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1. STRUCTURE

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

SECTION 1 GENERAL
This section explains the safety hints and gives the specification of the machine and major components.

SECTION 2 STRUCTURE AND FUNCTION
This section explains the structure and function of each component. It serves not only to give an understanding of the structure, but also serves as reference material for troubleshooting.

SECTION 3 HYDRAULIC SYSTEM
This section explains the hydraulic circuit, single and combined operation.

SECTION 4 ELECTRICAL SYSTEM
This section explains the electrical circuit, monitoring system and each component. It serves not only to give an understanding electrical system, but also serves as reference material for trouble shooting.

SECTION 5 MECHATRONICS SYSTEM
This section explains the computer aided power optimization system and each component.

SECTION 6 TROUBLESHOOTING
This section explains the troubleshooting charts correlating problems to causes.

SECTION 7 MAINTENANCE STANDARD
This section gives the judgement standards when inspecting disassembled parts.

SECTION 8 DISASSEMBLY AND ASSEMBLY
This section explains the order to be followed when removing, installing, disassembling or assembling each component, as well as precautions to be taken for these operations.

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

2. HOW TO READ THE SERVICE MANUAL

Distribution and updating

Any additions, amendments or other changes will be sent to HD Hyundai Construction Equipment distributors.

Get the most up-to-date information before you start any work.

Filing method

1. See the page number on the bottom of the page.
   File the pages in correct order.
2. Following examples shows how to read the page number.
   Example 1
   2 - 3
   Item number (2. Structure and Function)
   Consecutive page number for each item.
3. Additional pages : Additional pages are indicated by a hyphen (-) and number after the page number. File as in the example.
   8 - 4
   8 - 4 - 1
   8 - 4 - 2 Added pages
   8 - 5

Revised edition mark (①②③…)

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

Revisions

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

Symbols

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

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

3. CONVERSION TABLE

Method of using the Conversion Table

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

Example

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

   Convert 55 mm into inches.

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

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

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

2. Convert 550 mm into inches.

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

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

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

Millimeters to inches ⓑ

1 mm = 0.03937 in

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

Millimeters to inches

1mm = 0.03937in

	0	1	2	3	4	5	6	7	8	9
0		0.039	0.079	0.118	0.157	0.197	0.236	0.276	0.315	0.354
10	0.394	0.433	0.472	0.512	0.551	0.591	0.630	0.669	0.709	0.748
20	0.787	0.827	0.866	0.906	0.945	0.984	1.024	1.063	1.102	1.142
30	1.181	1.220	1.260	1.299	1.339	1.378	1.417	1.457	1.496	1.536
40	1.575	1.614	1.654	1.693	1.732	1.772	1.811	1.850	1.890	1.929
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80	3.150	3.189	3.228	3.268	3.307	3.346	3.386	3.425	3.465	3.504
90	3.543	3.583	3.622	3.661	3.701	3.740	3.780	3.819	3.858	3.898

Kilogram to Pound

1kg = 2.2046lb

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

Liter to U.S. Gallon

1 ℓ = 0.2642 U.S.Gal

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

Liter to U.K. Gallon

1 ℓ = 0.21997 U.K.Gal

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

kgf · m to lbf · ft

1kgf · m = 7.233lbf · ft

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

kgf/cm² to lbf/in²

1kgf / cm² = 14.2233lbf / in²

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

TEMPERATURE

Fahrenheit-Centigrade Conversion.

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

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

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

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

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

SECTION 1 GENERAL

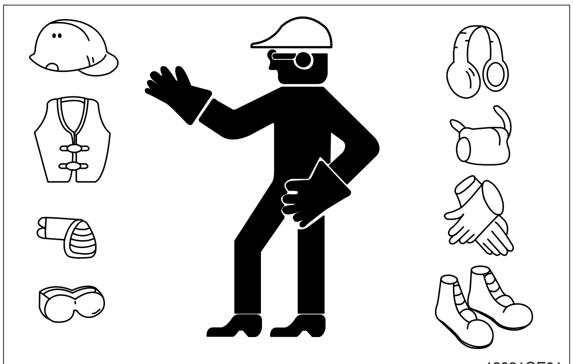
GROUP 1 SAFETY

FOLLOW SAFE PROCEDURE

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

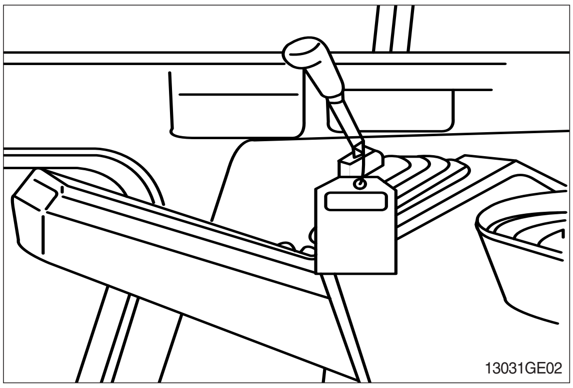
WEAR PROTECTIVE CLOTHING

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


13031GE01

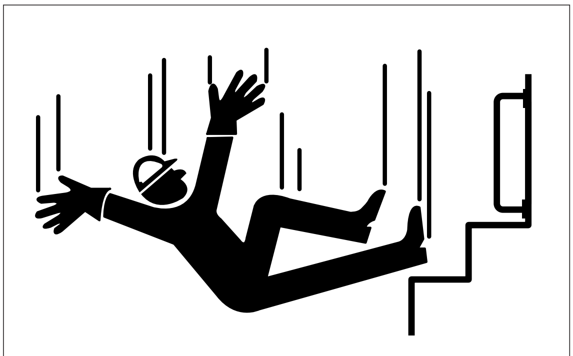
WARN OTHERS OF SERVICE WORK

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


13031GE02

USE HANDHOLDS AND STEPS

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

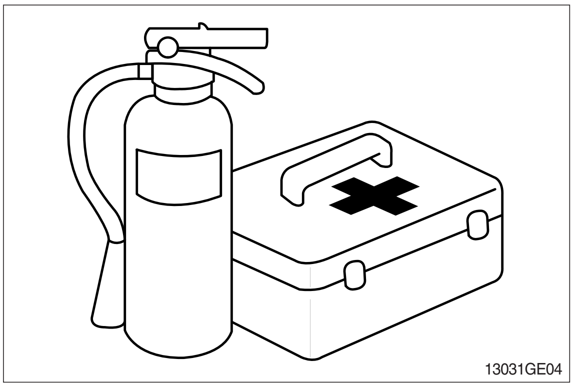

13031GE03

PREPARE FOR EMERGENCIES

Be prepared if a fire starts.

Keep a first aid kit and fire extinguisher handy.

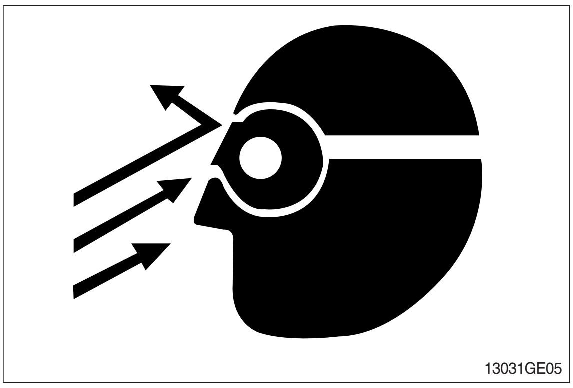
Keep emergency numbers for doctors, ambulance service, hospital, and fire department near your telephone.



13031GE04

PROTECT AGAINST FLYING DEBRIS

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

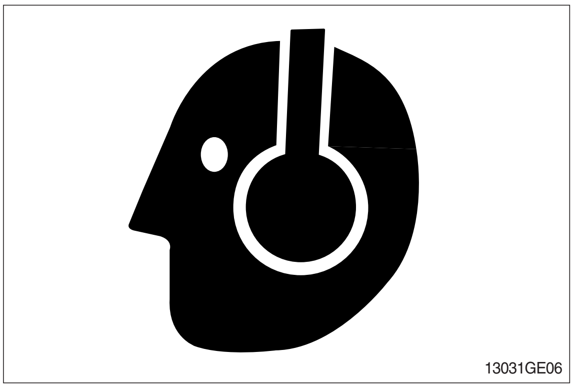


13031GE05

PROTECT AGAINST NOISE

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

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

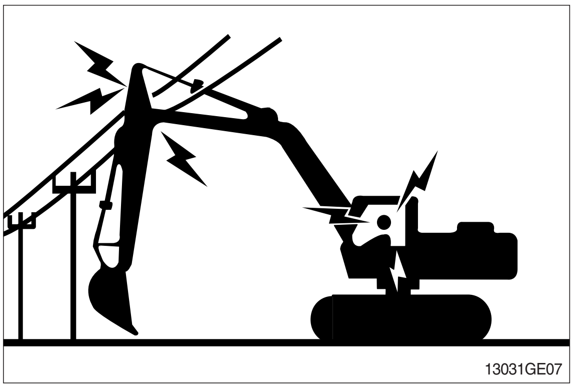


13031GE06

AVOID POWER LINES

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

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

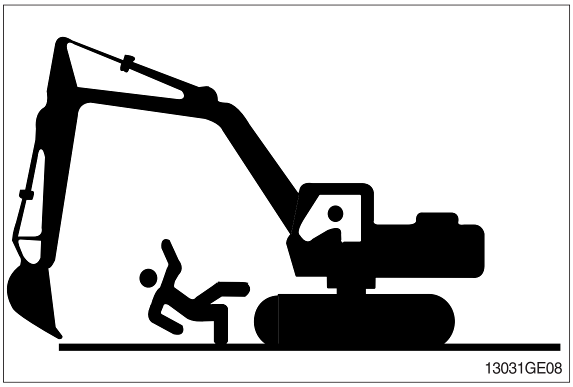


13031GE07

KEEP RIDERS OFF EXCAVATOR

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

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



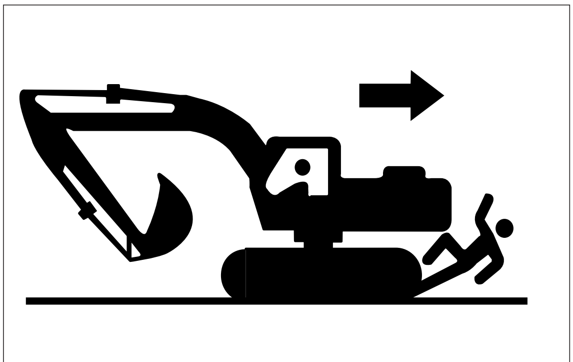
13031GE08

MOVE AND OPERATE MACHINE SAFELY

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

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

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



13031GE09

OPERATE ONLY FORM OPERATOR'S SEAT

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

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

13031GE26

PARK MACHINE SAFELY

Before working on the machine:

· Park machine on a level surface.
· Lower bucket to the ground.
· Turn auto idle switch off.
· Run engine at low idle speed without load for 5 minutes.
· Turn key switch to OFF to stop engine. Remove key from switch.
· Place safety lever to locked position.
· Allow engine to cool.

SUPPORT MACHINE PROPERLY

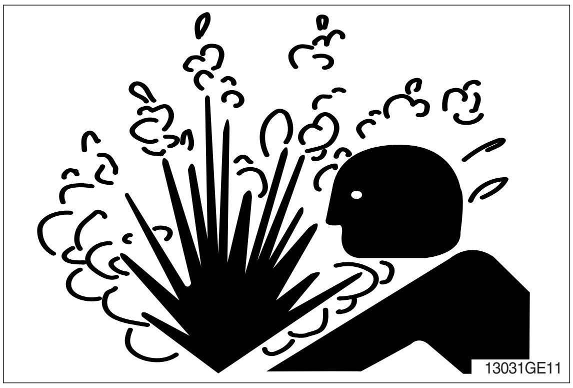
Always lower the attachment or implement to the ground before you work on the machine. If you must work on a lifted machine or attachment, securely support the machine or attachment.

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

SERVICE COOLING SYSTEM SAFELY

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

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



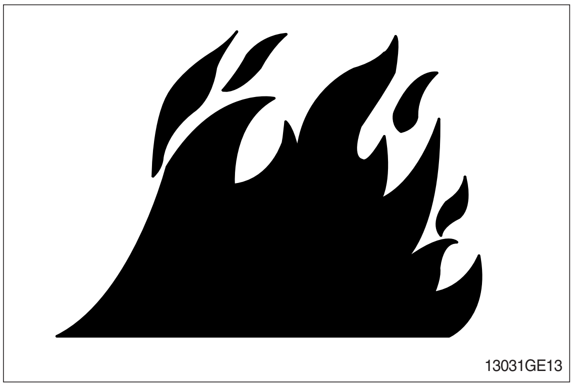
HANDLE FLUIDS SAFELY-AVOID FIRES

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

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

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

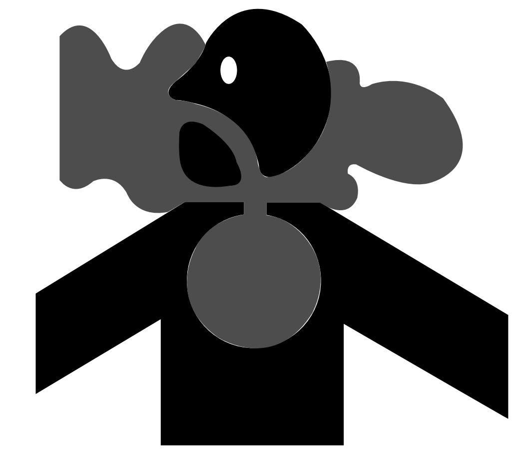
Do not store oily rags; They can ignite and burn spontaneously.



BEWARE OF EXHAUST FUMES

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

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



13031GE14

REMOVE PAINT BEFORE WELDING OR HEATING

Avoid potentially toxic fumes and dust.

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

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

Remove paint before welding or heating:

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

ILLUMINATE WORK AREA SAFELY

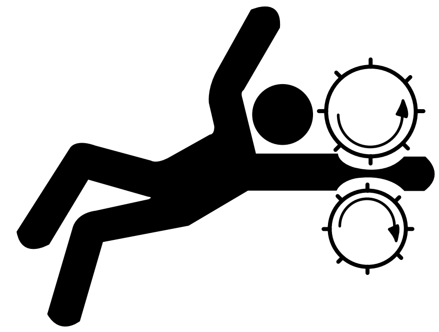
Illuminate your work area adequately but safely. Use a portable safety light for working inside or under the machine. Make sure the bulb is enclosed by a wire cage. The hot filament of an accidentally broken bulb can ignite spilled fuel or oil.

13031GE15

SERVICE MACHINE SAFELY

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

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

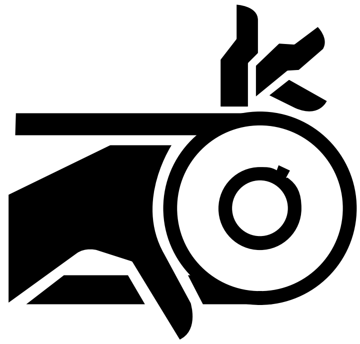


13031GE16

STAY CLEAR OF MOVING PARTS

Entanglements in moving parts can cause serious injury.

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



13031GE17

AVOID HIGH PRESSURE FLUIDS

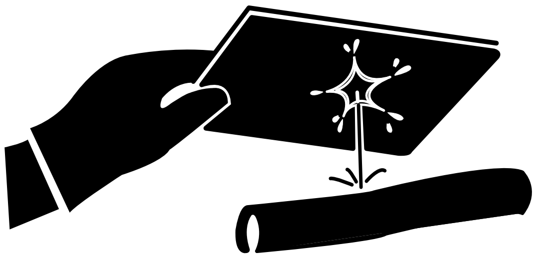
Escaping fluid under pressure can penetrate the skin causing serious injury.

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

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

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

13031GE18



13031GE19

AVOID HEATING NEAR PRESSURIZED FLUID LINES

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

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

13031GE20

PREVENT BATTERY EXPLOSIONS

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

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

Do not charge a frozen battery; It may explode. Warm battery to 16 ℃ (60 ℉).

13031GE21

PREVENT ACID BURNS

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

Avoid the hazard by:

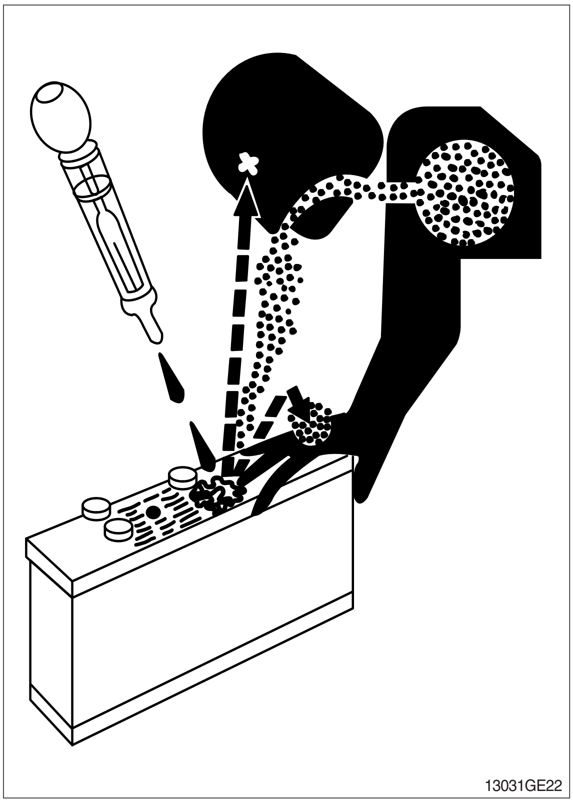
1. Filling batteries in a well-ventilated area.
2. Wearing eye protection and rubber gloves.
3. Avoiding breathing fumes when electrolyte is added.
4. Avoiding spilling of dripping electrolyte.
5. Use proper jump start procedure.

If you spill acid on yourself:

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

If acid is swallowed:

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



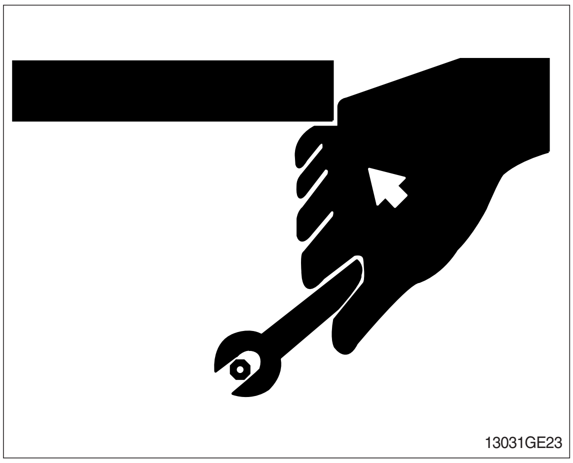
USE TOOLS PROPERLY

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

Use power tools only to loosen threaded tools and fasteners.

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

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

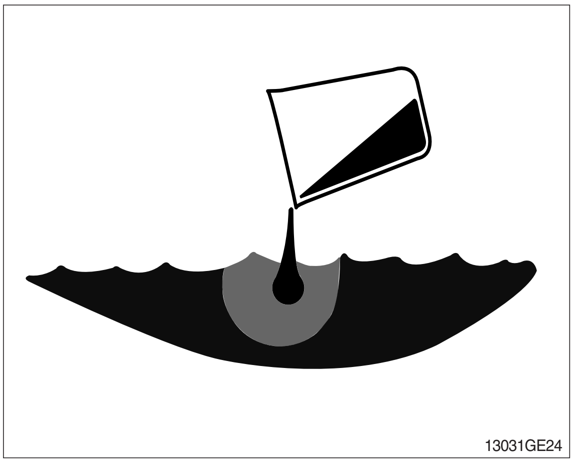


DISPOSE OF FLUIDS PROPERLY

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

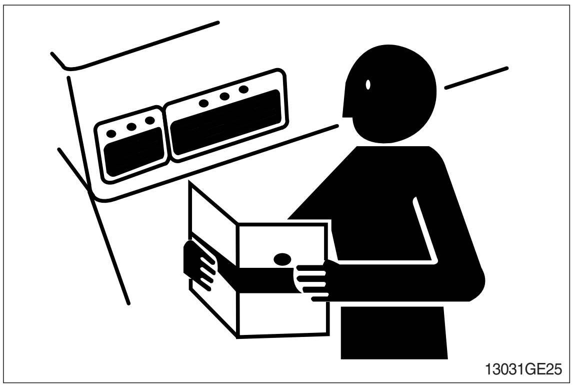
Use proper containers when draining fluids. Do not use food or beverage containers that may mislead someone into drinking from them.

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



REPLACE SAFETY LABELS

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

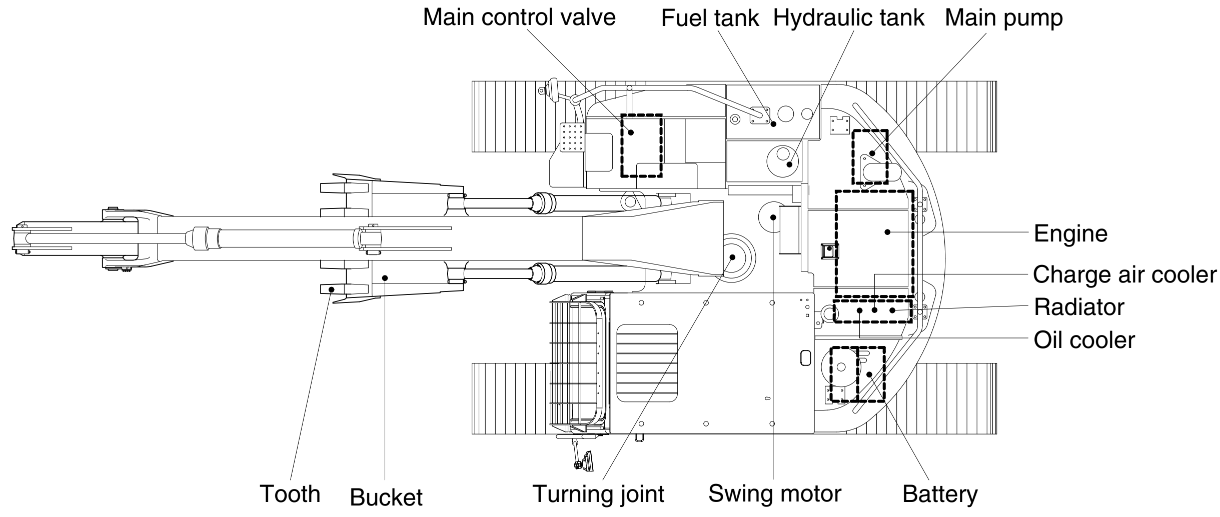


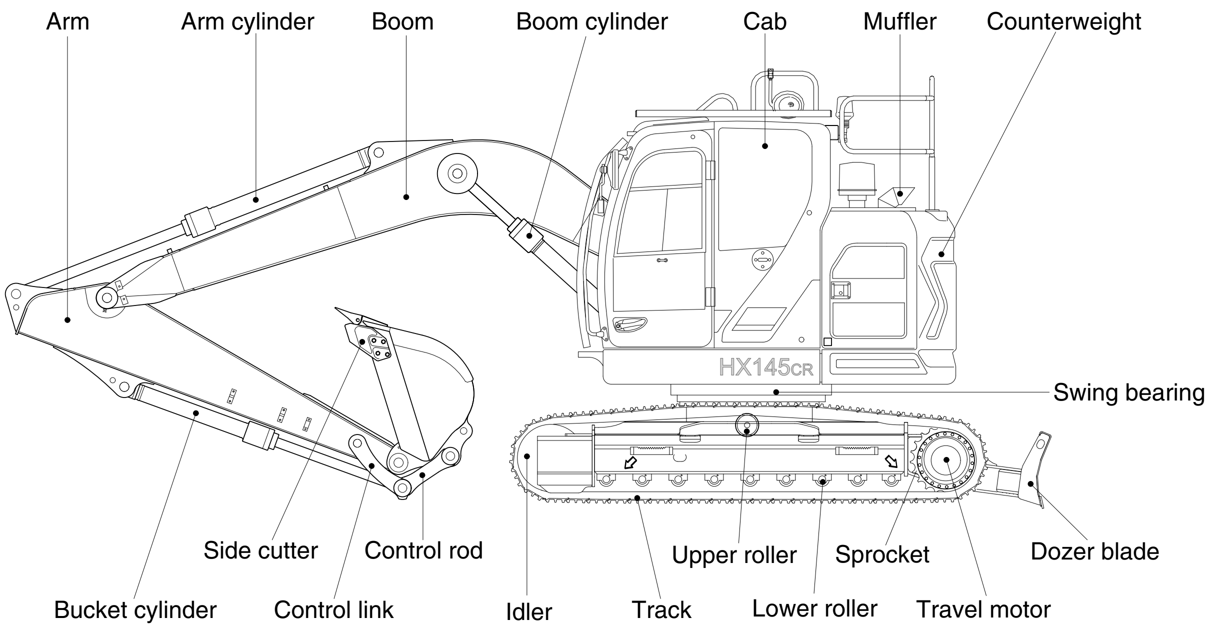
LIVE WITH SAFETY

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

GROUP 2 SPECIFICTIONS

1. MAJOR COMPONENT

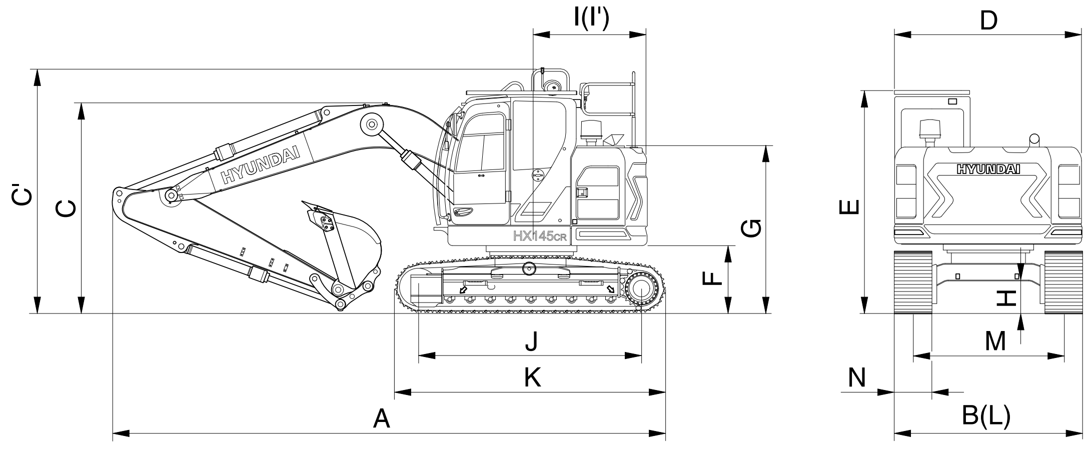




145SA2SP01

2. SPECIFICATIONS

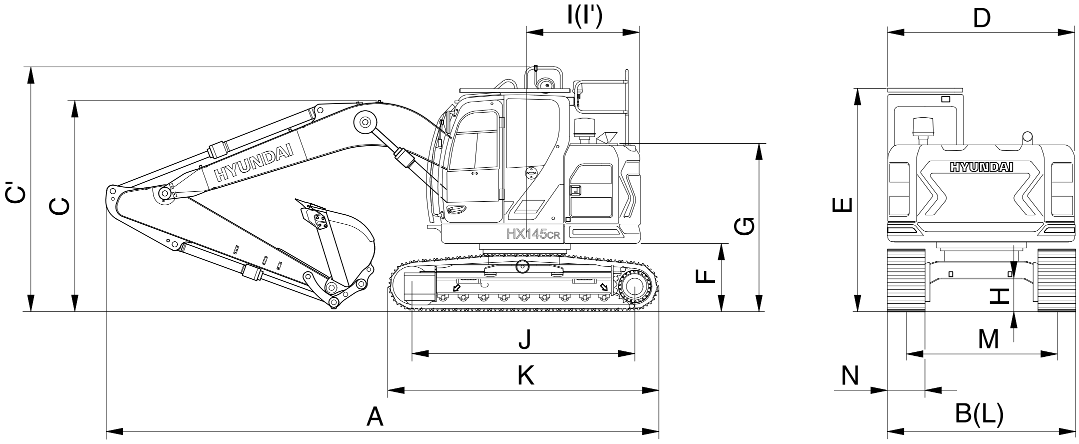
1) HX145CRT3, STD CRAWER



145SA2SP02

Description		Unit		Specification	
		m (ft-in)	Boom	4.60 (15' 1")	
			Arm	2.50 (8' 2")	3.00 (9' 10")
		mm (in)	Shoe	600 (24")	
Operating weight		kg (lb)		14880 (32800)	14,930 (32910)
Bucket capacity (SAE heaped), standard		m^3 (yd^3)		0.52 (0.68)	0.52 (0.68)
Overall length	A	mm (ft-in)		7320 (24' 0")	7435 (24' 5")
Overall width	B			2600 (8' 6")	2600 (8' 6")
Overall height of boom	C			2730 (8' 11")	3165 (10' 5")
Superstructure width	D			2485 (8' 2")	2485 (8' 2")
Overall height of cab	E			2810 (9' 3")	2810 (9' 3")
Ground clearance of counterweight	F			915 (3' 0")	915 (3' 0")
Overall height of engine hood	G			2270 (7' 5")	2270 (7' 5")
Overall height of handrail	G'			3430 (11' 3")	3430 (11' 3")
Minimum ground clearance	H			425 (1' 5")	425 (1' 5")
Rear-end distance	I			1500 (4' 11")	1500 (4' 11")
Rear-end swing radius	I'			1500 (4' 11")	1500 (4' 11")
Distance between tumblers	J			2950 (9' 8")	2950 (9' 8")
Undercarriage length	K			3620 (11' 11")	3620 (11' 11")
Undercarriage width	L			2600 (8' 6")	2600 (8' 6")
Track gauge	M			2000 (6' 7")	2000 (6' 7")
Track shoe width, standard	N			600 (2' 0")	600 (2' 0")
Travel speed (low/high)		km/hr (mph)		3.1/5.4 (1.9/3.4)	3.1/5.4 (1.9/3.4)
Swing speed		rpm		11.40	11.40
Gradeability		Degree (%)		35 (70)	35 (70)
Ground pressure		kgf/cm^2 (psi)		0.39 (5.59)	0.39 (5.61)
Max traction force		kg (lb)		12672 (27937)	12672 (27937)

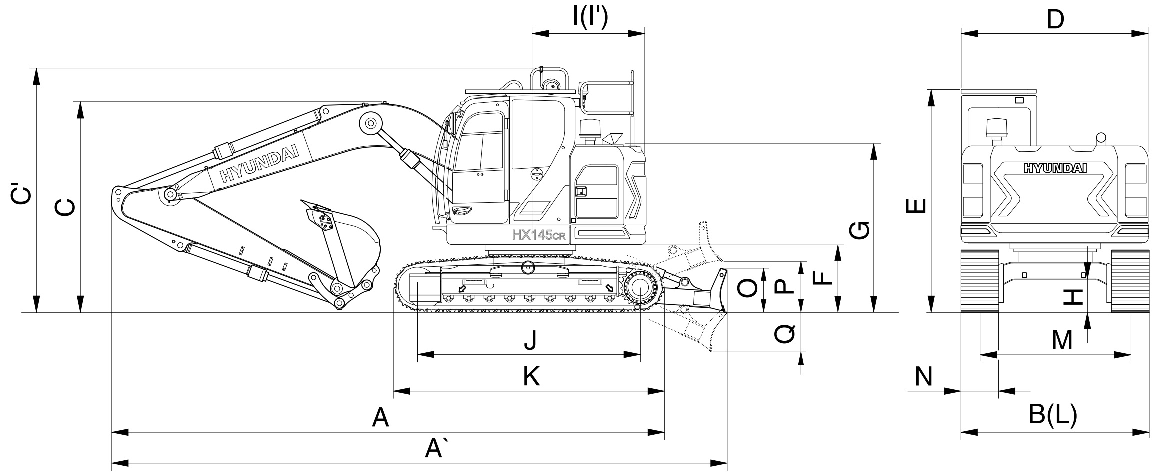
2) HX145LCRT3, LONG CRAWER



145SA2SP02

Description		Unit		Specification	
		m (ft-in)	Boom	4.60 (15' 1")	
			Arm	2.50 (8' 2")	3.00 (9' 10")
		mm (in)	Shoe	600 (24")	
Operating weight		kg (lb)		15130 (33360)	15170 (33440)
Bucket capacity (SAE heaped), standard		m^3 (yd^3)		0.52 (0.68)	0.52 (0.68)
Overall length	A	mm (ft-in)		7320 (24' 0")	7435 (24' 5")
Overall width	B			2600 (8' 6")	2600 (8' 6")
Overall height of boom	C			2730 (8' 11")	3165 (10' 5")
Superstructure width	D			2500 (8' 2")	2500 (8' 2")
Overall height of cab	E			2810 (9' 3")	2810 (9' 3")
Ground clearance of counterweight	F			915 (3' 0")	915 (3' 0")
Overall height of engine hood	G			2270 (7' 5")	2270 (7' 5")
Overall height of handrail	G'			3430 (11' 3")	3430 (11' 3")
Minimum ground clearance	H			425 (1' 5")	425 (1' 5")
Rear-end distance	I			1500 (4' 11")	1500 (4' 11")
Rear-end swing radius	I'			1500 (4' 11")	1500 (4' 11")
Distance between tumblers	J			3120 (10' 3")	3120 (10' 3")
Undercarriage length	K			3790 (12' 5")	3790 (12' 5")
Undercarriage width	L			2600 (8' 6")	2600 (8' 6")
Track gauge	M			2000 (6' 7")	2000 (6' 7")
Track shoe width, standard	N			600 (2' 0")	600 (2' 0")
Travel speed (low/high)		km/hr (mph)		3.1/5.4 (1.9/3.4)	3.1/5.4 (1.9/3.4)
Swing speed		rpm		11.40	11.40
Gradeability		Degree (%)		35 (70)	35 (70)
Ground pressure		kgf/cm^2 (psi)		0.38 (5.38)	0.38 (5.39)
Max traction force		kg (lb)		12672 (27937)	12672 (27937)

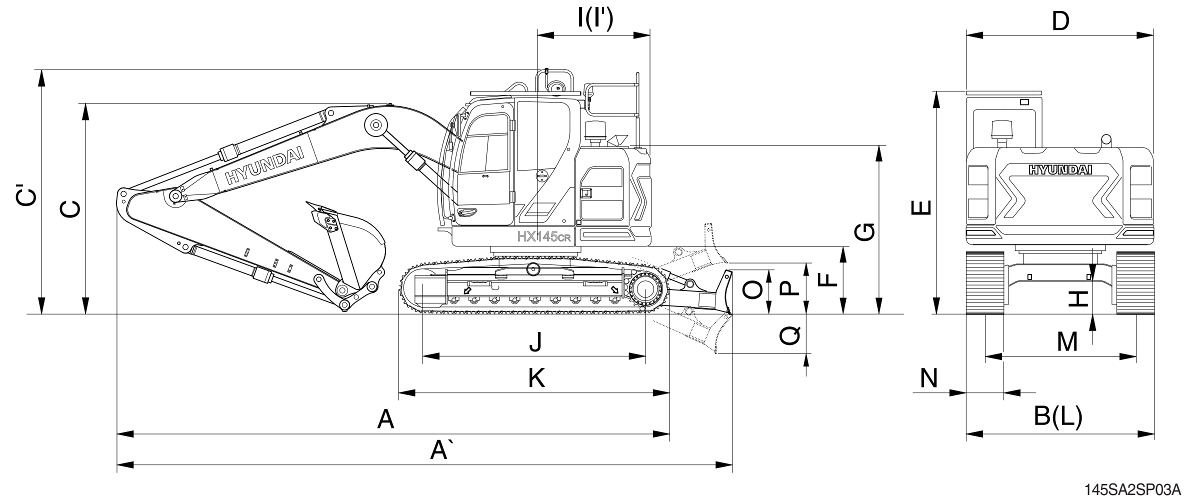
3) HX145CRT3, STD CRAWER WITH DOZER



145SA2SP03A

Description	Unit		Specification	
	m (ft-in)	Boom	4.60 (15' 1")	
		Arm	2.50 (8' 2")	3.00 (9' 10")
	mm (in)	Shoe	600 (24")	
Operating weight	kg (lb)		15700 (34610)	15740 (34700)
Bucket capacity (SAE heaped), standard	m^3 (yd^3)		0.52 (0.68)	0.52 (0.68)
Overall length	A	mm (ft-in)	7320 (24' 0")	7435 (24' 5")
Overall length (with dozer)	A'	mm (ft-in)	7755 (25' 5")	7870 (25' 10")
Overall width	B	mm (ft-in)	2600 (8' 6")	2600 (8' 6")
Overall height of boom	C	mm (ft-in)	2730 (8' 11")	3165 (10' 5")
Superstructure width	D	mm (ft-in)	2485 (8' 2")	2485 (8' 2")
Overall height of cab	E	mm (ft-in)	2810 (9' 3")	2810 (9' 3")
Ground clearance of counterweight	F	mm (ft-in)	915 (3' 0")	915 (3' 0")
Overall height of engine hood	G	mm (ft-in)	2270 (7' 5")	2270 (7' 5")
Overall height of handrail	G'	mm (ft-in)	3430 (11' 3")	3430 (11' 3")
Minimum ground clearance	H	mm (ft-in)	270 (0' 11")	270 (0' 11")
Rear-end distance	I	mm (ft-in)	1500 (4' 11")	1500 (4' 11")
Rear-end swing radius	I'	mm (ft-in)	1500 (4' 11")	1500 (4' 11")
Distance between tumblers	J	mm (ft-in)	2950 (9' 8")	2950 (9' 8")
Undercarriage length	K	mm (ft-in)	3620 (11' 11")	3620 (11' 11")
Undercarriage width	L	mm (ft-in)	2600 (8' 6")	2600 (8' 6")
Track gauge	M	mm (ft-in)	2000 (6' 7")	2000 (6' 7")
Track shoe width, standard	N	mm (ft-in)	600 (2' 0")	600 (2' 0")
Height of blade	O	mm (ft-in)	575 (1' 11")	575 (1' 11")
Ground clearance of blade up	P	mm (ft-in)	425 (1' 5")	425 (1' 5")
Depth of blade down	Q	mm (ft-in)	430 (1' 5")	430 (1' 5")
Travel speed (low/high)	km/hr (mph)		3.1/5.4 (1.9/3.4)	3.1/5.4 (1.9/3.4)
Swing speed	rpm		11.40	11.40
Gradeability	Degree (%)		35 (70)	35 (70)
Ground pressure	kgf/cm^2 (psi)		0.41 (5.90)	0.42 (5.91)
Max traction force	kg (lb)		12672 (27937)	12672 (27937)

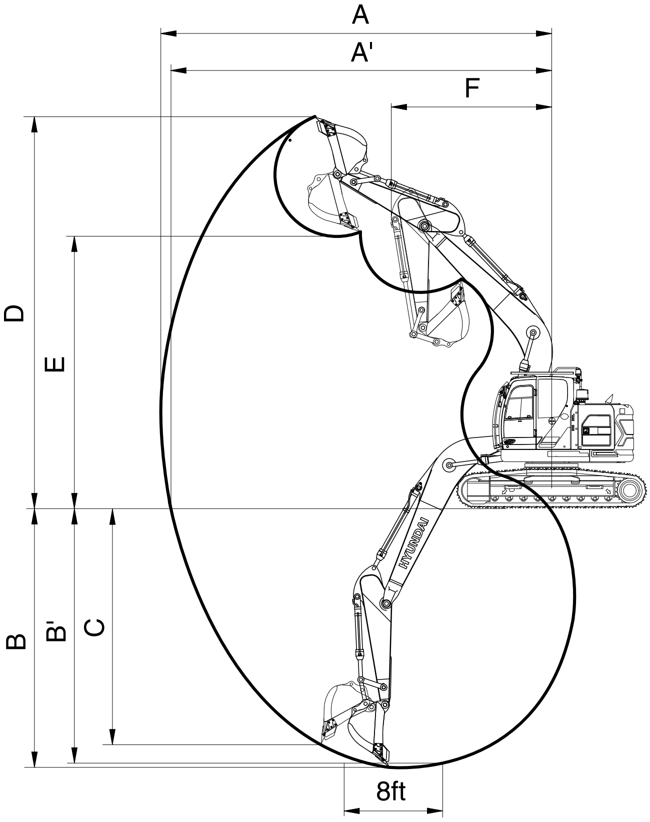
4) HX145LCRT3, LONG CRAWER WITH DOZER



Description		Unit		Specification	
		m (ft-in)	Boom	4.60 (15' 1")	
			Arm	2.50 (8' 2")	3.00 (9' 10")
		mm (in)	Shoe	600 (24")	
Operating weight		kg (lb)		15920 (35100)	15960 (35190)
Bucket capacity (SAE heaped), standard		m^3 (yd^3)		0.52 (0.68)	0.52 (0.68)
Overall length	A	mm (ft-in)		7320 (24' 0")	7435 (24' 5")
Overall length (with dozer)	A'			7755 (25' 5")	7870 (25' 10")
Overall width	B			2600 (8' 6")	2600 (8' 6")
Overall height of boom	C			2730 (8' 11")	3165 (10' 5")
Superstructure width	D			2485 (8' 2")	2485 (8' 2")
Overall height of cab	E			2810 (9' 3")	2810 (9' 3")
Ground clearance of counterweight	F			915 (3' 0")	915 (3' 0")
Overall height of engine hood	G			2270 (7' 5")	2270 (7' 5")
Overall height of handrail	G'			3430 (11' 3")	3430 (11' 3")
Minimum ground clearance	H			270 (0' 11")	270 (0' 11")
Rear-end distance	I			1500 (4' 11")	1500 (4' 11")
Rear-end swing radius	I'			1500 (4' 11")	1500 (4' 11")
Distance between tumblers	J			3120 (10' 3")	3120 (10' 3")
Undercarriage length	K			3790 (12' 5")	3790 (12' 5")
Undercarriage width	L			2600 (8' 6")	2600 (8' 6")
Track gauge	M			2000 (6' 7")	2000 (6' 7")
Track shoe width, standard	N			600 (2' 0")	600 (2' 0")
Height of blade	O			575 (1' 11")	575 (1' 11")
Ground clearance of blade up	P			425 (1' 5")	425 (1' 5")
Depth of blade down	Q			430 (1' 5")	430 (1' 5")
Travel speed (low/high)		km/hr (mph)		3.1/5.4 (1.9/3.4)	3.1/5.4 (1.9/3.4)
Swing speed		rpm		11.40	11.40
Gradeability		Degree (%)		35 (70)	35 (70)
Ground pressure		kgf/cm^2 (psi)		0.40 (5.66)	0.40 (5.67)
Max traction force		kg (lb)		12672 (27937)	12672 (27937)

3. WORKING RANGE AND DIGGING FORCE

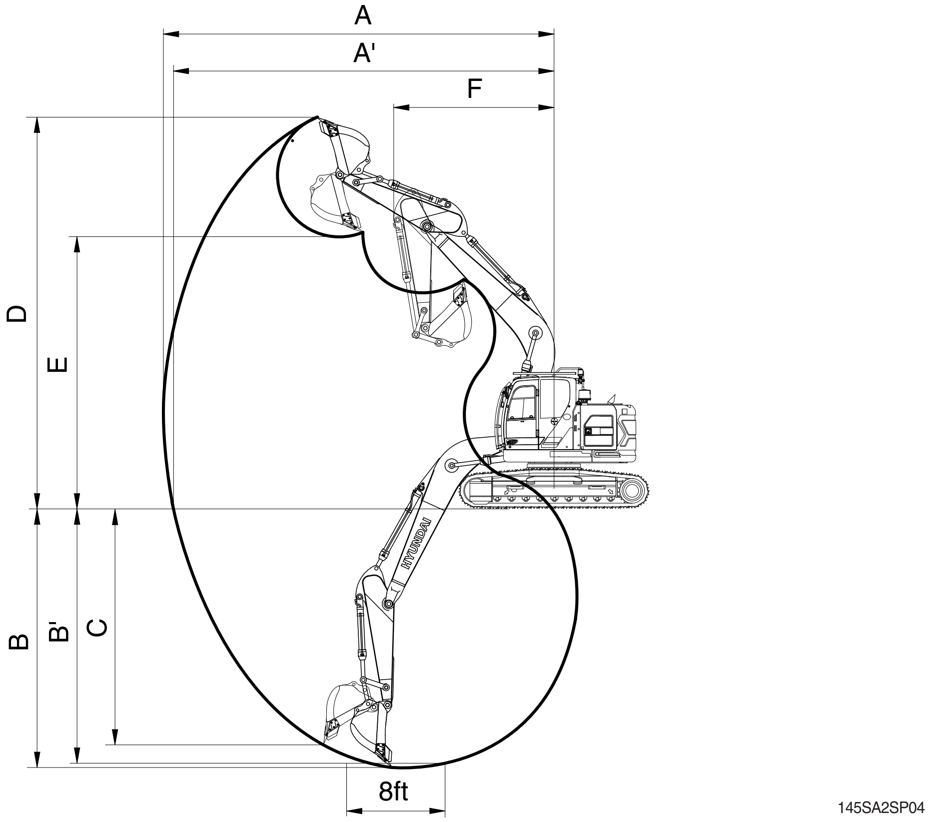
1) HX145CRT3, STD CRAWLER



Description	m (ft-in)	Boom	4.60 (15' 1")	
		Arm	2.50 (8' 2")	3.00 (9' 10")
Max digging reach	mm (ft-in)	A	8240 (27' 0")	8625 (28' 4")
Max digging reach on ground		A'	8100 (26' 7")	8490 (27' 10")
Max digging depth		B	5225 (17' 2")	5725 (18' 9")
Max digging depth (8 ft level)		B'	5020 (16' 6")	5540 (18' 2")
Max vertical wall digging depth		C	4725 (15' 6")	5000 (16' 5")
Max digging height		D	9205 (30' 2")	9395 (30' 10")
Max dumping height		E	6785 (22' 3")	7000 (23' 0")
Min swing radius		F	1990 (6' 6")	2305 (7' 7")
Bucket digging force	kN	SAE	94.3 [102.4]	94.3 [102.4]
	kgf		9620 [10440]	9620 [10440]
	lbf		21210 [23020]	21210 [23020]
	kN	ISO	111.4 [120.9]	111.4 [120.9]
	kgf		11360 [12330]	11360 [12330]
	lbf		25040 [27180]	25040 [27180]
Arm digging force	kN	SAE	62.0 [67.3]	57.0 [61.9]
	kgf		6320 [6860]	5810 [6310]
	lbf		13930 [15120]	12810 [13910]
	kN	ISO	64.6 [70.1]	59.0 [64.1]
	kgf		6590 [7150]	6020 [6540]
	lbf		14530 [15760]	13270 [14420]

[ ] : Power boost

2) HX145LCRT3, LONG CRAWLER



Description	m (ft-in)	Boom	4.60 (15' 1")	
		Arm	2.50 (8' 2")	3.00 (9' 10")
Max digging reach	mm (ft-in)	A	8240 (27' 0")	8625 (28' 4")
Max digging reach on ground		A'	8100 (26' 7")	8490 (27' 10")
Max digging depth		B	5225 (17' 2")	5725 (18' 9")
Max digging depth (8 ft level)		B'	5020 (16' 6")	5540 (18' 2")
Max vertical wall digging depth		C	4725 (15' 6")	5000 (16' 5")
Max digging height		D	9205 (30' 2")	9395 (30' 10")
Max dumping height		E	6785 (22' 3")	7000 (23' 0")
Min swing radius		F	1990 (6' 6")	2305 (7' 7")
Bucket digging force	kN	SAE	94.3 [102.4]	94.3 [102.4]
	kgf		9620 [10440]	9620 [10440]
	lbf		21210 [23020]	21210 [23020]
	kN	ISO	111.4 [120.9]	111.4 [120.9]
	kgf		11360 [12330]	11360 [12330]
	lbf		25040 [27180]	25040 [27180]
Arm digging force	kN	SAE	62.0 [67.3]	57.0 [61.9]
	kgf		6320 [6860]	5810 [6310]
	lbf		13930 [15120]	12810 [13910]
	kN	ISO	64.6 [70.1]	59.0 [64.1]
	kgf		6590 [7150]	6020 [6540]
	lbf		14530 [15760]	13270 [14420]

[ ] : Power boost

4. WEIGHT

1) HX145CRT3, STD CRAWLER

Item	HX145CRT3 W/O DOZER		HX145CRT3 W/DOZER	
	kg	lb	kg	lb
Upperstructure assembly	4,050	8,930	4,050	8,930
Main frame weld assembly	1,230	2,710	1,230	2,710
Engine assembly	370	820	370	820
Main pump assembly	88	190	88	190
Main control valve assembly	140	310	140	310
Swing motor assembly	122	270	120	260
Hydraulic oil tank WA	160	350	160	350
Fuel tank WA	150	330	150	330
Counterweight	2,800	6,170	2,800	6,170
Cab assembly	450	990	450	990
Lower chassis assembly	3,726	8,210	4,407	9,710
Track frame weld assembly	1,544	3,400	1,713	3,780
Swing bearing	214	470	214	470
Travel motor assembly (2EA)	278	610	280	620
Turning joint	60	130	60	130
Sprocket (2EA)	79	170	79	170
Track recoil spring (2EA)	189	420	189	420
Idler (2EA)	211	460	211	460
Upper roller (2EA)	38	80	38	80
Lower roller (14EA)	491	1,080	491	1,080
Dozer blade	-	-	510	1,120
Track-chain assembly (500 mm TRACK PAD shoe) (2EA)	1,124	2,480	1,124	2,480
Track-chain assembly (500 mm triple grouser shoe) (2EA)	902	1,990	902	1,990
Track-chain assembly (600 mm triple grouser shoe) (2EA)	1,004	2,210	1,004	2,210
Track-chain assembly (700 mm triple grouser shoe) (2EA)	1,107	2,440	1,107	2,440
Front attachment assembly	2,480	5,470	2,480	5,470
4.6 m boom assembly	834	1,840	810	1,790
2.5 m arm assembly	446	980	440	970
0.58 m³ SAE heaped bucket	468	1,030	450	990
Boom cylinder assembly (2EA)	240	530	240	530
Arm cylinder assembly	150	330	150	330
Bucket cylinder assembly	100	220	100	220
Bucket control linkage total	115	250	110	240

2) HX145LCRT3, LONG CRAWLER

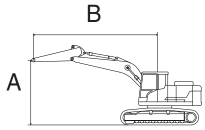
Item	HX145LCRT3 W/O DOZER		HX145LCRT3 W/DOZER	
	kg	lb	kg	lb
Upperstructure assembly	4,050	8,930	4,050	8,930
Main frame weld assembly	1,230	2,710	1,230	2,710
Engine assembly	370	820	370	820
Main pump assembly	88	190	88	190
Main control valve assembly	140	310	140	310
Swing motor assembly	120	260	120	260
Hydraulic oil tank WA	160	350	160	350
Fuel tank WA	150	330	150	330
Counterweight	2,800	6,170	2,800	6,170
Cab assembly	450	990	450	990
Lower chassis assembly	3,868	8,530	4,543	10,020
Track frame weld assembly	1,606	3,540	1,771	3,900
Swing bearing	214	470	214	470
Travel motor assembly (2EA)	280	620	280	620
Turning joint	60	130	60	130
Sprocket (2EA)	79	170	79	170
Track recoil spring (2EA)	189	420	189	420
Idler (2EA)	211	460	211	460
Upper roller (2EA)	77	170	77	170
Lower roller (14EA)	491	1,080	491	1,080
Dozer blade	-	-	510	1,120
Track-chain assembly (500 mm RUBBER PAD shoe) (2EA)	930	2,050	930	2,050
Track-chain assembly (500 mm triple grouser shoe) (2EA)	942	2,080	942	2,080
Track-chain assembly (600 mm triple grouser shoe) (2EA)	1,049	2,310	1,049	2,310
Track-chain assembly (700 mm triple grouser shoe) (2EA)	1,156	2,550	1,156	2,550
Front attachment assembly	2,480	5,470	2,480	5,470
4.6 m boom assembly	810	1,790	810	1,790
2.5 m arm assembly	440	970	440	970
0.58 m³ SAE heaped bucket	450	990	450	990
Boom cylinder assembly (2EA)	240	530	240	530
Arm cylinder assembly	150	330	150	330
Bucket cylinder assembly	100	220	100	220
Bucket control linkage total	110	240	110	240

5. LIFTING CAPACITIES

1) HX145CRT3

Model	Type	Boom	Arm	Counterweight	Shoe	Wheel	Dozer		Outrigger	
		Length [mm]	Length [mm]	weight [kg]	width [mm]	width [mm]	Front	Rear	Front	Rear
HX145CRT3	MONO BOOM	4600	2500	2800	600	-	-	-	-	-

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

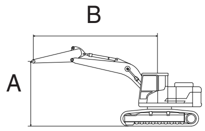


Lift-point height (A)		Lift-point radius (B)								At max. reach		
		1.5 m (4.9 ft)		3.0 m (9.8 ft)		4.5 m (14.8 ft)		6.0 m (19.7 ft)		Capacity		Reach
												m (ft)
7.5 m	kg			*3760	*3760					*2770	*2770	3.56
(24.6 ft)	lb			*8290	*8290					*6110	*6110	(11.7)
6.0 m	kg					*3650	*3650			*2180	*2180	5.37
(19.7 ft)	lb					*8050	*8050			*4810	*4810	(17.6)
4.5 m	kg			*4000	*4000	*4260	3720	*3100	2330	*2020	*2020	6.34
(14.8 ft)	lb			*8820	*8820	*9390	8200	*6830	5140	*4450	*4450	(20.8)
3.0 m	kg			*7400	6670	*5270	3530	3430	2270	*2010	1820	6.86
(9.8 ft)	lb			*16310	14700	*11620	7780	7560	5000	*4430	4010	(22.5)
1.5 m	kg			*8670	5980	5170	3300	3330	2170	*2120	1710	7.02
(4.9 ft)	lb			*19110	13180	11400	7280	7340	4780	*4670	3770	(23.0)
0.0 m	kg			*7060	5680	4980	3130	3250	2100	*2370	1740	6.85
(0.0 ft)	lb			*15560	12520	10980	6900	7170	4630	*5220	3840	(22.5)
-1.5 m	kg	*4940	*4940	*8670	5650	4910	3070	3220	2070	*2900	1940	6.32
(-4.9 ft)	lb	*10890	*10890	*19110	12460	10820	6770	7100	4560	*6390	4280	(20.7)
-3.0 m	kg			*6550	5760	*4580	3120			*3410	2490	5.33
(-9.8 ft)	lb			*14440	12700	*10100	6880			*7520	5490	(17.5)

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

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

Model	Type	Boom	Arm	Counterweight	Shoe	Wheel	Dozer		Outrigger	
HX145CRT3	MONO BOOM	Length [mm]	Length [mm]	weight [kg]	width [mm]	width [mm]	Front	Rear	Front	Rear
		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)		Capacity		Reach
												m (ft)
7.5 m	kg									*2450	*2450	4.28
(24.6 ft)	lb									*5400	*5400	(14.0)
6.0 m	kg					*3290	*3290			*2070	*2070	5.86
(19.7 ft)	lb					*7250	*7250			*4560	*4560	(19.2)
4.5 m	kg					*3580	*3580	*3180	2380	*1960	1930	6.76
(14.8 ft)	lb					*7890	*7890	*7010	5250	*4320	4250	(22.2)
3.0 m	kg			*5770	*5770	*4880	3600	3470	2300	*1980	1680	7.25
(9.8 ft)	lb			*12720	*12720	*10760	7940	7650	5070	*4370	3700	(23.8)
1.5 m	kg			*8900	6140	5220	3340	3350	2190	*2100	1580	7.40
(4.9 ft)	lb			*19620	13540	11510	7360	7390	4830	*4630	3480	(24.3)
0.0 m	kg			*8300	5700	4990	3140	3240	2090	*2360	1600	7.24
(0.0 ft)	lb			*18300	12570	11000	6920	7140	4610	*5200	3530	(23.7)
-1.5 m	kg	*4720	*4720	*9180	5590	4890	3040	3190	2040	2710	1750	6.74
(-4.9 ft)	lb	*10410	*10410	*20240	12320	10780	6700	7030	4500	5970	3860	(22.1)
-3.0 m	kg	*7780	*7780	*7460	5650	4900	3050			3360	2160	5.82
(-9.8 ft)	lb	*17150	*17150	*16450	12460	10800	6720			7410	4760	(19.1)

Note 1. Lifting capacity are based on ISO 10567.
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3. The Lift-point is bucket pivot mounting pin on the arm (without bucket mass).
4. *Indicates load limited by hydraulic capacity.

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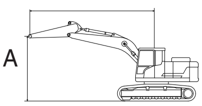
Lifting capacities will vary with different work tools, ground conditions and attachments.
The difference between the weight of a work tool attachment must be subtracted.
Consult your HD Hyundai Construction Equipment dealer regarding the lifting capacities for specific work tools and attachments.
Failure to comply to the rated load can cause possible personal injury or property damage.
Make adjustments to the rated load as necessory for non-standard configurations.

2) HX145LCRT3

Model	Type	Boom	Arm	Counterweight	Shoe	Wheel	Dozer		Outrigger	
HX145LCRT3	MONO BOOM	Length [mm]	Length [mm]	weight [kg]	width [mm]	width [mm]	Front	Rear	Front	Rear
		4600	2500	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)		Capacity		Reach
												m (ft)
7.5 m	kg			*3760	*3760					*2770	*2770	3.56
(24.6 ft)	lb			*8290	*8290					*6110	*6110	(11.7)
6.0 m	kg					*3650	*3650			*2180	*2180	5.37
(19.7 ft)	lb					*8050	*8050			*4810	*4810	(17.6)
4.5 m	kg			*4000	*4000	*4260	3760	*3100	2360	*2020	*2020	6.34
(14.8 ft)	lb			*8820	*8820	*9390	8290	*6830	5200	*4450	*4450	(20.8)
3.0 m	kg			*7400	6740	*5270	3570	3470	2300	*2010	1850	6.86
(9.8 ft)	lb			*16310	14860	*11620	7870	7650	5070	*4430	4080	(22.5)
1.5 m	kg			*8670	6050	5230	3340	3370	2200	*2120	1740	7.02
(4.9 ft)	lb			*19110	13340	11530	7360	7430	4850	*4670	3840	(23.0)
0.0 m	kg			*7060	5750	5040	3170	3280	2120	*2370	1770	6.85
(0.0 ft)	lb			*15560	12680	11110	6990	7230	4670	*5220	3900	(22.5)
-1.5 m	kg	*4940	*4940	*8670	5720	4970	3110	3260	2100	*2900	1970	6.32
(-4.9 ft)	lb	*10890	*10890	*19110	12610	10960	6860	7190	4630	*6390	4340	(20.7)
-3.0 m	kg			*6550	5830	*4580	3160			*3410	2530	5.33
(-9.8 ft)	lb			*14440	12850	*10100	6970			*7520	5580	(17.5)

Note 1. Lifting capacity are based on ISO 10567.
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3. The Lift-point is bucket pivot mounting pin on the arm (without bucket mass).
4. *Indicates load limited by hydraulic capacity.

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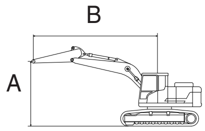
Lifting capacities will vary with different work tools, ground conditions and attachments.
The difference between the weight of a work tool attachment must be subtracted.
Consult your HD Hyundai Construction Equipment dealer regarding the lifting capacities for specific work tools and attachments.
Failure to comply to the rated load can cause possible personal injury or property damage.
Make adjustments to the rated load as necessory for non-standard configurations.

Model	Type	Boom	Arm	Counterweight	Shoe	Wheel	Dozer		Outrigger	
HX145LCRT3	MONO BOOM	Length [mm]	Length [mm]	weight [kg]	width [mm]	width [mm]	Front	Rear	Front	Rear
		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)		Capacity		Reach
												m (ft)
7.5 m	kg									*2450	*2450	4.28
(24.6 ft)	lb									*5400	*5400	(14.0)
6.0 m	kg					*3290	*3290			*2070	*2070	5.86
(19.7 ft)	lb					*7250	*7250			*4560	*4560	(19.2)
4.5 m	kg					*3580	*3580	*3180	2410	*1960	1950	6.76
(14.8 ft)	lb					*7890	*7890	*7010	5310	*4320	4300	(22.2)
3.0 m	kg			*5770	*5770	*4880	3640	3510	2330	*1980	1700	7.25
(9.8 ft)	lb			*12720	*12720	*10760	8020	7740	5140	*4370	3750	(23.8)
1.5 m	kg			*8900	6210	5280	3380	3390	2220	*2100	1600	7.40
(4.9 ft)	lb			*19620	13690	11640	7450	7470	4890	*4630	3530	(24.3)
0.0 m	kg			*8300	5770	5050	3180	3280	2120	*2360	1620	7.24
(0.0 ft)	lb			*18300	12720	11130	7010	7230	4670	*5200	3570	(23.7)
-1.5 m	kg	*4720	*4720	*9180	5660	4940	3080	3230	2070	2740	1770	6.74
(-4.9 ft)	lb	*10410	*10410	*20240	12480	10890	6790	7120	4560	6040	3900	(22.1)
-3.0 m	kg	*7780	*7780	*7460	5720	4950	3090			3400	2190	5.82
(-9.8 ft)	lb	*17150	*17150	*16450	12610	10910	6810			7500	4830	(19.1)

Note 1. Lifting capacity are based on ISO 10567.

2. Lifting capacity of the HX series does not exceed 75% of tipping load with the machine on firm, level ground or 87% of full hydraulic capacity.

3. The Lift-point is bucket pivot mounting pin on the arm (without bucket mass).

4. *Indicates load limited by hydraulic capacity.

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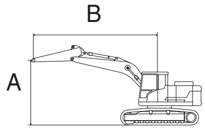
Lifting capacities will vary with different work tools, ground conditions and attachments.
The difference between the weight of a work tool attachment must be subtracted.
Consult your HD Hyundai Construction Equipment dealer regarding the lifting capacities for specific work tools and attachments.
Failure to comply to the rated load can cause possible personal injury or property damage.
Make adjustments to the rated load as necessory for non-standard configurations.

3) HX145CRT3, WITH DOZER

Model	Type	Boom	Arm	Counterweight	Shoe	Wheel	Dozer		Outrigger	
HX145CRT3 W/DOZER	MONO BOOM	Length [mm]	Length [mm]	weight [kg]	width [mm]	width [mm]	Front	Rear	Front	Rear
		4600	2500	2800	600	-	Down	-	-	-

· : 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)		Capacity		Reach
												m (ft)
7.5 m	kg			*3760	*3760					*2770	*2770	3.56
(24.6 ft)	lb			*8290	*8290					*6110	*6110	(11.7)
6.0 m	kg					*3650	*3650			*2180	*2180	5.37
(19.7 ft)	lb					*8050	*8050			*4810	*4810	(17.6)
4.5 m	kg			*4000	*4000	*4260	*4260	*3100	2720	*2020	*2020	6.34
(14.8 ft)	lb			*8820	*8820	*9390	*9390	*6830	6000	*4450	*4450	(20.8)
3.0 m	kg			*7400	*7400	*5270	4130	*4340	2660	*2010	*2010	6.86
(9.8 ft)	lb			*16310	*16310	*11620	9110	*9570	5860	*4430	*4430	(22.5)
1.5 m	kg			*8670	7180	*6050	3890	*4610	2560	*2120	2030	7.02
(4.9 ft)	lb			*19110	15830	*13340	8580	*10160	5640	*4670	4480	(23.0)
0.0 m	kg			*7060	6870	*6380	3720	*4670	2480	*2370	2070	6.85
(0.0 ft)	lb			*15560	15150	*14070	8200	*10300	5470	*5220	4560	(22.5)
-1.5 m	kg	*4940	*4940	*8670	6840	*5990	3660	*4200	2460	*2900	2300	6.32
(-4.9 ft)	lb	*10890	*10890	*19110	15080	*13210	8070	*9260	5420	*6390	5070	(20.7)
-3.0 m	kg			*6550	*6550	*4580	3710			*3410	2950	5.33
(-9.8 ft)	lb			*14440	*14440	*10100	8180			*7520	6500	(17.5)

Note 1. Lifting capacity are based on ISO 10567.
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3. The Lift-point is bucket pivot mounting pin on the arm (without bucket mass).
4. *Indicates load limited by hydraulic capacity.

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Lifting capacities will vary with different work tools, ground conditions and attachments.
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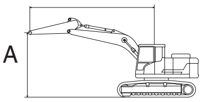
Consult your HD Hyundai Construction Equipment dealer regarding the lifting capacities for specific work tools and attachments.
Failure to comply to the rated load can cause possible personal injury or property damage.
Make adjustments to the rated load as necessory for non-standard configurations.

Model	Type	Boom	Arm	Counterweight	Shoe	Wheel	Dozer		Outrigger	
HX145CRT3 W/DOZER	MONO BOOM	Length [mm]	Length [mm]	weight [kg]	width [mm]	width [mm]	Front	Rear	Front	Rear
		4600	2500	2800	600	-	Up	-	-	-

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



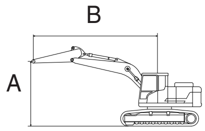
Lift-point height (A)		Lift-point radius (B)								At max. reach		
		1.5 m (4.9 ft)		3.0 m (9.8 ft)		4.5 m (14.8 ft)		6.0 m (19.7 ft)		Capacity		Reach
		Over-front	Over-side	Over-front	Over-side	Over-front	Over-side	Over-front	Over-side	Over-front	Over-side	m (ft)
7.5 m	kg			*3760	*3760					*2770	*2770	3.56
(24.6 ft)	lb			*8290	*8290					*6110	*6110	(11.7)
6.0 m	kg					*3650	*3650			*2180	*2180	5.37
(19.7 ft)	lb					*8050	*8050			*4810	*4810	(17.6)
4.5 m	kg			*4000	*4000	*4260	3910	*3100	2460	*2020	*2020	6.34
(14.8 ft)	lb			*8820	*8820	*9390	8620	*6830	5420	*4450	*4450	(20.8)
3.0 m	kg			*7400	6990	*5270	3710	3740	2400	*2010	1930	6.86
(9.8 ft)	lb			*16310	15410	*11620	8180	8250	5290	*4430	4250	(22.5)
1.5 m	kg			*8670	6300	5690	3480	3640	2300	*2120	1820	7.02
(4.9 ft)	lb			*19110	13890	12540	7670	8020	5070	*4670	4010	(23.0)
0.0 m	kg			*7060	6010	5500	3320	3550	2220	*2370	1850	6.85
(0.0 ft)	lb			*15560	13250	12130	7320	7830	4890	*5220	4080	(22.5)
-1.5 m	kg	*4940	*4940	*8670	5980	5430	3260	3530	2200	*2900	2060	6.32
(-4.9 ft)	lb	*10890	*10890	*19110	13180	11970	7190	7780	4850	*6390	4540	(20.7)
-3.0 m	kg			*6550	6080	*4580	3300			*3410	2640	5.33
(-9.8 ft)	lb			*14440	13400	*10100	7280			*7520	5820	(17.5)

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

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

Model	Type	Boom	Arm	Counterweight	Shoe	Wheel	Dozer		Outrigger	
HX145CRT3 W/DOZER	MONO BOOM	Length [mm]	Length [mm]	weight [kg]	width [mm]	width [mm]	Front	Rear	Front	Rear
		4600	3000	2800	600	-	Down	-	-	-

· : 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)		Capacity		Reach
												m (ft)
7.5 m	kg									*2450	*2450	4.28
(24.6 ft)	lb									*5400	*5400	(14.0)
6.0 m	kg					*3290	*3290			*2070	*2070	5.86
(19.7 ft)	lb					*7250	*7250			*4560	*4560	(19.2)
4.5 m	kg					*3580	*3580	*3180	2770	*1960	*1960	6.76
(14.8 ft)	lb					*7890	*7890	*7010	6110	*4320	*4320	(22.2)
3.0 m	kg			*5770	*5770	*4880	4200	*4010	2690	*1980	*1980	7.25
(9.8 ft)	lb			*12720	*12720	*10760	9260	*8840	5930	*4370	*4370	(23.8)
1.5 m	kg			*8900	7350	*5770	3940	*4460	2580	*2100	1870	7.40
(4.9 ft)	lb			*19620	16200	*12720	8690	*9830	5690	*4630	4120	(24.3)
0.0 m	kg			*8300	6890	*6300	3730	*4650	2480	*2360	1900	7.24
(0.0 ft)	lb			*18300	15190	*13890	8220	*10250	5470	*5200	4190	(23.7)
-1.5 m	kg	*4720	*4720	*9180	6780	*6170	3630	*4440	2430	*2870	2080	6.74
(-4.9 ft)	lb	*10410	*10410	*20240	14950	*13600	8000	*9790	5360	*6330	4590	(22.1)
-3.0 m	kg	*7780	*7780	*7460	6840	*5170	3640			*3520	2560	5.82
(-9.8 ft)	lb	*17150	*17150	*16450	15080	*11400	8020			*7760	5640	(19.1)

Note 1. Lifting capacity are based on ISO 10567.

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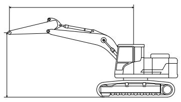
Failure to comply to the rated load can cause possible personal injury or property damage.
Make adjustments to the rated load as necessory for non-standard configurations.

Model	Type	Boom	Arm	Counterweight	Shoe	Wheel	Dozer		Outrigger	
HX145CRT3 W/DOZER	MONO BOOM	Length [mm]	Length [mm]	weight [kg]	width [mm]	width [mm]	Front	Rear	Front	Rear
		4600	3000	2800	600	-	Up	-	-	-

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

B

A



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)		Capacity		Reach
												m (ft)
7.5 m	kg									*2450	*2450	4.28
(24.6 ft)	lb									*5400	*5400	(14.0)
6.0 m	kg					*3290	*3290			*2070	*2070	5.86
(19.7 ft)	lb					*7250	*7250			*4560	*4560	(19.2)
4.5 m	kg					*3580	*3580	*3180	2510	*1960	*1960	6.76
(14.8 ft)	lb					*7890	*7890	*7010	5530	*4320	*4320	(22.2)
3.0 m	kg			*5770	*5770	*4880	3780	3780	2430	*1980	1780	7.25
(9.8 ft)	lb			*12720	*12720	*10760	8330	8330	5360	*4370	3920	(23.8)
1.5 m	kg			*8900	6460	5750	3530	3660	2320	*2100	1680	7.40
(4.9 ft)	lb			*19620	14240	12680	7780	8070	5110	*4630	3700	(24.3)
0.0 m	kg			*8300	6030	5510	3320	3550	2220	*2360	1700	7.24
(0.0 ft)	lb			*18300	13290	12150	7320	7830	4890	*5200	3750	(23.7)
-1.5 m	kg	*4720	*4720	*9180	5920	5400	3230	3500	2170	*2870	1860	6.74
(-4.9 ft)	lb	*10410	*10410	*20240	13050	11900	7120	7720	4780	*6330	4100	(22.1)
-3.0 m	kg	*7780	*7780	*7460	5980	*5170	3240			*3520	2290	5.82
(-9.8 ft)	lb	*17150	*17150	*16450	13180	*11400	7140			*7760	5050	(19.1)

Note 1. Lifting capacity are based on ISO 10567.
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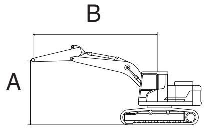
4. *Indicates load limited by hydraulic capacity.

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

4) HX145LCRT3, WITH DOZER

Model	Type	Boom	Arm	Counterweight	Shoe	Wheel	Dozer		Outrigger	
HX145LCRT3 W/DOZER	MONO BOOM	Length [mm]	Length [mm]	weight [kg]	width [mm]	width [mm]	Front	Rear	Front	Rear
		4600	2500	2800	600	-	Down	-	-	-

· : 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)		Capacity		Reach
												m (ft)
7.5 m	kg			*3760	*3760					*2770	*2770	3.56
(24.6 ft)	lb			*8290	*8290					*6110	*6110	(11.7)
6.0 m	kg					*3650	*3650			*2180	*2180	5.37
(19.7 ft)	lb					*8050	*8050			*4810	*4810	(17.6)
4.5 m	kg			*4000	*4000	*4260	*4260	*3100	2750	*2020	*2020	6.34
(14.8 ft)	lb			*8820	*8820	*9390	*9390	*6830	6060	*4450	*4450	(20.8)
3.0 m	kg			*7400	*7400	*5270	4170	*4340	2680	*2010	*2010	6.86
(9.8 ft)	lb			*16310	*16310	*11620	9190	*9570	5910	*4430	*4430	(22.5)
1.5 m	kg			*8670	7250	*6050	3930	*4610	2590	*2120	2050	7.02
(4.9 ft)	lb			*19110	15980	*13340	8660	*10160	5710	*4670	4520	(23.0)
0.0 m	kg			*7060	6950	*6380	3760	*4670	2510	*2370	2090	6.85
(0.0 ft)	lb			*15560	15320	*14070	8290	*10300	5530	*5220	4610	(22.5)
-1.5 m	kg	*4940	*4940	*8670	6910	*5990	3700	*4200	2490	*2900	2330	6.32
(-4.9 ft)	lb	*10890	*10890	*19110	15230	*13210	8160	*9260	5490	*6390	5140	(20.7)
-3.0 m	kg			*6550	*6550	*4580	3750			*3410	2980	5.33
(-9.8 ft)	lb			*14440	*14440	*10100	8270			*7520	6570	(17.5)

Note 1. Lifting capacity are based on ISO 10567.
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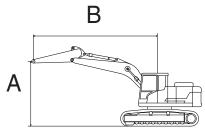
Consult your HD Hyundai Construction Equipment dealer regarding the lifting capacities for specific work tools and attachments.
Failure to comply to the rated load can cause possible personal injury or property damage.
Make adjustments to the rated load as necessory for non-standard configurations.

