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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.
   10 - 4
   10 - 4 - 1 ┐
   10 - 4 - 2 ┘ Added pages
   10 - 5

Revised edition mark(①②③…)

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

Revisions

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

Symbols

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

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

3. CONVERSION TABLE

Method of using the Conversion Table

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

Example

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

   Convert 55mm into inches.

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

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

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

2. Convert 550mm into inches.

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

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

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

Millimeters to inches

ⓑ

1mm = 0.03937 in

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

Millimeters to inches

1mm = 0.03937in

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

Kilogram to Pound

1kg = 2.2046lb

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

Liter to U.S. Gallon

1 l = 0.2642 U.S.Gal

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

Liter to U.K. Gallon

1 l = 0.21997 U.K.Gal

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

kgf · m to lbf · ft

1kgf · m = 7.233lbf · ft

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

kgf/cm² to lbf/in²

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

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

TEMPERATURE

Fahrenheit-Centigrade Conversion.
A simple way to convert a fahrenheit temperature reading into a centigrade temperature reading or vice verse is to enter the accompanying table in the center or boldface column of figures.
These figures refer to the temperature in either Fahrenheit or Centigrade degrees.
If it is desired to convert from Fahrenheit to Centigrade degrees, consider the center column as a table of Fahrenheit temperatures and read the corresponding Centigrade temperature in the column at the left.
If it is desired to convert from Centigrade to Fahrenheit degrees, consider the center column as a table of Centigrade values, and read the corresponding Fahrenheit temperature on the right.

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

SECTION 1 GENERAL

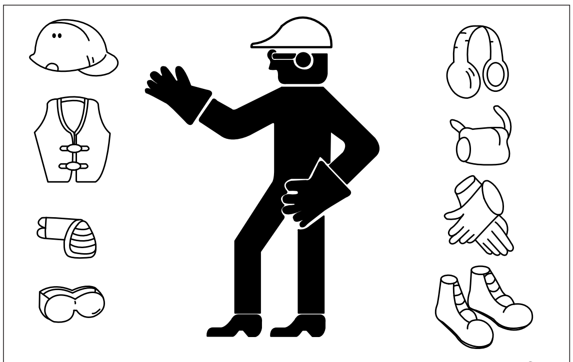
GROUP 1 SAFETY

FOLLOW SAFE PROCEDURE

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

WEAR PROTECTIVE CLOTHING

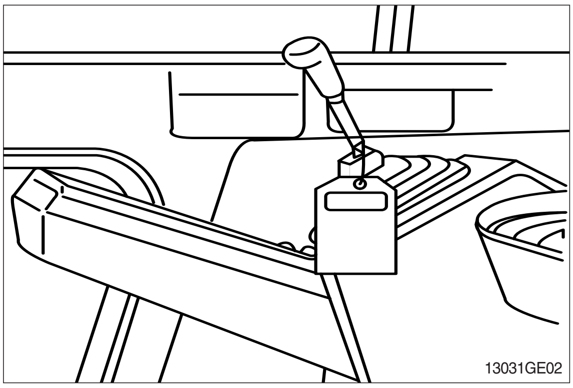
Wear close fitting clothing and safety equipment appropriate to the job.



13031GE01

WARN OTHERS OF SERVICE WORK

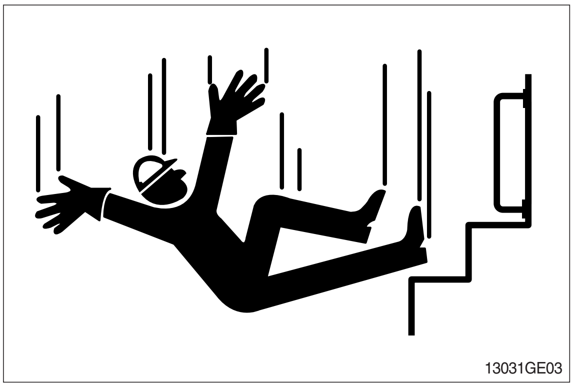
Unexpected machine movement can cause serious injury.
Before performing any work on the excavator, attach a 「**Do Not Operate**」 tag on the right side control lever.



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.



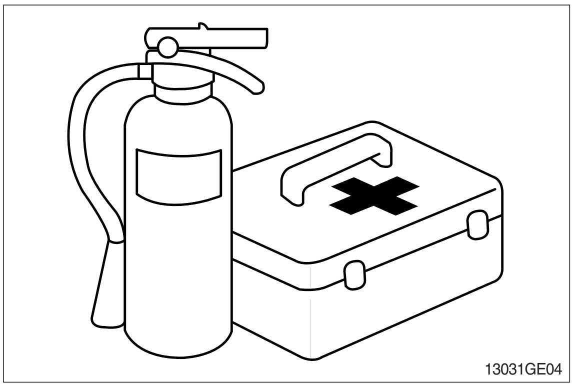
13031GE03

PREPARE FOR EMERGENCIES

Be prepared if a fire starts.

Keep a first aid kit and fire extinguisher handy.

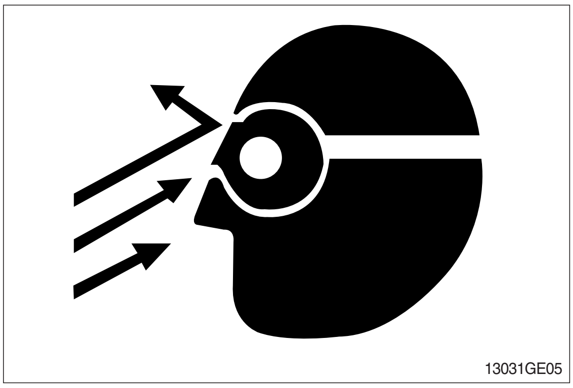
Keep emergency numbers for doctors, ambulance service, hospital, and fire department near your telephone.



13031GE04

PROTECT AGAINST FLYING DEBRIS

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

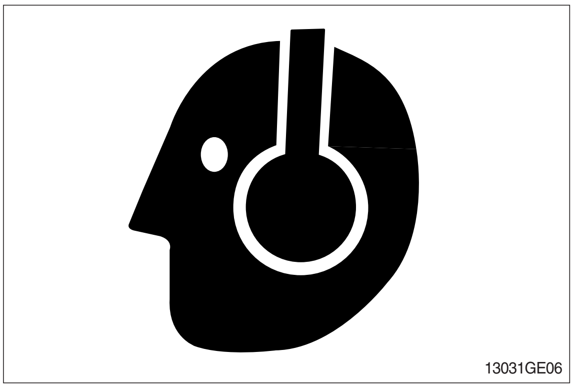


13031GE05

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.

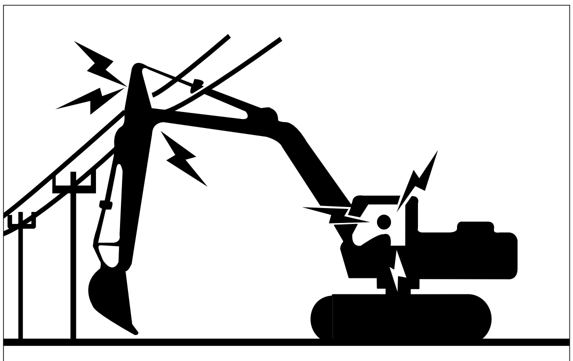


13031GE06

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.

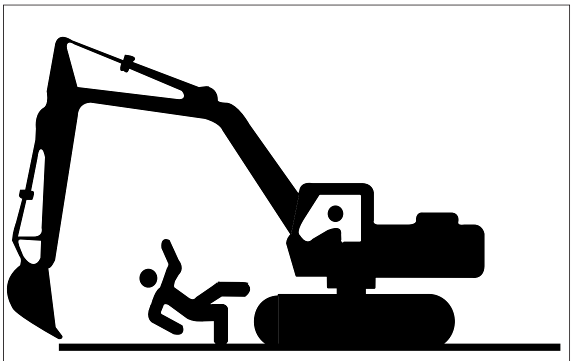


13031GE07

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.

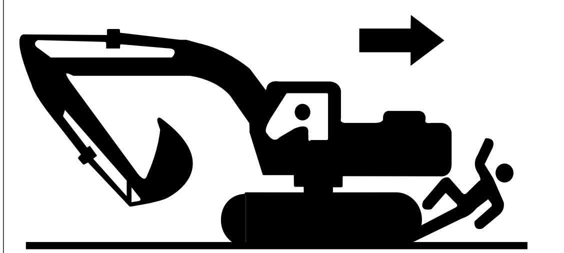

13031GE08

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.

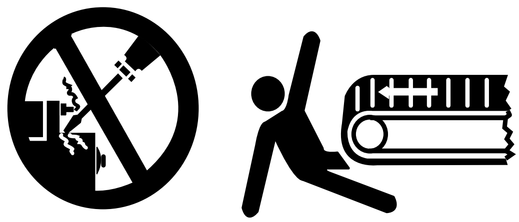
Use a signal person when moving, swinging, or operating the machine in congested areas. Coordinate hand signals before starting the excavator.


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

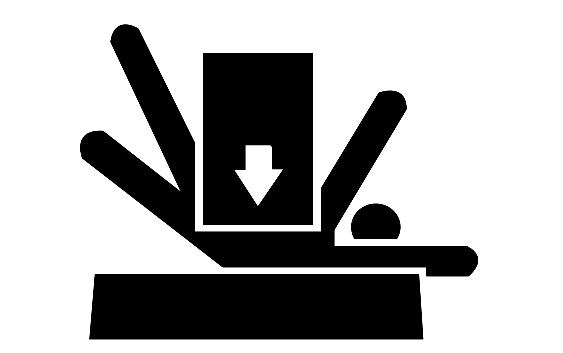
Before working on the machine:

· 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.

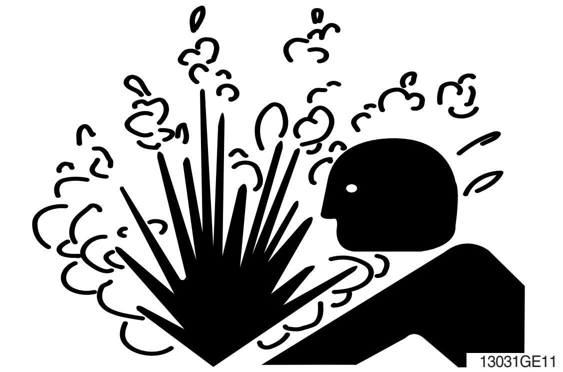


13031GE10

SERVICE COOLING SYSTEM SAFELY

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

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



13031GE11

HANDLE FLUIDS SAFELY-AVOID FIRES

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

13031GE12

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

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

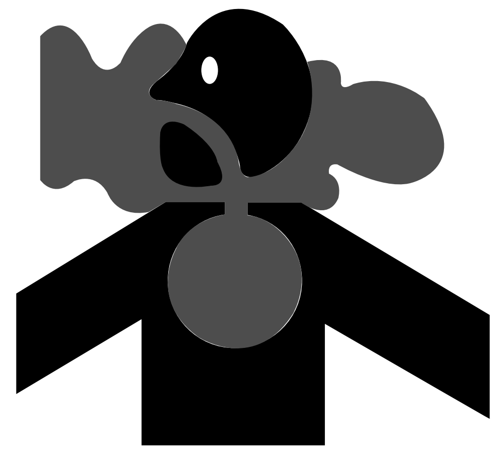
Do not store oily rags; They can ignite and burn spontaneously.

13031GE13

BEWARE OF EXHAUST FUMES

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

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



13031GE14

REMOVE PAINT BEFORE WELDING OR HEATING

Avoid potentially toxic fumes and dust.

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

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

Remove paint before welding or heating:

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

ILLUMINATE WORK AREA SAFELY

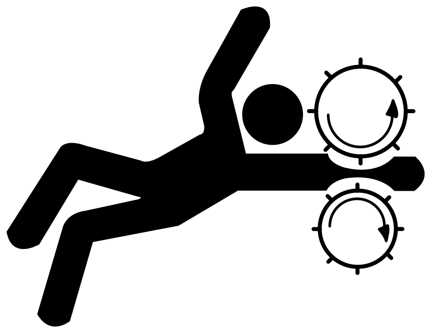
Illuminate your work area adequately but safely. Use a portable safety light for working inside or under the machine. Make sure the bulb is enclosed by a wire cage. The hot filament of an accidentally broken bulb can ignite spilled fuel or oil.

13031GE15

SERVICE MACHINE SAFELY

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

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

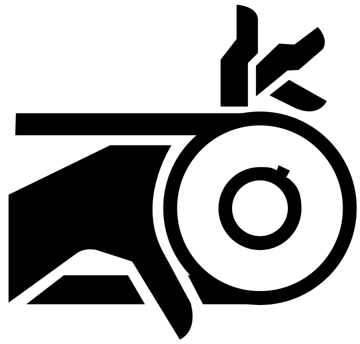


13031GE16

STAY CLEAR OF MOVING PARTS

Entanglements in moving parts can cause serious injury.

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



13031GE17

AVOID HIGH PRESSURE FLUIDS

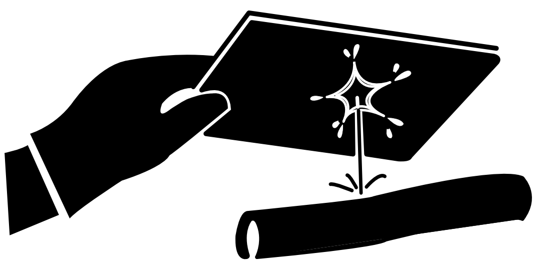
Escaping fluid under pressure can penetrate the skin causing serious injury.

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

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

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

13031GE18



13031GE19

AVOID HEATING NEAR PRESSURIZED FLUID LINES


13031GE20

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

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

PREVENT BATTERY EXPLOSIONS


13031GE21

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

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

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

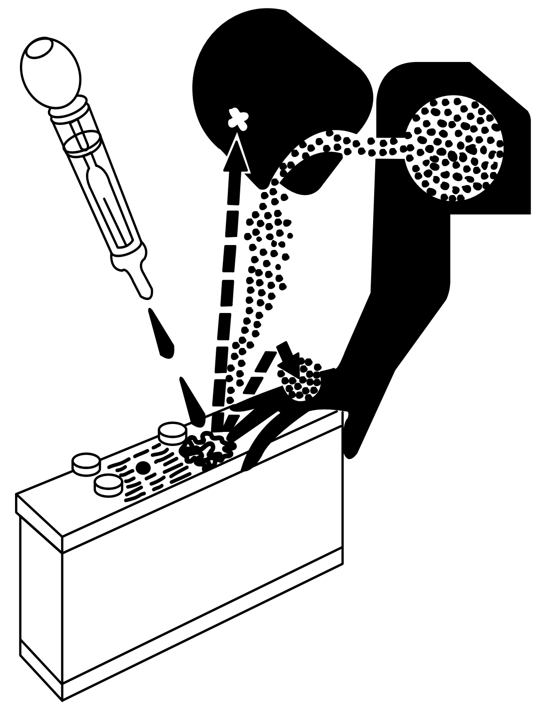
PREVENT ACID BURNS

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

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

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

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



13031GE22

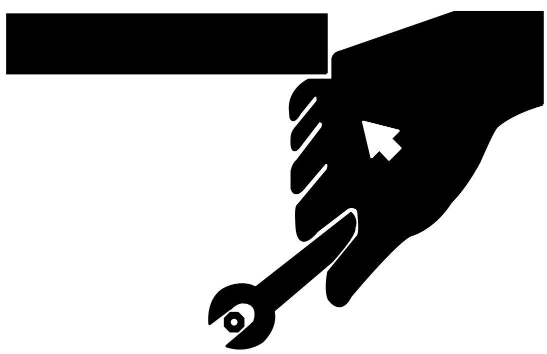
USE TOOLS PROPERLY

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

Use power tools only to loosen threaded tools and fasteners.

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

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



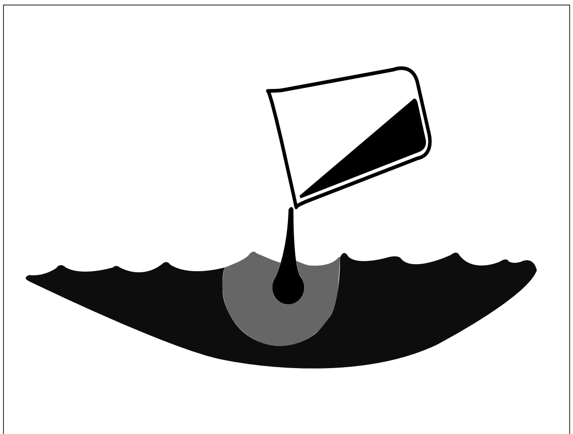
13031GE23

DISPOSE OF FLUIDS PROPERLY

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

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

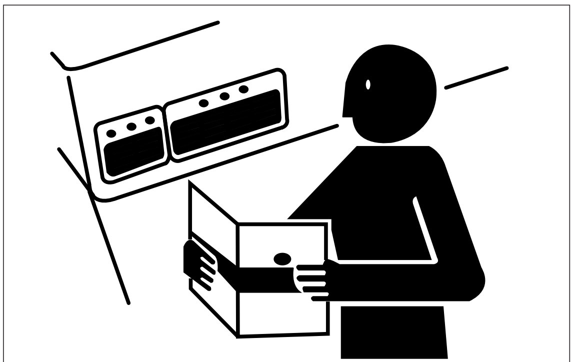
DO NOT pour oil into the ground, down a drain, or into a stream, pond, or lake. Observe relevant environmental protection regulations when disposing of oil, fuel, coolant, brake fluid, filters, batteries, and other harmful waste.



13031GE24

REPLACE SAFETY LABELS

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



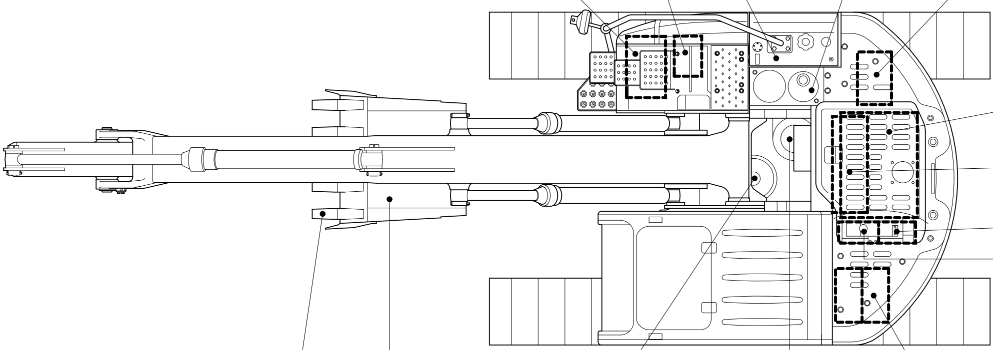
13031GE25

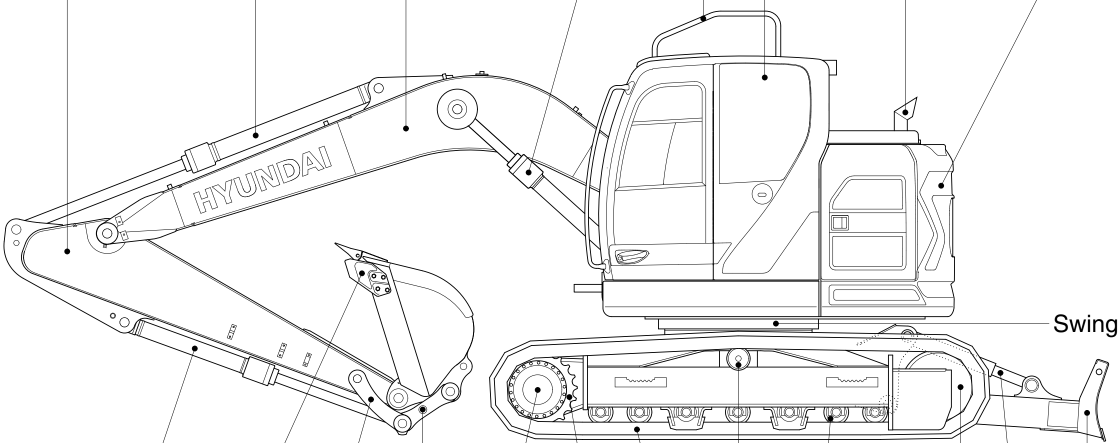
LIVE WITH SAFETY

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

GROUP 2 SPECIFICATIONS

1. MAJOR COMPONENT



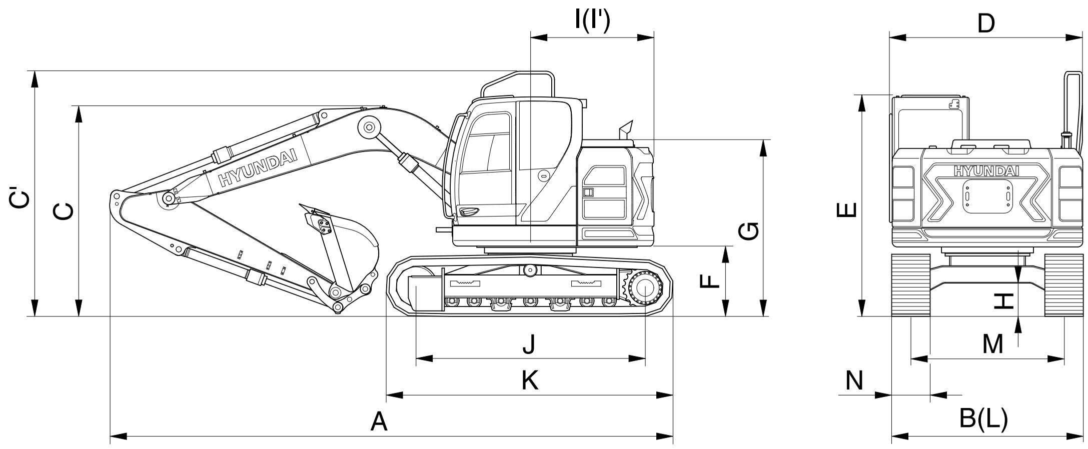


145ZF2SP01

2. SPECIFICATIONS

1) HX145 CR

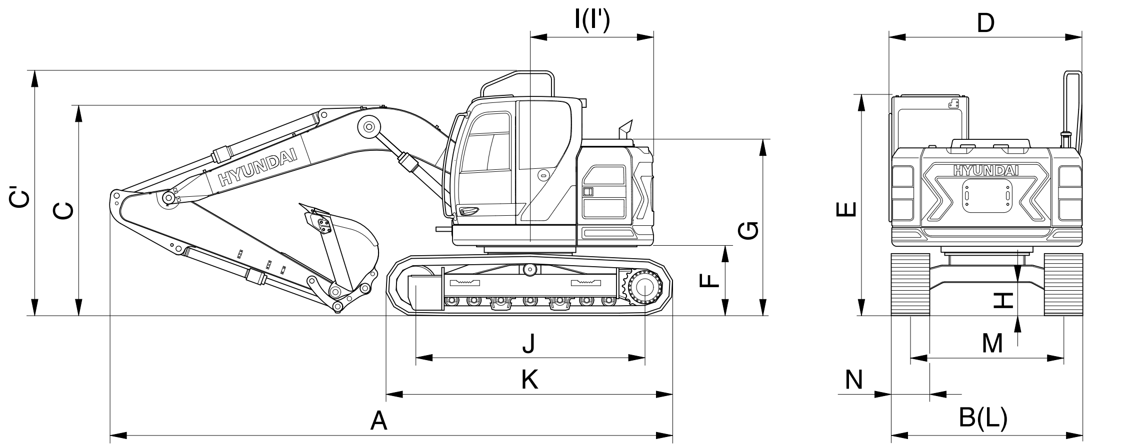
(1) 4.60 m (15' 1") boom and 1.9 m (6' 3"), 2.1 m (6' 11") arm



145ZF2SP02

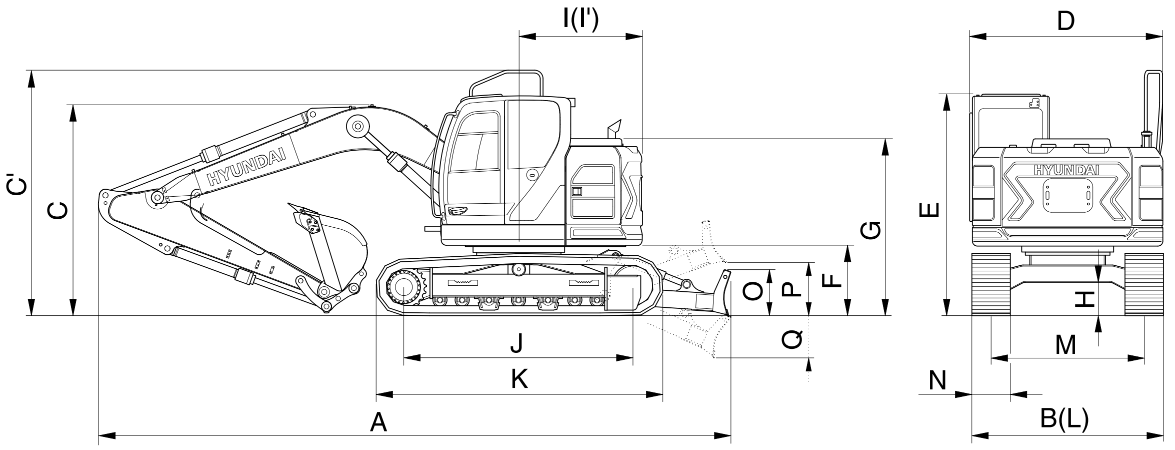
Description		Unit	Specification	
			1.9 m (6' 3") arm	2.1 m (6' 11") arm
Operating weight		kg (lb)	15180 (33470)	15210 (33530)
Bucket capacity (SAE heaped), standard		m^3 (yd^3)	0.52 (0.68)	←
Overall length	A	mm (ft-in)	7290 (23' 11")	7310 (24' 0")
Overall width, with 600 mm shoe	B		2600 (8' 6")	←
Overall height	C		2630 (8' 8")	2710 (8' 11")
Overall height of guardrail	C'		3215 (10' 7")	←
Superstructure width	D		2500 (8' 2")	←
Overall height of cab	E		2900 (9' 6")	←
Ground clearance of counterweight	F		930 (3' 1")	←
Engine cover height	G		2320 (7' 7")	←
Minimum ground clearance	H		440 (1' 5")	←
Rear-end distance	I		1500 (4' 11")	←
Rear-end swing radius	I'		1500 (4' 11")	←
Distance between tumblers	J		2910 (9' 7")	←
Undercarriage length	K		3618 (11' 8")	←
Undercarriage width	L		2600 (8' 6")	←
Track gauge	M		2000 (6' 7")	←
Track shoe width, standard	N		600 (24")	←
Travel speed (low/high)		km/hr (mph)	3.3/5.5 (2.1/3.4)	←
Swing speed		rpm	11.2	←
Gradeability		Degree (%)	35 (70)	←
Ground pressure (600 mm shoe)		kgf/cm^2(psi)	0.40 (5.7)	0.40 (5.72)
Max traction force		kg (lb)	12000 (26455)	←

(2) 4.60 m (15' 1") boom and 2.50 m (8' 2"), 3.0 m (9' 10") arm



Description		Unit	Specification	
			2.50 m (8' 2") arm	3.0 m (9' 10") arm
Operating weight		kg (lb)	15270 (33660)	15320 (33770)
Bucket capacity (SAE heaped), standard		m^3 (yd^3)	0.52 (0.68)	←
Overall length	A	mm (ft-in)	7270 (23' 10")	7210 (23' 8")
Overall width, with 600 mm shoe	B		2600 (8' 6")	←
Overall height	C		2860 (9' 5")	3210 (10' 6")
Overall height of guardrail	C'		3215 (10' 7")	←
Superstructure width	D		2500 (8' 2")	←
Overall height of cab	E		2900 (9' 6")	←
Ground clearance of counterweight	F		930 (3' 1")	←
Engine cover height	G		2320 (7' 7")	←
Minimum ground clearance	H		440 (1' 5")	←
Rear-end distance	I		1500 (4' 11")	←
Rear-end swing radius	I'		1500 (4' 11")	←
Distance between tumblers	J		2910 (9' 7")	←
Undercarriage length	K		3618 (11' 8")	←
Undercarriage width	L		2600 (8' 6")	←
Track gauge	M		2000 (6' 7")	←
Track shoe width, standard	N		600 (24")	←
Travel speed (low/high)		km/hr (mph)	3.3/5.5 (2.1/3.4)	←
Swing speed		rpm	11.2	←
Gradeability		Degree (%)	35 (70)	←
Ground pressure (600 mm shoe)		kgf/cm^2(psi)	0.40 (5.74)	0.40 (5.76)
Max traction force		kg (lb)	12000 (26455)	←

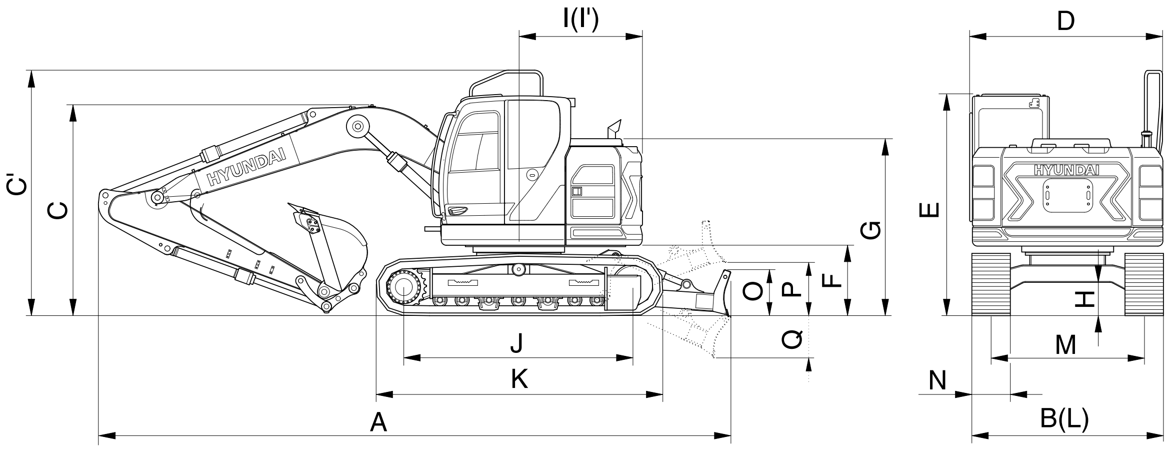
(3) 4.60 m (15' 1") boom and 1.9 m (6' 3"), 2.1 m (6' 11") arm with dozer



145ZF2SP03

Description		Unit	Specification	
			1.9 m (6' 3") arm	2.1 m (6' 11") arm
Operating weight		kg (lb)	16020 (35320)	16050 (35380)
Bucket capacity (SAE heaped), standard		m^3 (yd^3)	0.52 (0.68)	←
Overall length	A	mm (ft-in)	7840 (25' 9")	7860 (25' 9")
Overall width, with 600 mm shoe	B		2600 (8' 6")	←
Overall height	C		2630 (8' 8")	2710 (8' 11")
Overall height of guardrail	C'		3215 (10' 7")	←
Superstructure width	D		2500 (8' 2")	←
Overall height of cab	E		2900 (9' 6")	←
Ground clearance of counterweight	F		930 (3' 1")	←
Engine cover height	G		2320 (7' 7")	←
Minimum ground clearance	H		440 (1' 5")	←
Rear-end distance	I		1500 (4' 11")	←
Rear-end swing radius	I'		1500 (4' 11")	←
Distance between tumblers	J		2910 (9' 7")	←
Undercarriage length	K		3618 (11' 8")	←
Undercarriage width	L		2600 (8' 6")	←
Track gauge	M		2000 (6' 7")	←
Track shoe width, standard	N		600 (24")	←
Height of blade	O		575 (1' 11")	←
Ground clearance of blade up	P		420 (1' 5")	←
Depth of blade down	Q		430 (1' 5")	←
Travel speed (low/high)		km/hr (mph)	3.3/5.5 (2.1/3.4)	←
Swing speed		rpm	11.2	←
Gradeability		Degree (%)	35 (70)	←
Ground pressure (600 mm shoe)		kgf/cm^2(psi)	0.42 (6.02)	0.42 (6.03)
Max traction force		kg (lb)	12000 (26455)	←

(4) 4.60 m (15' 1") boom and 2.50 m (8' 2"), 3.0 m (9' 10") arm with dozer

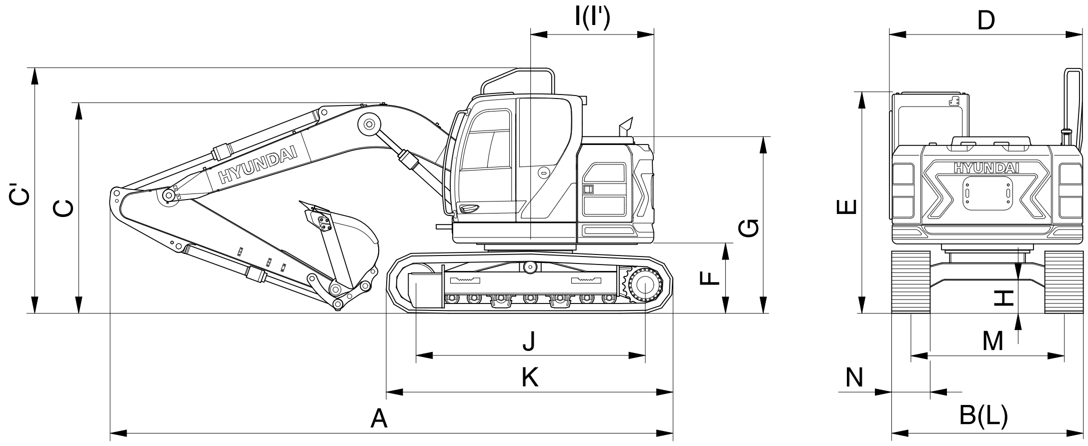


145ZF2SP03

Description		Unit	Specification	
			2.50 m (8' 2") arm	3.0 m (9' 10") arm
Operating weight		kg (lb)	16110 (35520)	16160 (35630)
Bucket capacity (SAE heaped), standard		m^3 (yd^3)	0.52 (0.68)	←
Overall length	A	mm (ft-in)	7820 (25' 8")	7760 (25' 6")
Overall width, with 600 mm shoe	B		2600 (8' 6")	←
Overall height	C		2860 (9' 5")	3210 (10' 6")
Overall height of guardrail	C'		3215 (10' 7")	←
Superstructure width	D		2500 (8' 2")	←
Overall height of cab	E		2900 (9' 6")	←
Ground clearance of counterweight	F		930 (3' 1")	←
Engine cover height	G		2320 (7' 7")	←
Minimum ground clearance	H		440 (1' 5")	←
Rear-end distance	I		1500 (4' 11")	←
Rear-end swing radius	I'		1500 (4' 11")	←
Distance between tumblers	J		2910 (9' 7")	←
Undercarriage length	K		3618 (11' 8")	←
Undercarriage width	L		2600 (8' 6")	←
Track gauge	M		2000 (6' 7")	←
Track shoe width, standard	N		600 (24")	←
Height of blade	O		575 (1' 11")	←
Ground clearance of blade up	P		420 (1' 5")	←
Depth of blade down	Q		430 (1' 5")	←
Travel speed (low/high)		km/hr (mph)	3.3/5.5 (2.1/3.4)	←
Swing speed		rpm	11.2	←
Gradeability		Degree (%)	35 (70)	←
Ground pressure (600 mm shoe)		kgf/cm^2(psi)	0.43 (6.05)	0.43 (6.07)
Max traction force		kg (lb)	12000 (26455)	←

2) HX145 LCR

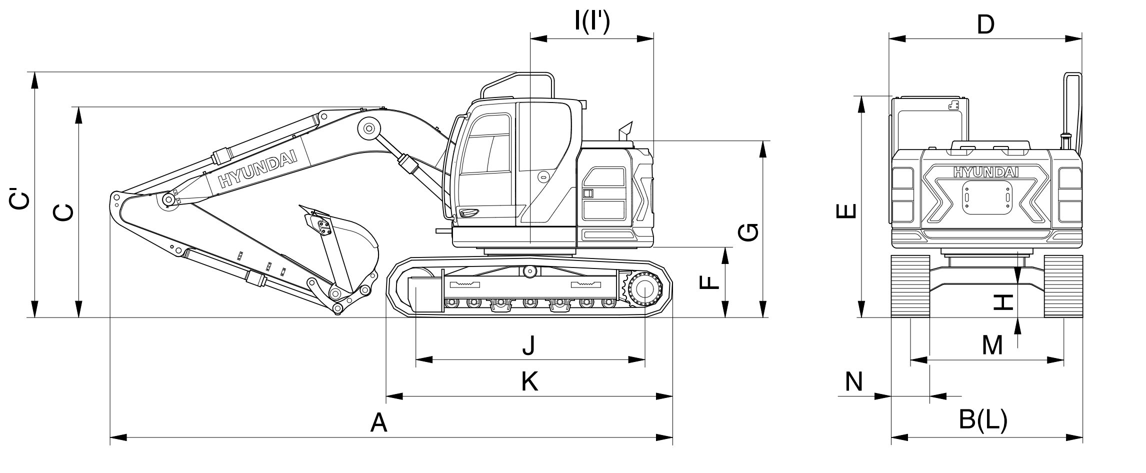
(1) 4.60 m (15' 1") boom and 1.9 m (6' 3"), 2.1 m (6' 11") arm



145ZF2SP02

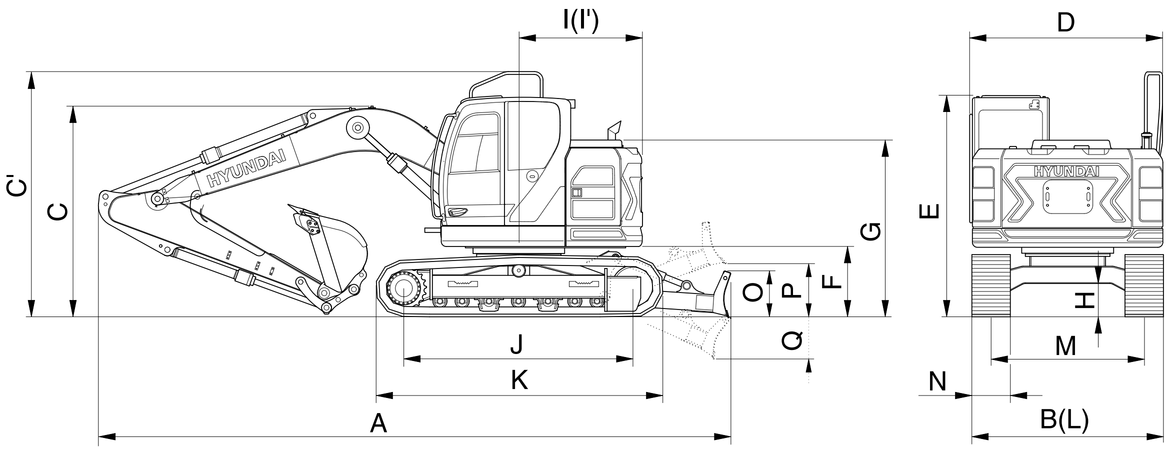
Description		Unit	Specification	
			1.9 m (6' 3") arm	2.1 m (6' 11") arm
Operating weight		kg (lb)	15440 (34040)	15480 (34130)
Bucket capacity (SAE heaped), standard		m^3 (yd^3)	0.52 (0.68)	←
Overall length	A	mm (ft-in)	7380 (24' 3")	7400 (24' 3")
Overall width, with 600 mm shoe	B		2600 (8' 6")	←
Overall height	C		2630 (8' 8")	2710 (8' 11")
Overall height of guardrail	C'		3215 (10' 7")	←
Superstructure width	D		2500 (8' 2")	←
Overall height of cab	E		2900 (9' 6")	←
Ground clearance of counterweight	F		930 (3' 1")	←
Engine cover height	G		2320 (7' 7")	←
Minimum ground clearance	H		440 (1' 5")	←
Rear-end distance	I		1500 (4' 11")	←
Rear-end swing radius	I'		1500 (4' 11")	←
Distance between tumblers	J		3090 (10' 2")	←
Undercarriage length	K		3798 (12' 6")	←
Undercarriage width	L		2600 (8' 6")	←
Track gauge	M		2000 (6' 7")	←
Track shoe width, standard	N		600 (24")	←
Travel speed (low/high)		km/hr (mph)	3.3/5.5 (2.1/3.4)	←
Swing speed		rpm	11.2	←
Gradeability		Degree (%)	35 (70)	←
Ground pressure (600 mm shoe)		kgf/cm^2(psi)	0.39 (5.49)	0.39 (5.5)
Max traction force		kg (lb)	12000 (26455)	←

(2) 4.60 m (15' 1") boom and 2.50 m (8' 2"), 3.0 m (9' 10") arm



Description		Unit	Specification	
			2.50 m (8' 2") arm	3.0 m (9' 10") arm
Operating weight		kg (lb)	15540 (34260)	15580 (34350)
Bucket capacity (SAE heaped), standard		m^3 (yd^3)	0.52 (0.68)	←
Overall length	A	mm (ft-in)	7360 (24' 2")	7300 (23' 11")
Overall width, with 600 mm shoe	B		2600 (8' 6")	←
Overall height	C		2860 (9' 5")	3210 (10' 6")
Overall height of guardrail	C'		3215 (10' 7")	←
Superstructure width	D		2500 (8' 2")	←
Overall height of cab	E		2900 (9' 6")	←
Ground clearance of counterweight	F		930 (3' 1")	←
Engine cover height	G		2320 (7' 7")	←
Minimum ground clearance	H		440 (1' 5")	←
Rear-end distance	I		1500 (4' 11")	←
Rear-end swing radius	I'		1500 (4' 11")	←
Distance between tumblers	J		3090 (10' 2")	←
Undercarriage length	K		3798 (12' 6")	←
Undercarriage width	L		2600 (8' 6")	←
Track gauge	M		2000 (6' 7")	←
Track shoe width, standard	N		600 (24")	←
Travel speed (low/high)		km/hr (mph)	3.3/5.5 (2.1/3.4)	←
Swing speed		rpm	11.2	←
Gradeability		Degree (%)	35 (70)	←
Ground pressure (600 mm shoe)		kgf/cm^2(psi)	0.39 (5.52)	0.39 (5.54)
Max traction force		kg (lb)	12000 (26455)	←

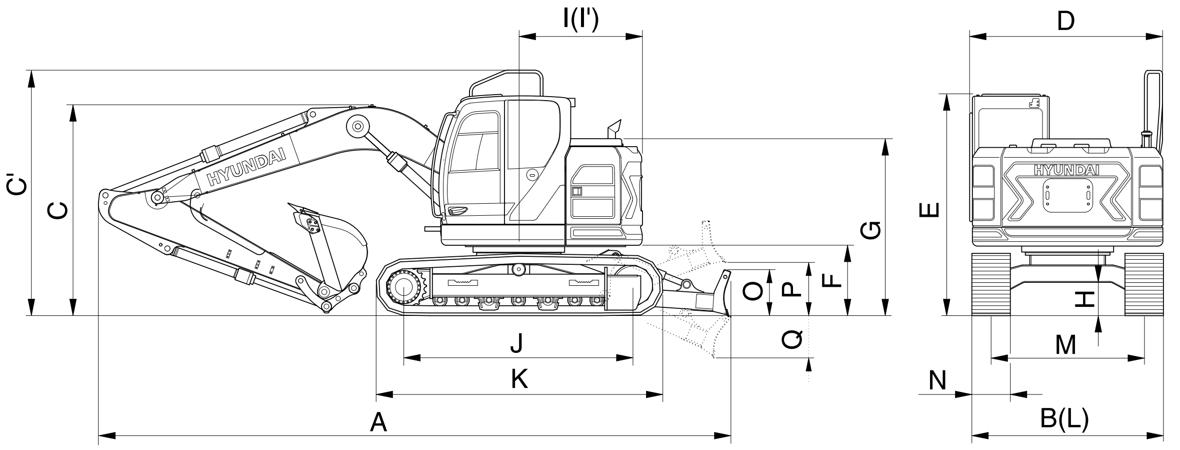
(3) 4.60 m (15' 1") boom and 1.9 m (6' 3"), 2.1 m (6' 11") arm with dozer



145ZF2SP03

Description		Unit	Specification	
			1.9 m (6' 3") arm	2.1 m (6' 11") arm
Operating weight		kg (lb)	16260 (35850)	16300 (35940)
Bucket capacity (SAE heaped), standard		m^3 (yd^3)	0.52 (0.68)	←
Overall length	A	mm (ft-in)	7840 (25' 9")	7860 (25' 9")
Overall width, with 600 mm shoe	B		2600 (8' 6")	←
Overall height	C		2630 (8' 8")	2710 (8' 11")
Overall height of guardrail	C'		3215 (10' 7")	←
Superstructure width	D		2500 (8' 2")	←
Overall height of cab	E		2900 (9' 6")	←
Ground clearance of counterweight	F		930 (3' 1")	←
Engine cover height	G		2320 (7' 7")	←
Minimum ground clearance	H		440 (1' 5")	←
Rear-end distance	I		1500 (4' 11")	←
Rear-end swing radius	I'		1500 (4' 11")	←
Distance between tumblers	J		3090 (10' 2")	←
Undercarriage length	K		3798 (12' 6")	←
Undercarriage width	L		2600 (8' 6")	←
Track gauge	M		2000 (6' 7")	←
Track shoe width, standard	N		600 (24")	←
Height of blade	O		575 (1' 11")	←
Ground clearance of blade up	P		420 (1' 5")	←
Depth of blade down	Q		430 (1' 5")	←
Travel speed (low/high)		km/hr (mph)	3.3/5.5 (2.1/3.4)	←
Swing speed		rpm	11.2	←
Gradeability		Degree (%)	35 (70)	←
Ground pressure (600 mm shoe)		kgf/cm^2(psi)	0.41 (5.78)	0.41 (5.79)
Max traction force		kg (lb)	12000 (26455)	←

(4) 4.60 m (15' 1") boom and 2.50 m (8' 2"), 3.0 m (9' 10") arm with dozer

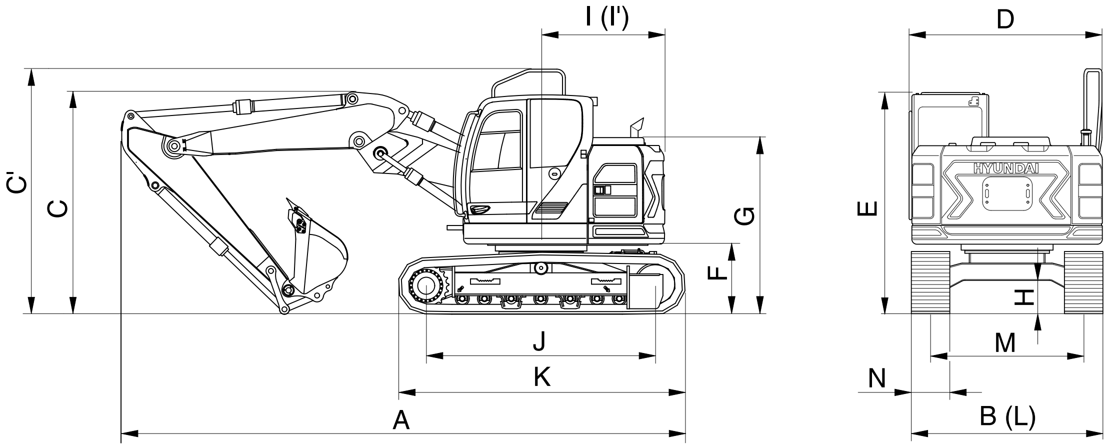


145ZF2SP03

Description		Unit	Specification	
			2.50 m (8' 2") arm	3.0 m (9' 10") arm
Operating weight		kg (lb)	16360 (36070)	16400 (36160)
Bucket capacity (SAE heaped), standard		m^3 (yd^3)	0.52 (0.68)	←
Overall length	A	mm (ft-in)	7820 (25' 8")	7760 (25' 6")
Overall width, with 600 mm shoe	B		2600 (8' 6")	←
Overall height	C		2860 (9' 5")	3210 (10' 6")
Overall height of guardrail	C'		3215 (10' 7")	←
Superstructure width	D		2500 (8' 2")	←
Overall height of cab	E		2900 (9' 6")	←
Ground clearance of counterweight	F		930 (3' 1")	←
Engine cover height	G		2320 (7' 7")	←
Minimum ground clearance	H		440 (1' 5")	←
Rear-end distance	I		1500 (4' 11")	←
Rear-end swing radius	I'		1500 (4' 11")	←
Distance between tumblers	J		3090 (10' 2")	←
Undercarriage length	K		3798 (12' 6")	←
Undercarriage width	L		2600 (8' 6")	←
Track gauge	M		2000 (6' 7")	←
Track shoe width, standard	N		600 (24")	←
Height of blade	O		575 (1' 11")	←
Ground clearance of blade up	P		420 (1' 5")	←
Depth of blade down	Q		430 (1' 5")	←
Travel speed (low/high)		km/hr (mph)	3.3/5.5 (2.1/3.4)	←
Swing speed		rpm	11.2	←
Gradeability		Degree (%)	35 (70)	←
Ground pressure (600 mm shoe)		kgf/cm^2(psi)	0.41 (5.82)	0.41 (5.83)
Max traction force		kg (lb)	12000 (26455)	←

3) HX145 LCR 2-PIECE BOOM

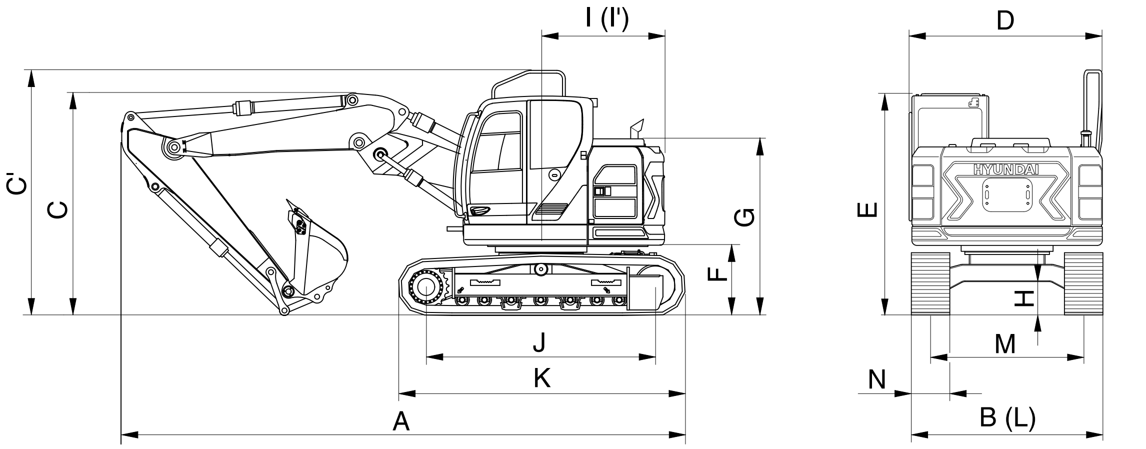
(1) 4.939 m (16' 2") 2-piece boom and 1.9 m (6' 3"), 2.1 m (6' 11") arm



145ZF2SP06

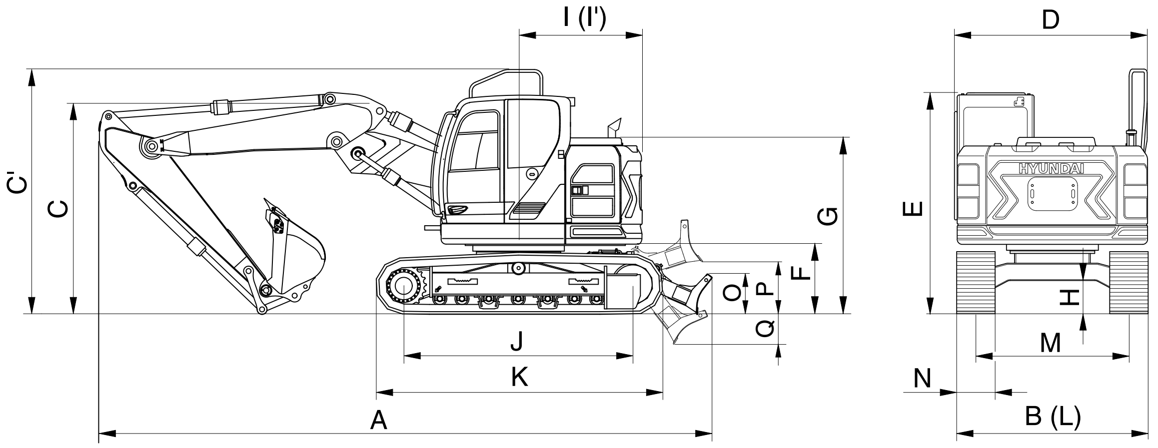
Description		Unit	Specification	
			1.9 m (6' 3") arm	2.1 m (6' 11") arm
Operating weight		kg (lb)	15770 (34770)	15800 (34830)
Bucket capacity (SAE heaped), standard		m^3 (yd^3)	0.52 (0.68)	←
Overall length	A	mm (ft-in)	7650 (25' 1")	7720 (25' 4")
Overall width, with 600 mm shoe	B		2600 (8' 6")	←
Overall height	C		2865 (9' 5")	2870 (9' 5")
Overall height of guardrail	C'		3215 (10' 7")	←
Superstructure width	D		2500 (8' 2")	←
Overall height of cab	E		2900 (9' 6")	←
Ground clearance of counterweight	F		930 (3' 1")	←
Engine cover height	G		2320 (7' 7")	←
Minimum ground clearance	H		440 (1' 5")	←
Rear-end distance	I		1500 (4' 11")	←
Rear-end swing radius	I'		1500 (4' 11")	←
Distance between tumblers	J		3090 (10' 2")	←
Undercarriage length	K		3798 (12' 6")	←
Undercarriage width	L		2600 (8' 6")	←
Track gauge	M		2000 (6' 7")	←
Track shoe width, standard	N		600 (24")	←
Travel speed (low/high)		km/hr (mph)	3.3/5.5 (2.1/3.4)	←
Swing speed		rpm	11.2	←
Gradeability		Degree (%)	35 (70)	←
Ground pressure (600 mm shoe)		kgf/cm^2(psi)	0.39 (5.61)	0.39 (5.62)
Max traction force		kg (lb)	12000 (26455)	←

(2) 4.939 m (16' 2") 2-piece boom and 2.50 m (8' 2") arm



Description		Unit	Specification
Operating weight		kg (lb)	15860 (34970)
Bucket capacity (SAE heaped), standard		m^3 (yd^3)	0.52 (0.68)
Overall length	A	mm (ft-in)	7690 (25' 3")
Overall width, with 600 mm shoe	B		2600 (8' 6")
Overall height	C		2900 (9' 6")
Overall height of guardrail	C'		3215 (10' 7")
Superstructure width	D		2500 (8' 2")
Overall height of cab	E		2900 (9' 6")
Ground clearance of counterweight	F		930 (3' 1")
Engine cover height	G		2320 (7' 7")
Minimum ground clearance	H		440 (1' 5")
Rear-end distance	I		1500 (4' 11")
Rear-end swing radius	I'		1500 (4' 11")
Distance between tumblers	J		3090 (10' 2")
Undercarriage length	K		3798 (12' 6")
Undercarriage width	L		2600 (8' 6")
Track gauge	M		2000 (6' 7")
Track shoe width, standard	N		600 (24")
Travel speed (low/high)		km/hr (mph)	3.3/5.5 (2.1/3.4)
Swing speed		rpm	11.2
Gradeability		Degree (%)	35 (70)
Ground pressure (600 mm shoe)		kgf/cm^2(psi)	0.40 (5.64)
Max traction force		kg (lb)	12000 (26455)

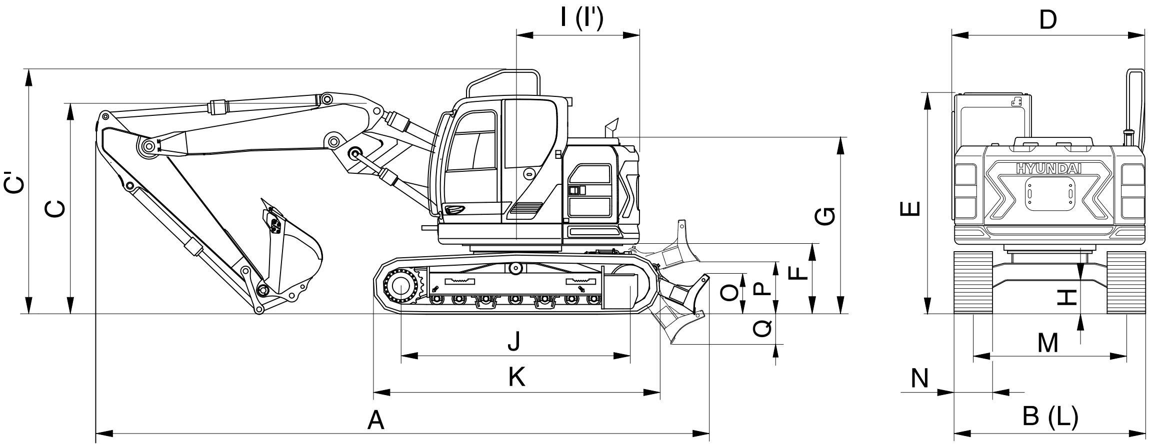
(3) 4.939 m (16' 2") 2-piece boom and 1.9 m (6' 3"), 2.1m (6' 11") arm with dozer



145ZF2SP07

Description		Unit	Specification	
			1.9 m (6' 3") arm	2.1 m (6' 11") arm
Operating weight		kg (lb)	16580 (36550)	16620 (36640)
Bucket capacity (SAE heaped), standard		m^3 (yd^3)	0.52 (0.68)	←
Overall length	A	mm (ft-in)	8110 (26' 7")	8180 (26' 10")
Overall width, with 600 mm shoe	B		2600 (8' 6")	←
Overall height	C		2865 (9' 5")	2870 (9' 5")
Overall height of guardrail	C'		3215 (10' 7")	←
Superstructure width	D		2500 (8' 2")	←
Overall height of cab	E		2900 (9' 6")	←
Ground clearance of counterweight	F		930 (3' 1")	←
Engine cover height	G		2320 (7' 7")	←
Minimum ground clearance	H		440 (1' 5")	←
Rear-end distance	I		1500 (4' 11")	←
Rear-end swing radius	I'		1500 (4' 11")	←
Distance between tumblers	J		3090 (10' 2")	←
Undercarriage length	K		3798 (12' 6")	←
Undercarriage width	L		2600 (8' 6")	←
Track gauge	M		2000 (6' 7")	←
Track shoe width, standard	N		600 (24")	←
Height of blade	O		575 (1' 11")	←
Ground clearance of blade up	P		410 (1' 4")	←
Depth of blade down	Q		450 (1' 6")	←
Travel speed (low/high)		km/hr (mph)	3.3/5.5 (2.1/3.4)	←
Swing speed		rpm	11.2	←
Gradeability		Degree (%)	35 (70)	←
Ground pressure (600 mm shoe)		kgf/cm^2(psi)	0.41 (5.89)	0.42 (5.91)
Max traction force		kg (lb)	12000 (26455)	←

(4) 4.939 m (16' 2") 2-piece boom and 2.50 m (8' 2") arm with dozer

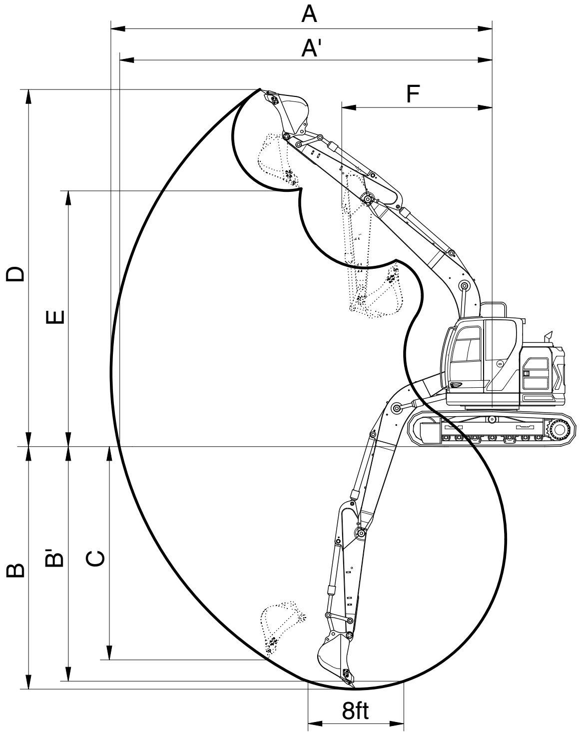


145ZF2SP07

Description		Unit	Specification
Operating weight		kg (lb)	16680 (36770)
Bucket capacity (SAE heaped), standard		m^3 (yd^3)	0.52 (0.68)
Overall length	A	mm (ft-in)	8150 (26' 9")
Overall width, with 600 mm shoe	B		2600 (8' 6")
Overall height	C		2900 (9' 6")
Overall height of guardrail	C'		3215 (10' 7")
Superstructure width	D		2500 (8' 2")
Overall height of cab	E		2900 (9' 6")
Ground clearance of counterweight	F		930 (3' 1")
Engine cover height	G		2320 (7' 7")
Minimum ground clearance	H		440 (1' 5")
Rear-end distance	I		1500 (4' 11")
Rear-end swing radius	I'		1500 (4' 11")
Distance between tumblers	J		3090 (10' 2")
Undercarriage length	K		3798 (12' 6")
Undercarriage width	L		2600 (8' 6")
Track gauge	M		2000 (6' 7")
Track shoe width, standard	N		600 (24")
Height of blade	O		575 (1' 11")
Ground clearance of blade up	P		410 (1' 4")
Depth of blade down	Q		450 (1' 6")
Travel speed (low/high)		km/hr (mph)	3.3/5.5 (2.1/3.4)
Swing speed		rpm	11.2
Gradeability		Degree (%)	35 (70)
Ground pressure (600 mm shoe)		kgf/cm^2(psi)	0.42 (5.93)
Max traction force		kg (lb)	12000 (26455)

3. WORKING RANGE

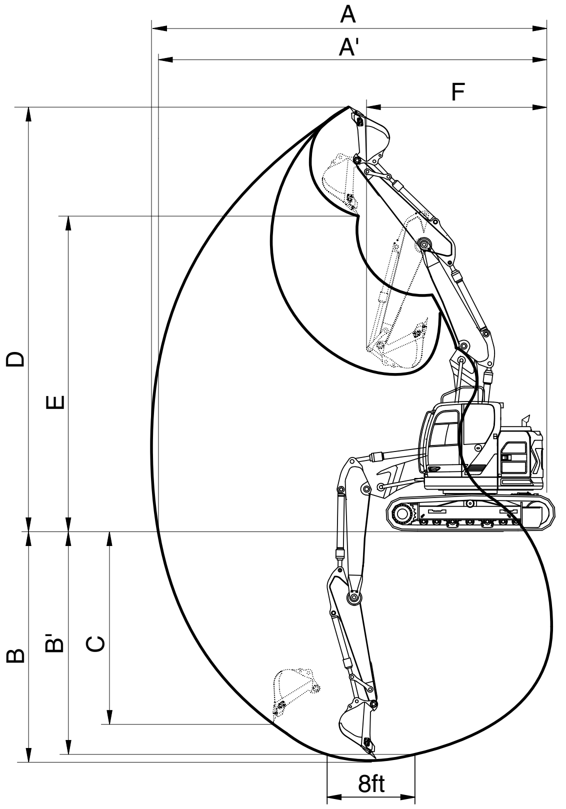
1) 4.60 m (15' 1") MONO BOOM



Description		1.90 m (6' 3") Arm	2.10 m (6' 11") Arm	※2.50 m (8' 2") Arm	3.00 m (9' 10") Arm
Max digging reach	A	7730 mm (25' 4")	7900 mm (25'11")	8310 mm (27' 3")	8770 mm (28' 9")
Max digging reach on ground	A'	7580 mm (24'10")	7750 mm (25' 0")	8170 mm (26'10")	8630 mm (28' 4")
Max digging depth	B	4890 mm (16' 1")	5100 mm (16' 9")	5500 mm (18' 1")	5990 mm (19' 8")
Max digging depth (8ft level)	B'	4640 mm (15' 3")	4870 mm (16' 0")	5290 mm (17' 4")	5810 mm (19' 1")
Max vertical wall digging depth	C	4400 mm (14' 5")	4600 mm (15' 1")	5000 mm (16' 5")	5400 mm (17' 9")
Max digging height	D	8840 mm (29' 0")	8970 mm (29' 5")	9350 mm (30' 8")	9730 mm (31'11")
Max dumping height	E	6350 mm (20'10")	6470 mm (21' 3")	6850 mm (22' 6")	7230 mm (23' 9")
Min swing radius	F	1860 mm (6' 1")	2030 mm (6' 8")	1980 mm (6' 6")	2260 mm (7' 5")
Bucket digging force	SAE	87.3 [94.8] kN	87.3 [94.8] kN	87.3 [94.8] kN	87.3 [94.8] kN
		8900 [9660] kgf	8900 [9660] kgf	8900 [9660] kgf	8900 [9660] kgf
		19620 [21300] lbf	19620 [21300] lbf	19620 [21300] lbf	19620 [21300] lbf
	ISO	102 [110.8] kN	102 [110.8] kN	102 [110.8] kN	102 [110.8] kN
		10400 [11290] kgf	10400 [11290] kgf	10400 [11290] kgf	10400 [11290] kgf
		22930 [24890] lbf	22930 [24890] lbf	22930[24890] lbf	22930 [24890] lbf
Arm crowd force	SAE	76.5 [83.1] kN	73.6 [79.9] kN	62.8 [68.2] kN	55.9 [60.7] kN
		7800 [8470] kgf	7500 [8140] kgf	6400 [6950] kgf	5700 [6190] kgf
		17200 [18670] lbf	16530 [17950] lbf	14110 [15320] lbf	12570 [13640] lbf
	ISO	80.4 [87.3] kN	77.5 [84.1] kN	65.7 [71.4] kN	57.9 [62.8] kN
		8200 [8900] kgf	7900 [8580] kgf	6700 [7270] kgf	5900 [6410] kgf
		18080 [19630] lbf	17420 [18910] lbf	14770 [16040] lbf	13010 [14120] lbf

※ : STD   [   ] : Power boost

2) 4.939 M (16' 2") 2-PIECE BOOM



145ZF2SP08

Description		1.90 m (6' 3") Arm	2.10 m (6' 11") Arm	2.50 m (8' 2") Arm
Max digging reach	A	8000 mm (26' 3")	8270 mm (27' 2")	8675 mm (28' 6")
Max digging reach on ground	A'	7850 mm (25' 9")	8130 mm (26' 8")	8540 mm (28' 0")
Max digging depth	B	4985 mm (16' 4")	5175 mm (17' 0")	5580 mm (18' 4")
Max digging depth (8ft level)	B'	4870 mm (16' 0")	5060 mm (16' 7")	5470 mm (17'11")
Max vertical wall digging depth	C	4030 mm (13' 3")	4555 mm (14'11")	5015 mm (16' 5")
Max digging height	D	9000 mm (29' 6")	9340 mm (30' 8")	9715 mm (31'10")
Max dumping height	E	6555 mm (21' 6")	6850 mm (22' 6")	7230 mm (23' 9")
Min swing radius	F	2220 mm (7' 3")	2300 mm (7' 7")	2250 mm (7' 5")
Bucket digging force	SAE	87.3 [94.8] kN	87.3 [94.8] kN	87.3 [94.8] kN
		8900 [9660] kgf	8900 [9660] kgf	8900 [9660] kgf
		19620 [21300] lbf	19620 [21300] lbf	19620 [21300] lbf
	ISO	102 [110.8] kN	102 [110.8] kN	102 [110.8] kN
		10400 [11290] kgf	10400 [11290] kgf	10400 [11290] kgf
		22930 [24890] lbf	22930 [24890] lbf	22930[24890] lbf
Arm crowd force	SAE	76.5 [83.1] kN	73.6 [79.9] kN	62.8 [68.2] kN
		7800 [8470] kgf	7500 [8140] kgf	6400 [6950] kgf
		17200 [18670] lbf	16530 [17950] lbf	14110 [15320] lbf
	ISO	80.4 [87.3] kN	77.5 [84.1] kN	65.7 [71.4] kN
		8200 [8900] kgf	7900 [8580] kgf	6700 [7270] kgf
		18080 [19630] lbf	17420 [18910] lbf	14770 [16040] lbf

[ ] : Power boost

4. WEIGHT

Item	HX145LCR		HX145 LCRD	
	kg	lb	kg	lb
Upper structure assembly				
· Main frame weld assembly	1300	2870	1266	2791
· Engine assembly	558	1230	←	←
· Main pump assembly	90	200	←	←
· Main control valve assembly	140	310	←	←
· Swing motor assembly	120	260	←	←
· Hydraulic oil tank assembly	150	330	←	←
· Fuel tank assembly	120	260	←	←
· Counterweight	2800	6170	←	←
· Cab assembly	450	990	←	←
Lower chassis assembly				
· Track frame weld assembly	1640	3620	1713★1 1771★2	3777★1 3904★2
· Swing bearing	228	503	←	←
· Travel motor assembly	240	530	←	←
· Turning joint	50	110	←	←
· Track recoil spring	93	206	←	←
· Idler	105	231	←	←
· Carrier roller	20	45	←	←
· Track roller	35	80	←	←
· Sprocket	40	88	←	←
· Track-chain assembly (600 mm standard triple grouser shoe)	1804	3977	←	←
· Dozer blade assembly	-	-	519	1144
Front attachment assembly				
· 4.6 m boom assembly	830	1830	←	←
· 2-piece boom assembly	1018	2244	←	←
· 2.5 m arm assembly	435	960	←	←
· 0.52 m^3 SAE heaped bucket	460	1010	←	←
· Boom cylinder assembly	130	290	←	←
· Arm cylinder assembly	160	350	←	←
· Bucket cylinder assembly	100	220	←	←
· Bucket control rod assembly	90	200	←	←
· Dozer blade cylinder assembly	-	-	44	97

★1 HX145CRD ★2 HX145LCRD

※ 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

1) HX145LCR MONO BOOM

Model	Boom Type	Boom Length	Arm Length	Counterweight Weight (kg)	Shoe Width	Dozer Front	Dozer Rear	Outrigger Front	Outrigger Rear
HX145LCR	Mono	4600	1900	2800	600	-	-	-	-

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

Lift-point height (A)		Lift-point radius (B) 1.5 m (4.9 ft)		3.0 m (9.8 ft)		4.5 m (14.8 ft)		6.0 m (19.7 ft)		At max. reach Capacity		Reach m (ft)
		Front	Side	Front	Side	Front	Side	Front	Side	Front	Side	
7.5m	kg									*5160	*5160	2.27
24.6ft	lb									*11380	*11380	(7.5)
6.0m	kg			*5270	*5270	*4160	3760			*3510	*3510	4.63
19.7ft	lb			*11620	*11620	*9170	8290			*7740	*7740	(15.2)
4.5m	kg			*6050	*6050	*4910	3730			*3160	2500	5.73
14.8ft	lb			*13340	*13340	*10820	8220			*6970	5510	(18.8)
3.0m	kg					*5560	3540	3760	2280	*3130	2100	6.30
9.8ft	lb					*12260	7800	8290	5030	*6900	4630	(20.7)
1.5m	kg					5710	3310	3670	2200	3270	1960	6.47
4.9ft	lb					12590	7300	8090	4850	7210	4320	(21.2)
0.0m	kg			*5830	5770	5560	3180	3610	2140	3380	2010	6.29
0.0ft	lb			*12850	12720	12260	7010	7960	4720	7450	4430	(20.6)
-1.5m	kg			*7860	5810	5530	3160			3890	2300	5.71
-4.9ft	lb			*17330	12810	12190	6970			8580	5070	(18.7)
-3.0m	kg			*5420	*5420	*3560	3280			*3380	3200	4.58
-9.8ft	lb			*11950	*11950	*7850	7230			*7450	7050	(15.0)

※ Note

1. Lifting capacity are based on SAE J1097 and ISO 10567.
2. Lifting capacity of the ROBEX series does not exceed 75% of tipping load with the machine on firm, level ground or 87% of full hydraulic capacity.
3. The lift-point is bucket pivot mounting pin on the arm (without bucket mass).
4. *indicates load limited by hydraulic capacity.

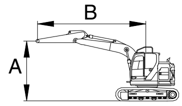
※ Lifting capacities are based upon a standard machine conditions.
Lifting capacities will vary with different work tools, ground conditions and attachments.
The difference between the weight of a work tool attachment must be subtracted.
Consult your HD Hyundai Construction Equipment dealer regarding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

Unit : mm

Model	Boom Type	Boom Length	Arm Length	Counterweight Weight (kg)	Shoe Width	Dozer Front	Dozer Rear	Outrigger Front	Outrigger Rear
HX145LCR	Mono	4600	2100	2800	600	-	-	-	-

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

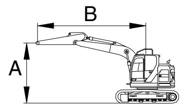


Lift-point height (A)		Lift-point radius (B) 1.5 m (4.9 ft)		3.0 m (9.8 ft)		4.5 m (14.8 ft)		6.0 m (19.7 ft)		At max. reach Capacity		Reach
		Rating over-front	Rating over-side or 360 degree	Rating over-front	Rating over-side or 360 degree	Rating over-front	Rating over-side or 360 degree	Rating over-front	Rating over-side or 360 degree	Rating over-front	Rating over-side or 360 degree	m (ft)
7.5m	kg									*4600	*4600	2.74
24.6ft	lb									*10140	*10140	(9.0)
6.0m	kg			*4950	*4950	*4460	3800			*3360	3310	4.87
19.7ft	lb			*10910	*10910	*9830	8380			*7410	7300	(16.0)
4.5m	kg			*5330	*5330	*4730	3750			*3070	2370	5.93
14.8ft	lb			*11750	*11750	*10430	8270			*6770	5220	(19.4)
3.0m	kg			*7860	6620	*5400	3550	3760	2280	*3050	2010	6.48
9.8ft	lb			*17330	14590	*11900	7830	8290	5030	*6720	4430	(21.2)
1.5m	kg					5720	3310	3660	2190	3140	1880	6.65
4.9ft	lb					12610	7300	8070	4830	6920	4140	(21.8)
0.0m	kg			*6280	5730	5540	3160	3590	2120	3220	1920	6.47
0.0ft	lb			*13850	12630	12210	6970	7910	4670	7100	4230	(21.2)
-1.5m	kg	*5280	*5280	*8140	5750	5500	3120			3680	2170	5.90
-4.9ft	lb	*11640	*11640	*17950	12680	12130	6880			8110	4780	(19.4)
-3.0m	kg			*5850	*5850	*4010	3210			*3450	2940	4.83
-9.8ft	lb			*12900	*12900	*8840	7080			*7610	6480	(15.8)

Unit : mm

Model	Boom Type	Boom Length	Arm Length	Counterweight Weight (kg)	Shoe Width	Dozer Front	Dozer Rear	Outrigger Front	Outrigger Rear
HX145LCR	Mono	4600	2500	2800	600	-	-	-	-

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

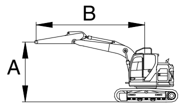


Lift-point height (A)		Lift-point radius (B) 1.5 m (4.9 ft)		3.0 m (9.8 ft)		4.5 m (14.8 ft)		6.0 m (19.7 ft)		At max. reach Capacity		Reach
		Rating over-front	Rating over-side or 360 degree	Rating over-front	Rating over-side or 360 degree	Rating over-front	Rating over-side or 360 degree	Rating over-front	Rating over-side or 360 degree	Rating over-front	Rating over-side or 360 degree	m (ft)
7.5m	kg			*4060	*4060					*2910	*2910	3.63
24.6ft	lb			*8950	*8950					*6420	*6420	(11.9)
6.0m	kg					*3820	*3820			*2260	*2260	5.42
19.7ft	lb					*8420	*8420			*4980	*4980	(17.8)
4.5m	kg			*3950	*3950	*4310	3810	*3330	2360	*2070	*2070	6.38
14.8ft	lb			*8710	*8710	*9500	8400	*7340	5200	*4560	*4560	(20.9)
3.0m	kg			*7130	6800	*5090	3590	3780	2290	*2040	1810	6.90
9.8ft	lb			*15720	14990	*11220	7910	8330	5050	*4500	3990	(22.6)
1.5m	kg			*8100	6020	5740	3320	3660	2180	*2130	1700	7.06
4.9ft	lb			*17860	13270	12650	7320	8070	4810	*4700	3750	(23.1)
0.0m	kg			*6750	5690	5530	3140	3570	2100	*2350	1730	6.89
0.0ft	lb			*14880	12540	12190	6920	7870	4630	*5180	3810	(22.6)
-1.5m	kg	*4740	*4740	*8620	5660	5450	3070	3540	2070	*2830	1920	6.36
-4.9ft	lb	*10450	*10450	*19000	12480	12020	6770	7800	4560	*6240	4230	(20.9)
-3.0m	kg	*8830	*8830	*6640	5780	*4620	3130			*3350	2470	5.38
-9.8ft	lb	*19470	*19470	*14640	12740	*10190	6900			*7390	5450	(17.6)

Unit : mm

Model	Boom	Boom	Arm	Counterweight	Shoe	Dozer		Outrigger	
	Type	Length	Length	Weight (kg)	Width	Front	Rear	Front	Rear
HX145LCR	Mono	4600	3000	2800	600	-	-	-	-

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



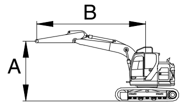
Lift-point height (A)		Lift-point radius (B)										At max. reach		
		1.5 m (4.9 ft)		3.0 m (9.8 ft)		4.5 m (14.8 ft)		6.0 m (19.7 ft)		7.5 m (24.6 ft)		Capacity		Reach
														m (ft)
7.5m 24.6ft	kg lb											*2300 *5070	*2300 *5070	4.48 (14.7)
6.0m 19.7ft	kg lb					*3280 *7230	*3280 *7230	*1920 *4230	*1920 *4230			*1900 *4190	*1900 *4190	6.01 (19.7)
4.5m 14.8ft	kg lb					*3450 *7610	*3450 *7610	*3230 *7120	2410 5310			*1760 *3880	*1760 *3880	6.89 (22.6)
3.0m 9.8ft	kg lb			*5250 *11570	*5250 *11570	*4630 *10210	3660 8070	3820 8420	2320 5110			*1750 *3860	1630 3590	7.37 (24.2)
1.5m 4.9ft	kg lb			*8650 *19070	6220 13710	*5600 *12350	3380 7450	3680 8110	2200 4850	*1910 *4210	1540 3400	*1820 *4010	1530 3370	7.52 (24.7)
0.0m 0.0ft	kg lb			*7520 *16580	5740 12650	5550 12240	3160 6970	3560 7850	2090 4610			*2000 *4410	1550 3420	7.36 (24.1)
-1.5m -4.9ft	kg lb	*4280 *9440	*4280 *9440	*9100 *20060	5620 12390	5430 11970	3050 6720	3500 7720	2040 4500			*2360 *5200	1700 3750	6.87 (22.5)
-3.0m -9.8ft	kg lb	*7420 *16360	*7420 *16360	*7510 *16560	5680 12520	*5160 *11380	3060 6750					*3150 *6940	2090 4610	5.97 (19.6)
-4.5m -14.8ft	kg lb			*4370 *9630	*4370 *9630							*2550 *5620	*2550 *5620	4.42 (14.5)

2) HX145LCR 2-PIECE BOOM

Unit : mm

Model	Boom Type	Boom Length	Arm Length	Counterweight Weight (kg)	Shoe Width	Dozer		Outrigger	
						Front	Rear	Front	Rear
HX145LCR	2PCS	4939	1900	2800	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
		Over-front	Over-side or 360 degree	Over-front	Over-side or 360 degree	Over-front	Over-side or 360 degree	Over-front	Over-side or 360 degree	m (ft)
7.5m	kg	*6340	*6340					*5810	*5810	3.21
24.6ft	lb	*13980	*13980					*12810	*12810	(10.5)
6.0m	kg	*5610	*5610	*5140	3830			*4390	3030	5.14
19.7ft	lb	*12370	*12370	*11330	8440			*9680	6680	(16.9)
4.5m	kg	*6910	*6910	*5450	3730	3860	2350	3690	2240	6.15
14.8ft	lb	*15230	*15230	*12020	8220	8510	5180	8140	4940	(20.2)
3.0m	kg			5970	3500	3790	2280	3190	1920	6.69
9.8ft	lb			13160	7720	8360	5030	7030	4230	(21.9)
1.5m	kg			5700	3270	3680	2190	3020	1800	6.85
4.9ft	lb			12570	7210	8110	4830	6660	3970	(22.5)
0.0m	kg			5550	3140	3610	2120	3100	1840	6.68
0.0ft	lb			12240	6920	7960	4670	6830	4060	(21.9)
-1.5m	kg	*9370	5770	5520	3120	3610	2120	3500	2070	6.13
-4.9ft	lb	*20660	12720	12170	6880	7960	4670	7720	4560	(20.1)

※ Note

1. Lifting capacity are based on SAE J1097 and ISO 10567.
2. Lifting capacity of the ROBEX series does not exceed 75% of tipping load with the machine on firm, level ground or 87% of full hydraulic capacity.
3. The lift-point is bucket pivot mounting pin on the arm (without bucket mass).
4. *indicates load limited by hydraulic capacity.

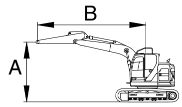
※ Lifting capacities are based upon a standard machine conditions.
Lifting capacities will vary with different work tools, ground conditions and attachments.
The difference between the weight of a work tool attachment must be subtracted.
Consult your HD Hyundai Construction Equipment dealer regarding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

Unit : mm

Model	Boom	Boom	Arm	Counterweight	Shoe	Dozer		Outrigger	
	Type	Length	Length	Weight (kg)	Width	Front	Rear	Front	Rear
HX145LCR	2PCS	4939	2100	2800	600	-	-	-	-

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

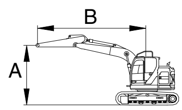


Lift-point height (A)		Lift-point radius (B)						At max. reach		
		3.0 m (9.8 ft)		4.5 m (14.8 ft)		6.0 m (19.7 ft)		Capacity		Reach
										m (ft)
7.5m	kg	*5810	*5810					*5300	*5300	3.58
24.6ft	lb	*12810	*12810					*11680	*11680	(11.7)
6.0m	kg			*4900	3850			*4170	2830	5.38
19.7ft	lb			*10800	8490			*9190	6240	(17.6)
4.5m	kg	*6190	*6190	*5260	3750	3870	2360	3510	2130	6.35
14.8ft	lb	*13650	*13650	*11600	8270	8530	5200	7740	4700	(20.8)
3.0m	kg			5980	3510	3790	2280	3050	1830	6.87
9.8ft	lb			13180	7740	8360	5030	6720	4030	(22.5)
1.5m	kg			5700	3260	3670	2180	2890	1720	7.03
4.9ft	lb			12570	7190	8090	4810	6370	3790	(23.1)
0.0m	kg			5530	3120	3590	2100	2960	1750	6.86
0.0ft	lb			12190	6880	7910	4630	6530	3860	(22.5)
-1.5m	kg	*9130	5710	5490	3080	3570	2090	3320	1950	6.33
-4.9ft	lb	*20130	12590	12100	6790	7870	4610	7320	4300	(20.8)
-3.0m	kg			5570	3150					
-9.8ft	lb			12280	6940					

Unit : mm

Model	Boom	Boom	Arm	Counterweight	Shoe	Dozer		Outrigger	
	Type	Length	Length	Weight (kg)	Width	Front	Rear	Front	Rear
HX145LCR	2PCS	4939	2500	2800	600	-	-	-	-

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

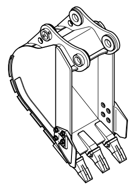
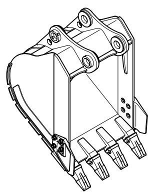
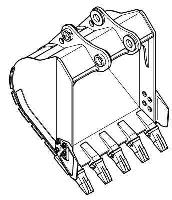


Lift-point height (A)		Lift-point radius (B)								At max. reach		
		3.0 m (9.8 ft)		4.5 m (14.8 ft)		6.0 m (19.7 ft)		7.5 m (24.6 ft)		Capacity		Reach
												m (ft)
7.5m	kg									*3570	*3570	4.33
24.6ft	lb									*7870	*7870	(14.2)
6.0m	kg			*4450	3920					*2910	2440	5.90
19.7ft	lb			*9810	8640					*6420	5380	(19.4)
4.5m	kg	*4440	*4440	*4860	3800	3900	2380			*2690	1900	6.80
14.8ft	lb	*9790	*9790	*10710	8380	8600	5250			*5930	4190	(22.3)
3.0m	kg	*8480	6640	*5820	3550	3800	2290			*2640	1660	7.28
9.8ft	lb	*18700	14640	*12830	7830	8380	5050			*5820	3660	(23.9)
1.5m	kg			5720	3280	3670	2170			2640	1560	7.43
4.9ft	lb			12610	7230	8090	4780			5820	3440	(24.4)
0.0m	kg	*4590	*4590	5510	3100	3560	2080			2700	1580	7.27
0.0ft	lb	*10120	*10120	12150	6830	7850	4590			5950	3480	(23.9)
-1.5m	kg	*8330	5600	5430	3030	3520	2040			2980	1740	6.78
-4.9ft	lb	*18360	12350	11970	6680	7760	4500			6570	3840	(22.2)
-3.0m	kg	*8520	5720	5480	3080							
-9.8ft	lb	*18780	12610	12080	6790							

6. BUCKET SELECTION GUIDE

1) HX145 LCR

(1) General bucket

		
0.23 m^3 SAE heaped bucket	0.40, 0.46 m^3 SAE heaped bucket	0.52, ※0.58, 0.65, 0.71 m^3 SAE heaped bucket

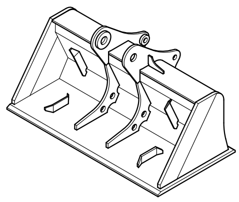
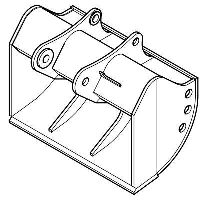
Capacity		Width		Weight	Recommendation					
					4.6 m (15' 1") Mono boom				4.9 m (16' 1") Adjust boom	
SAE heaped	CECE heaped	Without side cutter	With side cutter		1.9 m arm (6' 3")	2.1 m arm (6' 11")	2.5 m arm (8' 2")	3.0 m arm (9' 10")	2.1 m arm (6' 11")	2.5 m arm (8' 2")
0.23 m^3 (0.30 yd^3)	0.20 m^3 (0.26 yd^3)	520 mm (20.5")	620 mm (24.4")	335 kg (740 lb)	●	●	●	⊙	●	●
0.40 m^3 (0.52 yd^3)	0.35 m^3 (0.46 yd^3)	750 mm (29.5")	850 mm (33.5")	410 kg (900 lb)	●	●	●	⊙	●	●
0.46 m^3 (0.60 yd^3)	0.40 m^3 (0.52 yd^3)	840 mm (33.1")	940 mm (37.0")	435 kg (960 lb)	●	●	●	○	●	⊙
0.52 m^3 (0.68 yd^3)	0.45 m^3 (0.59 yd^3)	915 mm (36.0")	1015 mm (40.0")	460 kg (1010 lb)	●	●	●	X	⊙	⊙
※0.58 m^3 (0.76 yd^3)	0.50 m^3 (0.65 yd^3)	1000 mm (39.4")	1100 mm (43.3")	480 kg (1060 lb	●	●	⊙	X	⊙	○
0.65 m^3 (0.85 yd^3)	0.55 m^3 (0.72 yd^3)	1105 mm (43.5")	1205 mm (47.4")	500 kg (1100 lb)	⊙	⊙	○	X	○	X
0.71 m^3 (0.93 yd^3)	0.60 m^3 (0.78 yd^3)	1190 mm (46.9")	1290 mm (50.8")	540 kg (1190 lb)	○	○	X	X	X	X

※ : 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
X	Not recommended

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

(2) Special bucket

Slope finishing bucket	Ditch cleaning bucket
	
◎ 0.55 m^3 SAE heaped bucket	★ 0.45 m^3 SAE heaped bucket

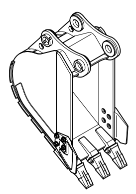
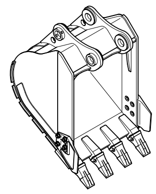
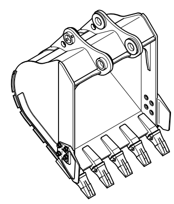
Capacity		Width		Weight	Recommendation				
					4.6 m (15' 1") Mono boom			4.9 m (16' 9") Adjust boom	
SAE heaped	CECE heaped	Without side cutter	With side cutter		1.9 m arm (6' 3")	2.1 m arm (6' 11")	2.5 m arm (8' 2")	2.1 m arm (6' 11")	2.5 m arm (8' 2")
◎ 0.55 m^3 (0.72 yd^3)	0.45 m^3 (0.59 yd^3)	1800 mm (70.9")	-	585 kg (1290 lb)	⊙	○	○	⊙	○
★ 0.45 m^3 (0.59 yd^3)	0.40 m^3 (0.52 yd^3)	1520 mm (59.8")	-	410 kg (900 lb)	●	●	⊙	●	⊙

◎ : Slope finishing 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

2) HX140 LCR 2-PIECE BOOM

(1) General bucket

		
0.23 m³ SAE heaped bucket	0.40, 0.46 m³ SAE heaped bucket	0.52, ※0.58, 0.65, 0.71 m³ SAE heaped bucket

Capacity		Width		Weight	Recommendation		
					4.9 m (16' 1") adjust boom		
SAE heaped	CECE heaped	Without side cutter	With side cutter		1.9 m arm (6' 3")	2.1 m arm (6' 11")	2.5 m arm (8' 2")
0.23 m^3 (0.30 yd^3)	0.20 m^3 (0.26 yd^3)	520 mm (20.5")	620 mm (24.4")	335 kg (740 lb)	●	●	●
0.40 m^3 (0.52 yd^3)	0.35 m^3 (0.46 yd^3)	750 mm (29.5")	850 mm (33.5")	410 kg (900 lb)	●	●	⊙
0.46 m^3 (0.60 yd^3)	0.40 m^3 (0.52 yd^3)	840 mm (33.1")	940 mm (37.0")	435 kg (960 lb)	⊙	⊙	■
0.52 m^3 (0.68 yd^3)	0.45 m^3 (0.59 yd^3)	915 mm (36.0")	1015 mm (40.0")	460 kg (1010 lb)	■	■	▲
※0.58 m^3 (0.76 yd^3)	0.50 m^3 (0.65 yd^3)	1000 mm (39.4")	1110 mm (43.7")	480 kg (1060 lb)	■	▲	▲
0.65 m^3 (0.85 yd^3)	0.55 m^3 (0.72 yd^3)	1105 mm (43.5")	1205 mm (47.4")	500 kg (1100 lb)	▲	▲	X
0.71 m^3 (0.93 yd^3)	0.60 m^3 (0.78 yd^3)	1190 mm (46.9")	1290 mm (50.8")	540 kg (1190 lb)	▲	X	X

※ : Standard bucket

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

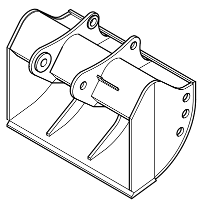
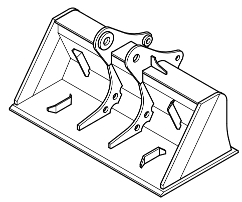
⊙ Applicable for materials with density of 1800 kg/m³ (3000 lb/yd³) or less

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

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

X Not recommended

(2) Special bucket

Ditch cleaning bucket	Slope finishing bucket
	
★0.45 m^3 SAE heaped bucket	◆0.55 m^3 SAE heaped bucket

Capacity		Width		Weight	Recommendation		
					4.9 m (16' 1") boom		
SAE heaped	CECE heaped	Without side cutter	With side cutter		1.9 m arm (6' 3")	2.1 m arm (6' 11")	2.5 m arm (8' 2")
★ 0.45 m^3 (0.59 yd^3)	0.40 m^3 (0.52 yd^3)	1520 mm (59.8")	-	410 kg (900 lb)	●	⊙	■
◆ 0.55 m^3 (0.72 yd^3)	0.45 m^3 (0.59 yd^3)	1800 mm (70.9")	-	585 kg (1290 lb)	■	▲	▲

★ : Ditch cleaning bucket
◆ : Slope finishing bucket

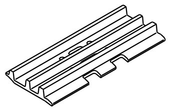
●	Applicable for materials with density of 2100 kg/m^3 (3500 lb/yd^3) or less
⊙	Applicable for materials with density of 1800 kg/m^3 (3000 lb/yd^3) or less
■	Applicable for materials with density of 1500 kg/m^3 (2500 lb/yd^3) or less
▲	Applicable for materials with density of 1200 kg/m^3 (2000 lb/yd^3)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

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		
					
HX145CR	Shoe width	mm (in)	500 (20)	600 (24)	700 (28)
	Operating weight	kg (lb)	15050 (33180)	15270 (33660)	15480 (34130)
	Ground pressure	kgf/cm^2 (psi)	0.48 (6.79)	0.4 (5.74)	0.35 (4.99)
	Overall width	mm (ft-in)	2500 (8' 2")	2600 (8' 6")	2700 (8' 10")
HX145CR (with dozer)	Shoe width	mm (in)	500 (20)	600 (24)	700 (28)
	Operating weight	kg (lb)	15880 (35010)	16110 (35520)	16330 (36000)
	Ground pressure	kgf/cm^2 (psi)	0.50 (7.16)	0.43 (6.06)	0.37 (5.26)
	Overall width	mm (ft-in)	2500 (8' 2")	2600 (8' 6")	2700 (8' 10")
HX145LCR	Shoe width	mm (in)	500 (20)	600 (24)	700 (28)
	Operating weight	kg (lb)	15310 (33750)	15540 (34260)	15750 (34720)
	Ground pressure	kgf/cm^2 (psi)	0.46 (6.53)	0.39 (5.52)	0.34 (4.8)
	Overall width	mm (ft-in)	2500 (8' 2")	2600 (8' 6")	2700 (8' 10")
HX145LCR (with dozer)	Shoe width	mm (in)	500 (20)	600 (24)	700 (28)
	Operating weight	kg (lb)	16120 (35540)	16360 (36070)	16580 (36550)
	Ground pressure	kgf/cm^2 (psi)	0.48 (6.88)	0.41 (5.82)	0.36 (5.05)
	Overall width	mm (ft-in)	2500 (8' 2")	2600 (8' 6")	2700 (8' 10")
HX145LCR 2-pcs boom	Shoe width	mm (in)	500 (20)	600 (24)	700 (28)
	Operating weight	kg (lb)	15630 (34460)	15860 (34970)	16080 (35450)
	Ground pressure	kgf/cm^2 (psi)	0.47 (6.67)	0.4 (5.64)	0.34 (4.90)
	Overall width	mm (ft-in)	2500 (8' 2")	2600 (8' 6")	2700 (8' 10")

3) NUMBER OF ROLLERS AND SHOES ON EACH SIDE

Item	Quantity	
	HX145CR	HX145LCR
Carrier rollers	2 EA	2 EA
Track rollers	7 EA	7 EA
Track shoes	45 EA	47 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	Standard	A
600 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 (269 cu in)
Compression ratio	16.5 : 1
Rated net horse power (SAE J1349)	116 Hp (87 kW) at 1950 rpm
Rated gross horse power (SAE J1995)	124 Hp (92.6 kW) at 1950 rpm
Maximum torque	54 kgf · m (391 lbf · ft) at 1400 rpm
Engine oil quantity	10.5 ℓ (2.8 U.S. gal)
Dry weight	558 kg (1230 lb)
High idling speed	2000 ± 50 rpm
Low idling speed	1000 ± 100 rpm
Rated fuel consumption	165 g/Hp · hr at 1950 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 × 65 cc/rev
Maximum pressure	350 kgf/cm² (4980 psi) [380 kgf/cm² (5400 psi)]
Rated oil flow	2 × 126.8 ℓ/min (33.5 U.S. gpm / 28.0 U.K. gpm)
Rated speed	1950 rpm

[ ]: Power boost

3) GEAR PUMP

Item	Specification
Type	Fixed displacement gear pump single stage
Capacity	15cc/rev
Maximum pressure	40 kgf/cm² (570 psi)
Rated oil flow	29.2 ℓ/min (7.7 U.S. gpm / 6.4 U.K. gpm)

4) MAIN CONTROL VALVE

Item	Specification
Type	11 spools
Operating method	Hydraulic pilot system
Main relief valve pressure	350 kgf/cm² (4980 psi) [380 kgf/cm² (5400 psi)]
Overload relief valve pressure	400 kgf/cm² (5690 psi)

[ ]: Power boost

5) SWING MOTOR

Item	Type 1	Type 2
Type	Fixed displacement axial piston motor	
Capacity	71 cc/rev	72 cc/rev
Relief pressure	285 kgf/cm² (4050 psi)	
Braking system	Automatic, spring applied hydraulic released	
Braking torque	31.3 kgf · m (226 lbf · ft)	30 kgf · m (217 lbf · ft)
Brake release pressure	33.8 kgf/cm² (481 psi)	15~50 kgf/cm² (213~711 psi)
Reduction gear type	2 - stage planetary	

6) TRAVEL MOTOR

Item	Type 1	Type 2	Type 3
Type	Variable displacement axial piston motor		
Relief pressure	350 kgf/cm² (4970 psi)		
Capacity (max / min)	77/45 cc/rev	77/45 cc/rev	77/45 cc/rev
Reduction gear type	2-stage planetary		
Braking system	Automatic, spring applied hydraulic released		
Brake release pressure	9.5 kgf/cm² (135 psi)	10.7 kgf/cm² (135 psi)	14.3 kgf/cm² (203 psi)
Braking torque	19.7 kgf · m (143 lbf · ft)	19.7 kgf · m (143 lbf · ft)	33 kgf/cm² (239 psi)

7) CYLINDER

Item		Specification
Boom cylinder	Bore dia × Stroke	Ø105 × 1105 mm
	Cushion	Extend only
Arm cylinder	Bore dia × Stroke	Ø115 × 1138 mm
	Cushion	Extend and retract
Bucket cylinder	Bore dia × Stroke	Ø100 × 850 mm
	Cushion	Extend only
Dozer cylinder (option)	Bore dia × Stroke	Ø100 × 250 mm
	Cushion	-
Adjust cylinder (opt)	Bore dia × Stroke	Ø145 × 613 mm
	Cushion	-
Adjust boom cylinder (opt)	Bore dia × Stroke	Ø105 × 975 mm
	Cushion	Extend only

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

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

8) SHOE

Item		Width	Ground pressure	Link quantity	Overall width
HX145LCR	Standard	500 mm (20")	0.45 kgf/cm² (6.40 psi)	47	2500 mm (8' 2")
	Option	600 mm (24")	0.38 kgf/cm² (5.40 psi)	47	2600 mm (8' 6")
		700 mm (28")	0.33 kgf/cm² (4.69 psi)	47	2700 mm (8' 10")

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 : 3.5 (0.9) TYPE 2 : 2.5 (0.7)	★SAE 75W-90 SAE 80W-90
Final drive	Gear oil	2.3×2 (0.6×2)	★SAE 75W-90 SAE 80W-90
Hydraulic tank	Hydraulic oil	Tank : 96 (25.4) System : 180 (47.6)	★ISO VG 15 ISO VG 32 ISO VG 46, HBHO VG 46★3 ISO VG 68
Fuel tank	Diesel fuel★1	265 (70.0)	★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	14.5 (3.8)	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
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).

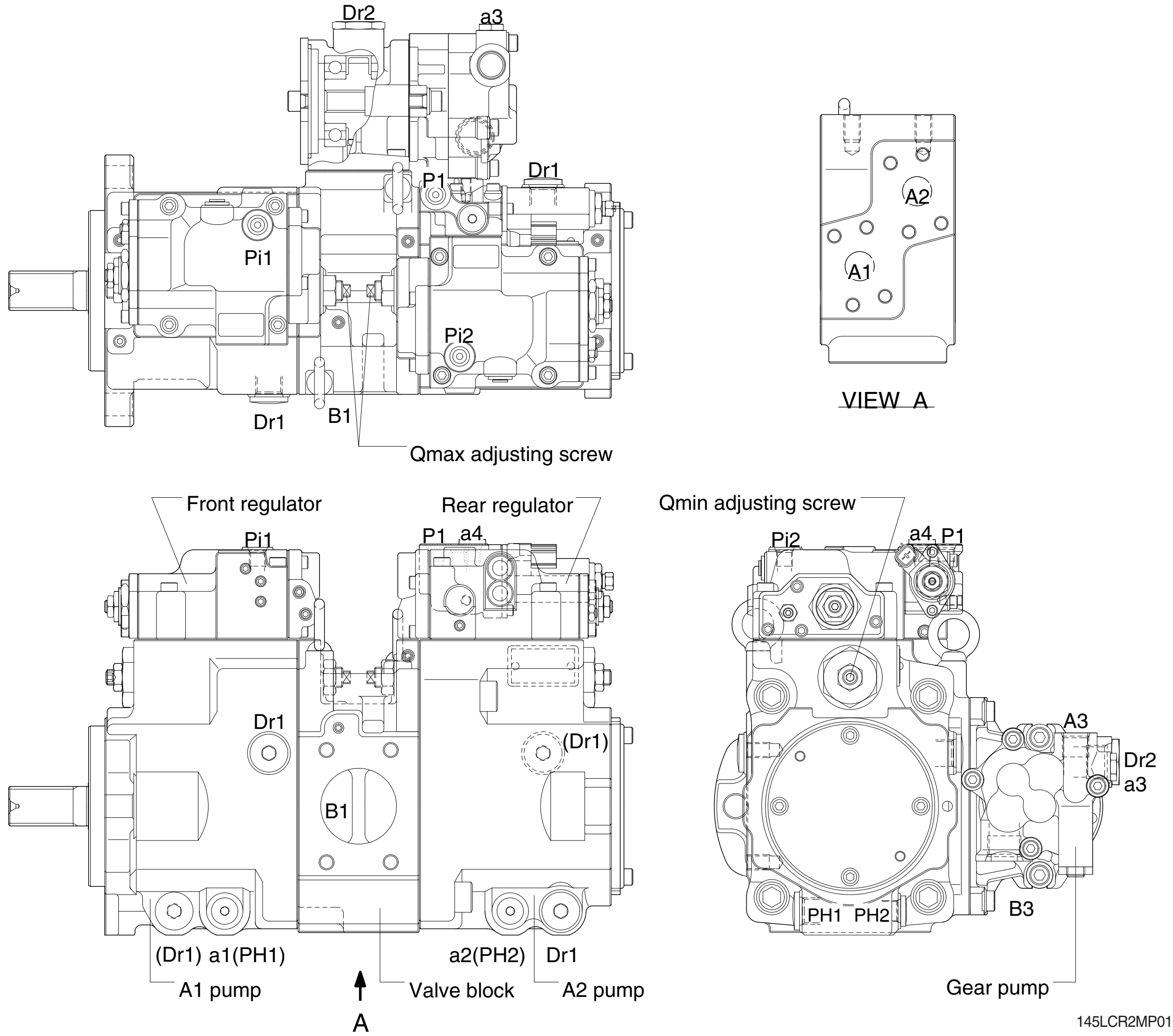
※ For HD Hyundai Construction Equipment genuine lubricating oils and grease for use in regions with extremely low temperatures, please contact HD Hyundai Construction Equipment dealers.

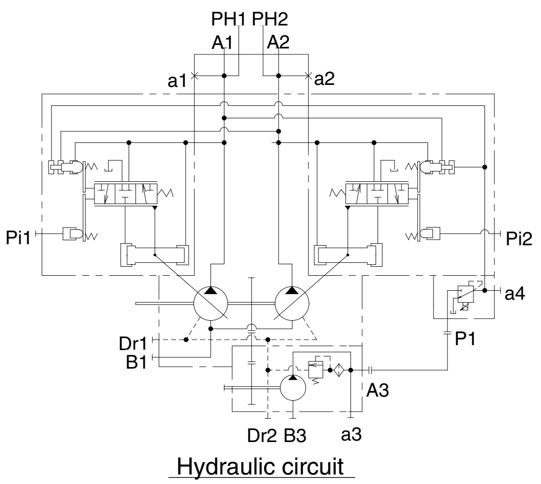
SECTION 2 STRUCTURE AND FUNCTION

GROUP 1 PUMP DEVICE

1. STRUCTURE

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



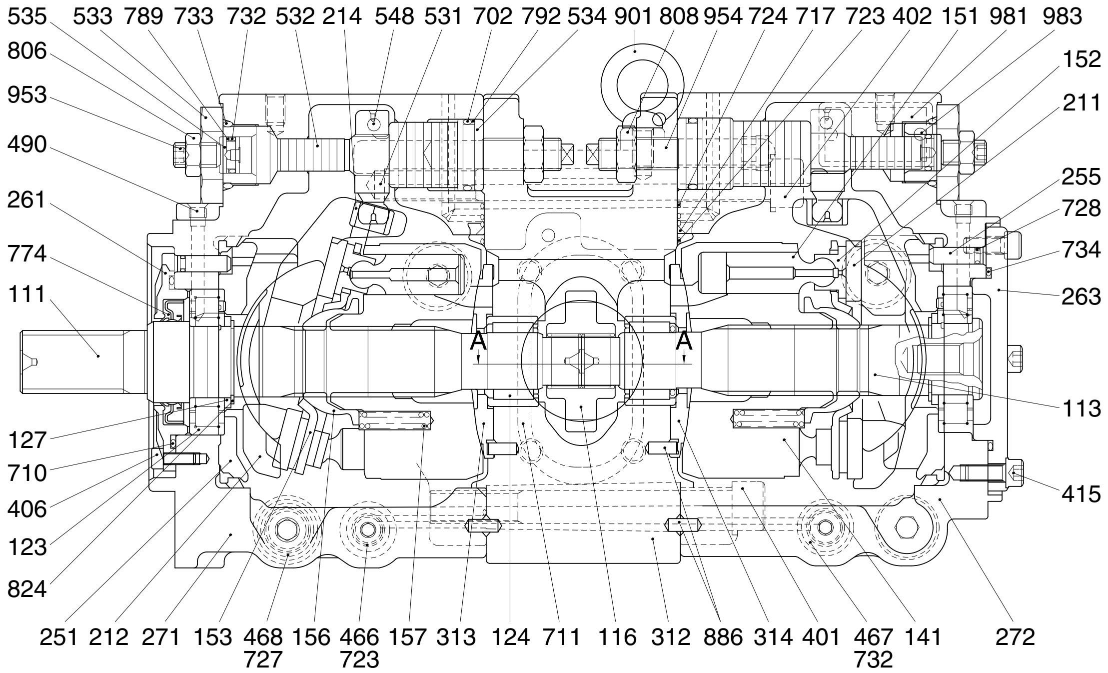


Hydraulic circuit

Port	Port name	Port size
A1, A2	Delivery port	SAE6000 psi 3/4"
B1	Suction port	SAE2500 psi 2 1/2"
Dr1	Drain port	PF 1/2 - 19
Dr2	Drain port	PF 3/4 - 20
Pi1, Pi2	Pilot port	PF 1/4 - 15
P1	EPPR port	PF 1/4 - 13
a1, a2	Gauge port	PF 1/4 - 15
a3	Gauge port	PF 1/4 - 14
PH1, PH2	Servo port	PF 3/8 - 17
a4	Gauge port	PF 1/4-13
A3	Gear pump delivery port	PF 1/2 - 19
B3	Gear pump suction port	PF 3/4 - 20.5

1) MAIN PUMP (1/2)

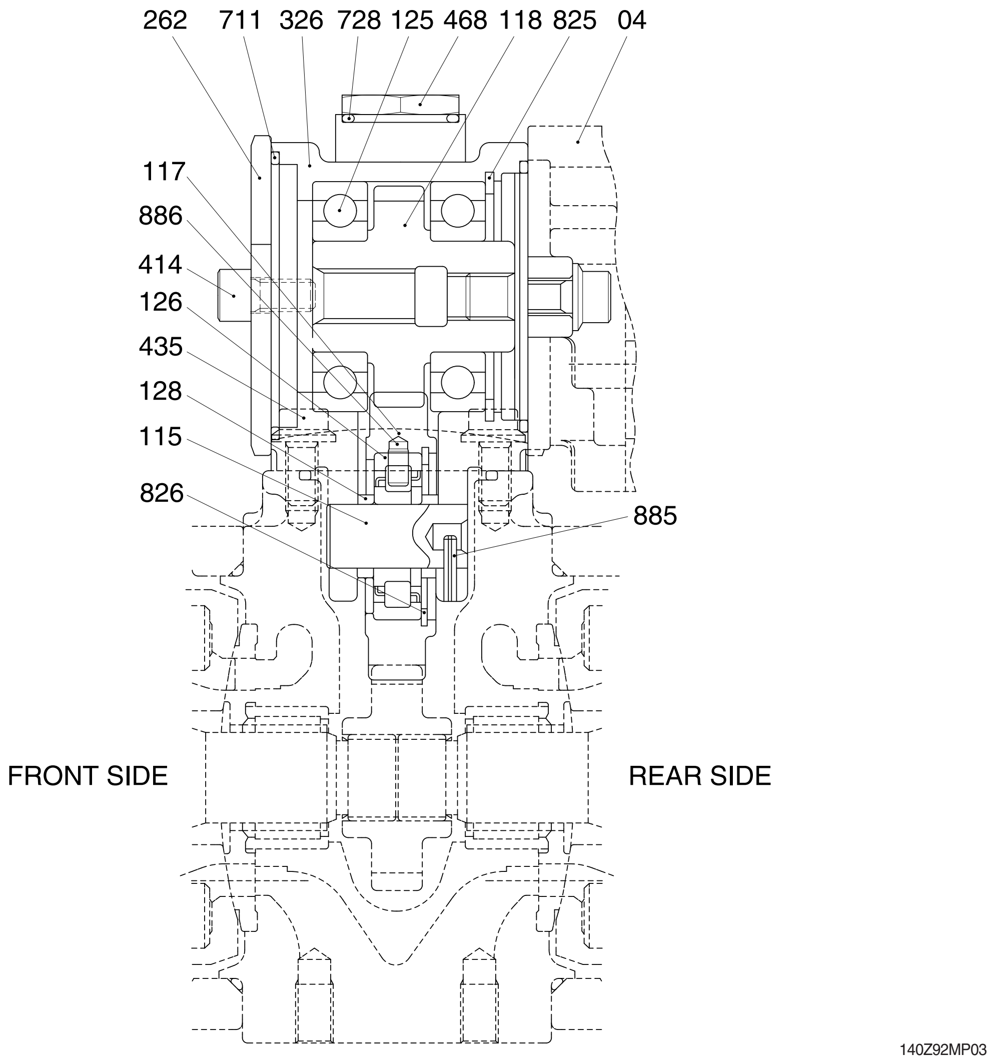
The main pump consists of two piston pumps (front & rear) and valve block.



140Z92MP02

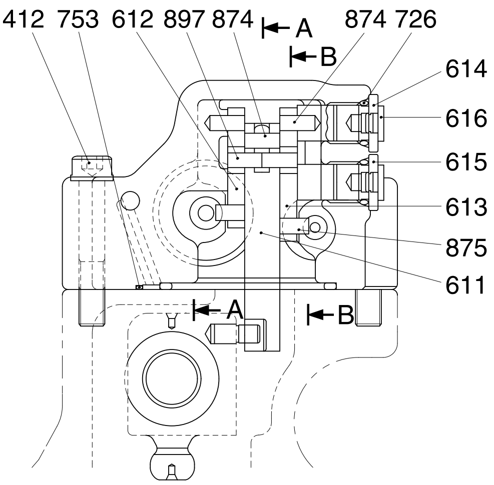
111 Drive shaft (F)
113 Drive shaft (R)
116 1st Gear
123 Roller bearing
124 Needle bearing
127 Bearing spacer
141 Cylinder block
151 Piston
152 Shoe
153 Set plate
156 Bushing
157 Cylinder spring
211 Shoe plate
212 Swash plate
214 Bushing
251 Support
255 Lock pin
261 Seal cover (F)
263 Seal cover (R)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

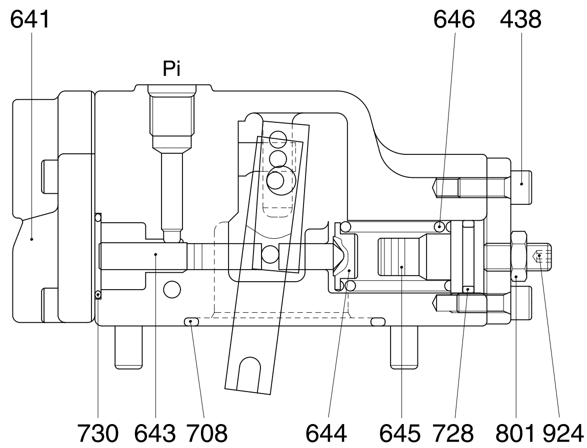
MAIN PUMP (2/2)



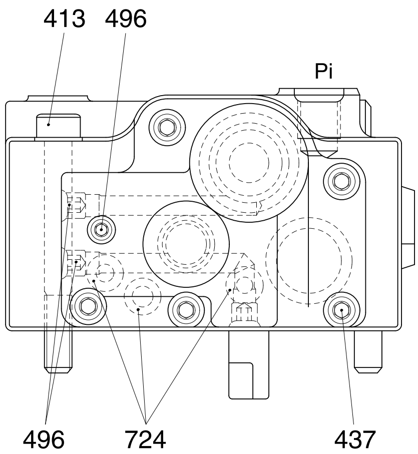
04	Gear pump	128	Bearing spacer	711	O-ring
115	Shaft	262	Cover	728	O-ring
117	Gear No. 2	326	Gear case	825	Retainer ring
118	Gear No. 3	414	Hexagon socket bolt	826	Retainer ring
125	Ball bearing	435	Flange socket bolt	885	Spring pin
126	Roller bearing	468	Plug	886	Pin

2) REGULATOR (1/2)

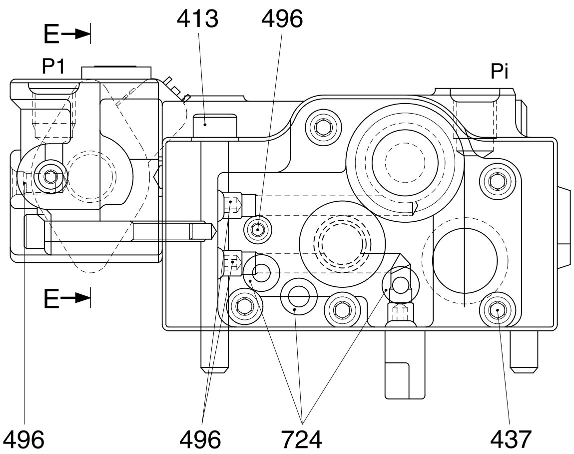




SECTION B-B

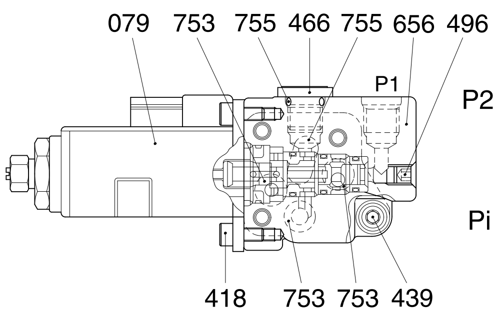


VIEW C (FRONT)

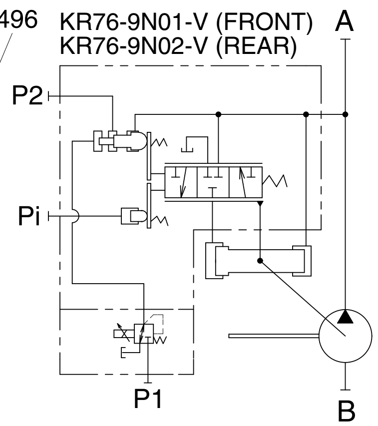


VIEW C (REAR)

140Z92MP04

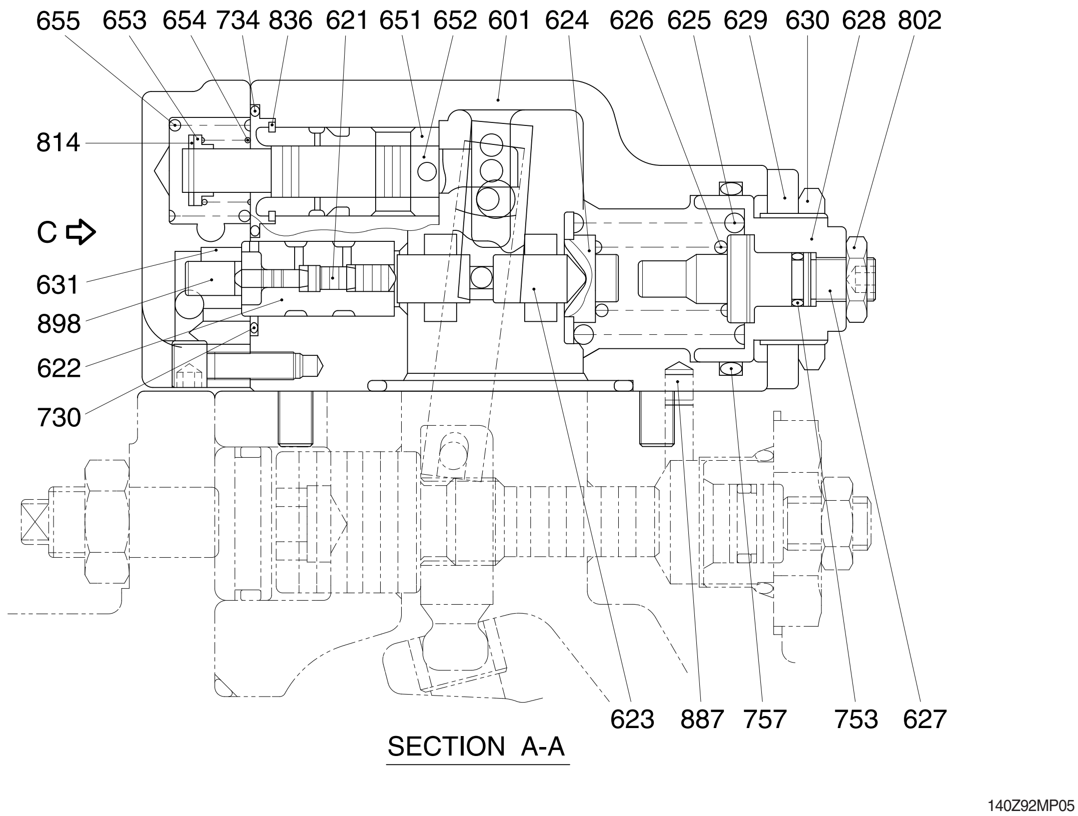


SECTION E-E (REAR)



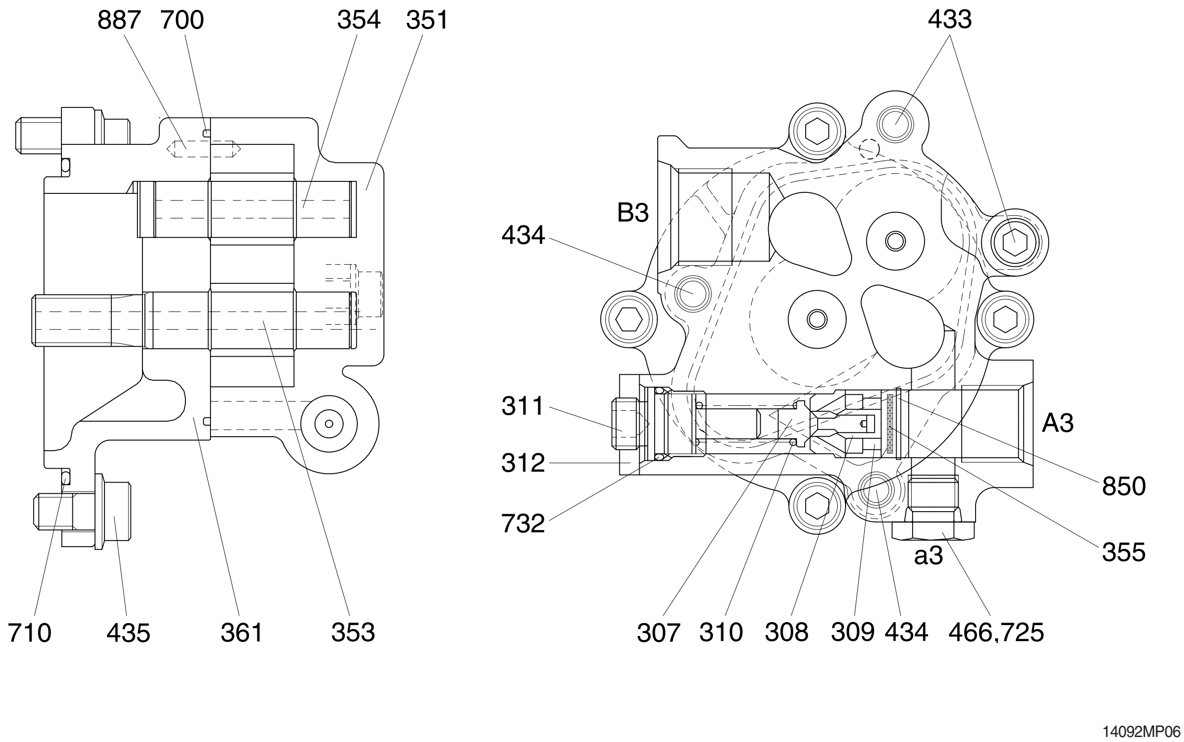
Port	Port name	Port size
A	Delivery port	SAE6000 psi 3/4"
B	Suction port	SAE2500 psi 2 1/2"
Pi	Pilot port	PF 1/4-15
P1	EPPR valve primary port	PF 1/4-13
P2	Companion delivery port	internal

REGULATOR (2/2)



079	EPPR valve assembly	624	Spring seat (C)	708	O-ring
412	Hexagon socket screw	625	Outer spring	724	O-ring
413	Hexagon socket screw	626	Inner spring	725	O-ring
418	Hexagon socket screw	627	Adjust stem (C)	728	O-ring
437	Hexagon socket screw	628	Adjust screw (C)	730	O-ring
438	Hexagon socket screw	629	Cover (C)	734	O-ring
439	Hexagon socket screw	630	Lock nut	753	O-ring
466	Plug	631	Sleeve, Pf	755	O-ring
496	Plug	641	Pilot cover	757	O-ring
601	Casing	643	Pilot piston	801	Nut
611	Feed back lever	644	Spring seat (Q)	802	Nut
612	Lever 1	645	Adjust stem (Q)	814	Snap ring
613	Lever 2	646	Pilot spring	836	Snap ring
614	Center plug	651	Sleeve	874	Pin
615	Adjust plug	652	Spool	875	Pin
616	Plug	653	Spring seat	887	Pin
621	Compensator piston	654	Return spring	897	Pin
622	Piston case	655	Set spring	898	Pin
623	Compensator rod	656	Block cover	924	Set screw

3) GEAR PUMP



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

2. FUNCTION

1) MAIN PUMP

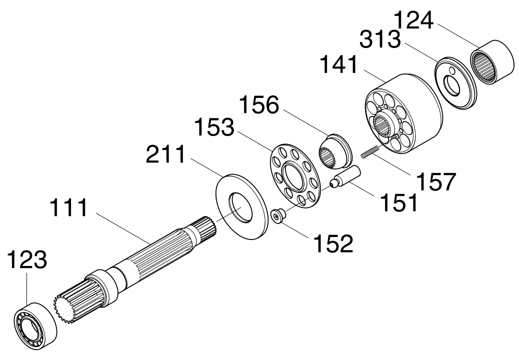
The pumps may be classified roughly into the rotary group performing a rotary motion and working as the major part of the whole pump function: the swash plate group that varies the delivery rates: and the valve cover group that changes over oil suction and discharge : and the PTO group that transfers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

(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 to 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 the set plate and a spherical bushing.

Similarly, the cylinder block is pressed against valve plate (313) by the action of the cylinder spring.



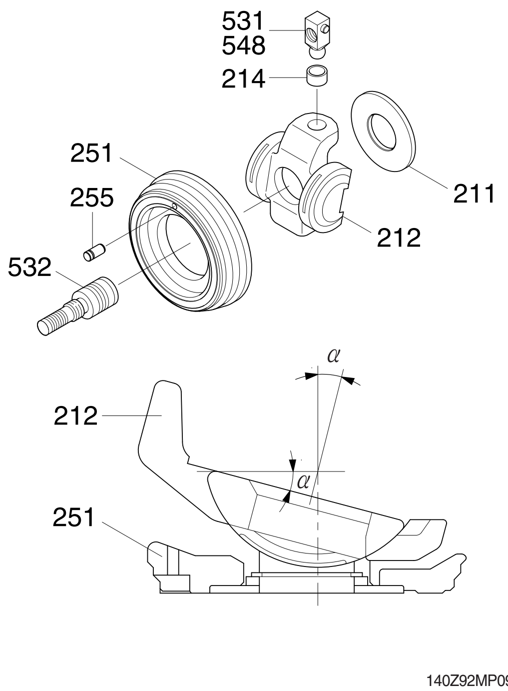
21092MP06

(2) Swash plate group

The swash plate group consists of swash plate (212), shoe plate (211), swash plate support (251), lock pin (255), tilting bushing (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 or left as hydraulic force controlled by the regulator connects 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)



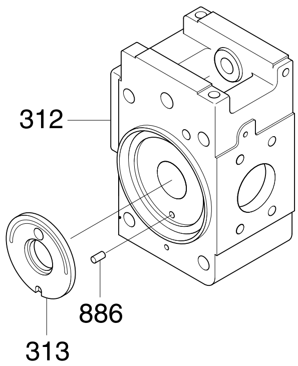
140Z92MP09

(3) Valve block group

The valve block group consists of valve block (312), valve plate (313, 314) and spring pin(886).

The valve plate having two kidmey 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.



140Z92MP07

(4) PTO group

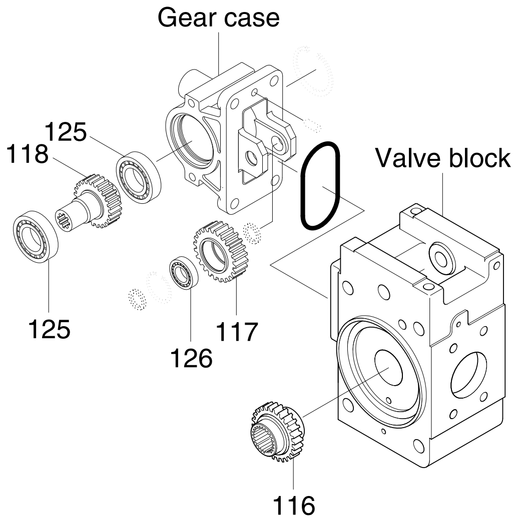
PTO group consist of 1st gear (116) and 2nd gear (117), 3rd gear (118).

2nd gear and 3rd gear are supported by bearings (125, 126), and it can be mounted to the valve block.

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

If you pay attention to a single piston, it performs a motion away from the valve plate (oil sucking process) within 180 degrees, and makes a motion towards the valve plate (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.

Concurrently, the auxiliary pump is driven by gears of PTO.



140Z92MP08

2) REGULATOR

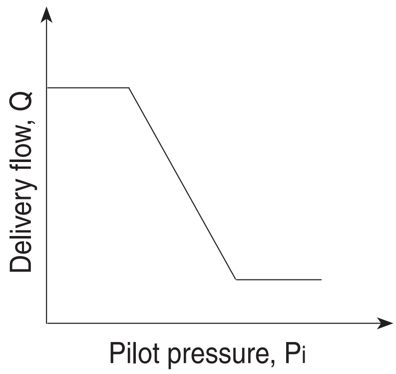
Regulator consists of the negative flow control, total horse power control and power shift control function.

(1) Negative flow control

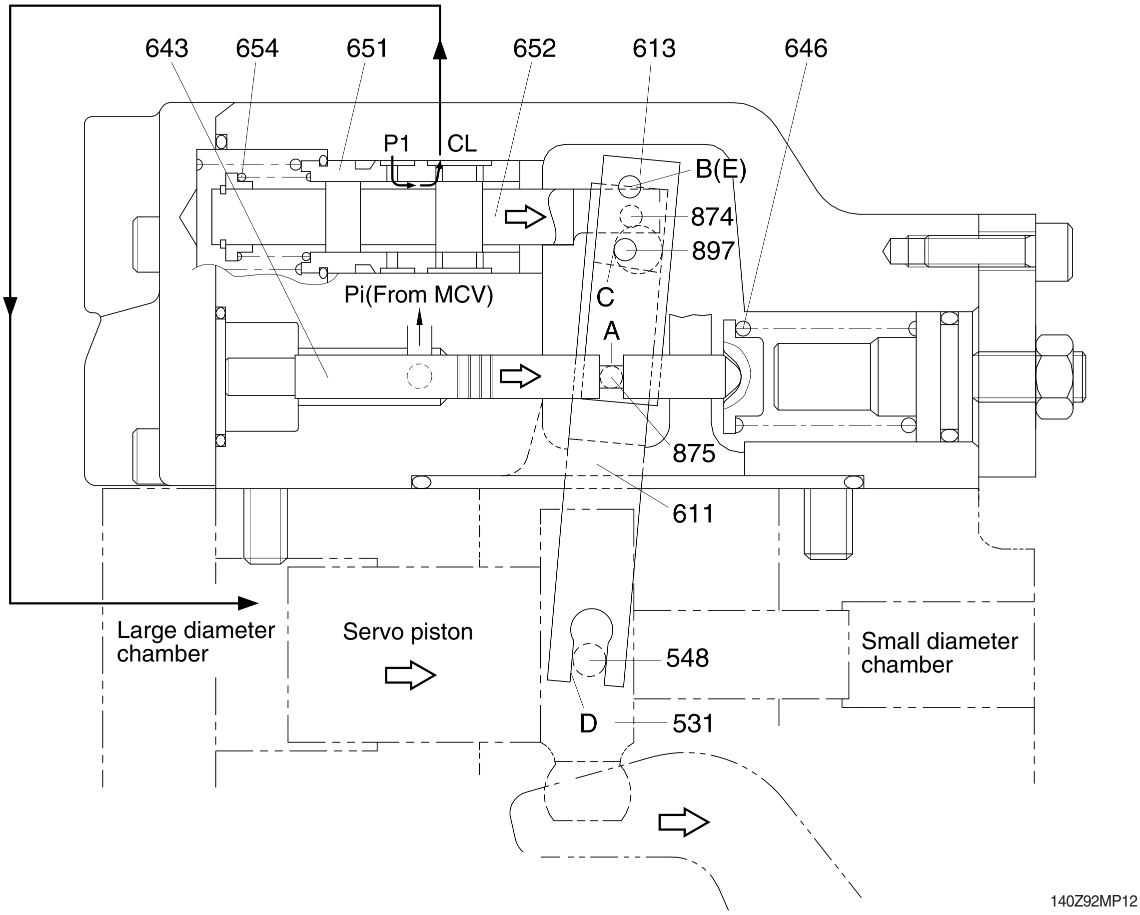
By changing the pilot pressure Pi, the pump tilting angle (delivery flow) is regulated arbitrarily, as shown in the figure.

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.

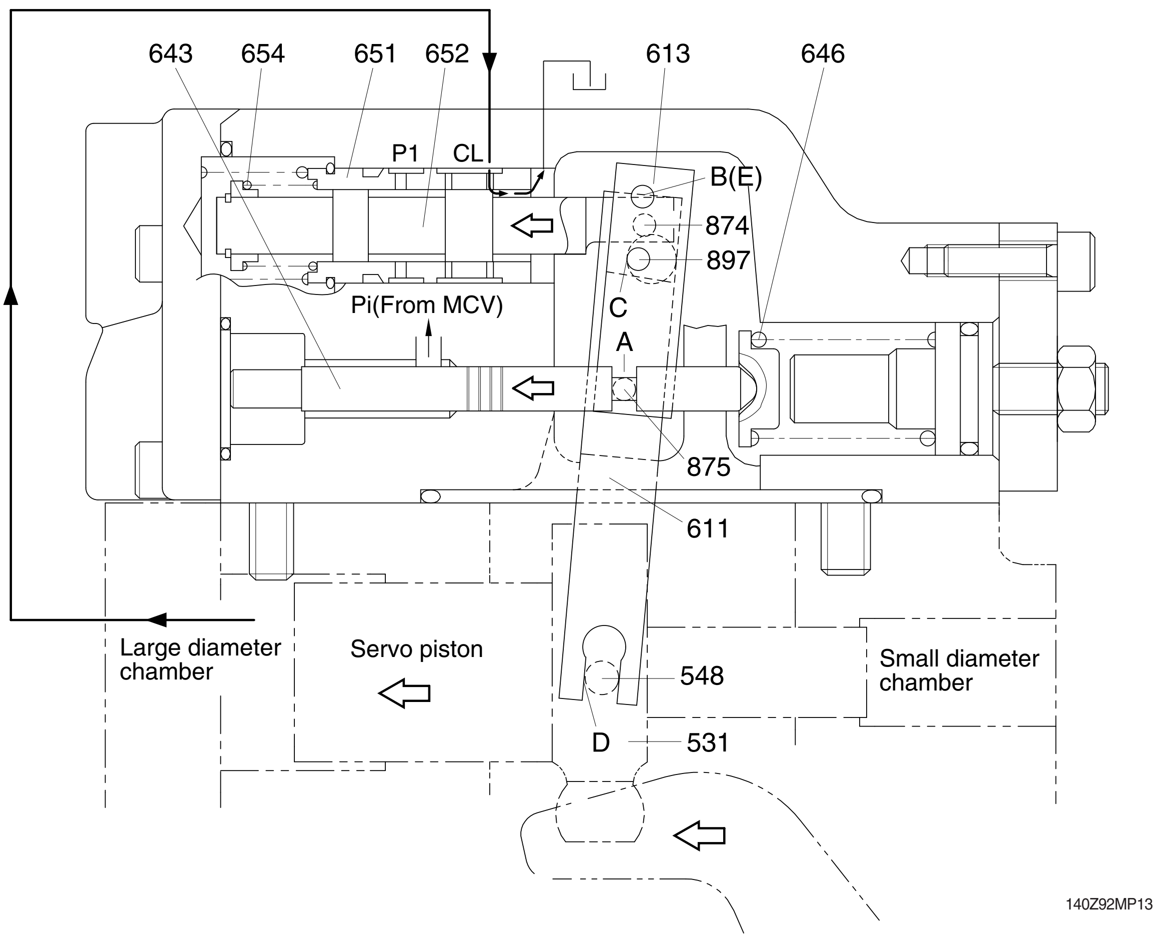
Since the feedback lever is connected with the spool (652) via the pin (874), the spool moves to the right.

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

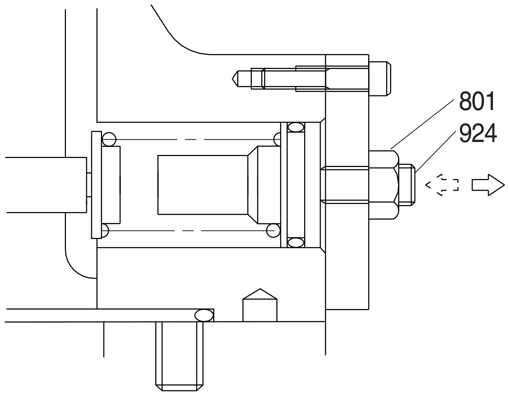
The flow control characteristic can be adjusted with the adjusting screw.

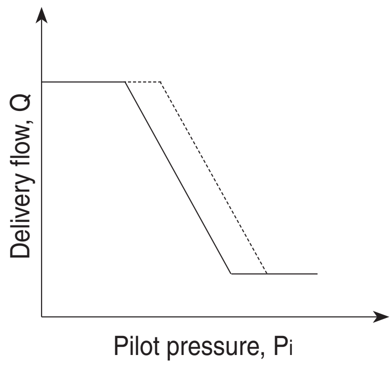
Adjust it by loosening the hexagon nut (801) and by tightening (or loosening) the hexagonal socket head screw (924).

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/cm^2)	(l /min)
2000	+1/4	+1.4	+7.5



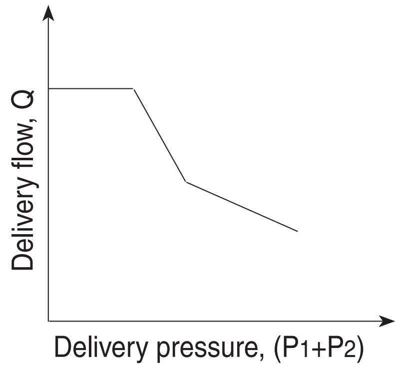


(2) Total horsepower control

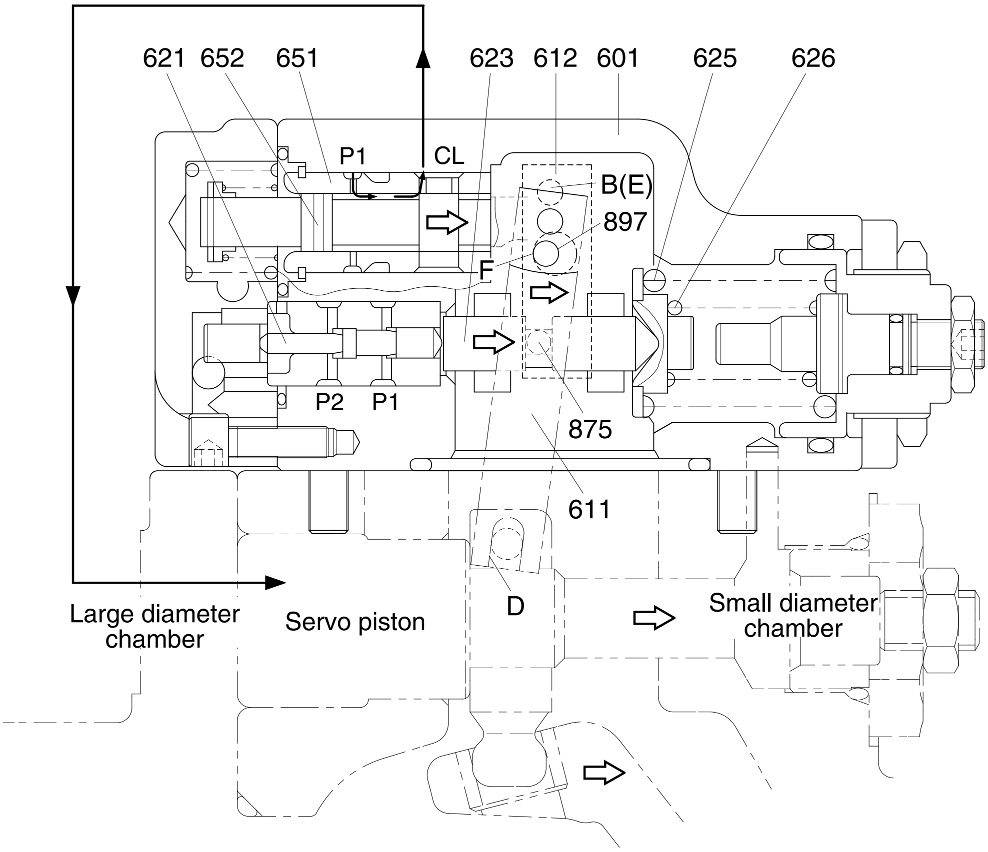
The regulator decreases the pump tilting angle (delivery flow) automatically to limit the input torque within a certain value with a rise in the delivery pressure P1 of the self pump and the delivery pressure P2 of the companion pump.
(The input horsepower is constant when the speed is constant.)
Since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

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

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



① Overload preventive function



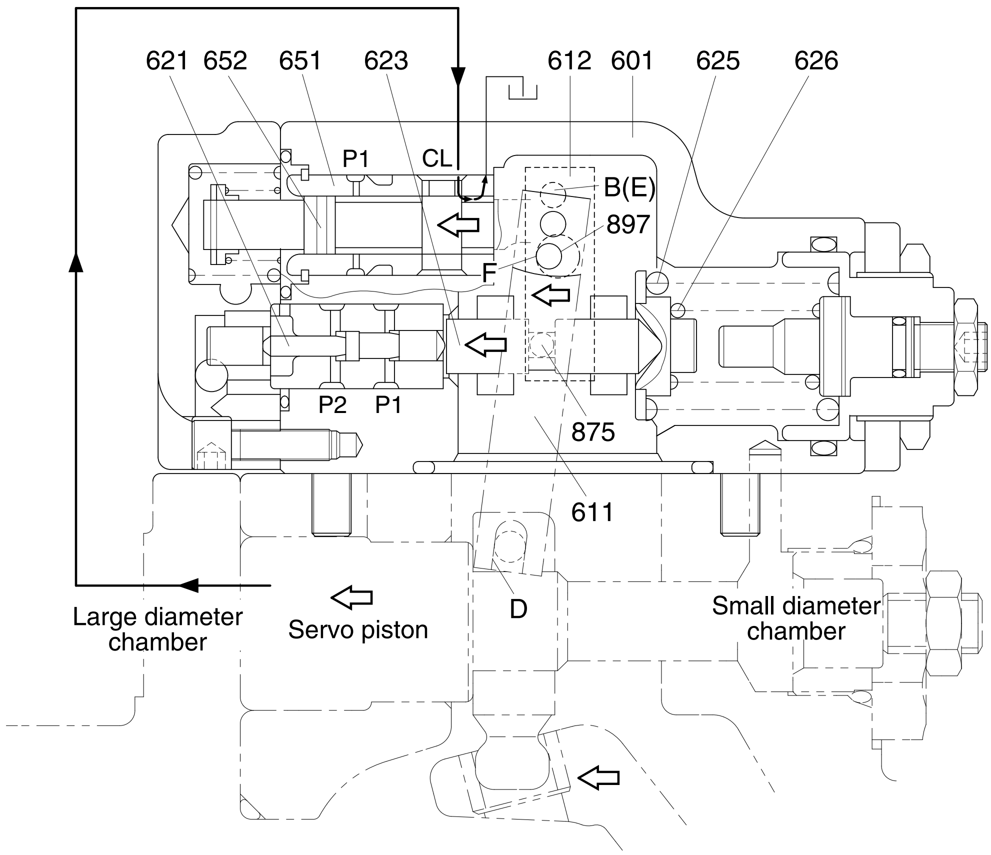
140Z92RG03

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



140Z92RG04

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.

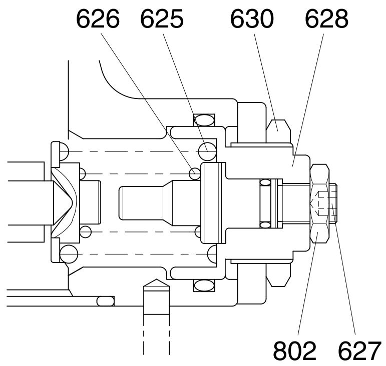
④ **Adjustment of input horsepower**

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).

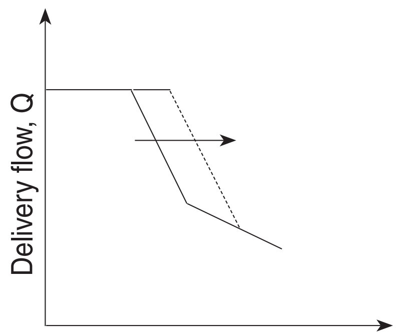
Tightening the screw shifts the control chart to the right and increases the input horsepower as shown in the figure. Since turning the adjusting screw C (628) by N turns changes the setting of the inner spring (626), return the adjusting stem C (627) by N×A turns at first. (A=1.48)



140Z92RG07

※ **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	+15.9	+2.7



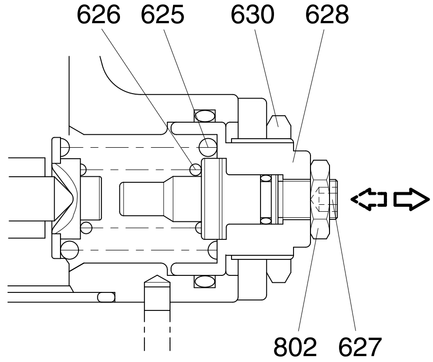
b. Adjustment of inner spring

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

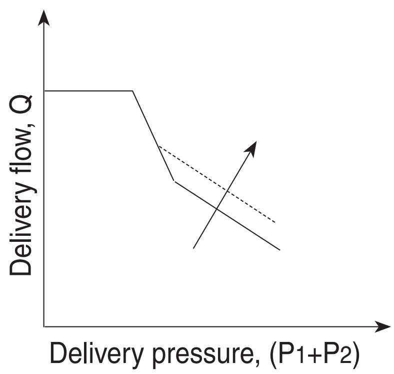
Tightening the screw increases the flow and then the input horsepower as shown in the figure.

※ Adjusting value

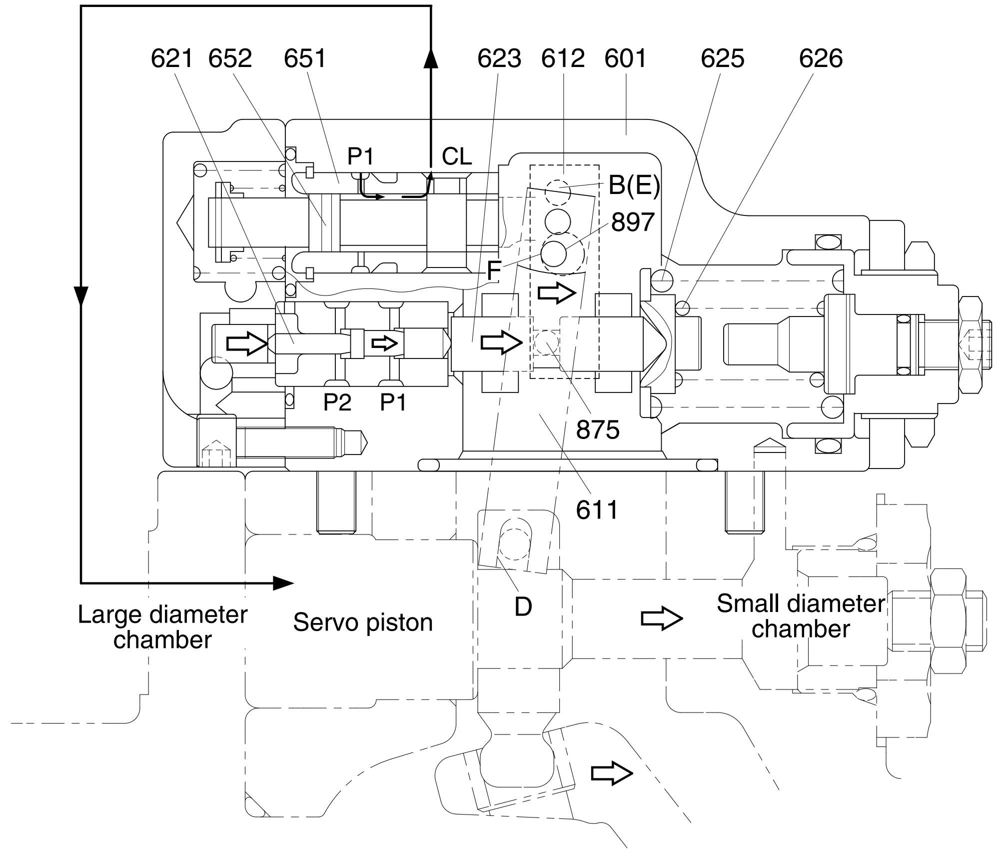
Speed	Adjustment of input horsepower		
	Tightening amount of adjusting stem (C) (627)	Flow change amount	Input torque change amount
(min $^{-1}$)	(Turn)	(l /min)	(kgf · m)
2000	+1/4	+6.9	+3.1



140Z92RG08



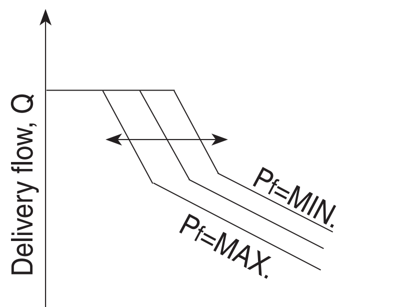
(3) Power shift control



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.

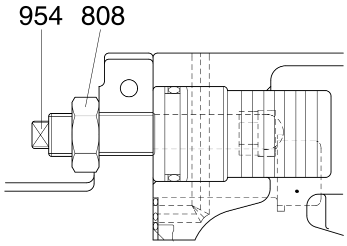
(4) Adjustment of maximum and minimum flows

① Adjustment of maximum flow

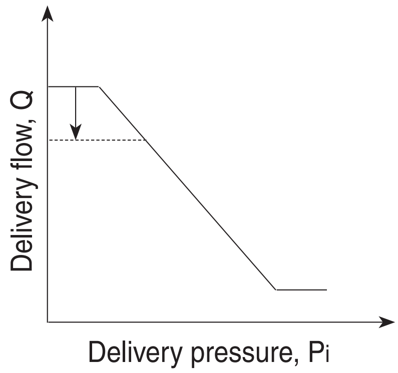
Adjust it by loosening the hexagon nut (808) and by tightening (or loosening) the set screw (954).

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



140Z92MP23

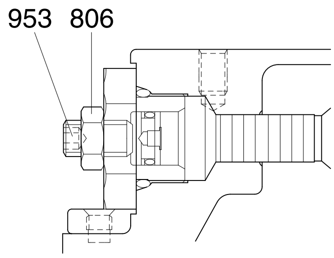


② Adjustment of minimum flow

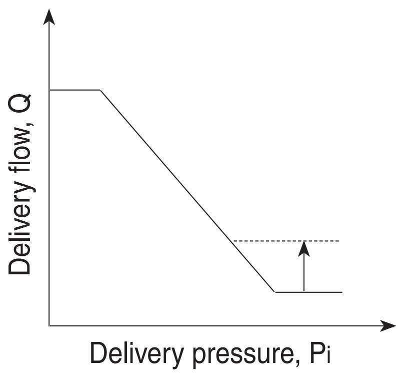
Adjust it by loosening the hexagon nut (806) and by tightening (or loosening) the hexagonal socket head set screw (953). Similarly to the adjustment of the maximum flow, other characteristics are not changed.

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

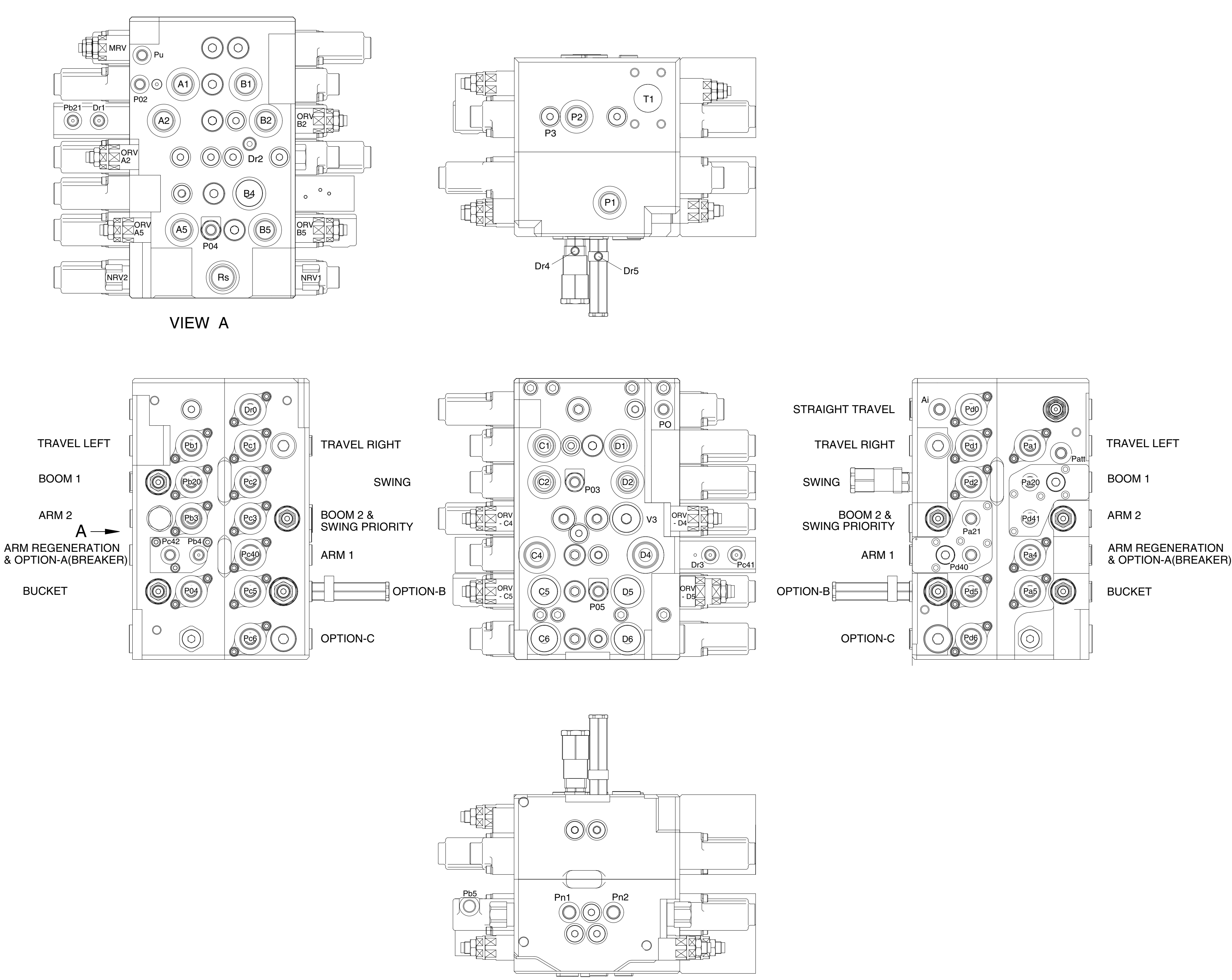


140Z92MP24



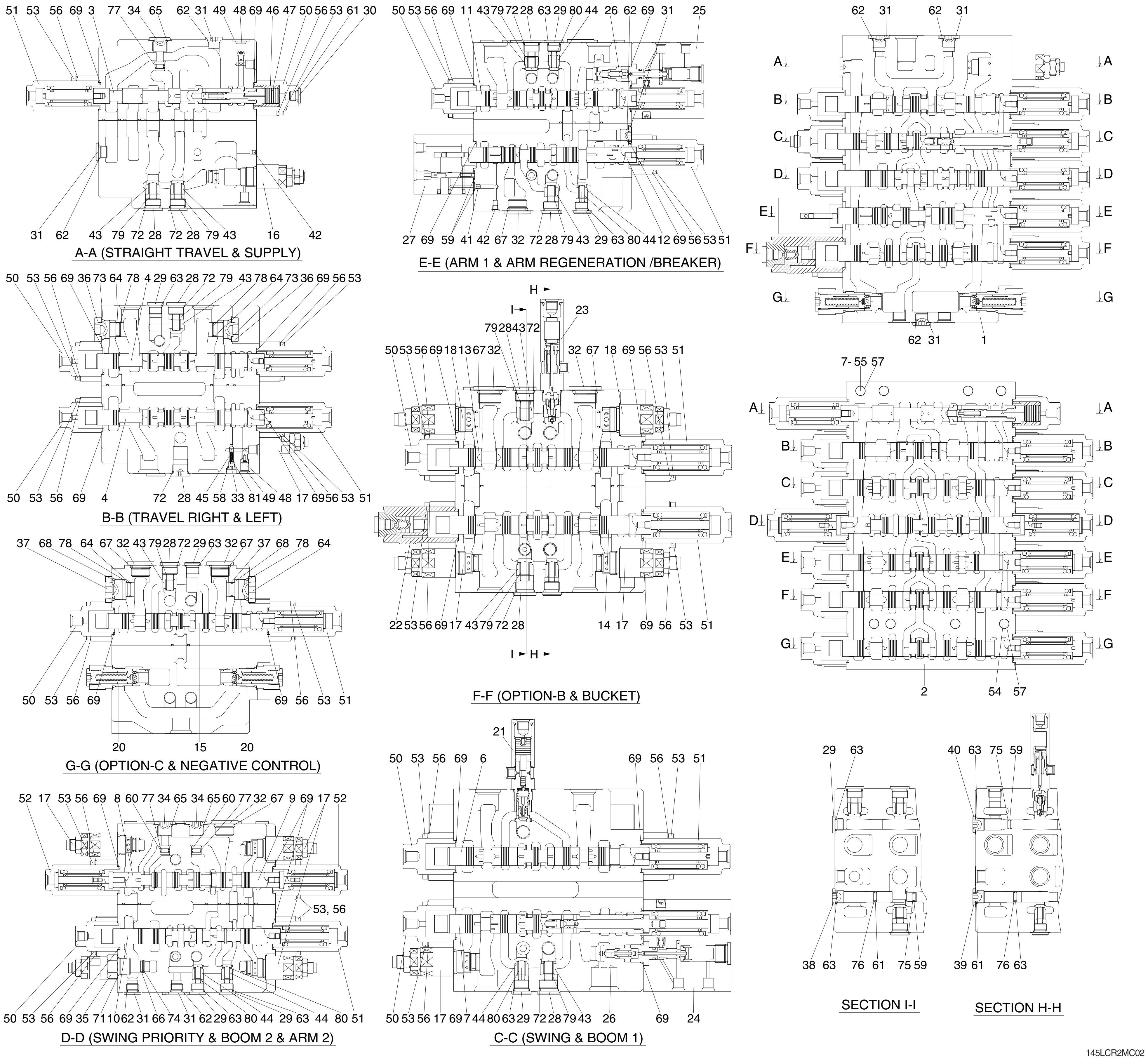
GROUP 2 MAIN CONTROL VALVE

1. STRUCTURE



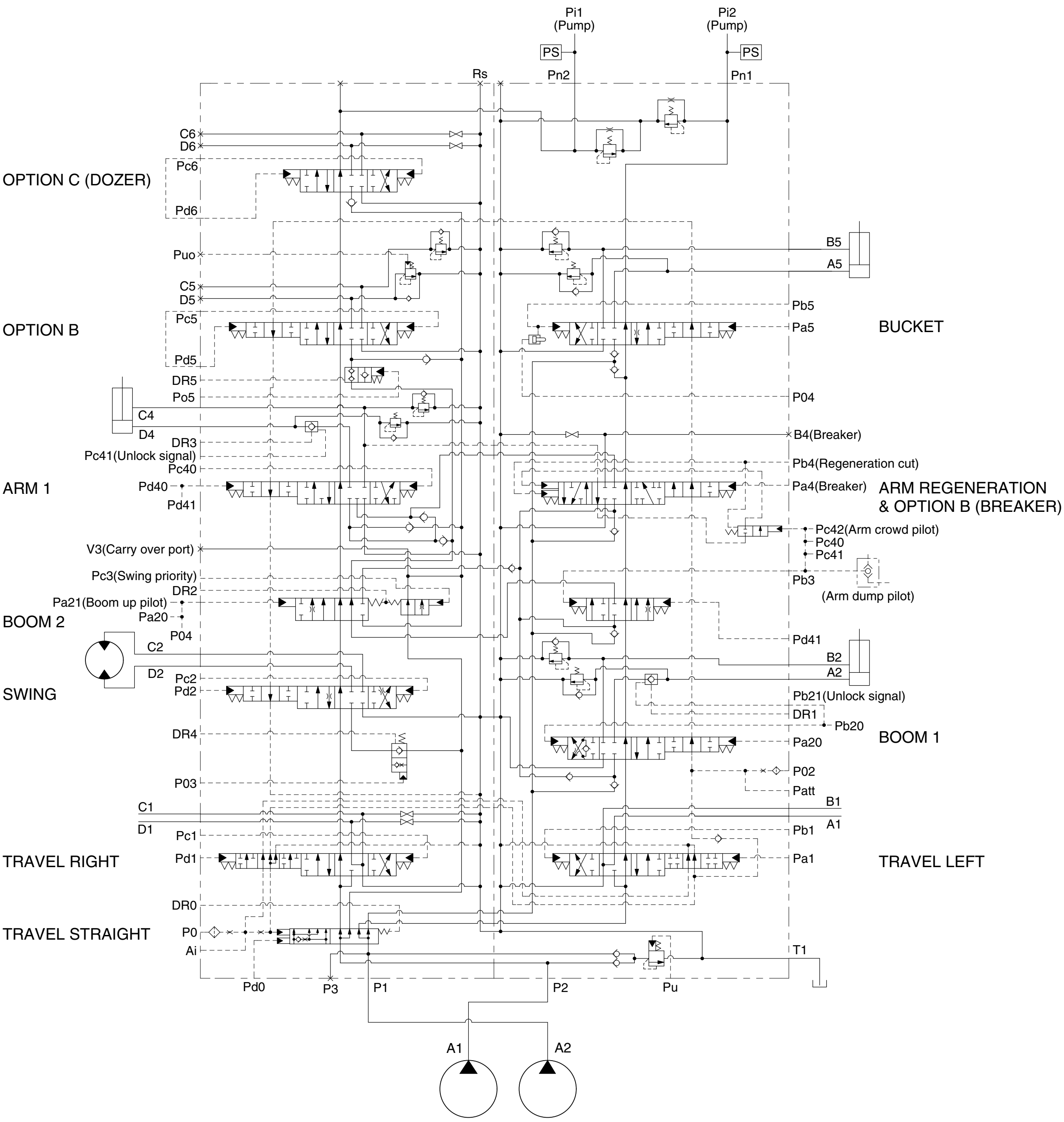
145LCR2MC01

Mark	Port name	Port size	Tightening torque
Rs	Make up for swing motor	UNF 1 3/16	18 kgf · m (130 lbf · ft)
Pa1	Travel left pilot port (BW)	PF 1/4	3.5~3.9 kgf · m (25.3~28.2 lbf · ft)
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		
Puo	Pilot pressure 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 $\times$ 1.75)	8.5~11.5 kgf · m (61.5~83.1 lbf · ft)



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 A
10	Spool-arm 2	51	Pilot cap B1
11	Spool-arm 1	52	Pilot cap B2
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
18	Overload relief valve	59	O-ring
19	Overload relief valve	60	O-ring
20	Negacon relief valve	61	O-ring
21	Swing logic valve	62	O-ring
22	Bucket strock limiter	63	O-ring
23	Option on-off valve	64	O-ring
24	Holding valve kit A1	65	O-ring
25	Holding valve kit A2	66	O-ring
26	Holding valve kit B	67	O-ring
27	Regeneration block	68	O-ring
28	Plug	69	O-ring
29	Plug	70	O-ring
30	Plug	71	O-ring
31	Plug	72	O-ring
32	Plug	73	O-ring
33	Plug	74	Backup-ring
34	Plug-parallel	75	Backup-ring
35	Plug-relief cat	76	Backup-ring
36	Plug-relief cat	77	Backup-ring
37	Plug-relief cat	78	Backup-ring
38	Plug-bucket	79	Load check spring
39	Plug-bucket parallel	80	Load check spring
40	Plug-option	81	Poppet signal spring
41	Plug-orifice	82	Regeneration block pin
42	Plug		

2. HYDRAULIC CIRCUIT



145ZF2MC05

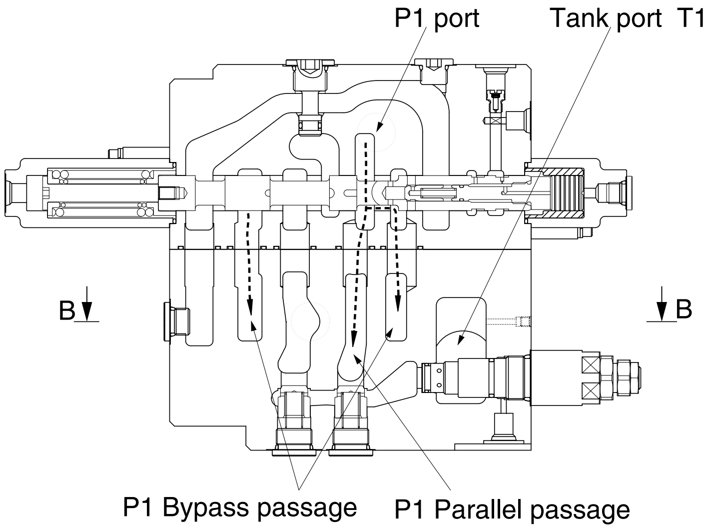
3. FUNCTION

1) CONTROL IN NEUTRAL

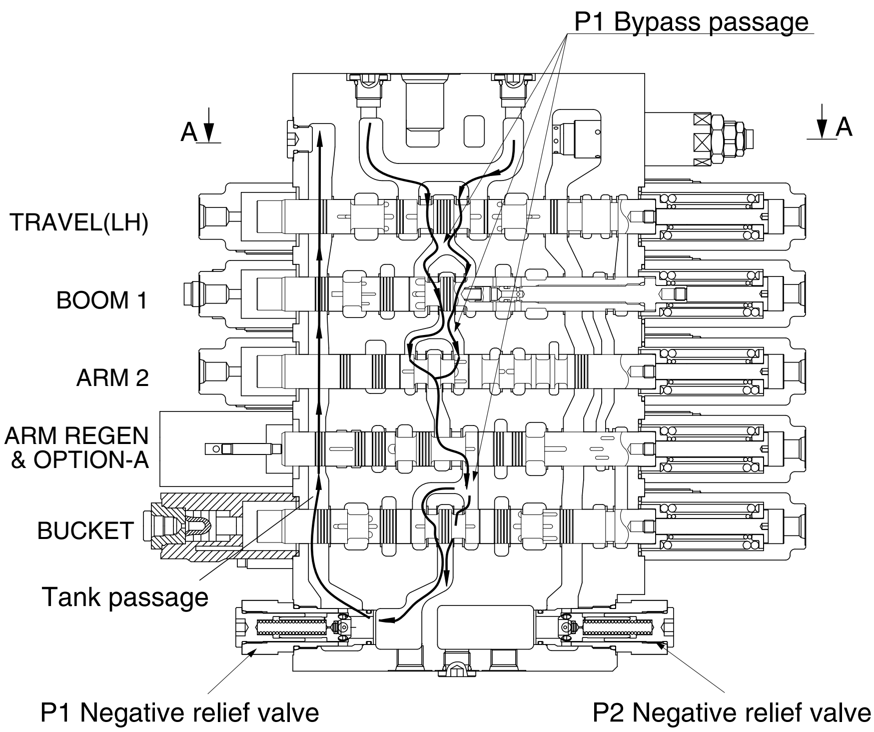
(1) P1 SIDE

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



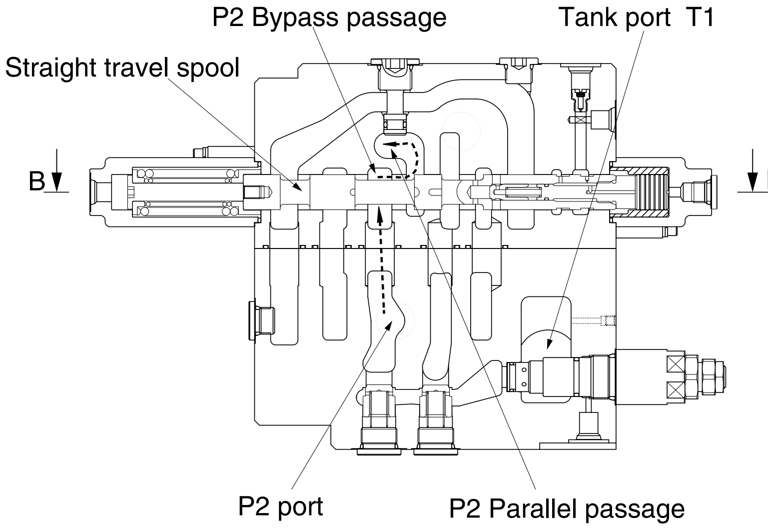
SECTION B-B

145LCR2MC11

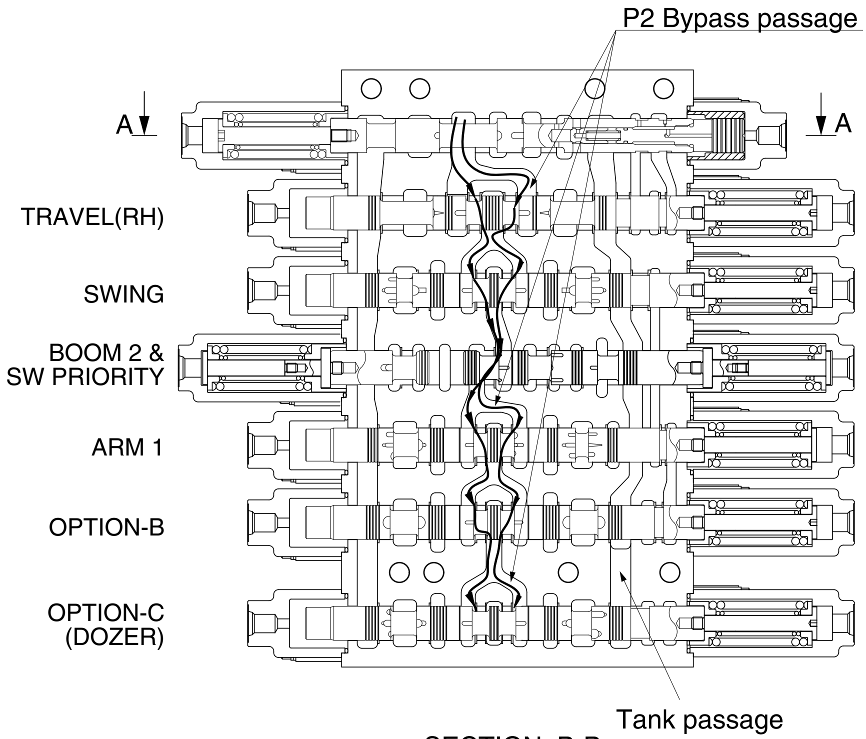
(2) P2 SIDE

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

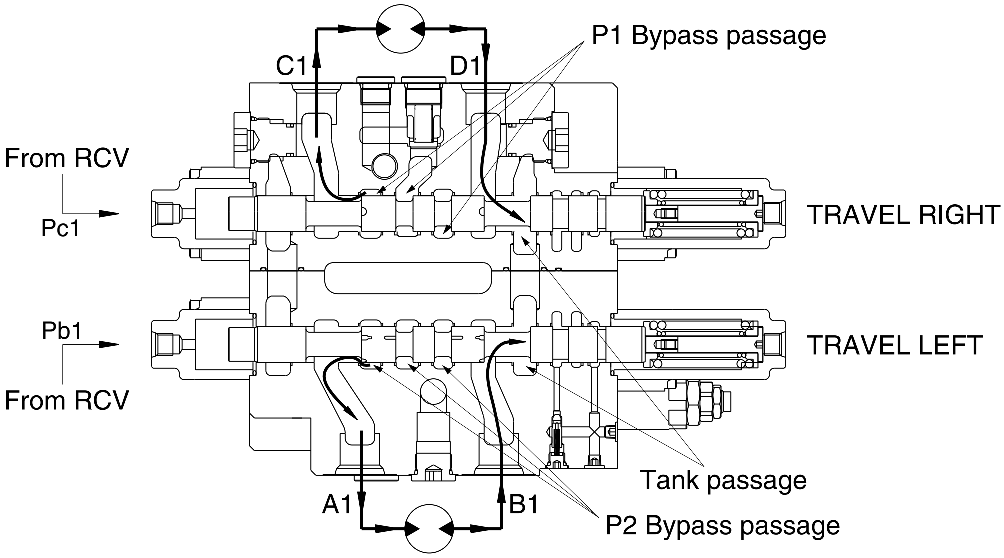


SECTION B-B

145LCR2MC12

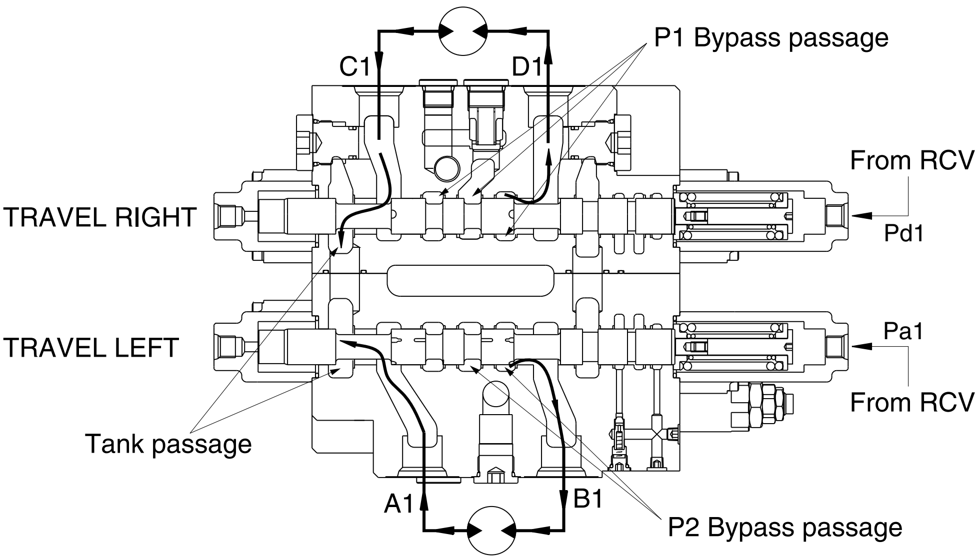
2) TRAVEL OPERATION

(1) TRAVEL FORWARD OPERATION



14092MC18

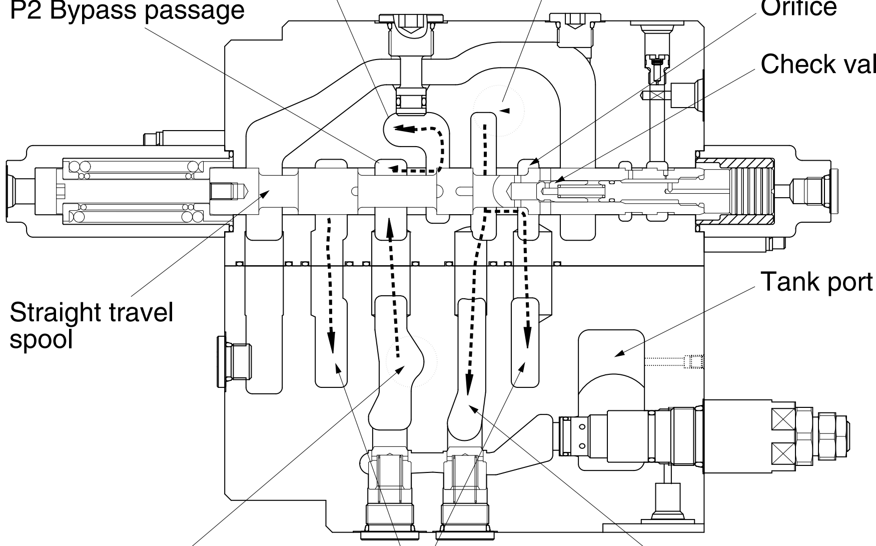
(2) TRAVEL BACKWARD OPERATION



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.

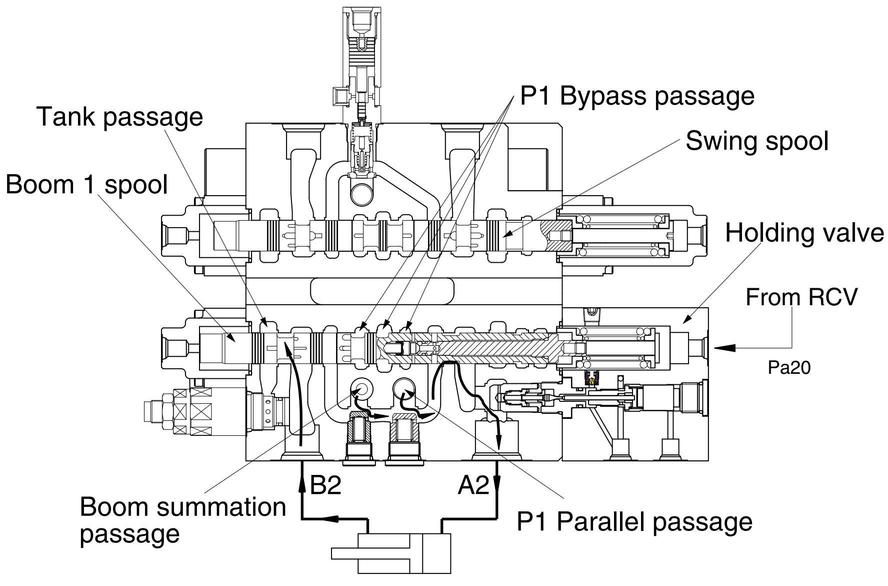
3) BOOM OPERATION

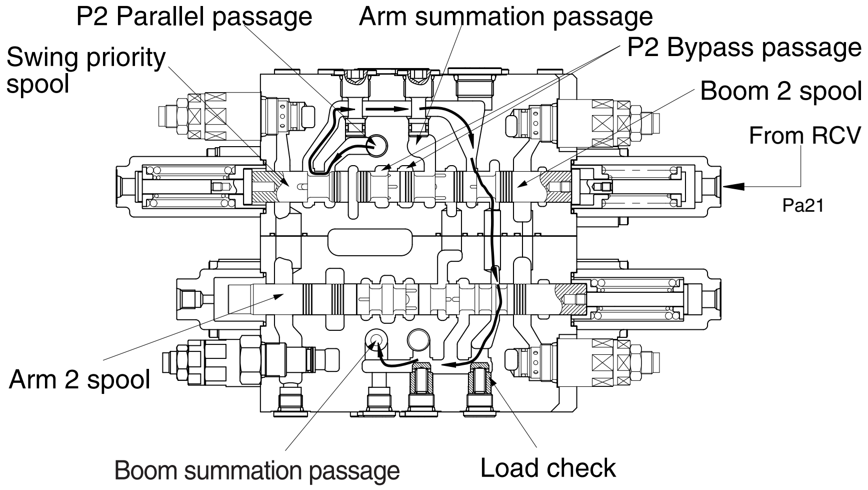
(1) BOOM UP OPERATION

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.





145LCR2MC24

(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.

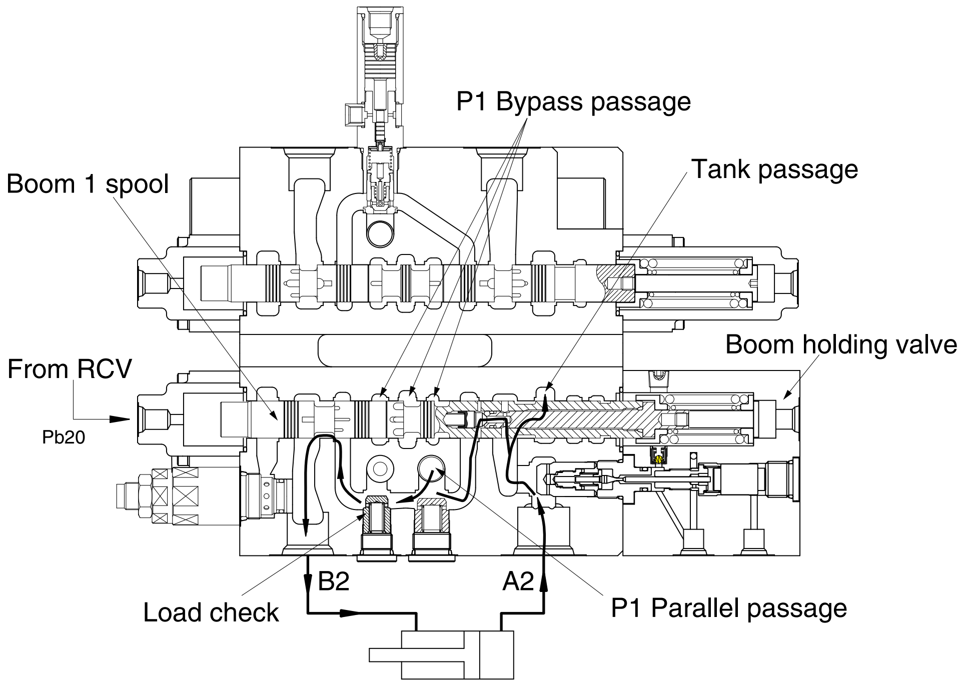
The bypass passage is shut off by the movement of the boom 1 spool and the hydraulic fluid from the pump A2 enters the parallel passage and is directed to the port B2 through the load check. Following this, it flows into the rod side of the boom cylinder.

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.

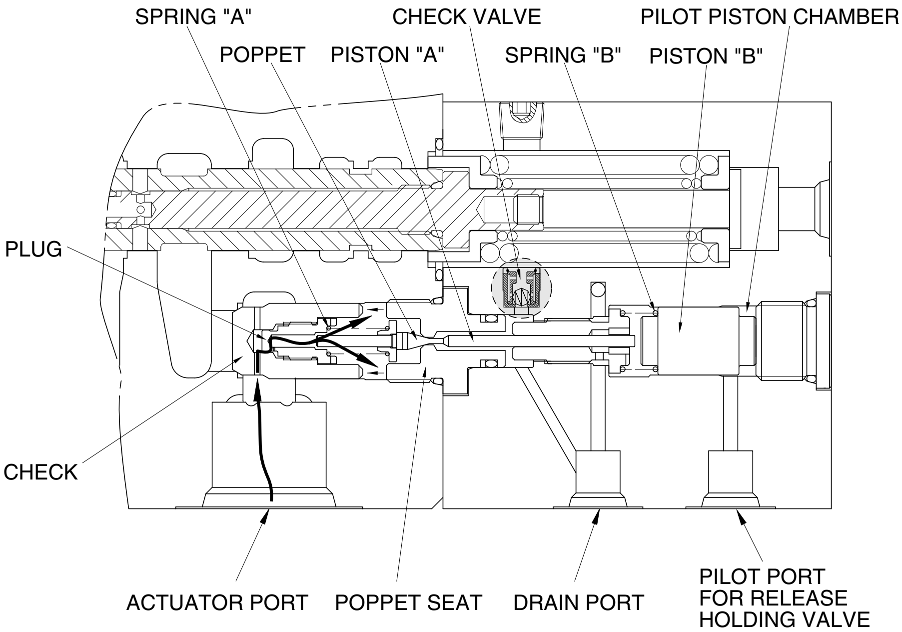


145LCR2MC26

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.



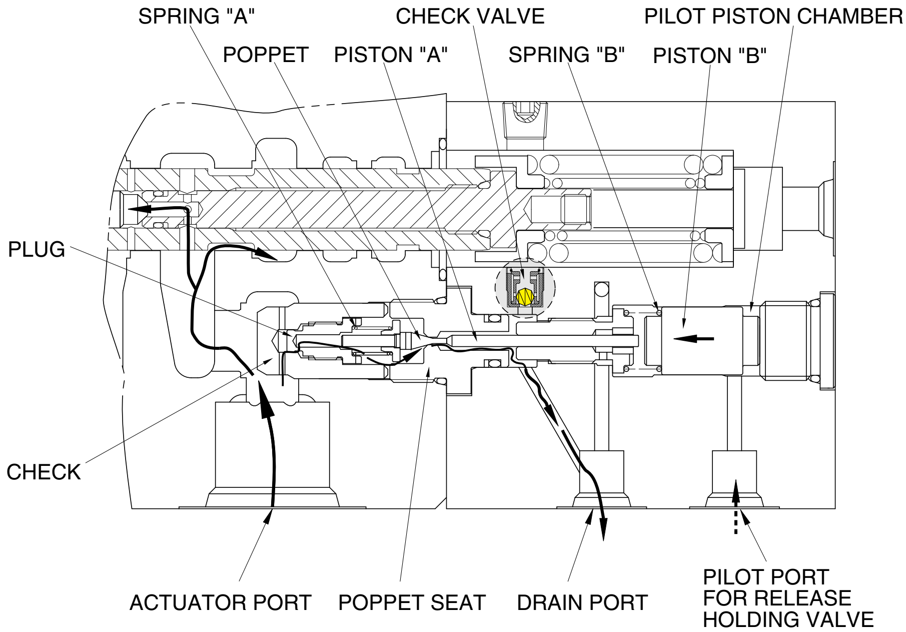
145LCR2MC15

(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.



145LCR2MC16

5) BUCKET OPERATION

(1) BUCKET IN OPERATION

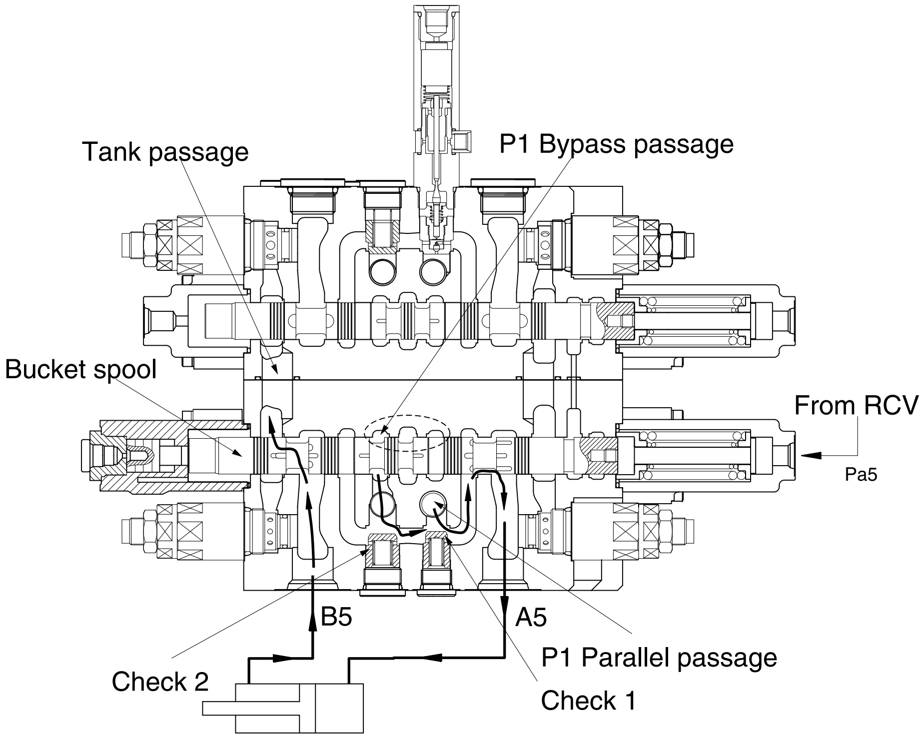
During the bucket in operation, the pilot secondary pressure from RCV is supplied to port Pa5 of the spring side and shifts the bucket spool in the left direction.

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.



145LCR2MC34

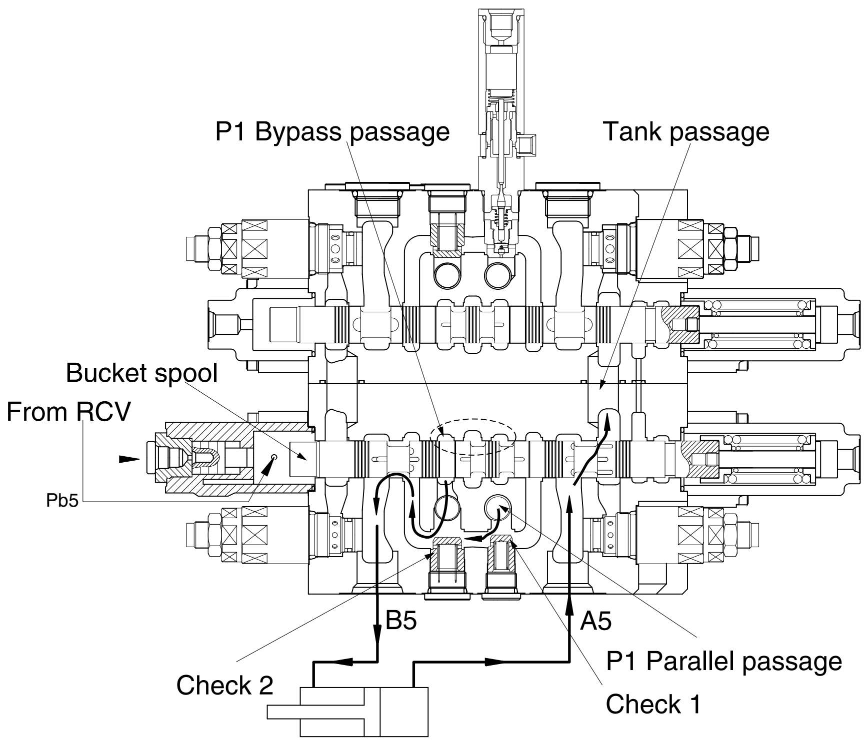
(2) BUCKET OUT OPERATION

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.

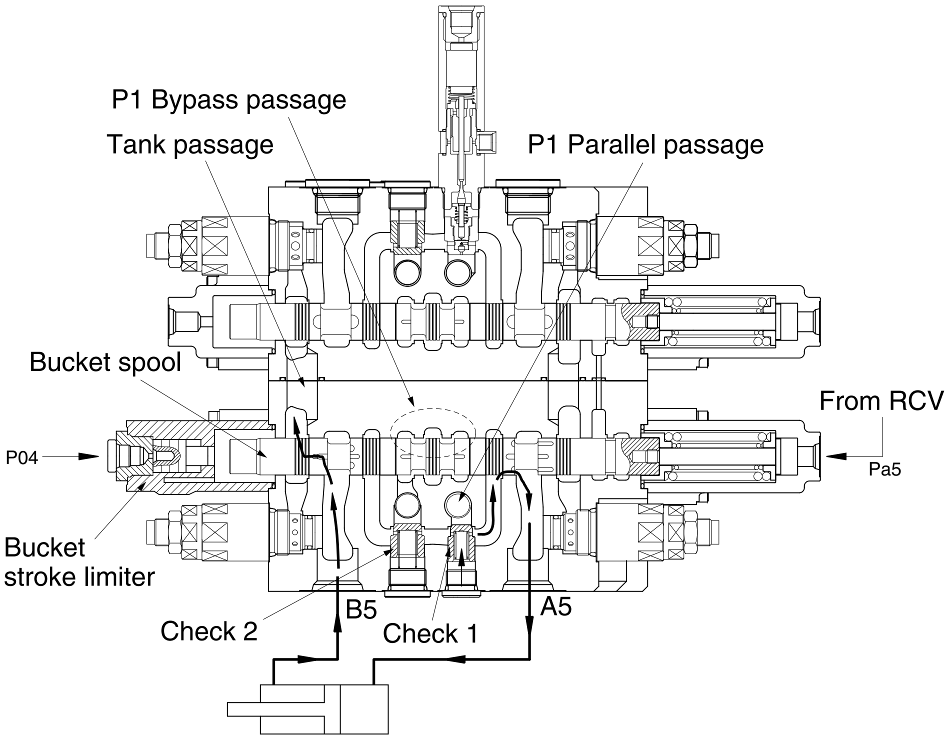


145LCR2MC35

(3) BUCKET IN OPERATION WITH BOOM UP OPERATION

When combined operation, mostly same as previous page but the fluid from P1 bypass passage is empty.

So only the fluid from P1 parallel passage is supplied to the bucket cylinder. Also, parallel passage is installed the bucket stroke limiter for supplying the fluid from pump A2 to the boom operation prior to the bucket operation. In case of the bucket out operation with boom operation, operation is similar.



145LCR2MC29

6) SWING OPERATION

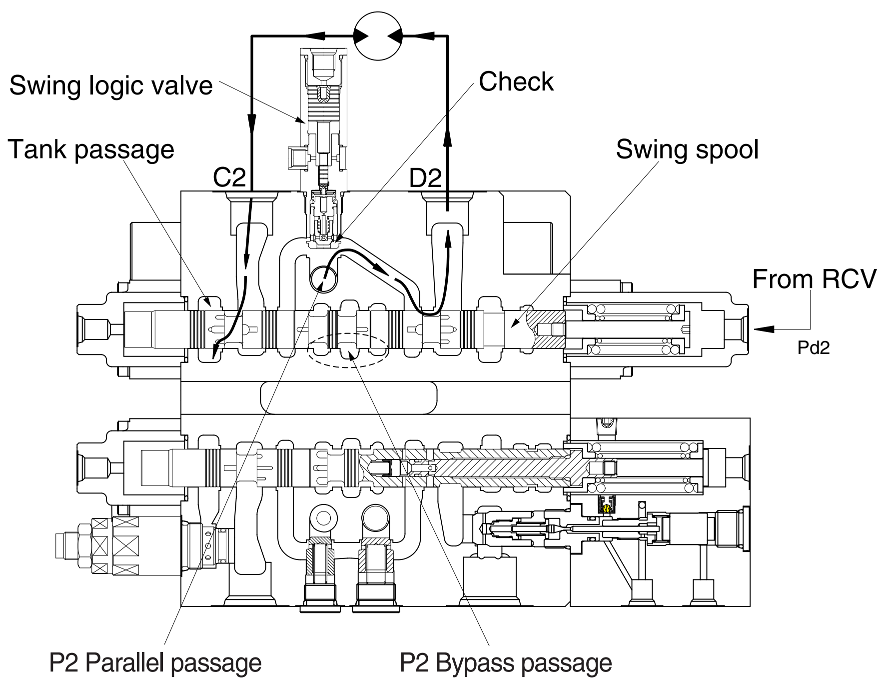
(1) SWING LEFT & RIGHT OPERATION

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.

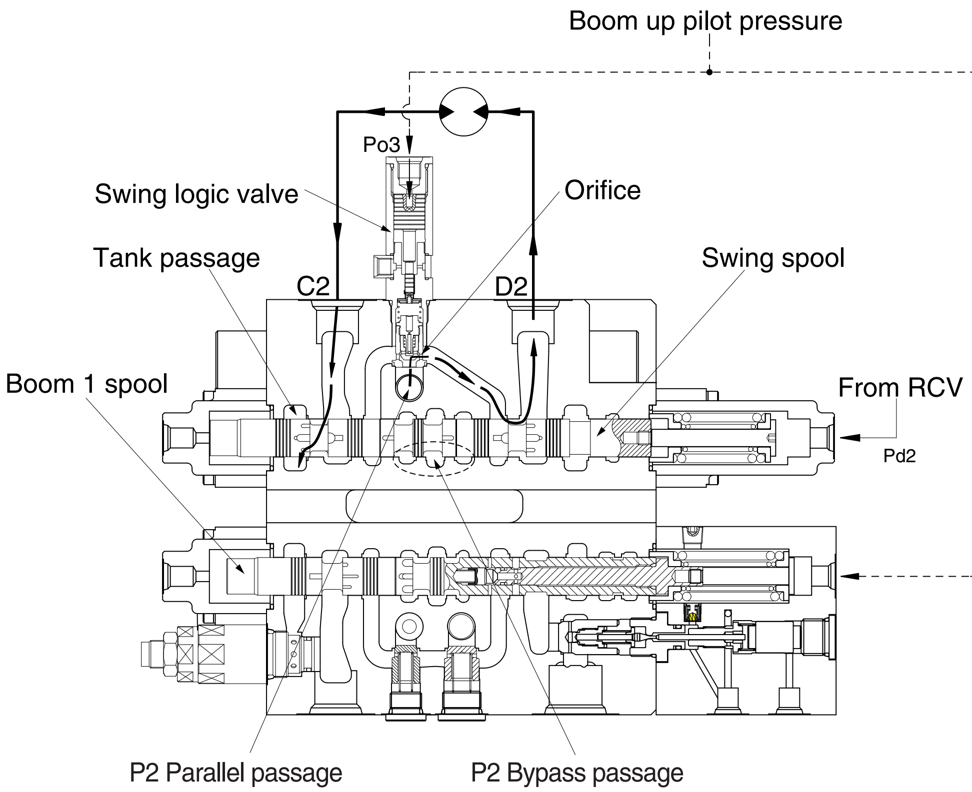


145LCR2MC32

(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.



145LCR2MC20

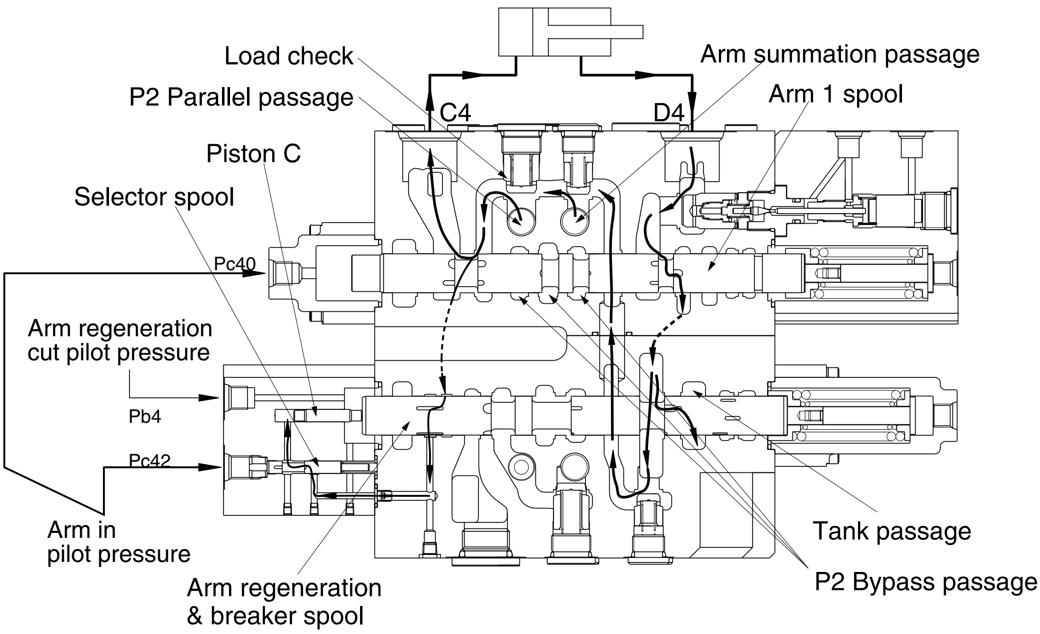
7) ARM OPERATION

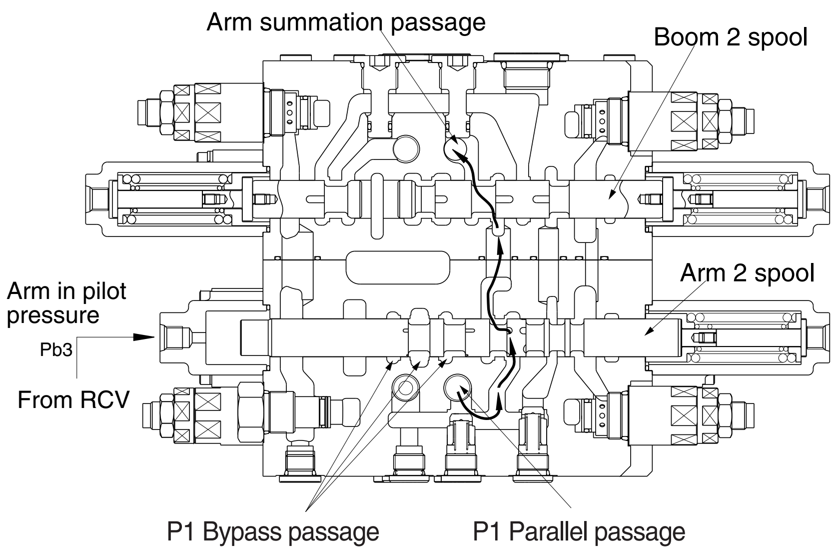
(1) ARM IN OPERATION

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.





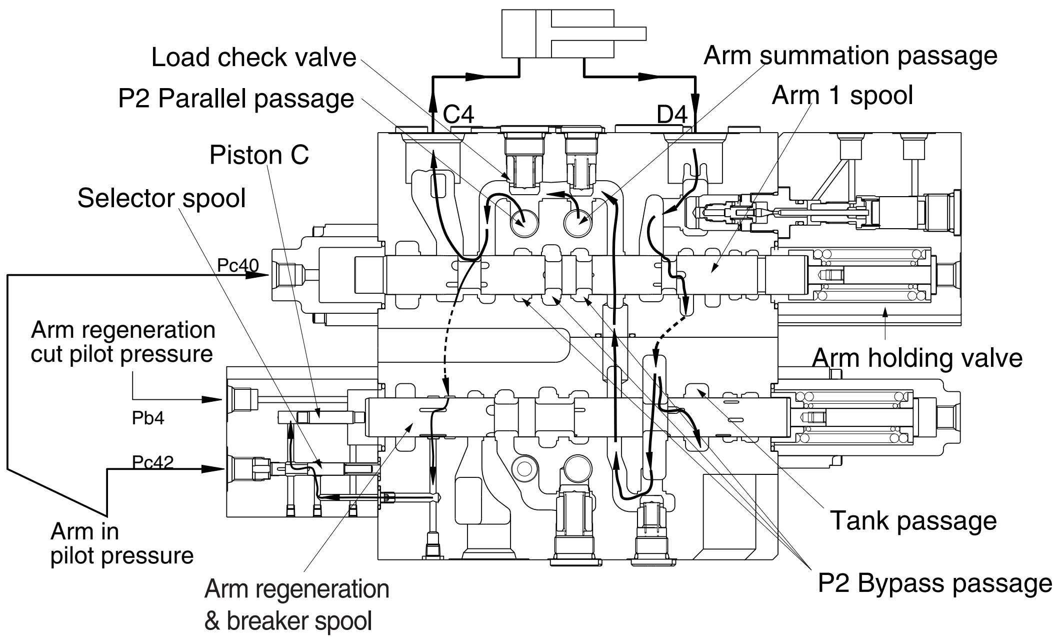
145LCR2MC21

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)



145LCR2MC22

(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.

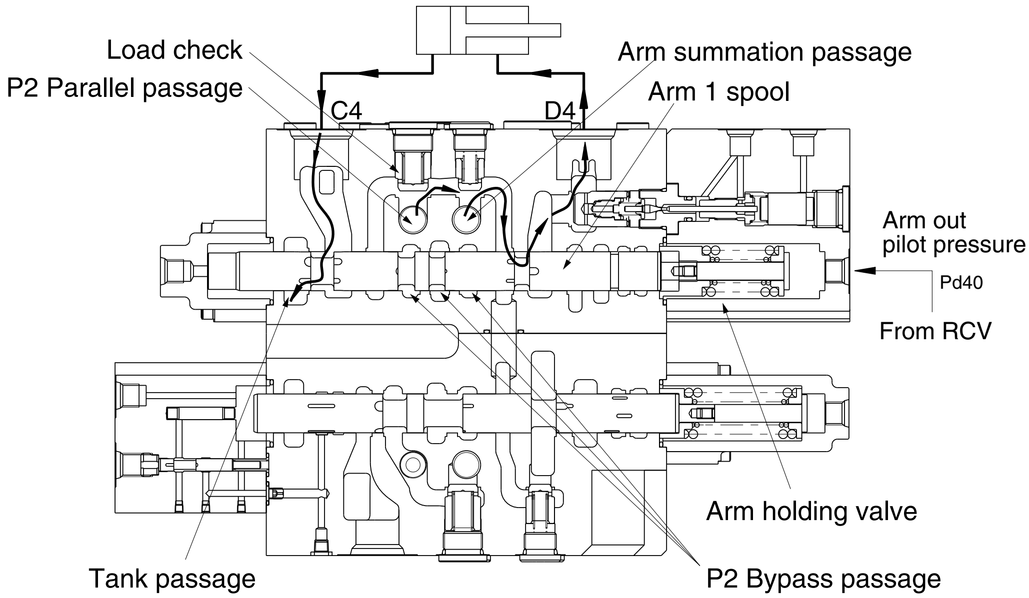
The bypass passage is shut off by the movement of the arm 1 spool and the hydraulic fluid from pump A1 flows into arm 1 spool through the P2 parallel passage. Then it enters into the arm cylinder rod side through the load check, bridge passage, arm holding valve and the port D4.

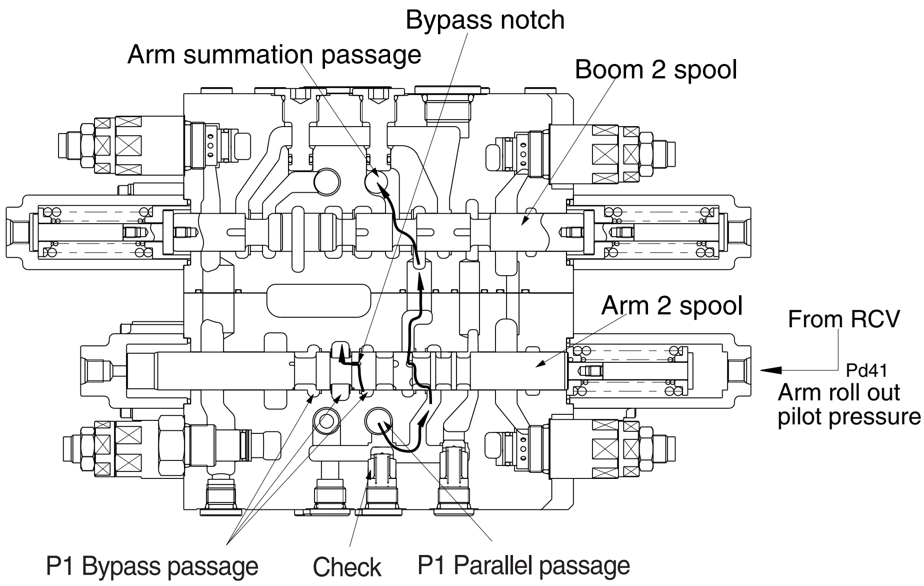
Also, the pilot secondary pressure from RCV is supplied to the port Pd41 of spring side and shifts arm 2 spool in the left direction.

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.





