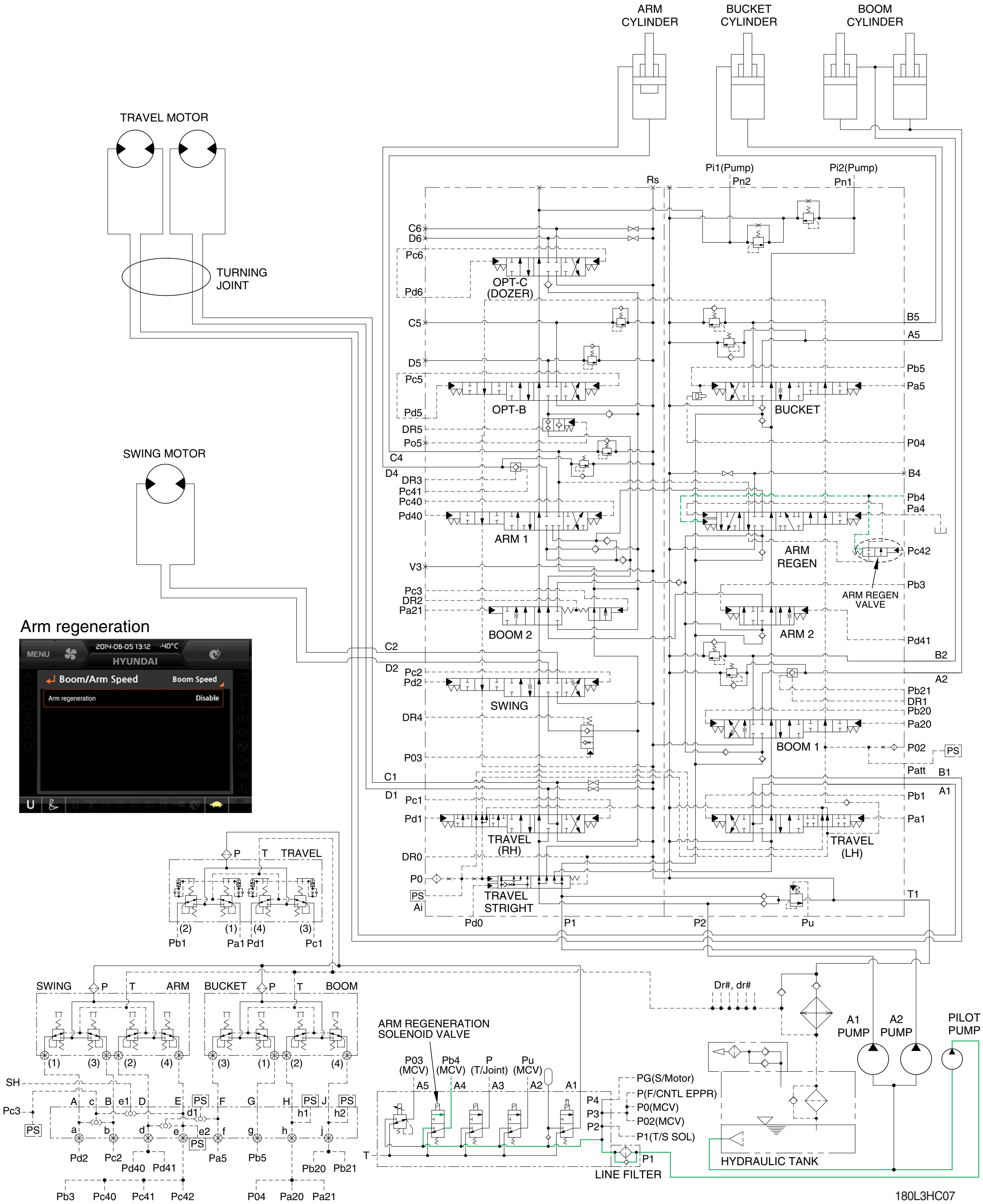
When the travel speed solenoid valve was placed in the Lo position, the oil of **Ps** port return to the tank and the control piston is returned, thus maximizing the displacement.

5. MAIN RELIEF PRESSURE CHANGE SYSTEM



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 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 (5400 psi) as working condition by the MCU.
It is operated max 8 seconds.

6. ARM REGENERATION CUT SYSTEM



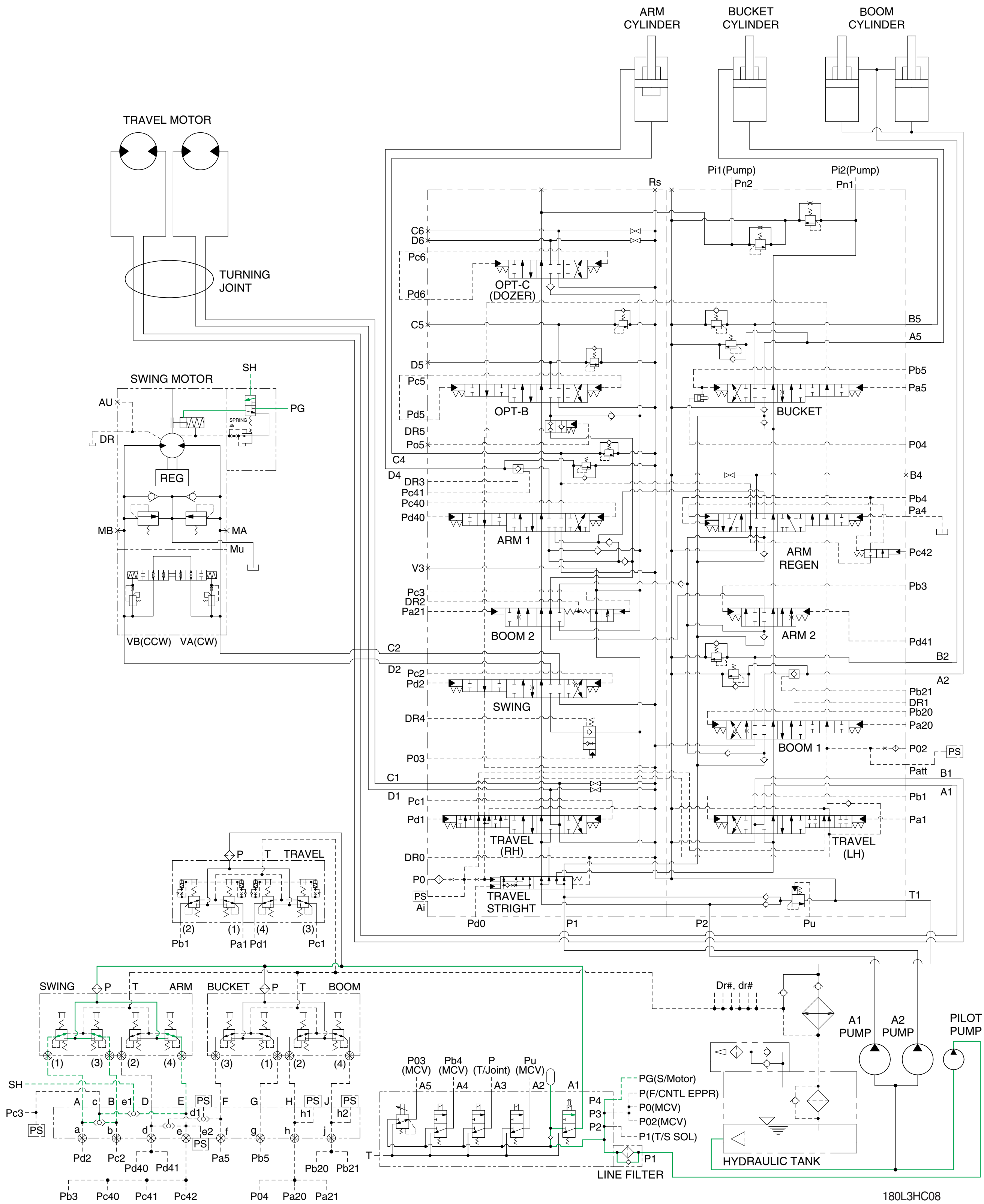
When the arm regeneration is selected to disable on the cluster, the arm regeneration solenoid valve is activated. The pilot oil from pilot pump flow into **Pb4** port in main control valve through solenoid valve and the arm regeneration spool is shifted to left.

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

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

Refer to page 2-36 for the arm regeneration function.

7. SWING PARKING BRAKE RELEASE

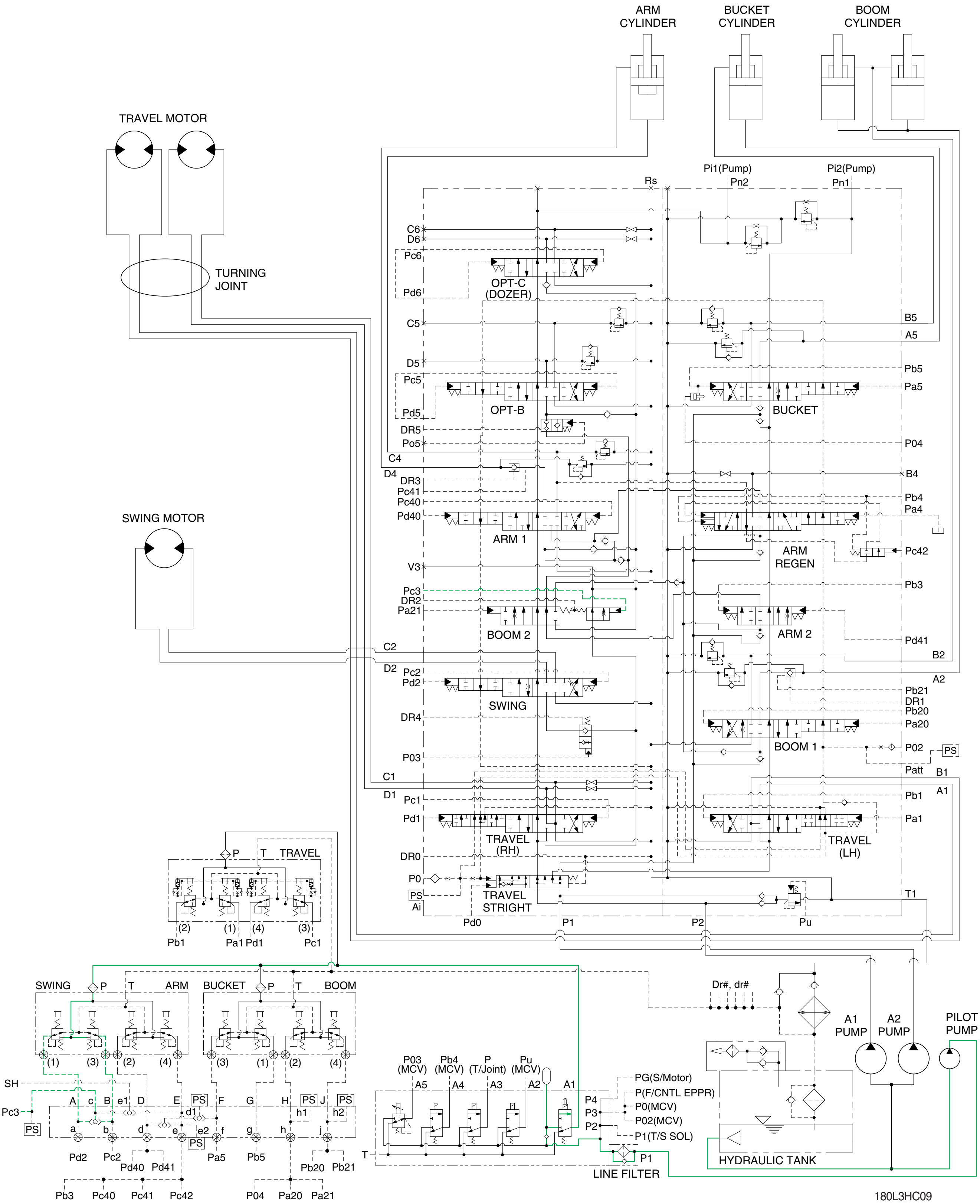


When the swing control lever or arm in control lever is tilted, the pilot oil flows into **SH** port of time delay valve.

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 the swing control lever and arm in control lever are set in the neutral position, oil in the swing motor disc cylinder is drained, thus the brake is applied.

8. SWING PRIORITY SYSTEM

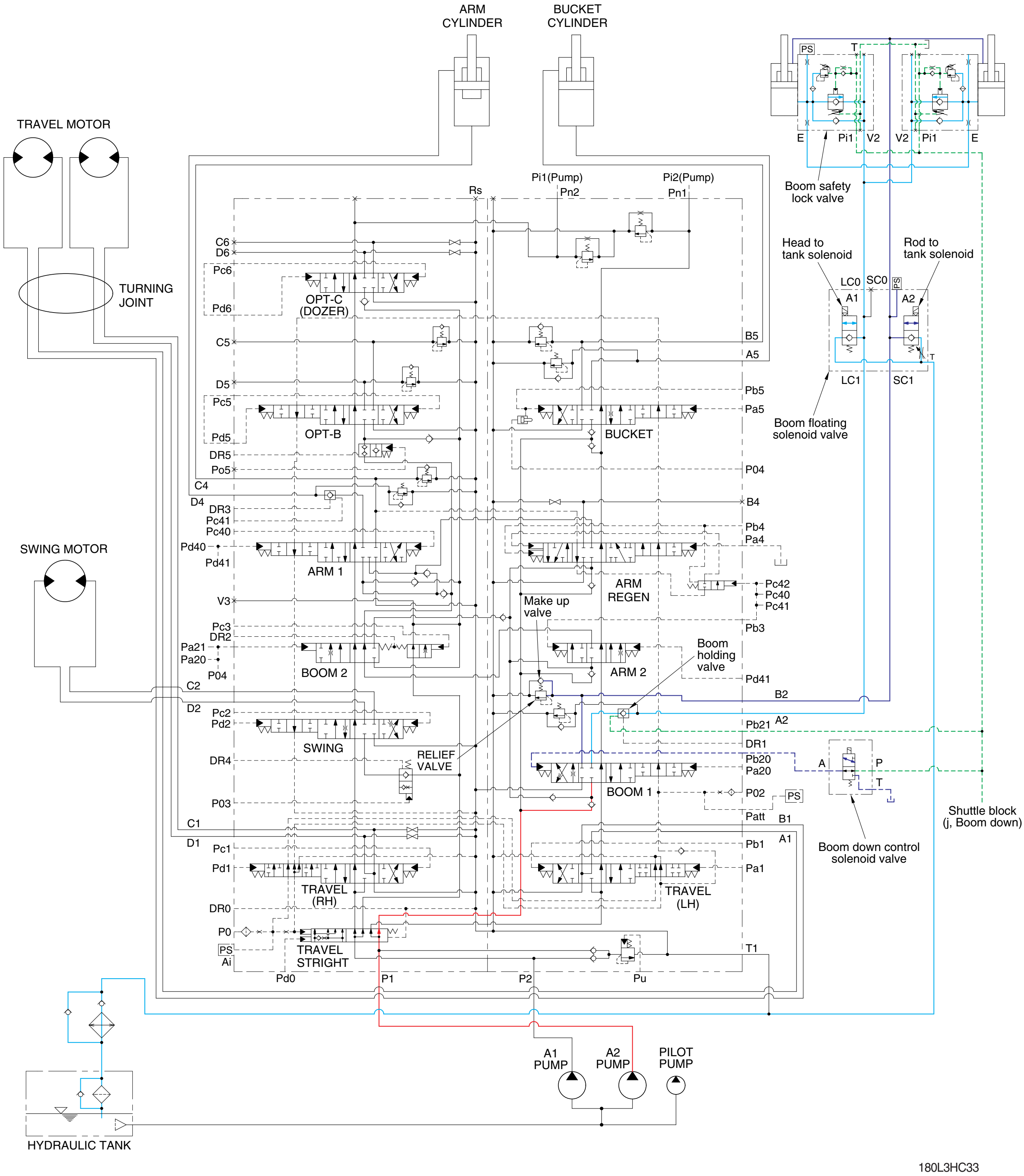


When carrying out the combined operation of swing and arm of the left control valve, the swing speed can be lowered than operating speed of arm.

Pc3 pressure from the swing shuttle block change the swing priority spool and decreases the oil flow rate to the next section to make the swing operation most preferential.

This is called the swing priority system. For details, refer to page 2-38.

9. BOOM FLOATING SYSTEM



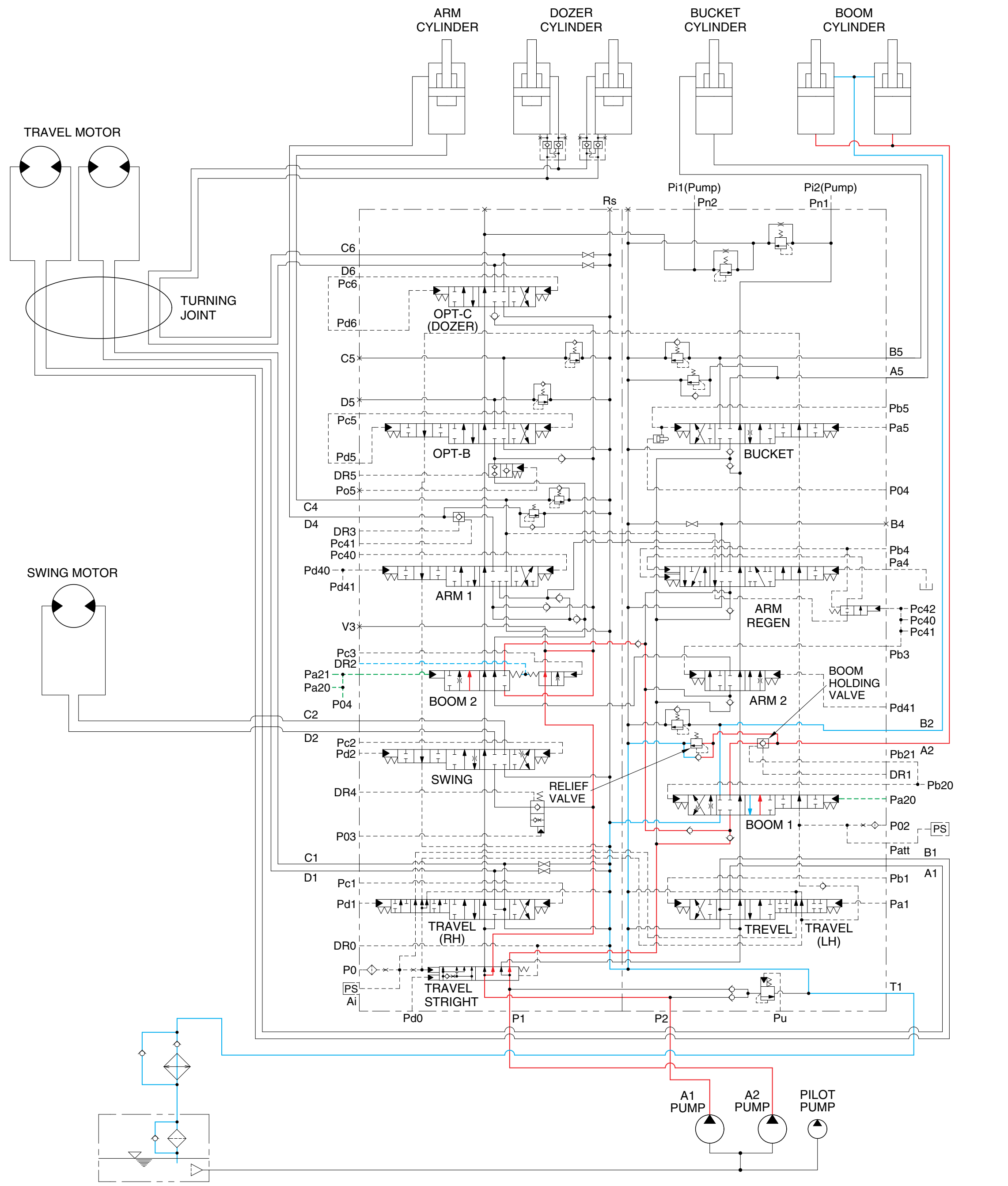
Smooth and convenient boom movement is accomplished by only arm control lever operation.

The boom floating solenoid valves are equipped in the rod and head of boom cylinder that are controlled to act as floating mode.

"Rod to tank solenoid" and "Head to tank solenoid" are active. So the hydraulic oil of rod and head goes to tank, and floating is accomplished. In the mode, boom down control solenoid is active so that boom down pilot pressure is cut.

For more details, refer to page 5-13.

1. BOOM UP OPERATION



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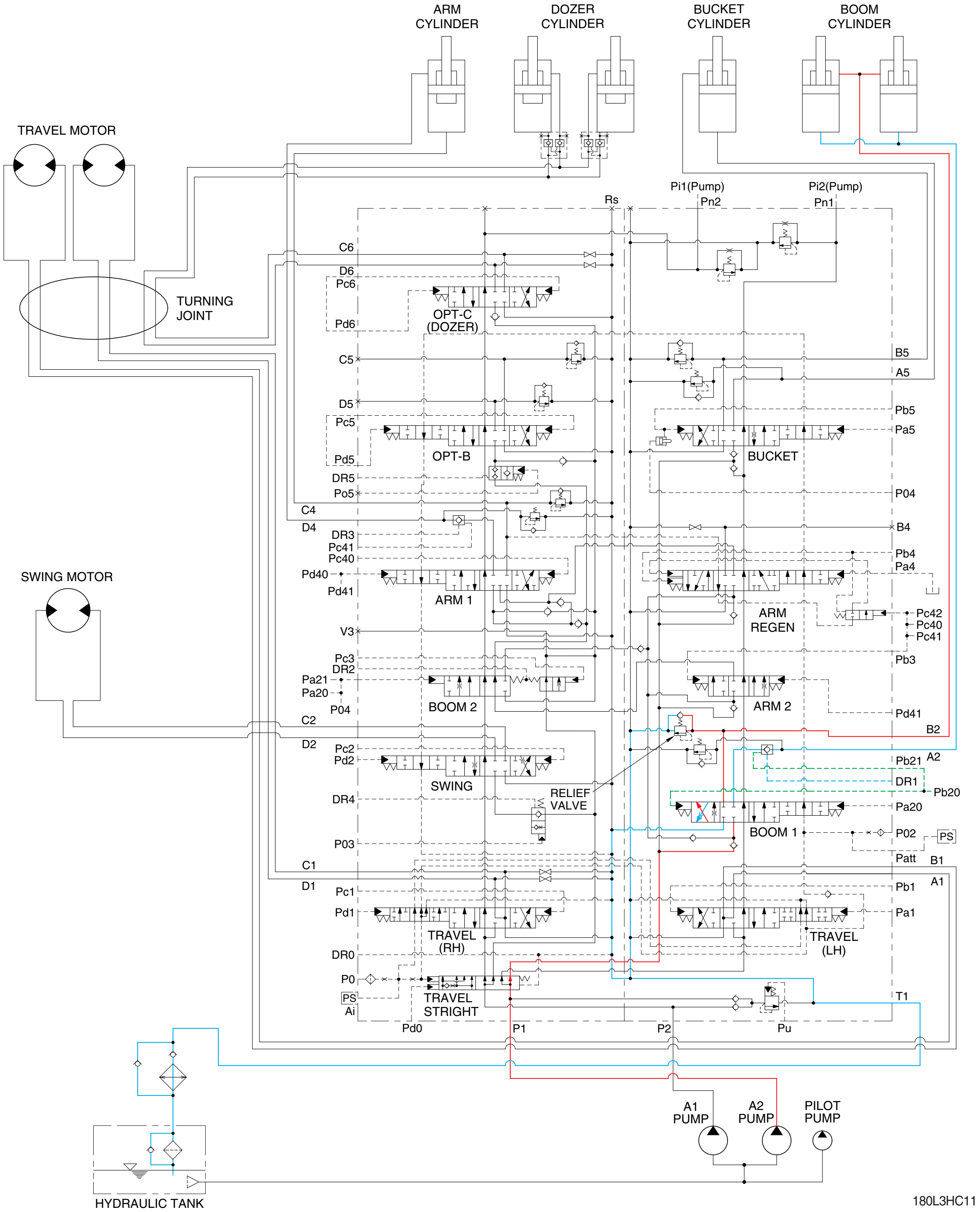
When the right control lever is pulled back, the boom spools in the main control valve are moved to the up position by the pilot oil pressure from the remote control valve.
The oil from the A1 and A2 pump flows into the main control valve and then goes to the large chamber of boom cylinders.
At the same 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.

2. BOOM DOWN OPERATION



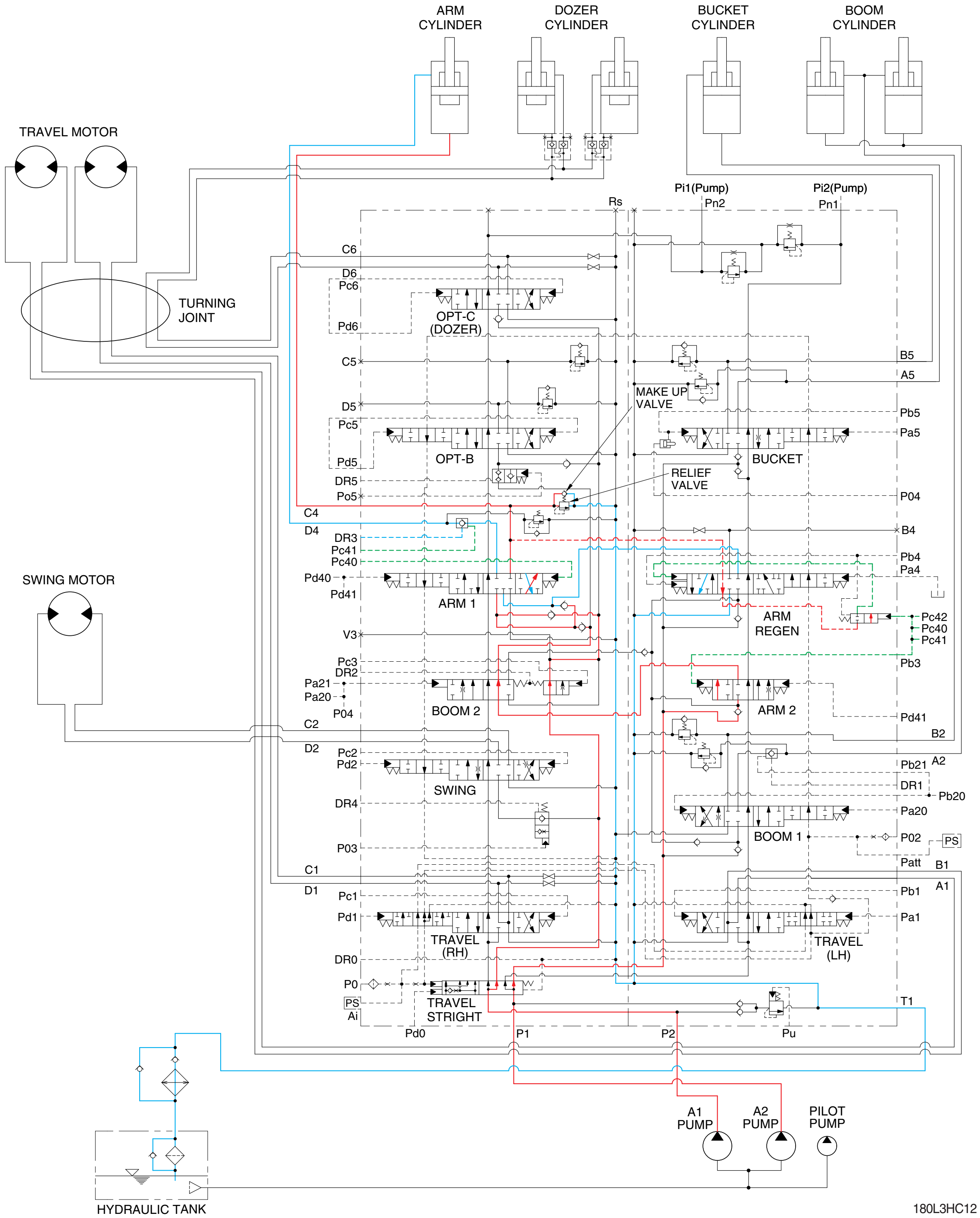
When the right control lever is pushed forward, the boom 1 spool in the main control valve is moved to the down position by the pilot oil pressure from the remote control valve.

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.

3. ARM IN OPERATION



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

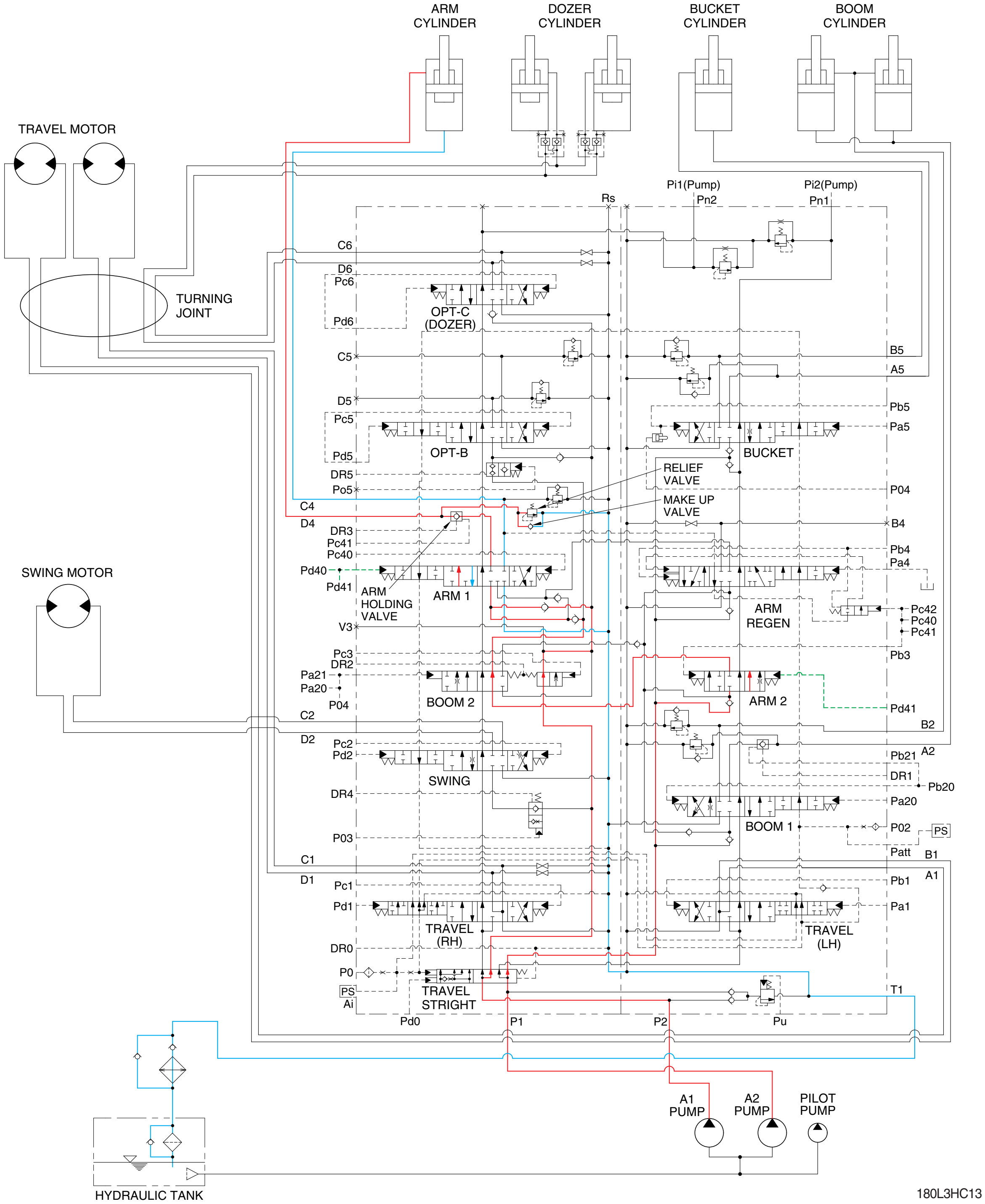
The oil from the A1 and A2 pump flows into the main control valve and then goes to the large chamber of arm cylinder.

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

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

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

4. ARM OUT OPERATION



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

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

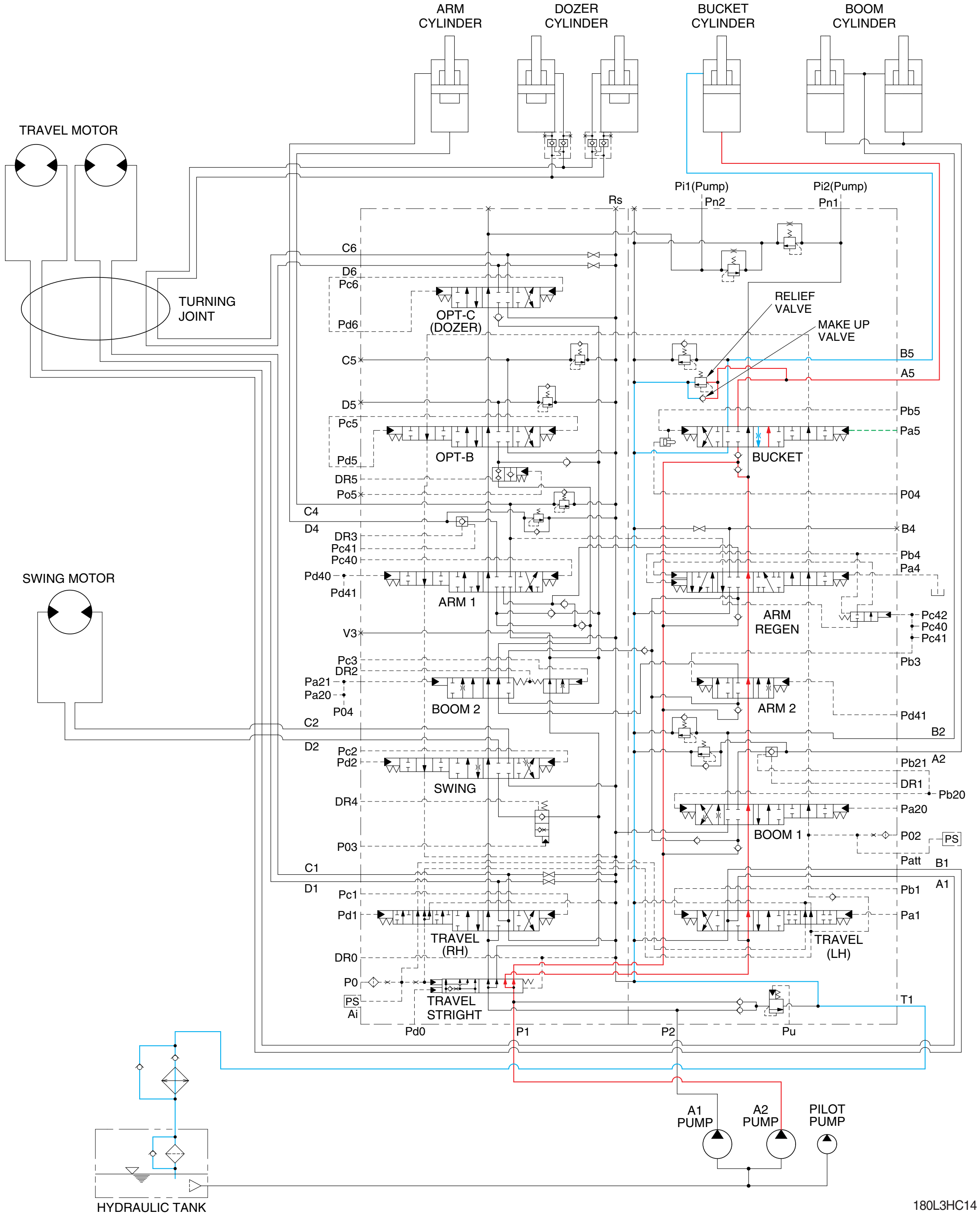
At the same time, the oil from the large chamber of arm cylinder returns to the hydraulic oil tank through the arm 1 spool in the main control valve. When this happens, the arm rolls out.

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

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

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

5. BUCKET IN OPERATION



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

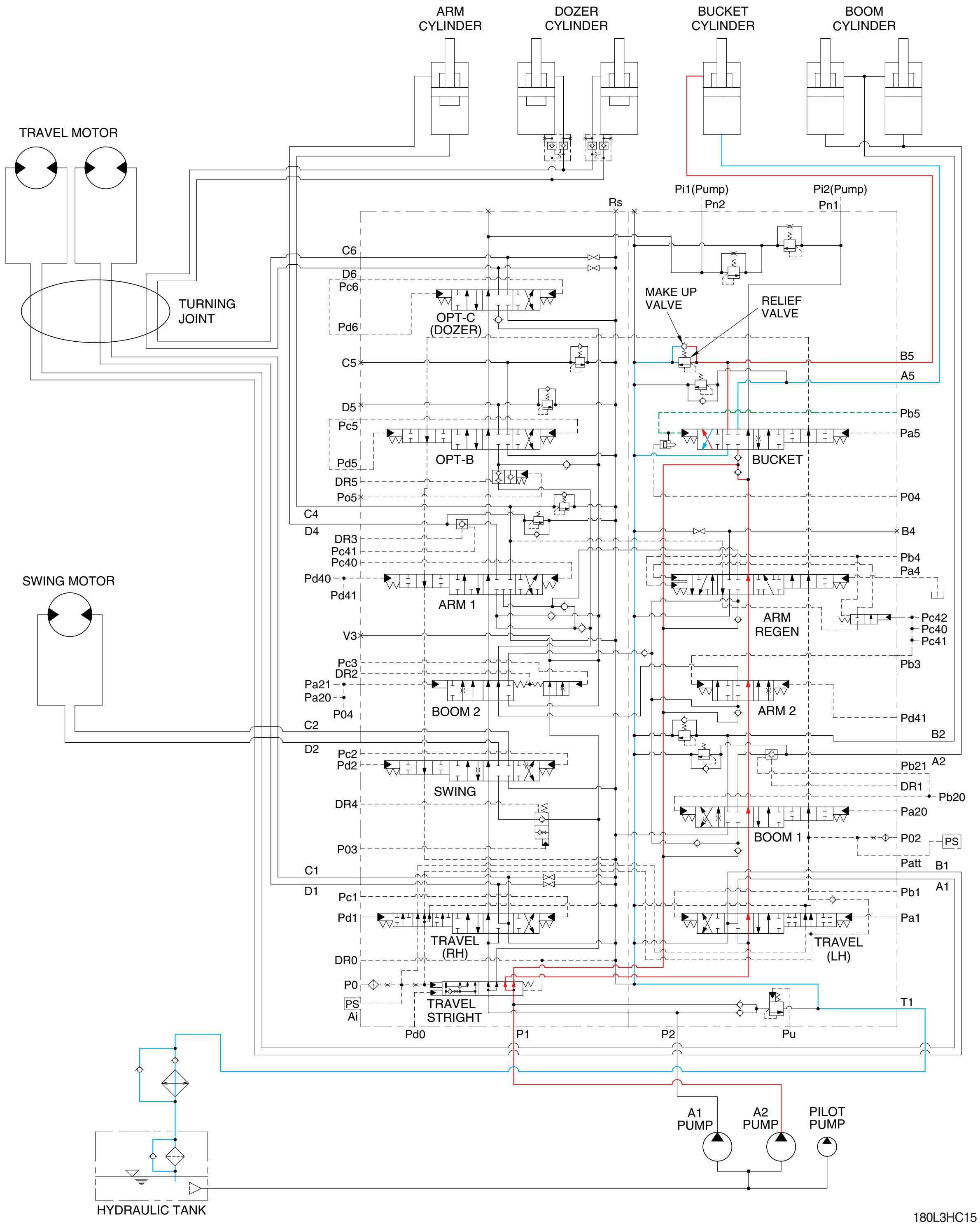
The oil from the A2 pump flows into the main control valve and then goes to the large chamber of bucket cylinder.

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.

6. BUCKET OUT OPERATION



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

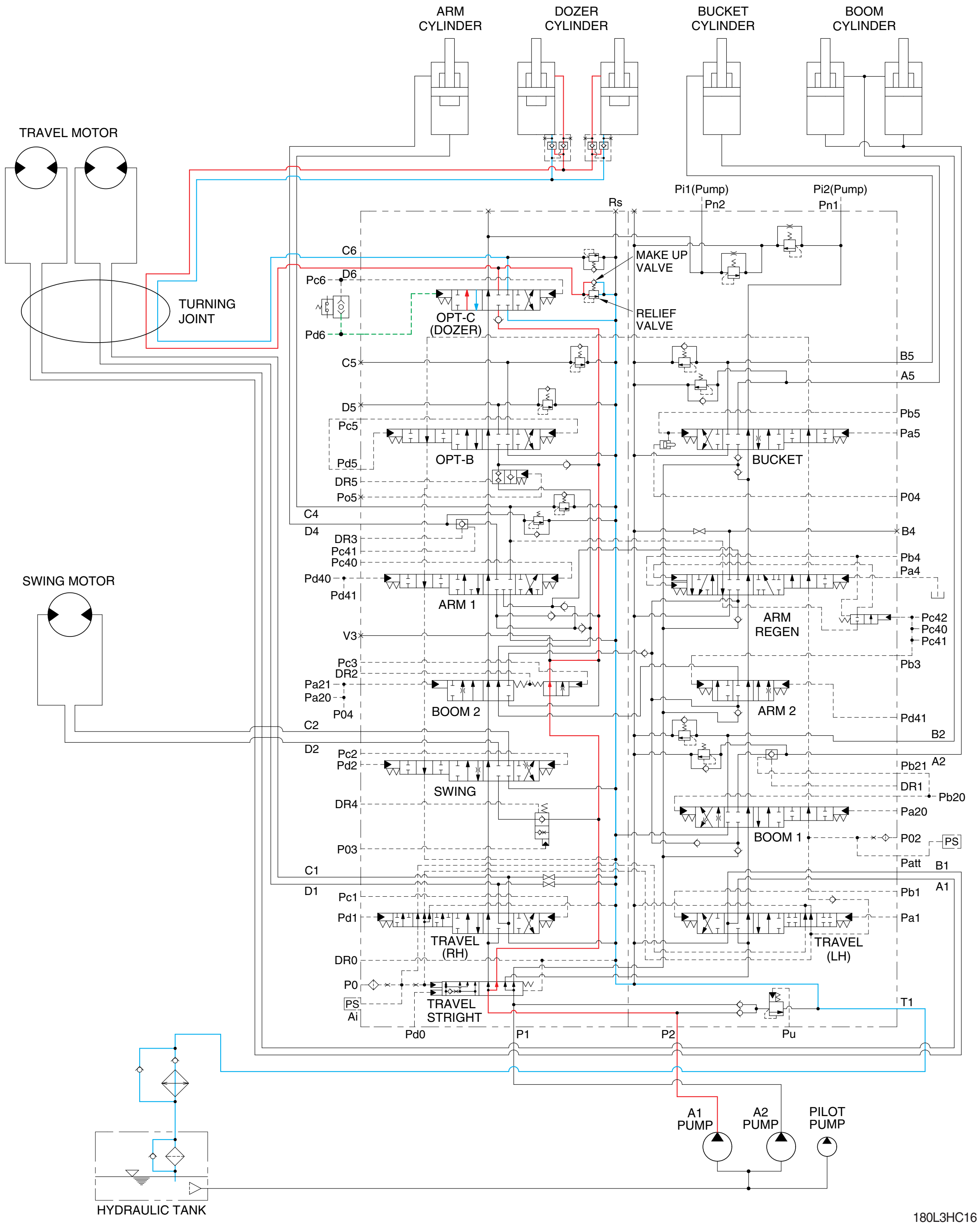
The oil from the A2 pump flows into the main control valve and then goes to the small chamber of bucket cylinder.

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

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

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

7. DOZER UP OPERATION

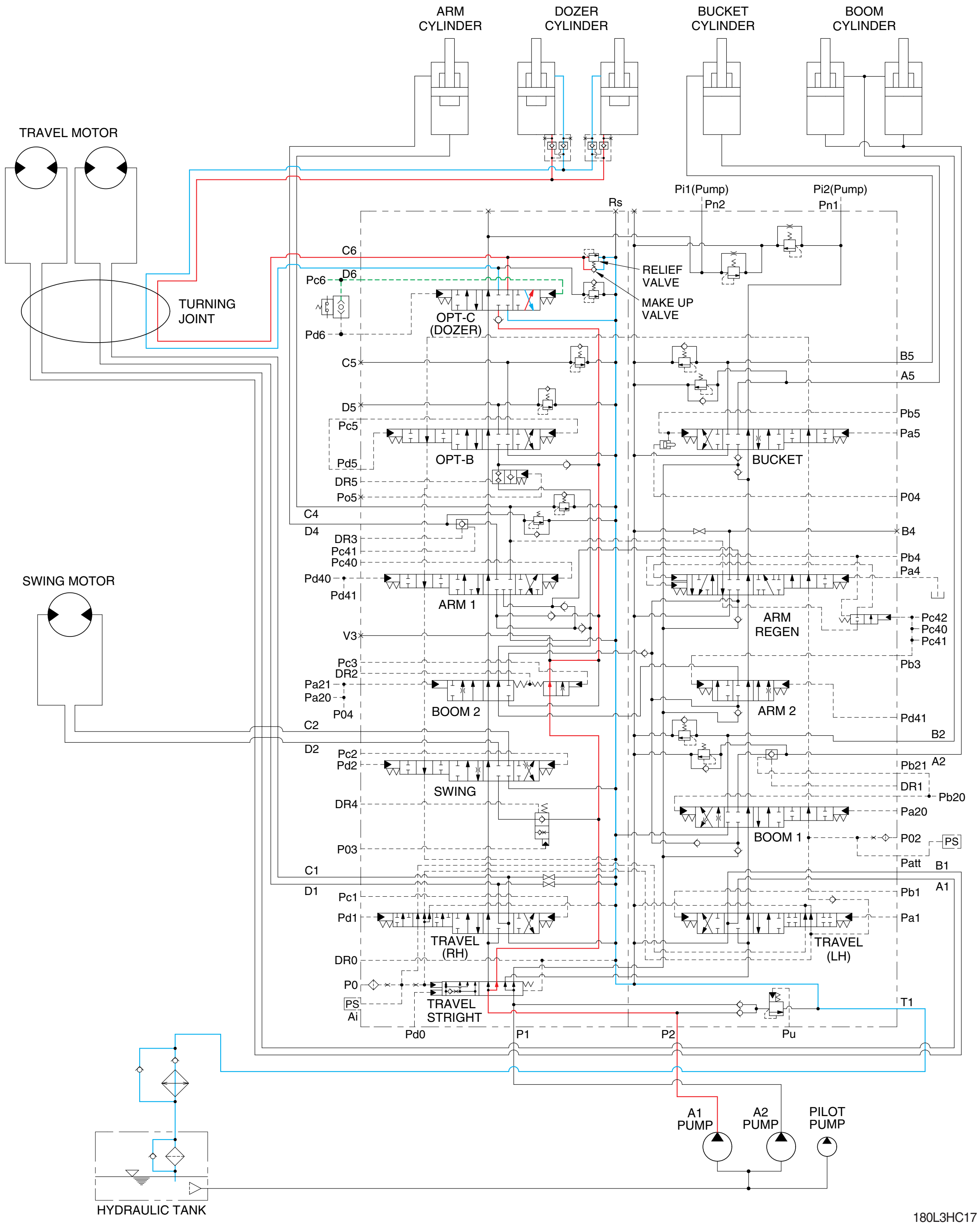


When the dozer control lever is pulled back, the dozer spool in the main control valve is moved to the dozer up position by the pilot oil pressure from the remote control valve.

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

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

8. DOZER DOWN OPERATION

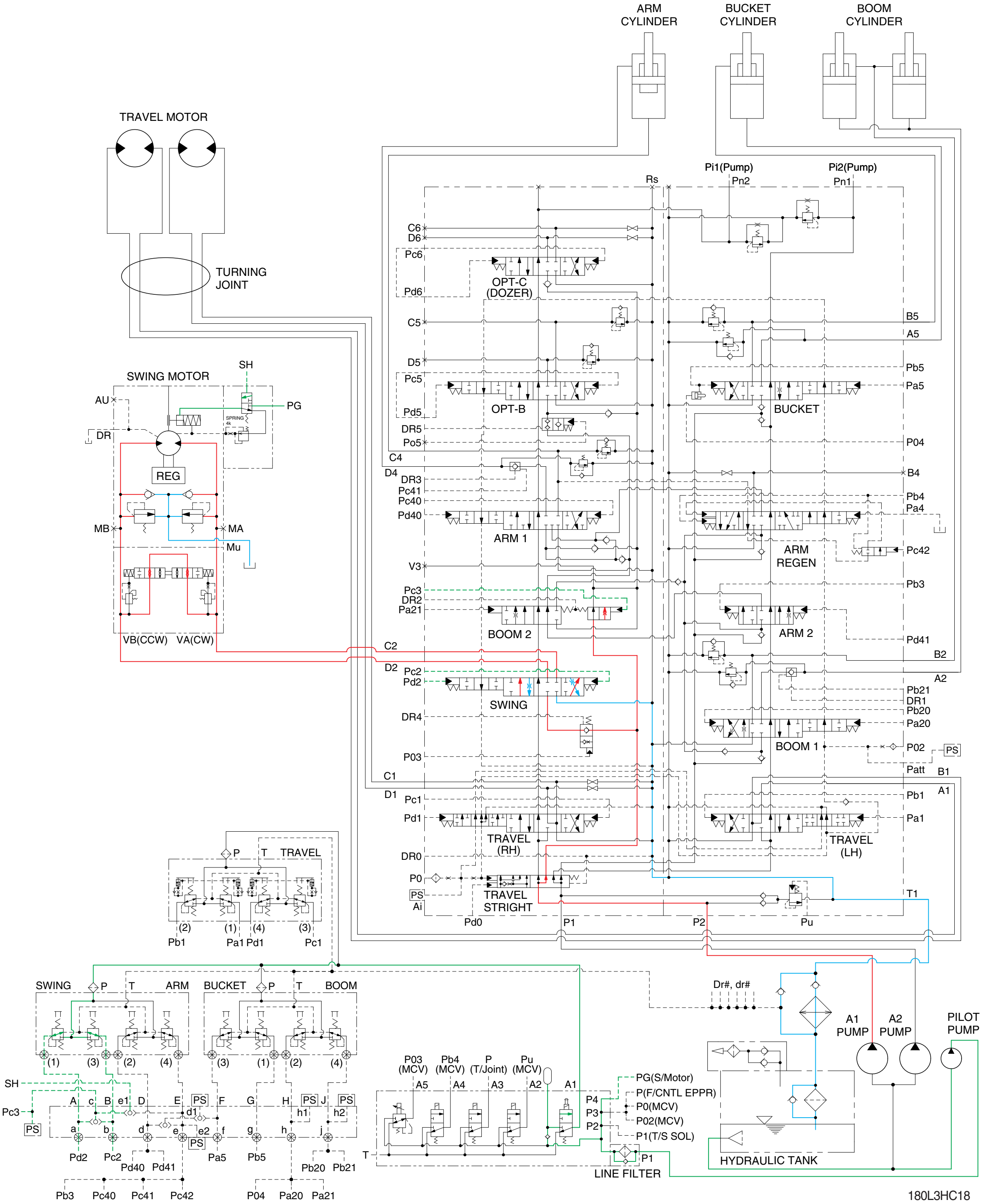


When the dozer control lever is pushed forward, the dozer spool in the main control valve is moved to the dozer down position by the pilot oil pressure from the remote control valve.

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

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

9. SWING OPERATION



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

Also the swing operation preference function is operated by the pilot pressure **Pc3** (refer to page 3-13).

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

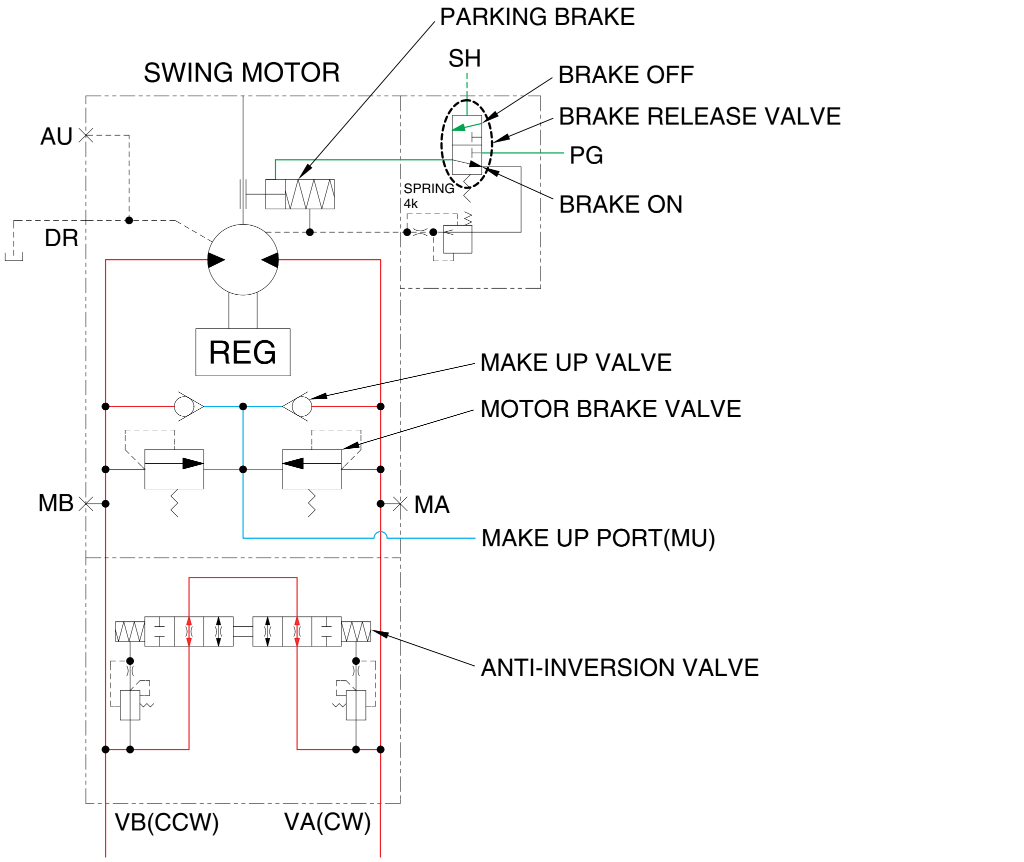
At the same time, the return oil from the swing motor returns to the hydraulic oil tank through the swing spool in the main control valve.

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

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

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

SWING CIRCUIT OPERATION



1) MOTOR BRAKE VALVE

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

2) MAKE UP VALVE

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

3) PARKING BRAKE

This is function as a parking brake only when 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

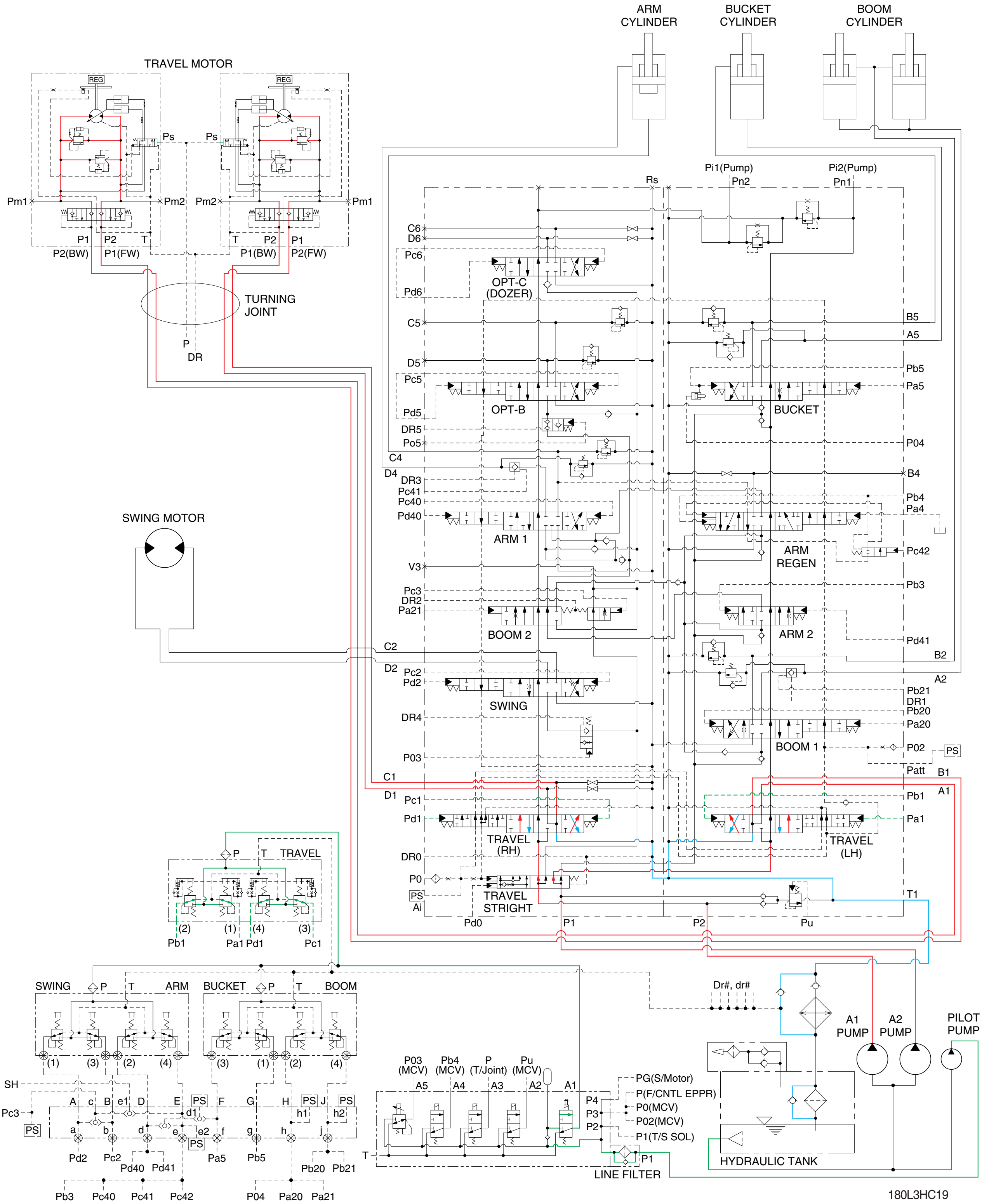
When the swing control lever and arm in control lever placed in the neutral position, the pressure of the pilot oil passage down.

Then the brake release valve returned to the neutral position and the oil is returned from the brake piston to the hydraulic oil 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.

10. TRAVEL FORWARD AND REVERSE OPERATION



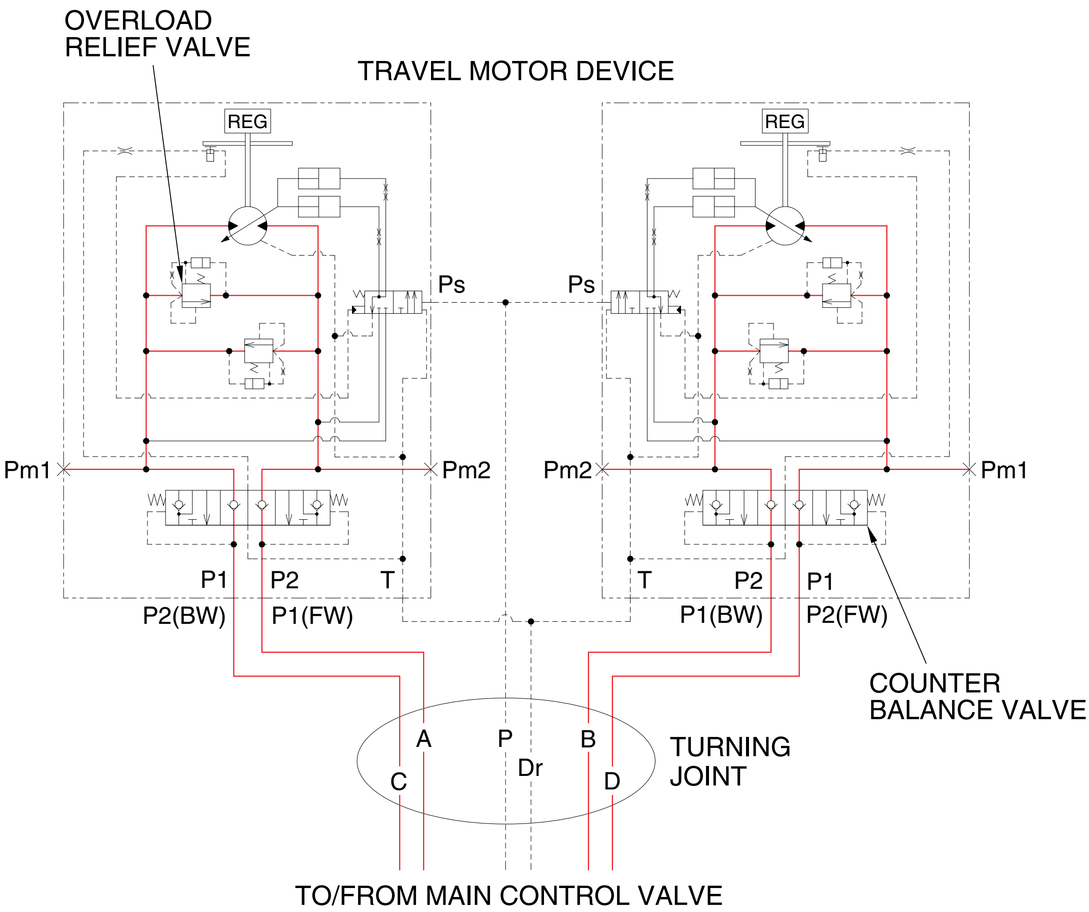
When the travel levers are pushed forward or reverse position, the travel spools in the main control valve are moved to the forward or reverse travel position by the pilot oil pressure from the remote control valve.

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

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

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

TRAVEL CIRCUIT OPERATION



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

1) COUNTER BALANCE VALVE

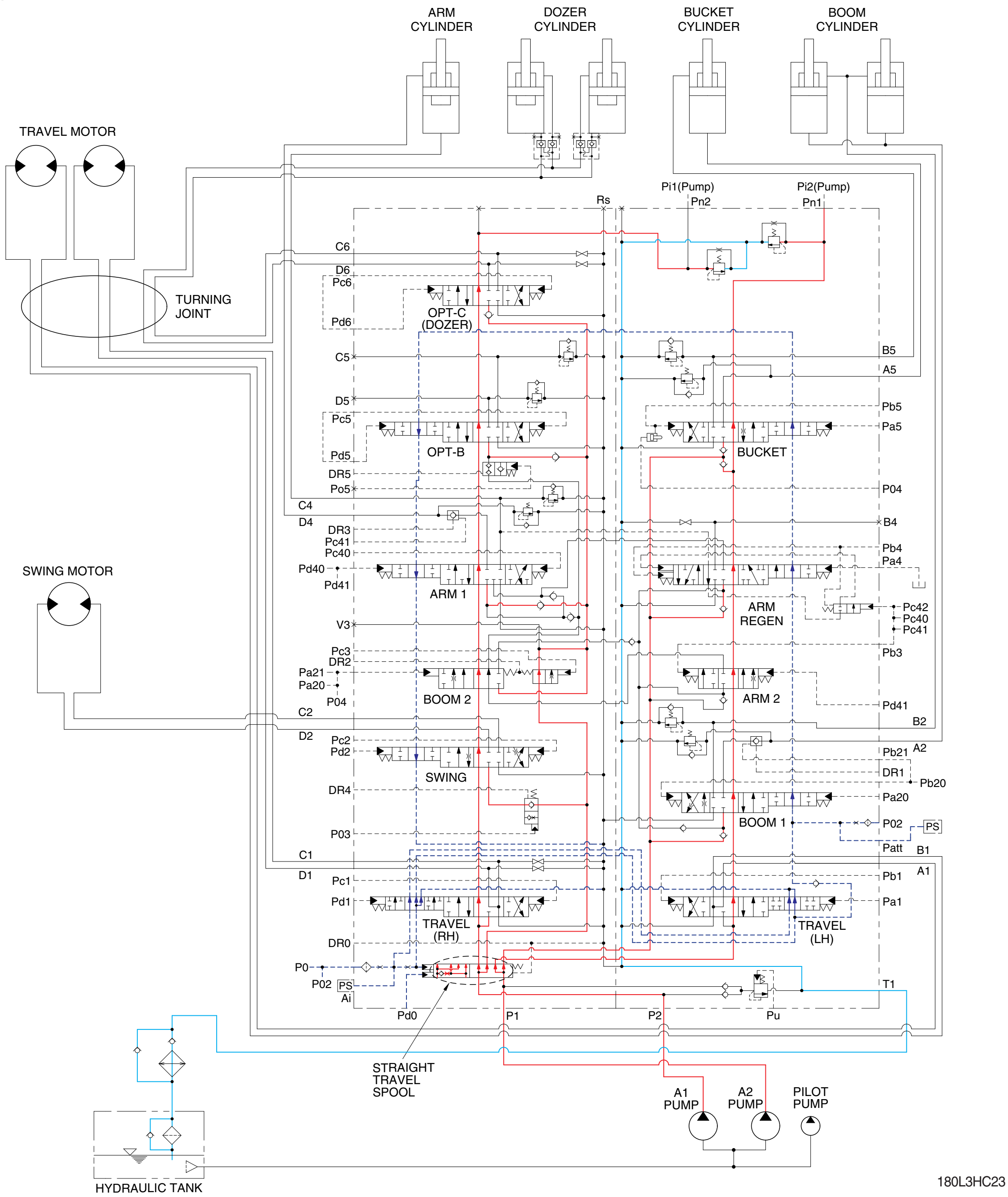
When stopping the motor of slope descending, this valve to prevent the motor over run.

2) OVERLOAD RELIEF VALVE

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

GROUP 5 COMBINED OPERATION

1. OUTLINE



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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.

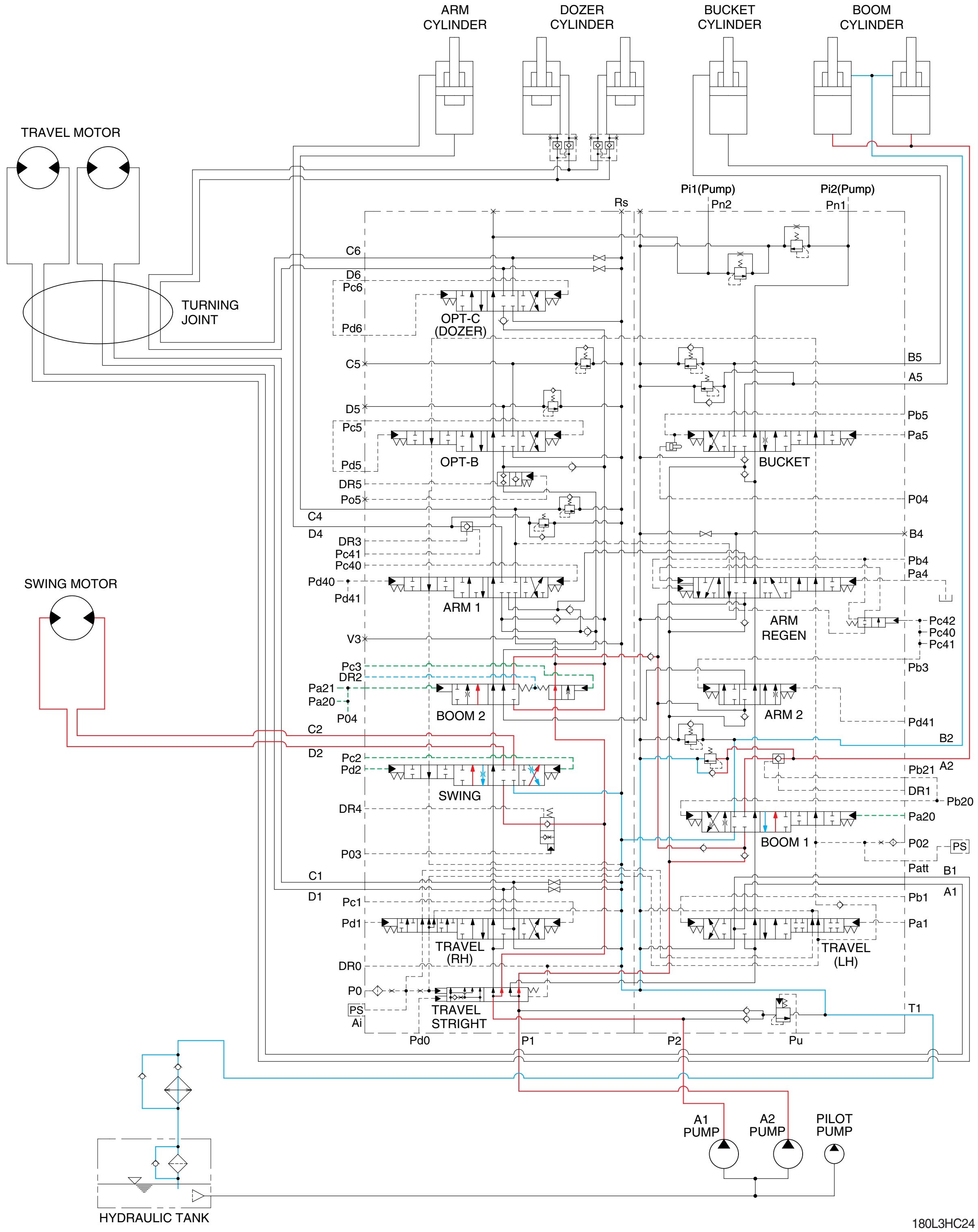
STRAIGHT TRAVEL SPOOL

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.

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

2. COMBINED SWING AND BOOM UP OPERATION



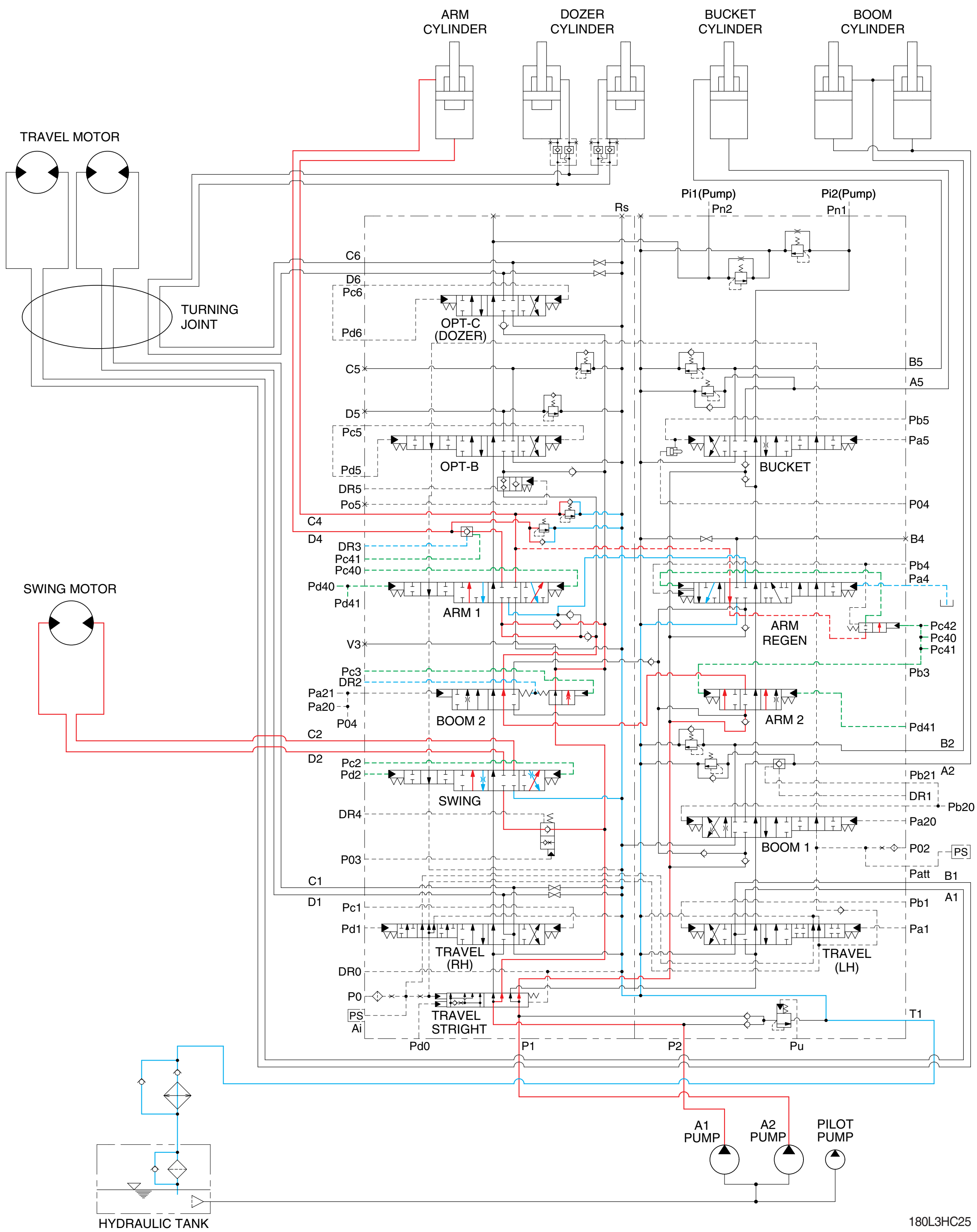
When the swing and boom up functions are operated simultaneously, the swing spool and boom spools in the main control valve are moved to the functional position by the pilot oil pressure from the remote control valve.

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

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

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

3. COMBINED SWING AND ARM OPERATION



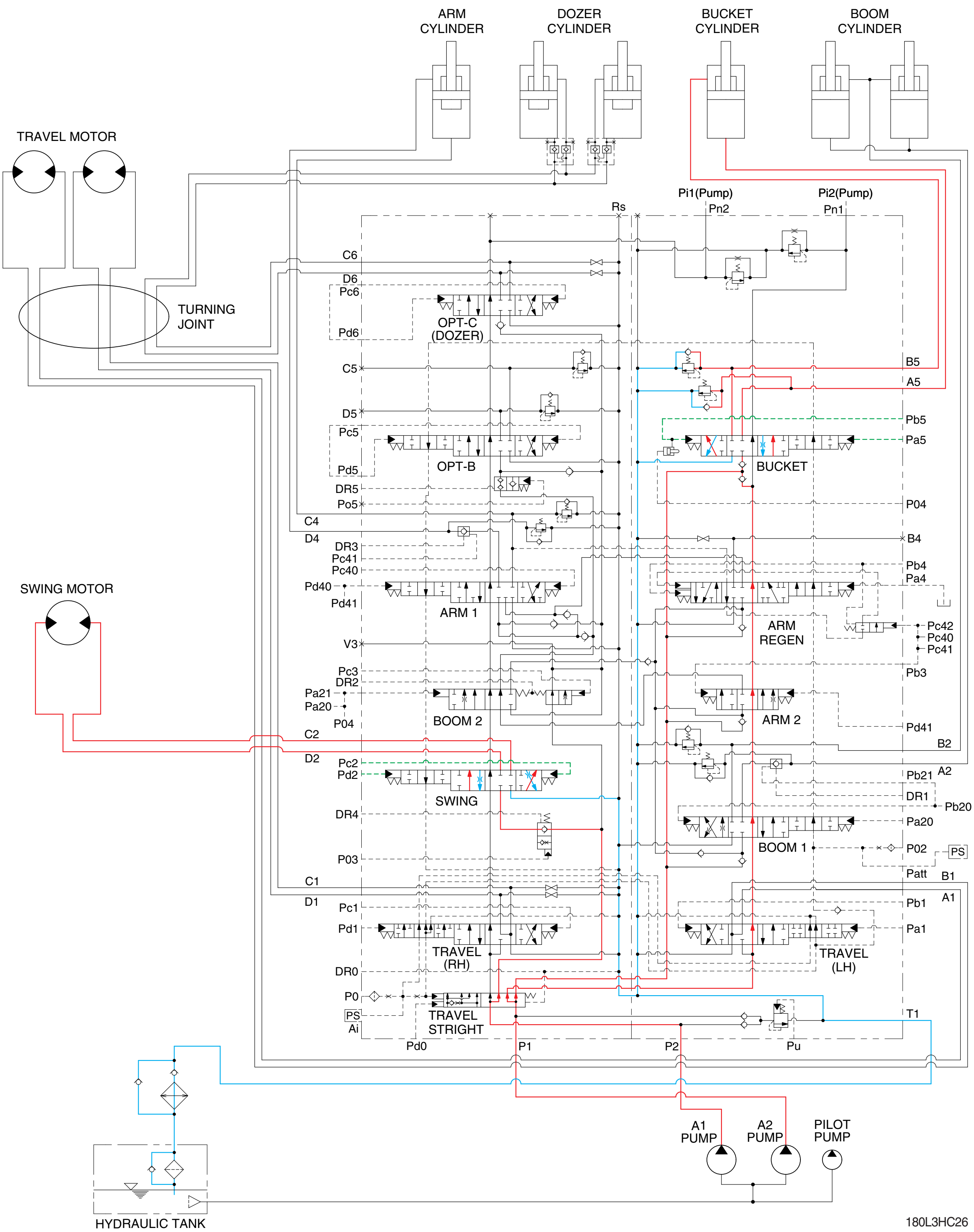
When the swing and arm functions are operated simultaneously, the swing spool and arm spools in the main control valve are moved to the functional position by the pilot oil pressure from the remote control valve.

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

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

Refer to page 3-13 for the swing operation preference function.

4. COMBINED SWING AND BUCKET OPERATION



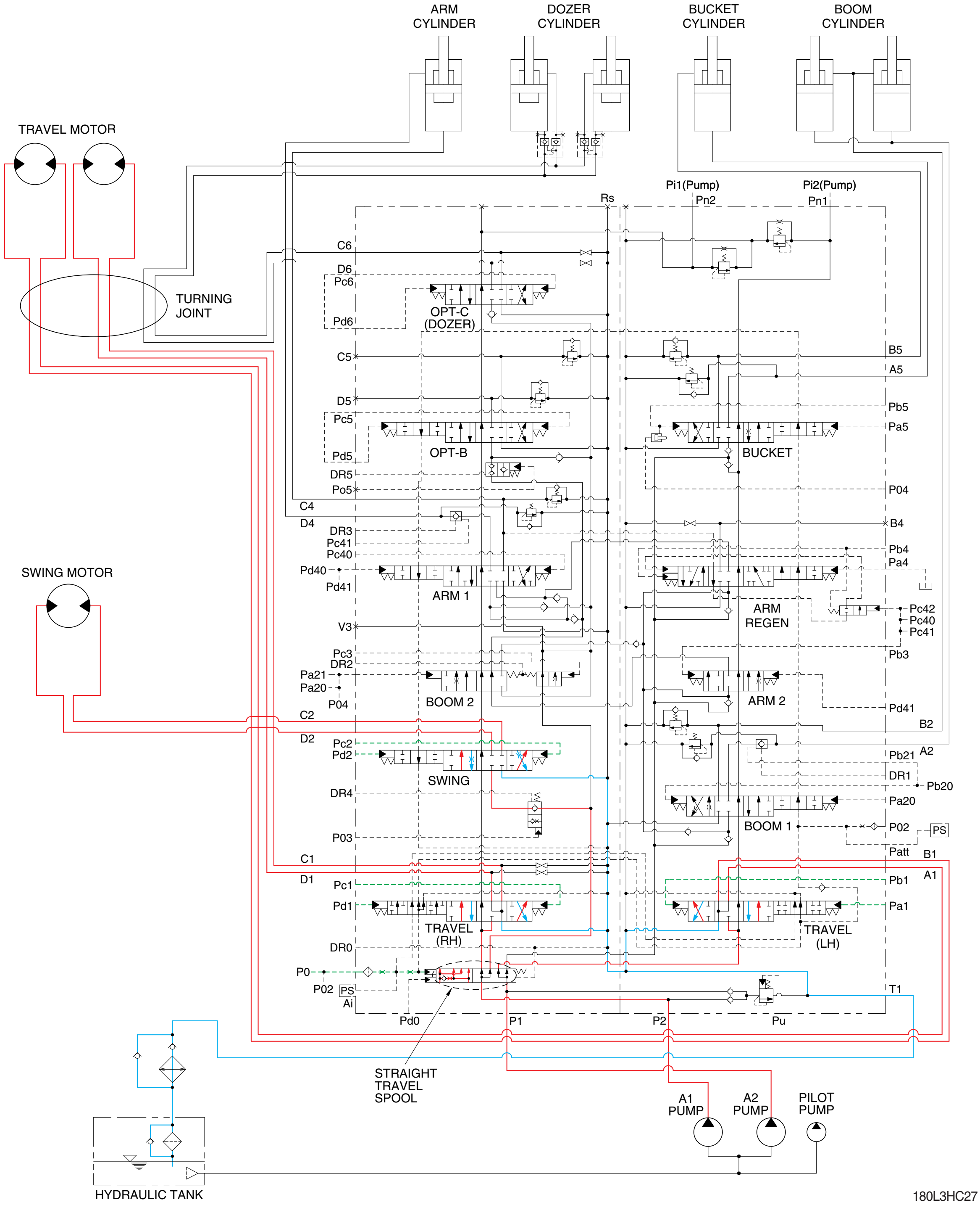
When the swing and bucket functions are operated simultaneously, the swing spool and bucket spool in the main control valve are moved to the functional position by the pilot oil pressure from the remote control valve.

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

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

The upper structure swings and the bucket is operated.

5. COMBINED SWING AND TRAVEL OPERATION



180L3HC27

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

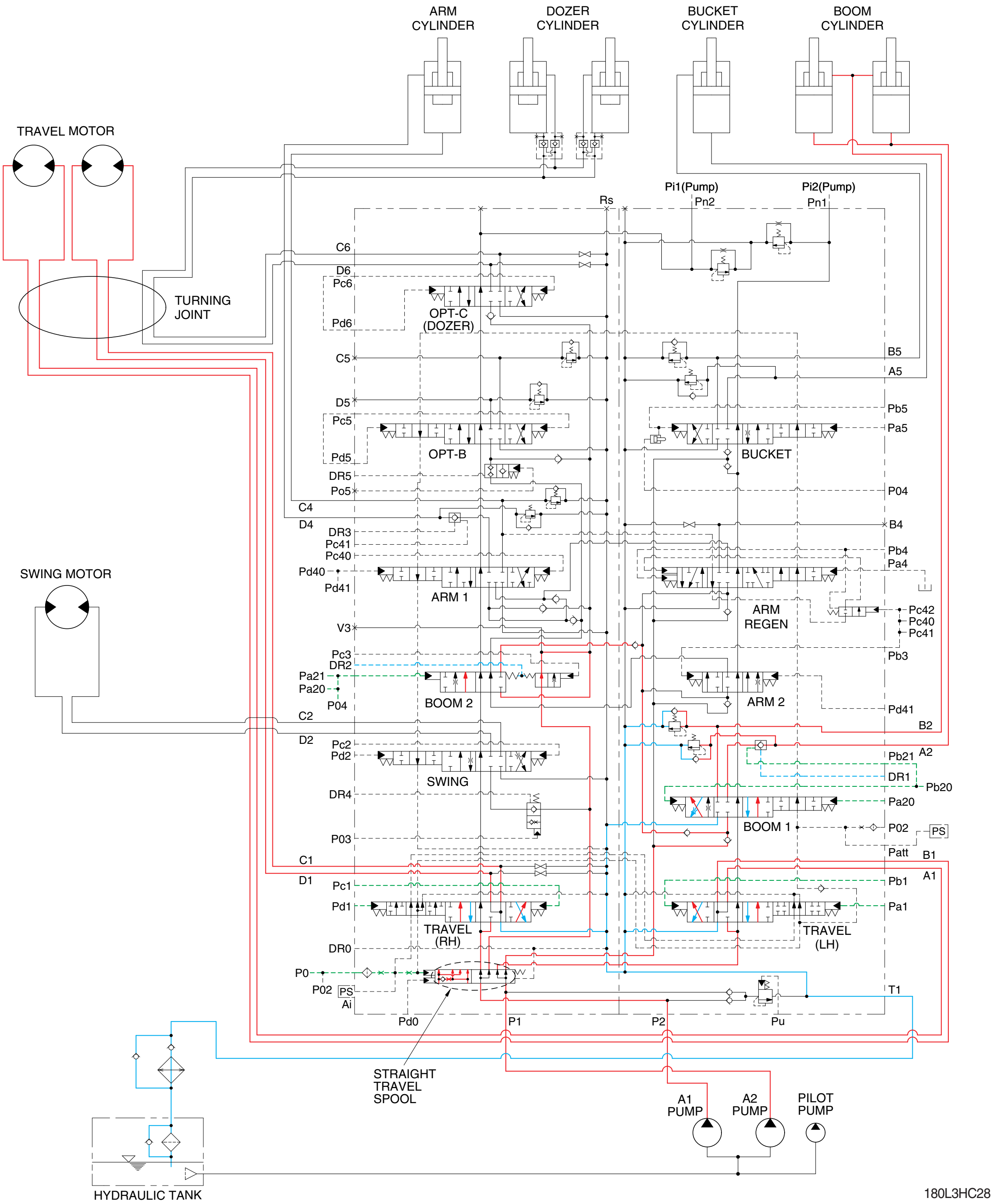
The oil from the A1 pump flows into the travel motors through the RH travel spool of the left control valve and the LH travel spool of the right control valve via the straight travel spool.

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

6. COMBINED BOOM AND TRAVEL OPERATION



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

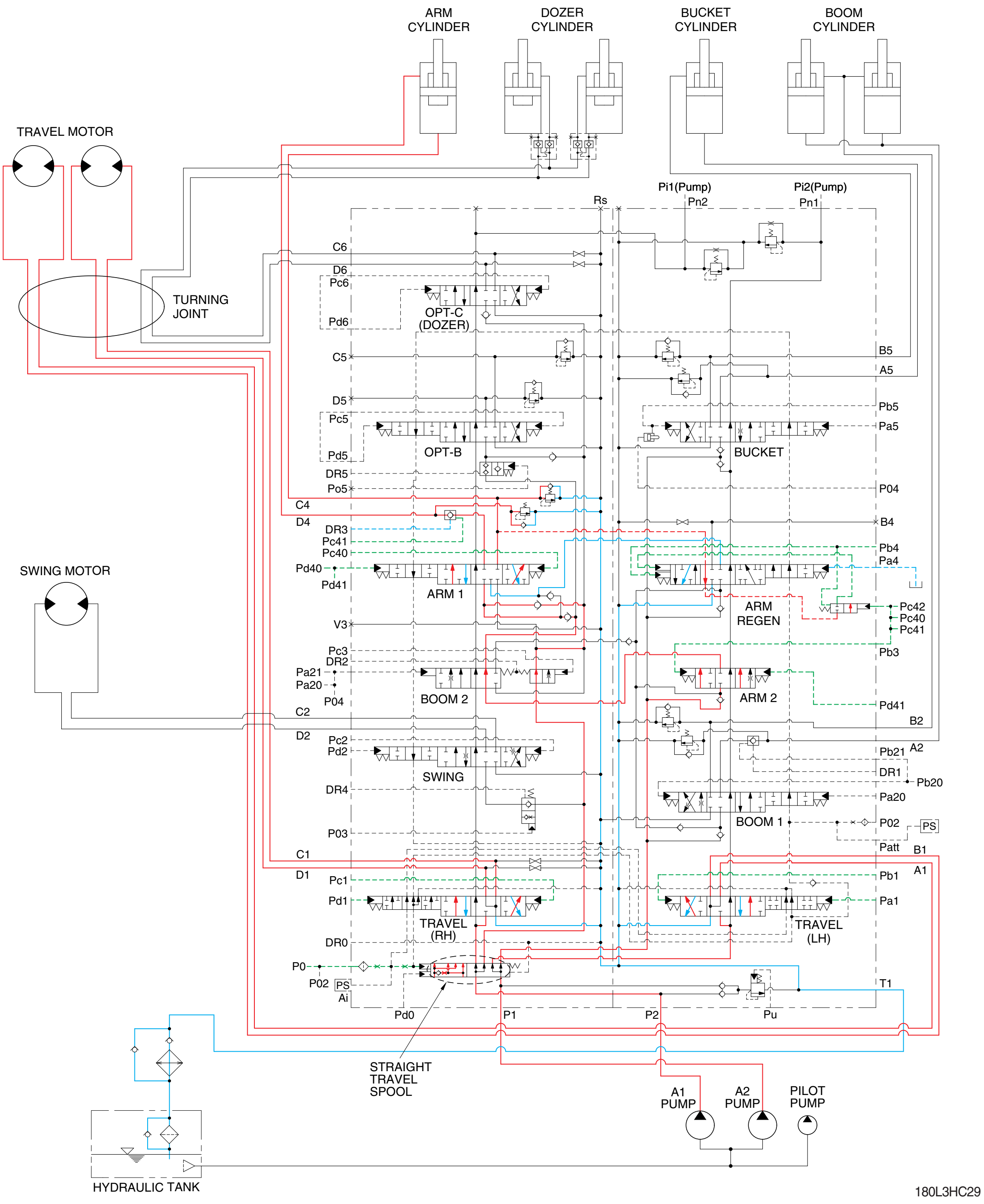
The oil from the A1 pump flows into the travel motors through the RH travel spool of the left control valve and the LH travel spool of the right control valve via the straight travel spool.

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

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.

7. COMBINED ARM AND TRAVEL OPERATION



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

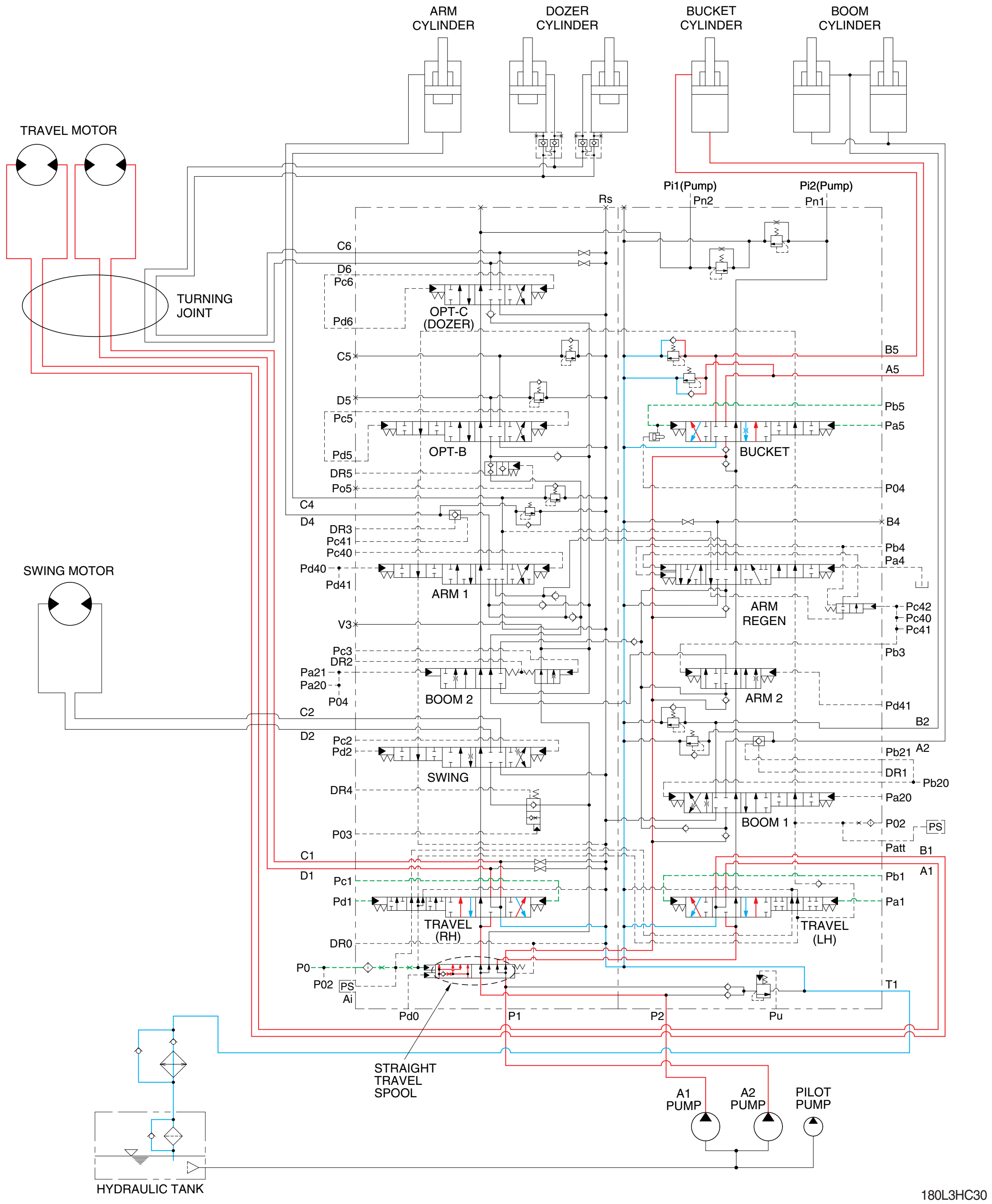
The oil from the A1 pump flows into the travel motors through the RH travel spool of the left control valve and the LH travel spool of the right control valve via the straight travel spool.

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

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.

8. COMBINED BUCKET AND TRAVEL OPERATION



180L3HC30

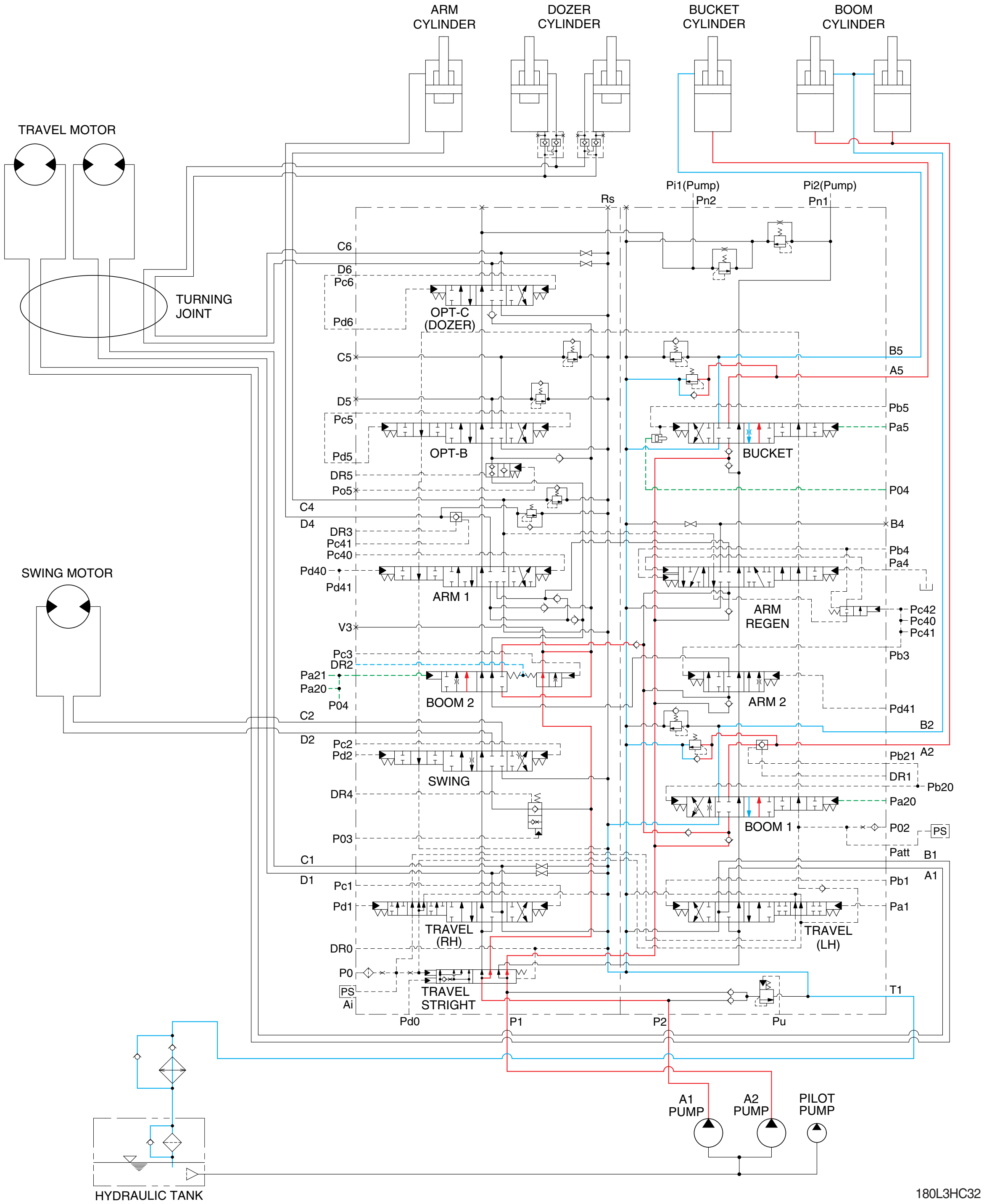
When the bucket and travel functions are operated simultaneously, the bucket spool and travel spools in the main control valve are moved to the functional position by the pilot oil pressure from the remote control valve, and the straight travel spool is pushed to the right by the oil pressure from pilot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

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

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.

9. COMBINED BOOM UP AND BUCKET IN 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 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.

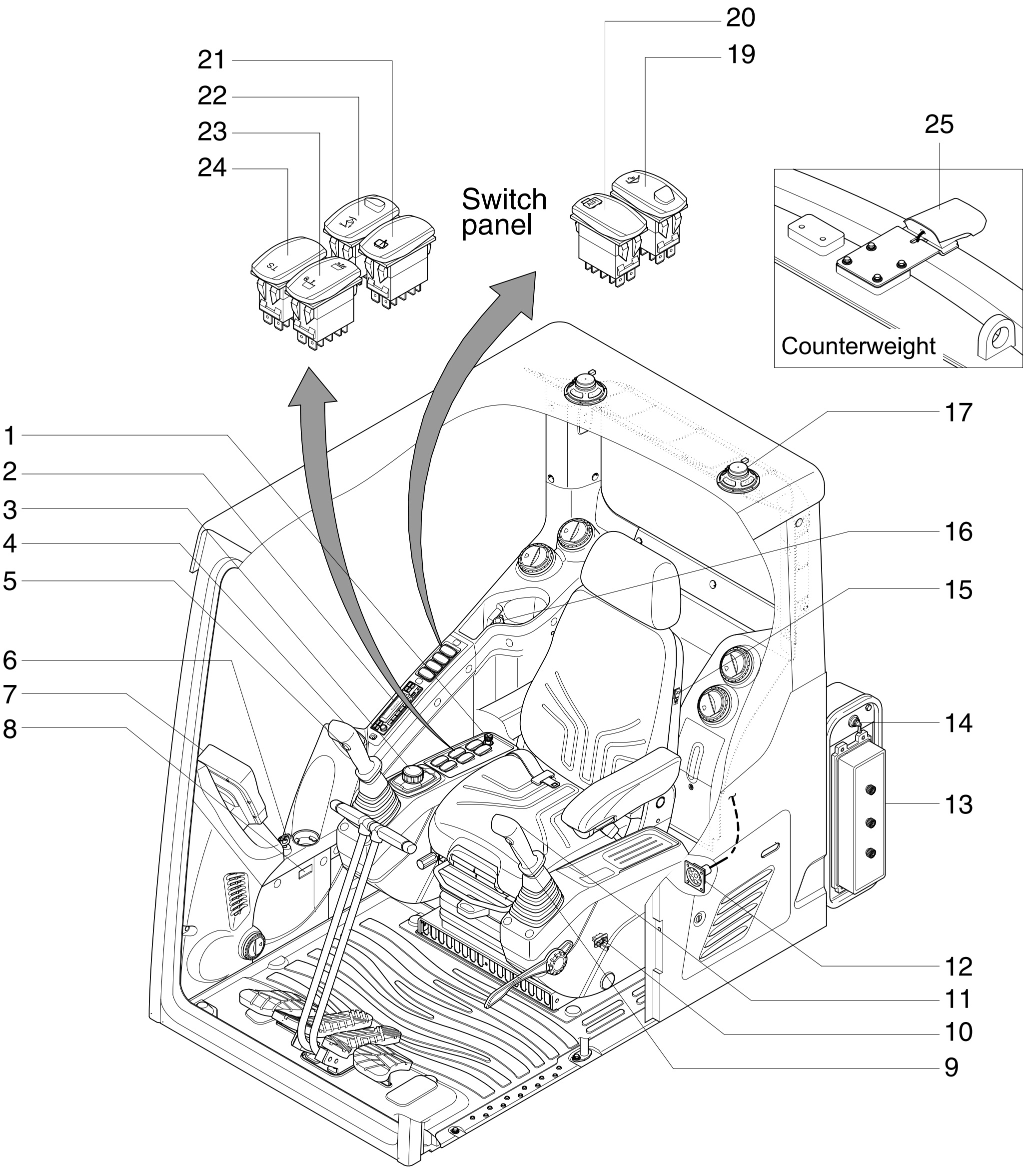
Also, when the boom up and bucket in functions are operated simultaneously, the boom up operation preference function is operated by the pilot pressure P04 and then the the bucket spool transfers in the half stroke not full stroke (refer to page 2-32). Therefore, the most of pressurized oil flows into boom 1 spool than the bucket spool to make the boom up operation more preferential.

The boom and bucket are operated.

SECTION 4 ELECTRICAL SYSTEM

GROUP 1 COMPONENT LOCATION

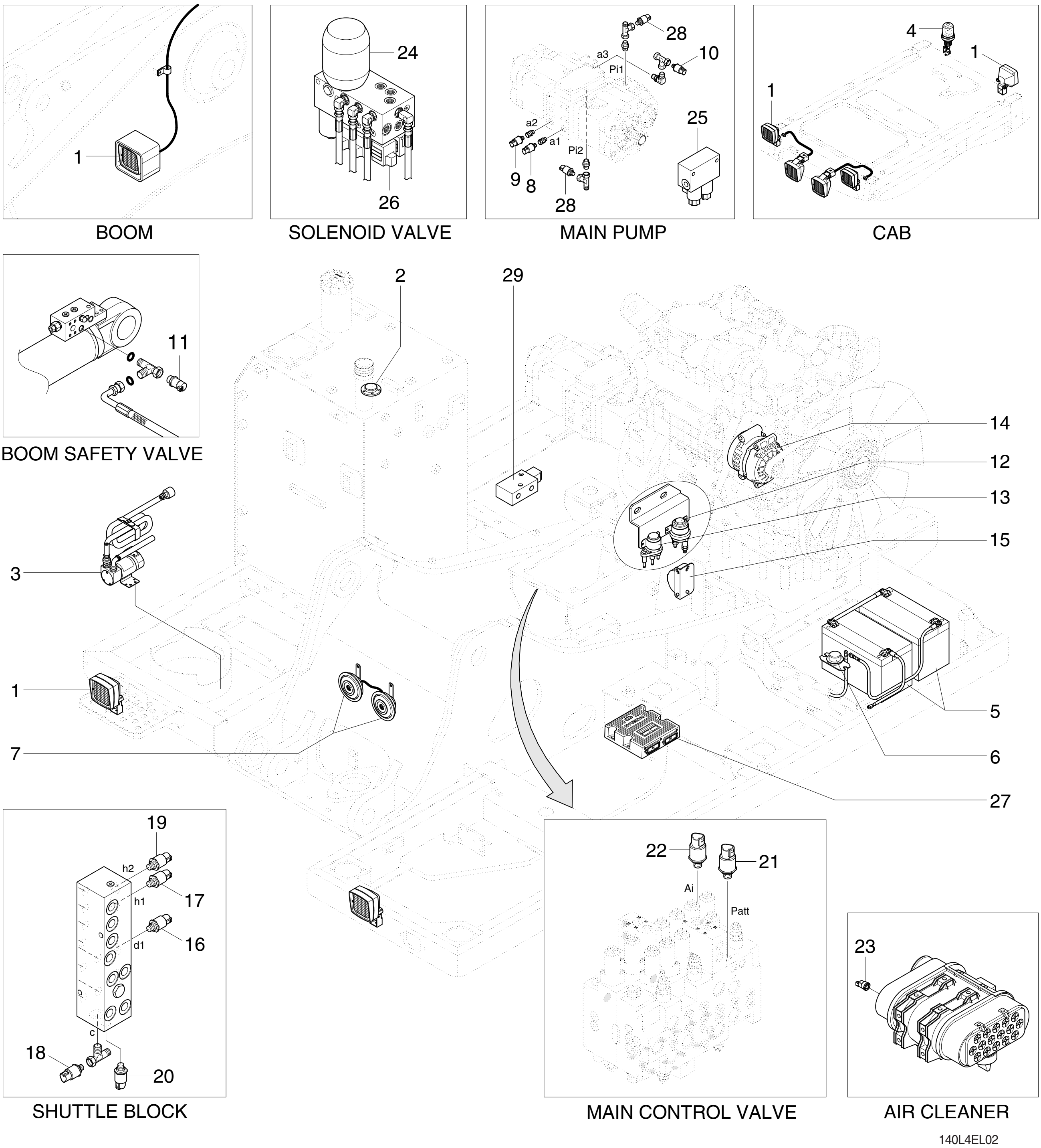
1. LOCATION 1



140L4EL01

1	Cigar lighter	9	Power max switch	17	Speaker
2	Radio & USB player	10	Emergency engine stop switch	19	Quick clamp switch
3	Haptic controller	11	One touch decel switch	20	Air compressor switch
4	Horn switch	12	RS232 & J1939 service socket	21	Lower wiper & washer switch
5	Breaker operation switch	13	Fuse & relay box	22	Boom floating switch
6	Starting switch	14	Master switch	23	Swing lock/fine switch
7	Cluster	15	Seat heater switch	24	Travel straight switch
8	Service meter	16	Power socket	25	Rear view camera

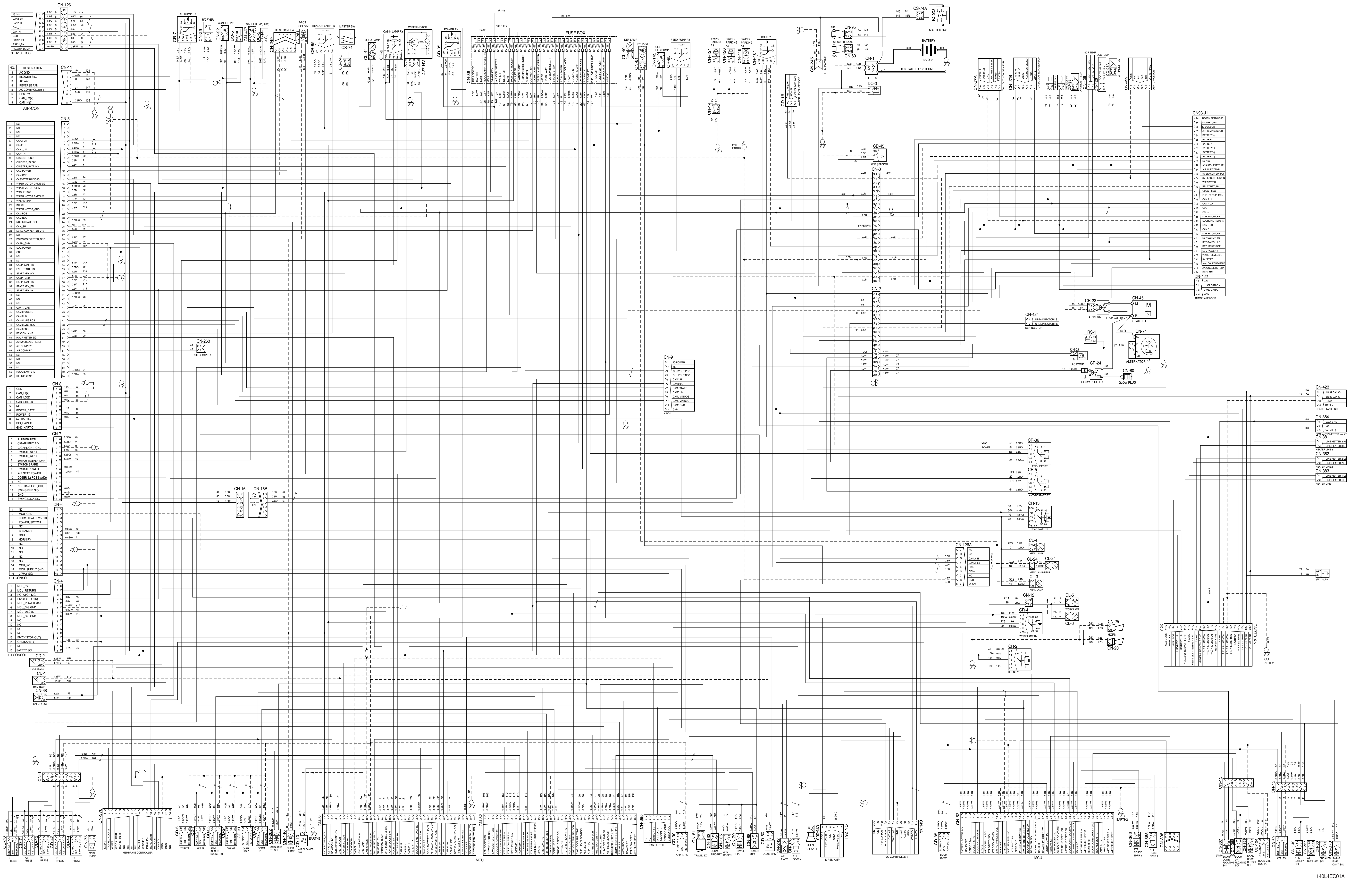
2. LOCATION 2



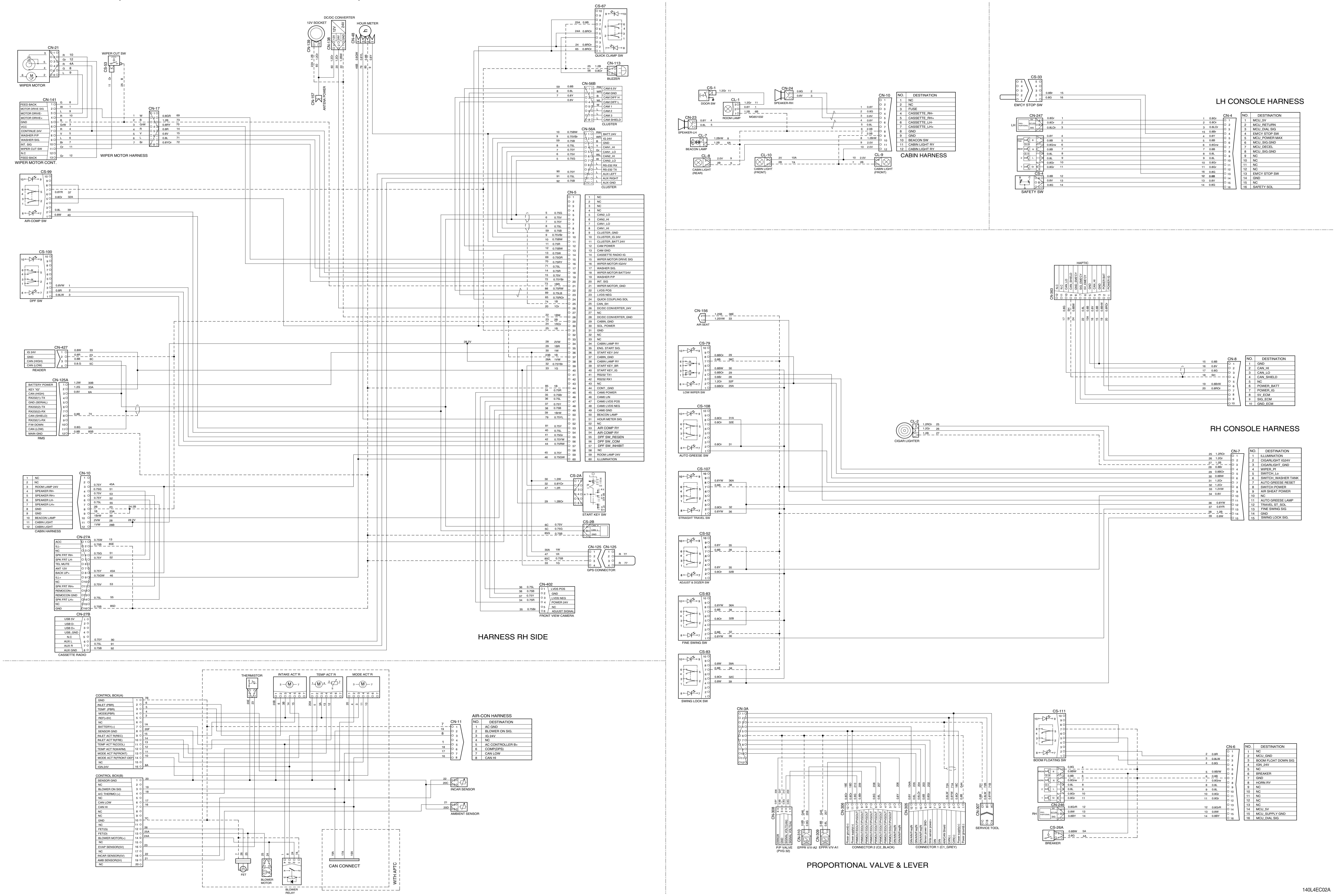
1	Lamp	11	Overload pressure sensor	21	Attach pressure sensor
2	Fuel sender	12	Start relay	22	Travel pressure sensor
3	Fuel filler pump	13	Heater relay	23	Air cleaner sensor
4	Beacon lamp	14	Alternator	24	Solenoid valve
5	Battery	15	Travel alarm buzzer	25	Pump EPPR valve
6	Battery relay	16	Arm/Bucket in pressure sensor	26	Boom priority EPPR valve
7	Horn	17	Boom up pressure sensor	27	MCU
8	P1 pressure sensor	18	Swing pressure sensor	28	Nega-control pressure sensor
9	P2 pressure sensor	19	Boom down pressure sensor	29	Travel straight solenoid valve
10	EPPR pressure sensor	20	Arm in pressure sensor		

GROUP 2 ELECTRICAL CIRCUIT

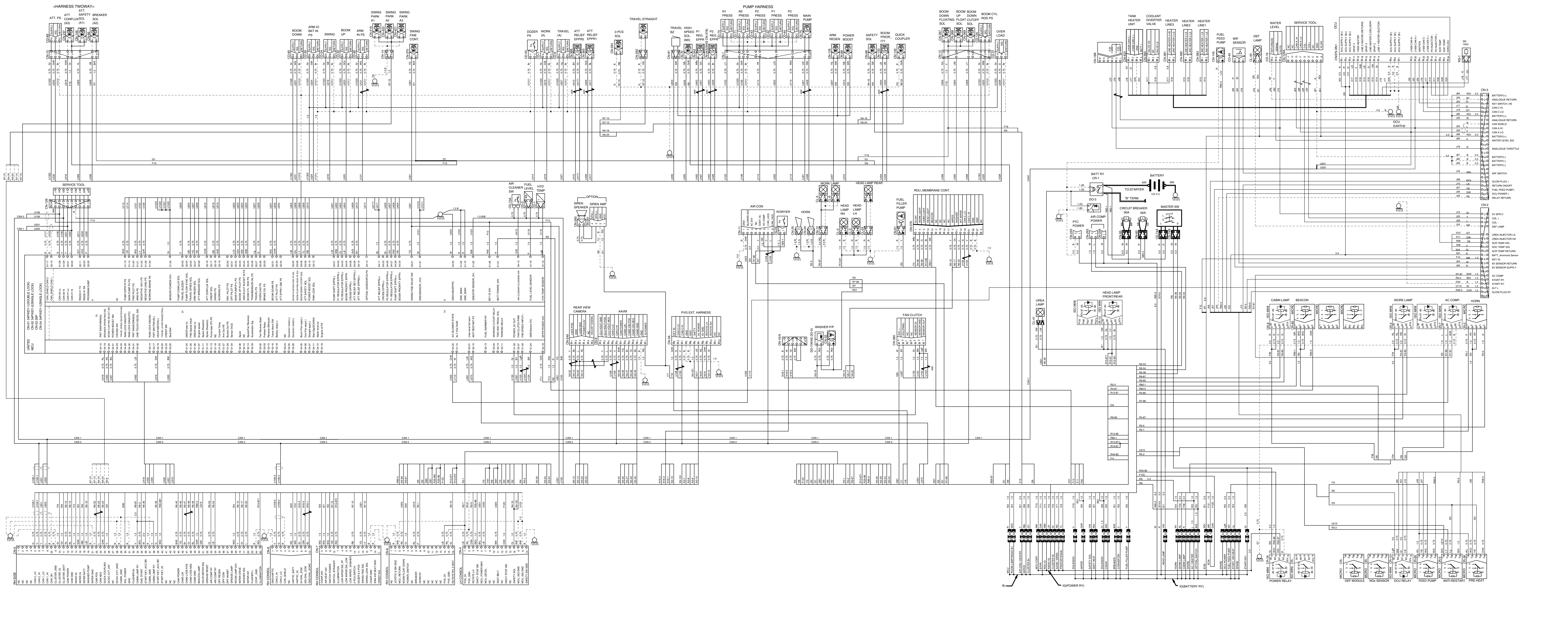
· ELECTRICAL CIRCUIT (1/5, SERIAL NO. HX160 L : -#0239 / HX180 L : -#0062)



· ELECTRICAL CIRCUIT (2/5, SERIAL NO. HX160 L : -#0239 / HX180 L : -#0062)

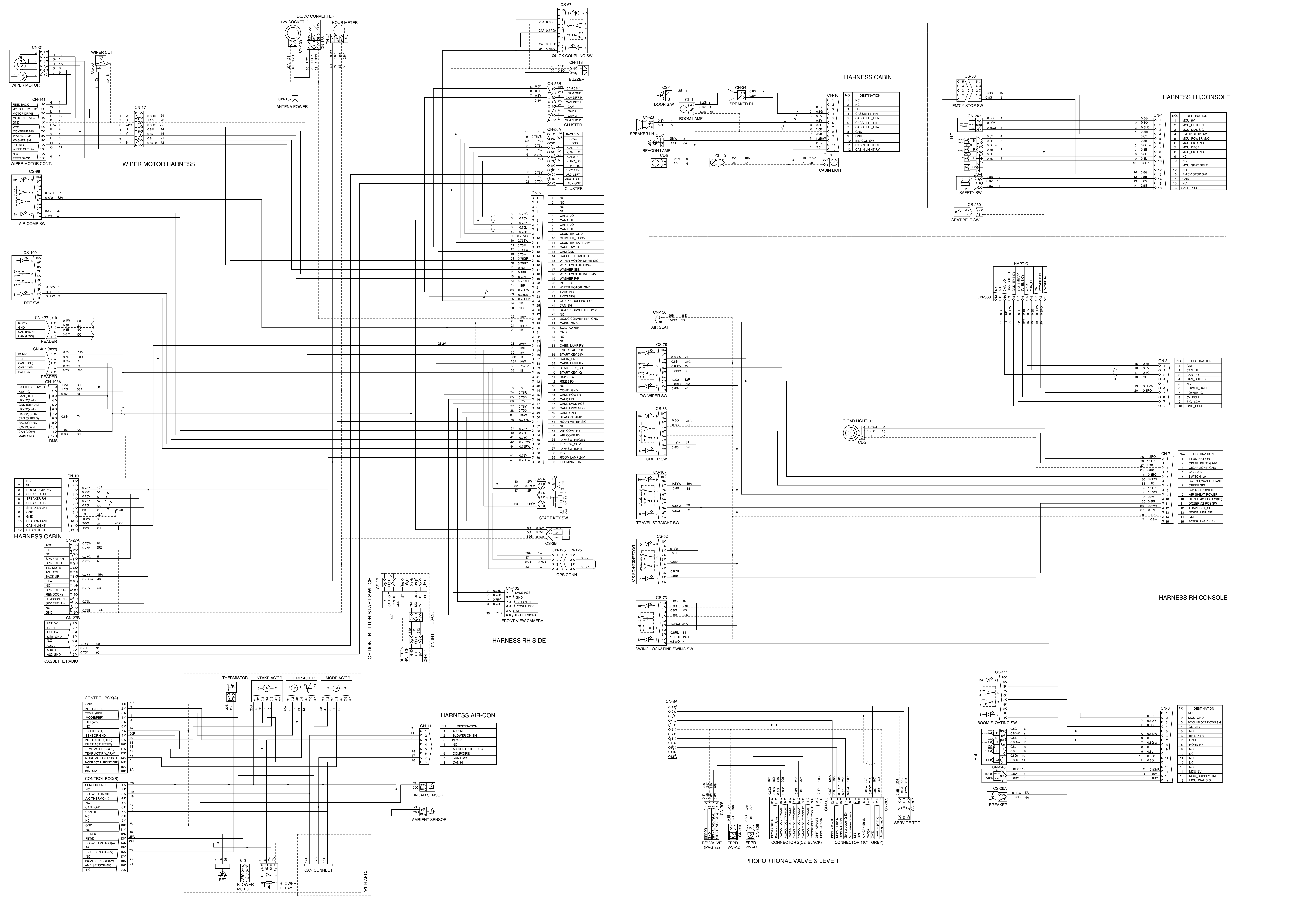


· ELECTRICAL CIRCUIT (3/5, SERIAL NO. HX160 L : #0240- / HX180 L : #0063-)



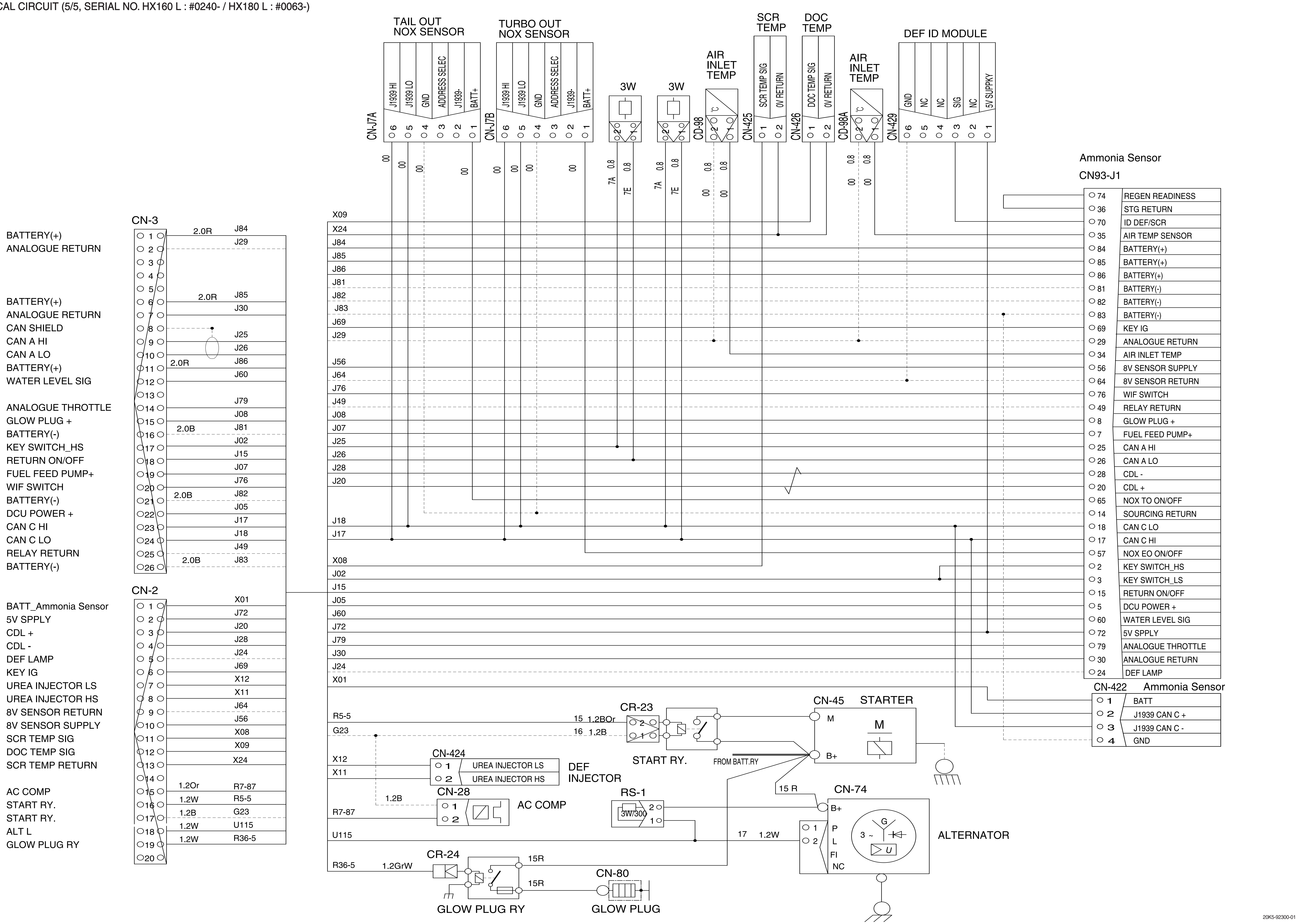
20K5-92401-00

· ELECTRICAL CIRCUIT (4/5, SERIAL NO. HX160 L : #0240- / HX180 L : #0063-)



20K5-92102-00

· ELECTRICAL CIRCUIT (5/5, SERIAL NO. HX160 L : #0240- / HX180 L : #0063-)



MEMORANDUM

1. POWER CIRCUIT

The negative terminal of battery is grounded to the machine chassis.
When the start switch is in the OFF position, the current flows from the positive battery terminal as shown below.