Model	Type	Boom	Arm	Counterweight	Shoe	Wheel	Dozer		Outrigger	
HX145LCRT3 W/DOZER	MONO BOOM	Length [mm]	Length [mm]	weight [kg]	width [mm]	width [mm]	Front	Rear	Front	Rear
		4600	2500	2800	600	-	Up	-	-	-

· : 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)		Capacity		Reach
												m (ft)
7.5 m	kg			*3760	*3760					*2770	*2770	3.56
(24.6 ft)	lb			*8290	*8290					*6110	*6110	(11.7)
6.0 m	kg					*3650	*3650			*2180	*2180	5.37
(19.7 ft)	lb					*8050	*8050			*4810	*4810	(17.6)
4.5 m	kg			*4000	*4000	*4260	3940	*3100	2480	*2020	*2020	6.34
(14.8 ft)	lb			*8820	*8820	*9390	8690	*6830	5470	*4450	*4450	(20.8)
3.0 m	kg			*7400	7060	*5270	3750	3780	2420	*2010	1950	6.86
(9.8 ft)	lb			*16310	15560	*11620	8270	8330	5340	*4430	4300	(22.5)
1.5 m	kg			*8670	6370	5750	3520	3670	2330	*2120	1840	7.02
(4.9 ft)	lb			*19110	14040	12680	7760	8090	5140	*4670	4060	(23.0)
0.0 m	kg			*7060	6070	5550	3350	3590	2250	*2370	1870	6.85
(0.0 ft)	lb			*15560	13380	12240	7390	7910	4960	*5220	4120	(22.5)
-1.5 m	kg	*4940	*4940	*8670	6040	5480	3290	3560	2230	*2900	2080	6.32
(-4.9 ft)	lb	*10890	*10890	*19110	13320	12080	7250	7850	4920	*6390	4590	(20.7)
-3.0 m	kg			*6550	6150	*4580	3340			*3410	2670	5.33
(-9.8 ft)	lb			*14440	13560	*10100	7360			*7520	5890	(17.5)

Note 1. Lifting capacity are based on ISO 10567.
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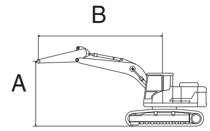
Failure to comply to the rated load can cause possible personal injury or property damage.
Make adjustments to the rated load as necessory for non-standard configurations.

Model	Type	Boom	Arm	Counterweight	Shoe	Wheel	Dozer		Outrigger	
HX145LCRT3 W/DOZER	MONO BOOM	Length [mm]	Length [mm]	weight [kg]	width [mm]	width [mm]	Front	Rear	Front	Rear
		4600	3000	2800	600	-	Down	-	-	-

· : 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)		Capacity		Reach
												m (ft)
7.5 m	kg									*2450	*2450	4.28
(24.6 ft)	lb									*5400	*5400	(14.0)
6.0 m	kg					*3290	*3290			*2070	*2070	5.86
(19.7 ft)	lb					*7250	*7250			*4560	*4560	(19.2)
4.5 m	kg					*3580	*3580	*3180	2800	*1960	*1960	6.76
(14.8 ft)	lb					*7890	*7890	*7010	6170	*4320	*4320	(22.2)
3.0 m	kg			*5770	*5770	*4880	4240	*4010	2720	*1980	*1980	7.25
(9.8 ft)	lb			*12720	*12720	*10760	9350	*8840	6000	*4370	*4370	(23.8)
1.5 m	kg			*8900	7420	*5770	3980	*4460	2600	*2100	1890	7.40
(4.9 ft)	lb			*19620	16360	*12720	8770	*9830	5730	*4630	4170	(24.3)
0.0 m	kg			*8300	6970	*6300	3770	*4650	2510	*2360	1920	7.24
(0.0 ft)	lb			*18300	15370	*13890	8310	*10250	5530	*5200	4230	(23.7)
-1.5 m	kg	*4720	*4720	*9180	6850	*6170	3670	*4440	2460	*2870	2100	6.74
(-4.9 ft)	lb	*10410	*10410	*20240	15100	*13600	8090	*9790	5420	*6330	4630	(22.1)
-3.0 m	kg	*7780	*7780	*7460	6910	*5170	3680			*3520	2590	5.82
(-9.8 ft)	lb	*17150	*17150	*16450	15230	*11400	8110			*7760	5710	(19.1)

Note 1. Lifting capacity are based on ISO 10567.
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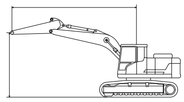
Make adjustments to the rated load as necessory for non-standard configurations.

Model	Type	Boom	Arm	Counterweight	Shoe	Wheel	Dozer		Outrigger	
HX145LCRT3 W/DOZER	MONO BOOM	Length [mm]	Length [mm]	weight [kg]	width [mm]	width [mm]	Front	Rear	Front	Rear
		4600	3000	2800	600	-	Up	-	-	-

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

B

A



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)		Capacity		Reach
		Over-front	Over-side	Over-front	Over-side	Over-front	Over-side	Over-front	Over-side	Over-front	Over-side	m (ft)
7.5 m	kg									*2450	*2450	4.28
(24.6 ft)	lb									*5400	*5400	(14.0)
6.0 m	kg					*3290	*3290			*2070	*2070	5.86
(19.7 ft)	lb					*7250	*7250			*4560	*4560	(19.2)
4.5 m	kg					*3580	*3580	*3180	2530	*1960	*1960	6.76
(14.8 ft)	lb					*7890	*7890	*7010	5580	*4320	*4320	(22.2)
3.0 m	kg			*5770	*5770	*4880	3820	3820	2450	*1980	1800	7.25
(9.8 ft)	lb			*12720	*12720	*10760	8420	8420	5400	*4370	3970	(23.8)
1.5 m	kg			*8900	6530	*5770	3560	3690	2340	*2100	1700	7.40
(4.9 ft)	lb			*19620	14400	*12720	7850	8140	5160	*4630	3750	(24.3)
0.0 m	kg			*8300	6090	5570	3360	3590	2240	*2360	1720	7.24
(0.0 ft)	lb			*18300	13430	12280	7410	7910	4940	*5200	3790	(23.7)
-1.5 m	kg	*4720	*4720	*9180	5980	5460	3260	3530	2200	*2870	1880	6.74
(-4.9 ft)	lb	*10410	*10410	*20240	13180	12040	7190	7780	4850	*6330	4140	(22.1)
-3.0 m	kg	*7780	*7780	*7460	6040	*5170	3270			*3520	2310	5.82
(-9.8 ft)	lb	*17150	*17150	*16450	13320	*11400	7210			*7760	5090	(19.1)

Note 1. Lifting capacity are based on ISO 10567.
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3. The Lift-point is bucket pivot mounting pin on the arm (without bucket mass).
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Make adjustments to the rated load as necessory for non-standard configurations.

6. BUCKET SELECTION GUIDE

1) BUCKET SELECTION

General bucket

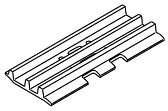
Type	Capacity		Width		Weight	Tooth	MONO Recommendation mm (ft-in)	
	SAE Heaped	CECE heaped	Without side cutter	With side cutter			4.6 m (15' 1") Boom	
	m^3 (yd^3)	m^3 (yd^3)	mm (in)	mm (in)	kg (lb)	EA	2.5 m (8' 2") Arm	3.0 m (9' 10") Arm
General bucket	0.51 (0.67)	0.45 (0.59)	865 (34.1')	995 (39.2')	395 (870)	5	◐	◐
	0.59 (0.77)	0.51 (0.67)	955 (37.6')	1085 (42.7')	415 (910)	5	■	■
	0.64 (0.84)	0.55 (0.72)	1040 (40.9")	1170 (46.1")	440 (970)	5	■	▲
	0.76 (0.99)	0.65 (0.85)	1215 (47.8")	1345 (53.0")	490 (1080)	6	▲	X

- ● 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

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

7. UNDERCARRIAGE

1) TYPES OF SHOES

Model	Shapes		Triple grouser		
					
-	Shoe width	mm (in)	500 (20)	600 (24)	700 (32)
HX145CRT3 STD CRAWLER WO DOZER	Operating weight	kg (lb)	14660 (32320)	14880 (32800)	15090 (33270)
	Ground pressure	kgf/cm^2 (psi)	0.46 (6.61)	0.39 (5.59)	0.34 (4.86)
	Overall width	mm (ft-in)	2500 (8' 2")	2600 (8' 6")	2700 (8' 10")
	Link quantity	EA	45	45	45
HX145LCRT3 LONG CRAWLER WO DOZER	Operating weight	kg (lb)	14900 (32850)	15130 (33360)	15350 (33840)
	Ground pressure	kgf/cm^2 (psi)	0.45 (6.36)	0.38 (5.38)	0.33 (4.68)
	Overall width	mm (ft-in)	2500 (8' 2")	2600 (8' 6")	2700 (8' 10")
	Link quantity	EA	47	47	47
HX145CRT3 STD CRAWLER WITH DOZER	Operating weight	kg (lb)	15470 (34110)	15700 (34610)	15910 (35080)
	Ground pressure	kgf/cm^2 (psi)	0.49 (6.98)	0.41 (5.90)	0.36 (5.12)
	Overall width	mm (ft-in)	2500 (8' 2")	2600 (8' 6")	2700 (8' 10")
	Link quantity	EA	45	45	45
HX145LCRT3 LONG CRAWLER WITH DOZER	Operating weight	kg (lb)	15680 (34570)	15920 (35100)	16150 (35600)
	Ground pressure	kgf/cm^2 (psi)	0.47 (6.69)	0.40 (5.66)	0.35 (4.92)
	Overall width	mm (ft-in)	2500 (8' 2")	2600 (8' 6")	2700 (8' 10")
	Link quantity	EA	47	47	47

2) SELECTION OF TRACK SHOE

Suitable track shoes should be selected according to operating conditions.

Method of selecting shoes

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

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

※ Table 1

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

※ Table 2

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

8. SPECIFICATIONS FOR MAJOR COMPONENTS

1) ENGINE

Item	Specification
Model	Cummins, QSB4.5
Type	4-cycle, turbocharged, charge air cooled, electronic controlled diesel engine
Cooling method	Water cooled
Number of cylinders and arrangement	4 cylinders, in-line
Firing order	1-3-4-2
Combustion chamber type	Direct injection type
Cylinder bore × stroke	107 × 124 mm (4.21" × 4.88")
Displacement	4.5 ℓ (275 cu in)
Compression ratio	17.2 : 1
Gross power	130 Hp (97 kW) at 2000 rpm
Net power	127 Hp (95 kW) at 2000 rpm
Max. power	135 Hp (101 kW) at 1800 rpm
Peak Torque	620 N · m (457 lbf · ft) at 1500 rpm
Engine oil quantity	11 ℓ (2.9 U.S. gal)
Wet weight	371 kg (818 lb)
Starter motor	24 V-4.8 kW
Alternator	24 V-70 A

2) MAIN PUMP

Item	Specification
Type	Variable displacement tandem axis piston pumps
Capacity	2 × 65 cc/rev
Maximum pressure	350 kgf/cm^2 (4980 psi) [380 kgf/cm^2 (5400 psi)]
Rated oil flow	2 × 120 ℓ/min (31.7 U.S. gpm/ 26.4 U.K. gpm)
Rated speed	1850 rpm

[ ] : Power boost

3) GEAR PUMP

Item	Specification
Type	Fixed displacement gear pump single stage
Capacity	15 cc/rev
Maximum pressure	40 kgf/cm^2 (570 psi)
Rated oil flow	27.8 ℓ/min (7.3 U.S. gpm/6.1 U.K. gpm)

4) MAIN CONTROL VALVE

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

[ ]: Power boost

5) SWING MOTOR

Item	Specification
Type	Fixed displacement axial piston motor
Capacity	72 cc/rev
Relief pressure	280 kgf/cm^2 (3983 psi)
Braking system	Automatic, spring applied hydraulic released
Braking torque	Minimum 36.8 kgf · m (266 lbf · ft)
Brake release pressure	24 kgf/cm^2 (341 psi)
Reduction gear type	2 - stage planetary

6) TRAVEL MOTOR

Item	Specification
Type	Variable displacement axial piston motor
Capacity	77/44.5 cc/rev
Relief pressure	350 kgf/cm^2 (4980 psi)
Reduction gear type	2-stage planetary
Braking system	Automatic, spring applied hydraulic released
Brake release pressure	12.5 kgf/cm^2 (178 psi)
Braking torque	33.1 kgf · m (240 lbf · ft)

7) CYLINDER

Item		Specification
Boom cylinder	Bore dia × Stroke	Ø105 × 1085 mm
	Cushion	Extend only
Arm cylinder	Bore dia × Stroke	Ø115 × 1108 mm
	Cushion	Extend and retract
Bucket cylinder	Bore dia × Stroke	Ø100 × 900 mm
	Cushion	Extend only
Dozer cylinder (opt)	Bore dia × Stroke	Ø100 × 250 mm
	Cushion	-

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

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

9. RECOMMENDED OILS

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

We recommend that you use only HD Hyundai Construction Equipment genuine lubricating oils and grease officially approved by HD Hyundai Construction Equipment.

Service point	Kind of fluid	Capacity ℓ (U.S. gal)	Ambient temperature °C (°F) -50 (-58), -30 (-22), -20 (-4), -10 (14), 0 (32), 10 (50), 20 (68), 30 (86), 40 (104)
Engine oil pan	Engine oil	11 (2.9)	★SAE 0W-30 SAE 5W-30 SAE 10W-30 SAE CI-4 and 10W-30 SAE 5W-40 or 15W-40
Swing drive	Gear oil	3.5 (0.9)	★SAE 75W-90
Final drive	Gear oil	2.3×2 (0.6×2)	SAE 80W-90
Hydraulic tank	Hydraulic oil	Tank : 96 (25.4) System : 180 (47.6)	★ISO VG 15 ISO VG 32 ISO VG 68
Fuel tank	Diesel fuel	210 (55.5)	★ASTM D975 NO.1 ASTM D975 NO.2
Fitting (grease nipple)	Grease	As required	★NLGI NO.1 NLGI NO.2
Radiator (reservoir tank)	Mixture of antifreeze and soft water★1	24 (6.3)	Ethylene glycol base permanent type (50 : 50) ★Ethylene glycol base permanent type (60 : 40)

SAE : Society of Automotive Engineers
API : American Petroleum Institute
ISO : International Organization for Standardization
NLGI : National Lubricating Grease Institute
ASTM : American Society of Testing and Material

★ : Cold region
Russia, CIS, Mongolia

★1 : Soft water
City water or distilled water

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

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

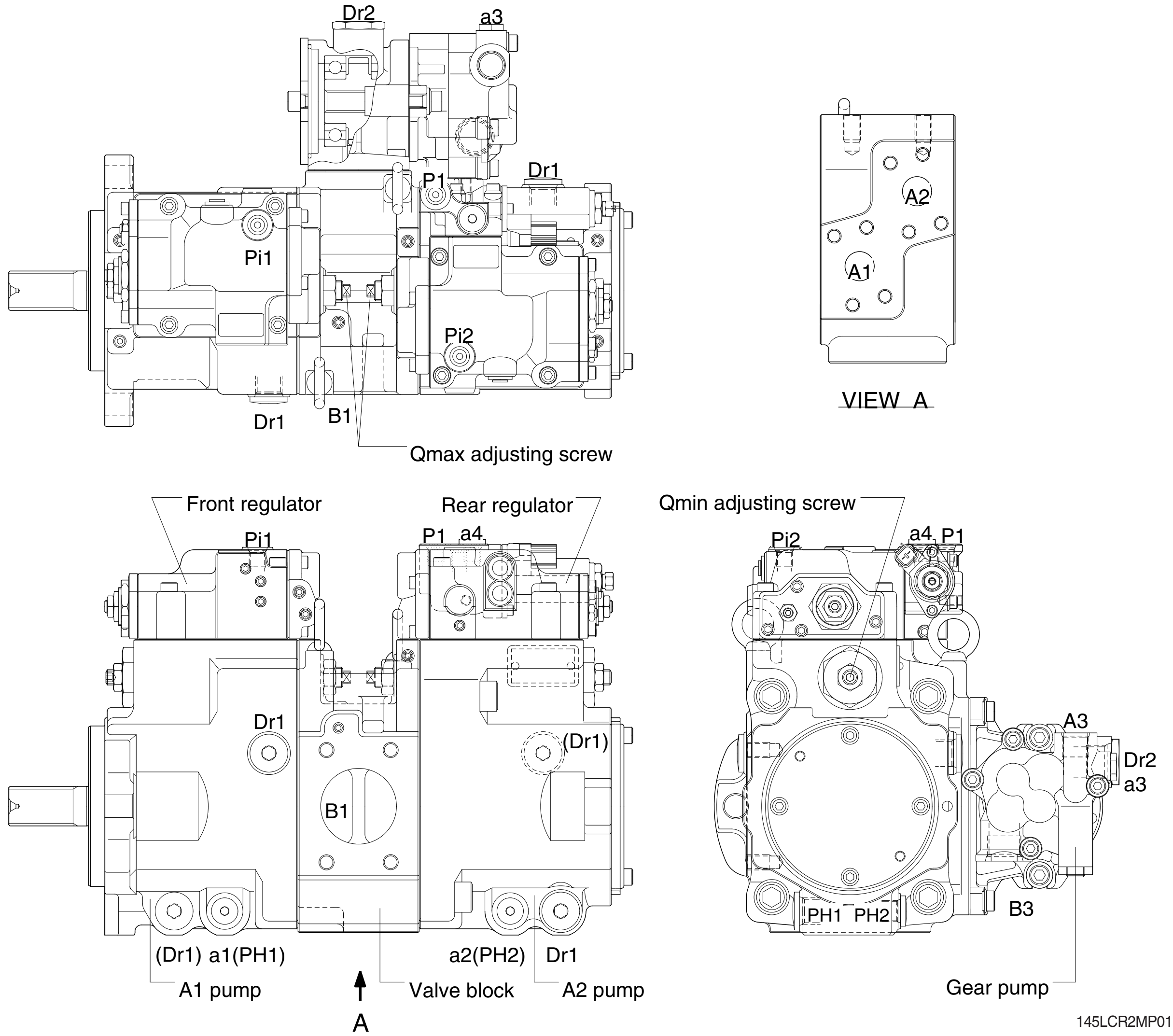
※ HD Hyundai Construction Equipment genuine lubricating oils and grease for use in regions with extremely low temperatures, please contact HD Hyundai Construction Equipment dealers.

SECTION 2 STRUCTURE AND FUNCTION

GROUP 1 PUMP DEVICE

1. STRUCTURE

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



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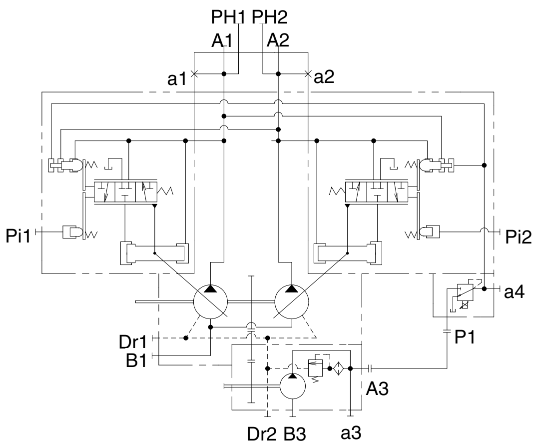
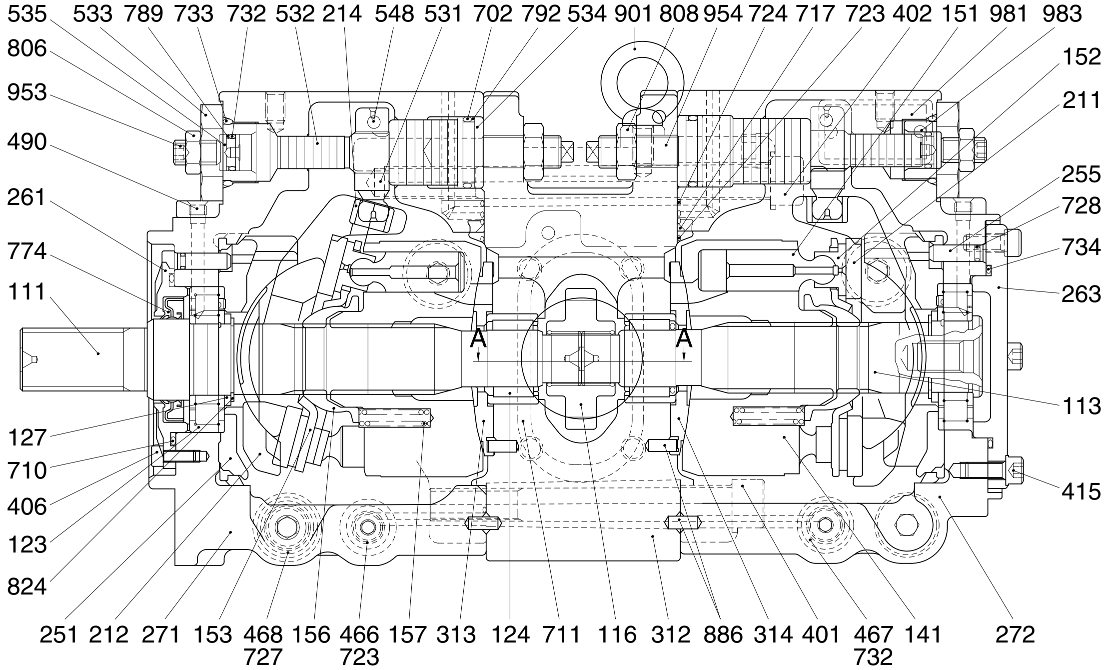


Hydraulic circuit

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)

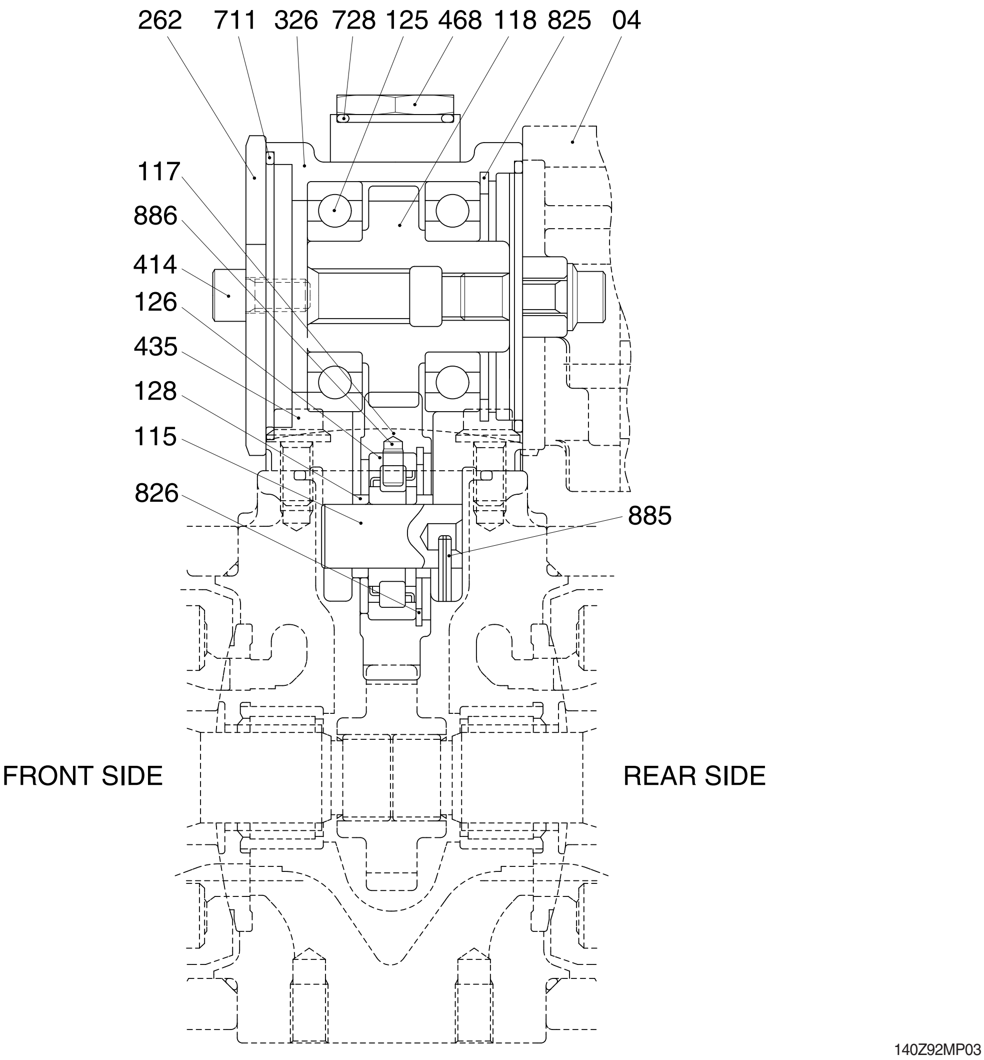
The main pump consists of two piston pumps (front & rear) and valve block.



140Z92MP02

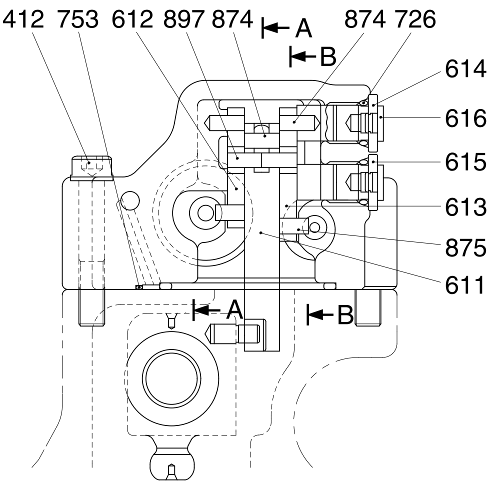
111	Drive shaft (F)	272	Pump casing (R)	711	O-ring
113	Drive shaft (R)	312	Valve block	717	O-ring
116	1st Gear	313	Valve plate (R)	723	O-ring
123	Roller bearing	314	Valve plate (L)	724	O-ring
124	Needle bearing	401	Hexagon socket bolt	728	O-ring
127	Bearing spacer	402	Hexagon socket bolt	732	O-ring
141	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

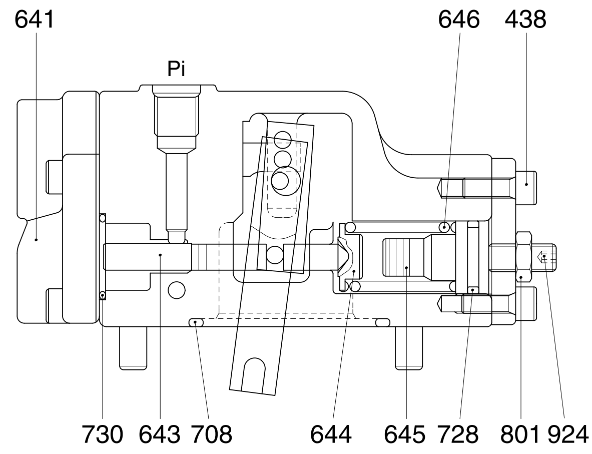
MAIN PUMP (2/2)



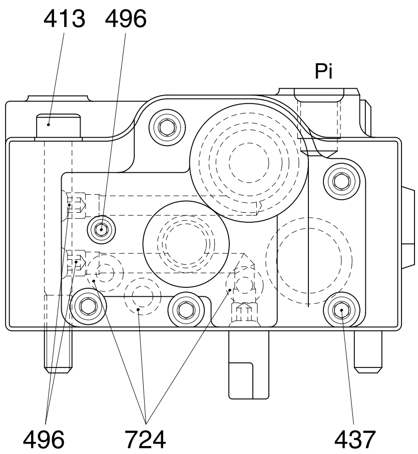
04	Gear pump	128	Bearing spacer	711	O-ring
115	Shaft	262	Cover	728	O-ring
117	Gear No. 2	326	Gear case	825	Retainer ring
118	Gear No. 3	414	Hexagon socket bolt	826	Retainer ring
125	Ball bearing	435	Flange socket bolt	885	Spring pin
126	Roller bearing	468	Plug	886	Pin

2) REGULATOR (1/2)

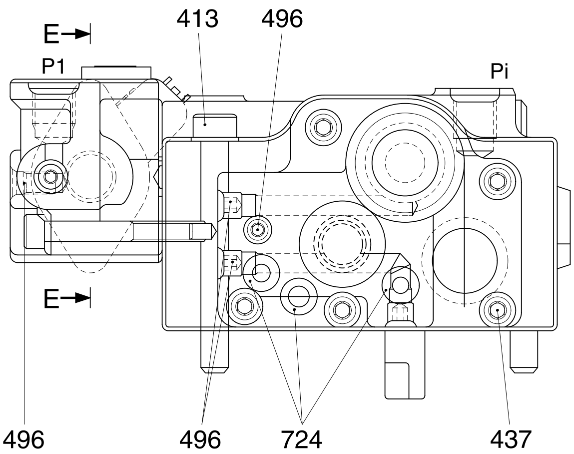




SECTION B-B

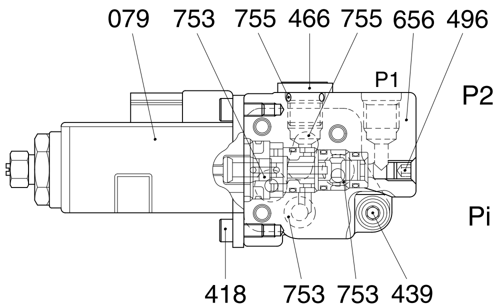


VIEW C (FRONT)

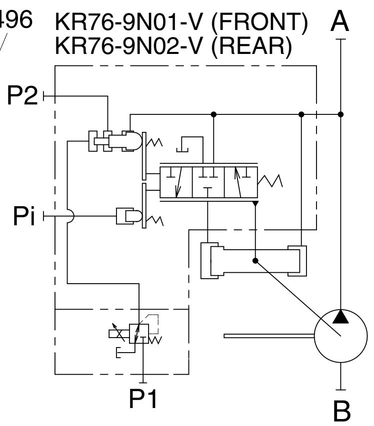


VIEW C (REAR)

140Z92MP04

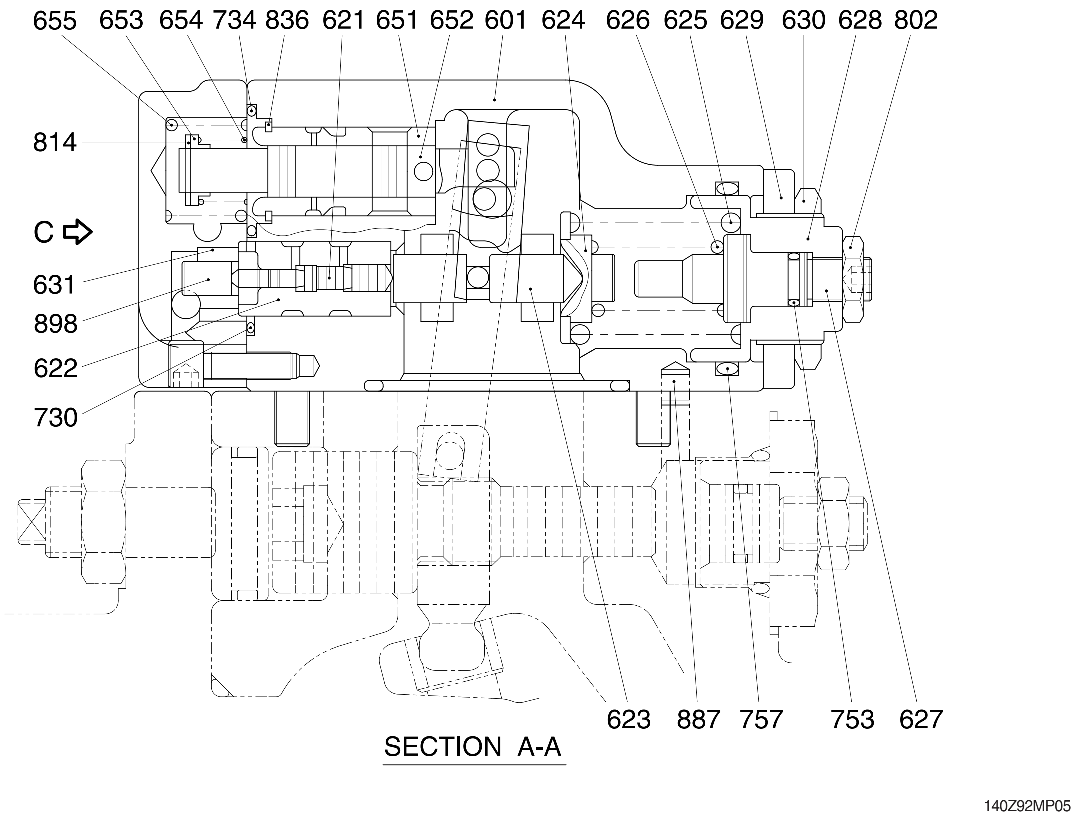


SECTION E-E (REAR)



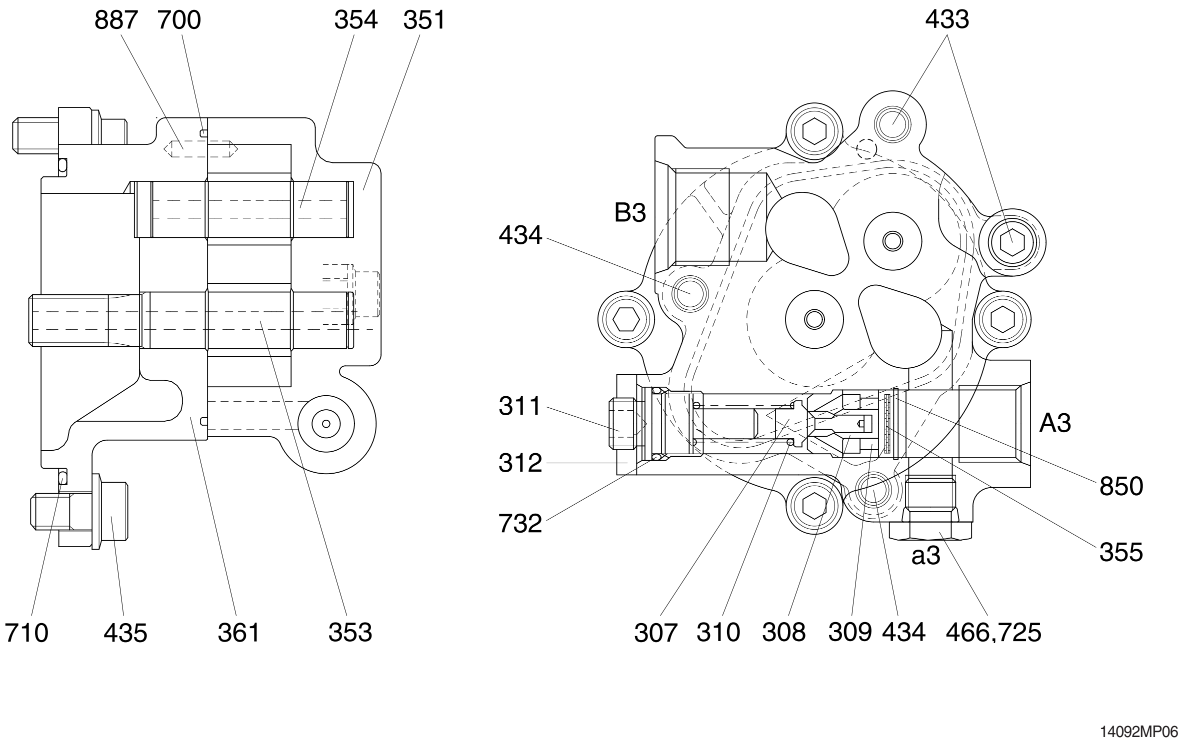
Port	Port name	Port size
A	Delivery port	SAE6000 psi 3/4"
B	Suction port	SAE2500 psi 2 1/2"
Pi	Pilot port	PF 1/4-15
P1	EPPR valve primary port	PF 1/4-13
P2	Companion delivery port	internal

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

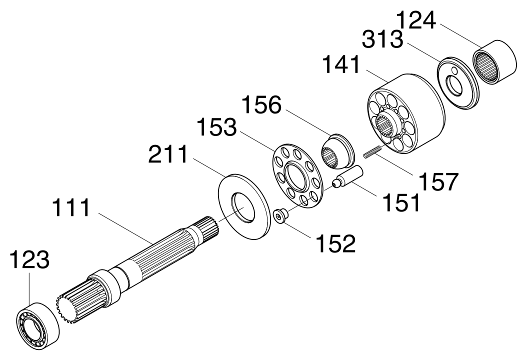
The pumps may be classified roughly into the rotary group performing a rotary motion and working as the major part of the whole pump function: the swash plate group that varies the delivery rates: and the valve cover group that changes over oil suction and discharge : and the PTO group that transfers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



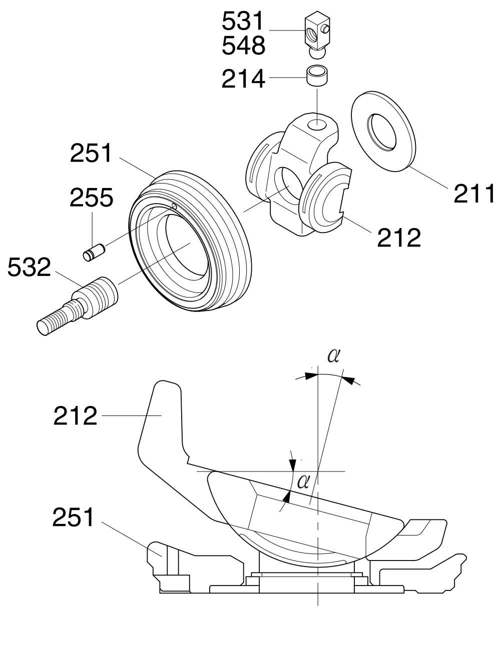
21092MP06

(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)



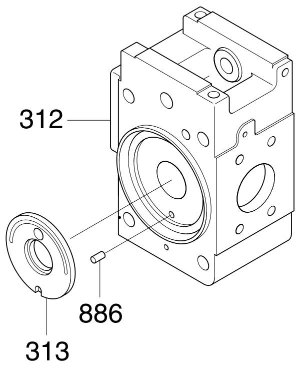
140Z92MP09

(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

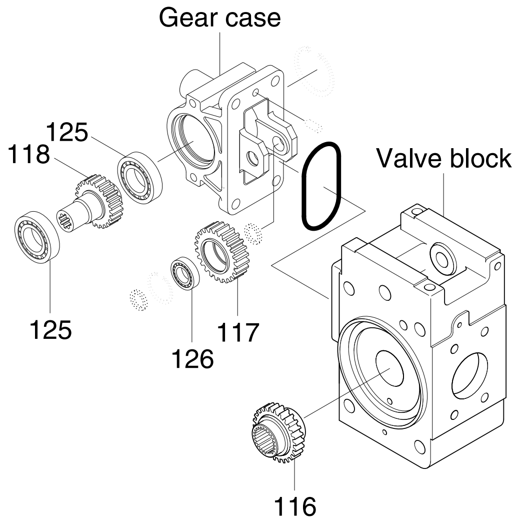
PTO group consist of 1st gear (116) and 2nd gear (117), 3rd gear (118).

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

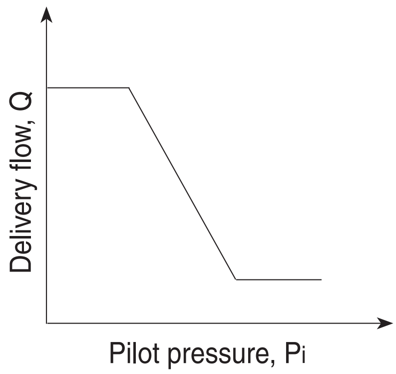
Regulator consists of the negative flow control, total horse power control and power shift control function.

(1) Negative flow control

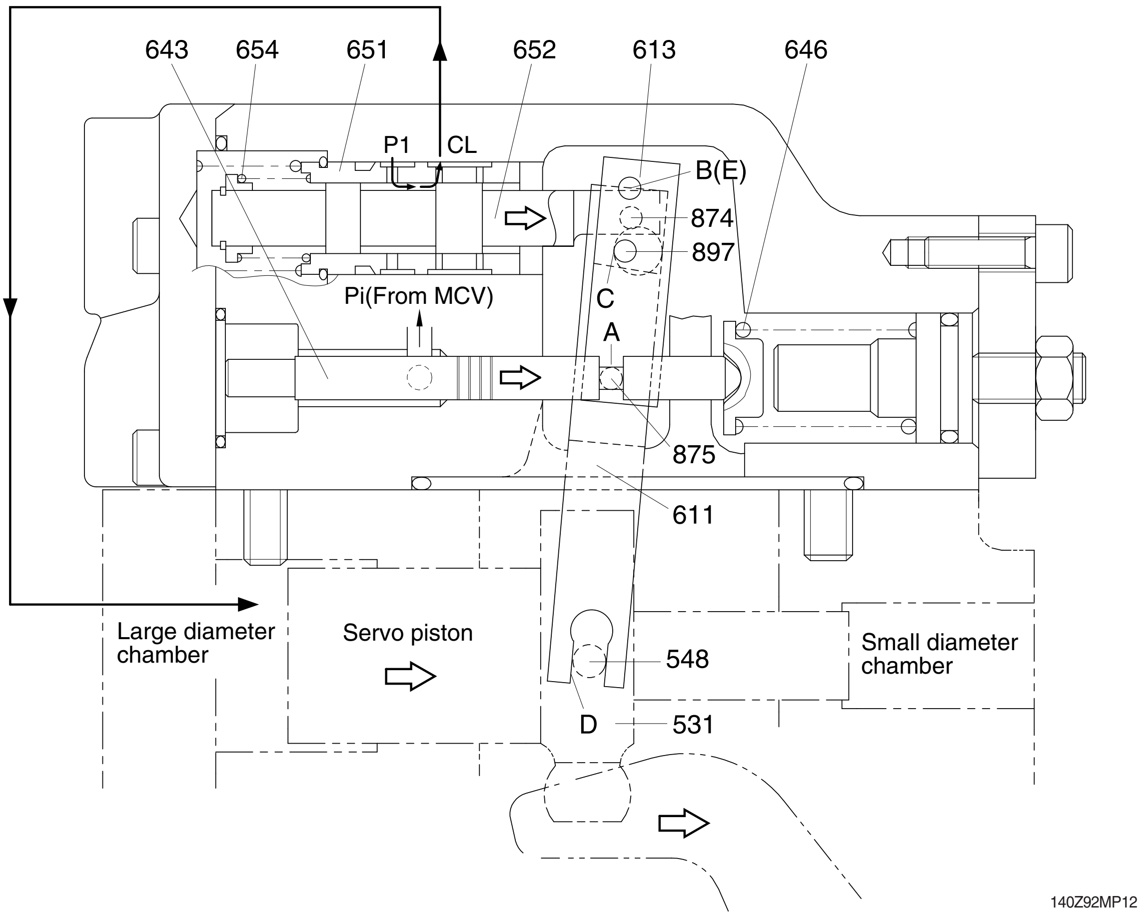
By changing the pilot pressure Pi, the pump tilting angle (delivery flow) is regulated arbitrarily, as shown in the figure.

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.

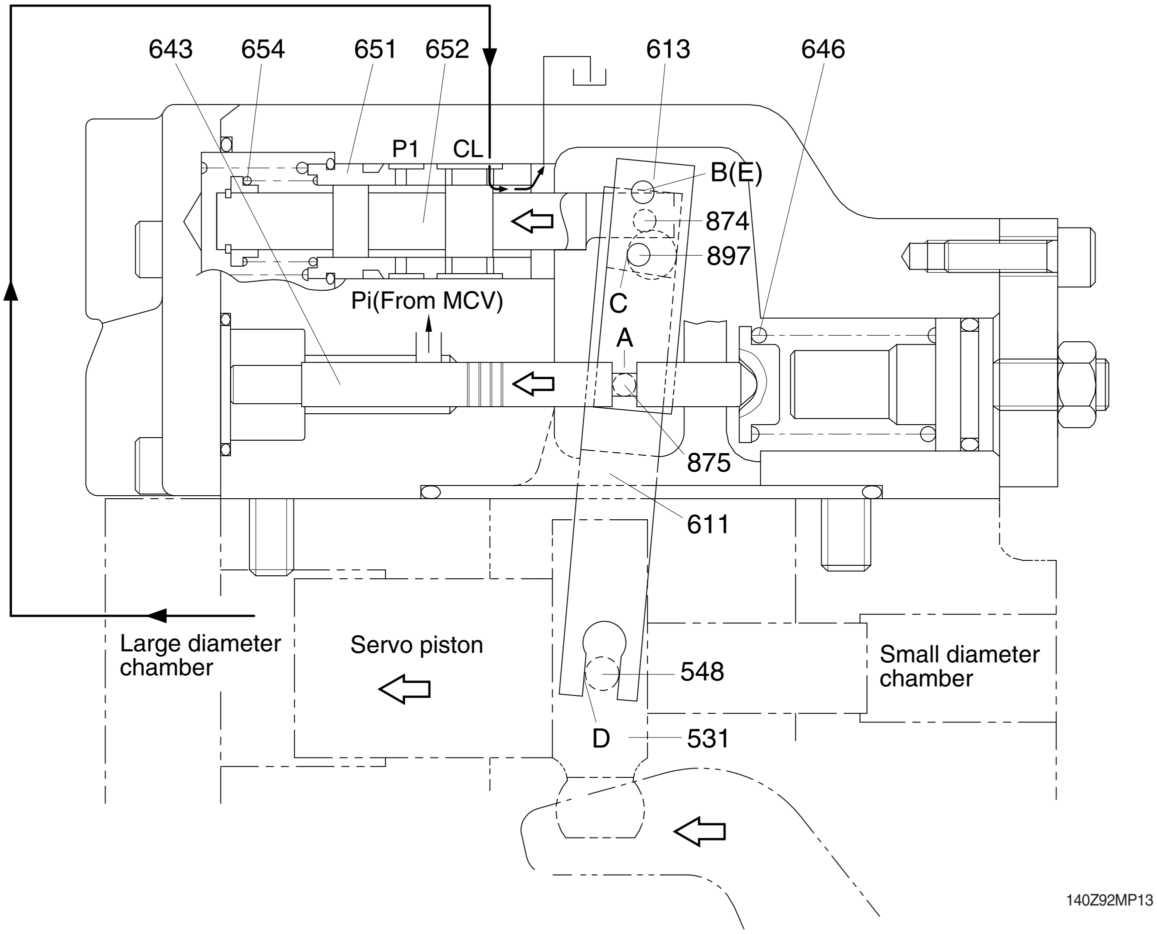
Since the feedback lever is connected with the spool (652) via the pin (874), the spool moves to the right.

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.

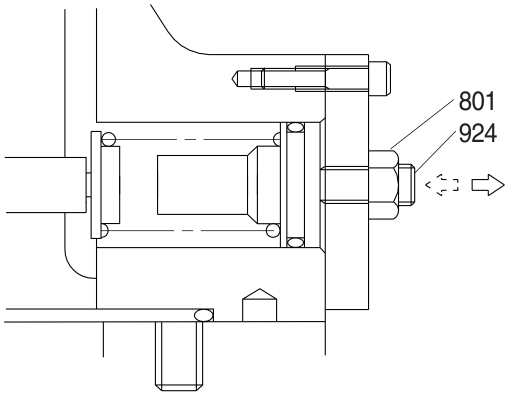
As the servo piston moves, point D also moves to the left, the feedback lever rotates around the fulcrum of point C, and the spool moves to the right till the opening between the spool and sleeve is closed.

③ **Adjustment of flow control characteristic**

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

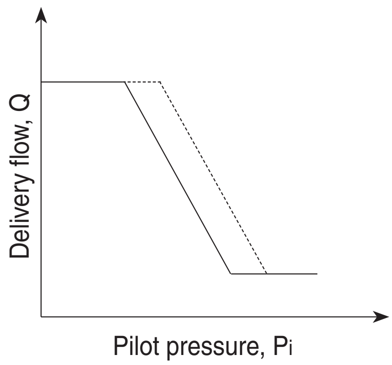
Adjust it by loosening the hexagon nut (801) and by tightening (or loosening) the hexagonal socket head screw (924).

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

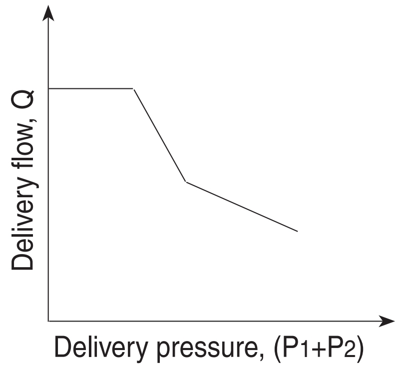


※ **Adjusting value**

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)
1900	+1/4	+1.4	+7.1



(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.)

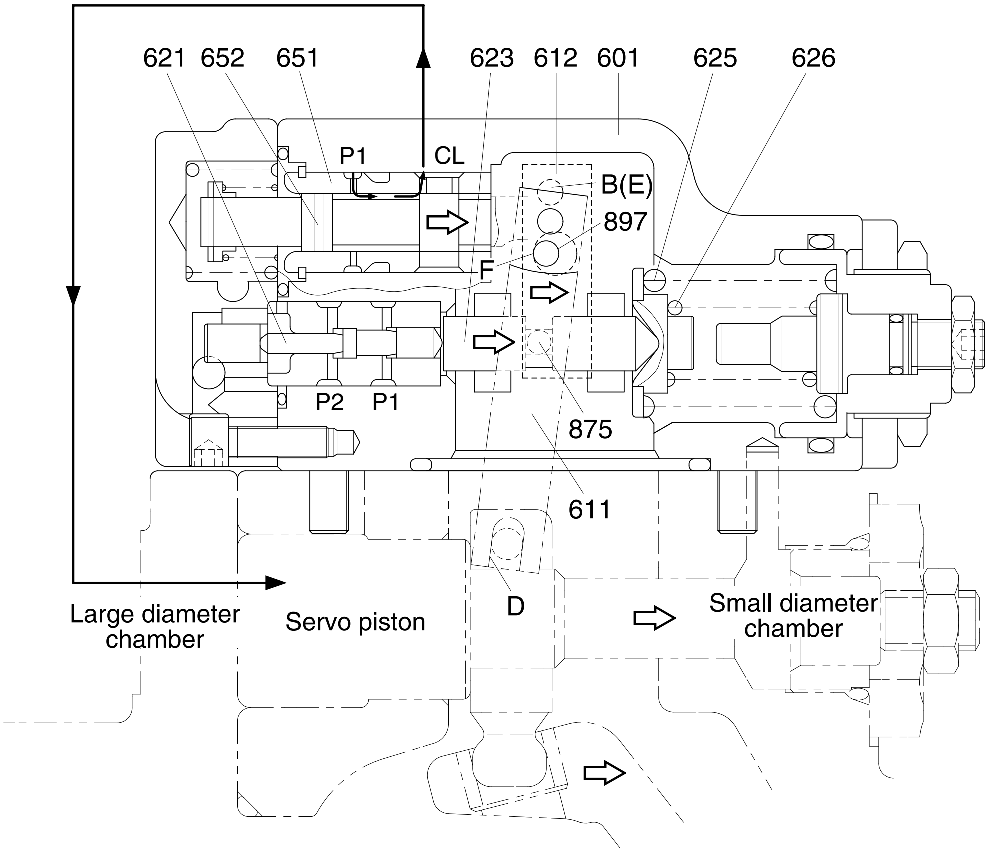
Since the regulator is of the simultaneous total horsepower type that operates by the sum of load pressures of the two pumps in the tandem double-pump system, the prime mover is automatically prevented from being overloaded, irrespective of the load condition of the two pumps, when horsepower control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



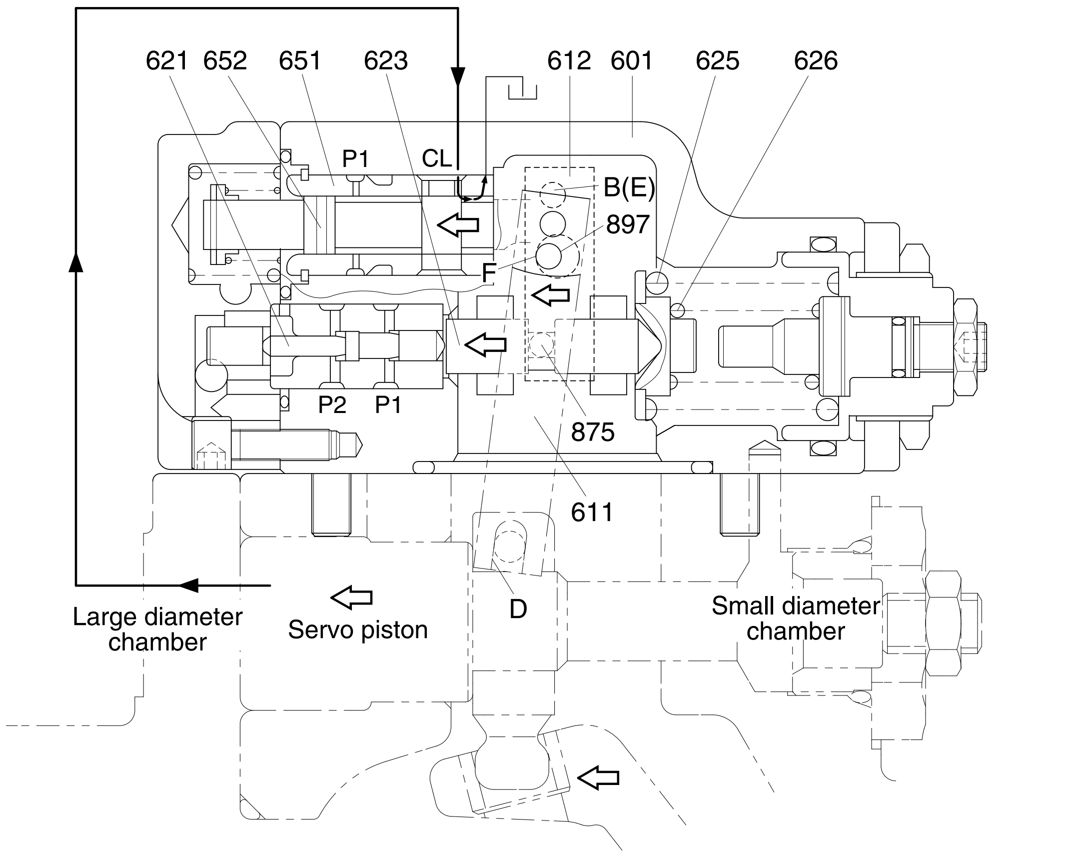
140Z92RG03

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.

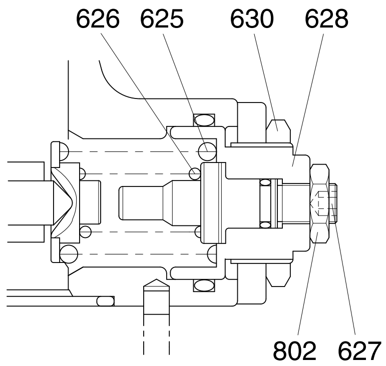
④ **Adjustment of input horsepower**

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).

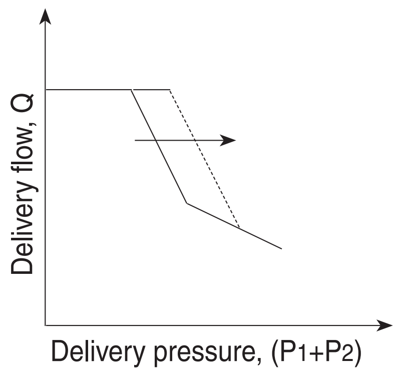
Tightening the screw shifts the control chart to the right and increases the input horsepower as shown in the figure. Since turning the adjusting screw C (628) by N turns changes the setting of the inner spring (626), return the adjusting stem C (627) by N×A turns at first. (A=1.48)



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)
1900	+1/4	+15.9	+2.5



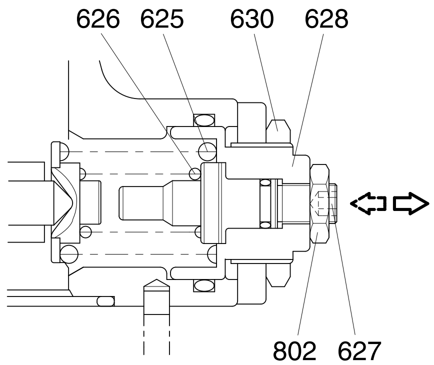
b. Adjustment of inner spring

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

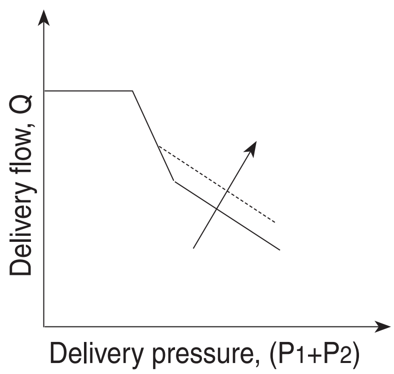
Tightening the screw increases the flow and then the input horsepower as shown in the figure.

※ Adjusting value

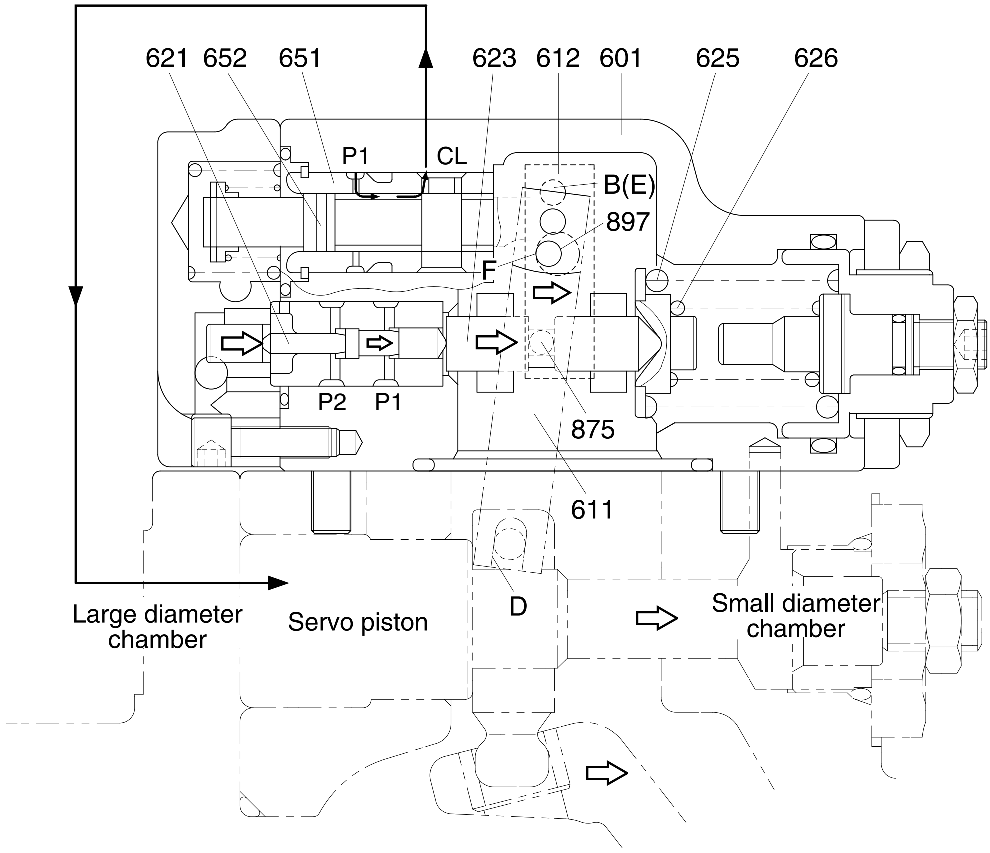
Speed	Adjustment of input horsepower		
	Tightening amount of adjusting stem (C) (627)	Flow change amount	Input torque change amount
(min^{-1})	(Turn)	(ℓ/min)	(kgf · m)
1900	+1/4	+3.22	+3.2



140Z92RG08



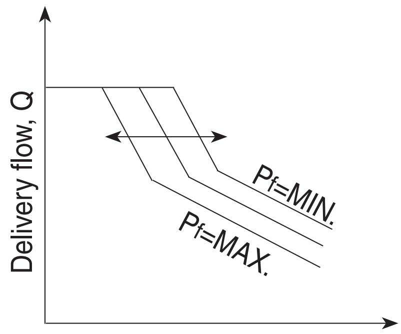
(3) Power shift control



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).

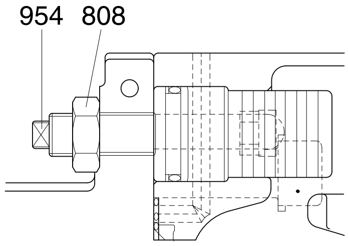
This decreases the pump tilting angle and then the set horsepower in the same way as explained in the overload preventive function of the horsepower control. On the contrary, the set horsepower rises as the power shift pressure Pf falls.

(4) Adjustment of maximum and minimum flows

① Adjustment of maximum flow

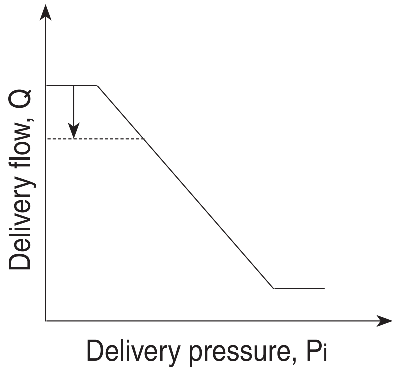
Adjust it by loosening the hexagon nut (808) and by tightening (or loosening) the set screw (954).

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



140Z92MP23

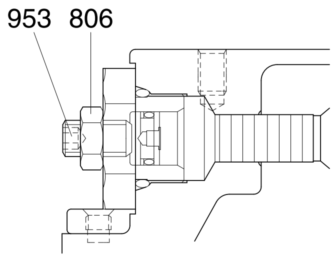
Speed	Adjustment of max flow	
	Tightening amount of adjusting screw (954)	Flow change amount
(min^{-1})	(Turn)	(ℓ/min)
1900	+1/4	-3.0



② Adjustment of minimum flow

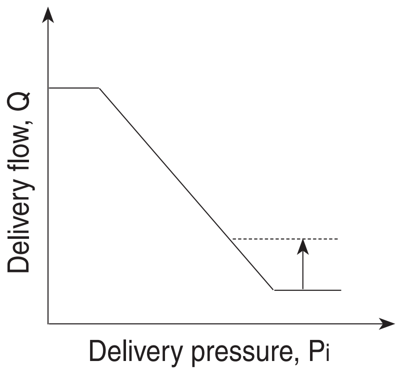
Adjust it by loosening the hexagon nut (806) and by tightening (or loosening) the hexagonal socket head set screw (953). Similarly to the adjustment of the maximum flow, other characteristics are not changed.