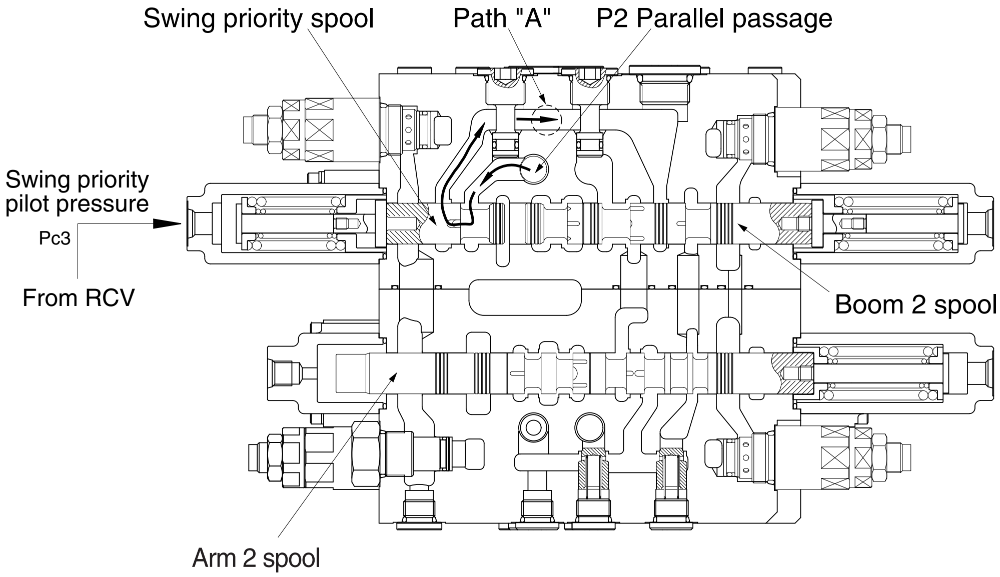
145LCR2MC23

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.

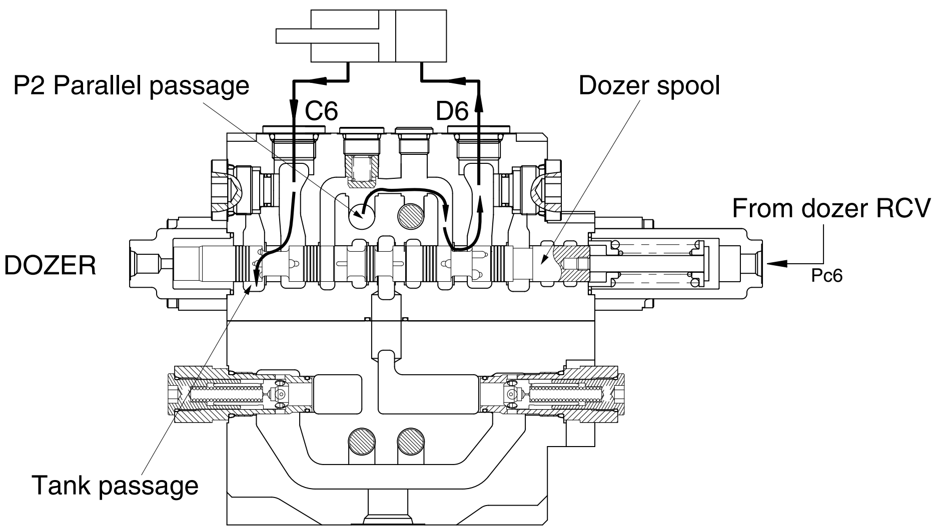
When the swing priority spool is neutral condition, the passage is same as normal condition. But due to shifting of the swing priority spool, the fluid from pump A1 flows to swing side more then the boom 2, arm 1, option B and dozer spools to make the swing operation most preferential.



145LCR2MC27

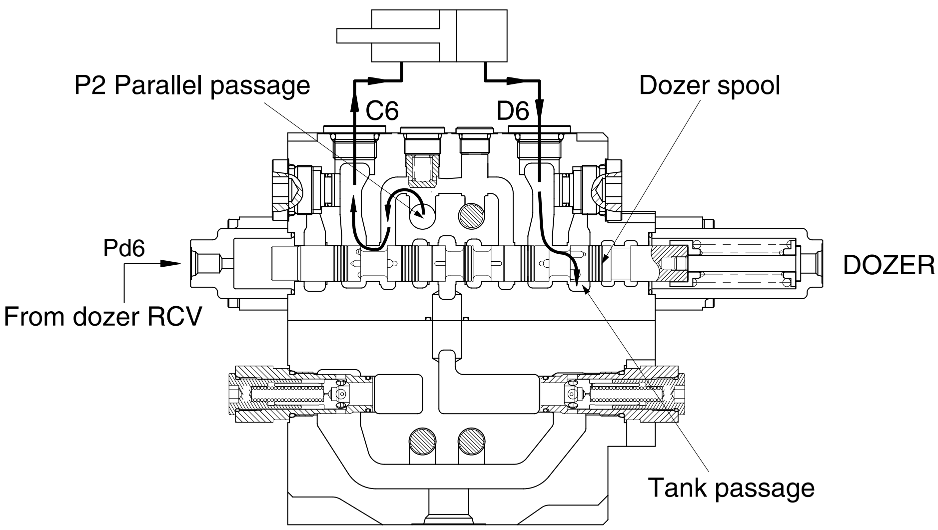
9) DOZER OPERATION

(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

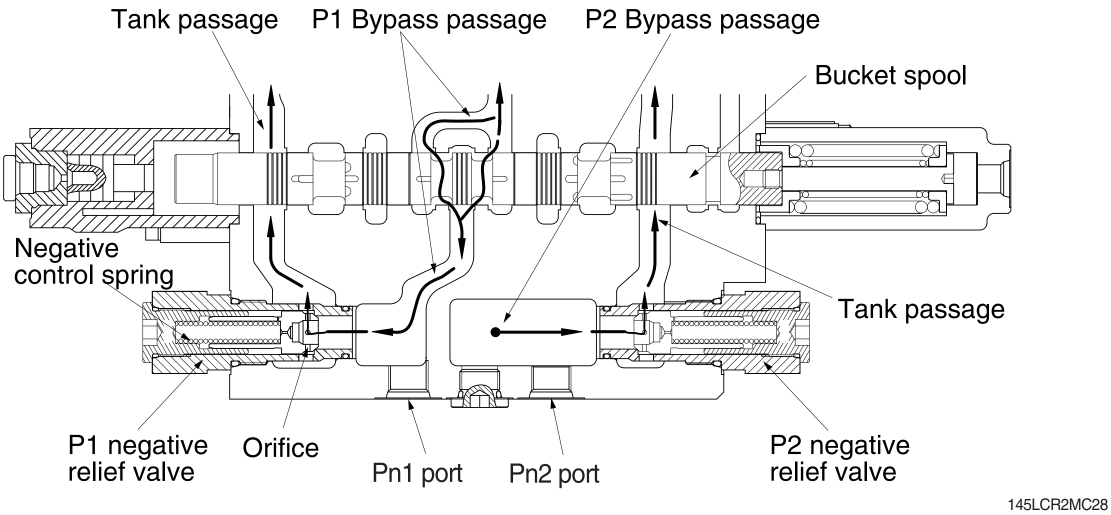
When no function is being actuated on P1 side, the hydraulic fluid from the pump A2, flows into the tank passage through the P1 bypass passage and orifice. The restriction caused by this orifice thereby pressurizes. This pressure is transferred as the negative control signal pressure Pn1 to the pump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

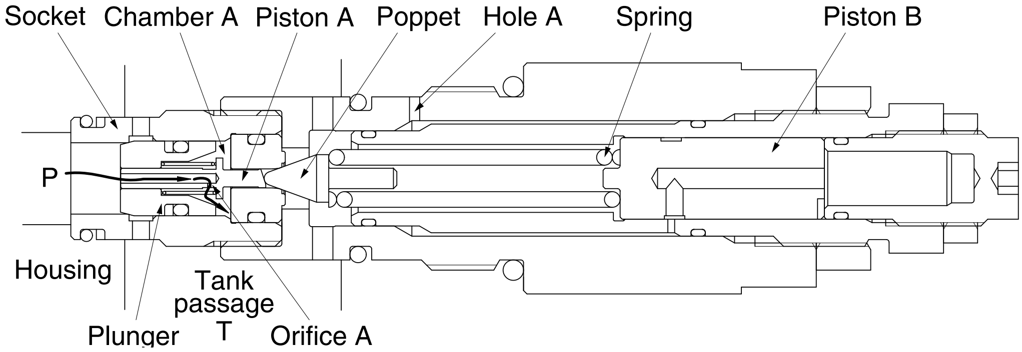
The negative control pressure reaches to the set level, the hydraulic fluid in the passage pushes open negative control valve and escapes into the return passage.

For the pump A1 the same negative control principle.



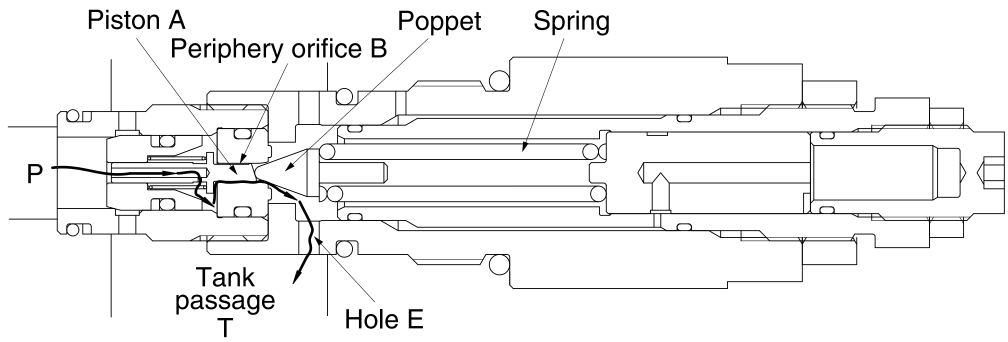
11) OPERATION OF MAIN RELIEF VALVE

(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.



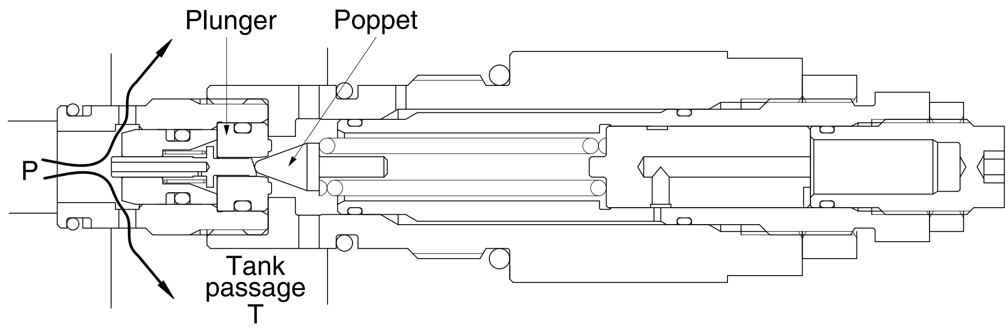
14W92MC36

(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).



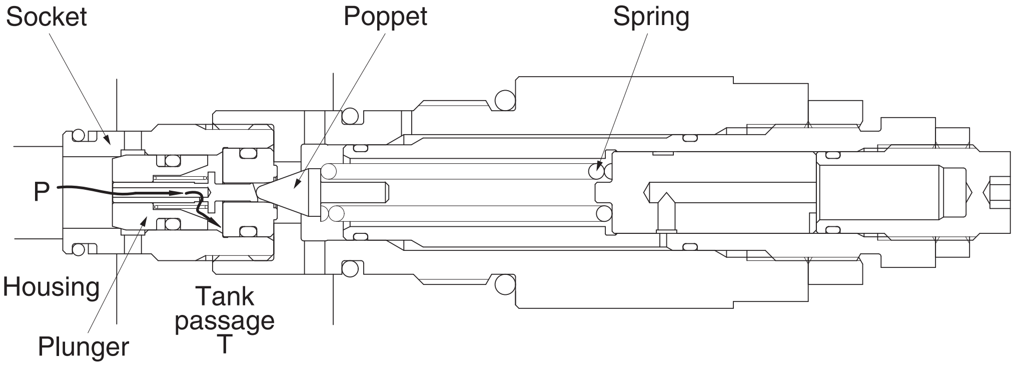
14W92MC37

(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).



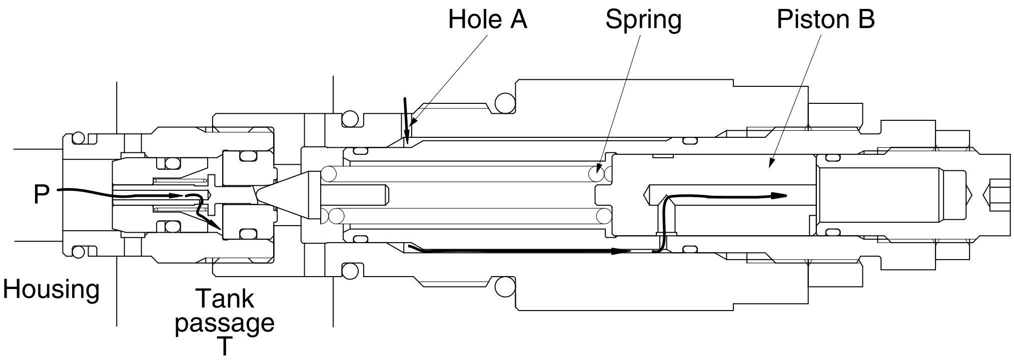
14W92MC38

(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.

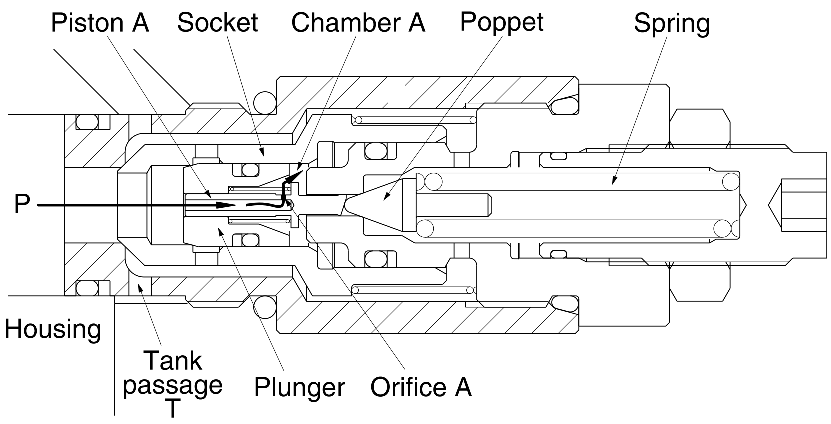


14W92MC40

12) OPERATION OF OVERLOAD RELIEF VALVE

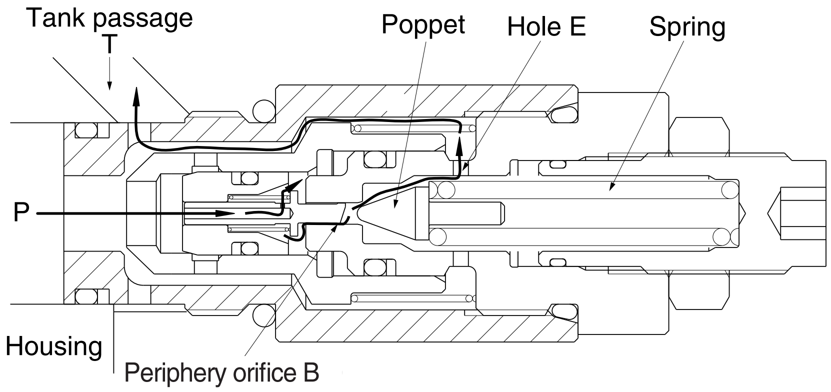
FUNCTION AS RELIEF VALVE

(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.



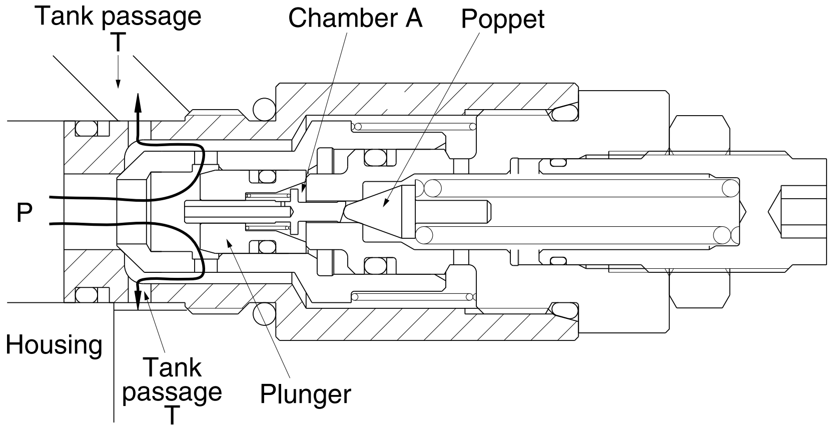
14W92MC41

(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.



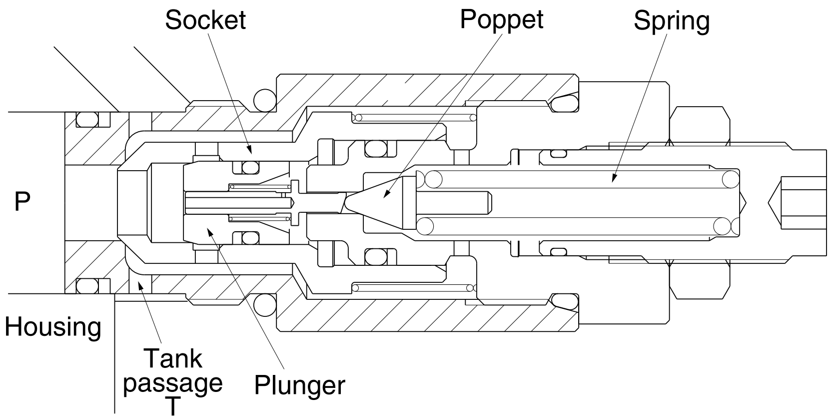
14W92MC42

(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

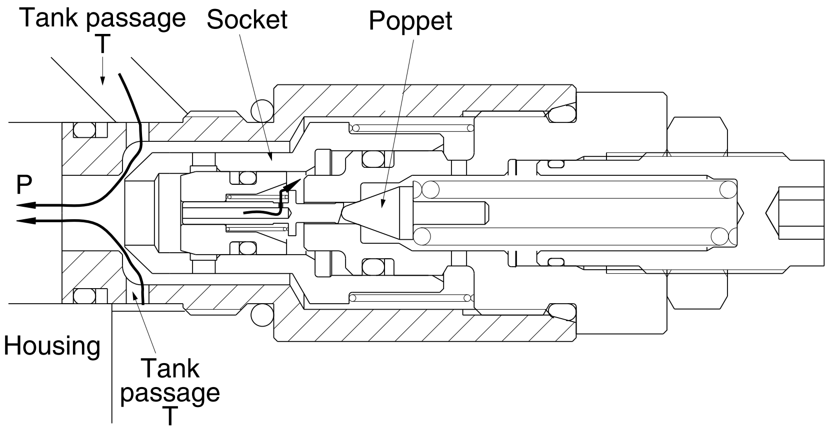
(4) The pressure at port P becomes lower than set pressure of the spring, the poppet is seated by spring force. Then the pressure at port P becomes equal to set pressure of the spring and the plunger is seated to the socket.



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.



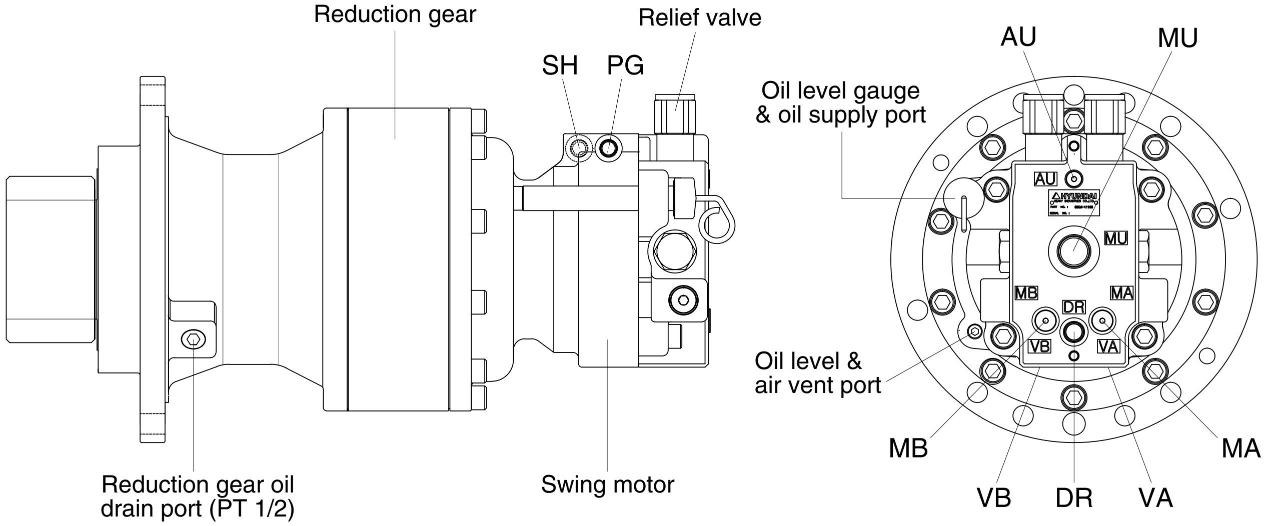
14W92MC45

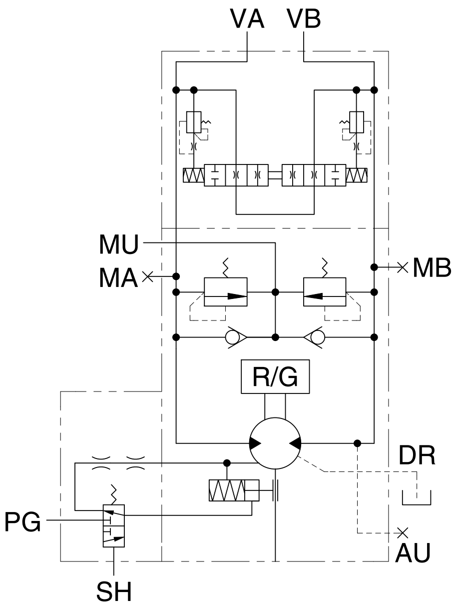
GROUP 3 SWING DEVICE

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.



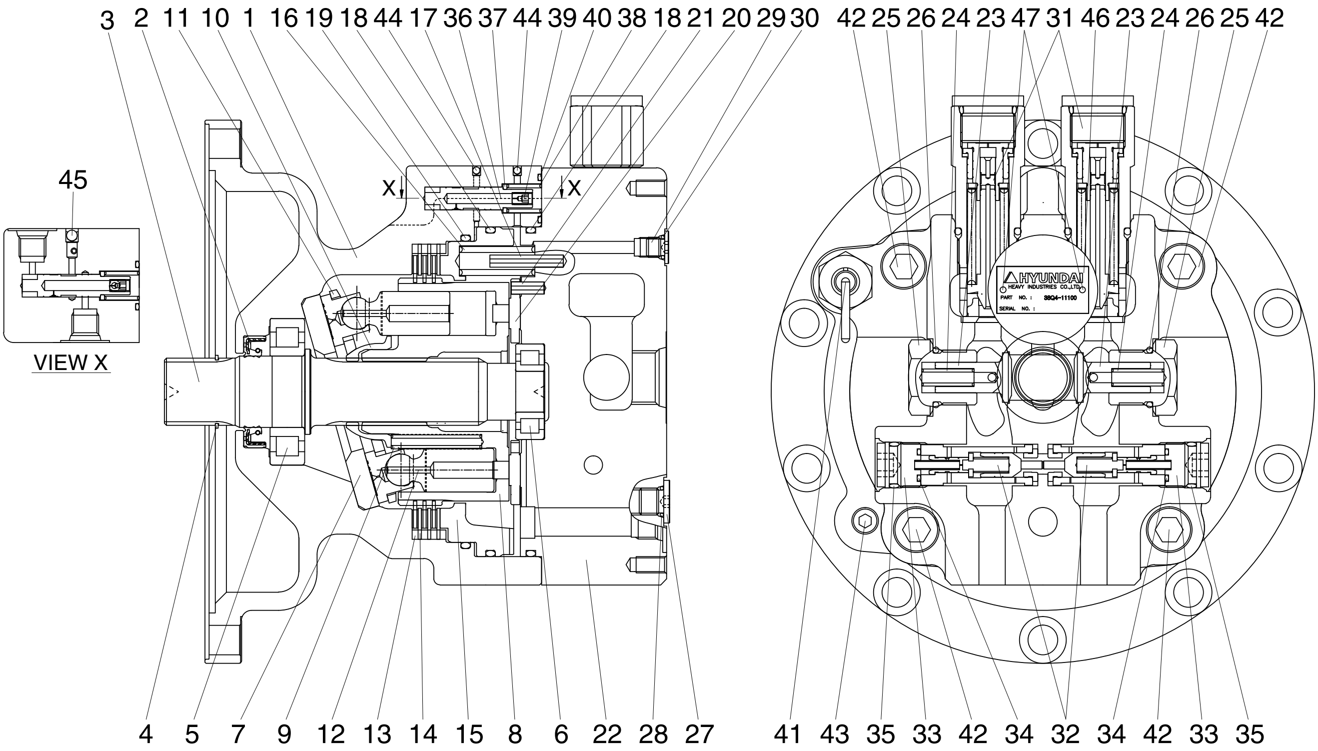


Hydraulic circuit

Port	Port name	Port size
VA	Main port	ø 13
VB	Main port	ø 13
DR	Drain port	PF 3/8
MU	Make up port	PF 3/4
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 1/8

125LCR2SM21

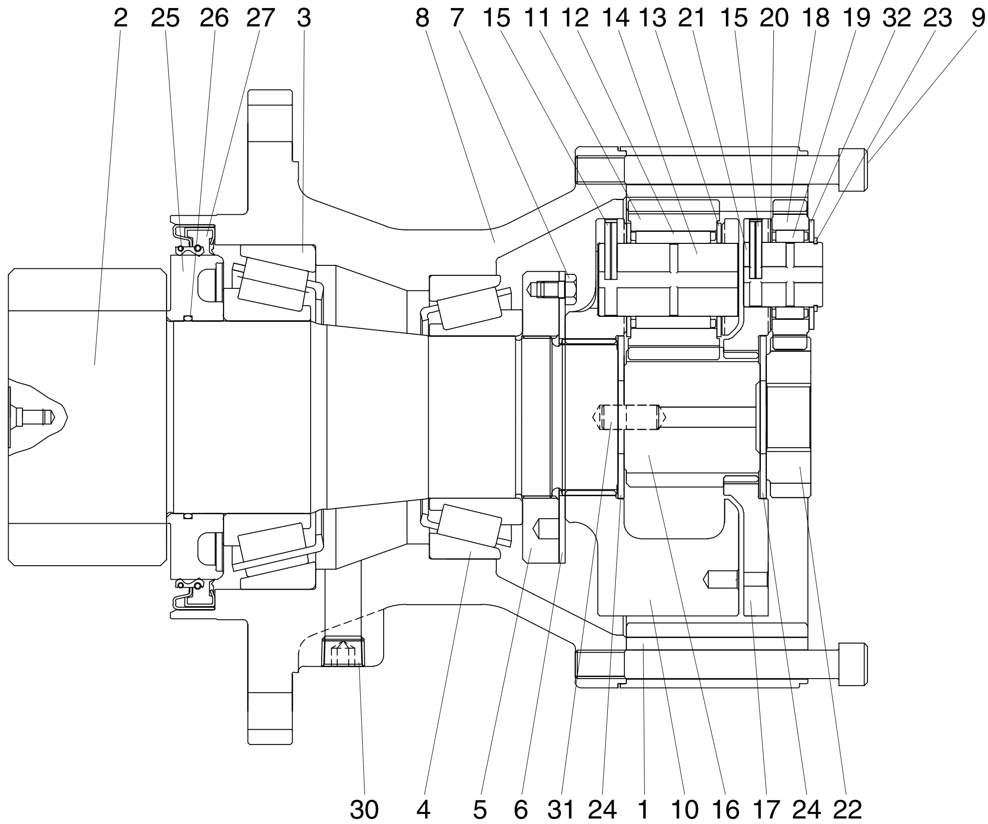
1) SWING MOTOR



125LCR2SM22

1	Casing	17	Spring pin	33	Plug
2	Oil seal	18	O-ring	34	O-ring
3	Shaft	19	O-ring	35	O-ring
4	Snap ring	20	Valve plate	36	Time delay valve spool
5	Roller bearing	21	Spring pin	37	Spring seat
6	Roller bearing	22	Valve casing	38	Spring
7	Swash plate	23	Check valve	39	Restrictor
8	Cylinder block	24	Spring	40	O-ring
9	Spring	25	Plug	41	Level gauge assy
10	Ball guide	26	O-ring	42	Socket bolt
11	Retainer plate	27	Plug	43	Plug
12	Piston assy	28	O-ring	44	Expander
13	Friction plate	29	Plug	45	Expander
14	Separate plate	30	O-ring	46	Name plate
15	Parking piston	31	Relief valve assy	47	Rivet
16	Spring	32	Anti-rotating valve assy		

2) REDUCTION GEAR



125LCR2SM23

1	Ring gear	11	Planetary gear No. 2	21	Carrier pin No. 1
2	Drive shaft	12	Needle bearing No. 2	22	Sun gear No. 1
3	Bearing	13	Thrust washer No. 2	23	Snap ring
4	Bearing	14	Carrier pin No. 2	24	Thrust plate
5	Ring nut	15	Spring pin	25	Sleeve
6	Lock plate	16	Sun gear No. 2	26	O-ring
7	Hexagon bolt	17	Carrier No. 1	27	Oil seal
8	Casing	18	Planetary gear No. 1	30	Plug
9	Socket bolt	19	Needle bearing No. 1	31	Parallel pin
10	Carrier No. 2	20	Thrust washer No. 1	32	Thrust washer No. 1

2. PRINCIPLE OF DRIVING

2.1 Generating the turning force

The high hydraulic supplied from a hydraulic pump flows into a cylinder block (8) through valve casing of motor (22), and valve plate (20).

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

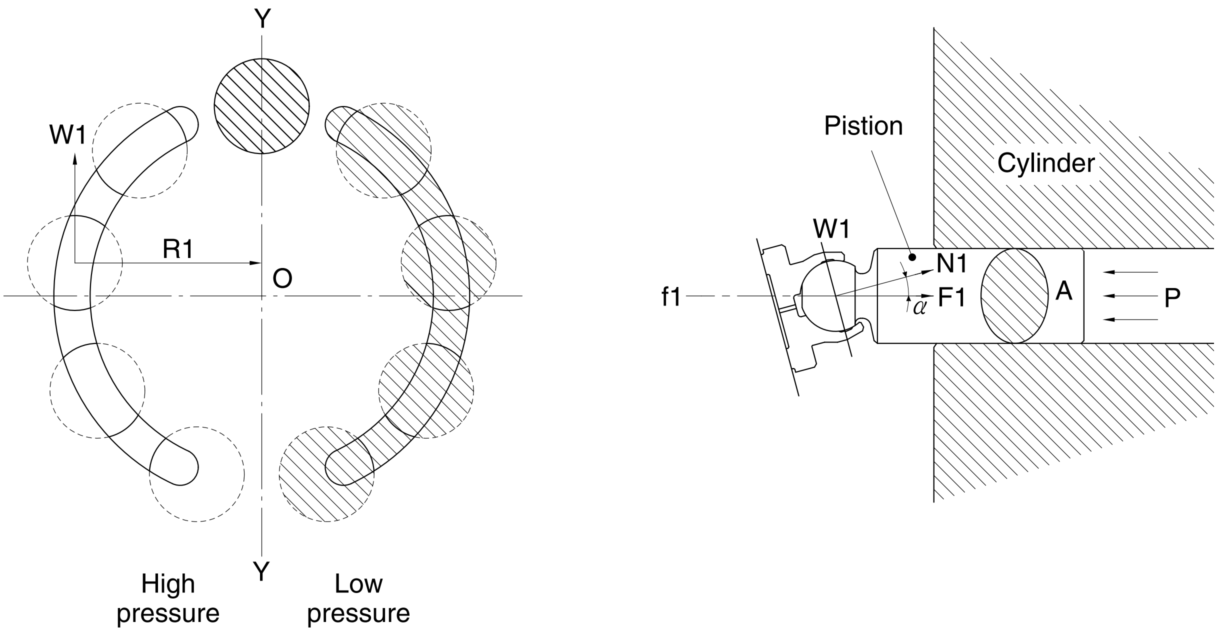
The high hydraulic can generate the force, F1=P×A (P : supplied pressure, A : water pressure area), like following pictures, working on a piston.

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

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

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

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



140WF8TM05

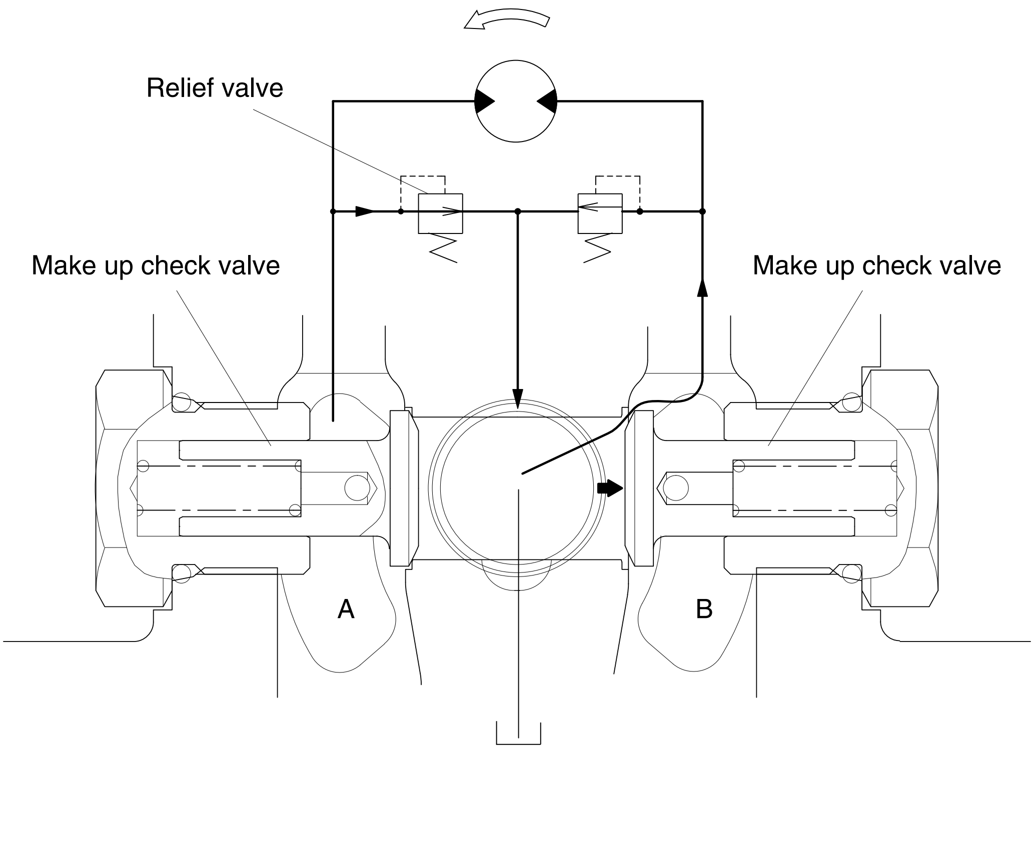
2) MAKE UP VALVE

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.

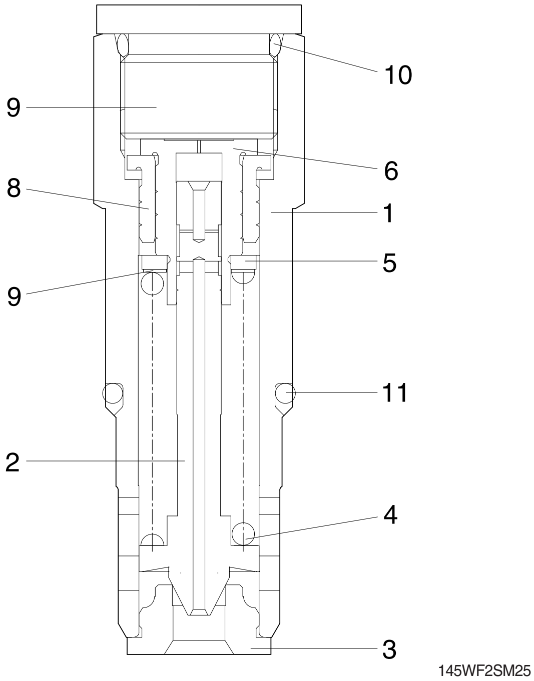
A make up valve is provided immediately before the port leading to the hydraulic oil tank to secure feed pressure required when the hydraulic motor makes a pumping action. The boost pressure acts on the hydraulic motor's feed port via the make up valve.

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.



3) RELIEF VALVE



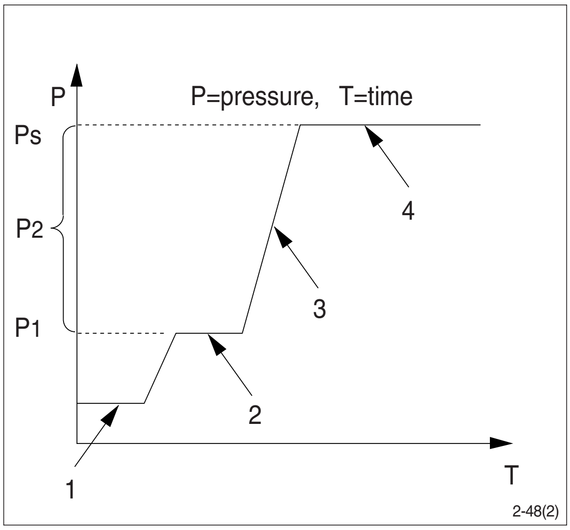
1	Sleeve
2	Poppet
3	Poppet seat
4	Spring
5	Spring seat
6	Shim
7	Piston
8	Stopper
9	Plug
10	O-ring
11	O-ring

(1) Construction of relief valve

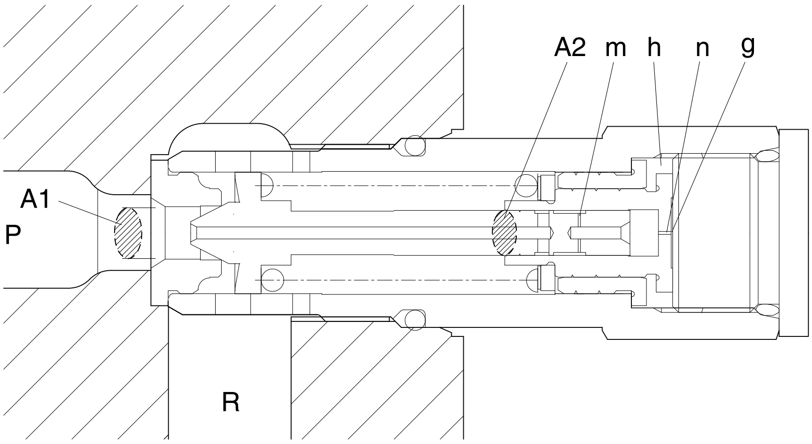
The valve casing contains two cartridge type relief valves that stop the regular and reverse rotations of the hydraulic motor. The relief valves relieve high pressure at start or at stop of swing motion and can control the relief pressure in two steps, high and low, in order to insure smooth operation.

(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.

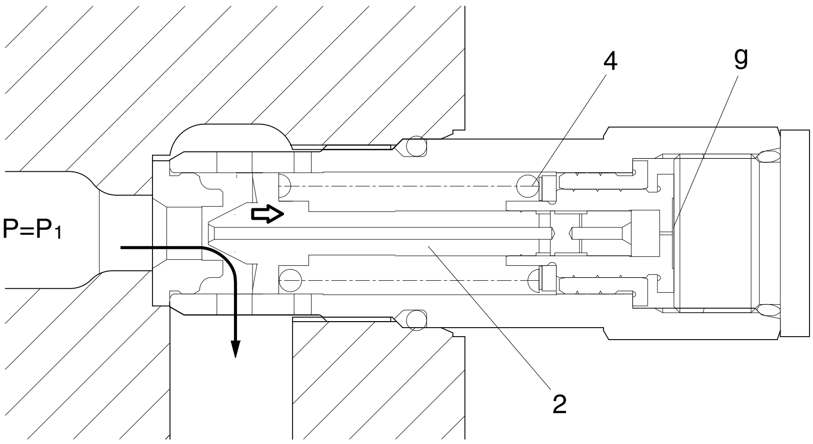


145WF2SM26

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

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

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



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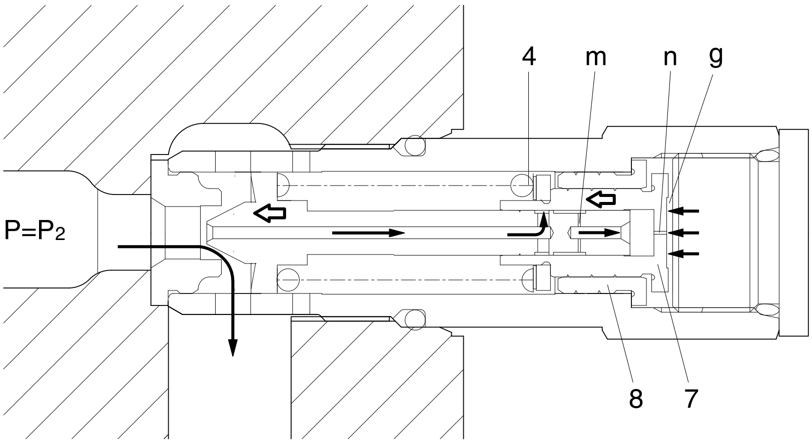
③ The oil flows into chamber (g) via orifice (m) and (n). When the pressure of chamber (g) reaches the preset force (F_{SP}) of spring (4), the piston (7) moves left and stop the piston (7) hits the bottom of stopper (8).

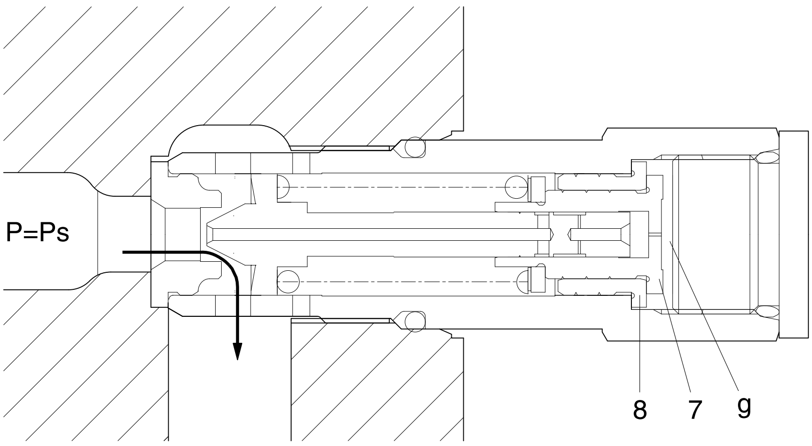


145WF2SM28

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

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

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



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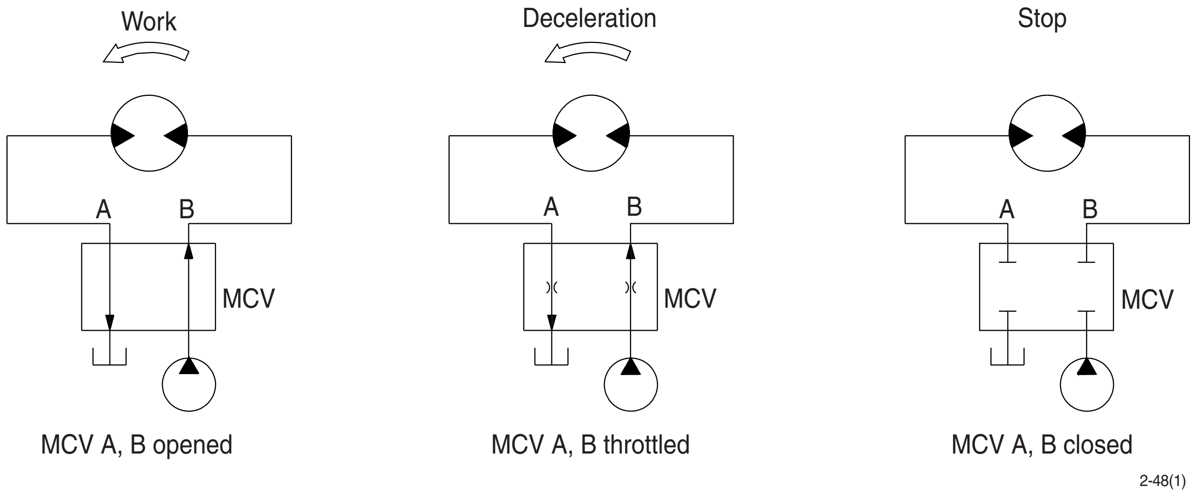
4) BRAKE SYSTEM

(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.



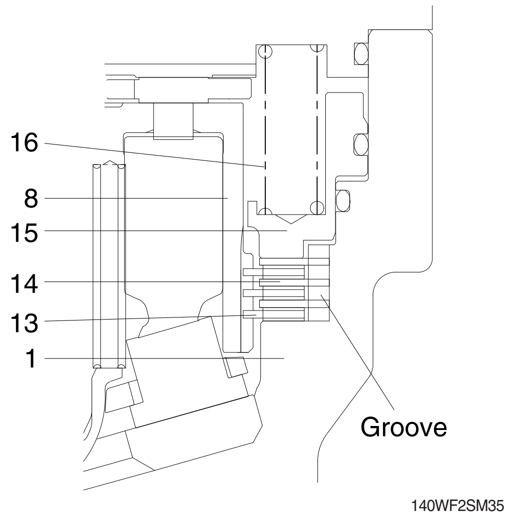
(2) Mechanical swing parking brake system

This is function as a parking brake only when the swing control lever and arm in control lever 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 between friction plate and separate plate.

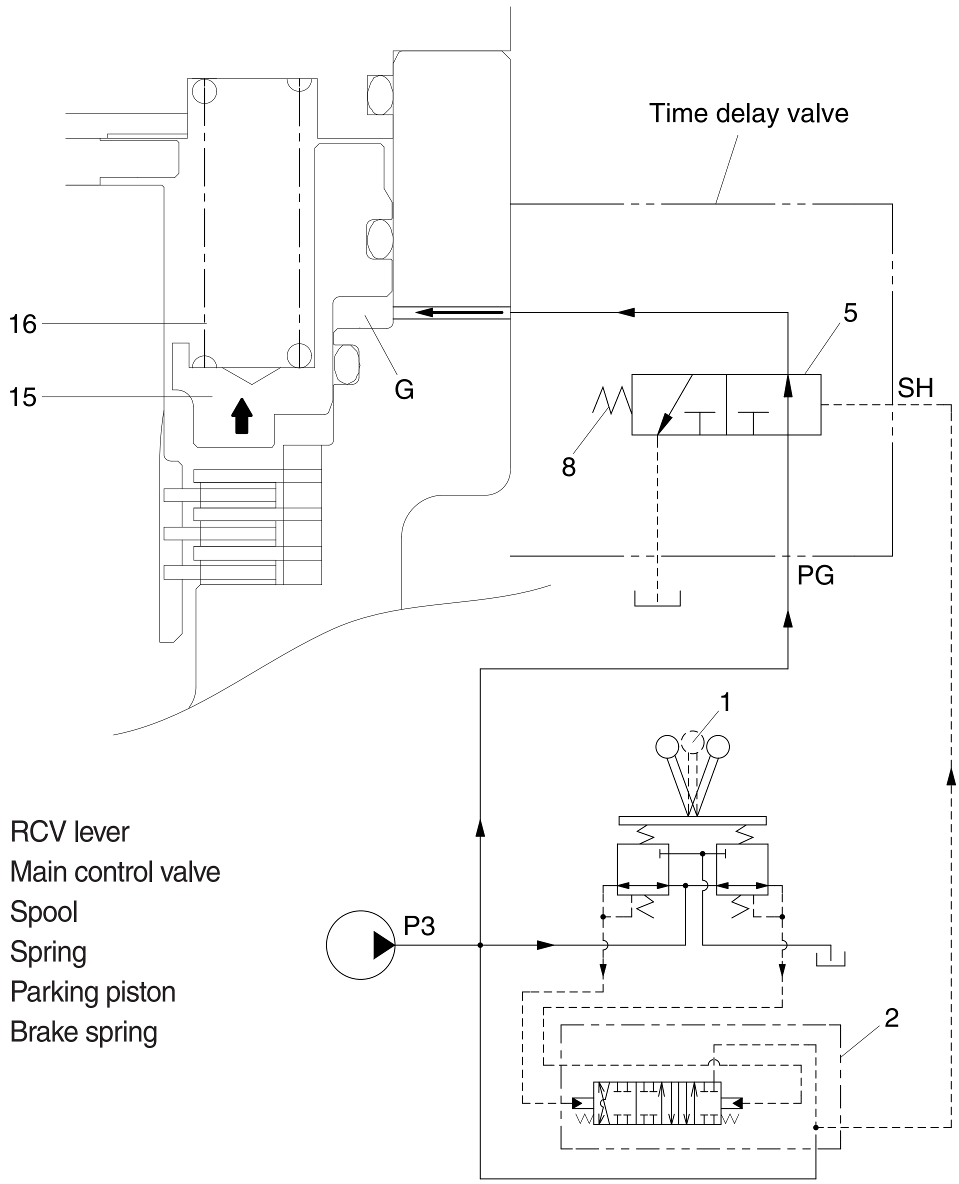
Friction force constrains motion of cylinder block (8). When hydraulic force exceeds spring force, brake is released.



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

② Operating principle

a. When one of the RCV lever (1) is set to the operation position, the each spool is shifted to left or right and the pilot oil flow is blocked. Then the pilot oil go to SH of the time delay valve (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 Main control valve
5 Spool
8 Spring
15 Parking piston
16 Brake spring

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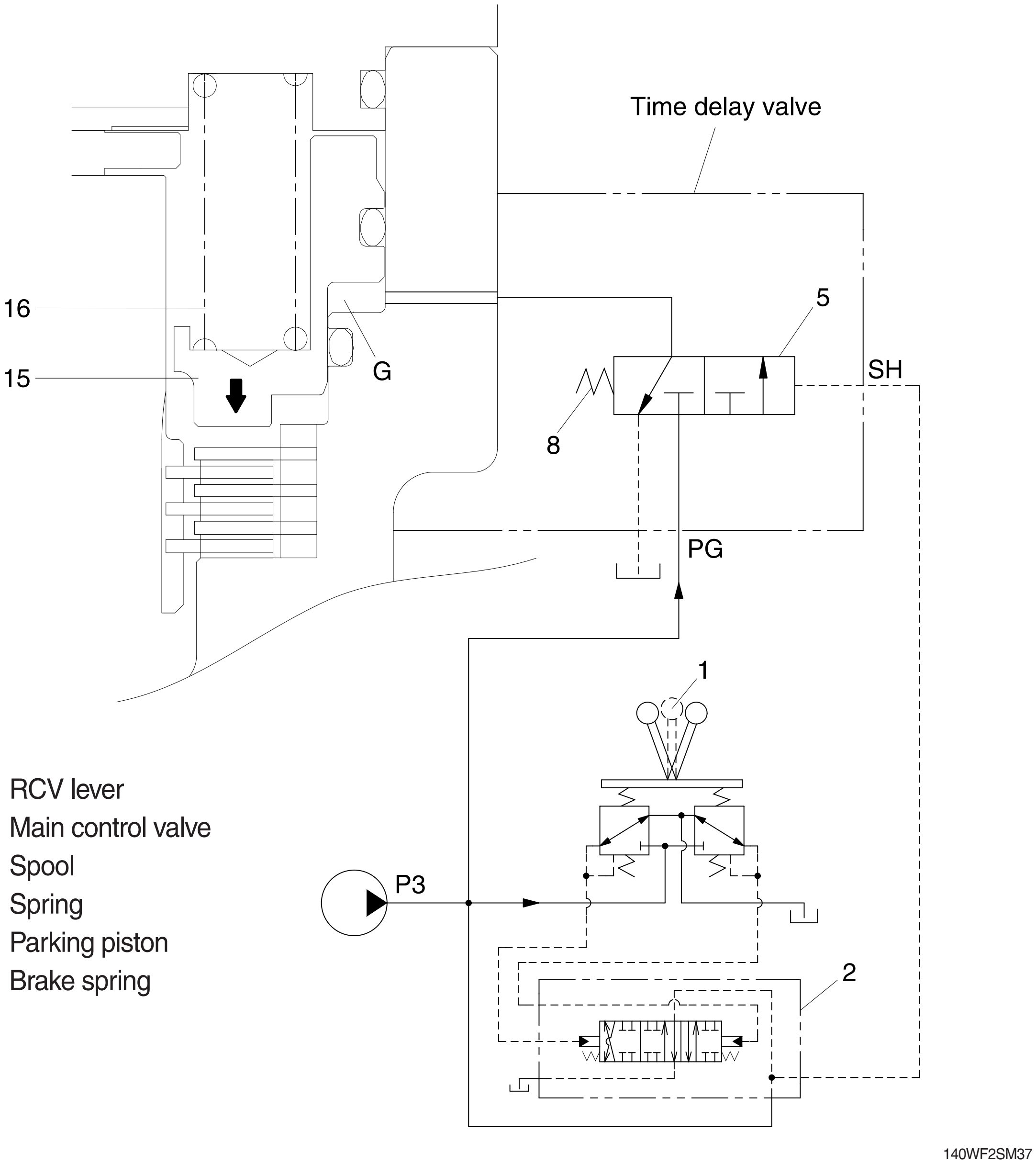
b. When all of the RCV lever (1) are set the neutral position, the spool (5) returns to right.
Then, the parking piston (15) is moved lower by spring force and the return oil from the chamber G flows back to tank port.
At this time, the brake works.



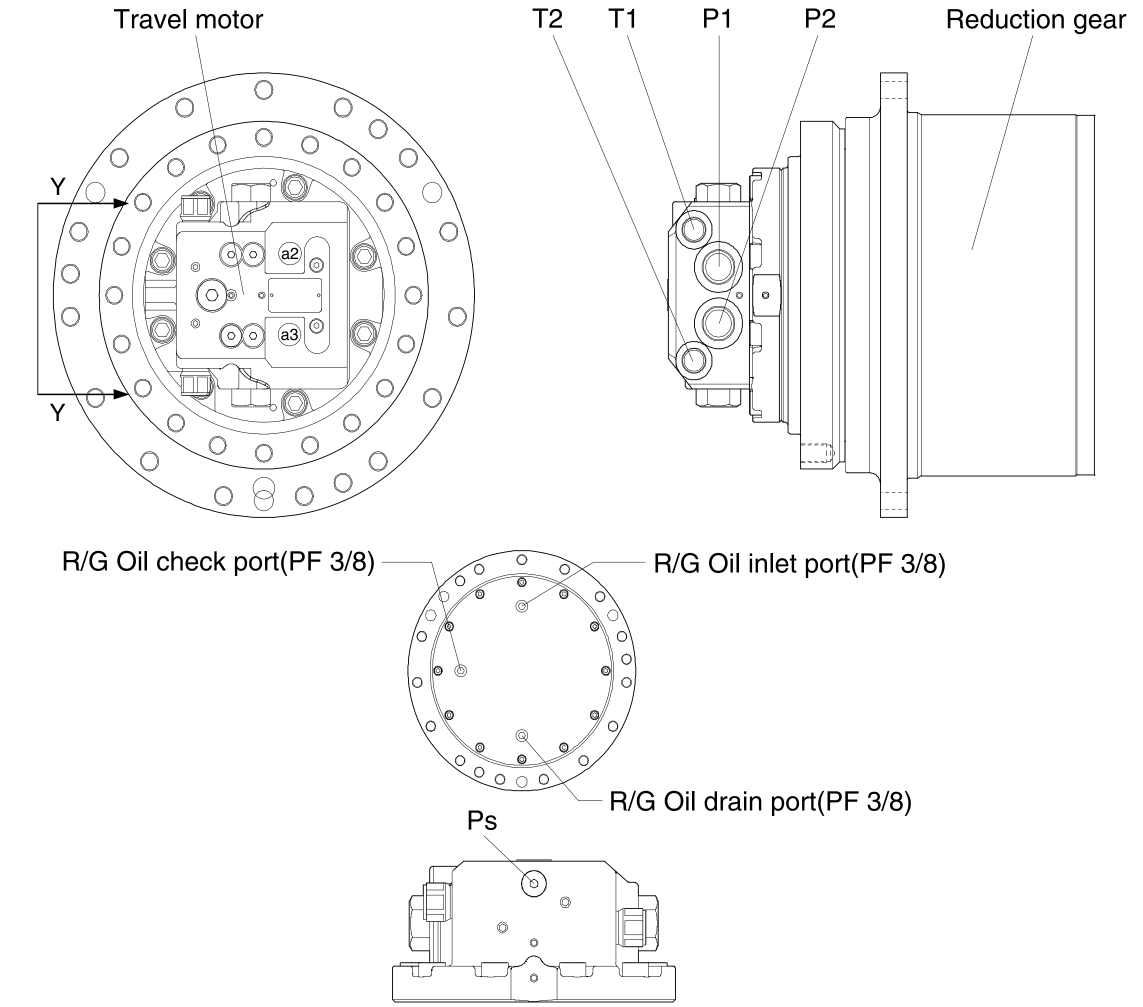
1	RCV lever
2	Main control valve
5	Spool
8	Spring
15	Parking piston
16	Brake spring

GROUP 4 TRAVEL DEVICE (TYPE 1)

1. CONSTRUCTION

Travel device consists travel motor and gear box.

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



VIEW Y

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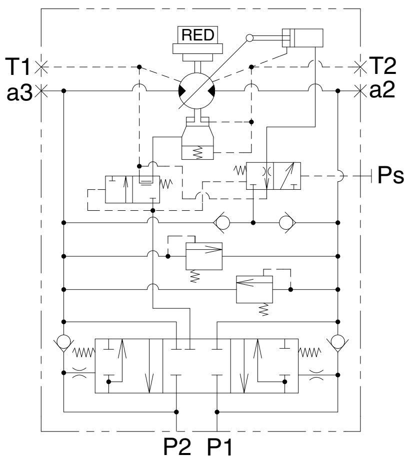
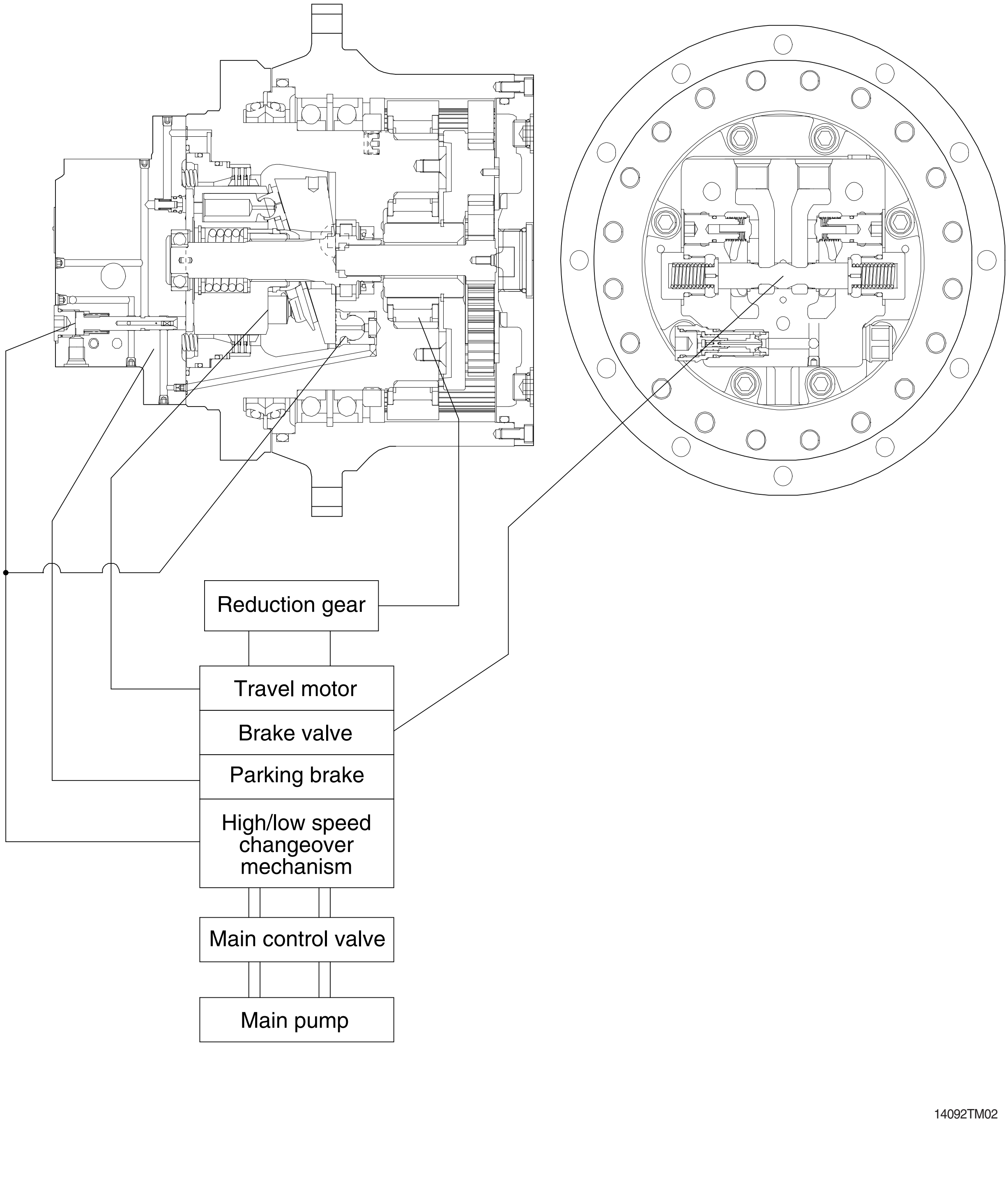


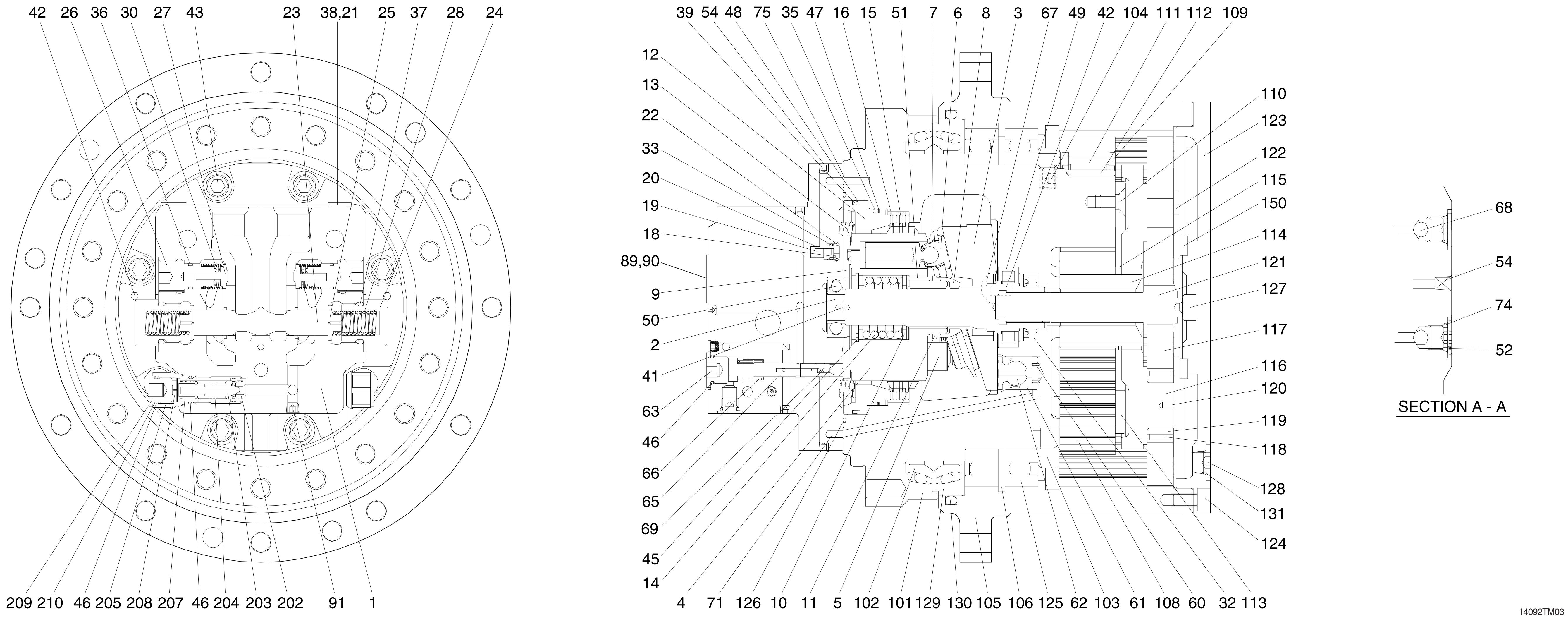
Hydraulic circuit

Port	Port name	Port size
P1	Main port	PF 3/4
P2	Main port	PF 3/4
a2, a3	Gauge port	PF 1/4
T1, T2	Drain port	PF 1/2
Ps	Parking brake release port	PF 1/4

1) BASIC STRUCTURE



2) STRUCTURE



1	Rear flange	19	Valve	39	O-ring	65	2 Speed spool	108	Planetary gear	125	Angular bearing
2	Shaft	20	Spring	41	Parallel pin	66	2 Speed spring	109	Thrust washer	126	O-ring
3	Swash plate	21	Plug	42	Parallel pin	67	Pivot	110	Screw	127	Thrust washer
4	Cylinder block	22	Ring	43	Socket bolt	68	Steel ball	111	Needle bearing	128	Plug
5	Piston	23	Main spool	45	Snap ring	69	Set screw	112	Collar	129	Seal ring
6	Shoe	24	Main plug	46	O-ring	71	Orifice	113	Thrust plate	130	O-ring
7	Retainer plate	25	Retainer spring	47	Back up-ring	74	O-ring	114	Sun gear	131	O-ring
8	Thrust ball	26	Check plug	48	Back up-ring	75	O-ring	115	Snap ring	150	Thrust plate
9	Timing plate	27	Check valve	49	Roller bearing	89	Name plate	116	Holder	205	Body
10	Washer	28	Main spring	50	Ball bearing	90	Set screw	117	Planetary gear	206	Shim
11	Washer-collar	30	Check spring	51	Roller	91	Plug	118	Needle bearing	207	Piston
12	Piston-parking	32	Oil seal	52	Plug	101	Spindle	119	Inner race	208	Rod
13	Spring	33	O-ring	54	Plug	102	Floating seal	120	Spring pin	209	Plug
14	Spring	35	O-ring	60	Spring	103	Nut ring	121	Drive gear	210	Back up-ring
15	Friction plate	36	O-ring	61	Piston	104	Plug	122	Thrust plate		
16	Mating plate	37	O-ring	62	Shoe	105	Hub	123	Cover		
18	Seat valve	38	O-ring	63	Plug	106	Snap ring	124	Socket bolt		

2. HYDRAULIC MOTOR ASSEMBLY

With brake valve, parking brake and high/low speed changeover mechanism.

1) FUNCTION

(1) Hydraulic motor

This hydraulic motor is a swash plate type piston motor and converts the force of pressurized oil delivered from the pump into a rotational movement.

(2) Brake valve

This brake valve is incorporated in the hydraulic motor assembly and has the following four functions.

① Smoothly brakes and stops the motor by controlling inertial rotation of the motor due to inertia of the main body.

② Check valve function to prevent cavitation of the hydraulic motor.

③ Relief valve function to control the brake pressure of hydraulic motor and anti-cavitation valve function to prevent cavitation.

④ Opens a port which releases the parking brake force upon running of the motor and closes the upon stopping.

(3) Parking brake

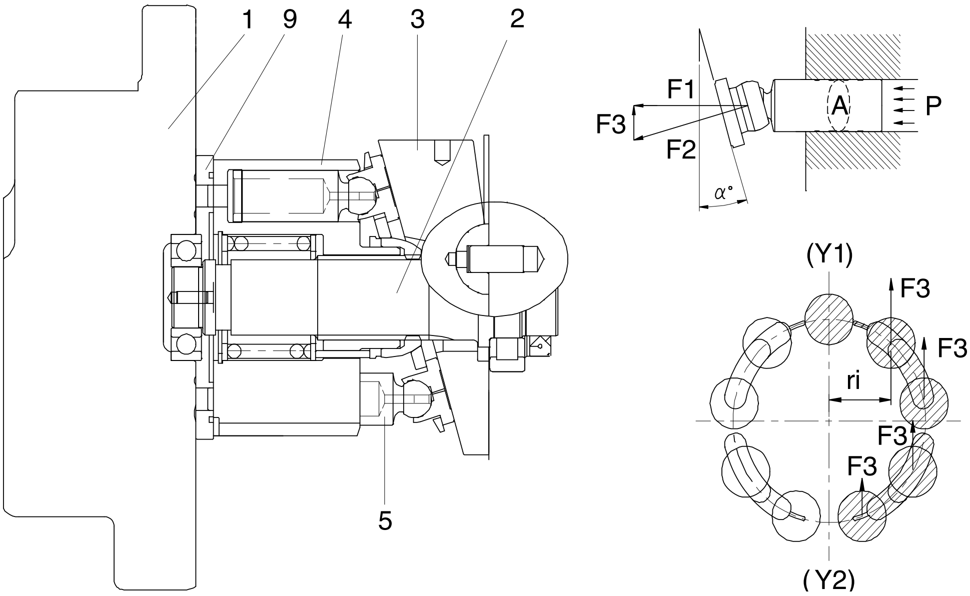
The parking brake prevents overrunning or slippage upon parking or stopping the machine on a slope with friction plate type brake mechanism, and combined with the hydraulic motor assembly into an integral structure.

(4) High/low speed changeover mechanism

This mechanism changes over the tilt angle of swash plate between high-speed/low-torque rotation and low-speed/high-torque rotation with the changeover valve and control piston.

2) OPERATING PRINCIPLE

(1) Hydraulic motor



14092TM05

The pressurized oil delivered from the hydraulic pump flows to rear flange (1) of the motor, passes through the brake valve mechanism and is introduced into cylinder block (4) via timing plate (9). This oil constructively introduced only to one side of (Y1) - (Y2) connecting the upper and lower dead points of stroke of piston (5). The pressurized oil fed to one side in cylinder block (4) pushes each piston (5) (four or five) and generates a force (F kgf = P kgf/cm^2 × A cm^2). This force acts on swash plate (3) and is resolves into components (F2 and F3) because swash plate (3) is fixed at an angle (α ˚) with the axis of drive shaft (2). Radial component (F3) generates respective torques (T = F3 × ri) for (Y1) - (Y2). This residual of torque (T = S (F3 × ri)) rotates cylinder block (4) via piston (5). Cylinder block (4) is spline coupled with drive shaft (2). So the drive shaft (2) rotates and the torque is transmitted.

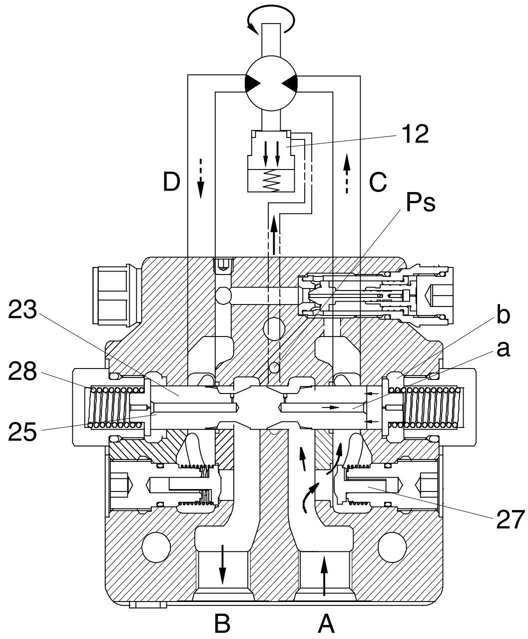
(2) Brake valve

① Brake released

When the pressurized oil supplied from port (A), the oil opens valve (27) and flows into port (C) at the suction side of hydraulic motor to rotate motor.

At the same time, the pressurized oil passes through pipe line (a) from a small hole in spool (23) and flow into chamber (b). The oil acts on the end face of spool (23) which is put in neutral position by the force of spring (28), thus causing spool (23) to slide to the left. When spool (23) slides, port (D) on the passage return side of hydraulic motor, which is closed by the spool groove during stoppage, communicates with port (B) at the tank side and the return oil from the hydraulic motor runs into the tank. In consequence, the hydraulic motor rotates.

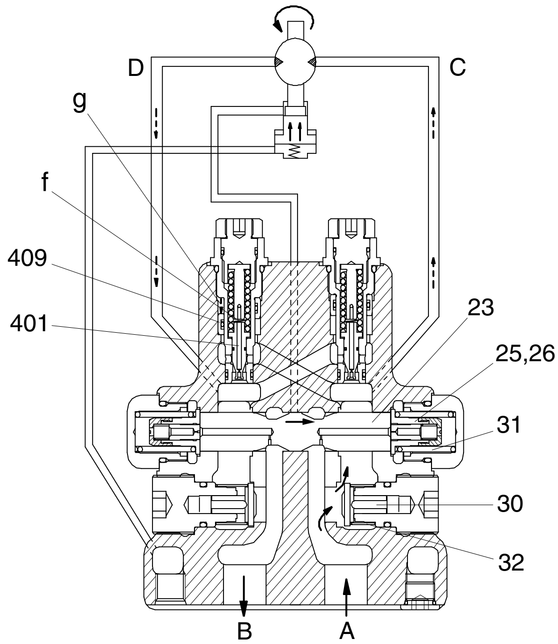
Moreover, sliding of spool (23) causes the pressurized oil to flow into ports (P) and (S). The pressurized oil admitted into port (P) activates piston (12) of the parking brake to release the parking brake force. (For details, refer to description of the parking brake.) When the pressurized oil is supplied from port (B), spool (23) and valve (27) move reversely and the hydraulic motor also rotates reversely.



14092TM06

② **Stopping and stalling** (brake applied)

When the pressurized oil supplied from port (A) is stopped during traveling, no hydraulic pressure is applied and spool (23) which has slid to the left will return on the right (neutral) via stopper (25, 26) by the force of spring (31). At the same time, the hydraulic motor will rotate by the inertia even if the pressurized oil stopped, so the port (D) of the motor will become high pressure. This pressurized oil goes from chamber (f) to chamber (g) through the left-hand valve (401). When the oil enters chamber (g), the piston (409) slides to the right so as not to rise the pressure, as shown in the figure. Meanwhile, the left-hand valve (401) is pushed open by the pressurized oil in port (D). Therefore, the pressurized oil in port (D) flows to port (C) at a relatively low pressure, controlling the pressure in port (D) and preventing cavitation in port (C). When the piston (409) reaches the stroke end, the pressure in chamber (g) and (f) increase and the left-hand valve (401) closes again, allowing the oil pressure in port (D) to increase further. Then, the right-hand valve opens port (C) with pressure higher than that machine relief set pressure. In this way, by controlling the pressure in port (D) in two steps, the hydraulic motor is smoothly braked and to a stop.

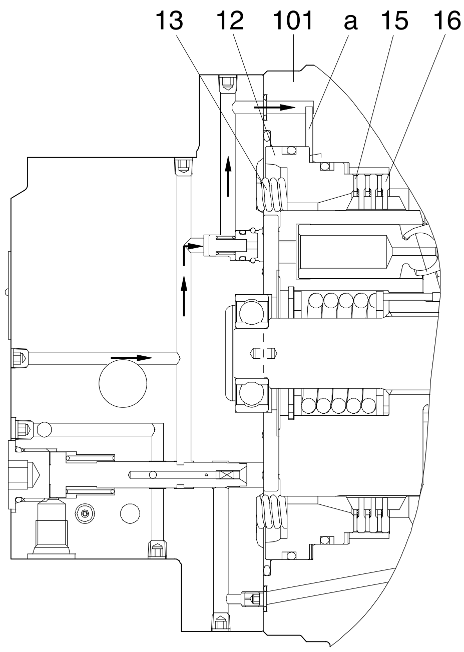


25092TM07

(3) Parking brake

① Running

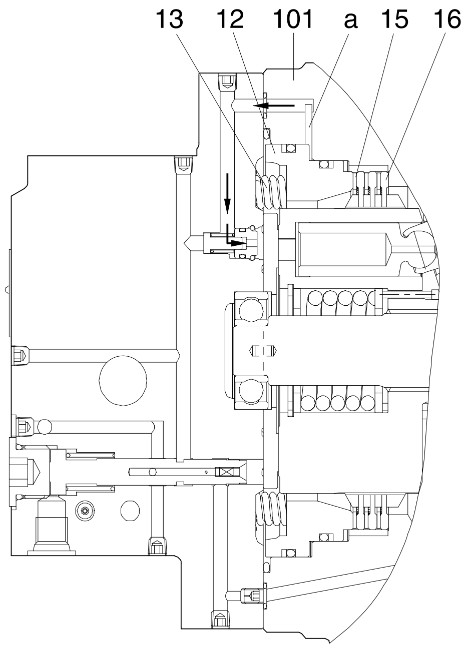
When the pressurized oil is supplied from the valve, the spool of brake valve in the hydraulic motor assembly actuates to open the passage to the parking brake and the pressurized oil is introduced into cylinder chamber (a) which is composed of the spindle of reduction gear assembly and piston (12). When the hydraulic pressure reaches 9.5 kgf/cm^2 or more, it overcomes the force of spring (13) and shifts piston (12). With shift of piston (12), no pressing force is applied to mating plate (16) and friction plate (15) and movement of friction plate (15) becomes free. Whereby the brake force to the cylinder in the hydraulic motor assembly is released.



14092TM08

② Stopping

When the pressurized oil from the brake valve is shut off and the pressure in cylinder chamber (a) drops 9.5 kgf/cm^2 or less, piston (12) will return by the force of spring (13). Piston (12) is pushed by this force of spring (13), and mating plate (16) and friction plate (15) in free condition are pressed against the spindle of reduction gear assembly. The friction force produced by this pressing stops rotation of the cylinder and gives a braking torque 19.7 kgf · m to the hydraulic motor shaft. Note that oil control through a proper oil passage ensures smooth operation.

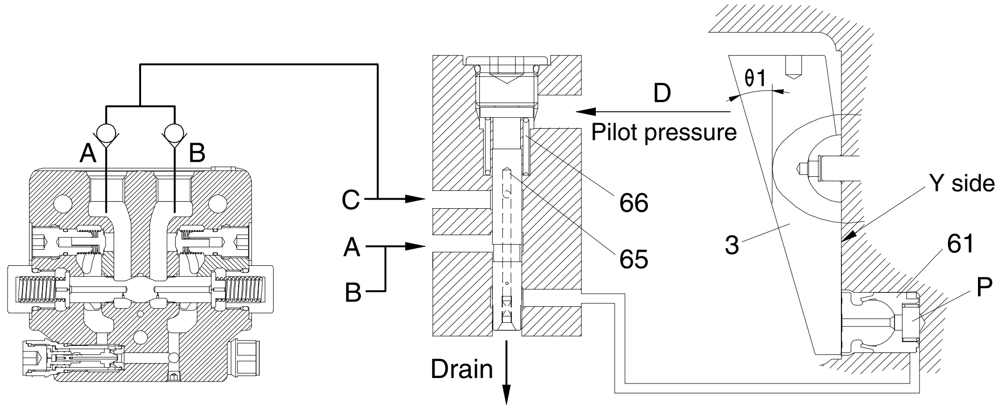


14092TM09

(4) High/low speed changeover mechanism

① **At low speed -** pilot pressure of less than 10 kgf/cm^2

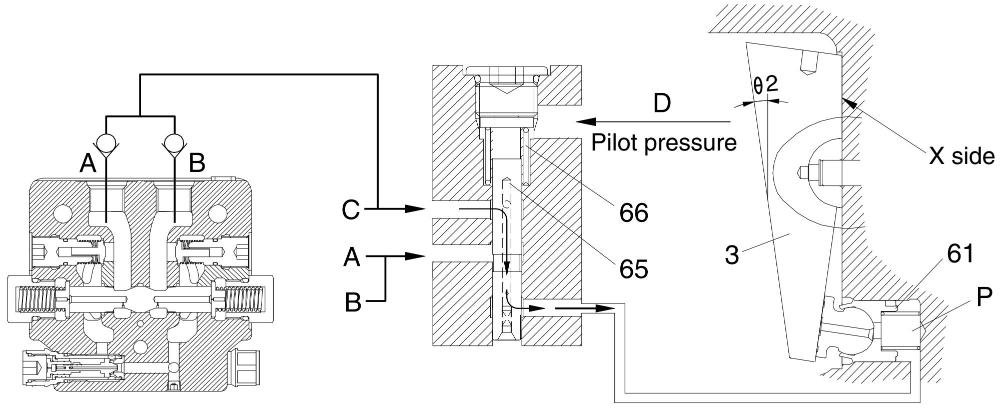
When no pilot pressure is supplied from (D) (at a pressure of 10 kgf/cm^2 or less), valve (65) is pressed toward the top by the force of spring (66) and (A) port or (B) port, the pressurized oil supply port (C) is shut off, and oil in chamber (P) is released into the motor case via valve(65). Consequently, swash plate (3) is tilted at a maximum angle (θ 1) and the piston displacement of hydraulic motor becomes maximum, thus leading to low-speed rotation.



14092TM10

② **At high speed -** pilot pressure of 20 kgf/cm^2 or more

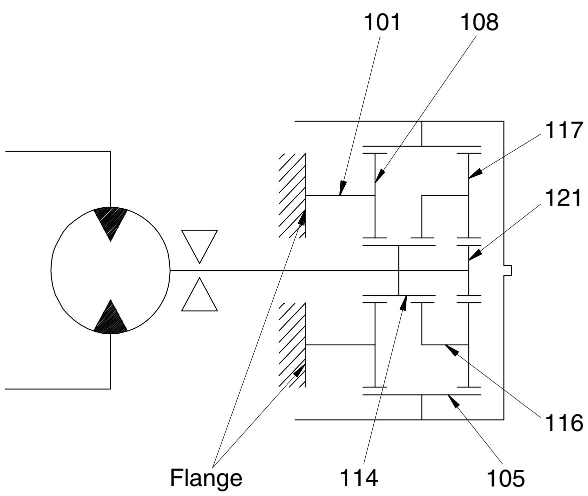
When a pilot pressure is supplied from port (D) (at a pressure of 20 kgf/cm^2 or more), the pressure overcomes the force of spring (66) and (A) port or (B) port of valve (65) is pressed toward the down. The pressurized oil at supply port (C) is then introduced into chamber (P) via valve (65). Piston (61) pushes up swash plate (3) until it touches side Y of the spindle. At this time, swash plate (3) is tilted at a minimum angle (θ 2) and the piston displacement of hydraulic motor becomes minimum, thus leading to high-speed rotation.

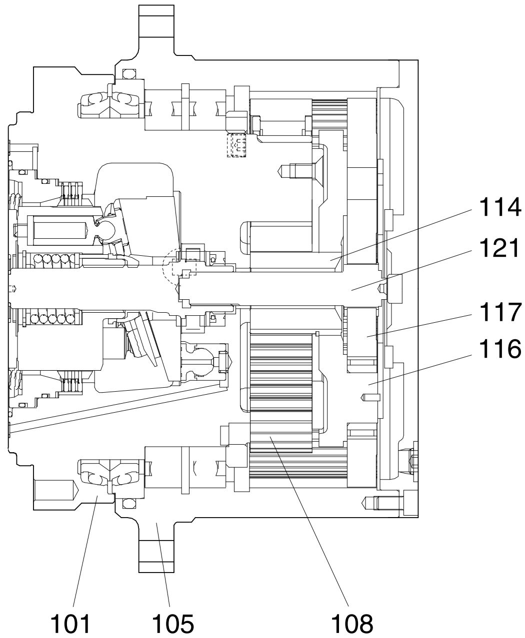


14092TM11

3. REDUCTION GEAR

1) The reduction gear is composed of a two-stage planetary gear mechanism shown in the following figure.





14092TM12

2) The rotating motion of the hydraulic motor is transmitted to drive gear (121) of 1st stage, and the drive gear rotate planetary gears (R, 117). Then planetary gears (R, 117) revolves inside fixed hub (105). This rotation becomes the output of 1st stage and is transmitted to carrier No.1 and sun gear (114). Similarly the revolution of planetary gears (F, 108) are transmitted to spindle (101). Then planetary gears (F, 108) do not revolve, but rotate to hub (105). Therefore, the rotating case is driven by the overall driving torque of hub (105).

This reduction ratio is expressed as shown below :

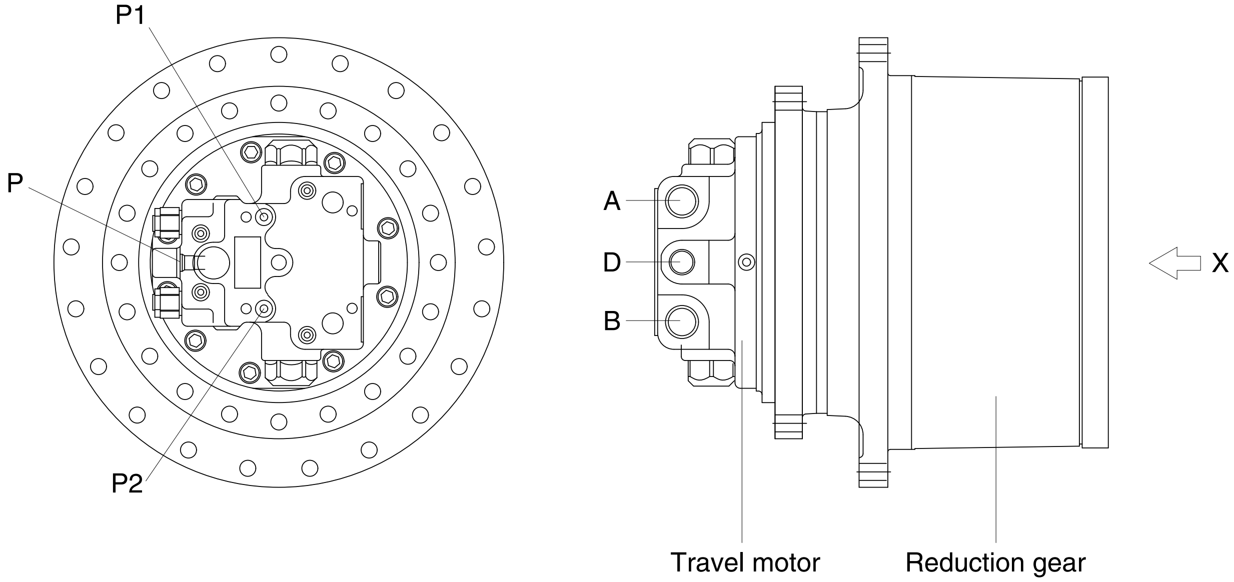
· Reduction ratio (I) = (Hub teeth / Drive gear teeth + 1) x (Hub teeth / Sun gear teeth + 1) - 1

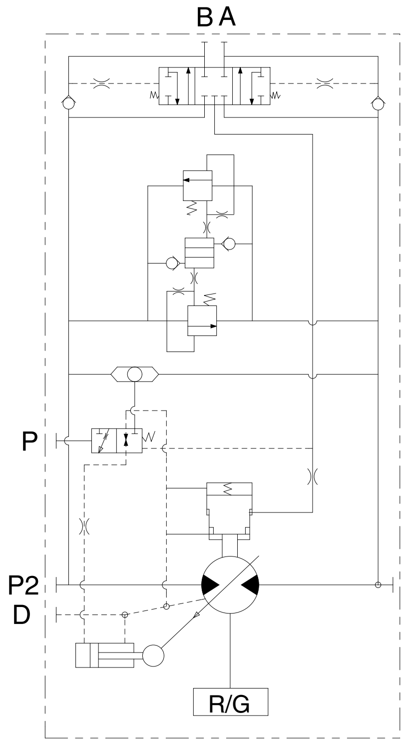
GROUP 4 TRAVEL DEVICE (TYPE 2)

1. CONSTRUCTION

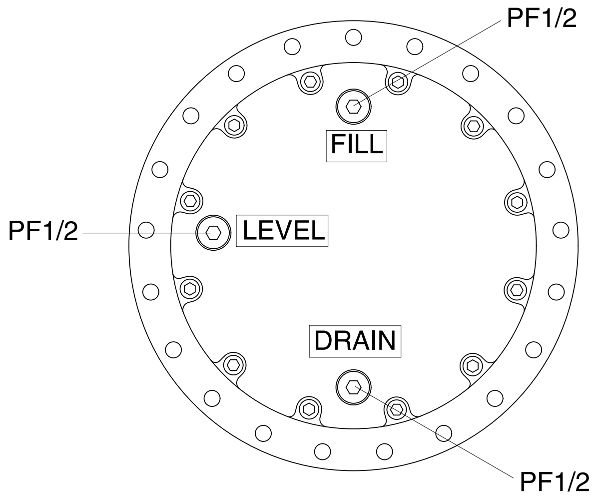
Travel device consists travel motor and gear box.

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





Hydraulic circuit



VIEW X

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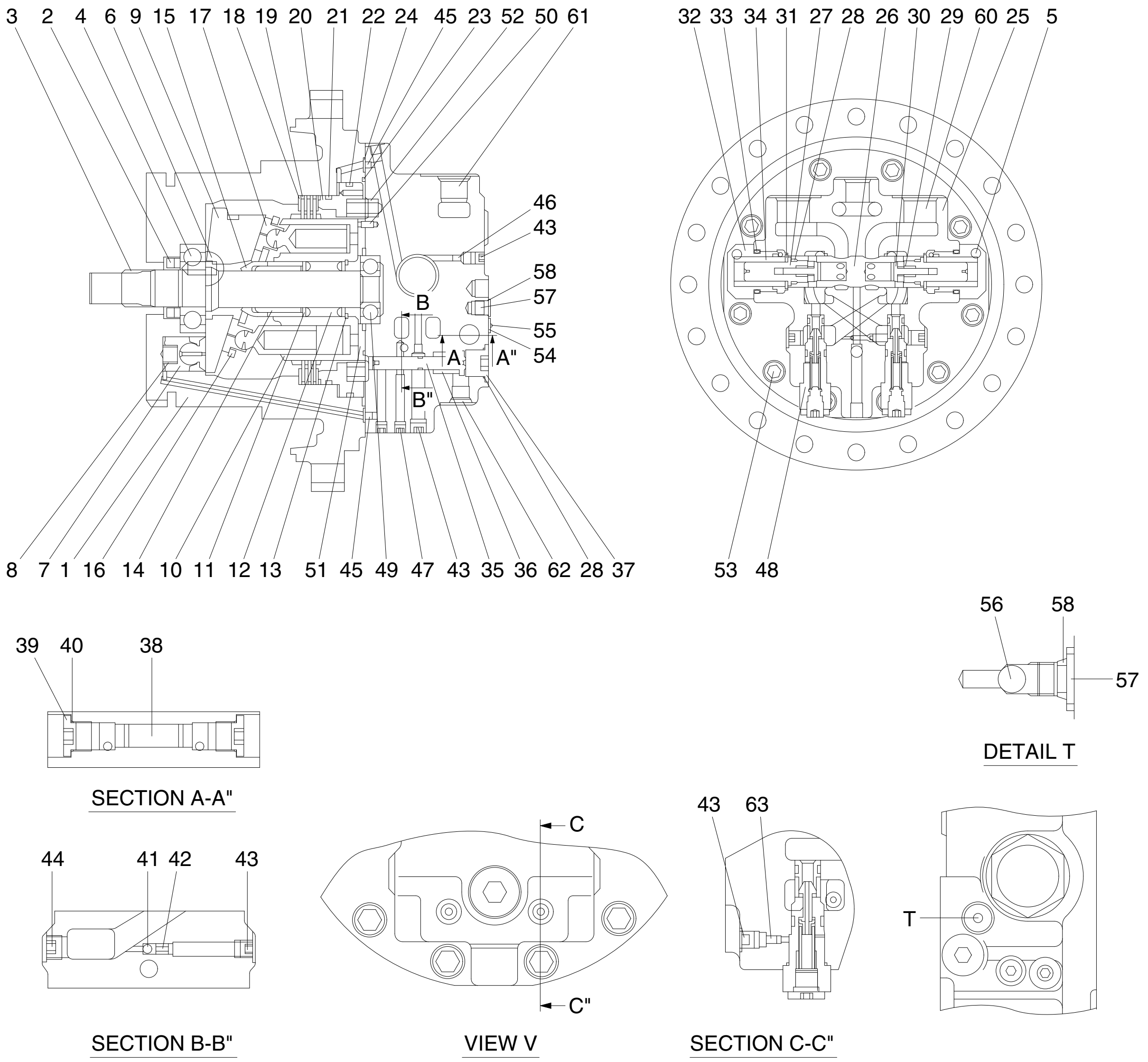
Port	Port name	Port size
A, B	Main port	PF 3/4
P	Two speed control port	PF 1/4
D	Drain port	PF 1/2
P_1, P_2	Gage port	PF 1/8

1) STRUCTURE



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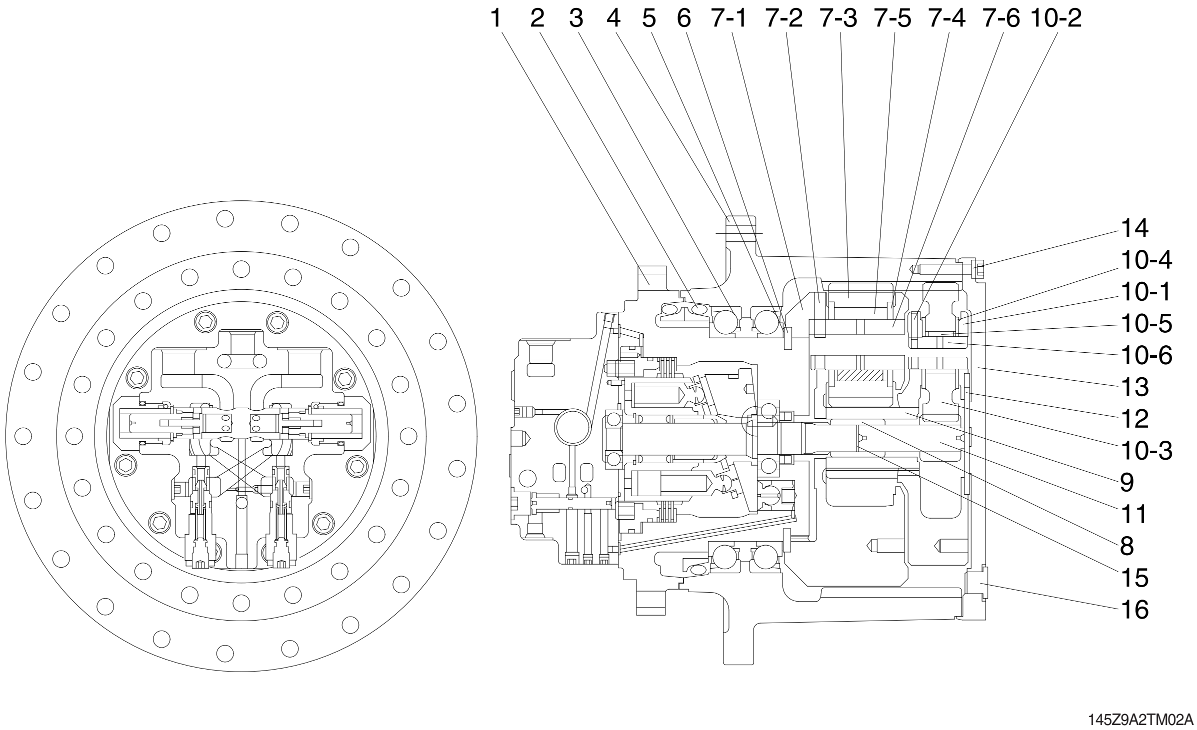
1	Shaft casing	17	Piston assy	33	O-ring	49	Bearing
2	Oil seal	18	Steel plate	34	Spring	50	Pin
3	Shaft	19	Friction plate	35	Spool	51	Valve plate
4	Bearing	20	Brake piston	36	Spring	52	Spring
5	Pin	21	Ring	37	Plug	53	Wrench bolt
6	Swash ball	22	Ring	38	Piston	54	Name plate
7	Swash piston	23	O-ring	39	Plug	55	Rivet
8	Spring	24	O-ring	40	O-ring	56	Steel ball
9	Swash plate	25	Valve casing	41	Steel ball	57	Plug
10	Cylinder block	26	Main spool	42	Orifice	58	O-ring
11	Spring seat	27	Plug	43	Plug	60	Plastic plug
12	Spring	28	O-ring	44	Plug	61	Plastic plug
13	Snap ring	29	Spring	45	Orifice	62	Plastic plug
14	Pin	30	Check	46	Orifice	63	Orifice
15	Ball guide	31	Plate	47	Plug		
16	Set plate	32	Plug	48	Relief valve assy		



1	Spindle	7-4	Washer 2	10-5	Bearing 1
2	Floating sesal	7-5	Bearing 2	10-6	Pin 1
3	Ball bearing	7-6	Pin 2	11	Sun gear 1
4	Housing	8	Coupling	12	Plate 1
5	Shim	9	Sun gear 2	13	Cover
6	Shim	10	Carrier assy 1	14	Bolt
7	Carrier assy 2	10-1	Carrier 1	15	Snap ring
7-1	Carrier 2	10-2	Spring pin 1	16	Plug
7-2	Spring pin 2	10-3	Planetary gear 1		
7-3	Planetary gear 2	10-4	Washer 1		

3. PRINCIPLE OF DRIVING

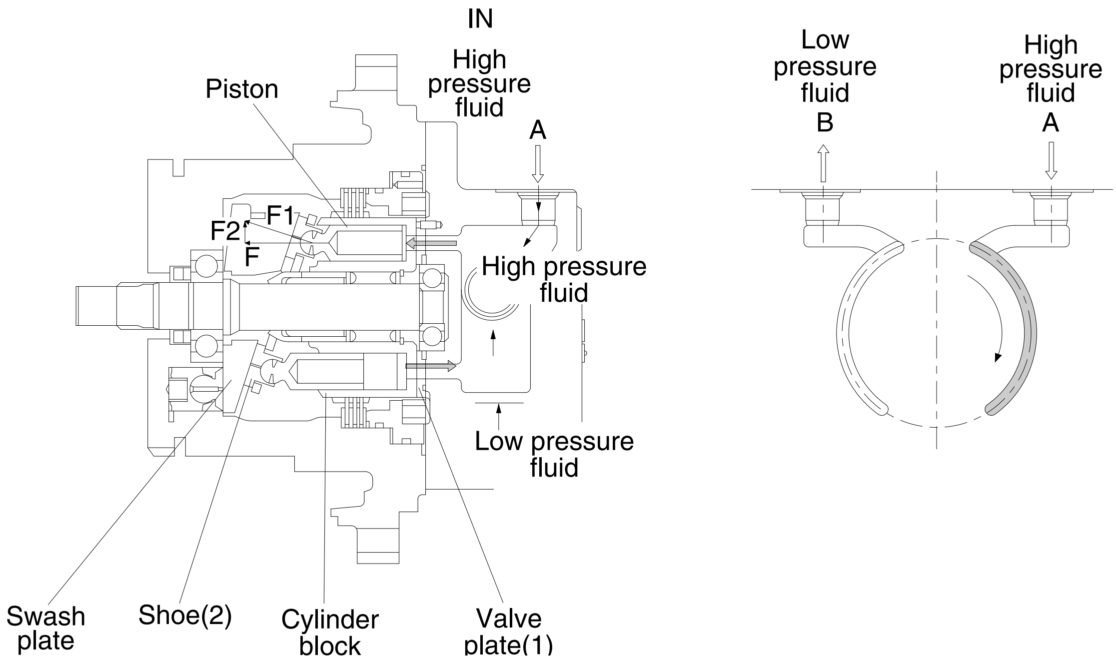
Travel motor comprises with rotary, relief valve, parking brake, counterbalance valve and 2-speed control.

1) WORKING OF ROTARY PART

In the figure below, axis directional force F1 occurs when the high pressure oil flows into the cylinder block through to the valve plate (1) port, and the piston moves to the left hand side.

This force F1, which takes shoe (3) as a medium, split into axial force F which is parallel with a shaft, and radial force F2 which is perpendicular to the shaft. By the reaction force F2, cylinder block rotate with piston and shoe, while shoe (2) moves on the shoe plate with piston.

There are 9 pistons inserted into the cylinder block and they rotate with the cylinder block by taking high pressure oil in order at the entrance. When the oil flow is reversed, piston and cylinder block rotate in the opposite direction.



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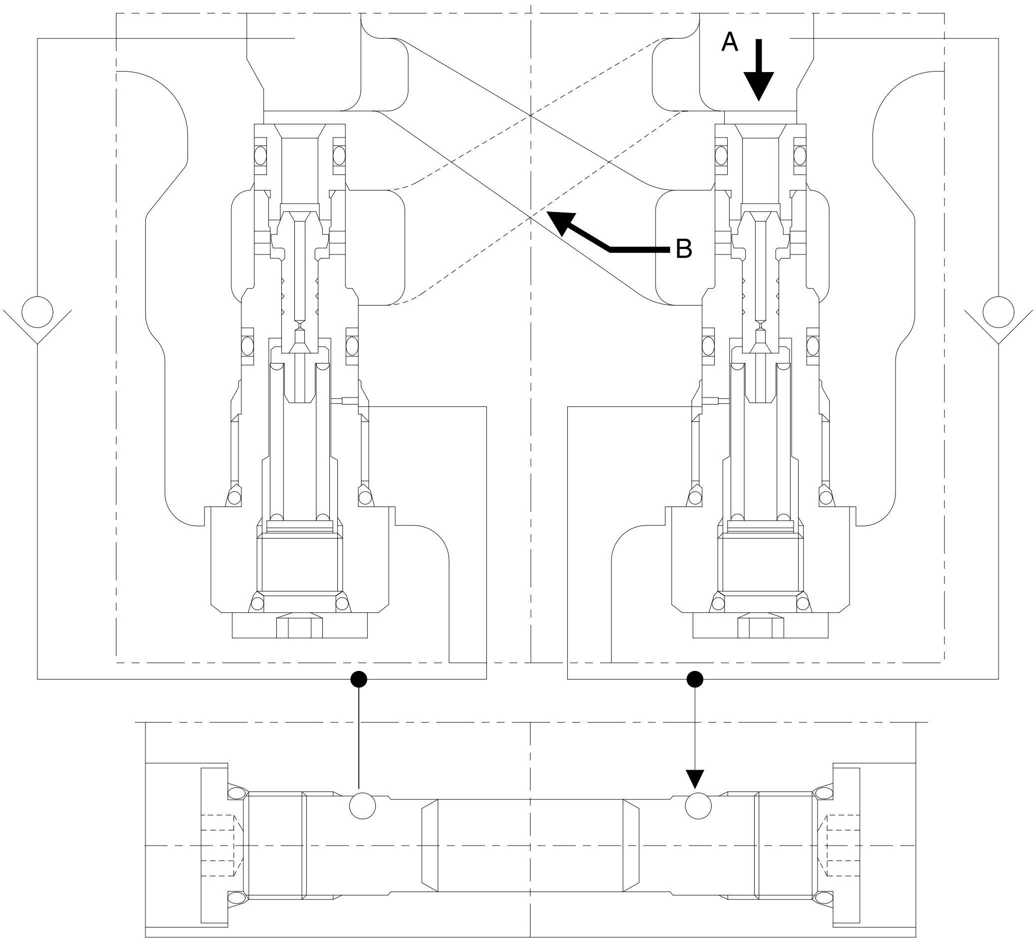
2) WORKING OF RELIEF VALVE

When the control valve spool is returned to neutral, the circuit between control valve and motor is blocked, and traveling movement stops.
However, motor continues rotating because of the traveling inertia of the excavator's heavy weight.
Then the motor will act as a pump, and oil blocked between control valve and motor will be pressured sharply and the increased oil pressure will damage internal parts.
To prevent this damage, relief valve discharge the high pressure oil from A to B which has lower pressure.



145Z9A2TM04

- Setting pressure : 350 kgf/cm^2
- Back pressure : 5 kgf/cm^2
- Cracking pressure : 315 kgf/cm^2 over

- AT THE BEGINNING OF TRAVELING

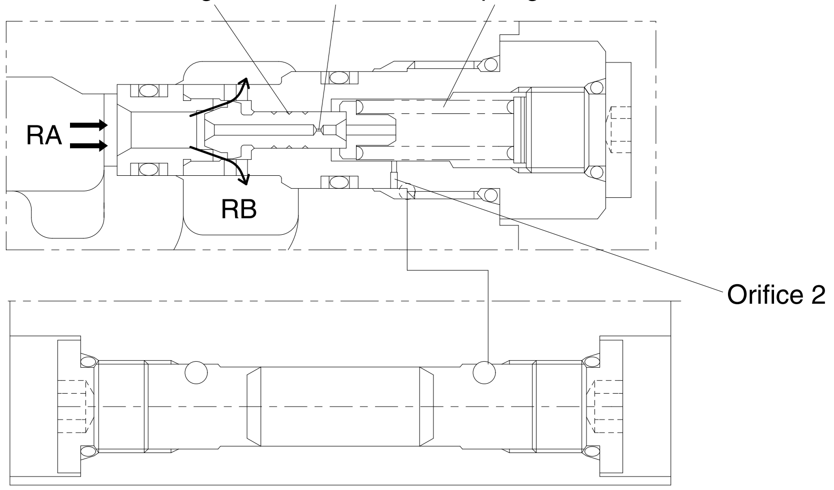
RELIEF VALVE A

When travel control lever moves, high pressure oil works to rise the pressure of RA port up. This pressurized oil press plunger to the right, and then sustain the power of the spring, the plunger moves to the right and release the pressure oil of RA port to RB port (Stage 1)

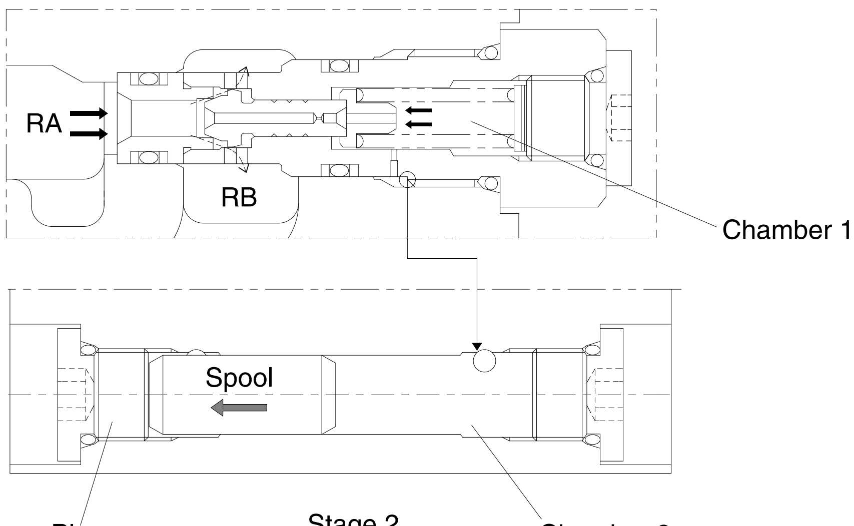
The plunger moves slowly by the pressure oil which flows into chamber 1 through orifice 1. The pressure oil flowed into chamber 1 flows into chamber 2 through orifice 2, and at this point, the plunger moves to the left again, when the spring is compressed by the flowed pressure oil which press the spool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

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

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



Stage 1



Stage 2

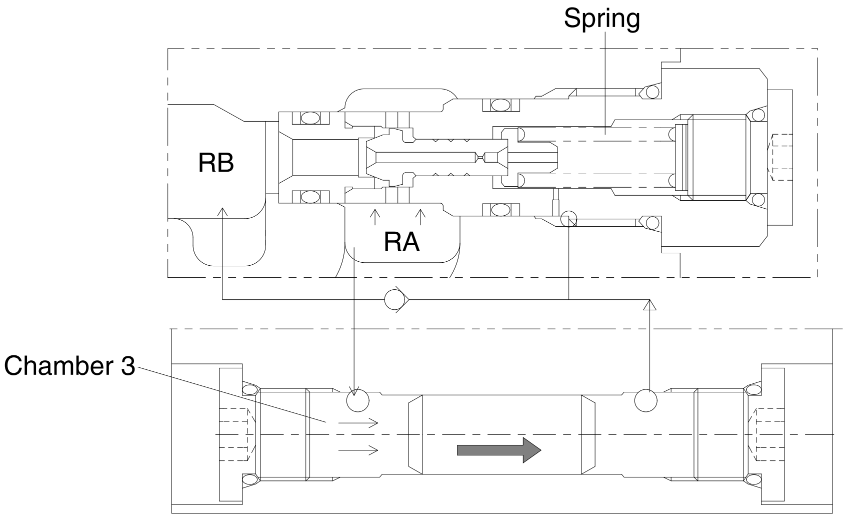
RELIEF VALVE A

145Z9A2TM05

- DURING TRAVELING OPERATION

RELIEF VALVE B

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



RELIEF VALVE B

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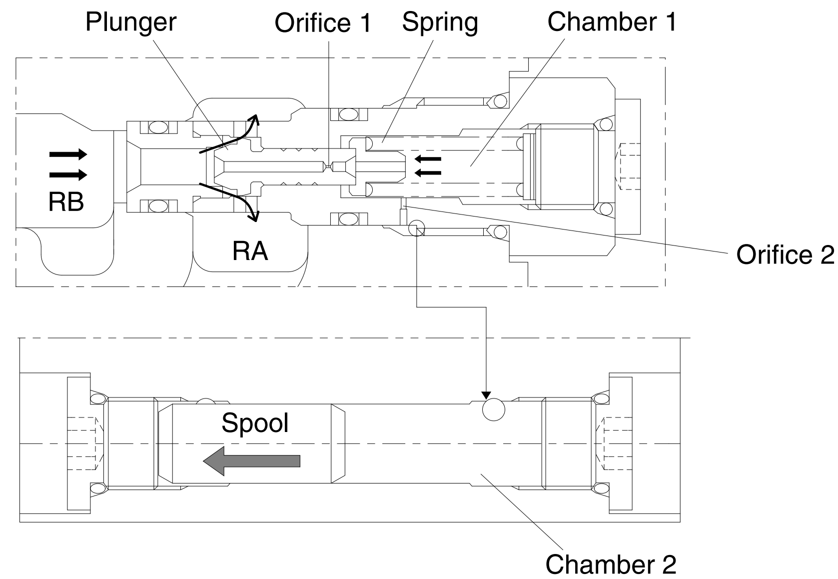
- WHEN IT STOP

RELIEF VALVE B

When it stops or operates reversely, RA port pressure is decreased and RB port pressure suddenly goes up by the inertia of the machine heavy structure.
Relief valve B operates as the same order as relief valve A, and maintains the set pressure by releasing the high pressure of RB port to RA port.



RELIEF VALVE B

145Z9A2TM07

3) WORKING OF PARKING BRAKE

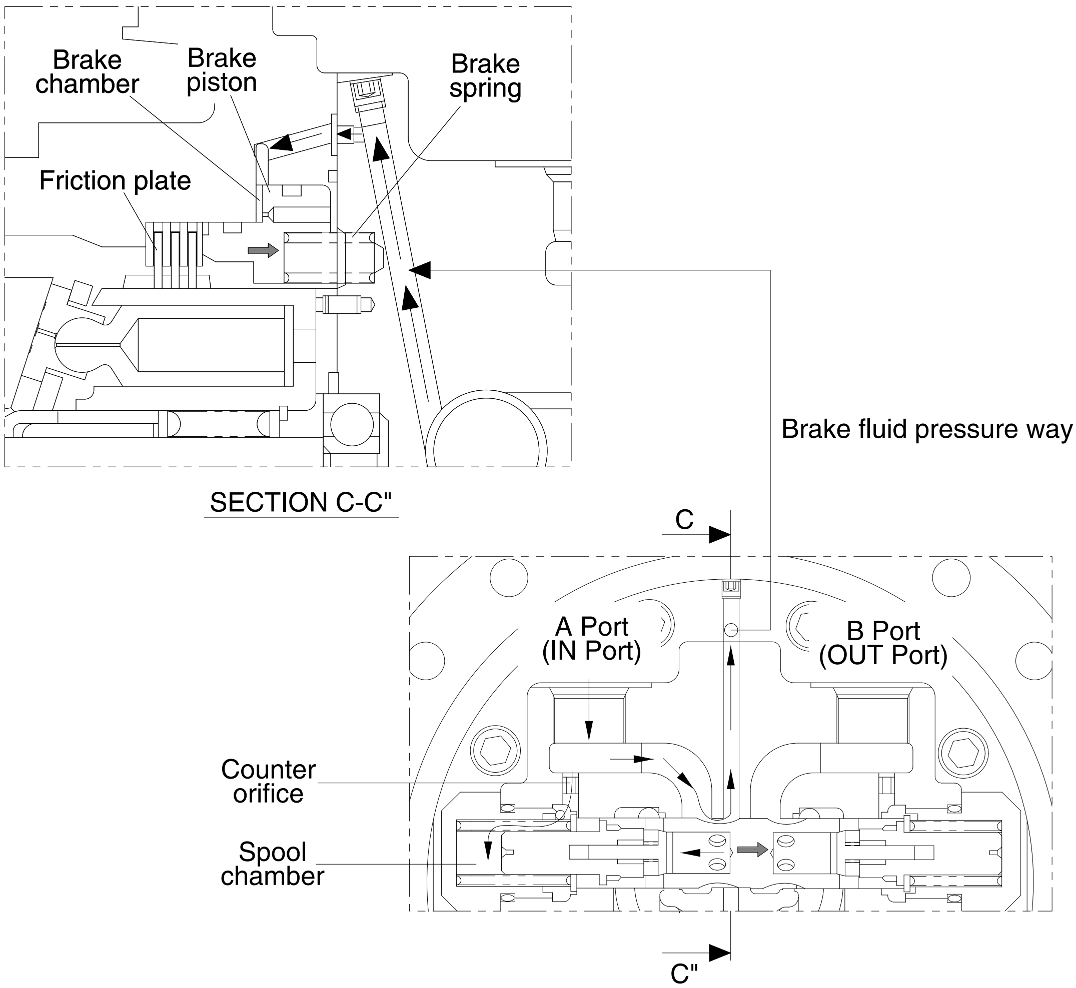
Parking brake system consists of a brake piston, springs, friction plates and separating plates, and some orifices to control responsibility of the brake piston. The brake is usually held with the force of compressed spring, and it is released automatically by traveling oil pressure coming from inlet A, or B when the motor starts to run.

- Parking brake OFF

  When operator moves the traveling control lever, traveling working pressurized oil into IN PORT flows from spool chamber through counter orifice.

  Pressurized oil pushes counter balance spool to right.

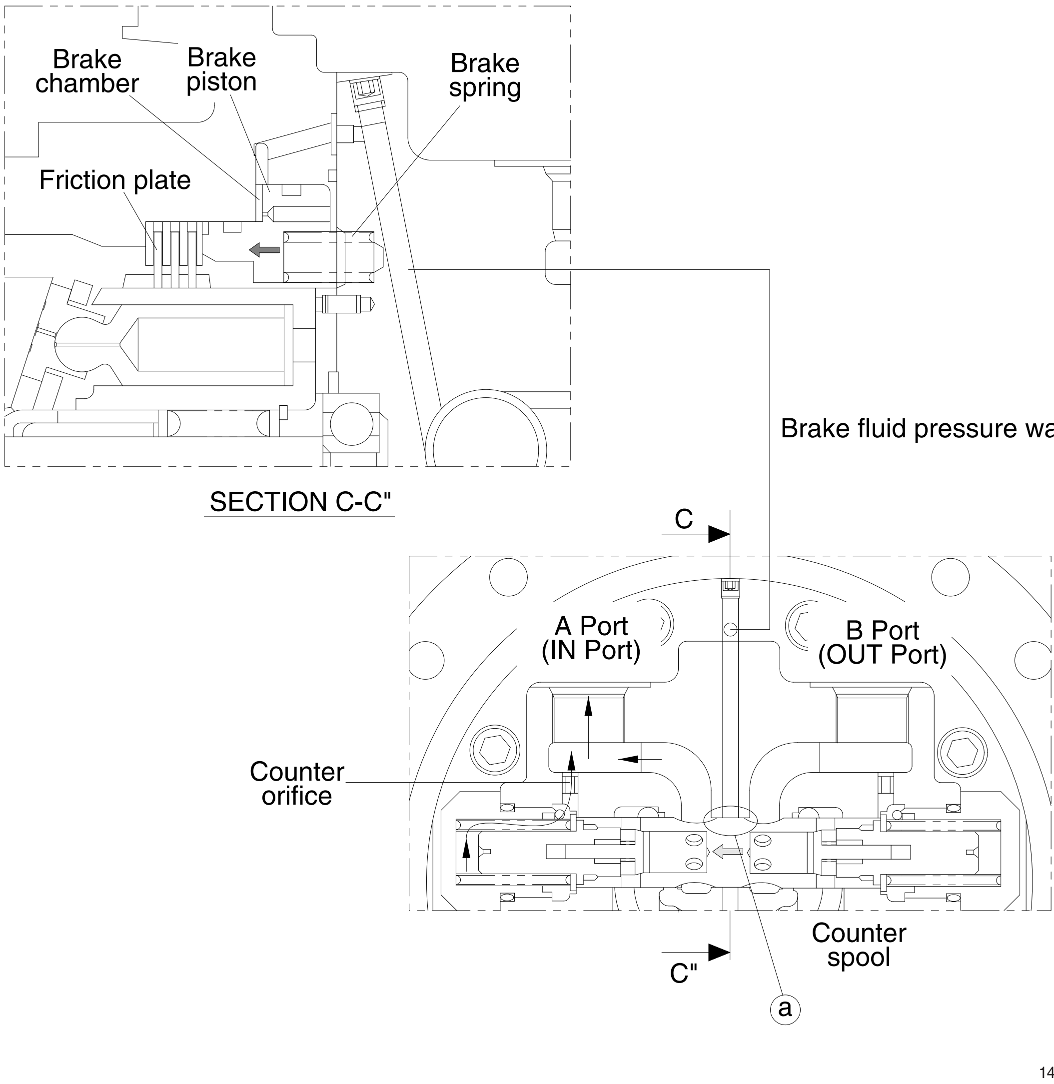
  Then notch of spool opens the brake line. At the same time, pressurized oil flows to the brake chamber of motor through a brake passage, and makes brake piston move against brake spring force to allow clearance between fiction plates and separate plates thereby releasing the brake.



145Z9A2TM08

- **Parking brake ON**

  When the control lever is returned to neutral position, the circuit between control valve and motor is blocked. As oil pressure in spool chamber drops to zero and the counter balance spool returns to neutral position. At the spool neutral position, notch ⓐ is disconnected from oil supply port A, instead, brake chamber oil is drained to tank through brake orifice which is center opened.



4) COUNTERBALANCE VALVE

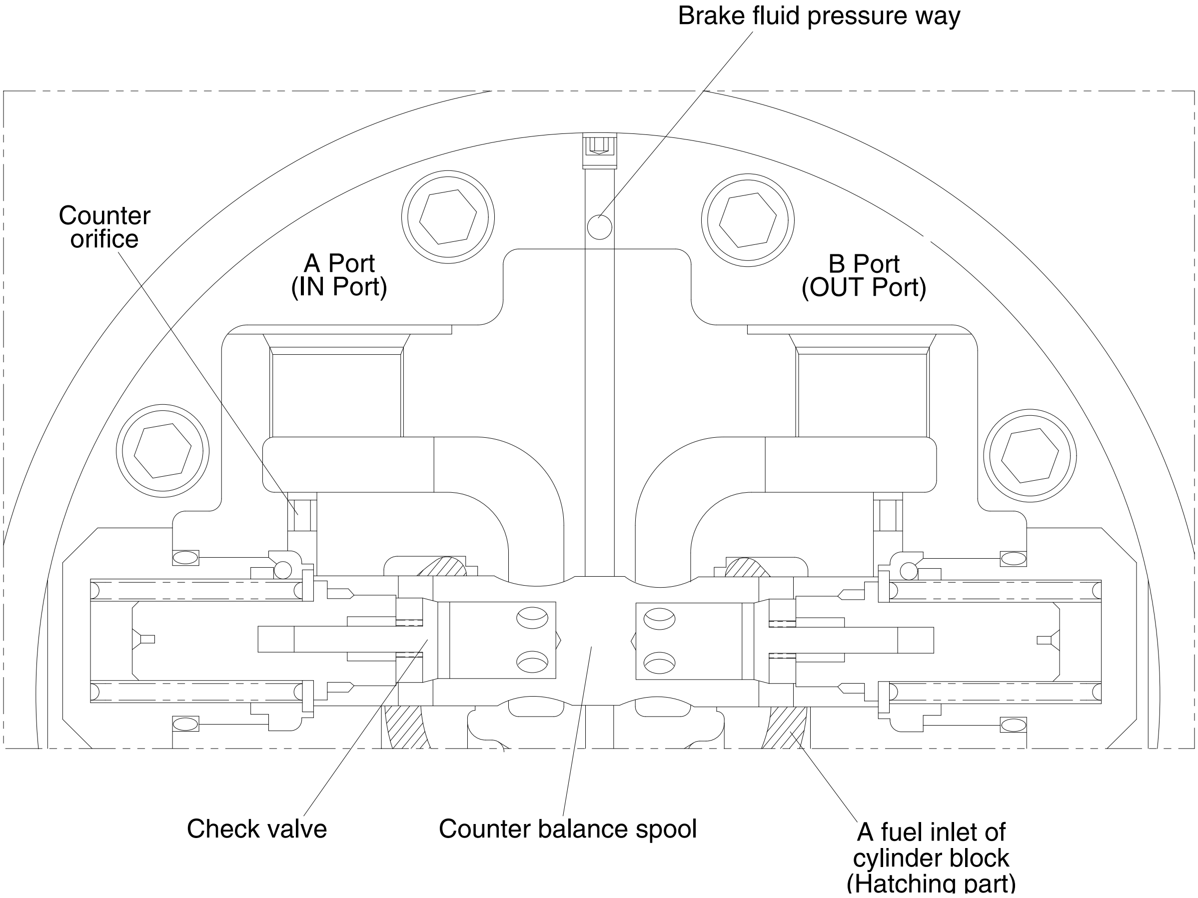
(1) Function

① Control oil flow in the action of mechanical parking brake operation.

② Prevent overrun while traveling on down slope.

③ Work as a hydraulic brake when motor stops, and prevent motor not to slip on slope.

(2) NEUTRAL

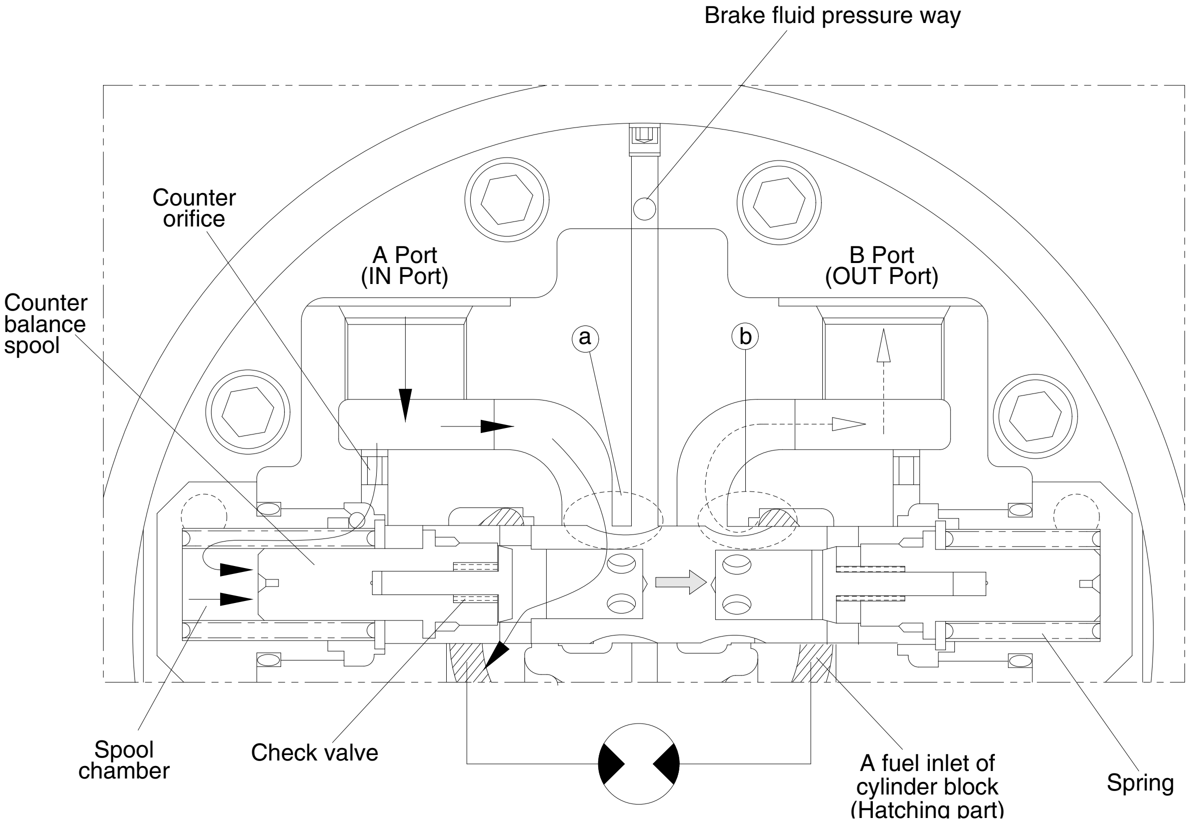


145Z9A2TM10

(3) How to work

① **When motor travel**

When operator moves a traveling control lever, pressurized oil flows from pump to motor inlet A, and passes into spool chamber through counter orifice, and hydraulic force moves counter balance spool to the right, it makes pump oil flow into cylinder block through check poppet and kidney port. At that time spool notch is opened and pump oil also go through line ⓐ and passes into parking brake chamber, and it releases parking brake. At the same time, return oil from cylinder block flows to outlet B through the line ⓑ.

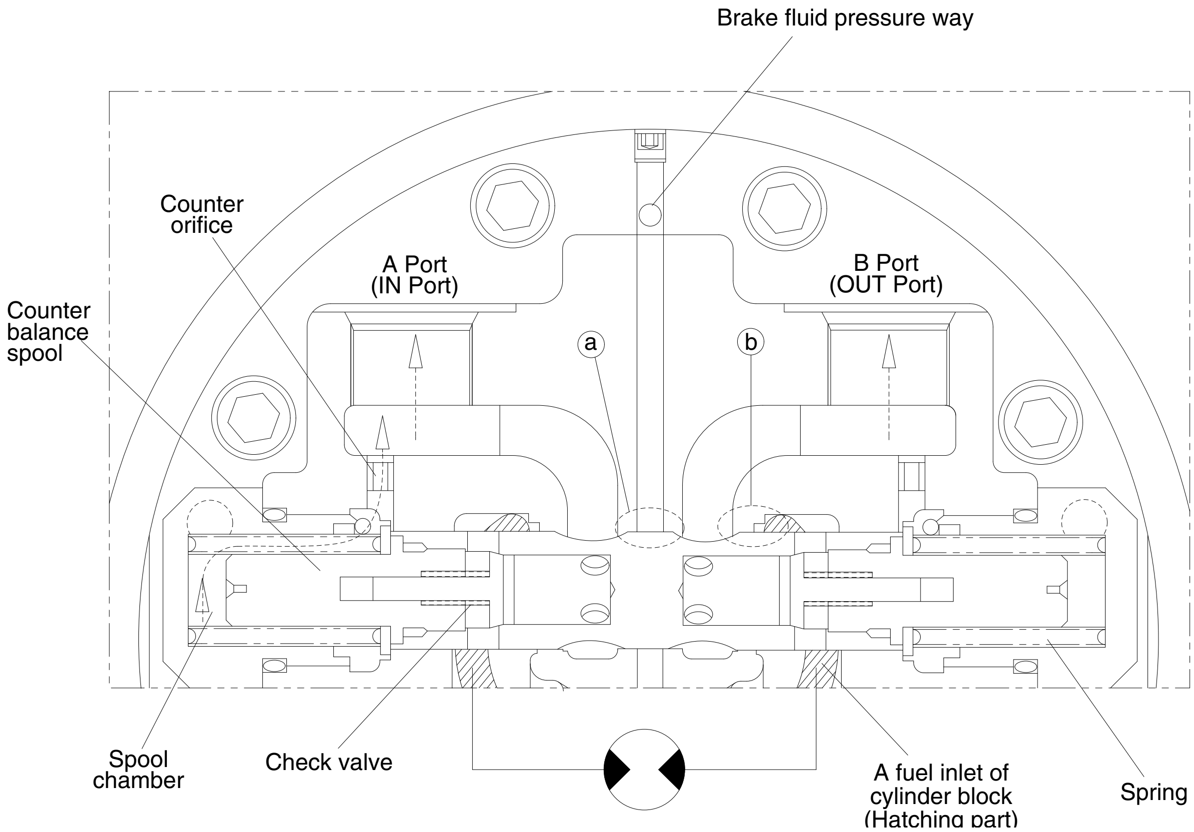


145Z9A2TM11

② When motor stop

When operator moves a travel control lever to neutral position, pump oil flow is blocked. It reduce oil pressure of supply line down to zero, and oil in the spool chamber moves back to oil tank through counter orifice by the return force of spring in opposite side, and then counter balance spool returns to neutral position.

As the counter balance spool moves to left, line ⓐ is blocked, parking brake line is connected to drain passage designed in the center of counter balance spool, and oil in the parking brake chamber return to tank, finally brake piston return to parking ON position.



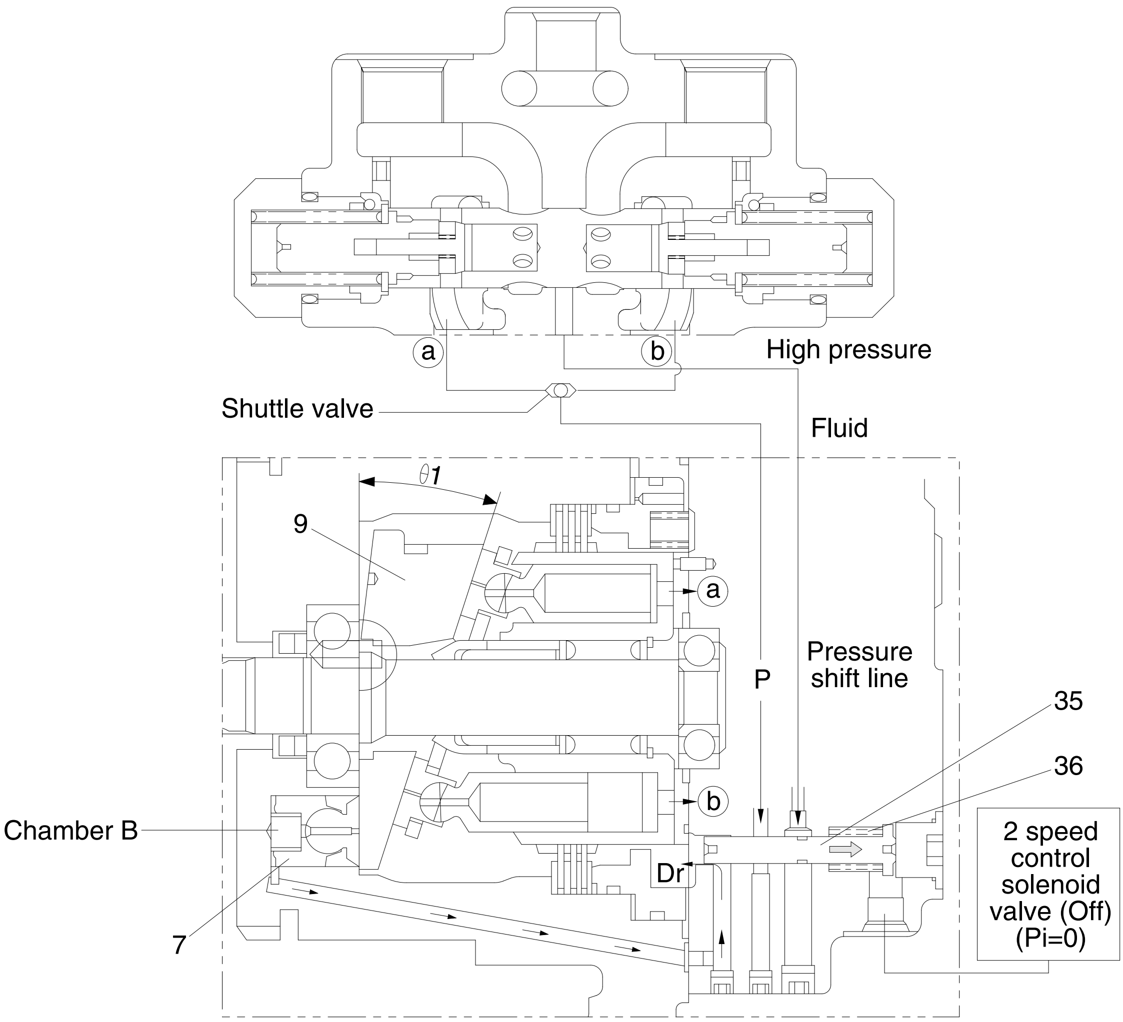
145Z9A2TM12

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

Rotating speed of the motor depends on slope angle of swash plate (9). Motor rotates slow when the angle is large, and rotates fast when the angle is small.

- Low speed

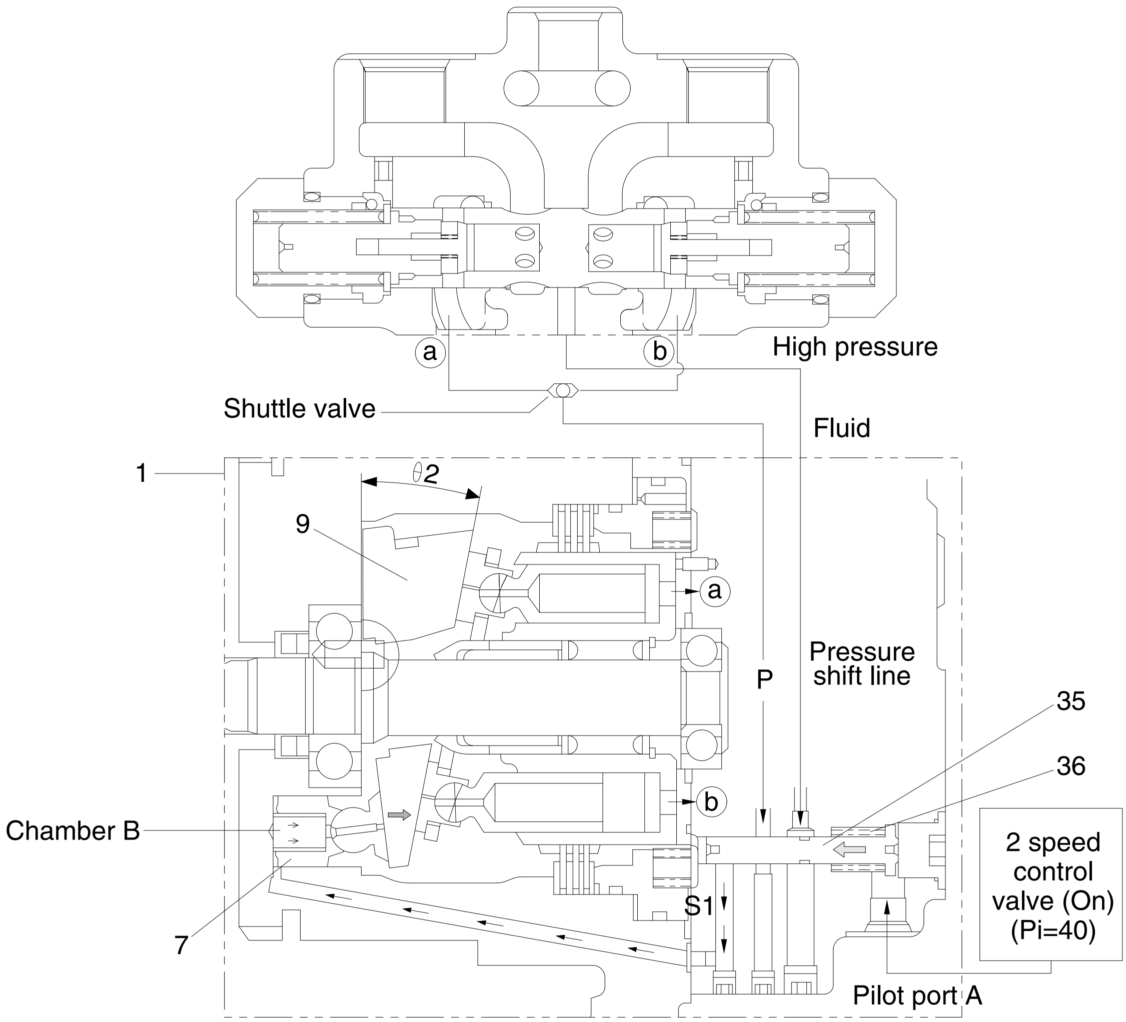
When pilot pressure signal Pi=0, spool (35) is located at right side by the spring (36) force and chamber A is connected to casing drain through hole S1. At this spool position, swash plate (9) sustain large angle, and motor rotate at low speed.



145Z9A2TM13

- **High speed**

  When pilot pressure signal Pi is activated on spool (35), the spool moves to left hand end, and high pressure oil from Port ⓐ or ⓑ is transferred to S1 which is connected to chamber A. The high pressure transferred to chamber B lift the piston (7) up, then the swash plate (9) tilts to smaller angle, and the motor rotates higher speed.



145Z9A2TM14

4. REDUCTION GEAR

1) PLANETARY GEAR MECHANISM

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

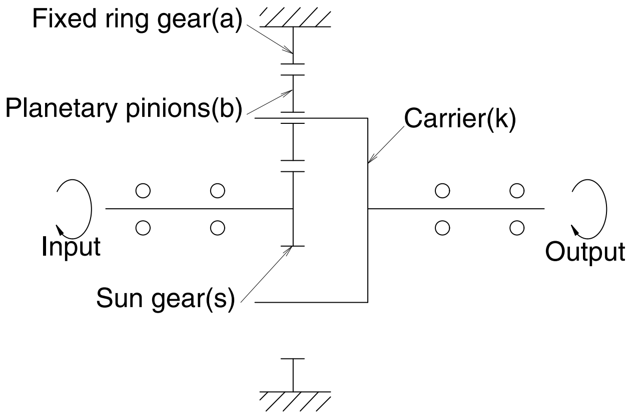
This reduction unit utilizes two stages, planetary reduction system.

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

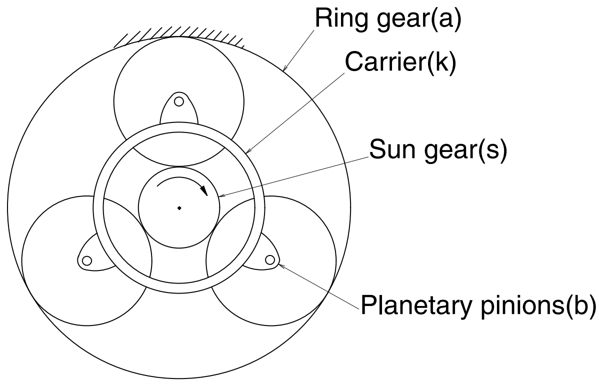
When the sun gear (s) is driven through input shaft, planetary pinions (b), rotating on their center, also move, meshing with fixed ring gear (a), around sun gears (s).

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

This mechanism is called planetary gear mechanism.



29072TM10

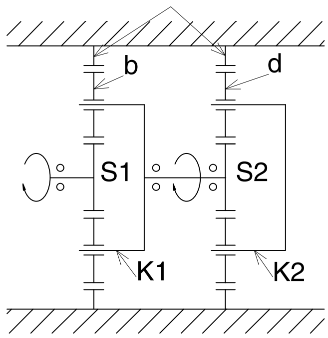


29072TM11

2) TWO STAGES REDUCTION GEAR

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

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

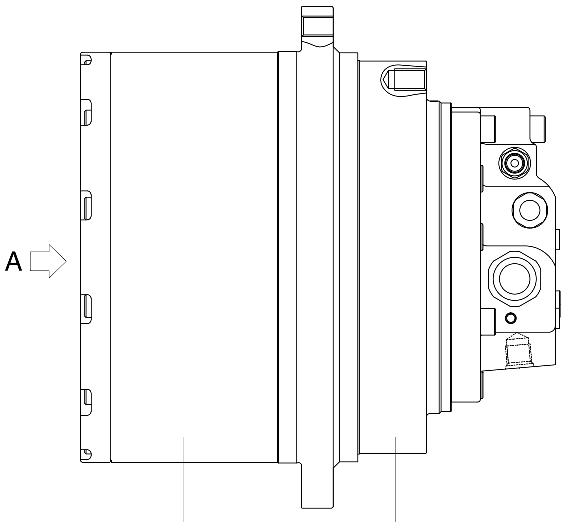


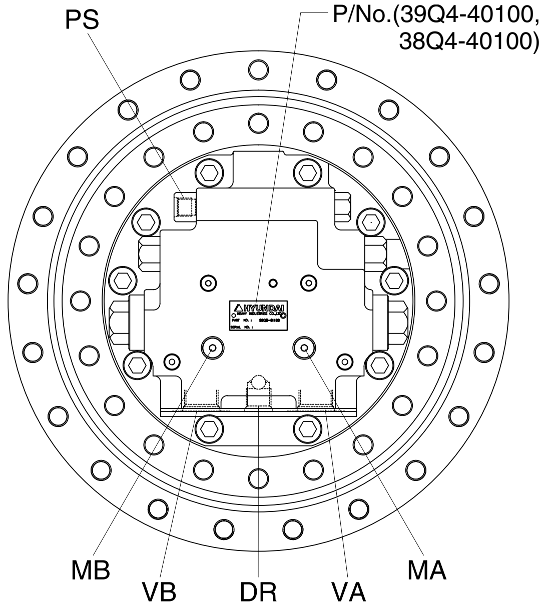
29072TM12

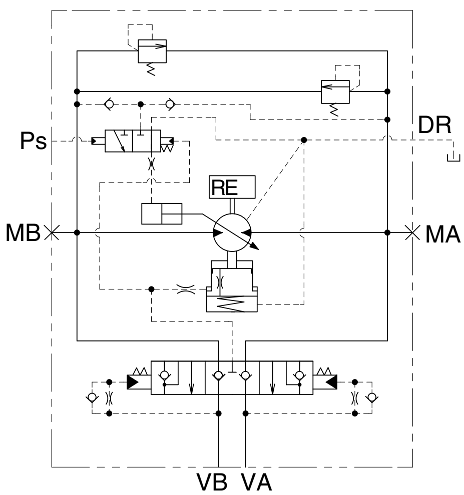
1. CONSTRUCTION

Travel device consists travel motor and gear box.

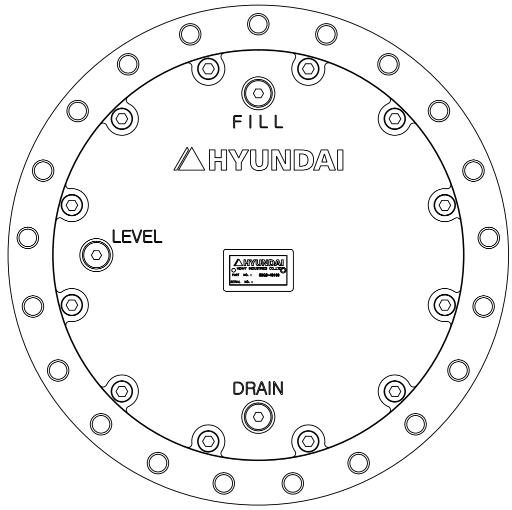
Travel motor includes brake valve, parking brake and high/low speed changeover mechanism.







Hydraulic circuit

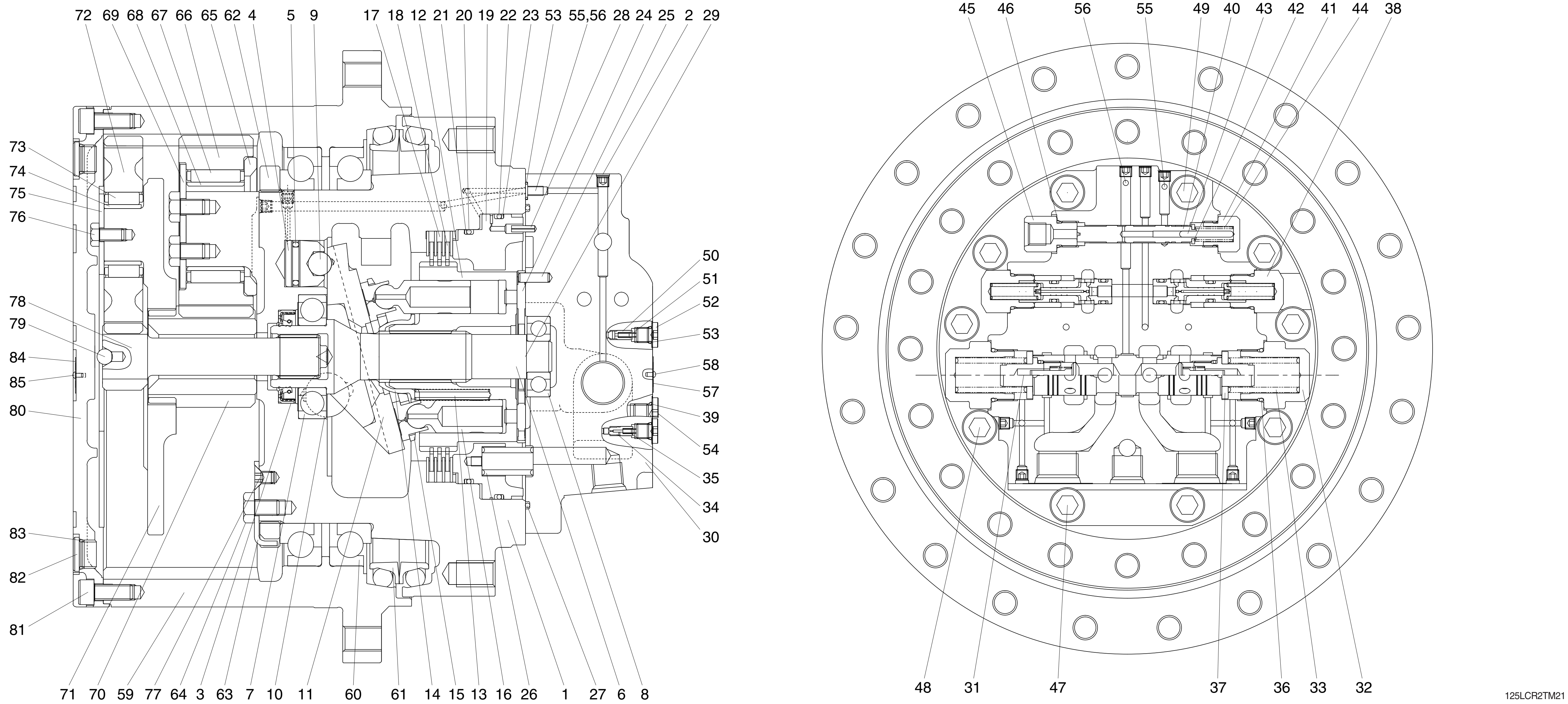


VIEW A

145LCR2TM20

Port	Port name	Port size
VA, VB	Valve port	PF 3/4
Ps	Pilot port	PF 1/4
DR	Drain port	PF 1/2
MA, MB	Gauge port	PF 1/4

2. STRUCTURE



125LCR2TM21

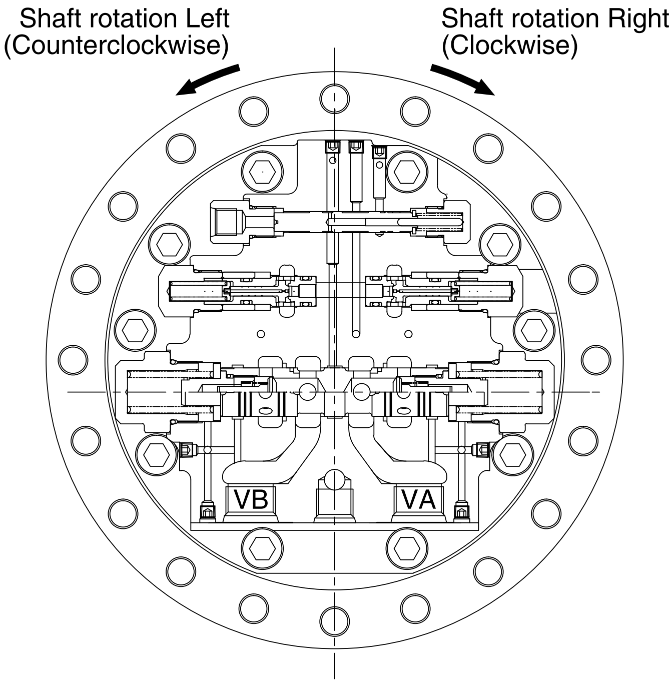
1 Casing
2 Plug
3 Oil seal
4 Piston
5 Piston seal
6 Shaft
7 Front ball bearing
8 Rear ball bearing
9 Steel ball
10 Steel ball
11 Swash plate
12 Cylinder block
13 Spring
14 Ball guide
15 Retainer plate
16 Piston assy
17 Friction plate
18 Separated plate
19 Parking piston
20 O-ring
21 Back up ring
22 O-ring
23 Back up ring
24 Valve plate
25 Spring pin
26 Spring
27 O-ring
28 Spring pin
29 Parallel pin
30 Rear cover
31 Main spool assy
32 Cover
33 Spring
34 Restrictor
35 Spring
36 O-ring
37 Spring seat
38 Relief valve assy
39 O-ring
40 Spool
41 Plug
42 Spring seat
43 Parallel pin
44 Spring
45 Connector
46 O-ring
47 Hexagon socket head bolt
48 Hexagon socket head bolt
49 Hexagon socket head bolt
50 Check valve
51 Spring
52 Plug
53 O-ring
54 Plug
55 Restrictor
56 Restrictor
57 Name plate
58 Rivet
59 Ring gear
60 Bearing
61 Floating seal assy
62 Nut ring
63 Lock plate
64 Hexagon head bolt
65 Thrust plate No. 2
66 Planetary gear No.2
67 Needle bearing No.2
68 Inner race No. 2
69 Thrust washer No. 2
70 Sun gear No.2
71 Carrier No.1
72 Planetary gear No.1
73 Needle bearing No.1
74 Inner race No. 1
75 Thrust plate No. 1
76 Hexagon head bolt
77 Countersunk head screw
78 Sun gear No.1
79 Steel ball
80 Cover
81 Hex socket head bolt
82 Plug
83 O-ring
84 Name plate
85 Rivet

3. OPERATION

1) MOTOR

High pressure oil delivered form hydraulic pump is led to inlet port that is provided in the brake valve portion and, through the rear cover (30) and valve plate (24), led to cylinder block (12).

The oil flow and direction of shaft rotation are indicated in table.



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

125LCR2TM23

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

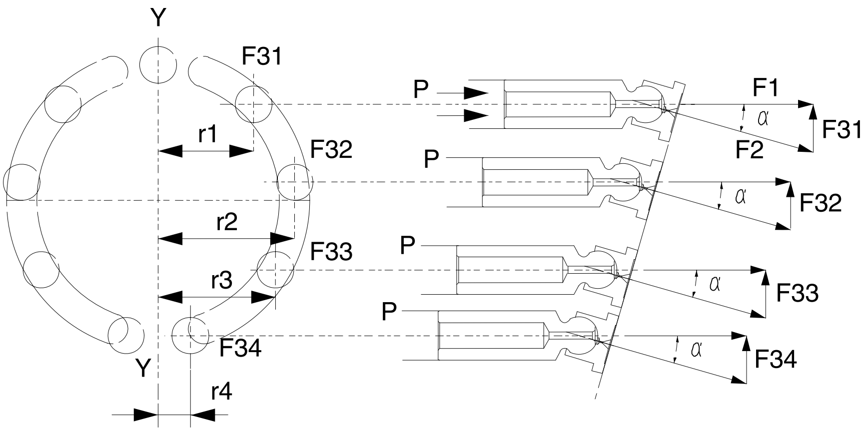
$F1 = P \times A$ (P : pressure, A : area of piston section)

The swash plate (11) with inclined angle of α divides this force F1 into thrust force F2 and radial force F31-34.

This radial force is applied to axis Y-Y as turning force and generate drive torque of T.

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

This drive torque is transmitted via cylinder block (12) to driving shaft (6).

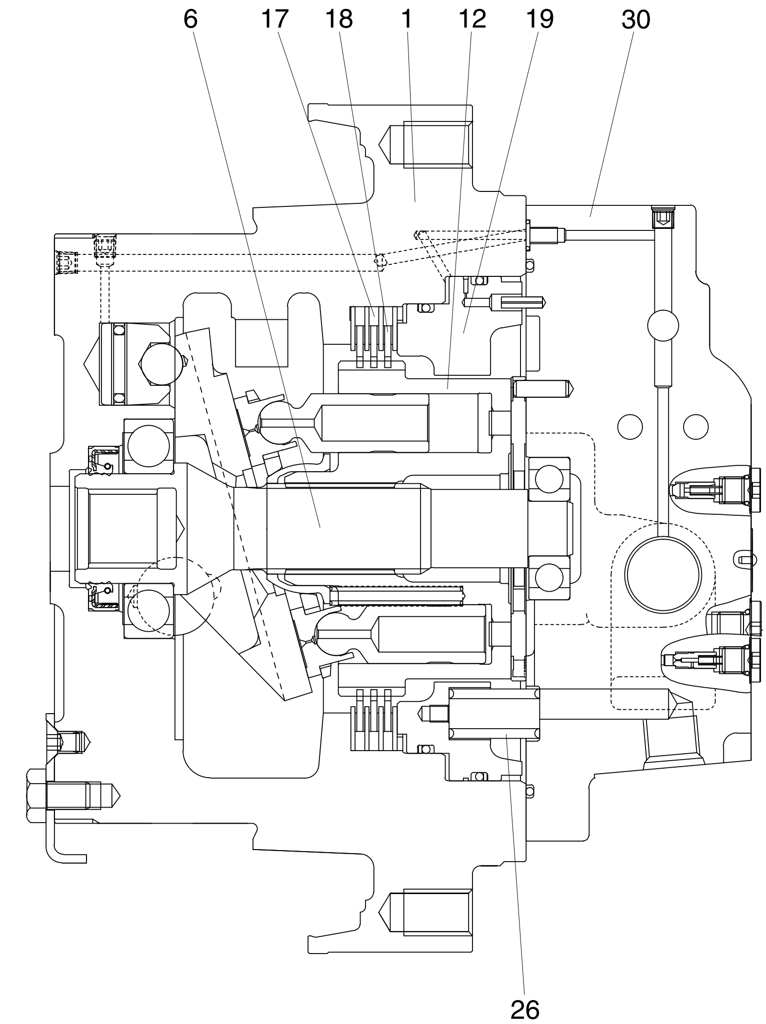


29092TM07

2) PARKING BRAKE

Parking brake is released when high pressure oil selected by the brake valve portion that is connected directly to the rear cover (30), is applied to the parking piston (19).
Otherwise the braking torque is always applied.

This braking torque is generated by the friction between the separated plates (18), inserted into the casing (1), and friction plates (17), coupled to cylinder block (12) by the outer splines.
When no pressure is activated on the parking piston (19), it is pushed by the brake springs (26) and it pushes friction plates (17) and separated plates (18) towards casing (1) and generates the friction force which brakes the rotation of cylinder block (12) and hence the shaft (6).



125LCR2TM24

3) CAPACITY CONTROL MECHANISM

Figure typically shows the capacity control mechanism.

When high speed pilot line is charged with the pressure P_A that overcome the spring (44), the spring (44) is compressed and spool (40) shifts to the right to connect the port P and port C.

Then, the highest pressure is selected by the check valve (50) from inlet and outlet pressure of the motor and high speed pilot line pressure and pushes shifter piston (4). As a result, swash plate (11) turns around the line L which connect the two steel balls (10) as shown by dotted lines. The turn stops at the stopper (1-1) of casing and swash plate (11) keeps the position.

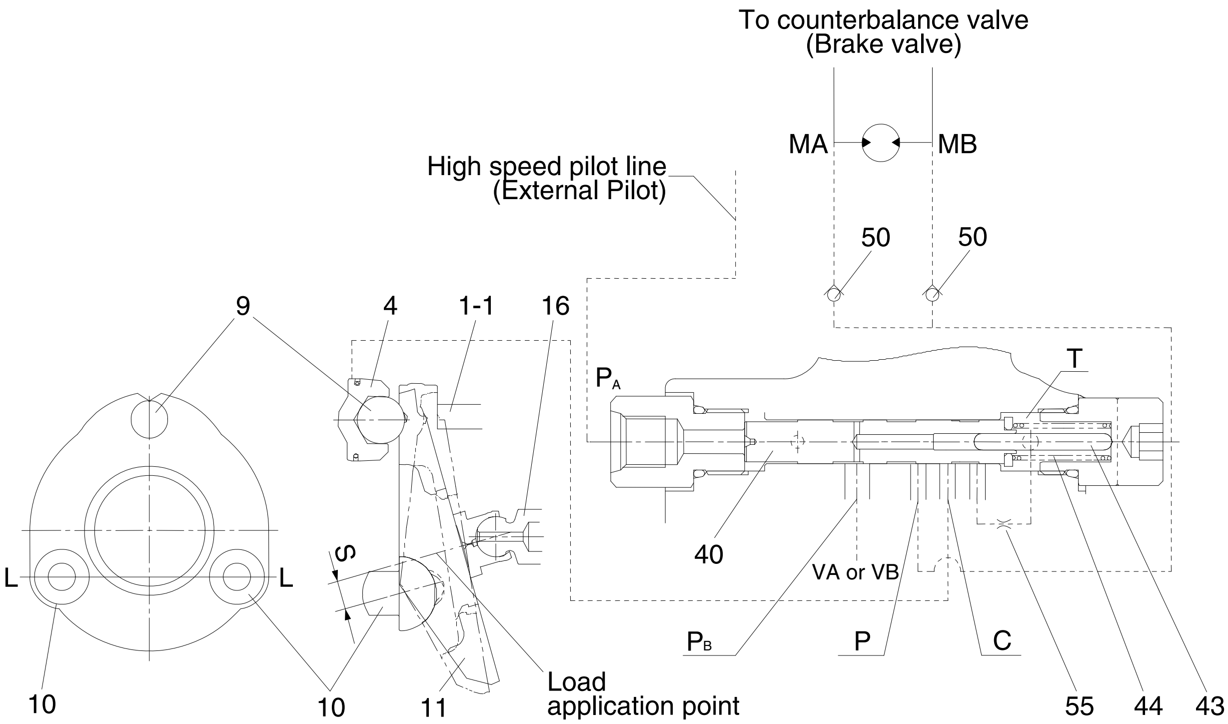
In this case, the piston stroke become shorter and motor capacity become smaller and motor rotates faster, around 1.60 times, by the same volume of oil.

When no pressure is in the high speed pilot line P_A, spool (40) is pushed back by the spring (44) and pressure that pressed the shifter piston (4) is released to the hydraulic tank through restrictor (55).

Here, nine pistons are there and they equally spaced on the swash plate (11). The force that summed up those of pistons comes to almost the center of the swash plate (11) as shown. Since the steel balls (10) are off-set by S from the center, the rotating force of product S and the force moves swash plate (11) to the former position and the speed returns to low.

When the power demand exceeds the engine power, such as in steep slope climbing or turning at high speed mode, the system step down to the low speed automatically. The mechanism is that: pump pressure is led to the port P_B and this pressure activate on pin (43). When the pressure at P_B exceeds predetermined value, spool (40) returns to the left by the counter-pressure against pin (43) and the pressure on the shifter piston (4) through port C is released to the tank and the motor comes to low speed.

When P_B goes down, the spool (40) moves to the right and the speed become high.

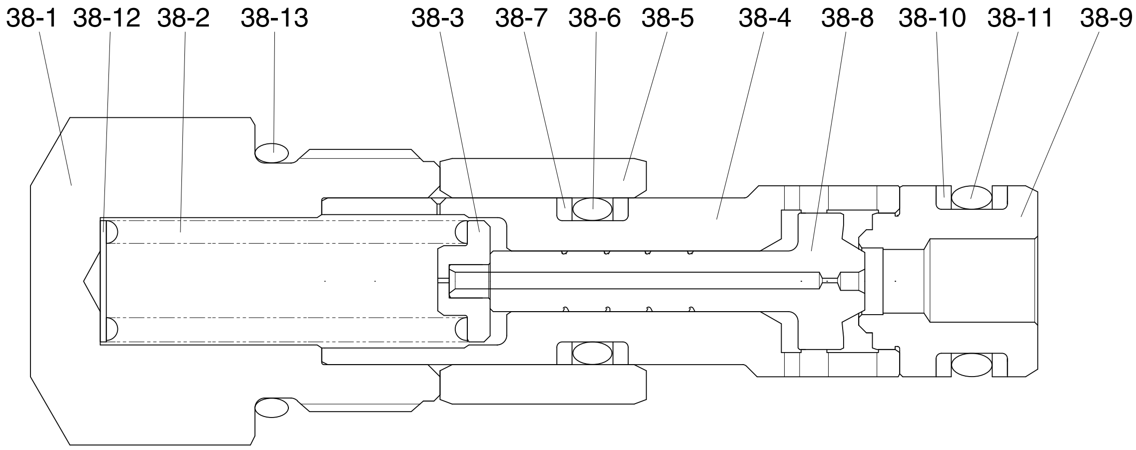


125LCR2TM19

4) OVERLOAD RELIEF VALVE

(1) Structure

This valve is screwed in the motor rear cover (30) and consists of : plug (38-1) that is screwed and fixed in the rear cover (30), poppet (38-8) and supports the poppet seat (38-9), spring (38-2) that is operating relief valve setting pressure and supports the spring seat (38-3), that is inserted in the sleeve (38-4), piston (38-5) that reduce the shock.



125LCR2TM25

38-1	Plug	38-6	O-ring	38-11	O-ring
38-2	Spring	38-7	Back-up ring	38-12	Ring
38-3	Spring seat	38-8	Poppet	38-13	O-ring
38-4	Sleeve	38-9	Poppet seat		
38-5	Piston	38-10	Back-up ring		

(2) Operation

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

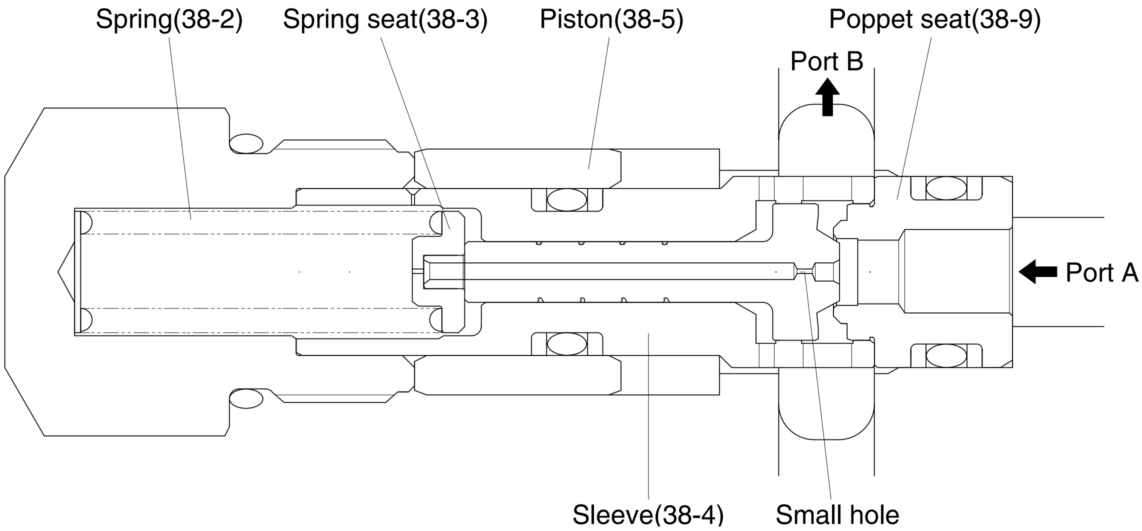
① When hydraulic motor starts, keep the driving pressure below predetermined value and while accelerating, bypasses surplus oil to return line.

② When stopping the motor, keep the brake pressure, that develops on the outlet side of motor, under the predetermined value to stop the inertial force.

③ To accelerate sharply while starting, and to mitigate the braking shock while stopping. For these purposes, the developed pressure is kept comparatively low for a short period, then keep the line pressure as normal value. While the pressure is low, meshing of reduction gears, crawler and sprocket etc. can be smoothly done and the shock are absorbed.

When starting, "A" port pressure of overload valve increases, this pressure is applied to the effective diameter of poppet (38-8) which seats on the poppet seat (38-9) and, at the same time, is delivered, via small hole, to the spring seat (38-3) located inside the sleeve (38-4) and the seat bore pressure increases up to "A" port pressure. The poppet (38-8) opposes to spring (38-2) by the force of the pressure exerted on the area difference between poppet seat's effective diameter and spring seat bore and keep the predetermined pressure.

When hydraulically braking, the piston (38-5) is at the left position by the driving pressure, and when "A" port pressure increases, the pressure is applied also to the piston (38-5) through the small hole in the poppet (38-8), sleeve (38-4) and piston (38-5) moves rightward until it touches the stopper in rear cover. In this while, the poppet (38-8) maintains "A" port pressure at comparatively low against the spring (38-2) force and exhaust oil to "B" port side. After the piston reached to the plug, the valve acts the same as at starting.



125LCR2TM27

5) BRAKE VALVE

(1) Structure

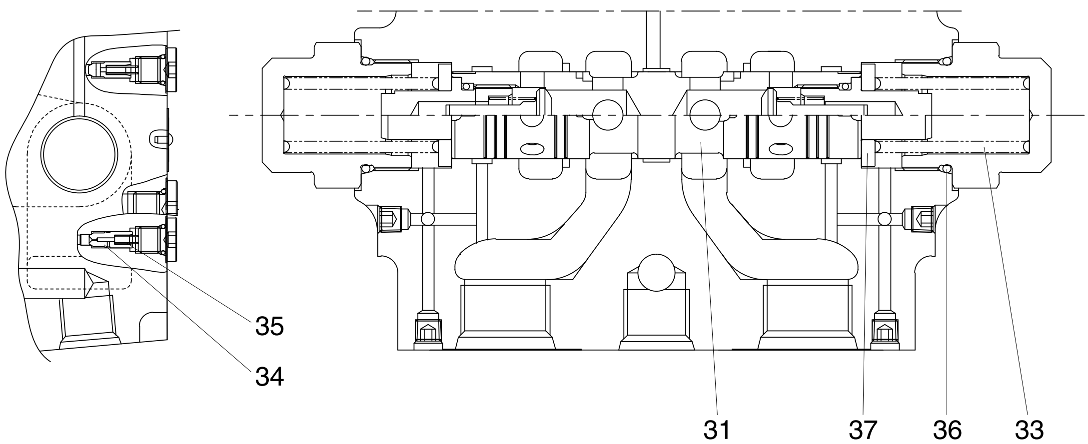
The brake valve portion mainly consists of the following parts:

① Spool

By shifting the spool (31), the discharged oil from hydraulic motor is automatically shut off or restricted according to the condition and give the effect of holding, accelerating, stopping and counterbalance operations.
(See page 2-66, (2) Operation)

② Check valve (built in the spool)

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



125LCR2TM28

31	Main spool	34	Restrictor	36	O-ring
33	Spring	35	Restrictor spring	37	Spring seat

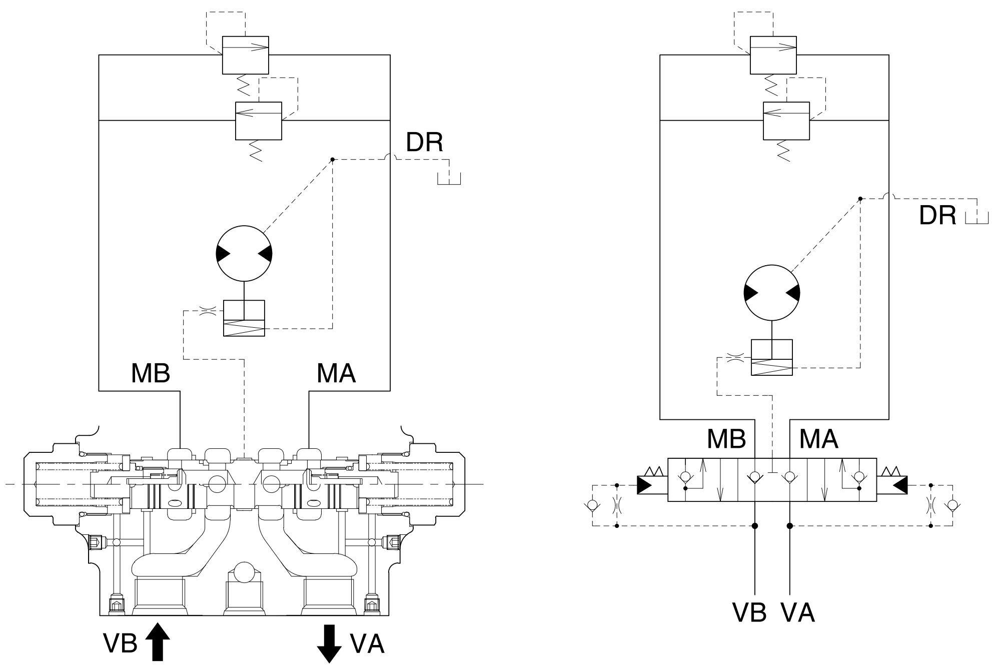
(2) Operation

① Holding operation

When the control valve is at neutral position, VA and VB ports are connected to the tank, and the spring (33) located on both spool ends holds the spool (31) at central position.
Therefore, the passages from VA to MA and VB to MB are closed, which result in closing MA and MB ports connected to hydraulic motor.

Since the passage to parking brake is connected to the tank line, the brake cylinder pressure is equal to the tank pressure and the brake is applied by the springs. Thus, the rotation of the motor is mechanically prevented.
If external torque is exerted on the motor shaft, the motor would not rotate as usual by this negative parking brake.

In case the brake should be released for some reason, pressure is built on MA or MB port. But, due to oil leakage inside hydraulic motor or so, high-pressure oil escapes from the closed circuit and motor rotates a bit. So, the cavitation tends to occur in the lower pressure side of the closed circuit. Then, the check valve, built in the spool (31), operates to avoid the cavitation and opens the passage from VA to MA or from VB to MB. Then the oil equivalent to the leakage is sucked from the tank line to the closed circuit.



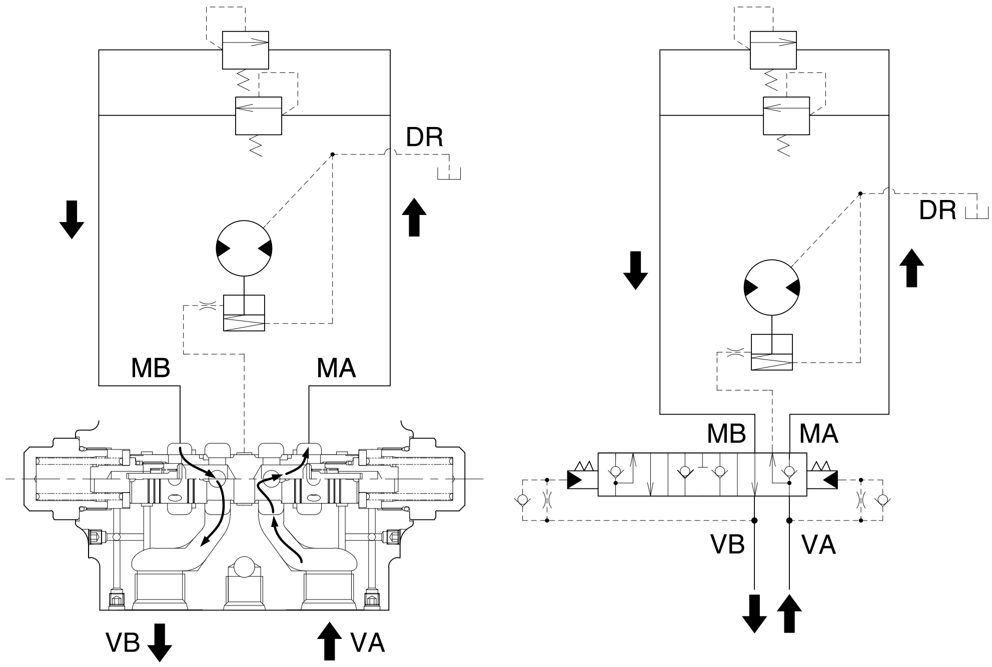
125LCR2TM29

② Accelerating operation

When VA and VB ports are connected respectively to pump and tank by operating the control valve, hydraulic oil from pump is forwarded through VA port to push open the check valve provided inside spool (31), and oil flows to motor via MA port to rotate the motor.

Therefore, the pressure increases and negative brake is released by the pressure supplied from pump. At the same time, the pressure of pilot chamber increases to push and move the spool (31) leftwards, overcoming the spring (33) force. Thus, the return line from MB to VB opens to rotate the motor.

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



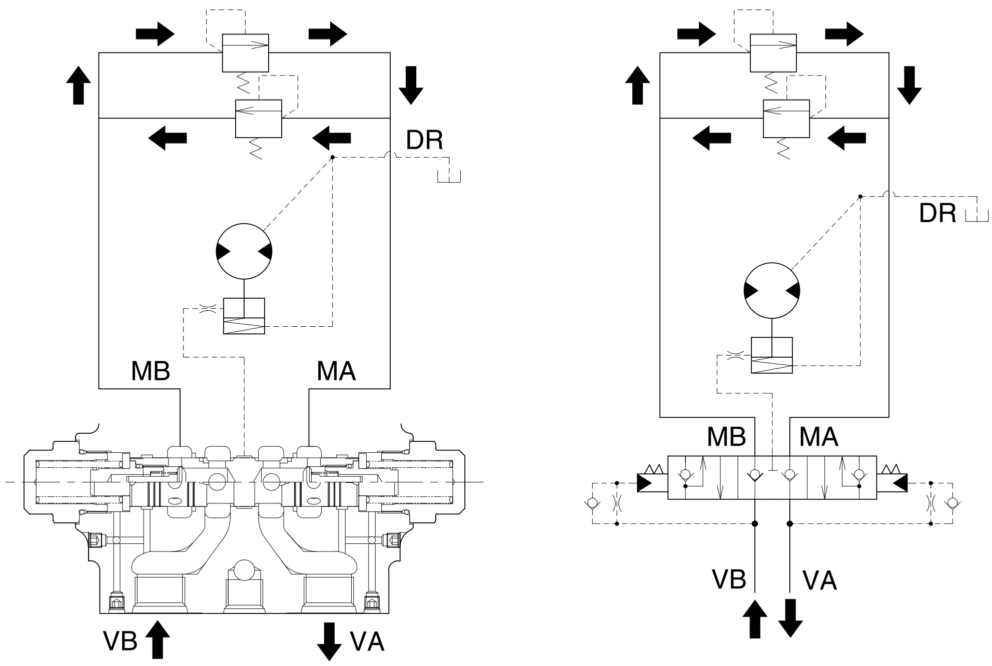
125LCR2TM30

③ Stopping operation

Returning the control valve to neutral position while running the motor, the oil supply is cut off and VA and VB ports are connected to the tank line. Then the pressure of the pilot chamber located on both spool ends become equal, and the spool (31) returns to the neutral position by spring (33) force. Thus, the passage from MA to VA is closed.

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

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



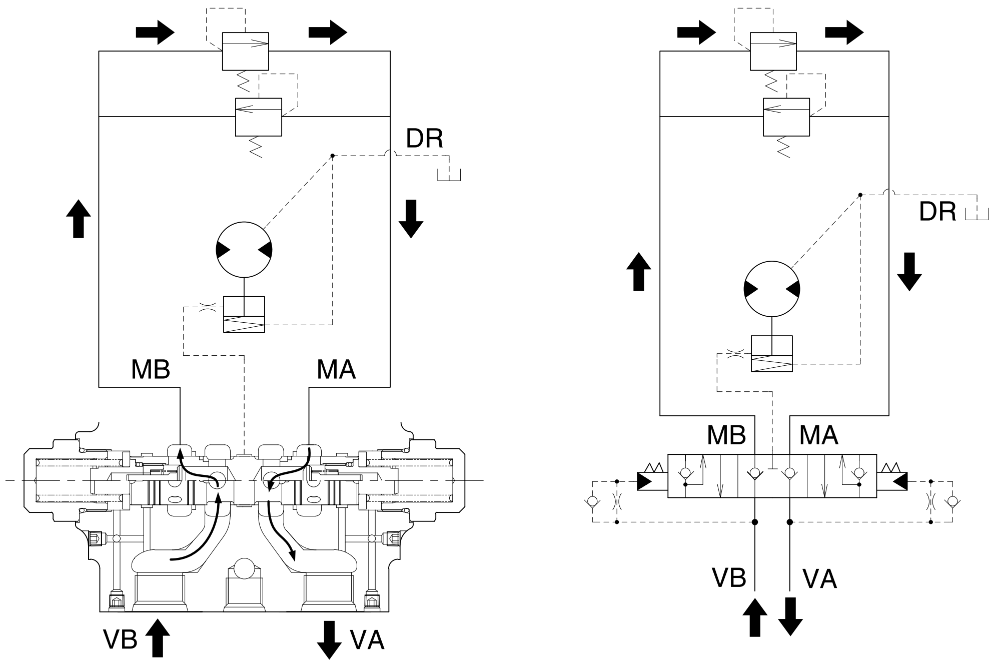
125LCR2TM31

④ Counterbalance operation

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

In case the hydraulic oil is gradually decreased from pump to VB port, the drive shaft of hydraulic motor tends to rotate faster than that matched to the volume of oil supply.
Consequently, the pilot chamber pressure on MB to VB side decreases and the spring (33) force moves the spool (31) leftwards towards neutral position.
Therefore, the area of passage from MA to VA becomes smaller and the pressure on MA side rises due to increased resistance in the passage and the motor receives hydraulic braking effect.

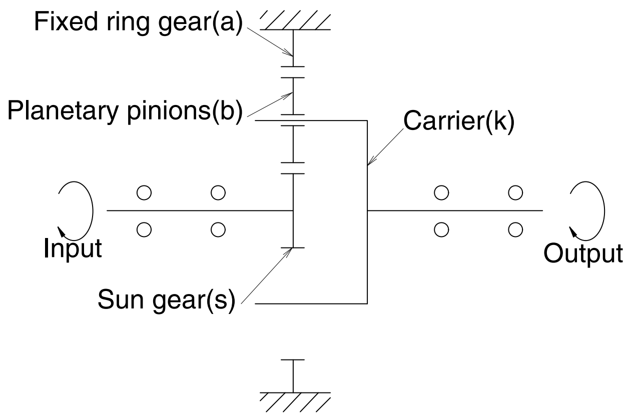
If the motor rotates slower than that matched to the volume of supplied oil, the pilot chamber pressure on VB port increases, and spool (31) moves rightwards to enlarge the area of passage from MA to VA. Therefore the braking effect becomes smaller and the rotational speed of motor is controlled to correspond to the volume of supplied oil.
In order to give stable counterbalance operation, the restrictors (34) are set in the pilot chamber to damp the spool (31) movement.
The parking brake is released during pressure adjusting action of the spool (31).



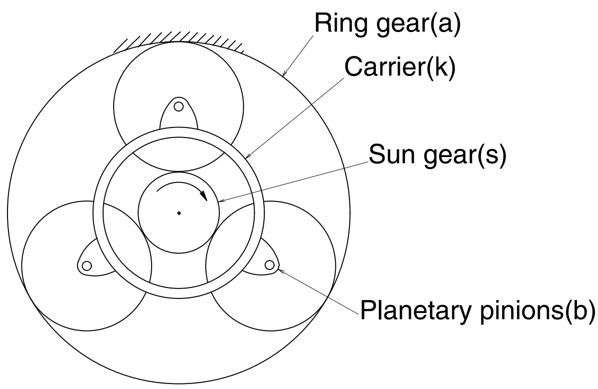
125LCR2TM32

6) REDUCTION GEAR

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

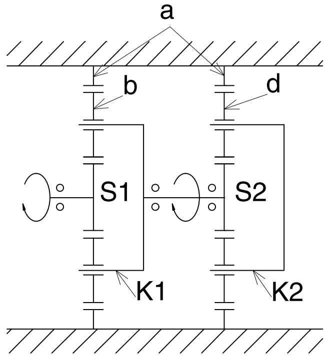


29072TM10



29072TM11

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



29072TM12

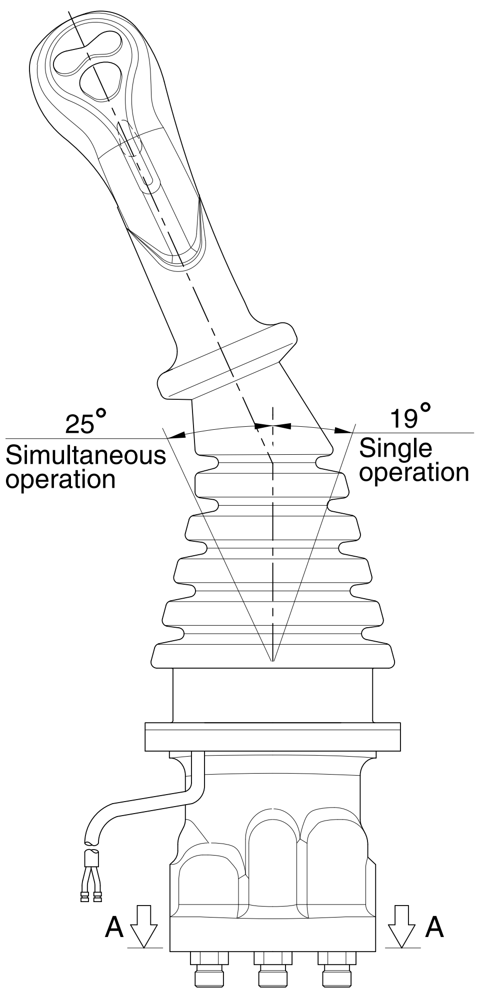
GROUP 5 RCV LEVER

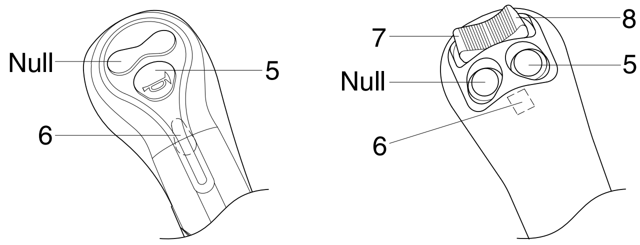
1. STRUCTURE

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

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

1) TYPE M1, M3, M5, M10



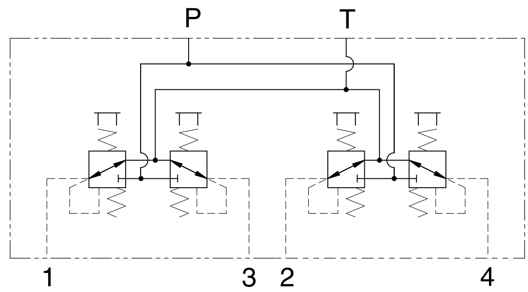


TYPE M1, M3, M10 TYPE M5

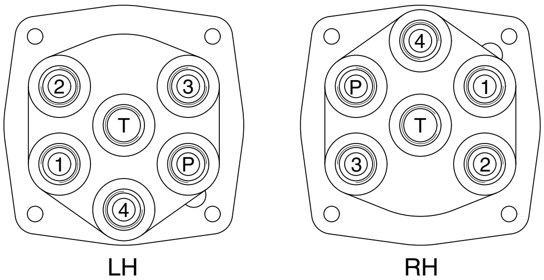
Switches

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



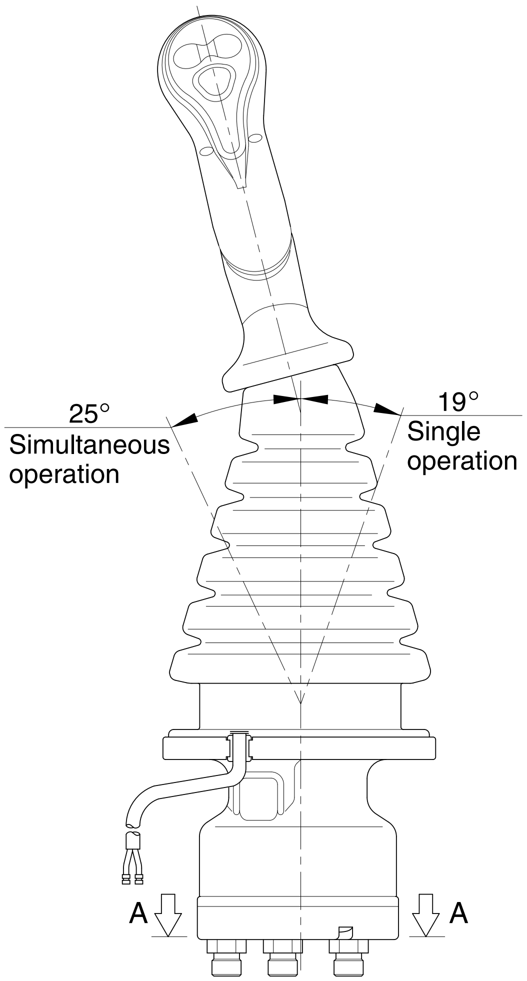
VIEW A-A

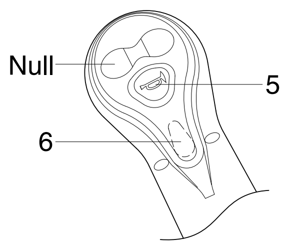
Pilot ports

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	

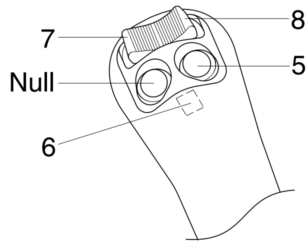
235ZF2RL01

2) TYPE M2, M4, M6, M9





TYPE M2, M4, M9

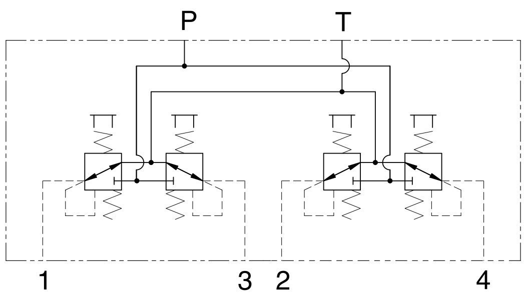


TYPE M6

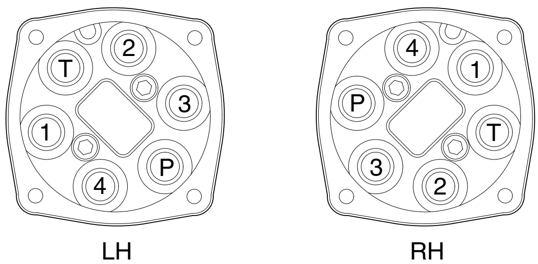
Switches

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



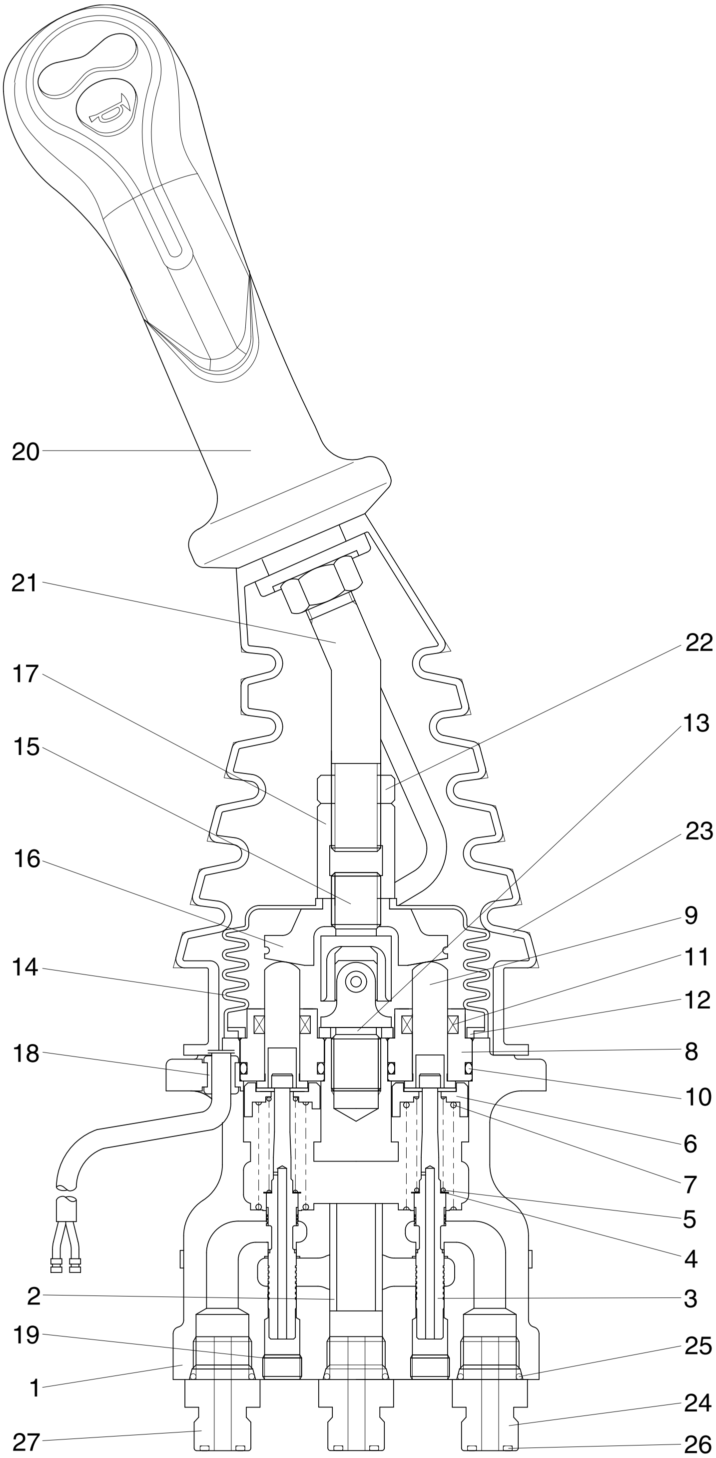
VIEW A-A

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	

235ZF2RL05

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.

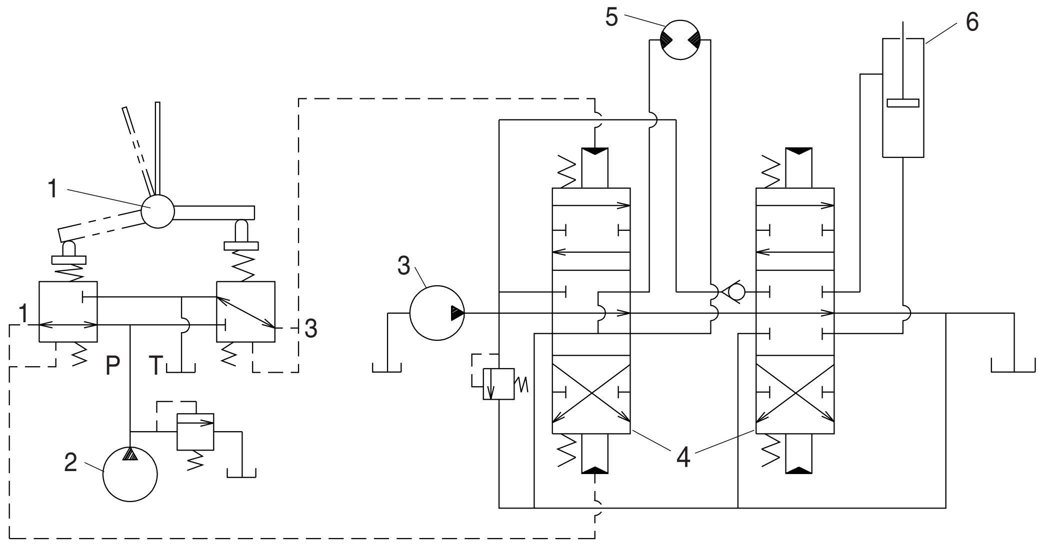
The spring (7) works on the case (1) and spring seat (6) and tries to return the push rod (9) to the zero-displacement position irrespective of the output pressure, securing its resetting to the center position.

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.

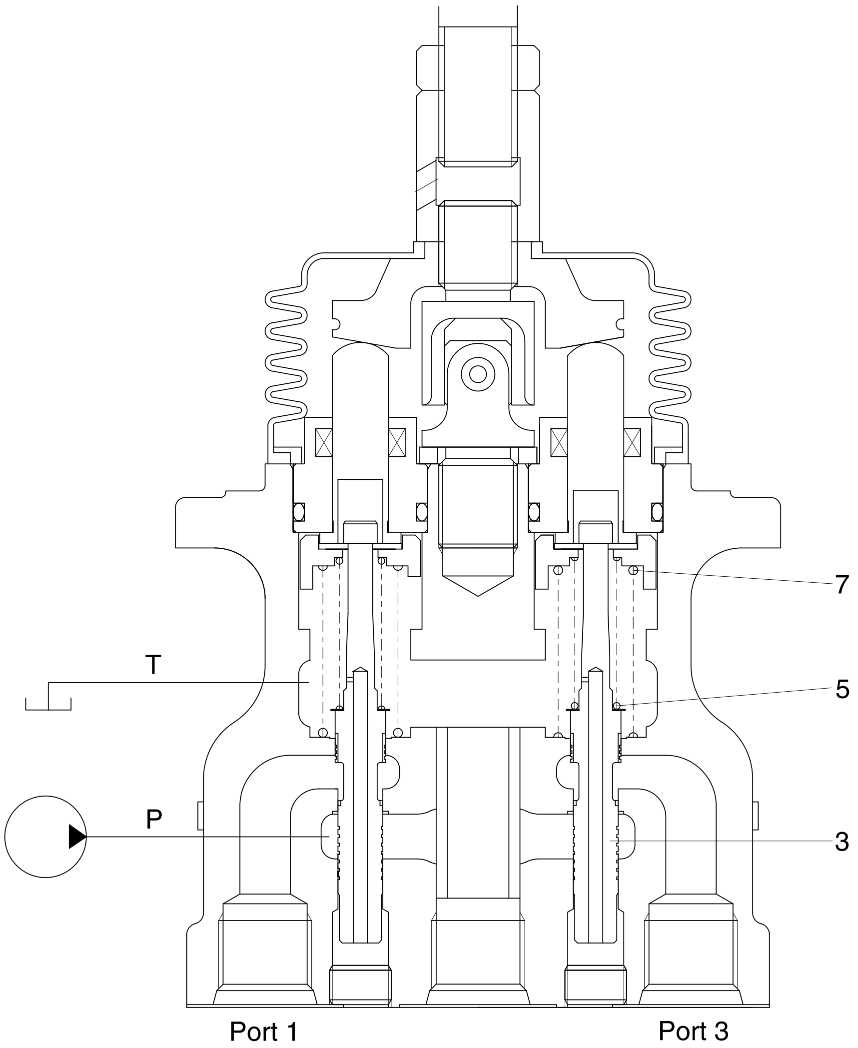
The diagram shown below is the typical application example of the pilot valve.



2-70

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

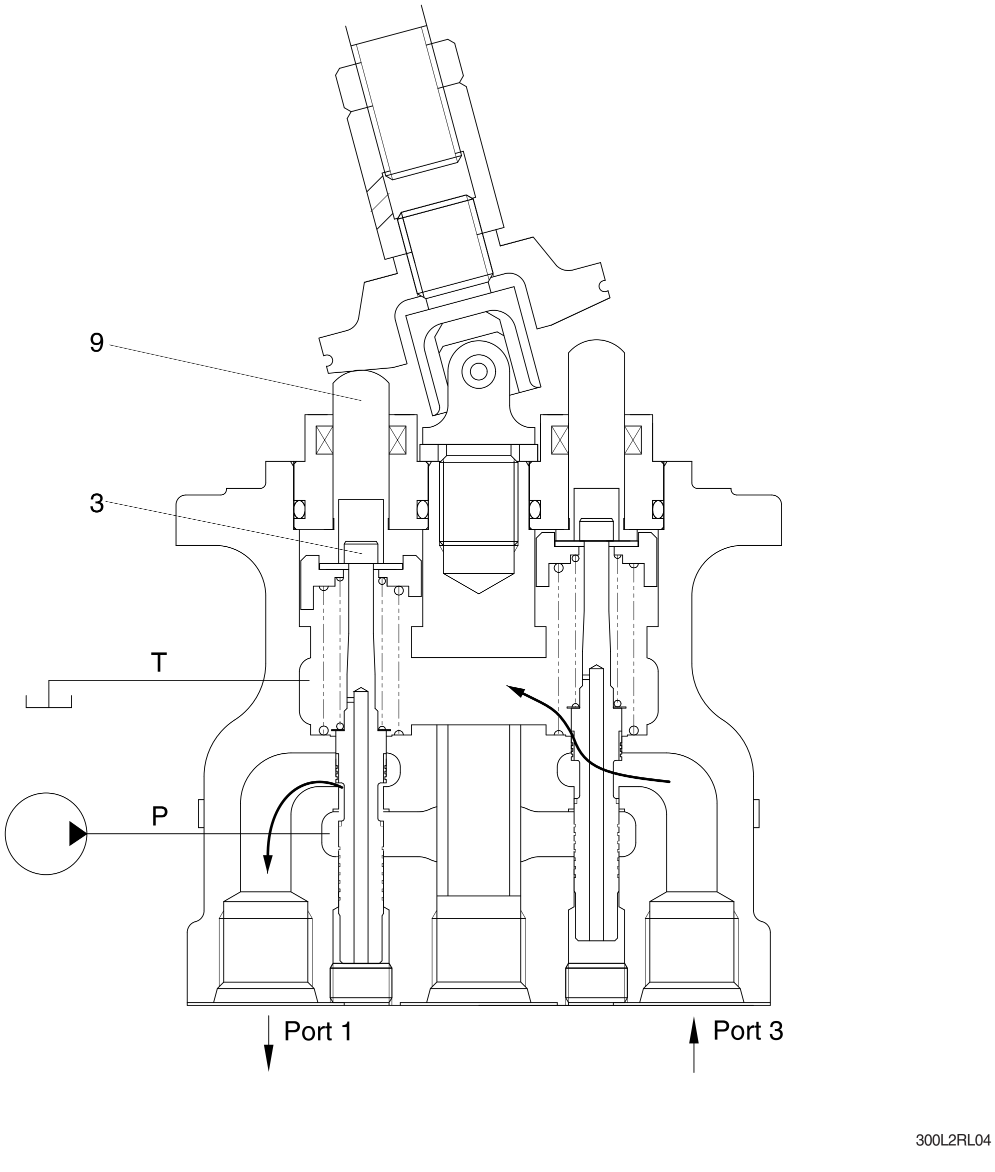
(1) Case where handle is in neutral position



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

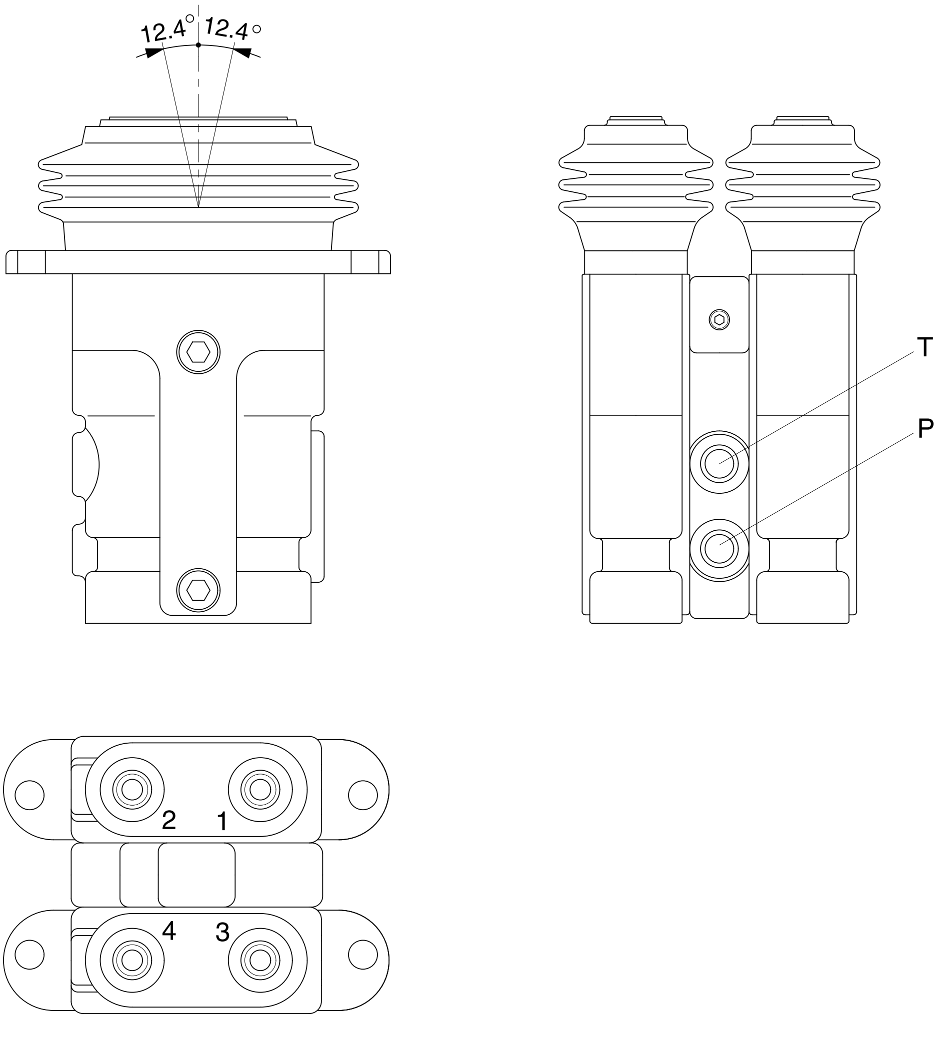


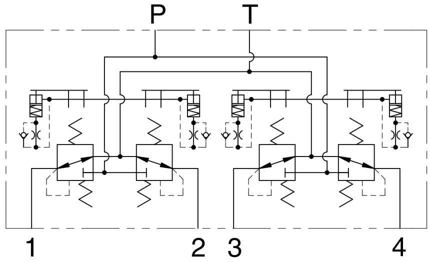
When the push rod (9) is stroked, the spool (3) moves downwards.
Then port P is connected with port (1) and the oil supplied from the pilot pump flows through port (1) to generate the pressure.
When the pressure at port (1) increases to the value corresponding to the spring force set by tilting the handle,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

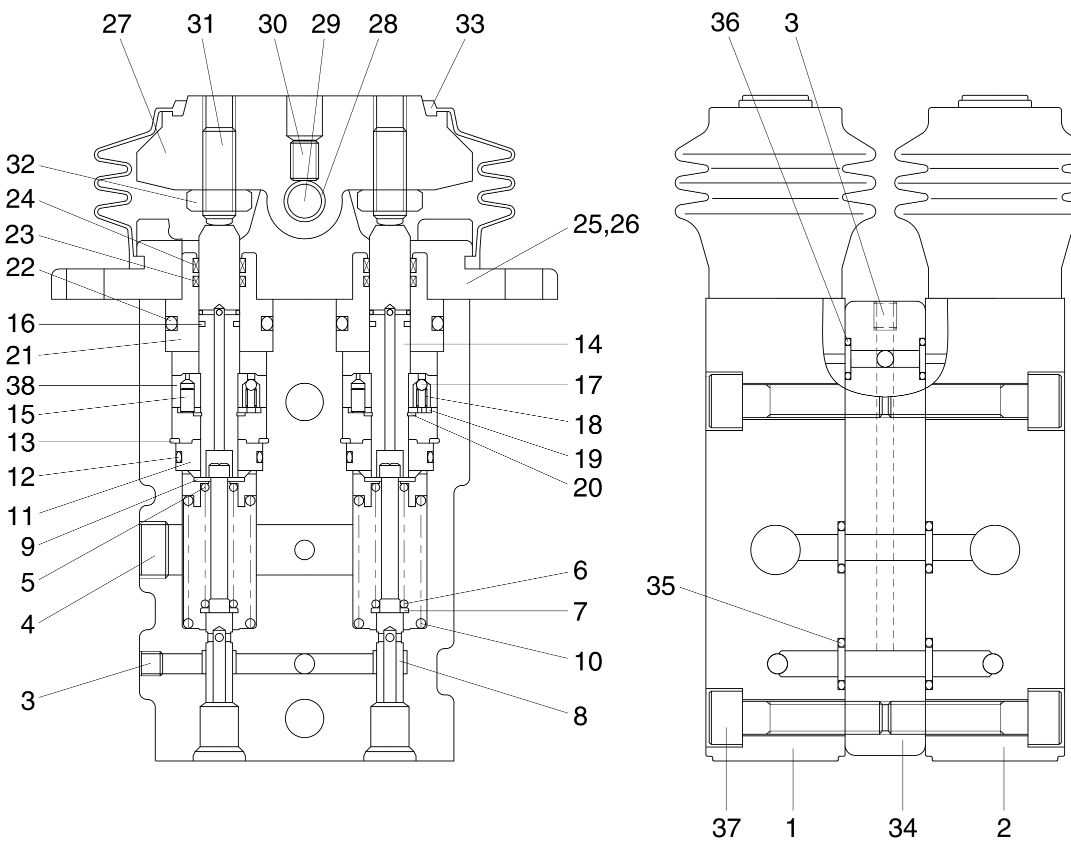
21092RP01

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.