1) OPERATING FLOW

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

- → Fuse box [No.1] → DCU relay [CR-101 (30)]
- → Fuse box [No.2] → I/conn [CN-8 (6)] → Haptic controller [CN-363 (2)]
- → Fuse box [No.3]
  - → I/conn [CN-3 (1, 6, 11)] → Engine ECM [CN 93-J1 (84, 85, 86)]
  - → DEF/AdBlue® purging lamp [CL-40 (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]
  - → MCU [CN-51 (1)]
  - → MCU [CN-53 (1)]
- → Fuse box [No.6]
  - → Master switch [CS-74B] → I/conn [CN-5 (36)]
    - → Start switch [CS-2A (1)]
    - → RMS [CN-125A (1)]
    - → GPS connection [CN-125 (1)]
  - → Power relay [CR-35 (30)]
- → Fuse box [No.7] → I/conn [CN-11 (5)]
  - → AC & Heater control box A (7)
  - → Blower relay (4)
- → Fuse box [No.8] → I/conn [CN - 5 (18)] → I/conn [CN -17 (5)]
  - → Wiper motor controller [CN-141 (7)]
  - → Wiper motor [CN-21 (4)]
- → Fuse box [No.9] → I/conn [CN - 5 (11)]
  - → Cluster [CN -56A (1)]
  - → Hour meter [CN-48 (1)]

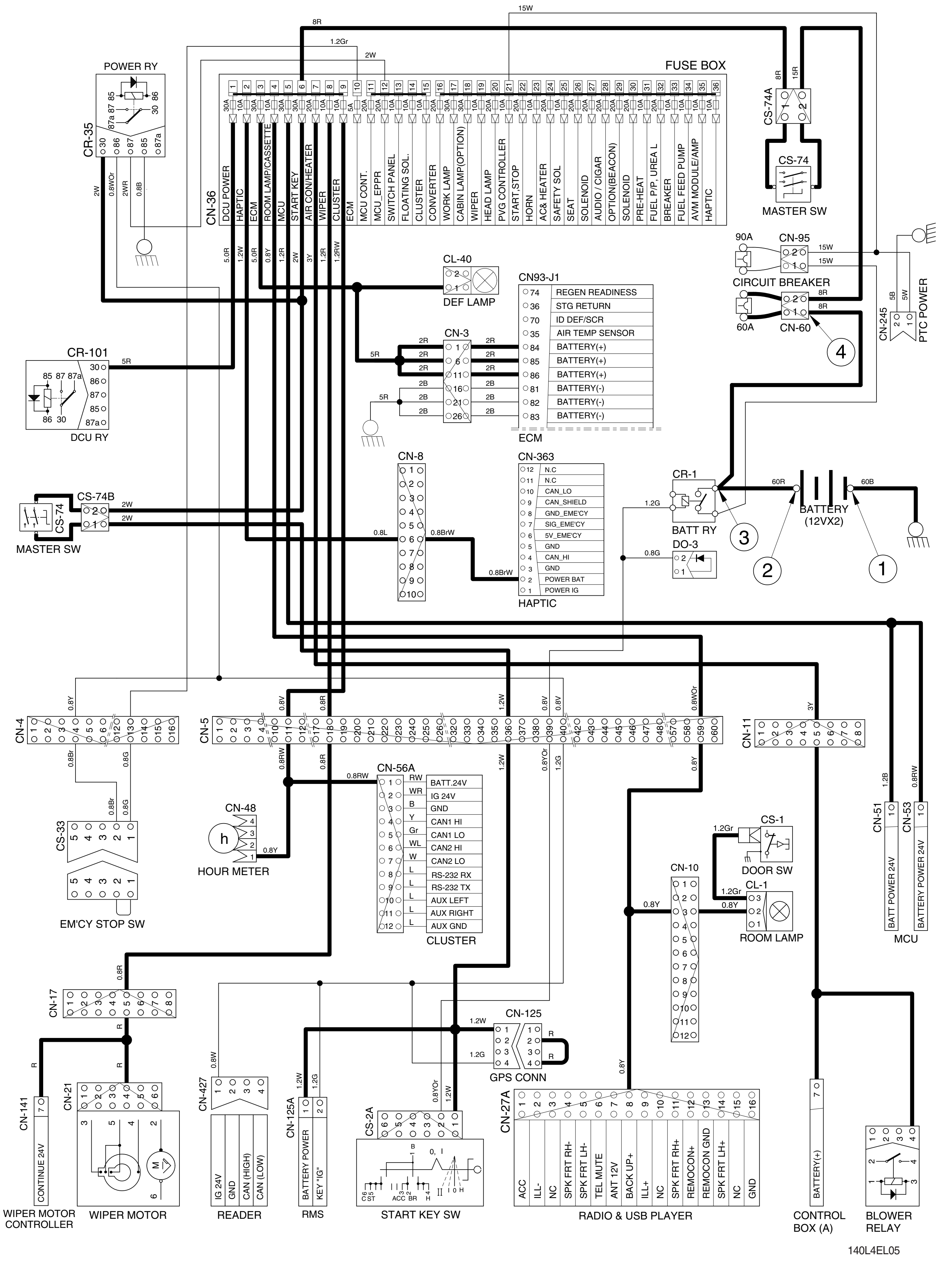
※ I/conn : Intermediate connector

2) CHECK POINT

Engine	Start switch	Check point	Voltage
OFF	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

POWER CIRCUIT



2. STARTING CIRCUIT

1) OPERATING FLOW

Battery(+) terminal → Battery relay [CR-1] → Circuit breaker [CN-60] → Master switch [CS-74A] → Fuse box [No.6] → Master switch [CS-74B] → I/conn [CN-5(36)] → Start switch [CS-2A (1)]

(1) When start key switch is in ON position

- → Start switch ON [CS-2A (2)] → I/conn [CN-5 (39)]
  - → Battery relay [CR-1] → Battery relay operating (all power is supplied with the electric component)
  - → I/conn [CN-4 (4)] → Emergency engine stop sw [CS-33 (2)→(1)] → I/conn [CN-4 (13)] → Fuse box [No. 10] → I/conn [CN-2 (6)] → Engine ECM [CN 93-J1 (69)]
- → 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.12]
  - → I/conn [CN-427 (1)]
  - → RMS [CN-125A (2)]

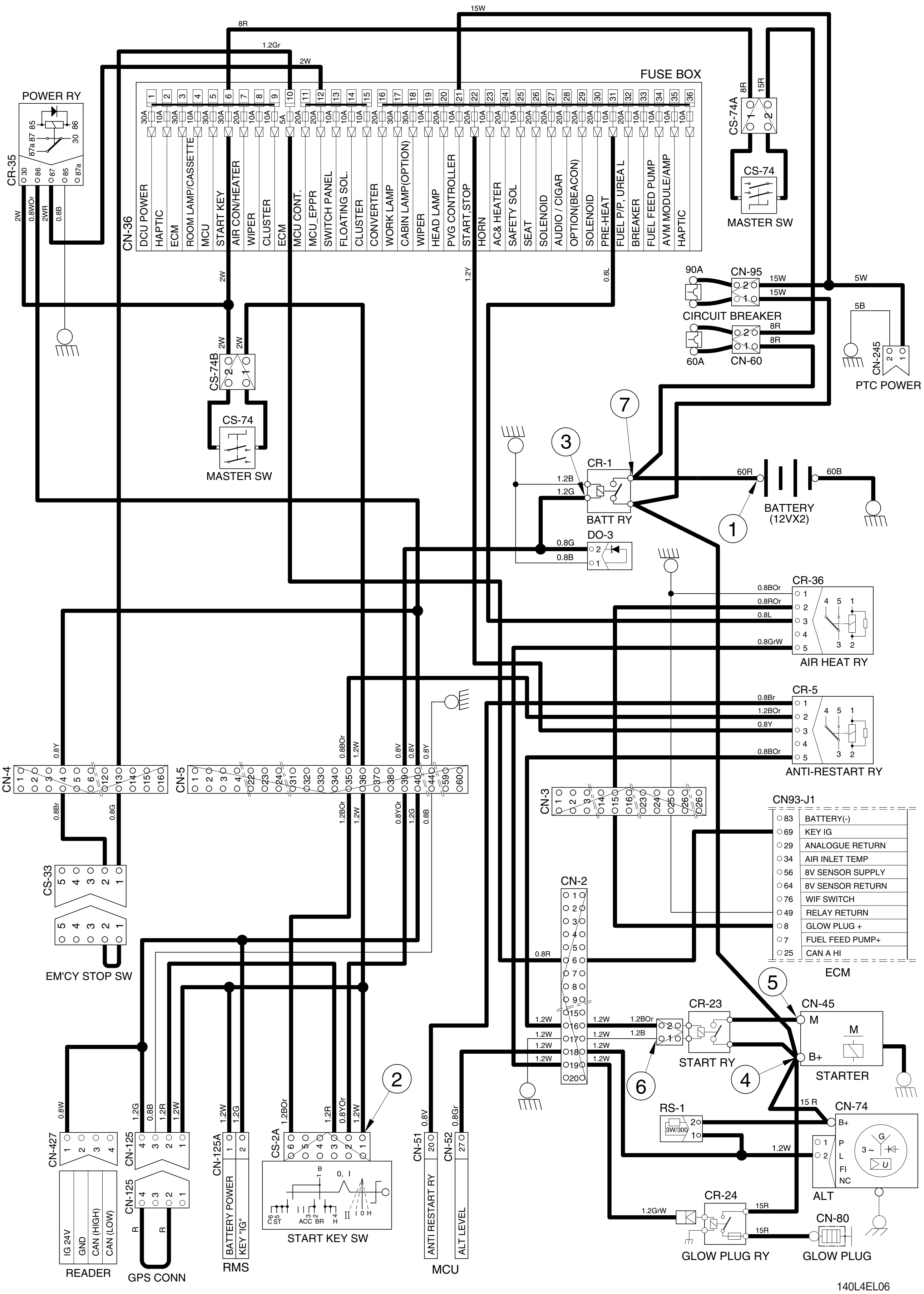
(2) When start key switch is in START position

Start switch START [CS-2A (6)] → I/conn [CN-5 (35)] → Anti-restart relay [CR-5 (2)→(5)] → I/conn [CN-2 (16)] → Start relay [CR-23 (2)] → Starter motor operating

2) CHECK POINT

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

STARTING CIRCUIT



3. CHARGING CIRCUIT

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

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

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

1) OPERATING FLOW

(1) Warning flow

Alternator [CN-74 (2)] → I/conn [CN-2 (18)] → MCU alternator level [CN-52 (27)]
→ Cluster charging warning lamp (Via CAN interface)

(2) Charging flow

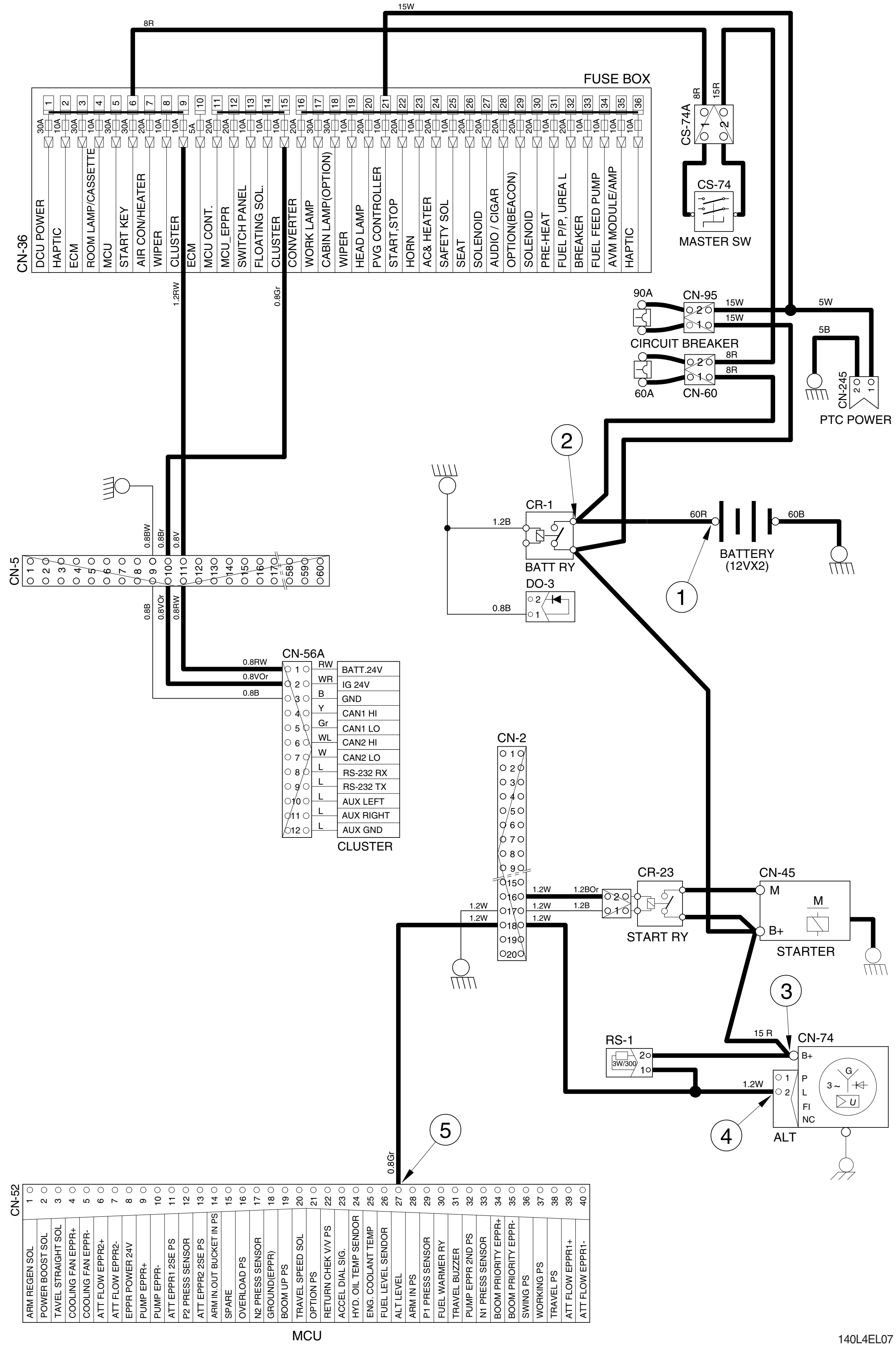
Alternator "B^+" terminal → Starter motor [CN-45 (B+)]
→ Battery relay (M8) → Battery (+) terminal
→ Circuit breaker [CN-60] → Master switch [CS-74A]
→ Fuse box
→ Circuit breaker [CN-95] → Fuse box

2) CHECK POINT

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

※ GND : Ground

CHARGING CIRCUIT



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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)]

(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 (2), CL-24 (2)]
→ I/conn [CN-7 (1)] → Cigar light [CL-2]
→ I/conn [CN-5 (60)] → Radio & USB player illumination ON [CN-27A (9)]

(2) Work light switch ON

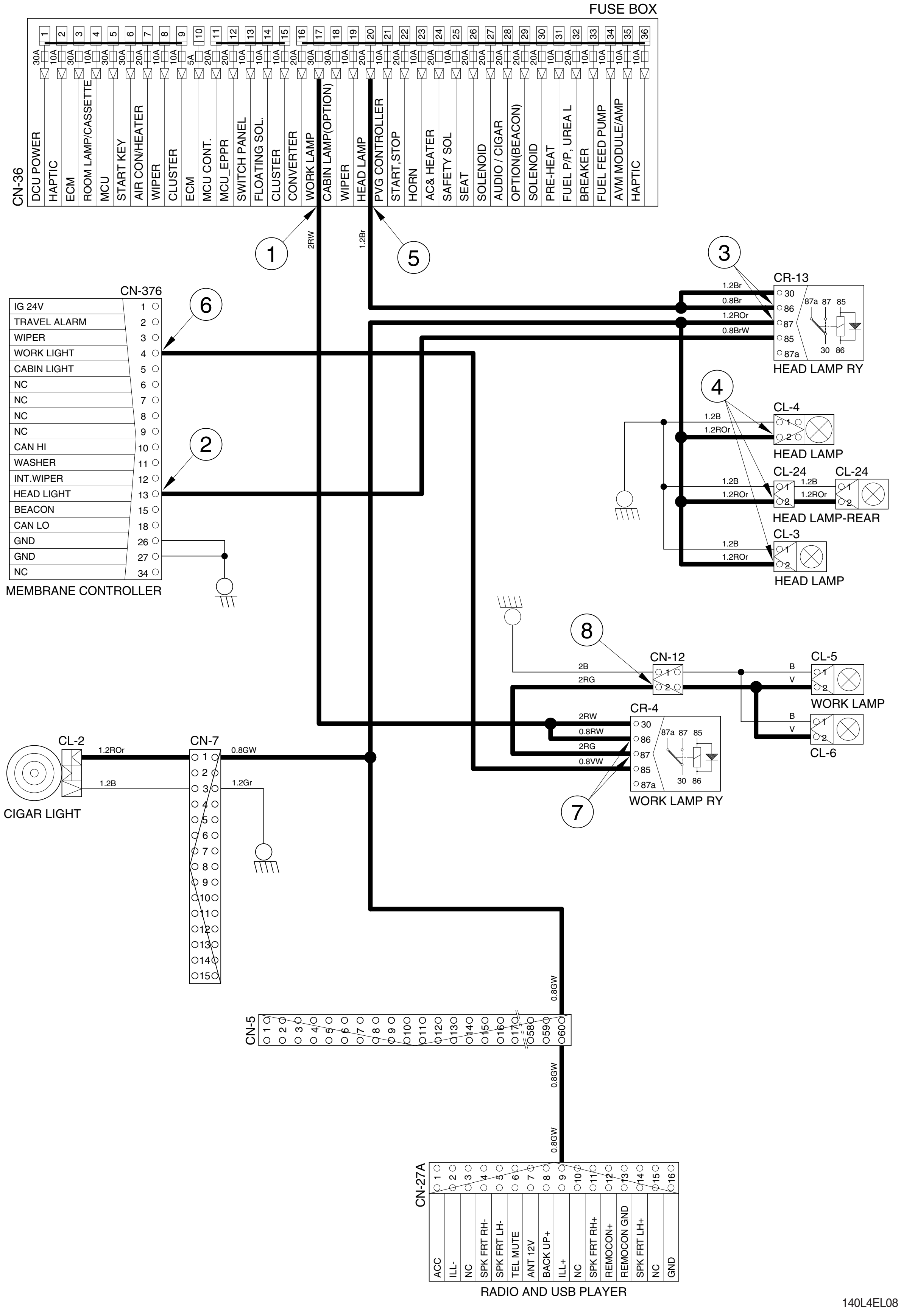
Work light switch ON [CN-376 (4)] → Work light relay [CR-4 (85) → (87)]
→ I/conn [CN-12 (2)] → Work light ON [CL-5 (2), CL-6 (2)]

2) CHECK POINT

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

※ GND : Ground

HEAD AND WORK LIGHT CIRCUIT



5. BEACON LAMP AND CAB LIGHT CIRCUIT

1) OPERATING FLOW

Fuse box (No.29) → Beacon lamp relay [CR-85 (2, 3)]

Fuse box (No.18) → Cab light relay [CR-9 (30, 86)]

(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

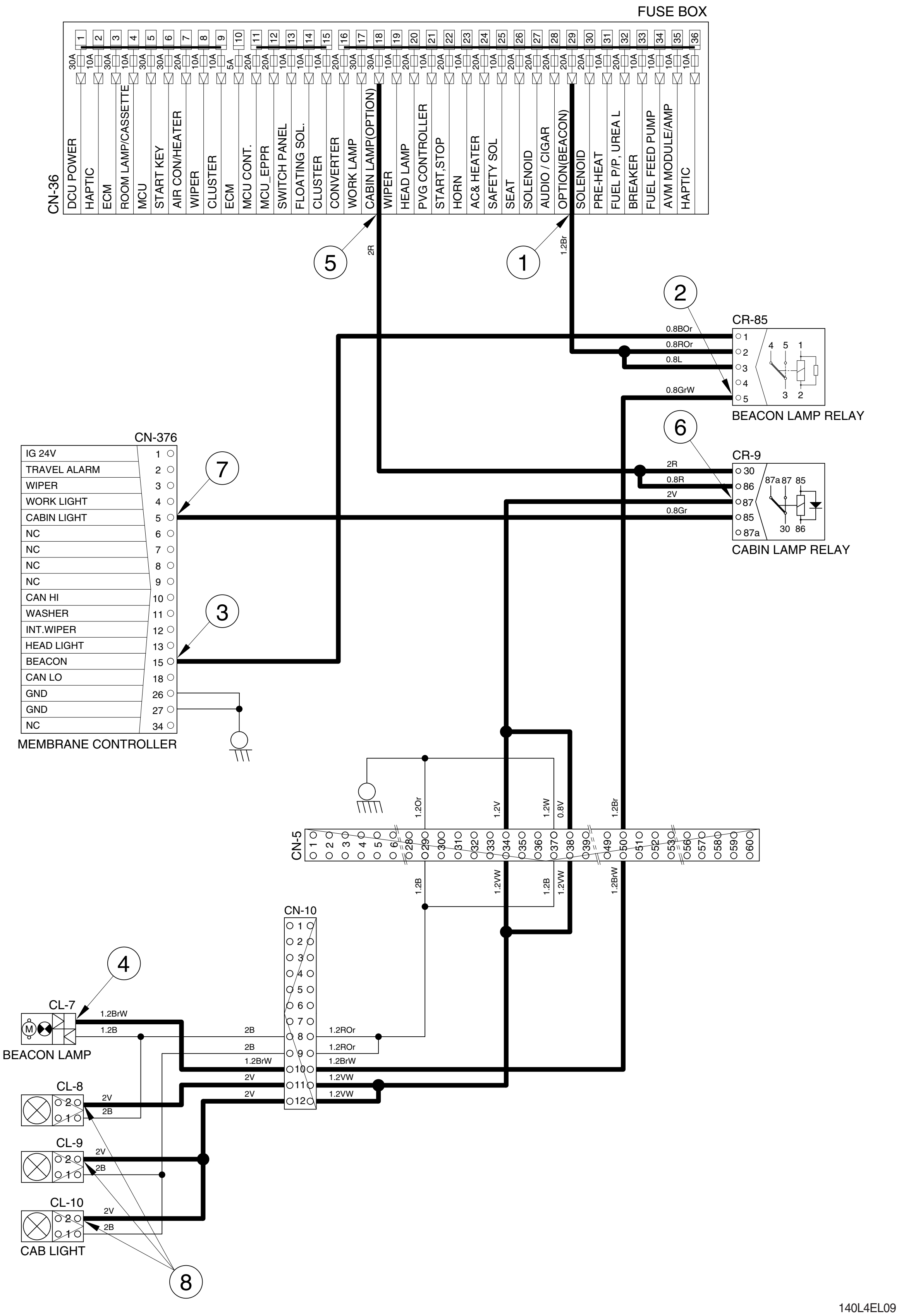
Cab light switch ON [CN-376 (5)] → Cab lamp relay [CR-9 (85)→(87)]
→ I/conn [CN-5 (34, 38)] ┬→ I/conn [CN-10 (11)] → Cab light ON [CL-8 (2)]
└→ I/conn [CN-10 (12)] → Cab light ON [CL-9 (2), CL-10 (2)]

2) CHECK POINT

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

※ GND : Ground

BEACON LAMP AND CAB LIGHT CIRCUIT



6. WIPER AND WASHER CIRCUIT

1) OPERATING FLOW

(1) Key switch ON

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

Fuse box (No.8) → 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)]
→ Low wiper motor [CN-407 (3)]
→ Washer 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, 12)] → Wiper motor parking position by wiper motor controller

2) OPERATING FLOW (LOW WIPER)

(1) Key switch ON

Fuse box (No. 29) → I/conn [CN-7 (8)] → Low wiper switch [CS-79 (2, 5)]

(2) Wiper switch ON (1st)

Wiper switch ON [CS-79 (2 → 3)] → I/conn [CN-7 (5)] → Low wiper motor [CN-407 (4)] → Wiper operating

(3) Wiper switch ON (2nd)

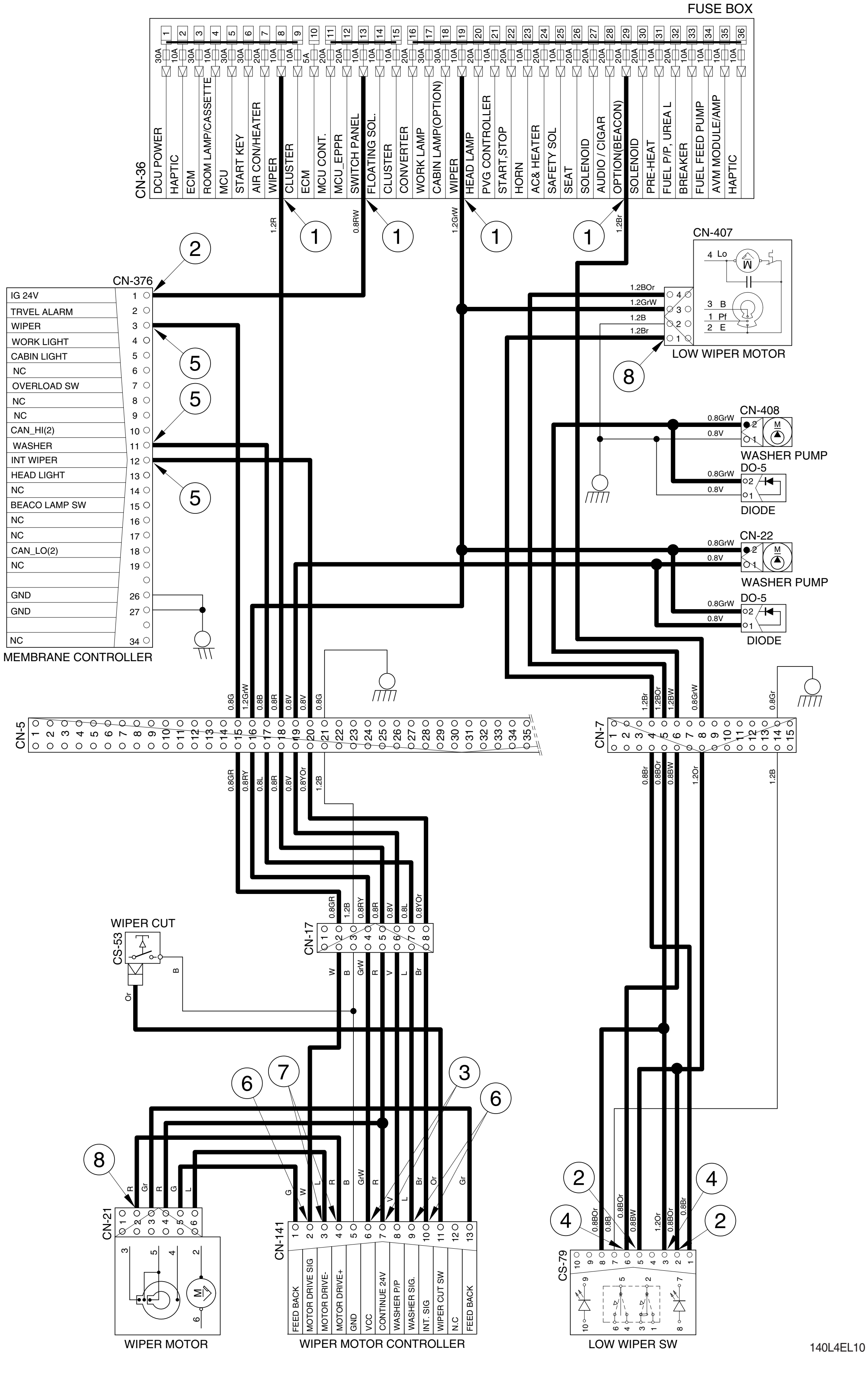
Wiper switch ON [CS-79 (5 → 6)] → I/conn [CN-7 (6)] → Low washer pump [CN-408 (2)] → Washer operating
Wiper switch ON [CS-79 (2 → 3)] → I/conn [CN-7 (5)] → Low wiper motor [CN-407 (4)] → Wiper operating

3) CHECK POINT

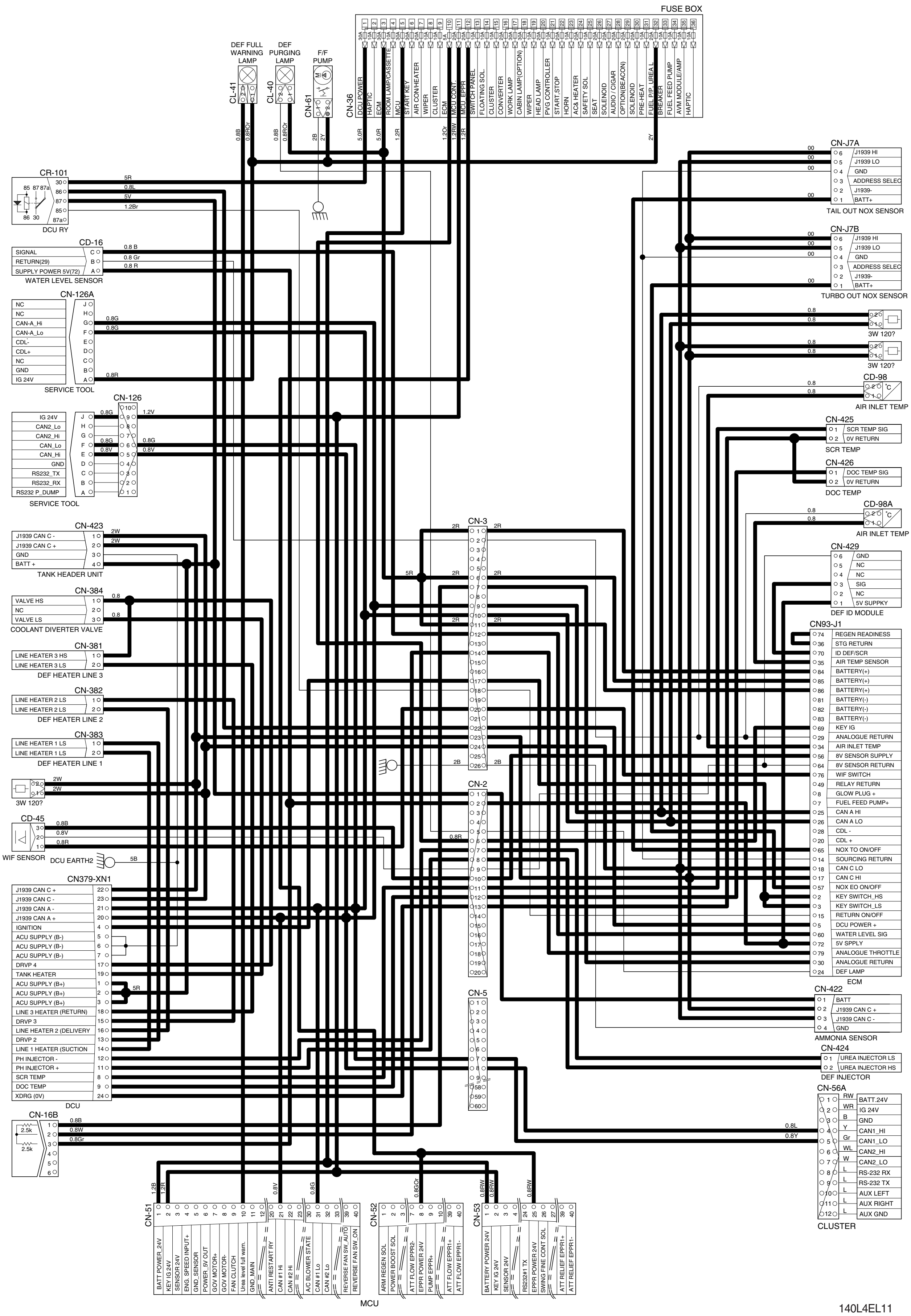
Engine	Start switch	Check point	Voltage
STOP	ON	① - GND (fuse box)	20~25V
		② - GND (switch power input)	
		③ - GND (wiper power input)	
		④ - GND (switch power output)	
		⑤ - GND (switch power output)	0 ~ 5V
		⑥ - GND (wiper power input)	
		⑦ - GND (wiper power output)	24V
		⑧ - GND (wiper motor)	0 or 24V

※ GND : Ground

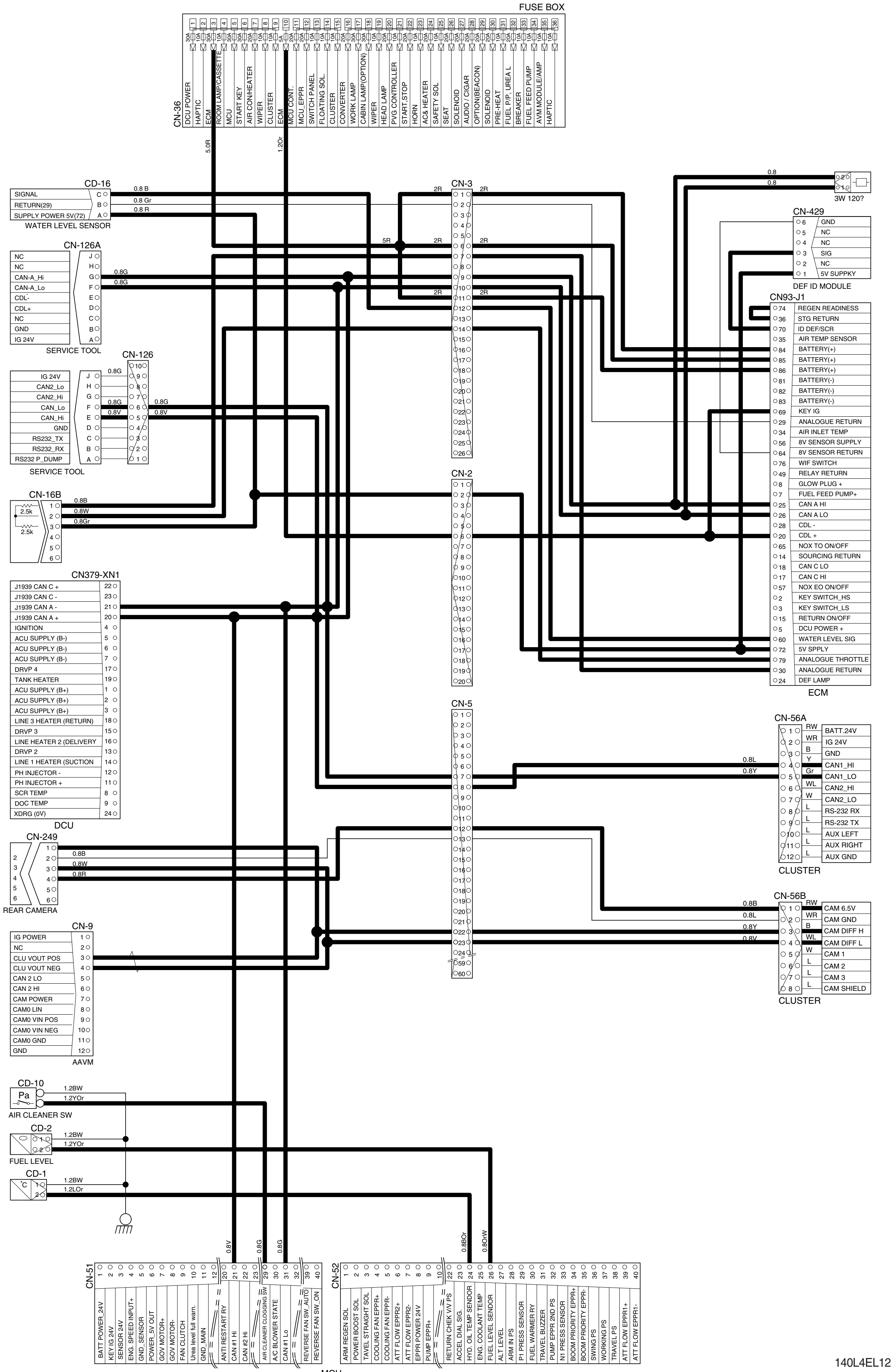
WIPER AND WASHER CIRCUIT



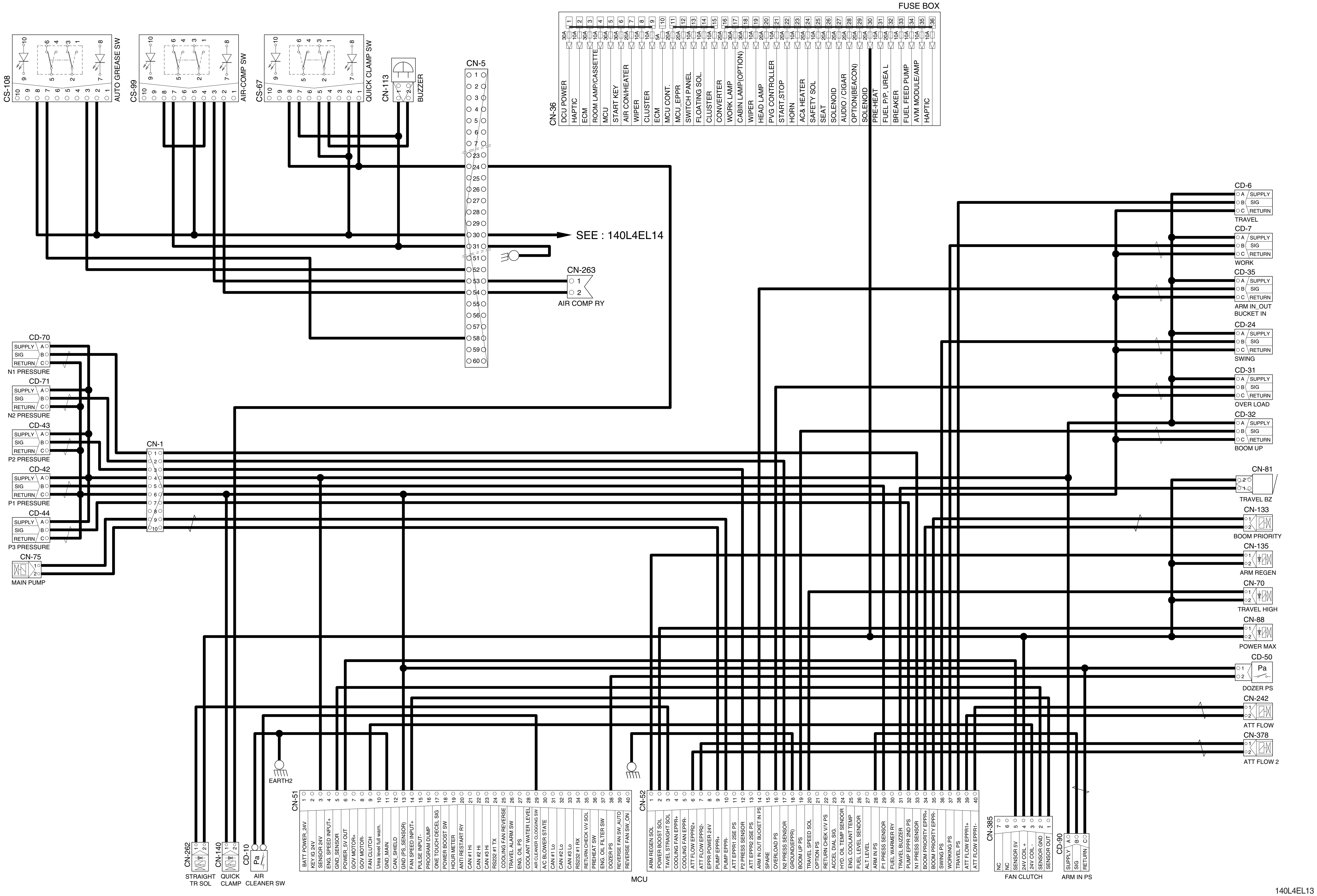
CONTROLLER CIRCUIT



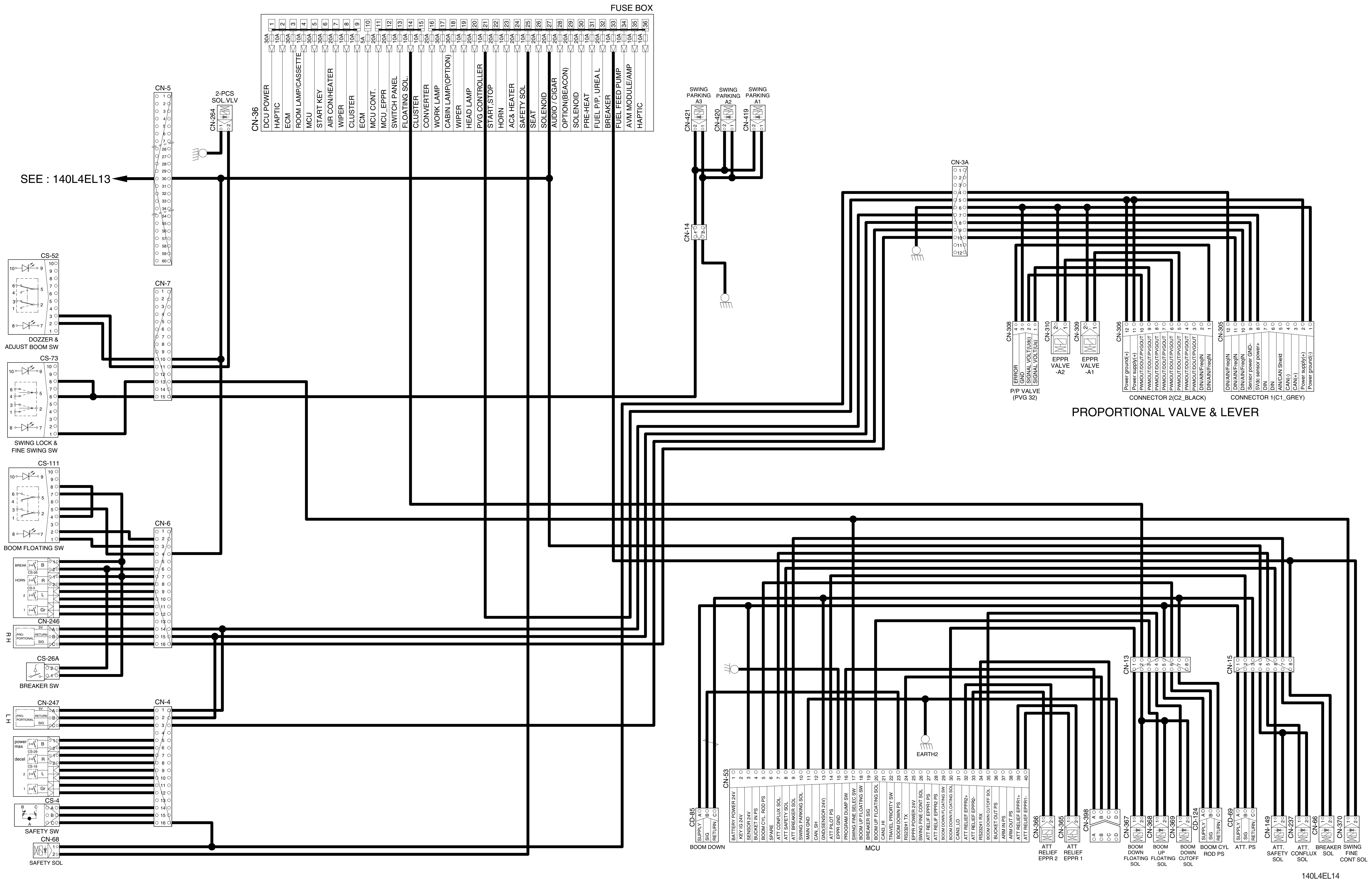
MONITORING CIRCUIT



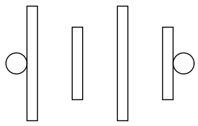
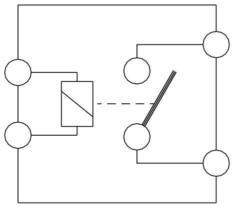
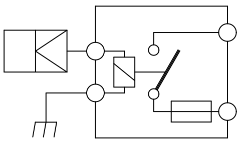
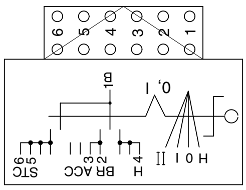
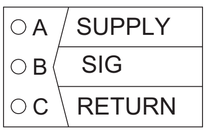
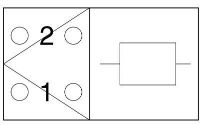
ELECTRIC CIRCUIT FOR HYDRAULIC (1/2)

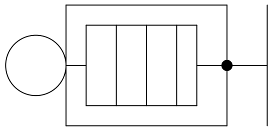
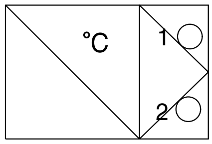
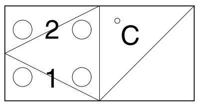
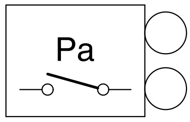
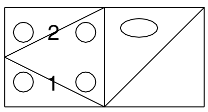
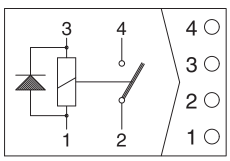


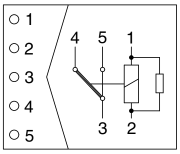
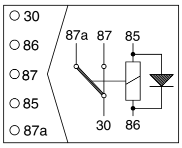
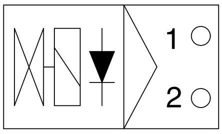
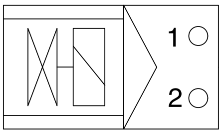
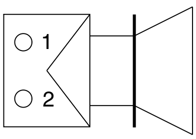
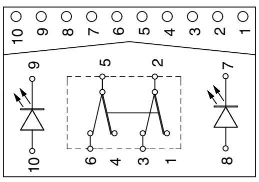
ELECTRIC CIRCUIT FOR HYDRAULIC (2/2)

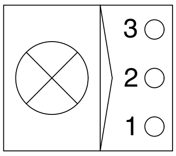
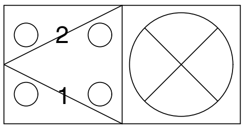
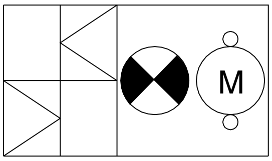
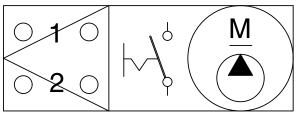
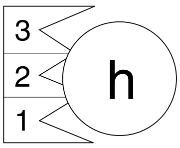
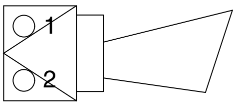


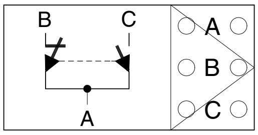
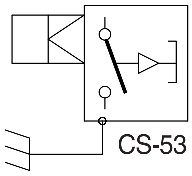
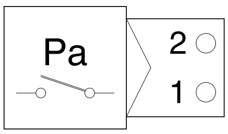
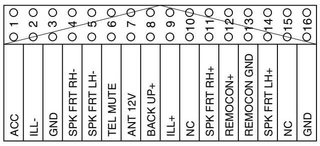
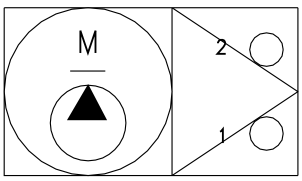
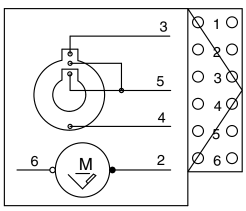
GROUP 3 ELECTRICAL COMPONENT SPECIFICATION

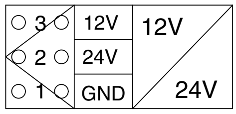
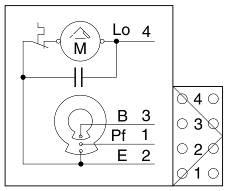
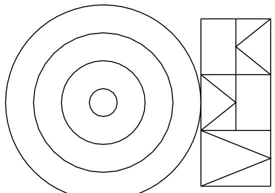
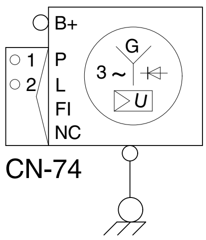
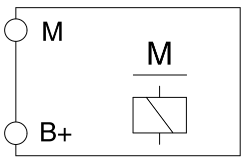
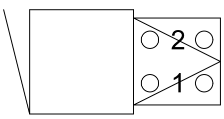
Part name	Symbol	Specifications	Check
Battery		12V × 100Ah (2EA)	※ Check specific gravity 1.280 over : Over charged 1.280 ~ 1.250 : Normal 1.250 below : Recharging
Battery relay	 CR-1	Rated load : 24V 100A (continuity) 1000A (30 seconds)	※ Check coil resistance(M4 to M4) Normal : About 50 Ω ※ Check contact Normal : ∞ Ω
Glow plug relay	 CR-24	24V 200A	※ Check contact Normal : 0.942 Ω (For terminal 1-GND)
Start key	 CS-2A	B-BR : 24V 1A B-ACC : 24V 10A B-ST : 24V 40A	※ Check contact OFF : ∞ Ω (for each terminal) ON : 0 Ω (for terminal 1-3 and 1-2) START : 0 Ω (for terminal 1-6)
Pressure sensor	 CD-6 CD-7 CD-24 CD-31 CD-32 CD-35 CD-42 CD-43 CD-44 CD-69 CD-70 CD-71 CD-85 CD-90 CD-124	8~30V	※ Check contact Normal : 0.1 Ω
Resistor		3W 120 Ω	※ Check resistance A-B : 120 Ω

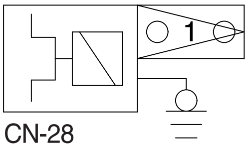
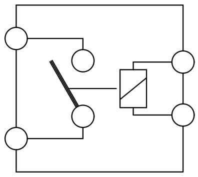
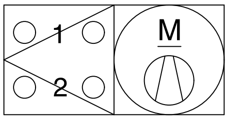
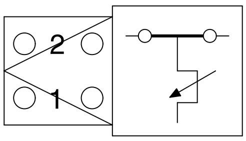
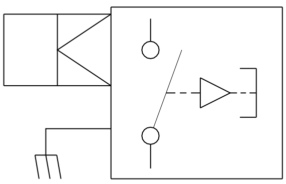
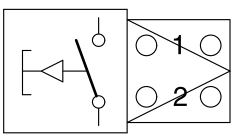
Part name	Symbol	Specifications	Check
Glow plug	 CN-80	24V 200A	※ Check resistance 0.25~0.12 Ω
Temperature sensor (hydraulic)	 CD-1	-	※ Check resistance 50˚C : 804 Ω 80˚C : 310 Ω 100˚C : 180 Ω
Air inlet temperature sensor	 CD-98 CD-98A	-	-
Air cleaner pressure switch	 CD-10	N.O TYPE	※ Check contact High level : ∞ Ω Low level : 0 Ω
Fuel level sender	 CD-2	-	※ Check resistance Full : 50 Ω 6/12 : 350 Ω 11/12 : 100 Ω 5/12 : 400 Ω 10/12 : 150 Ω 4/12 : 450 Ω 9/12 : 200 Ω 3/12 : 500 Ω 8/12 : 250 Ω 2/12 : 550 Ω 7/12 : 300 Ω 1/12 : 600 Ω Empty warning : 700 Ω
Relay (air con blower)		24V 16A	※ Check resistance Normal : About 200 Ω (for terminal 1-3) ∞ Ω (for terminal 2-4)

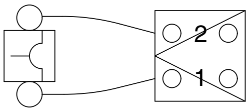
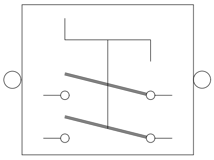
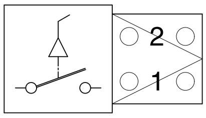
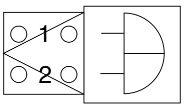
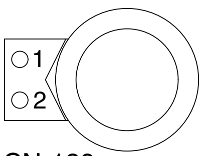
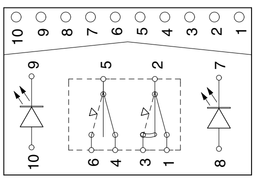
Part name	Symbol	Specifications	Check
Relay	 CR-2 CR-5 CR-36 CR-85 CR-95	24V 16A	※ Check resistance Normal : About 160 Ω (for terminal 1-2) 0 Ω (for terminal 3-4) ∞ Ω (for terminal 3-5)
Relay	 CR-4 CR-7 CR-9 CR-13 CR-35 CR-101	24V 16A	※ Check resistance Normal : About 160 Ω (for terminal 85-86) 0 Ω (for terminal 30-87a) ∞ Ω (for terminal 30-87)
Solenoid valve	 CN-66 CN-68 CN-70 CN-88 CN-135 CN-140 CN-149 CN-237 CN-262 CN-264 CN-367 CN-368 CN-369 CN-370 CN-419 CN-420 CN-421	24V 1A	※ Check resistance Normal : 15~25 Ω (for terminal 1-2)
EPPR valve	 CN-75 CN-133 CN-242 CN-309 CN-310 CN-365 CN-366 CN-378	700mA	※ Check resistance Normal : 15~25 Ω (for terminal 1-2)
Speaker	 CN-23(LH) CN-23(RH) CN-260	20W	※ Check resistance Normal : A few Ω
Switch (locking type)	 CS-52 CS-67 CS-83 CS-99 CS-107 CS-108 CS-111	24V 1.5A	※ Check contact Normal ON : 0 Ω (for terminal 2-3, 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)

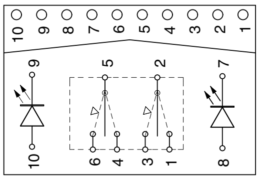
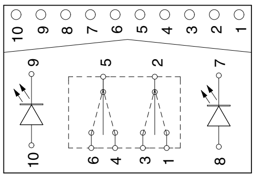
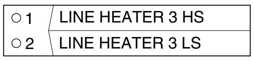
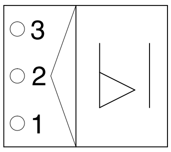
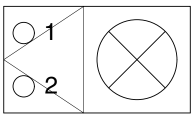
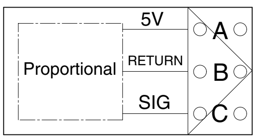
Part name	Symbol	Specifications	Check
Room lamp	 CL-1	24V 10W	※ Check disconnection Normal : 1.0 Ω ON : 0 Ω (For terminal 1-2) ∞ Ω (For terminal 1-3) OFF : ∞ Ω (For terminal 1-2) 0 Ω (For terminal 1-3)
Head lamp, Work lamp, Cab lamp	 CL-3 CL-4 CL-5 CL-6 CL-8 CL-9 CL-10 CL-24	24V 65W (H3 Type)	※ Check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

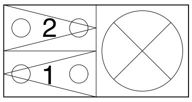
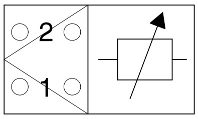
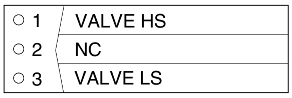
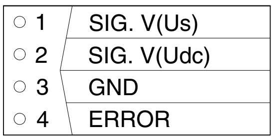
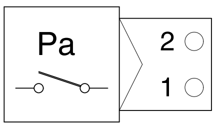
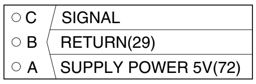
Part name	Symbol	Specifications	Check
Safety switch	 CS-4	24V 15A (N.C TYPE)	※ Check contact Normal : 1.0 Ω ON : 0 Ω (for terminal A-B) ∞ Ω (for terminal A-C) OFF : ∞ Ω (for terminal A-B) 0 Ω (for terminal A-C)
Wiper cut switch	 CS-53	24V (N.O TYPE)	※ Check contact Normal : 0 Ω (one pin to ground)
Receiver dryer	 CN-29	24V 2.5A	※ Check contact Normal : ∞ Ω
Radio & USB player	 CN-27A	24V 2A	※ Check voltage 20~25V (for terminal 1-3, 3-8)
Washer pump	 CN-22 CN-145	24V 3.8A	※ Check contact Normal : 10.7 Ω (for terminal 1-2)
Wiper motor	 CN-21	24V 2A	※ Check disconnection Normal : 7 Ω (for terminal 2-6)

Part name	Symbol	Specifications	Check
DC/DC Converter	 CN-138	12V 3A	※ Check voltage 24V (for terminal 1-2) 12V (for terminal 1-3)
Low wiper motor	 CN-407	-	-
Cigar lighter	 CL-2	24V 5A 1.4W	※ Check coil resistance Normal : About 1MΩ ※ Check contact Normal : ∞ Ω Operating time : 5~15sec
Alternator	 CN-74	Delco Remy 24V 100A	※ Check contact Normal : 0 Ω (for terminal B^+-2) Normal : 24~27.5V
Starter	 CN-45	24V 4.5kW	※ Check contact Normal : 0.1 Ω
Travel alarm	 CN-81	24V 0.5A	※ Check contact Normal : 5.2 Ω

Part name	Symbol	Specifications	Check
Air conditioner compressor	 CN-28	24V 79W	※ Check contact Normal : 13.4 Ω
Start relay	 CR-23	24V 300A	※ Check contact Normal : 0.94 Ω (for terminal 1-2)
Blower motor		24V 9.5A	※ Check resistance Normal : 2.5 Ω (for terminal 1-2)
Thermistor		1˚C OFF 4˚C ON	※ Check resistance Normal : 0 Ω (for terminal 1-2), the atmosphere temp : Over 4˚C
Door switch	 CS-1	24V 2W	※ Check resistance Normal : About 5M Ω
Switch (power max, one touch decel, horn, breaker)	 CS-5 CS-19 CS-26 CS-29	24V 6A	※ Check resistance Normal : ∞ Ω

Part name	Symbol	Specifications	Check
Circuit breaker	 CN-60 CN-95	CN-60 : 60A CN-95 : 90A	※ Check disconnection Normal : 0 Ω (connect ring terminal and check resist between terminal 1 and 2)
Master switch	 CS-74A CS-74B	6-36V	※ Check disconnection Normal : 0.1 Ω
Breaker switch	 CS-26A	-	-
Quick clamp buzzer	 CN-113	24V 200mA 107±4dB	-
Socket	 CN-139	12V 10A	-
Switch	 CS-79	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)

Part name	Symbol	Specifications	Check
Switch	 CS-100	24V 8A	※ Check contact Normal OFF : ∞ Ω (for terminal 2-1, 2-3, 5-4, 5-6)
Switch	 CS-73	24V 8A	※ Check contact Normal OFF : ∞ Ω (for terminal 2-1, 2-3, 5-4, 5-6)
DEF/AdBlue® line heater	 CN-381 CN-382 CN-383	-	-
WIF sensor	 CD-45	-	※ Check disconnection Normal : 68.8~4.94 Ω
DEF/AdBlue® fill up warning lamp (LED)	 CL-40	-	-
Proportional valve sensor	 CN-246 CN-247	-	-

Part name	Symbol	Specifications	Check
DEF/AdBlue® full lamp	 CL-41	-	-
Temperature sensor (A/C incar, A/C ambient)		-	-
Coolant diverter valve	 CN-384	-	-
Proportional valve sensor	 CN-308	-	-
Dozer act pressure switch	 CD-50	N.O type	※Check resistance Normal : ∞ Ω (open)
Water level sensor	 CD-16	-	-

Part name	Symbol	Specifications	Check
Camera	○1 LVDS POS ○2 GND ○3 LVDS NEG ○4 POWER 24V ○5 NC ○6 ADJUST SIGNAL CN-402	-	-
NOx sensor (tail out, turbo out)	○ 6 J1939 HI ○ 5 J1939 LO ○ 4 GND ○ 3 ADDRESS SELEC ○ 2 J1939- ○ 1 BATT+ CN-J7A CN-J7B	-	-

GROUP 4 CONNECTORS

1. CONNECTOR DESTINATION

Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CN-1	AMP	10	I/conn (Frame harness-Pump PS harness)	S816-010002	S816-110002
CN-2	AMP	20	I/conn (Frame harness-Engine harness)	936777-2	936780-2
CN-3	-	26	I/conn (Frame harness-Engine harness)	1897009-2	1897013-2
CN-3A	AMP	12	PVG harness	174661-2	368537-1
CN-4	AMP	16	I/conn (Console harness LH-Frame harness)	368047-1	368050-1
CN-5	DEUTSCH	60	I/conn (Side harness RH-Frame harness)	DRB16-60SAE-L018	DRB14-60PAE-L018
CN-6	AMP	16	I/conn (Console harness RH-Frame harness)	368047-1	368050-1
CN-7	AMP	15	I/conn (Console harness RH-Frame harness)	368301-1	2-85262-1
CN-8	AMP	10	I/conn (Console harness RH-Frame harness)	S816-010002	174655-2
CN-9	DEUTSCH	12	I/conn (AAVM harness-Frame 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-13	AMP	8	I/conn (Frame harness-Boom floating harness)	174982-2	174984-2
CN-14	DEUTSCH	2	I/conn (Frame harness-Swing parking harness)	DT06-2S-EP06	DT04-2P-EP06
CN-15	AMP	8	I/conn (Frame harness-Breaker sol)	174982-2	174984-2
CN-16B	AMP	6	Emergency engine start & speed control	S816-006002	21NB-10710
CN-17	AMP	8	I/conn (Side harness RH-Wiper harness)	S816-008002	S816-108002
CN-20	MOLEX	2	Horn	36825-0211	-
CN-21	AMP	6	Wiper motor	S810-006202	-
CN-22	KET	2	Washer tank	MG640605	-
CN-23	KET	2	Speaker-LH	MG610070	-
CN-24	KET	2	Speaker-RH	MG610070	-
CN-25	MOLEX	2	Horn	36825-0211	-
CN-27A	KUM	16	Radio & USB player	PK145-16017	-
CN-27B	AMP	8	Radio & USB player	-	174984-2
CN-28	KUM	1	Aircon compressor	NMWP01F-B	-
CN-29	KET	2	Receiver dryer	MG640795	-
CN-36	-	-	Fuse & relay box	21Q7-10901	-
CN-45	RING-TERM	-	Starter motor B^+	S820-108000	-
CN-48	KET	1	Hour meter	2-520193-2	-
CN-51	DEUTSCH	40	MCU	DRC26-40SA	-
CN-52	DEUTSCH	40	MCU	DRC26-40SB	-
CN-53	DEUTSCH	40	MCU	DRC26-40SA	-

Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CN-56A	AMP	12	Cluster	-	174663-2
CN-56B	AMP	8	Cluster	-	174984-2
CN-60	-	2	Circuit breaker	-	S813-130201
CN-61	DEUTSCH	2	Fuel filler pump	DT06-2S-EP06	DT04-2P-E005
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	RING-TERM	2	Alternator "L" terminal	-	S820-108000
CN-75	AMP	2	Pump EPPR valve	S816-002002	-
CN-80	RING-TERM	-	Glow plug	S820-306000	-
CN-81	DEUTSCH	2	Travel buzzer solenoid	DT06-2S-EP06	DT04-2P-E005
CN-88	DEUTSCH	2	Power max solenoid	DT06-2S-EP06	-
CN-93	DEUTSCH	86	ECM	DRCP28-86SA	-
CN-95	-	2	Circuit breaker	-	S813-130201
CN-113	KET	2	Buzzer	MG651205-5	-
CN-125	Econoseal J	4	GPS connector	S816-004002	S816-104002
CN-125A	DEUTSCH	12	GPS	DT06-12S-P021	DT04-12PA-P021
CN-126	AMP	10	I/conn (Frame harness-Service tool)	2-1418390-1	S816-110002
CN-126	DEUTSCH	4	Service tool	DT06-4S	DT04-4P
CN-126A	-	9	Service tool	-	HD10-9-969
CN-133	DEUTSCH	2	Boom priority solenoid	DT06-2S-EP06	-
CN-135	DEUTSCH	2	Arm regeneration 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-145	DEUTSCH	2	Fuel filler pump	DT06-2S-EP06	-
CN-149	DEUTSCH	2	Attach safety solenoid	DT06-2S-EP06	-
CN-156	DEUTSCH	2	Air seat heat	-	DT04-2P
CN-157	AMP	1	Antena power	S822-014002	-
CN-236	DEUTSCH	2	Air compressor relay	DT06-2S-EP06	-
CN-237	DEUTSCH	2	Attach conflux solenoid	DT06-2S-EP06	-
CN-242	DEUTSCH	2	Attach EPPR 2 (MCU 1)	DT06-2S-EP06	-
CN-245	FCI	4	PTC power	180900-0	-
CN-246	DEUTSCH	3	Proportional valve-RH	DT06-3S	DT04-3P
CN-247	DEUTSCH	3	Proportional valve-LH	DT06-3S	DT04-3P
CN-258	KET	1	Air compressor power	MG640944-5	-
CN-260	-	2	Siren AMP	-	S816-102002

Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CN-261	KET	4	Siren AMP	MG610047	-
CN-262	DEUTSCH	2	Straight travel solenoid	DT06-2S-EP06	DT04-2P-E005
CN-263	DEUTSCH	2	2 Piece solenoid	DT06-2S-EP06	DT04-2P-E005
CN-305	DEUTSCH	12	To PVG controller	DTM06-12SA	-
CN-306	DEUTSCH	12	To PVG controller	DTM06-12SB	-
CN-307	DEUTSCH	3	Proportional-Service tool	DT06-3S-EP06	DT04-3P-E005
CN-308	AMP	4	Proportional-PVG32	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-363	AMP	12	Haptic controller	174045-2	-
CN-365	DEUTSCH	2	Attach EPPR valve 1	DT06-2S-EP06	-
CN-366	DEUTSCH	2	Attach EPPR valve 2	DT06-2S-EP06	DT04-2P-E005
CN-367	DEUTSCH	2	Boom down floating solenoid	DT06-2S-E005	-
CN-368	DEUTSCH	2	Boom up floating solenoid	DT06-2S-E005	-
CN-369	DEUTSCH	2	Boom down cut off solenoid	DT06-2S-E005	-
CN-370	DEUTSCH	2	Swing fine control solenoid	DT06-2S-EP06	-
CN-376	AMP	34	Membrane controller	4-1437290-1	-
CN-378	DEUTSCH	2	Attach EPPR 1 (MCU 1)	DT06-2S-EP06	-
CN-379-XNI	DEUTSCH	24	DCU module	HDP24-24-31ST	-
CN-381	DEUTSCH	2	DEF/AdBlue® line heater 1	DT06-2S-EP06	-
CN-382	DEUTSCH	2	DEF/AdBlue® line heater 2	DT06-2S-EP06	-
CN-383	DEUTSCH	2	DEF/AdBlue® line heater 3	DT06-2S-EP06	-
CN-384	AMP	3	Coolant diverter valve	1-1418448-1	-
CN-385	-	7	Fan clutch	965570	-
CN-398	DEUTSCH	3	RS232	DT06-3S-EP06	DT04-3P-E005
CN-401	FCI	90	AAVM controller	A2C00021583	-
CN-401	DEUTSCH	12	AAVM	DT06-12S	-
CN-402	DEUTSCH	6	Front view camera	DT06-6S-P021	DT04-6P-P021
CN-403	DEUTSCH	6	Rear view camera	DT06-6S-EP06	DT04-6P-EP14
CN-404	DEUTSCH	6	RH view camera	DT06-6S-EP06	DT04-6P-EP14
CN-405	DEUTSCH	6	LH view camera	DT06-6S-EP06	DT04-6P-EP14
CN-406	DEUTSCH	3	Service tool	DT06-3S-E005	DT04-3P-EP06
CN-407	FCI	4	Low wiper motor	180900-0	-
CN-408	FCI	4	Low washer pump	MG640795	-
CN-419	DEUTSCH	2	Swing parking solenoid-A1	DT06-2S-EP06	-
CN-420	DEUTSCH	2	Swing parking solenoid-A2	DT06-2S-EP06	-
CN-421	DEUTSCH	2	Swing parking solenoid-A3	DT06-2S-EP06	-
CN-422	AMP	4	Ammonia sensor	1-1418390-1	-

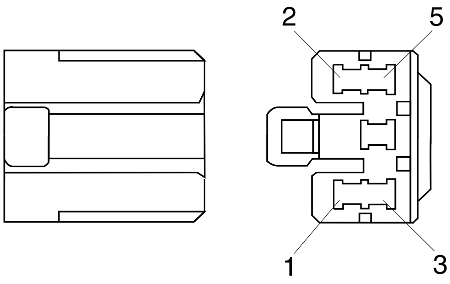
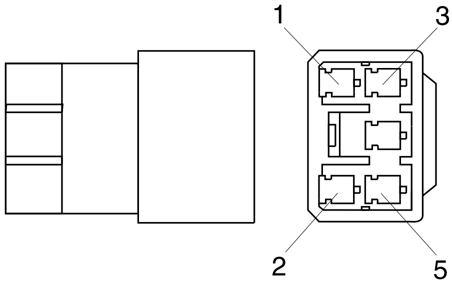
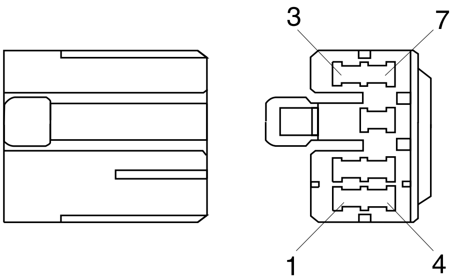
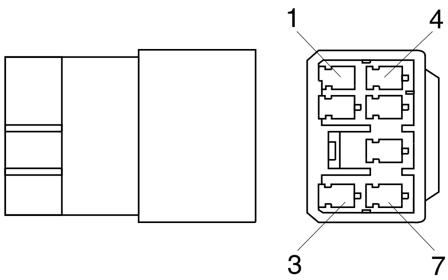
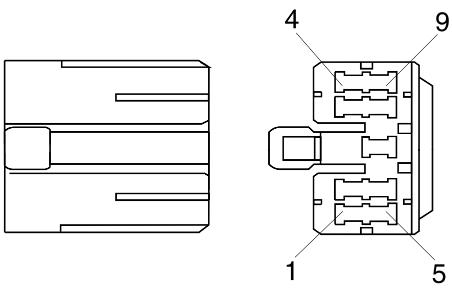
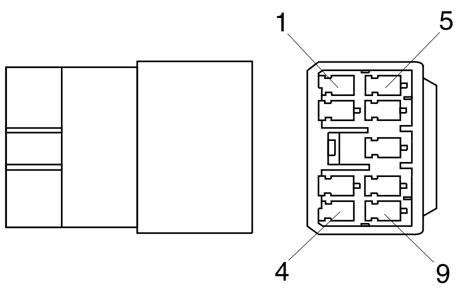
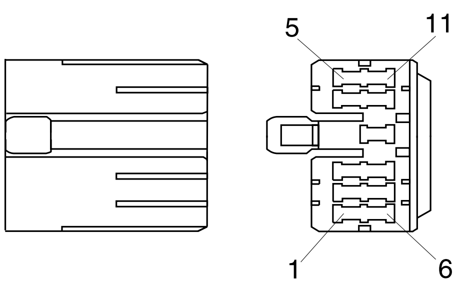
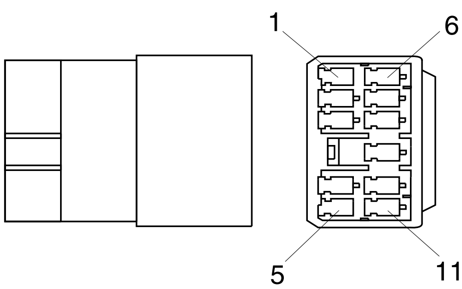
Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CN-423	DEUTSCH	4	Tank header unit	DT06-4S	-
CN-424	AMP	2	DEF/AdBlue® injector temperature sensor	2098557-1	-
CN-425	AMP	2	SCR temperature sensor	282080-1	-
CN-426	AMP	2	DOC temperature sensor	282080-1	-
CN-427	MOLEX	4	Reader-RMS	039012040	026013096
		12		5557-12R	5559-12P
CN-429	AMP	6	DEF/AdBlue® ID module sensor	776433-2	-
CN-J7A	AMP	6	DOC NOx sensor	776433-2	-
CN-J7B	AMP	6	SCR NOx sensor	776433-2	-
· 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	-	MG640322
CR-24	RING TERM	1	Preheat relay	S822-014000	-
CR-35	-	5	Power relay	-	-
CR-36	-	5	Preheat relay	-	-
CR-85	-	5	Beacon lamp relay	-	-
CR-95	-	5	Feed pump relay	-	-
CR-101	-	5	DCU relay	-	-
· Switch					
CS-1	SHUR	1	Door switch	S822-014002	-
CS-2A	WP	6	Start key switch	S814-006100	-
CS-2B	DEUTSCH	3	Reader	DT06-3S-EP06	DT04-3P-E005
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	Adjust & dozer switch	VC2-01	-
CS-53	AMP	1	Wiper cut switch	S822-014002	-
CS-67	CARLING	10	Quick clamp switch	VC2-01	-

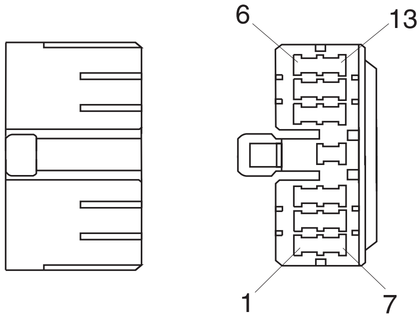
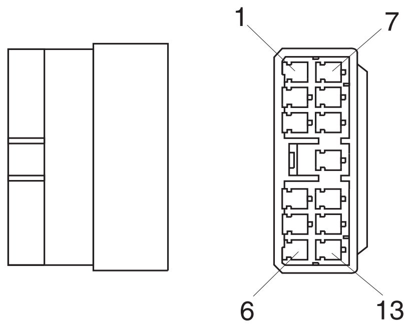
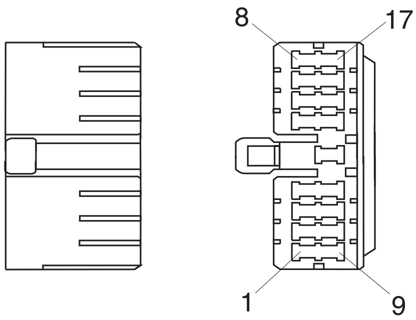
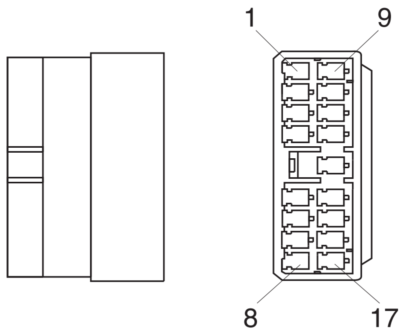
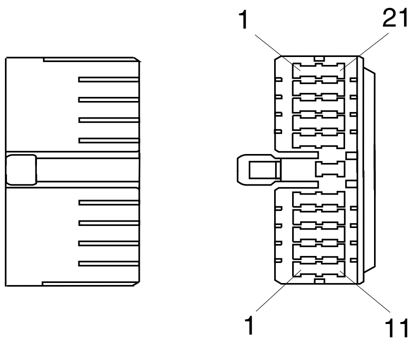
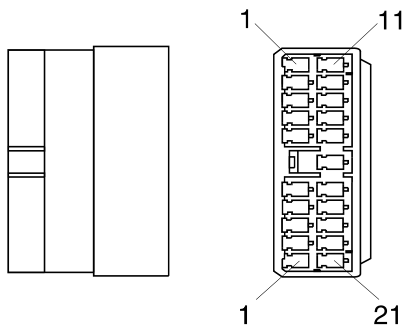
Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CS-73	CARLING	10	Swing lock & fine switch	VC2-01	-
CS-74A	AMP	2	Master switch	S813-030201	-
CS-74B	DEUTSCH	2	Master switch	DT06-2S-EP06	-
CS-78	CARLING	10	Lower wiper switch	VC2-01	-
CS-79	CARLING	10	Lower wiper switch	VC2-01	-
CS-83	CARLING	10	Spare switch	VC2-01	-
CS-99	CARLING	10	Air compressor switch	VC2-01	-
CS-100	CARLING	10	SCR system cleaning switch	VC2-01	-
CS-107	CARLING	10	Travel straight switch	VC2-01	-
CS-108	CARLING	10	Auto grease switch	VC2-01	-
CS-111	CARLING	10	Boom floating switch	VC2-01	-
· Light					
CL-1	KET	3	Room lamp	MG651032	-
CL-2	AMP	1	Cigar lighter	S822-014002	S822-114002
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	-
CL-6	DEUTSCH	2	Work lamp-RH	DT06-2S	-
CL-7	SHUR	1	Beacon lamp	S822-014002	S822-114002
CL-8	DEUTSCH	2	Cab light-LH	DT06-2S-EP06	DT04-2P
CL-9	DEUTSCH	2	Cab light-RH	DT06-2S-EP06	DT04-2P
CL-10	DEUTSCH	2	Cab light	DT06-2S-EP06	DT04-2P
CL-24	DEUTSCH	2	Head lamp	DT06-2S-EP06	DT04-2P-E005
CL-40	DEUTSCH	2	DEF/AdBlue® purging lamp	DT06-2S-EP06	DT04-2P
CL-41	AMP	1	DEF/AdBlue® F/warning lamp	S822-01400	S822-11400
· 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-16	DELPHI	3	Water level sensor	12110293	-
CD-24	DEUTSCH	2	Swing pressure sensor	DT06-2S-EP06	-
CD-31	DEUTSCH	3	Overload pressure sensor	DT06-3S-EP06	DT04-3S-EP06
CD-32	DEUTSCH	2	Boom up pressure sensor	DT06-2S-EP06	-
CD-35	DEUTSCH	3	Arm in/out pressure sensor	DT06-3S-EP06	-
CD-42	DEUTSCH	3	Pump pressure sensor 1	DT06-3S-EP06	-
CD-43	DEUTSCH	3	Pump pressure sensor 2	DT06-3S-EP06	-

Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CD-44	DEUTSCH	3	Pump pressure sensor 3	DT06-3S-EP06	-
CD-45	AMP	3	WIF sensor	776429-3	-
CD-50	KET	2	Dozer pressure sensor	MG640795	-
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	2	Boom down sensor	DT06-2S-EP06	-
CD-90	DEUTSCH	2	Arm in pressure sensor	DT06-2S-EP06	-
CD-93A	AMP	2	Air inlet temperature sensor	776427-1	-
CD-98	AMP	2	Air intake sensor	776427-1	-
CD-124	DEUTSCH	3	Boom cylinder rod pressure snensor	DT06-3S-E005	-

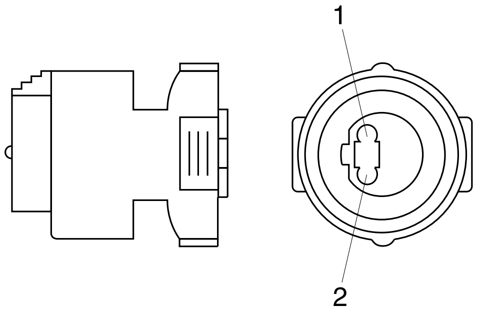
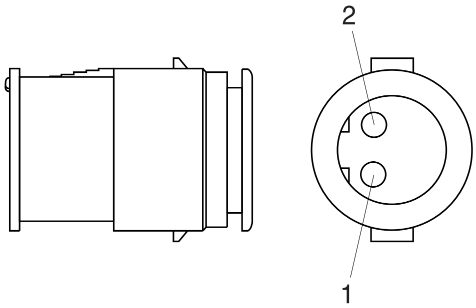
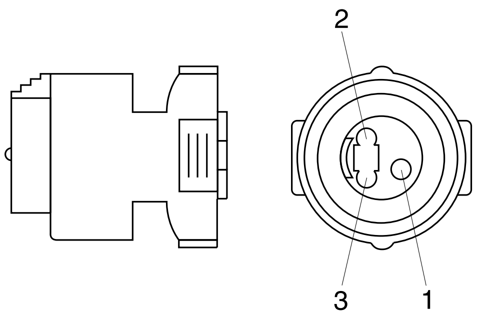
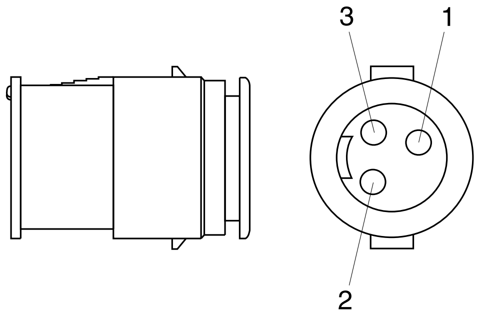
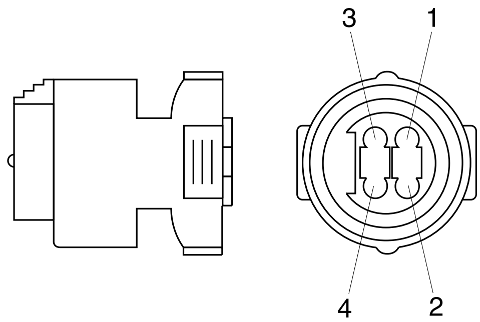
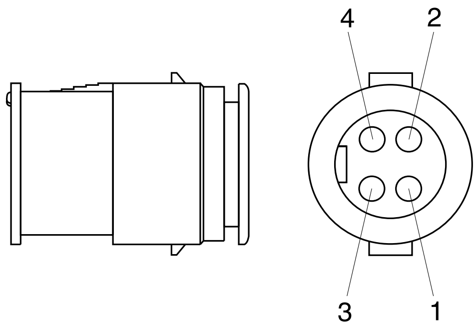
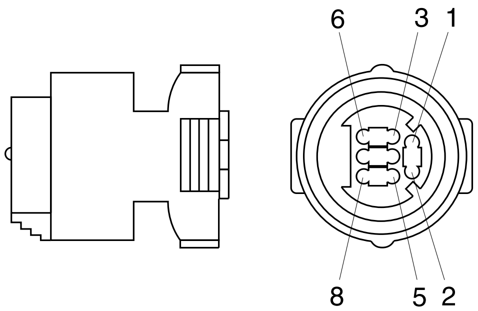
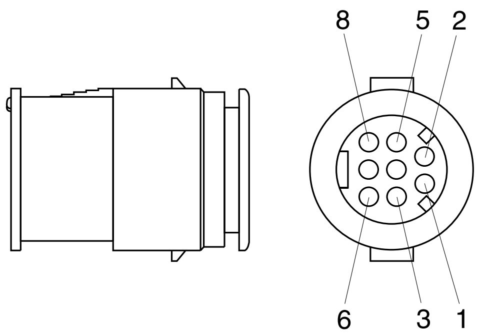
2. CONNECTION TABLE FOR CONNECTORS

1) PA TYPE CONNECTOR

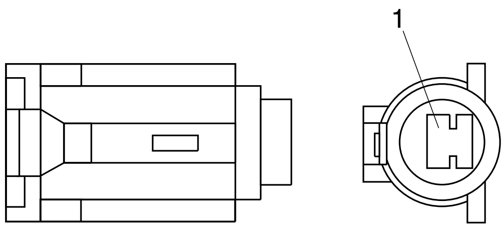
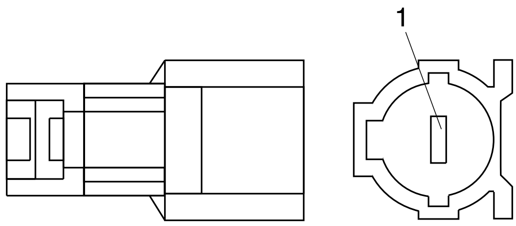
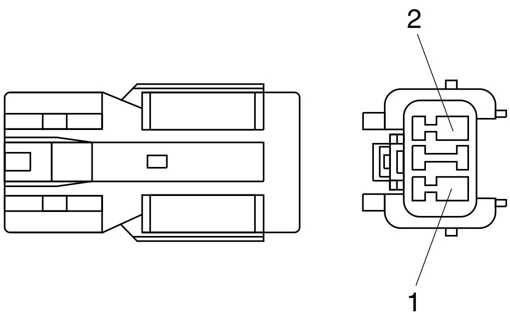
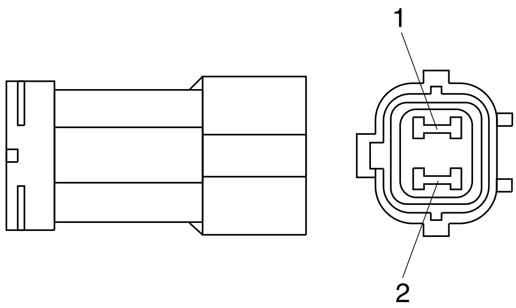
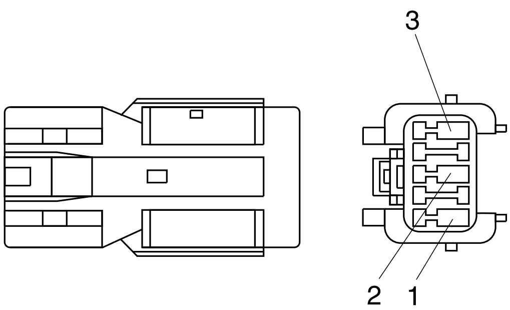
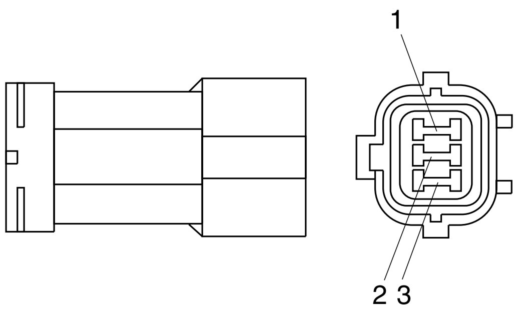
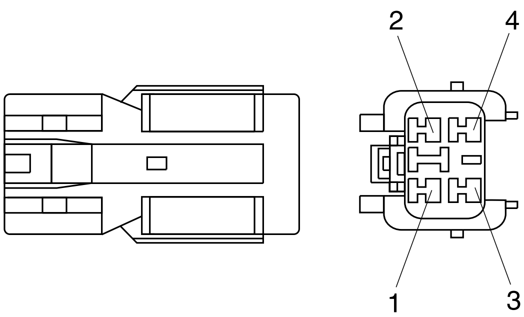
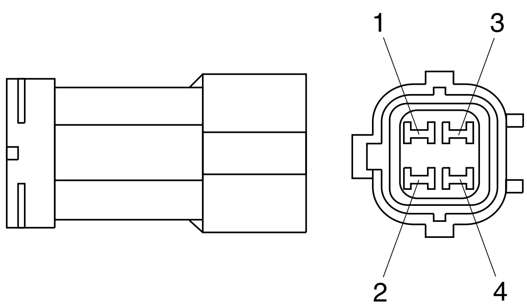
No. of pin	Receptacle connector (female)	Plug connector (male)
5	 S811-005002	 S811-105002
7	 S811-007002	 S811-107002
9	 S811-009002	 3S811-109002
11	 S811-011002	 S811-111002

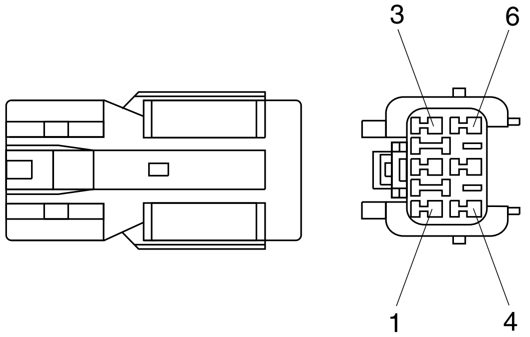
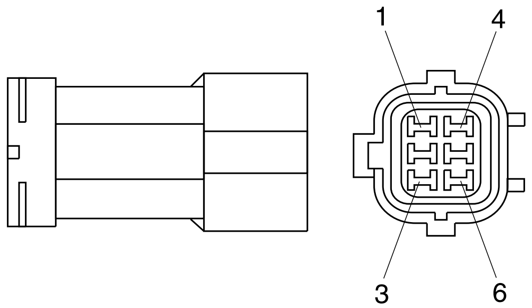
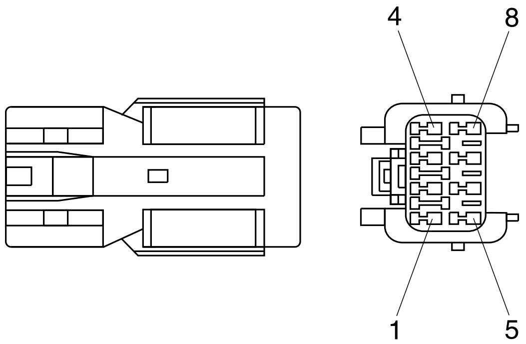
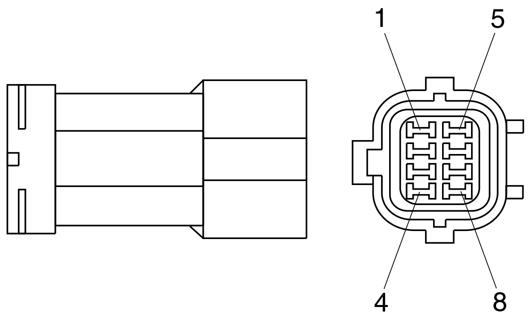
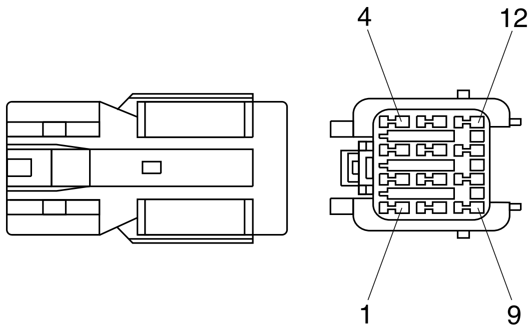
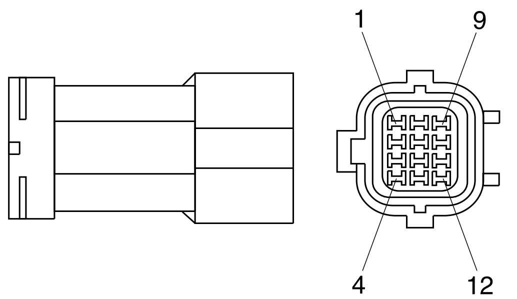
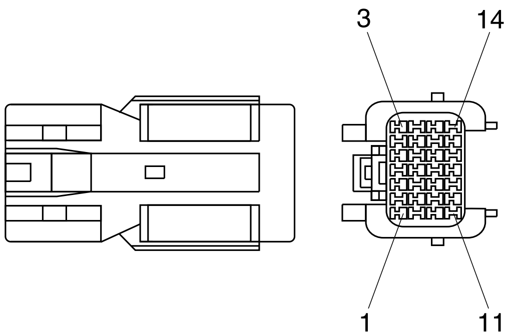
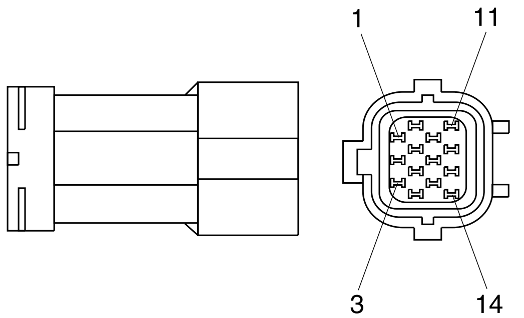
No. of pin	Receptacle connector (female)	Plug connector (male)
13	 S811-013002	 S811-113002
17	 S811-017002	 S811-117002
21	 S811-021002	 S811-121002

2) J TYPE CONNECTOR

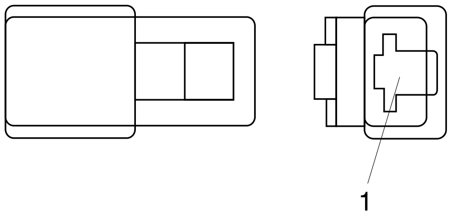
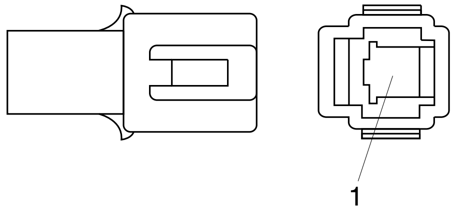
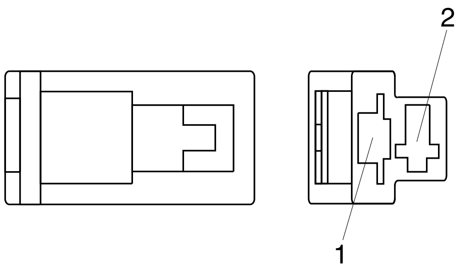
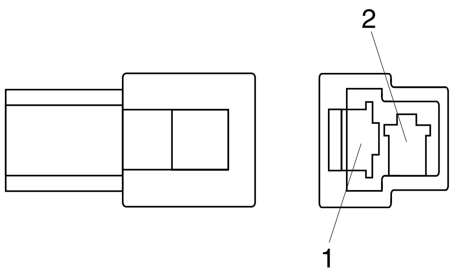
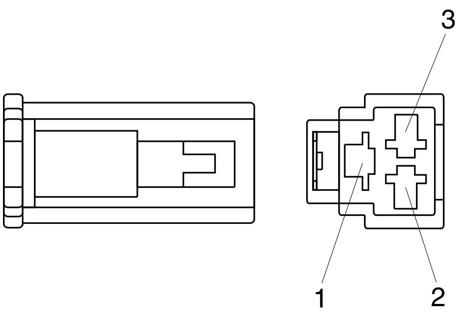
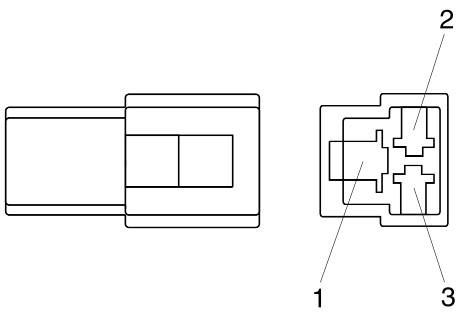
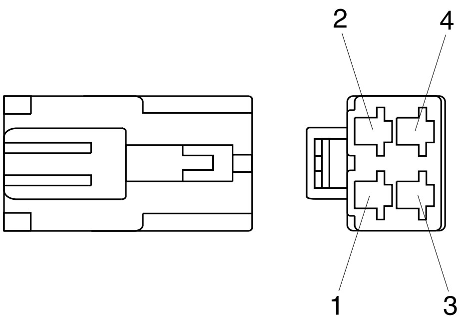
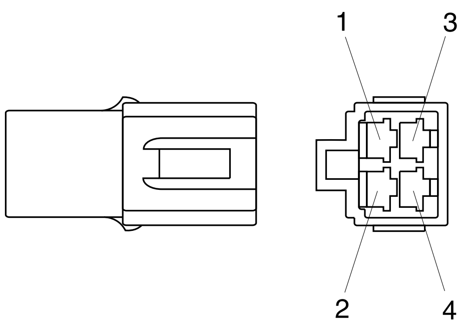
No. of pin	Receptacle connector (female)	Plug connector (male)
2	 S816-002001	 S816-102001
3	 S816-003001	 S816-103001
4	 S816-004001	 S816-104001
8	 S816-008001	 S816-108001

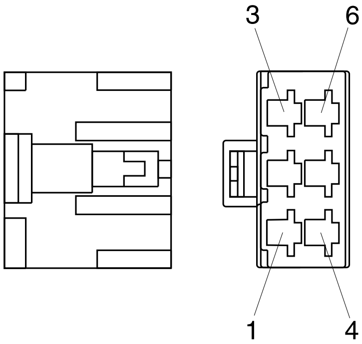
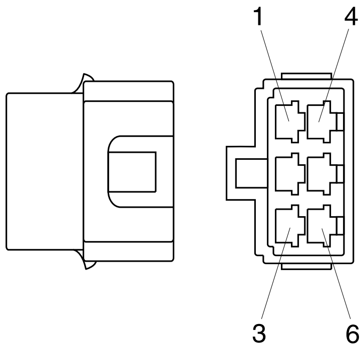
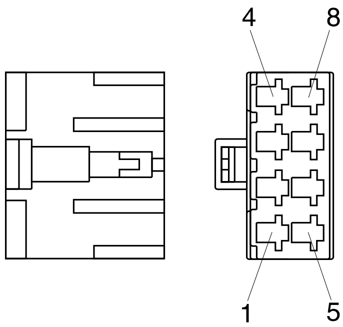
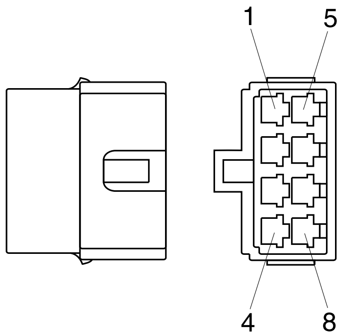
3) SWP TYPE CONNECTOR

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

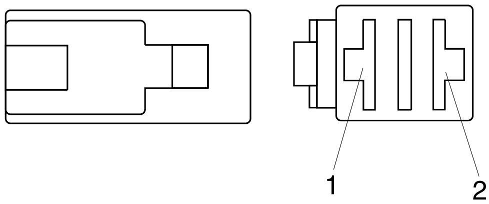
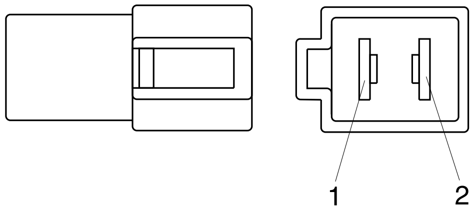
No. of pin	Receptacle connector (female)	Plug connector (male)
6	 S814-006000	 S814-106000
8	 S814-008000	 S814-108000
12	 S814-012000	 S814-112000
14	 S814-014000	 S814-114000

4) CN TYPE CONNECTOR

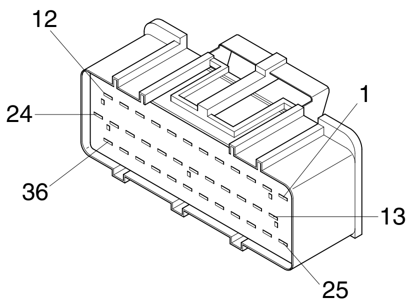
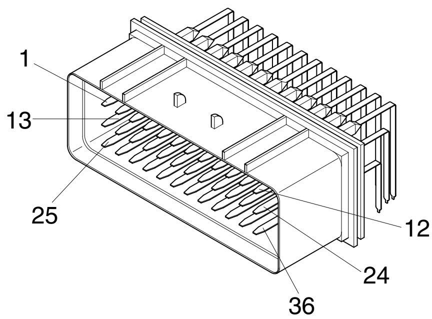
No. of pin	Receptacle connector (female)	Plug connector (male)
1	 S810-001202	 S810-101202
2	 S810-002202	 S810-102202
3	 S810-003202	 S810-103202
4	 S810-004202	 S810-104202

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

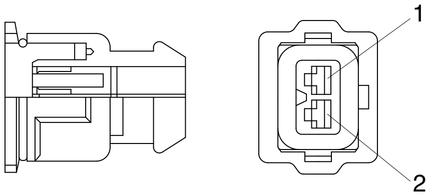
5) 375 FASTEN TYPE CONNECTOR

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

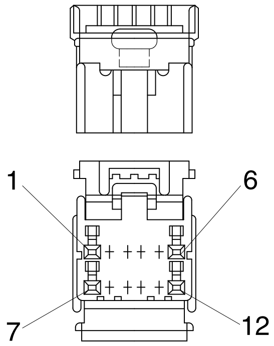
6) AMP ECONOSEAL CONNECTOR

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

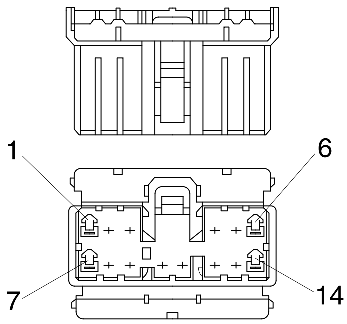
7) AMP TIMER CONNECTOR

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

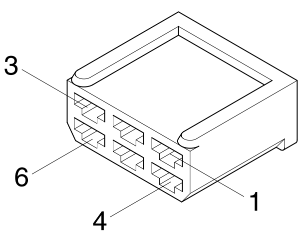
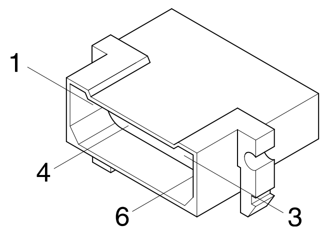
8) AMP 040 MULTILOCK CONNECTOR

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

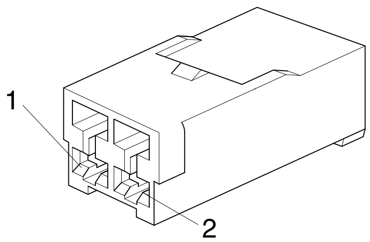
9) AMP 070 MULTILOCK CONNECTOR

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

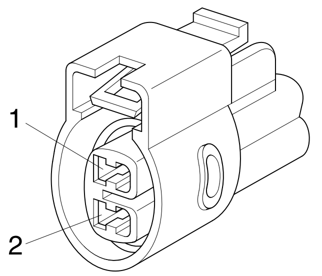
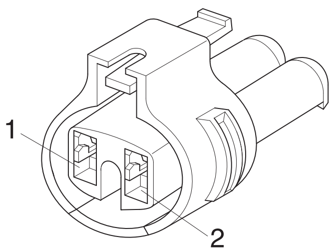
10) AMP FASTIN - FASTON CONNECTOR

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

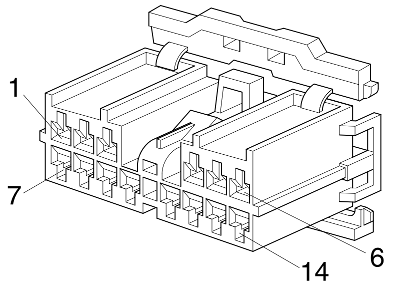
11) KET 090 CONNECTOR

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

12) KET 090 WP CONNECTORS

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

13) KET SDL CONNECTOR

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

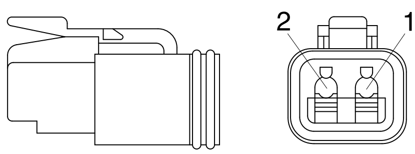
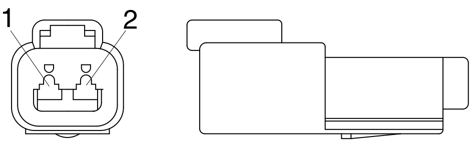
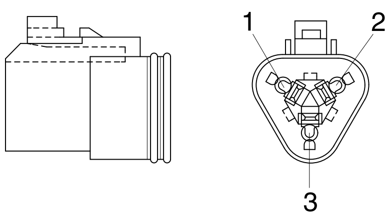
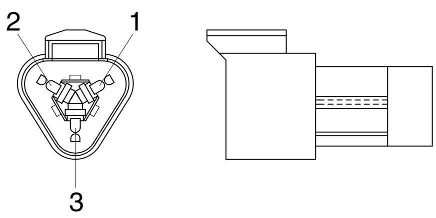
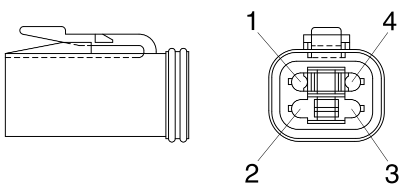
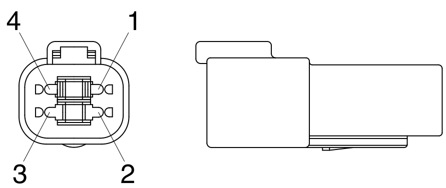
14) DEUTSCH DT CONNECTORS

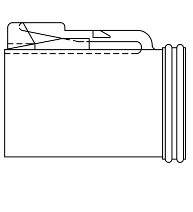
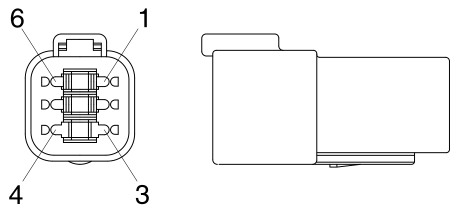
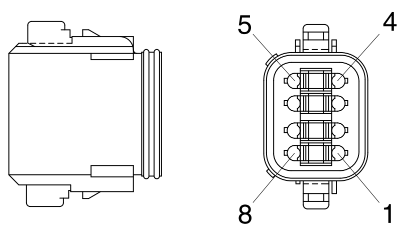
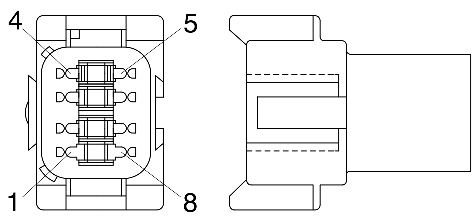
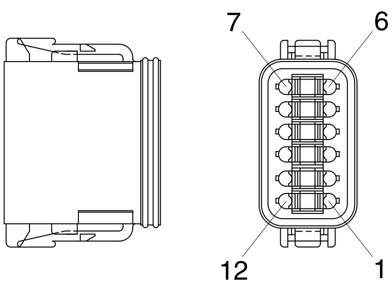
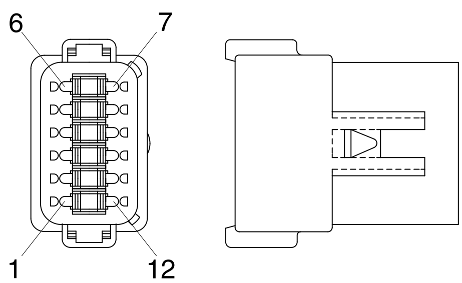
DT 06 - 3S - ★★★★

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

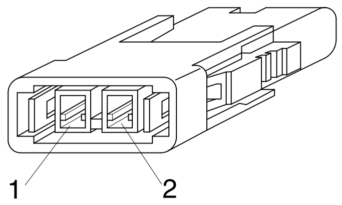
※ Modification

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

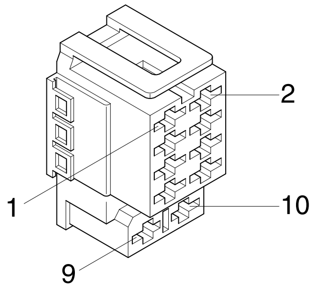
No. of pin	Receptacle connector (female)	Plug connector (male)
2	 DT06-2S	 DT04-2P
3	 DT06-3S	 DT04-3P
4	 DT06-4S	 DT04-4P

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

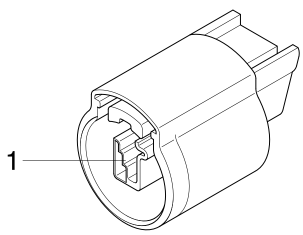
15) MOLEX 2CKTS CONNECTOR

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

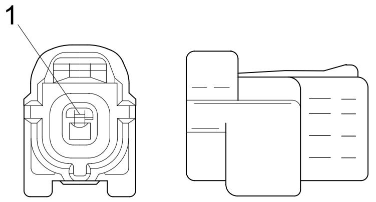
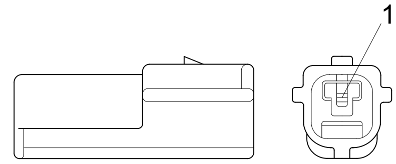
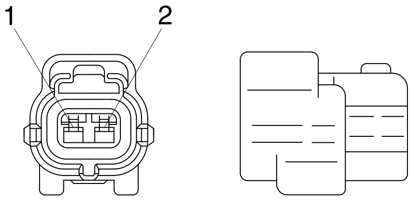
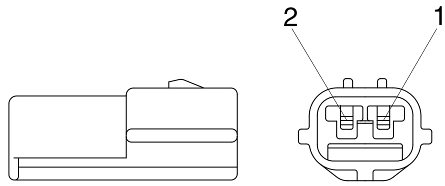
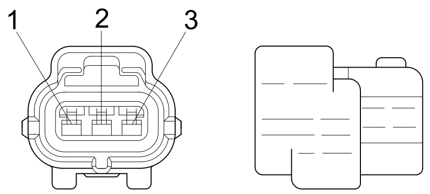
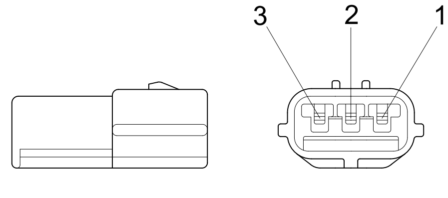
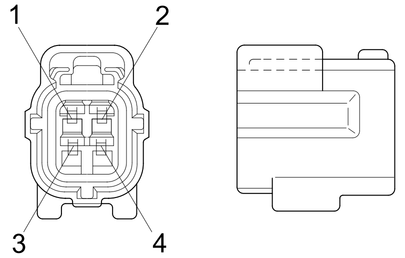
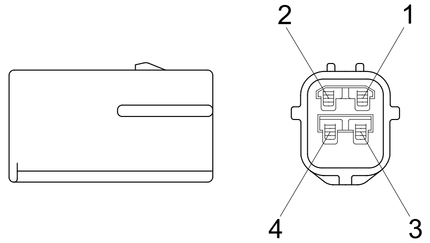
16) ITT SWF CONNECTOR

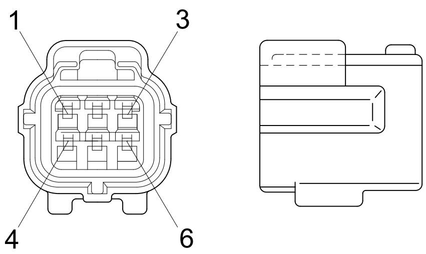
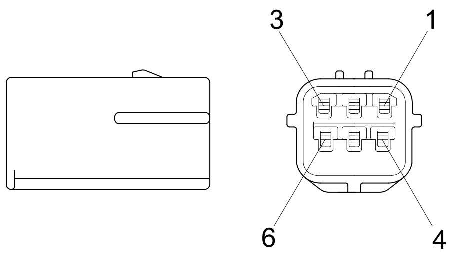
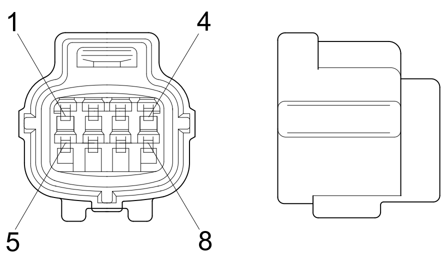
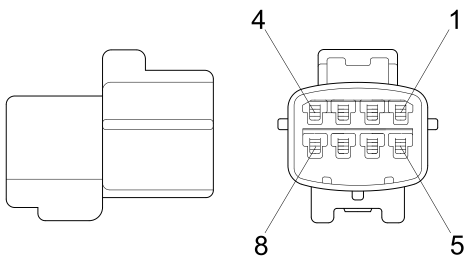
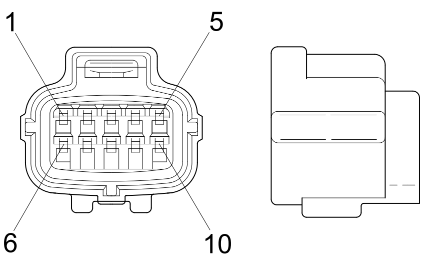
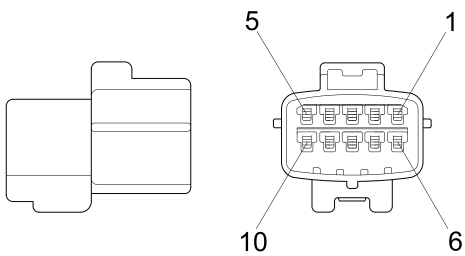
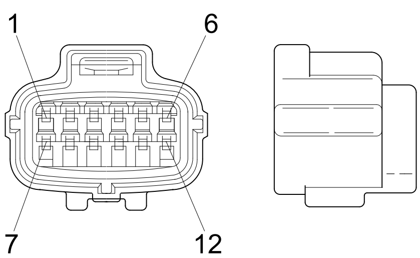
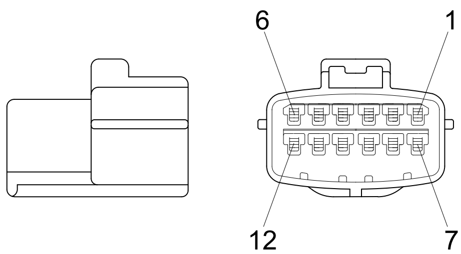
No. of pin	Receptacle connector (female)	Plug connector (male)
10	 SWF593757	

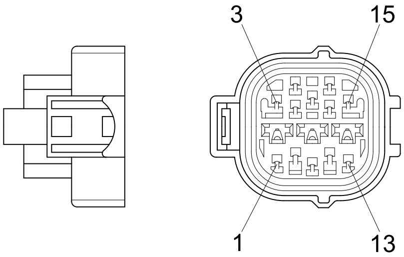
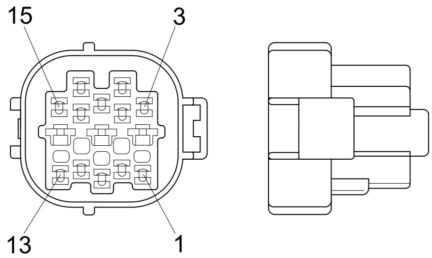
17) MWP NMWP CONNECTOR

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

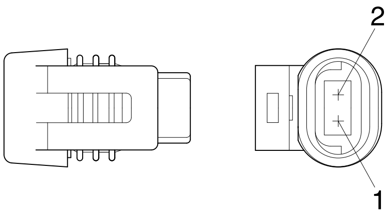
18) ECONOSEAL J TYPE CONNECTORS

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

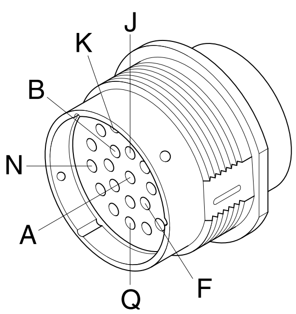
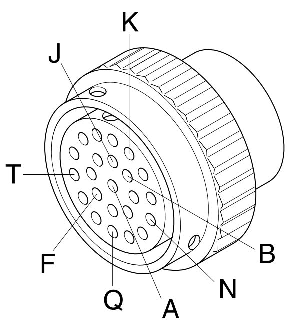
No. of pin	Receptacle connector (female)	Plug connector (male)
6	 S816-006002	 S816-106002
8	 S816-008002	 S816-108002
10	 S816-010002	 S816-110002
12	 S816-012002	 S816-112002

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

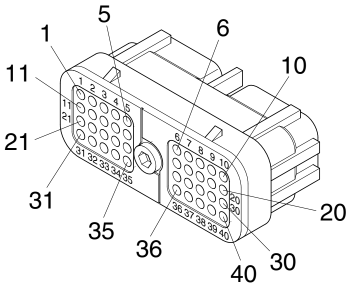
19) METRI-PACK TYPE CONNECTOR

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

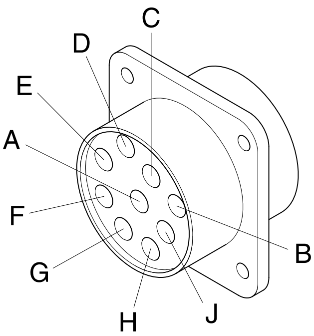
20) DEUTSCH HD30 CONNECTOR

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

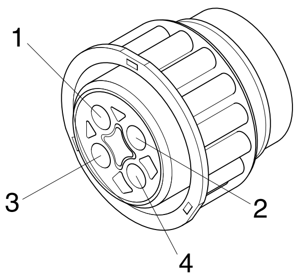
21) DEUTSCH MCU CONNECTOR

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

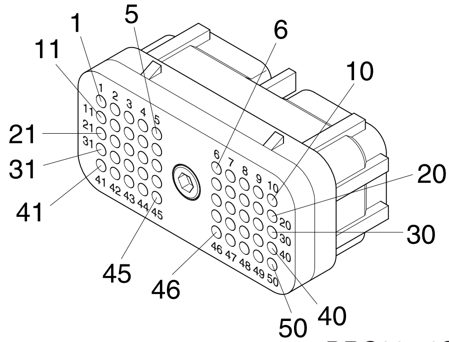
22) DEUTSCH SERVICE TOOL CONNECTOR

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

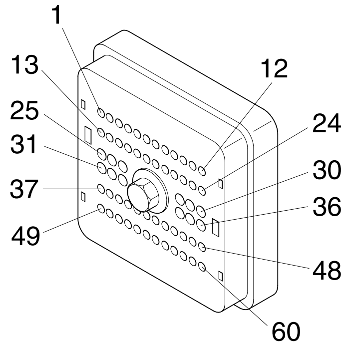
23) AMP FUEL WARMER CONNECTOR

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

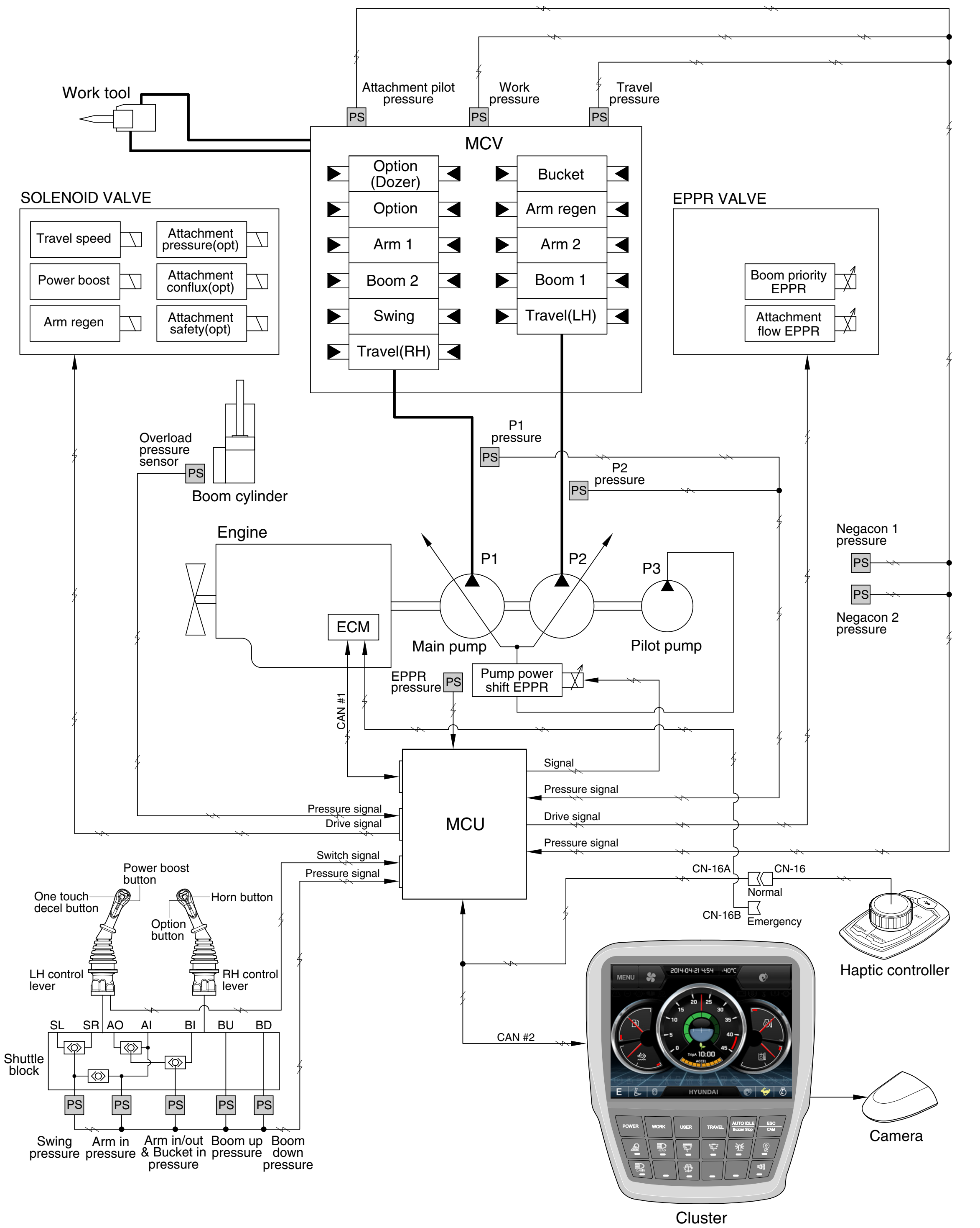
SECTION 5 MECHATRONICS SYSTEM

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 two MCU, a cluster, an ECM, EPPR valves, and other components. The MCU and the cluster protect themselves from over-current and high voltage input, and diagnose malfunctions caused by short or open circuit in electric system, and display error codes on the cluster.

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

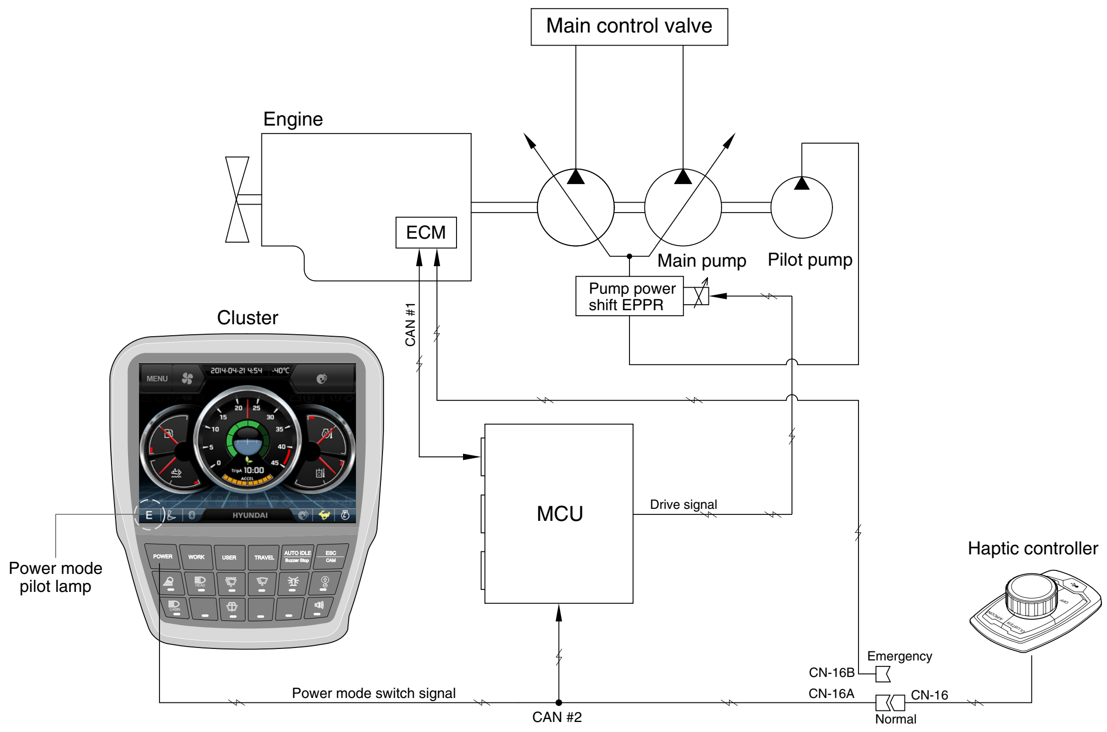
SYSTEM DIAGRAM



140L5MS04

GROUP 2 MODE SELECTION SYSTEM

1. POWER MODE SELECTION SYSTEM



300L5MS02

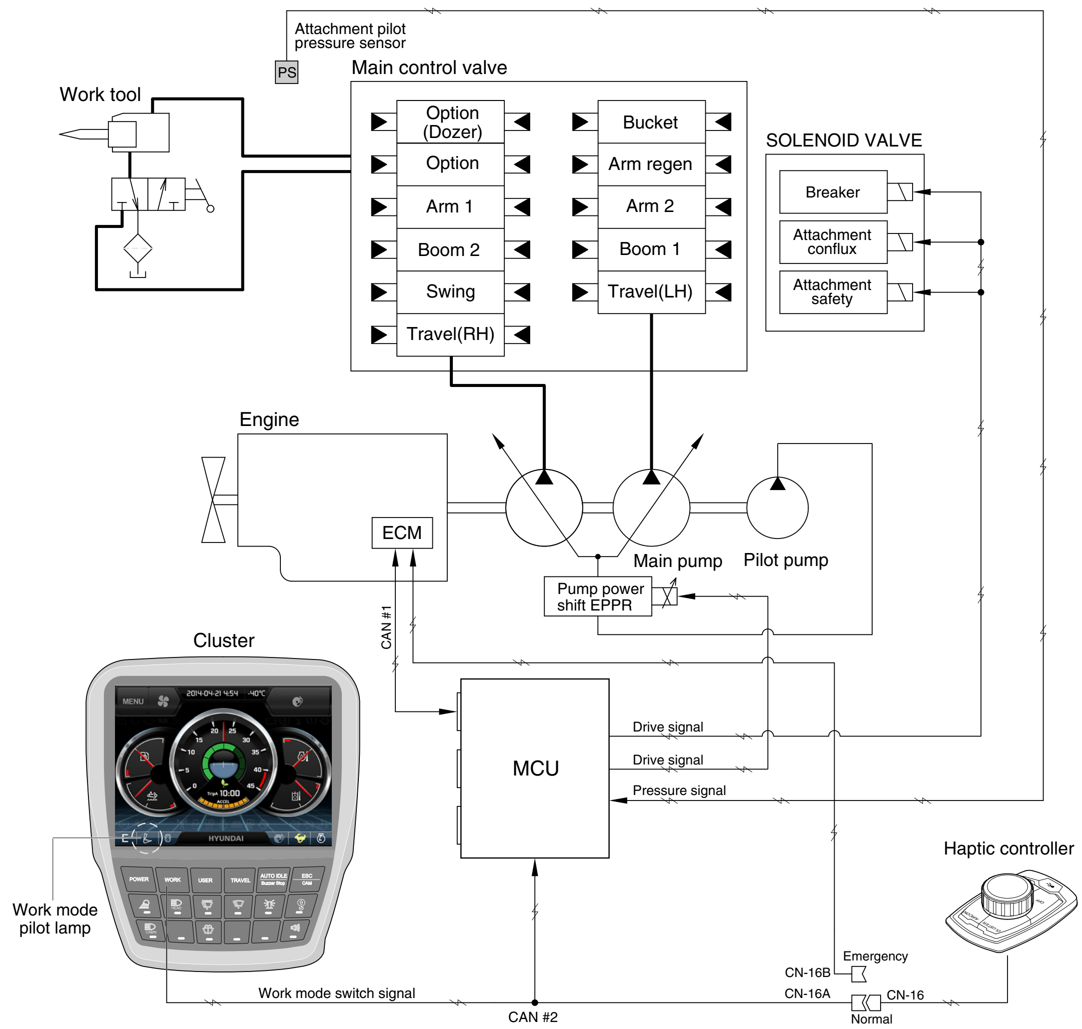
Mode selection system (micro computer based electro-hydraulic pump and engine mutual control system) optimizes the engine and pump performance.
The combination of 3 power modes (P, S, E) and acceleration mode (10 set) of haptic controller makes it possible to use the engine and pump power more effectively 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	1950±50	2050±50	2100±50	2050±50	280±30	10 (~5)	230±30	0
S	Standard power	1850±50	1950±50	2000±50	1950±50	305±30	13 (~8)±3	260±30	5±3
E	Economy operation	1750±50	1850±50	1750±50	1850±50	340±30	15 (~10)±3	340±30	10 (~5)±3
AUTO DECEL	Engine deceleration	1100±100	-	1100±100	-	700±30	38±3	700±30	38±3
One touch decel	Engine quick deceleration	1000±100	-	1000±100	-	700±30	38±3	700±30	38±3
KEY START	Key switch start position	1000±100	-	1000±100	-	700±30	38±3	700±30	38±3

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

2. WORK MODE SELECTION SYSTEM

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



140L5MS05

1) GENERAL WORK MODE (bucket)

This mode is used to general digging work.

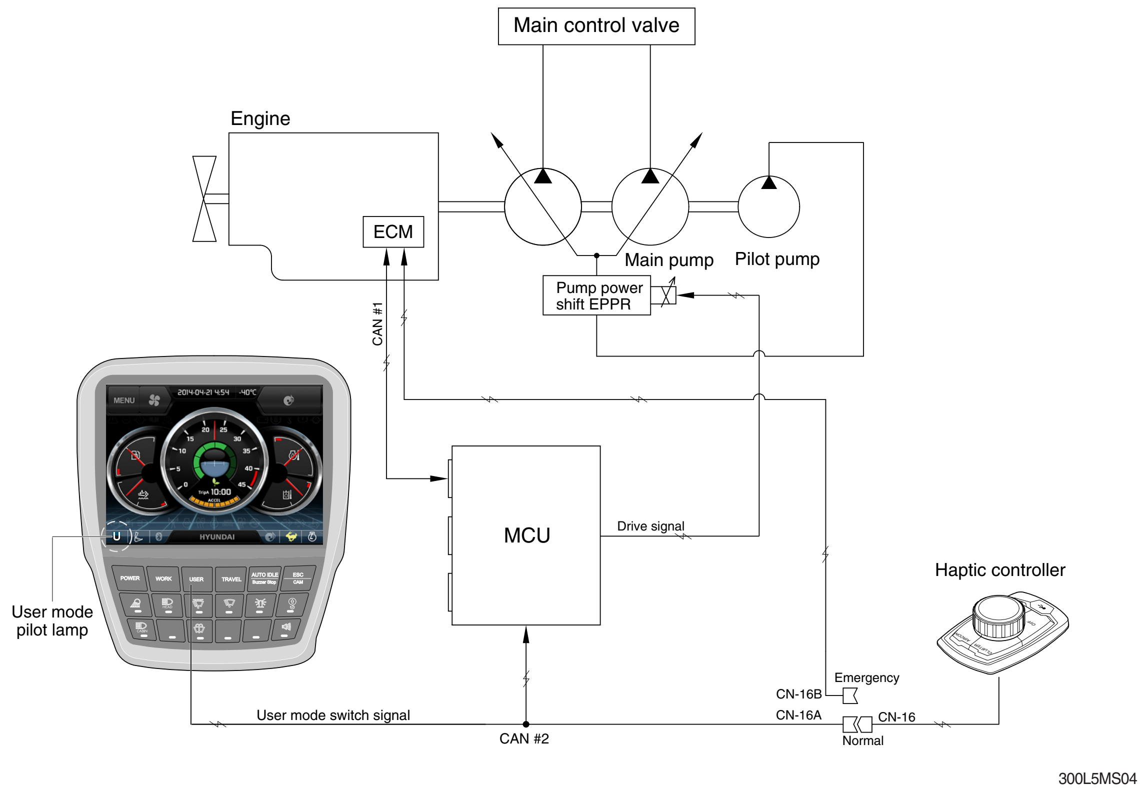
2) ATT WORK MODE (breaker, crusher)

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

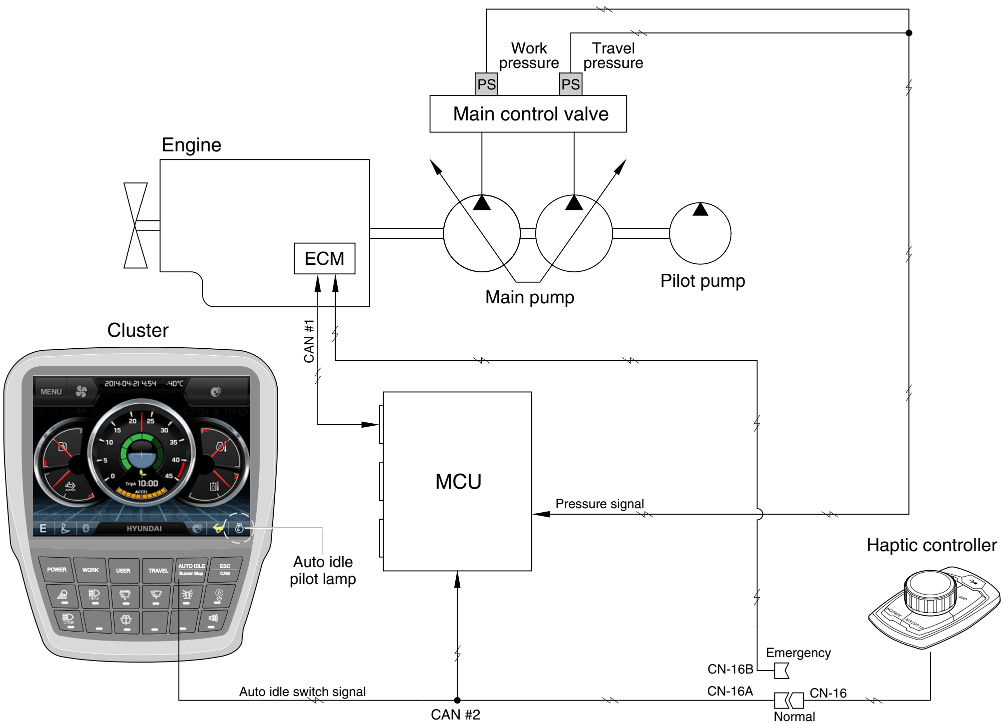


1) High idle rpm, auto idle rpm and EPPR pressure can be adjusted and memorized in the U-mode.

2) LCD segment vs parameter setting

Step (▮)	Engine speed (rpm)	Idle speed (rpm)	Power shift (bar)
1	1300	1000	0
2	1400	1030	3
3	1500	1050	6
4	1600	1080	9
5	1700	1100 (auto decel)	12
6	1800	1130	16
7	1850	1150	20
8	1900	1180	26
9	1950	1200	32
10	2000	1250	38

GROUP 3 AUTOMATIC DECELERATION SYSTEM

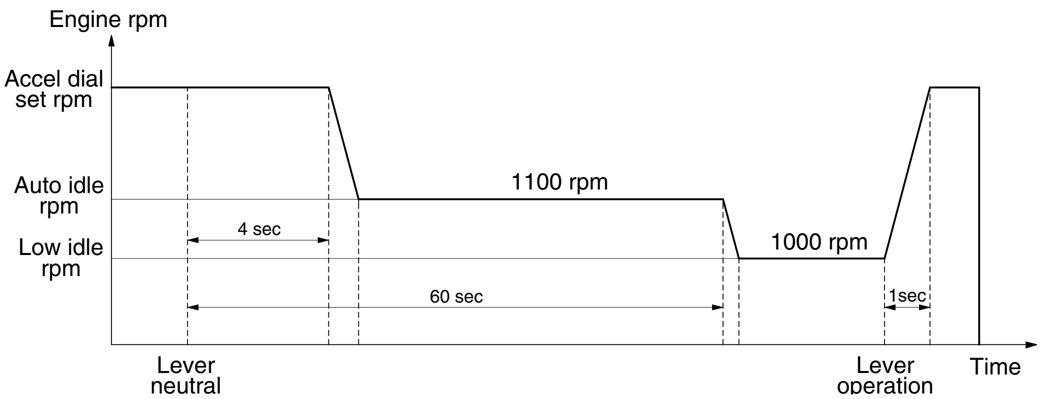


300L5MS05

1. WHEN AUTO IDLE PILOT LAMP ON

When all of the work equipment control levers including swing and travel levers are at neutral for 4 seconds, MCU sends throttle command to ECM to reduce the engine speed to 1100 rpm. If the control levers are at neutral for 1 minute, MCU reduces the engine speed to 1000 rpm. As the result of reducing the engine speed, fuel consumption and noise are effectively cut down during non-operation of the control levers.

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



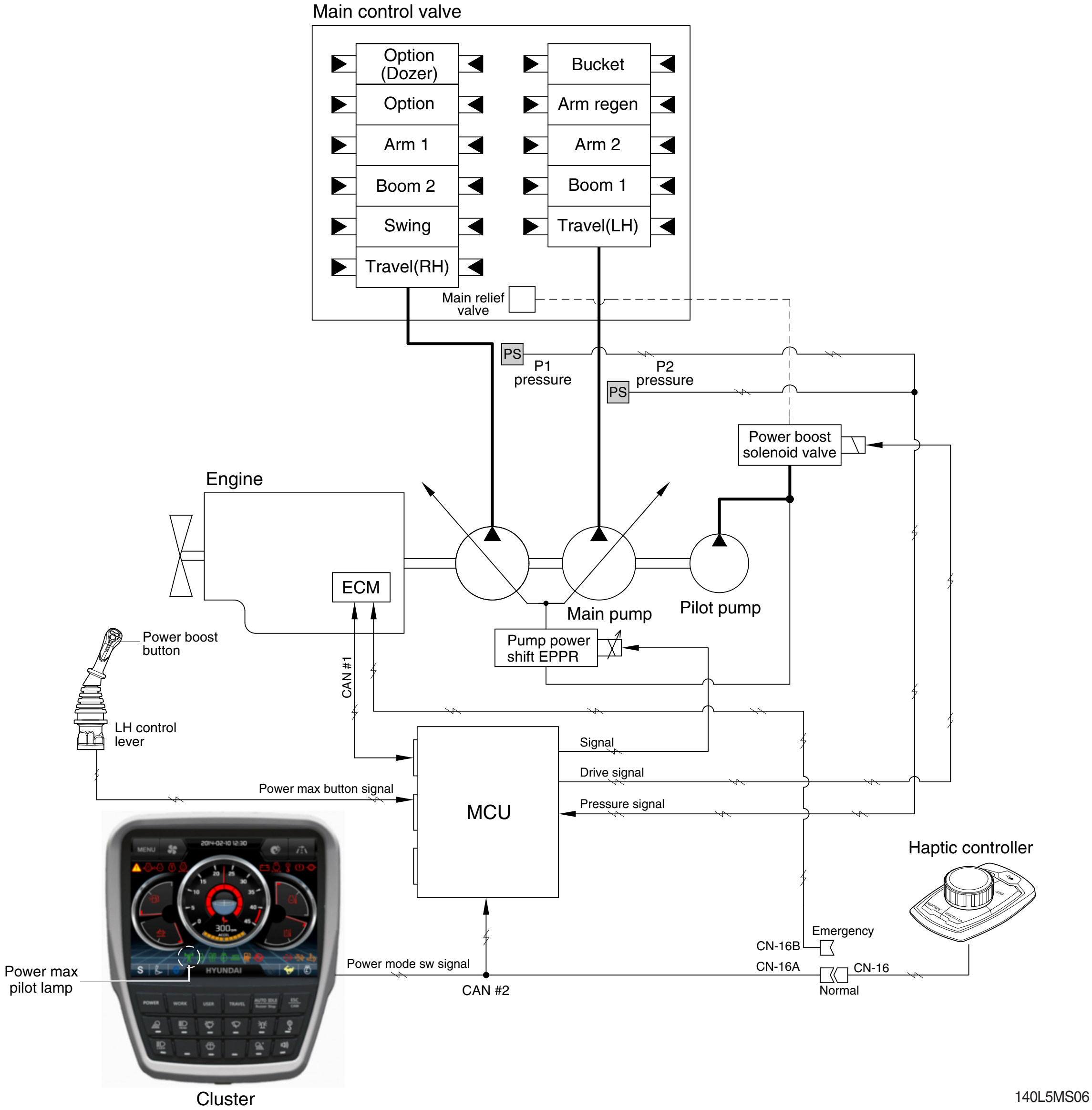
140L5MS01

2. WHEN AUTO IDLE PILOT LAMP OFF

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

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

GROUP 4 POWER BOOST SYSTEM



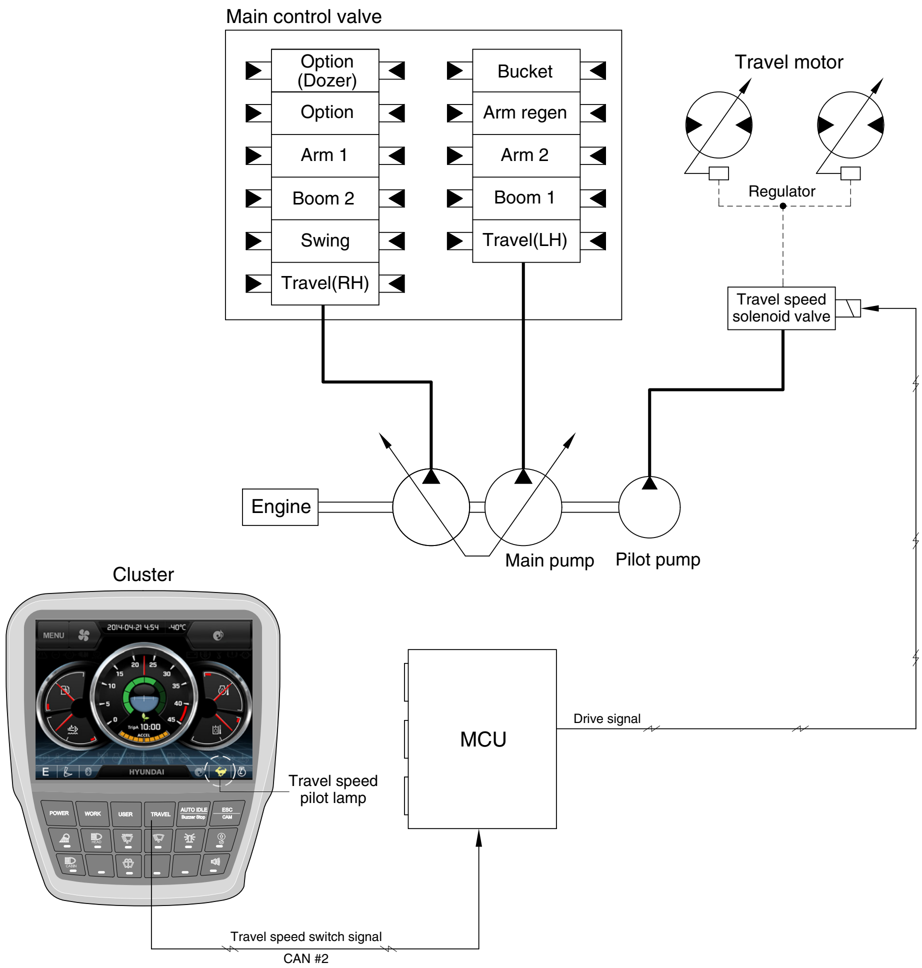
· When the power boost switch on the left control lever knob is pushed ON, the power mode is set P mode and maximum digging power is increased by 10 %.

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

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

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

GROUP 5 TRAVEL SPEED CONTROL SYSTEM



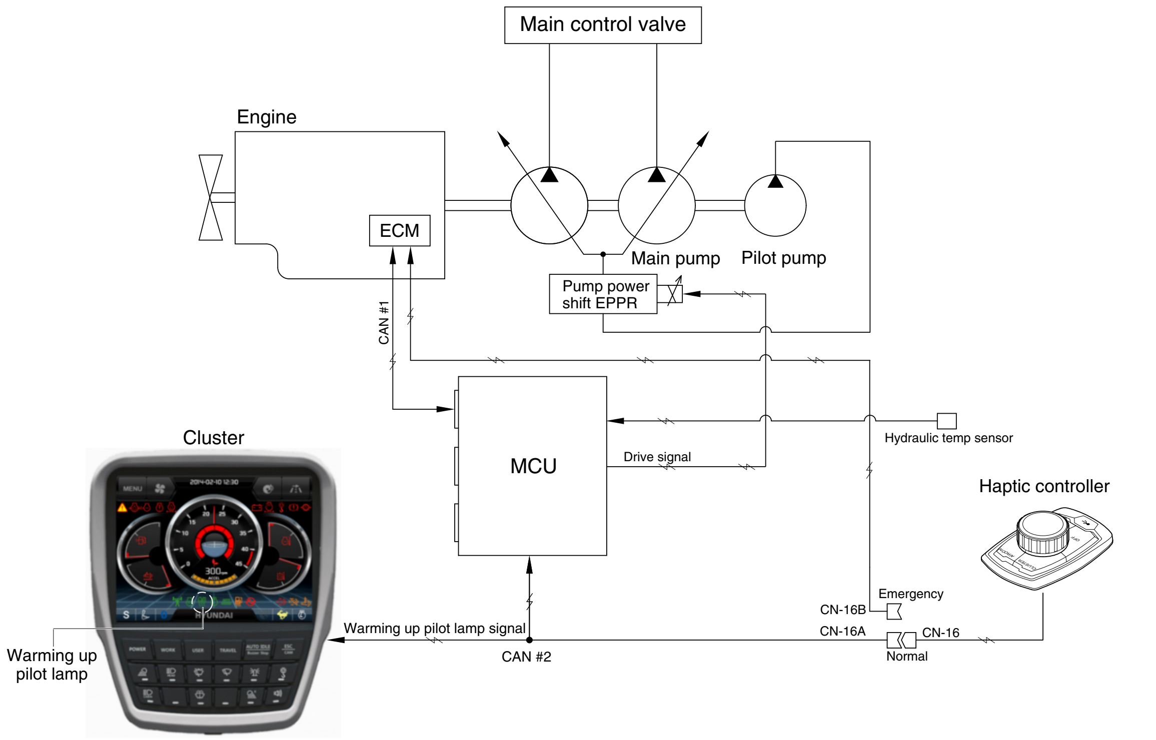
140L5MS07

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



300L5MS08

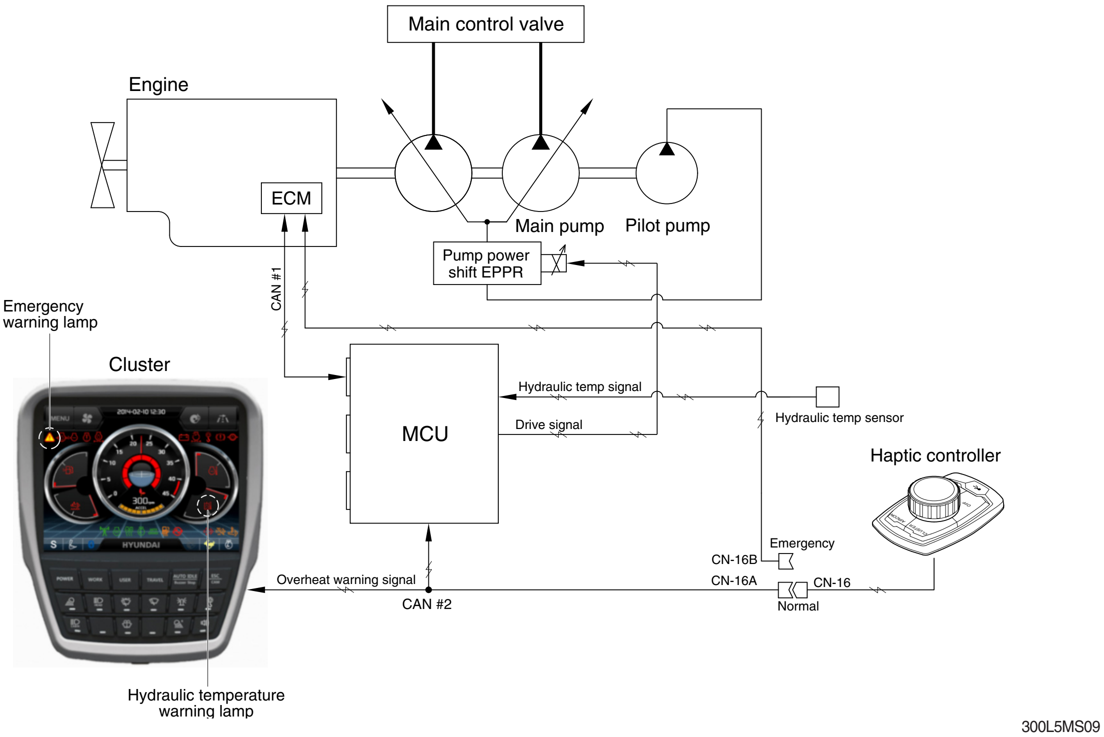
1. The MCU receives the engine coolant temperature from the ECM, and if the coolant temperature is below 30˚C, it increases the engine speed from key start rpm to 1100 rpm. At this time the mode does not change. If the coolant temperature sensor has fault, the hydraulic oil temperature signal is substituted.

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

3. LOGIC TABLE

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

GROUP 7 ENGINE OVERHEAT PREVENTION SYSTEM

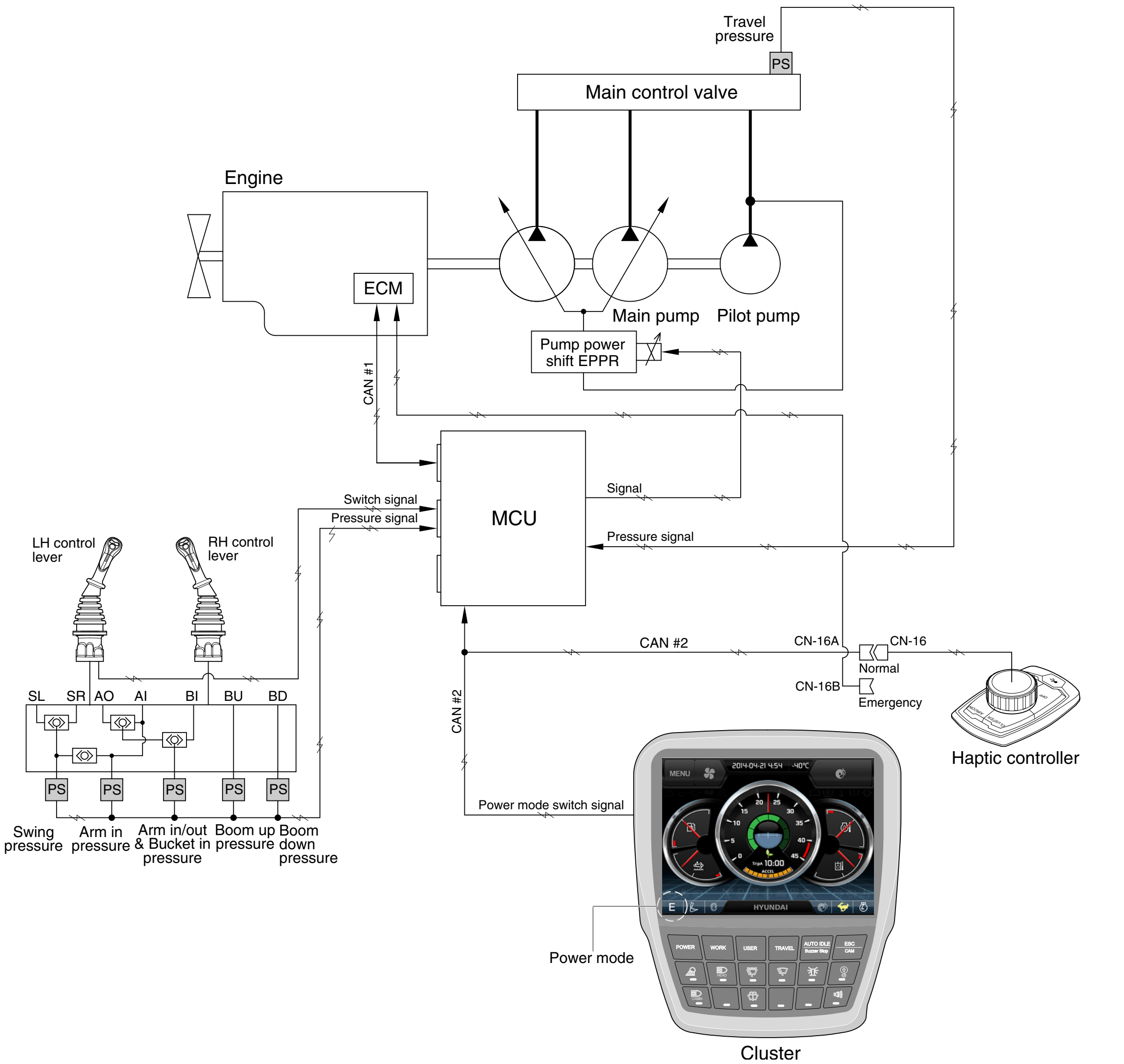


1. If the engine coolant temperature or the hydraulic oil temperature is overheated over 100˚C, the warning lamp is ON and the pump input torque or the engine speed is reduced as below logic table.