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

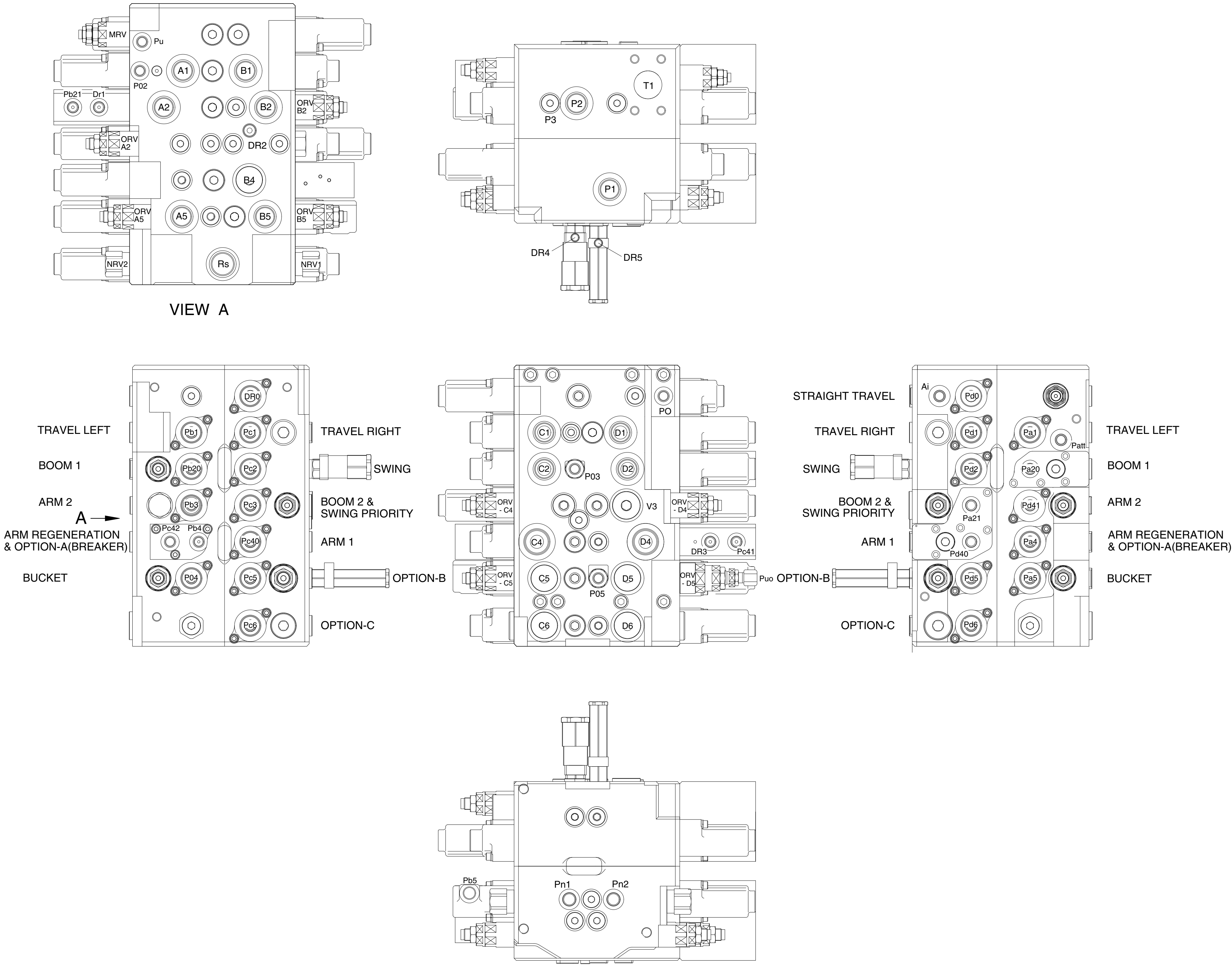


140Z92MP24

Speed	Adjustment of min flow	
	Tightening amount of adjusting screw (953)	Flow change amount
(min^{-1})	(Turn)	(ℓ/min)
1900	+1/4	+3.0

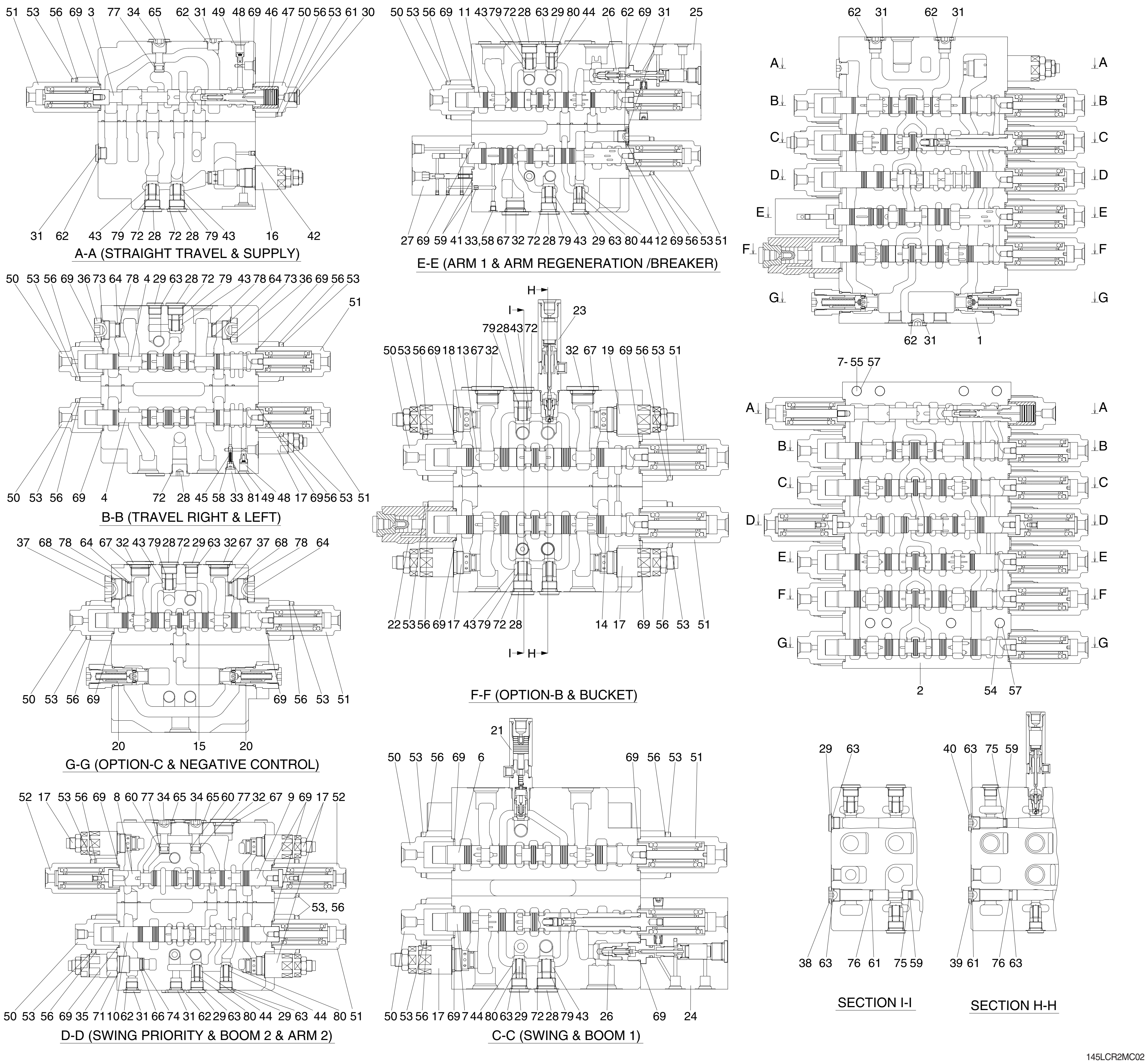


1. STRUCTURE



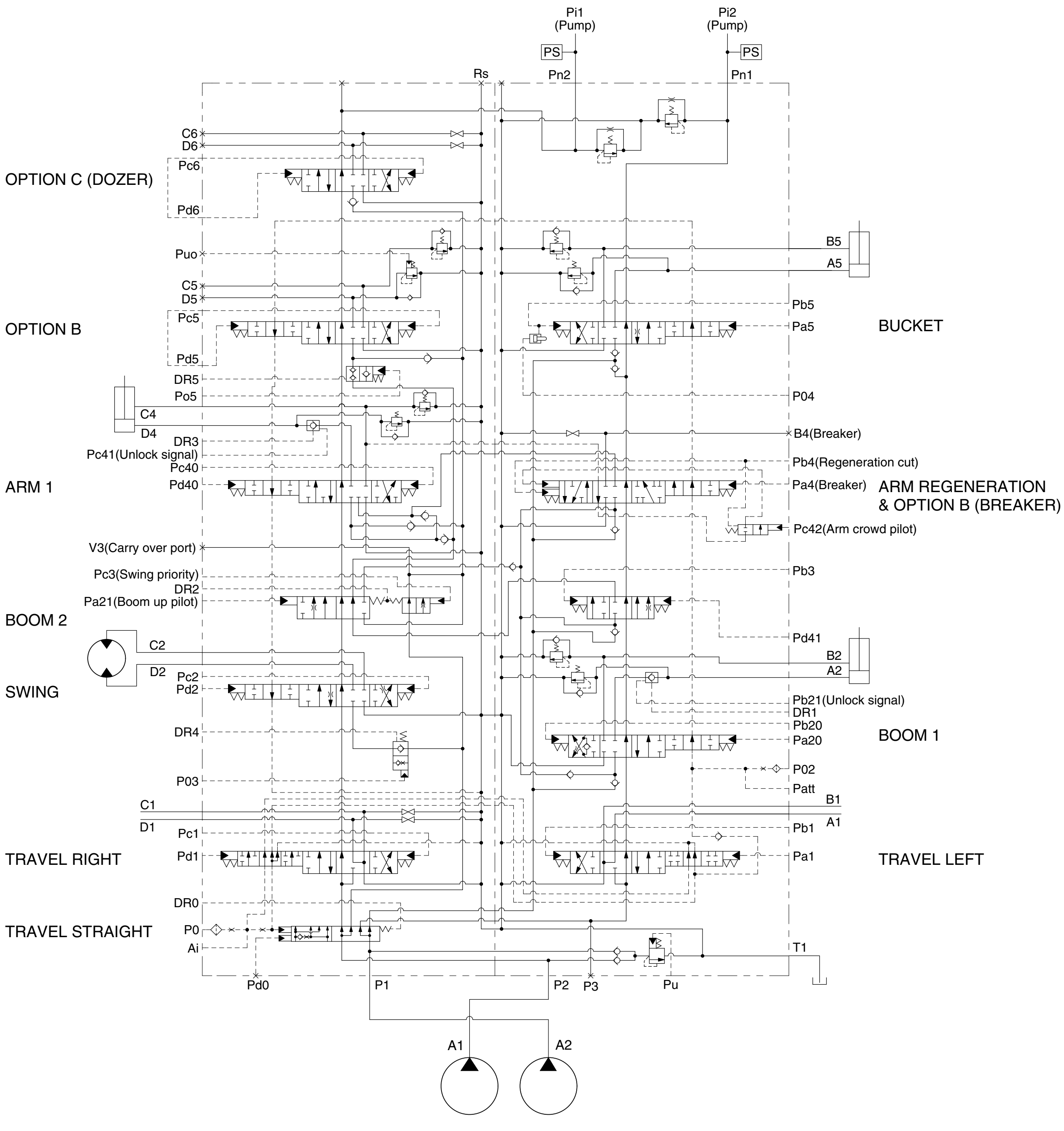
145SA2MC01

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	3~4 kgf · m (21.7~28.9 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	6~7 kgf · m (43.4~50.6 lbf · ft)
Pn2	Negative control signal port (P2 port side)		
P3	Quick clamp port		
A1	Travel motor left side port (BW)	PF 3/4	9~10 kgf · m (65.1~72.3 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	1~1.2 kgf · m (7.2~8.7 lbf · ft)
Dr5	Drain port (flow summation)		
T1	Return port	SAE3000, 1 1/2 (M12×1.75)	9~10 kgf · m (65.1~72.3 lbf · ft)



1	Housing P1	43	Poppet load check
2	Housing P2	44	Poppet load check
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 (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 assy	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



145SA2MC05

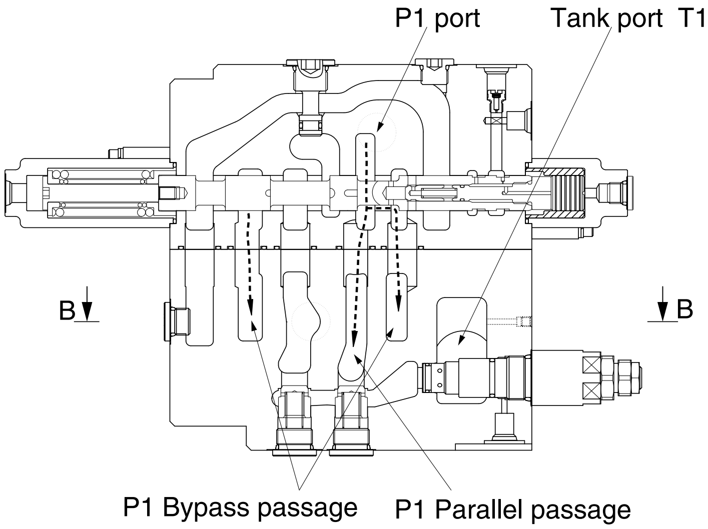
3. FUNCTION

1) CONTROL IN NEUTRAL

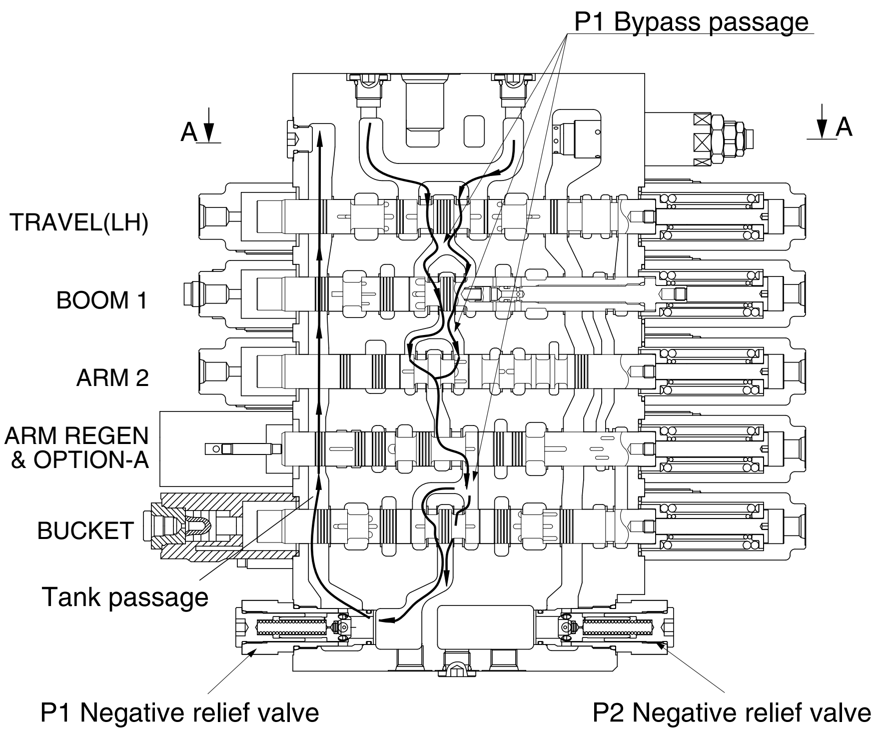
(1) P1 SIDE

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



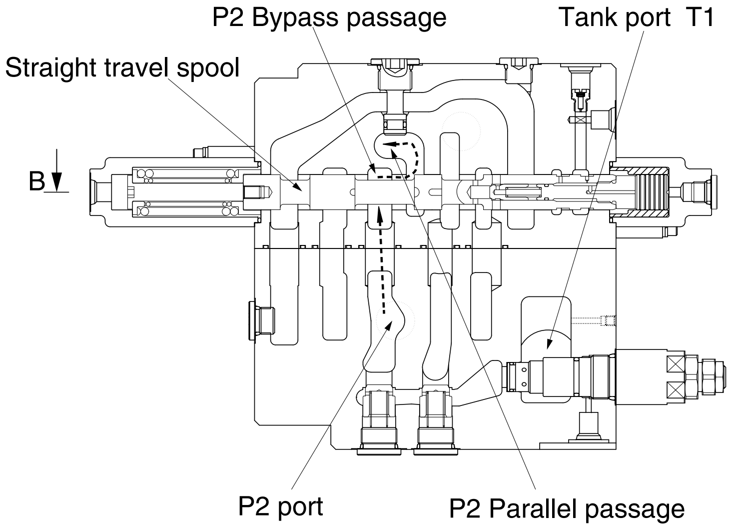
SECTION B-B

145LCR2MC11

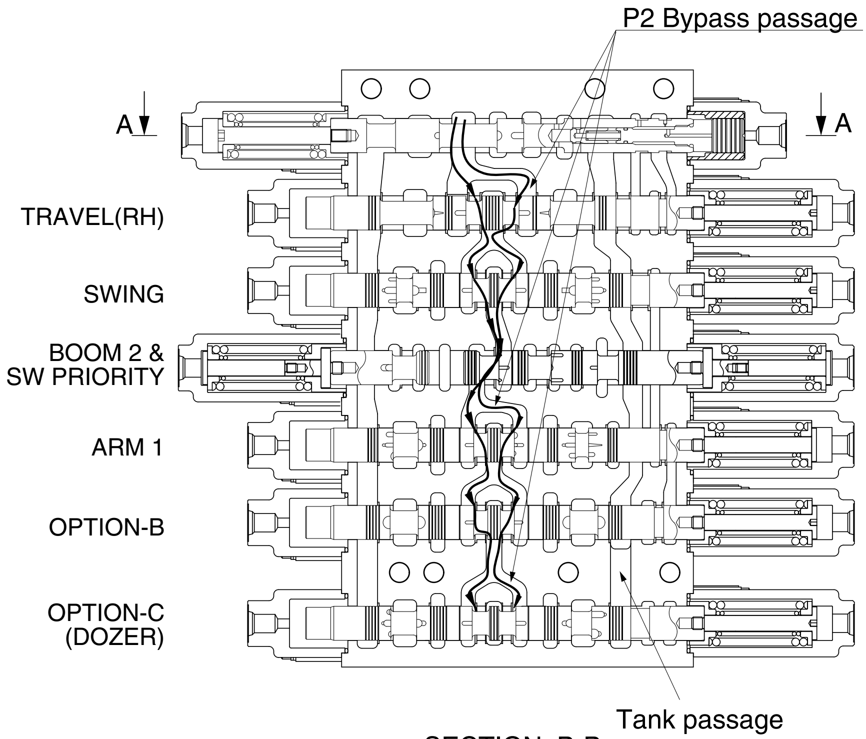
(2) P2 SIDE

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

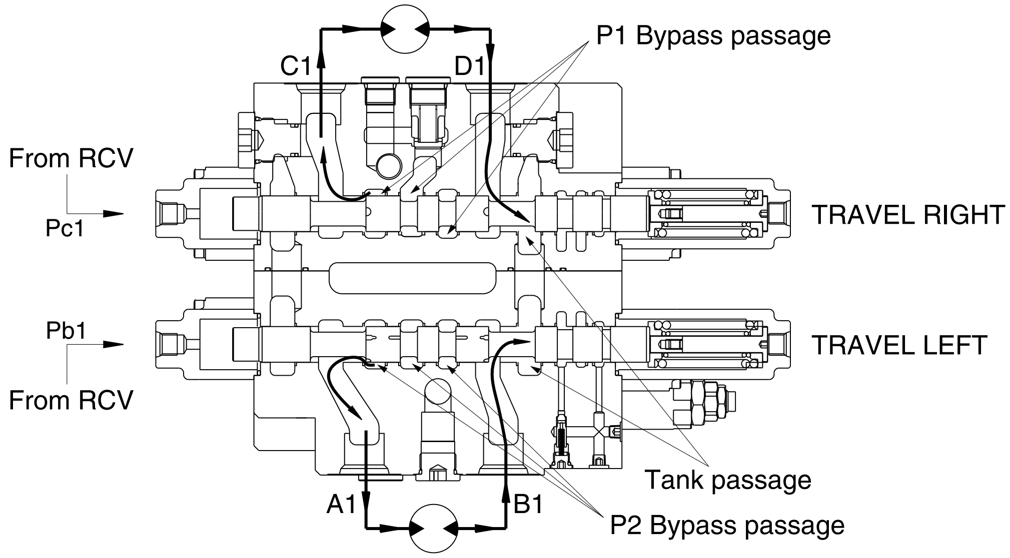


SECTION B-B

145LCR2MC12

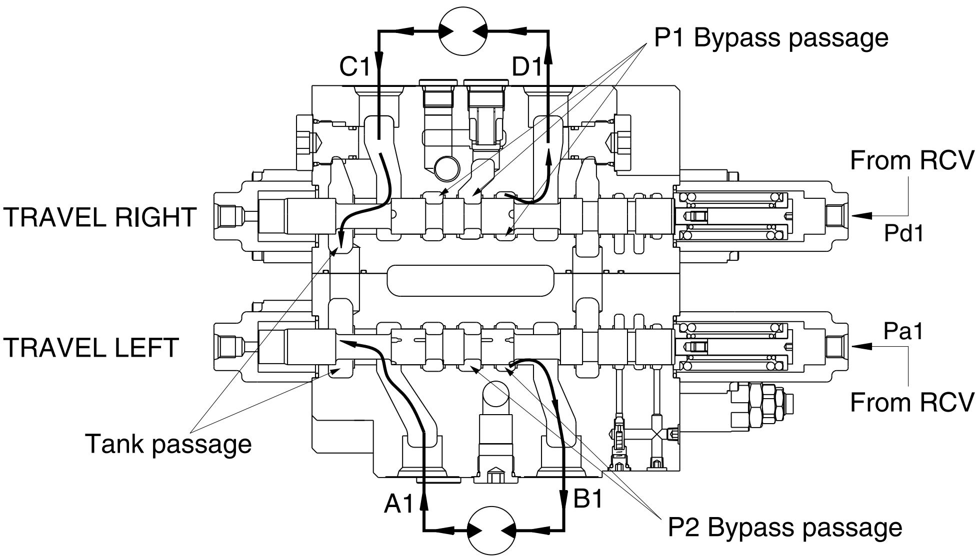
2) TRAVEL OPERATION

(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.

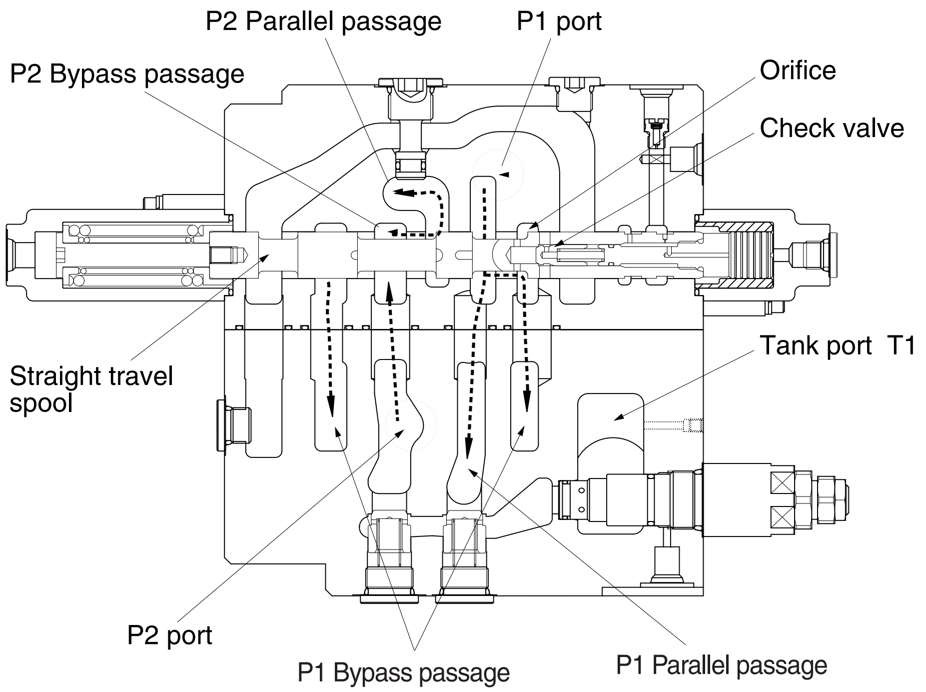
The pilot pressure from the pilot control valve is supplied to the spring side of pilot port (pb1, pc1).

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.

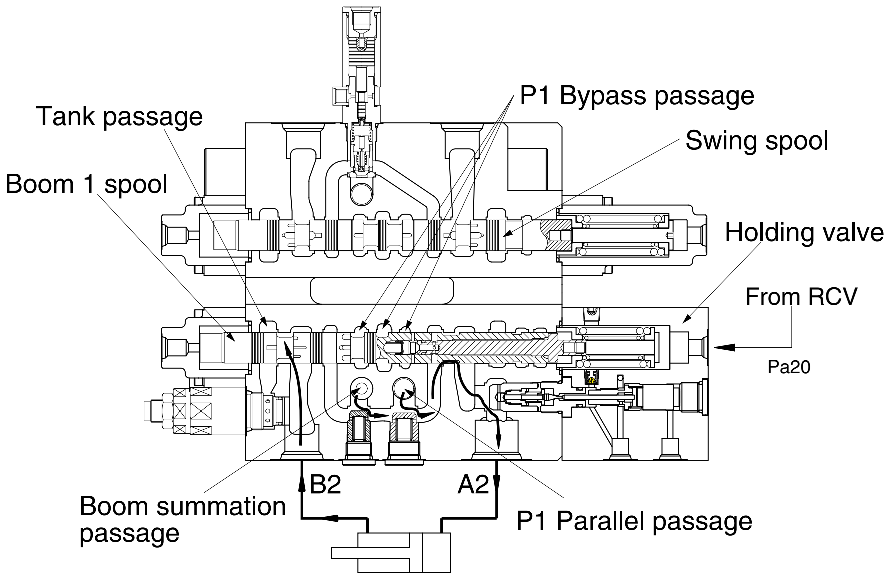
3) BOOM OPERATION

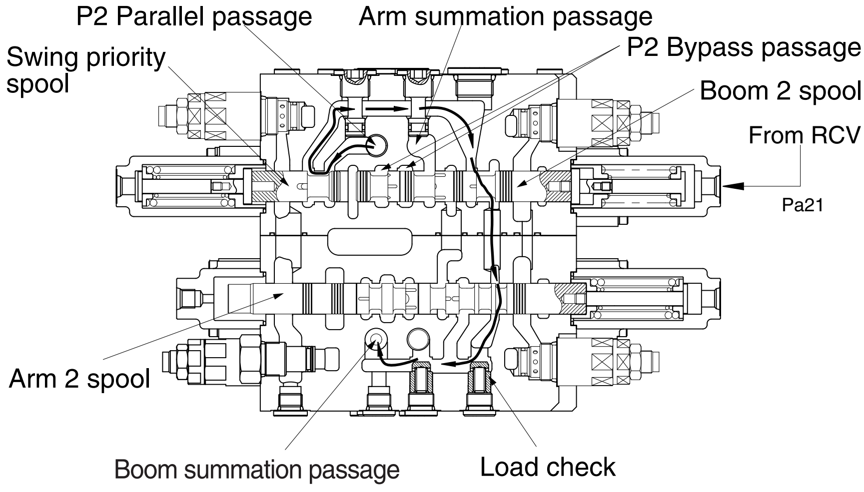
(1) BOOM UP OPERATION

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.

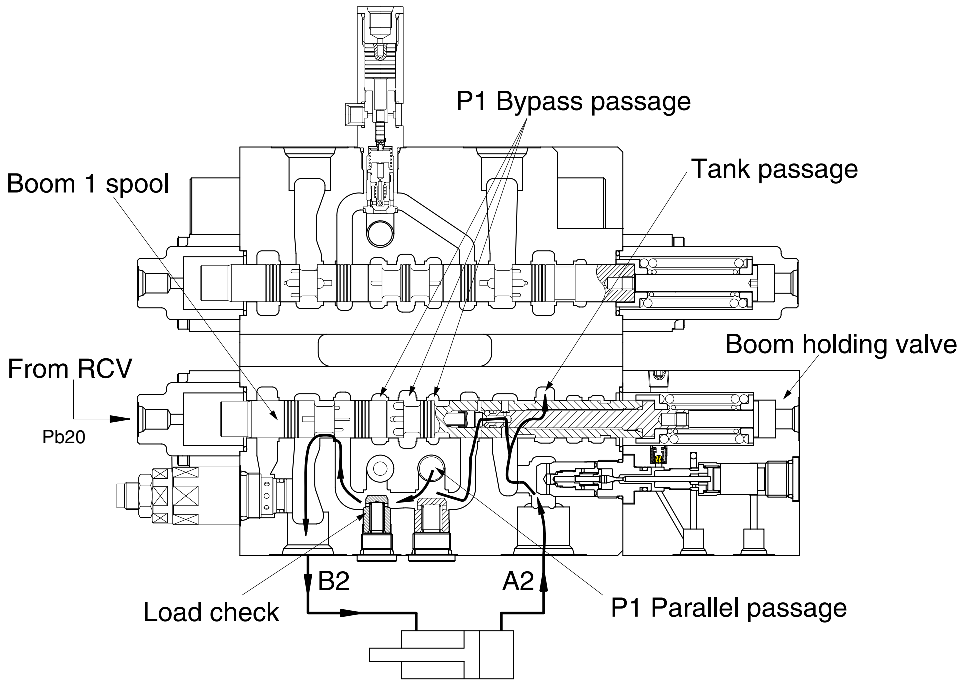
The bypass passage is shut off by the movement of the boom 1 spool and the hydraulic fluid from the pump A2 enters the parallel passage and is directed to the port B2 through the load check. Following this, it flows into the rod side of the boom cylinder.

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.

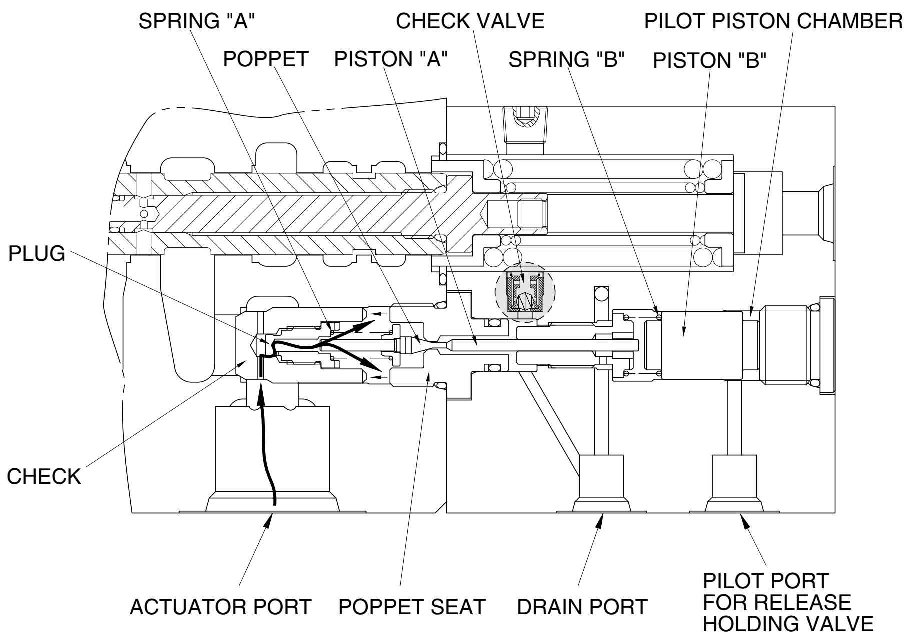


145LCR2MC26

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.



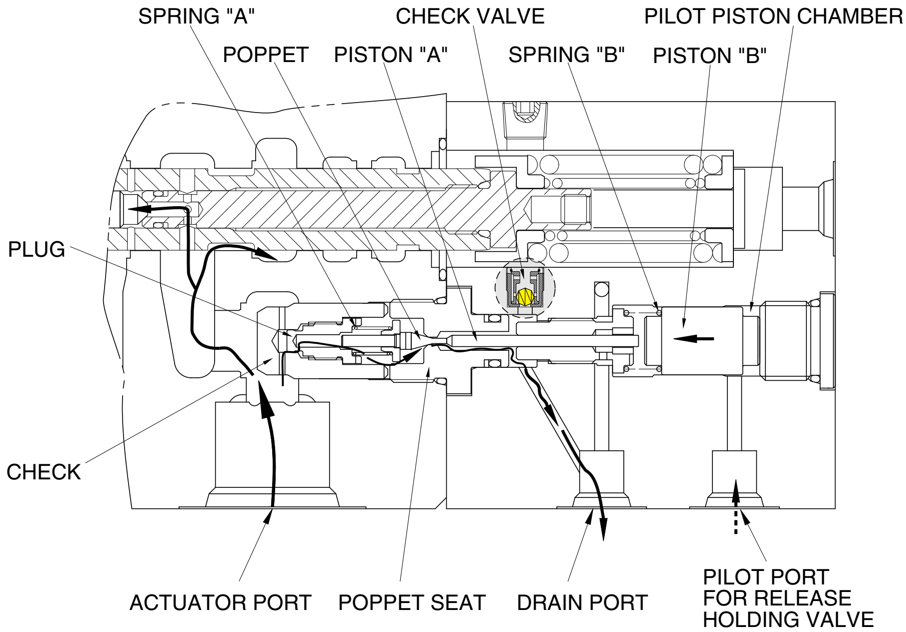
145LCR2MC15

(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.

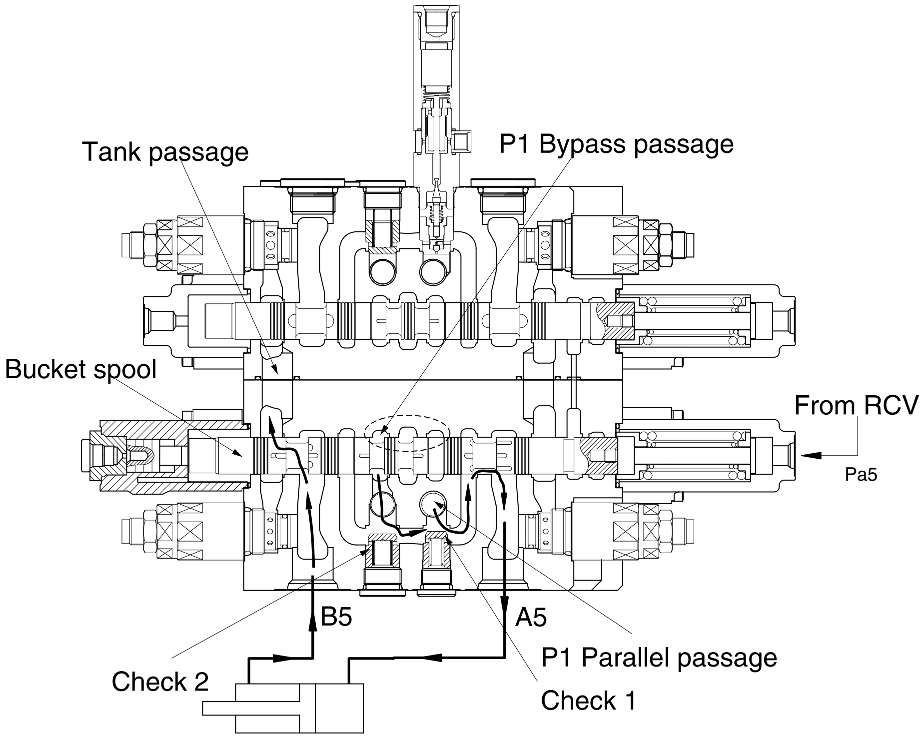


145LCR2MC16

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

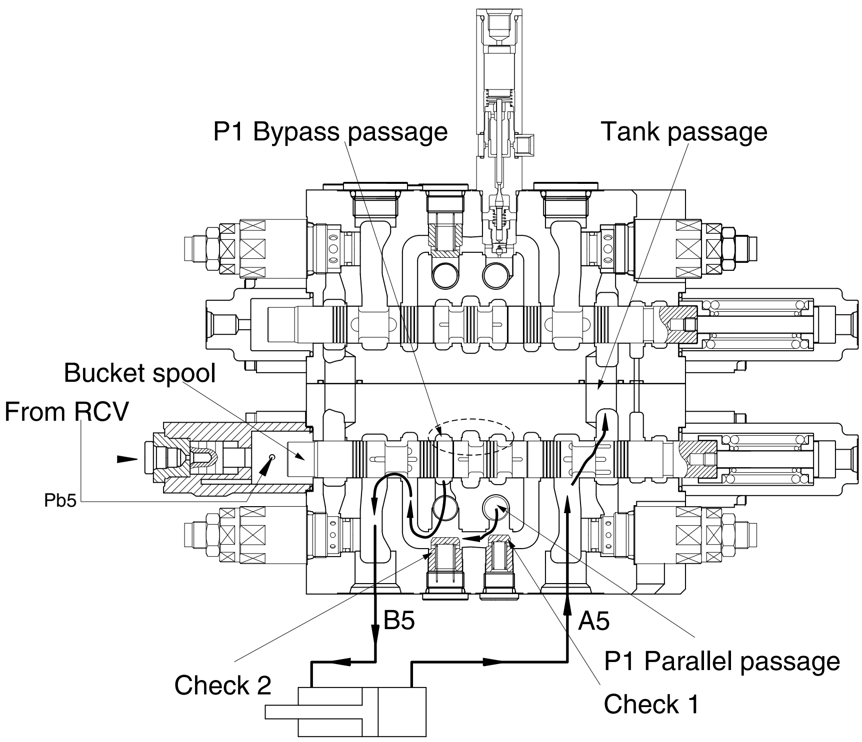
(2) BUCKET OUT OPERATION

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.

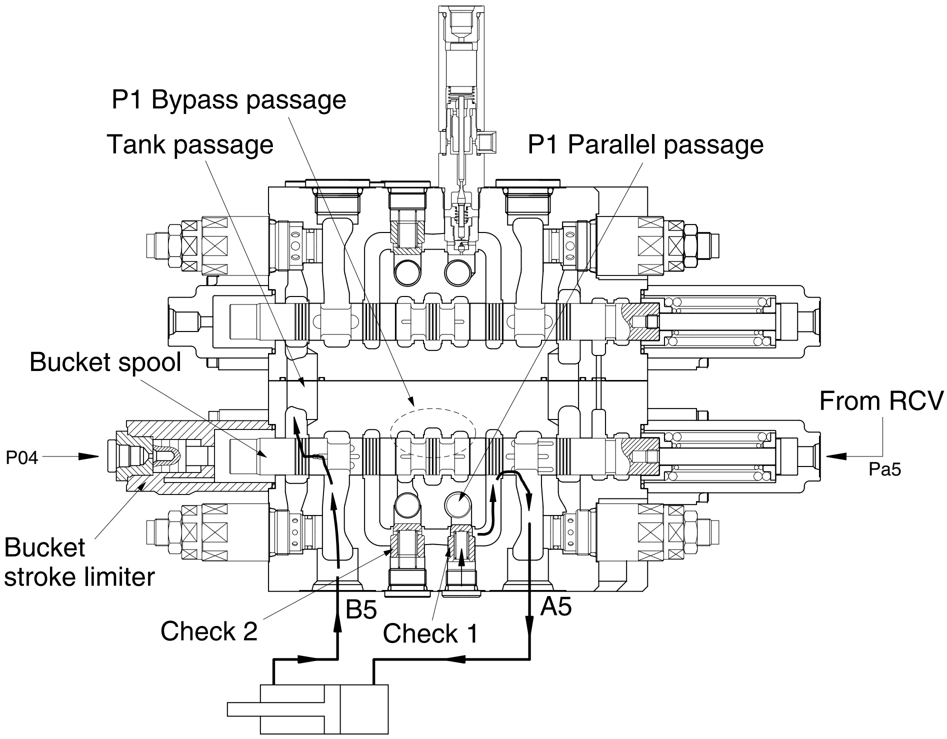


145LCR2MC35

(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

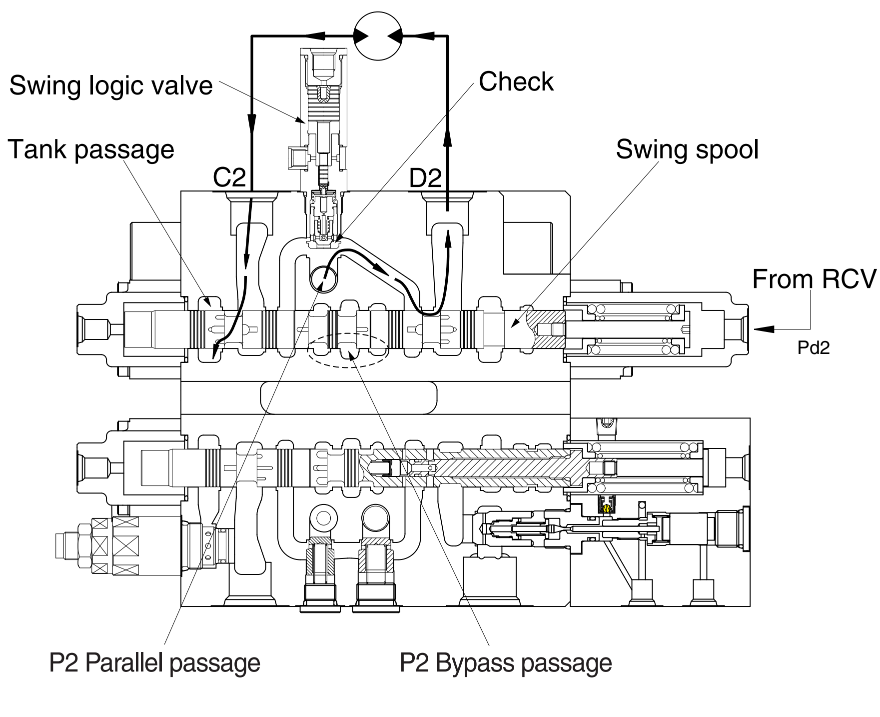
(1) SWING LEFT & RIGHT OPERATION

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.

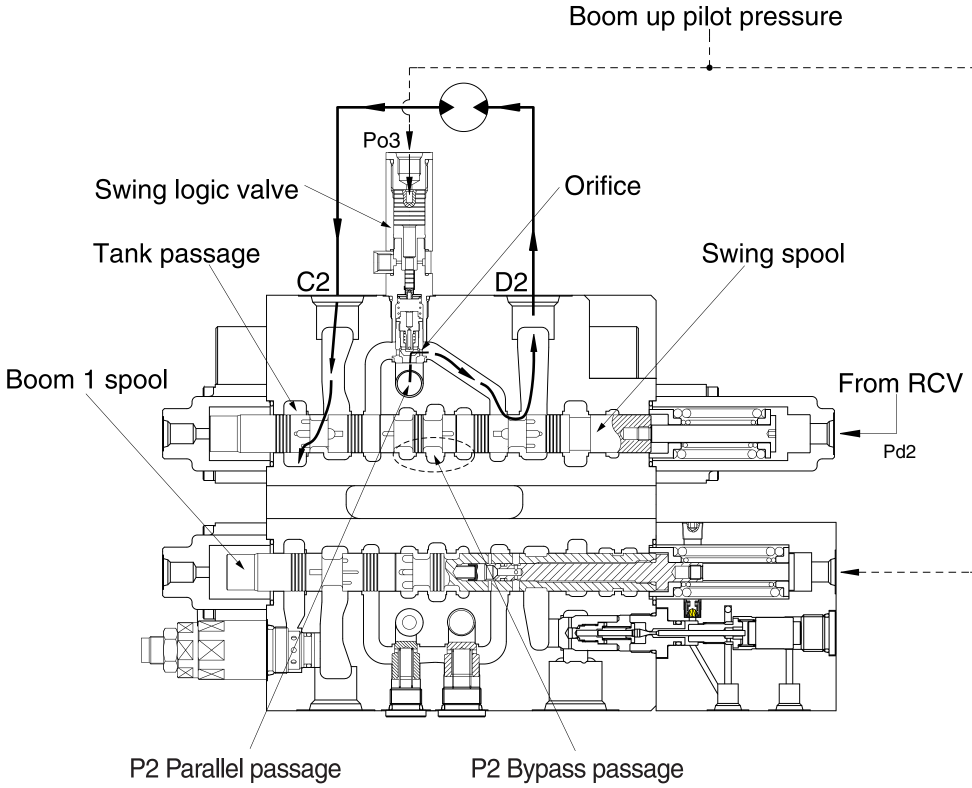
Accordingly, the hydraulic fluid from pump A1 flows into swing motor through the port C2 and returns to the hydraulic oil tank through the port D2 and the tank passage.



(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

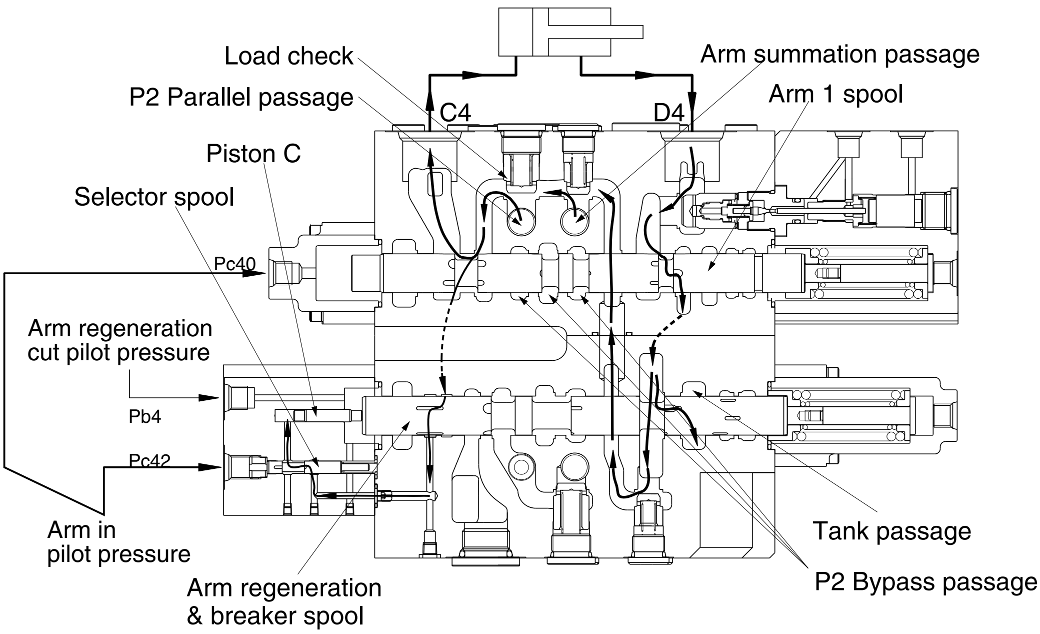
7) ARM OPERATION

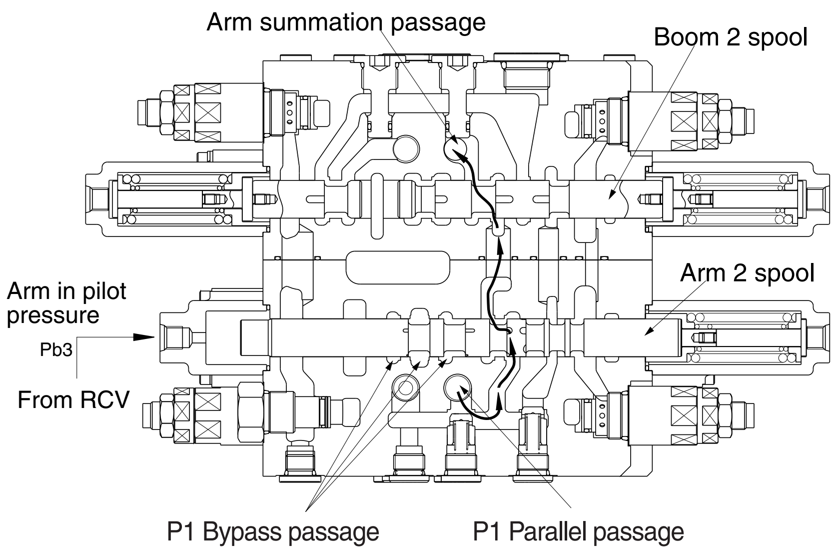
(1) ARM IN OPERATION

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.





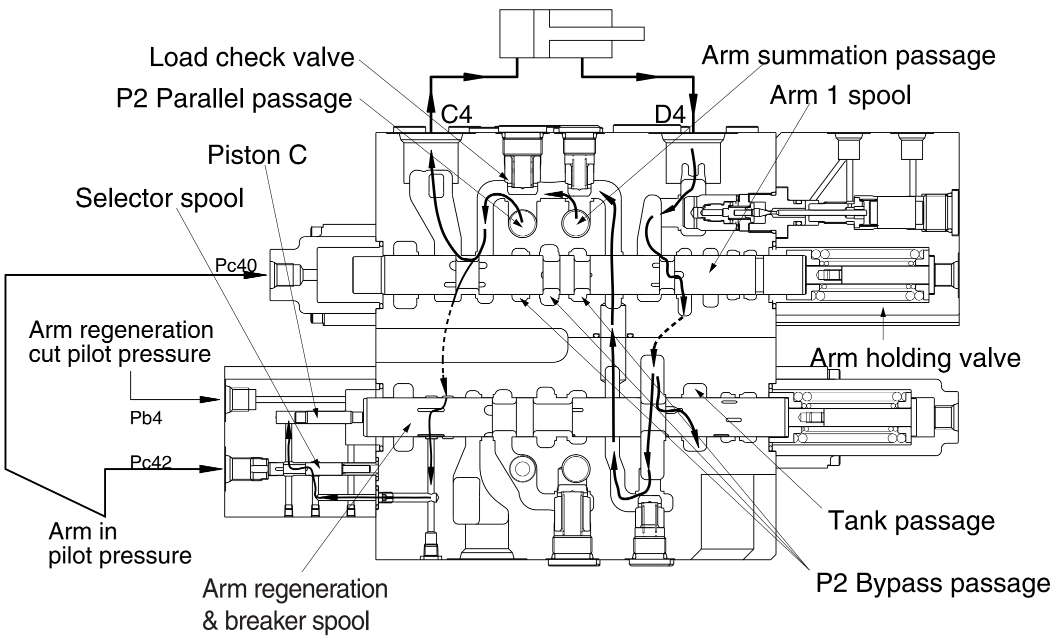
145LCR2MC21

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.

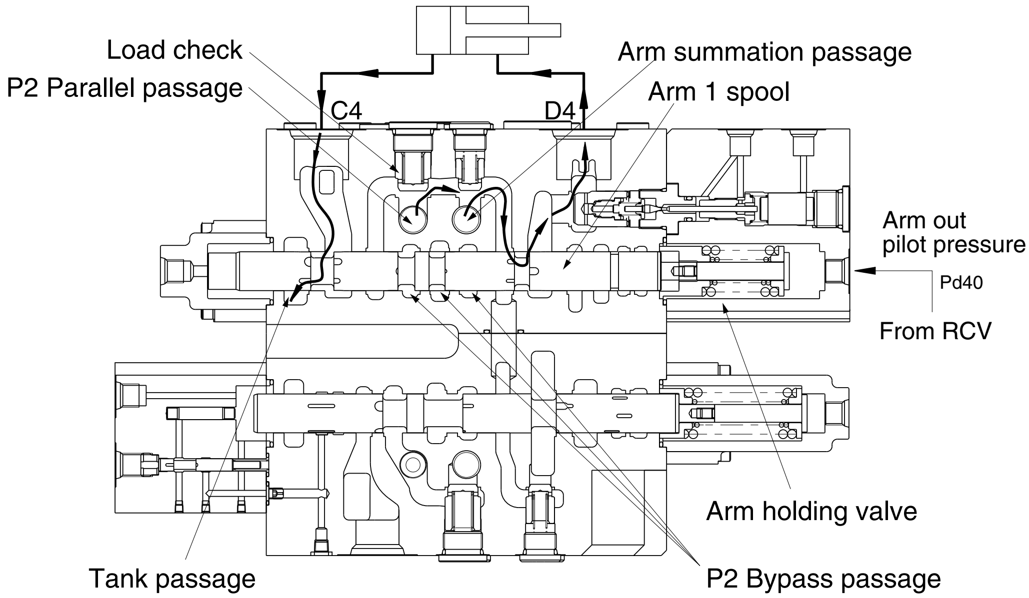
The bypass passage is shut off by the movement of the arm 1 spool and the hydraulic fluid from pump A1 flows into arm 1 spool through the P2 parallel passage. Then it enters into the arm cylinder rod side through the load check, bridge passage, arm holding valve and the port D4.

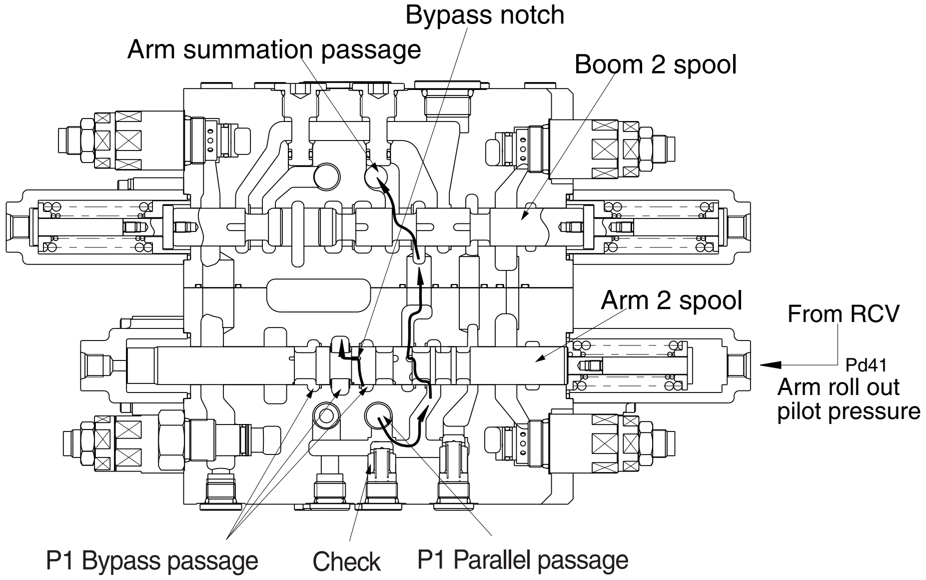
Also, the pilot secondary pressure from RCV is supplied to the port Pd41 of spring side and shifts arm 2 spool in the left direction.

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.





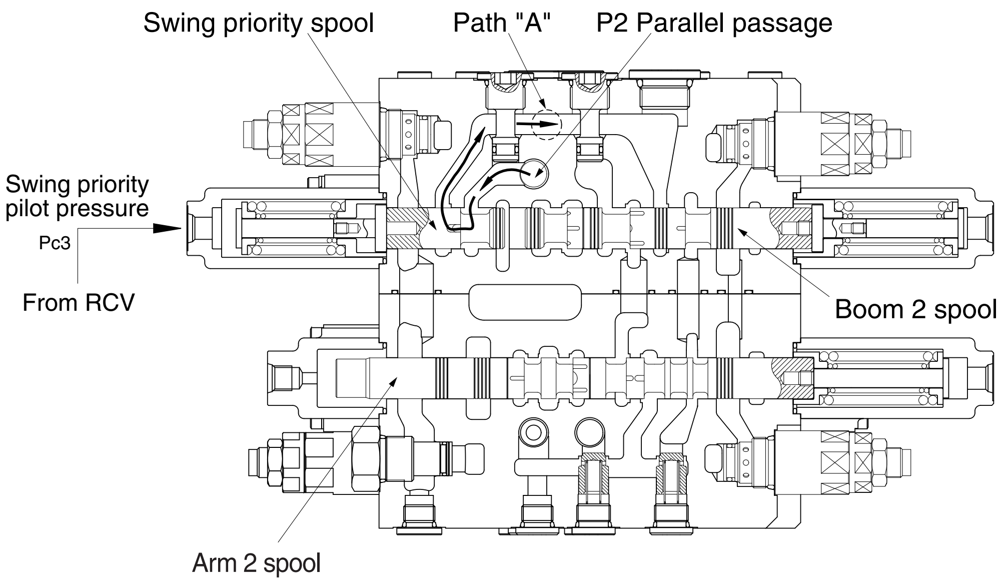
145LCR2MC23

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.

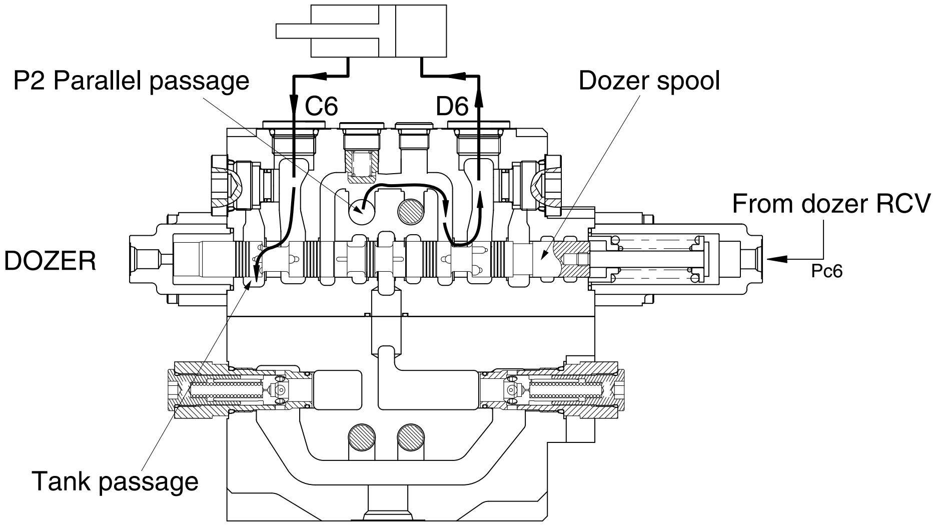
When the swing priority spool is neutral condition, the passage is same as normal condition. But due to shifting of the swing priority spool, the fluid from pump A1 flows to swing side more then the boom 2, arm 1, option B and dozer spools to make the swing operation most preferential.



145LCR2MC27

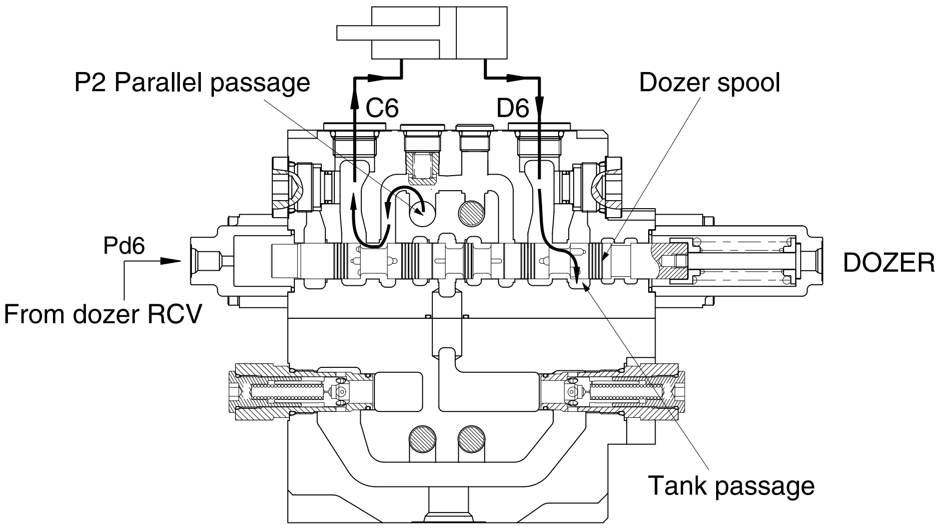
9) DOZER OPERATION

(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

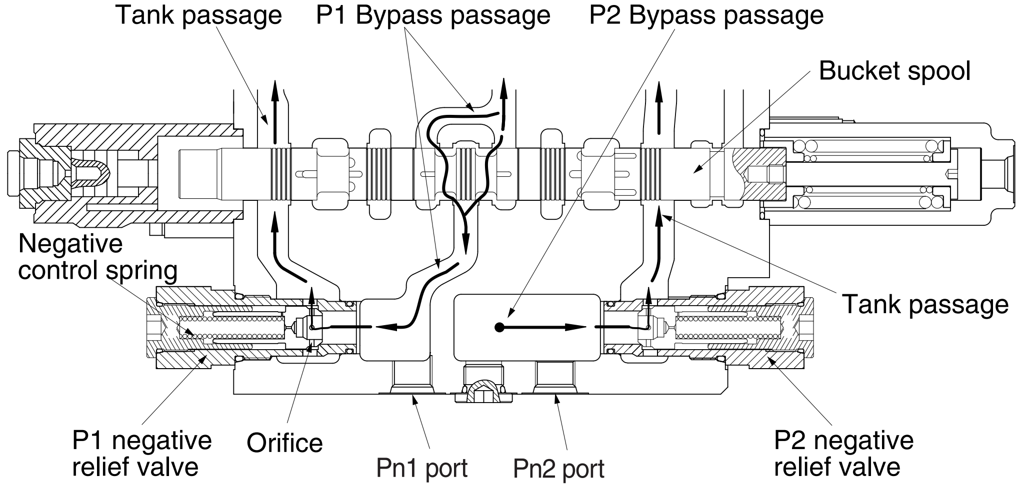
When no function is being actuated on P1 side, the hydraulic fluid from the pump A2, flows into the tank passage through the P1 bypass passage and orifice. The restriction caused by this orifice thereby pressurizes. This pressure is transferred as the negative control signal pressure Pn1 to the pump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

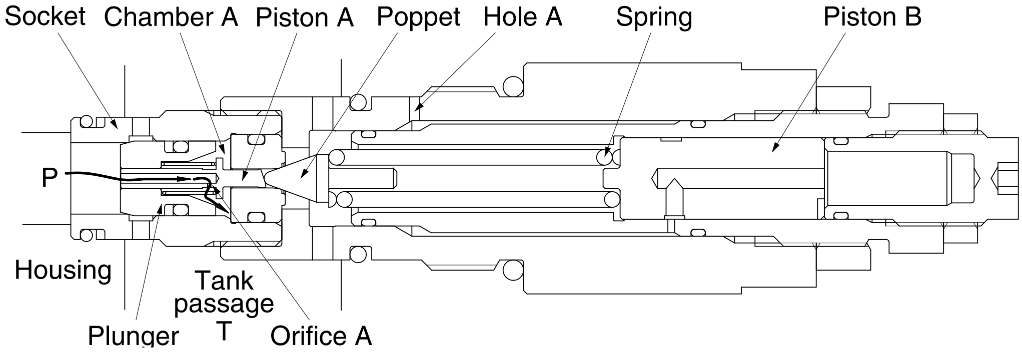
For the pump A1 the same negative control principle.



145LCR2MC28

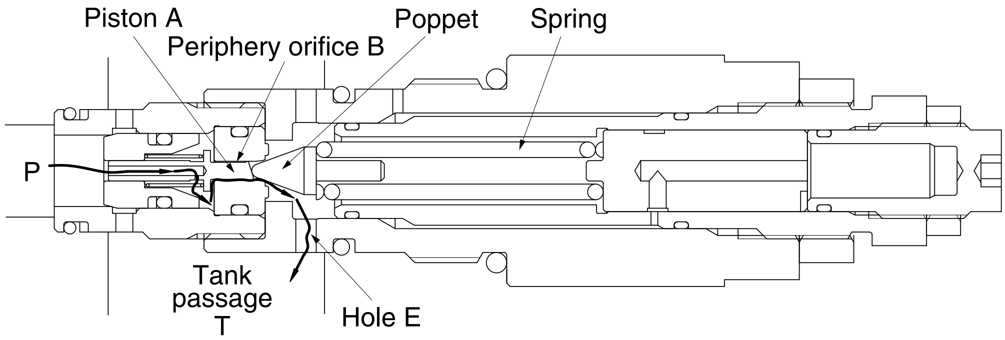
11) OPERATION OF MAIN RELIEF VALVE

(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.



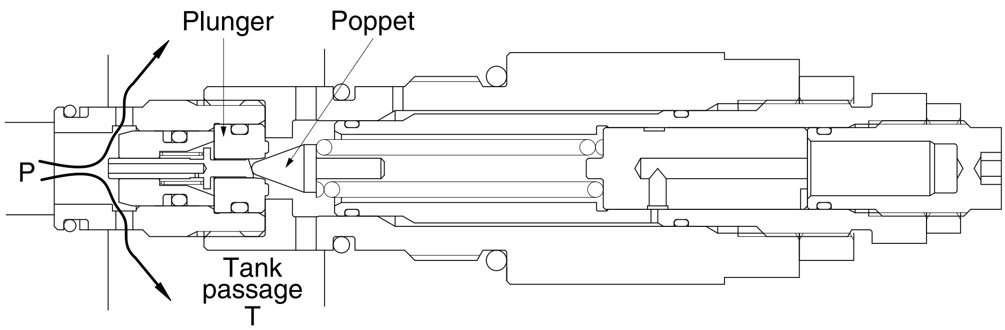
14W92MC36

(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).



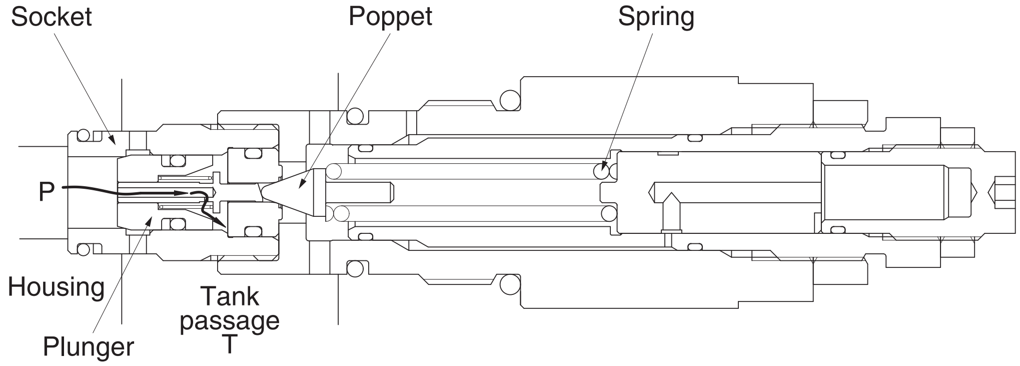
14W92MC37

(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).



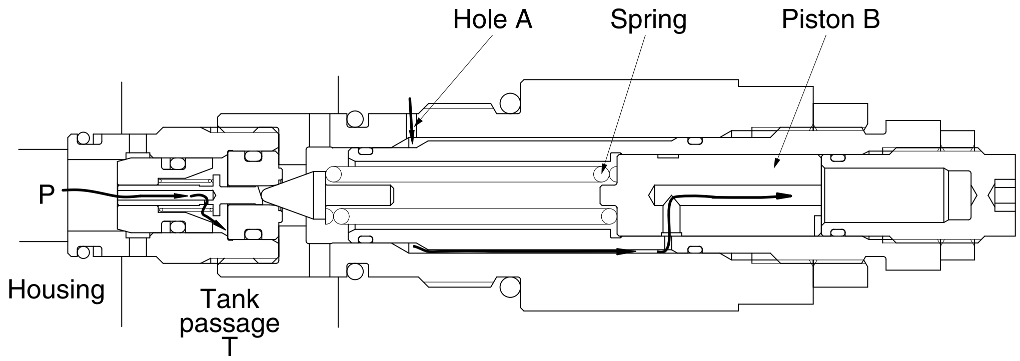
14W92MC38

(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.

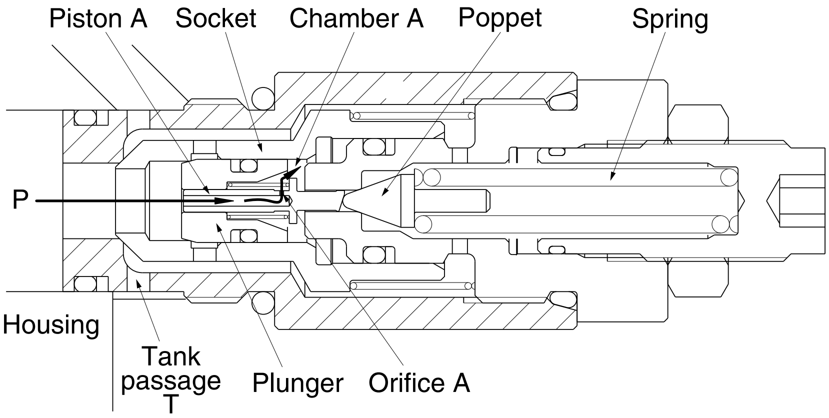


14W92MC40

12) OPERATION OF OVERLOAD RELIEF VALVE

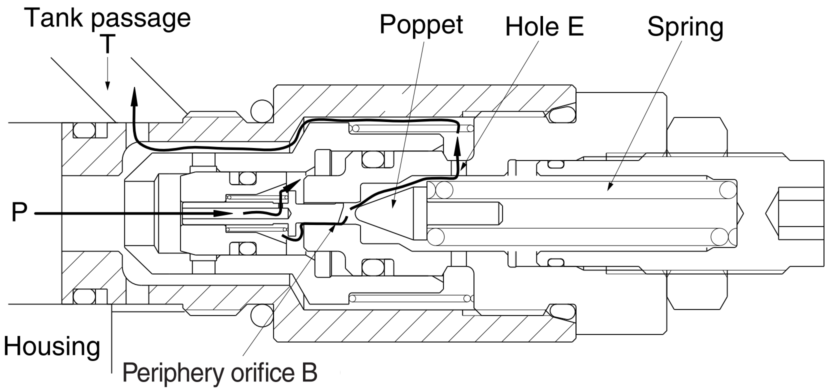
FUNCTION AS RELIEF VALVE

(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.



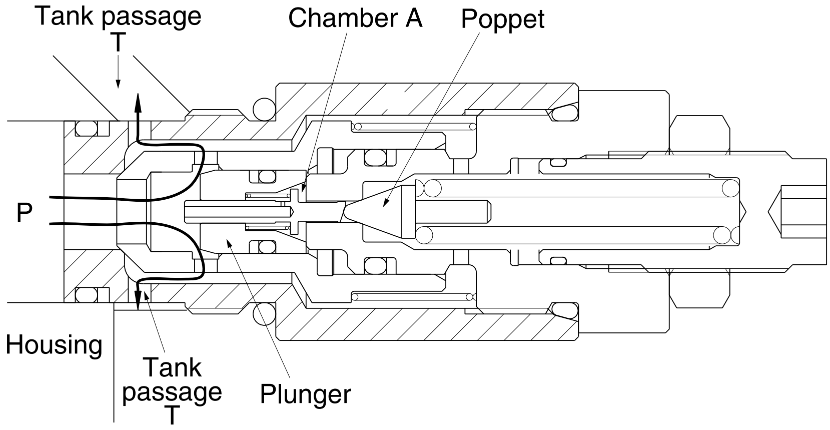
14W92MC41

(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.



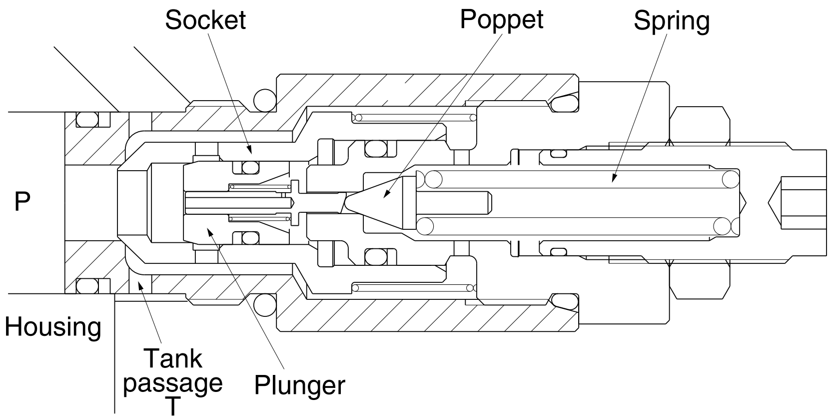
14W92MC42

(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

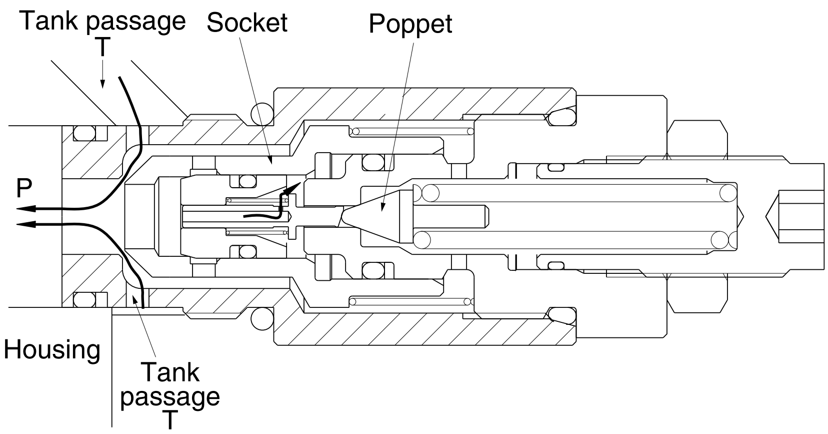
(4) The pressure at port P becomes lower than set pressure of the spring, the poppet is seated by spring force. Then the pressure at port P becomes equal to set pressure of the spring and the plunger is seated to the socket.



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.



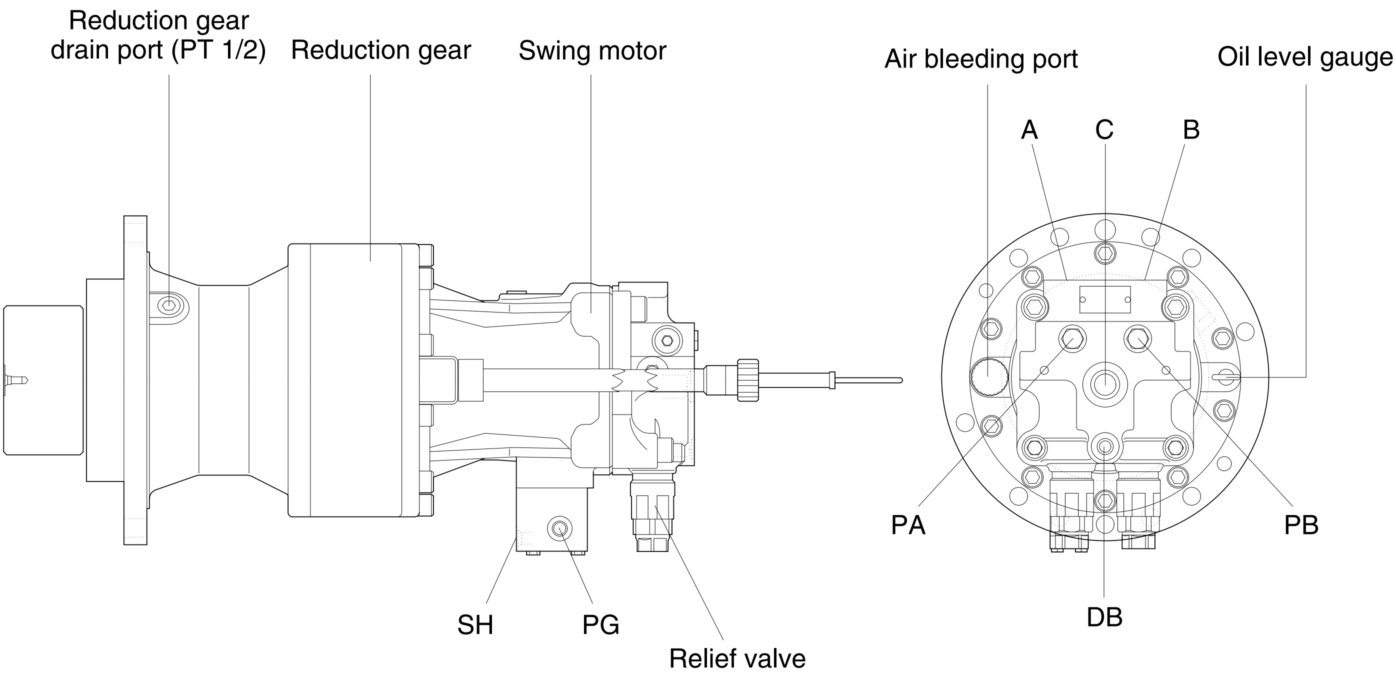
14W92MC45

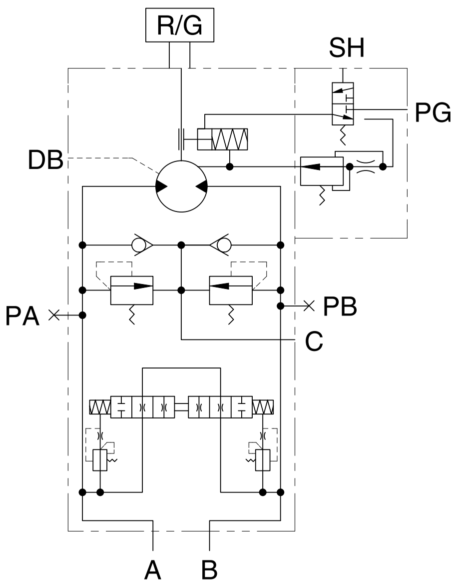
GROUP 3 SWING DEVICE

1. STRUCTURE

Swing device consists swing motor, and swing reduction gear.