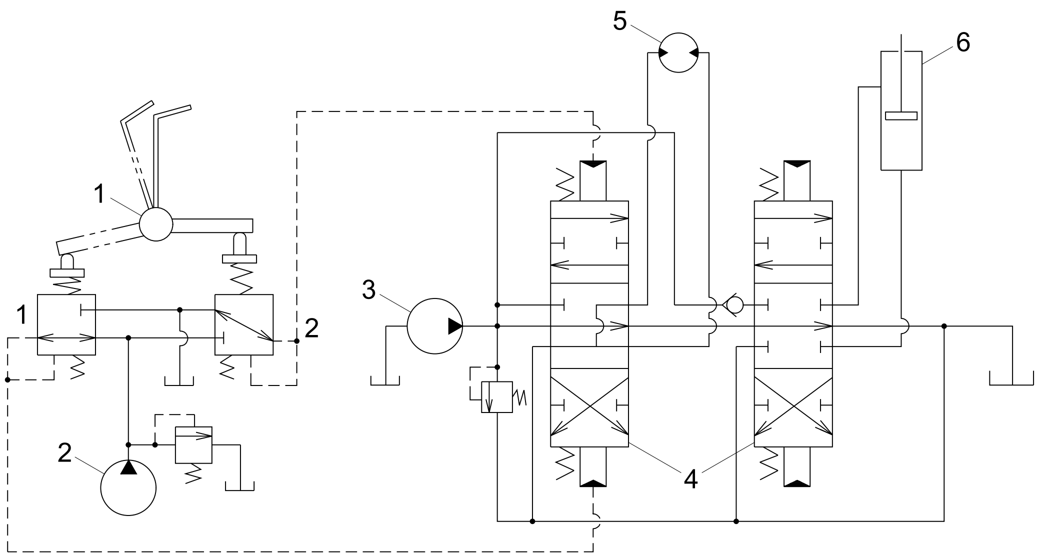
The spring (10) works on the body 1 (1) and body 2 (2) and spring seat (7) and tries to return the push rod (14) to the zero-displacement position irrespective of the output pressure, securing its resetting to the center position.

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.

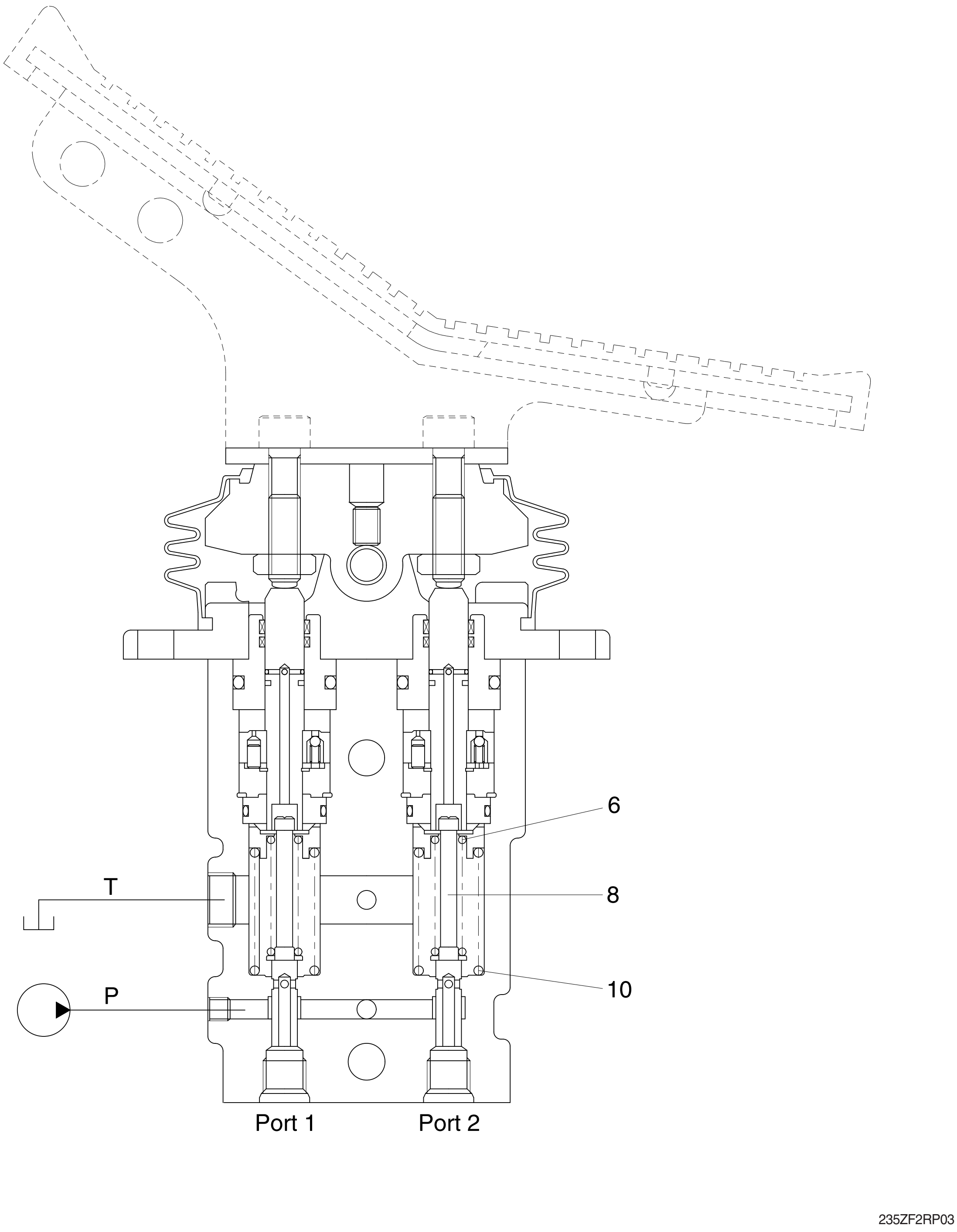
The diagram shown below is the typical application example of the pilot valve.



36072SF01

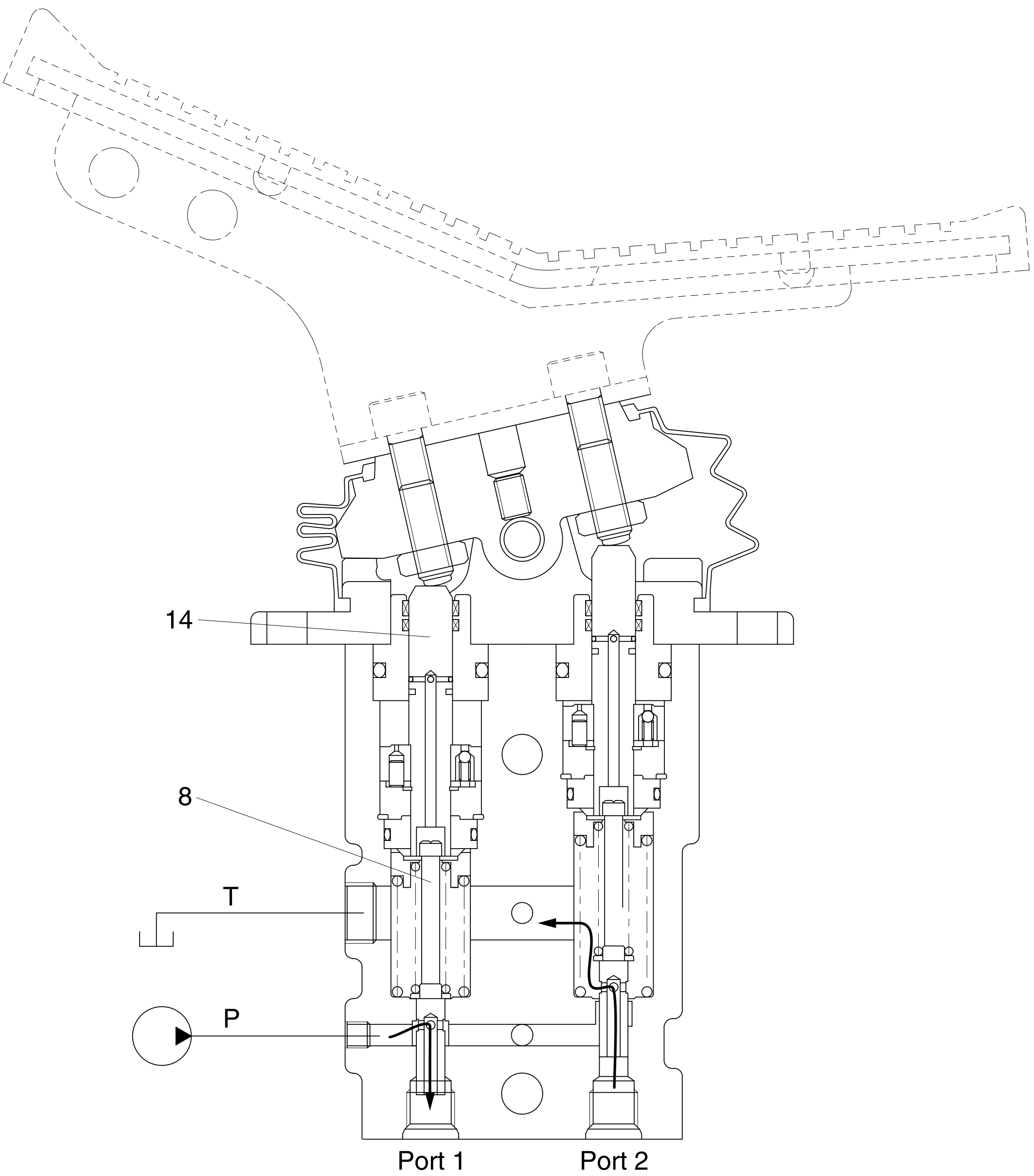
1	Pilot valve	3	Main pump	5	Hydraulic motor
2	Pilot pump	4	Main control valve	6	Hydraulic cylinder

(1) Case where pedal is in neutral position



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

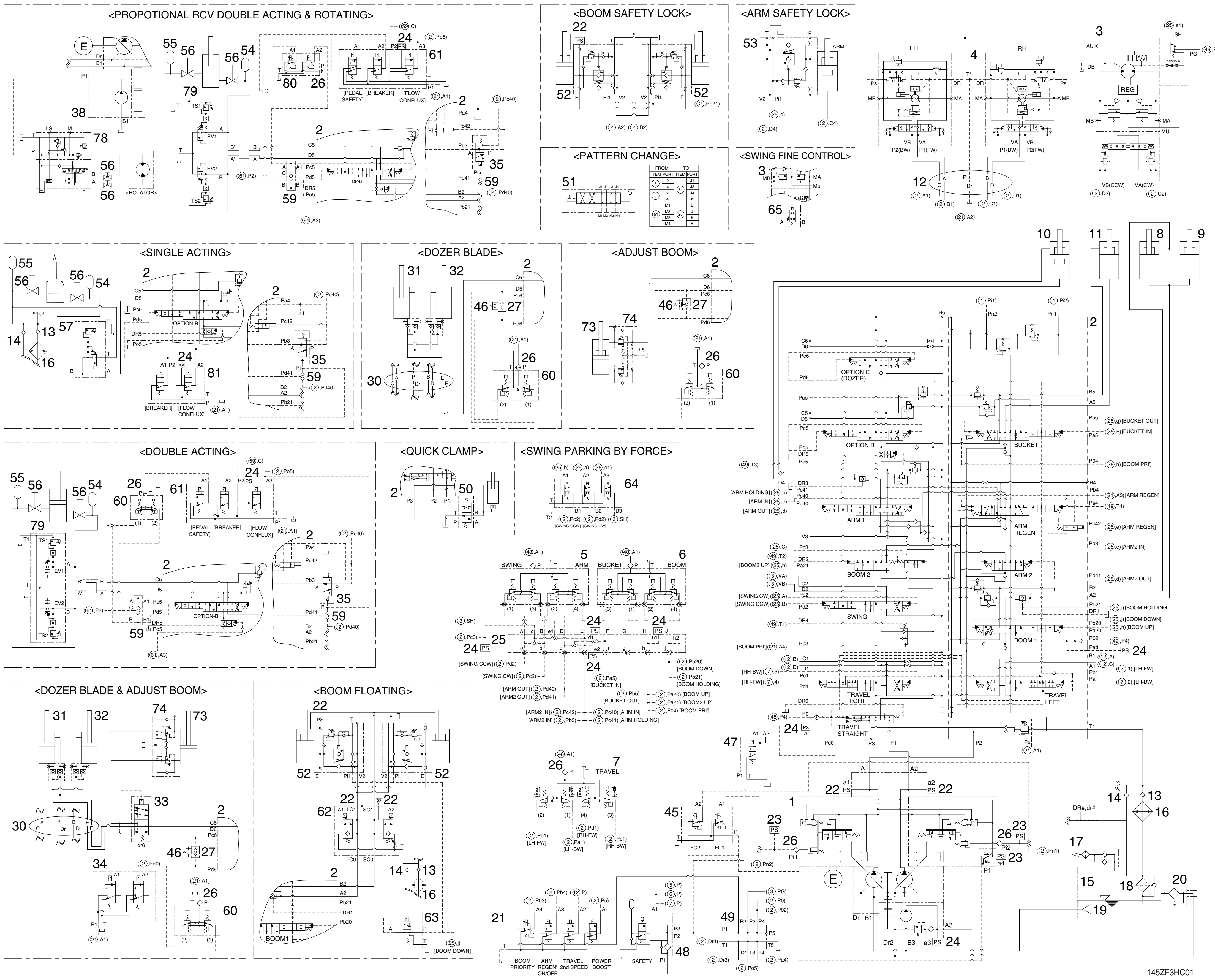


235ZF2RP04

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

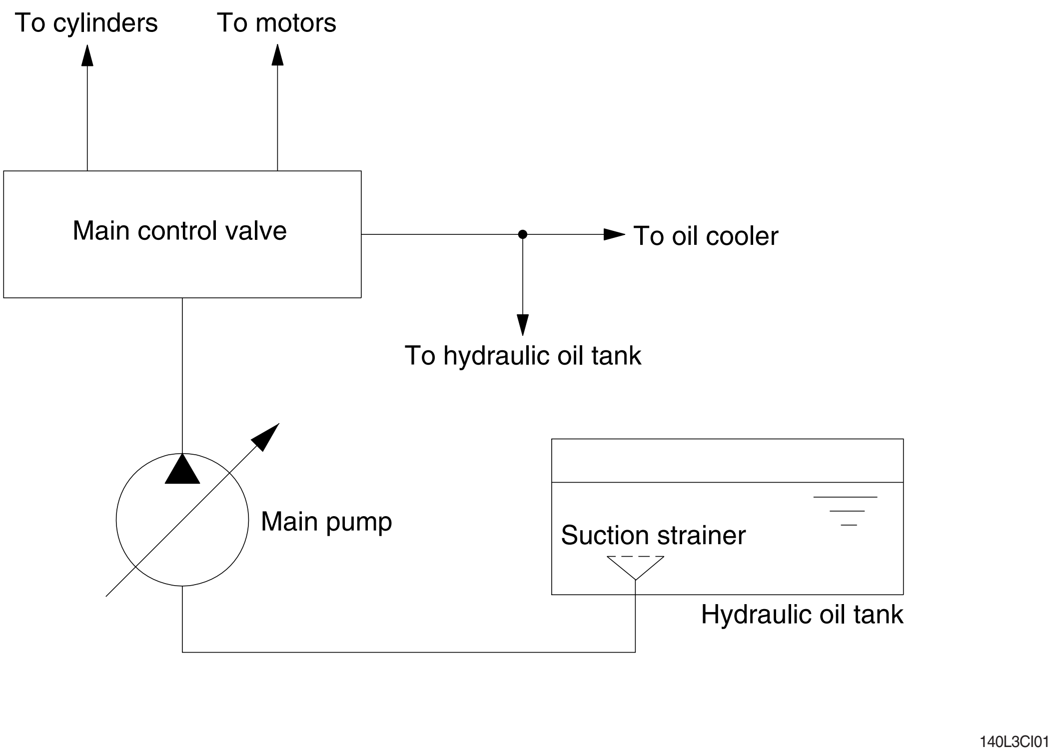


1 Main pump
2 Main control valve
3 Swing motor
4 Travel motor
5 RCV lever(LH)
6 RCV lever(RH)
7 RCV pedal
8 Boom cylinder(LH)
9 Boom cylinder(RH)
10 Arm cylinder
11 Bucket cylinder
12 Turning joint
13 Check valve
14 Check valve
15 Hydraulic tank
16 Oil cooler
17 Air breather
18 Return filter
19 Suction strainer
20 Drain filter
21 4 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 Gear pump(option)
44 Solenoid valve(option)
45 2 EPPR cartridge valve(option)
46 Pressure switch(option)
47 Solenoid valve(option)
48 1 cartridge valve
49 Block
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)
78 Proportional valve(option)
79 Proportional relief valve(option)
80 2 EPPR valve(option)
81 Solenoid valve(option)

GROUP 2 MAIN CIRCUIT

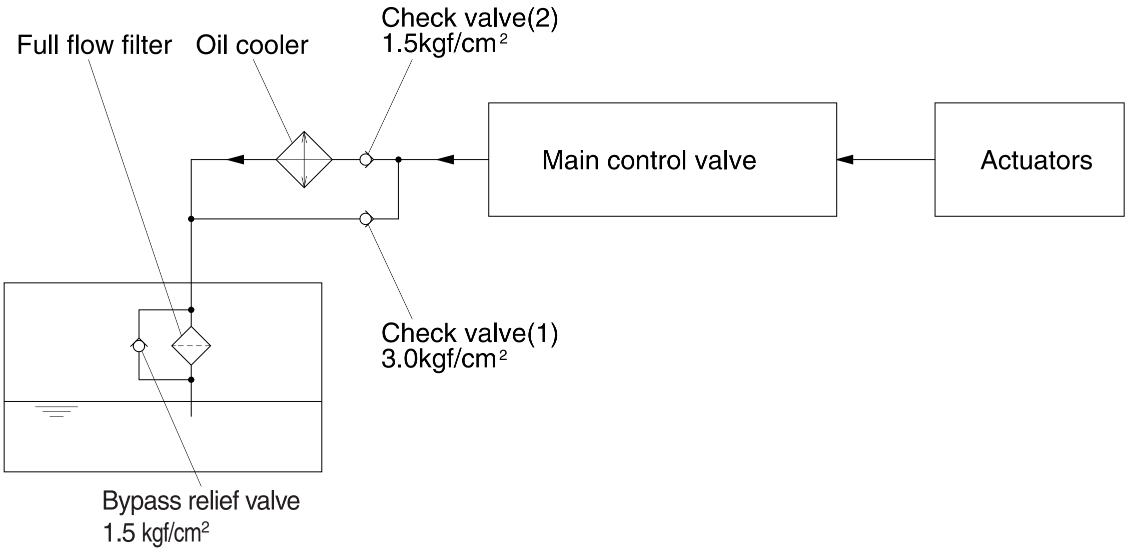
The main hydraulic circuit consists of suction circuit, delivery circuit, return circuit and drain circuit.
The hydraulic system consists of one main pump, one control valve, one swing motor, four cylinders and two travel motors.
The swash plate type variable displacement axial piston pump is used as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

1. SUCTION AND DELIVERY CIRCUIT



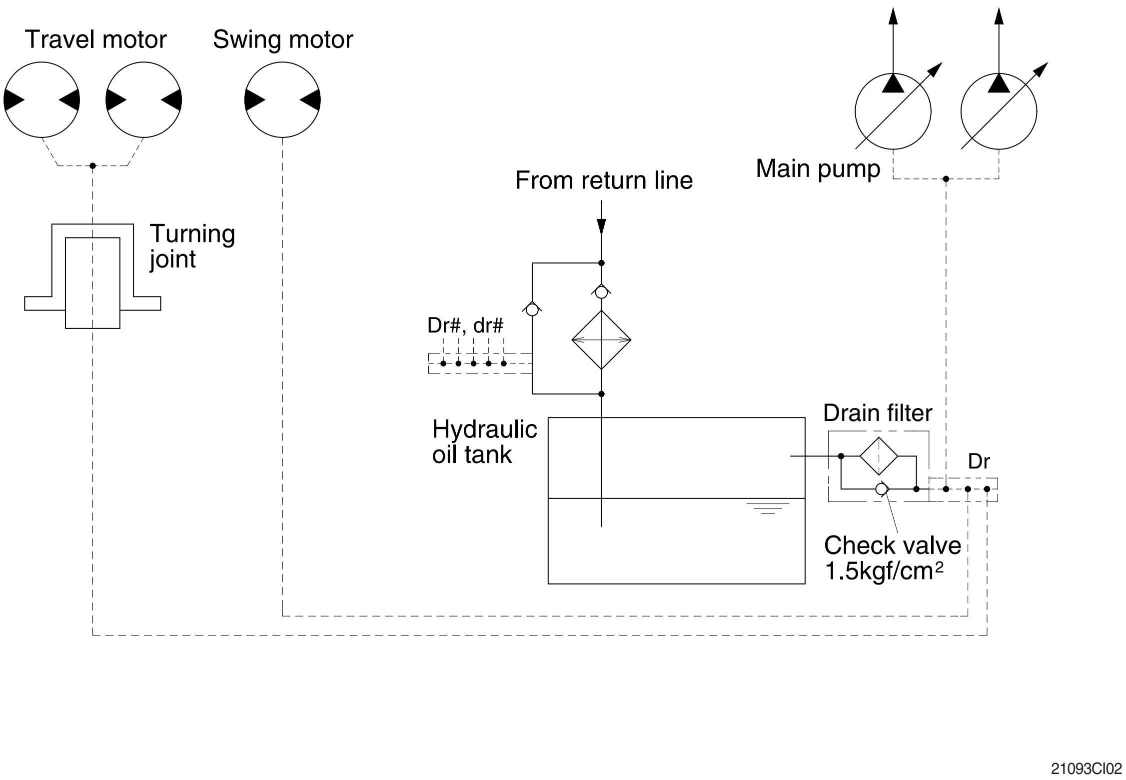
The pumps receive oil from the hydraulic tank through a suction strainer. The discharged oil from the pump flows into the control valve and goes out the tank ports.
The oil discharged from the main pump flows to the actuators through the main control valve.
The main control valve controls the hydraulic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

2. RETURN CIRCUIT



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 1.5 kgf/cm^2 (21 psi) and 3.0 kgf/cm^2 (43 psi). Usually, oil returns to the hydraulic tank from the left side of control valve through oil cooler.
When oil temperature is low, viscosity becomes higher and flow resistance increases when passing through the oil cooler. When the oil pressure exceeds 3.0 kgf/cm^2 (43 psi), the oil returns directly to the hydraulic tank, resulting in the oil temperature being raised quickly at an appropriate level.
When the oil cooler is clogged, the oil returns directly to the hydraulic tank through bypass check valve (1).
The full-flow filter and bypass relief valve are provided in the hydraulic tank.
The oil 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



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.

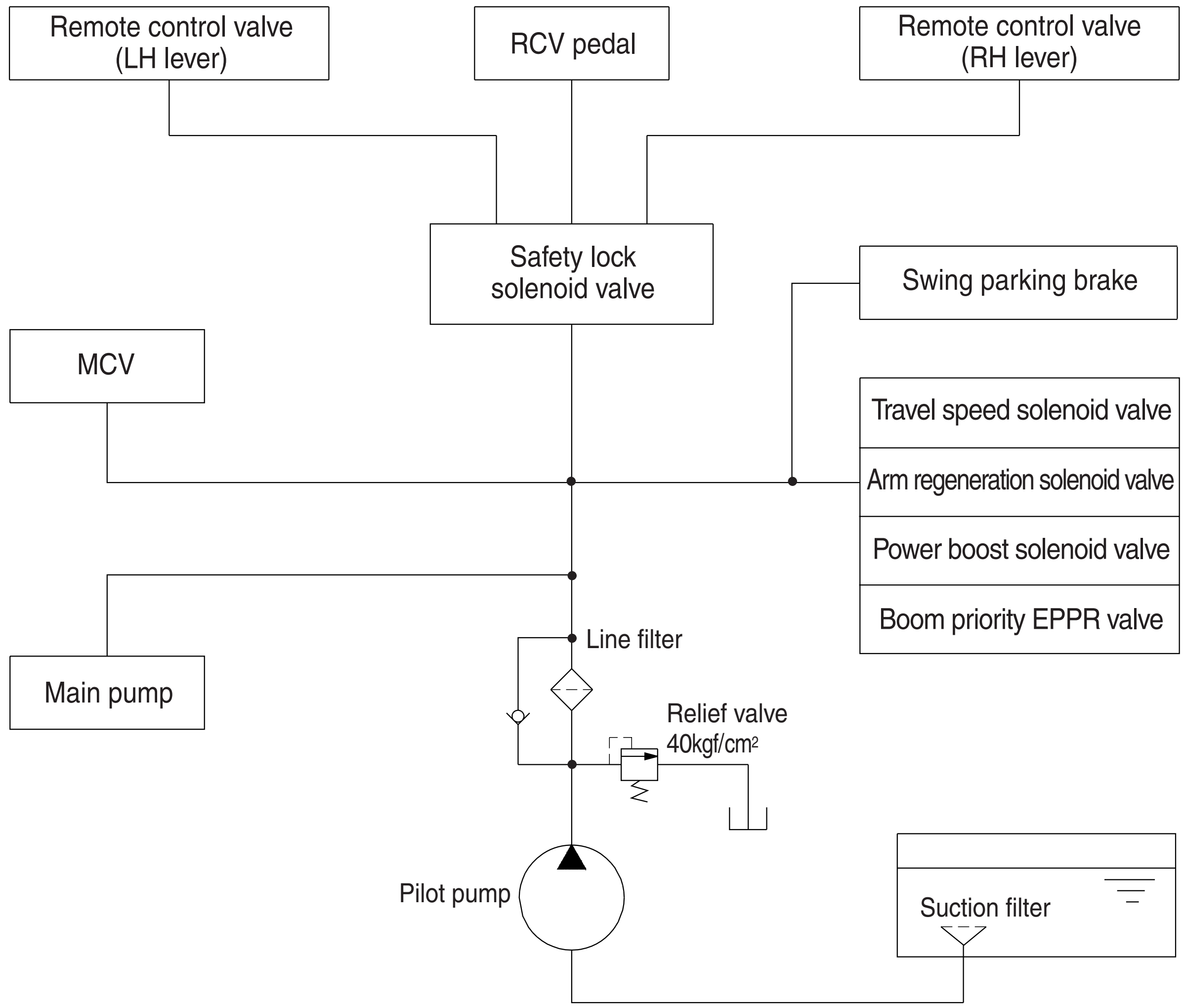
2) SWING MOTOR DRAIN CIRCUIT

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



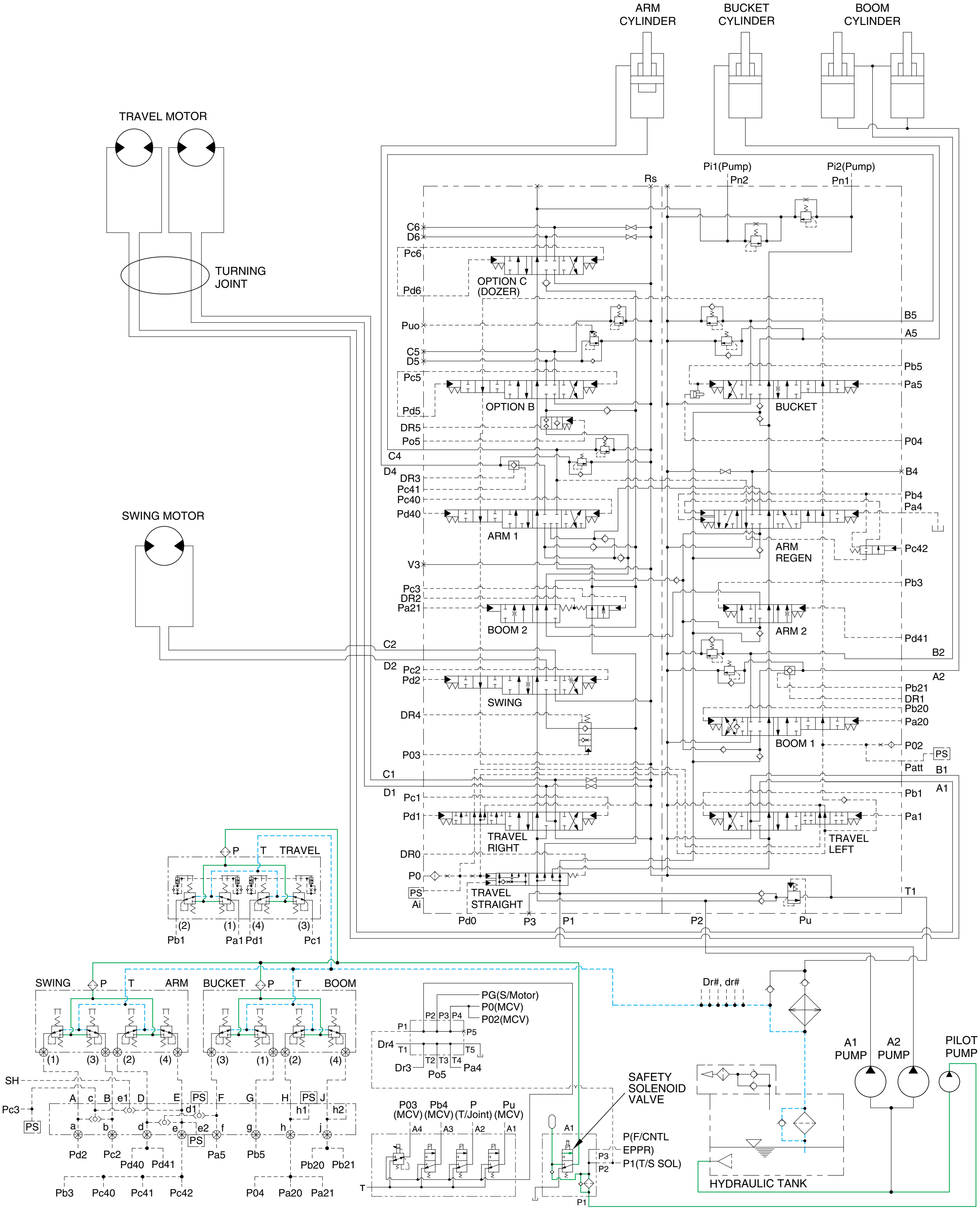
(210-7) 3-05

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

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

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

1. SUCTION, DELIVERY AND RETURN CIRCUIT



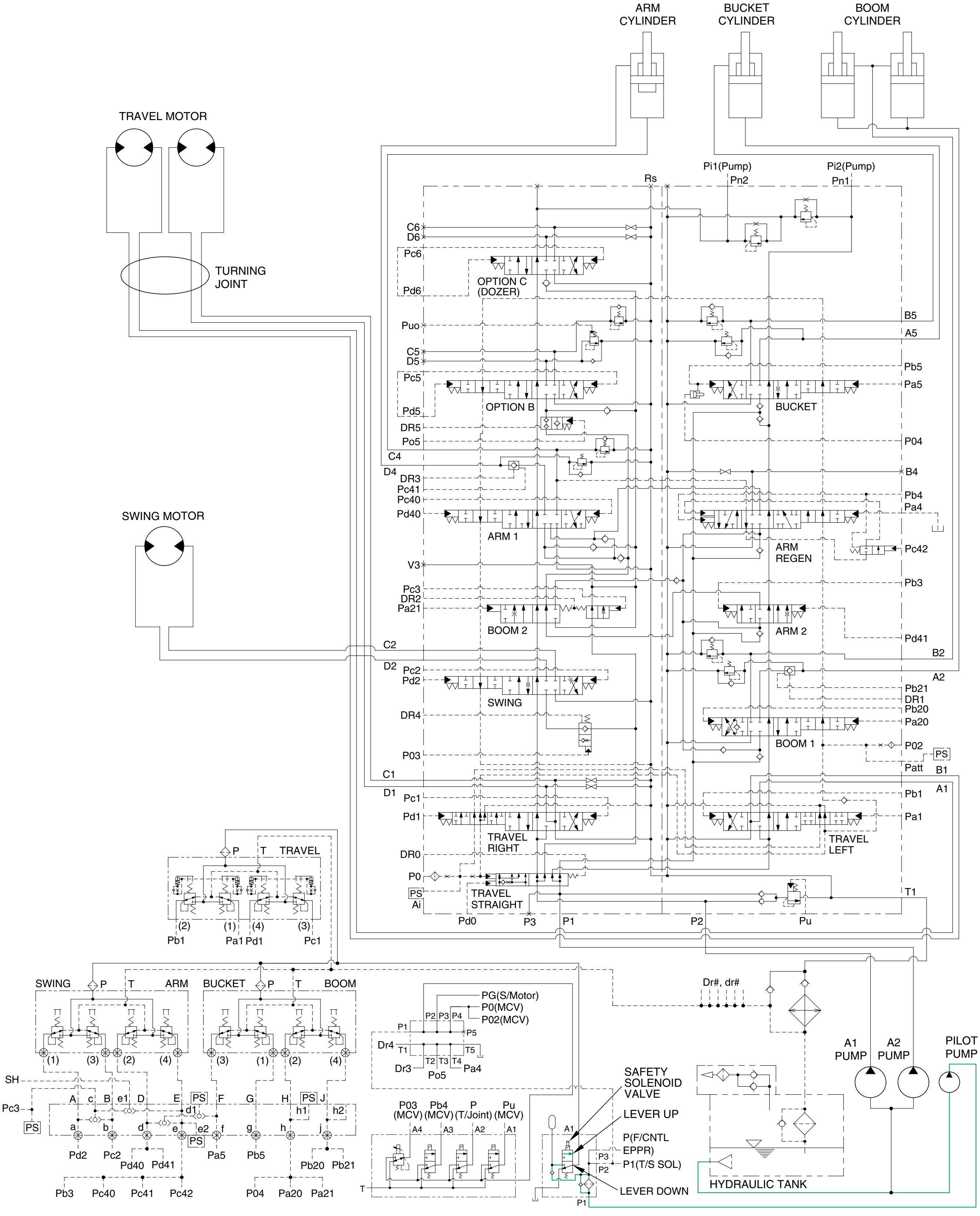
The pilot pump receive oil from the hydraulic tank. The discharged oil from the pilot pump flows to the safety solenoid valve. The oil is filtered by the line filter.

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)

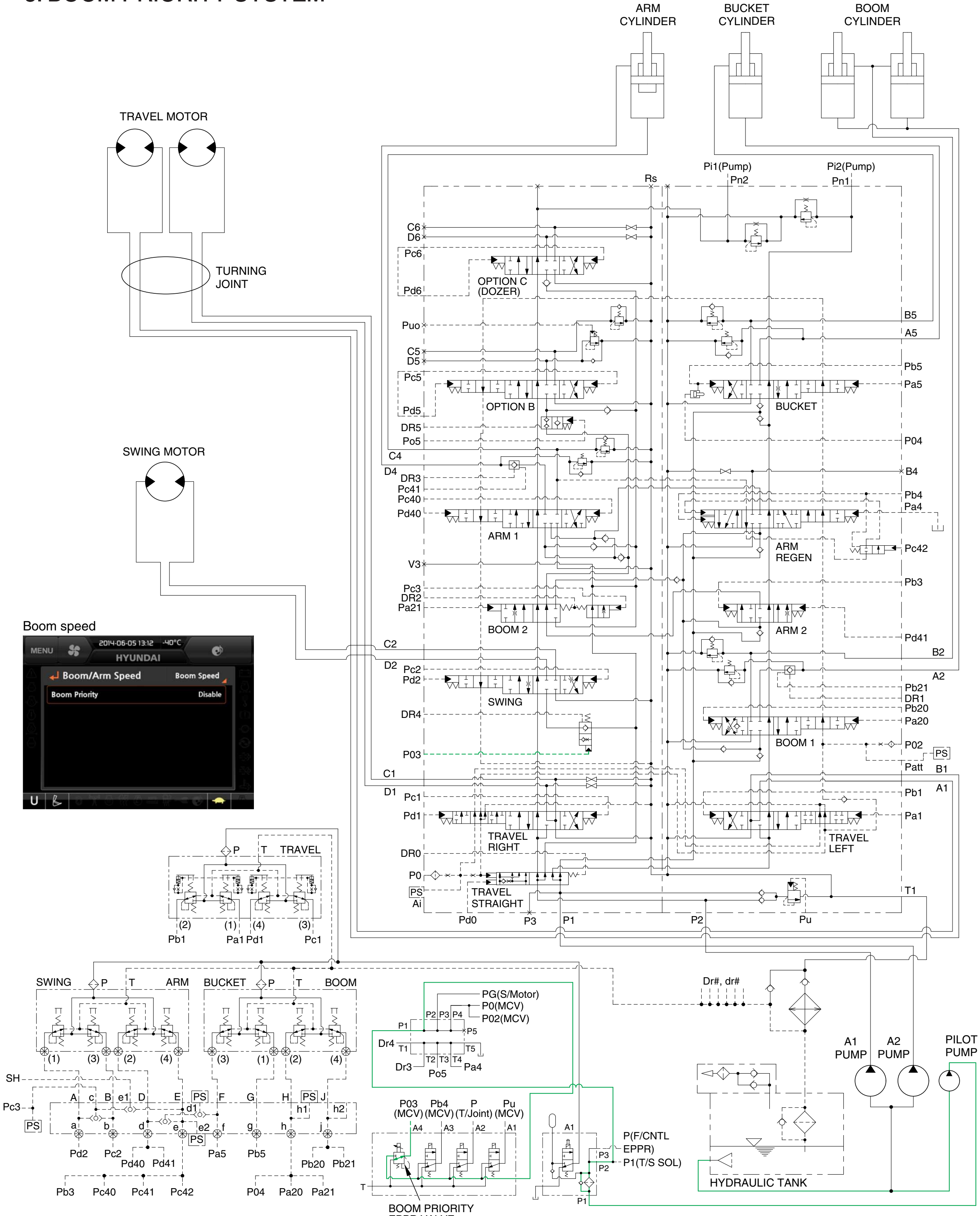


145ZF3HC03

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

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

3. BOOM PRIORITY SYSTEM



145ZF3HC04

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

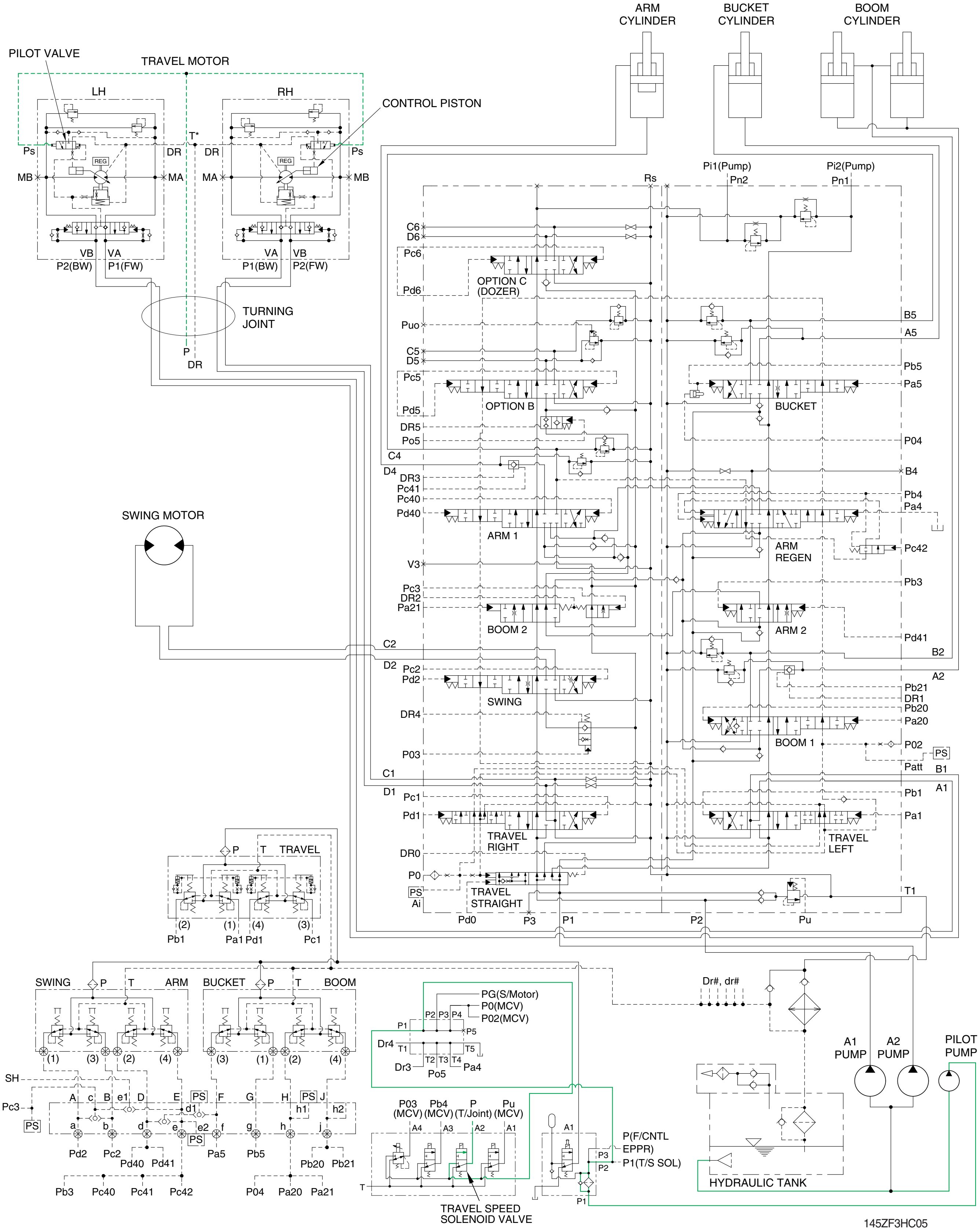
To increase working efficiency, swing speed reducing system is used.

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.

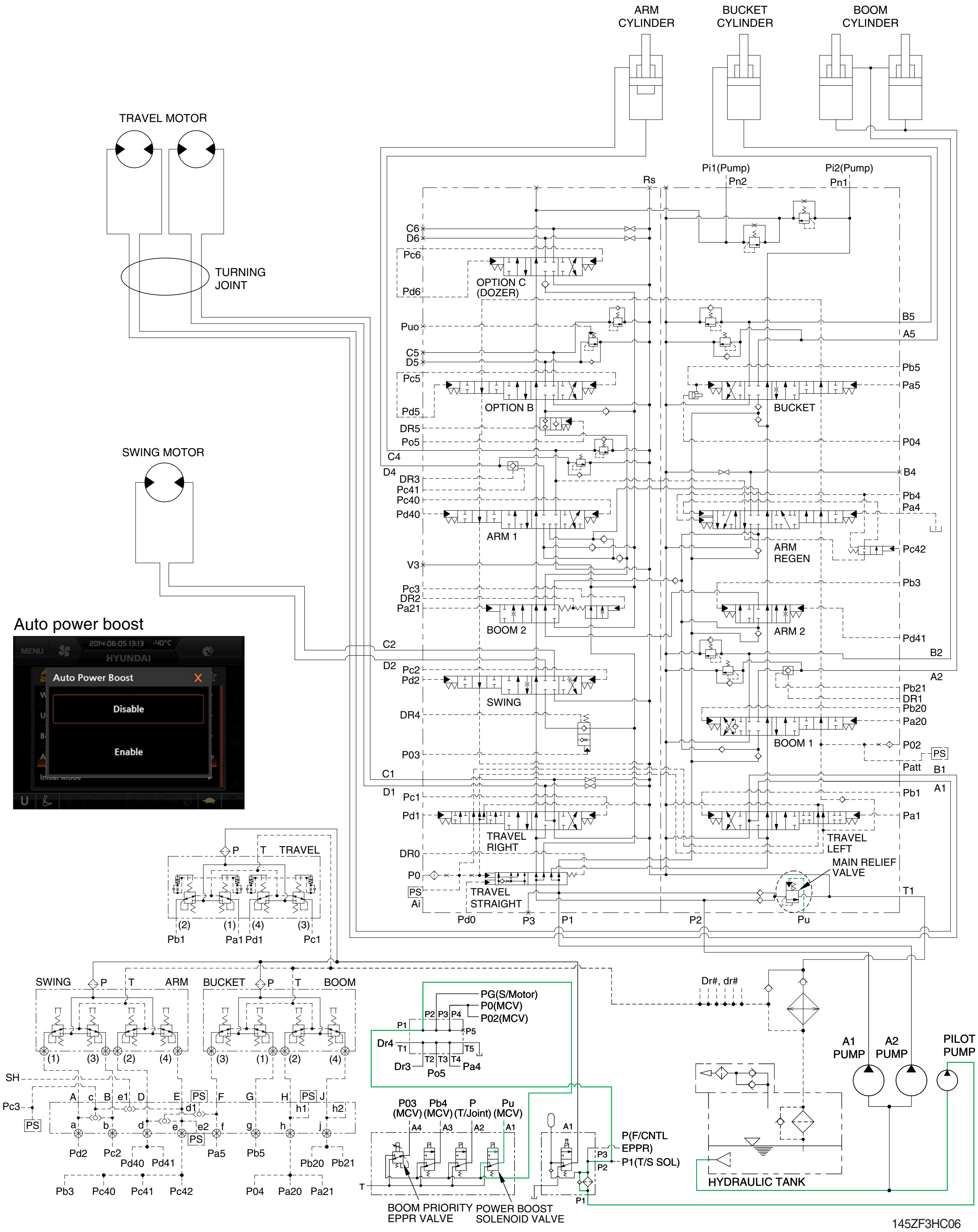
4. TRAVEL SPEED CONTROL SYSTEM



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 up, 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



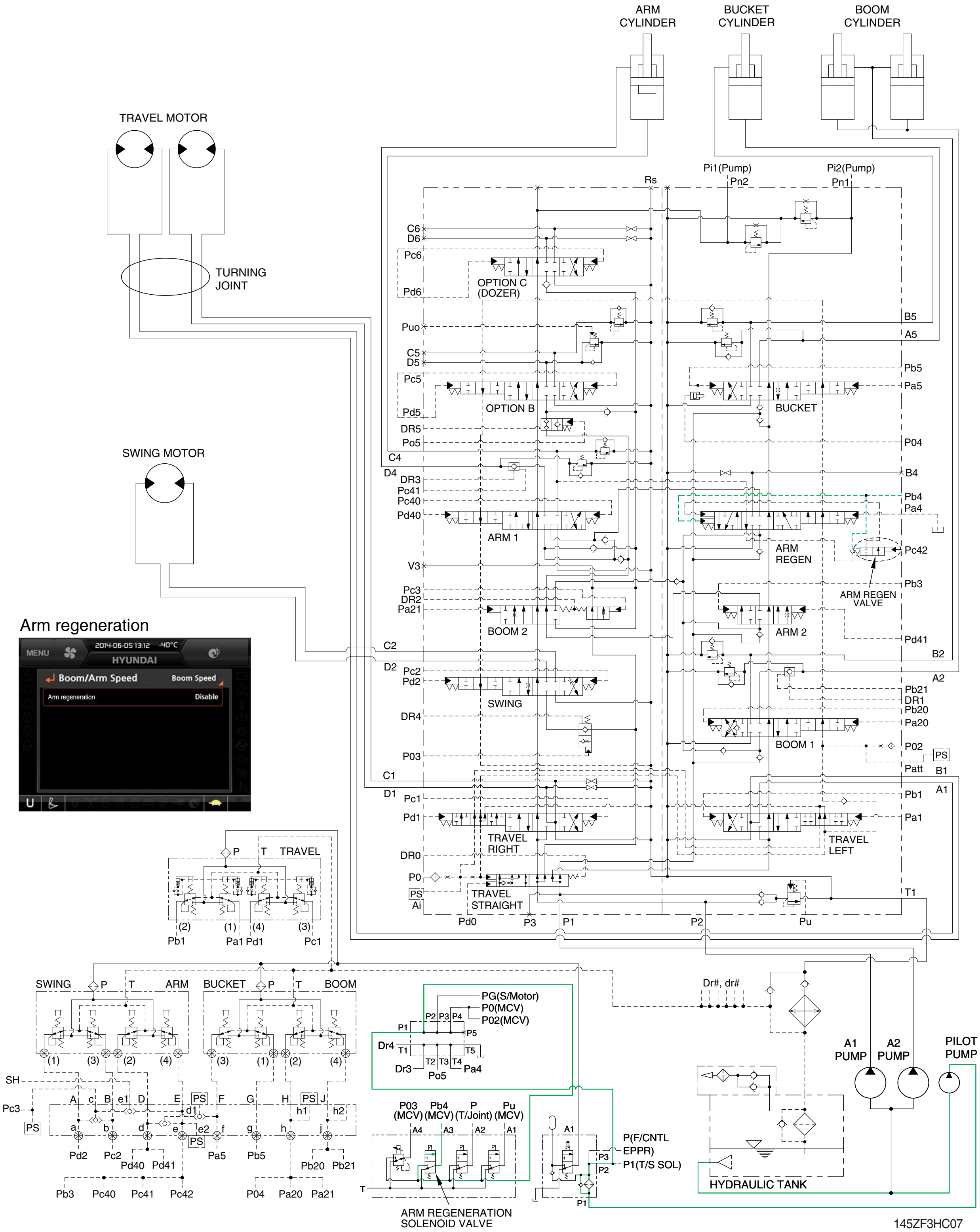
Auto power boost

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/cm^2 (4980 psi) to 380 kgf/cm^2 (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/cm^2 (5400 psi) as working condition by the MCU. It is operated max 8 seconds.

6. ARM REGENERATION CUT SYSTEM



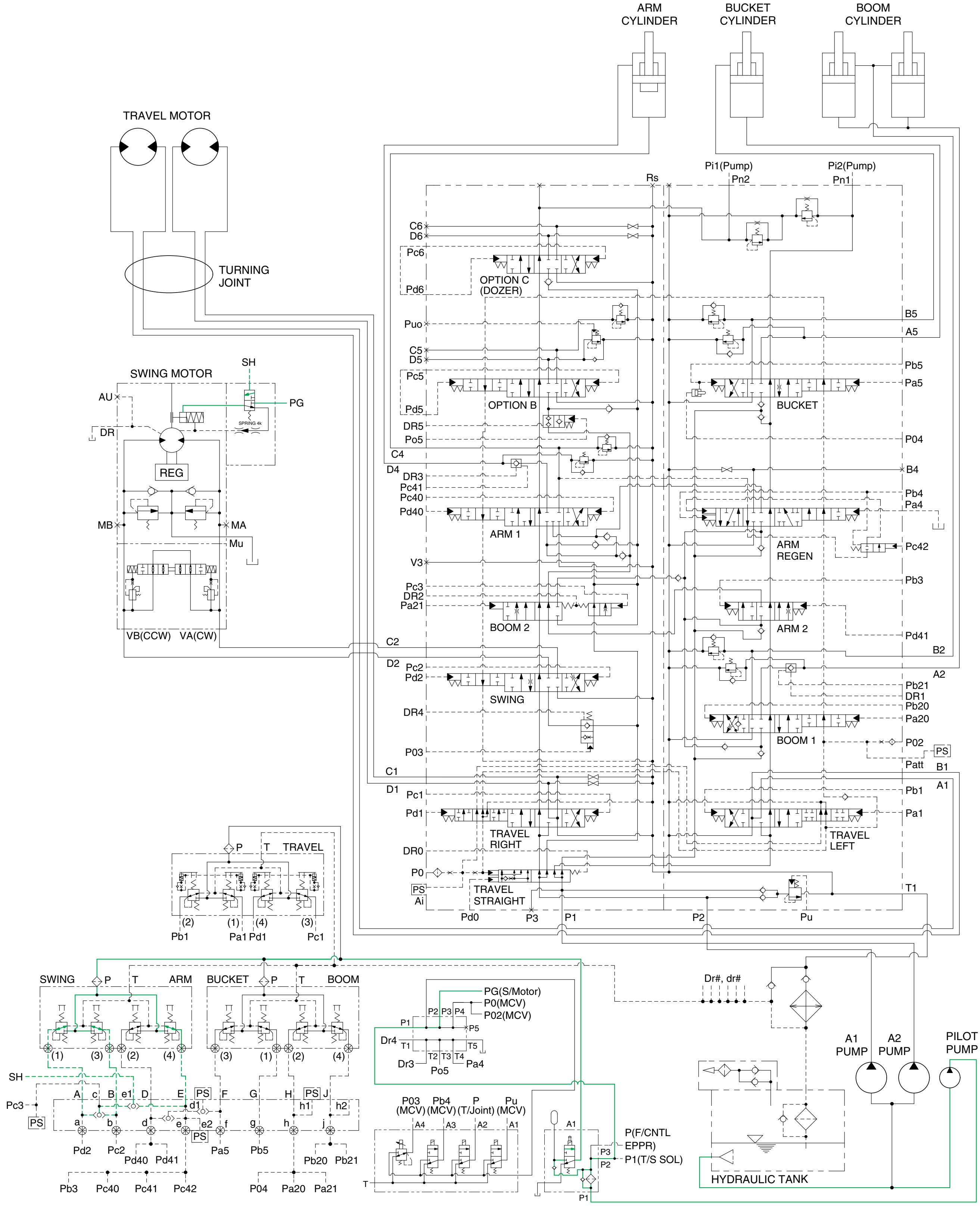
When the arm regeneration is selected to disable on the cluster, the arm regeneration solenoid valve is activated. The pilot oil from pilot pump flow into **Pb4** port in main control valve through solenoid valve and the arm regeneration spool is shifted to left.

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



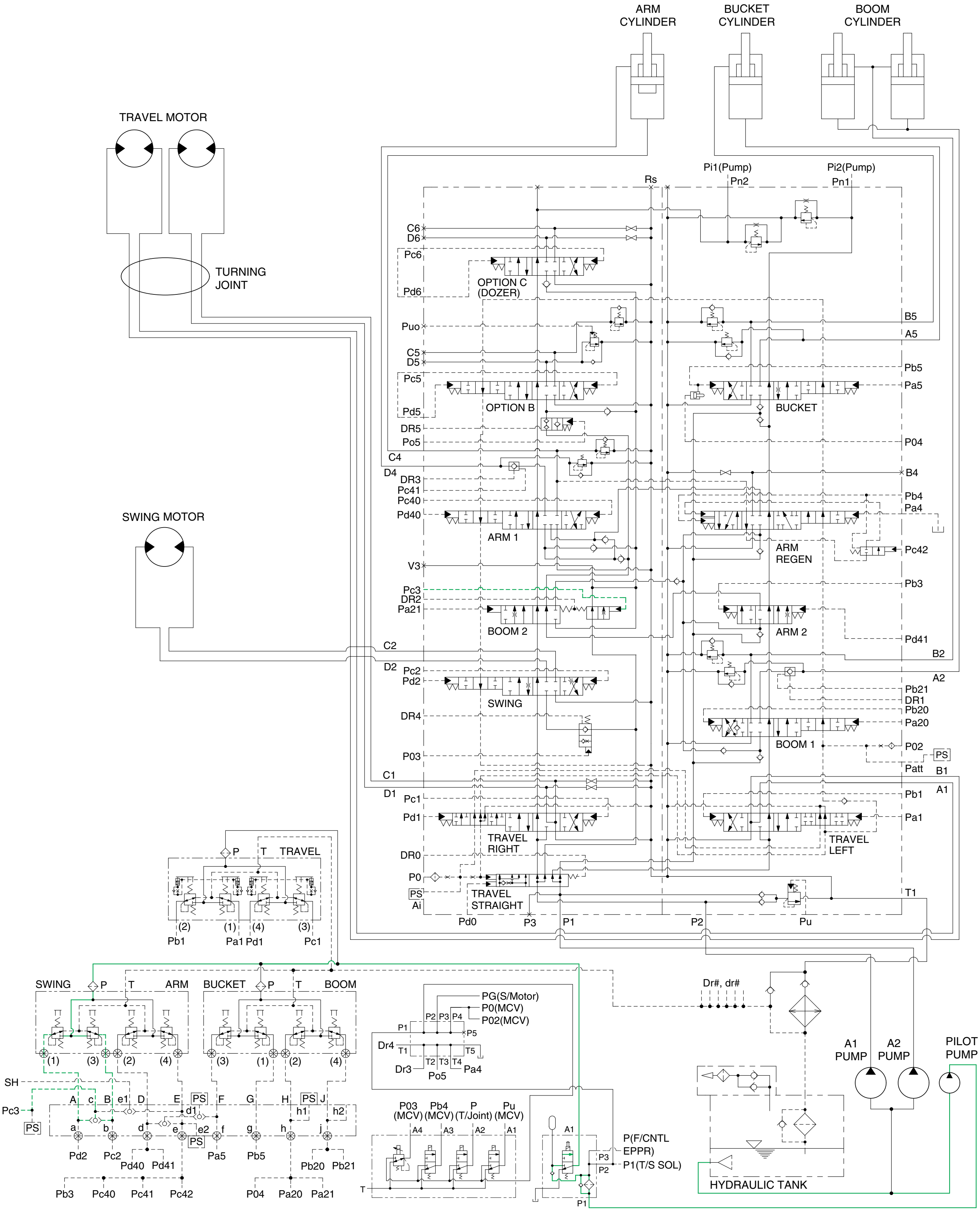
145ZF3HC08

When the swing control lever or arm in control lever is tilted, the pilot oil flows into SH port through shuttle 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



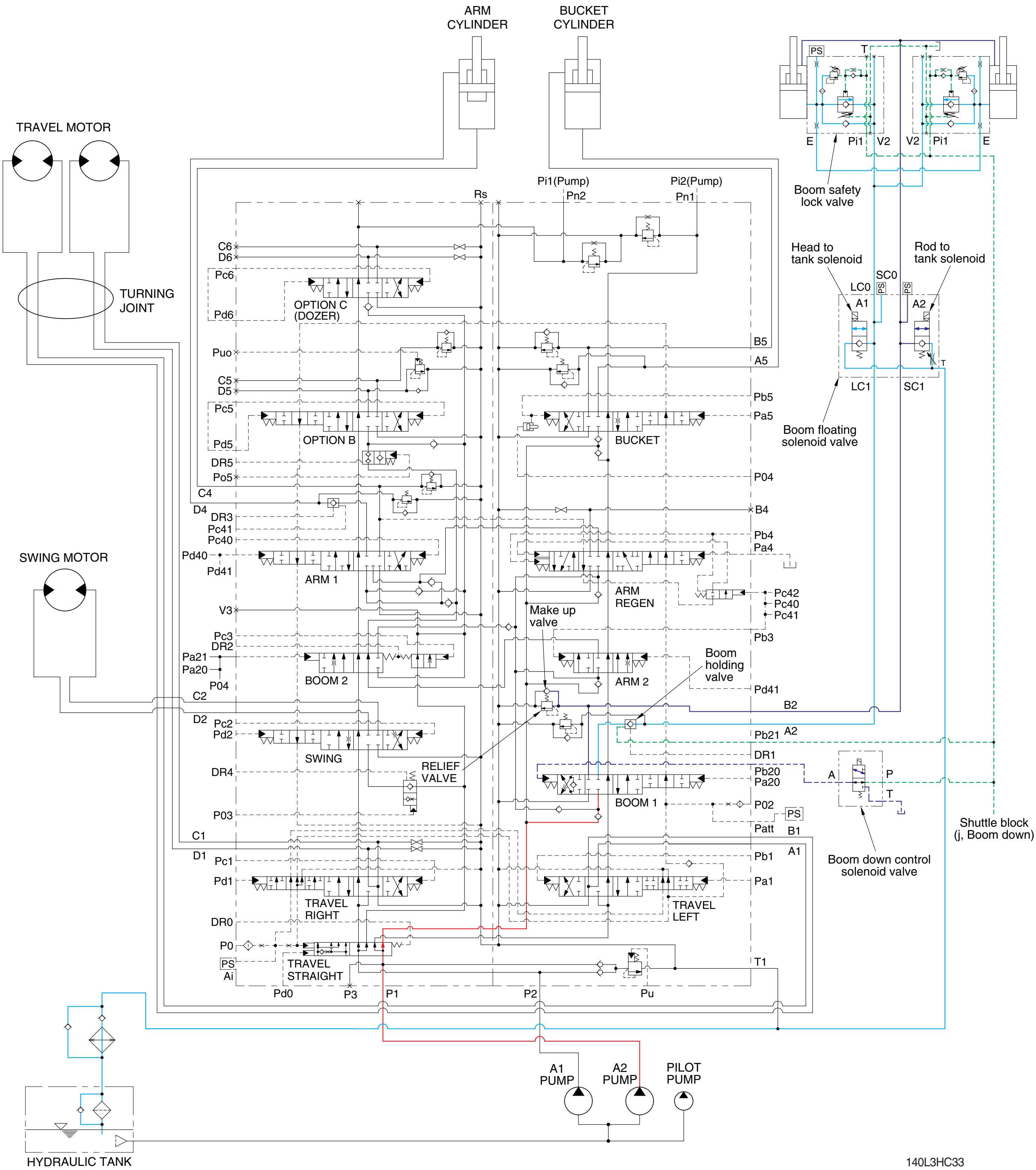
145ZF3HC09

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 2-39.

9. BOOM FLOATING SYSTEM



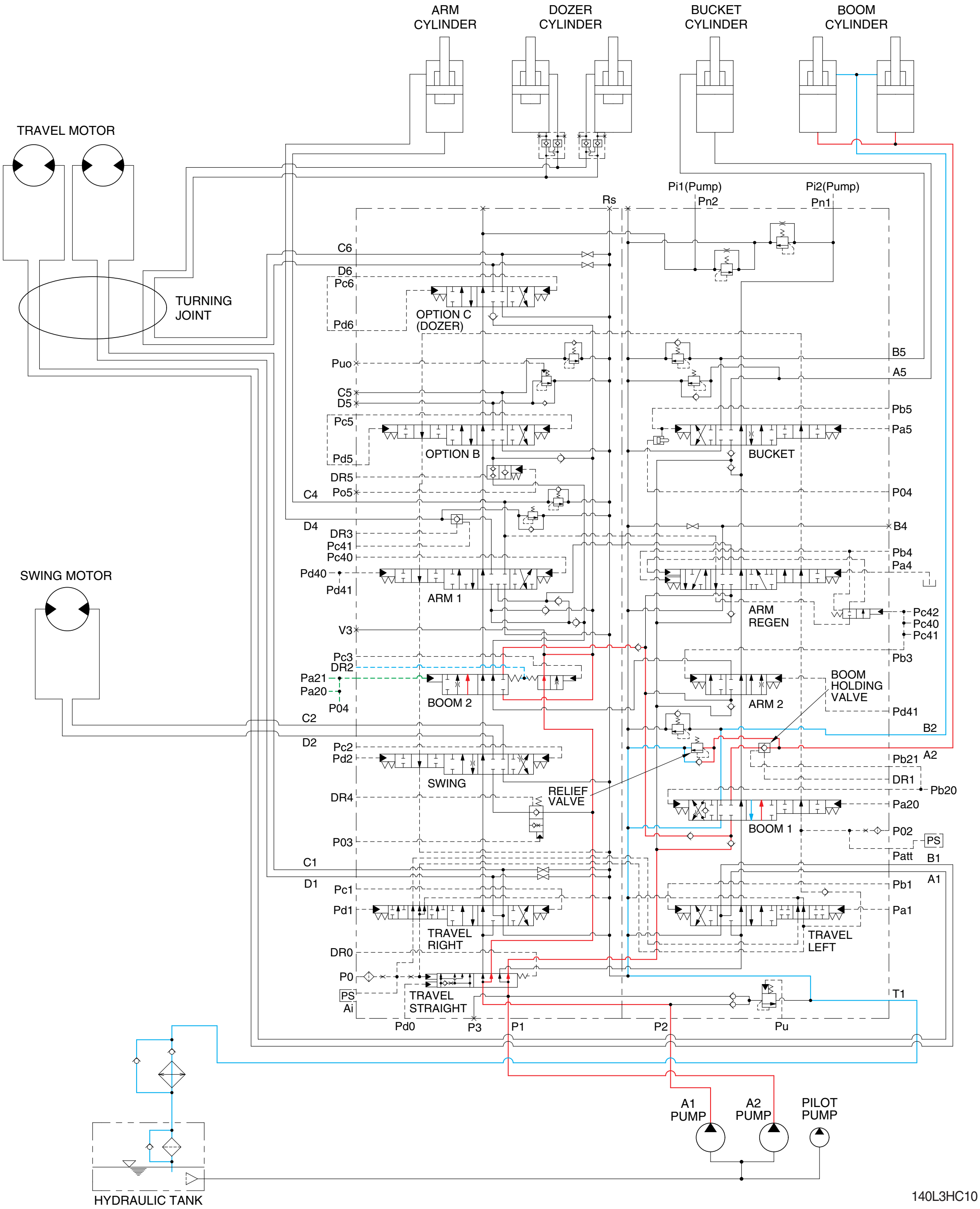
Smooth and convenient boom movement is accomplished by only arm control lever operation.

The boom floating solenoid values 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.

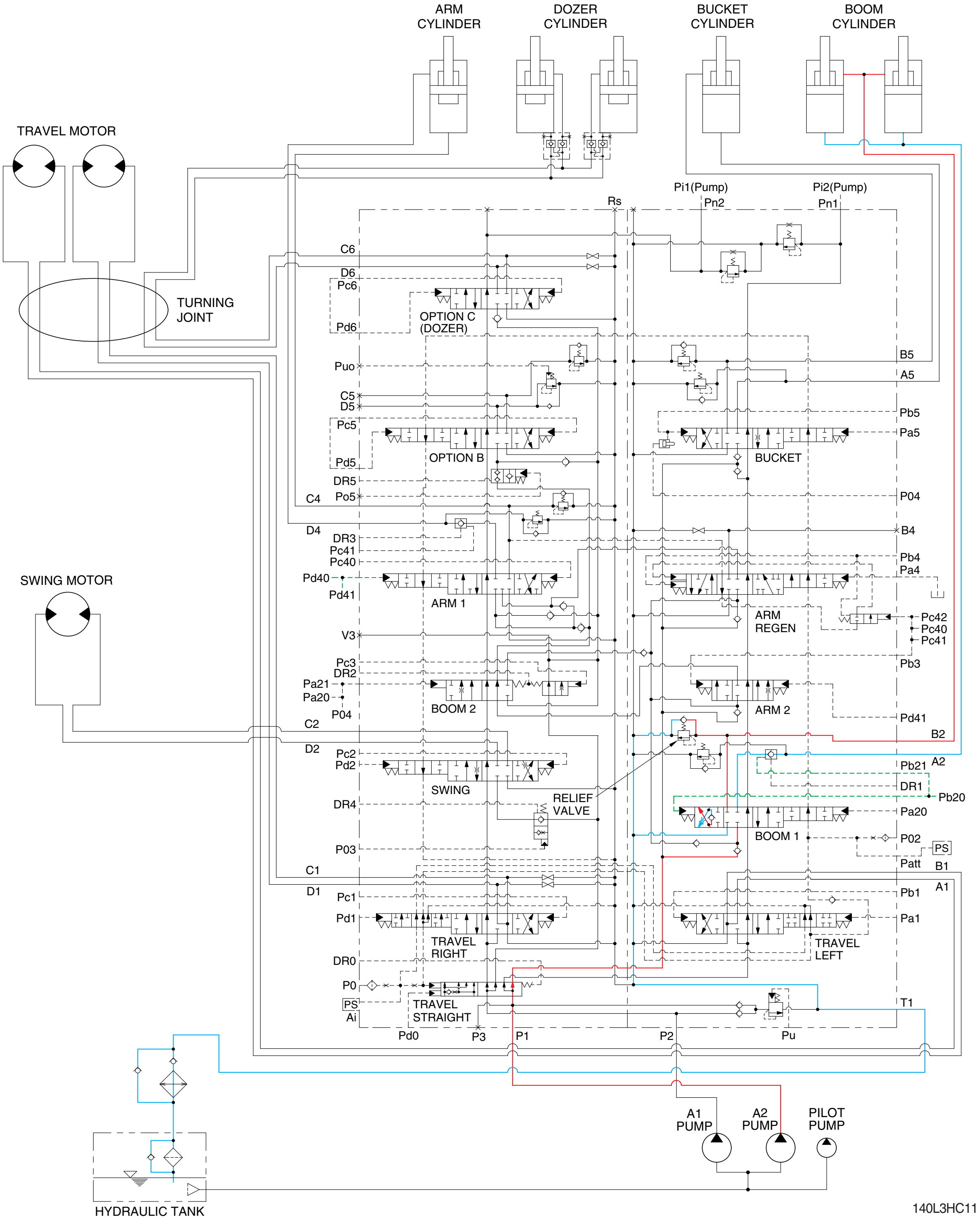
1. BOOM UP OPERATION



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 head side of the boom cylinder is closed by the boom holding valve. This prevents the hydraulic drift of boom cylinder.

2. BOOM DOWN OPERATION



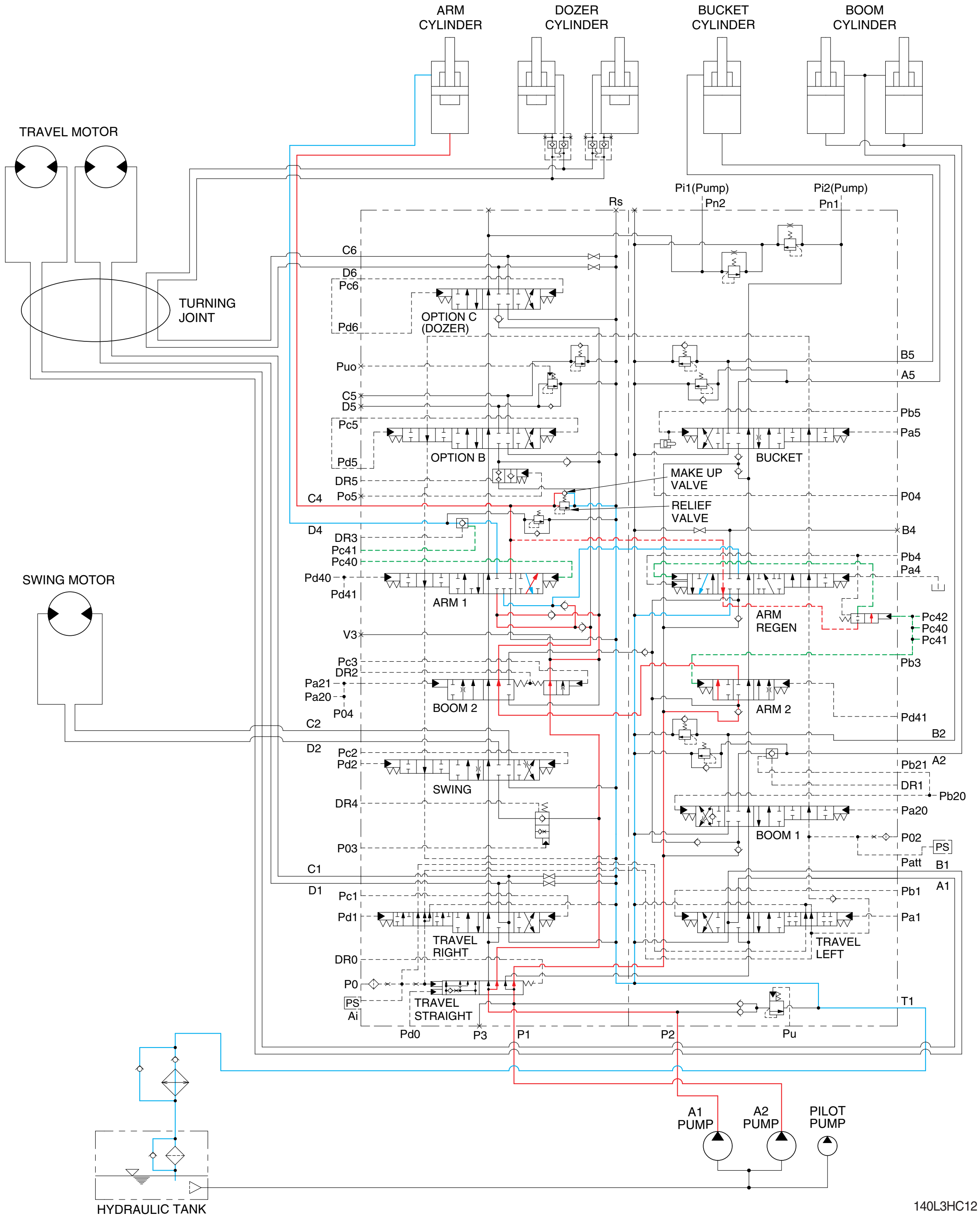
When the right control lever is pushed forward, the boom 1 spool in the main control valve is moved to the down position by the pilot oil pressure from the remote control valve.

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 arm in position by the pilot oil pressure from the remote control valve.

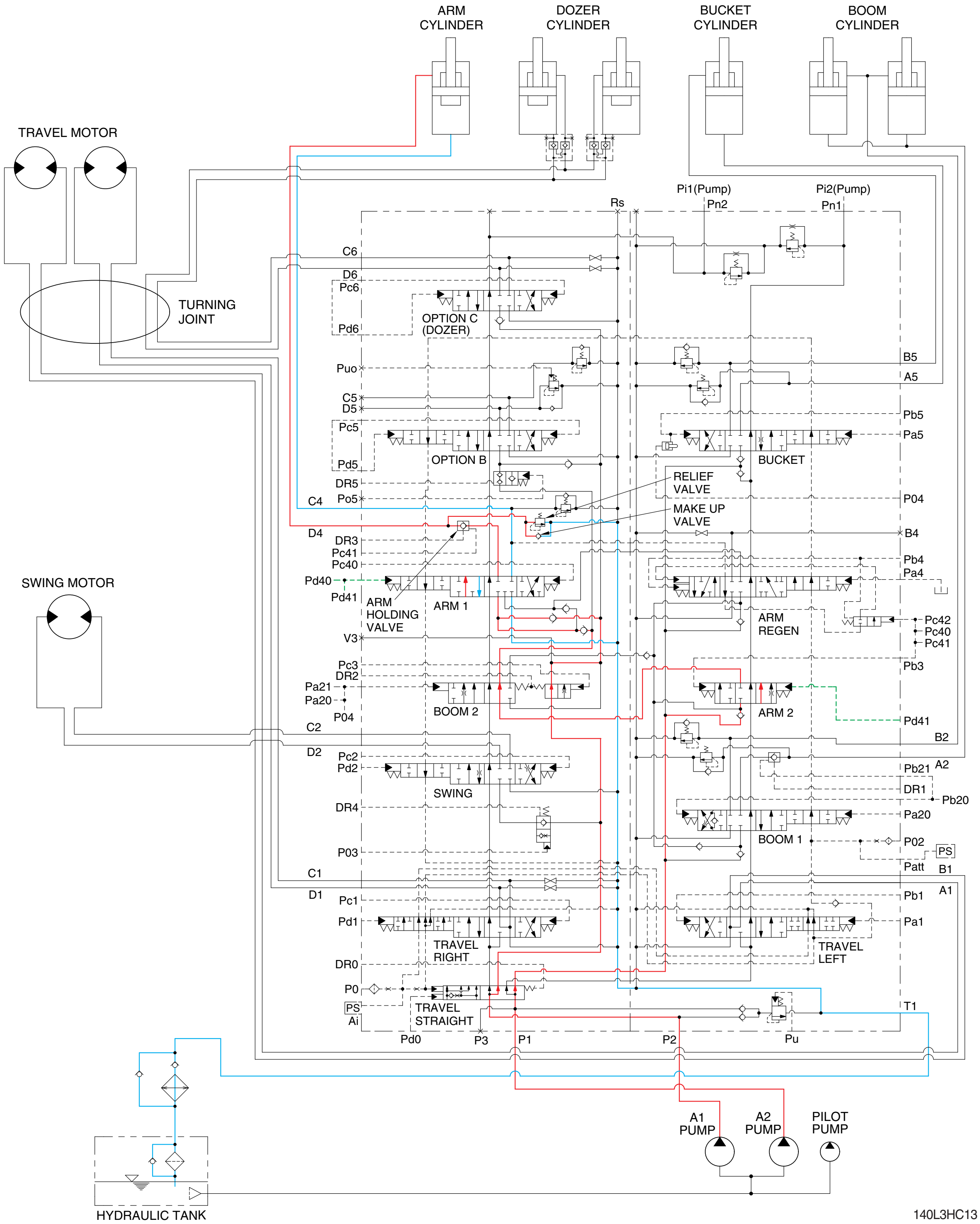
The oil from the A1 and A2 pump flows into the main control valve and then goes to the large chamber of arm cylinder.

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.

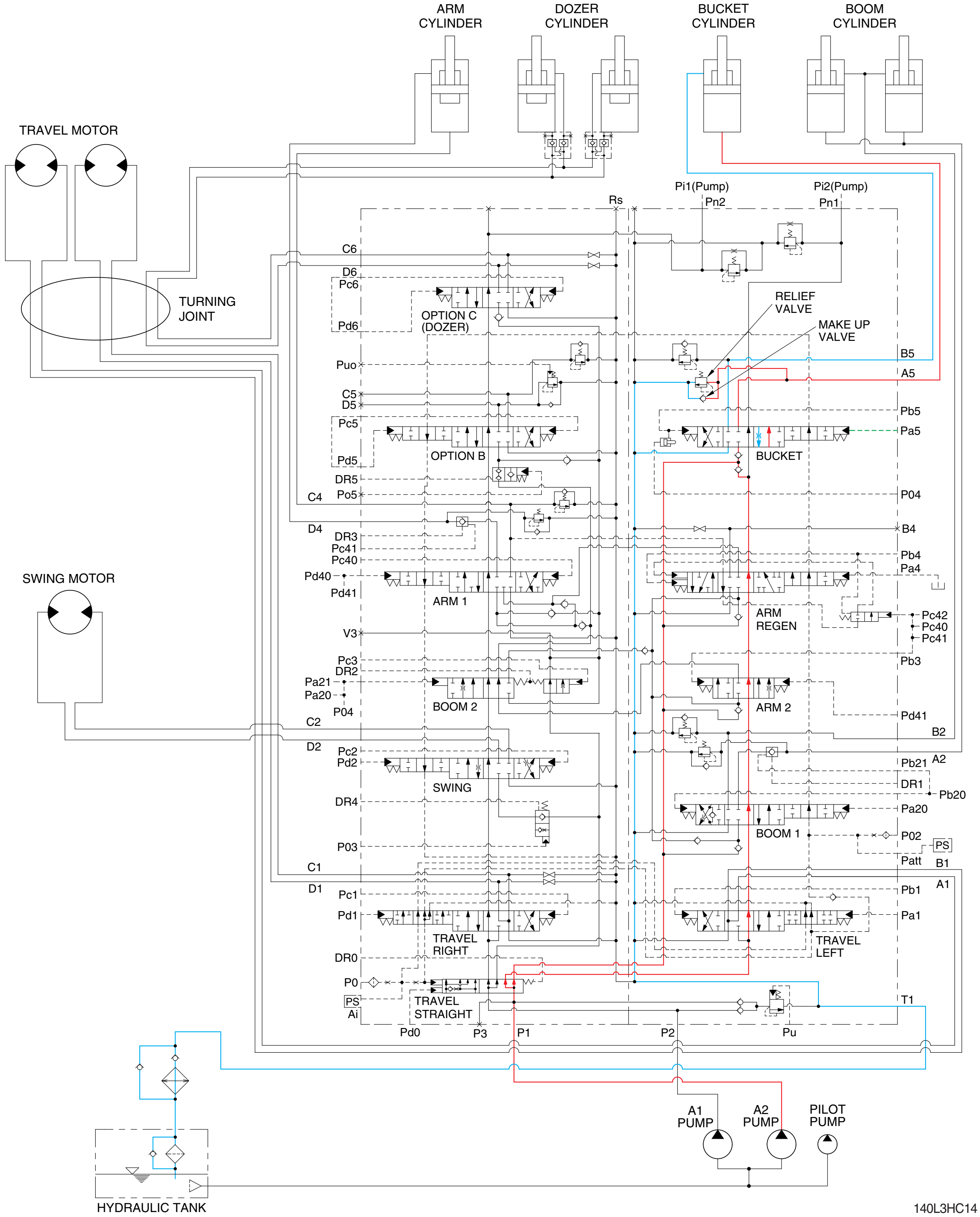
4. ARM OUT OPERATION



When the left control lever is pushed forward, the arm spools in the main control valve are moved to the arm 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 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. 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. This prevent the hydraulic drift of arm cylinder.

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.

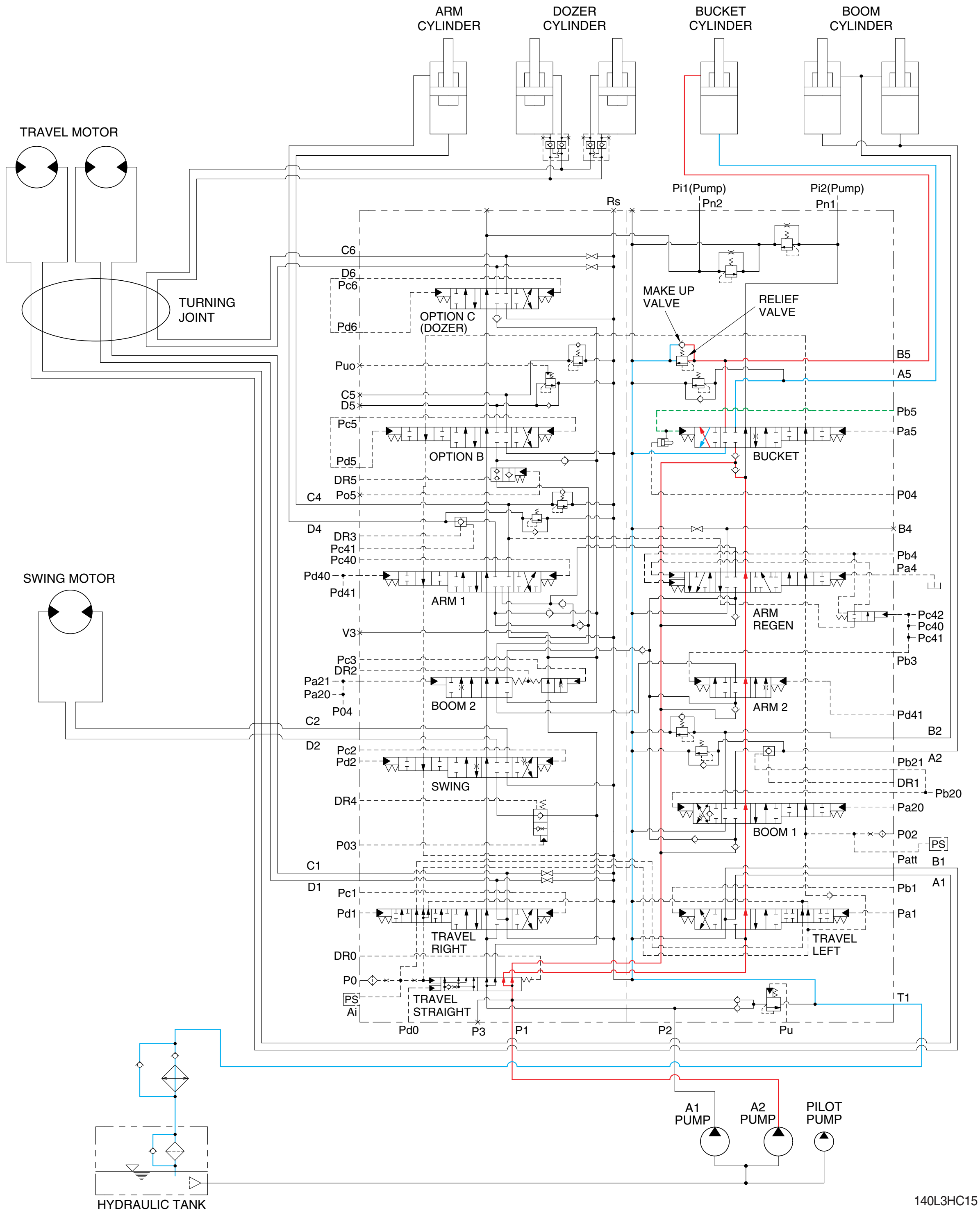
The oil from the A2 pump flows into the main control valve and then goes to the large chamber of bucket cylinder.

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 bucket out position by the pilot oil pressure from the remote control valve.

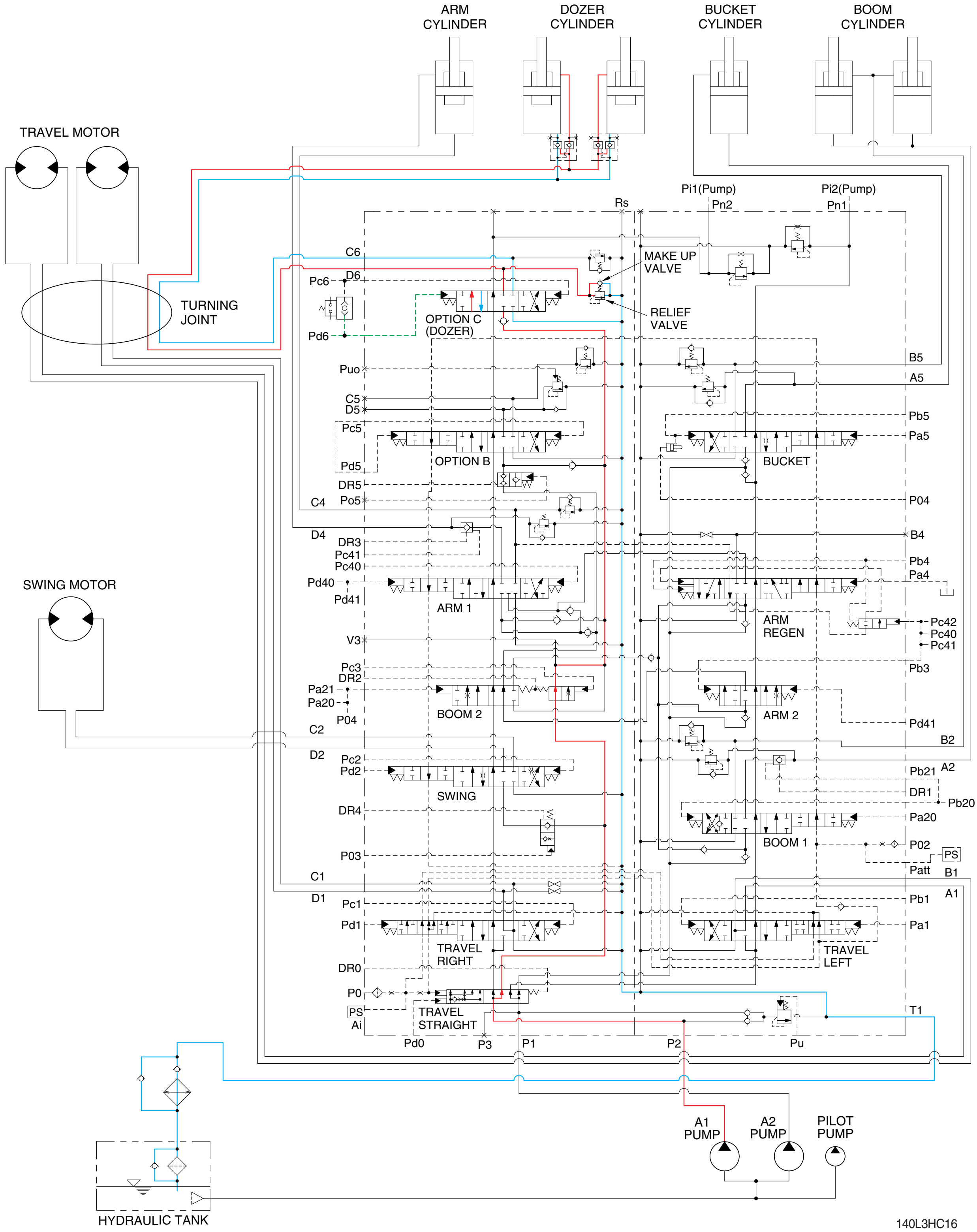
The oil from the A2 pump flows into the main control valve and then goes to the small chamber of bucket cylinder.

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

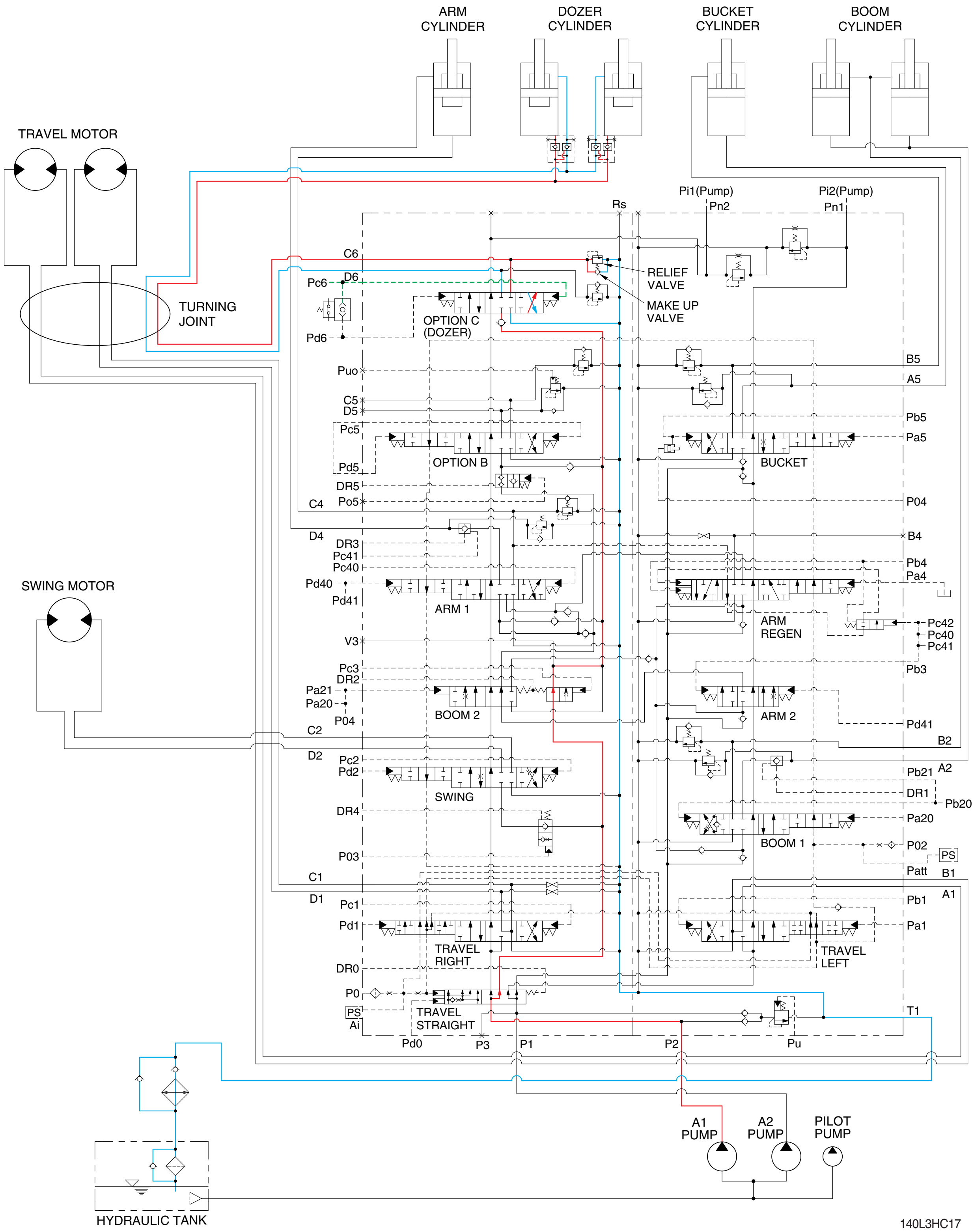


When the dozer control lever is pulled back, the dozer spool in the main control valve is moved to the dozer up position by the pilot oil pressure from the remote control valve.

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

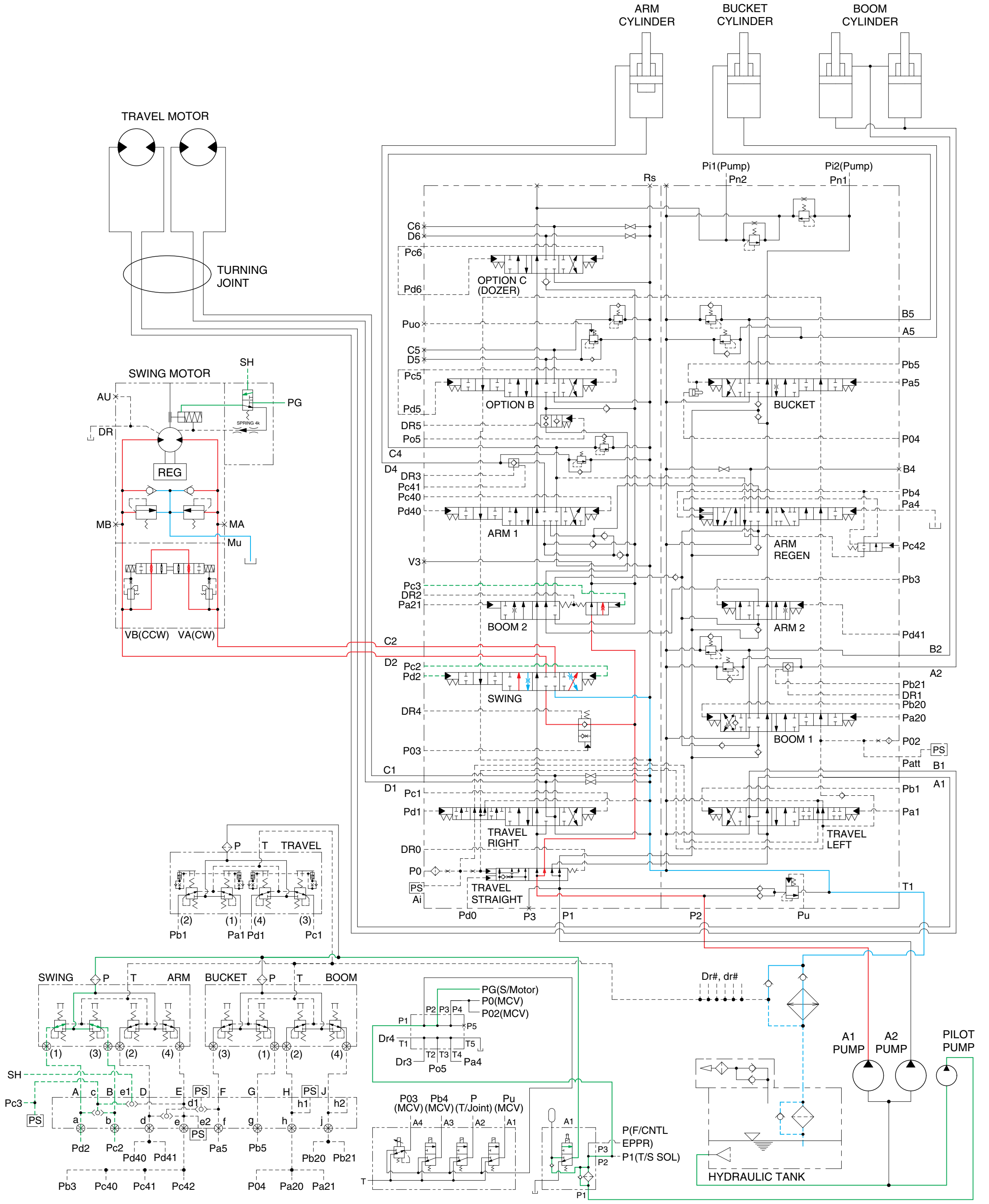


When the dozer control lever is pushed forward, the dozer spool in the main control valve is moved to the dozer down position by the pilot oil pressure from the remote control valve.

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



145ZF3HC18

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.

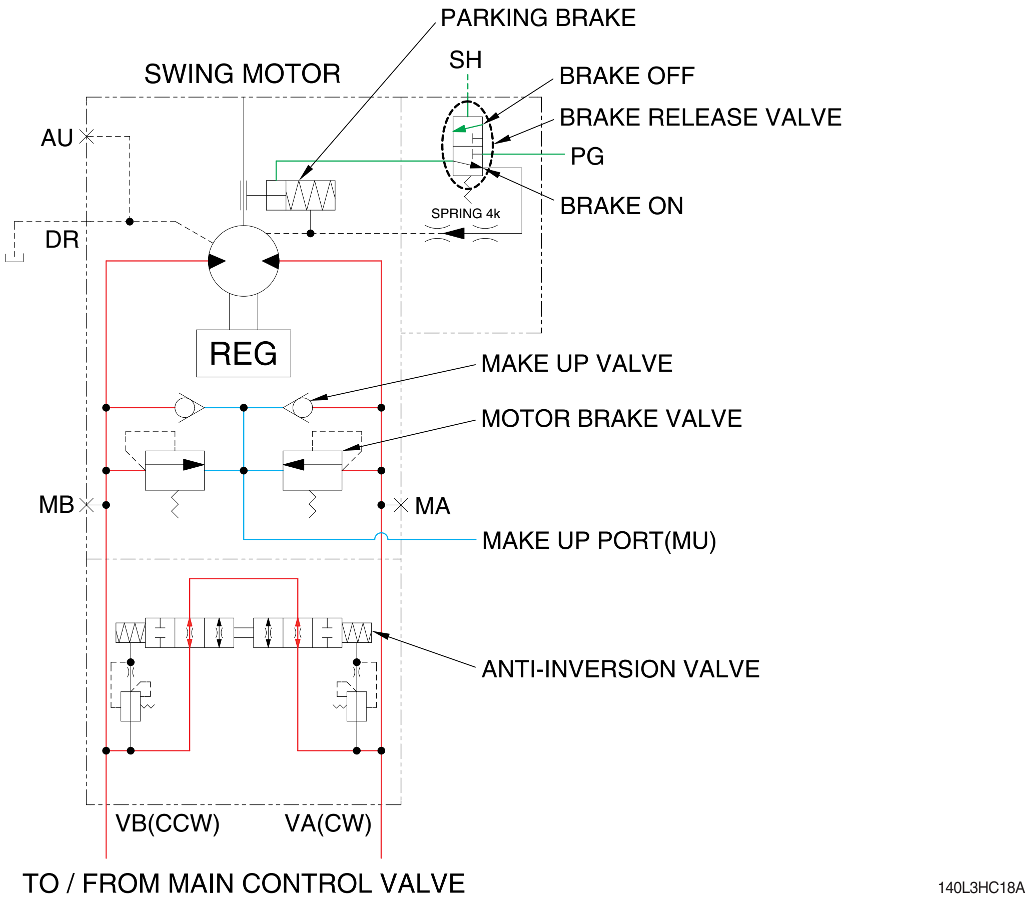
At the same time, the return oil from the swing motor returns to the hydraulic oil tank through the swing spool in the main control valve.

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.

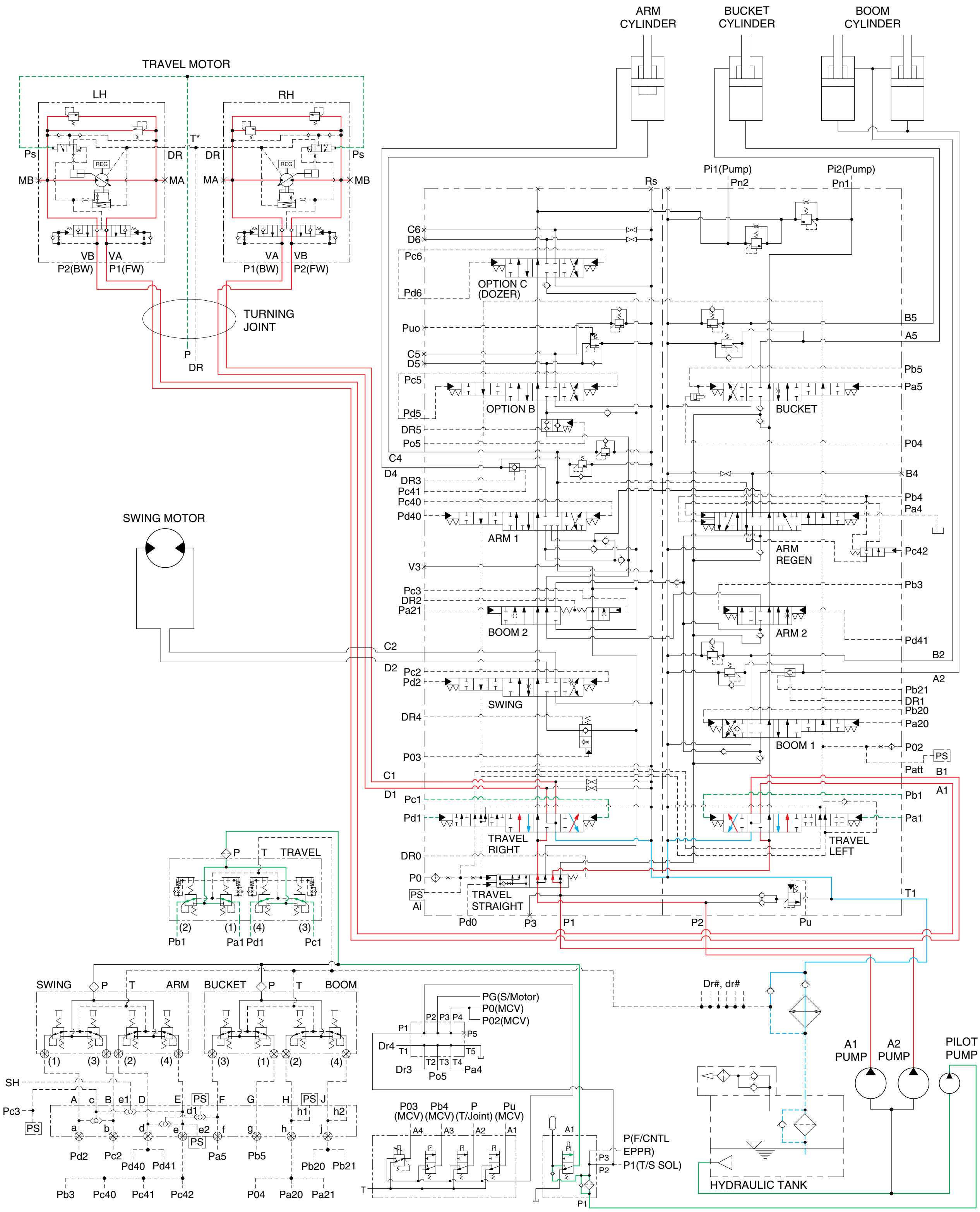
PARKING BRAKE "ON" OPERATION

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



145ZF3HC19

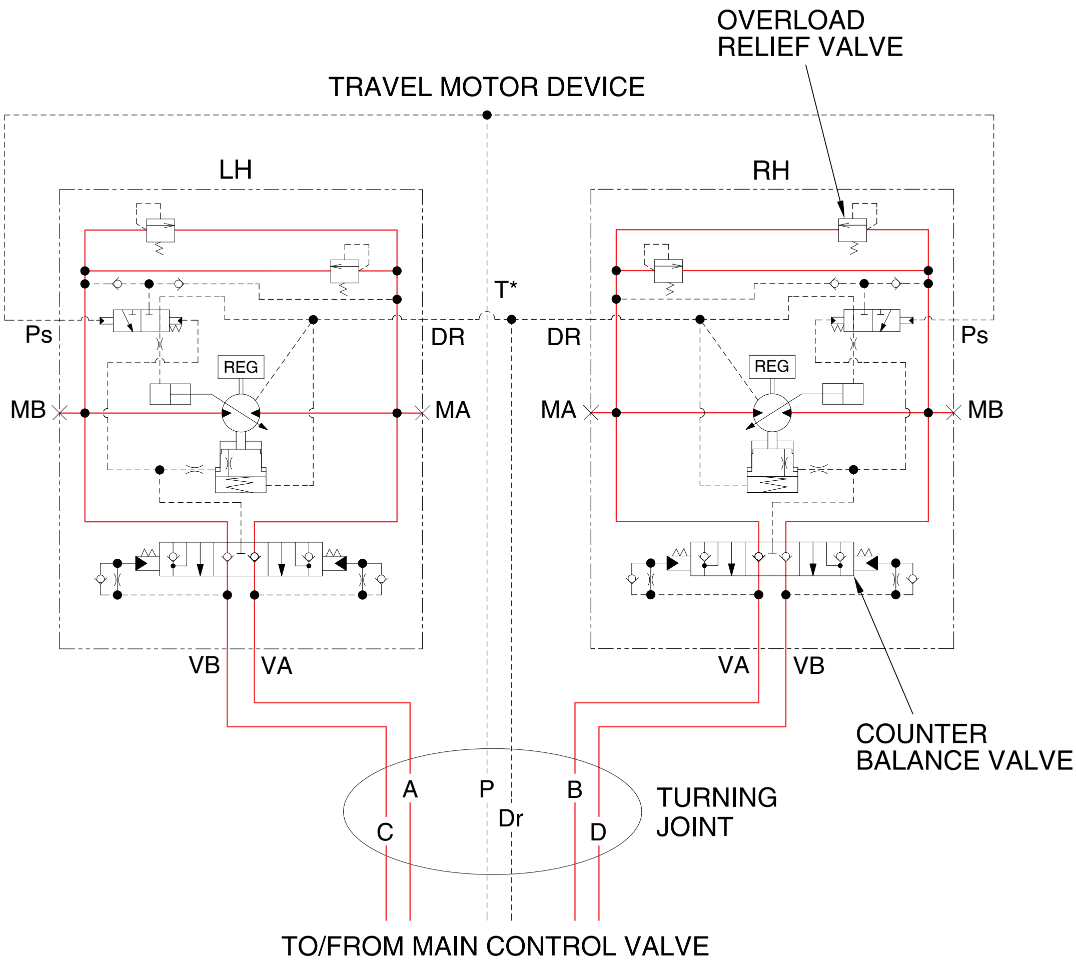
When the travel levers are pushed forward or reverse position, the travel spools in the main control valve are moved to the forward or reverse travel position by the pilot oil pressure from the remote control valve.

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



140L3HC19A

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

1) COUNTER BALANCE VALVE

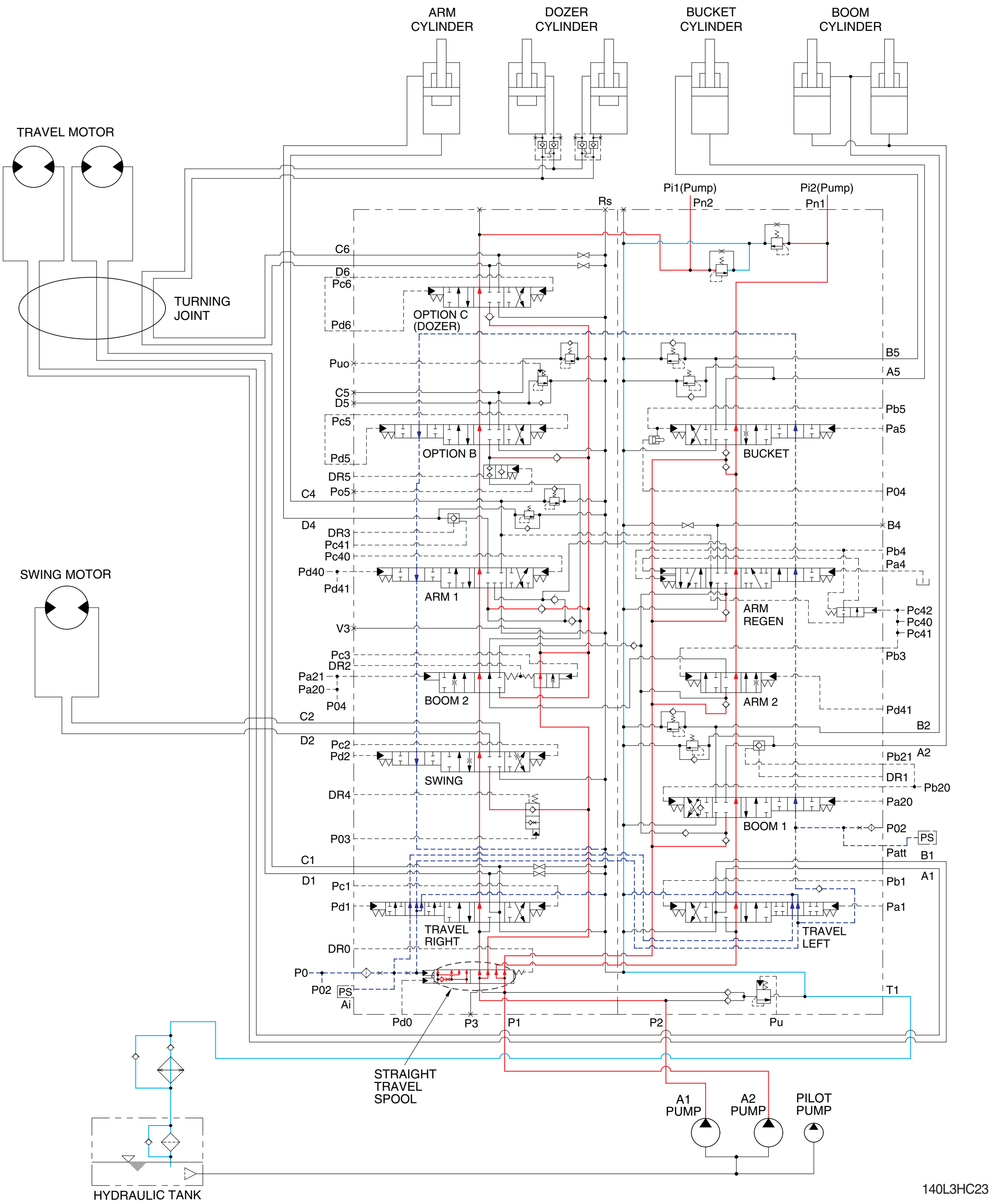
When stopping the motor of slope descending, this valve to prevent the motor over run.

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



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.

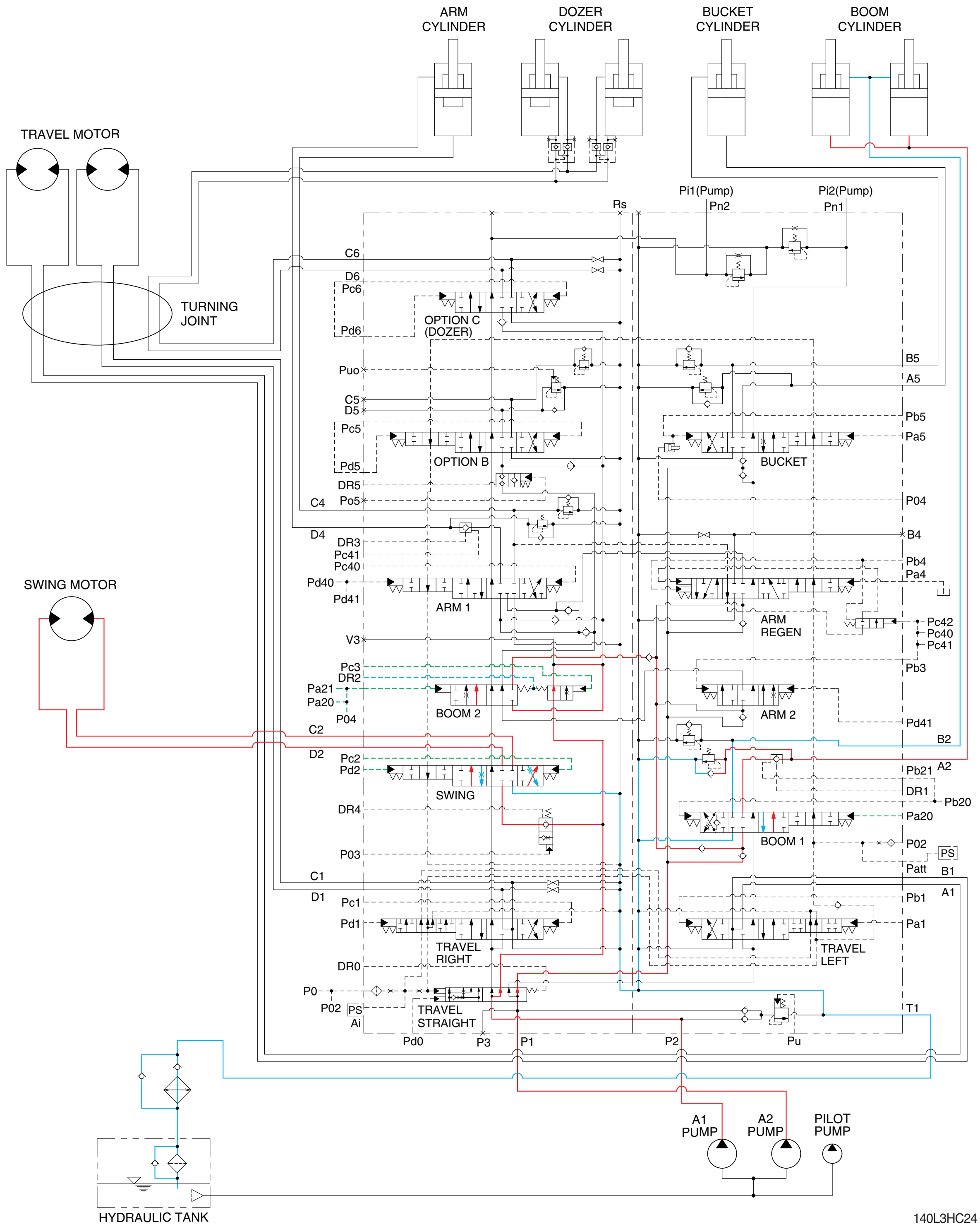
STRAIGHT TRAVEL SPOOL

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.

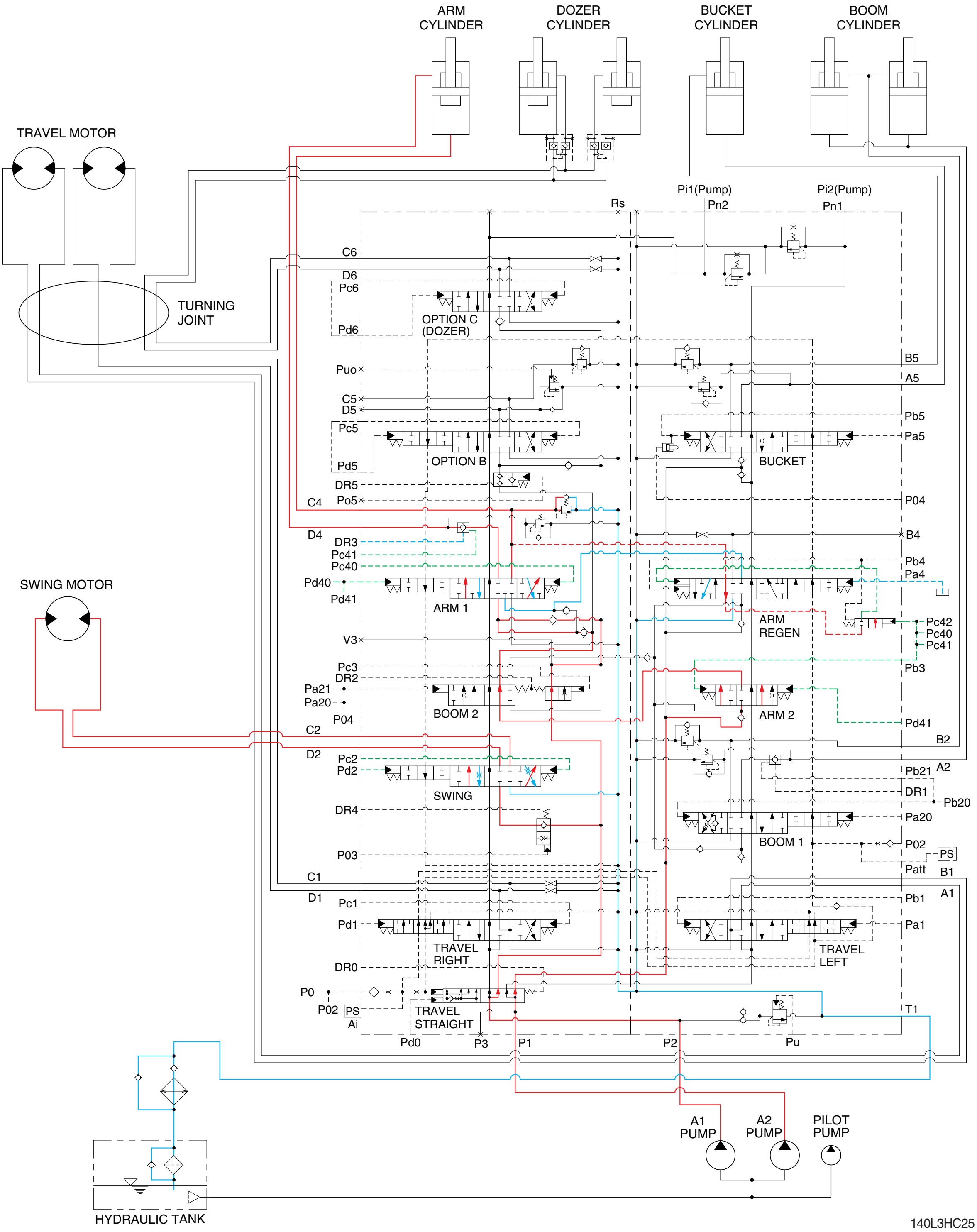
The oil from the A1 pump flows into the swing motor through swing spool and the boom cylinder through boom 2 spool.

The oil from the A2 pump flows into the boom cylinders through the boom 1 spool in the right control valve.

The super 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.

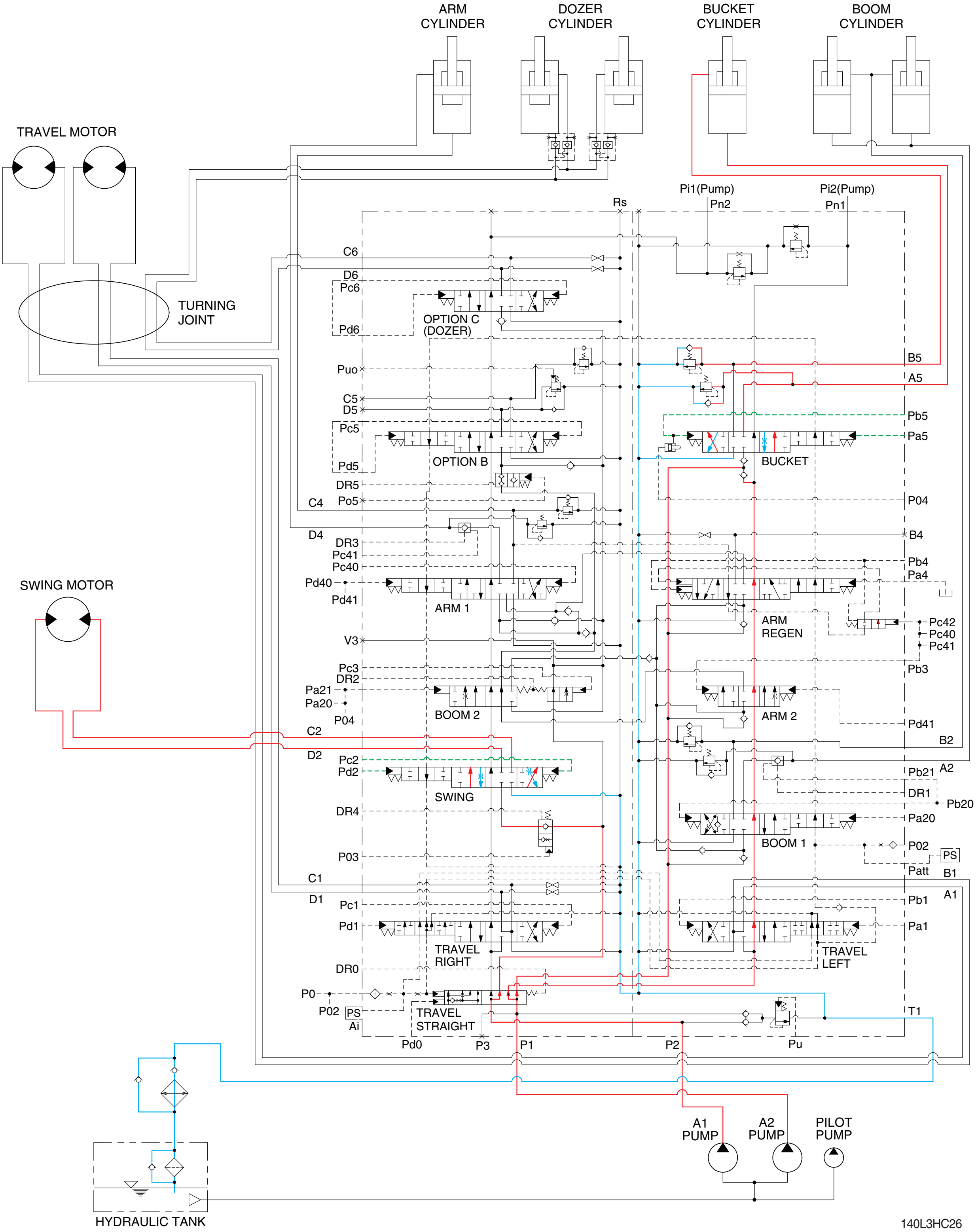
The oil from the A1 pump flows into the swing motor through swing spool and the arm cylinder through arm 1 spool.

The oil from the A2 pump flows into the arm cylinder through the arm 2 spool of the right control valve.

The super structure swings and the arm is operated.

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

4. COMBINED SWING AND BUCKET OPERATION



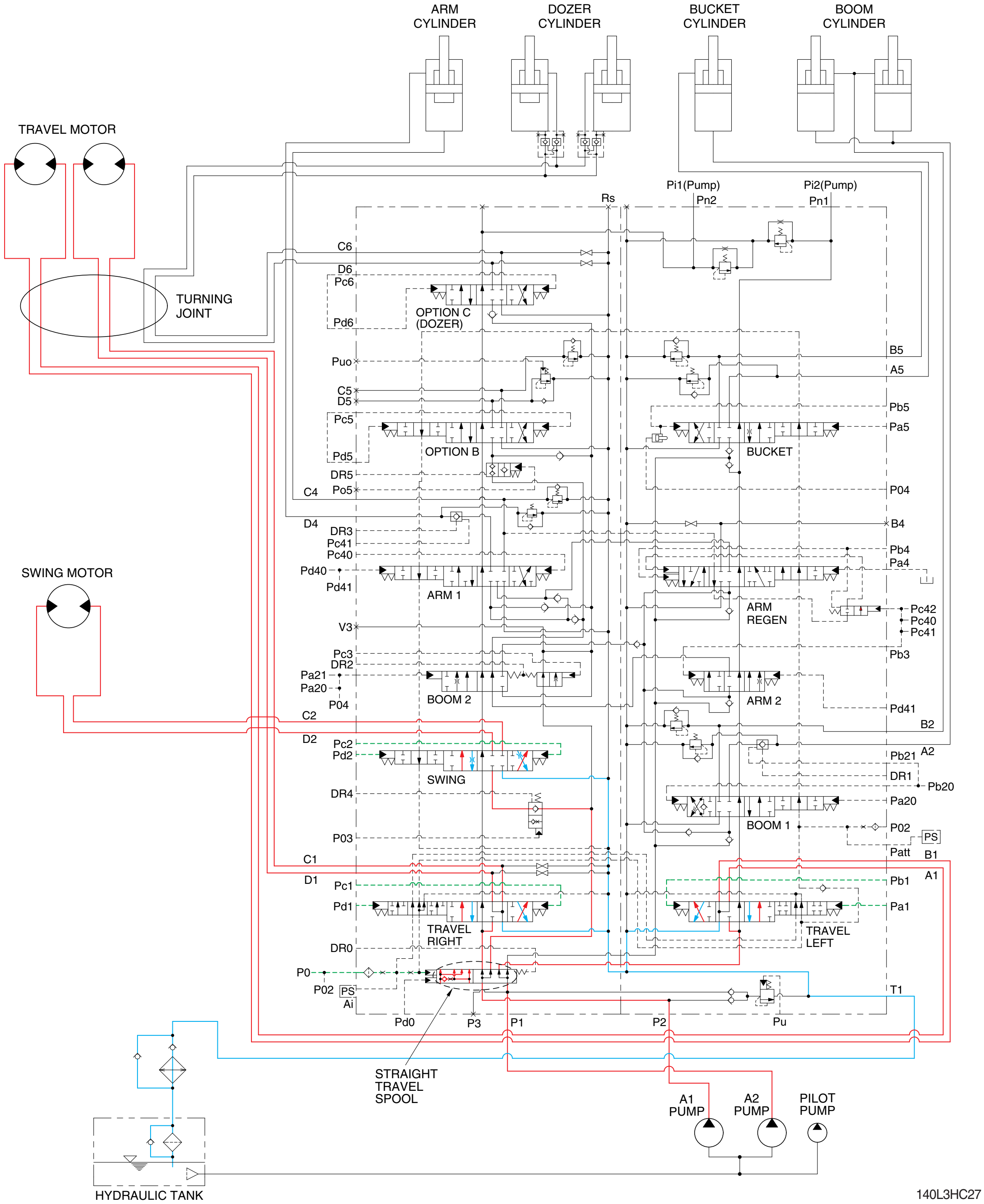
When the swing and bucket functions are operated simultaneously, the swing spool and bucket spool in the main control valve are moved to the functional position by the pilot oil pressure from the remote control valve.

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 super structure swings and the bucket is operated.

5. COMBINED SWING AND TRAVEL OPERATION



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

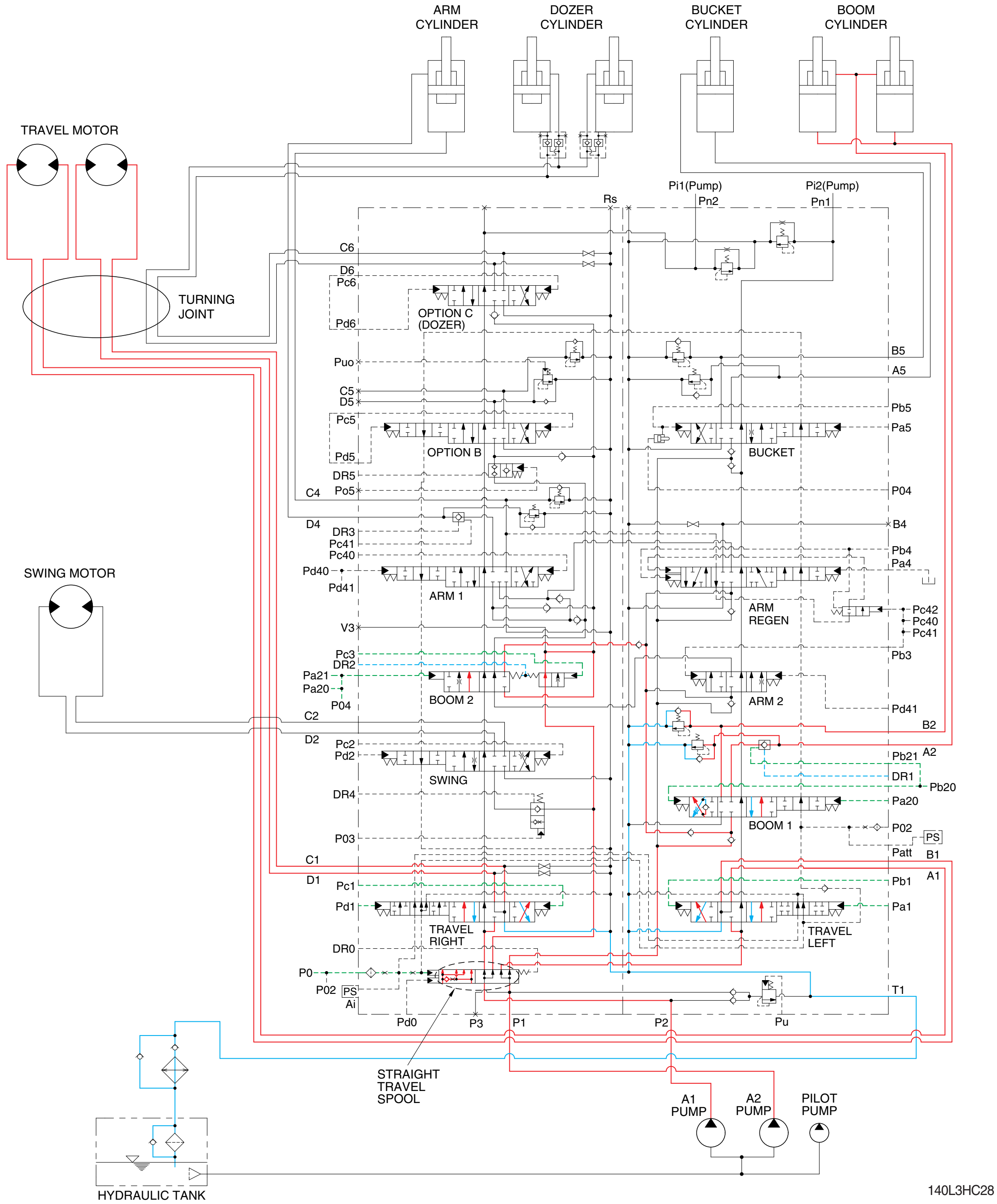
The oil from the A1 pump flows into the travel motors through the RH travel spool of the left control valve and the LH travel spool of the right control valve via the straight travel spool.

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

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

The upper structure swings and the machine travels straight.

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.

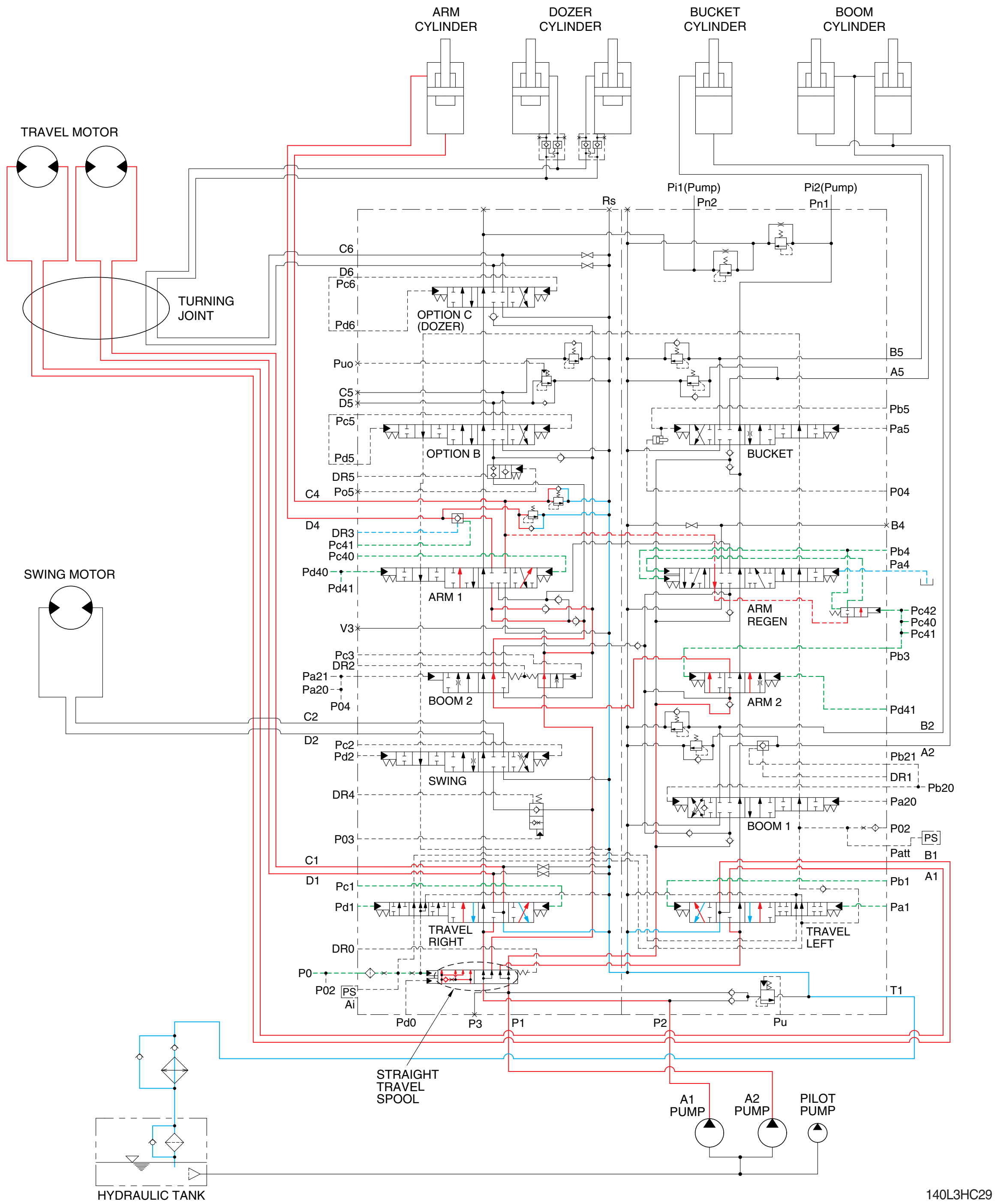
The oil from the A1 pump flows into the travel motors through the RH travel spool of the left control valve and the LH travel spool of the right control valve via the straight travel spool.

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.

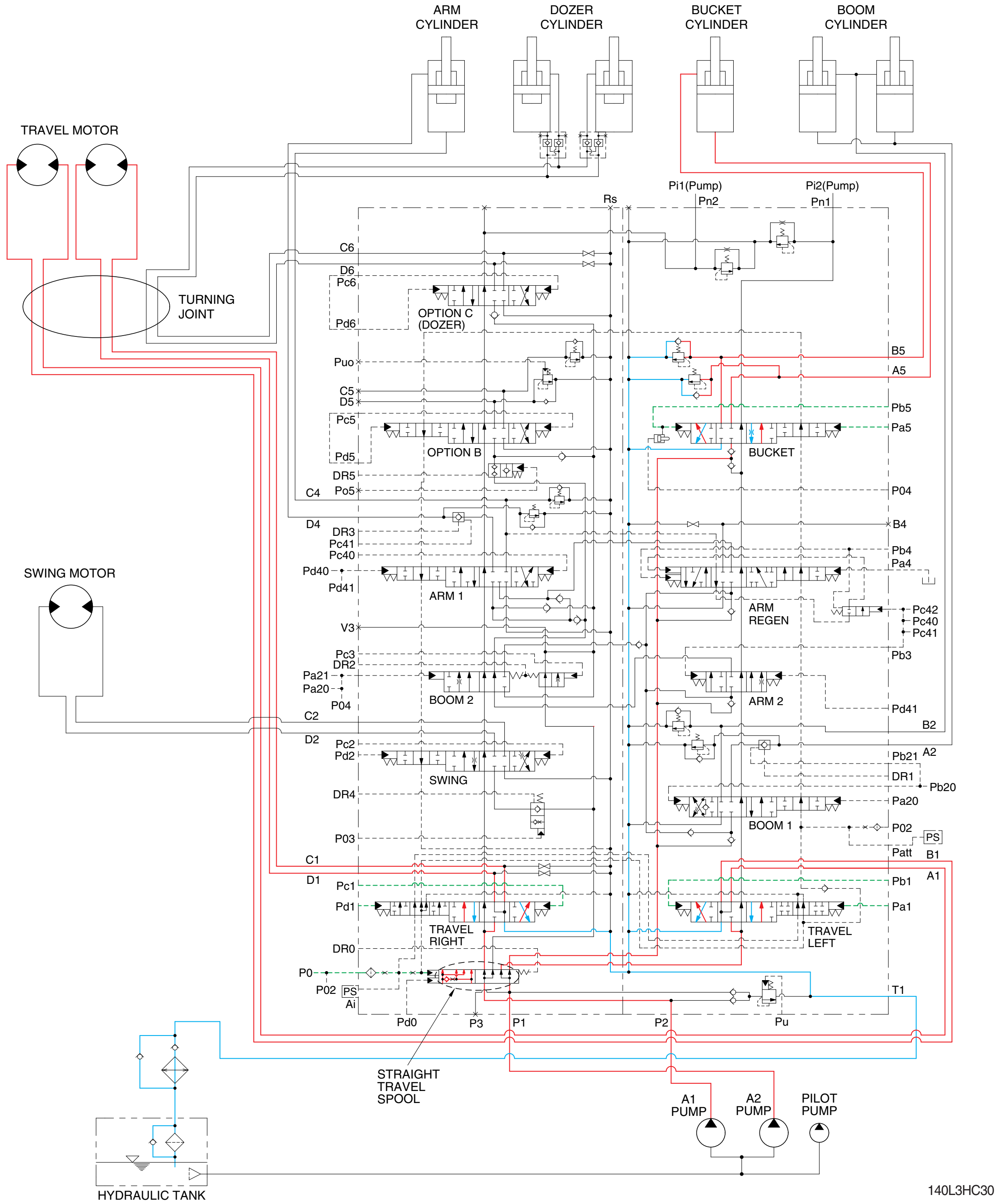
The oil from the A1 pump flows into the travel motors through the RH travel spool of the left control valve and the LH travel spool of the right control valve via the straight travel spool.

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



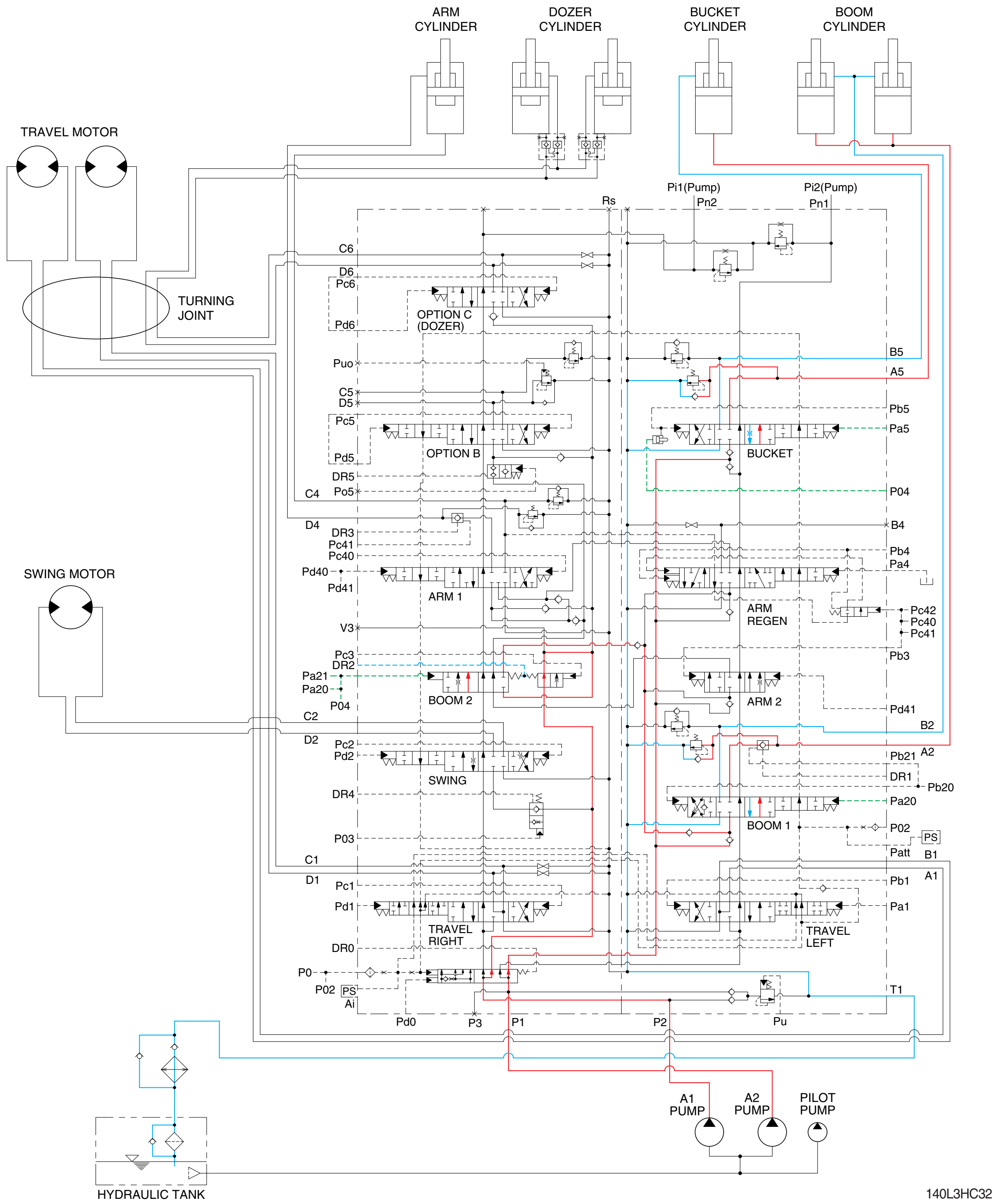
When the bucket and travel functions are operated simultaneously, the bucket spool and travel spools in the main control valve are moved to the functional position by the pilot oil pressure from the remote control valve, and the straight travel spool is pushed to the right by the oil pressure from pilot 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 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 bucket spool transfers in the half stroke not full stroke (refer to page 2-33). Therefore, the most of pressurized oil flows into boom 1 spool than the bucket spool to make the boom up operation more preferential.

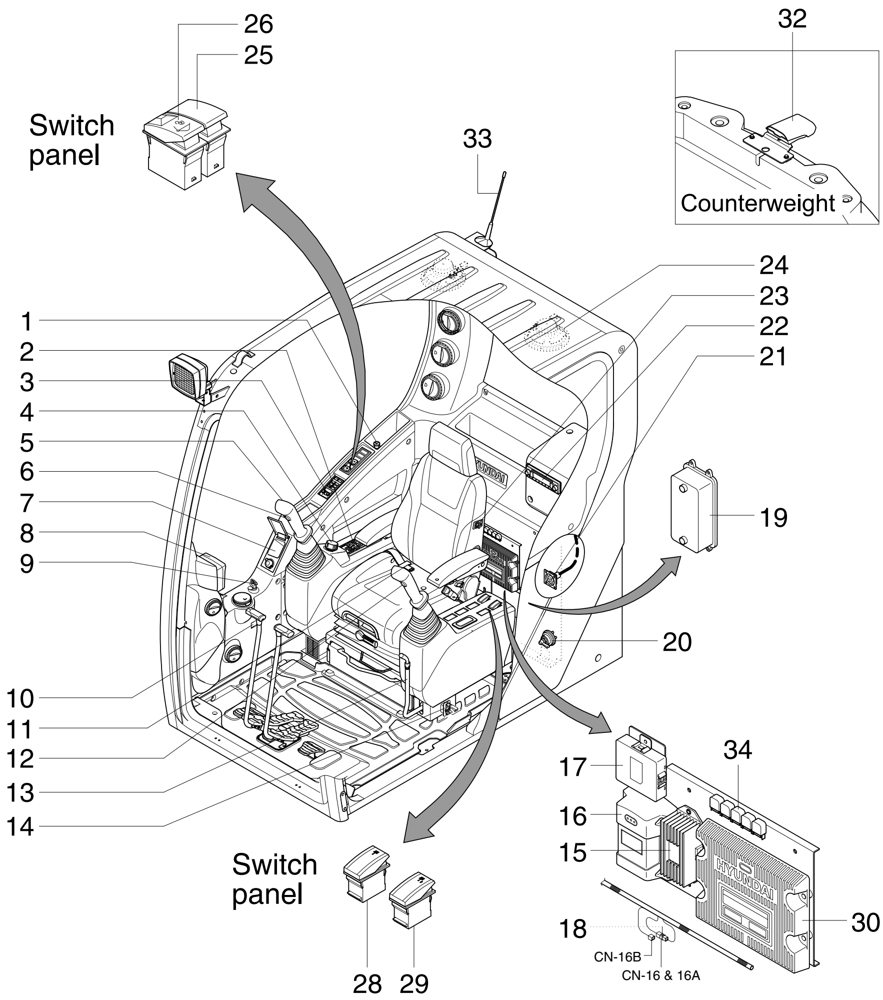
The boom and bucket are operated.

SECTION 4 ELECTRICAL SYSTEM

SECTION 4 ELECTRICAL SYSTEM

GROUP 1 COMPONENT LOCATION

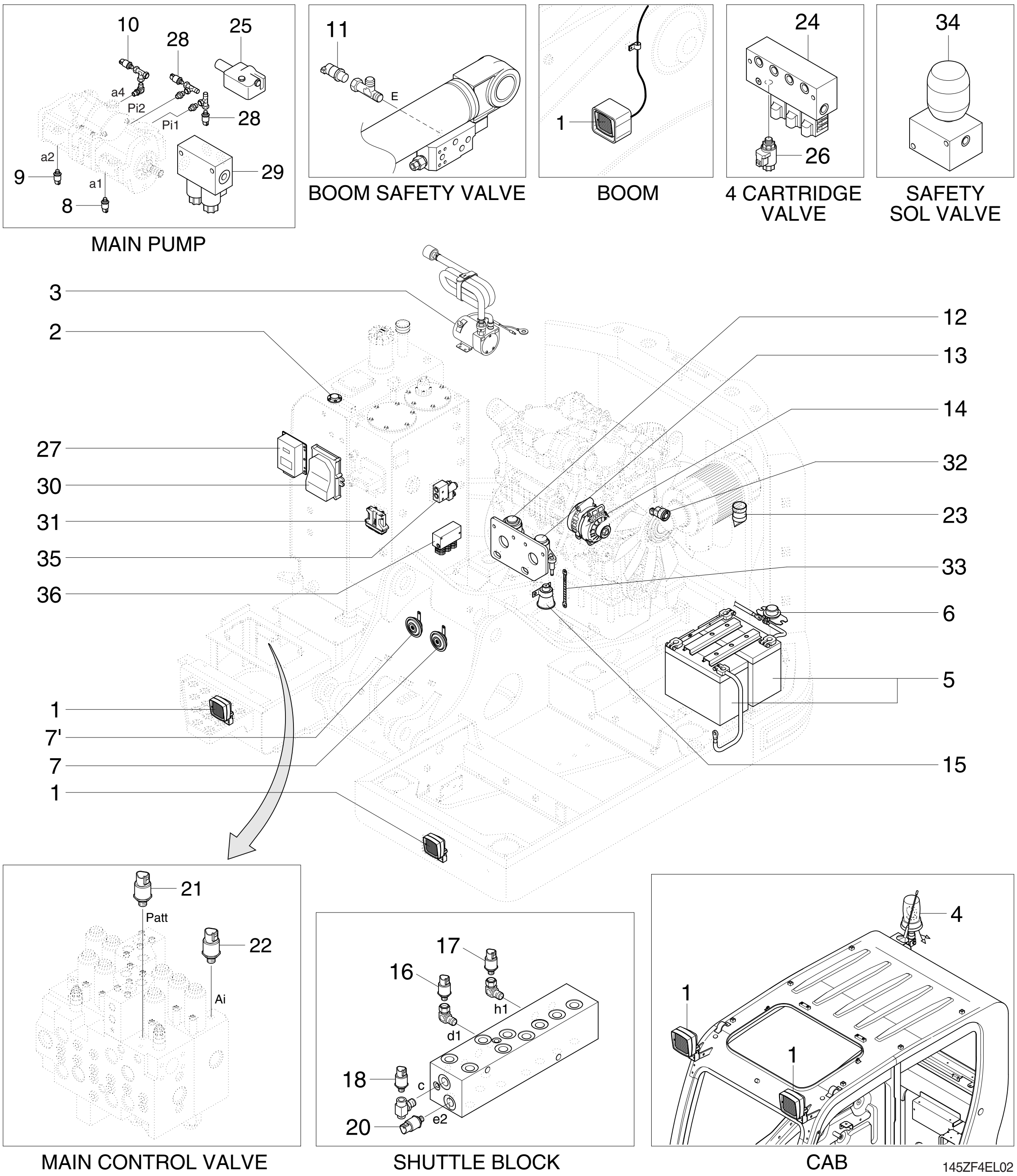
1. LOCATION 1



145ZF4EL01

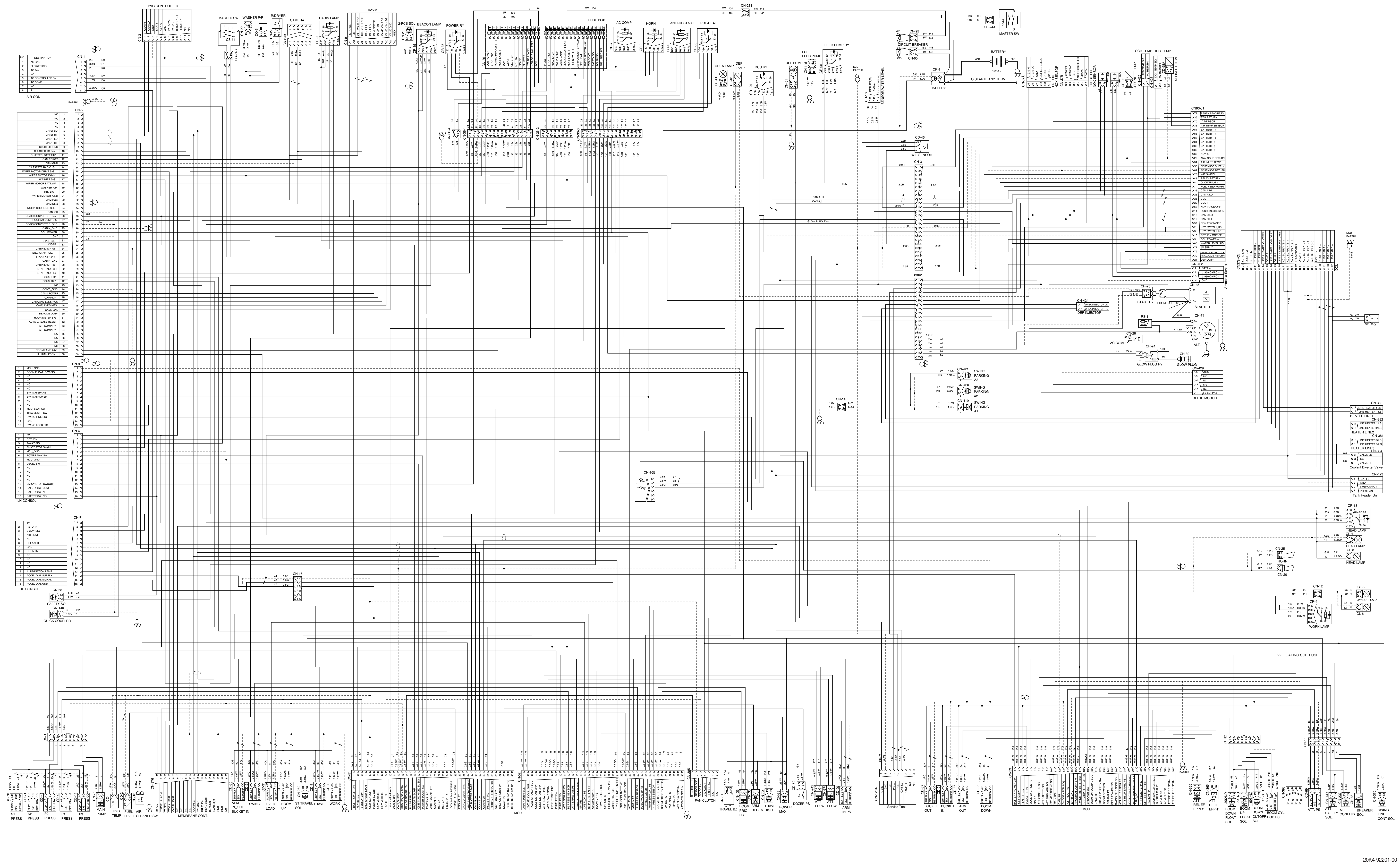
1	Cigar lighter	12	Power max switch	23	Heated seat switch
2	Aircon and heater switch	13	Safety lever	24	Speaker
3	Remote controller	14	Emergency engine stop switch	25	Option attachment switch
4	Accel dial switch	15	DC/DC converter	26	Quick clamp switch
5	Horn switch	16	Remote controller unit	28	Swing fine switch
6	Breaker operation switch	17	Handsfree control unit	29	Swing lock switch
7	USB & socket assy	18	Emergency engine connector	30	Machine control unit
8	Cluster	19	Fuse & relay box	32	Rear view camera
9	Start switch	20	Master switch	33	Satellite antenna
10	Service meter	21	RS232 & J1939 service socket	34	Relay - 5P
11	One touch decel switch	22	Radio & USB player		

2. LOCATION 2

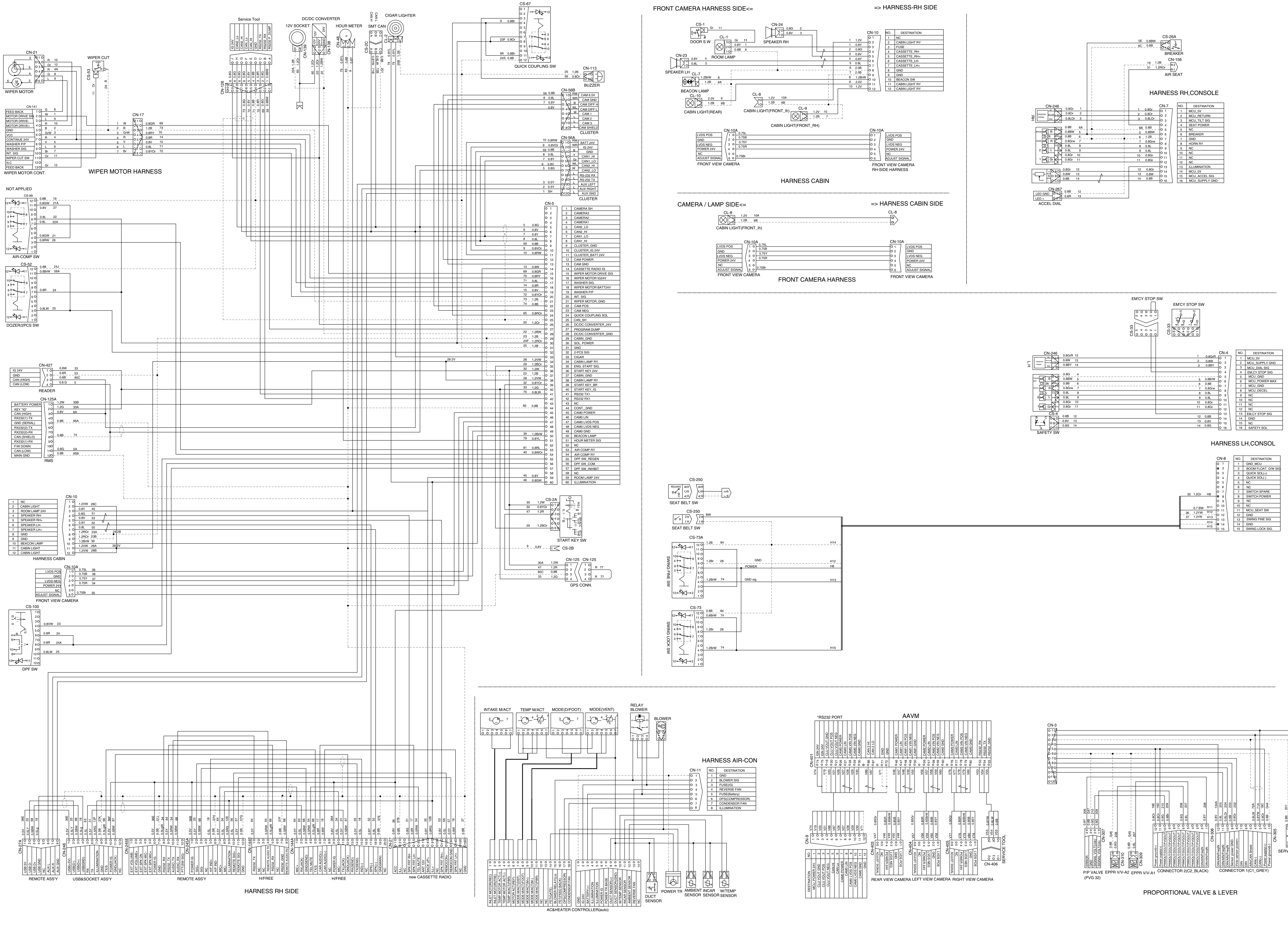


1	Lamp	12	Start relay	25	Pump EPPR valve
2	Fuel sender	13	Heater relay	26	Boom priority EPPR valve
3	Fuel filler pump	14	Alternator	27	Machine control unit - attach
4	Beacon lamp	15	Travel alarm buzzer	28	Nega-control pressure sensor
5	Battery	16	Arm/Bucket in pressure sensor	29	Flow control EPPR valve
6	Battery relay	17	Boom up pressure sensor	30	Relay drive unit
7	Horn - high	18	Swing pressure sensor	31	PVG 32 controller
7'	Horn - low	20	Arm in pressure sensor	32	Air cleaner indicator
8	P1 pressure sensor	21	Attach pressure sensor	33	Earth strap
9	P2 pressure sensor	22	Travel pressure sensor	34	Safety solenoid valve
10	EPPR pressure sensor	23	Air cleaner sensor	35	Swing fine solenoid valve
11	Overload pressure sensor	24	4 cartridge valve	36	Swing lock solenoid valve

· ELECTRICAL CIRCUIT (1/4, SERIAL NO. : -#0967)

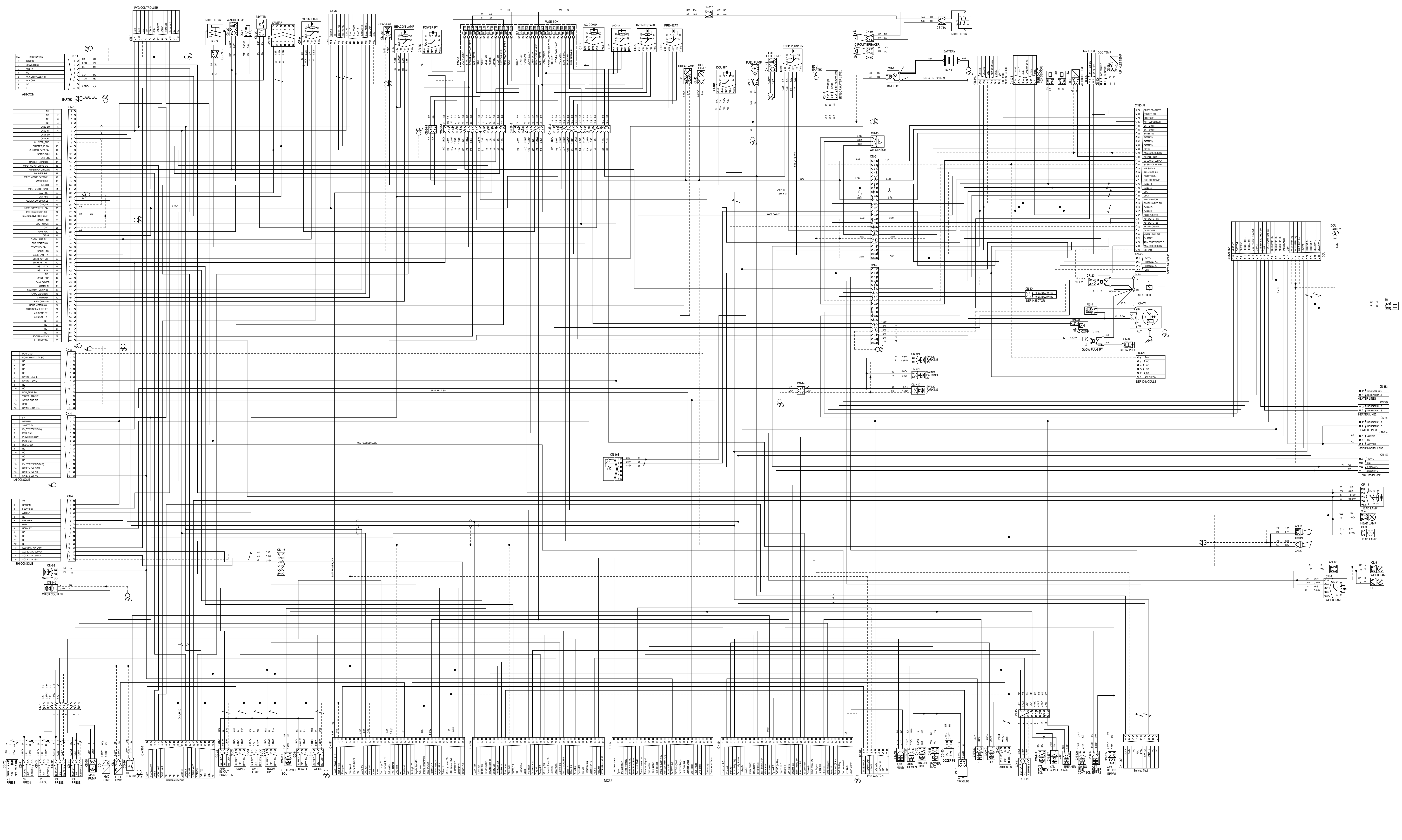


· ELECTRICAL CIRCUIT (2/4, SERIAL NO. : -#0967)



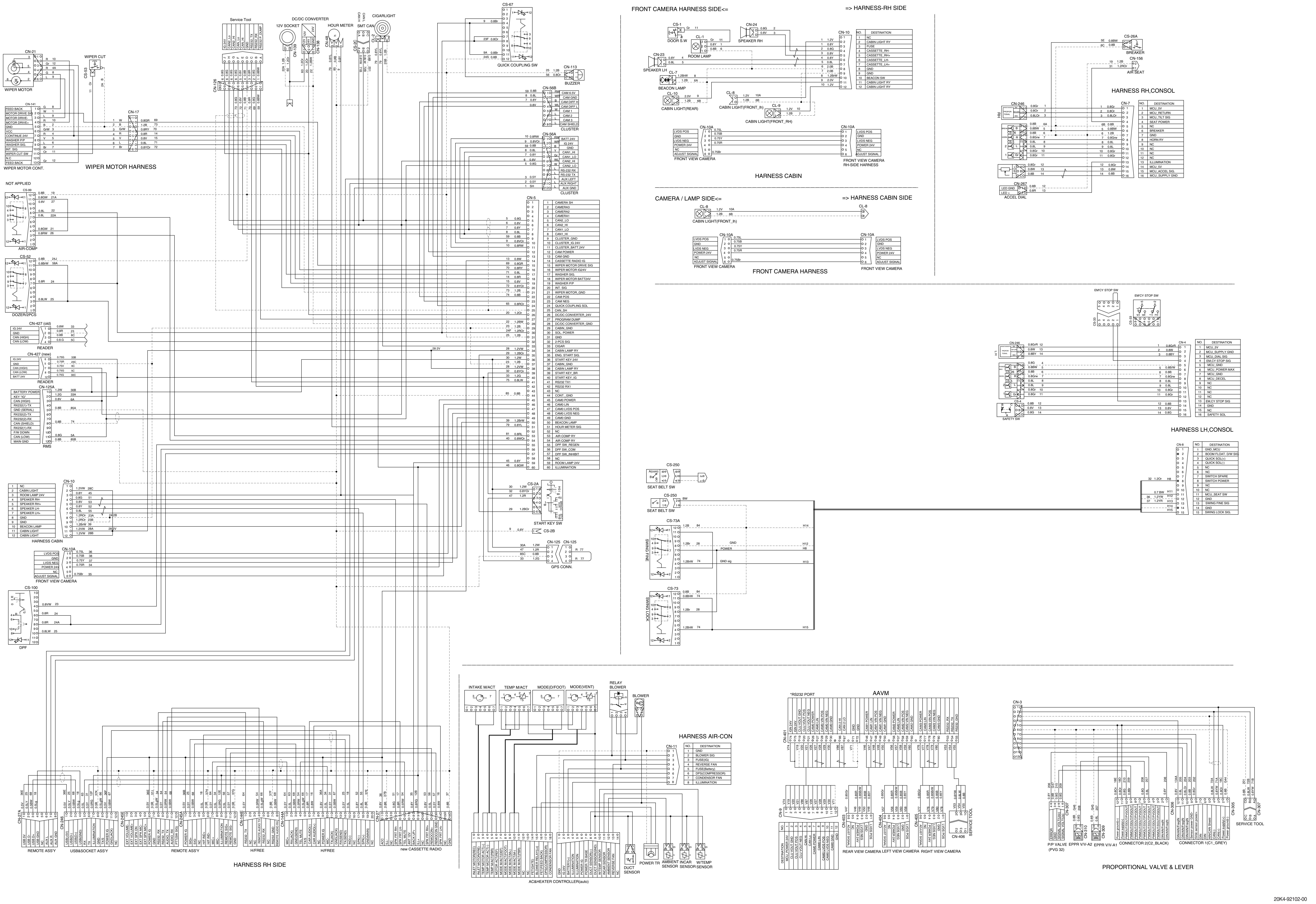
20K4-92101-01

· ELECTRICAL CIRCUIT (3/4, SERIAL NO. : #0968-)



20K4-95201-00

· ELECTRICAL CIRCUIT (4/4, SERIAL NO. : #0968-)



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] → I/conn [CN-231 (2)]

- → Fuse box [No.1] → I/conn [CN-36-4 (2)] → DCU relay [CR-101 (30)]
- → Fuse box [No.2]
  - → I/conn [CN-36-1 (7)] → 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.3] → I/conn [CN-36-1 (8)] → I/conn [CN-5 (59)]
  - → I/conn [CN-10 (3)] → Room lamp [CL-1 (2)] → Door switch [CS-1]
  - → Radio & USB player [CN-27 (8)]
  - → Hour meter [CN-48 (1)]
- → Fuse box [No.4] → I/conn [CN-36-2 (2)] → I/conn [CN-11 (5)]
  - → AC & Heater controller (3)
  - → Blower relay (3)
- → Fuse box [No.5] → I/conn [CN-36-4 (1)]
  - → 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.6] → I/conn [CN-36-1 (11)] → I/conn [CN - 5 (18)] → I/conn [CN -17 (5)]
  - → Wiper motor controller [CN-141 (7)]
  - → Wiper motor [CN-21 (4)]
- → Fuse box [No.7] → I/conn [CN-36-1 (12)] → I/conn [CN-5 (11)] → Cluster [CN -56A (1)]
- → Fuse box [No.8] → I/conn [CN-36-1 (13)]
  - → MCU [CN-51 (1)]
  - → MCU [CN-53 (1)]

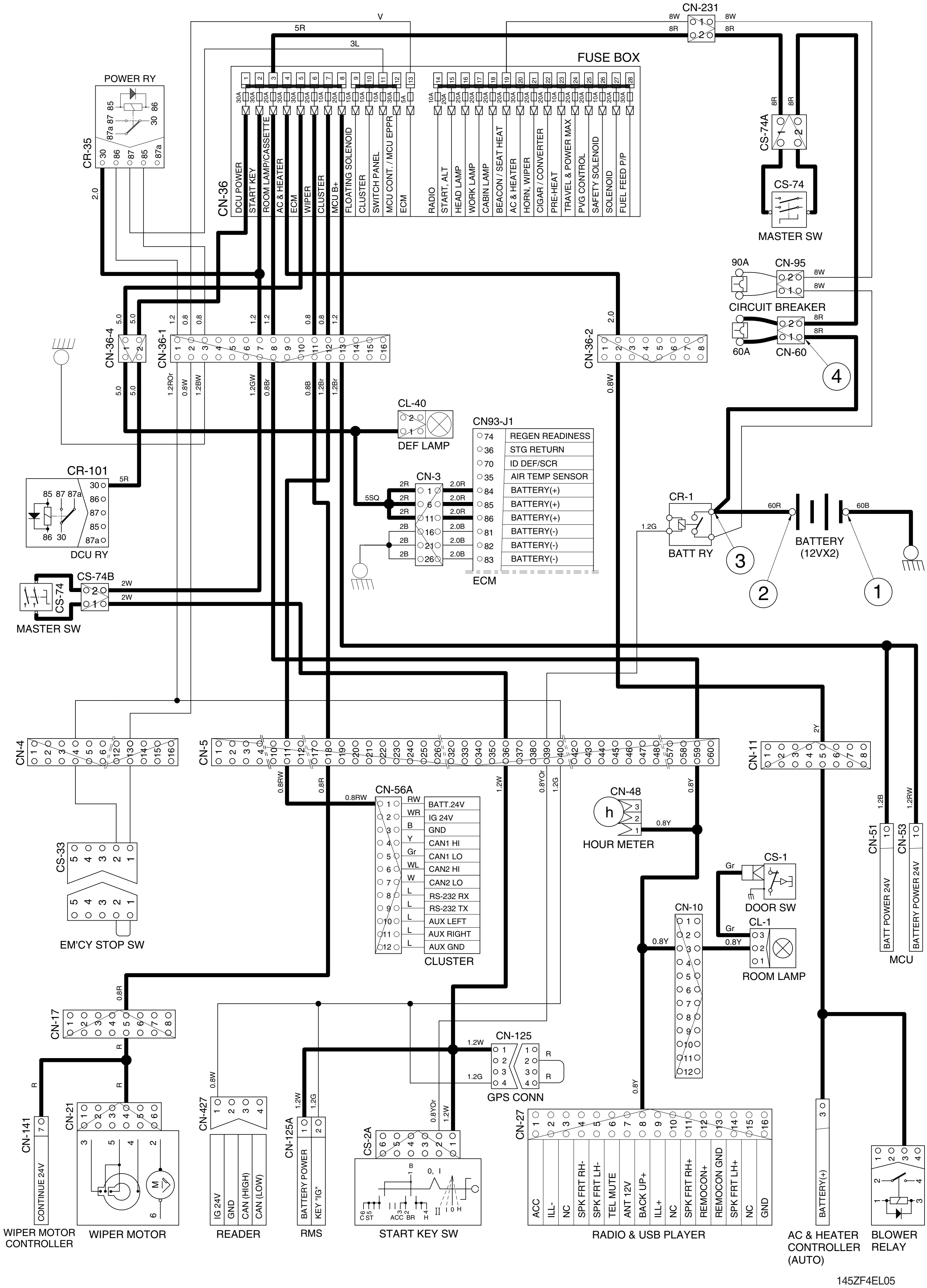
※ I/conn : Intermediate connector

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] → I/conn [CN-231 (2)] → Fuse box [No.2] → I/conn [CN-36-1 (7)] → Master switch [CS-74B] → I/conn [CN-5 (36)] → Start switch [CS-2A (1)]

(1) When start key switch is in ON position

- → Start switch ON [CS-2A (2)] → I/conn [CN-5 (39)]
  → Battery relay [CR-1] → Battery relay operating (all power is supplied with the electric component)
- → Start switch ON [CS-2A (3)] → GPS conn [CN-125 (2)→(4)]
  - → I/conn [CN-5 (40)]
    - → I/conn [CN-36-1 (1)] → Power relay [CR-35 (86)→(87)]
      → Fuse box [No.9~12]
    - → I/conn [CN-4 (4)] → Emergency engine stop sw [CS-33 (2)→(1)]
      → I/conn [CN-4 (13)] → I/conn [CN-36-1 (2)] → Fuse box [No. 13]
      → I/conn [CN-36-1 (6)] → I/conn [CN-2 (6)]
      → Engine ECM [CN 93-J1 (69)]
  - → Reader [CN-427 (1)]
  - → RMS [CN-125A (2)]

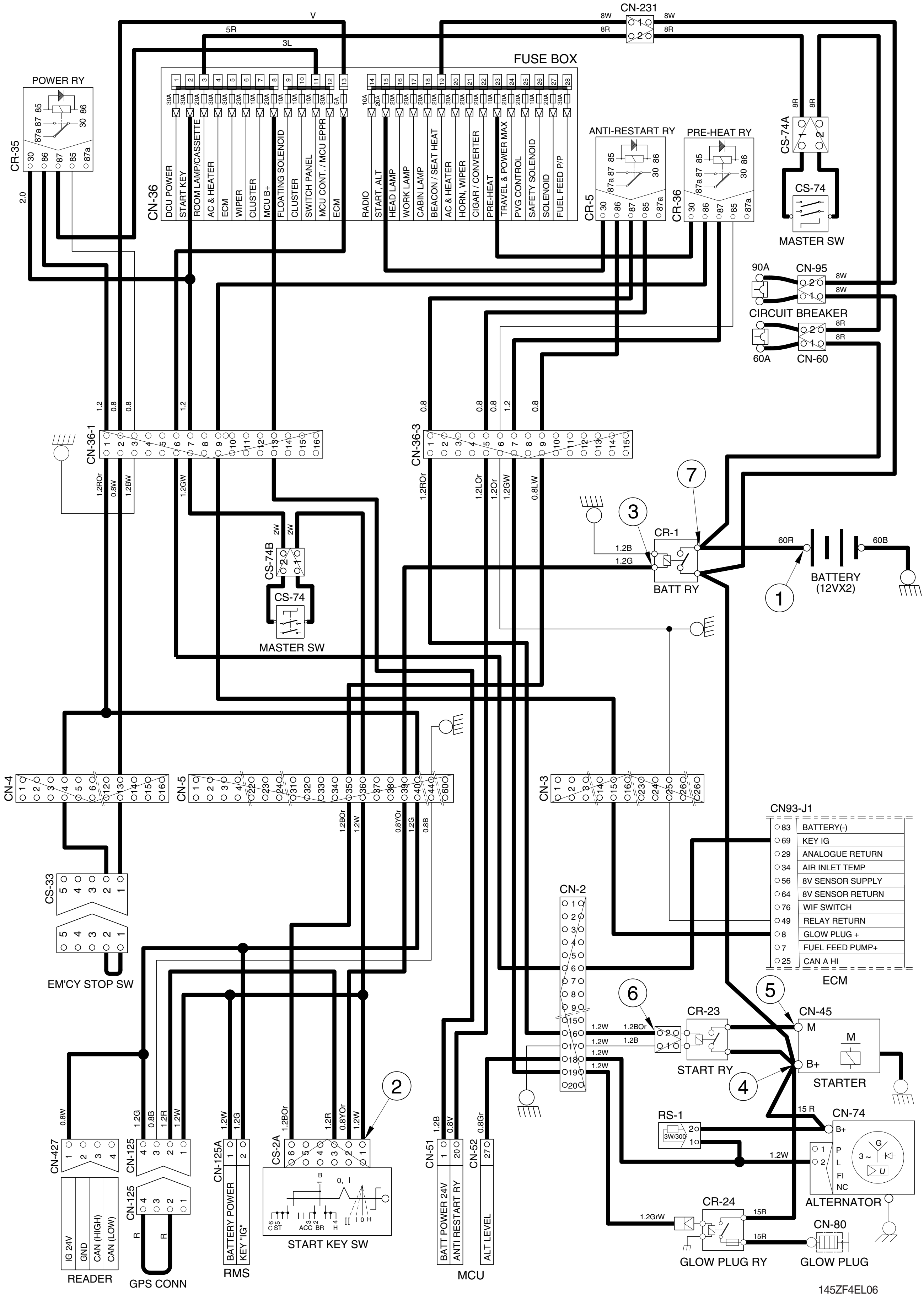
(2) When start key switch is in START position

Start switch START [CS-2A (6)] → I/conn [CN-5 (35)] → I/conn [CN-36-3 (9)] → Anti-restart relay [CR-5 (86)→(87)] → I/conn [CN-36-3 (1)] → 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 starting switch to the ON position.

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

The current also flows from the 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

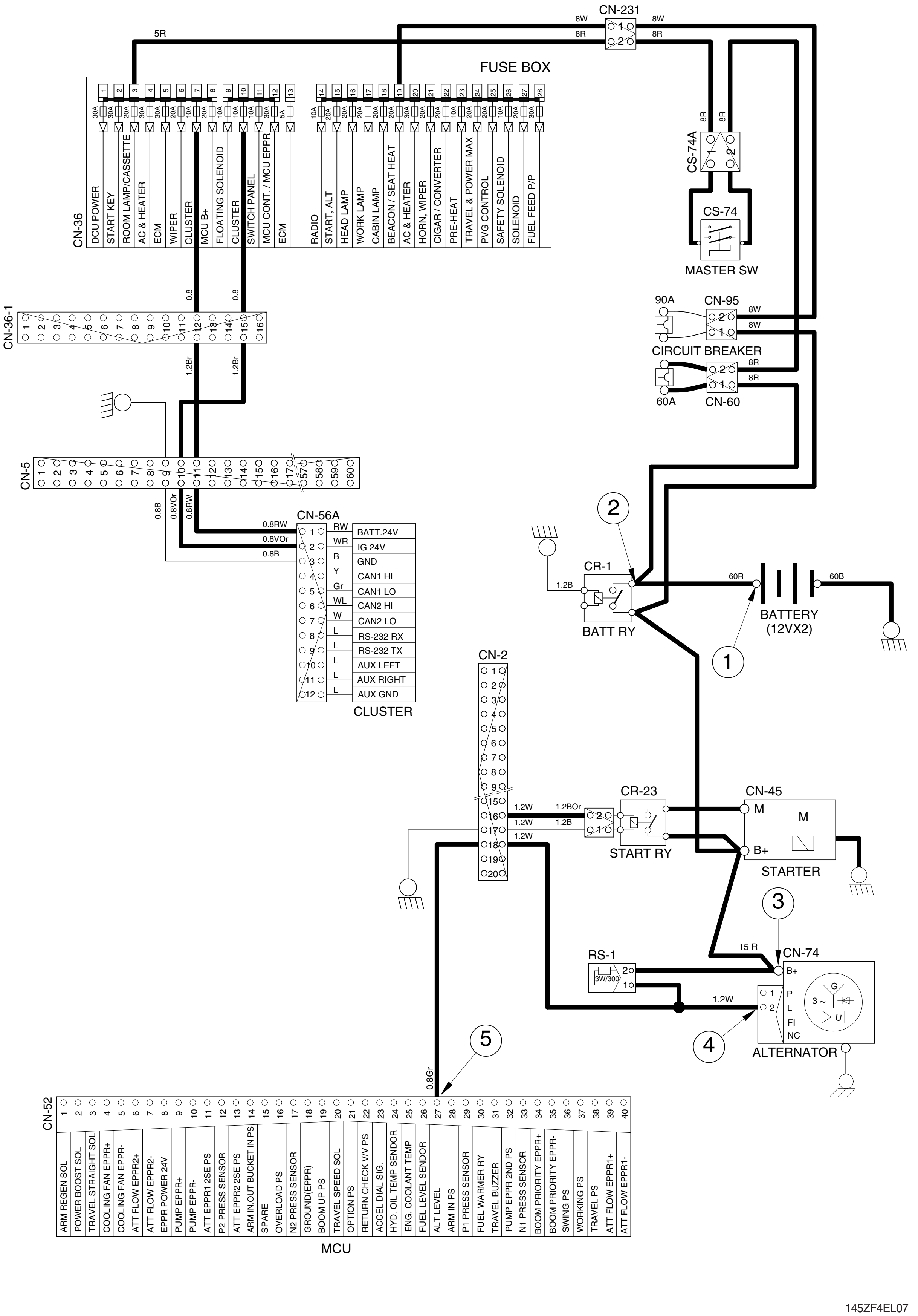
Alternator "B^+" terminal → Starter motor [CN-45 (B+)]
→ Battery relay
- → Battery (+) terminal
- → Circuit breaker [CN-60] → Master switch [CS-74A] → I/conn [CN-231 (2)]
  → Fuse box [No. 1~8]
- → Circuit breaker [CN-95] → I/conn [CN-231 (1)] → Fuse box [No. 14~28]

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



4. HEAD AND WORK LIGHT CIRCUIT

1) OPERATING FLOW

Fuse box (No.16) → I/conn [CN-36-2 (4)] → Head light relay [CR-13 (30, 86)]
Fuse box (No.17) → I/conn [CN-36-2 (5)] → 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)]
- → I/conn [CN-7 (13)] → Accel dial LED ON [CN-267 (2)]
- → I/conn [CN-5 (60)]
  - → Radio & USB player illumination ON [CN-27 (9)]
  - → Remote controller illumination ON [CN-245A (9)]
  - → USB & socket illumination ON [CN-246 (7)]
  - → Cigar lighter [CL-2]
- → I/conn [CN-11 (8)] → AC & heater controller illumination ON (4)

(2) Work light switch ON

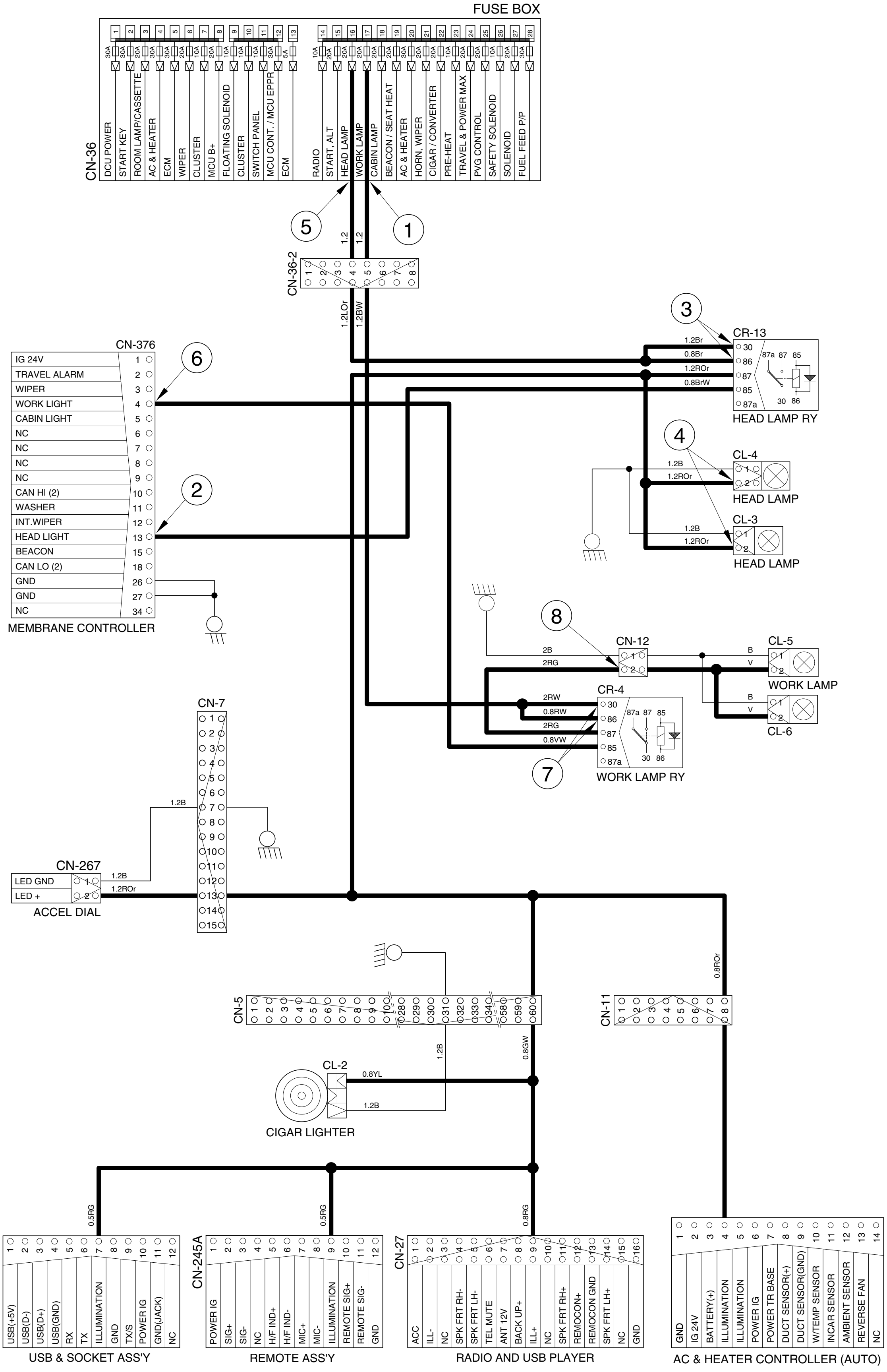
Work light switch ON [CN-376 (4)] → Work light relay [CR-4 (85) → (87)]
→ I/conn [CN-12 (2)] → Work light ON [CL-5 (2), CL-6 (2)]

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



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5. BEACON LAMP AND CAB LIGHT CIRCUIT

1) OPERATING FLOW

Fuse box (No.19) → I/conn [CN-36-1 (5)] → Beacon lamp relay [CR-85 (30, 86)]
Fuse box (No.18) → I/conn [CN-36-2 (6)] → Cab light relay [CR-9 (30, 86)]

(1) Beacon lamp switch ON

Beacon lamp switch ON [CN-376 (15)] → Beacon lamp relay [CR-85 (85)→(87)]
→ I/conn [CN-5 (50)] → I/conn [CN-10 (10)] → Beacon lamp ON [CL-7]

(2) Cab light switch ON

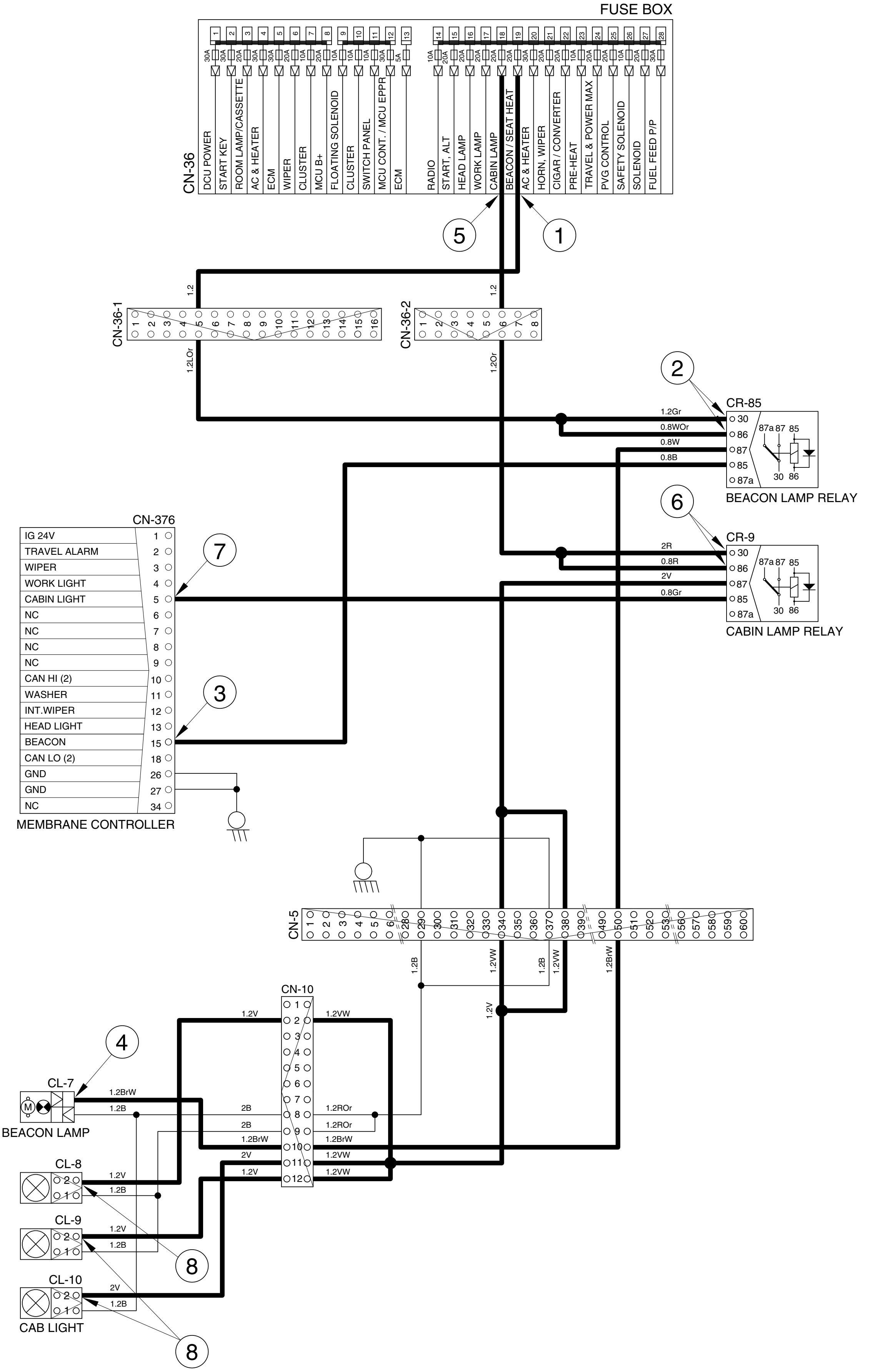
Cab light switch ON [CN-376 (5)] → Cab lamp relay [CR-9 (85)→(87)]
→ I/conn [CN-5 (34, 38)] ┬→ I/conn [CN-10 (2)] → Cab light ON [CL-8 (2)]
├→ I/conn [CN-10 (12)] → Cab light ON [CL-9 (2)]
└→ I/conn [CN-10 (11)] → Cab light ON [CL-10 (2)]

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 (cab 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.11) → I/conn [CN-36-1 (16)] → Membrane controller [CN-376 (1)]

Fuse box (No.6) → I/conn [CN-36-1 (11)] → I/conn [CN-5 (18)] → I/conn [CN-17 (5)]

→ Wiper motor controller [CN-141 (7)]

→ Wiper motor [CN-21 (4)]

Fuse box (No.21) → I/conn [CN-36-1 (4)] → I/conn [CN-5 (16)] → I/conn [CN-17 (4)]

→ Wiper motor controller [CN-141 (6)]

→ 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)

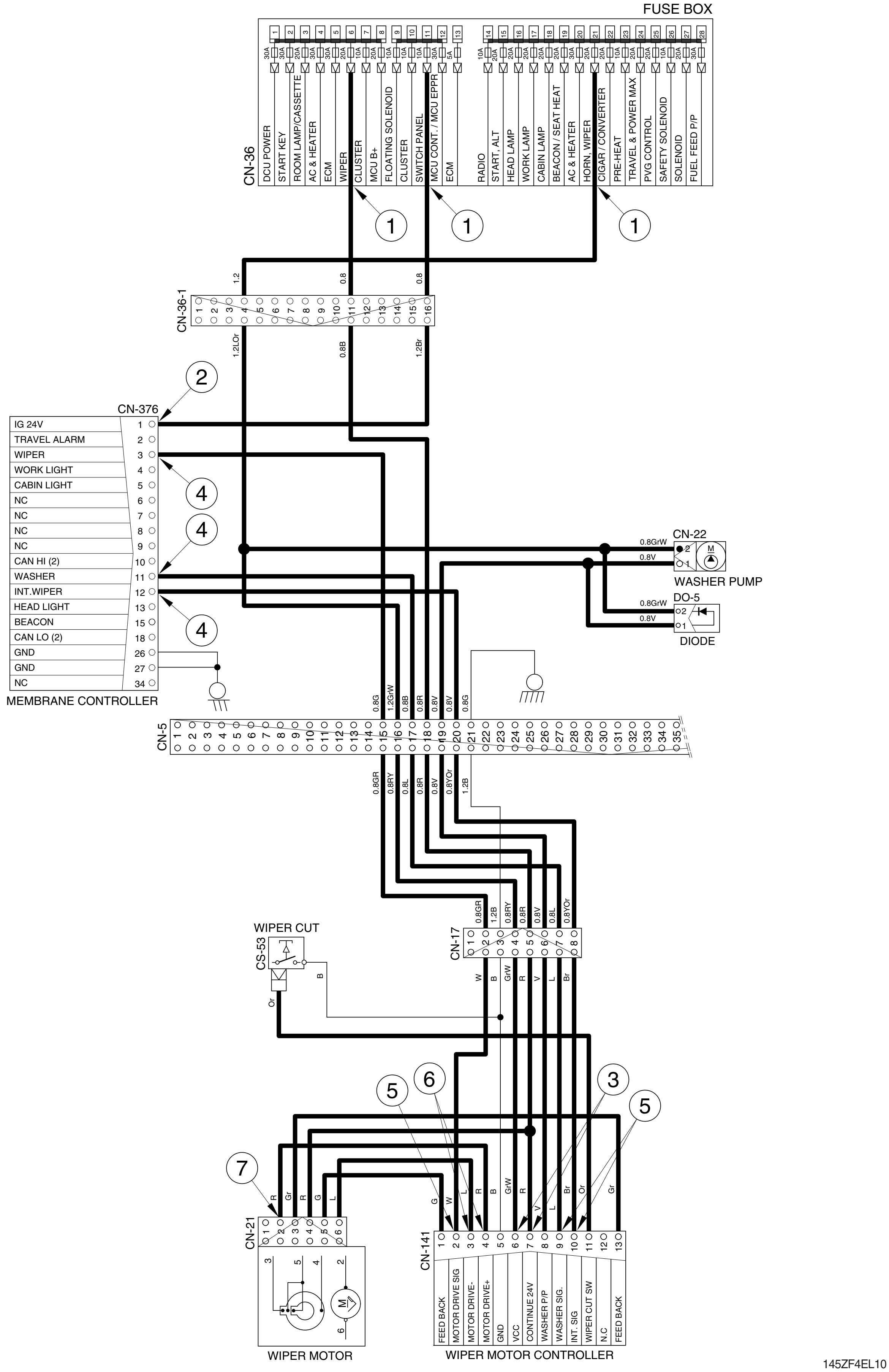
Switch OFF [CN-376 (3, 12)] → Wiper motor parking position by wiper motor controller

3) CHECK POINT

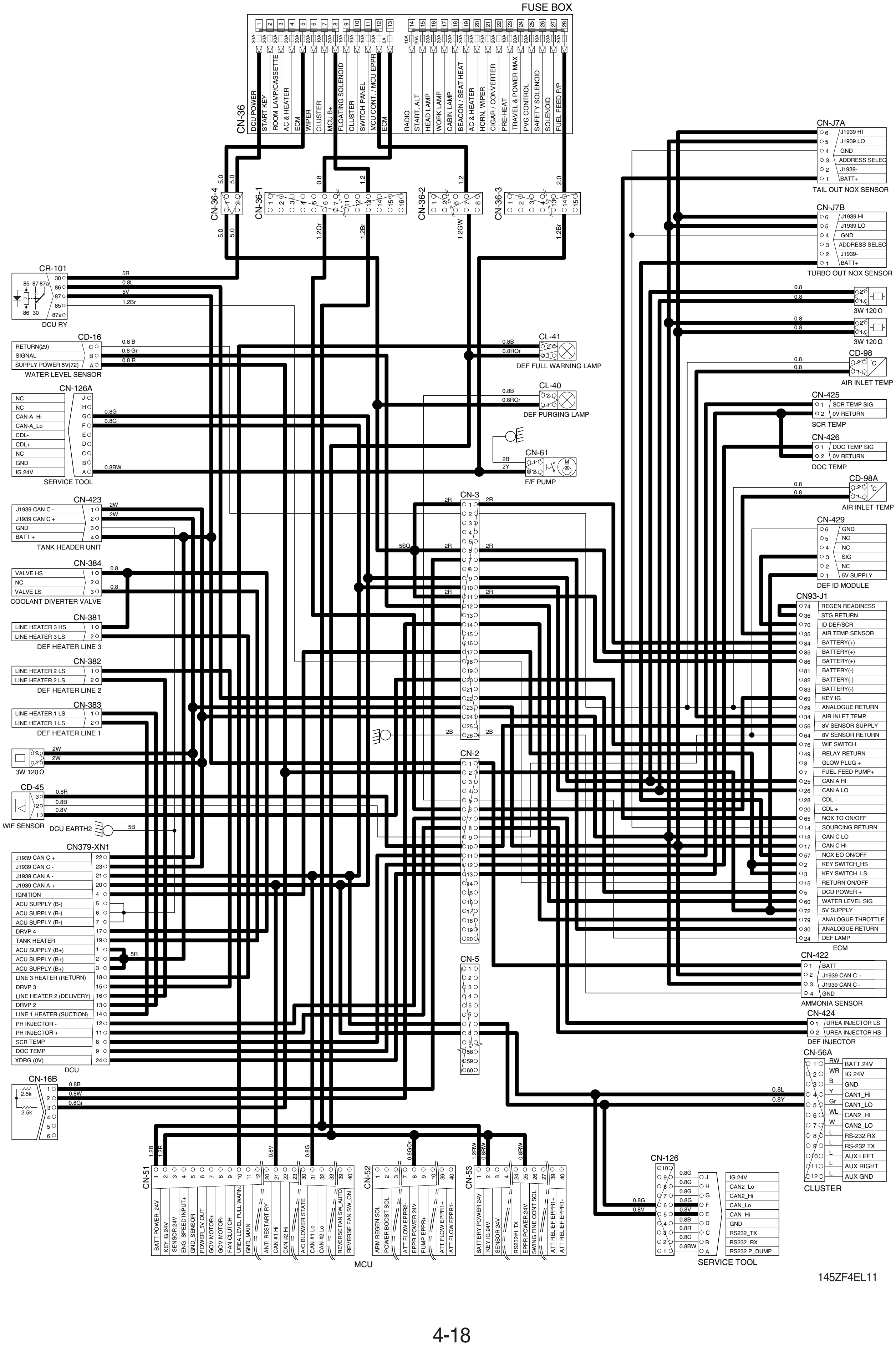
Engine	Start switch	Check point	Voltage
STOP	ON	① - GND (fuse box)	20~25V
		② - GND (switch power input)	
		③ - GND (wiper power input)	
		④ - GND (switch power output)	0 ~ 5V
		⑤ - GND (wiper power input)	
		⑥ - GND (wiper power output)	24V
		⑦ - GND (wiper motor)	0 or 24V

※ GND : Ground

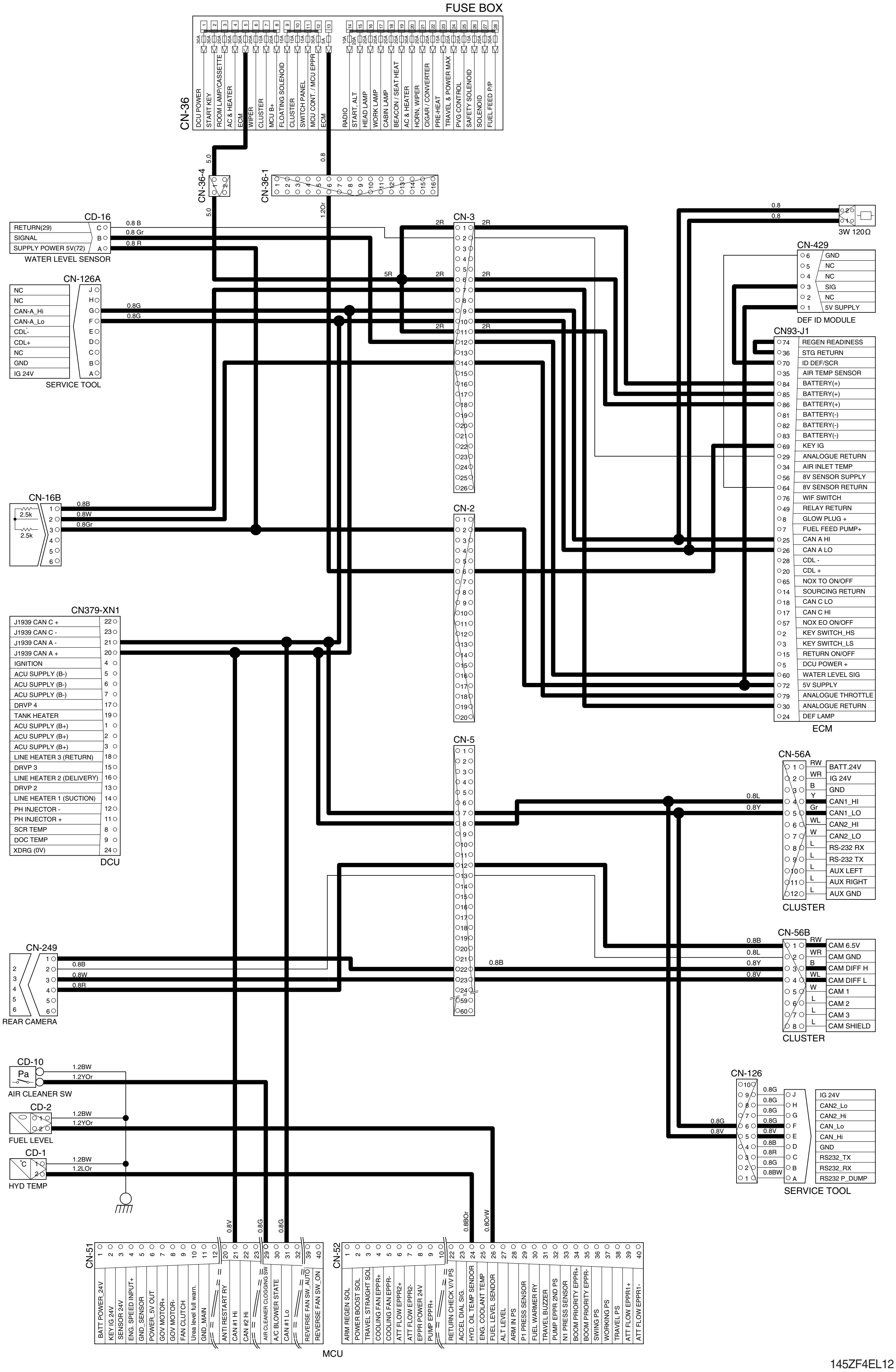
WIPER AND WASHER CIRCUIT



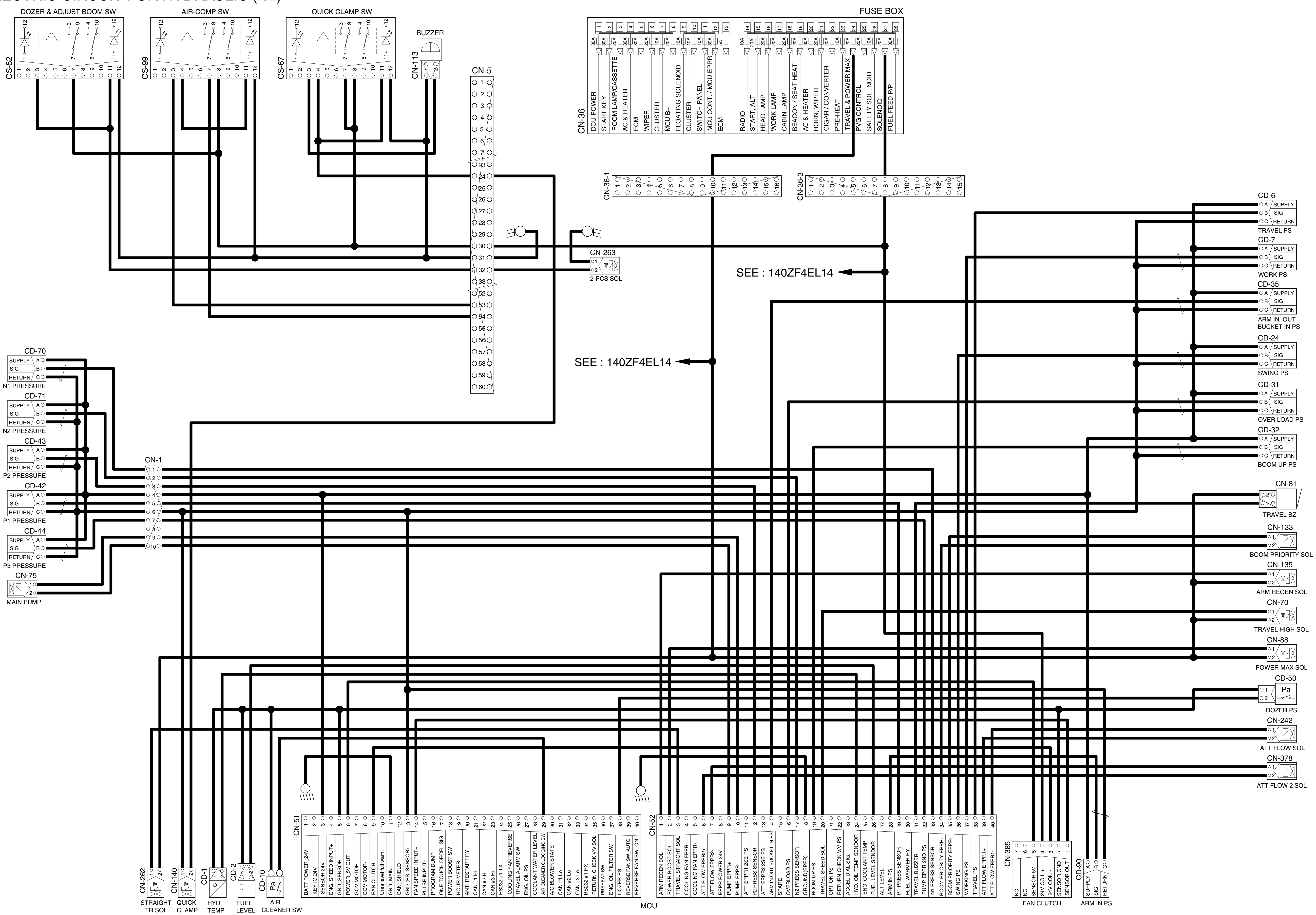
CONTROLLER CIRCUIT



MONITORING CIRCUIT



ELECTRIC CIRCUIT FOR HYDRAULIC (1/2)



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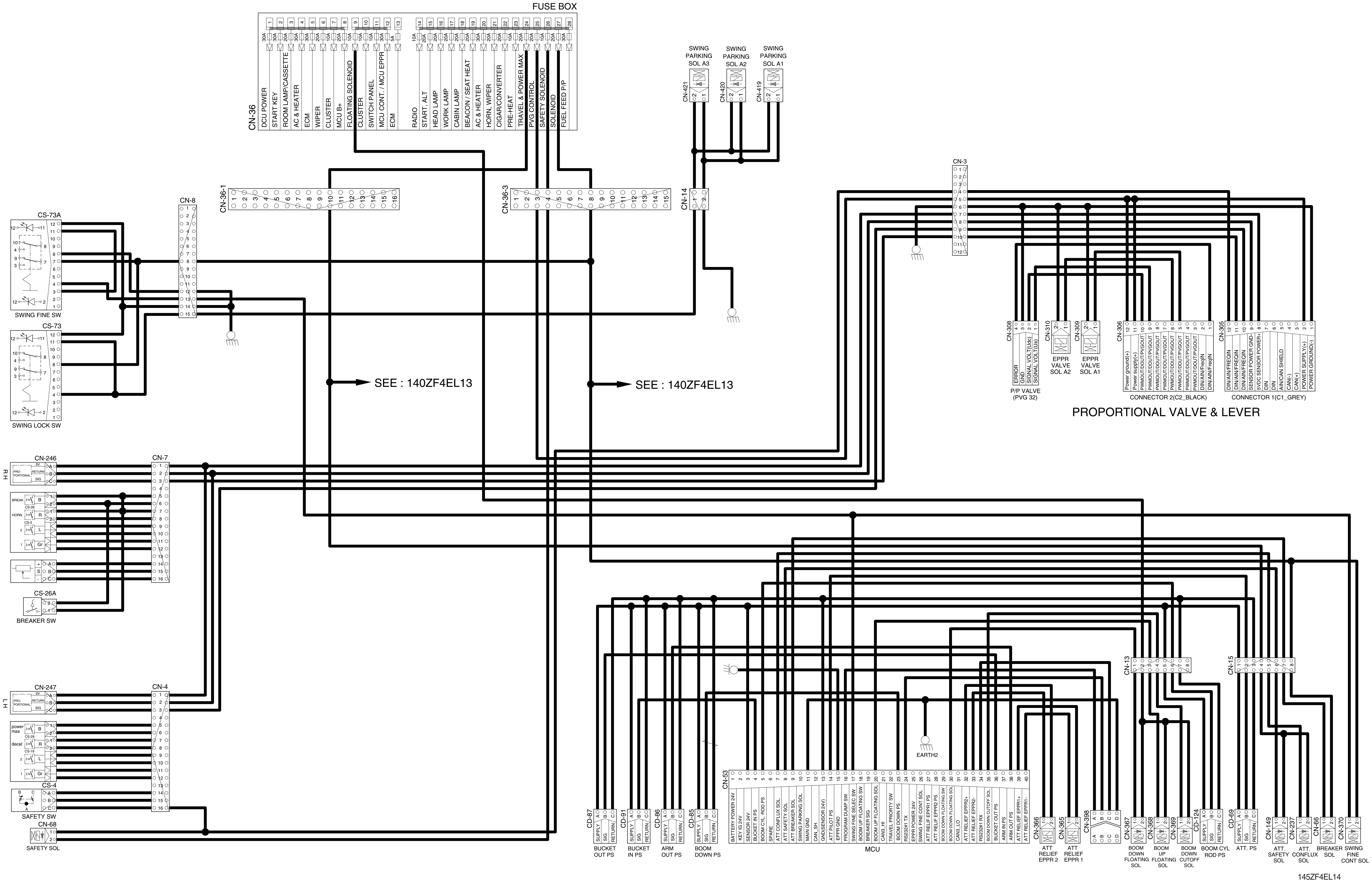
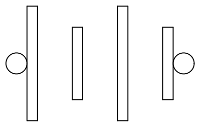
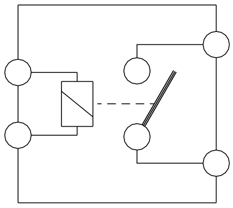
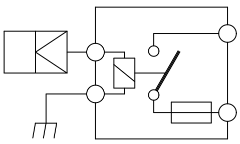
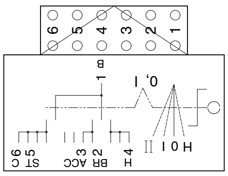
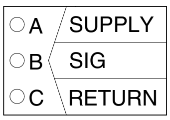
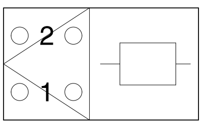
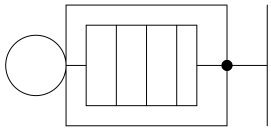
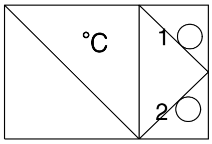
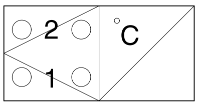
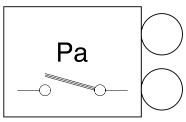
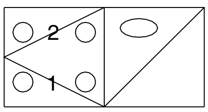
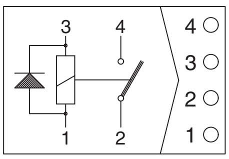
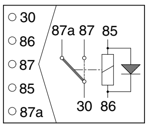
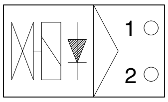
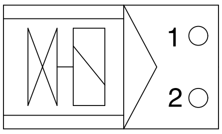
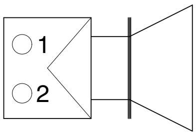
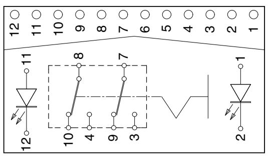
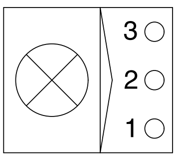
ELECTRIC CIRCUIT FOR HYDRAULIC (2/2)

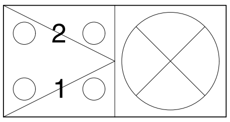
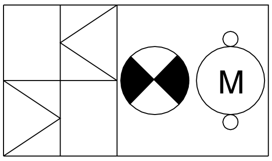
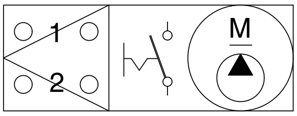
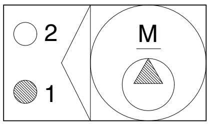
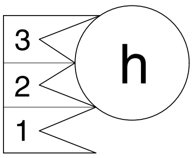
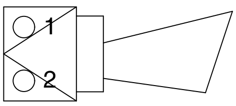


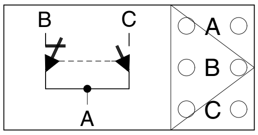
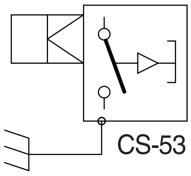
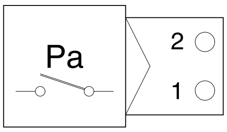
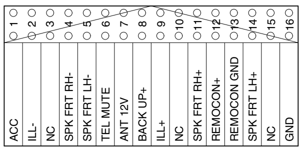
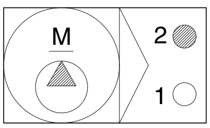
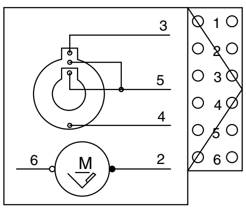
GROUP 3 ELECTRICAL COMPONENT SPECIFICATION

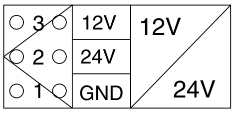
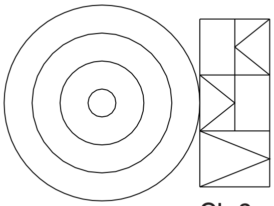
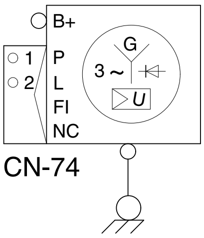
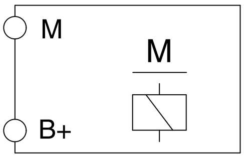
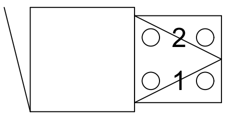
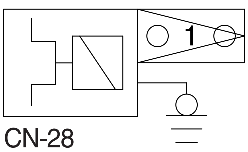
Part name	Symbol	Specifications	Check
Battery		12V × 100Ah (2EA)	※ Check specific gravity 1.280 over : Over charged 1.280 ~ 1.250 : Normal 1.250 below : Recharging
Battery relay	 CR-1	Rated load : 24V 100A (continuity) 1000A (30 seconds)	※ Check coil resistance(M4 to M4) Normal : About 50 Ω ※ Check contact 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-C : 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-86 CD-87 CD-90 CD-91 CD-124	8~30V	※ Check contact Normal : 0.1 Ω
Resistor		3W 120 Ω	※ Check resistance 1-2 : 120 Ω

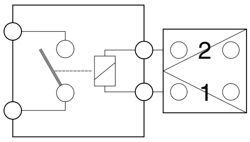
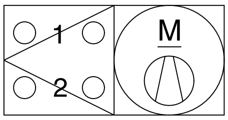
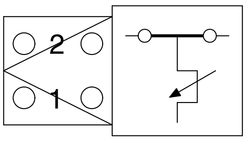
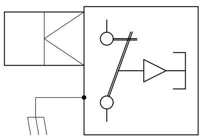
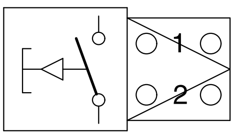
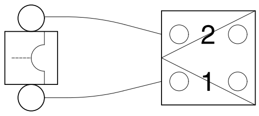
Part name	Symbol	Specifications	Check
Glow plug	 CN-80	24V 200A	※ Check resistance 0.25~0.12 Ω
Temperature sensor (hydraulic)	 CD-1	-	※ Check resistance 50˚C : 804 Ω 80˚C : 310 Ω 100˚C : 180 Ω
Air inlet temperature sensor	 CD-98 CD-98A	-	-
Air cleaner pressure switch	 CD-10	N.O TYPE	※ Check contact High 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)

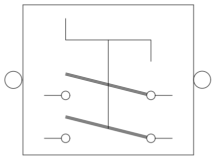
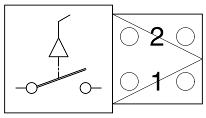
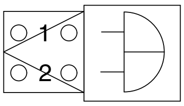
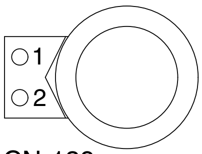
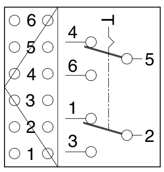
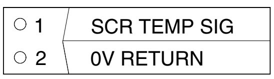
Part name	Symbol	Specifications	Check
Relay	 CR-2 CR-4 CR-5 CR-7 CR-9 CR-13 CR-35 CR-36 CR-85 CR-95 CR-101	24V 16A	※ Check resistance Normal : About 160 Ω (for terminal 85-86) 0 Ω (for terminal 30-87a) ∞ Ω (for terminal 30-87)
Solenoid valve	 CN-66 CN-68 CN-70 CN-88 CN-135 CN-140 CN-149 CN-237 CN-262 CN-263 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-24(RH)	20W 86±2dB	※ Check resistance Normal : A few Ω
Switch (locking type)	 CS-52 CS-67 CS-73 CS-73A CS-99	24V 1.5A	※ Check contact Normal ON : 0 Ω (for terminal 7-3) ∞ Ω (for terminal 7-9) OFF : ∞ Ω (for terminal 7-3) 0 Ω (for terminal 7-9)
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)

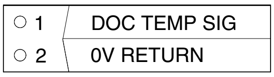
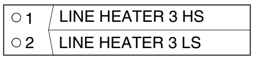
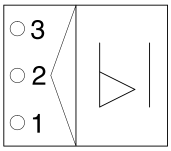
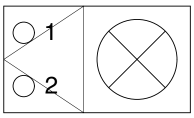
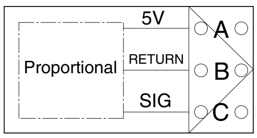
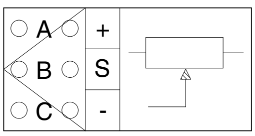
Part name	Symbol	Specifications	Check
Head lamp, Work lamp, Cab lamp	 CL-3 CL-4 CL-5 CL-6 CL-8 CL-9 CL-10	24V 65W (H3 Type)	※ Check disconnection Normal : 1.2 Ω
Beacon lamp	 CL-7	24V 70W (H1 Type) 2.4W (LED Type)	※ Check disconnection Normal : A few Ω
Fuel filler pump	 CN-61	24V 10A 35 l /min	※ Check resistance Normal : 1.0 Ω
Fuel feed pump	 CN-145	24V	-
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	22~28V 2A	※ Check operation Supply power(24V) to each terminal and connect ground.