2. LOGIC TABLE

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

GROUP 8 VARIABLE POWER CONTROL SYSTEM

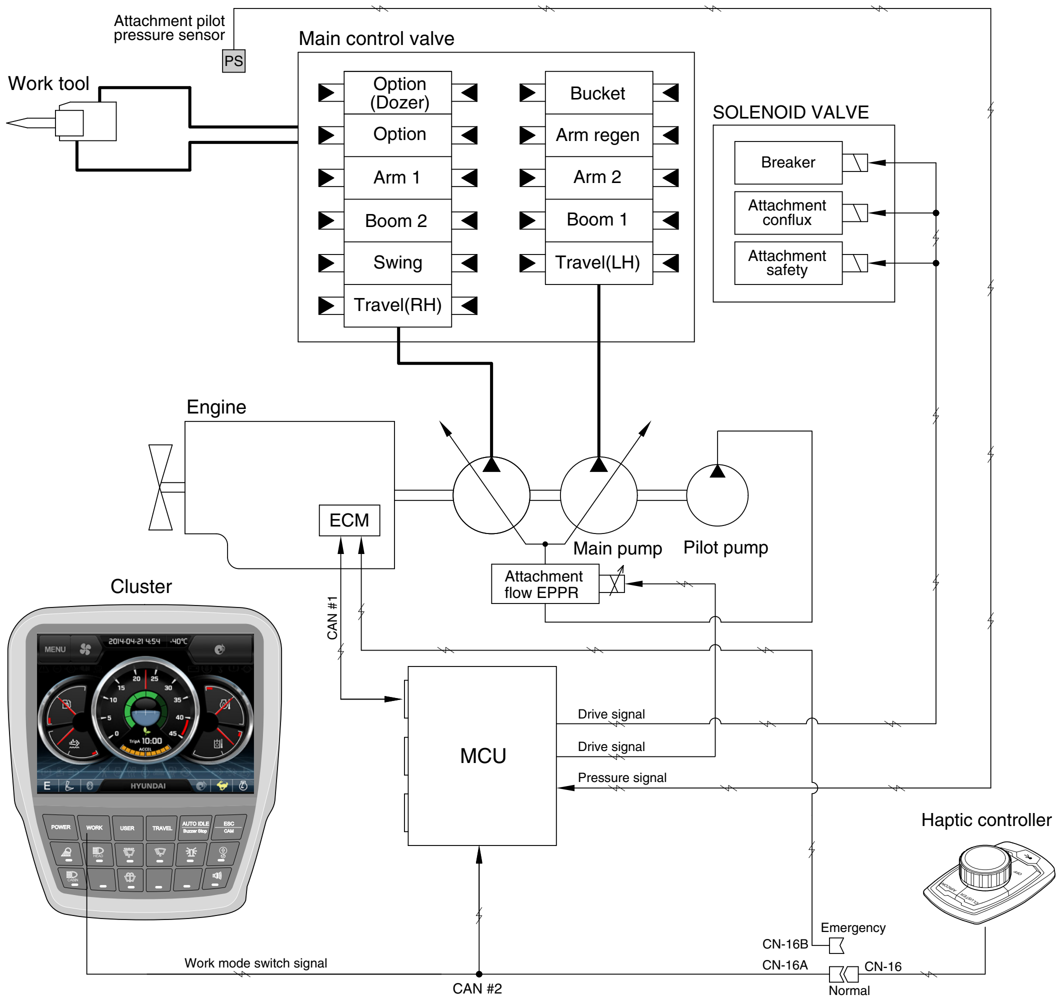


· The variable power control system controls the engine and pump mutual power according to RCV lever stroke and pump load.
It makes fuel saving and smooth control at precise work.

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



140L5MS11

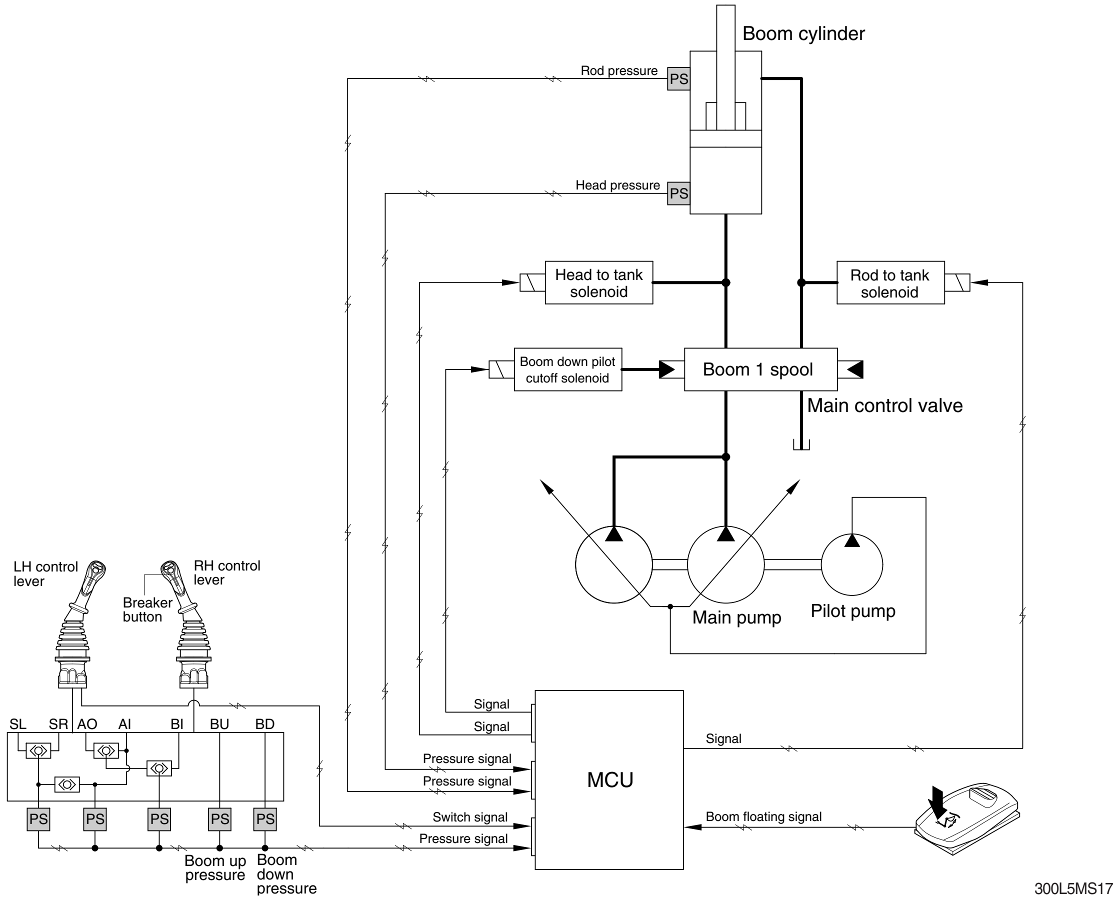
· The system is used to control the pump delivery flow according to set of the work tool on the cluster by the attachment flow EPPR valve.

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



300L5MS17

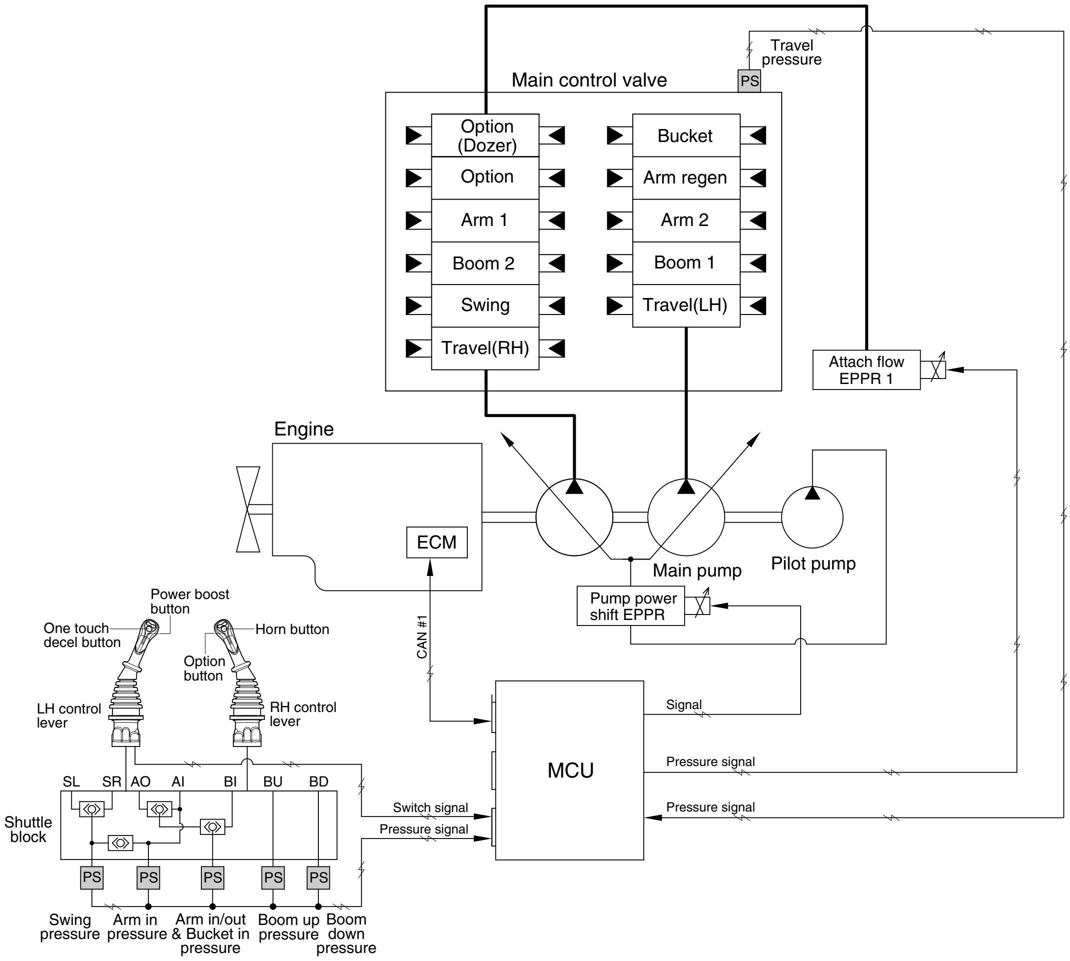
· Boom floating automatically controls boom cylinder along the ground by operating arm cylinder only.

Description		Condition	Function
Work mode★1	Floating mode		
General mode	Boom up floating★2	Floating mode sw : ON	Rod to tank solenoid : ON Head to tank solenoid : OFF Boom down cutoff solenoid : OFF
	Boom up/down floating★2	Floating mode sw : ON Breaker button : Pressed Boom down pilot pressure > 25 bar Boom up pilot pressure < 5 bar	Rod to tank solenoid : ON Head to tank solenoid : ON Boom down cutoff solenoid : ON
Breaker mode	Boom down floating	Floating mode sw : ON Breaker button : Pressed Boom down pilot pressure > 25 bar Boom up pilot pressure < 5 bar	Rod to tank solenoid : OFF Head to tank solenoid : ON Boom down cutoff solenoid : ON
Temporarily canceled		During operation of boom floating Boost sw : Pressed	Rod to tank solenoid : OFF Head to tank solenoid : OFF Boom down cutoff solenoid : OFF

★1 Boom floating is not activated when work mode is crusher mode.

★2 These functions are activated just in case the excavator is not in jack up status.

GROUP 11 INTELLIGENT POWER CONTROL SYSTEM



140L5MS18

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

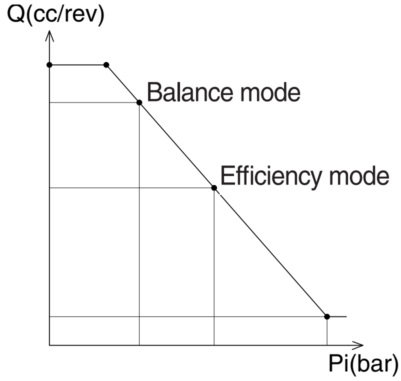
Condition★1	Function
IPC mode : ON★2 Boom up Arm in Not travel motion Not swing motion	Limitation of pump flow rate : Activated
None of upper condition	Limitation of pump flow rate : Canceled

★1 AND condition

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

2. IPC MODE SELECTION

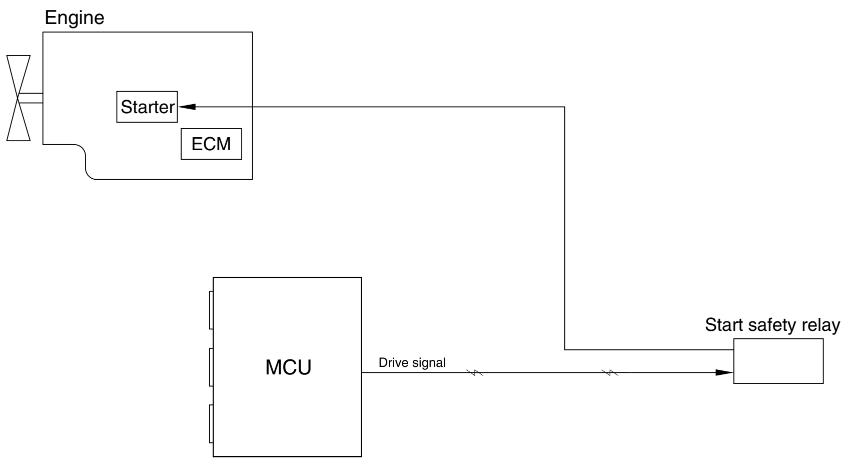
IPC mode ON/OFF and the levels of flow rate limit can be selected at "Mode setup > IPC mode"



290F3CD311

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 12 ANTI-RESTART SYSTEM



300L5MS12

1. ANTI-RESTART FUNCTION

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

GROUP 13 SELF-DIAGNOSTIC SYSTEM

1. OUTLINE

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

2. MONITORING

1) Active fault

290F3CD120

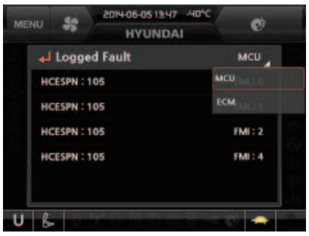
290F3CD121

290F3CD125

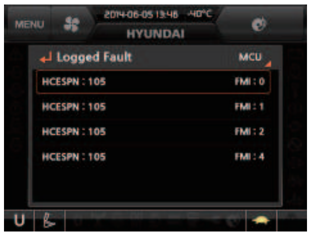
· The active faults of the MCU, engine ECM or air conditioner can be checked by this menu.

2) Logged fault

290F3CD128



290F3CD123

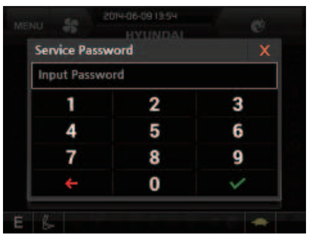


290F3CD124

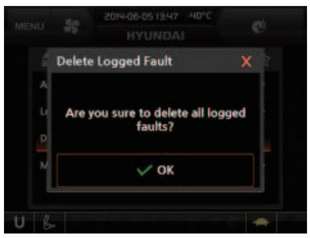
· The logged faults of the MCU, engine ECM or air conditioner can be checked by this menu.

3) Delete logged fault

290F3CD134



290F3CD126



290F3CD127

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

3. MACHINE ERROR CODES TABLE

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

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

<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 (#12) 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 (#16) 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-52 (#33) Checking Open/Short
2. CD-70 (#A) – CN-51 (#3) Checking Open/Short
3. CD-70 (#C) – CN-51 (#13) Checking Open/Short</td></tr>
<tr><td rowspan="4">124</td><td>0</td><td>10 seconds continuous, Negative 2 Press. Sensor Measurement Voltage > 5.2V</td><td>●</td><td></td><td></td></tr>
<tr><td>1</td><td>10 seconds continuous, 0.3V≤ Negative 2 Press. Sensor Measurement Voltage < 0.8V</td><td>●</td><td></td><td></td></tr>
<tr><td>4</td><td>10 seconds continuous, Negative 2 Press. Sensor Measurement Voltage < 0.3V</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Monitor – Negative 2 Press. display failure
2. Control Function – Option attachment flow control operation failure
(Checking list)
1. CD-71 (#B) – CN-52 (#17) Checking Open/Short
2. CD-71 (#A) – CN-51 (#3) Checking Open/Short
3. CD-71 (#C) – CN-51 (#13) Checking Open/Short</td></tr>
<tr><td rowspan="4">127</td><td>0</td><td>10 seconds continuous, Boom Up Pilot Press. Sensor Measurement Voltage > 5.2V</td><td>●</td><td></td><td></td></tr>
<tr><td>1</td><td>10 seconds continuous, 0.3V≤ Boom Up Pilot Press. Sensor Measurement Voltage < 0.8V</td><td>●</td><td></td><td></td></tr>
<tr><td>4</td><td>10 seconds continuous, Boom Up Pilot Press. Sensor Measurement < 0.3V</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Monitor – Boom Up Pilot Press. display failure
2. Control Function – Engine/Pump variable horse power control operation failure, IPC operation failure, Boom first operation failure
(Checking list)
1. CD-32 (#B) – CN-52 (#19) Checking Open/Short
2. CD-32 (#A) – CN-51 (#3) Checking Open/Short
3. CD-32 (#C) – CN-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

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

※ 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-53 (#14) Checking Open/Short 2. CD-69 (#A) – CN-53 (#3) Checking Open/Short 3. CD-69 (#C) – CN-53 (#13) Checking Open/Short				
139	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><td colspan="2">DTC</td><td rowspan="2">Diagnostic Criteria</td><td colspan="3">Application</td></tr>
<tr><td>HCESPN</td><td>FMI</td><td>G</td><td>C</td><td>W</td></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 (#10) Checking Open/Short</td></tr>
<tr><td rowspan="3">141</td><td>5</td><td>(Model Parameter) mounting Boom Priority EPPR
(Detection)
(When Boom Priority EPPR Current is more than 10 mA)
10 seconds continuous, Boom Priority EPPR drive current < 0 mA
(Cancellation)
(When Boom Priority EPPR Current is more than 10 mA)
3 seconds continuous, Boom Priority EPPR drive current ≥ 10 mA</td><td>●</td><td></td><td></td></tr>
<tr><td>6</td><td>(Detection)
10 seconds continuous, Boom Priority EPPR drive current > 1.0 A
(Cancellation)
3 seconds continuous, Boom Priority EPPR drive current ≤ 1.0 A</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Control Function – Boom first control operation failure
(Checking list)
1. CN-133 (#2) – CN-52 (#34) Checking Open/Short
2. CN-133 (#1) – CN-52 (#35) Checking Open/Short</td></tr>
</table>

※ 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	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	5	(Model Parameter) mounting Remote Cooling Fan EPPR (Detection) (When Remote Cooling Fan EPPR Current is more than 10 mA) 10 seconds continuous, Remote Cooling Fan EPPR drive current = 0 mA (Cancellation) (When Remote Cooling Fan EPPR Current is more than 10 mA) 3 seconds continuous, Remote Cooling Fan EPPR drive current ≥ 10 mA	●		
	6	(Detection) 10 seconds continuous, Remote Cooling Fan EPPR drive current > 1.0 A (Cancellation) 3 seconds continuous, Remote Cooling Fan EPPR drive current ≤ 1.0 A	●		
	(Results / Symptoms) 1. Control Function – Remote fan control operation failure (Checking list) 1. CD-52 (#1) – CN-51 (#9) Checking Open/Short 2. CD-52 (#2) – 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</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) – CN-45 (#B+ term) 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) – CN-45 (#B+ term) 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">167</td><td rowspan="2">4</td><td>(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</td><td></td><td>●</td><td></td></tr>
<tr><td>(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</td><td></td><td></td><td>●</td></tr>
<tr><td>6</td><td>(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</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Control Function – driving in 1/2 transmission operation failure
(Checking list)
1. CN-70 (#1) – CN-52(#20) Checking Open/Short
2. CN-70 (#2) – CN-45(#B+ term) 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">169</td><td>4</td><td>Monitor – Selecting attachment(breaker / crusher)
(Detection)
(When Attachment Conflux Solenoid is Off)
10 seconds continuous, Attachment Conflux Solenoid drive unit Measurement Voltage ≤ 3.0V
(Cancellation)
(When Attachment Conflux Solenoid is Off)
3 seconds continuous, Attachment Conflux Solenoid drive unit Measurement Voltage > 3.0V</td><td>●</td><td></td><td></td></tr>
<tr><td>6</td><td>(Detection)
(When Attachment Conflux Solenoid is On)
10 seconds continuous, Attachment Conflux Solenoid drive Current > 6.5 A
(Cancellation)
(When Attachment Conflux Solenoid is On)
3 seconds continuous, Attachment Conflux Solenoid drive Current ≤ 6.5 A</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(Results / symptoms)
1. Control Function – Option attachment flow control – Joining operation failure
(Eco breaker mode, crusher mode)
(Checking list)
1. CD-237 (#1) – CN-53 (#7) Checking Open/Short
2. CD-237 (#2) – CR-35 (#87) Checking Open/Short</td></tr>
<tr><td rowspan="3">170</td><td>4</td><td>(Model Parameter) mounting Arm Regenerating Solenoid
(Detection)
(When Arm Regeneration Solenoid is Off)
10 seconds continuous, Arm Regeneration Solenoid drive unit Measurement Voltage ≤ 3.0V
(Cancellation)
(When Arm Regeneration Solenoid is Off)
3 seconds continuous, Arm Regeneration Solenoid drive unit Measurement Voltage > 3.0V</td><td>●</td><td></td><td></td></tr>
<tr><td>6</td><td>(Detection)
(When Arm Regeneration Solenoid is On)
10 seconds continuous, Arm Regeneration Solenoid drive current > 4.5 A
(Cancellation)
(When Arm Regeneration Solenoid is On)
3 seconds continuous, Arm Regeneration Solenoid drive current ≤ 4.5 A</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(Detection)
(When Arm Regeneration Solenoid is On)
10 seconds continuous, Arm Regeneration Solenoid drive current > 4.5 A
(Cancellation)
(When Arm Regeneration Solenoid is On)
3 seconds continuous, Arm Regeneration Solenoid drive current ≤ 4.5 A</td></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">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. CD-149 (#1) – CN-53 (#8) Checking Open/Short
2. CD-149 (#2) – CR-35 (#87) 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. CD-66 (#1) – CN-53 (#9) Checking Open/Short
2. CD-66 (#2) – CN-45 (#B+ term) Checking Open/Short
3. CD-66 (#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
181	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 (#39) Checking Open/Short 2. CN-242 (#1) – CN-52 (#40) 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">189</td><td>5</td><td>(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</td><td>●</td><td></td><td></td></tr>
<tr><td>6</td><td>(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</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Control Function – Option attachment flow control operation failure
(Checking list)
1. CN-243 (#2) – CN-52 (#6) Checking Open/Short
2. CN-243 (#1) – CN-52 (#7) Checking Open/Short</td></tr>
<tr><td rowspan="4">196</td><td>0</td><td>HW145
10 seconds continuous,
Attachment flow control EPPR 1 press. Sensor Measurement Voltage > 5.2V</td><td></td><td></td><td></td></tr>
<tr><td>1</td><td>HW145
10 seconds continuous,
0.3V≤ Attachment flow control EPPR 1 press. Sensor Measurement Voltage < 0.8V</td><td></td><td></td><td></td></tr>
<tr><td>4</td><td>HW145
10 seconds continuous,
Attachment flow control EPPR 1 press. Sensor Measurement Voltage < 0.3V</td><td></td><td></td><td></td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Control Function – Driving second pump joining function operation failure
(Checking list)
1. CD-33 (#B) – CN-52 (#11) Checking Open/Short
2. CD-33 (#A) – CN-51 (#3) Checking Open/Short
3. CD-33 (#C) – CN-51 (#13) Checking Open/Short</td></tr>
<tr><td rowspan="4">200</td><td>0</td><td>10 seconds continuous, Pump EPPR Press. Sensor Measurement Voltage > 5.2V</td><td>●</td><td></td><td></td></tr>
<tr><td>1</td><td>10 seconds continuous, 0.3V≤ Pump EPPR Press. Sensor Measurement Voltage < 0.8V</td><td>●</td><td></td><td></td></tr>
<tr><td>4</td><td>10 seconds continuous, Pump EPPR Press. Sensor Measurement Voltage < 0.3V</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(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</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">205</td><td>0</td><td>(Mounting pressure sensor)
10 seconds continuous, Boom Cylinder Rod Press. Sensor Measurement Voltage > 5.2V</td><td>●</td><td></td><td></td></tr>
<tr><td>1</td><td>(Mounting pressure sensor)
10 seconds continuous, 0.3V≤ Boom Cylinder Rod Press. Sensor Measurement Voltage < 0.8V</td><td>●</td><td></td><td></td></tr>
<tr><td>4</td><td>(Mounting pressure sensor)
10 seconds continuous, Boom Cylinder Rod Press. Sensor Measurement Voltage < 0.3V</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Monitor – Boom Cylinder Rod Press. display failure
2. Control Function – Boom floating control operation failure
(Checking list)
1. CD-124 (#B) – CN-53 (#5) Checking Open/Short
2. CD-124 (#A) – CN-53 (#3) Checking Open/Short
3. CD-124 (#C) – CN-53 (#13) Checking Open/Short</td></tr>
<tr><td rowspan="3">218</td><td>4</td><td>Mounting pressure sensor (HCESPN128 or HCESPN 205)
(Detection)
(When Boom Up Floating Solenoid is Off)
10 seconds continuous, Boom Up Floating Solenoid drive unit Measurement Voltage ≤ 3.0V
(Cancellation)
(When Boom Up Floating Solenoid is Off)
3 seconds continuous, Boom Up Floating Solenoid drive unit Measurement Voltage > 3.0V</td><td>●</td><td></td><td></td></tr>
<tr><td>6</td><td>(Detection)
(When Boom Up Floating Solenoid is On)
10 seconds continuous, Boom Up Floating Solenoid drive current > 6.5 A
(Cancellation)
(When Boom Up Floating Solenoid is On)
3 seconds continuous, Boom Up Floating Solenoid drive current ≤ 6.5 A</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Control Function – Boom floating control operation failure
(Checking list)
1. CD-368 (#1) – CN-53 (#20) Checking Open/Short
2. CD-368 (#2) – CR-35 (#87) Checking Open/Short</td></tr>
</table>

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

DTC		Diagnostic Criteria	Application		
HCESPN	FMI		G	C	W
220	4	Mounting pressure sensor (HCESPN 128 or 205) (Detection) (When Boom Down Pilot Pressure Cutoff Solenoid is Off) 10 seconds continuous, Boom Down Pilot Pressure Cutoff Solenoid drive unit Measurement Voltage ≤ 3.0V (Cancellation) (When Boom Down Pilot Pressure Cutoff Solenoid is Off) 3 seconds continuous, Boom Down Pilot Pressure Cutoff Solenoid drive unit Measurement Voltage > 3.0V	●		
	6	(Detection) (When Boom Down Pilot Pressure Cutoff Solenoid is On) 10 seconds continuous, Boom Down Pilot Pressure Cutoff Solenoid drive current > 6.5 A (Cancellation) (When Boom Down Pilot Pressure Cutoff Solenoid is On) 3 seconds continuous, Boom Down Pilot Pressure Cutoff Solenoid drive current ≤ 6.5 A	●		
	(Results / Symptoms) 1. Control Function – Boom floating control operation failure (Checking list) 1. CD-369 (#1) – CN-53 (#35) Checking Open/Short 2. CD-369 (#2) – CR-35 (#87) Checking Open/Short				
221	5	Monitor – Selecting attachment(breaker / crusher) (Detection) (When ATT Relief Setting EPPR 1 Current is equal or more than 10 mA) 10 seconds continuous, ATT Relief Setting EPPR 1 drive current = 0 mA (Cancellation) ATT Relief Setting EPPR 1 Current is equal or more than 10 mA) 3 seconds continuous, ATT Relief Setting EPPR 1 drive current ≥ 10 mA	●		
	6	(Detection) 10 seconds continuous, ATT Relief Setting EPPR 1 drive current > 1.0 A (Cancellation) 3 seconds continuous, ATT Relief Setting EPPR 1 drive current ≤ 1.0 A	●		
	(Results / Symptoms) 1. Control Function – Option attachment flow control – P1 relief pressure setting failure (Checking list) 1. CD-365 (#2) – CN-53 (#39) Checking Open/Short 2. CD-365 (#1) – CN-53 (#40) Checking Open/Short				

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

DTC		Diagnostic Criteria	Application		
HCESPN	FMI		G	C	W
222	5	Monitor – Selecting attachment(crusher) (Detection) (When ATT Relief Setting EPPR 2 Current is equal or more than 10 mA) 10 seconds continuous, ATT Relief Setting EPPR 2 drive current = 0 mA (Cancellation) (When ATT Relief Setting EPPR 2 Current is equal or more than 10 mA) 3 seconds continuous, ATT Relief Setting EPPR 2 drive current ≥ 10mA	●		
	6	(Detection) 10 seconds continuous, ATT Relief Setting EPPR 2 drive current > 1.0 A (Cancellation) 3 seconds continuous, ATT Relief Setting EPPR 2 drive current ≤ 1.0 A	●		
	(Results / Symptoms) 1. Control Function – Option attachment flow control – P2 relief pressure setting failure (Checking list) 1. CD-366 (#2) – CN-53 (#32) Checking Open/Short 2. CD-366 (#1) – CN-53 (#33) Checking Open/Short				
301	3	10 seconds continuous, Fuel Level Measurement Voltage > 3.8V	●		
	4	10 seconds continuous, Fuel Level Measurement Voltage < 0.3V	●		
	(Results / Symptoms) 1. Monitor – Fuel remaining display failure (Checking list) 1. CD-2 (#2) – CN-52 (#26) Checking Open/Short 2. CD-2 (#1) – CN-51 (#5) Checking Open/Short				
325	4	(Model Parameter) mounting Fuel Warmer Relay (Detection) (When Fuel Warmer Relay is Off) 10 seconds continuous, Fuel Warmer Relay drive unit Measurement Voltage ≤ 3.0V (Cancellation) (When Fuel Warmer Relay is Off) 3 seconds continuous, Fuel Warmer Relay drive unit Measurement Voltage > 3.0V	●		
	6	(Detection) (When Fuel Warmer Relay is On) 10 seconds continuous, Fuel Warmer Relay drive current > 4.5 A (Cancellation) (When Fuel Warmer Relay is On) 3 seconds continuous, Fuel Warmer Relay drive current ≤ 4.5 A	●		
	(Results / Symptoms) 1. Control Function – Fuel warmer operation failure (Checking list) 1. CR-46 (#85) – CN-52 (#30) Checking Open/Short 2. CR-46 (#86) – CN-45 (#B+ term) Checking Open/Short				

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

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

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

DTC		Diagnostic Criteria	Application		
HCESPN	FMI		G	C	W
514	4	(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			●
	6	(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			●
	(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) – CN-45 (#B+ term) Checking Open/Short				
517	4	(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			●
	6	(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			●
	(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) – CN-45 (#B+ term) 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">525</td><td>4</td><td>(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</td><td></td><td></td><td>●</td></tr>
<tr><td>6</td><td>(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</td><td></td><td></td><td>●</td></tr>
<tr><td colspan="5">(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) – CN-45 (#B+ term) Checking Open/Short</td></tr>
<tr><td rowspan="3">527</td><td>4</td><td>(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</td><td></td><td></td><td>●</td></tr>
<tr><td>6</td><td>(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</td><td></td><td></td><td>●</td></tr>
<tr><td colspan="5">(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) – CN-45 (#B+ term) 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
530	0	10 seconds continuous, Travel Forward Press. Sensor Measurement Voltage > 5.2V			●
	1	10 seconds continuous, 0.3V≤ Travel Forward Press. Sensor Measurement Voltage < 0.8V			●
	4	10 seconds continuous, Travel Forward Press. Sensor Measurement Voltage < 0.3V			●
		(Results / Symptoms) 1. Monitor – Travel Forward Press. display failure 2. Control Function – Driving interoperability power control operation failure (Checking list) 1. CD-73 (#B) – CN-54 (#6) Checking Open/Short 2. CD-73 (#A) – CN-54 (#3) Checking Open/Short 3. CD-73 (#C) – CN-54 (#13) Checking Open/Short			
531	1	10 seconds continuous, 0.3V≤ Travel Reverse Press. Sensor Measurement Voltage < 0.8V			●
	4	10 seconds continuous, Travel Reverse Press. Sensor Measurement Voltage < 0.3V			●
		(Results / Symptoms) 1. Monitor – Travel Reverse Press. display failure 2. Control Function – Driving interoperability power control operation failure (Checking list) 1. CD-74 (#B) – CN-54 (#23) Checking Open/Short 2. CD-74 (#A) – CN-54 (#3) Checking Open/Short 3. CD-74 (#C) – CN-54 (#13) Checking Open/Short			
705	0	10 seconds continuous, Battery input Voltage > 35V	●		
	1	10 seconds continuous, Battery input Voltage < 18V	●		
		(Results / Symptoms) 1. Control Function – Startup impossibility (Checking list) 1. CS-74A (#1) – CN-51 (#1) Checking Open/Short			
707	1	(When Engine is equal or more than 400 rpm) 10 seconds continuous, Alternator Node L Measurement Voltage < 18V (In case 12v goods, Alternator Node L 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-7 (#15) – 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 (#31) Checking Open/Short
2. CN-81 (#2) – CN-45 (#B+ term) 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 (#22) Checking Open/Short
2. CN-56A (#6) – 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

DTC		Diagnostic Criteria	Application		
HCESPN	FMI		G	C	W
841	2	10 seconds continuous, ECM Communication Data Error	●		
		(Results / Symptoms) 1. Control Function – ECM operation failure (Checking list) 1. CN-93 (#25) – CN-51 (#21) Checking Open/Short 2. CN-93 (#26) – CN-51 (#31) Checking Open/Short			
845	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	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-125 (#3) – CN-51 (#22) Checking Open/Short 2. CN-125 (#11) – CN-51 (#32) Checking Open/Short			
861	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-54 (#21) – CN-51 (#23) Checking Open/Short 2. CN-54 (#31) – CN-51 (#33) Checking Open/Short			

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

<table>
<tr><th colspan="2">DTC</th><th rowspan="2">Diagnostic Criteria</th><th colspan="3">Application</th></tr>
<tr><th>HCESPN</th><th>FMI</th><th>G</th><th>C</th><th>W</th></tr>
<tr><td rowspan="2">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-56A (#7) – CN-51 (#22) Checking Open/Short
2. CN-56A (#6) – CN-51 (#32) 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

J1939 Code	Description	Refer to Procedure
27-3	Engine Exhaust Gas Recirculation Valve Position Sensor : Voltage Above Normal	Valve Position Sensor - Test
27-4	Engine Exhaust Gas Recirculation Valve Position Sensor : Voltage Below Normal	Valve Position Sensor - Test
29-2	Accelerator Pedal Position 2 : Erratic, Intermittent, or Incorrect (Engines equipped with a throttle switch)	Throttle Switch Circuit - Test
29-2	Accelerator Pedal Position 2 : Erratic, Intermittent or Incorrect (Engines equipped with an analog throttle)	Analog Throttle Position Sensor Circuit - Test
29-3	Accelerator Pedal Position 2 : Voltage Above Normal (Engines equipped with an analog throttle)	Analog Throttle Position Sensor Circuit - Test
29-3	Accelerator Pedal Position 2 : Voltage Above Normal (Engines equipped with a digital throttle)	Digital Throttle Position Sensor Circuit - Test
29-4	Accelerator Pedal Position 2 : Voltage Below Normal (Engines equipped with an analog throttle)	Analog Throttle Position Sensor Circuit - Test
29-4	Accelerator Pedal Position 2 : Voltage Below Normal (Engines equipped with a digital throttle)	Digital Throttle Position Sensor Circuit - Test

※ Some fault codes are not applied to this machine.

J1939 Code	Description	Refer to Procedure
29-8	Accelerator Pedal Position 2 : Abnormal Frequency, Pulse Width or Period	Digital Throttle Position Sensor Circuit - Test
91-2	Accelerator Pedal Position 1 : Erratic, Intermittent, or Incorrect (Engines equipped with a throttle switch)	Throttle Switch Circuit - Test
91-2	Accelerator Pedal Position 1 : Erratic, Intermittent or Incorrect (Engines equipped with an analog throttle)	Analog Throttle Position Sensor Circuit - Test
91-3	Accelerator Pedal Position 1 : Voltage Above Normal (Engines equipped with an analog throttle)	Analog Throttle Position Sensor Circuit - Test
91-3	Accelerator Pedal Position 1 : Voltage Above Normal (Engines equipped with a digital throttle)	Digital Throttle Position Sensor Circuit - Test
91-4	Accelerator Pedal Position 1 : Voltage Below Normal (Engines equipped with an analog throttle)	Analog Throttle Position Sensor Circuit - Test
91-4	Accelerator Pedal Position 1 : Voltage Below Normal (Engines equipped with a digital throttle)	Digital Throttle Position Sensor Circuit - Test
91-8	Accelerator Pedal Position 1 : Abnormal Frequency, Pulse Width or Period	Digital Throttle Position Sensor Circuit - Test

※ Some fault codes are not applied to this machine.

J1939 Code	Description	Refer to Procedure
97-3	Water In Fuel Indicator : Voltage Above Normal	Water in Fuel - Test
97-15	Water In Fuel Indicator : High - least severe (1)	Fuel System Water Separator Has Water
97-16	Water In Fuel Indicator : High - moderate severity (2)	Fuel System Water Separator Has Water
98-1	Engine Oil Level : Low - most severe (3)	Oil Level Is Low
98-18	Engine Oil Level : Low - moderate severity (2)	Oil Level Is Low
100-1	Engine Oil Pressure : Low - most severe (3)	Low Engine Oil Pressure
100-3	Engine Oil Pressure : Voltage Above Normal	Engine Pressure Sensor Open or Short Circuit - Test
100-4	Engine Oil Pressure : Voltage Below Normal	Engine Pressure Sensor Open or Short Circuit - Test
100-17	Engine Oil Pressure : Low - least severe (1)	Low Engine Oil Pressure

※ Some fault codes are not applied to this machine.

J1939 Code	Description	Refer to Procedure
100-18	Engine Oil Pressure : Low - moderate severity (2)	Oil Pressure Is Low
100-21	Engine Oil Pressure : Data Drifted Low	5 V Sensor Supply Circuit - Test
102-16	Engine Intake Manifold #1 Pressure : High - moderate severity (2)	Intake Manifold Air Pressure Is High
102-18	Engine Intake Manifold #1 Pressure : Low - moderate severity (2)	Intake Manifold Air Pressure Is Low
105-0	Engine Intake Manifold #1 Temperature : High - most severe (3)	Intake Manifold Air Temperature Is High
105-3	Engine Intake Manifold #1 Temperature : Voltage Above Normal	Engine Temperature Sensor Open or Short Circuit - Test (Passive Sensors)
105-4	Engine Intake Manifold #1 Temperature : Voltage Below Normal	Engine Temperature Sensor Open or Short Circuit - Test (Passive Sensors)
105-15	Engine Intake Manifold #1 Temperature : High - least severe (1)	Intake Manifold Air Temperature Is High

※ Some fault codes are not applied to this machine.

J1939 Code	Description	Refer to Procedure
105-16	Engine Intake Manifold #1 Temperature : High - moderate severity (2)	Intake Manifold Air Temperature Is High
107-3	Engine Air Filter 1 Differential Pressure : High - Voltage Above Normal	Sensor Signal (Analog, Active) - Test
107-4	Engine Air Filter 1 Differential Pressure : High - Voltage Below Normal	Sensor Signal (Analog, Active) - Test
107-15	Engine Air Filter 1 Differential Pressure : High - least severe (1)	Inlet Air Is Restricted
107-16	Engine Air Filter 1 Differential Pressure : High - moderate severity (2)	Inlet Air Is Restricted
108-3	Barometric Pressure : Voltage Above Normal	Engine Pressure Sensor Open or Short Circuit - Test
108-4	Barometric Pressure : Voltage Below Normal	Engine Pressure Sensor Open or Short Circuit - Test
108-21	Barometric Pressure : Data Drifted Low	5 V Sensor Supply Circuit - Test

※ Some fault codes are not applied to this machine.

J1939 Code	Description	Refer to Procedure
110-0	Engine Coolant Temperature : High - most severe (3)	Coolant Temperature Is Too High
110-3	Engine Coolant Temperature : Voltage Above Normal	Engine Temperature Sensor Open or Short Circuit - Test (Passive Sensors)
110-4	Engine Coolant Temperature : Voltage Below Normal	Engine Temperature Sensor Open or Short Circuit - Test (Passive Sensors)
110-15	Engine Coolant Temperature : High - least severe (1)	Coolant Temperature Is Too High
110-16	Engine Coolant Temperature : High - moderate severity (2)	Coolant Temperature Is Too High
111-1	Engine Coolant Level : Low - most severe (3)	Coolant Level Is Low
111-18	Engine Coolant Level : Low - moderate severity (2)	Coolant Level Is Low
157-3	Engine Injector Metering Rail #1 Pressure : Voltage Above Normal	Engine Pressure Sensor Open or Short Circuit - Test

※ Some fault codes are not applied to this machine.

J1939 Code	Description	Refer to Procedure
157-4	Engine Injector Metering Rail #1 Pressure : Voltage Below Normal	Engine Pressure Sensor Open or Short Circuit - Test
157-15	Engine Injector Metering Rail #1 Pressure : High - least severe (1)	Fuel Rail Pressure Problem
157-16	Engine Injector Metering Rail #1 Pressure : High - moderate severity (2)	Fuel Rail Pressure Problem
157-17	Engine Injector Metering Rail #1 Pressure : Low - least severe (1)	Fuel Rail Pressure Problem
157-18	Engine Injector Metering Rail #1 Pressure : Low - moderate severity (2)	Fuel Rail Pressure Problem
168-2	Battery Potential / Power Input 1 : Erratic, Intermittent or Incorrect	Ignition Keyswitch Circuit and Battery Supply Circuit - Test
168-3	Battery Potential / Power Input 1 : Voltage Above Normal	Ignition Keyswitch Circuit and Battery Supply Circuit - Test
168-4	Battery Potential / Power Input 1 : Voltage Below Normal	Ignition Keyswitch Circuit and Battery Supply Circuit - Test

※ Some fault codes are not applied to this machine.

J1939 Code	Description	Refer to Procedure
172-3	Engine Air Inlet Temperature : Voltage Above Normal	Engine Temperature Sensor Open or Short Circuit - Test (Passive Sensors)
172-4	Engine Air Inlet Temperature : Voltage Below Normal	Engine Temperature Sensor Open or Short Circuit - Test (Passive Sensors)
174-3	Engine Fuel Temperature 1 : Voltage Above Normal	Engine Temperature Sensor Open or Short Circuit - Test (Passive Sensors)
174-4	Engine Fuel Temperature 1 : Voltage Below Normal	Engine Temperature Sensor Open or Short Circuit - Test (Passive Sensors)
174-15	Engine Fuel Temperature 1 : High - least severe (1)	Fuel Temperature Is High
174-16	Engine Fuel Temperature 1 : High - moderate severity (2)	Fuel Temperature Is High
190-0	Engine Speed : High - most severe (3)	Engine Overspeeds
190-8	Engine Speed : Abnormal Frequency, Pulse Width or Period	Engine Speed/Timing Sensor Circuit - Test

※ Some fault codes are not applied to this machine.

J1939 Code	Description	Refer to Procedure
190-15	Engine Speed : High - least severe (1)	Engine Overspeeds
411-3	Engine Exhaust Gas Recirculation Differential Pressure : Voltage Above Normal	Sensor Signal (Analog, Active) - Test
411-4	Engine Exhaust Gas Recirculation Differential Pressure : Voltage Below Normal	Sensor Signal (Analog, Active) - Test
411-13	Engine Exhaust Gas Recirculation Differential Pressure : Out of Calibration	Sensor Calibration Required - Test
412-3	Engine Exhaust Gas Recirculation Temperature : Voltage Above Normal	Engine Temperature Sensor Open or Short Circuit - Test (Passive Sensors)
412-4	Engine Exhaust Gas Recirculation Temperature : Voltage Below Normal	Engine Temperature Sensor Open or Short Circuit - Test (Passive Sensors)
412-15	Engine Exhaust Gas Recirculation Temperature : High - least severe (1)	NRS Exhaust Gas Temperature Is High
412-16	Engine Exhaust Gas Recirculation Temperature : High - moderate severity (2)	NRS Exhaust Gas Temperature Is High

※ Some fault codes are not applied to this machine.

J1939 Code	Description	Refer to Procedure
558-2	Accelerator Pedal 1 Low Idle Switch : Erratic, Intermittent or Incorrect	Idle Validation Switch Circuit - Test
626-5	Engine Start Enable Device 1 : Current Below Normal	Ether Starting Aid - Test
626-6	Engine Start Enable Device 1 : Current Above Normal	Ether Starting Aid - Test
630-2	Calibration Memory : Erratic, Intermittent or Incorrect	Flash Programming
631-2	Calibration Module : Erratic, Intermittent or Incorrect	ECM Memory - Test
637-11	Engine Timing Sensor : Other Failure Mode	Engine Speed/Timing Sensor Circuit - Test
639-9	J1939 Network #1 : Abnormal Update Rate	CAN Data Link Circuit - Test
639-14	J1939 Network #1 : Special Instruction	Data Link Configuration Status - Test
649-3	Engine Exhaust Back Pressure Regulator Solenoid : Voltage Above Normal	Motorized Valve - Test

※ Some fault codes are not applied to this machine.

J1939 Code	Description	Refer to Procedure
649-5	Engine Exhaust Back Pressure Regulator Solenoid : Current Below Normal	Motorized Valve - Test
649-6	Engine Exhaust Back Pressure Regulator Solenoid : Current Above Normal	Motorized Valve - Test
649-7	Engine Exhaust Back Pressure Regulator Solenoid : Not Responding Properly	Motorized Valve - Test
651-2	Engine Injector Cylinder #01 : Erratic, Intermittent or Incorrect	Injector Data Incorrect - Test
651-5	Engine Injector Cylinder #01 : Current Below Normal	Injector Solenoid Circuit - Test
651-6	Engine Injector Cylinder #01 : Current Above Normal	Injector Solenoid Circuit - Test
652-2	Engine Injector Cylinder #02 : Erratic, Intermittent or Incorrect	Injector Data Incorrect - Test
652-5	Engine Injector Cylinder #02 : Current Below Normal	Injector Solenoid Circuit - Test

※ Some fault codes are not applied to this machine.

J1939 Code	Description	Refer to Procedure
652-6	Engine Injector Cylinder #02 : Current Above Normal	Injector Solenoid Circuit - Test
653-2	Engine Injector Cylinder #03 : Erratic, Intermittent or Incorrect	Injector Data Incorrect - Test
653-5	Engine Injector Cylinder #03 : Current Below Normal	Injector Solenoid Circuit - Test
653-6	Engine Injector Cylinder #03 : Current Above Normal	Injector Solenoid Circuit - Test
654-2	Engine Injector Cylinder #04 : Erratic, Intermittent or Incorrect	Injector Data Incorrect - Test
654-5	Engine Injector Cylinder #04 : Current Below Normal	Injector Solenoid Circuit - Test
654-6	Engine Injector Cylinder #04 : Current Above Normal	Injector Solenoid Circuit - Test
655-2	Engine Injector Cylinder #05 : Erratic, Intermittent or Incorrect (1206E-E66 Engine Only)	Injector Data Incorrect - Test

※ Some fault codes are not applied to this machine.

J1939 Code	Description	Refer to Procedure
655-5	Engine Injector Cylinder #05 : Current Below Normal (1206E-E66 Engine Only)	Injector Solenoid Circuit - Test
655-6	Engine Injector Cylinder #05 : Current Above Normal (1206E E66 Engine Only)	Injector Solenoid Circuit - Test
656-2	Engine Injector Cylinder #06 : Erratic, Intermittent or Incorrect (1206E-E66 Engine Only)	Injector Data Incorrect - Test
656-5	Engine Injector Cylinder #06 : Current Below Normal (1206E-E66 Engine Only)	Injector Solenoid Circuit - Test
656-6	Engine Injector Cylinder #06 : Current Above Normal (1206E-E66 Engine Only)	Injector Solenoid Circuit - Test
676-5	Engine Glow Plug Relay : Current Below Normal	Glow Plug Starting Aid - Test
676-6	Engine Glow Plug Relay : Current Above Normal	Starting Aid (Glow Plug) Relay Circuit - Test
678-3	ECU 8 Volts DC Supply : Voltage Above Normal	Digital Throttle Position Sensor Circuit - Test

※ Some fault codes are not applied to this machine.

J1939 Code	Description	Refer to Procedure
678-4	ECU 8 Volts DC Supply : Voltage Below Normal	Digital Throttle Position Sensor Circuit - Test
723-8	Engine Speed Sensor #2 : Abnormal Frequency, Pulse Width or Period	Engine Speed/Timing Sensor Circuit - Test
1075-5	Engine Electric Lift Pump For Engine Fuel Supply : Current Below Normal	Fuel Pump Relay Circuit - Test
1075-6	Engine Electric Lift Pump For Engine Fuel Supply : Current Above Normal	Fuel Pump Relay Circuit - Test
1076-5	Engine Fuel Injection Pump Fuel Control Valve : Current Below Normal	Solenoid Valve - Test
1076-6	Engine Fuel Injection Pump Fuel Control Valve : Current Above Normal	Solenoid Valve - Test
1188-3	Engine Turbocharger 1 Wastegate Drive : Voltage Above Normal	Solenoid Valve - Test
1188-5	Engine Turbocharger 1 Wastegate Drive : Current Below Normal	Solenoid Valve - Test

※ Some fault codes are not applied to this machine.

J1939 Code	Description	Refer to Procedure
1188-6	Engine Turbocharger 1 Wastegate Drive : Current Above Normal	Solenoid Valve - Test
1196-9	Anti-theft Component Status States : Abnormal Update Rate	Data Link Circuit - Test
1235-9	J1939 Network #3 : Abnormal Update Rate	CAN Data Link - Test
1235-14	J1939 Network #3 : Special Instruction	Data Link Configuration Status - Test
1239-0	Engine Fuel Leakage 1: High - most severe (3)	Fuel Rail Pressure Problem
1761-1	Aftertreatment #1 DEF/AdBlue® Tank Volume : Low - most severe (3)	DEF/AdBlue® Tank Level Is Low
1761-12	Aftertreatment #1 DEF/AdBlue® Tank Volume : Failure	DEF/AdBlue® Tank Sensor - Test
1761-17	Aftertreatment #1 DEF/AdBlue® Tank Volume : Low - least severe (1)	DEF/AdBlue® Tank Level Is Low

※ Some fault codes are not applied to this machine.

J1939 Code	Description	Refer to Procedure
1761-18	Aftertreatment #1 DEF/AdBlue® Tank Volume : Low - moderate severity (2)	DEF/AdBlue® Tank Level Is Low
2659-7	Engine Exhaust Gas Recirculation (EGR) Mass Flow Rate : Not Responding Properly	NRS Mass Flow Rate Problem
2659-15	Engine Exhaust Gas Recirculation (EGR) Mass Flow Rate : High - least severe (1)	TBA
2791-3	Engine Exhaust Gas Recirculation (EGR) Valve Control : Voltage Above Normal	Motorized Valve - Test
2791-5	Engine Exhaust Gas Recirculation (EGR) Valve Control : Current Below Normal	Motorized Valve - Test
2791-6	Engine Exhaust Gas Recirculation (EGR) Valve Control : Current Above Normal	Motorized Valve - Test
2791-7	Engine Exhaust Gas Recirculation (EGR) Valve Control : Not Responding Properly	Motorized Valve - Test
2882-2	Engine Alternate Rating Select : Erratic, Intermittent, or Incorrect	Mode Selection Circuit - Test

※ Some fault codes are not applied to this machine.

J1939 Code	Description	Refer to Procedure
2970-2	Accelerator Pedal 2 Low Idle Switch : Erratic, Intermittent, or Incorrect	Idle Validation Switch Circuit - Test
3031-7	Aftertreatment #1 DEF/AdBlue® Tank Temperature : Not Responding Properly	DEF/AdBlue® Tank Temperature Is Low
3031-12	Aftertreatment #1 DEF/AdBlue® Tank Temperature : Failure	DEF/AdBlue® Tank Sensor - Test
3031-16	Aftertreatment #1 DEF/AdBlue® Tank Temperature : High - moderate Severity (2)	DEF/AdBlue® Tank Temperature Is High
3031-18	Aftertreatment #1 DEF/AdBlue® Tank Temperature : Low - moderate Severity (2)	DEF/AdBlue® Tank Temperature Is Low
3216-5	Aftertreatment #1 Intake NOx : Current Below Normal	Electrical Power Supply -Test
3216-6	Aftertreatment #1 Intake NOx : Current Above Normal	Electrical Power Supply -Test
3216-7	Aftertreatment #1 Intake NOx : Not Responding Properly	NOx Sensor - Test

※ Some fault codes are not applied to this machine.

J1939 Code	Description	Refer to Procedure
3216-11	Aftertreatment #1 Intake NOx : Other Failure Mode	Sensor (Data Link Type) - Test
3216-12	Aftertreatment #1 Intake NOx : Failure	Sensor (Data Link Type) - Test
3217-16	Aftertreatment #1 Intake O2 : High - moderate Severity (2)	Clean Emissions Module Has High Oxygen Level
3226-5	Aftertreatment #1 Outlet NOx : Current Below Normal	Electrical Power Supply -Test
3226-6	Aftertreatment #1 Outlet NOx : Current Above Normal	Electrical Power Supply -Test
3226-7	Aftertreatment #1 Outlet NOx : Not Responding Properly	NOx Sensor - Test
3226-11	Aftertreatment #1 Outlet NOx : Other Failure Mode	Sensor (Data Link Type) - Test
3226-12	Aftertreatment #1 Outlet NOx : Failure	Sensor (Data Link Type) - Test

※ Some fault codes are not applied to this machine.

J1939 Code	Description	Refer to Procedure
3227-16	Aftertreatment #1 Outlet O2 : High - Moderate Severity (2)	Clean Emissions Module Has High Oxygen Level
3242-3	Particulate Trap Intake Gas Temperature : Voltage Above Normal	Engine Temperature Sensor Open or Short Circuit - Test (Active Sensors)
3242-4	Particulate Trap Intake Gas Temperature : Voltage Below Normal	Engine Temperature Sensor Open or Short Circuit - Test (Active Sensors)
3242-17	Particulate Trap Intake Gas Temperature : Low - least severe (1)	Diesel Particulate Filter Temperature Is High
3242-18	Particulate Trap Intake Gas Temperature : Low - moderate severity (2)	Diesel Particulate Filter Temperature Is Low
3358-3	Engine Exhaust Gas Recirculation Inlet Pressure : Voltage Above Normal	Engine Pressure Sensor Open or Short Circuit - Test
3358-4	Engine Exhaust Gas Recirculation Inlet Pressure : Voltage Below Normal	Engine Pressure Sensor Open or Short Circuit - Test

※ Some fault codes are not applied to this machine.

J1939 Code	Description	Refer to Procedure
3358-13	Engine Exhaust Gas Recirculation Inlet Pressure : Calibration Required	Sensor Calibration Required - Test
3358-21	Engine Exhaust Gas Recirculation Inlet Pressure : Data Drifted Low	5 V Sensor Supply Circuit - Test
3360-3	Aftertreatment #1 DEF/AdBlue® Controller : Voltage Above Normal	Electrical Power Supply -Test
3360-4	Aftertreatment #1 DEF/AdBlue® Controller : Voltage Below Normal	Electrical Power Supply -Test
3360-9	Aftertreatment #1 DEF/AdBlue® Controller : Abnormal Update Rate	Can Data Link - Test
3360-14	Aftertreatment #1 DEF/AdBlue® Controller : Special Instruction	Sensor (Data Link Type) - Test
3361-5	Aftertreatment #1 DEF/AdBlue® Dosing Unit : Current Below Normal	Solenoid Valve - Test (Solenoid Valves that Connect to the Dosing control Unit (DUC))

※ Some fault codes are not applied to this machine.

J1939 Code	Description	Refer to Procedure
3361-6	Aftertreatment #1 DEF/AdBlue® Dosing Unit : Current Above Normal	Solenoid Valve - Test (Solenoid Valves that Connect to the Dosing control Unit (DUC))
3361-7	Aftertreatment #1 DEF/AdBlue® Dosing Unit : Not Responding Property	DEF/AdBlue® Module Does Not Respond
3363-5	Aftertreatment #1 DEF/AdBlue® Tank Heater : Current Below Normal	Solenoid Valve - Test (Solenoid Valves that Connect to the Dosing control Unit (DUC))
3363-6	Aftertreatment #1 DEF/AdBlue® Tank Heater : Current Above Normal	Solenoid Valve - Test (Solenoid Valves that Connect to the Dosing control Unit (DUC))
3509-3	Sensor Supply Voltage 1 : Voltage Above Normal	5 V Sensor Supply Circuit - Test
3509-4	Sensor Supply Voltage 1 : Voltage Below Normal	5 V Sensor Supply Circuit - Test
3510-3	Sensor Supply Voltage 2 : Voltage Above Normal	5 V Sensor Supply Circuit - Test
3510-4	Sensor Supply Voltage 2 : Voltage Below Normal	5 V Sensor Supply Circuit - Test
3511-3	Sensor Supply Voltage 3 : Voltage Above Normal	DEF/AdBlue® Pump Sensor Supply - Test

※ Some fault codes are not applied to this machine.

J1939 Code	Description	Refer to Procedure
3511-4	Sensor Supply Voltage 3 : Voltage Below Normal	DEF/AdBlue® Pump Sensor Supply - Test
3512-3	Sensor Supply Voltage 4 : Voltage Above Normal	Speed/Timing - Test
3512-4	Sensor Supply Voltage 4 : Voltage Below Normal	Speed/Timing - Test
3516-12	Aftertreatment #1 DEF/AdBlue® Concentration : Failure	DEF/AdBlue® Concentration Is Incorrect
3516-16	Aftertreatment #1 DEF/AdBlue® Concentration : High - moderate severity (2)	DEF/AdBlue® Concentration Is Incorrect
3516-18	Aftertreatment #1 DEF/AdBlue® Concentration : Low - moderate severity (2)	DEF/AdBlue® Concentration Is Incorrect
3563-3	Engine Intake Manifold #1 Absolute Pressure : Voltage Above Normal	Engine Pressure Sensor Open or Short Circuit - Test
3563-4	Engine Intake Manifold #1 Absolute Pressure : Voltage Below Normal	Engine Pressure Sensor Open or Short Circuit - Test

※ Some fault codes are not applied to this machine.

J1939 Code	Description	Refer to Procedure
3563-13	Engine Intake Manifold #1 Absolute Pressure : Calibration Required	Sensor Calibration Required - Test
3563-21	Engine Intake Manifold #1 Absolute Pressure : Data Drifted Low	5 V Sensor Supply Circuit - Test
3719-0	Particulate Trap #1 Soot Load Percent : High - most severe (3)	Diesel Particulate Filter Collects Excessive Soot
3719-16	Particulate Trap #1 Soot Load Percent : High - moderate severity (2)	Diesel Particulate Filter Collects Excessive Soot
4334-3	Aftertreatment #1 DEF/AdBlue® #1 Pressure (absolute) : Voltage Above Normal	DEF/AdBlue® Pump Pressure Sensor - Test
4334-4	Aftertreatment #1 DEF/AdBlue® #1 Pressure (absolute) : Voltage Below Normal	DEF/AdBlue® Pump Pressure Sensor - Test
4334-16	Aftertreatment #1 DEF/AdBlue® #1 Pressure (absolute) : High - moderate severity (2)	DEF/AdBlue® Pressure Is High
4334-18	Aftertreatment #1 DEF/AdBlue® #1 Pressure (absolute) : Low - moderate severity (2)	DEF/AdBlue® Pressure Is Low

※ Some fault codes are not applied to this machine.

J1939 Code	Description	Refer to Procedure
4334-21	Aftertreatment #1 DEF/AdBlue® #1 Pressure (absolute) : Data Drifted Low	Sensor Supply - Test
4354-5	Aftertreatment #1 DEF/AdBlue® Line Heater #1 : Current Below Normal	DEF/AdBlue® Line Heater - Test
4354-6	Aftertreatment #1 DEF/AdBlue® Line Heater #1 : Current Above Normal	DEF/AdBlue® Line Heater - Test
4355-5	Aftertreatment #1 DEF/AdBlue® Line Heater #2 : Current Below Normal	DEF/AdBlue® Line Heater - Test
4355-6	Aftertreatment #1 DEF/AdBlue® Line Heater #2 : Current Above Normal	DEF/AdBlue® Line Heater - Test
4356-5	Aftertreatment #1 DEF/AdBlue® Line Heater #3 : Current Below Normal	DEF/AdBlue® Line Heater - Test
4356-6	Aftertreatment #1 DEF/AdBlue® Line Heater #3 : Current Above Normal	DEF/AdBlue® Line Heater - Test
4360-3	Aftertreatment #1 SCR Catalyst Intake Gas Temperature : Voltage Above Normal	Sensor Signal (Analog, Passive) - Test

※ Some fault codes are not applied to this machine.

J1939 Code	Description	Refer to Procedure
4360-4	Aftertreatment #1 SCR Catalyst Intake Gas Temperature : Voltage Below Normal	Sensor Signal (Analog, Passive) - Test
4360-16	Aftertreatment #1 SCR Catalyst Intake Gas Temperature : High - moderate severity (2)	SCR Catalyst Has Incorrect Inlet Temperature
4360-17	Aftertreatment #1 SCR Catalyst Intake Gas Temperature : Low - least severe (1)	SCR Catalyst Has Incorrect Inlet Temperature
4360-18	Aftertreatment #1 SCR Catalyst Intake Gas Temperature : Low - moderate severity (2)	SCR Catalyst Has Incorrect Inlet Temperature
4360-20	Aftertreatment #1 SCR Catalyst Intake Gas Temperature : Data Drifted High	Sensor Signal (Analog, Passive) - Test
4364-2	Aftertreatment #1 SCR Catalyst Conversion Efficiency : Erratic, Intermittent, or Incorrect	NOx Sensor - Test
4364-18	Aftertreatment #1 SCR Catalyst Conversion Efficiency : Low - moderate severity (2)	NOx Conversion Is Low
4374-5	Aftertreatment #1 DEF/AdBlue® Pump #1 Motor Speed : Current Below Normal	DEF/AdBlue® Pump - Test

※ Some fault codes are not applied to this machine.

J1939 Code	Description	Refer to Procedure
4374-6	Aftertreatment #1 DEF/AdBlue® Pump #1 Motor Speed : Current Above Normal	DEF/AdBlue® Pump - Test
4377-12	Aftertreatment #1 Outlet NH3 : Failure	Sensor (Data Link Type) - Test
4380-2	Aftertreatment #1 Outlet NH3 Gas Sensor Power In Range : Erratic, Intermittent or Incorrect	Electrical Power Supply - Test
4765-3	Aftertreatment #1 Diesel Oxidation Catalyst Intake Gas Temperature : Voltage Above Normal	Sensor Signal (Analog, Passive) - Test
4765-4	Aftertreatment #1 Diesel Oxidation Catalyst Intake Gas Temperature : Voltage Below Normal	Sensor Signal (Analog, Passive) - Test
4765-17	Aftertreatment #1 Diesel Oxidation Catalyst Intake Gas Temperature : Low - least severe (1)	Diesel Oxidation Catalyst Has Incorrect inlet Temperature
4783-3	Diesel Particulate Filter #1 Mean Soot Signal : Voltage Above Normal	Soot Sensor - Test
4783-4	Diesel Particulate Filter #1 Mean Soot Signal : Voltage Below Normal	Soot Sensor - Test

※ Some fault codes are not applied to this machine.

J1939 Code	Description	Refer to Procedure
4783-9	Diesel Particulate Filter #1 Mean Soot Signal : Abnormal Update Rate	Soot Sensor - Test
4783-12	Diesel Particulate Filter #1 Mean Soot Signal : Failure	Soot Sensor - Test
4783-13	Diesel Particulate Filter #1 Mean Soot Signal : Calibration Required	Soot Sensor - Test
4783-19	Diesel Particulate Filter #1 Mean Soot Signal : Data Error	Soot Sensor - Test
4783-21	Diesel Particulate Filter #1 Mean Soot Signal : Data Drifted Low	Soot Sensor - Test
5019-3	Engine Exhaust Gas Recirculation Outlet Pressure : Voltage Above Normal	Engine Pressure Sensor Open or Short Circuit - Test
5019-4	Engine Exhaust Gas Recirculation Outlet Pressure : Voltage Below Normal	Engine Pressure Sensor Open or Short Circuit - Test
5019-13	Engine Exhaust Gas Recirculation Outlet Pressure : Calibration Required	Sensor Calibration Required - Test

※ Some fault codes are not applied to this machine.

J1939 Code	Description	Refer to Procedure
5019-21	Engine Exhaust Gas Recirculation Outlet Pressure : Data Drifted Low	5 V Sensor Supply Circuit - Test
5246-0	Aftertreatment SCR Operator Inducement Severity : High - most severe (3)	SCR Warning System Problem
5246-15	Aftertreatment SCR Operator Inducement Severity : High - least severe (1)	SCR Warning System Problem
5246-16	Aftertreatment SCR Operator Inducement Severity : High - mederate severity (2)	SCR Warning System Problem
5298-17	Aftertreatment #1 Diesel Oxidation Catalyst Conversion Efficiency : Low-least severe (1)	Diesel Oxidation Catalyst Has Low Conversion Efficiency
5392-31	Aftertreatment Diesel Exhaust Fluid Dosing Unit Loss of Prime	DEF/AdBlue® Pressure Is Low
5571-0	High Pressure Common Rail Fuel Pressure Relief Valve : High - most severe (3)	Fuel Rail Pressure Problem

※ Some fault codes are not applied to this machine.

J1939 Code	Description	Refer to Procedure
5576-2	Aftertreatment #1 Identification Number Module : Erratic, Intermittent or incorrect	Diesel Particulate Filter Identification Signal - Test
5576-8	Aftertreatment #1 Identification Number Module : Abnormal Frequency, Pulse Width, or Period	Diesel Particulate Filter Identification Signal - Test
5576-14	Aftertreatment #1 Identification Number Module : Special Instruction	Diesel Particulate Filter Identification Signal - Test
5625-3	Exhaust Back Pressure Regulator Position : Voltage Above Normal	Valve Position Sensor - Test
5625-4	Exhaust Back Pressure Regulator Position : Voltage Below Normal	Valve Position Sensor - Test
5629-31	Particulate Trap Active Regeneration Inhibited Due To Low Exhaust Gas Pressure - least severe (1)	Diesel Particulate Filter Collects Excessive Soot
5706-5	Aftertreatment #1 Diesel Exhaust Fluid Pump Heater : Current Below Normal	DEF/AdBlue® Pump - Test
5706-6	Aftertreatment #1 Diesel Exhaust Fluid Pump Heater : Current Above Normal	DEF/AdBlue® Pump - Test

※ Some fault codes are not applied to this machine.

J1939 Code	Description	Refer to Procedure
5758-11	Aftertreatment #1 Intake Gas Sensor Power Supply : Other Failure Mode	Electrical Power Supply - Test
5759-11	Aftertreatment #1 Outlet Gas Sensor Power Supply : Other Failure Mode	Electrical Power Supply - Test
5965-5	Aftertreatment #1 DEF/AdBlue® Control Module Relay Control : Current Below Normal	Relay - Test (Aftertreatment Power Relay)
5965-6	Aftertreatment #1 DEF/AdBlue® Control Module Relay Control : Current Above Normal	Relay - Test (Aftertreatment Power Relay)
5966-5	Aftertreatment #1 DEF/AdBlue® Control Module Power Supply : Current Below Normal	DEF/AdBlue® Control Module Power - Test
5966-6	Aftertreatment #1 DEF/AdBlue® Control Module Power Supply : Current Above Normal	DEF/AdBlue® Control Module Power - Test
6309-5	Aftertreatment #1 Diesel Exhaust Fluid Control Module Power Supply 2 : Current Below Normal	DEF/AdBlue® Control Module Power - Test
6309-6	Aftertreatment #1 Diesel Exhaust Fluid Control Module Power Supply 2 : Current Above Normal	DEF/AdBlue® Control Module Power - Test

※ Some fault codes are not applied to this machine.

J1939 Code	Description	Refer to Procedure
7441-3	Aftertreatment Ambient Air Temperature : Voltage Above Normal	Sensor Signal (Analog, Passive) - Test
7441-4	Aftertreatment Ambient Air Temperature : Voltage Below Normal	Sensor Signal (Analog, Passive) - Test

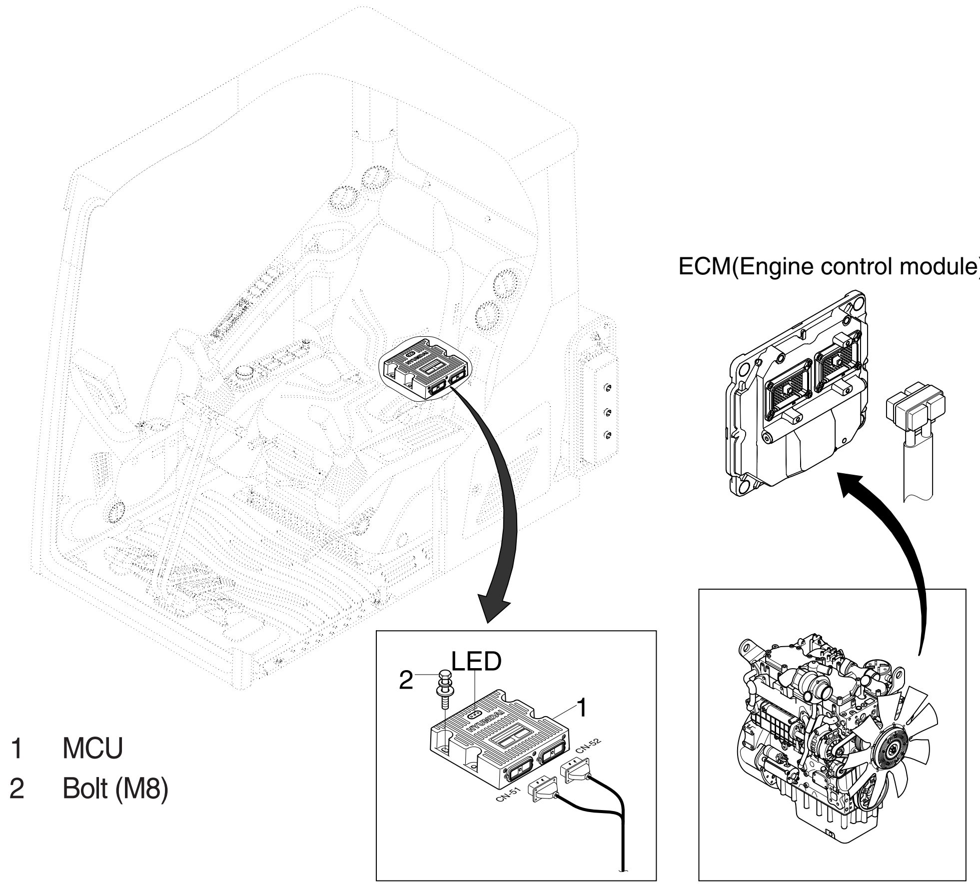
※ Some fault codes are not applied to this machine.

5. AAVM FAULT CODE

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

GROUP 14 ENGINE CONTROL SYSTEM

1. MCU and Engine ECM (Electronic Control Module)



140L5MS02

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 15 EPPR VALVE

1. PUMP EPPR VALVE

1) COMPOSITION

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

(1) Electro magnet valve

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

(2) Spool valve

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

(3) Pressure and electric current value for each mode

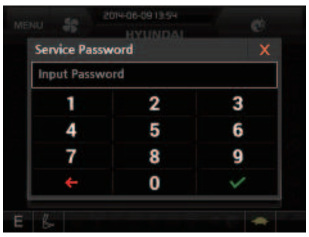
Mode		Pressure		Electric current (mA)	Engine rpm (at accel dial 10)
		kgf/cm^2	psi		
Standard	P	10	142	280 ± 30	1950 ± 50
	S	13 ± 3	189 ± 40	305 ± 30	1850 ± 50
	E	15 ± 3	218 ± 40	340 ± 30	1750 ± 50
Option	P	0	0	230 ± 30	2100 ± 50
	S	5 ± 3	73 ± 40	260 ± 30	2000 ± 50
	E	10 ± 3	142 ± 40	340 ± 30	1750 ± 50

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

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

- Management
  · Service menu

290F3CD149



Enter the password 290F3CD126

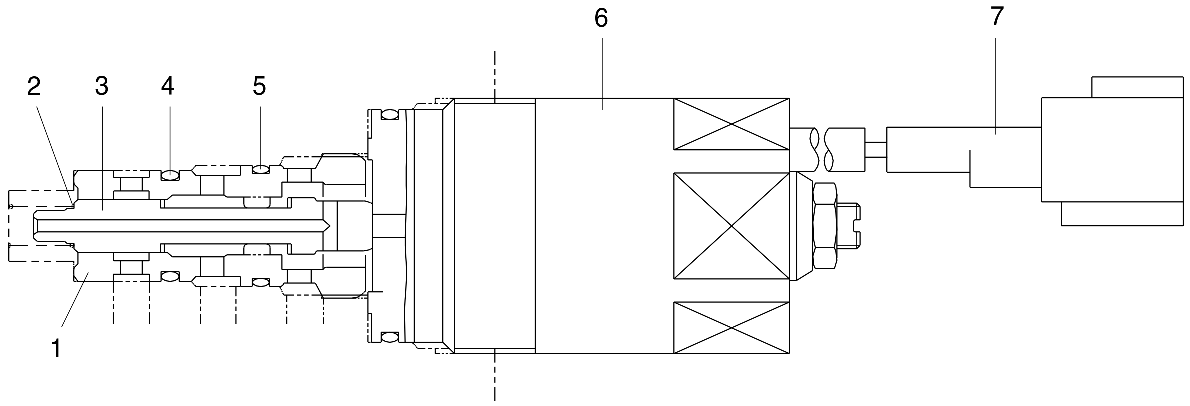
290F3CD150

290F3CD151

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

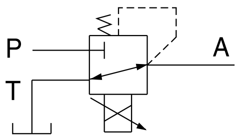
3) OPERATING PRINCIPLE (pump EPPR valve)

(1) Structure



5-22(1)

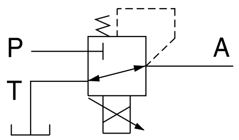
1	Sleeve	4	O-ring	6	Solenoid valve
2	Spring	5	O-ring	7	Connector
3	Spool				

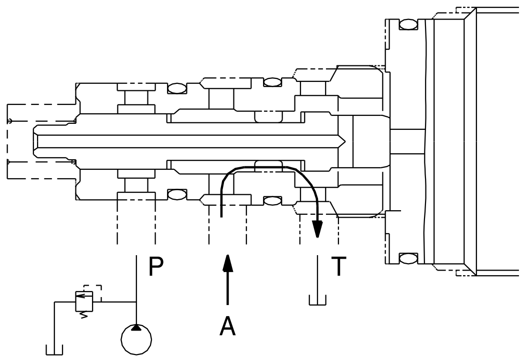


P Pilot oil supply line (pilot pressure)
T Return to tank
A Secondary pressure to flow regulator at main pump

(2) Neutral

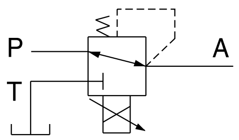
Pressure line is blocked and A oil returns to tank.

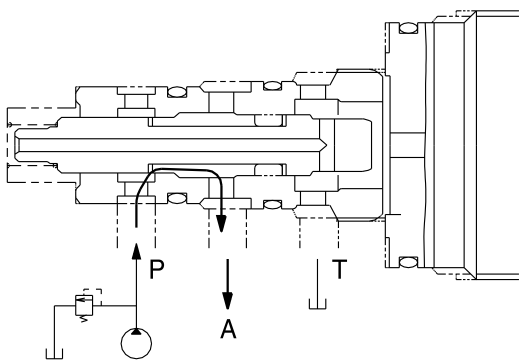




(3) Operating

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.

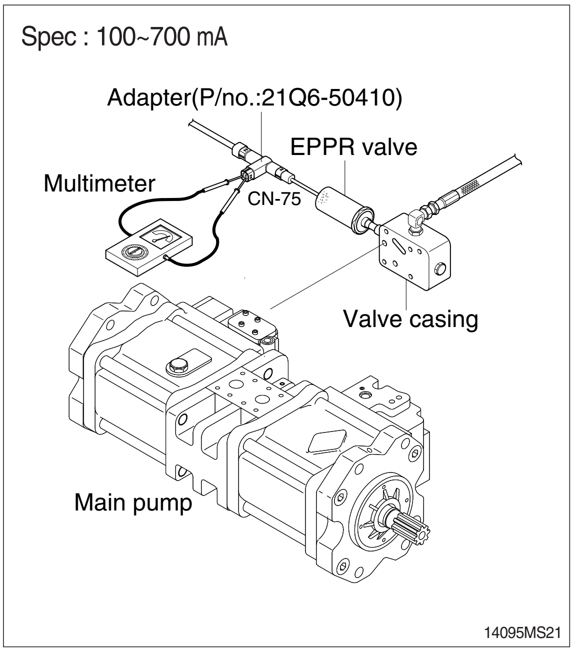
③ Start engine.

④ Set S-mode and cancel auto decel mode.

⑤ Position the multimodal dial at 10.

⑥ If rpm display show approx 1850±50 rpm check electric current at bucket circuit relief position.

⑦ Check electric current at bucket circuit relief position.



(2) Check pressure at EPPR valve

① Remove plug and connect pressure gauge as figure.

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

② Start engine.

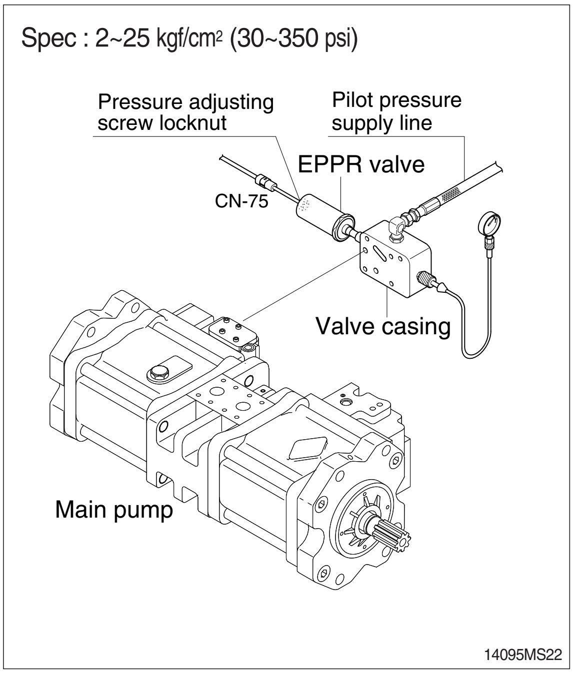
③ Set S-mode and cancel auto decel mode.

④ Position the multimodal dial at 10.

⑤ If tachometer show approx 1850±50 rpm check pressure at relief position of bucket circuit by operating bucket control lever.

⑥ If pressure is not correct, adjust it.

⑦ After adjust, test the machine.



2. BOOM PRIORITY EPPR VALVE

1) COMPOSITION

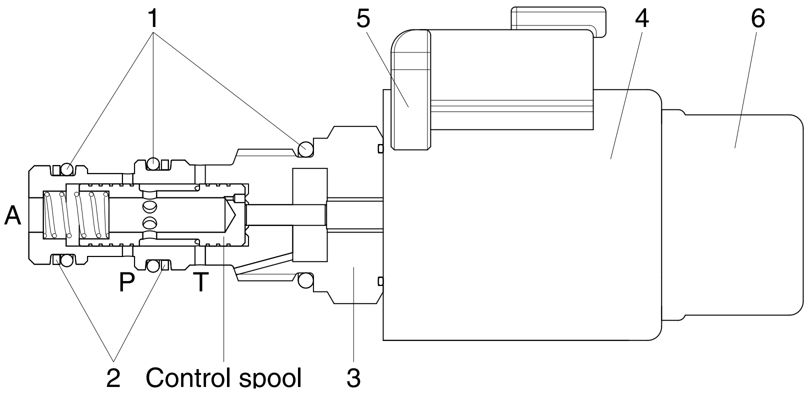
The boom priority EPPR valve is built in a manifold and mainly consisting of valve body and coil. This EPPR valve installed under the solenoid valve.

2) CONTROL

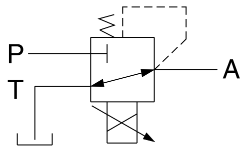
The boom priority EPPR valve has to be controlled by a specific electronic amplifier card, which is supplying the coil with a current 580 mA at 30Ω and 24 V.

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.

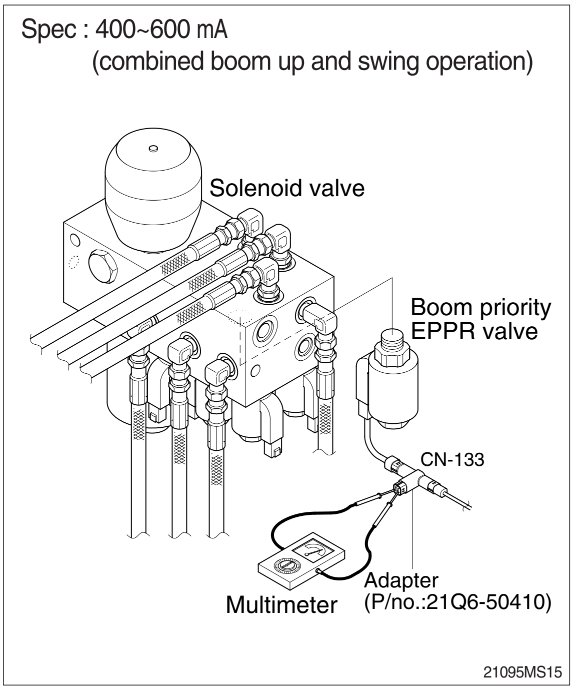
② Insert the adapter to CN-133 and install multimeter as figure.

③ Start engine.

④ Set S-mode and cancel auto decel mode.

⑤ If rpm display approx 1850±50 rpm disconnect one wire harness from EPPR valve.

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



(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)

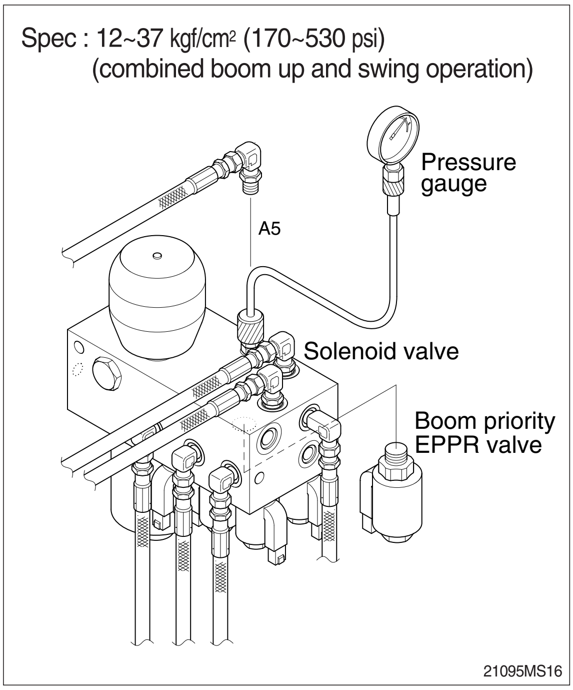
② Start engine.

③ Set S-mode and cancel auto decel mode.

④ If rpm display approx 1850±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.



GROUP 16 MONITORING SYSTEM

1. OUTLINE

Monitoring system consists of the monitor part and switch part.

The monitor part gives warnings when any abnormality occurs in the machine and informs the condition of the machine.

Various select switches are built into the monitor panel, which act as the control portion of the machine control system.

2. CLUSTER

1) MONITOR PANEL

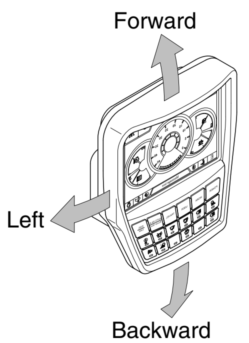
220F3CD01

※ The warning lamp pops up and/or blinks and the buzzer sounds when the machine has a problem.
The warning lamp blinks until the problem is cleared. Refer to page 5-65 for details.

※ This cluster is adjustable.

· Vertical (forward/backward) : each 15°

· Horizontal (left only) : 8°



290F3CD47

2) CLUSTER CHECK PROCEDURE

(1) Start key : ON

① Check monitor

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

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

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

a. Engine rpm display : 0 rpm

b. Engine coolant temperature gauge : White range

c. Hydraulic oil temperature gauge : White range

d. Fuel level gauge : White range

③ Indicating lamp state

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

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

c. Travel speed pilot lamp : Low (turtle)

(2) Start of engine

① Check machine condition

a. RPM display indicates at present rpm

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

※ When normal condition : All warning lamp OFF

c. Work mode selection : General work

d. Power mode selection : E mode or U mode

e. Travel speed pilot lamp : Low (turtle)

② When warming up operation

a. Warming up pilot lamp : ON

b. After engine started, engine speed increases 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

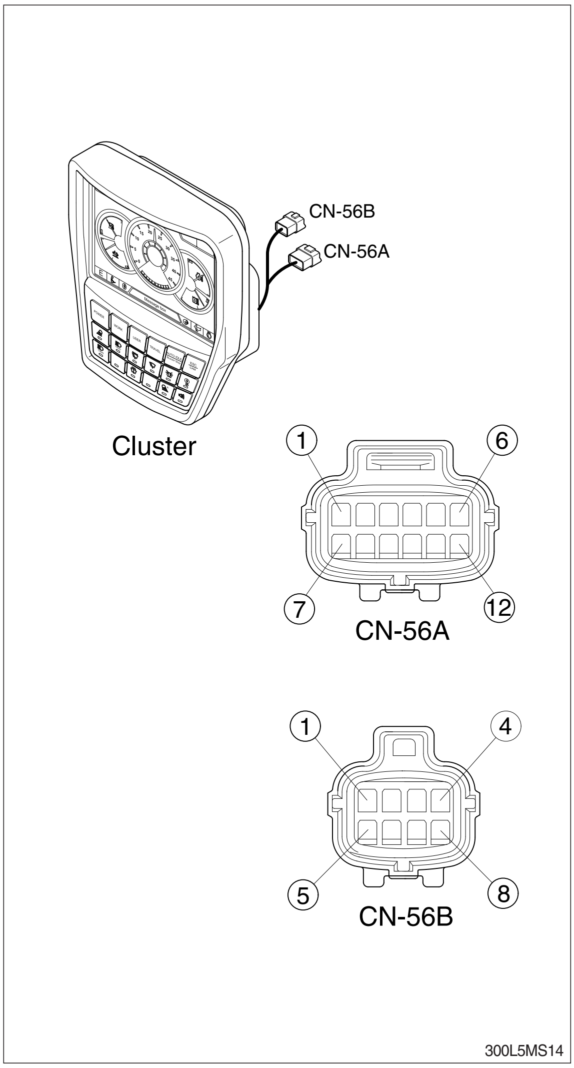
1) CN-56A

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

2) CN-56B

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

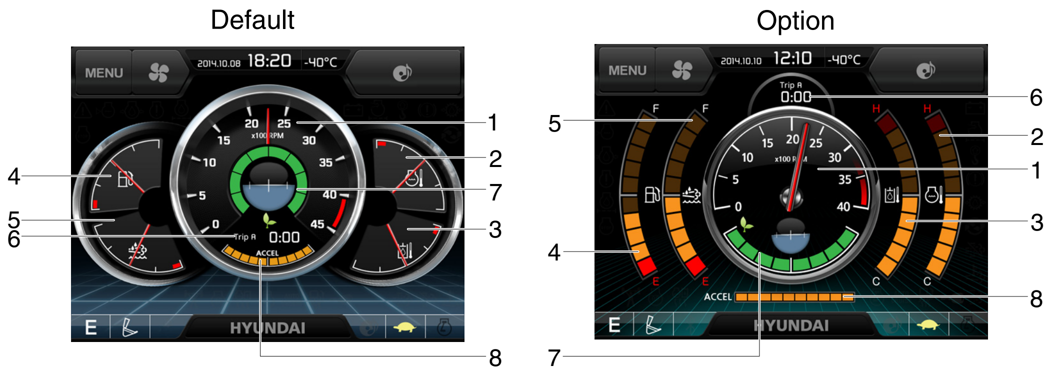
NTSC : National Television System Committee



2) GAUGE

(1) Operation screen

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



290F3CD51

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

※ Operation screen type can be set by the screen type menu of the display. Refer to page 5-86 for details.

(2) RPM / Speed gauge

290F3CD49

① This display the engine speed.

(3) Engine coolant temperature gauge

290F3CD53

① This gauge indicates the temperature of coolant.

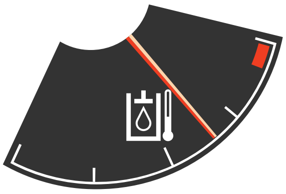
· White range : 40-107˚C (104-225˚F)

· Red range : Above 107˚C (225˚F)

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

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

(4) Hydraulic oil temperature gauge



290F3CD54

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

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

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

(5) Fuel level gauge

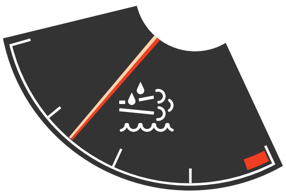
290F3CD55

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

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

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

(6) DEF/AdBlue® Level gauge



290F3CD57

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

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

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

※ Refer to page 5-70.

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

(7) Tripmeter display

290F3CD56

① This displays the engine the tripmeter.

※ Refer to page 5-88 for details.

(8) Eco gauge

290F3CD58

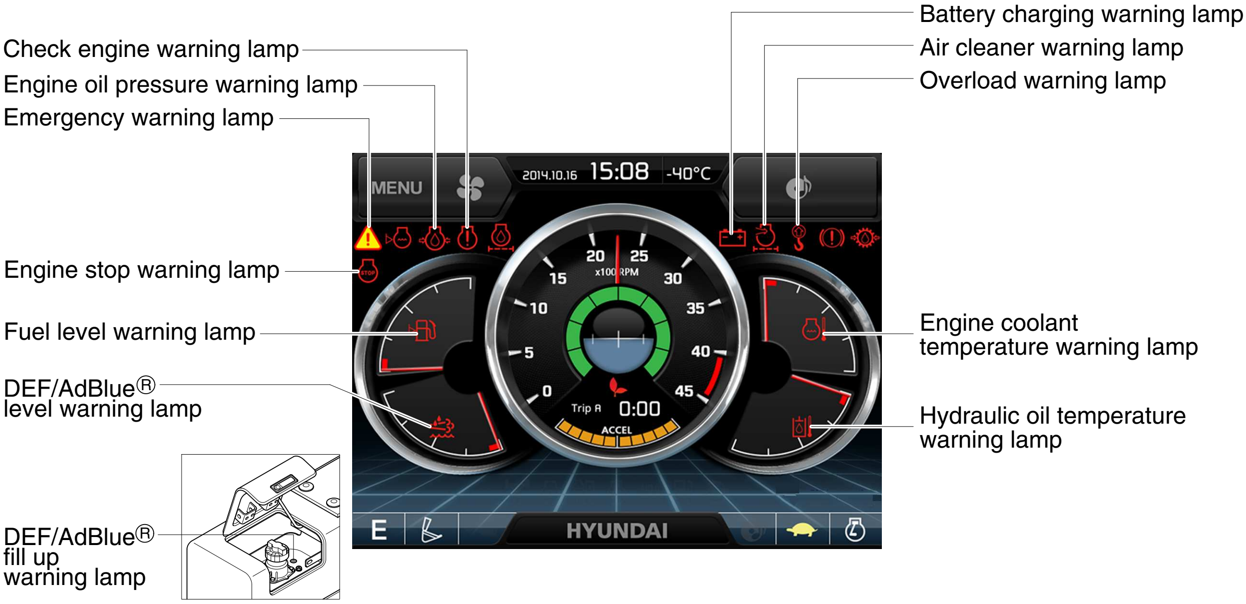
① This gauge indicates the fuel consumption rate and machine load status. So that operators can be careful with fuel economy.
② The fuel consumption rate or machine load is higher, the number of segment is increased.
③ The color of Eco gauge indicates operation status.
  · White : Idle operation
  ·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

(9) Accel dial gauge

290F3CD59

① This gauge indicates the level of accel dial.

3) WARNING LAMPS



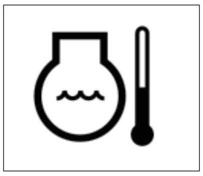
160F3CD60

※ Warning lamps and buzzer

Warnings	When error happened	Lamps and buzzer
All warning lamps except below	Warning lamp pops up on the center of the LCD and the buzzer sounds	· The pop-up warning lamp moves to the original position and blinks, and the buzzer stops when ; - the buzzer stop switch AUTO IDLE Buzzer Stop is pushed - the knob of the haptic controller is pushed - the lamp of the LCD is touched
	Warning lamp pops up on the center of the LCD and the buzzer sounds	· The pop-up warning lamp moves to the original position and light ON, and the buzzer stops when ; - the buzzer stop switch AUTO IDLE Buzzer Stop is pushed - the knob of the haptic controller is pushed - the lamp of the LCD is touched **※ Refer to operator's manual page 3-11 for details.**
 	Warning lamp pops up on the center of the LCD and the buzzer sounds	**※ Refer to operator's manual page 3-7 for details.**

※ Refer to page 5-75 for the buzzer stop switch AUTO IDLE Buzzer Stop and operator's manual page 3-57 for the haptic controller.

(1) Engine coolant temperature warning lamp



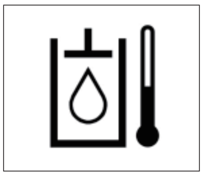
290F3CD61

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

② The pop-up , lamps move to the original position and blinks when the buzzer stop switch 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



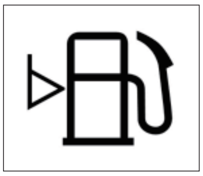
290F3CD62

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 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 31 ℓ (8.2 U.S. gal).

② Fill the fuel immediately when the lamp blinks.

(4) Emergency warning lamp

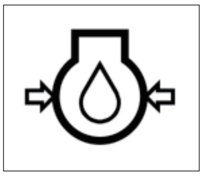
290F3CD64

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

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

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

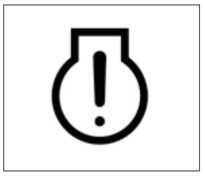
(5) Engine oil pressure warning lamp



290F3CD65

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

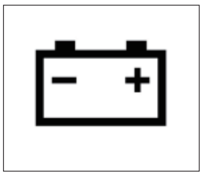
(6) Check engine warning lamp



290F3CD66

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

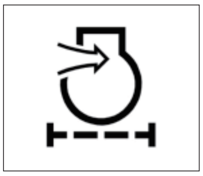
(7) Battery charging warning lamp



290F3CD67

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

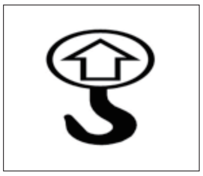
(8) Air cleaner warning lamp



290F3CD68

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

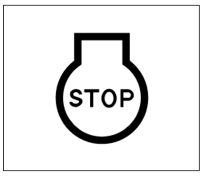
(9) Overload warning lamp (opt)



290F3CD69

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

(10) Engine stop warning lamp



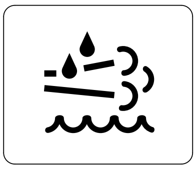
290F3CD252

① This warning lamp pops up and the buzzer sounds when 30 minutes elapsed with empty condition of the DEF/AdBlue® tank, stop the engine immediately and check the DEF/AdBlue® tank.

② Fill the DEF/AdBlue® immediately in the DEF/AdBlue® tank.

※ Refer to page 5-70.

(11) DEF/AdBlue® level warning lamp



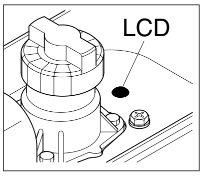
290F3CD257

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

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

Warning lamp			Description
DEF/AdBlue® level 	Check engine 	Stop engine 	
On	Off	Off	· The DEF/AdBlue® level has fallen below the initial warning level (20%).
On	Off	Off	· The DEF/AdBlue® level has fallen below the critical warning level (14%).
On	On	Off	· The DEF/AdBlue® level has fallen below the initial derate warning level (8%). · 75% torque derate.
On	On	On	· The DEF/AdBlue® level has fallen below the initial warning level (3.5%). · 5 minute control engine speed and then hold idle only.

(12) DEF/AdBlue® fill up warning lamp



290F3CD272

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

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

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

4) PILOT LAMPS

290F3CD74

(1) Mode pilot lamps

No	Mode	Pilot lamp	Selected mode
1	Power mode	P	Heavy duty power work mode
		S	Standard power mode
		E	Economy power mode
2	User mode	U	User preferable power mode
3	Work 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

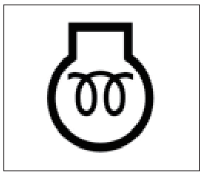
290F3CD78

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 manual page 3-38 for power max function.

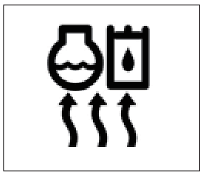
(3) Preheat pilot lamp



290F3CD79

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

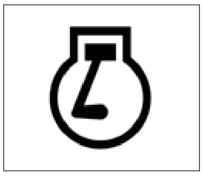
(4) Warming up pilot lamp



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.

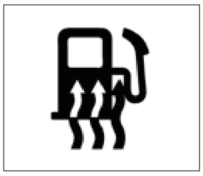
(5) Decel pilot lamp



290F3CD81

① Operating one touch decel switch on the RCV lever makes the lamp ON.
② Also, the lamp will be ON and engine speed will be lowered automatically to save fuel consumption when all levers and pedals are at neutral position, and the auto idle function is selected.
※ **One touch decel is not available when the auto idle pilot lamp is turned ON.**
※ **Refer to the operator's manual page 3-38.**

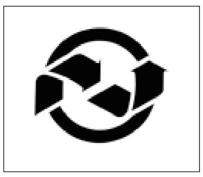
(6) Fuel warmer pilot lamp



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.

(7) Maintenance pilot lamp



290F3CD83

① This lamp will be ON when the consuming parts are needed to change or replace. It means that the change or replacement interval of the consuming parts remains below 30 hours.
② Check the message in maintenance information of main menu. Also, this lamp lights ON for 3 minutes when the start switch is ON position.
※ **Refer to the page 5-82.**

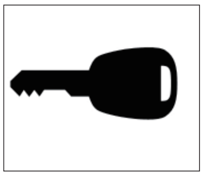
(8) Entertainment pilot lamp

290F3CD84

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

※ Refer to the page 5-88.

(9) Smart key pilot lamp (opt)



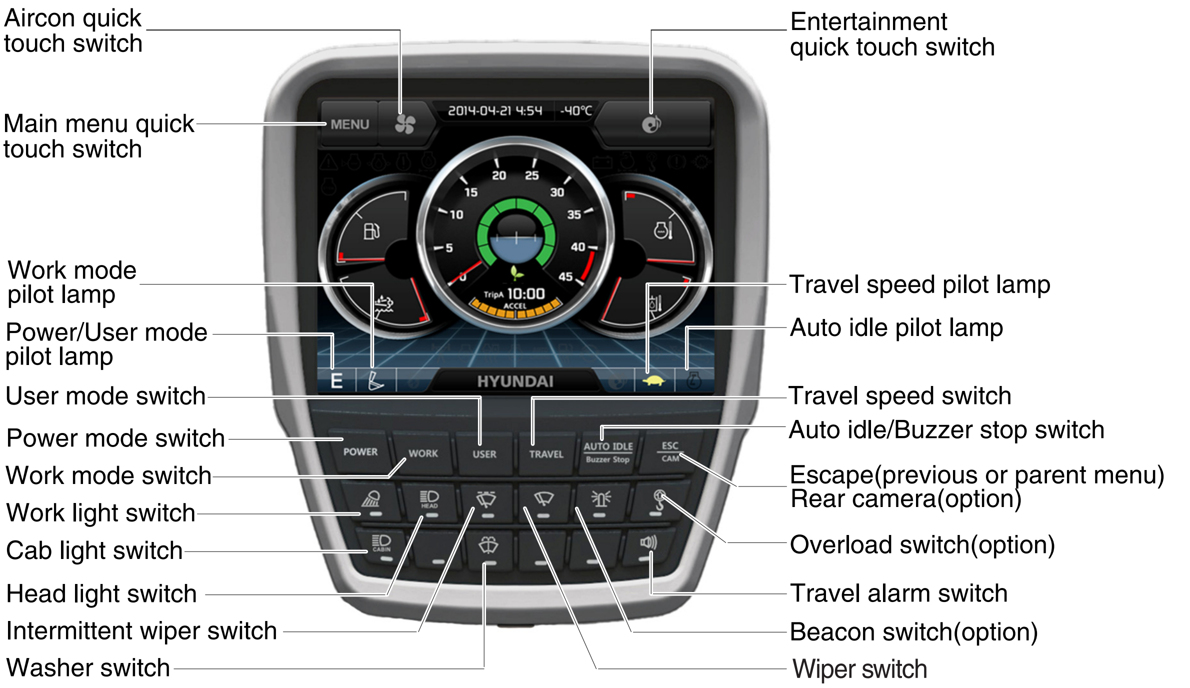
290F3CD214

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

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

※ Refer to the page 5-83.

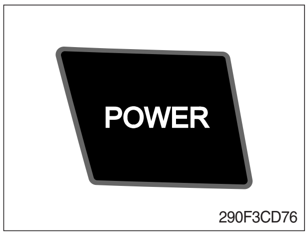
5) SWITCHES



290F3CD86

※ When some of the switches are selected, the pilot lamps are displayed on the LCD. Refer to the page 5-71 for details.

(1) Power mode switch



290F3CD76

① This switch is to select the machine power mode and selected power mode pilot lamp is displayed on the pilot lamp position.

· P : Heavy duty power work.
· S : Standard power work.
· E : Economy power work.

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

(2) Work mode switch

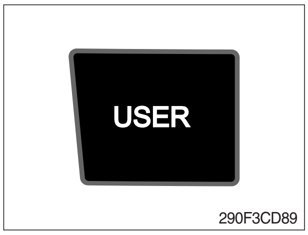
290F3CD88

① This switch is to select the machine work mode, which shifts from general operation mode to optional attachment operation mode.

· : General operation mode
· : Breaker operation mode (if equipped)
· : Crusher operation mode (if equipped)
· Not installed : Breaker or crusher is not installed.

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

(3) User mode switch



① This switch is used to memorize the current machine operating status in the MCU and activate the memorized user mode.

- Memory : Automatically saved after key OFF.
- Action : Push this switch.
- Cancel : Push this switch once more.

② Refer to the page 5-79 for another set of user mode.

(4) Travel speed switch

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

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 5-88 for the camera.

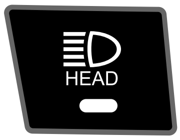
③ If the camera is not installed, this switch is used only ESC function.

(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



290F3CD94

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

(9) Intermittent wiper switch

290F3CD95

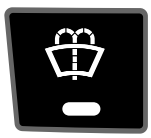
① This switch is used to wipe operates intermittently.
② The pilot lamp is turned ON when operating the switch.

(10) Wiper switch

290F3CD96

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

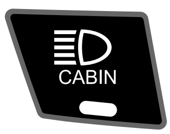
(11) Washer switch



290F3CD100

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

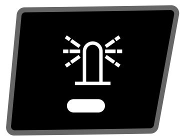
(12) Cab light switch



290F3CD99

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

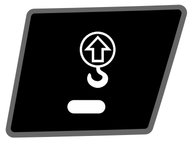
(13) Beacon switch



290F3CD97

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

(14) Overload switch



290F3CD98

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

(15) Travel alarm switch

290F3CD101

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

(16) Air conditioner quick touch switch

290F3CD216

① This switch used to select air conditioner control mode.
※ Refer to the page 5-90.

(17) Main menu quick touch switch

290F3CD217

① This switch is to activate the main menu in the cluster.
※ Refer to the page 5-78.

(18) Entertainment quick touch switch

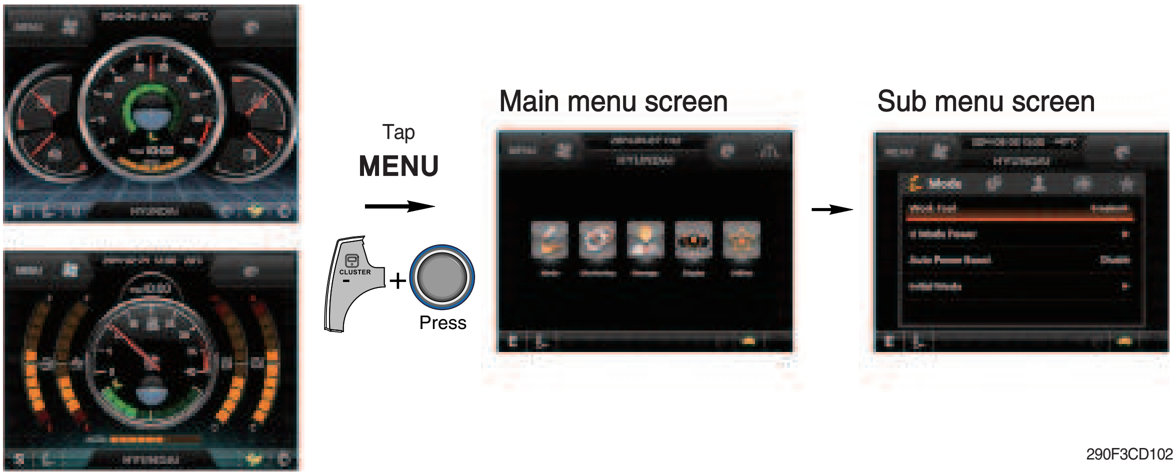
290F3CD218

① This switch is to activate the entertainment control menu in the cluster.
※ Refer to the page 5-87.

6) MAIN MENU

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

· Operation screen



290F3CD102

※ Please refer to the haptic controller, operator's manual page 3-58 for selection and change of menu and input value.

(1) Structure

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

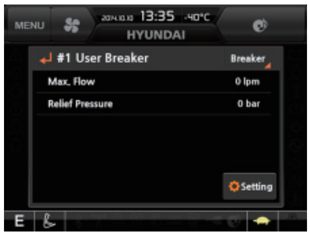
(2) Mode setup

① Work tool

210WF3CD108

290F3CD253

A



290F3CD254

B

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

② U mode power

210WF3CD111

290F3CD112

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

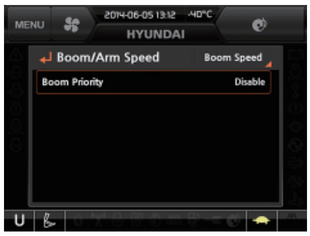
Step (▮)	Engine speed (rpm)	Idle speed (rpm)	Power shift (bar)
1	1300	1000	0
2	1400	1030	3
3	1500	1050	6
4	1600	1080	9
5	1700	1100 (auto decel)	12
6	1800	1130	16
7	1850	1150	20
8	1900	1180	26
9	1950	1200	32
10	2000	1250	38

※One touch decel & low idle : 1000 rpm

③ Boom/Arm speed

210WF3CD113

290F3CD114



290F3CD115

· 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

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

④ Auto power boost

210WF3CD118

290F3CD117

· The power boost function can be activated or cancelled.
Enable - The digging power is automatically increased as working conditions by the MCU.
It is operated max 8 seconds.
Disable - Not operated.

⑤ IPC mode

290F3CD310

290F3CD311

290F3CD304

290F3CD312

290F3CD305

290F3CD313

290F3CD306

· The IPC mode can be selected by this menu.
  - Speed mode
  - Balance mode (default)
  - Efficiency mode
· This mode is applied only general operation mode of the work tool mode.
※ Please update the cluster programs if this mode is not displayed in the mode setup menu. Refer to the operator's manual page 3-25-1.

⑥ Automatic engine shutdown (option)

210WF3CD11

210WF3CD12

210WF3CD13

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

⑦ Initial mode

290F3CD122

290F3CD119

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

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

· Accel initial step
  - 0~9 step

⑧ Emergency mode

290F3CD248

290F3CD249

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

(3) Monitoring

① Active fault

290F3CD120

→

290F3CD121

→

290F3CD125

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

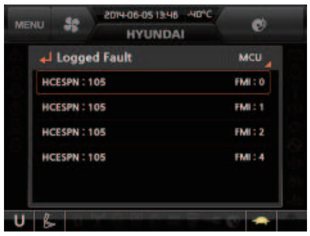
② Logged fault

290F3CD128

→

290F3CD123

→



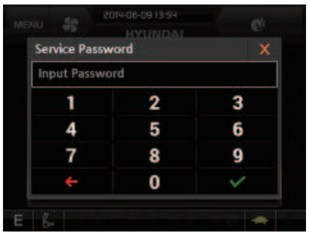
290F3CD124

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

③ Delete logged fault

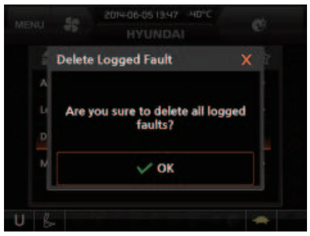
290F3CD134

→



290F3CD126

→



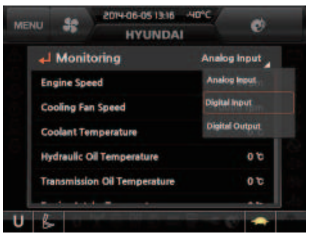
290F3CD127

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

④ Monitoring

290F3CD172

→



290F3CD188

→

290F3CD189

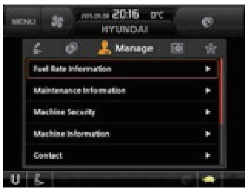
· The machine status such as the engine rpm, oil temperature, voltage and pressure etc. can be checked by this menu (Analog input).

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

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

(4) Management

① Fuel rate information



210WF3CD14

210WF3CD15

A

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

B

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

C

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

D

210WF3CD16

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

② Maintenance information

210WF3CD131

290F3CD132

290F3CD133

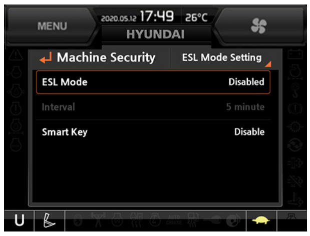
· Alarm lamp (●) is ON when oil or filter needs to be changed or replaced.
· Replacement : The elapsed time will be reset to zero (0).
· Change interval : The change or replace interval can be changed in the unit of 50 hours.
· Change or relpace interval

No	Item	Interval
1	Engine oil	500
2	Final gear oil	1000
3	Swing gear oil	1000
4	Hydraulic oil	5000
5	Pilot line filter	1000
6	Drain filter	1000
7	Hydraulic oil return filter	1000
8	Engine oil filter	500
9	Fuel filter	500
10	Pre-filter	500
11	Hydraulic tank breather	1000
12	Air cleaner (inner & outer)	2000
13	Radiator coolant	2000
14	Swing gear pinion grease	1000
15	DEF/AdBlue® supply module filter	1500
16	Crankcase Breather Filter	1500

③ Machine security

210WF3CD190B

290F3CD135B



290F3CD136A

· ESL mode setting

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

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

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

  ※Default password : 00000＋☑

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

290F3CD137A

290F3CD138A

· Password change

- The password is 5~10 digits.

210WF3CD190A

290F3CD140B

290F3CD135C

Enter the current password

290F3CD142B

Enter the new password

290F3CD143B

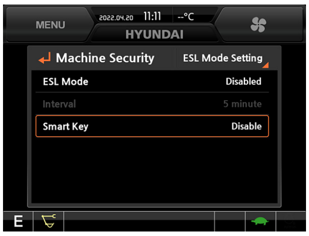
Enter the new password again

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

- Smart key

210WF3CD190A

290F3CD135C

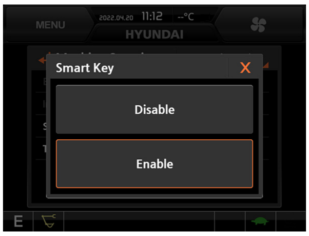


290F3CD001

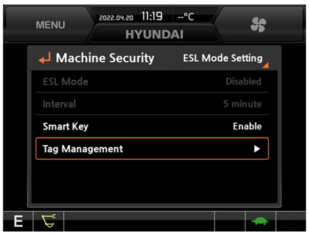
- Smart key is registered when equipped with optional smart key. If smart key is not inside of the cabin, authentication process fails and the password is needed.
- Tag management menu is activated when the Smart key menu is Enabled.
  You can register and delete the tags.

- Tag management

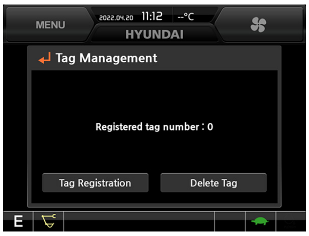
- When registering a tag : Only the tag you want to register must be in the cabin.
- When deleting a tag : All registered tags are deleted.



290F3CD002

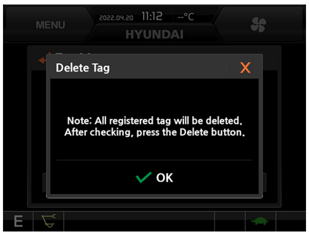


290F3CD003



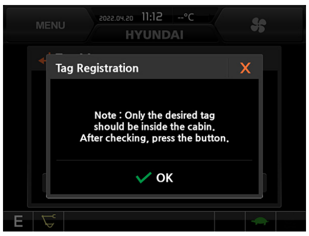
290F3CD004

Deleting



290F3CD006

Registering



290F3CD005

④ Machine Information

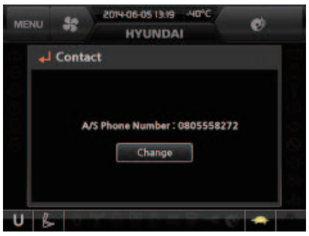
290F3CD144

290F3CD145

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

⑤ Contact (A/S phone number)

290F3CD146



290F3CD147

290F3CD148

Enter the new A/S phone number

⑥ Service menu

290F3CD149

290F3CD250

290F3CD151

· Power shift (standard/option) : Power shift pressure can be set by option menu.
· Operating hours : Operating hours since the machine line out can be checked by this menu.
· Breaker mode pump acting (1 pump/2 pump)
· EPPR current level (attach flow EPPR 1 & 2, boom priority EPPR, attach relief pressure EPPR 1& 2)
· Overload pressure : 100 ~ 350 bar

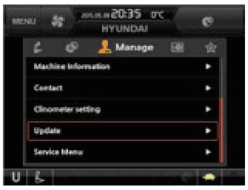
⑦ Clinometer

290F3CD152

290F3CD153

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

⑧ Update (cluster & ETC devices)

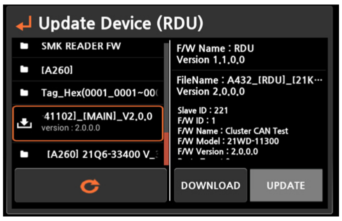


210WF3CD17

210WF3CD18

210WF3CD19

380F3CD04

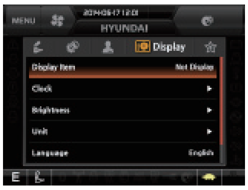


380F3CD06

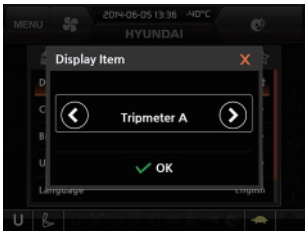
· ETC devices and cluster can be updated through CAN 2 network.
· Insert USB memory stick which includes program files, start download.

(5) Display

① Display item



290F3CD154

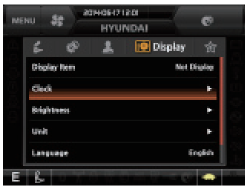


290F3CD155

290F3CD156

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

② Clock

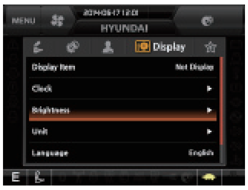


290F3CD157

290F3CD158

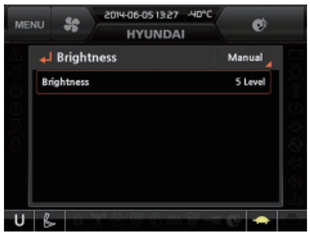
· The first line's three spots "**/**/****" represent Month/Day/Year each.
· The second line shows the current time. (0:00~23:59)

③ Brightness



290F3CD159

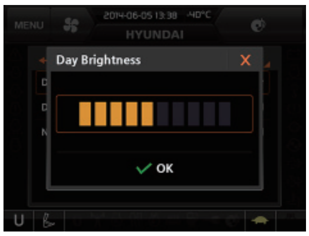
290F3CD160



290F3CD139

290F3CD141

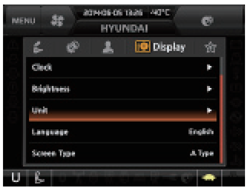
290F3CD191



290F3CD192

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

④ Unit



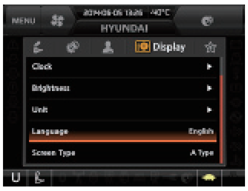
290F3CD161

210WF3CD162

290F3CD193

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

⑤ Language

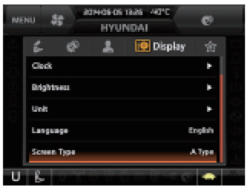


290F3CD163

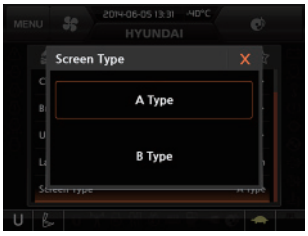
290F3CD164

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

⑥ Screen type

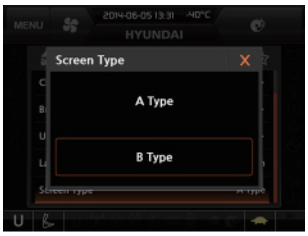


290F3CD165



A Type (Default) 290F3CD166

290F3CD156A

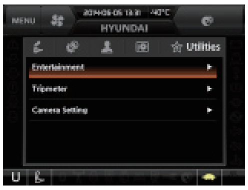


B Type (Option) 290F3CD194

290F3CD167A

(6) Utilities

① Entertainment



290F3CD195

A

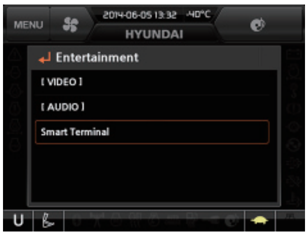
290F3CD196

210WF3CD219

B

290F3CD197

210WF3CD220



C

290F3CD198

210WF3CD199

210WF3CD22

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

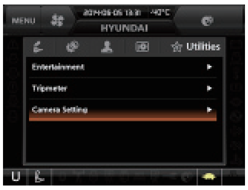
② Tripmeter

290F3CD168

290F3CD169

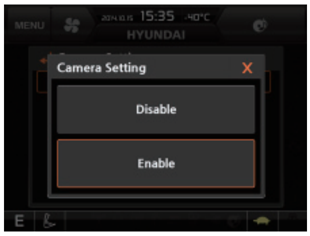
· Maximum 3 kinds of tripmeters can be used at the same time.
· Each tripmeter can be turned on by choosing "Start" while it also can be turned off by choosing "Stop".
· If the tripmeter icon is activated in the operation screen, it can be controlled directly there.

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



290F3CD200

290F3CD255



290F3CD256

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

290F3CD156


290F3CD221

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

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

290F3CD244

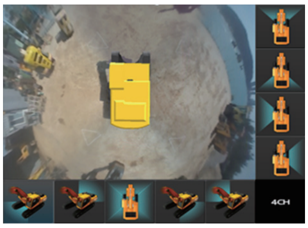
- Escape button

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

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

290F3CD156

The beginning screen



AAVM mode

290F3CD222

- Buzzer stop button

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

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

290F3CD246

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

290F3CD247

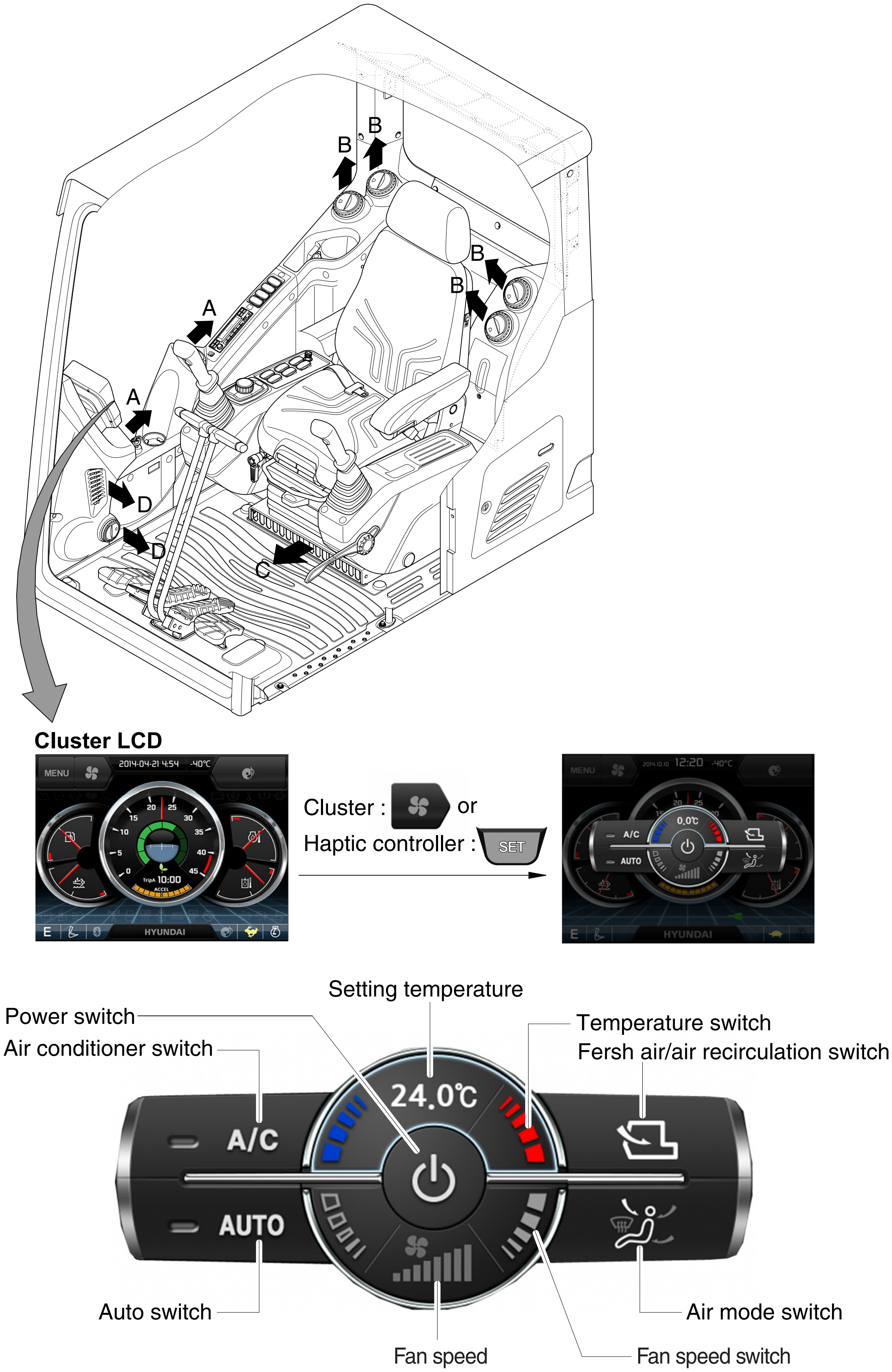
· When the worker or pedestrian go inside of red line (radius 3 m), an internal danger area of equipping on the cluster screen, the warning buzzer sounds and it displays the red rectangular box for the recognition of the worker and pedestrian.
At this time, the operator should stop work immediately,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

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

7) AIR CONDITIONER AND HEATER

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

· Location of air flow ducts



290F3CD201

※ Haptic controller : Refer to the operator's manual page 3-58.

(1) Power switch


290F3CD251

① This switch makes the system ON/OFF.
Just before the power OFF, set values are stored.
② Default setting values

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

(2) Air conditioner switch

290F3CD203

① This switch turns the compressor ON/OFF.
※ Air conditioner operates to remove vapor and drains water through a drain hose. Water can be sprayed into the cab in case that the drain cock at the ending point of drain hose has a problem.
In this case, exchange the drain cock.

(3) Auto switch

290F3CD223

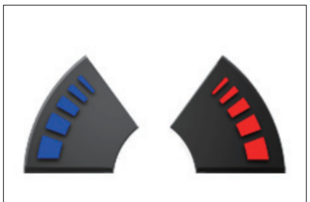
① Auto air conditiner and heater system automatically keeps the optimum condition in accordance with operator's temperature configuration sensing ambient and cabin inside temperature.

(4) Setting temperature

290F3CD224

① Display the temperature setting out.

(5) Temperature switch


290F3CD225

① Setting temperature indication
· Lo (17˚C), 17.5~31.5˚C, Hi (32˚C)
② Max cool and max warm beeps 5 times.
③ The max cool or the max warm position operates as following table.

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

④ Temperature unit can be changed between celsius (˚C) and fahrenheit (˚F)
a. Default status (˚C)
b. Push Up/Down temperature switch simultaneously more than 5 second displayed temperature unit change (˚C → ˚F)

(6) Fan speed switch

290F3CD226

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

(7) Fan speed

290F3CD227

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

(8) Fresh air/air recirculation switch

290F3CD228

① It is possible to change the air-inlet method.

a. Fresh air ( )
Inhaling air from the outside.

b. Air recirculation ( )
It recycles the heated or cooled air to increase the energy efficiency.

※ Change air occasionally when using recirculation for a long time.

※ Check out the fresh air filter and the recirculation filter periodically to keep a good efficiency.

(9) Air mode switch

290F3CD229

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

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

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

8) SELF DIAGNOSIS FUNCTION

(1) Diagnostic methods : Diagnostic information window, select

(2) Diagnostic indication (Displays fault)

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

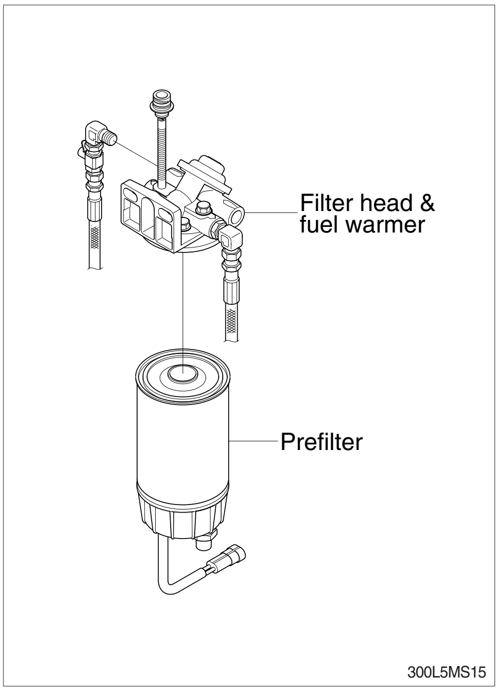
GROUP 17 FUEL WARMER SYSTEM

1. SPECIFICATION

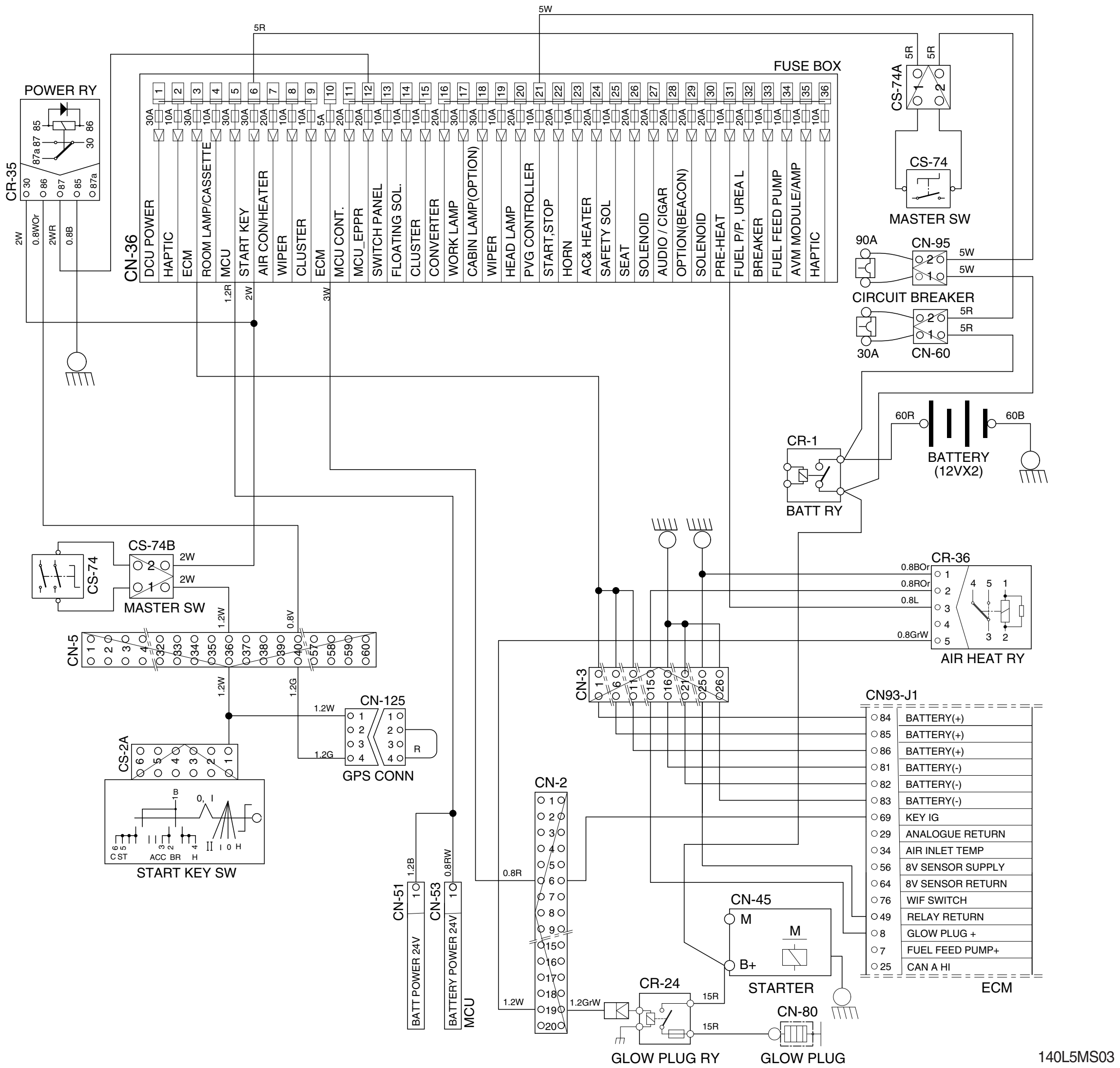
1) Operating voltage : 24±4 V
2) Power : 350±50 W
3) Current : 15 A

2. OPERATION

1) The current of fuel warmer system is automatically controlled without thermostat according to fuel temperature.
2) At the first state, the 15 A current flows to the fuel warmer and engine may be started in 1~2 minutes.
3) If the fuel starts to flow, ceramic-disk in the fuel warmer heater senses the fuel temperature to reduce the current as low as 1.5 A.
So, fuel is protected from overheating by this mechanism.



3. ELECTRIC CIRCUIT



SECTION 6 TROUBLESHOOTING

SECTION 6 TROUBLESHOOTING

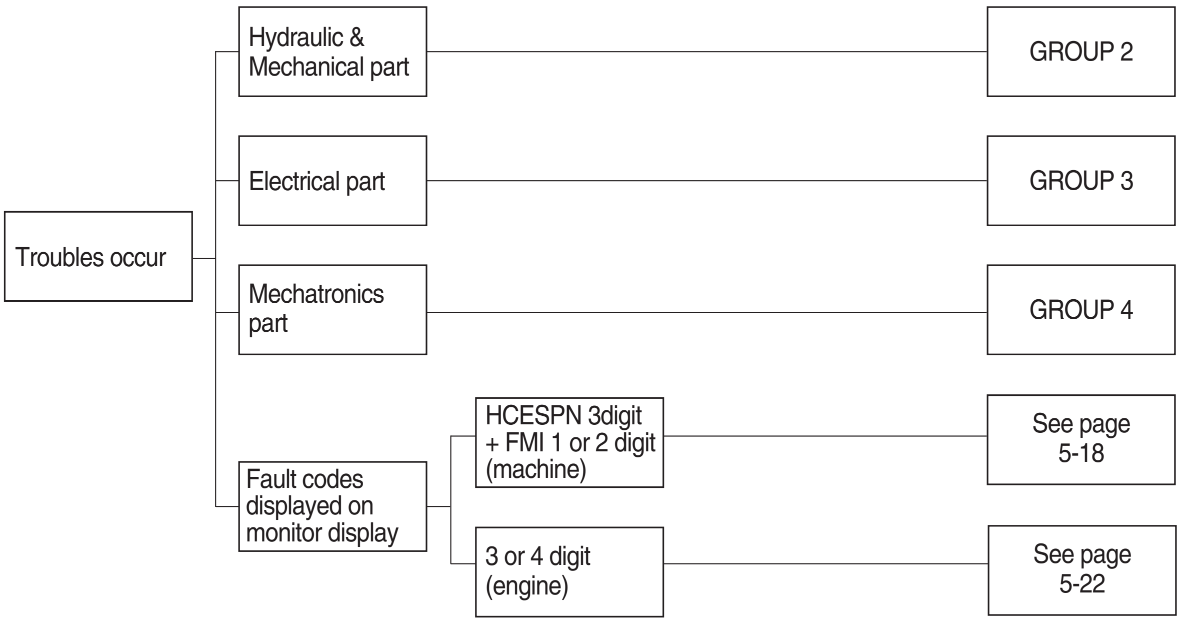
GROUP 1 BEFORE TROUBLESHOOTING

1. INTRODUCTION

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

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

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

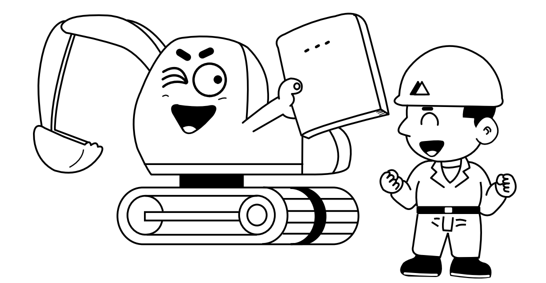


2. DIAGNOSING PROCEDURE

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

STEP 1. Study the machine system

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

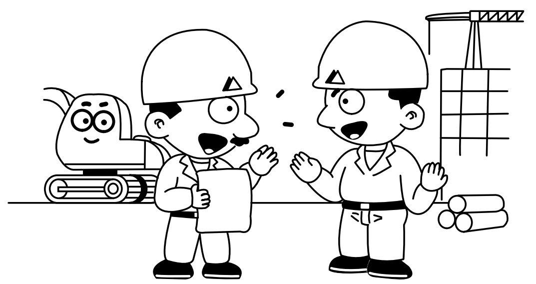


13031SH02

STEP 2. Ask the operator

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

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

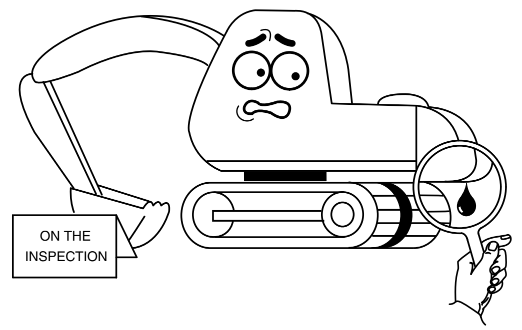


13031SH03

STEP 3. Inspect the machine

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

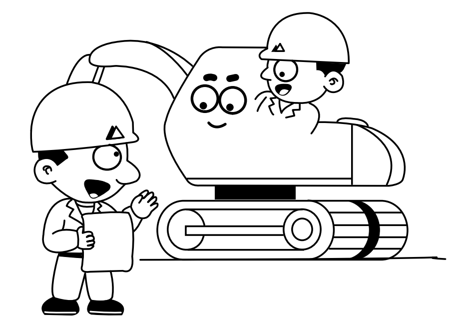
And also check the electrical system including batteries, as the troubles in the electrical system such as low battery voltage, loose connections and blown out fuses will result in malfunction of the controllers causing total operational failures of the machine.



(210-7) 6-2(3)

STEP 4. Inspect the trouble actually on the machine

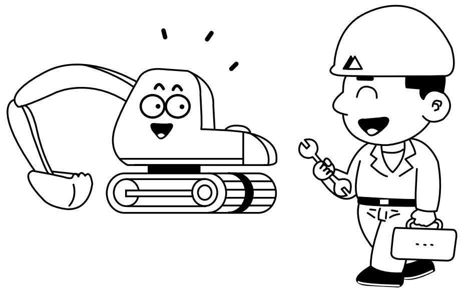
In case that some trouble cannot be confirmed, obtain the details of the malfunction from the operator.
Also, check if there are any in complete connections of the wire harnesses are or not.



(210-7) 6-3(1)

STEP 5. Perform troubleshooting

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

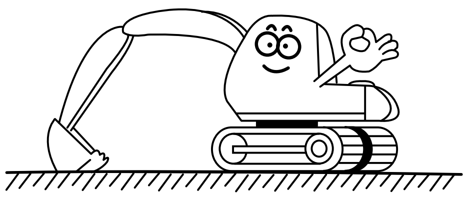


13031SH05

STEP 6. Trace a cause

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

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



(210-7) 6-3(3)

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.

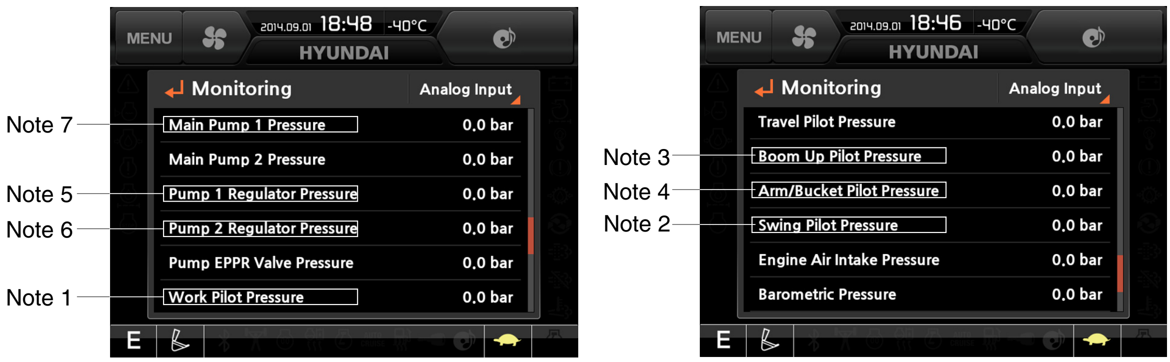
(3) When carrying out troubleshooting, do not hurry to disassemble the components.
It will become impossible to find the cause of the problem.

(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.