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



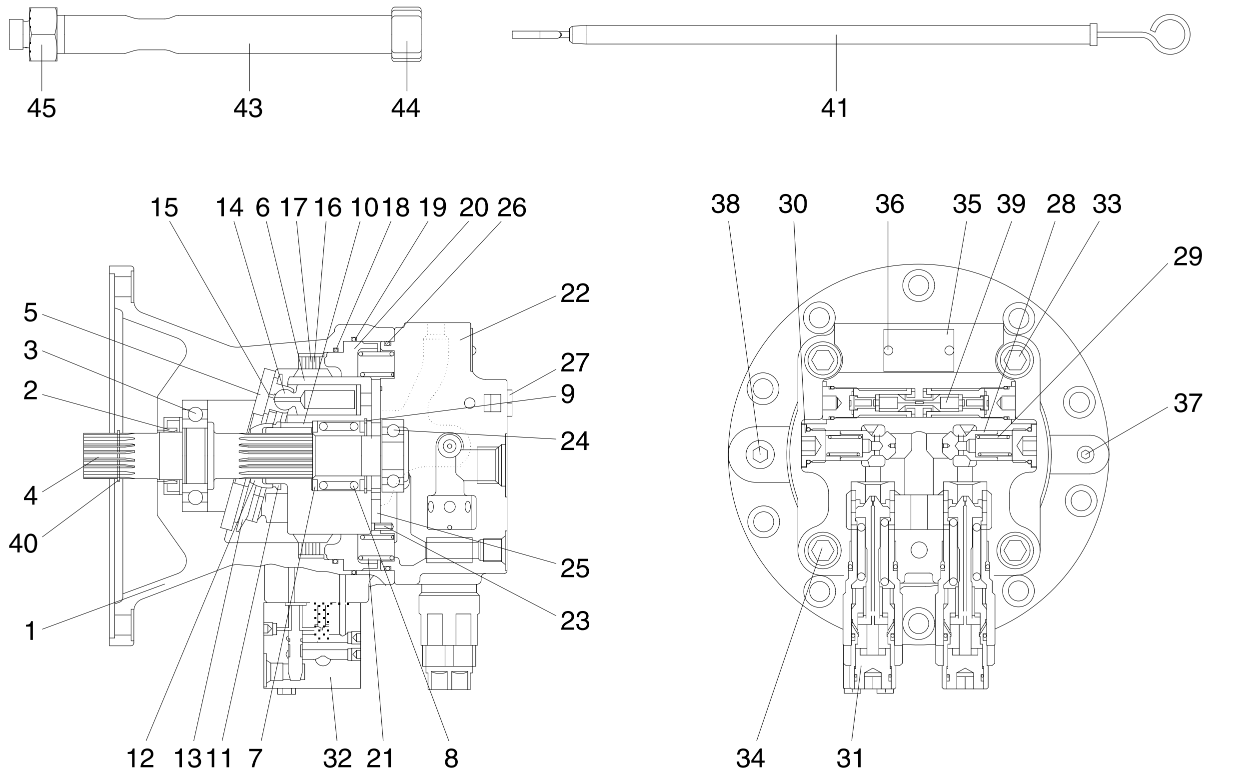


Hydraulic circuit

Port	Port name	Port size
A	Main port	Ø13
B	Main port	Ø13
DB	Drain port	PF 3/8
C	Make up port	PF 3/4
PG	Brake release stand by port	PF 1/4
SH	Brake release pilot port	PF 1/4
PA, PB	Gauge port	PF 1/4
Au	Air vent port	PF 1/2

145WF2SM80E

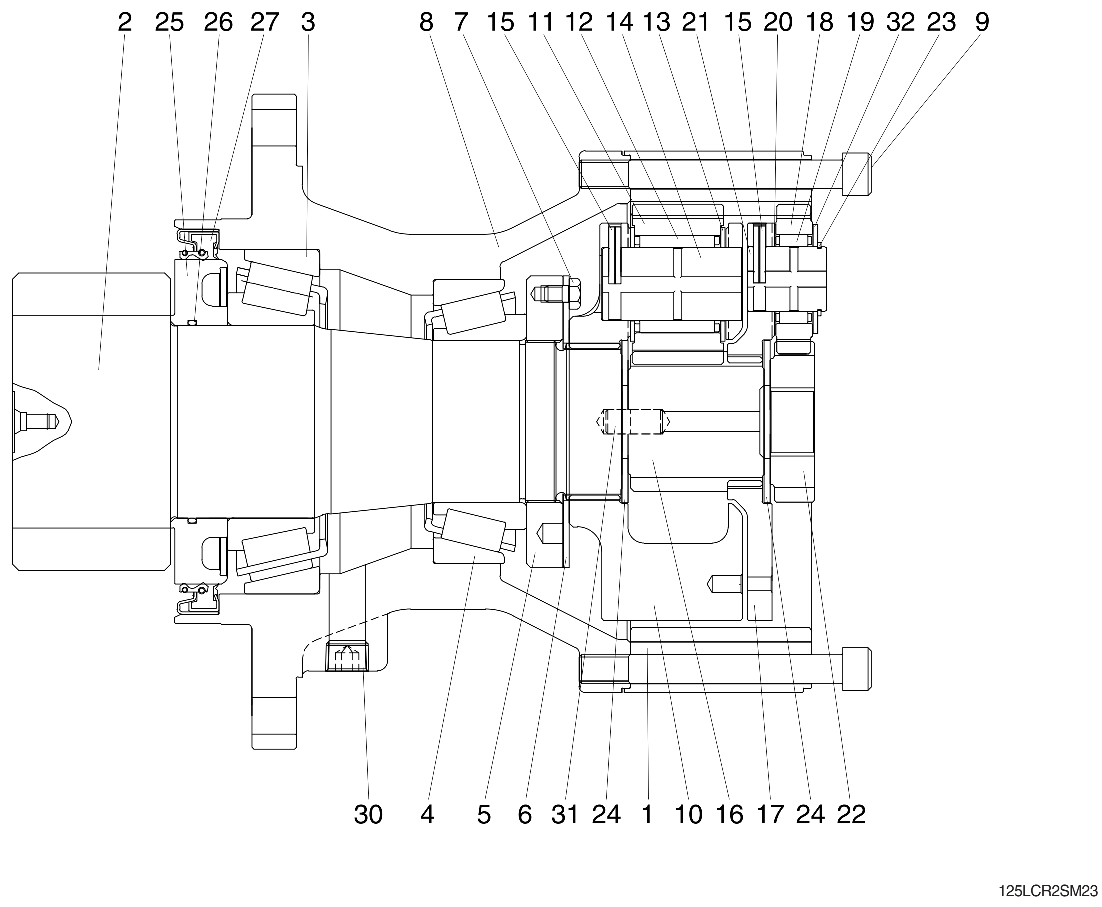
1) SWING MOTOR



145WF2SM81

1	Casing	16	Separate plate	31	Relief valve assy
2	Oil seal	17	Friction plate	32	Brake valve assy
3	Ball bearing	18	O-ring	33	Socket bolt
4	Drive shaft	19	O-ring	34	Socket bolt
5	Shoe plate	20	Brake piston	35	Name plate
6	Cylinder block	21	Spring	36	Screw
7	Washer	22	Valve casing	37	Plug
8	Spring	23	Spring pin	38	Plug
9	Snap ring	24	Ball bearing	39	Reactionless valve assy
10	Roller	25	Valve plate	40	Snap ring
11	Collar washer	26	O-ring	41	Level gauge
12	Thrust ball	27	Plug	42	pipe
13	Retainer plate	28	Plunger	43	Bar
14	Piston	29	Spring	44	Cap
15	Shoe	30	Plug	45	Reducer

2) REDUCTION GEAR

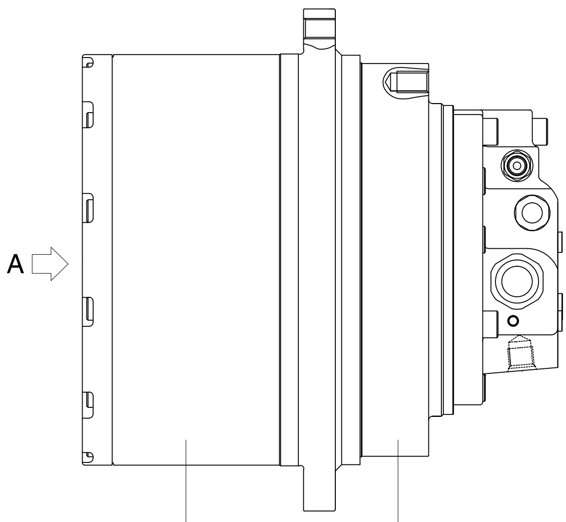


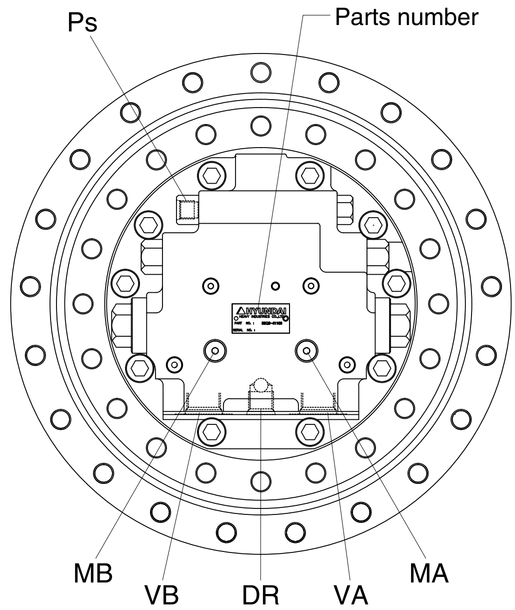
1	Ring gear	11	Planetary gear No. 2	21	Carrier pin No. 1
2	Drive shaft	12	Needle bearing No. 2	22	Sun gear No. 1
3	Taper roller bearing	13	Thrust washer No. 2	23	Snap ring
4	Taper roller bearing	14	Carrier pin No. 2	24	Thrust plate
5	Ring nut	15	Spring pin	25	Sleeve
6	Lock plate	16	Sun gear No. 2	26	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

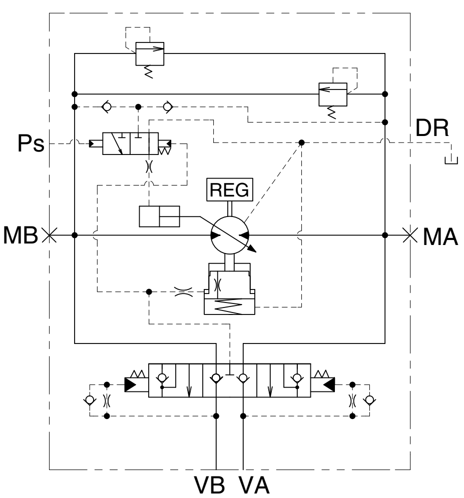
1. CONSTRUCTION

Travel device consists travel motor and gear box.

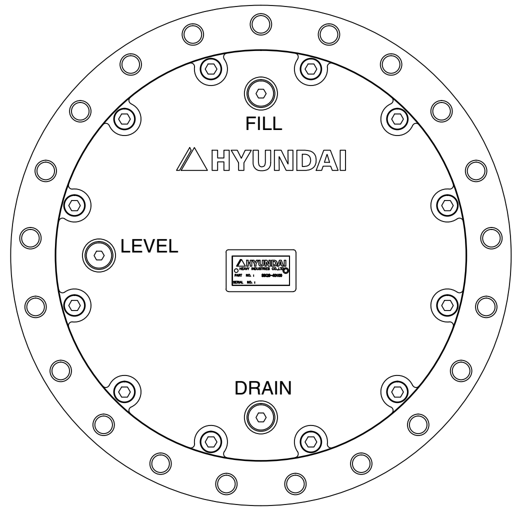
Travel motor includes brake valve, parking brake and high/low speed changeover mechanism.







Hydraulic circuit

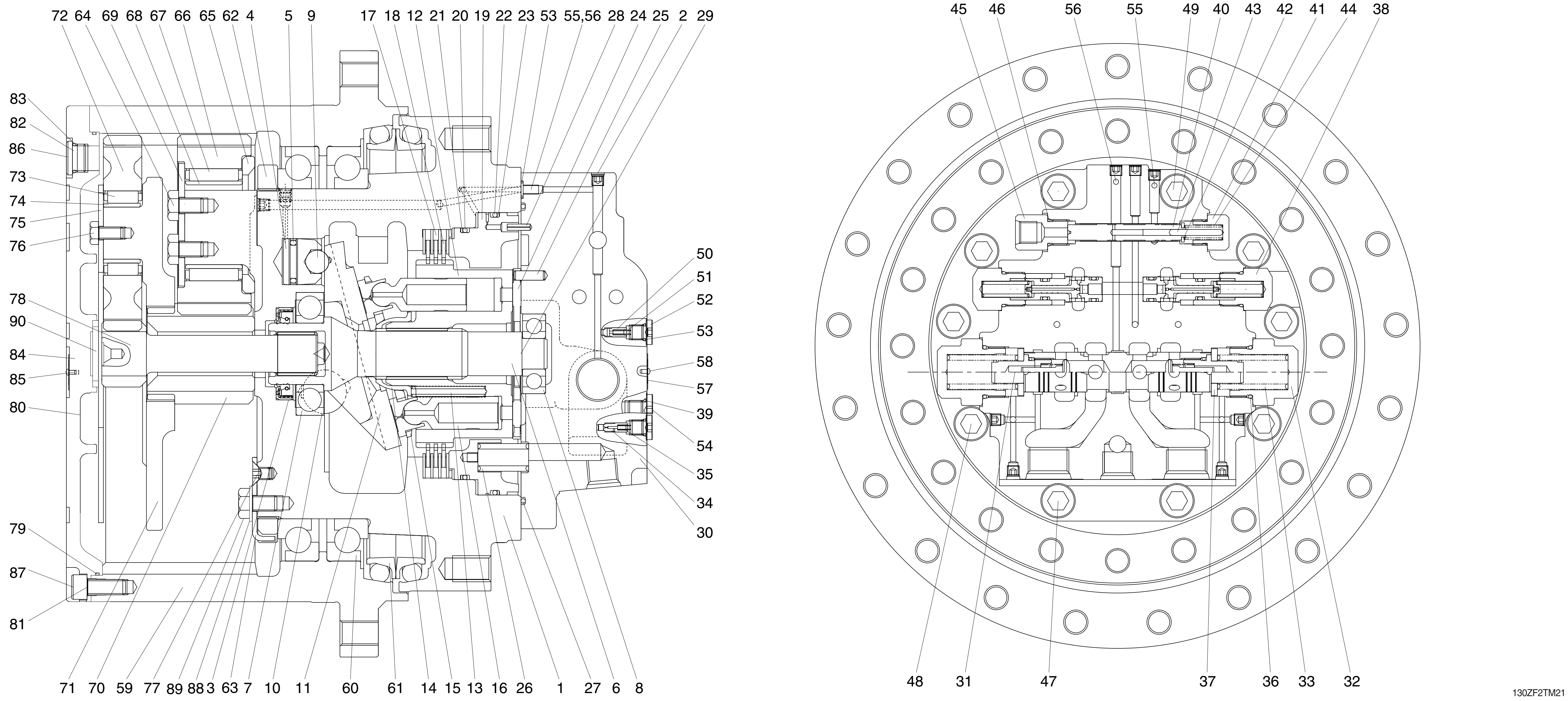


VIEW A

140LC2TM20

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

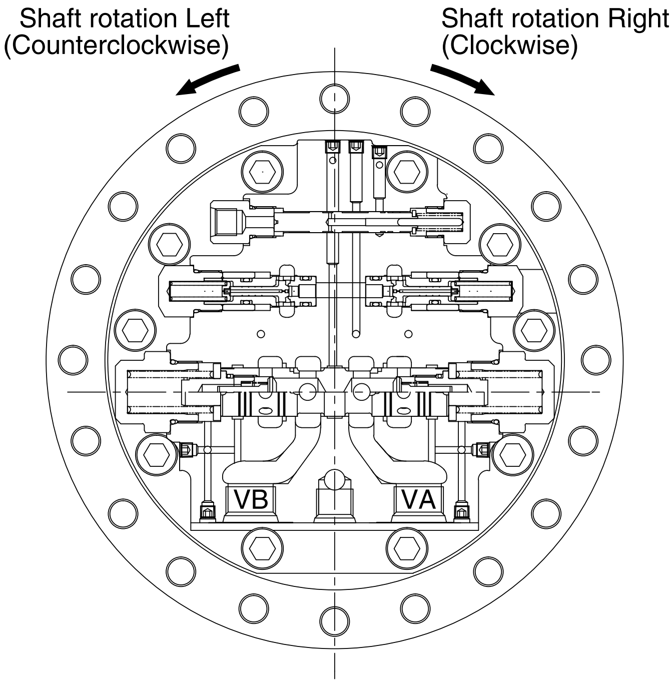


1	Casing
2	Plug
3	Oil seal
4	Piston
5	Piston seal
6	Shaft
7	Front ball bearing
8	Rear ball bearing
9	Steel ball
10	Pivot
11	Swash plate
12	Cylinder block
13	Spring
14	Ball guide
15	Retainer plate
16	Piston assy
17	Friction plate
18	Separated plate
19	Parking piston
20	O-ring
21	Back up ring
22	O-ring
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	O-ring
80	Cover
81	Hex socket head bolt
82	Plug
83	O-ring
84	Name plate
85	Rivet
86	Rubber cap
87	Rubber cap
88	Plain washer
89	Hexagon bolt
90	Thrust plate

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

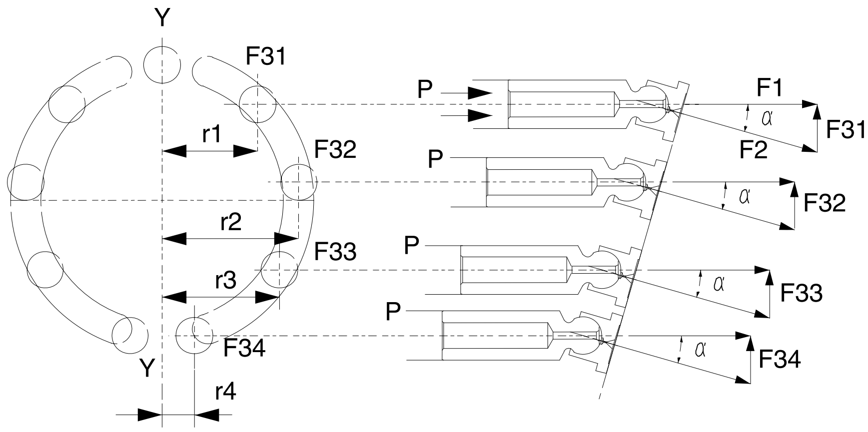
As shown in below figure, high pressure oil is supplied to the pistons which are on one side of the line Y-Y that connects upper and lower dead points and produces force F1.

F1 = P × 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).

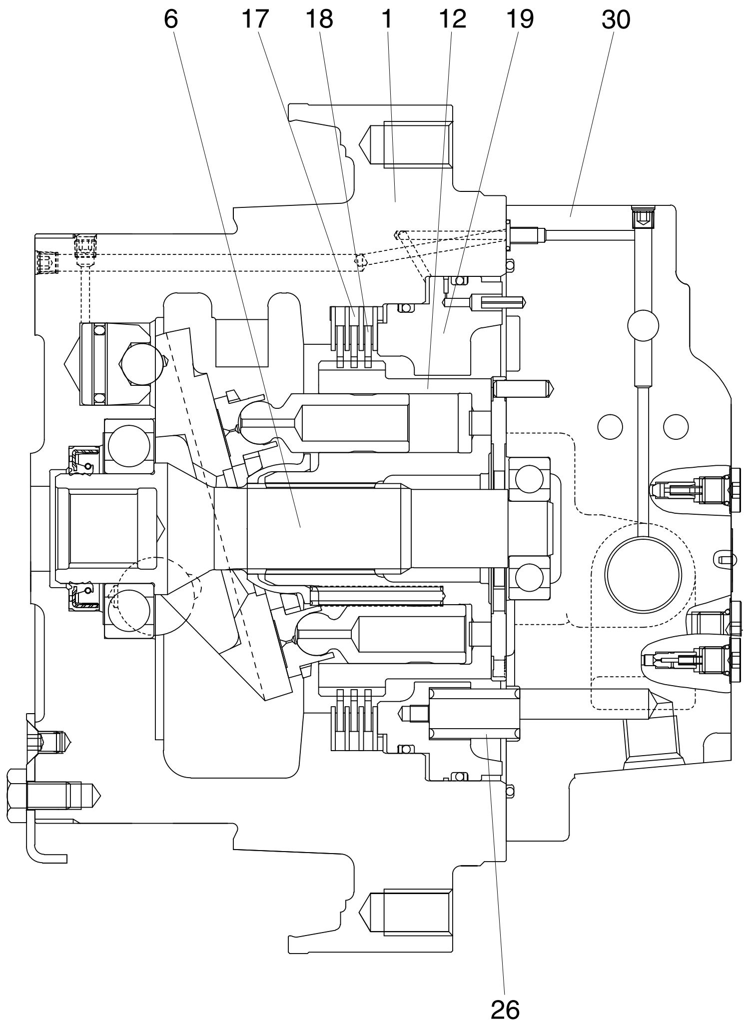


29092TM07

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 pivot (10) as shown by dotted lines. The turn stops at the stopper (1-1) of casing and swash plate (11) keeps the position.

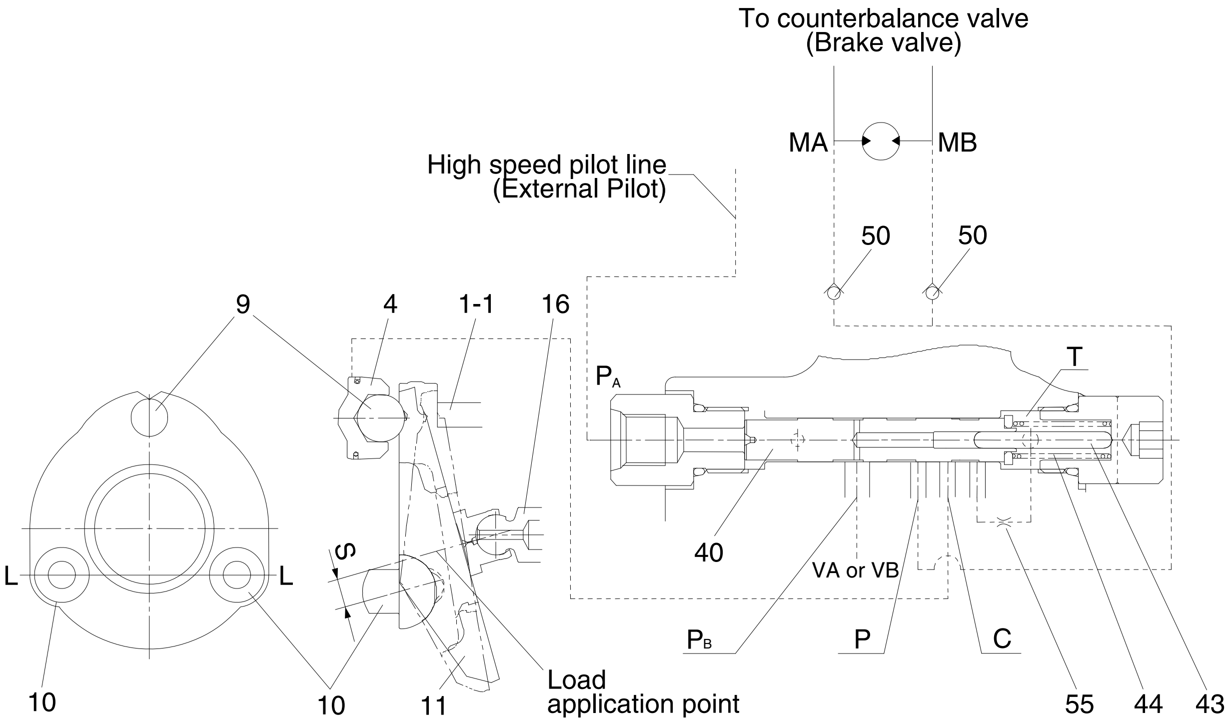
In this case, the piston stroke become shorter and motor capacity become smaller and motor rotates faster, around 1.60 times, by the same volume of oil.

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.

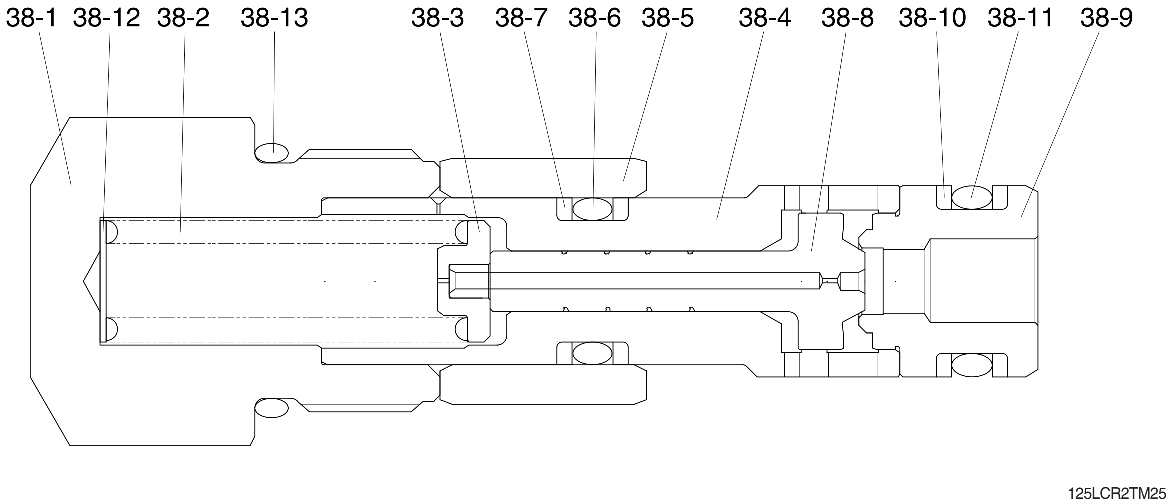


125LCR2TM19

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.



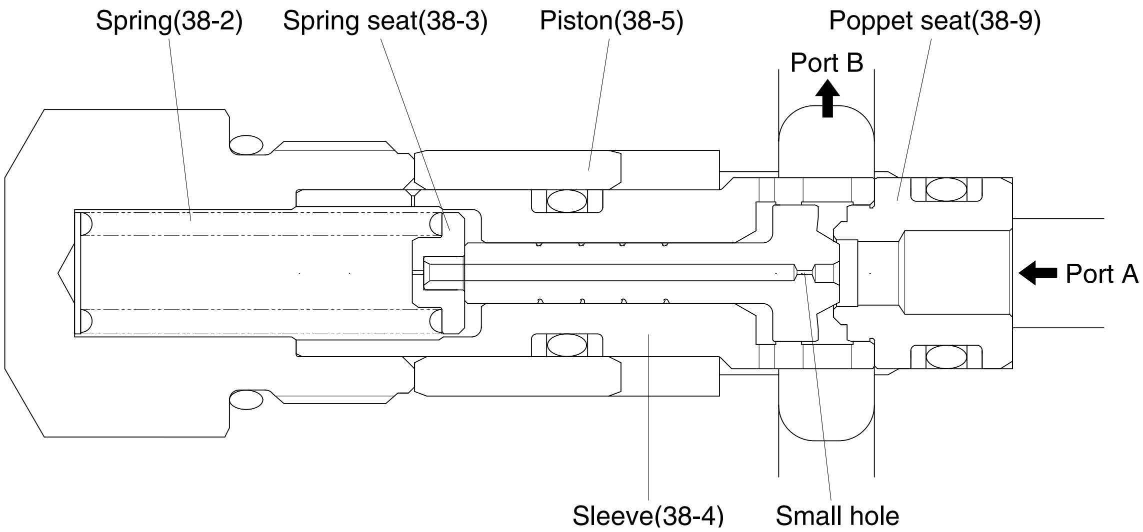
38-1	Plug	38-6	O-ring	38-11	O-ring
38-2	Spring	38-7	Back-up ring	38-12	Ring
38-3	Spring seat	38-8	Poppet	38-13	O-ring
38-4	Sleeve	38-9	Poppet seat		
38-5	Piston	38-10	Back-up ring		

(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:

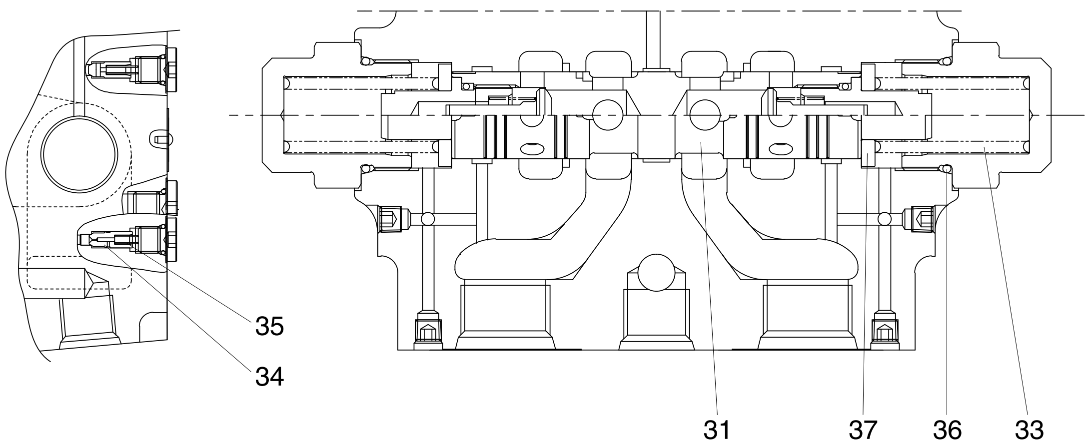
① Spool

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 2-67, (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

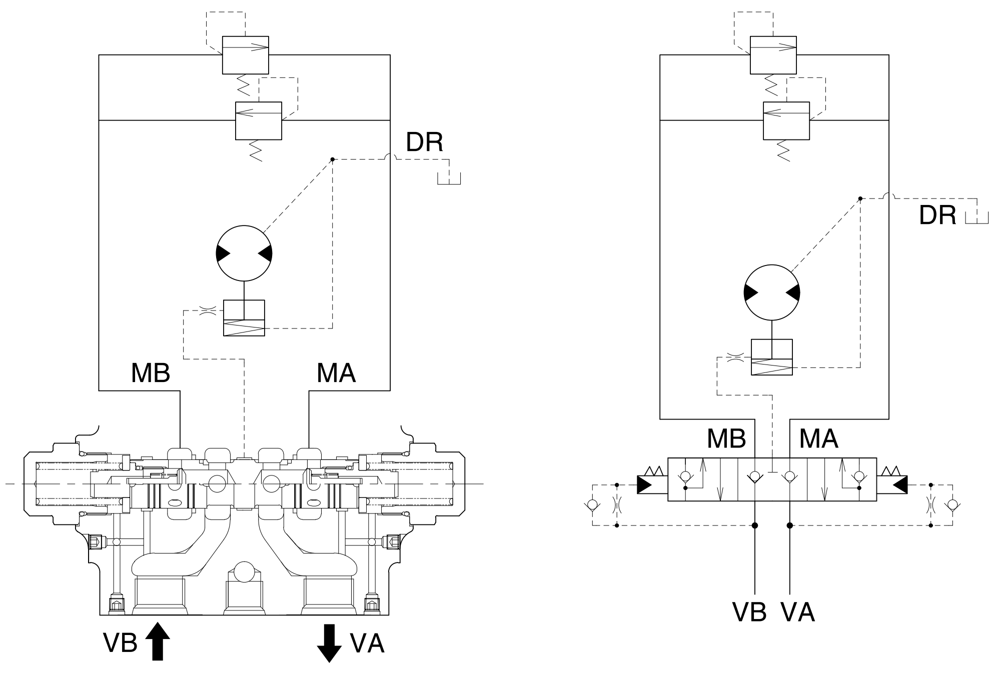
(2) Operation

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.



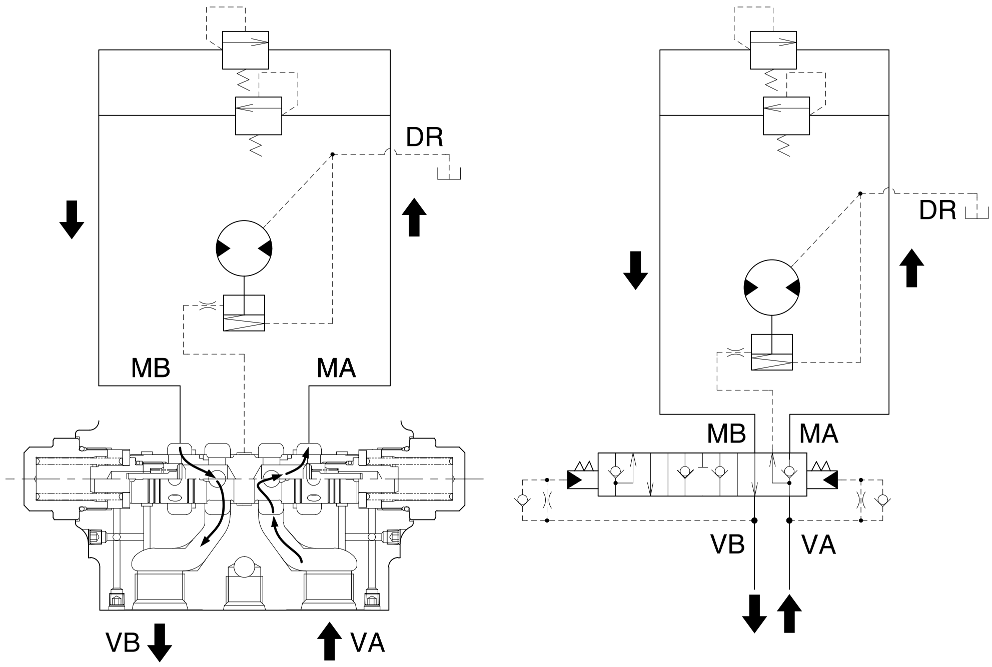
125LCR2TM29

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.



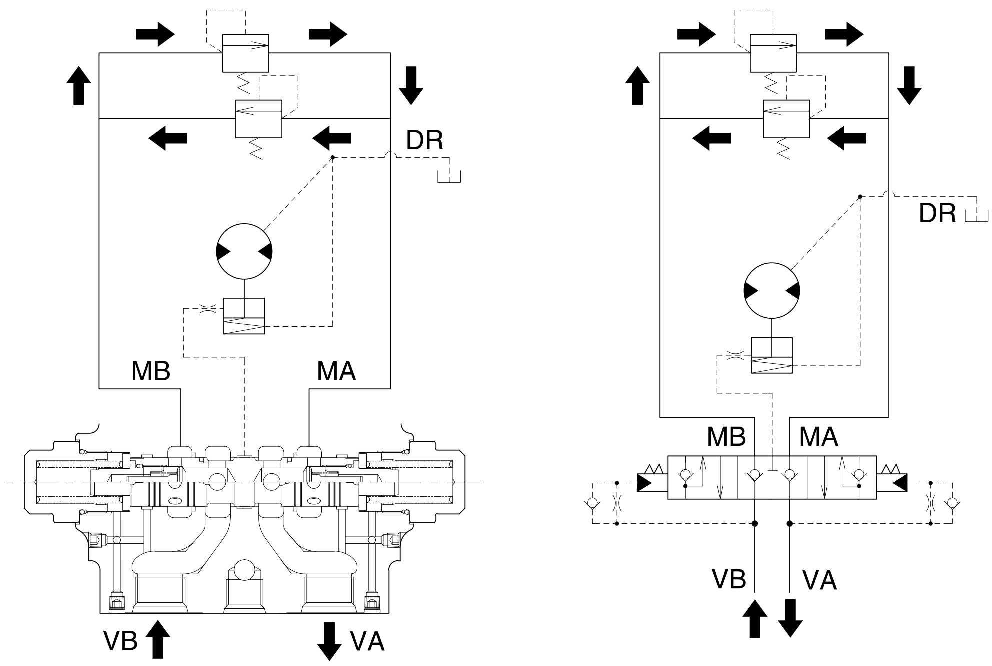
125LCR2TM30

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.



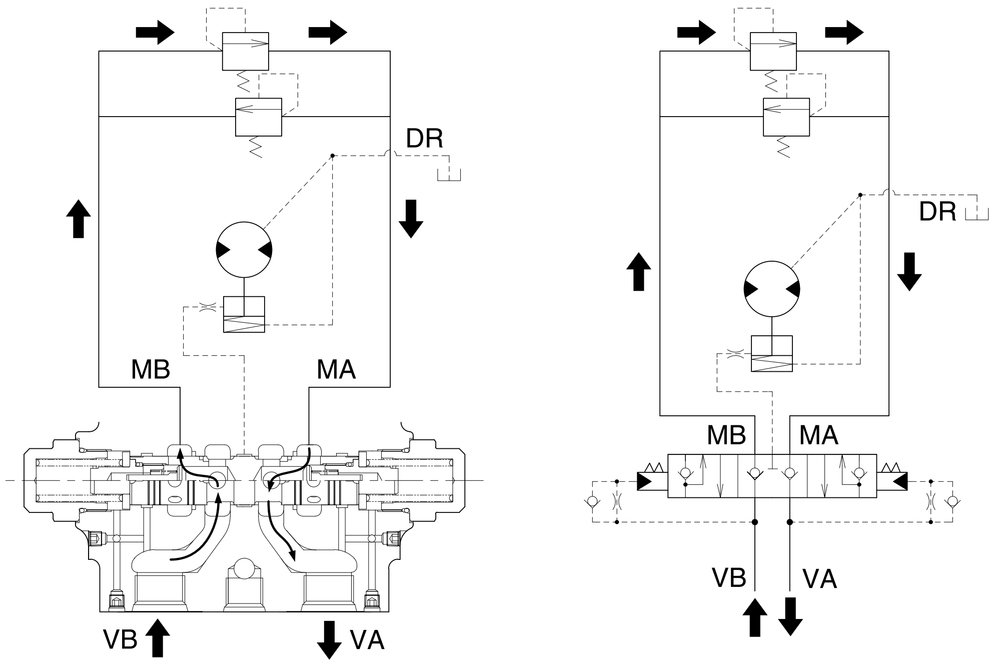
125LCR2TM31

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.

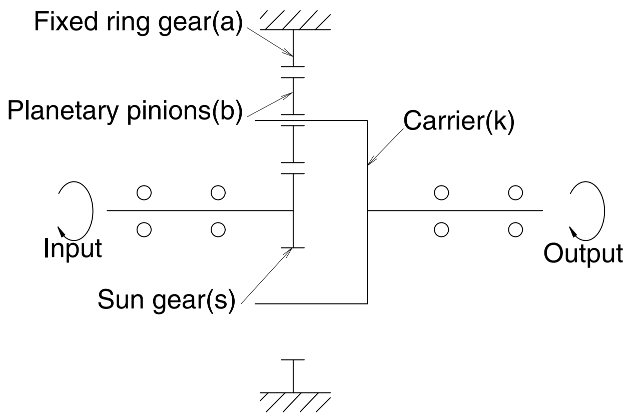
This reduction unit utilizes two stages, planetary reduction system.

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

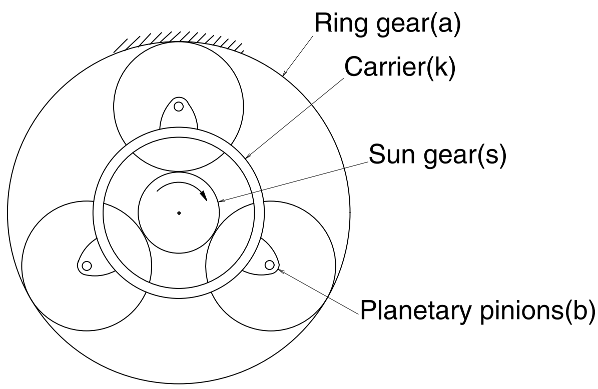
When the sun gear (s) is driven through input shaft, planetary pinions (b), rotating on their center, also move, meshing with fixed ring gear (a), around sun gear (s).

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

This mechanism is called planetary gear mechanism.



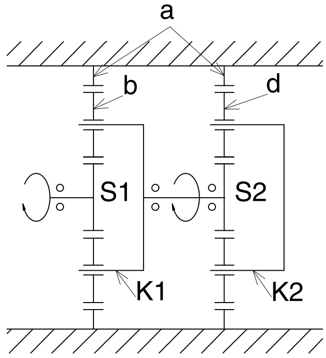
29072TM10



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.



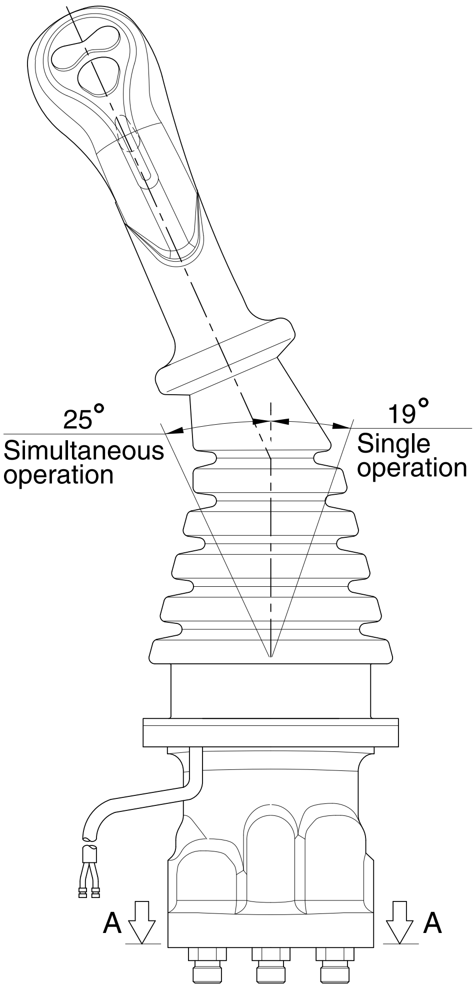
29072TM12

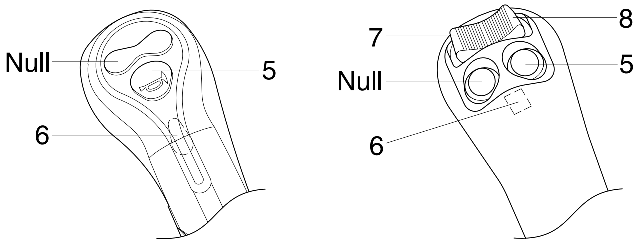
1. STRUCTURE

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, M10



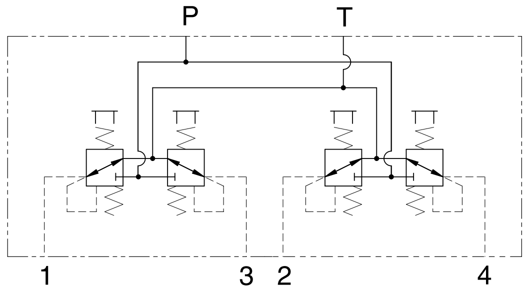


TYPE M1 TYPE M10

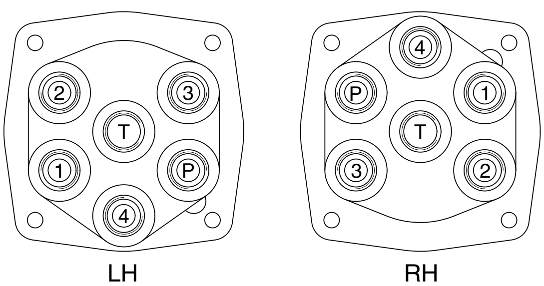
Switches

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



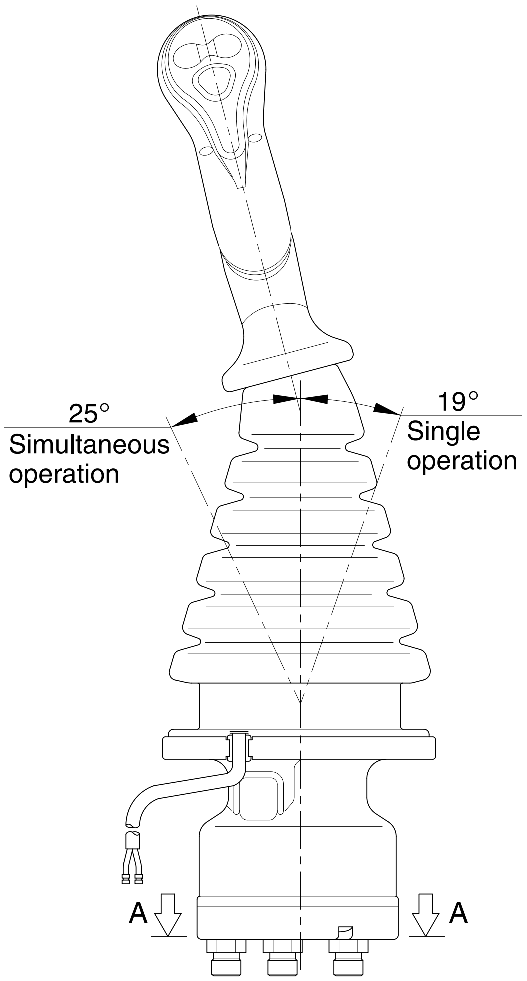
VIEW A-A

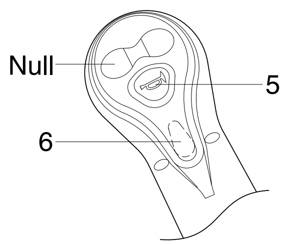
Pilot ports

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	

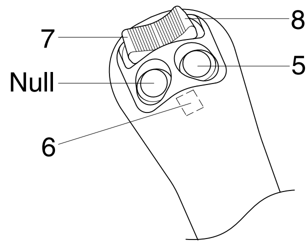
235ZF2RL01

2) TYPE M12, M11





TYPE M12

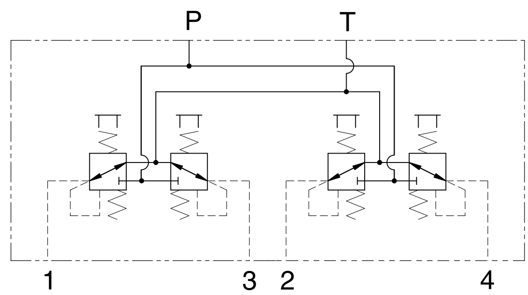


TYPE M11

Switches

Type	No.	LH	RH
M12	5	One touch decel	Horn
	6	Power boost	Breaker
M11	5	One touch decel	Horn
	6	Power boost	Null
	7	CCW rotation	Close
	8	CW rotation	Open

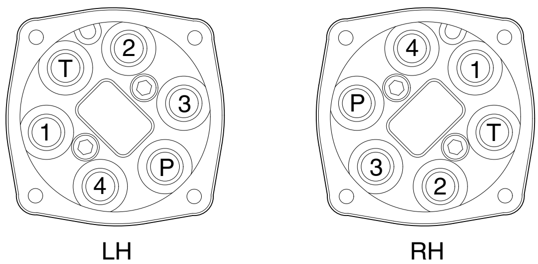
※ Number 7 and 8 : Option attachment



Hydraulic circuit

Pilot ports

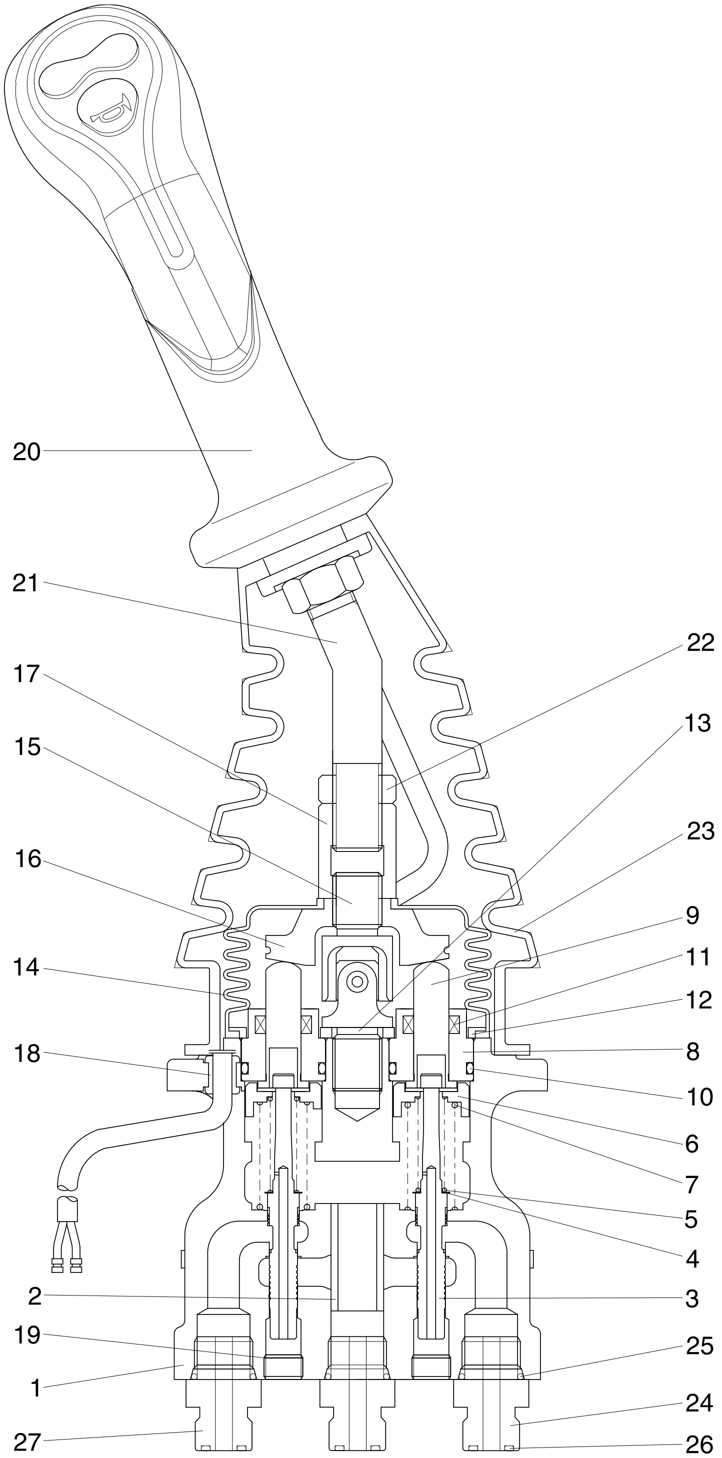
Port	LH	RH	Port size
P	Pilot oil inlet port	Pilot oil inlet port	PF 3/8
T	Pilot oil return port	Pilot oil return port	
1	Left swing port	Bucket out port	
2	Arm out port	Boom up port	
3	Right swing port	Bucket in port	
4	Arm in port	Boom down port	



VIEW A-A

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.

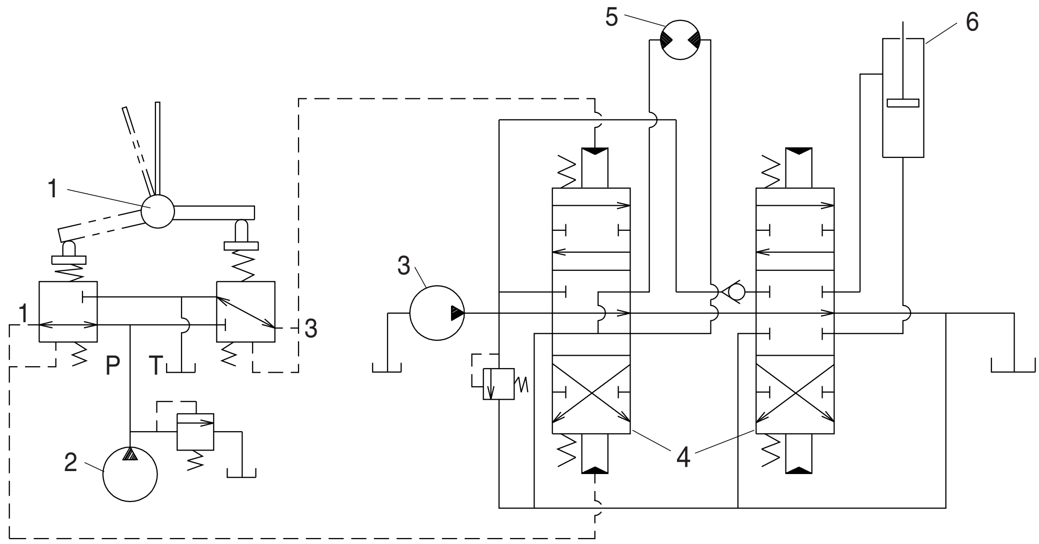
The spring (7) works on the case (1) and spring seat (6) and tries to return the push rod (9) to the zero-displacement position irrespective of the output pressure, securing its resetting to the center position.

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.

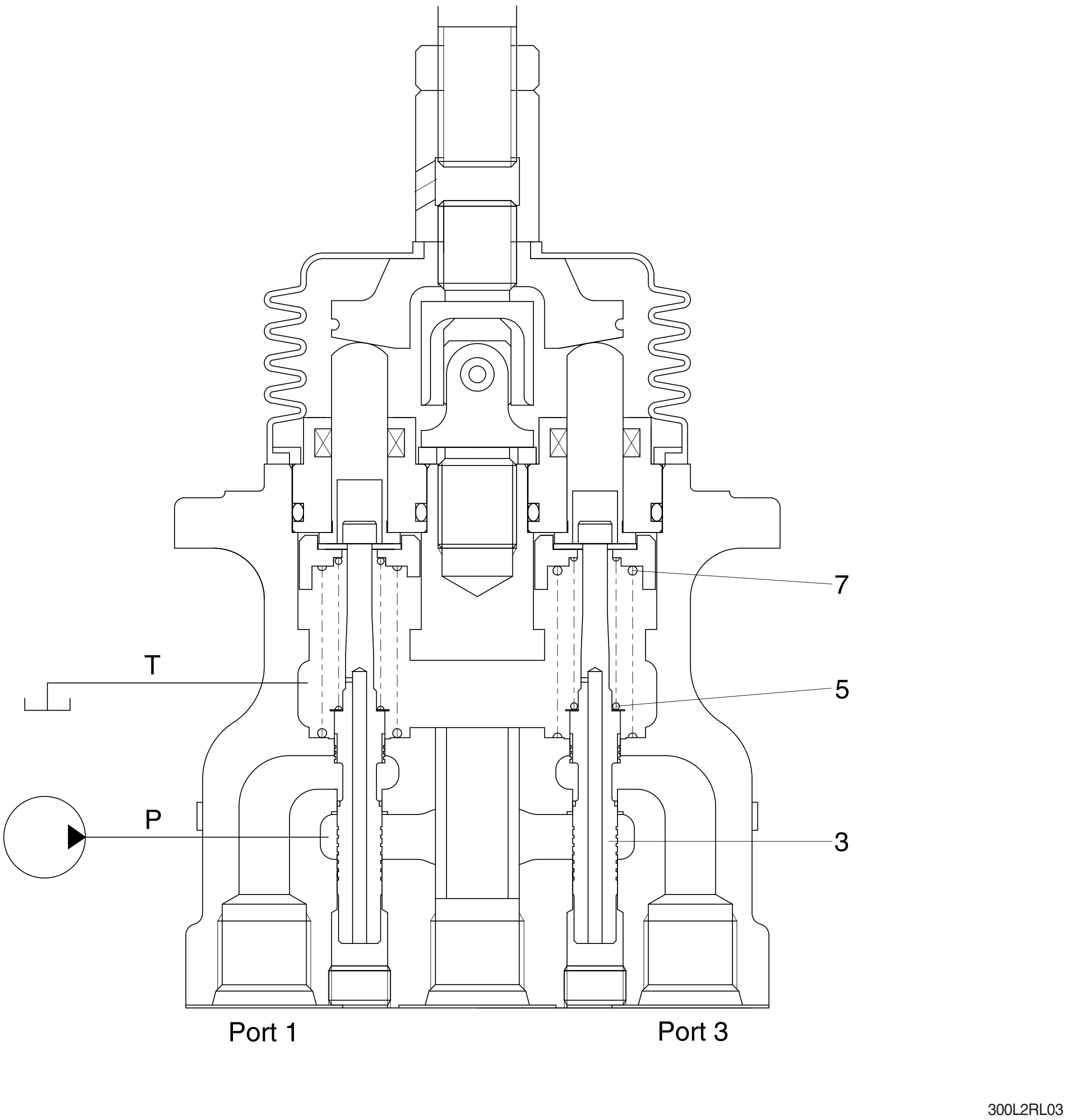
The diagram shown below is the typical application example of the pilot valve.



2-70

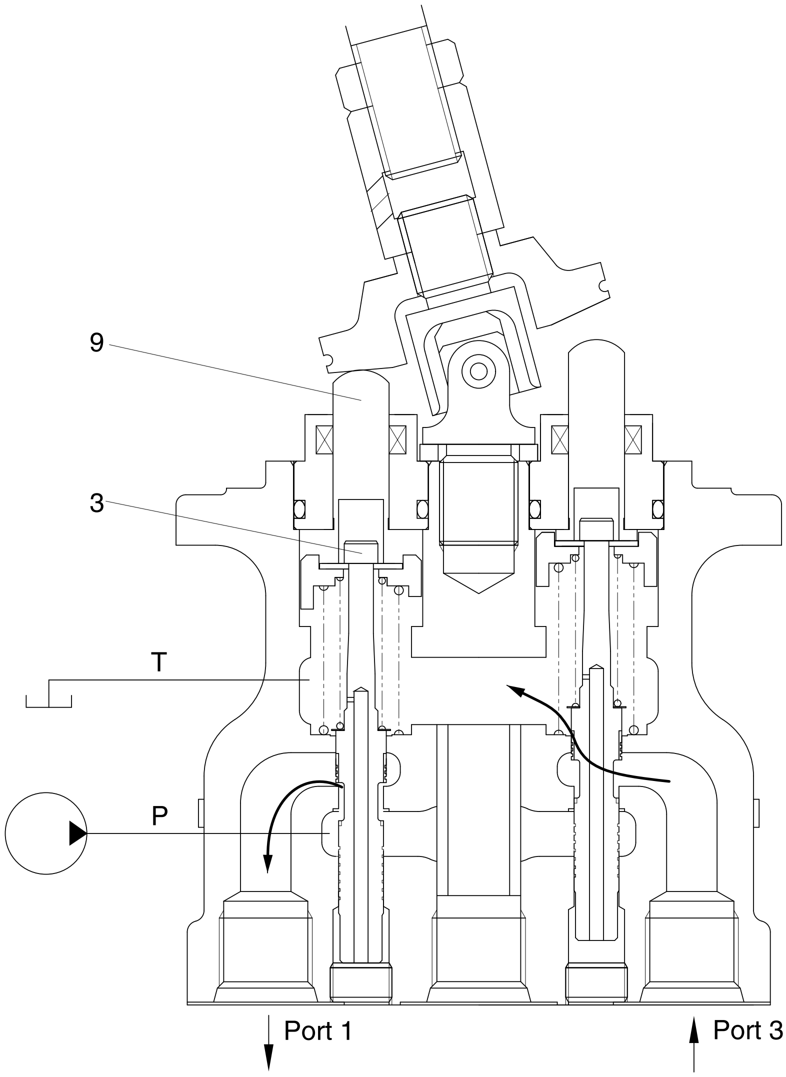
1	Pilot valve	3	Main pump	5	Hydraulic motor
2	Pilot pump	4	Main control valve	6	Hydraulic cylinder

(1) Case where handle is in neutral position



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.

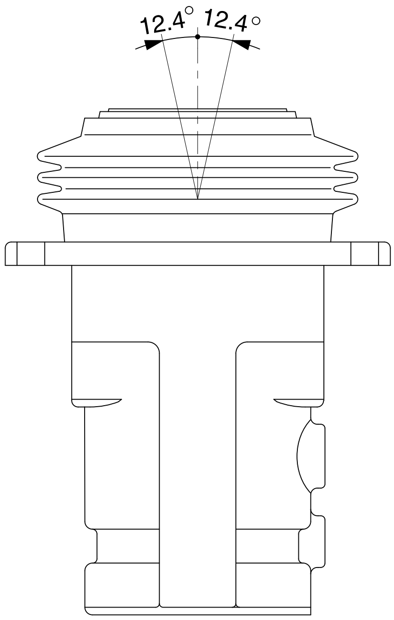
In this manner the secondary pressure is kept at the constant value.

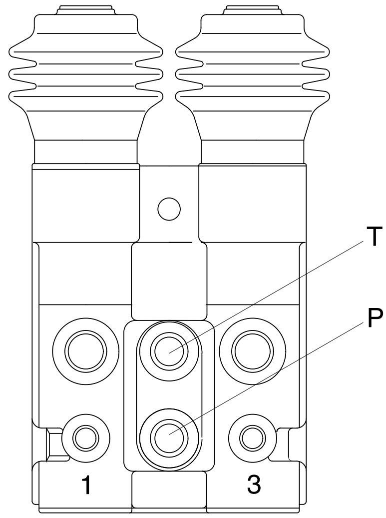
Besides, in some type, when the handle is tilted more than a certain angle, the upper end of the spool contacts with the inside bottom of the push rod and the output pressure is left to be connected with port P.

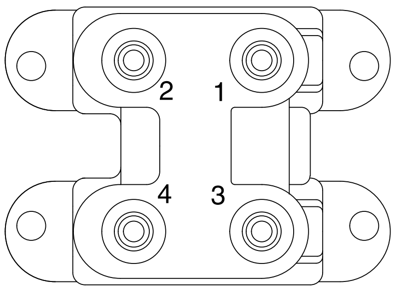
GROUP 6 RCV PEDAL

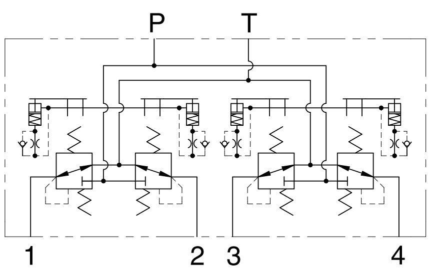
1. STRUCTURE

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)	

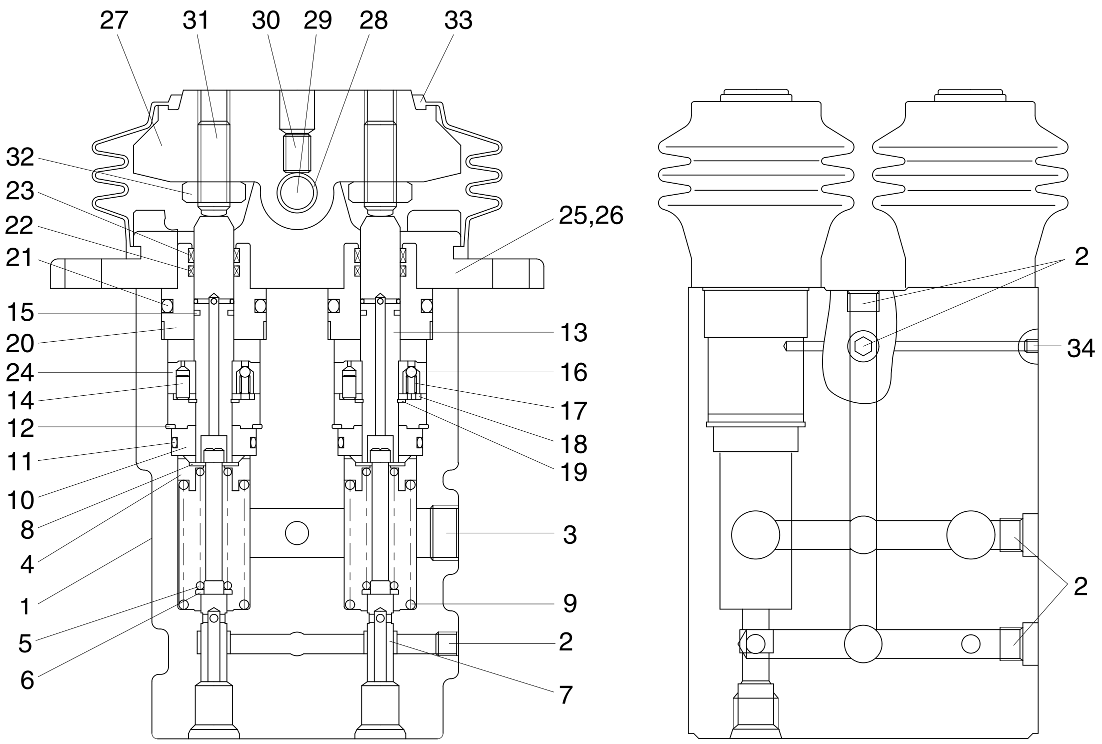
130ZF2RP01

CROSS SECTION

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

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

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



130ZF2RP02

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

2. FUNCTION

1) FUNDAMENTAL FUNCTIONS

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

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

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

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

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

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

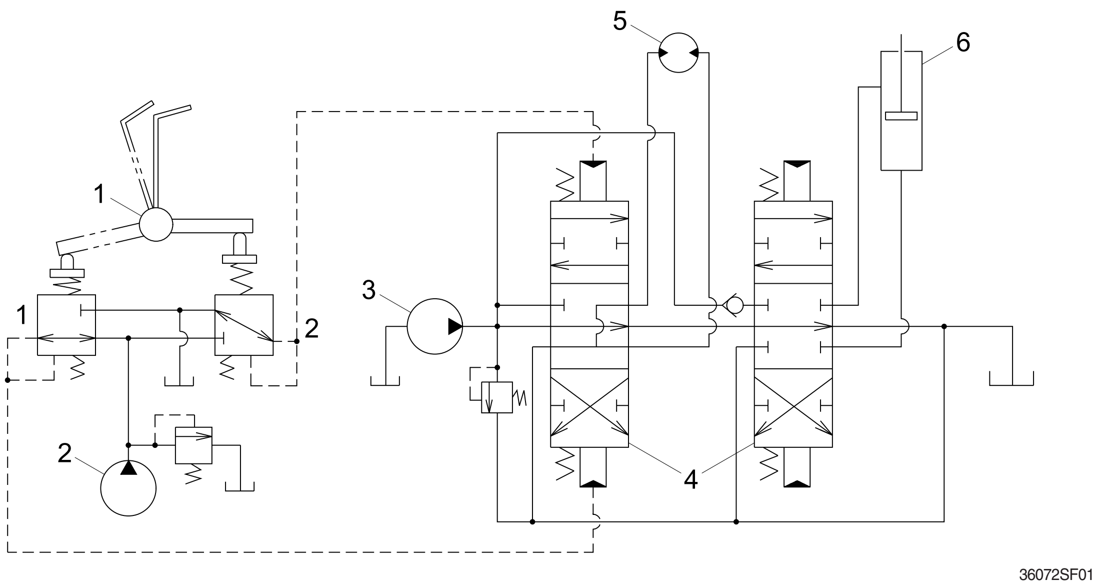
2) FUNCTIONS OF MAJOR SECTIONS

The functions of the spool (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 (13) is inserted and can slide in the plug (20).
For the purpose of changing th displacement of the push rod through the cam (27) and adjusting nut (32) are provided the pedal that can be tilted in any direction around the fulcrum of the cam (27) center.
The spring (9) works on the body (1) and spring seat (6) and tries to return the push rod (13) to the zero-displacement position irrespective of the output pressure, securing its resetting to the center position.
This also has the effect of a reaction spring to give appropriate control feeling to the operator.

3) OPERATION

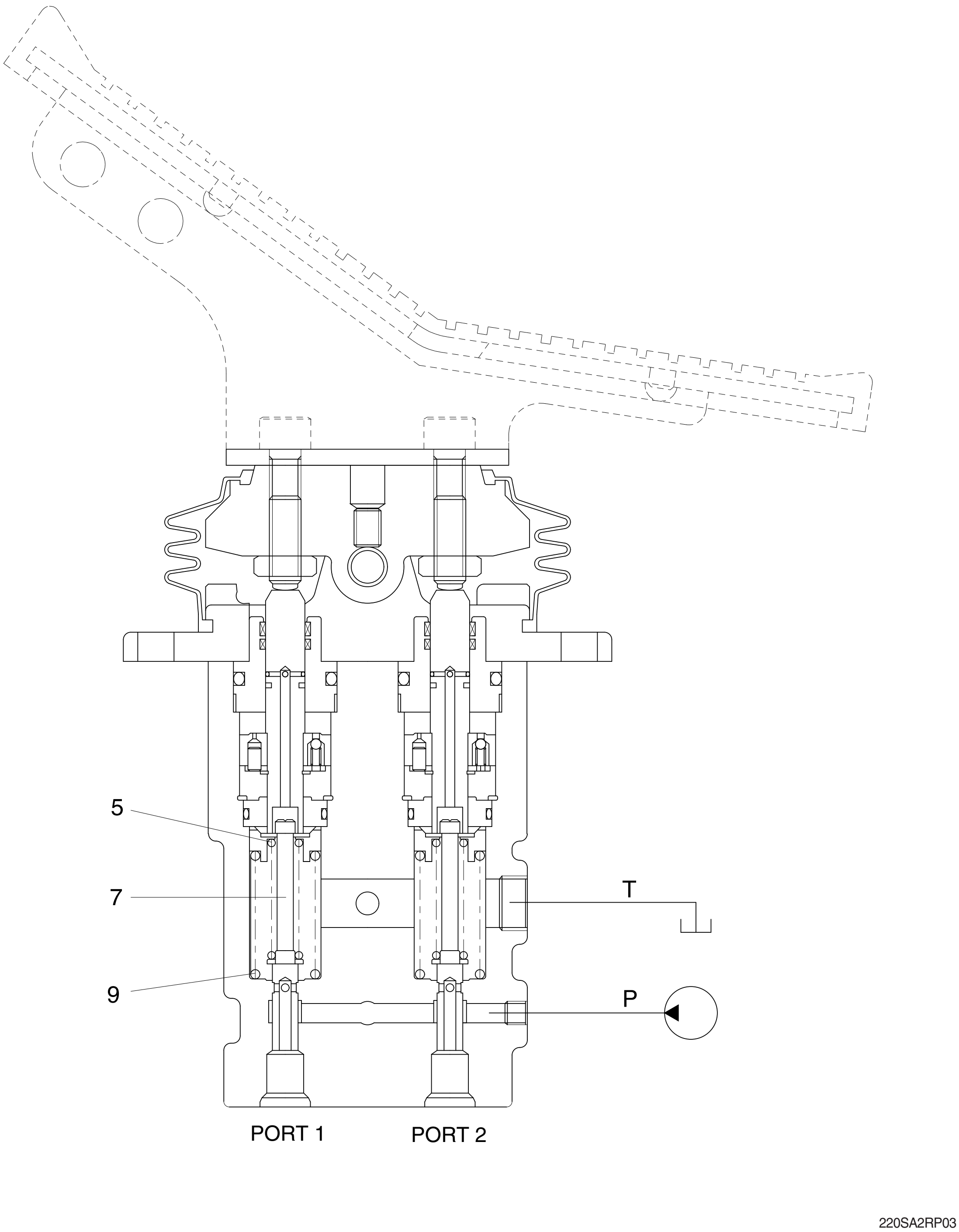
The operation of the pilot valve will be described on the basis of the hydraulic circuit diagram shown below and the attached operation explanation drawing.

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



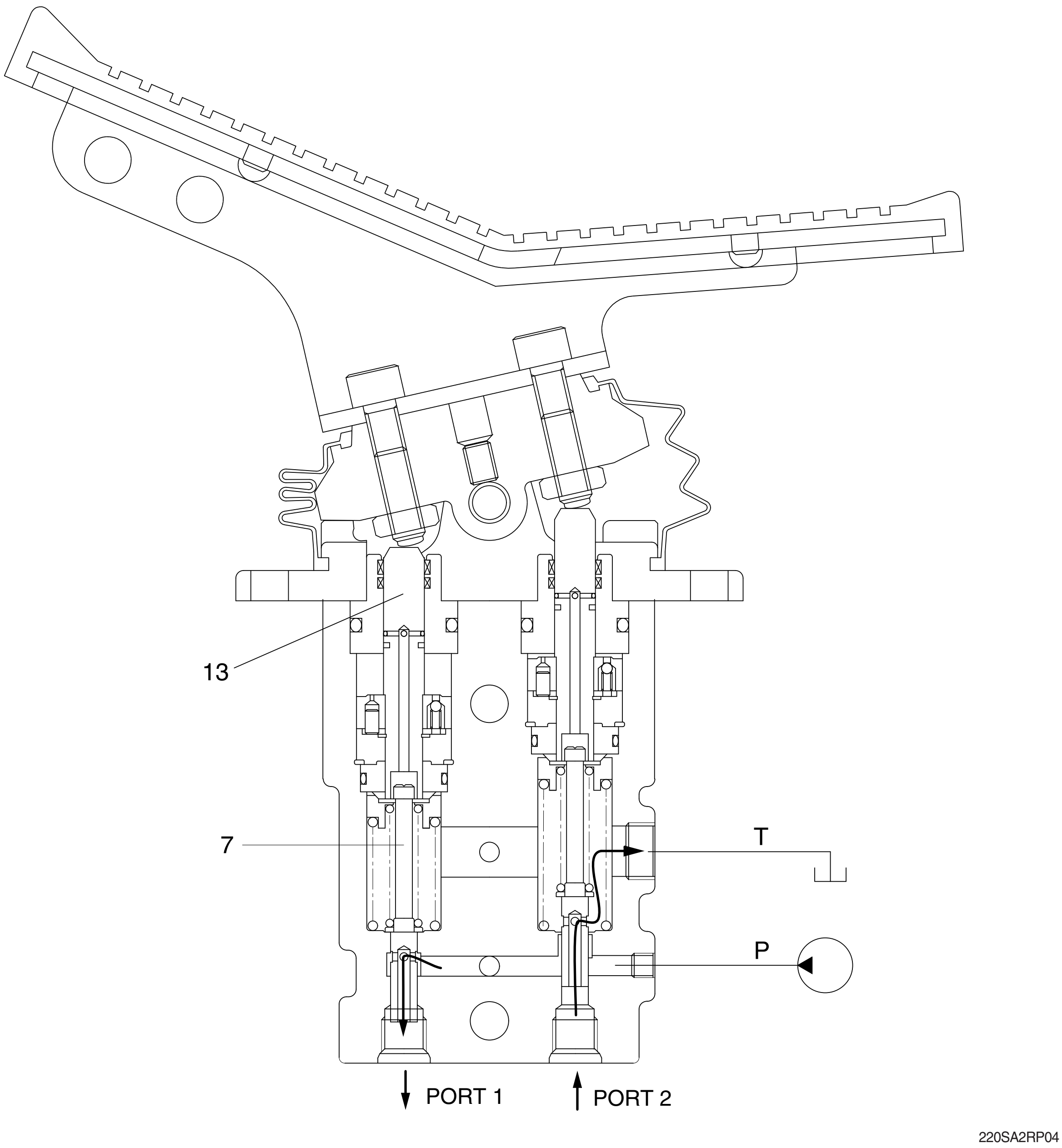
1	Pilot valve	3	Main pump	5	Hydraulic motor
2	Pilot pump	4	Main control valve	6	Hydraulic cylinder

(1) Case where pedal is in neutral position



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

(2) Case where pedal is tilted

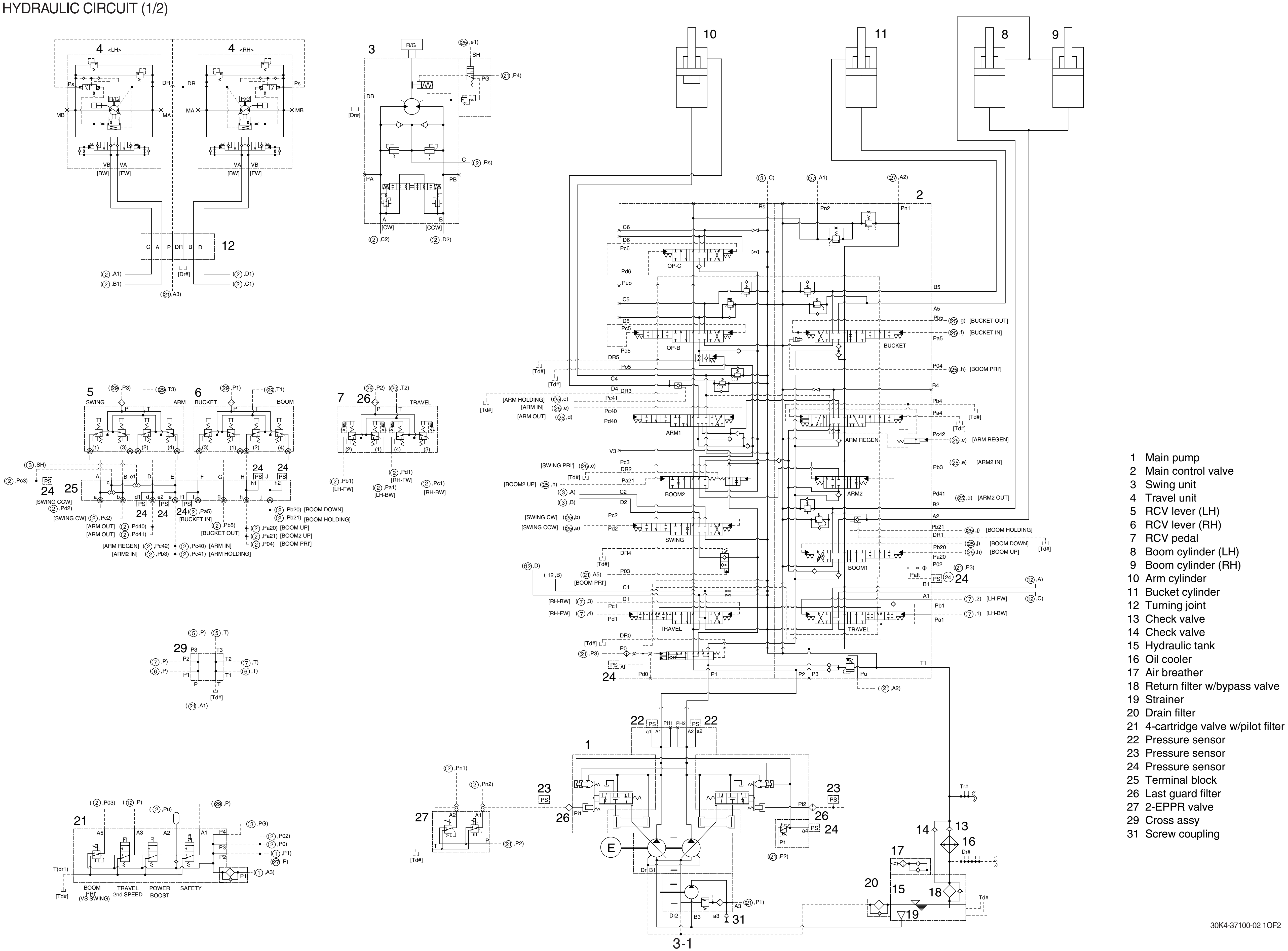


When the push rod (13) is stroked, the spool (7) moves downwards.
Then port P is connected with port 1, and the oil supplied from the pilot pump flows through port 1 to generate the pressure.
When the pressure at port 1 increases to the value corresponding to the spring force set by tilting the handle, the hydraulic pressure force balances with the spring force. If the pressure at port 1 increases higher than the set pressure, port P is disconnected from port 1 and port T is connected with port 1. If it decreases lower than the set pressure, port P is connected with port 1 and port T is disconnected from port 1.
In this manner the secondary pressure is kept at the constant value.
Besides, in some type, when the handle is tilted more than a certain angle, the upper end of the spool contacts with inside bottom of the push rod and the output pressure is left to be connected with port P.