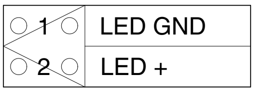
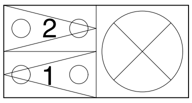
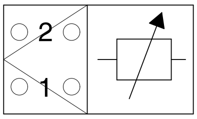
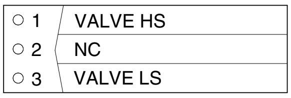
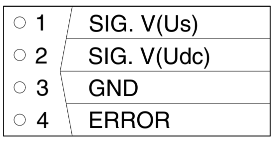
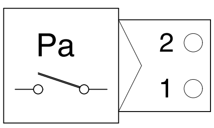
Part name	Symbol	Specifications	Check
Safety switch	 CS-4	24V 15A (N.C TYPE)	※ Check contact Normal : 1.0 Ω ON : 0 Ω (for terminal A-B) ∞ Ω (for terminal A-C) OFF : ∞ Ω (for terminal A-B) 0 Ω (for terminal A-C)
Wiper cut switch	 CS-53	24V (N.O TYPE)	※ Check contact Normal : 0 Ω (one pin to ground)
Receiver dryer	 CN-29	24V 2.5A (N.O TYPE)	※ Check contact Normal : ∞ Ω
Radio & USB player	 CN-27	24V 2A	※ Check voltage 20~25V (for terminal 1-3, 3-8)
Washer pump	 CN-22	24V 3.8A	※ Check contact Normal : 10.7 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	24V 3A	※ Check voltage 24V (for terminal 1-2) 12V (for terminal 1-3)
Cigar lighter	 CL-2	24V 5A 1.4W	※ Check coil resistance Normal : About 1M Ω ※ 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
Air conditioner compressor	 CN-28	24V 79W	※ Check contact Normal : 13.4 Ω

Part name	Symbol	Specifications	Check
Start relay	 CR-23	24V 300A	※ Check contact Normal : 0.94 Ω (for terminal 1-2)
Blower motor		24V 14A	※ Check resistance Normal : 2.5 Ω (for terminal 1-2)
Air conditioner duct sensor (switch)		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
Circuit breaker	 CN60 CN-95	CN-60 : 60A CN-95 : 90A	※ Check disconnection Normal : 0 Ω (connect ring terminal and check resist between terminal 1 and 2)

Part name	Symbol	Specifications	Check
Master switch	 CS-74A CS-74B	6-36V	※ Check disconnection Normal : 0.1 Ω
Breaker pedal switch	 CS-26A	-	-
Quick clamp buzzer	 CN-113	24V 80mA Min 65dB	-
12V Socket	 CN-139	12V 10A	-
Engine emergency stop switch	 CS-33	24V	※ Check contact Normal 0 Ω (for terminal 1-2)
SCR temperature sensor	 CN-425	-	-

Part name	Symbol	Specifications	Check
DOC temperature sensor	 CN-426	-	-
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(RH) CN-247(LH)	-	-
Accel dial	 CN-142	5V, 8mA	-

Part name	Symbol	Specifications	Check
Accel dial LED	 CN-267	24V	-
DEF/AdBlue® full lamp	 CL-41	-	-
Temperature sensor (A/C incar, A/C ambient, water)		-	-
Coolant diverter valve	 CN-384	-	-
Proportional valve sensor	 CN-308	-	-
Dozer act pressure switch	 CD-50	N.O type	※Check resistance Normal : ∞ Ω (open)

Part name	Symbol	Specifications	Check
Water level sensor	○ C RETURN(29) ○ B SIGNAL ○ A SUPPLY POWER 5V(72) CD-16	5V 12.5mA	-
DEF/AdBlue® injector	○ 1 UREA INJECTOR LS ○ 2 UREA INJECTOR HS CN-424	-	-
Camera	○ 1 LVDS POS ○ 2 GND ○ 3 LVDS NEG ○ 4 POWER 24V ○ 5 NC ○ 6 ADJUST SIGNAL CN-249	7V 100mA	-
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	-	-
Ammonia sensor	○ 1 BATT + ○ 2 J1939 CAN C + ○ 3 J1939 CAN C - ○ 4 GND CN-422	-	-
DEF/AdBlue® Id module	○ 6 GND ○ 5 NC ○ 4 NC ○ 3 SIG ○ 2 NC ○ 1 5V SUPPKY CN-429	-	-

Part name	Symbol	Specifications	Check
Fan clutch	1 SENSOR OUT 2 SENSOR GND 3 24V COIL - 4 24V COIL + 5 SENSOR 5V 6 NC 7 NC CN-385	-	-
PVG 32 controller	1 CAN HI 2 CAN LO 3 GND 4 SAFETY 5 KEY IG 6 GND 7 5V POWER 8 5V GND 9 ROTATE / LH 10 ROTATE /RH 11 NC 12 NC CN-3A	-	-

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 controller 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-7	AMP	16	I/conn (Console harness RH-Frame harness)	368047-1	368050-1
CN-8	AMP	15	I/conn (Console harness LH-Frame harness)	2-85262-1	S816-112002
CN-10	TYCO	12	I/conn (Cab harness-Side harness RH)	368542-1	368507-1
CN-11	DEUTSCH	8	I/conn (Frame harness-Aircon harness)	DT06-8S	-
CN-12	DEUTSCH	2	I/conn (Frame harness-Boom wire harness)	DT06-2S-EP06	DT04-2P-E005
CN-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
CN-15	AMP	8	I/conn (Frame harness-2 way harness)	174982-2	174984-2
CN-16	AMP	6	Emergency engine start & speed control	-	S816-106002
CN-16A	AMP	6	Emergency engine start & speed control	S816-006002	-
CN-16B	AMP	6	Emergency engine start & speed control	S816-006002	S816-106002
CN-17	DEUTSCH	8	I/conn (Side harness RH-Wiper harness)	DT06-8S-EP06	DT04-8P
CN-20	MOLEX	2	Horn	36812-0211	-
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	36812-0211	-
CN-27	KUM	16	Radio & USB player	PK145-16017	-
CN-27A	AMP	8	Radio & USB player	-	S816-108002
CN-28	KUM	1	Air conditioner compressor	NMWP01F-B	-
CN-29	KET	2	Receiver dryer	MG640795	-
CN-36-1	AMP	16	To fuse box	368047-1	-
CN-36-2	KET	8	To fuse box	MG610051	-
CN-36-3	-	26	To fuse box	1897009-2	-
CN-36-4	KET	2	To fuse box	MG610557-5	-
CN-45	RING-TERM	-	Starter motor B^+	S820-108000	-
CN-48	KET	1	Hour meter	2-520193-2	-

Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CN-51	DEUTSCH	40	MCU	DRC26-40SA	-
CN-52	DEUTSCH	40	MCU	DRC26-40SB	-
CN-53	DEUTSCH	40	MCU (option)	DRC26-40SA	-
CN-56A	AMP	12	Cluster	-	174663-2
CN-56B	AMP	8	Cluster	-	174984-2
CN-60	YAZAKI	2	Circuit breaker	-	7122-4125-50
CN-61	DEUTSCH	2	Fuel filler pump	DT06-2S-EP06	-
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	DT06-2S-EP06	DT04-2P-E005
CN-88	DEUTSCH	2	Power max solenoid	DT06-2S-EP06	-
CN-93-J1	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	RMS	DT06-12S-EP06	DT04-12P
CN-126	AMP	10	I/conn (Service tool-Frame harness)	S816-010002	S816-110002
CN-126A	-	9	Service tool	-	HD10-9-96P
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-142	DEUTSCH	3	Accel dial	DT06-3S-EP06	-
CN-144A	KET	20	Handsfree	MG610240	-
CN-144E	-	8	Handsfree	175964-2	-
CN-145	DEUTSCH	2	Fuel filler pump	DT06-2S-EP06	-
CN-149	DEUTSCH	2	Attach safety solenoid	DT06-2S-EP06	-
CN-156	-	2	Air seat heat	-	S816-102002
CN-157	AMP	1	Antena power	S822-014002	-
CN-231	-	2	To fuse box	S813-030201	-
CN-237	DEUTSCH	2	Attach conflux solenoid	DT06-2S-EP06	-
CN-242	DEUTSCH	2	Attach EPPR 1	DT06-2S-EP06	-

Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CN-245	FCI	2	PTC power	-	-
CN-245A	AMP	12	Remote controller assy	368542-1	-
CN-245E	AMP	12	Remote controller assy	174045-2	-
CN-246	AMP	12	USB & socket assy	174045-2	-
CN-246	DEUTSCH	3	Proportional valve-RH	DT06-3S	DT04-3P
CN-247	DEUTSCH	3	Proportional valve-LH	DT06-3S	DT04-3P
CN-249	DEUTSCH	6	Rear view camera	-	DT04-6P
CN-259	AMP	6	Camera	S816-006002	S816-106002
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-267	AMP	2	Accel dial LED	S816-002002	-
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-365	DEUTSCH	2	Attach relief EPPR valve 1	DT06-2S-EP06	-
CN-366	DEUTSCH	2	Attach relief 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	DT04-2P-E005
CN-376	AMP	34	Membrane controller	4-1437290-1	-
CN-378	DEUTSCH	2	Attach EPPR 2	DT06-2S-EP06	-
CN-379-XN1	DEUTSCH	24	DCU module	HDP24-24-31ST	-
CN-381	DEUTSCH	2	DEF/AdBlue® line heater 2	DT06-2S-EP06	-
CN-382	DEUTSCH	2	DEF/AdBlue® line heater 1	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	4	Service tool	DT06-4S	-
CN-398	DEUTSCH	4	Service tool	DT06-4S	DT04-4P
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	-

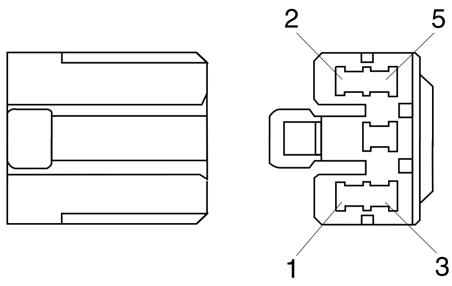
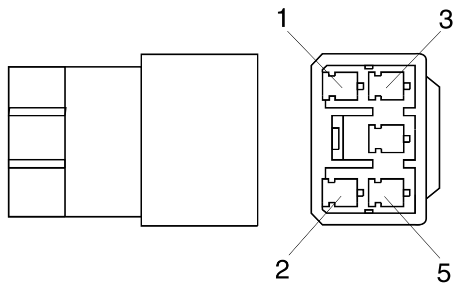
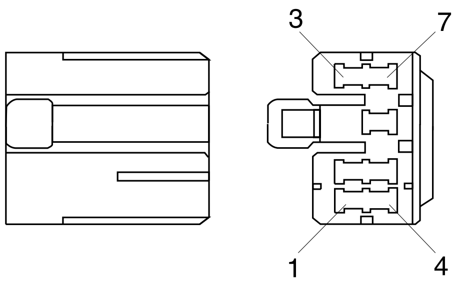
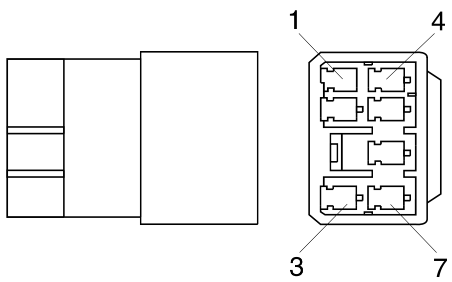
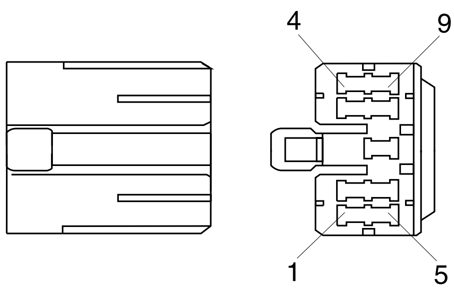
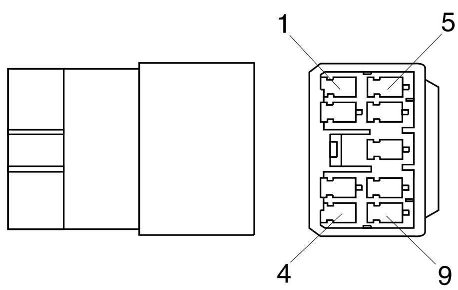
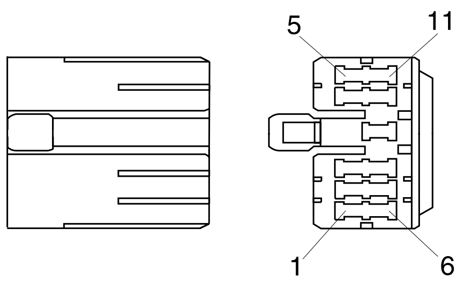
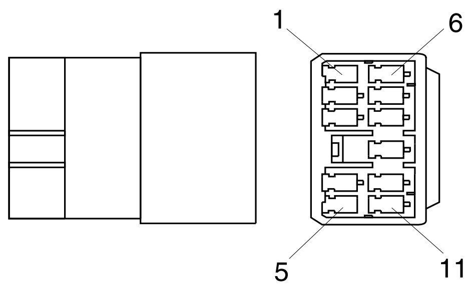
Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CN-423	DEUTSCH	4	Tank header unit	DT06-4S	-
CN-424	AMP	2	DEF/AdBlue® injector temperature sensor	2098557-1	-
CN-425	AMP	2	SCR temperature sensor	282080-1	-
CN-426	AMP	2	DOC temperature sensor	282080-1	-
CN-427	MOLEX	4	Reader-RMS	039012040	026013096
		12		5557-12R	5559-12P
CN-429	AMP	6	DEF/AdBlue® ID module sensor	776433-3	-
CN-J7A	AMP	6	NOx sensor (tail)	776433-2	-
CN-J7B	AMP	6	NOx sensor (turbo out)	776433-1	-
· Relay					
CR-1	RING-TERM	-	Battery relay	ST710289-2	-
CR-2	-	5	Horn relay	-	-
CR-4	-	5	Work lamp relay	8JA 003 526-001	-
CR-5	-	5	Anti restart relay	-	-
CR-7	-	5	Aircon compressor relay	-	-
CR-9	-	5	Cabin lamp relay	8JA 003 526-001	-
CR-13	-	5	Head lamp relay	8JA 003 526-001	-
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	8JA 003 526-001	-
CR-95	-	5	Feed pump relay	8JA 003 526-001	-
CR-101	-	5	DCU relay	8JA 003 526-001	-
· Switch					
CS-1	SHUR	1	Door switch	S822-014002	-
CS-2A	WP	6	Start key switch	S814-006100	-
CS-2B	DEUTSCH	3	Start button	DT06-3S-EP06	DT04-3P-E005
CS-4	AMP	3	Safety switch	S816-003002	-
CS-5	DEUTSCH	2	Horn switch	-	DT04-2P-E005
CS-19	DEUTSCH	2	One touch decel switch	-	DT04-2P-E005
CS-26	DEUTSCH	2	Breaker switch	DT06-2S-EP06	-
CS-26A	AMP	2	Breaker pedal switch	S816-002002	S816-102002
CS-29	DEUTSCH	2	Power max switch	DT06-2S-EP06	-
CS-33	AMP	6	Emergency engine stop switch	S816-006002	S816-106002
CS-52	SWF	12	Adjust & dozer switch	SWF589790	-
CS-53	AMP	1	Wiper cut switch	S822-014002	-
CS-67	SWF	12	Quick clamp switch	SWF589790	-
CS-73	SWF	12	Swing lock switch	SWF589790	-

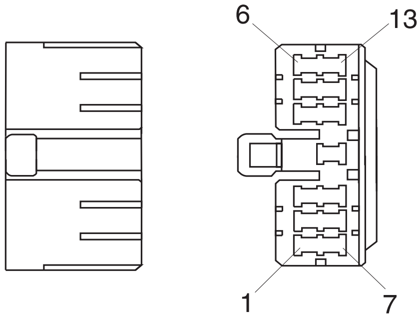
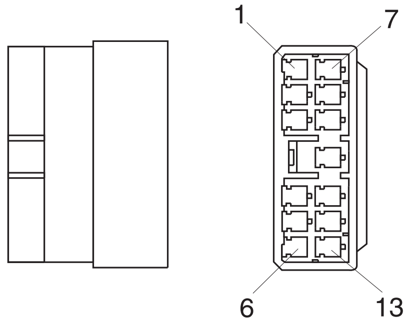
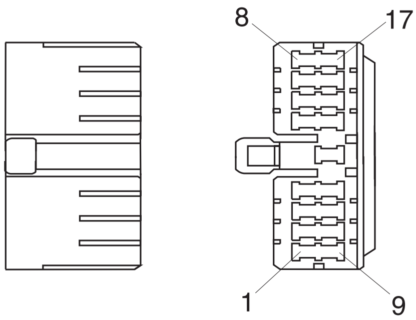
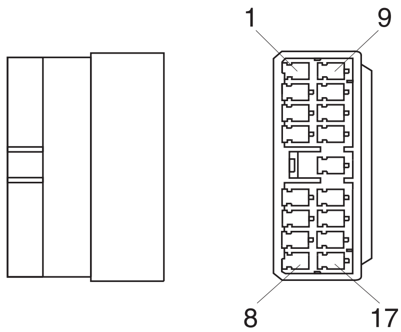
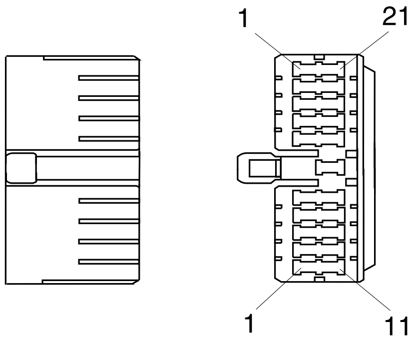
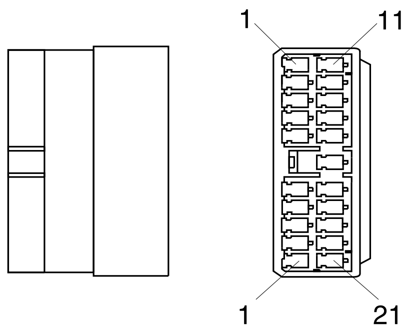
Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CS-73A	SWF	12	Swing fine switch	SWF589790	-
CS-74A	AMP	2	Master switch	S813-030201	-
CS-74B	AMP	2	Master switch	S813-030201	-
CS-83	SWF	12	Spare switch	SWF589790	-
CS-99	SWF	12	Air compressor switch	SWF589790	-
CS-100	SWF	12	Spare switch	SWF589790	-
CS-107	SWF	12	Travel straight switch	SWF589790	-
CS-111	SWF	12	Boom floating switch	SWF589790	-
· Light					
CL-1	KET	3	Room lamp	MG651032	-
CL-2	AMP	1	Cigar lighter	S822-014002	S822-114002
CL-3	DEUTSCH	2	Head lamp-LH	DT06-2S-EP06	-
CL-4	DEUTSCH	2	Head lamp-RH	DT06-2S-EP06	-
CL-5	DEUTSCH	2	Work lamp-LH	DT06-2S-EP06	-
CL-6	DEUTSCH	2	Work lamp-RH	DT06-2S-EP06	-
CL-7	SHUR	1	Beacon lamp	S822-014002	S822-114002
CL-8	DEUTSCH	2	Cab light-LH	DT06-2S-EP06	DT04-2P
CL-9	DEUTSCH	2	Cab light-RH	DT06-2S-EP06	DT04-2P
CL-10	DEUTSCH	2	Cab light-rear	DT06-2S-EP06	DT04-2P
CL-40	DEUTSCH	2	DEF/AdBlue® purging lamp	DT06-2S-EP06	DT04-2P
CL-41	AMP	1	DEF/AdBlue® F/warning lamp	S822-010400	S822-101400
· 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	3	Swing pressure sensor	DT06-3S-EP06	-
CD-31	DEUTSCH	3	Overload pressure sensor	DT06-3S-EP06	DT04-3P-E004
CD-32	DEUTSCH	3	Boom up pressure sensor	DT06-3S-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	-
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	-

Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CD-70	DEUTSCH	3	N1 pressure sensor	DT06-3S-EP06	-
CD-71	DEUTSCH	3	N2 pressure sensor	DT06-3S-EP06	-
CD-85	DEUTSCH	3	Boom down sensor	DT06-3S-EP06	-
CD-86	DEUTSCH	3	Arm out pressure sensor	DT06-3S-E005	-
CD-87	DEUTSCH	3	Bucket out pressure sensor	DT06-3S-E005	-
CD-90	DEUTSCH	3	Arm in pressure sensor	DT06-3S-EP06	-
CD-91	DEUTSCH	3	Bucket in pressure sensor	DT06-3S-E005	-
CD-98	AMP	2	Air inlet temperature sensor	776427-1	-
CD-98A	AMP	2	Air intake temperature sensor	776427-1	-
CD-124	DEUTSCH	3	Boom cylinder rod pressure snensor	DT06-3S-E005	-

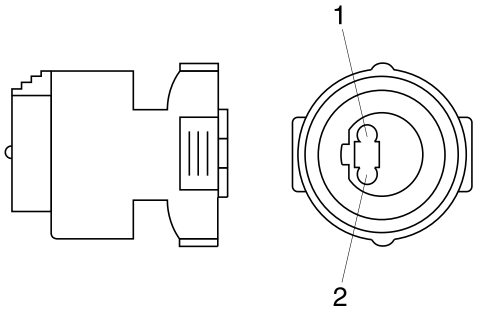
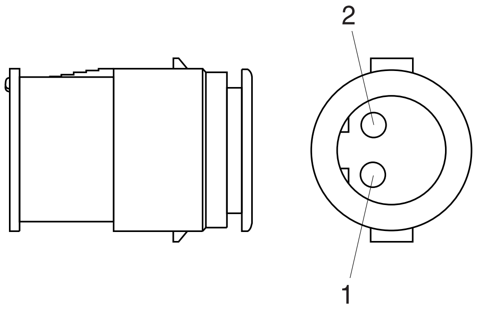
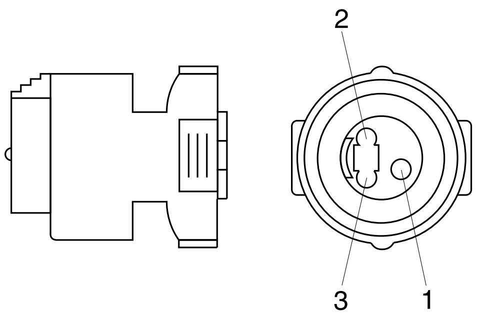
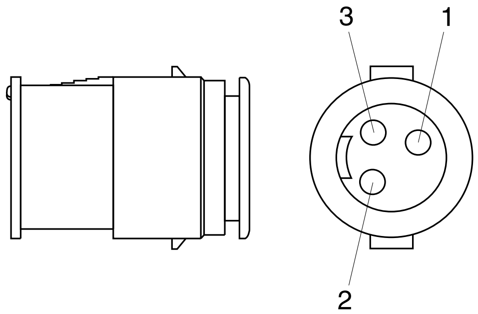
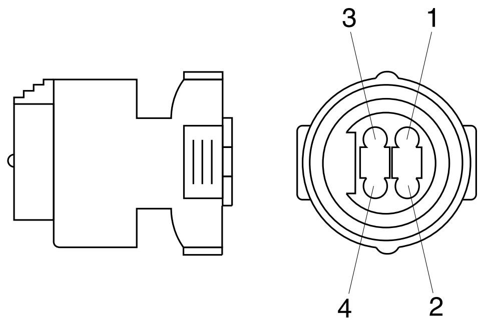
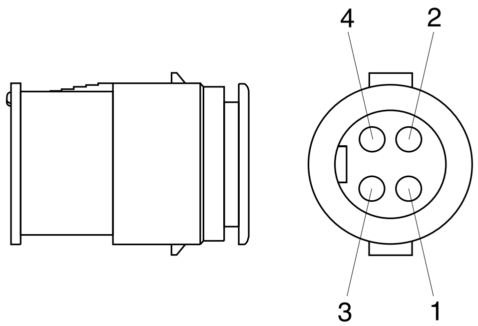
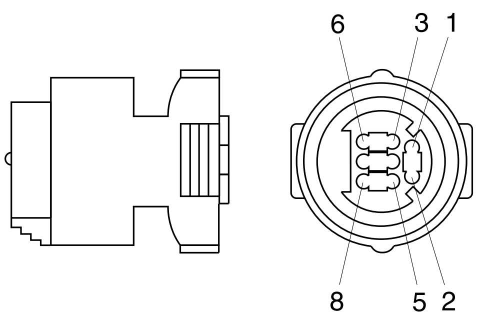
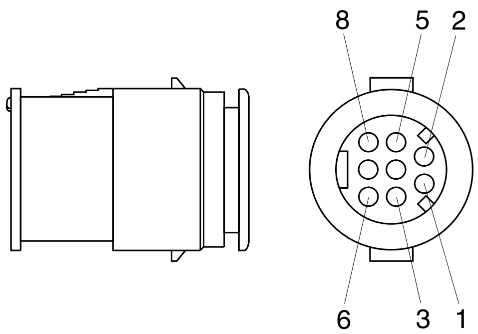
2. CONNECTION TABLE FOR CONNECTORS

1) PA TYPE CONNECTOR

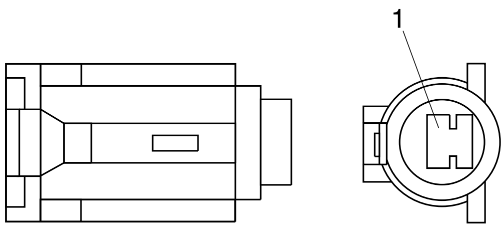
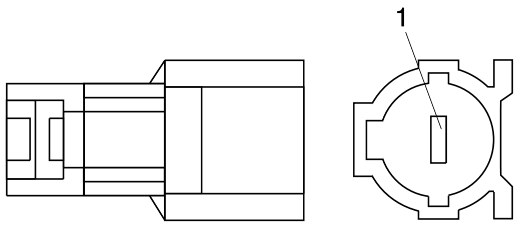
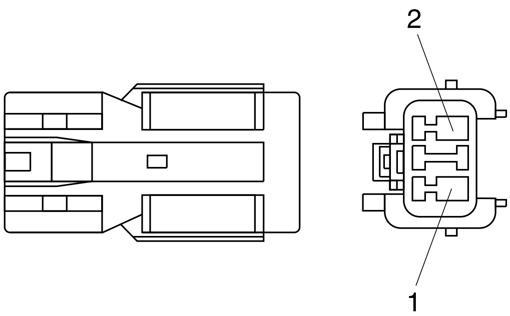
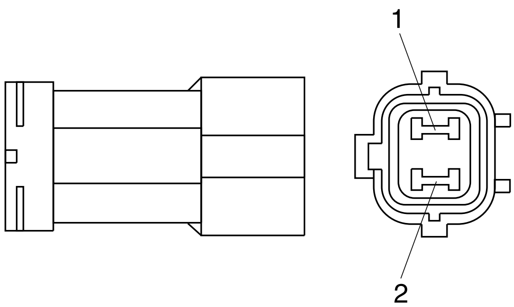
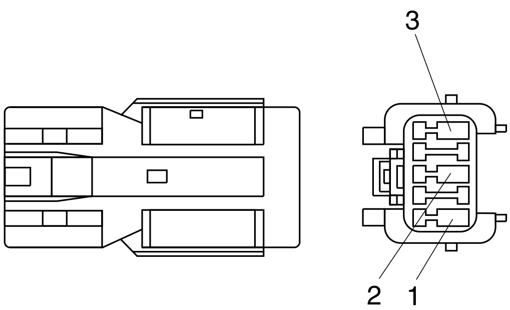
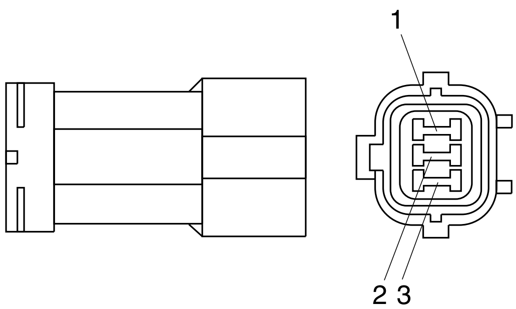
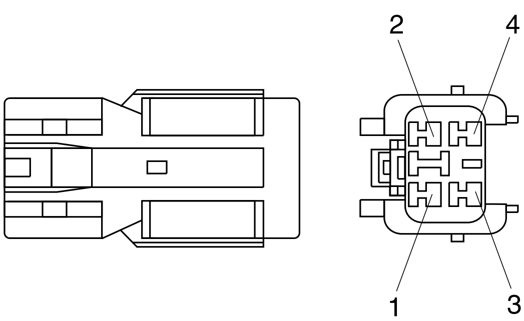
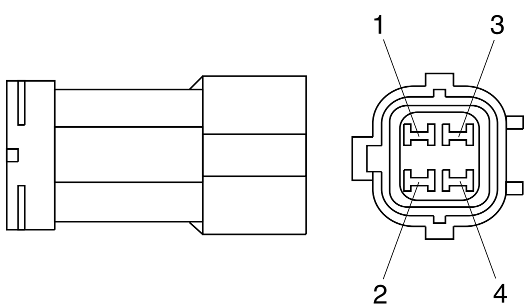
No. of pin	Receptacle connector (female)	Plug connector (male)
5	 S811-005002	 S811-105002
7	 S811-007002	 S811-107002
9	 S811-009002	 3S811-109002
11	 S811-011002	 S811-111002

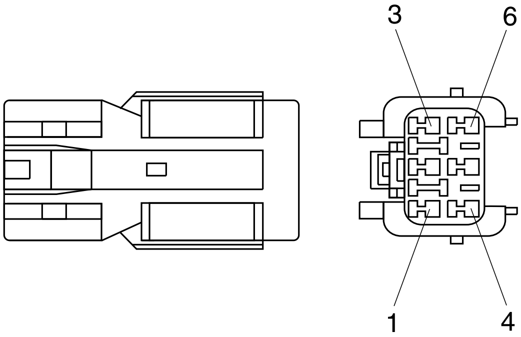
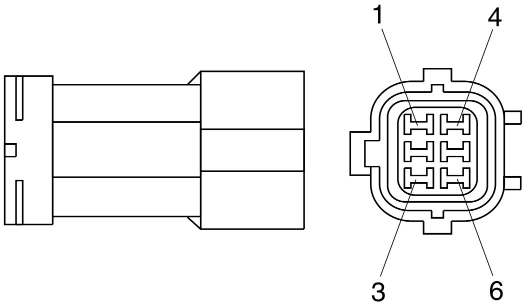
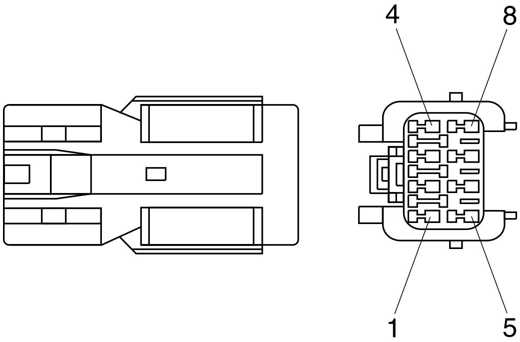
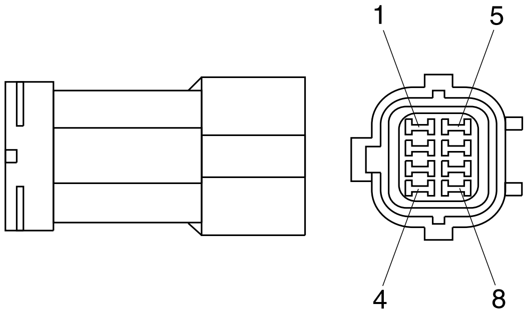
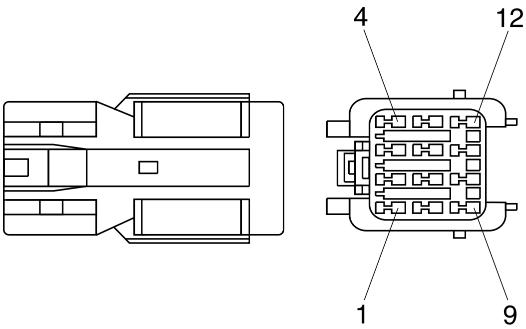
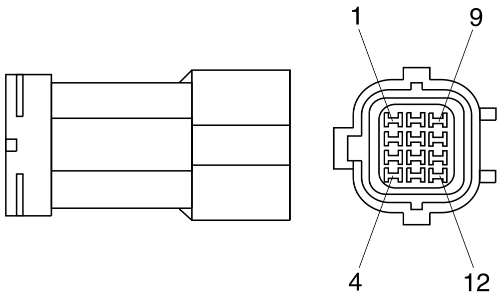
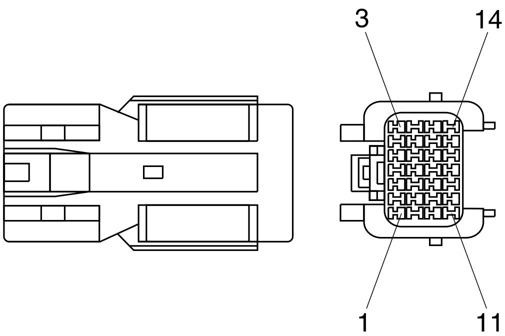
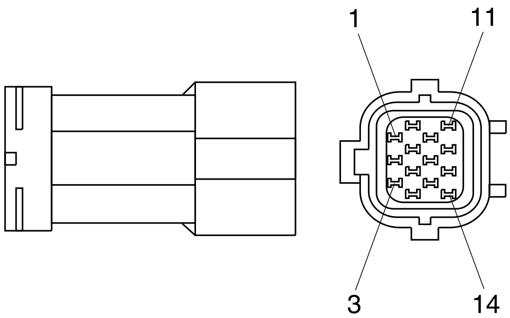
No. of pin	Receptacle connector (female)	Plug connector (male)
13	 S811-013002	 S811-113002
17	 S811-017002	 S811-117002
21	 S811-021002	 S811-121002

2) J TYPE CONNECTOR

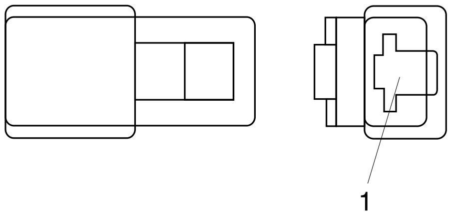
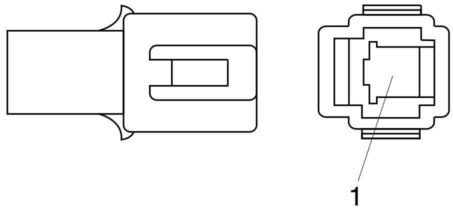
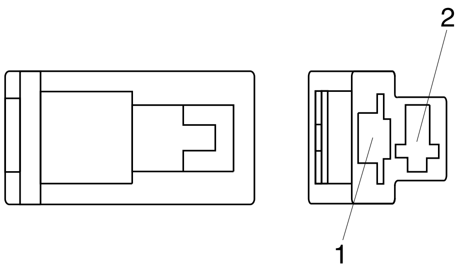
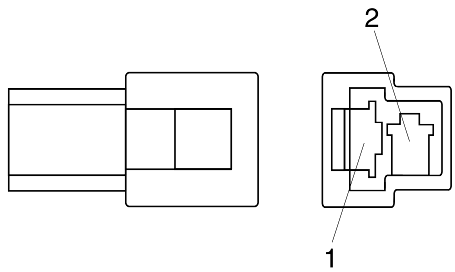
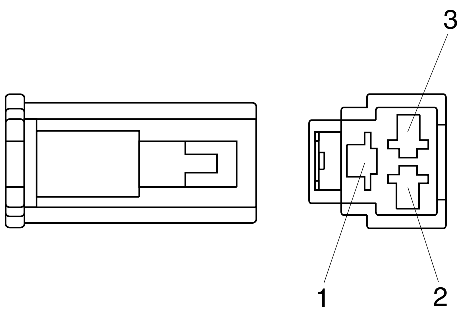
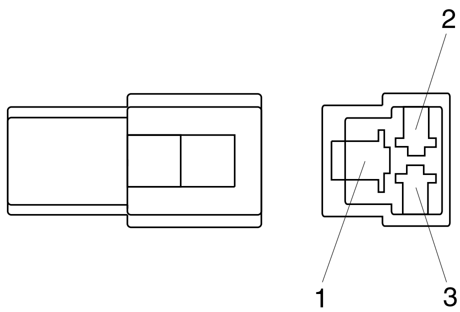
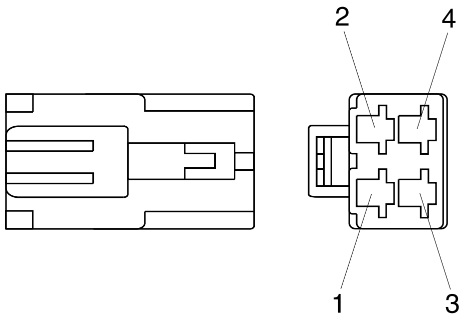
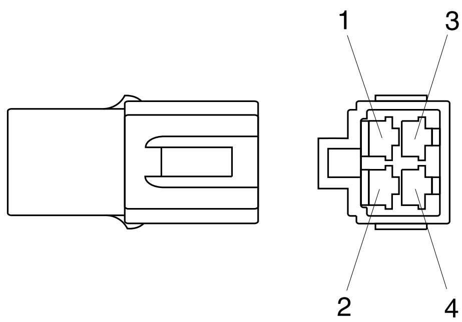
No. of pin	Receptacle connector (female)	Plug connector (male)
2	 S816-002001	 S816-102001
3	 S816-003001	 S816-103001
4	 S816-004001	 S816-104001
8	 S816-008001	 S816-108001

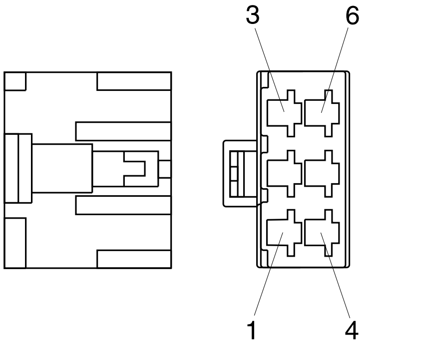
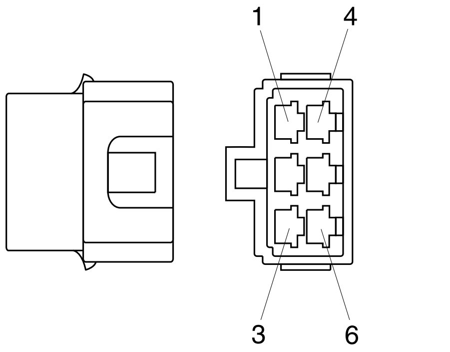
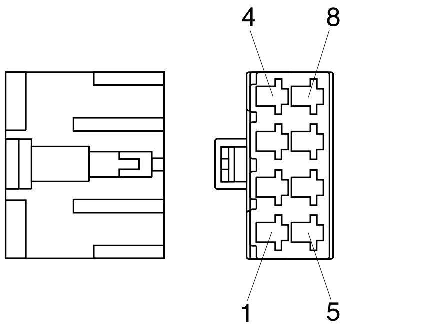
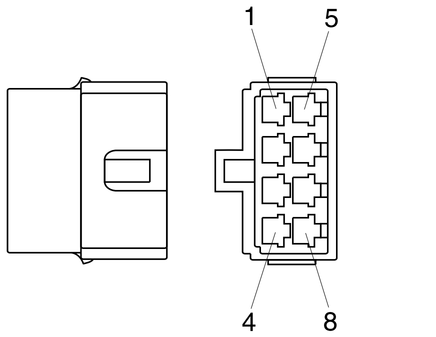
3) SWP TYPE CONNECTOR

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

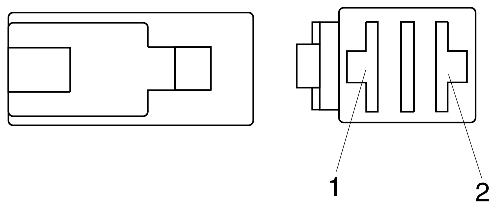
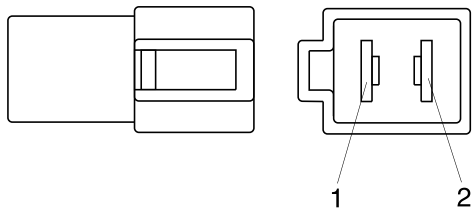
No. of pin	Receptacle connector (female)	Plug connector (male)
6	 S814-006000	 S814-106000
8	 S814-008000	 S814-108000
12	 S814-012000	 S814-112000
14	 S814-014000	 S814-114000

4) CN TYPE CONNECTOR

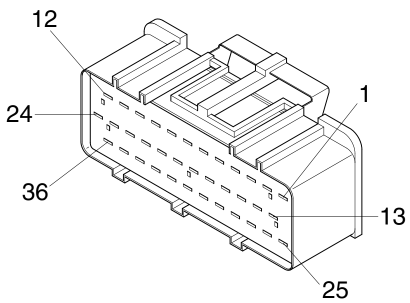
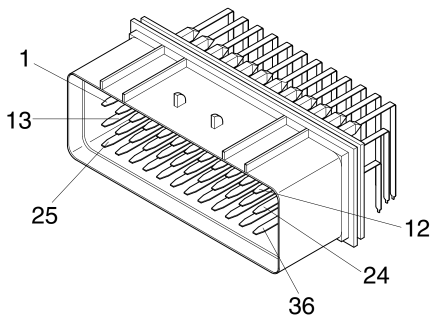
No. of pin	Receptacle connector (female)	Plug connector (male)
1	 S810-001202	 S810-101202
2	 S810-002202	 S810-102202
3	 S810-003202	 S810-103202
4	 S810-004202	 S810-104202

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

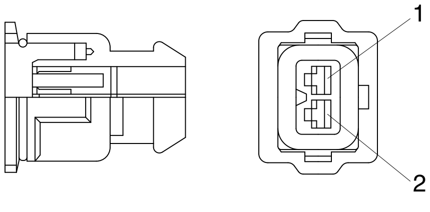
5) 375 FASTEN TYPE CONNECTOR

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

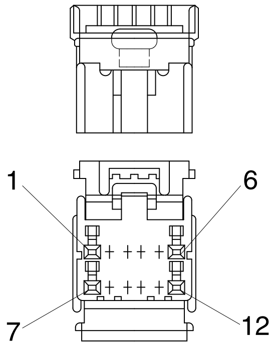
6) AMP ECONOSEAL CONNECTOR

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

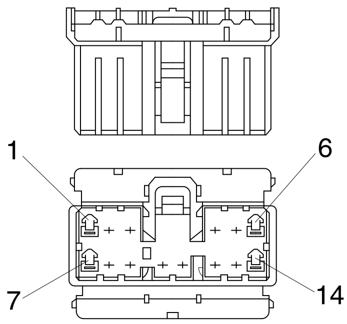
7) AMP TIMER CONNECTOR

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

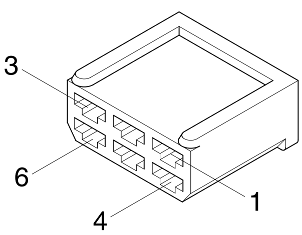
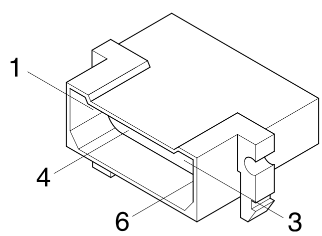
8) AMP 040 MULTILOCK CONNECTOR

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

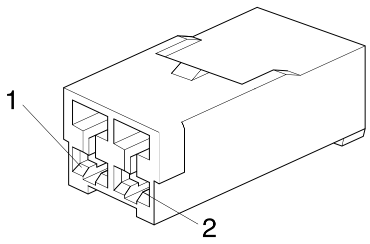
9) AMP 070 MULTILOCK CONNECTOR

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

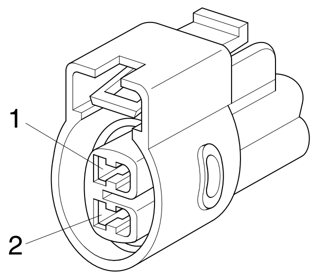
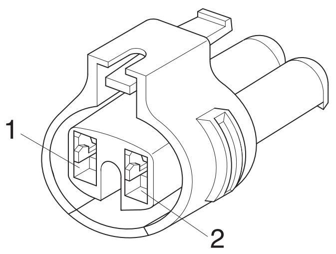
10) AMP FASTIN - FASTON CONNECTOR

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

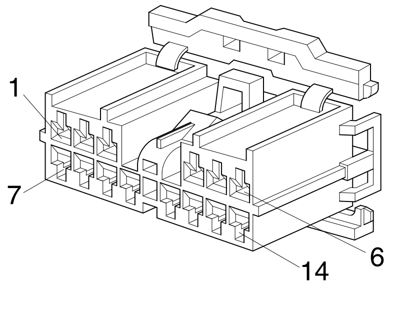
11) KET 090 CONNECTOR

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		

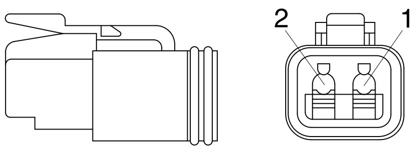
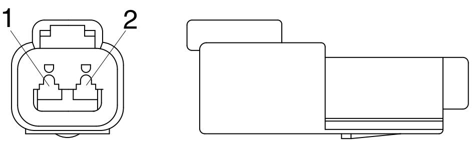
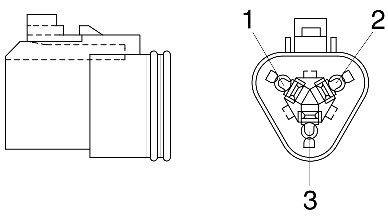
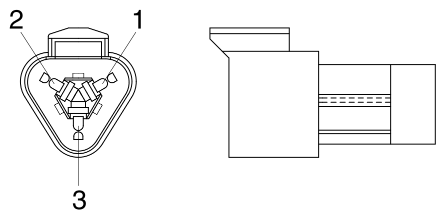
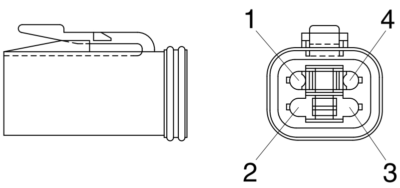
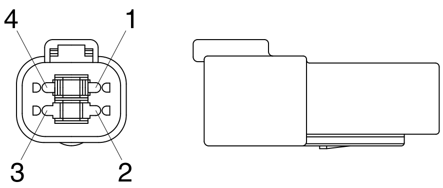
14) DEUTSCH DT CONNECTORS

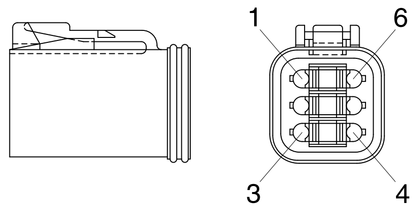
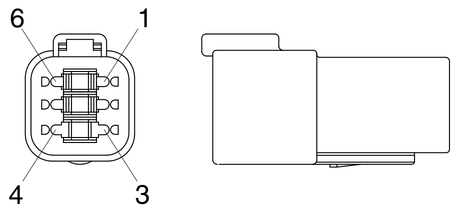
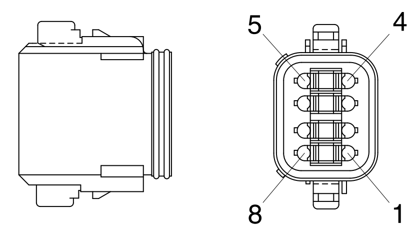
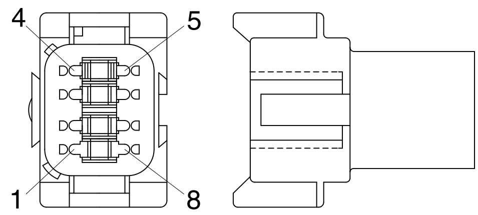
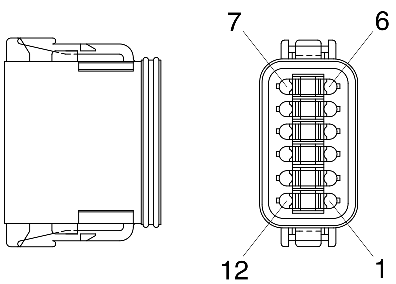
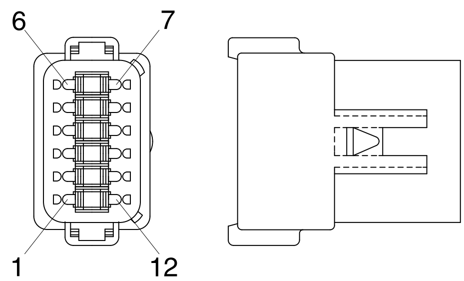
DT 06 - 3S - ★★★★

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

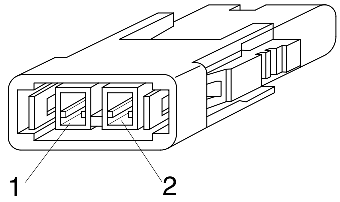
※ Modification

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

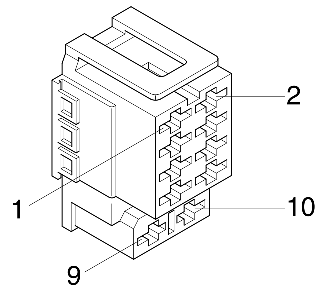
No. of pin	Receptacle connector (female)	Plug connector (male)
2	 DT06-2S	 DT04-2P
3	 DT06-3S	 DT04-3P
4	 DT06-4S	 DT04-4P

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

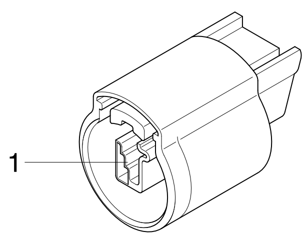
15) MOLEX 2CKTS CONNECTOR

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

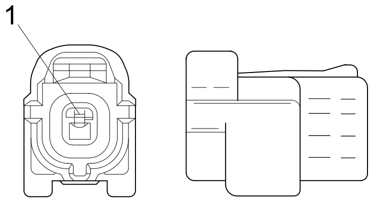
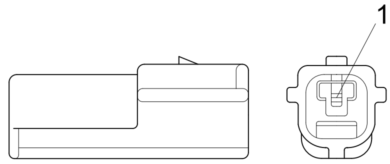
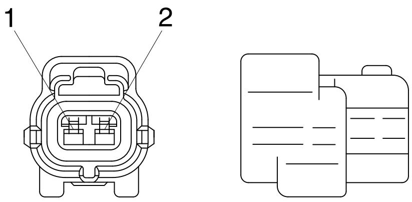
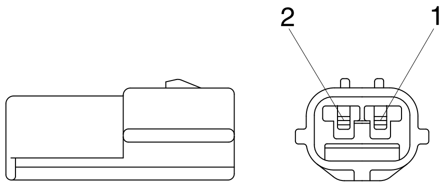
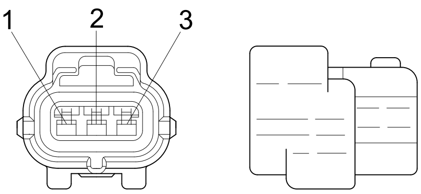
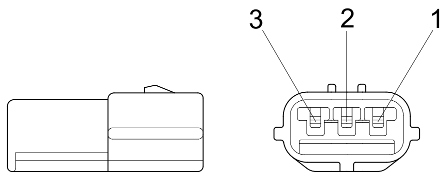
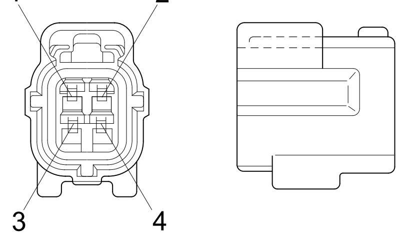
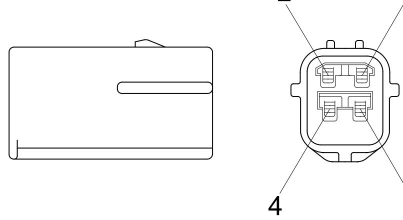
16) ITT SWF CONNECTOR

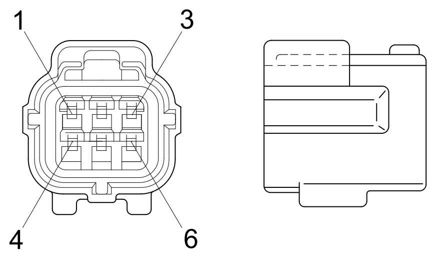
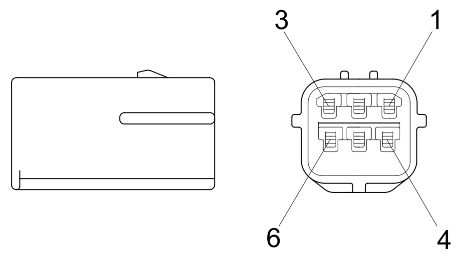
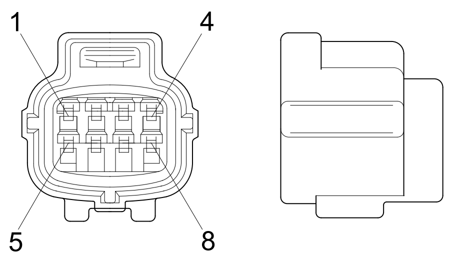
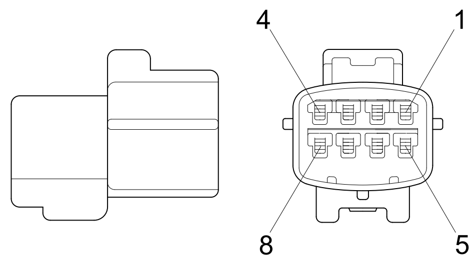
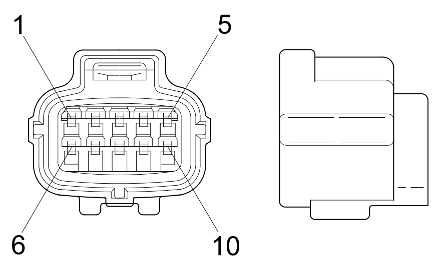
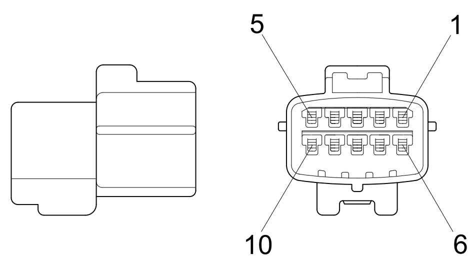
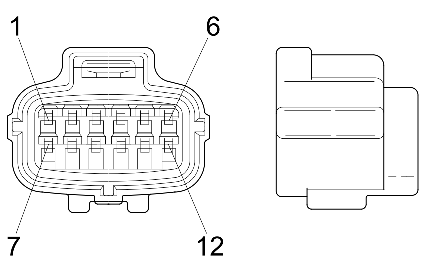
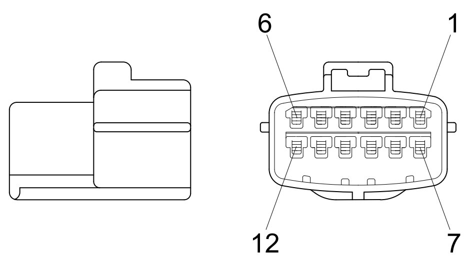
No. of pin	Receptacle connector (female)	Plug connector (male)
10	 SWF593757	

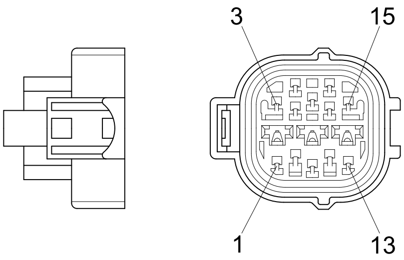
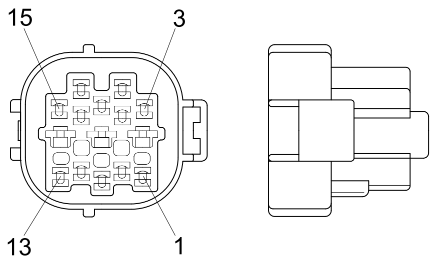
17) MWP NMWP CONNECTOR

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

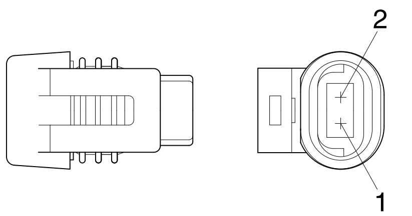
18) ECONOSEAL J TYPE CONNECTORS

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

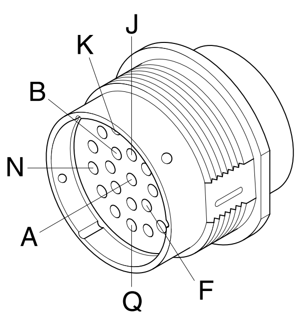
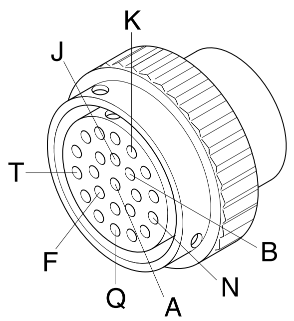
No. of pin	Receptacle connector (female)	Plug connector (male)
6	 S816-006002	 S816-106002
8	 S816-008002	 S816-108002
10	 S816-010002	 S816-110002
12	 S816-012002	 S816-112002

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

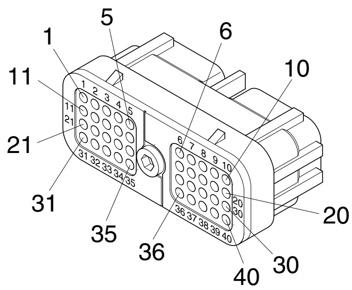
19) METRI-PACK TYPE CONNECTOR

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

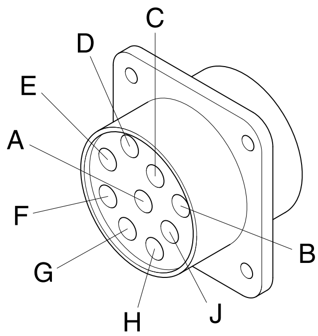
20) DEUTSCH HD30 CONNECTOR

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

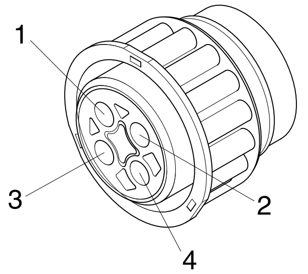
21) DEUTSCH MCU CONNECTOR

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

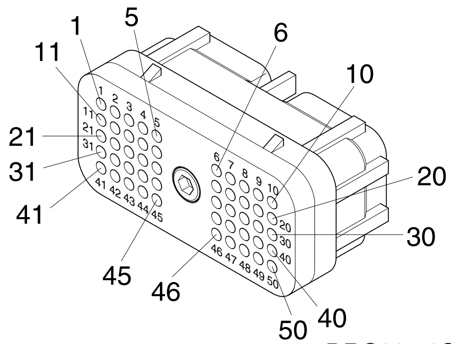
22) DEUTSCH SERVICE TOOL CONNECTOR

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

<table>
<tr><th>No. of pin</th><th>Receptacle connector (Female)</th><th>Plug connector (Male)</th></tr>
<tr><td>50</td><td>

DRC26-50S-04</td><td></td></tr>
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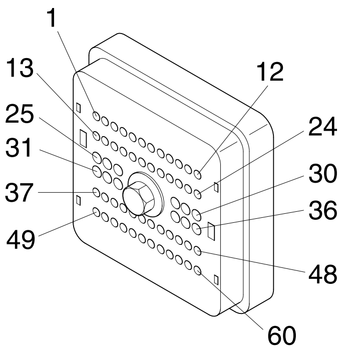
25) DEUTSCH INTERMEDIATE CONNECTOR

<table>
<tr><th>No. of pin</th><th>Receptacle connector (Female)</th><th>Plug connector (Male)</th></tr>
<tr><td>60</td><td>

DRB16-60SAE-L018</td><td></td></tr>
</table>

SECTION 5 MECHATRONICS SYSTEM

SECTION 5 MECHATRONICS SYSTEM

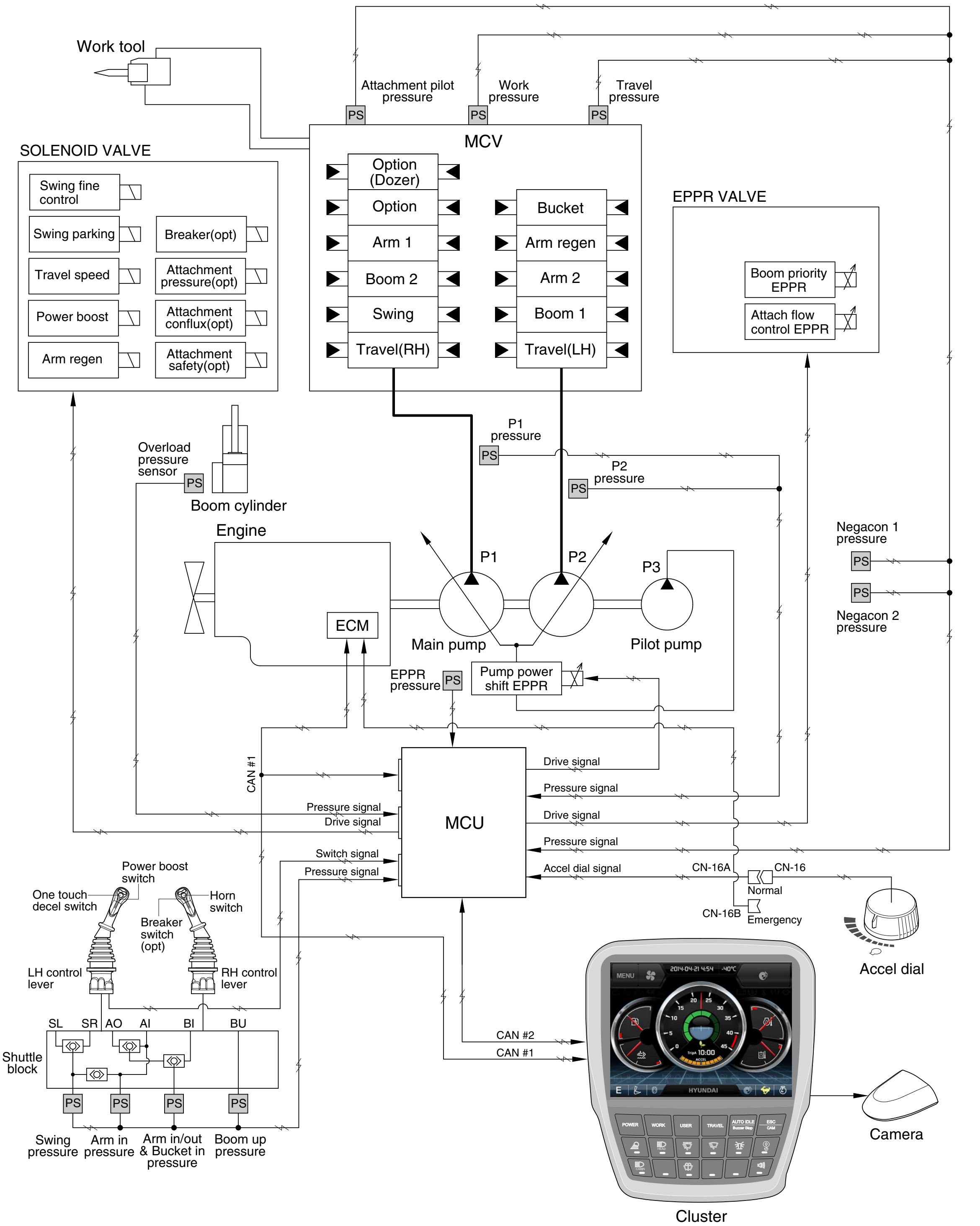
GROUP 1 OUTLINE

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
- New 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

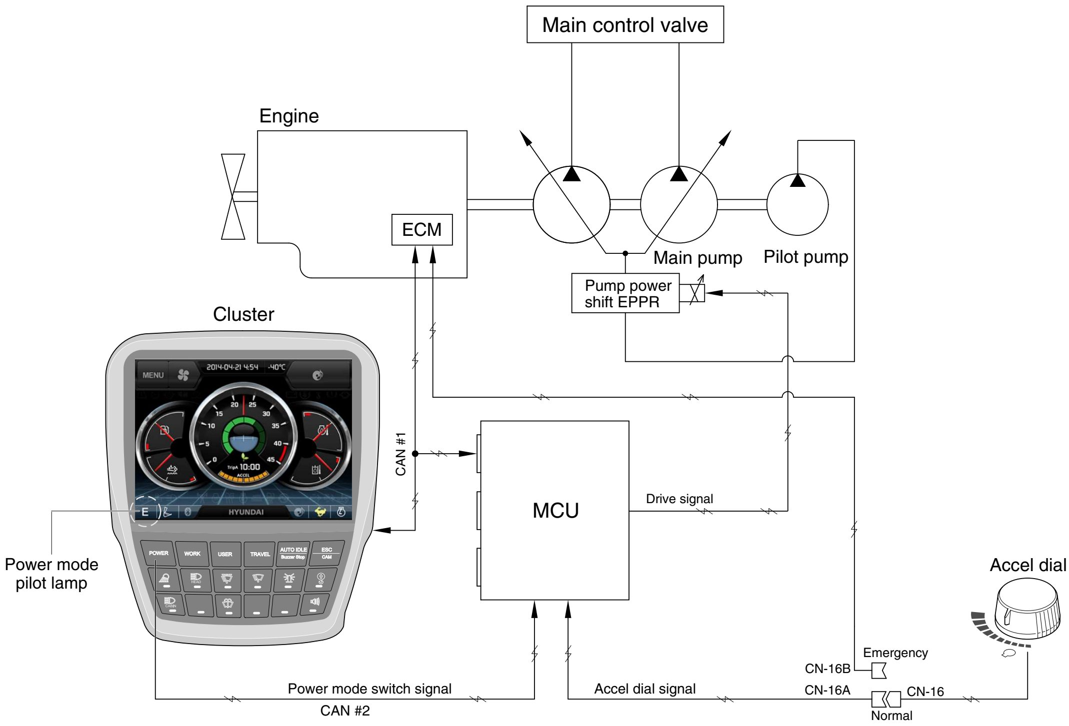
SYSTEM DIAGRAM



145ZF5MS01

GROUP 2 MODE SELECTION SYSTEM

1. POWER MODE SELECTION SYSTEM



145ZF5MS02

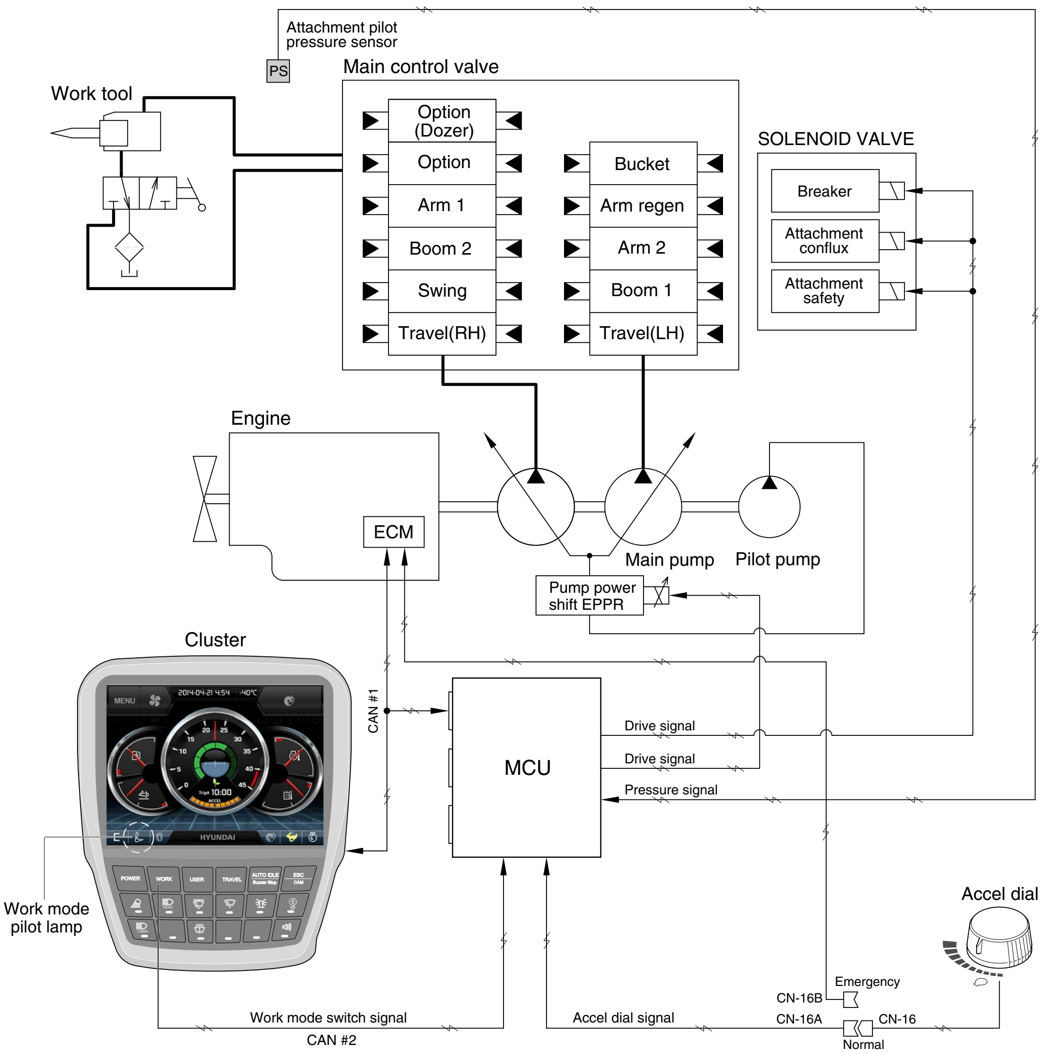
Mode selection system (micro computer based electro-hydraulic pump and engine mutual control system) optimizes the engine and pump performance.
The combination of 3 power modes (P, S, E) and accel dial position (10 set) makes it possible to use the engine and pump power more effectively corresponding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

Power mode	Application	Engine rpm				Power shift by EPPR valve			
		Standard		Option		Standard		Option	
		Unload	Load	Unload	Load	Current (mA)	Pressure (kgf/cm^2)	Current (mA)	Pressure (kgf/cm^2)
P	Heavy duty power	1850±50	1950±50	2100±50	2050±50	290±30	8 (~3)	160±30	0
S	Standard power	1750±50	1850±50	2000±50	1950±50	330±30	10 (~5)±3	250±30	5±3
E	Economy operation	1650±50	1750±50	1750±50	1850±50	360±30	12 (~7)±3	330±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).



145ZF5MS03

1) GENERAL WORK MODE (bucket)

This mode is used to general digging work.

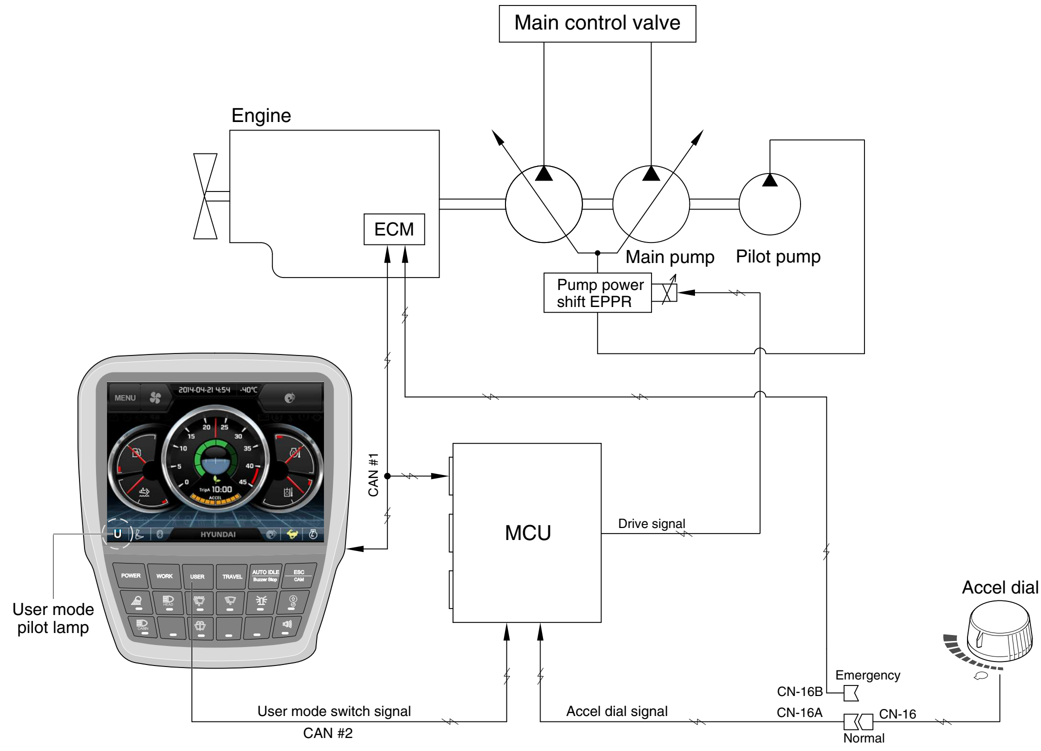
2) ATT WORK MODE (breaker, crusher)

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



145ZF5MS04

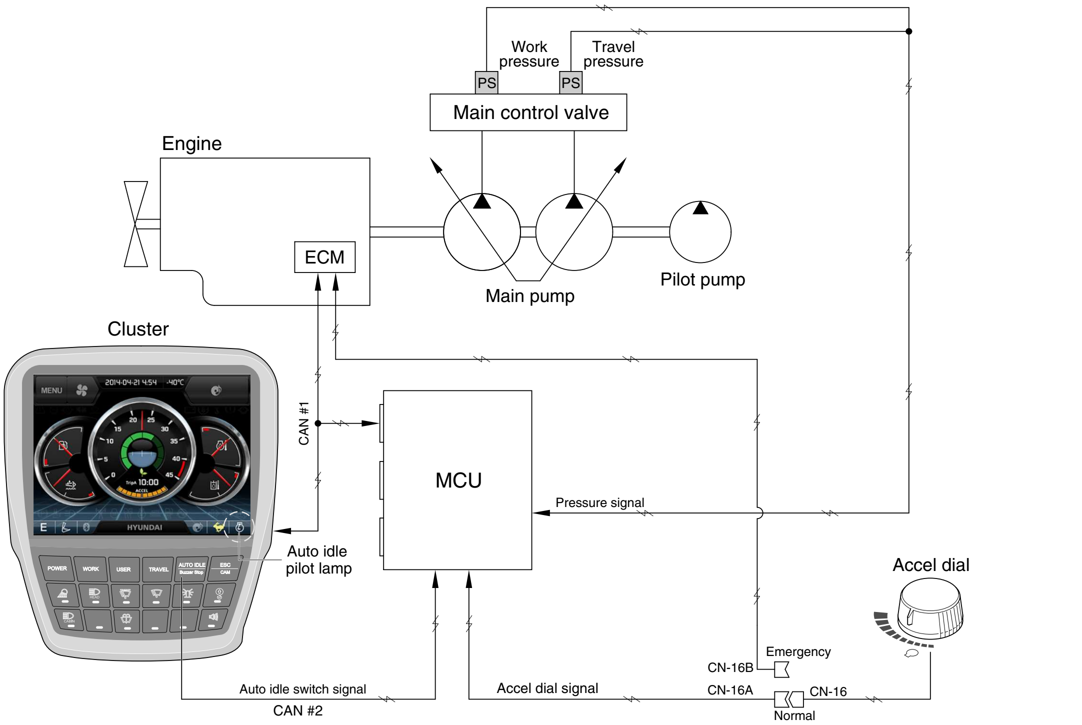
1) Engine speed, idle speed and pump power shift pressure can be adjusted and memorized in the U-mode.

2) LCD segment vs parameter setting

Step (▮)	Engine speed (rpm)	Idle speed (rpm)	Power shift pressure (bar)
1	1300	750	0
2	1400	800	3
3	1500	850	6
4	1600	900	9
5	1700	950	12
6	1800	1000	16
7	1850	1050	20
8	1900	1100 (auto decel)	26
9	1950	1150	32
10	2000	1200	38

※ Refer to the page 5-78.

GROUP 3 AUTOMATIC DECELERATION SYSTEM

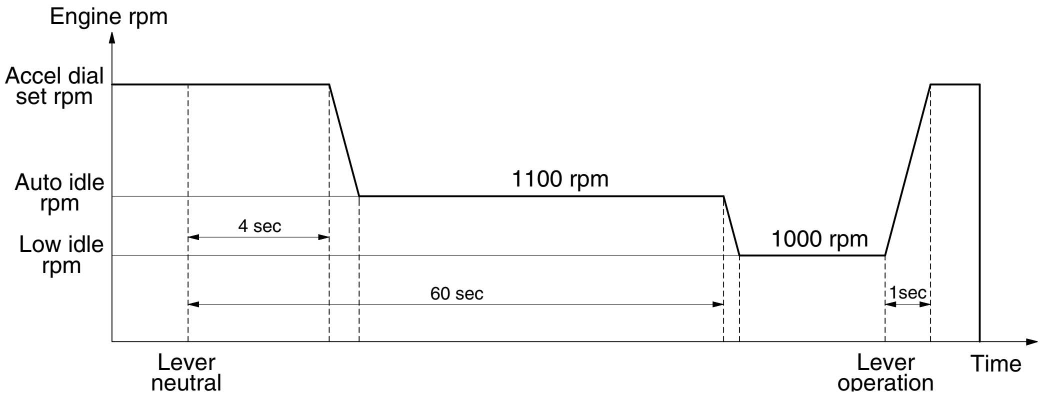


145ZF5MS05

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.



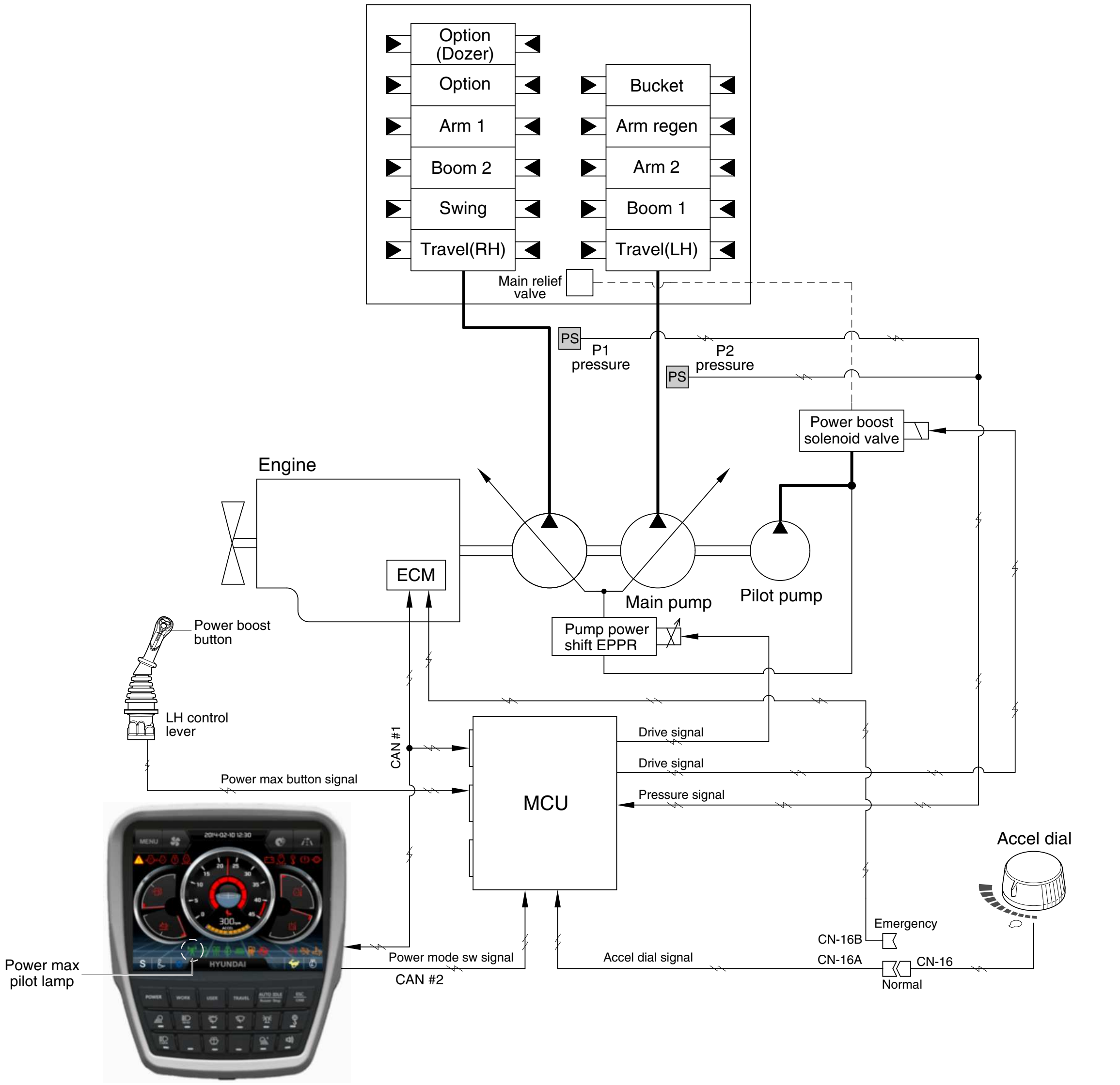
140L5MS01

2. WHEN AUTO IDLE PILOT LAMP OFF

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

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

GROUP 4 POWER BOOST SYSTEM



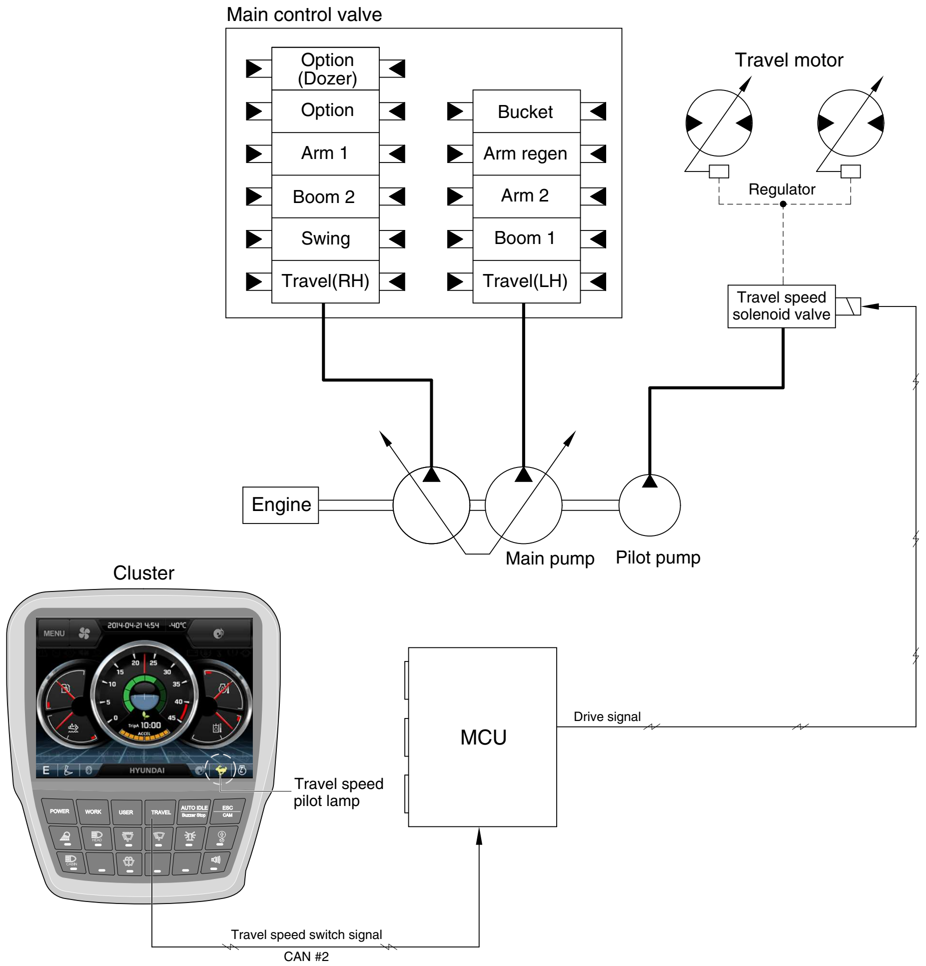
· When the power boost switch on the left control lever is pushed ON, the power mode is set P mode and maximum digging power is increased by 10 %.

· 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



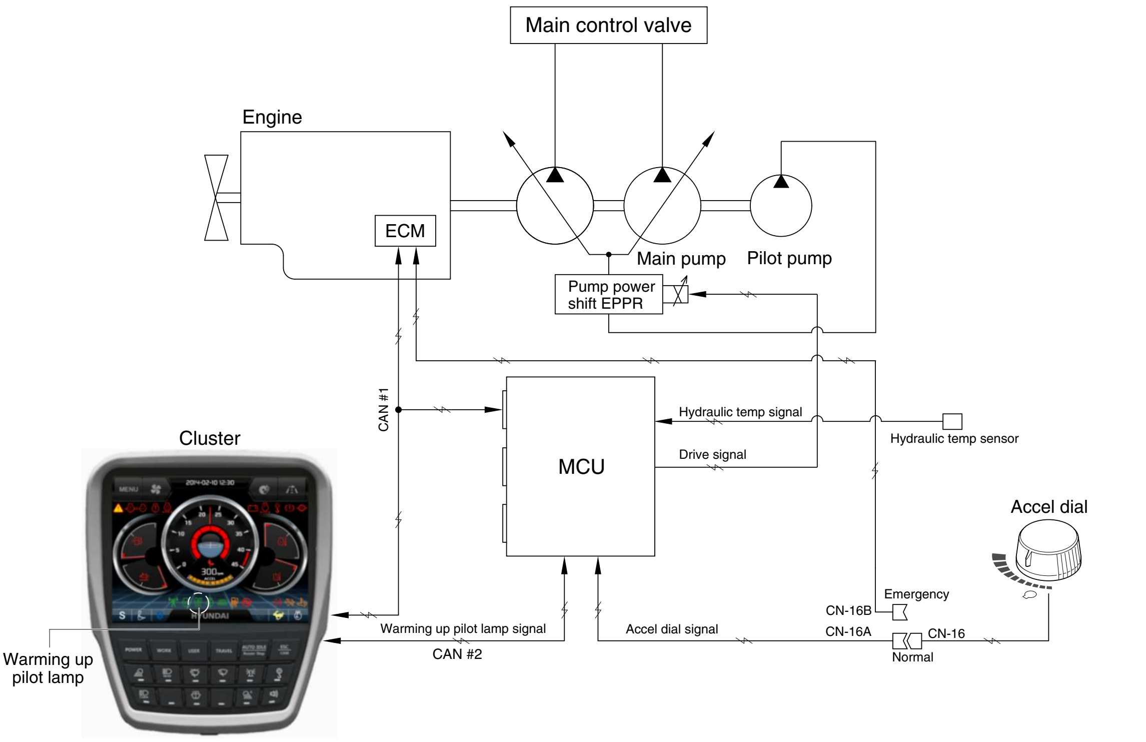
145ZF5MS07

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 speed)

GROUP 6 AUTOMATIC WARMING UP SYSTEM



145ZF5MS08

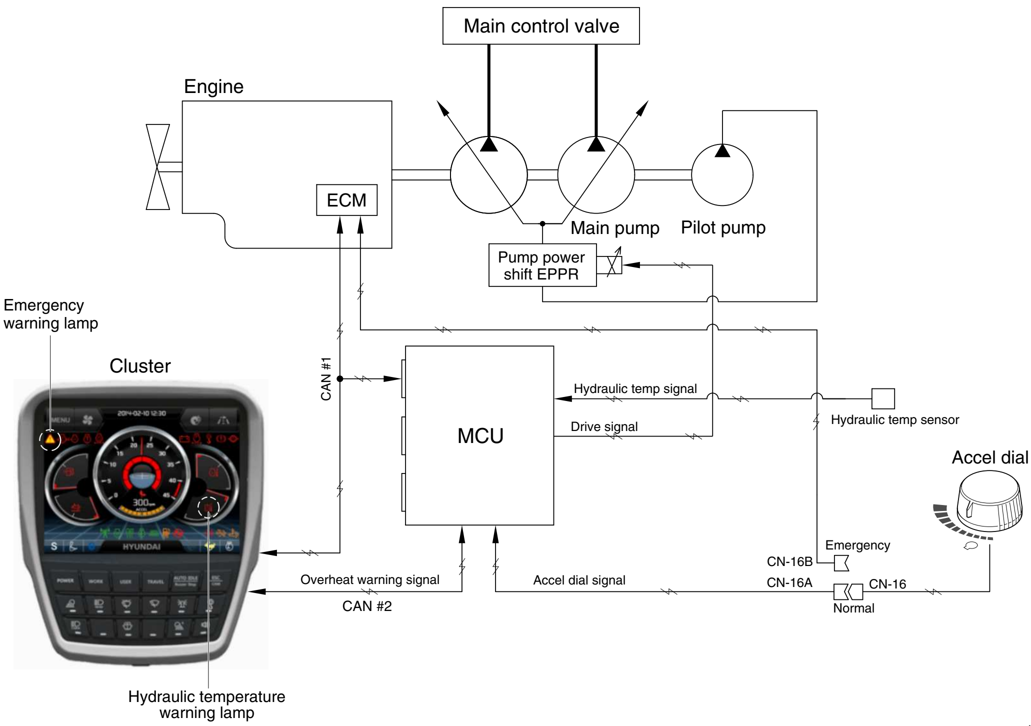
1. The MCU receives the engine coolant temperature from the ECM, and if the coolant temperature is below 30˚C, it increases the engine speed from key start rpm to 1000 rpm. At this time the mode does not change. If the coolant temperature sensor has fault, the hydraulic oil temperature signal is substituted.

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

3. LOGIC TABLE

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

GROUP 7 ENGINE OVERHEAT PREVENTION SYSTEM



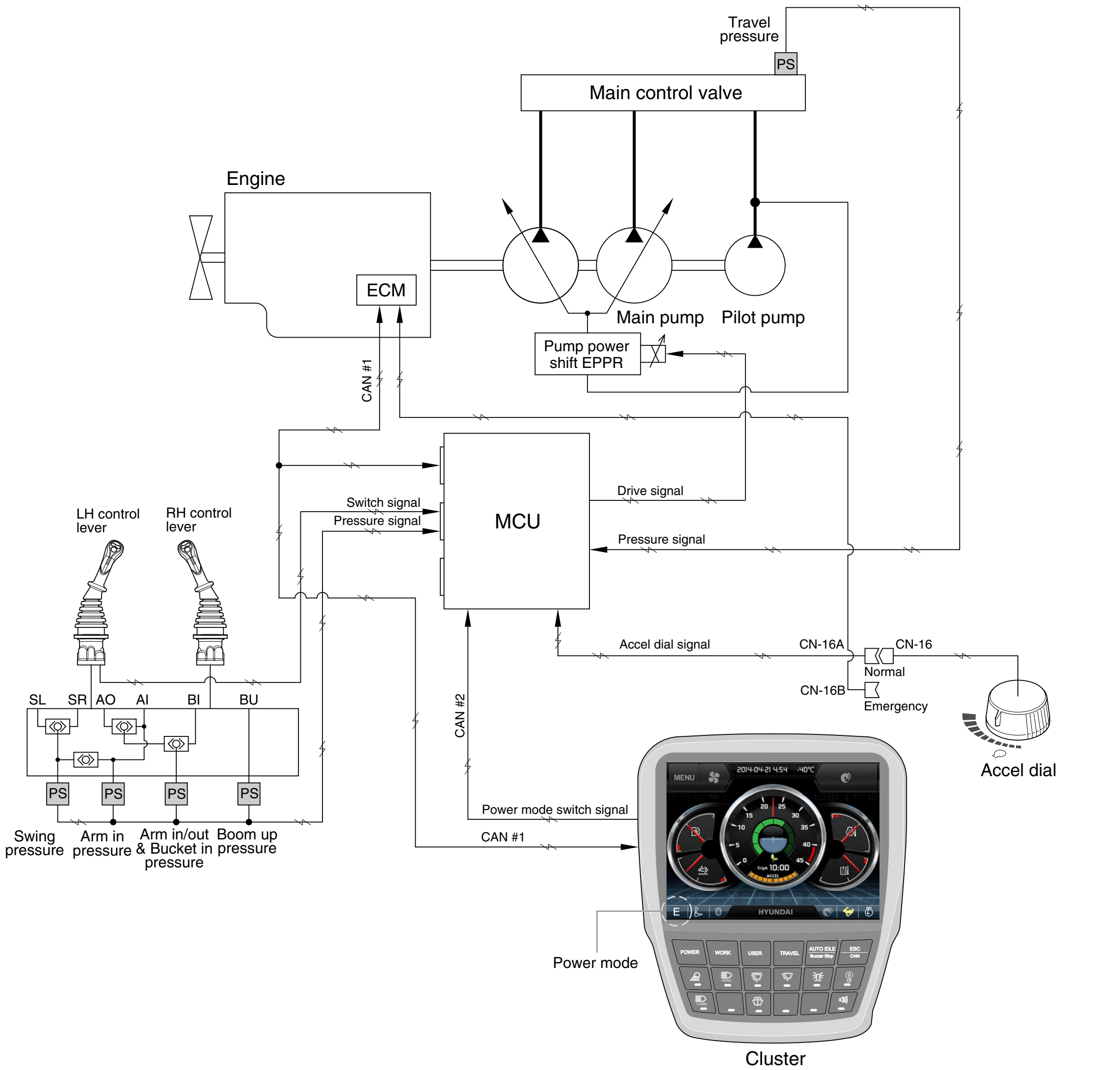
145ZF5MS09

1. If the engine coolant temperature or the hydraulic oil temperature is overheated over set temperature, 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 : Pops up and buzzer sounds. - 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 NEW VARIABLE POWER CONTROL SYSTEM



145ZF5MS10

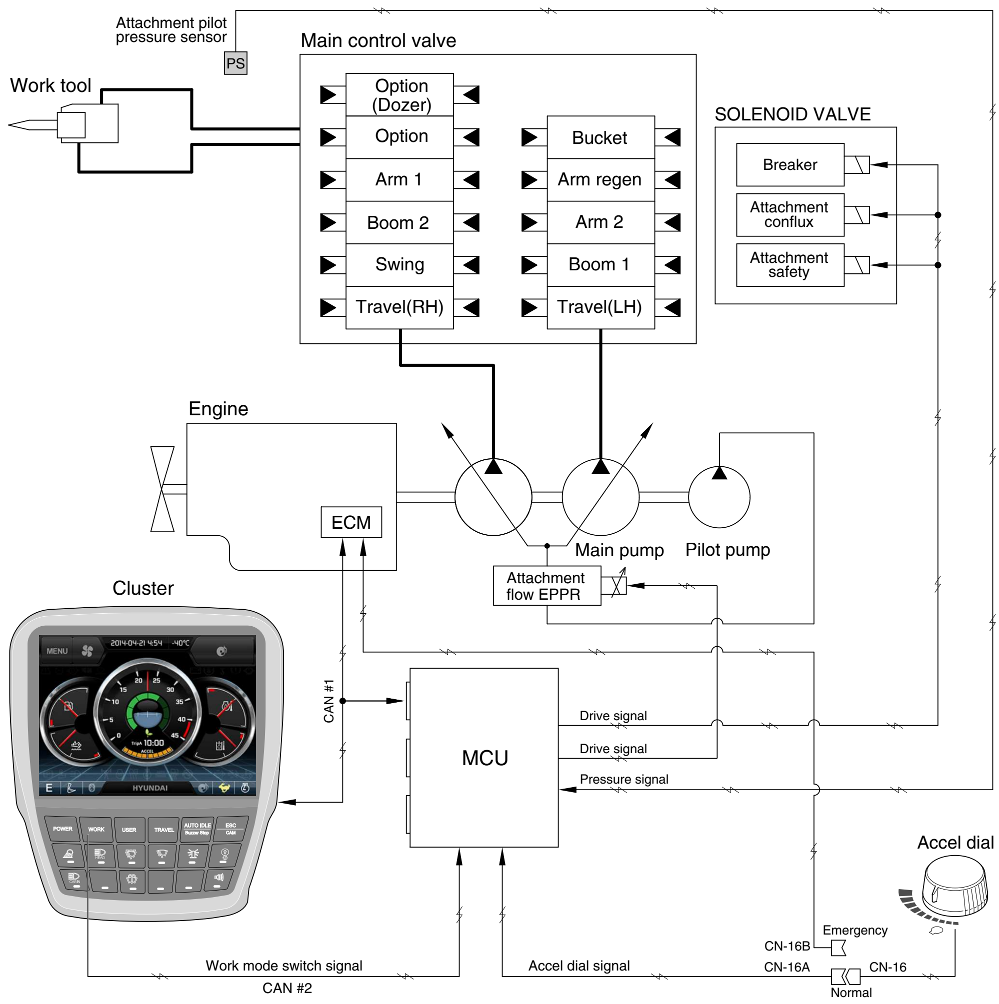
· The new variable power control system makes constantly exact pump control through improvement variable engine speed control and response and optimization of control input sensor signal.

It makes fuel saving and smooth control at precise work.

Description	Function	
	Stand by	Working
Engine speed	- 100 ~ 150 rpm lower than working	- Set rpm
Pump EPPR	- 13 bar	- 8 bar
Pump flow	- Lower than working	- Normal pump flow

※ The variable power control function can be activated at all of the power mode.

GROUP 9 ATTACHMENT FLOW CONTROL SYSTEM



145ZF5MS11

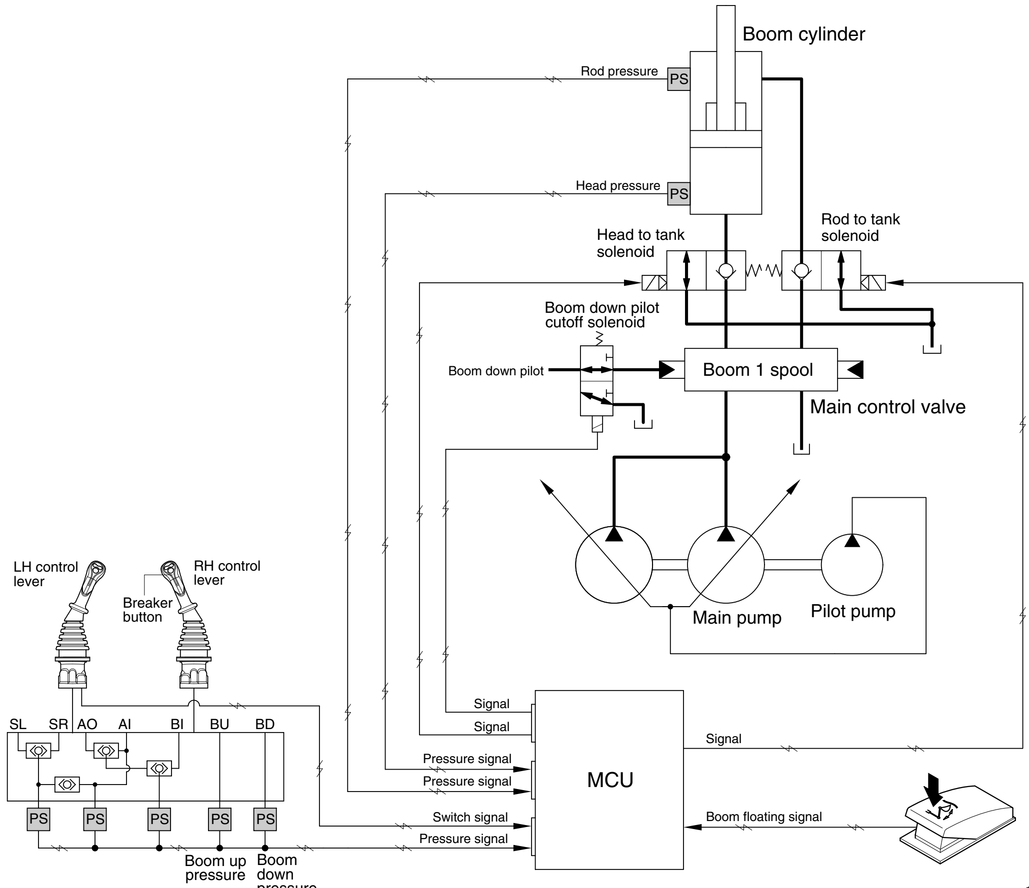
· The system is used to control the pump delivery flow according to set of the work tool on the cluster by the attachment flow EPPR valve.

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 5-78 for the attachment kinds and max flow.

★ When breaker operating switch is pushed.

GROUP 10 BOOM FLOATING CONTROL SYSTEM



145ZF5MS12

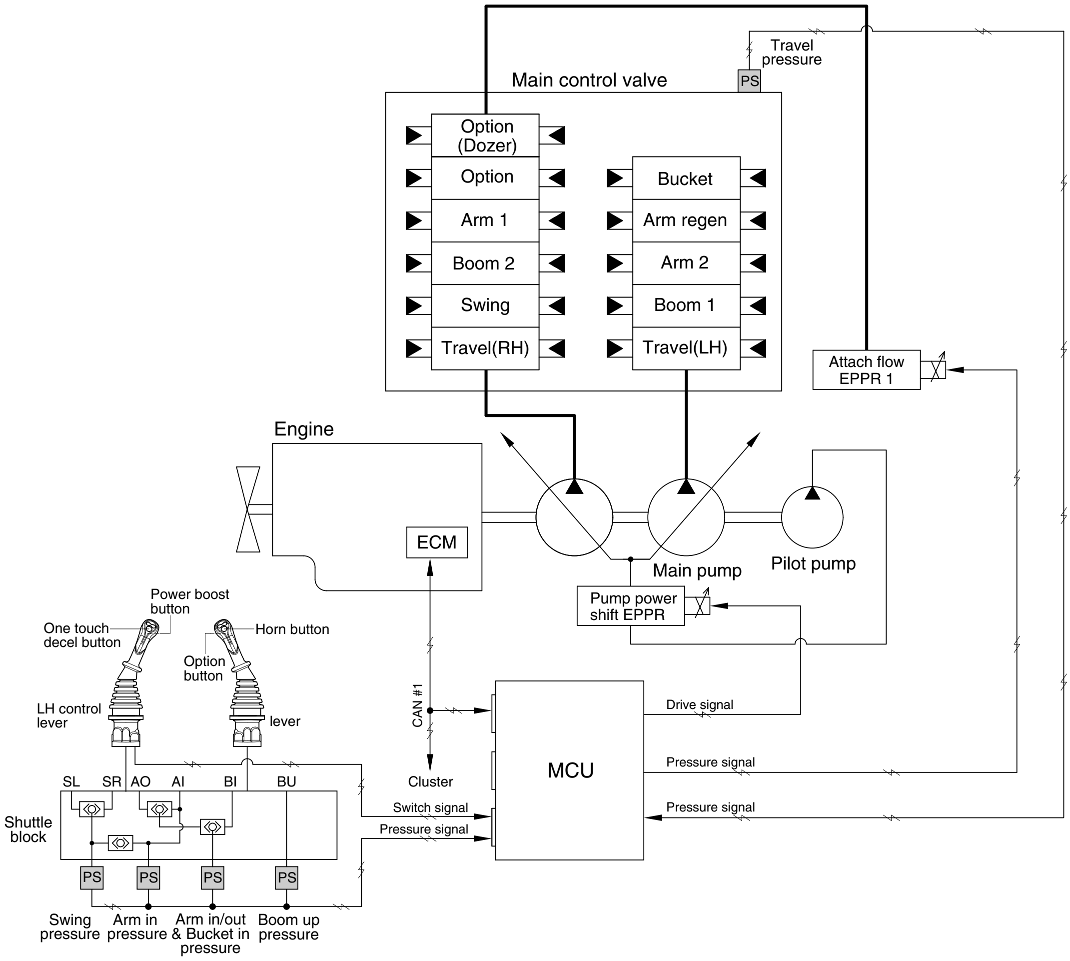
· Boom floating automatically controls boom cylinder along the ground by operating arm cylinder only.

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
General mode	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



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

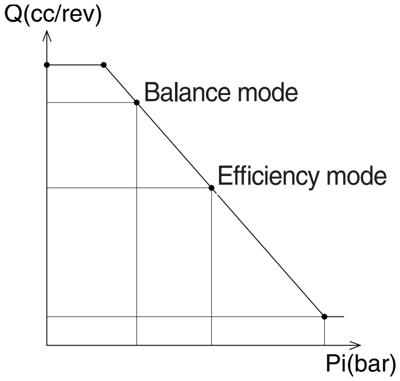
Condition★1	Function
IPC mode : ON★2 Boom up Arm in Not travel motion Not swing motion	Limitation of pump flow rate : Activated
None of upper condition	Limitation of pump flow rate : Canceled

★1 AND condition

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

2. IPC MODE SELECTION

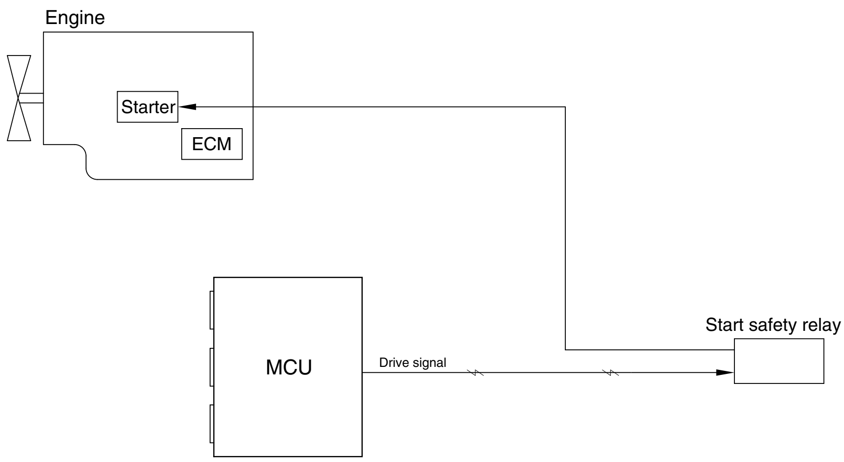
IPC mode ON/OFF and the levels of flow rate limit can be selected at "Mode setup > IPC mode"



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

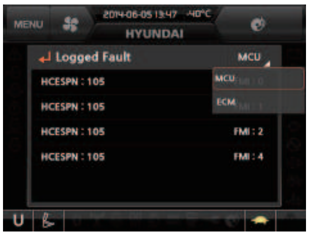
290F3CD121

290F3CD125

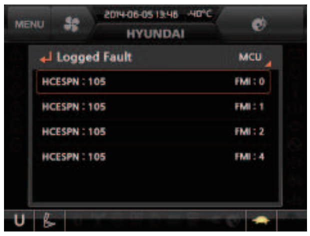
· The active faults of the MCU, engine ECM or air conditioner can be checked by this menu.

2) Logged fault

290F3CD128



290F3CD123

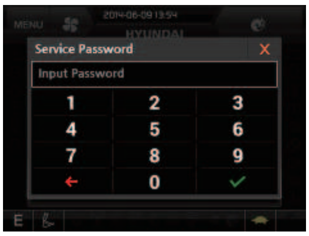


290F3CD124

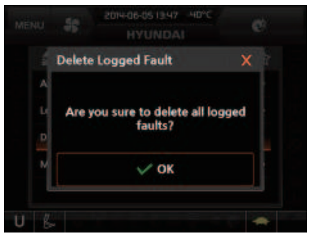
· The logged faults of the MCU, engine ECM or air conditioner can be checked by this menu.

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

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

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

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

DTC		Diagnostic Criteria	Application		
HCESPN	FMI		G	C	W
123	0	10 seconds continuous, Negative 1 Press. Sensor Measurement Voltage > 5.2V	●		
	1	10 seconds continuous, 0.3V≤ Negative 1 Press. Sensor Measurement Voltage < 0.8V	●		
	4	10 seconds continuous, Negative 1 Press. Sensor Measurement Voltage < 0.3V	●		
		(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			
124	0	10 seconds continuous, Negative 2 Press. Sensor Measurement Voltage > 5.2V	●		
	1	10 seconds continuous, 0.3V≤ Negative 2 Press. Sensor Measurement Voltage < 0.8V	●		
	4	10 seconds continuous, Negative 2 Press. Sensor Measurement Voltage < 0.3V	●		
		(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			
127	0	10 seconds continuous, Boom Up Pilot Press. Sensor Measurement Voltage > 5.2V	●		
	1	10 seconds continuous, 0.3V≤ Boom Up Pilot Press. Sensor Measurement Voltage < 0.8V	●		
	4	10 seconds continuous, Boom Up Pilot Press. Sensor Measurement < 0.3V	●		
		(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			

※ 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

DTC		Diagnostic Criteria	Application		
HCESPN	FMI		G	C	W
140	5	(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	●		
	6	(Detection) 10 seconds continuous, Pump EPPR drive current > 1.0A (Cancellation) 3 seconds continuous, Pump EPPR drive current ≤ 1.0 A	●		
	(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				
141	5	(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	●		
	6	(Detection) 10 seconds continuous, Boom Priority EPPR drive current > 1.0 A (Cancellation) 3 seconds continuous, Boom Priority EPPR drive current ≤ 1.0 A	●		
	(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				

※ 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

DTC		Diagnostic Criteria	Application		
HCESPN	FMI		G	C	W
167	4	(Detection) (When Travel Speed Solenoid is Off) 10 seconds continuous, Travel Speed Solenoid drive unit Measurement Voltage $\leq$ 3.0V (Cancellation) (When Travel Speed Solenoid is Off) 3 seconds continuous, Travel Speed Solenoid drive unit Measurement Voltage > 3.0V		●	
		(When Parking mode is not) (Detection) (When Travel Speed Solenoid is Off) 10 seconds continuous, Travel Speed Solenoid drive unit Measurement Voltage $\leq$ 3.0V (Cancellation) (When Travel Speed Solenoid is Off) 3 seconds continuous, Travel Speed Solenoid drive unit Measurement Voltage > 3.0V			●
	6	(Detection) (When Travel Speed Solenoid is On) 10 seconds continuous, Travel Speed Solenoid drive current > 4.5 A (Cancellation) (When Travel Speed Solenoid is On) 3 seconds continuous, Travel Speed Solenoid drive current $\leq$ 4.5 A	●		
	(Results / Symptoms) 1. Control Function – driving in 1/2 transmission operation failure (Checking list) 1. CN-70 (#1) – CN-52(#20) Checking Open/Short 2. CN-70 (#2) – CN-45(#B+ term) Checking Open/Short				

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

DTC		Diagnostic Criteria	Application		
HCESPN	FMI		G	C	W
169	4	Monitor – Selecting attachment(breaker / crusher) (Detection) (When Attachment Conflux Solenoid is Off) 10 seconds continuous, Attachment Conflux Solenoid drive unit Measurement Voltage ≤ 3.0V (Cancellation) (When Attachment Conflux Solenoid is Off) 3 seconds continuous, Attachment Conflux Solenoid drive unit Measurement Voltage > 3.0V	●		
	6	(Detection) (When Attachment Conflux Solenoid is On) 10 seconds continuous, Attachment Conflux Solenoid drive Current > 6.5 A (Cancellation) (When Attachment Conflux Solenoid is On) 3 seconds continuous, Attachment Conflux Solenoid drive Current ≤ 6.5 A	●		
	(Results / symptoms) 1. Control Function – Option attachment flow control – Joining operation failure (Eco breaker mode, crusher mode) (Checking list) 1. CD-237 (#1) – CN-53 (#7) Checking Open/Short 2. CD-237 (#2) – CR-35 (#87) Checking Open/Short				
170	4	(Model Parameter) mounting Arm Regenerating Solenoid (Detection) (When Arm Regeneration Solenoid is Off) 10 seconds continuous, Arm Regeneration Solenoid drive unit Measurement Voltage ≤ 3.0V (Cancellation) (When Arm Regeneration Solenoid is Off) 3 seconds continuous, Arm Regeneration Solenoid drive unit Measurement Voltage > 3.0V	●		
	6	(Detection) (When Arm Regeneration Solenoid is On) 10 seconds continuous, Arm Regeneration Solenoid drive current > 4.5 A (Cancellation) (When Arm Regeneration Solenoid is On) 3 seconds continuous, Arm Regeneration Solenoid drive current ≤ 4.5 A	●		
	(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				

※ 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
171	4	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	●		
	6	(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	●		
	(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				
179	4	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	●		
	6	(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	●		
	(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				

※ 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

DTC		Diagnostic Criteria	Application		
HCESPN	FMI		G	C	W
189	5	(Detection) (When Attachment Flow EPPR 2 current is equal or more than 300 mA) 10 seconds continuous, Attachment Flow EPPR drive current < 100 mA (Cancellation) (When Attachment Flow EPPR 2 current is equal or more than 300 mA) 3 seconds continuous, Attachment Flow EPPR drive current ≥ 100 mA	●		
	6	(Detection) 10 seconds continuous, Attachment Flow EPPR 2 drive current > 1.0 A (Cancellation) 3 seconds continuous, Attachment Flow EPPR 2 drive current ≤ 1.0 A	●		
		(Results / Symptoms) 1. Control Function – Option attachment flow control operation failure (Checking list) 1. CN-243 (#2) – CN-52 (#6) Checking Open/Short 2. CN-243 (#1) – CN-52 (#7) Checking Open/Short			
196	0	HW145 10 seconds continuous, Attachment flow control EPPR 1 press. Sensor Measurement Voltage > 5.2V			
	1	HW145 10 seconds continuous, 0.3V≤ Attachment flow control EPPR 1 press. Sensor Measurement Voltage < 0.8V			
	4	HW145 10 seconds continuous, Attachment flow control EPPR 1 press. Sensor Measurement Voltage < 0.3V			
		(Results / Symptoms) 1. Control Function – Driving second pump joining function operation failure (Checking list) 1. CD-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			
200	0	10 seconds continuous, Pump EPPR Press. Sensor Measurement Voltage > 5.2V	●		
	1	10 seconds continuous, 0.3V≤ Pump EPPR Press. Sensor Measurement Voltage < 0.8V	●		
	4	10 seconds continuous, Pump EPPR Press. Sensor Measurement Voltage < 0.3V	●		
		(Results / Symptoms) 1. Monitor – Pump EPPR Press. display failure 2. Control Function – Pump input horse power control failure, Overload at compensation control operation failure (Fuel efficiency/speed performance failure) (Checking list) 1. CD-44 (#B) – CN-52 (#32) Checking Open/Short 2. CD-44 (#A) – CN-51 (#3) Checking Open/Short 3. CD-44 (#C) – CN-51 (#13) Checking Open/Short			

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

<table>
<tr><th colspan="2">DTC</th><th rowspan="2">Diagnostic Criteria</th><th colspan="3">Application</th></tr>
<tr><th>HCESPN</th><th>FMI</th><th>G</th><th>C</th><th>W</th></tr>
<tr><td rowspan="4">205</td><td>0</td><td>(Mounting pressure sensor)
10 seconds continuous, Boom Cylinder Rod Press. Sensor Measurement Voltage > 5.2V</td><td>●</td><td></td><td></td></tr>
<tr><td>1</td><td>(Mounting pressure sensor)
10 seconds continuous, 0.3V≤ Boom Cylinder Rod Press. Sensor Measurement Voltage < 0.8V</td><td>●</td><td></td><td></td></tr>
<tr><td>4</td><td>(Mounting pressure sensor)
10 seconds continuous, Boom Cylinder Rod Press. Sensor Measurement Voltage < 0.3V</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Monitor – Boom Cylinder Rod Press. display failure
2. Control Function – Boom floating control operation failure
(Checking list)
1. CD-124 (#B) – CN-53 (#5) Checking Open/Short
2. CD-124 (#A) – CN-53 (#3) Checking Open/Short
3. CD-124 (#C) – CN-53 (#13) Checking Open/Short</td></tr>
<tr><td rowspan="3">218</td><td>4</td><td>Mounting pressure sensor (HCESPN128 or HCESPN 205)
(Detection)
(When Boom Up Floating Solenoid is Off)
10 seconds continuous, Boom Up Floating Solenoid drive unit Measurement Voltage ≤ 3.0V
(Cancellation)
(When Boom Up Floating Solenoid is Off)
3 seconds continuous, Boom Up Floating Solenoid drive unit Measurement Voltage > 3.0V</td><td>●</td><td></td><td></td></tr>
<tr><td>6</td><td>(Detection)
(When Boom Up Floating Solenoid is On)
10 seconds continuous, Boom Up Floating Solenoid drive current > 6.5 A
(Cancellation)
(When Boom Up Floating Solenoid is On)
3 seconds continuous, Boom Up Floating Solenoid drive current ≤ 6.5 A</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Control Function – Boom floating control operation failure
(Checking list)
1. 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	●		
220	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	●		
220	(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	●		
221	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	●		
221	(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

<table>
<tr><th colspan="2">DTC</th><th rowspan="2">Diagnostic Criteria</th><th colspan="3">Application</th></tr>
<tr><th>HCESPN</th><th>FMI</th><th>G</th><th>C</th><th>W</th></tr>
<tr><td rowspan="3">514</td><td>4</td><td>(Detection)
(When Parking Relay is Off)
10 seconds continuous, Parking Relay drive unit
Measurement Voltage ≤ 3.0V
(Cancellation)
(When Parking Relay is Off)
3 seconds continuous, Parking Relay drive unit
Measurement Voltage > 3.0V</td><td></td><td></td><td>●</td></tr>
<tr><td>6</td><td>(Detection)
(When Parking Relay is On)
10 seconds continuous, Parking Relay drive current > 6.5 A
(Cancellation)
(When Parking Relay is On)
3 seconds continuous, Parking Relay drive current ≤ 6.5 A</td><td></td><td></td><td>●</td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Control Function – Parking Relay operation failure
(Checking list)
1. CR-66 (#1) – CN-54 (#20) Checking Open/Short
2. CR-66 (#2) – CN-45 (#B+ term) Checking Open/Short</td></tr>
<tr><td rowspan="3">517</td><td>4</td><td>(Detection)
(When Traveling Cutoff Relay is Off)
10 seconds continuous, Traveling Cutoff Relay drive unit Measurement Voltage ≤ 3.0V
(Cancellation)
(When Traveling Cutoff Relay is Off)
3 seconds continuous, Traveling Cutoff Relay drive unit Measurement Voltage > 3.0V</td><td></td><td></td><td>●</td></tr>
<tr><td>6</td><td>(Detection)
(When Traveling Cutoff Relay is On)
10 seconds continuous, Traveling Cutoff Relay drive current > 6.5 A
(Cancellation)
(When Traveling Cutoff Relay is On)
3 seconds continuous, Traveling Cutoff Relay drive current ≤ 6.5 A</td><td></td><td></td><td>●</td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Control Function – Traveling Cutoff Relay operation failure
(Checking list)
1. CR-47 (#85) – CN-54 (#9) Checking Open/Short
2. CR-47 (#86) – 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
525	4	(Detection) (When Ram Lock Solenoid is Off) 10 seconds continuous, Ram Lock Solenoid drive unit Measurement Voltage ≤ 3.0V (Cancellation) (When Ram Lock Solenoid is Off) 3 seconds continuous, Ram Lock Solenoid drive unit Measurement Voltage > 3.0V			●
	6	(Detection) (When Ram Lock Solenoid is On) 10 seconds continuous, Ram Lock Solenoid drive current > 6.5 A (Cancellation) (When Ram Lock Solenoid is On) 3 seconds continuous, Ram Lock Solenoid drive current ≤ 6.5 A			●
	(Results / Symptoms) 1. Control Function – Ram lock control operation failure (Checking list) 1. CN-69 (#1) – CN-54 (#8) Checking Open/Short 2. CN-69 (#2) – CN-45 (#B+ term) Checking Open/Short				
527	4	(Detection) (When Creep Solenoid is Off) 10 seconds continuous, Creep Solenoid drive unit Measurement Voltage ≤ 3.0V (Cancellation) (When Creep Solenoid is Off) 3 seconds continuous, Creep Solenoid drive unit Measurement Voltage > 3.0V			●
	6	(Detection) (When Creep Solenoid is On) 10 seconds continuous, Creep Solenoid drive current > 6.5 A (Cancellation) (When Creep Solenoid is On) 3 seconds continuous, Creep Solenoid drive current ≤ 6.5 A			●
	(Results / Symptoms) 1. Control Function – Creep mode operation failure (Checking list) 1. CN-206 (#1) – CN-54 (#7) Checking Open/Short 2. CN-206 (#2) – CN-45 (#B+ term) Checking Open/Short				

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

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

<table>
<tr><th colspan="2">DTC</th><th rowspan="2">Diagnostic Criteria</th><th colspan="3">Application</th></tr>
<tr><th>HCESPN</th><th>FMI</th><th>G</th><th>C</th><th>W</th></tr>
<tr><td rowspan="2">841</td><td>2</td><td>10 seconds continuous, ECM Communication Data Error</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Control Function – ECM operation failure
(Checking list)
1. CN-93 (#22) – CN-51 (#21) Checking Open/Short
2. CN-93 (#46) – CN-51 (#31) Checking Open/Short</td></tr>
<tr><td rowspan="2">845</td><td>2</td><td>(When mounting the I/O Controller 1)
60 seconds continuous, I/O Controller 1 Communication Data Error</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Control Function – I/O Controller 1 operation failure
(Checking list)
1. CN-53 (#21) – CN-51 (#23) Checking Open/Short
2. CN-53 (#31) – CN-51 (#33) Checking Open/Short</td></tr>
<tr><td rowspan="2">848</td><td>2</td><td>(When mounting the Haptic Controller)
60 seconds continuous, Haptic Controller Communication Data Error</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Control Function – Haptic Controller operation failure
(Checking list)
1. CN-8 (#2) – CN-51 (#22) Checking Open/Short
2. CN-8 (#3) – CN-51 (#32) Checking Open/Short</td></tr>
<tr><td rowspan="2">850</td><td>2</td><td>(When mounting the RMCU)
60 seconds continuous, RMCU communication Data Error</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(Resuluts / Symptoms)
1. Control Function – RMCU operation failure
(Checking list)
1. CN-125 (#3) – CN-51 (#22) Checking Open/Short
2. CN-125 (#11) – CN-51 (#32) Checking Open/Short</td></tr>
<tr><td rowspan="2">861</td><td>2</td><td>(When mounting the I/O Controller 2)
60 seconds continuous, I/O Controller 2 communication Data Error</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Control Function – I/O Controller 2 operation failure
(Checking list)
1. CN-54 (#21) – CN-51 (#23) Checking Open/Short
2. CN-54 (#31) – CN-51 (#33) Checking Open/Short</td></tr>
</table>

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

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

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

4. ENGINE FAULT CODE

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
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
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

※ Some fault codes are not applied to this machine.

J1939 Code	Description	Refer to Procedure
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
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
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
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)

※ Some fault codes are not applied to this machine.

J1939 Code	Description	Refer to Procedure
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
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
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

※ Some fault codes are not applied to this machine.

J1939 Code	Description	Refer to Procedure
190-8	Engine Speed : Abnormal Frequency, Pulse Width or Period	Engine Speed/Timing Sensor Circuit - Test
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
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
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

※ Some fault codes are not applied to this machine.

J1939 Code	Description	Refer to Procedure
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
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
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
678-4	ECU 8 Volts DC Supply : Voltage Below Normal	Digital Throttle Position Sensor Circuit - Test

※ Some fault codes are not applied to this machine.

J1939 Code	Description	Refer to Procedure
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
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
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

※ Some fault codes are not applied to this machine.

J1939 Code	Description	Refer to Procedure
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
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
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
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)

※ Some fault codes are not applied to this machine.

J1939 Code	Description	Refer to Procedure
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
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))
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
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

※ Some fault codes are not applied to this machine.

J1939 Code	Description	Refer to Procedure
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
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
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

※ Some fault codes are not applied to this machine.

J1939 Code	Description	Refer to Procedure
4360-3	Aftertreatment #1 SCR Catalyst Intake Gas Temperature : Voltage Above Normal	Sensor Signal (Analog, Passive) - Test
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
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
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

※ Some fault codes are not applied to this machine.

J1939 Code	Description	Refer to Procedure
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
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
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

※ Some fault codes are not applied to this machine.

J1939 Code	Description	Refer to Procedure
5706-6	Aftertreatment #1 Diesel Exhaust Fluid Pump Heater : Current Above Normal	DEF/AdBlue® Pump - Test
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
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

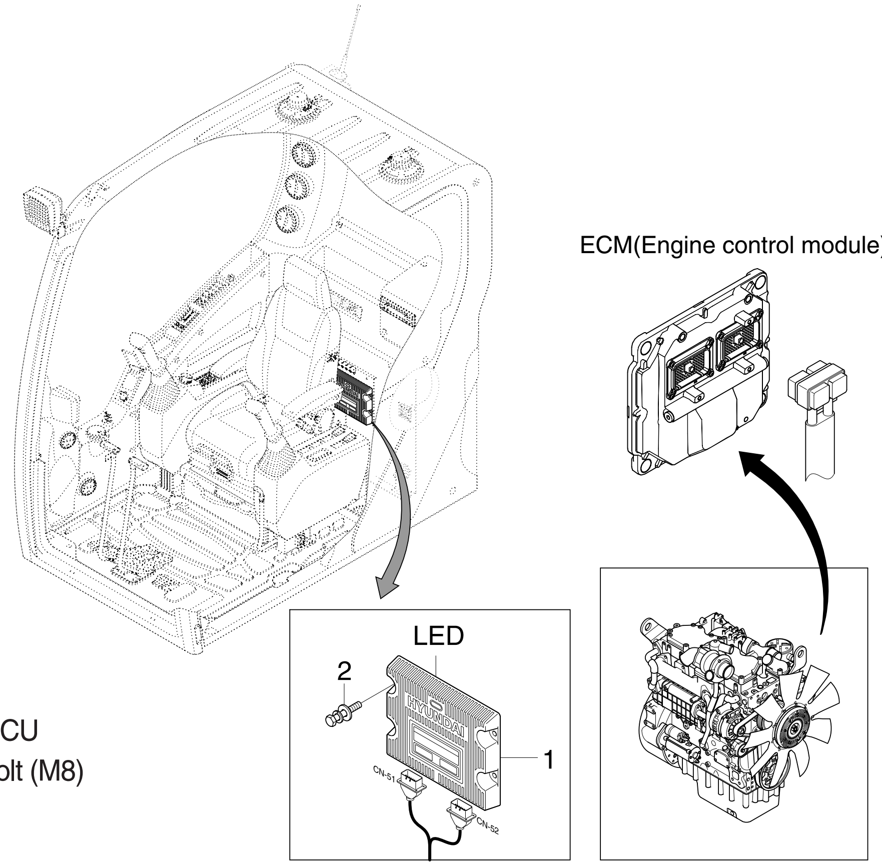
※ Some fault codes are not applied to this machine.

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)



1 MCU
2 Bolt (M8)

145LCR5MS01

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	8	114	290 ± 30	1850 ± 50
	S	10 ± 3	142 ± 40	330 ± 30	1750 ± 50
	E	12 ± 3	171 ± 40	360 ± 30	1650 ± 50
Option	P	0	0	160 ± 30	2100 ± 50
	S	5 ± 3	73 ± 40	250 ± 30	2000 ± 50
	E	10 ± 3	142 ± 40	330 ± 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 (standard ↔ option).

- Management
  · Service menu

290F3CD149

Enter the password 290F3CD126

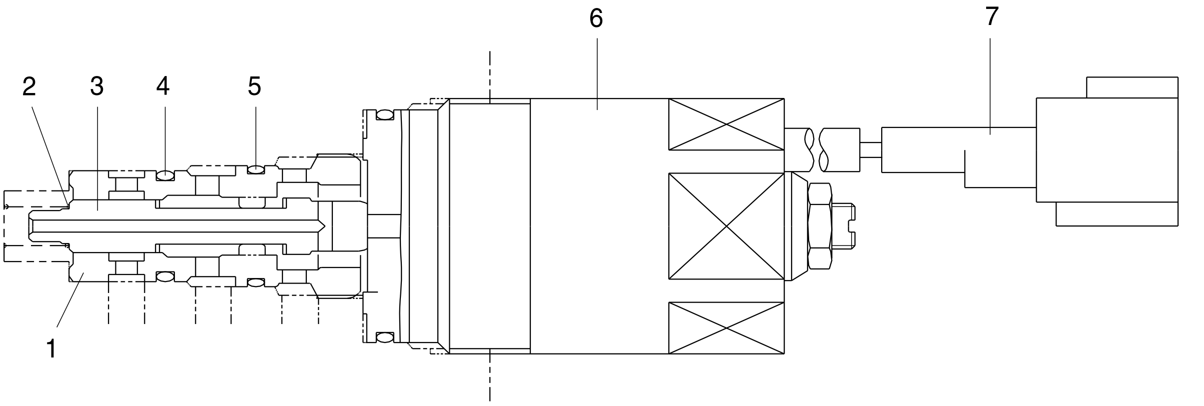
290F3CD150

290F3CD151

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

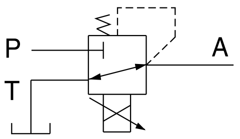
3) OPERATING PRINCIPLE

(1) Structure



5-22(1)

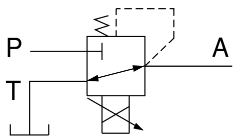
1 Sleeve
2 Spring
3 Spool
4 O-ring
5 O-ring
6 Solenoid valve
7 Connector

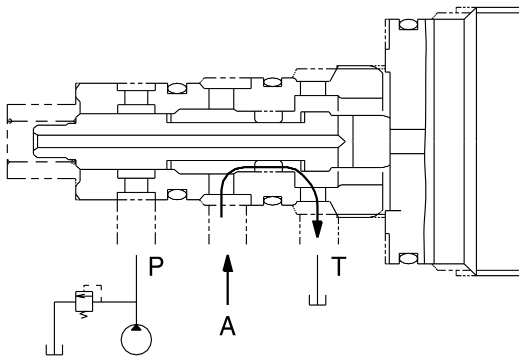


P Pilot oil supply line (pilot pressure)
T Return to tank
A Secondary pressure to flow regulator at main pump

(2) Neutral

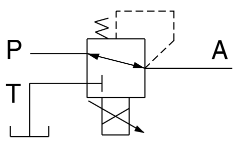
Pressure line is blocked and A oil returns to tank.

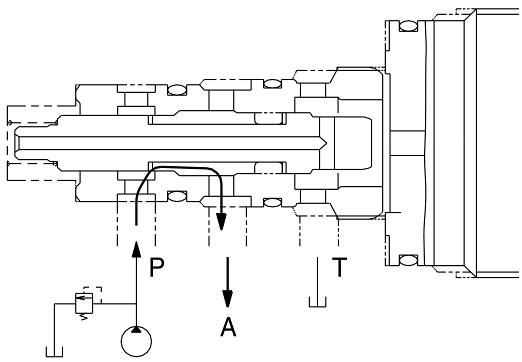




(3) Operating

Secondary pressure enters into A.

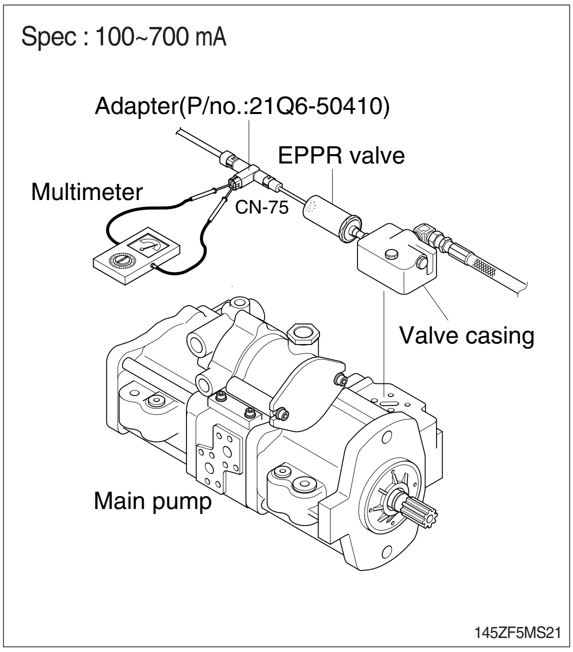




5-22(2)

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.

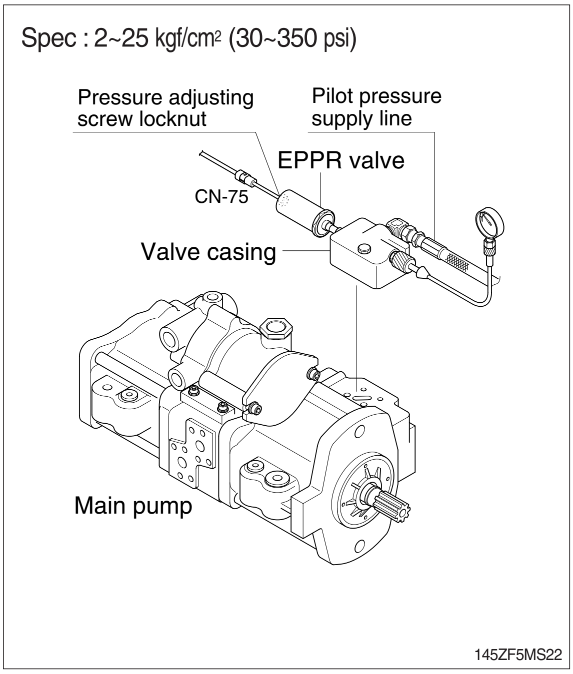
④ Set S-mode and cancel auto decel mode.

⑤ Position the accel dial at 10.

⑥ If rpm display show approx 1750±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 accel dial at 10.

⑤ If tachometer show approx 1750±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

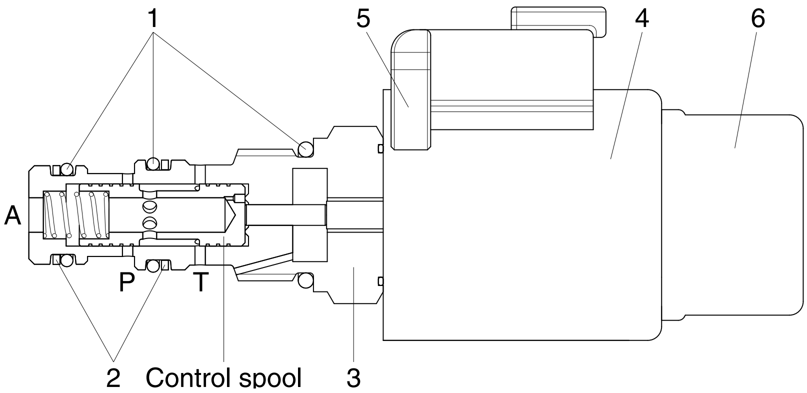
The boom priority EPPR valve is built in a manifold and mainly consisting of valve body and coil. This EPPR valve installed under the solenoid valve.

2) CONTROL

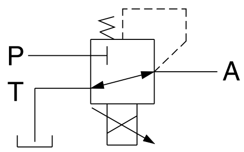
The boom priority EPPR valve has to be controlled by a specific electronic amplifier card, which is supplying the coil with a current 580 mA at 30Ω and 24 V.

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.

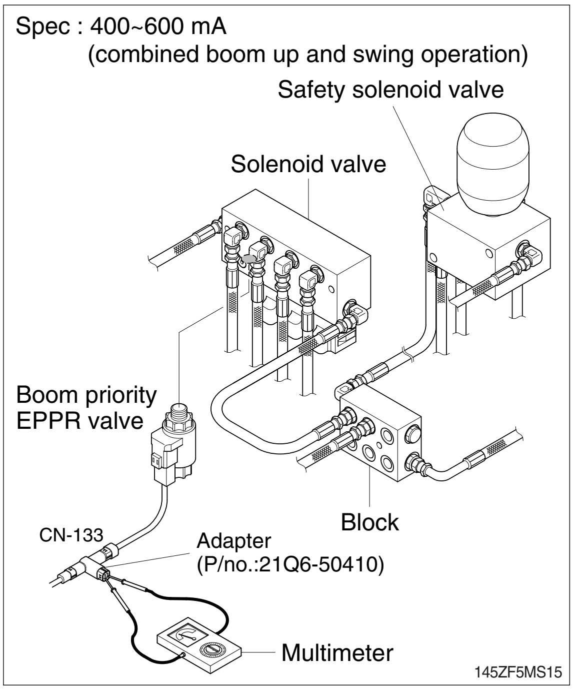
② Insert the adapter to CN-133 and install multimeter as figure.

③ Start engine.

④ Set S-mode and cancel auto decel mode.

⑤ If rpm display approx 1750±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)

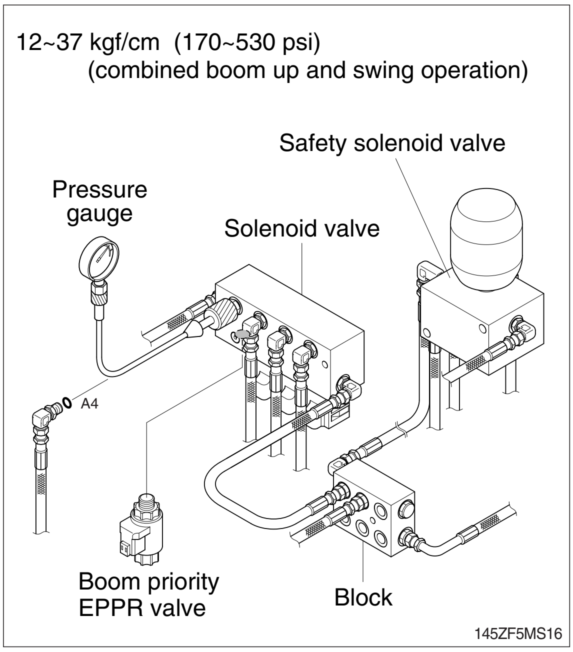
② Start engine.

③ Set S-mode and cancel auto decel mode.

④ If rpm display approx 1750±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. Also, monitor part is to set and display for modes, monitoring and utilities with the switches.

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

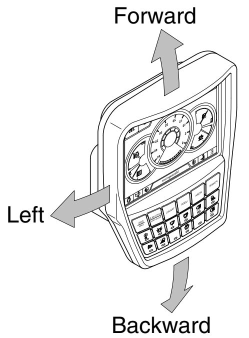
2. CLUSTER

1) MONITOR PANEL

235F3CD05

※ The warning lamp pops up and/or blinks and the buzzer sounds when the machine has a problem.
The warning lamp lights up or 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

e. DEF/AdBlue® 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 to 1000 rpm.

※ Others same as above.

③ When abnormal condition

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

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

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

3) CLUSTER CONNECTOR

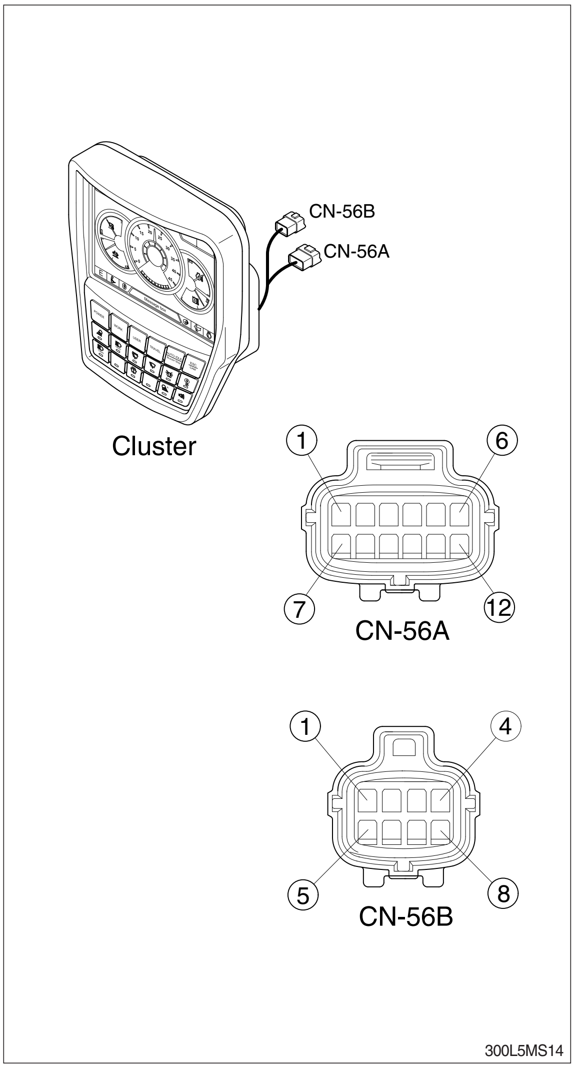
(1) CN-56A

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)	0~5V
7	CAN 2 (L)	20~32V
8	N.C.	-
9	N.C.	-
10	Aux left	0~5V
11	Aux right	0~5V
12	Aux GND	-

(2) CN-56B

No.	Name	Signal
1	CAM 6.5V	6.3~6.7V
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	0~5V

NTSC : National Television System Committee

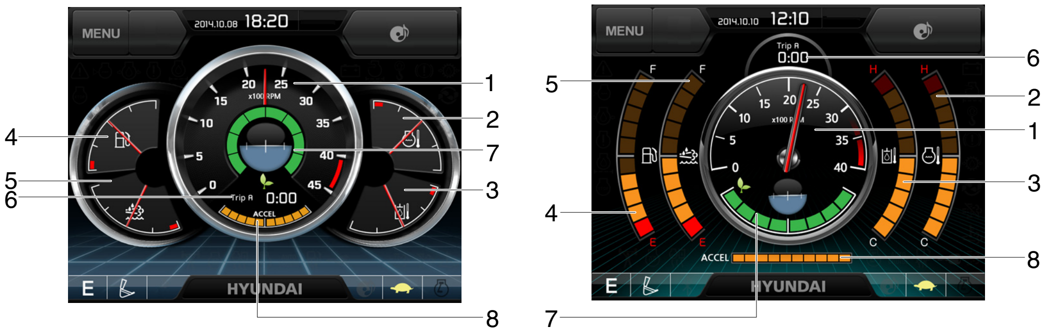


4) GAUGE

(1) Operation screen

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

Default | Option

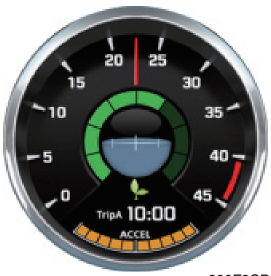


235F3CD07

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 5-88 for details.

(2) RPM / Speed gauge



290F3CD49

① This display the engine speed.

(3) Engine coolant temperature gauge

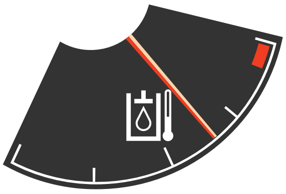
290F3CD53

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

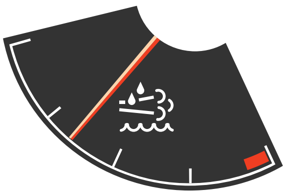
290F3CD55

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 5-69.

※ 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 5-90 for details.

(8) Eco gauge

290F3CD58

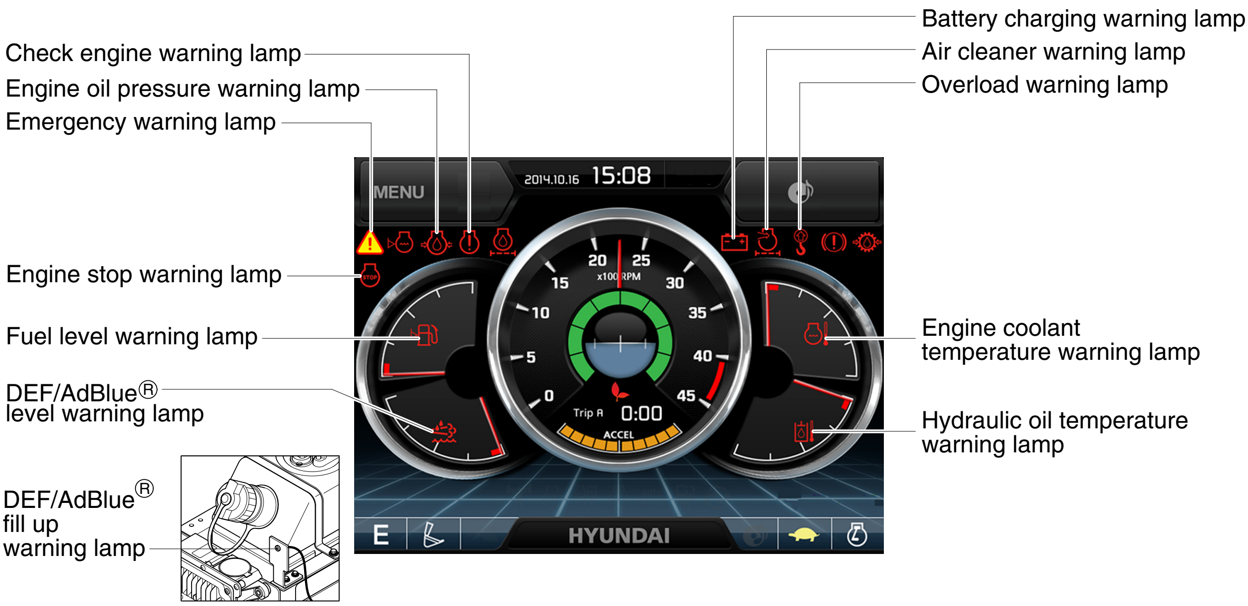
① This gauge indicates the fuel consumption rate and machine load status. So that operators can be careful with fuel economy.
② The fuel consumption rate or machine load is higher, the number of segment is increased.
③ The color of Eco gauge indicates operation status.
- White : Idle operation
- Green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

(9) Accel dial gauge

290F3CD59

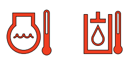
① This gauge indicates the level of accel dial.

5) WARNING LAMPS



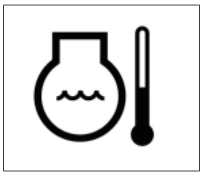
145ZF3CD03

※ 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 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 lamp of the LCD is touched ※ Refer to page 5-69 for details.
	Warning lamp pops up on the center of the LCD and the buzzer sounds	※ Refer to page 5-66 for details.

※ Refer to page 5-74 for the buzzer stop switch AUTO IDLE Buzzer Stop .

(1) Engine coolant temperature warning lamp



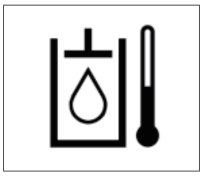
290F3CD61

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



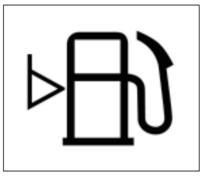
290F3CD62

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

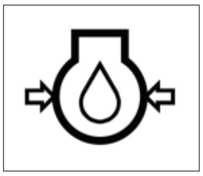
290F3CD64

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.

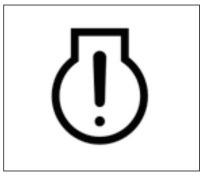
(5) Engine oil pressure warning lamp



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.

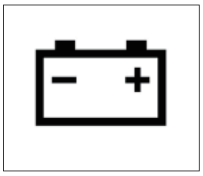
(6) Check engine warning lamp



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.

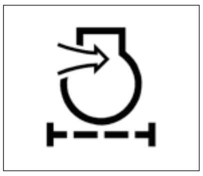
(7) Battery charging warning lamp



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

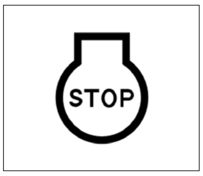
① This warning lamp pops up and the buzzer sounds when the filter of air cleaner is clogged.
② Check the filter and clean or replace it.

(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



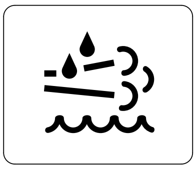
290F3CD252

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 5-69.

(11) DEF/AdBlue® level warning lamp



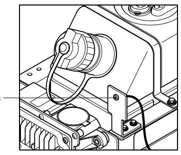
290F3CD257

① This warning lamp indicates when ON, 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



145ZF3CD07

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

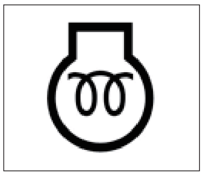
No	Mode	Pilot lamp	Selected mode
1	Power mode	P S E	Heavy duty power work mode Standard power mode Economy power mode
2	User mode	U	User preferable power mode
3	Work tool mode	    	General operation - IPC speed mode General operation - IPC balance mode General operation - IPC efficiency mode Breaker operation mode Crusher operation mode
4	Travel mode	 	Low speed traveling High speed traveling
5	Auto idle mode		Auto idle

(2) Power max pilot lamp


290F3CD78

① The lamp will be ON when pushing power max switch on the LH RCV lever.
② The power max function is operated maximum 8 seconds.
※ **Refer to the operator's manual page 3-34 for power max function.**

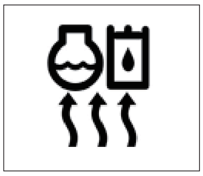
(3) Preheat pilot lamp



290F3CD79

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

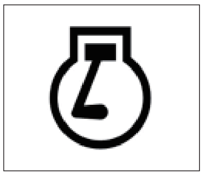
(4) Warming up pilot lamp



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.

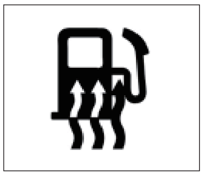
(5) Decel pilot lamp



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 3-33.**

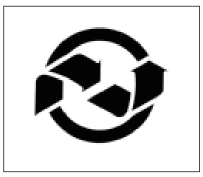
(6) Fuel warmer pilot lamp



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 5-83.**

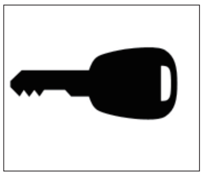
(8) Entertainment pilot lamp

290F3CD84

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

※ Refer to the page 5-89.

(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.

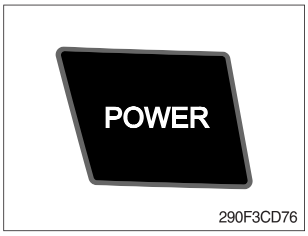
※ Refer to the page 5-84.

5) SWITCHES

235F3CD86

※ When some of the switches are selected, the pilot lamps are displayed on the LCD. Refer to the page 5-70 for details.

(1) Power mode switch



290F3CD76

① This switch is to select the machine power mode and selected power mode pilot lamp is displayed on the pilot lamp position.
- P : Heavy duty power work.
- S : Standard power work.
- E : Economy power work.

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

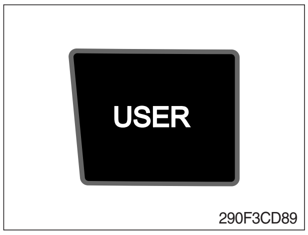
(2) Work mode switch

290F3CD88

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

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

(3) User mode switch



290F3CD89

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

② Refer to the page 5-78 for another set of user mode.

(4) Travel speed switch

290F3CD91

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

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

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

(5) Auto idle/ buzzer stop switch

290F3CD90

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

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

(6) Escape/Camera switch

290F3CD92

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

② In the operation screen, pushing this switch will display the view of the camera on the machine (if equipped).
Please refer to page 5-90 for the camera.

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

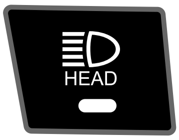
(7) Work light switch


290F3CD93

① This switch is used to operate the work light.

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

(8) Head light switch



290F3CD94

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

(9) Intermittent wiper switch

290F3CD95

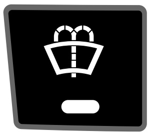
① This switch is used to wipe operates intermittently.
② The pilot lamp is turned ON when operating the switch.

(10) Wiper switch

290F3CD96

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

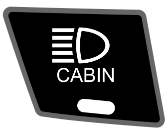
(11) Washer switch



290F3CD100

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

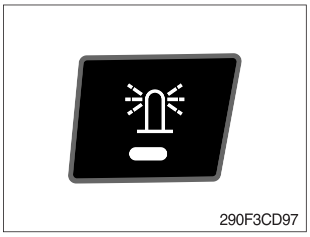
(12) Cab light switch



290F3CD99

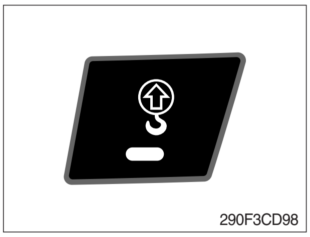
① This switch turns ON the cab light on the cab.
② The pilot lamp is turned ON when operating the switch.

(13) Beacon switch



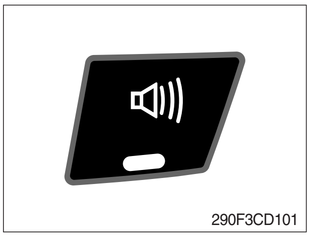
① This switch turns ON the rotary light on the cab.
② The pilot lamp is turned ON when operating the switch.

(14) Overload switch



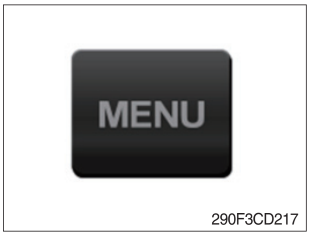
① When this switch turned ON, buzzer makes sound and overload warning lamp comes ON in case that the machine is overload.
② When it turned OFF, buzzer stops and warning lamp goes out.
⚠ **Overloading the machine could impact the machines stability which could result in tipover hazard. A tipover hazard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

(15) Travel alarm switch



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

(16) Main menu quick touch switch



① This switch is to activate the main menu in the cluster.
※ Refer to the page 5-77.

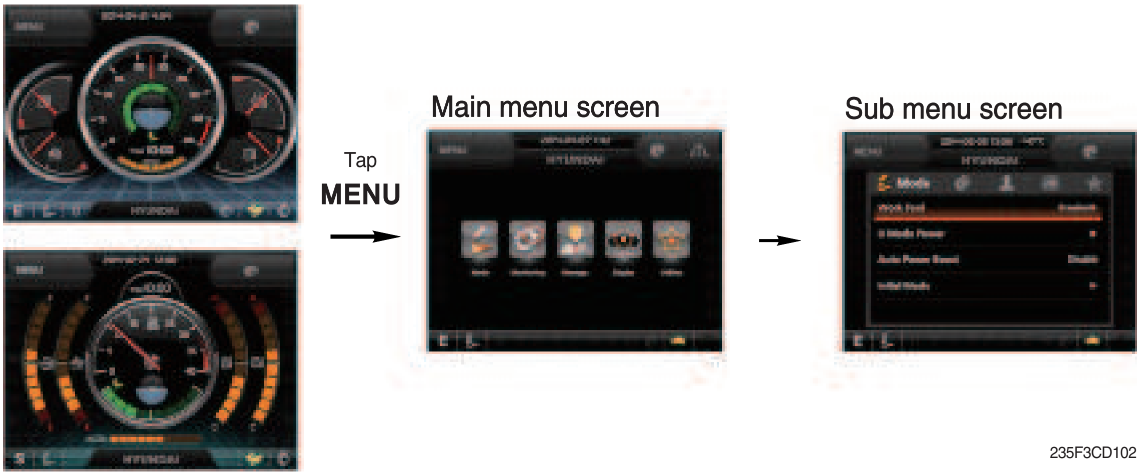
(17) Entertainment quick touch switch

① This switch is to activate the entertainment control menu in the cluster.
※ Refer to the page 5-89.

8) MAIN MENU

※ You can select or set the menu by 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



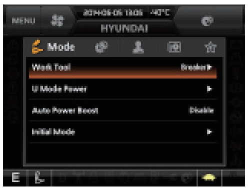
235F3CD102

(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

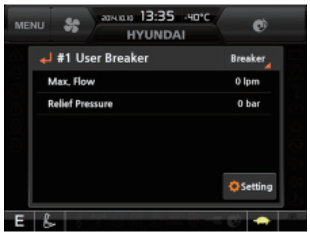
① Work tool



290F3CD108

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

290F3CD111

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.

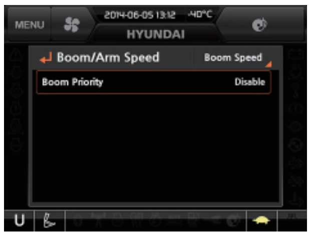
Step (▮)	Engine speed (rpm)	Idle speed (rpm)	Power shift (bar)
1	1300	750	0
2	1400	800	3
3	1500	850	6
4	1600	900	9
5	1700	950	12
6	1800	1000	16
7	1850	1050	20
8	1900	1100 (auto decel)	26
9	1950	1150	32
10	2000	1200	38

※One touch decel & low idle : 1000 rpm

③ Boom/Arm speed

290F3CD113

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

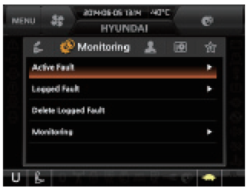
290F3CD248

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



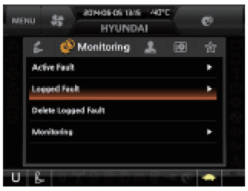
290F3CD120

290F3CD121

290F3CD125

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

② Logged fault



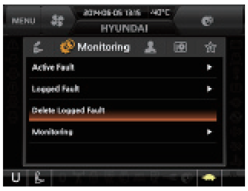
290F3CD128

290F3CD123

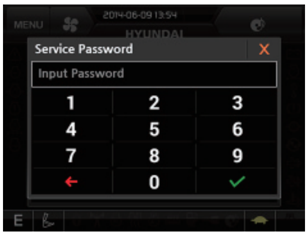
290F3CD124

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

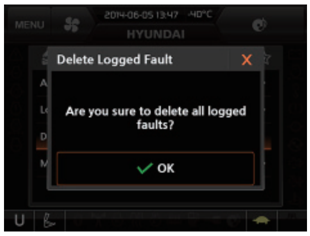
③ Delete logged fault



290F3CD134



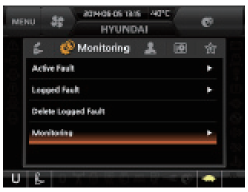
290F3CD126



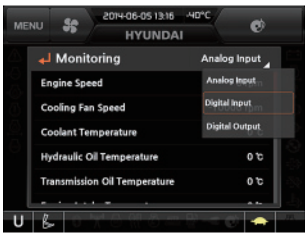
290F3CD127

· 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

290F3CD131

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

220S3CD190A

220S3CD135A

220S3CD136A

220S3CD137A

220S3CD138A

· ESL mode setting

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

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

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

  ※Default password : 00000 + ☑

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

· Password change

- The password is 5~10 digits.

220S3CD190A

220S3CD140A

220S3CD135A

Enter the current password

220S3CD142A

Enter the new password

220S3CD143A

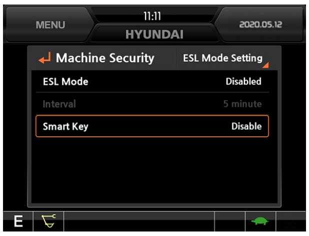
Enter the new password again

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

- Smart key

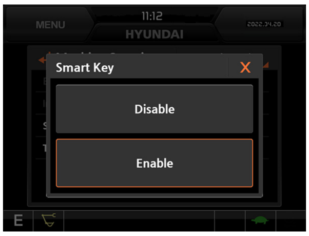
220S3CD190A

220S3CD135A



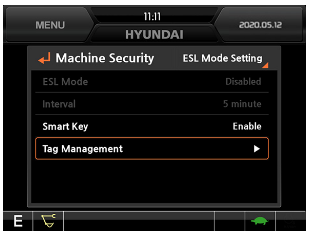
235F3CD001

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

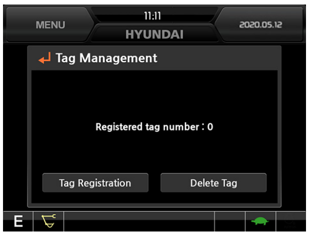


235F3CD002

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

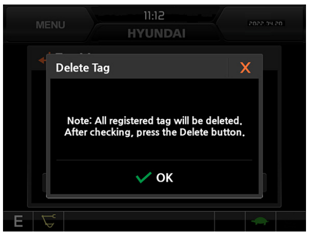


235F3CD003



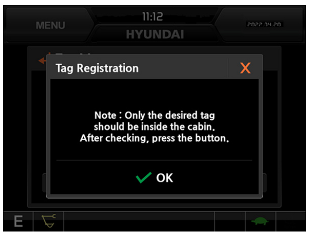
235F3CD004

Deleting



235F3CD006

Registering



235F3CD005

④ Machine Information

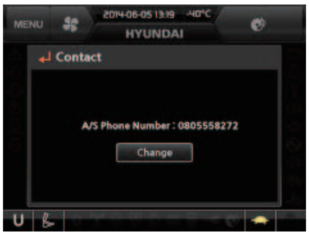
290F3CD144

290F3CD145

· This can confirm the identification of the model information (ECU), MCU, monitor, 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

145ZF3CD250

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

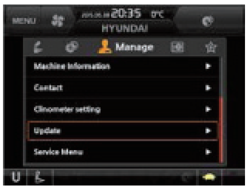
⑦ Clinometer

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.

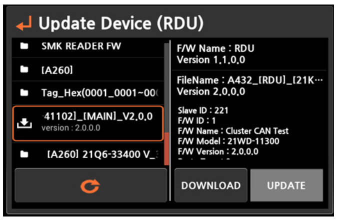
⑧ Update (cluster & ETC devices)



210WF3CD17

210WF3CD18

210WF3CD19



380F3CD06

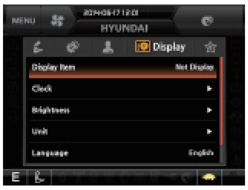
380F3CD04

· ETC devices and cluster can be updated through CAN 2 network.

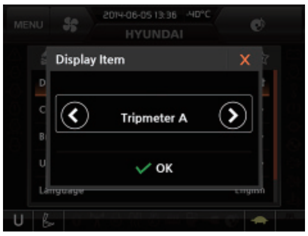
· Insert USB memory stick which includes program files, start download.

(5) Display

① Display item



290F3CD154



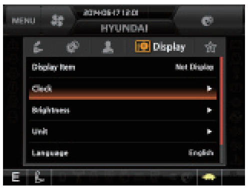
290F3CD155

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



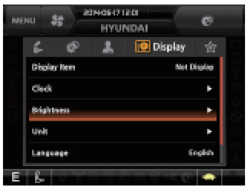
290F3CD157

290F3CD158

· The first line's three spots "**/**/****" represent Month/Day/Year each.

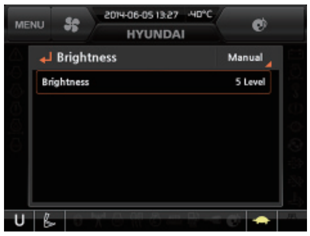
· The second line shows the current time. (0:00~23:59)

③ Brightness



290F3CD159

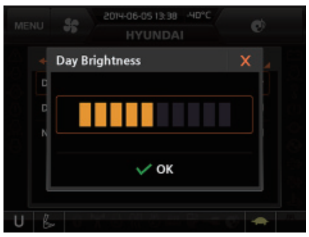
290F3CD160



290F3CD139

290F3CD141

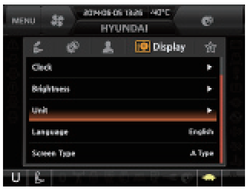
290F3CD191



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



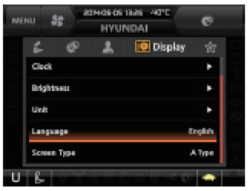
290F3CD161

290F3CD162

290F3CD193

- Temperature : ˚C ↔ ˚F
- Pressure : bar ↔ MPa ↔ kgf/cm²
- Volume : ℓ ↔ gal
- Flow : lpm ↔ gpm
- Distance : km ↔ mile
- Date format : yy/mm/dd ↔ mm/dd/yy ↔ dd-mm-yy

⑤ Language

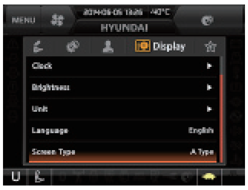


290F3CD163

290F3CD164

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

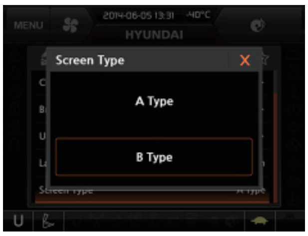
⑥ Screen type



290F3CD165

A Type (Default) 290F3CD166

290F3CD156A

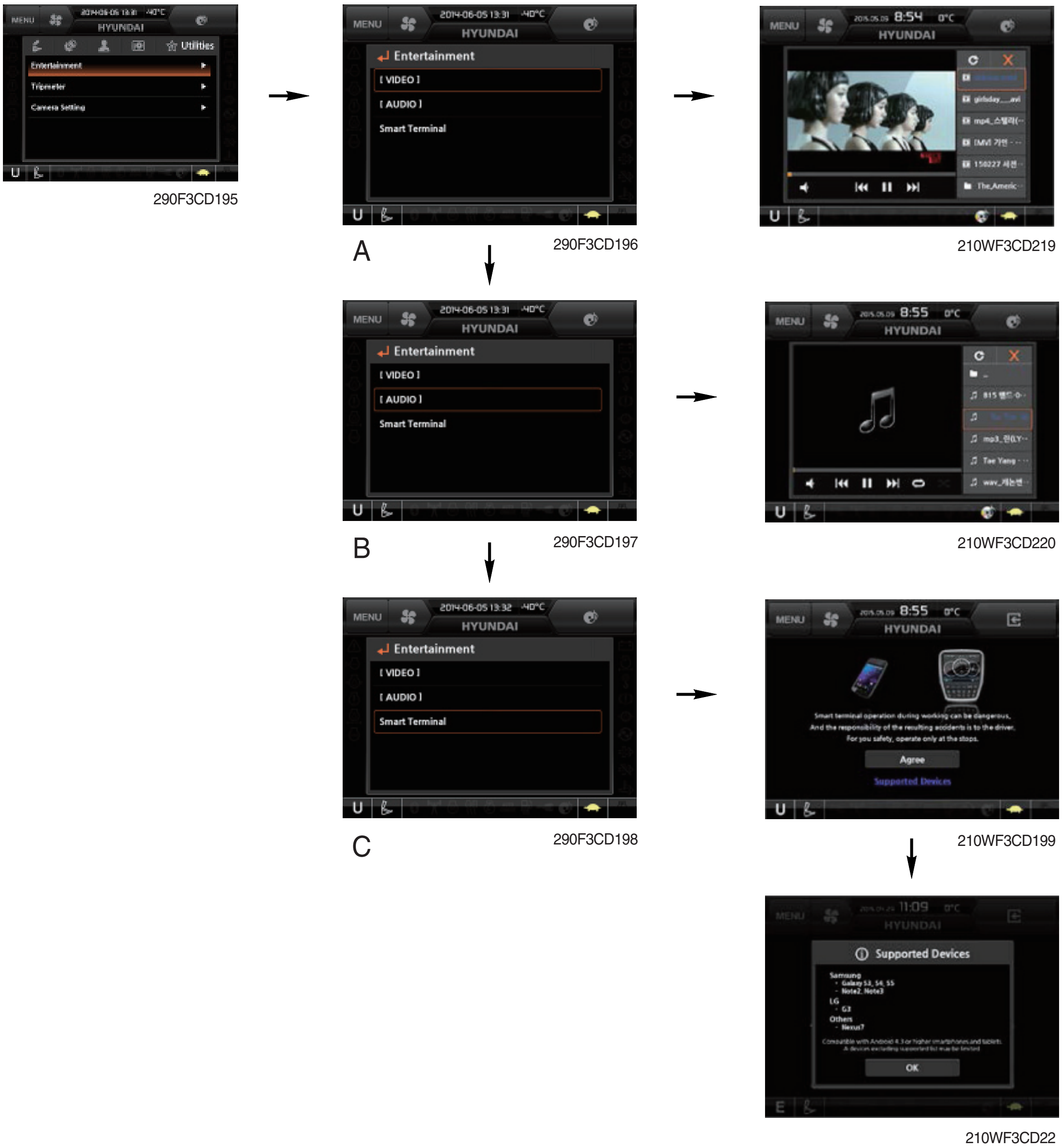


B Type (Option) 290F3CD194

290F3CD167A

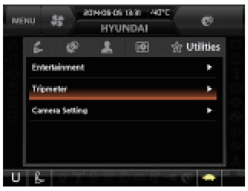
(6) Utilities

① Entertainment



- 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



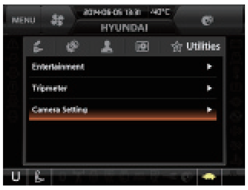
290F3CD168

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.

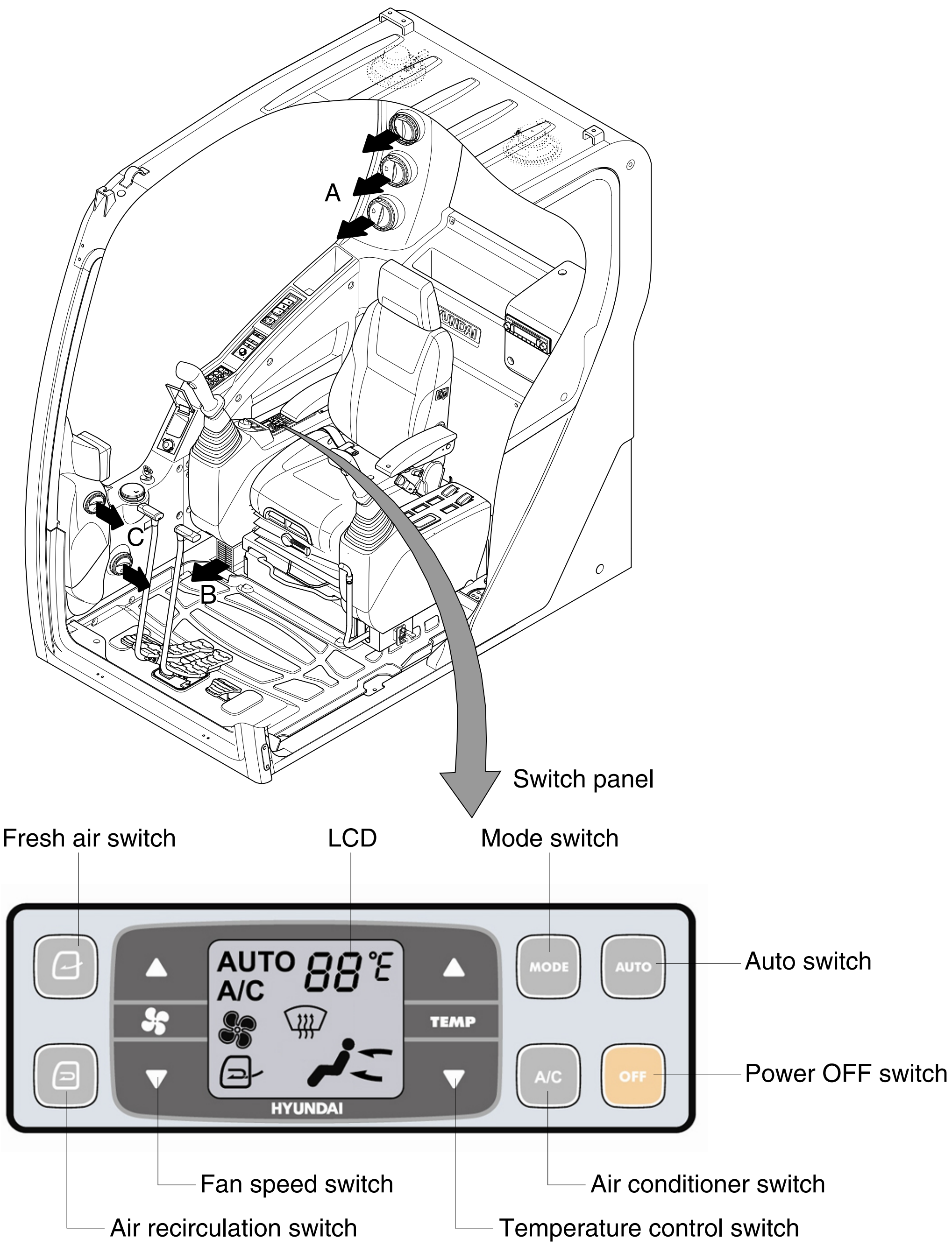
290F3CD156

290F3CD221

3. AIR CONDITIONER AND HEATER

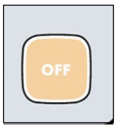
Full auto air conditioner and heater system automatically keeps the optimum condition in accordance with operator's temperature configuration sensing ambient and cabin inside temperature.

· Location of air flow ducts



145ZF3CD06

1) POWER OFF SWITCH



370073CD54

(1) This switch makes the system and the LED 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

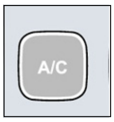
2) AUTO SWITCH

370073CD52

(1) Turn the starting switch to ON position, LCD lights ON.
Auto air conditioner and heater system automatically keeps the optimum condition in accordance with operator's temperature configuration sensing ambient and cabin inside temperature.

(2) This switch can restart system after system OFF.

3) AIR CONDITIONER SWITCH (compressor switch)



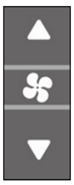
370073CD53

(1) This switch turns the compressor and the LCD ON.

(2) In accordance with the temperature sensed by duct (evaporator) sensor, compressor turns ON or OFF automatically.

※ 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.

4) FAN SPEED SWITCH



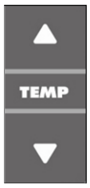
370074CD56

(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.

(3) This switch makes the system ON.

5) TEMPERATURE CONTROL SWITCH



370074CD57

(1) Setting temperature indication
① Type A : 17~32˚C, scale : 1˚C
② Type B : Lo, 18~31˚C, Hi, scale : 1˚C

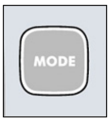
(2) Max cool and max warm beeps 5 times.

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

Temperature	Compressor	Fan speed	In/Outlet	Mode
Max cool	ON	Max (Hi)	Recirculation	Vent
Max warm	OFF	Max (Hi)	Fresh	Foot

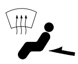
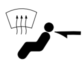
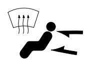
(4) Temperature unit can be changed between celsius (˚C) and fahrenheit (˚F)
① Default status (˚C)
② Push Up/Down temperature control switch simultaneously more than 5 second displayed temperature unit change (˚C → ˚F)

6) MODE SWITCH



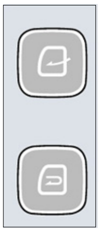
370074CD50

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

Mode switch		Vent	Vent/Foot	Def/Foot	Def/Vent	Def/Vent/Foot
						
Outlet	A	●	●		●	●
	B		●	●		●
	C			●	●	●

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

7) FRESH AIR/AIR RECIRCULATION SWITCH



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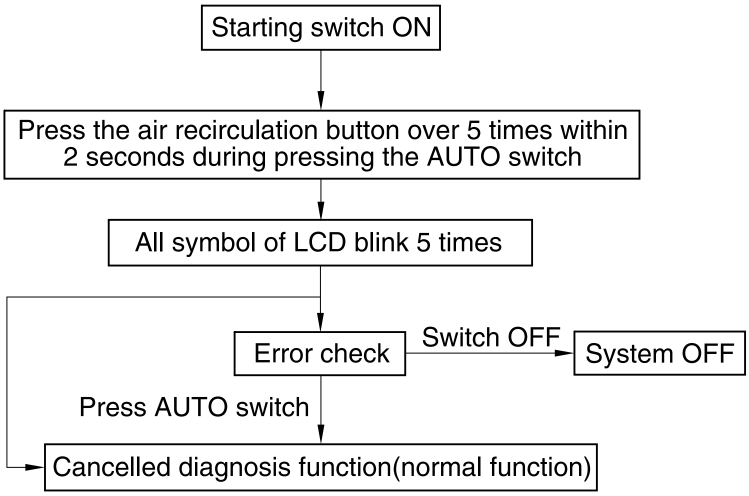
(1) It is possible to change the air-inlet method.
① Fresh air ()
Inhaling air from the outside.
※ Check out the fresh air filter periodically to keep a good efficiency.
② Air recirculation ()
It recycles the heated or cooled air to increase the energy efficiency.
※ Change air occasionally when using recirculation for a long time.
※ Check out the recirculation filter periodically to keep a good efficiency.

8) SELF DIAGNOSIS FUNCTION

(1) Procedure



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(2) Error check

- The corresponding error code flickers on the setup temperature display panel, the other symbol will turn OFF.
- Error code flickers every 0.5 second.
- If error code is more than two, each code flickers 2 times in sequence.
- Error code

Error code	Description	Error code	Description
11	Cabin inside sensor	16	Mode actuator 1
12	Ambient sensor	17	Mode actuator 2
14	Duct (evaporator) sensor	18	Intake actuator
15	Temp actuator	-	-

(3) Fail safe function

Error description	Fail safe function
Cabin inside sensor (11)	25˚C alternate value control
Ambient sensor (12)	20˚C alternate value control
Duct (evaporator) sensor (14)	1˚C alternate value control
Temp actuator (15)	If opening amount is 0 %, the alternate value is 0 %
	If not, the alternate value is 100 %
Mode actuator 1, 2 (16, 17)	The alternate value is vent

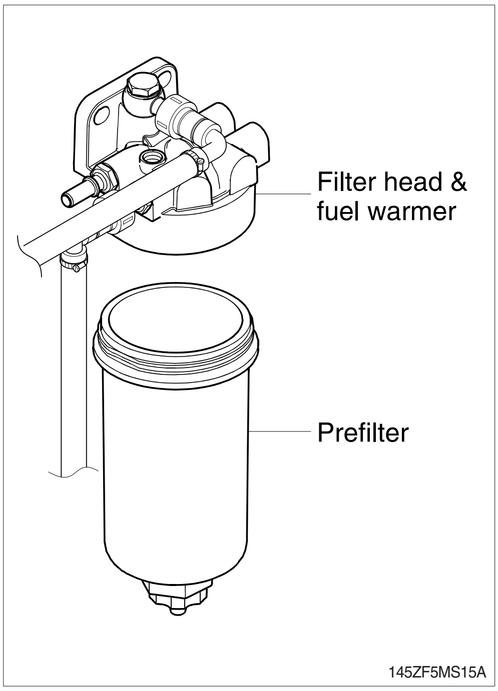
GROUP 17 FUEL WARMER SYSTEM

1. SPECIFICATION

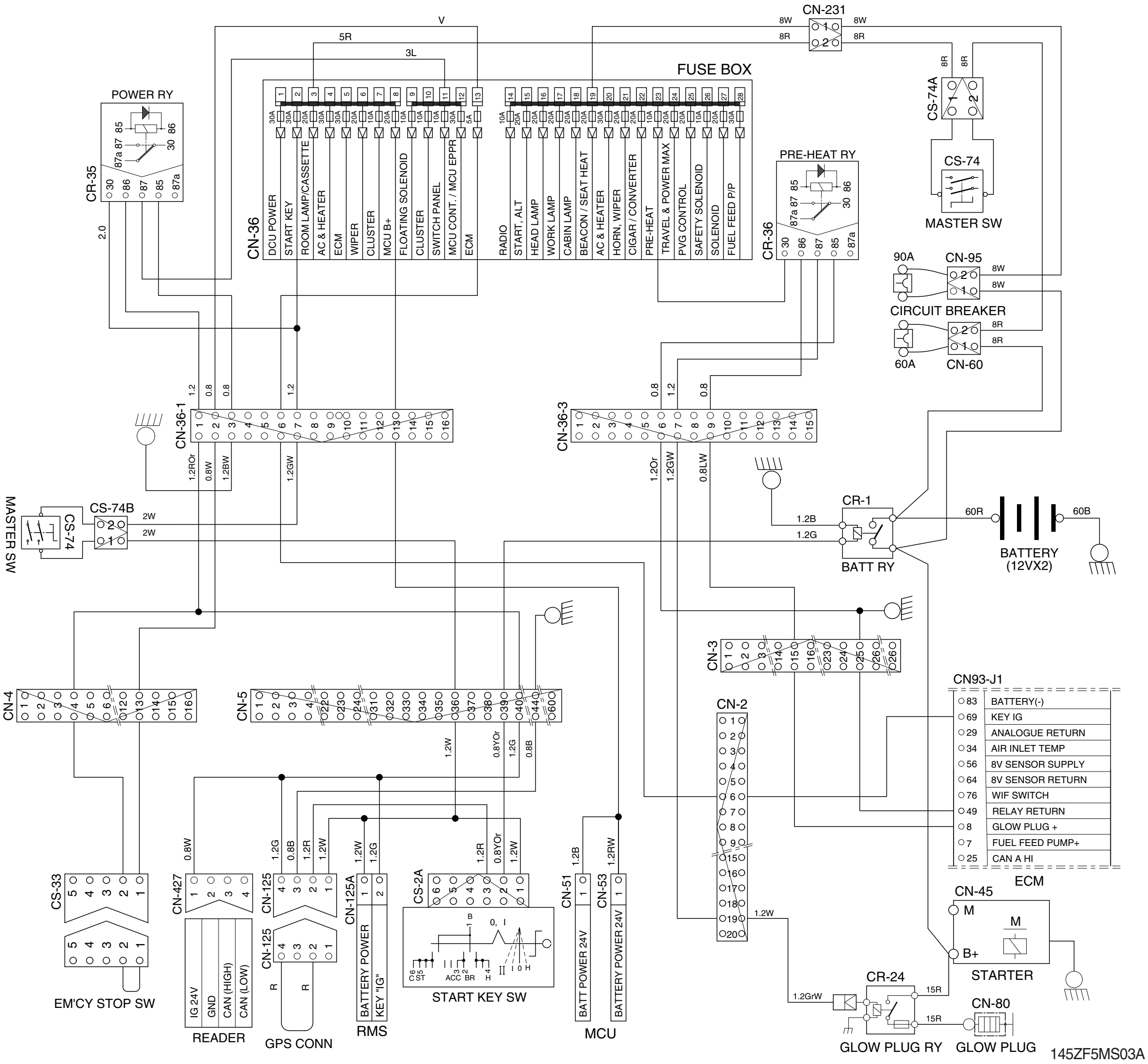
1) Operating voltage : 24±4 V
2) Power : 350±50 W
3) Current : 15 A

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

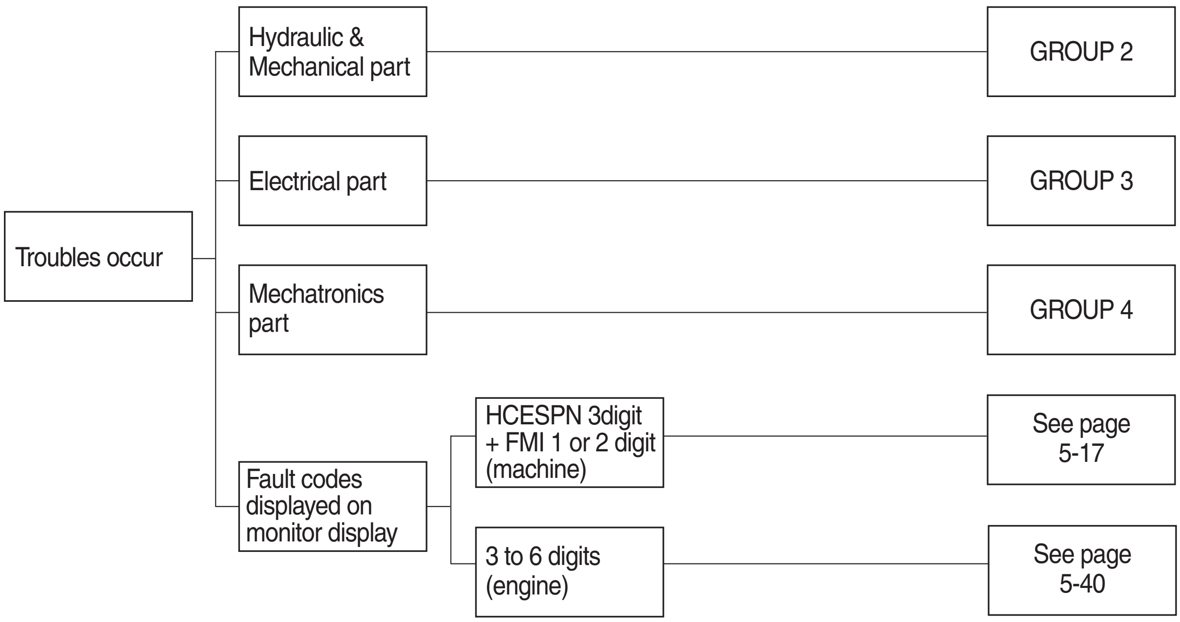
GROUP 1 BEFORE TROUBLESHOOTING

1. INTRODUCTION

When a trouble is occurred in the machine, this section will help service men repair the machine with easy.

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

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

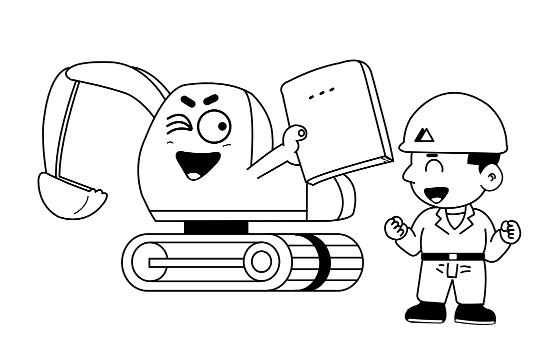


2. DIAGNOSING PROCEDURE

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.

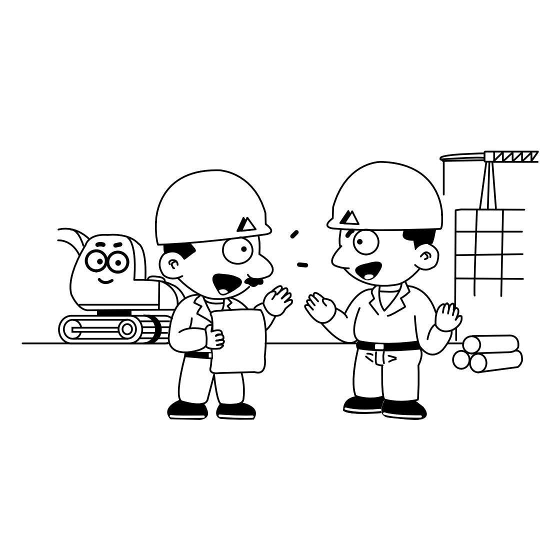


13031SH02

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.

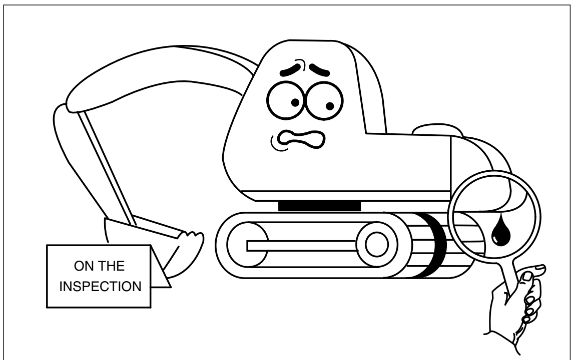


13031SH03

STEP 3. Inspect the machine

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

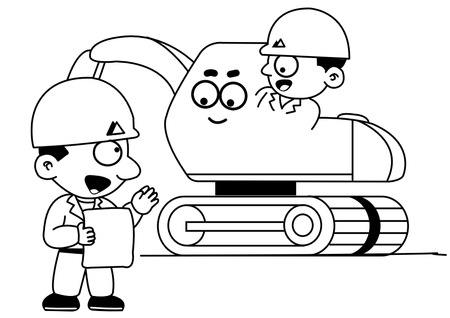
And also check the electrical system including batteries, as the troubles in the electrical system such as low battery voltage, loose connections and blown out fuses will result in malfunction of the controllers causing total operational failures of the machine.



(210-7) 6-2(3)

STEP 4. Inspect the trouble actually on the machine

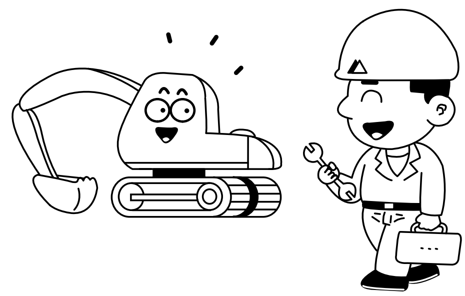
In case that some trouble cannot be confirmed, obtain the details of the malfunction from the operator.
Also, check if there are any in complete connections of the wire harnesses are or not.



(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.



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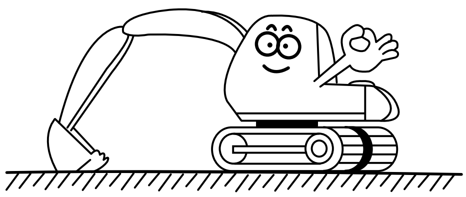
STEP 6. Trace a cause

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.

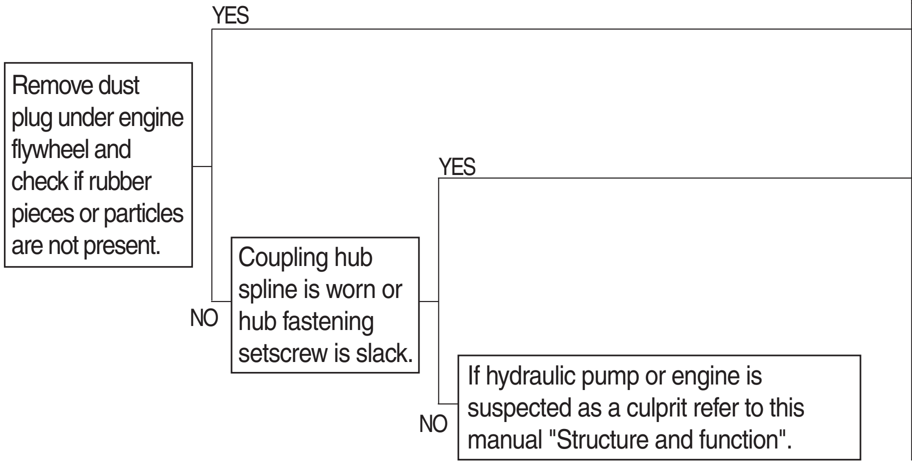
Analog 1 Analog 2 300L6HS01

(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

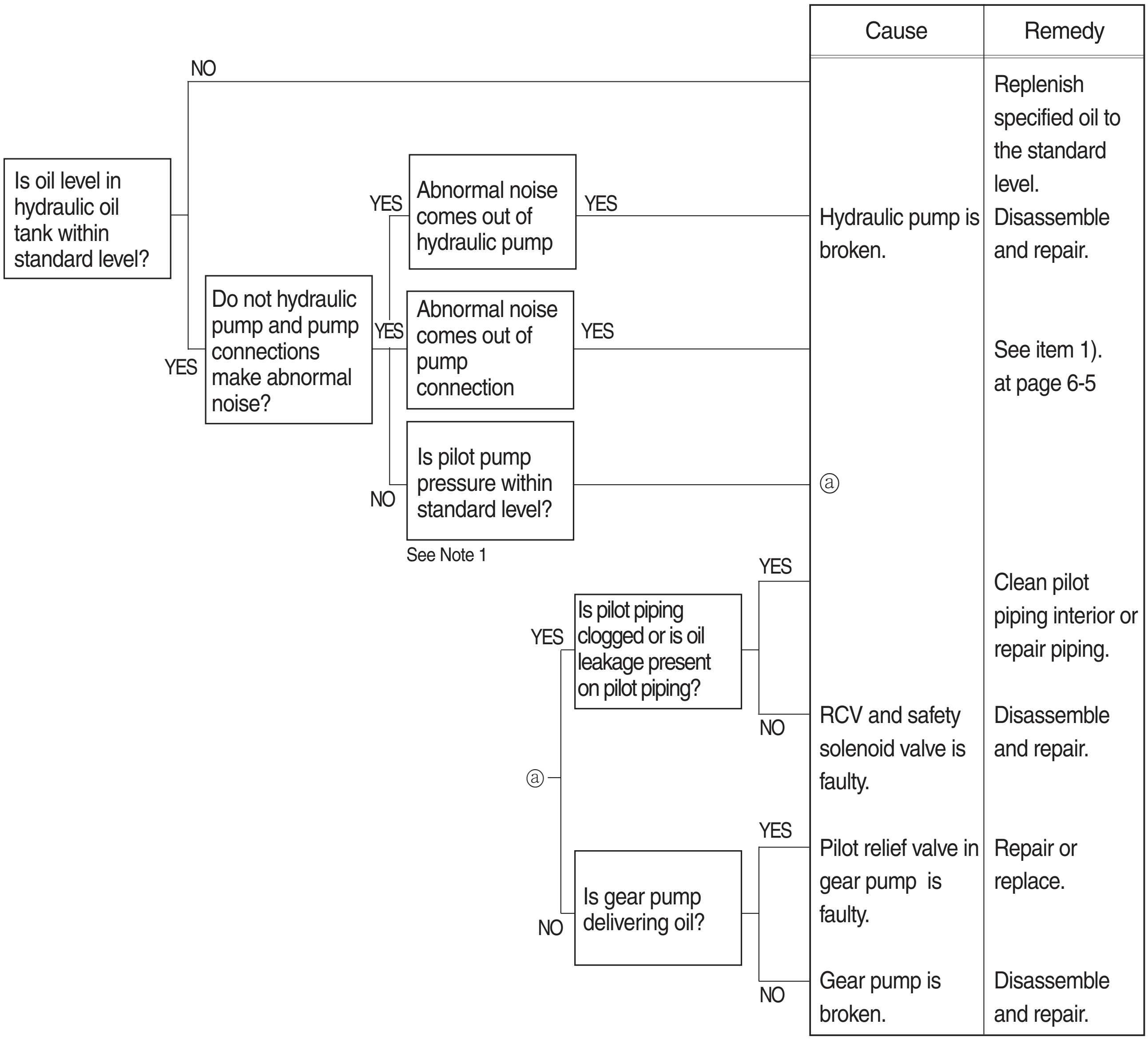
2. DRIVE SYSTEM

1) UNUSUAL NOISE COMES OUT OF PUMP CONNECTION



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

2) ENGINE STARTS BUT MACHINE DOES NOT OPERATE AT ALL

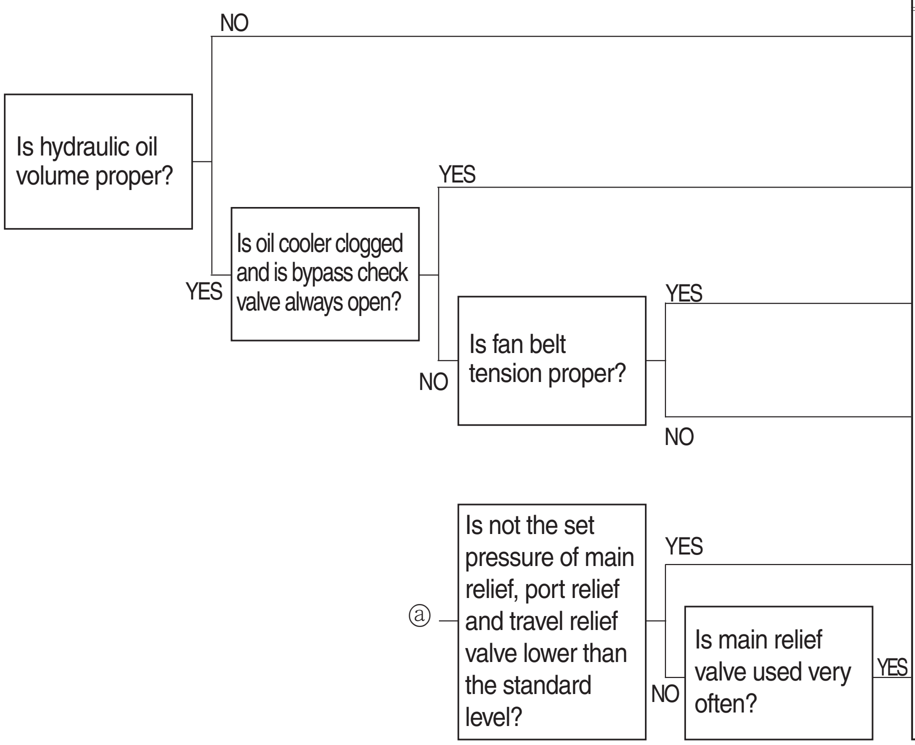


3. HYDRAULIC SYSTEM

1) HYDRAULIC OIL IS CLOUDY

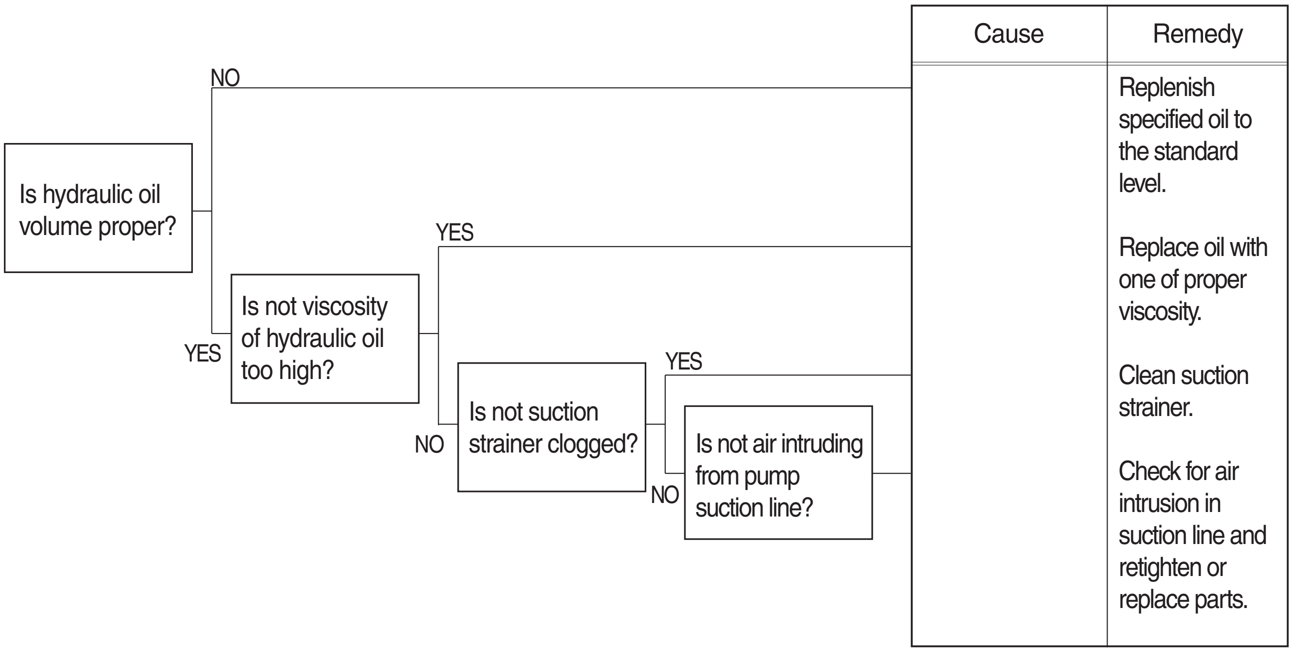
Cause	Remedy
Water is mixed.	Put hydraulic oil still, separate water and dispose it or replace hydraulic oil.
Air is intruded.	Check suction line and return line and eliminate the air intruding source.