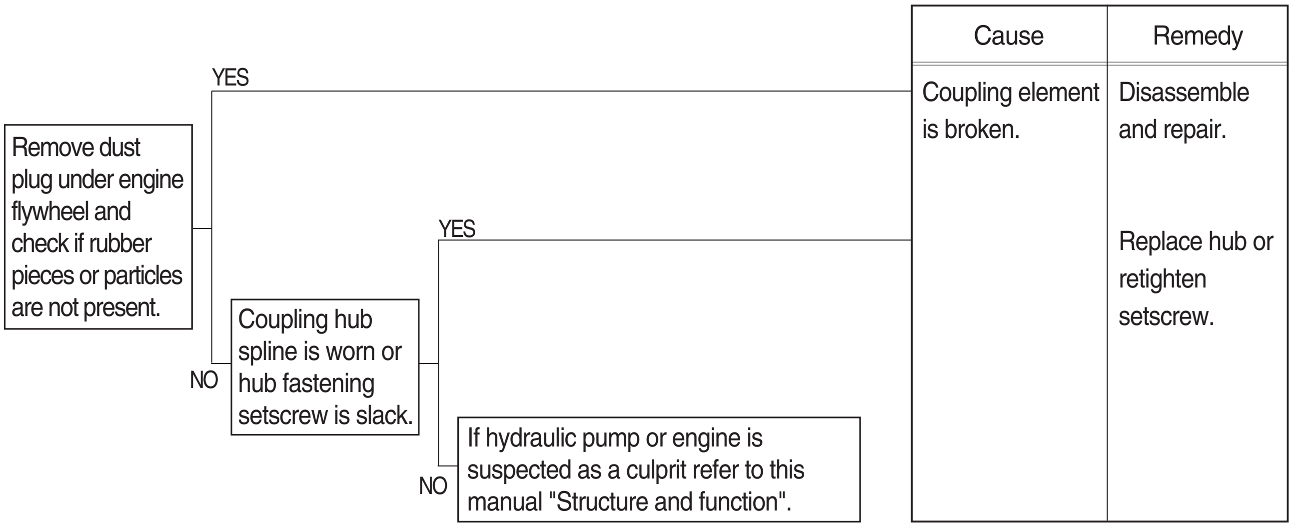
Analog 1 Analog 2 300L6HS01

(2) Specification

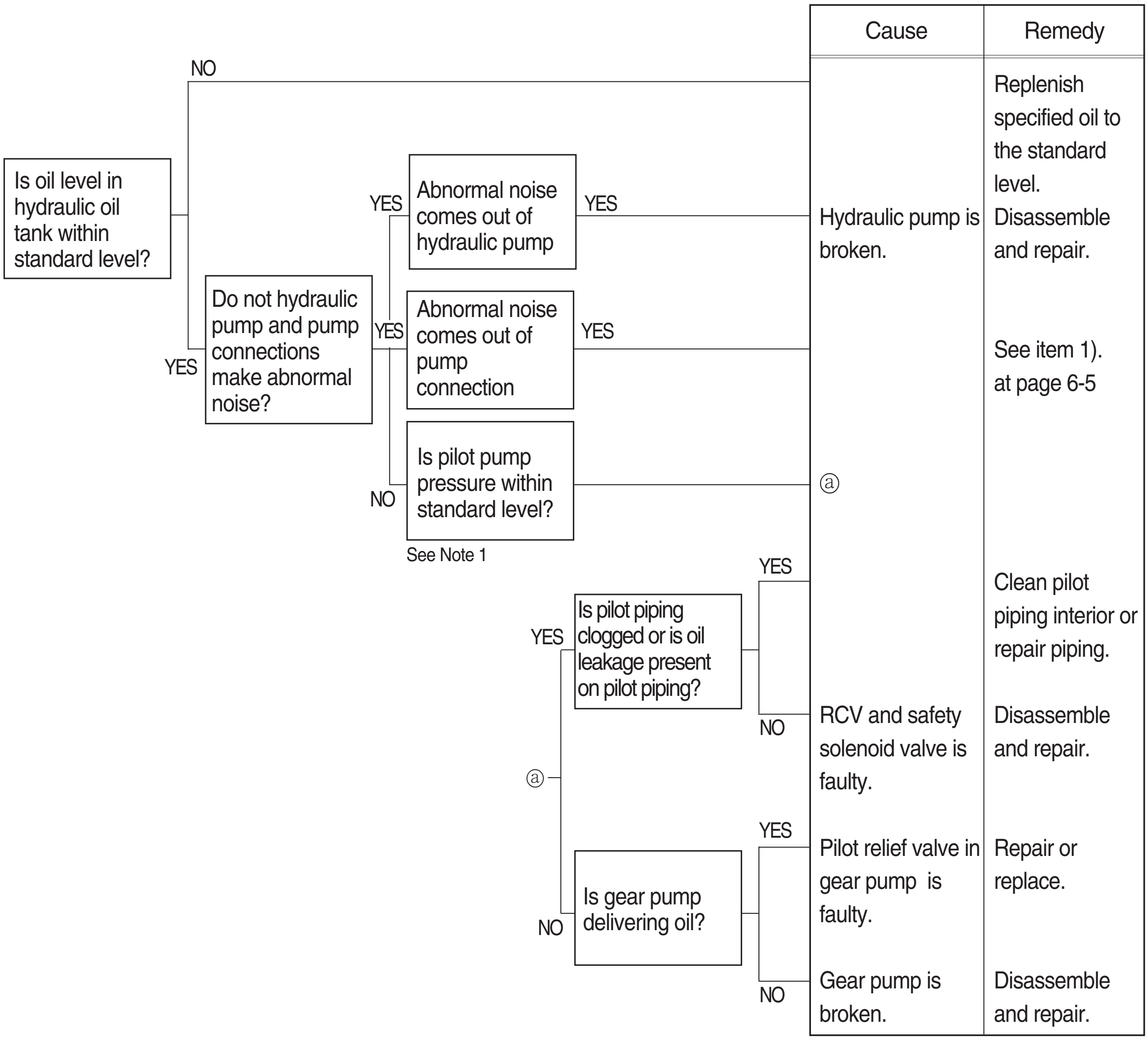
No.	Description	Specification
Note 1	Work pilot pressure	40^{+2}_{0} bar
Note 2	Swing pilot pressure	0~40 bar
Note 3	Boom up pilot pressure	0~40 bar
Note 4	Arm/bucket pilot pressure	0~40 bar
Note 5	Pump 1 regulator pressure	0~50 bar
Note 6	Pump 2 regulator pressure	0~50 bar
Note 7	Pump 1 pressure	350 bar

2. DRIVE SYSTEM

1) UNUSUAL NOISE COMES OUT OF PUMP CONNECTION

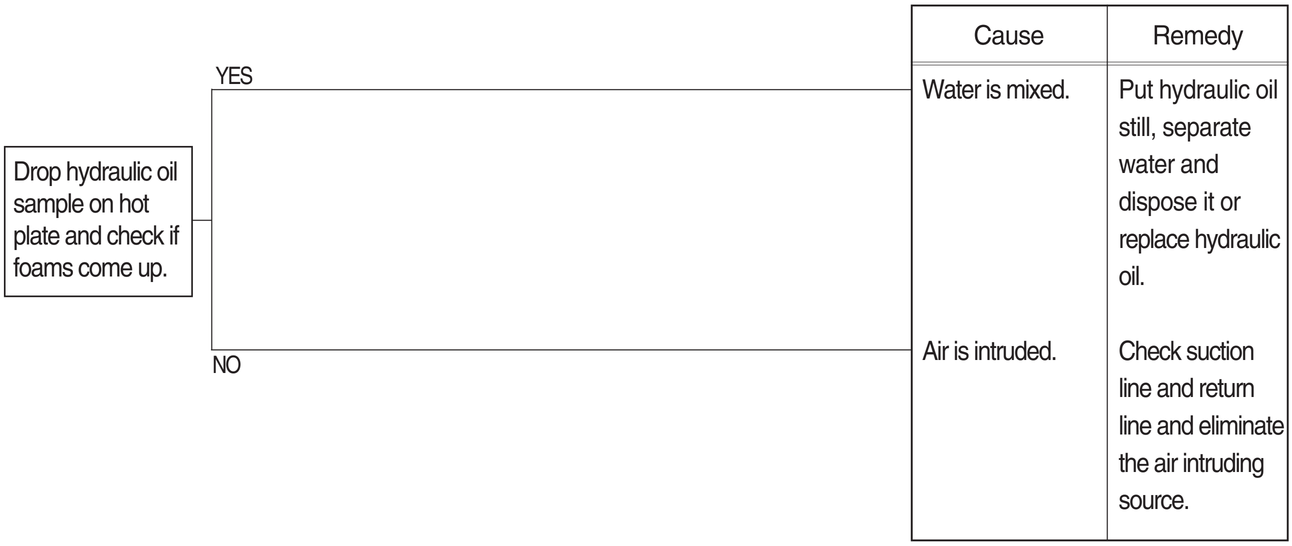


2) ENGINE STARTS BUT MACHINE DOES NOT OPERATE AT ALL

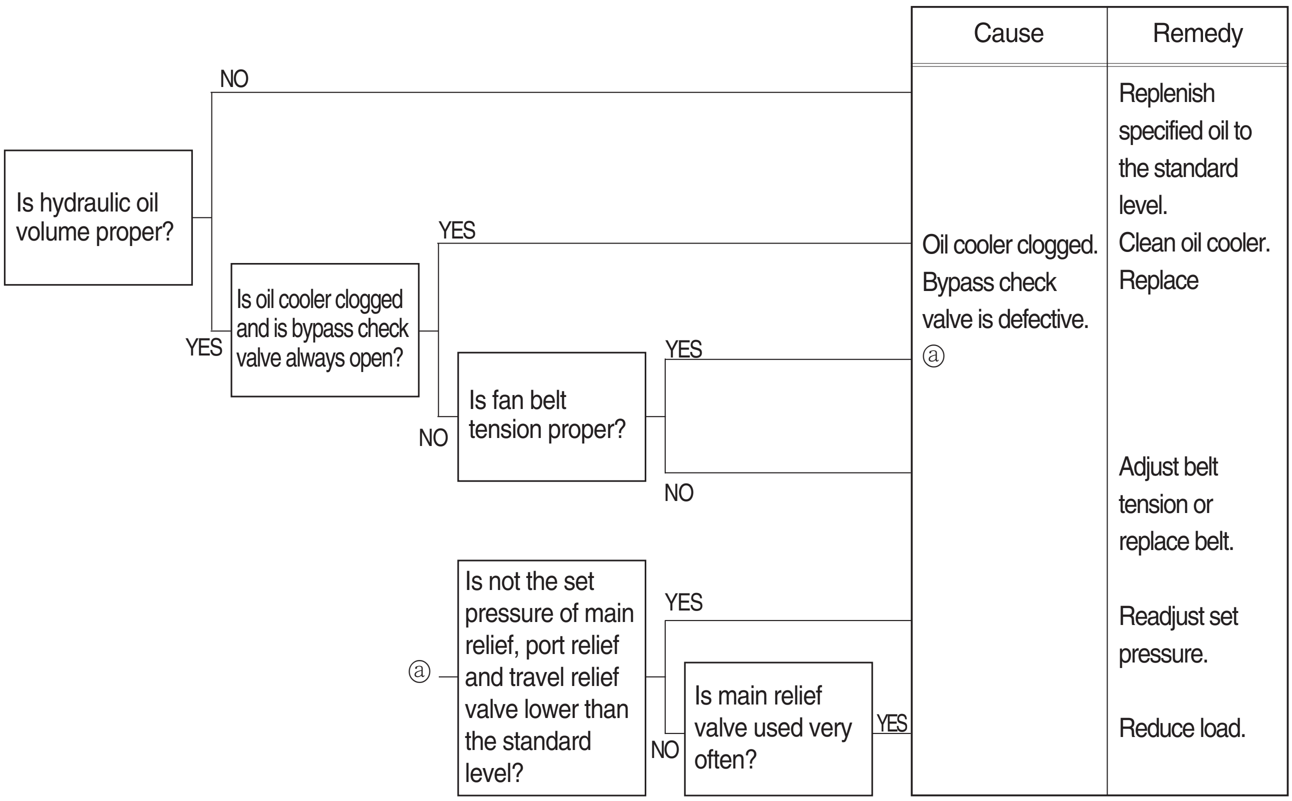


3. HYDRAULIC SYSTEM

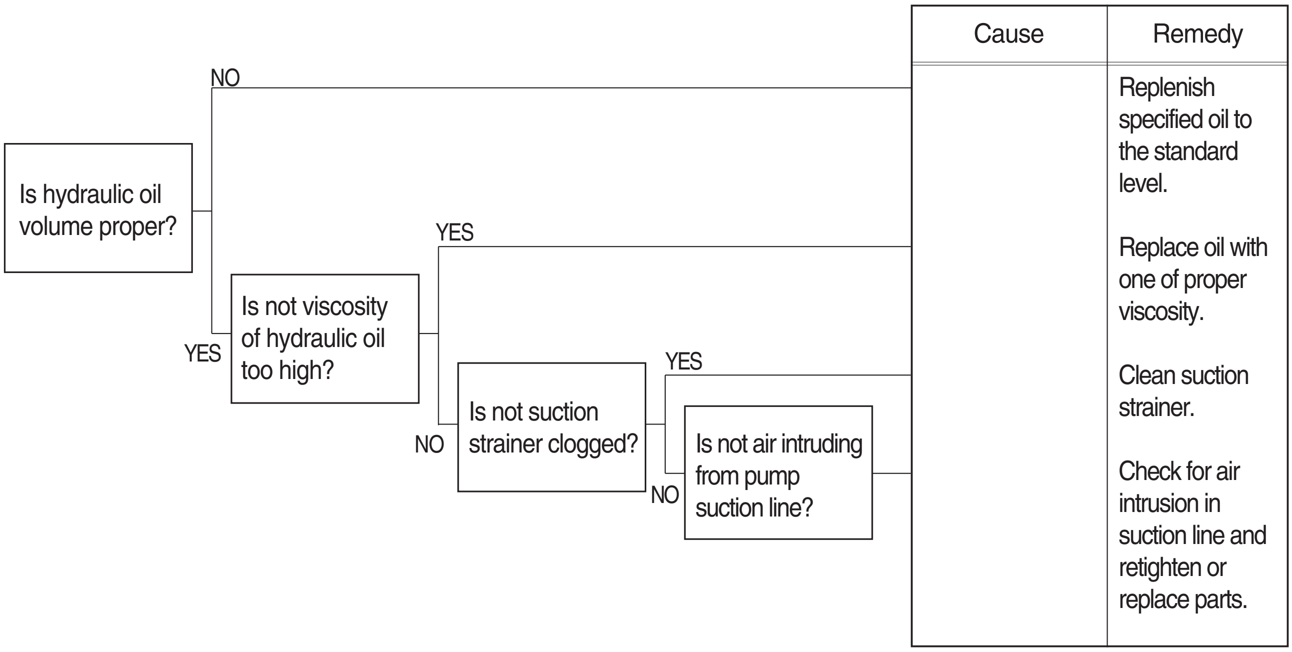
1) HYDRAULIC OIL IS CLOUDY



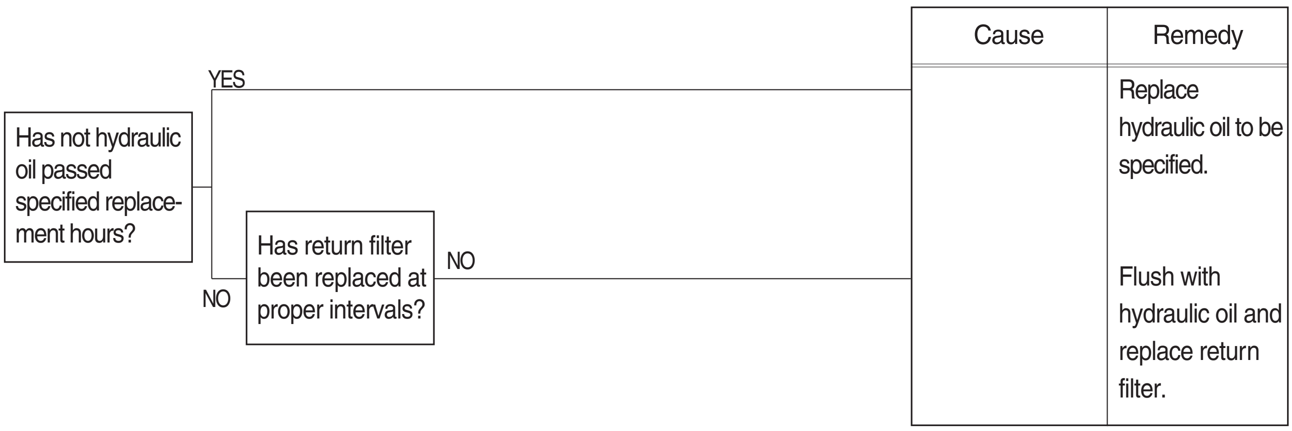
2) HYDRAULIC OIL TEMPERATURE HAS RISEN ABNORMALLY



3) CAVITATION OCCURS WITH PUMP

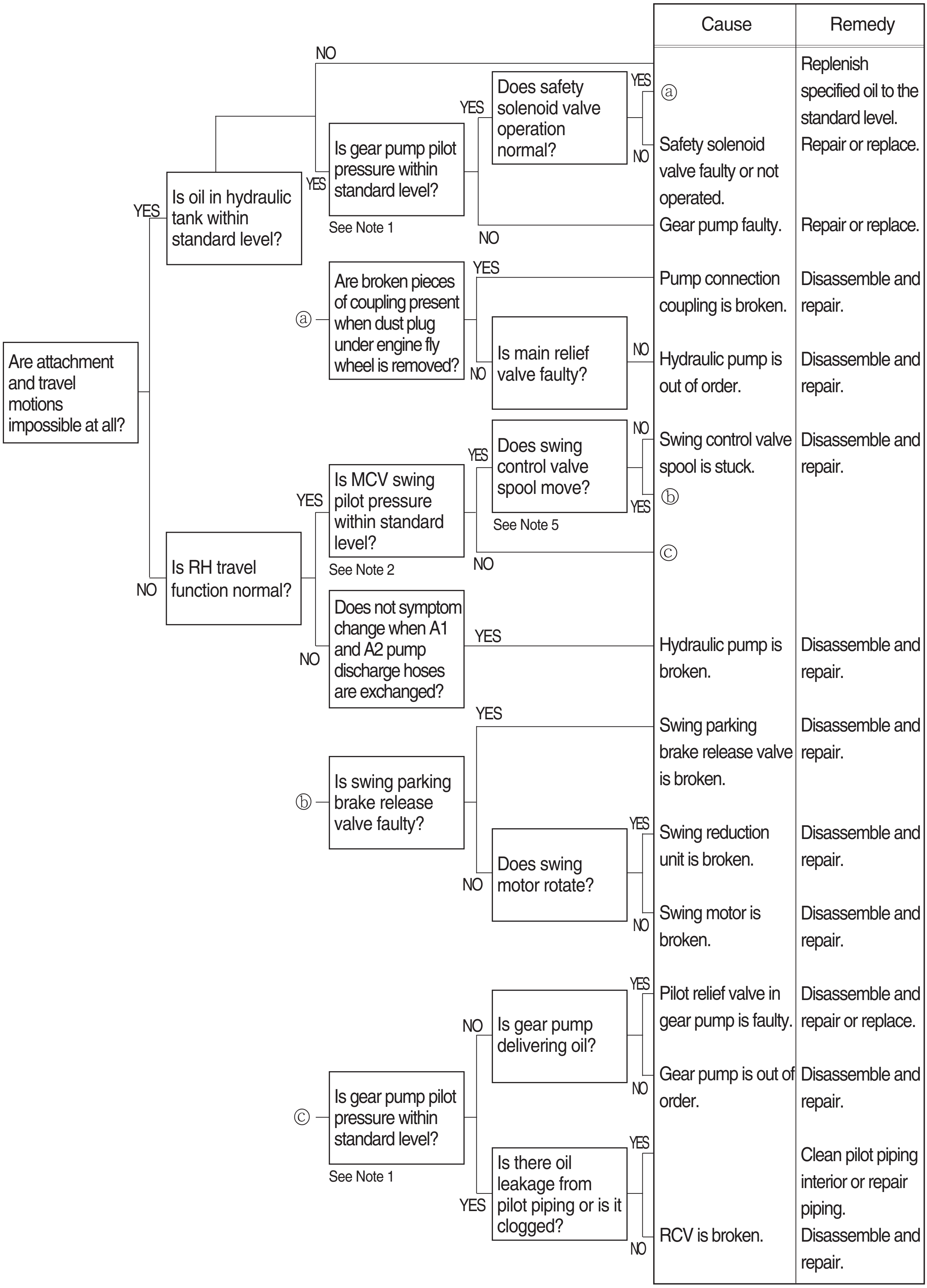


4) HYDRAULIC OIL IS CONTAMINATED

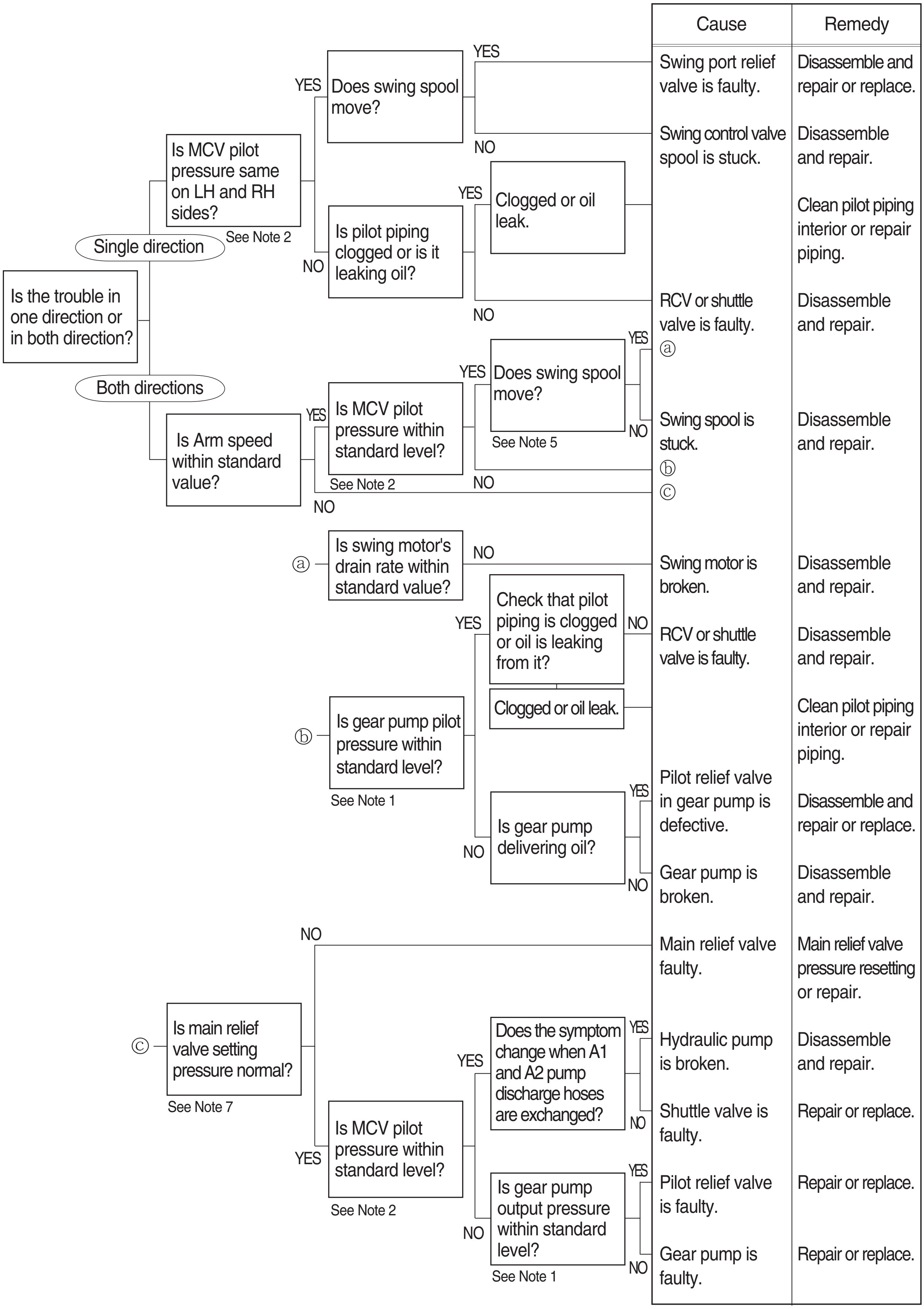


4. SWING SYSTEM

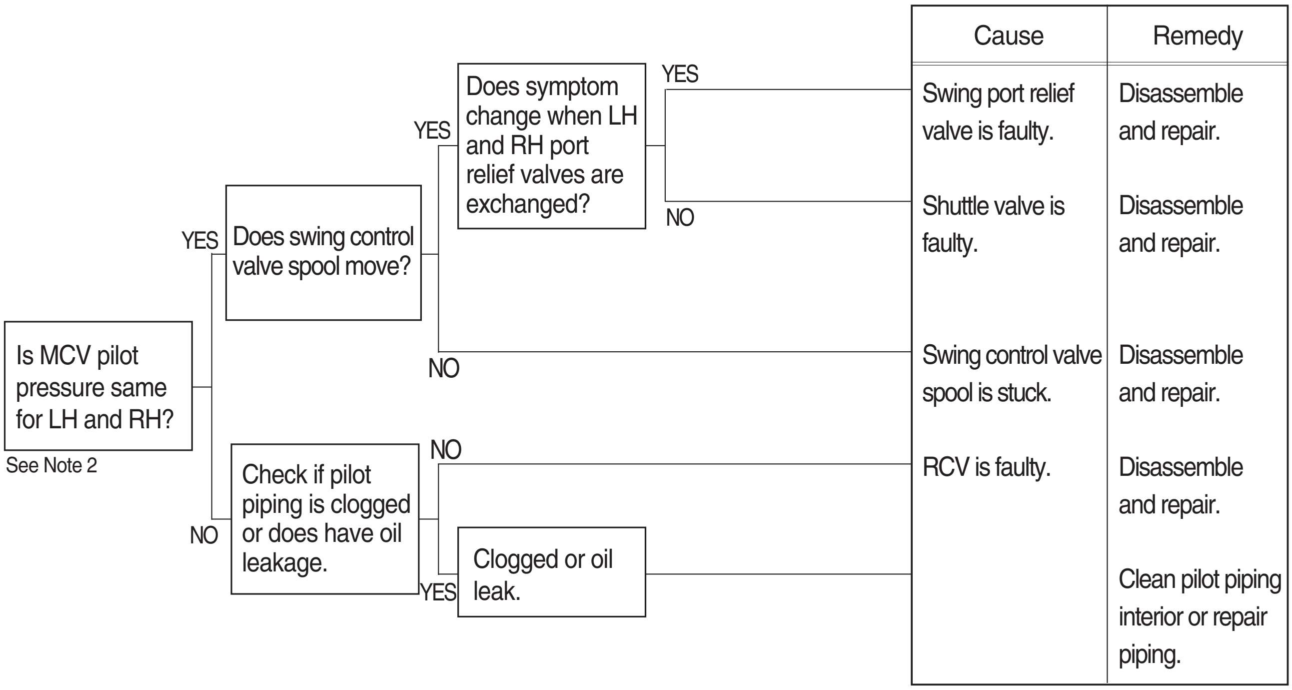
1) BOTH LH AND RH SWING ACTIONS ARE IMPOSSIBLE



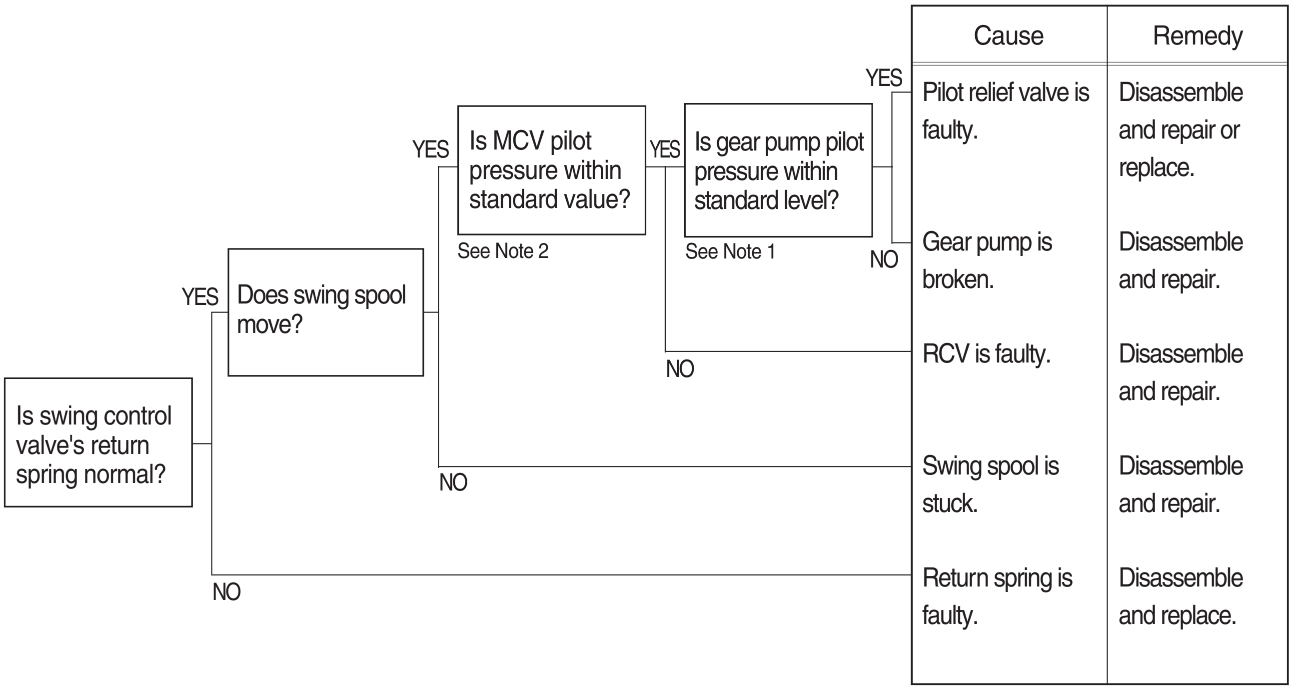
2) SWING SPEED IS LOW



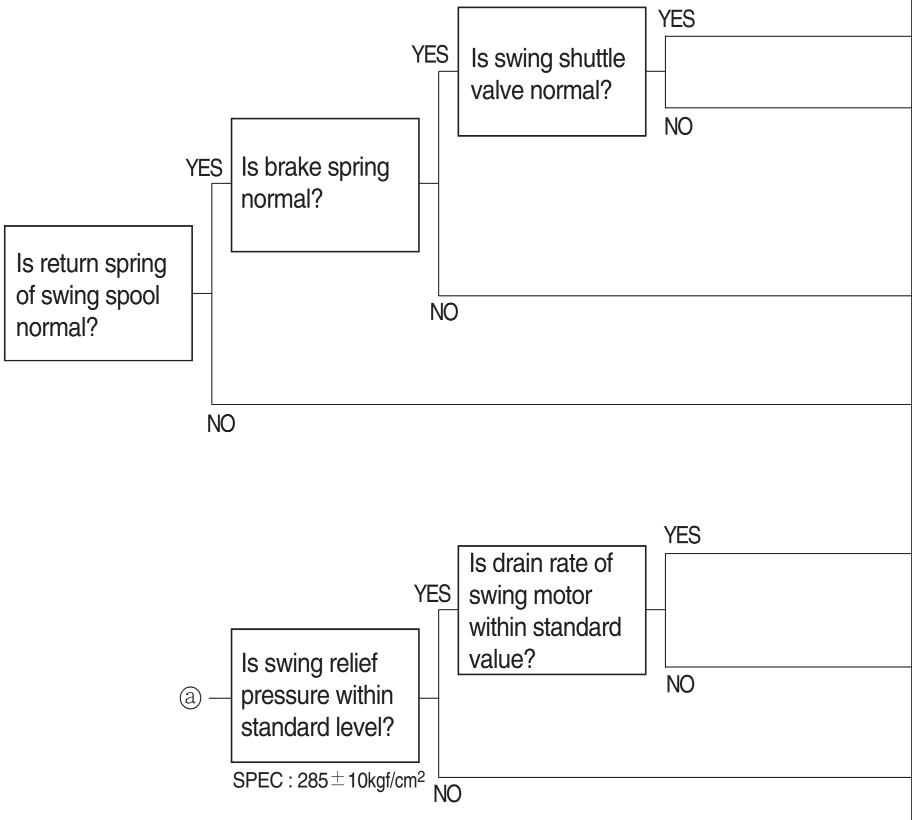
3) SWING MOTION IS IMPOSSIBLE IN ONE DIRECTION



4) MACHINE SWINGS BUT DOES NOT STOP



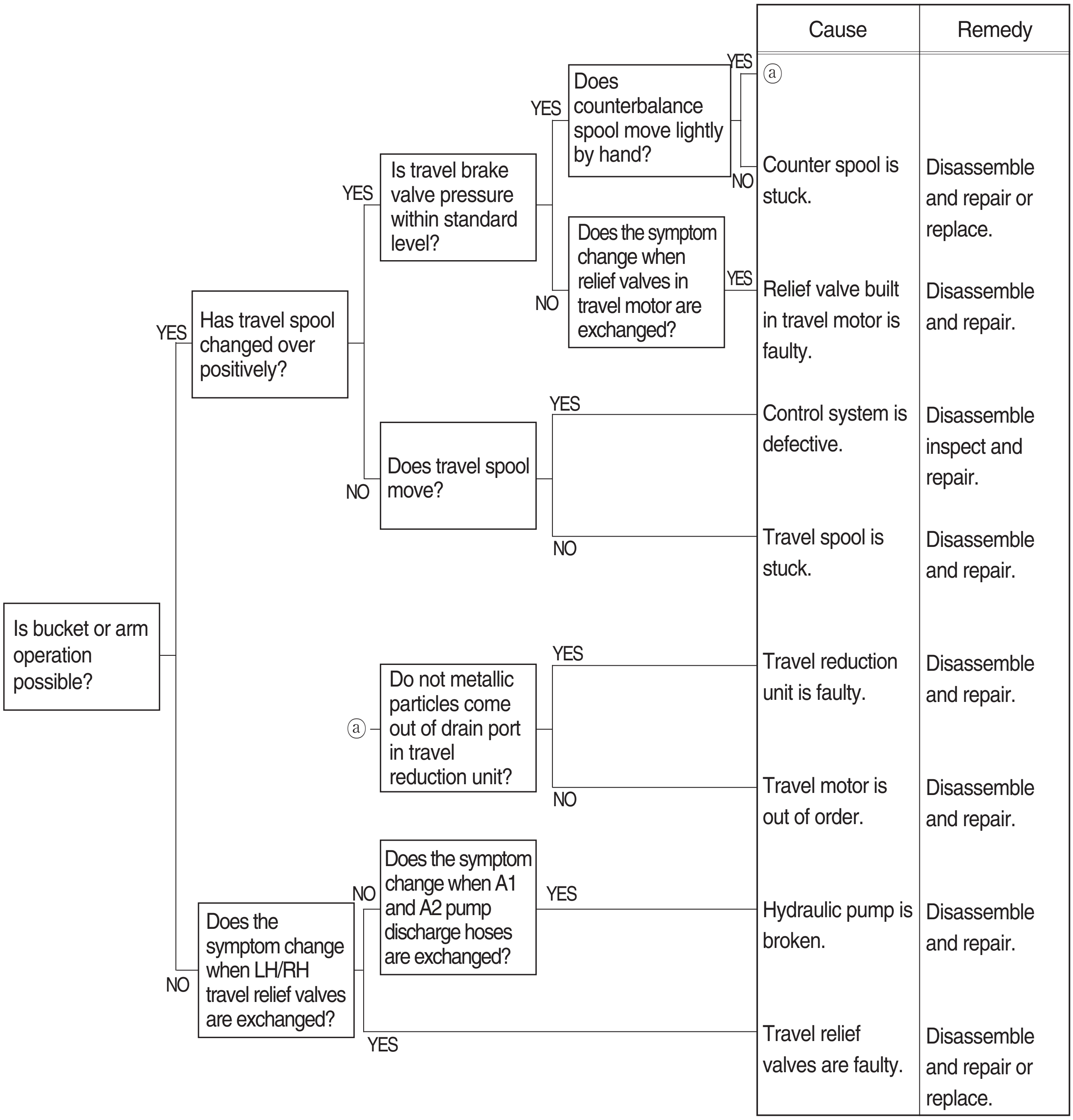
5) THE SWING UNIT DRIFTS WHEN THE MACHINE IS AT REST ON A SLOPE



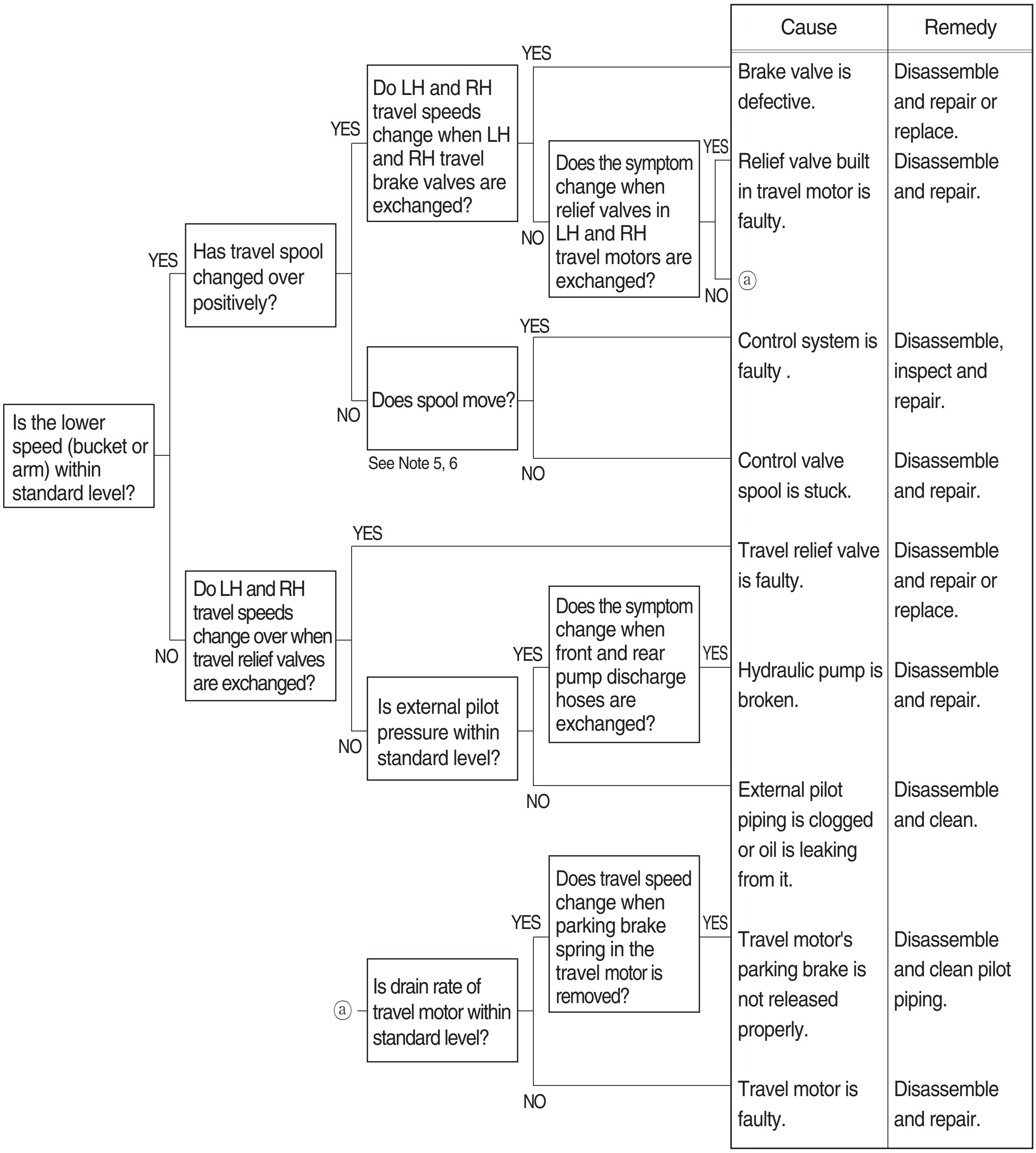
Cause	Remedy
ⓐ	
Shuttle valve is faulty.	Disassemble and replace.
Brake spring is faulty.	Disassemble and replace.
Return spring of swing control valve is faulty.	Disassemble and replace.
Swing port relief valve is faulty.	Disassemble and repair or replace.
Swing motor is broken.	Disassemble and repair.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

5. TRAVEL SYSTEM

1) TRAVEL DOES NOT FUNCTION AT ALL ON ONE SIDE

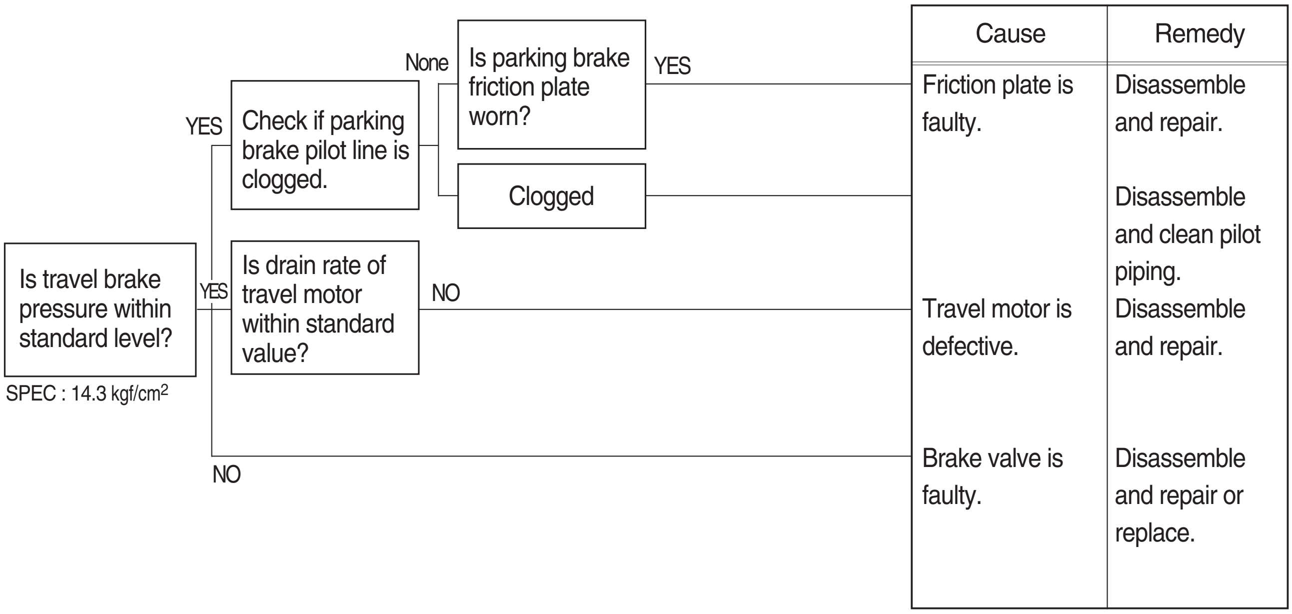


2) SPEED ON ONE SIDE FALLS AND THE MACHINE CURVES

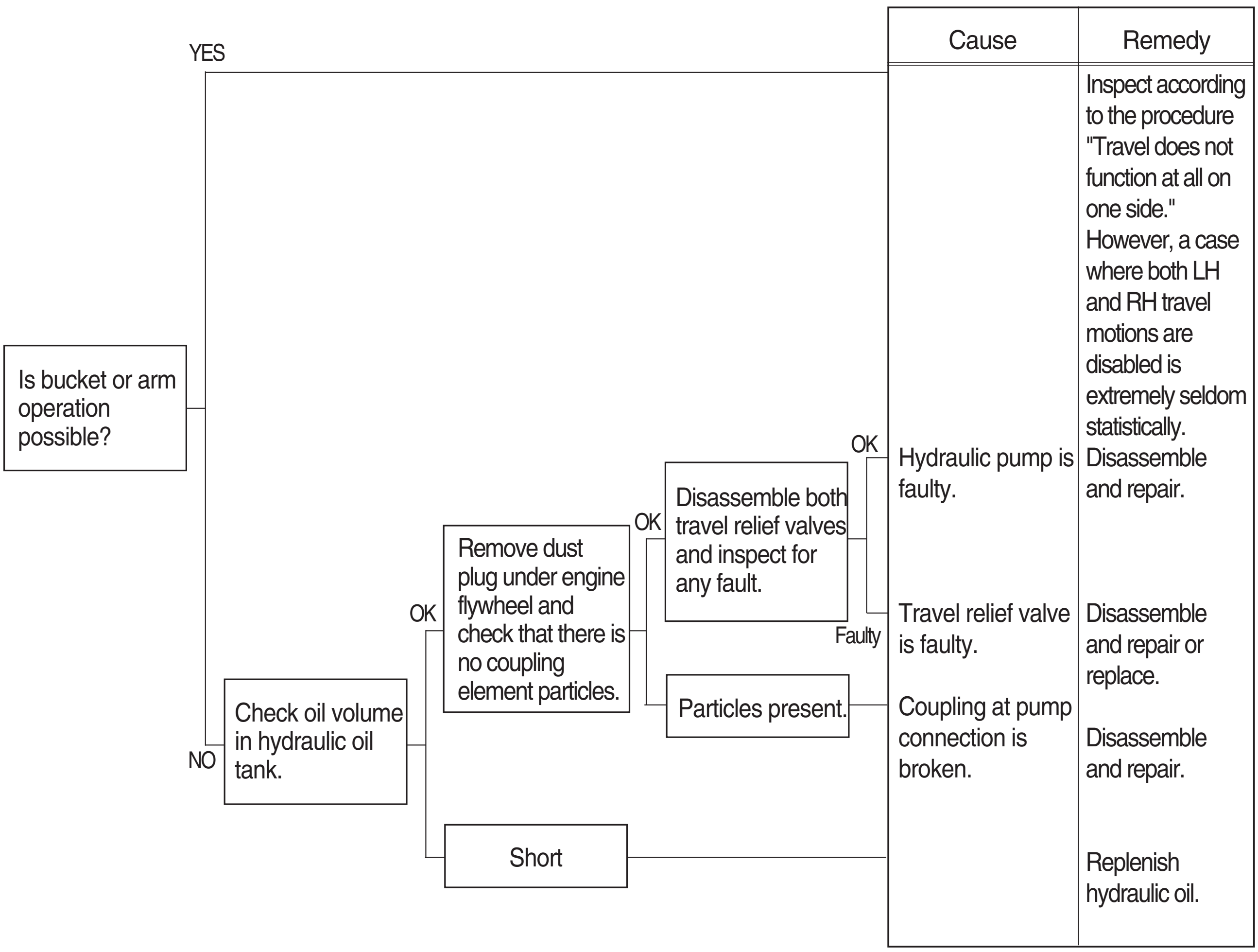


3) MACHINE DOES NOT STOP ON A SLOPE

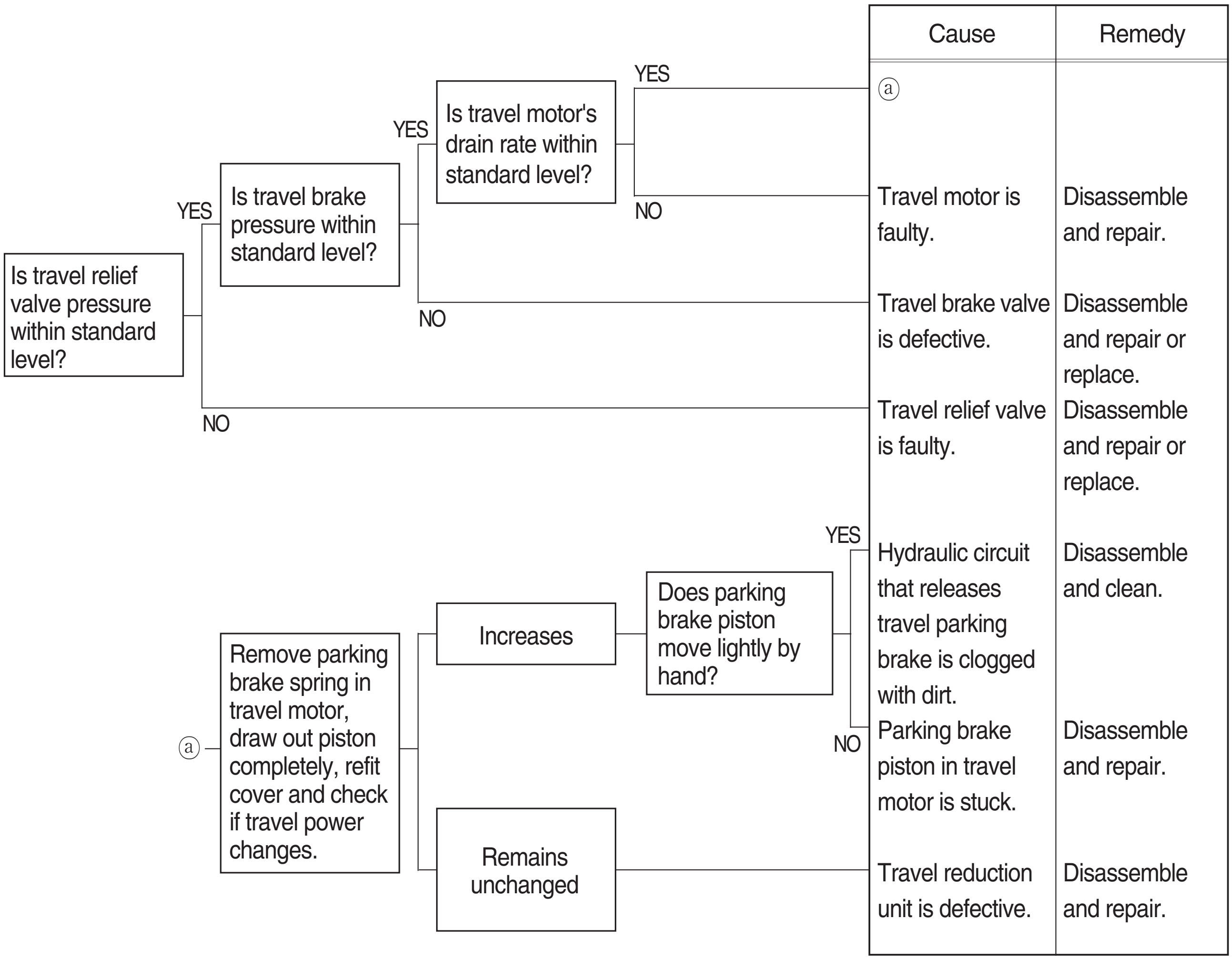
Machine is pulled forward as sprocket rotates during digging operation.



4) LH AND RH TRAVEL MOTIONS ARE IMPOSSIBLE

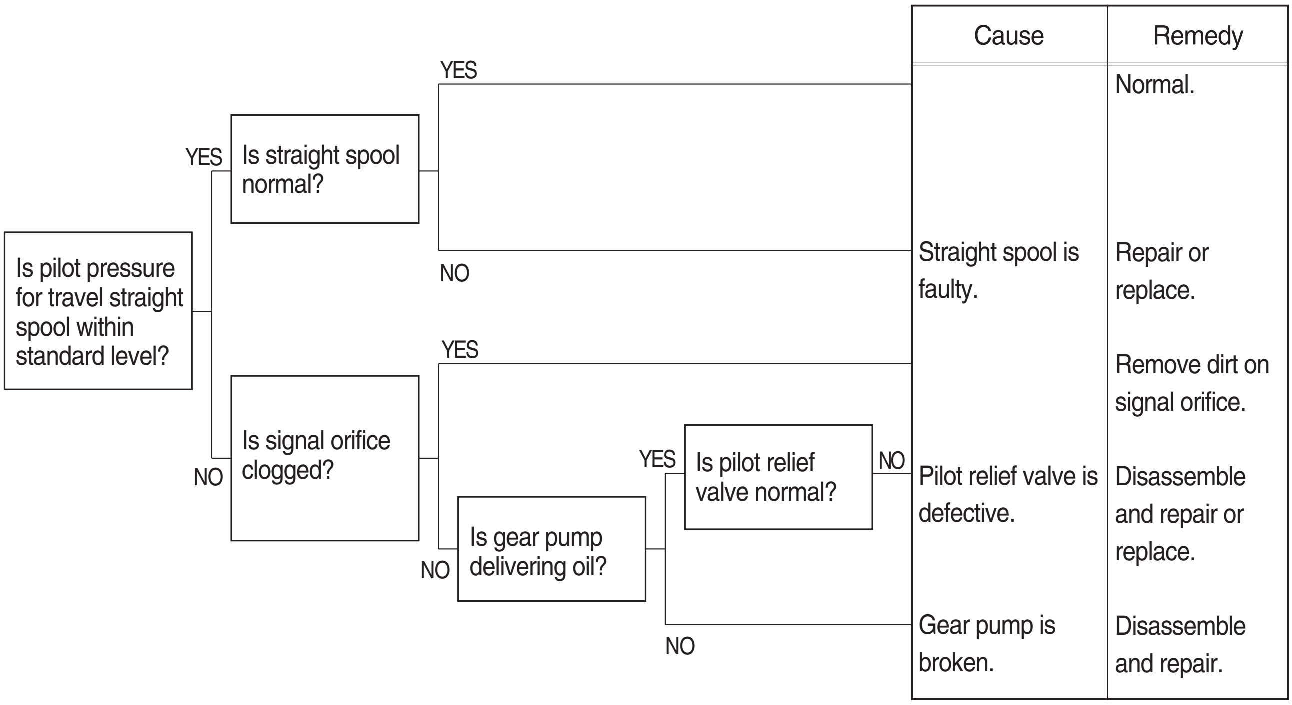


5) TRAVEL ACTION IS POWERLESS (travel only)



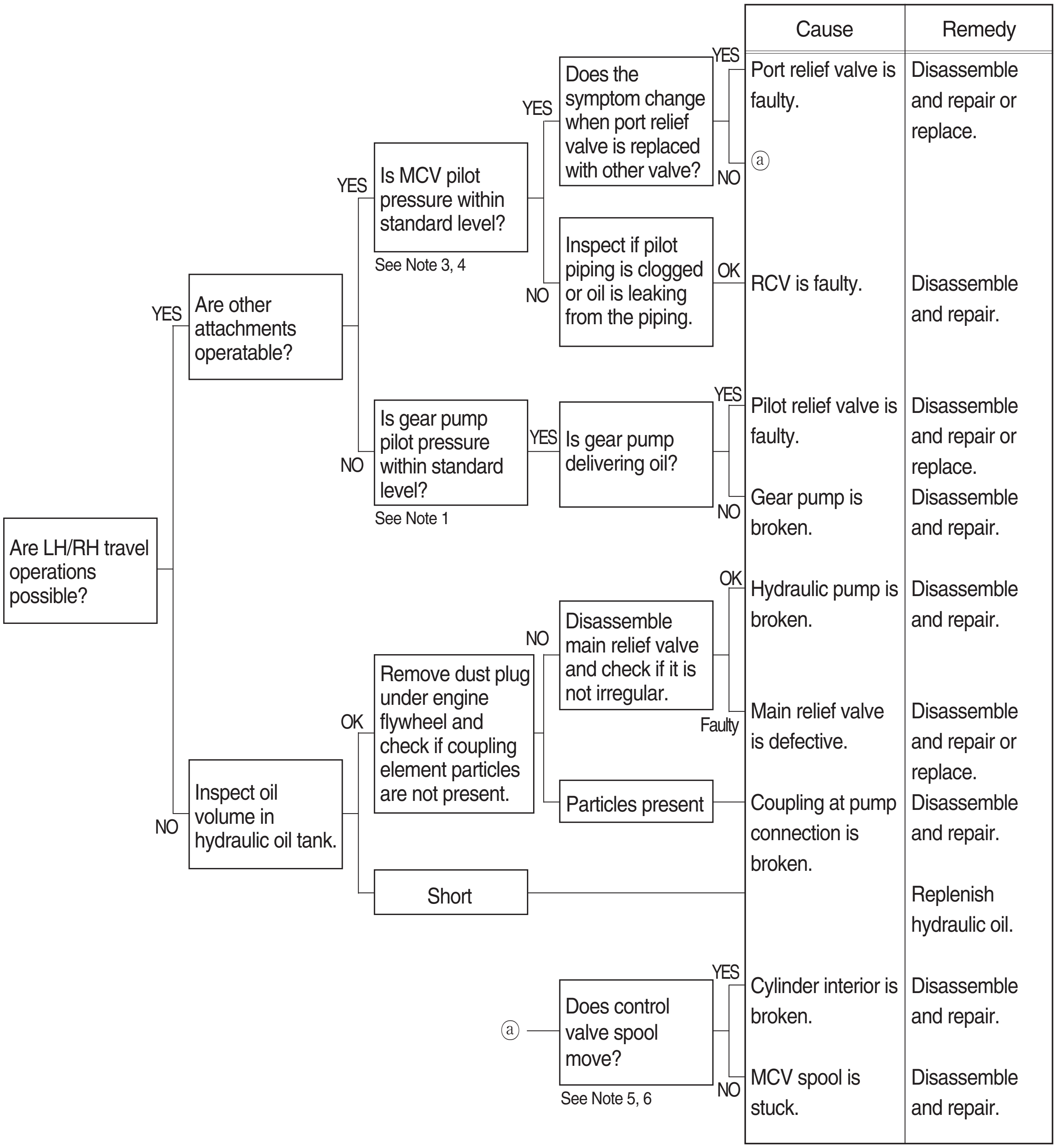
6) MACHINE RUNS RECKLESSLY ON A SLOPE

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

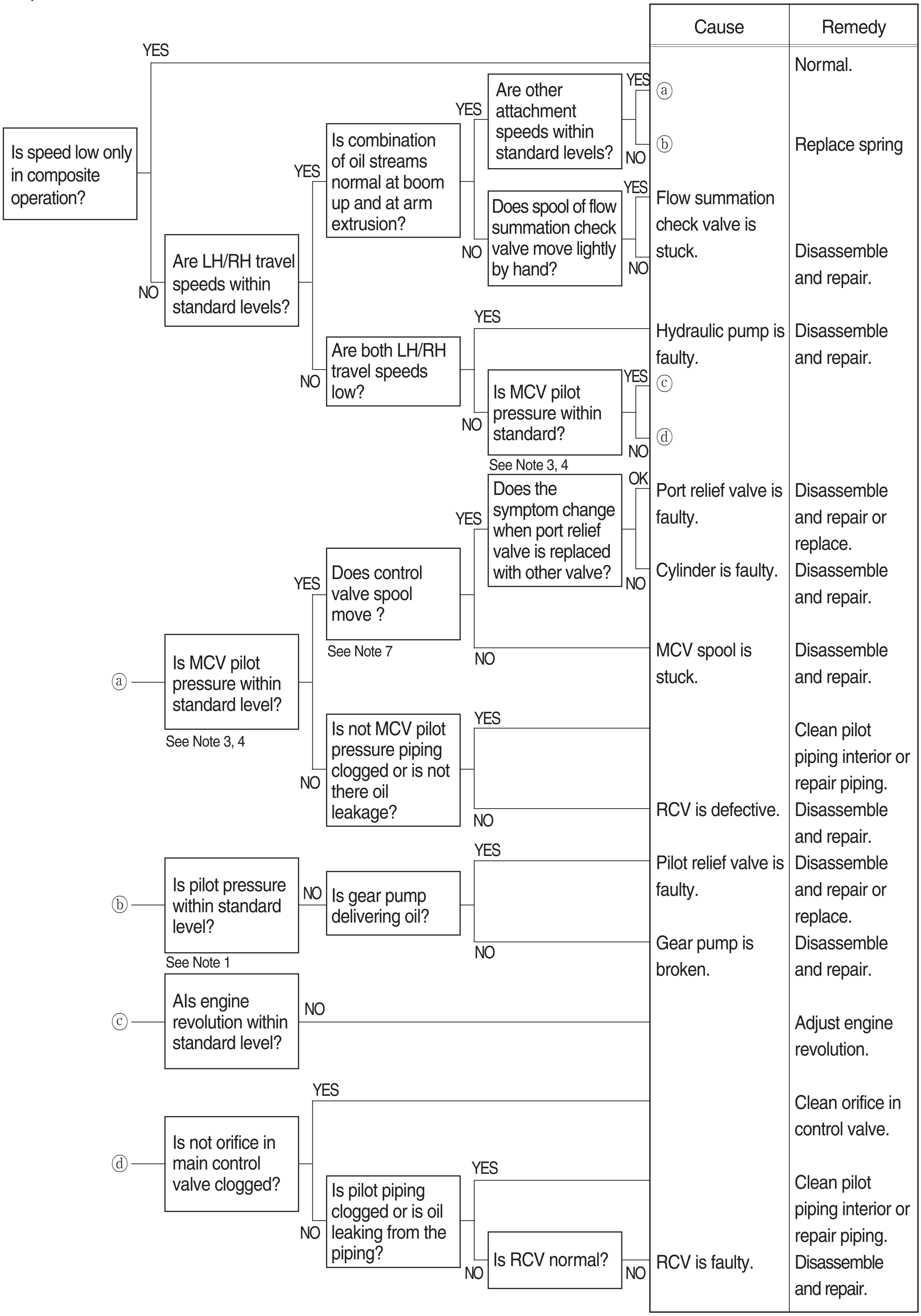


6. ATTACHMENT SYSTEM

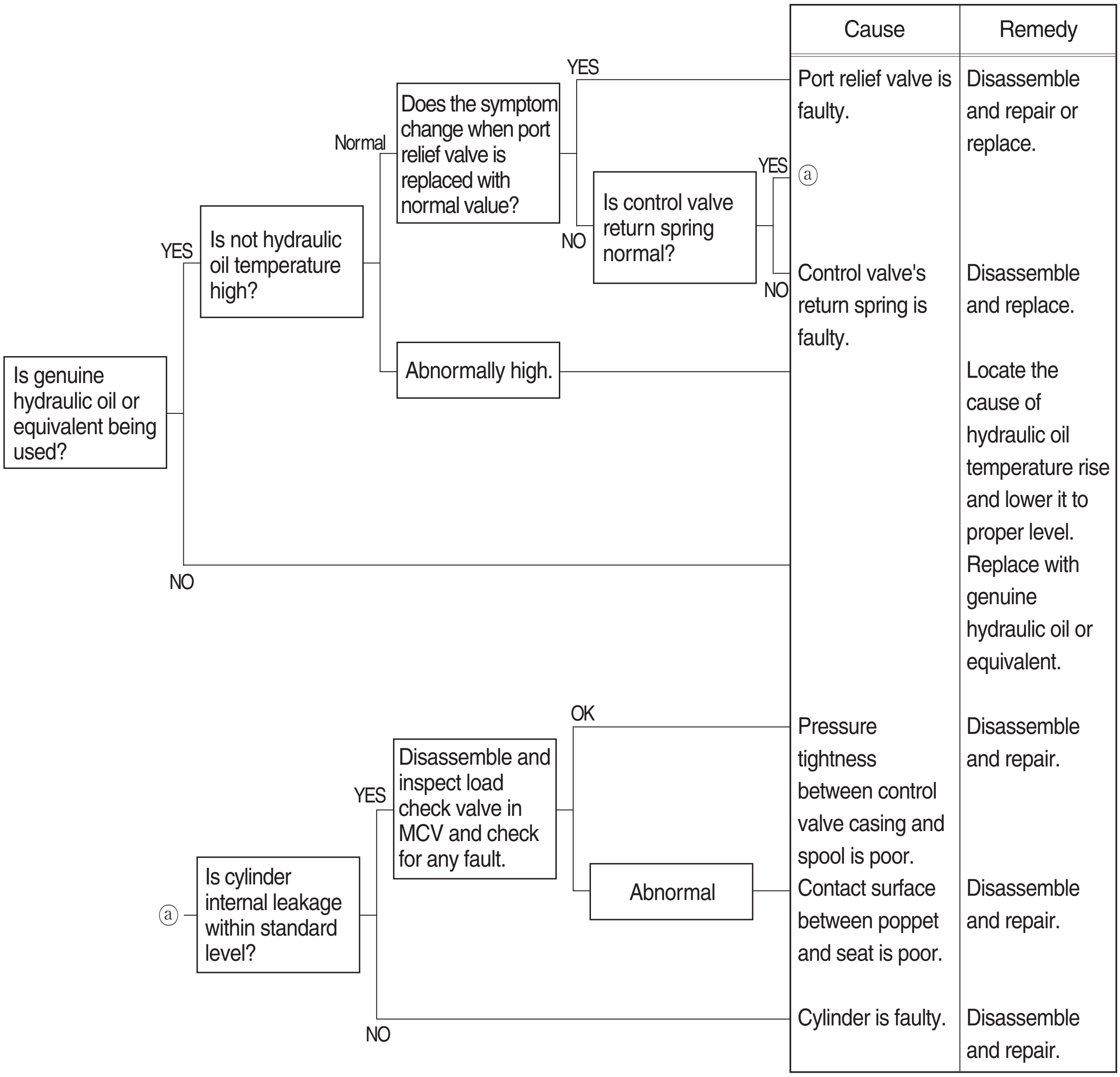
1) BOOM OR ARM ACTION IS IMPOSSIBLE AT ALL



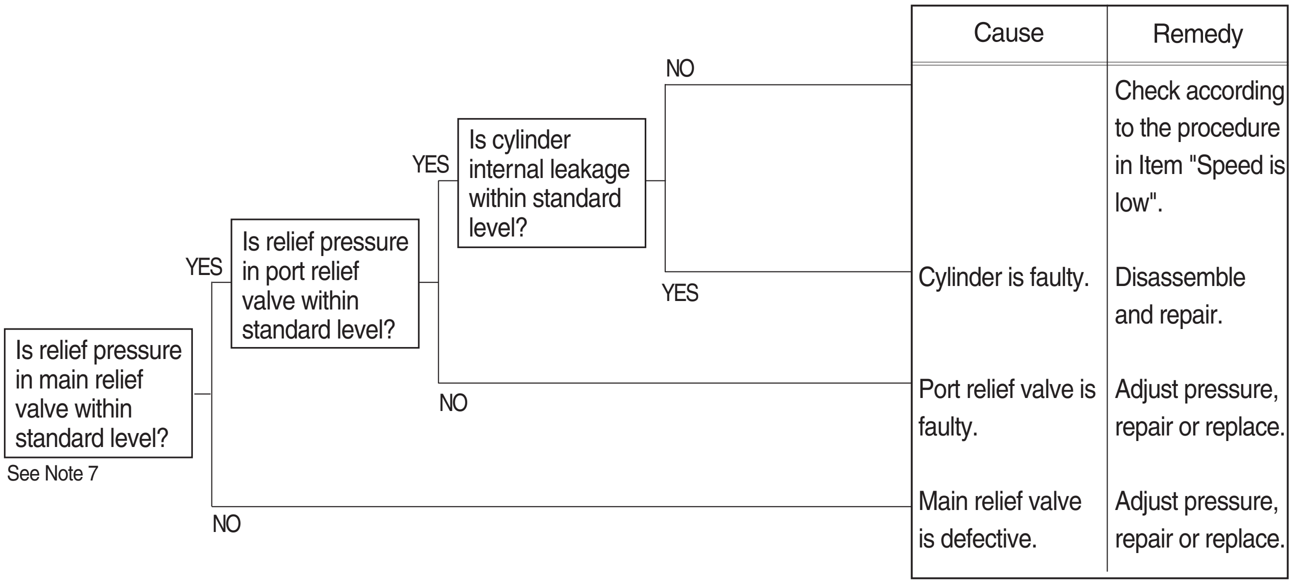
2) BOOM, ARM OR BUCKET SPEED IS LOW



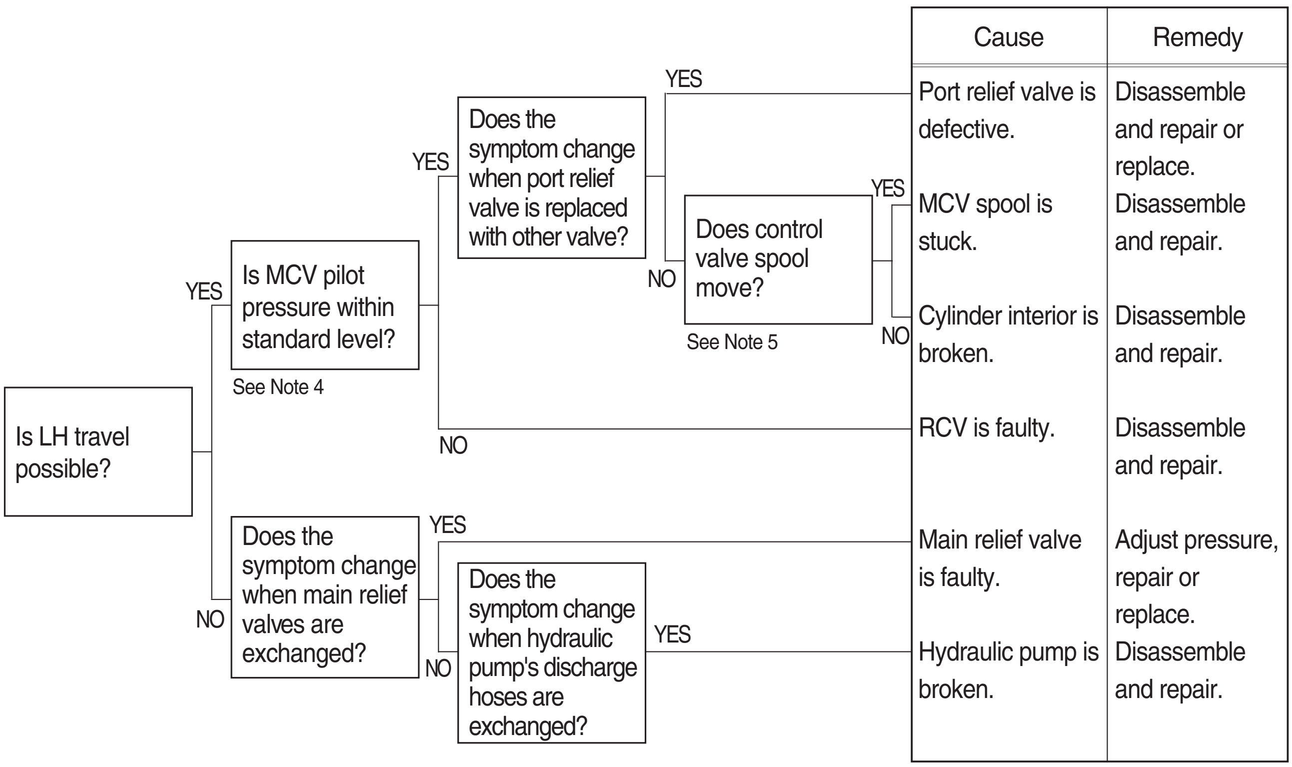
3) BOOM, ARM OR BUCKET CYLINDER EXTENDS OR CONTRACTS ITSELF AND ATTACHMENT FALLS



4) BOOM, ARM OR BUCKET POWER IS WEAK



5) ONLY BUCKET OPERATION IS TOTALLY IMPOSSIBLE



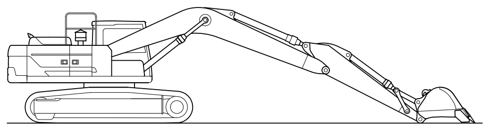
6) BOOM MAKES A SQUEAKING NOISE WHEN BOOM IS OPERATED

Is boom foot pin greased sufficiently?

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

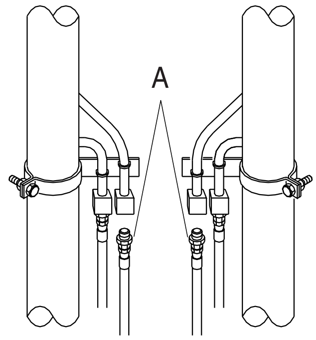
※ HOW TO CHECK INTERNAL BOOM CYLINDER LEAKAGE

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



300L6TS01

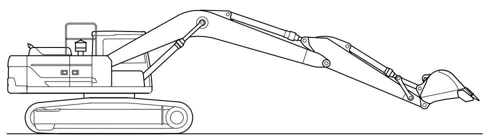
2. Disconnect hose (A) from rod side of boom cylinder and drain oil from cylinders and hose. (put cups on piping and hose ends)



(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.



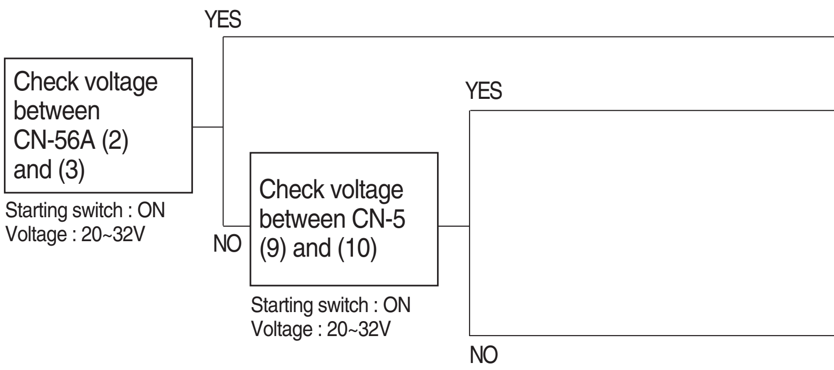
300L6TS02

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. 9, 15.

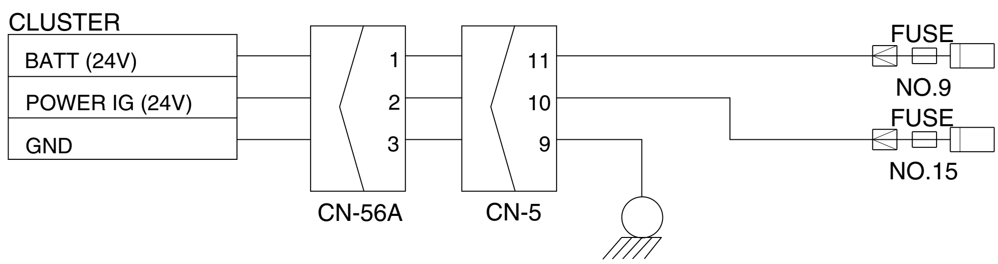
· After checking, insert the disconnected connectors again immediately unless otherwise specified.



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. 9, 15	Repair or replace (after clean)

Check voltage

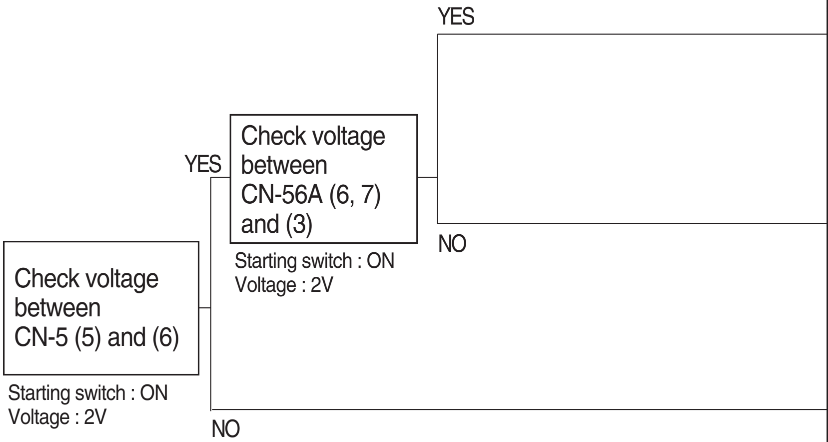
YES	20~32V
NO	0V



140L6ES01

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

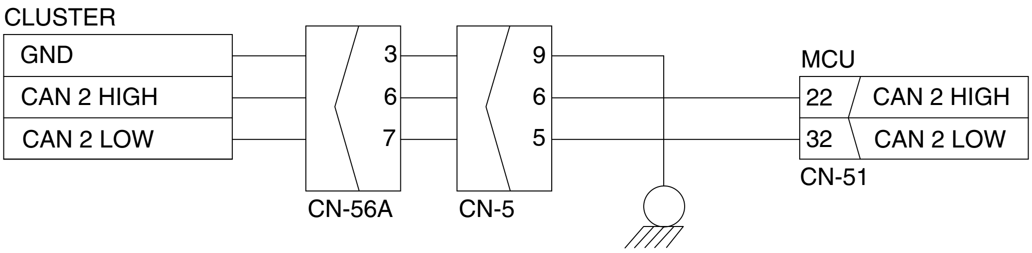
· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.



Cause	Remedy
Defective cluster	Replace
Disconnection in wiring harness or poor contact between CN-56A (6, 7)-CN-5 (5, 6)	Repair or replace (after clean)
Defective MCU Disconnection in wiring harness or poor contact between CN-5 (5, 6)- CN-51(22, 32)	Replace Repair or replace (after clean)

Check voltage

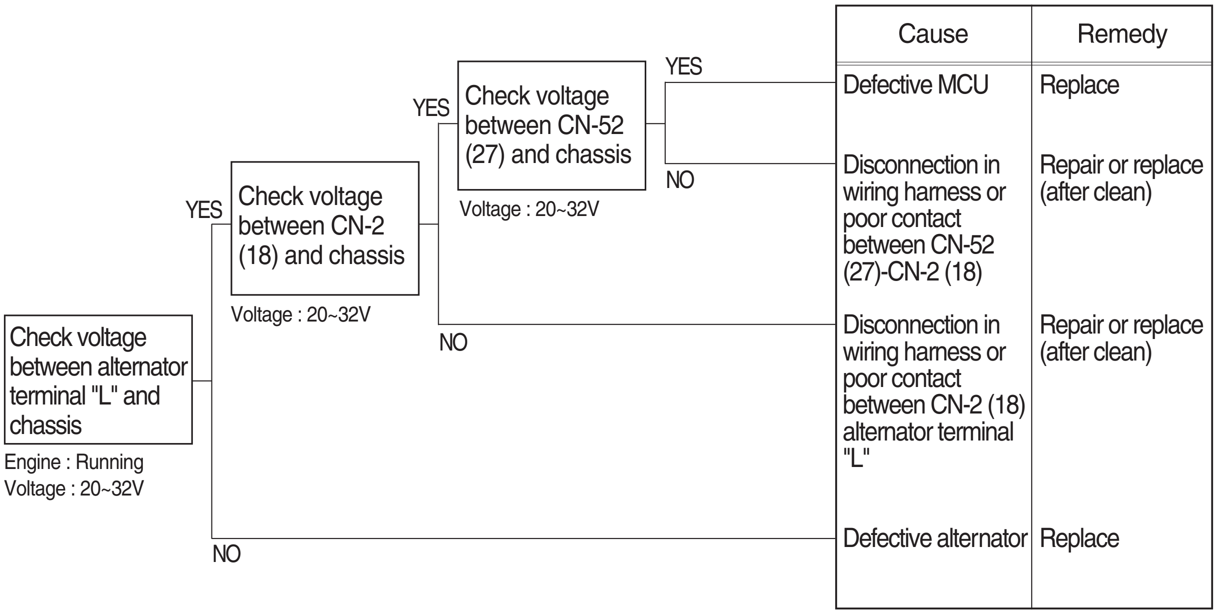
YES	2V
NO	0V



300L6ES02

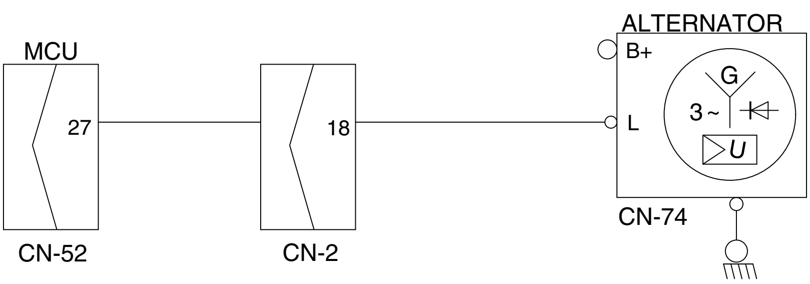
3. BATTERY CHARGING WARNING LAMP LIGHTS UP (Starting switch : ON)

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



Check voltage

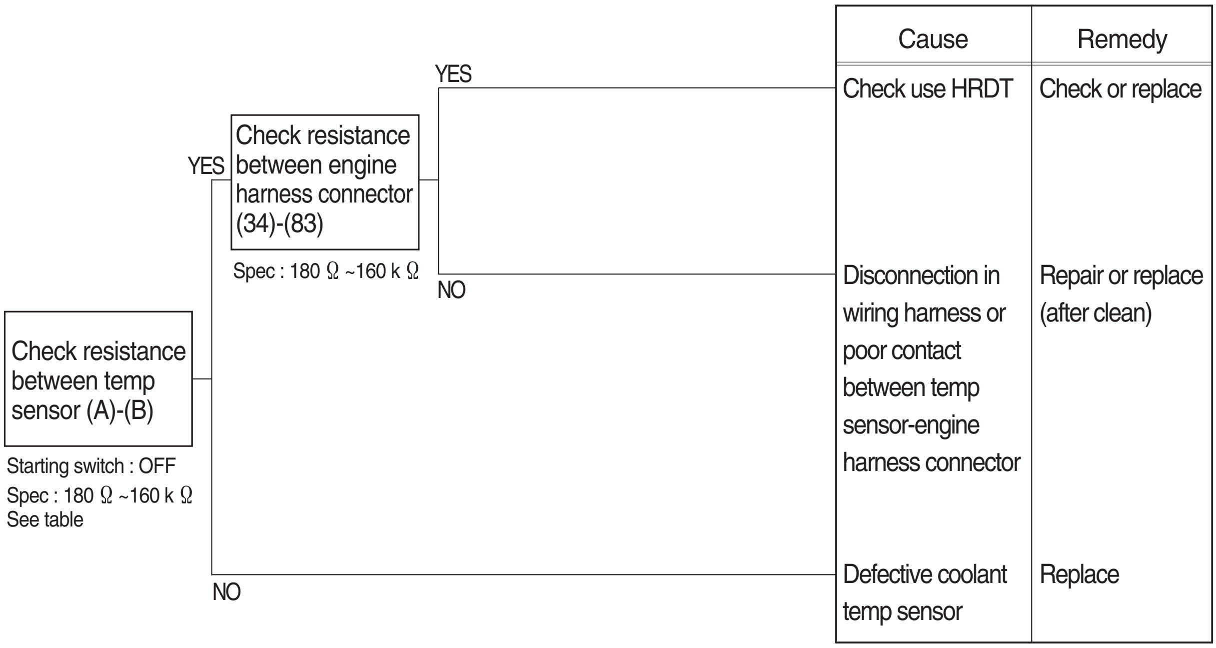
YES	20~32V
NO	0V



140L6ES02

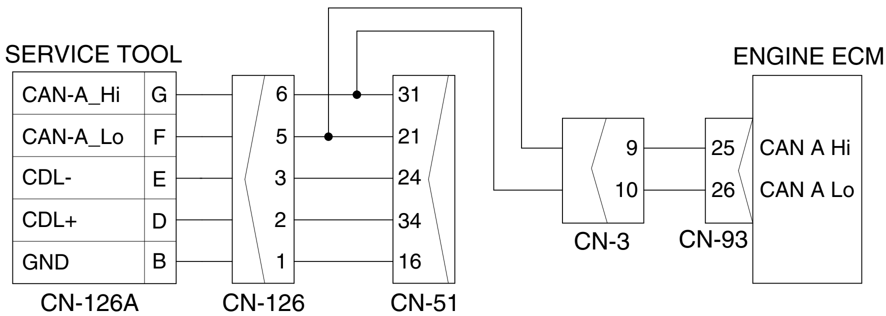
4. WHEN COOLANT OVERHEAT WARNING LAMP LIGHTS UP (engine is started)

· 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

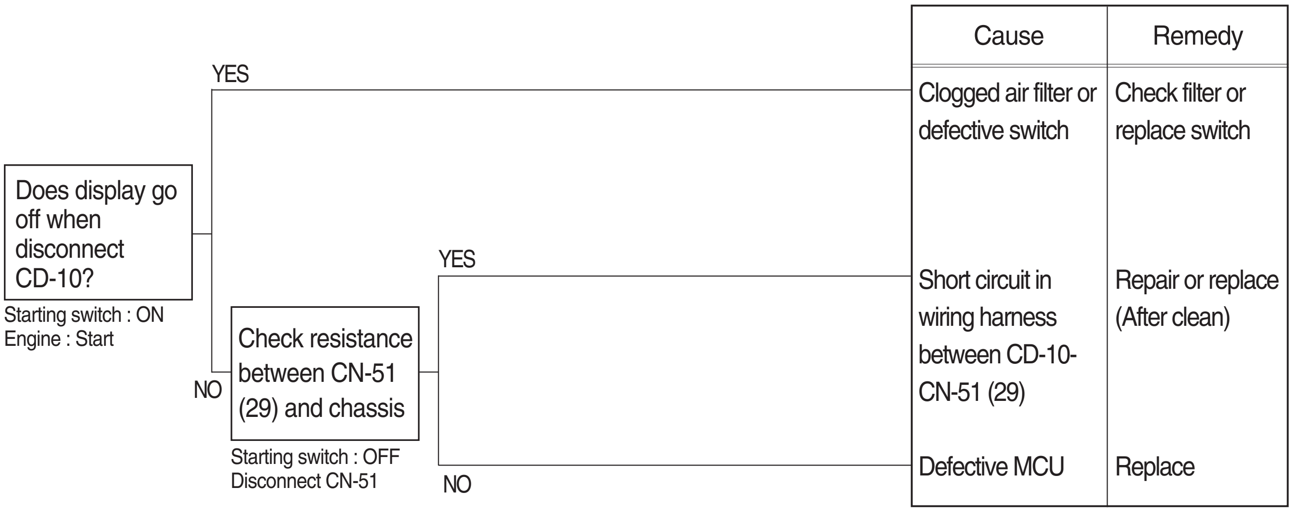
Temperature (˚C)	0	25	50	80	95
Resistance (kΩ)	30~37	9.3~10.7	3.2~3.8	1.0~1.3	0.7~0.8



140L6ES03

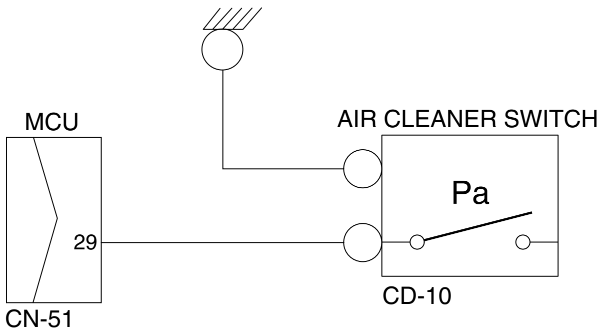
5. WHEN AIR CLEANER WARNING LAMP LIGHTS UP (engine is started)

· 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

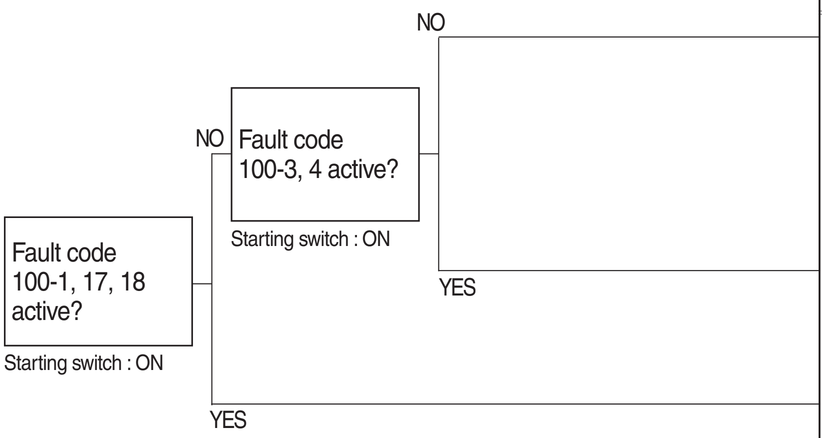
YES	MAX 1Ω
NO	MIN 1MΩ



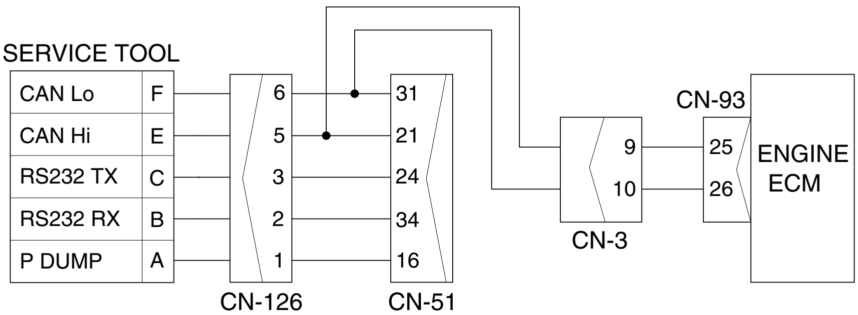
300L6ES06

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.



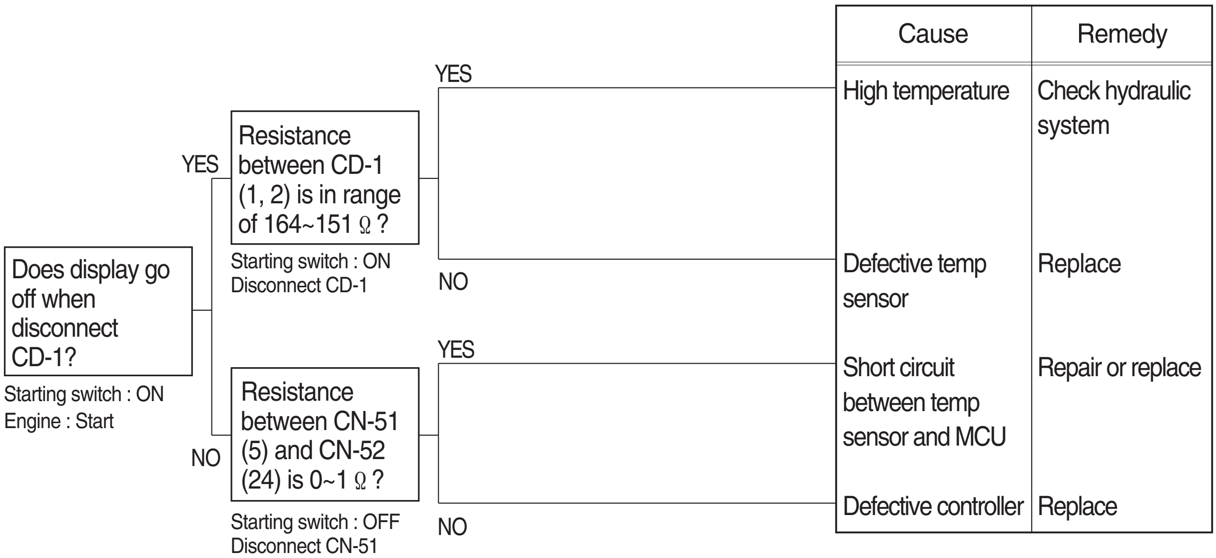
Cause	Remedy
Defective circuit, sensor or ECM.	Contact Perkins.
Voltage above or below normal	Refer to engine fault code 100-3, 4
Low engine oil pressure	Refer to engine fault code 100-1, 17, 18



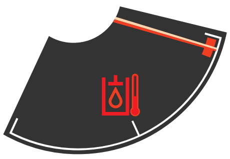
140L6ES04

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

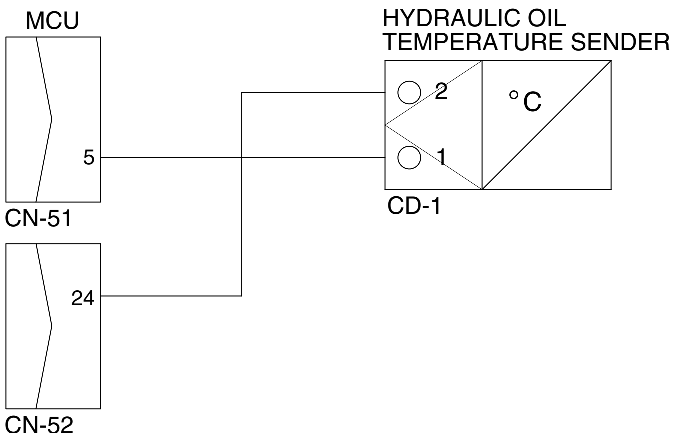
· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.



Check Table



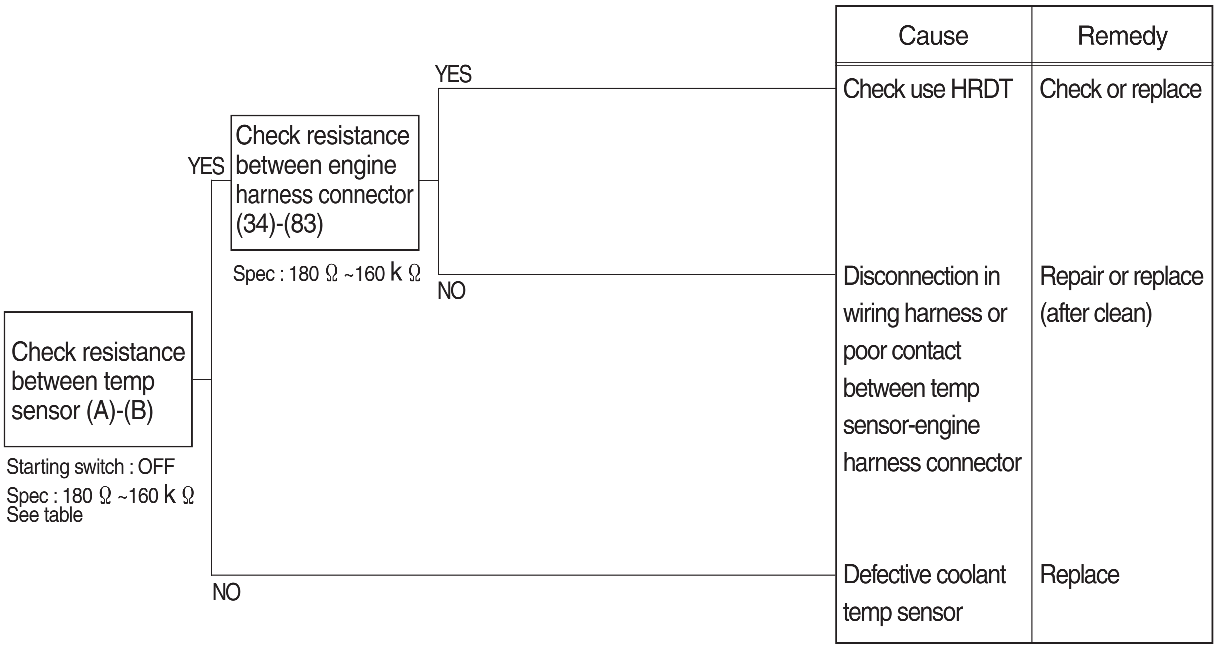
Temperature (˚C)	~ -30	~ -10	~ 0	~ 40	~ 70	~ 80	~ 90	~ 100	105~
Resistance (kΩ)	22.22 ~31.78	8.16 ~10.74	5.18 ~ 6.6	1.06 ~1.28	0.39 ~0.476	0.322 ~0.298	0.243 ~0.219	0.185 ~0.167	0.164 0.151



300L6ES08

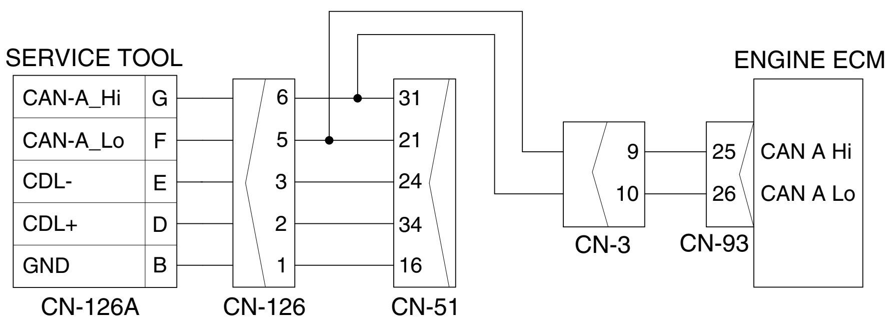
8. WHEN COOLANT TEMPERATURE GAUGE DOES NOT OPERATE

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



Check Table

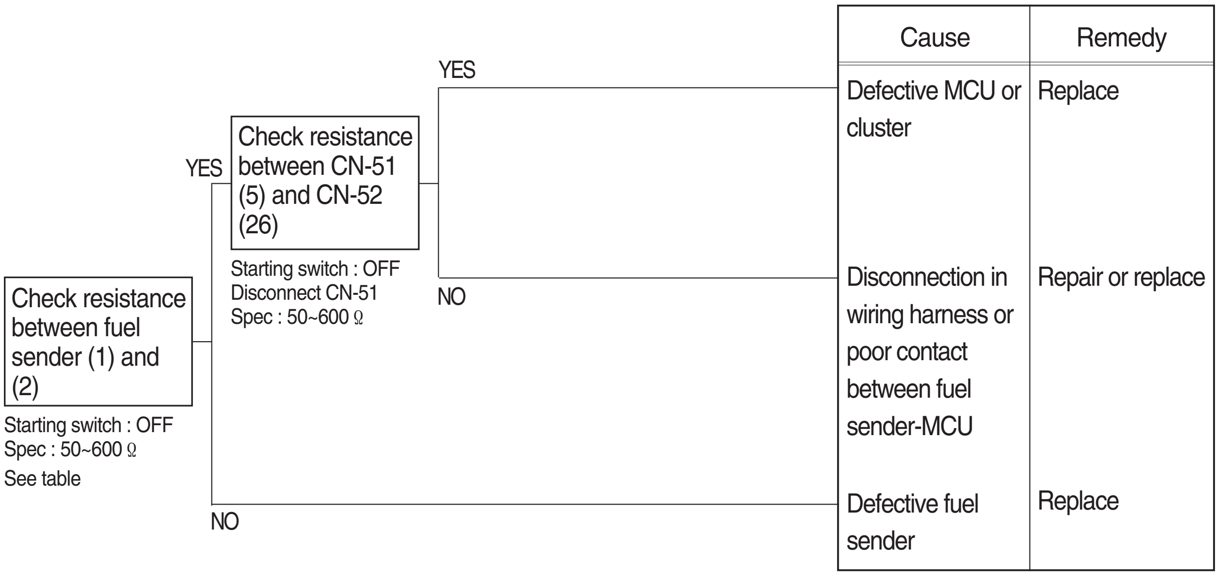
Temperature (˚C)	0	25	50	80	95
Resistance (kΩ)	30~37	9.3~10.7	3.2~3.8	1.0~1.3	0.7~0.8

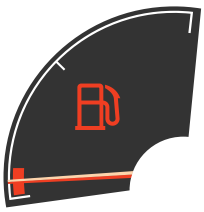


140L6ES03

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

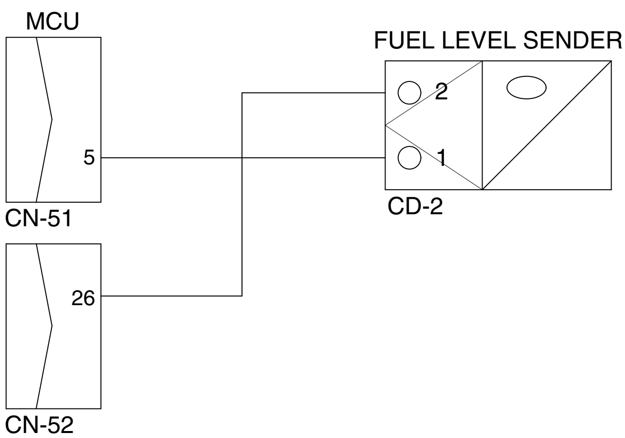
· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.





Check Table

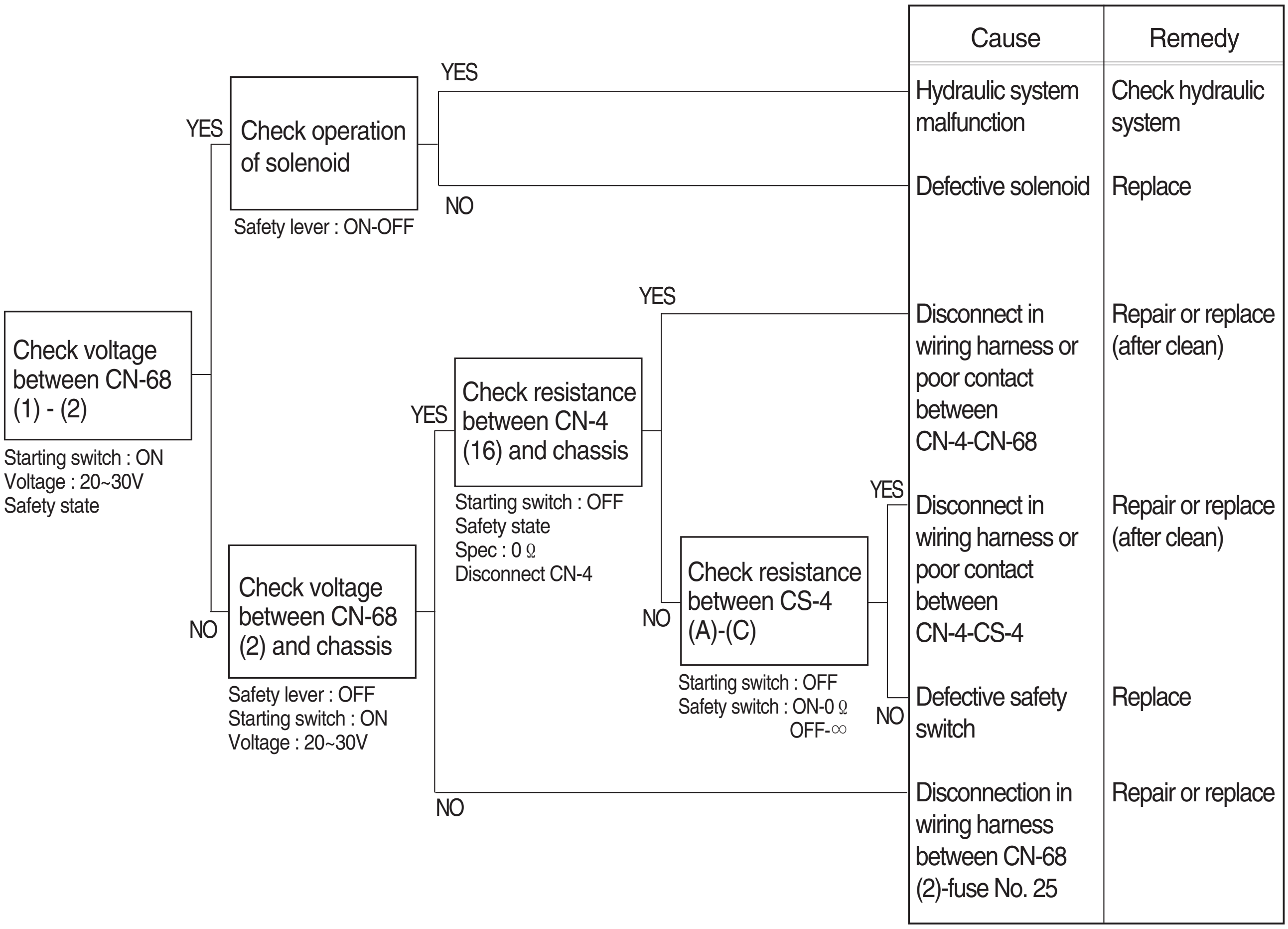
Range	Resistance (Ω)	Range	Resistance (Ω)
Full	50	5/12	400
11/12	100	4/12	450
10/12	150	3/12	500
9/12	200	2/12	550
8/12	250	1/12	600
7/12	300	Empty warning	700
6/12	350	-	-

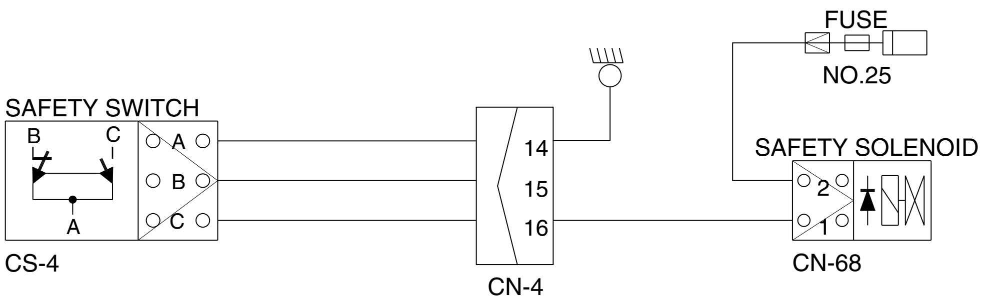


300L6ES10

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.

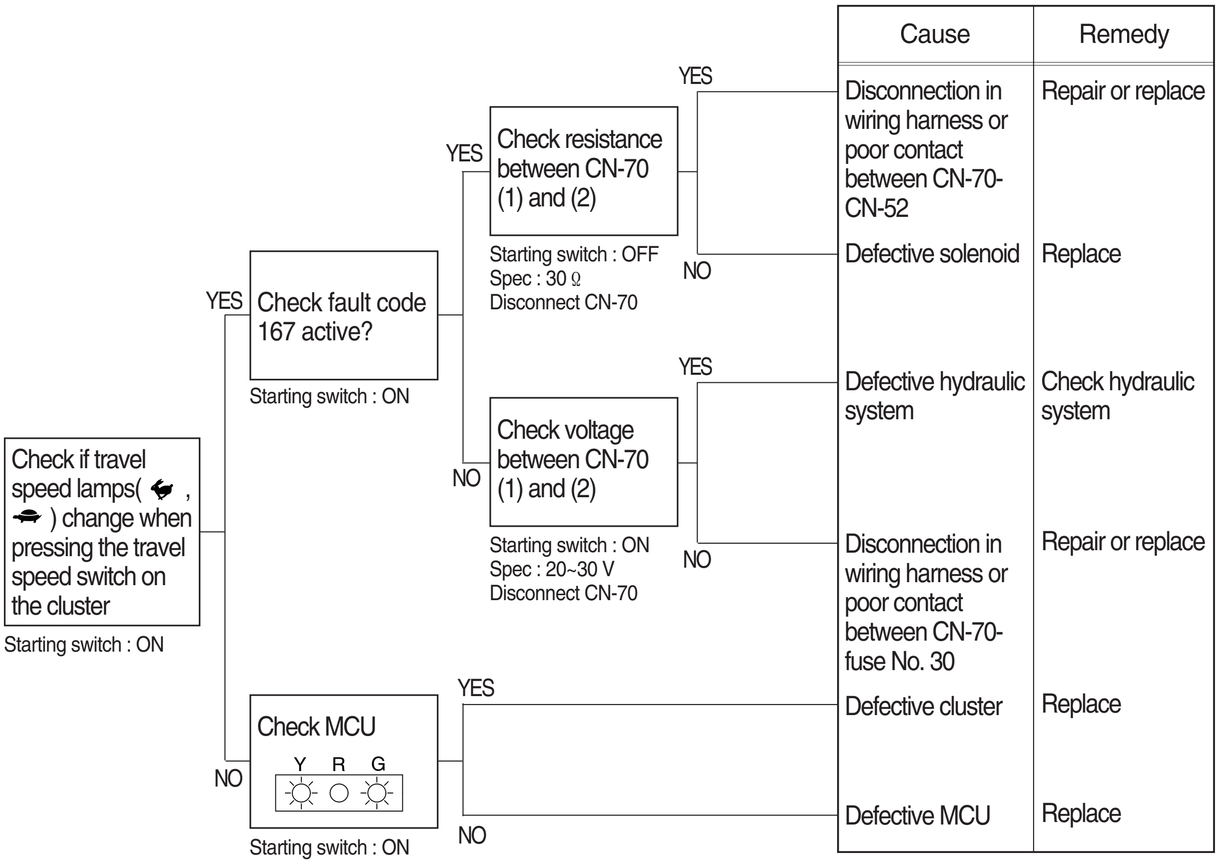


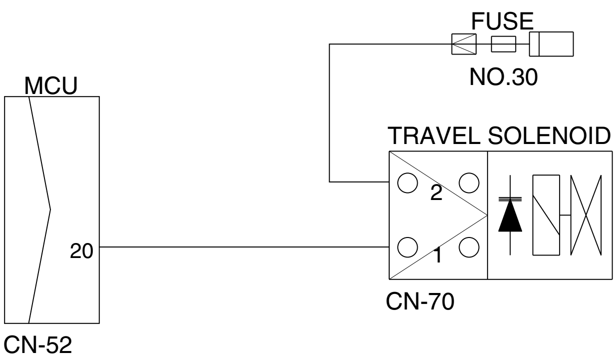


140L6ES06

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.

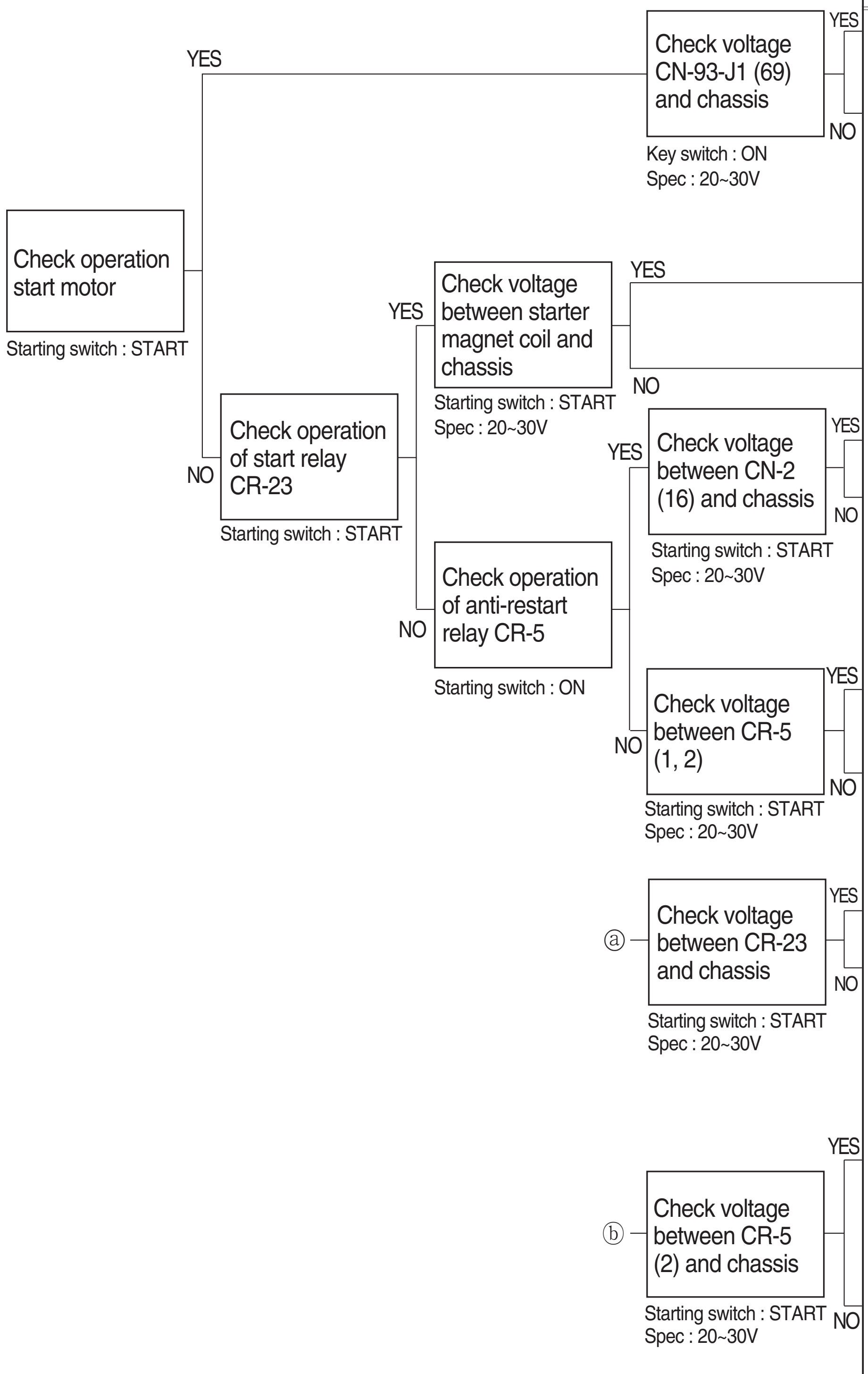




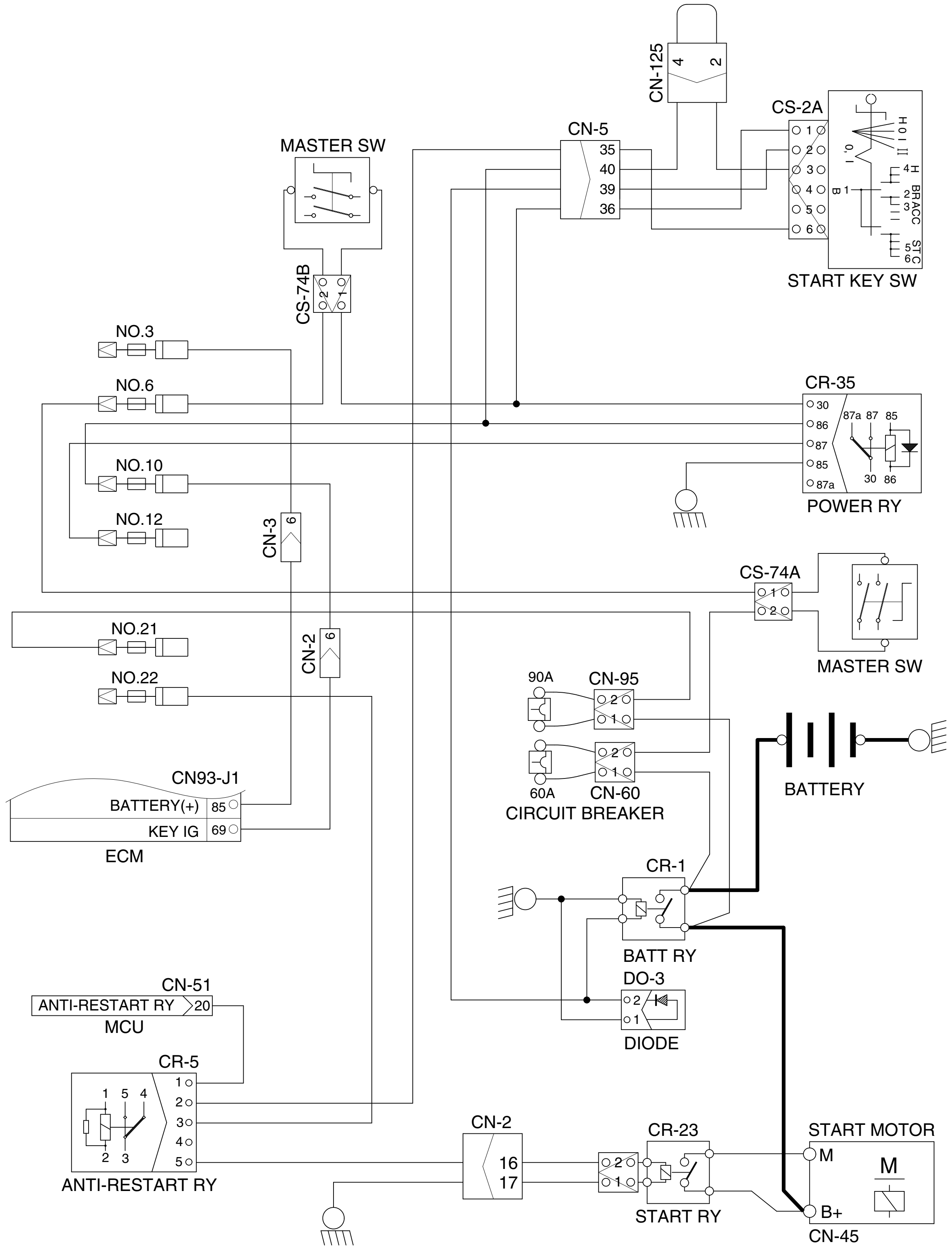
140L6ES07

12. WHEN ENGINE DOES NOT START (lights up condition)

· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted and short of fuse No. 3, 6, 10, 12, 21, 22.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.



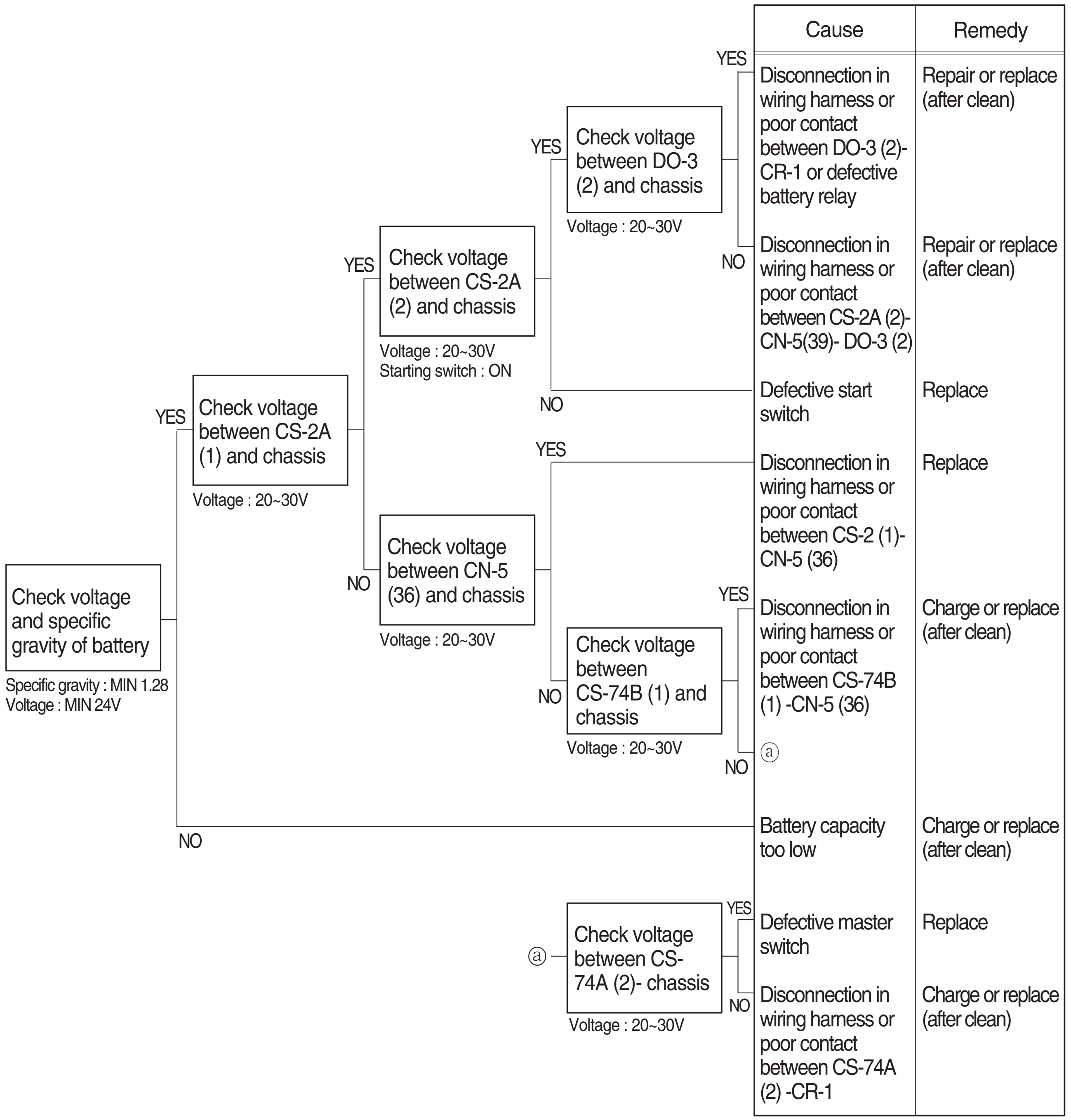
Cause	Remedy
Defective ECM or battery	Replace
Disconnection in wiring harness or poor contact between CR-35 (86) -CN-93-J1 (69)	Repair or replace
Defective magnet of start motor	Replace
Defective start relay	Replace
ⓐ	
Disconnection in wiring harness or poor contact between CN-2 (16) -CR-5 (5)	Repair or replace
Defective anti-restart relay	Replace
ⓑ	
Defective start relay	Replace
Disconnection in wiring harness or poor contact between CN-2 (16) -CR-5 (5)	Repair or replace
Disconnection in wiring harness or poor contact between CN-51 (20)-CR-5 (1)	Repair or replace
Disconnection in wiring harness or poor contact between CS-2A (6)- CR-5 (2)	Repair or replace

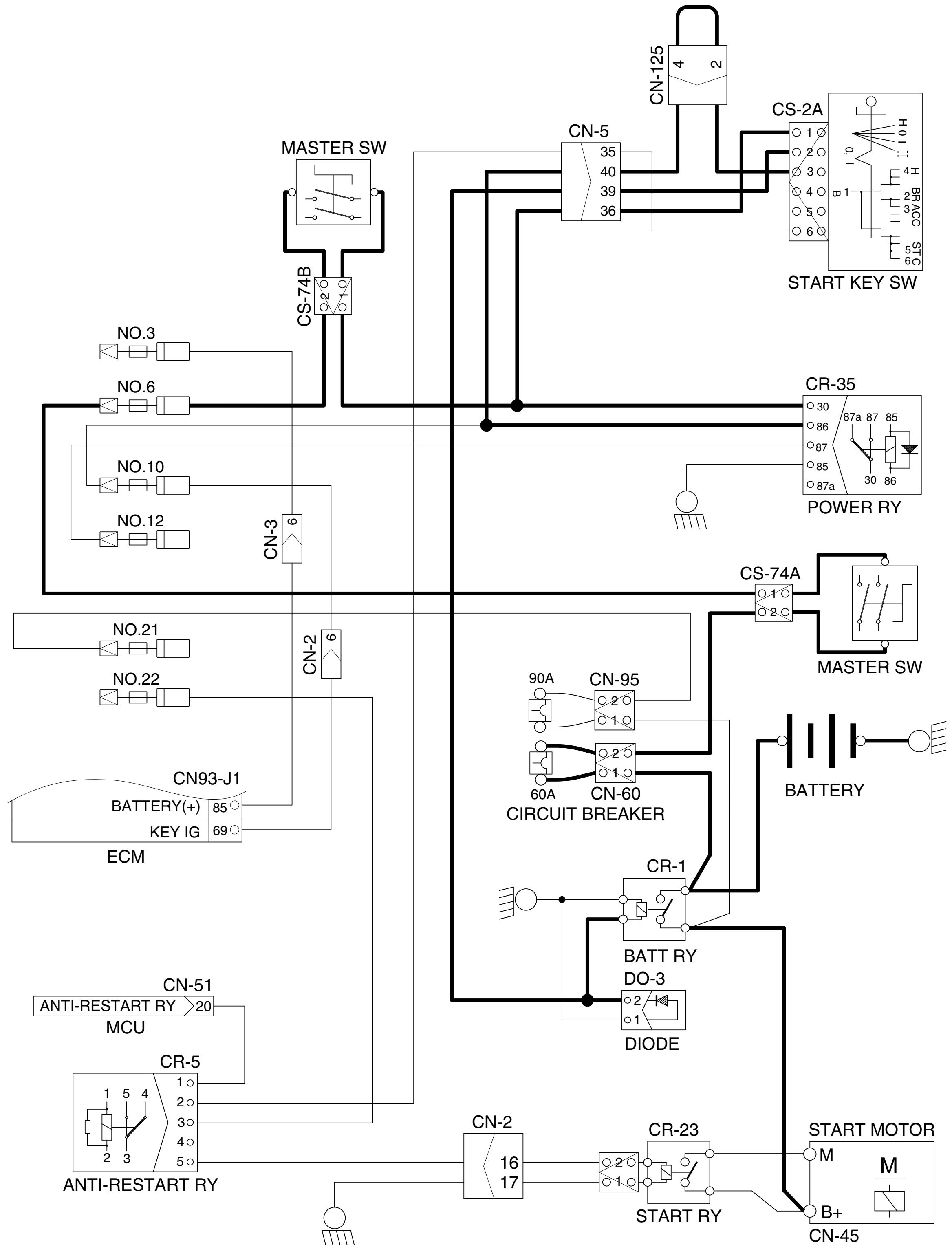


140L6ES08

13. WHEN STARTING SWITCH ON DOES NOT OPERATE

- Before disconnecting the connector, always turn the starting switch OFF.
- Before carrying out below procedure, check all the related connectors are properly inserted, master switch ON and check open circuit of circuit breaker (CN-60, CN-95).
- After checking, insert the disconnected connectors again immediately unless otherwise specified.

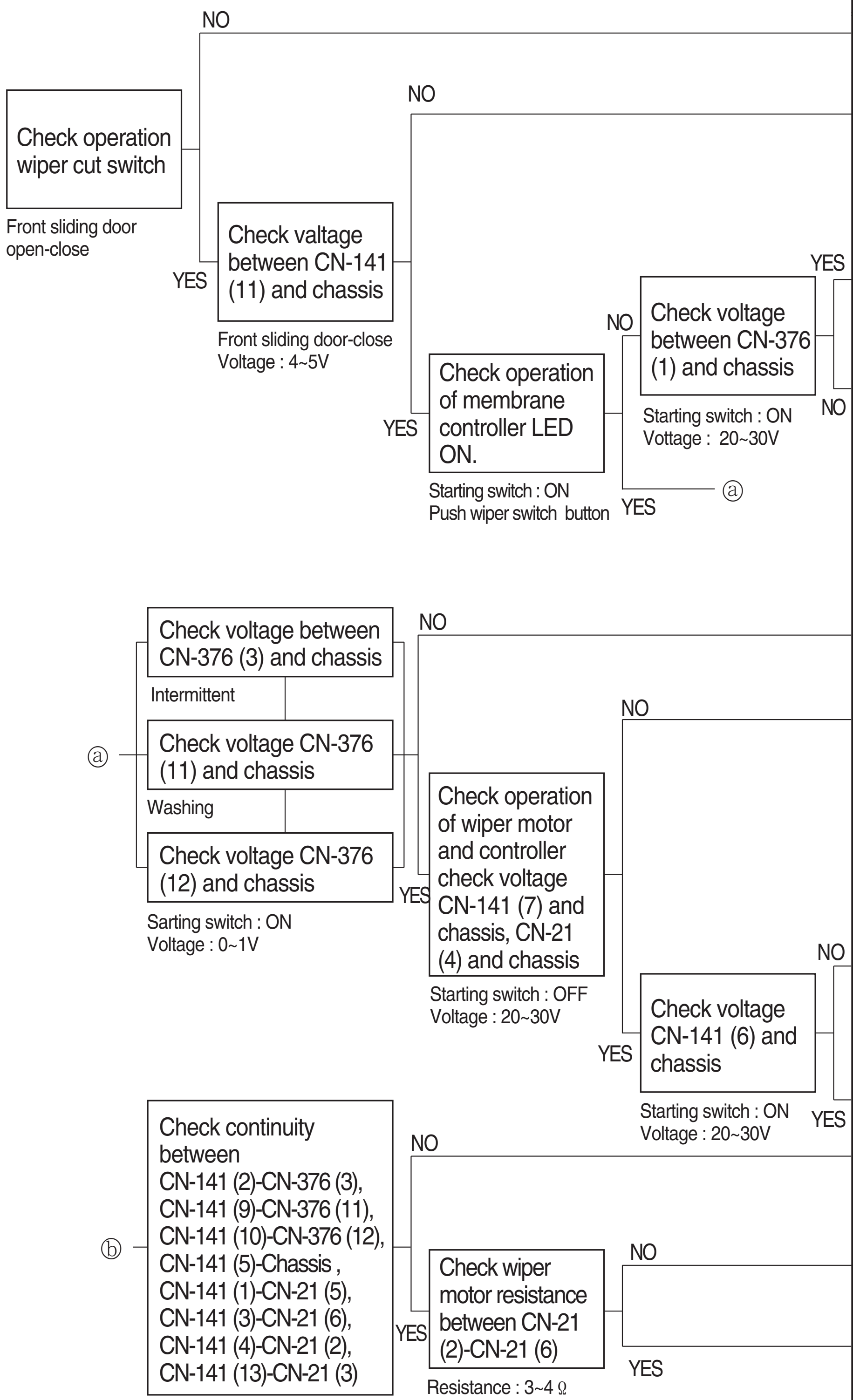




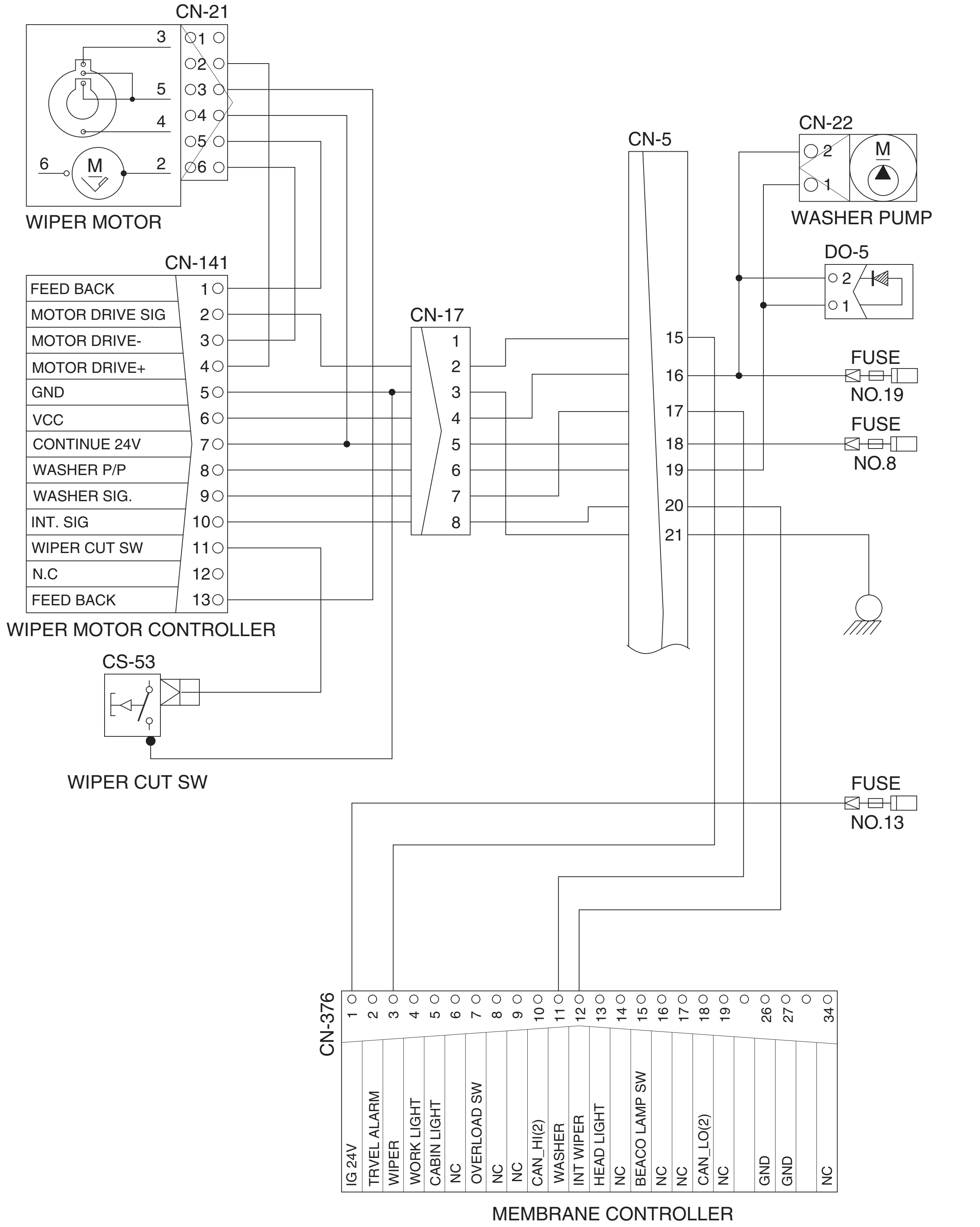
140L6ES09

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

· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted and the fuse No. 8, 13 and 19 is not blown out.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.



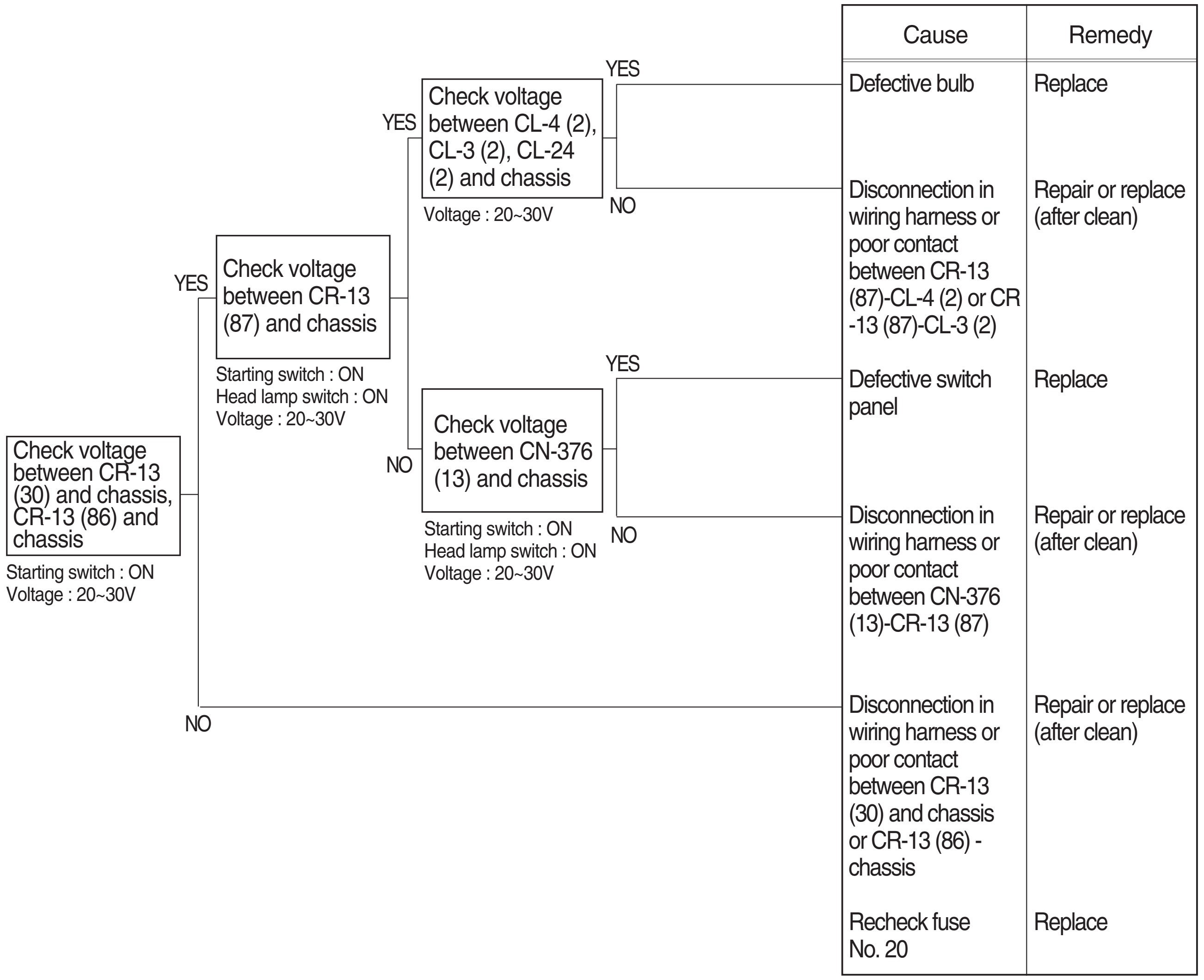
Cause	Remedy
Defective wiper cut switch	Replace
Short circuit in wiring harness or poor contact between CN-141 (11)- CS-53	Repair or replace (after clean)
Defective membrane controller	Replace
1)Recheck fuse No.13 2)Disconnection in wiring harness or poor contact between CN-376(1)-Fuse	Replace Repair or replace (after clean)
Defective switch panel	Replace
1) Recheck fuse No.8 2) Disconnection in wiring harness or poor contact between CN-141(7)-Fuse, CN-21(4)-Fuse	Replace Repair or replace (after clean)
1) Recheck fuse No.19 2) Disconnection CN-141(6)-Fuse	Replace Repair or replace (after clean)
Disconnection in wiring harness or poor contact	Repair or replace (after clean)
Defective wiper motor	Replace
Defective wiper motor controller	Replace

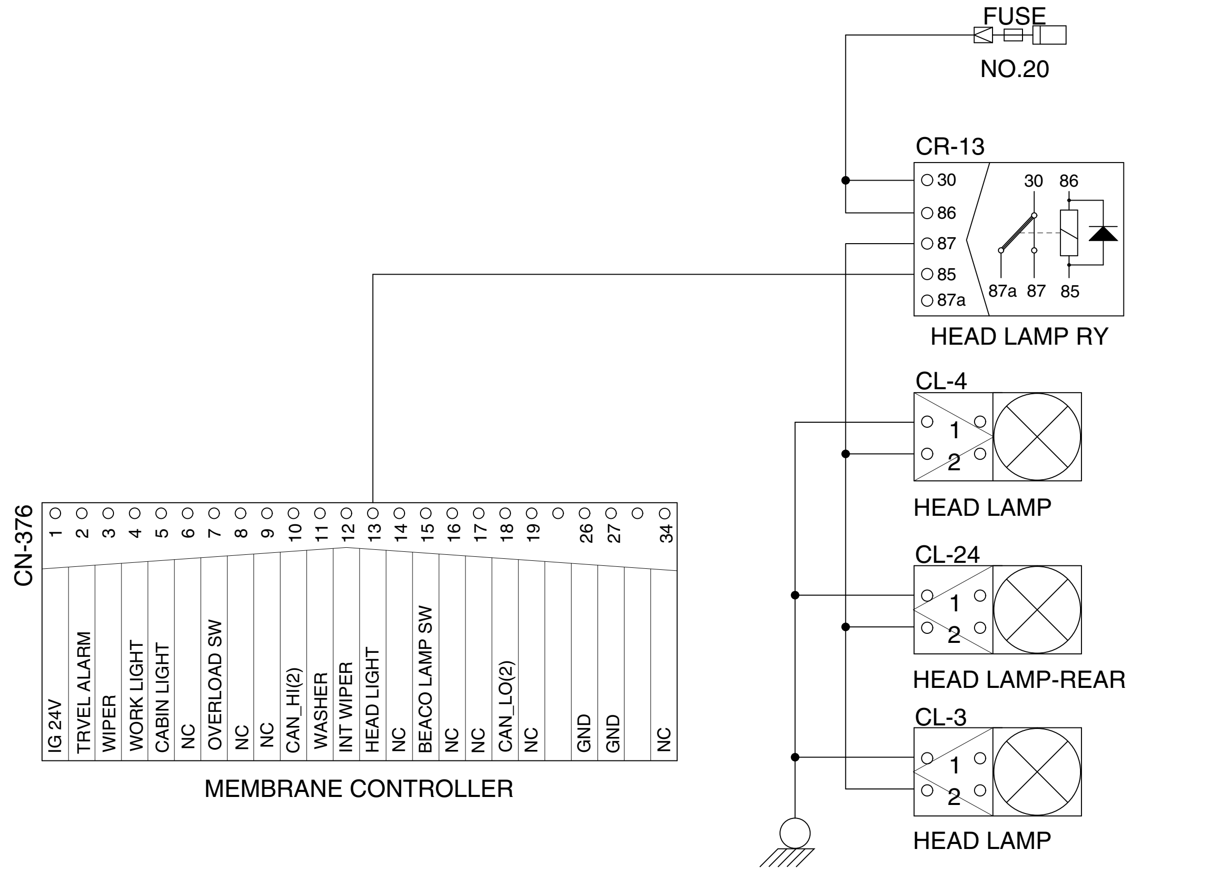


140L6ES10

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

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

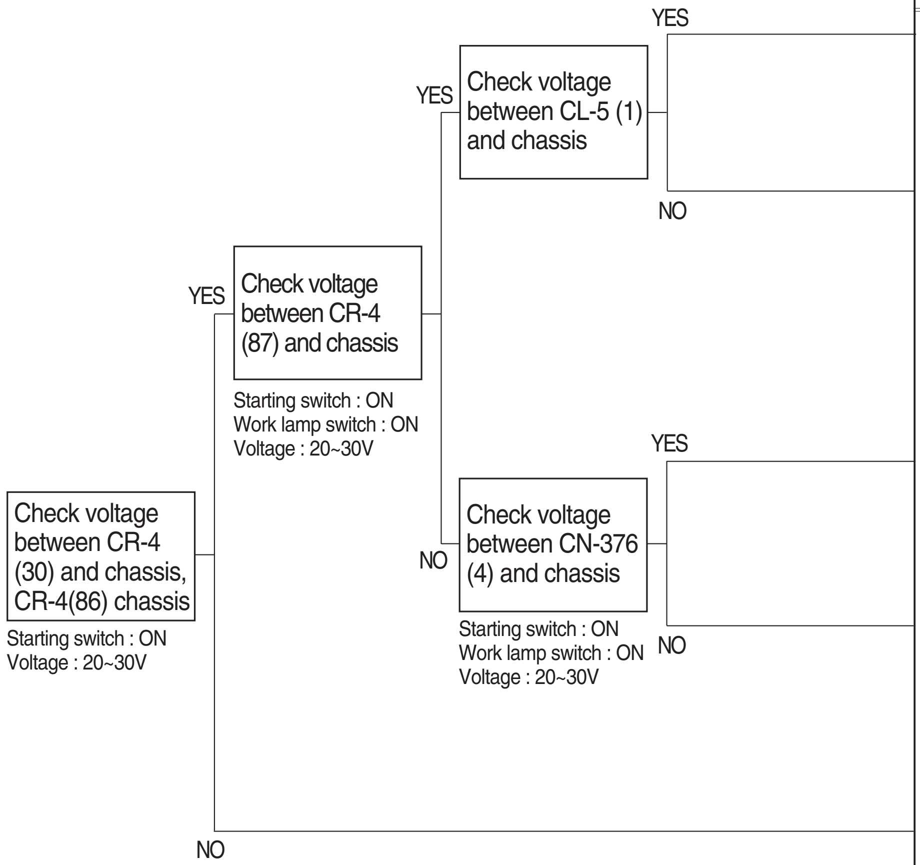




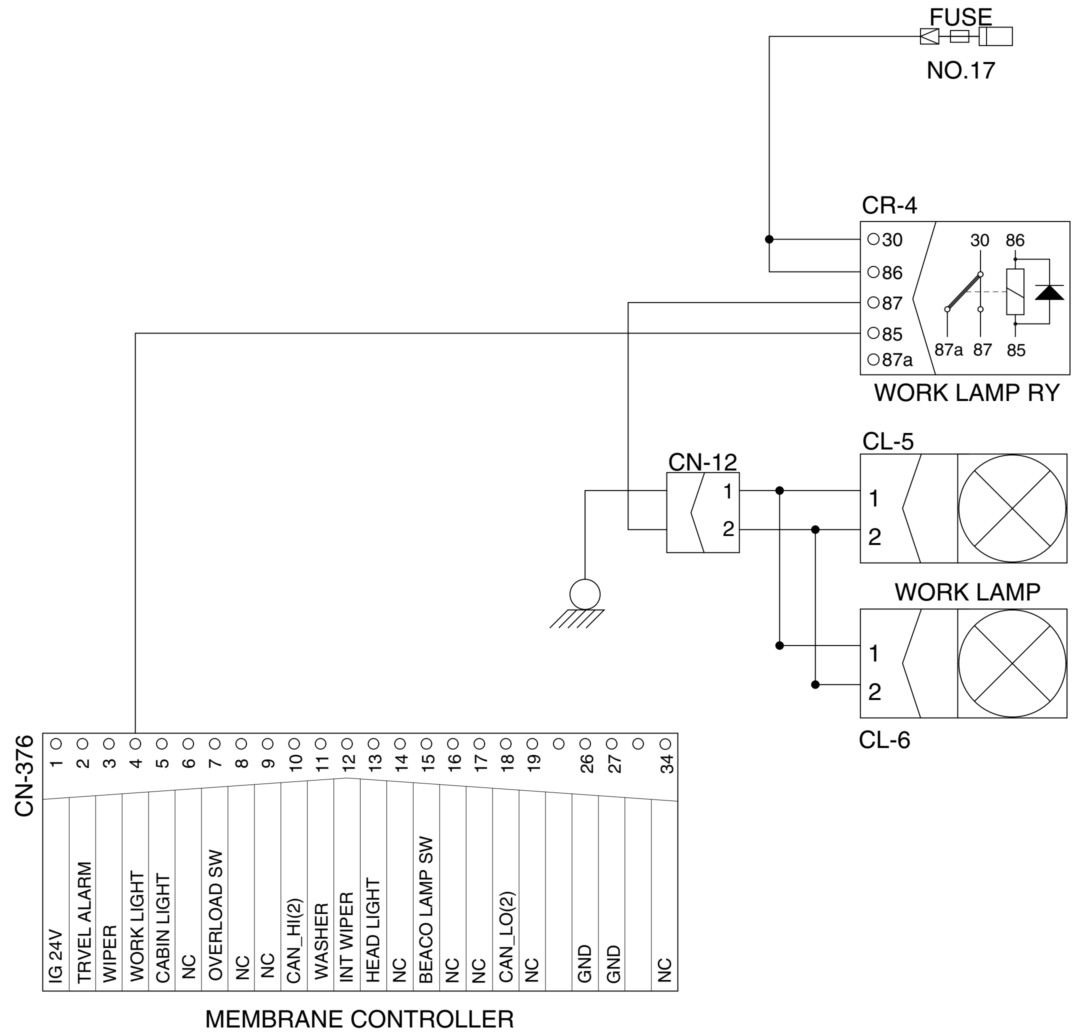
140L6ES11

16. WHEN STARTING SWITCH IS TURNED ON, WORK LAMP DOES NOT LIGHTS UP

· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted and short of fuse No.17.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.