SECTION 3 HYDRAULIC SYSTEM

GROUP 1 HYDRAULIC CIRCUIT

1. HYDRAULIC CIRCUIT (1/2)



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

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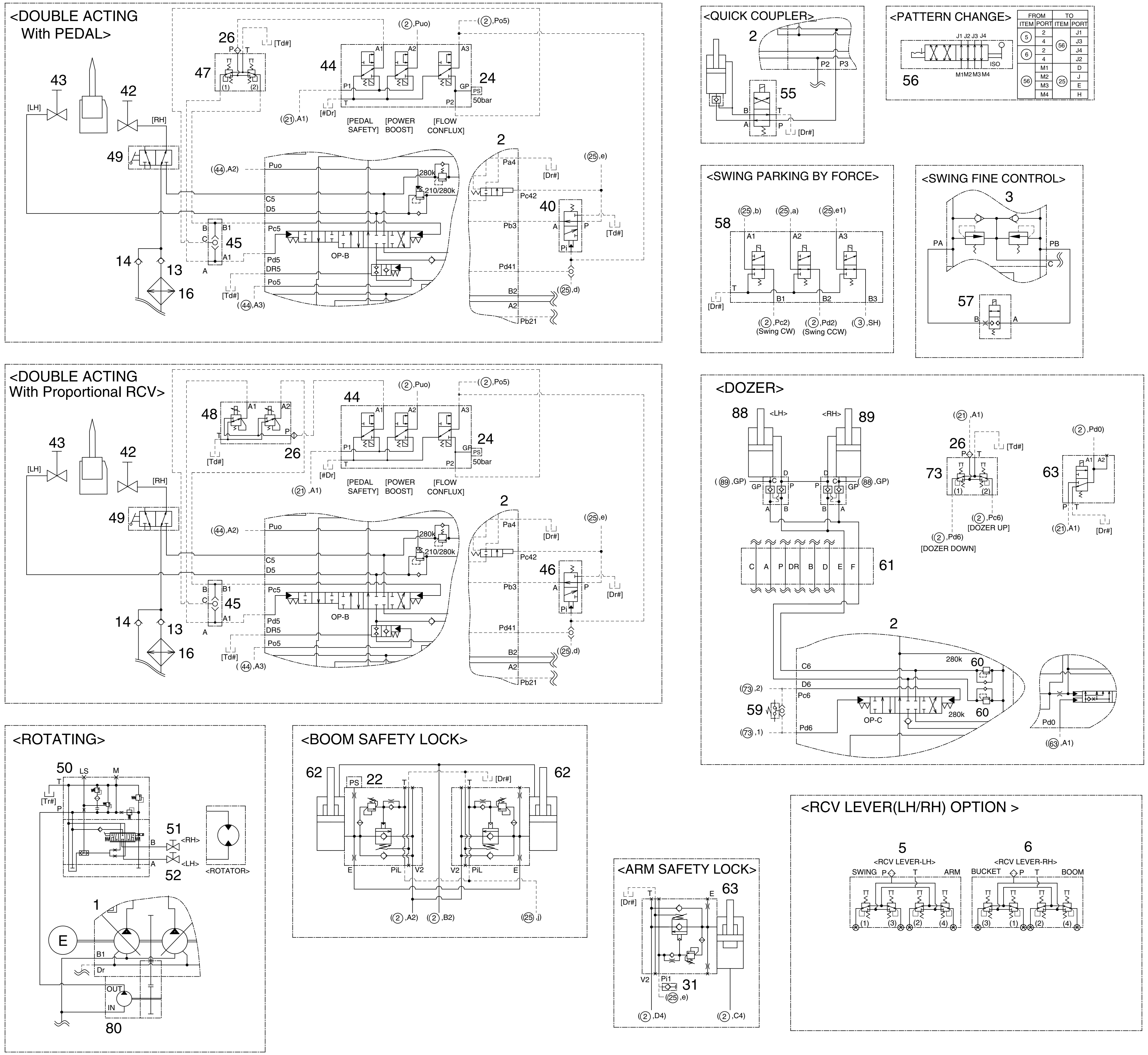
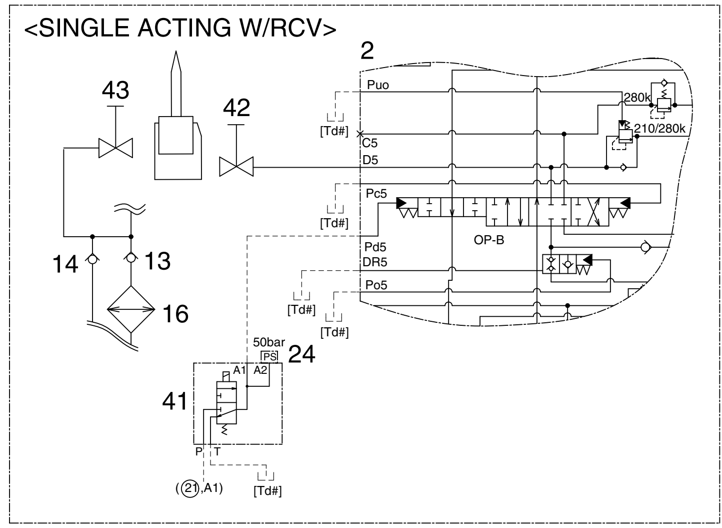
2. HYDRAULIC CIRCUIT (2/2)





1 Main pump
2 Main control valve
3 Swing unit
5 RCV lever (LH)
6 RCV lever (RH)
13 Check valve
14 Check valve
16 Oil cooler
22 Pressure sensor
24 Pressure sensor
26 Last guard filter
41 Solenoid valve (option)
42 Stop valve (option)
43 Stop valve (option)
44 Solenoid valve (option)
45 Shuttle valve (option)
46 Pilot selector valve (option)
47 2 way pedal (option)
48 EPPR valve assy (option)
49 3 way valve (option)
50 Proportional valve (option)
51 Stop valve (option)
52 Stop valve (option)
53 Boom cylinder safety valve (option)
54 Arm cylinder safety valve (option)
55 Solenoid valve (option)
56 Pattern change valve (option)
57 Solenoid valve (option)
58 3 solenoid valve (option)
59 Pressure switch (option)
60 Proportional relief valve (option)
61 Turning joint-dozer (option)
63 Solenoid valve (option)
73 Dozer valve (option)
80 Gear pump (option)
88 Dozer cylinder (LH, option)
89 Dozer cylinder (RH, option)

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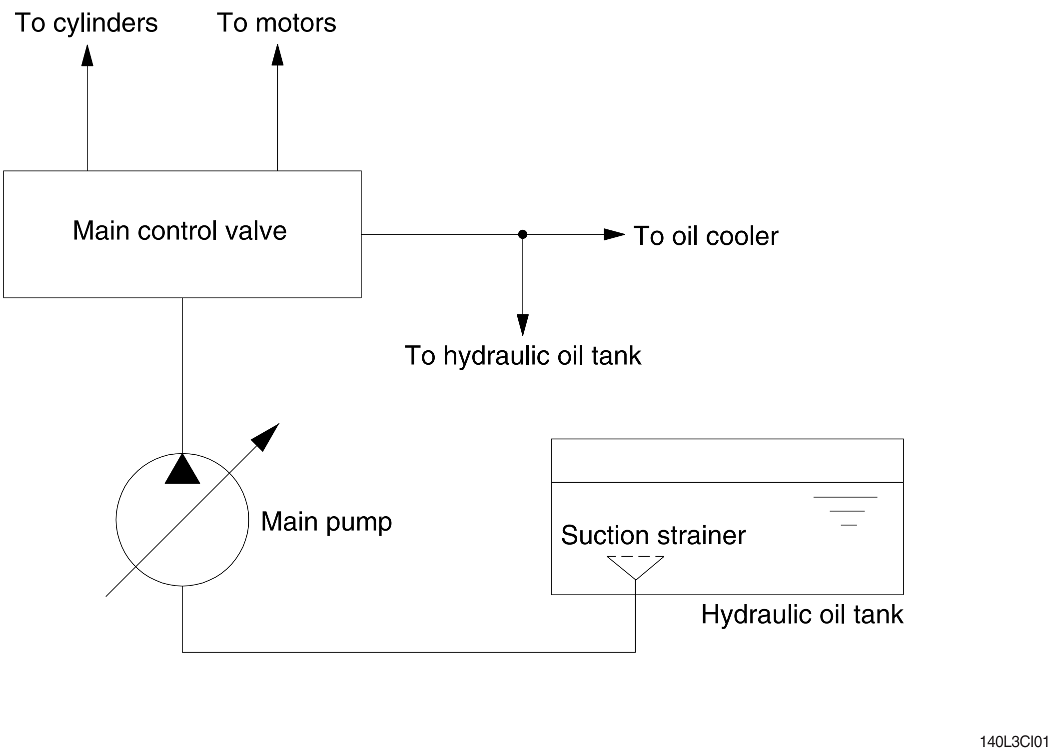
GROUP 2 MAIN CIRCUIT

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.

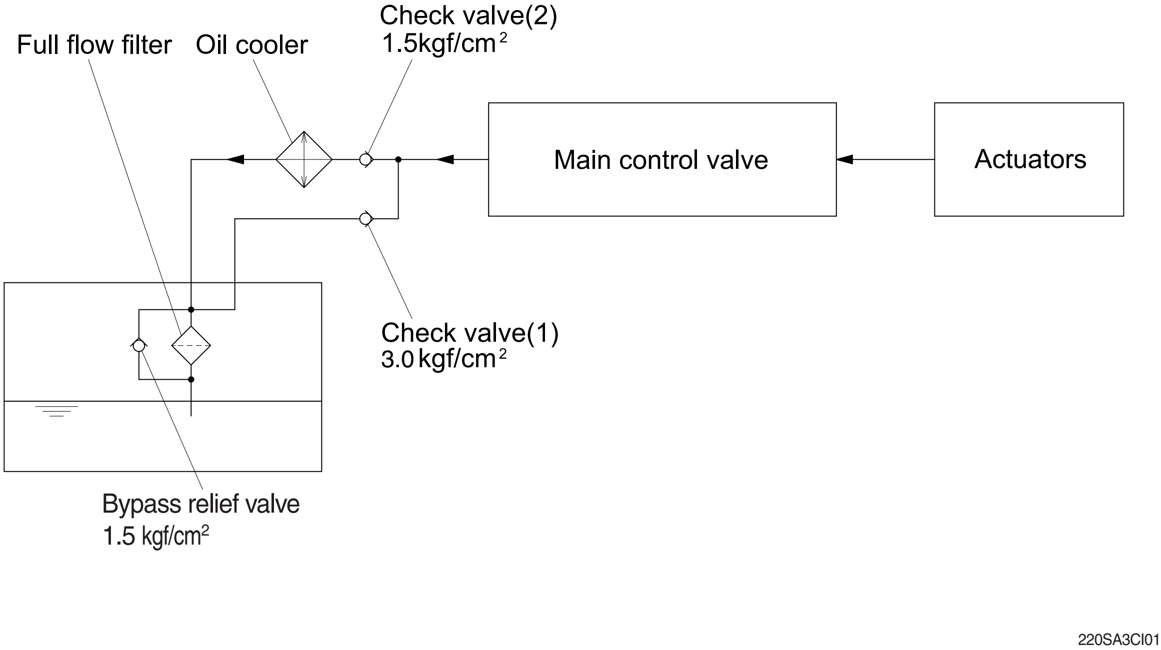
1. SUCTION AND DELIVERY CIRCUIT



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.

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

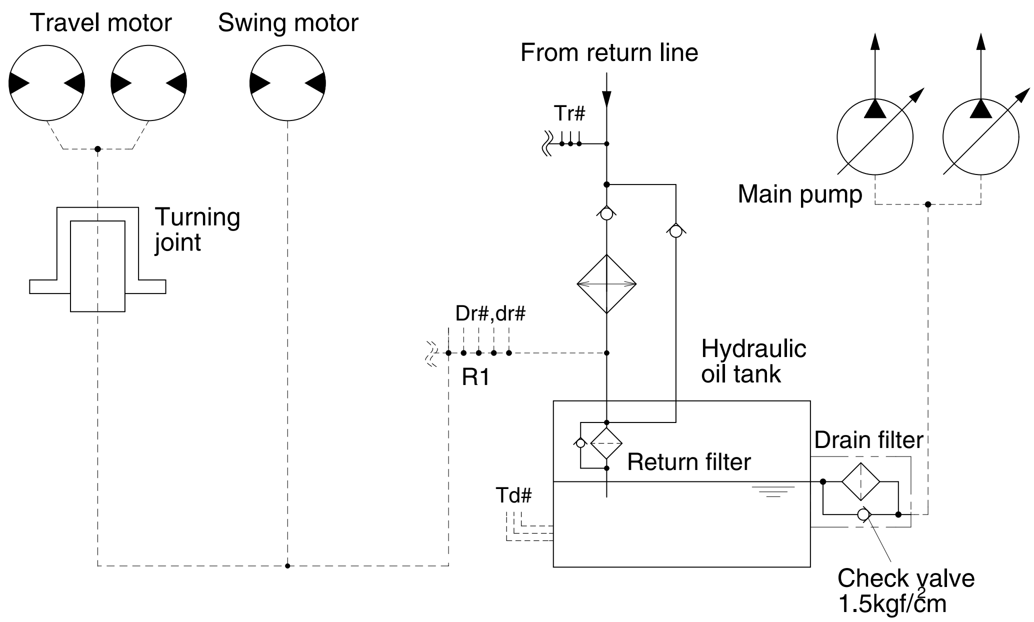
2. RETURN CIRCUIT



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.

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

3. DRAIN CIRCUIT



145SA3CI02

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 AND SWING MOTOR DRAIN CIRCUIT

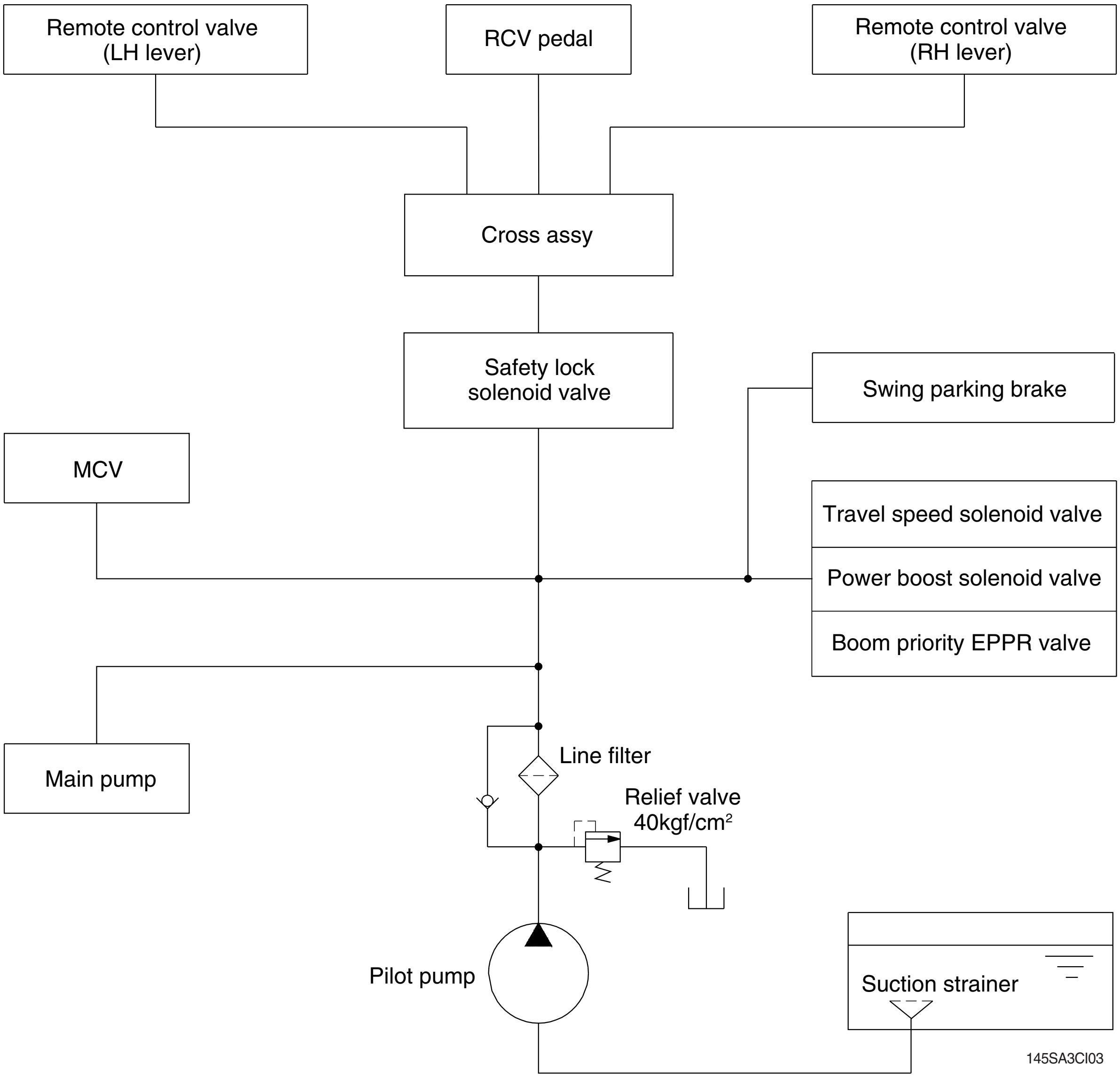
Oil leaked from the right and left travel motors comes out of the drain ports provided in the respective motor casing and join with each other. These oils pass through the turning joint and join with oil leak line of the swing motor and return to the hydraulic tank after being filtered by drain filter.

2) MAIN PUMP DRAIN CIRCUIT

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

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

GROUP 3 PILOT CIRCUIT



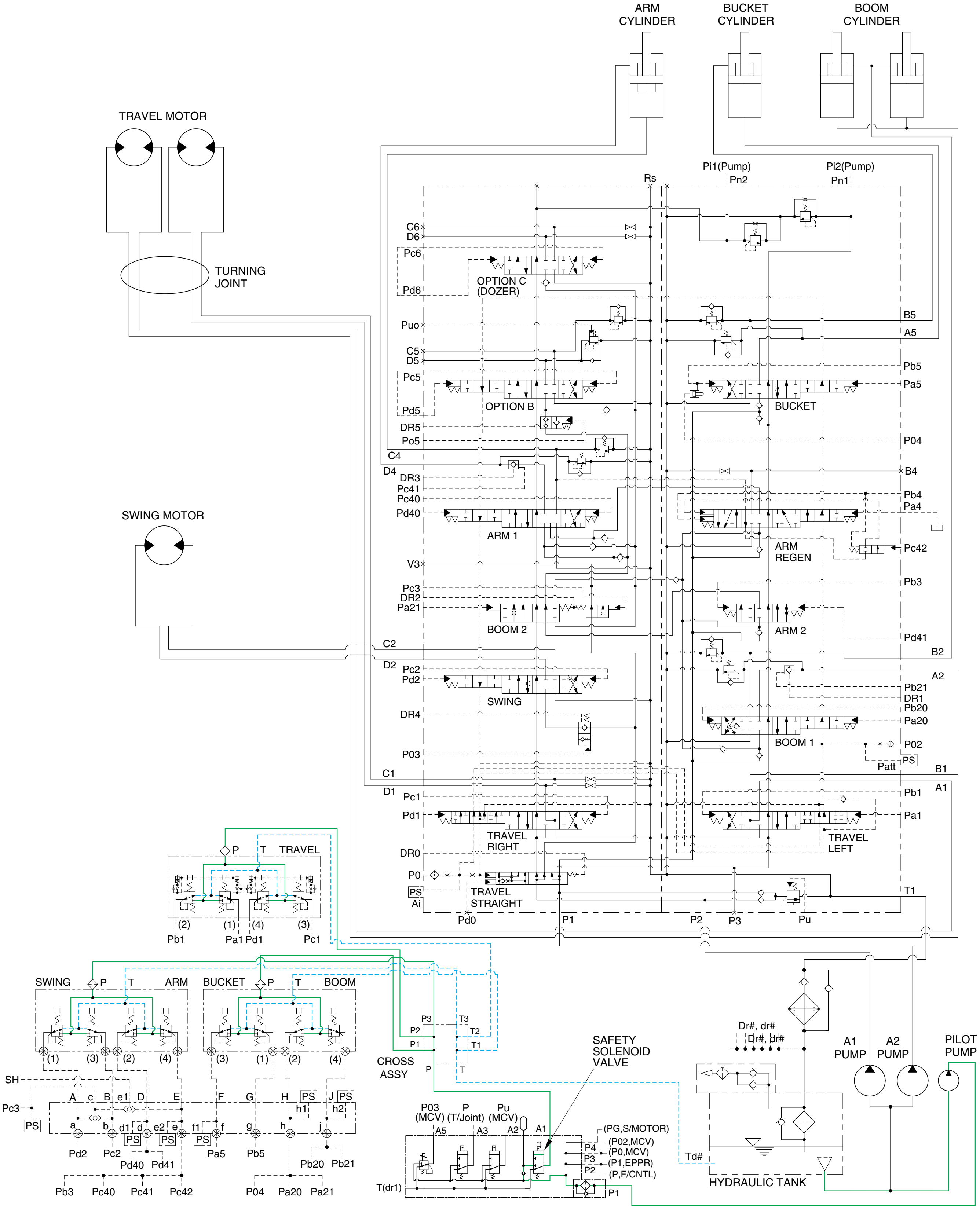
The pilot circuit consists of suction circuit, delivery circuit and return circuit.

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

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

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

1. SUCTION, DELIVERY AND RETURN CIRCUIT



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.

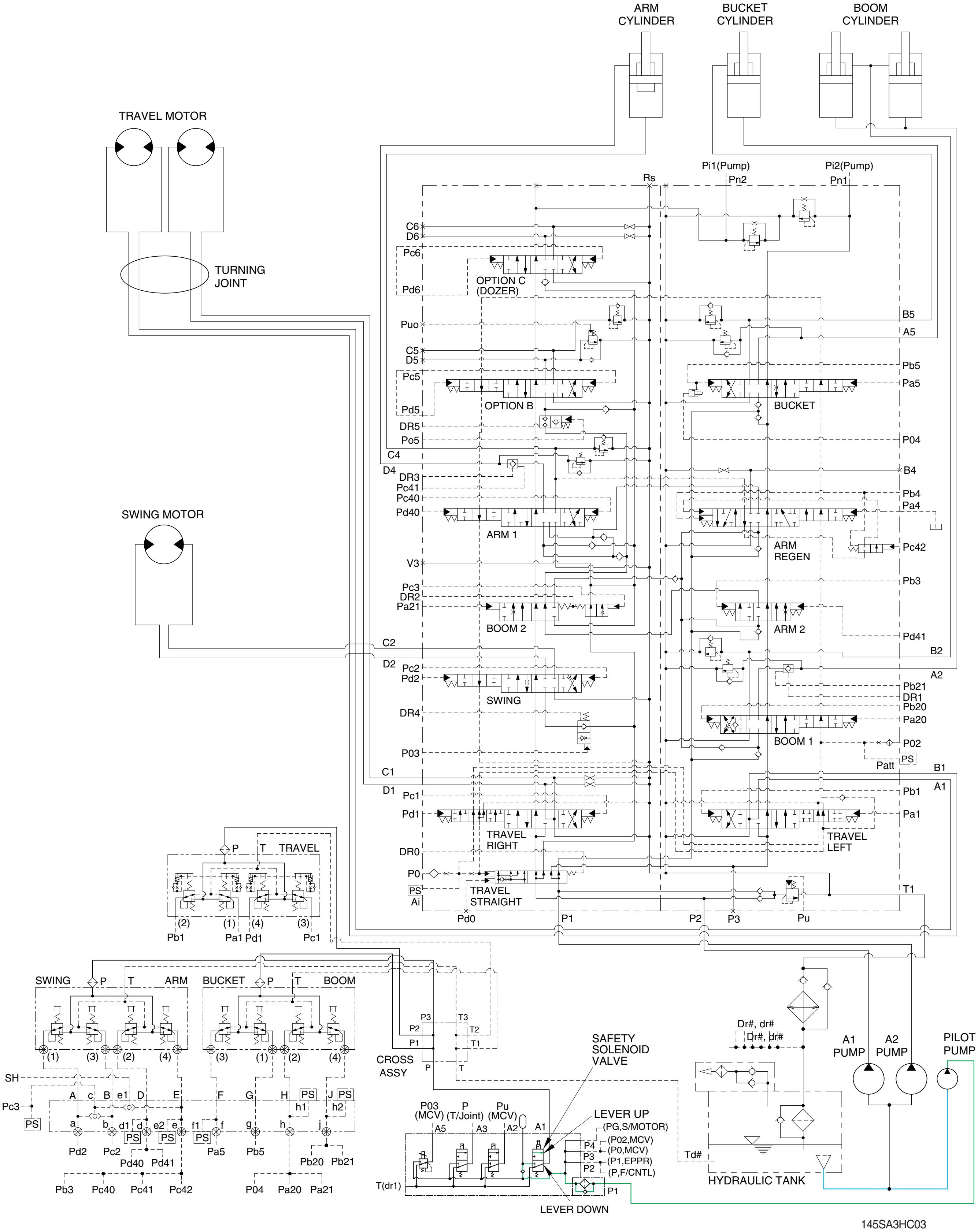
The pilot relief valve is provided in the pilot pump for limiting the pilot circuit pressure.

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

The return oil flow into the hydraulic tank.

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

2. SAFETY VALVE (SAFETY LEVER)

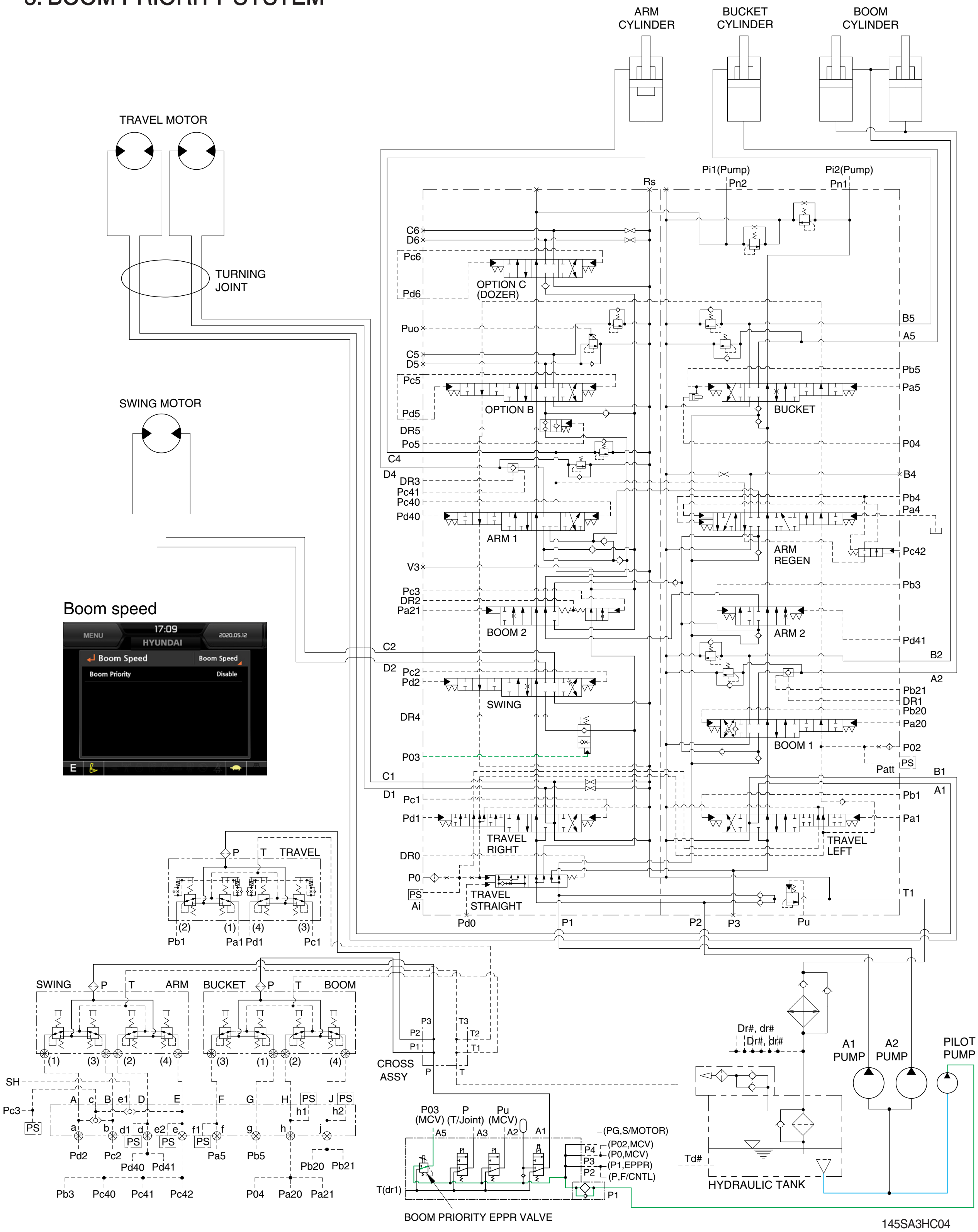


When the lever of the safety solenoid valve is moved upward, oil flows into the remote control valve through line filter solenoid valve and cross assy.

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

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

3. BOOM PRIORITY SYSTEM



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.

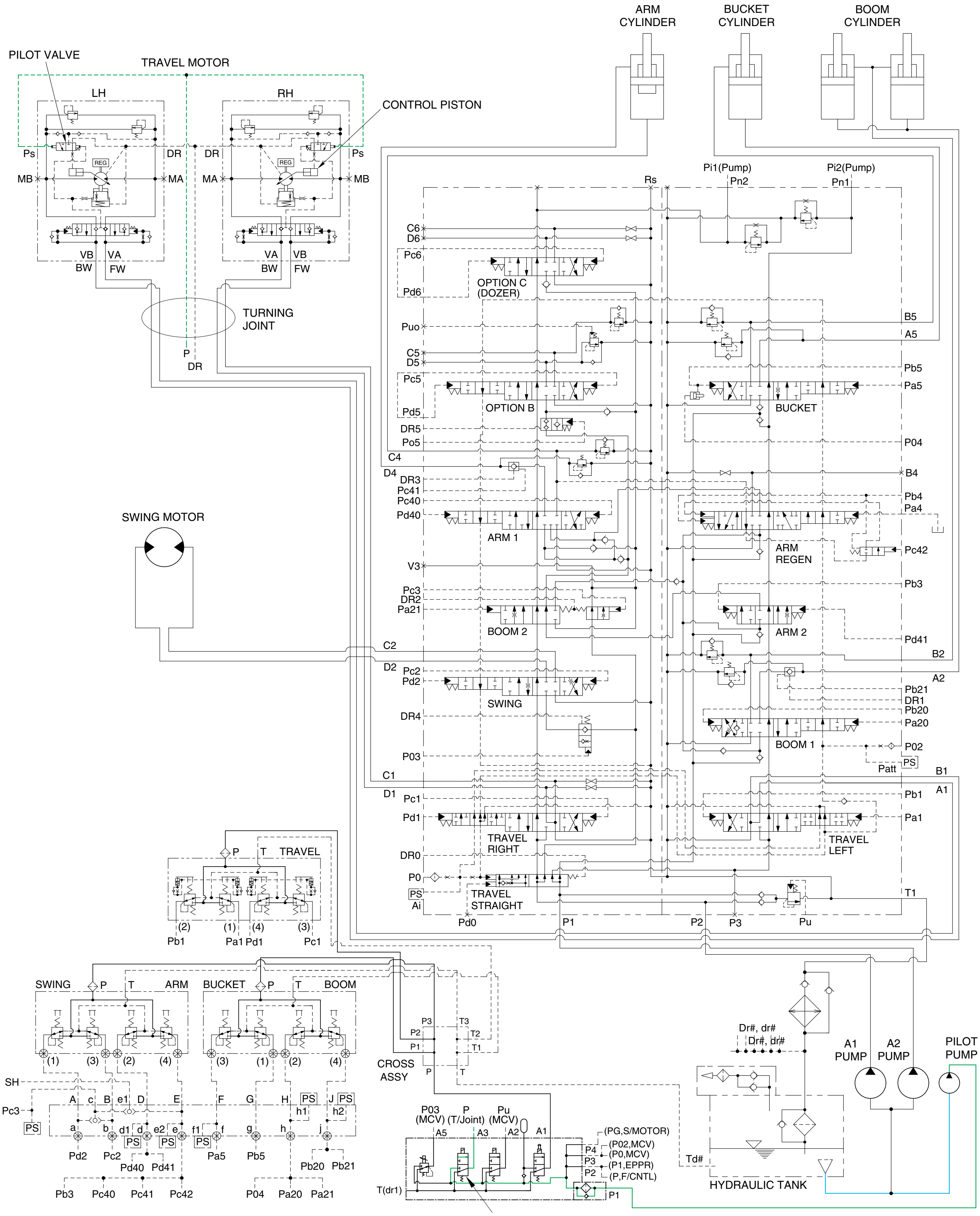
The pilot oil from pilot pump flow into **P03** port in main control valve through boom priority EPPR valve. **P03** oil pressure moves swing reducing spool to lower position and oil flow rate to the swing motor decreased.

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 5-77.

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

4. TRAVEL SPEED CONTROL SYSTEM



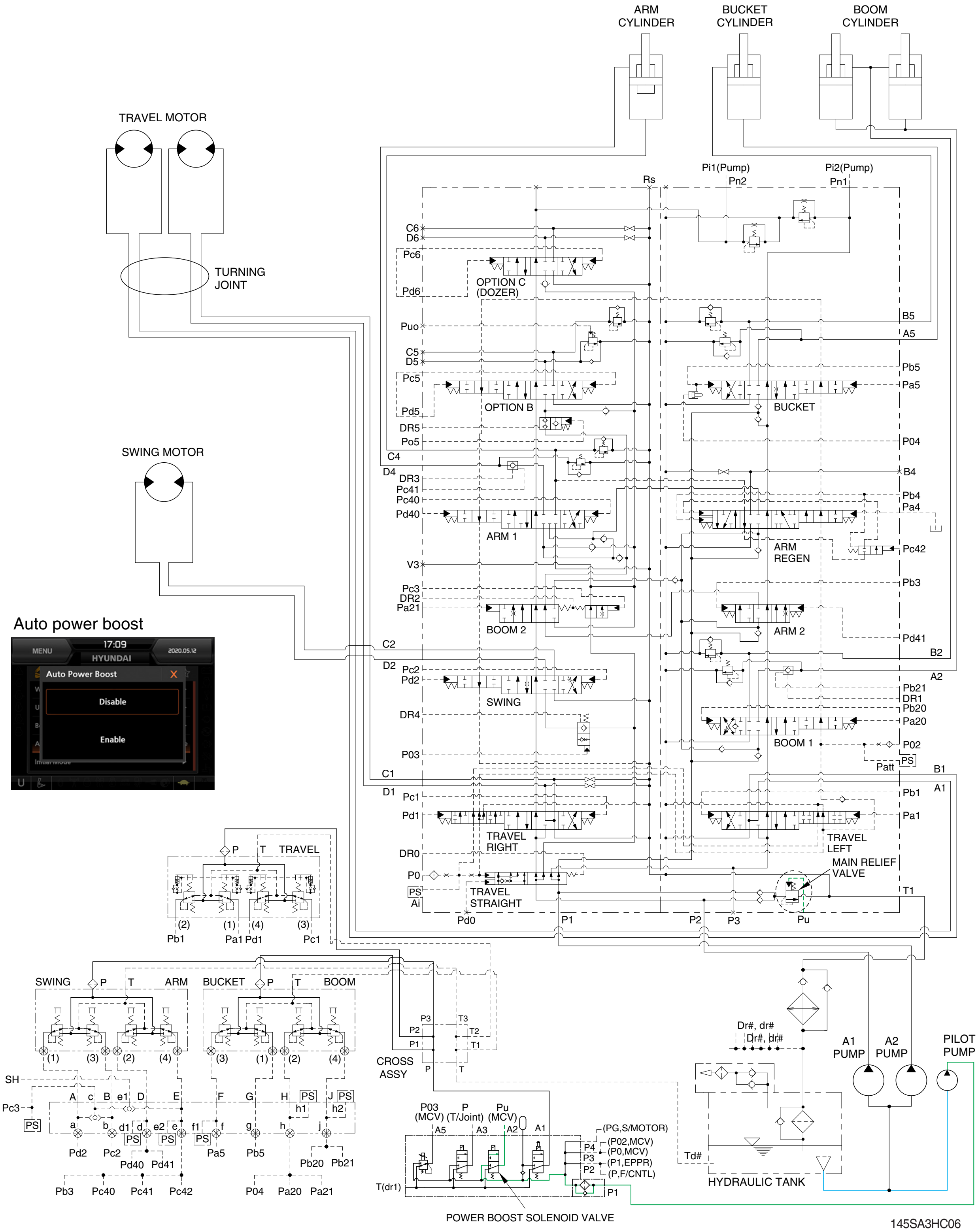
145SA3HC05

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.

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

5. MAIN RELIEF PRESSURE CHANGE SYSTEM



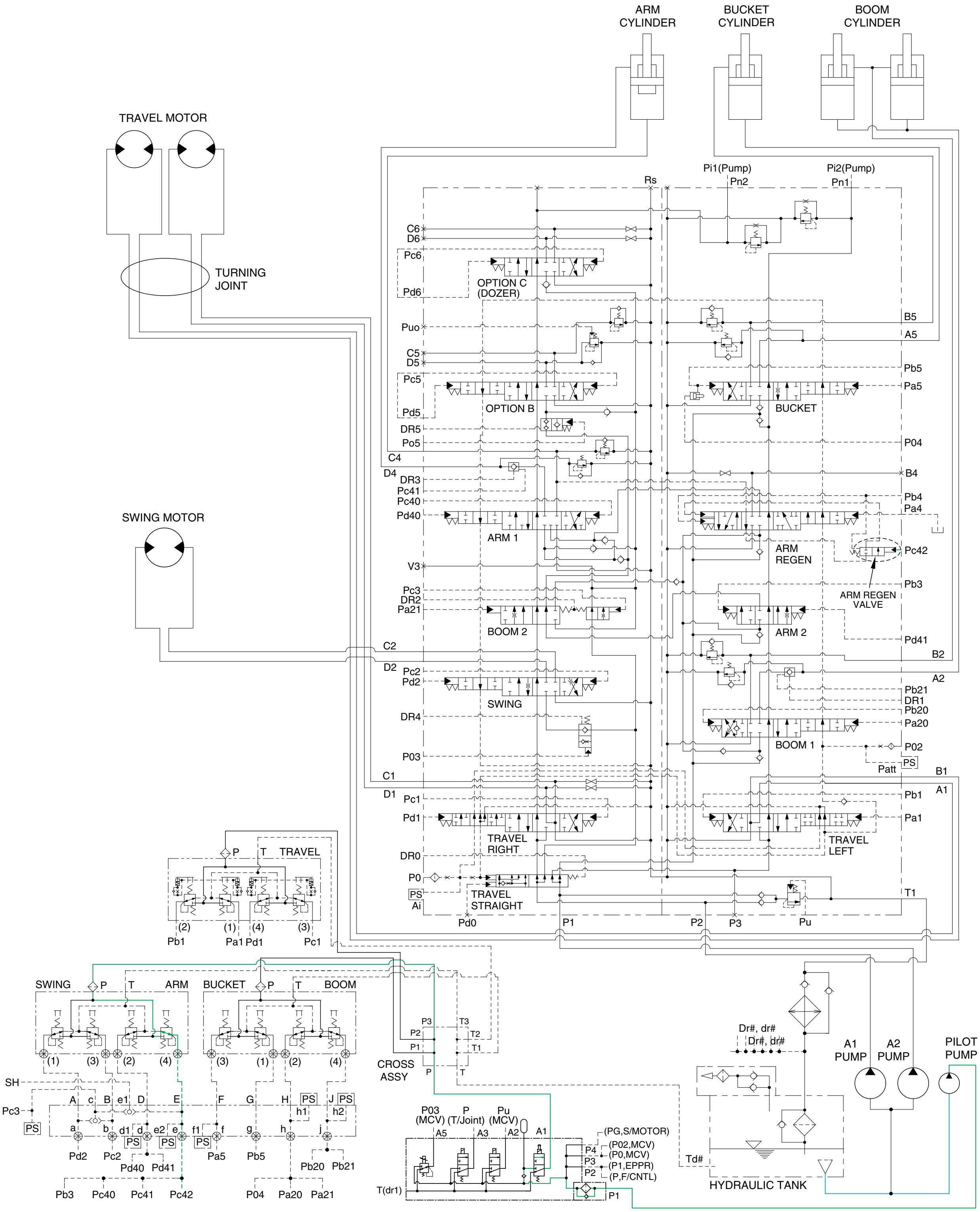
When the power boost switch on the left control lever is pushed ON, the power boost solenoid valve is actuated, the discharged oil from the pilot pump flows into **Pu** port of the main relief valve of main control valve; then the setting pressure of the main relief valve is raised from 350 kgf/cm² (4980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

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

When the auto power boost function is selected to enable on the cluster, the pressure of the main relief pressure is automatically increased to 380 kgf/cm² (5400 psi) as working condition by the MCU. It is operated max 8 seconds.

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

6. ARM REGENERATION SYSTEM



145SA3HC07

When the arm in control lever is tilted, the pilot oil from pilot pump flow into **Pc42** port in main control valve and the arm regeneration valve is shifted to left.

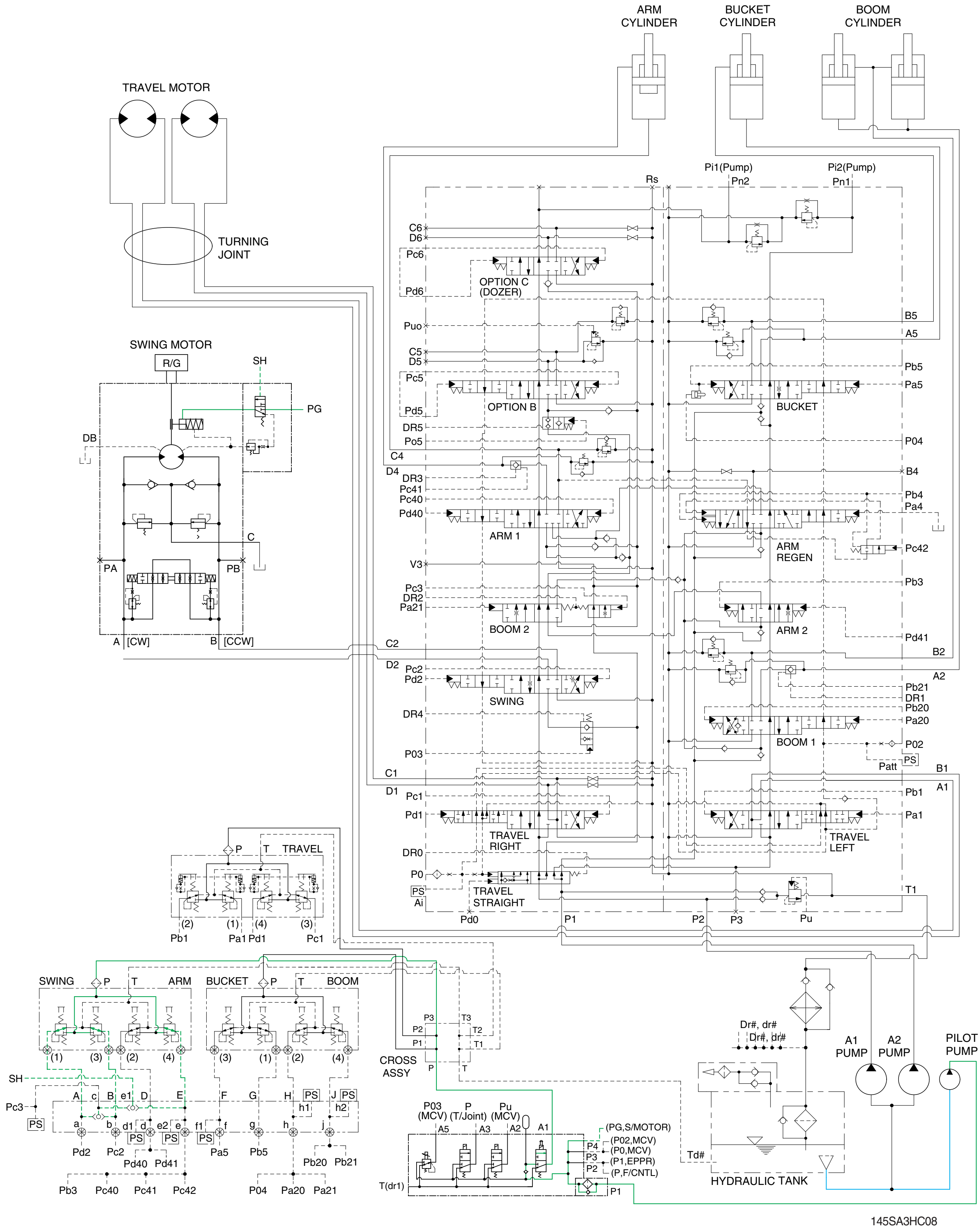
Then, the arm regeneration spool is shift to right and the return oil from arm cylinder rod supplied to arm cylinder head through internal passage. The amount of regeneration oil is changed by movement of the arm regeneration spool.

This is called arm regeneration function.

Refer to page 2-37 for the arm regeneration function.

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

7. SWING PARKING BRAKE RELEASE



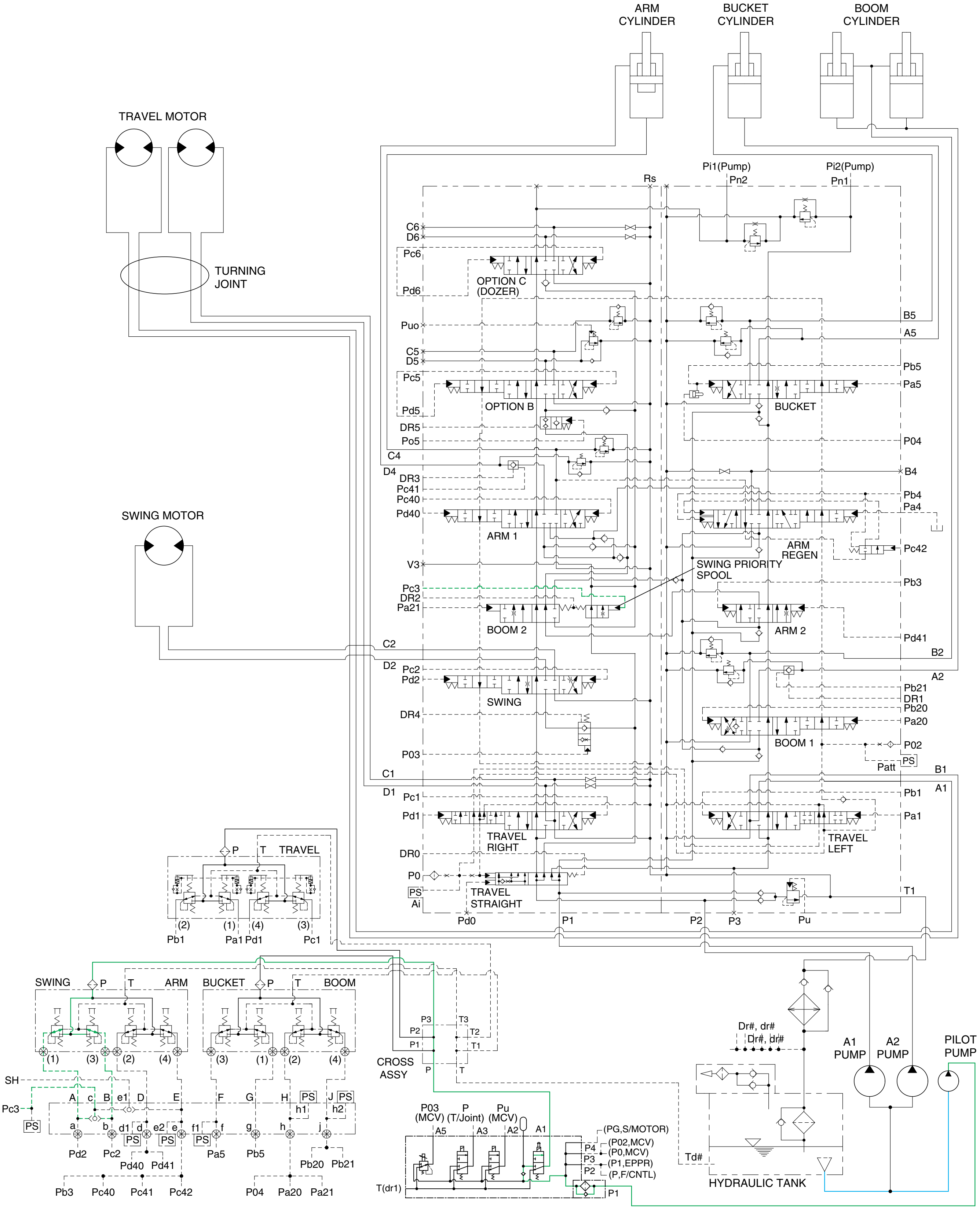
When the swing control lever or arm in control lever is tilted, the pilot oil flows into SH port through shuttle valve.

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.

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

8. SWING PRIORITY SYSTEM



145SA3HC09

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.

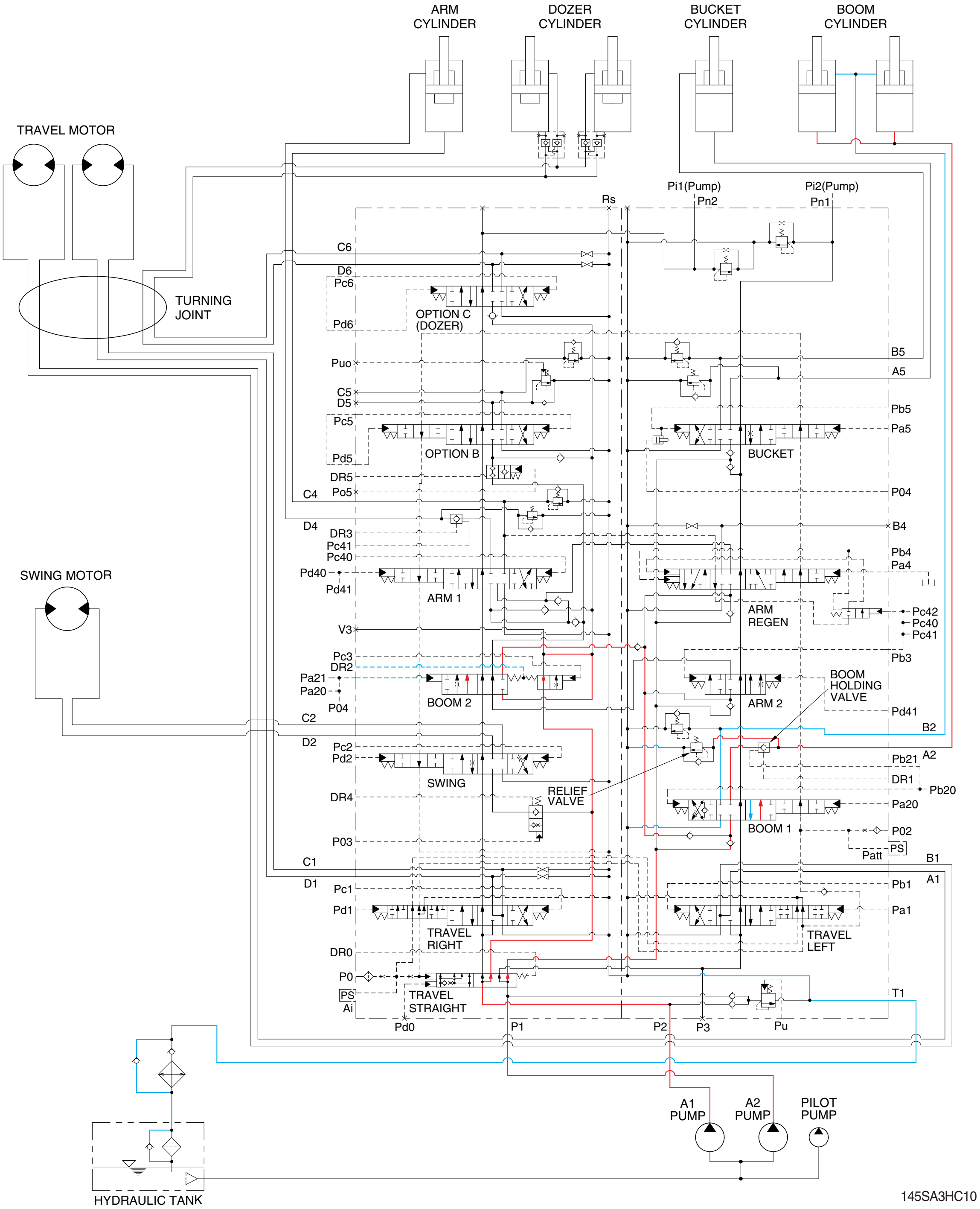
Pc3 pressure from the swing shuttle block change the swing priority spool and decreases the oil flow rate to the next section to make the swing operation most preferential.

This is called the swing priority system. For details, refer to page 2-39.

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

GROUP 4 SINGLE OPERATION

1. BOOM UP OPERATION

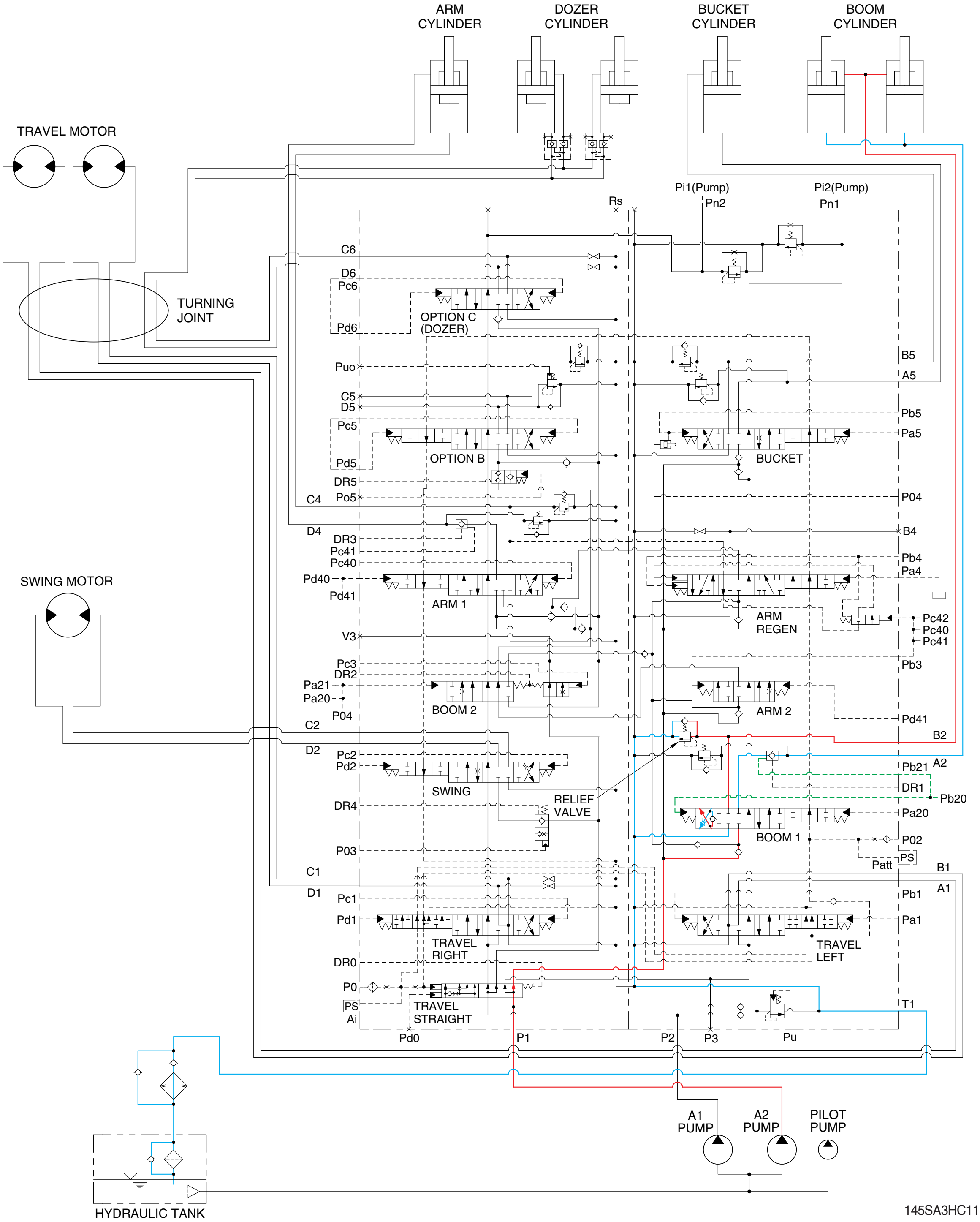


When the right control lever is pulled back, the boom spools in the main control valve are moved to the up position by the pilot oil pressure (Pa20, Pa21) from the remote control valve.

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.

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

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 (Pb20) from the remote control valve.

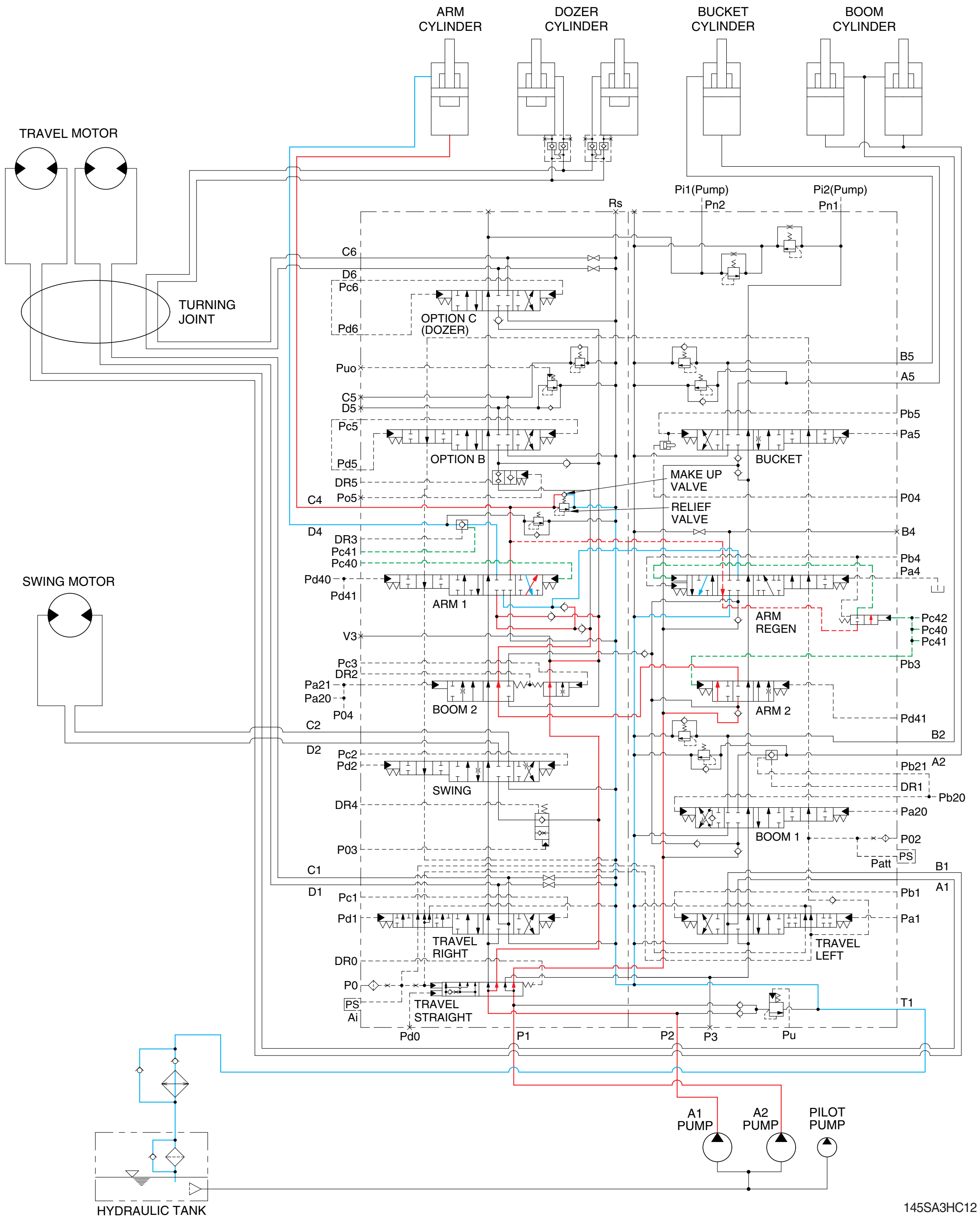
The oil from the A2 pump flows into the main control valve and then goes to the small chamber of boom cylinders. At the same time, the oil from the large chamber of boom cylinders returns to the hydraulic tank through the boom 1 spool in the main control valve.

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

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

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

3. ARM IN OPERATION



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 (Pc40, Pb3) 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.

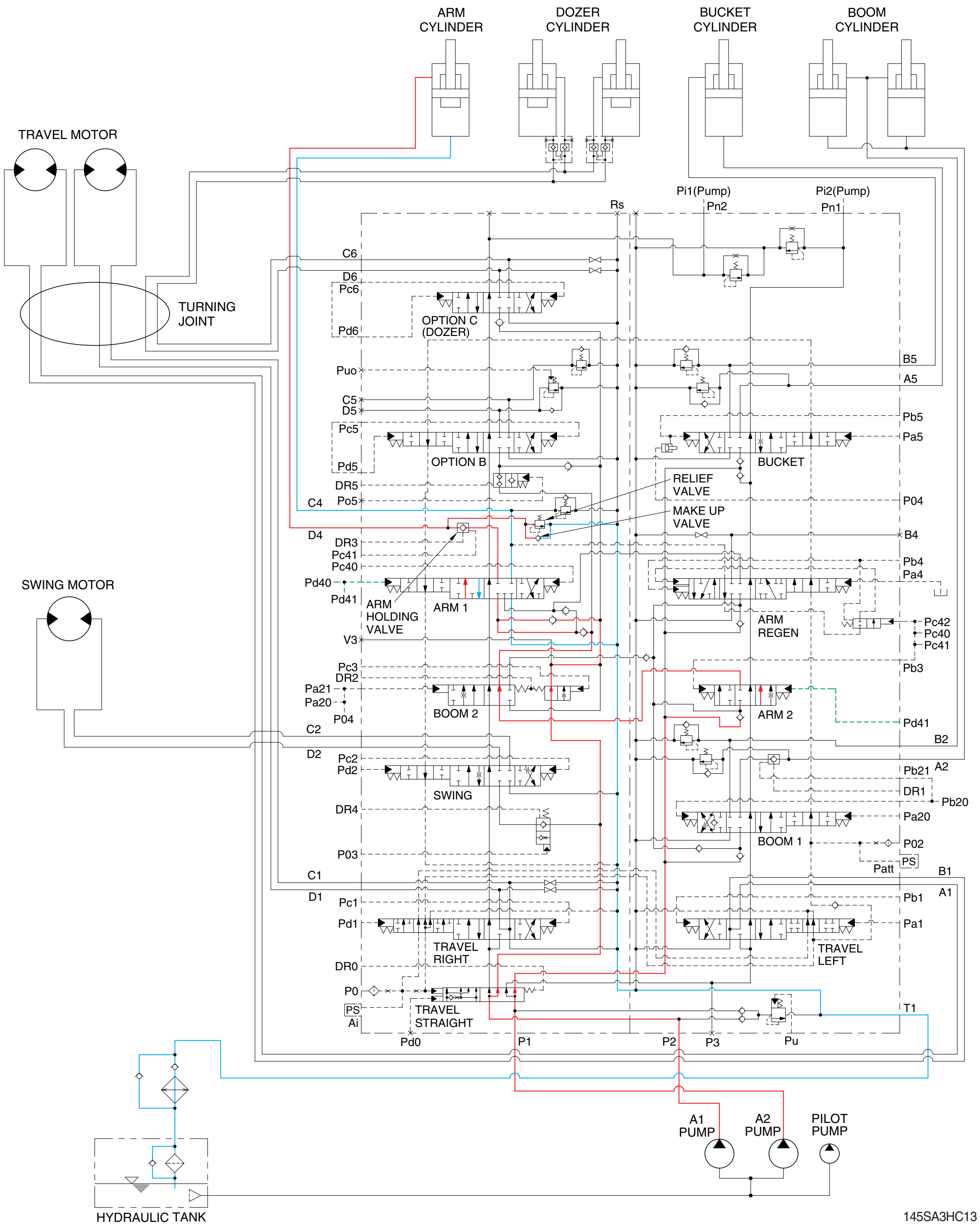
At the same time, the oil from small chamber of arm cylinder returns to the hydraulic oil tank through the arm 1 spool in the main control valve. When this happens, the arm rolls in.

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.

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

4. ARM OUT OPERATION

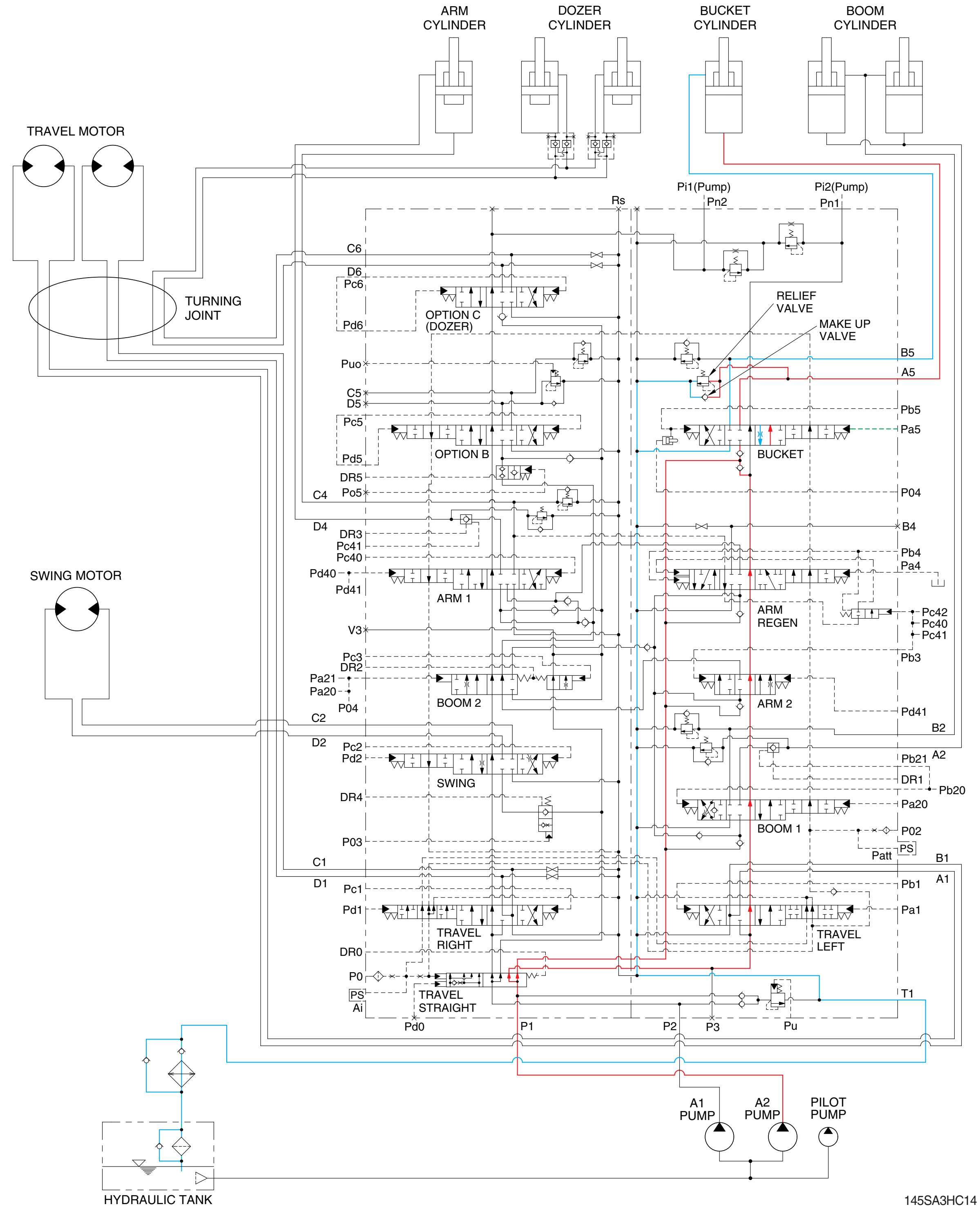


When the left control lever is pushed forward, the arm spools in the main control valve are moved to the arm out position by the pilot oil pressure (Pd40, Pd41) from the remote control valve.

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.

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

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 (Pa5) 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.