2) HYDRAULIC OIL TEMPERATURE HAS RISEN ABNORMALLY

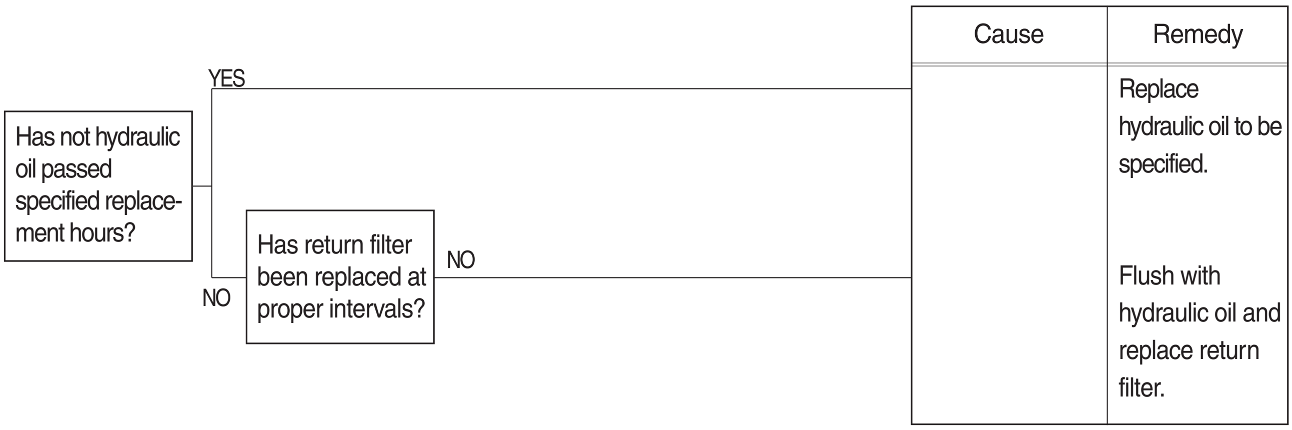


Cause	Remedy
	Replenish specified oil to the standard level.
Oil cooler clogged.	Clean oil cooler.
Bypass check valve is defective. ⓐ	Replace
	Adjust belt tension or replace belt.
	Readjust set pressure.
	Reduce load.

3) CAVITATION OCCURS WITH PUMP

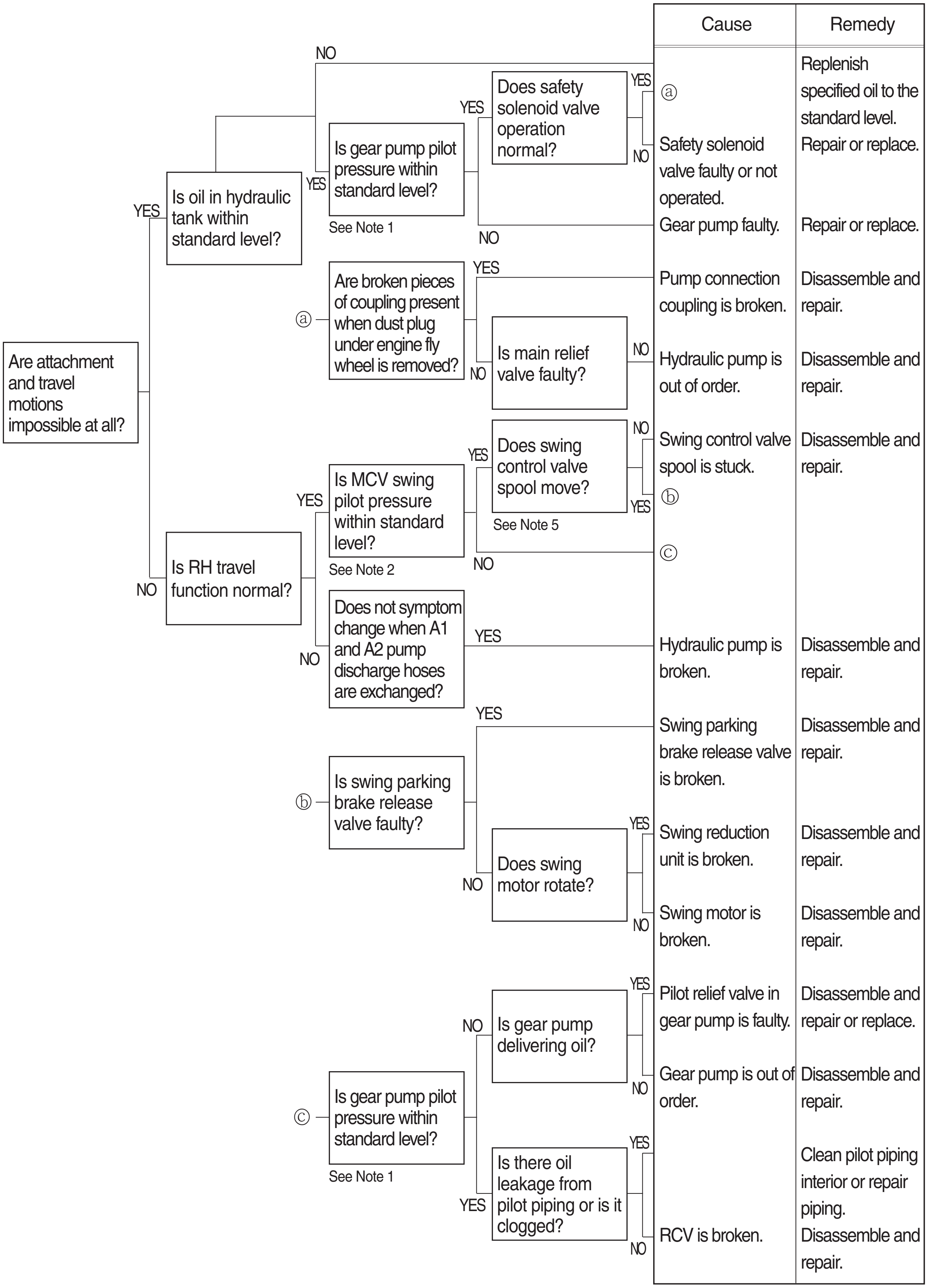


4) HYDRAULIC OIL IS CONTAMINATED

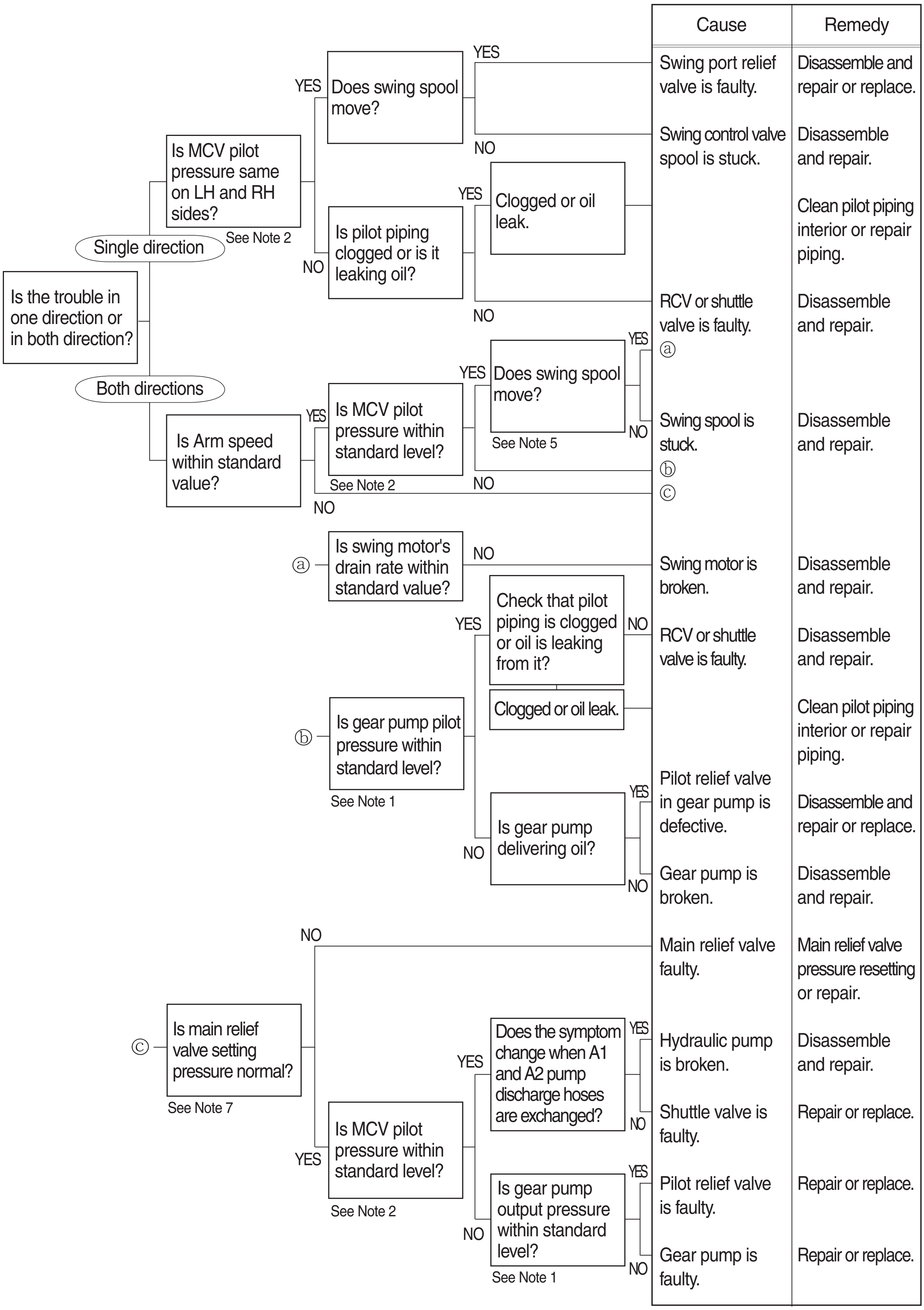


4. SWING SYSTEM

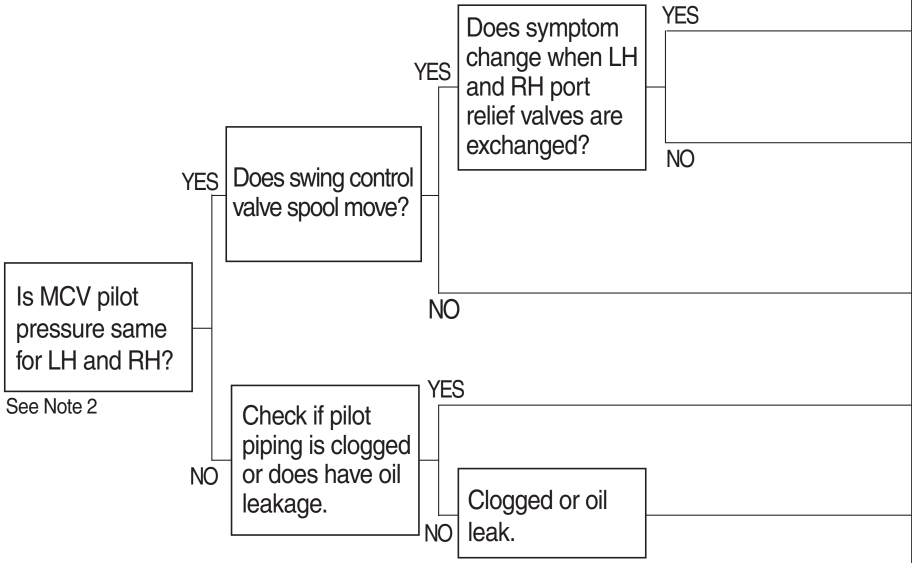
1) BOTH LH AND RH SWING ACTIONS ARE IMPOSSIBLE



2) SWING SPEED IS LOW

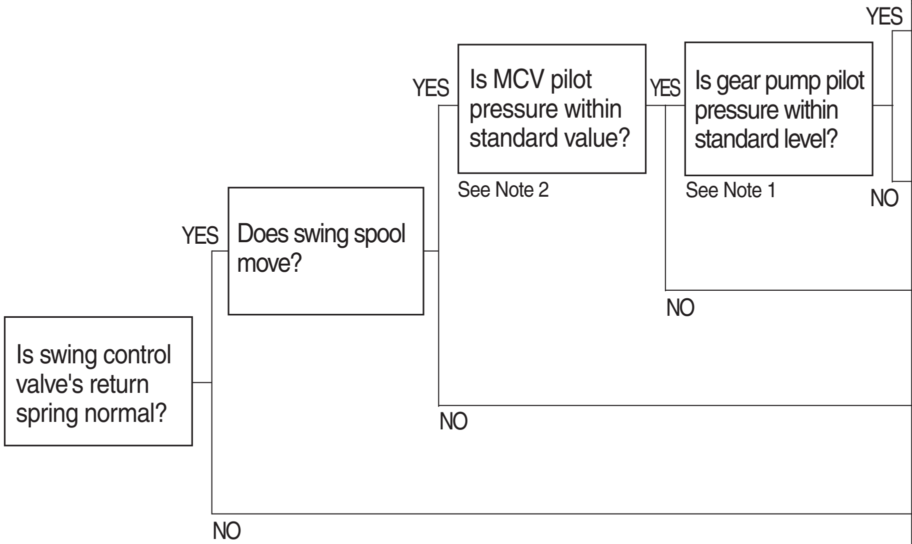


3) SWING MOTION IS IMPOSSIBLE IN ONE DIRECTION



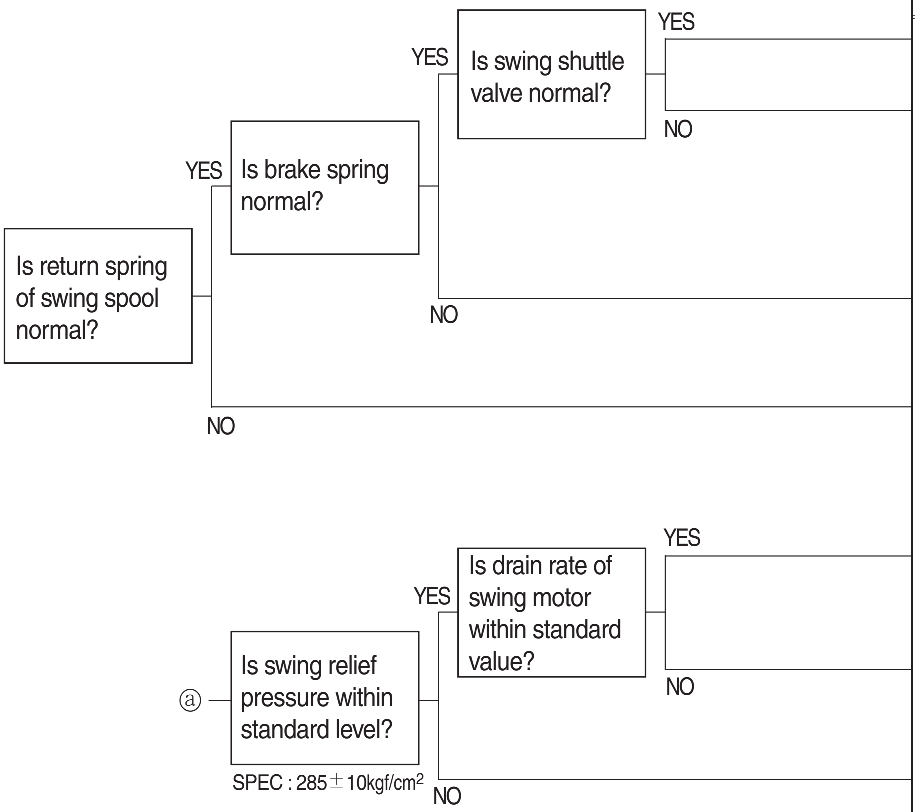
Cause	Remedy
Swing port relief valve is faulty.	Disassemble and repair.
Shuttle valve is faulty.	Disassemble and repair.
Swing control valve spool is stuck.	Disassemble and repair.
RCV is faulty.	Disassemble and repair.
	Clean pilot piping interior or repair piping.

4) MACHINE SWINGS BUT DOES NOT STOP



Cause	Remedy
Pilot relief valve is faulty.	Disassemble and repair or replace.
Gear pump is broken.	Disassemble and repair.
RCV is faulty.	Disassemble and repair.
Swing spool is stuck.	Disassemble and repair.
Return spring is faulty.	Disassemble and replace.

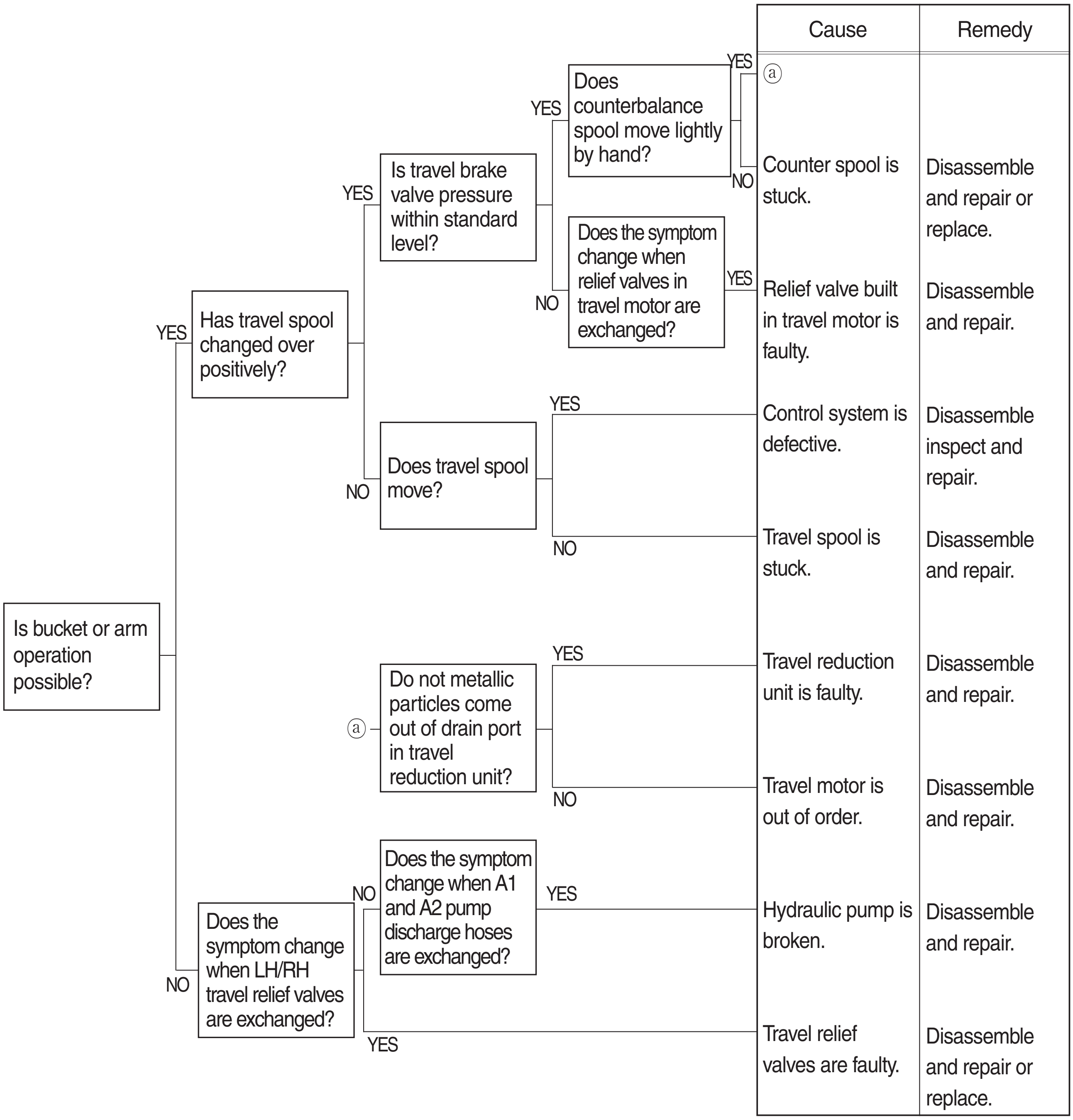
5) THE SWING UNIT DRIFTS WHEN THE MACHINE IS AT REST ON A SLOPE



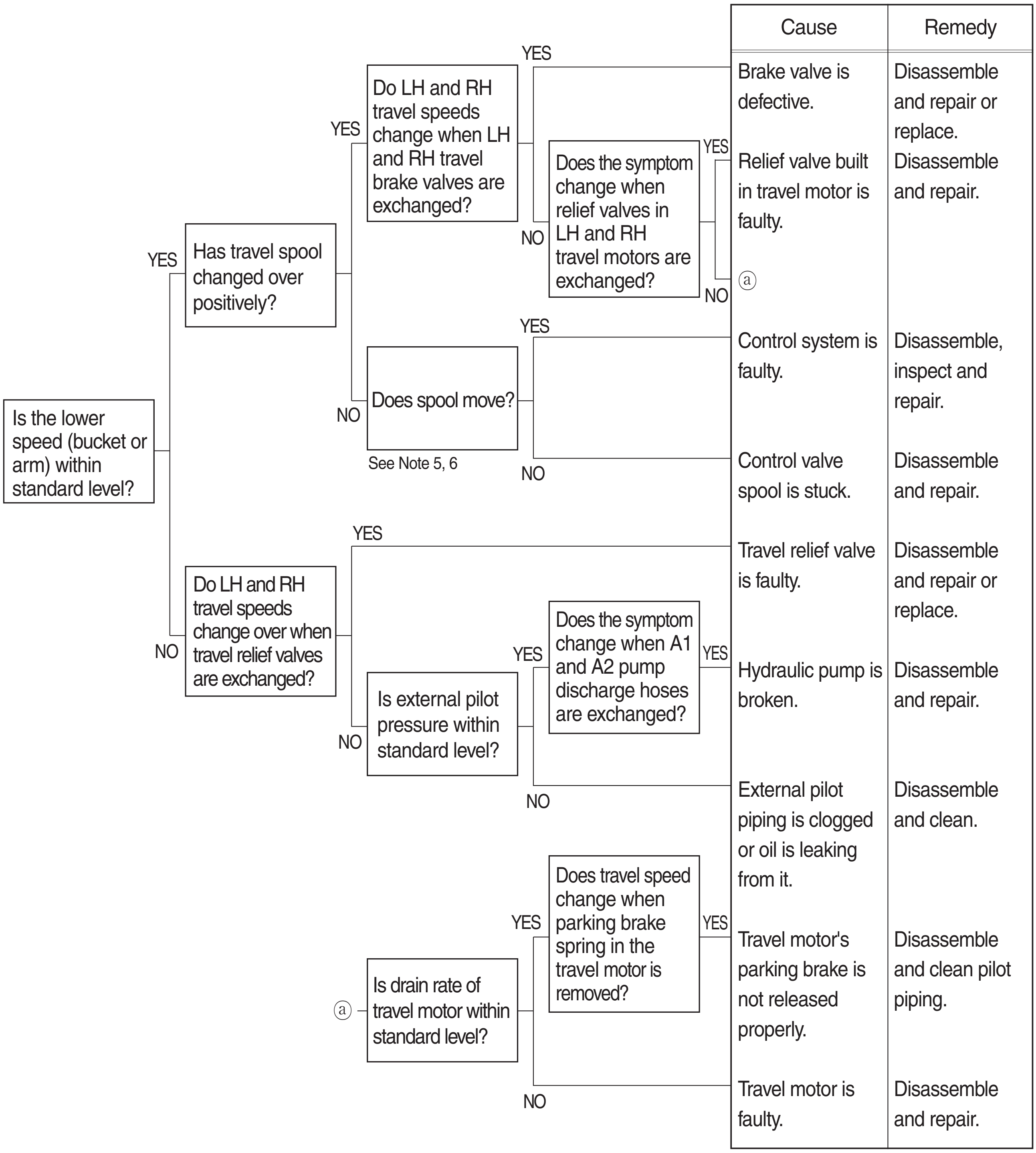
Cause	Remedy
ⓐ	
Shuttle valve is faulty.	Disassemble and replace.
Brake spring is faulty.	Disassemble and replace.
Return spring of swing control valve is faulty.	Disassemble and replace.
Swing port relief valve is faulty.	Disassemble and repair or replace.
Swing motor is broken.	Disassemble and repair.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

5. TRAVEL SYSTEM

1) TRAVEL DOES NOT FUNCTION AT ALL ON ONE SIDE

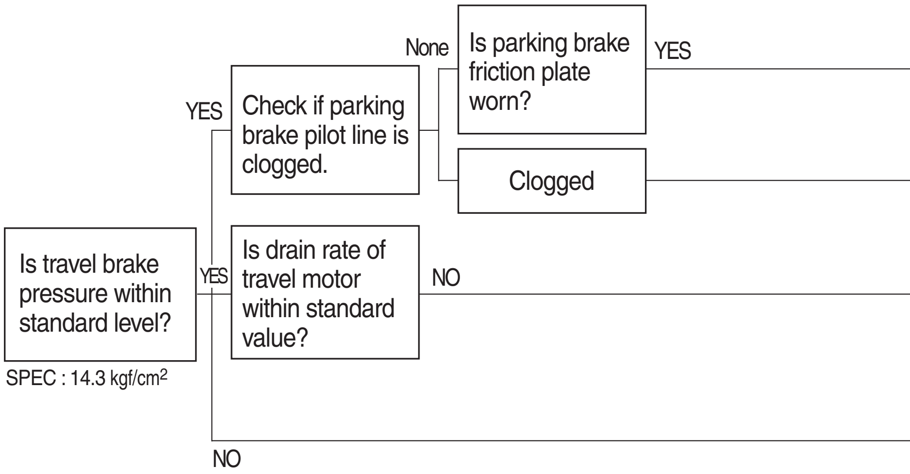


2) SPEED ON ONE SIDE FALLS AND THE MACHINE CURVES



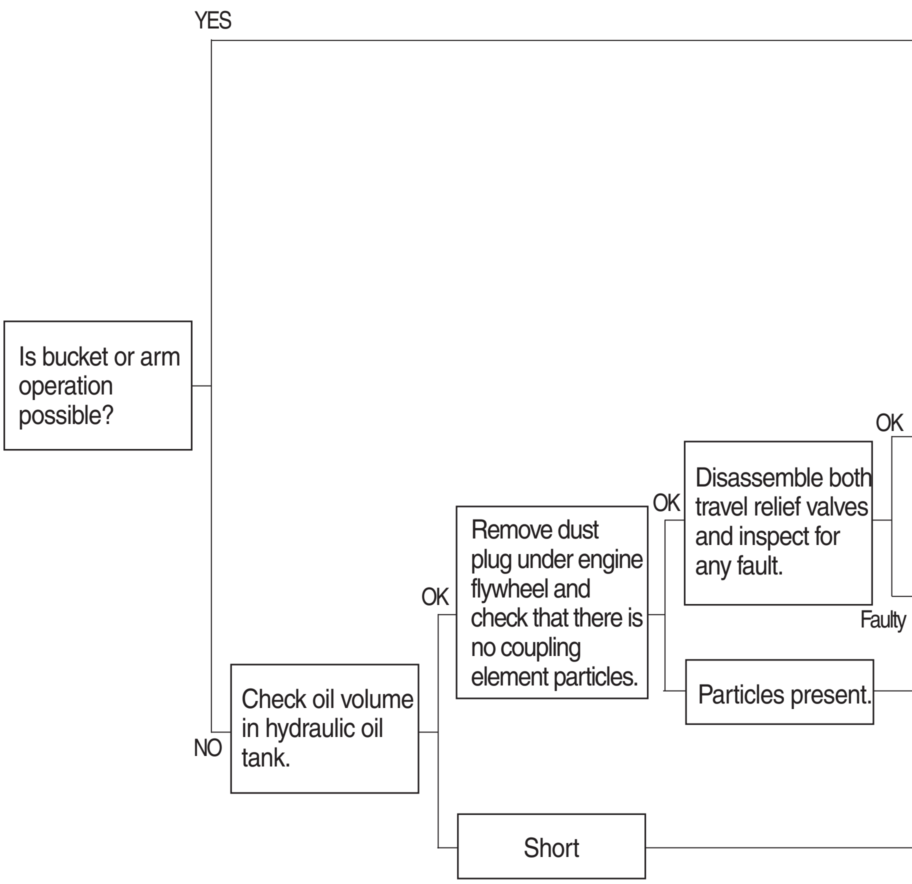
3) MACHINE DOES NOT STOP ON A SLOPE

Machine is pulled forward as sprocket rotates during digging operation.



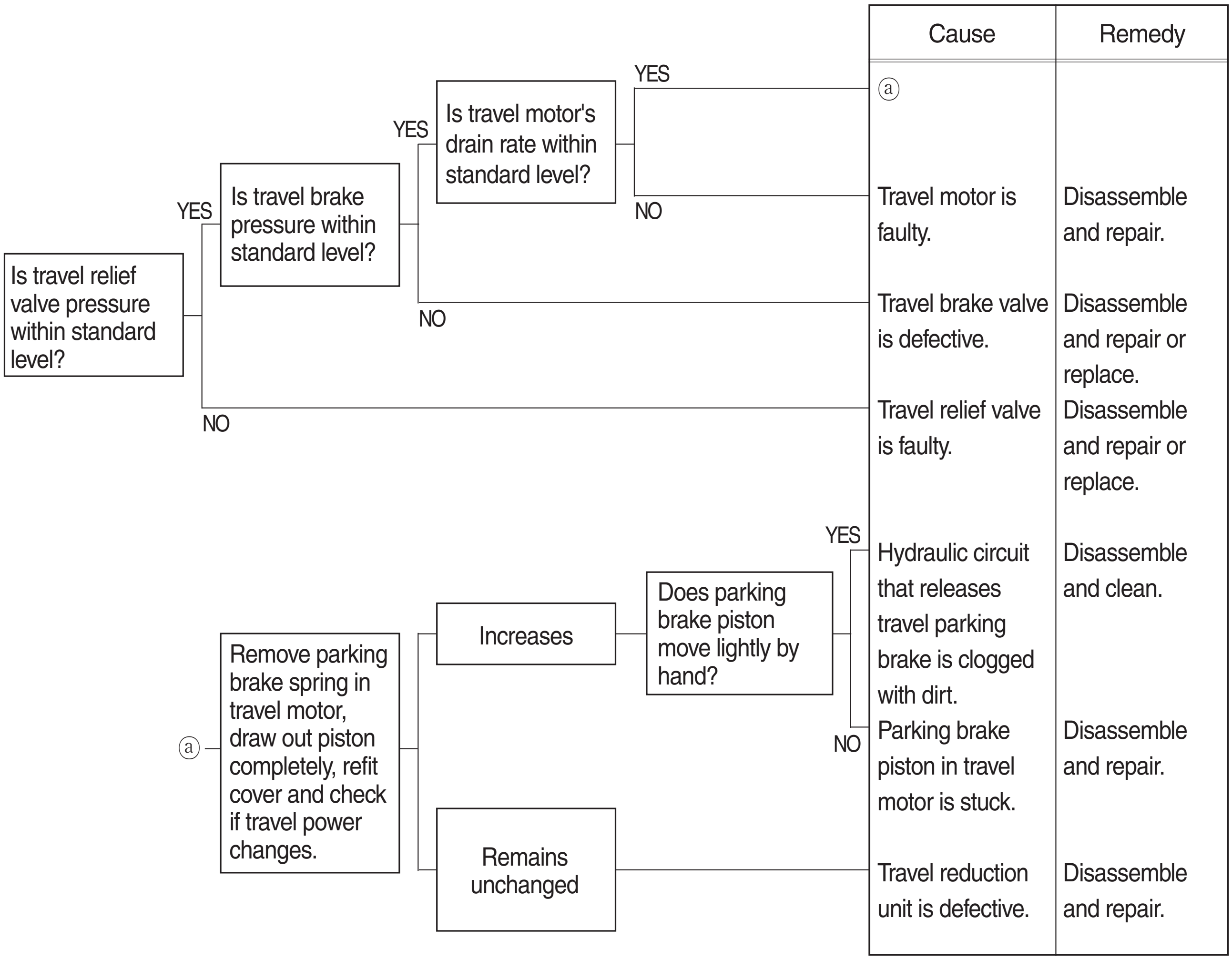
Cause	Remedy
Friction plate is faulty.	Disassemble and repair.
	Disassemble and clean pilot piping.
Travel motor is defective.	Disassemble and repair.
Brake valve is faulty.	Disassemble and repair or replace.

4) LH AND RH TRAVEL MOTIONS ARE IMPOSSIBLE



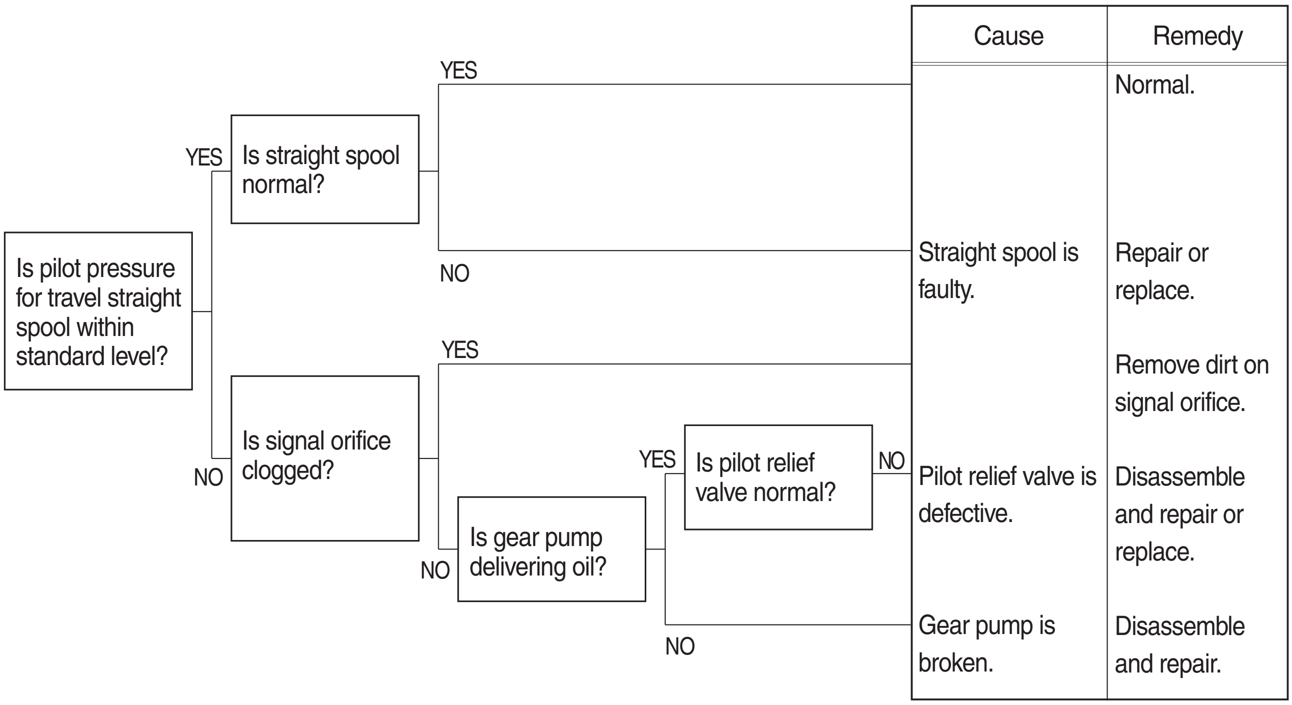
Cause	Remedy
	Inspect according to the procedure "Travel does not function at all on one side." However, a case where both LH and RH travel motions are disabled is extremely seldom statistically.
Hydraulic pump is faulty.	Disassemble and repair.
Travel relief valve is faulty.	Disassemble and repair or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

5) TRAVEL ACTION IS POWERLESS (travel only)



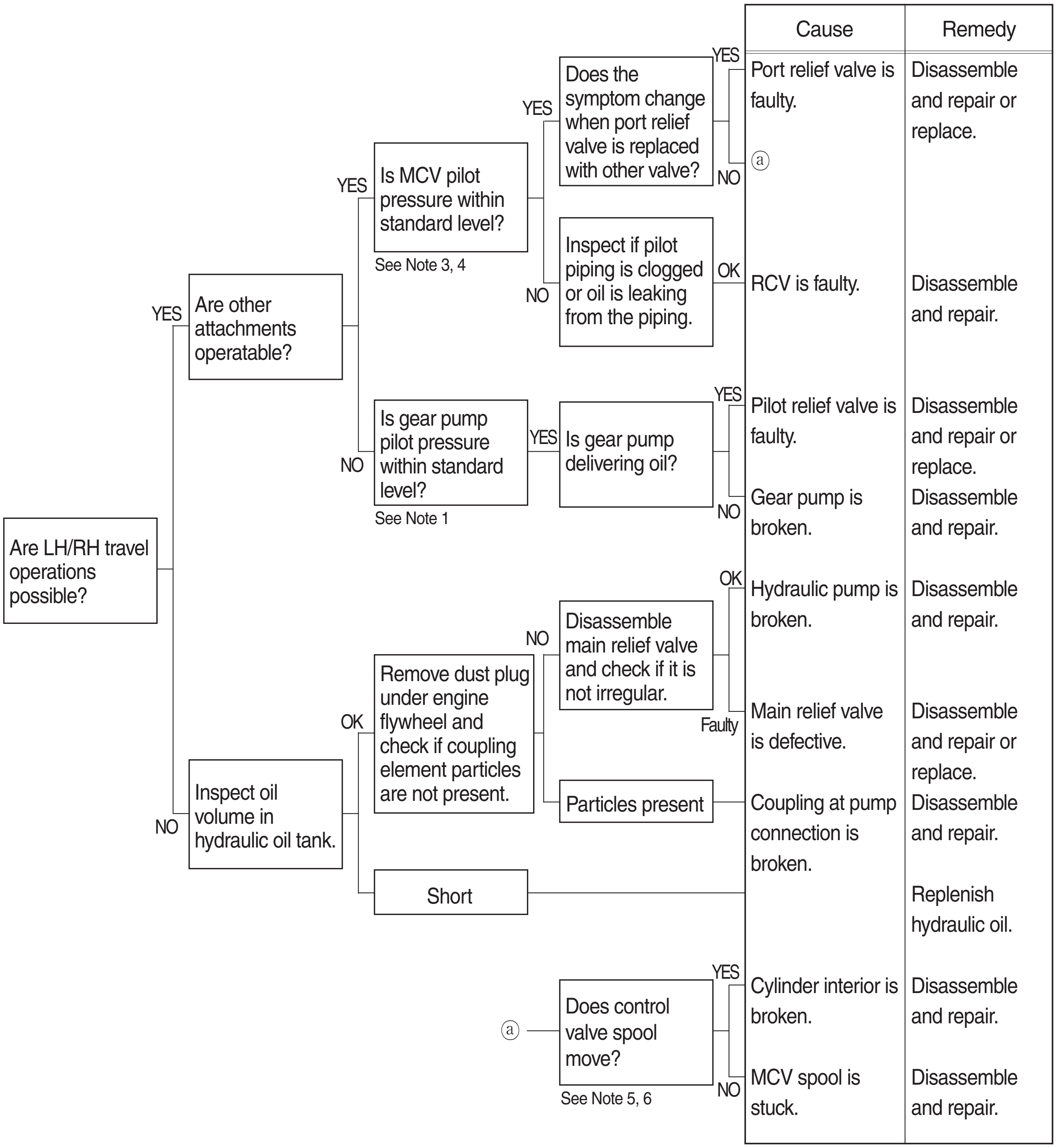
6) MACHINE RUNS RECKLESSLY ON A SLOPE

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

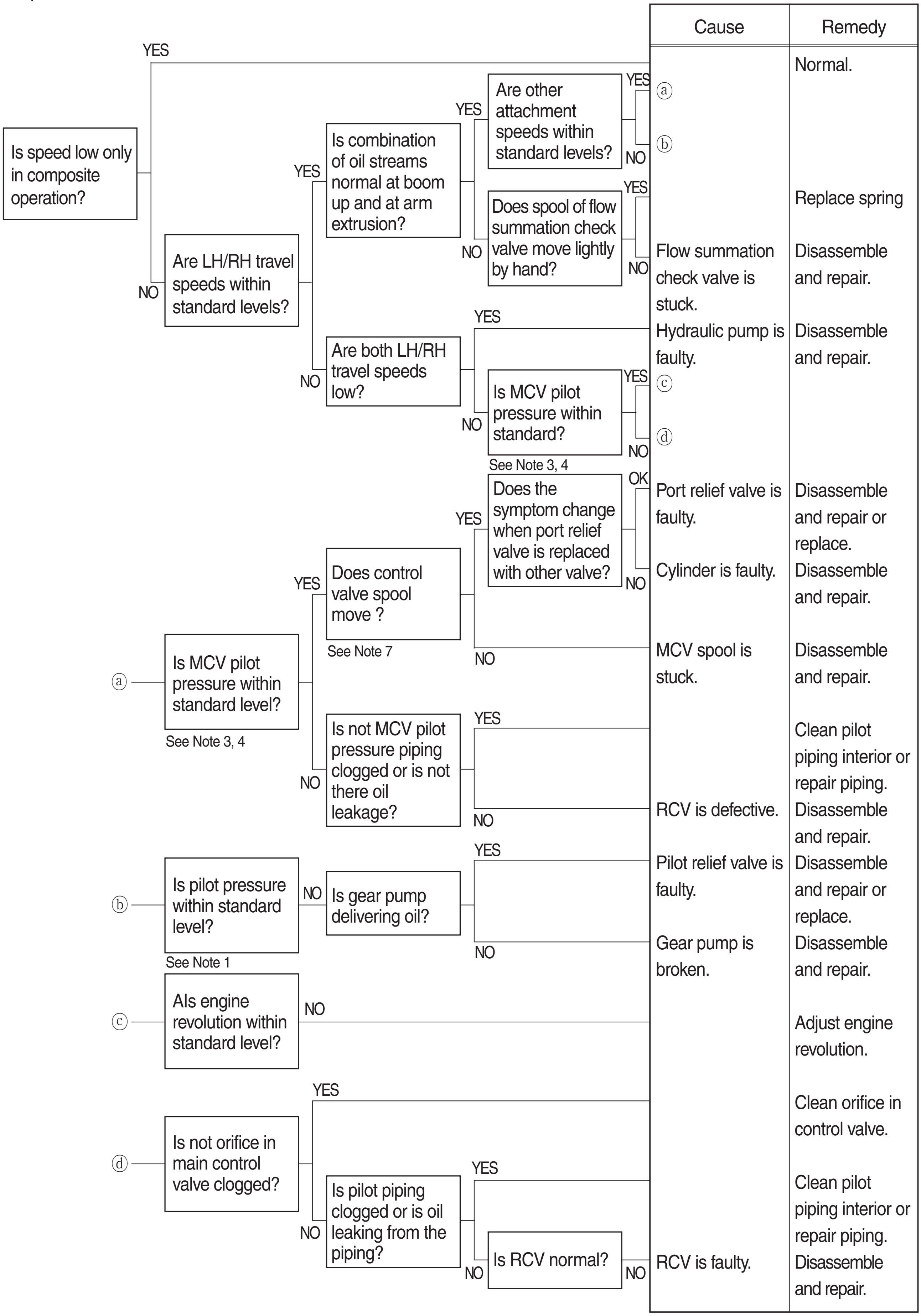


6. ATTACHMENT SYSTEM

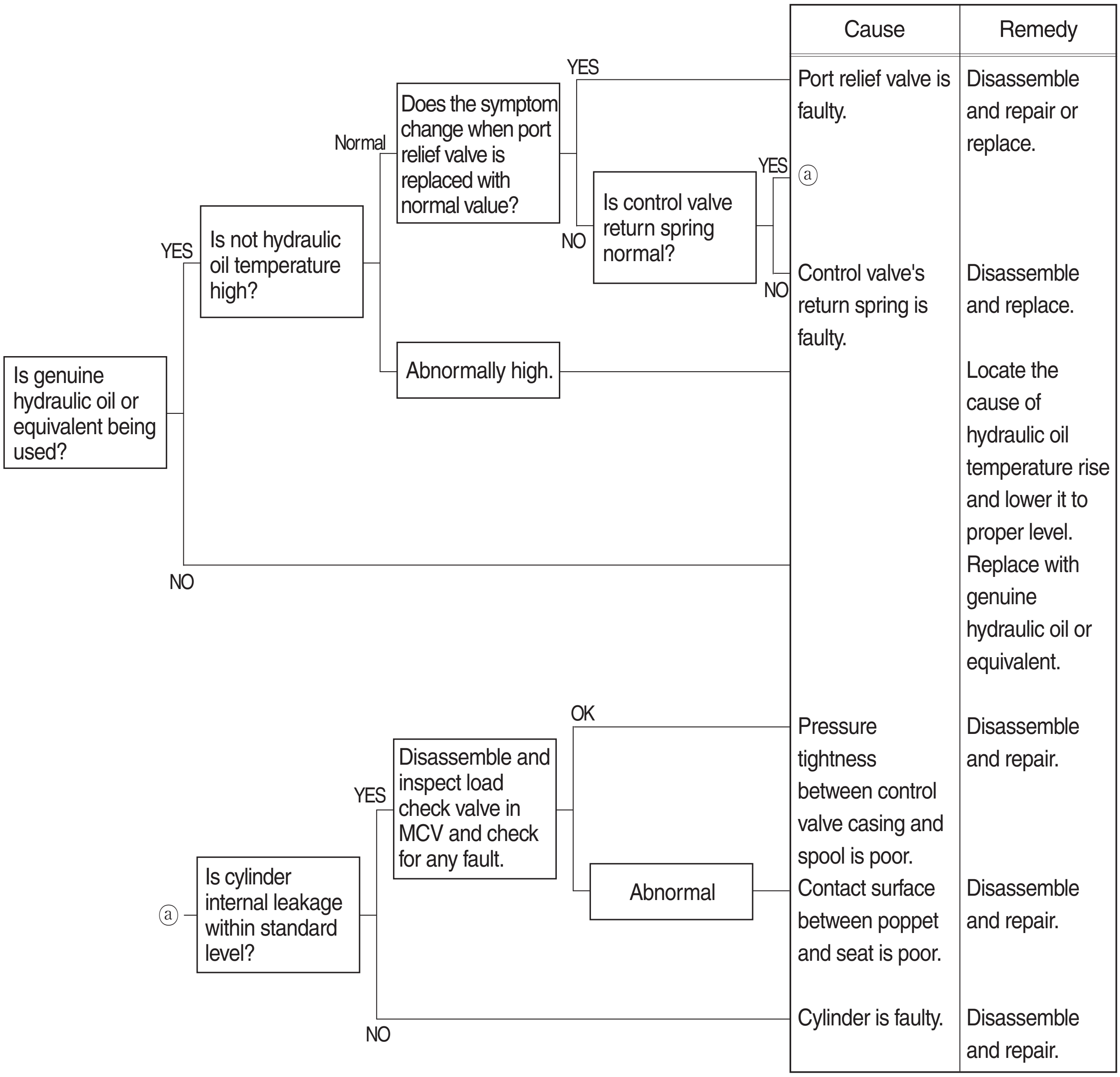
1) BOOM OR ARM ACTION IS IMPOSSIBLE AT ALL



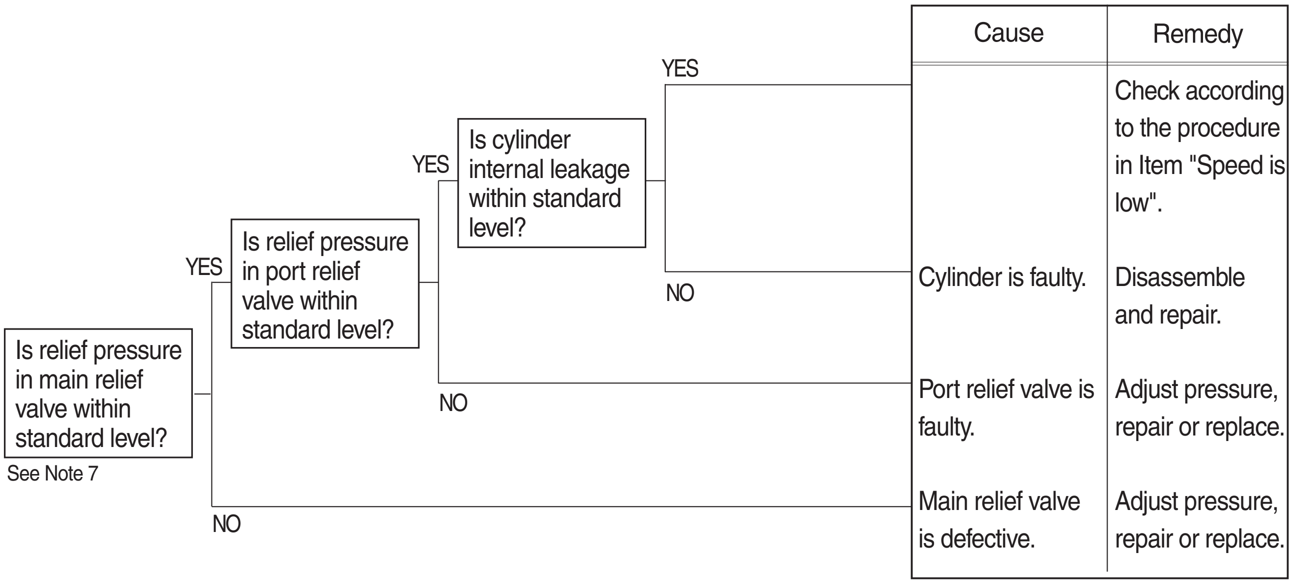
2) BOOM, ARM OR BUCKET SPEED IS LOW



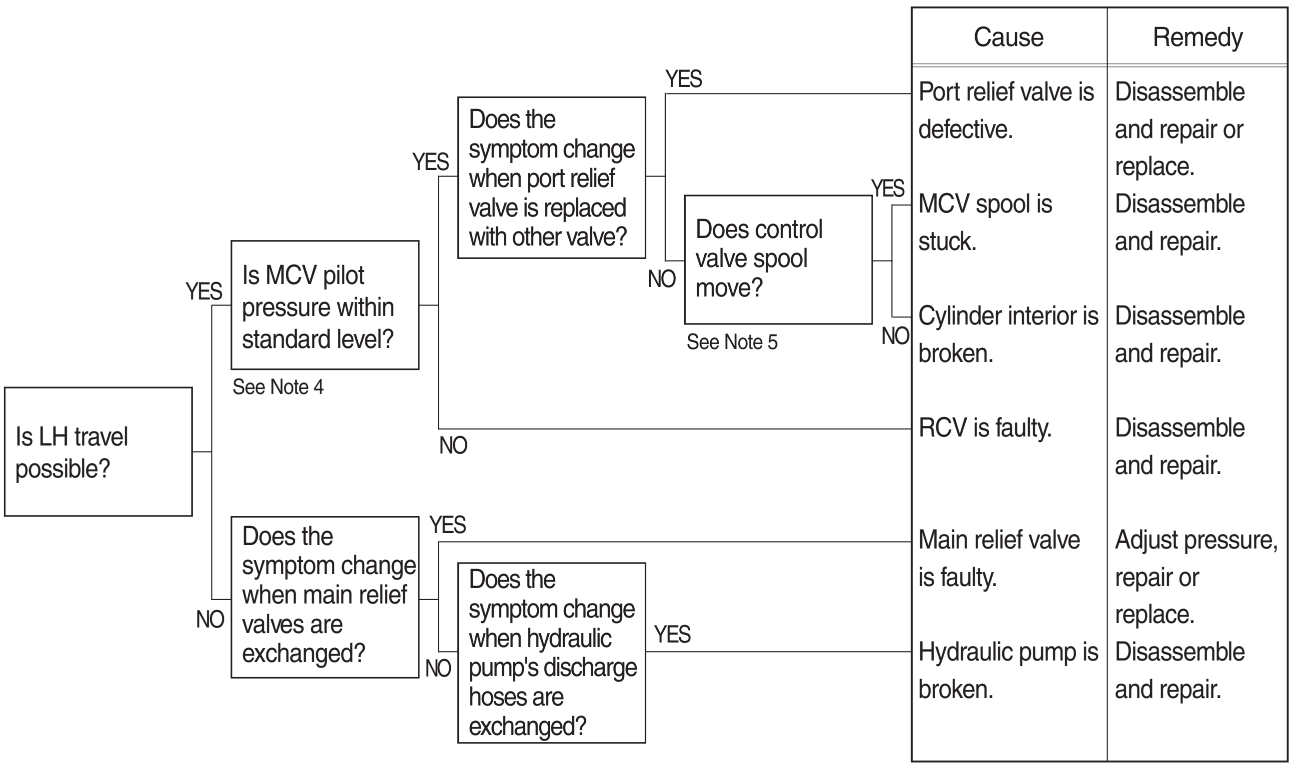
3) BOOM, ARM OR BUCKET CYLINDER EXTENDS OR CONTRACTS ITSELF AND ATTACHMENT FALLS



4) BOOM, ARM OR BUCKET POWER IS WEAK



5) ONLY BUCKET OPERATION IS TOTALLY IMPOSSIBLE

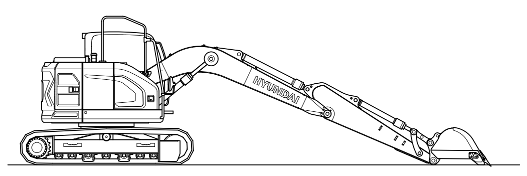


6) BOOM MAKES A SQUEAKING NOISE WHEN BOOM IS OPERATED

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

※ HOW TO CHECK INTERNAL BOOM CYLINDER LEAKAGE

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



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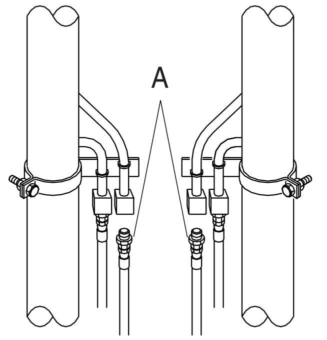
2. Disconnect hose (A) from rod side of boom cylinder and drain oil from cylinders and hose. (put cups on piping and hose ends)



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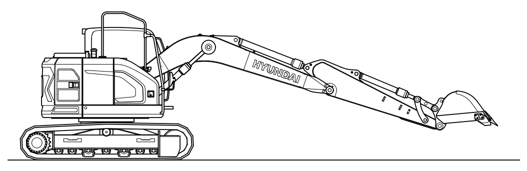
3. Raise bucket OFF the ground by retracting the arm cylinder rod.

   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.



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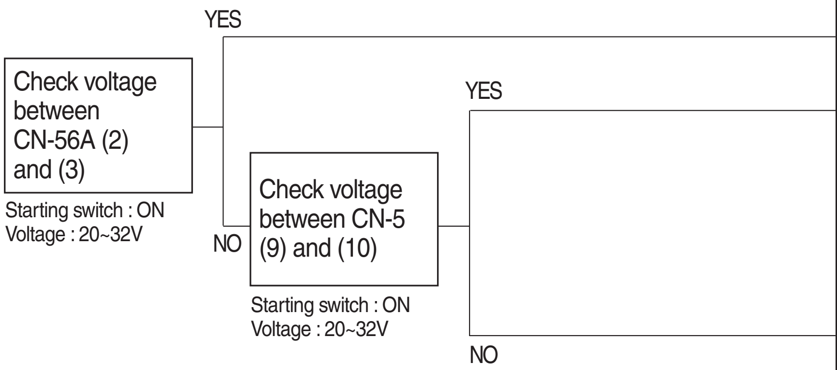
GROUP 3 ELECTRICAL SYSTEM

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

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

· Before carrying out below procedure, check all the related connectors are properly inserted and short of fuse No. 7, 10.

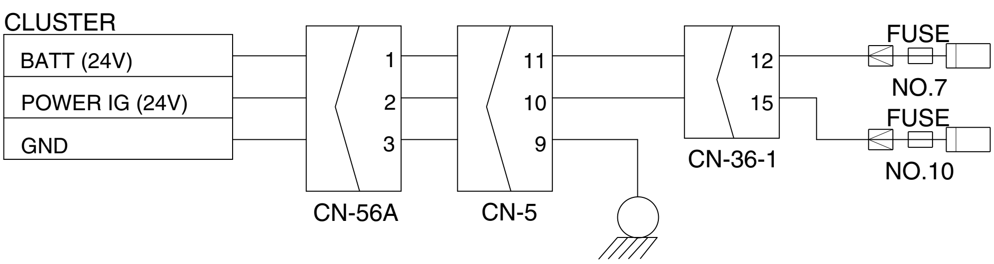
· After checking, insert the disconnected connectors again immediately unless otherwise specified.



Cause	Remedy
Defective cluster	Replace
Disconnection in wiring harness or poor contact between CN-5-CN-56A	Repair or replace (after clean)
Disconnection in wiring harness or poor contact between CN-5 (9) -GND or fuse No. 7, 10	Repair or replace (after clean)

Check voltage

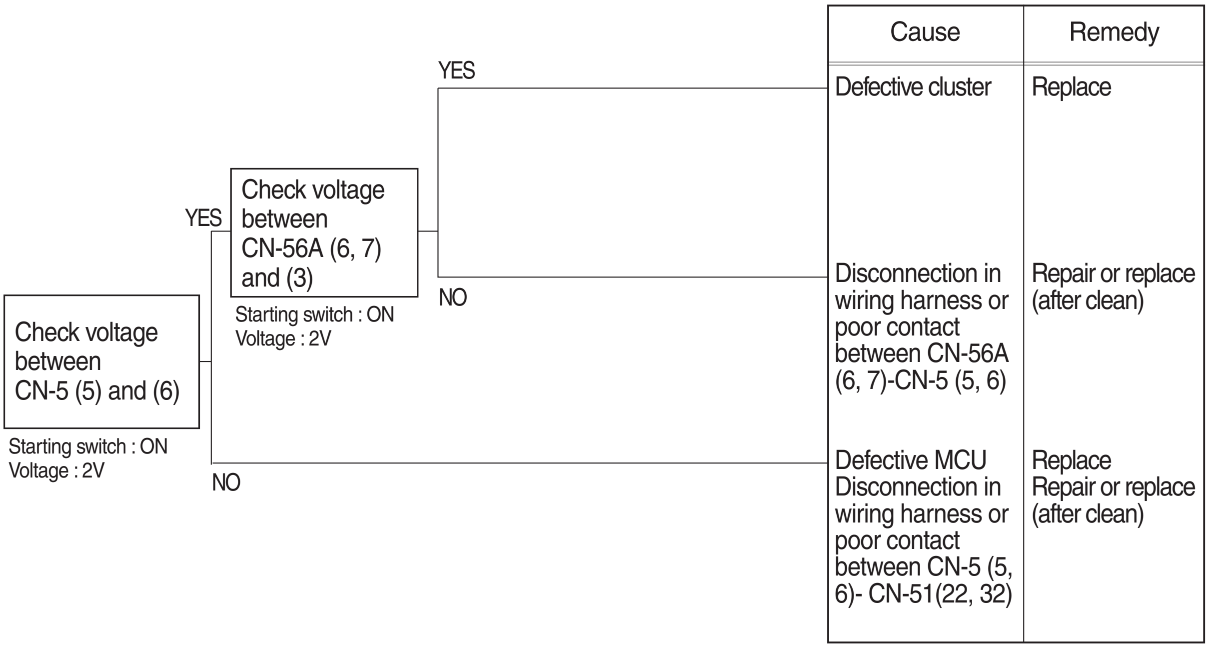
YES	20~32V
NO	0V



145LCR6ES01

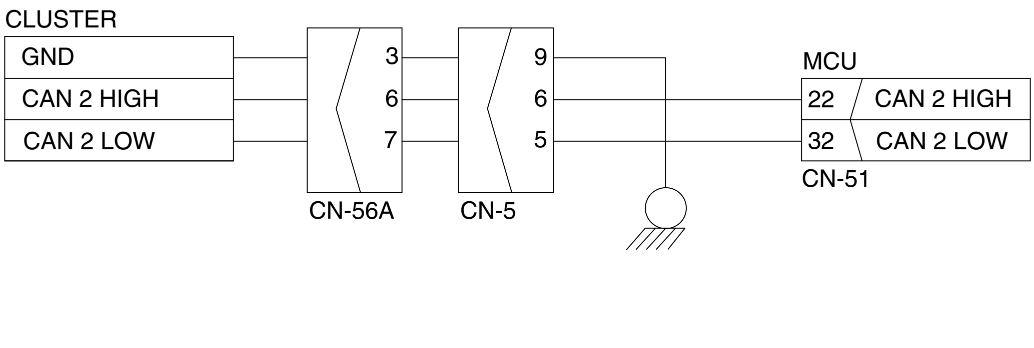
2. ⚠ COMMUNICATION ERROR FLASHES ON THE CLUSTER (HCESPN 840, FMI 2)

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



Check voltage

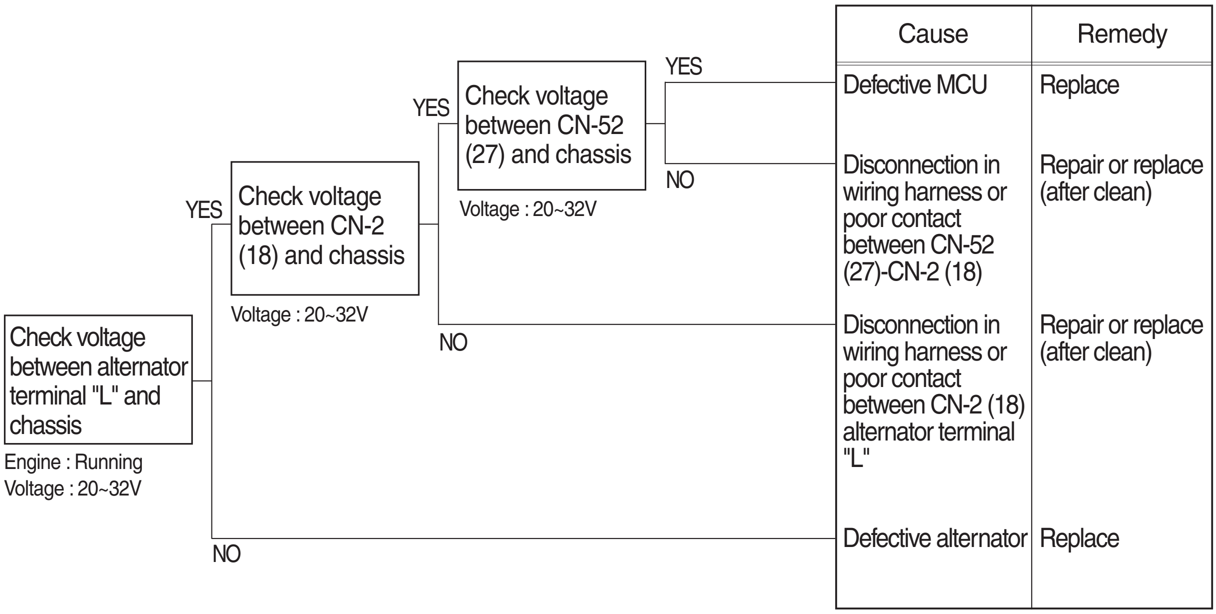
YES	2V
NO	0V



300L6ES02

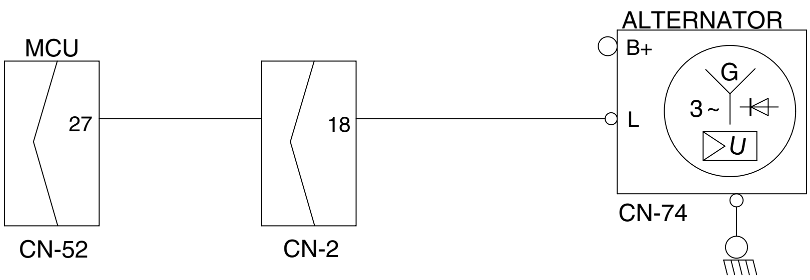
3. BATTERY CHARGING WARNING LAMP LIGHTS UP (Starting switch : ON)

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



Check voltage

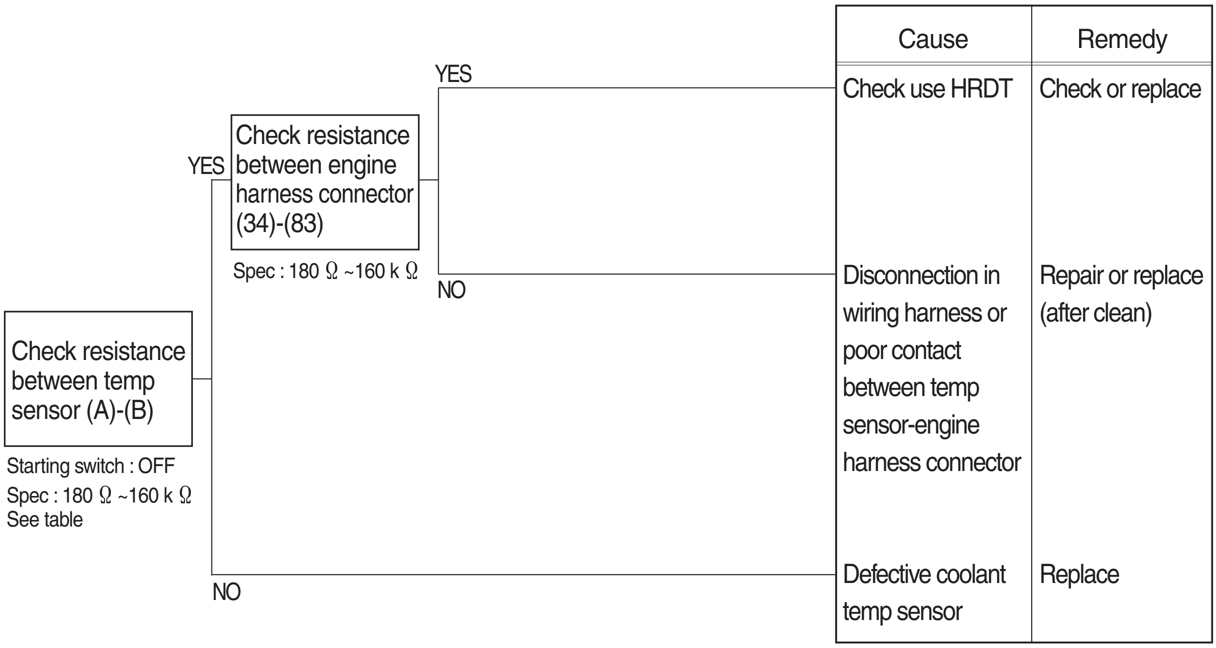
YES	20~32V
NO	0V



140L6ES02

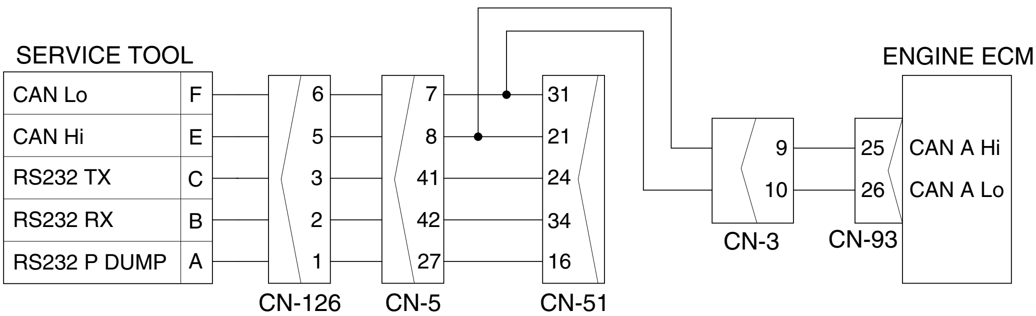
4. WHEN COOLANT OVERHEAT WARNING LAMP LIGHTS UP (engine is started)

· 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

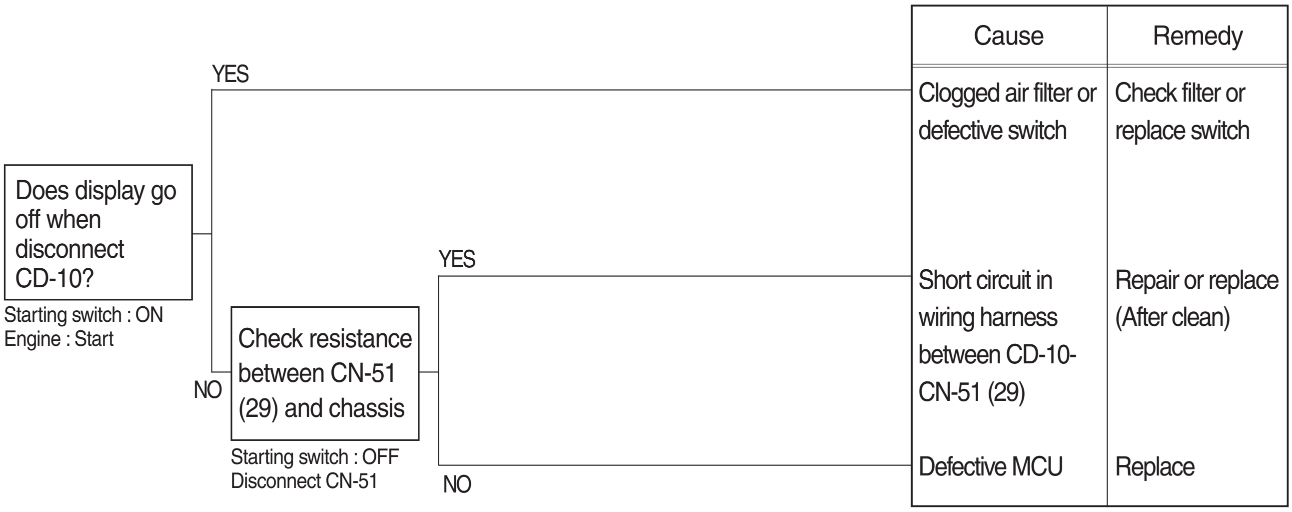
Temperature (˚C)	0	25	50	80	95
Resistance (k Ω)	30~37	9.3~10.7	3.2~3.8	1.0~1.3	0.7~0.8



145LCR6ES03

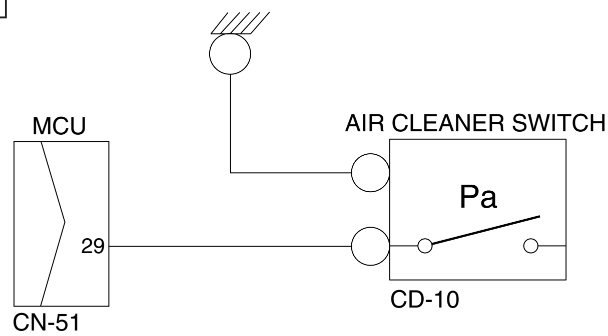
5. WHEN AIR CLEANER WARNING LAMP LIGHTS UP (engine is started)

· 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

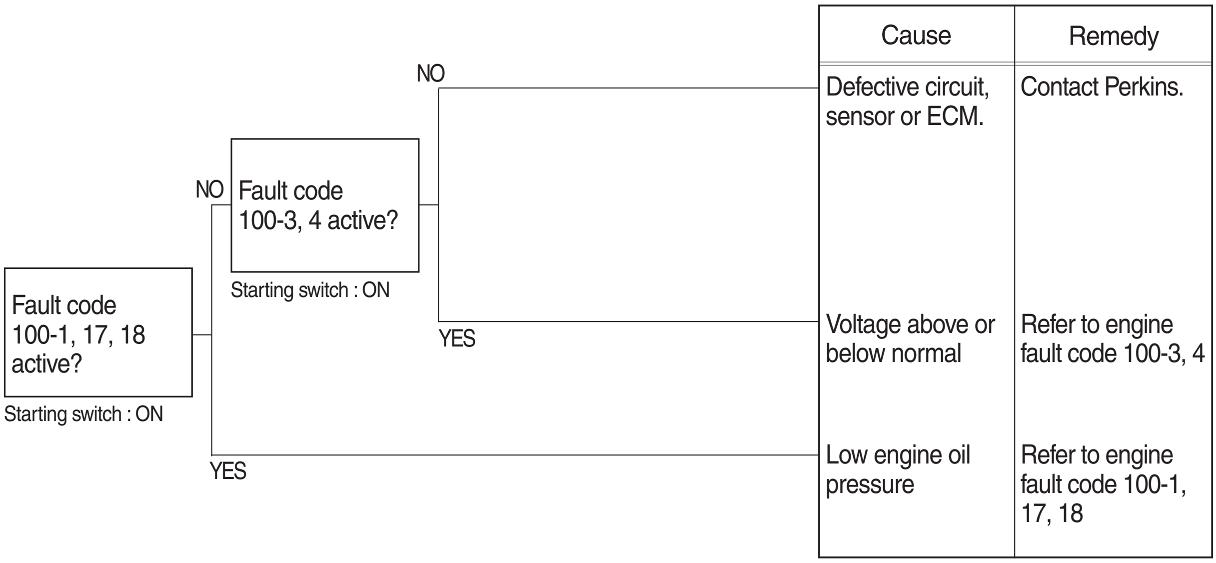
YES	MAX 1Ω
NO	MIN 1MΩ

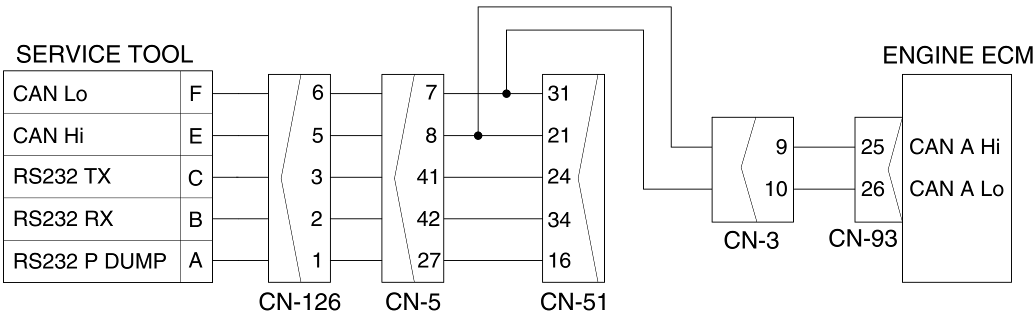


300L6ES06

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.

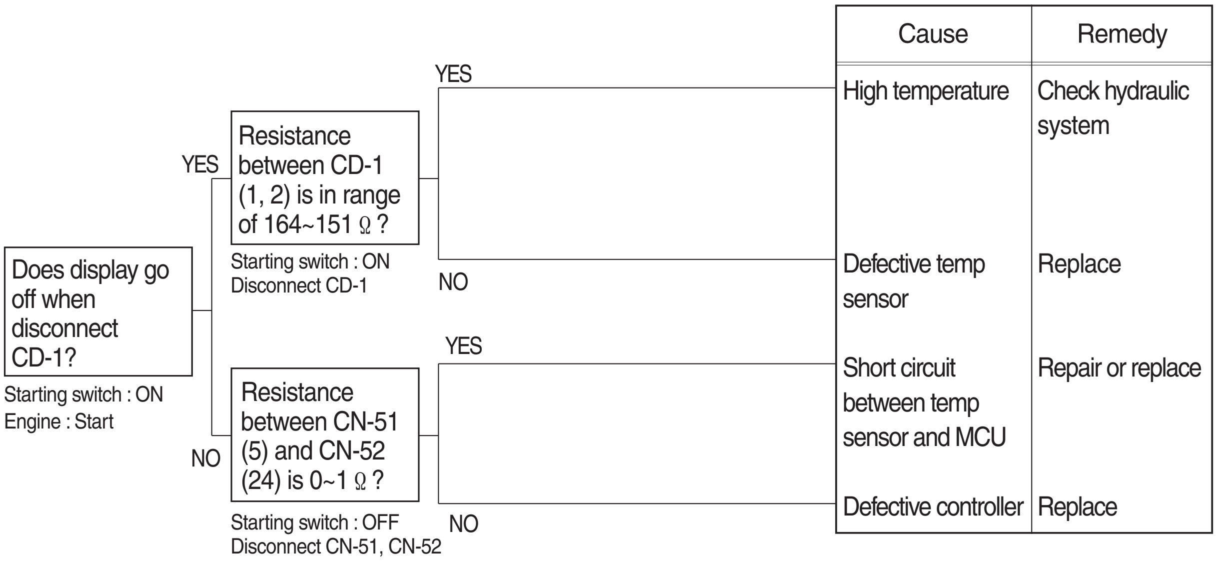


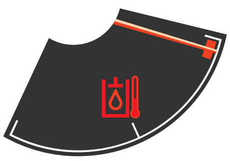


145LCR6ES03

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

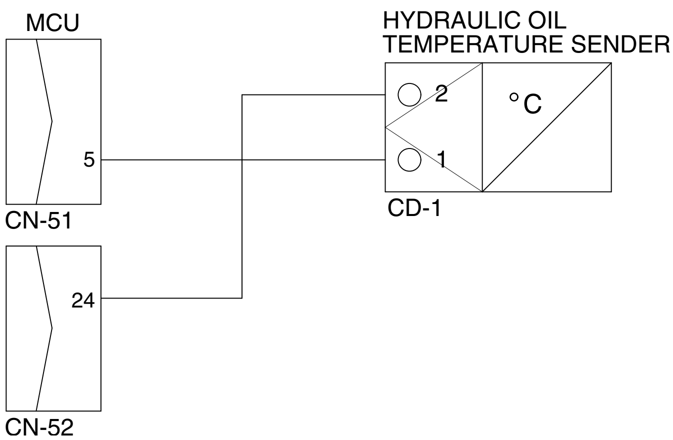
· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.





Check Table

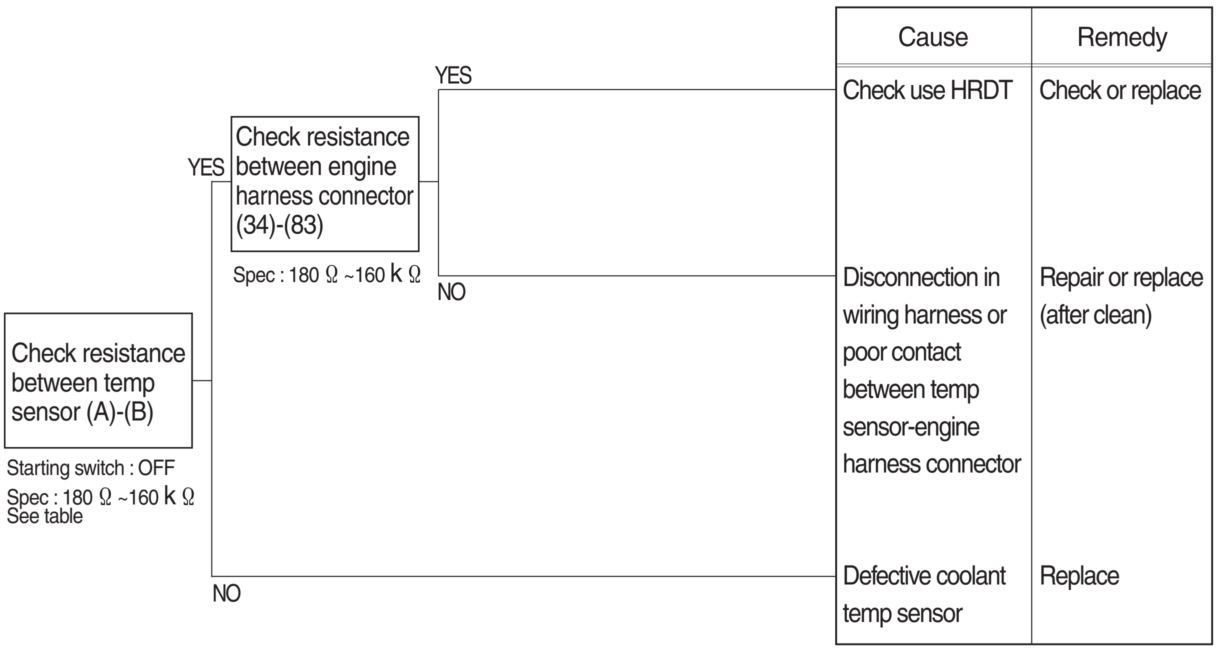
Temperature (°C)	~ -30	~ -10	~ 0	~ 40	~ 70	~ 80	~ 90	~ 100	105~
Resistance (kΩ)	22.22 ~31.78	8.16 ~10.74	5.18 ~ 6.6	1.06 ~1.28	0.39 ~0.476	0.322 ~0.298	0.243 ~0.219	0.185 ~0.167	0.164 0.151



300L6ES08

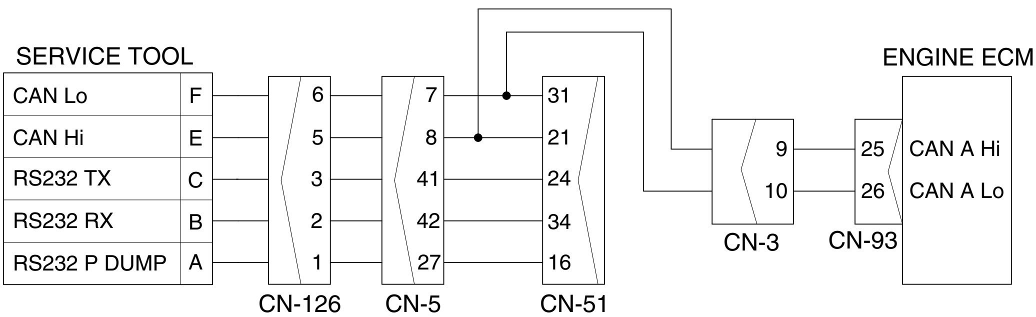
8. WHEN COOLANT TEMPERATURE GAUGE DOES NOT OPERATE

· 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

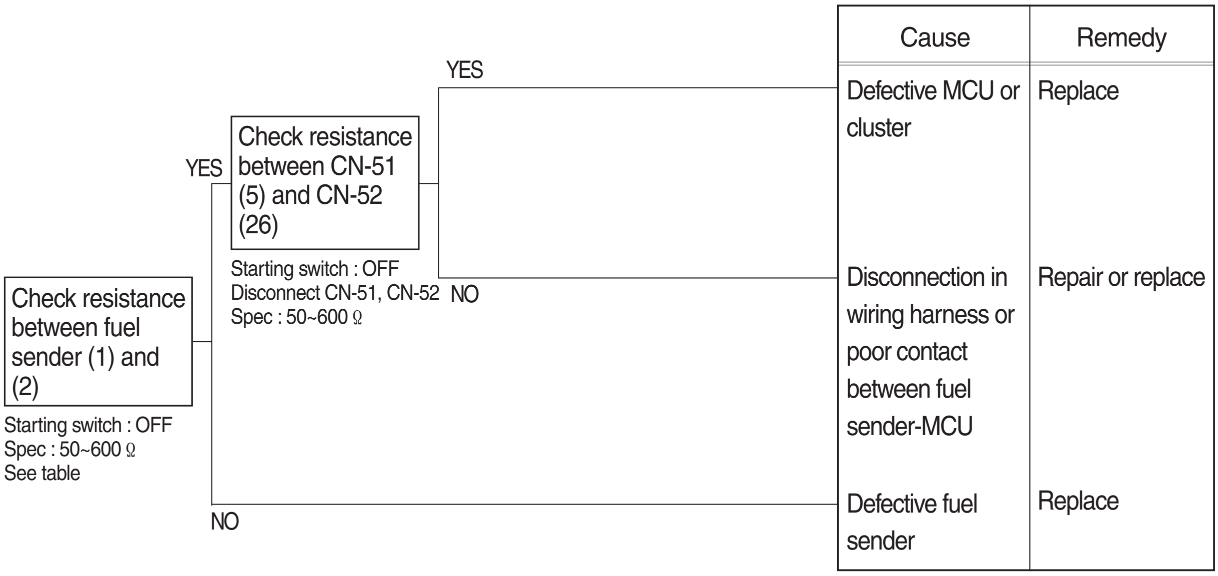
Temperature (˚C)	0	25	50	80	95
Resistance (k Ω)	30~37	9.3~10.7	3.2~3.8	1.0~1.3	0.7~0.8

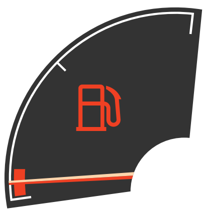


145LCR6ES03

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

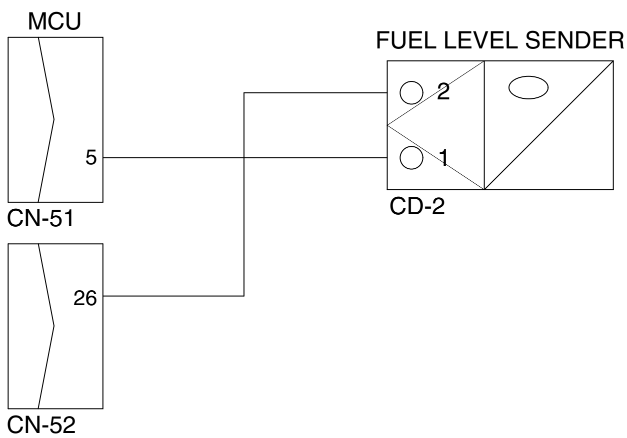
- Before disconnecting the connector, always turn the starting switch OFF.
- Before carrying out below procedure, check all the related connectors are properly inserted.
- After checking, insert the disconnected connectors again immediately unless otherwise specified.





Check Table

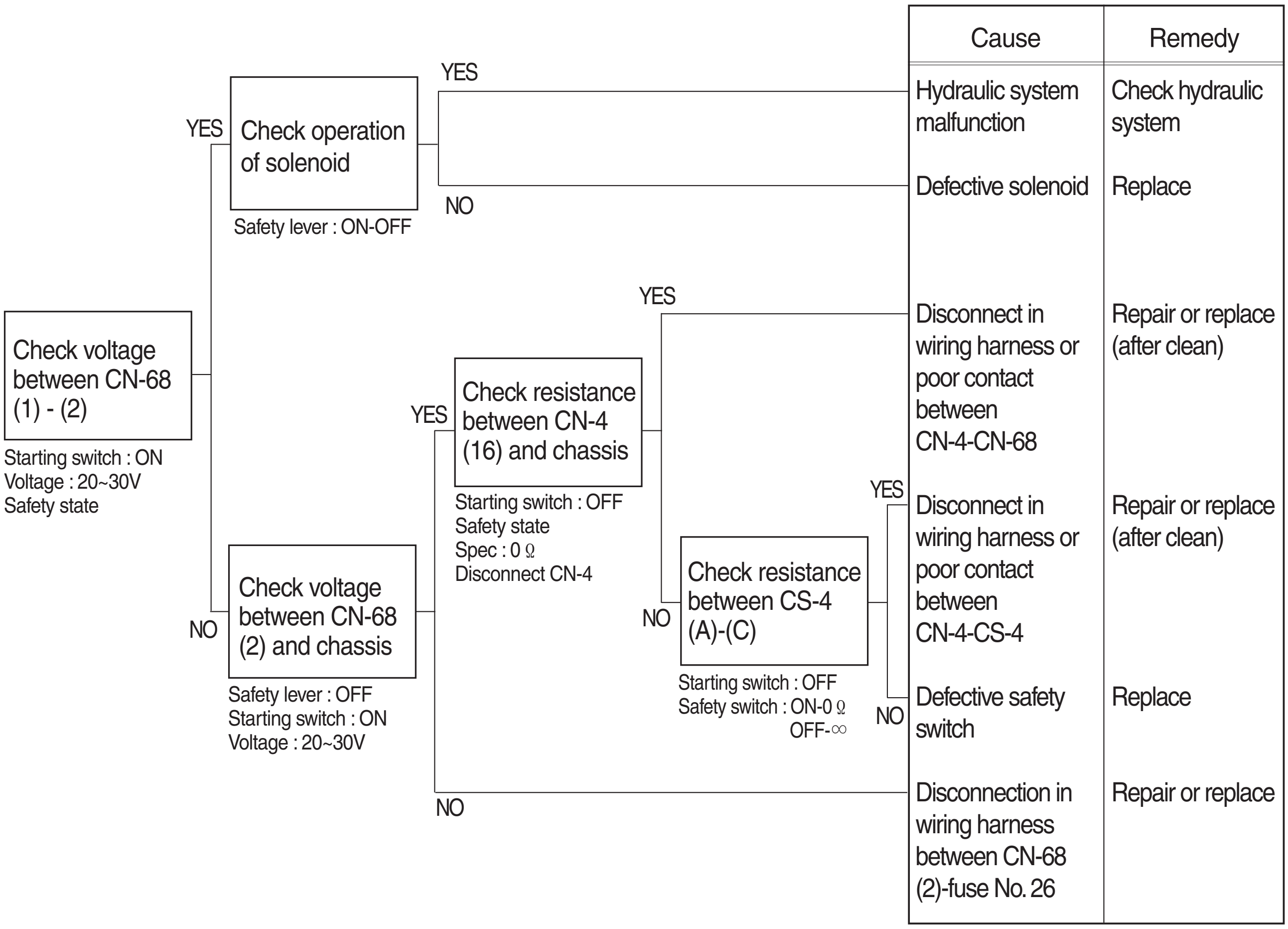
Range	Resistance (Ω)	Range	Resistance (Ω)
Full	50	5/12	400
11/12	100	4/12	450
10/12	150	3/12	500
9/12	200	2/12	550
8/12	250	1/12	600
7/12	300	Empty warning	700
6/12	350	-	-

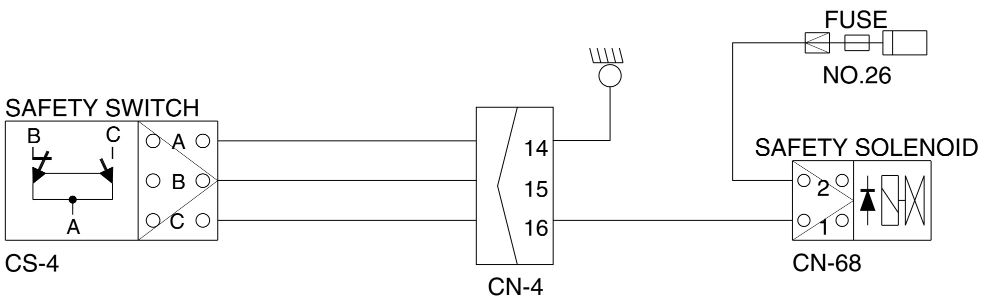


300L6ES10

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. 26.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.

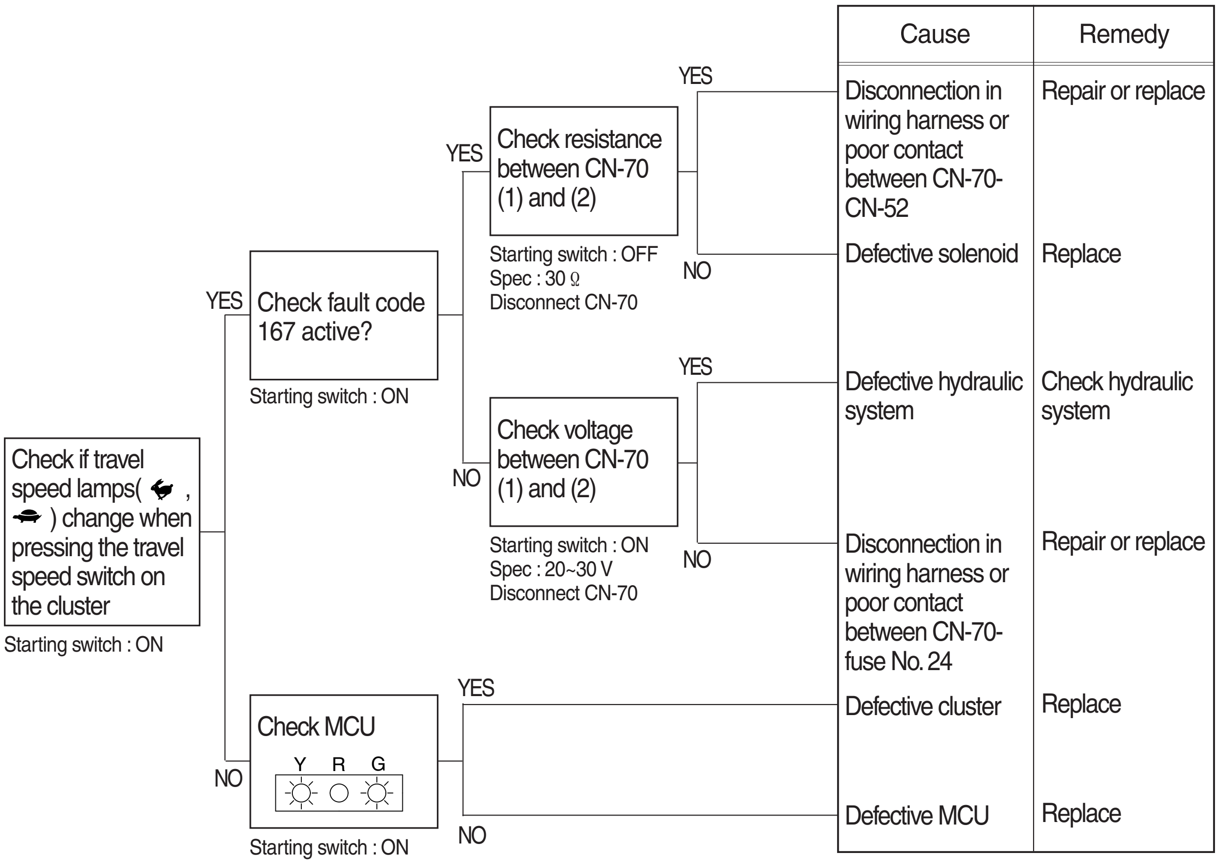


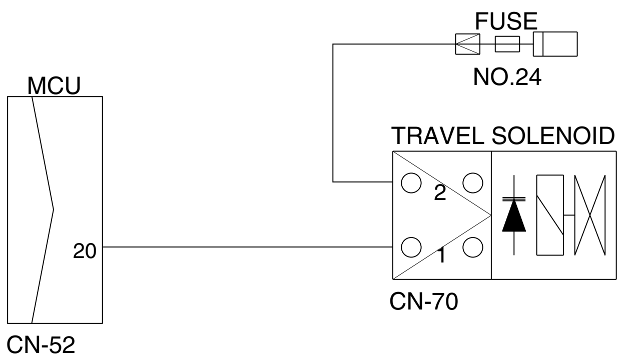


145LCR6ES11

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. 24.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.





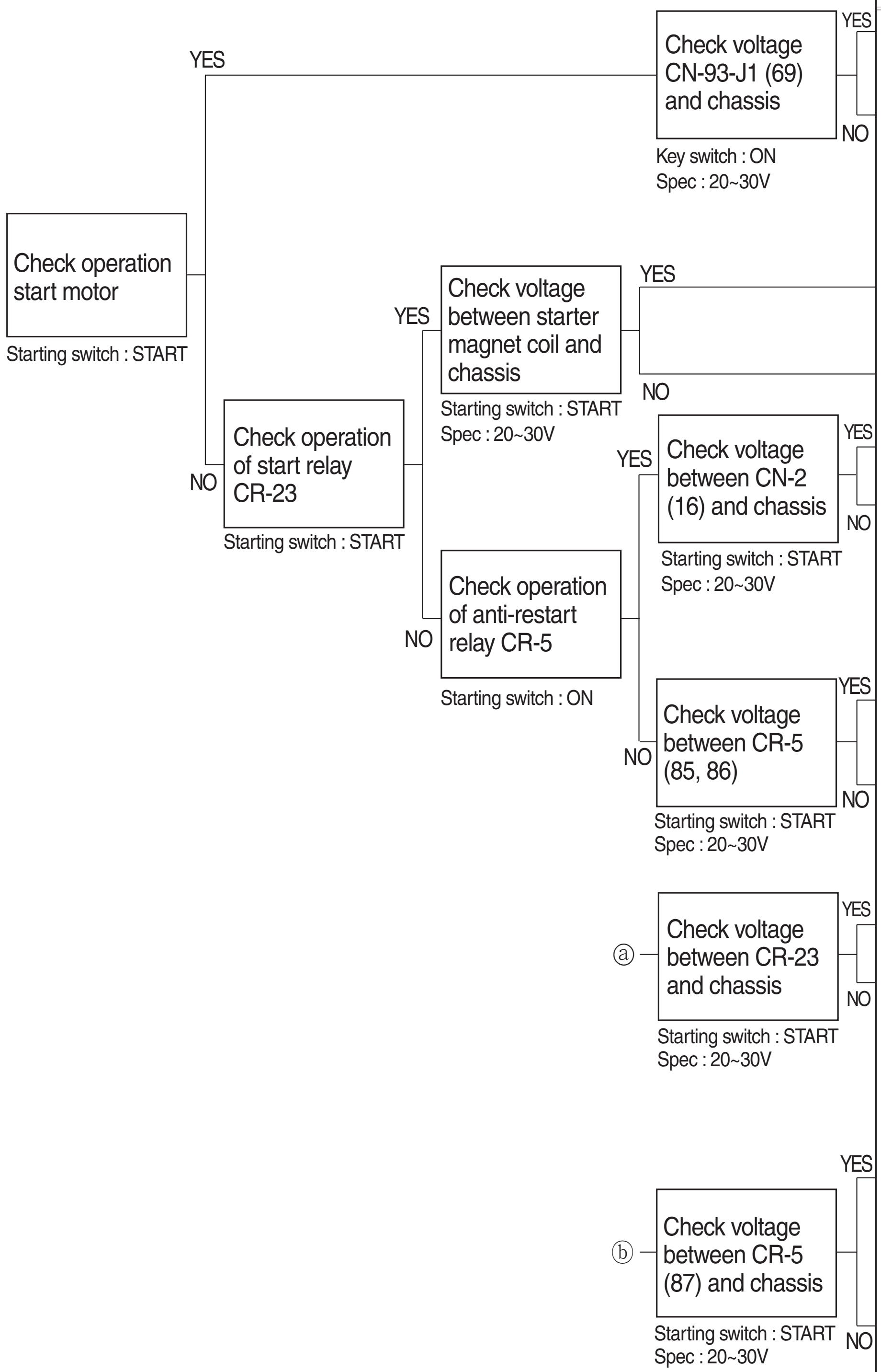
145LCR6ES12

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

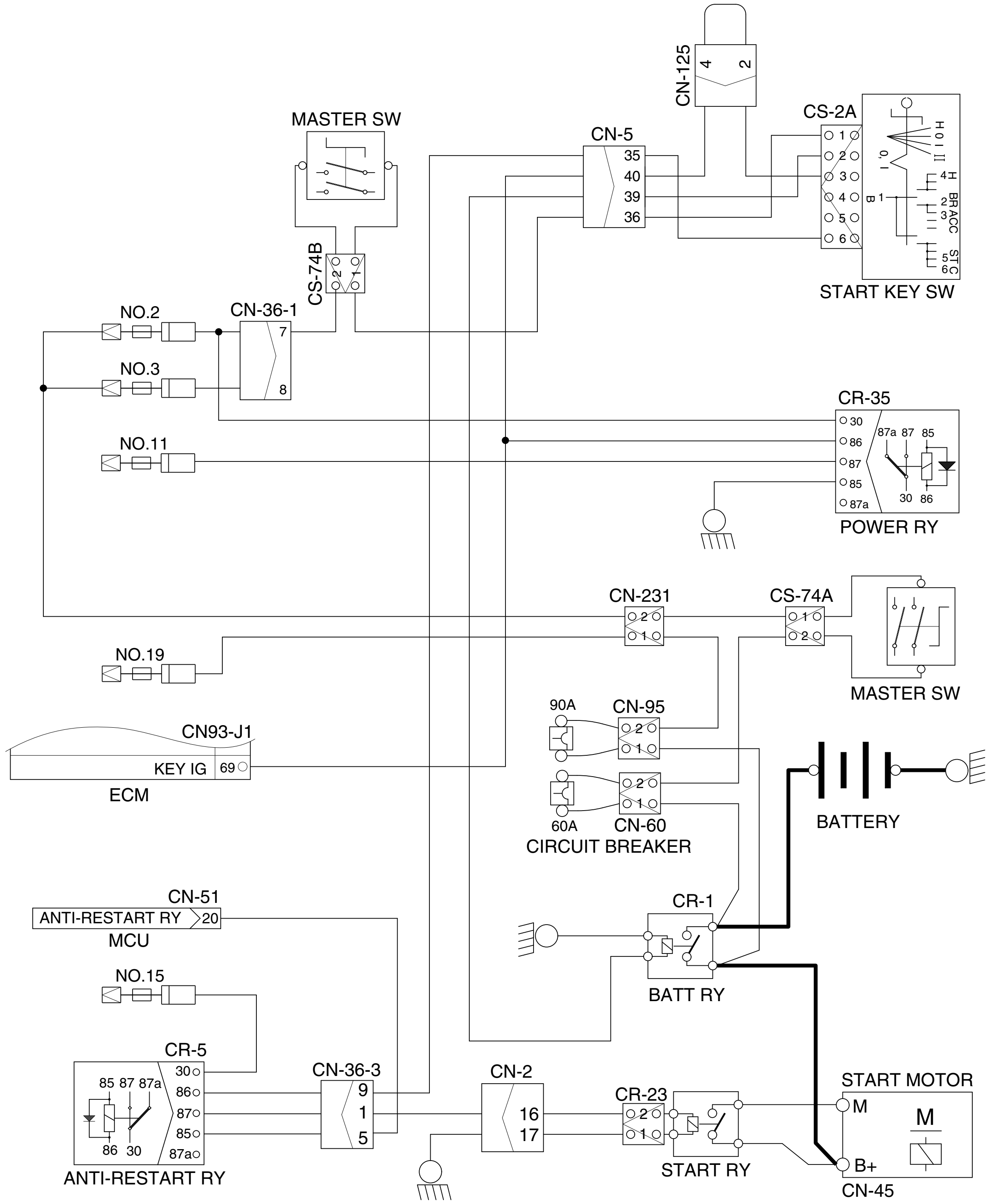
· Before disconnecting the connector, always turn the starting switch OFF.

· Before carrying out below procedure, check all the related connectors are properly inserted and short of fuse No. 2, 3, 11, 15, 19.

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



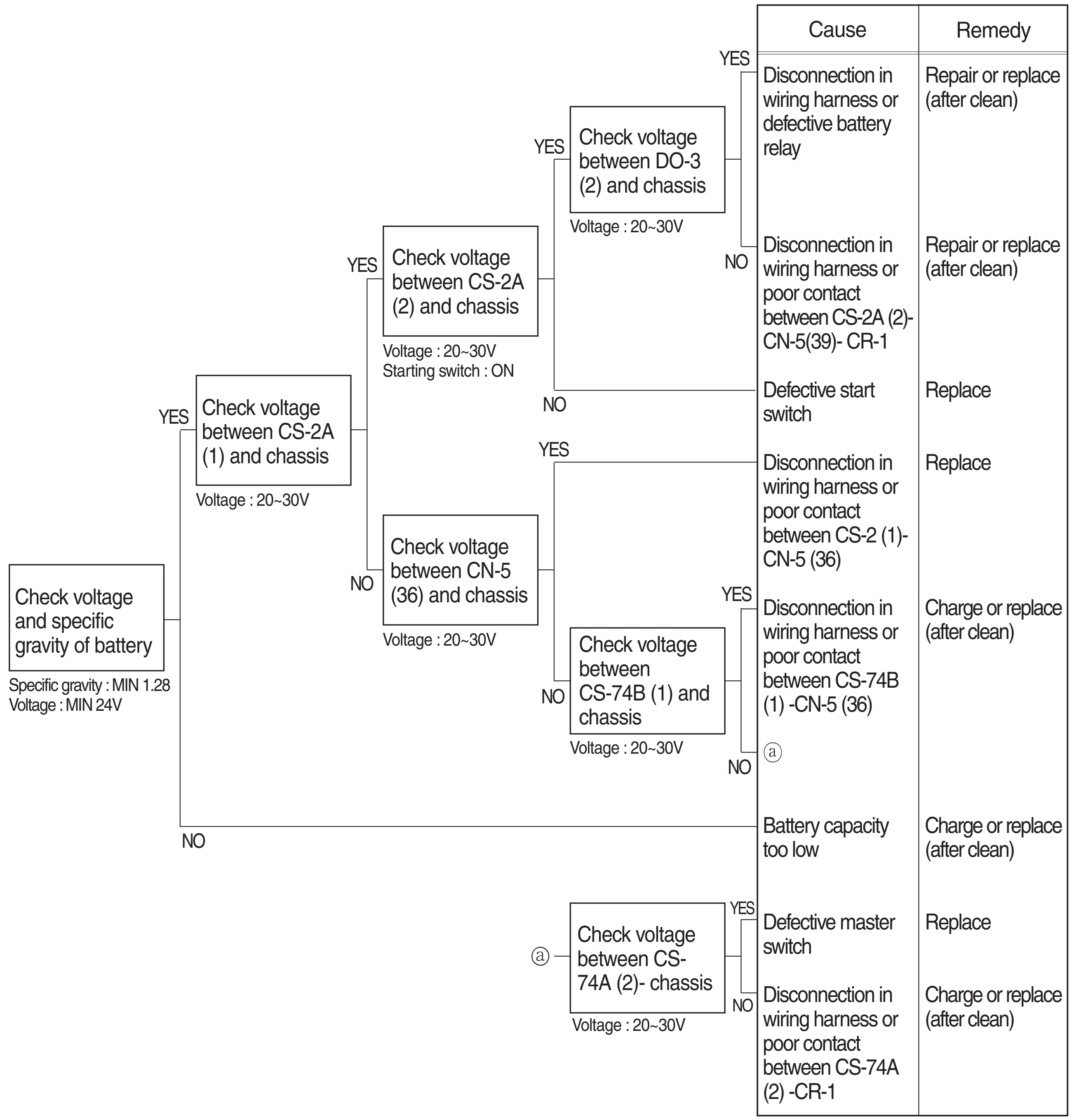
Cause	Remedy
Defective ECM or battery	Replace
Disconnection in wiring harness or poor contact between CR-35 (86) -CN-93-J1 (69)	Repair or replace
Defective magnet of start motor	Replace
Defective start relay	Replace
ⓐ	
Disconnection in wiring harness or poor contact between CN-2 (16) -CR-5 (87)	Repair or replace
Defective anti-restart relay	Replace
ⓑ	
Defective start relay	Replace
Disconnection in wiring harness or poor contact between CN-2 (16) -CR-5 (87)	Repair or replace
Disconnection in wiring harness or poor contact between CN-51 (20)-CR-5 (30)	Repair or replace
Disconnection in wiring harness or poor contact between CS-2A (6)- CR-5 (86)	Repair or replace

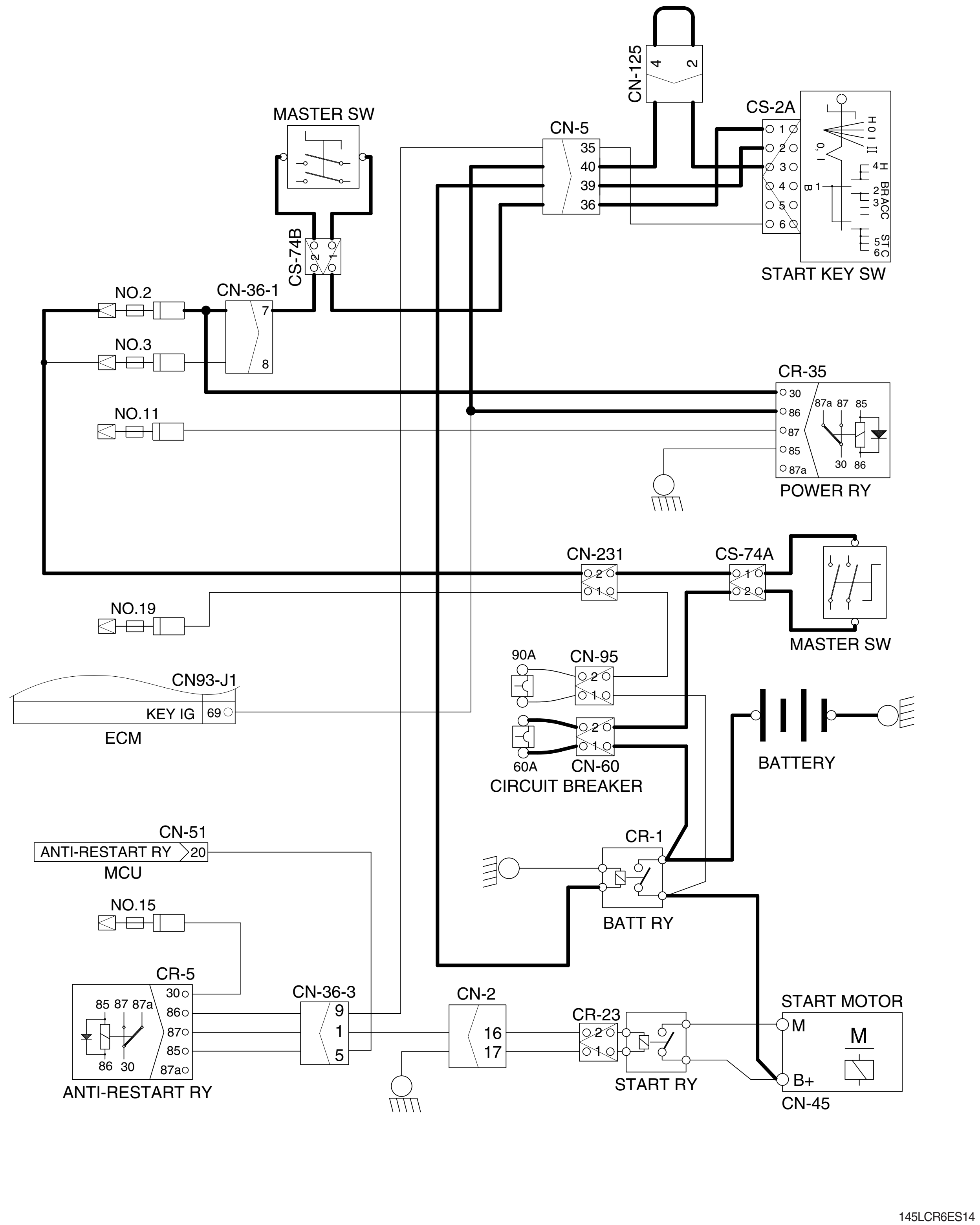


145LCR6ES13

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.



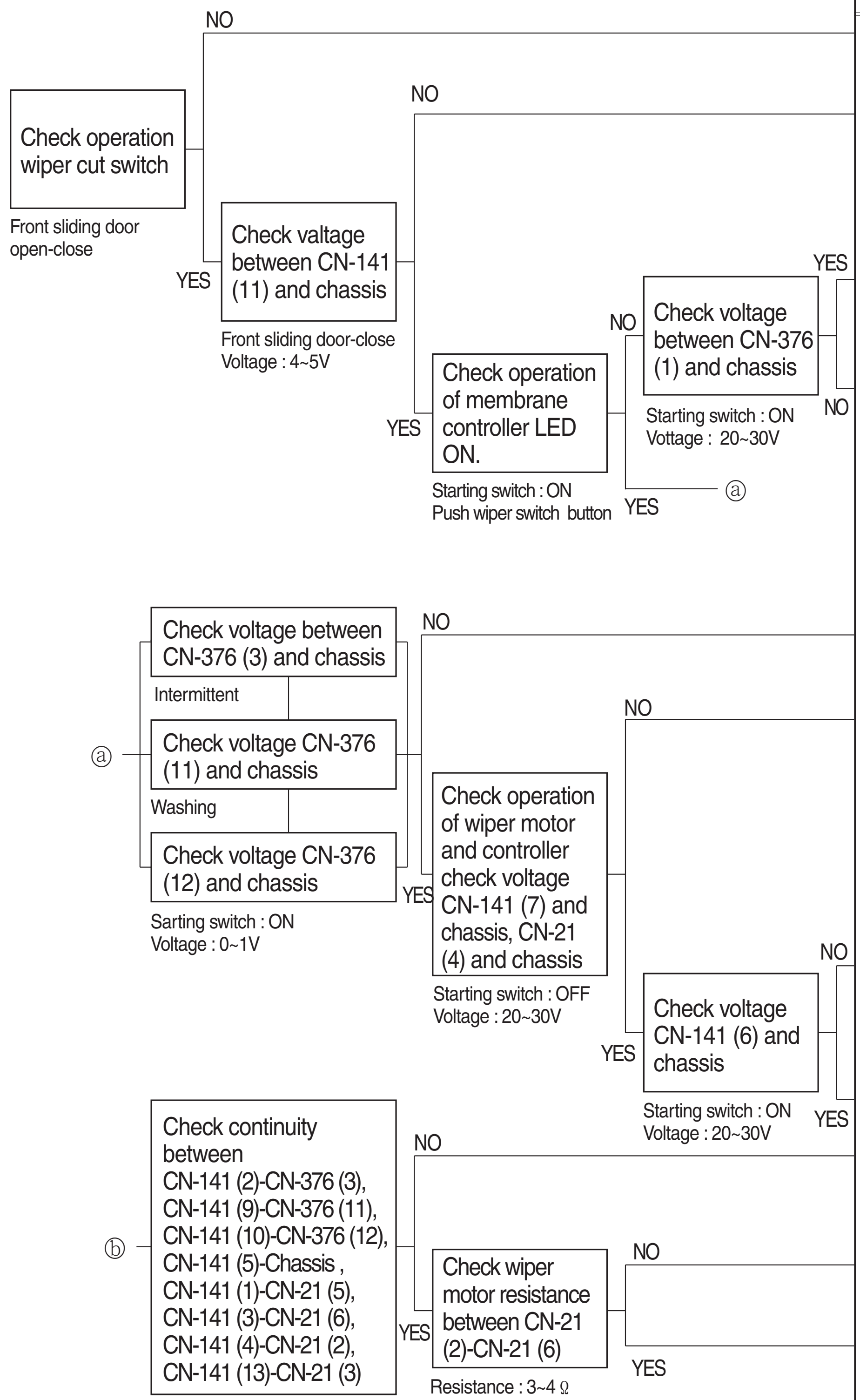


14. WHEN STARTING SWITCH IS TURNED ON, WIPER MOTOR DOES NOT OPERATE

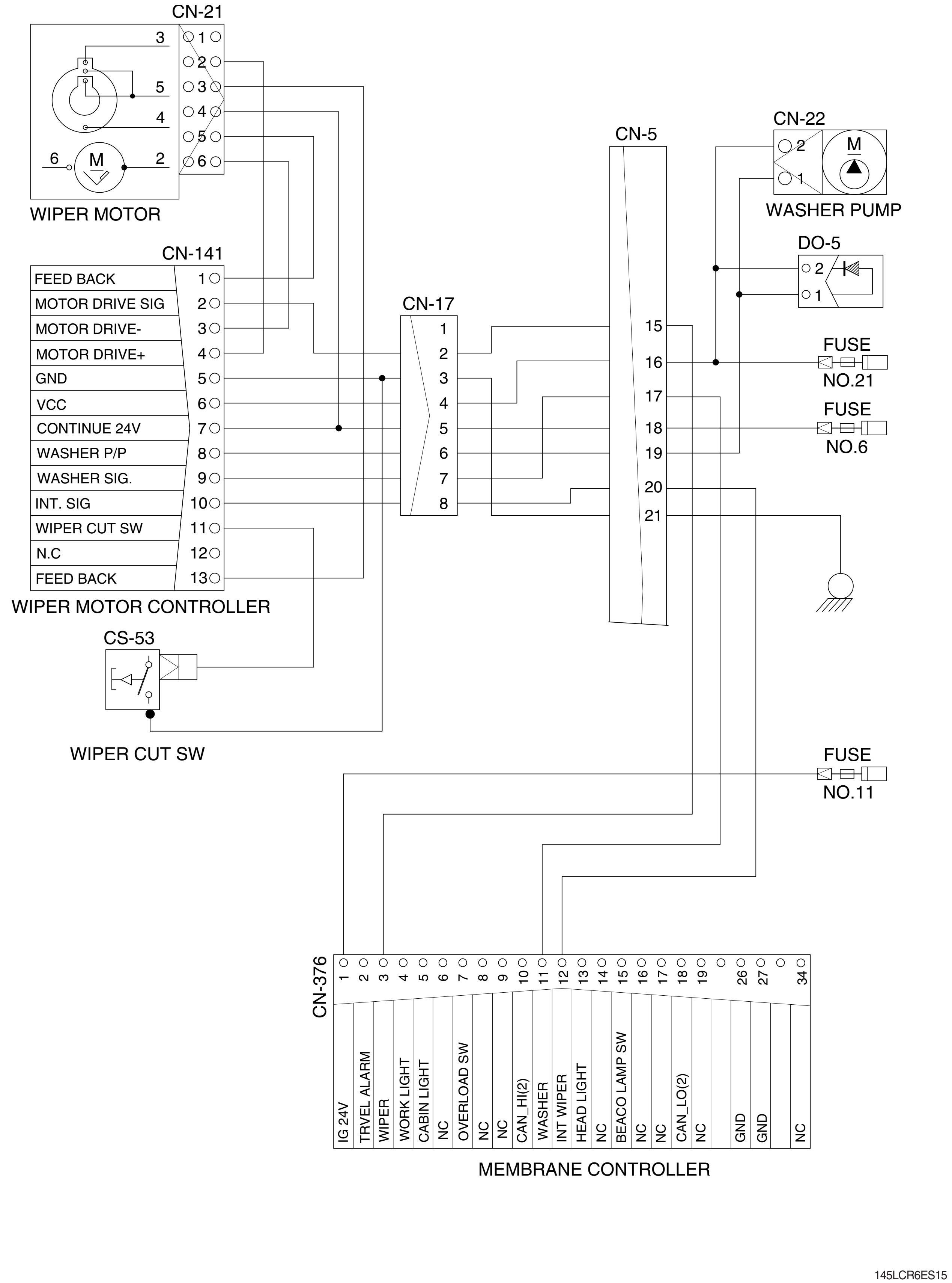
· Before disconnecting the connector, always turn the starting switch OFF.

· Before carrying out below procedure, check all the related connectors are properly inserted and the fuse No. 6, 11 and 21 is not blown out.

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



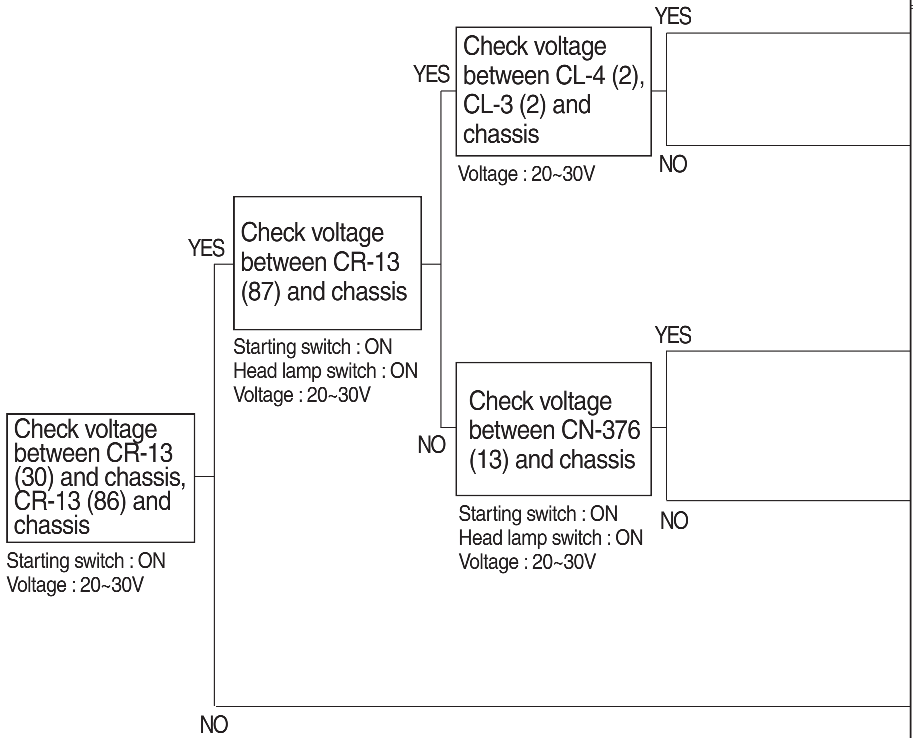
Cause	Remedy
Defective wiper cut switch	Replace
Short circuit in wiring harness or poor contact between CN-141 (11)- CS-53	Repair or replace (after clean)
Defective membrane controller	Replace
1)Recheck fuse No.11	Replace
2)Disconnection in wiring harness or poor contact between CN-376(1)-Fuse	Repair or replace (after clean)
Defective switch panel	Replace
1) Recheck fuse No.6	Replace
2) Disconnection in wiring harness or poor contact between CN-141(7)-Fuse, CN-21(4)-Fuse	Repair or replace (after clean)
1) Recheck fuse No.21	Replace
2) Disconnection CN-141(6)-Fuse	Repair or replace (after clean)
Disconnection in wiring harness or poor contact	Repair or replace (after clean)
Defective wiper motor	Replace
Defective wiper motor controller	Replace



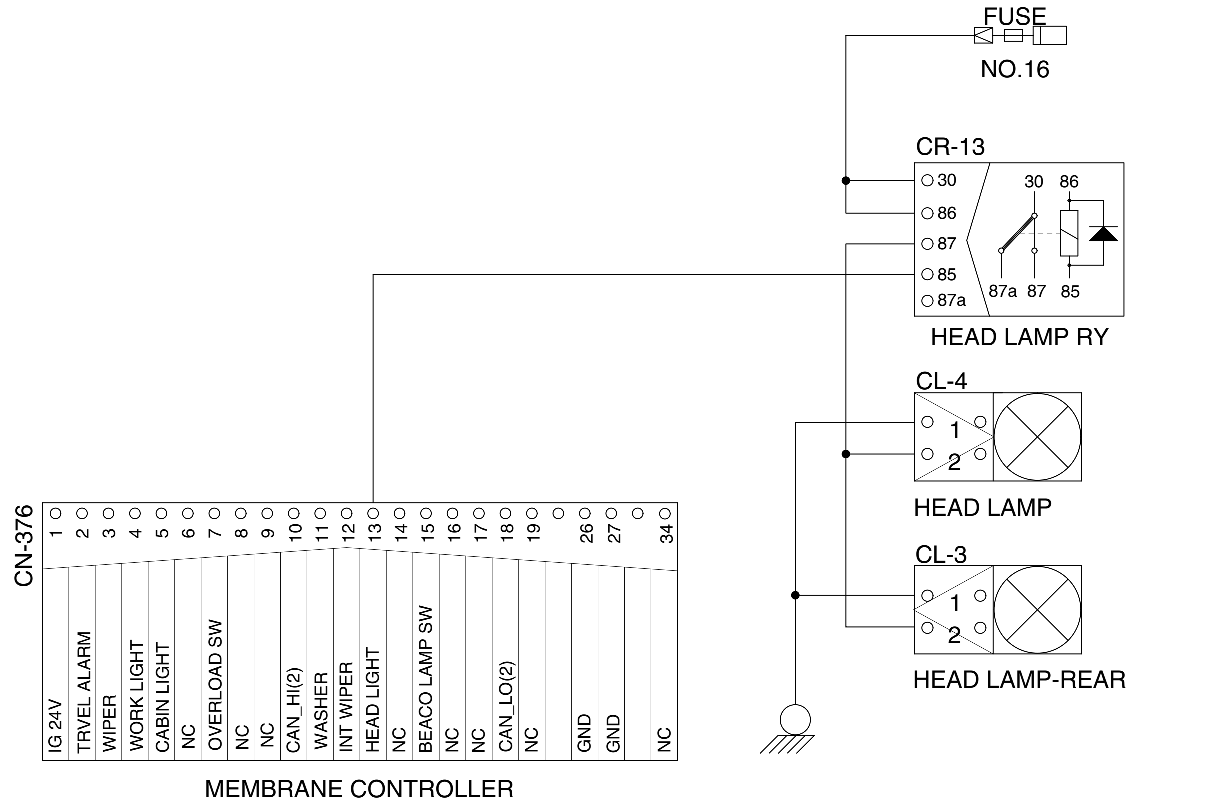
145LCR6ES15

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.16.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.



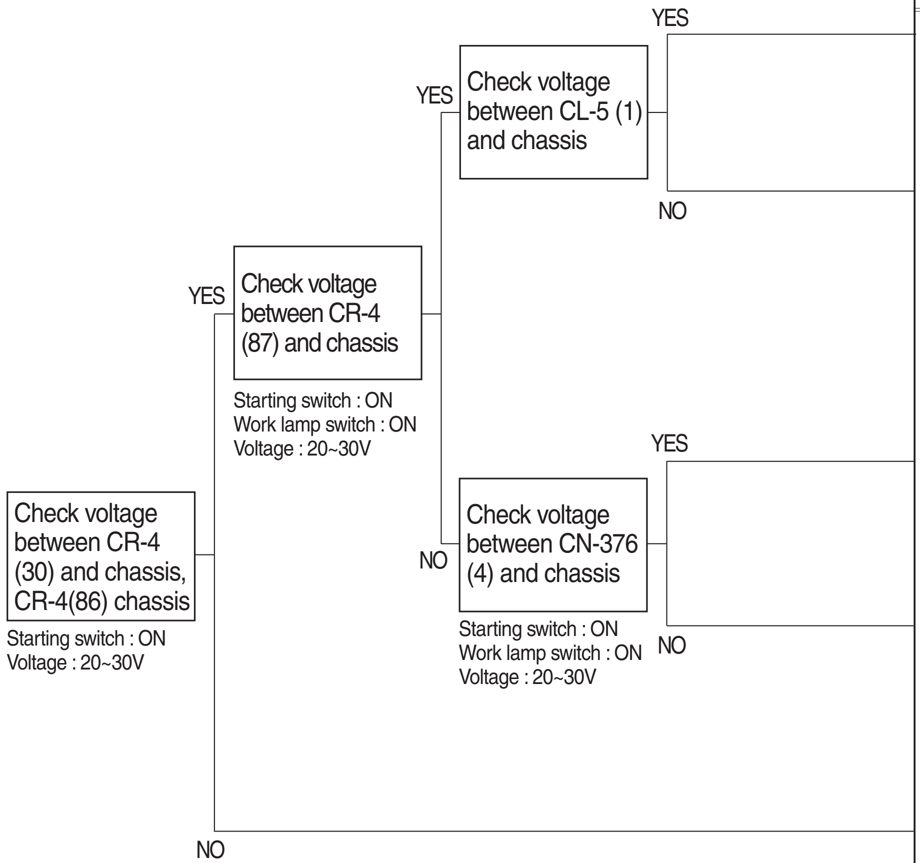
Cause	Remedy
Defective bulb	Replace
Disconnection in wiring harness or poor contact between CR-13 (87)-CL-4 (2) or CR -13 (87)-CL-3 (2)	Repair or replace (after clean)
Defective switch panel	Replace
Disconnection in wiring harness or poor contact between CN-376 (13)-CR-13 (87)	Repair or replace (after clean)
Disconnection in wiring harness or poor contact between CR-13 (30) and chassis or CR-13 (86) - chassis	Repair or replace (after clean)
Recheck fuse No. 16	Replace



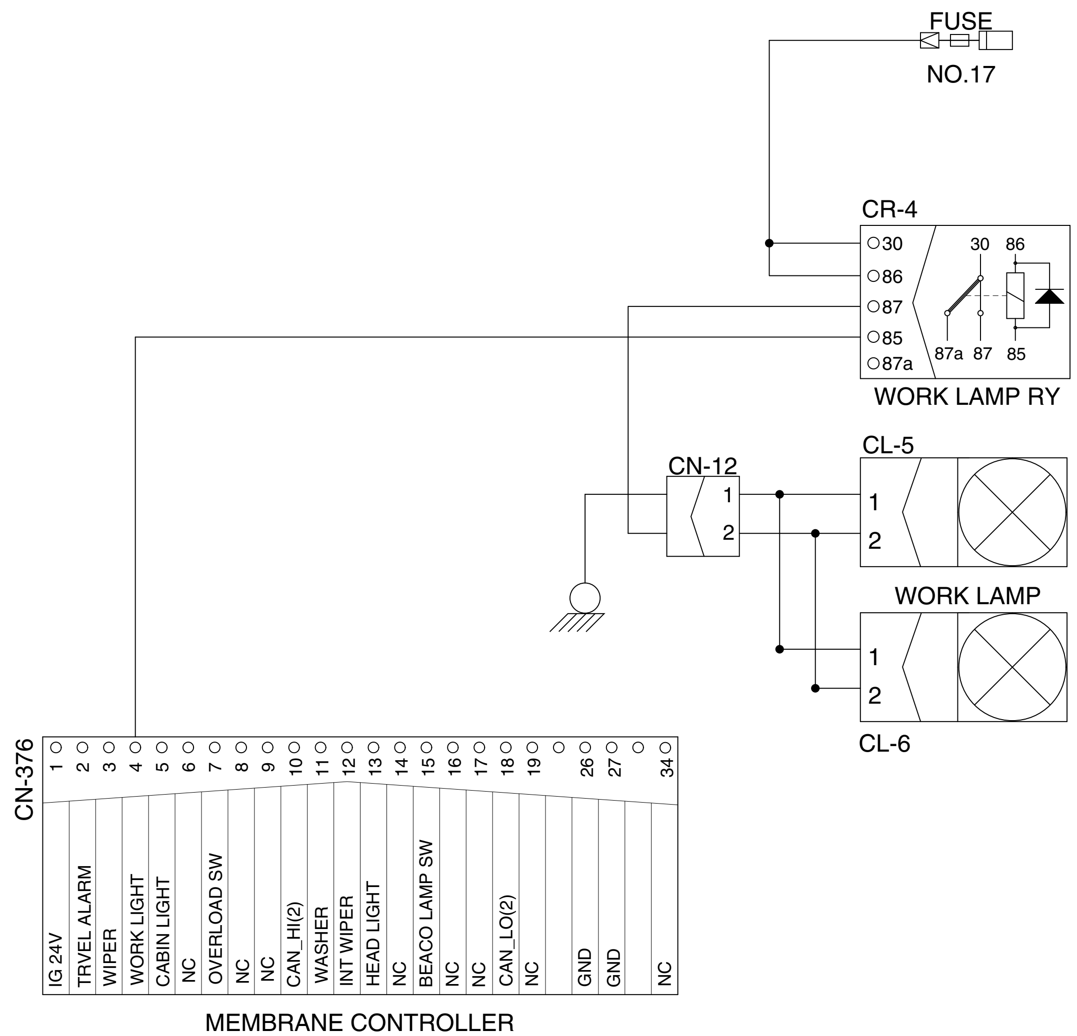
145LCR6ES16

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

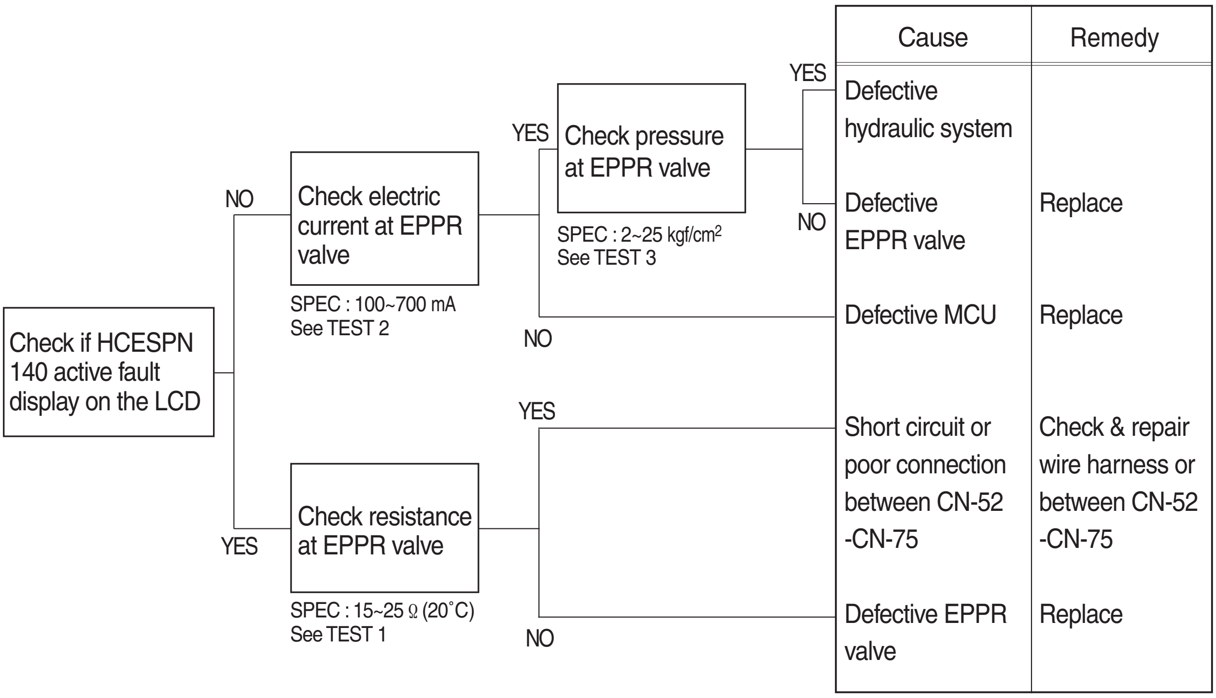
1. ALL ACTUATORS SPEED ARE SLOW

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

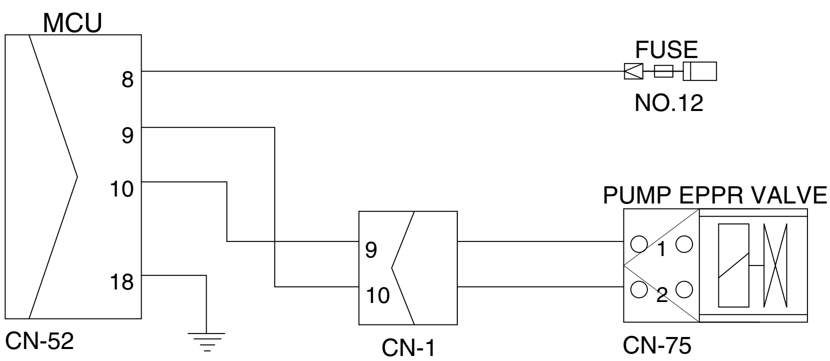
※ Spec : P-mode 1850 ± 50 rpm S -mode 1750 ± 50 rpm E-mode 1650 ± 50 rpm

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

1) INSPECTION PROCEDURE



Wiring diagram

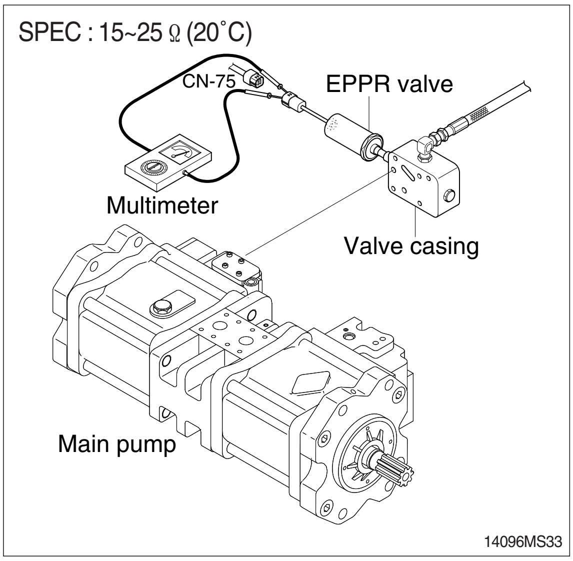


140L6MS01

2) TEST PROCEDURE

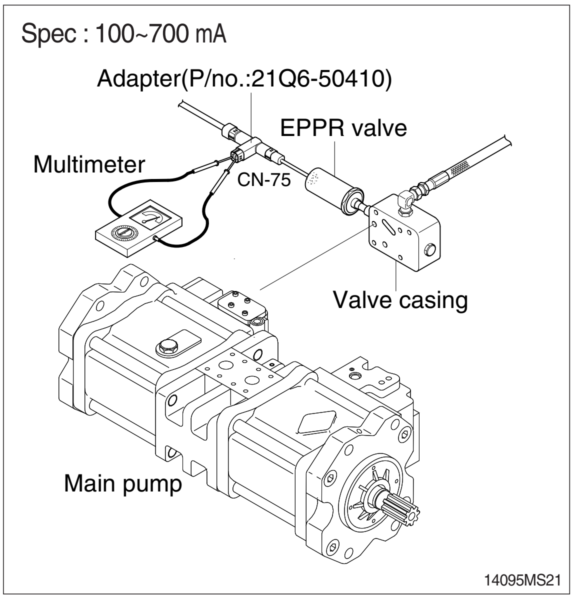
(1) Test 1 : Check resistance at connector CN-75.

① Starting switch OFF.
② Disconnect connector CN-75 from EPPR valve at main hydraulic pump.
③ Check resistance between 2 lines as figure.



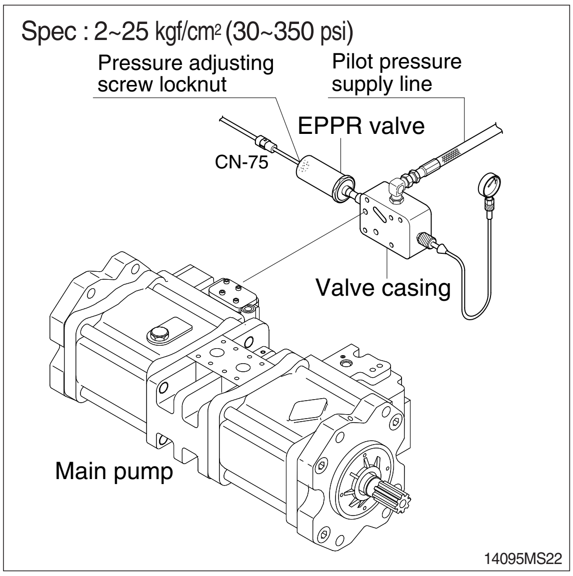
(2) Test 2 : Check electric current at EPPR valve.

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 1750±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.

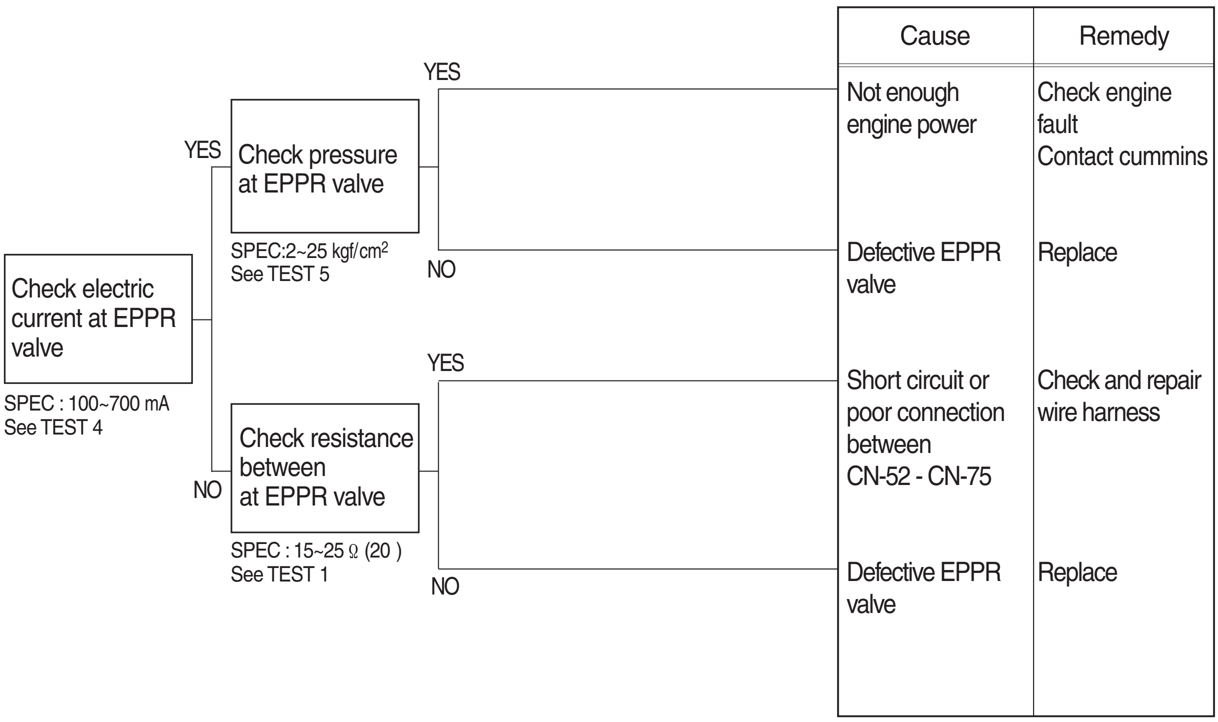
① Remove plug and connect pressure gauge as figure.
  · Gauge capacity : 0 to 50 kgf/cm^2 (0 to 725 psi)
② Start engine.
③ Set S-mode and cancel auto decel mode.
④ Position the multimodal dial at 10.
⑤ If tachometer show approx 1750±50 rpm check pressure at relief position of bucket circuit by operating bucket control lever.
⑥ If pressure is not correct, adjust it.
⑦ After adjust, test the machine.



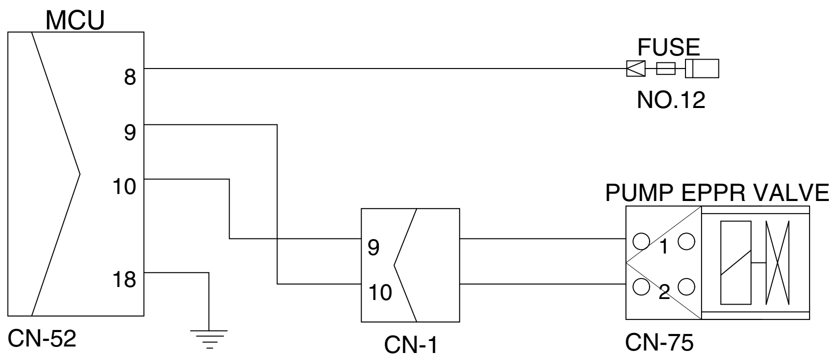
2. ENGINE STALL

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

1) INSPECTION PROCEDURE



Wiring diagram

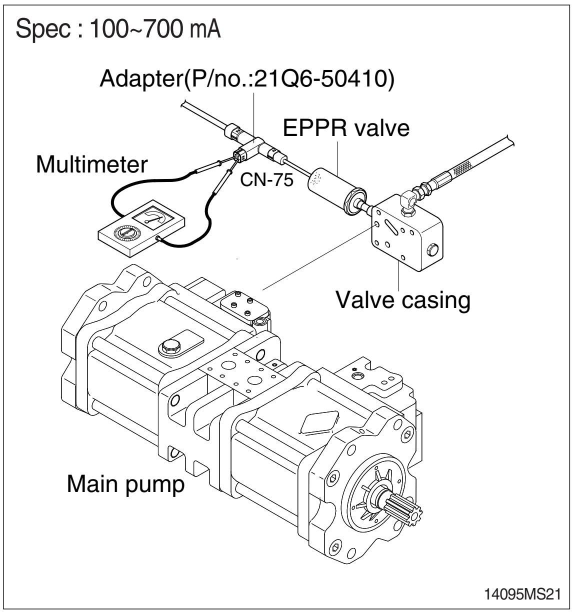


140L6MS01

2) TEST PROCEDURE

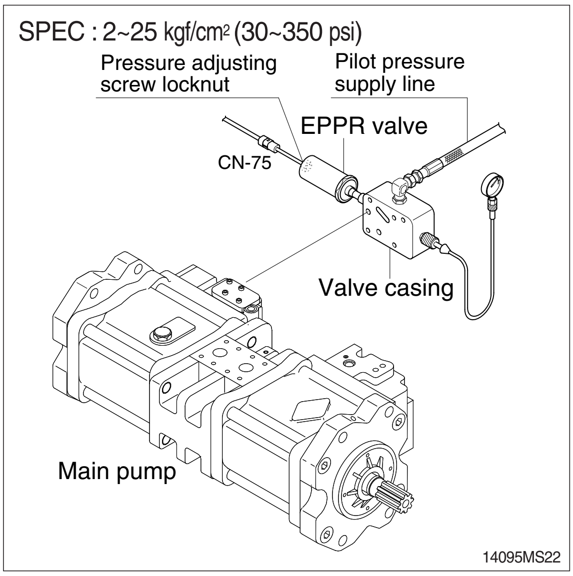
(1) Test 4 : Check electric current at EPPR valve.

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 1750±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.

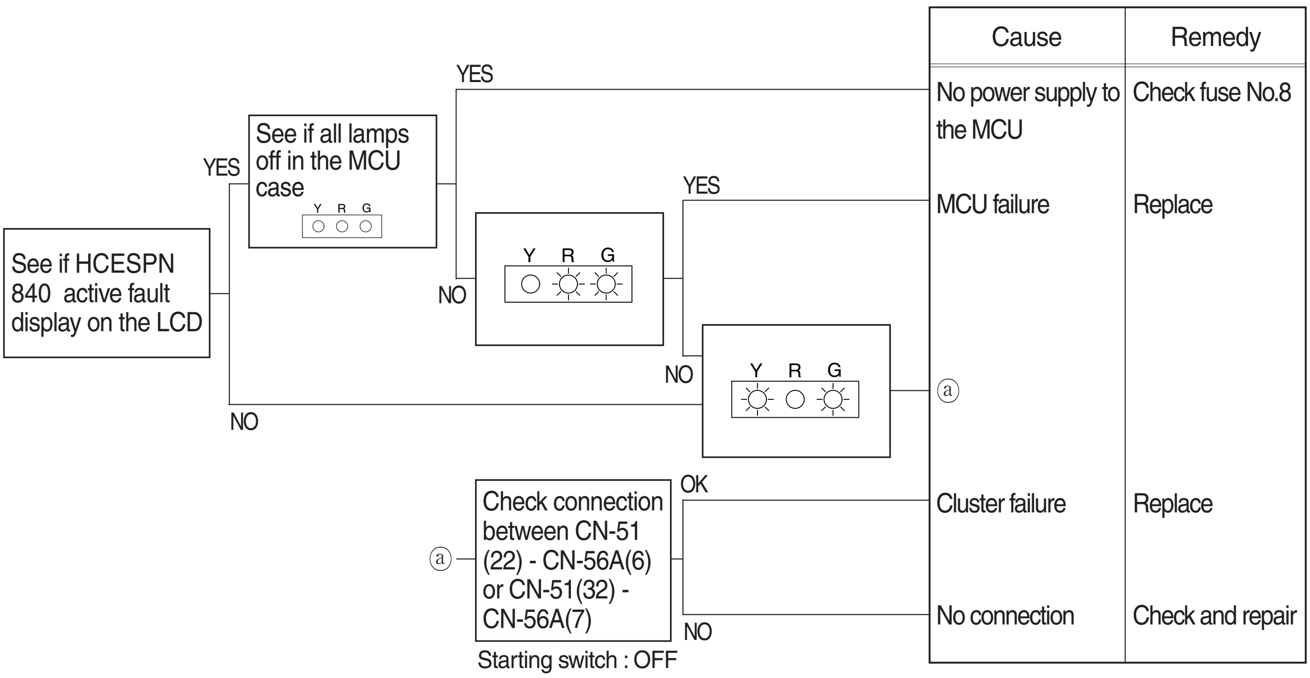
① Remove plug and connect pressure gauge as figure.
 · Gauge capacity : 0 to 50 kgf/cm² (0 to 725 psi)
② Start engine.
③ Set S-mode and cancel auto decel mode.
④ Position the multimodal dial at 10.
⑤ If rpm show approx 1750±50 rpm check pressure at relief position of bucket circuit by operating bucket control lever.
⑥ If pressure is not correct, adjust it.
⑦ After adjust, test the machine.



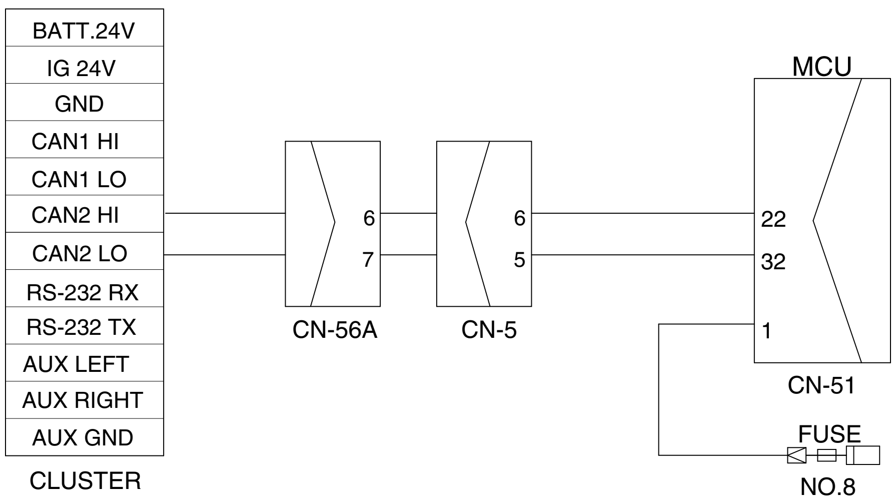
3. MALFUNCTION OF CLUSTER OR MODE SELECTION SYSTEM

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

1) INSPECTION PROCEDURE



Wiring diagram



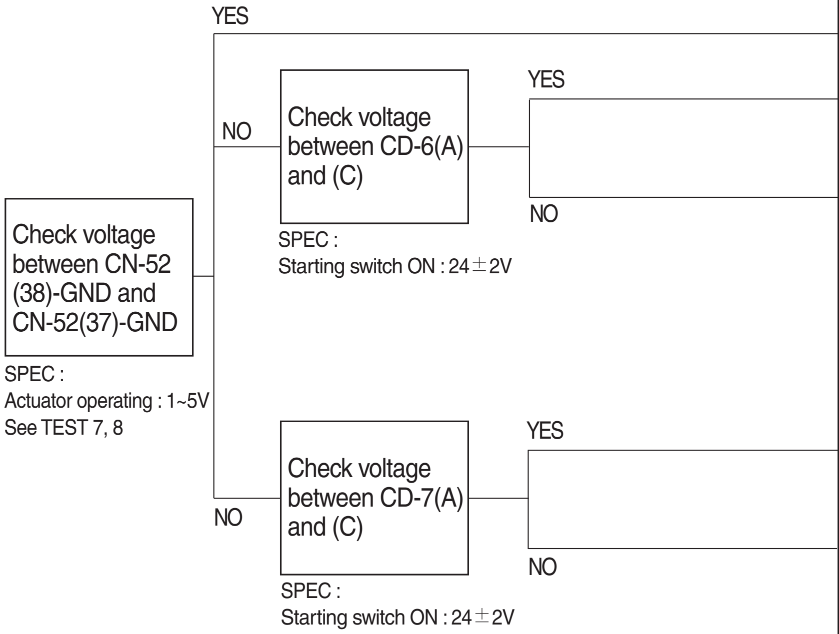
145LCR6MS02

4. AUTO DECEL SYSTEM DOES NOT WORK

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

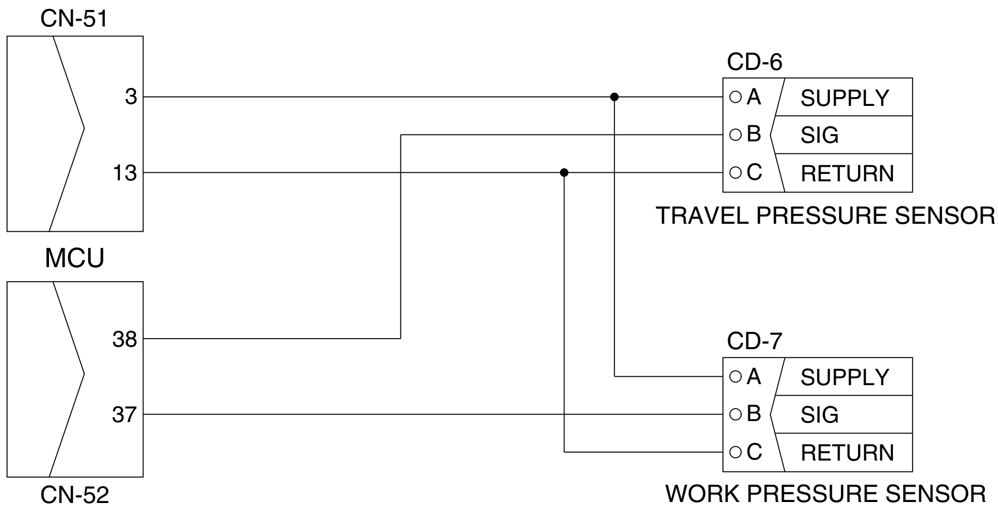
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective MCU	Replace
Defective travel pressure switch	Replace
Short circuit or poor connection between CN-51(3)-CD-6(A) and / or CN-51(13)-CD-6 (C) (fault code 108 displayed)	Replace or repair
Defective work pressure sensor	Replace
Short circuit or poor connection between CN-51(3)-CD-7(A) and / or CN-51(13)-CD-7 (C) (fault code 105 displayed)	Replace or repair

Wiring diagram



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.

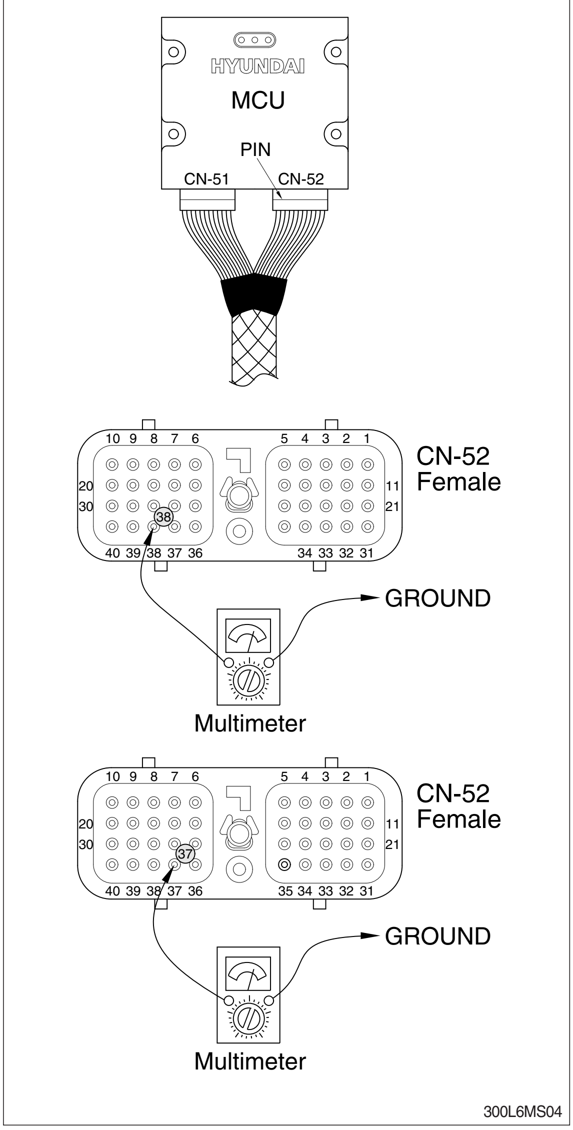
① Prepare 1 piece of thin sharp pin, steel or copper

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

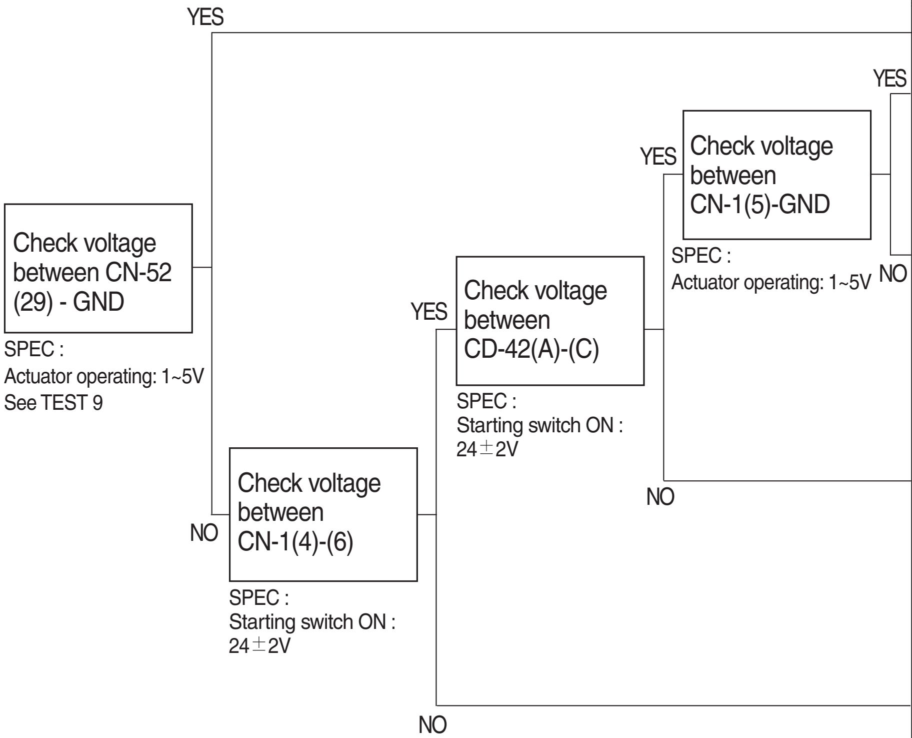


5. MALFUNCTION OF PUMP 1 PRESSURE SENSOR

· Fault code : HCESPN 120, FMI 0~4

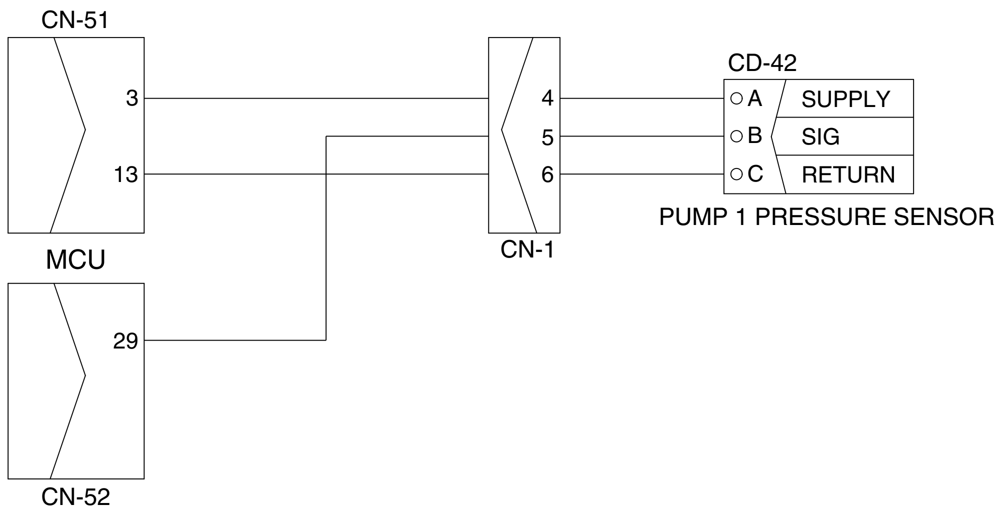
※ Before carrying out below procedure, check all the related connectors are properly inserted.

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.

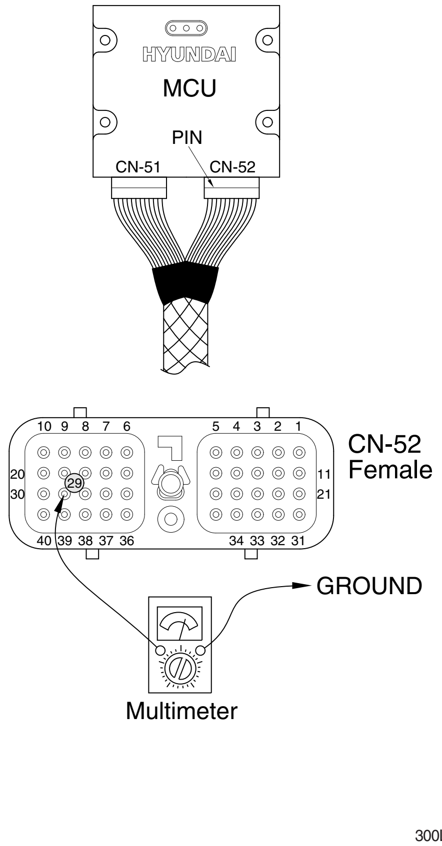
① Prepare 1 piece of thin sharp pin, steel or copper.

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

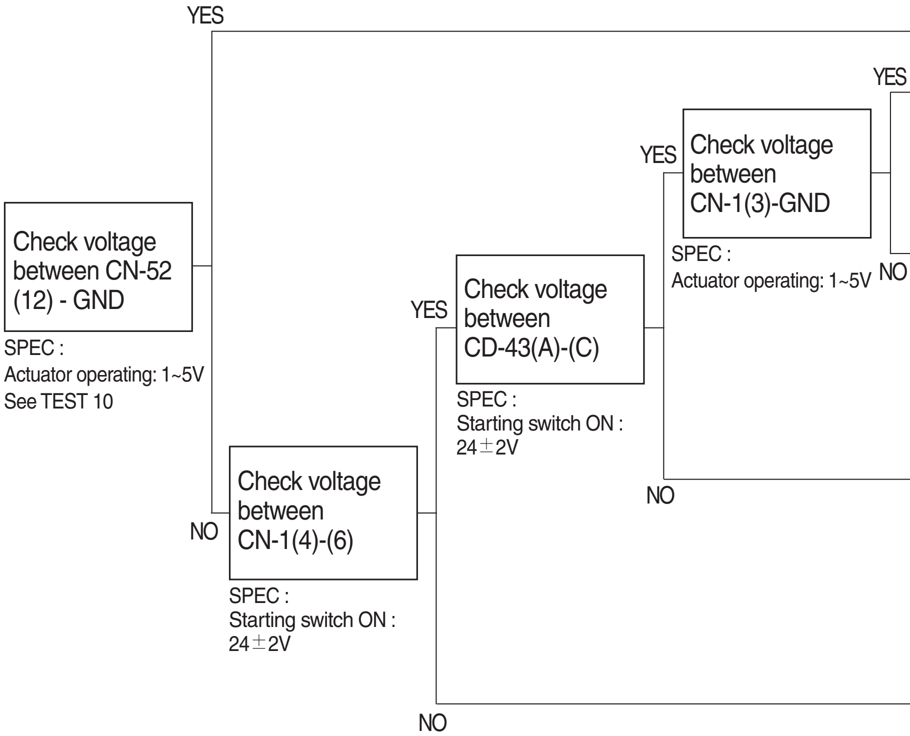


6. MALFUNCTION OF PUMP 2 PRESSURE SENSOR

· Fault code : HCESPN 121, FMI 0~4

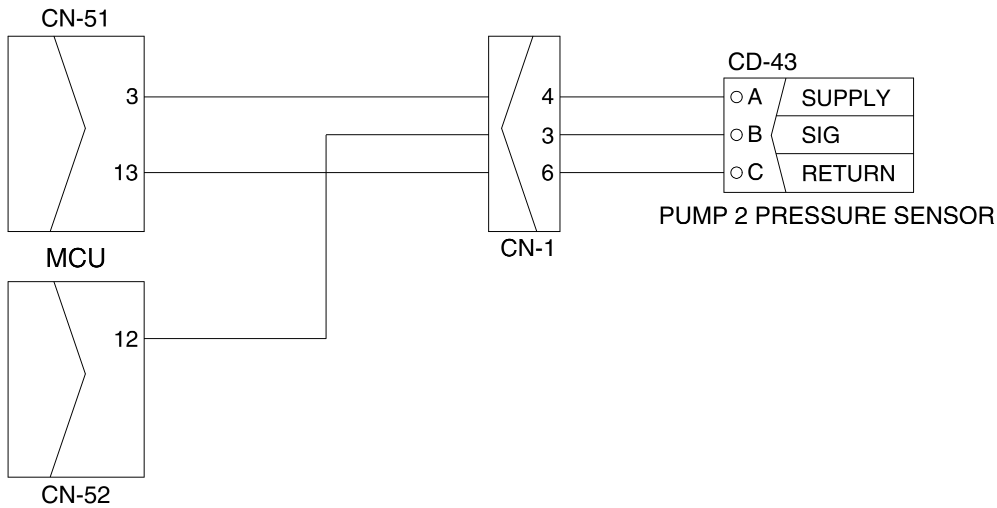
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective MCU	Replace
Short circuit or poor connection between CN-52-(12)-CN-1(3)	Replace or repair
Detective P2 pressure sensor	Replace or repair
Short circuit or poor connection between CN-1(3)-CD-43(B)	Replace or repair
Short circuit or poor connection between CD-43(A)-CN-1(4) or CD-43(C)-CN-1(6)	Replace or repair
Short circuit or poor connection between CN-1(4)-CN-51(3) or CN-1(6) - CN-51(13)	Replace or repair

Wiring diagram



300L6MS07

2) TEST PROCEDURE

(1) Test 10 : Check voltage at CN-52 (12) and ground.

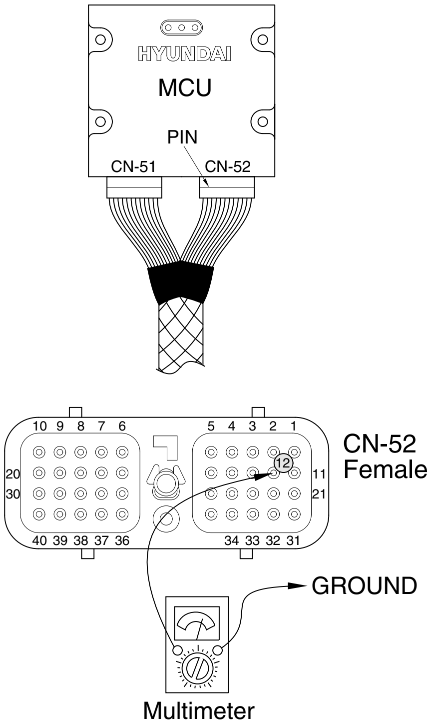
① Prepare 1 piece of thin sharp pin, steel or copper.

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

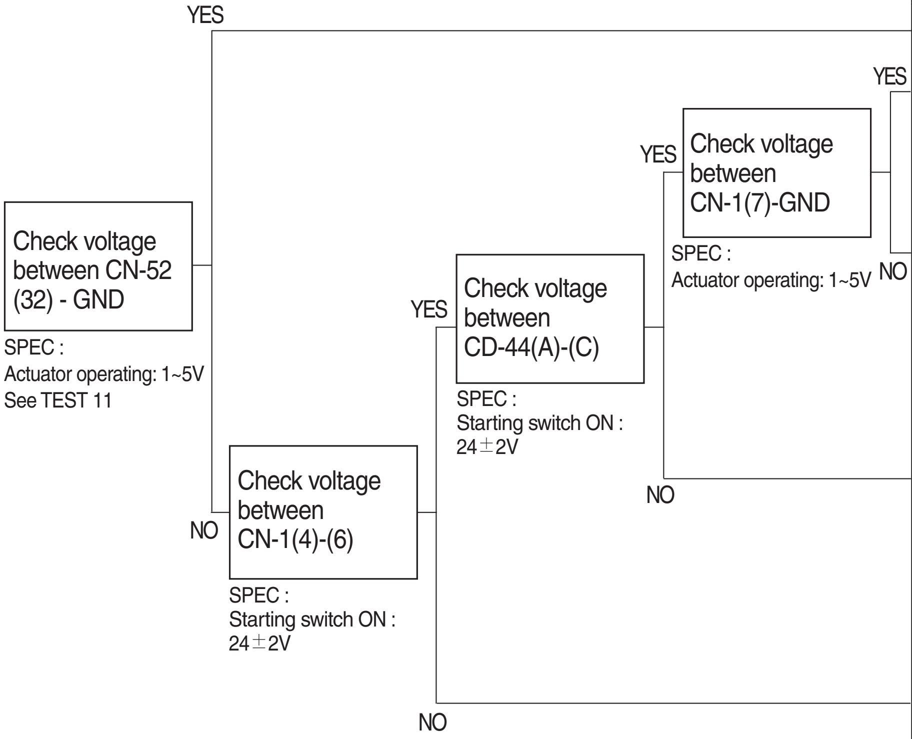


300L6MS08

7. MALFUNCTION OF PUMP 3 PRESSURE SENSOR

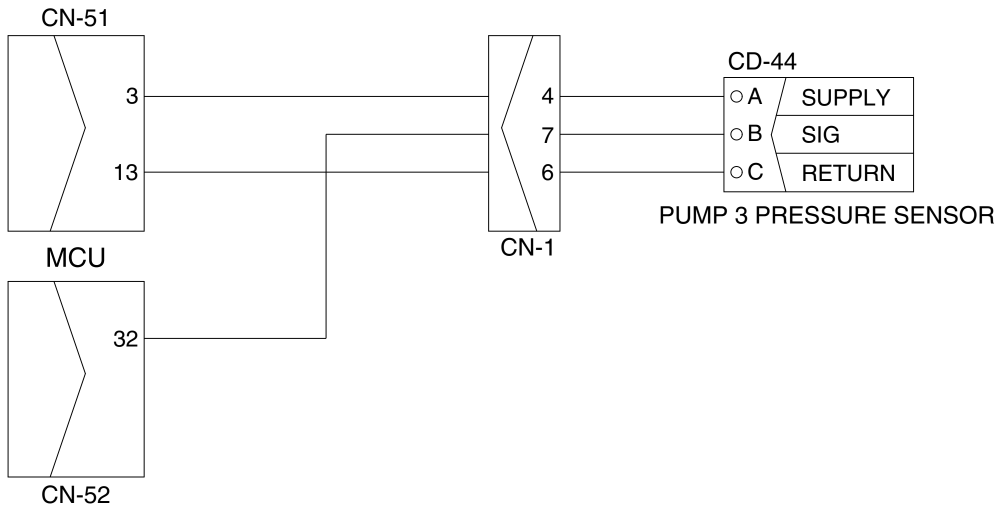
※ Before carrying out below procedure, check all the related connectors are properly inserted.

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



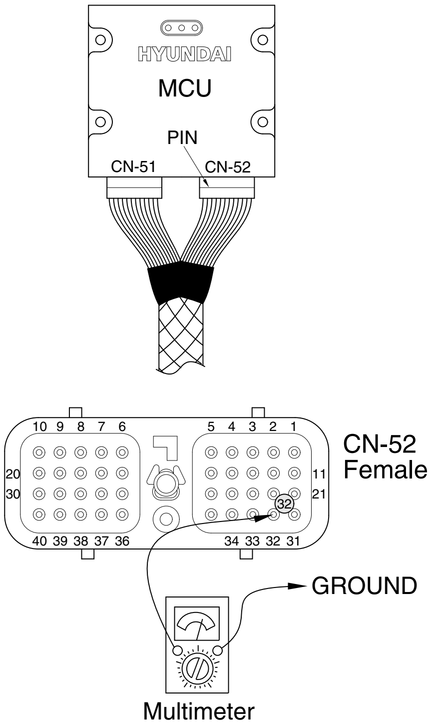
300L6MS09

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



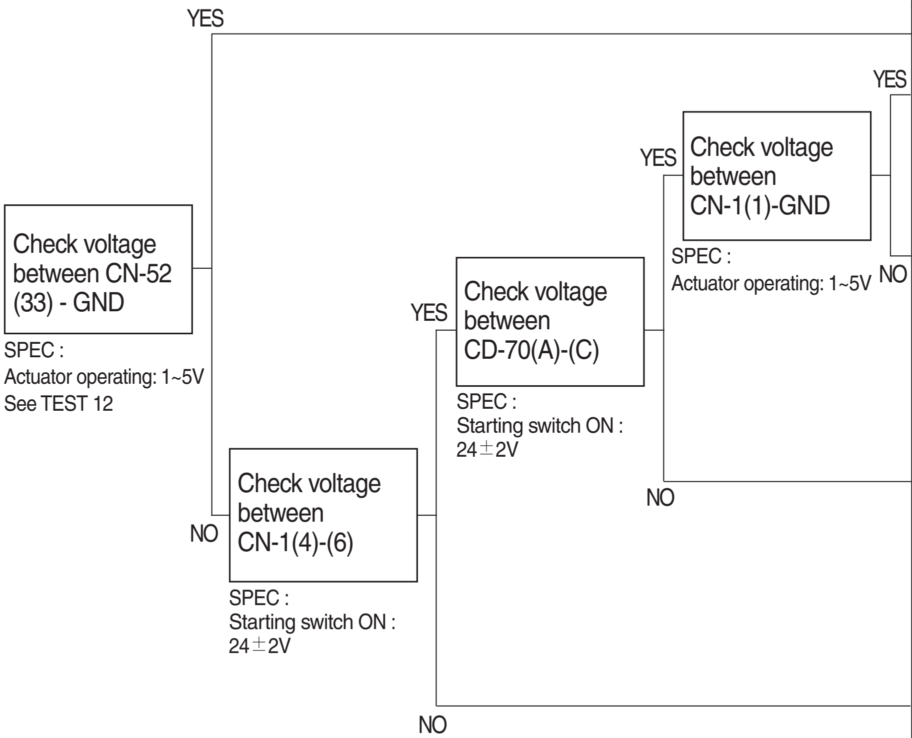
300L6MS10

8. MALFUNCTION OF NEGATIVE 1 PRESSURE SENSOR

· Fault code : HCESPN 123, FMI 0~4

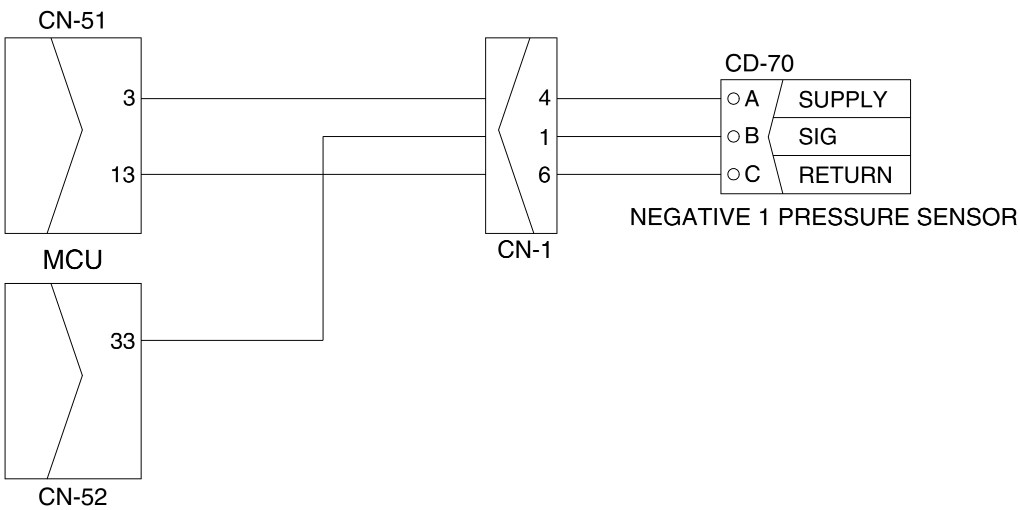
※ Before carrying out below procedure, check all the related connectors are properly inserted.

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



300L6MS11

2) TEST PROCEDURE

(1) Test 12 : Check voltage at CN-52 (33) and ground.

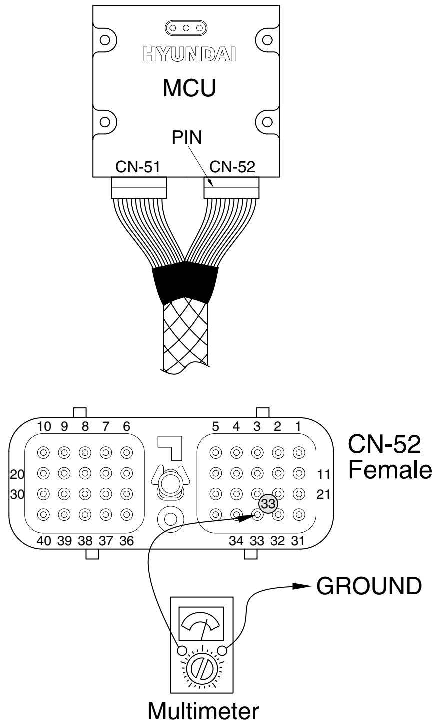
① Prepare 1 piece of thin sharp pin, steel or copper.

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



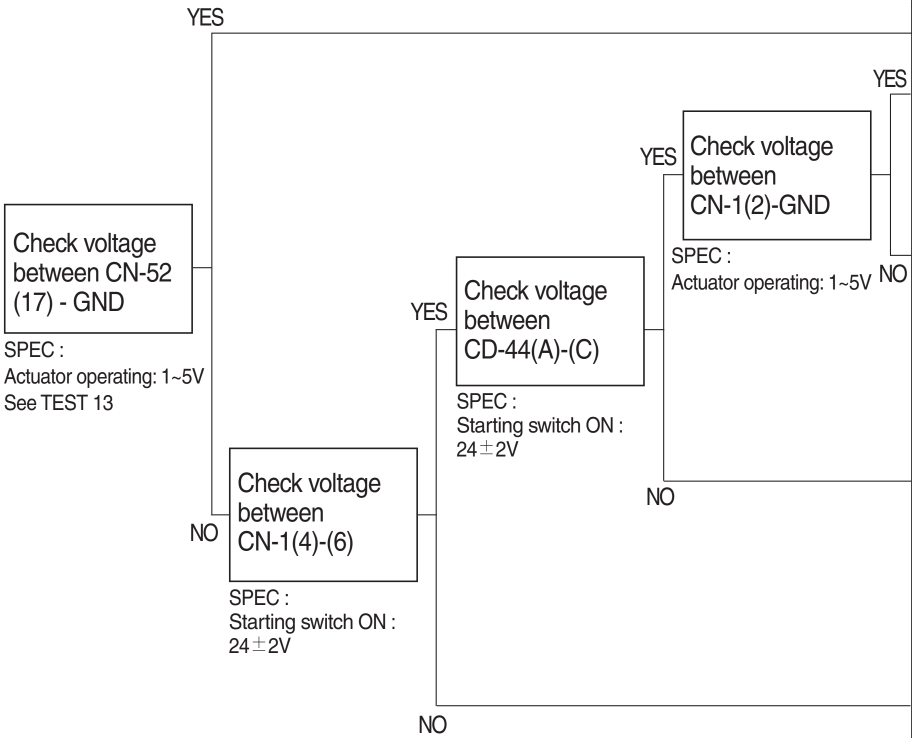
300L6MS12

9. MALFUNCTION OF NEGATIVE 2 PRESSURE SENSOR

· Fault code : HCESPN 124, FMI 0~4

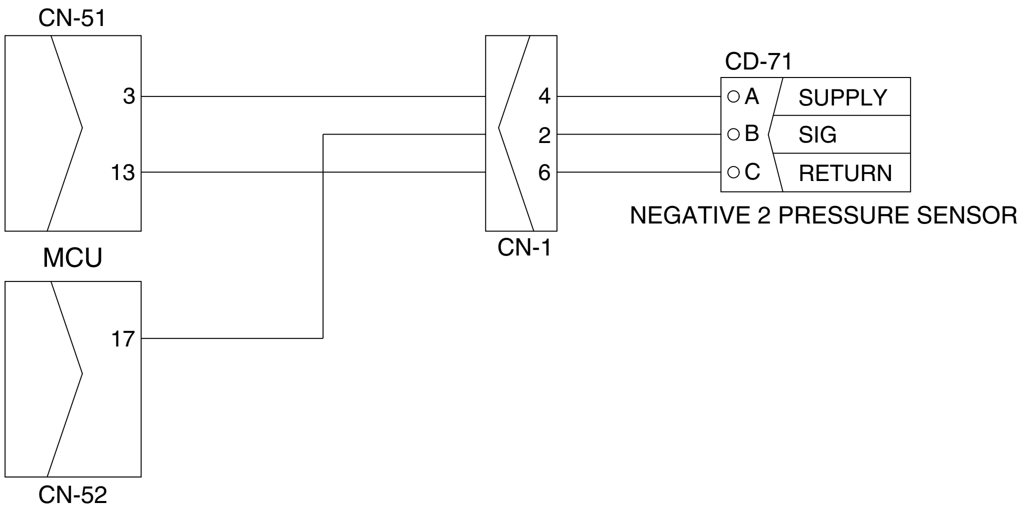
※ Before carrying out below procedure, check all the related connectors are properly inserted.

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



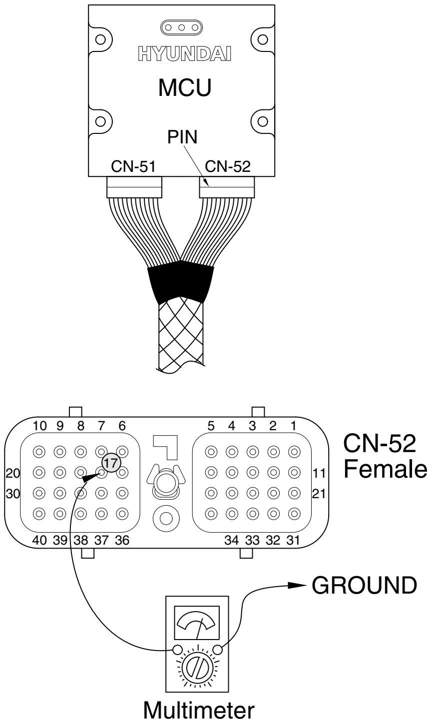
300L6MS13

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



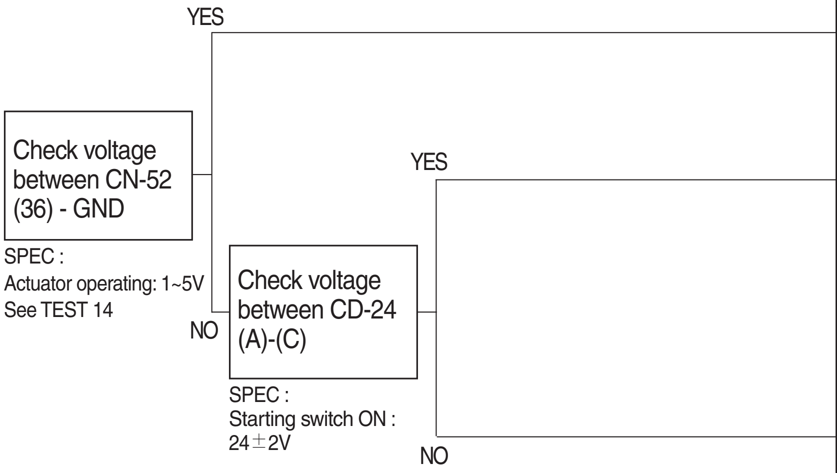
300L6MS14

10. MALFUNCTION OF SWING PRESSURE SENSOR

· Fault code : HCESPN 135, FMI 0~4

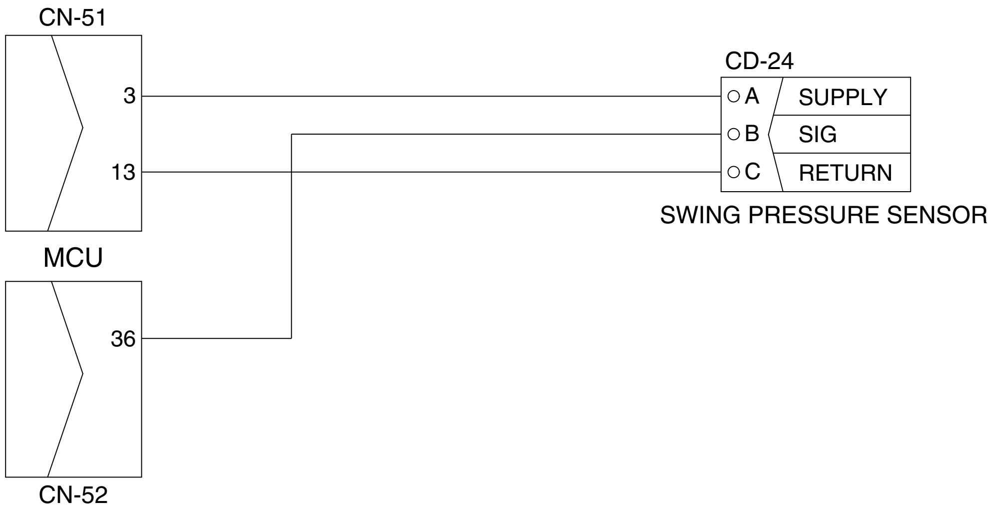
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective MCU	Replace
Detective swing pressure sensor	Replace or repair
Short circuit or poor connection between CN-52 (36)-CD-24 (B)	Replace or repair
Short circuit or poor connection between CD-24 (A)-CN-51(3) or CD-24(C)- CN-51 (13)	Replace or repair

Wiring diagram



300L6MS15

2) TEST PROCEDURE

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

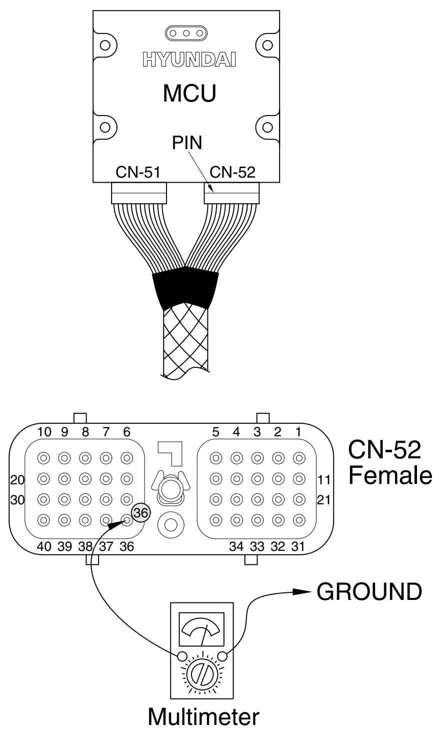
① Prepare 1 piece of thin sharp pin, steel or copper.

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



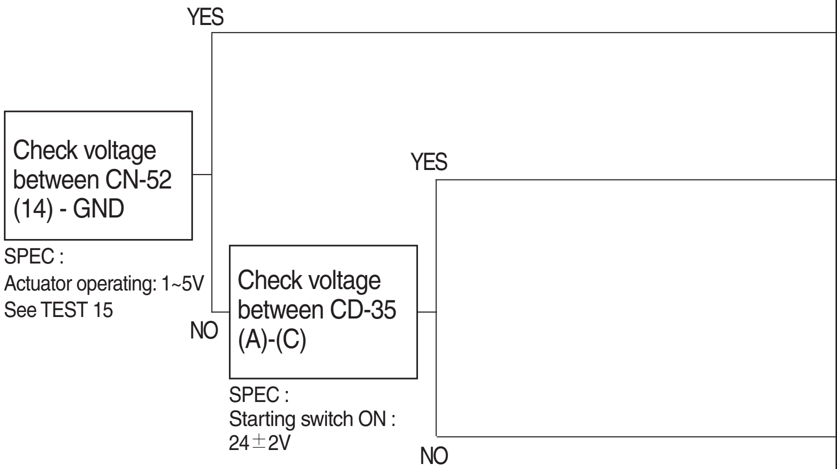
300L6MS16

11. MALFUNCTION OF ARM IN/OUT & BUCKET IN PRESSURE SENSOR

· Fault code : HCESPN 133, FMI 0~4

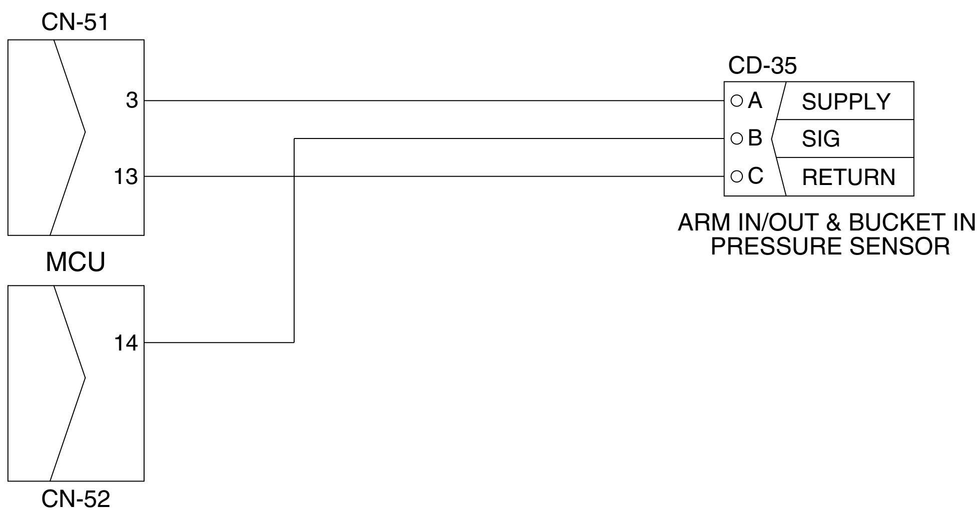
※ Before carrying out below procedure, check all the related connectors are properly inserted.

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



300L6MS17

2) TEST PROCEDURE

(1) Test 15 : Check voltage at CN-52 (14) and ground.

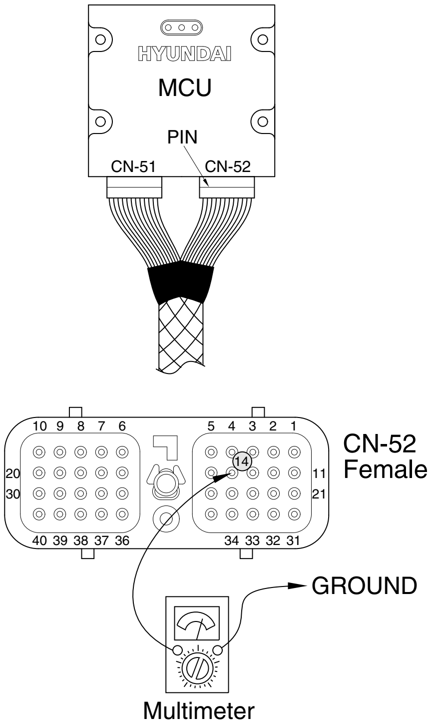
① Prepare 1 piece of thin sharp pin, steel or copper.

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



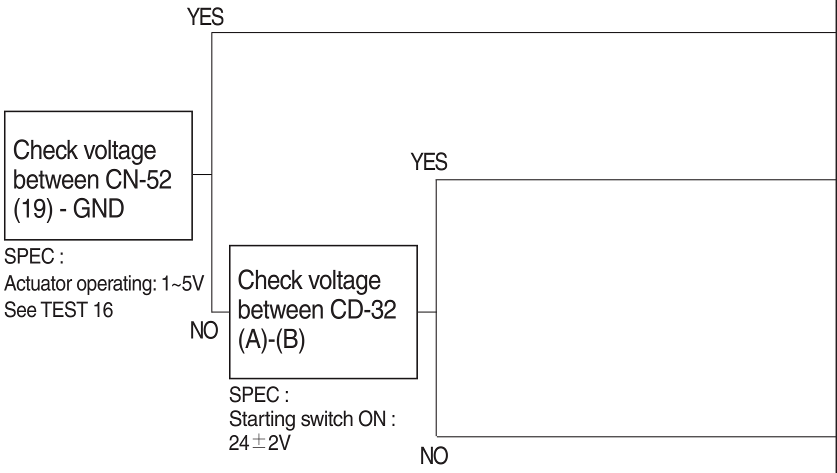
300L6MS18

12. MALFUNCTION OF BOOM UP PRESSURE SENSOR

· Fault code : HCESPN 127, FMI 0~4

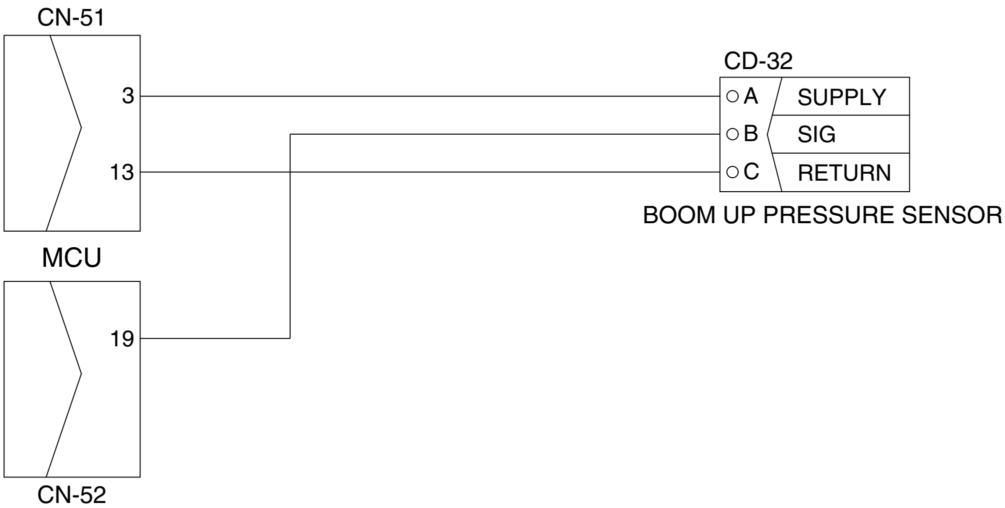
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective MCU	Replace
Detective boom up pressure sensor	Replace or repair
Short circuit or poor connection between CN-52 (19)-CD-32 (B)	Replace or repair
Short circuit or poor connection between CD-32 (A)-CN-51(3) or CD-32(C)- CN-51 (13)	Replace or repair

Wiring diagram



300L6MS19

2) TEST PROCEDURE

(1) Test 16 : Check voltage at CN-52 (19) and ground.

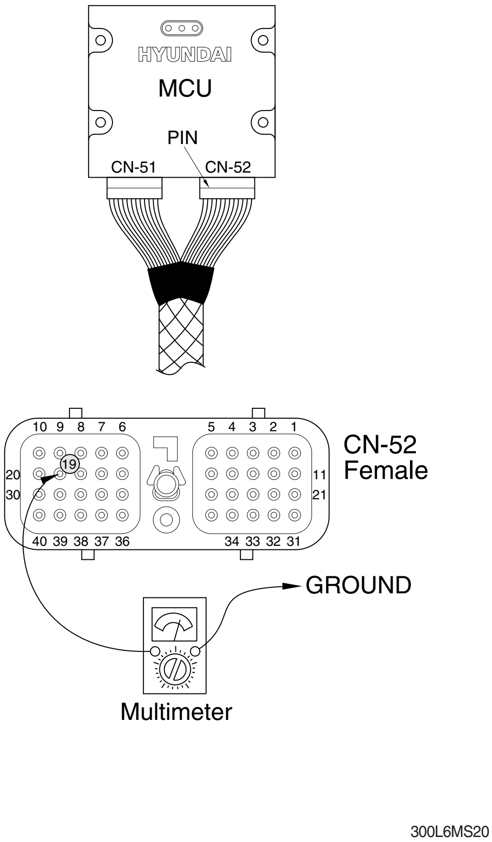
① Prepare 1 piece of thin sharp pin, steel or copper.

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

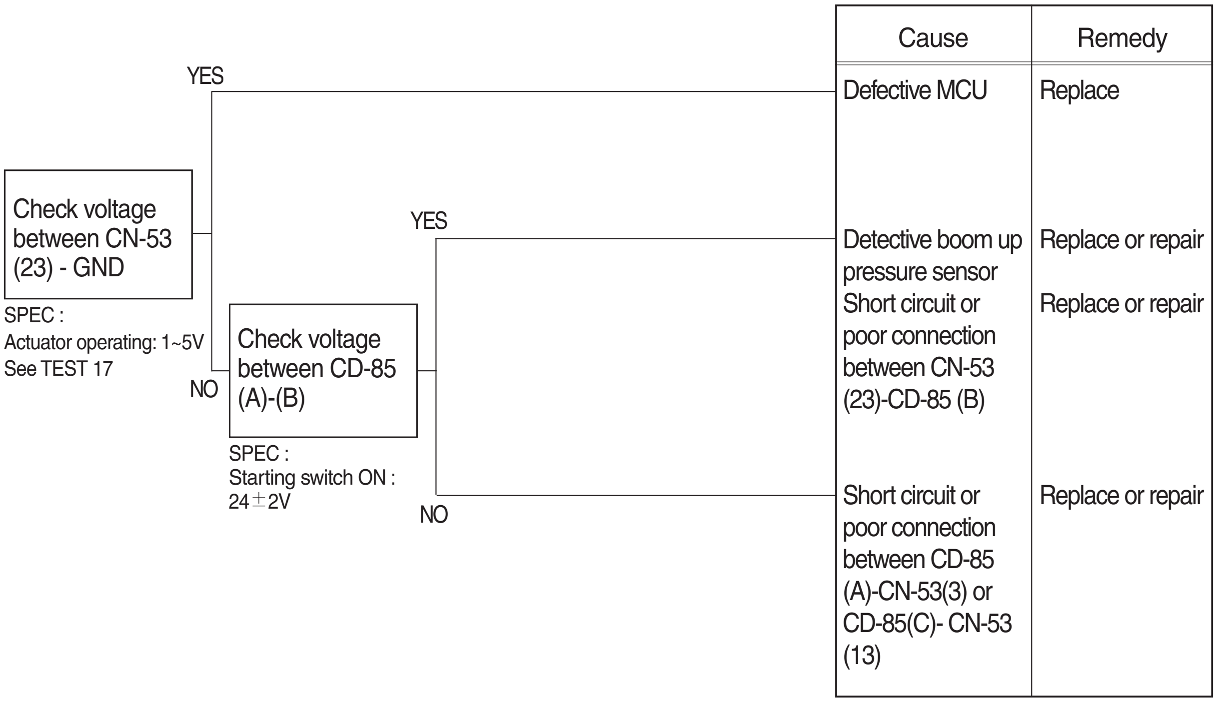


13. MALFUNCTION OF BOOM DOWN PRESSURE SENSOR

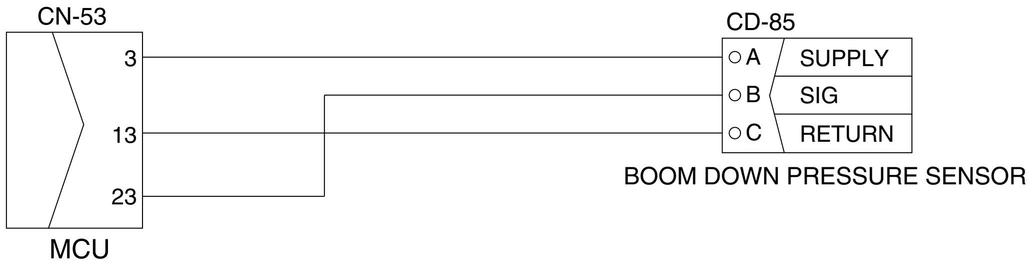
· Fault code : HCESPN 128, FMI 0~4

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

1) INSPECTION PROCEDURE



Wiring diagram



300L6MS25

2) TEST PROCEDURE

(1) Test 17 : Check voltage at CN-53 (23) and ground.

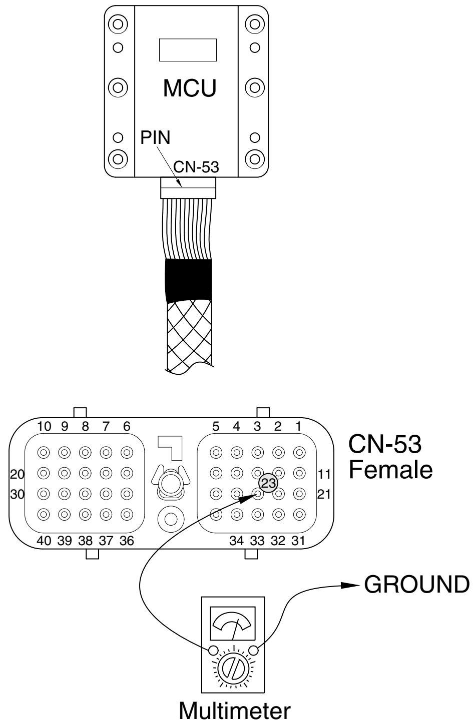
① Prepare 1 piece of thin sharp pin, steel or copper.

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



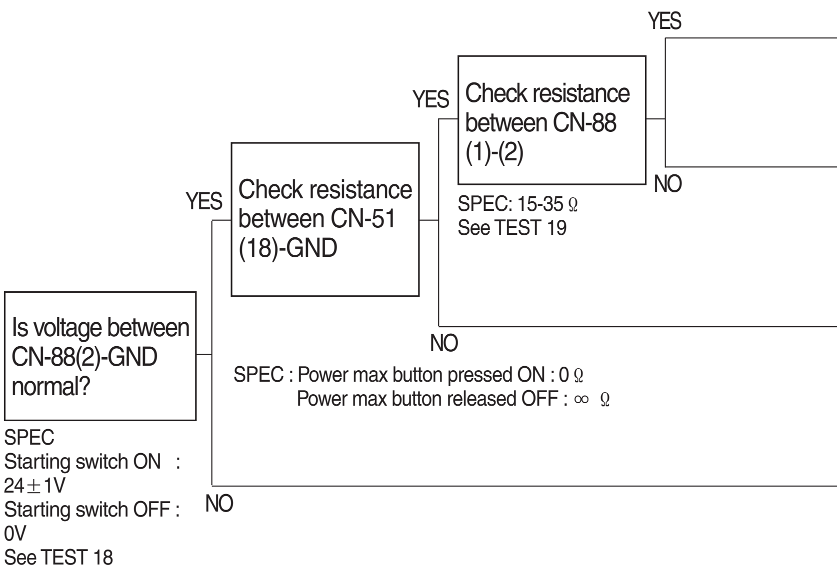
300L6MS26

14. MALFUNCTION OF POWER MAX

· Fault code : HCESPN 166, FMI 4 or 6

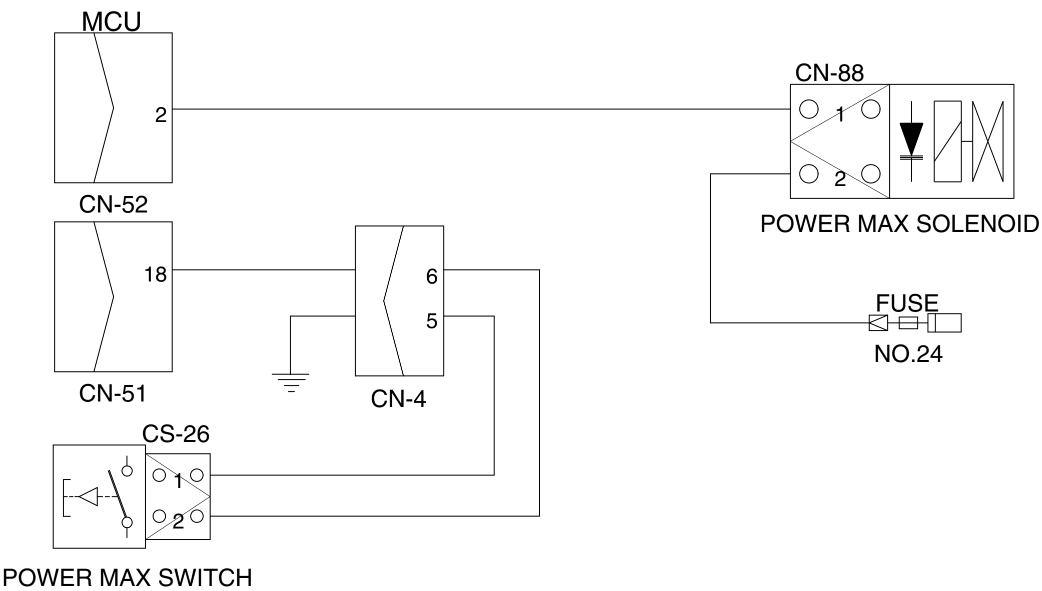
※ Before carrying out below procedure, check all the related connectors are properly inserted.