Cause	Remedy
Defective bulb	Replace
Disconnection in wiring harness or poor contact between CR-4 (87)-CL-5 (2)	Repair or replace (after clean)
Defective switch panel	Replace
Disconnection in wiring harness or poor contact between CR-4 (85)-CN-376 (4)	Repair or replace (after clean)
Disconnection in wiring harness or poor contact between CR-4 (30) and chassis or CR-4 (86) and chassis	Repair or replace (after clean)
Recheck fuse No.17	Replace



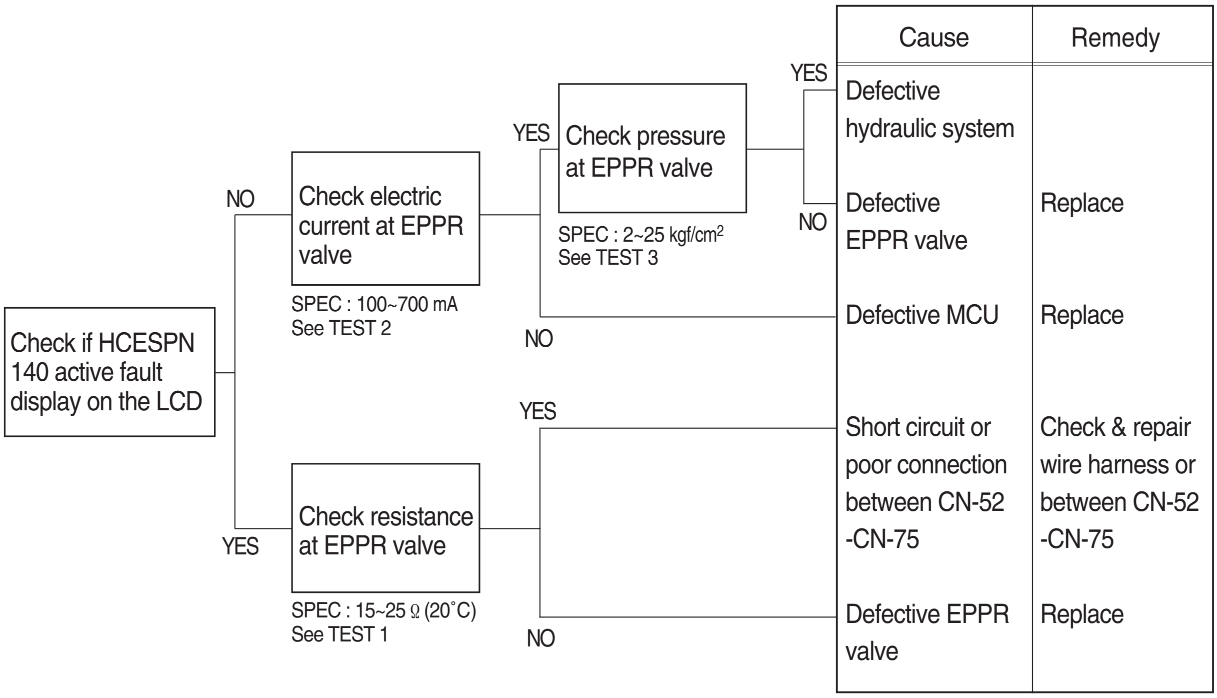
140L6ES12

GROUP 4 MECHATRONICS SYSTEM

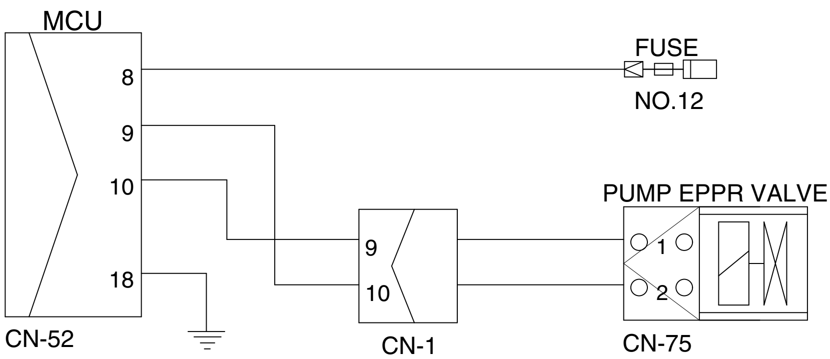
1. ALL ACTUATORS SPEED ARE SLOW

※ Boom, Arm, Bucket, Swing and travel speed are slow, but engine speed is good.
※ Spec : P-mode 1950 ± 50 rpm S -mode 1850 ± 50 rpm E-mode 1750 ± 50 rpm
※ Before carrying out below procedure, check all the related connectors are properly inserted and fault code on the cluster.

1) INSPECTION PROCEDURE



Wiring diagram



140L6MS01

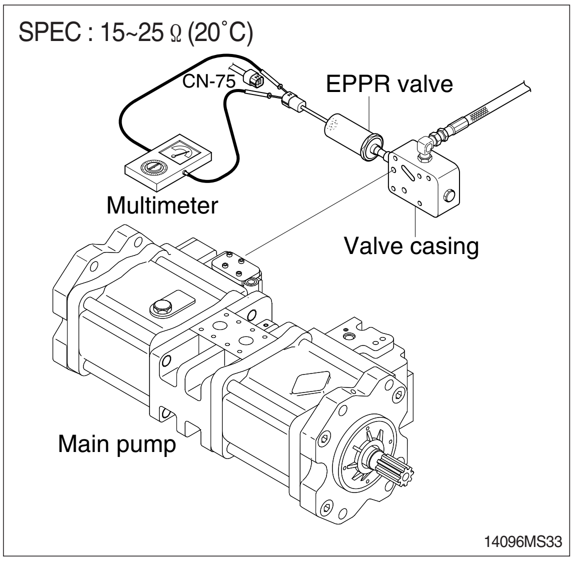
2) TEST PROCEDURE

(1) Test 1 : Check resistance at connector CN-75.

① Starting switch OFF.

② Disconnect connector CN-75 from EPPR valve at main hydraulic pump.

③ Check resistance between 2 lines as figure.



(2) Test 2 : Check electric current at EPPR valve.

① Disconnect connector CN-75 from EPPR valve.

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

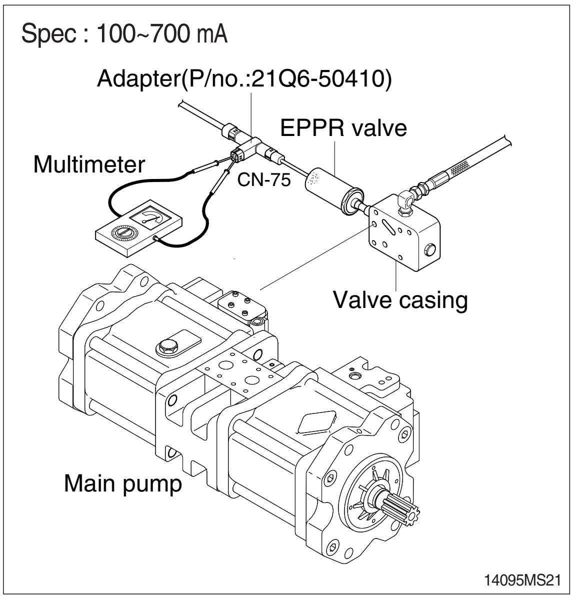
③ Start engine.

④ Set S-mode and cancel auto decel mode.

⑤ Position the multimodal dial at 10.

⑥ If tachometer show approx 1850±50 rpm disconnect one wire harness from EPPR valve.

⑦ Check electric current at bucket circuit relief position.



(3) Test 3 : Check pressure at EPPR valve.

① Remove plug and connect pressure gauge as figure.

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

② Start engine.

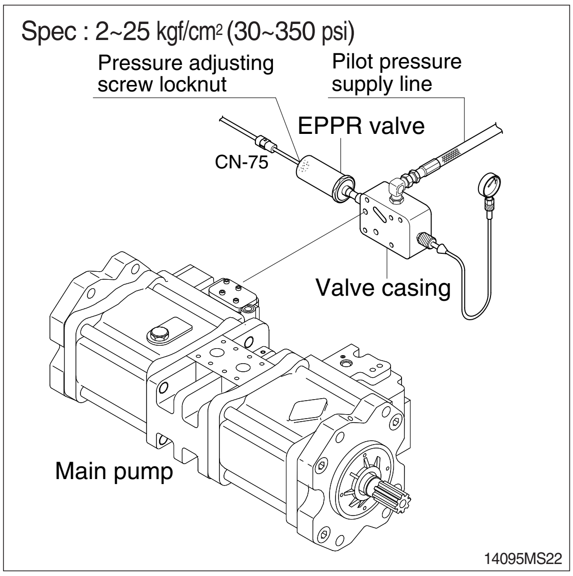
③ Set S-mode and cancel auto decel mode.

④ Position the multimodal dial at 10.

⑤ If tachometer show approx 1850±50 rpm check pressure at relief position of bucket circuit by operating bucket control lever.

⑥ If pressure is not correct, adjust it.

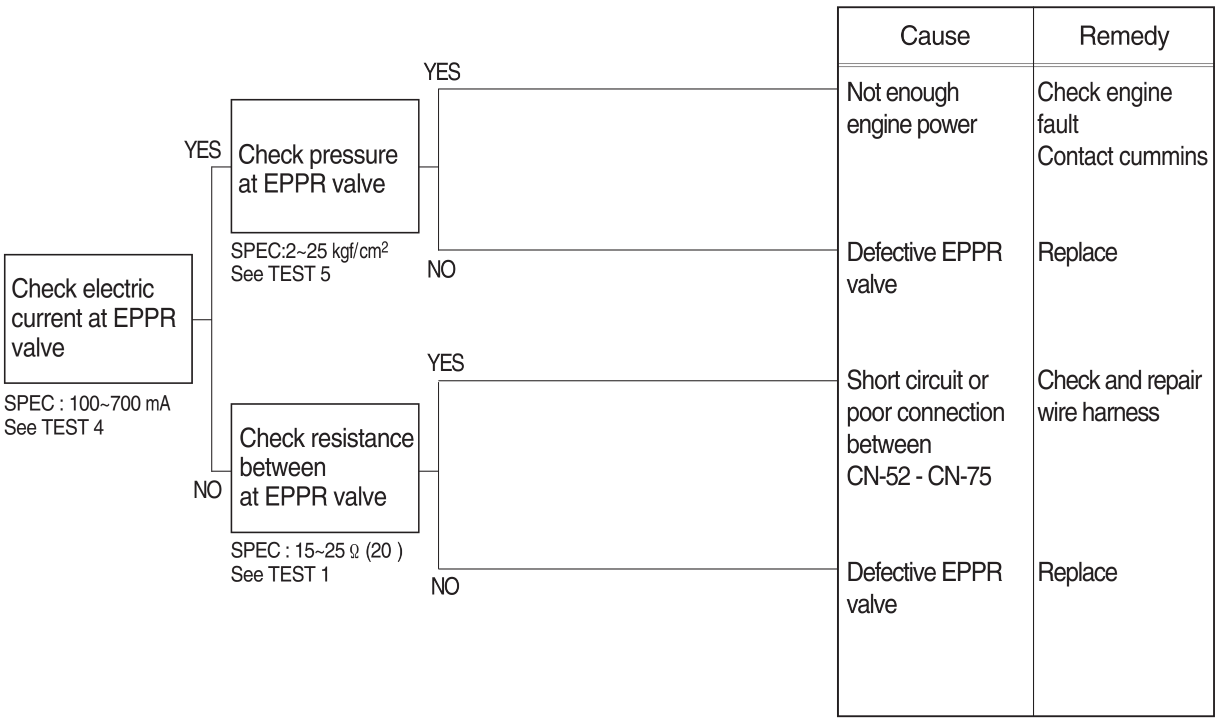
⑦ After adjust, test the machine.



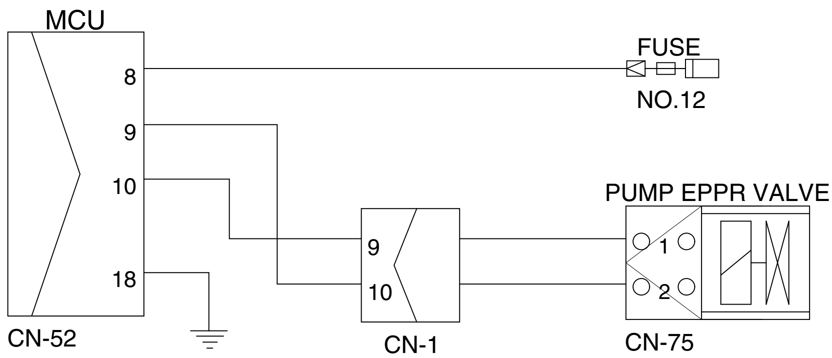
2. ENGINE STALL

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

1) INSPECTION PROCEDURE



Wiring diagram

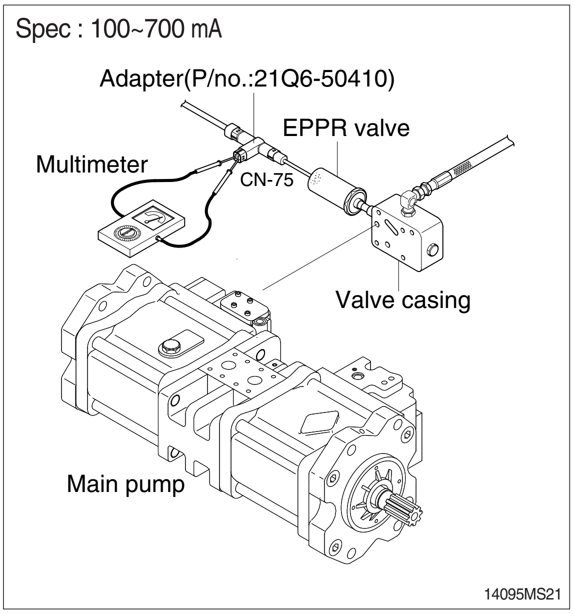


140L6MS01

2) TEST PROCEDURE

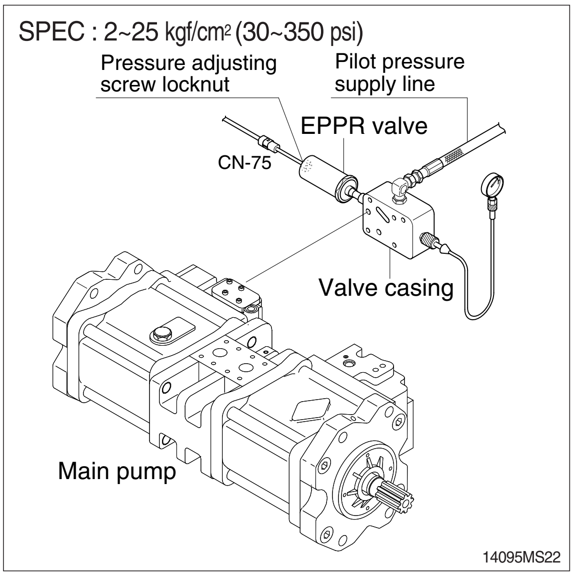
(1) Test 4 : Check electric current at EPPR valve.

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 multimodal dial at 10.
⑥ If rpm show approx 1850±50 rpm disconnect one wire harness from EPPR valve.
⑦ Check electric current at bucket circuit relief position.



(2) Test 5 : Check pressure at EPPR valve.

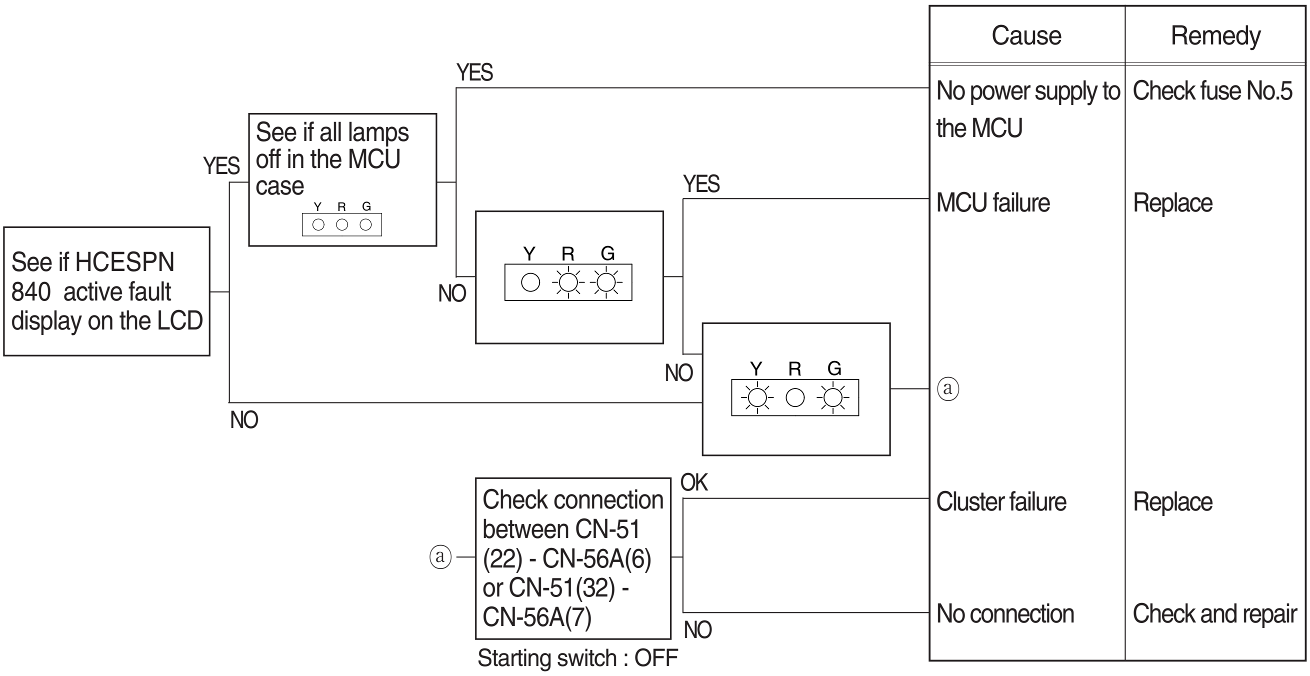
① Remove plug and connect pressure gauge as figure.
· Gauge capacity : 0 to 50 kgf/cm² (0 to 725 psi)
② Start engine.
③ Set S-mode and cancel auto decel mode.
④ Position the multimodal dial at 10.
⑤ If rpm show approx 1850±50 rpm check pressure at relief position of bucket circuit by operating bucket control lever.
⑥ If pressure is not correct, adjust it.
⑦ After adjust, test the machine.



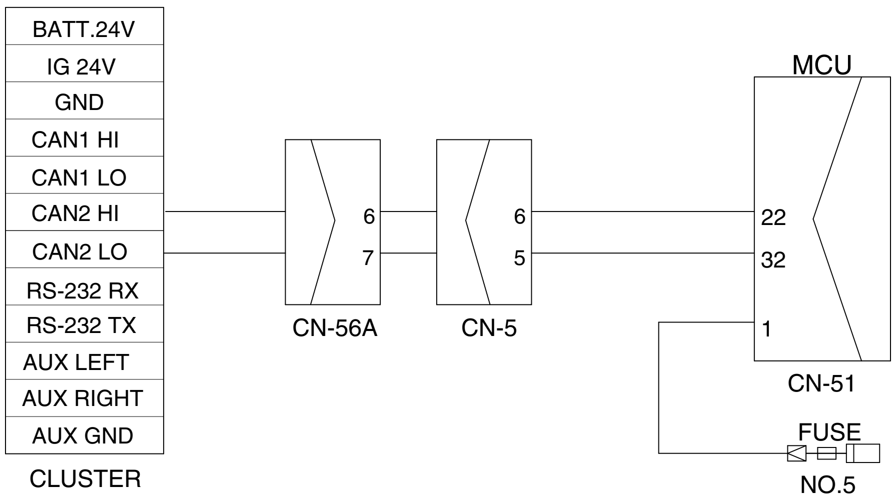
3. MALFUNCTION OF CLUSTER OR MODE SELECTION SYSTEM

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

1) INSPECTION PROCEDURE



Wiring diagram



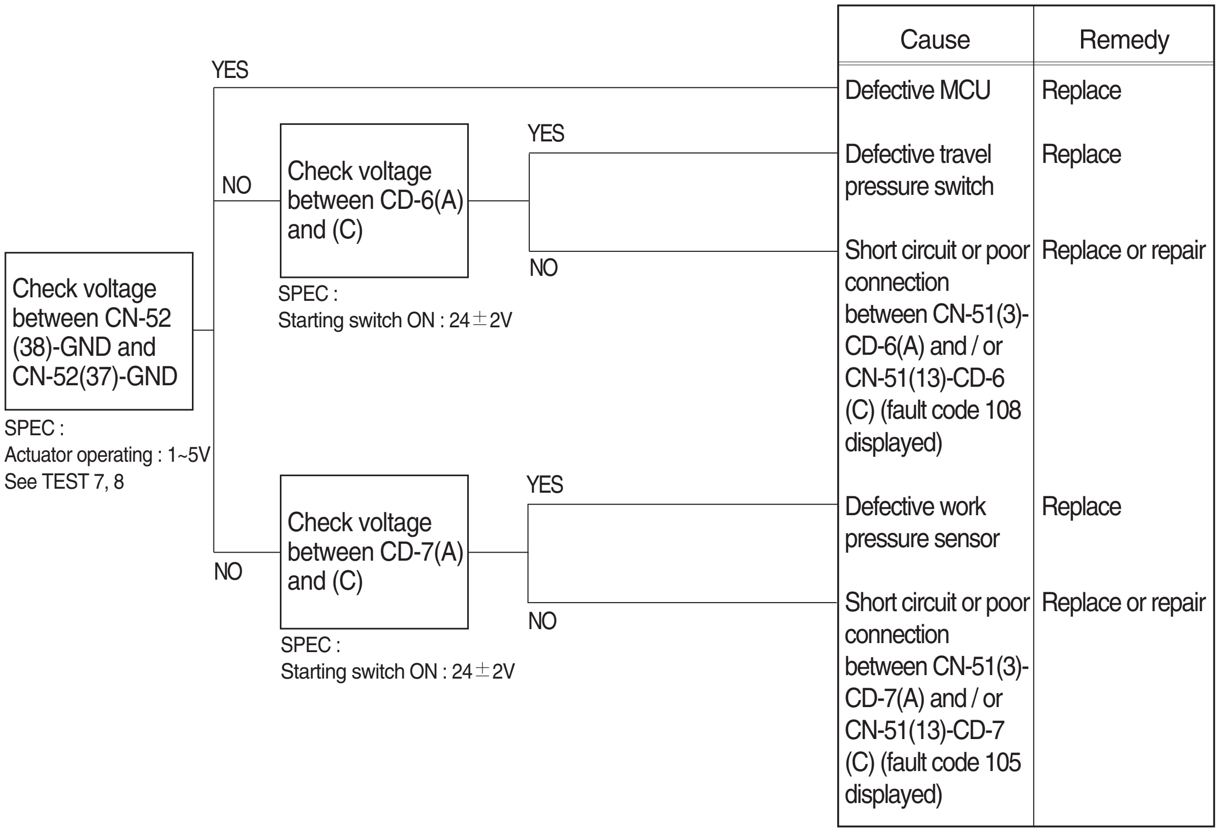
140L6MS02

4. AUTO DECEL SYSTEM DOES NOT WORK

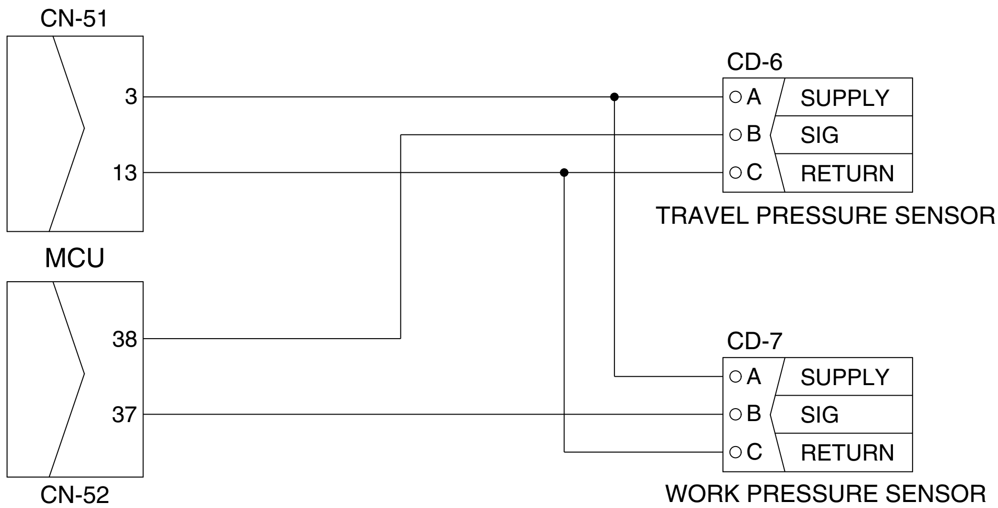
· Fault code : HCESPN 105, FMI 0~4 (work pressure sensor)
  HCESPN 108, FMI 0~4 (travel oil pressure sensor)

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

1) INSPECTION PROCEDURE



Wiring diagram



300L6MS03

2) TEST PROCEDURE

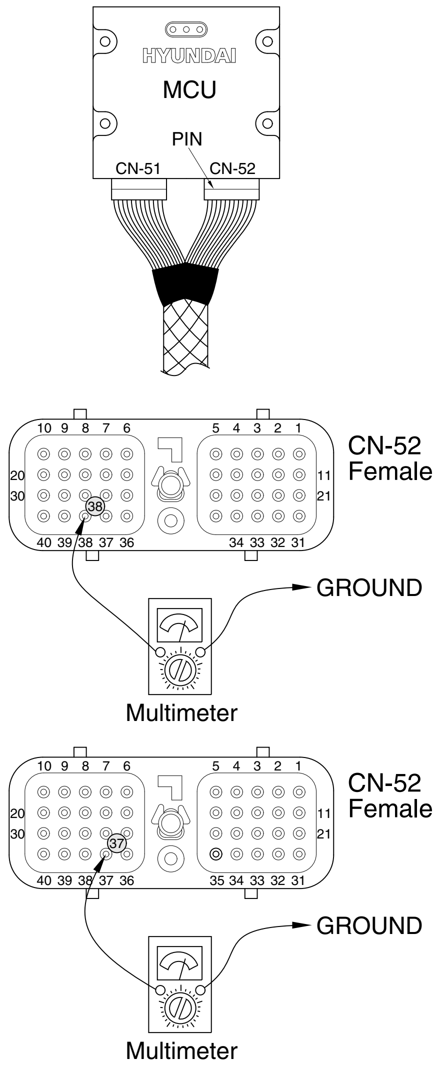
(1) Test 7 : Check voltage at CN-52 (38) and ground.

① Prepare 1 piece of thin sharp pin, steel or copper.
② Insert prepared pin to rear side of connectors : One pin to (38) of CN-52.
③ Starting switch ON.
④ Check voltage as figure.

(2) Test 8 : Check voltage at CN-52 (37) and ground.

① Prepare 1 piece of thin sharp pin, steel or copper
② Insert prepared pin to rear side of connectors : One pin to (37) of CN-52.
③ Starting switch ON.
④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V



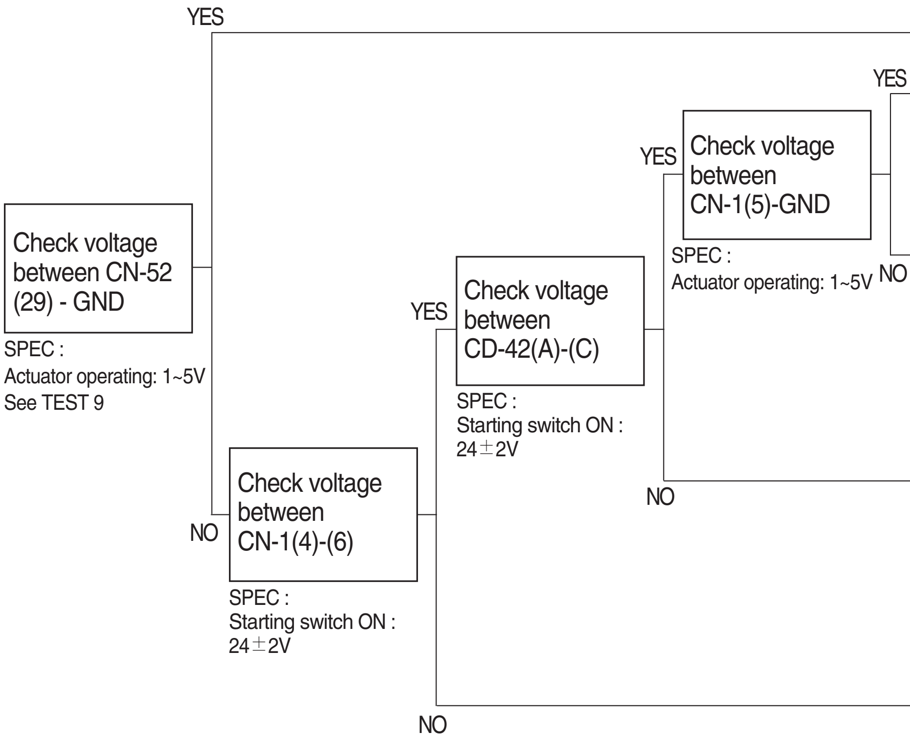
300L6MS04

5. MALFUNCTION OF PUMP 1 PRESSURE SENSOR

· Fault code : HCESPN 120, FMI 0~4

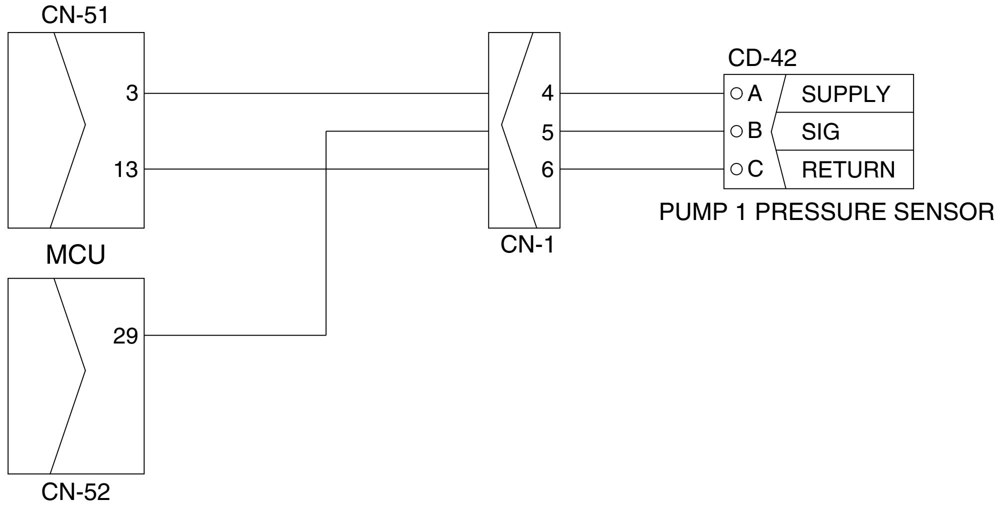
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective MCU	Replace
Short circuit or poor connection between CN-52-(29)-CN-1(5)	Replace or repair
Detective P1 pressure sensor	Replace or repair
Short circuit or poor connection between CN-1(5)-CD-42(B)	Replace or repair
Short circuit or poor connection between CD-42(A)-CN-1(4) or CD-42(C)-CN-1(6)	Replace or repair
Short circuit or poor connection between CN-1(4)-CN-51(3) or CN-1(6) - CN-51(13)	Replace or repair

Wiring diagram



300L6MS05

2) TEST PROCEDURE

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

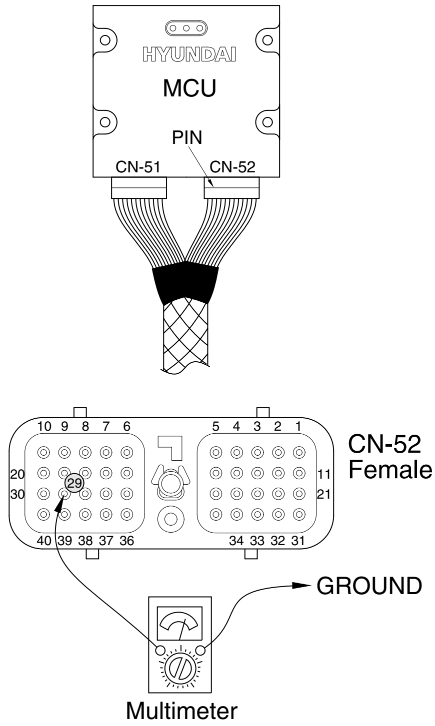
① Prepare 1 piece of thin sharp pin, steel or copper.

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

③ Starting switch ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V



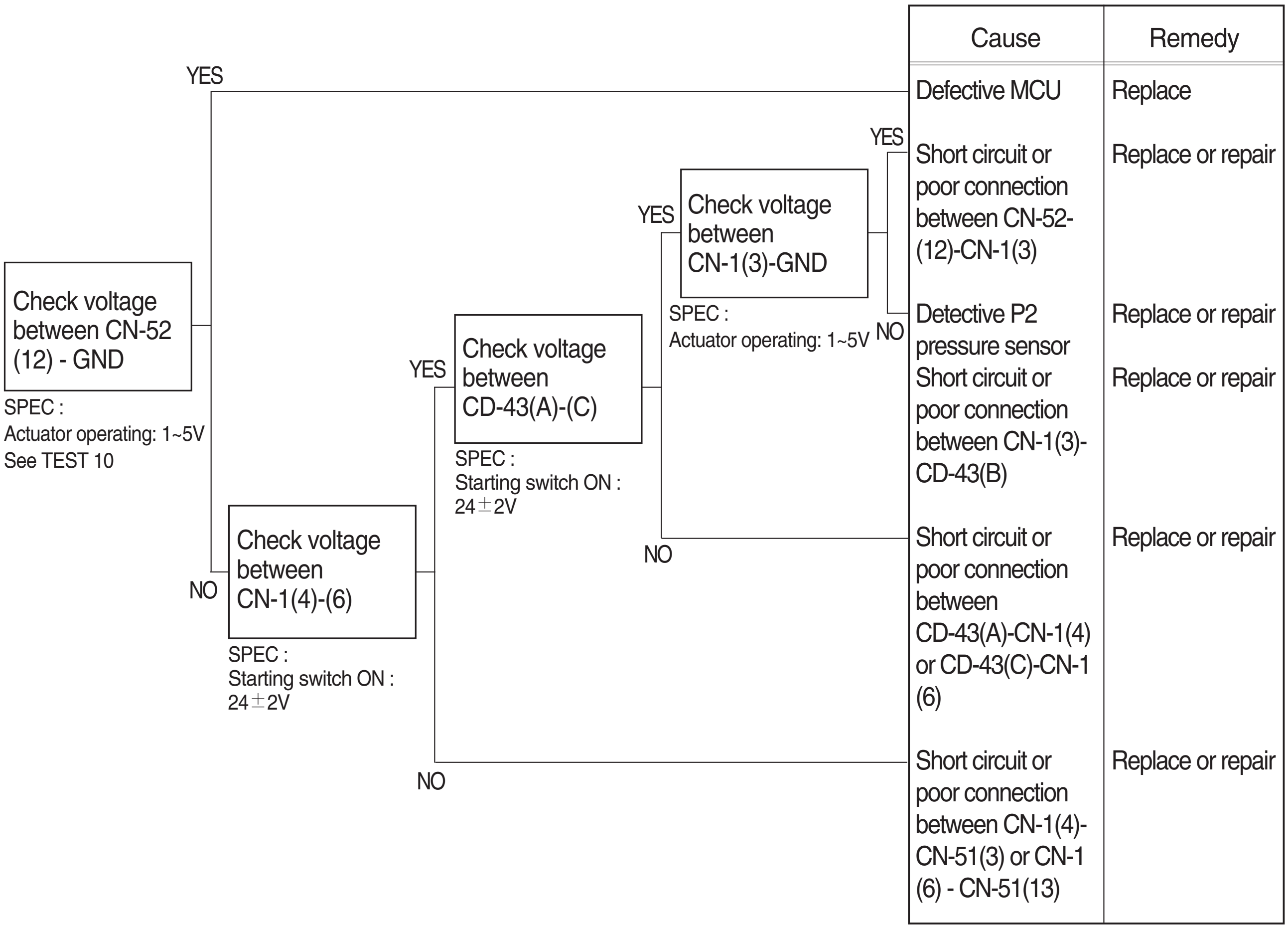
300L6MS06

6. MALFUNCTION OF PUMP 2 PRESSURE SENSOR

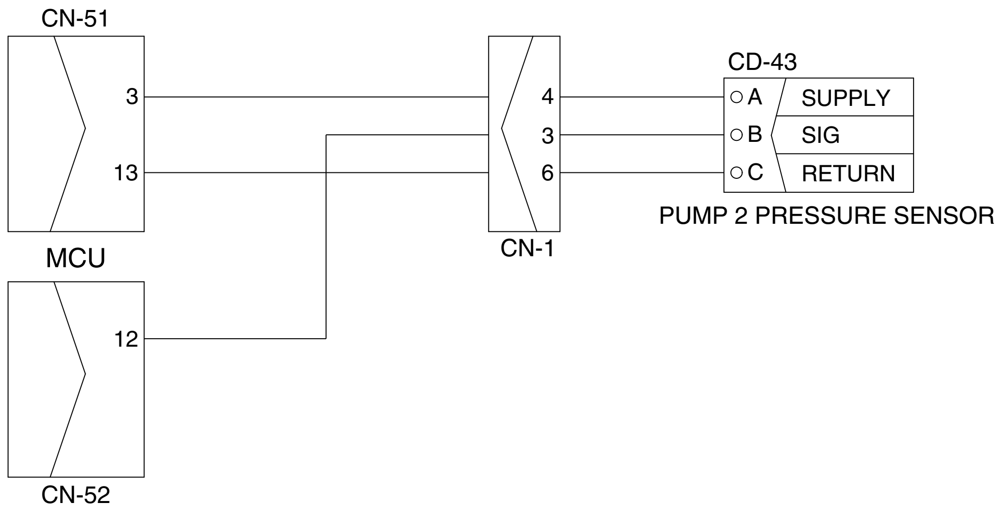
· Fault code : HCESPN 121, FMI 0~4

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

1) INSPECTION PROCEDURE



Wiring diagram



300L6MS07

2) TEST PROCEDURE

(1) Test 10 : Check voltage at CN-52 (12) and ground.

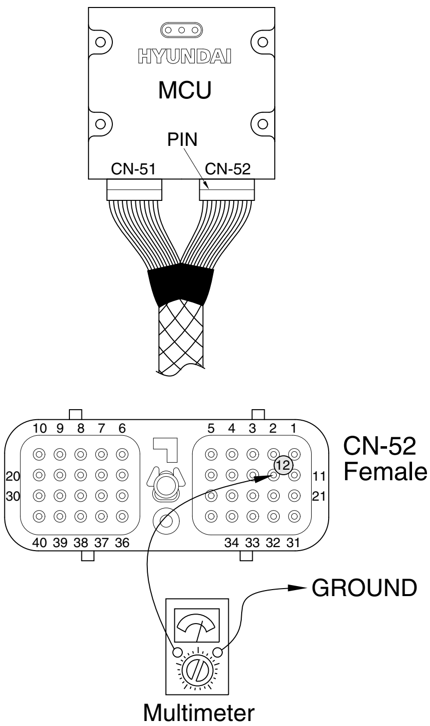
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (12) of CN-52.

③ Starting switch ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V

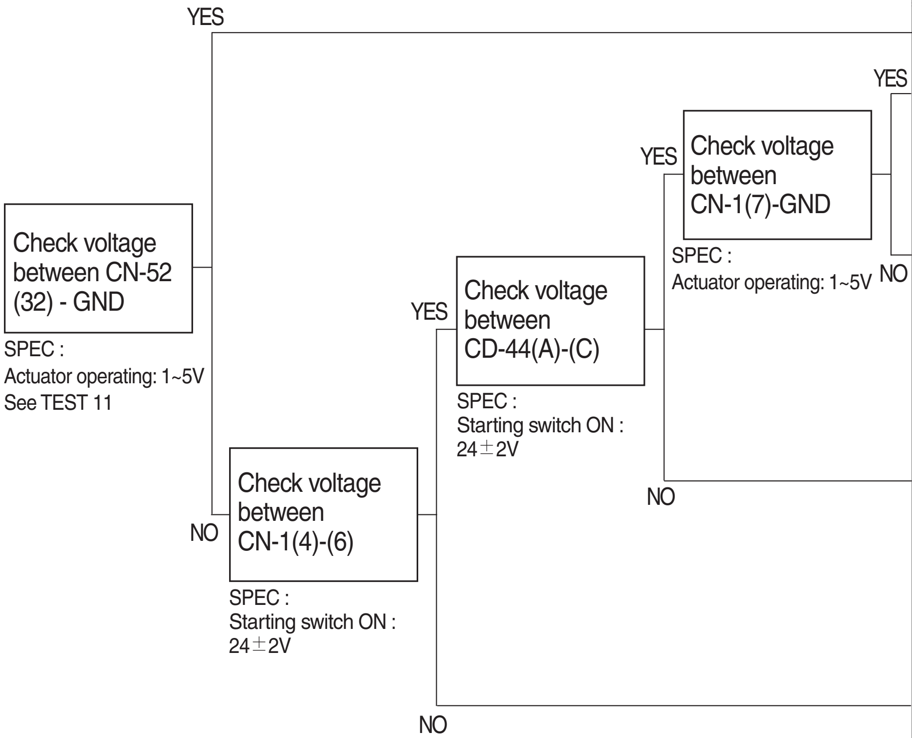


300L6MS08

7. MALFUNCTION OF PUMP 3 PRESSURE SENSOR

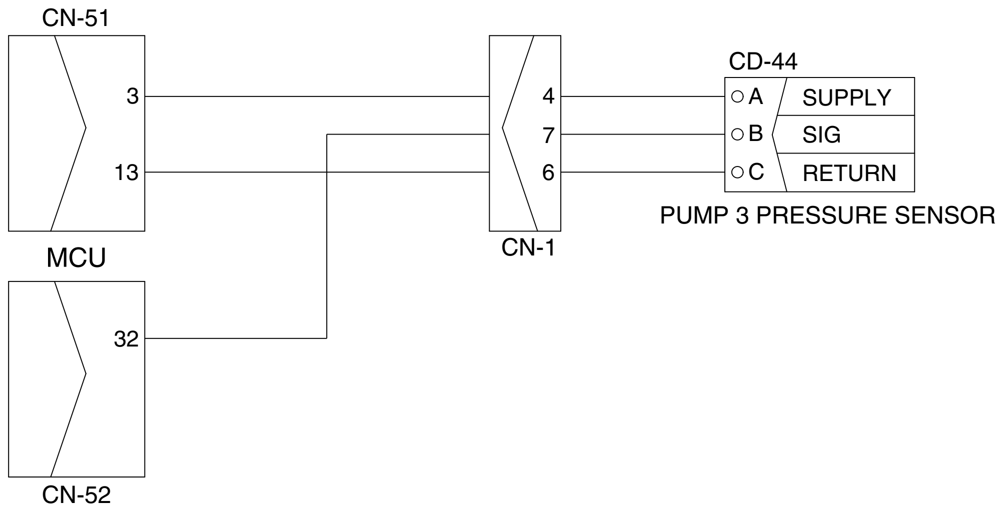
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective MCU	Replace
Short circuit or poor connection between CN-52-(32)-CN-1(7)	Replace or repair
Detective P3 pressure sensor	Replace or repair
Short circuit or poor connection between CN-1(7)-CD-44(B)	Replace or repair
Short circuit or poor connection between CD-44(A)-CN-1(4) or CD-44(C)-CN-1 (6)	Replace or repair
Short circuit or poor connection between CN-1(4)-CN-51(3) or CN-1 (6) - CN-51(13)	Replace or repair

Wiring diagram



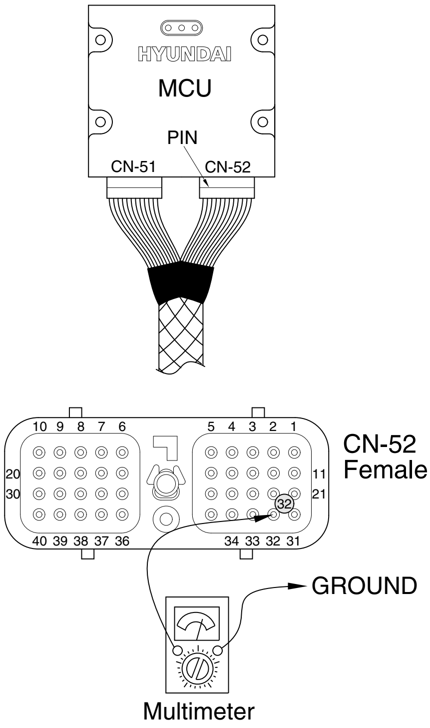
300L6MS09

2) TEST PROCEDURE

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

① Prepare 1 piece of thin sharp pin, steel or copper.
② Insert prepared pin to rear side of connectors : One pin to (32) of CN-52.
③ Starting switch ON.
④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V



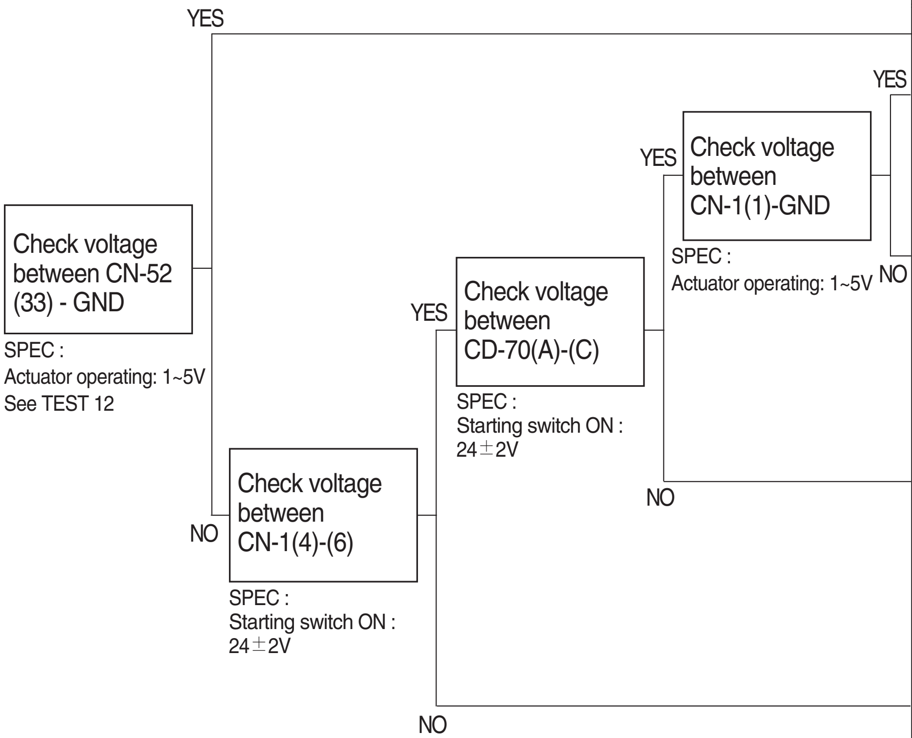
300L6MS10

8. MALFUNCTION OF NEGATIVE 1 PRESSURE SENSOR

· Fault code : HCESPN 123, FMI 0~4

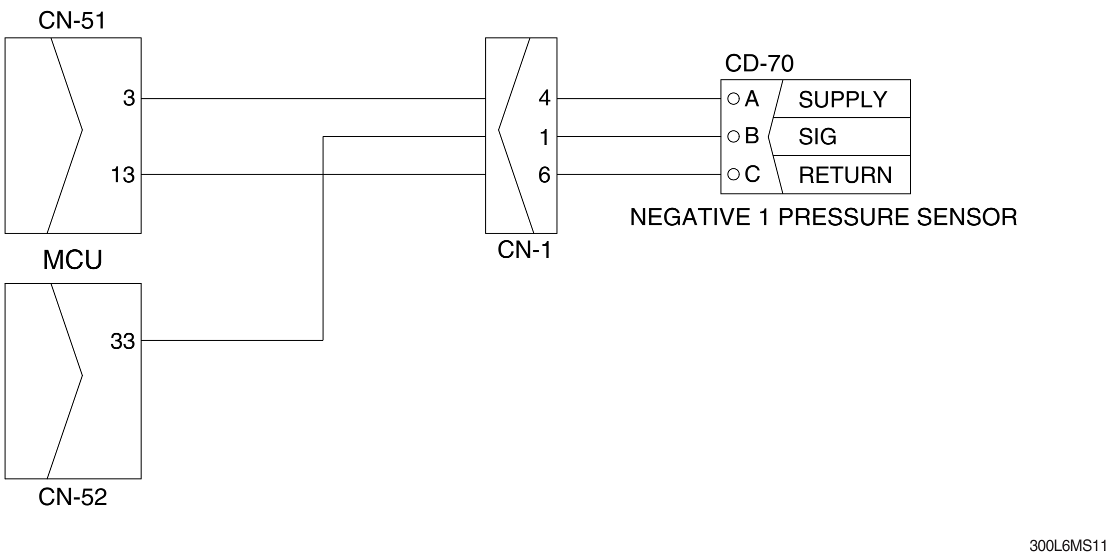
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective MCU	Replace
Short circuit or poor connection between CN-52-(33)-CN-1(1)	Replace or repair
Detective N1 pressure sensor	Replace or repair
Short circuit or poor connection between CN-1(1)-CD-70(B)	Replace or repair
Short circuit or poor connection between CD-70(A)-CN-1(4) or CD-70(C)-CN-1 (6)	Replace or repair
Short circuit or poor connection between CN-1(4)-CN-51(3) or CN-1 (6) - CN-51(13)	Replace or repair

Wiring diagram

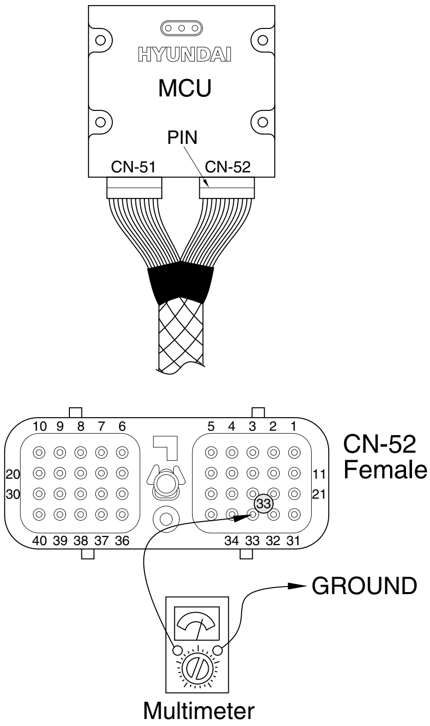


2) TEST PROCEDURE

(1) Test 12 : Check voltage at CN-52 (33) and ground.

① Prepare 1 piece of thin sharp pin, steel or copper.
② Insert prepared pin to rear side of connectors : One pin to (33) of CN-52.
③ Starting switch ON.
④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V



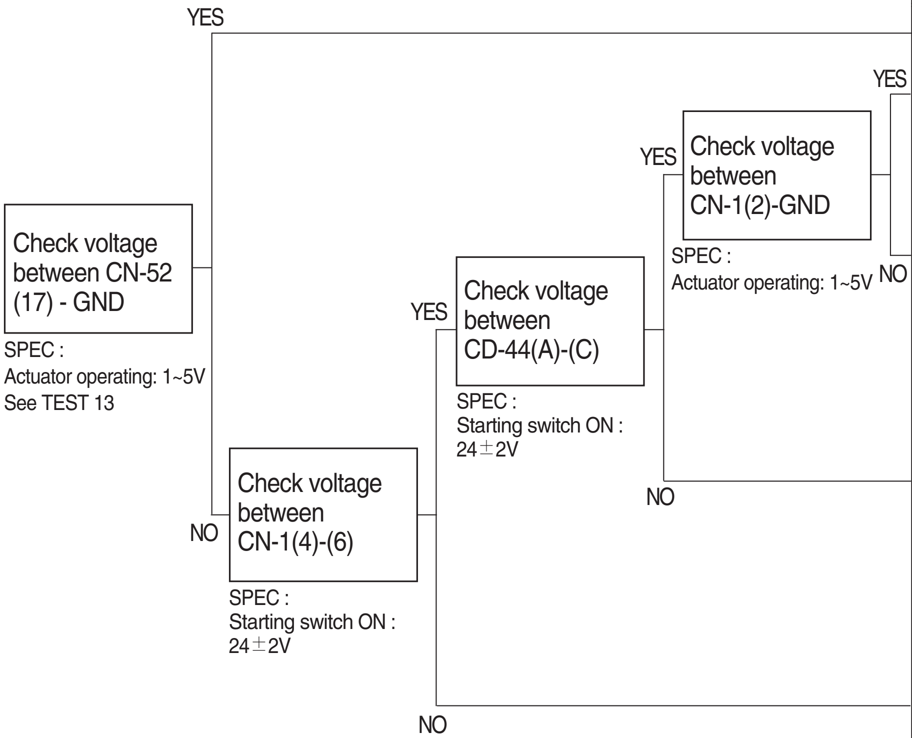
300L6MS12

9. MALFUNCTION OF NEGATIVE 2 PRESSURE SENSOR

· Fault code : HCESPN 124, FMI 0~4

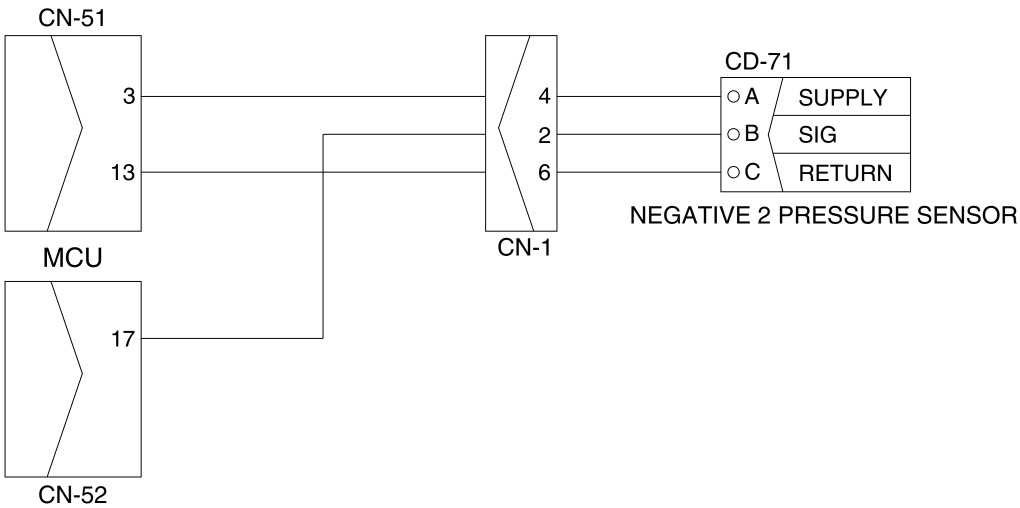
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective MCU	Replace
Short circuit or poor connection between CN-52-(17)-CN-1(2)	Replace or repair
Detective N2 pressure sensor	Replace or repair
Short circuit or poor connection between CN-1(2)-CD-71(B)	Replace or repair
Short circuit or poor connection between CD-71(A)-CN-1(4) or CD-71(C)-CN-1(6)	Replace or repair
Short circuit or poor connection between CN-1(4)-CN-51(3) or CN-1 (6) - CN-51(13)	Replace or repair

Wiring diagram



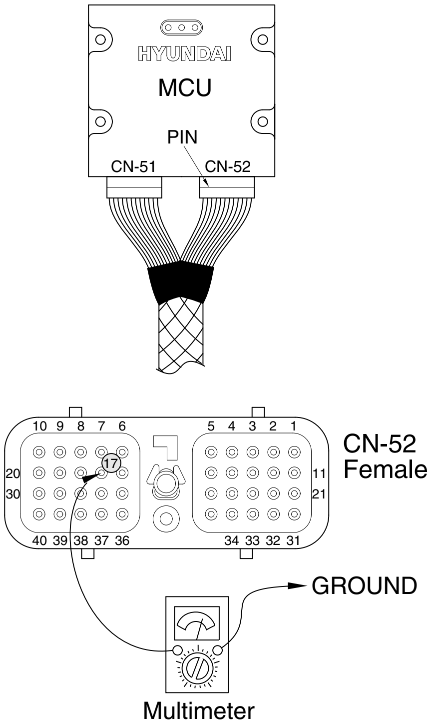
300L6MS13

2) TEST PROCEDURE

(1) Test 13 : Check voltage at CN-52 (17) and ground.

① Prepare 1 piece of thin sharp pin, steel or copper.
② Insert prepared pin to rear side of connectors : One pin to (17) of CN-52.
③ Starting switch ON.
④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V



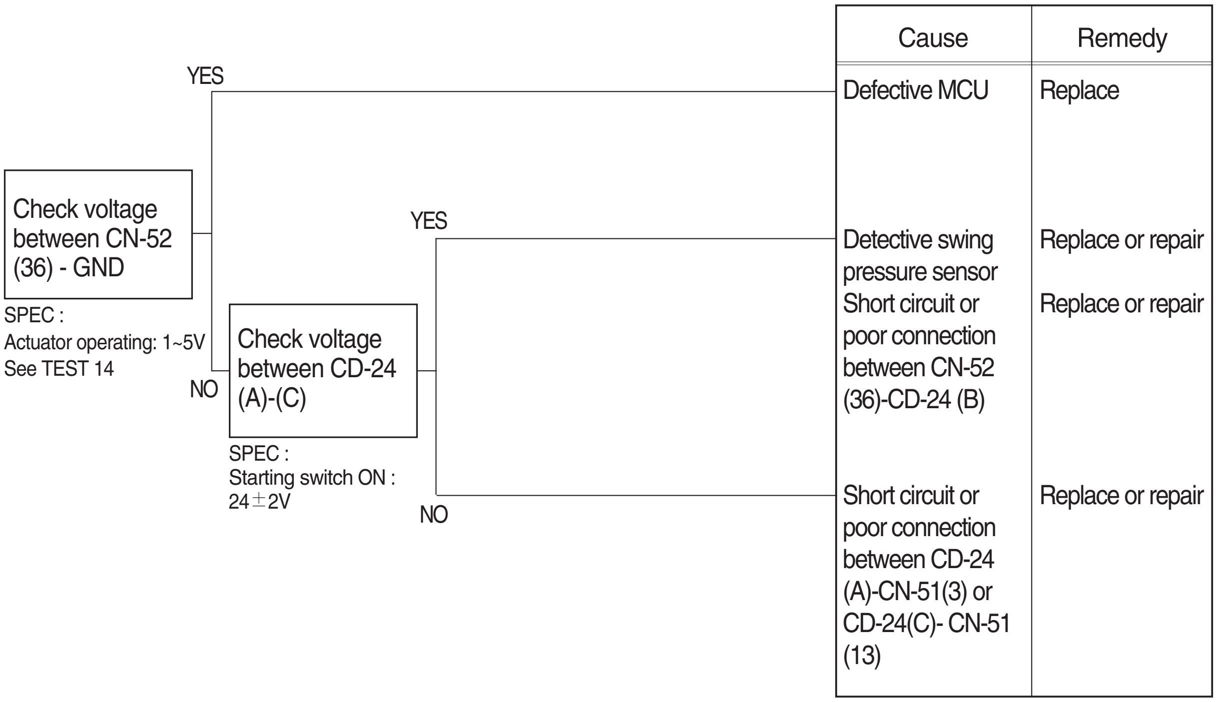
300L6MS14

10. MALFUNCTION OF SWING PRESSURE SENSOR

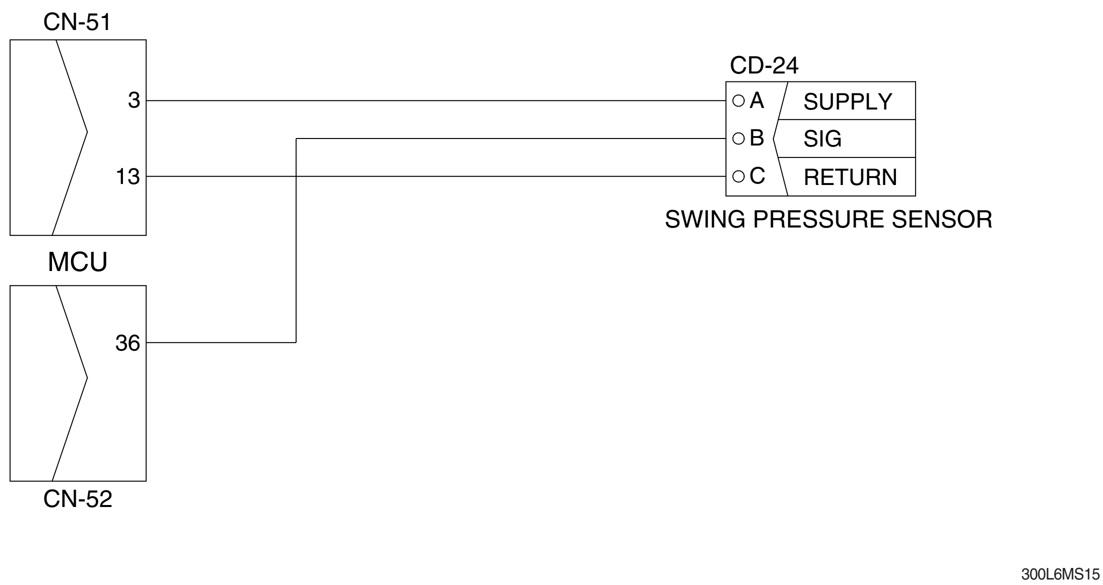
· Fault code : HCESPN 135, FMI 0~4

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

1) INSPECTION PROCEDURE



Wiring diagram



2) TEST PROCEDURE

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

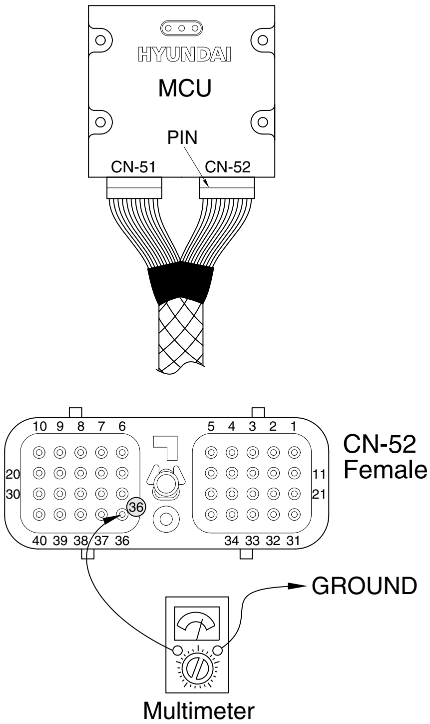
① Prepare 1 piece of thin sharp pin, steel or copper.

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



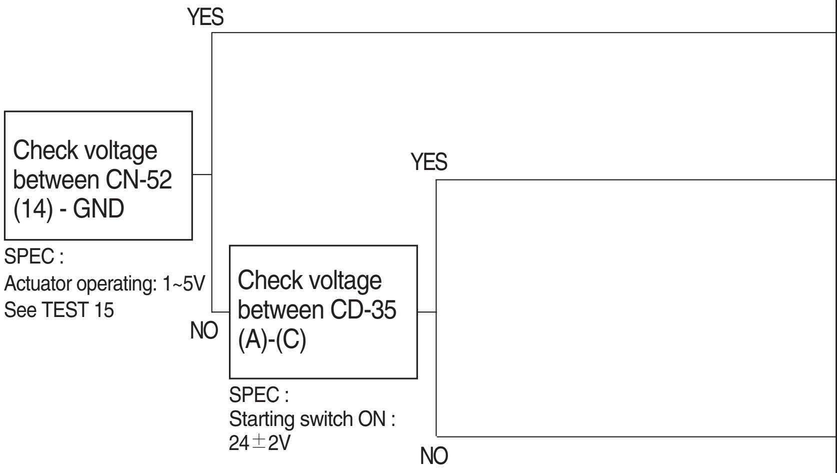
300L6MS16

11. MALFUNCTION OF ARM IN/OUT & BUCKET IN PRESSURE SENSOR

· Fault code : HCESPN 133, FMI 0~4

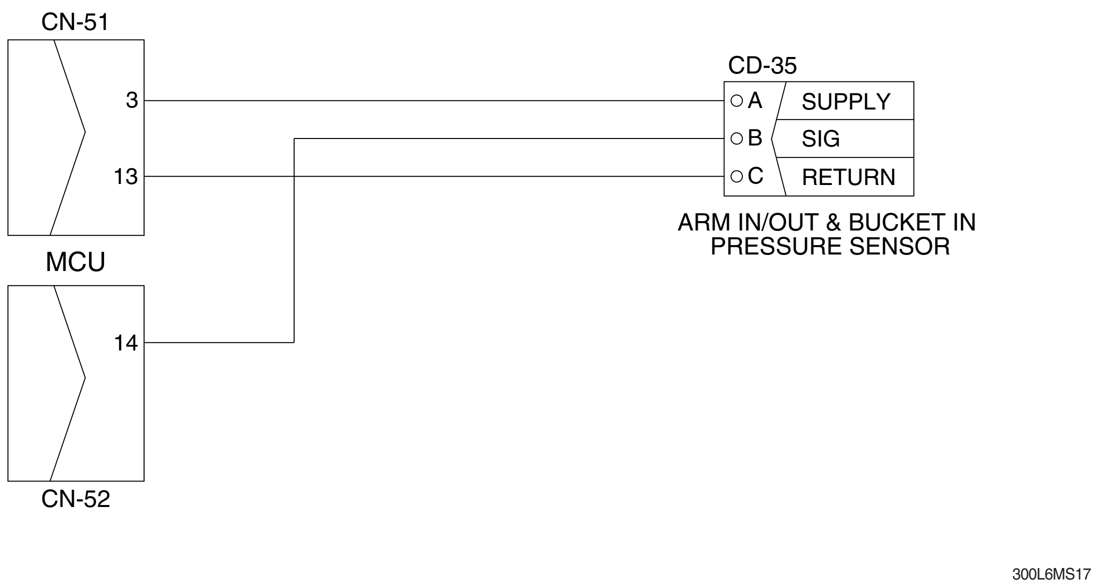
※ Before carrying out below procedure, check all the related connectors are properly inserted.

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 (14)-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



2) TEST PROCEDURE

(1) Test 15 : Check voltage at CN-52 (14) and ground.

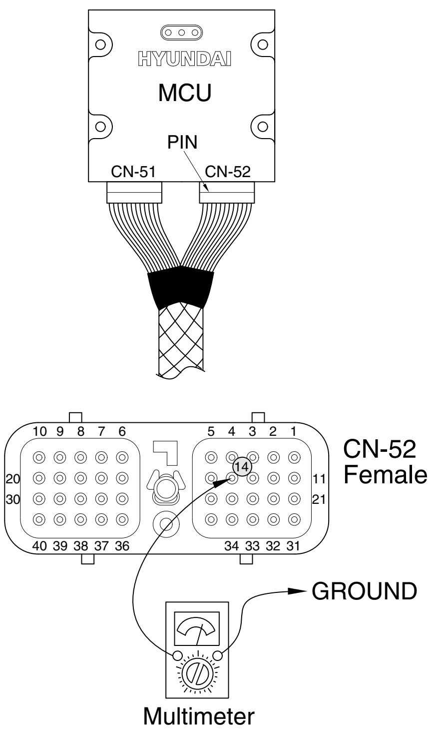
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (14) of CN-52.

③ Starting switch ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V



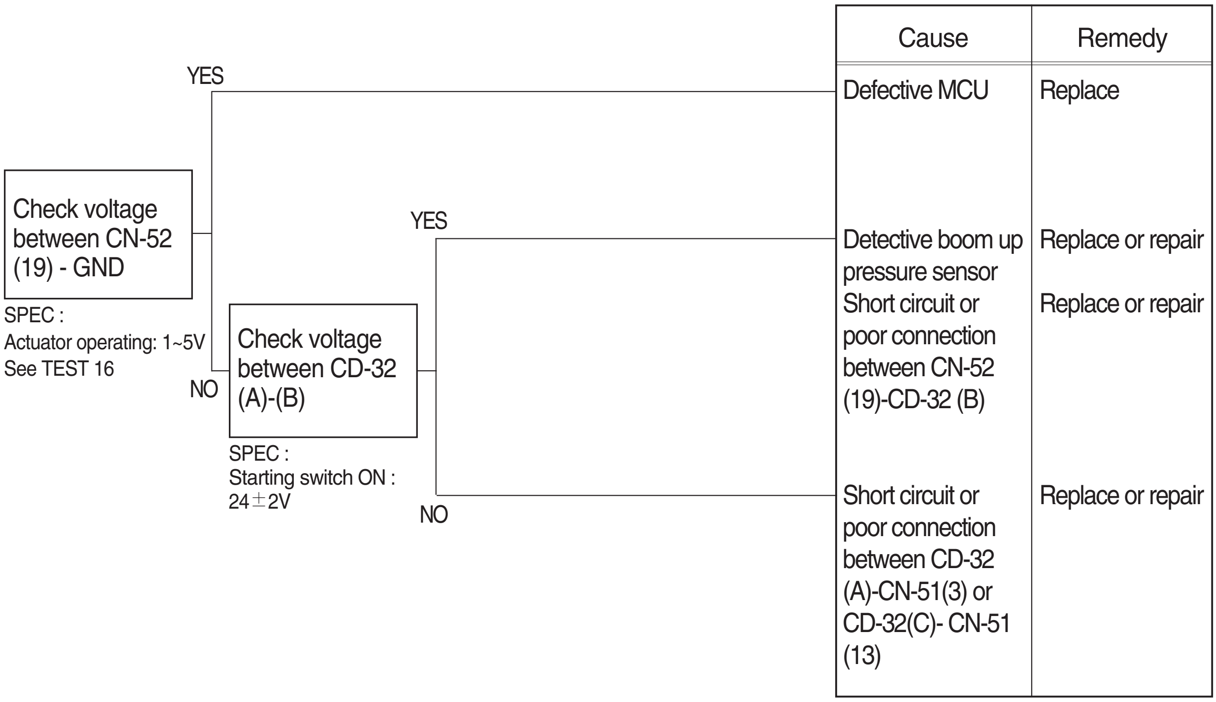
300L6MS18

12. MALFUNCTION OF BOOM UP PRESSURE SENSOR

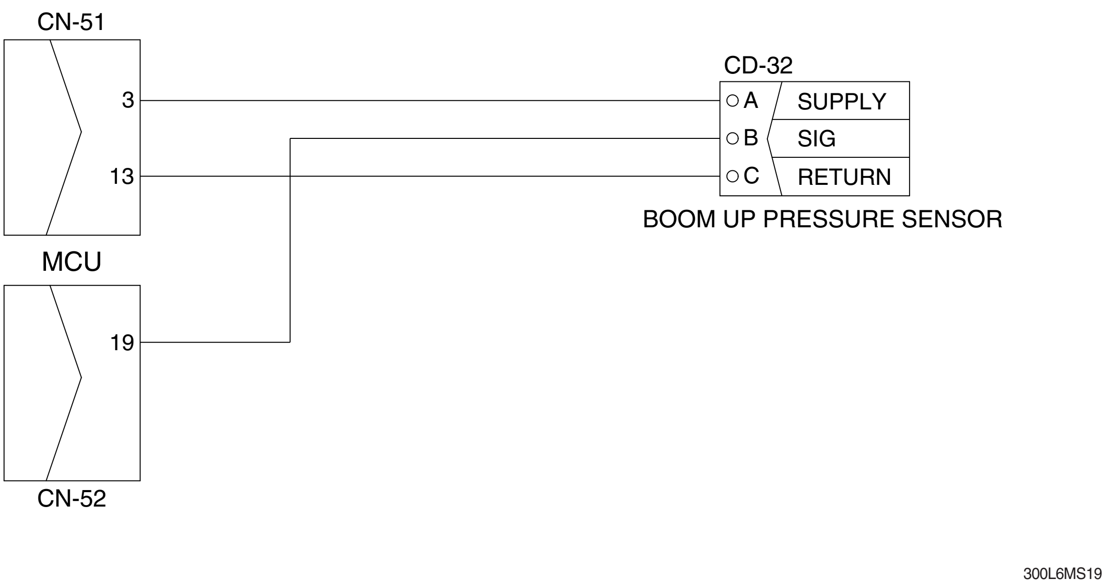
· Fault code : HCESPN 127, FMI 0~4

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

1) INSPECTION PROCEDURE



Wiring diagram



2) TEST PROCEDURE

(1) Test 16 : Check voltage at CN-52 (19) and ground.

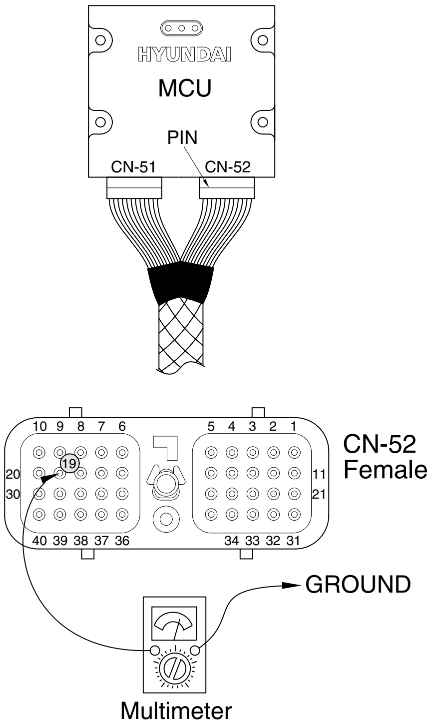
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (19) of CN-52.

③ Starting switch ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V



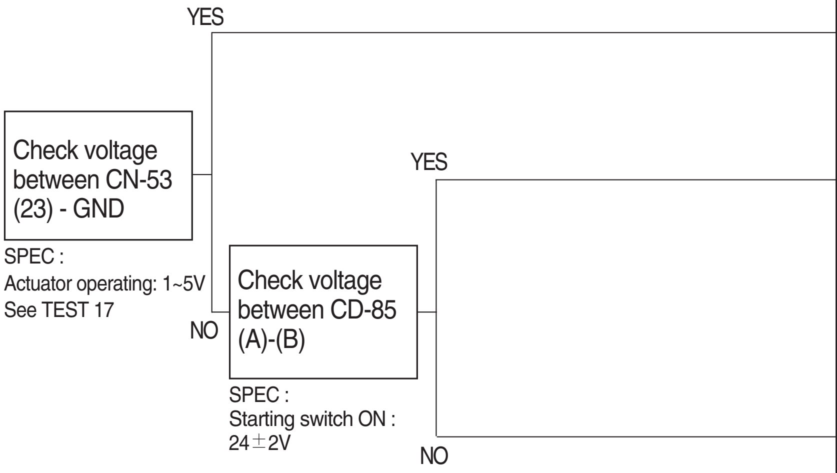
300L6MS20

13. MALFUNCTION OF BOOM DOWN PRESSURE SENSOR

· Fault code : HCESPN 128, FMI 0~4

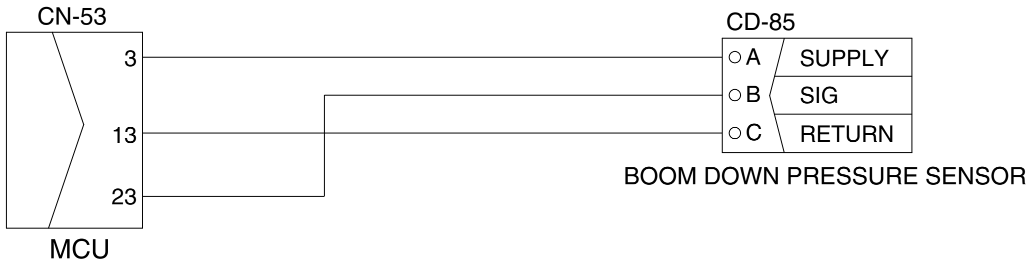
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective MCU	Replace
Detective boom up pressure sensor	Replace or repair
Short circuit or poor connection between CN-53 (23)-CD-85 (B)	Replace or repair
Short circuit or poor connection between CD-85 (A)-CN-53(3) or CD-85(C)- CN-51 (13)	Replace or repair

Wiring diagram



300L6MS25

2) TEST PROCEDURE

(1) Test 17 : Check voltage at CN-53 (23) and ground.

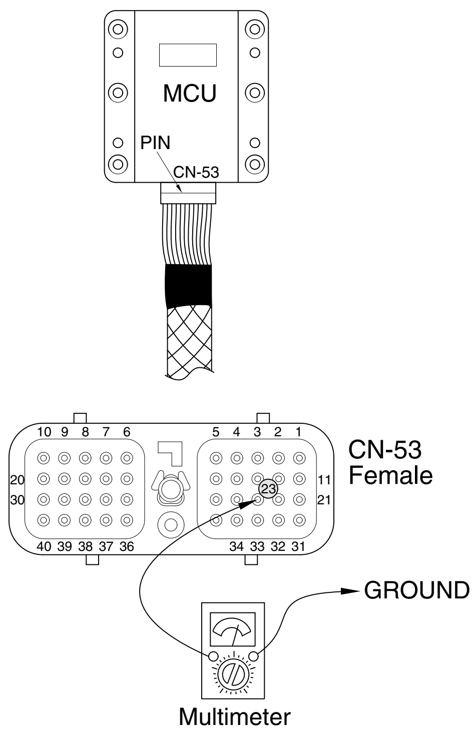
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (23) of CN-53.

③ Starting switch ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V



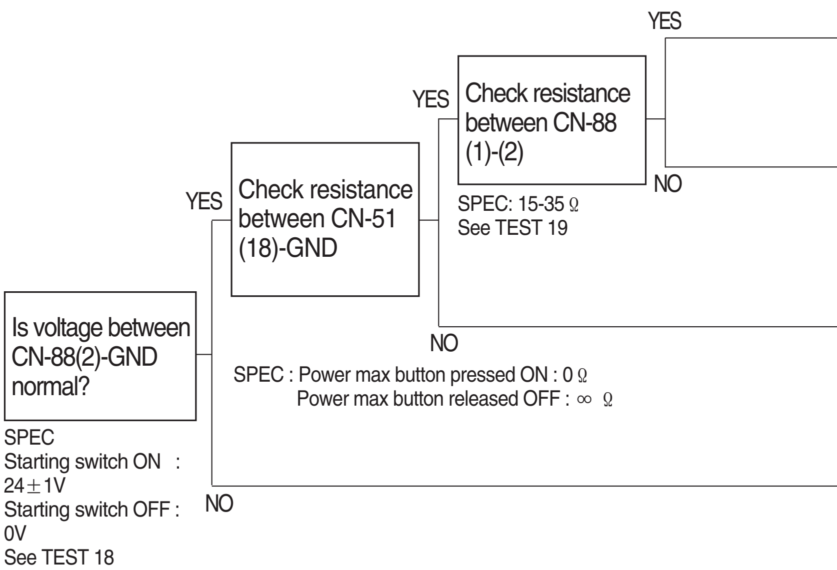
300L6MS26

14. MALFUNCTION OF POWER MAX

· Fault code : HCESPN 166, FMI 4 or 6

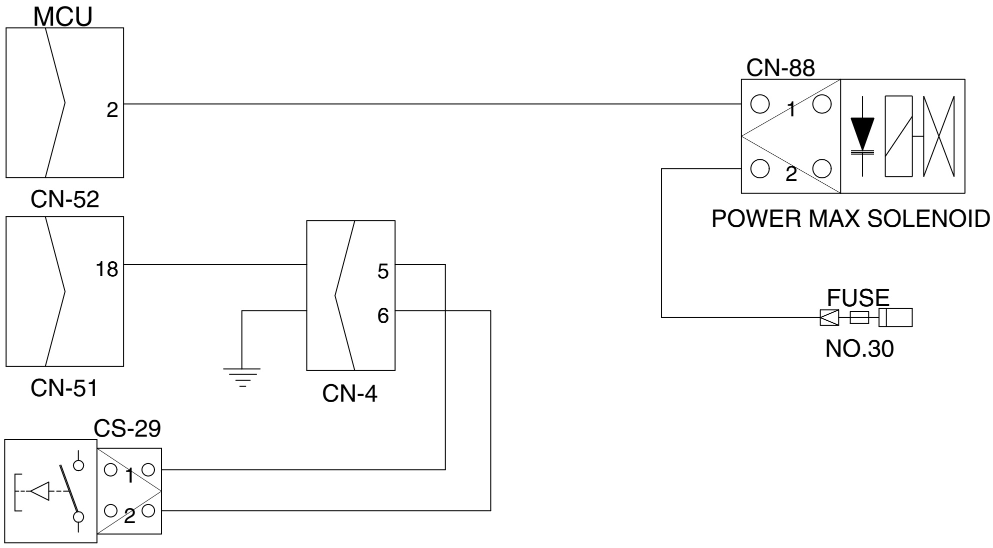
※ Before carrying out below procedure, check all the related connectors are properly inserted.

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	Repair or replace
Short circuit or poor connection between CN-88(2)- Fuse No. 30	Repair or replace

Wiring diagram

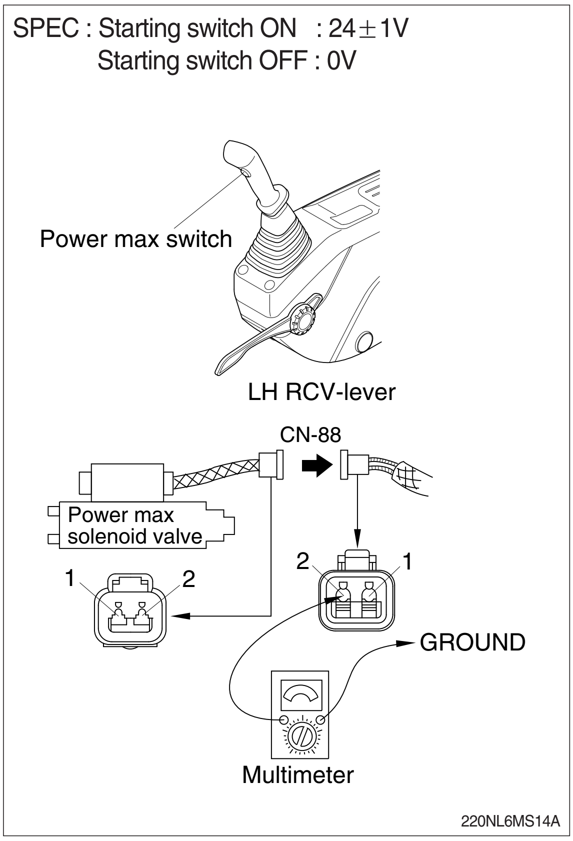


140L6MS03

2) TEST PROCEDURE

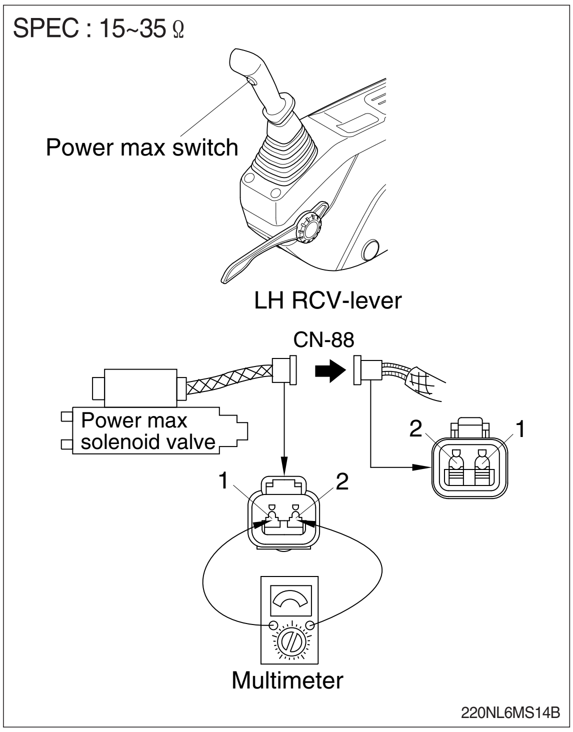
(1) Test 18: Check voltage between connector CN-88 (2) - GND.

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

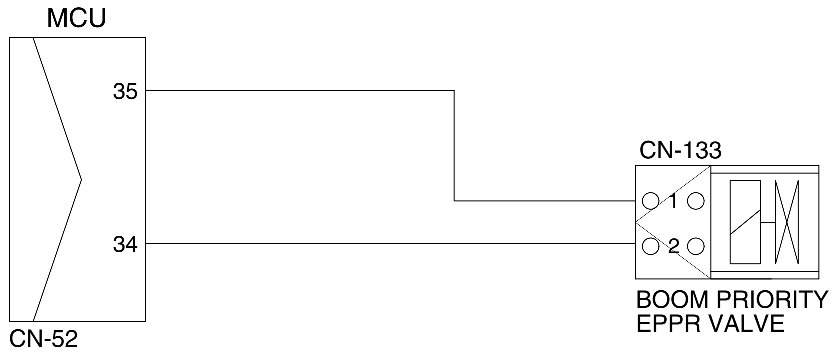
· Fault code : HCESPN 141, FMI 5 or 6

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

1) INSPECTION PROCEDURE

Cause	Remedy
Short circuit or poor connection between CN-52(35)-CN-133 (1) or CN-52(34)-CN-133(2)	Repair or replace
Defective EPPR valve	Repair or replace

Wiring diagram



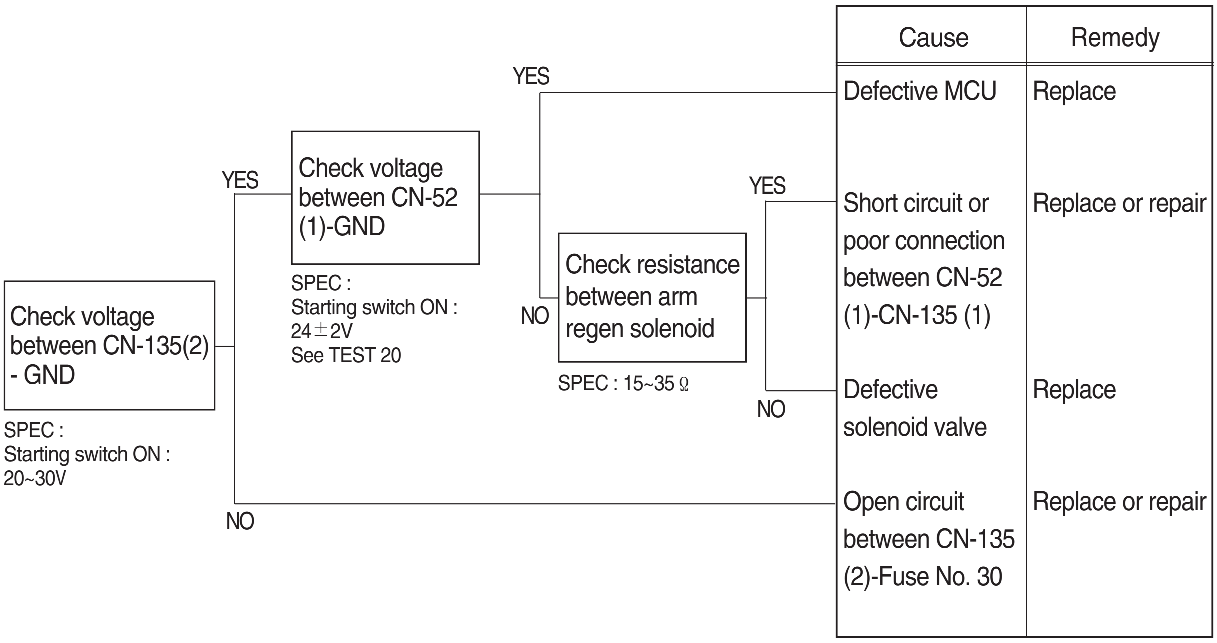
300L6MS23

16. MALFUNCTION OF ARM REGENERATION SOLENOID

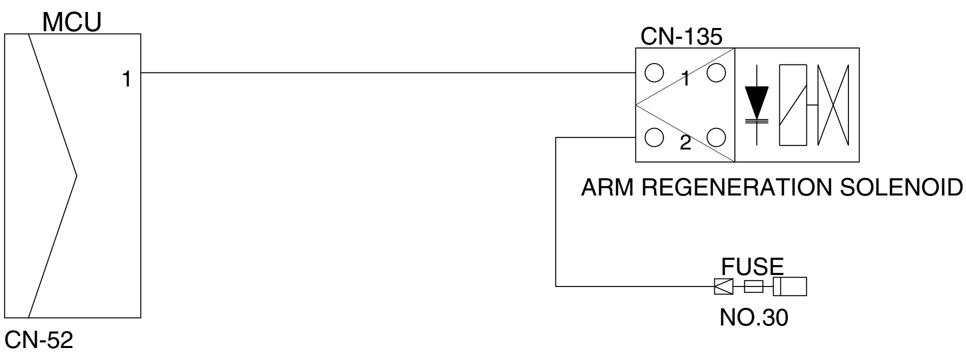
· Fault code : HCESPN 170, FMI 4 or 6

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

1) INSPECTION PROCEDURE



Wiring diagram



140L6MS04

2) TEST PROCEDURE

(1) Test 20 : Check voltage at CN-52 (1) and ground.

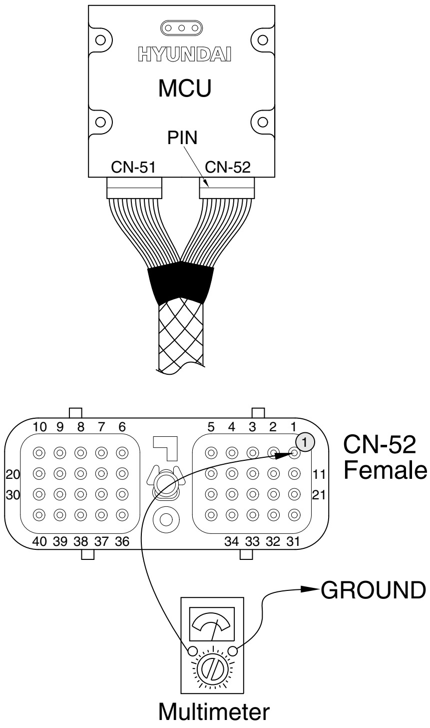
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (1) of CN-52.

③ Starting switch ON.

④ Check voltage as figure.

SPEC : Starting switch ON : 24±2 V



300L6MS22

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.

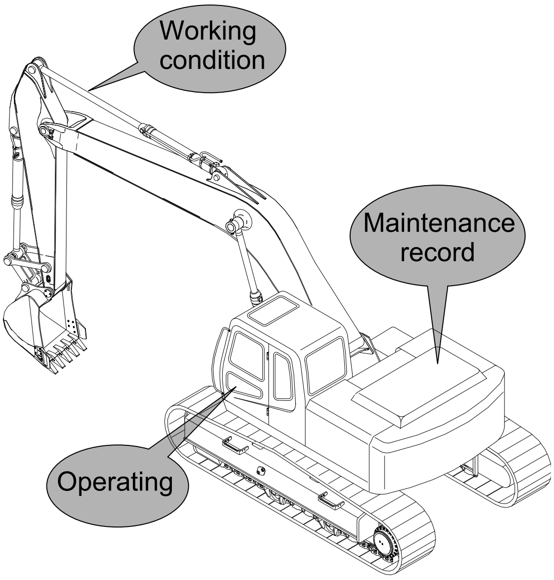
2) OPERATIONAL PERFORMANCE OF A WORKING MACHINE

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.

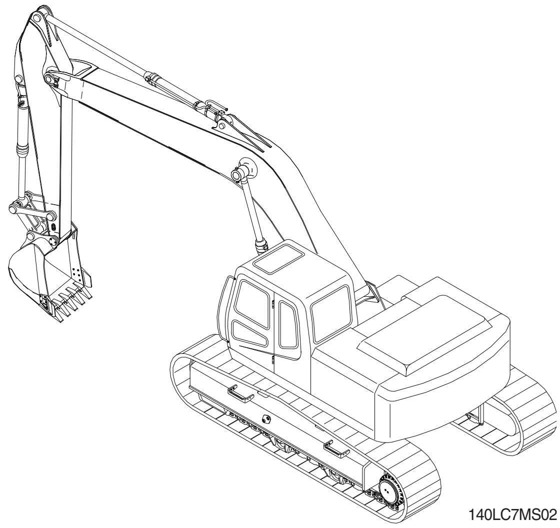


140LC7MS01

2. TERMINOLOGY

1) STANDARD

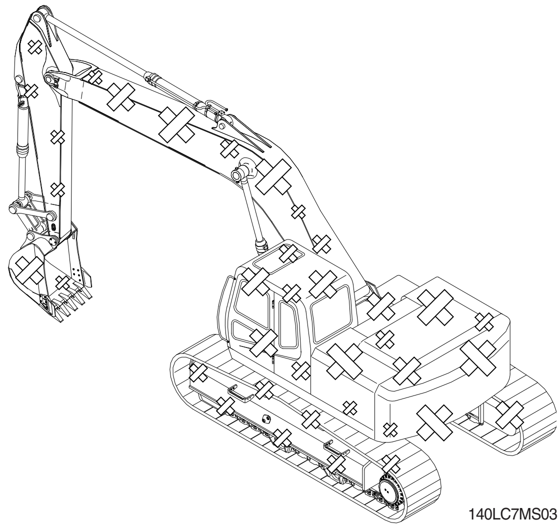
Specifications applied to the brand-new machine, components and parts.



140LC7MS02

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.



140LC7MS03

3. OPERATION FOR PERFORMANCE TESTS

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

(1) The machine

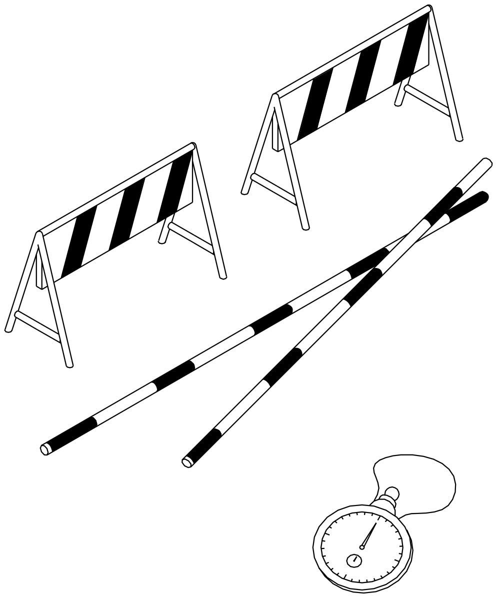
Repair any defects and damage found, such as oil or water leaks, loose bolts, cracks and so on, before starting to test.

(2) Test area

① Select a hard, flat surface.

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

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



(290-7TIER) 7-3

(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.

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 multimodal dial at 10 (Max) position.

③ Measure the engine RPM.

(3) Measurement

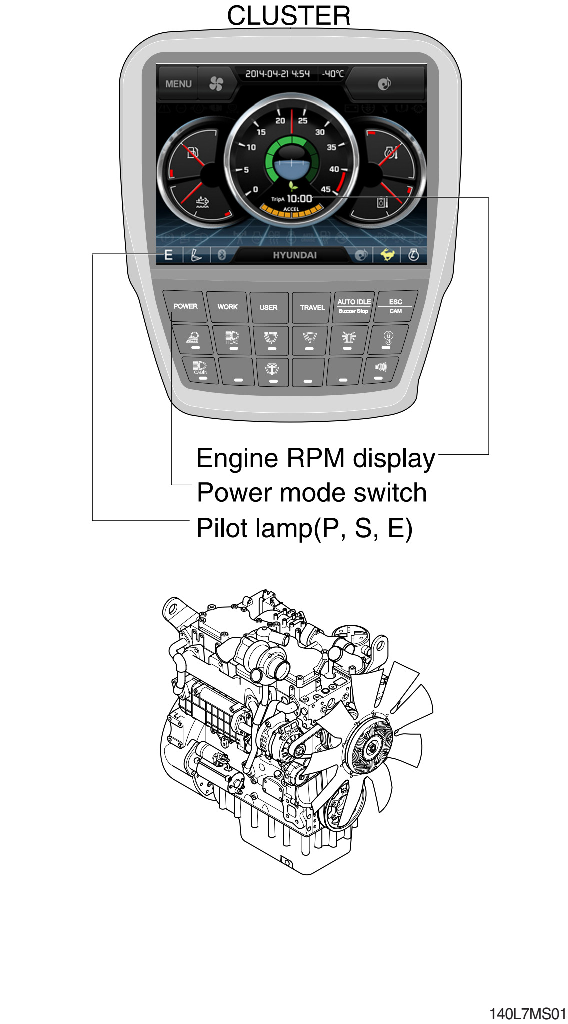
① Start the engine. The engine will run at start idle speed. Measure engine speed with a engine rpm display.

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.



(4) Evaluation

The measured speeds should meet the following specifications.

Unit : rpm

Model	Engine speed	Standard	Remarks
HX160 L HX180 L	Start idle	1000±100	
	P mode	1950±50	
	S mode	1850±50	
	E mode	1750±50	
	Auto decel	1100±100	
	One touch decel	1000±100	

Condition : Set the multimodal dial at 10 (Max) position.

3) TRAVEL SPEED

(1) Measure the time required for the excavator to travel a 20 m test track.

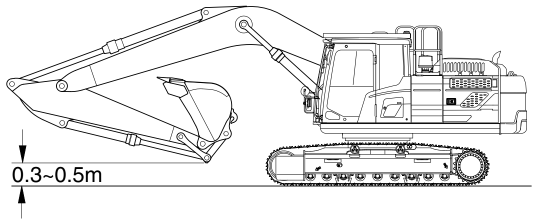
(2) Preparation

① Adjust the tension of both tracks to be equal.

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

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

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



260A7MS02

(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.

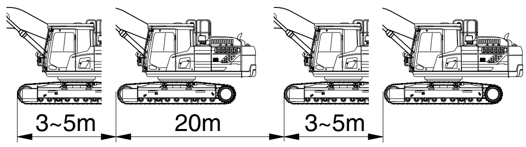
· Power mode switch : P mode

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.



260A7MS03

(4) Evaluation

The average measured time should meet the following specifications.

Unit : Seconds / 20 m

Model	Travel speed	Standard	Maximum allowable	Remarks
HX160 L HX180 L	1 Speed	22.3±2.0	27.8	
	2 Speed	13.6±1.0	17.1	

4) TRACK REVOLUTION SPEED

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

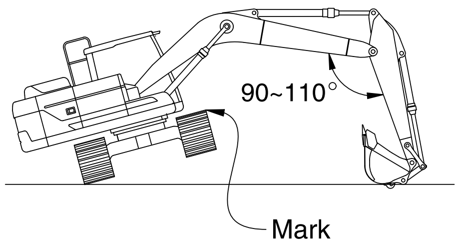
(2) Preparation

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

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

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

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



160F7MS06

(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
HX160 L HX180 L	1 Speed	29.0±2.0	36.3
	2 Speed	17.0±2.0	21.3

5) TRAVEL DEVIATION

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

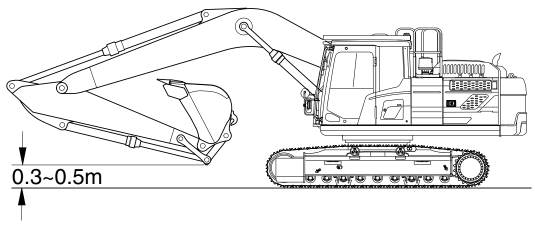
(2) Preparation

① Adjust the tension of both tracks to be equal.

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

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

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



260A7MS02

(3) Measurement

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

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

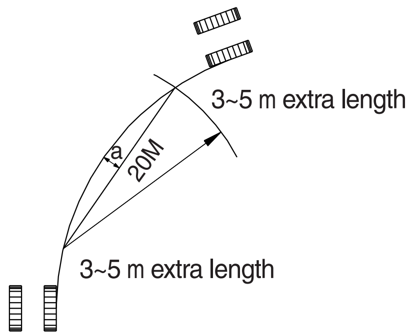
· Power mode switch : P mode

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

④ Measure the distance between a straight 20 m line and the track made by the machine. (dimension a)

⑤ After measuring the tracking in forward travel, turn the upperstructure 180˚ and measure that in reverse travel.

⑥ Repeat steps ④ and ⑤ three times and calculate the average values.



(210-7) 7-7(2)

(4) Evaluation

Mistrack should be within the following specifications.

Unit : mm / 20 m

Model	Standard	Maximum allowable	Remarks
HX160 L HX180 L	200 below	240	

6) SWING SPEED

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

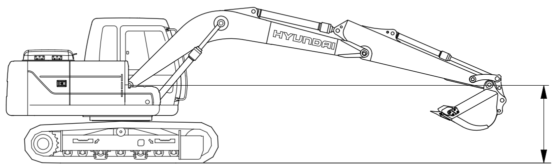
(2) Preparation

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

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

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

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



16097MS07

(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
HX160 L HX180 L	P mode	17.5±1.5	22

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.

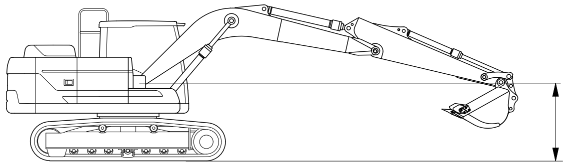
② Place the machine on flat, solid ground with ample space for swinging. Do not conduct this test on slopes.

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.



160F7MS07

(3) Measurement

① Conduct this test in the M mode.

② Select the following switch positions.

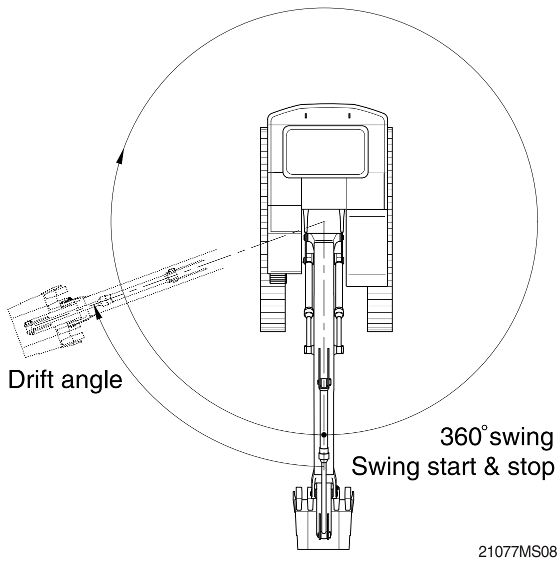
· Power mode switch : P mode

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

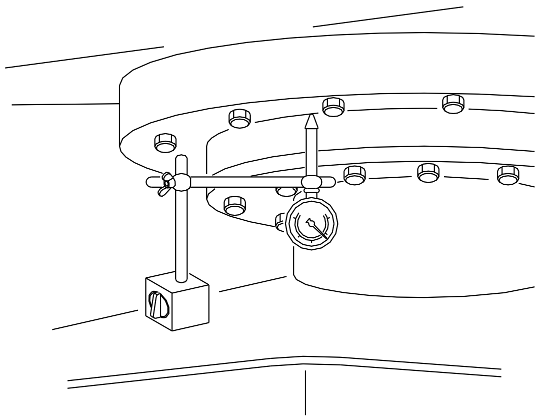
The measured drift angle should be within the following specifications.

Unit : Degree

Model	Power mode switch	Standard	Maximum allowable	Remarks
HX160 L HX180 L	P mode	90 below	157.5	

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.

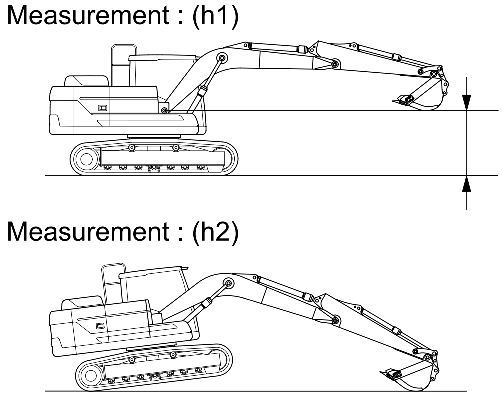
⑥ Bucket should be empty.

(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 50cm.
Record the dial gauge reading (h2).

③ Calculate bearing play (H) from this data (h1 and h2) as follows.
H=h2-h1



160F7MS09

(4) Evaluation

The measured drift should be within the following specifications.

Unit : mm

Model	Standard	Maximum allowable	Remarks
HX160 L HX180 L	0.5 ~ 1.5	3.0	

9) HYDRAULIC CYLINDER CYCLE TIME

(1) Measure the cycle time of the boom, standard arm, and standard bucket cylinders.

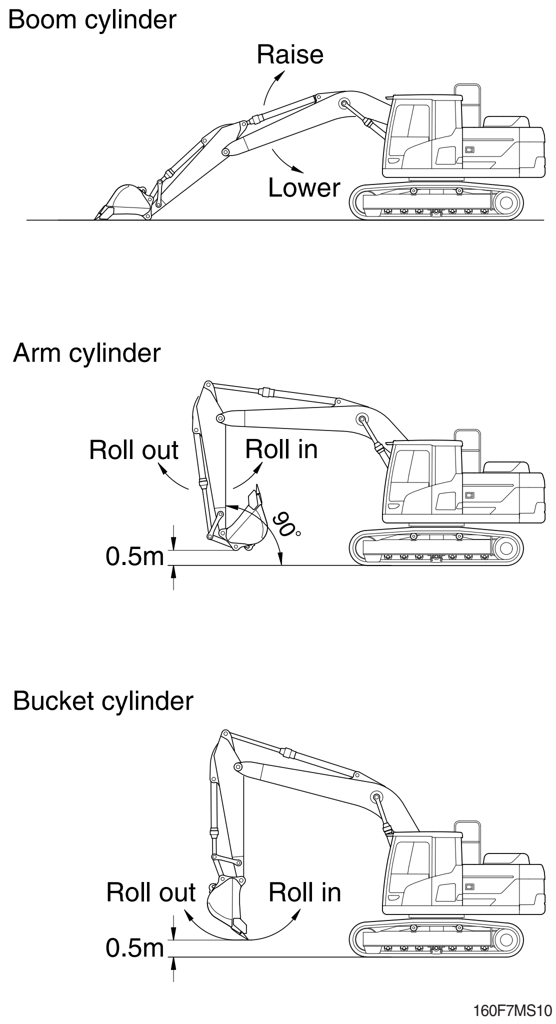
(2) Preparation

① To measure the cycle time of the boom cylinders:
With the arm rolled out and the empty bucket rolled out, lower the bucket to the ground, as shown.

② To measure the cycle time of the arm cylinder.
With the empty bucket rolled in, position the arm so that it is vertical to the ground. Lower the boom until the bucket is 0.5 m above the ground.

③ To measure the cycle time of the bucket cylinder.
The empty bucket should be positioned at midstroke between roll-in and roll-out, so that the sideplate edges are vertical to the ground.

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



(3) Measurement

① Select the following switch positions.

· Power mode switch : P mode

② To measure cylinder cycle times.

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

- Arm cylinder.
Measure the time it takes to roll in the arm, and the time it takes to roll out the arm. To do so, position the bucket at one stroke end, then move the control lever to the other stroke end as quickly as possible.

- Bucket cylinders
  Measure the time it takes to roll in the bucket, and the time it takes to roll out the bucket. To do so, position the bucket at one stroke end, then move the control lever to the other stroke end as quickly as possible.
- Repeat each measurement 3 times and calculate the average values.

(4) Evaluation

The average measured time should meet the following specifications.

Unit : Seconds

Model	Function		Standard	Maximum allowable	Remarks
HX160 L HX180 L	Boom raise		3.6±0.4	4.2	
	Boom lower		2.3±0.4	2.9	
	Arm in	Regen ON	2.7±0.4	3.4	
		Regen OFF	3.1±0.4	3.9	
	Arm out		3.1±0.3	3.9	
	Bucket in		3.9±0.4	4.6	
	Bucket out		2.7±0.3	3.3	

10) DIG FUNCTION DRIFT CHECK

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

(2) Preparation

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

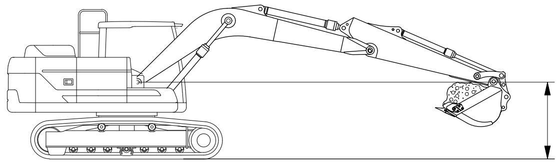
· $W = M^3 \times 1.5$
Where :
M^3 = Bucket heaped capacity (m^3)
1.5 = Soil specific gravity

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

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

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

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



160F7MS11

(3) Measurement

① Stop the engine.

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

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

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

Unit : mm / 5 min

Model	Drift to be measured	Standard	Maximum allowable	Remarks
HX160 L HX180 L	Boom cylinder	10 below	20	
	Arm cylinder	10 below	20	
	Bucket cylinder	40 below	50	

11) CONTROL LEVER OPERATING FORCE

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

(2) Preparation

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

(3) Measurement

① Start the engine.

② Select the following switch positions.

· Power mode switch: P mode

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
HX160 L HX180 L	Boom lever	1.3 or below	1.7	
	Arm lever	1.3 or below	1.7	
	Bucket lever	1.3 or below	1.7	
	Swing lever	1.3 or below	1.7	
	Travel lever	2.1 or below	3.15	

12) CONTROL LEVER STROKE

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

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

(2) Preparation

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

(3) Measurement

① Stop the engine.

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

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

(4) Evaluation

The measured drift should be within the following specifications.

Unit : mm

Model	Kind of lever	Standard	Maximum allowable	Remarks
HX160 L HX180 L	Boom lever	90±10	115	
	Arm lever	90±10	115	
	Bucket lever	90±10	115	
	Swing lever	90±10	115	
	Travel lever	142±10	178	

13) PILOT PRIMARY PRESSURE

(1) Preparation

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

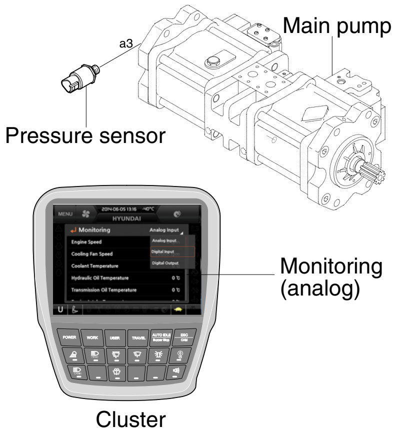
(2) Measurement

① Select the following switch positions.

· Power mode switch : P mode

· Auto decel switch : OFF

② Measure the primary pilot pressure by the monitoring menu of the cluster.



140L7MS02

(3) Evaluation

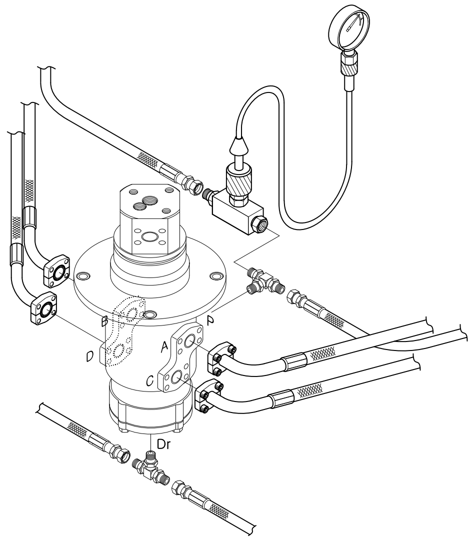
The average measured pressure should meet the following specifications:

Unit : kgf / cm2

Model	Engine speed	Standard	Allowable limits	Remarks
HX160 L / HX180 L	P mode	40^{+2}_{0}	-	

14) FOR TRAVEL SPEED SELECTING PRESSURE:

(1) Preparation



21077MS13

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.

(2) Measurement

① Select the following switch positions.
Travel mode switch : 1 speed
2 speed
· Mode selector : P mode
② Measure the travel speed selecting pressure in the Hi or Lo mode.
③ Repeat step ② three times and calculate the average values.

(3) Evaluation

The average measured pressure should be within the following specifications.

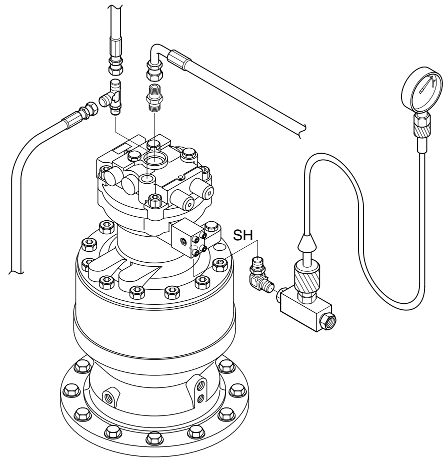
Unit : kgf / cm^2

Model	Travel speed mode	Standard	Maximum allowable	Remarks
HX160 L HX180 L	1 Speed	0	-	
	2 Speed	40±5	-	

15) SWING PARKING BRAKE RELEASING PILOT 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.



16097MS14

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

(3) Evaluation

The average measured pressure should be within the following specifications.

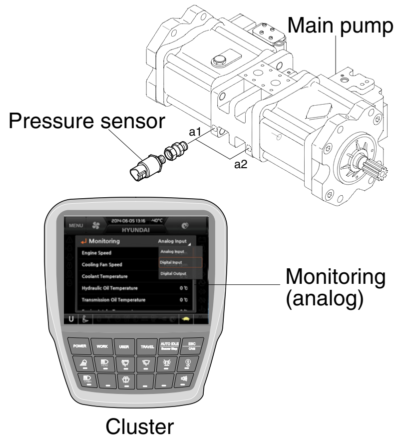
Unit : kgf / cm^2

Model	Description	Standard	Allowable limits	Remarks
HX160 L HX180 L	Brake disengaged	40	Over 4	
	Brake applied	0	-	

16) MAIN PUMP DELIVERY PRESSURE

(1) Preparation

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



140L7MS03

(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).

(3) Evaluation

The average measured pressure should meet the following specifications.

Unit : kgf / cm^2

Model	Engine speed	Standard	Allowable limits	Remarks
HX160 L / HX180L	High idle	32±5	-	

17) SYSTEM PRESSURE REGULATOR RELIEF SETTING

(1) Preparation

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

(2) Measurement

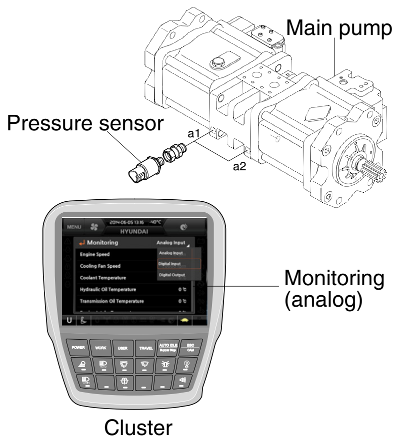
① Select the following switch positions.

· 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.



140L7MS03

(3) Evaluation

The average measured pressure should be within the following specifications.

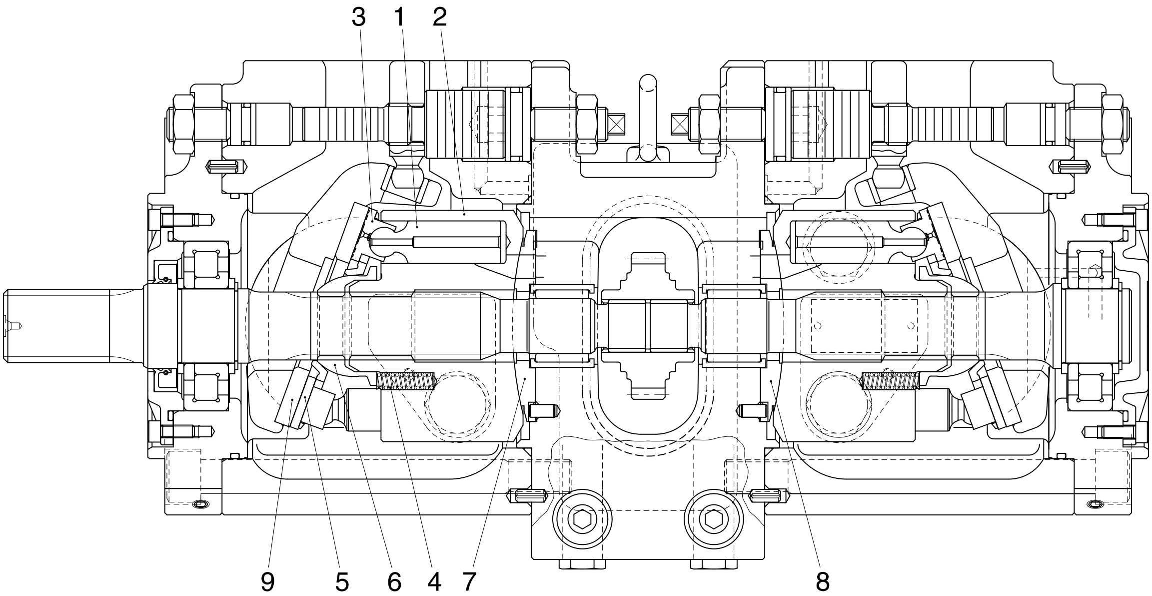
Unit : kgf / cm^2

Model	Function to be tested	Standard	Port relief setting at 20 lpm
HX160 L HX180 L	Boom, Arm, Bucket	350 (380)±10	400±10
	Travel	350±10	-
	Swing	275±10	-

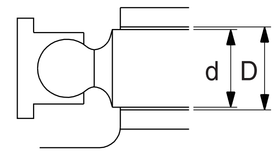
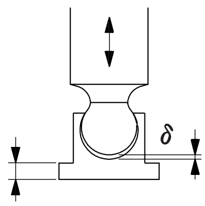
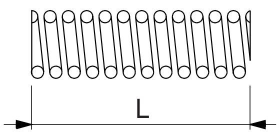
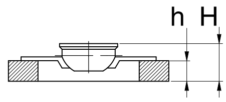
( ) : Power boost

GROUP 2 MAJOR COMPONENT

1. MAIN PUMP



14097MP01

Part name & inspection item		Standard dimension	Recommended replacement value	Counter measures
Clearance between piston (1) & cylinder bore (2) (D-d)		0.028	0.056	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)		3.9	3.7	
Free height of cylinder spring(4) (L)		31.3	30.5	Replace cylinder spring.
Combined height of set plate(5)(H) & spherical bushing(6)(h) (H-h)		19.0	18.3	Replace retainer or set plate.
Surface roughness for valve plate (Sliding face)(7,8), swash plate (shoe plate area) (9), & cylinder (2) (Sliding face)	Surface roughness necessary to be corrected	3z		Lapping
	Standard surface roughness (Corrected value)	0.4z or lower		

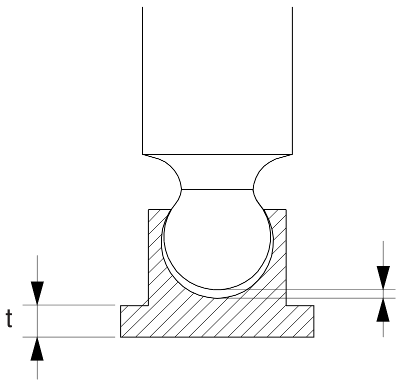
2. MAIN CONTROL VALVE

Part name	Inspection item	Criteria & measure
Casing	· Existence of scratch, rusting or corrosion.	· In case of damage in following section, replace part. - Sliding sections of casing fore and spool, especially land sections applied with holded pressure. - Seal pocket section where spool is inserted. - Seal section of port where O-ring contacts. - Seal section of each relief valve for main, travel, and port. - Other damages that may damage normal functions.
Spool	· Existence of scratch, gnawing, rusting or corrosion. · O-ring seal sections at both ends. · Insert spool in 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 poppet or spring · Insert poppet into casing and function it.	· Correction or replacement when sealing is incomplete. · Normal when it can function lightly without being caught.
Around spring	· Rusting, corrosion, deformation or breaking of spring, spring seat, plug or cover.	· Replacement for significant damage.
Around seal for spool	· External oil leakage. · Rusting, corrosion or deformation of seal plate.	· Correction or replacement. · Correction or replacement.
Main relief valve, port relief valve & negative control relief valve	· External rusting or damage. · Contacting face of valve seat. · Contacting face of poppet. · Abnormal spring. · O-rings, back up rings and seals.	· Replacement. · Replacement when damaged. · Replacement when damaged. · Replacement. · 100% replacement in general.

3. SWING DEVICE

1) WEARING PARTS

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



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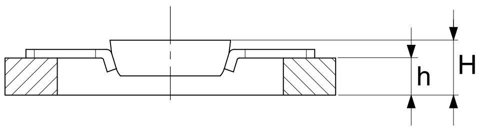


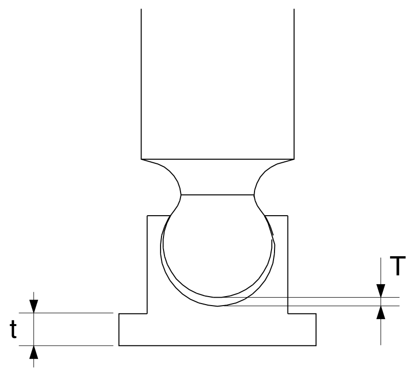
2507A7MS05

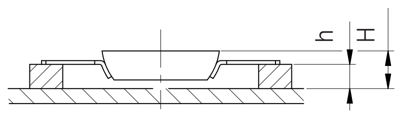
2) SLIDING PARTS

Part name	Standard roughness	Allowable roughness	Remark
Shoe	0.8-Z (Ra=0.2) (LAPPING)	3-Z (Ra=0.8)	
Shoe plate	0.4-Z (Ra=0.1) (LAPPING)	3-Z (Ra=0.8)	
Cylinder	1.6-Z (Ra=0.4) (LAPPING)	12.5-Z (Ra=3.2)	
Valve plate	0.8-Z (Ra=0.2) (LAPPING)	6.3-Z (Ra=1.6)	

4. TRAVEL MOTOR

Inspection item	Standard dimension	Recommended replacement value	Counter measures
Clearance between piston and cylinder block bore	0.025	0.050	Replace piston or cylinder block
Play between piston and shoe caulking section (T)	0	0.3	Replace assembly of piston and shoe
Thickness of shoe (t)	4.5	4.3	Replace assembly of piston and shoe
Combined height of set plate and ball guide (H)	7.3	7.0	Replace set of set plate and ball guide
Thickness of friction plate	3.0	2.6	Replace

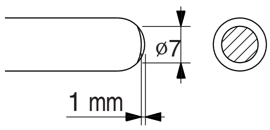




2) SLIDING PARTS

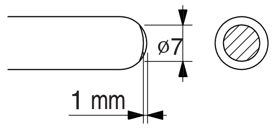
Part name	Standard roughness	Remark
Shoe	0.8S	-
Shoe plate	0.8S	-
Cylinder	0.8S	-
Valve plate	0.8S	-

5. RCV LEVER

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

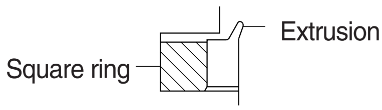
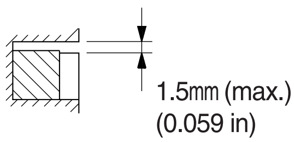
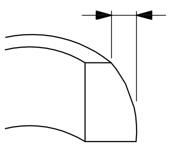
Notes 1. It is desirable to replace seal materials, such as O-rings, every disassembling. However, they may be reused, after being confirmed to be free of damage.