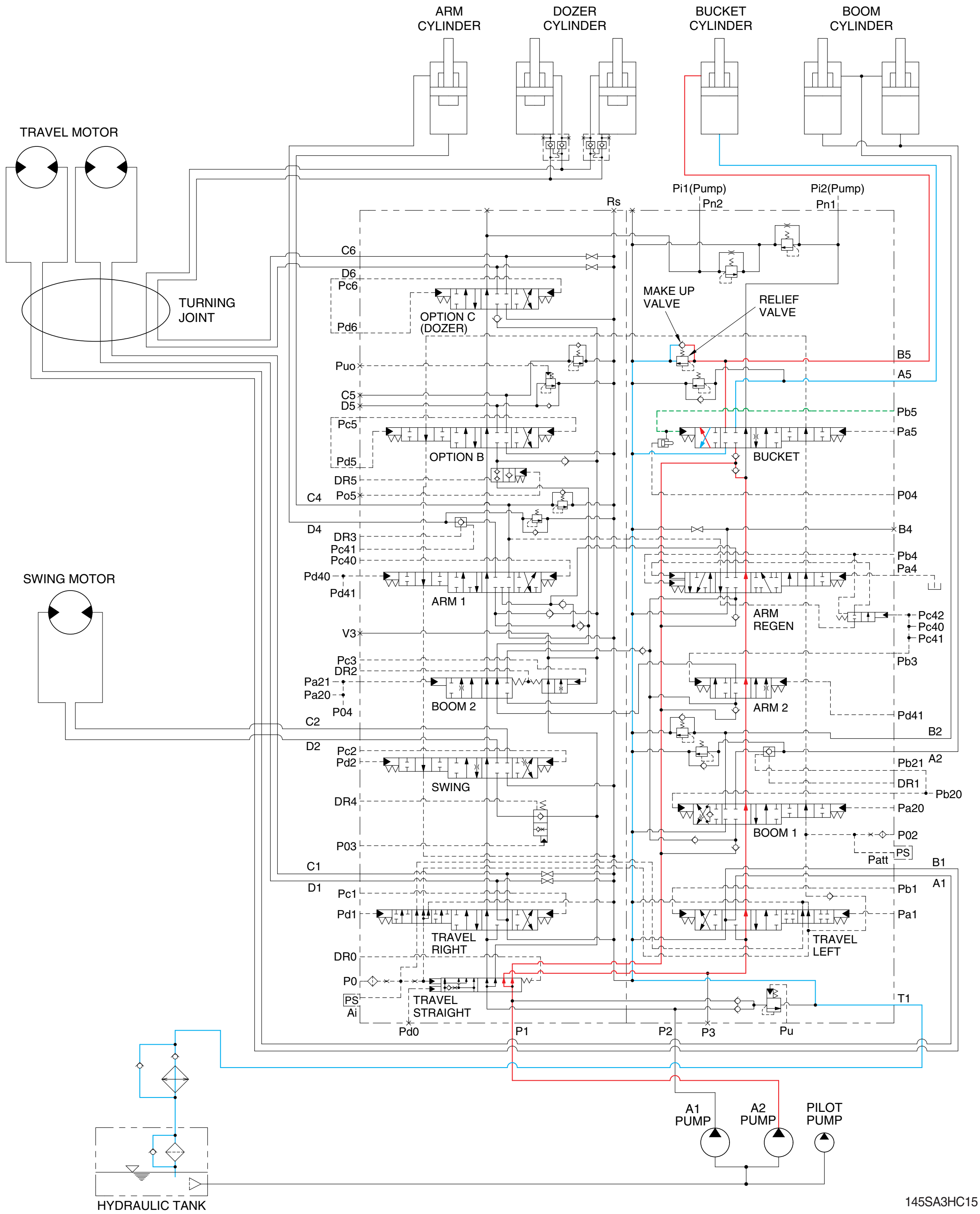
At the same time, the oil from the small chamber of bucket cylinder returns to the hydraulic oil tank through the bucket spool in the main control valve. When this happens, the bucket rolls in.

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.

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

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 (Pb5) from the remote control valve.

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

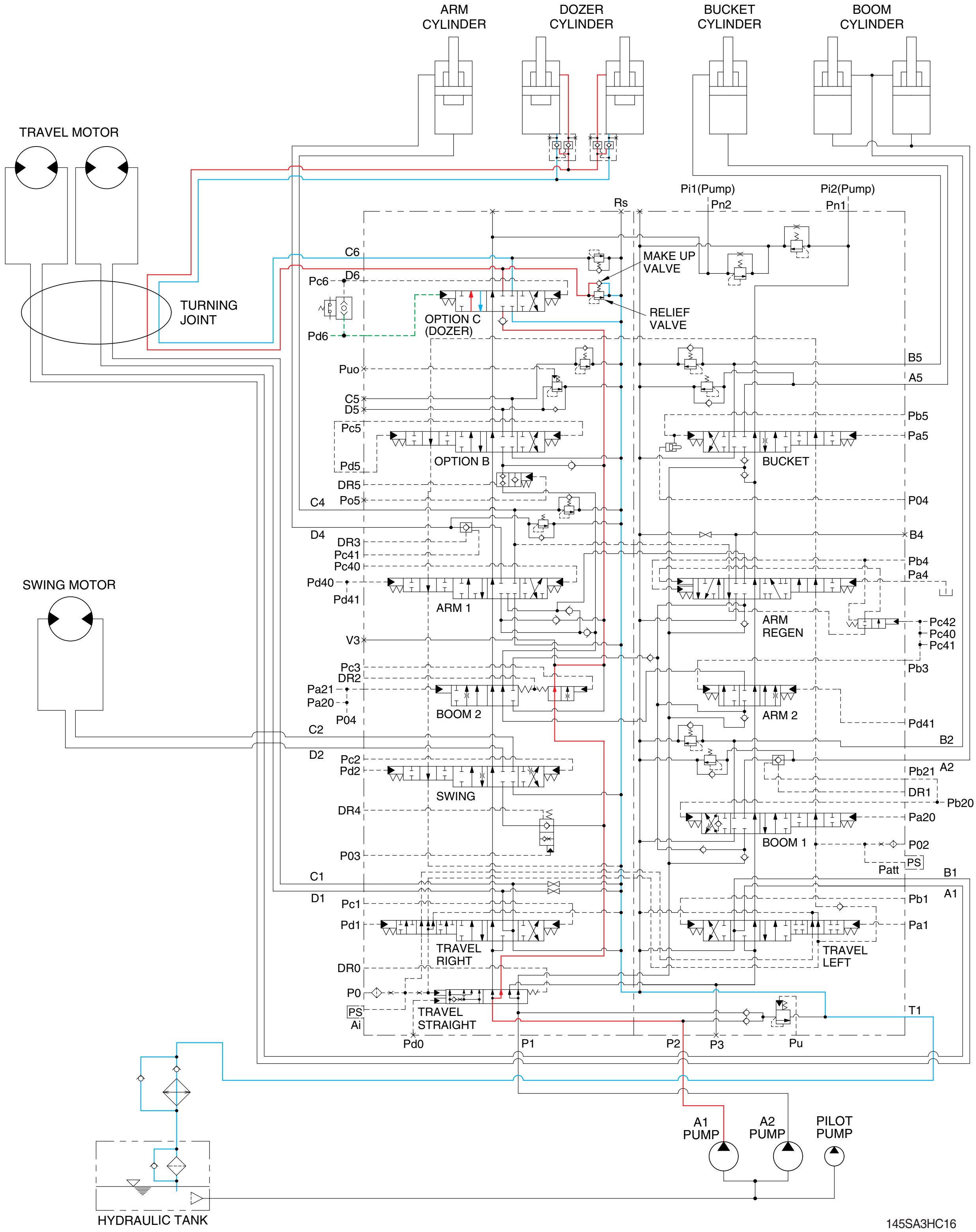
At the same time, the oil from the large chamber of bucket cylinder returns to the hydraulic oil tank through the bucket spool in the main control valve. When this happens, the bucket rolls out.

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

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

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

7. DOZER UP OPERATION



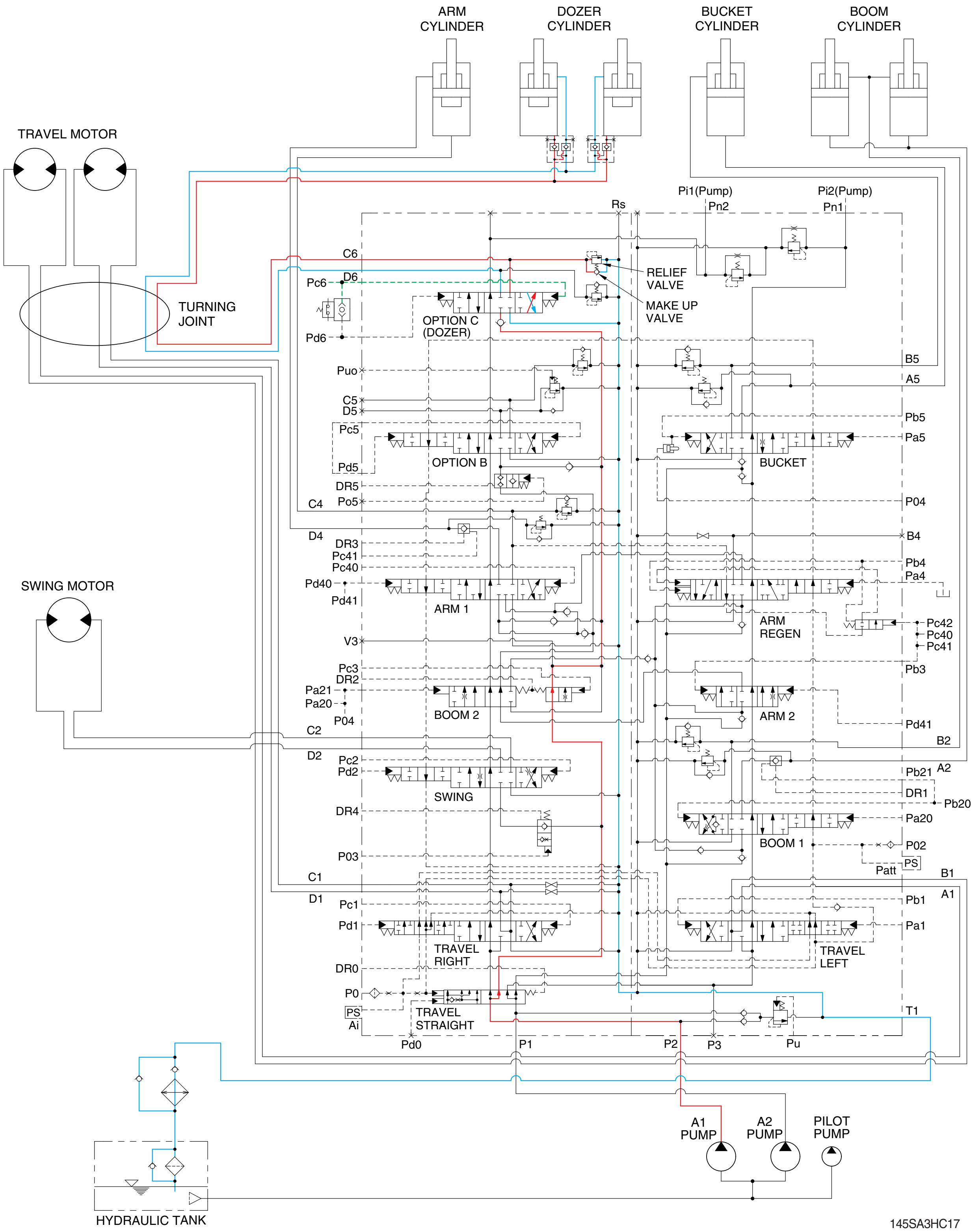
When the dozer control lever is pulled back, the dozer spool in the main control valve is moved to the dozer up position by the pilot oil pressure (Pd6) from the remote control valve.

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.

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

8. DOZER DOWN OPERATION



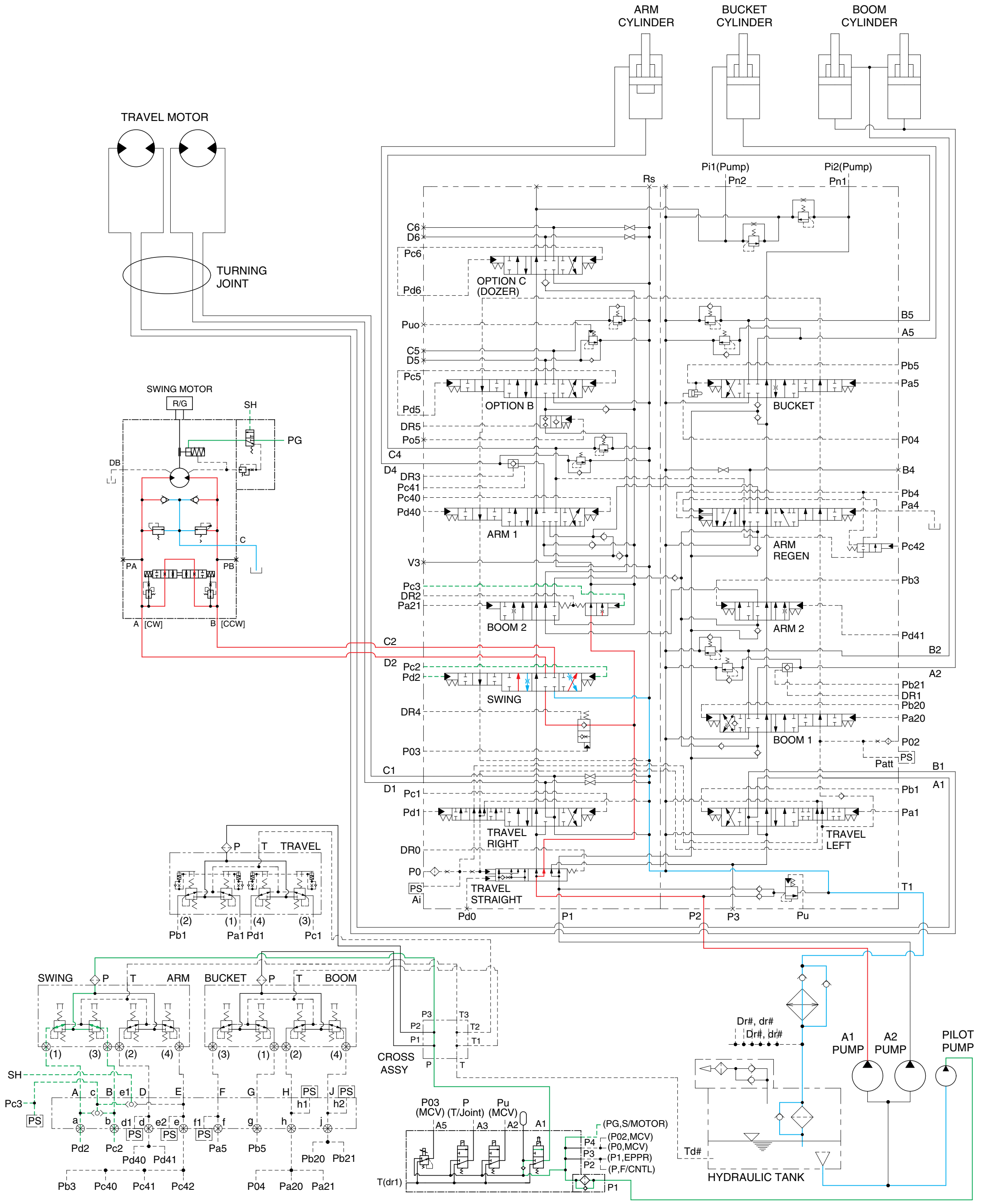
When the dozer control lever is pushed forward, the dozer spool in the main control valve is moved to the dozer down position by the pilot oil pressure (Pc6) from the remote control valve.

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.

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

9. SWING OPERATION



145SA3HC18

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 (Pc2, Pd2) from the remote control valve.

Also the swing operation preference function is operated by the pilot pressure Pc3 (refer to page 3-14).

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

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

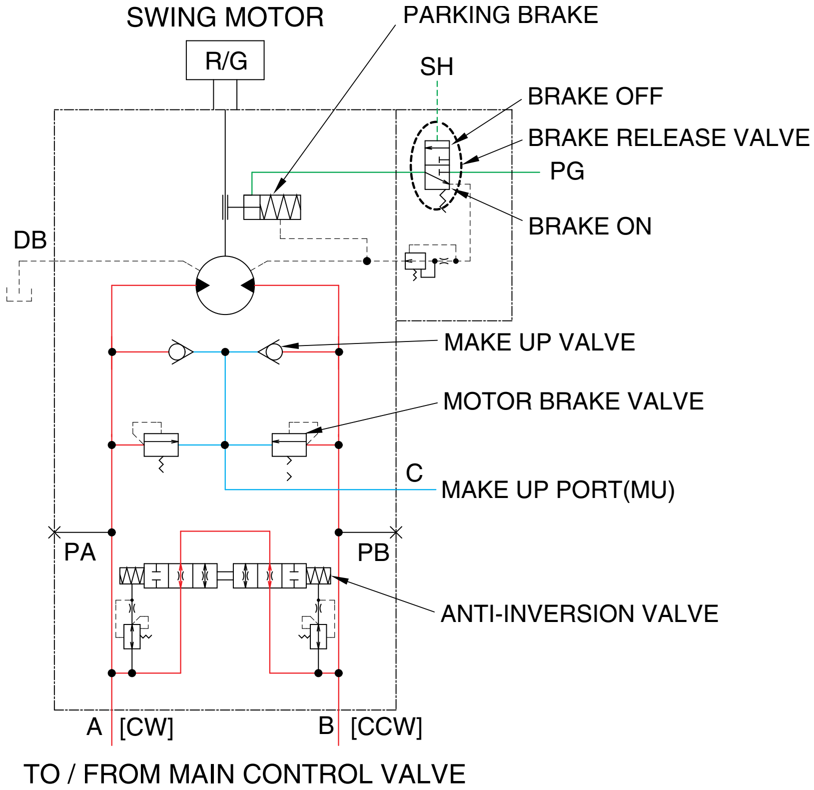
When this happens, the upper structure swings to the left or right.

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

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

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

SWING CIRCUIT OPERATION



145SA3HC18A

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.

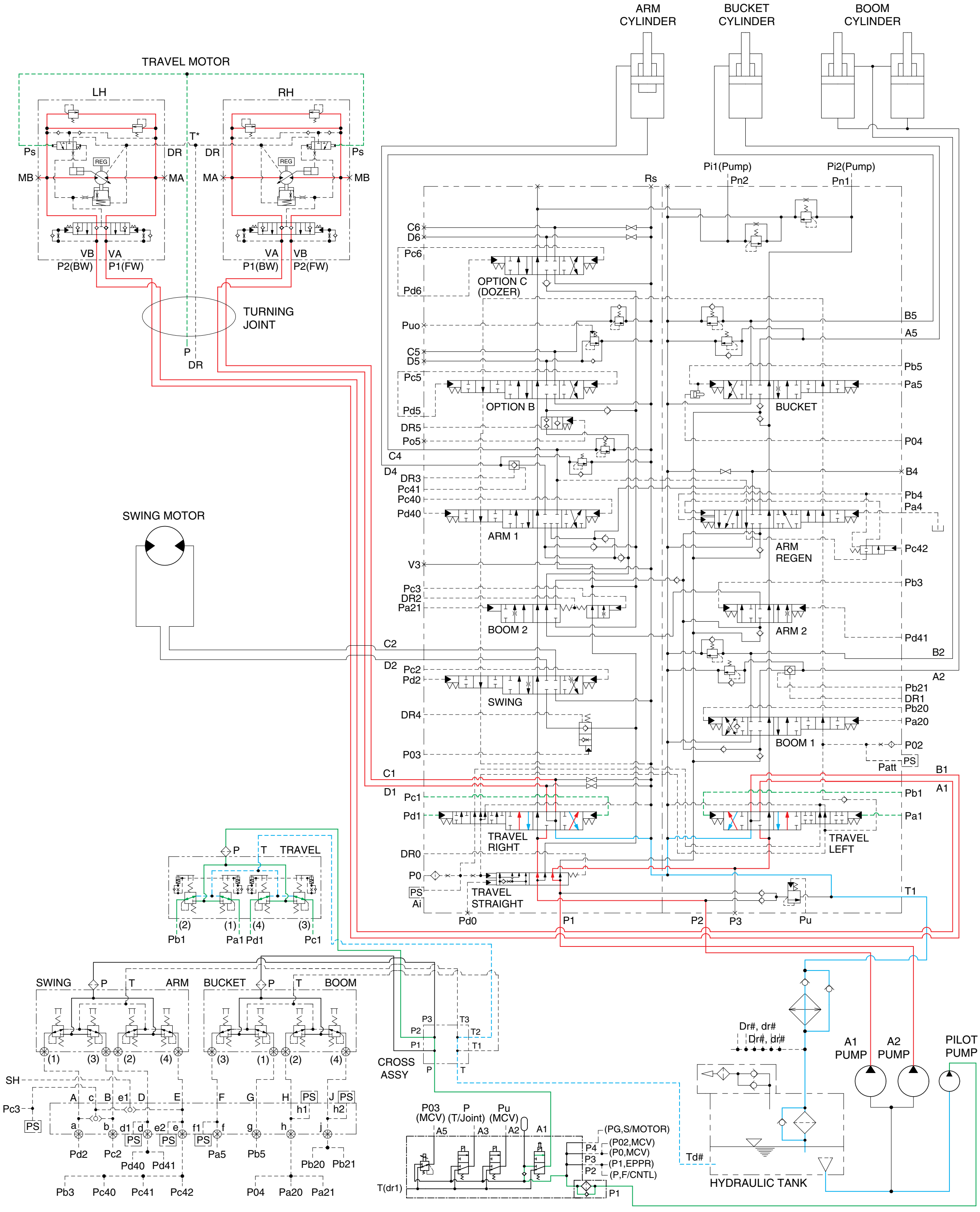
Then the brake release valve returned to the neutral position and the oil is returned from the brake piston to the hydraulic oil tank. And the brake is set to 'ON'.

4) ANTI-INVERSION VALVE

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

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

10. TRAVEL FORWARD AND REVERSE OPERATION



When the travel levers are pushed forward or reverse position, the travel spools in the main control valve are moved to the forward or reverse travel position by the pilot oil pressure (Pa1, Pb1, Pc1, Pd1) from the remote control valve.

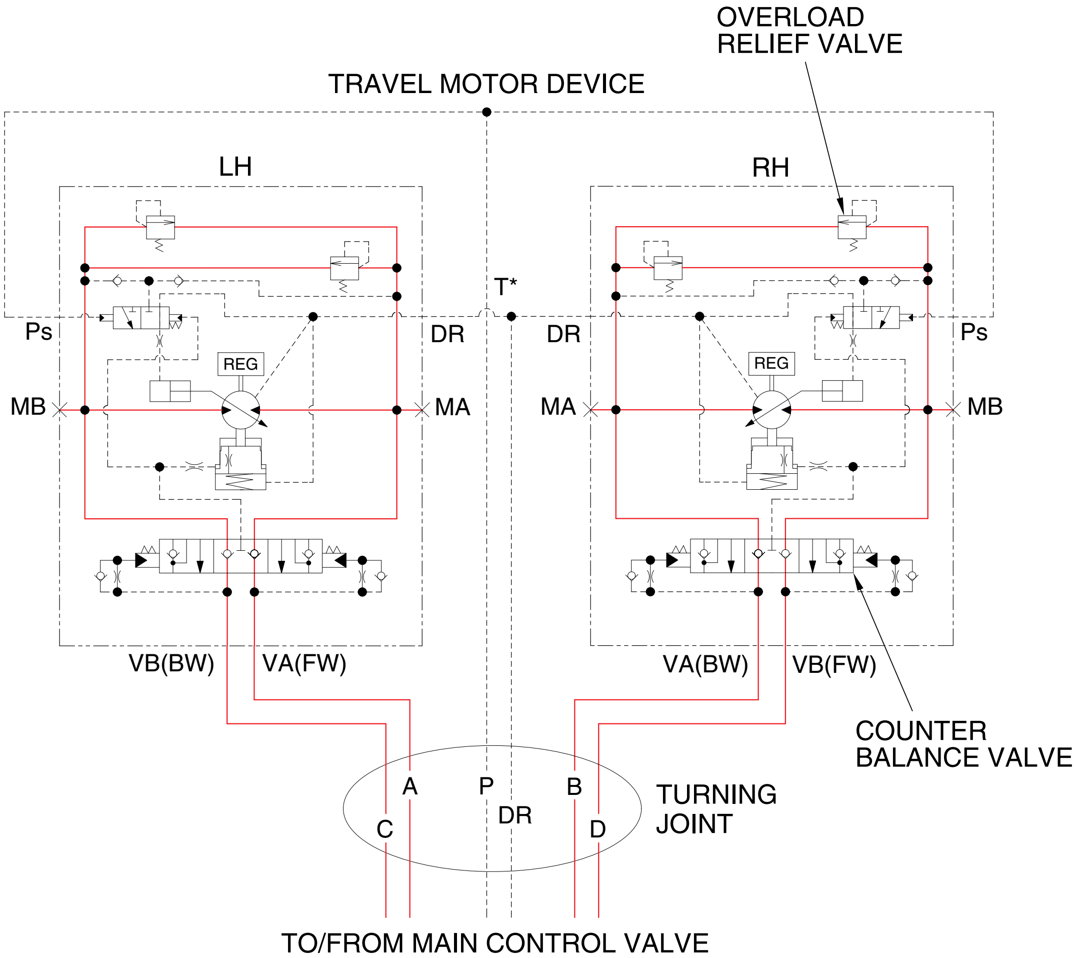
The oil from the each pump flows into the main control valve and then goes to the each travel motor through the turning joint.

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

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

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

TRAVEL CIRCUIT OPERATION



145SA3HC19A

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

1) COUNTER BALANCE VALVE

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

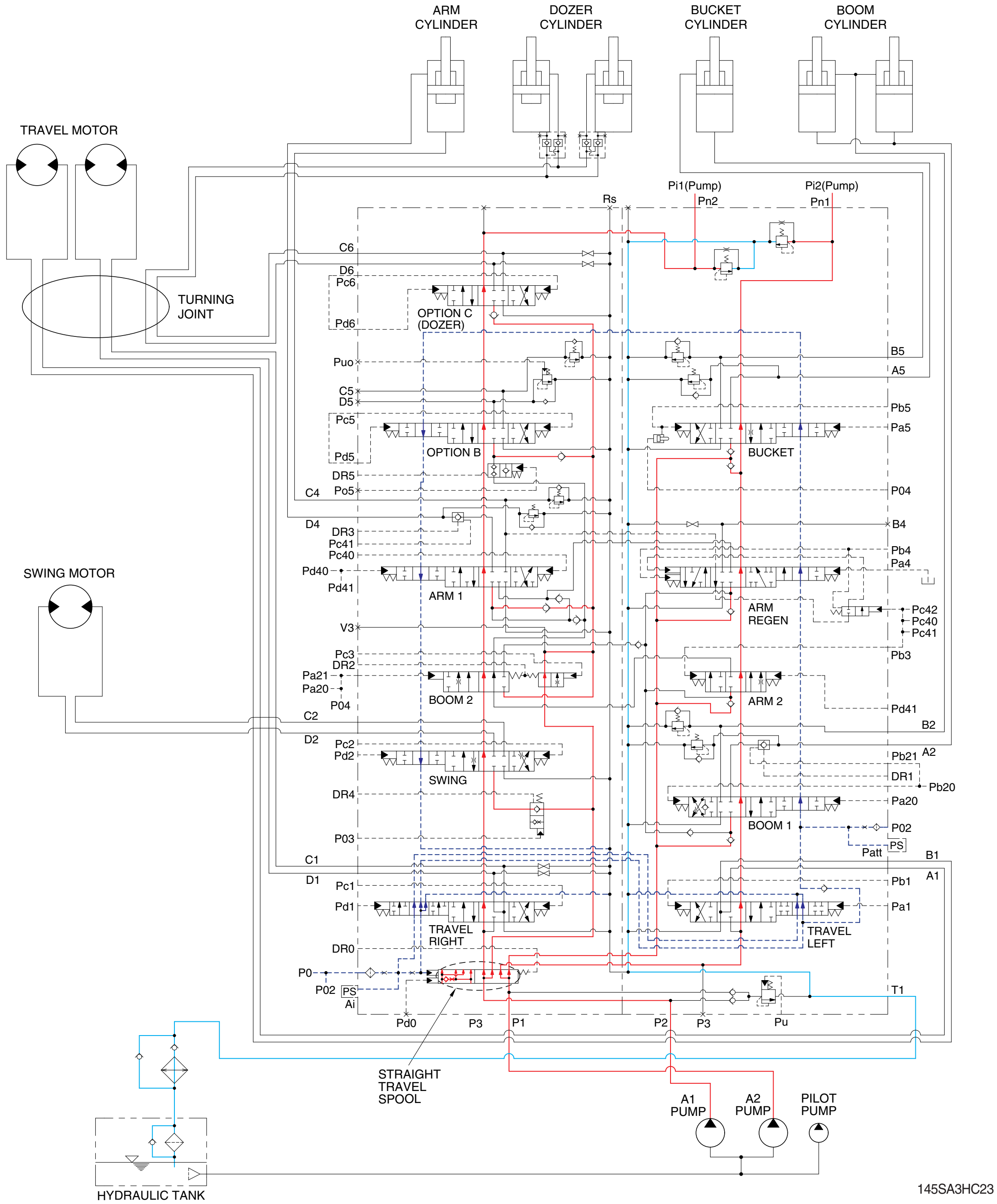
2) OVERLOAD RELIEF VALVE

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

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

GROUP 5 COMBINED OPERATION

1. OUTLINE



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

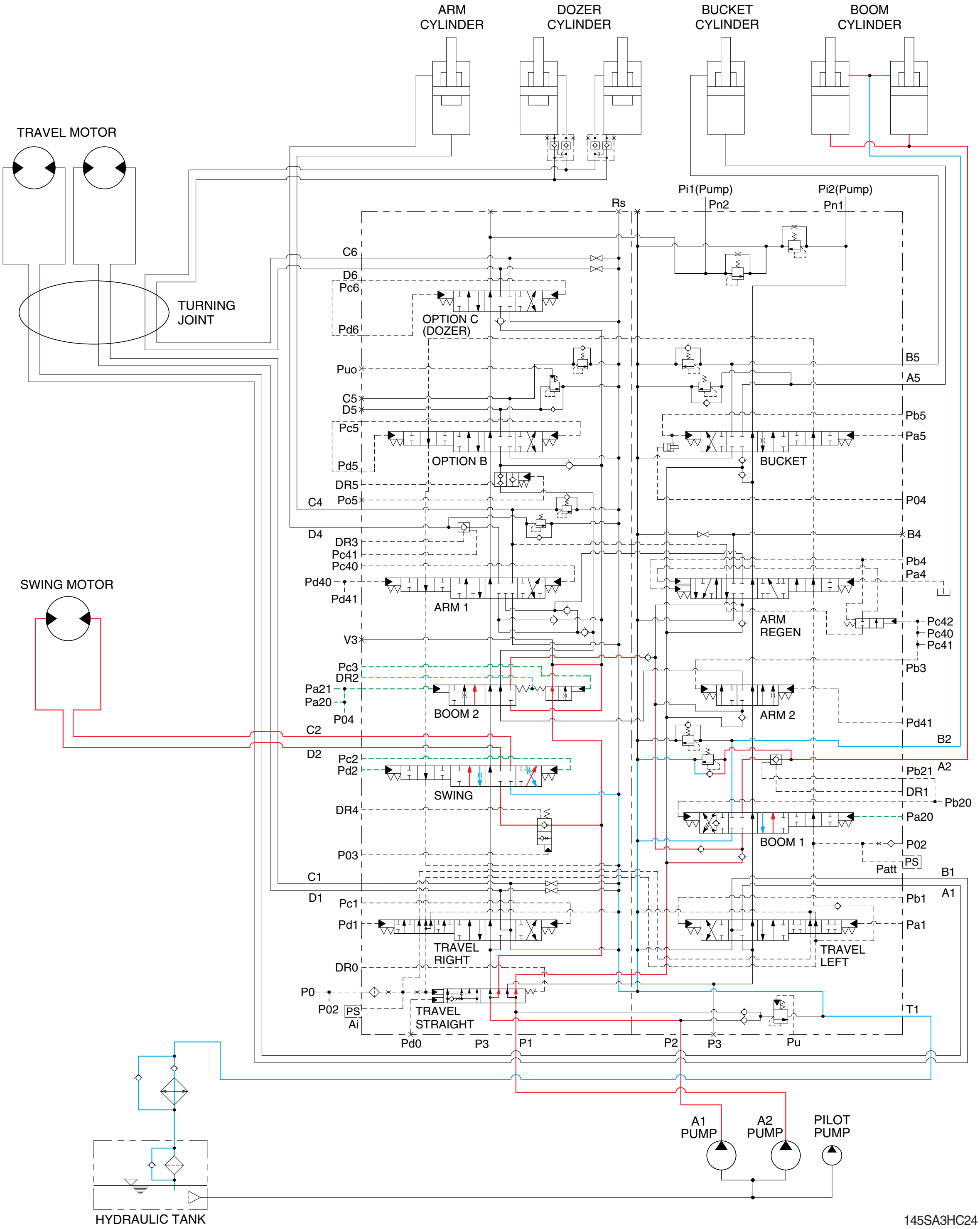
This straight travel spool for straight travel is provided in the main control valve.

If any actuator is operated when traveling, the straight travel spool is pushed to the right by the pilot oil pressure (P0, P02).

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

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

2. COMBINED SWING AND BOOM UP OPERATION



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 (Pc2, Pd2, Pa20, Pa21) 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.

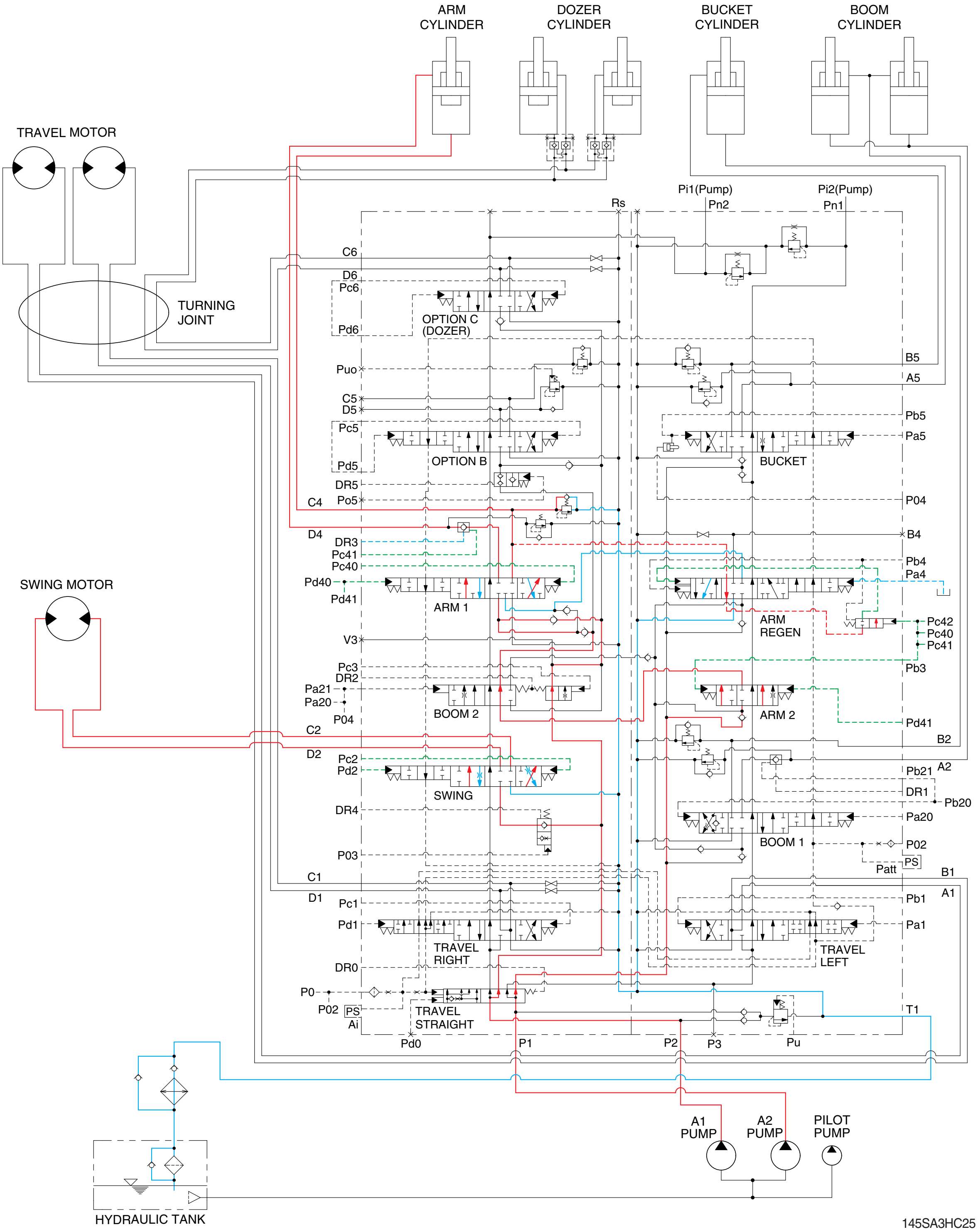
The oil from the A2 pump flows into the boom cylinders through the boom 1 spool in the right control valve.

The super structure swings and the boom is operated.

Refer to page 3-9 for the boom priority system.

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

3. COMBINED SWING AND ARM OPERATION



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 (Pc2, Pd2, Pc40, Pd40, Pd41, Pb3) 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.

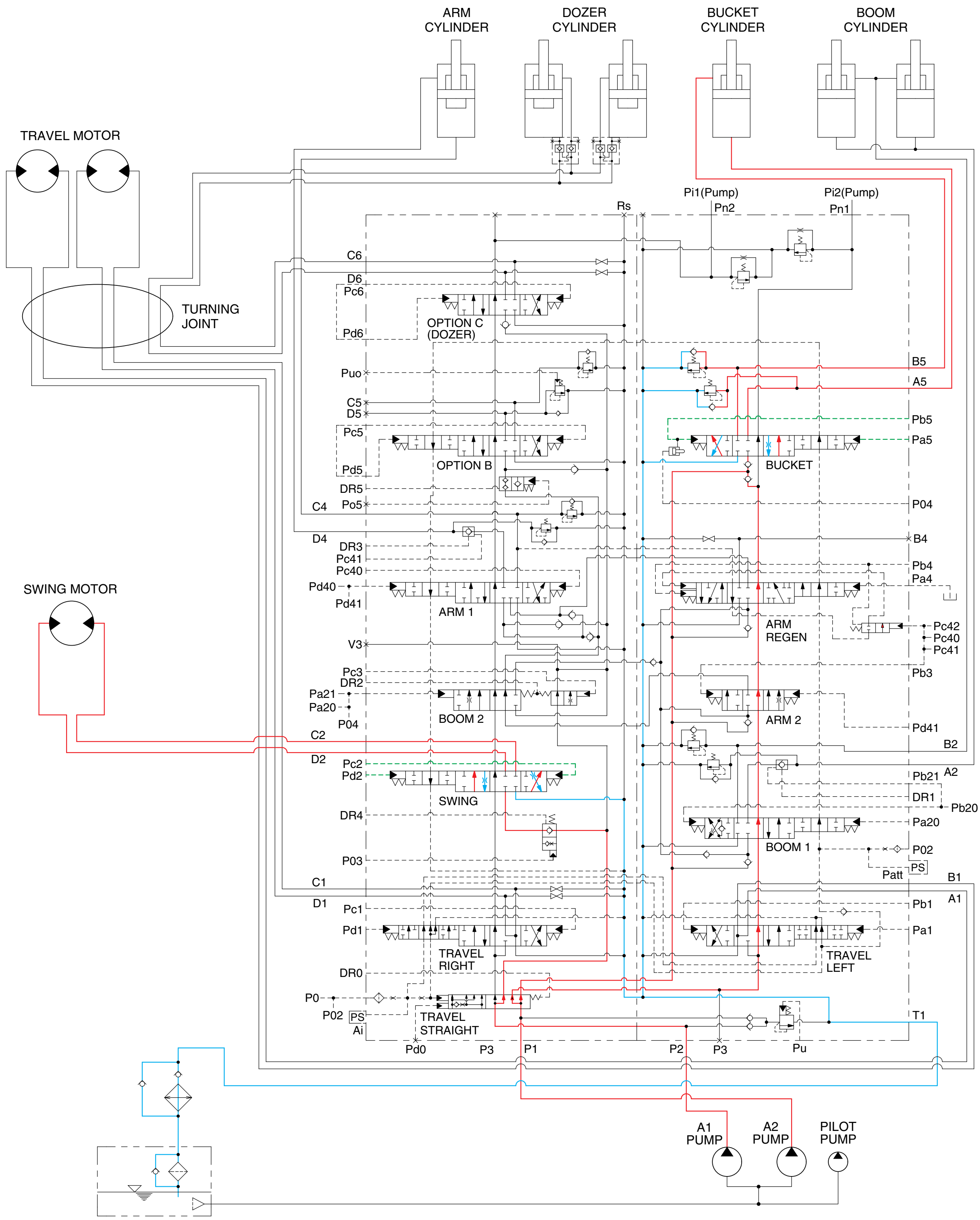
The oil from the A2 pump flows into the arm cylinder through the arm 2 spool of the right control valve.

The super structure swings and the arm is operated.

Refer to page 3-14 for the swing operation preference function.

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

4. COMBINED SWING AND BUCKET OPERATION



145SA3HC26

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 (Pc2, Pd2, Pa5, Pb5) from the remote control valve.

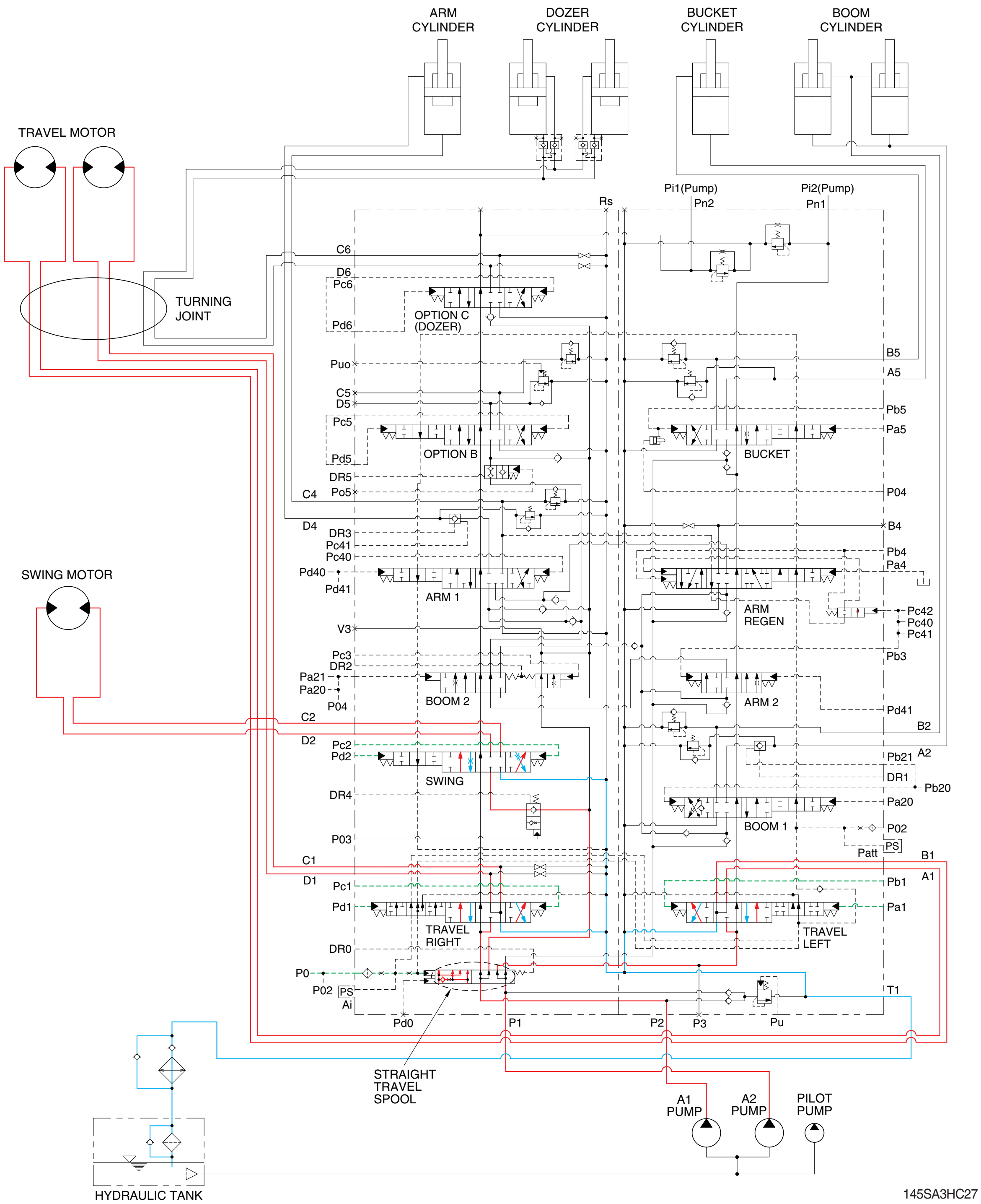
The oil from the A1 pump flows into the swing motor through the swing spool in the left control valve.

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.

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

5. COMBINED SWING AND TRAVEL OPERATION



When the swing and travel functions are operated simultaneously, the swing spool and travel spools in the main control valve are moved to the functional position by the pilot oil pressure (Pc2, Pd2, Pa1, Pb1, Pc1, Pd1) from the remote control valve and straight travel spool is pushed to the right by the pilot oil pressure (P0, P01) 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.

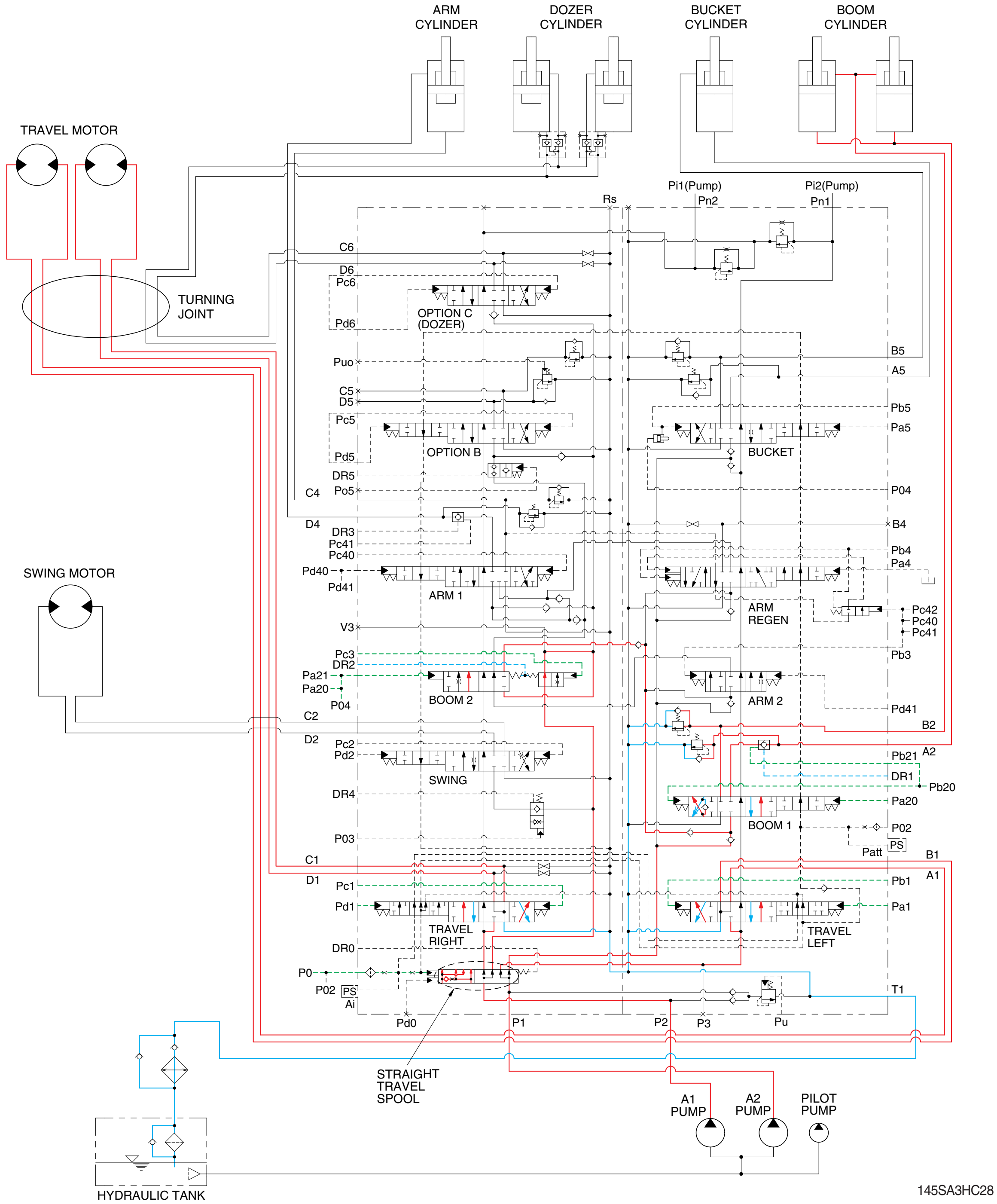
The oil from the A2 pump flows into the swing motor through in the straight travel spool.

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.

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

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 (Pa20, Pa21, Pc2, Pd2, Pa1, Pb1, Pc1, Pd1) from the remote control valve and the straight travel spool is pushed to the right by the oil pressure (P0, P01) from pilot pump.

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

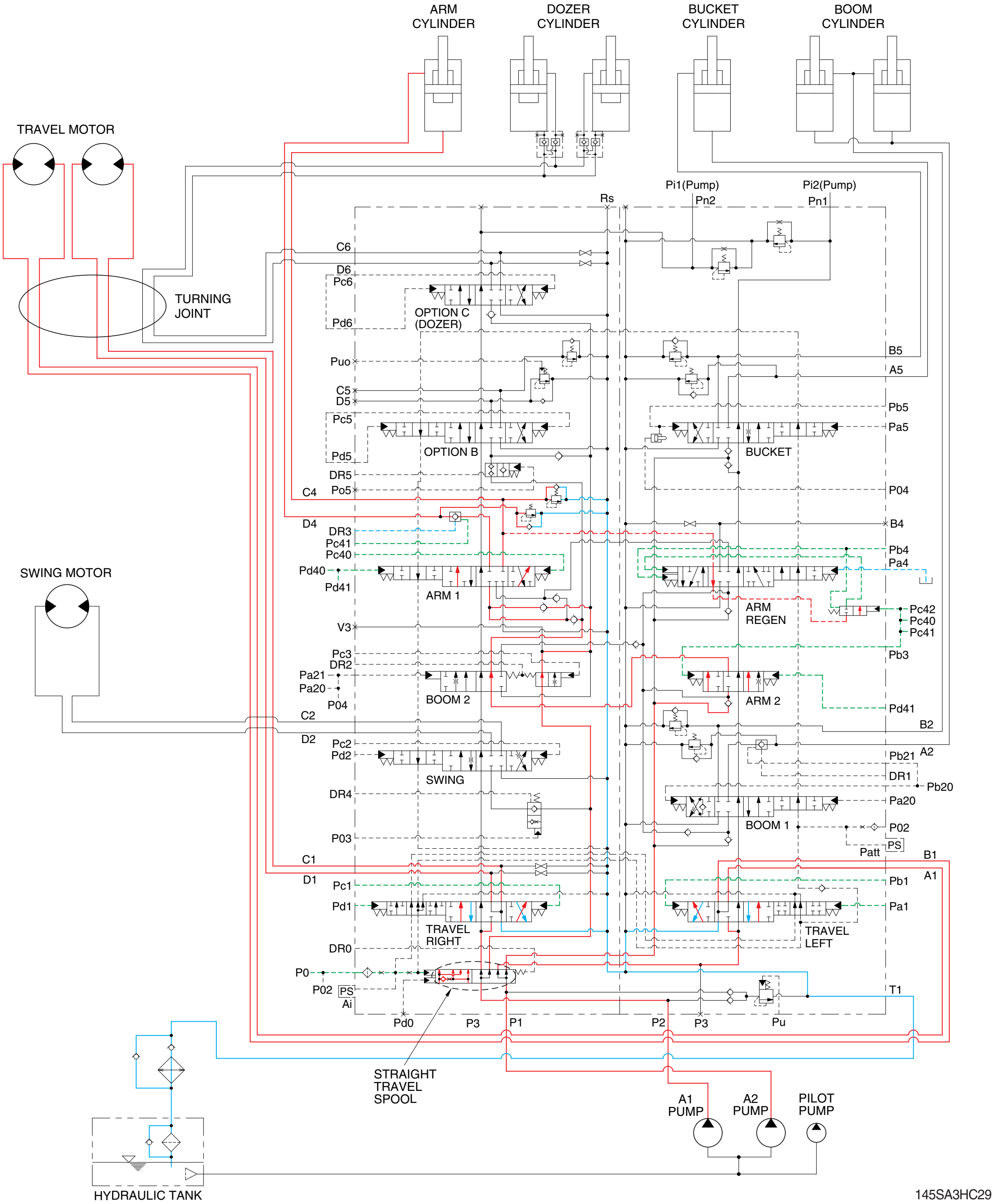
The oil from the A2 pump flows into the boom cylinders through the boom 2 spool and boom 1 spool via the parallel and confluence oil passage in case boom up operation.

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

The boom is operated and the machine travels straight.

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

7. COMBINED ARM AND TRAVEL OPERATION



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 (Pc40, Pd40, Pd41, Pb3, Pc2, Pd2, Pa1, Pb1, Pc1, Pd1) from the remote control valve and the straight travel spool is pushed to the right by the oil pressure (P0, P01) from pilot pump.

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

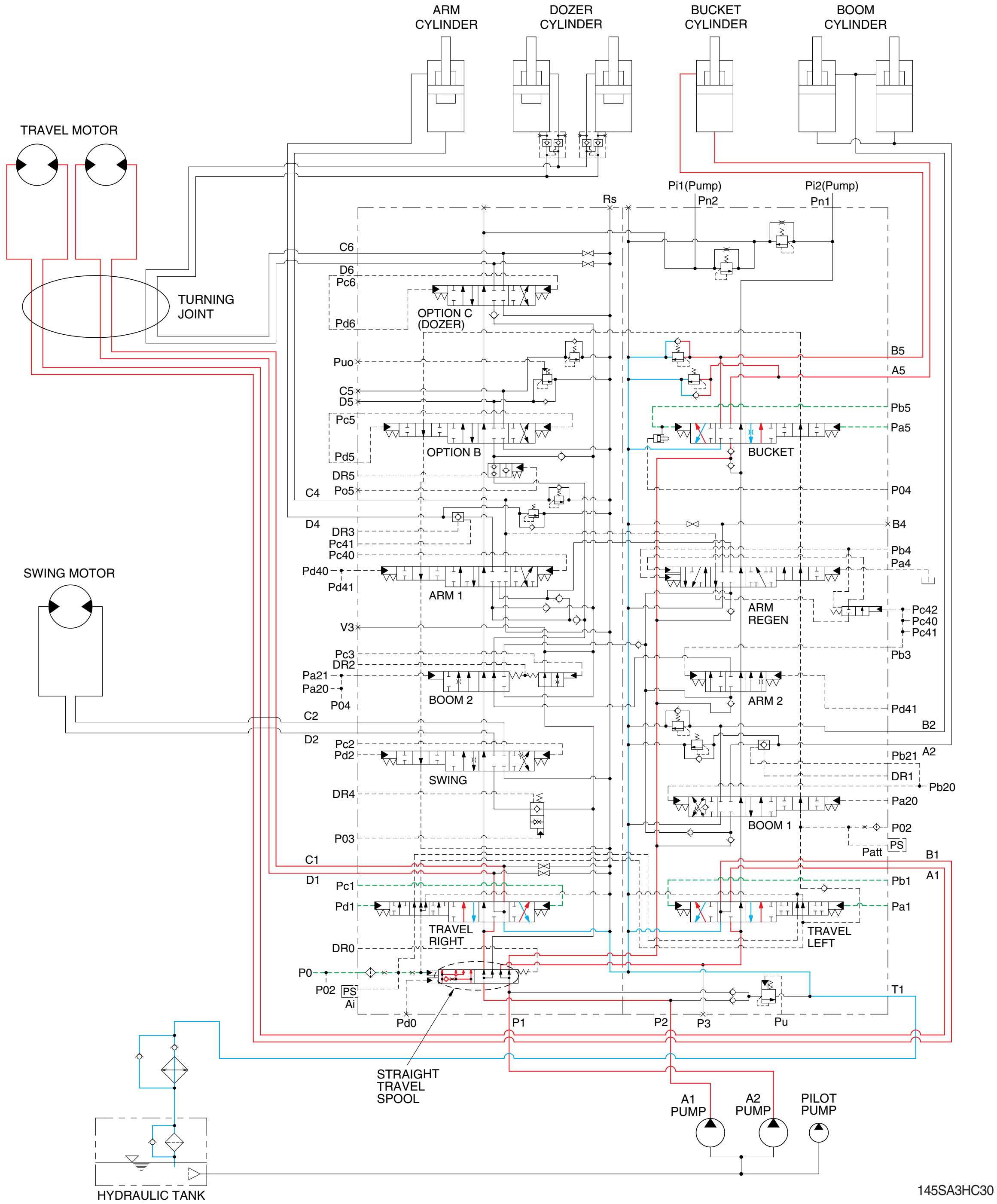
The oil from the A2 pump flows into the arm cylinders through the arm 1 spool and arm 2 spool via the parallel and confluence oil passage.

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

The arm is operated and the machine travels straight.

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

8. COMBINED BUCKET AND TRAVEL OPERATION



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 (Pa5, Pb5, Pa1, Pb1, Pc1, Pd1) from the remote control valve, and the straight travel spool is pushed to the right by the oil pressure (P0, P01) from pilot pump. The oil from the A1 pump flows into the travel motors through the RH travel spool of the left control valve and the LH travel spool of the right control valve via the straight travel spool of the control valve.

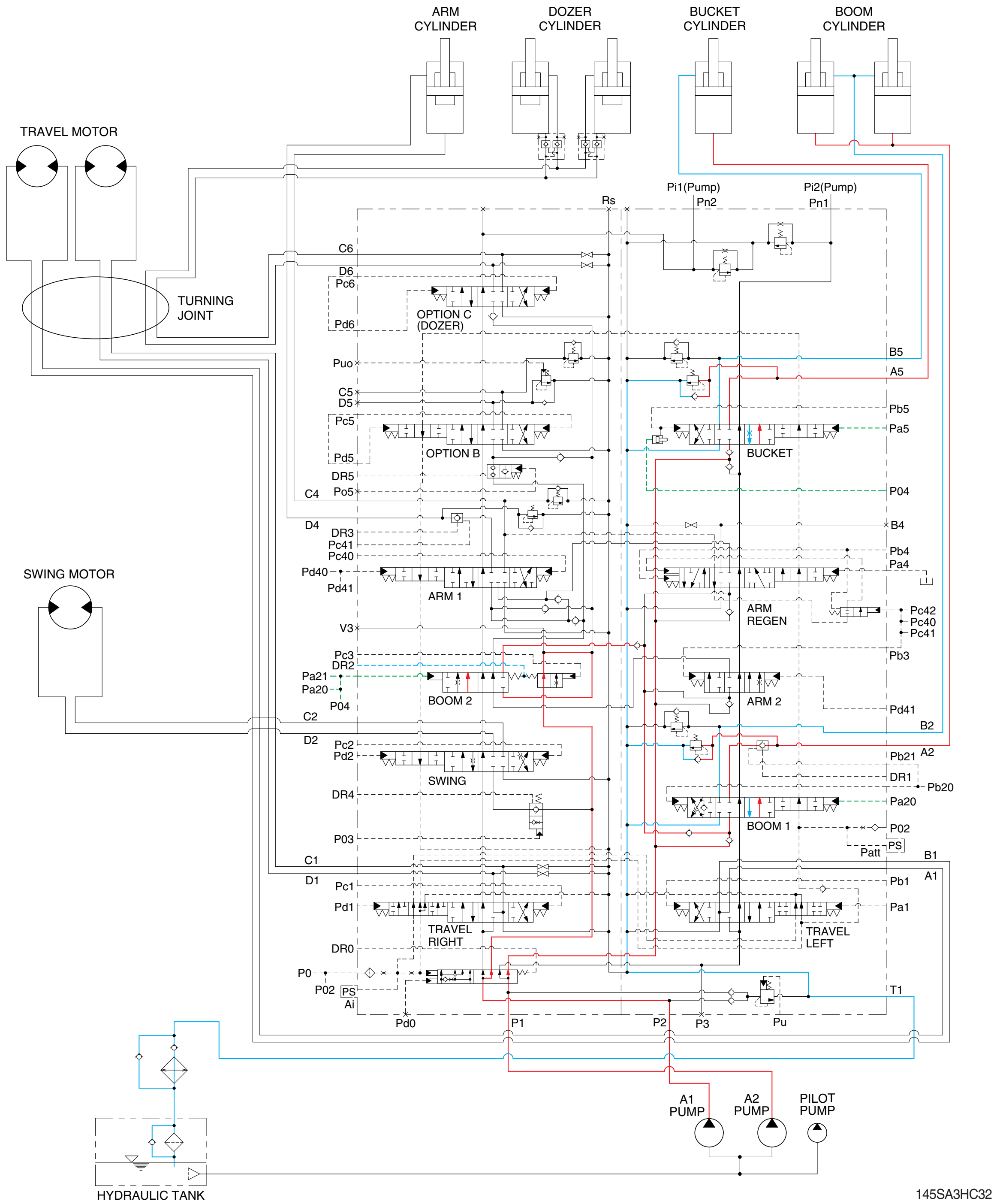
The oil from the A2 pump flows into the bucket cylinder through the bucket spool via the confluence oil passage.

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

The bucket is operated and the machine travels straight.

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

9. COMBINED BOOM UP AND BUCKET IN OPERATION



When the boom up and bucket in functions are operated simultaneously, each spool in the main control valve is moved to the functional position by the pilot oil pressure (Pa20, Pa21, Pa5) 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.

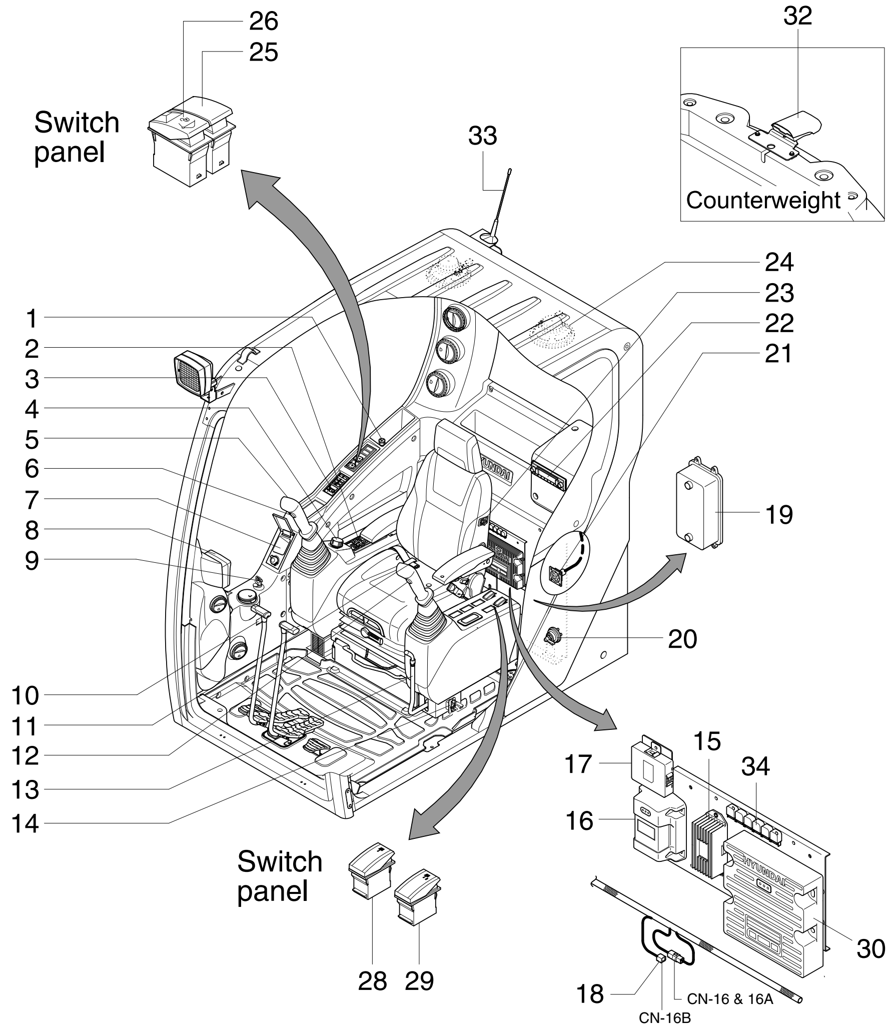
The boom and bucket are operated.