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-26	Repair or replace
Short circuit or poor connection between CN-88(2)-Fuse No. 24	Repair or replace

Wiring diagram

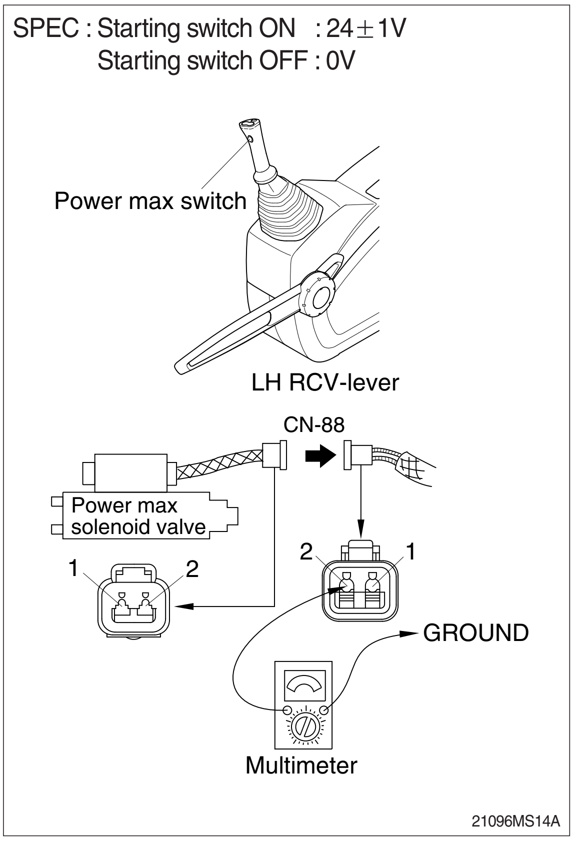


145LCR6MS03

2) TEST PROCEDURE

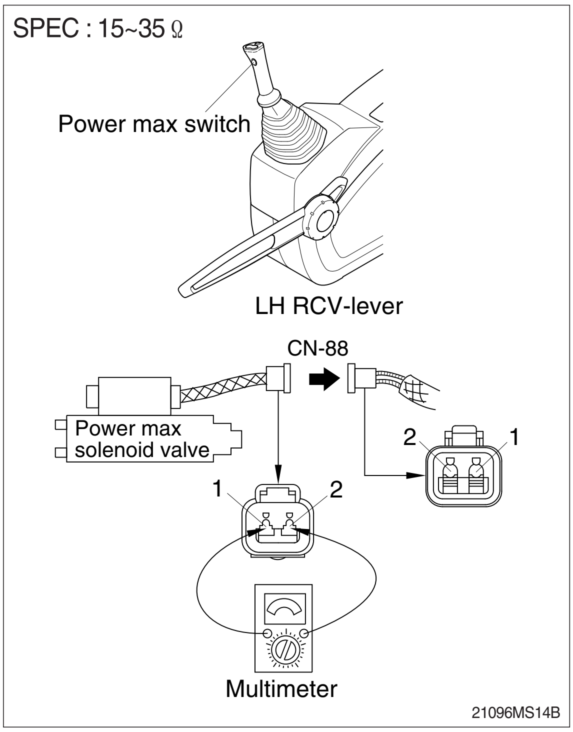
(1) Test 18: Check voltage between connector CN-88 (2) - GND.

① Disconnect connector CN-88 from power max solenoid valve.
② Start switch ON.
③ Check voltage as figure.



(2) Test 19: Check resistance of the solenoid valve between CN-88 (1)-(2).

① Starting switch OFF.
② Disconnect connector CN-88 from power max solenoid valve.
③ Check resistance as figure.



15. MALFUNCTION OF BOOM PRIORITY EPPR VALVE

· Fault code : HCESPN 141, FMI 5 or 6

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

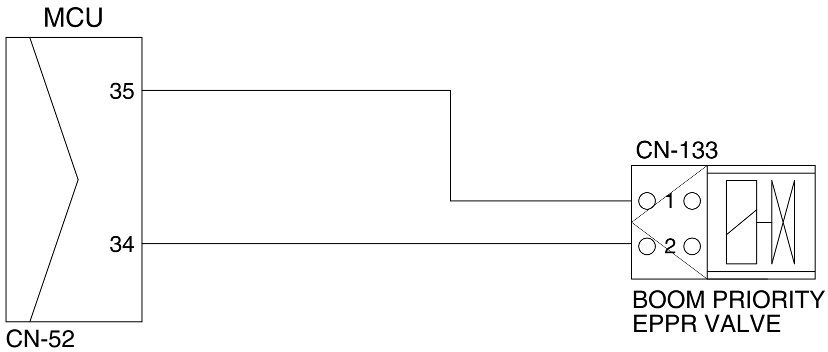
1) INSPECTION PROCEDURE

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

SPEC : 20~30V
Starting switch : ON

	Cause	Remedy
YES	Short circuit or poor connection between CN-52(35)-CN-133 (1) or CN-52(34)-CN-133(2)	Repair or replace
NO	Defective EPPR valve	Repair or replace

Wiring diagram



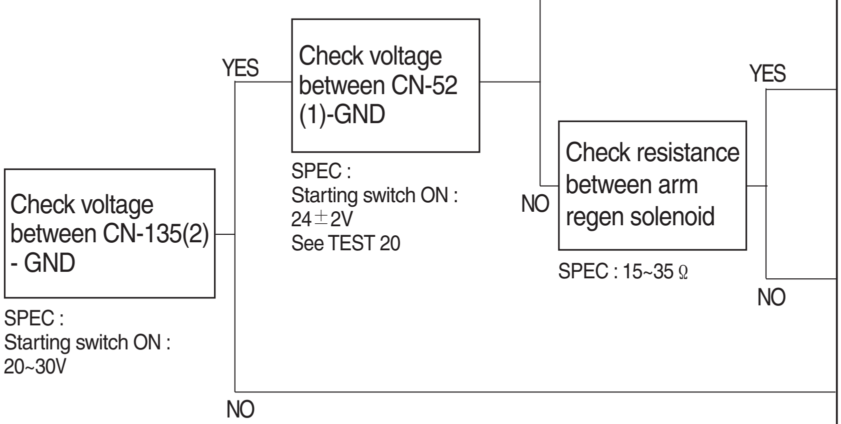
300L6MS23

16. MALFUNCTION OF ARM REGENERATION SOLENOID

· Fault code : HCESPN 170, FMI 4 or 6

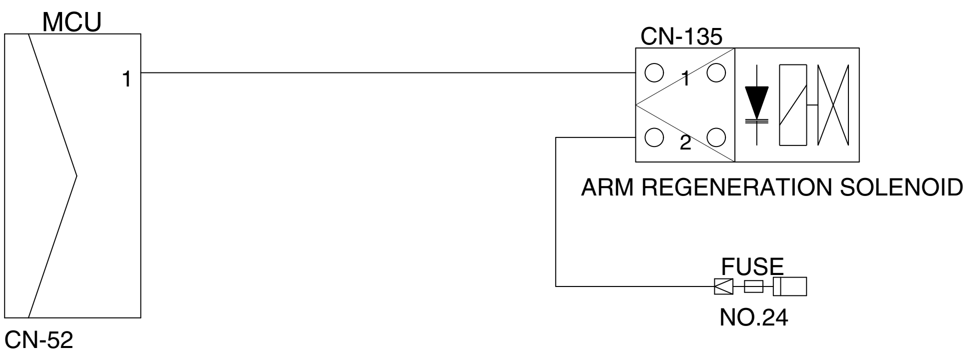
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective MCU	Replace
Short circuit or poor connection between CN-52 (1)-CN-135 (1)	Replace or repair
Defective solenoid valve	Replace
Open circuit between CN-135 (2)-Fuse No. 24	Replace or repair

Wiring diagram



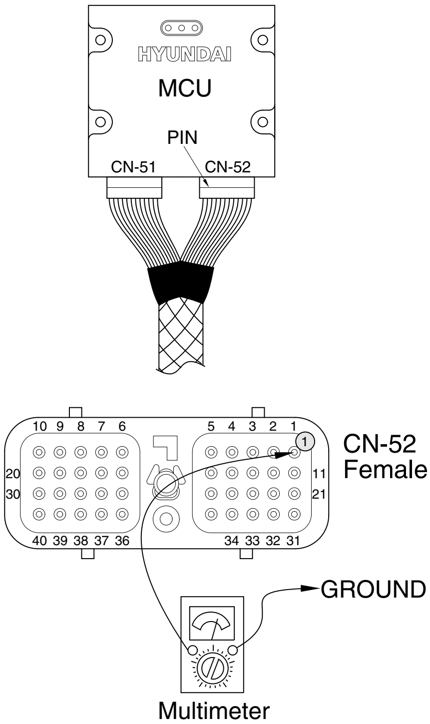
145LCR6MS04

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.

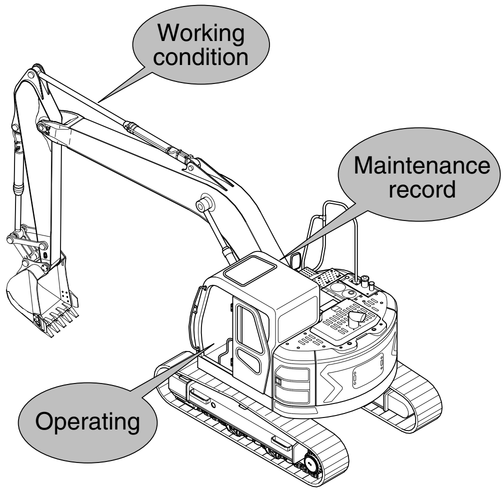
2) OPERATIONAL PERFORMANCE OF A WORKING MACHINE

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.

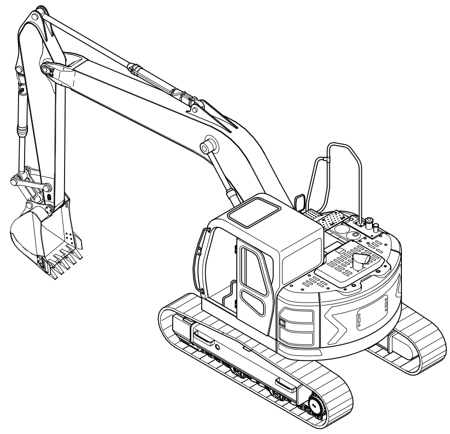


145ZF7MS01

2. TERMINOLOGY

1) STANDARD

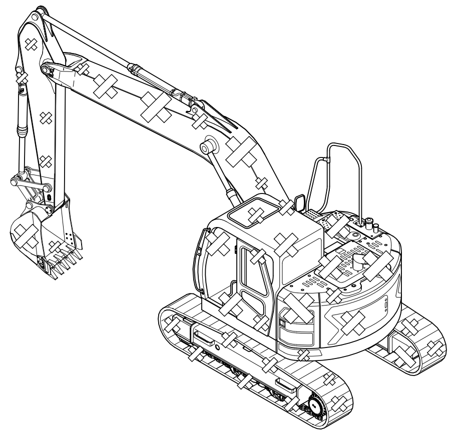
Specifications applied to the brand-new machine, components and parts.



145ZF7MS02

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.



145ZF7MS02A

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.

(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.

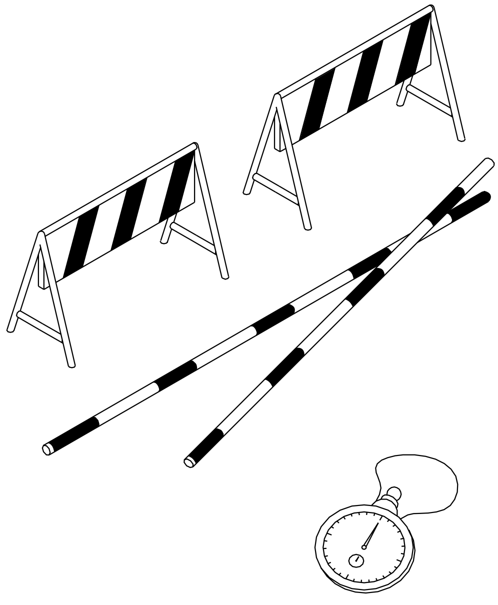
④ Avoid polluting the machine and the ground with leaking oil. Use oil pans to catch escaping oil. Pay special attention to this when removing hydraulic pipings.

(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.



(290-7TIER) 7-3

2) ENGINE SPEED

(1) Measure the engine speed at each power mode

※ The engine speed at each power mode must meet standard RPM; if not, all other operational performance data will be unreliable. It is essential to perform this test first.

(2) Preparation

① Warm up the machine, until the engine coolant temperature reaches 50˚C or more, and the hydraulic oil is 50±5˚C.

② Set the accel dial at 10 (Max) position. Measure the engine RPM.

③

Measurement

(3) Start the engine. The engine will run at

① start idle speed. Measure engine speed with a engine rpm display.

Measure and record the engine speed at

② each mode (P, S, E).

Select the P-mode.

③ Lightly operate the bucket control lever a

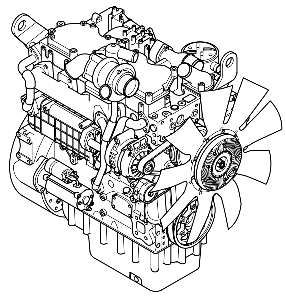
④ few times, then return the control lever to neutral; The engine will automatically enter the auto-idle speed after 4 seconds.

Measure and record the auto deceleration

⑤ speed.

CLUSTER

Engine RPM display
Power mode switch
Pilot lamp(P, S, E)



140L7MS01

(4) Evaluation

The measured speeds should meet the following specifications.

Unit : rpm

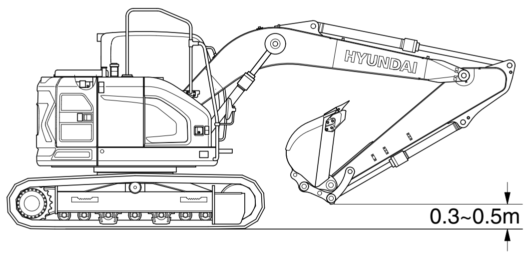
Model	Engine speed	Standard	Remarks
HX145CR HX145LCR	Start idle	1000±100	
	P mode	1850±50	
	S mode	1750±50	
	E mode	1650±50	
	Auto decel	1100±100	
	One touch decel	1000±100	

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

3) TRAVEL SPEED

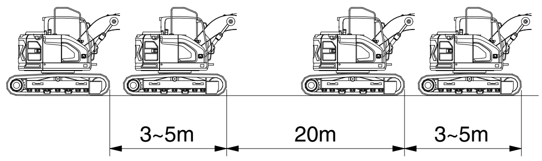
(1) Measure the time required for the excavator to travel a 20 m test track.

(2) Preparation
① Adjust the tension of both tracks to be equal.
② Prepare a flat and solid test track 20m in length, with extra length of 3 to 5 m on both ends for machine acceleration and deceleration.
③ Hold the bucket 0.3 to 0.5 m above the ground with the arm and bucket rolled in.
④ Keep the hydraulic oil temperature at 50±5˚C.



145ZF7MS04

(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.



145ZF7MS05A

(4) Evaluation
The average measured time should meet the following specifications.

Unit : Seconds / 20 m

Model	Travel speed	Standard	Maximum allowable	Remarks
HX145CR HX145LCR	1 Speed	22.5±2.0	28.1	
	2 Speed	13.3±1.0	16.6	

4) TRACK REVOLUTION SPEED

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

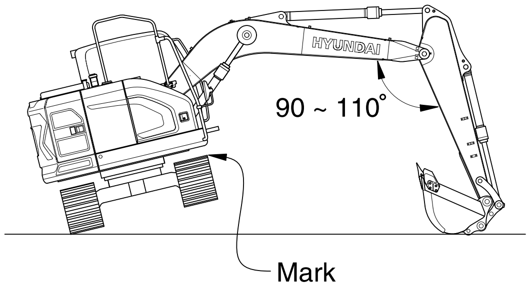
(2) Preparation

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

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

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

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



145ZF7MS06

(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
HX145CR HX145LCR	1 Speed	26.1±2.0	32.6
	2 Speed	15.2±2.0	19

5) TRAVEL DEVIATION

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

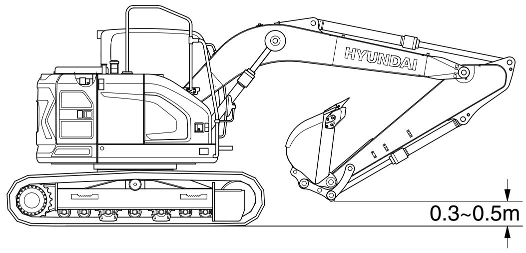
(2) Preparation

① Adjust the tension of both tracks to be equal.

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

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

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



145ZF7MS04

(3) Measurement

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

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

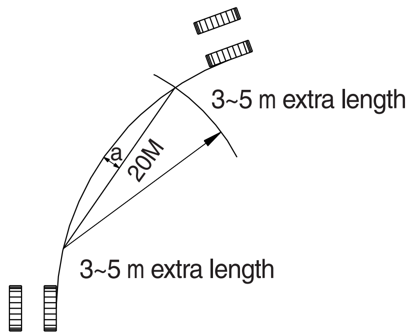
· Power mode switch : P mode

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
HX145CR HX145LCR	200 below	240	

6) SWING SPEED

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

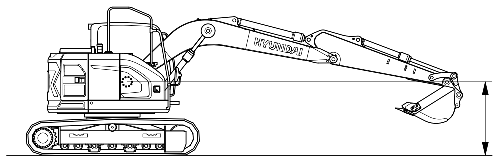
(2) Preparation

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.



145ZF7MS07

(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
HX145CR HX145LCR	P mode	16±1.5	28

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.

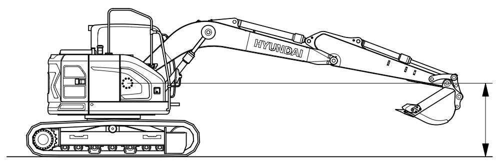
② Place the machine on flat, solid ground with ample space for swinging. Do not conduct this test on slopes.

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.



145ZF7MS07

(3) Measurement

① Conduct this test in the M mode.

② Select the following switch positions.

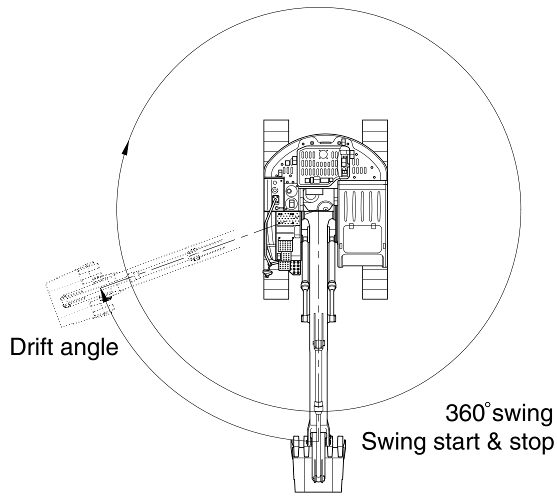
· Power mode switch : P mode

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.



145ZF7MS08

(4) Evaluation

The measured drift angle should be within the following specifications.

Unit : Degree

Model	Power mode switch	Standard	Maximum allowable	Remarks
HX145CR HX145LCR	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.

(2) Preparation

① Check swing bearing mounting cap screws for loosening.

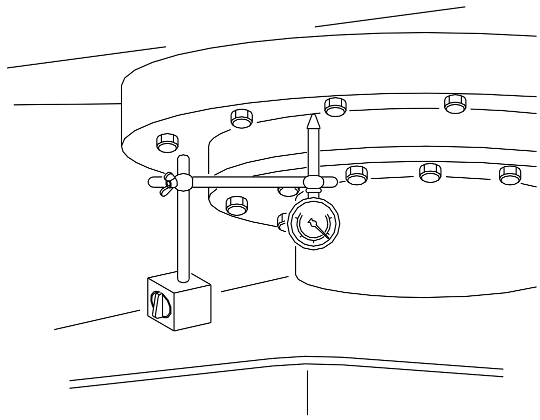
② Check the lubrication of the swing bearing. Confirm that bearing rotation is smooth and without noise.

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.



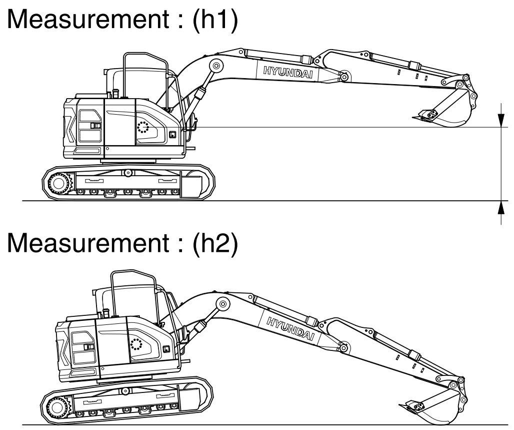
(210-7) 7-10(1)

(3) Measurement

① With the arm rolled out and bucket rolled in, hold the bottom face of the bucket to the same height of the boom foot pin.
Record the dial gauge reading (h1).

② Lower the bucket to the ground and use it to raise the front idler 50㎝.
Record the dial gauge reading (h2).

③ Calculate bearing play (H) from this data (h1 and h2) as follows.
H=h2-h1



145ZF7MS09

(4) Evaluation

The measured drift should be within the following specifications.

Unit : mm

Model	Standard	Maximum allowable	Remarks
HX145CR HX145LCR	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

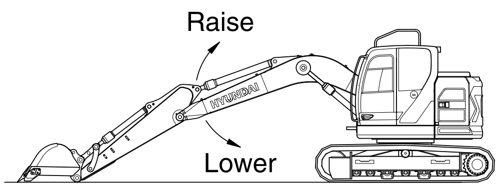
① Select the following switch positions.

· Power mode switch : P mode

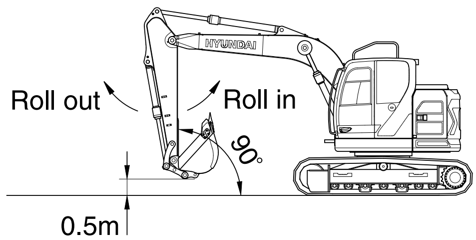
② To measure cylinder cycle times.

- 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.

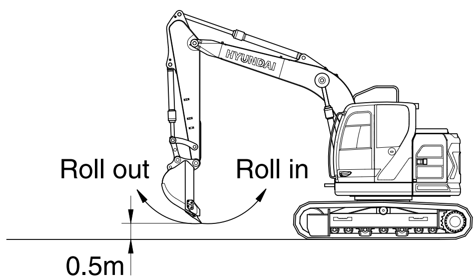
Boom cylinder



Arm cylinder



Bucket cylinder



145ZF7MS10

- 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
HX145CR HX145LCR	Boom raise		4±0.4	5.2	
	Boom lower		3.3±0.4	4.3	
	Arm in	Regen ON	2.8±0.4	3.6	
		Regen OFF	3.2±0.4	4.2	
	Arm out		2.8±0.3	3.6	
	Bucket in		3.5±0.4	4.6	
	Bucket out		2.2±0.3	2.9	

10) DIG FUNCTION DRIFT CHECK

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

(2) Preparation

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

· $W = M^3 \times 1.5$

Where :

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

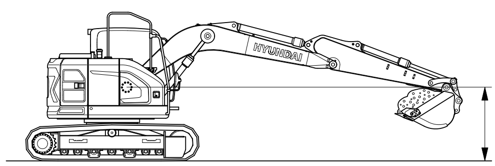
1.5 = Soil specific gravity

② Position the arm cylinder with the rod 20 to 30 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.



145ZF7MS11

(3) Measurement

① Stop the engine.

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

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

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

Unit : mm / 5min

Model	Drift to be measured	Standard	Maximum allowable	Remarks
HX145CR HX145LCR	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
HX145CR HX145LCR	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
HX145CR HX145LCR	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.

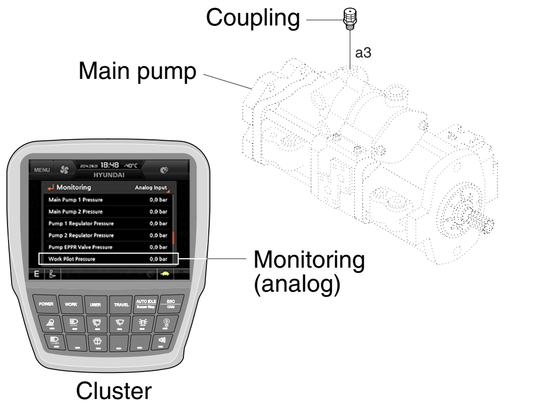
(2) Measurement

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.



145ZF7MS12

(3) Evaluation

The average measured pressure should meet the following specifications:

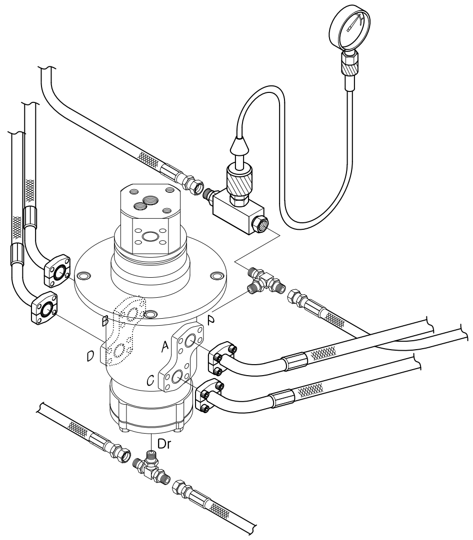
Unit : kgf / cm2

Model	Engine speed	Standard	Allowable limits	Remarks
HX145CR HX145LCR	P mode	40^{+2}_{0}	-	

14) FOR TRAVEL SPEED SELECTING PRESSURE:

(1) Preparation

① Stop the engine.
② Loosen the cap and relieve the pressure in the tank by pushing the top of the air breather.
③ To measure the speed selecting pressure: Install a connector and pressure gauge assembly to turning joint P port as shown.
④ Start the engine and check for on leakage from the adapter.
⑤ Keep the hydraulic oil temperature at 50±5˚C.



21077MS13

(2) Measurement

① Select the following switch positions.
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.

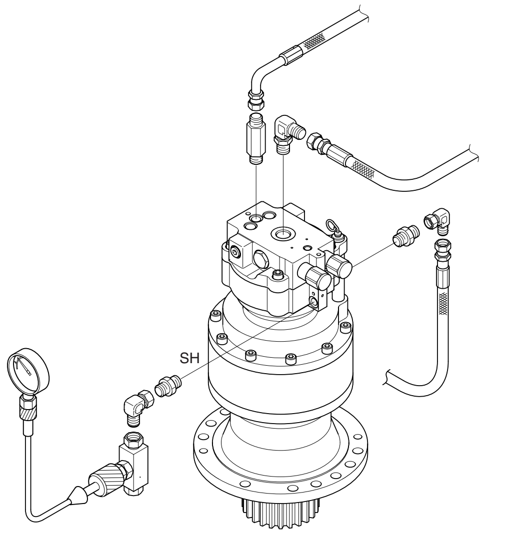
Unit : kgf / cm^2

Model	Travel speed mode	Standard	Maximum allowable	Remarks
HX145CR HX145LCR	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.



145ZF7MS14

(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 / cm²

Model	Description	Standard	Allowable limits	Remarks
HX145CR HX145LCR	Brake disengaged	40	Over 9	
	Brake applied	0	-	

16) MAIN PUMP DELIVERY PRESSURE

(1) Preparation

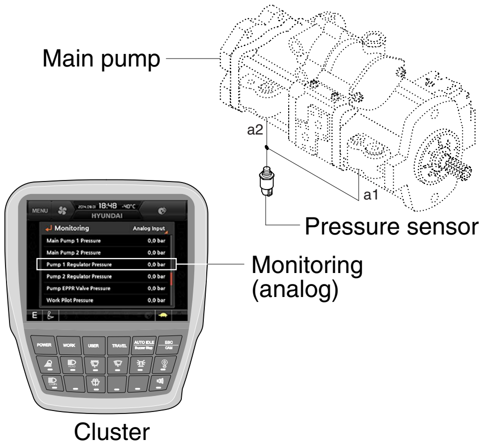
① Keep the hydraulic oil temperature at 50±5˚C.

(2) Measurement

① Select the following switch positions.

· Power mode switch : P mode

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



145ZF7MS15

(3) Evaluation

The average measured pressure should meet the following specifications.

Unit : kgf / cm^2

Model	Engine speed	Standard	Allowable limits	Remarks
HX145CR HX145LCR	High idle	40^{+2}_{0}	-	

17) SYSTEM PRESSURE REGULATOR RELIEF SETTING

(1) Preparation

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

(2) Measurement

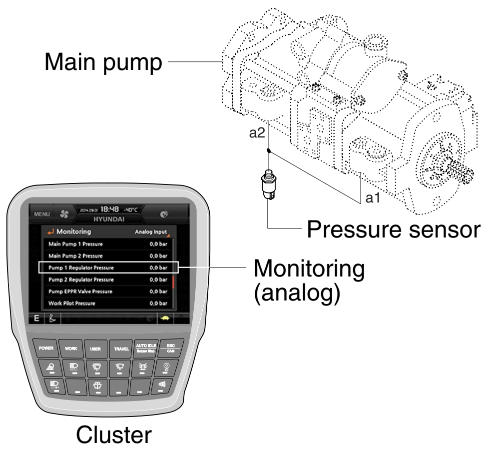
① Select the following switch positions.

・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.



145ZF7MS15

(3) Evaluation

The average measured pressure should be within the following specifications.

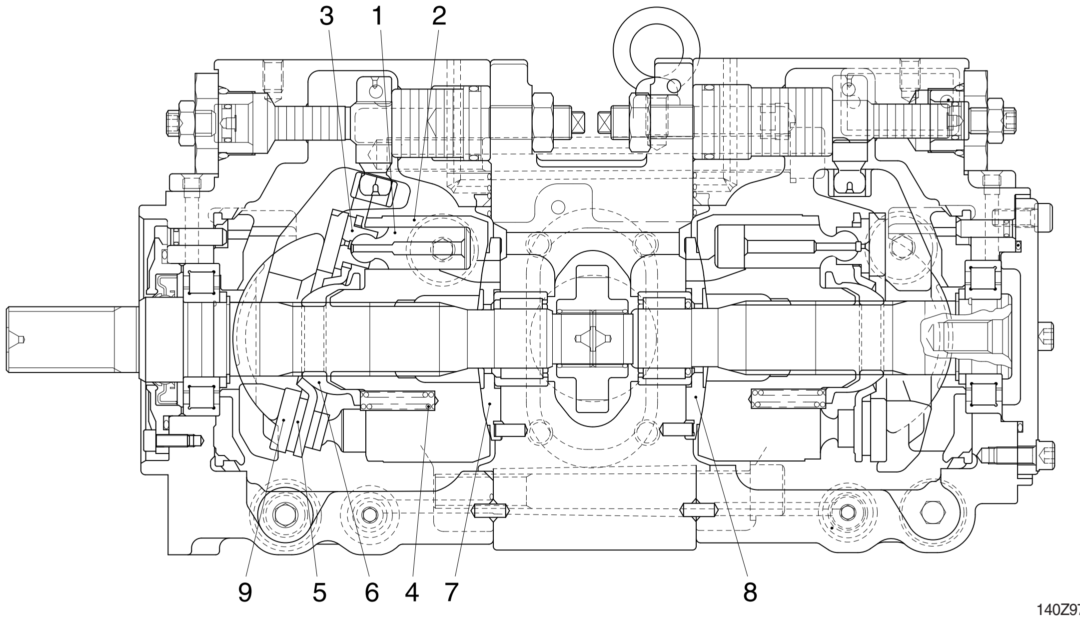
Unit : kgf / cm²

Model	Function to be tested	Standard	Port relief setting at 20 lpm
HX145CR HX145LCR	Boom, Arm, Bucket	350 (380)±10	400±10
	Travel	350±10	-
	Swing	285±10	-

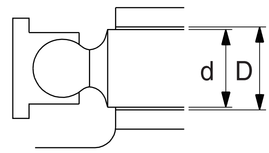
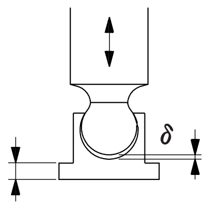
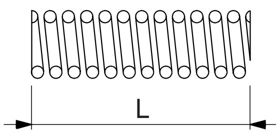
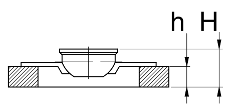
( ) : Power boost

GROUP 2 MAJOR COMPONENT

1. MAIN PUMP



140Z97MP01

Part name & inspection item		Standard dimension	Recommended replacement value	Counter measures
Clearance between piston (1) & cylinder bore (2) (D-d)		0.032	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)		41.1	40.3	Replace cylinder spring.
Combined height of set plate (5) (H) & spherical bushing (6) (h) (H-h)		17.0	15.8	Replace set plate or spherical bushing.
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		

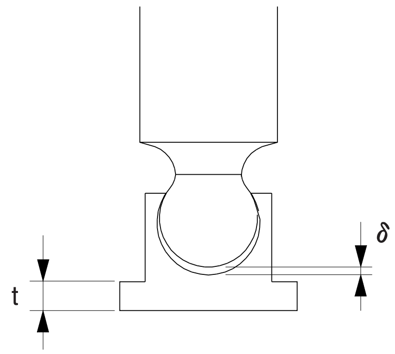
2. MAIN CONTROL VALVE

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	Recommended replacement value	Counter measures
Clearance between piston and cylinder block bore	0.041	0.060	Replace piston or cylinder block
Thickness of valve plate	6	5.88	Replace
Play between piston and shoe caulking section (δ)	0.025	0.1	Replace assembly of piston and shoe
Thickness of shoe (t)	6.6	6.5	Replace assembly of piston and shoe
Combined height of retainer plate and spherical bushing (H-h)	17.6	17.3	Replace set of retainer plate and sperical bushing
Thickness of friction plate	2.94	2.7	Replace



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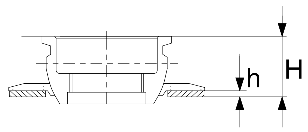

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2) SLIDING PARTS

Part name	Standard roughness	Allowable roughness	Remark
Shoe	Rmax=1S (Ra=0.2a) (LAPPING)	4S (Ra=0.1a)	
Shoe plate	Rmax=0.4S (Ra=0.1a) (LAPPING)	3S (Ra=0.8a)	
Cylinder	Rmax=0.4S (Ra=0.1a) (LAPPING)	3S (Ra=0.8a)	
Valve plate	Rmax=0.4S (Ra=0.1a) (LAPPING)	2S (Ra=0.5a)	

4. TRAVEL MOTOR

1) TYPE 1

Problem		Cause	Remedy
Does not start	Pressure is not developed	· Pump failure · Control valve malfunction	· Check if action other than traveling is available. If faulty, repair. · Check if spool moves correctly. Repair if necessary.
	Pressure is developed	· Brake valve failure -Sleeve stick -Check valve stick · Motor failure -Valve seat seizure · Gear broken and fragment locked · Overloaded	· Replace brake valve · Replace -Check hydraulic oil for contamination · Replace reduction gear · Reduce load
Oil leakage	Leakage from engaging surfaces	· Scratch on engaging surfaces · Loosening by poor bolt tightening	· Correct surfaces by oilstone or sandpaper or replace · Check after retightening
	Leakage from casing	· Plug loosened · Crack formed by stone	· Retighten · Replace reduction gear
	Leakage from floating seal	· Sliding surfaces worn · Creep on O-ring	· Replace reduction gear · Replace floating seal
	Leakage from hydraulic motor	· Bolt loosened · O-ring damaged · Sealing surface scratched	· Tighten properly · Replace O-ring · Correct by oilstone or sandpaper
Coasts on slope excessively		· Poor volumetric efficiency of hydraulic motor · Increase of internal leakage of brake valve · Parking brake not actuated -Spring breakage -Wear of friction plate	· Replace hydraulic motor · Replace brake valve · Replace spring · Replace parking brake
Excessive temperature on reduction gear case		· Pitting on bearing · Lack of gear oil · Hydraulic oil introduced to gear case	· Replace reduction gear · Supply gear oil properly · Check motor and replace oil seal
Meanders	Meanders at low pressure	· Delivery rate is different between right and left · Motor drain rate is different between right and left	· Repair pump · Replace motor
	Meanders at high pressure	· Delivery rate is different between right and left · Motor drain rate is different between right and left	· Repair regulator or pump · Replace motor
	Meanders at high pressure	· Relief pressure dropped at right and left brake valve · Main relief pressure dropped at right or left of control valve	· Replace brake valve · Replace main relief valve
Pump delivery is poor		· Regulator operation poor · External leakage of pump is excessive	· Repair regulator · Repair pump
External leakage of motor is excessive		-	· Replace motor

2) TYPE 2

(1) Troubleshooting

① The motor does not rotate

Problem	Cause	Remedy
The pressure of a motor does not increase	· The oil is bypassed at relief valve	- Fix or exchange relief valve
	· Malfunction of relief valve - Stick of plunger - Malfunction of plunger seat part - Cut of Spring	- Modify of stick part - Disassembly, clean - Exchange a parts - Exchange the relief valve
	· The cracks happens at the inner path of valve casing	- Exchange the check valve
	· Abrasion and abnormality on the adhered surface of check	- Fix or exchange the abnormal parts
Although the pressure increases, a hydraulic motor does not rotate	· Unmeasured external resistance	- Exchange friction plate and separated Plate
	· Stick of counter balance spool	- Check of counter balance spool
	· Do not become break off	- Check and exchange the orifice (4) - Check of brake piston ring
	· Stick of brake piston	- Disassembly and check
	· Stick of friction plate	- Fix or exchange the abnormal parts
	· Damage of traveling reduction gear	- Exchange the traveling reduction gear

② Rotate very slow

Problem	Cause	Remedy
Lack of the number of rotation	· Shortage of supplied oil	- Check the oil circuit up to a motor
	· Oil Temperature is too higher	- Make the temperature down of the oil
	· Abnormal oil leakage	- Fix or exchange the abnormal parts
	· Two speed is late - Stick of swash piston	- Fix or exchange the abnormal parts

③ To control or adjust a brake is hard

Problem	Cause	Remedy
Brake torque is low	· Abrasion of friction and separated plate	- Fix or exchange the abnormal parts
	· Damage of brake spring	
	· Damage of brake piston	

④ Shortage of rotating force at the standard value

Problem	Cause	Remedy
Brake is released, but the turning force is low	· Excavator main relief valve is not set correctly	- Resetting the main relief valve
	· Pressure down of motor relief valve	- Resetting the relief valve pressure - Exchange the relief valve
	· Malfunction of check valve	- Exchange the check valve
	· Scratch of valve plate	- Fix or exchange the abnormal parts

⑤ Many slip

Problem	Cause	Remedy
Brake is released, but the turning force is week	· Malfunction of relief valve	- Fix or exchange the abnormal parts
	· Check valve error	
	· Stick of counter balance spool	
	· Valve plate scratch / copper peeling phenomena	

⑥ It is not two speed changeover

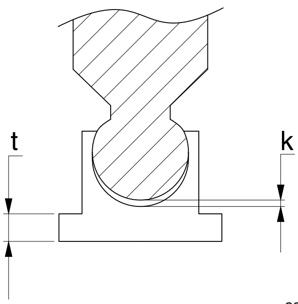
Problem	Cause	Remedy
It is not variable speed (low/high 2- stage speed) changeover	· Pilot Line error	- Fix or exchange the abnormal parts
	· Two speed changeover spool stick	
	· Swash piston stick	

⑦ Oil leakage

Problem	Cause	Remedy
Leakage at oil seal	· Drain pressure is high	- Remove the abnormal substances after exchanging the damaged part
	· Seal error	- Check a drain line of an equip
Leakage on a assembled surface	· Damage of a O-ring	- Exchange O-ring
	· Bolt or plug is released	- Tighten the parts with fixed torque

(2) Wearing parts

Part name & inspection item	Standard dimension	Recommended value for replacement	Remedy
Piston and cylinder block bore tolerance (space = D – d)	0.05 mm	0.065 mm	D : Cylinder block bore dia d : Piston out dia
Piston and shoe tolerance (space = k)	0	0.3 mm	After pulling the piston and the shoe, measures the distance
Thickness of shoe (t)	5.5 mm	5.2 mm	-
Thickness of shoe plate (h)	3.3 mm	3.0 mm	-
Thickness of set plate (t1)	6 mm	5.8 mm	If the plate thickness is below 5.8 mm, change the set plate and ball guide at the same time
Set plate and the ball guide height of the assembly (height of the assembly H – h)	13.5 mm	13.3 mm	If assembly height is below 13.3 mm, change the set plate and ball guide at the same time



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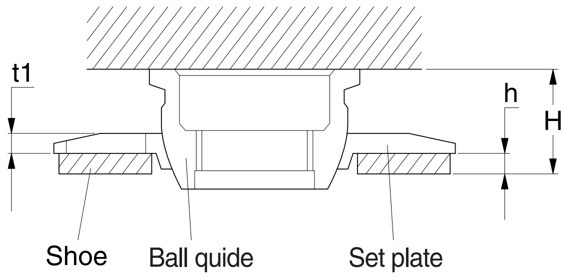

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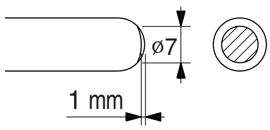
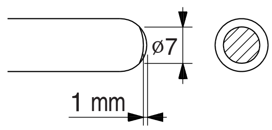
5. RCV LEVER

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

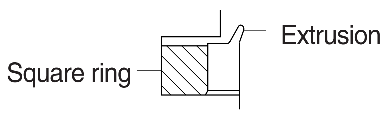
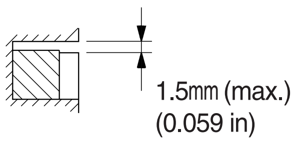
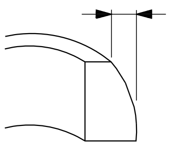
Notes 1. It is desirable to replace seal materials, such as O-rings, every disassembling. However, they may be reused, after being confirmed to be free of damage.

6. RCV PEDAL

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

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

7. TURNING JOINT

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

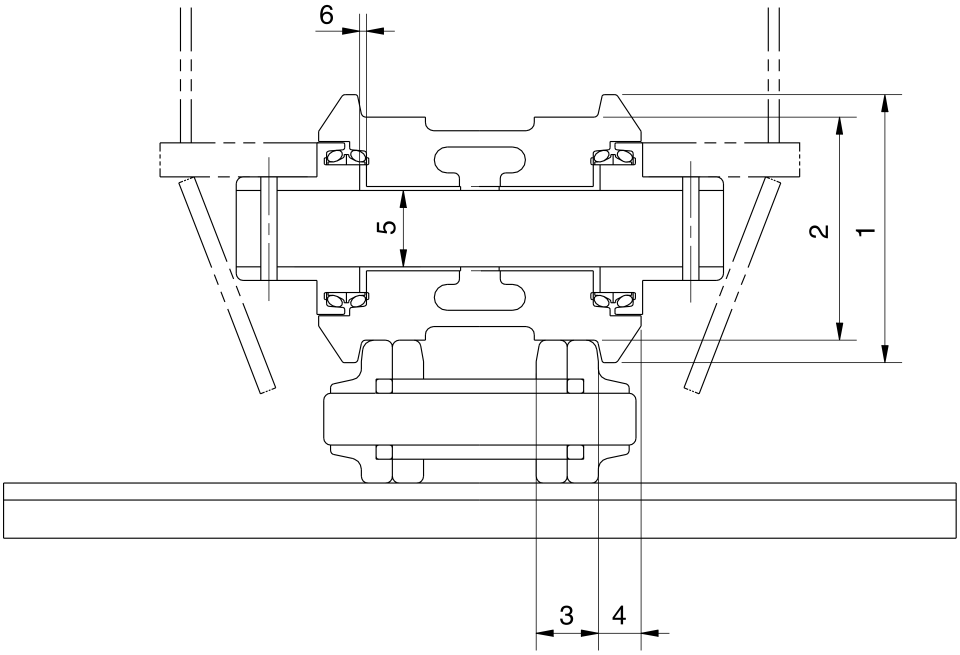
8. CYLINDER

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

GROUP 3 TRACK AND WORK EQUIPMENT

1. TRACK

1) TRACK ROLLER



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Unit : ㎜

<table>
<tr><th>No.</th><th>Check item</th><th colspan="5">Criteria</th><th>Remedy</th></tr>
<tr><td rowspan="2">1</td><td rowspan="2">Outside diameter of flange</td><td colspan="3">Standard size</td><td colspan="2">Repair limit</td><td rowspan="5">Rebuild or replace</td></tr>
<tr><td colspan="3">ø 190</td><td colspan="2">-</td></tr>
<tr><td>2</td><td>Outside diameter of tread</td><td colspan="3">ø 150</td><td colspan="2">ø 138</td></tr>
<tr><td>3</td><td>Width of tread</td><td colspan="3">36.5</td><td colspan="2">42.5</td></tr>
<tr><td>4</td><td>Width of flange</td><td colspan="3">26.5</td><td colspan="2">-</td></tr>
<tr><td rowspan="3">5</td><td rowspan="3">Clearance between shaft and bushing</td><td rowspan="2">Standard size</td><td colspan="2">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 65</td><td>-0.25
-0.35</td><td>+0.12
+0.075</td><td>0.325
to 0.47</td><td>2.0</td></tr>
<tr><td rowspan="2">6</td><td rowspan="2">Side clearance of roller (both side)</td><td colspan="3">Standard clearance</td><td colspan="2">Clearance limit</td><td rowspan="2">Replace</td></tr>
<tr><td colspan="3">0.1 to 1.3</td><td colspan="2">2.0</td></tr>
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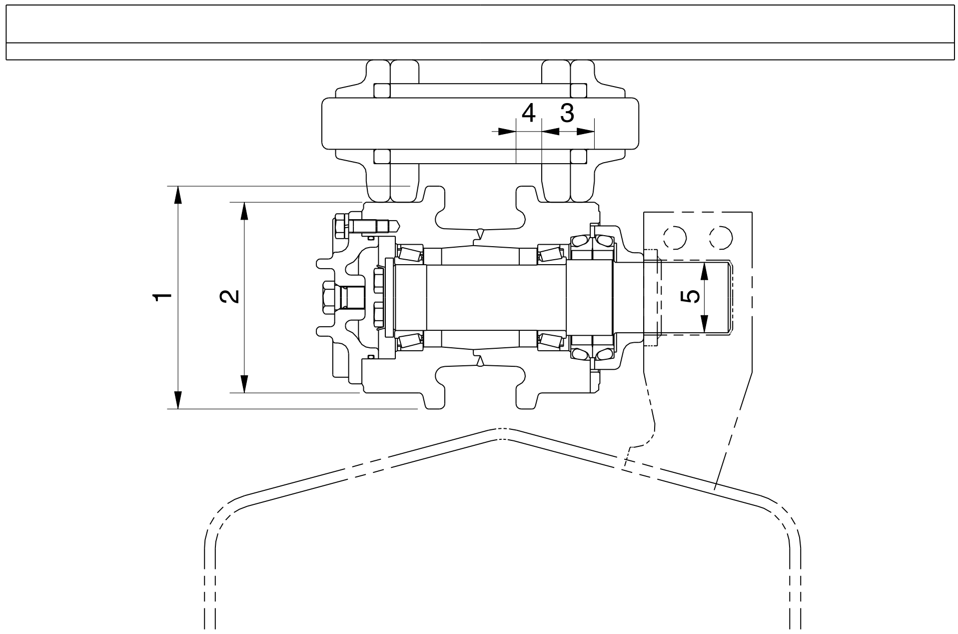
2) CARRIER ROLLER



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Unit : ㎜

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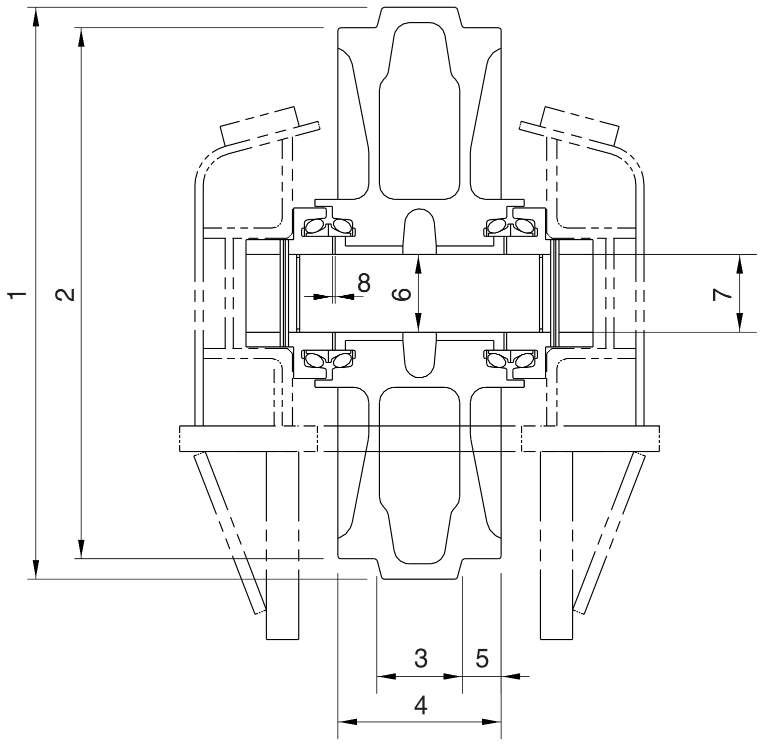
<tr><td colspan="2">ø 175</td><td colspan="2">-</td></tr>
<tr><td>2</td><td>Outside diameter of tread</td><td colspan="2">ø 151</td><td colspan="2">ø 141</td></tr>
<tr><td>3</td><td>Width of tread</td><td colspan="2">37.25</td><td colspan="2">42.25</td></tr>
<tr><td>4</td><td>Width of flange</td><td colspan="2">18.25</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>$\varnothing 41.27\ ^{0}_{+0.05}$</td><td>$\varnothing 41.5\ ^{+0.2}_{-0.1}$</td><td>0.13 to 0.48</td><td>1.2</td></tr>
</table>

3) IDLER



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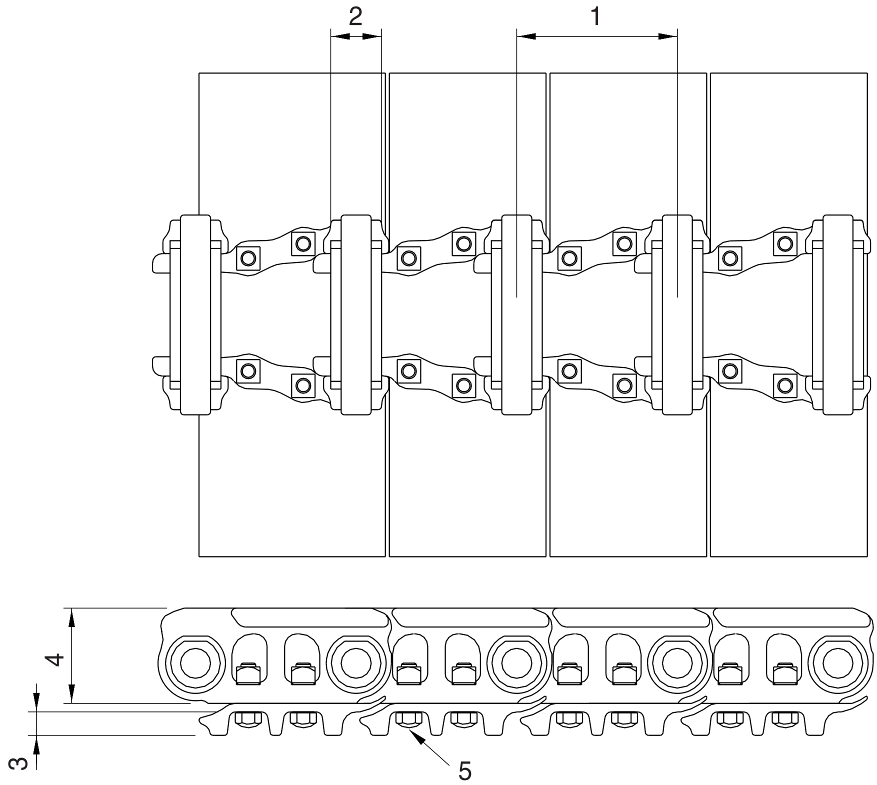
Unit : mm

No.	Check item	Criteria				Remedy
1	Outside diameter of flange	Standard size		Repair limit		Rebuild or replace
		ø 552		-		
2	Outside diameter of tread	ø 507		ø 497		
3	Width of protrusion	67		-		
4	Total width	135		-		
5	Width of tread	34		39		
6	Clearance between shaft and bushing	Standard size & Tolerance		Standard clearance	Clearance limit	Replace bushing
		Shaft	Hole			
		ø 70 $^{0}_{-0.03}$	ø 70.3 $^{+0.05}_{0}$	0.3 to 0.38	2.0	
7	Clearance between shaft and support	ø 70 $^{0}_{-0.03}$	ø 70 $^{+0.07}_{+0.03}$	0.03 to 0.1	1.2	Replace
8	Side clearance of idler (both side)	Standard clearance		Clearance limit		Replace bushing
		0.25 to 1.15		2.0		

4) TRACK



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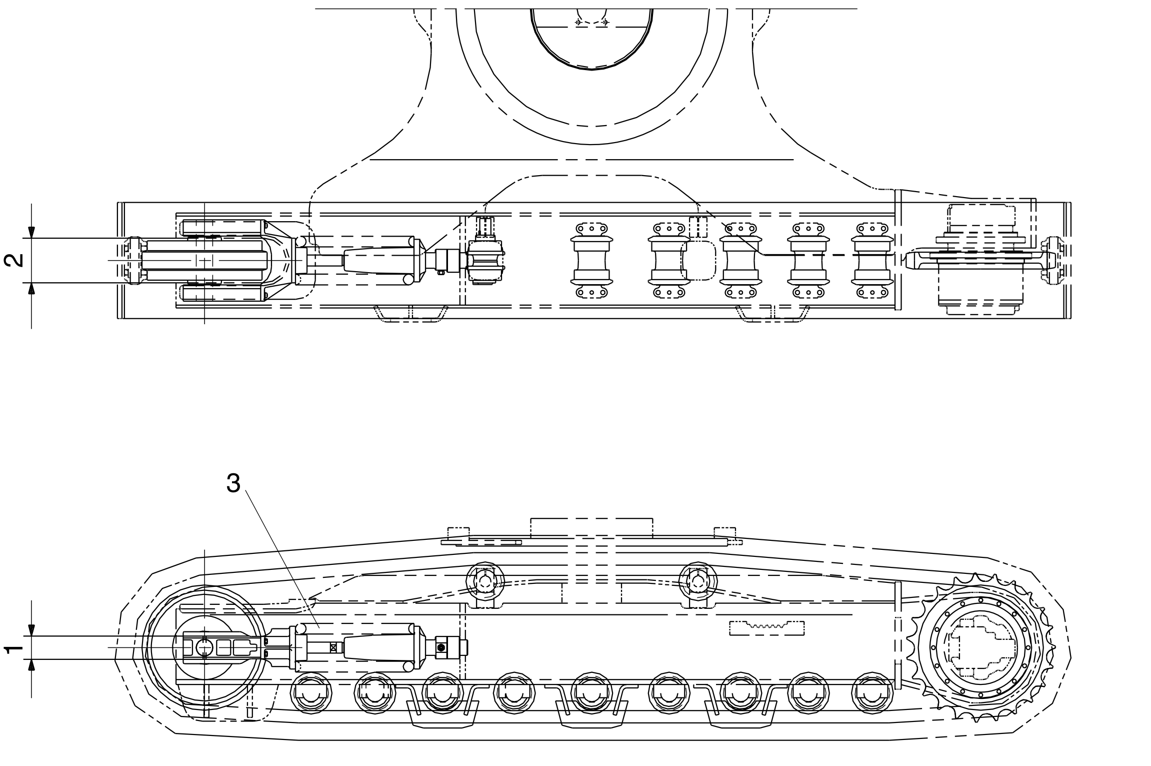
Unit : ㎜

No.	Check item	Criteria		Remedy
1	Link pitch	Standard size	Repair limit	Turn or replace
		171.45	175.65	
2	Outside diameter of bushing	ø 53.75	ø 43.95	Rebuild or replace
3	Height of grouser	25	16	
4	Height of link	94.5	86.5	
5	Tightening torque (Tightening angle method)	Initial tightening torque : 42 ± 4 kgf · m Additional tightening angle : 32˚		Retighten

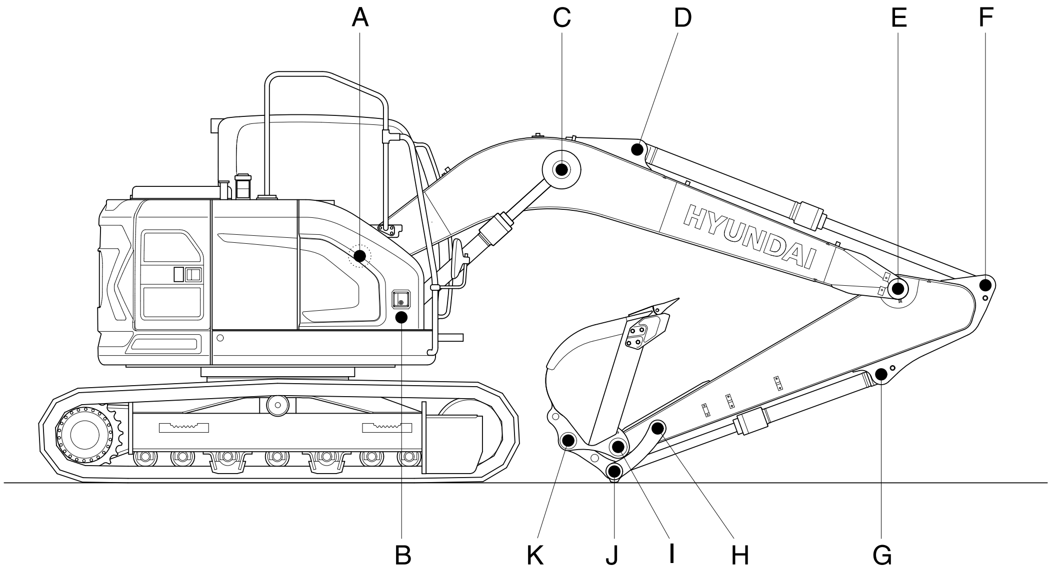
5) TRACK FRAME AND RECOIL SPRING



Unit : mm

No.	Check item	Criteria					Remedy
1	Vertical width of idler guide		Standard size	Tolerance	Repair limit		Rebuild or replace
		Track frame	103	+2 0	107		
		Idler support	100	0 - 0.5	98		
2	Horizontal width of idler guide	Track frame	192	+2 0	196		
		Idler support	190	-	188		
3	Recoil spring	Standard size			Repair limit		Replace
		Free length	Installation length	Installation load	Free length	Installation load	
		ø 192 × 470	405	8,497kg	-	6,978kg	

2. WORK EQUIPMENT



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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	70	69	68.5	70.5	71	Replace
B	Boom Cylinder Head	70	69	68.5	70.5	71	〃
C	Boom Cylinder Rod	70	69	68.5	70.5	71	〃
D	Arm Cylinder Head	70	69	68.5	70.5	71	〃
E	Boom Front	70	69	68.5	70.5	71	〃
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	65	64	63.5	65.5	66	〃
I	Bucket and Arm Link	65	64	63.5	65.5	66	〃
J	Bucket Cylinder Rod	70	69	68.5	70.5	71	〃
K	Bucket Link	65	64	63.5	65.5	66	〃

SECTION 8 DISASSEMBLY AND ASSEMBLY

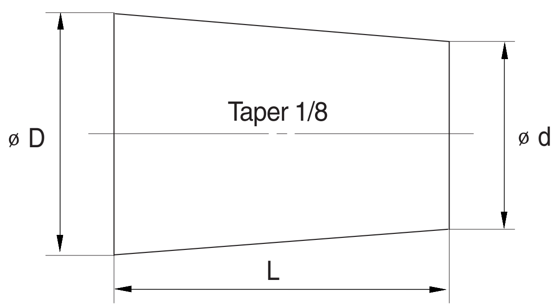
SECTION 8 DISASSEMBLY AND ASSEMBLY

GROUP 1 PRECAUTIONS

1. REMOVAL WORK

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

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



2. INSTALL WORK

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

2) Install the hoses without twisting or interference.

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

4) Bend the cotter pin or lock plate securely.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

3. COMPLETING WORK

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

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

3) If the piping or hydraulic equipment, such as hydraulic cylinders, pumps, or motors, have been removed for repair, always bleed the air from the system after reassembling the parts.

4) Add the specified amount of grease (molybdenum disulphied grease) to the work equipment related parts.

GROUP 2 TIGHTENING TORQUE

1. MAJOR COMPONENTS

No.	Descriptions		Bolt size	Torque	
				kgf · m	lbf · ft
1	Engine	Engine mounting bolt (engine-bracket, FR)	M12 × 1.75	12.3 ± 1.2	89 ± 8.7
2		Engine mounting bolt (engine-bracket, RR)	M12 × 1.75	12.3 ± 1.2	89 ± 8.7
3		Engine mounting bolt (bracket-frame, FR)	M16 × 2.0	34 ± 4.0	246 ± 28.9
4		Engine mounting bolt (bracket-frame, RR)	M16 × 2.0	34 ± 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	6.5 ± 0.7	47 ± 5.06
8	Hydraulic system	Main pump mounting socket bolt	M16 × 2.0	22 ± 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 ± 5.0	333 ± 36.2
11		Hydraulic oil tank mounting bolt	M20 × 2.5	46 ± 5.0	333 ± 36.2
12		Turning joint mounting bolt, nut	M12 × 1.75	12.8 ± 3.0	92.6 ± 21.7
13	Power train system	Swing motor mounting bolt	M16 × 2.0	29.6 ± 3.2	214 ± 23.1
14		Swing bearing upper part mounting bolt	M18 × 2.5	41.3 ± 4.0	299 ± 28.9
15		Swing bearing lower part mounting bolt	M16 × 1.5	29.7 ± 3.0	215 ± 21.7
16		Travel motor mounting bolt	M16 × 2.0	25.7 ± 4.0	186 ± 28.9
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	29.7 ± 4.5	215 ± 32.5
21		Track shoe mounting bolt, nut	5/8 - 18UNF	42 ± 4.0	304 ± 28.9
22		Track guard mounting bolt	M16 × 2.0	29.6 ± 3.2	214 ± 23.1
23	Others	Counterweight mounting bolt	M36 × 3.0	308 ± 46	2228 ± 333
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

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

2. TORQUE CHART

Use following table for unspecified torque.

1) BOLT AND NUT

(1) Coarse thread

Bolt size	8.8T		10.9T		12.9T	
	kgf·m	lbf·ft	kgf·m	lbf·ft	kgf·m	lbf·ft
M 6 × 1.0	0.8 ~ 1.2	5.8 ~ 8.6	1.2 ~ 1.8	8.7 ~ 13.0	1.5 ~ 2.1	10.9 ~ 15.1
M 8 × 1.25	2.0 ~ 3.0	14.5 ~ 21.6	2.8 ~ 4.2	20.3 ~ 30.4	3.4 ~ 5.0	24.6 ~ 36.1
M10 × 1.5	4.0 ~ 6.0	29.0 ~ 43.3	5.6 ~ 8.4	40.5 ~ 60.8	6.8 ~ 10.0	49.2 ~ 72.3
M12 × 1.75	6.8 ~ 10.2	50.0 ~ 73.7	9.6 ~ 14.4	69.5 ~ 104	12.3 ~ 16.5	89.0 ~ 119
M14 × 2.0	10.9 ~ 16.3	78.9 ~ 117	16.3 ~ 21.9	118 ~ 158	19.5 ~ 26.3	141 ~ 190
M16 × 2.0	17.9 ~ 24.1	130 ~ 174	25.1 ~ 33.9	182 ~ 245	30.2 ~ 40.8	141 ~ 295
M18 × 2.5	24.8 ~ 33.4	180 ~ 241	34.8 ~ 47.0	252 ~ 340	41.8 ~ 56.4	302 ~ 407
M20 × 2.5	34.9 ~ 47.1	253 ~ 340	49.1 ~ 66.3	355 ~ 479	58.9 ~ 79.5	426 ~ 575
M22 × 2.5	46.8 ~ 63.2	339 ~ 457	65.8 ~ 88.8	476 ~ 642	78.9 ~ 106	570 ~ 766
M24 × 3.0	60.2 ~ 81.4	436 ~ 588	84.6 ~ 114	612 ~ 824	102 ~ 137	738 ~ 991
M30 × 3.5	120 ~ 161	868 ~ 1164	168 ~ 227	1216 ~ 1641	202 ~ 272	1461 ~ 1967

(2) Fine thread

Bolt size	8.8T		10.9T		12.9T	
	kgf · m	lbf · ft	kgf · m	lbf · ft	kgf · m	lbf · ft
M 8 × 1.0	2.1 ~ 3.1	15.2 ~ 22.4	3.0 ~ 4.4	21.7 ~ 31.8	3.6 ~ 5.4	26.1 ~ 39.0
M10 × 1.25	4.2 ~ 6.2	30.4 ~ 44.9	5.9 ~ 8.7	42.7 ~ 62.9	7.0 ~ 10.4	50.1 ~ 75.2
M12 × 1.25	7.3 ~ 10.9	52.8 ~ 78.8	10.3 ~ 15.3	74.5 ~ 110	13.1 ~ 17.7	94.8 ~ 128
M14 × 1.5	12.4 ~ 16.6	89.7 ~ 120	17.4 ~ 23.4	126 ~ 169	20.8 ~ 28.0	151 ~ 202
M16 × 1.5	18.7 ~ 25.3	136 ~ 182	26.3 ~ 35.5	191 ~ 256	31.6 ~ 42.6	229 ~ 308
M18 × 1.5	27.1 ~ 36.5	196 ~ 264	38.0 ~ 51.4	275 ~ 371	45.7 ~ 61.7	331 ~ 446
M20 × 1.5	37.7 ~ 50.9	273 ~ 368	53.1 ~ 71.7	384 ~ 518	63.6 ~ 86.0	460 ~ 622
M22 × 1.5	51.2 ~ 69.2	370 ~ 500	72.0 ~ 97.2	521 ~ 703	86.4 ~ 116	625 ~ 839
M24 × 2.0	64.1 ~ 86.5	464 ~ 625	90.1 ~ 121	652 ~ 875	108 ~ 146	782 ~ 1056
M30 × 2.0	129 ~ 174	933 ~ 1258	181 ~ 245	1310 ~ 1772	217 ~ 294	1570 ~ 2126

2) PIPE AND HOSE (FLARE TYPE)

Thread size (PF)	Width across flat (mm)	kgf · m	lbf · ft
1/4"	19	4	28.9
3/8"	22	5	36.2
1/2"	27	9.5	68.7
3/4"	36	18	130
1"	41	21	152
1-1/4"	50	35	253

3) PIPE AND HOSE (ORFS TYPE)

Thread size (UNF)	Width across flat (mm)	kgf · m	lbf · ft
9/16-18	19	4	28.9
11/16-16	22	5	36.2
13/16-16	27	9.5	68.7
1-3/16-12	36	18	130
1-7/16-12	41	21	152
1-11/16-12	50	35	253

4) FITTING

Thread size	Width across flat (mm)	kgf · m	lbf · ft
1/4"	19	4	28.9
3/8"	22	5	36.2
1/2"	27	9.5	68.7
3/4"	36	18	130
1"	41	21	152
1-1/4"	50	35	253

GROUP 3 PUMP DEVICE

1. REMOVAL AND INSTALL

1) REMOVAL

(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 drain plug under the hydraulic tank and drain the oil from the hydraulic tank.

· Hydraulic tank quantity : 96 l (25.4 U.S. gal)

(5) Remove socket bolts (11) and disconnect hoses (1,2).

(6) Disconnect pilot line hoses (5, 6, 7, 8, 9, 10).

(7) Remove socket bolts (12) and disconnect pump suction pipe (4).

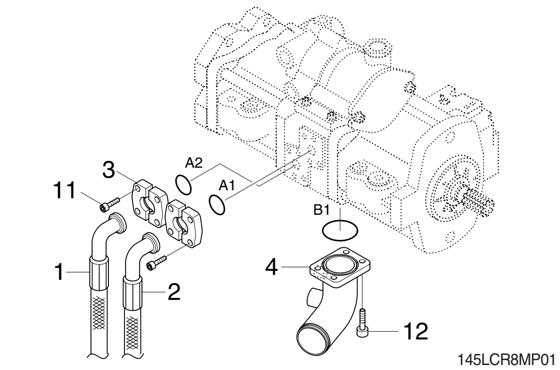
※ When pump suction tube is disconnected, the oil inside the piping will flow out, so catch it in oil pan.

(8) Sling the pump assembly and remove the pump mounting bolts.

· Weight : 90 kg (200 lb)

※ Pull out the pump assembly from housing.
When removing the pump assembly, check that all the hoses have been disconnected.

13031GE18



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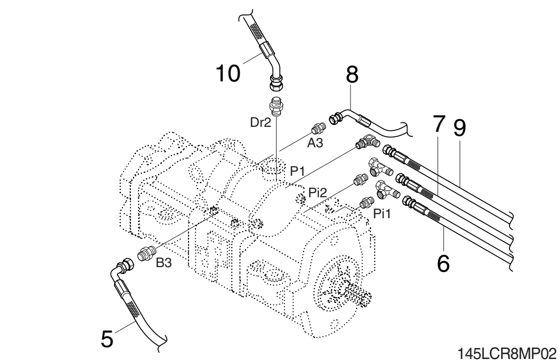


145LCR8MP02

2) INSTALL

(1) Carry out installation in the reverse order to removal.

(2) Remove the suction strainer and clean it.

(3) Replace return filter with new one.

(4) Remove breather and clean it.

(5) After adding oil to the hydraulic tank to the specified level.

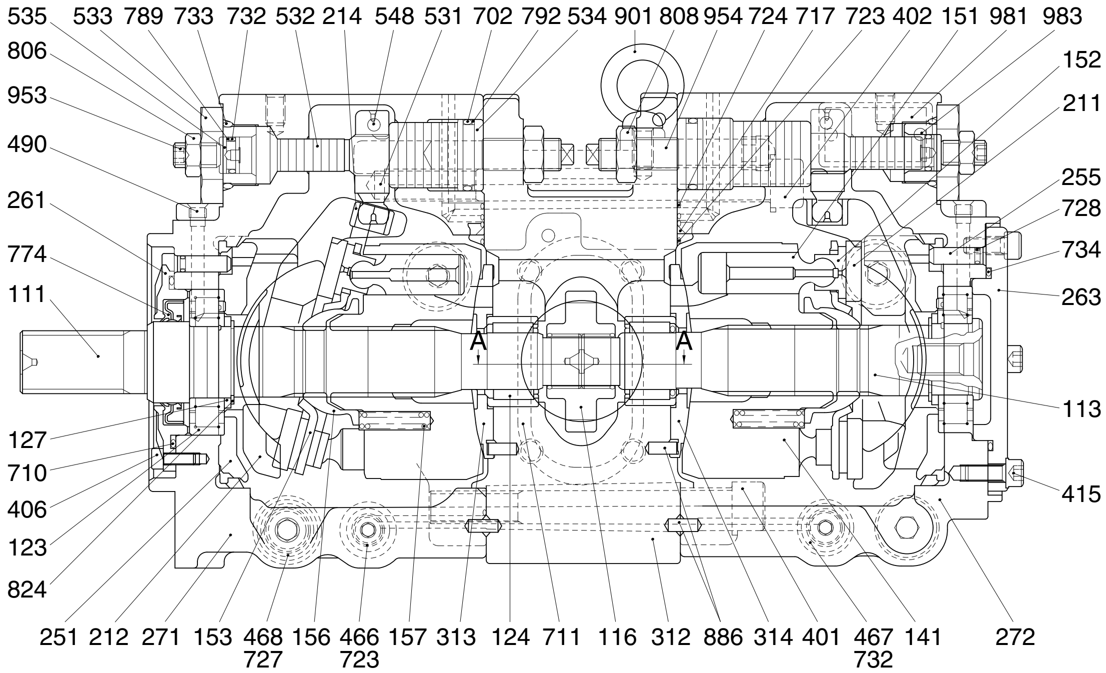
(6) Bleed the air from the hydraulic pump.
① Remove the air vent plug (2EA).
② Tighten plug lightly.
③ Start the engine, run at low idling, and check oil come out from plug.
④ Tighten plug.

(7) Start the engine, run at low idling (3~5 minutes) to circulate the oil through the system.

(8) Confirm the hydraulic oil level and check the hydraulic oil leak or not.

2. MAIN PUMP

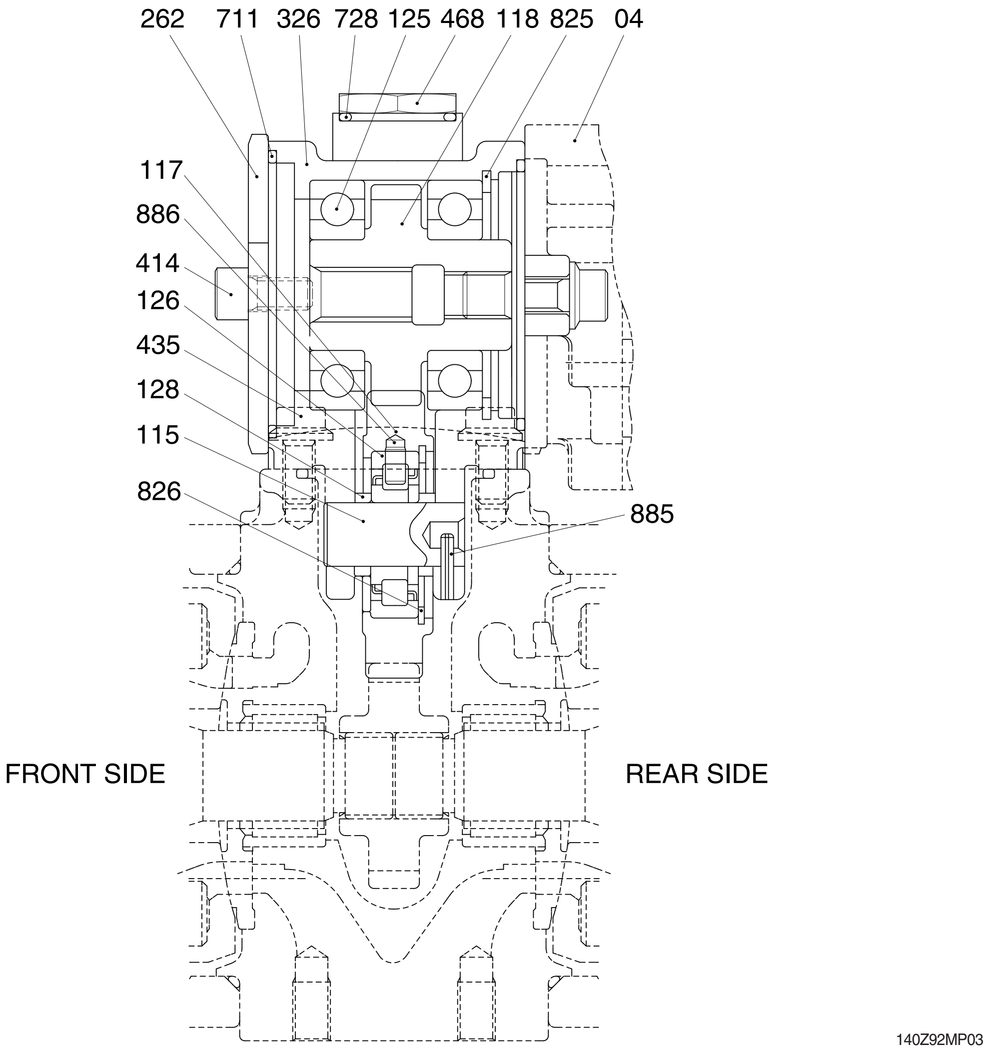
1) STRUCTURE (1/2)



140Z92MP02

111	Drive shaft (F)	272	Pump casing (R)	711	O-ring
113	Drive shaft (R)	312	Valve block	717	O-ring
116	1st Gear	313	Valve plate (R)	723	O-ring
123	Roller bearing	314	Valve plate (L)	724	O-ring
124	Needle bearing	401	Hexagon socket bolt	728	O-ring
127	Bearing spacer	402	Hexagon socket bolt	732	O-ring
141	Cylinder block	406	Hexagon socket bolt	733	O-ring
151	Piston	415	Hexagon socket bolt	734	O-ring
152	Shoe	466	Plug	774	Oil seal
153	Set plate	467	plug	789	Back up ring
156	Bushing	468	Plug	792	Back up ring
157	Cylinder spring	490	Plug	806	Nut
211	Shoe plate	531	Tilting pin	808	Hexagon head nut
212	Swash plate	532	Servo piston	824	Snap ring
214	Bushing	533	Plug	886	Spring pin
251	Support	534	Stopper (L)	901	Eye bolt
255	Lock pin	535	Stopper (S)	953	Set screw
261	Seal cover (F)	548	Pin	954	Set screw
263	Seal cover (R)	702	O-ring	981	Plate
271	Pump casing (F)	710	O-ring	983	Pin

STRUCTURE (2/2)

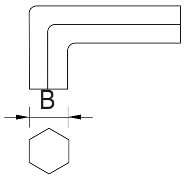
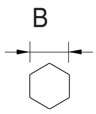


04	Gear pump	128	Bearing spacer	711	O-ring
115	Shaft	262	Cover	728	O-ring
117	Gear No. 2	326	Gear case	825	Retainer ring
118	Gear No. 3	414	Hexagon socket bolt	826	Retainer ring
125	Ball bearing	435	Flange socket bolt	885	Spring pin
126	Roller bearing	468	Plug	886	Pin

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)	ROH/VP/UNF plug (PF screw)	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	PF-1/4	M12, M14
	8	M10	BP-3/8	PF-3/8	M16, M18
	10	M12	BP-1/2	PF-1/2	M20
	14	M16, M18	BP-3/4	PF-3/4	-
	17	M20, M22	BP-1	PF-1	-
Double ring spanner, socket wrench, double (single) open end spanner 	-	Hexagon bolt	Hexagon nut	VP plug (PF screw)	
	19	M12	M12	PF-1/4	
	24	M16	M16	-	
	27	M18	M18	PF-1/2	
	30	M20	M20	-	
	41	-	-	PF-1	
Adjustable angle wrench		Medium size, 1 set			
Screw driver		Minus type screw driver, Medium size, 2 sets			
Hammer		Plastic hammer, 1 set			
Pliers		For snap ring, TSR-160			
Steel bar		Steel bar of key material approx. 10×8×200			
Torque wrench		Capable of tightening with the specified torques			

(2) Tightening torque

Part name	Bolt size	Torque		Wrench size	
		kgf · m	lbf · ft	in	mm
Hexagon socket head bolt (material : SCM435)	M 5	0.7	5.1	0.16	4
	M 6	1.2	8.7	0.20	5
	M 8	3.0	21.7	0.24	6
	M10	5.8	42.0	0.31	8
	M12	10.0	72.3	0.39	10
	M14	16.0	116	0.47	12
	M16	24.0	174	0.55	14
	M18	34.0	246	0.55	14
	M20	44.0	318	0.67	17
PT Plug (material : S45C) ※Wind a seal tape 1.5 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 3/8	7.55	54.6	0.31	8
	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.

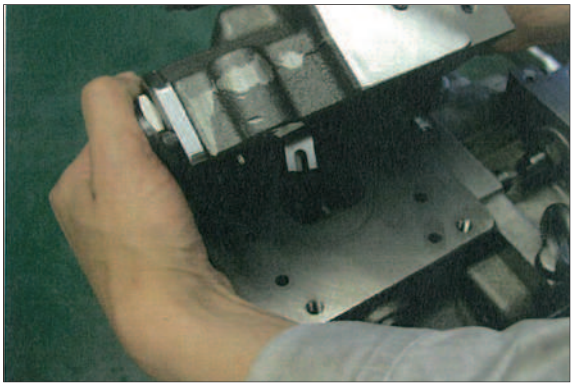
※ Select clean place.

※ Spread rubber sheet, cloth or so on 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 drain oil pump casing (271, 272).

(4) Remove hexagon socket head bolts (412, 413) and remove regulator.



140Z98MP11

(5) Place pump horizontally on workbench with its regulator fitting surface down, and remove flange socket (435) and remove PTO unit (05).

※ Be careful about the attaching direction of the PTO unit (05).

※ Before bringing regulator fitting surface down, spread rubber sheet on workbench without fail to prevent this surface from being damaged.

140Z98MP12

(6) In case the pump is provided without the PTO unit (05), remove the cover (262) with the hexagon socket head cap screws (414).

140Z98MP13

(7) Remove flange socket (435) and remove gear pump (04).

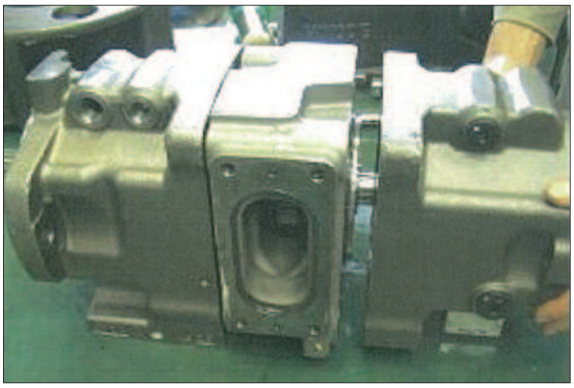
140Z98MP14

(8) Loosen hexagon socket head bolt (401) which tighten pump casing (271, 272) and valve block (312).

140Z98MP15

(9) Place pump horizontally on workbench with its regulator fitting surface down, and separate pump casing (271,272) from valve block (312).

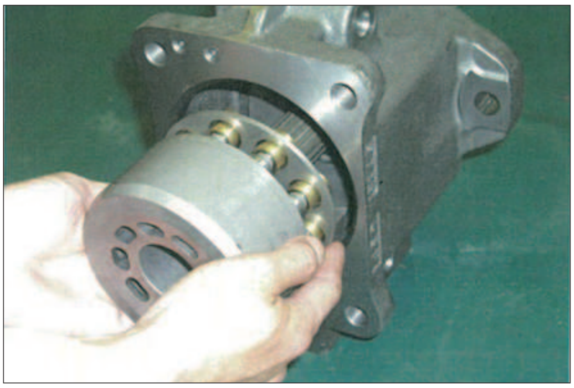
※ Remove 1st gear (116) when separating pump casing from valve block (312) too.



140Z98MP16

(10) Pull out cylinder (141), pistons (151), set screw (153), spherical bush (156) and cylinder springs (157) simultaneously from pump casing (271, 272) straightly over drive shaft (111, 113).

※ Take care not to damage sliding surface of cylinder (141), spherical bush (156), shoes (152), swash plate (212), etc.



140Z98MP17

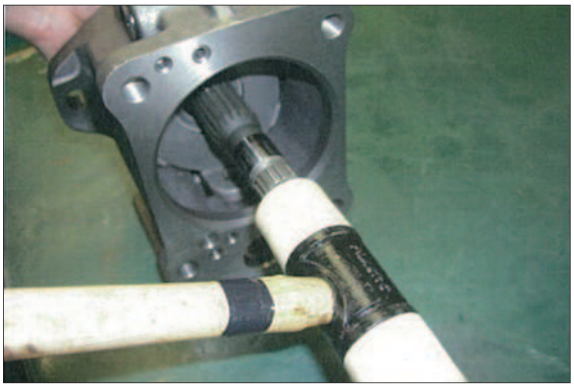
(11) Remove hexagon socket head bolts (406) and then seal cover (F, 261).

※ In the case removing it is difficult, and hooking pull thin rod into notch, and the cover can be removed easily.

※ Since oil seal is fitted on seal cover (F) (261), take care not to damage it at removing the cover.

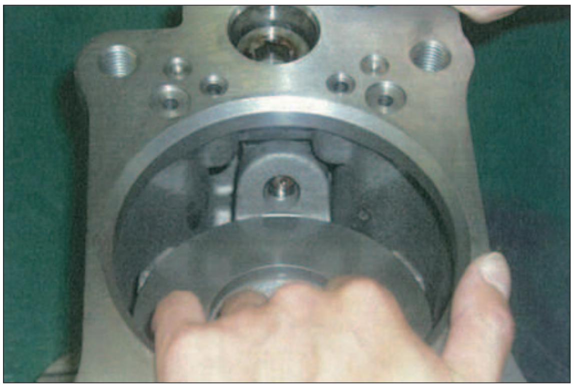
140Z98MP18

(12) Tapping shaft ends of drive shaft (111, 113) lightly with plastic hammer, remove it from pump casing (271, 272).



140Z98MP19

(13) Remove shoe plate (211) and swash plate (212) from pump casing (271, 272).



140Z98MP20

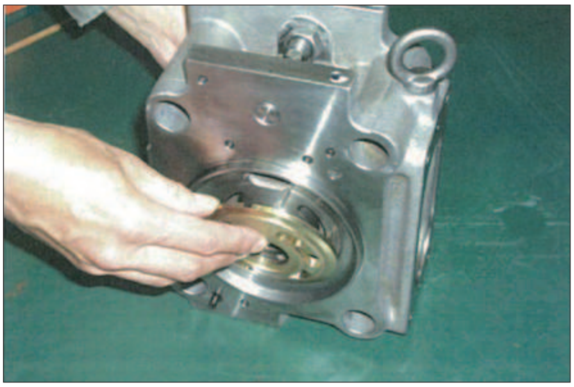
(14) Insert thin steel bar into the hole and remove the lock pin (255) from pump casing (271, 272).

※ When holding with thin steel bar, do not confuse the unlocking hole with the arc shaped oil passage.

140Z98MP21

(15) Remove valve plate (313, 314) from valve block (312).

※ These may be removed in Work 8.



140Z98MP22

If necessary, remove stopper (L) (534), Qmin. plug (533), servo piston (532) and tilting pin (531) from pump casing (271, 272), and needle bearing (124) from valve block.

※ When removing tilting pin, use a protector to prevent pin head from being damaged.

※ Since lock tight is applied to fitting areas of tilting pin (531) and servo piston (532), take care not to damage servo piston (532).

※ Do not remove needle bearing (124) as far as possible, except the case that considered to be out of its life span.

※ Do not loosen hexagon nuts of valve block (312) and Qmin. plug (533).
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 repair 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.

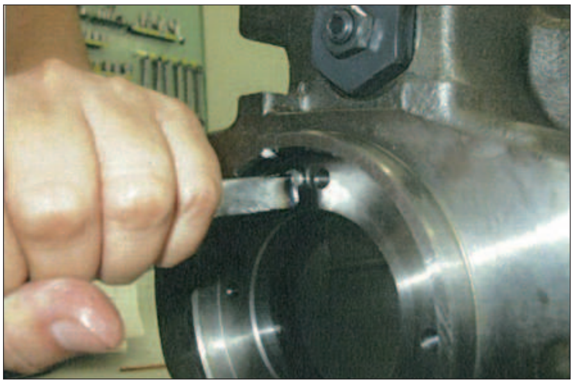
⑤ For fitting bolts, plug, etc., prepare a torque wrench or so on, and tighten them with torques shown in page 8-11, 12.

⑥ For the double-pump, take care not to mix up parts of the front pump with those of the rear pump.

(2) Insert the lock pin (255) after the swash plate support (251) into the pump casing (271, 272), and fit the lock pin (255) into the hole of the swash plate support (251).

※ In case the servo piston, tilting pin, stopper (L), stopper (S), and Qmin. plug have been removed, attached then to the pump casing in advance.

※ In the tightening work of the servo piston and the tilting pin, use the tool not to damaged the head of the tilting pin and the feed back pin. Besides, apply loctite (of medium strength) to the thread portion.



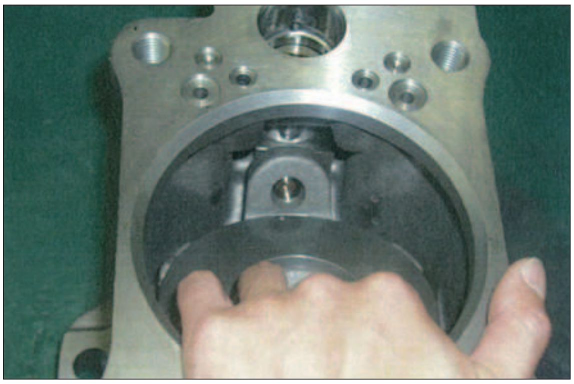
140Z98MP23

(3) Fit tilting bush (214) of swash plate (212) to tilting pin (531), and fit swash plate (212) with shoe plate (211) to swash plate support (251) correctly.

※ Confirm with fingers of both hands that swash plate can be removed smoothly.

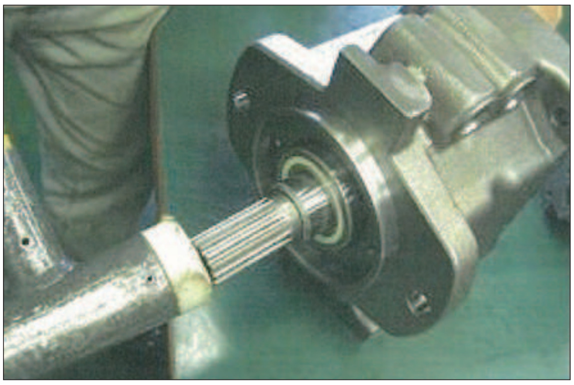
※ Apply grease to sliding sections of swash plate (212) and swash plate support (251), and drive shaft (111, 113) can be fitted easily.

※ Take care not to damage shoe plate (211) surface.



140Z98MP24

(4) To pump casing (271, 272), fit drive shaft (111, 113) set with bearing (123), bearing spacer (127) and stop ring (824).

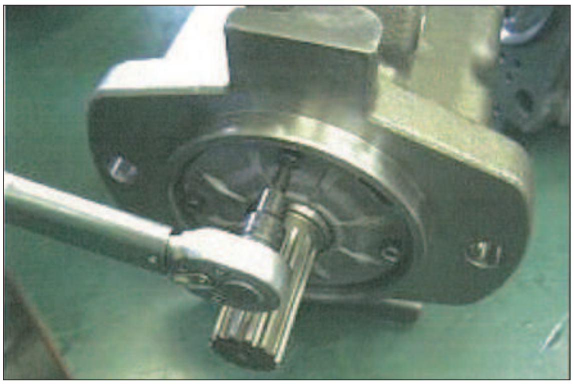


140Z98MP25

(5) In assemble of front pump, assemble seal cover (F) (261) to pump casing (271) and fix it with hexagon socket head bolt (406).

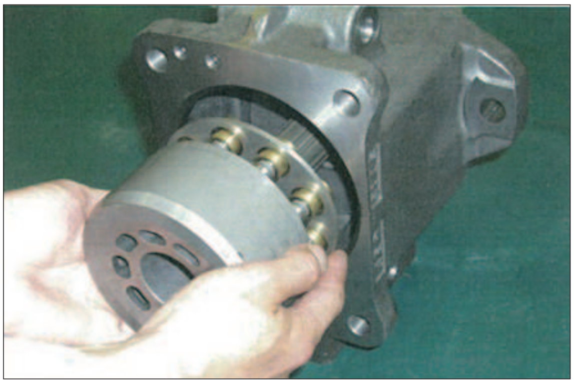
※ Apply grease lightly to oil seal in seal cover (F) (261).

※ For assemble oil seal (774), taking full care not to damage it.



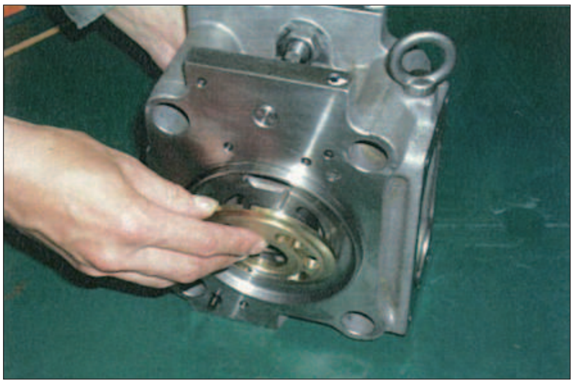
140Z98MP26

(6) Assemble piston cylinder subassembly [cylinder (141), piston subassembly (151, 152), set plate (153), spherical bush (156) and cylinder spring (157)]. Fitting spline phases of cylinder, spherical bush (156) and drive shaft (111, 113), insert piston cylinder subassembly into pump casing (271, 272).



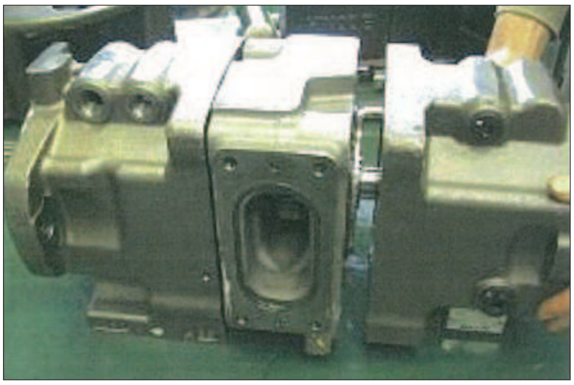
140Z98MP27

(7) Fit valve plate (313, 314) to valve block (312), spring pin (886) into pin hole.
※ Take care not to mistake suction / delivery direction of valve plate (312).



140Z98MP28

(8) Place pump horizontally on workbench with its regulator fitting surface down, and attach pump casing (271, 272) to valve block (312). Fit 1st gear (116) simultaneously.
※ Before bringing regulator fitting surface down, spread rubber sheet on workbench without fail to prevent this surface from being damaged.
※ Take care not to mistake direction of valve block (312). [Clockwise rotation (viewed from input shaft side)]. Fit the valve block (312) with suction flange left when regulator side below, viewed from front side.

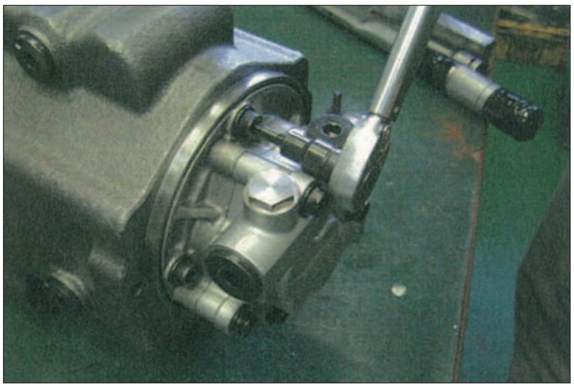


140Z98MP29

(9) Fix valve block (312) to pump casing (271, 272) with hexagon socket head bolts (401).

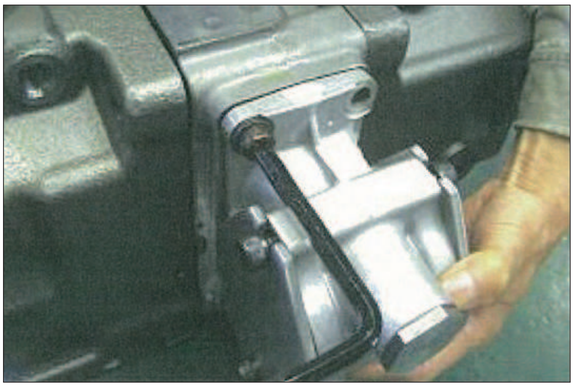
140Z98MP30

(10) Fit gear pump (04) to pump casing (272) with hexagon socket head bolts (435).



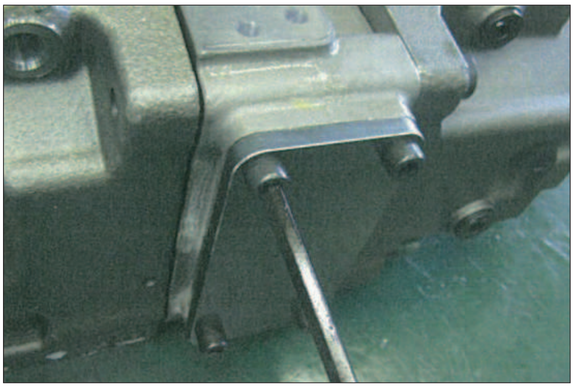
140Z98MP31

(11) Attach the PTO unit (05) by fastening the flange socket (435) to the valve block (312).



140Z98MP32

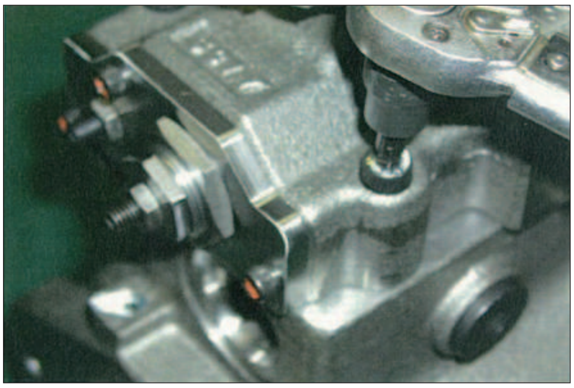
(12) In case the pump is not provided with the PTO unit (05), attach the cover (262) with the hexagon socket head cap screw (414).



140Z98MP33

(13) Putting feedback lever (611) of regulator into feedback pin (548) of tilting pin (531), fit regulator with hexagon socket head bolt (415).

※ Take care not to mix up regulator of front pump and that of rear pump.

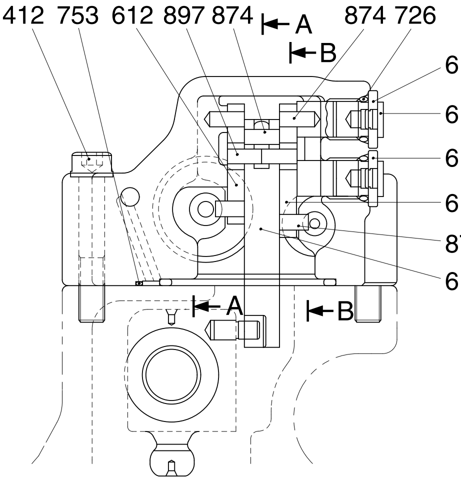


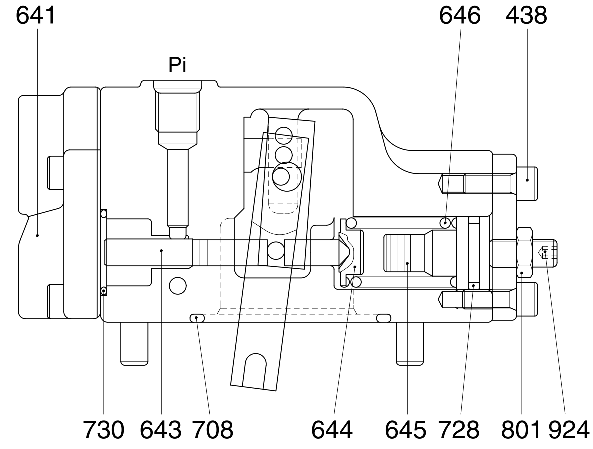
140Z98MP34

(14) Fit drain port plug (468).
This is the end of reassembling procedures.

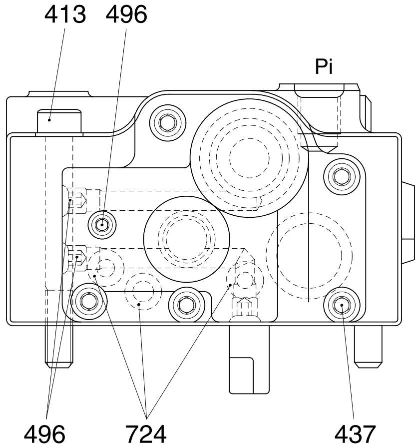
3. REGULATOR

1) STRUCTURE (1/2)

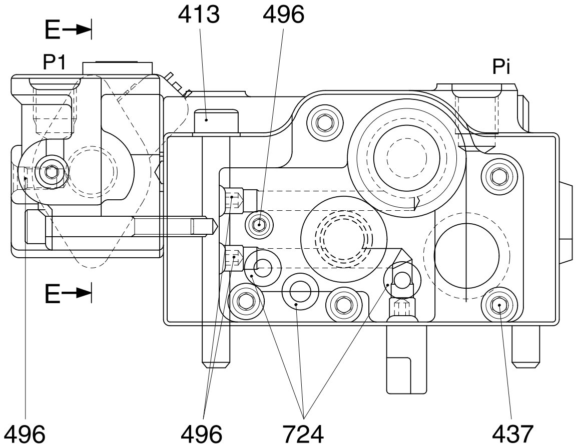




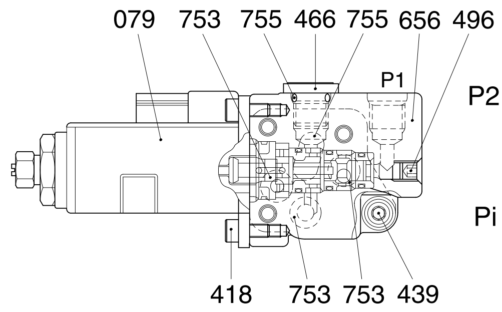
SECTION B-B



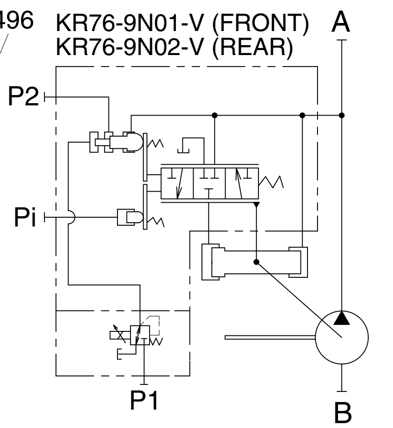
VIEW C (FRONT)



VIEW C (REAR)

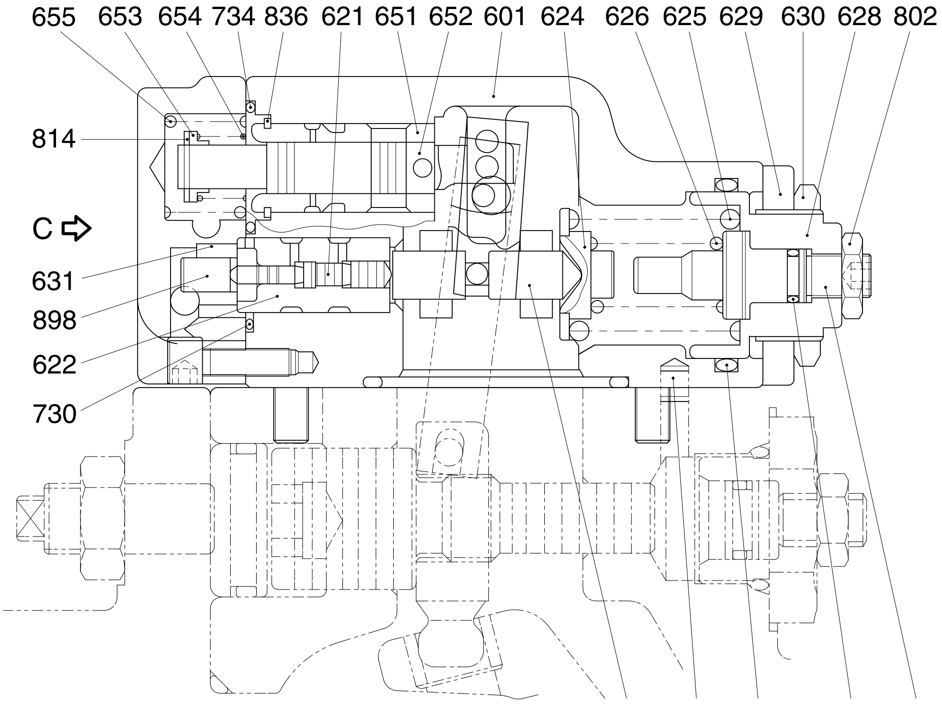


SECTION E-E (REAR)



140Z92MP04

STRUCTURE (2/2)



SECTION A-A

140Z92MP05

079	EPPR valve assembly	624	Spring seat (C)	708	O-ring
412	Hexagon socket screw	625	Outer spring	724	O-ring
413	Hexagon socket screw	626	Inner spring	725	O-ring
418	Hexagon socket screw	627	Adjust stem (C)	728	O-ring
437	Hexagon socket screw	628	Adjust screw (C)	730	O-ring
438	Hexagon socket screw	629	Cover (C)	734	O-ring
439	Hexagon socket screw	630	Lock nut	753	O-ring
466	Plug	631	Sleeve, Pf	755	O-ring
496	Plug	641	Pilot cover	757	O-ring
601	Casing	643	Pilot piston	801	Nut
611	Feed back lever	644	Spring seat (Q)	802	Nut
612	Lever (1)	645	Adjust stem (Q)	814	Snap ring
613	Lever (2)	646	Pilot spring	836	Snap ring
614	Center plug	651	Sleeve	874	Pin
615	Adjust plug	652	Spool	875	Pin
616	Plug	653	Spring seat	887	Pin
621	Compensator piston	654	Return spring	897	Pin
622	Piston case	655	Set spring	898	Pin
623	Compensator rod	656	Block cover	924	Set screw

2) TOOLS AND TIGHTENING TORQUE

(1) Tools

The tools necessary to disassemble/reassemble the pump are shown in the follow list.

<table>
<tr><td colspan="2">Tool name & size</td><td colspan="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.

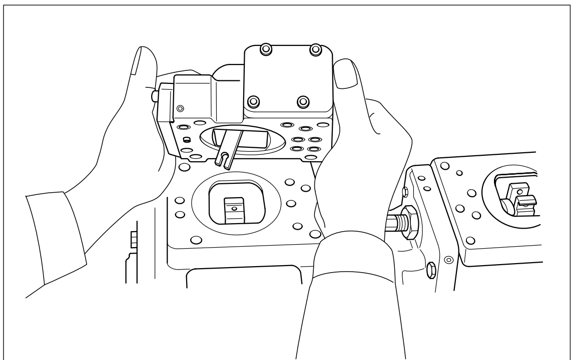
※ Choose a clean place.

※ 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.



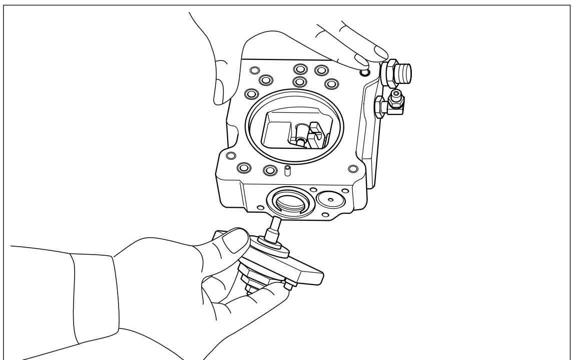
(210-7) REG01

(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).

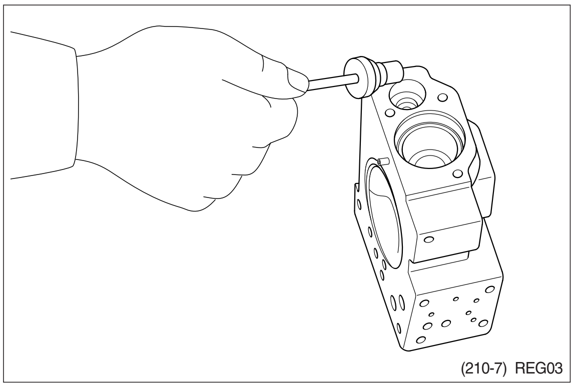
※ Do not loosen these screws and nuts.

If they are loosened, adjusted pressure-flow setting will vary.



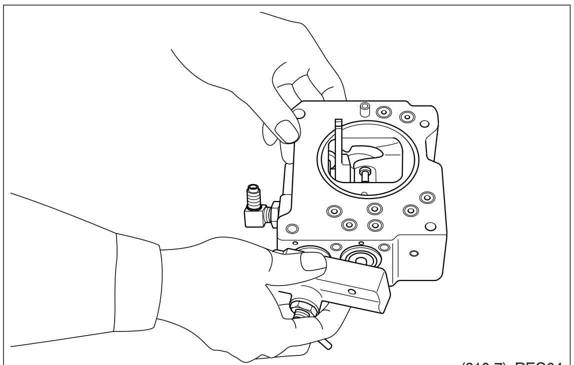
(210-7) REG02

(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.



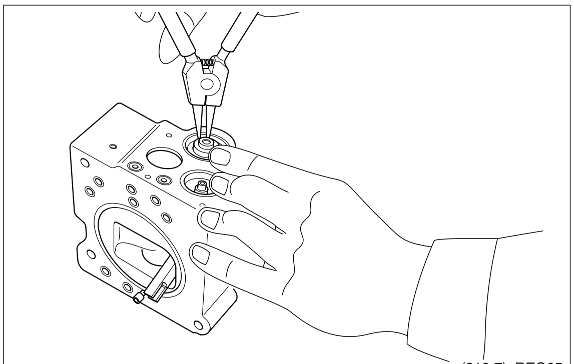
(210-7) REG03

(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.



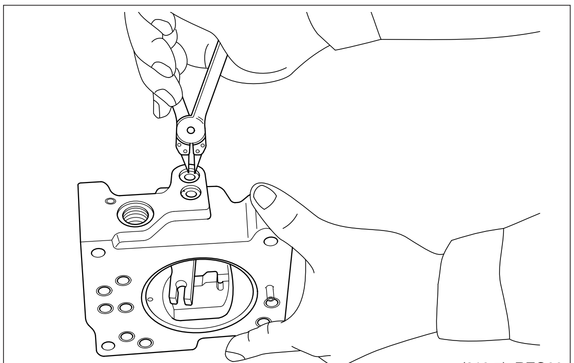
(210-7) REG04

(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.

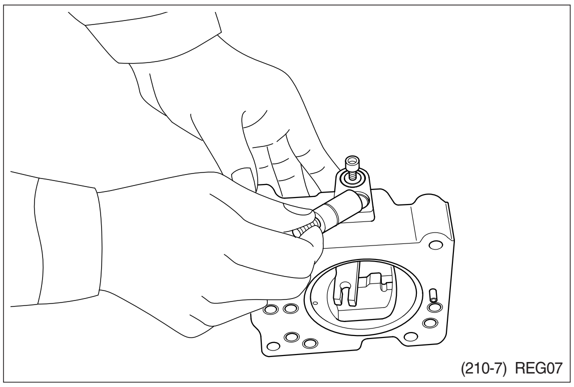


(210-7) REG05

(8) Remove prevention plug (616) and take out center plug (614) and adjusting plug (615).
※ Center plug (614) and adjusting plug (615) can easily be taken out with M6 bolt.



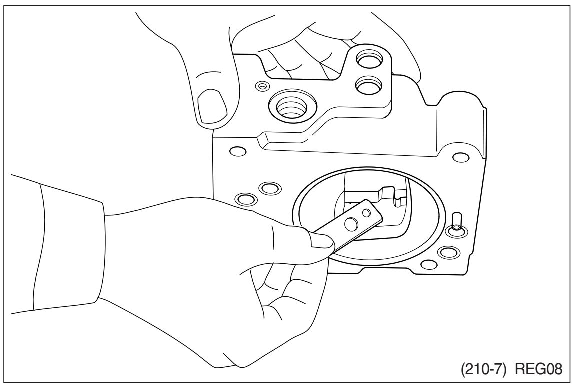
(210-7) REG06



(210-7) REG07

(9) Remove lever (2, 613). Do not draw out pin (875).

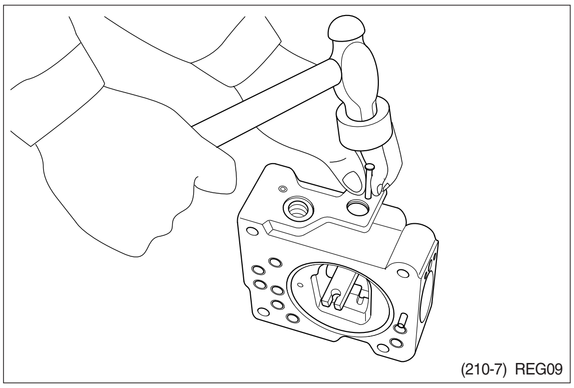
※ Work will be promoted by using pincers or so on.



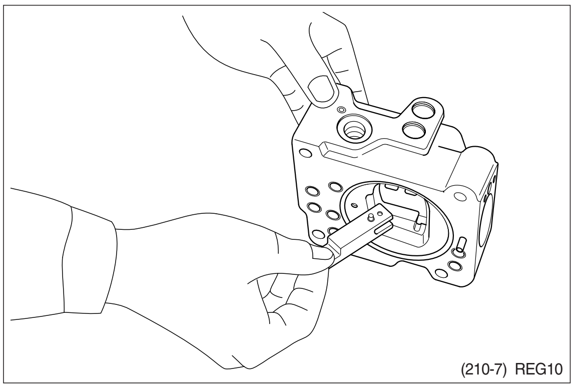
(210-7) REG08

(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.

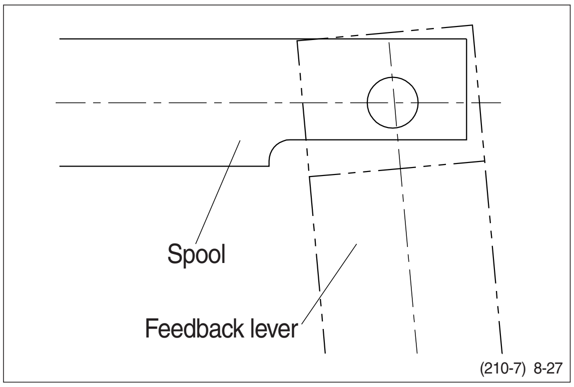
(2) Put compensating rod (623) into compensating hole of casing (601).

(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.

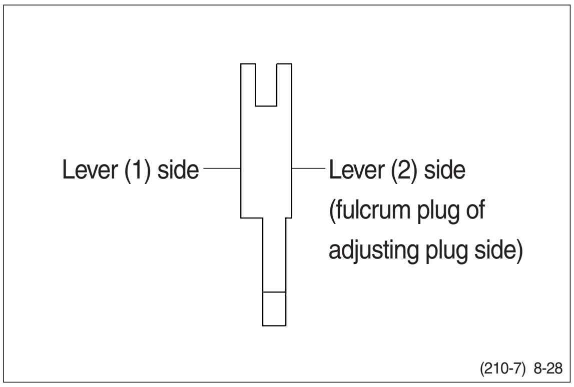
※ Confirm that spool and sleeve slide smoothly in casing without binding.

※ Pay attention to orientation of spool.



(210-7) 8-27

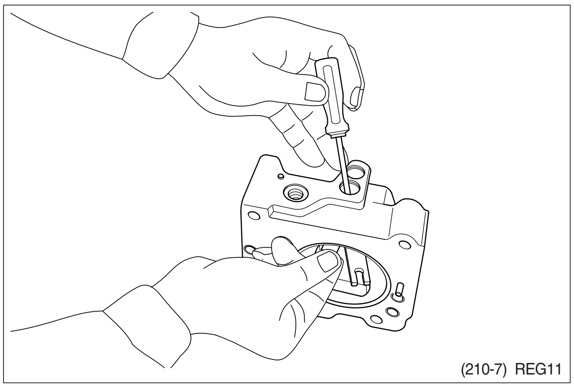
(5) Fit feedback lever (611), matching its pin hole with pin hole in spool.
Then insert pin (874).
※ Insert pin in feedback lever a little to ease operation.
※ Take care not to mistake direction of feedback lever.



(210-7) 8-28

(6) Put pilot piston (643) into pilot hole of casing.
※ Confirm that pilot piston slides smoothly without binding.

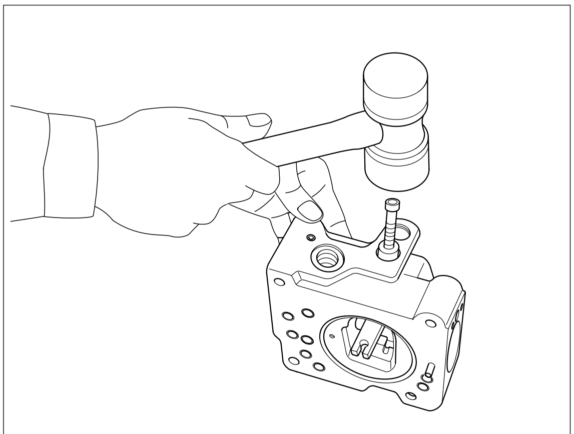
(7) Put pin force-fitted in lever (2, 613) into groove of pilot piston.
Then fix lever (2).



(210-7) REG11

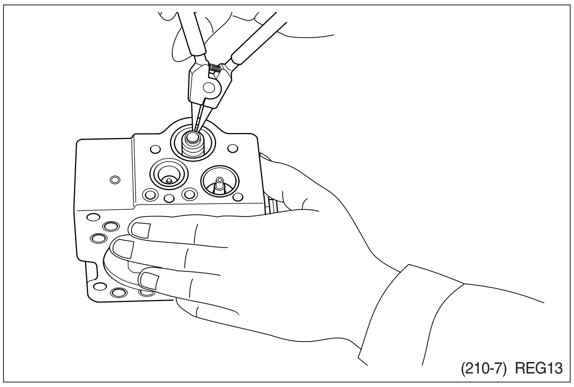
(8) Fit center plug (614) so that pin force-fitted in center plug (614) can be put into pin hole of lever (2).
Then install prevention plug (858).

(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.



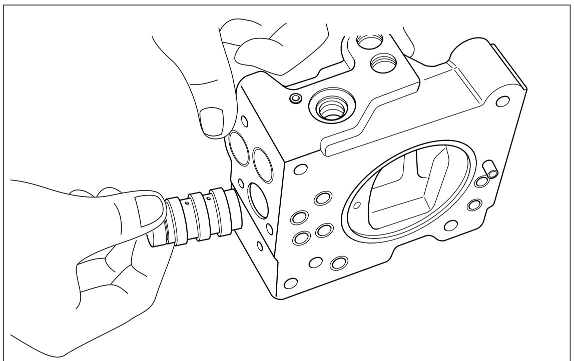
(210-7) REG12

(10) Fit return spring (654) and spring seat (653) into spool hole and attach snap ring (814).



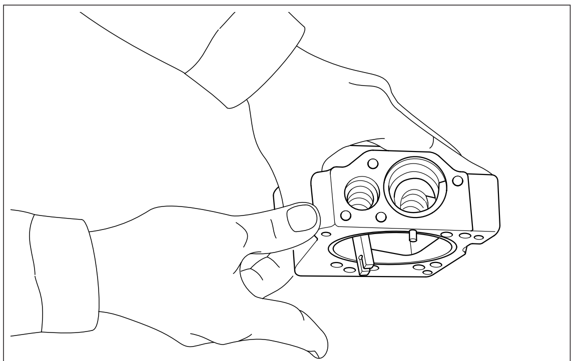
(210-7) REG13

(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 (437, 438).



(210-7) REG14

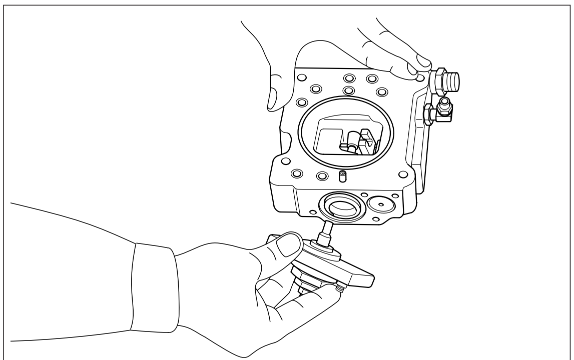
(12) Put spring seat (644), pilot spring (646) and adjusting ring (Q, 645) into pilot hole.
Then fix spring seat (624), inner spring (626) and outer spring (625) into compensating hole.
※ When fitting spring seat, take care not to mistake direction of spring seat.



(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


13031GE18

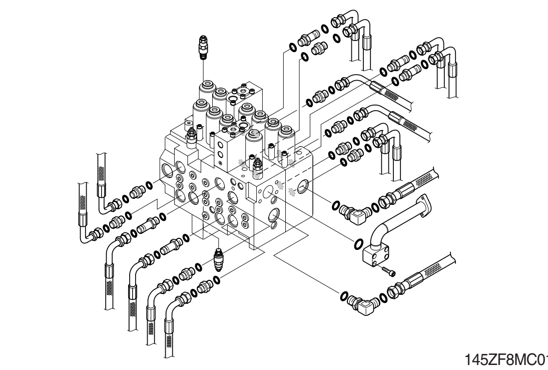
(1) Lower the work equipment to the ground and stop the engine.

(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.


145ZF8MC01

(4) Remove the wirings for the pressure sensor and so on.

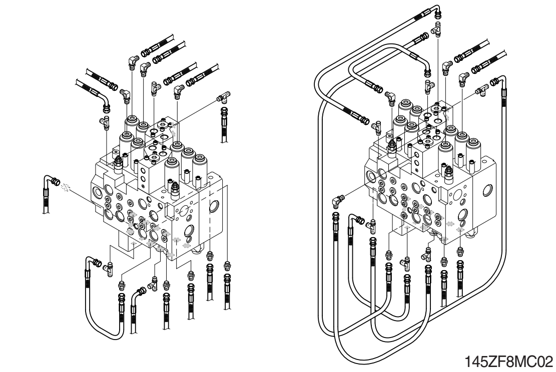
(5) Remove bolts and disconnect pipe.

(6) Disconnect pilot line hoses.

(7) Disconnect pilot piping.

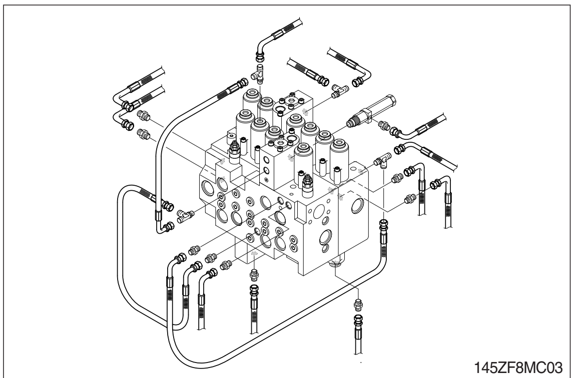
(8) Sling the control valve assembly and remove the control valve mounting bolt and bracket.

· Weight : 140 kg (310 lb)


145ZF8MC02

(9) Remove the control valve assembly. When removing the control valve assembly, check that all the piping have been disconnected.

2) INSTALL


145ZF8MC03

(1) Carry out installation in the reverse order to removal.

(2) Bleed the air from below items.

① Cylinder (Boom, arm, bucket)

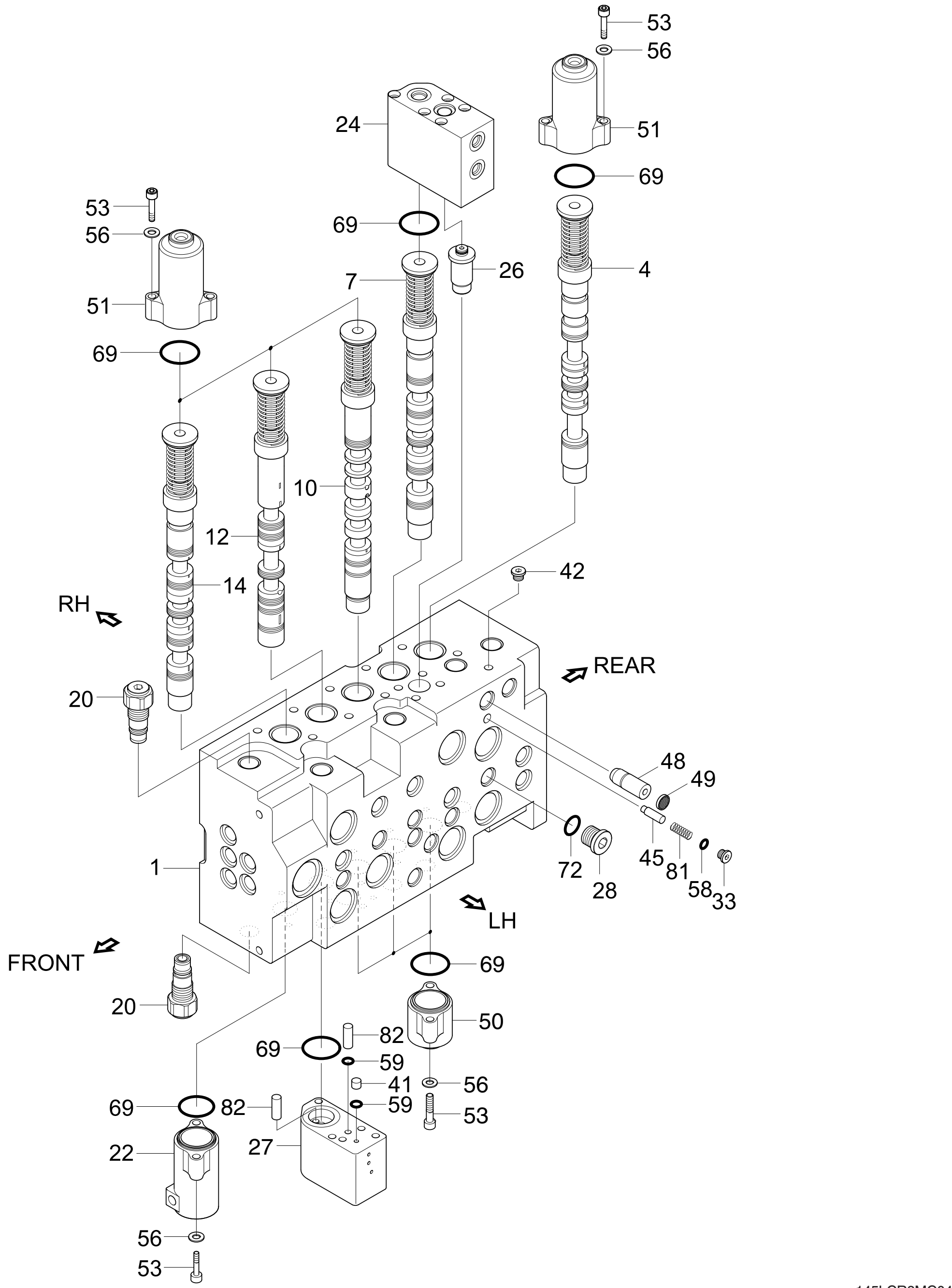
② Swing motor

③ Travel motor

※ See each item removal and install.

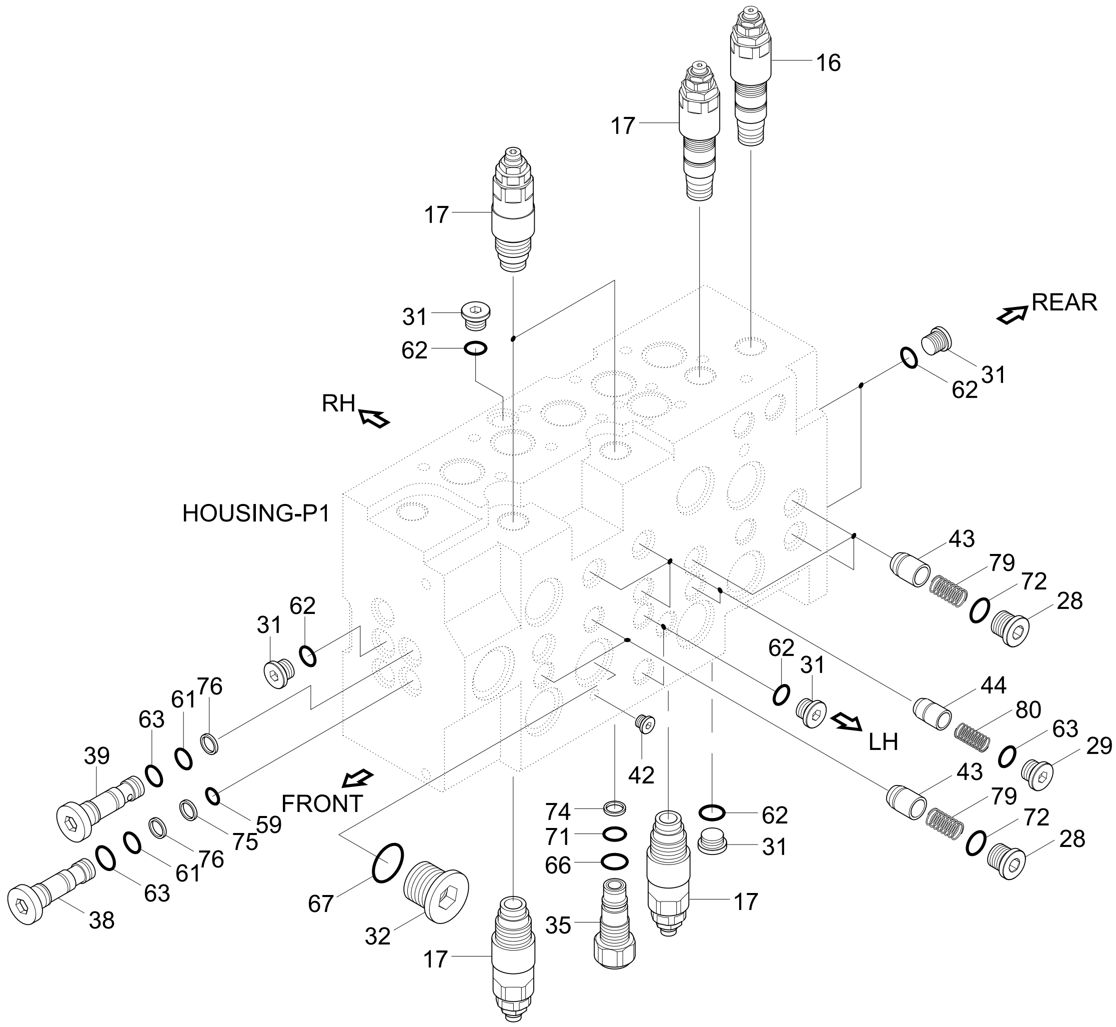
(3) Confirm the hydraulic oil level and recheck the hydraulic oil leak or not.

2. STRUCTURE (1/4)



1	Housing-P1	27	Regeneration block	53	Socket head bolt
4	Spool assy-travel LH	28	Plug	56	Plain washer
7	Spool assy-boom 1	33	Plug	58	O-ring
10	Spool assy-arm 2	41	Orifice	59	O-ring
12	Spool assy-arm regen	42	Plug	69	O-ring
14	Spool assy-bucket	45	Poppet	72	O-ring
20	Nega con relief valve	48	Orifice	81	Spring
22	Bucket stroke limiter	49	Coin type filter	82	Pin-regeneration
24	Holding valve kit A1	50	Pilot A cap		
26	Lock valve kit B	51	Pilot B1 cap		

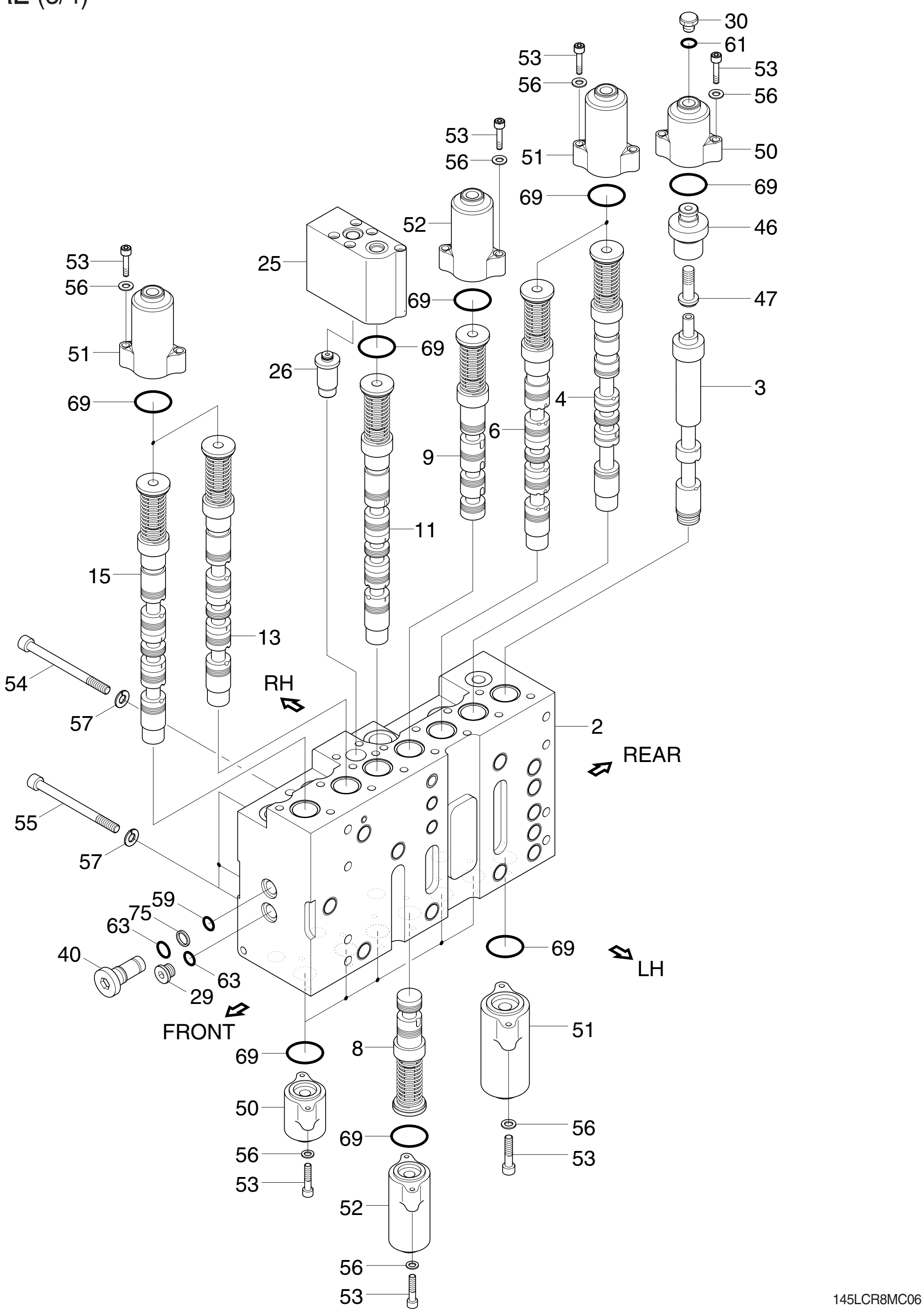
STRUCTURE (2/4)



145LCR8MC05

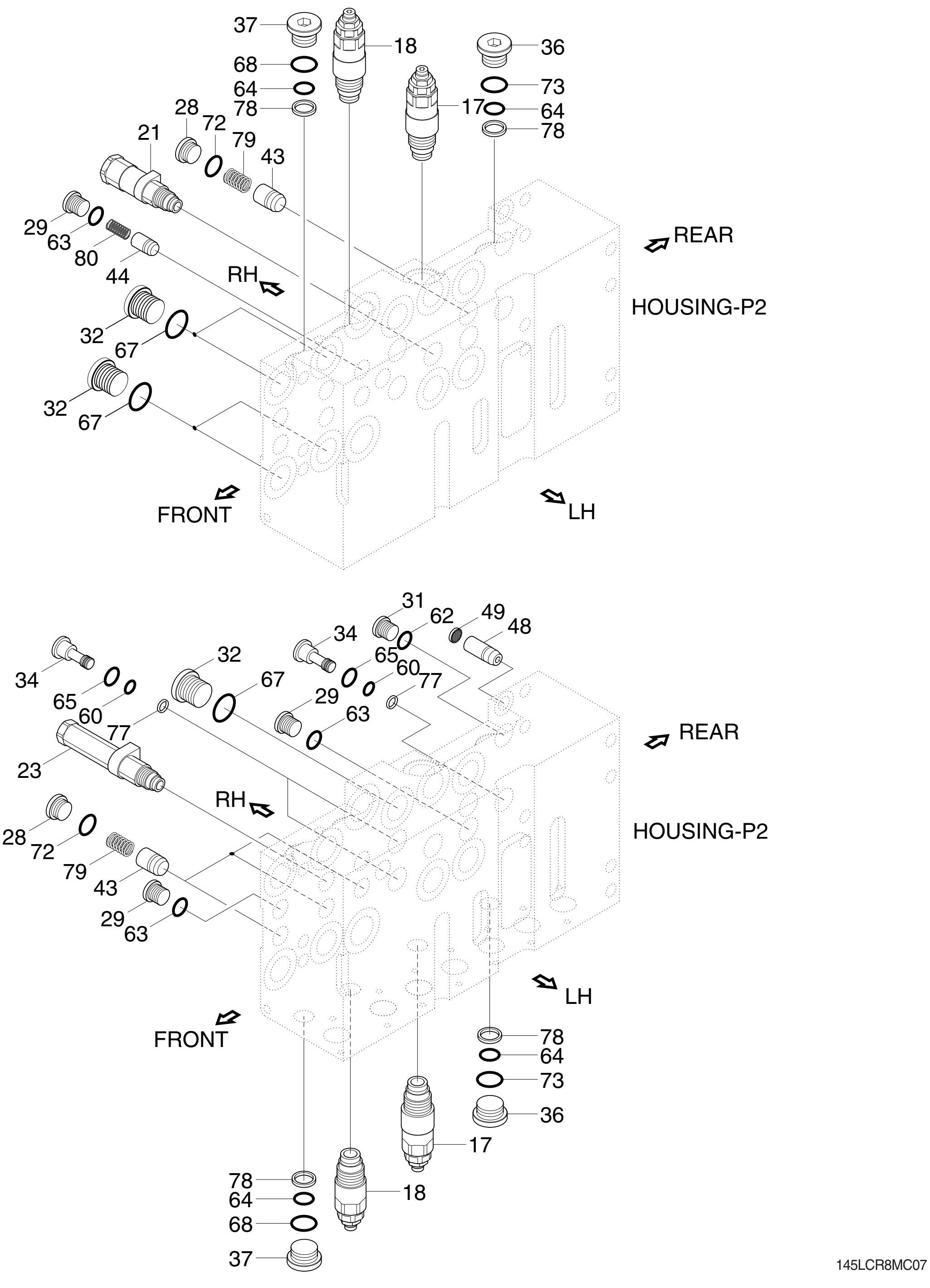
16	Main relief valve	42	Plug	71	O-ring
17	Overload relief valve	43	Poppet 1	72	O-ring
28	Plug	44	Poppet 2	74	Back up ring
29	Plug	59	O-ring	75	Back up ring
31	Plug	61	O-ring	76	Back up ring
32	Plug	62	O-ring	79	Spring
35	Plug	63	O-ring	80	Spring
38	Plug	66	O-ring		
39	Plug	67	O-ring		

STRUCTURE (3/4)



2	Housing-P2	26	Lock valve kit-B	54	Socket head bolt
3	Spool assy	29	Plug	55	Socket head bolt
4	Spool assy-travel RH	30	Plug	56	Plain washer
6	Spool assy-swing	40	Plug	57	Spring washer
8	Spool assy-swing priority	46	Travel straight sleeve	59	O-ring
9	Spool assy-boom 2	47	Travel straight piston	61	O-ring
11	Spool assy-arm 1	50	Pilot A cap	63	O-ring
13	Spool assy-option B	51	Pilot B1 cap	69	O-ring
15	Spool assy-dozer	52	Pilot B2 cap	75	Back up ring
25	Holding valve kit A2	53	Socket head bolt		

STRUCTURE (4/4)



17	Overload relief valve	37	Plug	67	O-ring
18	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-signal	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

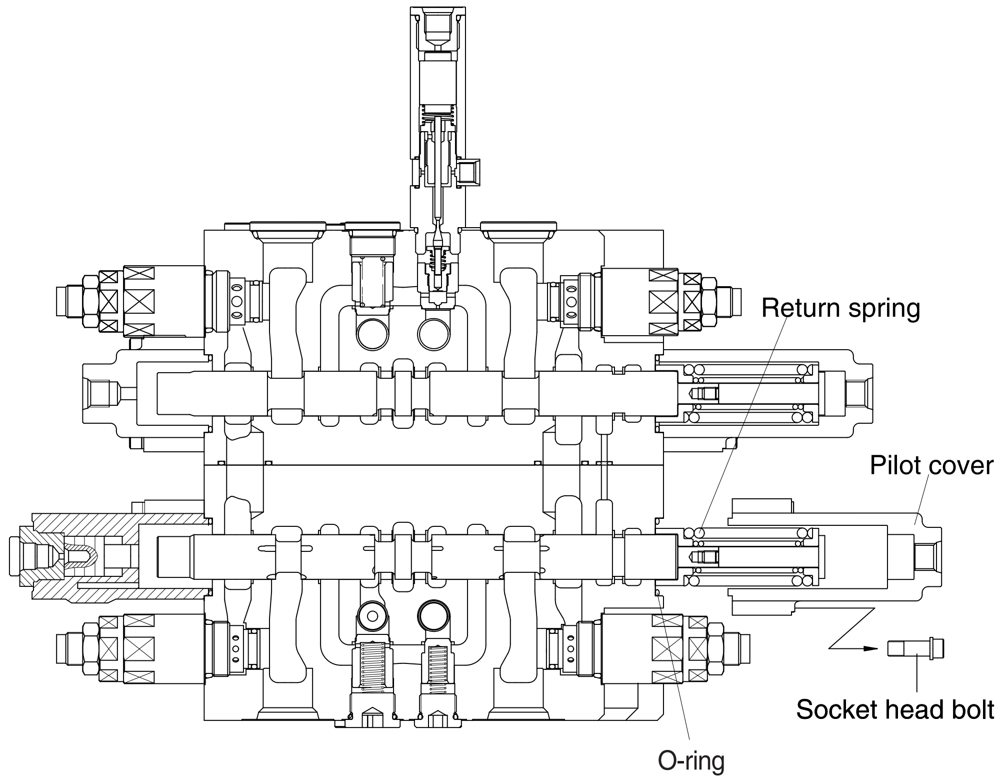
① Loosen hexagon socket head bolts with washer.
(hexagon wrench : 5 mm)

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.



145LCR8MC10

(2) **Disassembly of spools with holding valve** (boom 1, Arm 1 spool)

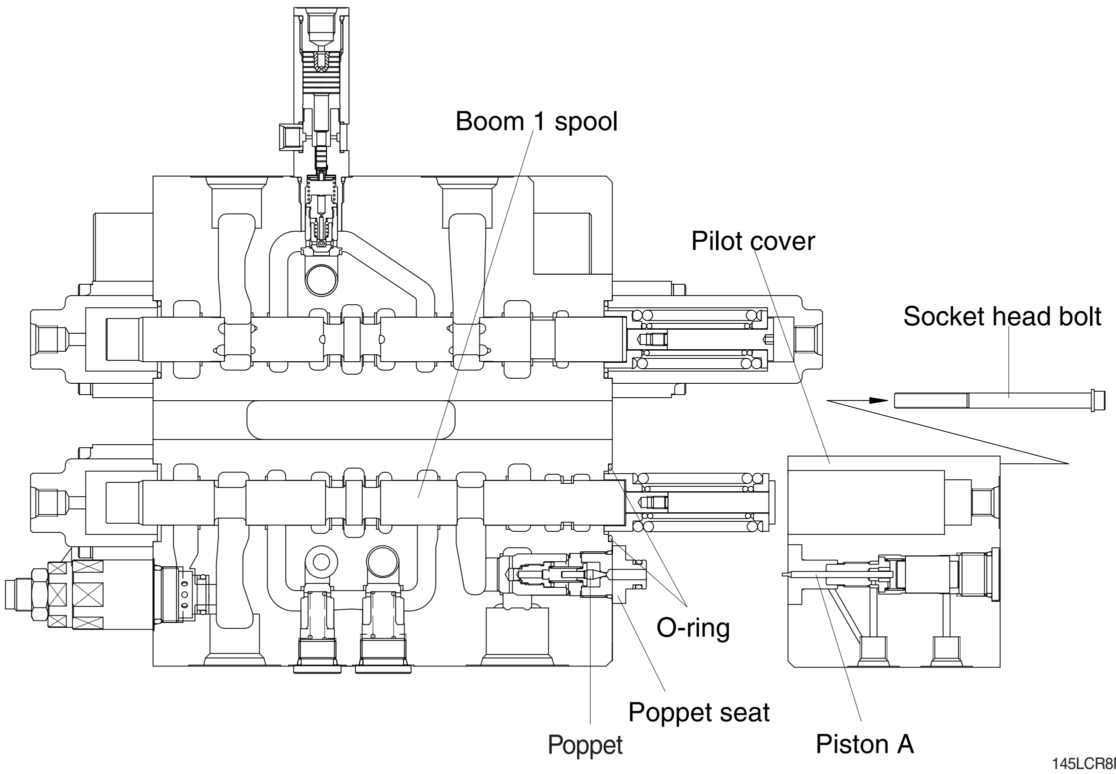
① Loosen hexagon socket head bolts with washer.
(hexagon wrench : 5 ㎜)

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.



145LCR8MC11

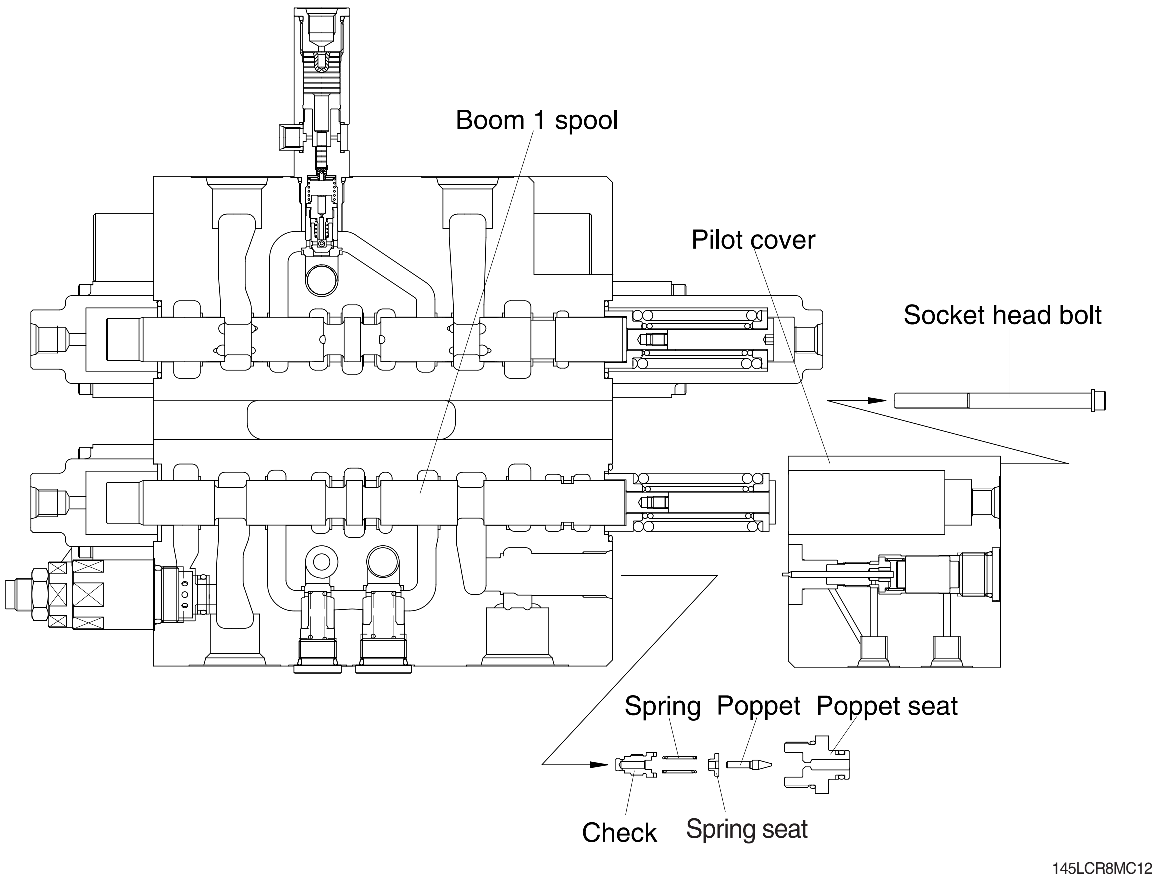
(3) Disassembly of the holding valve

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 mm)

※ 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.

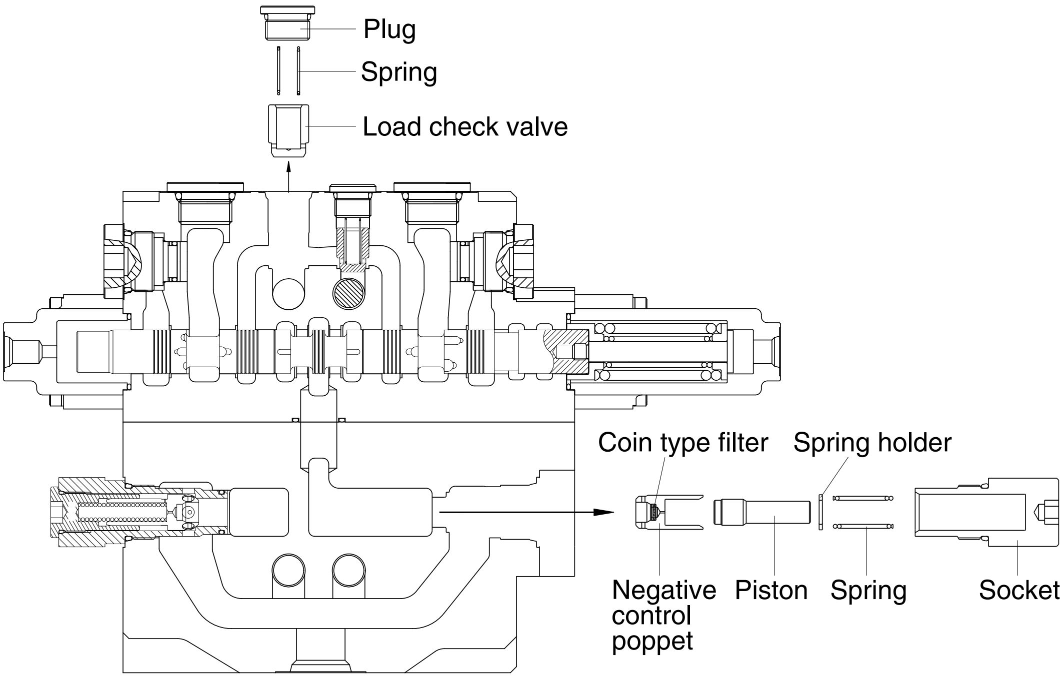
b. Loosen the plug (hexagon wrench : 10 mm).

c. Remove the spring and the load check valve with pincers or magnet.

② The negative relief valve

a. Loosen the socket (spanner : 32 mm).

b. Remove the spring, spring holder, piston and negative control poppet.



14W98MC13

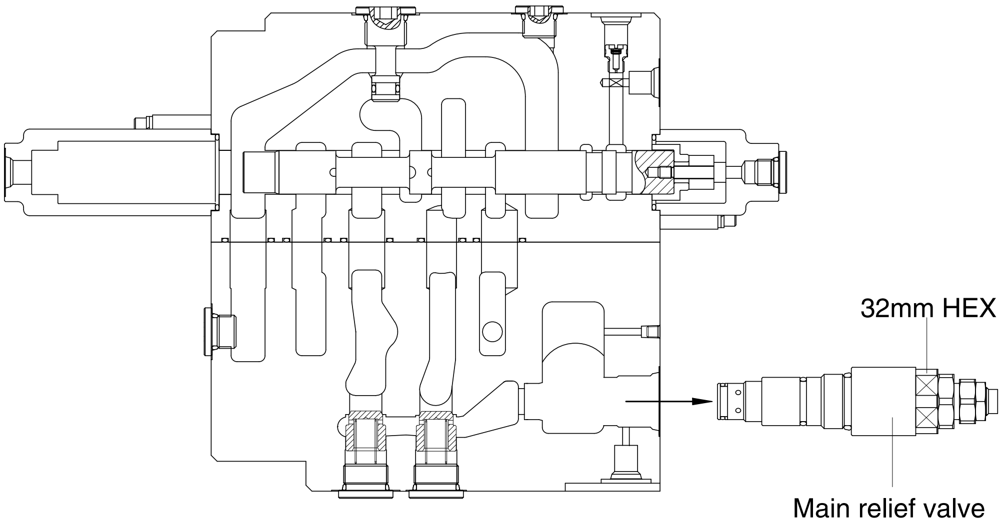
(5) Disassembly of the main and overload relief valve

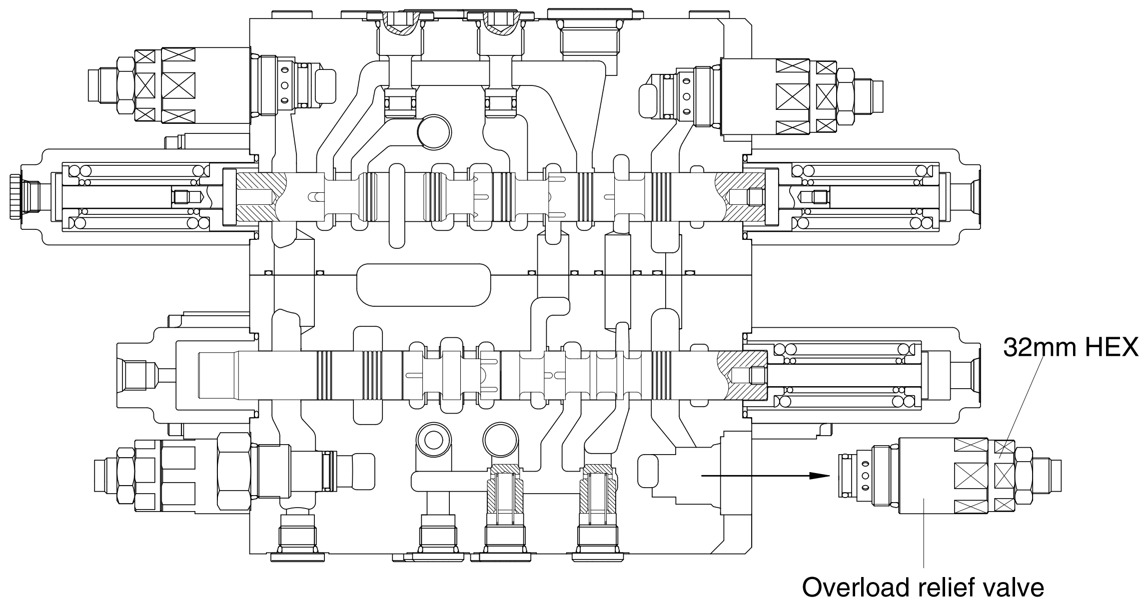
① Fix the body to suitable work bench.

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.





145LCR8MC14

(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 : 5mm
  · 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 : 5mm
  · 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.

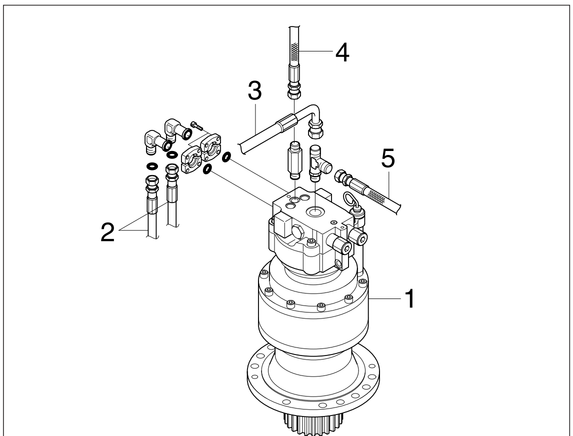
13031GE18

(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 : 34 ㎏ (75 ℔)



140WF8SM01

(7) Remove the swing motor assembly.

※ When removing the swing motor assembly, check that all the piping have been disconnected.

2) INSTALL

(1) Carry out installation in the reverse order to removal.

(2) Bleed the air from the swing motor.

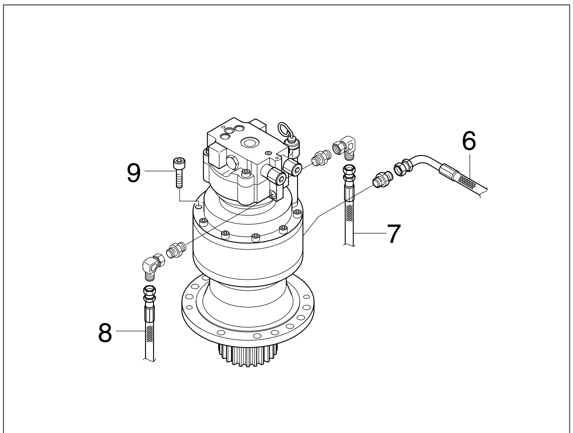
① Remove the air vent plug.

② Pour in hydraulic oil until it 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.

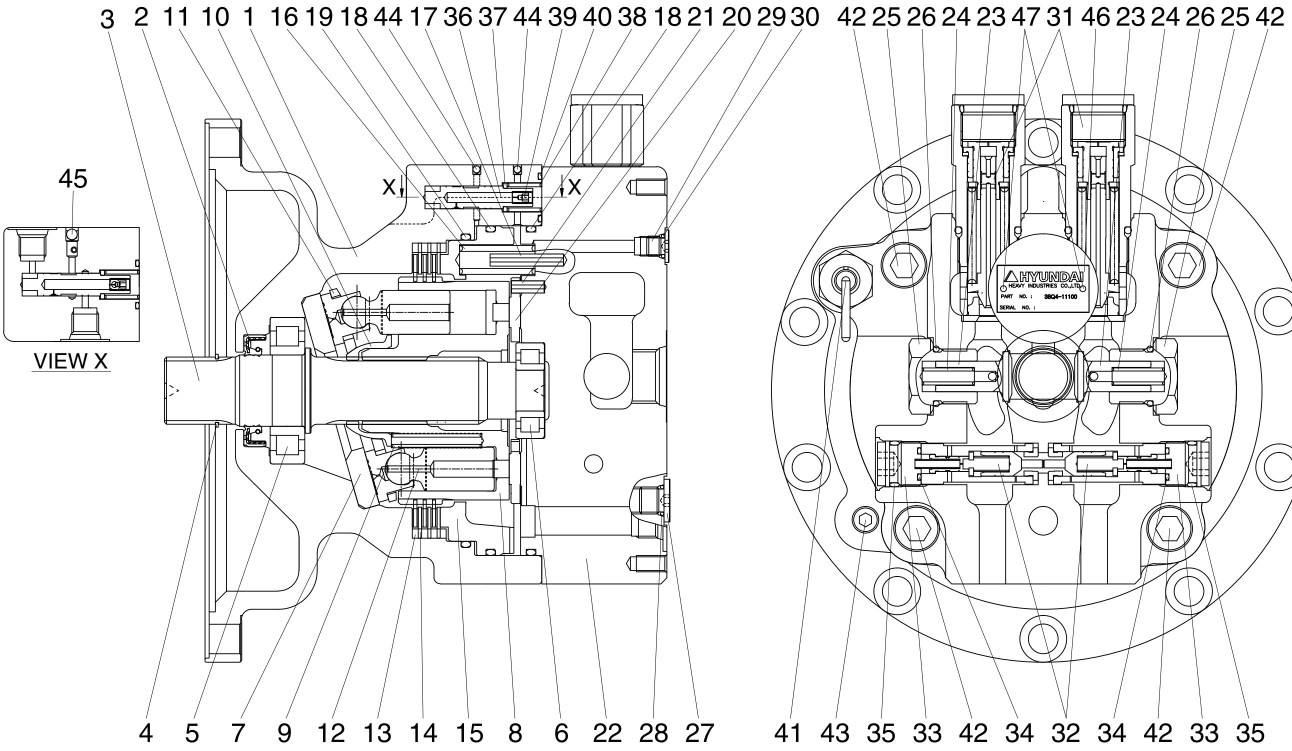


145WF8SM01A

(3) Confirm the hydraulic oil level and check the hydraulic oil leak or not.

2. DISASSEMBLY AND ASSEMBLY OF SWING MOTOR

1) STRUCTURE



125LCR2SM22

1	Casing
2	Oil seal
3	Shaft
4	Snap ring
5	Roller bearing
6	Roller 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	Valve casing
23	Check valve
24	Spring
25	Plug
26	O-ring
27	Plug
28	O-ring
29	Plug
30	O-ring
31	Relief valve assy
32	Anti-rotating valve assy
33	Plug
34	O-ring
35	O-ring
36	Time delay valve spool
37	Spring seat
38	Spring
39	Restrictor
40	O-ring
41	Level gauge assy
42	Socket bolt
43	Plug
44	Expander
45	Expander
46	Name plate
47	Rivet

2) DISASSEMBLY

(1) For easy assembly, put motor on worktable with the spline side of shaft (3) facing downwards.

※ Lay rubber plate on worktable and take care not to damage the components.

(2) Remove snap ring (4) using snap ring plier.

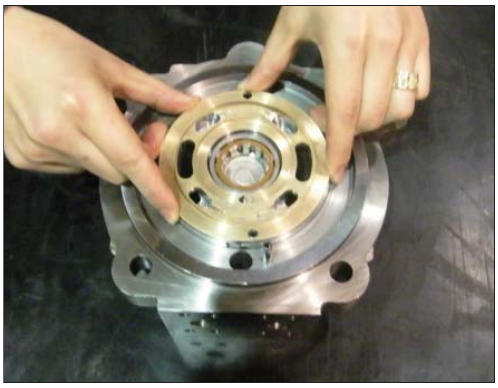
(3) Disassemble level gauge assembly (41) using pipe wrench.

(4) Disassemble two sets of relief valve assembly (31) using 36 mm socket wrench.

(5) Unscrew socket bolt (42) (4EA) using 12 mm hexagon wrench.

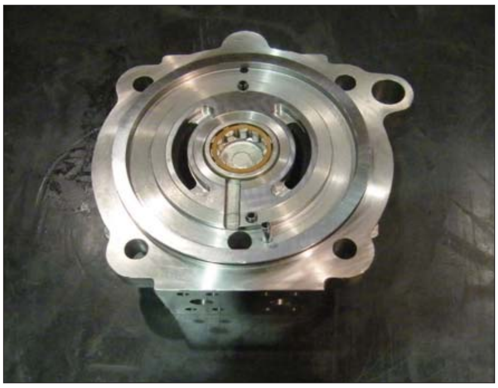
125LCR8SM07

(6) Remove valve plate (20) from valve casing.
※ Take care not to drop the valve plate (20).



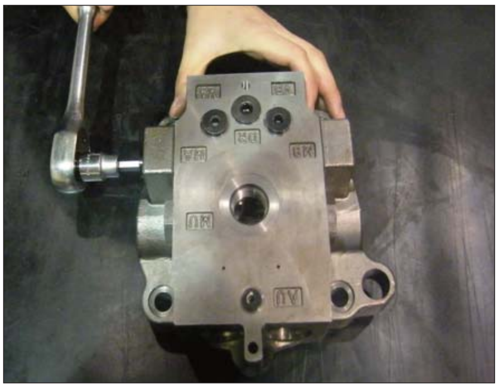
125LCR8SM08

(7) Remove O-ring (18) from valve casing.



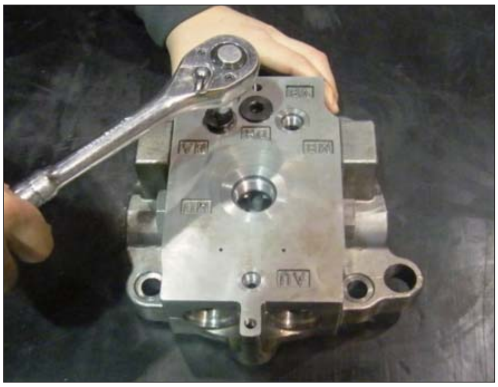
125LCR8SM09

(8) Remove plug (33) using 10 mm hexagon wrench and take out anti-rotating valve assembly (32). (same for the set on opposite side)



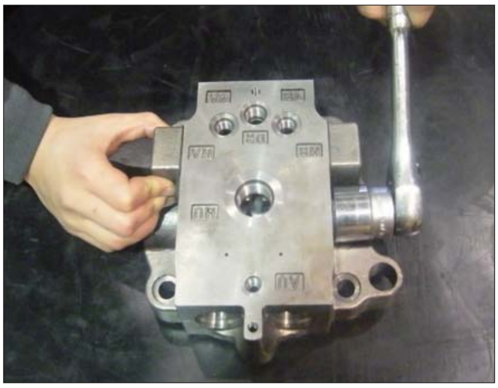
125LCR8SM10

(9) Remove plug (29) (1EA), plug (27) (2EA) using 4 mm, 6 mm hexagon wrench.



125LCR8SM11

(10) Remove plug (25) using 32 mm socket wrench and separate spring ; spring (24) and check valve (23). (same for the set on opposite side)

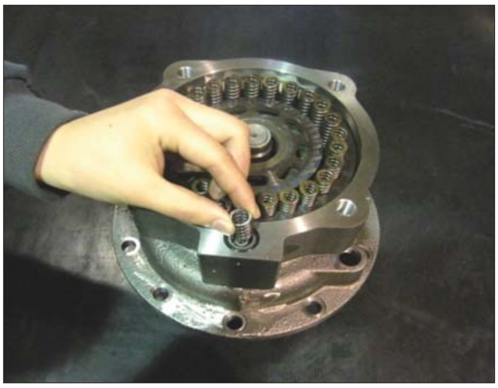


125LCR8SM12

(11) Separate each one of O-ring (40) and spring (38).

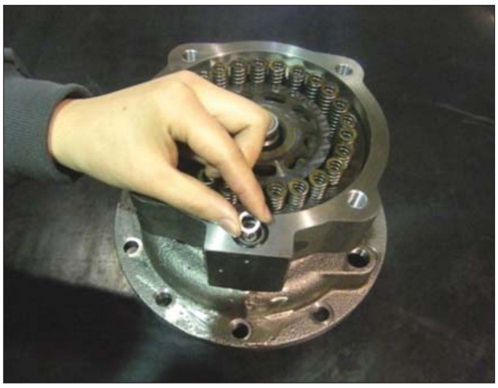
※ Do not lose spring.

※ Do not mix spring with other springs.



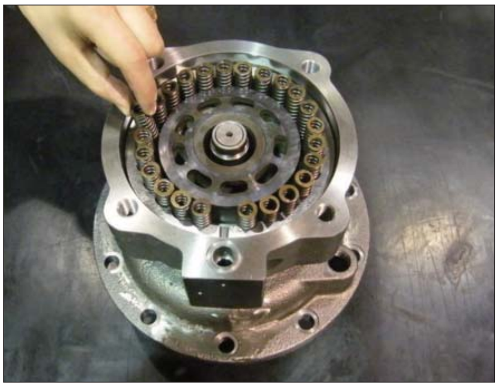
125LCR8SM13

(12) Remove spool (36) and spring seat (37).



125LCR8SM14

(13) Remove spring (16) (24EA) from parking piston.



125LCR8SM15

(14) Disassemble parking piston (15) from casing using air gun.

125LCR8SM16

(15) Lay casing down horizontally and remove cylinder block assembly from shaft.
And remove all friction plate (13) and separator plate (14).

125LCR8SM17

(16) Separate piston assembly (12), ball guide (10), retainer plate (11) and spring (9).

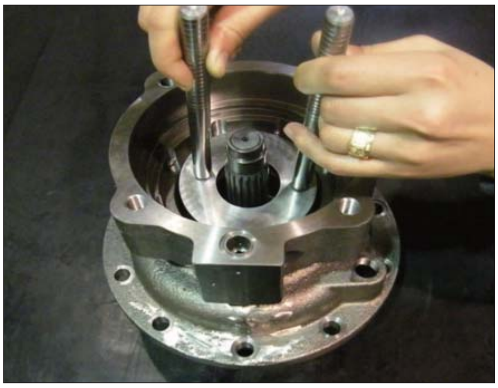
125LCR8SM18

(17) Remove O-ring (19) from casing.

125LCR8SM19

(18) Use a magnet to separate swash plate (7) from casing.

※ Sliding surface should be carefully treated to avoid scratches and damage.



125LCR8SM20

(19) Disassemble shaft (3) and cylinderical roller bearing (5).

※ Do not remove cylinderical roller bearing (5) unless malfunction is detected, since it is mounted by shrink fit.

125LCR8SM21

(20) Turn casing (1) upside down and remove oil seal (2) using jig.

125LCR8SM22

3) ASSEMBLY

※ Even though assembly is accomplished by reversing disassembly steps, be careful of the following.

① Repair the damaged part when disassemblying and prepare parts for exchange in advance.
② All parts should be cleaned with cleaner, dried with compressed air.
③ Sliding surface, O-ring, bearing and oil seal should be lubricated with clean hydraulic oil, prior to final assembly.
④ Replacement of O-ring and oil seal with new parts is generally recommended.
⑤ Use a torque wrench to make sure that assembly fasteners are tightened to specified values.
⑥ When assembling bolt, spread loctite.

(1) Put casing (1) on worktable.
Press oil seal (2) using oil seal jig, until it reach the bottom.
※ Spread grease on external diameter of oil seal.

125LCR8SM23

(2) Mount cylinderical roller bearing (5, 6) on shaft (3) using shrink fitting method.

125LCR8SM24

(3) Assemble shaft assembly in casing using urethane hammer.
※ Take care not to damage oil seal.

125LCR8SM25

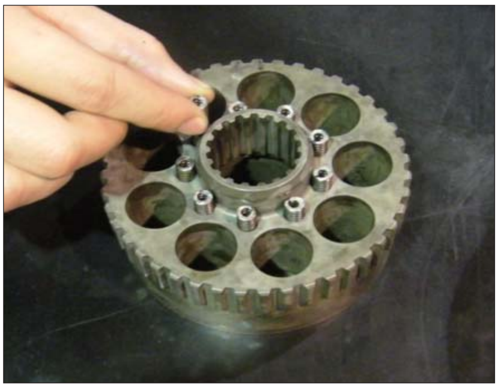
(4) Insert swash plate (7).
※ Take care not to damage sliding surface.

125LCR8SM26

(5) After applying grease on O-ring (19), insert O-ring in casing (1).

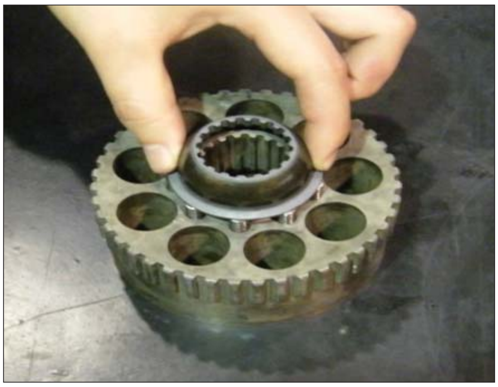
125LCR8SM27

(6) Assemble spring (9) (9EA) in cylinder block (8).



125LCR8SM28

(7) Assemble ball guide (10) in cylinder block.
※ Take care not to damage sliding surface of cylinder block.



125LCR8SM29

(8) Insert piston assembly (12) in retainer plate (11).
※ Do not mix piston with other piston (9EA/1set).
※ Spread sufficient amount of hydraulic oil on piston assembly.

125LCR8SM30

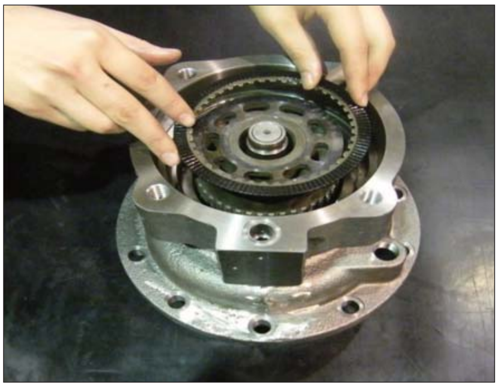
(9) Place all 9 pistons simultaneously into the holes of cylinder block.
※ Take care not to damage sliding surface.

125LCR8SM31

(10) Lay casing down horizontally and put cylinder block assembly in casing.
※ Check whether cylinder block assembly rotates smoothly.

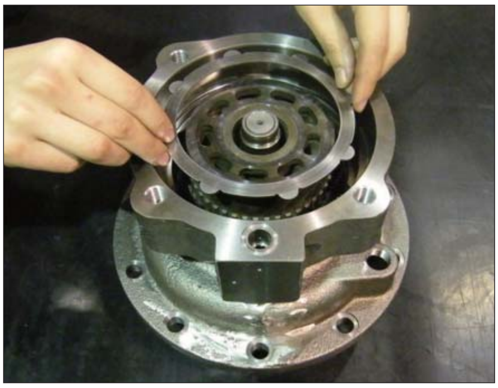
125LCR8SM32

(11) Put friction plate (13) in casing.



125LCR8SM33

(12) Put separator plate (14) in casing.
※ Put friction plate and separator plate alternately.

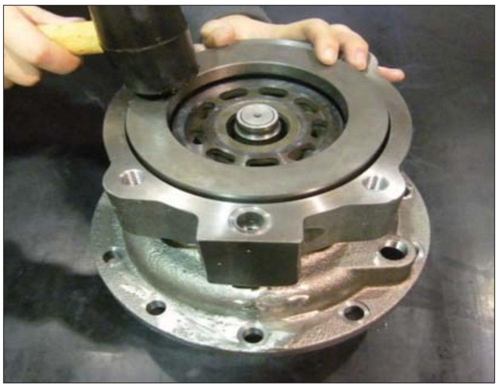


125LCR8SM34

(13) Assemble O-ring (18) in parking piston (15).
※ Apply grease on O-ring.

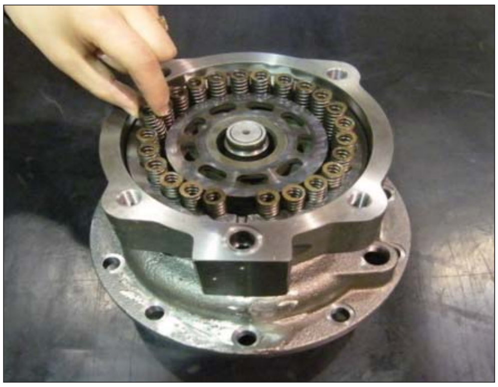
125LCR8SM35

(14) Assemble parking piston (15) in casing using jig.
※ Pay attention to the hole location of parking piston.



125LCR8SM36

(15) Put spring (16) (24EA) in each hole of parking piston.



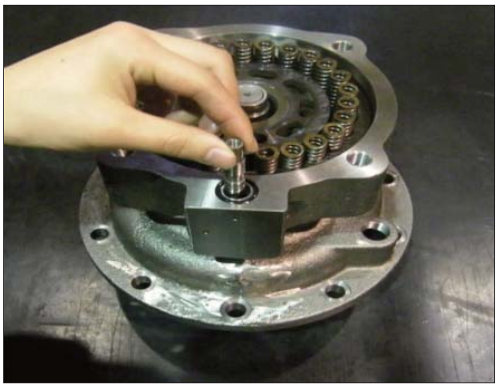
125LCR8SM37

(16) Assemble restrictor (39) in spool (36).

※ Spread loctite #242.

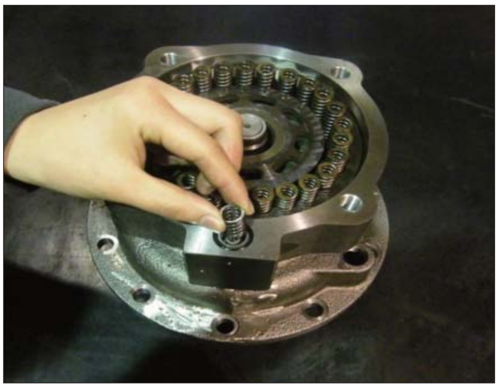
125LCR8SM38

(17) Place spool in casing.



125LCR8SM39

(18) Assemble spring (38) & spring seat (37) in casing.



125LCR8SM40

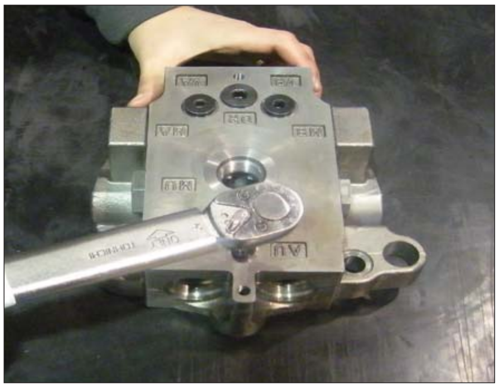
(19) Assemble plug (27) using 6 mm hexagon wrench.

※ Tightening torque : 4.5 kgf · m (32.5 lbf · ft)

125LCR8SM41

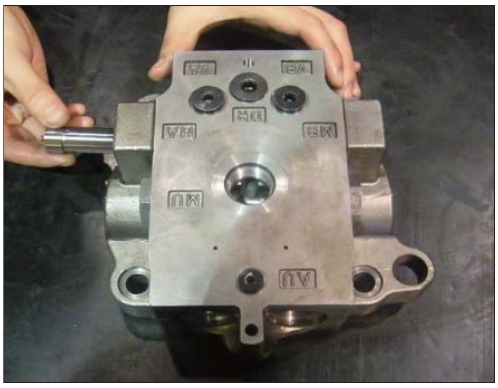
(20) Assemble plug (29) using 4 mm hexagon wrench.

※ Tightening torque : 3 kgf · m (21.7 lbf · ft)



125LCR8SM42

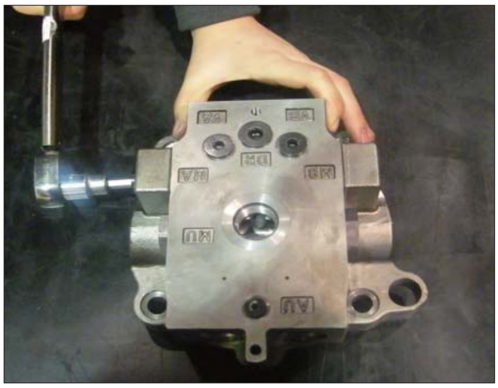
(21) Assemble anti-rotating valve assembly (32) in valve casing.



125LCR8SM43

(22) Assemble plug (33) using 32 mm hexagon wrench.

※ Tightening torque : 10 kgf · m (72.3 lbf · ft)



125LCR8SM44

(23) Caulk check valve (23) using jig. (same for the set on opposite side)

125LCR8SM45

(24) Assemble spring (24), plug (25). (in that order) (same for the set on opposite side)

※ Tightening torque : 15 kgf · m (108 lbf · ft)

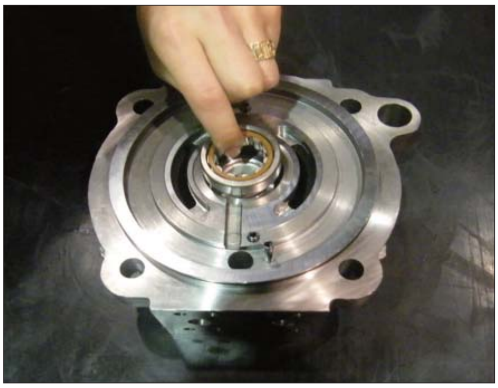
125LCR8SM46

(25) Assemble spring pin (21) in valve casing using jig.

125LCR8SM47

(26) Assemble O-ring (18) & cylinderical roller bearing (6) in valve casing.

※ Use jig (press fit or cold shrink fit).

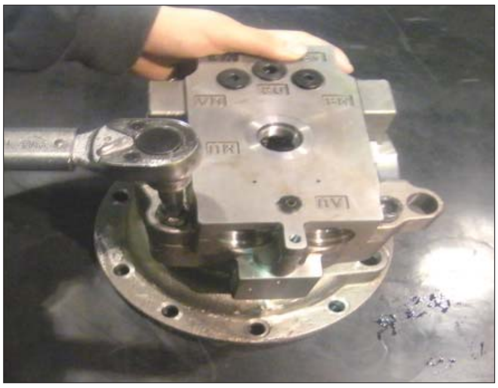


125LCR8SM48

(27) Apply grease on steel side of valve plate (20) to prevent plate from sliding.
Assemble valve plate with the copper side facing upwards.
※ Pay attention to the assembly direction.
※ Take care not to damage sliding surface.

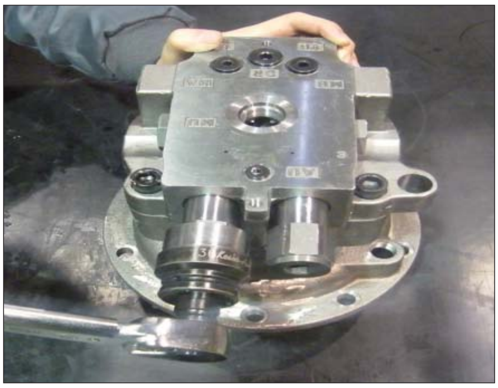
125LCR8SM49

(28) Assemble valve casing by matching its holes and pins of casing and parking piston. And tighten bolt; socket (42) (4EA) using 12 mm hexagon wrench.
※ Tightening torque : 17.5 kgf · m (127 lbf · ft)
※ Make sure valve plate stays in place.
※ When tightening bolts, make sure mating surfaces between casing and valve casing maintain parallel to each other.



125LCR8SM50

(29) Assemble relief valve assembly (31) using 36 mm socket wrench in valve casing.
※ Spread grease on O-ring part of relief valve assembly.
※ Tightening torque : 18 kgf · m (130 lbf · ft)

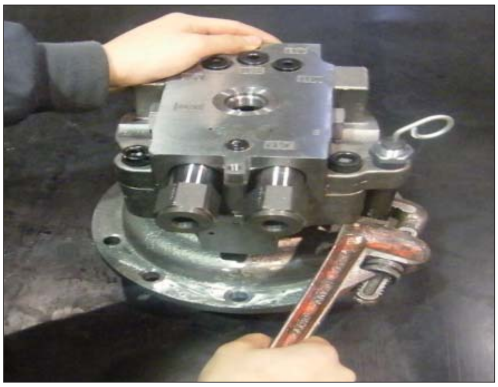


125LCR8SM51

(30) Assemble snap ring (4) in shaft by using snap ring plier.

125LCR8SM52

(31) Wrap teflon tape 2 or 3 times around the tap part of level gauge assembly (41).
And assemble it using pipe wrench.



125LCR8SM53

3. REMOVAL AND INSTALL OF REDUCTION GEAR

1) REMOVAL

(1) Remove the swing motor assembly.
For details, see removal of swing motor assembly.

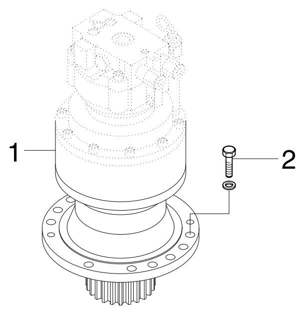
(2) Sling reduction gear assembly (1) and remove mounting bolts (2).

(3) Remove the reduction gear assembly.
· Reduction gear device weight : 75 kg (165 lb)

13031GE18

2) INSTALL

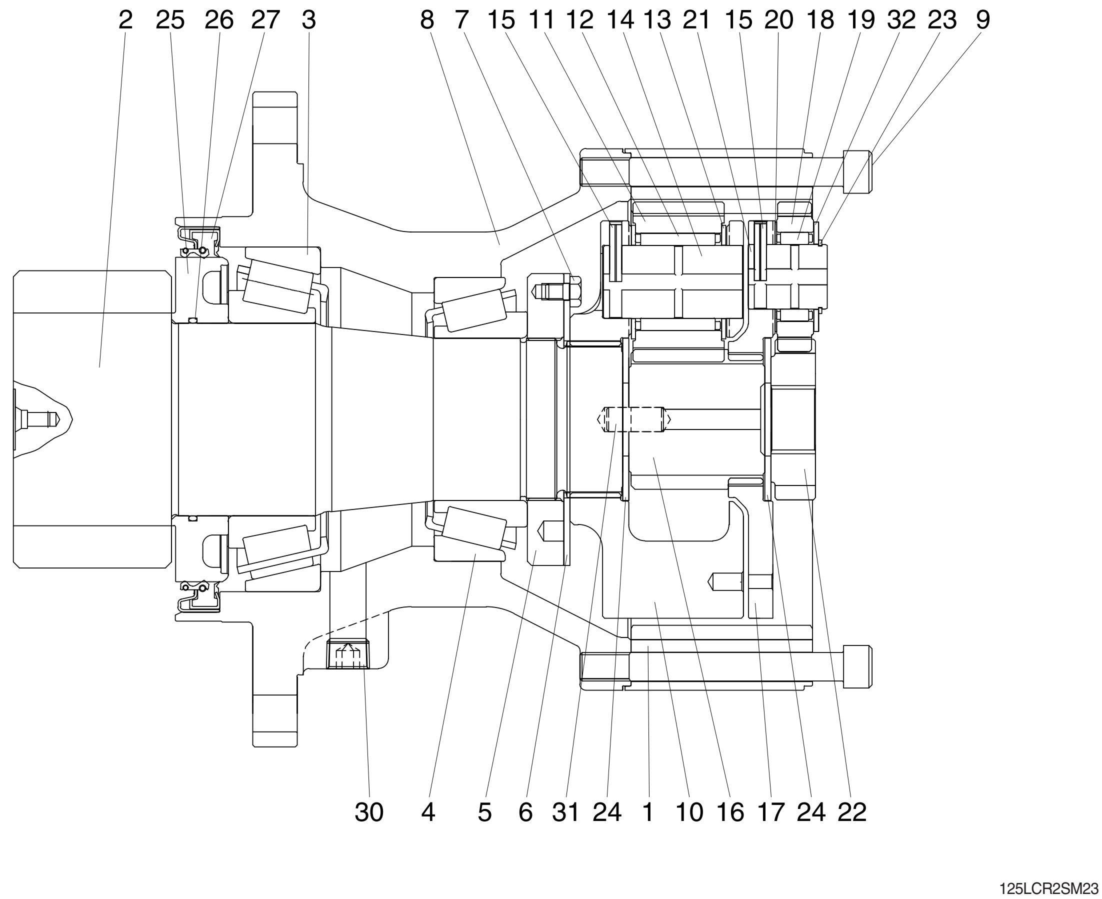
(1) Carry out installation in the reverse order to removal.
· Tightening torque : 17.5 kgf · m (126 lbf · ft)



125LCR9A8SM03

4. DISASSEMBLY AND ASSEMBLY OF REDUCTION GEAR

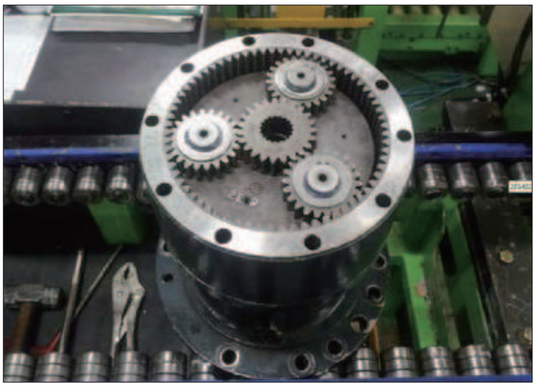
1) STRUCTURE



1	Ring gear	11	Planetary gear No. 2	21	Carrier pin No. 1
2	Drive shaft	12	Needle bearing No. 2	22	Sun gear No. 1
3	Bearing	13	Thrust washer No. 2	23	Snap ring
4	Bearing	14	Carrier pin No. 2	24	Thrust plate
5	Ring nut	15	Spring pin	25	Sleeve
6	Lock plate	16	Sun gear No. 2	26	O-ring
7	Hexagon bolt	17	Carrier No. 1	27	Oil seal
8	Casing	18	Planetary gear No. 1	30	Plug
9	Socket bolt	19	Needle bearing No. 1	31	Parallel pin
10	Carrier No. 2	20	Thrust washer No. 1	32	Thrust washer No. 1

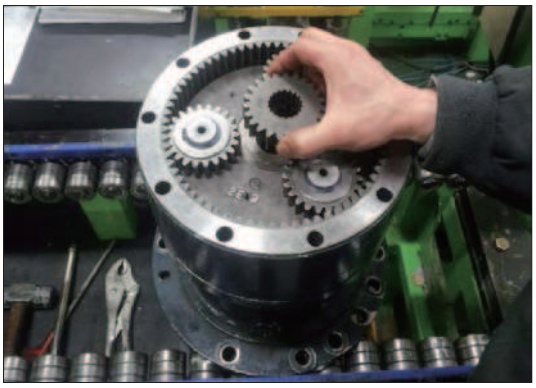
2) DISASSEMBLY

(1) Remove the swing motor, and then place swing reduction gear on the bench.



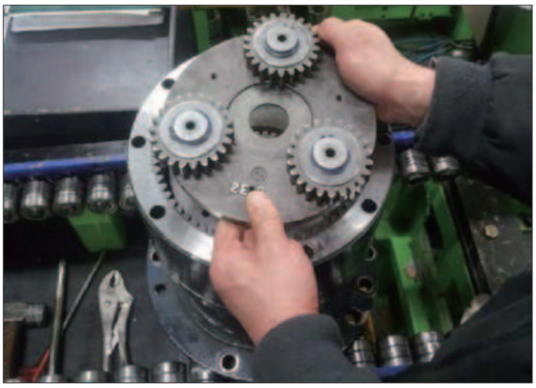
125LCR8SM60

(2) Disassemble sun gear No.1 (22).



125LCR8SM61

(3) Disassemble carrier No.1 sub assembly.



125LCR8SM62

Carrier No.1 sub assy disassembly

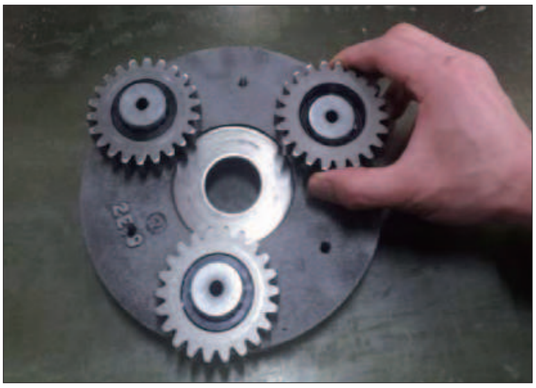
(4) Put carrier No.1 sub assembly on the bench, then remove the snap ring (23).

125LCR8SM63

(5) Disassemble thrust washer No.1 (upper) (32).(3 pcs)

125LCR8SM64

(6) Disassemble planetary gear No.1 (18). (3 pcs)

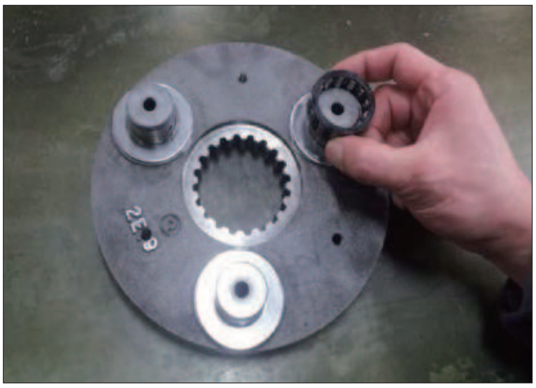


125LCR8SM65

(7) Disassemble thrust plate (24).

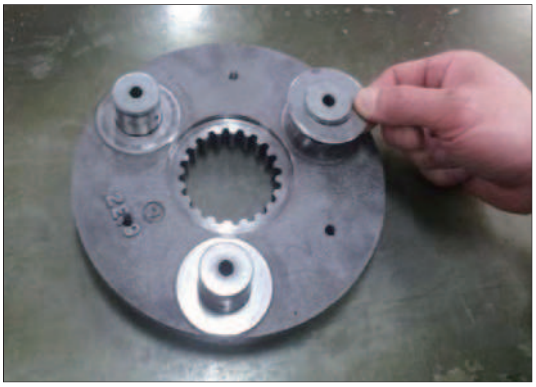
125LCR8SM66

(8) Disassemble needle bearing No.1 (19). (3 pcs)



125LCR8SM67

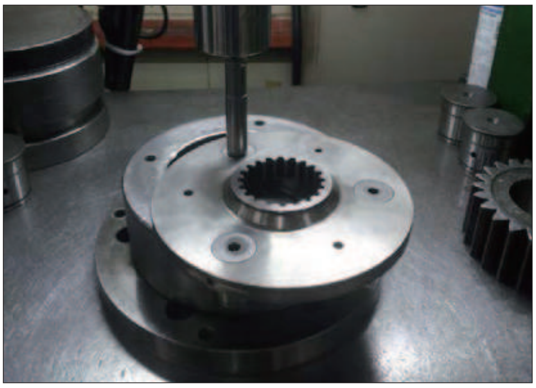
(9) Disassemble thrust washer No.1 (lower) (20). (3 pcs)



125LCR8SM68

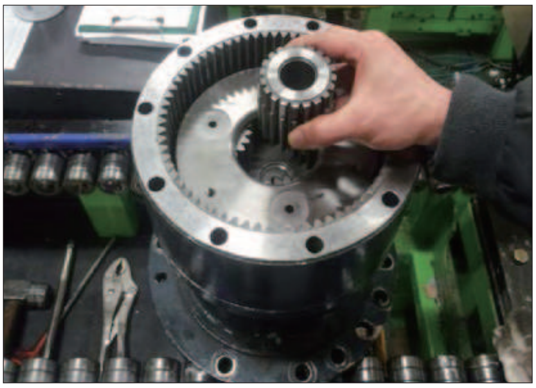
(10) After placing spring pin (15) to center of carrier pin No.1 (21) with a jig, disassemble it. (3 pcs)

※ Do not reuse spring pin, carrier and carrier pin.



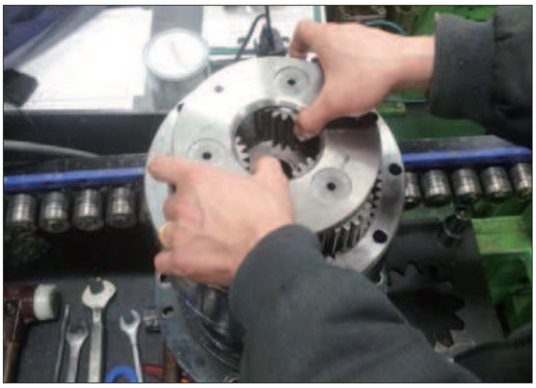
125LCR8SM69

(11) Disassemble sun gear No.2 (16).



125LCR8SM70

(12) Disassemble carrier No.2 sub assembly.

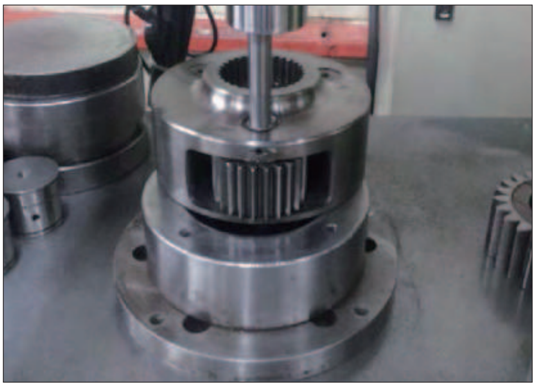


125LCR8SM71

Carrier No.2 sub assy disassembly

(13) After placing spring pin (15) to center of carrier pin No.2 (14) with a press machine, disassemble it.(3 pcs)

※ Do not reuse spring pin.

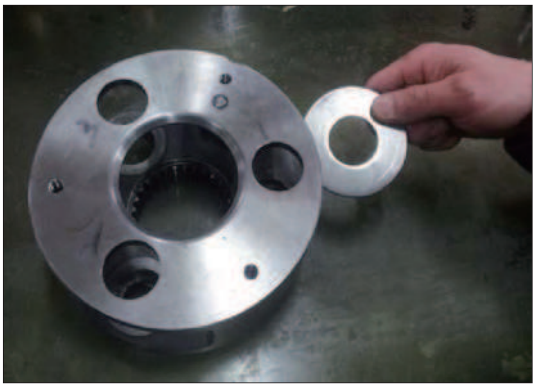


125LCR8SM72

(14) Disassemble planetary gear No.2.(3 pcs)

125LCR8SM73

(15) Disassemble thrust plate (24).



125LCR8SM74

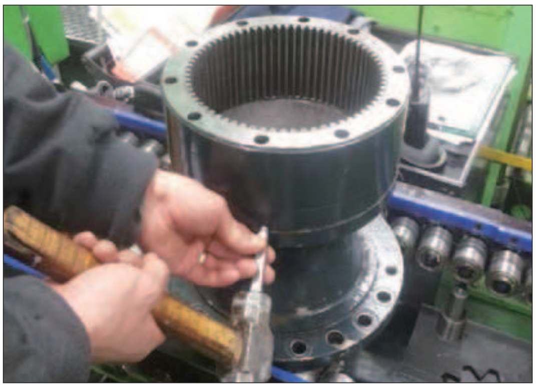
(16) Disassemble thrust washer No.2 (13).(6 pcs)

125LCR8SM75

(17) Disassemble needle bearing No.2 (12). (3 pcs)

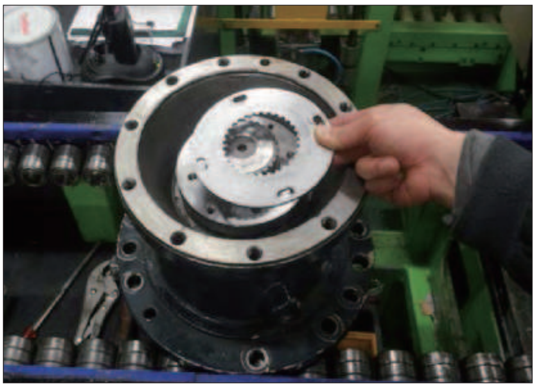
125LCR8SM76

(18) Separate ring gear (1) from casing (8).



125LCR8SM77

(19) Loosen a bolt (7) (4 pcs), and disassemble lock plate (6).



125LCR8SM78

(20) Disassemble nut ring (5) by using the jig.

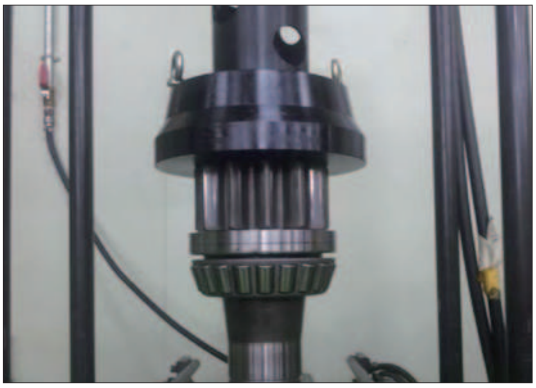
125LCR8SM79

Drive shaft sub assy disassembly

(21) Separate drive shaft sub assembly from casing (8).

125LCR8SM80

(22) Disassemble taper bearing (3) and oil seal (27) by using a press machine.

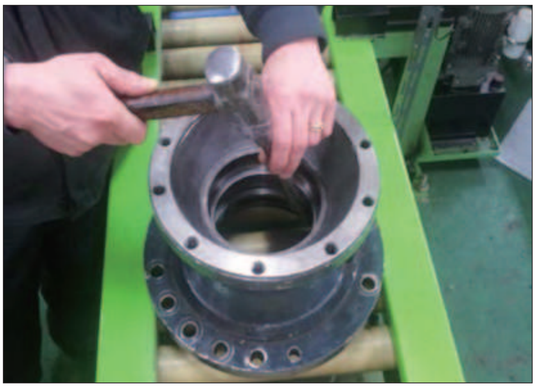


125LCR8SM81

(23) Disassemble sleeve (25) and O-ring (26).

125LCR8SM82

(24) Disassemble the outer ring of taper bearing (3) in casing (8) by using the jig.



125LCR8SM83

3) ASSEMBLY

※ Even though assembly is accomplished by reversing disassembly steps, be careful of the following.

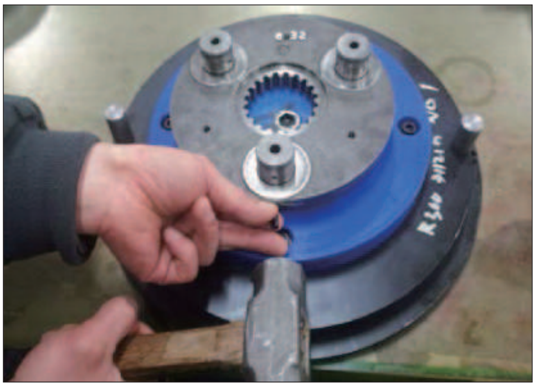
① Repair the damaged part when disassemblying and prepare parts for exchange in advance.
② All parts should be cleaned with cleaner, dried with compressed air.
③ Sliding surface, O-ring, bearing and oil seal should be lubricated with clean hydraulic oil, prior to final assembly.
④ Replacement of O-ring and oil seal with new parts is generally recommended.
⑤ Use a torque wrench to make sure that assembly fasteners are tightened to specified values.
⑥ When assembling bolt, spread loctite.

Carrier No.1 sub assembly

(1) After heating the carrier No.1 (17), assemble carrier pin No.1 (21) to the side without thehole.

125LCR8SM84

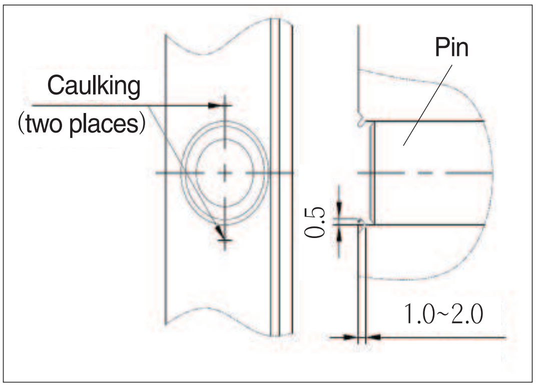
(2) After drilling ø 6 hole, assemble spring pin (15).(3 pcs)



125LCR8SM85

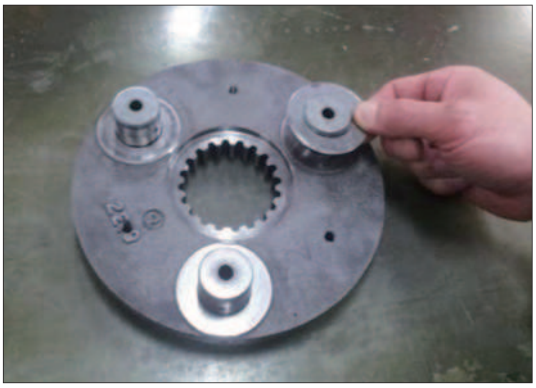
(3) Caulking is performed on the assembled spring pin unit.

※ To cover pins, implement the caulking in two places that are located direction of 180 degrees around assembled spring pin.



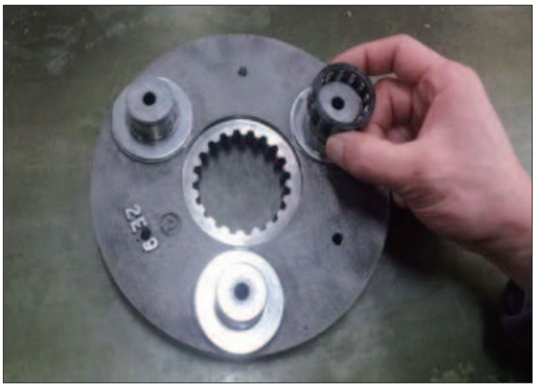
125LCR8SM86

(4) Assemble thrust washer No.1 (lower) (20). (3 pcs)



125LCR8SM87

(5) Assemble needle bearing No.1 (19).(3 pcs)

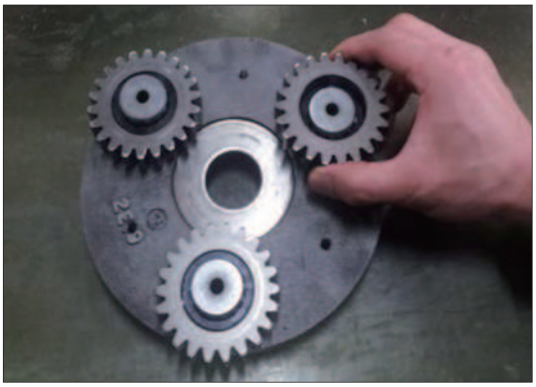


125LCR8SM88

(6) Assemble thrust plate (24).

125LCR8SM89

(7) Assemble planetary gear No.1 (18) of which groove is faced downward.(3 pcs)



125LCR8SM90

(8) Assemble thrust washer No.1 (upper) (32). (3 pcs)

125LCR8SM91

(9) Assemble snap ring (23) (3 pcs), complete carrier No.1 sub assembly.

※ Gear rotation state should be smooth.

125LCR8SM92

Carrier No.2 sub assy assembly

(10) Assemble needle bearing No.2 (12) in the planetary gear No.2 (11).

125LCR8SM93

(11) After spreading grease on thrust washer No.2 (13), assemble it on both upper side and lower side of planetary gear No.2.

125LCR8SM94

(12) Assemble thrust plate (24).

125LCR8SM95

(13) Assemble planetary gear No.2 in the carrier No.2 (10).(3 pcs)
※ Thrust washer No.2 should notseparated.

125LCR8SM96

(14) Assemble carrier pin No.2 (14) to match the pin hole of the carrier No.2.(3 pcs)

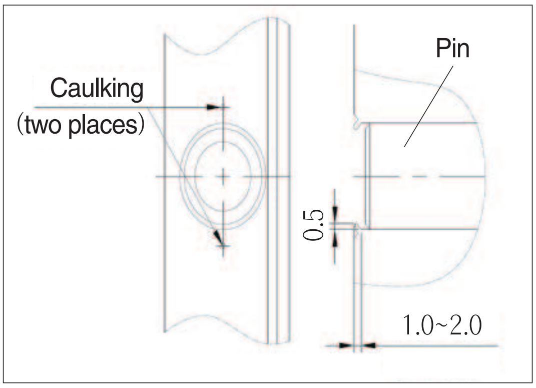
125LCR8SM97

(15) Assemble spring pin (15).(3 pcs)

125LCR8SM98

(16) Caulking is performed on the assembled spring pin unit.