6. RCV PEDAL

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

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

7. TURNING JOINT

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

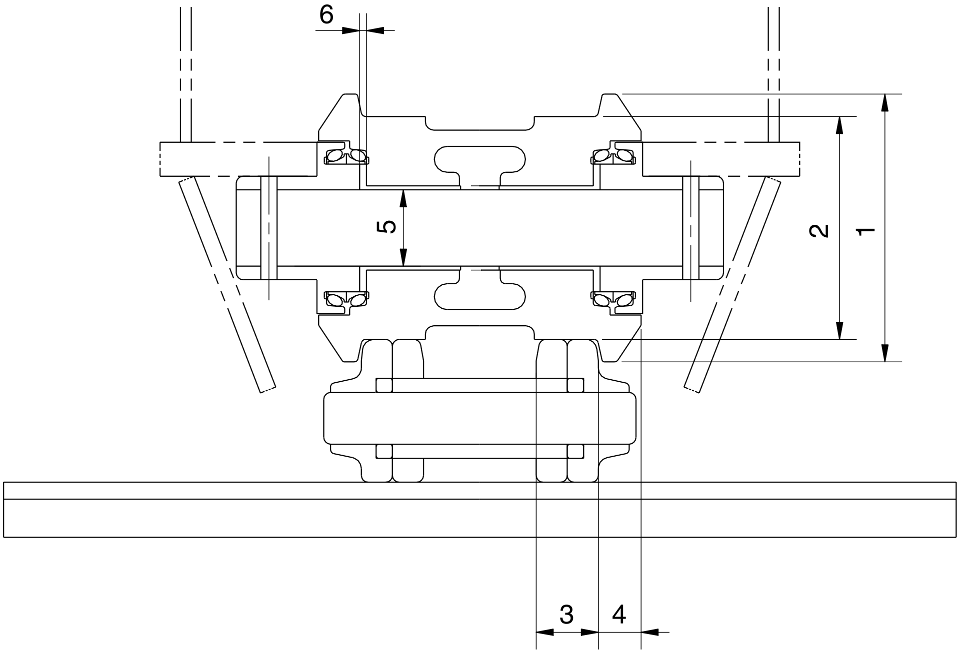
8. CYLINDER

Part name	Inspecting section	Inspection item	Remedy
Piston rod	· Neck of rod pin	· Presence of crack	· Replace
	· Weld on rod hub	· Presence of crack	· Replace
	· Stepped part to which piston is attached.	· Presence of crack	· Replace
	· Threads	· Presence of crack	· Recondition or replace
	· Plated surface	· Plating is not worn off to base metal.	· 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 (HX160 L, HX180 L : -#0119)

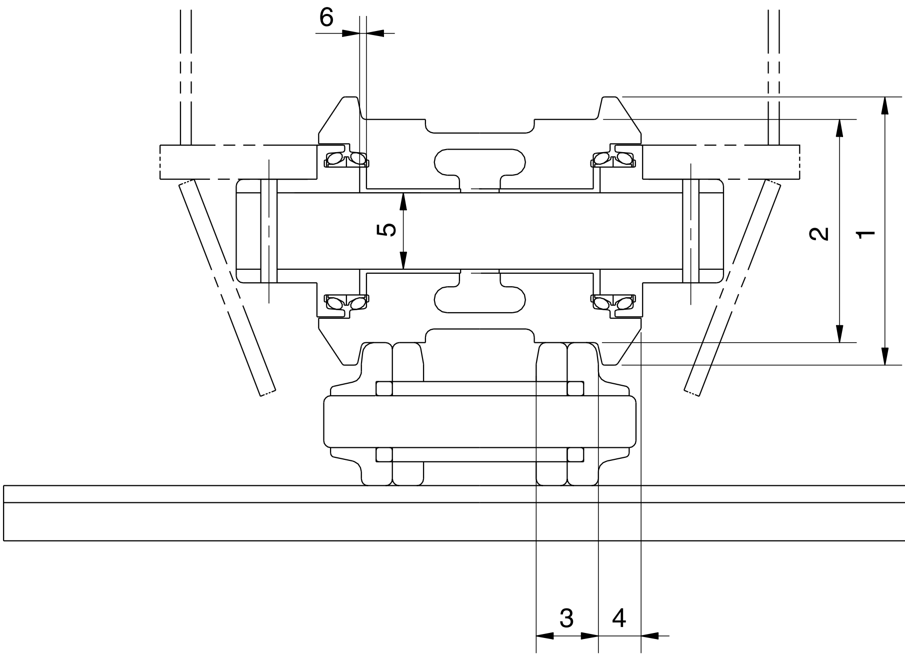


21037MS01

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 flange</td><td colspan="2">Standard size</td><td colspan="2">Repair limit</td><td rowspan="5">Rebuild or replace</td></tr>
<tr><td colspan="2">Ø195</td><td colspan="2">–</td></tr>
<tr><td>2</td><td>Outside diameter of tread</td><td colspan="2">Ø160</td><td colspan="2">Ø148</td></tr>
<tr><td>3</td><td>Width of tread (HX160L/180L)</td><td colspan="2">43.5/44</td><td colspan="2">49.5/50</td></tr>
<tr><td>4</td><td>Width of flange (HX160L/180L)</td><td colspan="2">33.3</td><td colspan="2">-</td></tr>
<tr><td rowspan="3">5</td><td rowspan="3">Clearance between shaft and bushing</td><td colspan="2">Standard size & tolerance</td><td rowspan="2">Standard clearance</td><td rowspan="2">Clearance limit</td><td rowspan="3">Replace bushing</td></tr>
<tr><td>Shaft</td><td>Hole</td></tr>
<tr><td>Ø70 0 -0.03</td><td>Ø70 +0.35 +0.3</td><td>0.32 ~ 0.38</td><td>2.0</td></tr>
<tr><td rowspan="2">6</td><td rowspan="2">Side clearance of roller (both side)</td><td colspan="2">Standard clearance</td><td colspan="2">Clearance limit</td><td rowspan="2">Replace</td></tr>
<tr><td colspan="2">0.26 ~ 1.22</td><td colspan="2">2.0</td></tr>
</table>

TRACK ROLLER (HX180 L : #0120-)



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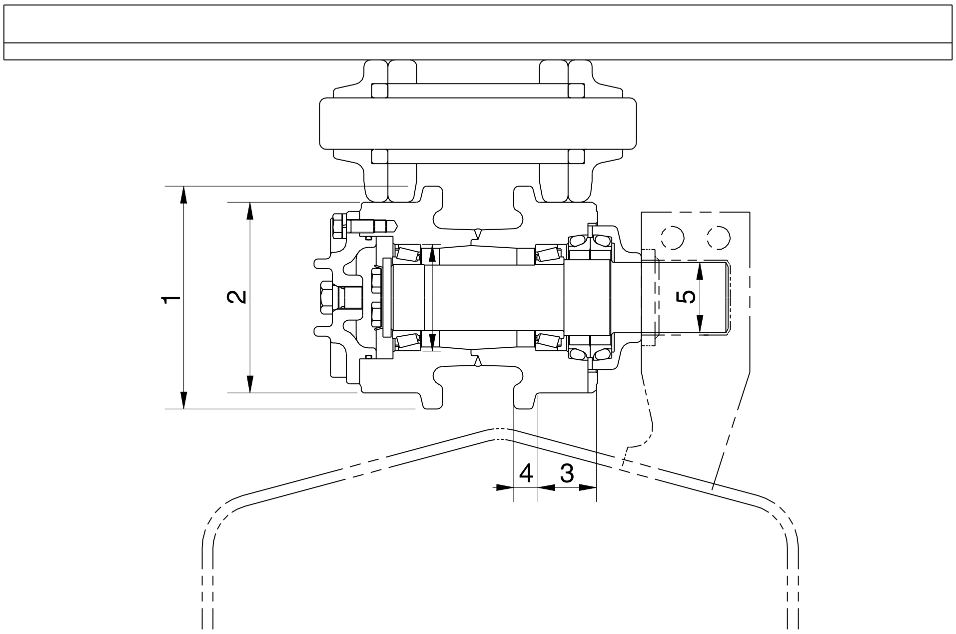
Unit : ㎜

No.	Check item	Criteria				Remedy
1	Outside diameter of flange	Standard size		Repair limit		Rebuild or replace
		Ø185		–		
2	Outside diameter of tread	Ø150		Ø138		
3	Width of tread	45		51		
4	Width of flange	29		-		
5	Clearance between shaft and bushing	Standard size & tolerance		Standard clearance	Clearance limit	Replace bushing
		Shaft	Hole			
		Ø65 0 -0.03	Ø65 +0.37 +0.32	0.32 ~ 0.4	2.0	
6	Side clearance of roller (both side)	Standard clearance		Clearance limit		Replace
		0.23 ~ 1.32		2.0		

2) CARRIER ROLLER



16077MSS02

Unit : mm

<table>
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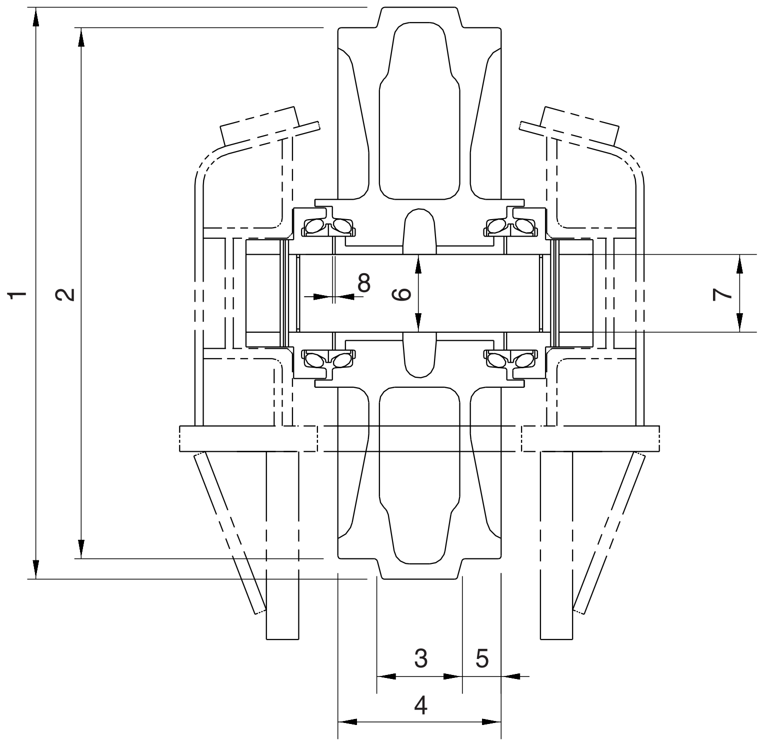
<tr><td colspan="2">ø 169</td><td colspan="2">ø 155</td></tr>
<tr><td>2</td><td>Outside diameter of tread</td><td colspan="2">ø 144</td><td colspan="2">ø 134</td></tr>
<tr><td>3</td><td>Width of tread</td><td colspan="2">45.7</td><td colspan="2">40.7</td></tr>
<tr><td>4</td><td>Width of flange</td><td colspan="2">17</td><td colspan="2">-</td></tr>
<tr><td rowspan="3">5</td><td rowspan="3">Clearance between shaft and bushing</td><td colspan="2">Standard size & Tolerance</td><td rowspan="2">Standard clearance</td><td rowspan="2">Clearance limit</td><td rowspan="3">Replace bushing</td></tr>
<tr><td>Shaft</td><td>Hole</td></tr>
<tr><td>ø 55 $^{-0.05}_{-0.1}$</td><td>ø 55 $^{+0.3}_{+0.1}$</td><td>0.15 to 0.48</td><td>1.2</td></tr>
</table>

3) IDLER

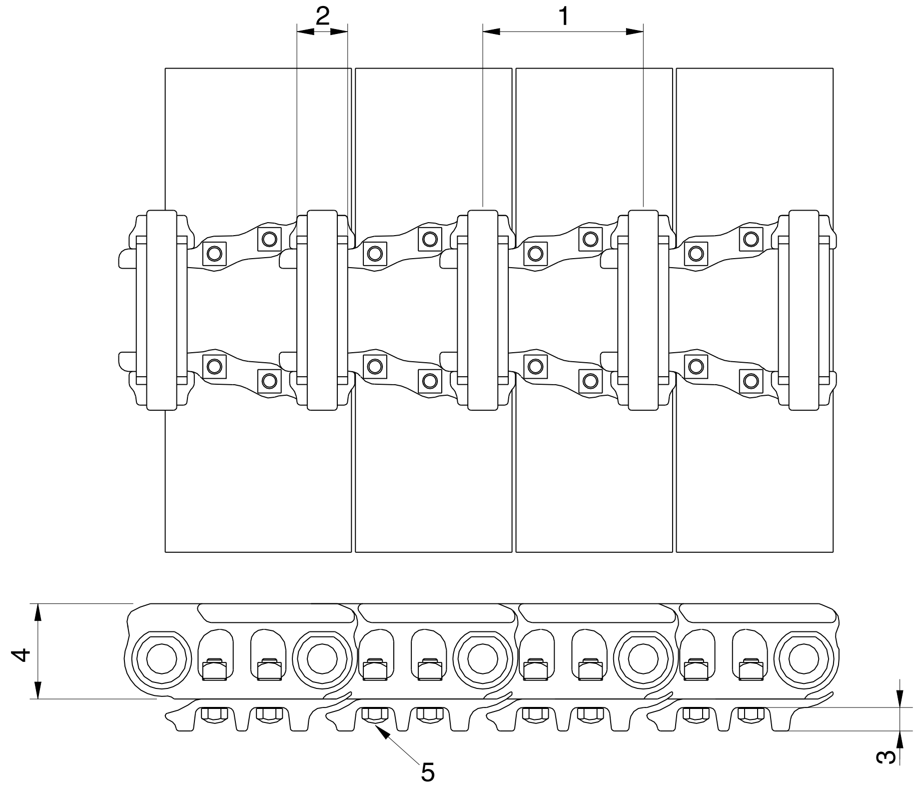


21037MS03

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 flange</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">ø 560</td><td colspan="2">-</td></tr>
<tr><td>2</td><td>Outside diameter of tread</td><td colspan="2">ø 520</td><td colspan="2">ø 510</td></tr>
<tr><td>3</td><td>Width of protrusion</td><td colspan="2">82</td><td colspan="2">-</td></tr>
<tr><td>4</td><td>Total width</td><td colspan="2">160</td><td colspan="2">-</td></tr>
<tr><td>5</td><td>Width of tread</td><td colspan="2">39</td><td colspan="2">43</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>ø 75 $^{0}_{-0.03}$</td><td>ø 75.35 $^{+0.05}_{0}$</td><td>0.35 to 0.43</td><td>2.0</td></tr>
<tr><td>7</td><td>Clearance between shaft and support</td><td>ø 75 $^{0}_{-0.03}$</td><td>ø 75 $^{+0.07}_{+0.03}$</td><td>0.03 to 0.1</td><td>1.2</td><td>Replace</td></tr>
<tr><td rowspan="2">8</td><td rowspan="2">Side clearance of idler (both side)</td><td colspan="2">Standard clearance</td><td colspan="2">Clearance limit</td><td rowspan="2">Replace bushing</td></tr>
<tr><td colspan="2">0.25 to 1.2</td><td colspan="2">2.0</td></tr>
</table>

4) TRACK

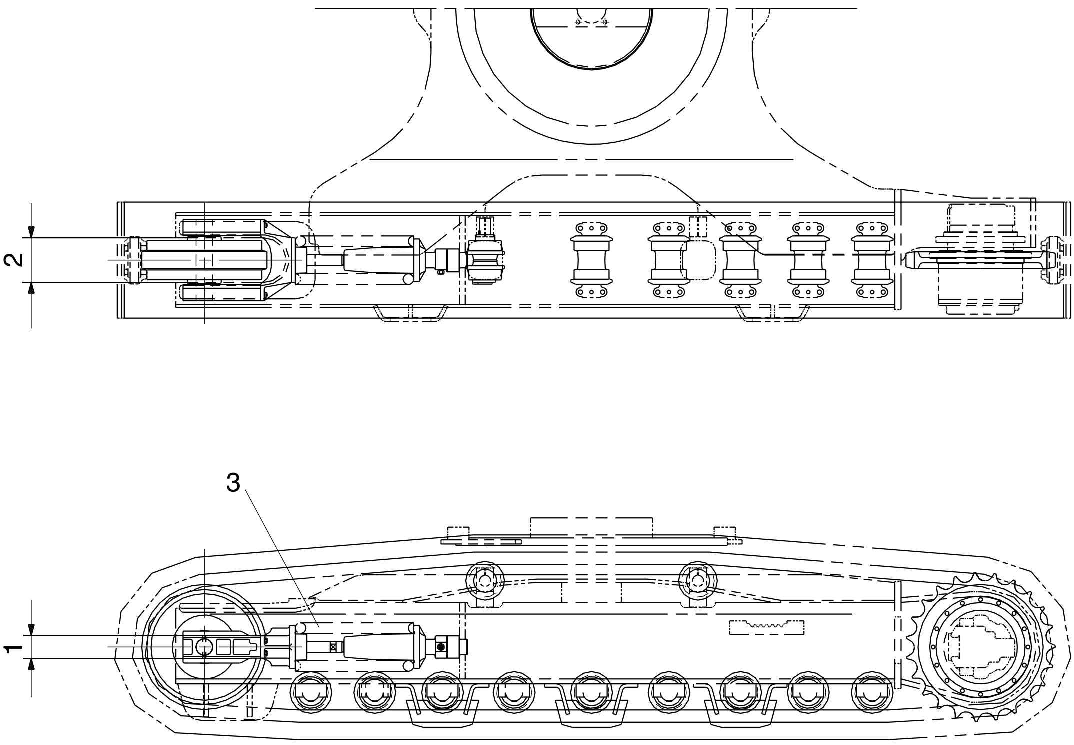


32077MS04

Unit : ㎜

No.	Check item	Criteria		Remedy
1	Link pitch	Standard size	Repair limit	Turn or replace
		171.45	178.95	
2	Outside diameter of bushing	ø 54	ø 46	Rebuild or replace
3	Height of grouser	25	16	
4	Height of link	101.6	93.6	
5	Tightening torque	Initial tightening torque : 40 ± 4 kgf · m		Retighten

5) TRACK FRAME AND RECOIL SPRING

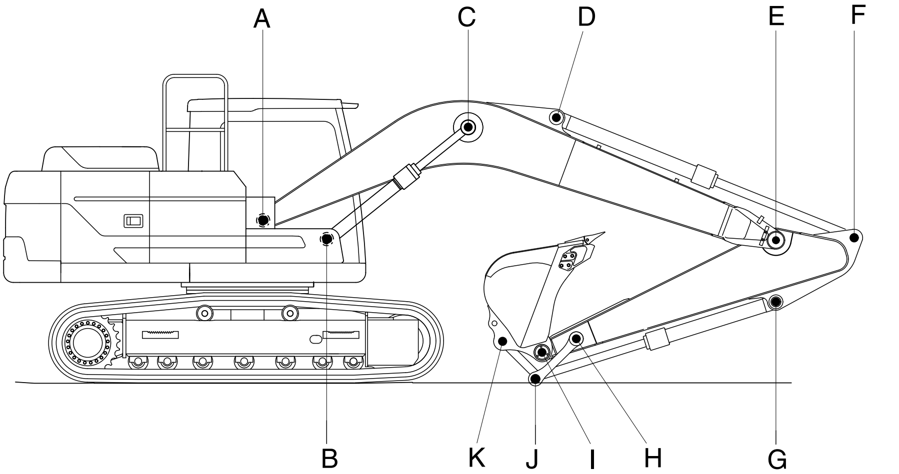


21037MS05

Unit : mm

<table>
<tr><td>No.</td><td>Check item</td><td colspan="5">Criteria</td><td>Remedy</td></tr>
<tr><td rowspan="3">1</td><td rowspan="3">Vertical width of idler guide</td><td></td><td colspan="2">Standard size</td><td>Tolerance</td><td>Repair limit</td><td rowspan="5">Rebuild or replace</td></tr>
<tr><td>Track frame</td><td colspan="2">113</td><td>+2
0</td><td>117</td></tr>
<tr><td>Idler support</td><td colspan="2">110</td><td>- 0.5
- 1.0</td><td>106</td></tr>
<tr><td rowspan="2">2</td><td rowspan="2">Horizontal width of idler guide</td><td>Track frame</td><td colspan="2">272</td><td>+2
0</td><td>276</td></tr>
<tr><td>Idler support</td><td colspan="2">270</td><td>-</td><td>267</td></tr>
<tr><td rowspan="3">3</td><td rowspan="3">Recoil spring</td><td colspan="3">Standard size</td><td colspan="2">Repair limit</td><td rowspan="3">Replace</td></tr>
<tr><td>Free length</td><td>Installation length</td><td>Installation load</td><td>Free length</td><td>Installation load</td></tr>
<tr><td>ø 225 × 525</td><td>420</td><td>11,908kg</td><td>-</td><td>9,526kg</td></tr>
</table>

2. WORK EQUIPMENT



160F7MS01

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	75	74	73.5	75.5	76	Replace
B	Boom Cylinder Head	70	69	68.5	70.5	71	〃
C	Boom Cylinder Rod	75	74	73.5	75.5	76	〃
D	Arm Cylinder Head	70	69	68.5	70.5	71	〃
E	Boom Front	75	74	73.5	75.5	76	〃
F	Arm Cylinder Rod	70	69	68.5	70.5	71	〃
G	Bucket Cylinder Head	70	69	68.5	70.5	71	〃
H	Arm Link	70	69	68.5	70.5	71	〃
I	Bucket and Arm Link	70	69	68.5	70.5	71	〃
J	Bucket Cylinder Rod	70	69	68.5	70.5	71	〃
K	Bucket Link	70	69	68.5	70.5	71	〃

SECTION 8 DISASSEMBLY AND ASSEMBLY

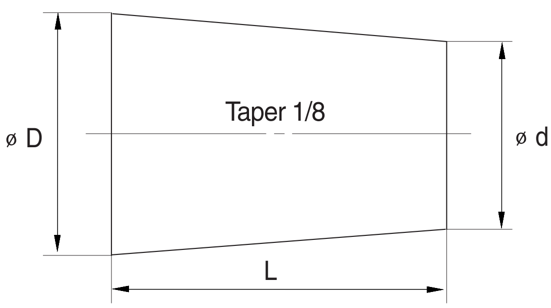
SECTION 8 DISASSEMBLY AND ASSEMBLY

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 (HX160 L)

No.	Descriptions		Bolt size	Torque	
				kgf · m	lbf · ft
1	Engine	Engine mounting bolt (engine-bracket, FR)	M12 × 1.75	11.2 ± 1.1	81 ± 8.0
2		Engine mounting bolt (engine-bracket, RR)	M12 × 1.75	7.9 ± 2.0	57.1 ± 14.5
3		Engine mounting bolt (bracket-frame, FR)	M16 × 2.0	34.0 ± 4.0	246 ± 28.9
4		Engine mounting bolt (bracket-frame, RR)	M16 × 2.0	34.0 ± 4.0	246 ± 28.9
5		Radiator mounting bolt	M16 × 2.0	29.7 ± 4.5	215 ± 32.5
6		Coupling mounting socket bolt	M16 × 2.0	32.0 ± 1.6	231 ± 11.6
7		Main pump housing mounting bolt	M10 × 1.5	6.0 ± 1.5	43.4 ± 10.9
8	Hydraulic system	Main pump mounting socket bolt	M16 × 2.0	22.0 ± 1.5	159 ± 10.9
9		Main control valve mounting bolt	M12 × 1.75	12.2 ± 1.3	88.2 ± 9.4
10		Fuel tank mounting bolt	M20 × 2.5	46.0 ± 5.0	333 ± 36.9
11		Hydraulic oil tank mounting bolt	M20 × 2.5	46.0 ± 5.0	333 ± 36.9
12		Turning joint mounting bolt, nut	M12 × 1.75	12.3 ± 1.3	89.0 ± 9.4
13	Power train system	Swing motor mounting bolt	M20 × 2.5	57.9 ± 8.7	419 ± 62.9
14		Swing bearing upper part mounting bolt	M20 × 2.5	57.9 ± 6.0	419 ± 49.9
15		Swing bearing lower part mounting bolt	M20 × 2.5	57.9 ± 6.0	419 ± 49.9
16		Travel motor mounting bolt	M16 × 2.0	23.0 ± 2.5	166 ± 18.1
17		Sprocket mounting bolt	M16 × 2.0	29.7 ± 3.0	215 ± 21.7
18	Under carriage	Carrier roller mounting bolt, nut	M16 × 2.0	29.7 ± 3.0	215 ± 21.7
19		Track roller mounting bolt	M16 × 2.0	29.7 ± 3.0	215 ± 21.7
20		Track tension cylinder mounting bolt	M16 × 2.0	21.9 ± 3.3	158 ± 23.9
21		Track shoe mounting bolt, nut	5/8 - 18UNF	42.0 ± 4.0	304 ± 28.9
22		Track guard mounting bolt	M20 × 2.5	57.9 ± 8.7	419 ± 62.9
23	Others	Counterweight mounting bolt	M30 × 3.5	199 ± 30	1439 ± 217
24		Cab mounting bolt	M12 × 1.75	12.8 ± 3.0	92.6 ± 21.7
25		Operator's seat mounting bolt	M 8 × 1.25	4.05 ± 0.8	29.3 ± 5.8

2. MAJOR COMPONENTS (HX180 L)

No.	Descriptions		Bolt size	Torque	
				kgf · m	lbf · ft
1	Engine	Engine mounting bolt (engine-bracket, FR)	M12 × 1.75	11.2 ± 1.1	81 ± 8.0
2		Engine mounting bolt (engine-bracket, RR)	M12 × 1.75	7.9 ± 2.0	57.1 ± 14.5
3		Engine mounting bolt (bracket-frame, FR)	M16 × 2.0	34.0 ± 4.0	246 ± 28.9
4		Engine mounting bolt (bracket-frame, RR)	M16 × 2.0	34.0 ± 4.0	246 ± 28.9
5		Radiator mounting bolt	M16 × 2.0	29.7 ± 4.5	215 ± 32.5
6		Coupling mounting socket bolt	M16 × 2.0	32.0 ± 1.6	231 ± 11.6
7		Main pump housing mounting bolt	M10 × 1.5	6.0 ± 1.5	43.4 ± 10.9
8	Hydraulic system	Main pump mounting socket bolt	M16 × 2.0	22.0 ± 1.5	159 ± 10.9
9		Main control valve mounting bolt	M12 × 1.75	12.2 ± 1.3	88.2 ± 9.4
10		Fuel tank mounting bolt	M20 × 2.5	46.0 ± 5.0	333 ± 36.9
11		Hydraulic oil tank mounting bolt	M20 × 2.5	46.0 ± 5.0	333 ± 36.9
12		Turning joint mounting bolt, nut	M12 × 1.75	12.3 ± 1.3	89.0 ± 9.4
13	Power train system	Swing motor mounting bolt	M20 × 2.5	57.9 ± 8.7	419 ± 62.9
14		Swing bearing upper part mounting bolt	M20 × 2.5	57.9 ± 6.0	419 ± 49.9
15		Swing bearing lower part mounting bolt	M20 × 2.5	57.9 ± 6.0	419 ± 49.9
16		Travel motor mounting bolt	M16 × 2.0	23.0 ± 2.5	166 ± 18.1
17		Sprocket mounting bolt	M16 × 2.0	29.7 ± 3.0	215 ± 21.7
18	Under carriage	Carrier roller mounting bolt, nut	M16 × 2.0	29.7 ± 3.0	215 ± 21.7
19		Track roller mounting bolt	M 20× 2.5	57.9 ± 6.0	419 ± 43.4
20		Track tension cylinder mounting bolt	M16 × 2.0	21.9 ± 3.3	158 ± 23.9
21		Track shoe mounting bolt, nut	5/8 - 18UNF	42.0 ± 4.0	304± 28.9
22		Track guard mounting bolt	M20 × 2.5	57.9 ± 8.7	419± 62.9
23	Others	Counterweight mounting bolt	M30 × 3.5	199 ± 30	1439 ± 217
24		Cab mounting bolt	M12 × 1.75	12.8 ± 3.0	92.6 ± 21.7
25		Operator's seat mounting bolt	M 8 × 1.25	4.05 ± 0.8	29.3 ± 5.8

3. 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.

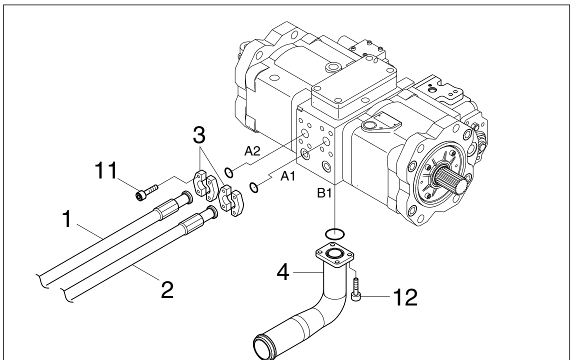
⚠ **Escaping fluid under pressure can penetrate the skin causing serious injury.**

13031GE18

(4) Loosen the drain plug under the hydraulic tank and drain the oil from the hydraulic tank.

· Hydraulic tank quantity : 125 l (33.0 U.S. gal)

(5) Remove socket bolts (11) and disconnect hoses (1, 2).



160F8MP01

(6) Disconnect pilot line hoses (5, 6, 7, 8, 9, 10).

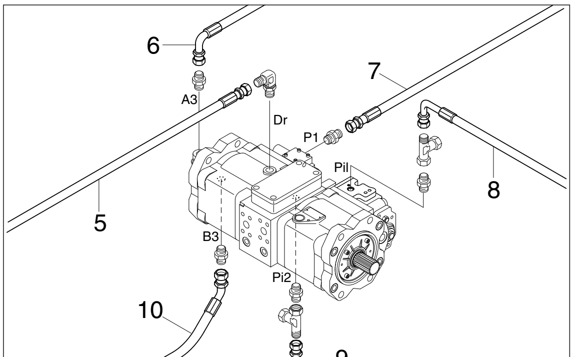
(7) Remove socket bolts (12) and disconnect pump suction pipe (4).

※ When pump suction tube is disconnected, the oil inside the piping will flow out, so catch it in oil pan.

(8) Sling the pump assembly and remove the pump mounting bolts.

· Weight : 89 kg (200 lb)

※ Pull out the pump assembly from housing.
When removing the pump assembly, check that all the hoses have been disconnected.



160F8MP02

2) INSTALL

(1) Carry out installation in the reverse order to removal.

(2) Remove the suction strainer and clean it.

(3) Replace return filter with new one.

(4) Remove breather and clean it.

(5) After adding oil to the hydraulic tank to the specified level.

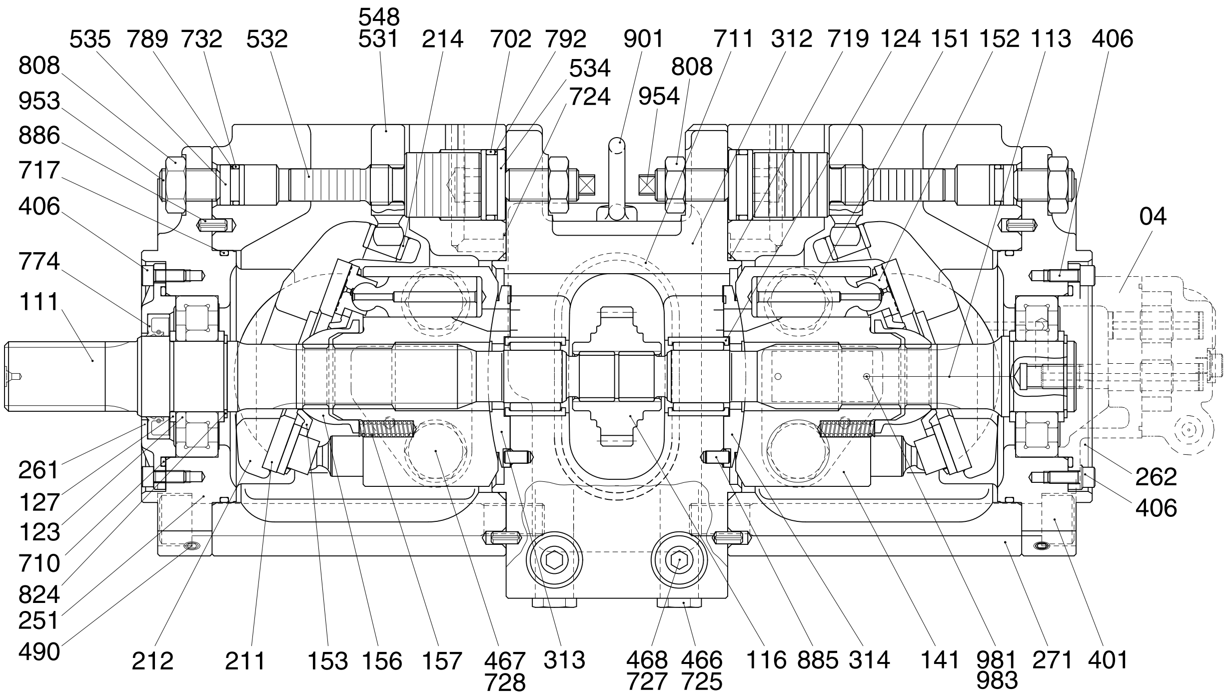
(6) Bleed the air from the hydraulic pump.
 ① Remove the air vent plug (2 EA).
 ② Tighten plug lightly.
 ③ Start the engine, run at low idling, and check oil come out from plug.
 ④ Tighten plug.

(7) Start the engine, run at low idling (3~5 minutes) to circulate the oil through the system.

(8) Confirm the hydraulic oil level and check the hydraulic oil leak or not.

2. MAIN PUMP (1/2)

1) STRUCTURE



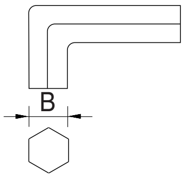
14092MP02

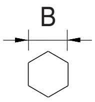
04	Gear pump	312	Valve block	717	O-ring
111	Drive shaft (F)	313	Valve plate (R)	719	O-ring
113	Drive shaft (R)	314	Valve plate (L)	724	O-ring
116	1st Gear	326	Cover	725	O-ring
123	Roller bearing	401	Hexagon socket bolt	727	O-ring
124	Needle bearing	406	Hexagon socket bolt	728	O-ring
127	Bearing spacer	414	Hexagon socket bolt	732	O-ring
141	Cylinder block	466	Plug	774	Oil seal
151	Piston	467	plug	789	Back up ring
152	Shoe	468	Plug	792	Back up ring
153	Set plate	490	Plug	808	Hexagon head nut
156	Bushing	531	Tilting pin	824	Snap ring
157	Cylinder spring	532	Servo piston	885	Pin
211	Shoe plate	534	Stopper (L)	886	Spring pin
212	Swash plate	535	Stopper (S)	901	Eye bolt
214	Bushing	548	Pin	953	Set screw
251	Support	702	O-ring	954	Set screw
261	Seal cover (F)	710	O-ring	981	Plate
271	Pump casing	711	O-ring	983	Pin

2) TOOLS AND TIGHTENING TORQUE

(1) Tools

The tools necessary to disassemble/reassemble the pump are shown in the follow list.

Tool name & size		Part name			
Name	B	Hexagon socket head bolt	PT plug (PT thread)	PO plug (PF thread)	Hexagon socket head setscrew
Allen wrench 	4	M 5	BP-1/16	-	M 8
	5	M 6	BP-1/8	-	M10
	6	M 8	BP-1/4	PO-1/4	M12, M14
	8	M10	BP-3/8	PO-3/8	M16, M18
	17	M20, M22	BP-1	PO-1, 1 1/4, 1 1/2	-

Name	B	Hexagon bolt	Hexagon nut	VP plug (PF thread)
Double ring spanner, socket wrench, double (single) open end spanner 	-	Hexagon bolt	Hexagon nut	VP plug (PF thread)
	19	M12	M12	VP-1/4
	24	M16	M16	-
	27	M18	M18	VP-1/2
	30	M20	M20	-
	36	-	-	VP-3/4

Tool name	Part name
Adjustable angle wrench	Medium size, 1 set
Screw driver	Minus type screw driver, Medium size, 2 sets
Hammer	Plastic hammer, 1 set
Pliers	For snap ring, TSR-160
Steel bar	Steel bar of key material approx. $10 \times 8 \times 200$
Torque wrench	Capable of tightening with the specified torques

(2) Tightening torque

Part name	Bolt size	Torque		Wrench size	
		kgf · m	lbf · ft	in	mm
Hexagon socket head bolt (material : SCM435)	M 5	0.7	5.1	0.16	4
	M 6	1.2	8.7	0.20	5
	M 8	3.0	21.7	0.24	6
	M10	5.8	42.0	0.31	8
	M12	10.0	72.3	0.39	10
	M14	16.0	116	0.47	12
	M16	24.0	174	0.55	14
	M18	34.0	246	0.55	14
	M20	44.0	318	0.67	17
PT Plug (material : S45C) ※Wind a seal tape 1 1/2 to 2 turns round the plug	PT1/16	0.7	5.1	0.16	4
	PT 1/8	1.05	7.59	0.20	5
	PT 1/4	1.75	12.7	0.24	6
	PT 3/8	3.5	25.3	0.31	8
	PT 1/2	5.0	36.2	0.39	10
PF Plug (material : S45C)	PF 1/4	3.0	21.7	0.24	6
	PF 1/2	10.0	72.3	0.39	10
	PF 3/4	15.0	109	0.55	14
	PF 1	19.0	137	0.67	17
	PF 1 1/4	27.0	195	0.67	17
	PF 1 1/2	28.0	203	0.67	17

3) DISASSEMBLY

(1) Select place suitable to disassembling.

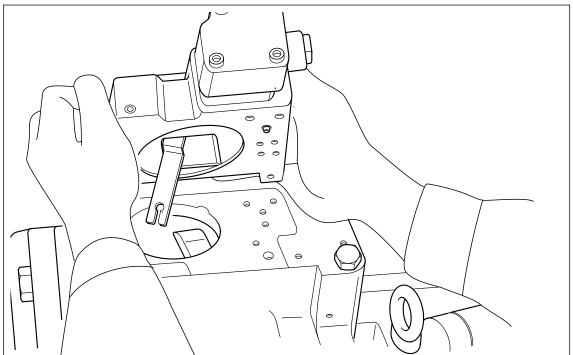
※ Select clean place.

※ Spread rubber sheet, cloth or so on on overhaul workbench top to prevent parts from being damaged.

(2) Remove dust, rust, etc, from pump surfaces with cleaning oil or so on.

(3) Remove drain port plug (468) and let oil out of pump casing (front and rear pump).

(4) Remove hexagon socket head bolts (412, 413) and remove regulator.



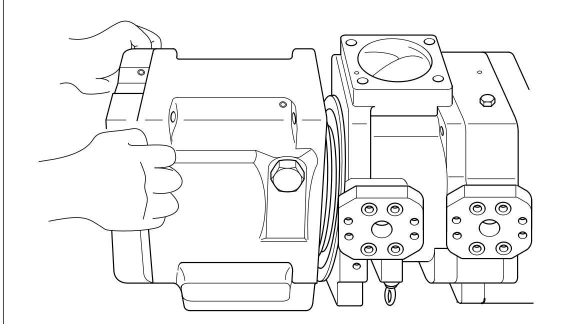
(210-7) MP01

(5) Loosen hexagon socket head bolts (401) which tighten swash plate support (251), pump casing (271) and valve block (312).

※ If gear pump and so on are fitted to rear face of pump, remove them before starting this work.

(6) Place pump horizontally on workbench with its regulator-fitting surface down and separate pump casing (271) from valve block (312).

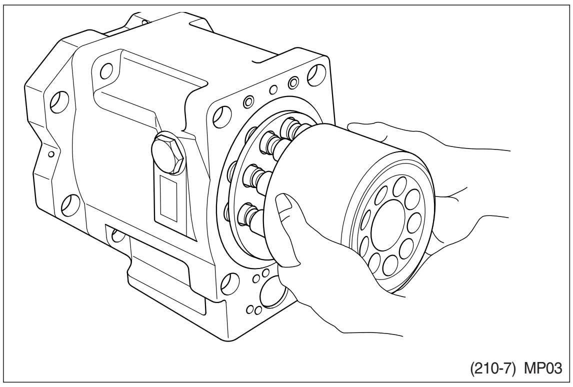
※ Before bringing this surface down, spread rubber sheet on workbench without fail to prevent this surface from being damaged.



(210-7) MP02

(7) Pull cylinder block (141) out of pump casing (271) straightly over drive shaft (111). Pull out also pistons (151), set plate (153), spherical bush (156) and cylinder springs (157) simultaneously.

※ Take care not to damage sliding surfaces of cylinder, spherical bushing, shoes, swash plate, etc.

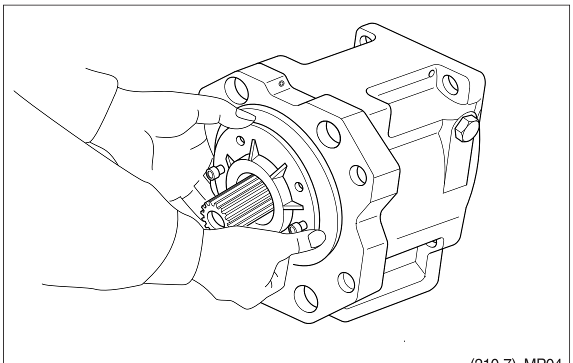


(210-7) MP03

(8) Remove hexagon socket head bolts (406) and then seal cover (F, 261).

※ Fit bolt into pulling out tapped hole of seal cover (F), and cover can be removed easily.

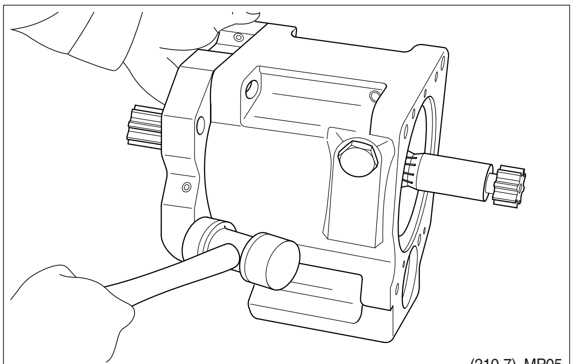
※ Since oil seal is fitted on seal cover (F), take care not to damage it in removing cover.



(210-7) MP04

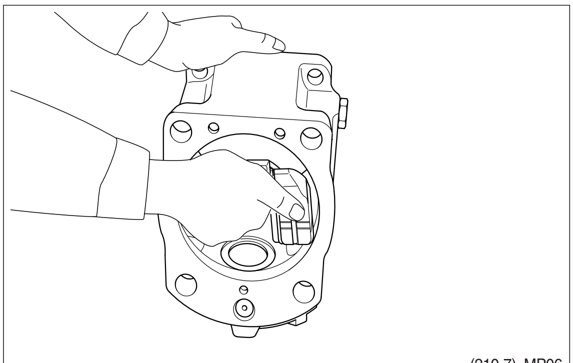
(9) Remove hexagon socket head bolts (408) and then seal cover (R, 262).
In case fitting a gear pump, first, remove gear pump.

(10) Tapping lightly fitting flange section of swash plate support (251) on its pump casing side, separate swash plate support from pump casing.



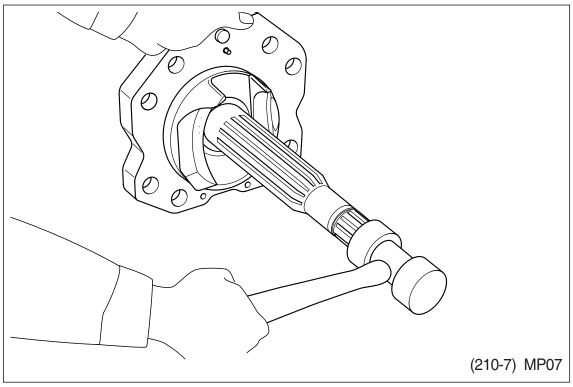
(210-7) MP05

(11) Remove shoe plate (211) and swash plate (212) from pump casing (271).



(210-7) MP06

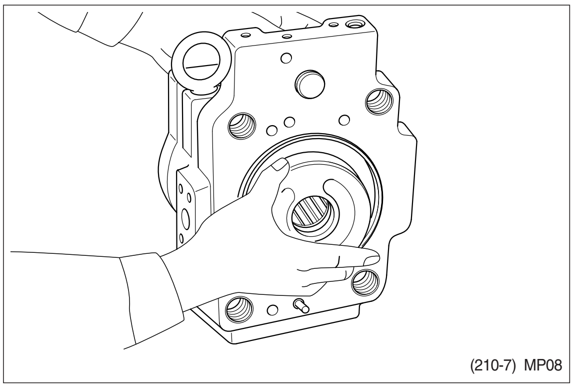
(12) Tapping lightly shaft ends of drive shafts (111, 113) with plastic hammer, take out drive shafts from swash plate supports.



(210-7) MP07

(13) Remove valve plates (313, 314) from valve block (312).

※ These may be removed in work (6).



(210-7) MP08

(14) If necessary, remove stopper (L, 534), stopper (S, 535), servo piston (532) and tilting pin (531) from pump casing (271), and needle bearing (124) and splined coupling (114) from valve block (312).

※ In removing tilting pin, use a protector to prevent pin head from being damaged.

※ Since loctite is applied to fitting areas of tilting pin and servo piston, take care not to damage servo piston.

※ Do not remove needle bearing as far as possible, except when it is considered to be out of its life span.

※ Do not loosen hexagon nuts of valve block and swash plate support.
If loosened, flow setting will be changed.

4) ASSEMBLY

(1) For reassembling reverse the disassembling procedures, paying attention to the following items.

① Do not fail to repair the parts damaged during disassembling, and prepare replacement parts in advance.

② Clean each part fully with cleaning oil and dry it with compressed air.

③ Do not fail to apply clean working oil to sliding sections, bearings, etc. before assembling them.

④ In principle, replace seal parts, such as O-rings, oil seals, etc.

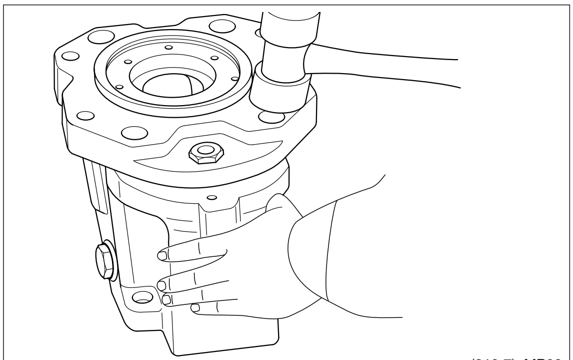
⑤ For fitting bolts, plug, etc., prepare a torque wrench or so on, and tighten them with torques shown in page 8-11, 12.

⑥ For the double-pump, take care not to mix up parts of the front pump with those of the rear pump.

(2) Fit swash plate support (251) to pump casing (271), tapping the former lightly with a hammer.

※ After servo piston, tilting pin, stopper (L) and stopper (S) are removed, fit them soon to pump casing in advance for reassembling.

※ In tightening servo piston and tilting pin, use a protector to prevent tilting pin head and feedback pin from being damaged. In addition, apply loctite (Medium strength) to their threaded sections.

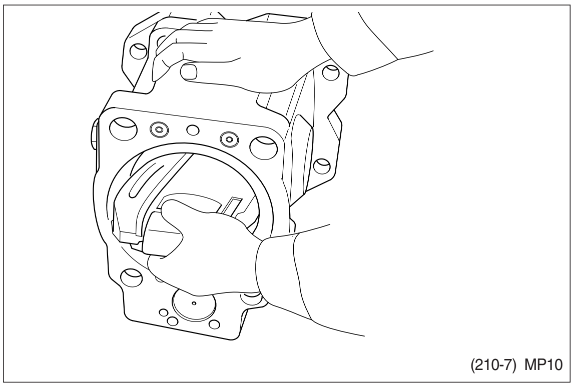


(210-7) MP09

(3) Place pump casing with its regulator fitting surface down, fit tilting bush of swash plate to tilting pin (531) and fit swash plate (212) to swash plate support (251) correctly.

※ Confirm with fingers of both hands that swash plate can be removed smoothly.

※ Apply grease to sliding sections of swash plate and swash plate support, and drive shaft can be fitted easily.



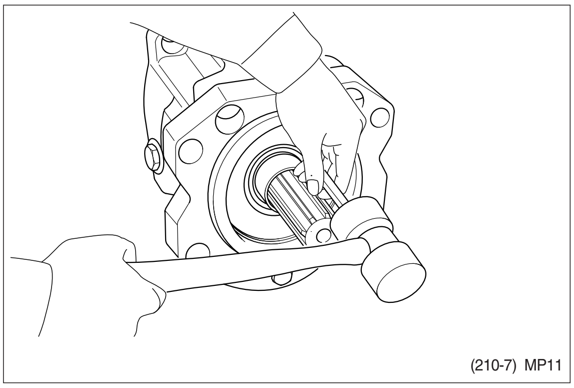
(210-7) MP10

(4) To swash plate support (251), fit drive shaft (111) set with bearing (123), bearing spacer (127) and snap ring (824).

※ Do not tap drive shaft with hammer or so on.

※ Assemble them into support, tapping outer race of bearing lightly with plastic hammer.

Fit them fully, using steel bar or so on.



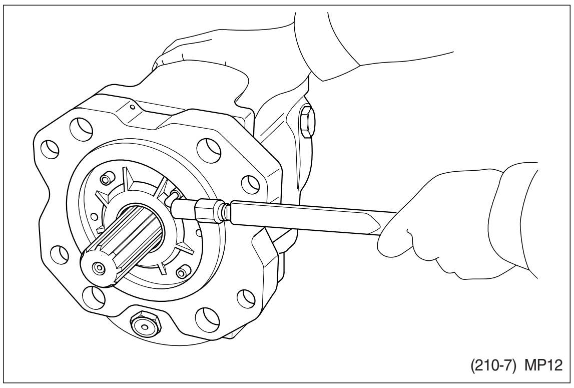
(210-7) MP11

(5) Assemble seal cover (F, 261) to pump casing (271) and fix it with hexagon socket head bolts (406).

※ Apply grease lightly to oil seal in seal cover (F).

※ Assemble oil seal, taking full care not to damage it.

※ For tandem type pump, fit rear cover (263) and seal cover (262) similarly.

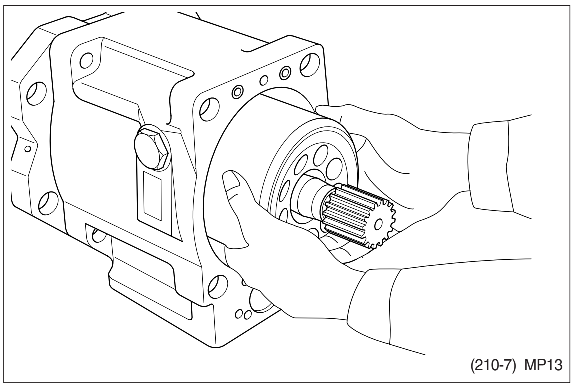


(210-7) MP12

(6) Assemble piston cylinder subassembly 〔cylinder block (141), piston subassembly (151, 152), set plate (153), spherical bush (156), spacer (158) and cylinder spring (157)〕.

Fit spline phases of retainer and cylinder.

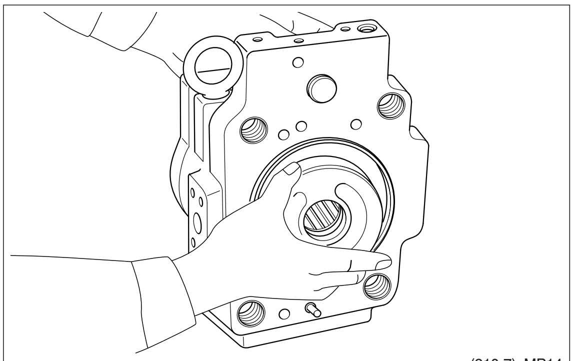
Then, insert piston cylinder subassembly into pump casing.



(210-7) MP13

(7) Fit valve plate (313) to valve block (312), entering pin into pin hole.

※ Take care not to mistake suction / delivery directions of valve plate.



(210-7) MP14

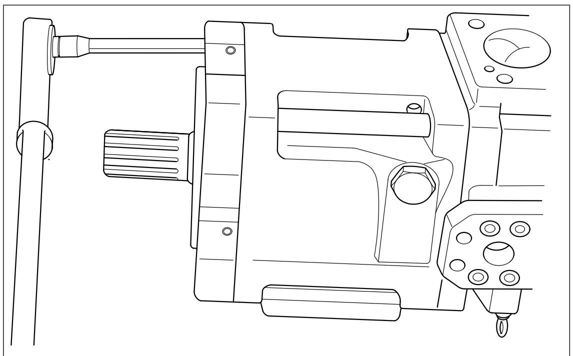
(8) Fit valve block (312) to pump casing (271) and tighten hexagon socket head bolts (401).

※ At first assemble this at rear pump side, and this work will be easy.

※ Take care not to mistake direction of valve block.

※ Clockwise rotation (viewed from input shaft side) - Fit block with regulator up and with delivery flange left, viewed from front side.

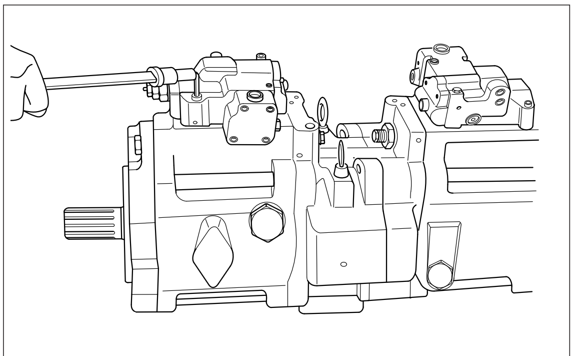
※ Counter clockwise rotation (viewed from input shaft side) - Fit block with delivery flange right, viewed from front side.



(210-7) MP16

(9) Putting feedback pin of tilting pin into feedback lever of regulator, fit regulator and tighten hexagon socket head bolts (412, 413).

※ Take care not to mistake regulator of front pump for that of rear pump.



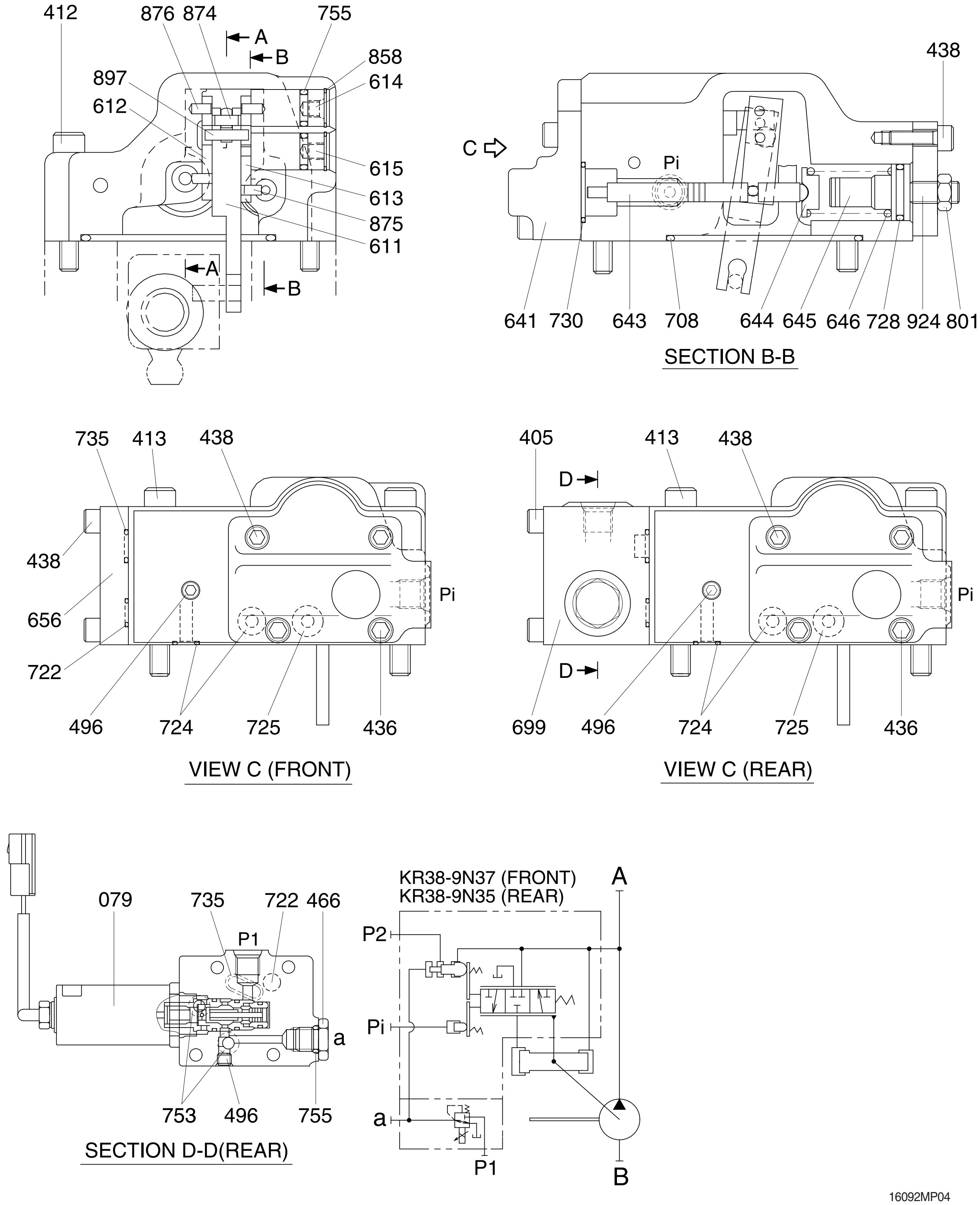
(210-7) MP17

(10) Fit drain port plug (468).

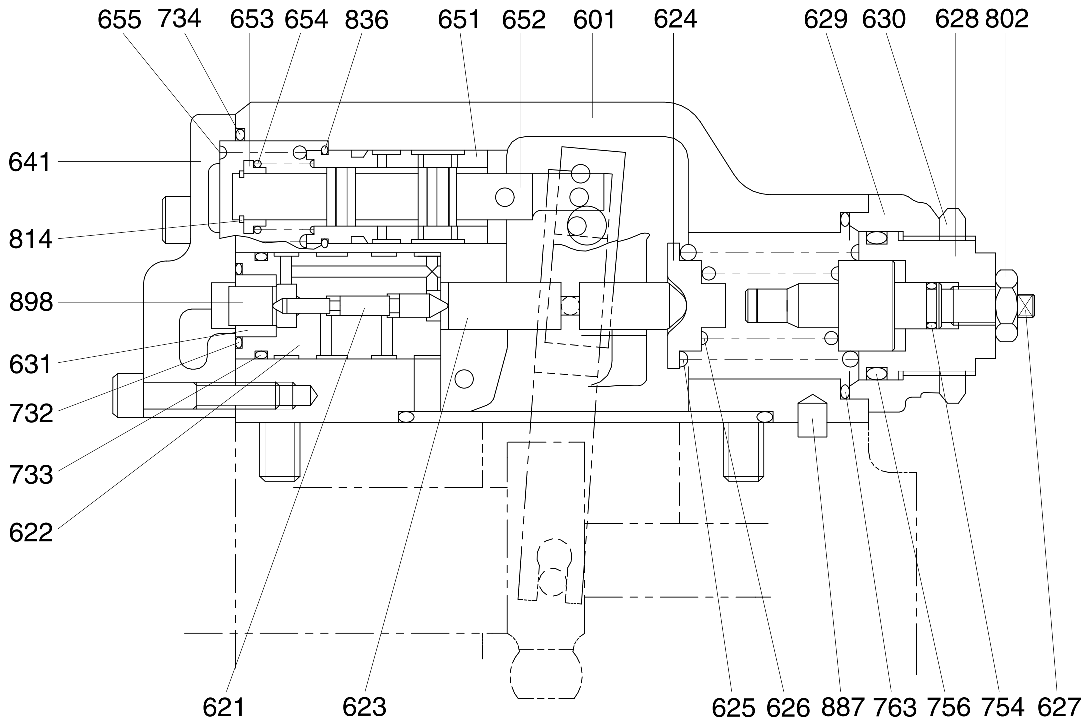
This is the end of reassembling procedures.

3. REGULATOR

1) STRUCTURE (1/2)



REGULATOR (2/2)



SECTION A-A

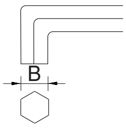
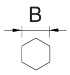
14092MP05

079	EPPR valve assembly	629	Cover (C)	733	O-ring
405	Hexagon socket screw (R)	630	Lock nut	734	O-ring
412	Hexagon socket screw	631	Sleeve, Pf	735	O-ring
413	Hexagon socket screw	641	Pilot cover	753	O-ring (R)
436	Hexagon socket screw	643	Pilot piston	754	O-ring
438	Hexagon socket screw	644	Spring seat (Q)	755	O-ring
466	Plug (R)	645	Adjust stem (Q)	756	O-ring
496	Plug	646	Pilot spring	763	O-ring
601	Casing	651	Sleeve	801	Nut
611	Feed back lever	652	Spool	802	Nut
612	Lever (1)	653	Spring seat	814	Snap ring
613	Lever (2)	654	Return spring	836	Snap ring
614	Fulcrum plug	655	Set spring	858	Snap ring
615	Adjust plug	656	Block cover (F)	874	Pin
621	Compensator piston	699	Valve casing (R)	875	Pin
622	Piston case	708	O-ring	876	Pin
623	Compensator rod	722	O-ring	887	Pin
624	Spring seat (C)	724	O-ring	897	Pin
625	Outer spring	725	O-ring	898	Pin
626	Inner spring	728	O-ring	924	Set screw
627	Adjust stem (C)	730	O-ring		
628	Adjust screw (C)	732	O-ring		

2) TOOLS AND TIGHTENING TORQUE

(1) Tools

The tools necessary to disassemble/reassemble the pump are shown in the follow list.

<table>
<tr><td colspan="2">Tool name & size</td><td colspan="12">Part name</td></tr>
<tr><td>Name</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 rowspan="3">Allen wrench </td><td>4</td><td colspan="3">M5</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">M6</td><td colspan="3">BP-1/8</td><td colspan="3">-</td><td colspan="3">M10</td></tr>
<tr><td>6</td><td colspan="3">M8</td><td colspan="3">BP-1/4</td><td colspan="3">PO-1/4</td><td colspan="3">M12, M14</td></tr>
<tr><td rowspan="2">Double ring spanner, socket wrench, double (single) open end spanner </td><td>-</td><td colspan="4">Hexagon head bolt</td><td colspan="4">Hexagon 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">4 × 100 mm</td></tr>
<tr><td colspan="2">Torque wrench</td><td colspan="12">Capable of tightening with the specified torques</td></tr>
<tr><td colspan="2">Pincers</td><td colspan="12">-</td></tr>
<tr><td colspan="2">Bolt</td><td colspan="12">M4, Length : 50 mm</td></tr>
</table>

(2) Tightening torque

Part name	Bolt size	Torque		Wrench size	
		kgf · m	lbf · ft	in	mm
Hexagon socket head bolt (material : SCM435)	M 5	0.7	5.1	0.16	4
	M 6	1.2	8.7	0.20	5
	M 8	3.0	21.7	0.24	6
	M10	5.8	42.0	0.31	8
	M12	10.0	72.3	0.39	10
	M14	16.0	116	0.47	12
	M16	24.0	174	0.55	14
	M18	34.0	246	0.55	14
	M20	44.0	318	0.67	17
PT Plug (material : S45C) ※Wind a seal tape 1 1/2 to 2 turns round the plug	PT1/16	0.7	5.1	0.16	4
	PT 1/8	1.05	7.59	0.20	5
	PT 1/4	1.75	12.7	0.24	6
	PT 3/8	3.5	25.3	0.31	8
	PT 1/2	5.0	36.2	0.39	10
PF Plug (material : S35C)	PF 1/4	3.0	21.7	0.24	6
	PF 1/2	10.0	72.3	0.39	10
	PF 3/4	15.0	109	0.55	14
	PF 1	19.0	137	0.67	17
	PF 1 1/4	27.0	195	0.67	17
	PF 1 1/2	28.0	203	0.67	17

3) DISASSEMBLY

Since the regulator consists of small precision finished parts, disassembly and assembly are rather complicated.

For this reason, replacement of a regulator assembly is recommended, unless there is a special reason, but in case disassembly is necessary for an unavoidable reason, read through this manual to the end before starting disassembly.

(1) Choose a place for disassembly.

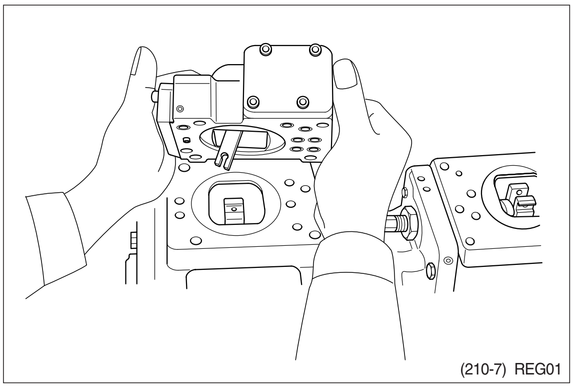
※ Choose a clean place.

※ Spread rubber sheet, cloth, or so on on top of work-bench to prevent parts from being damaged.

(2) Remove dust, rust, etc. from surfaces of regulator with clean oil.

(3) Remove hexagon socket head screw (412, 413) and remove regulator main body from pump main body.

※ Take care not to lose O-ring.



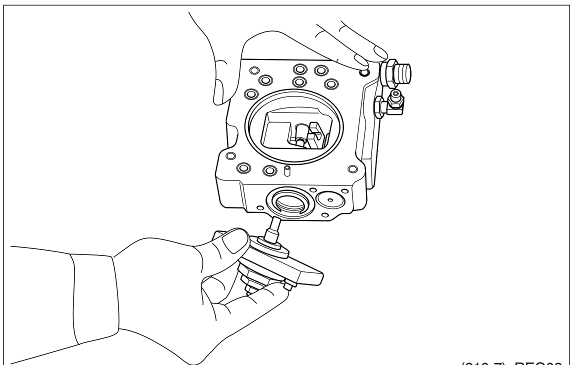
(210-7) REG01

(4) Remove hexagon socket head screw (438) and remove cover (C, 629)

※ Cover (C) is fitted with adjusting screw (C, 628), adjusting ring (C, 627), lock nut (630), hexagon nut (801) and adjusting screw (924).

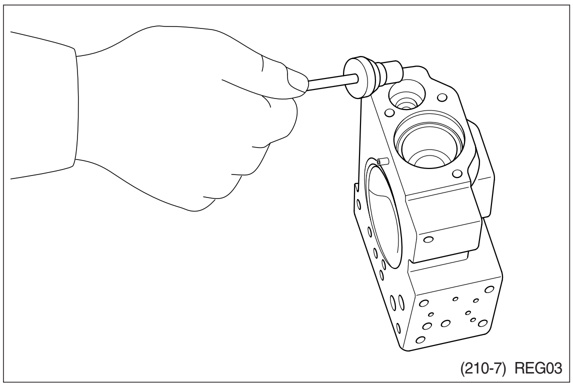
※ Do not loosen these screws and nuts.

If they are loosened, adjusted pressure-flow setting will vary.



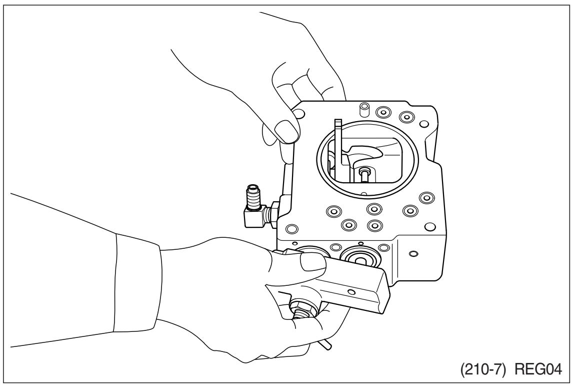
(210-7) REG02

(5) After removing cover (C, 629) subassembly, take out outer spring (625), inner spring (626) and spring seat (C, 624) from compensating section.
Then draw out adjusting ring (Q, 645), pilot spring (646) and spring seat (644) from pilot section.
※ Adjusting ring (Q, 645) can easily be drawn out with M4 bolt.



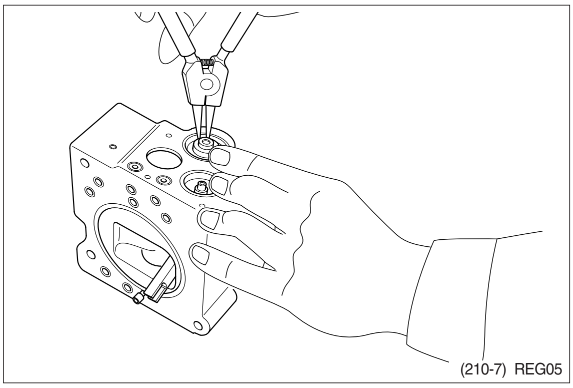
(210-7) REG03

(6) Remove hexagon socket head screws (436, 438) and remove pilot cover (641).
After removing pilot cover, take out set spring (655) from pilot section.



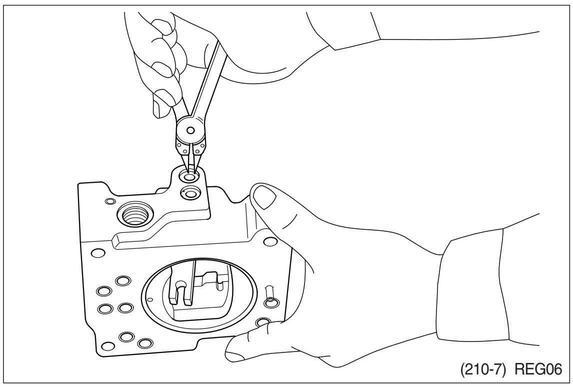
(210-7) REG04

(7) Remove snap ring (814) and take out spring seat (653), return spring (654) and sleeve (651).
※ Sleeve (651) is fitted with snap ring (836).
※ When removing snap ring (814), return spring (654) may pop out.
Take care not to lose it.

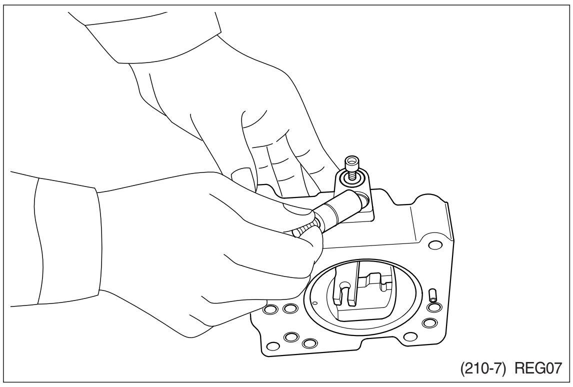


(210-7) REG05

(8) Remove locking ring (858) and take out fulcrum plug (614) and adjusting plug (615).
※ Fulcrum plug (614) and adjusting plug (615) can easily be taken out with M6 bolt.



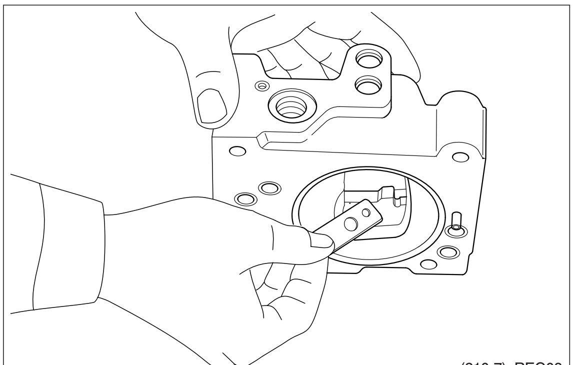
(210-7) REG06



(210-7) REG07

(9) Remove lever (2, 613). Do not draw out pin (875).

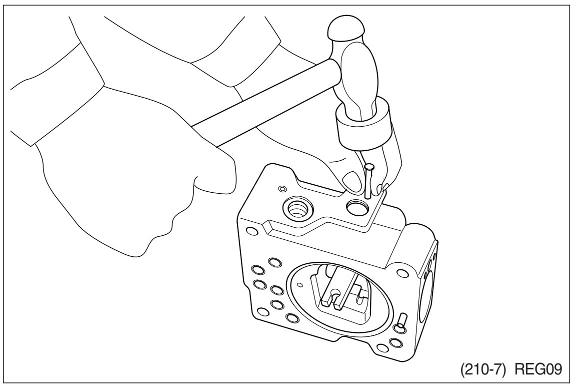
※ Work will be promoted by using pincers or so on.



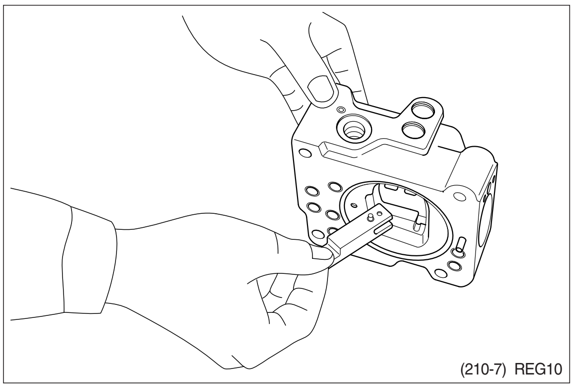
(210-7) REG08

(10) Draw out pin (874) and remove feedback lever (611).

Push out pin (874, 4 mm in dia.) from above with slender steel bar so that it may not interfere with lever (1, 612).



(210-7) REG09



(210-7) REG10

(11) Remove lever (1, 612). Do not draw out pin (875).

(12) Draw out pilot piston (643) and spool (652).

(13) Draw out piston case (622), compensating piston (621) and compensating rod (623).

※ Piston case (622) can be taken out by pushing compensating rod (623) at opposite side of piston case.

This completes disassembly.

4) ASSEMBLY

(1) For assembly, reverse disassembly procedures, but pay attention to the following items.

① Always repair parts that were scored at disassembly.

② Get replacement parts ready beforehand. Mixing of foreign matter will cause malfunction.
Therefore, wash parts well with cleaning oil, let them dry with jet air and handle them in clean place.

③ Always tighten bolts, plugs, etc. to their specified torques.

④ Do not fail to coat sliding surfaces with clean hydraulic oil before assembly.

⑤ Replace seals such as O-ring with new ones as a rule.

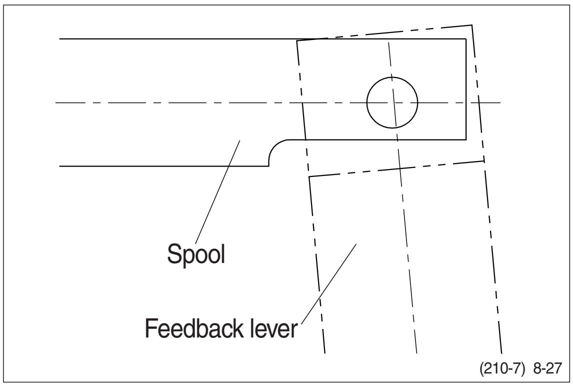
(2) Put compensating rod (623) into compensating hole of casing (601).

(3) Put pin force-fitted in lever (1, 612) into groove of compensating rod and fit lever (1) to pin force-fitted in casing.

(4) Fit spool (652) and sleeve (651) into hole in spool of casing.

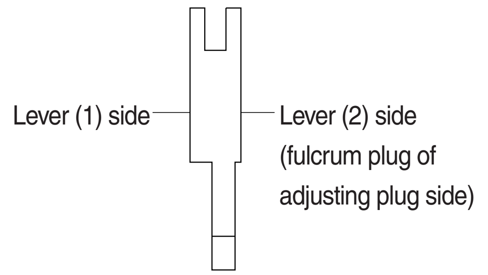
※ Confirm that spool and sleeve slide smoothly in casing without binding.

※ Pay attention to orientation of spool.



(210-7) 8-27

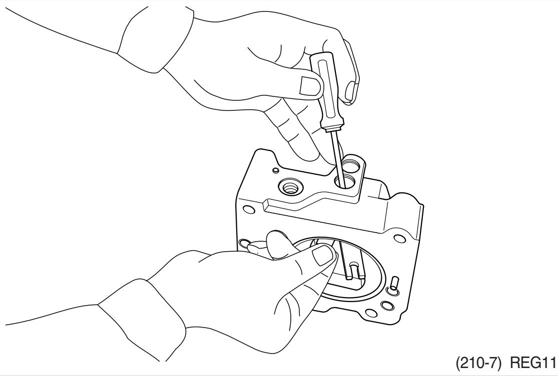
(5) Fit feedback lever (611), matching its pin hole with pin hole in spool.
Then insert pin (874).
※ Insert pin in feedback lever a little to ease operation.
※ Take care not to mistake direction of feedback lever.



(210-7) 8-28

(6) Put pilot piston (643) into pilot hole of casing.
※ Confirm that pilot piston slides smoothly without binding.

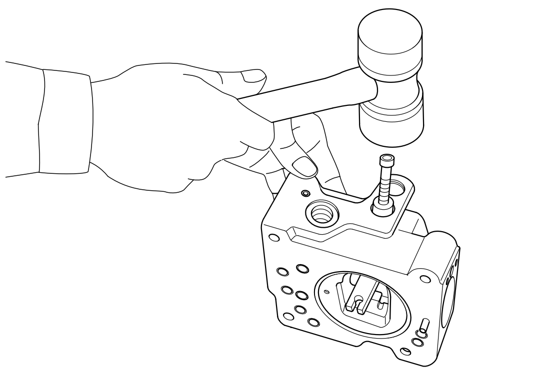
(7) Put pin force-fitted in lever (2, 613) into groove of pilot piston.
Then fix lever (2).



(210-7) REG11

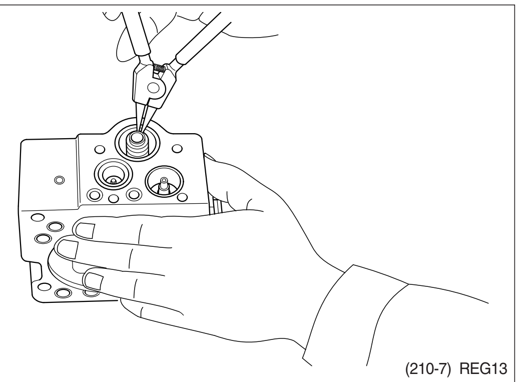
(8) Fit fulcrum plug (614) so that pin force-fitted in fulcrum plug (614) can be put into pin hole of lever (2).
Then fix locking ring (858).

(9) Insert adjusting plug (615) and fit locking ring.
※ Take care not to mistake inserting holes for fulcrum plug and adjusting plug.
At this point in time move feedback lever to confirm that it has no large play and is free from binding.



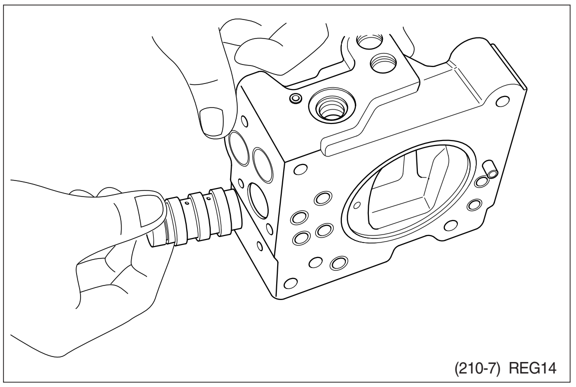
(210-7) REG12

(10) Fit return spring (654) and spring seat (653) into spool hole and attach snap ring (814).

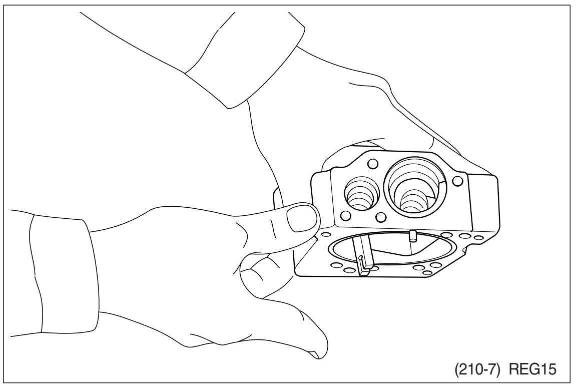


(210-7) REG13

(11) Fit set spring (655) to spool hole and put compensating piston (621) and piston case (622) into compensating hole.
Fit pilot cover (641) and tighten it with hexagonal socket head screws (436, 438).

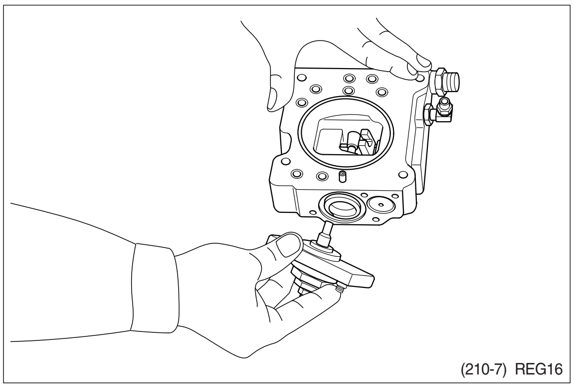

(210-7) REG14

(12) Put spring seat (644), pilot spring (646) and adjusting ring (Q, 645) into pilot hole.
Then fix spring seat (624), inner spring (626) and outer spring (625) into compensating hole.
※ When fitting spring seat, take care not to mistake direction of spring seat.


(210-7) REG15

(13) Install cover (C, 629) fitted with adjusting screws (628), adjusting ring (C, 627), lock nut (630), hexagon nut (801) and adjusting screw (924).
Then tighten them with hexagonal socket head screws (438).

This completes assembly.


(210-7) REG16

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.

(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.

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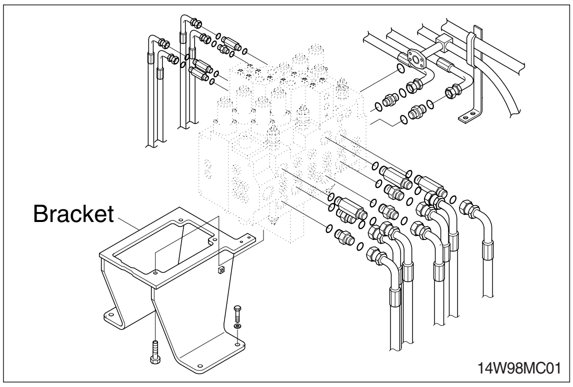
(4) Remove the wirings for the pressure sensor and so on.

(5) Remove bolts and disconnect pipe.

(6) Disconnect pilot line hoses.

(7) Disconnect pilot piping.

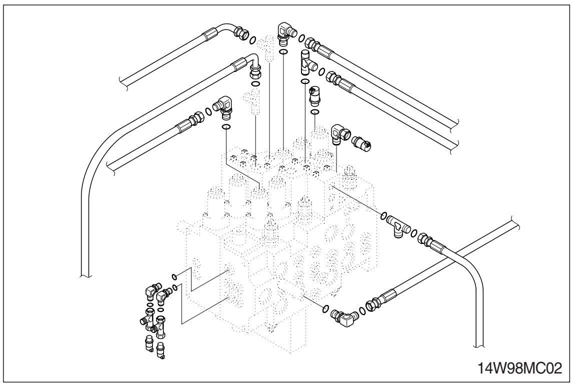


14W98MC01

(8) Sling the control valve assembly and remove the control valve mounting bolt and bracket.

- Weight : 140 kg (310 lb)

(9) Remove the control valve assembly.
When removing the control valve assembly, check that all the piping have been disconnected.



14W98MC02

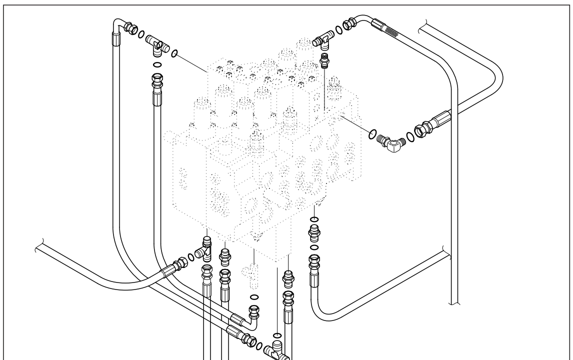
2) INSTALL

(1) Carry out installation in the reverse order to removal.

(2) Bleed the air from below items.

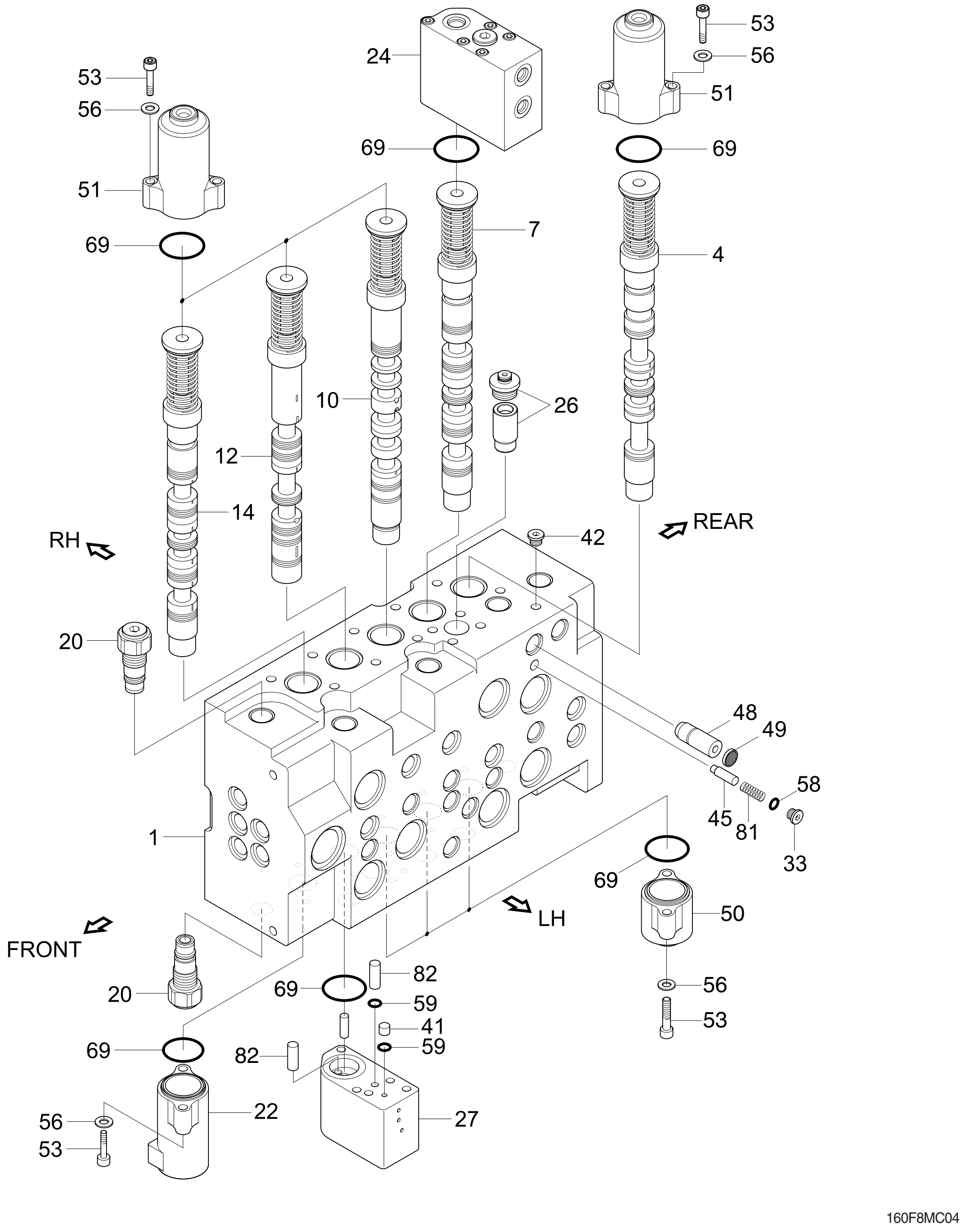
① Cylinder (boom, arm, bucket)
② Swing motor
③ Travel motor
※ See each item removal and install.

(3) Confirm the hydraulic oil level and recheck the hydraulic oil leak or not.



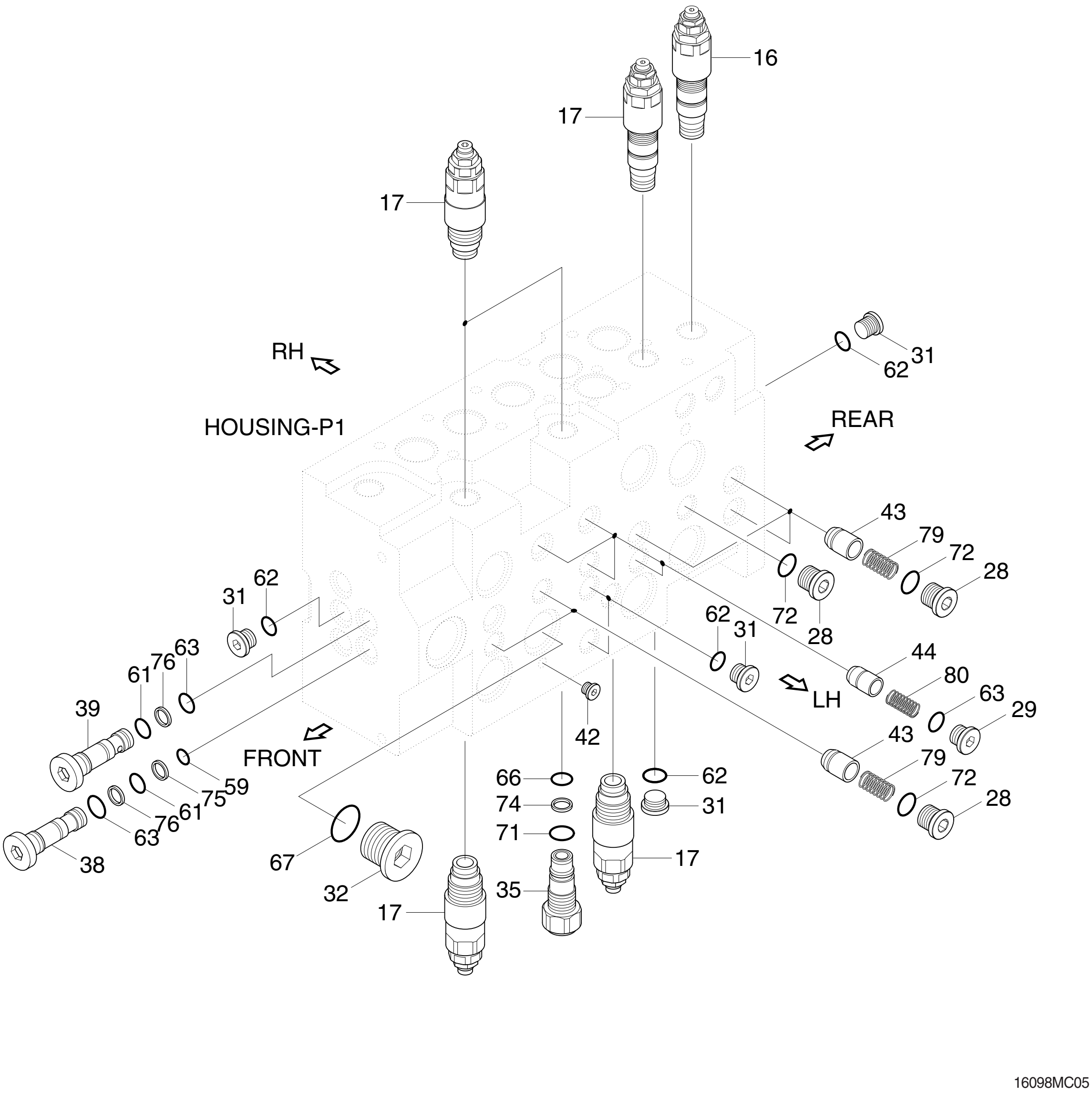
14W98MC03

2. STRUCTURE (1/4)



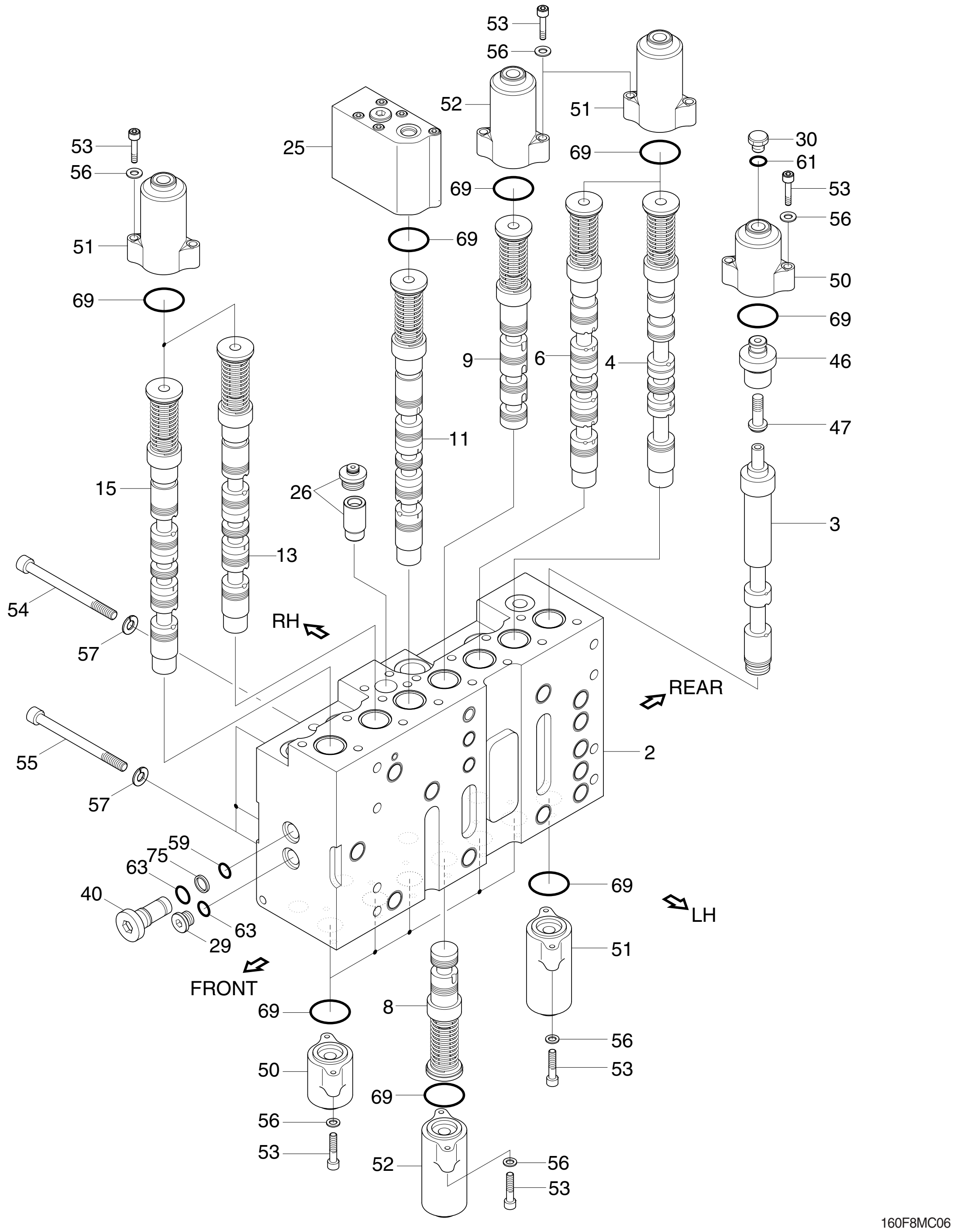
1	Housing P1	26	Lock valve kit B	51	Pilot B1 cap
4	Travel (LH) spool assy	27	Regeneration block	53	Socket bolt
7	Boom 1 spool assy	33	Plug	56	Plain washer
10	Arm 2 spool assy	41	Orifice	58	O-ring
12	Arm regen spool assy	42	Plug	59	O-ring
14	Bucket spool assy	45	Poppet	69	O-ring
20	Nega con relief valve	48	Orifice	81	Spring
22	Bucket stroke limiter	49	Coin type filter	82	Pin
24	Holding valve kit A1	50	Pilot A cap		

STRUCTURE (2/4)



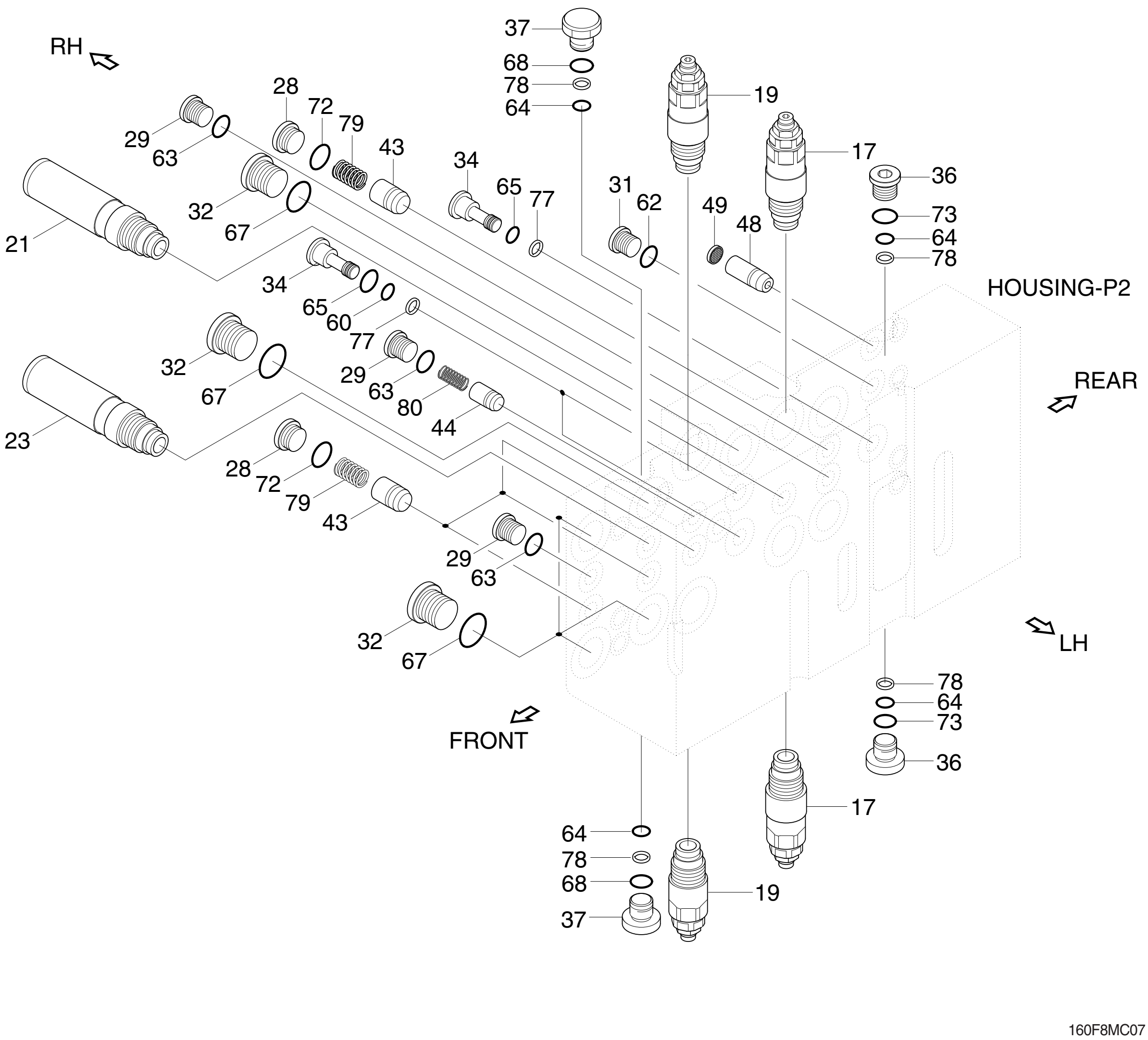
16	Main relief valve	42	Plug	71	O-ring
17	Overload relief valve	43	Poppet 1	72	O-ring
28	Plug	44	Poppet 2	74	Back up ring
29	Plug	59	O-ring	75	Back up ring
31	Plug	61	O-ring	76	Back up ring
32	Plug	62	O-ring	79	Spring
35	Plug	63	O-ring	80	Spring
38	Plug	66	O-ring		
39	Plug	67	O-ring		

STRUCTURE (3/4)



2	Housing P2	26	Lock valve kit B	54	Socket bolt
3	Travel straight spool assy	29	Plug	55	Socket bolt
4	Travel (RH) spool assy	30	Plug	56	Plain washer
6	Swing spool assy	40	Plug	57	Spring washer
8	Swing priority spool assy	46	Sleeve	59	O-ring
9	Boom 2 spool assy	47	Piston	61	O-ring
11	Arm 1 spool assy	50	Pilot A cap	63	O-ring
13	Option B spool assy	51	Pilot B1 cap	69	O-ring
15	Option C spool assy	52	Pilot B2 cap	75	Back up ring
25	Holding valve kit A2	53	Socket bolt		

STRUCTURE (4/4)



17	Overload relief valve	37	Plug	67	O-ring
19	Overload relief valve	43	Poppet 1	68	O-ring
21	Swing logic valve	44	Poppet 2	72	O-ring
23	ON/OFF valve-option	48	Orifice	73	O-ring
28	Plug	49	Coin type filter	77	Back up ring
29	Plug	60	O-ring	78	Back up ring
31	Plug	62	O-ring	79	Spring
32	Plug	63	O-ring	80	Spring
34	Plug	64	O-ring		
36	Plug	65	O-ring		

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.

(2) In handling a control valve, pay full attention to prevent dust, sand, etc. from entering into it.

(3) When a control valve is to be remove from the machine, apply caps and masking seals to all ports. Before disassembling the valve, recheck that these caps and masking seals are fitted completely, and then clean the outside of the assembly. Use a proper bench for working. Spread paper or a rubber mat on the bench, and disassemble the valve on it.

(4) Support the body section carefully when carrying or transferring the control valve. Do not lift by the exposed spool, end cover section etc.

(5) After disassembling and assembling of the component it is desired to carry out various tests (for the relief characteristics, leakage, flow resistance, etc.), but 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)
Vice mounted on bench (soft jaws)	1 unit	
Hexagon wrench	Each 1 piece	5, 6, 10, 12 and 14
Socket wrench	Each 1 piece	27 and 32
Spanner	Each 1 piece	32 (main relief valve, overload relief valve, negative relief valve) 26 (holding valve)

3) DISASSEMBLY

(1) Disassembly of spools without holding valve (travel right, travel left)

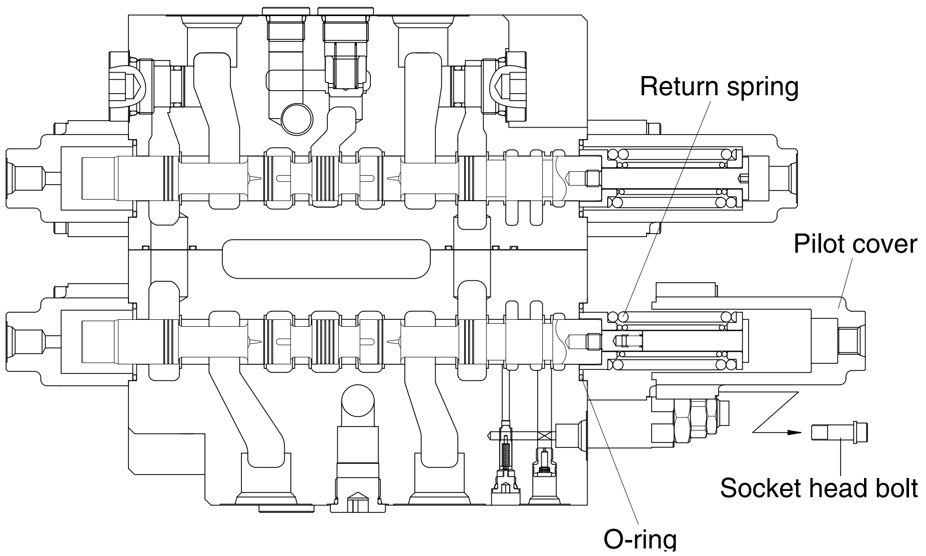
① Loosen hexagon socket head bolts with washer.
(hexagon wrench : 5 ㎜)

② Remove the pilot cover.

※ Pay attention not to lose the O-ring under the pilot cover.

③ Remove the spool assembly from the body by hand slightly.

※ When extracting each spool from its body, pay attention not to damage the body.
※ When extracting each spool assembly, it must be extracted from spring side only.
※ When any abnormal parts are found, replace it with completely new spool assembly.
※ When disassembled, tag the components for identification so that they can be reassembled correctly.



14098MC10

(2) **Disassembly of spools with holding valve** (boom 1, arm 1 spool)

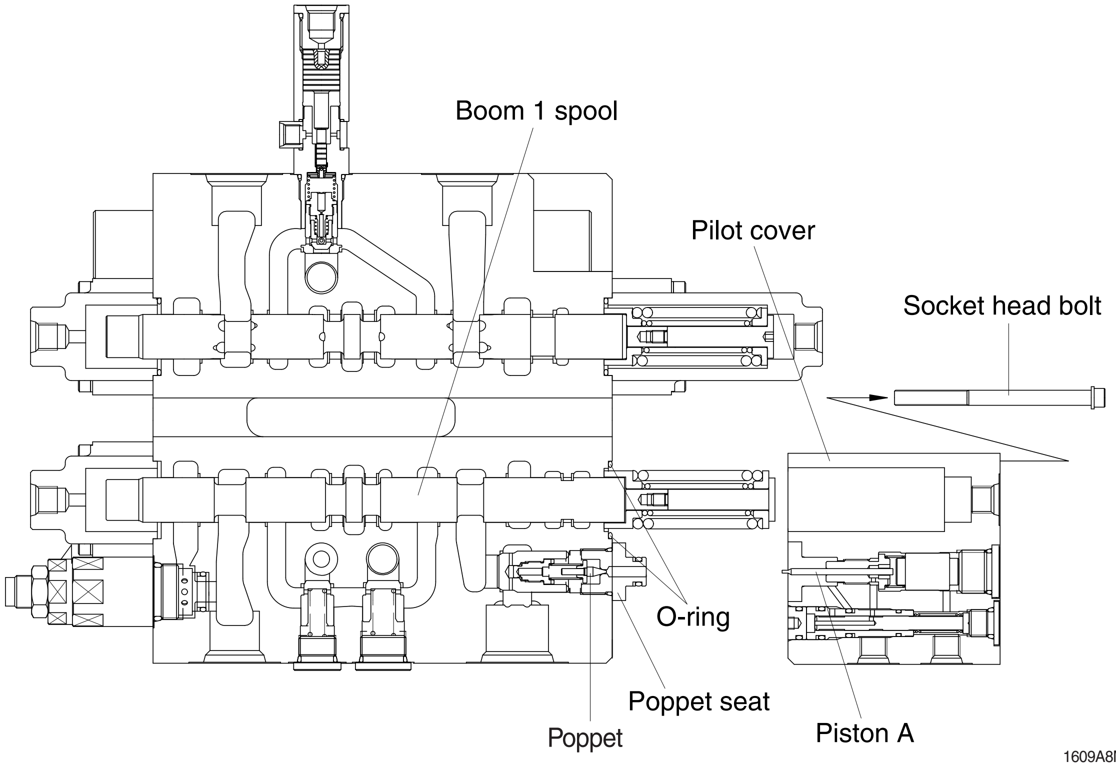
① Loosen hexagon socket head bolts with washer.
(hexagon wrench : 5 ㎜)

② Remove the pilot cover with internal parts.

※ Pay attention not to lose the O-ring and the poppet under the pilot cover.
※ Pay attention not to damage the "piston A" under pilot cover.

③ Remove the spool assembly from the body by hand slightly.

※ When extracting each spool from its body, pay attention not to damage the body.
※ When extracting each spool assembly, it must be extracted from spring side only.
※ When any abnormal parts are found, replace it with completely new spool assembly.
※ When disassembled, tag the components for identification so that they can be reassembled correctly.



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(3) Disassembly of the holding valve

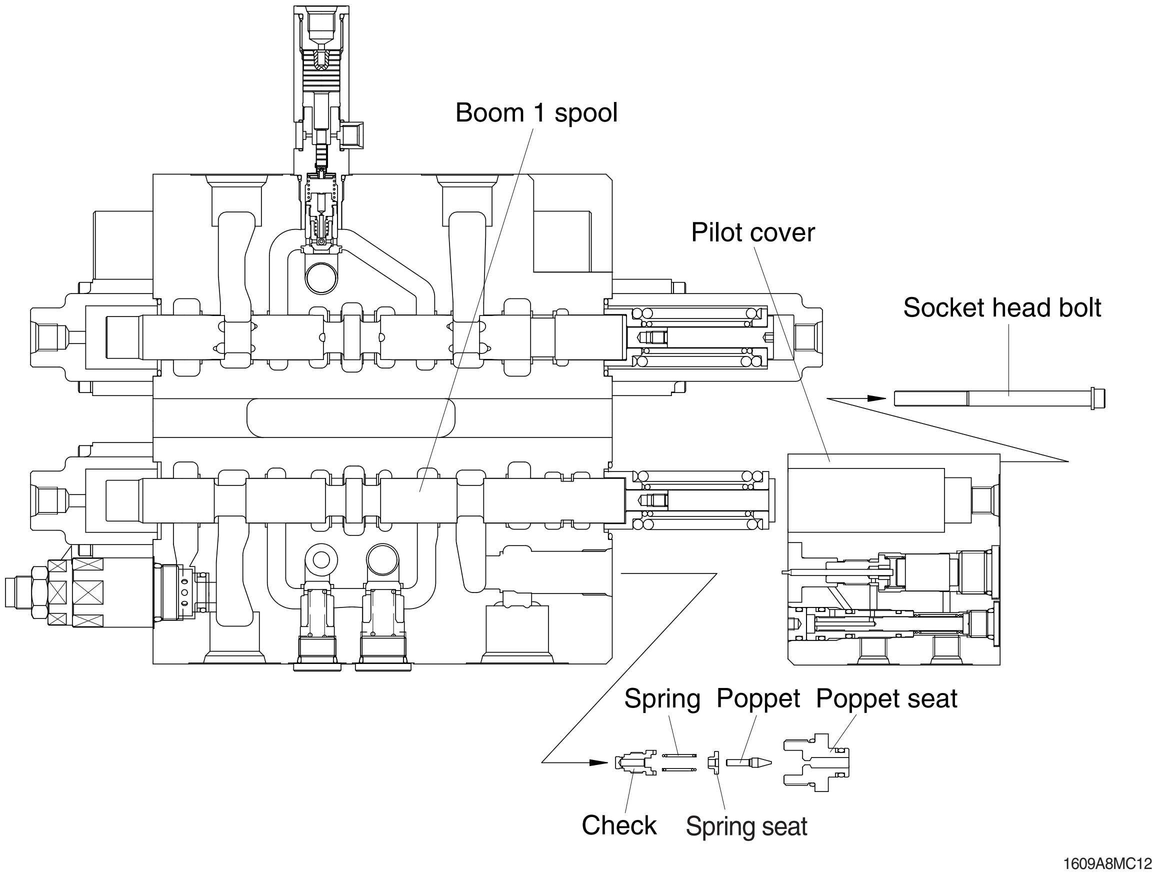
① Remove the pilot cover with the holding valve as described on previous page.

※ Do not disassembled internal parts of the pilot cover.

② Loosen the poppet seat and remove the poppet, spring seat, spring and check. (spanner : 26 ㎜)

※ Pay attention not to lose the poppet.

※ Do not disassembled internal parts of the check.



(4) Disassembly of the load check valve and the negative relief valve

① The load check valve

a. Fix the body to suitable work bench.

※ Pay attention not to damage the body.

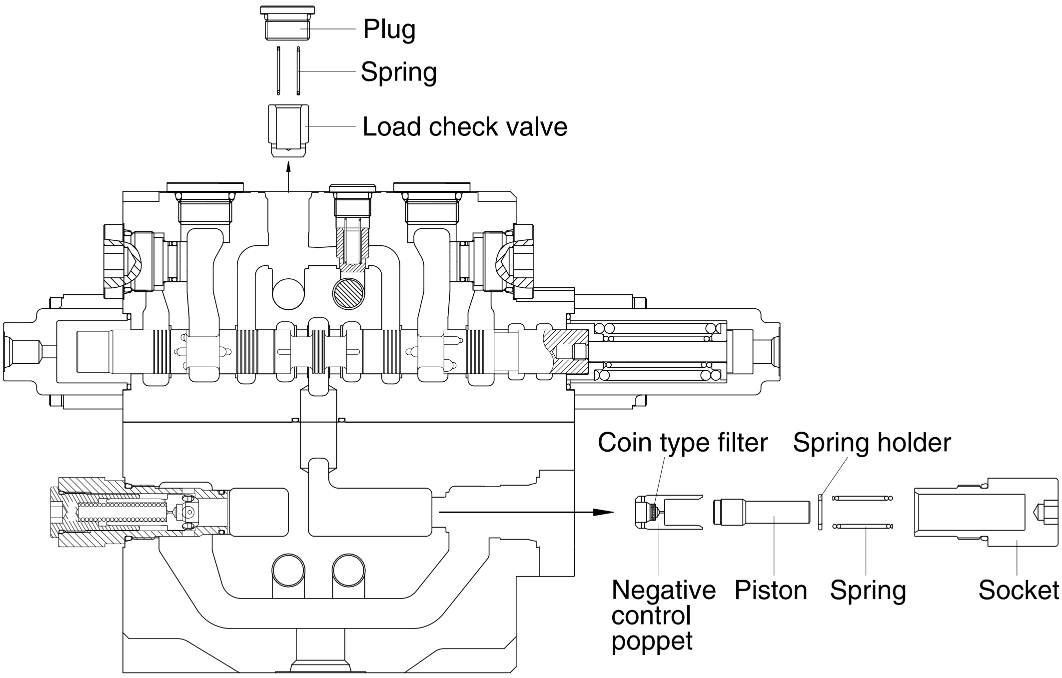
b. Loosen the plug (hexagon wrench : 10 ㎜).

c. Remove the spring and the load check valve with pincers or magnet.

② The negative relief valve

a. Loosen the socket (spanner : 32 ㎜).

b. Remove the spring, spring holder, piston and negative control poppet.



14W98MC13

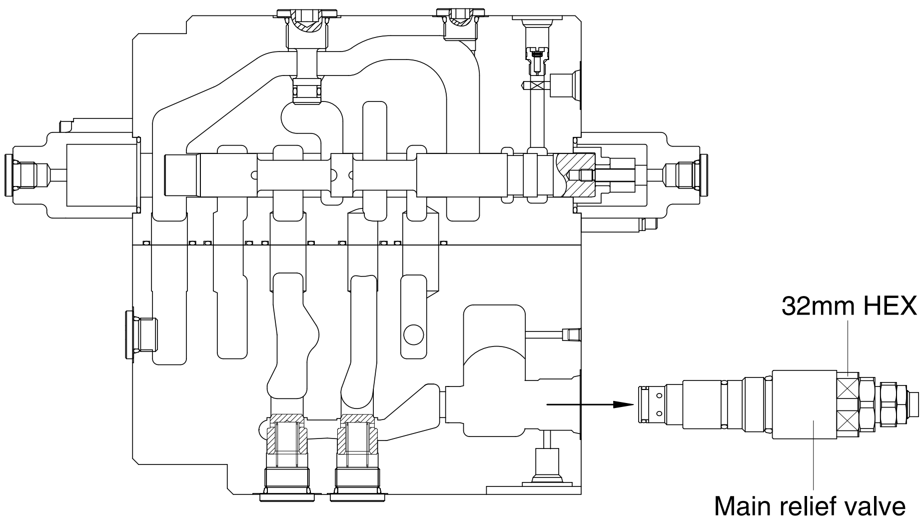
(5) Disassembly of the main and overload relief valve

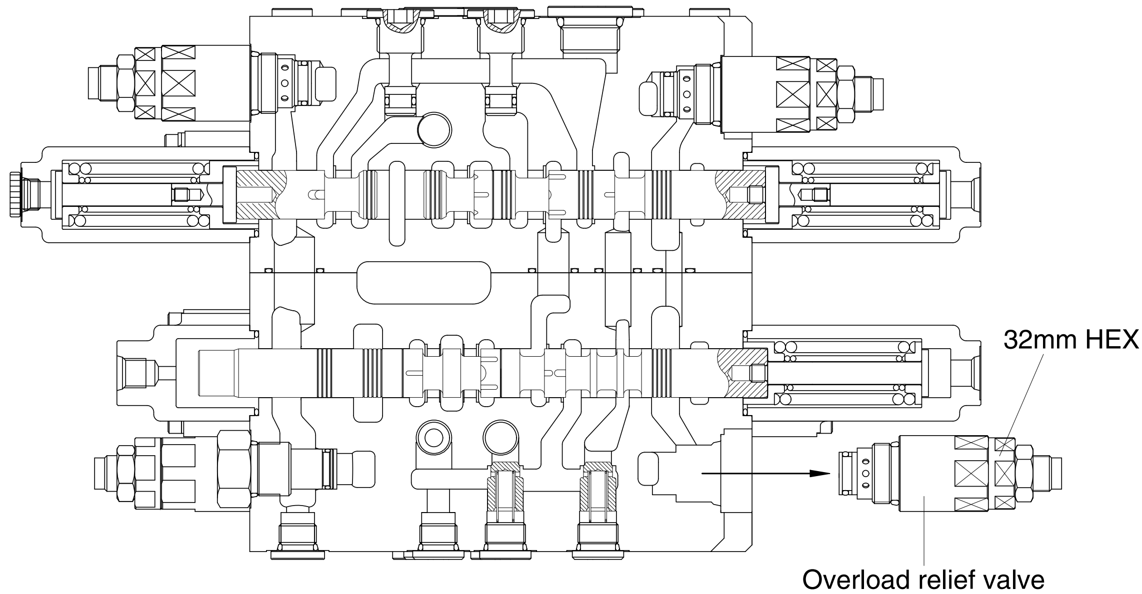
① Fix the body to suitable work bench.

② Remove the main relief valve.
(spanner : 32 mm)

③ Remove the overload relief valve.
(spanner : 32 mm)

※ When disassembled, tag the relief valve for identification so that they can be reassembled correctly.
※ Pay attention not to damage seat face.
※ When any abnormal parts are found, replace it with completely new relief valve assembly.





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(6) 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 seal groove faces of body and block are smooth and free of dust, dent, rust etc.
c. Correct dents and damages and check seat faces within the body, if any, by lapping.
※ Pay careful attention not to leave any lapping agent within the body.
d. Confirm that all sliding and fitting parts can be moved manually and that all grooves and path's are free 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 it's the prescribed disassembly and assembly procedures.
g. Replace all seals and O-rings with new ones.

② Relief valve

a. Confirm that all seat faces at ends of all poppets and seats are free of defects and show uniform and consistent contact faces.
b. Confirm manually that main poppet and seat can slide lightly and smoothly.
c. Confirm that outside face of main poppet and inside face of seat are free from scratches and so on.
d. Confirm that springs are free from breakage, deformation, and wear.
e. Confirm that orifices of main poppet and seat section are not clogged with foreign matter.
f. Replace all O-rings with new ones.
g. When any light damage is found in above inspections, correct it by lapping.
h. When any abnormal part is found, replace it with a completely new relief valve assembly.

4) ASSEMBLY

(1) General precaution

① In this assembly section, explanation only is shown.
For further understanding, please refer to the figures shown in the previous structure & disassembly section.
② Pay close attention to keeping all seals free from handling damage and inspect carefully for damage before using them.
③ Apply clean grease or hydraulic oil to the seal so as to ensure it is fully lubricated before assembly. Do not stretch seals so much as to deform them permanently.
④ In fitting O-rings, pay close attention not to roll them into their final position in addition, a twisted
⑤ O-ring cannot easily untwist itself naturally and could thereby cause inadequate sealing and thereby both internal and external oil leakage.
⑥ Tighten fitting bolts for all sections with a torque wrench adjusted to the respective tightening torque.
⑦ Do not reuse removed O-rings and seals.

(2) Load check valve

① Assemble the load check valve and spring.
② Put O-rings on to plug.
③ Tighten plug to the specified torque.
· Hexagon wrench : 10 mm
· Tightening torque : 6~7 kgf · m (43.4~50.6 lbf · ft)

(3) Negative control relief valve

① Assemble the nega-con poppet, piston, spring holder and spring together into body.
② Put O-ring on to plug and tighten the latter to its specified torque.
· Hexagon wrench : 12 mm
· Tightening torque : 8~9 kgf · m (57.8~65.1 lbf · ft)

(4) Main relief, overload relief valves

Install main relief valve, overload relief valve into the body and tighten to the specified torque.

Component	Tools	Tightening torque	
		kgf · m	lbf · ft
Main relief valve	Spanner 32 mm	8~9	57.8~65.1
Overload relief valve	Spanner 32 mm	8~9	57.8~65.1

(5) Main spools

① Carefully insert the previously assembled spool assemblies into their respective bores within of body.
※ Fit spool assemblies into body carefully and slowly. Do not under any circumstances push them forcibly in.

(6) Pilot covers

① Fit spool covers to the non-spring assembly end of the spool, and tighten the hexagonal socket head bolts to the specified torque.
- Hexagon wrench : 5 mm
- Tightening torque : 1.0~1.1 kgf · m (7.2~7.9 lbf · ft)

※ Confirm that O-rings have been fitted.

② Fit spring covers to the spring end for the spools, and tighten hexagon socket head bolts to the specified torque.
- Hexagon wrench : 5 mm
- Tightening torque : 1.0~1.1 kgf·m (7.2~7.9 lbf·ft)

※ Confirm that O-rings have been fitted.

(7) Holding valves

① Assemble the check, spring seat and poppet together into body.

② Tighten the poppet seat to the specified torque.
- Spanner : 26 mm
- Tightening torque : 6~7 kgf · m (43.4~50.6 lbf · ft)

③ Fit the "piston A" under pilot cover with internal parts into hole on the poppet seat.

④ Tighten hexagon socket head bolt to specified torque.
- Hexagon wrench : 5 mm
- Tightening torque : 1.0~1.1 kgf · m (7.2~7.9 lbf · ft)

GROUP 5 SWING DEVICE (TYPE 1)

1. REMOVAL AND INSTALL OF MOTOR

1) REMOVAL

(1) Lower the work equipment to the ground and stop the engine.

(2) Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

(3) Loosen the breather slowly to release the pressure inside the hydraulic tank.

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

※ When pipes and hoses are disconnected, the oil inside the piping will flow out, so catch it in oil pan.


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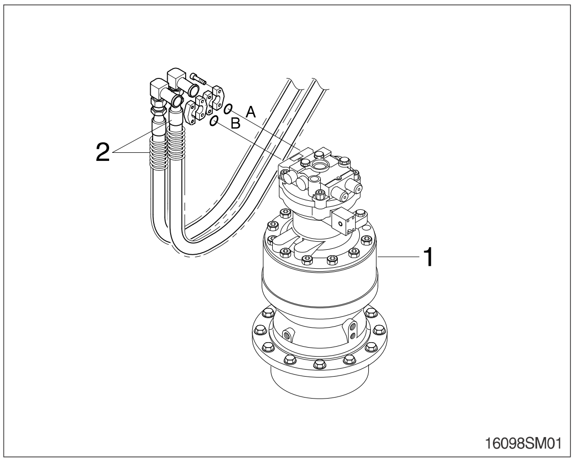
(4) Disconnect hose assembly (2).

(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 ℔)



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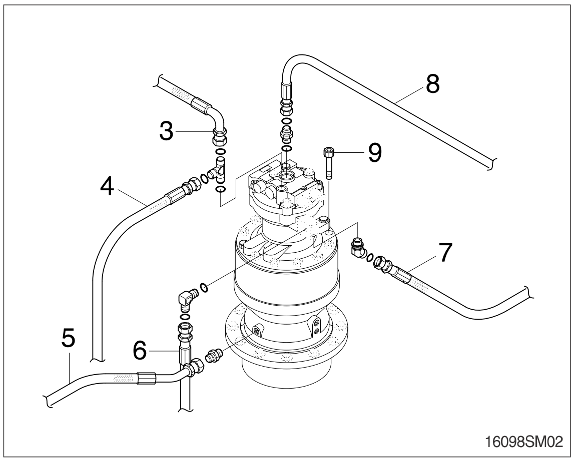
(7) Remove the swing motor assembly.

※ When removing the swing motor assembly, check that all the piping have been disconnected.



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2) INSTALL

(1) Carry out installation in the reverse order to removal.

(2) Bleed the air from the swing motor.

① Remove the air vent plug.

② Pour in hydraulic oil until it overflows from the port.

③ Tighten plug lightly.

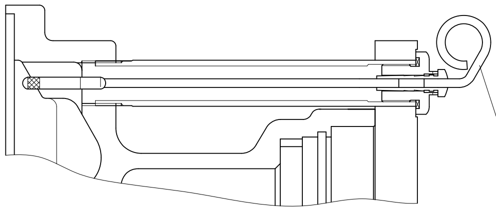
④ Start the engine, run at low idling and check oil come out from plug.

⑤ Tighten plug fully.

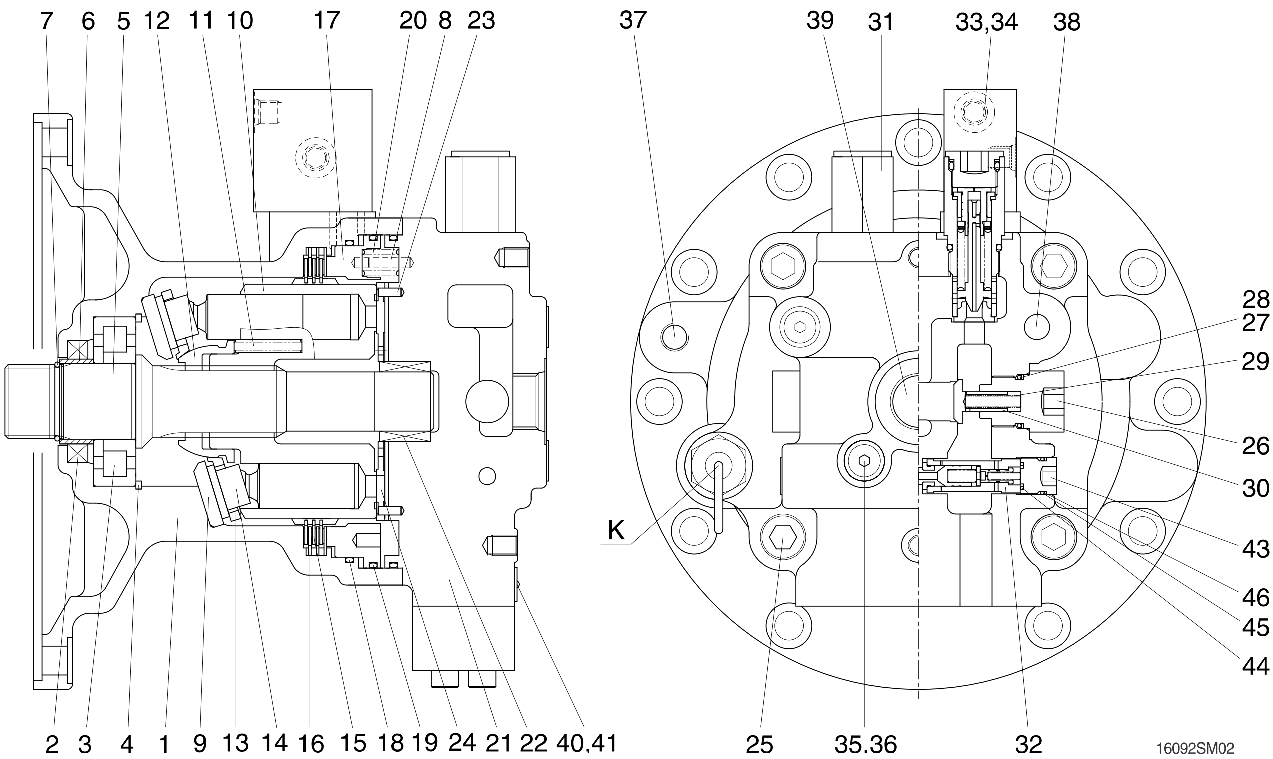
(3) Confirm the hydraulic oil level and check the hydraulic oil leak or not.

2. DISASSEMBLY AND ASSEMBLY OF SWING MOTOR

1) STRUCTURE



DETAIL K

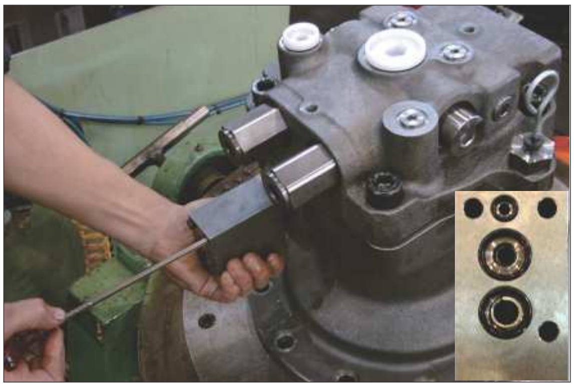


1	Body	17	Brake piston	33	Time delay valve
2	Oil seal	18	O-ring	34	Wrench bolt
3	Roller bearing	19	O-ring	35	Plug
4	Snap ring	20	Brake spring	36	O-ring
5	Shaft	21	Rear cover	37	Plug
6	Bushing	22	Needle bearing	38	Plug
7	Stop ring	23	Pin	39	Plug
8	Pin	24	Valve plate	40	Name plate
9	Shoe plate	25	Wrench bolt	41	Rivet
10	Cylinder block	26	Plug	42	Level gauge
11	Spring	27	Back up ring	43	Plug
12	Ball guide	28	O-ring	44	O-ring
13	Set plate	29	Spring	45	O-ring
14	Piston assy	30	Check	46	Back up ring
15	Friction plate	31	Relief valve		
16	Separate plate	32	Anti-inversion valve		

2) DISASSEMBLING

(1) Disassemble the sub of a TURNING AXIS

① Unloosing wrench bolt and disassemble time delay valve assy (33) from rear cover (21)



14078SM201/201A

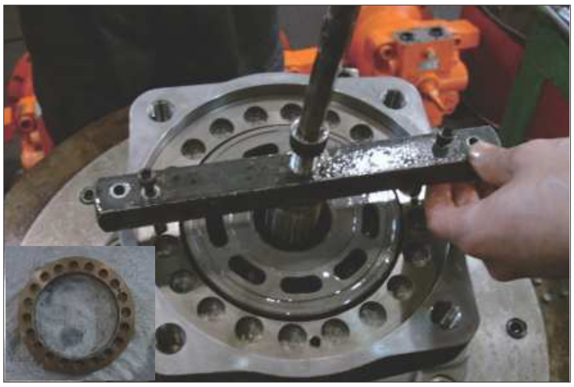
② Disassemble level gauge (42) from body (1).

14078SM202/202A

③ Hang rear cover (21) on hoist, unloose wrench bolt (25) and disassemble from body (1).

14078SM203/203A

④ Using a jig, disassemble brake piston (17) from body (1).



14078SM204/204A

⑤ Disassemble respectively cylinder block assy, friction plate (15), separate plate (16) from body (1).

14078SM205/205A/B

(2) Disassemble cylinder block assy sub

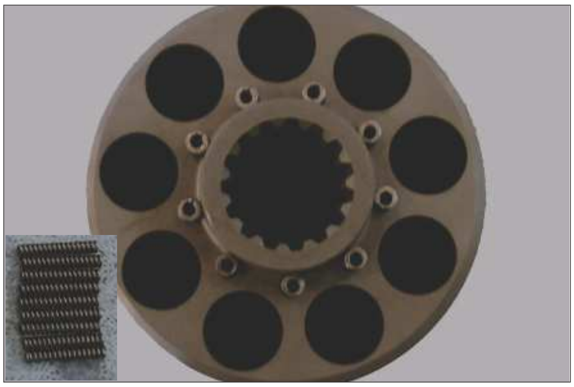
① Disassemble piston assy (14), set plate (13) from cylinder block assy.

14078SM206/205B

② Disassemble ball guide (12) from cylinder block (10).

14078SM207/207A

③ Disassemble spring (11) from cylinder block (10).



14078SM208/208A

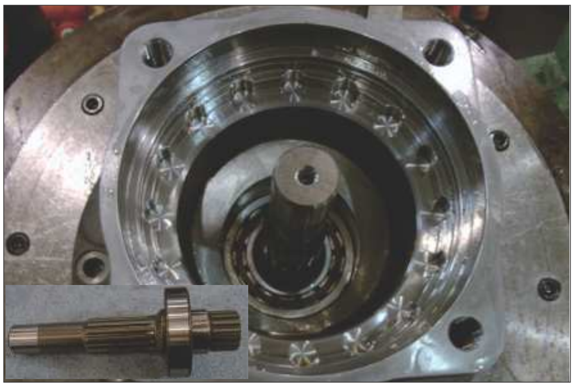
④ Disassemble shoe plate (9) from body (1).

14078SM209/209A

⑤ Using a plier jig, disassemble snap ring (4) from shaft (5).

14078SM210/210A

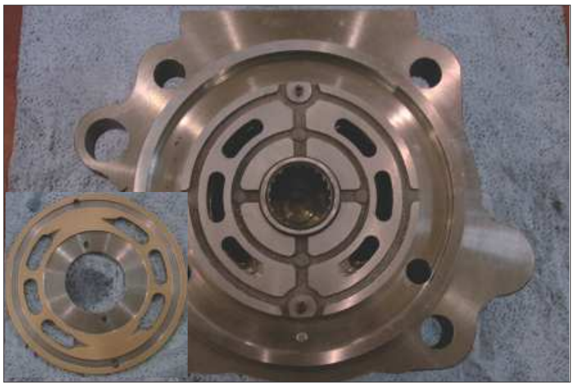
⑥ Disassemble shaft assy from body (1).



14078SM211/211A

(3) Disassemble rear cover assy sub

① Disassemble pin (8, 23), valve plate (24) from rear cover (21).

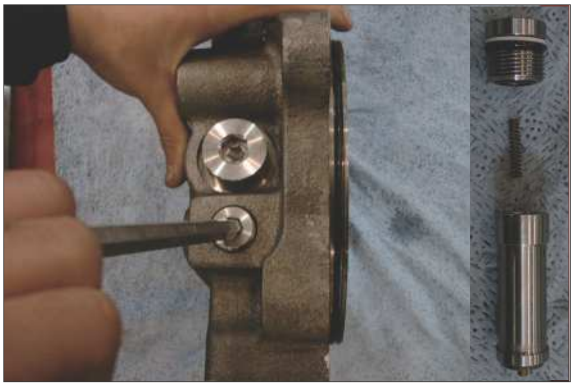


14078SM212/212A

② Using a torque wrench, disassemble relief valve assy (31) 2 set from rear cover (21).

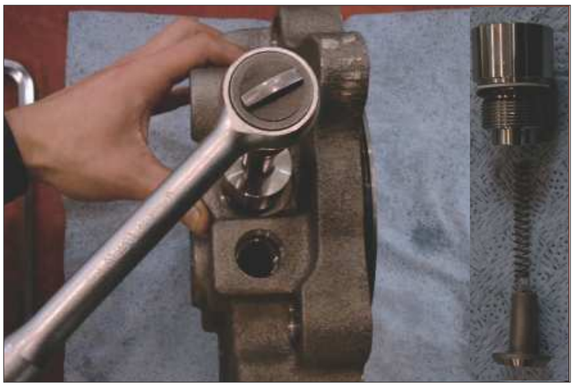
14078SM213/213A

③ After disassembling plug with a L-wrench from rear cover (21), disassemble respectively back up ring, O-ring, O-ring, spring, anti-inversion valve assy (32)



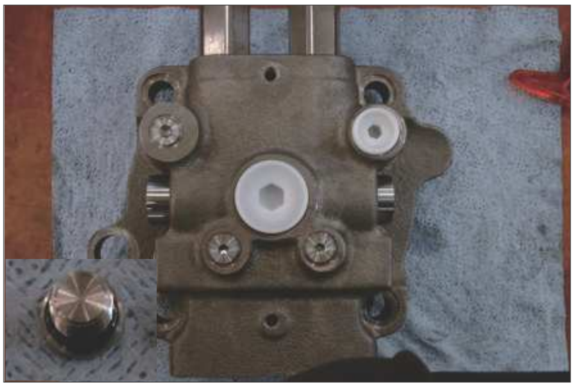
14078SM214/214A

④ Disassemble make up check valve assy with a torque wrench from rear cover (21).



14078SM215/215A

⑤ Disassemble respectively plug (35, 38, 39), with a L-wrench from rear cover (21).



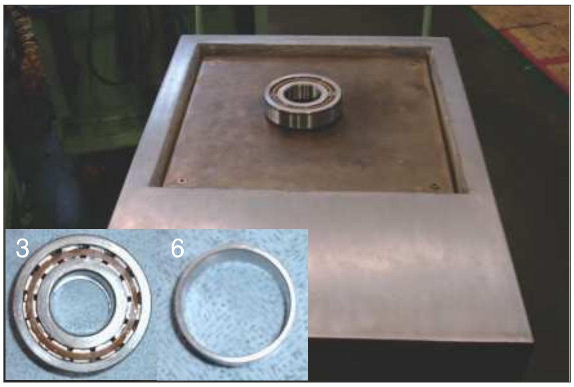
14078SM216/216A

3) ASSEMBLING

(1) Assemble the sub of a turning axls

① Put roller bearing (3), bushing (6) on pre-heater and provide heat to inner wheel (compressing temp : 290˚C for 2minutes)

- · Roller bearing × 1 EA
- · Bushing × 1 EA



14078SM217/217A/B

② After assembling and compressing pre-heated roller bearing (3), bushing (6) into shaft (5).

- · Stop ring × 1 EA
- · Shaft × 1 EA

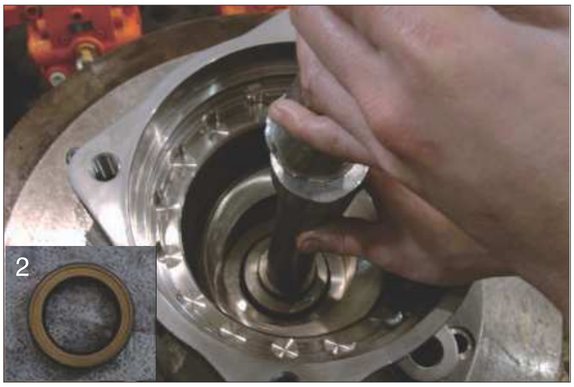
14078SM218/218A/B

③ Put body (1) on a assembling jig, fix it with bolts to prohibit moving.


14078SM219

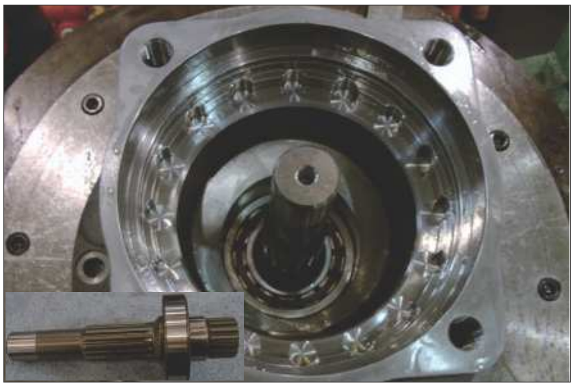
④ Using a compressing tool and steel stick, assemble oil seal (2) into body (1).

· Oil seal × 1 EA



14078SM220/220A

⑤ Insert above shaft sub into body (1) and assemble it with a steel stick.



14078SM211/211A

⑥ Fix snap ring (4) to shaft with a plier jig.

· Snap ring × 1 EA

14078SM210/210A

⑦ Spread grease on shoe plate (9) and assemble on the body.

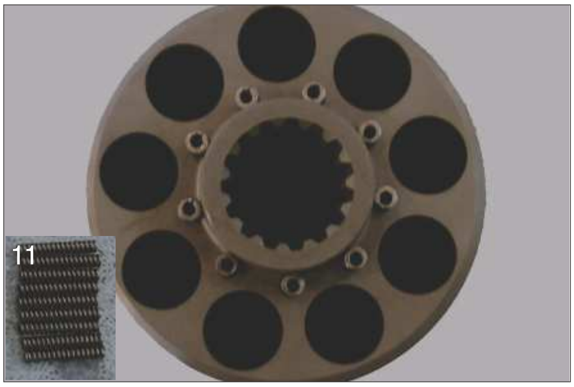
· Shoe plate × 1 EA

14078SM222/209A

(2) Assemble the sub of cylinder block assy

① Assemble spring (11) 9 set into cylinder block (10).

· Spring × 9 EA



14078SM208/208A

② Assemble ball guide (12) into cylinder.

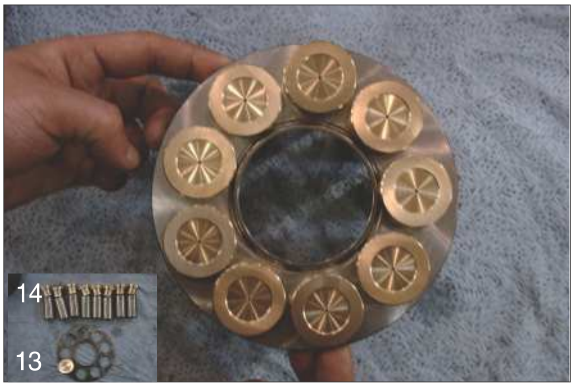
· Ball guide × 1 EA

14078SM207/207A

③ Assemble piston assy (14) 9 set into set plate (13).

· Piston assy × 9 EA

· Set plate × 1 EA



14078SM223/223A

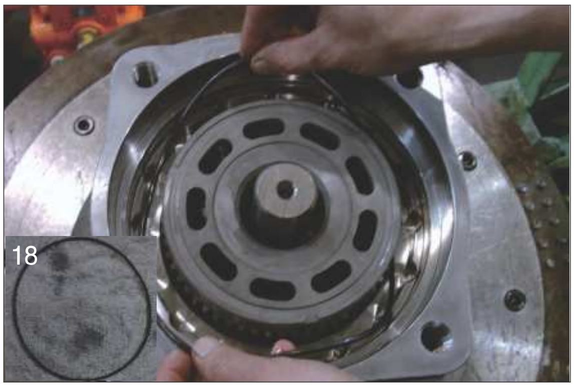
④ Assemble above item ② and ③.

14078SM224

⑤ Assemble cylinder block assy into body (1).

14078SM225

⑥ Assemble O-ring (18) into body (1).
 · O-ring × 1 EA



14078SM226/226A

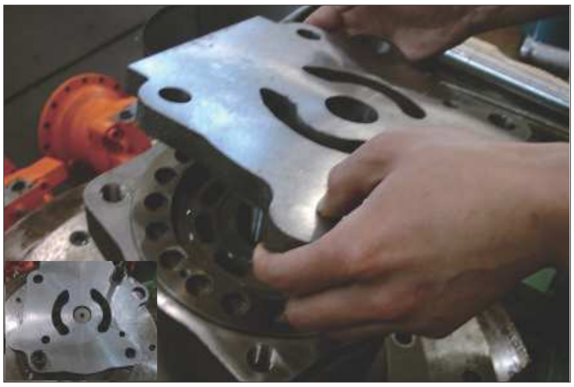
⑦ Assemble 3 set of plate (16), friction plate (15) respectively into body.
 · Plate × 3 EA
 · Friction plate × 3 EA

14078SM227/205A

⑧ Assemble O-ring (19) into break piston (17).
 · O-ring × 2 EA

14078SM228/226A

⑨ Insert break piston assy into body (1) and compress it with a jig and hammer.



14078SM229/229A

⑩ Assemble spring (20) (20 EA) into break piston (17).

· Spring × 20 EA

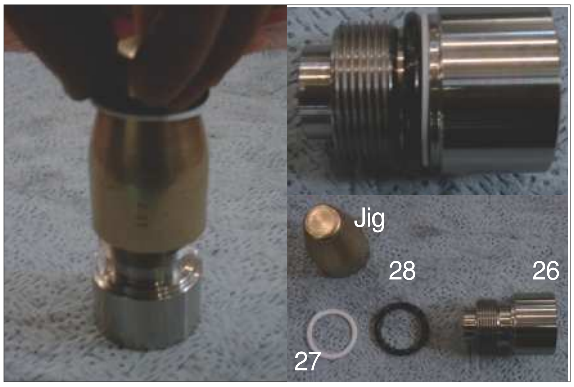
14078SM230/230A

(3) Assemble the sub of rear cover assy sub

① Assemble the sub of make up check valve assy.

Assemble O-ring (28), back up ring (27) into plug (26) with a O-ring assembling jig.

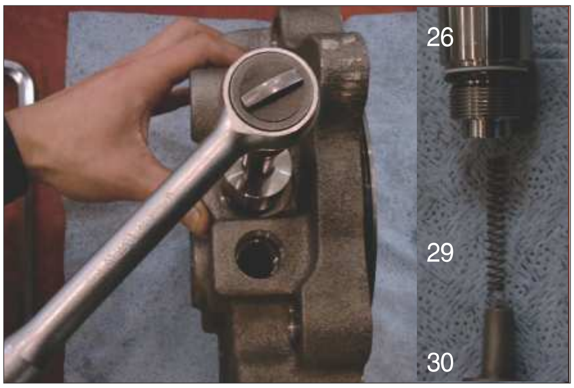
· Plug ×1 EA
· Back up ring ×1 EA
· O-ring ×1 EA



16098SM231/231A/B

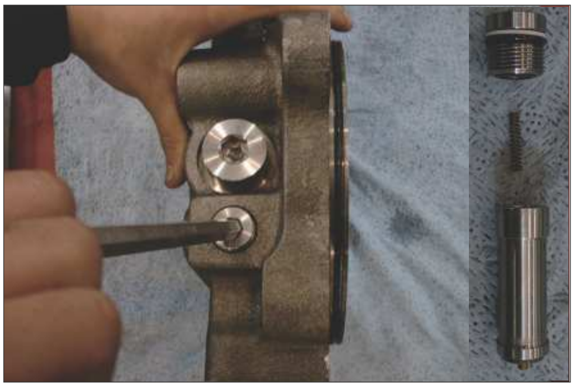
② Assemble respectively make up check valve assy spring (29), check (30), plug (26) into rear cover (21) after then screw it torque wrench.

· Make up check sub × 2 set
· Spring × 2 EA
· Check × 3 EA

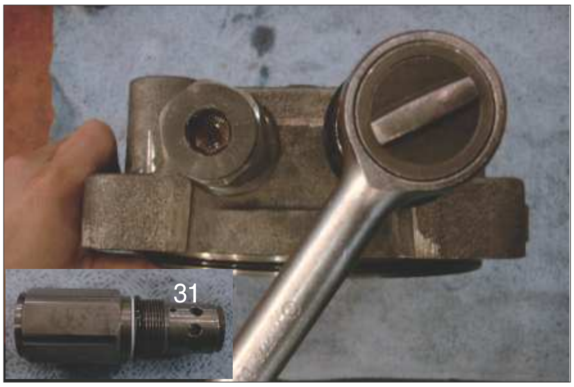


16098SM215/215A

③ Assemble respectively plug (43), back up ring, O-ring, O-ring, spring, anti-inversion valve assy (32) into rear cover (21).
(Bilateral symmetry assembling)
· Anti-Inversion v/v assy × 2 set
· O-ring (P12) × 2 EA
· O-ring (P18) × 2 EA
· Back up ring (P18) × 2 EA

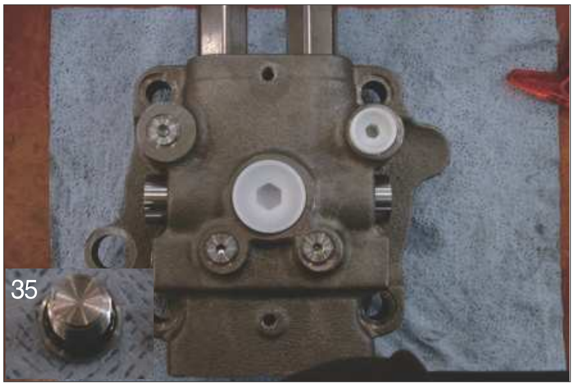

14078SM214/214A

④ Assemble relief valve assy (31) 2set into rear cover (21) with a torque wrench.
(Bilateral symmetry assembling)



16098SM213/213A

⑤ Assemble plug (35), plug (38, 39) into rear cover (21) with a L-wrench.
* Plug × 3 EA (PF1/4)

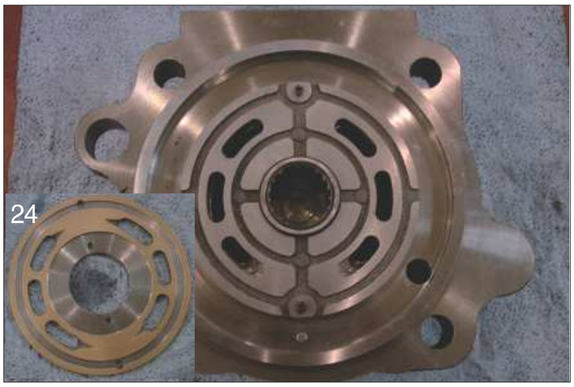


16098SM216/216A

⑥ After assembling needle bearing (22) into rear cover (21), with a hammer assemble pin (8, 23).
* Pin × 1 EA
* Pin × 2 EA


14078SM212

⑦ Spreading grease on valve plate (24), assemble into rear cover (21).
  · Valve plate × 1 EA

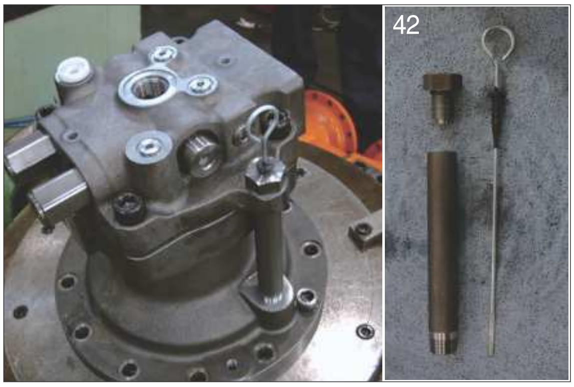


14078SM212/212A

⑧ Lift up rear cover assy on body (1) by a crane and assemble it with a wrench bolt (25).