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

SECTION 4 ELECTRICAL SYSTEM

GROUP 1 COMPONENT LOCATION

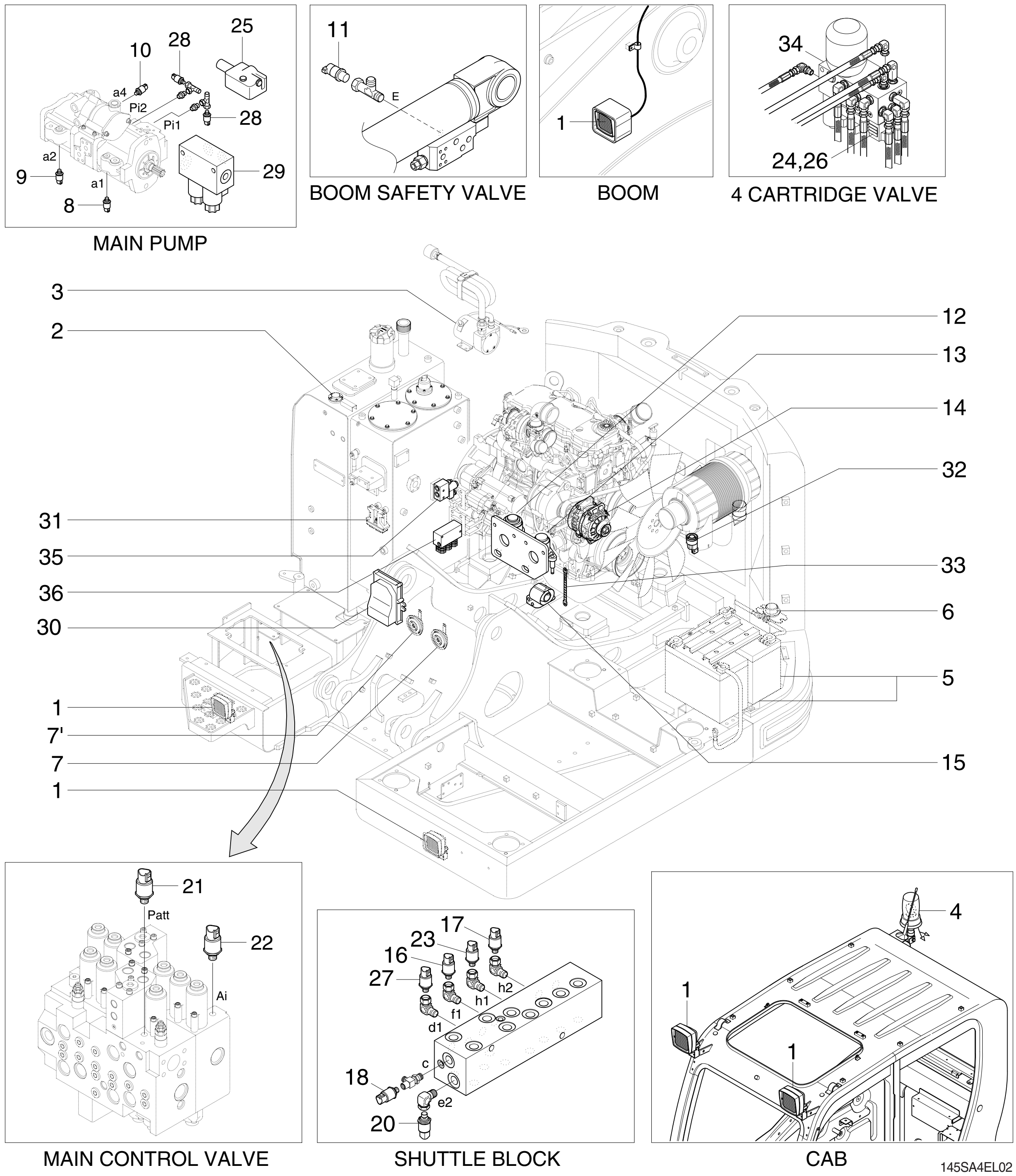
1. LOCATION 1



145SA4EL01

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	Fine swing 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
11	One touch decel switch	22	Radio & USB player		

2. LOCATION 2

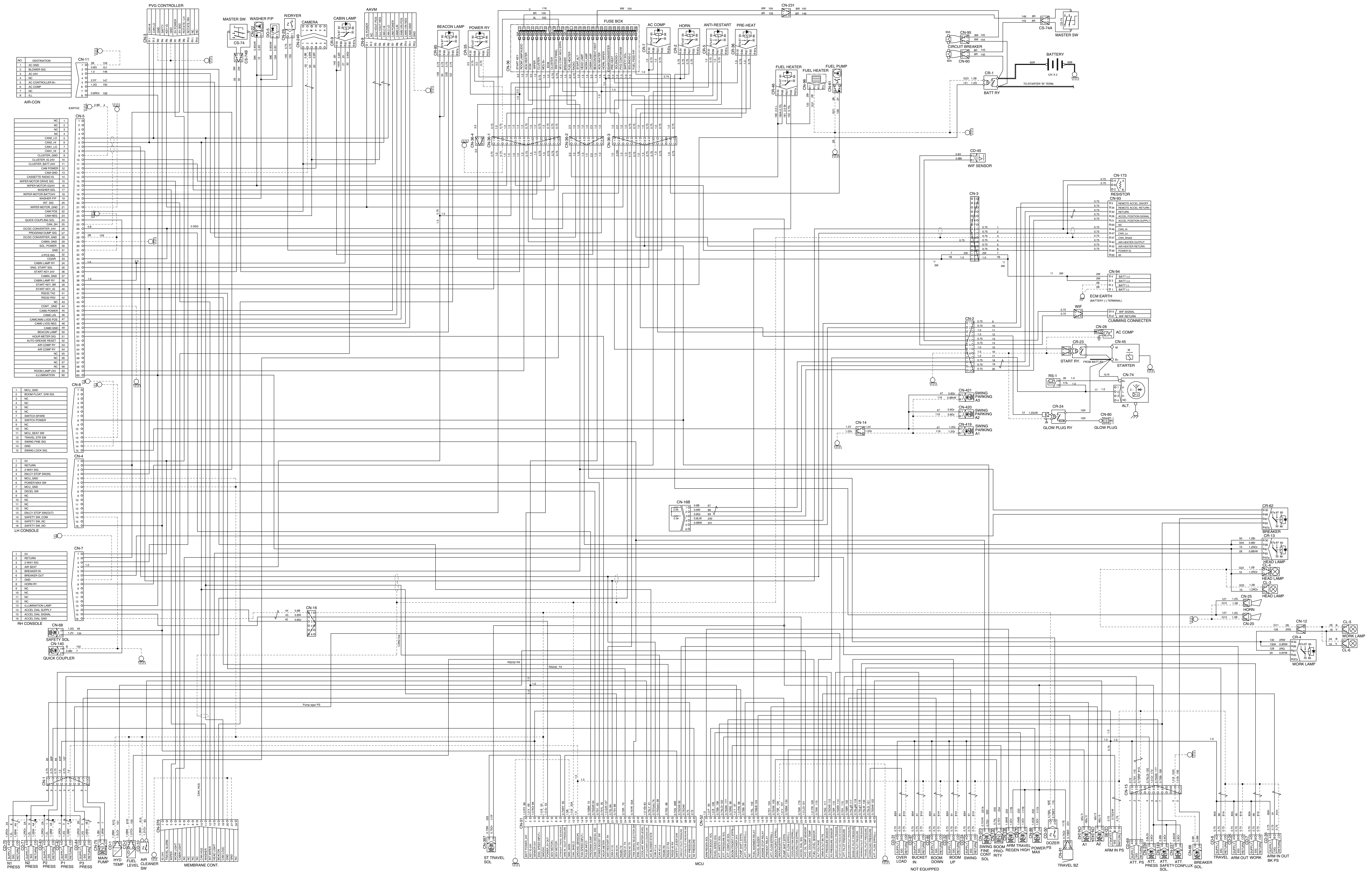


1	Lamp	12	Start relay	25	Pump EPPR valve
2	Fuel sender	13	Heater relay	26	Boom priority EPPR valve
3	Fuel filler pump	14	Alternator	27	Arm out pressure sensor
4	Beacon lamp	15	Travel alarm buzzer	28	Nega-control pressure sensor
5	Battery	16	Bucket in pressure sensor	29	Flow control EPPR valve
6	Battery relay	17	Boom down 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	Boom up pressure sensor	35	Swing fine solenoid valve
11	Overload pressure sensor	24	4 cartridge valve	36	Swing lock solenoid valve

GROUP 2 ELECTRICAL CIRCUIT

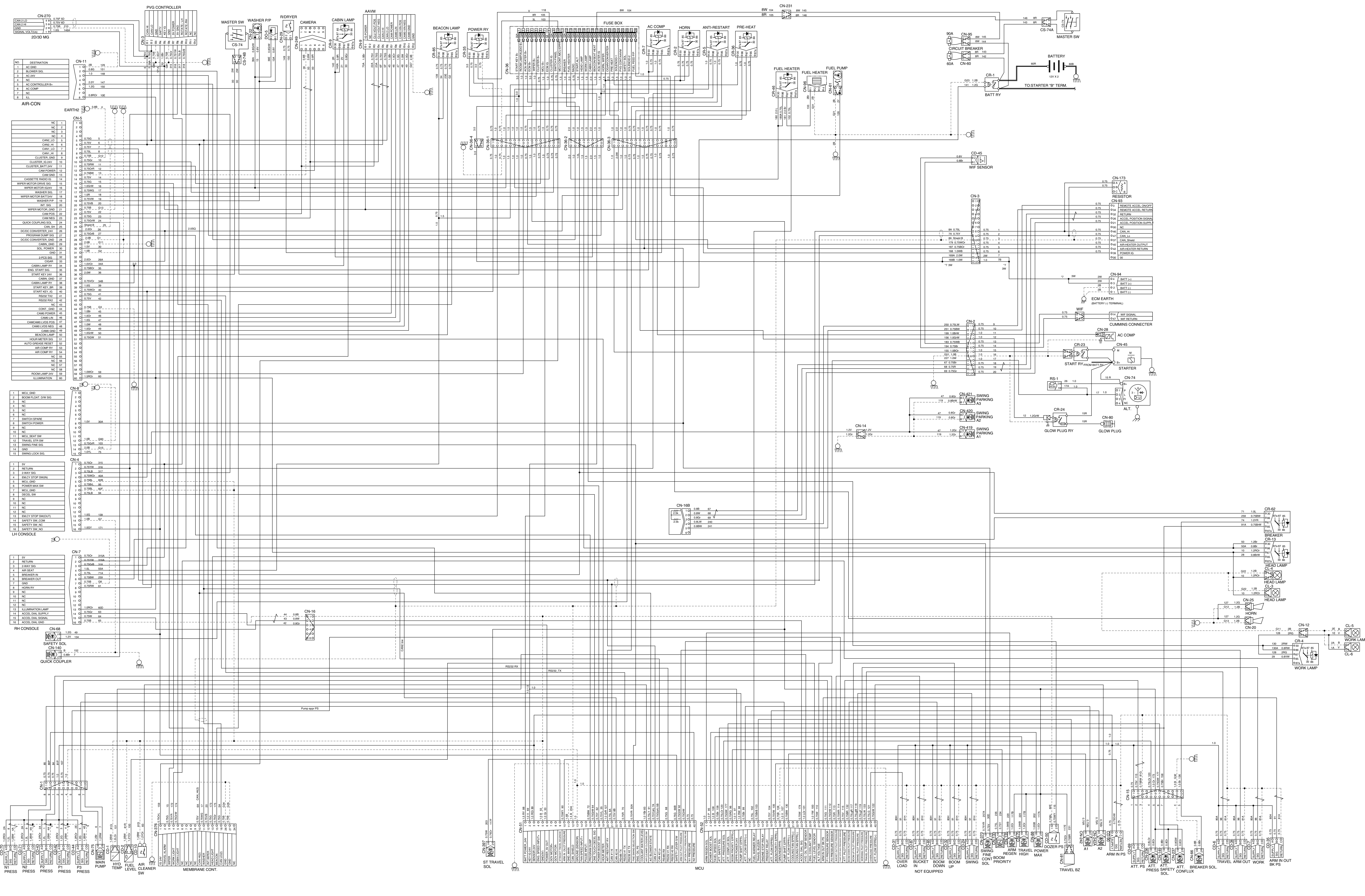
· ELECTRICAL CIRCUIT (1/2)

- MACHINE SERIAL NO. : -#0004



20K4-94200-01

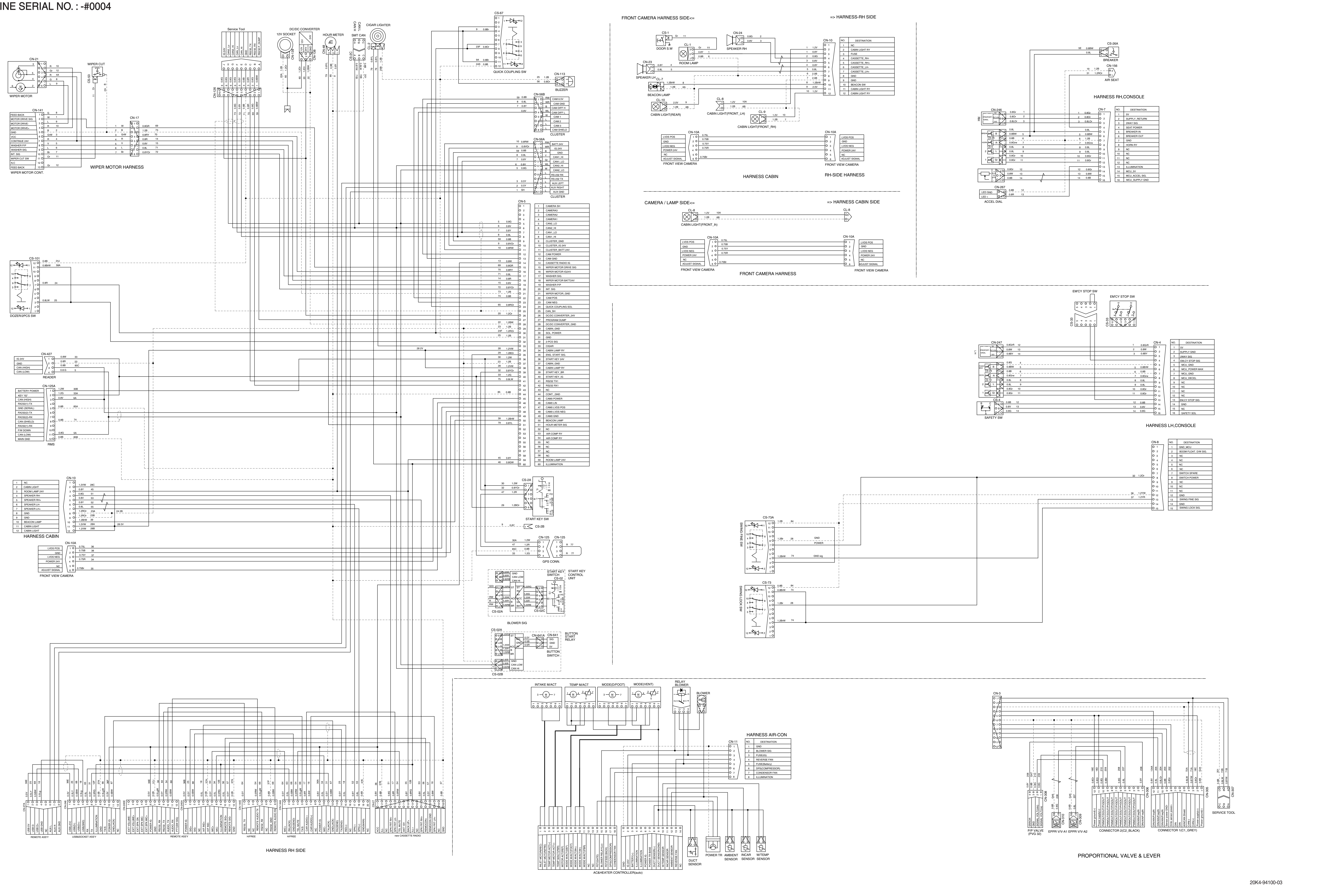
- MACHINE SERIAL NO. : #0005-



20K4-94202-00

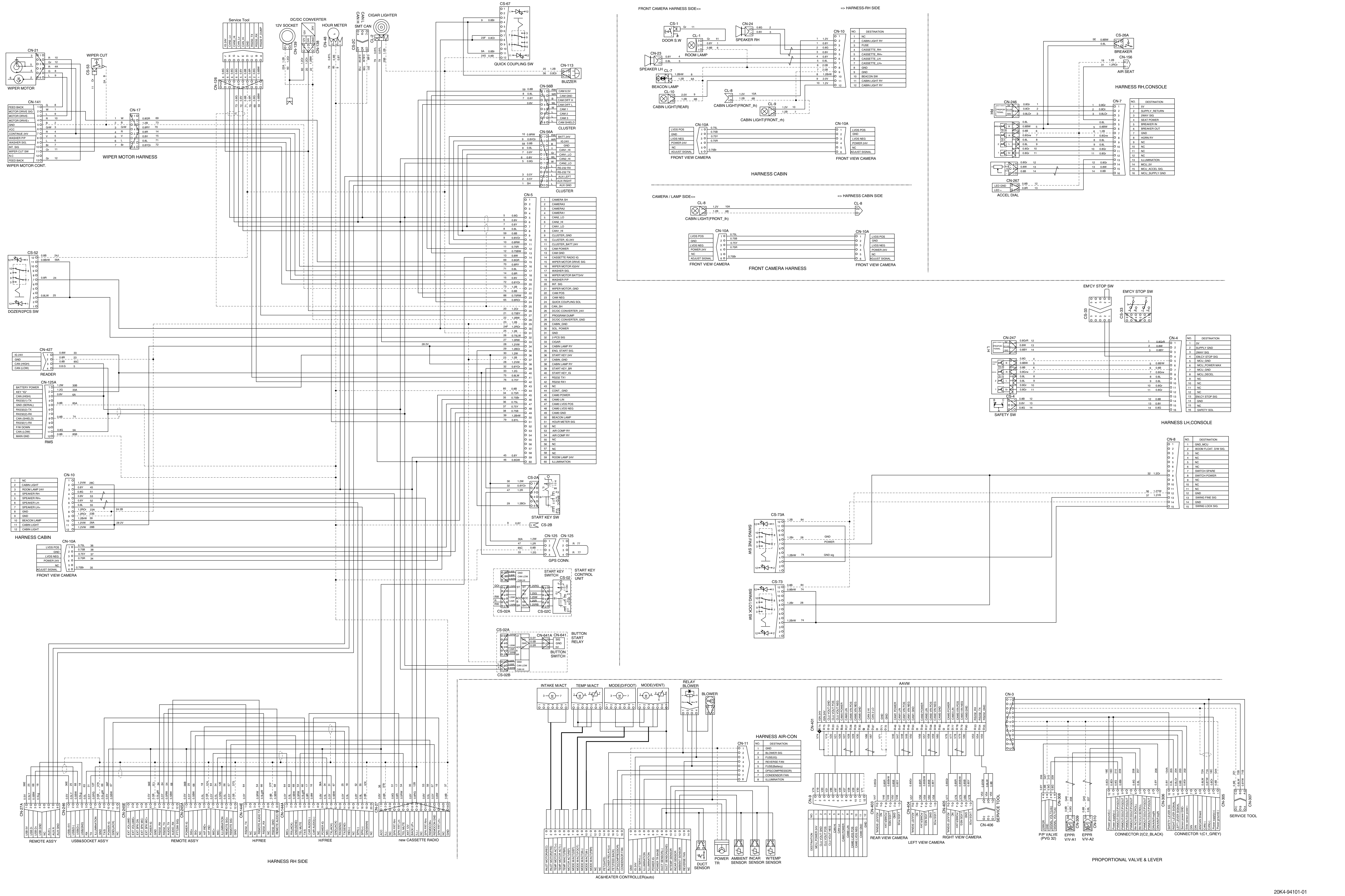
· ELECTRICAL CIRCUIT (2/2)

- MACHINE SERIAL NO. : -#0004

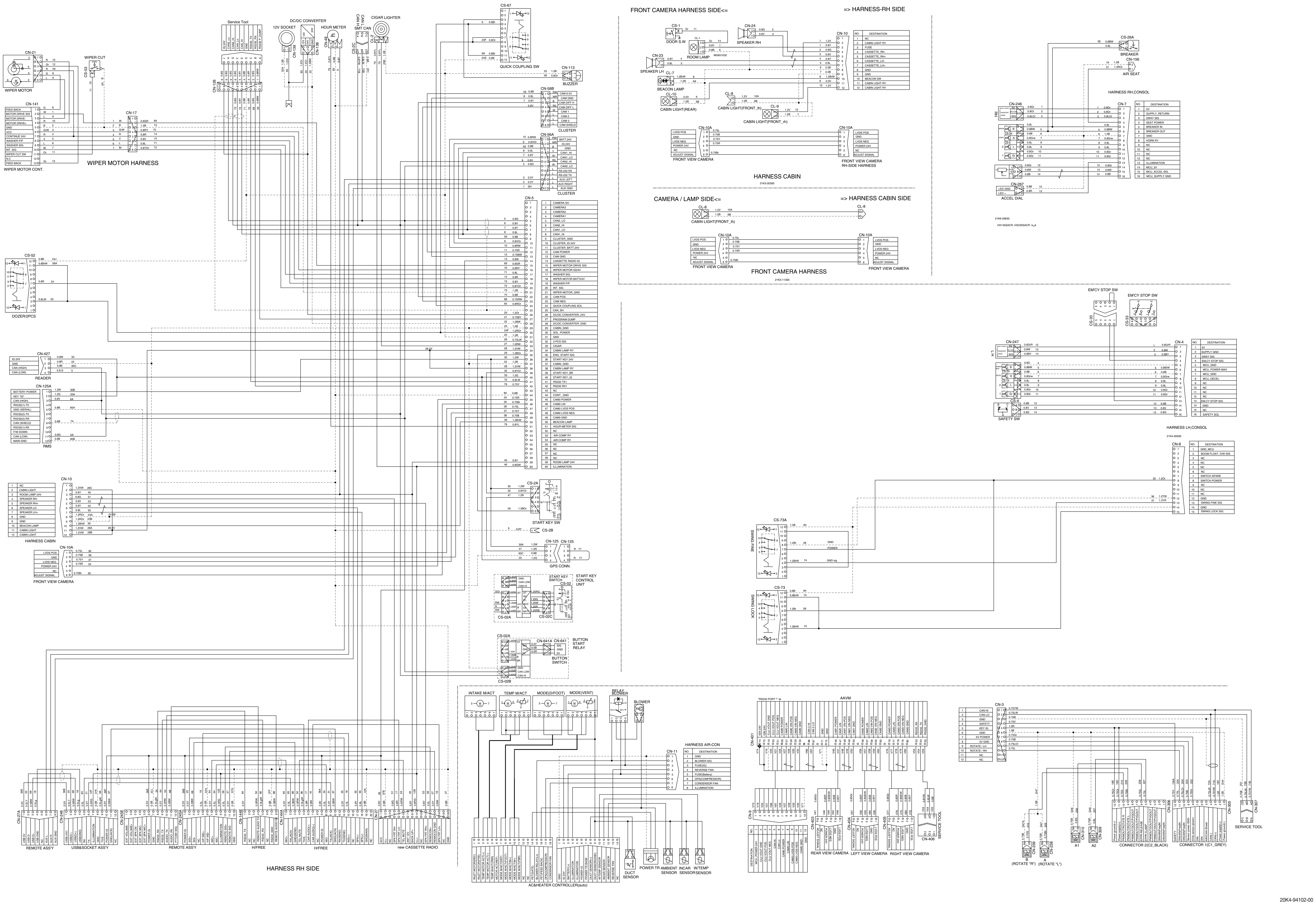


20K4-94100-03

- MACHINE SERIAL NO. : #0005-#0131



- MACHINE SERIAL NO. : #0132-



MEMORANDUM

1. POWER CIRCUIT

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

1) OPERATING FLOW

Battery → Battery relay → Circuit breaker [CN-60] → Master switch [CS-74A] → I/conn [CN-231 (2)]
- → Fuse box [No.5] → I/conn [CN-36-4 (1)] → I/conn [CN-3 (14, 15)]
  - → Engine ECM [CN -94 (3, 4)]
- → 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)]
  - → Service meter [CN-48 (1)]
- → Fuse box [No.8] → I/conn [CN-36-1 (13)] → MCU [CN-51 (1)]
- → Fuse box [No.2] → I/conn [CN-36-1 (7)] → Master switch [CS-74B] → I/conn [CN-5 (36)]
  - → Start switch [CS-2A (1)]
  - → GPS connection [CN-125 (1)]
  - → RMS power [CN-125A (1)]
  - → Power relay [CR-35 (30)]
- → 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.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 -56 (1)]

※ I/conn : Intermediate connector

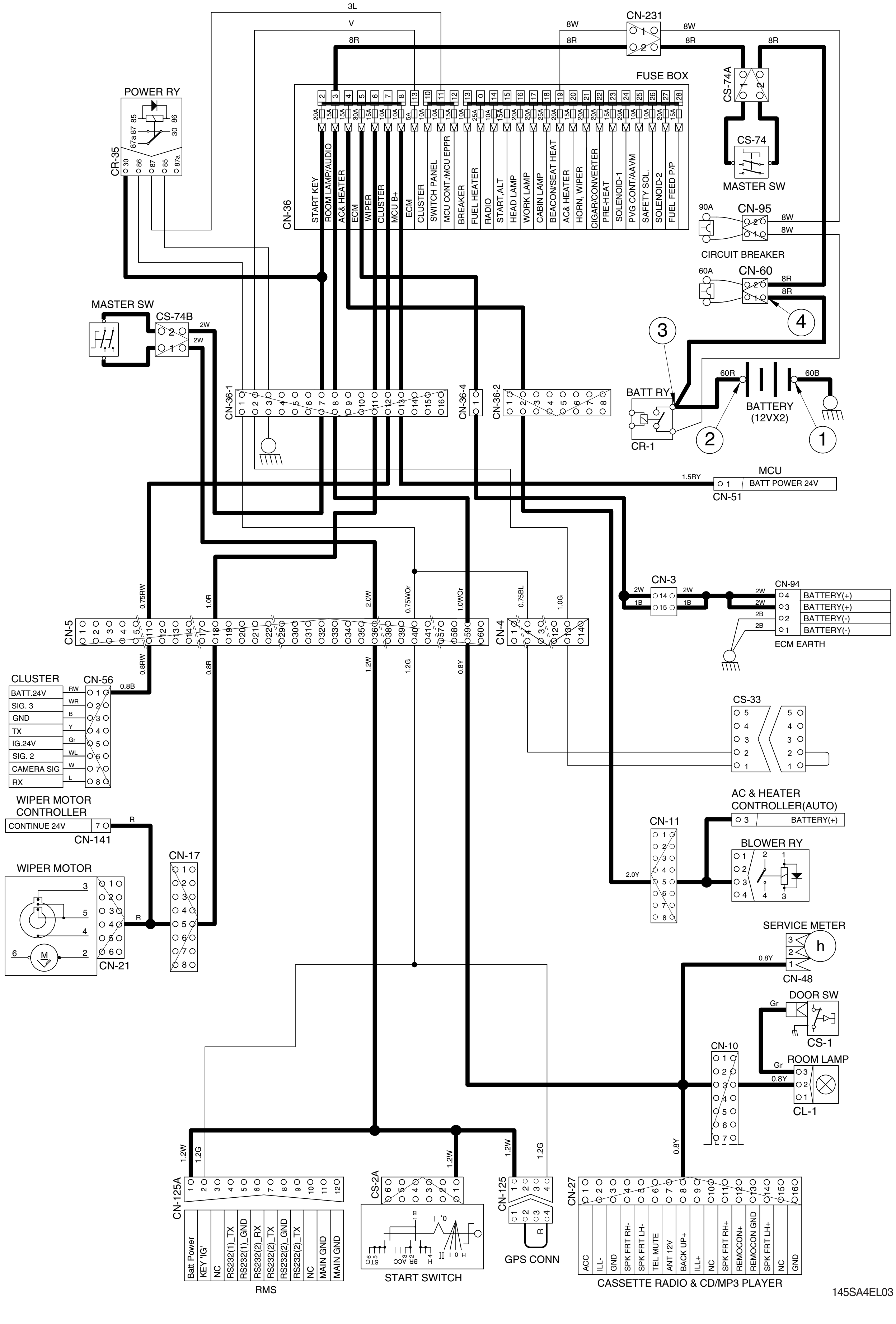
2) CHECK POINT

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

※ GND : Ground

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

POWER CIRCUIT



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

2. STARTING CIRCUIT

1) OPERATING FLOW

Battery (+) terminal → Battery relay [CR-1] → Circuit breaker [CN-60] → Master switch [CS-74A] → 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-2 (3)] → GPS connector [CN-125 (2)→(4)] → I/conn [CN-5 (40)]
→ I/conn [CN-36-1 (1)] → Power relay [CR-35 (86)→(87)] → Fuse box [No.11]
→ I/conn [CN-4 (4)] → Emergency engine stop switch [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-3 (13)] → ECM [CN-93 (39)]

(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 (7)] → Start relay [CR-23] → Start motor operating

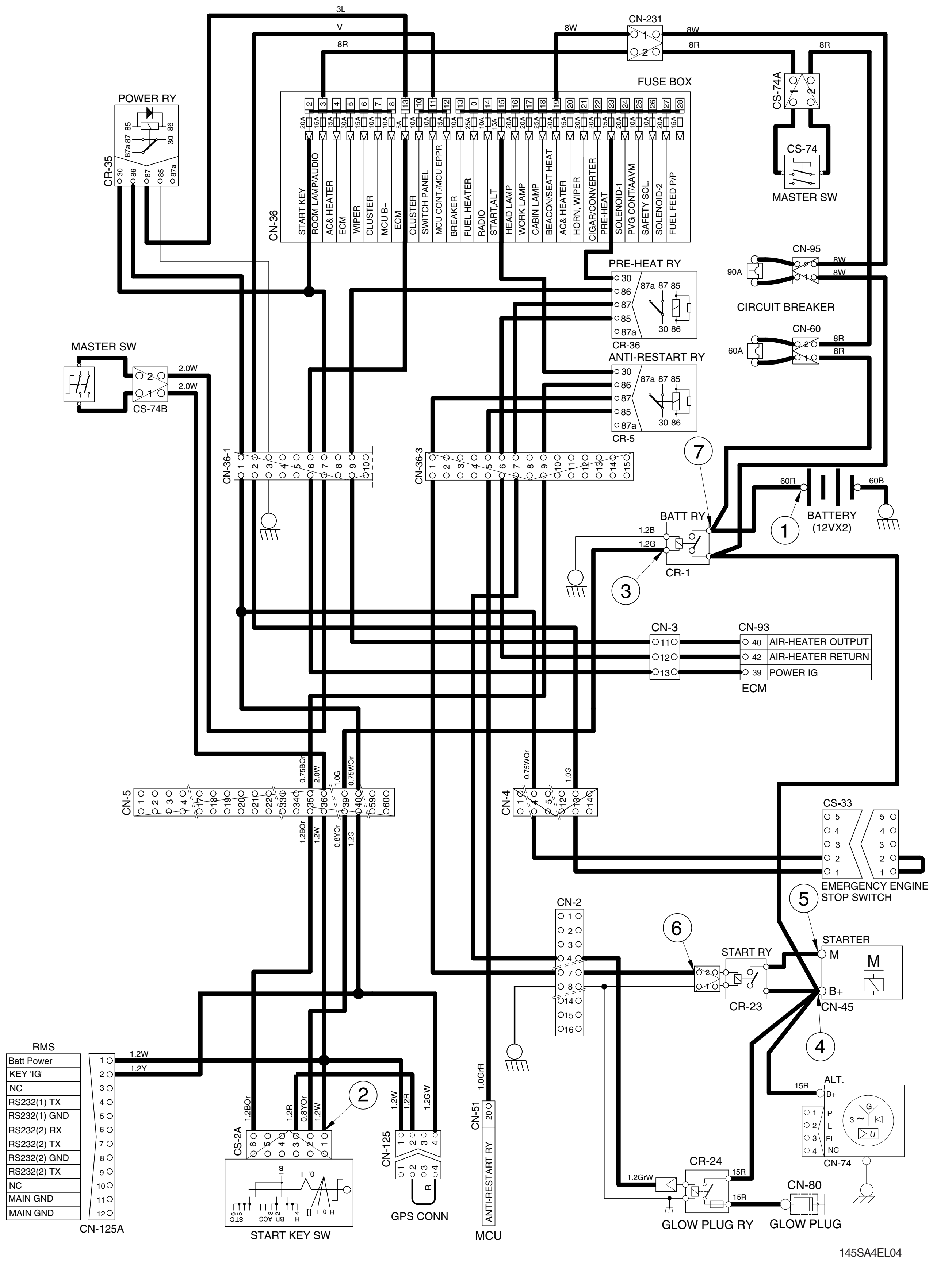
2) CHECK POINT

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

※ GND : Ground

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

STARTING CIRCUIT



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

3. CHARGING CIRCUIT

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

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

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

1) OPERATING FLOW

(1) Warning flow

Alternator "L" terminal [CN-74 (2)] → I/conn [CN-2 (9)] → MCU alternator voltage level [CN-52 (27)] → Cluster charging warning lamp (via CAN interface)

(2) Charging flow

Alternator "B^+" terminal → Start motor [B^+] → Battery relay

- → Battery (+) terminal
- → Circuit breaker [CN-60] → Master switch [CS-74A] → I/conn [CN-231 (2)] → Fuse box [No.2~8]
- → Circuit breaker [CN-95] → I/conn [CN-231 (1)] → Fuse box [No. 13~28]

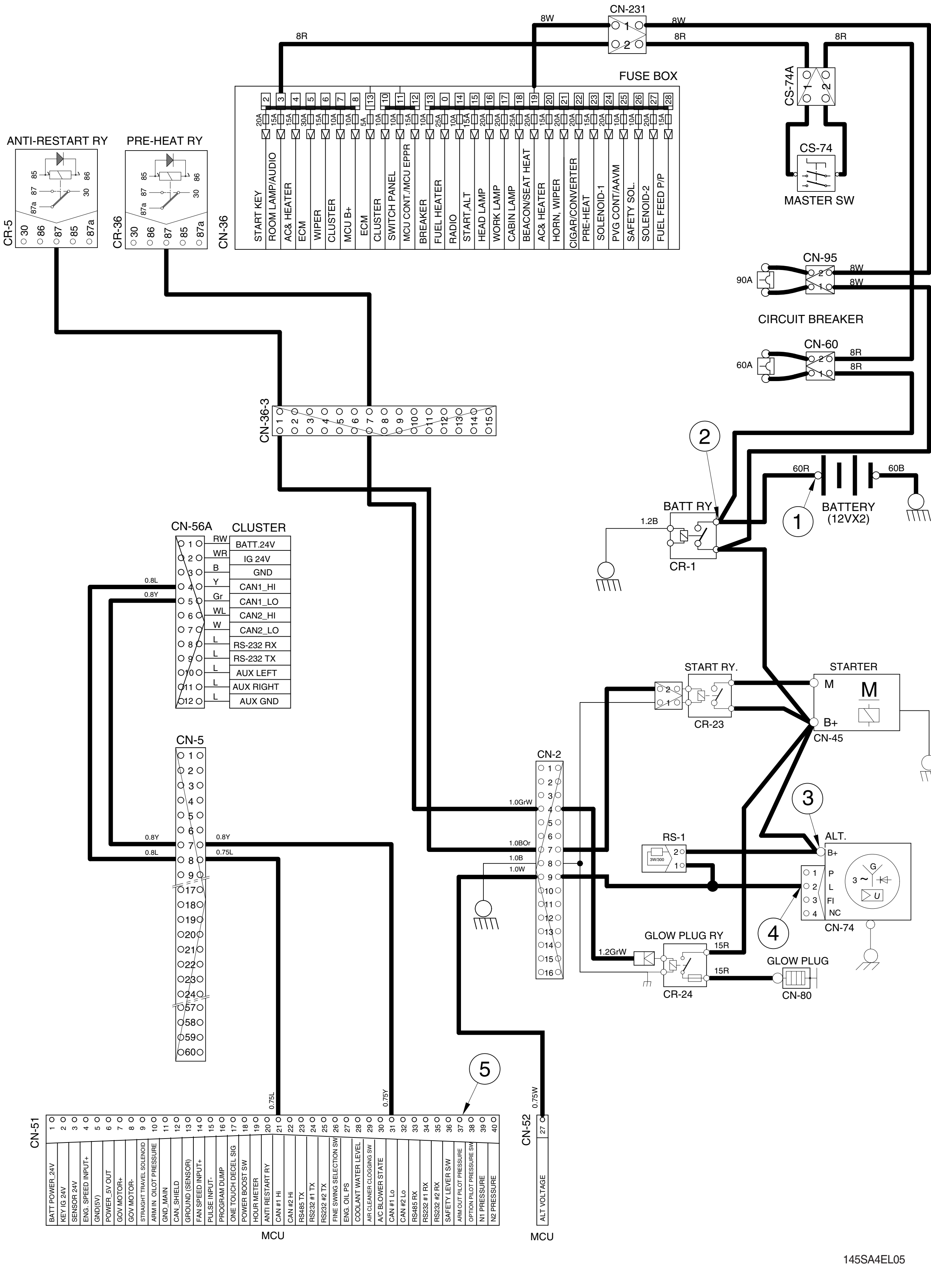
2) CHECK POINT

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)	20~30V

※ GND : Ground

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

CHARGING CIRCUIT



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

4. HEAD AND WORK LIGHT CIRCUIT

1) OPERATING FLOW

Fuse box (No.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)]
Fuse box (No.11) → I/conn [CN-36-4 (16)] → Membrane controller [CN-376 (1)]

(1) Head light switch ON

Head light switch ON [CN-376 (13)] → Head light relay [CR-13 (85) → (87)]
→ Head light ON [CL-3 (2)] , [CL-4 (2)]
→ I/conn [CN-11 (8)] → AC & Heater controller illumination ON [4]
→ I/conn [CN-5 (60)] → Remote controller illumination ON [CN-245A (9)]
→ Cigar lighter [CL-2]
→ USB & Socket illumination ON [CN-246 (7)]
→ Radio & USB player illumination ON [CN-27 (9)]
→ I/conn [CN-7 (13)] → Accel dial LED [CN-267 (2)]

(2) Work light switch ON

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

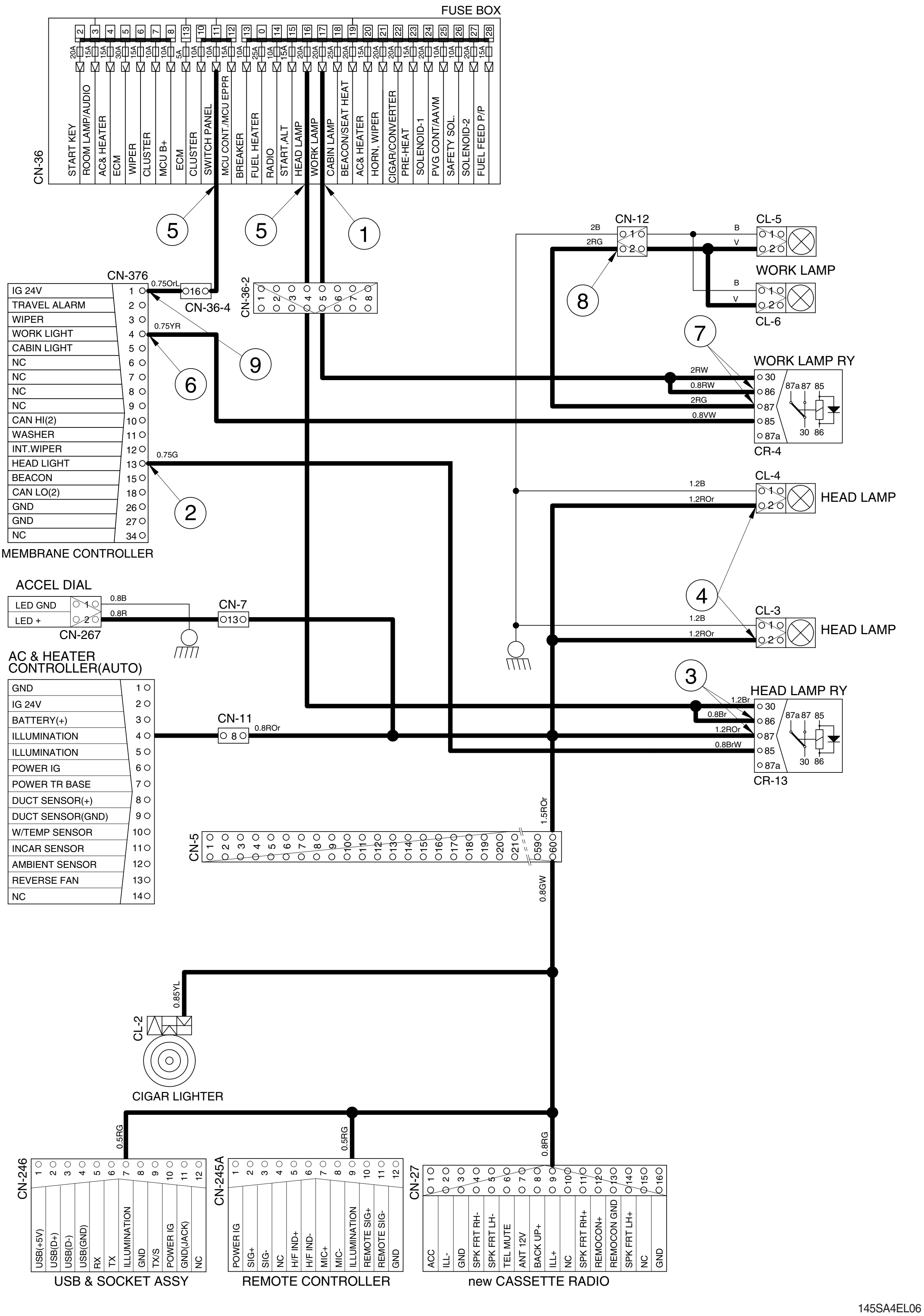
2) CHECK POINT

Engine	Start switch	Check point	Voltage
STOP	ON	① - GND (fuse box) ② - GND (switch power output) ③ - GND (head light relay) ④ - GND (head light) ⑤ - GND (fuse box) ⑥ - GND (switch power output) ⑦ - GND (work light relay) ⑧ - GND (work light) ⑨ - GND (switch power input)	20~25V

※ GND : Ground

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

HEAD AND WORK LIGHT CIRCUIT



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

5. BEACON LAMP AND CAB LIGHT CIRCUIT

1) OPERATING FLOW

Fuse box (No.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)]
Fuse box (No.11) → I/conn [CN-36-4 (16)] → Membrane controller [CN-376 (1)]

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

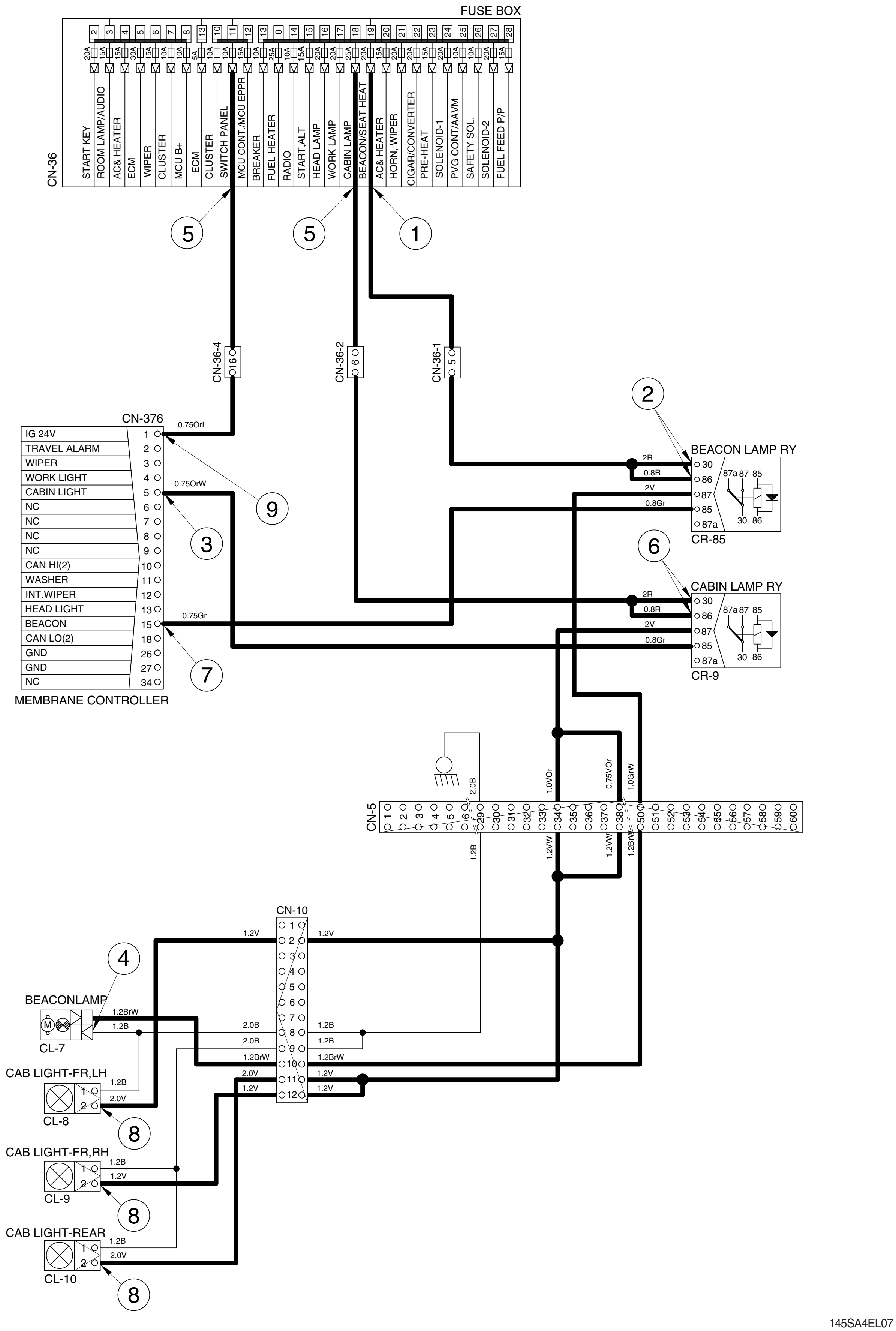
2) CHECK POINT

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

※ GND : Ground

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

BEACON LAMP AND CAB LIGHT CIRCUIT



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

6. WIPER AND WASHER CIRCUIT

1) OPERATING FLOW

(1) Start switch ON

Fuse box (No.10) → I/conn [CN-36-4 (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) Intermittent 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 intermittently operating [CN-21 (6)]

(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 operating [CN-21 (2)]

(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 operating [CN-21 (2)]

(5) Auto parking(when switch OFF)

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

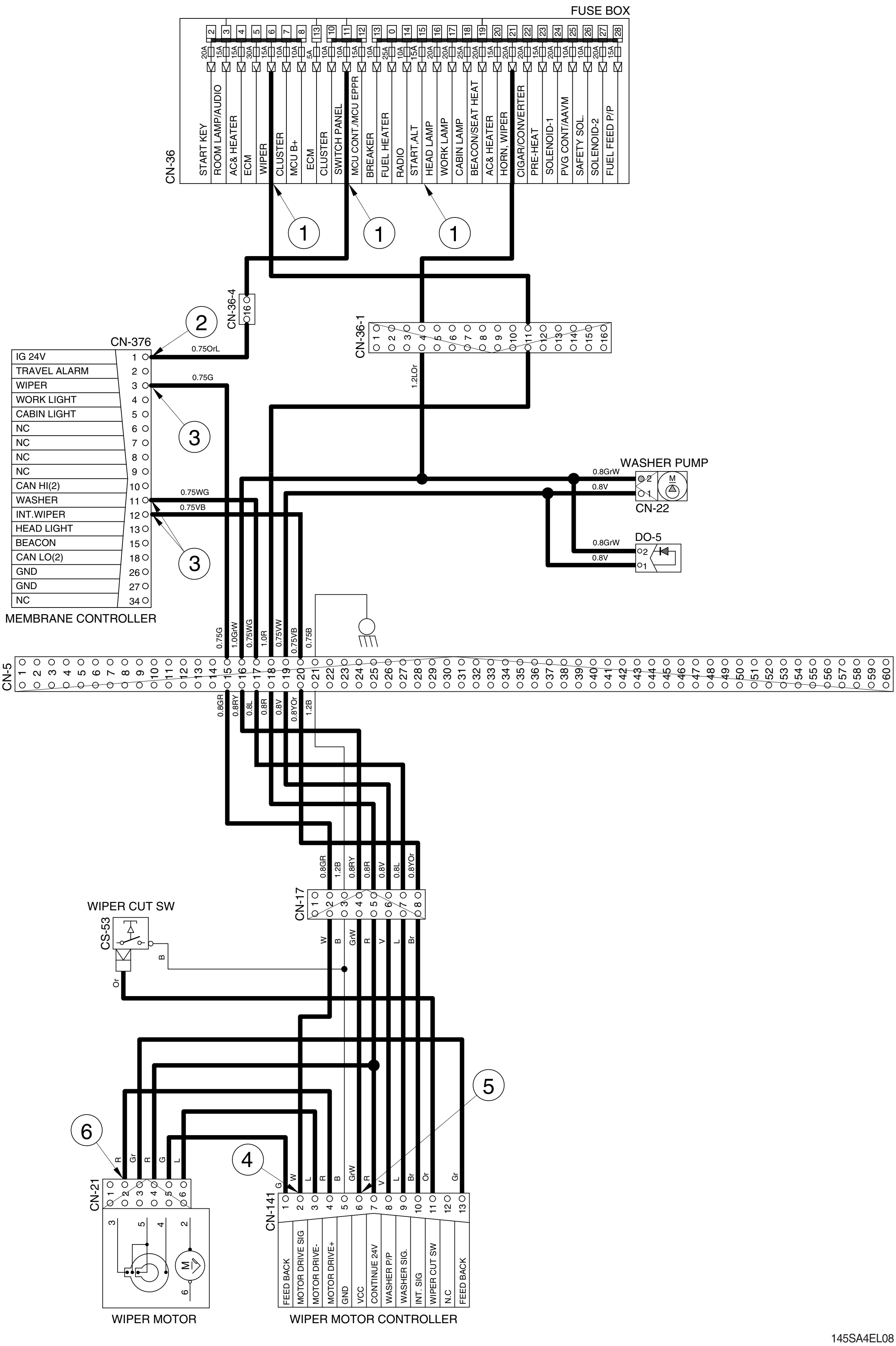
2) CHECK POINT

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

※ GND : Ground

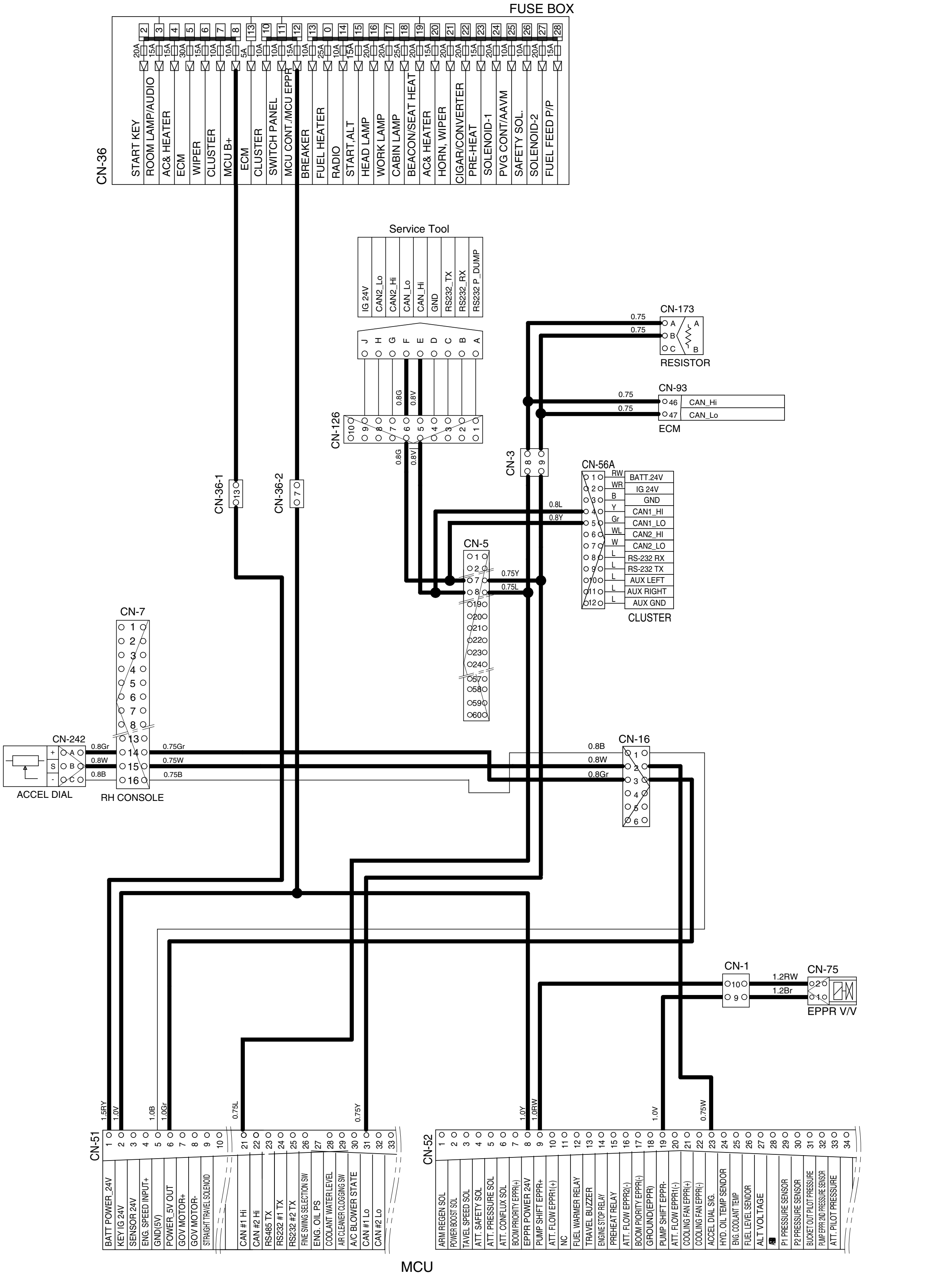
※ The circuit diagram may differ from the equipment, so please check before a repair.

WIPER AND WASHER CIRCUIT



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

CONTROLLER CIRCUIT



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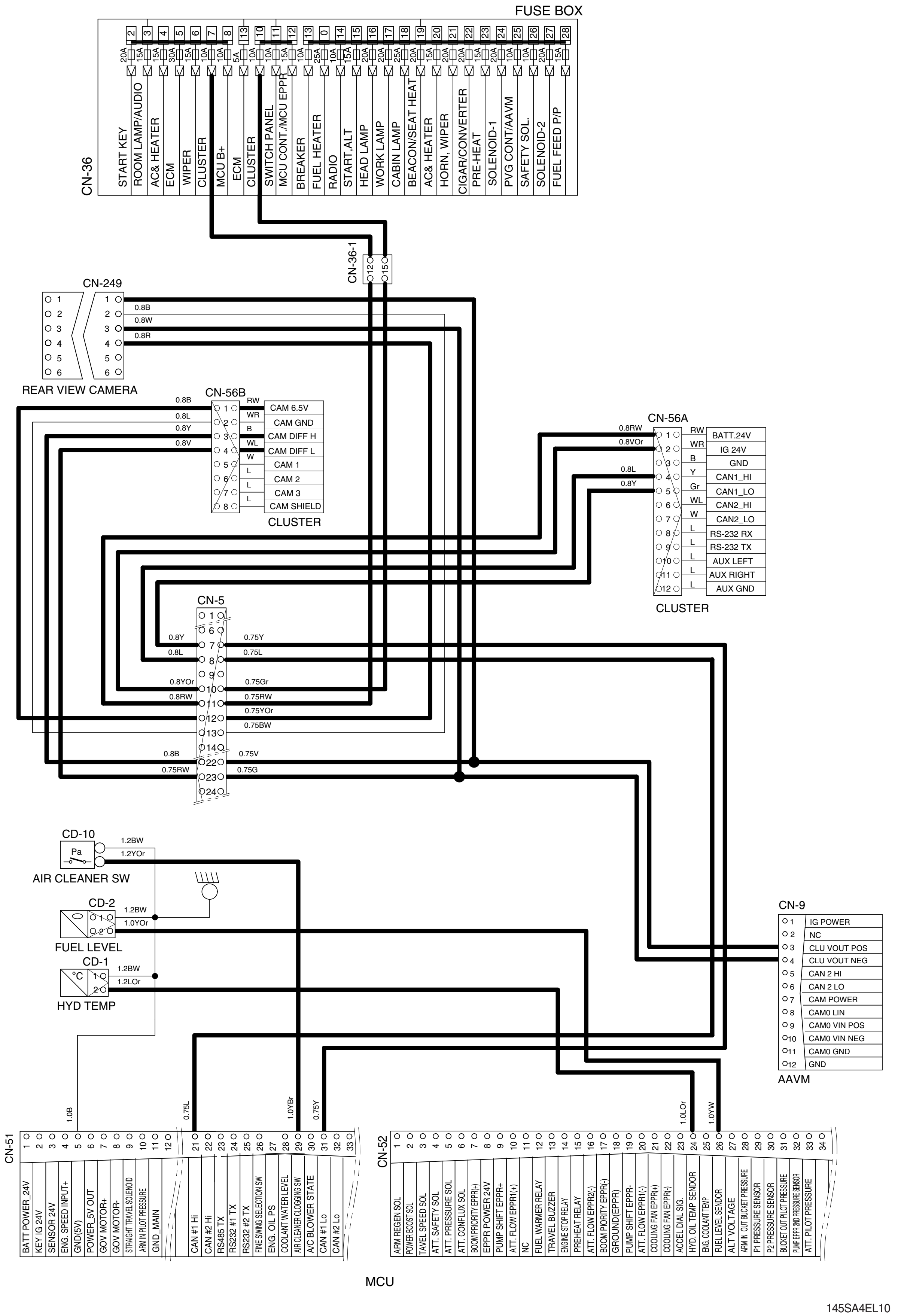
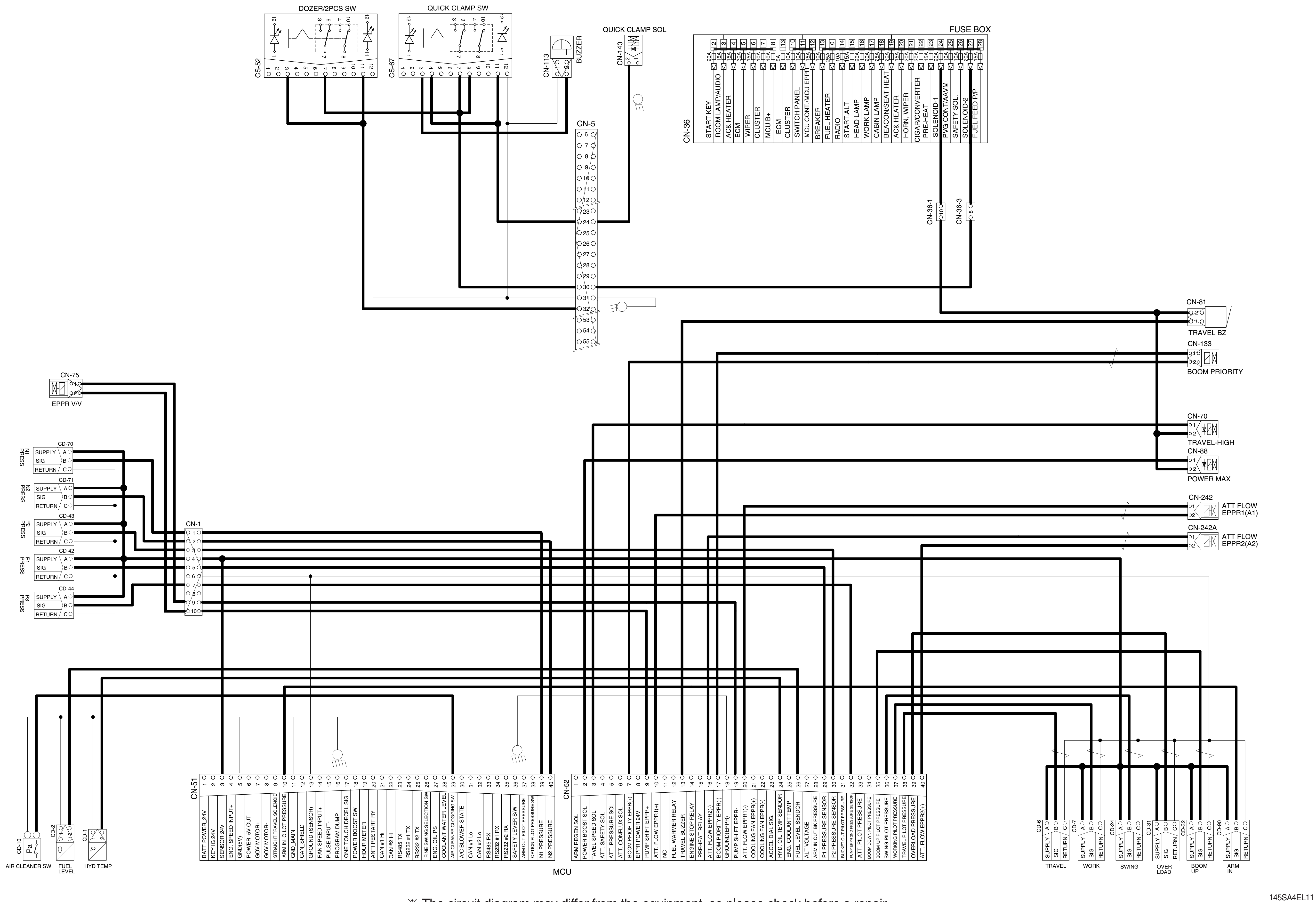
※ The circuit diagram may differ from the equipment, so please check before a repair.

MONITORING CIRCUIT



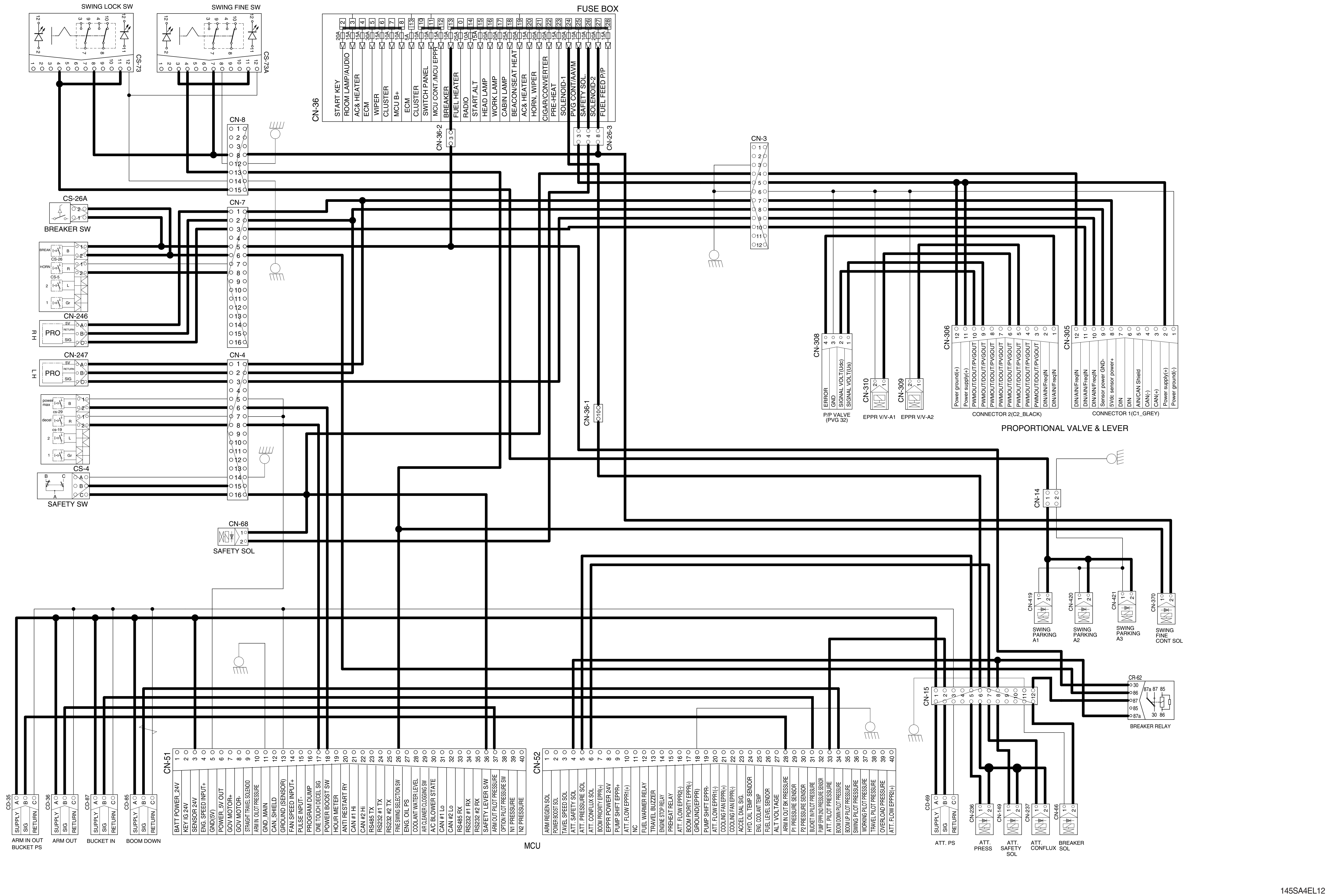
※ The circuit diagram may differ from the equipment, so please check before a repair.

ELECTRIC CIRCUIT FOR HYDRAULIC (1/2)



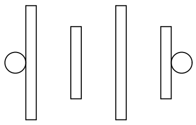
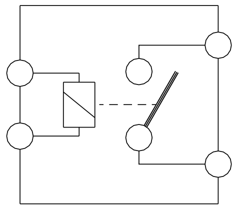
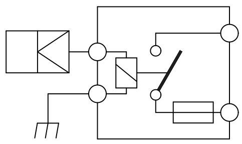
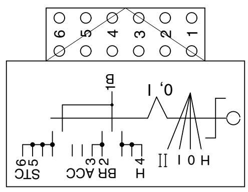
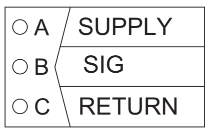
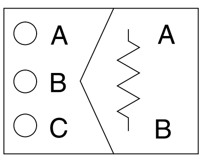
※ The circuit diagram may differ from the equipment, so please check before a repair.

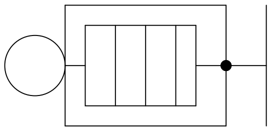
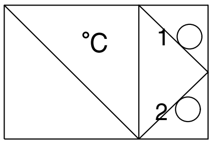
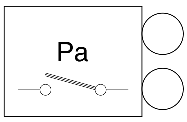
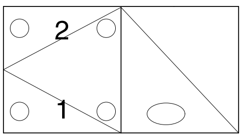
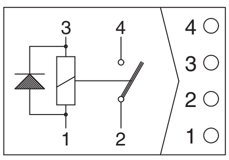
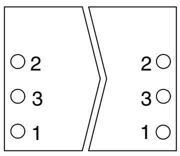
ELECTRIC CIRCUIT FOR HYDRAULIC (2/2)

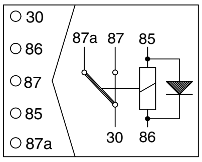
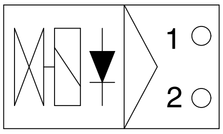
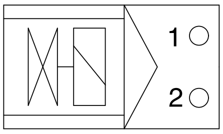
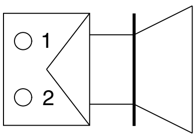
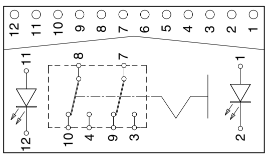
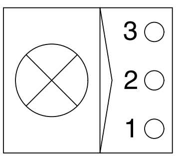


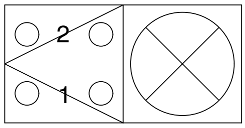
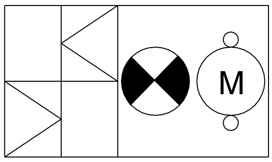
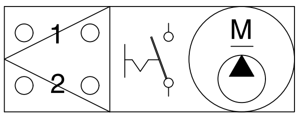
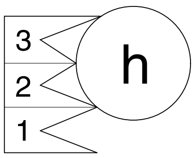
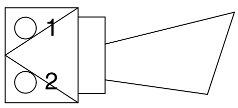
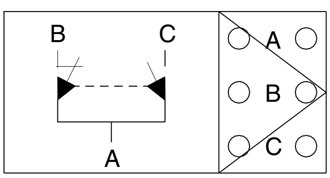
※ The circuit diagram may differ from the equipment, so please check before a repair.