※ To cover pins, implement the caulking in two places that are located direction of 180 degrees around assembled spring pin.



125LCR8SM99

Drive shaft sub assy assembly

(17) After heating sleeve (25), assemble O-ring (26) to groove of inside diameter in it.

125LCR8SM100

(18) Shrink fit the sleeve on drive shaft (2).

※ Be careful of fully seat at the bottom.

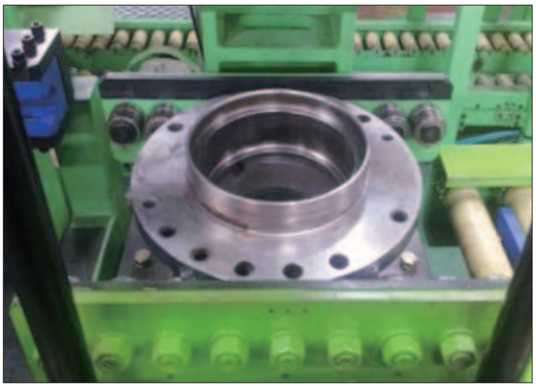
125LCR8SM101

(19) Shrink fit taper bearing (3) on drive shaft, complete drive shaft sub assembly.

125LCR8SM102

Casing assembly

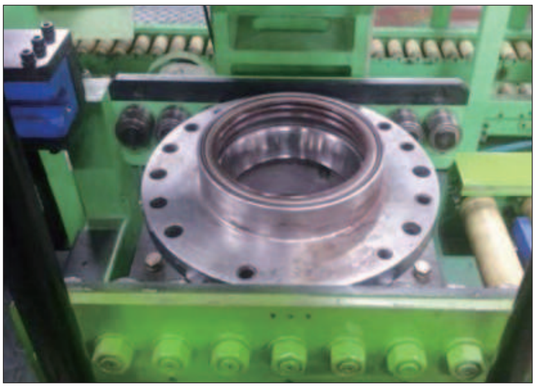
(20) Press outer ring of the taper bearing in the casing (8) by using the jig.



125LCR8SM103

(21) Press in oil seal (27) by using the jig.

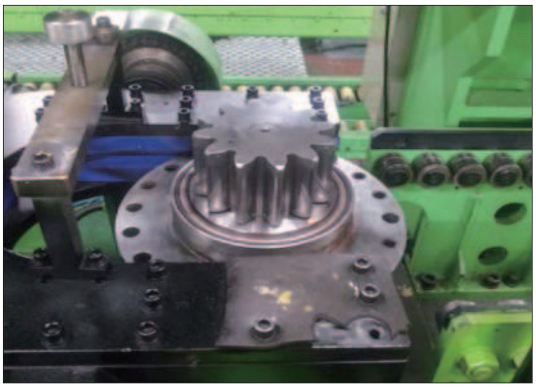
※ Be careful of the direction of the assembly.



125LCR8SM104

(22) Assemble drive shaft sub assembly.

※ Be careful of damage of oil seal.



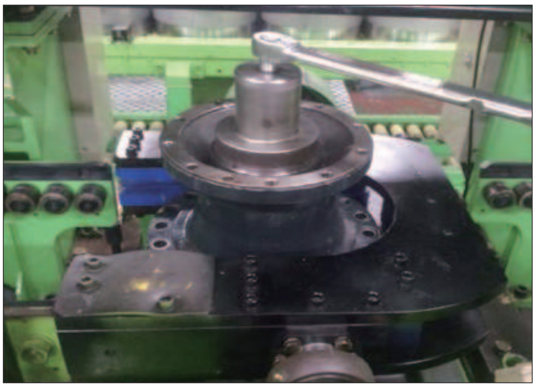
125LCR8SM105

(23) After fixing drive shaft so that it does not fall, and then turn it over, press taper bearing (4).

125LCR8SM106

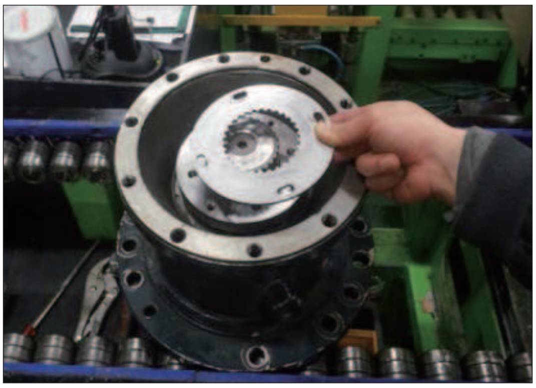
(24) Assemble nut ring (5) by using the jig.

※ Tightening torque : 3.5±0.4 kgf · m (25.3±2.9 lbf · ft)



125LCR8SM107

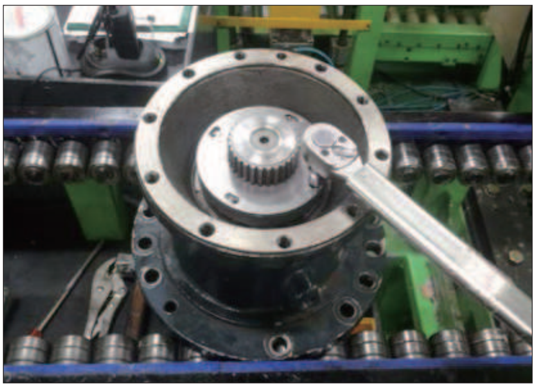
(25) Place lock plate (6) on the nut ring.



125LCR8SM108

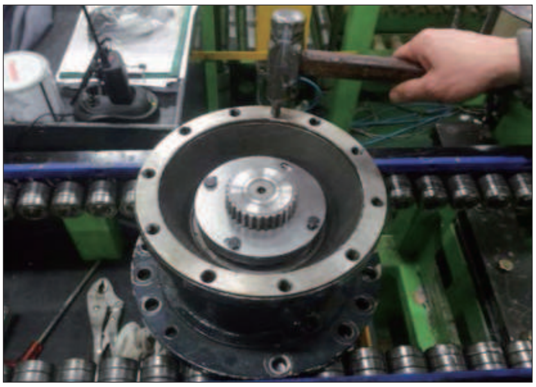
(26) After spreading loctite #242, assemble the bolt (7) (4 pcs).

※ Tightening torque : 2.5±0.25 kgf · m (18.1±1.8 lbf · ft)



125LCR8SM109

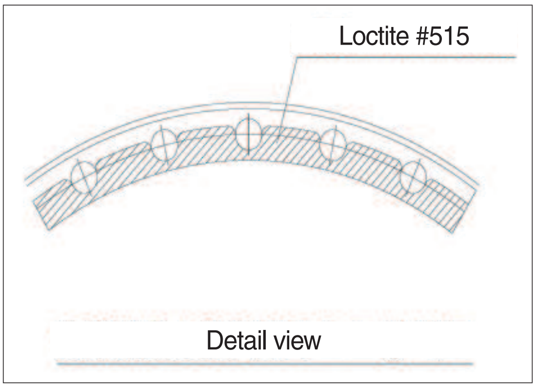
(27) Press parallel pin (31) by using press machine.



125LCR8SM110

(28) Spread the loctite #515 on the casing with reference to the right detail view.

※ Loctite should not flow into casing.



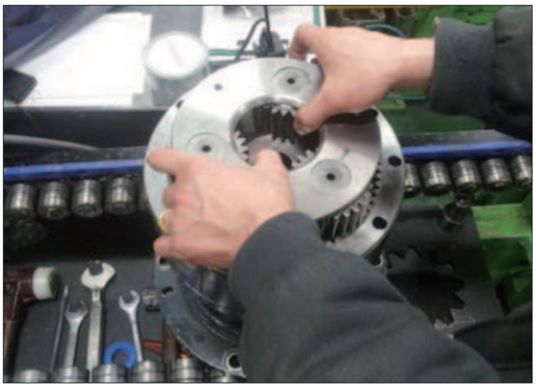
125LCR8SM111

(29) Assemble ring gear (1) in accordance with a pin hole on casing.

※ Be careful of damage of the ring gear.

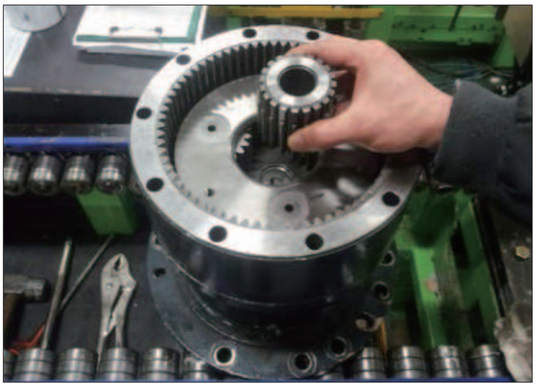
125LCR8SM112

(30) Assemble carrier No.2 sub assembly.



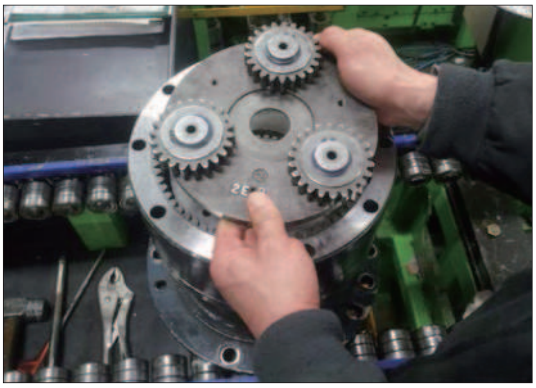
125LCR8SM113

(31) Assemble sun gear No.2 (16).



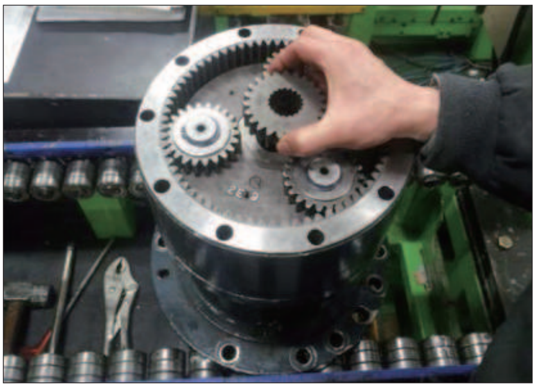
125LCR8SM114

(32) Assemble carrier No.1 sub assembly.



125LCR8SM115

(33) Assemble sun gear No.1 (22) of which grinding surface is faced downward.



125LCR8SM116

(34) Fill with gear oil 3.5 liter.

125LCR8SM117

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.

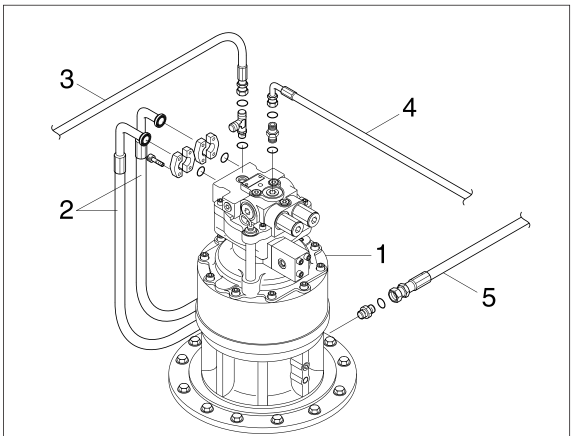
13031GE18

(4) Disconnect hose assembly (2).

(5) Disconnect pilot line hoses (3, 4, 5, 6, 7, 9).

(6) Sling the swing motor assembly (1) and remove the swing motor mounting socket bolts (10).

· Motor device weight : 32kg (71lb)



14W98SM01

(7) Remove the swing motor assembly.

※ When removing the swing motor assembly, check that all the piping have been disconnected.

2) INSTALL

(1) Carry out installation in the reverse order to removal.

(2) Bleed the air from the swing motor.

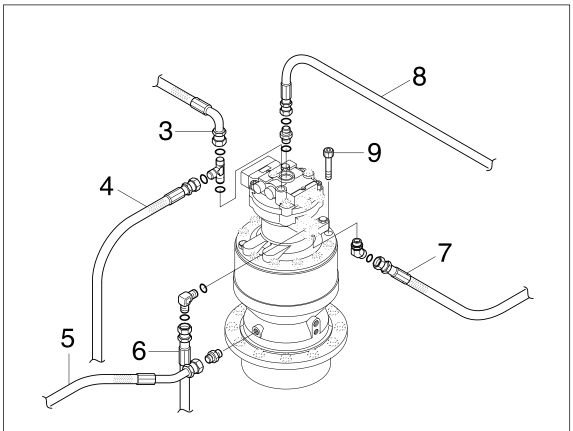
① Remove the air vent plug.

② Pour in hydraulic oil until it 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.

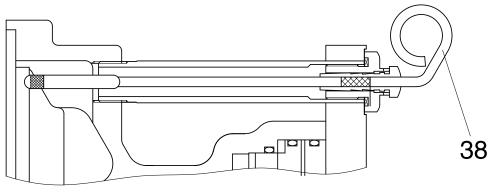


14W98SM02

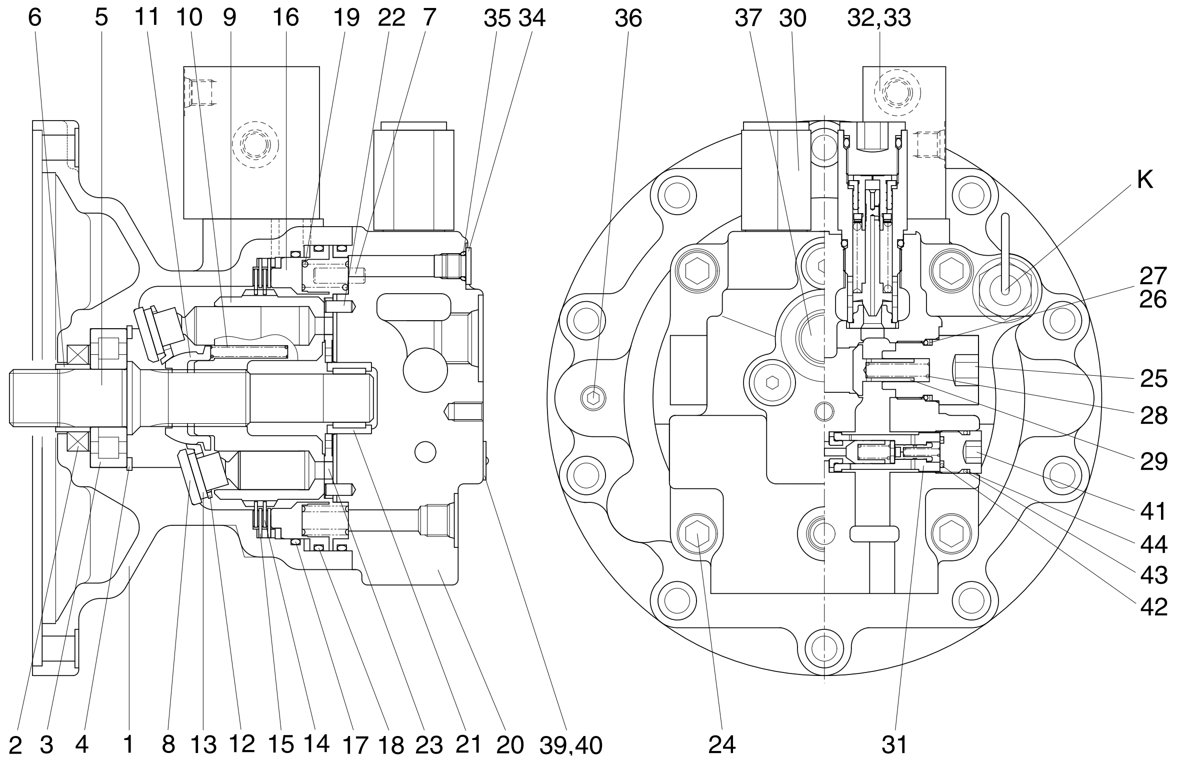
(3) Confirm the hydraulic oil level and check the hydraulic oil leak or not.

2. DISASSEMBLY AND ASSEMBLY OF SWING MOTOR

1) STRUCTURE



DETAIL K



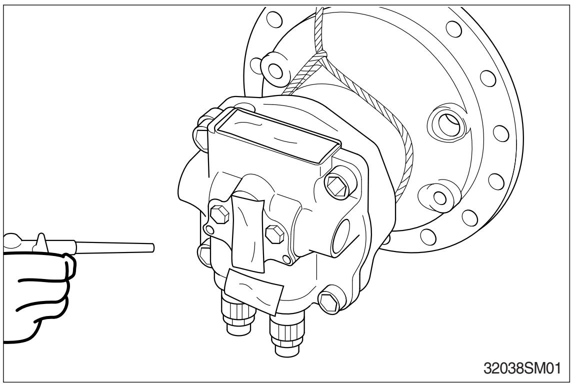
14W92SM02

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

2) DISASSEMBLY

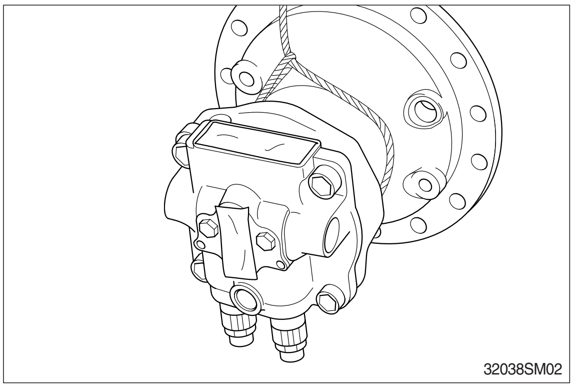
(1) Lift the motor out. Clean the motor in kerosene and dry with compressed air.

※ To avoid dust inside the motor, mask all the ports of the motor with tapes.



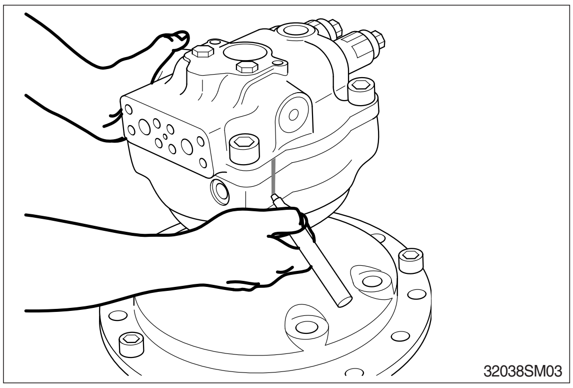
32038SM01

(2) Loosen the drain plug to discharge oil in the body(1).



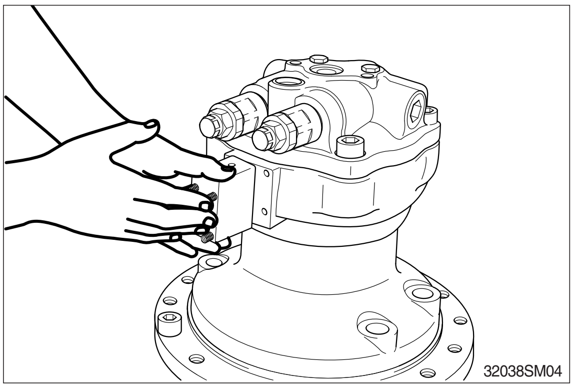
32038SM02

(3) Fix the drive shaft (5) on the workbench with the end of output shaft down. Put matching marks on body (1) and valve rear cover (20) for easy reassembly.



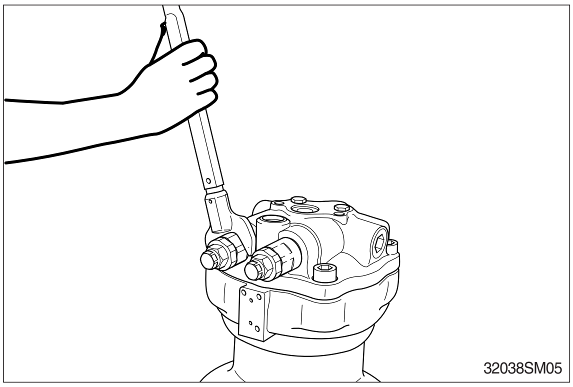
32038SM03

(4) Remove the valve (32).

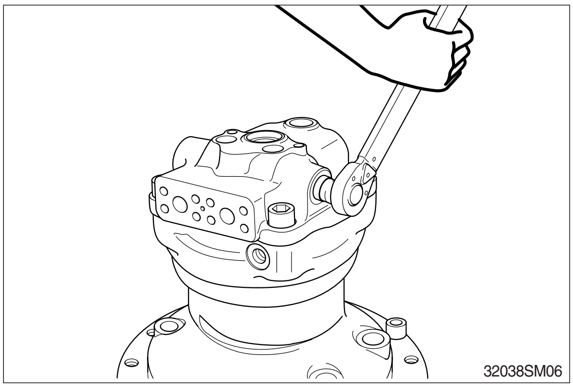


32038SM04

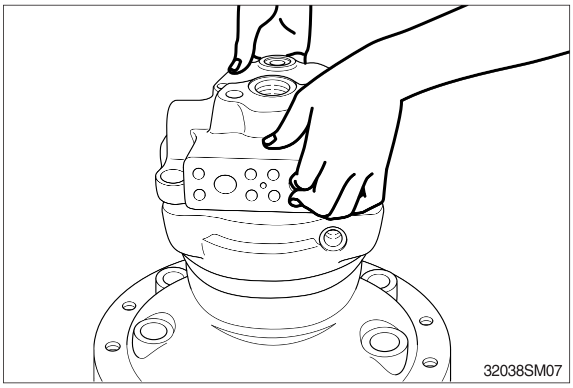
(5) Remove the relief valve (30) from rear cover (20).



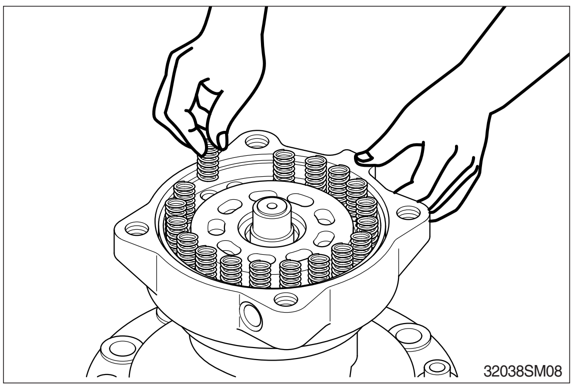
(6) Remove plug (25) from rear cover (20) and spring (28), check (29).
※ Be careful not to damage the check seat assembly.



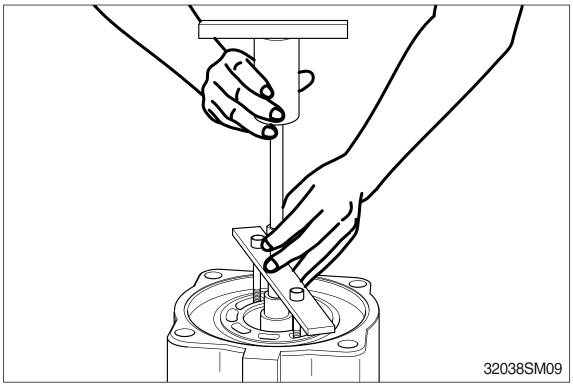
(7) Remove rear cover (20) from body (1). Then, remove the valve plate (23) from rear cover (20) with care.



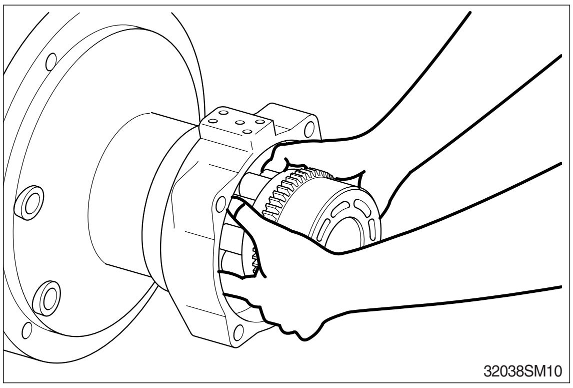
(8) Remove the brake spring (19) from brake piston (16).



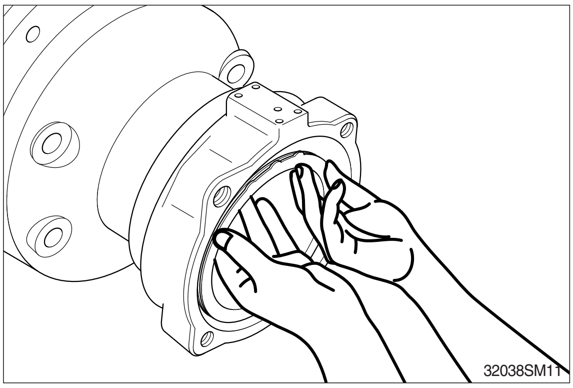
(9) Remove brake piston (16) from body (1).


32038SM09

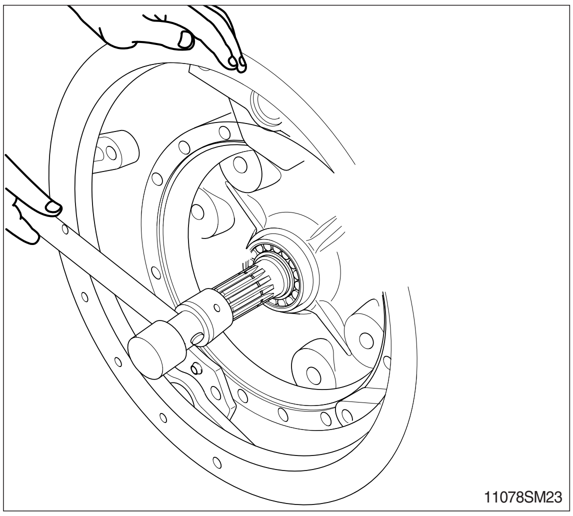
(10) Remove the cylinder (9) from the drive shaft (5) with the motor positioned horizontally. Remove ball guide (11), set plate (12), piston (13) and shoe plate (8).


32038SM10

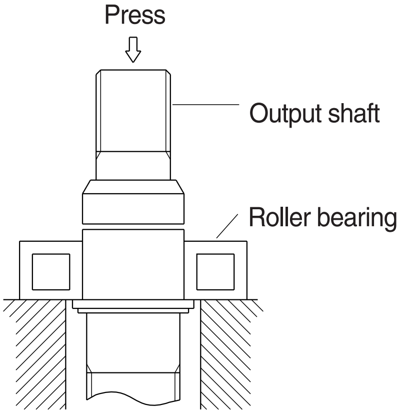
(11) Remove friction plate (14) and separate plate (15) from body (1).

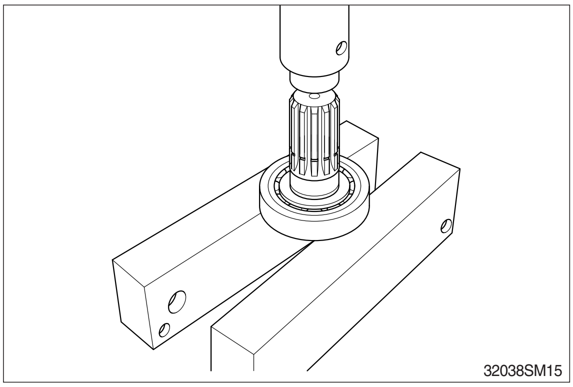

32038SM11

(12) Remove snap ring (4) and remove drive shaft (5) from body (1).

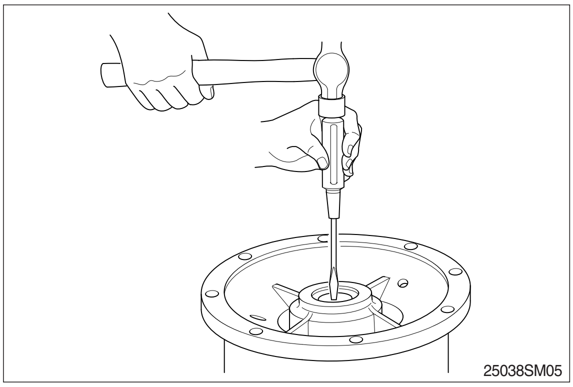

11078SM23

(13) Remove the cone of roller bearing (3) by press.
※ Do not reuse bearings.

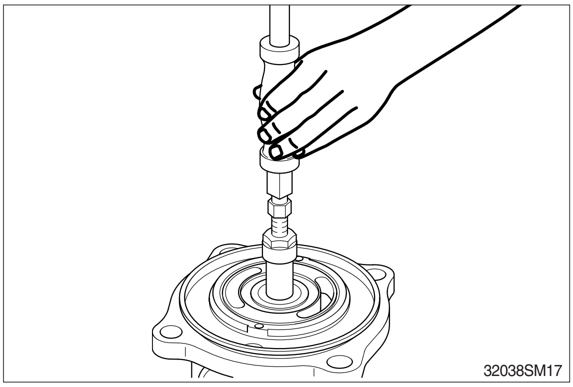




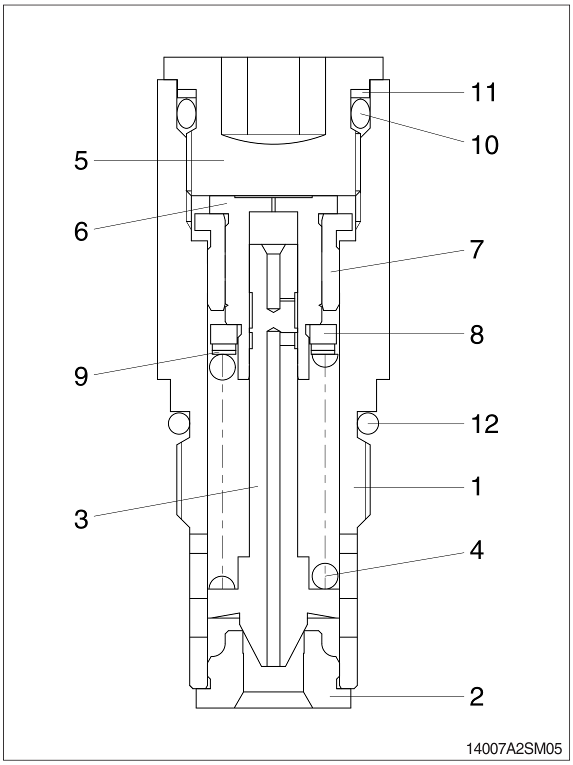
(14) Remove bushing (6) and oil seal (2) from body (1).



(15) Remove the needle bearing (21) from the rear cover (20) by using slide hammer bearing puller.



(16) When disassembling the relief valve, release the adjusting screw (5).
Remove the piston (6), spring seat (8), spring (4) and plunger (3) with the body (1) downwards.

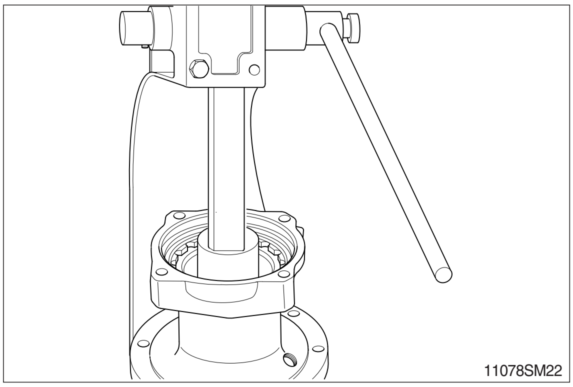


This completes disassembly.

3) ASSEMBLY

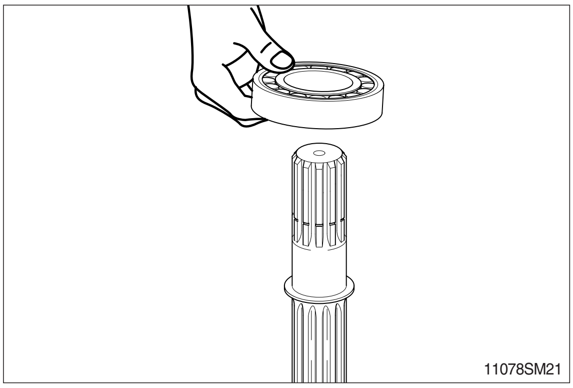
Do the reassembly in the reverse procedure of the disassembly.

(1) Apply three bond of white color on outer surface of oil seal (2) and insert it to the body (1).



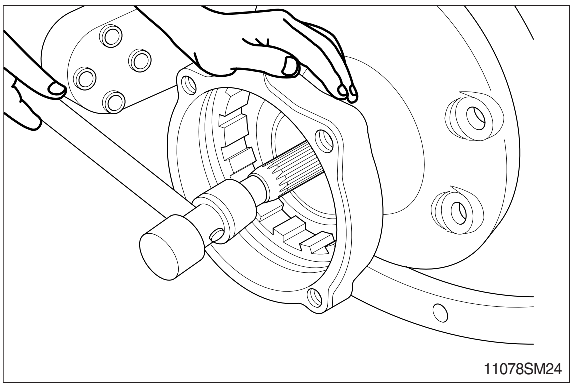
11078SM22

(2) Install the roller bearing (3) to the drive shaft (5).



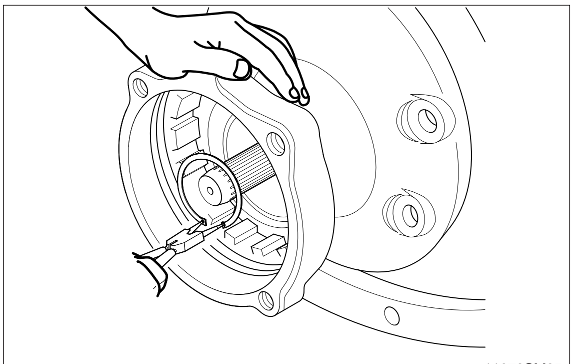
11078SM21

(3) Insert the drive shaft (5) into the body (1) with the plastic hammer lightly.



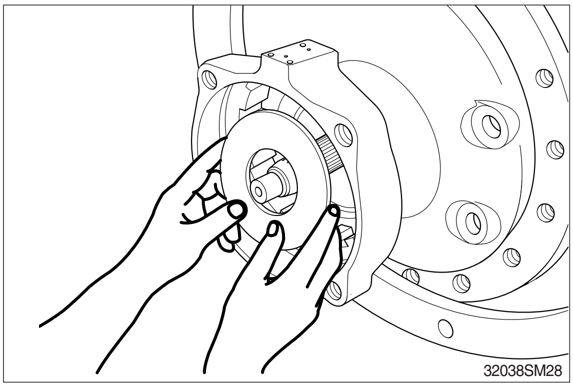
11078SM24

(4) Install the snap ring (4) to the body (1).



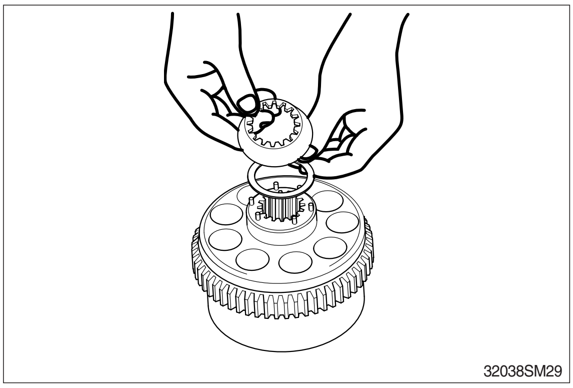
11078SM25

(5) Insert the shoe plate (8) with the body (1) position horizontally.



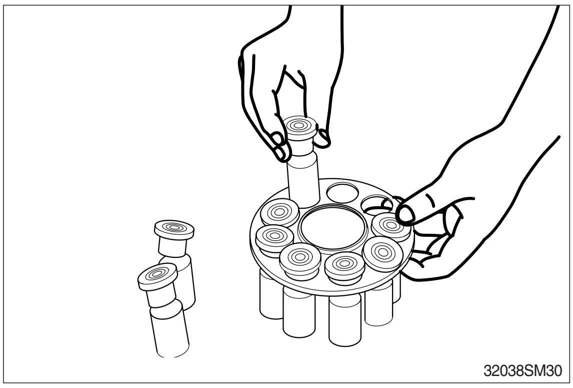
32038SM28

(6) Insert the ball guide (11) into the cylinder (9).



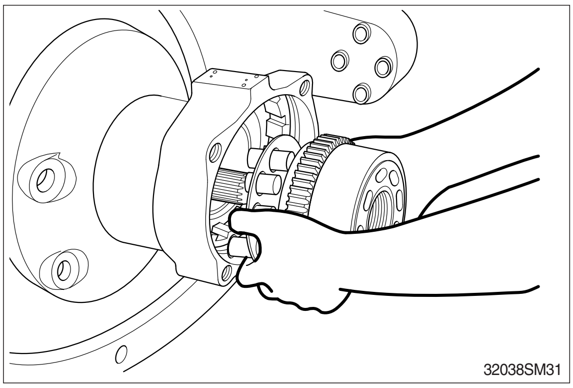
32038SM29

(7) Install the piston sub-assembly (13) to the set plate (12).



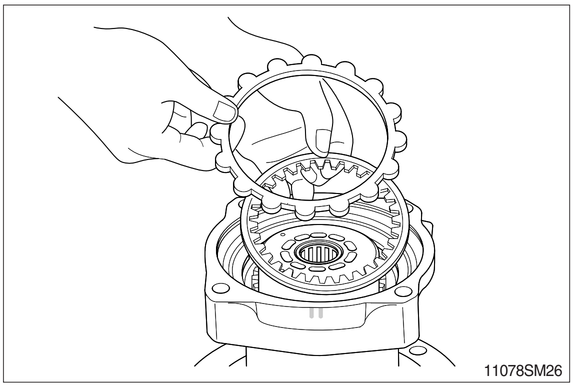
32038SM30

(8) Reassemble the piston assembly (9) to the body (1).

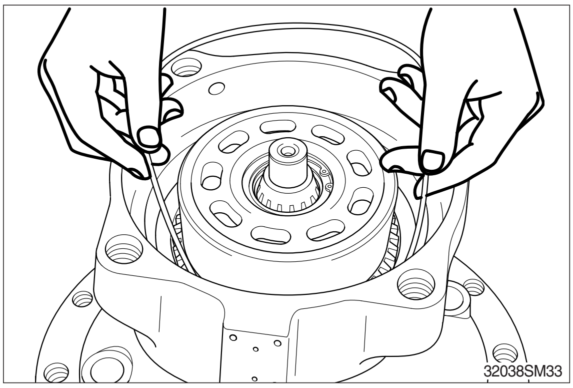


32038SM31

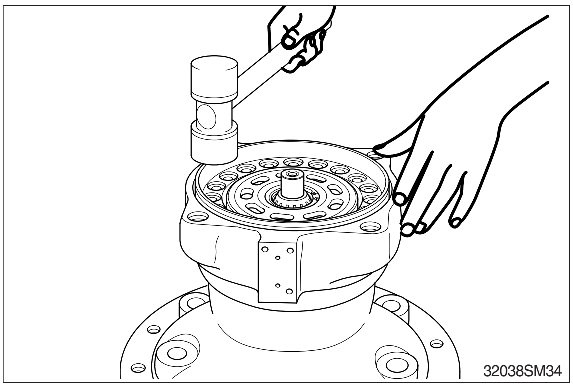
(9) Assembly friction plate (14) and separate plate (15) to the body (1).



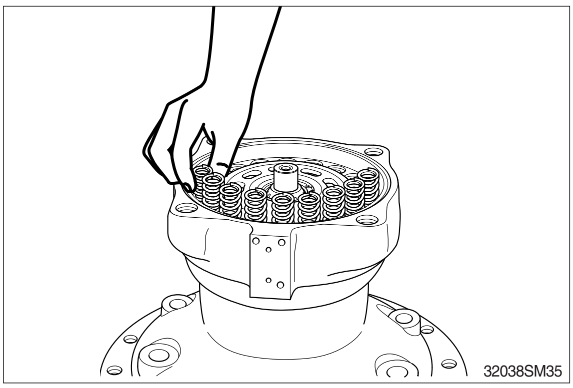
(10) Insert O-ring (17) inside the body (1).



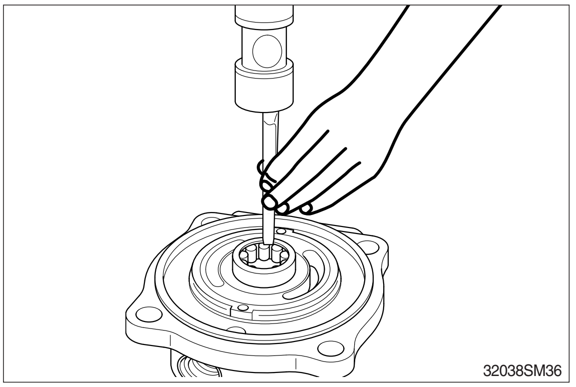
(11) Reassemble brake piston (16) to the body (1).



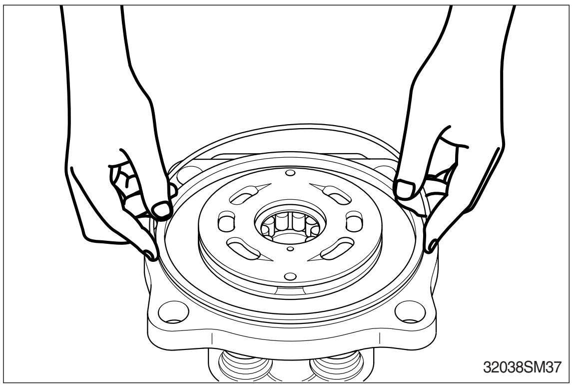
(12) Reassemble brake spring (19) to the brake piston (16).



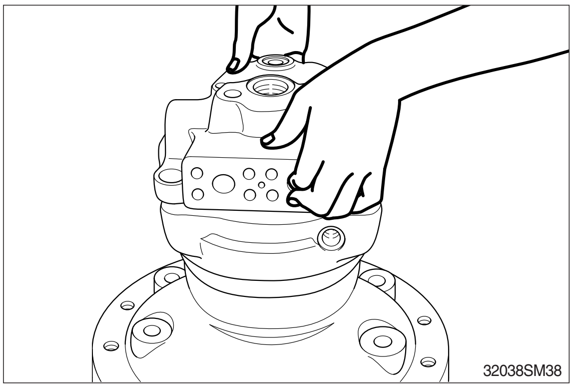
(13) When assembling the needle bearing (21), insert the needle bearing (21) into rear cover (20) by hammering.



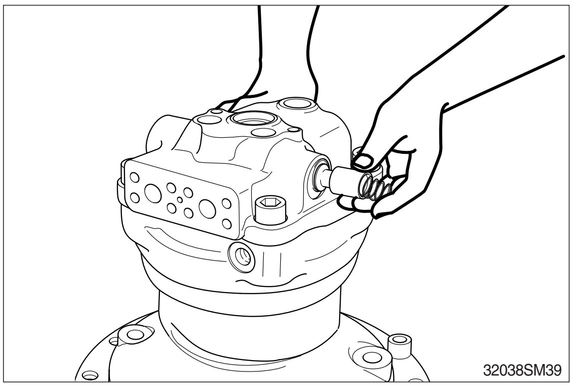
(14) Reassemble valve plate (23) to the rear cover (20) and reassemble O-ring (18).



(15) Connect the rear cover (20) with the body (1) and tighten the wrench bolt (24).

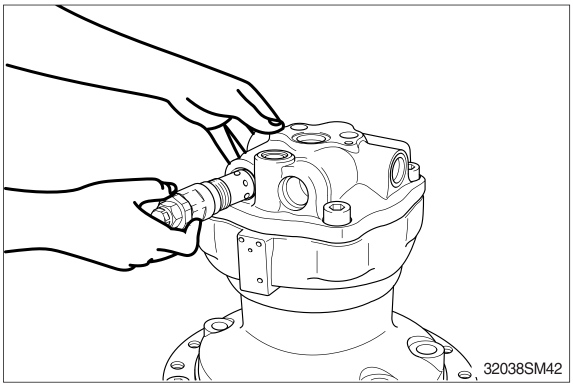


(16) Insert check (29) and spring (28) in the valve casing and install O-ring (27) and back up ring (26). Tighten plug (25) to the rear cover (20).



(17) Insert O-rings to the relief valve (30) and reassemble them to rear cover (20).

This completes assembly.



3. REMOVAL AND INSTALL OF REDUCTION GEAR

1) REMOVAL

(1) Remove the swing motor assembly.
For details, see removal of swing motor assembly.

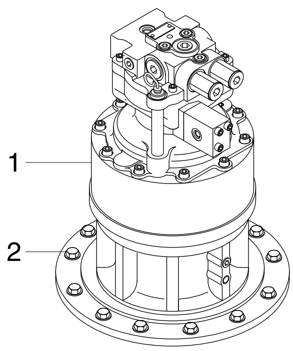
(2) Sling reduction gear assembly (1) and remove mounting bolts (2).

(3) Remove the reduction gear assembly.
- Reduction gear device weight : 60 kg (132 lb)

13031GE18

2) INSTALL

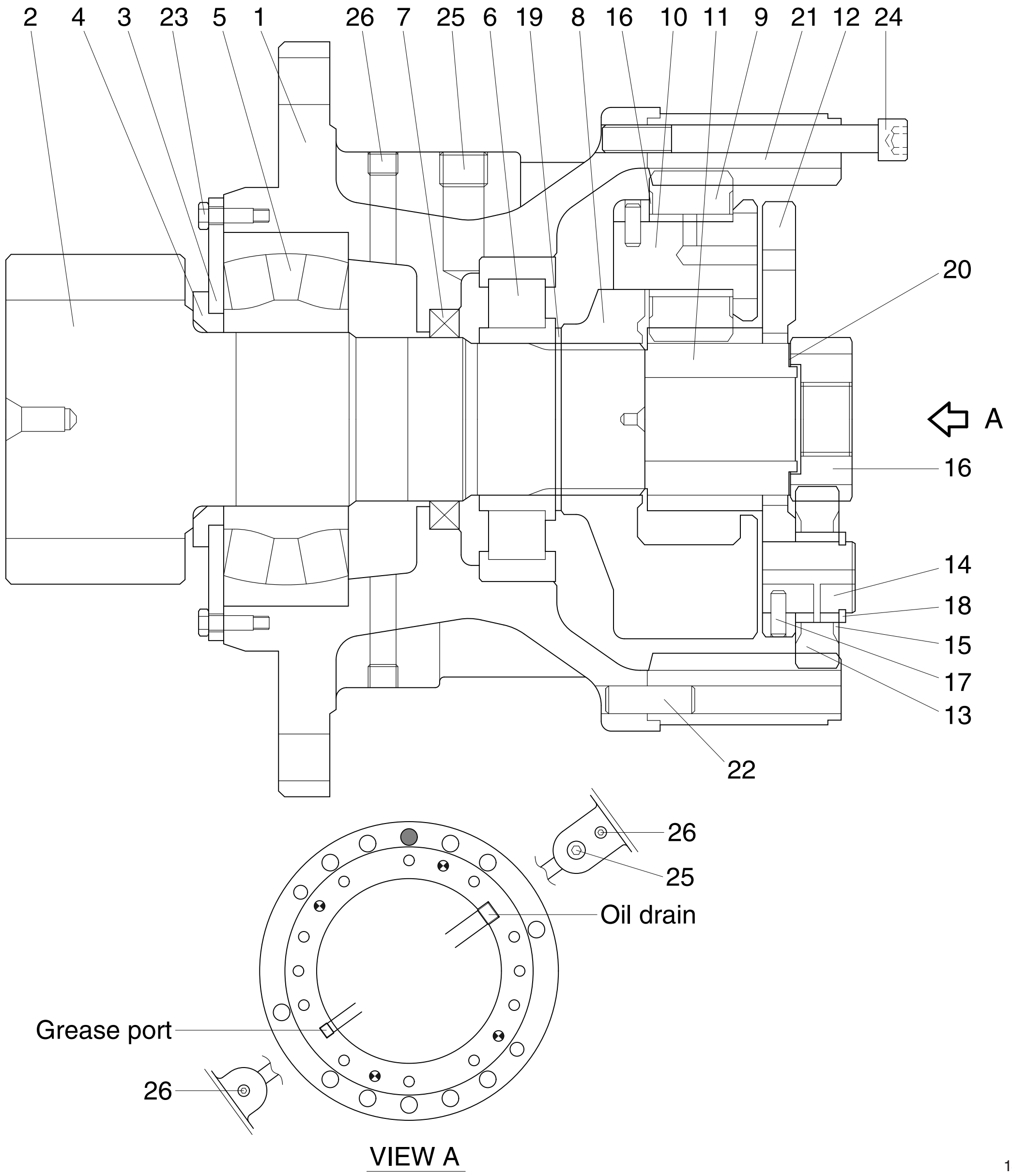
(1) Carry out installation in the reverse order to removal.
- Tightening torque : 29.6±3.2 kgf · m (214±23.1 lbf · ft)



14W98SM03

4. DISASSEMBLY AND ASSEMBLY OF REDUCTION GEAR

1) STRUCTURE



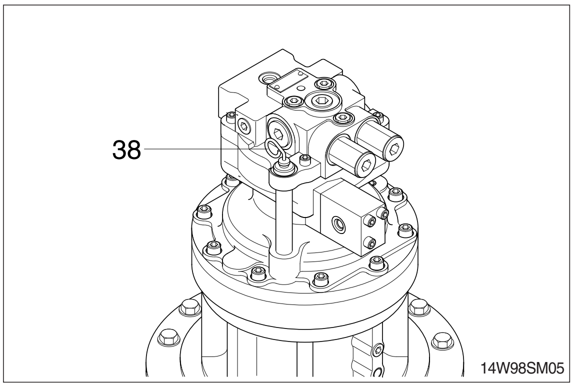
14W92SM03

1	Casing	10	Pin No.2 assembly	19	Stop ring
2	Drive shaft	11	Sun gear No. 2	20	Side plate No. 1
3	Cover plate	12	Carrier No. 1	21	Ring gear
4	Spacer	13	Planet gear No. 1	22	Knock pin
5	Roller bearing	14	Pin No.1	23	Hexagonal bolt
6	Roller bearing	15	Thrust washer (B)	24	Socket head bolt
7	Oil seal	16	Sun gear No. 1	25	Plug
8	Carrier No. 2	17	Spring pin	26	Plug
9	Planet gear No. 2	18	Stop ring		

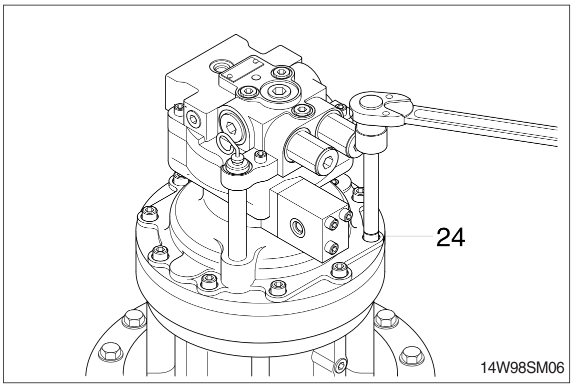
2) DISASSEMBLY

(1) Remove level gauge (38) from the swing motor casing.

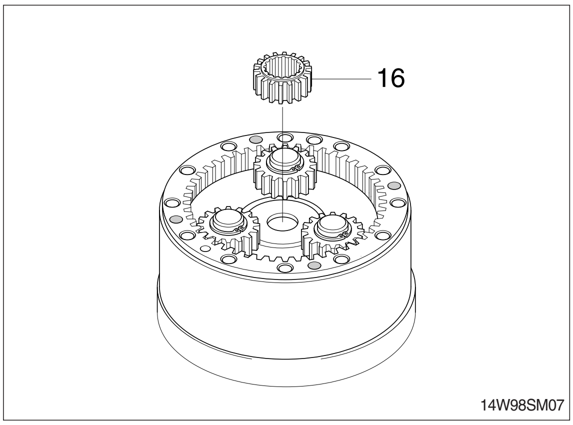
※ Pour the gear oil out of reduction gear into the clean bowl to check out the friction decrease.



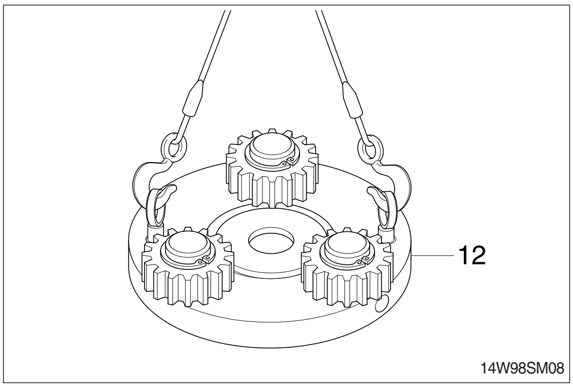
(2) Loosen the socket bolts (24) to separate swing motor from reduction gear.



(3) Remove sun gear 1 (16).



(4) Tighten two M10 eye bolts to carrier 1 (12) and lift up and remove carrier 1 (12) as subassembly.



(5) Disassembling carrier 1 (12) assembly.

① Remove stop ring (18).

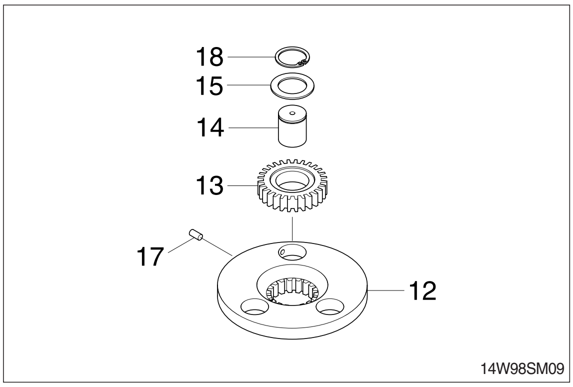
② Remove thrust washer (15) and planet gear 1(13) from the carrier 1 (12).

③ Using M8 solid drill, crush spring pin (17) so that the pin 1 (14) can be removed by hammering.

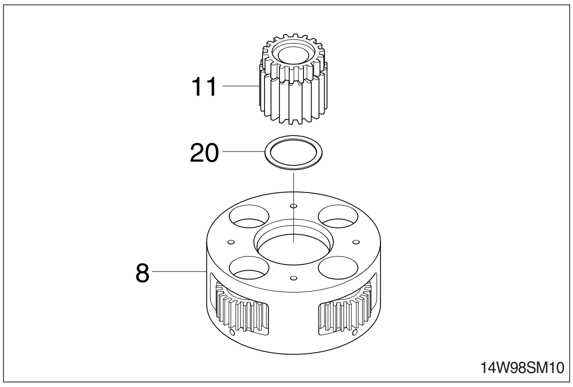
※ Do not reuse spring pin (17).

※ Do not remove pin 1 (14), carrier 1 (12) and spring pin (17) but in case of replacement.

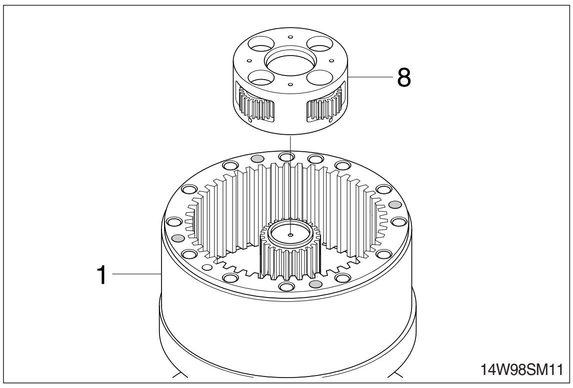
※ Put matching marks on the planet gear 1 (13) and the pin 1 (14) for easy reassembly.



(6) Remove sun gear 2 (11) and side plate 1 (20) from carrier 2 (8).



(7) Remove carrier 2 (8) assembly from casing (1).



(8) Disassembling carrier 2 (8) assembly.

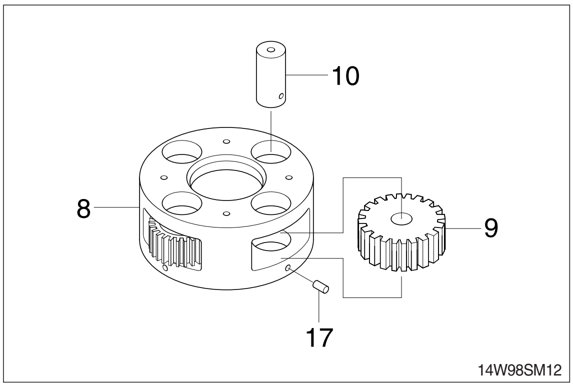
① Using M8 solid drill, crush spring pin (17) so that the pin 2 (10) can be removed.

※ Do not reuse spring pin (17).

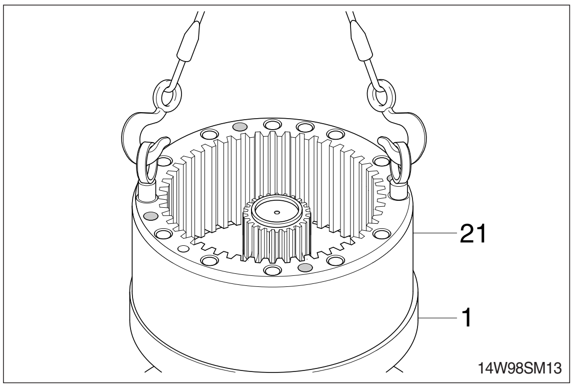
② Remove pin 2 (10) and planet gear 2 (9) from the carrier 2 (8).

※ Put matching marks on the planet gear 2 (9) and the pin 2 (17) for easy reassembly.

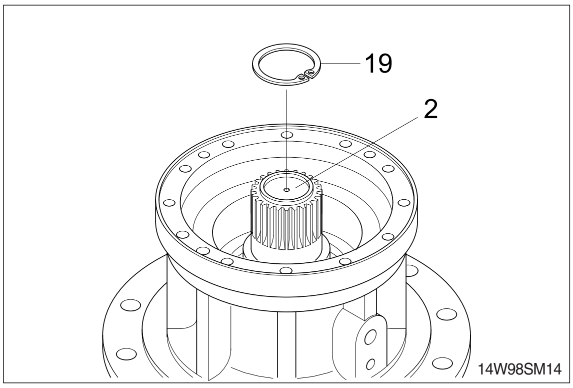
※ Do not disassemble pin 2 (10), carrier 2 (8) and spring pin (17) but in case of replacement.



(9) Tighten two M16 eyebolt to the ring gear (21) and then lift the ring gear (21) out of casing (1).

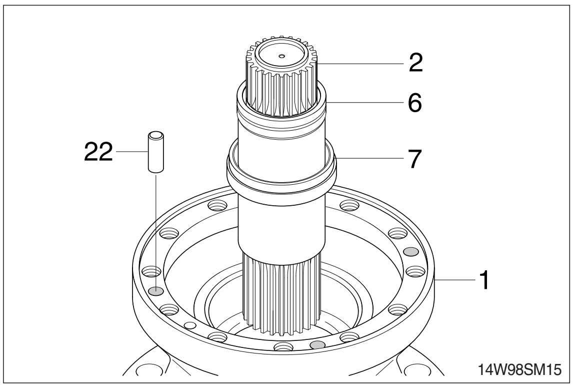


(10) Remove stop ring (19) from the drive shaft (2).



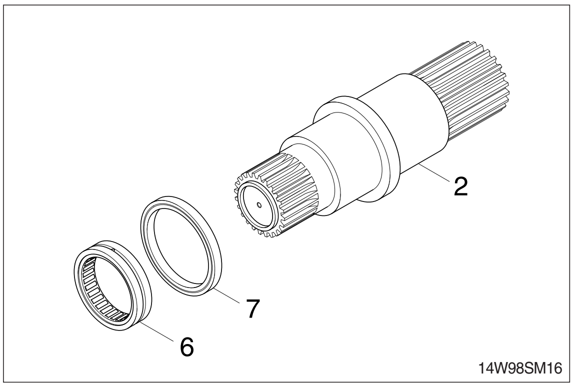
(11) Remove drive shaft (2) with roller bearing (6) and oil seal (7) assembled.

Remove knock pin (22) from the casing (1).

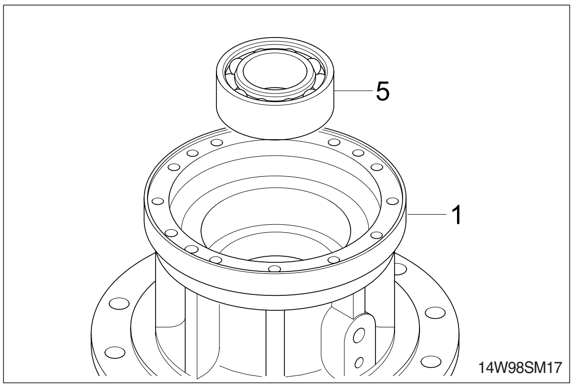


(12) Remove roller bearing (6) and oil seal (7) from the drive shaft (2).

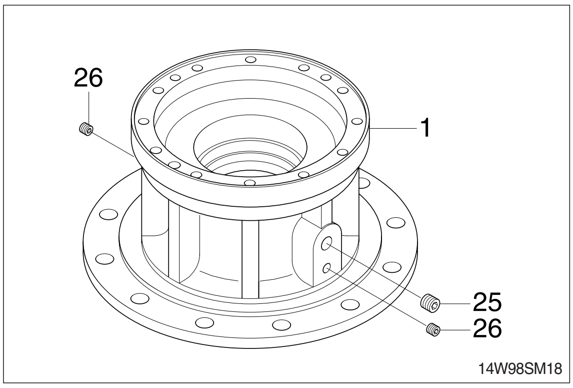
※ Do not reuse oil seal (20) once removed.



(13) Using the bearing disassembly tool, remove roller bearing (5).

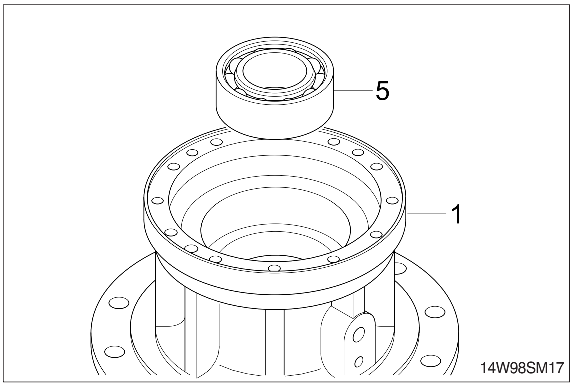


(14) Remove plugs (25, 26) from the casing (1).

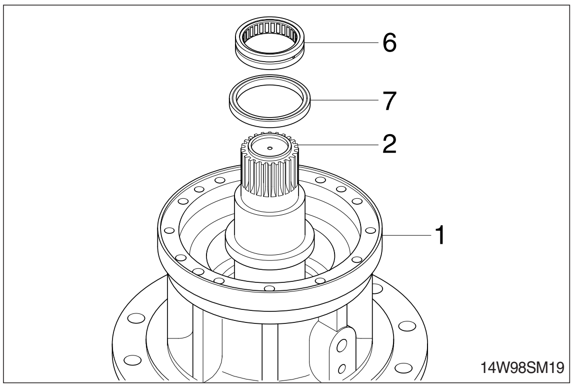


3) ASSEMBLY

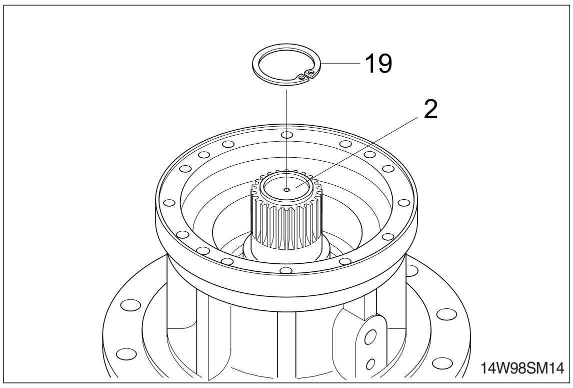
(1) Assemble roller bearing (5) inside the casing (1).



(2) Assemble the drive shaft (2) into the casing (1) and then install oil seal (7) and roller bearing (6).



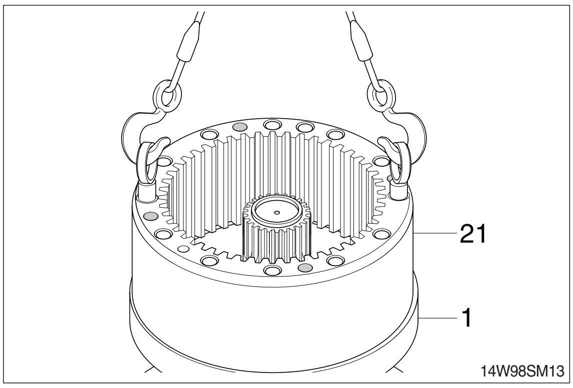
(3) Install stop ring (19) on top of drive shaft (2).



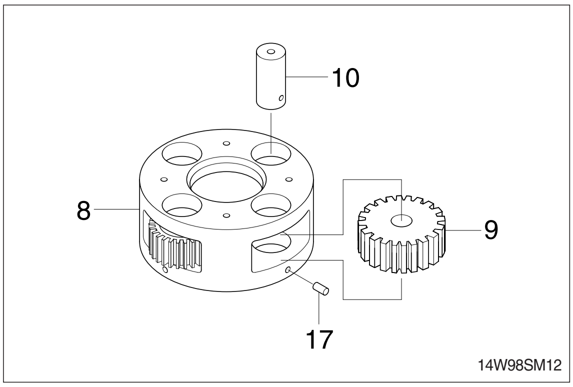
(4) Apply loctite to the tapped holes of casing (1).

(5) Tighten 2 M16 eye bolts to the ring gear (21) and lift up and then assemble it onto the casing (1).

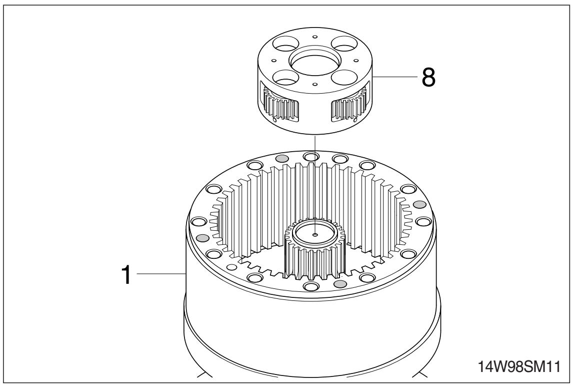
※ Don't fail to coincide the knock pin (22) holes.



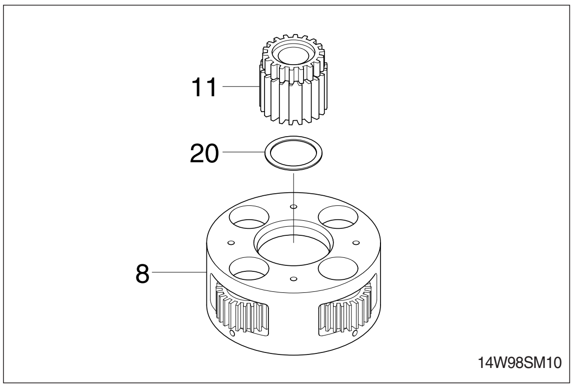
(6) Assembling carrier 2 (8) assembly.
① Install the planet gear 2 (9) inside the carrier 2 (8).
② Assemble the pin 2 (10) to the carrier 2 (8) and then press the spring pin (17) by hammering.
③ Punch 2 points of the spring pin (17) lip.
※ Take care not to mistake the matching marks of each part.



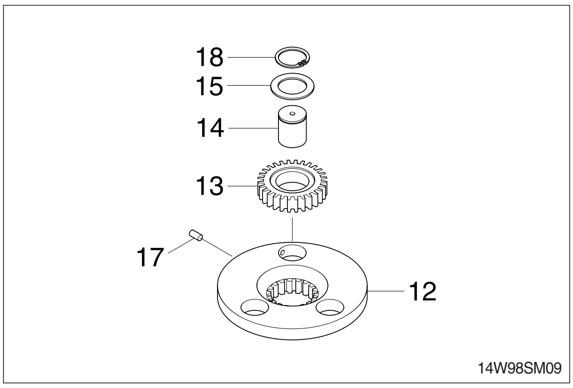
(7) Assemble carrier 2 (8) assembly correctly to the casing (1).



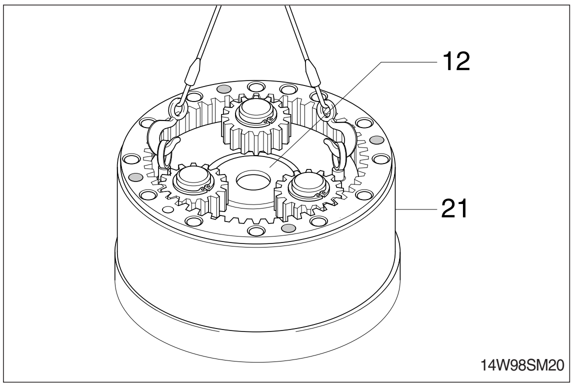
(8) Assemble sun gear 2 (11) and side plate 1 (20) to the center of the carrier 2 (8) assembly.



(9) Assembling carrier 1 (12) assembly.
① Assemble the pin1 (14) to the carrier 1 (12) and then press the spring pin (17) by hammering.
② Punch 2 points of the spring pin's (17) lip.
③ Assemble thrust washer (15), planet gear 1 (13), and then stop ring (18) to the pin 1 (11).
※ Take care not to mistake the matching marks of each part.

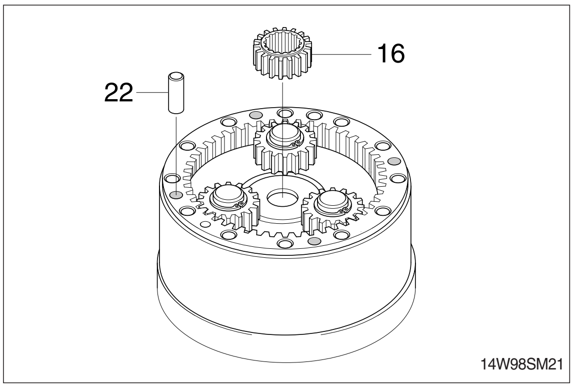


(10) Assemble carrier 1 (12) assembly into the ring gear (21).



(11) Hammer 4 knock pins (22) around the ring gear (21).

(12) Assemble sun gear 1 (16) to the drive shaft of the swing reduction gear.

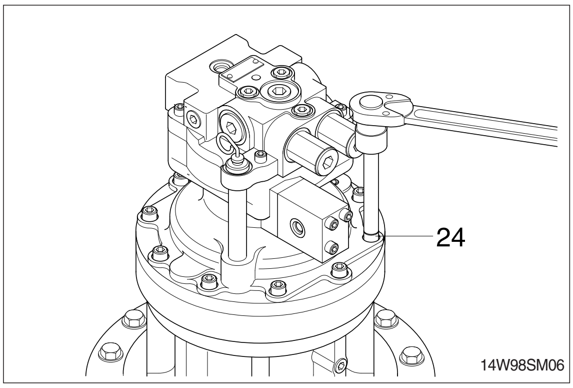


(13) Apply loctite to the tapped holes of the ring gear (21) and then mount swing motor onto the ring gear (21).

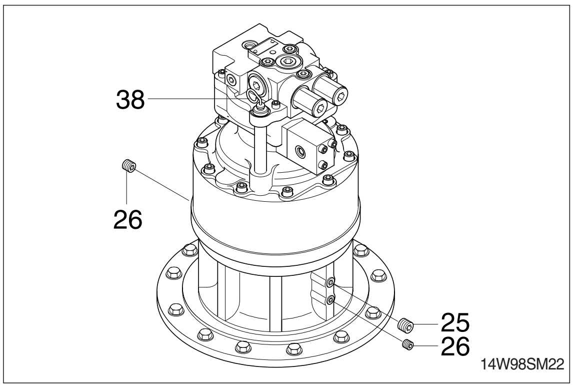
※ Don't fail to coincide the gauge bar hole.

(14) Tighten socket bolts (24) around the swing motor assembly.

· Tightening torque : 13.5 kgf · m (98 lbf · ft)



(15) Assemble plugs (25, 26) and level gauge (38).



■ TRAVEL MOTOR (TYPE 1)

1. REMOVAL AND INSTALL

1) REMOVAL

(1) Swing the work equipment 90˚and lower it completely to the ground.

(2) Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

(3) Loosen the breather slowly to release the pressure inside the hydraulic tank.

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

※ When pipes and hoses are disconnected, the oil inside the piping will flow out, so catch it in oil pan.

(4) Remove the track shoe assembly.
For details, see **removal of track shoe assembly.**

(5) Remove the cover.

(6) Remove the hose.

※ Fit blind plugs to the disconnected hoses.

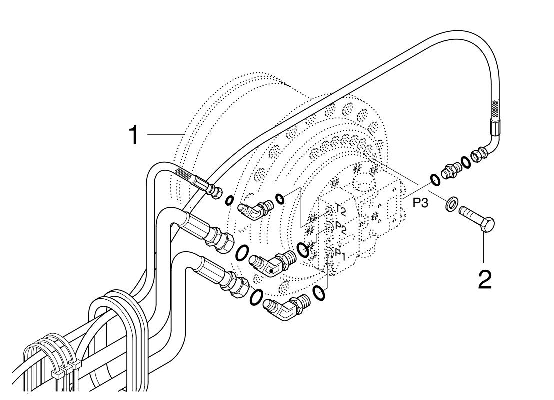
(7) Remove the bolts and the sprocket.

(8) Sling travel device assembly (1).

(9) Remove the mounting bolts (2), then remove the travel device assembly.

· Weight : 240 kg (530 lb)


13031GE18



14098TM01

2) INSTALL

(1) Carry out installation in the reverse order to removal.

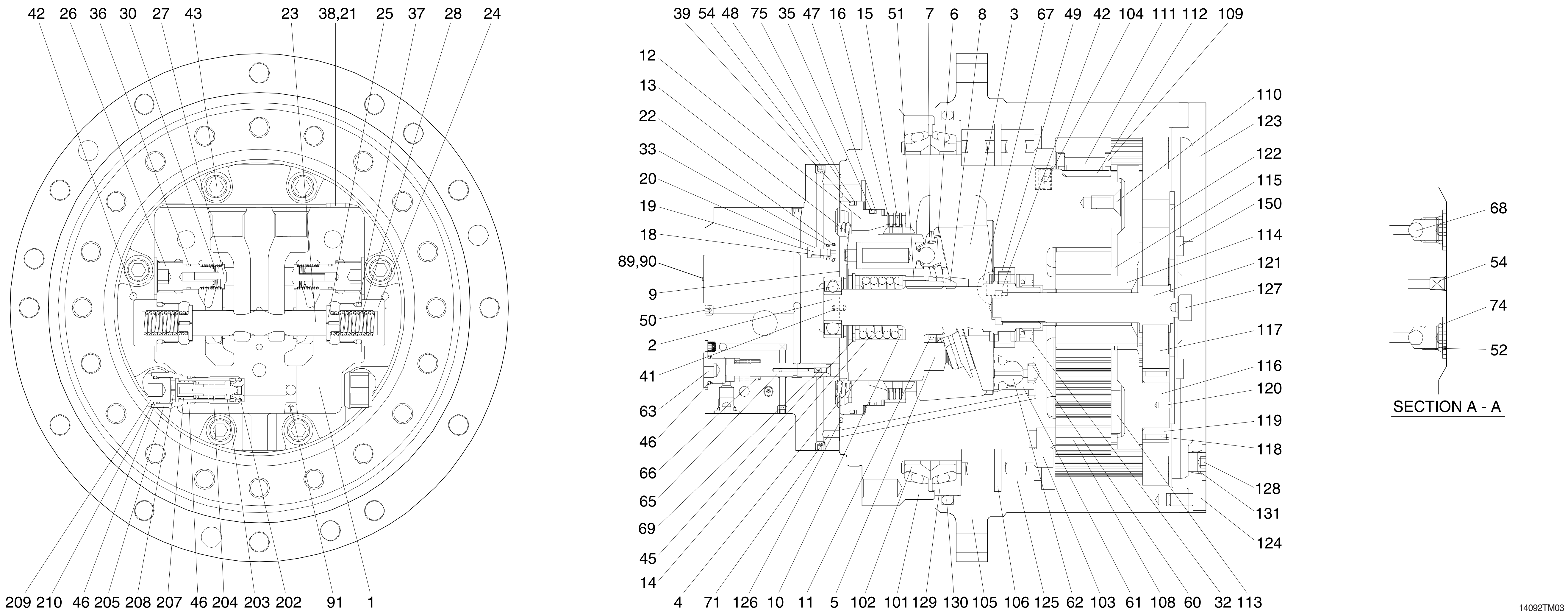
(2) Bleed the air from the travel motor.

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



1	Rear flange	19	Valve	39	O-ring	65	2 Speed spool	108	Planetary gear	125	Angular bearing
2	Shaft	20	Spring	41	Parallel pin	66	2 Speed spring	109	Thrust washer	126	O-ring
3	Swash plate	21	Plug	42	Parallel pin	67	Pivot	110	Screw	127	Thrust washer
4	Cylinder block	22	Ring	43	Socket bolt	68	Steel ball	111	Needle bearing	128	Plug
5	Piston	23	Main spool	45	Snap ring	69	Set screw	112	Collar	129	Seal ring
6	Shoe	24	Main plug	46	O-ring	71	Orifice	113	Thrust plate	130	O-ring
7	Retainer plate	25	Retainer spring	47	Back up-ring	74	O-ring	114	Sun gear	131	O-ring
8	Thrust ball	26	Check plug	48	Back up-ring	75	O-ring	115	Snap ring	150	Thrust plate
9	Timing plate	27	Check valve	49	Roller bearing	89	Name plate	116	Holder	205	Body
10	Washer	28	Main spring	50	Ball bearing	90	Set screw	117	Planetary gear	206	Shim
11	Washer-collar	30	Check spring	51	Roller	91	Plug	118	Needle bearing	207	Piston
12	Piston-parking	32	Oil seal	52	Plug	101	Spindle	119	Inner race	208	Rod
13	Spring	33	O-ring	54	Plug	102	Floating seal	120	Spring pin	209	Plug
14	Spring	35	O-ring	60	Spring	103	Nut ring	121	Drive gear	210	Back up-ring
15	Friction plate	36	O-ring	61	Piston	104	Plug	122	Thrust plate		
16	Mating plate	37	O-ring	62	Shoe	105	Hub	123	Cover		
18	Seat valve	38	O-ring	63	Plug	106	Snap ring	124	Socket bolt		

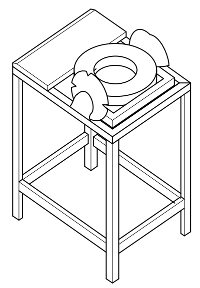
2) TOOLS

(1) Standard tools

No.	Name	Description/Size	Qty
1	Hexagon wrench (JIS B 4650)	6 (M8) (PT1/4), 8 (M10)	each 1
		10 (M12) (PF1/2)	each 1
		4 (M6)	1
2	Socket wrench	-	1
3	Torque wrench	Nominal 30 kgf · m dial type	1
		Nominal 90 kgf · m dial type	1
4	Adapter for torque wrench	Socket 26, 27, 36	each 1
		Bar 4, 5, 6, 8, 10	each 1
5	Extension bar (JIS B 4637)	150 mm	1
6	Hammer (JIS B 4613)	12	1
7	Plastic hammer	L=300	1
8	(-) driver	150 mm	1
9	Snap ring plier	For shaft, For hole	1
10	Hanger	Weight : over 300 kgf	1
		Eye bolt (M16)	2
		Eye bolt (M10)	2
		Eye bolt (PF 1/2)	2
		Wire	1
11	Press	Press capacity above 200 kgf	1
12	Compressed air	3~5 kgf/cm^2, nozzle	1
13	Vessel	General vessel : W450 × D300 × H120	2
14	Heating vessel	Heating capacity : over 100˚C	1
		Volume : 500 × 500 × 500	
15	Depth micro-meter	Measuring range : 0.04 ~ 0.3 mm	1
16	Air hammer	BRH-8 (compressed air 5~6 kgf/cm^2)	1
17	Sealant	Silicone rubber (780-RTV)	1

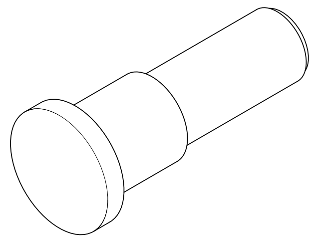
(2) Special tools

① Inversion working bench



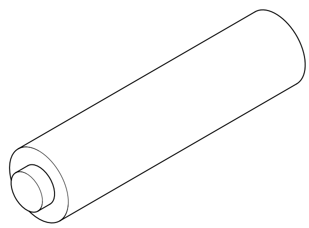
25098TM101

② Pressurize jig (Ⅰ)



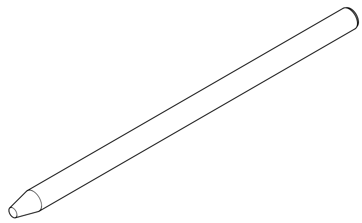
14098TM90

③ Pressurize jig (Ⅱ)



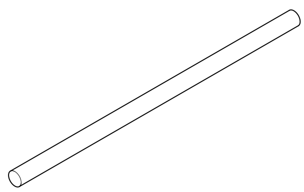
25098TM102

④ Aluminum bar



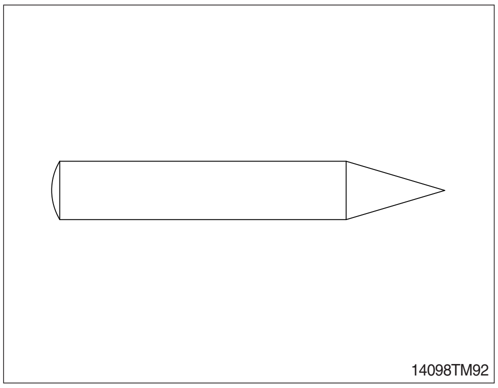
14098TM91

⑤ Steel bar



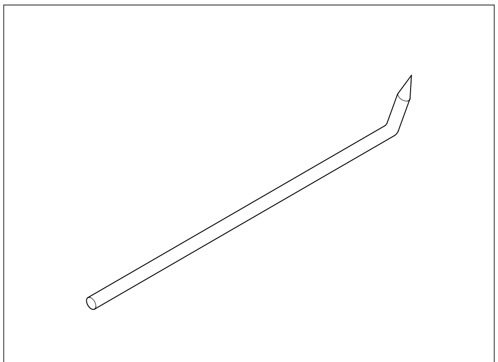
25098TM103

⑥ Sharp punch



14098TM92

⑦ Draw bar



14098TM93

3) TIGHTENING TORQUE

Item No.	Parts name	Size	Qty	Tightening torque	
				kgf · m	lbf · ft
21	Plug	PF 3/8	1	10 ± 2	72.3 ±14.5
24	Plug	M30×1.5	2	36 ± 7.2	260 ±52.1
26	Plug	M24×1.5	2	17 ± 3.4	123 ±24.6
43	Socket bolt	M10×1.5	8	5.9 ± 1.2	42.7 ±8.7
52	RO plug	PF 1/4	4	3.0 ± 0.5	21.7 ±3.6
54	Plug	NPTF 1/16	7	1.0 ± 0.25	7.2 ±1.8
63, 209	Plug	PF 1/2	1	3.0 ± 0.5	21.7 ±3.6
91	Plug	PT 1/8	4	1.25 ± 0.2	9 ±1.4
104	Plug	PT 3/8	3	6.0 ± 0.9	43 ±6.5
110	Screw	M6	4	0.83 ± 0.12	6 ±0.9
128	Plug	PF 3/8	3	6.0 ± 0.9	43 ±6.5
124	Socket bolt	M8	12	1.25 ± 0.2	9 ±1.4
205	Body	M20	1	12 ± 1.5	86.8 ±10.8
301	Plug	PF 1 1/2	1	26 ± 5.2	188 ±37.6

3. DISASSEMBLY

3.1 GENERAL PRECAUTIONS

1) Spread rubber or vinyl cover on the work bench.

2) When disassembling the travel motor, provide a match mark on the mating face or each part.

3) Arrange the detached parts to prevent them from being damaged or lost.

4) The disassembled seals must be replaced with new ones as a rule even if they are free from damage. For disassembly, therefore, prepare new seals in advance.

3.2 DISASSEMBLY PROCEDURE

1) When inspecting or repairing the travel motors, use the disassembling procedures described below.

2) Numerals in brackets ( ) following the part name denote the item numbers used in the structure drawing at page 8-68.

3) Prior to disassembly, install the travel motor on a inversion working bench.

3.3 DISASSEMBLING ORDER

1) DISASSEMBLING THE REDUCTION GEAR PART

(1) Remove plugs (128, 3EA) and drain the reduction gear oil.

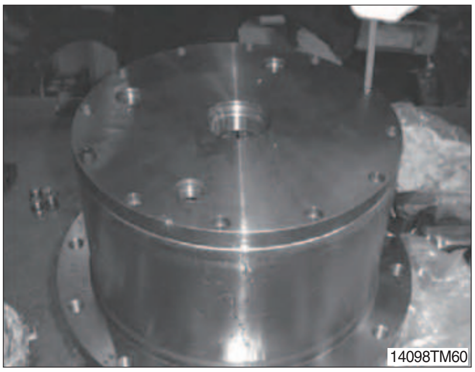
(2) Loosen socket bolts (124, 16EA) and remove the cover (123).

※ Remove the cover (123), after hook it, fit the eye bolt in a screw hole for use of the plug (128). If it's impossible, please remove the cover using the rod.

※ You can have difficulty removing it because loctite is spread in the socket bolt (124).

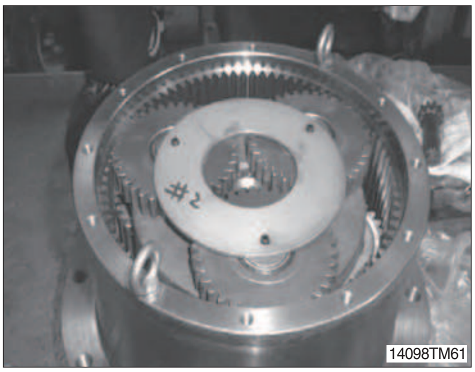
※ Tools

· Hexagon wrench 6, 8



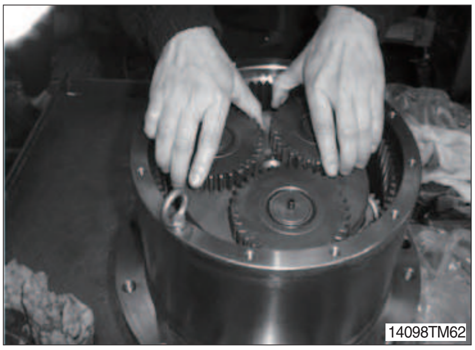
14098TM60

(3) Remove thrust plate R (122) and drive gear (121).



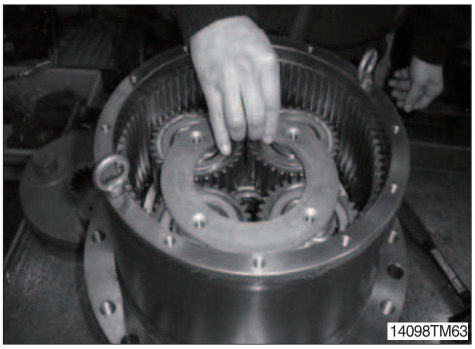
14098TM61

(4) Remove planetary gear R (117), needle bearing, inner race (119) and holder (116) from hub (105).



14098TM62

(5) Remove sun gear (114), screw (110) and thrust plate F (113).

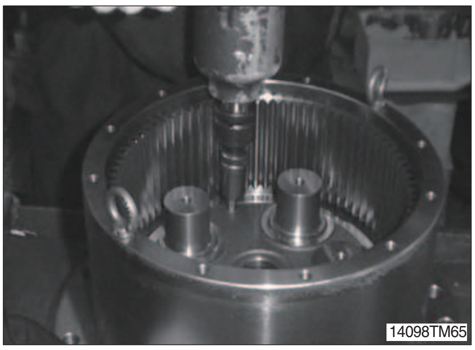


14098TM63

(6) Remove the thrust washer (109), planetary gears F (108), needle bearings (111) and collar (112) from hub (105).

14098TM64

(7) Remove the plugs (104, 3EA).



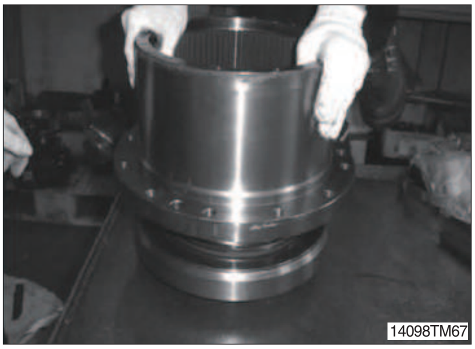
14098TM65

(8) Remove the nut ring (103) from hub (105).

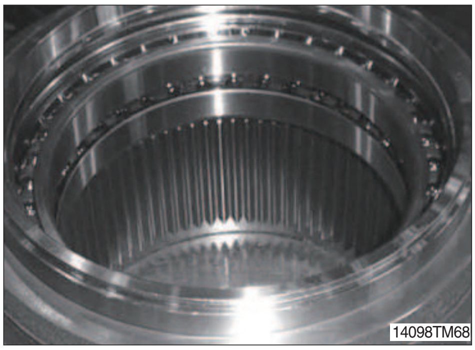

14098TM66

(9) Remove the spindle (101) from the hub (105).

※ Remove it using a crane after eye bolt is assembled at the hub (105).

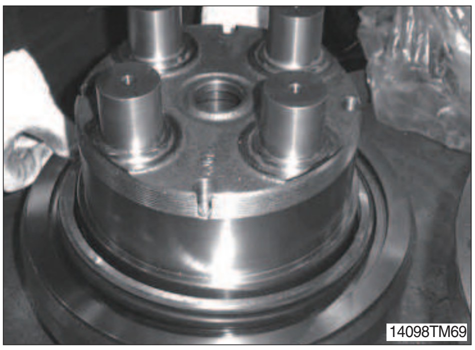

14098TM67

(10) Remove the floating seal (102), seal ring (129), angular bearings (125, 2EA), snap ring (106) and O-ring (130) from the hub (105).

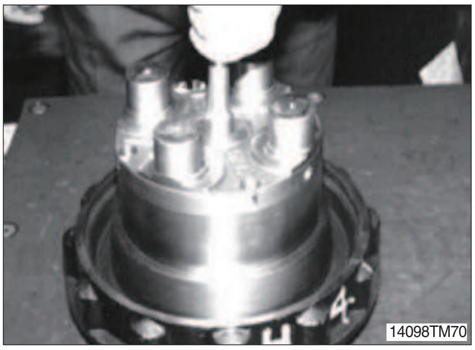

14098TM68

(11) Remove the floating seal (102) from the spindle (101).

※ User can remove easily if using (-) drivers.


14098TM69

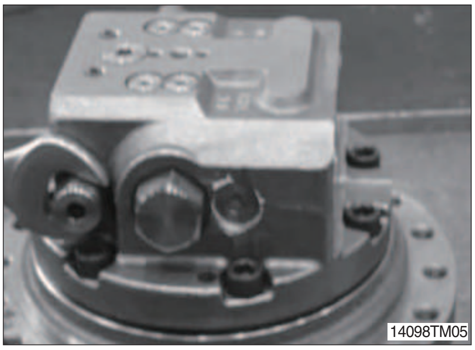
(12) Remove the oil seal (32) from spindle (101).


14098TM70

2) DISASSEMBLING THE HYDRAULIC MOTOR PART

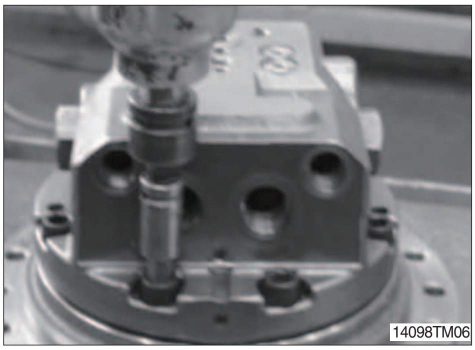
(1) Remove the relief valve (70, 2EA) from rear flange (1).

※ Tools
  · Hexagon socket
  · Torque wrench


14098TM05

(2) Remove hexagon socket head bolts (43, 8EA) from the rear flange (1).

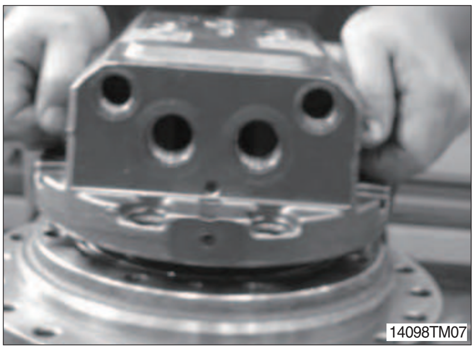
※ Tools
  · Hexagon wrench 8


14098TM06

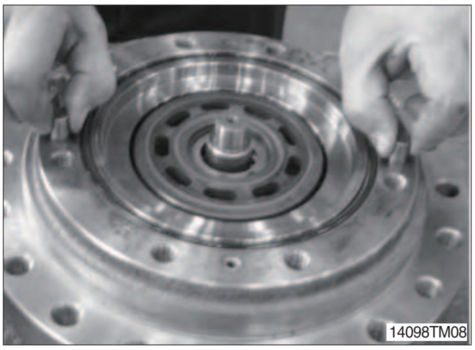
(3) Remove the rear flange (1) from the spindle (101).

(4) Remove the springs (13, 10EA) form the rear flange [1].

※ Remove the rear flange (1) carefully after taken using hands. Be careful not to detach the timing plate (9) and the spring (13) if twisted or beated by constraint.

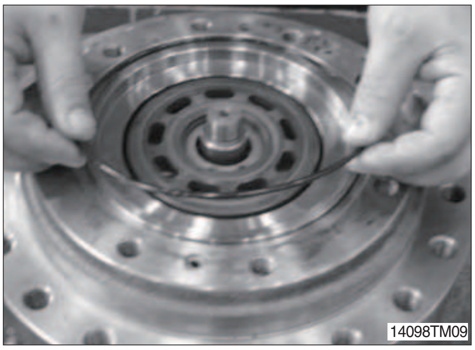

14098TM07

(5) Remove the parallel pin (42) from the spindle (101).



(6) Remove the O-ring (126) from the spindle (101).

※ Do not reuse the O-ring (126).



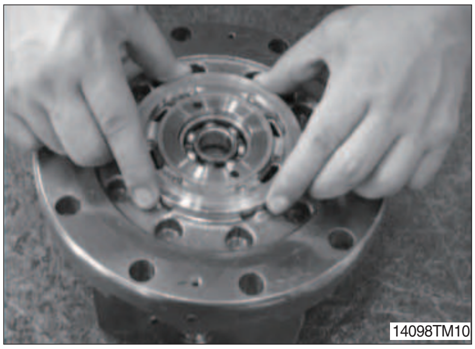
(7) Disassembling the rear flange (1) part

① Place the rear flange with the contact surface of the spindle upward.

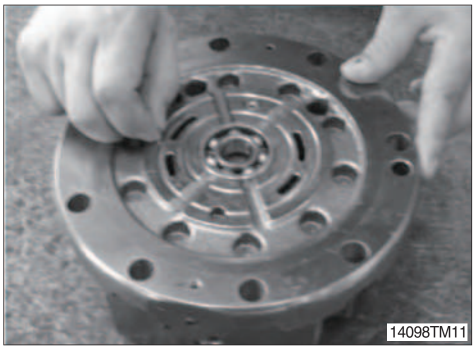
② Remove the timing plate (9) from the rear flange (1).

※ When removing the timing plate, user can have difficulty of the removal due to the close adhesion of rear flange (1) and oil. Remove it after fitting a rod through the hole which is used when a casting is detached.

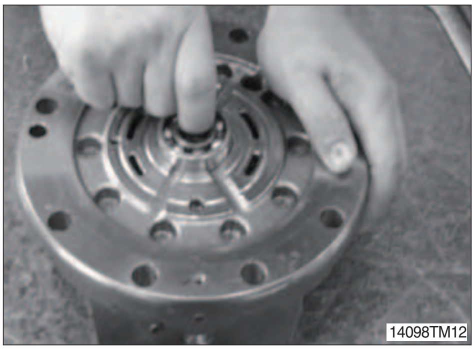
※ Be careful of the leakage due to both surface scratch if using a sharp tool.



③ Remove the paralell pin (41) from the rear flange (1).



④ Remove the ball bearing (50) from the rear flange (1).


14098TM12

(8) Disassembling the brake valve part

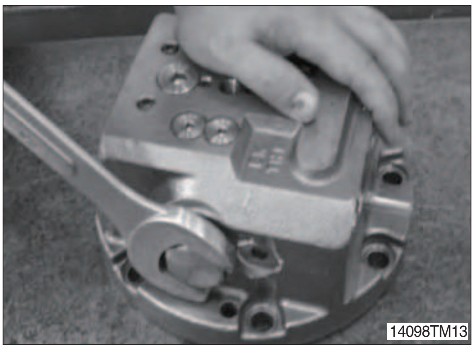
① Remove two plugs (24) from the rear flange (1).

※ User can work easily if sub-disassembly was done on the reversal table.

※ Tools

 · Hexagon wrench 36

 · Torque wrench

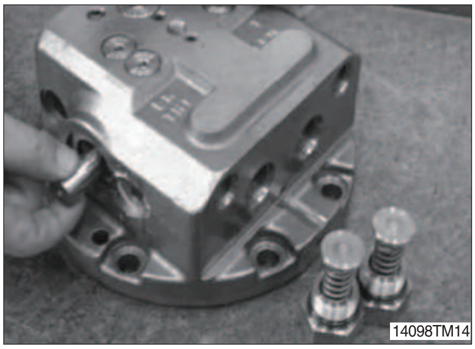

14098TM13

② Take out two spring retainers (25), two springs (28) from the rear flange (1).

③ Remove the spool (23) from the rear flange (1).

※ Be careful not to damage the outer surface of the spool (23) and the sliding surface of the rear flange (1).

※ Since the rear flange (1) and the spool (23) are of the selective fitting type, replace them together as a kit even if only one of the two parts is damaged.

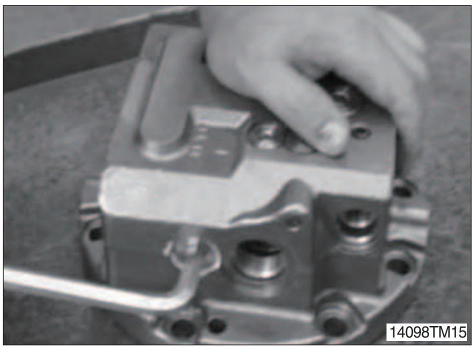

14098TM14

④ Remove two plugs (26) from the rear flange (1).

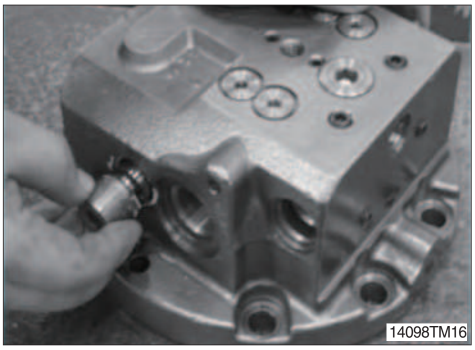
※ User can work easily if sub-disassembly was done on the reversal table.

※ Tools

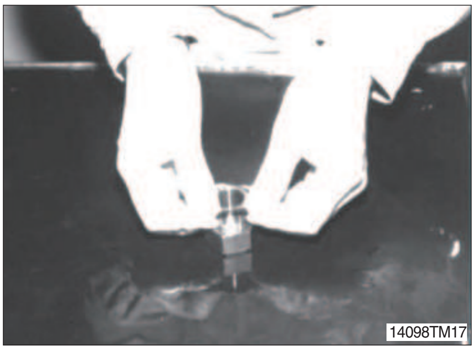
 · Hexagon wrench 10


14098TM15

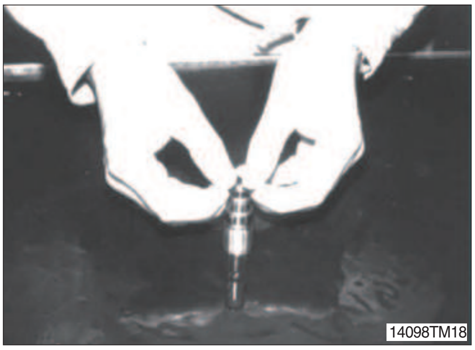
⑤ Remove the springs (30, 2EA), valves (27, 2EA) from rear flange (1).


14098TM16

⑥ Remove the O-ring (37) from plug (24).
※ Do not reuse the O-ring (37).


14098TM17

⑦ Remove the O-ring (36) from plug (26).
※ Do not reuse the O-ring (36).


14098TM18

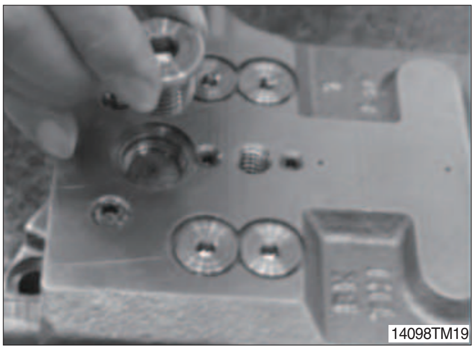
(9) Disassembling the two speed change valve

① Remove the plug (63) from the rear flange (1).

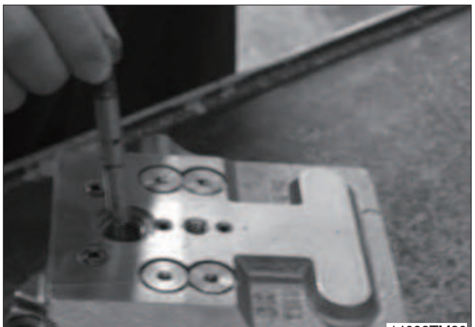
※ User can work easily if sub-disassembly was done on the reversal table.

※ Tools

· Hexagon wrench 10


14098TM19

② Remove the spool (65) and spring (66) from rear flange (1).


14098TM20

(10) Disassembling the plug (52).

① Do not remove plug (52) if it not to be necessary. Disassembling the plug (52) if it was malfunction because of get mixed with dust. Clean the plug (52) after disassembled.

※ Be careful not to drop the steel ball (68).

(11) Disassembling the parking brake valve (19)

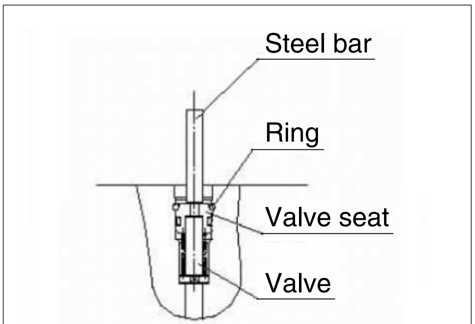
① Mount the rear flange (1) on a working bench that the mounting side of the spindle (101) faces upward.

② Pushing valve seat (18) by a steel bar, disassemble ring (22) from rear flange (1).


14098TM21

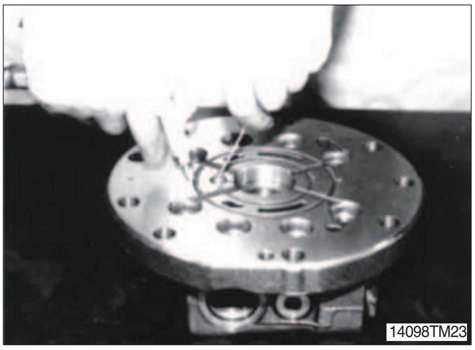
※ Do not remove ring (22) if it not to be replace.

※ Do not reuse the ring (22), valve seat (18) and O-ring (33).



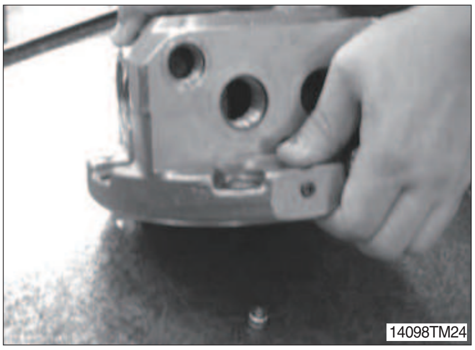
14098TM22

③ Remove the valve seat (18) by injecting compressed air from the access hole in the spindle (101) after caulking the hole of valve seat (18).



14098TM23

④ Remove the valve (19) and spring (20) from rear flange (1) downside hole with shaking lightly.



14098TM24

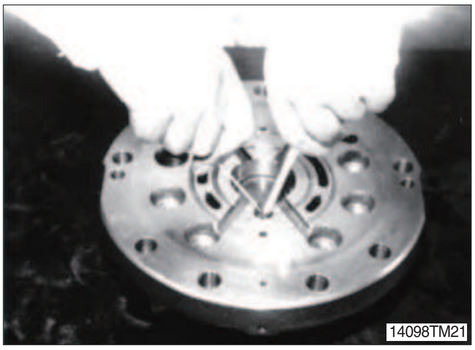
⑤ Remove the O-ring (33) and valve seat (18).
※ Do not reuse the O-ring (33).

14098TM25

(12) Disassembling the parking brake

① Remove the piston (12) by injecting compressed air from the parking brake access hole in the spindle (101).

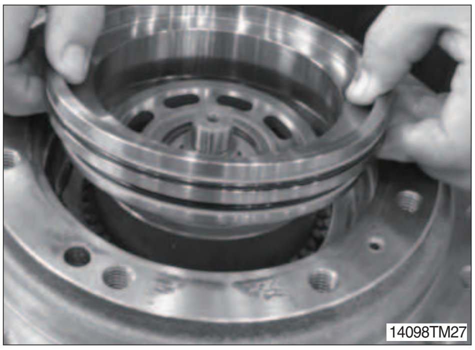
※ Use the protection cover on the upper part of spindle (101) when users put the pressed air into suddenly. Otherwise part damage and accident might go on because the piston (12) is rushed out of the spindle (101).



14098TM21

② Remove the O-rings (35, 39) and backup rings (47 , 48) from the piston (12).

※ Do not reuse O-rings (35, 39) and backup rings (47, 48) after removal.

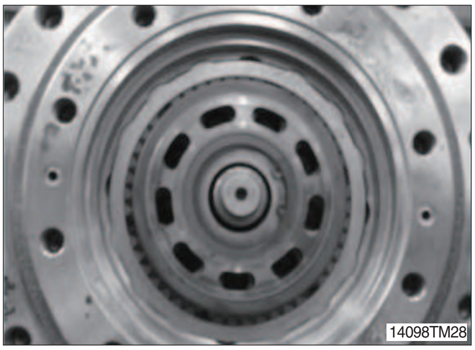

14098TM27

(13) Disassembling the hydraulic motor part

① Lay the travel motor body on the side.

② Drain out the oil from the travel motor.

※ Place an oil receptacle under the travel motor to receive the oil flowing out as the motor is being laid on the side.

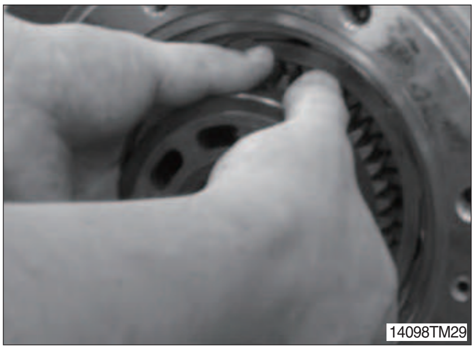

14098TM28

③ Hold the cylinder block (4) with both hands, and remove it from the shaft (2).

④ Remove the mating plates (16) and friction plates (15) from the cylinder block (4).

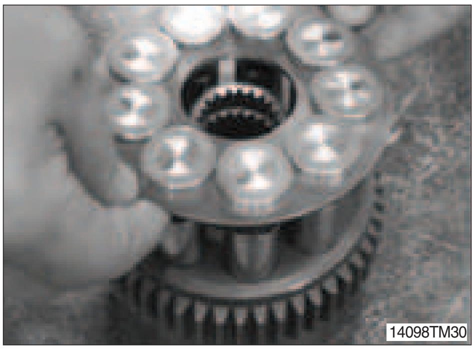
※ Before removal, hold the cylinder block (4) with both hands and turn it two to three times in a clockwise and a counterclockwise direction alternately to detach the shoe (6) from the swash plate (3).

※ Be careful that if an attempt is made to remove the cylinder block (4) without detaching the shoe (6) from the swash plate (3), then the piston, shoe and other parts that are connected to the cylinder block may come the cylinder loose and fall into the spindle (101).


14098TM29

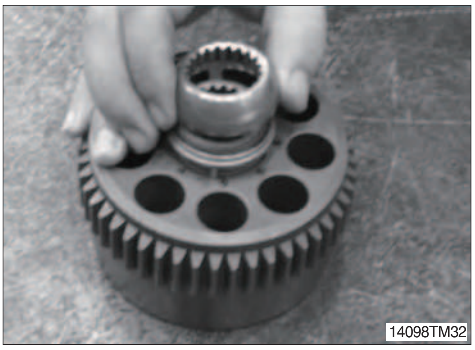
(14) Disassembling the cylinder block kit

① Piston assembly [piston (5), shoe (6)] from the removed cylinder block (4).

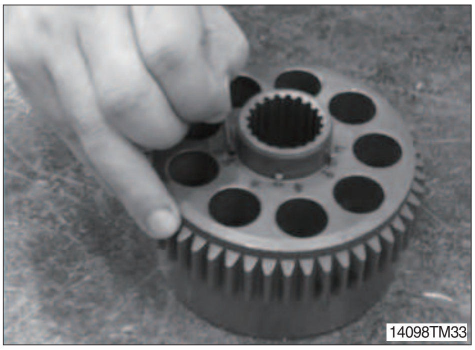


② Piston (5) and shoe (6) from the removed retainer plate (7).

③ Thrust ball (8) from the removed cylinder block (4).



④ Roller (51, 5EA) from the removed cylinder block (204).



(15) Disassembling the spring of the cylinder block

① Put the cylinder block (4) on the pressurize jig.
② Press the washer (10) with pressurize jig, and remove the spring (14) after snap ring (45) removed.
※ Put a vinyl cover on the sliding surface of cylinder block (4) for protection.
※ Do not remove spring (14) if it not to be replace.

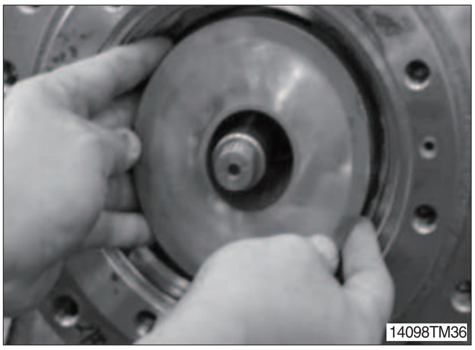
14098TM34

③ Remove the snap ring (45), washer (10), spring (14) and washer (10) from cylinder block (4).

14098TM35

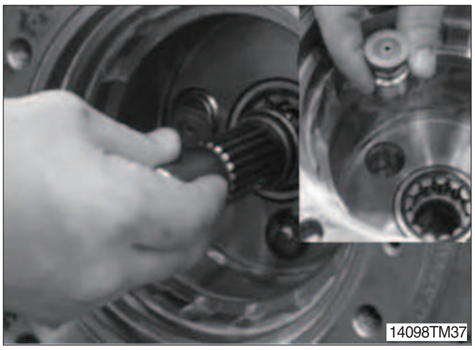
(16) Disassembling the shaft

① Remove swash plate (3) from the shaft (2).
② Remove shaft (2) from the spindle (101).
※ When separating the swash plate, separate and turn it by using hands to free from intervention of the stopper.



14098TM36

③ Remove speed selector piston assembly [piston (61) and shoe (62)] form the spindle [101] by feeding compressed air into the access hole in spindle (101).
④ Remove parallel pins (42, 2EA) and pivots (67, 2EA) from the spindle (101).
⑤ Remove roller bearing (49) from the spindle (101).
※ Piston assembly ; Piston (61), Shoe (62)
※ Compressed air ; 3~5 kgf/cm^2 (43~71 psi)
※ When piston (61) or shoe (62) is damaged, if exchange is necessary, they have to be exchanged together because the separation is impossible. Use the protection cover on the upper part spindle when users put the compressed air into suddenly. Otherwise part damage and accident might go on because the piston is rushed out of the spindle.



14098TM37

4. REASSEMBLY

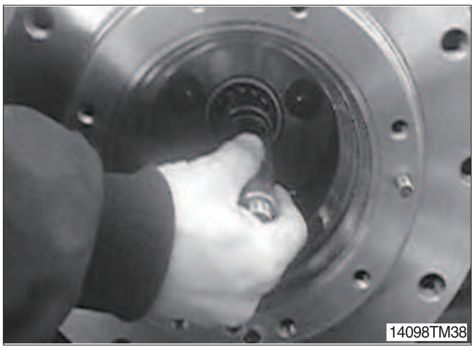
4.1 GENERAL PRECAUTIONS

1) Reassemble in a work area that is clean and free from dust and dirt.
2) Handle parts with bare hands to keep them free of linty contaminants.
3) Repair or replace the damaged parts.
   Each parts must be free of burrs its corners.
4) Do not reuse O-ring, oil seal and floating seal that were removed in disassembly. Provide the new parts.
5) Wash all parts thoroughly in a suitable solvent. Dry thoroughly with compressed air.
   Do not use the cloths.
6) When reassembling oil motor components of travel motor, be sure to coat the sliding parts of the motor and valve with fresh hydraulic oil. (NAS class 9 or above)
7) Use a torque wrench to tighten bolts and plugs, to the torque specified as follows.

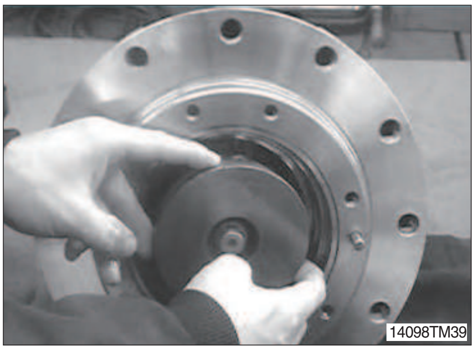
4.2 REASSEMBLY PROCEDURE

1) REASSEMBLE THE HYDRAULIC MOTOR PART

(1) Install roller bearing (49) into the spindle (101).
(2) Install pivots (67, 2EA), parallel pin (42, 2EA) and two speed piston assembly (61, 62) into the spindle (101).
(3) Install shaft (2) into the roller bearing (49) assembled spindle (101).
※ Be careful not to damage the seal (3) of assembling part.



(4) Lay the travel motor body on the side.
(5) Apply lithium grease to the shaft (2)'s spline part.
(6) Install swash plate (3) to the spindle (101).



(7) Reassembe the cylinder block kit

① Install washer (10), spring (14, 9EA), washer (10) and snap ring (45) in that order, into the cylinder block (4) inner part.
② Put the cylinder block (4) on the pressurize jig.


14098TM35

③ While pressing washer (10) by pressurize jig, install snap ring (45).
※ Put a vinyl cover on the sliding surface of the cylinder block (4) and timing plate (9) for protection.

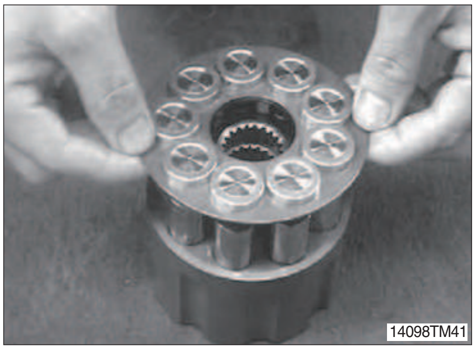

14098TM34

(8) Reassembe the hydraulic motor

① Install roller (51, 5EA) to the pin hole of cylinder block (4).
② Install thrust ball (8) to the cylinder block (4).
③ Insert piston assembly [piston (61) and shoe (62), 9 set] into retainer plate (7).
※ After mounting, immerse the entire them in a working fluid.


14098TM40

④ Mount the piston assembly (9 set) into the cylinder block (4).
※ The retainer plate (7) must be in contact with the round part of thrust ball (8).

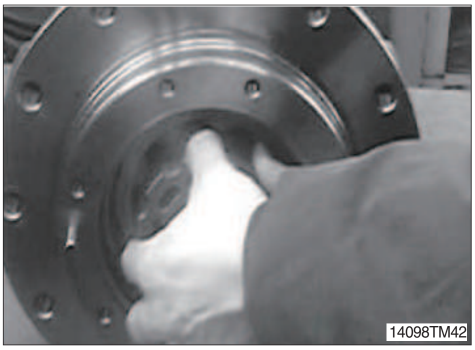

14098TM41

⑤ Install cylinder block (4) assembly to the shaft (2).

※ After fitting splines of both cylinder block (4) and shaft (2), assemble them.

※ After installing the cylinder (4), confirm whether it revolves or not by turning using both hands.

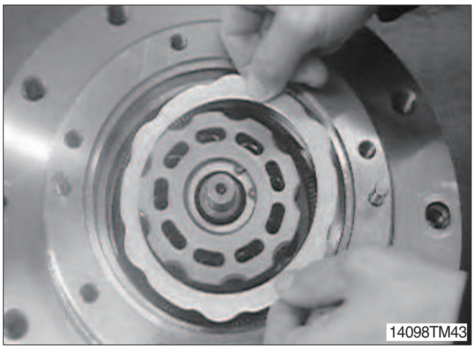
※ Motor is malfunction when it isn't revolve.



(9) Reassembe the parking brake

① Install mating plate (16) first and then a friction plate (15), one by one, into the grooves of the outer surface of the cylinder block (4).

※ Immerse the friction plates (15) in a working fluid before fitting them into the grooves.



② Install two O-rings (35, 39) and two back up ring (47, 48) into O-ring grooves.

③ Mount a piston (12) in the spindle (101).

※ Apply a thin coat of grease to the O-rings (35, 39).

※ If the piston (12) does not fit into the spindle (101) because of the resistance of the O-ring, tap the edge of the piston (12) lightly and equally with a plastic hammer.

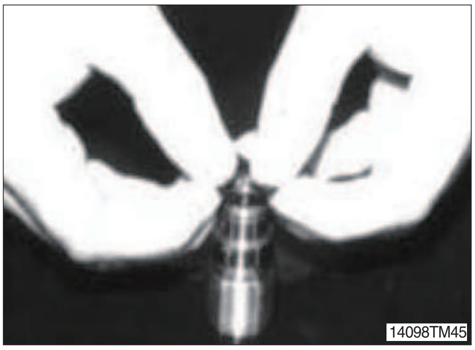
※ Be careful not to damage the O-ring and back up ring at this time.

2) REASSEMBLE THE REAR FLANGE (1) PART

(1) Reassemble the check valve

① Install O-ring (36, 2EA) on the plug (26, 2EA).

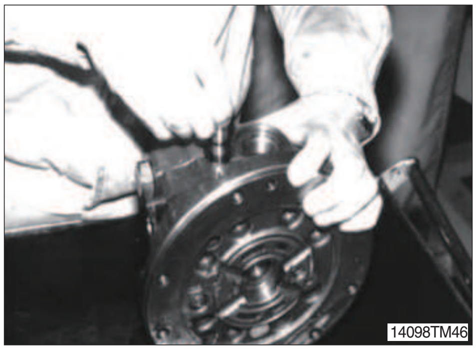
※ Apply grease to the O-ring (36).



② Install spring (30) and valve (27) into the plug (26).

③ Install plug (26) into the rear flange (1).

※ Install spring (30) and valve (27) into the plug (26), and then grease the spring (30) and the valve (27) and hand-lock the former.



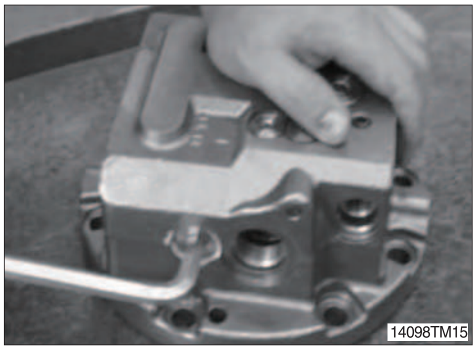
14098TM46

④ Install plug (26) in conjunction with the spring (30) and the valve (27) into the rear flange (1), and tighten the plug to the required torque.

※ Tightening torque : 17±2.6 kgf · m (123±18.8 lbf · ft)

※ Tools

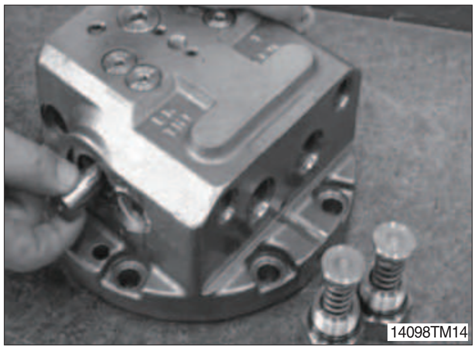
  · Adapter for hexagon wrench 10
  · Torque wrench



14098TM15

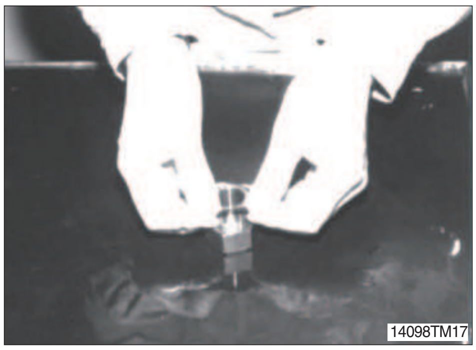
⑤ Install spool (23) into the rear flange (1).

※ Before installing the spool (23), apply hydraulic oil to the spool. Be careful not to damage the spool's surface and the inner of rear flange (1).



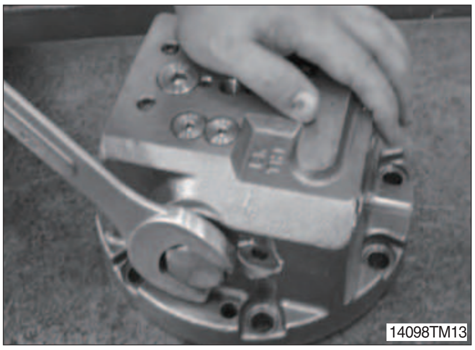
14098TM14

⑥ Install O-ring (37) on the plug (24).
Apply grease to the O-ring (37).

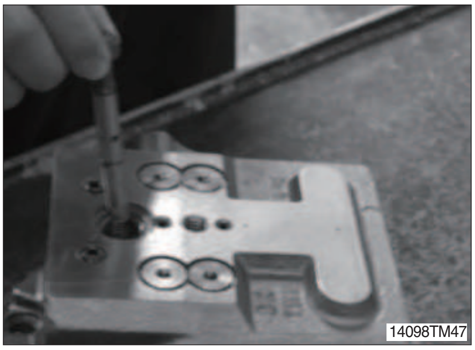


14098TM17

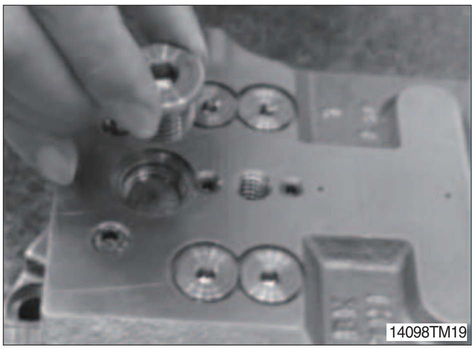
⑦ Install spring retainer (25) and spring (28) into the plug (24).
⑧ Install plug (24) into the rear flange (1).
⑨ Tighten the plug (24) to the required torque.
※ Tightening torque : 36±5.4 kgf · m (260±39 lbf · ft)
※ Socket (#36) / Torque for hexagon wrench.
※ Tools
· Hexagon socket 36
· Torque wrench



(2) Reassembe the two speed change valve
① Install spring (66) into the valve (65).
② Insert the valve (65) into the rear flange (1).



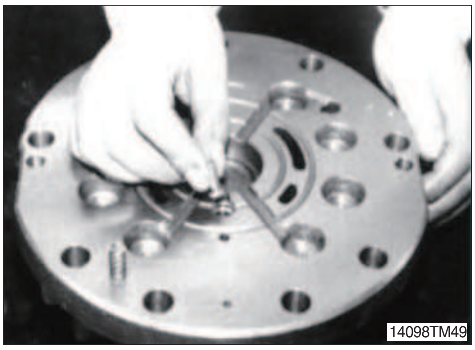
③ Insert a plug (63) into the rear flange (1).
※ Tightening torque : 13±2.6 kgf · m (94±18.8 lbf · ft)
※ Tools
· Adapter for hexagon wrench 10
· Torque wrench



(3) Reassembe the parking brake valve
① Install O-ring (33) on the valve seat (18).
※ Do not reuse the O-ring (33).

② Mount the rear flange (1) on a working bench that the mounting side of the spindle (101) faces upward.

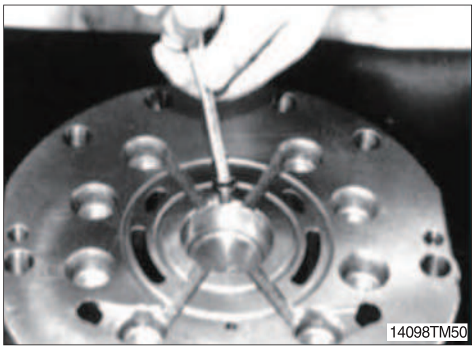
③ Install valve (19), spring (20) and valve seat (18) in that order.



14098TM49

④ After new ring (22) bend somewhat and put the valve seat (18), then into the rear flange (1) ring's groove.

※ Do not reuse the ring (22).



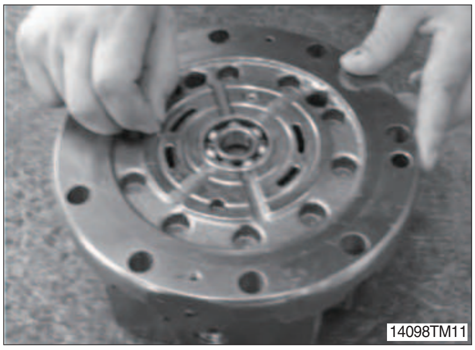
14098TM50

⑤ Install ball bearing (50) into the rear flange (1).

※ Apply hydraulic oil to the ball bearing (50).

14098TM51

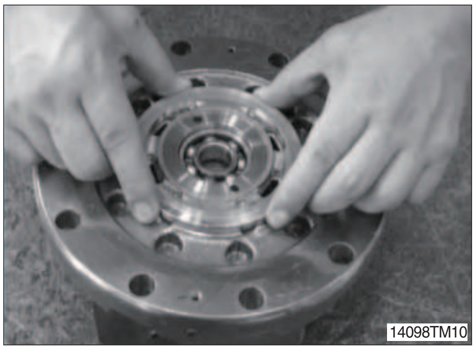
⑥ Install parallel pin (41) into the pin hole of rear flange (1).



14098TM11

⑦ Install timing plate (9) into the rear flange (1).

※ Apply hydraulic oil to the contact surface of rear flange.

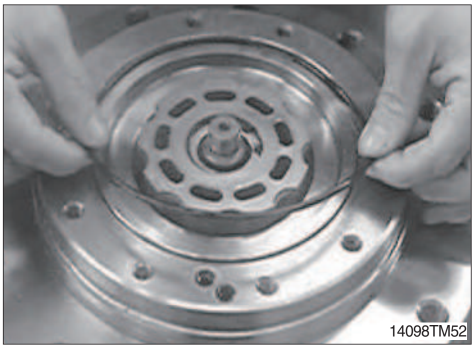

14098TM10

(4) Reassembe the rear flange (1) and spindle (101)

① Tilt the work bench 90˚ for travel motor reassembling.

② Insert the O-ring (75, 126) on the spindle (101).

※ Apply grease to the O-rings (75, 126) thinly.

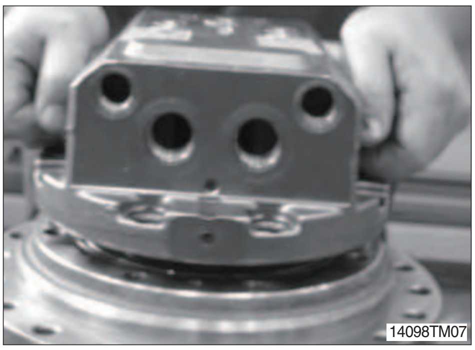

14098TM52

③ Install parallel pins (42, 2EA) into the spindle (101).


14098TM53

④ Mount the rear flange (1) on the spindle (101).

※ When the rear flange (1) is mounted on the spindle (101), fix the spring (13) applied grease to not drop.


14098TM07

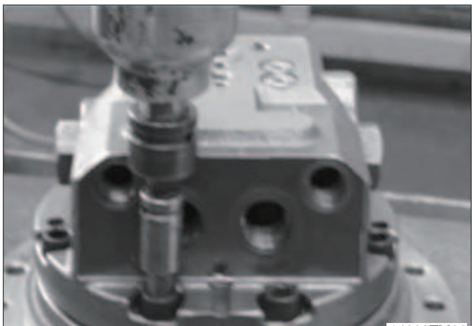
⑤ Tighten the socket bolt (43) into the spindle (101) to the required torque.

※ Tightening torque : 5.9±1.0 kgf · m (42.7±7.2 lbf · ft)

※ Tools

· Adapter for hexagon wrench 8

· Torque wrench



14098TM06

⑥ Tighten the plug (24) into the rear flange (1) to the required torque.

※ Tightening torque : 13±4.0 kgf · m(94±28.9 lbf · ft)

※ Tools

· Hexagon socket 36

· Torque wrench

14098TM54

⑦ Tighten the plug (26) into the rear flange (1) to the required torque.

※ Tightening torque : 36±1.5 kgf · m (260±10.8 lbf · ft)

※ Tools

· Hexagon socket 10

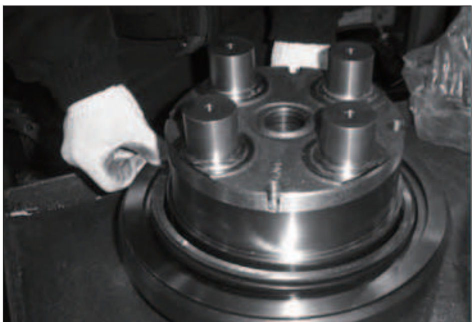
· Torque wrench

14098TM55

3) REASSEMBLE THE REDUCTION GEAR ASSEMBLY

(1) Install floating seal (102) on the spindle (101).

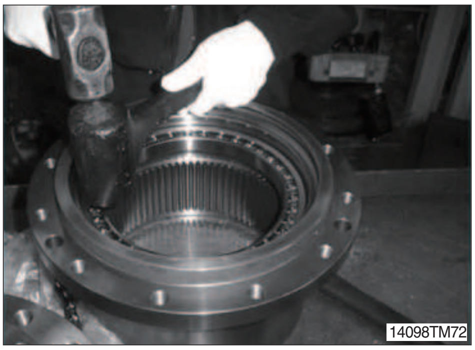
※ Apply grease to the floating seal (102).



14098TM71

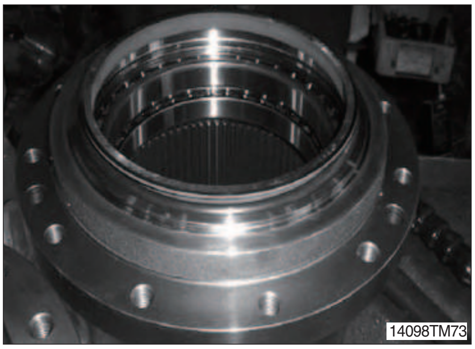
(2) Install angular bearing (125) and snap ring (106) into the hub (105).

※ Be careful for the insert direction.

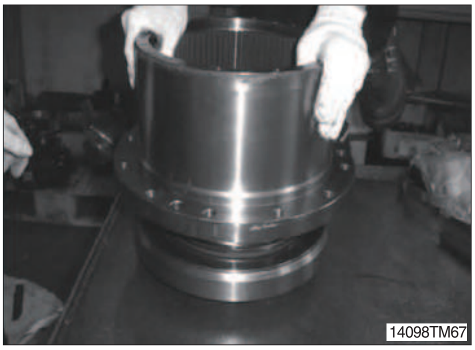


(3) Insert the O-ring (130), the sealing (129) and floating seal (102) in the hub (105).

※ Apply grease to the floating seal (102) thinly.



(4) Install the spindle (101) into the hub (105) assembly.



(5) Tighten the nut ring (103) and plug (104) into the hub (105) to the required torque.

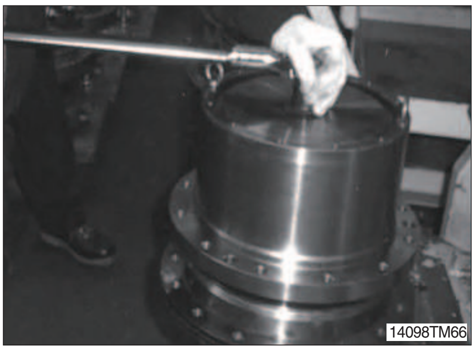
※ Do not wind the seal tape to the plug (104).

※ Punch two place for not to loosen the plug (104).

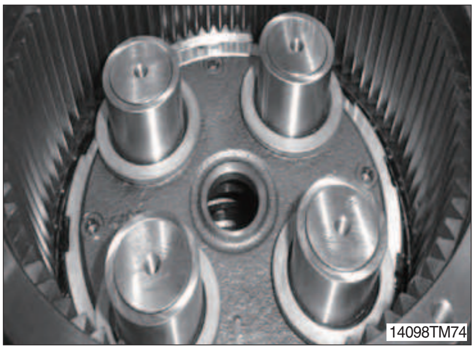
※ Tightening torque : 3.5±0.7 kgf · m (25.3±5.1 lbf · ft)

· Hexagon socket 8

· Torque wrench



(6) Install thrust washer (109) and collar (112) into the hub (105).

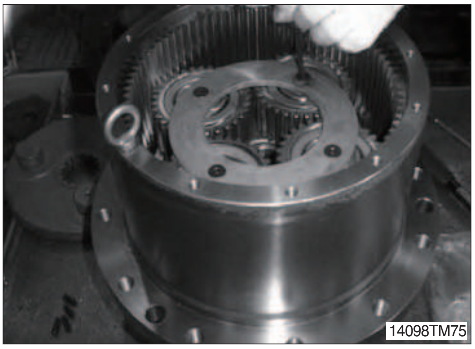


(7) Install needle bearing (111) planetary gear F (108), thrust washer (109), thrust plate F (113) and screw (110) into the hub (105).

※ Tightening torque : 0.83 kgf · m (6.0 lbf · ft)

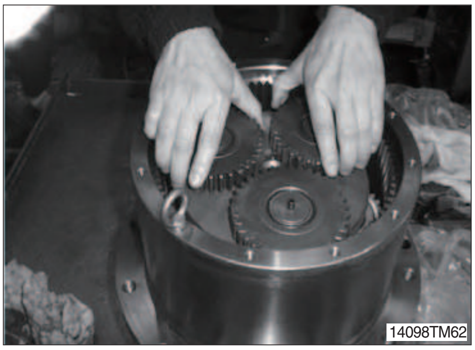
· Hexagon socket 5

· Torque wrench

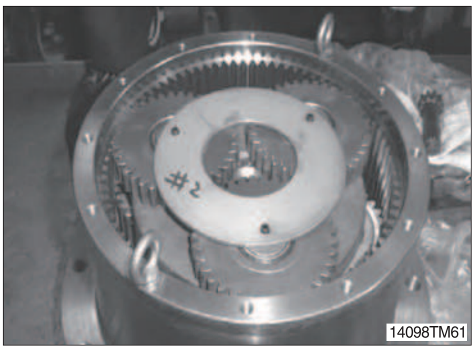


(8) Install sun gear (114) and holder assembly, then insert needle bearing (118) and planetary gear R (117) into the hub (105).

※ Holder assembly : holder (116) + spring pin (120) + inner race (119)

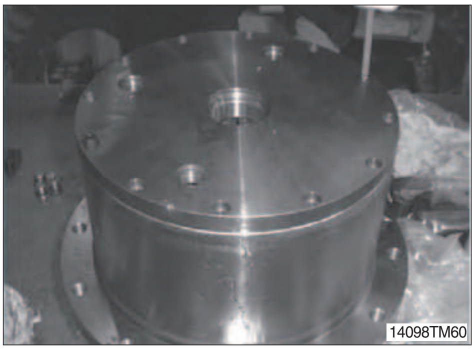


(9) Install drive gear (121) and thrust plate R (122) into the hub (105).



(10) Install cover (123), thrust plate (150), plug (301, 128) and socket bolt (124) into the hub (105).

※ Apply grease to the cover (123) after installed O-ring (127).

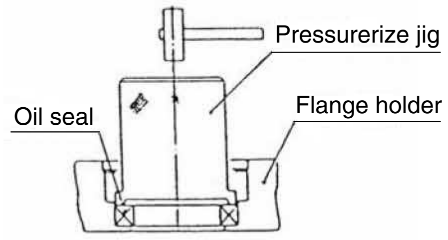


14098TM60

(11) Pressing the oil seal

① Insert the oil seal (32) by hit the pressurize jig with plastic hammer.

※ Apply grease to the seat of oil seal (32).



14098TM76

3.4 CHECKING FACTS AFTER ASSEMBLY

1) AIR TEST OF REDUCTION GEAR

Disassemble plug (128) of reduction gear part. When compressed air (0.3 kgf/cm^2) is inserted that in water during the 2 minutes, it should be not happened air bubble.

Fill the gear oil.

· Oil amount : 3.0 liter (0.79 U.S.gallon)

2) AIR TEST OF HYDRAULIC MOTOR

One port should be opened, the others port should be closed. When compressed air (3 kgf/cm^2) is inserted opened port in water during the 2 minutes, it should be not happened air bubble.

Fill the hydraulic oil.

· Oil amount : 0.55 liter (0.15 U.S.gallon)

■ TRAVEL MOTOR (TYPE 2)

1. REMOVAL AND INSTALL

1) REMOVAL

(1) Swing the work equipment 90˚ and lower it completely to the ground.

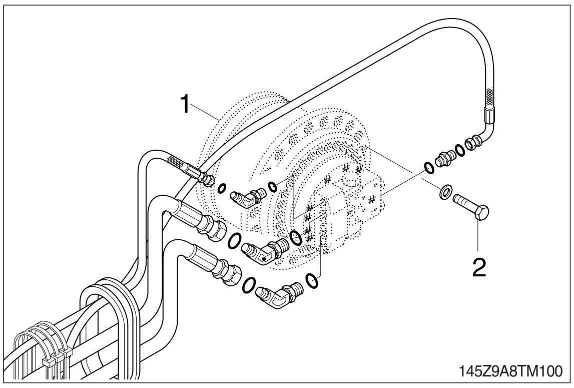
13031GE18

(2) Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

(3) Loosen the breather slowly to release the pressure inside the hydraulic tank.

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

※ When pipes and hoses are disconnected, the oil inside the piping will flow out, so catch it in oil pan.



145Z9A8TM100

(4) Remove the track shoe assembly.
For details, see **removal of track shoe assembly.**

(5) Remove the cover.

(6) Remove the hose.

※ Fit blind plugs to the disconnected hoses.

(7) Remove the bolts and the sprocket.

(8) Sling travel device assembly (1).

(9) Remove the mounting bolts (2), then remove the travel device assembly.
· Weight : 185 kg (410 lb)

2) INSTALL

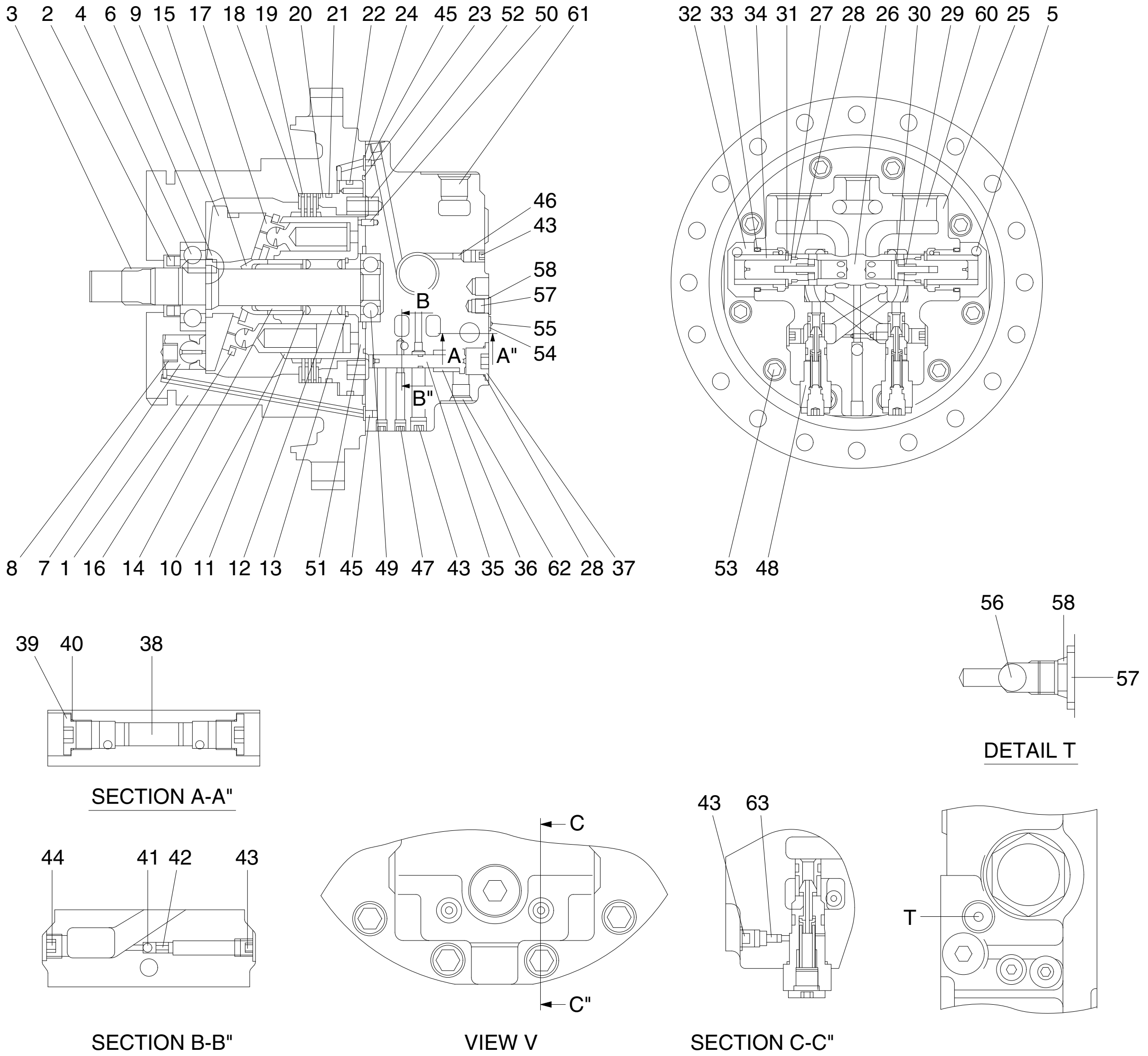
(1) Carry out installation in the reverse order to removal.

(2) Bleed the air from the travel motor.
① Remove the air vent plug.
② Pour in hydraulic oil until it overflows from the port.
③ Tighten plug lightly.
④ Start the engine, run at low idling, and check oil come out from plug.
⑤ Tighten plug fully.

(3) Confirm the hydraulic oil level and check the hydraulic oil leak or not.

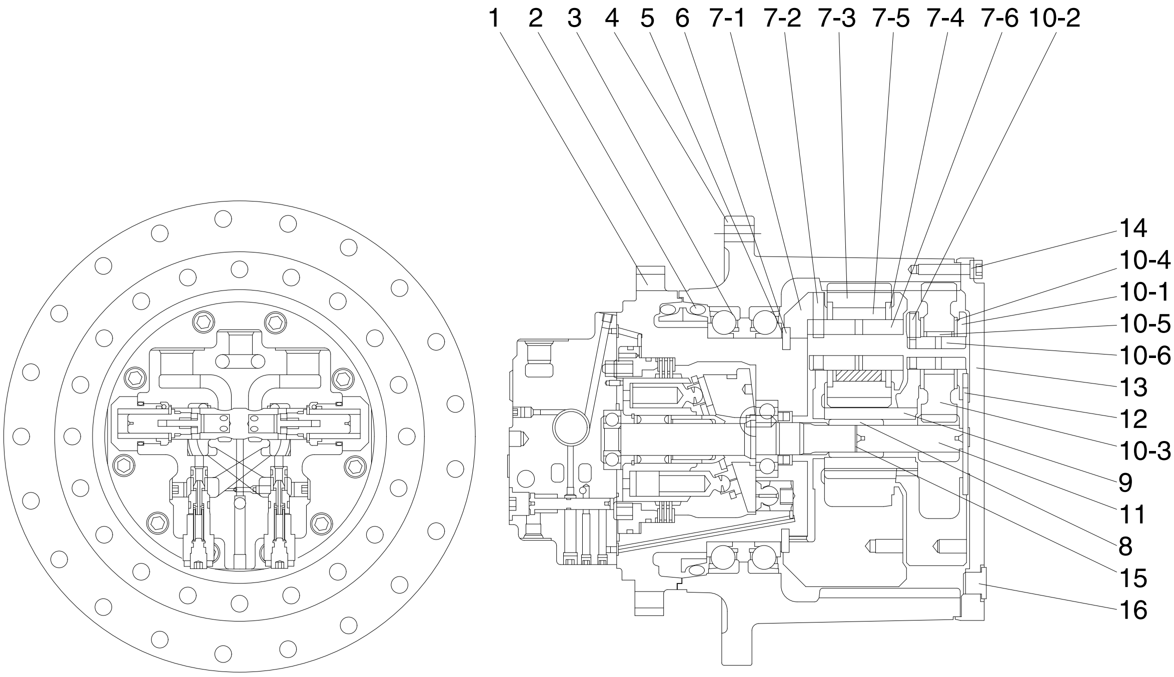
2. SPECIFICATION

1) STRUCTURE



145Z9A2TM02

1	Shaft casing	17	Piston assy	33	O-ring	49	Bearing
2	Oil seal	18	Steel plate	34	Spring	50	Pin
3	Shaft	19	Friction plate	35	Spool	51	Valve plate
4	Bearing	20	Brake piston	36	Spring	52	Spring
5	Pin	21	Ring	37	Plug	53	Wrench bolt
6	Swash ball	22	Ring	38	Piston	54	Name plate
7	Swash piston	23	O-ring	39	Plug	55	Rivet
8	Spring	24	O-ring	40	O-ring	56	Steel ball
9	Swash plate	25	Valve casing	41	Steel ball	57	Plug
10	Cylinder block	26	Main spool	42	Orifice	58	O-ring
11	Spring seat	27	Plug	43	Plug	60	Plastic plug
12	Spring	28	O-ring	44	Plug	61	Plastic plug
13	Snap ring	29	Spring	45	Orifice	62	Plastic plug
14	Pin	30	Check	46	Orifice	63	Orifice
15	Ball guide	31	Plate	47	Plug		
16	Set plate	32	Plug	48	Relief valve assy		



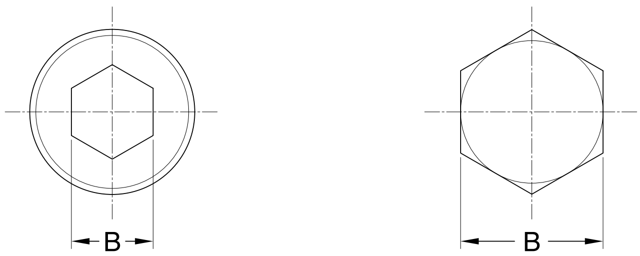
145Z9A2TM02A

1	Spindle	7-4	Washer 2	10-5	Bearing 1
2	Floating sesal	7-5	Bearing 2	10-6	Pin 1
3	Ball bearing	7-6	Pin 2	11	Sun gear 1
4	Housing	8	Coupling	12	Plate 1
5	Shim	9	Sun gear 2	13	Cover
6	Shim	10	Carrier assy 1	14	Bolt
7	Carrier assy 2	10-1	Carrier 1	15	Snap ring
7-1	Carrier 2	10-2	Spring pin 1	16	Plug
7-2	Spring pin 2	10-3	Planetary gear 1		
7-3	Planetary gear 2	10-4	Washer 1		

2) TOOL AND TIGHTENING TORQUE

(1) Tools

Name of tools	B (mm)	Name of part applied
Hexagonal L-Wrench	4	Plug (42, 45, 46, 47)
	6	Plug (43, 44)
	8	Plug (39)
	10	Plug (37, 57), Wrench bolt (53)
Socket wrench/ spanner	24	Relief plug (48)
	41	Main spool plug (32)
Snap ring plier (for holes, axis)		ø 42 (13)
Hammer		Ball bearing (49), Pin (50)
Torque wrench		Size : 5 kgf · m, 100 kgf · m
Jig for oil seal assembling		Oil seal (2)
Heating tool for bearing		Parking spring (20)



Size B

145Z9A8TM99

(2) Tightening torque

Item no.	Part name	Size	B (mm)	Torque	
				kgf · m	lbf · ft
25	Wrench bolt	-	-	68	491.8
32	Main spool plug	M36	41	45	325.5
37	Plug	PF 3/8	10	6	43.4
39	Plug	PF 1/4	8	3	21.7
42, 45, 46, 47	Plug	PT 1/16	4	0.7~1.1	5.1~8.0
43	Plug	PT 1/8	6	1.25	9.0
48	Relief valve plug	PF 1/2	24	10	72.3
53	Wrench bolt	M12×30	10	10.4	75.2

2. DISASSEMBLING AND ASSEMBLING

1) GENERAL INSTRUCTIONS

(1) Generally, hydraulic equipment is precisely manufactured and clearances between each parts are very narrow. Therefore, disassembling and assembling works should be performed on the clean place where dusts hardly gather. Tools and kerosene to wash parts should also be clean and handled with great care.

(2) When motor is removed from the host machine, wash around the ports sufficiently and put the plugs so that no dust and/or water may invade. Take off these plugs just before the piping works when re-attach it to the host machine.

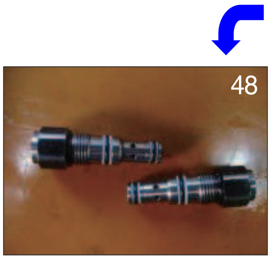
(3) Before disassembling, review the sectional drawing and prepare the required parts, depending on the purpose and the range of disassembling.
Seals, O-rings, etc., if once disassembled, are not reusable.
There are some parts that should be replaced as a subassembly.
Consult with the parts manual in advance.

(4) The piston can be inserted to whichever cylinder block for the initial assembling.
However, their combination should not be changed if they are once used. To reuse them, put the matching mark on both pistons and cylinder block before disassembling.

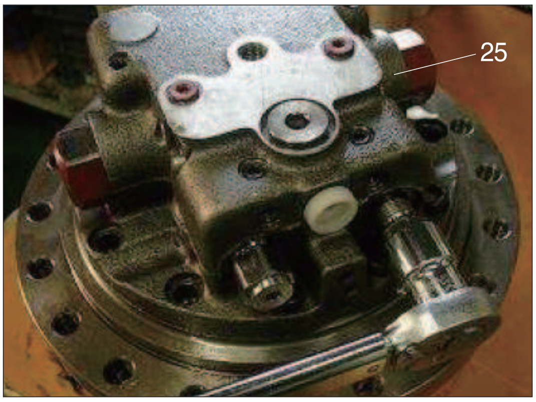
⚠ **Take great care not to pinch your hand between parts while disassembling nor let fall parts on your foot while lifting them.**

2) DISASSEMBLING MOTOR UNIT

(1) Disassemble relief valve (48) from valve casing (25) using a torque wrench.

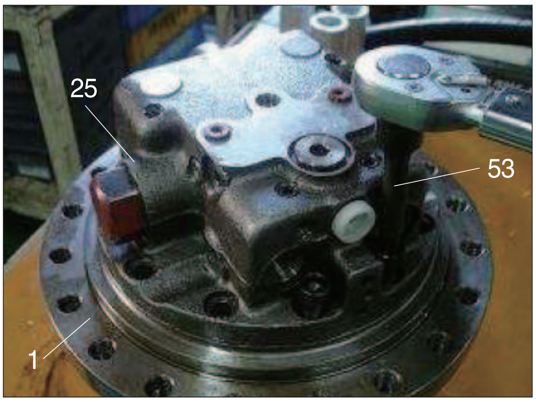


145Z9A8TM01



145Z9A8TM02

(2) Disassemble wrench bolt (53) (M12 × 30) and take out valve casing sub assembly.



145Z9A8TM03

(3) Remove parking spring (52) - 12EA.

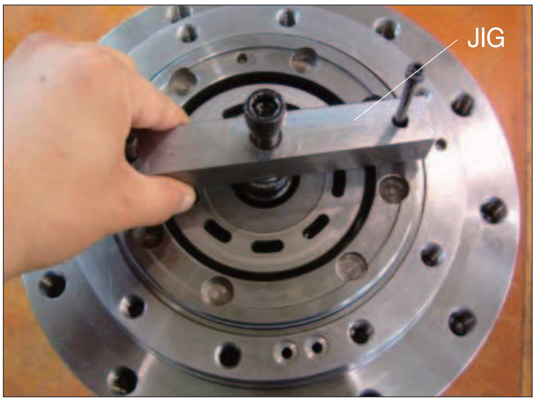
145Z9A8TM04

(4) Remove O-ring (23).

145Z9A8TM05

(5) Disassemble brake piston (20) using a jig.

145Z9A8TM06



145Z9A8TM07

(6) Disassemble friction plate (19)-3EA, steel plate (18)-4EA.

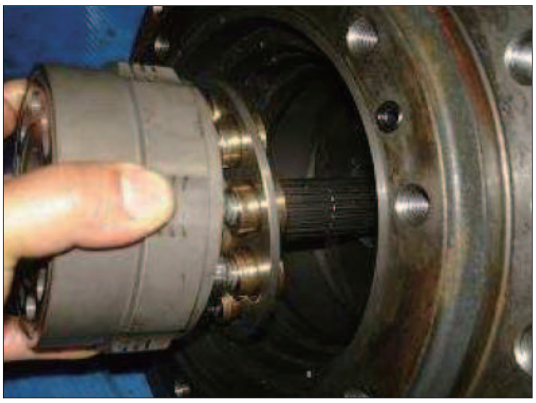
145Z9A8TM08

145Z9A8TM09

145Z9A8TM10

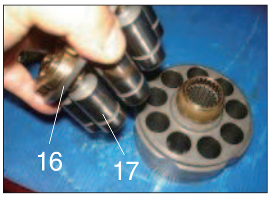
(7) Remove the cylinder block kit (II).
※ It is easier to work by placing the shaft casing (1) horizontal.


145Z9A8TM12

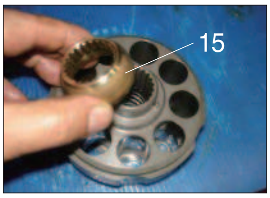

145Z9A8TM11

(8) Disassemble cylinder block (10), ball guide (15), set plate (16), piston assy (17), pin (14) from cylinder block kit (II).
Press spring (12) using a jig and take out snap ring (14) using a plier.
Disassemble snap ring (13), spring seat (11), spring (12) from cylinder block kit (II).

145Z9A8TM13



145Z9A8TM14



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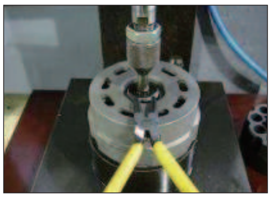
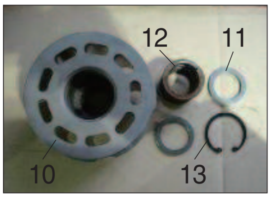
145Z9A8TM16

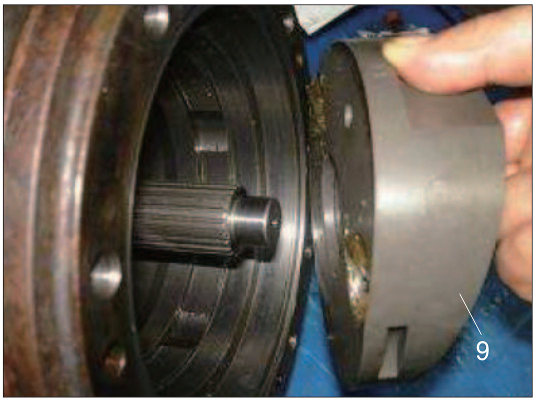


145Z9A8TM17



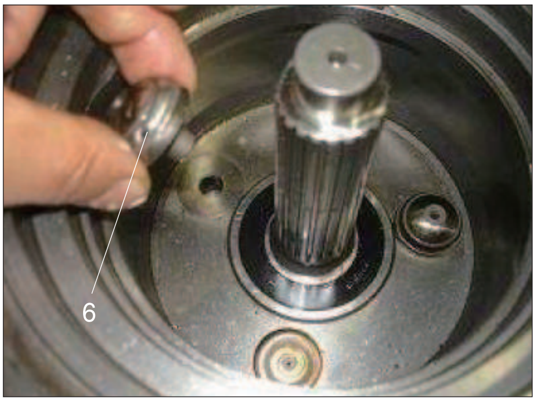
145Z9A8TM18

(9) Disassemble swash plate (9).



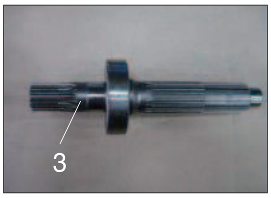
145Z9A8TM19

(10) Disassemble swash ball (6).

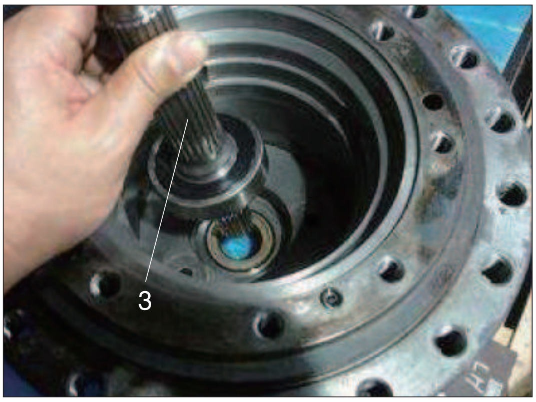


145Z9A8TM20

(11) Disassemble shaft (3) from shaft casing (1).



145Z9A8TM21

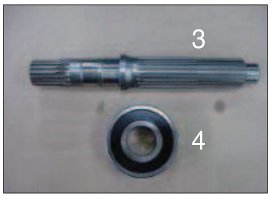


145Z9A8TM22

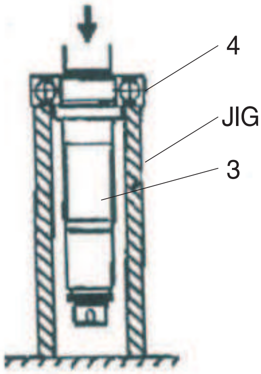
- After disassembled shaft (3) is placed on a jig, top of shaft is pressed down using a press. It can remove ball bearing (4) portion.

※ Remove ball bearing (4) in case it is replaced only.

- Dismantled bearing can't be reused.

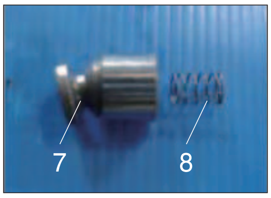


145Z9A8TM23

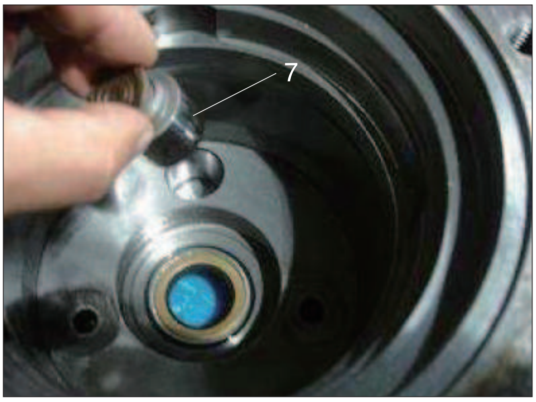


145Z9A8TM24

(12) Disassemble swash piston (7), spring (8) into shaft casing(1).

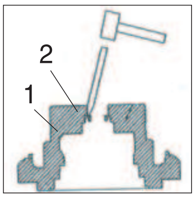


145Z9A8TM25

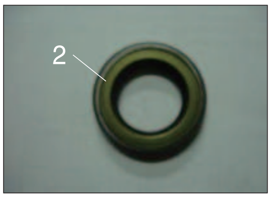


145Z9A8TM26

(13) Disassemble oil seal (2) from shaft casing (1) using a tool.



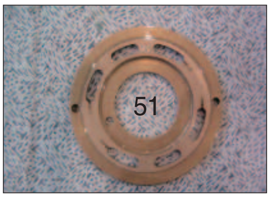
145Z9A8TM27



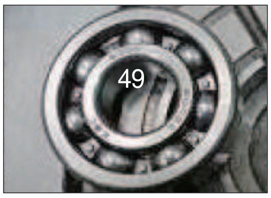
145Z9A8TM28


145Z9A8TM29

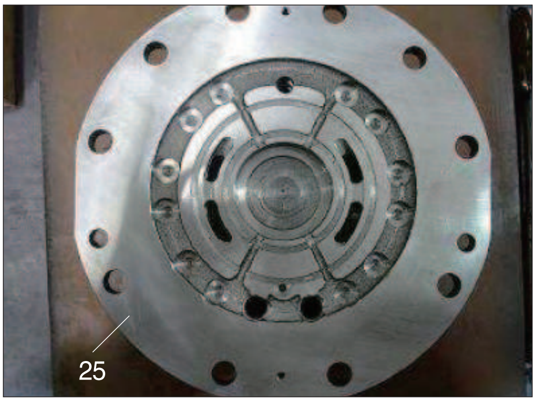
(14) Disassemble valve plate (51) and ball bearing (49) from valve casing (25).



145Z9A8TM30

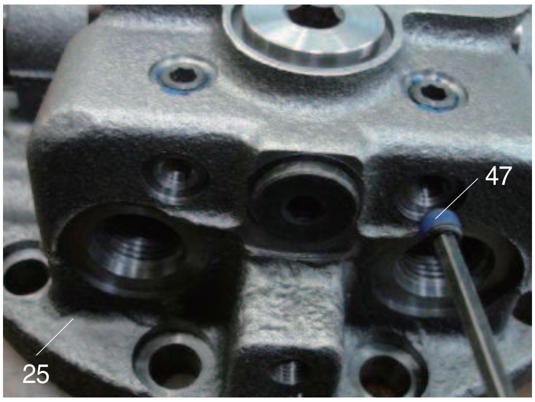


145Z9A8TM31



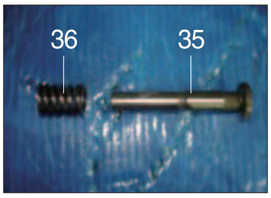
145Z9A8TM32

(15) Disassemble plug (47) from valve casing (25).

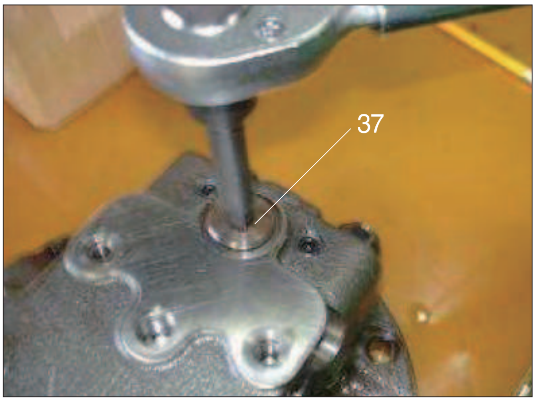


145Z9A8TM33

(16) Disassemble plug (37) from valve casing (25) using a torque wrench and disassemble two speed control spool (35), spring (36) in regular sequence.

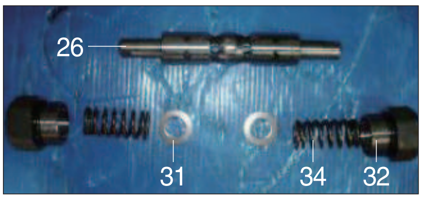


145Z9A8TM34

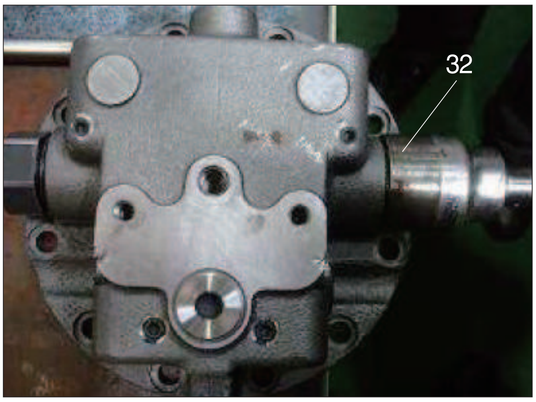


145Z9A8TM35

(17) Disassemble main spool plug (32) from valve casing (25) using a torque wrench and disassemble spring (34), plate (31), main spool (26) in regular sequence.

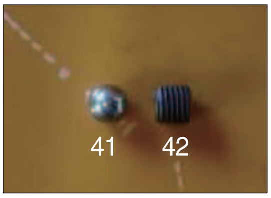


145Z9A8TM36

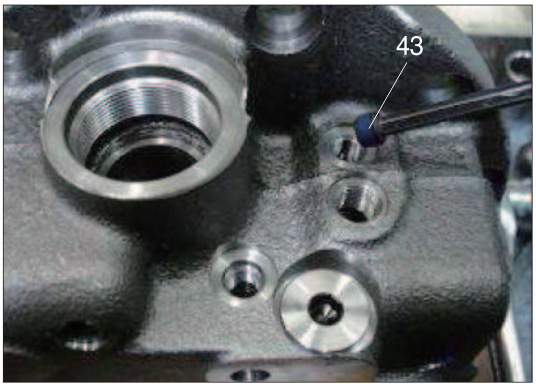


145Z9A8TM37

(18) Disassemble plug (43) from valve casing (25) and then disassemble orifice (42), steel ball (41) one by one.

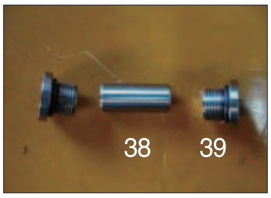


145Z9A8TM38

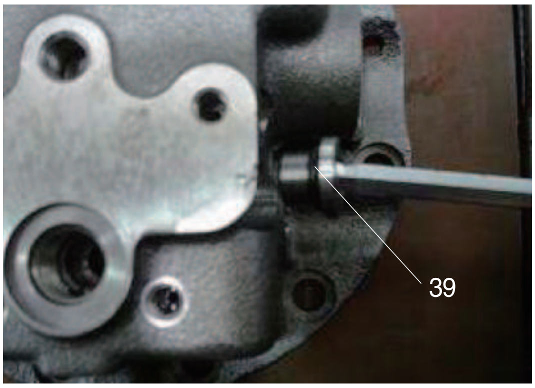


145Z9A8TM39

(19) Disassemble plug (39), relief valve damping piston (38) from valve casing (25).

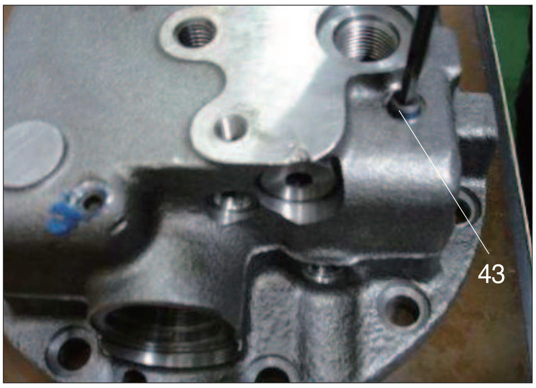


145Z9A8TM40



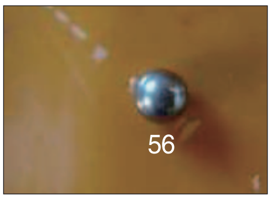
145Z9A8TM41

(20) Disassemble plug (43) from valve casing (25) and disassemble orifice (63).



145Z9A8TM42

(21) Disassemble plug (57), steel ball (56) from valve casing (25).

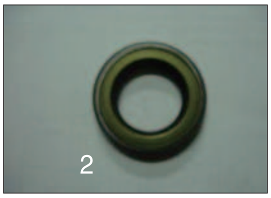


145Z9A8TM43

145Z9A8TM44

3) ASSEMBLING MOTOR UNIT

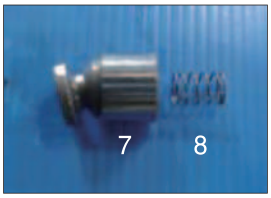
(1) Put oil seal into shaft casing (1) using a jig.
※ Caution direction of oil seal.



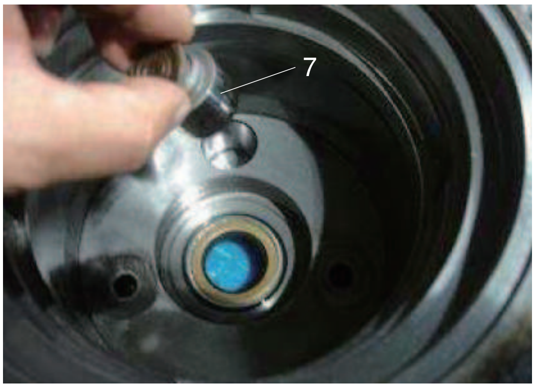
145Z9A8TM45

145Z9A8TM46

(2) Assemble swash spring (8) into shaft casing (1) and put swash piston (7) into shaft casing (1).



145Z9A8TM47

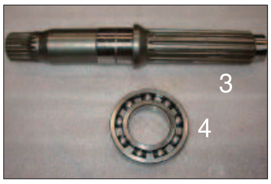


145Z9A8TM48

(3) Press the ball bearing (4) into shaft (3) after preheating of ball bearing (4).

① Induction heating apparatus temperature : 100˚C
② Be careful not to damage the sliding surface for the seal on the shaft.

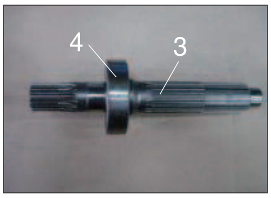

145Z9A8TM49



145Z9A8TM50


145Z9A8TM51

(4) Assemble shaft into shaft casing (1).



145Z9A8TM52

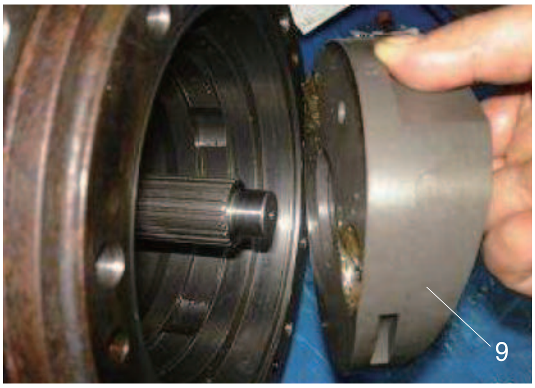

145Z9A8TM53

(5) Assemble swash ball (6)-2EA.

145Z9A8TM54

(6) Apply grease to swash plate (9) and assemble swash plate (9) into shaft casing (1).

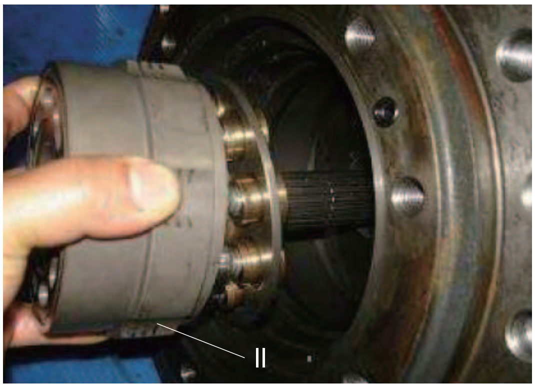
145Z9A8TM55



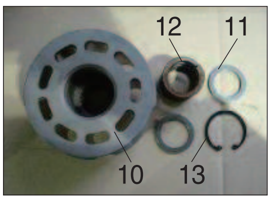
145Z9A8TM56

(7) Slant the shaft casing (1) and then assemble cylinder block kit (II).

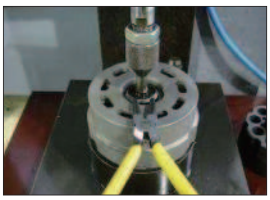
- Assemble spring seat (11), spring (12), spring seat (11) into cylinder block kit (II) in regular sequence.
  Push down spring(12) and then assemble snap ring (13) into gap of cylinder block(10) using a plier.
- Assemble pin (14), ball guide (15), set plate (16), piston assy (17) into cylinder block (10) in regular sequence.



145Z9A8TM57

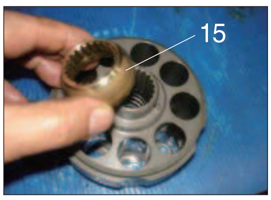


145Z9A8TM58

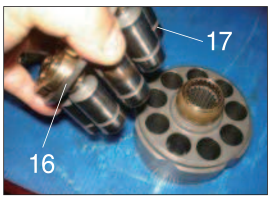


145Z9A8TM59

145Z9A8TM60



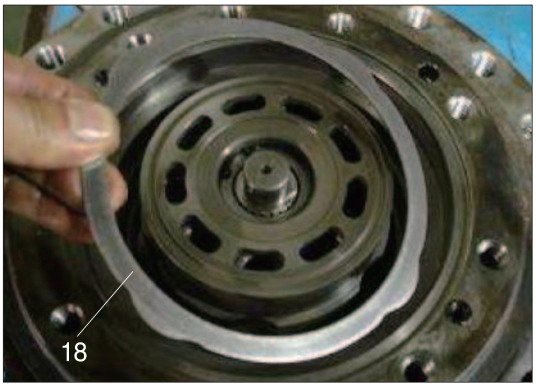
145Z9A8TM61



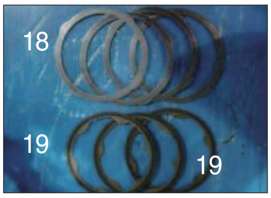
145Z9A8TM62

145Z9A8TM63

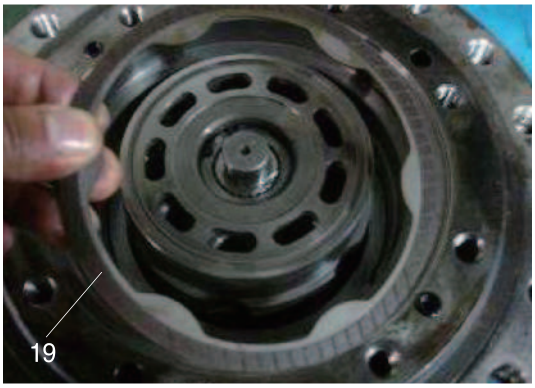
(8) Assemble friction plate (19), steel plate (18) into cylinder block in regular sequence.
Friction plate : 3 EA
Steel Plate : 4 EA



145Z9A8TM64

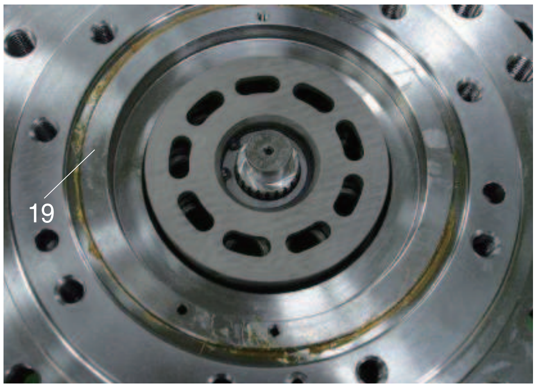


145Z9A8TM65

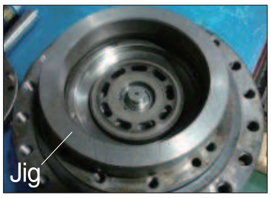


145Z9A8TM66

(9) Assemble parking piston (20) into shaft casing (1) using a jig.



145Z9A8TM67



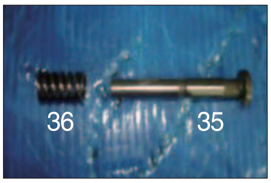
145Z9A8TM68

(10) Put O-ring (23) into shaft casing (1).
Apply the grease to O-ring.

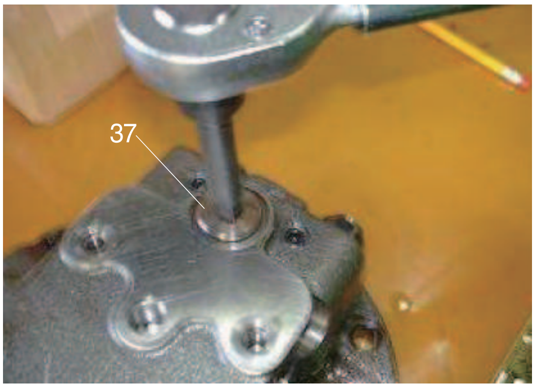
145Z9A8TM69

(11) Put spring (36), two speed control spool (35) into valve casing (25) in regular sequence and assemble plug (37) into valve casing (25) using a torque wrench.

· Tighten torque : 10 kgf-m (72.3 lbf-ft)



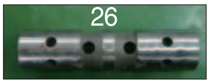
145Z9A8TM70



145Z9A8TM71

(12) Assemble check (30), spring (29), plug (27) into main spool (26) in regular sequence.

145Z9A8TM72



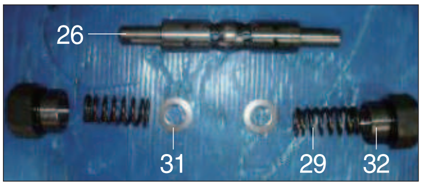
145Z9A8TM73


145Z9A8TM74

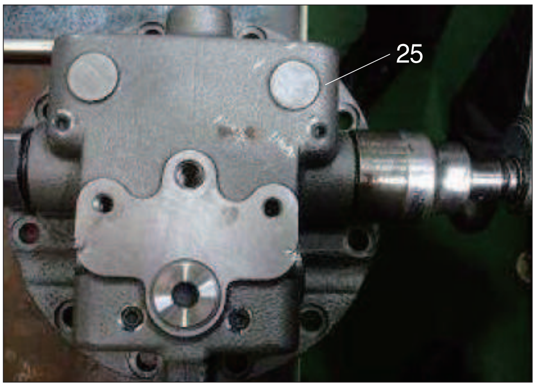

145Z9A8TM75

(13) Put the main spool (26) into valve casing (25) and assemble plate (31), spring (29) into it. Tighten main spool plug (32) using a torque wrench.

· Tighten torque : 45 kgf-m (325.5 lbf-ft)



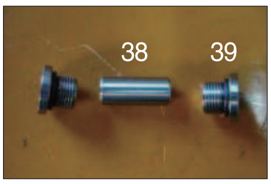
145Z9A8TM76



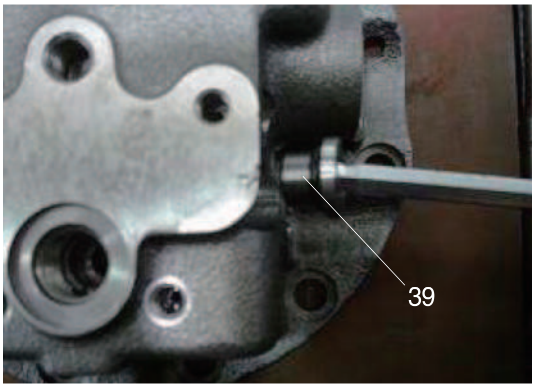
145Z9A8TM77

(14) Put relief valve damping piston (38) into valve casing (25) and assemble plug (39) into valve casing (25).

· Tighten torque : 6 kgf-m (43.4 lbf-ft)



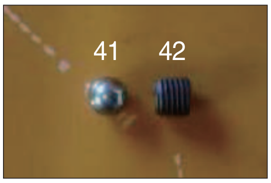
145Z9A8TM78



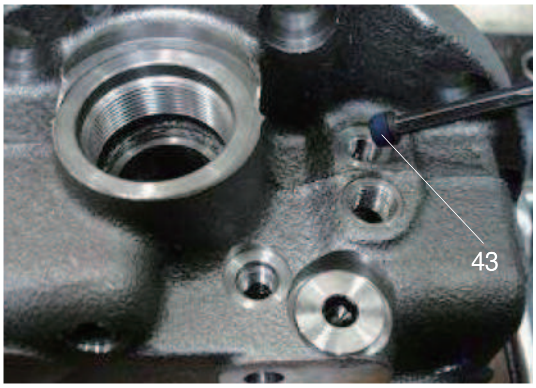
145Z9A8TM79

(15) Put steel ball (41), orifice (42) into valve casing (25) and tighten the plug (43).

· Tighten torque : 1.25 kgf-m (9.0 lbf-ft)



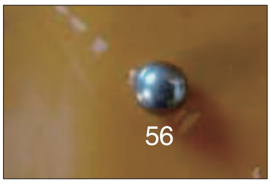
145Z9A8TM80



145Z9A8TM81

(16) Put steel ball (56) into valve casing (25) and tighten the plug (57).

· Tighten torque : 1.25 kgf-m (9.0 lbf-ft)

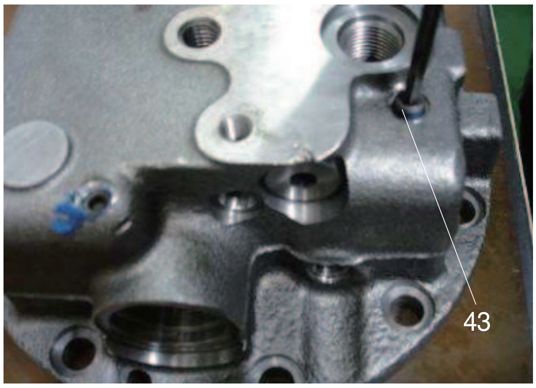


145Z9A8TM82

145Z9A8TM83

(17) Assemble orifice (63) into valve casing (25) and tighten the plug (43).

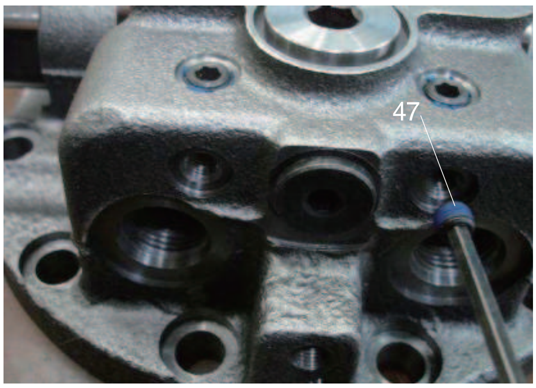
· Tighten torque : 1.25 kgf-m (9.0 lbf-ft)



145Z9A8TM84

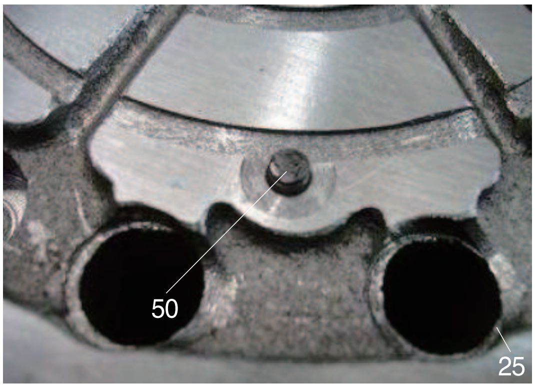
(18) Assemble orifice (63) into valve casing (25) and tighten the plug (47).

· Tighten torque : 0.7~1.1 kgf-m (5.1~8.0 lbf-ft)



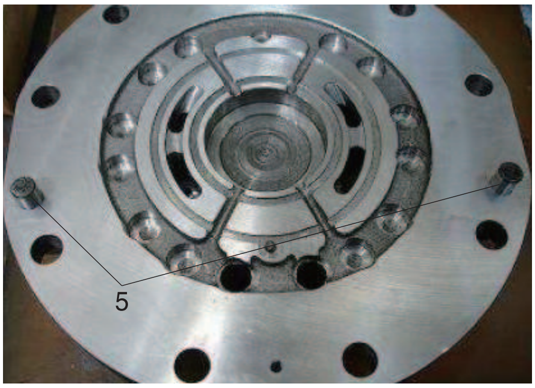
145Z9A8TM85

(19) Assemble pin (50) into valve casing (25).



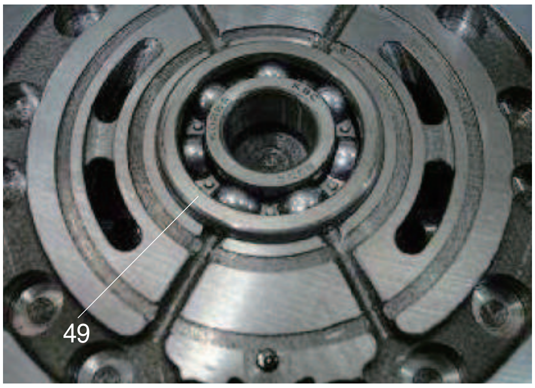
145Z9A8TM86

(20) Assemble pin (5) into valve casing (25).



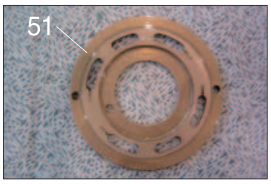
145Z9A8TM87

(21) Assemble ball bearing (49) into valve casing (25).

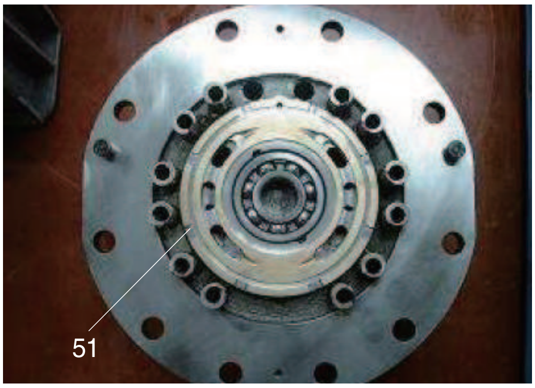


145Z9A8TM88

(22) Apply grease on the face of valve plate and assemble valve plate (51) into valve casing (25).



145Z9A8TM89



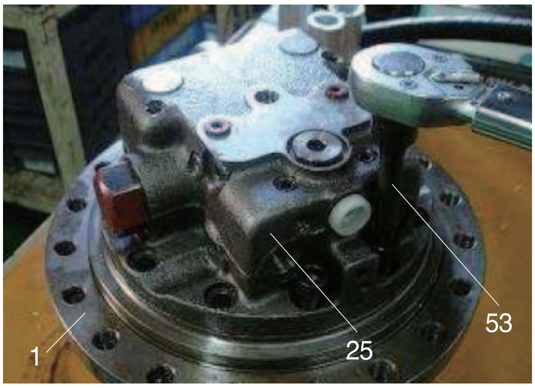
145Z9A8TM90

(23) Apply grease to brake spring (52)-12EA and assemble brake spring (52)-12EA into valve casing (25).

145Z9A8TM91

(24) Assemble valve casing (25) into shaft casing (1) and tighten the wrench bolt (53) using a torque wrench.

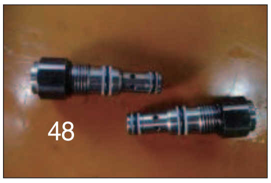
· Tighten torque : 10.4 kgf-m (75.2 lbf-ft)



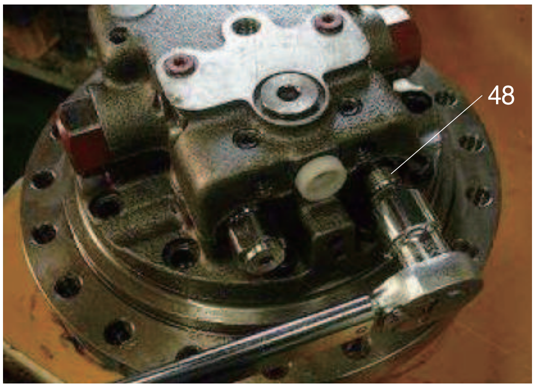
145Z9A8TM92

(25) Assemble relief valve (48) into valve casing (25) using a torque wrench.

· Tighten torque : 10 kgf-m (72.3 lbf-ft)



145Z9A8TM93



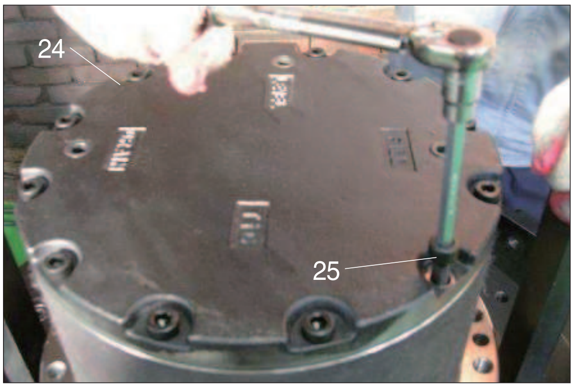
145Z9A8TM94

4) DISASSEMBLING REDUCTION GEAR

(1) Loose plug (26)-3EA and drain reduction oil.

145Z9A8TR02

(2) Loose wrench bolt (25) using a tool.



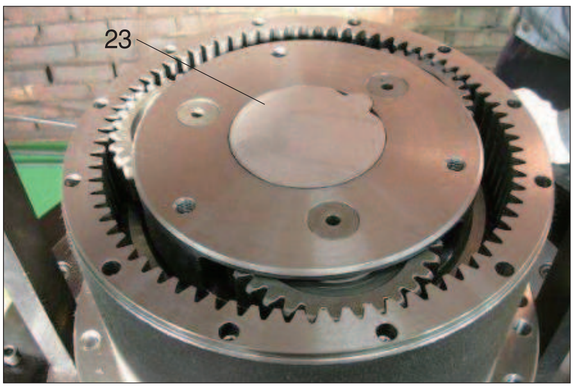
145Z9A8TR03

(3) Disassemble end cover (24).

145Z9A8TR04

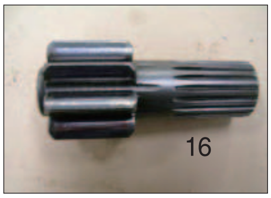
(4) Disassemble trust plate (23).

145Z9A8TR05

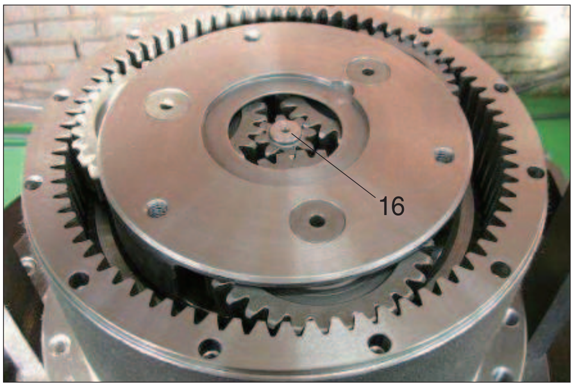


145Z9A8TR06

(5) Disassemble driver gear (16).



145Z9A8TR07



145Z9A8TR08

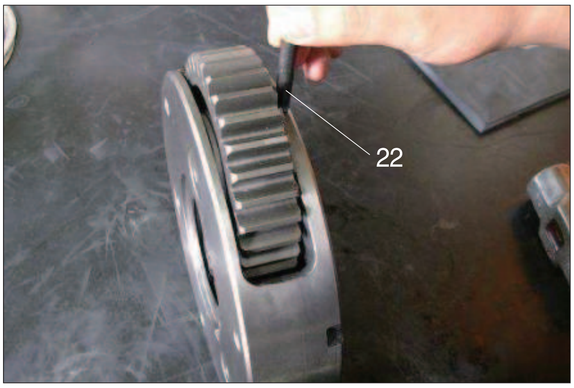
(6) Disassemble carrier No.1 (17) sub assy.

※ Assemble eyebolt into carrier No.1 tap hole and disassemble carrier No.1 (17) sub assy using a hoist.

145Z9A8TR09

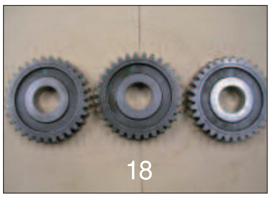
(7) Disassemble carrier No.1 sub assy.

※ Remove spring pin No.1 (22) from carrier No.1 (17) and planetary gear No.1 (18), washer No.1 (19), needle bearing No.1 (20), carrier pin No.1 (21) in regular sequence.

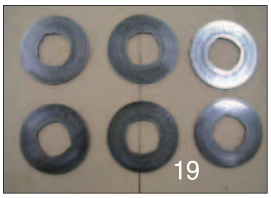


145Z9A8TR10

145Z9A8TR11



145Z9A8TR12

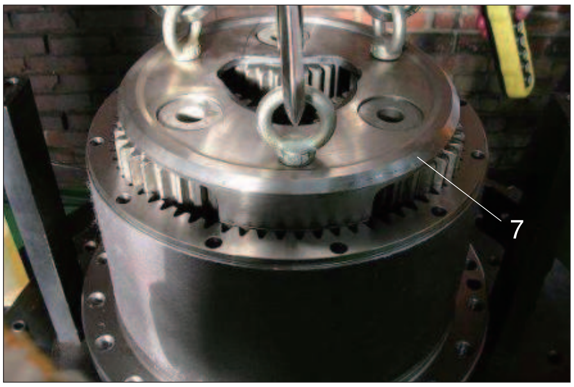


145Z9A8TR13

145Z9A8TR14

(8) Disassemble carrier No.2 (7) sub assy.

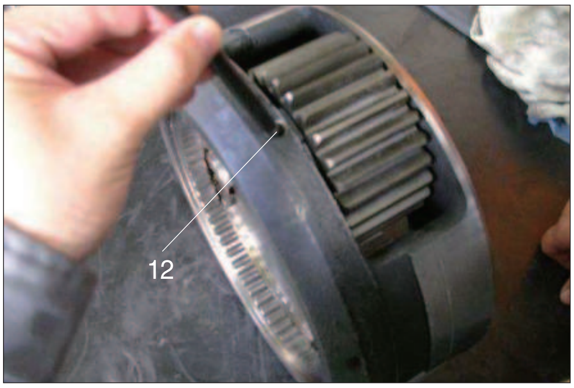
※ Assemble eyebolt into carrier No.2 tap hole and disassemble carrier No.2 (7) sub assy using a hoist.



145Z9A8TR15

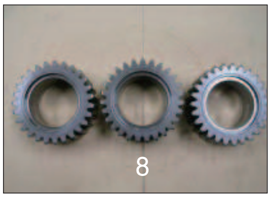
(9) Disassemble carrier No.2 (7) sub assy.

※ Remove spring pin No.2 (12) from carrier No.2 (7) and disassemble planetary gear No.2 (8), washer No.2 (9), needle bearing No.2 (10), carrier pin No.2 (11) in regular sequence.

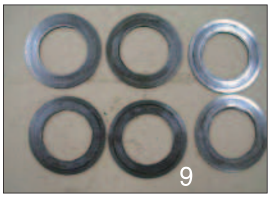


145Z9A8TR16

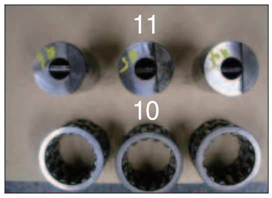
145Z9A8TR17



145Z9A8TR18

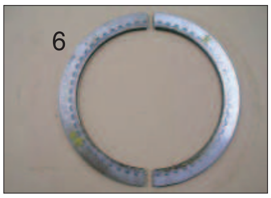


145Z9A8TR19

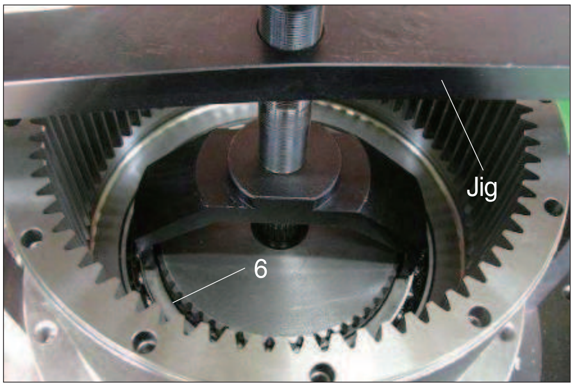


145Z9A8TR20

(10) Push down ring gear (4) using a jig and disassemble shim (6).



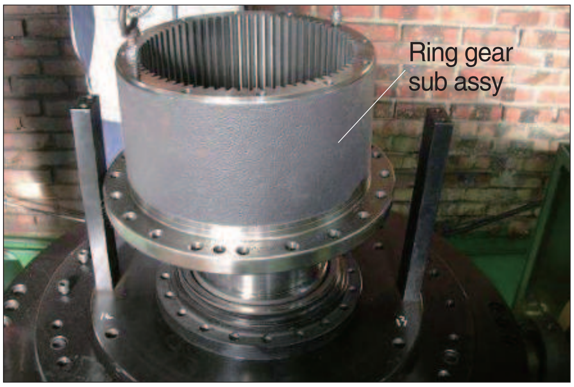
145Z9A8TR21



145Z9A8TR22

(11)Disassemble ring gear sub assy (4) into motor assy.

※ Assemble eye bolt into tap hole of ring gear sub assy (4) and disassemble ring gear sub assy (4) using a hoist.



145Z9A8TR23

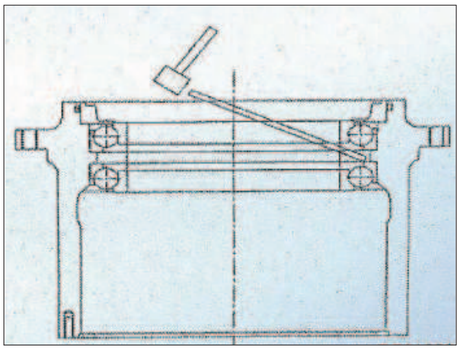
(12)Disassemble floating seal (2) from ring gear sub assy (4).

145Z9A8TR24

145Z9A8TR25

(13)Disassemble angular bearing (3) from ring gear sub assy (4).

※ Be careful not to damage the parts using a hammer.



145Z9A8TR26

4) ASSEMBLING REDUCTION GEAR

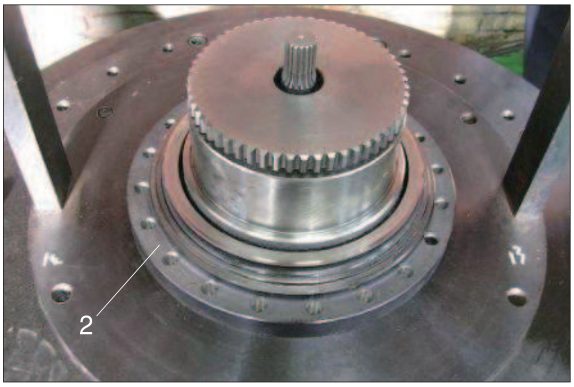
Before assembing please observe following item.

- Wash all parts cleanly using solvent and dry all parts perfectly using compressed air.
- Check metal dust in casing and cleansing solution.
- Before application packing, please remove oil certainly.
- Before insert needle bearing, apply grease to bearing inlet enough.
- Apply lubricant to rotation part and sliding part.
- Damaged part or discolored part exchanges by new parts.

(1) Assemble hub

① Place the motor assy on the bench and assemble floating seal (2) into motor (1) using a jig.

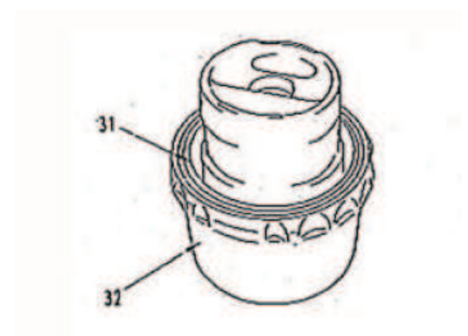
145Z9A8TR27



145Z9A8TR28

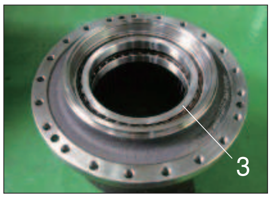
② Remove completely the oil of surface that O-ring and O-ring contact.

- Dry completely the floating seal.
- After assembling the floating seal, coat lubricant to the sliding surface of the floating seal.

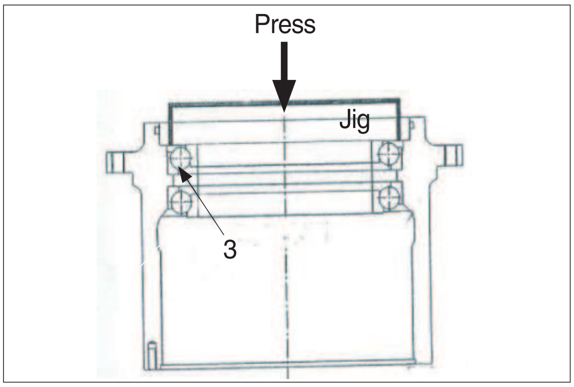


145Z9A8TR29

(2) Press angular bearing (3) into ring gear (4) using a jig.



145Z9A8TR30



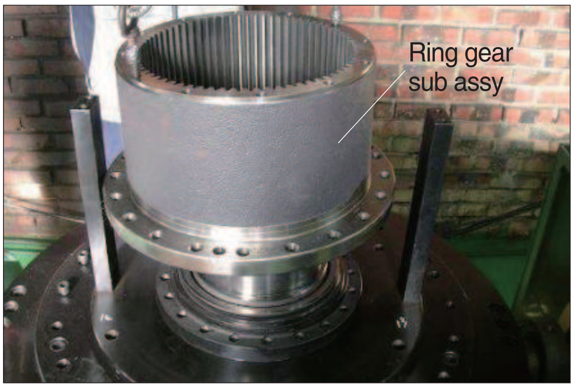
145Z9A8TR31

(3) Assemble floating seal(2) into ring gear(4) using a jig.

145Z9A8TR32

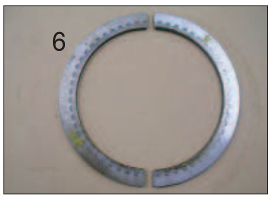
145Z9A8TR33

(4) Assemble ring gear sub assy (4) into motor assy using a assembly epuipment.

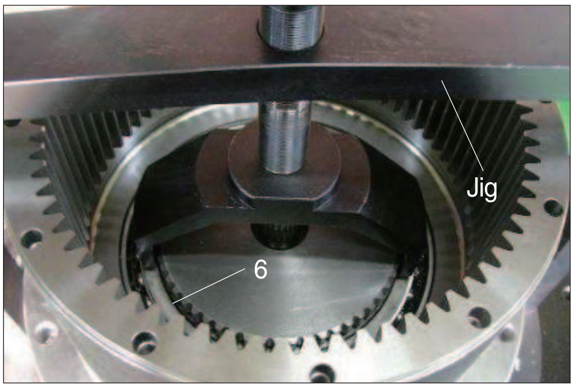


145Z9A8TR34

(5) Push down ring gear (4) using a jig and assemble shim (6).



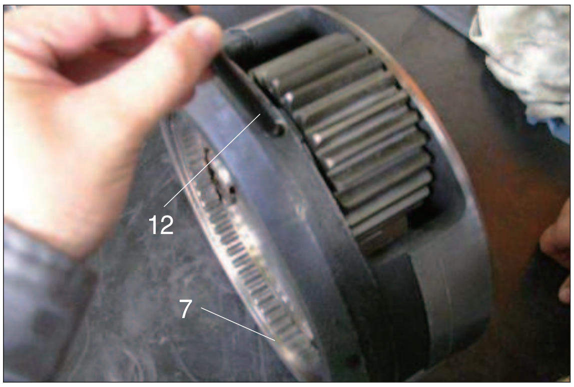
145Z9A8TR35



145Z9A8TR36

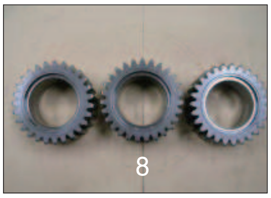
(6) Assemble carrier No.2 sub assy.

- Assemble planetary gear No.2 (8), washer No.2 (9), needle bearing No.2 (10) and carrier pin No.2 (11) into carrier No.2 (7) in regular sequence.
  Assemble spring pin No.2 (12).
- Assemble spring pin No.2 (12) and caulk spring pin into pin hole.

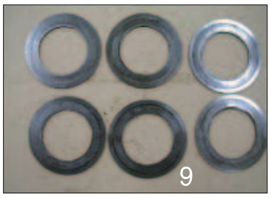


145Z9A8TR37

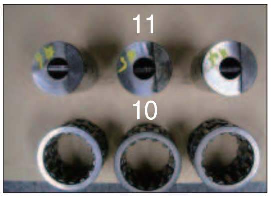
145Z9A8TR38



145Z9A8TR39



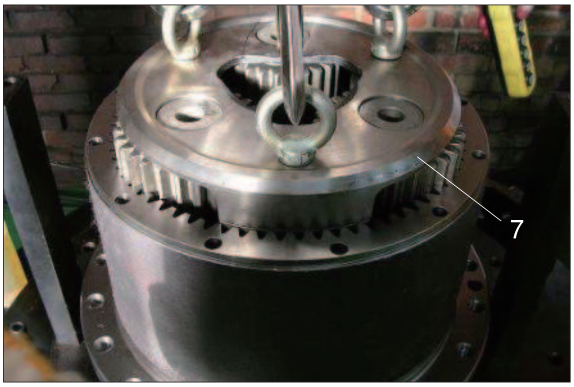
145Z9A8TR40



145Z9A8TR41

(7) Disassemble carrier No.2 (7) sub assy.

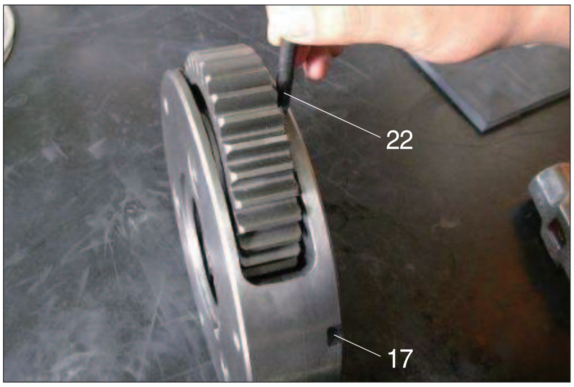
- Assemble eyebolt into carrier No.2 and assemble carrier No.2 (7) sub assy into ring gear using hoist.