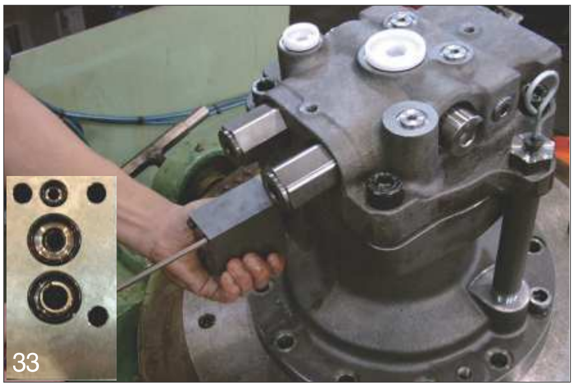

14078SM203/203A

⑨ Assemble level gauge (42) into body (1).



16098SM202/202A

⑩ Assemble time delay valve assy (33) into rear cover (21) with a wrench bolt (34).



16098SM201/201A

(4) Air pressing test

Be sure of leakage, after press air into assembled motor

14078SM232

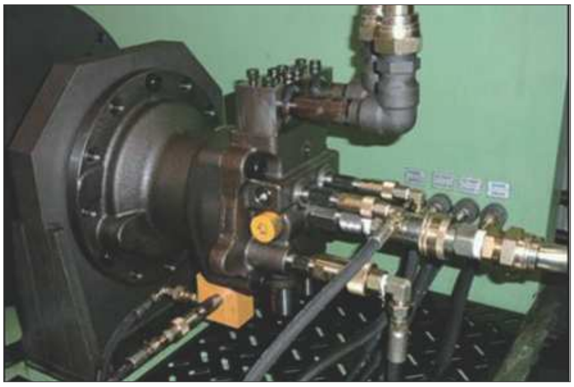
(5) Leakage check

After cleaning motor by color check No.1, paint No.3 and be sure of leakage.

14078SM233/233A

(6) Mount test bench

Mounting motor test bench, test the availability of each part.



220078SM14

3. REMOVAL AND INSTALL OF REDUCTION GEAR

1) REMOVAL

(1) Remove the swing motor assembly.
For details, see removal of swing motor assembly.

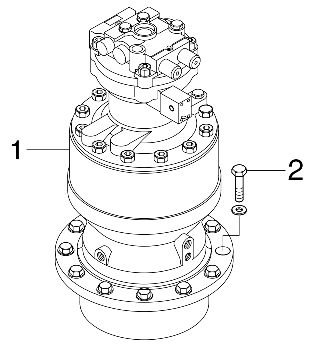
(2) Sling reduction gear assembly (1) and remove mounting bolts (2).

(3) Remove the reduction gear assembly.
· Reduction gear device weight : 180 kg (396 lb)

13031GE18

2) INSTALL

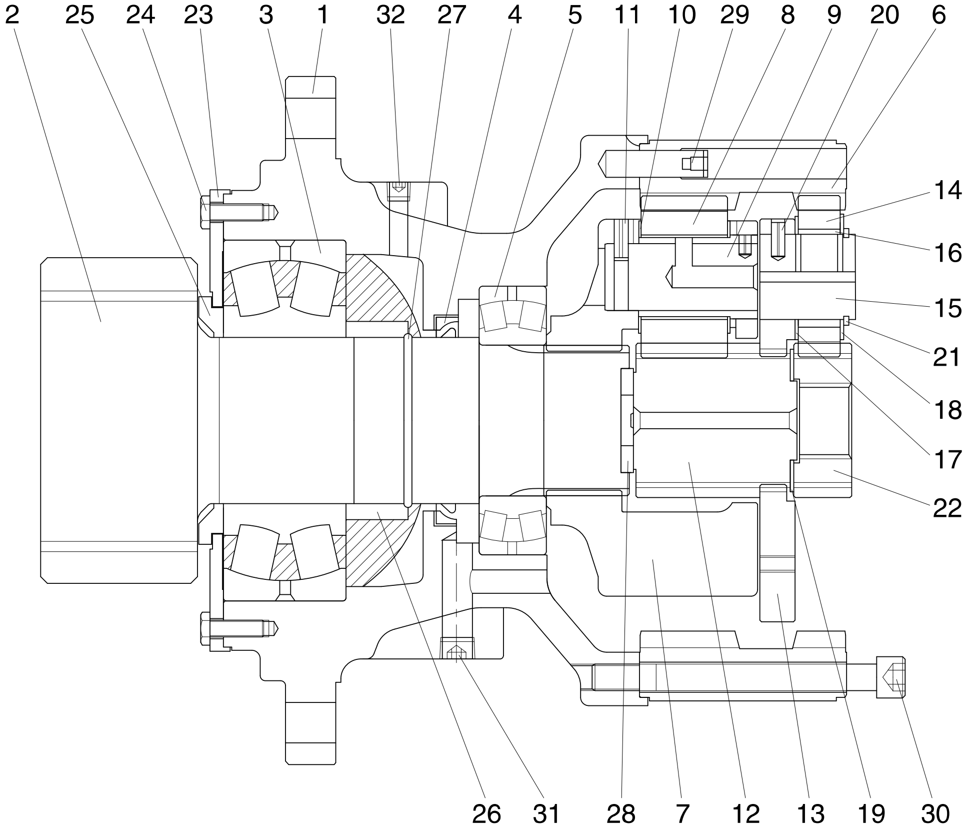
(1) Carry out installation in the reverse order to removal.
· Tightening torque : 57.9±8.7 kgf · m (419±62.9 lbf · ft)



16098SM11

4. DISASSEMBLY AND ASSEMBLY OF REDUCTION GEAR

1) STRUCTURE



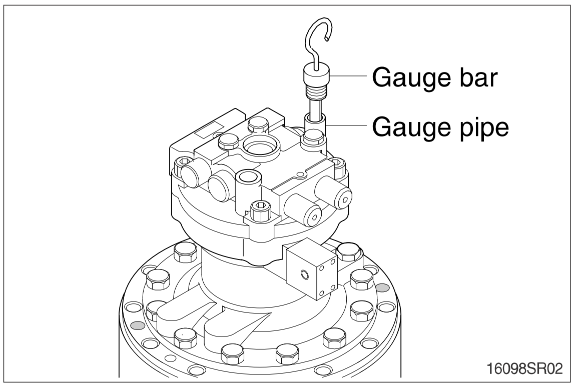
160F2SM05

1	Casing	12	Sun gear 2	23	Cover plate
2	Drive shaft	13	Carrier 1	24	Hexagon bolt
3	Roller bearing	14	Planet gear 1	25	Spacer
4	Oil seal	15	Pin 1	26	Spacer pipe
5	Roller bearing	16	Needle cage	27	Wire
6	Ring gear	17	Side plate 1	28	Thrust plate
7	Carrier 2	18	Side plate 2	29	Knock pin
8	Planet gear 2	19	Side plate 3	30	Socket bolt
9	Pin 2	20	Spring pin	31	Plug
10	Thrust washer	21	Stop ring	32	Plug
11	Spring pin	22	Sun gear 1		

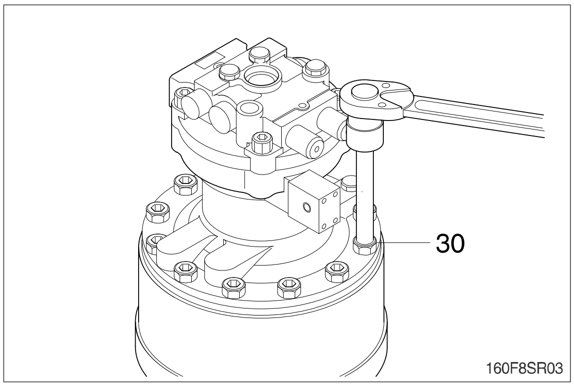
2) DISASSEMBLY

(1) Remove gauge bar and gauge pipe from the swing motor casing.

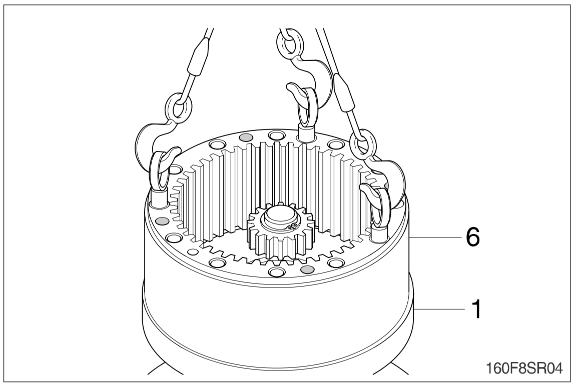
※ Pour the gear oil out of reduction gear into the clean bowl to check out the friction decrease.



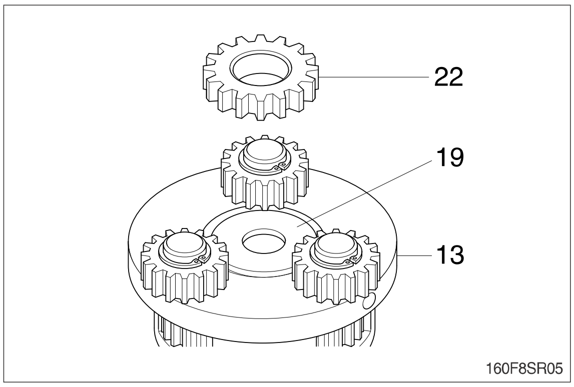
(2) Loosen the socket bolts (30) to separate swing motor from reduction gear.



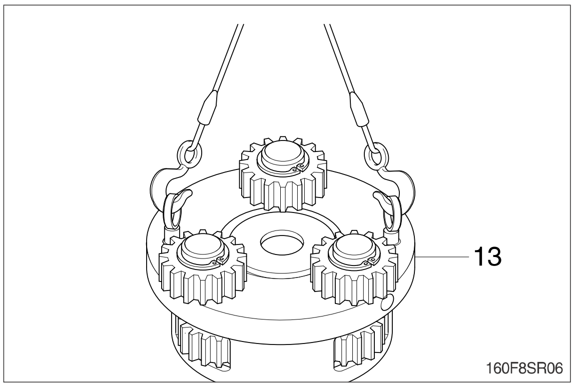
(3) Tighten 3 M16 eye bolts to the ring gear (6) and then lift the ring gear (6) out of the casing (1).



(4) Remove sun gear1 (22) from side plate 3 (19).



(5) Tighten two M10 eye bolts to carrier 1 (13) and lift up and remove carrier 1 (13) as subassembly.



(6) Disassembling carrier 1 (13) assembly.

① Remove stop ring (21).

② Remove side plate 2 (23), planet gear 1 (14), needle cage (16), side plate 1 (17) and side plate 3 (19) from the carrier.

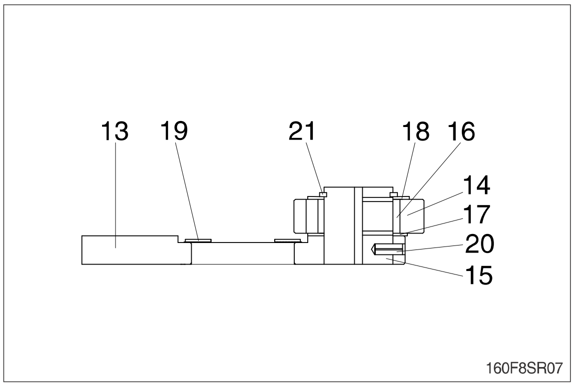
③ Using M8 solid drill, crush spring pin (20) so that the pin 1 (15) can be removed by hammering.

④ Remove side plate 3 (19) from carrier 1 (13).

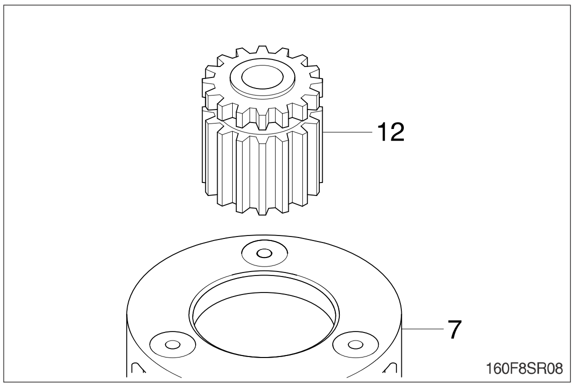
※ Do not reuse spring pin (20).

※ Do not remove pin 1 (15), carrier 1 (13) and spring pin (20) but in case of replacement.

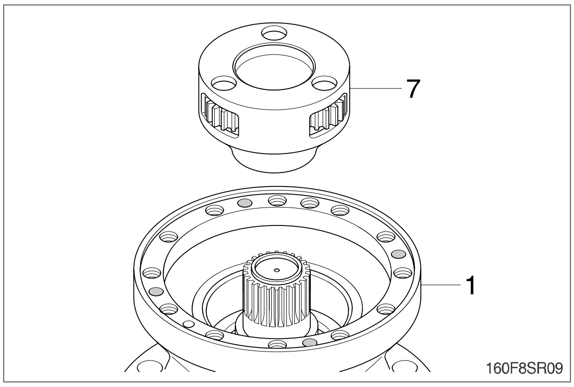
※ Put matching marks on the planet gear 1 (14) and the pin 1 (15) for easy reassembly.



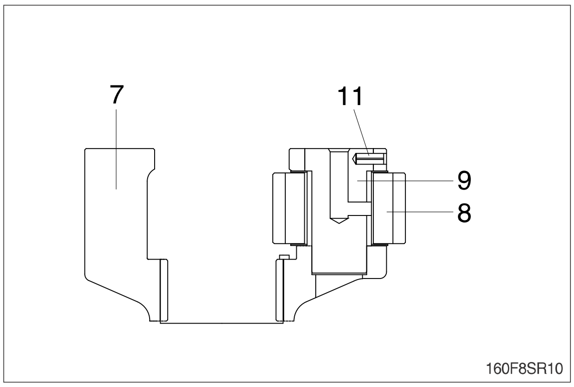
(7) Remove sun gear 2 (12) from carrier 2 (7).



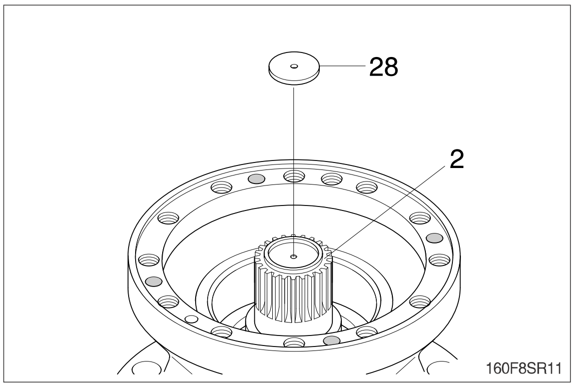
(8) Remove carrier 2 (7) assembly from casing (1).



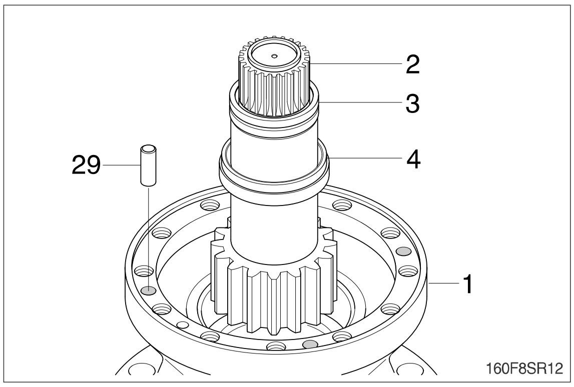
(9) Disassembling carrier 2 (7) assembly
① Using M8 solid drill, crush spring pin (11) so that the pin assembly (9) can be removed.
※ Do not reuse spring pin (11).
② Remove pin assembly (9), planet gear 2 (8) from the carrier 2 (7).
※ Put matching marks on the planet gear 2 (8) and the pin assembly (9) for easy reassembly.
※ Do not disassemble pin assembly (9), carrier 2 (7) and spring pin (11) but in case of replacement.



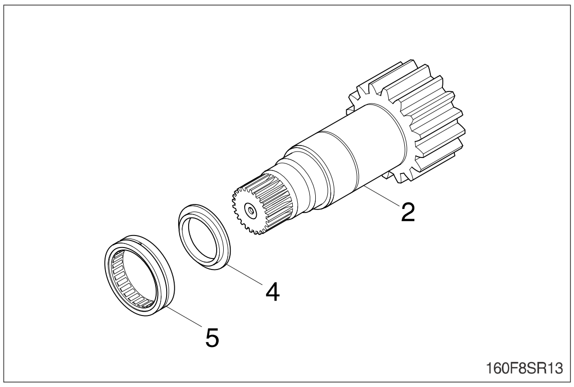
(10) Remove thrust plate 3 (28) from the drive shaft (2).



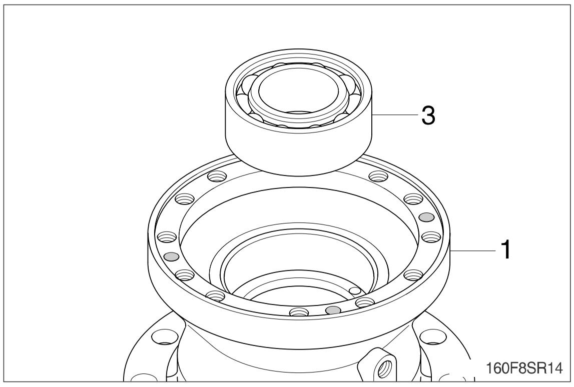
(11) Remove drive shaft (2) with roller bearing (3) and oil seal (4) assembled.
Remove knock pin (29) from the casing (1).



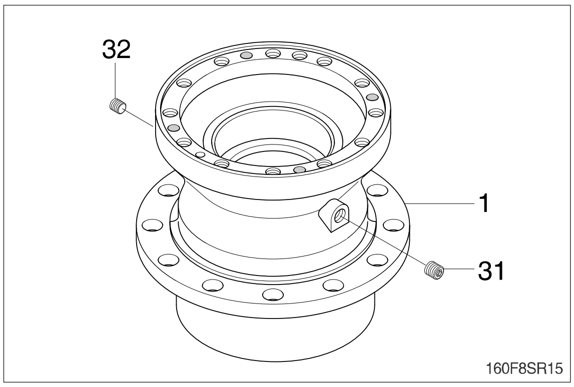
(12) Remove roller bearing (5) and oil seal (4) from the drive shaft (2).
※ Do not reuse oil seal (5) once removed.



(13) Using the bearing disassembly tool, remove roller bearing (3).

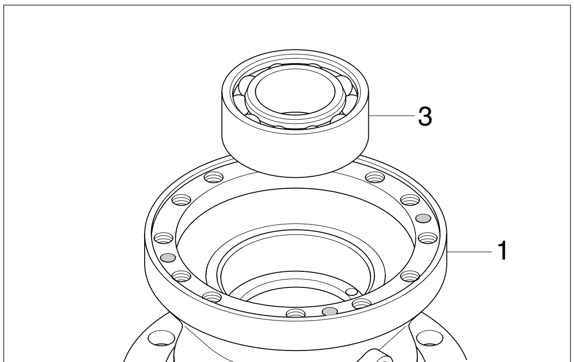


(14) Remove plugs (31, 32) from the casing (1).



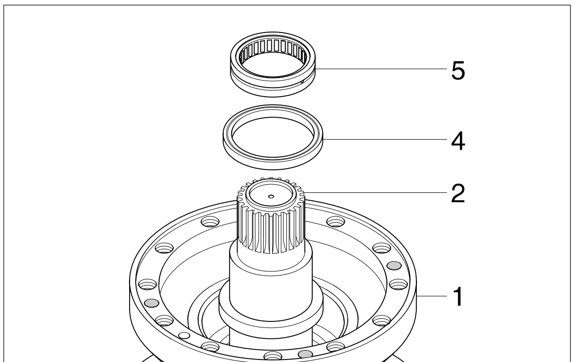
3) ASSEMBLY

(1) Assemble roller bearing (3) inside the casing (1).



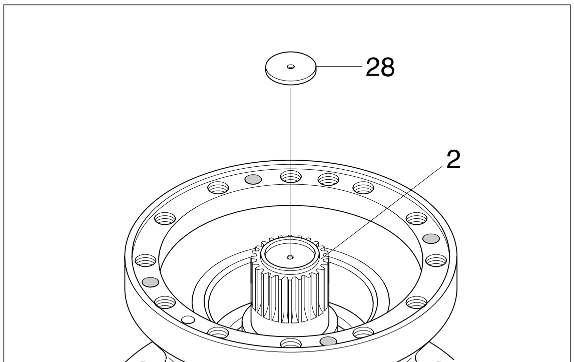
160F8SR14

(2) Assemble the drive shaft (2) into the casing (1) and then install oil seal (4) and roller bearing (5).



160F8SR17

(3) Install thrust plate 3 (28) on top of drive shaft (2).



160F8SR11

(4) Assembling carrier 2 (7) assembly.

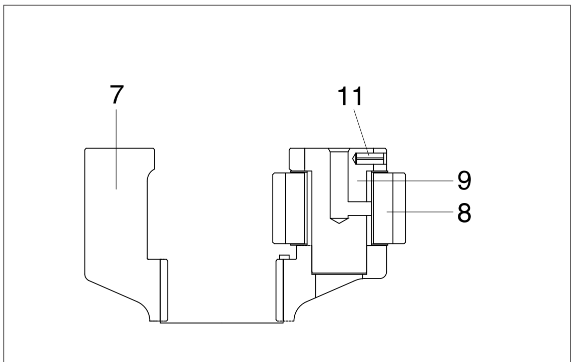
① Install thrust washer (10) inside the carrier 2 (7).

② Assemble planetary gear 2 (8) to the carrier 2 (7).

③ Assemble the pin assembly (12) to the carrier 2 (7) and then press the spring pin (11) by hammering.

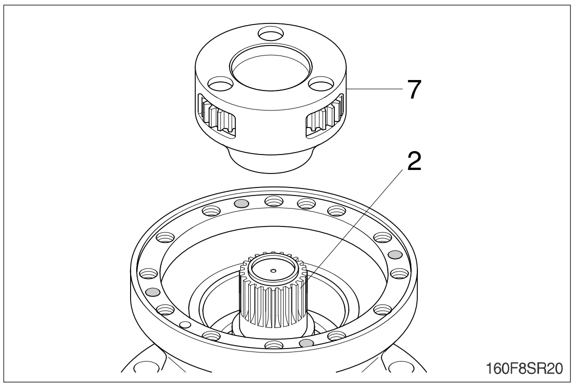
④ Punch 2 points of the spring pin (11) lip.

※ Take care not to mistake the matching marks of each part.

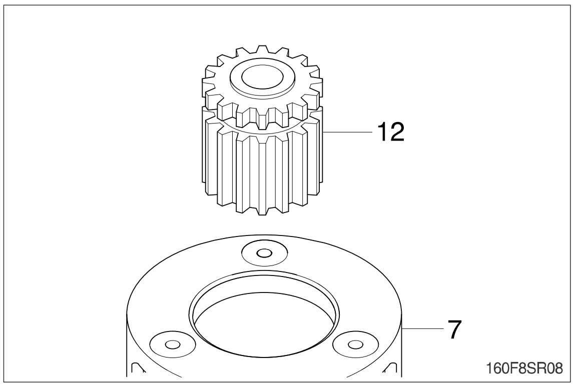


160F8SR10

(5) Assemble carrier 2 (7) assembly correctly to the drive shaft (2).



(6) Assemble sun gear 2 (12) to the center of the carrier 2 (7) assembly.



(7) Assembling carrier 1 (13) assembly.

① Assemble the pin 1 (15) to the carrier 1 (13) and then press the spring pin (20) by hammering.

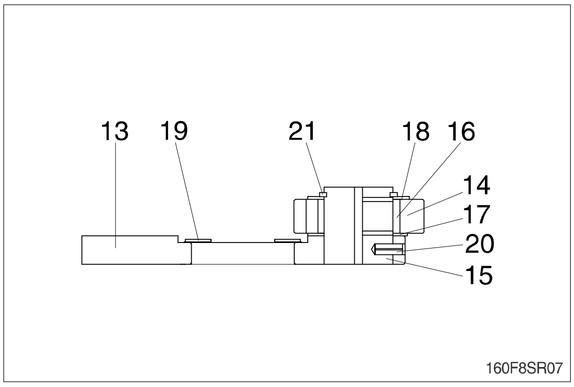
② Punch 2 points of the spring pin's (20) lip.

③ Install side plate 3 (19) onto the center of carrier 1 (15).

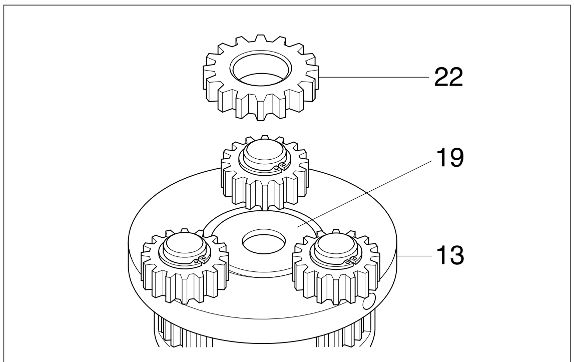
④ Install needle cage (16) into the planet gear 1 (18).

⑤ Assemble side plate (17), planet gear 1 (14), side plate 2 (18) and then stop ring (21) to the pin 1 (15).

※ Take care not to mistake the matching marks of each part.

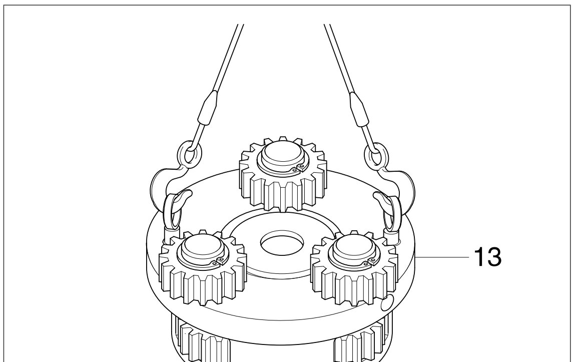


(8) Install sun gear 1 (22) onto the side plate 3 (19).



160F8SR05

(9) Assemble carrier 1 (13) assembly onto the carrier 2 (7) assembly.

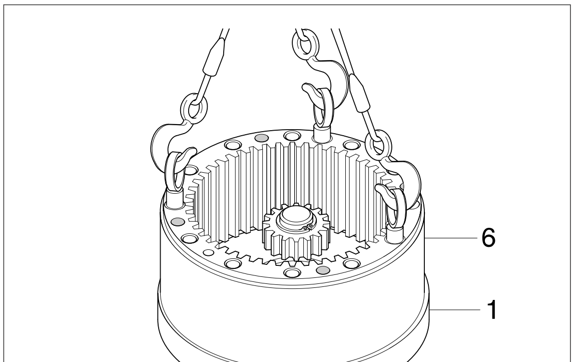


160F8SR06

(10) Apply loctite to the tapped holes of casing (1).

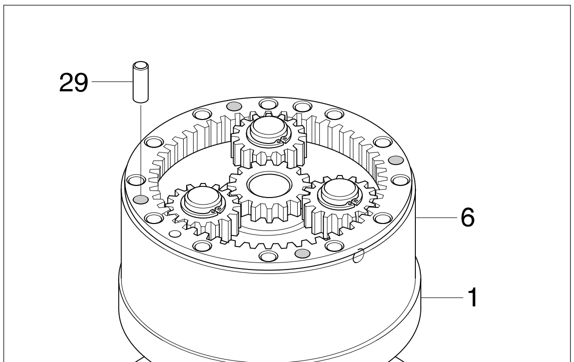
(11) Tighten 3 M16 eye bolts to the ring gear (6) and lift up and then assemble it onto the casing (1).

※ Don't fail to coincide the knock pin (29) holes.



160F8SR04

(12) Hammer 4 knock pins (29) around the ring gear (6).



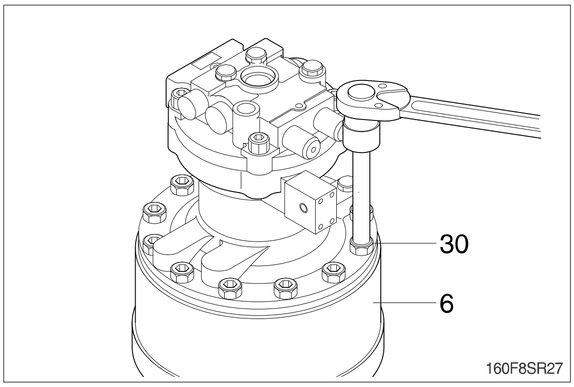
160F8SR26

(13) Apply loctite to the tapped holes of the ring gear (6) and then mount swing motor onto the ring gear (6).

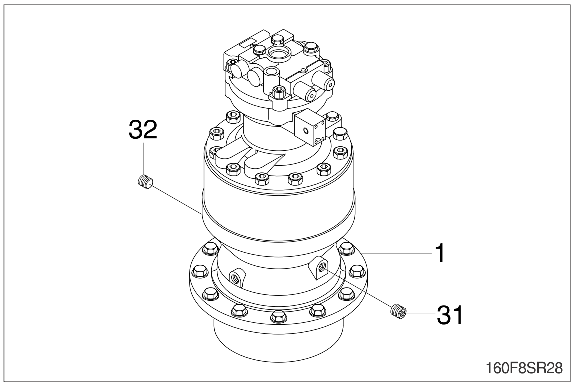
※ Don't fail to coincide the gauge bar hole.

(14) Tighten socket bolts (30) around the swing motor assembly.

· Tightening torque : 24±2.5 kgf · m (173±18.1 lbf · ft)



(15) Assemble plugs (31, 32) to the casing (1).



GROUP 5 SWING DEVICE (TYPE 2)

1. REMOVAL AND INSTALL OF MOTOR

1) REMOVAL

(1) Lower the work equipment to the ground and stop the engine.

(2) Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

(3) Loosen the breather slowly to release the pressure inside the hydraulic tank.

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

※ When pipes and hoses are disconnected, the oil inside the piping will flow out, so catch it in oil pan.

13031GE18

(4) Disconnect hose assembly (2).

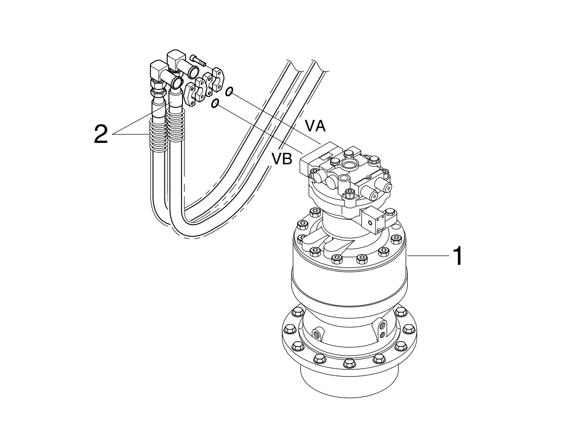
(5) Disconnect pilot line hoses (3, 4, 5, 6, 7, 8).

(6) Sling the swing motor assembly (1) and remove the swing motor mounting socket bolts (9).

· Motor device weight : 61 kg (135 lb)

(7) Remove the swing motor assembly.

※ When removing the swing motor assembly, check that all the piping have been disconnected.



2209A8SM21

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.

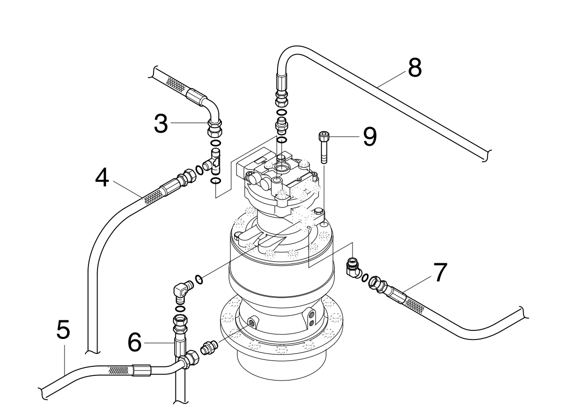
② Pour in hydraulic oil until it overflows from the port.

③ Tighten plug lightly.

④ Start the engine, run at low idling and check oil come out from plug.

⑤ Tighten plug fully.

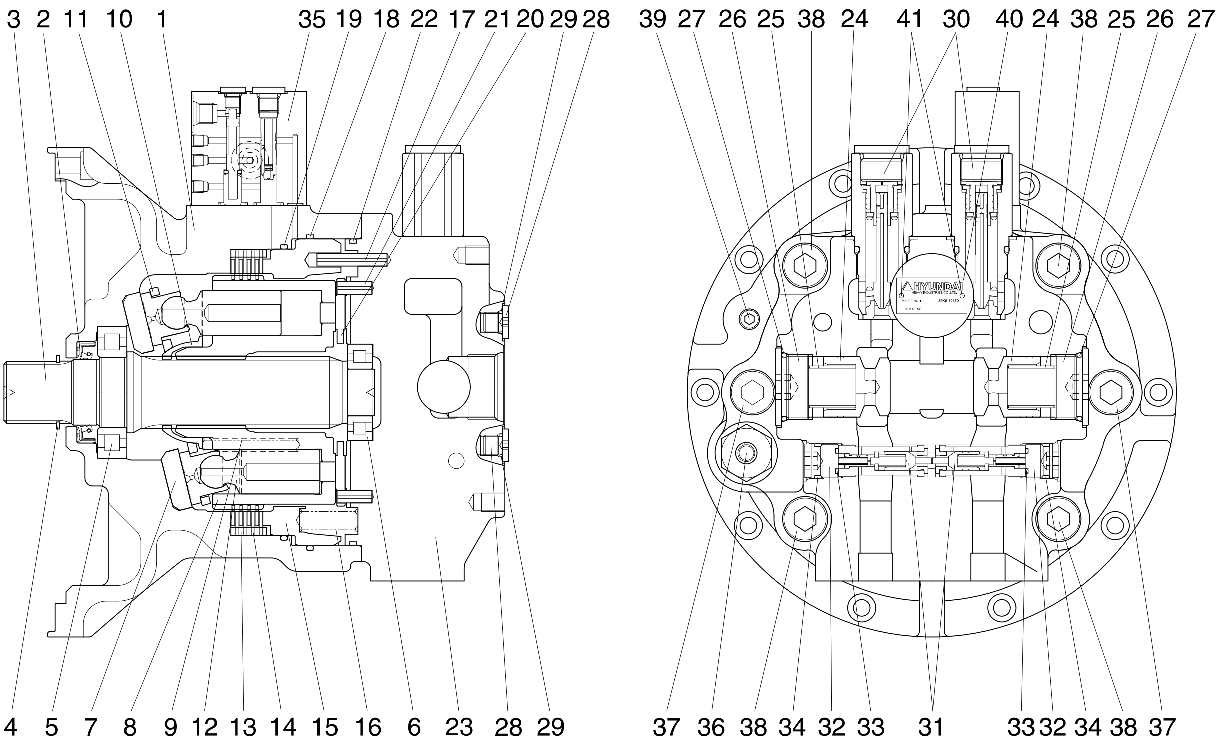
(3) Confirm the hydraulic oil level and check the hydraulic oil leak or not.



2209A8SM22

2. DISASSEMBLY AND ASSEMBLY OF SWING MOTOR

1) STRUCTURE



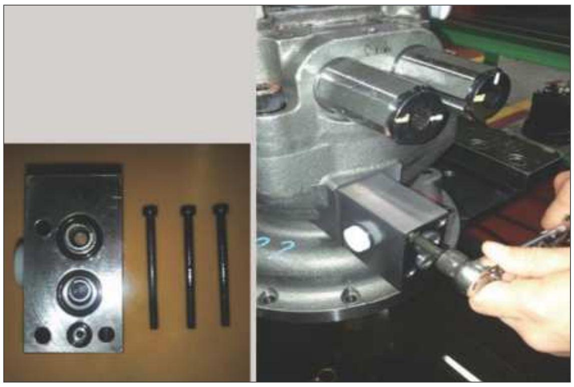
220L2SM02

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	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

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

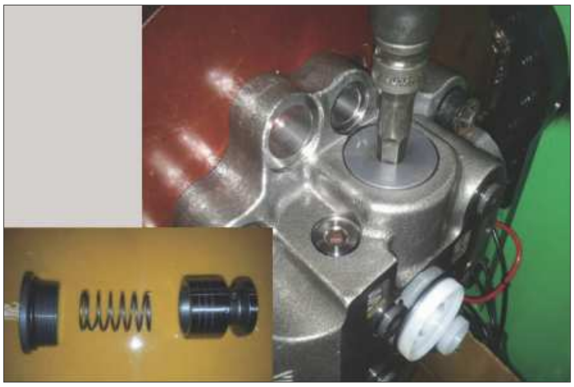
② Using a torque wrench, disassemble relief valve (30) from valve casing (23).

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.

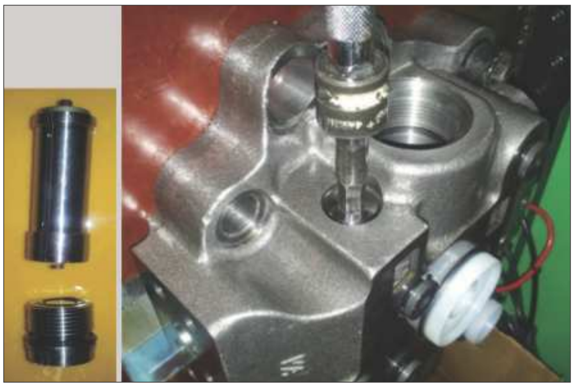
- Make up check valve × 2EA
- Spring × 2EA
- Plug × 2EA
- O-ring × 2EA

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



2209A8SM73

③ Using a torque wrench, assemble relief valve (30) 2 sets into valve casing (23).

- Relief valve (30) × 2EA

2209A8SM74

④ Assemble plug (28) and O-ring (27) into valve casing (23).

- Plug (28) × 3EA
- O-ring (27) × 3EA

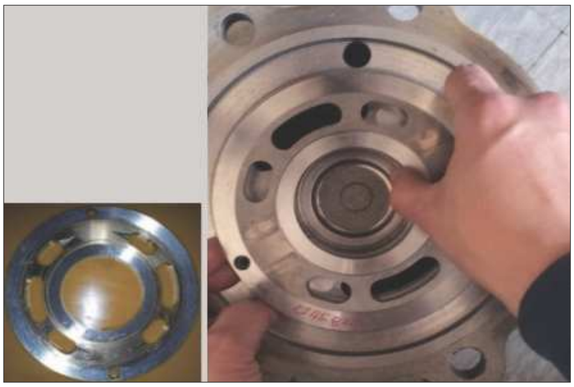
2209A8SM75

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).


2209A8SM86

⑩ Assemble level gauge (36) and plug (39) into casing (1).


2209A8SM87

⑪ Assemble time delay valve assy (35) into valve casing (23) with socket bolt (42).
- Time delay valve × 1EA
- Socket bolt × 3EA


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/cm2).


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

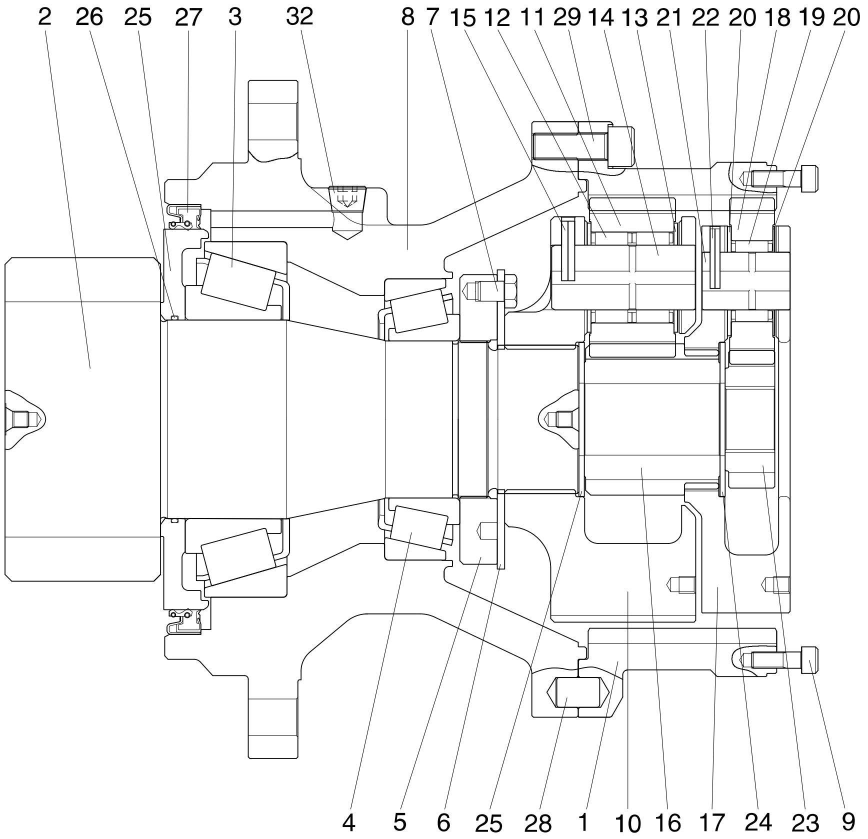
⑭ Mount test bench

Mounting motor a test bench, test the availability of each part.

2209A8SM91

3. DISASSEMBLY AND ASSEMBLY OF REDUCTION GEAR

1) STRUCTURE



160F2SM03

1	Ring gear	11	Planetary gear 2	21	Carrier pin 1
2	Drive shaft	12	Needle bearing 2	22	Spring pin 1
3	Taper bearing	13	Thrust washer 2	23	Sun gear 1
4	Taper bearing	14	Carrier pin 2	24	Thrust plate
5	Ring nut	15	Spring pin 2	25	Sleeve
6	Lock plate	16	Sun gear 2	26	O-ring
7	Hexagon bolt	17	Carrier 1	27	Oil seal
8	Casing	18	Planetary gear 1	28	Parallel pin
9	Socket bolt	19	Needle bearing 1	29	Socket bolt
10	Carrier 2	20	Thrust washer 1	32	Plug

2) DISASSEMBLY

(1) Preparation


2209A8SM01

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) Disassembly


2209A8SM02

① Remove every "Socket bolt (M10)" that secure swing motor and reduction gear.
② Removing carrier sub assy & sun gear
a. Removing No.1 sun gear from No.1 carrier sub assy.
※ Be sure maintaining it vertical with ground when disassembling No.1 sun gear.


2209A8SM03

b. Removing No.1 carrier sub assy screwing I-bolt to tab hole (M10) in No.1 carrier.
Lifting it gradually maintaining it vertical with ground.
※ It's impossible to disassemble No.1 spring pin. If No.1 spring pin has problem, change whole No.1 carrier sub assy.

c. Removing No.2 sun gear from No.2 carrier sub assy.

※ Be sure maintaining it vertical with ground when disassembling No.2 sun gear.

2209A8SM04

d. Removing No.2 carrier sub assy screwing I-bolt to tab hole (M10) in No.2 carrier. Lifting it gradually maintaining it vertical with ground.

※ It's impossible to disassemble No.2 spring pin. If No.2 spring pin has problem, change whole No.2 carrier sub assy.

2209A8SM05

③ Removing ring gear

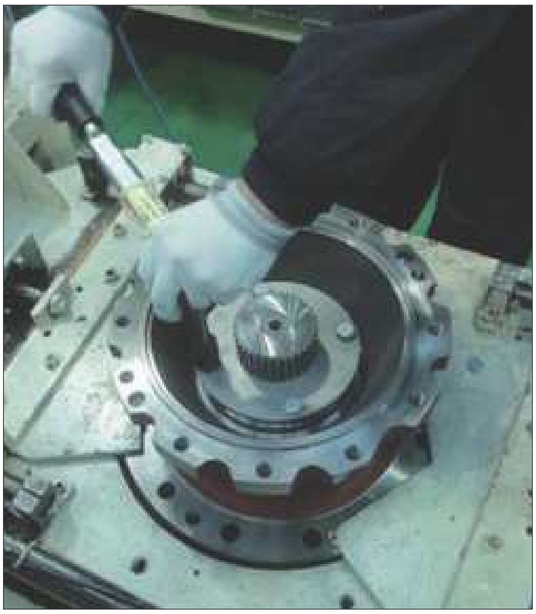
After unscrewing every socket bolt (M16), remove ring gear from casing.

※ Because of liquid gaskets between ring gear and casing, put sharp punch between ring gear and casing and tapping it to remove them.

2209A8SM06

④ Removing drive shaft sub assy

a. Unscrew every hex head bolt (M12) to remove lock plate.

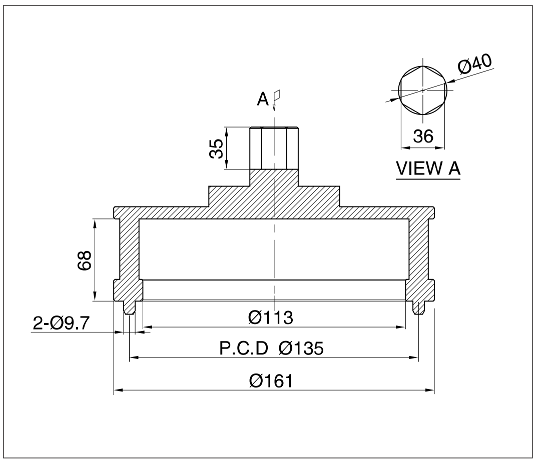


2209A8SM07

b. Rolling ring nut for removing them from drive shaft sub assy.

2209A8SM08

※ Use special tool to roll ring nut to counter clockwise.



220L8SM01

c. Remove drive shaft sub assy from casing.
※ Set a rack for flange of casing, and remove drive shaft sub assy from casing by using press.

2209A8SM09

d. Remove oil seal & taper bearing (small) from casing.
※ Do not re-use oil seal. It is impossible to disassemble drive shaft sub assy.

2209A8SM10

2209A8SM11

4. ASSEMBLY REDUCTION UNIT

1) GENERAL NOTES

(1) Clean every part by kerosene and dry them in a cool and dry place.

(2) Loctite on surface must be removed by solvent.

(3) Check every part for any abnormal.

(4) Each hexagon socket head bolt should be used with loctite #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 assembling.

Thrust washer
- Check the seizure, abnormal wear or uneven wear.
- Check the unallowable wear.

Gear
- Check the pitting or seizure on tooth surface.
- Check the cracks on the root of tooth.

Bearing
- Rotate it by hands to check such noise or uneven rotation.

2) ASSEMBLING NO.1 CARRIER SUB ASSY

(1) Put thrust plate firmly in No.1 carrier.

2209A8SM12

(2) After assembling No.1 needle bearing to No.1 planetary gear, put a pair of No.1 thrust washer on both sides of bearing and install them to No.1 carrier.

2209A8SM13

(3) Make of spring pin hole No.1 pin and No.1 carrier of spring pin hole in line, press No.1 spring pin into the holes.
Make No.1 spring pin hole head for No.1 planetary gear.

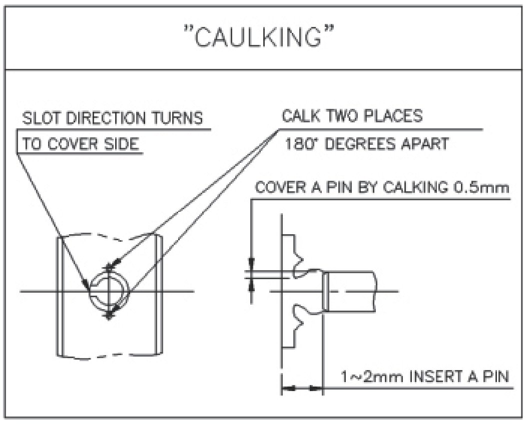
2209A8SM14

(4) Caulk carrier holes to make No.1 spring pin settle down stably.

2209A8SM15

※ Refer to "Caulking details"

Use paint marker for marking after caulking.



2209A8SM16

2) ASSEMBLING NO.2 CARRIER SUB ASSY

(1) Put thrust plate in firmly No.2 carrier.

2209A8SM17

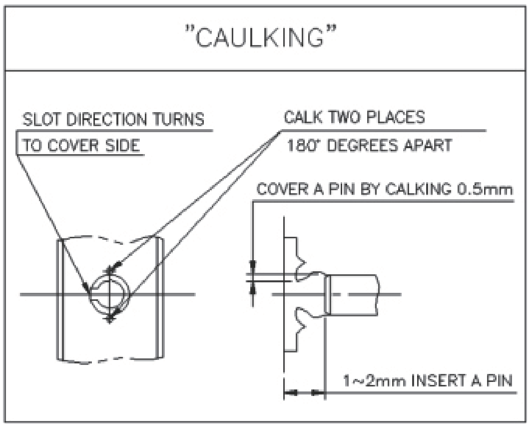
(2) After assembling No.2 needle bearing to No.2 planetary gear, put 2 pieces of No.2 thrust washer on both sides of bearing and install them to No.2 carrier.

2209A8SM18

(3) Align No.2 spring pin hole and No.2 carrier spring pin hole, put No.2 spring pin into the holes.
Make No.2 spring pin cutting line face to No.2 planetary gear.

2209A8SM19

(4) Caulk carrier holes to make No.2 spring pin settle down stably.
※ Refer to “Caulking details”
Use paint marker for marking after caulking.



2209A8SM20

3) ASSEMBLING PINION GEAR SUB ASSY

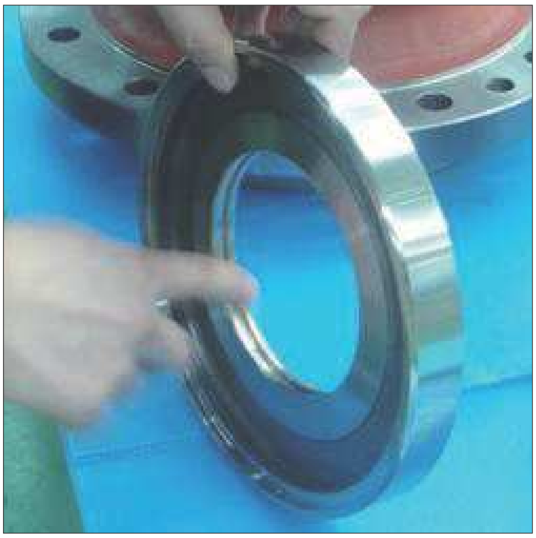
(1) Prepare drive shaft pinion gear vertical with ground.

2209A8SM21

(2) Fully apply grease (albania EP02) to O-ring groove of sleeve.

※ Be sure to maintain it vertical with ground when assembling it.

(3) Put O-ring into O-ring groove of sleeve. Fully apply grease on O-ring.



2209A8SM22

(4) Assemble taper bearing and sleeve into drive shaft using press jig. Use special jig for pressing. Leave no space between sleeve and taper bearing.

2209A8SM23

2209A8SM24

4) ASSEMBLING BEARING CUP & OIL SEAL (PRESSING)

(1) Put top, bottom bearing cup into casing.
Use special jig for pressing. Pay attention to foreign materials while assembling bearing cup.

※ Flip over casing to assemble oil seal.

2209A8SM25

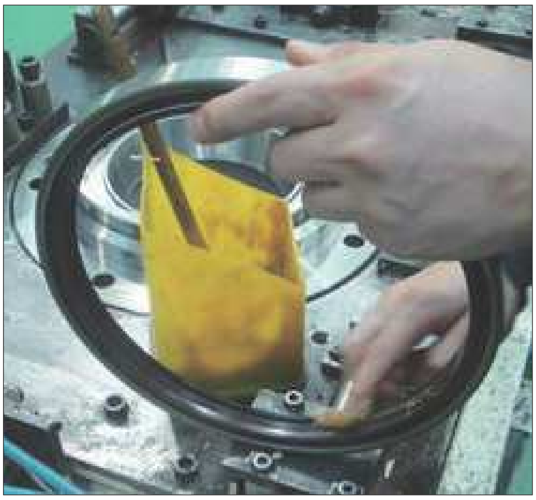
2209A8SM26

(2) Assemble oil seal to casing.
Use special jig for pressing. Pay attention to direction of dust seal and dent.

2209A8SM27

※ WHILE ASSEMBLING OIL SEAL

1. Be sure to set dust seal to gear oil.
2. Before assembling, charge enough grease in oil seal.
3. Before assembling, apply enough grease inside and outside of oil seal.



2209A8SM28

5) ASSEMBLING SHAFT SUB ASSY & RING NUT

(1) After assembling casing & drive shaft sub assy, flip it over.

2209A8SM29

(2) Put drive shaft sub assy into casing.
※ Be sure to maintain it vertical with ground when assembling it.

2209A8SM30

(3) Put taper bearing into it.
Rotate bearing by hands for checking after assembly.

2209A8SM31

(4) Put ring nut into drive shaft sub assy by using special jig.

The tightening torque (M95) = 3.5±0.4 kgf·m
(25.3±2.9 lbf·ft)

2209A8SM32

※ Apply enough loctite #242 before screwing bolts.

2209A8SM33

(5) Align bolt screw of ring nut with lock plate's hole.
In case of misalign between bolt screw ring nut and lock plate's hole, put lock plate as near as possible to hole of bolt screw of ring nut and make it in line by increasing tightening torque.

2209A8SM34

2209A8SM35

(6) Screw 4 bolts (M12 × 16) to connect ring nut and lock plate by using torque wrench.
Bolt (M12, 4EA) = 10.9T
The tightening torque = 8.8 ± 0.9 kgf·m
(63.7 ± 6.5 lbf·ft)

※ Apply enough loctite #242 before screwing bolts.

2209A8SM36

(7) Use paint marker for checking surplus parts after assembling.

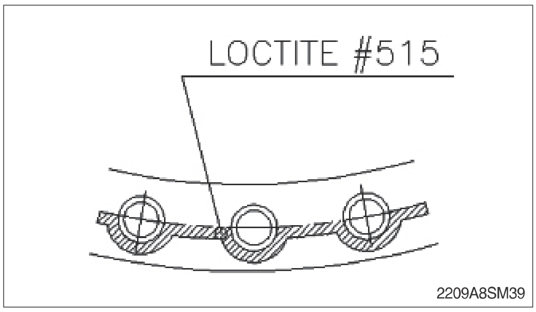
2209A8SM37

6) ASSEMBLING RING GEAR

(1) Apply loctite #515 bottom of casing sub assy contacting with ring gear without disconnection.

2209A8SM38

Refer to loctite detail.



2209A8SM39

(2) Put parallel pin into hole of casing sub assy. Mark parallel pin position using paint marker.

2209A8SM40

(3) Align ring gear with parallel pin to put them into casing sub assy.

※ Be sure to maintain them vertical with ground while using press.

2209A8SM41

(4) Screw 12 bolts (M16 × 45) to connect casing sub assy and ring gear (01) by using torque wrench.
Bolt (M16, 12EA) = 12.9T
The tightening torque = 27 ± 2.7 kgf·m
(195 ± 19.5 lbf·ft)

※ Apply enough loctite #242 before screwing bolts.


2209A8SM42

(5) Use paint marker for checking surplus parts after assembling.


2209A8SM43


2209A8SM44

7) ASSEMBLING CARRIER SUB ASSY & SUN GEAR

(1) Put No.2 carrier sub assy along spline of drive shaft spline.

- Screw M10 I-bolt to No.2 carrier sub assy.
- Lifting up No.2 carrier sub assy and align planetary gear and tooth of ring gear by rotating planetary gear by hands.
- Rotate No.2 carrier sub assy by hands to fit No.2 carrier sub assy into drive shaft spline.

2209A8SM45

(2) Put No.2 sun gear into No.2 carrier sub assy.

2209A8SM46

(3) Put No.1 carrier sub assy into No.2 sun gear along spline.

- Screw M10 I-bolt to No.1 carrier sub assy.
- Lifting up No.1 carrier sub assy and align planetary gear and tooth of ring gear by rotating planetary gear by hands.
- Rotate No.1 carrier sub assy by hands to fit No.1 carrier into No.2 sun gear spline.

2209A8SM47

(4) Put No.1 sun gear into No.1 carrier sub assy. Be sure to maintain it vertical with ground. And align with No.1 planetary gear spline.

(5) Rotate No.1 carrier sub assy by hands to check noise.

2209A8SM48

8) MEASURING CLEARANCE & ASSEMBLING NAME PLATE

(1) Check the clearance between ring gear and No.1 sun gear using a tool with dial gauge.

Check the clearance
Dial gauge = -0.3 ~ +2.95

2209A8SM49

GROUP 6 TRAVEL DEVICE

1. REMOVAL AND INSTALL

1) REMOVAL

(1) Swing the work equipment 90° and lower it completely to the ground.

(2) Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

(3) Loosen the breather slowly to release the pressure inside the hydraulic tank.

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

※ When pipes and hoses are disconnected, the oil inside the piping will flow out, so catch it in oil pan.

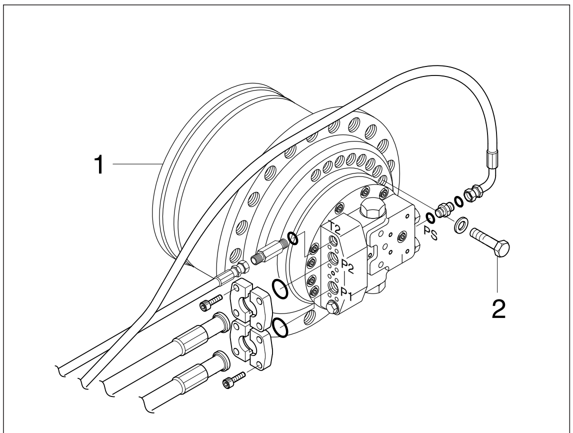
13031GE18

(4) Remove the track shoe assembly.
For details, see **removal of track shoe assembly.**

(5) Remove the cover.

(6) Remove the hose.

※ Fit blind plugs to the disconnected hoses.



16098TM01

(7) Remove the bolts and the sprocket.

(8) Sling travel device assembly (1).

(9) Remove the mounting bolts (2), then remove the travel device assembly.
· Weight : 300 kg (660 lb)

2) INSTALL

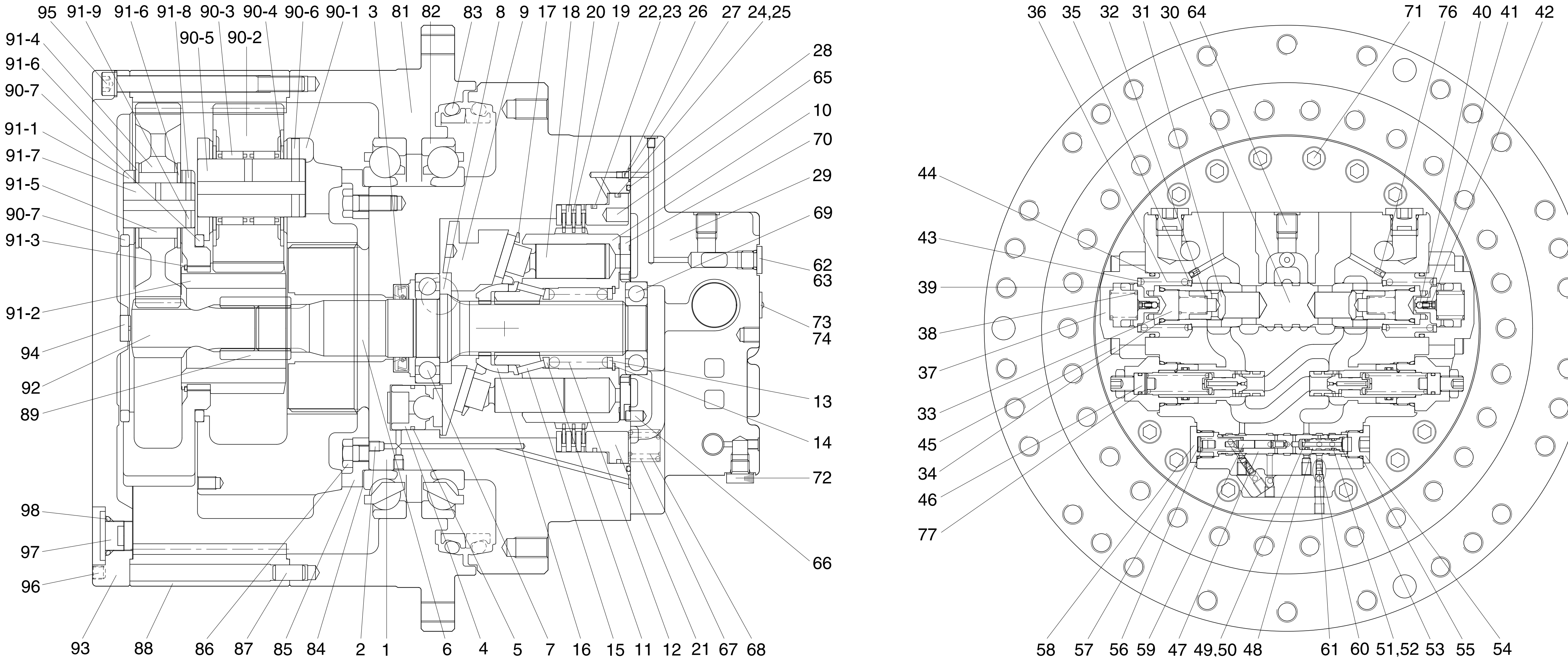
(1) Carry out installation in the reverse order to removal.

(2) Bleed the air from the travel motor.
① Remove the air vent plug.
② Pour in hydraulic oil until it overflows from the port.
③ Tighten plug lightly.
④ Start the engine, run at low idling, and check oil come out from plug.
⑤ Tighten plug fully.

(3) Confirm the hydraulic oil level and check the hydraulic oil leak or not.

2. TRAVEL MOTOR

1) STRUCTURE

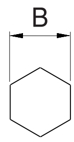


16092TM02

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

2) TOOLS AND TIGHTENING TORQUE

(1) Tools

Tool name		Remark	
Allen wrench		2, 5, 4, 6, 10	
Socket for socket wrench, spanner	Socket	8, 14, 24, 27	
Torque wrench		Capable of tightening with the specified torques	
Pliers		-	
Plastic and iron hammer		Wooden hammer allowed. Normal 1 or so	
Monkey wrench		-	
Oil seal inserting jig		-	
Bearing pliers		-	
Seal tape		-	
Eye bolt		M10, M12, M14	
Press (0.5 ton)		-	
Oil stone		-	
Bearing assembling jig		-	

(2) Tightening torque

Part name	Item	Size	Torque	
			kgf · m	lbf · ft
Plug	2	NPT 1/16	1±0.1	7.2±0.7
Orifice	26	M5	0.7±0.1	5±0.7
Wrench bolt	45	M12×40	10±1.0	72±7.0
Relief valve	46	HEX 27	18±1.0	130±7.0
Plug	54	PF 1/2	8.5±1.0	61±7.0
Plug	58	HEX 24	5±1.0	36±7.0
Plug	62	PF 1/4	5±1.0	36±7.0
Wrench bolt	71	M12×35	10±1.0	72±7.0
Hex head bolt	-	M12×25	11±1.5	79±10
Hex socket head bolt	-	M12×155	11±1.5	79±10
Hex socket head plug	-	PF 3/4	19±1	137±7.0

3. OUTLINE OF DISASSEMBLING

1) GENERAL SUGGESTIONS

(1) Select a clean place for dismantling.
Spread a rubber plate on a working table in order to prohibit the damage of parts.

(2) Clean a deceleration equipment and a motor part, washing out dirt and unnecessary substances.

(3) Without any damage of O-ring, oil seal, the adhered surface of other seals, a gear, a pin, the adhered surface of other bearings, and the surface of moisturized copper, treat each parts.

(4) Numbers written in the parenthesis, ( ), next to the name of a part represent the part numbers of a cross-sectional view annexed with a drawing.

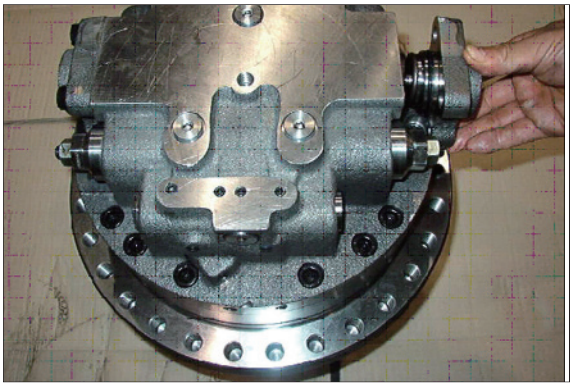
(5) The side of a pipe in a motor can be written as a rear side; the side of out-put as a front side.

(6) Using and combining a liquid gasket, both sides must be dried completely before spraying a liquid gasket.

(7) In case of bonding volts, combine a standard torque by torque wrench after spraying loctite 262 on the tab parts. (It can be dealt as assembling NPTF screws and an acceleration equipment.)

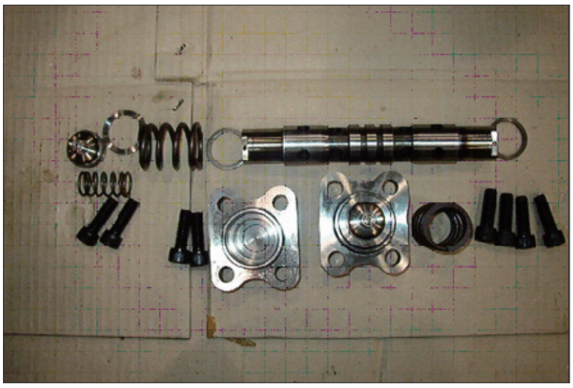
3.1 DISASSEMBLING

1) Unloosing wrench bolt and disassemble cover (37).
※ Wrench bolt = M12×40L-8 EA
(purchasing goods)



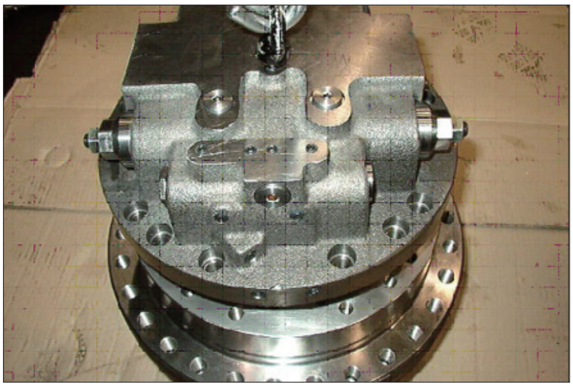
21078TM21

2) Disassemble parts related to counterbalance valve.

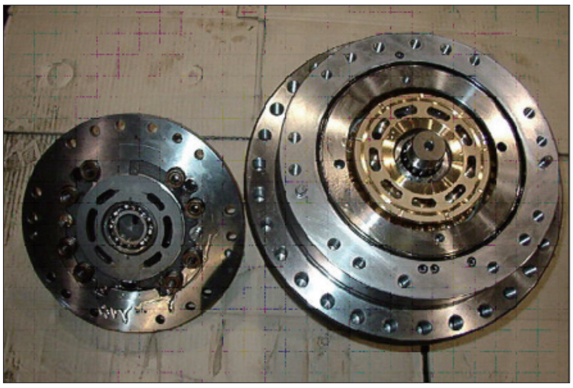


21078TM22

3) Unloosing wrench bolt (M12 × 35L, 16 EA) and disassemble rear cover assembly from motor assembly.

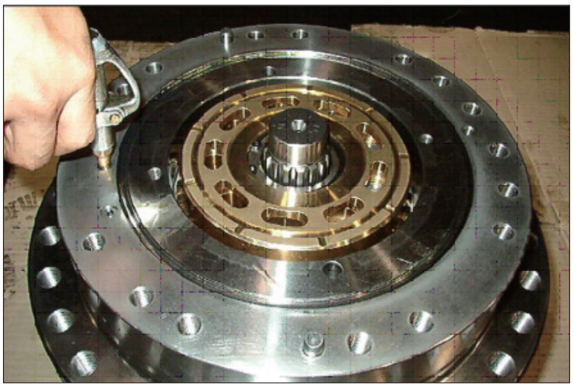


21078TM23



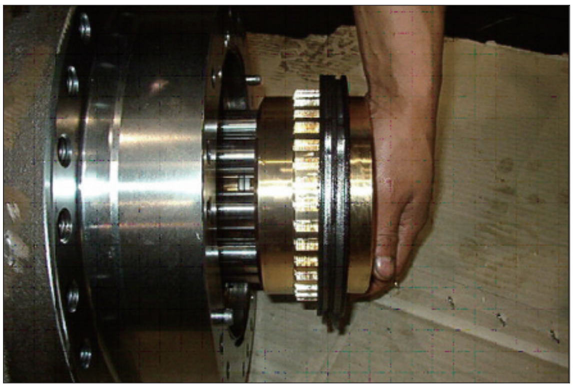
21078TM24

4) Dismantle packing piston (21) using compressed air.



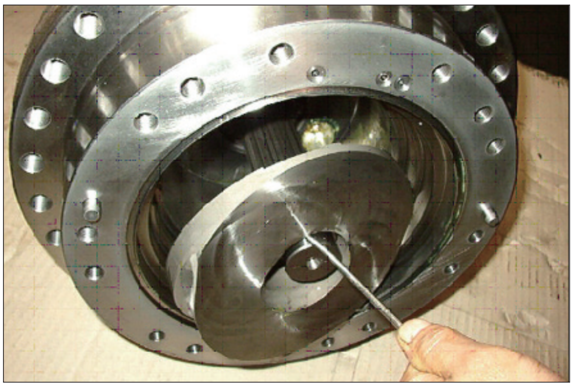
21078TM25

5) Disassembly rotary kit from motor assembly (cylinder block assembly, piston assembly, ball guide, set plate, friction plate, steel plate...)



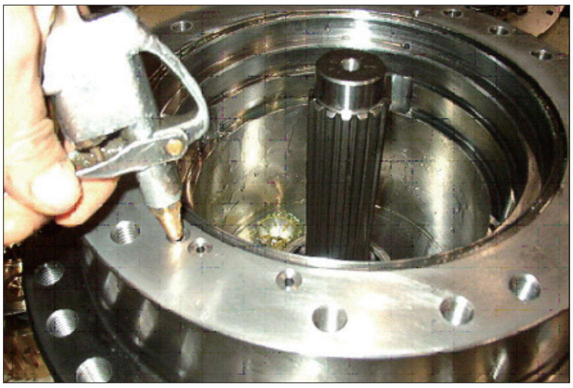
21078TM26

6) Using a jig, disassemble swash plate (9) from shaft casing.

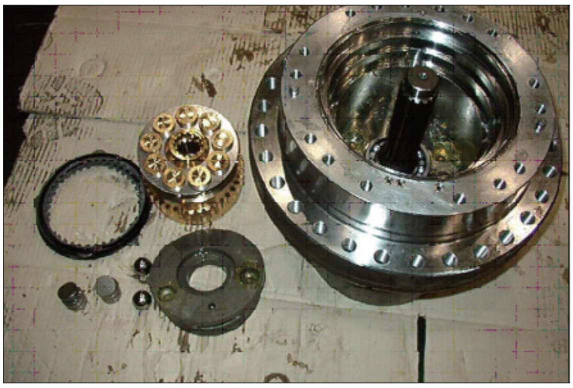


21078TM27

7) Using compressed air, disassemble piston swash (4) piston ring (5), respectively.

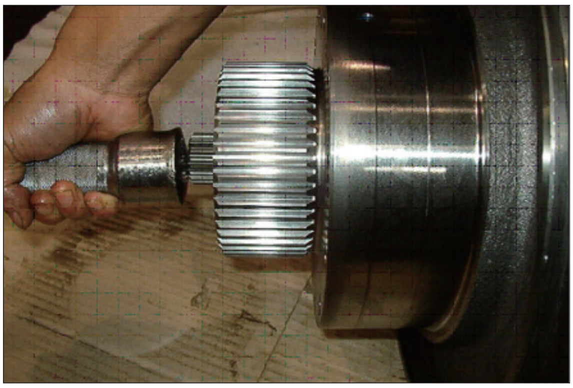


21078TM28



21078TM29

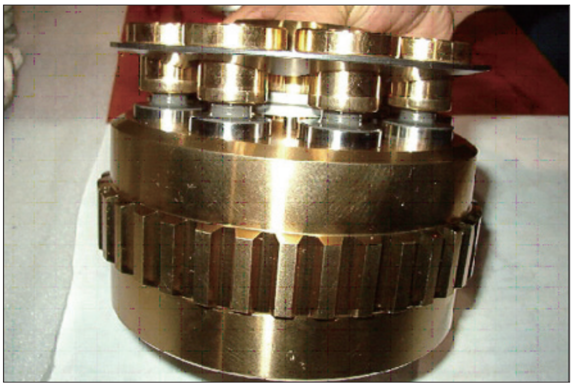
8) Using a hammer, disassemble shaft (6) from shaft casing (1).



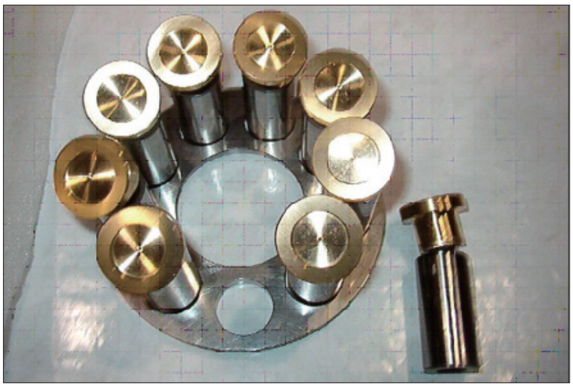
21078TM30

■ Disassemble cylinder sub.

9) Disassemble cylinder block assembly, piston assembly (9) and seat plate (M).

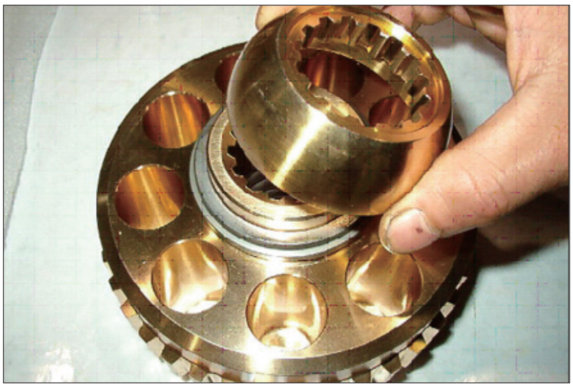


21078TM31

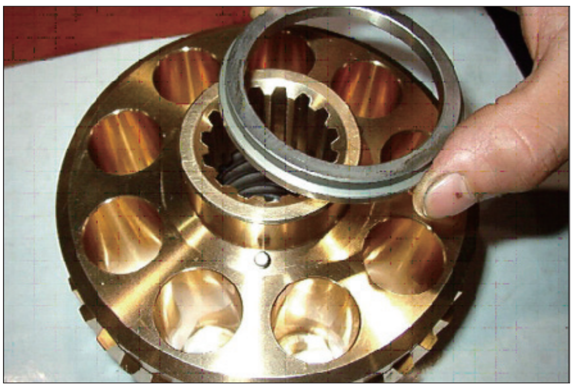


21078TM32

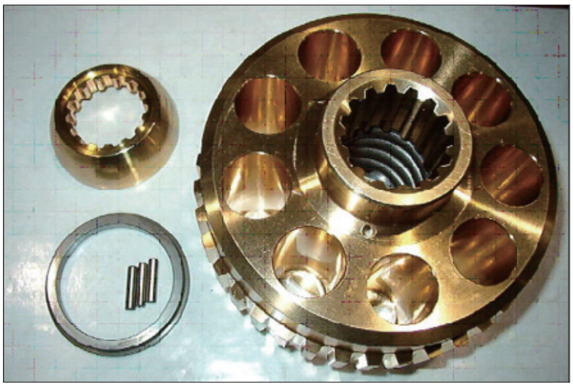
10) Disassemble ball guide (16), ring and pin (15) from cylinder block, respectively.



21078TM33

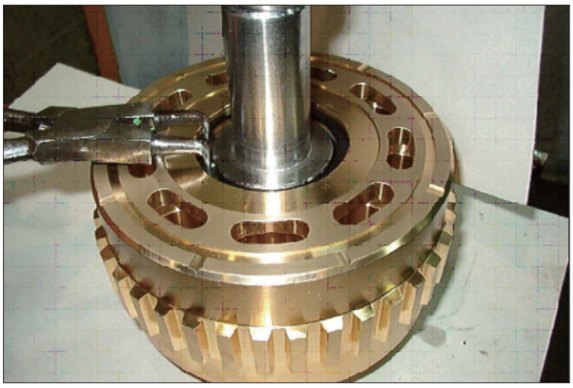


21078TM34



21078TM35

11) Pushing spring (12) by an assembling jig, disassemble snap ring (14), spring seat (13), spring (12) and spring seat (11), respectively.

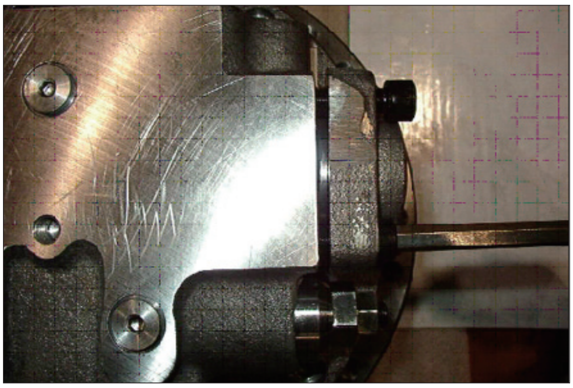


21078TM36

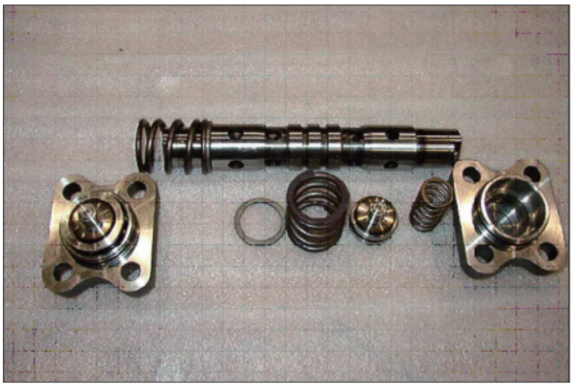
21078TM37

■ Disassemble valve casing sub.

12) Using an hexagon wrench, unloosing wrench bolt (45) and disassemble cover (37), spring (38), spool (39), spring seat (43), spring (36) and spring seat (35), respectively.
(same balance on both sides)

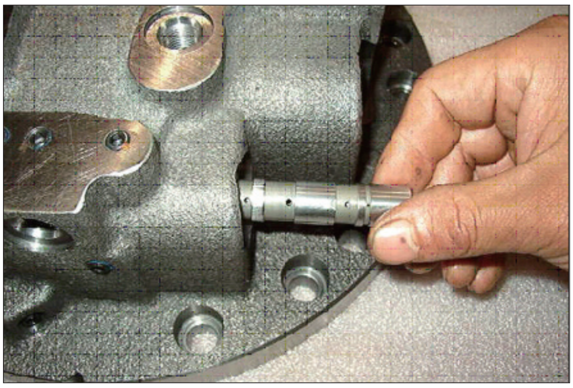


21078TM38

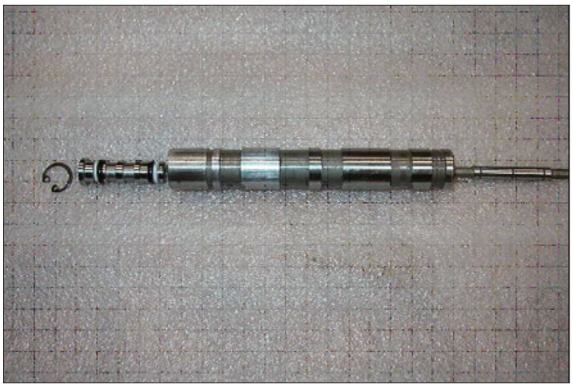


21078TM39

13) Disassemble spool (59), spool (47), O-ring (51), guide (48) and snap ring (53) on rear cover, respectively.

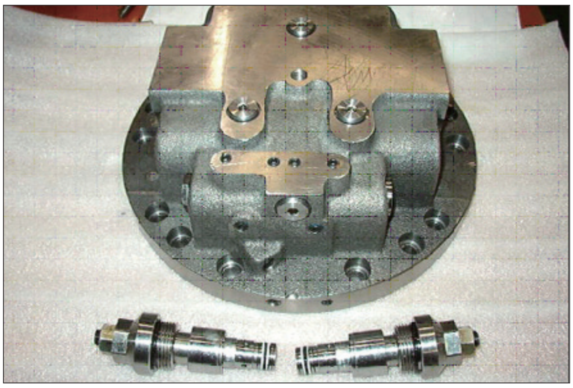


21078TM40



21078TM41

14) Using a torque wrench, disassemble relief valve assembly (46) on rear cover.



21078TM42

4. OUTLINE FOR ASSEMBLING

1) GENERAL SUGGESTIONS

(1) After washing each parts cleanly, dry it with compressed air.
Provided that you do not wash friction plate with treated oil.

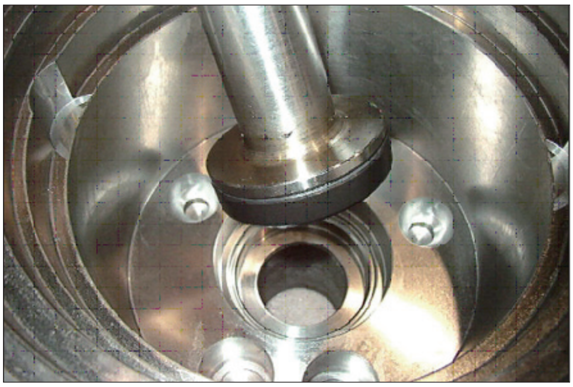
(2) In bonding each part, fasten bond torque.

(3) When using a hammer, do not forget to use a plastic hammer.

4.1 ASSEMBLING

■ **Assemble the sub of turning axis**

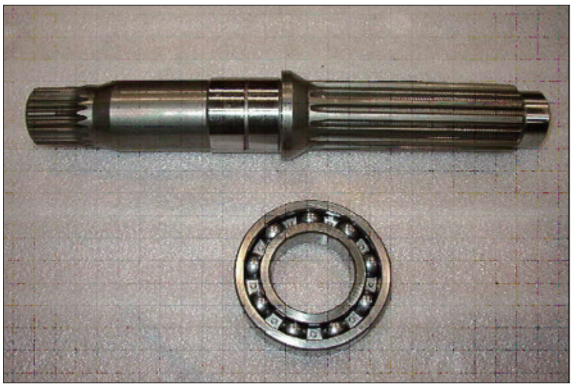
1) Using a jig, assemble oil seal (3) into shaft casing (1)



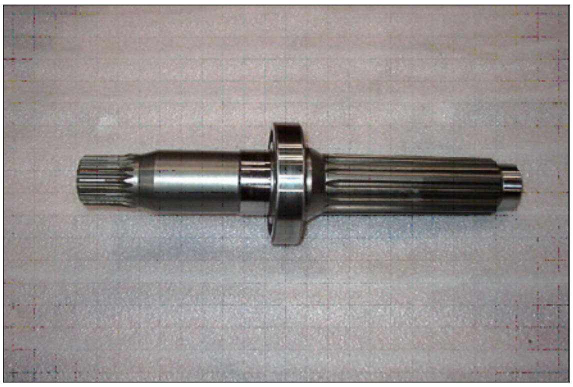
21078TM43

2) Have a bearing (8) thermal reacted into shaft (6).

21078TM44



21078TM45

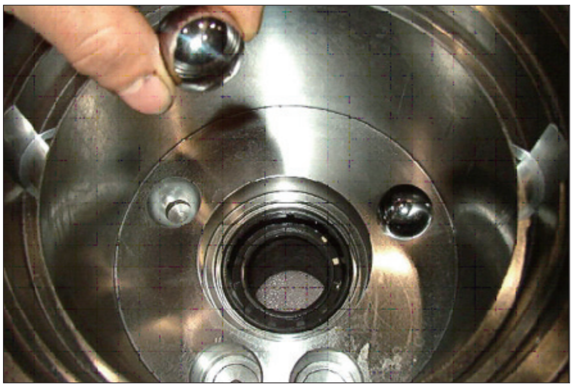


21078TM46

3) Using a jig, assemble shaft assembly into shaft casing (1).

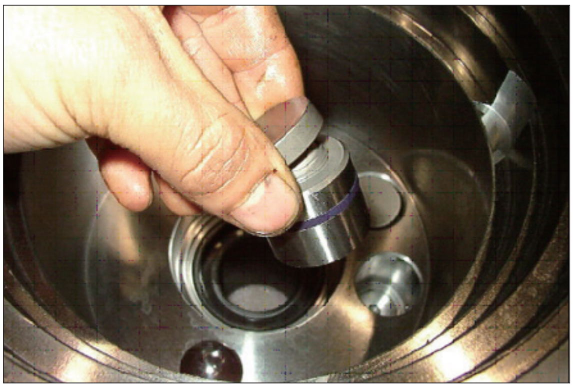
21078TM47

4) After spreading grease on steel ball (8) assemble into shaft casing (1).



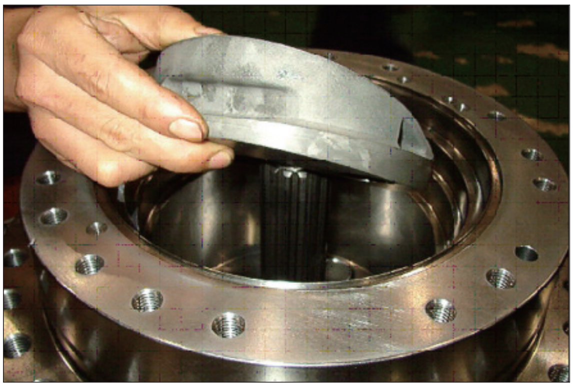
21078TM48

5) Assemble swash piston assembly (4, 5) into shaft casing (1).



21078TM49

6) Assemble swash plate (9) into shaft casing (1).

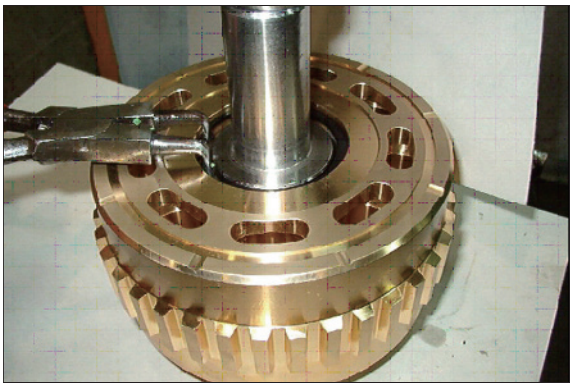


21078TM50

■ Assemble cylinder block sub.

7) Assemble spring seat (13), spring (12), spring seat (11) into cylinder block (10) respectively, pushing spring (12) using by a jig, assemble snap ring (14) with a snap ring (14).

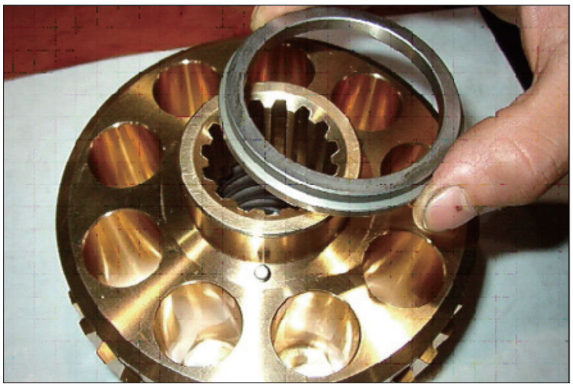
21078TM51



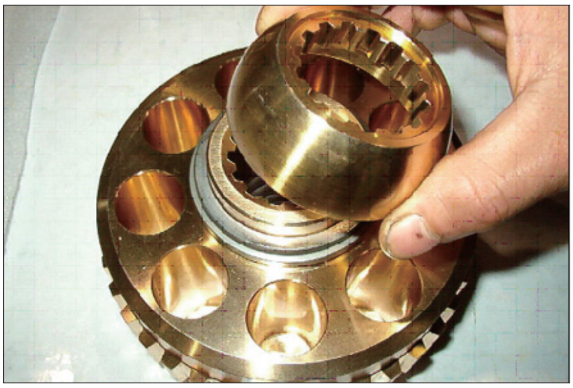
21078TM52

8) Assemble ring, pin (15) on cylinder block (10) ball guide (16) respectively.

21078TM53

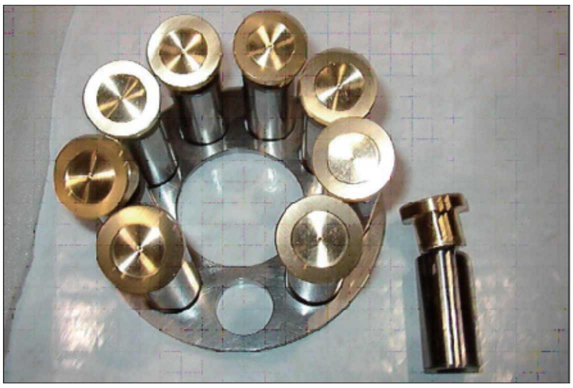


21078TM54

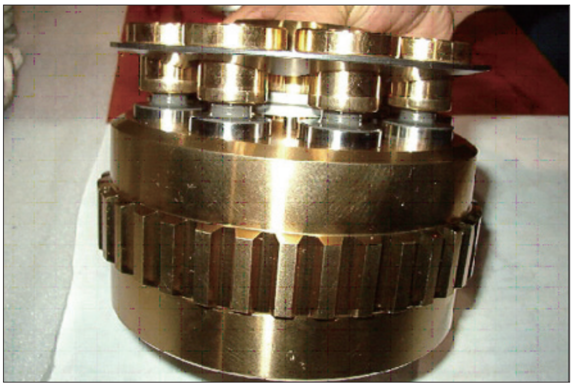


21078TM55

9) Assemble cylinder block assembly, piston assembly (9), seat plate (17).

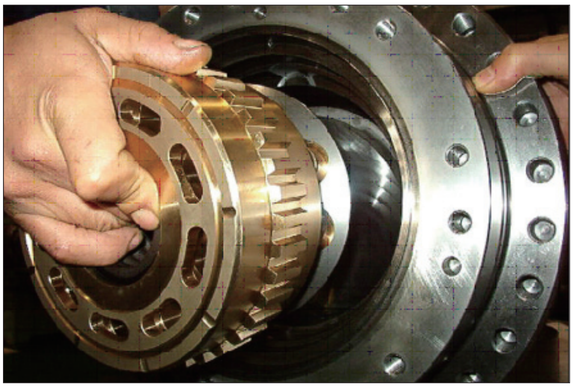


21078TM56



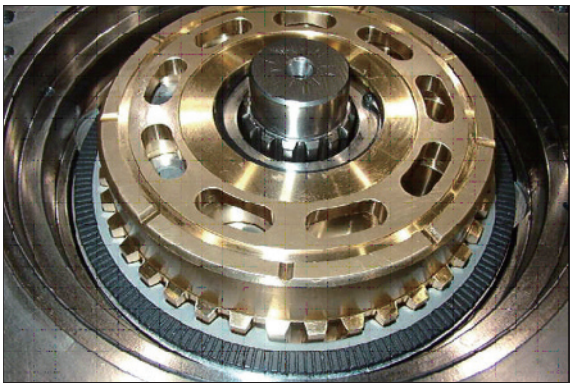
21078TM57

10) Assemble cylinder block assembly (9) into shaft casing (1).



21078TM58

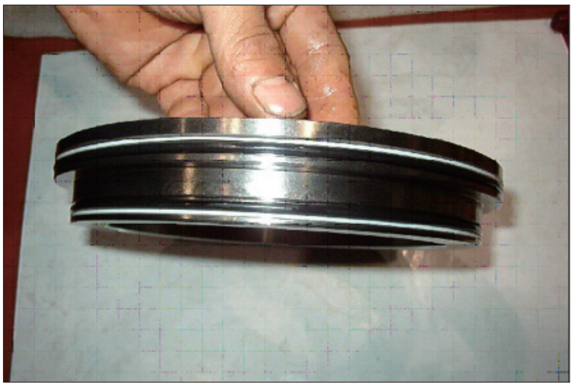
11) Assemble friction plate (19) and plate (20) into shaft casing (1) respectively, prepare 6 set.



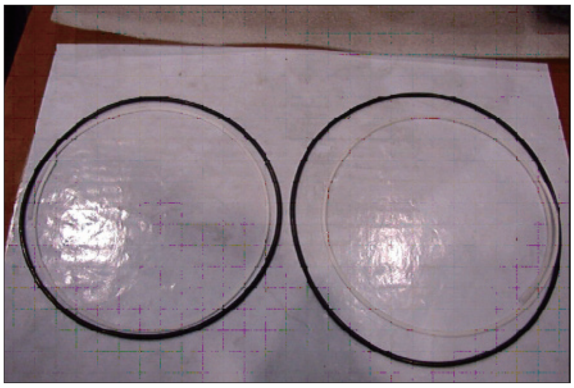
21078TM59

21078TM59-1

12) Assemble O-ring (22, 23) into packing piston (21).

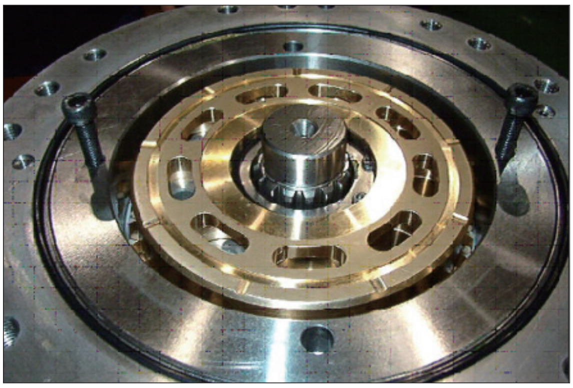


21078TM60



21078TM60-1

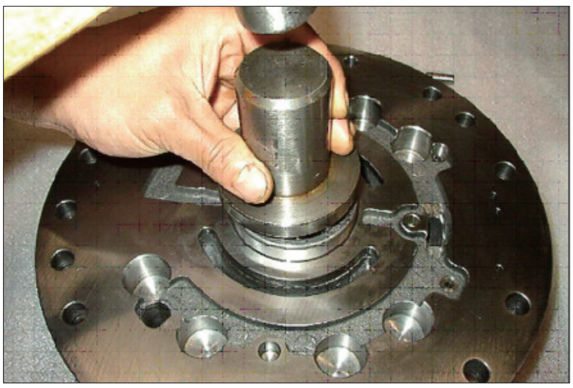
13) After spreading grease on packing piston (21) bond wrench bolt and assemble shaft casing (1).



21078TM61

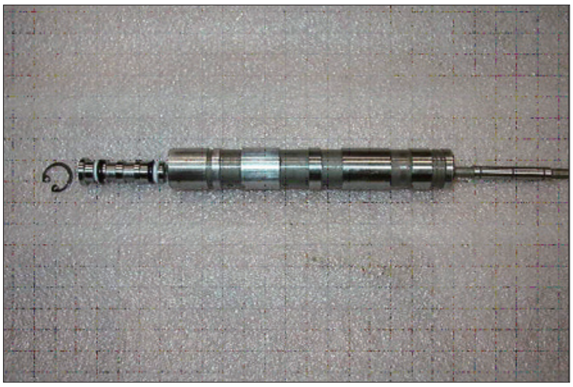
■ **Assemble rear cover sub.**

14) Using a jig, assemble bearing (69) into rear cover (29).

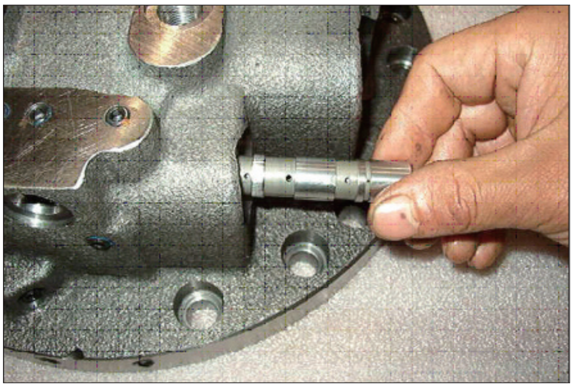


21078TM62

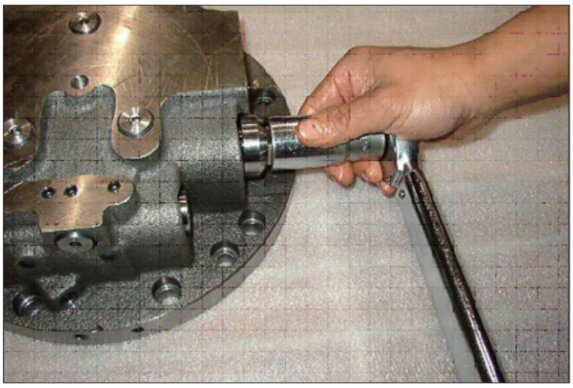
15) After assembling spool (59), spool (47), O-ring (51), guide (48) and snap ring (53) respectively into rear cover (29).
Using torque wrench, assemble it.



21078TM63

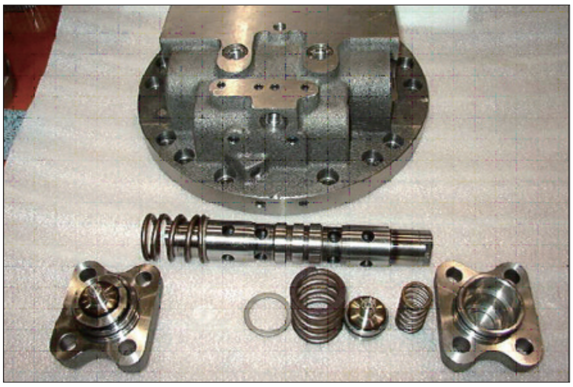


21078TM64

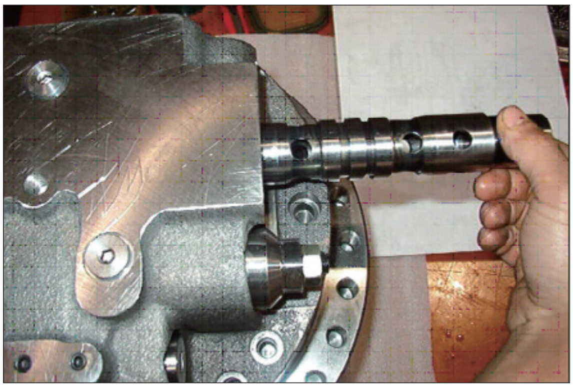


21078TM65

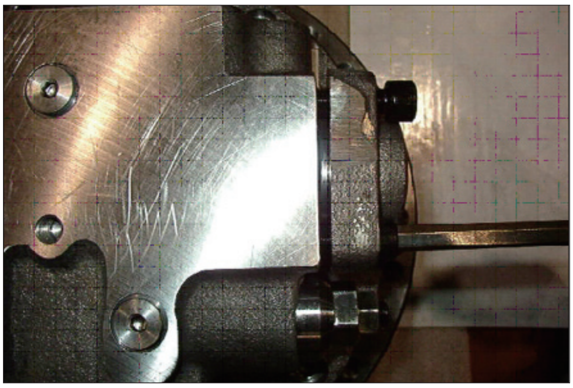
16) Assemble spring seat (35), spring (36), spring seat (43), spool (39), spring (38), cover (37) respectively and assemble wrench bolt (45).
(same balance on both sides)



21078TM66



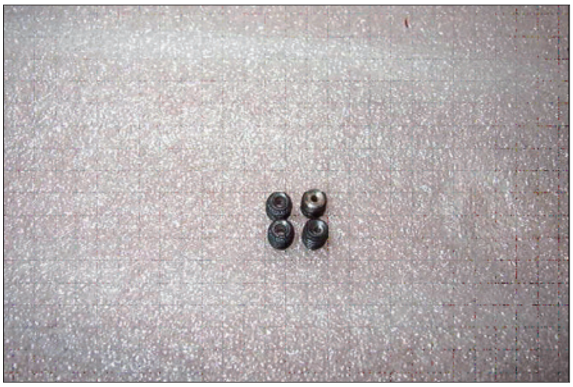
21078TM67



21078TM67-1

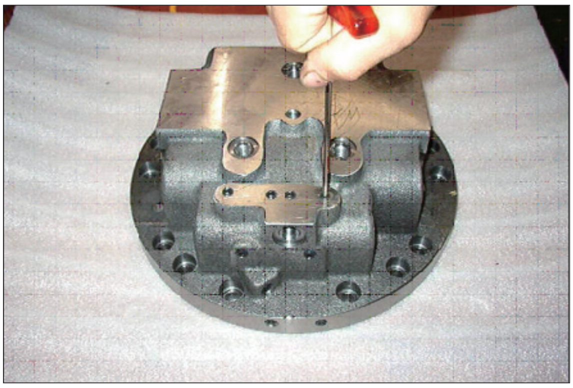
17) Assemble plug (2).

※ Plug (NPT1/16) - 11 EA

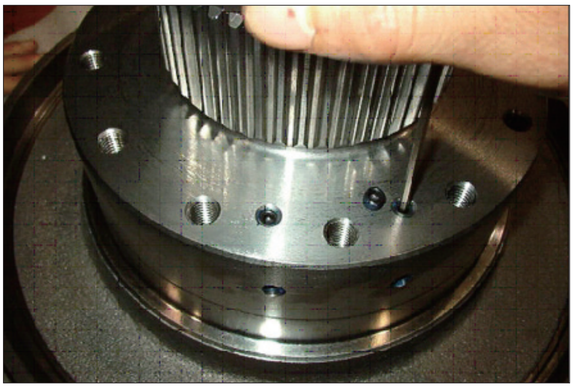


21078TM68

21078TM69



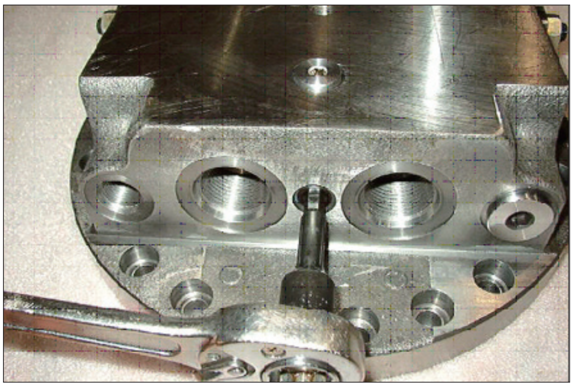
21078TM70



21078TM71

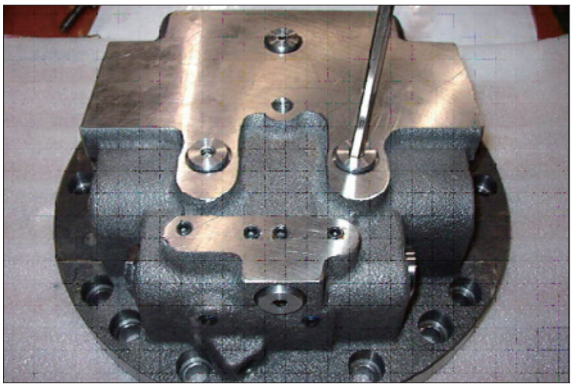
18) Assemble plug (64).

※ Plug (PT3/8) - 11 EA

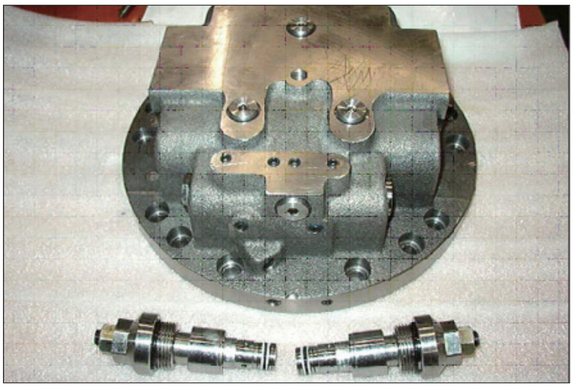


21078TM72

19) Assemble plug (62, 63) into rear cover (29) and assemble relief valve assembly.

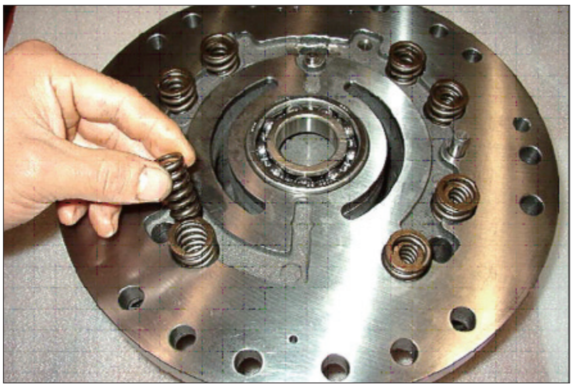


21078TM73



21078TM74

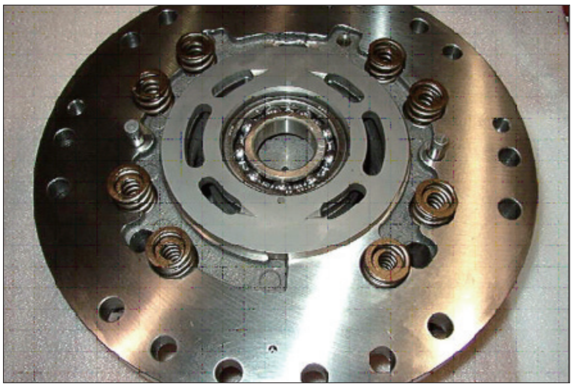
20) Put spring (67, 68) together into rear cover (29), prepare 6 set.



21078TM75

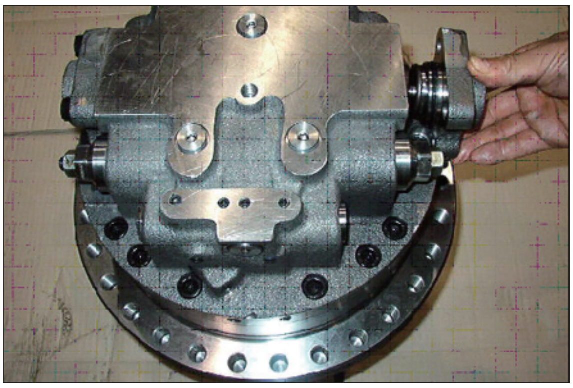
21078TM76

21) Assemble valve plate (70) into rear cover (29).



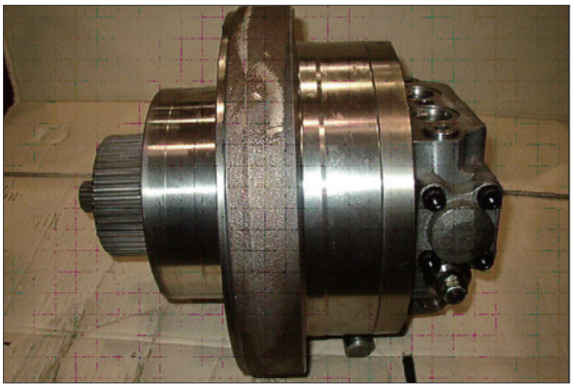
21078TM77

22) After assembling shaft casing (1) and rear cover (29).
Assemble spool assembly (30), spring (38), spool (39), cover (37) after then complete assembly with wrench bolt (45).



21078TM78

23) Finish assembly.



21078TM79

5.1 DISASSEMBLING REDUCTION UNIT

1) Preparation for disassembling

(1) The reduction units removed from excavator are usually covered with mud. Wash outside of propelling unit and dry it.

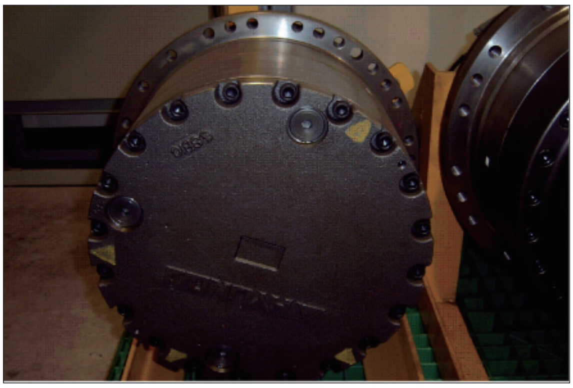
(2) Locate reducer in order for drain port to be at the lowest level loosen taper screw plug of drain port, and drain oil from reduction gear.

※ While oil is still hot, inside of the unit may be pressurized.

⚠ Take care of the hot oil gushing out of the unit when loosening the plug.

(3) Mark for mating

Put marks on each mating parts when disassembling so as to reassemble correctly as before.



21078TM80

2) Setting reduction unit (or whole propelling unit) on work stand for disassembling

(1) Remove M12 hexagon socket head bolts (95) at 3 places from cover (93) almost equally apart each other, and then install M12×155L eye bolts.

Lift up the unit using them and place it on work stand with cover upward.

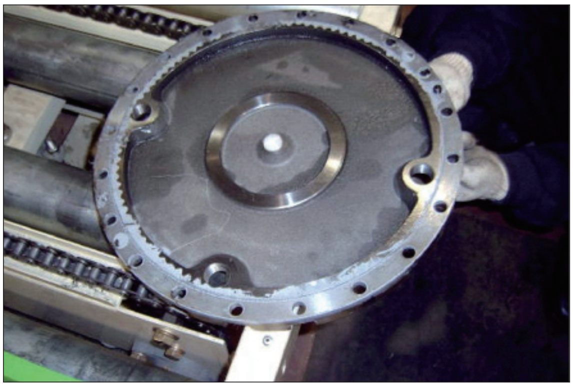
⚠ Take great care not to pinch your hand between parts while disassembling nor let fall parts on your foot while lifting them.

21078TM81

3) Removing cover

(1) Remove the rest of M12 hexagon socket head bolts (95) that securing gear and housing. Loosen all the socket bolts and then, disassemble cover.

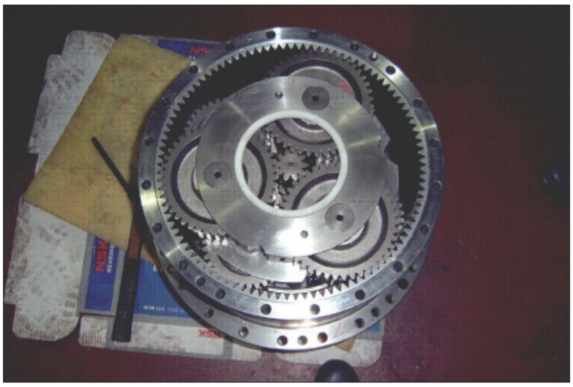
(2) As the cover (93) is adhered to ring gear (88), disassemble ring gear (88) and cover (93) vy lightly hammering slantwise upward using sharpen punch inserted between the cover and ring gear.



21078TM82

4) Removing No.1 carrier sub assembly

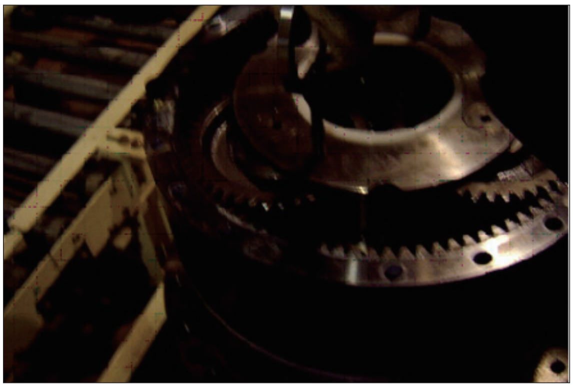
(1) Screw three M10 eye-bolt in No.1 carrier and lift up and remove No.1 carrier assy.



21078TM83

(2) Remove No.1 sun gear

※ Be sure to maintain it vertical with the ground when disassembling No.1 sun gear.



21078TM84

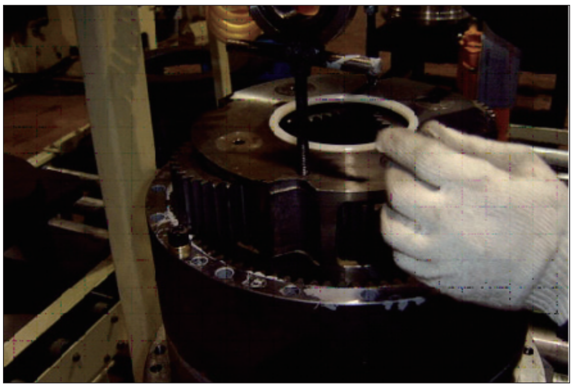
5) Removing No.2 carrier sub assembly

(1) Screw three M10 eye-bolt in No.2 carrier and lift up and remove No.2 carrier assy.

21078TM85

(2) Remove No.2 sun gear

※ Be sure to maintain it vertical with the ground when disassembling No.2 sun gear.



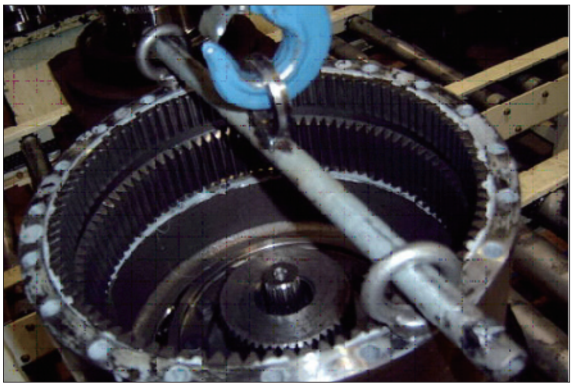
21078TM86

6) Removing ring gear

(1) As the ring gear (88) is adhered to housing (81), disassemble ring gear (88) and housing (81) by lightly hammering slantwise upward using sharpen punch inserted between the ring gear and housing.

※ Carefully disassembling ring gear not to make scratch on it.

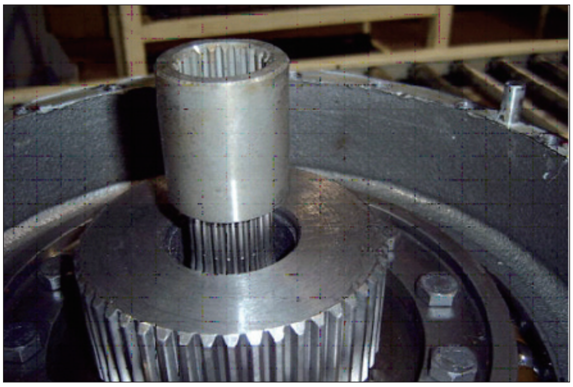
(2) Screw M14 eye-bolt in ring gear and lift up and remove it.



21078TM87

7) Removing coupling

(1) Remove coupling.

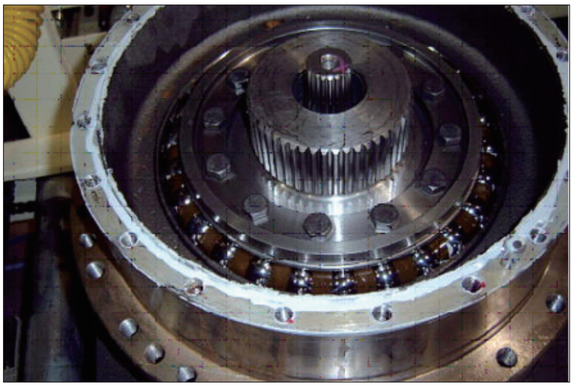


21078TM88

8) Removing retainer & shim

(1) Remove M12 hexagon socket head bolts that secure retainer and motor.

(2) Remove retainer & shim.



21078TM89

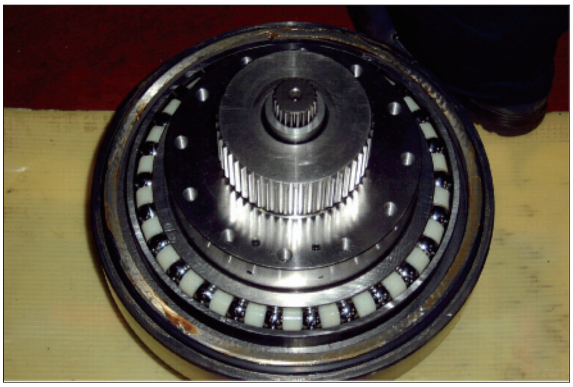
9) Removing housing sub assembly

(1) Screw M12 eye bolt in housing and lift up housing assembly including angular bearing and floating seal.

21078TM90

10) Removing floating seal

(1) Lift up a piece of floating seal of motor side.

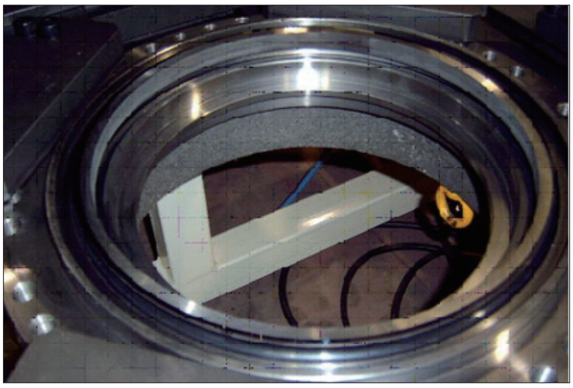


21078TM91

11) Disassembling housing assembly

(1) After turning housing, lift up a piece of floating seal from housing and then remove it.

※ Don't disassemble angular bearing.



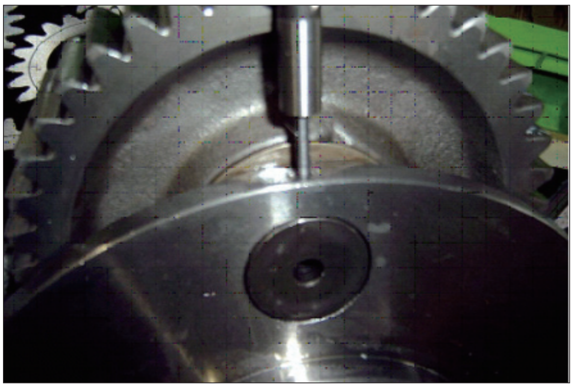
21078TM92

12) Disassembling No.1 carrier

(1) Remove thrust ring (90-7) from carrier.

(2) Knock spring pin (91-8) fully into No.1 pin (91-7).

(3) Remove planetary, thrust washer, No.1 pin, bearing from carrier.



21078TM93

21078TM94

21078TM95

13) Disassembling No.2 carrier

(1) Disassemble No.2 carriers, using the same method for No.1 carrier assembly.

21078TM96

21078TM97

6.1 ASSEMBLY REDUCTION GEAR

■ **General notes**

Clean every part by kerosene and dry them by air blow.
Surfaces to be applied by locktite must be decreased by solvent.
Check every part for any abnormals.
Each hexagon socket head bolt should be used with locktite No. 262 applied on its threads.
Apply gear oil slightly on each part before assembling.
Take great care not to pinch your hand between parts or tools while assembling nor let fall parts on your foot while lifting them.

Inspection before reassembling

Thrust washer

· Check if there are seizure, abnormal wear or uneven wear.
· Check if wear is over the allowable limit.

Gears

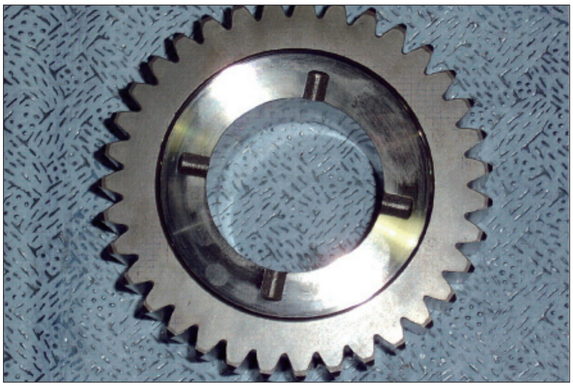
· Check if there are pitting or seizure on the tooth surface.
· Check if there are cracks on the root of tooth by die check.

Bearings

· Rotate by hand to see if there are something unusual such as noise or uneven rotation.

Floating seal

· Check flaw or score on sliding surfaces or O-ring.

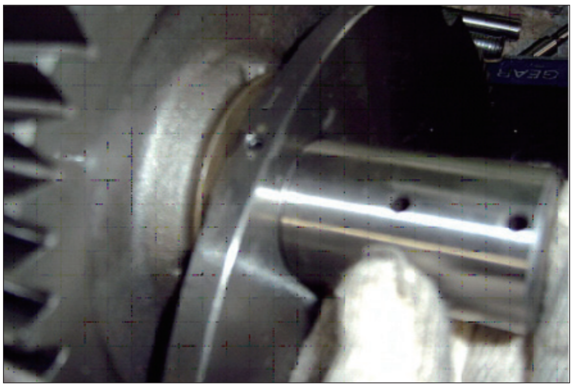


21078TM98

1) Assembling No.1 carrier

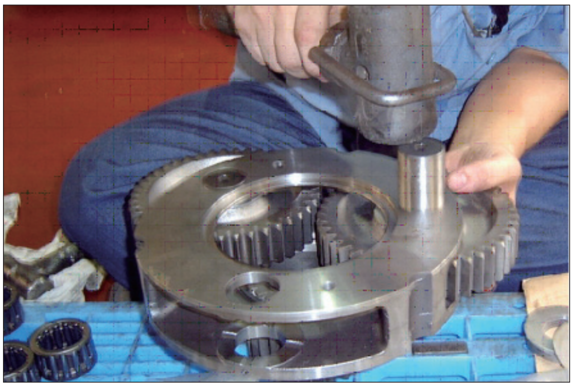
(1) Put No.1 carrier (91-1) on a flat place.

(2) Install No.1 needle bearing (91-5) into No.1 planetary gear (91-4), put 2 EA of No.1 thrust washer (91-6) on both sides of bearing, and then, install it into carrier.



21078TM99

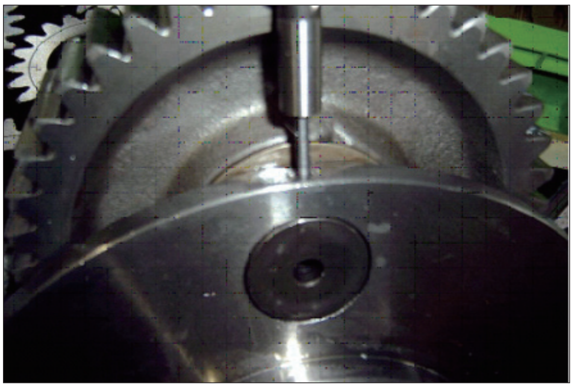
(3) Install No.1 pin (91-5) into No.1 carrier where the holes for No.1 pin (91-5) are to be in line with those of No.1 carrier, and then, install spring pins into the holes.



21078TM100

(4) Caulk carrier holes as shown on the picture.

(5) Assembly thrust ring (90-7) into carrier.

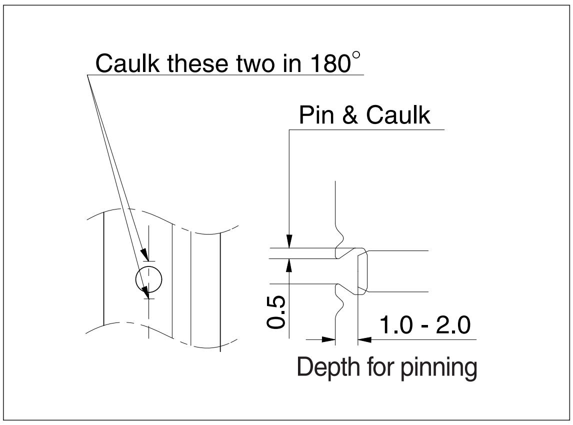


21078TM101

2) Assembling No.2 carrier

(1) Put No.2 carrier (90-1) on a flat place.

(2) Install No.2 needle bearing (90-3) into No.2 planetary gear (90-2), put 2 EA of No.2 thrust washer (90-4) on both sides of bearing, and then, install it into carrier.



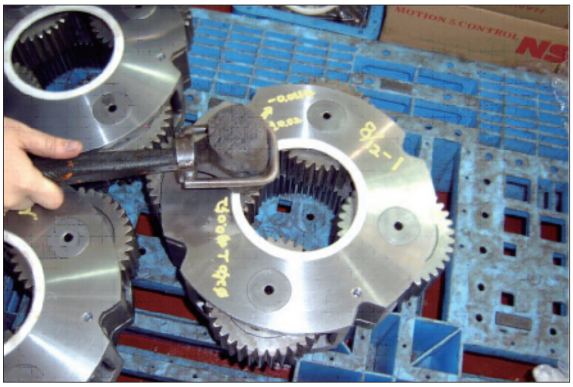
21078TM102

(3) Install No.2 pin (90-5) into No.2 carrier where the holes for No.2 pin (90-5) are to be in line with those of No.2 carrier, and then, install spring pins into the holes.

21078TM103

(4) Caulk carrier holes as shown on the picture.

(5) Assembly thrust ring (90-7) into carrier.

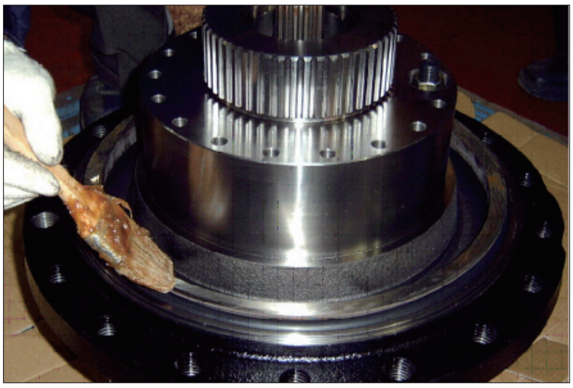


21078TM104

3) Assembling floating seal (83) and main bearing (82)

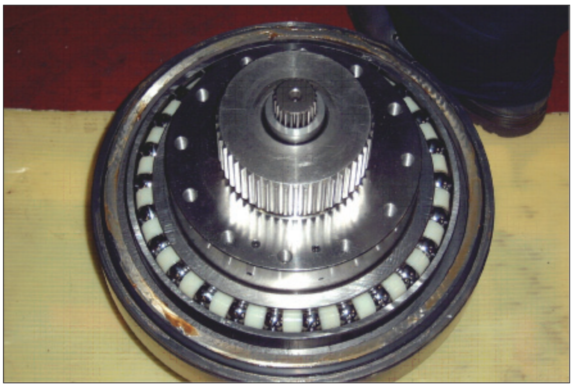
(1) Assemble floating seal into motor by use of pressing jig. Grease the contact parts for floating seal which is assembled into motor.

(2) Heat bearing at 60~70˚C and then, put into the motor side.



21078TM105

※ Be sure to maintain it vertical with the ground when assembling bearing and floating seal.

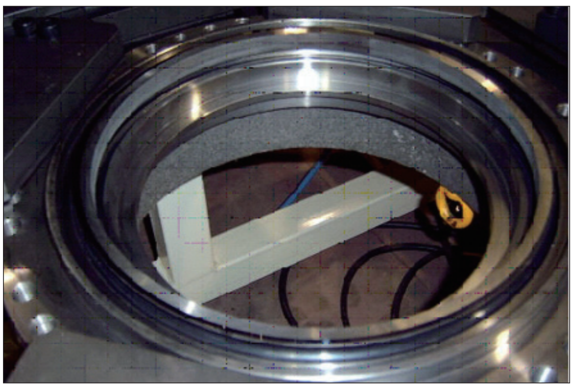


21078TM106

4) Assembling housing

(1) Heat housing at 60~70˚C while clearing it out and then, assemble floating seal into housing by use of pressing jig.

※ Be sure to maintain it vertical with the ground when assembling floating seal.



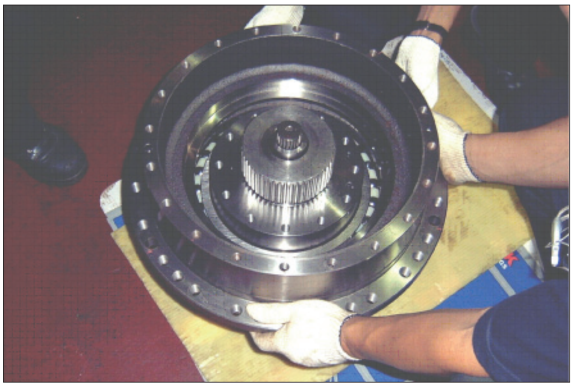
21078TM705

5) Installing housing assembly

(1) Install 2 EA of M12 eye-bolt into housing assembly.

(2) Assemble housing into motor by use of hoist and eye-bolt.

※ Be sure to tighten eye-bolt deep enough.

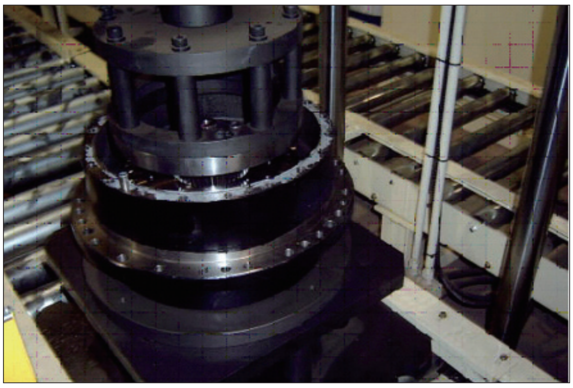


21078TM108

6) Installing main bearing (82)

(1) Heat main bearing at 60~70° C and then, install.

※ Be sure to maintain it vertical with the ground when assembling bearing.

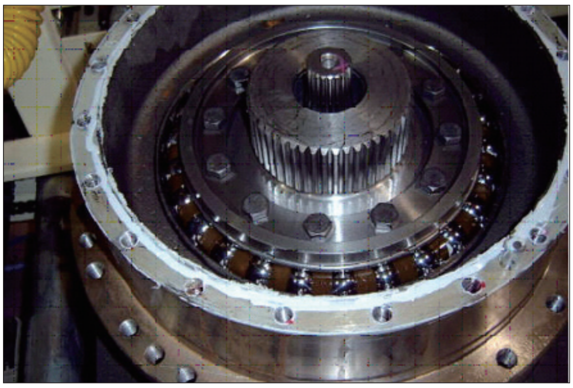


21078TM109

7) Installing retainer (85) and shim (84)

(1) Measure clearance between main bearing and retainer by use of jig to decide the thickness of shim and select an appropriate shim, and then, assemble retainer.

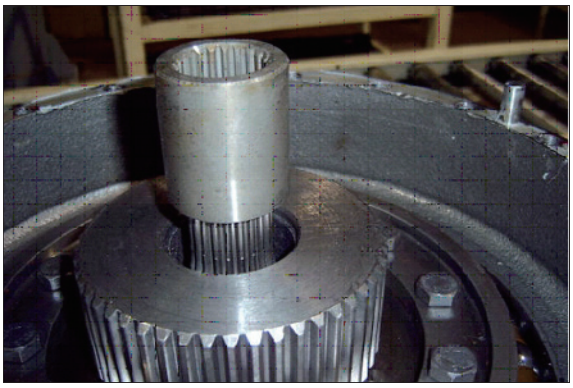
(2) Apply locktite (#262) on M12 hexagon head bolt, and then, bolt.



21078TM110

8) Installing coupling

(1) Install coupling on spline of the motor.



21078TM111

9) Installing ring gear

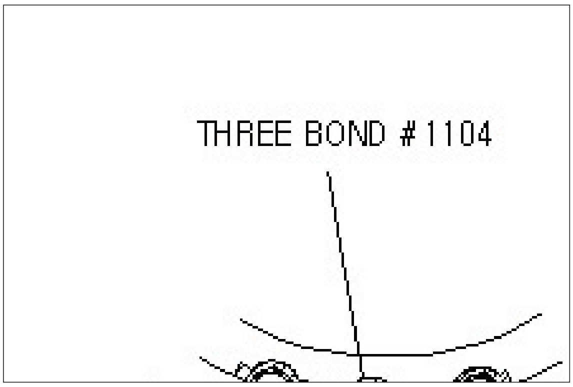
(1) Apply three bone #1104 (loctite #515) on housing for ring gear without gap.

(2) Insert lock pin into housing hole.

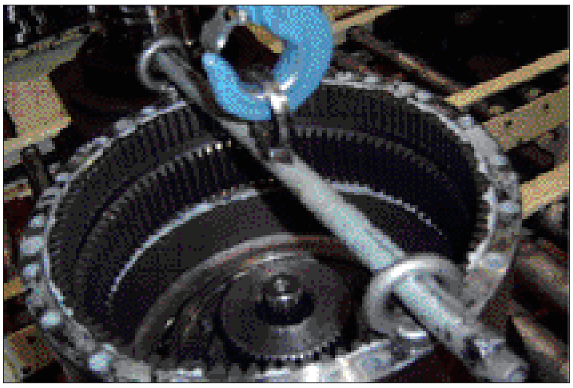
(3) Install M14 eye-bolt on the tap of ring gear.

(4) Lift ring gear and then, assemble into housing in order for hole of ring gear and parallel pin of housing to be in line.

(5) Temporarily secure 4EA of M12 hexagon socket bolt and shim with cover thickness having appropriate torque.



21078TM112A

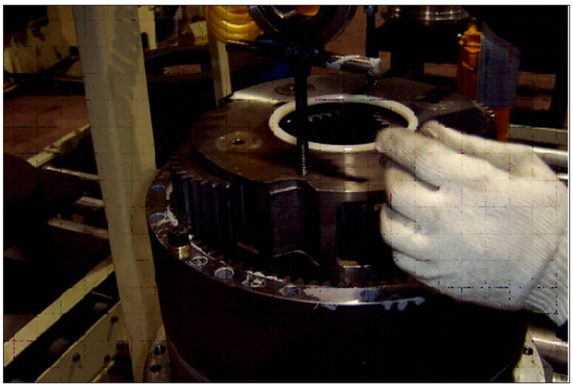

21078TM113

10) Installing No.2 carrier sub assembly

(1) Install M10 eye-bolt on No.2 carrier assembly.

(2) Lift No.2 carrier assembly and then, slowly put it down on ring gear.

(3) Rotate planetary gear by hands and install on ring gear.

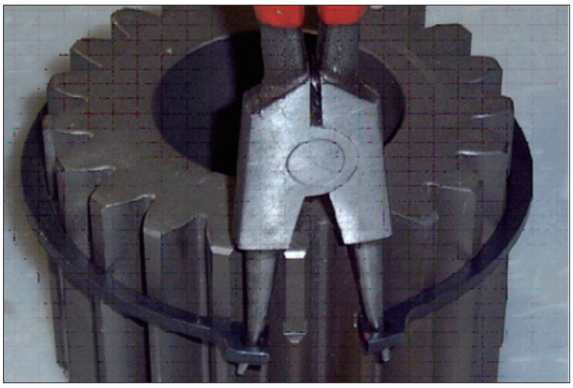

21078TM114

11) Installing No.2 sun gear (91-2)

(1) Install No.2 sun gear on the spline of No.2 carrier and No.2 planetary gear, matching teeth of them.

21078TM115

(2) Install No.2 sun gear on the spline of No.2 carrier and No.2 planetary gear, matching teeth of them.



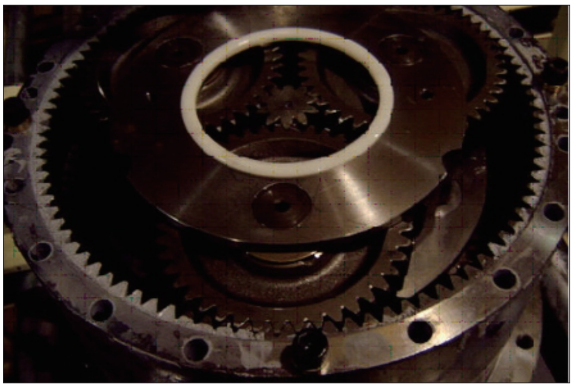
21078TM116

12) Installing No.1 carrier sub assembly

(1) Install M10 eye-bolt on No.2 carrier assembly.

(2) Lift No.1 carrier assembly and then, slowly put it down on ring gear.

(3) Rotate planetary gear by hands and install on ring gear.

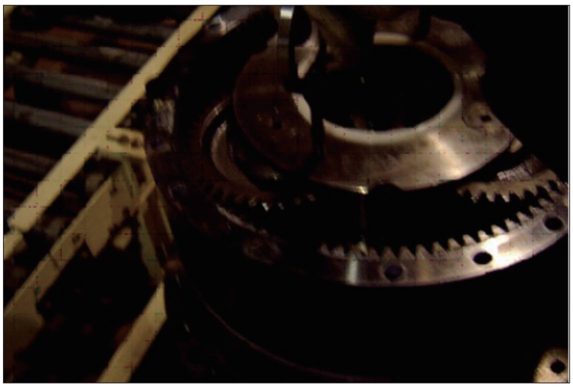


21078TM117

13) Installing No.1 sun gear (92)

(1) Put down No.1 sun gear on No.1 carrier, maintaining it vertical with spline of coupling.

(2) Install No.1 sun gear on No.1 planetary gear, matching their teeth.



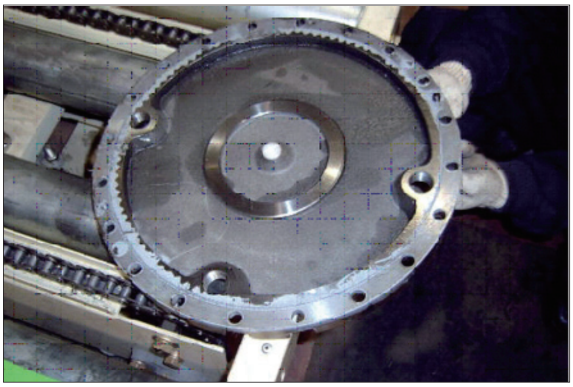
21078TM118

14) Installing cover (93)

(1) Beat pad (94) with plastic hammer, and press it into the center of cover.

(2) Apply three bond #1104, loctite (#515) on the ring gear for cover without gap.

(3) Put cover on ring gear, apply loctite (#262) on M12 hexagon socket head bolt, and then, bolt.



21078TM119

(4) Fill gear oil (5.8 liter) into drain port.

(5) Apply gear oil on PF3/4 hydraulic plug (97) and then, bolt.

21078TM120

GROUP 7 RCV LEVER

1. REMOVAL AND INSTALL

1) REMOVAL

(1) Lower the work equipment to the ground and stop the engine.

(2) Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

(3) Loosen the breather slowly to release the pressure inside the hydraulic tank.

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

(4) Loosen the socket bolt (1).

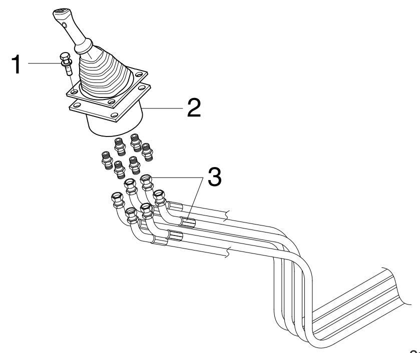
(5) Remove the cover of the console box.

(6) Disconnect pilot line hoses (3).

(7) Remove the pilot valve assembly (2).

※ When removing the pilot valve assembly, check that all the hoses have been disconnected.

13031GE18



21098RL01

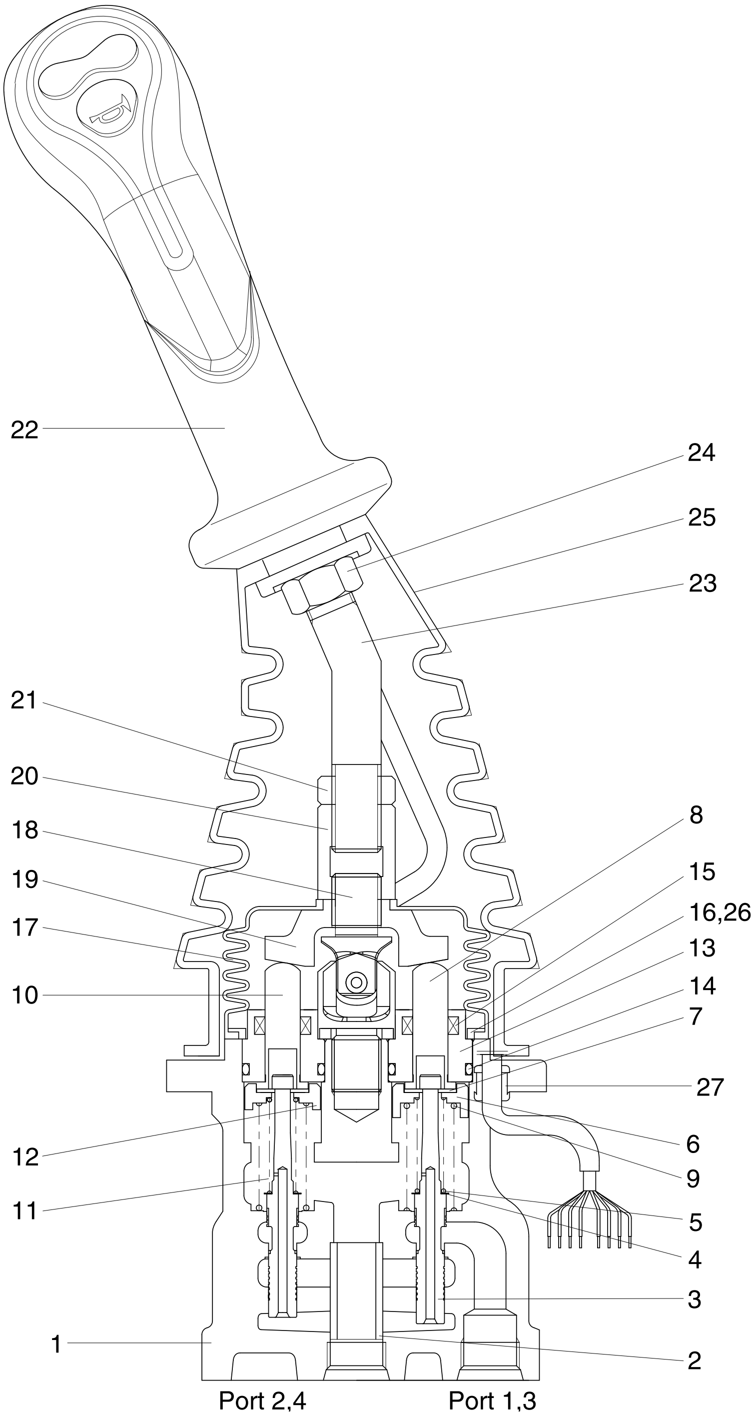
2) INSTALL

(1) Carry out installation in the reverse order to removal.

(2) Confirm the hydraulic oil level and check the hydraulic oil leak or not.

2. DISASSEMBLY AND ASSEMBLY

1) STRUCTURE

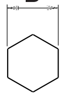


1409S2RL02

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

2) TOOLS AND TIGHTENING TORQUE

(1) Tools

Tool name	Remark	
Allen wrench	6	B 
Spanner	22	
	27	
(+) Driver	Length 150	
(-) Driver	Width 4~5	
Torque wrench	Capable of tightening with the specified torques	

(2) Tightening torque

Part name	Item	Size	Torque	
			kgf · m	lbf · ft
Joint	18	M14	3.5	25.3
Swash plate	19	M14	5.0±0.35	36.2±2.5
Adjusting nut	20	M14	5.0±0.35	36.2±2.5
Lock nut	21	M14	5.0±0.35	36.2±2.5

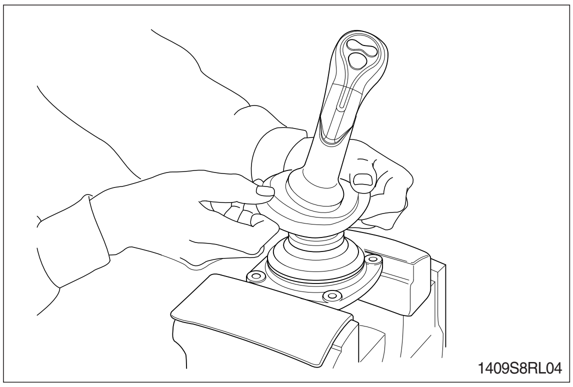
3) DISASSEMBLY

(1) Clean pilot valve with kerosene.

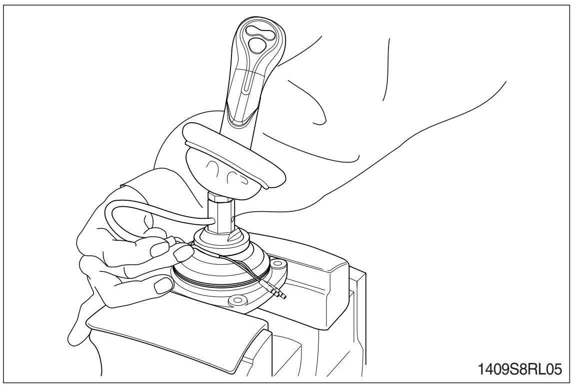
※ Put blind plugs into all ports

(2) Fix pilot valve in a vise with copper (or lead) sheets.

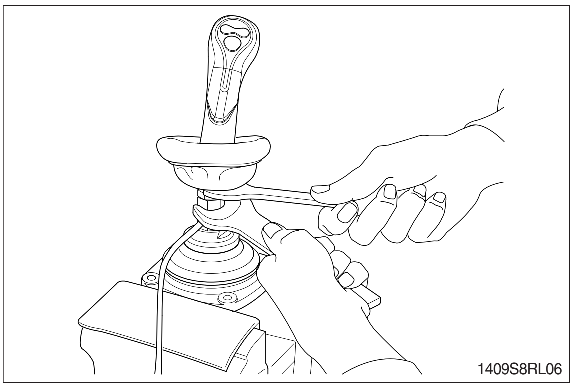
(3) Remove end of boot (25) from case (1) and take it out upwards.



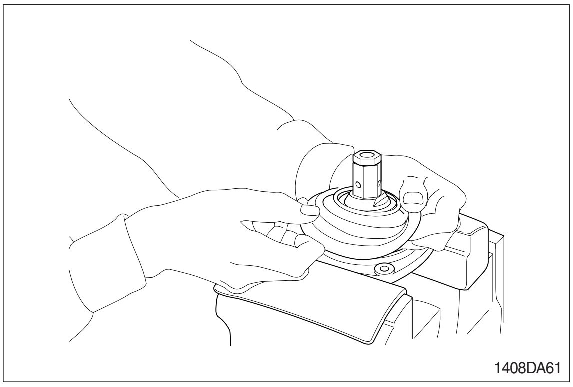
※ For valve with switch, remove cord also through hole of casing.



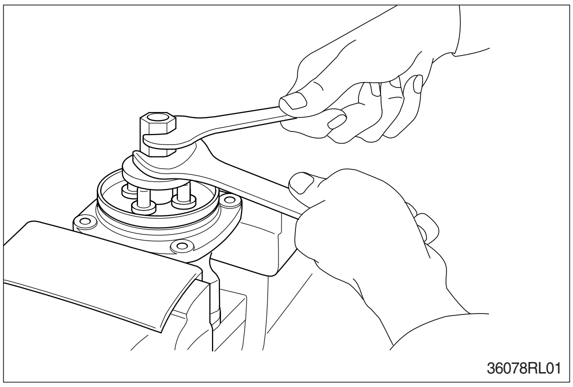
(4) Loosen lock nut (21) and adjusting nut (20) with spanners on them respectively, and take out handle section as one body.



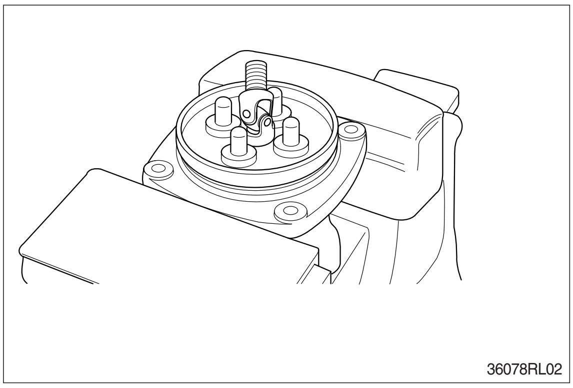
(5) Remove the boot (17).



(6) Loosen adjusting nut (20) and swash plate (19) with spanners on them respectively, and remove them.



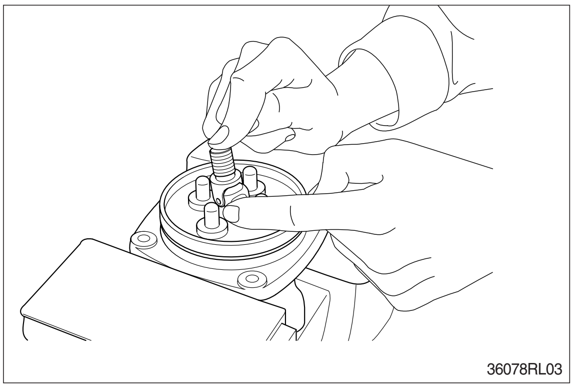
36078RL01



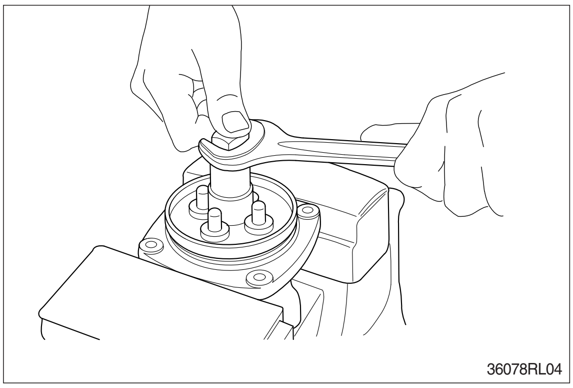
36078RL02

(7) Turn joint anticlockwise to loosen it, utilizing jig (special tool).

※ When return spring (9) is strong in force, plate (16), plug (13) and push rod (10) will come up on loosening joint.
Pay attention to this.

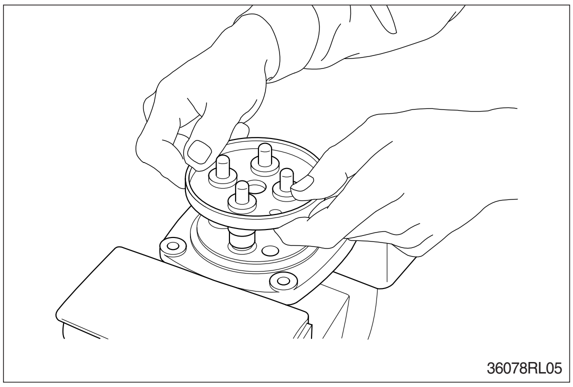


36078RL03



36078RL04

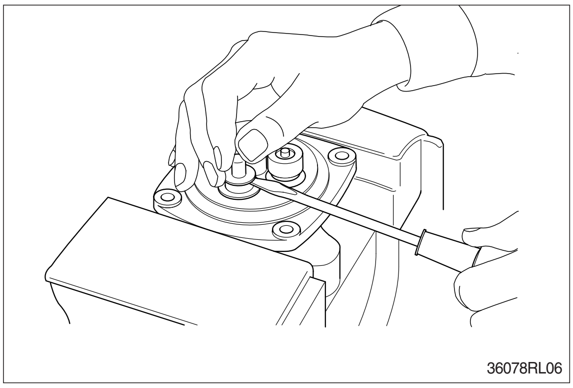
(8) Remove plate (16).



(9) When return spring (9) is weak in force, plug (13) stays in casing because of sliding resistance of O-ring.

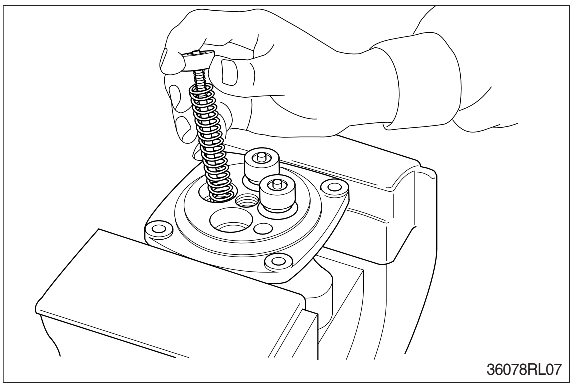
※ Take it out with minus screwdriver.
Take it out, utilizing external periphery groove of plug and paying attention not to damage it by partial loading.

※ During taking out, plug may jump up due to return spring (9) force.
Pay attention to this.



(10) Remove reducing valve subassembly and return spring (9) out of casing.

※ Record relative position of reducing valve subassembly and return springs.

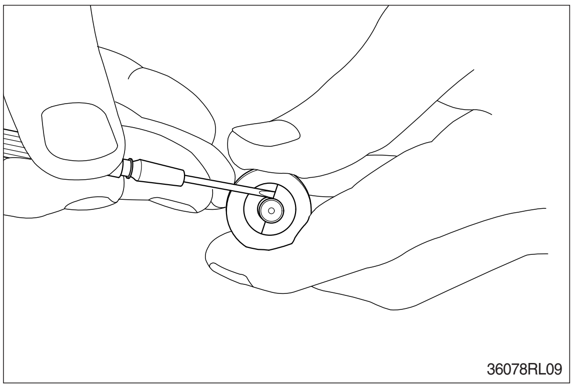


(11) For disassembling reducing valve section, stand it vertically with spool (3) bottom placed on flat workbench. Push down spring seat (6) and remove two pieces of semicircular stopper (7) with tip of small minus screwdriver.

※ Pay attention not to damage spool surface.

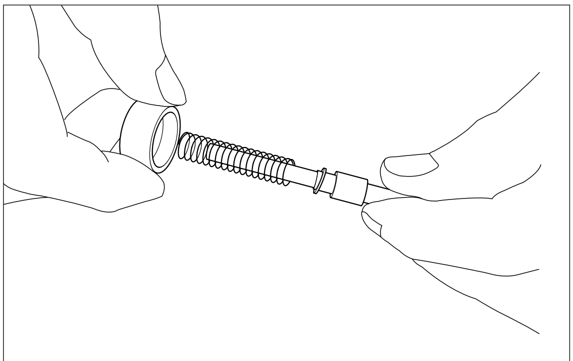
※ Record original position of spring seat (6).

※ Do not push down spring seat more than 6mm.



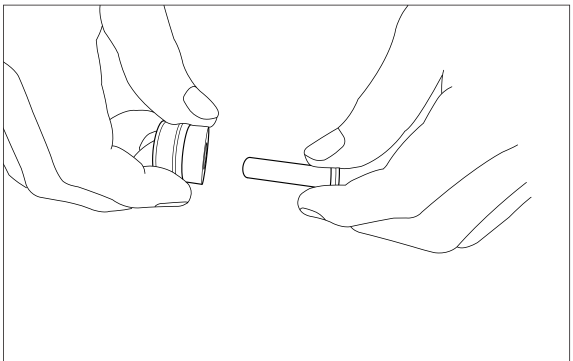
(12) Separate spool (3), spring seat (6), spring (5) and shim (5) individually.

※ Until being assembled, they should be handled as one subassembly group.



36078RL10

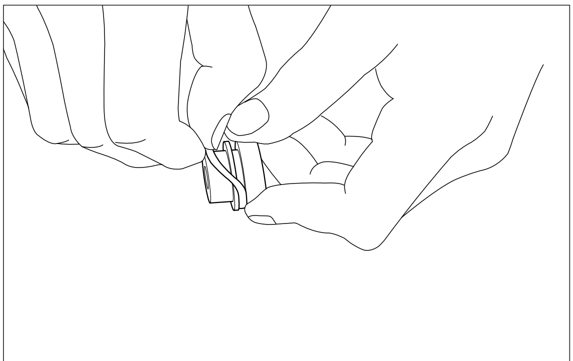
(13) Take push rod (10) out of plug (13).



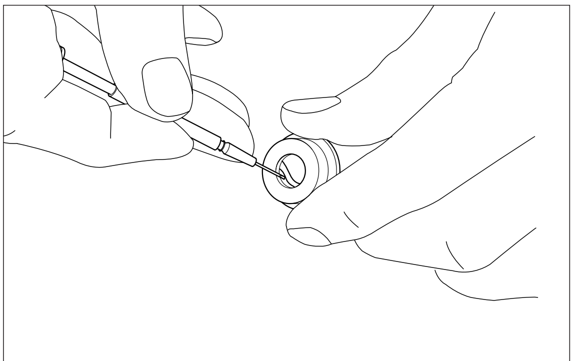
36078RL11

(14) Remove O-ring (14) and seal (15) from plug (13).

Use small minus screwdriver or so on to remove this seal.

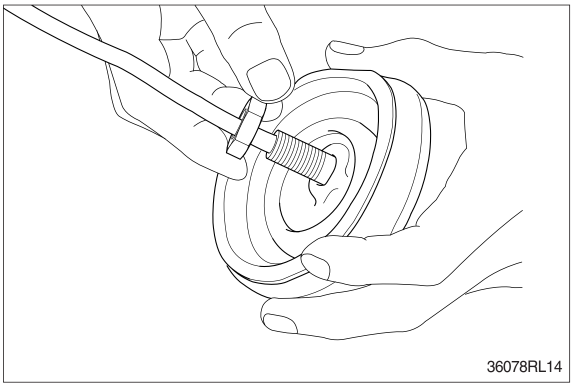


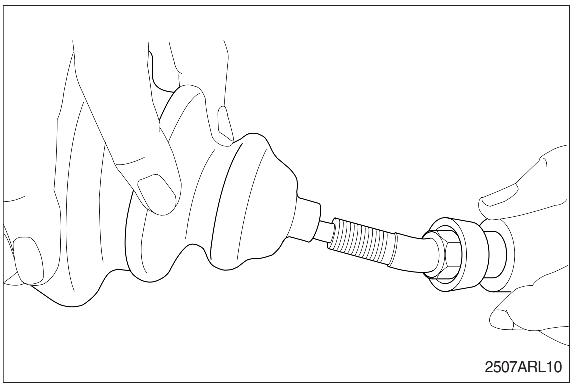
36078RL12



36078RL13

(15) Remove lock nut (21) and then boot (25).


36078RL14


2507ARL10

(16) Cleaning of parts

① Put all parts in rough cleaning vessel filled with kerosene and clean them (rough cleaning).

※ If dirty part is cleaned with kerosene just after putting it in vessel, it may be damaged. Leave it in kerosene for a while to loosen dust and dirty oil.

※ If this kerosene is polluted, parts will be damaged and functions of reassembled valve will be degraded.
Therefore, control cleanliness of kerosene fully.

② Put parts in final cleaning vessel filled with kerosene, turning it slowly to clean them even to their insides (finish cleaning).

※ Do not dry parts with compressed air, since they will be damaged and/or rusted by dust and moisture in air.

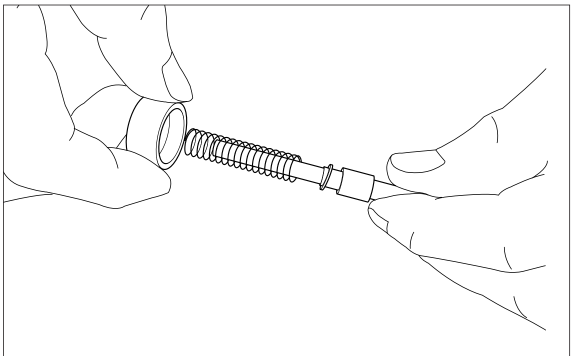
(17) Rust prevention of parts

Apply rust-preventives to all parts.

※ If left as they after being cleaned, they will be rusted and will not display their functions fully after being reassembled.

4) ASSEMBLY

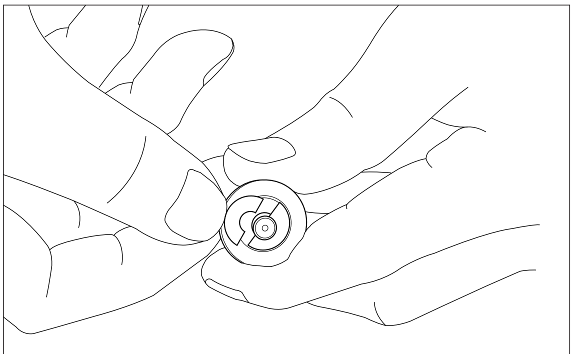
(1) Put shim (4), springs (5) and spring seat (6) onto spool (3) in this order.



36078RL16

(2) Stand spool vertically with its bottom placed on flat workbench, and with spring seat pushed down, put two pieces of semicircular stopper (7) on spring seat without piling them on.

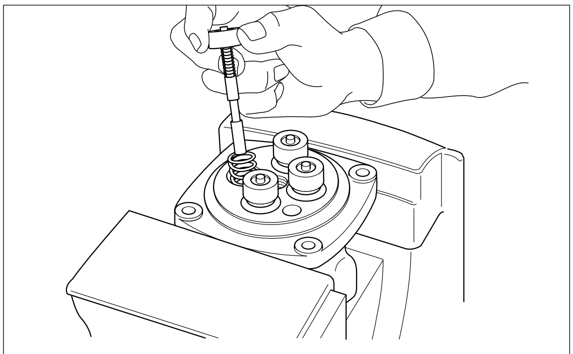
※ Assemble stopper (7) so that its sharp edge side will be caught by head of spool. Do not push down spring seat more than 6mm.



36078RL17

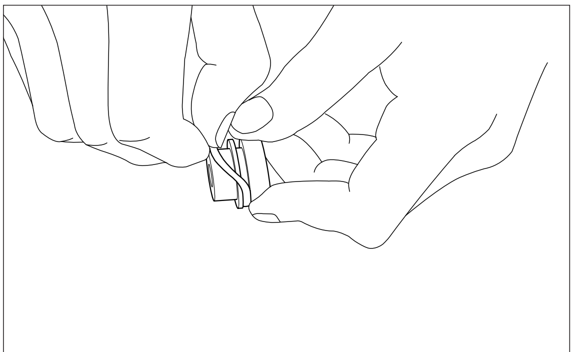
(3) Assemble spring (9) into casing (1). Assemble reducing valve subassembly into casing.

※ Assemble them to their original positions.



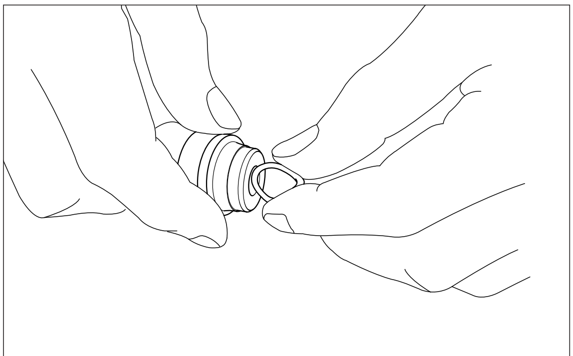
36078RL18

(4) Assemble O-ring (14) onto plug (13).

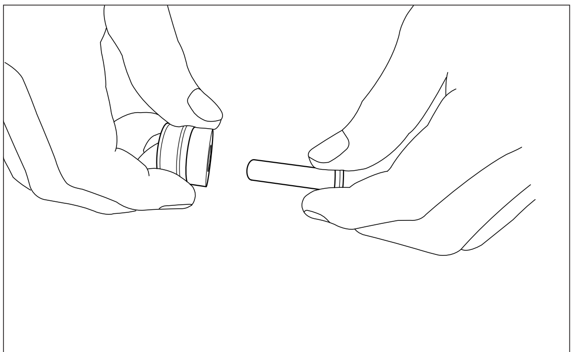


36078RL19

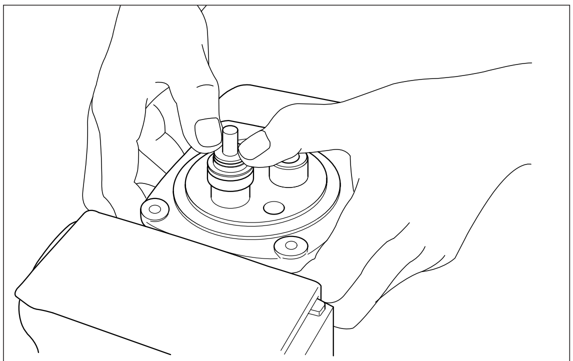
(5) Assemble seal (15) to plug (13).
※ Assemble seal in such lip direction as shown below.


36078RL20

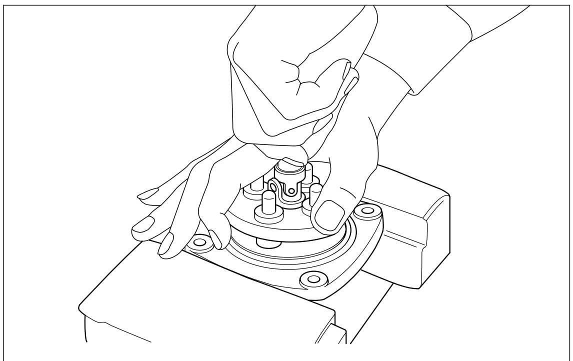
(6) Assemble push rod (10) to plug (13).
※ Apply working oil on push-rod surface.


36078RL21

(7) Assemble plug subassembly to casing.
※ When return spring is weak in force, subassembly stops due to resistance of O-ring.

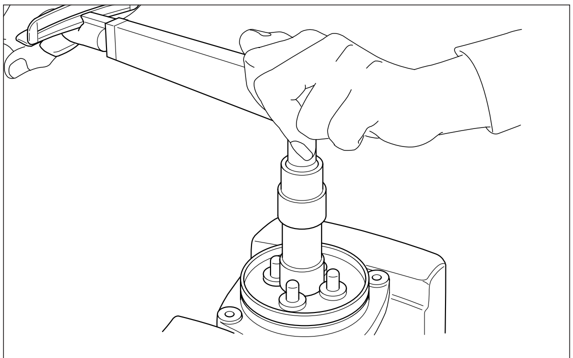

36078RL22

(8) When return spring is strong in force, assemble 4 sets at the same time, utilizing plate (16), and tighten joint (18) temporarily.


36078RL23

(9) Fit plate (16).

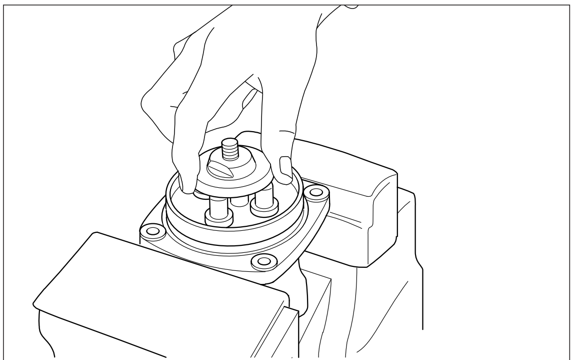
(10) Tighten joint (18) with the specified torque to casing, utilizing jig.


36078RL24

(11) Assemble swash plate (19) to joint (18).

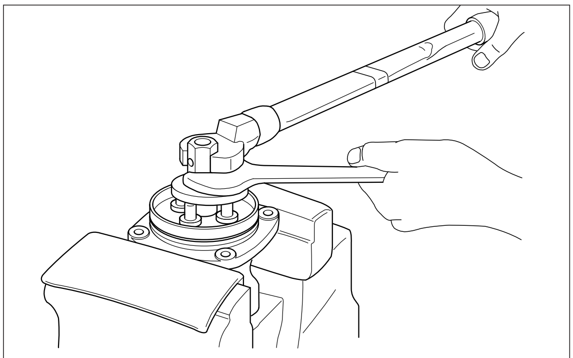
※ Screw it to position that it contacts with 4 push rods evenly.

※ Do not screw it over.

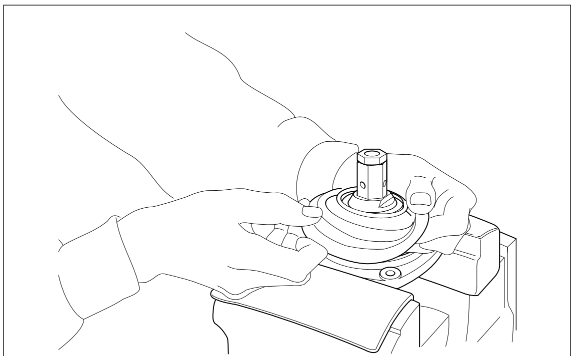

36078RL25

(12) Assemble adjusting nut (20), apply spanner to width across flat of plate (19) to fix it, and tighten adjusting nut to the specified torque.

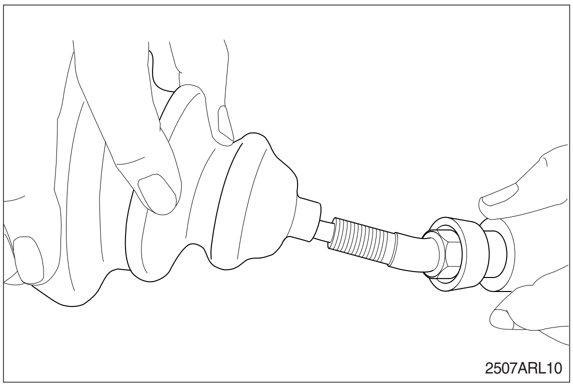
※ During tightening, do not change position of disk.

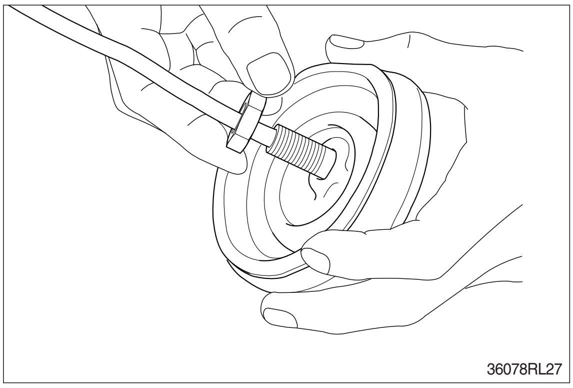

36078RL26

(13) Fit boot (17) to plate.

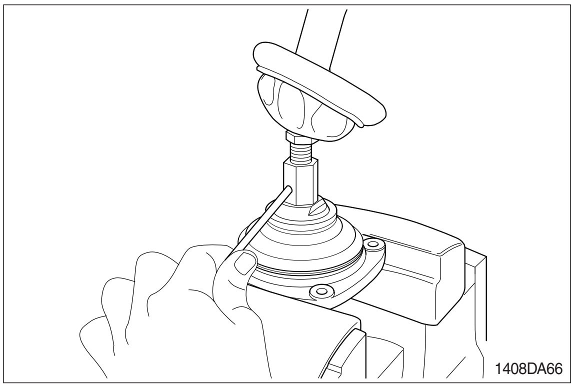

1408DA61

(14) Fit boot (25) and lock nut (21), and handle subassembly is assembled completely.


2507ARL10

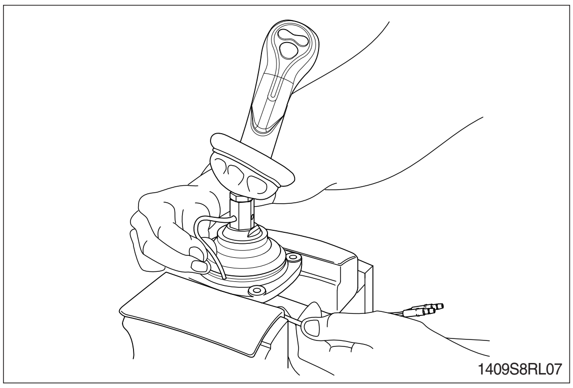

36078RL27

(15) Pull out cord and tube through adjusting nut hole provided in direction 60° to 120° from casing hole.

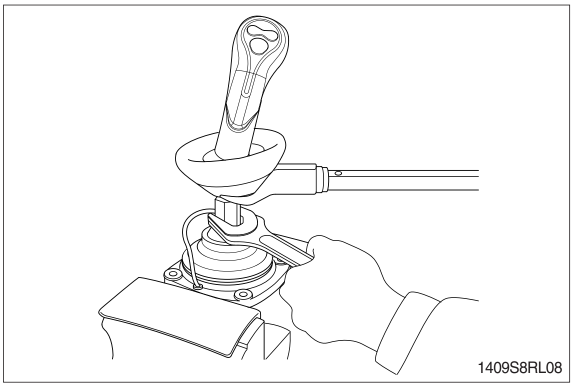

1408DA66

(16) Assemble bushing (27) to plate and pass cord and tube through it.

※ Provide margin necessary to operation.

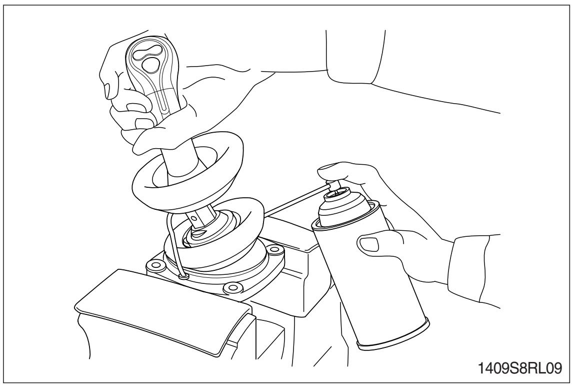

1409S8RL07

(17) Determine handle direction, tighten lock nut (22) to specified torque to fix handle.



1409S8RL08

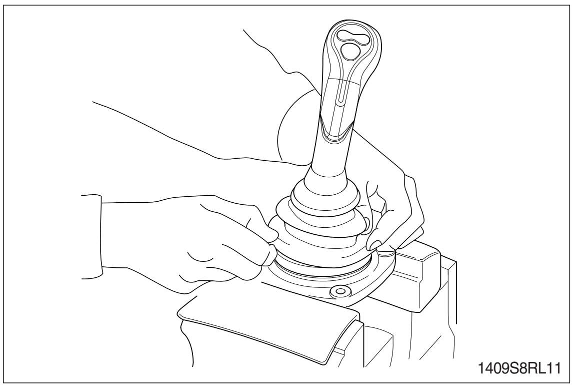
(18) Apply grease to rotating section of joint and contacting faces of disk and push rod.



1409S8RL09

(19) Assemble lower end of bellows to casing.

(20) Inject volatile rust-preventives through all ports and then put blind plugs in ports.



1409S8RL11

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).

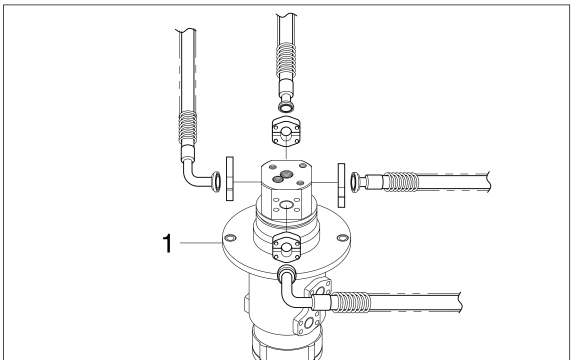
· Weight : 50 kg (110 lb)

· Tightening torque : 12.3± 1.3 kgf · m (88.9± 9.4 lbf · ft)

(6) Remove the turning joint assembly.

※ When removing the turning joint, check that all the hoses have been disconnected.

13031GE18



14098TJ01

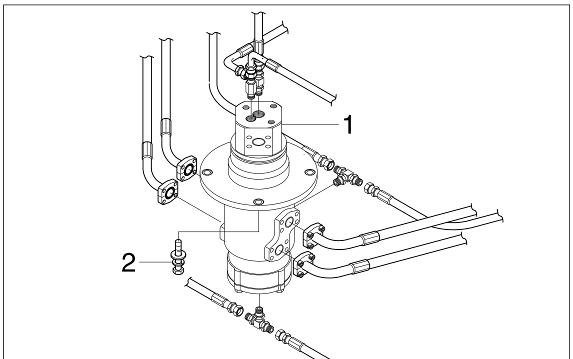
2) INSTALL

(1) Carry out installation in the reverse order to removal.

※ Take care of turning joint direction.

※ Assemble hoses to their original positions.

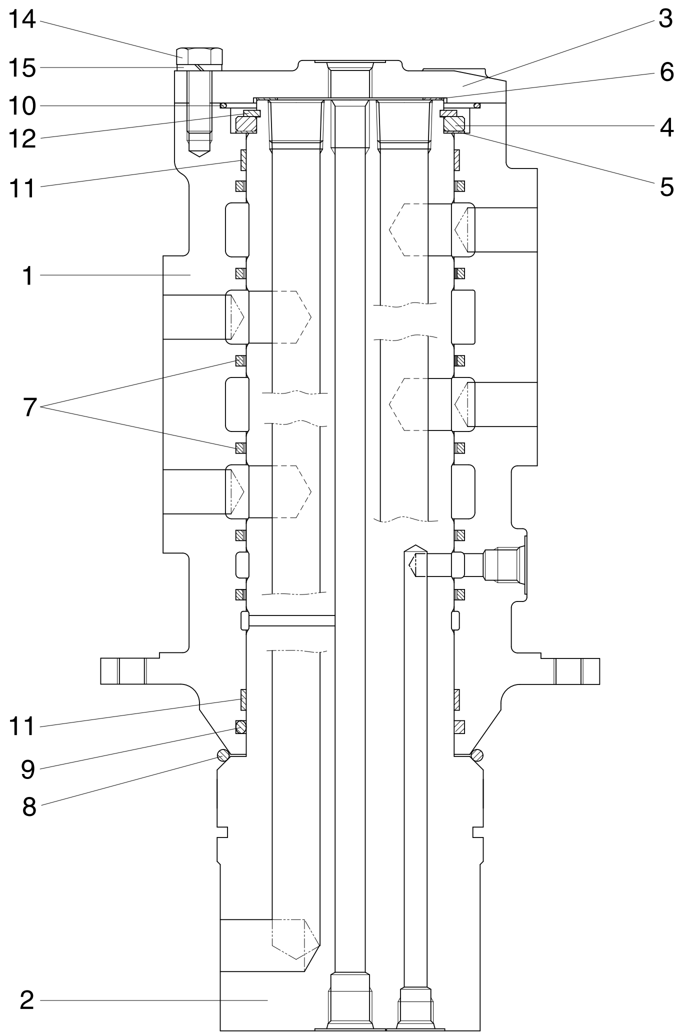
※ Confirm the hydraulic oil level and check the hydraulic oil leak or not.



14098TJ02

2. DISASSEMBLY AND ASSEMBLY

1) STRUCTURE



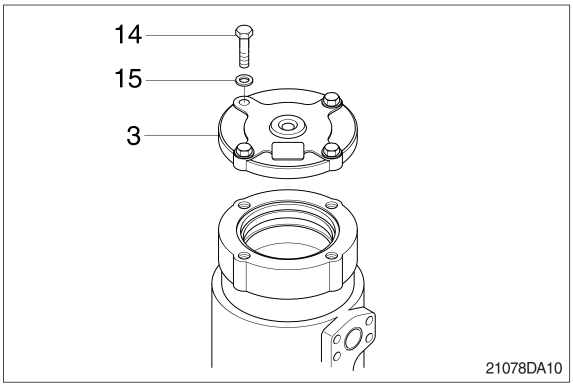
14098TJ03

1	Hub	6	Shim	11	Wear ring
2	Shaft	7	Slipper seal	12	Retainer ring
3	Cover	8	O-ring	13	Plug
4	Spacer	9	O-ring	14	Hexagon bolt
5	Shim	10	O-ring	15	Spring washer

2) DISASSEMBLY

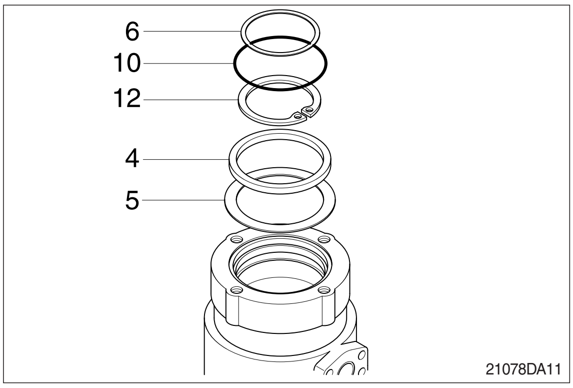
※ Before the disassembly, clean the turning joint.

(1) Remove bolts (14), washer (15) and cover (3).



(2) Remove shim (6) and O-ring (10).

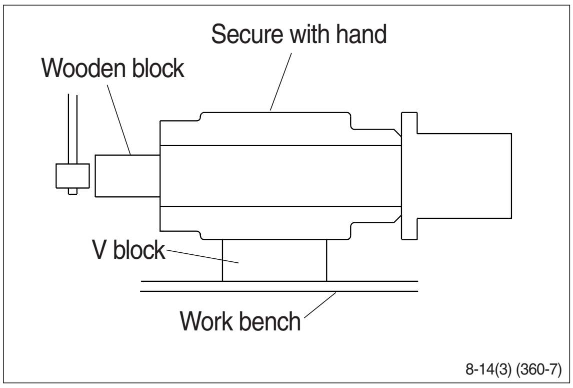
(3) Remove retainer ring (12), spacer (4) and shim (5).



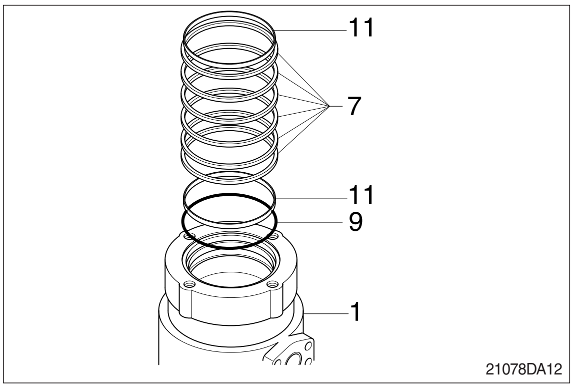
(4) Place hub (1) on a V-block and by using a wood buffer at the shaft end, hit out shaft (2) to about 1/2 from the body with a hammer.

※ Take care not to damage the shaft (2) when remove hub (1) or rest it sideway.

※ Put a fitting mark on hub (1) and shaft (2).



(5) Remove six slipper seals (7) and O-ring (9), two wear ring (11) from hub (1).

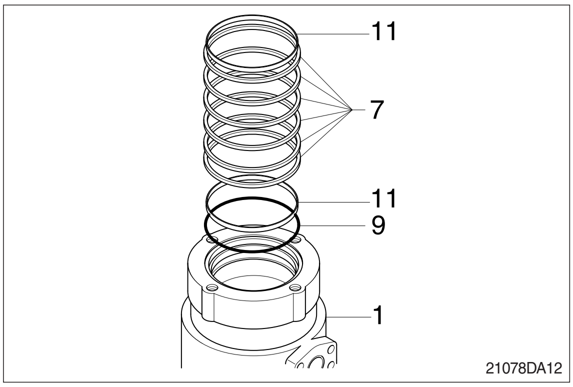


3) ASSEMBLY

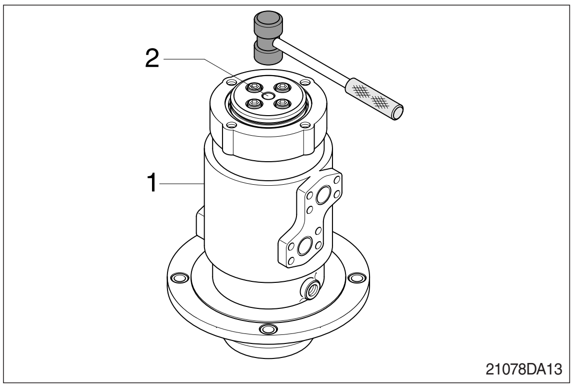
※ Clean all parts.
※ As a general rule, replace oil seals and O-ring.
※ Coat the sliding surfaces of all parts with engine oil or grease before installing.

(1) Fix seven slipper seal (7) and O-ring (9), two wear ring (11) to hub (1).

(2) Fit O-ring (8) to shaft (2).



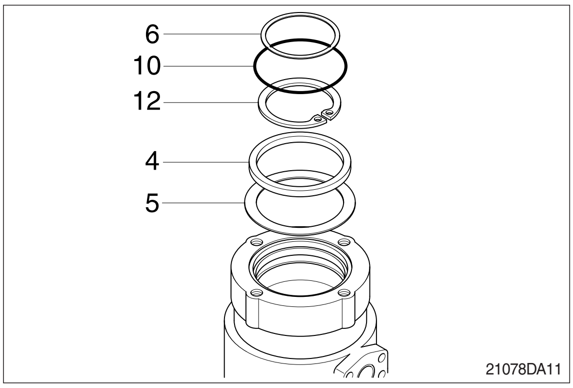
(3) Set shaft (2) on block, tap hub (1) with a plastic hammer to install.



(4) Fit shim (5), spacer (4) and retainer ring (12) to shaft (2).

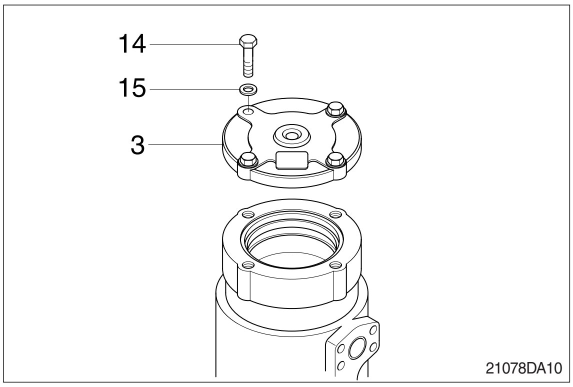
(5) Fit O-ring (10) to hub (1).

(6) Fit shim (6) to shaft (2).



(7) Install cover (3) to body (1) and tighten bolts (14).

· Torque : 10~12.5 kgf · m (72.3~90.4 lbf · ft)



GROUP 9 BOOM, ARM AND BUCKET CYLINDERS

1. REMOVAL AND INSTALL

1) BUCKET CYLINDER

(1) Removal

※ Expand the arm and bucket fully, lower the work equipment to the ground and stop the engine.

※ Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

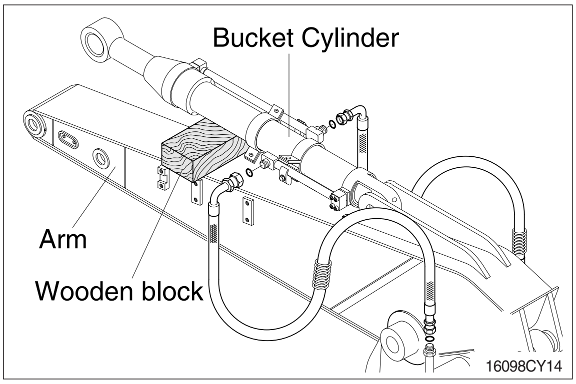
※ Loosen the breather slowly to release the pressure inside the hydraulic tank.

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

※ Fit blind plugs in the hoses after disconnecting them, to prevent dirt or dust from entering.


13031GE18

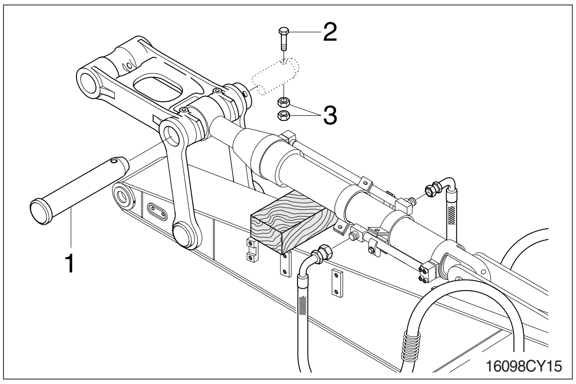
① Set block between bucket cylinder and arm.



16098CY14

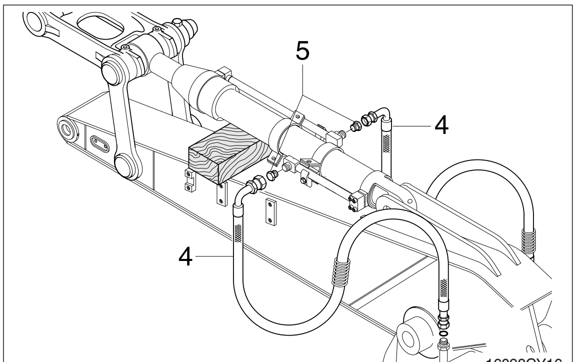
② Remove bolt (2), nut (3) and pull out pin (1).

※ Tie the rod with wire to prevent it from coming out.



16098CY15

③ Disconnect bucket cylinder hoses (4) and put plugs (5) on cylinder pipe.

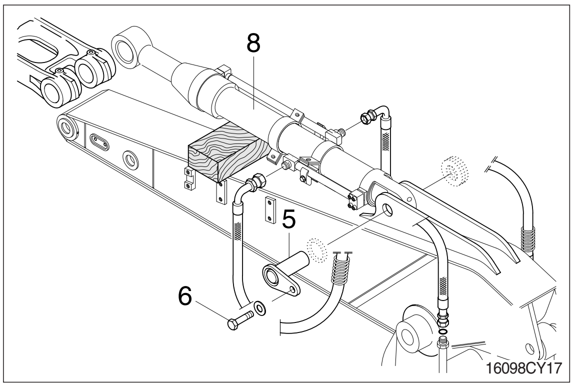


16098CY16

④ Sling bucket cylinder assembly (8) and remove bolt (6) then pull out pin (5).

⑤ Remove bucket cylinder assembly (8).

· Weight : 125 ㎏ (280 ℔)



(2) Install

① Carry out installation in the reverse order to removal.

⚠ **When aligning the mounting position of the pin, do not insert your fingers in the pin hole.**

※ Bleed the air from the bucket cylinder.

※ Confirm the hydraulic oil level and check the hydraulic oil leak or not.

2) ARM CYLINDER

(1) Removal

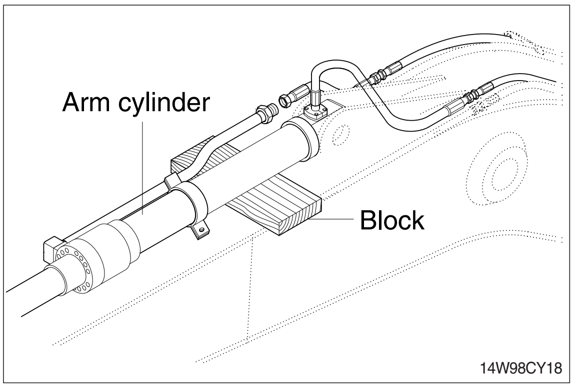
※ Expand the arm and bucket fully, lower the work equipment to the ground and stop the engine.

※ Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

※ Loosen the breather slowly to release the pressure inside the hydraulic tank.

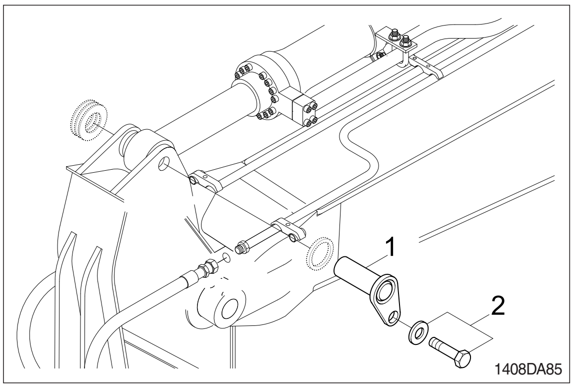
⚠ Escaping fluid under pressure can penetrate the skin causing serious injury. Fit blind plugs in the hoses after disconnecting them, to prevent dirt or dust from entering.

① Set block between arm cylinder and boom.



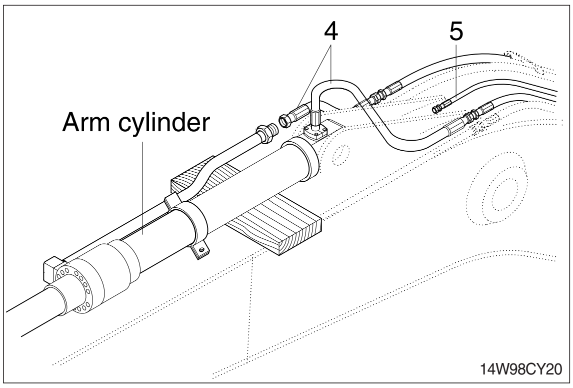
② Remove bolt (2) and pull out pin (1).

※ Tie the rod with wire to prevent it from coming out.



③ Disconnect arm cylinder hoses (4) and put plugs on cylinder pipe.

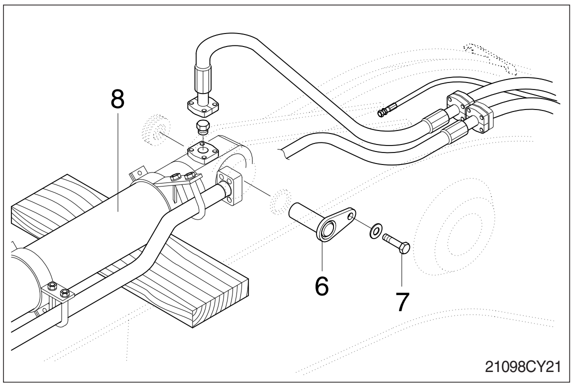
④ Disconnect greasing pipings (5).



⑤ Sling arm cylinder assembly(8) and remove bolt (7) then pull out pin (6).

⑥ Remove arm cylinder assembly (8).

- Weight : 180 ㎏ (400 ㍀)



(2) Install

① Carry out installation in the reverse order to removal.

⚠ **When aligning the mounting position of the pin, do not insert your fingers in the pin hole.**

※ Bleed the air from the arm cylinder.

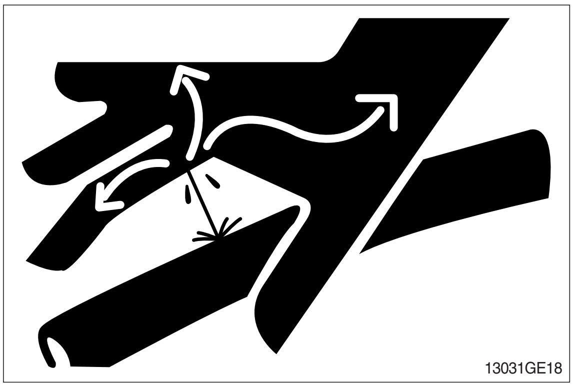
※ Confirm the hydraulic oil level and check the hydraulic oil leak or not.

3) BOOM CYLINDER

(1) Removal

※ Expand the arm and bucket fully, lower the work equipment to the ground and stop the engine.

※ Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.



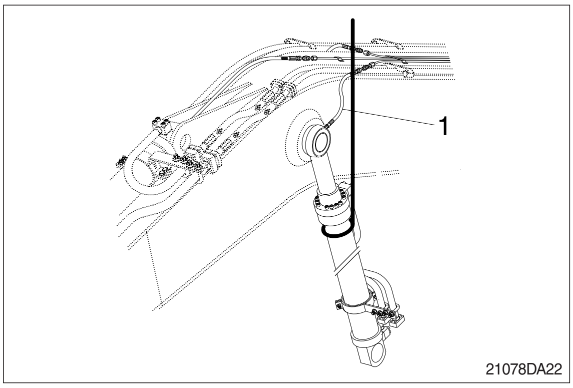
※ Loosen the breather slowly to release the pressure inside the hydraulic tank.

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

※ Fit blind plugs in the hoses after disconnecting them, to prevent dirt or dust from entering.

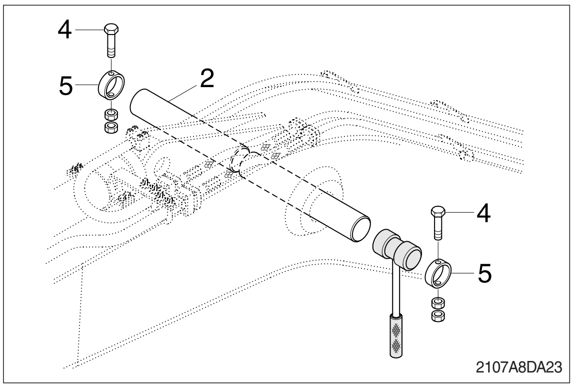
① Disconnect greasing hoses (1).

② Sling boom cylinder assembly.

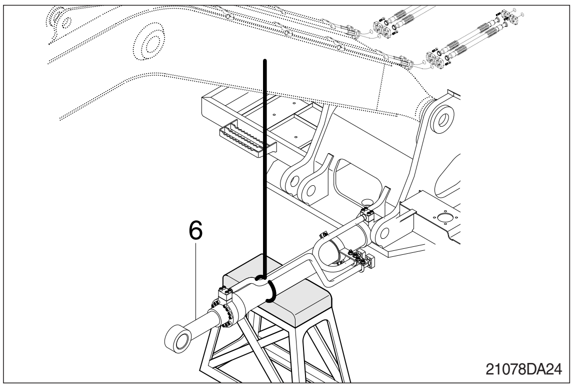


③ Remove bolt (4), stopper (5) and pull out pin (2).

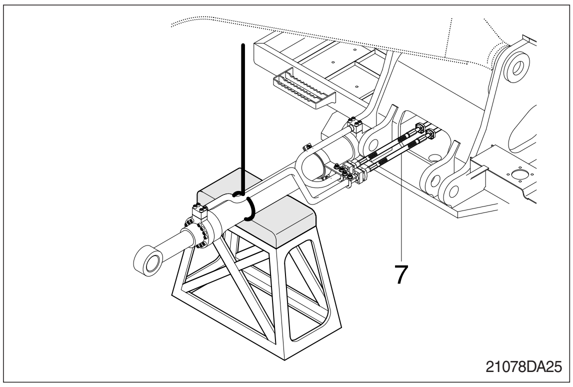
※ Tie the rod with wire to prevent it from coming out.



④ Lower the boom cylinder assembly (6) on a stand.



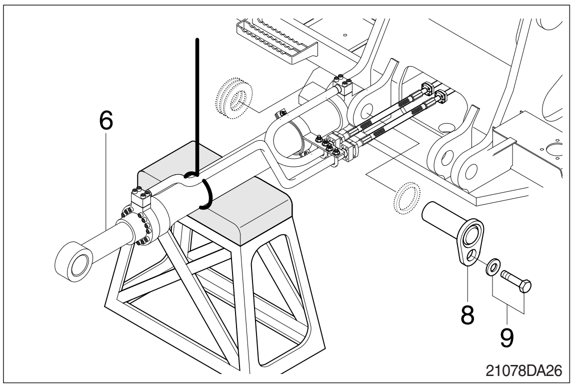
⑤ Disconnect boom cylinder hoses (7) and put plugs on cylinder pipe.



⑥ Remove bolt (9) and pull out pin (8).

⑦ Remove boom cylinder assembly (6).

· Weight : 155 ㎏ (340 ㏈)



(2) Install

① Carry out installation in the reverse order to removal.

⚠ **When aligning the mounting position of the pin, do not insert your fingers in the pin hole.**

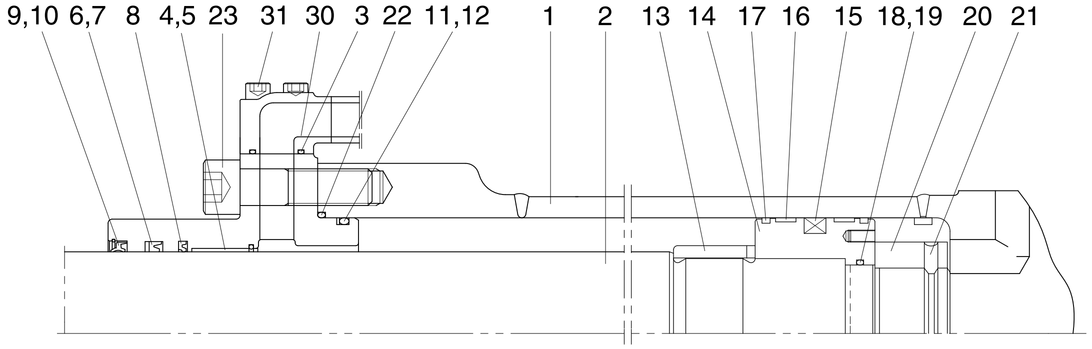
※ Bleed the air from the boom cylinder.

※ Conformed the hydraulic oil level and check the hydraulic oil leak or not.

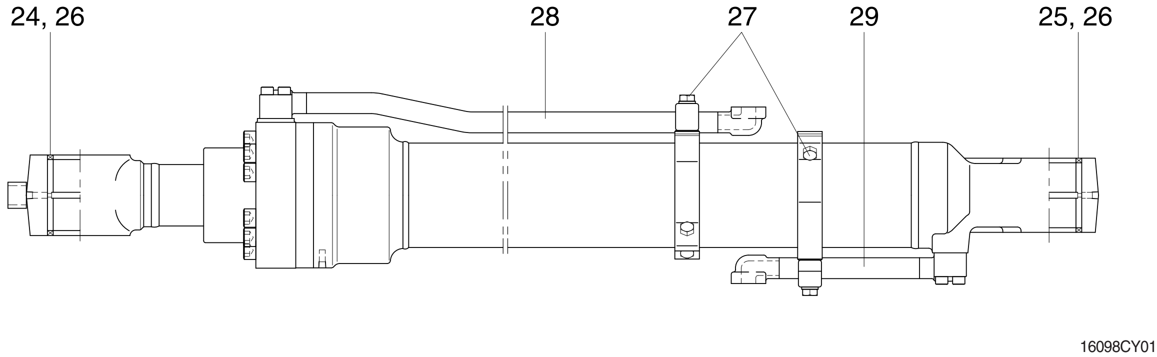
2. DISASSEMBLY AND ASSEMBLY

1) STRUCTURE

(1) Bucket cylinder

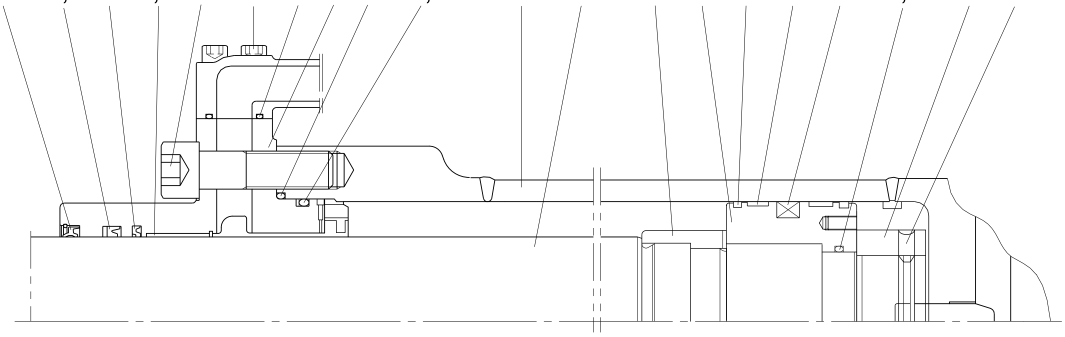


Internal detail

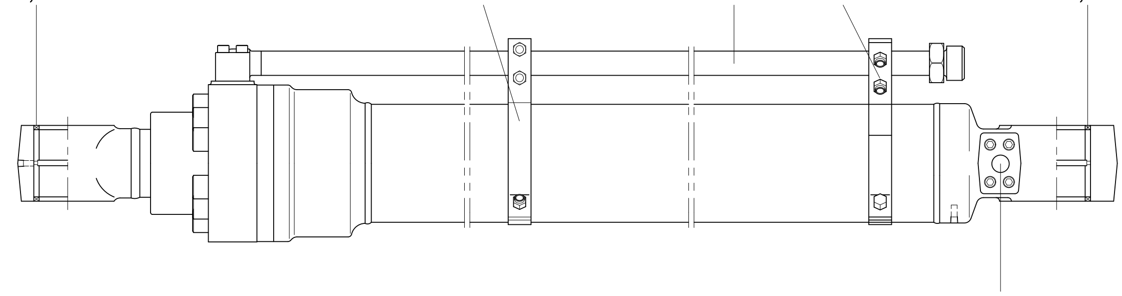


1	Tube assembly	12	Back up ring	23	Hexagon socket head bolt
2	Rod assembly	13	Cushion ring	24	Pin bushing
3	Gland	14	Piston	25	Pin bushing
4	DD2 bushing	15	Piston seal	26	Dust seal
5	Snap ring	16	Wear ring	27	Band assembly
6	Rod seal	17	Dust ring	28	Pipe assembly-R
7	Back up ring	18	O-ring	29	Pipe assembly-B
8	Buffer ring	19	Back up ring	30	O-ring
9	Dust wiper	20	Lock nut	31	Hexagon socket head bolt
10	Snap ring	21	Hexagon socket set screw		
11	O-ring	22	O-ring		

(2) Arm cylinder

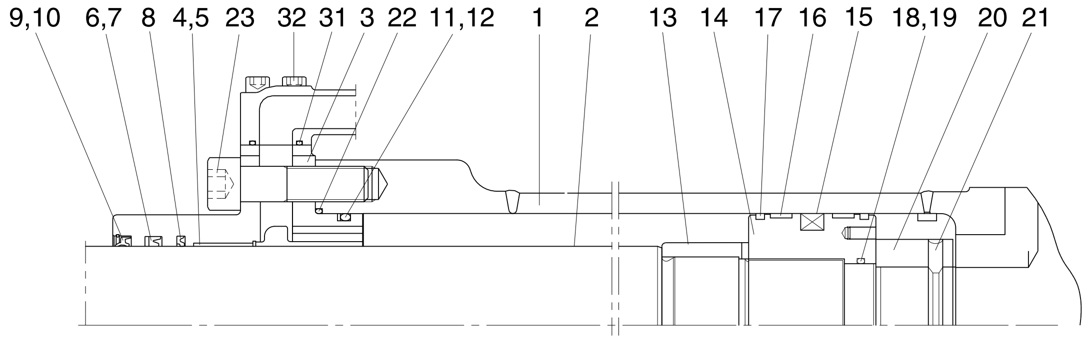


Internal detail

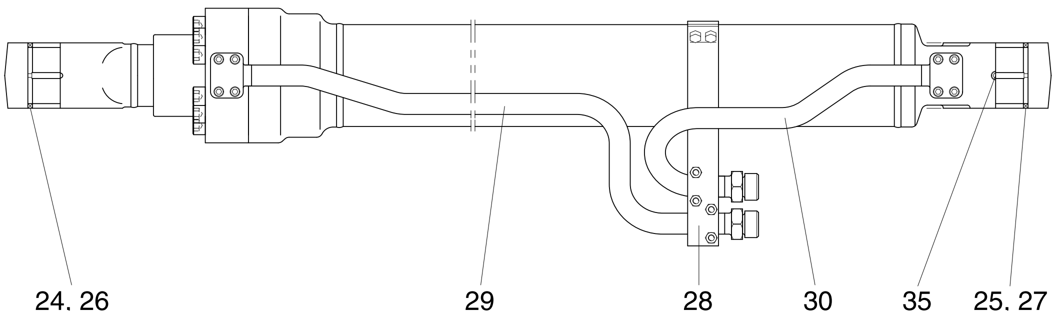


1	Tube assembly	13	Cushion ring	25	Dust seal
2	Rod assembly	14	Piston	26	Check valve
3	Gland	15	Piston seal	27	Coil spring
4	DD2 bushing	16	Wear ring	28	O-ring
5	Snap ring	17	Dust ring	29	Plug
6	Rod seal	18	O-ring	30	Band assembly-R
7	Back up ring	19	Back up ring	31	Band assembly-B
8	Buffer ring	20	Lock nut	32	Pipe assembly-R
9	Dust wiper	21	Hexagon socket set screw	33	O-ring
10	Snap ring	22	O-ring	34	Hexagon socket head bolt
11	O-ring	23	Hexagon socket head bolt		
12	Back up ring	24	Pin bushing		

(3) Boom cylinder

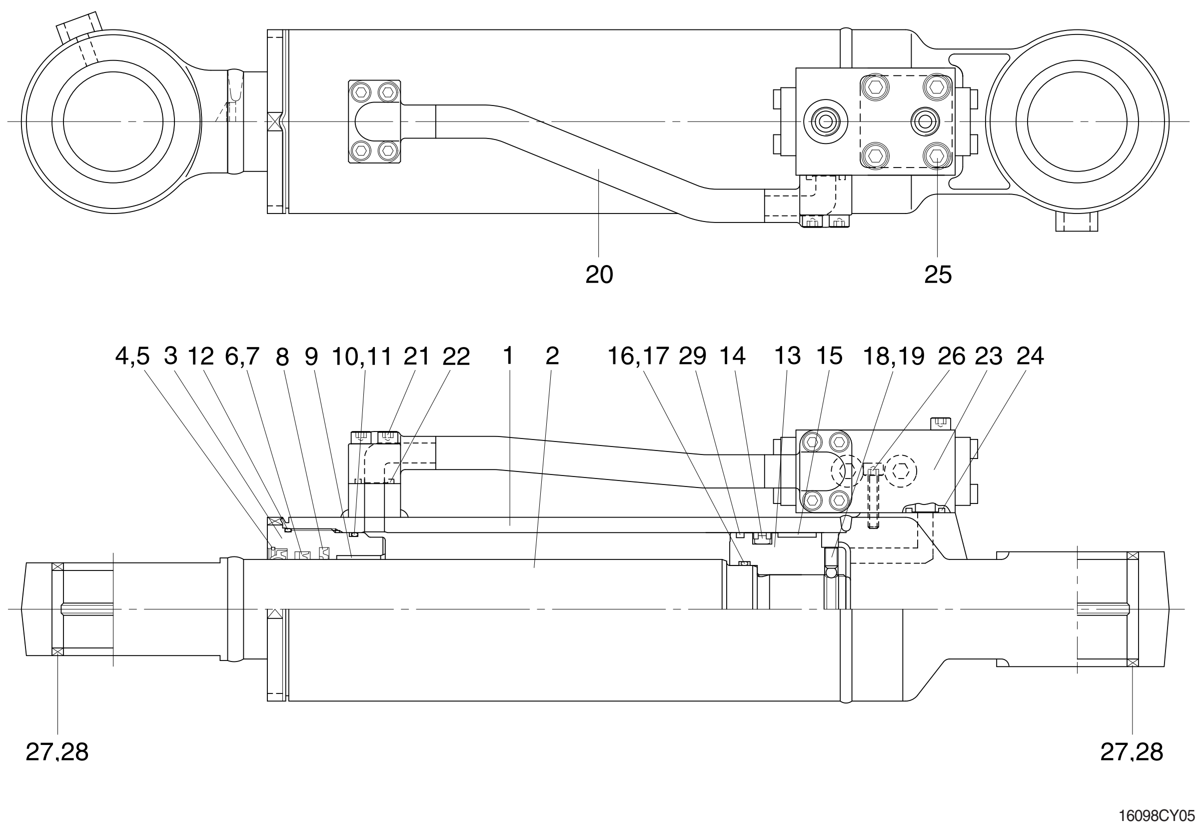


Internal detail



1	Tube assembly
2	Rod assembly
3	Gland
4	DD2 bushing
5	Snap ring
6	Rod seal
7	Back up ring
8	Buffer ring
9	Dust wiper
10	Snap ring
11	O-ring
12	Back up ring
13	Cushion ring
14	Piston
15	Piston seal
16	Wear ring
17	Dust ring
18	O-ring
19	Back up ring
20	Lock nut
21	Hexagon socket set screw
22	O-ring
23	Hexagon socket head bolt
24	Pin bushing
25	Pin bushing
26	Dust seal
27	Dust seal
28	Band assembly
29	Pipe assembly-R
30	Pipe assembly-B
31	O-ring
32	Hexagon socket head bolt

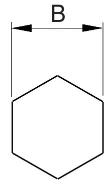
(4) Dozer cylinder



1	Tube assembly	11	Back up ring	21	Hexagon socket head bolt
2	Rod assembly	12	O-ring	22	O-ring
3	Gland	13	Piston	23	Check valve assembly
4	Dust wiper	14	Piston seal	24	O-ring
5	Retainer ring	15	Wear ring	25	Hexagon socket head bolt
6	Rod seal	16	O-ring	26	Hexagon socket head bolt
7	Back up ring	17	Back up ring	27	Pin bushing
8	Buffer ring	18	Steel ball	28	Dust seal
9	DU bushing	19	Set screw	29	Dust ring
10	O-ring	20	Pipe assembly		

2) TOOLS AND TIGHTENING TORQUE

(1) Tools

Tool name	Remark	
Allen wrench	6	
	8	
	14	
	17	
Spanner	7	
	8	
(-) Driver	Small and large sizes	
Torque wrench	Capable of tightening with the specified torques	

(2) Tightening torque

Part name		Item	Size	Torque	
				kgf · m	lbf · ft
Gland mounting socket head bolt	Bucket cylinder	23	M14 × 2.0	15 ± 2.0	108 ± 14.5
	Boom cylinder		M16 × 2.0	23 ± 2.0	166 ± 14.5
	Arm cylinder		M16 × 2.0	23 ± 2.0	166 ± 14.5
	Dozer cylinder	21	M 8 × 1.25	2.7 ± 0.3	19.5 ± 2.2
		25	M10 × 1.5	5.4 ± 0.5	39.1 ± 3.6
Pipe mounting socket head bolt	Bucket	31	M10 × 1.5	5.4 ± 0.5	39.1 ± 3.6
	Boom	32			
	Arm	34			
Lock nut	Bucket cylinder	20	M52 × 2.0	100 ± 10.0	723 ± 72.3
	Boom cylinder		M56 × 2.0		
	Arm cylinder		M56 × 2.0		
Piston	Bucket cylinder	14	-	150 ± 15.0	1085 ± 109
	Boom cylinder				
	Arm cylinder				
	Dozer cylinder - Rear	13	M68 × 3.0	170 ± 17.0	1230 ± 123
Set screw	Bucket cylinder	21	M 8 × 1.25	2.7 ± 0.3	19.5 ± 2.2
	Boom cylinder				
	Arm cylinder				
	Dozer cylinder - Rear	19			

3) DISASSEMBLY

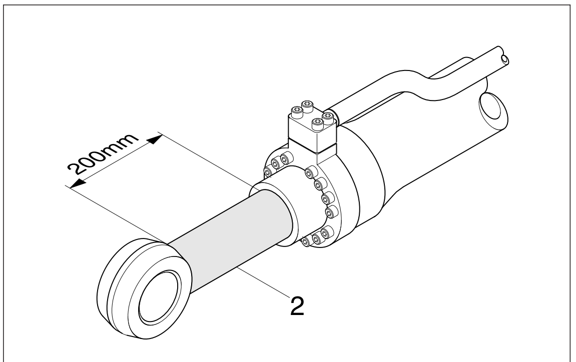
(1) Remove cylinder head and piston rod

※ Procedures are based on the bucket cylinder.

① Hold the clevis section of the tube in a vise.

※ Use mouth pieces so as not to damage the machined surface of the cylinder tube. Do not make use of the outside piping as a locking means.

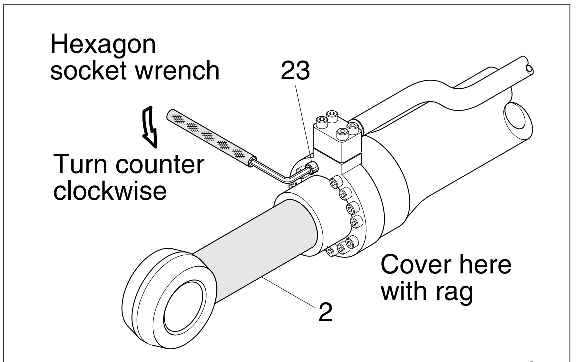
② Pull out rod assembly (2) about 200 mm (7.1 in). Because the rod assembly is rather heavy, finish extending it with air pressure after the oil draining operation.



21078DA30

③ Loosen and remove socket bolts (23) of the gland in sequence.

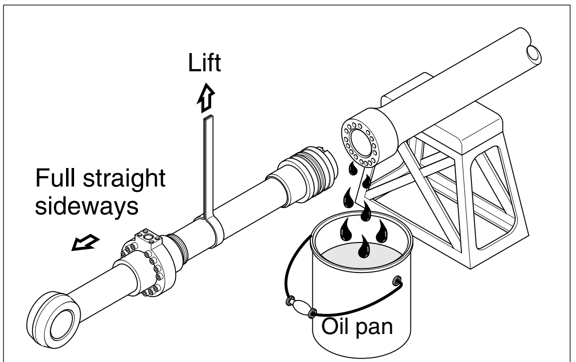
※ Cover the extracted rod assembly (2) with rag to prevent it from being accidentally damaged during operation.



16098CY31

④ Draw out cylinder head and rod assembly together from tube assembly (1).

※ Since the rod assembly is heavy in this case, lift the tip of the rod assembly (2) with a crane or some means and draw it out. However, when rod assembly (2) has been drawn out to approximately two thirds of its length, lift it in its center to draw it completely.



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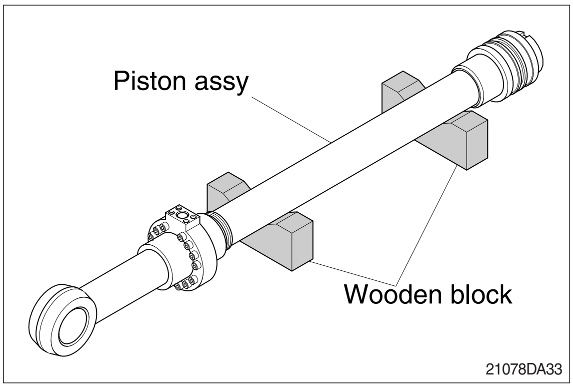
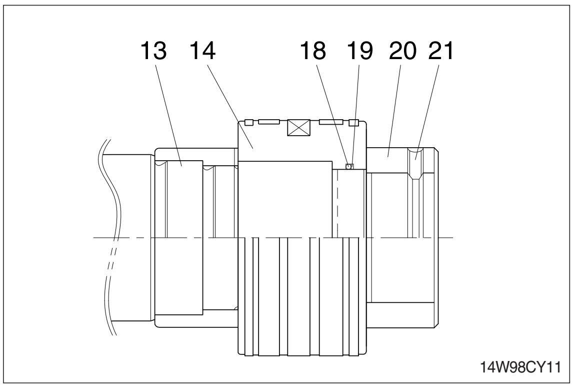
Note that the plated surface of rod assembly (2) is to be lifted. For this reason, do not use a wire sling and others that may damage it, but use a strong cloth belt or a rope.

⑤ Place the removed rod assembly on a wooden V-block that is set level.
※ Cover a V-block with soft rag.

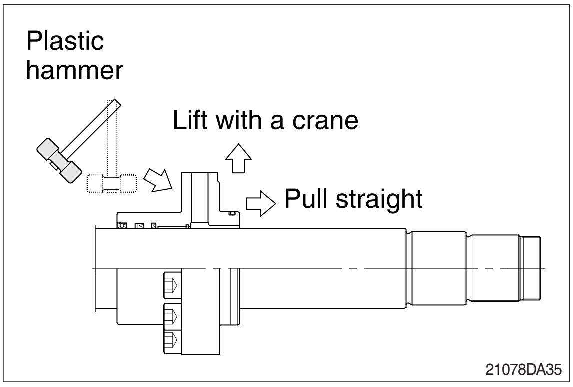


(2) Remove piston and cylinder head

① Remove set screw (21).
※ Since set screw (21) and lock nut (20) is tightened to a high torque, use a hydraulic and power wrench that utilizers a hydraulic cylinder, to remove the lock set screw (21) and lock nut (20).
② Remove piston assembly (14), back up ring (19), and O-ring (18).



③ Remove the cylinder head assembly from rod assembly (2).
※ If it is too heavy to move, move it by striking the flanged part of cylinder head with a plastic hammer.
※ Pull it straight with cylinder head assembly lifted with a crane.
Exercise care so as not to damage the lip of rod bushing (4) and packing (5, 6, 7, 8, 9, 10) by the threads of rod assembly (2).

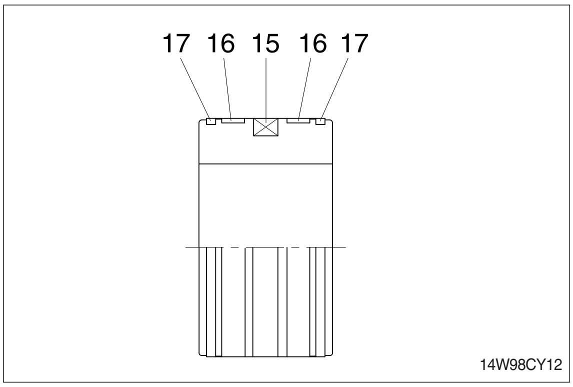


(3) Disassemble the piston assembly

① Remove wear ring (16).

② Remove dust ring (17) and piston seal (15).

※ Exercise care in this operation not to damage the grooves.



(4) Disassemble cylinder head assembly

① Remove back up ring (12) and O-ring (11).

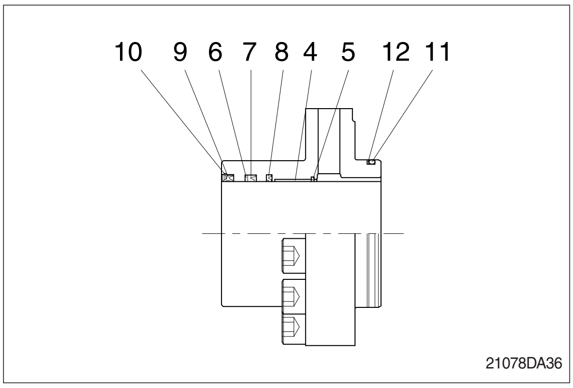
② Remove snap ring (10), dust wiper (9).

③ Remove back up ring (7), rod seal (6) and buffer ring (8).

※ Exercise care in this operation not to damage the grooves.

※ Do not remove seal and ring, if does not damaged.

※ Do not remove bushing (4).

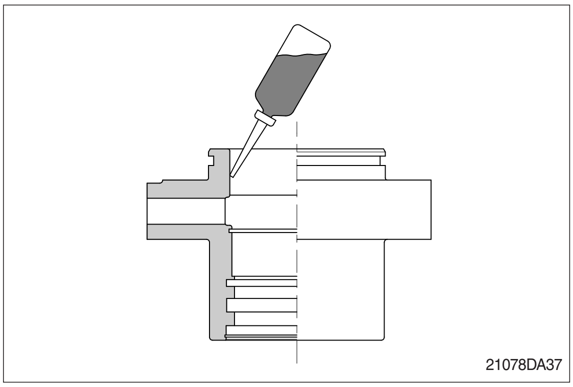


3) ASSEMBLY

(1) Assemble cylinder head assembly

※ Check for scratches or rough surfaces if found smooth with an oil stone.

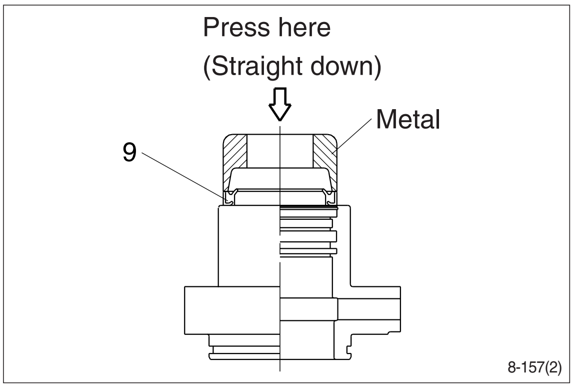
① Coat the inner face of gland (3) with hydraulic oil.



21078DA37

② Coat dust wiper (9) with grease and fit dust wiper (9) to the bottom of the hole of dust seal.
At this time, press a pad metal to the metal ring of dust seal.

③ Fit snap ring (10) to the stop face.

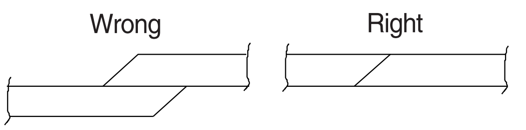


8-157(2)

④ Fit back up ring (7), rod seal (6) and buffer ring (8) to corresponding grooves, in that order.

※ Coat each packing with hydraulic oil before fitting it.

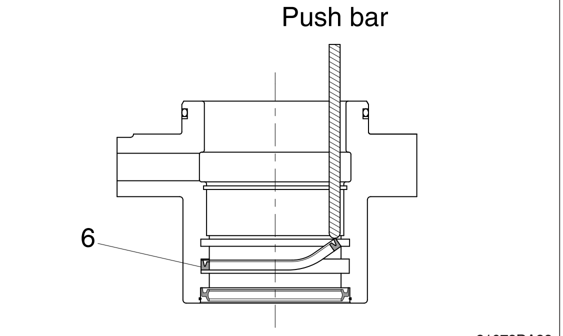
※ Insert the backup ring until one side of it is inserted into groove.



8-157(3)

※ Rod seal (6) has its own fitting direction. Therefore, confirm it before fitting them.

※ Fitting rod seal (6) upside down may damage its lip. Therefore check the correct direction that is shown in fig.



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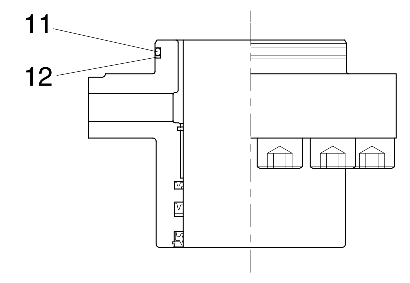
⑤ Fit back up ring (12) to gland (3).
※ Put the backup ring in the warm water of 30~50˚C.
⑥ Fit O-ring (11) to gland (3).



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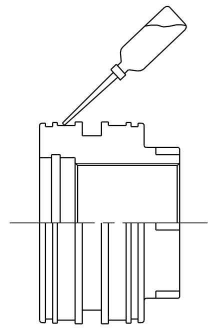
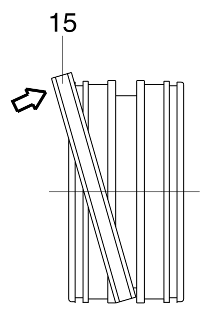
(2) Assemble piston assembly
※ Check for scratches or rough surfaces. If found smooth with an oil stone.
① Coat the outer face of piston (14) with hydraulic oil.



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.



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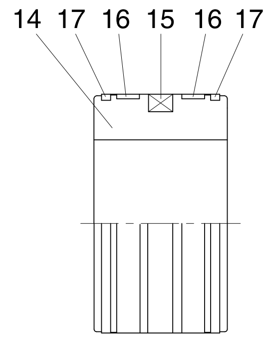
③ Fit wear ring (16) and dust ring (17) to piston (14).



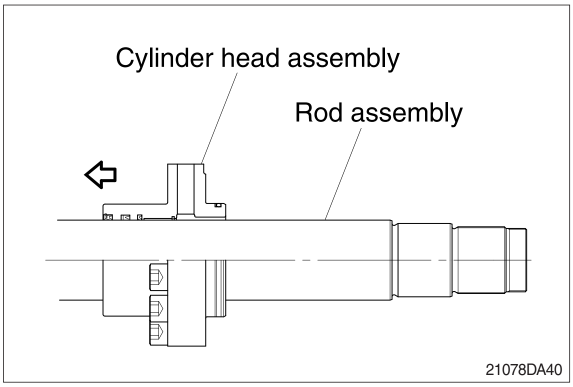
14W98CY13

(3) Install piston and cylinder head

① Fix the rod assembly to the work bench.

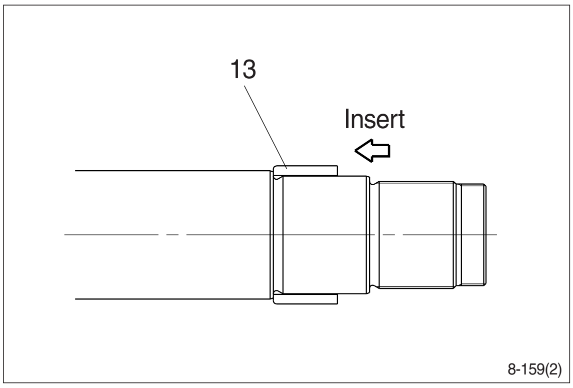
② Apply hydraulic oil to the outer surface of rod assembly (2), the inner surface of piston and cylinder head.

③ Insert cylinder head assembly to rod assembly.



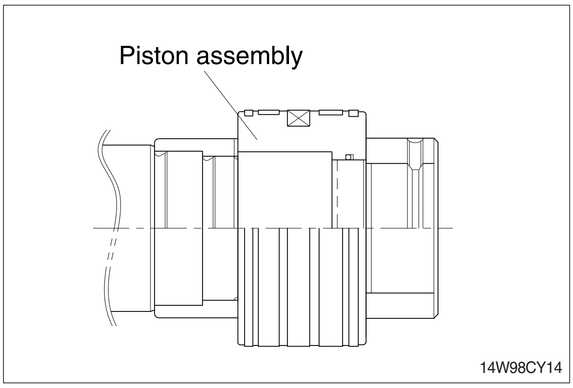
④ Insert cushion ring (13) to rod assembly.

※ Note that cushion ring (13) has a direction in which it should be fitted.



⑤ Fit piston assembly to rod assembly.

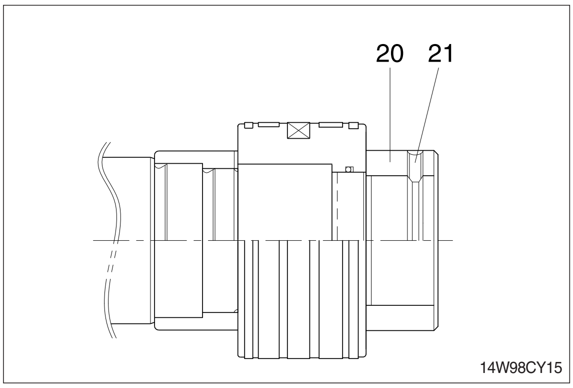
· Tightening torque : 150±15 kgf · m (1085±108 lbf · ft)



⑥ Fit lock nut (20) and tighten the screw (21).

· Tightening torque :

Item		kgf · m	lbf · ft
20	Bucket	100±10	723±72.3
	Boom		
	Arm		
21		2.7±0.3	19.5±2.2



(3) Overall assemble

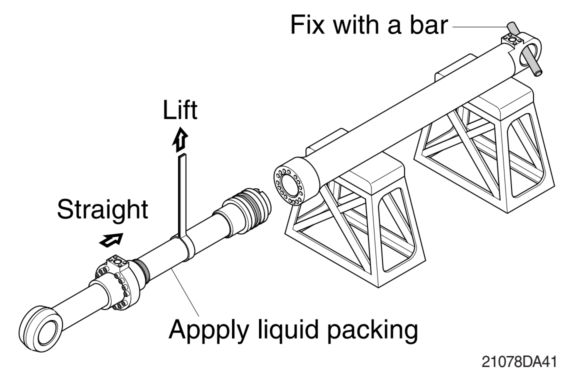
① Place a V-block on a rigid work bench. Mount the tube assembly (1) on it and fix the assembly by passing a bar through the clevis pin hole to lock the assembly.

② Insert the rod assembly in to the tube assembly, while lifting and moving the rod assembly with a crane.

※ Be careful not to damage piston seal by thread of tube assembly.

③ Match the bolt holes in the cylinder head flange to the tapped holes in the tube assembly and tighten socket bolts to a specified torque.

※ Refer to the table of tightening torque.



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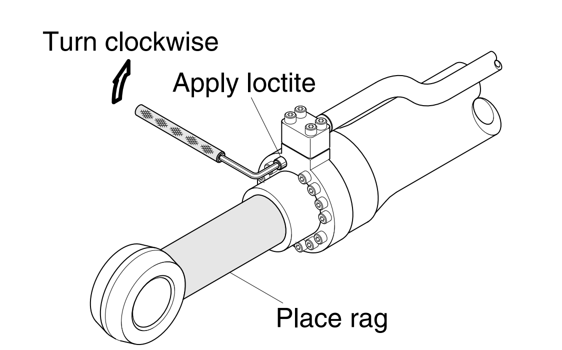


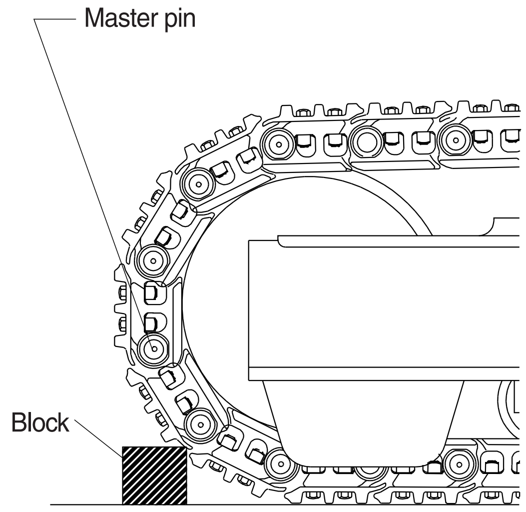
21078DA42

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.



8-161(1)

(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.

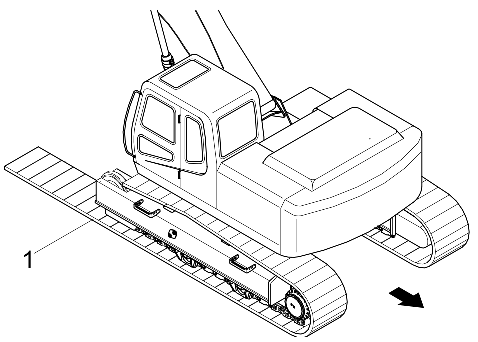
※ Unscrew the grease nipple after release the tension by pushing the poppet only when necessarily required.
Grease leaking hole is not existing. So, while unscrew the grease nipple, grease is not leaking until the grease nipple is completely coming out. If the tension is not released in advance, the 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.

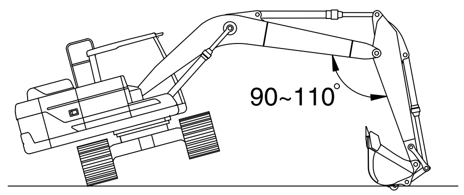


1408DA100

2) INSTALL

(1) Carry out installation in the reverse order to removal.

※ Adjust the tension of the track link.

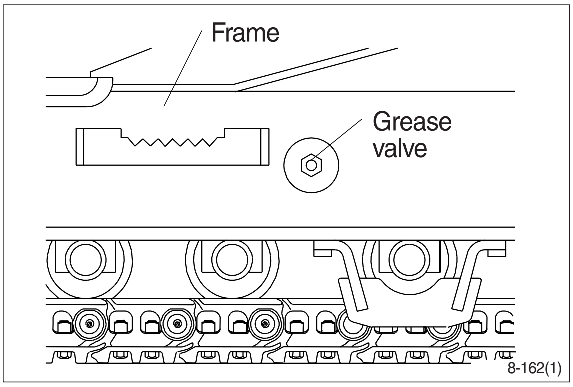


160F8UC05

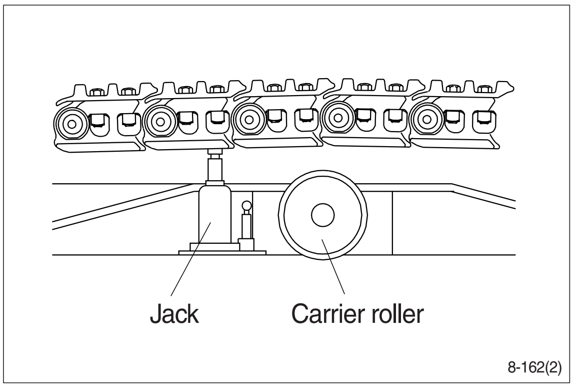
2. CARRIER ROLLER

1) REMOVAL

(1) Loosen tension of the track link.



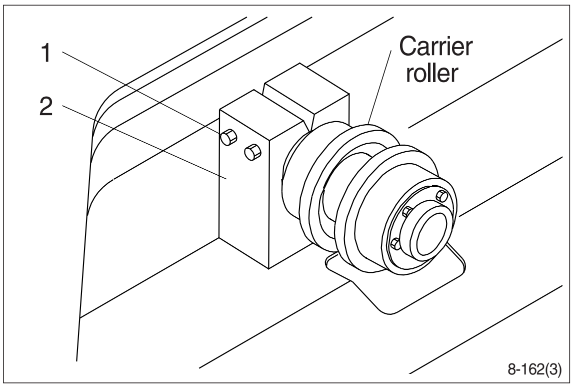
(2) Jack up the track link height enough to permit carrier roller removal.



(3) Loosen the lock nut (1).

(4) Open bracket(2) with a screwdriver, push out from inside, and remove carrier roller assembly.

· Weight : 20 kg (45 lb)



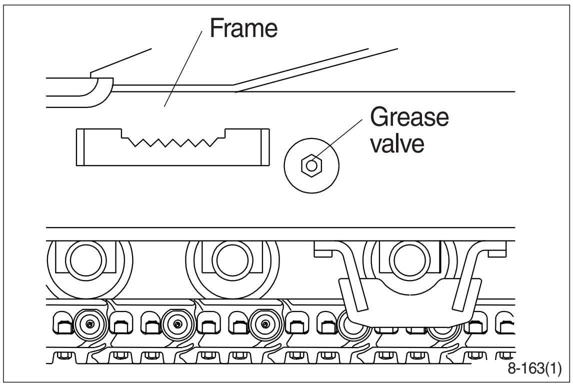
2) INSTALL

(1) Carry out installation in the reverse order to removal.

3. TRACK ROLLER

1) REMOVAL

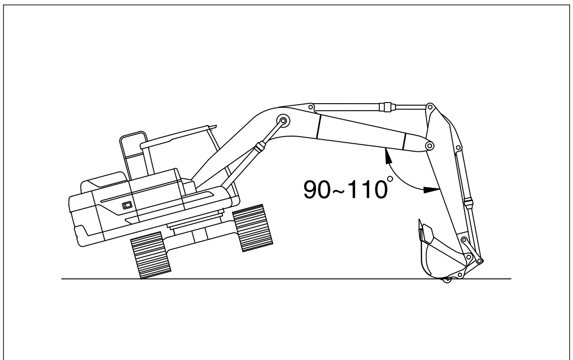
(1) Loosen tension of the track link.



8-163(1)

(2) Using the work equipment, push up track frame on side which is to be removed.

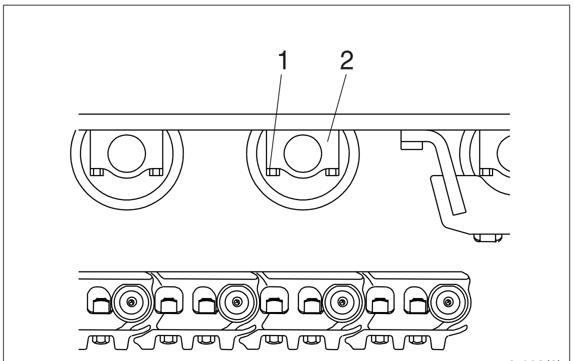
※ After jack up the machine, set a block under the unit.



160F8UC05

(3) Remove the mounting bolt (1) and draw out the track roller (2).

· Weight : 45 kg (100 lb)



8-163(3)

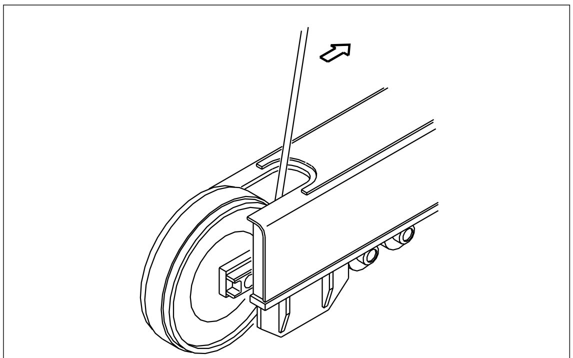
2) INSTALL

(1) Carry out installation in the reverse order to removal.

4. IDLER AND RECOIL SPRING

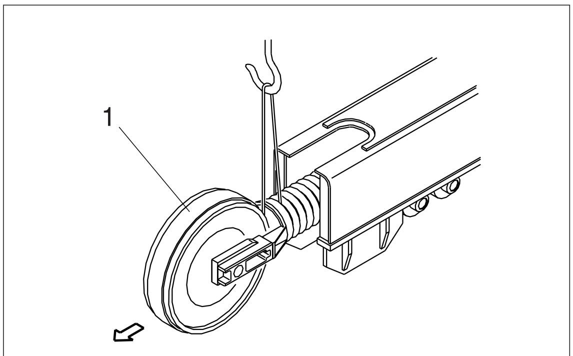
1) REMOVAL

(1) Remove the track link.
For detail, see removal of track link.



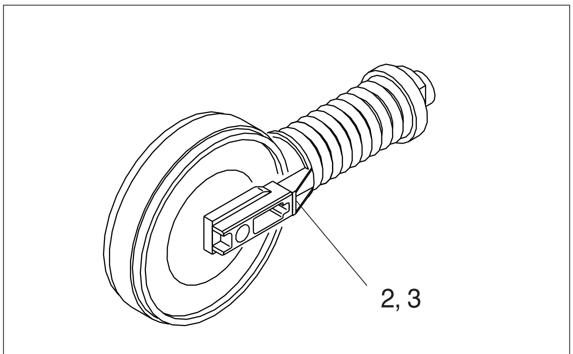
8-164(1)

(2) Sling the recoil spring (1) and pull out idler and recoil spring assembly from track frame, using a pry.
· Weight : 300 kg (660 lb)



8-164(2)

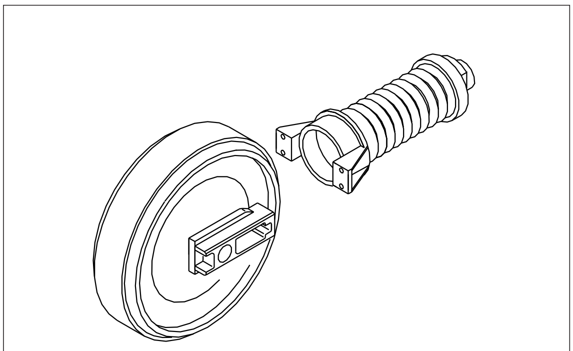
(3) Remove the bolts (2), washers (3) and separate ilder from recoil spring.



8-164(3)

2) INSTALL

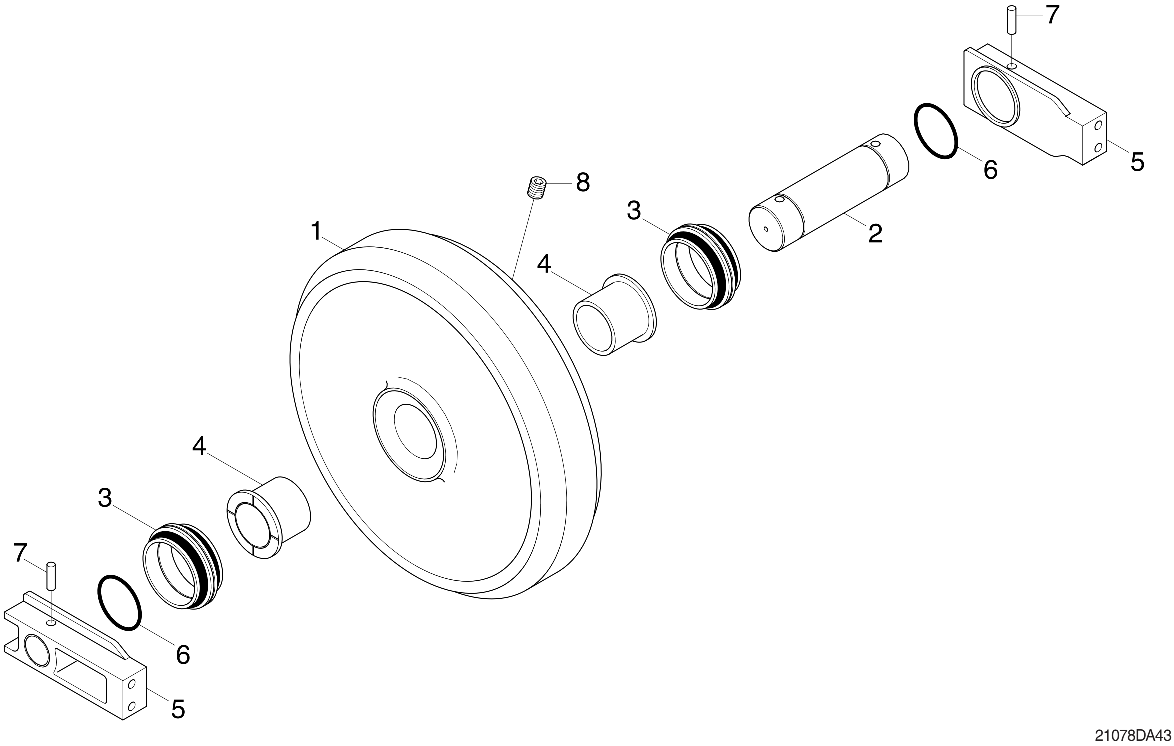
(1) Carry out installation in the reverse order to removal.
※ Make sure that the boss on the end face of the recoil cylinder rod is in the hole of the track frame.



8-164(4)

3) DISASSEMBLY AND ASSEMBLY OF IDLER

(1) Structure

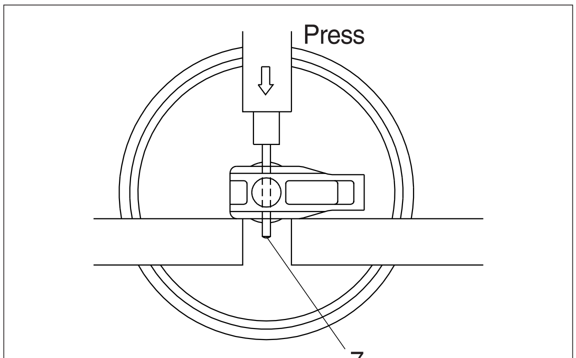


1	Shell	4	Bushing	7	Spring pin
2	Shaft	5	Bracket	8	Plug
3	Seal assembly	6	O-ring		

(2) Disassembly

① Remove plug and drain oil.

② Draw out the spring pin (7), using a press.

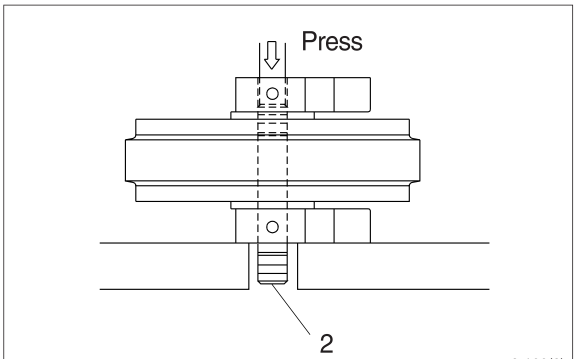


8-166(1)

③ Pull out the shaft (2) with a press.

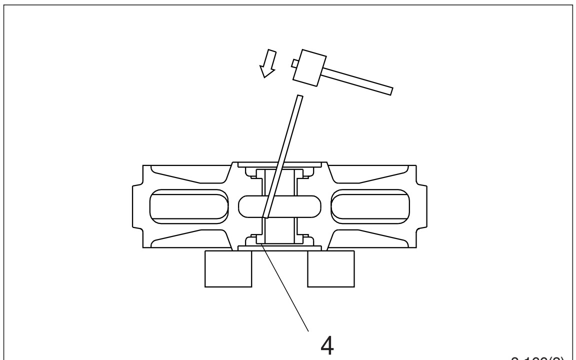
④ Remove seal (3) from idler (1) and bracket (5).

⑤ Remove O-ring (6) from shaft.



8-166(2)

⑥ Remove the bushing (4) from idler, using a special tool.
Only remove bushing if replacement is necessity.



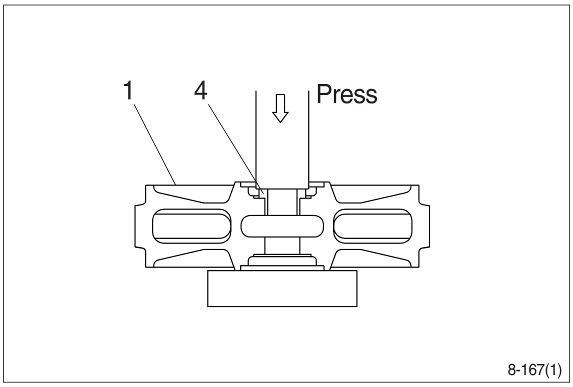
8-166(3)

(3) Assembly

※ Before assembly, clean the parts.

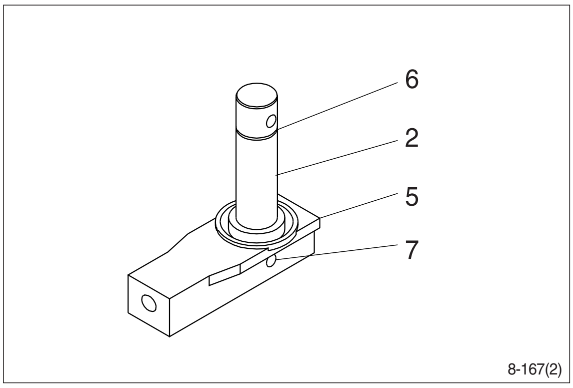
※ Coat the sliding surfaces of all parts with oil.

① Cool up bushing (4) fully by some dry ice and press it into shell (1).
Do not press it at the normal temperature, or not knock in with a hammer even after the cooling.

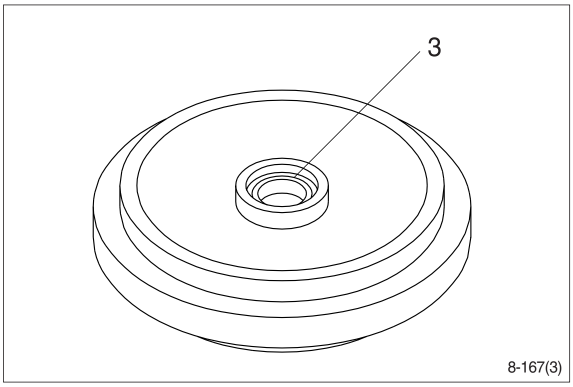


② Coat O-ring (6) with grease thinly, and install it to shaft (2).

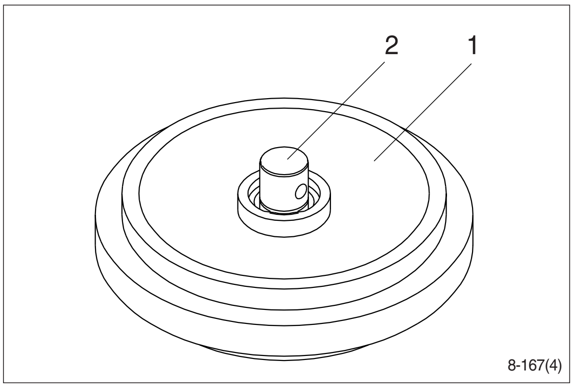
③ Insert shaft (2) into bracket (5) and drive in the spring pin (7).



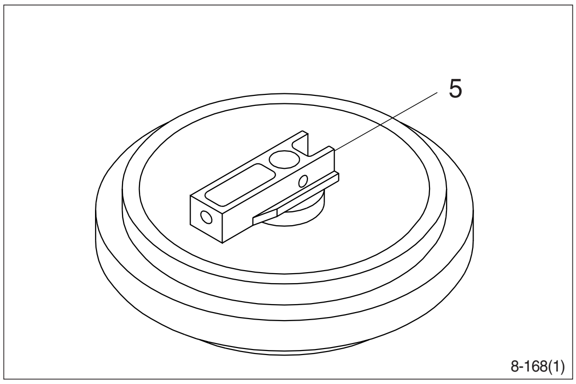
④ Install seal (3) to shell (1) and bracket (5).



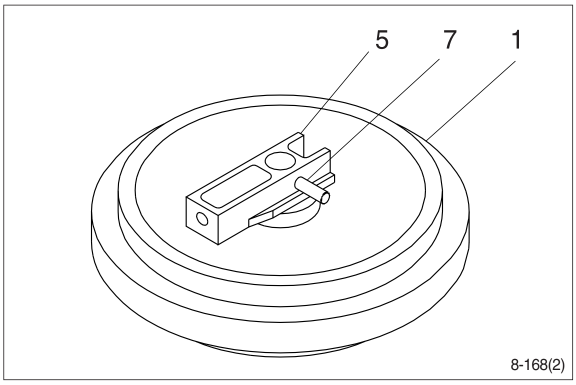
⑤ Install shaft (2) to shell (1).



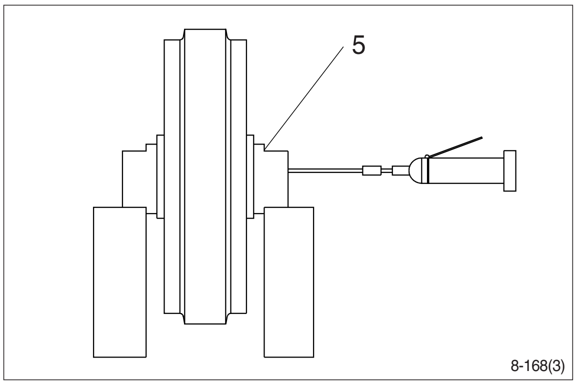
⑥ Install bracket (5) attached with seal (3).



⑦ Knock in the spring pin (7) with a hammer.

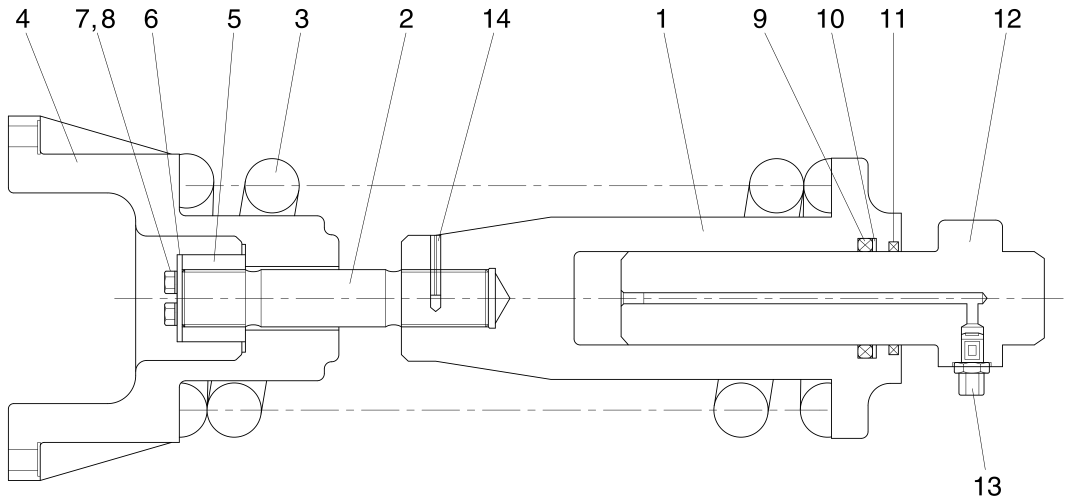


⑧ Lay bracket (5) on its side.
Supply engine oil to the specified level, and tighten plug.



4) DISASSEMBLY AND ASSEMBLY OF RECOIL SPRING

(1) Structure



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1	Body	6	Lock plate	11	Dust seal
2	Tie bar	7	Bolt	12	Rod
3	Spring	8	Spring washer	13	Grease valve
4	Bracket	9	Rod packing	14	Spring pin
5	Lock nut	10	Back up ring		

(2) Disassembly

① Apply pressure on spring (3) with a press.

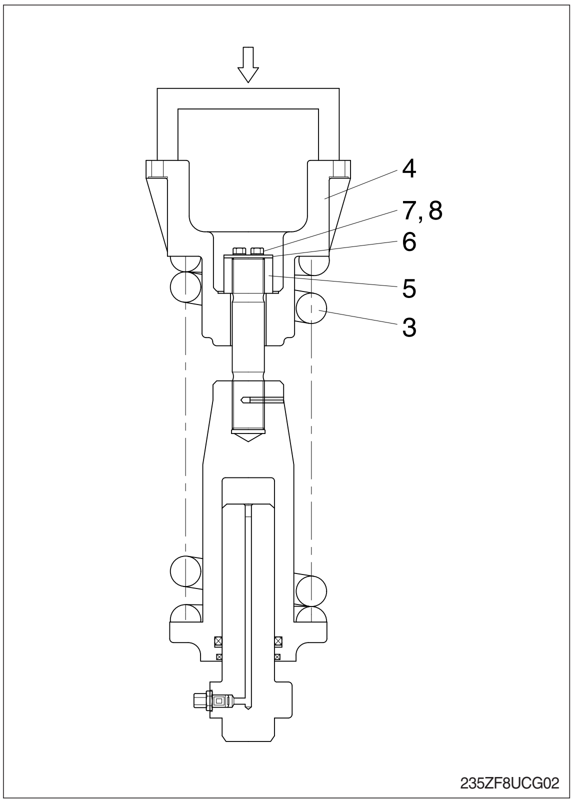
※ The spring is under a large installed load. This is dangerous, so be sure to set properly.

· Spring set load : 11908 ㎏ (26253 ㏈)

② Remove bolt (7), spring washer (8) and lock plate (6).

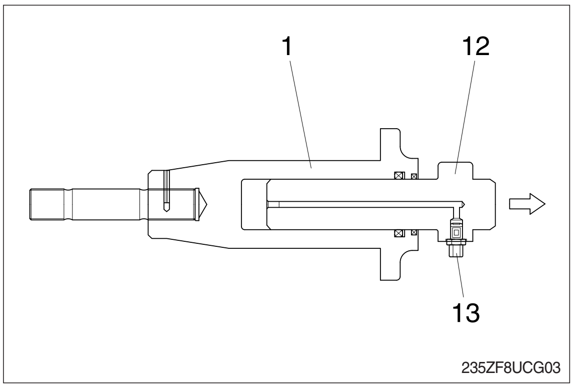
③ Remove lock nut (5).
Take enough notice so that the press which pushes down the spring, should not be slipped out in its operation.

④ Lighten the press load slowly and remove bracket (4) and spring (3).

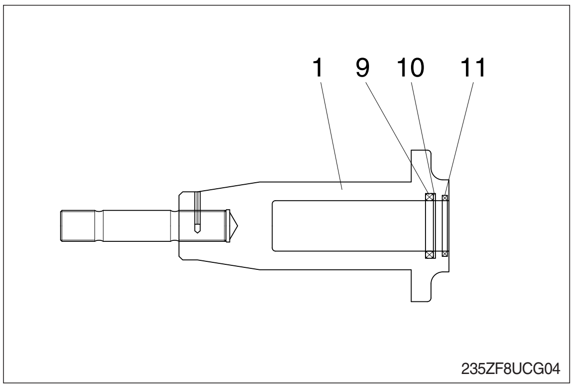


⑤ Remove rod (12) from body (1).

⑥ Remove grease valve (13) from rod (12).



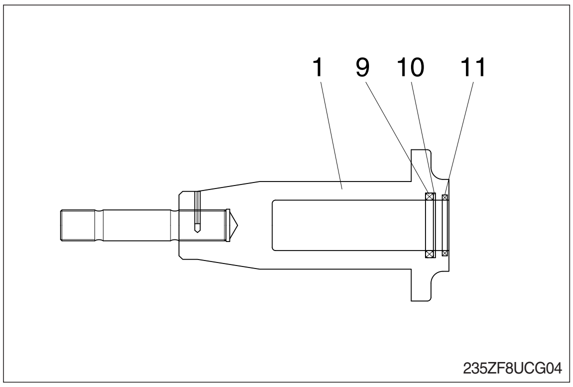
⑦ Remove rod packing (9), back up ring (10) and dust seal (11).



(3) Assembly

Install dust seal (11), back up ring (10) and rod packing (9) to body (1).

※ When installing dust seal (11) and rod packing (9), take full care so as not to damage the lip.



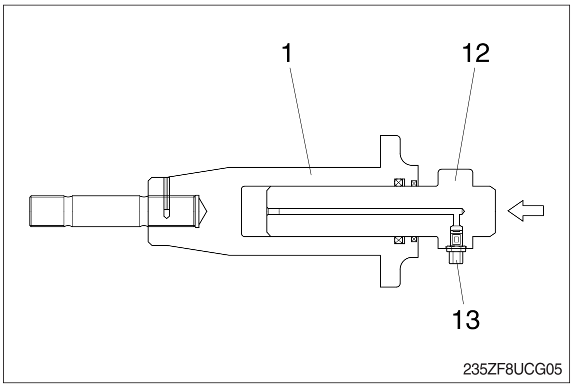
② Pour grease into body (1), then push in rod (12) by hand.

After take grease out of grease valve mounting hole, let air out.

※ If air letting is not sufficient, it may be difficult to adjust the tension of crawler.

③ Fit grease valve (13) to rod (12).

· Tightening torque : 13±1.0 kgf · m (94.0±7.2 lbf · ft)



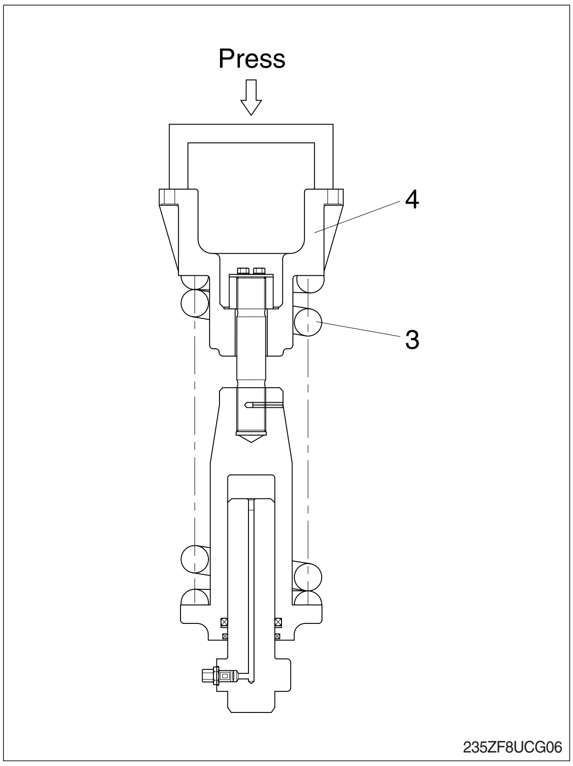
④ Install spring (3) and bracket (4) to body (1).

⑤ Apply pressure to spring (3) with a press and tighten lock nut (5).

· Tightening torque : 15±0.5 kgf·m (108±3.6 lbf·ft)

※ Apply sealant before assembling.

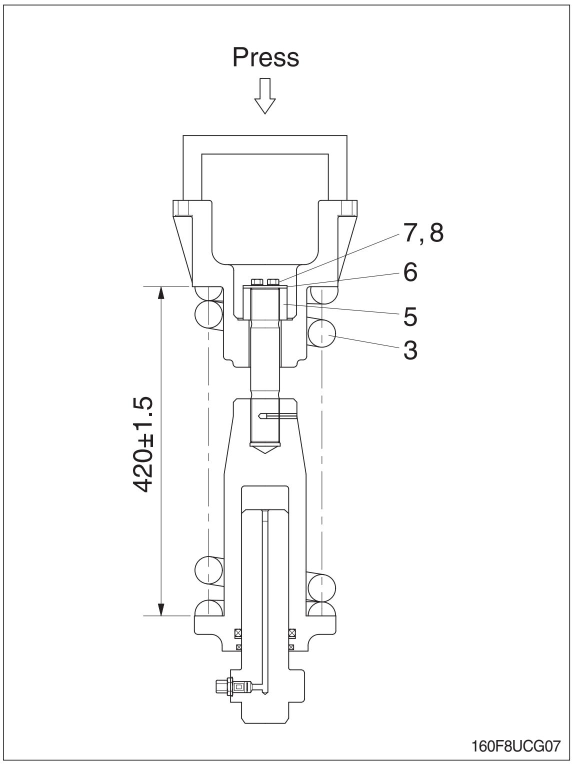
※ During the operation, pay attention specially to prevent the press from slipping out.



⑥ Lighten the press load and confirm the set length of spring (3).

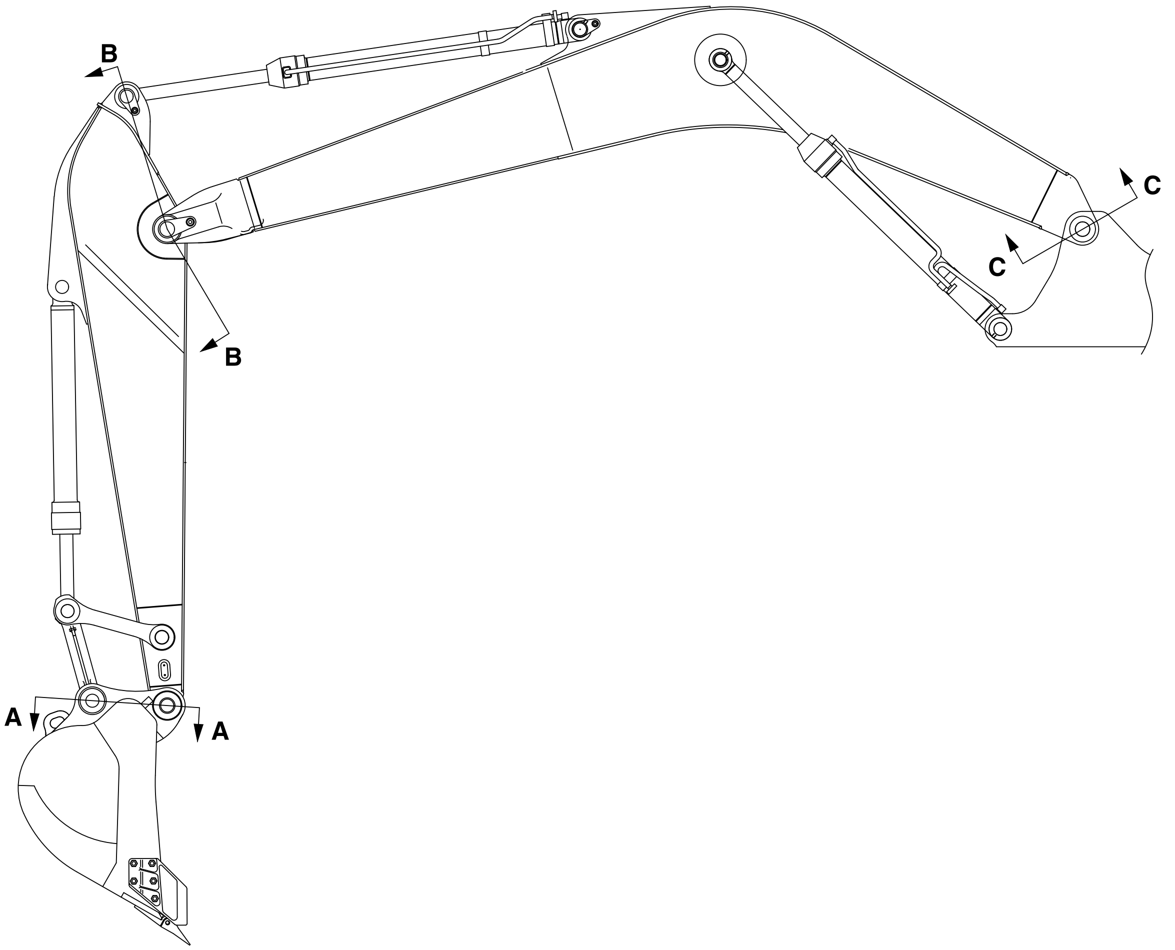
· Spring install dimension : 420 ± 1.5 mm (17 ± 0.06 in)

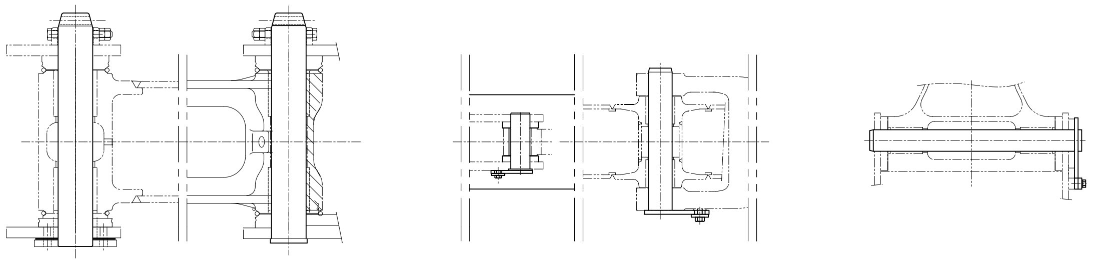
⑦ After the setting of spring (3), install lock plate (6), spring washer (8) and bolt (7).



GROUP 11 WORK EQUIPMENT

1. STRUCTURE





SECTION A SECTION B SECTION C

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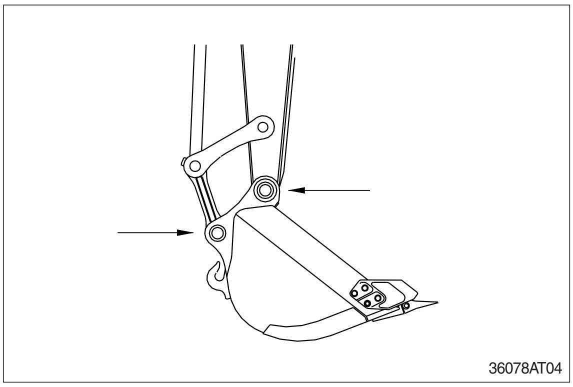
2. REMOVAL AND INSTALL

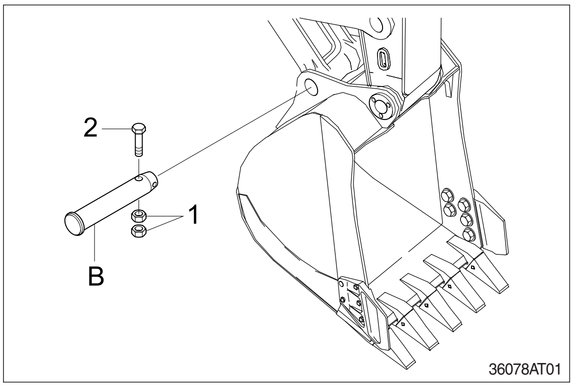
1) BUCKET ASSEMBLY

(1) Removal

① Lower the work equipment completely to ground with back of bucket facing down.



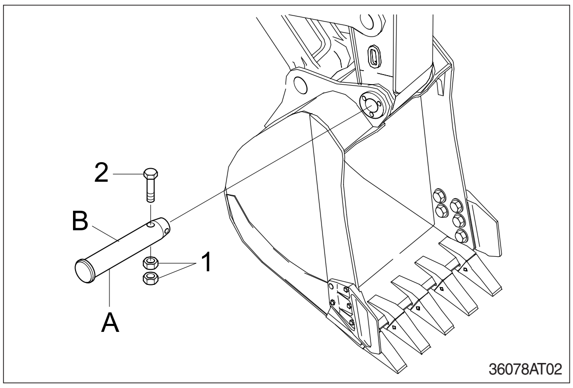
② Remove nut (1), bolt (2) and draw out the pin (B).



③ Remove nut (3), bolt (4) and draw out the pin (A) then remove the bucket assembly.

· Weight :

- 600 kg (1320 lb) : 0.70 m^3 SAE heaped
- 620 kg (1370 lb) : 0.76 m^3 SAE heaped

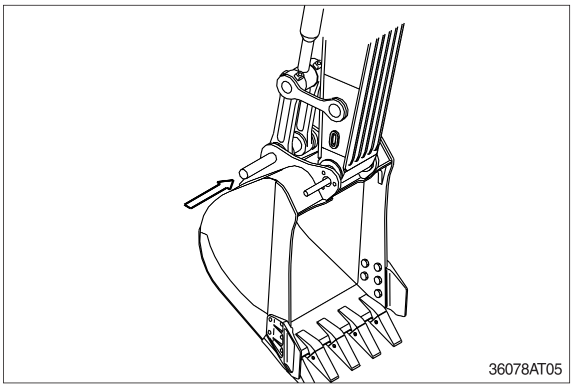


(2) Install

① Carry out installation in the reverse order to removal.

⚠ **When aligning the mounting position of the pin, do not insert your fingers in the pin hole.**

※ Adjust the bucket clearance.
For detail, see operation manual.



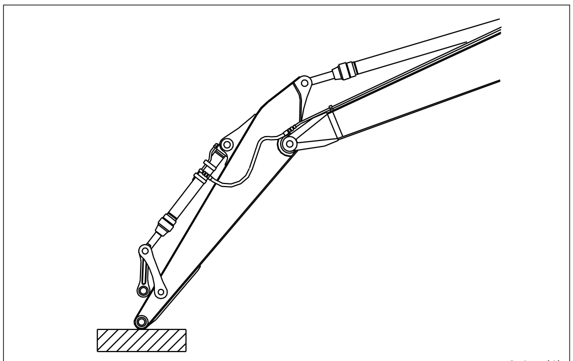
2) ARM ASSEMBLY

(1) Removal

※ Loosen the breather slowly to release the pressure inside the hydraulic tank.

⚠ **Escaping fluid under pressure can penetrated the skin causing serious injury.**

① Remove bucket assembly.
For details, see removal of bucket assembly.



8-175(1)

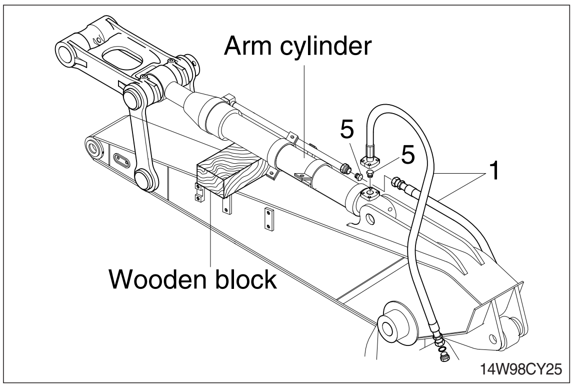
② Disconnect bucket cylinder hose (1).

⚠ **Fit blind plugs (5) in the piping at the chassis end securely to prevent oil from spurting out when the engine is started.**

③ Sling arm cylinder assembly, remove spring, pin stopper and pull out pin.

※ Tie the rod with wire to prevent it from coming out.

④ For details, see removal of arm cylinder assembly.
Place a wooden block under the cylinder and bring the cylinder down to it.



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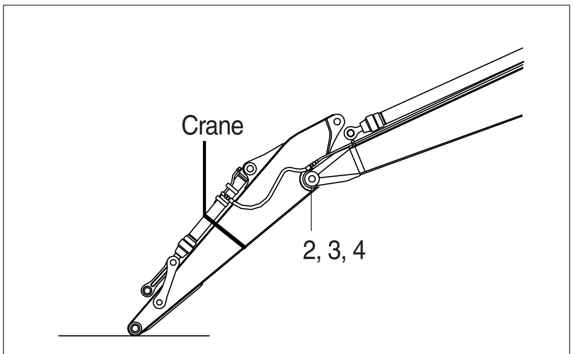
⑤ Remove bolt (2), plate (3) and pull out the pin (4) then remove the arm assembly (2.6 ㎥).

· Weight : 540 ㎏ (1190 ℔)

※ When lifting the arm assembly, always lift the center of gravity.



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.**

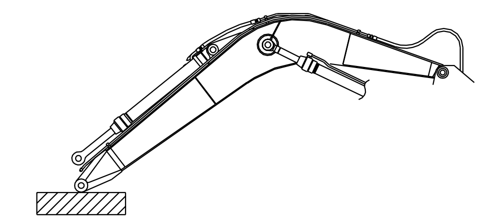
※ Bleed the air from the cylinder.

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.



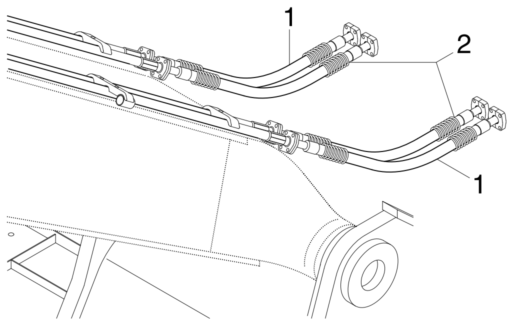
8-176(1)

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).



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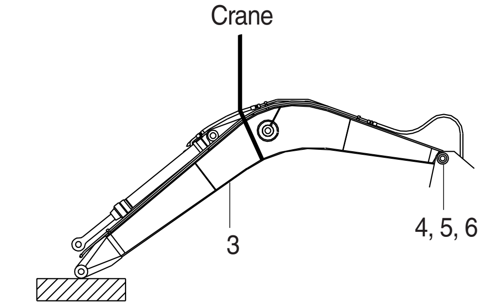
⑥ Remove bolt (4), plate (5) and pull out the pin (6) then remove boom assembly (5.1 m).

· Weight :1060 kg (2340 lb)

※ When lifting the boom assembly always lift the center of gravity.



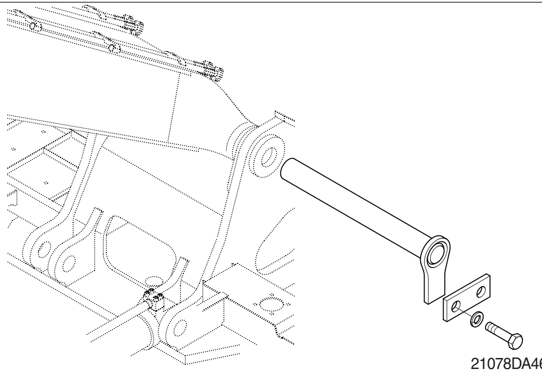
8-176(3)

(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.



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