145Z9A8TR42

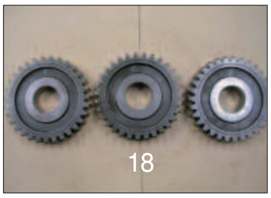
(8) Disassemble carrier No.2 (7) sub assy.

- Assemble planetary gear No.1 (18), washer No.1 (19), needle bearing No.1 (20) and carrier pin No.1 (21) into carrier No.1 (17) in regular sequence.
  Assemble spring pin No.1 (22)
- Assemble spring pin No.1 (22) and caulk spring pin into pin hole.

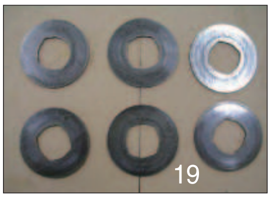


145Z9A8TR43

145Z9A8TR44



145Z9A8TR45



145Z9A8TR46

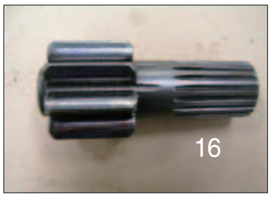
145Z9A8TR47

(9) Assemble carrier No.1 (17) sub assy.

- Assemble eyebolt into carrier No.1 and assemble carrier No.1 (17) sub assy into ring gear using hoist.

145Z9A8TR48

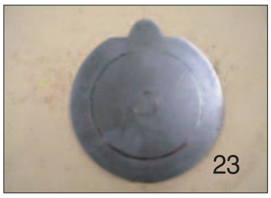
(10)Assemble driver gear(16).



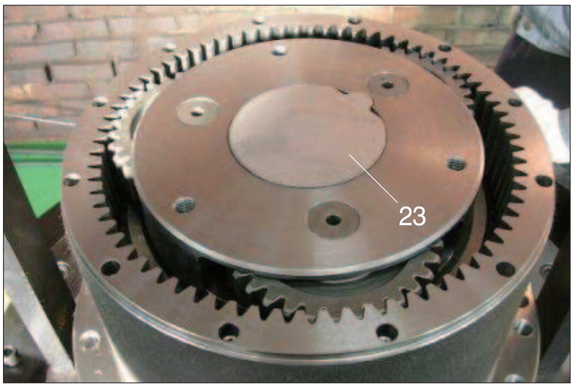
145Z9A8TR49

145Z9A8TR50

(11)Assemble trust plate (23).



145Z9A8TR51

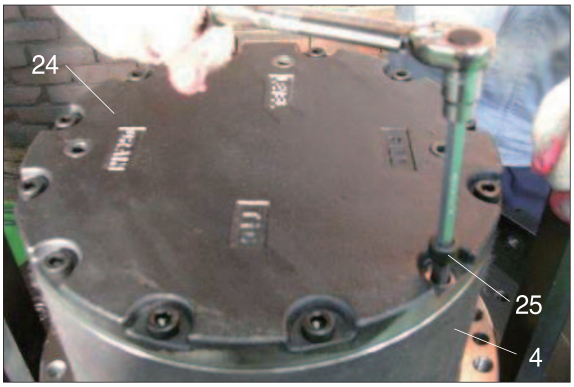


145Z9A8TR52

(12)Assemble end cover (24).

145Z9A8TR53

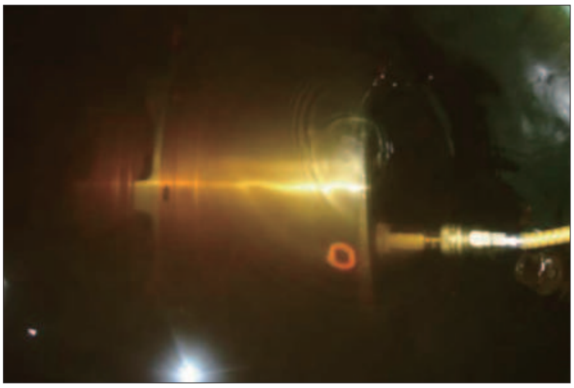
(13)Tighten wrench bolt (25) using a air impact.
· Tighten torque : 68 kgf-m (491.8 lbf-ft)



145Z9A8TR54

(14)Adjust control lever to be sunk the product under the test oil and then check the air leak.
*TEST : Air pressure 0.7 kgf/cm^2 × 30sec


145Z9A8TR55


145Z9A8TR56

(15)Inject gear oil and assemble plug (26)-3EA.
- Volume of gear oil : 2.2 ℓ
· Tightening torque : 10 kgf-m (72.3 lbf-ft)

145Z9A8TR57

■ TRAVEL MOTOR (TYPE 3, 4)

1. REMOVAL AND INSTALL

1) REMOVAL

(1) Swing the work equipment 90˚and lower it completely to the ground.

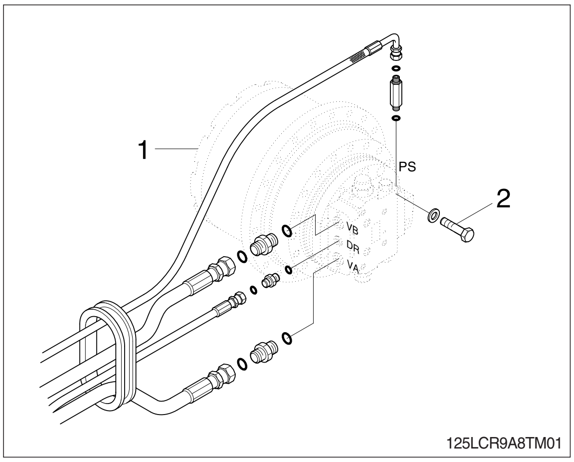
(2) Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

13031GE18

(3) Loosen the breather slowly to release the pressure inside the hydraulic tank.

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

※ When pipes and hoses are disconnected, the oil inside the piping will flow out, so catch it in oil pan.



125LCR9A8TM01

(4) Remove the track shoe assembly.
For details, see **removal of track shoe assembly.**

(5) Remove the cover.

(6) Remove the hose.

※ Fit blind plugs to the disconnected hoses.

(7) Remove the bolts and the sprocket.

(8) Sling travel device assembly (1).

(9) Remove the mounting bolts (2), then remove the travel device assembly.

· Weight : 140 ㎏ (310 ℔)

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.

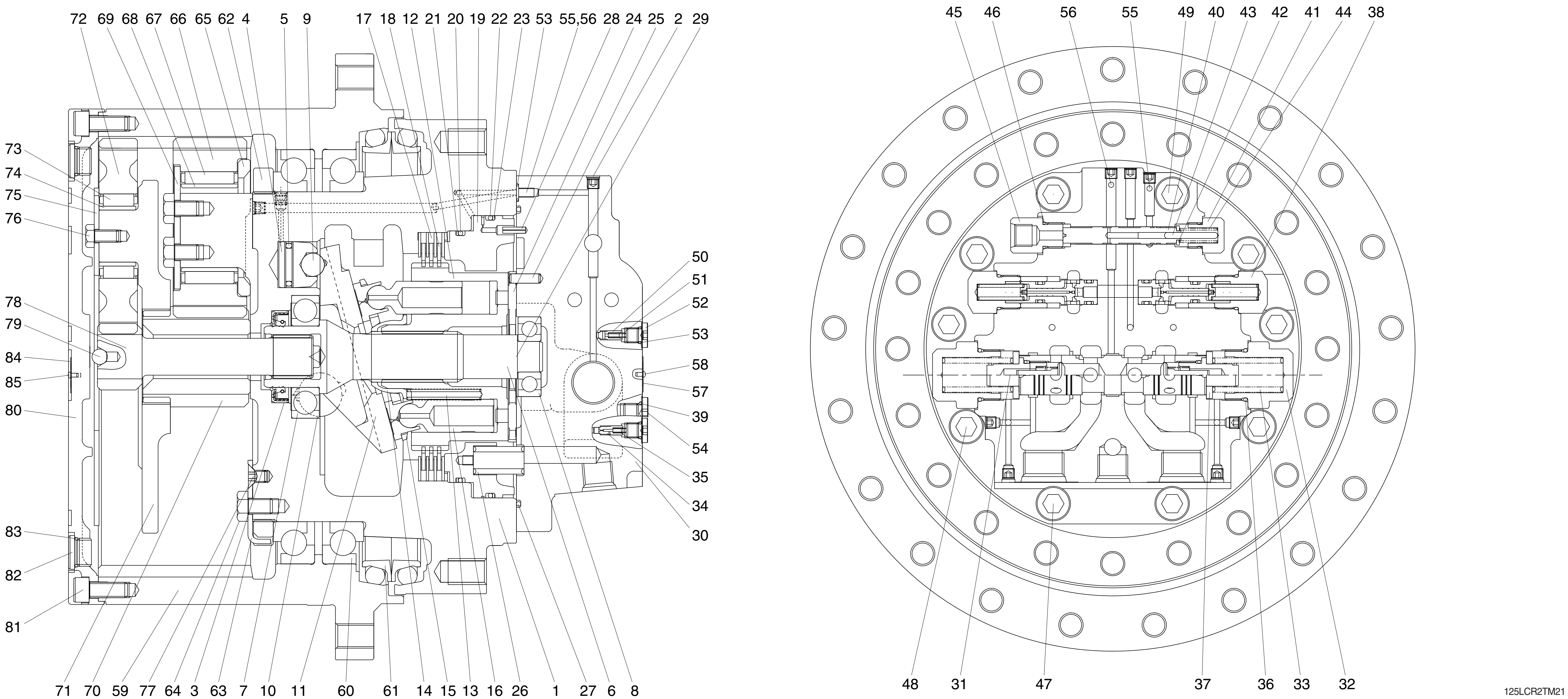
④ Start the engine, run at low idling, and check oil come out from plug.

⑤ Tighten plug fully.

(3) Confirm the hydraulic oil level and check the hydraulic oil leak or not.

2. TRAVEL MOTOR

1) STRUCTURE

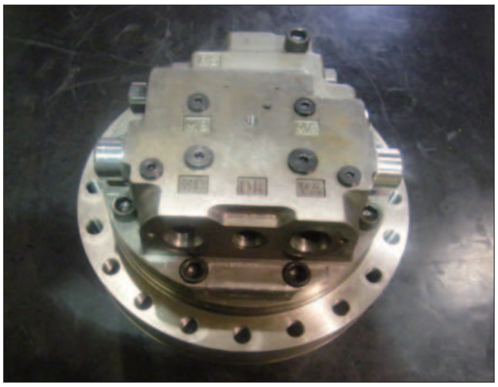


1 Casing
2 Plug
3 Oil seal
4 Piston
5 Piston seal
6 Shaft
7 Front ball bearing
8 Rear ball bearing
9 Steel ball
10 Steel ball
11 Swash plate
12 Cylinder block
13 Spring
14 Ball guide
15 Retainer plate
16 Piston assy
17 Friction plate
18 Separated plate
19 Parking piston
20 O-ring
21 Back up ring
22 O-ring
23 Back up ring
24 Valve plate
25 Spring pin
26 Spring
27 O-ring
28 Spring pin
29 Parallel pin
30 Rear cover
31 Main spool assy
32 Cover
33 Spring
34 Restrictor
35 Spring
36 O-ring
37 Spring seat
38 Relief valve assy
39 O-ring
40 Spool
41 Plug
42 Spring seat
43 Parallel pin
44 Spring
45 Connector
46 O-ring
47 Hexagon socket head bolt
48 Hexagon socket head bolt
49 Hexagon socket head bolt
50 Check valve
51 Spring
52 Plug
53 O-ring
54 Plug
55 Restrictor
56 Restrictor
57 Name plate
58 Rivet
59 Ring gear
60 Bearing
61 Floating seal assy
62 Nut ring
63 Lock plate
64 Hexagon head bolt
65 Thrust plate No. 2
66 Planetary gear No.2
67 Needle bearing No.2
68 Inner race No. 2
69 Thrust washer No. 2
70 Sun gear No.2
71 Carrier No.1
72 Planetary gear No.1
73 Needle bearing No.1
74 Inner race No. 1
75 Thrust plate No. 1
76 Hexagon head bolt
77 Countersunk head screw
78 Sun gear No.1
79 Steel ball
80 Cover
81 Hex socket head bolt
82 Plug
83 O-ring
84 Name plate
85 Rivet

2) DISASSEMBLY

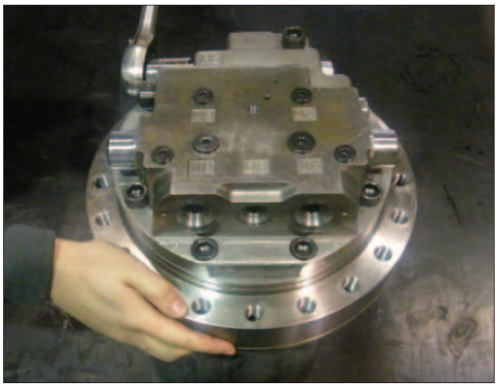
(1) Choose a clean place, remove contaminants (dust, etc) and cleans motor before placing it on worktable.

※ Lay the rubber plate on worktable and take care not to damage the component.



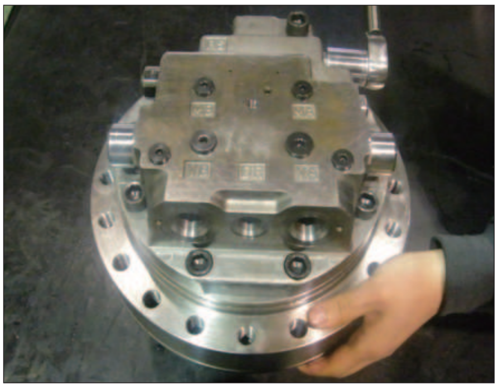
125LCR8TM02

(2) Remove the connector (45) using 21 mm socket wrench.



125LCR8TM03

(3) Remove plug (41) using 21 mm socket wrench.

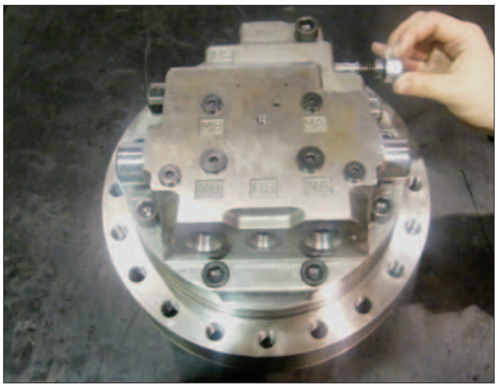


125LCR8TM04

(4) Disassemble parallel pin (43) and spring (44).

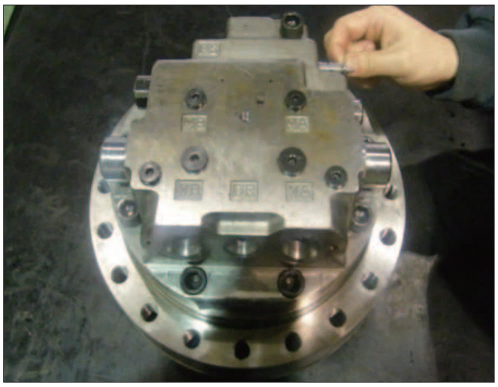
※ Do not lose spring.

※ Do not mix spring with other springs.



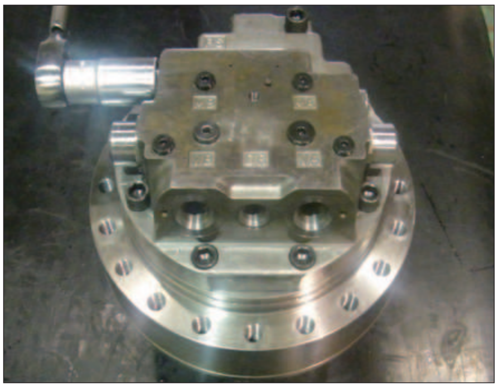
125LCR8TM05

(5) Remove spring seat (42) and spool (40).



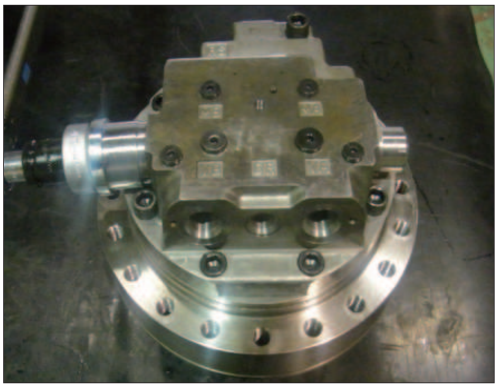
125LCR8TM06

(6) Disassemble relief valve assembly (38) using 26 mm socket wrench. (2 sets)



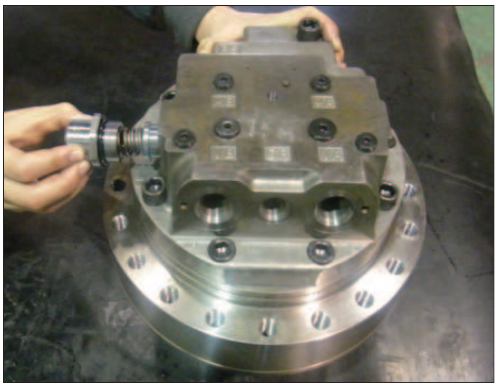
125LCR8TM07

(7) Disassemble cover (32) using 41 mm socket wrench.



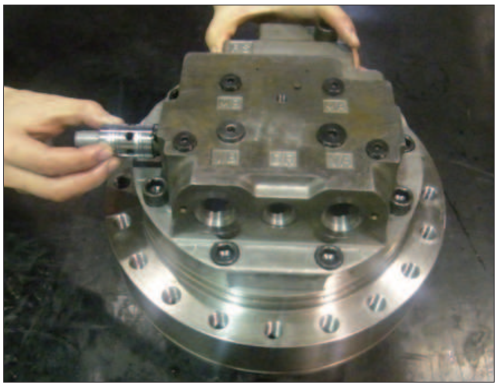
125LCR8TM08

(8) Disassemble spring seat (37) and spring (33). (2 sets)



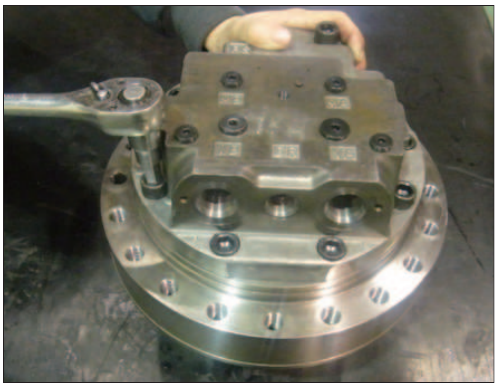
125LCR8TM09

(9) Separate main spool assembly (31) from rear cover.



125LCR8TM10

(10) Unscrew socket bolt (47) (1EA), (48) (3EA), (49) (6EA) from rear cover.



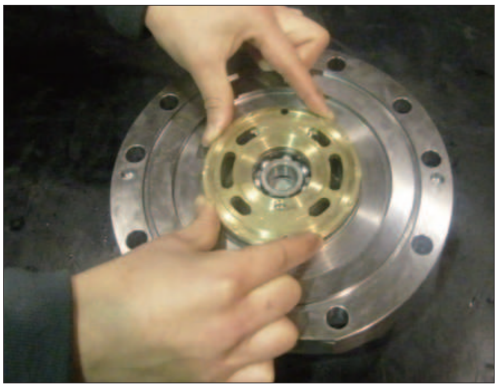
125LCR8TM11

(11) Remove parallel pin (29).

125LCR8TM12

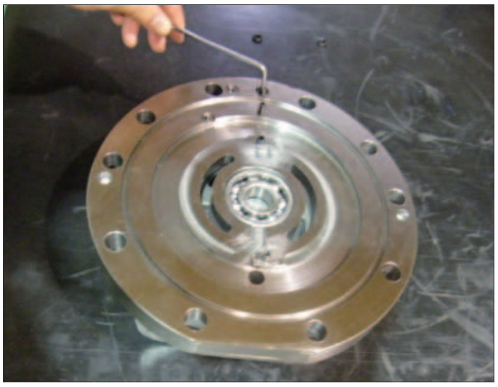
(12) From rear cover, disassemble valve plate (24) and O-ring (27).

※ Take care not to damage assembly surface of rear cover.



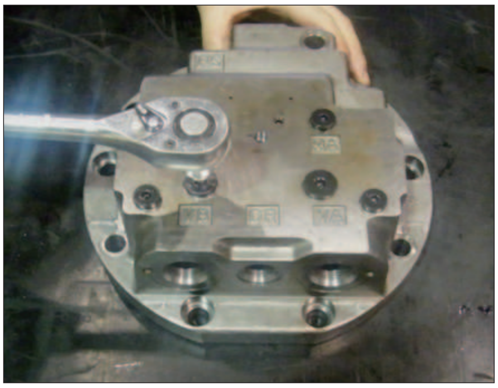
125LCR8TM13

(13) Disassemble restrictor (55, 56) (2EA).
※ Mark the number on restrictor and its hole to avoid confusing (55) and (56).



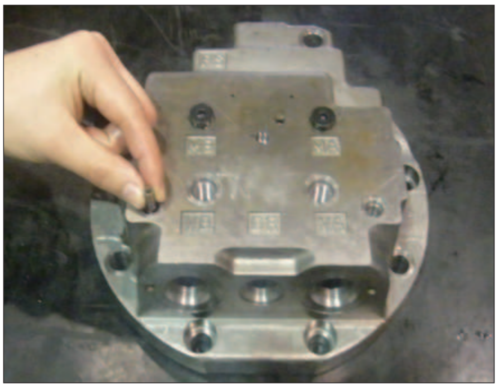
125LCR8TM14

(14) Remove plug (52).



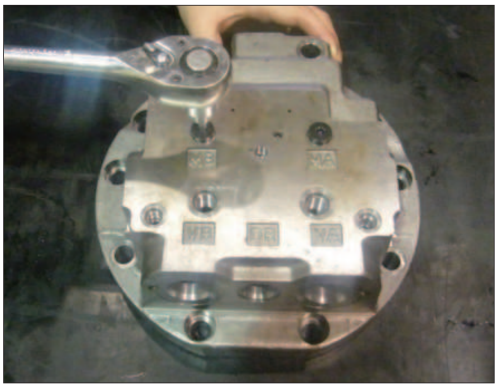
125LCR8TM15

(15) Remove restrictor (34) and spring (35). (2 sets)
※ Do not confuse restrictor (34) and check valve (50).
※ Do not confuse spring (35) and spring (51).
※ Do not lose spring.
※ Do not mix spring with other springs.



125LCR8TM16

(16) Remove plug (52) using 5 mm hexagon wrench.



125LCR8TM17

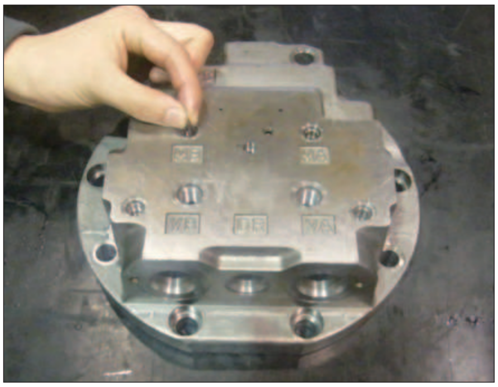
(17) Remove check valve (50) and spring (51). (2 sets)

※ Do not confuse restrictor (34) and check valve (50).

※ Do not confuse spring (35) and spring (51).

※ Do not lose spring.

※ Do not mix spring with other springs.



125LCR8TM18

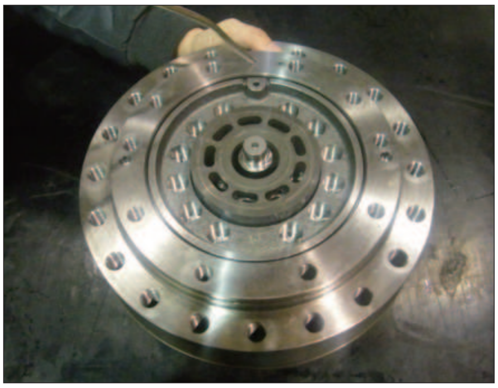
(18) From parking piston, remove spring (26) (12ea).

※ Do not lose spring.

※ Do not mix spring with other springs.

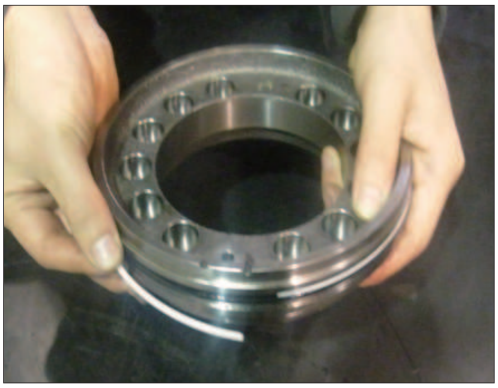
125LCR8TM19

(19) Disassemble parking piston (19) using air gun or jig.



125LCR8TM20

(20) From parking piston, separate O-ring (22) and back-up ring (23).

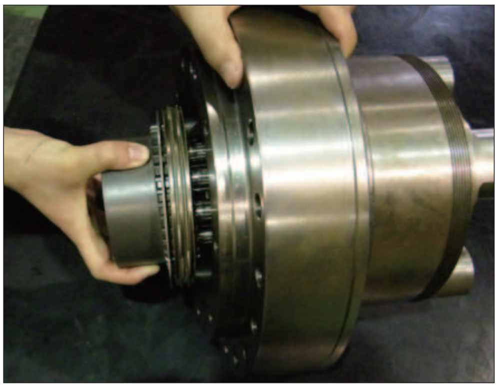


125LCR8TM21

(21) From parking piston separate O-ring (20) and back-up ring (21).

125LCR8TM22

(22) Lay casing down horizontally and remove cylinder block assembly, friction plate (17) (3EA) and separator plate (18) (4EA).



125LCR8TM23

(23) Separate retainer plate (15) and piston assembly (16).

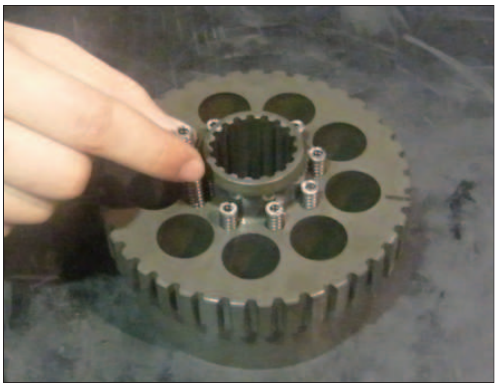
※ Take care not to damage sliding surface of each component.

125LCR8TM24

(24) Disassemble ball guide (14) and spring (13) (9EA).

※ Do not lose spring.

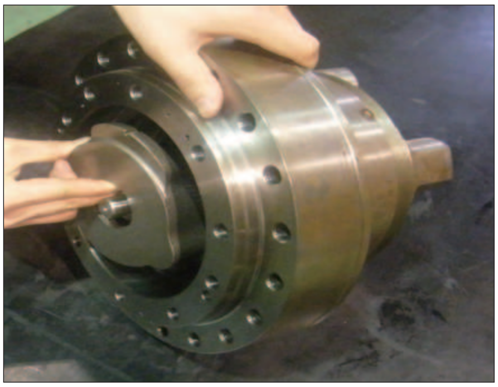
※ Do not mix spring with other springs.



125LCR8TM25

(25) Disassemble swash plate (11) and steel ball (10).

※ Take care not to damage sliding surface.



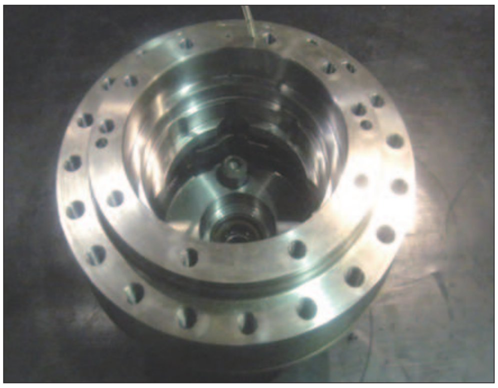
125LCR8TM26

(26) Disassemble shaft (6) and ball bearing (7).

※ Do not remove ball bearing unless malfunction is detected, since it is mounted by shrink fit.

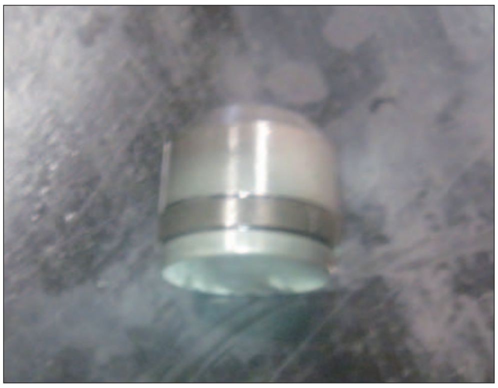
125LCR8TM27

(27) Disassemble 1, 2 speed piston (4) and steel ball (9) using air gun.



125LCR8TM28

(28) Disassemble piston seal (5).



125LCR8TM29

(29) Turn casing (1) upside down and remove oil seal (3) using jig.

125LCR8TM30

3) ASSEMBLY

※ Even though assembly is accomplished by reversing disassembly steps, be careful of the following.

① Repair the damaged part when disassemblying and prepare parts for exchange in advance.
② All parts should be cleaned with cleaner, dried with compressed air.
③ Sliding surface, O-ring, bearing and oil seal should be lubricated with clean hydraulic oil, prior to final assembly.
④ Replacement of O-ring and oil sealwith new parts is generally recommended.
⑤ Use a torque wrench to make sure that assembly fasteners are tightened to specified values shown table1.
⑥ When assembling bolt, spread Loctite.

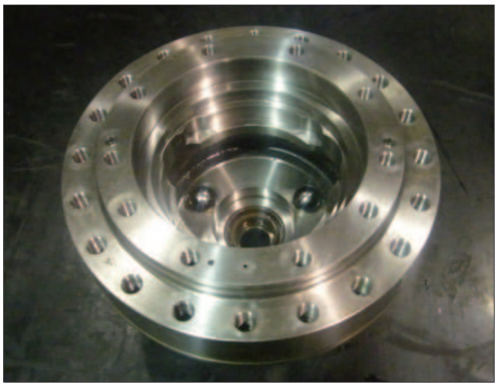
(1) Put casing (1) on the worktable.

125LCR8TM31

(2) After applying grease on the external diameter of oil seal (3), insert oil seal in casing.

125LCR8TM32

(3) After applying grease on steel ball (10), insert steel ball in casing.

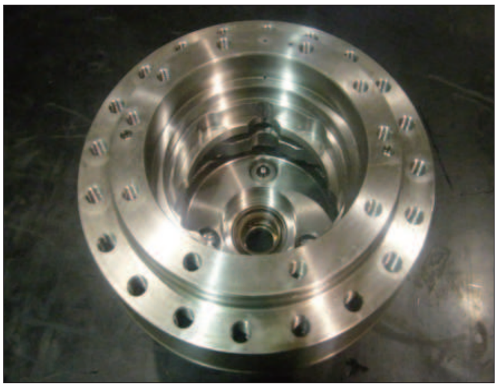


125LCR8TM33

(4) After assembling piston seal (5) and steel ball (9) in 1, 2 speed piston (4), insert piston in hole of casing.

※ Check whether piston sticks in hole.

※ Use piston seal jig.



125LCR8TM34

(5) Mount ball bearing (7) on shaft (6) by shrink fit. Insert shaft in casing.

※ Take care not to damage oil seal.

125LCR8TM35

(6) Assemble swash plate (11) by matching its hole and steel ball.

※ Take care not to damage sliding surface.

125LCR8TM36

(7) Assemble spring (13) (9ea) and ball guide (14) in cylinder block (12) in that order.

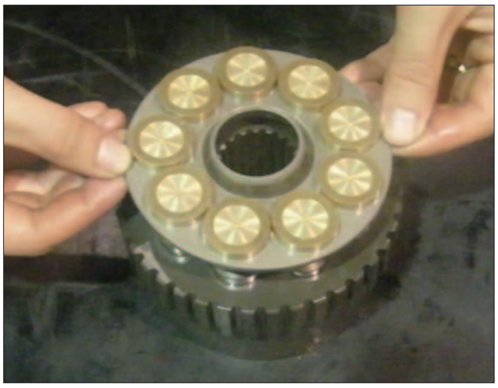
125LCR8TM37

(8) Insert piston assembly (16) in retainer plate (15) and assemble them in cylinder block.

※ Spread hydraulic oil on piston assembly.

※ Take care not to damage each component.

※ Check cylinder block and piston assembly runs properly.

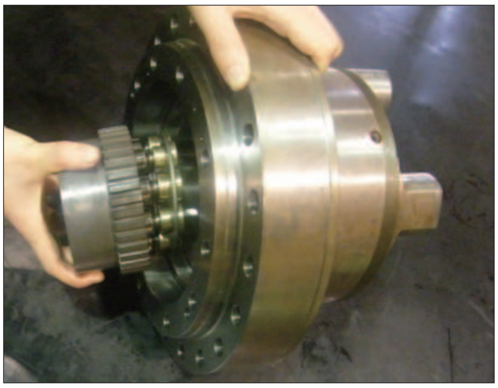


125LCR8TM38

(9) Lay casing down horizontally and assemble cylinder block assembly by matching its spline with shaft.

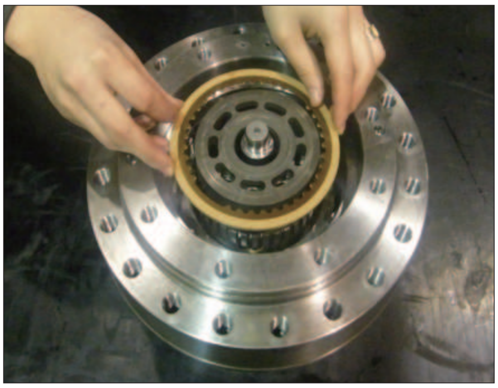
※ Make sure swash plate stays in place.

※ Check the assembling status of cylinder block by pressing it.



125LCR8TM39

(10) Assemble separator plate (18) (4EA) and friction plate (17) (3EA) alternately.



125LCR8TM40

(11) Insert back-up ring & O-ring in parking piston.

125LCR8TM41

(12) Align the pin hole of parking piston (19) with oil hole of casing, assemble them using jig.

※ Spread grease on O-ring and back-up ring.

※ Take care not to damage components.

125LCR8TM42

(13) Insert spring (26) (12EA) in parking piston.

125LCR8TM43

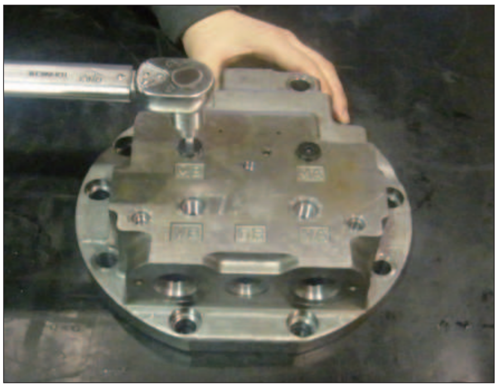
(14) Insert parallel pin (29) (2EA) in casing.

125LCR8TM44

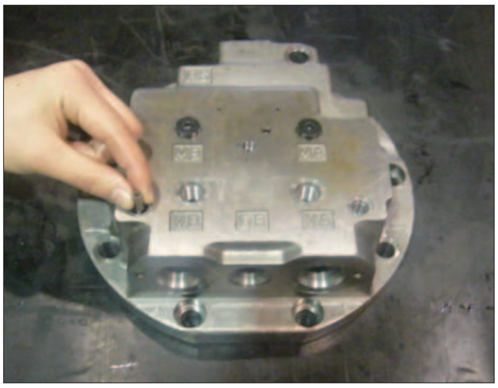
(15) Assemble check valve (50) and spring (51) in order.
※ Do not confuse check valve (50) and restrictor (34).
※ Do not confuse spring (51) and spring (35)


125LCR8TM45

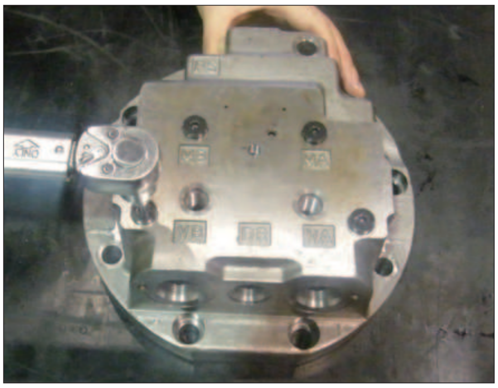
(16) Clamp plug (52) using 5 mm hexagon wrench.
※ Tightening torque : 1.5 kgf · m (10.9 lbf · ft)


125LCR8TM46

(17) Assemble restrictor (34) and spring (35) in order.
※ Do not confuse check valve (50) and restrictor (34).
※ Do not confuse spring (51) and spring (35).

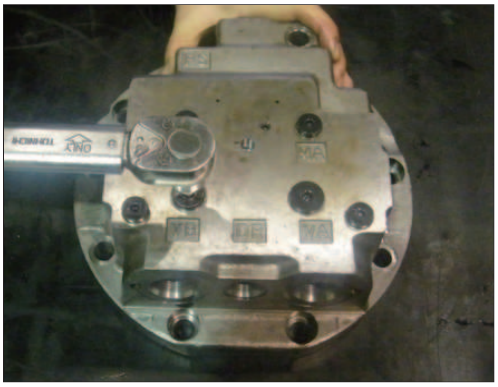

125LCR8TM47

(18) Clamp plug (52).
※ Tightening torque : 1.5 kgf · m (10.9 lbf · ft)


125LCR8TM48

(19) Clamp plug (54).

※ Tightening torque : 3 kgf · m (21.7 lbf · ft)

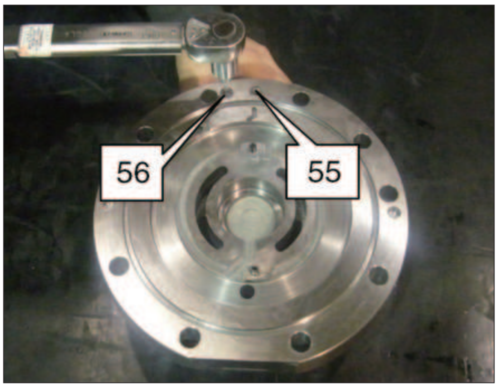


125LCR8TM49

(20) Assemble restrictor (55) and (56) in rear cover.

※ Check whether the restrictor is placed in exact hole.

※ Do not confuse (55) and (56).



125LCR8TM50

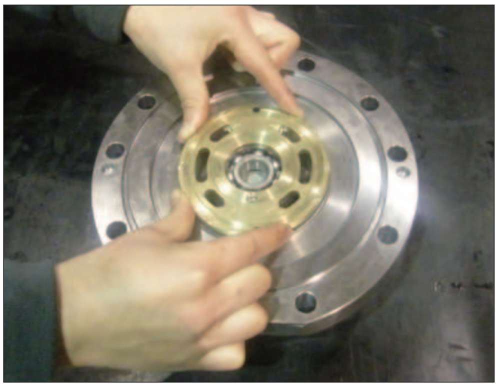
(21) Assemble ball bearing (8) in rear cover using jig.

125LCR8TM51

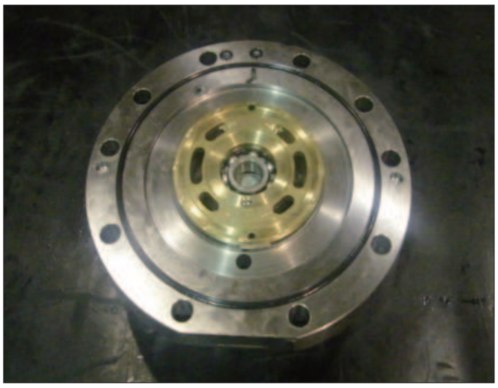
(22) Insert spring pin (25) (2ea) and (28) in rear cover using jig.

125LCR8TM52

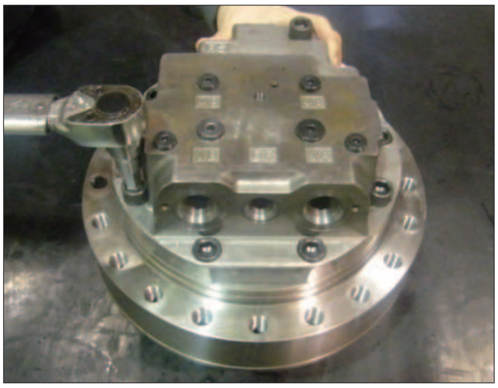
(23) After spreading grease sufficiently to the bottom side of valve plate (24), assemble valve plate in rear cover by matching its holes with pins.
※ Take care not to damage sliding surface.
※ Pay attention to the assembly direction.


125LCR8TM53

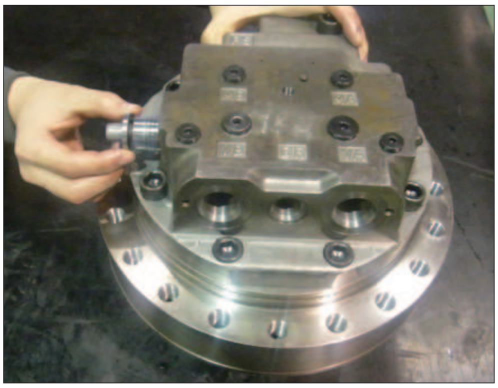
(24) Assemble O-ring (27) in rear cover.
※ Spread grease on O-ring.


125LCR8TM54

(25) Put rear cover upon casing, paying attention to the location of pin and hole. And tighten bolt (47), (48) and (49).
※ Tightening torque : 17.5 kgf · m (127 lbf · ft)
※ Make sure valve plate stays in place.
※ Check bolt position.

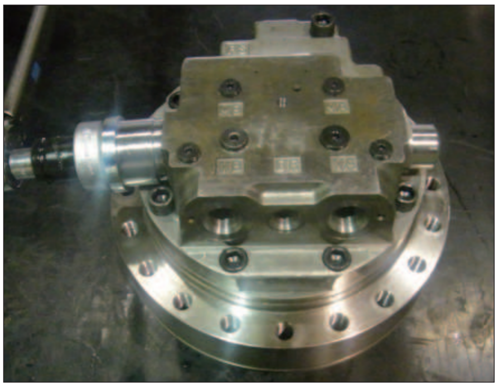

125LCR8TM55

(26) Assemble main spool assembly (31), spring seat (37) and spring (33) in rear cover.


125LCR8TM56

(27) Settle cover (32).

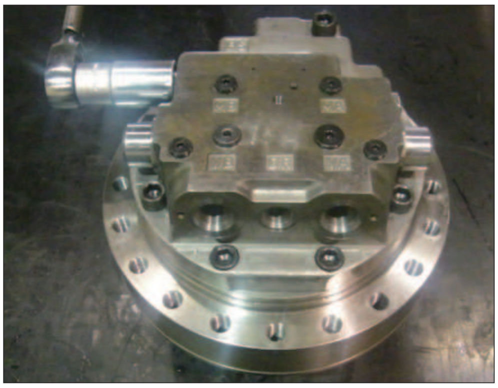
※ Tightening torque : 15 kgf · m (108 lbf · ft)



125LCR8TM57

(28) Insert relief valve (38) in rear cover.

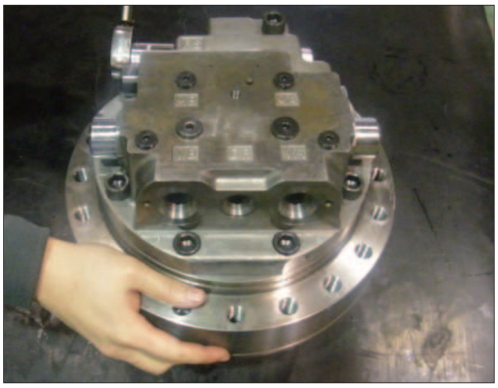
※ Tightening torque : 15 kgf · m (108 lbf · ft)



125LCR8TM58

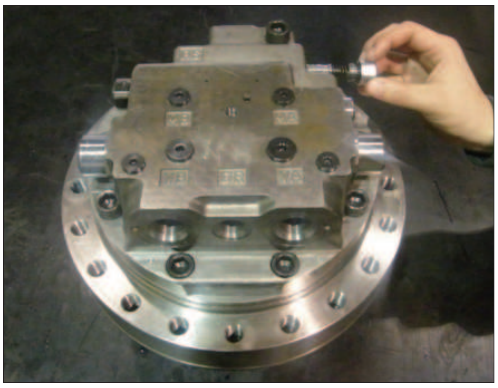
(29) After clamping connector (45) to rear cover, assemble spool (40).

※ Tightening torque : 5 kgf · m (36 lbf · ft)



125LCR8TM59

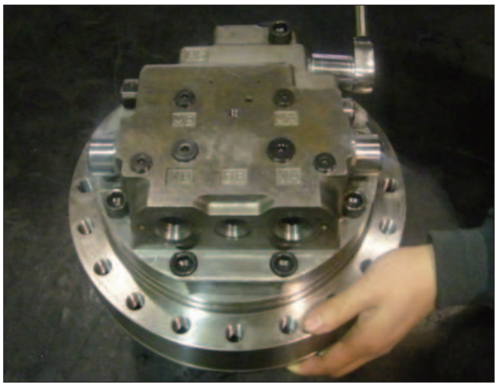
(30) After inserting parallel pin (43), assemble seat-spring (42).



125LCR8TM60

(31) After assembling spring (44) in order, clamp plug (41).

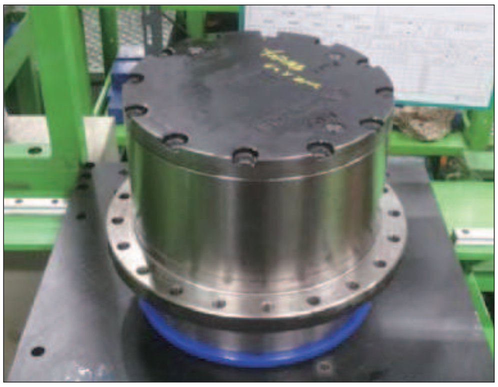
※ Tightening torque : 5 kgf · m (36 lbf · ft)



125LCR8TM61

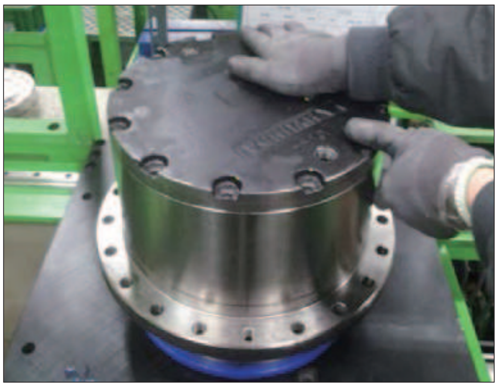
3. TRAVEL REDUCTION GEAR DISASSEMBLY

1) While travel reduction gear is tilted to one side disassemble PF3/8 plug (24), remove gear oil and place motor sideto the bench.



125LCR8TM70

2) Disassemble cover (22) by unscrewing the M10 bolts (23) (12 pcs).



125LCR8TM71

3) Disassemble sun gear No.1 (20), steel ball (21).

125LCR8TM72

4) Disassemble carrier No.1 assembly.

125LCR8TM73

Carrier No. 1 sub assy disassembly

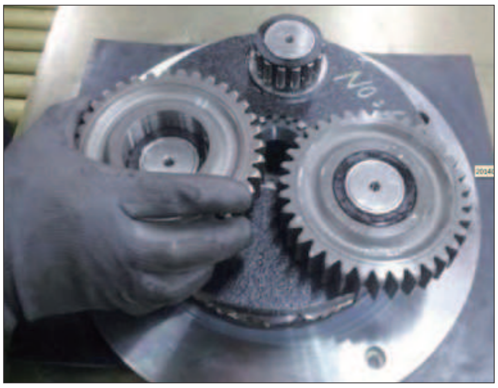
5) Disassemble M8 bolt (18) from the carrier assembly. (3 pcs)

125LCR8TM74

6) Disassemble thrust plate No.1 (17) from the carrier assembly.

125LCR8TM75

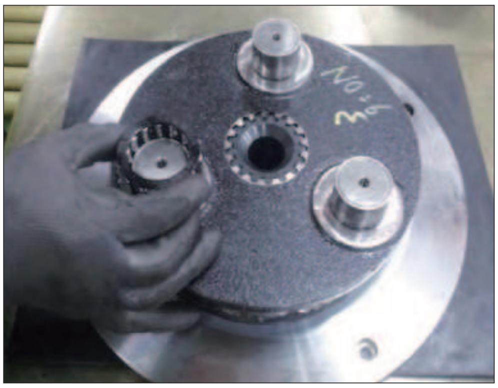
7) Disassemble planetary gear No.1 (14).(3 pcs)



125LCR8TM76

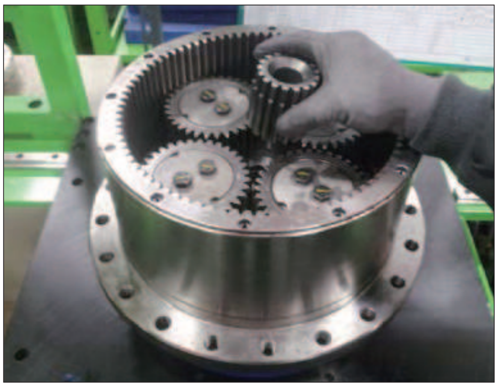
8) Disassemble needle bearing (15).(3 pcs)

※ Do not disassemble inner race in the absence of abnormalities.



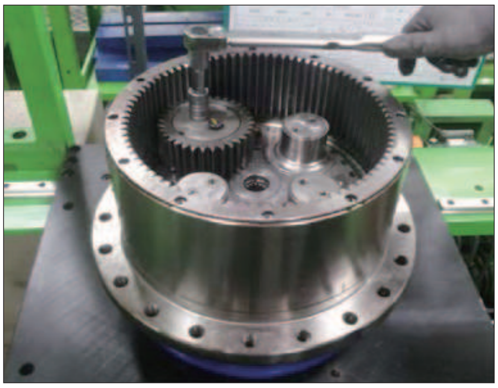
125LCR8TM77

9) Disassemble Sun gear No.2 (12).



125LCR8TM78

10) Disassemble M10 bolt (6).(4 pcs)



125LCR8TM79

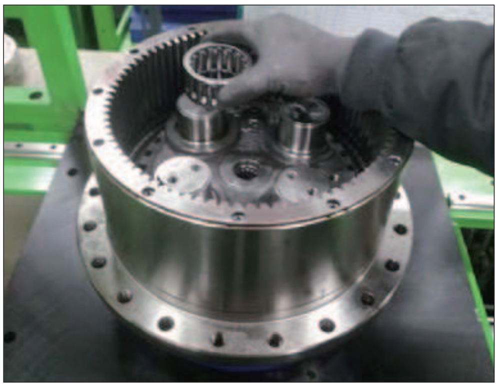
11) Disassemble thrust washer No.2 (11).(4 pcs)

125LCR8TM80

12) Disassemble planetary gear No.2 (8).(4 pcs)

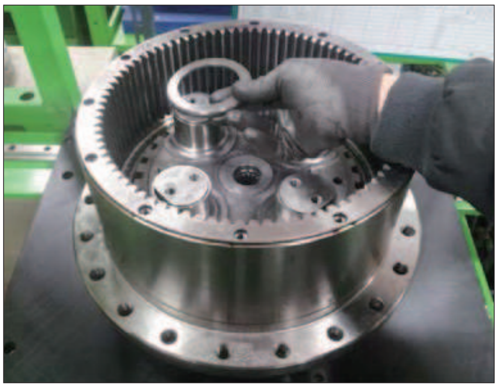
125LCR8TM81

13) Disassemble needle bearing No.2 (9).(4 pcs)

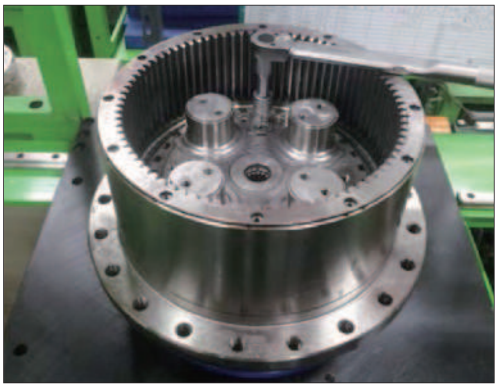

125LCR8TM82

14) Disassemble thrust plate No.2 (7).(4 pcs)

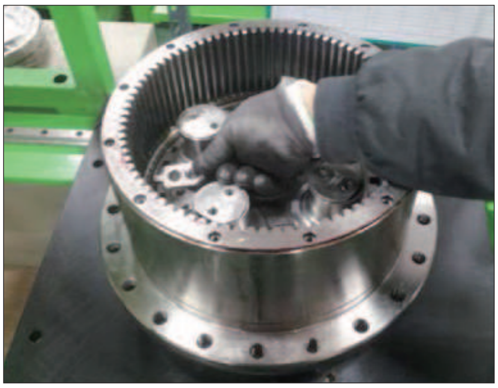
※ Do not disassemble inner race in the absence of abnormalities.


125LCR8TM83

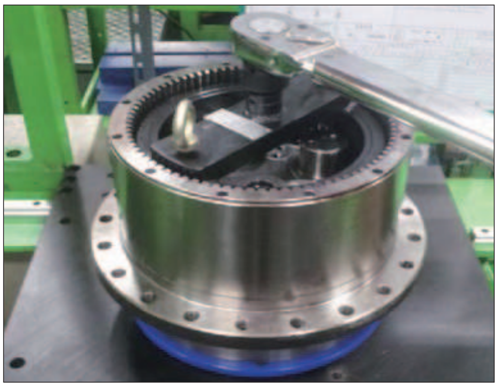
15) Disassemble M10 bolt (6) and M8 screw bolt (19).


125LCR8TM84

16) Disassemble lock plate (5).

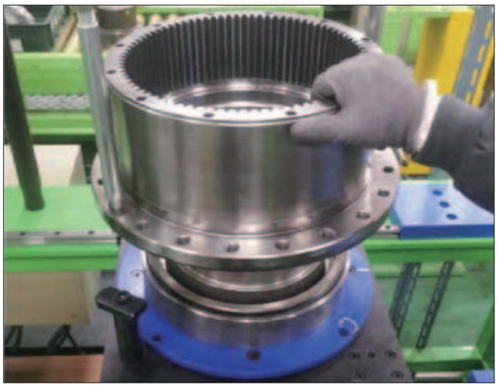

125LCR8TM85

17) Disassemble nut ring (4) by using the jig.



125LCR8TM86

18) Disassemble ring gear sun assembly from motor assembly.



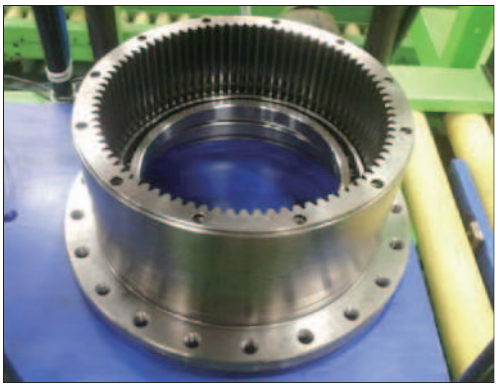
125LCR8TM87

19) Disassemble folating seal assembly (3) from ring gear sun assembly and motor assembly.

125LCR8TM88

20) Disassemble bearing (2) (2ea) from ring gear assembly.

※ Do not disassemble bearing in the absence of abnormalities.



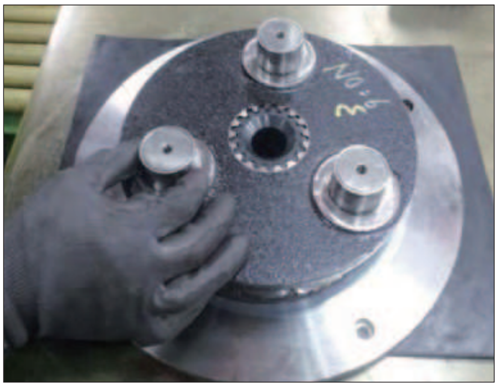
125LCR8TM89

4. TRAVEL REDUCTION GEAR ASSEMBLY

※ Even though assembly is accomplished by reversing disassembly steps, be careful of the following.

① Repair the damaged part when disassemblying and prepare parts for exchange in advance.
② All parts should be cleaned with cleaner, dried with compressed air.
③ Sliding surface, O-ring, bearing and oil seal should be lubricated with clean hydraulic oil, prior to final assembly.
④ Replacement of O-ring and oil seal with new parts is generally recommended.
⑤ Use a torque wrench to make sure that assembly fasteners are tightened to specified values.
⑥ When assembling bolt, spread loctite.

1) Put carrier No.1 (13) on the jig, and shrink-fit inner race No.1 (16) to carrier pin.(3 places)
※ Do not tilt inner race to one side.
※ Match inner race and end of carrier pin.



125LCR8TM90

2) Assemble needle bearing No.1 (15).(3 pcs)

125LCR8TM91

3) Assemble planetary gear No.1 (14) of which groove is faced downward. (3 places)

125LCR8TM92

4) Assemble thrust plate No.1(17).

125LCR8TM93

5) After spreading loctite #242, assemble the M8 bolt (18).(3 pcs)

※ Tightening torque : 2.7 ± 0.3 kgf · m

※ After the assembly, instantly check the noise and interference by rotatong the gear.

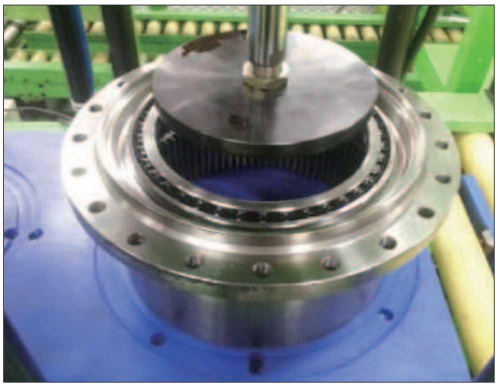
125LCR8TM94

6) First, place bearing (2) on the ring gear (1), then put jig on it, then press it with press machine.

125LCR8TM95

7) After turning ring gear over, assemble bearing the same way.

※ Be care of nick and safety when turn ring gear over.

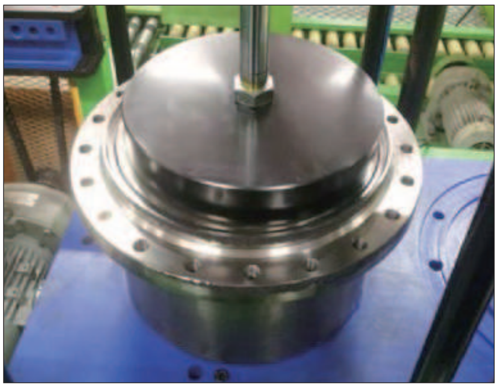


125LCR8TM96

8) Assemble folating seal assembly (3) by usingthe jig.

※ After assembling, wipe steel-lined section with alcohol.

※ Flatness deviation has to be less than 1 mm.



125LCR8TM97

9) Place folating seal assembly on the motor assembly then assemble it.

※ After assembling, wipe steel-lined section with alcohol.

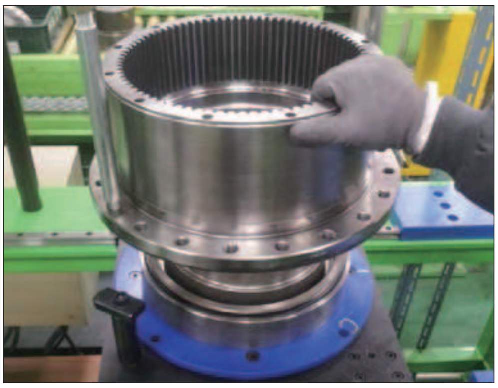
※ Flatness deviation has to be less than 1 mm.

125LCR8TM98

10) After arriving safely ring gear sun assembly inthe motor assembly, press it with press machine.

※ After press-fitting, clamp ring gear to fixit.

※ When using the press pay attention to bearing damage.

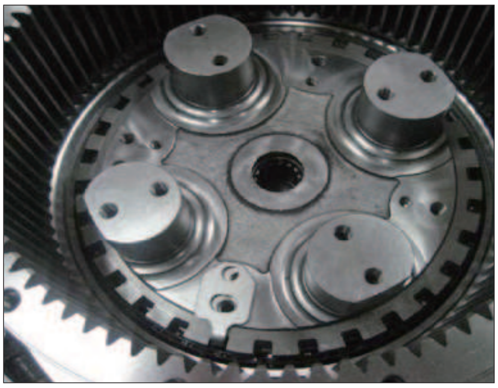


125LCR8TM99

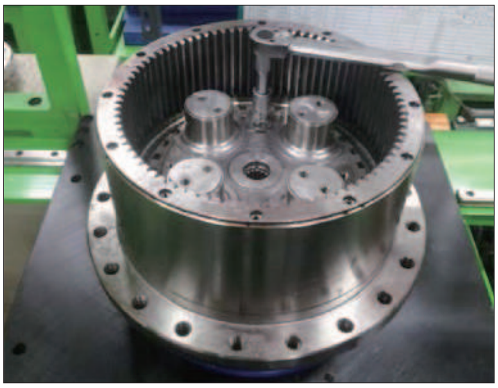
11) After assembling nut ring (4) by using the jig, disassemble the clamping.
※ Tightening torque : 60 kgf · m (434 lbf · ft)


125LCR8TM100

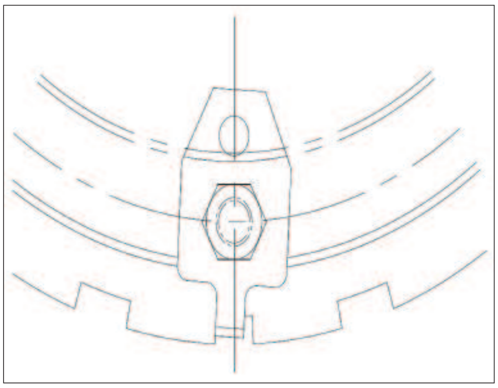
12) Place lock plate (5) on the nut ring groove.
※ Select best position from one of 4 casing hole to assemble lock plate.


125LCR8TM101

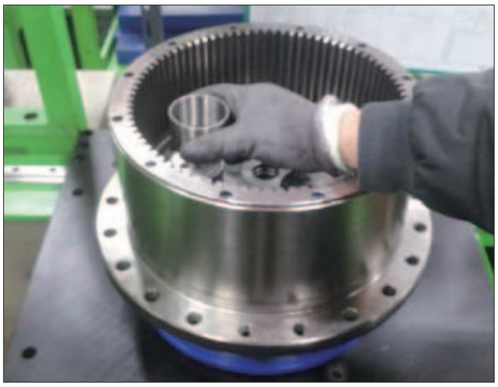
13) Place lock plate th the direction which nut ring is loosed and then assemble M10 bolt (6) with M8 screw (19) after spreading loctite #242.(Refer to assembly detail drawing)
※ Tightening torque (M10) : 5.5 ± 0.6 kgf · m
(39.8 ± 4.3 lbf · ft)
※ Tightening torque (M8) : 2.7 ± 0.3 kgf · m
(19.5 ± 2.2 lbf · ft)
※ Make sure that M8 bolt doesn't stick out of lock plate.


125LCR8TM102

※ Assembly detail drawing lock plate.

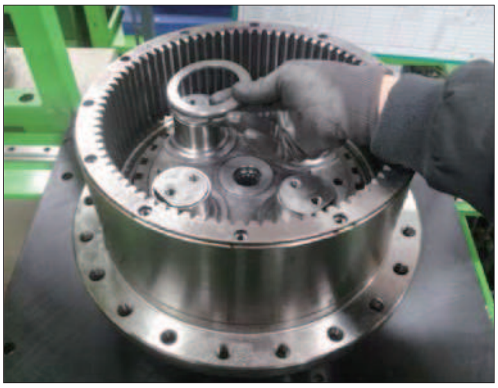

125LCR8TM103

14) Shrink fit the inner race No.2 (10).(4 pcs)



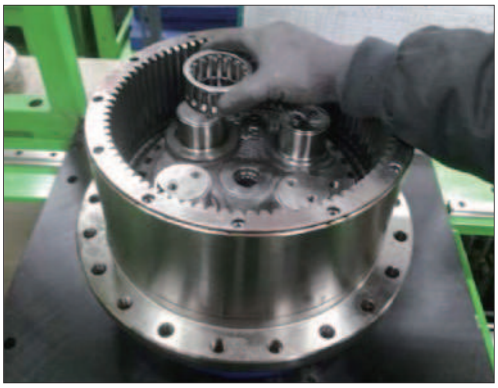
125LCR8TM104

15) Assemble thrust plate No.2 (7).(4 pcs)



125LCR8TM105

16) Assemble needle bearing No.2 (9).(4 pcs)



125LCR8TM106

17) Assemble planetary gear No.2 (8).(4 pcs)
※ Grooves of planetary gear will be facingup.

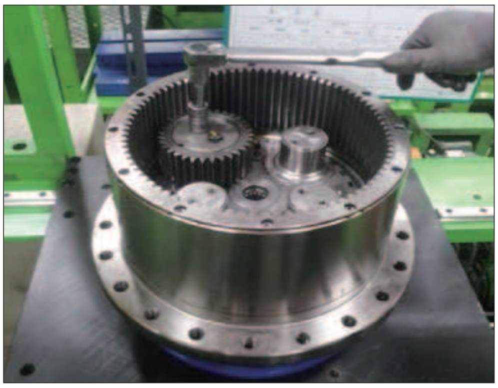
125LCR8TM107

18) Assemble thrust washer No.2 (11).(4 pcs)

125LCR8TM108

19) After spreading loctite #242, assemble the M10 bolt (6).(4 pcs)

※ Tightening torque : 5.5 ± 0.6 kgf · m
(39.8 ± 4.3 lbf · ft)



125LCR8TM109

20) Assemble sun gear No.2 (12).

125LCR8TM110

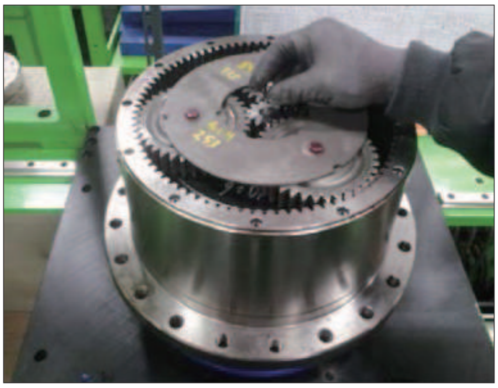
21) Assemble carrier No.1 assembly.

125LCR8TM111

22) Assemble sun gear No.1 (20).

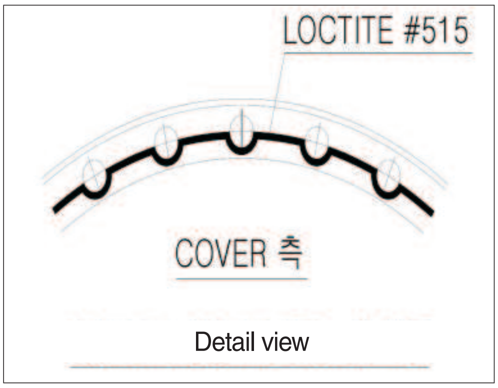
125LCR8TM112

23) Place steel ball (21) on the sun gear No.1.



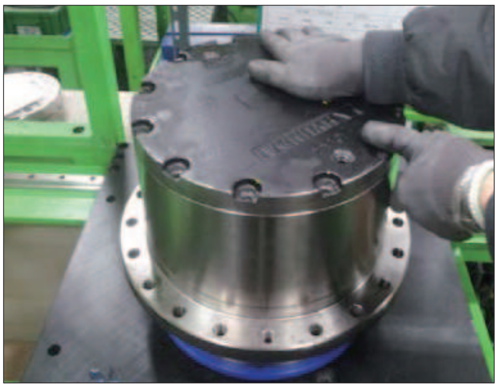
125LCR8TM113

24) Spread the loctite #515 on the cover (22) with reference to the right detail view.



125LCR8TM114

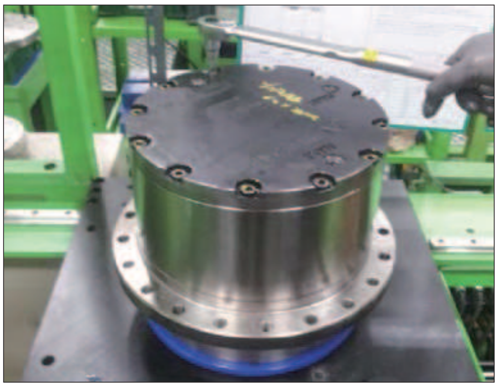
25) Place cover (22) to fit the bolt holes.



125LCR8TM115

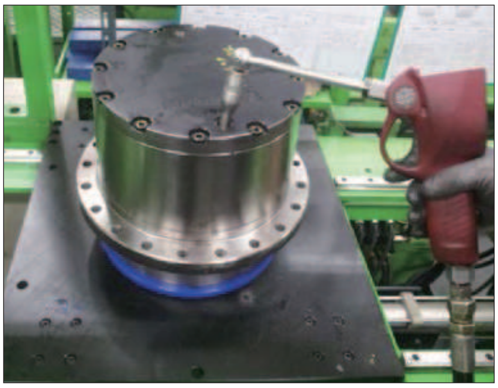
26) After spreading loctite #242, assemble the M10 bolt (23).(12 pcs)

※ Tightening torque : 6.3 ± 0.7 kgf · m (45.6 ± 5.1 lbf · ft)



125LCR8TM116

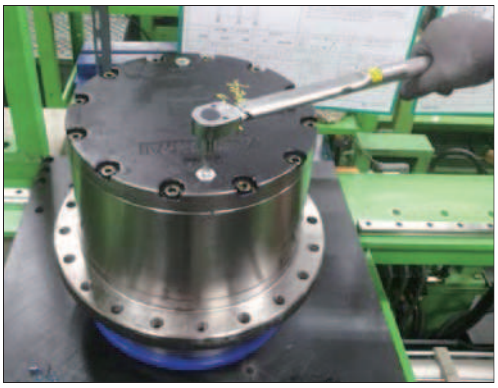
27) Inject the 2.5 ± 0.3 liter gear oil to PF3/8 tap section.



125LCR8TM117

28) After assembling the O-ring (25) to the plug (24), assemble it to the cover.(3 pcs)

※ Tightening torque : 5 ± 0.5 kgf · m (36.2 ± 3.6 lbf · ft)



125LCR8TM118

GROUP 7 RCV LEVER

1. REMOVAL AND INSTALL

1) REMOVAL

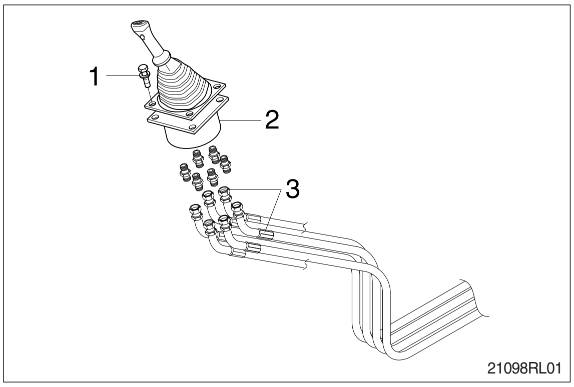
13031GE18

(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.



21098RL01

(4) Loosen the socket bolt (1).

(5) Remove the cover of the console box.

(6) Disconnect pilot line hoses (3).

(7) Remove the pilot valve assembly (2).

※ When removing the pilot valve assembly, check that all the hoses have been disconnected.

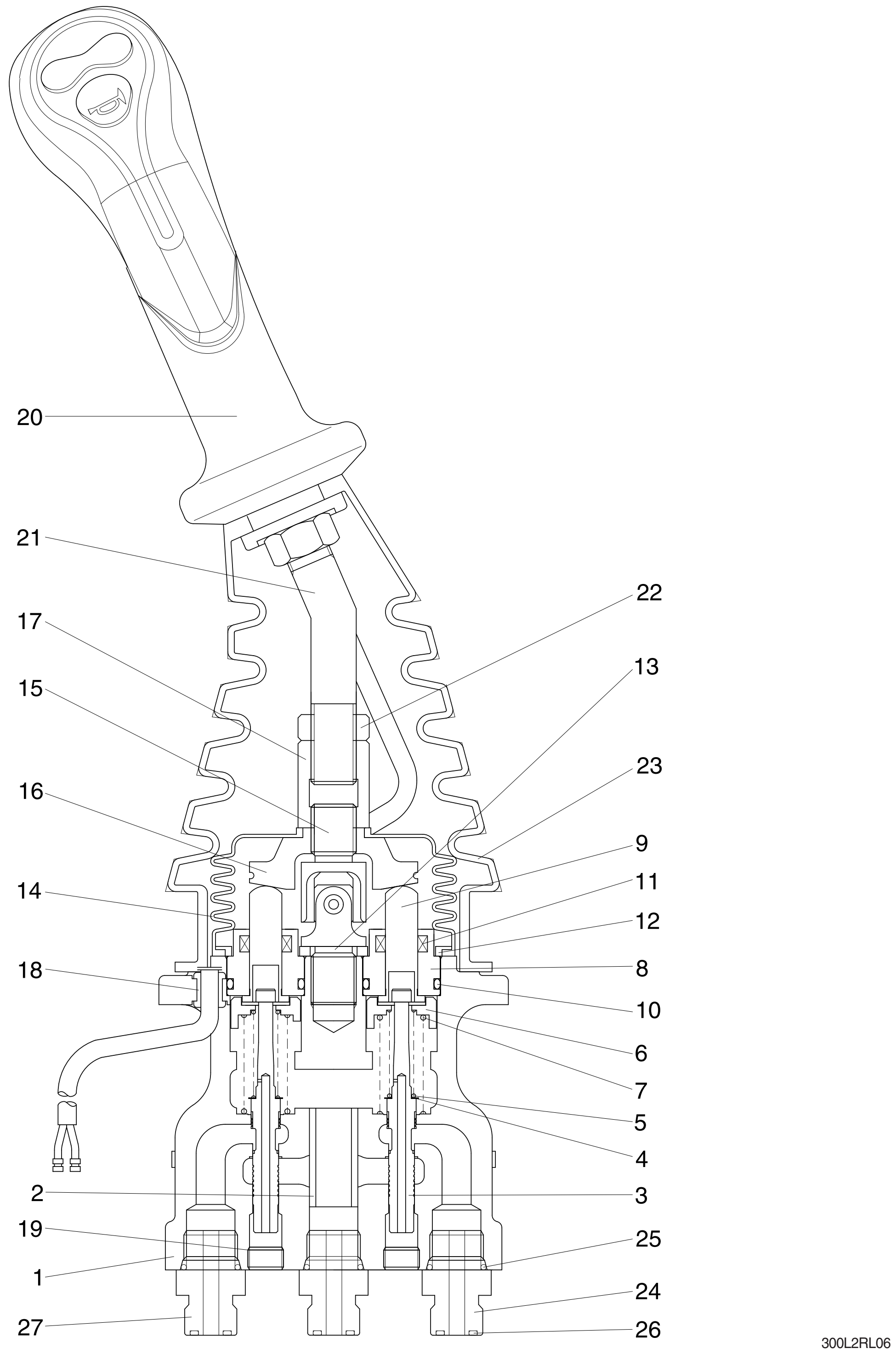
2) INSTALL

(1) Carry out installation in the reverse order to removal.

(2) Confirm the hydraulic oil level and check the hydraulic oil leak or not.

2. DISASSEMBLY AND ASSEMBLY

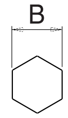
1) STRUCTURE



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

2) TOOLS AND TIGHTENING TORQUE

(1) Tools

<table>
<tr><th>Tool name</th><th colspan="2">Remark</th></tr>
<tr><td>Allen wrench</td><td>6</td><td rowspan="3"></td></tr>
<tr><td rowspan="2">Spanne</td><td>22</td></tr>
<tr><td>27</td></tr>
<tr><td>(+) Driver</td><td colspan="2">Length 150</td></tr>
<tr><td>(-) Driver</td><td colspan="2">Width 4~5</td></tr>
<tr><td>Torque wrench</td><td colspan="2">Capable of tightening with the specified torques</td></tr>
</table>

(2) Tightening torque

Part name	Item	Size	Torque	
			kgf · m	lbf · ft
Joint	15	M14	3.5	25.3
Swash plate	16	M14	5.0±0.35	36.2±2.5
Adjusting nut	17	M14	5.0±0.35	36.2±2.5
Lock nut	22	M14	5.0±0.35	36.2±2.5

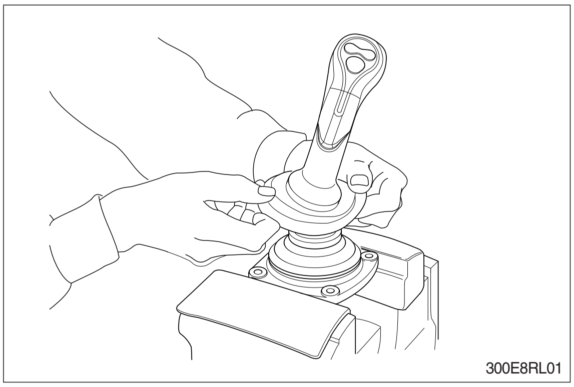
3) DISASSEMBLY

※ Procedures are based on the type M1.

(1) Clean pilot valve with kerosene.
※ Put blind plugs into all ports

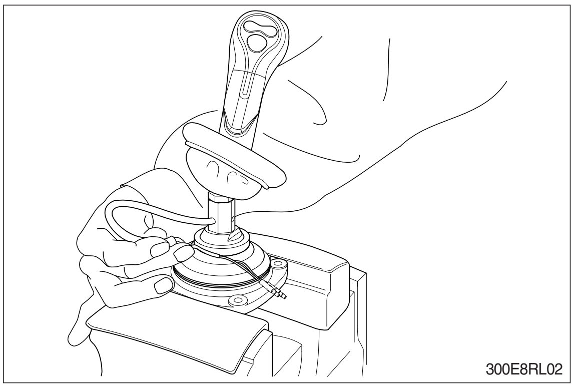
(2) Fix pilot valve in a vise with copper (or lead) sheets.

(3) Remove end of boot (23) from case (1) and take it out upwards.



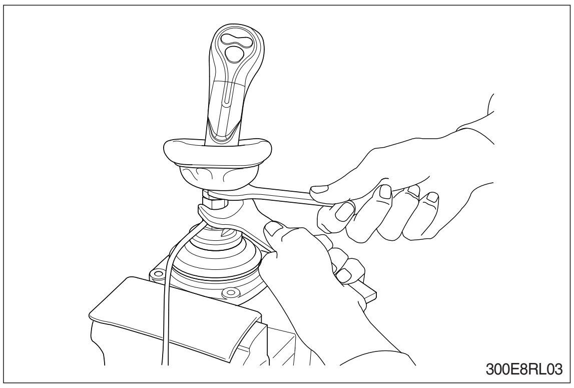
300E8RL01

※ For valve with switch, remove cord also through hole of casing.



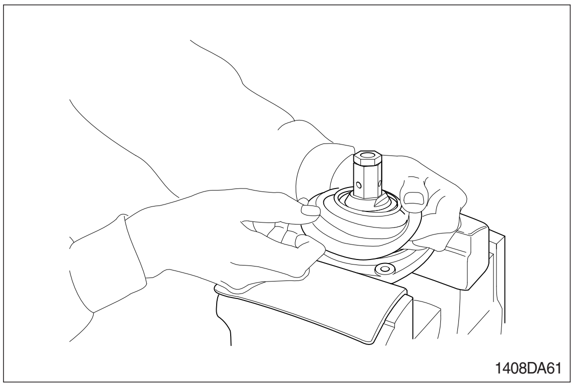
300E8RL02

(4) Loosen lock nut (22) and adjusting nut (17) with spanners on them respectively, and take out handle section as one body.



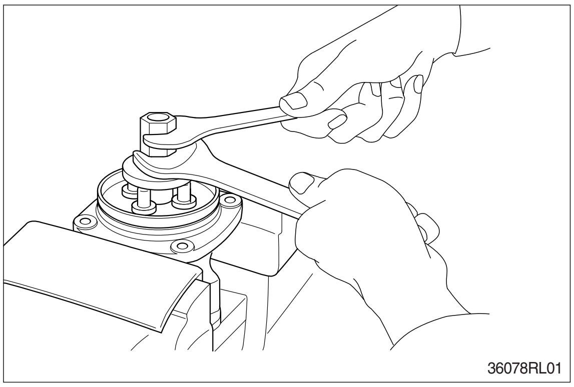
300E8RL03

(5) Remove the boot (14).

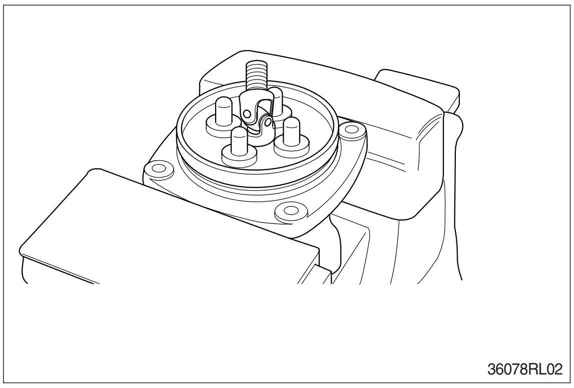


1408DA61

(6) Loosen adjusting nut (17) and swash plate (16) with spanners on them respectively, and remove them.



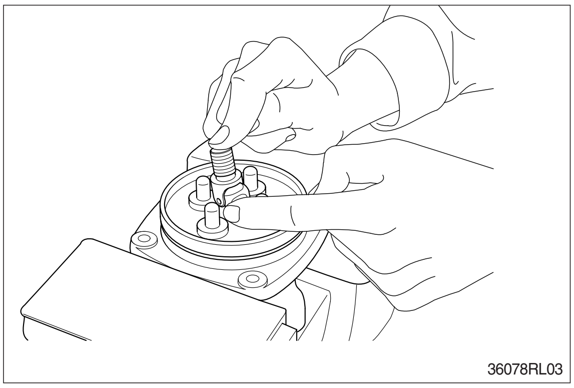
36078RL01



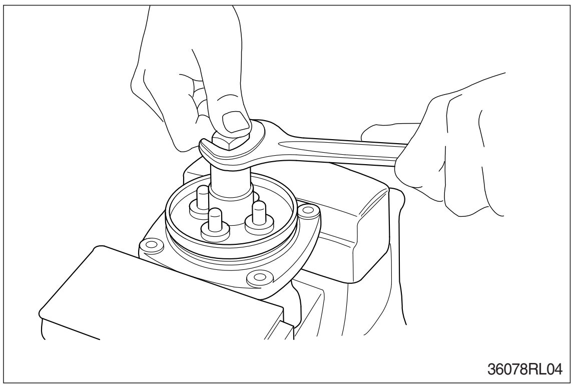
36078RL02

(7) Turn joint anticlockwise to loosen it, utilizing jig (Special tool).

※ When return spring (7) is strong in force, plate (12), plug (8) and push rod (9) will come up on loosening joint.
Pay attention to this.

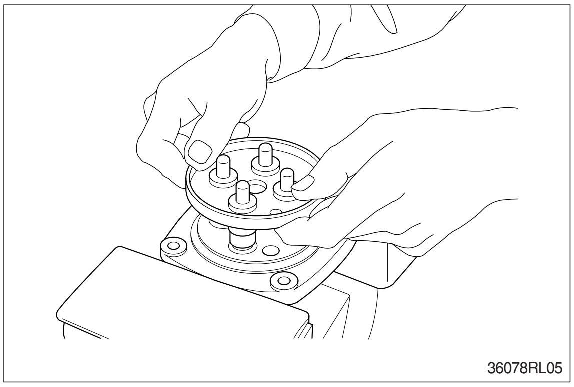


36078RL03



36078RL04

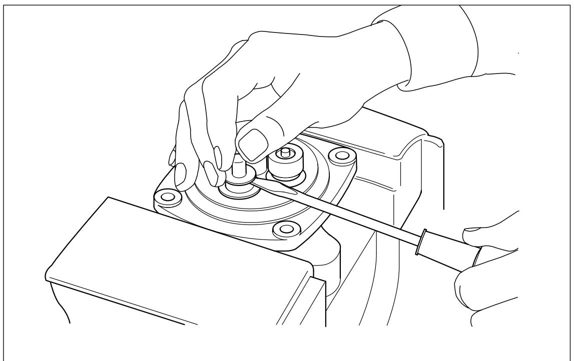
(8) Remove plate (12).


36078RL05

(9) When return spring (7) is weak in force, plug (8) stays in casing because of sliding resistance of O-ring.

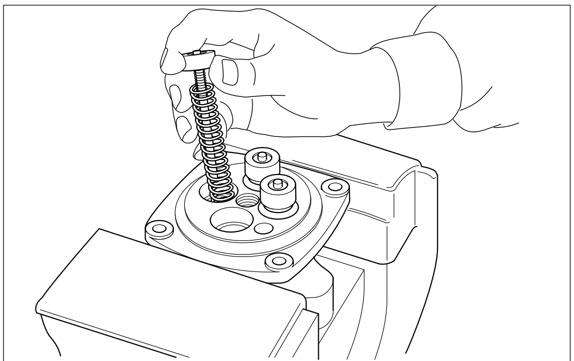
※ Take it out with minus screwdriver.
Take it out, utilizing external periphery groove of plug and paying attention not to damage it by partial loading.

※ During taking out, plug may jump up due to return spring (7) force.
Pay attention to this.


36078RL06

(10) Remove reducing valve subassembly and return spring (7) out of casing.

※ Record relative position of reducing valve subassembly and return springs.

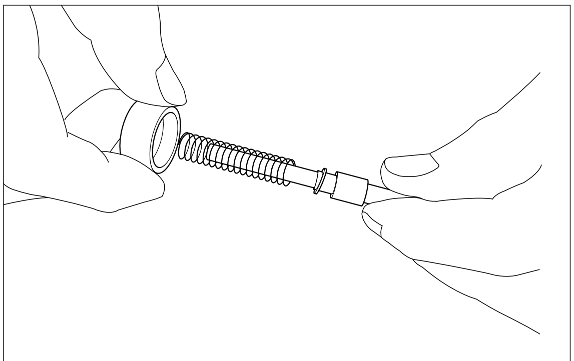

36078RL07

(11) Separate spool (3), spring seat (6), spring (5) and shim (4) individually.

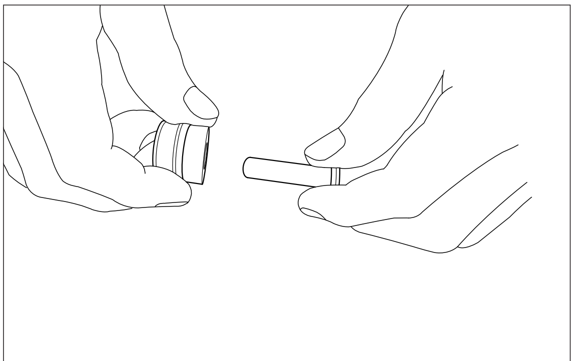
※ Pay attention not to damage spool surface.

※ Record original position of spring seat (6).

※ Until being assembled, they should be handled as one subassembly group.

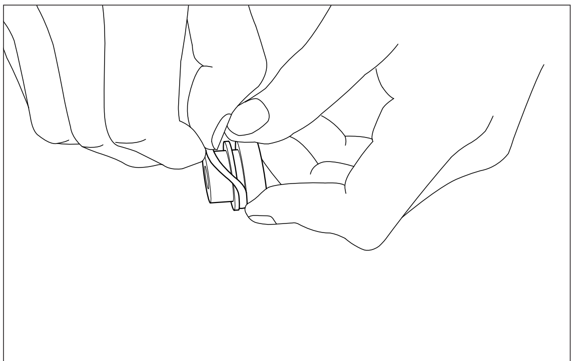

36078RL10

(12) Take push rod (9) out of plug (8).

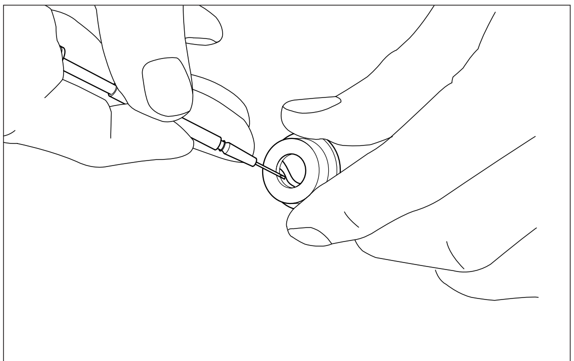


36078RL11

(13) Remove O-ring (10) and seal (11) from plug (8).
Use small minus screwdriver or so on to remove this seal.

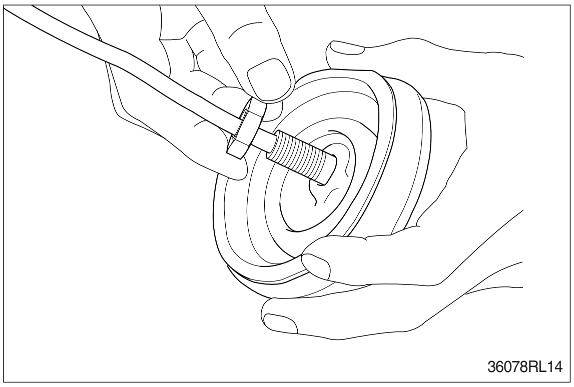


36078RL12

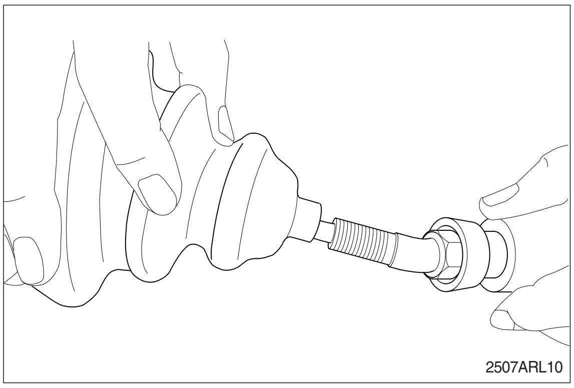


36078RL13

(14) Remove lock nut (22) and then boot (23).



36078RL14



2507ARL10

(15) Cleaning of parts

① Put all parts in rough cleaning vessel filled with kerosene and clean them (rough cleaning).

※ If dirty part is cleaned with kerosene just after putting it in vessel, it may be damaged. Leave it in kerosene for a while to loosen dust and dirty oil.

※ If this kerosene is polluted, parts will be damaged and functions of reassembled valve will be degraded.
Therefore, control cleanliness of kerosene fully.

② Put parts in final cleaning vessel filled with kerosene, turning it slowly to clean them even to their insides (finish cleaning).

※ Do not dry parts with compressed air, since they will be damaged and/or rusted by dust and moisture in air.

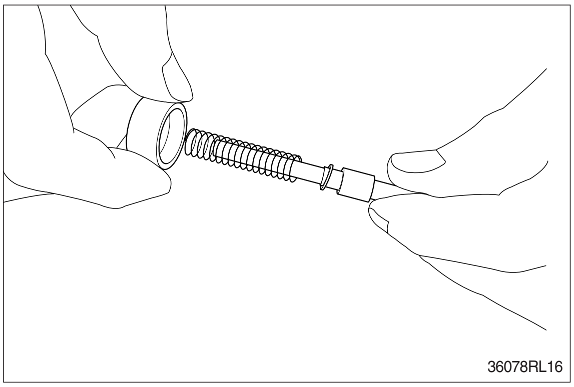
(16) Rust prevention of parts

Apply rust-preventives to all parts.

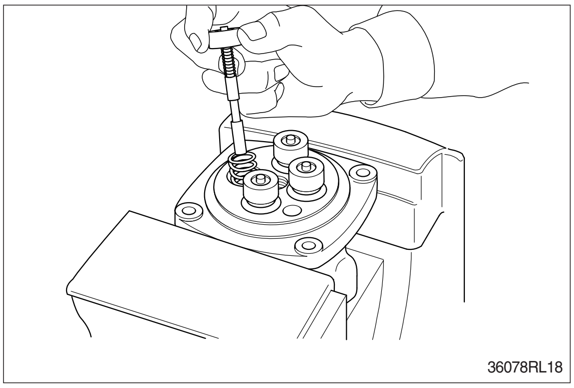
※ If left as they after being cleaned, they will be rusted and will not display their functions fully after being reassembled.

4) ASSEMBLY

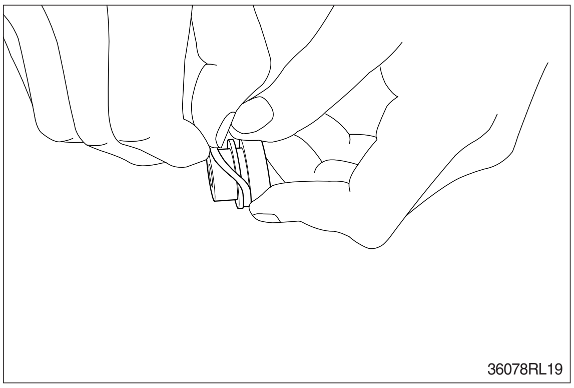
(1) Put shim (4), springs (5) and spring seat (6) onto spool (3) in this order.



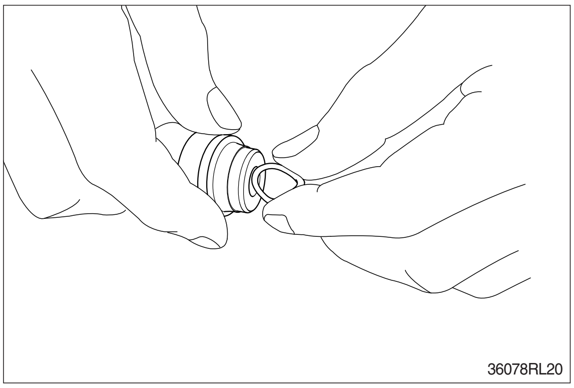
(2) Assemble spring (7) into casing (1).
Assemble reducing valve subassembly into casing.
※ Assemble them to their original positions.



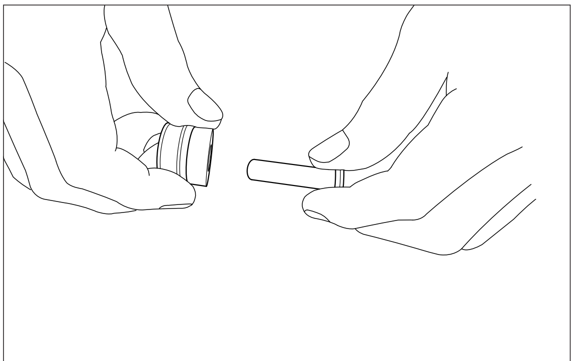
(3) Assemble O-ring (10) onto plug (8).



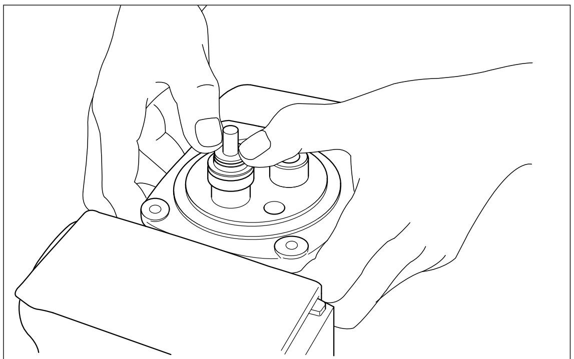
(4) Assemble seal (11) to plug (8).
※ Assemble seal in such lip direction as shown below.



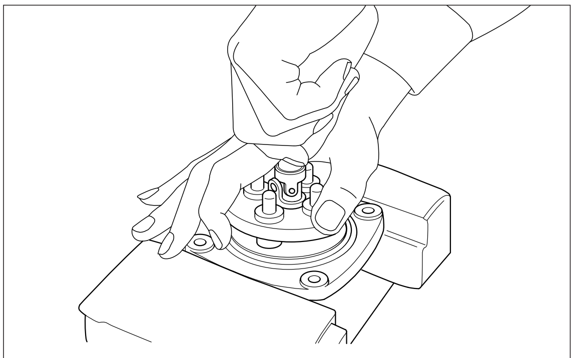
(5) Assemble push rod (9) to plug (8).
※ Apply working oil on push-rod surface.


36078RL21

(6) Assemble plug subassembly to casing.
※ When return spring is weak in force, subassembly stops due to resistance of O-ring.

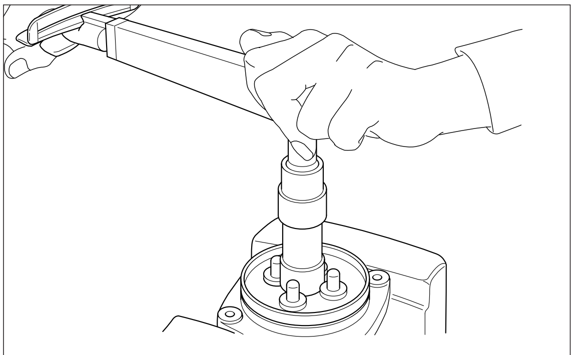

36078RL22

(7) When return spring is strong in force, assemble 4 sets at the same time, utilizing plate (12), and tighten joint (15) temporarily.


36078RL23

(8) Fit plate (12).

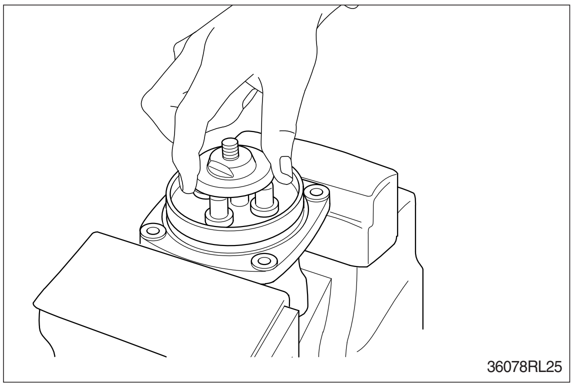
(9) Tighten joint (15) with the specified torque to casing, utilizing jig.


36078RL24

(10) Assemble swash plate (16) to joint (15).

※ Screw it to position that it contacts with 4 push rods evenly.

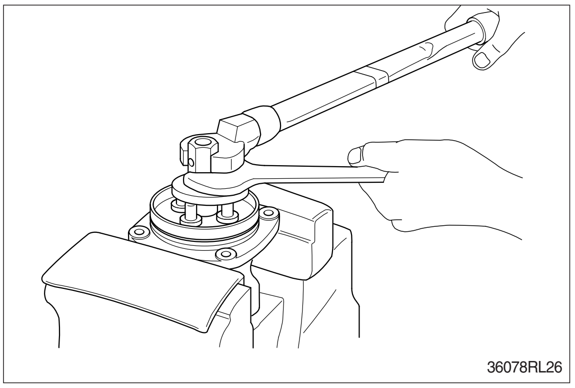
※ Do not screw it over.



36078RL25

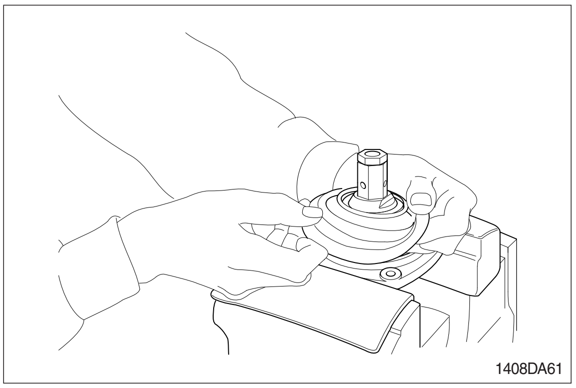
(11) Assemble adjusting nut (17), apply spanner to width across flat of plate (16) to fix it, and tighten adjusting nut to the specified torque.

※ During tightening, do not change position of disk.



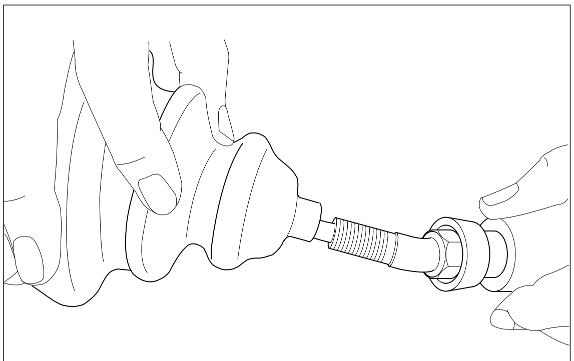
36078RL26

(12) Fit boot (14) to plate.

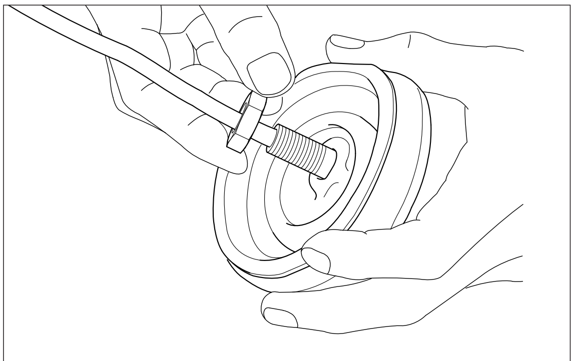


1408DA61

(13) Fit boot (23) and lock nut (22), and handle subassembly is assembled completely.

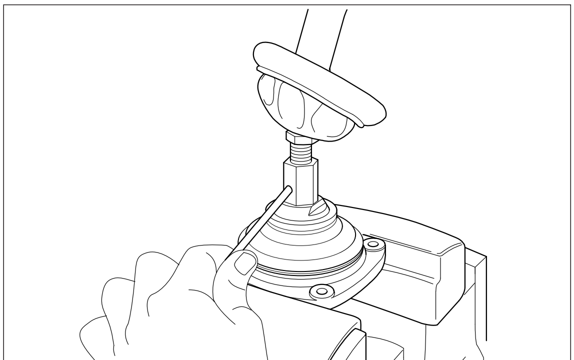


2507ARL10



36078RL27

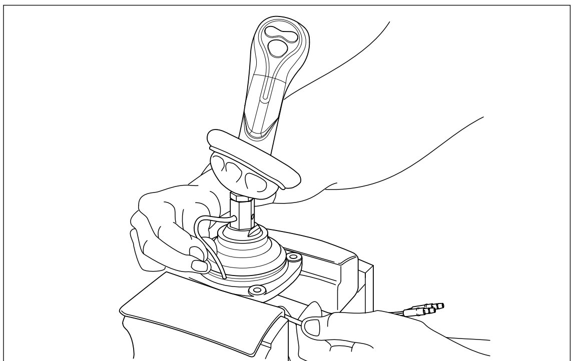
(14) Pull out cord and tube through adjusting nut hole provided in direction 60° to 120° from casing hole.



1408DA66

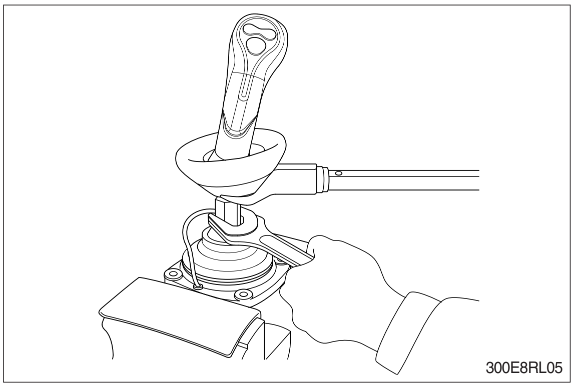
(15) Assemble bushing (18) to plate and pass cord and tube through it.

※ Provide margin necessary to operation.

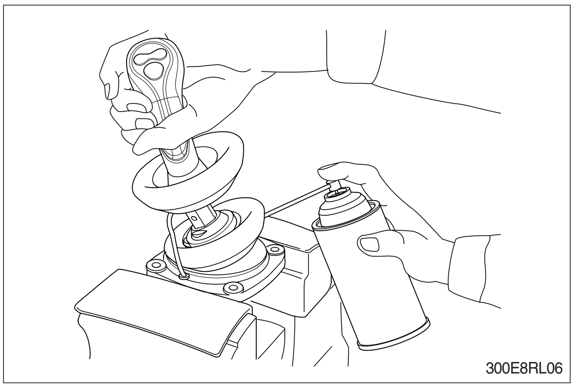


300E8RL04

(16) Determine handle direction, tighten lock nut (22) to specified torque to fix handle.

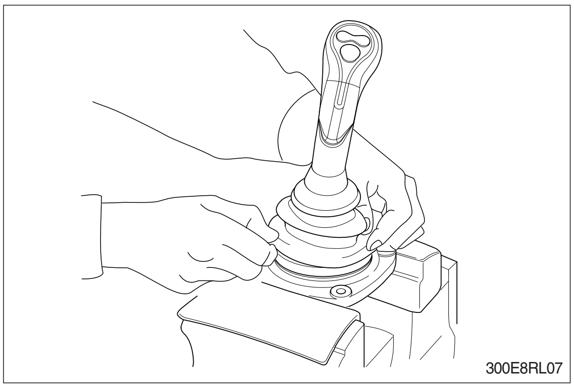


(17) Apply grease to rotating section of joint and contacting faces of disk and push rod.



(18) Assemble lower end of bellows to casing.

(19) Inject volatile rust-preventives through all ports and then put blind plugs in ports.



GROUP 8 TURNING JOINT

1. REMOVAL AND INSTALL

1) REMOVAL

(1) Lower the work equipment to the ground and stop the engine.

(2) Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

(3) Loosen the breather slowly to release the pressure inside the hydraulic tank.

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

※ When pipes and hoses are disconnected, the oil inside the piping will flow out, so catch it in oil pan.

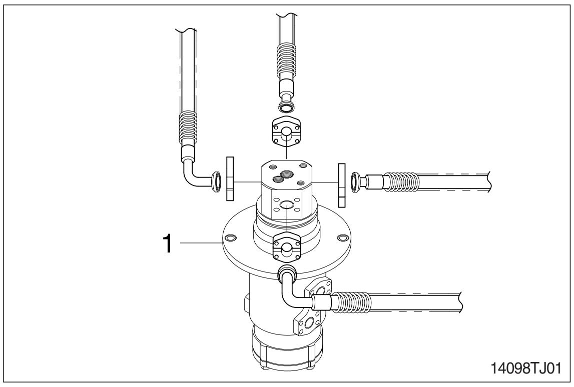
13031GE18

(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)



14098TJ01

(6) Remove the turning joint assembly.

※ When removing the turning joint, check that all the hoses have been disconnected.

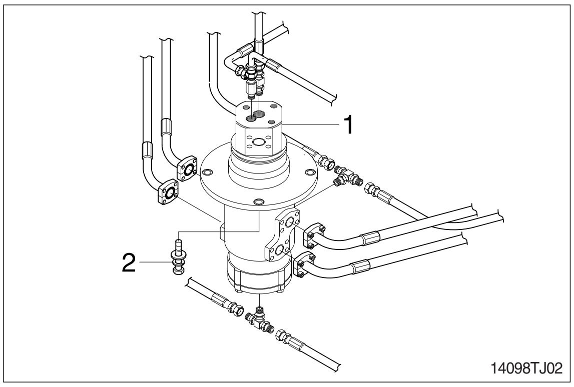
2) INSTALL

(1) Carry out installation in the reverse order to removal.

※ Take care of turning joint direction.

※ Assemble hoses to their original positions.

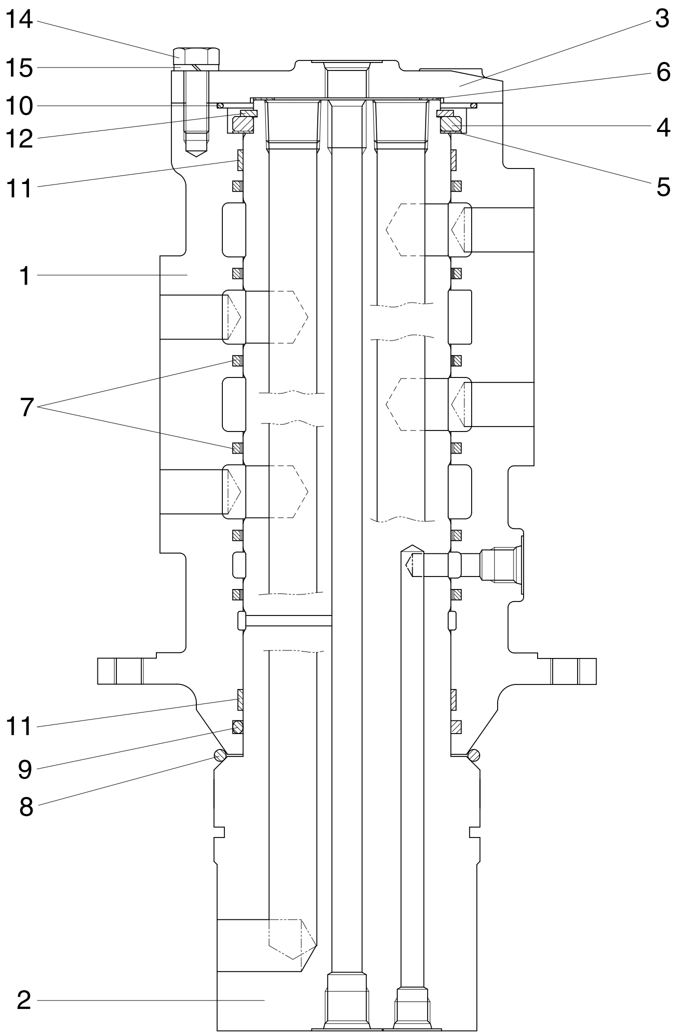
※ Confirm the hydraulic oil level and check the hydraulic oil leak or not.



14098TJ02

2. DISASSEMBLY AND ASSEMBLY

1) STRUCTURE



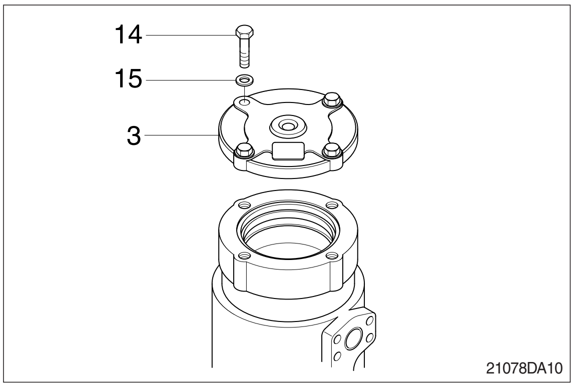
14098TJ03

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

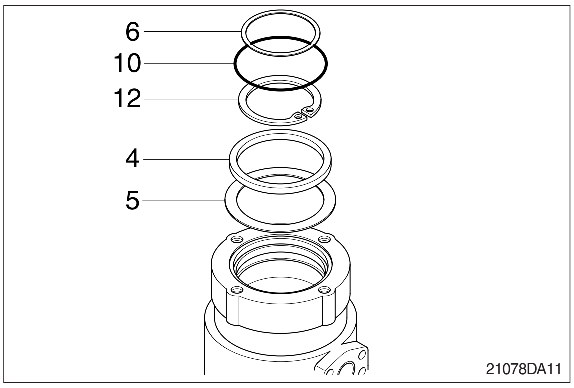
※ Before the disassembly, clean the turning joint.

(1) Remove bolts (14), washer (15) and cover (3).



(2) Remove shim (6) and O-ring (10).

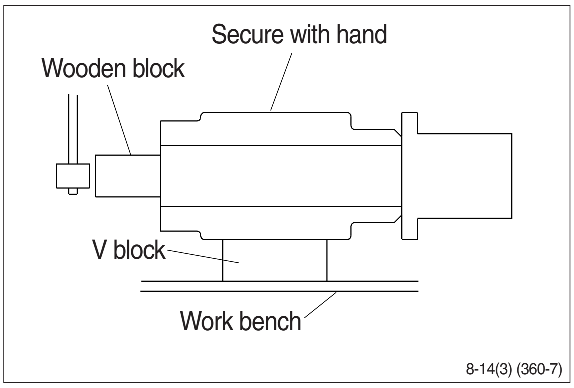
(3) Remove retainer ring (12), spacer (4) and shim (5).



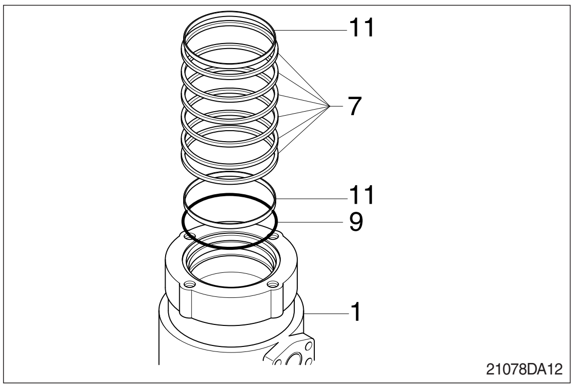
(4) Place hub (1) on a V-block and by using a wood buffer at the shaft end, hit out shaft (2) to about 1/2 from the body with a hammer.

※ 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

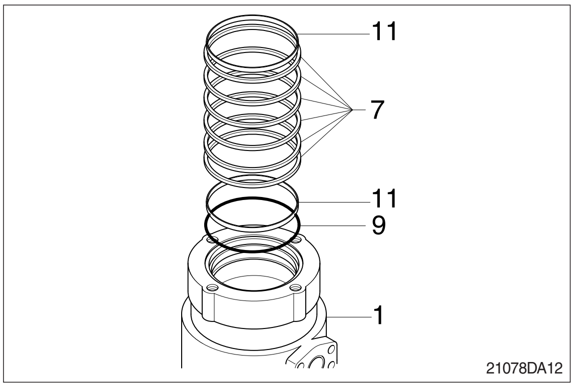
※ Clean all parts.

※ As a general rule, replace oil seals and O-ring.

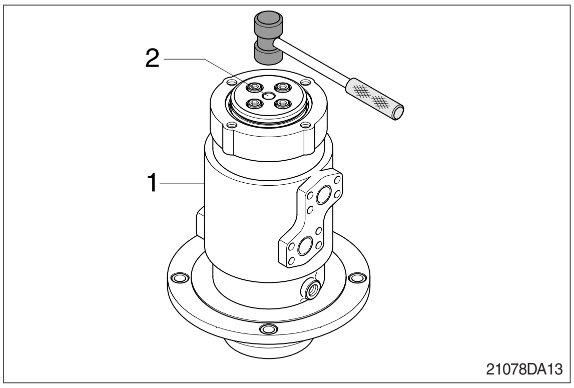
※ Coat the sliding surfaces of all parts with engine oil or grease before installing.

(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).



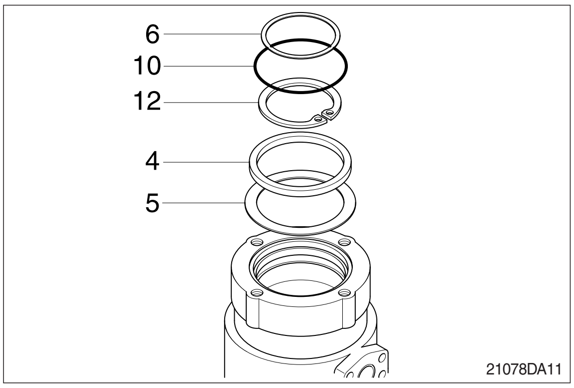
(3) Set shaft (2) on block, tap hub (1) with a plastic hammer to install.



(4) Fit shim (5), spacer (4) and retainer ring (12) to shaft (2).

(5) Fit O-ring (10) to hub (1).

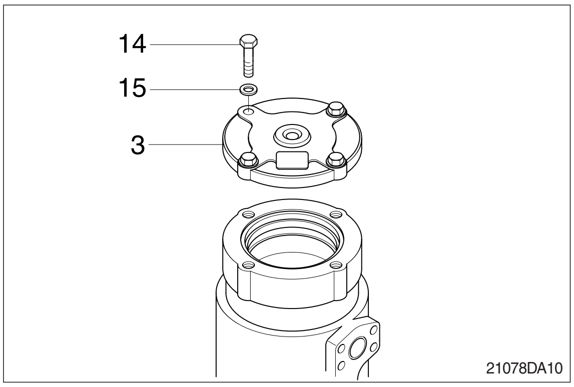
(6) Fit shim (6) to shaft (2).



(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, BUCKET AND DOZER CYLINDERS

1. REMOVAL AND INSTALL

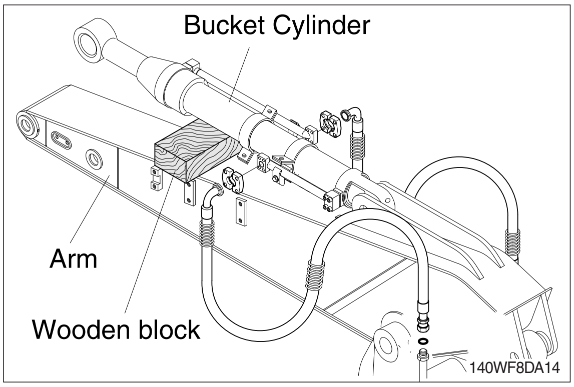
1) BUCKET CYLINDER

(1) Removal


13031GE18

※ Expand the arm and bucket fully, lower the work equipment to the ground and stop the engine.
※ Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.
※ Loosen the breather slowly to release the pressure inside the hydraulic tank.
⚠ **Escaping fluid under pressure can penetrate the skin causing serious injury.**
※ Fit blind plugs in the hoses after disconnecting them, to prevent dirt or dust from entering.

① Set block between bucket cylinder and arm.



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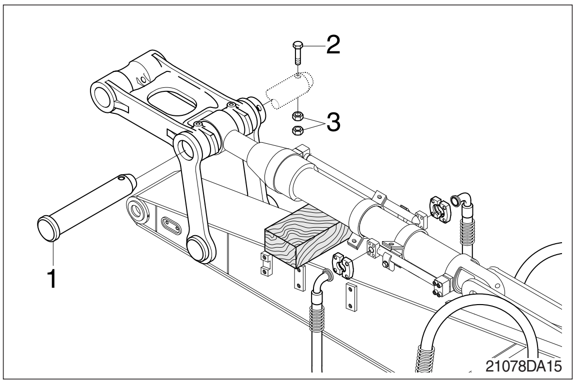
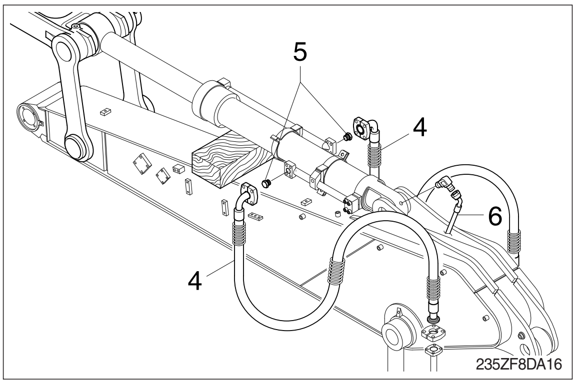
② Remove bolt (2), nut (3) and pull out pin (1).
※ Tie the rod with wire to prevent it from coming out.



21078DA15

③ Disconnect bucket cylinder hoses (4) and put plugs (5) on cylinder pipe.
④ Disconnect greasing piping (6).

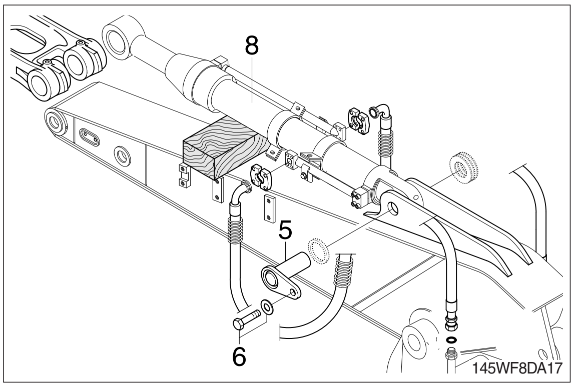


235ZF8DA16

⑤ Sling bucket cylinder assembly (8) and remove bolt (6) then pull out pin (5).

⑥ Remove bucket cylinder assembly (8).

· Weight : 100 kg (220 lb)



(2) Install

① Carry out installation in the reverse order to removal.

⚠ When aligning the mounting position of the pin, do not insert your fingers in the pin hole.

※ Bleed the air from the bucket cylinder.

※ Confirm the hydraulic oil level and check the hydraulic oil leak or not.

2) ARM CYLINDER

(1) Removal

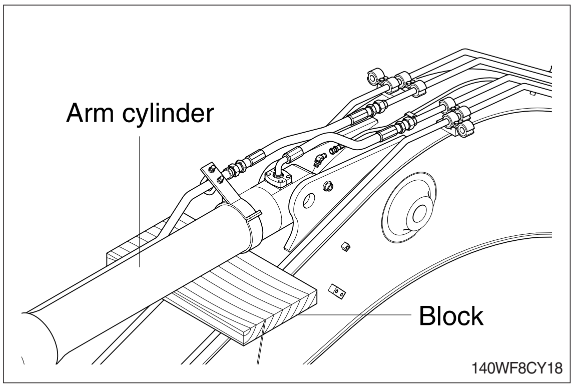
※ Expand the arm and bucket fully, lower the work equipment to the ground and stop the engine.

※ Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

※ Loosen the breather slowly to release the pressure inside the hydraulic tank.

⚠ Escaping fluid under pressure can penetrate the skin causing serious injury.
Fit blind plugs in the hoses after disconnecting them, to prevent dirt or dust from entering.

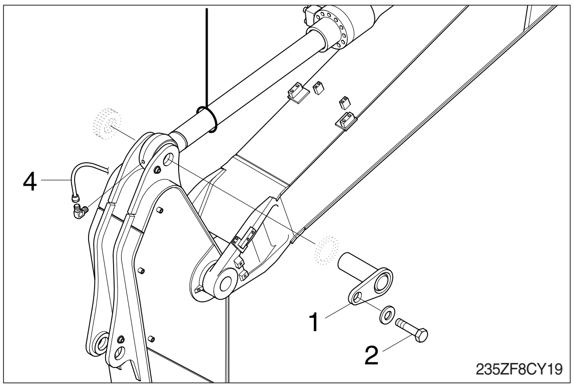
① Set block between arm cylinder and boom.



② Remove bolt (2) and pull out pin (1).

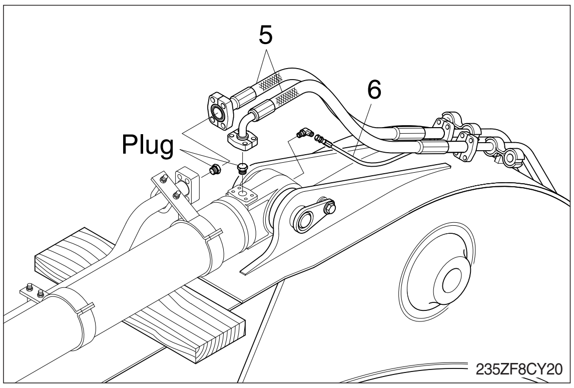
③ Disconnect greasing piping (4) of arm cylinder rod.

※ Tie the rod with wire to prevent it from coming out.



④ Disconnect arm cylinder hoses (5) and put plugs on cylinder pipe.

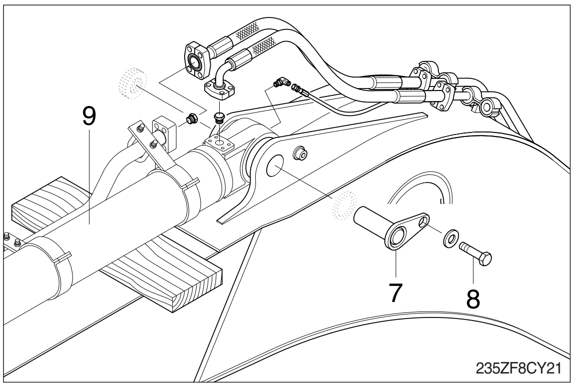
⑤ Disconnect greasing pipings (6).



⑥ Sling arm cylinder assembly (9) and remove bolt (8) then pull out pin (7).

⑦ Remove arm cylinder assembly (9).

  · Weight : 160 ㎏ (350 ℔)



(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.

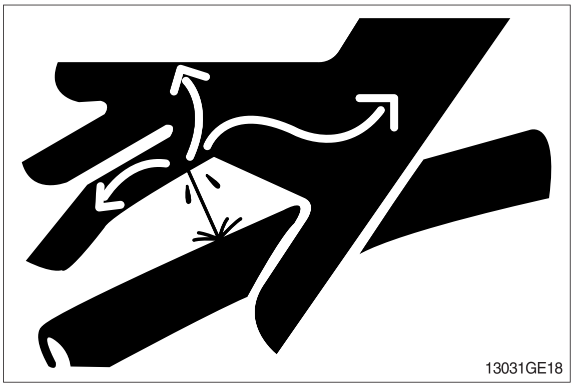
3) BOOM CYLINDER

(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.

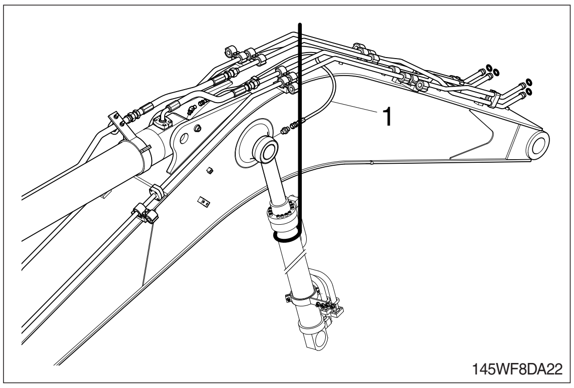

13031GE18

⚠ 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.



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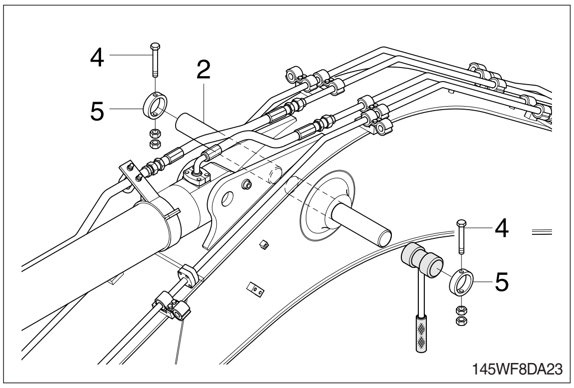
③ Remove bolt (4), stopper (5) and pull out pin (2).

※ Tie the rod with wire to prevent it from coming out.



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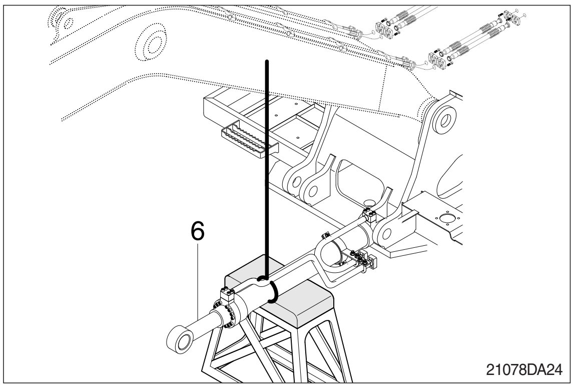
④ Lower the boom cylinder assembly (6) on a stand.



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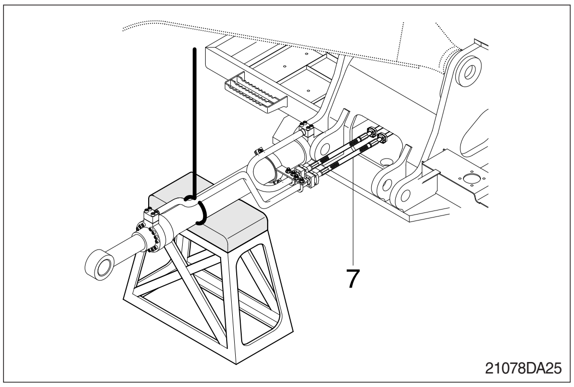
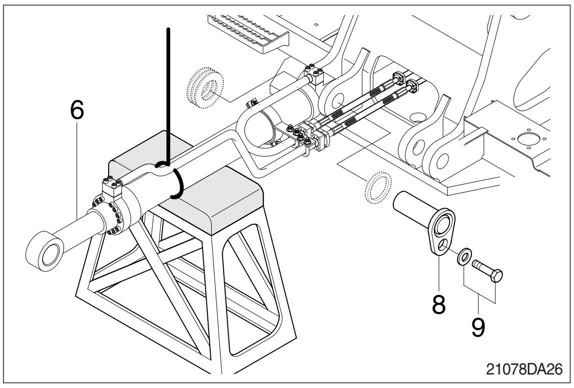
⑤ Disconnect boom cylinder hoses (7) and put plugs on cylinder pipe.



⑥ Remove bolt (9) and pull out pin (8).

⑦ Remove boom cylinder assembly (6).

· Weight : 130 ㎏ (285 ㏐)



(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.**

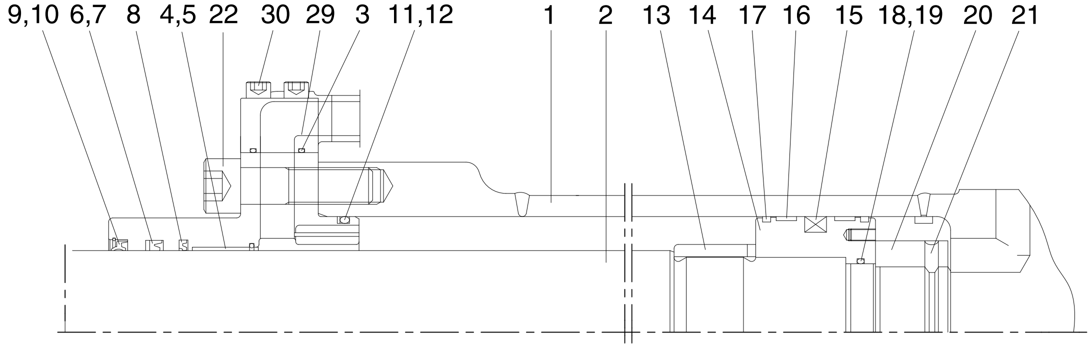
※ Bleed the air from the boom cylinder.

※ Conformed the hydraulic oil level and check the hydraulic oil leak or not.

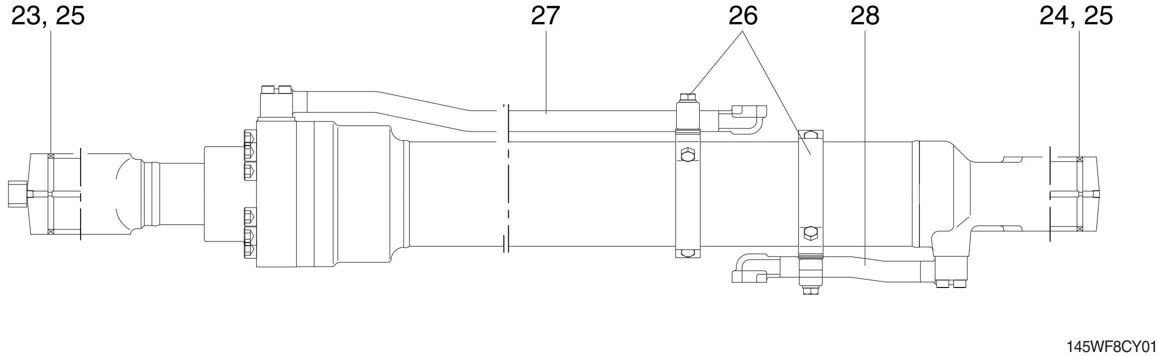
2. DISASSEMBLY AND ASSEMBLY

1) STRUCTURE

(1) Bucket cylinder

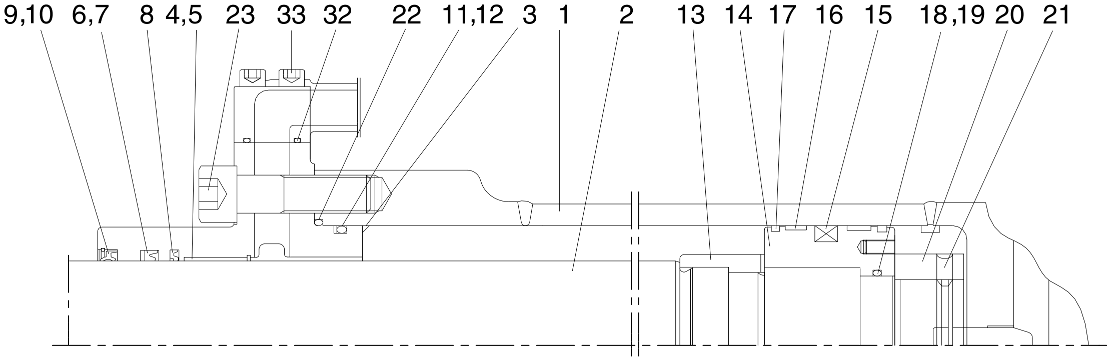


Internal detail

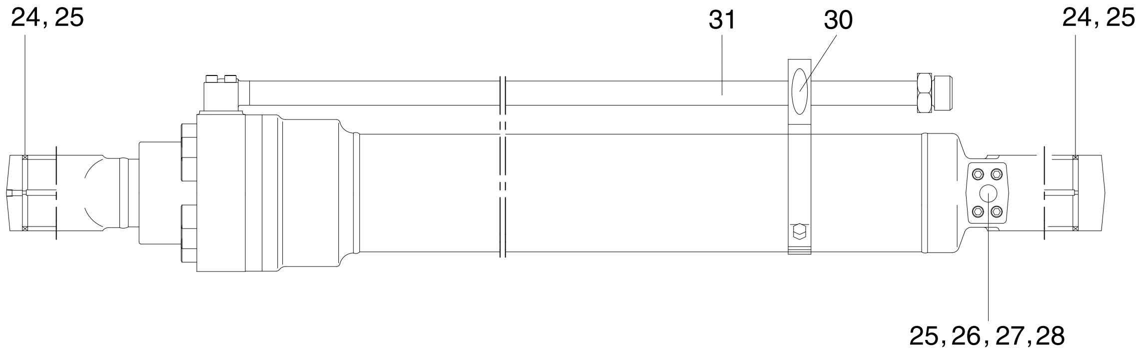


1	Tube assembly	11	O-ring	21	Hexagon socket set screw
2	Rod assembly	12	Back up ring	22	Hexagon socket head bolt
3	Gland	13	Cushion ring	23	Pin bushing
4	DD2 bushing	14	Piston	24	Pin bushing
5	Snap ring	15	Piston seal	25	Dust seal
6	Rod seal	16	Wear ring	26	Band assembly
7	Back up ring	17	Dust ring	27	Pipe assembly-R
8	Buffer ring	18	O-ring	28	Pipe assembly-B
9	Dust wiper	19	Back up ring	29	O-ring
10	Snap ring	20	Lock nut	30	Hexagon socket head bolt

(2) Arm cylinder



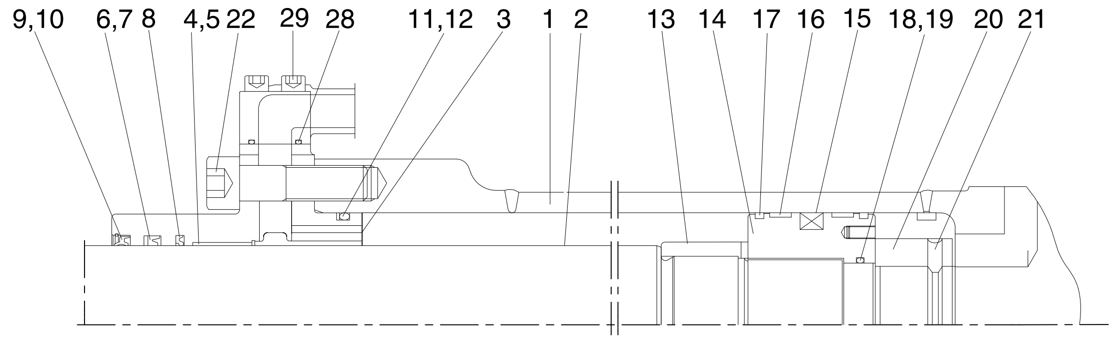
Internal detail



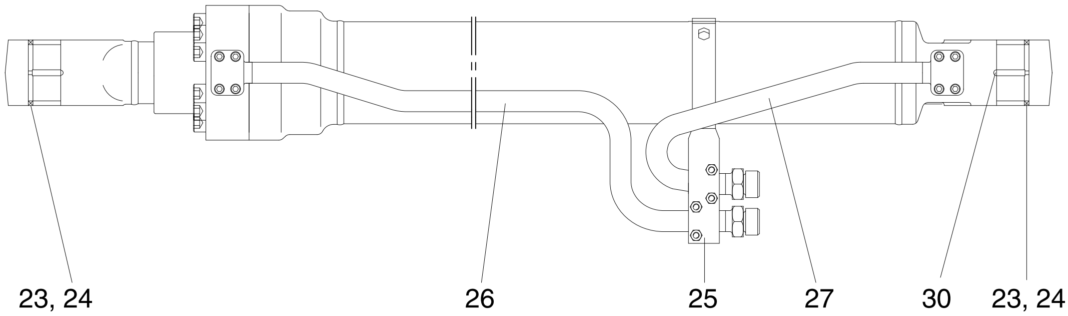
145WF8CY02

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	Dust seal
4	DD2 bushing	15	Piston seal	26	Check valve
5	Snap ring	16	Wear ring	27	Coil spring
6	Rod seal	17	Dust ring	28	O-ring
7	Back up ring	18	O-ring	29	Plug
8	Buffer ring	19	Back up ring	30	Band assembly
9	Dust wiper	20	Lock nut	31	Pipe assembly-R
10	Snap ring	21	Hexagon socket set screw	32	O-ring
11	O-ring	22	O-ring	33	Hexagon socket head bolt

(3) Boom cylinder



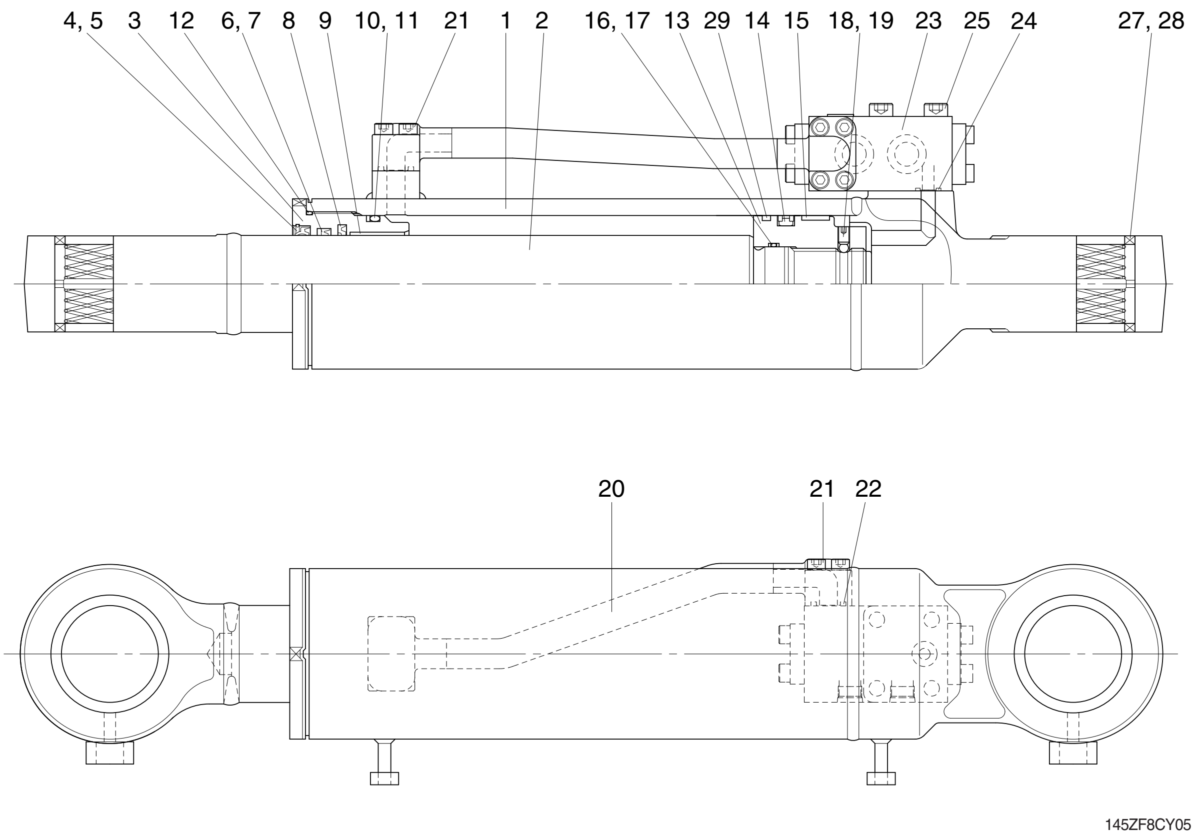
Internal detail



145WF8CY03

1	Tube assembly	11	O-ring	21	Hexagon socket set screw
2	Rod assembly	12	Back up ring	22	Hexagon socket head bolt
3	Gland	13	Cushion ring	23	Pin bushing
4	DD2 bushing	14	Piston	24	Dust seal
5	Snap ring	15	Piston seal	25	Band assembly
6	Rod seal	16	Wear ring	26	Pipe assembly-R
7	Back up ring	17	Dust ring	27	Pipe assembly-B
8	Buffer ring	18	O-ring	28	O-ring
9	Dust wiper	19	Back up ring	29	Hexagon socket head bolt
10	Snap ring	20	Lock nut	30	Socket plug

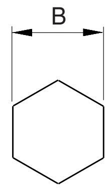
(4) Dozer cylinder



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	Dry bearing	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
Socket head bolt	Bucket cylinder (★1)	22	M14	15±2.0	108±14.5
	Boom cylinder (★1)	22	M14	15±2.0	108±14.5
	Arm cylinder (★1)	23	M16	23±2.0	166±14.5
Check valve mounting socket head bolt	Dozer cylinder	25	M10	5.4±0.5	39.1±3.6
Pipe mounting socket head bolt	Bucket	30	M10	5.4±0.5	39.1±3.6
	Boom	29	M8	2.7±0.3	19.6±2.2
	Arm	33	M10	5.4±0.5	39.1±3.6
	Dozer cylinder	21	M8	2.7±0.3	19.5±2.2
Lock nut	Bucket cylinder	20	M45	100±10.0	723±72.3
	Boom cylinder	20	M52		
	Arm cylinder	20	M56		
Piston	Bucket cylinder	14	-	150±15.0	1085±109
	Boom cylinder	14			
	Arm cylinder	14			
	Dozer cylinder	13	M52		
Gland	Dozer cylinder	3	M105	85±8.5	615±61.5
Set screw	Bucket cylinder	21	M8	2.7±0.3	19.5±2.2
	Boom cylinder	21	M8	2.7±0.3	19.5±2.2
	Arm cylinder	21	M8	2.7±0.3	19.5±2.2
	Dozer cylinder	19	M8	2.7±0.3	19.5±2.2

※ Apply loctite #243 (★1) on the thread before tightening.

3) DISASSEMBLY

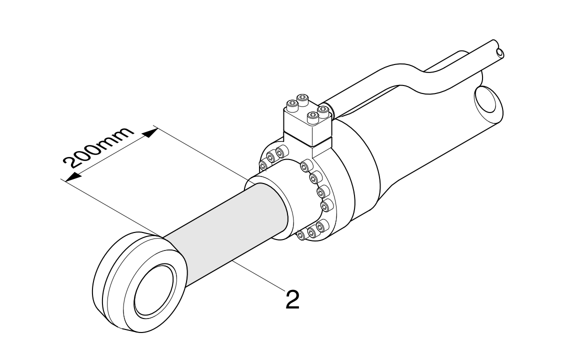
(1) Remove cylinder head and piston rod

※ Procedures are based on the bucket cylinder.

① Hold the clevis section of the tube in a vise.

※ Use mouth pieces so as not to damage the machined surface of the cylinder tube. Do not make use of the outside piping as a locking means.

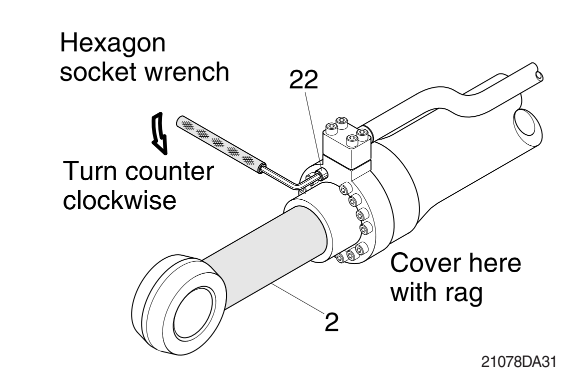
② Pull out rod assembly (2) about 200mm (7.1in). Because the rod assembly is rather heavy, finish extending it with air pressure after the oil draining operation.



21078DA30

③ Loosen and remove socket bolts (22) of the gland in sequence.

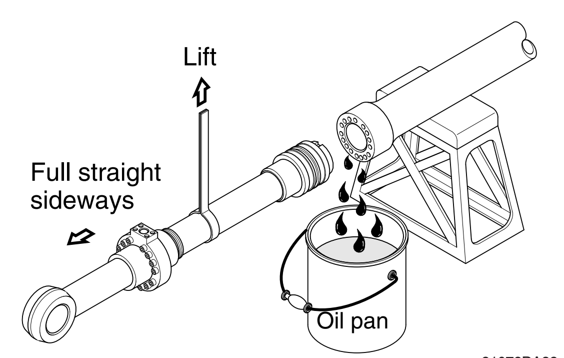
※ Cover the extracted rod assembly (2) with rag to prevent it from being accidentally damaged during operation.



21078DA31

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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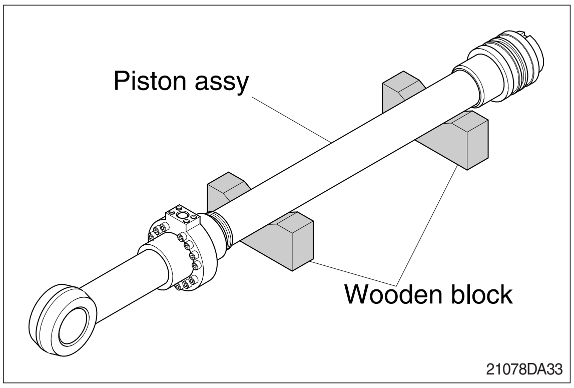
Note that the plated surface of rod assembly (2) is to be lifted. For this reason, do not use a wire sling and others that may damage it, but use a strong cloth belt or a rope.

⑤ Place the removed rod assembly on a wooden V-block that is set level.

※ Cover a V-block with soft rag.

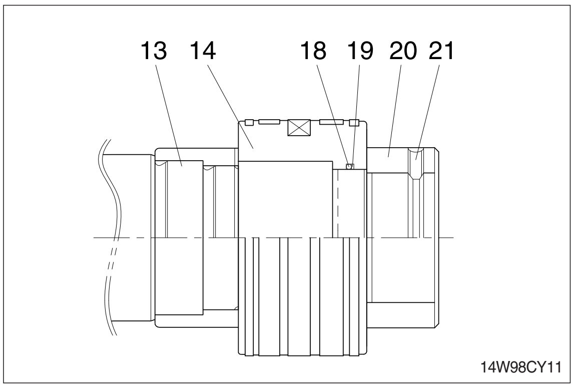


(2) Remove piston and cylinder head

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).

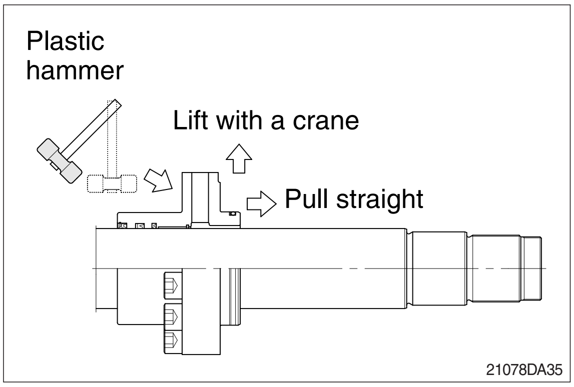


③ Remove the cylinder head assembly from rod assembly (2).

※ 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).

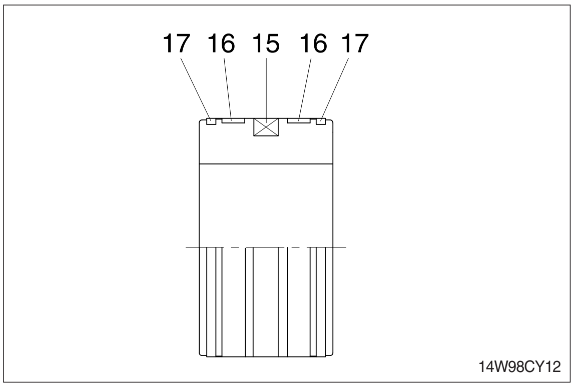


(3) Disassemble the piston assembly

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).

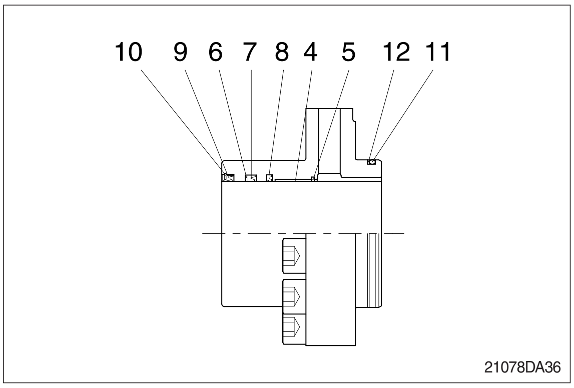
② Remove snap ring (10), dust wiper (9).

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).

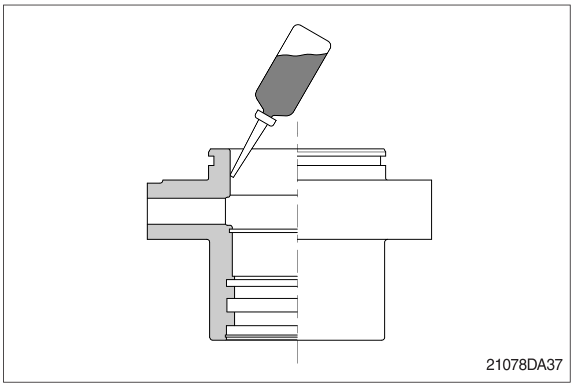


3) ASSEMBLY

(1) Assemble cylinder head assembly

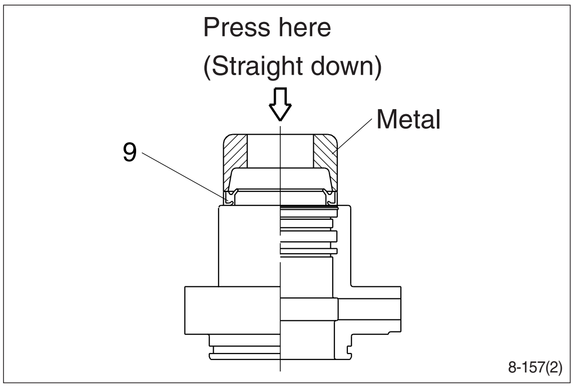
※ Check for scratches or rough surfaces if found smooth with an oil stone.

① Coat the inner face of gland (3) with hydraulic oil.



② Coat dust wiper (9) with grease and fit dust wiper (9) to the bottom of the hole of dust wiper.
At this time, press a pad metal to the metal ring of dust wiper.

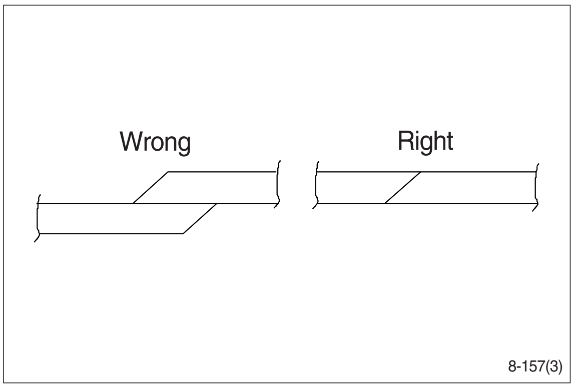
③ Fit snap ring (10) to the stop face.



④ Fit back up ring (7), rod seal (6) and buffer ring (8) to corresponding grooves, in that order.

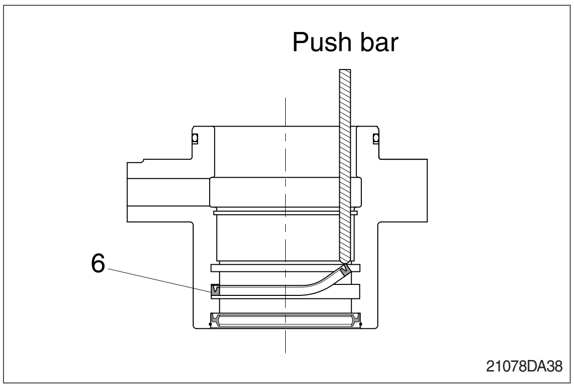
※ Coat each packing with hydraulic oil before fitting it.

※ Insert the backup ring until one side of it is inserted into groove.



※ Rod seal (6) has its own fitting direction. Therefore, confirm it before fitting them.

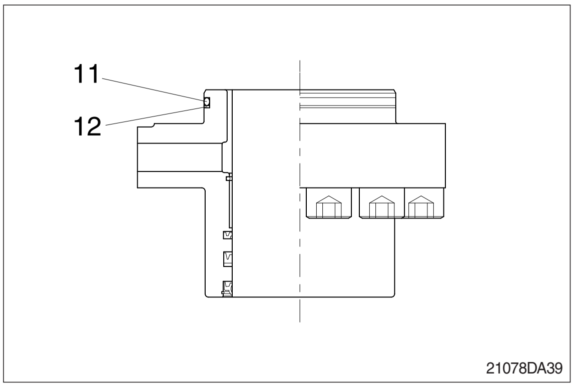
※ Fitting rod seal (6) upside down may damage its lip. Therefore check the correct direction that is shown in fig.



⑤ Fit back up ring (12) to gland (3).

※ Put the backup ring in the warm water of 30~50˚C.

⑥ Fit O-ring (11) to gland (3).



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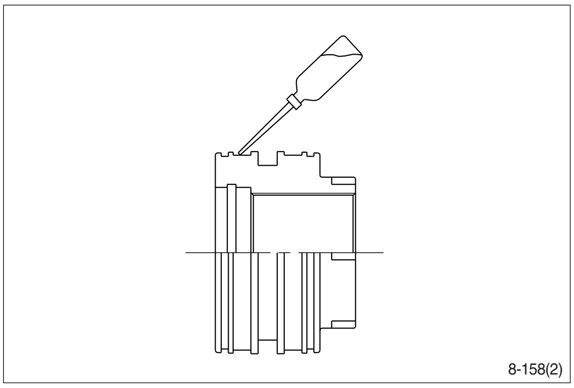
(2) Assemble piston assembly

※ Check for scratches or rough surfaces. If found smooth with an oil stone.

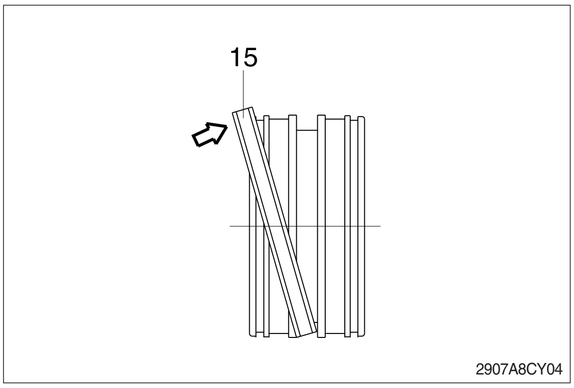
① Coat the outer face of piston (14) with hydraulic oil.


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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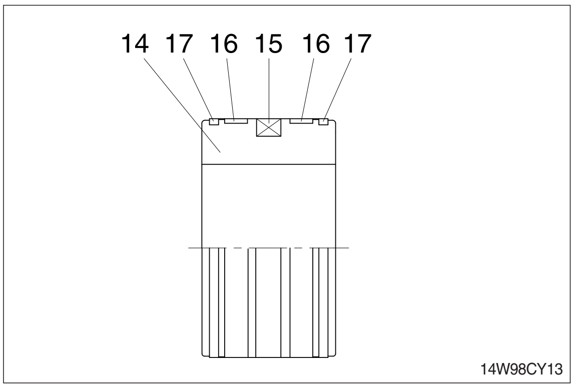
③ Fit wear ring (16) and dust ring (17) to piston (14).



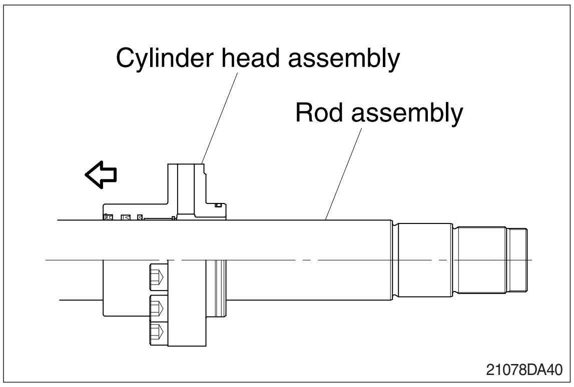
14W98CY13

(3) Install piston and cylinder head

① Fix the rod assembly to the work bench.

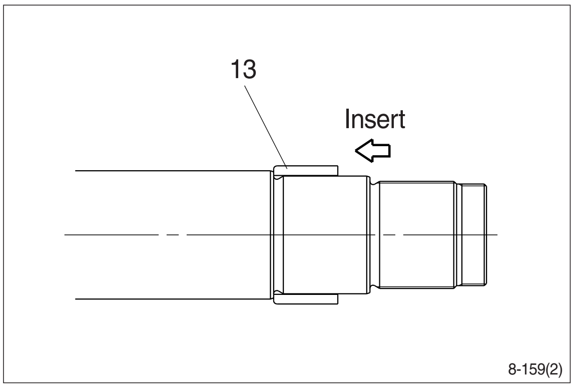
② Apply hydraulic oil to the outer surface of rod assembly (2), the inner surface of piston and cylinder head.

③ Insert cylinder head assembly to rod assembly.



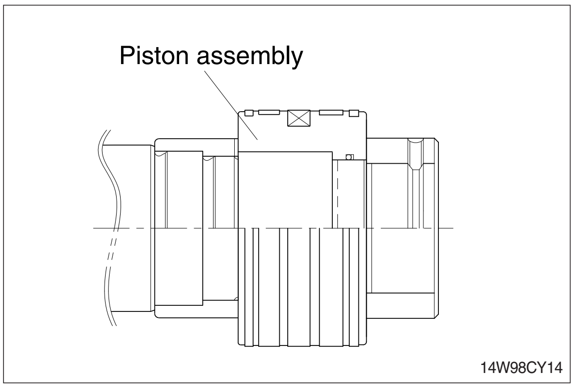
④ Insert cushion ring (13) to rod assembly.

※ Note that cushion ring (13) has a direction in which it should be fitted.



⑤ Fit piston assembly to rod assembly.

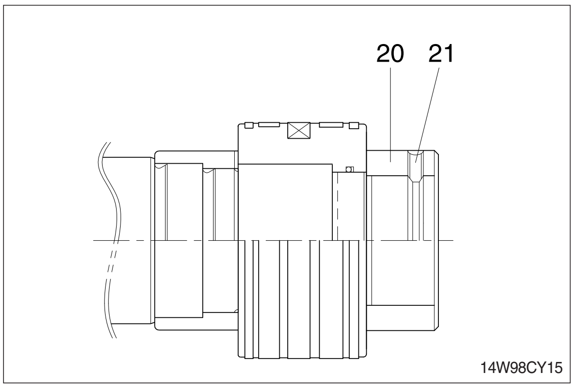
· Tightening torque : 150±15 kgf · m (1085±108 lbf · ft)



⑥ Fit lock nut (20) and tighten the set screw (21).

· Tightening torque :

Item		kgf · m	lbf · ft
20	Bucket	100±10	723±72.3
	Boom		
	Arm		
21		2.7±0.3	19.6±2.2



(3) Overall assemble

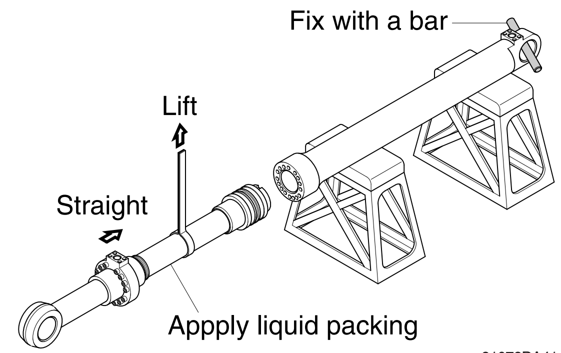
① Place a V-block on a rigid work bench. Mount the tube assembly (1) on it and fix the assembly by passing a bar through the clevis pin hole to lock the assembly.

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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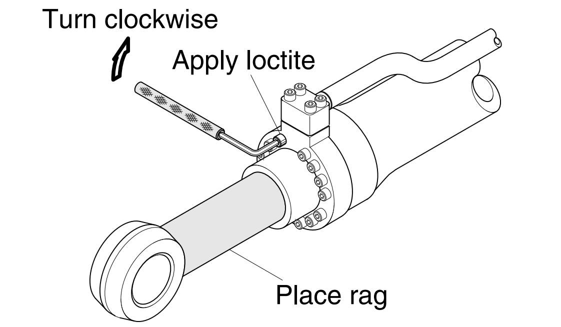


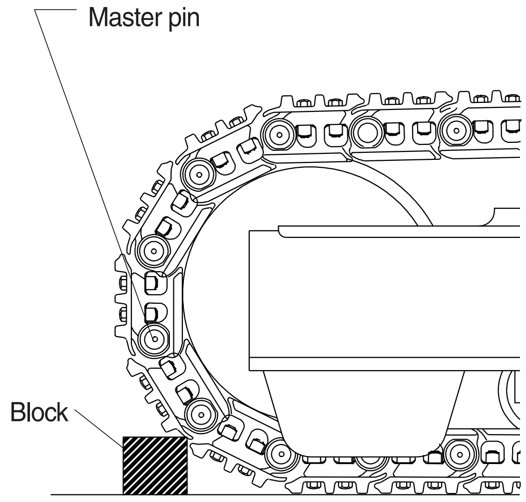
21078DA42

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.

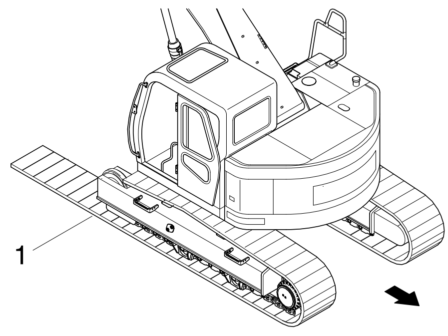
※ Unscrew the grease nipple after release the tension by pushing the poppet only when necessarily required.
Grease leaking hole is not existing. So, while unscrew the grease nipple, grease is not leaking until the grease nipple is completely coming out. If the tension is not released in advance, the 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.

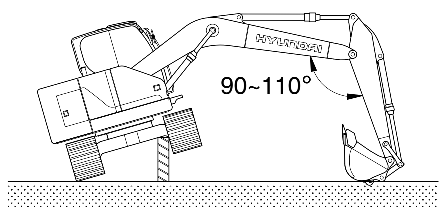


140Z98UC04

2) INSTALL

(1) Carry out installation in the reverse order to removal.

※ Adjust the tension of the track link.

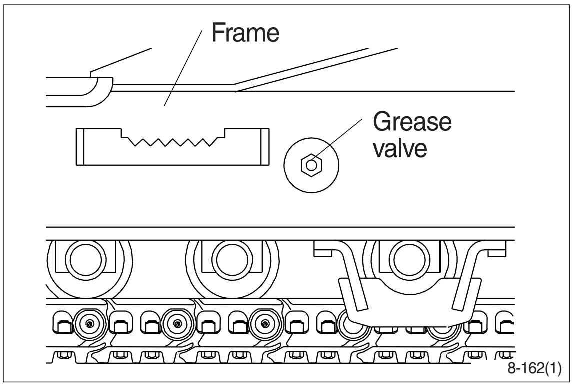


140Z98UC05

2. CARRIER ROLLER

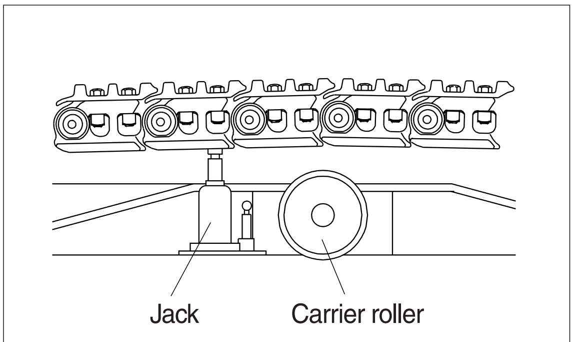
1) REMOVAL

(1) Loosen tension of the track link.



8-162(1)

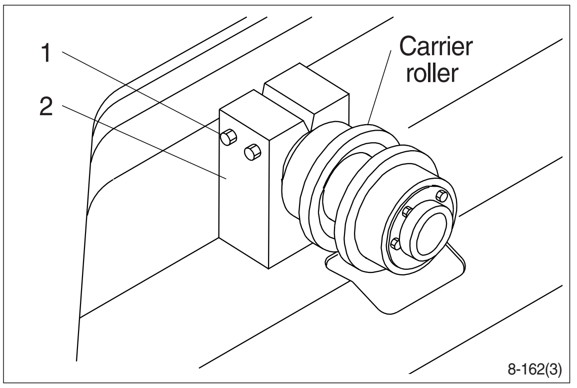
(2) Jack up the track link height enough to permit carrier roller removal.



8-162(2)

(3) Loosen the lock nut (1).
  · Tightening torque : 29.7±4.4 kgf · m (215±31.8 lbf · ft)

(4) Open bracket(2) with a screwdriver, push out from inside, and remove carrier roller assembly.
  · Weight : 20 kg (45 lb)



8-162(3)

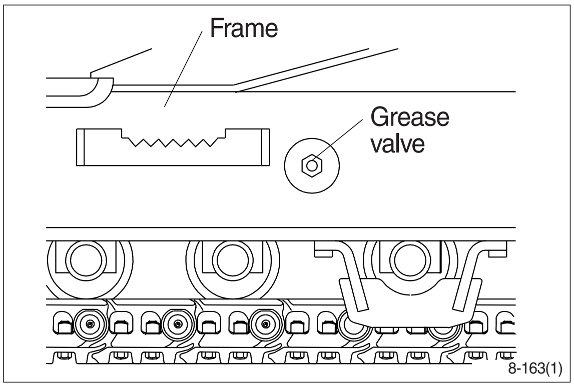
2) INSTALL

(1) Carry out installation in the reverse order to removal.

3. TRACK ROLLER

1) REMOVAL

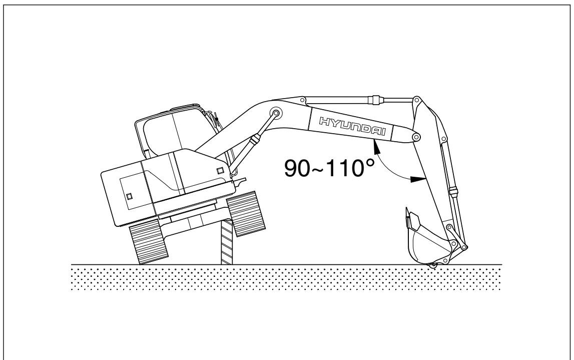
(1) Loosen tension of the track link.



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.

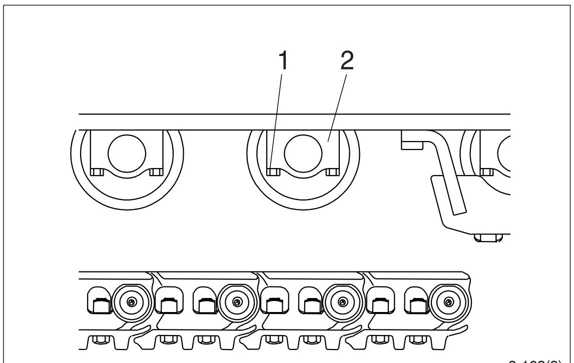


140Z98UC05

(3) Remove the mounting bolt (1) and draw out the track roller (2).

· Weight : 35.1 kg (77.4 lb)

· Tightening torque : 29.6±3.2 kgf · m (214±23.1 lbf · ft)



8-163(3)

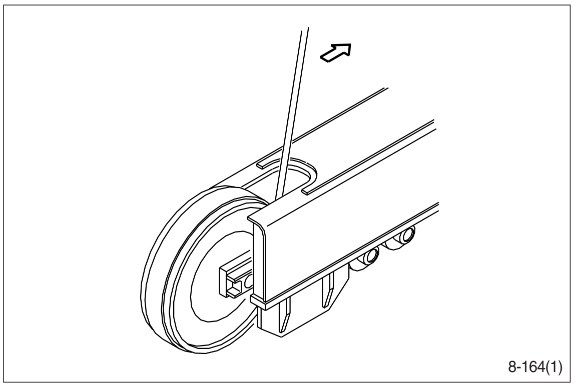
2) INSTALL

(1) Carry out installation in the reverse order to removal.

4. IDLER AND RECOIL SPRING

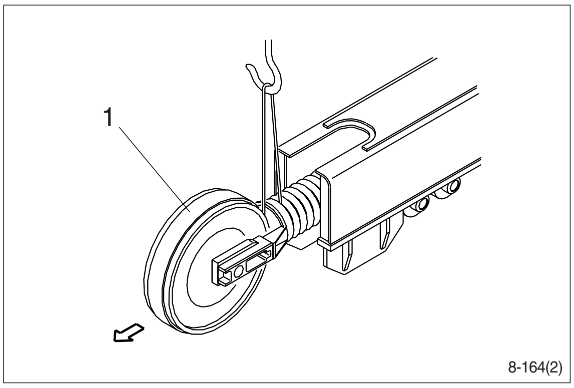
1) REMOVAL

(1) Remove the track link.
For detail, see removal of track link.



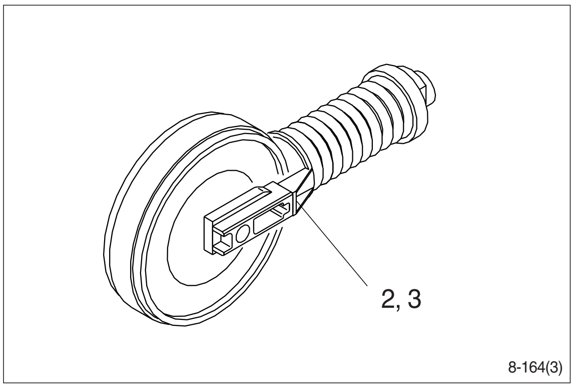
8-164(1)

(2) Sling the recoil spring (1) and pull out idler and recoil spring assembly from track frame, using a pry.
- Weight : 192 kg (423 lb)



8-164(2)

(3) Remove the bolts (2), washers (3) and separate ilder from recoil spring.
- Tightening torque : 29.7±4.5 kgf · m (215±32.5 lbf · ft)

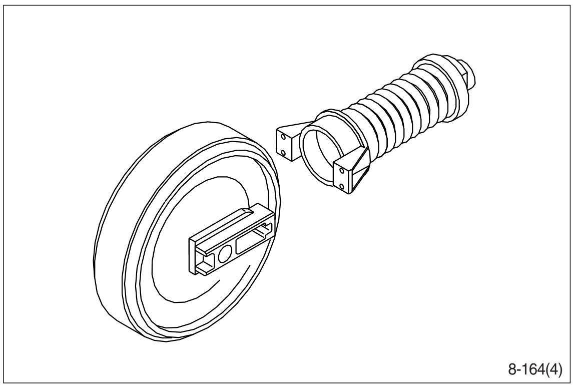


8-164(3)

2) INSTALL

(1) Carry out installation in the reverse order to removal.

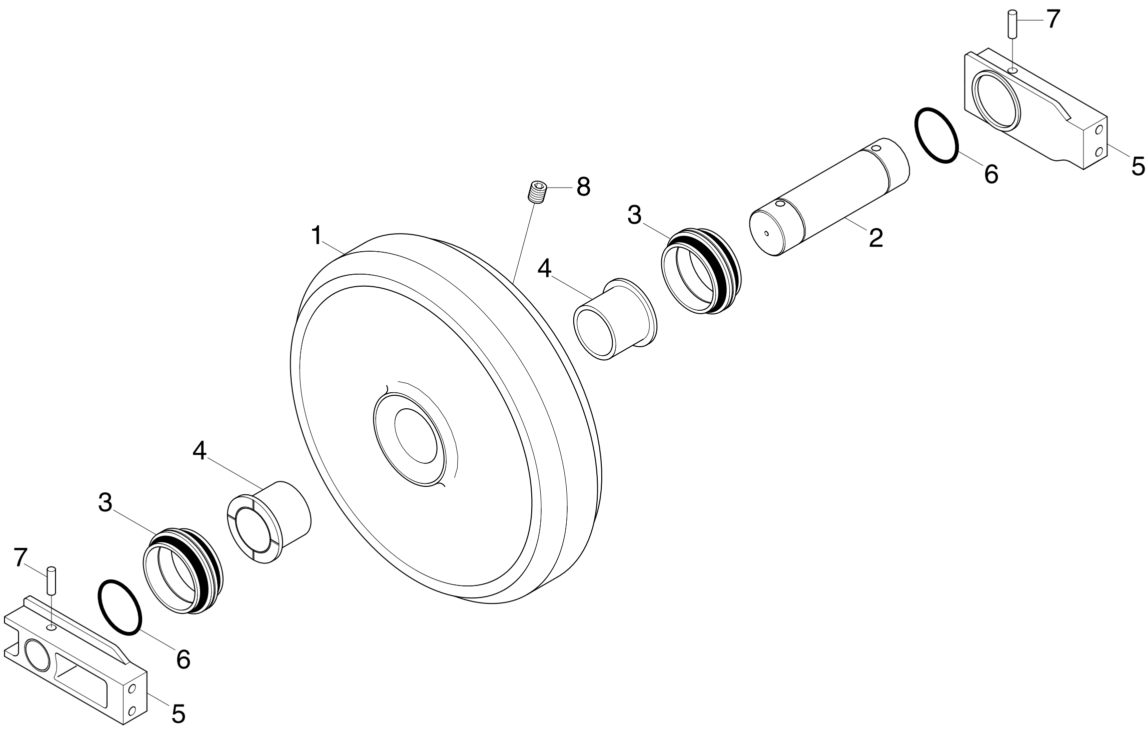
※ Make sure that the boss on the end face of the recoil cylinder rod is in the hole of the track frame.



8-164(4)

3) DISASSEMBLY AND ASSEMBLY OF IDLER

(1) Structure



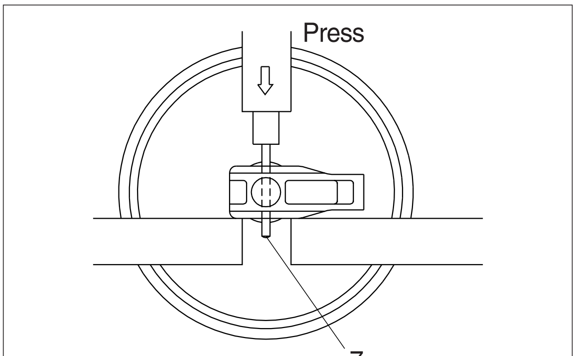
21078DA43

1	Shell	4	Bushing	7	Spring pin
2	Shaft	5	Bracket	8	Plug
3	Seal assembly	6	O-ring		

(2) Disassembly

① Remove plug (8) and drain oil.

② Draw out the spring pin (7), using a press.

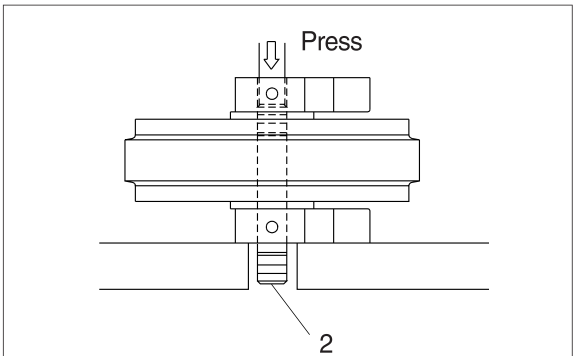


8-166(1)

③ Pull out the shaft (2) with a press.

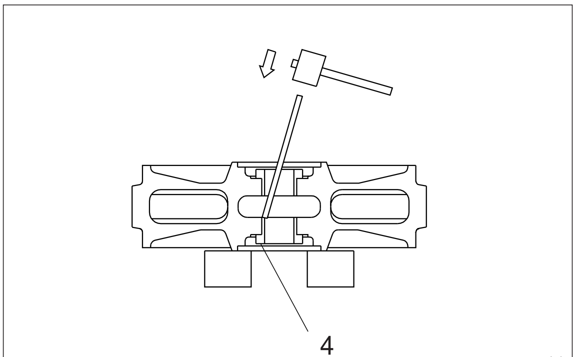
④ Remove seal (3) from idler (1) and bracket (5).

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.



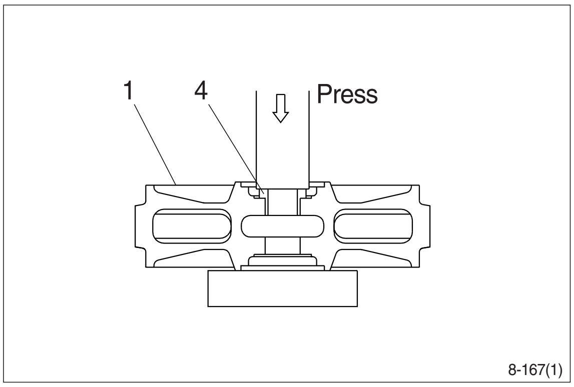
8-166(3)

(3) Assembly

※ Before assembly, clean the parts.

※ Coat the sliding surfaces of all parts with oil.

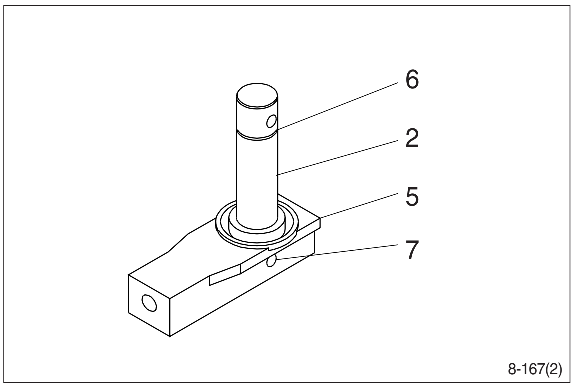
① Cool up bushing (4) fully by some dry ice and press it into shell (1).
Do not press it at the normal temperature, or not knock in with a hammer even after the cooling.



8-167(1)

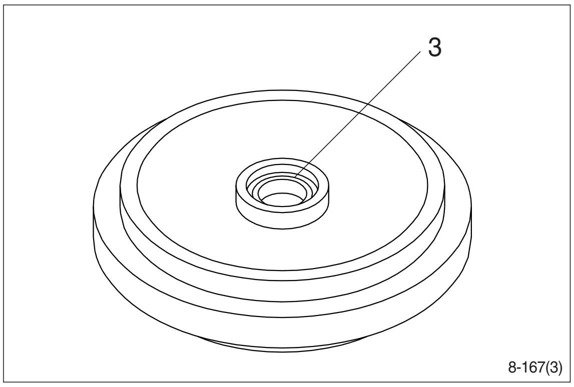
② Coat O-ring (6) with grease thinly, and install it to shaft (2).

③ Insert shaft (2) into bracket (5) and drive in the spring pin (7).



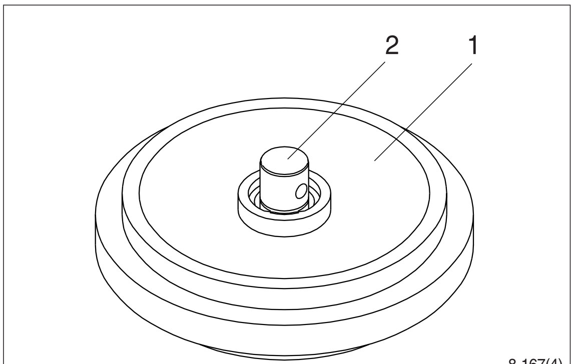
8-167(2)

④ Install seal (3) to shell (1) and bracket (5).



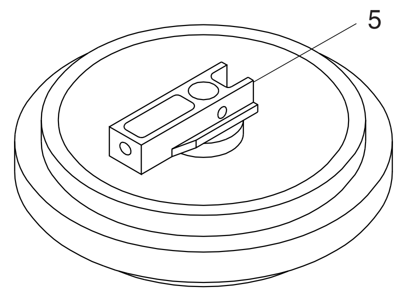
8-167(3)

⑤ Install shaft (2) to shell (1).



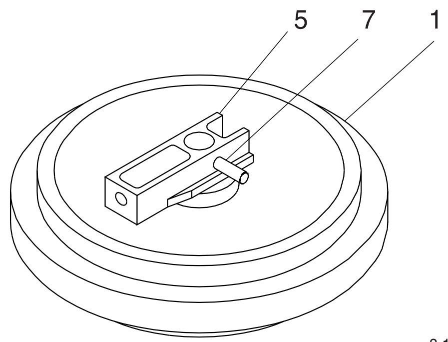
8-167(4)

⑥ Install bracket (5) attached with seal (3).



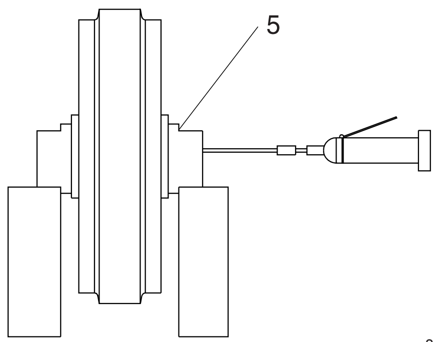
8-168(1)

⑦ Knock in the spring pin (7) with a hammer.



8-168(2)

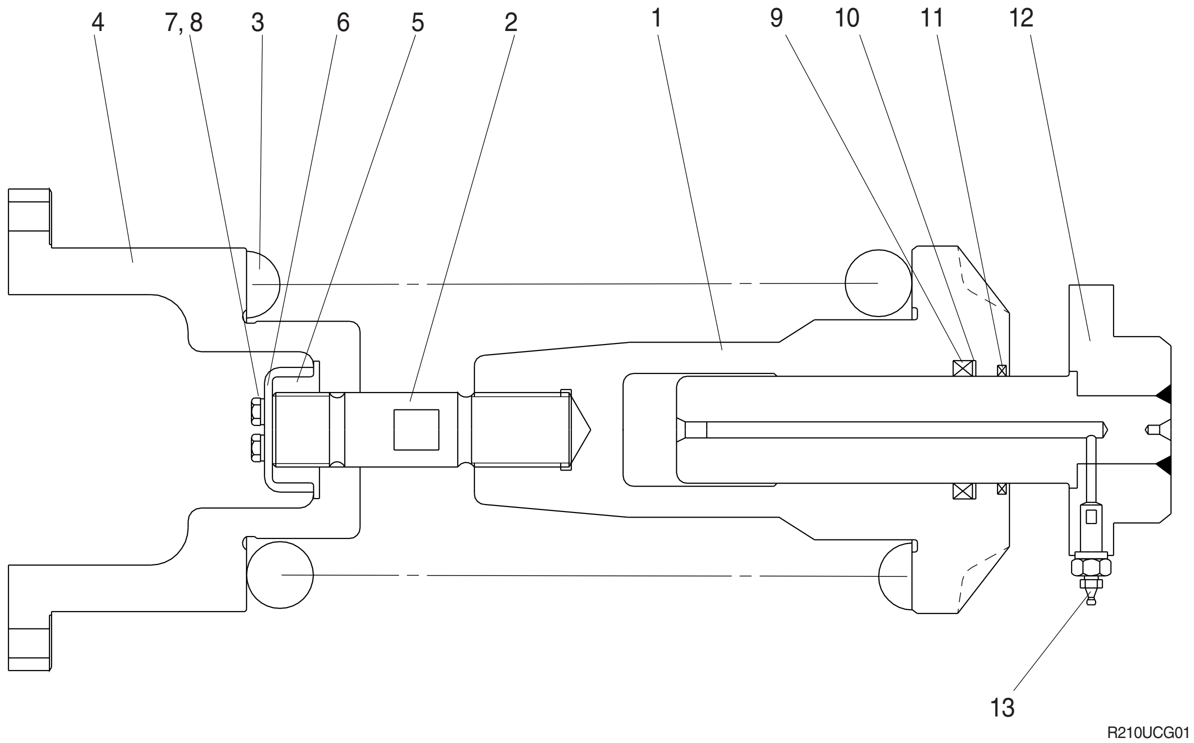
⑧ Lay bracket (5) on its side.
Supply engine oil to the specified level, and tighten plug (8).



8-168(3)

4) DISASSEMBLY AND ASSEMBLY OF RECOIL SPRING

(1) Structure



1	Body	6	Lock plate	11	Dust seal
2	Tie bar	7	Bolt	12	Rod assembly
3	Spring	8	Spring washer	13	Grease valve
4	Bracket	9	Rod seal		
5	Lock nut	10	Back up ring		

(2) Disassembly

① Apply pressure on spring (3) with a press.

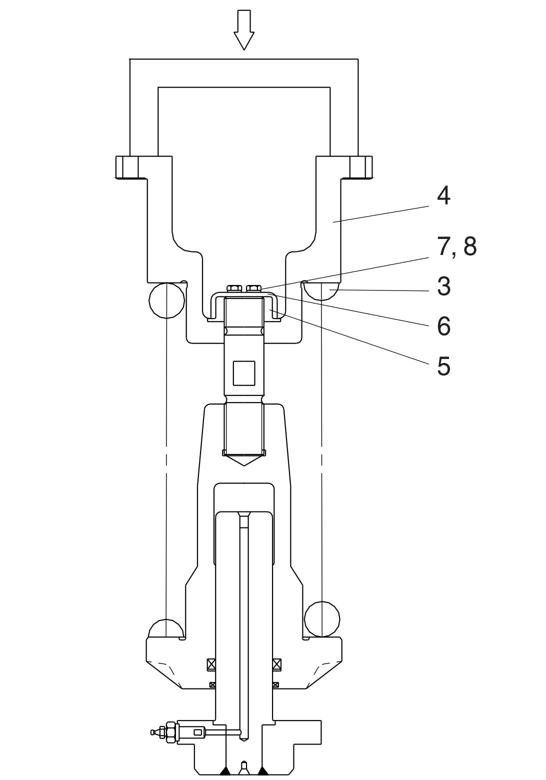
※ The spring is under a large installed load. This is dangerous, so be sure to set properly.

· Spring set load : 11132 kg (24542 lb)

② Remove bolt (7), spring washer (8) and lock plate (6).

③ Remove lock nut (5).
Take enough notice so that the press which pushes down the spring, should not be slipped out in its operation.

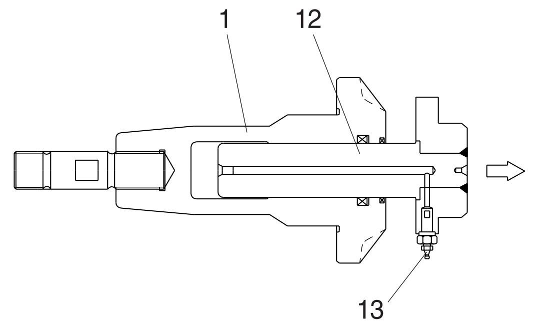
④ Lighten the press load slowly and remove bracket (4) and spring (3).



R210UCG2(1)

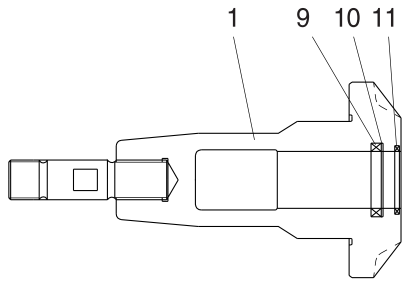
⑤ Remove rod (12) from body (1).

⑥ Remove grease valve (13) from rod (12).



R210UCG2(2)

⑦ Remove rod seal (9), back up ring (10) and dust seal (11).

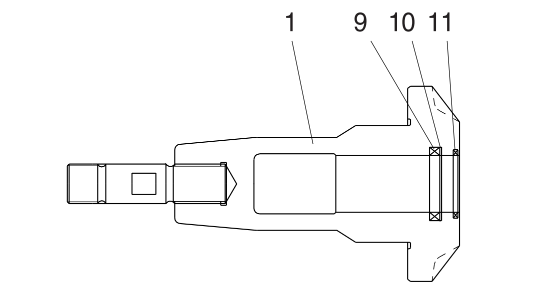


R210UCG2(3)

(3) Assembly

Install dust seal (11), back up ring (10) and rod seal (9) to body (1).

※ When installing dust seal (11) and rod seal (9), take full care so as not to damage the lip.



R210UCG2(3)

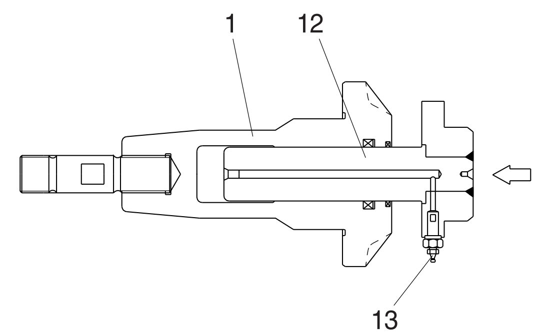
② Pour grease into body (1), then push in rod (12) by hand.

After take grease out of grease valve mounting hole, let air out.

※ If air letting is not sufficient, it may be difficult to adjust the tension of crawler.

③ Fit grease valve (13) to rod (12).

· Tightening torque : 13±1.0 kgf · m (94±7.2 lbf · ft)



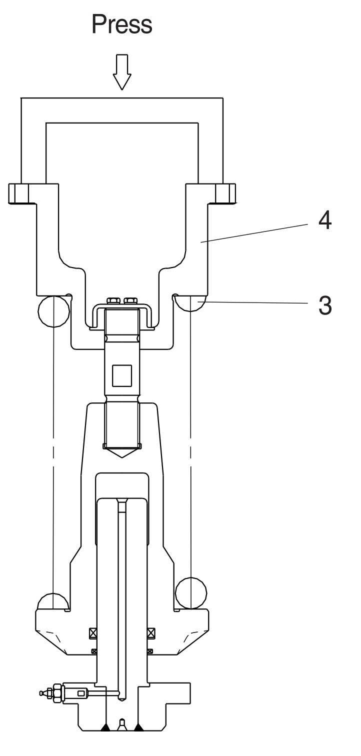
R210UCG2(4)

④ Install spring (3) and bracket (4) to body (1).

⑤ Apply pressure to spring (3) with a press and tighten lock nut (5).

※ Apply sealant before assembling.

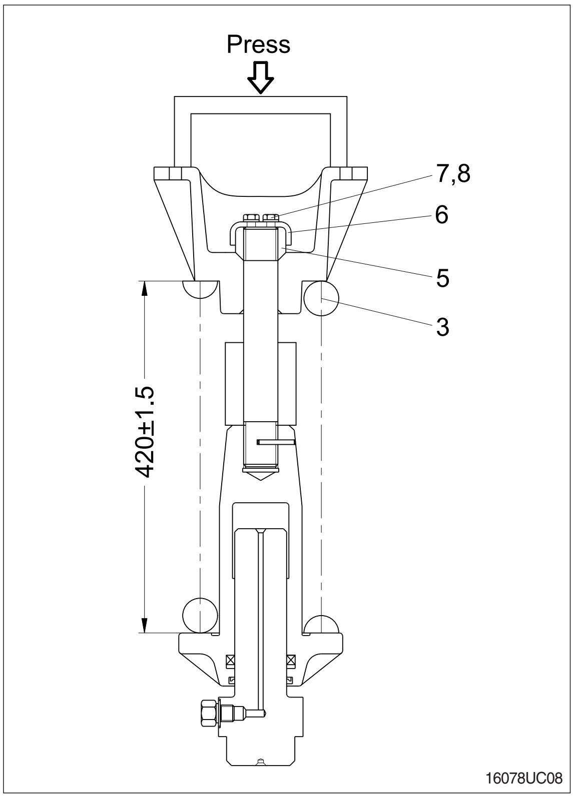
※ During the operation, pay attention specially to prevent the press from slipping out.



R210UCG2(5)

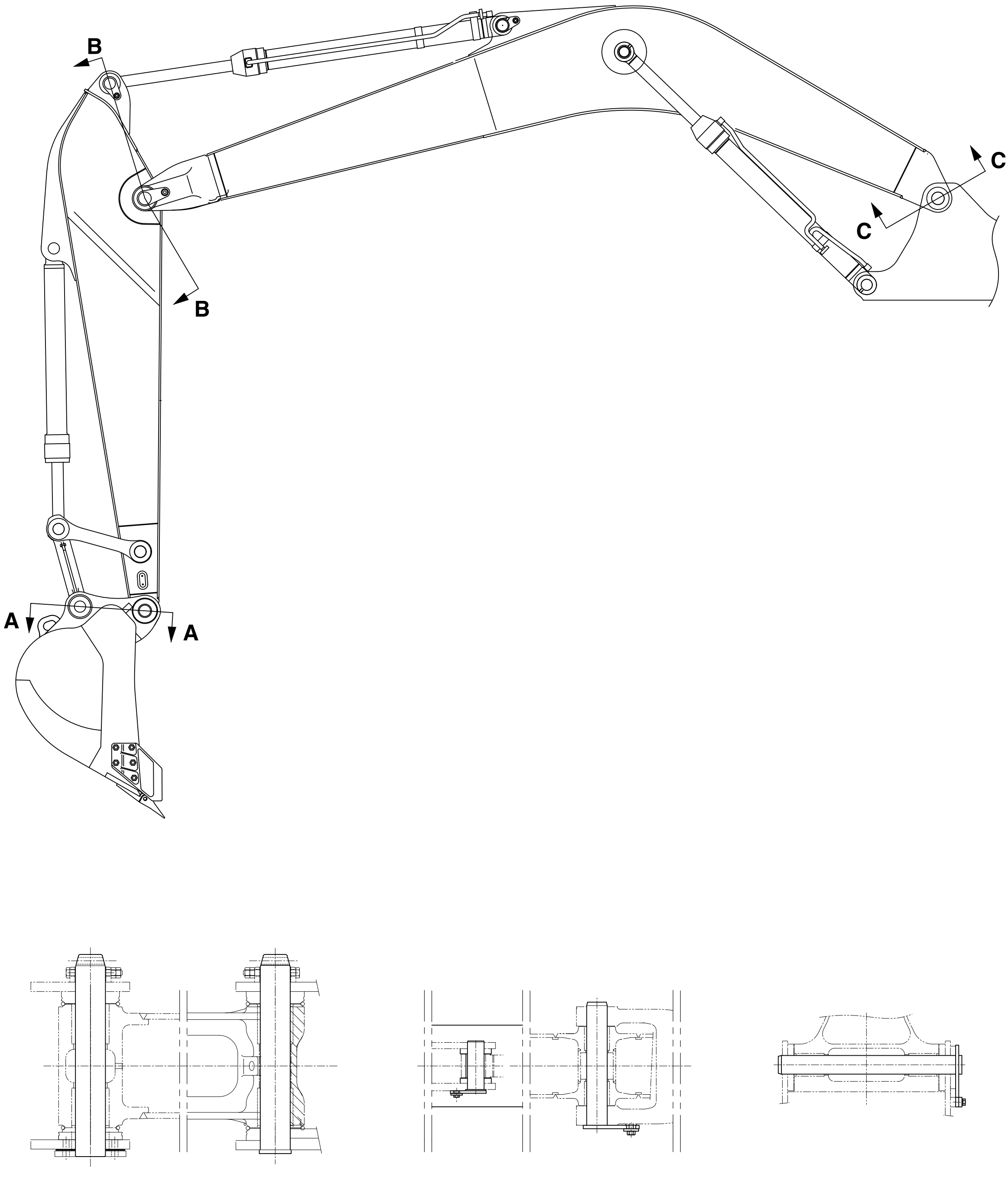
⑥ Lighten the press load and confirm the set length of spring (3).

⑦ After the setting of spring (3), install lock plate (6), spring washer (8) and bolt (7).



GROUP 11 WORK EQUIPMENT

1. STRUCTURE



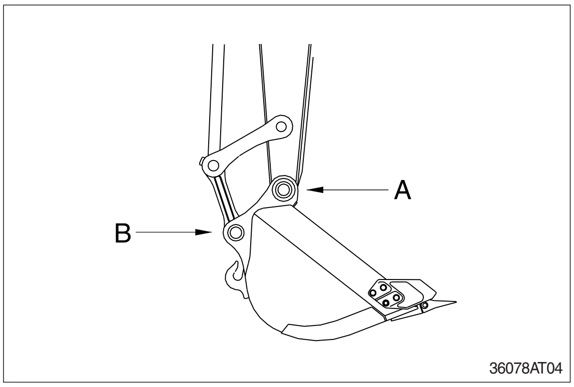
21078D 44

2. REMOVAL AND INSTALL

1) BUCKET ASSEMBLY

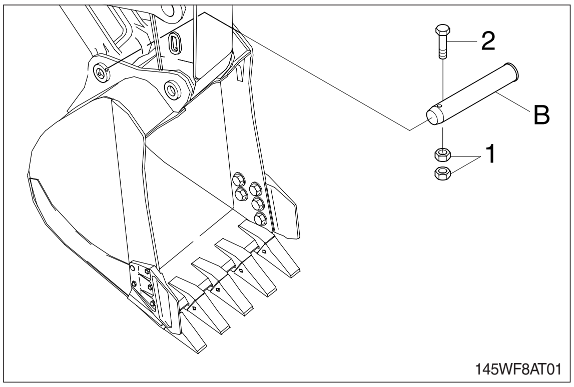
(1) Removal

① Lower the work equipment completely to ground with back of bucket facing down.



36078AT04

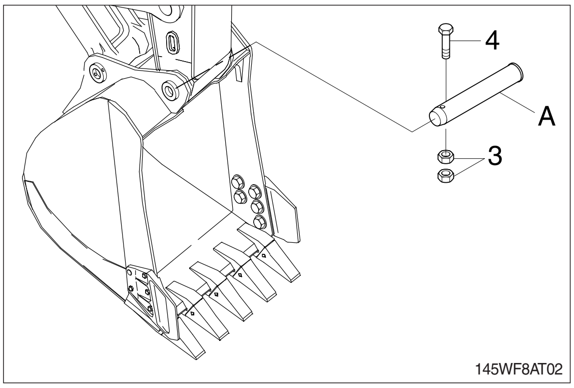
② Remove nut (1), bolt (2) and draw out the pin (B).



145WF8AT01

③ Remove nut (3), bolt (4) and draw out the pin (A) then remove the bucket assembly.

· Weight : 480 ㎏ (1060 ㏈)



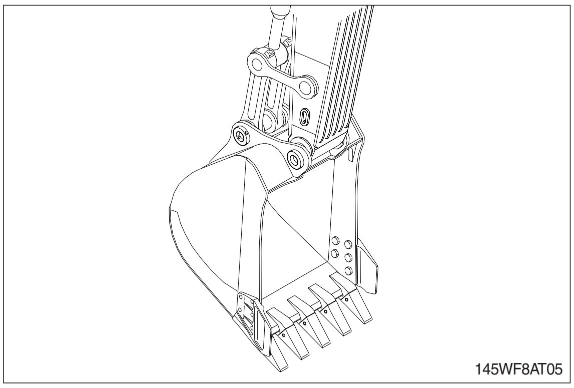
145WF8AT02

(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.



145WF8AT05

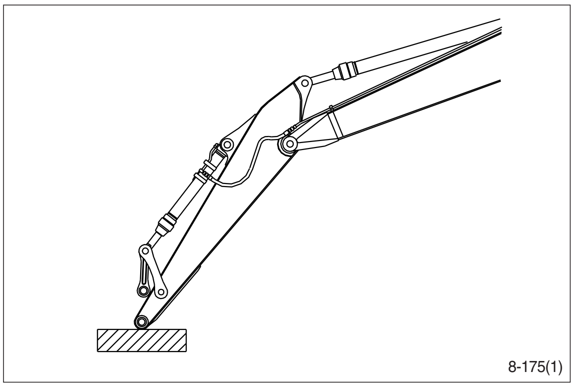
2) ARM ASSEMBLY

(1) Removal

※ Loosen the breather slowly to release the pressure inside the hydraulic tank.

⚠ **Escaping fluid under pressure can penetrated the skin causing serious injury.**

① Remove bucket assembly.
For details, see removal of bucket assembly.



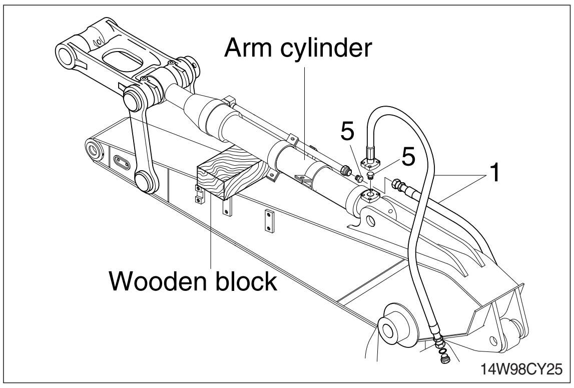
② Disconnect bucket cylinder hose (1).

⚠ **Fit blind plugs (5) in the piping at the chassis end securely to prevent oil from spurting out when the engine is started.**

③ Sling arm cylinder assembly, remove spring, pin stopper and pull out pin.

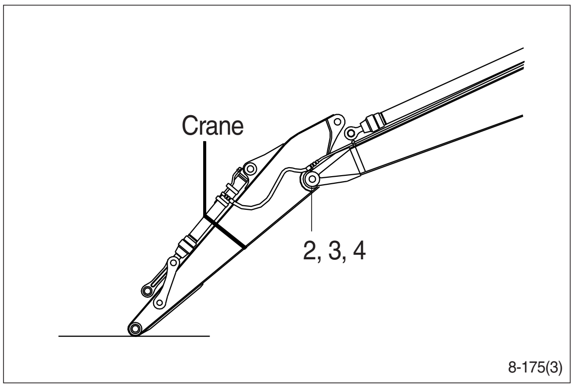
※ Tie the rod with wire to prevent it from coming out.

④ For details, see removal of arm cylinder assembly.
Place a wooden block under the cylinder and bring the cylinder down to it.



⑤ Remove bolt (2), plate (3) and pull out the pin (4) then remove the arm assembly.

※ · Weight : 570 kg (1260 lb)
When lifting the arm assembly, always lift the center of gravity.



(2) Install

① Carry out installation in the reverse order to removal.

⚠ **When lifting the arm assembly, always lift the center of gravity.**

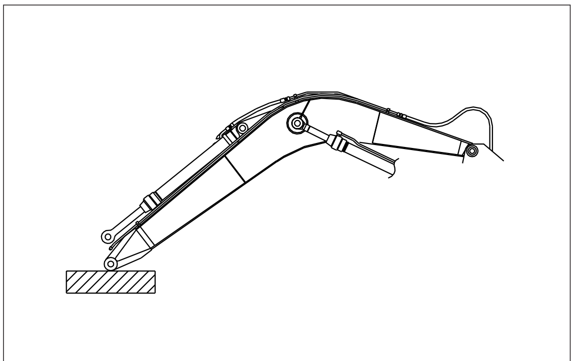
※ Bleed the air from the cylinder.

3) BOOM CYLINDER

(1) Removal

① Remove arm and bucket assembly.
For details, see removal of arm and bucket assembly.

② Remove boom cylinder assembly from boom.
For details, see removal of arm cylinder assembly.



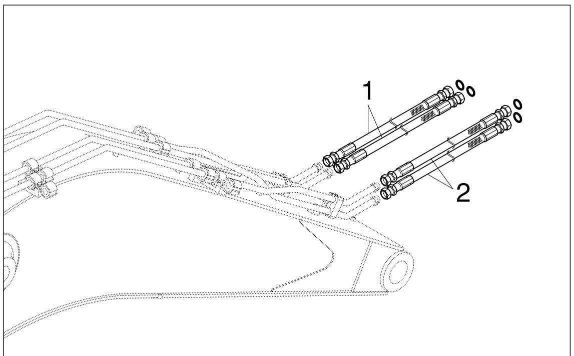
8-176(1)

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.

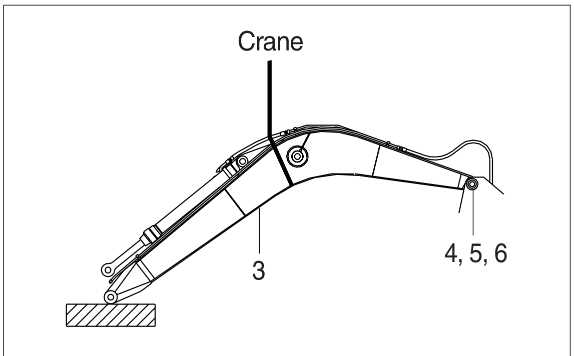
⑤ Sling boom assembly (3).



145WF8DA45

⑥ Remove bolt (4), plate (5) and pull out the pin (6) then remove boom assembly.
· Weight : 1020 ㎏ (2250 ℔)

※ When lifting the boom assembly always lift the center of gravity.



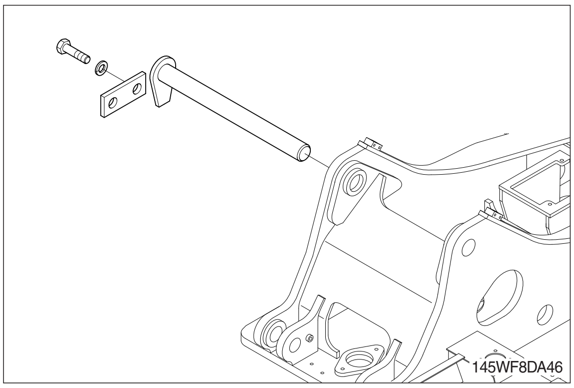
8-176(3)

(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.



145WF8DA46