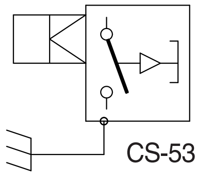
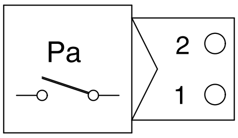
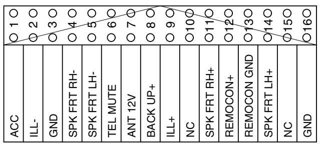
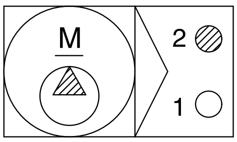
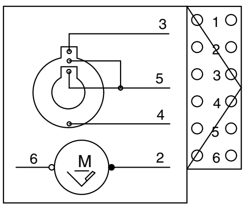
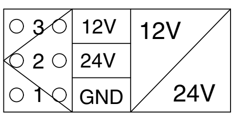
GROUP 3 ELECTRICAL COMPONENT SPECIFICATION

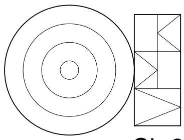
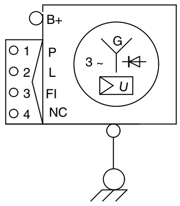
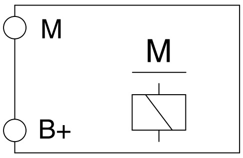
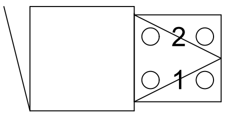
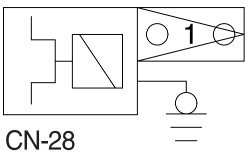
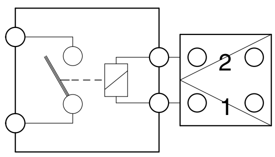
Part name	Symbol	Specifications	Check
Battery		12V × 100Ah (2EA)	※ Check specific gravity 1.280 over : Over charged 1.280 ~ 1.250 : Normal 1.250 below : Recharging
Battery relay	 CR-1	Rated load : 24V 100A (continuity) 1000A (30seconds)	※ Check coil resistance(M4 to M4) Normal : About 50Ω ※ Check contact Normal : ∞Ω
Glow plug relay	 CR-24	24V 200A	※ Check contact Normal : 0.942Ω (For terminal 1-GND)
Start key	 CS-2A	B-BR : 24V 1A B-ACC : 24V 10A B-ST : 24V 40A	※ Check contact OFF : ∞Ω (for each terminal) ON : 0Ω (for terminal 1-3 and 1-2) START : 0Ω (for terminal 1-6)
Pressure sensor	 CD-6 CD-7 CD-24 CD-31 CD-32 CD-35 CD-36 CD-42 CD-43 CD-44 CD-69 CD-70 CD-71 CD-85 CD-87 CD-90	8~30V	※ Check contact Normal : 0.1Ω
Resistor	 CN-173	4W	※ Check resistance A-B : 120Ω

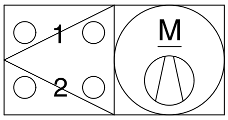
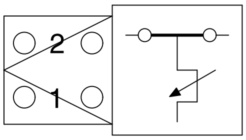
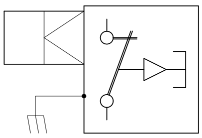
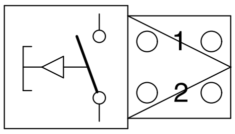
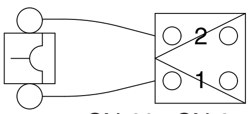
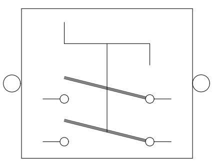
Part name	Symbol	Specifications	Check
Glow plug	 CN-80	24V 200A	※ Check resistance 0.25~0.12Ω
Temperature sensor (hydraulic)	 CD-1	-	※ Check resistance 50˚C : 804Ω 80˚C : 310Ω 100˚C : 180Ω
Air cleaner pressure switch	 CD-10	N.O TYPE	※ Check contact High level : ∞Ω Low level : 0Ω
Fuel level sender	 CD-2	-	※ Check resistance Full : 50Ω 6/12 : 350Ω 11/12 : 100Ω 5/12 : 400Ω 10/12 : 150Ω 4/12 : 450Ω 9/12 : 200Ω 3/12 : 500Ω 8/12 : 250Ω 2/12 : 550Ω 7/12 : 300Ω 1/12 : 600Ω Empty warning : 700Ω
Relay (air con blower)	 CR-46	24V 20A	※ Check resistance Normal : About 200Ω (for terminal 1-3) ∞Ω (for terminal 2-4)
Service tool	 CR-406	-	-

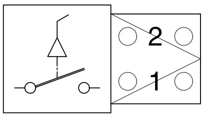
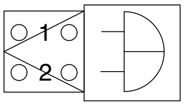
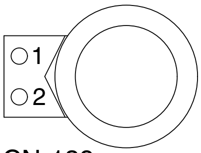
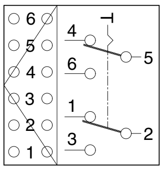
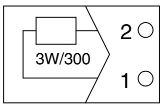
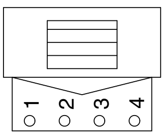
Part name	Symbol	Specifications	Check
Relay	 CR-2 CR-4 CR-5 CR-7 CR-9 CR-13 CR-35 CR-46 CR-62 CR-85	24V 16A	※ Check resistance Normal : About 160 Ω (for terminal 85-86) 0Ω (for terminal 30-87a) ∞ Ω (for terminal 30-87)
Solenoid valve	 CN-66 CN-68 CN-70 CN-88 CN-135 CN-140 CN-149 CN-236 CN-237 CN-242 CN-242A CN-370 CN-397 CN-419 CN-420 CN-421	24V 1A	※ Check resistance Normal : 15~25Ω (for terminal 1-2)
EPPR valve	 CN-75 CN-133 CN-309 CN-310	700mA	※ Check resistance Normal : 15~25Ω (for terminal 1-2)
Speaker	 CN-23(LH) CN-24(RH)	20W	※ Check resistance Normal : A few Ω
Switch (locking type)	 CS-52 CS-67 CS-73 CS-73A	24V 1.5A	※ Check contact Normal ON : 0 Ω (for terminal 7-3, 8-4) ∞ Ω (for terminal 7-9, 8-10) OFF : ∞ Ω (for terminal 7-9, 8-10) 0 Ω (for terminal 7-3, 8-4)
Room lamp	 CL-1	24V 10W	※ Check disconnection Normal : 1.0Ω ON : 0Ω (For terminal 1-2) ∞ Ω (For terminal 1-3) OFF : ∞ Ω (For terminal 1-2) 0Ω (For terminal 1-3)

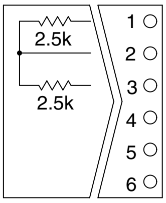
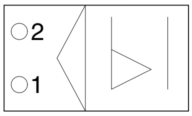
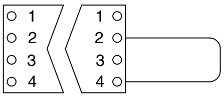
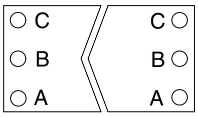
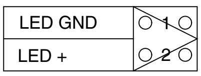
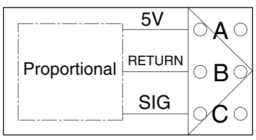
Part name	Symbol	Specifications	Check
Head lamp, Work lamp, Cab lamp	 CL-3 CL-4 CL-5 CL-6 CL-8 CL-9 CL-10	24V 65W (H3 Type)	※ Check disconnection Normal : 1.2Ω
Beacon lamp	 CL-7	21V 70W (H1 Type)	※ Check disconnection Normal : A fewΩ
Fuel filler pump	 CN-61	24V 10A 35 ℓ /min	※ Check resistance Normal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

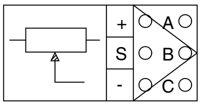
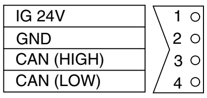
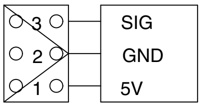
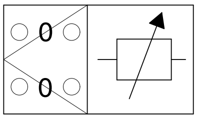
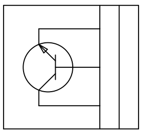
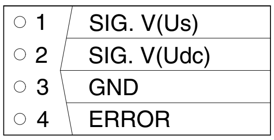
Part name	Symbol	Specifications	Check
Wiper cut switch	 CS-53	24V (N.O TYPE)	※ Check contact Normal : 0Ω(one pin to ground)
Receiver dryer	 CN-29	24V 2.5A	※ Check contact Normal : ∞Ω
Radio & USB player	 CN-27	24V 2A	※ Check voltage 20~25V (for terminal 1-3, 3-8)
Washer pump	 CN-22	24V 3.8A	※ Check contact Normal : 10.7Ω(for terminal 1-2)
Wiper motor	 CN-21	24V 2A	※ Check disconnection Normal : 7Ω(for terminal 2-6)
DC/DC converter	 CN-138	12V 3A	※ Check voltage 24V (for terminal 1-2) 12V (for terminal 1-3)

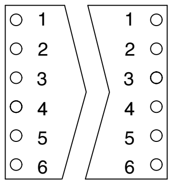
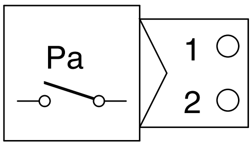
Part name	Symbol	Specifications	Check
Cigar lighter	 CL-2	24V 5A 1.4W	※ Check coil resistance Normal : About 1MΩ ※ Check contact Normal : ∞Ω Operating time : 5~15sec
Alternator	 CN-74	24V 70A	※ Check contact Normal : 0Ω (for terminal B^{+}-2) Normal : 24~27.5V
Starter	 CN-45	24V 4.8kW	※ Check contact Normal : 0.1Ω
Travel alarm	 CN-81	24V 0.5A	※ Check contact Normal : 5.2Ω
Air conditioner compressor	 CN-28	24V 79W	※ Check contact Normal : 13.4Ω
Start relay	 CR-23	24V 300A	※ Check contact Normal : 0.94Ω(for terminal 1-2)

Part name	Symbol	Specifications	Check
Air conditioner blower motor		24V 9.5A	※ Check resistance Normal : 2.5Ω (for terminal 1-2)
Air conditioner duct sensor (switch)		1˚C OFF 4˚C ON	※ Check resistance Normal : 0Ω (for terminal 1-2), the atmosphere temp : Over 4˚C
Door switch	 CS-1	24V 2W	※ Check resistance Normal : About 5MΩ
Switch (power max, one touch decel, horn, breaker)	 CS-5 CS-19 CS-26 CS-29	24V 6A	※ Check resistance Normal : ∞Ω
Circuit breaker	 CN-60 CN-95	60A (CN-60) 90A (CN-95)	※ Check disconnection Normal : 0Ω (connect ring terminal and check resist between terminal 1 and 2)
Master switch	 CS-74	6-36V	※ Check disconnection Normal : 0.1Ω

Part name	Symbol	Specifications	Check
Breaker switch	 CS-26A	-	-
Quick clamp buzzer	 CN-113	24V 200mA 107±4dB	-
Socket	 CN-139	12V 10A	-
Emergency stop switch	 CS-33	-	※ Check contact Normal 0Ω(for terminal 1-2)
Resistor	 RS-1	5W 300Ω	※ Check resitance 1-2 : 300Ω
Fuel heater	 CN-96	-	-

Part name	Symbol	Specifications	Check
Emergency eng control connector	 CN-16B	-	-
WIF sensor	 CD-45	-	-
GPS connector	 CN-125	-	-
Secvice tool	 CN-307	-	-
Accel dial lamp	 CN-267	-	-
Proportional valve sensor	 CN-246 CN-247	-	-

Part name	Symbol	Specifications	Check
Accel dial	 CN-242	-	-
Reader	 CN-427	-	-
Button switch	 CN-641	-	-
Air conditioner temperature sensor (incar, ambient, water)		-	-
Air conditioner power TR		-	-
Proportional valve sensor	 CN-308	-	-

Part name	Symbol	Specifications	Check
Camera	 CN-249	-	-
Dozer pressure sw	 CD-50	-	-

GROUP 4 CONNECTORS

1. CONNECTOR DESTINATION

Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CN-1	TYCO/AMP	10	I/conn (Frame harness-Pump ps harness)	174982-2	S816-110002
CN-2	AMP	12	I/conn (Frame harness-Engine harness)	S816-012002	S816-112002
CN-3	TYCO	12	I/conn (Frame harness-Pro vlv harness)	174661-2	368537-1
CN-3	AMP	15	I/conn (Frame harness-Engine harness)	1897009-2	368301-1
CN-4	AMP/TYCO	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/TYCO	16	I/conn (Console harness RH-Frame harness)	368047-1	368050-1
CN-8	AMP/TYCO	15	I/conn (Console harness LH-Frame harness)	2-85262-1	368301-1
CN-9	DEUTSCH	12	I/conn (Frame harness-AAVM harness)	DT06-12SA-EP06	DT04-12PA-BE02
CN-10	TYCO	12	I/conn (Cab harness-Side harness RH)	368542-1	368507-1
CN-10A	DEUTSCH	6	Front camera	DT06-6S	DT04-6P
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-14	DEUTSCH	2	I/conn (Frame harness-Swing parking harness)	DT06-2S-EP06	DT04-2P-E005
CN-15	AMP	12	I/conn (Frame harness-2 Way harness)	174661-2	368537-1
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	-
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	925276-0	-
CN-21A	AMP	6	Wiper motor	S816-006202	-
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	Remote assy	-	S816-108002
CN-28	KUM	1	Aircon compressor	NMWP01F-B	-
CN-29	KET	2	Receiver dryer	MG640795	-
CN-36-1	-	16	Fuse box	368047-1	-
CN-36-2	KET	8	I/conn (Frame harness-Fuse box)	MG610051	-
CN-36-3	-	26	I/conn (Frame harness-Fuse box)	1897009-2	-
CN-36-4	KET	2	I/conn (Frame harness-Fuse box)	MG610557-5	-
CN-45	RING-TERM	-	Starter motor B+	S820-108000	-
CN-48	-	3	Hour meter	-	-

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-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	DT04-2P-E005
CN-66	DEUTSCH	2	Breaker solenoid	DT06-2S-EP06	-
CN-68	DEUTSCH	2	Safety solenoid	DT06-2S-EP06	-
CN-70	DEUTSCH	2	Travel high solenoid	DT06-2S-EP06	-
CN-74	RING-TERM	1	Alternator "B" terminal	-	S820-108000
CN-74	-	4	Alternator terminal	1218-6568	-
CN-75	AMP	2	Pump EPPR	S816-002002	-
CN-80	RING-TERM	-	Glow plug	S820-306000	-
CN-81	DEUTSCH	2	Travel buzzer solenoid	DT06-2S-EP06	DT04-2P-E005
CN-88	DEUTSCH	2	Power max solenoid	DT06-2S-EP06	-
CN-93	DEUTSCH	50	ECM	DRC26-50S-04	-
CN-94	DEUTSCH	4	ECM	DTP06-4S-EP06	-
CN-95	YAZAKI	2	Circuit breaker	-	S813-130201
CN-96	BUCHEON/AMP	4	I/conn (Frame harness-fuel warmer harness)	2-967325-3	2-967402-2
CN-96A	AMP	3	Fuel warmer	368523-1	-
CN-96B	AMP	4	Fuel warmer	2-967325-2	-
CN-113	KET	2	Buzzer	MG651205-5	-
CN-125	Econoseal J	4	GPS connector	S816-004002	S816-104002
CN-125A	DEUTSCH	12	RMS	DT06-12S-EP06	DT04-12P
CN-126	AMP	10	I/conn (Frame harness-Sevice tool harness)	S816-010002	S816-110002
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 switch	DT06-3S-EP06	-
CN-144A	KET	20	Handsfree	MG610240	-
CN-144E	-	8	Handsfree	175964-2	-
CN-149	DEUTSCH	2	Attach safety solenoid (A1)	DT06-2S-EP06	-
CN-156	TE	2	Air seat heat	187907-0	-
CN-173	DEUTSCH	3	Resistor	DT06-3S-EP06	-
CN-231	DEUTSCH	3	I/conn (Frame harness-fuse box)	S813-030201	-
CN-236	DEUTSCH	3	Attach pressure solenoid	DT06-2S-EP06	-

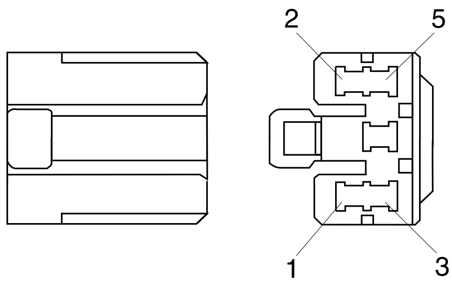
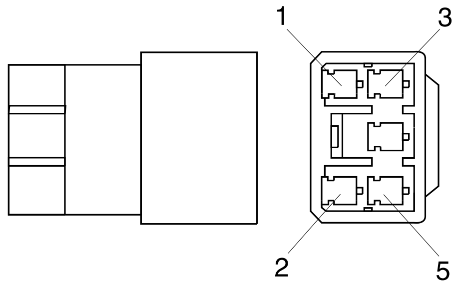
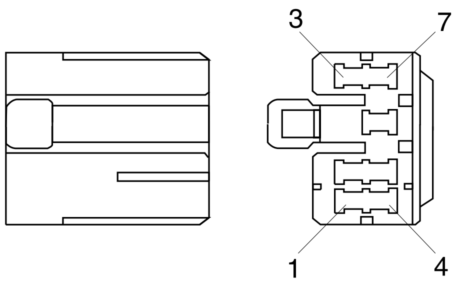
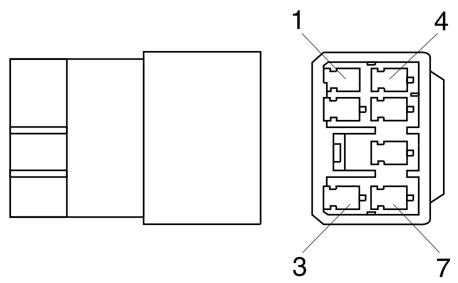
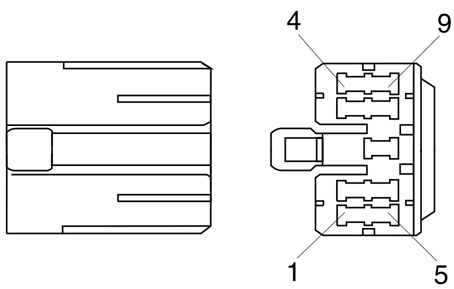
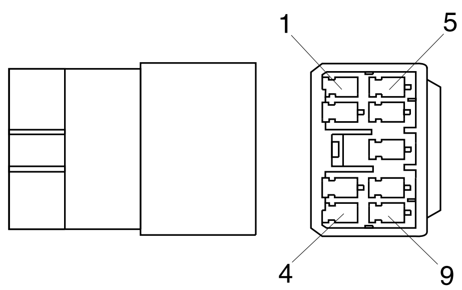
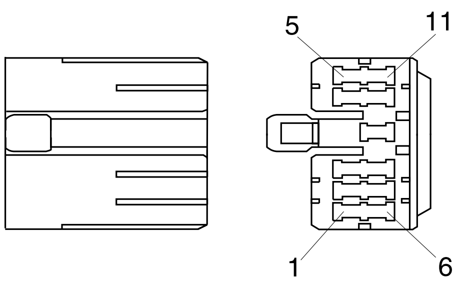
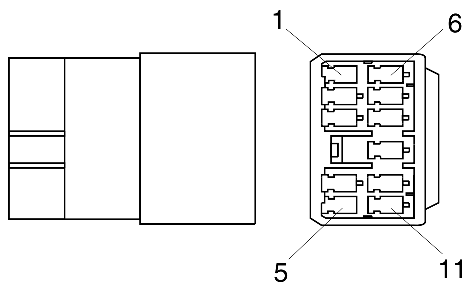
Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CN-237	DEUTSCH	2	Attach conflux solenoid (A3)	DT06-2S-EP06	-
CN-242	DEUTSCH	2	Attach flow EPPR 1	DT06-2S-EP06	-
CN-242A	DEUTSCH	2	Attach flow EPPR 2	DT06-2S-EP06	-
CN-245A	AMP	12	Remote controller assy	368542-1	-
CN-245E	AMP	12	Remote controller assy	174045-2	-
CN-246	DEUTSCH	3	Proportional valve-RH	DT06-3S-EP06	DT04-3P-E005
CN-247	DEUTSCH	3	Proportional valve-LH	DT06-3S	DT04-3P
CN-249	DEUTSCH	6	Rear view camera	DT06-6S-P012	DT04-6P
CN-267	AMP	2	Accel dial LED	S816-002002	-
CN-305	DEUTSCH	12	Proportional-connector 1	DTM06-12SA	-
CN-306	DEUTSCH	12	Proportional-connector 2	DTM06-12SB	-
CN-307	DEUTSCH	3	Service tool	DT06-3S-EP06	DT06-3P-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-366	DEUTSCH	2	Swing fine harness	DT06-2S-EP06	DT04-2P-E005
CN-370	DEUTSCH	2	Swing fine harness	DT06-2S-EP06	DT04-2P-E005
CN-376	AMP	34	Relay drive unit	4-1437290-1	-
CN-397	DEUTSCH	2	Straight travel solenoid	DT06-2S-EP06	DT04-2P-E005
CN-401	TE	35	AAVM controller	776164-1	-
CN-403	DEUTSCH	6	Rear view camera	-	DT04-6P-E005
CN-404	DEUTSCH	6	LH view camera	-	DT04-6P-E005
CN-405	DEUTSCH	6	RH view camera	-	DT04-6P-E005
CN-406	DEUTSCH	4	RS 232	DT06-4S-EP06	DT04-4P-E005
CN-419	DEUTSCH	2	Swing parking-A1	DT06-2S-EP06	-
CN-420	DEUTSCH	2	Swing parking-A2	DT06-2S-EP06	-
CN-421	DEUTSCH	2	Swing parking-A3	DT06-2S-EP06	-
CN-427	MOLEX	4	Reader-RMS	039012040	026013096
WIF	DEUTSCH	2	Wif	-	DT04-2P-E005
· Relay					
CR-1	RING-TERM	-	Battery relay coll	ST710289-2	-
CR-2	-	5	Horn relay	-	-
CR-4	-	5	Working 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	S814-002001	S814-102001
CR-24	RING TERM	1	Preheat relay	S822-014000	-

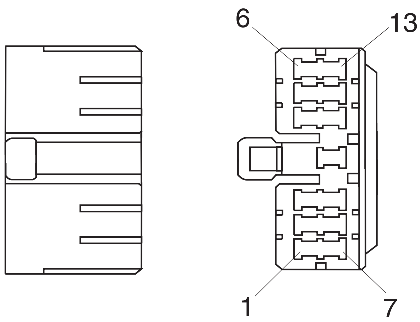
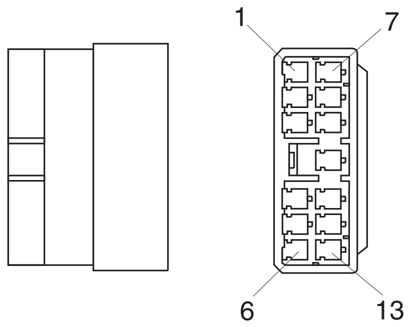
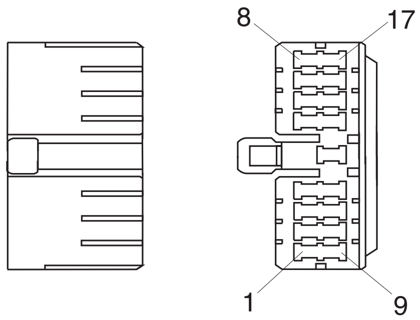
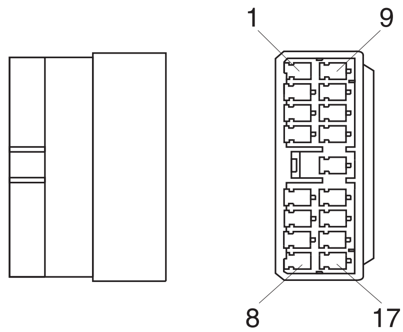
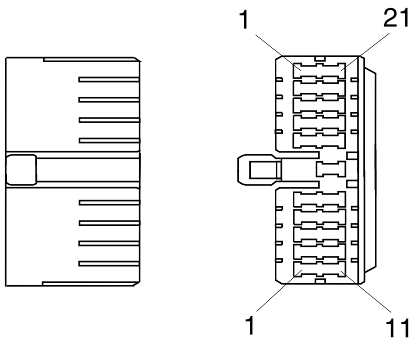
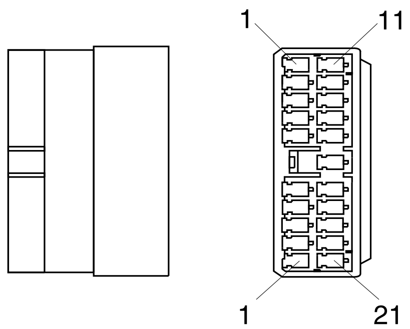
Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CR-35	-	5	Power relay	-	-
CR-36	-	5	Air preheat relay	-	-
CR-46	-	5	Fuel warmer relay	8JA 003 526-001	-
CR-62	-	5	Breaker relay	8JA 003 526-001	-
CR-85	-	5	Beacon lamp relay	8JA 003 526-001	-
· Switch					
CS-1	SHUR	1	Door switch	S822-014002	-
CS-2A	WP	6	Start switch	S814-006100	-
CS-02B	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	Dozer & 2 pcs 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 & fine switch	SWF589790	-
CS-73A	SWF	12	Swing fine switch	SWF589790	-
CS-74A	AMP	2	Master switch	S813-030201	S813-130201
CS-74B	AMP	2	Master switch	S813-030201	S813-130201
· 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	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
· Sensor, sendor					
CD-1	AMP	2	Hydraulic oil temp sender	85202-1	-
CD-2	DEUTSCH	2	Fuel level sender	DT06-2S-EP06	-
CD-6	DEUTSCH	3	Travel pressure switch	DT06-3S-EP06	-
CD-7	DEUTSCH	3	Working pressure switch	DT06-3S-EP06	-

Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CD-10	TYCO	2	Air cleaner switch	85202-1	-
CD-24	DEUTSCH	3	Swing pressure sensor	DT06-3S-EP06	-
CD-31	DEUTSCH	3	Overload pressure sensor	DT06-3S-EP06	DT04-3P-E004
CD-32	DEUTSCH	3	Boom up pressure sensor	DT06-3S-EP06	-
CD-35	DEUTSCH	3	Arm in/out, bucket in pressure sensor	DT06-3S-EP06	-
CD-36	DEUTSCH	3	Arm out pressure sensor	DT06-3S-EP06	-
CD-42	DEUTSCH	3	Pump pressure sensor P1	DT06-3S-EP06	-
CD-43	DEUTSCH	3	Pump pressure sensor P2	DT06-3S-EP06	-
CD-44	DEUTSCH	3	Pump pressure sensor P3	DT06-3S-EP06	-
CD-45	DEUTSCH	2	WIF sensor	DT06-2S-EP06	-
CD-50	KET/BUCHEON	2	Dozer pressure sensor	MG640795	BS 2.36
CD-69	DEUTSCH	3	Attach pressure sensor	DT06-3S-EP06	-
CD-70	DEUTSCH	3	N1 pressure sensor	DT06-3S-EP06	-
CD-71	DEUTSCH	3	N2 pressure sensor	DT06-3S-EP06	-
CD-85	DEUTSCH	3	Boom down pressure sensor	DT06-3S-EP06	-
CD-87	DEUTSCH	3	Bucket in pressure sensor	DT06-3S-EP06	-
CD-90	DEUTSCH	3	Arm in pressure sensor	DT06-3S-EP06	-

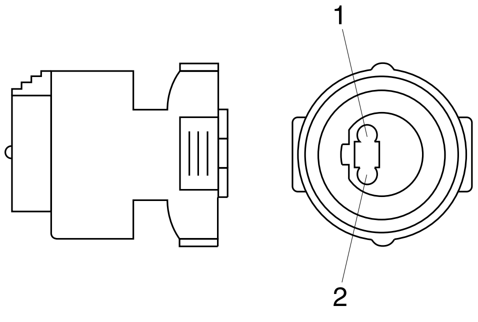
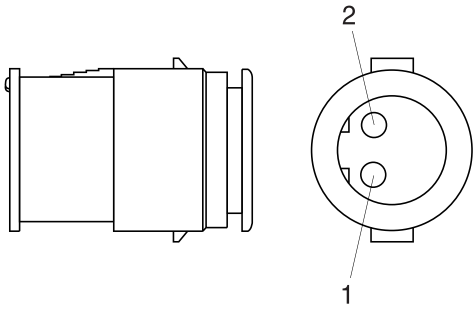
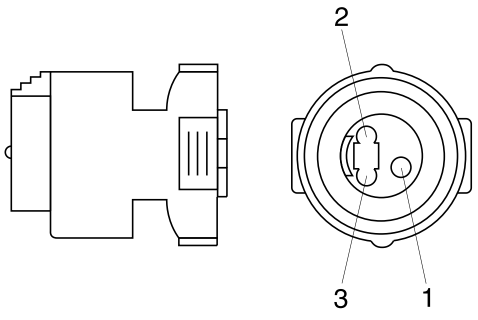
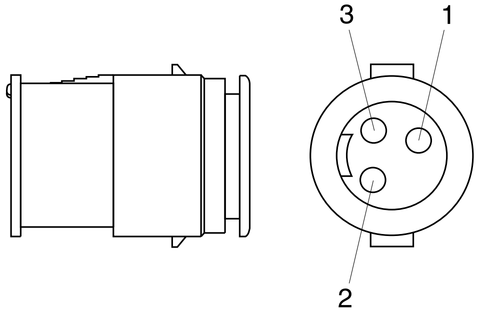
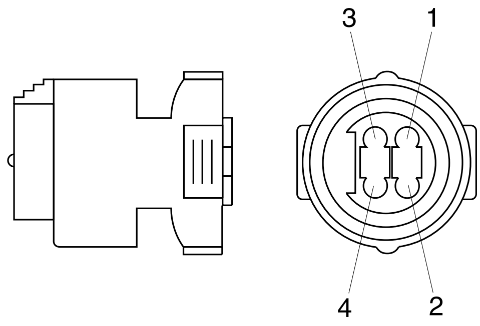
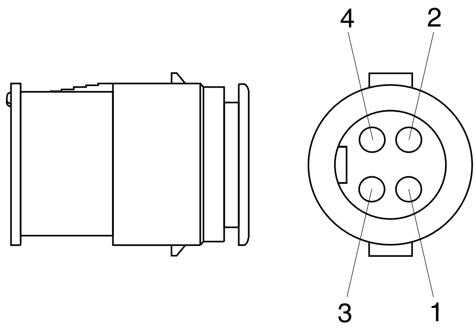
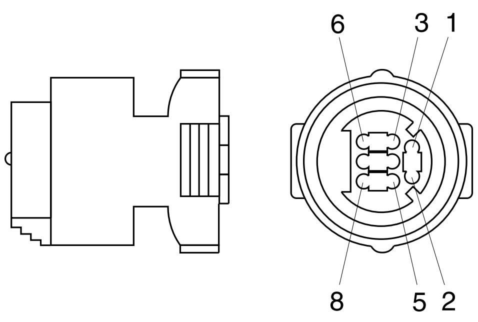
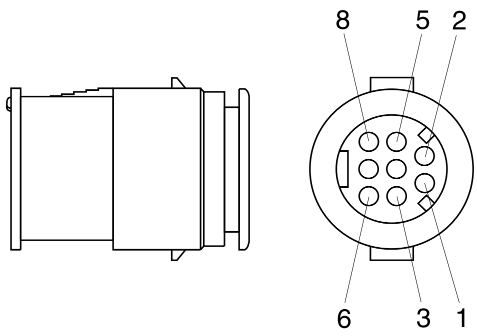
2. CONNECTION TABLE FOR CONNECTORS

1) PA TYPE CONNECTOR

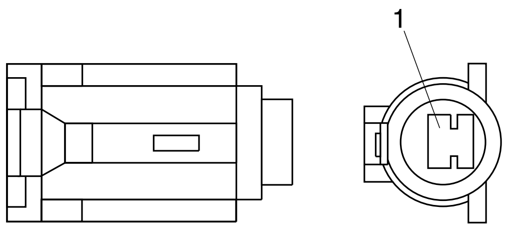
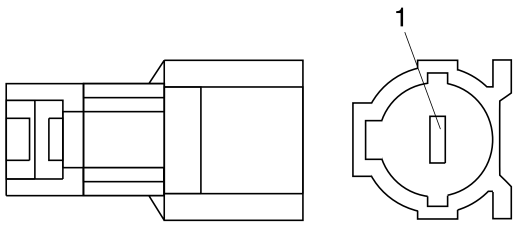
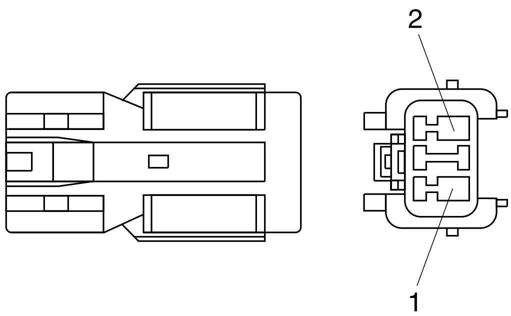
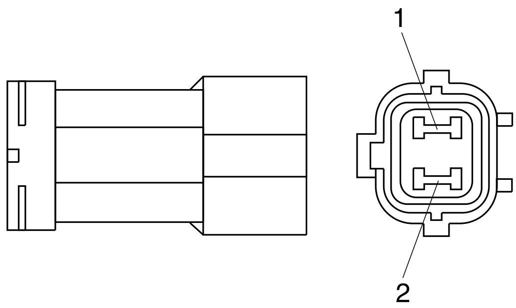
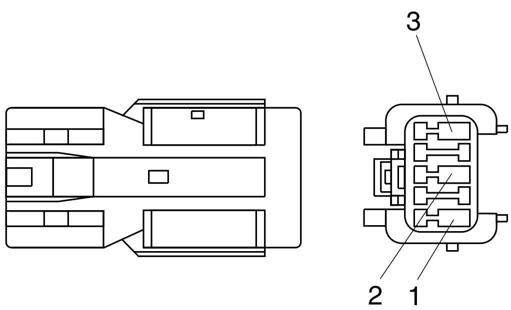
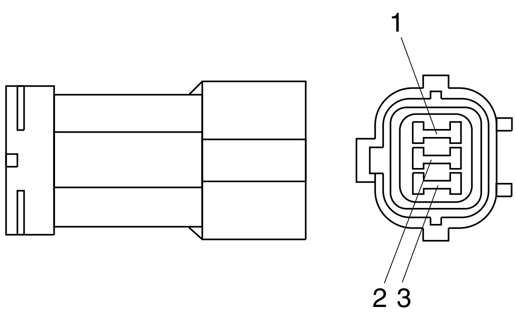
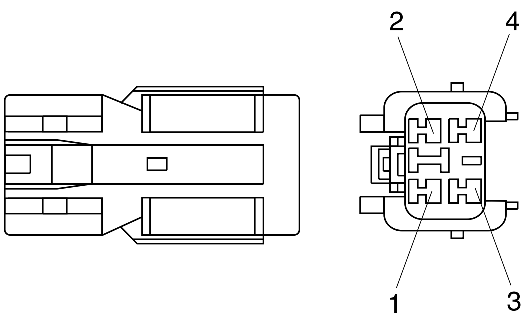
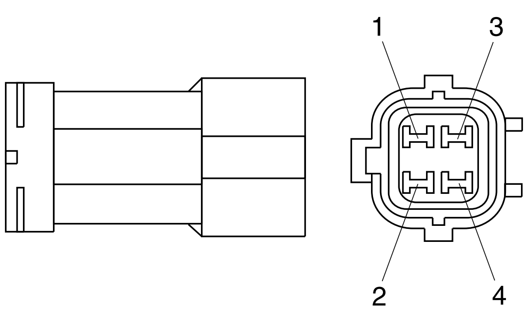
No. of pin	Receptacle connector (female)	Plug connector (male)
5	 S811-005002	 S811-105002
7	 S811-007002	 S811-107002
9	 S811-009002	 3S811-109002
11	 S811-011002	 S811-111002

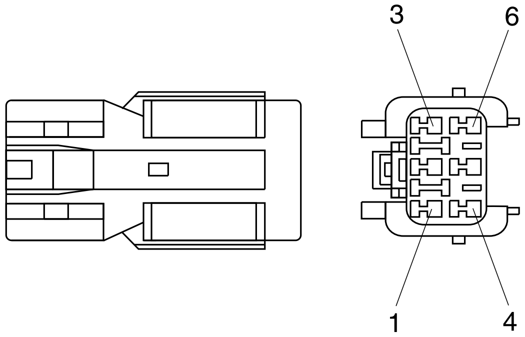
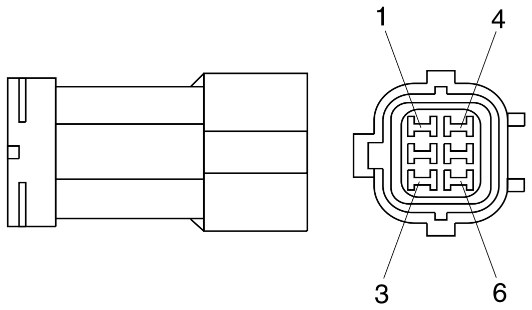
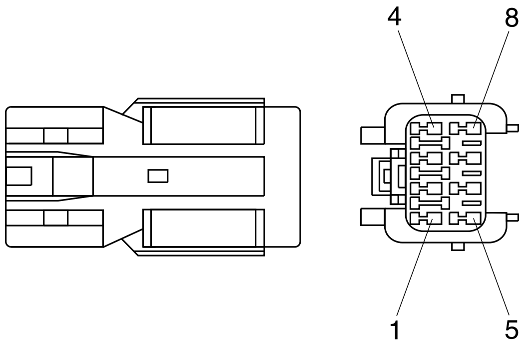
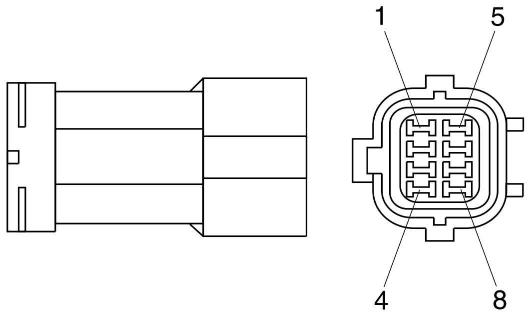
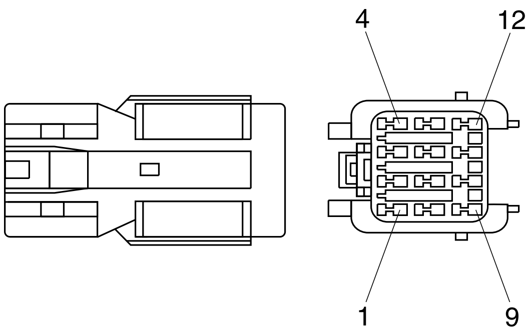
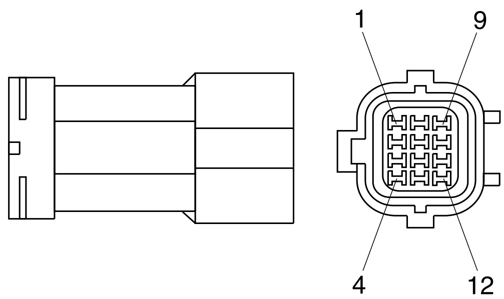
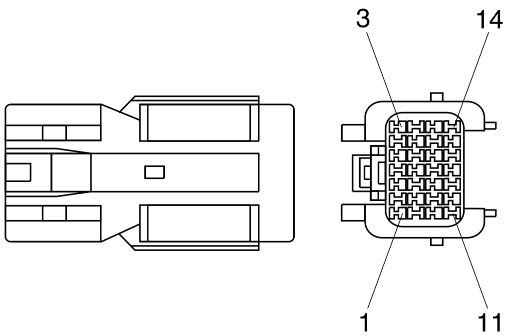
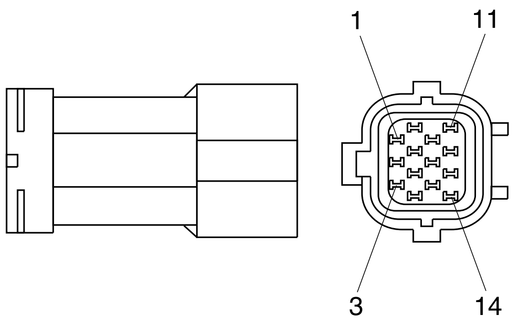
No. of pin	Receptacle connector (female)	Plug connector (male)
13	 S811-013002	 S811-113002
17	 S811-017002	 S811-117002
21	 S811-021002	 S811-121002

2) J TYPE CONNECTOR

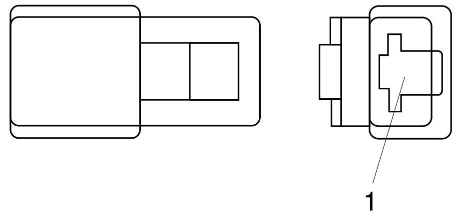
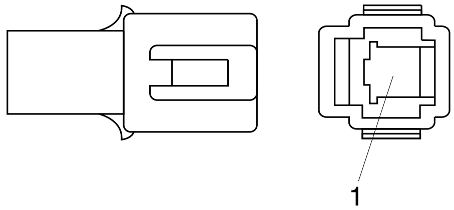
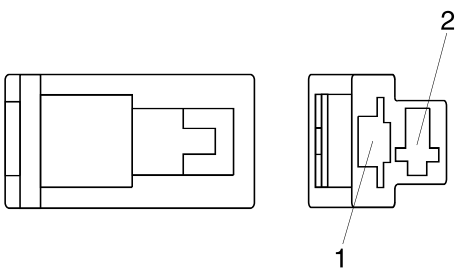
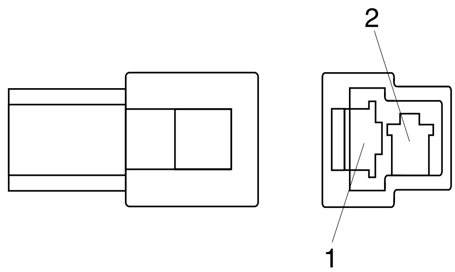
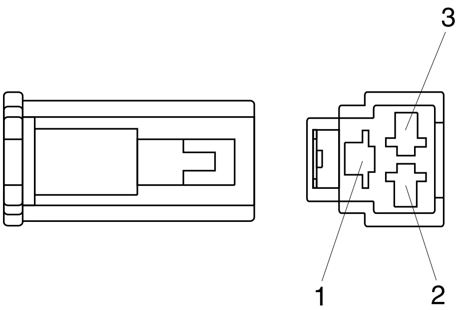
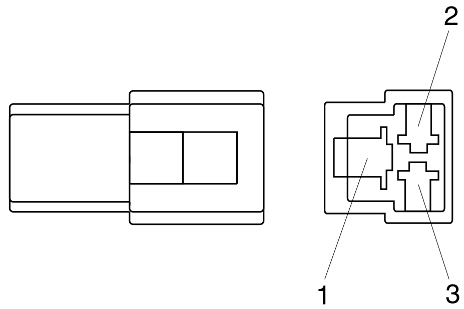
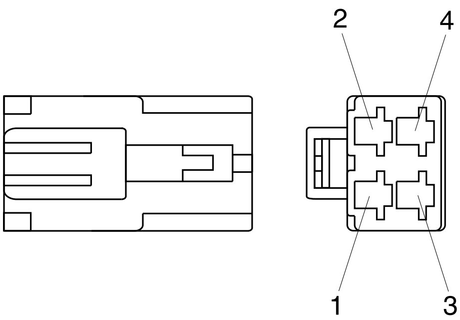
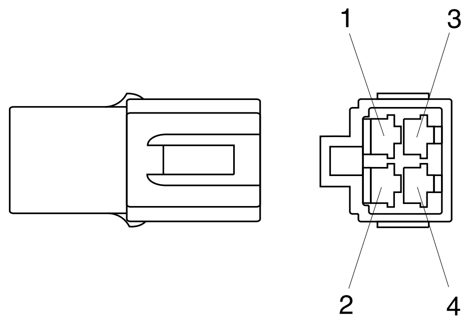
No. of pin	Receptacle connector (female)	Plug connector (male)
2	 S816-002001	 S816-102001
3	 S816-003001	 S816-103001
4	 S816-004001	 S816-104001
8	 S816-008001	 S816-108001

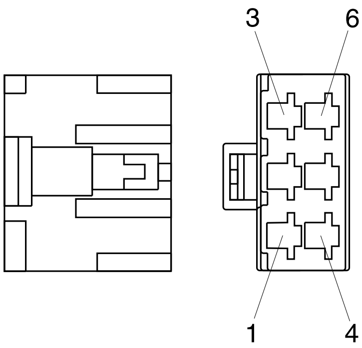
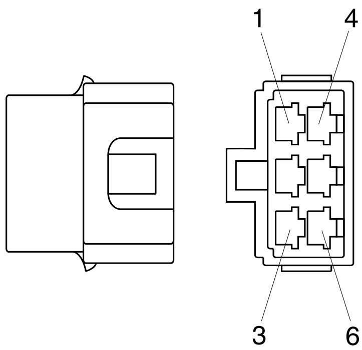
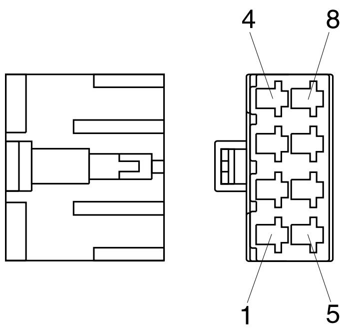
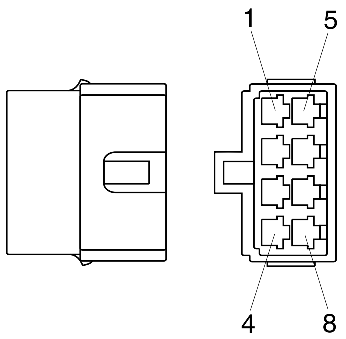
3) SWP TYPE CONNECTOR

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

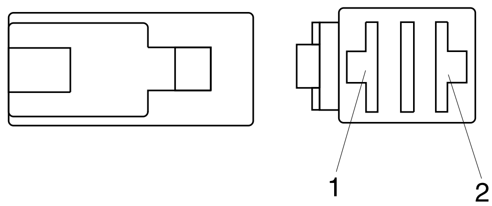
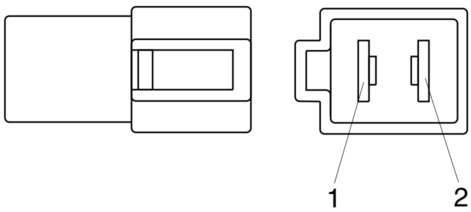
No. of pin	Receptacle connector (female)	Plug connector (male)
6	 S814-006000	 S814-106000
8	 S814-008000	 S814-108000
12	 S814-012000	 S814-112000
14	 S814-014000	 S814-114000

4) CN TYPE CONNECTOR

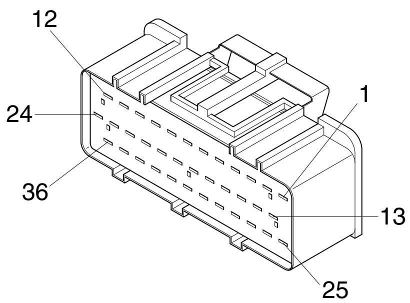
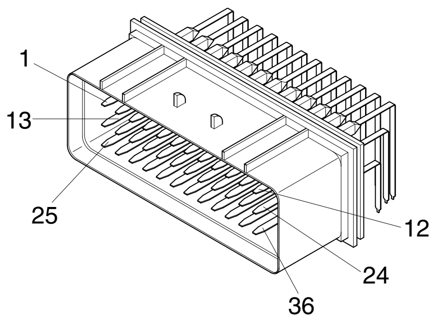
No. of pin	Receptacle connector (female)	Plug connector (male)
1	 S810-001202	 S810-101202
2	 S810-002202	 S810-102202
3	 S810-003202	 S810-103202
4	 S810-004202	 S810-104202

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

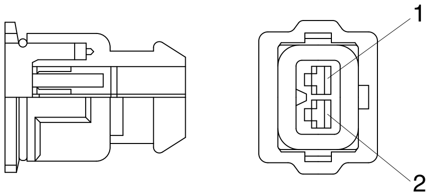
5) 375 FASTEN TYPE CONNECTOR

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

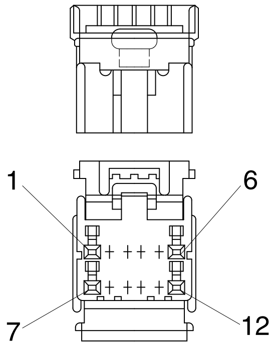
6) AMP ECONOSEAL CONNECTOR

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

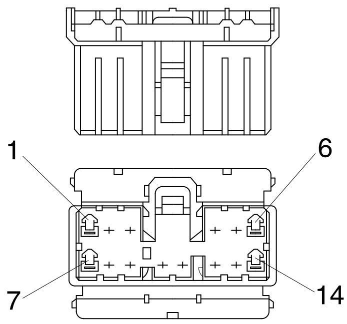
7) AMP TIMER CONNECTOR

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

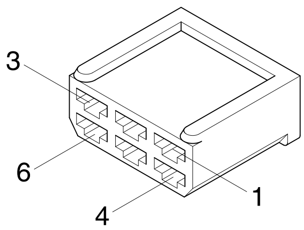
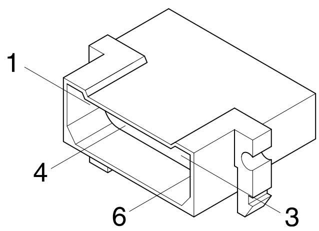
8) AMP 040 MULTILOCK CONNECTOR

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

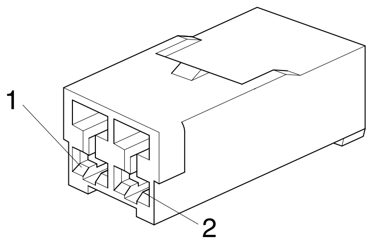
9) AMP 070 MULTILOCK CONNECTOR

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

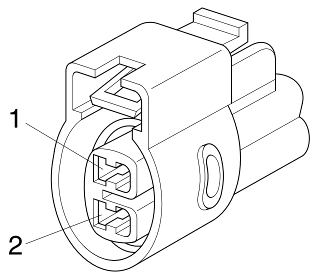
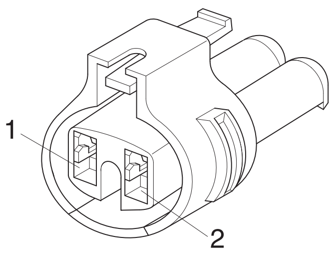
10) AMP FASTIN - FASTON CONNECTOR

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

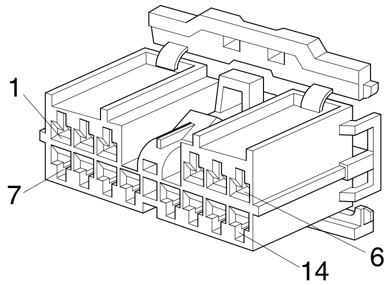
11) KET 090 CONNECTOR

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

12) KET 090 WP CONNECTORS

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

13) KET SDL CONNECTOR

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

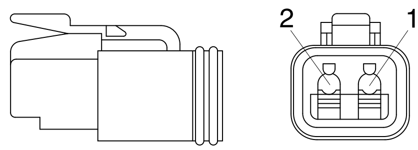
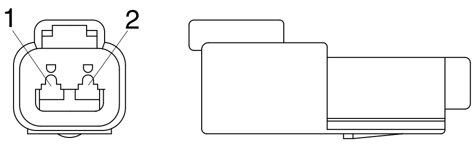
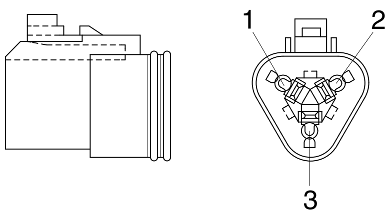
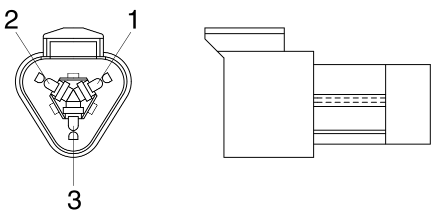
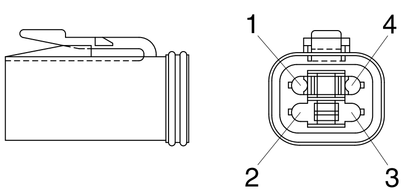
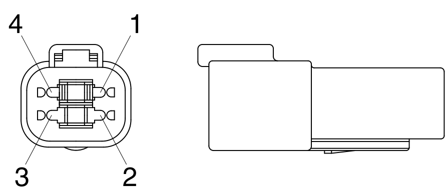
14) DEUTSCH DT CONNECTORS

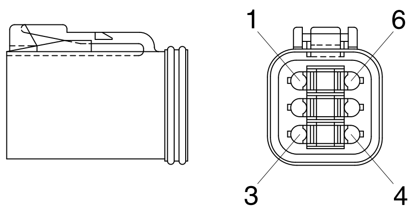
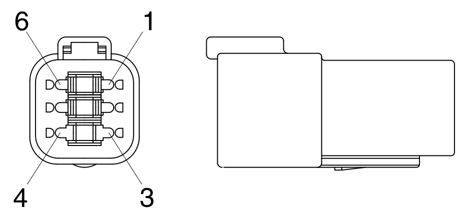
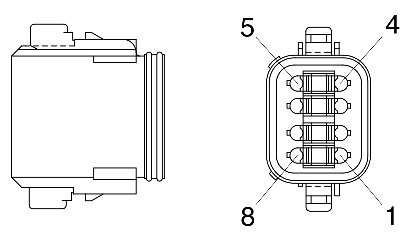
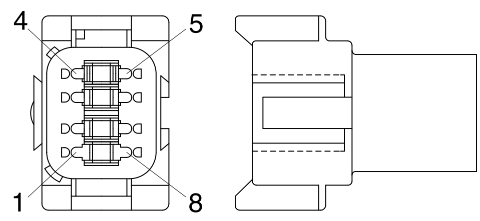
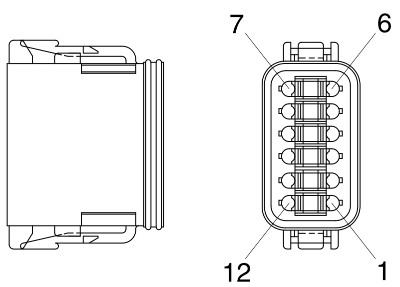
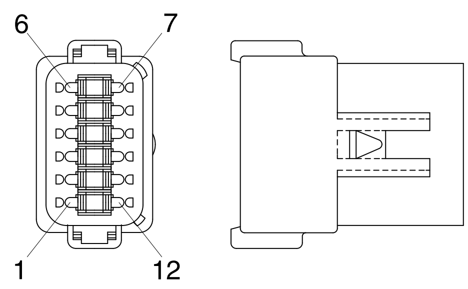
DT 06 - 3S - ★★★★

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

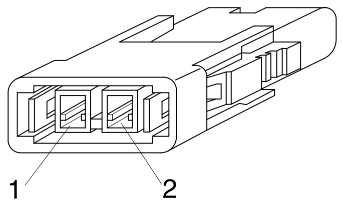
※ Modification

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

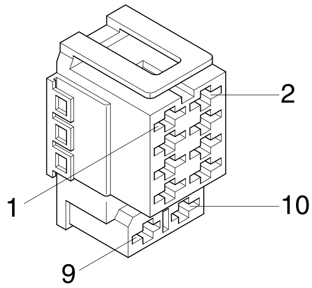
No. of pin	Receptacle connector (female)	Plug connector (male)
2	 DT06-2S	 DT04-2P
3	 DT06-3S	 DT04-3P
4	 DT06-4S	 DT04-4P

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

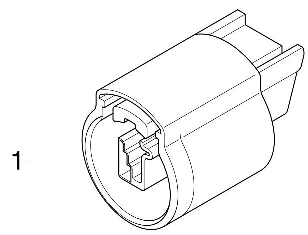
15) MOLEX 2CKTS CONNECTOR

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

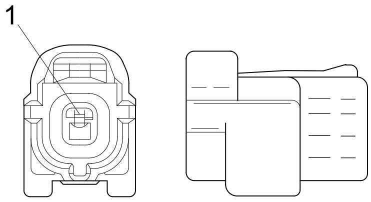
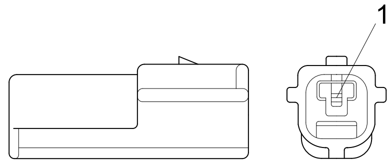
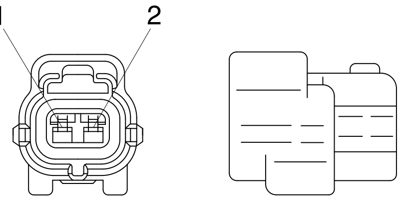
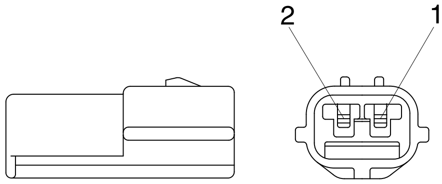
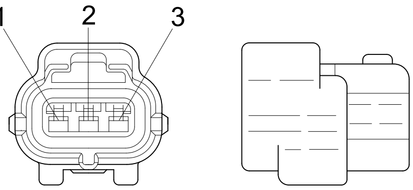
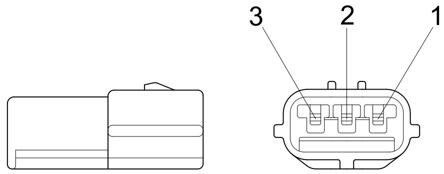
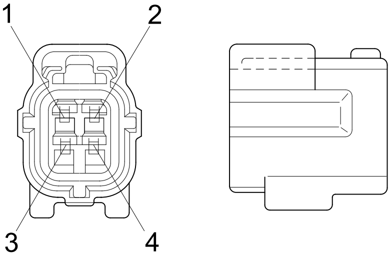
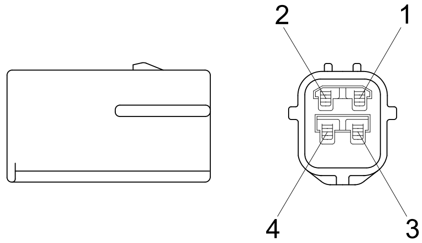
16) ITT SWF CONNECTOR

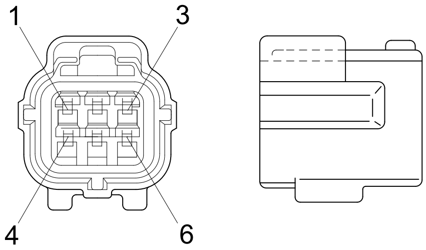
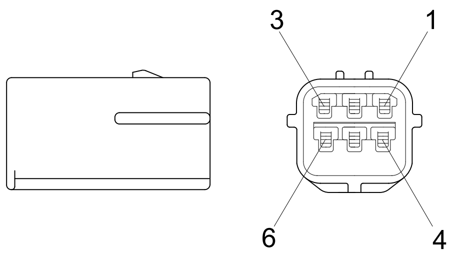
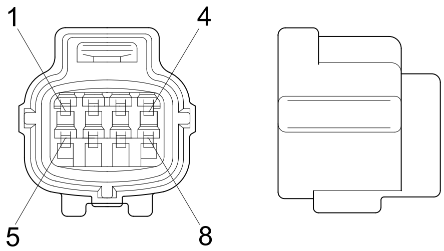
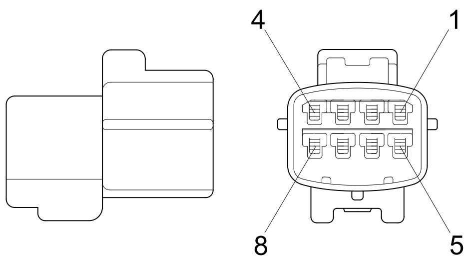
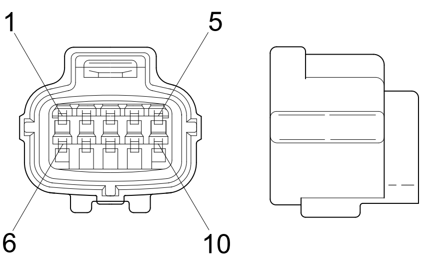
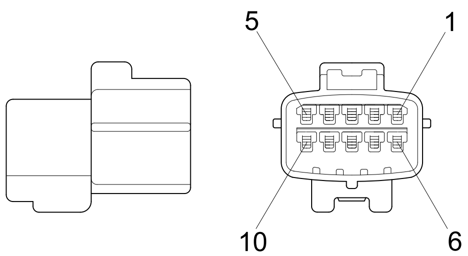
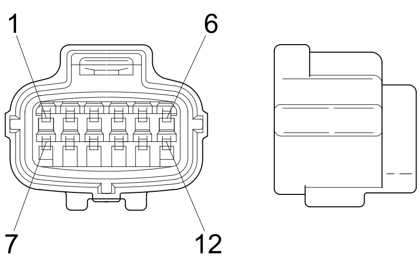
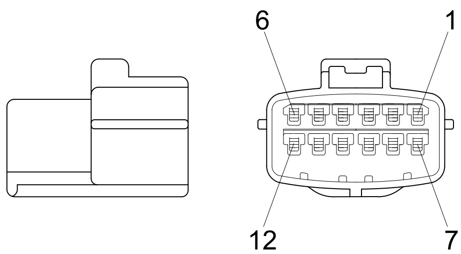
No. of pin	Receptacle connector (female)	Plug connector (male)
10	 SWF593757	

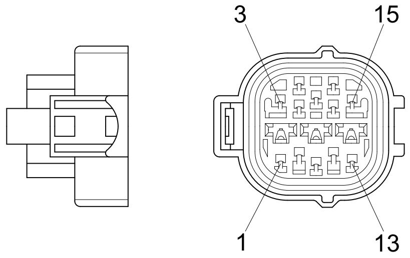
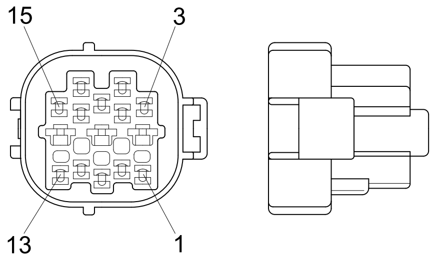
17) MWP NMWP CONNECTOR

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

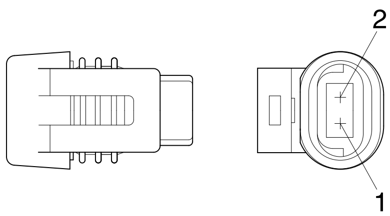
18) ECONOSEAL J TYPE CONNECTORS

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

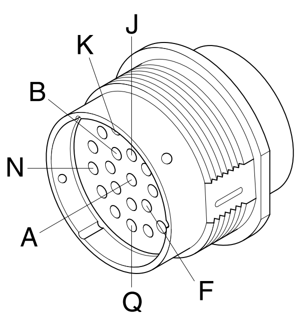
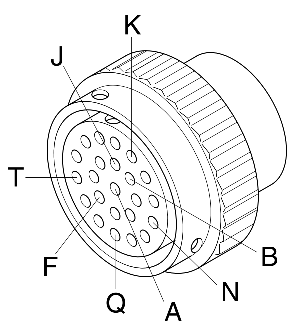
No. of pin	Receptacle connector (female)	Plug connector (male)
6	 S816-006002	 S816-106002
8	 S816-008002	 S816-108002
10	 S816-010002	 S816-110002
12	 S816-012002	 S816-112002

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

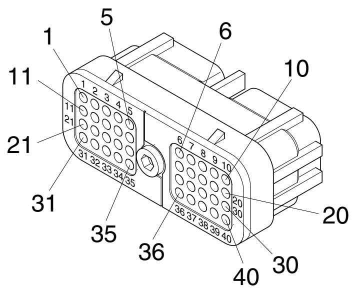
19) METRI-PACK TYPE CONNECTOR

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

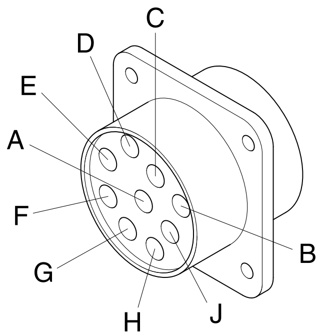
20) DEUTSCH HD30 CONNECTOR

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

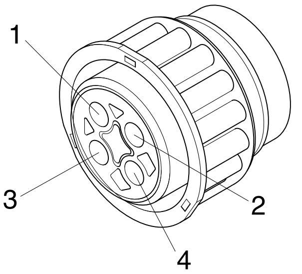
21) DEUTSCH MCU CONNECTOR

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

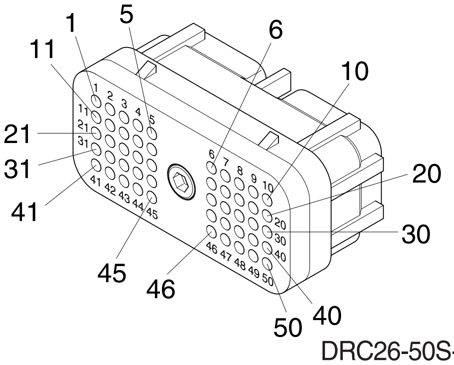
22) DEUTSCH SERVICE TOOL CONNECTOR

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

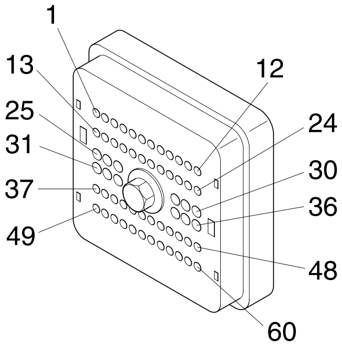
23) AMP FUEL WARMER CONNECTOR

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

24) DEUTSCH ENGINE ECM CONNECTOR

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

25) DEUTSCH INTERMEDIATE CONNECTOR

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

SECTION 5 MECHATRONICS SYSTEM

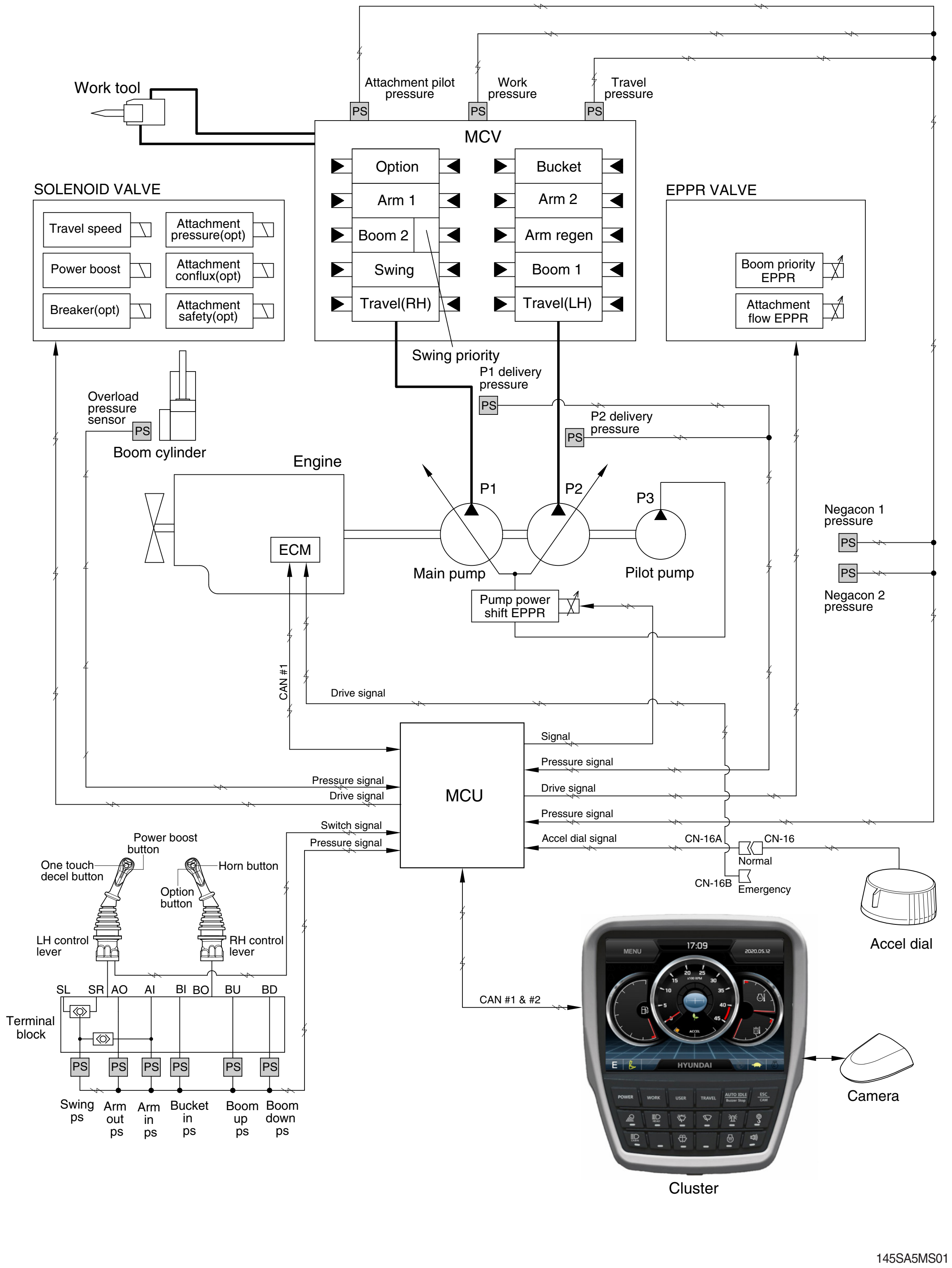
SECTION 5 MECHATRONICS SYSTEM

GROUP 1 OUTLINE

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

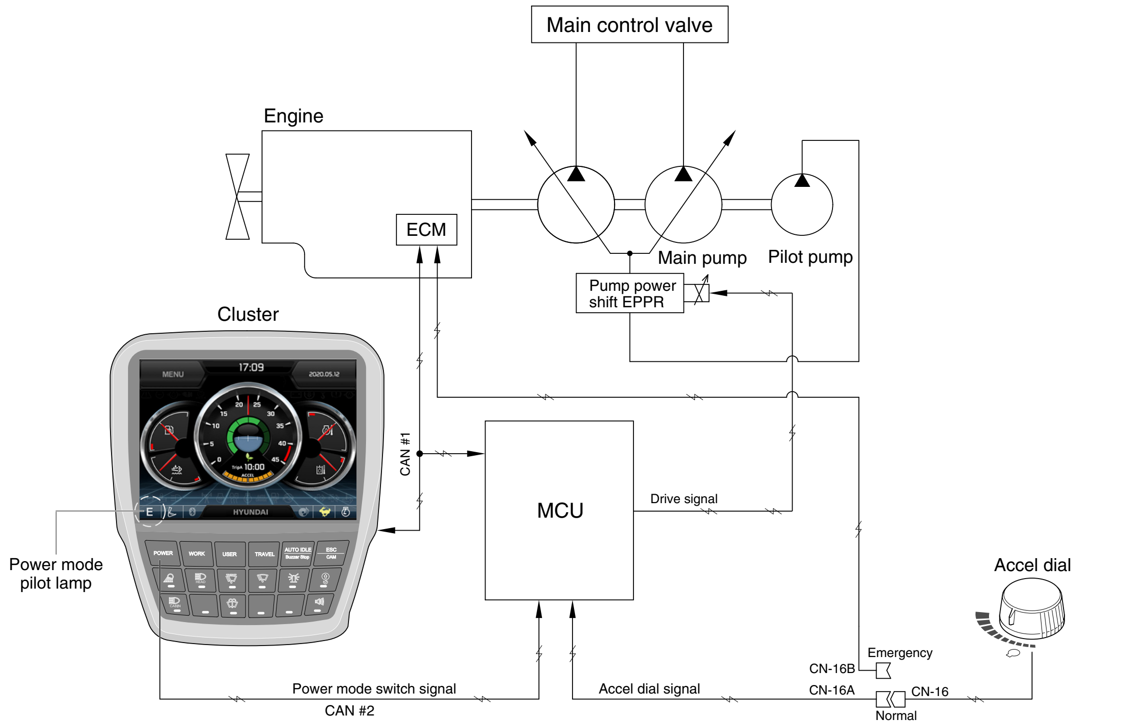
- ADVANCED CAPO SYSTEM
  - Mode selection system
    - Power mode selection (P, S, E)
    - Work mode selection
    - User mode system (U)
  - Auto deceleration system
  - Power boost system
  - Travel speed control system
  - Automatic warming up system
  - Engine overheat prevention system
  - New 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



GROUP 2 MODE SELECTION SYSTEM

1. POWER MODE SELECTION SYSTEM



145SA5MS02

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.

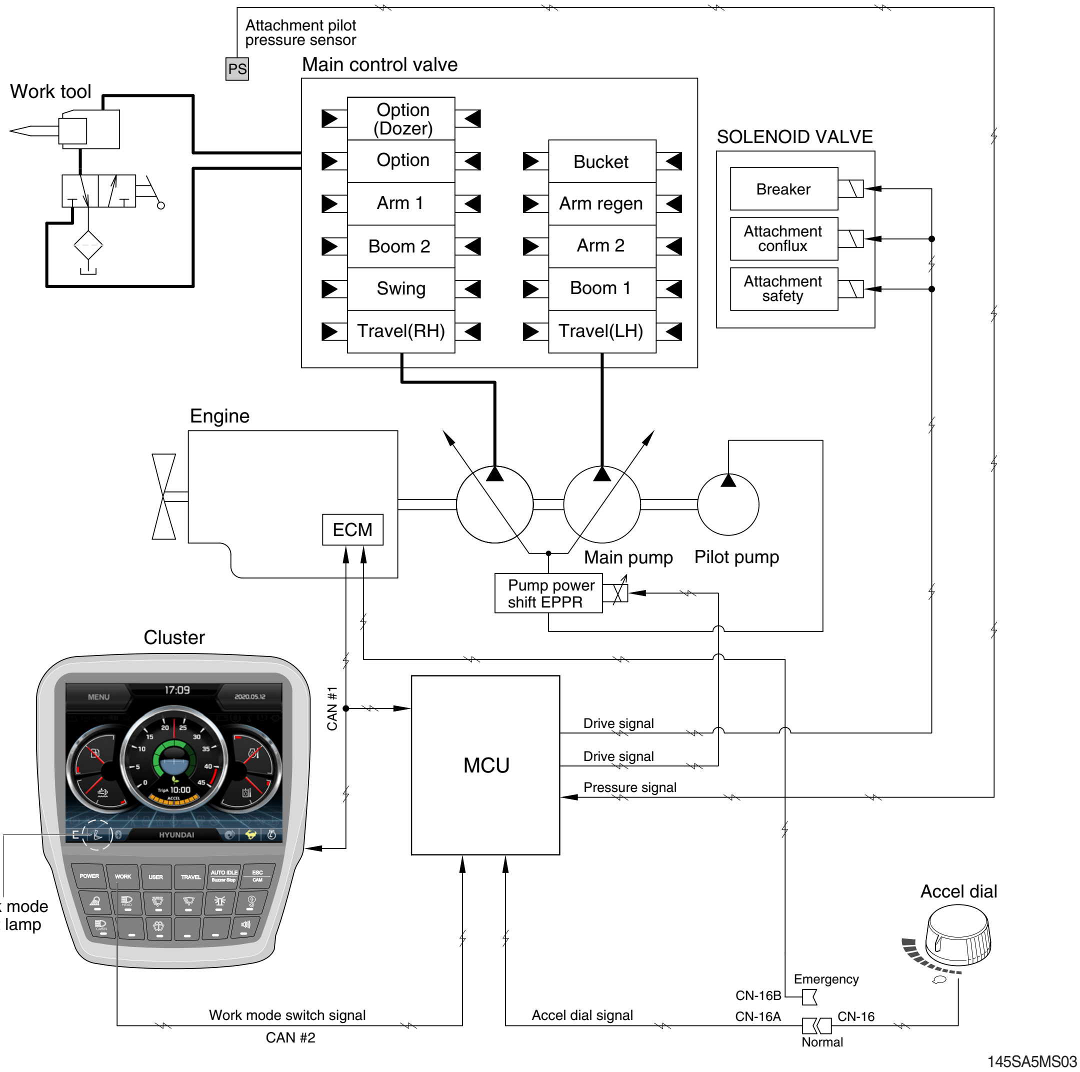
Power mode	Application	Engine rpm				Power shift by EPPR valve	
		Standard		Option		Standard	Option
		Unload	Load	Unload	Load	Pressure (kgf/cm^2)	Pressure (kgf/cm^2)
P	Heavy duty power	1850±50	1950±50	2000±50	1950±50	8 (~3)±3	8 (~3)±3
S	Standard power	1750±50	1850±50	1900±50	1850±50	10 (~5)±3	10 (~5)±3
E	Economy operation	1650±50	1750±50	1800±50	1750±50	12 (~7)±3	12 (~7)±3
AUTO DECEL	Engine deceleration	1150±100	-	1150±100	-	38±3	38±3
One touch decel	Engine quick deceleration	1000±100	-	1000±100	-	38±3	38±3
KEY START	Key switch start position	1000±100	-	1000±100	-	38±3	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).



1) GENERAL WORK MODE (bucket)

This mode is used to general digging work.

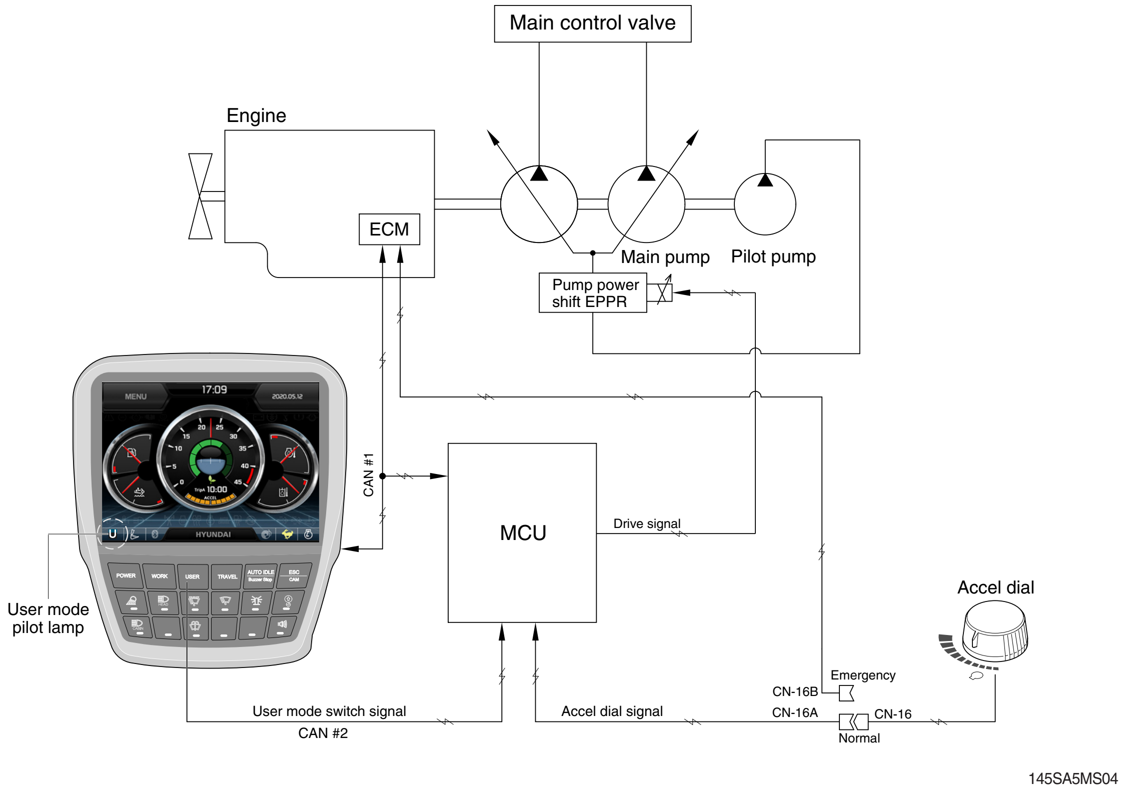
2) ATT WORK MODE (breaker, crusher)

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

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

★ When breaker operating button is pushed.

3. USER MODE SELECTION SYSTEM



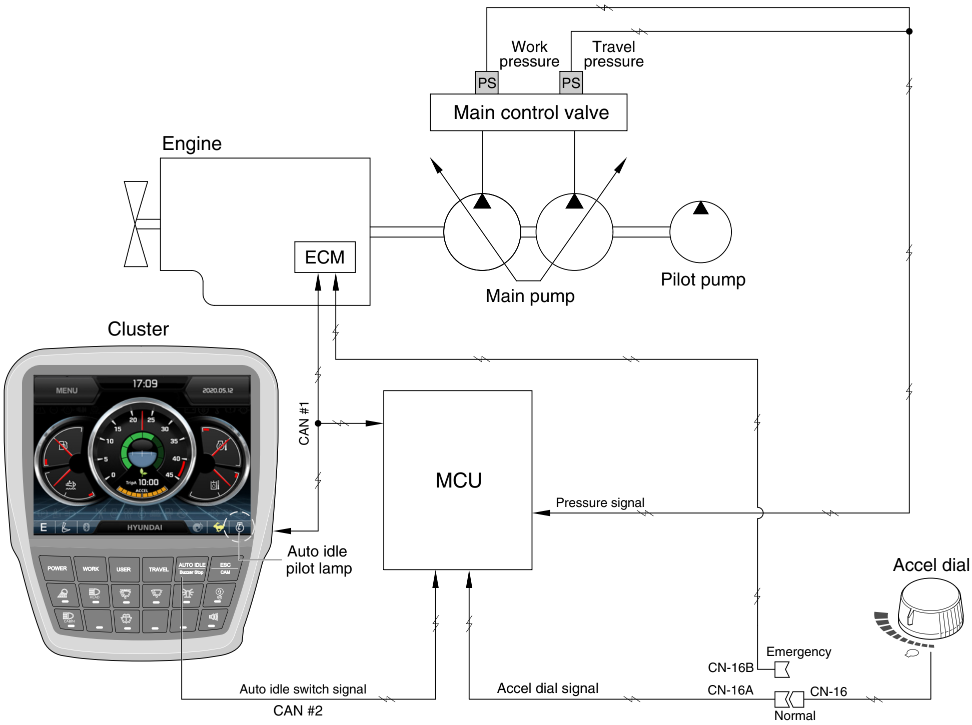
1) Engine speed, idle speed and pump power shift pressure can be adjusted and memorized in the U-mode.

2) LCD segment vs parameter setting

Step (▮)	Engine speed (rpm)	Idle speed (rpm)	Power shift pressure (bar)
1	1550	1000	0
2	1600	1050	3
3	1650	1100	6
4	1700	1150 (auto decel)	9
5	1750	1200	12
6	1800	1250	16
7	1850	1300	20
8	1900	1350	26
9	1950	1400	32
10	2000	1450	38

※ Refer to the page 5-77.

GROUP 3 AUTOMATIC DECELERATION SYSTEM

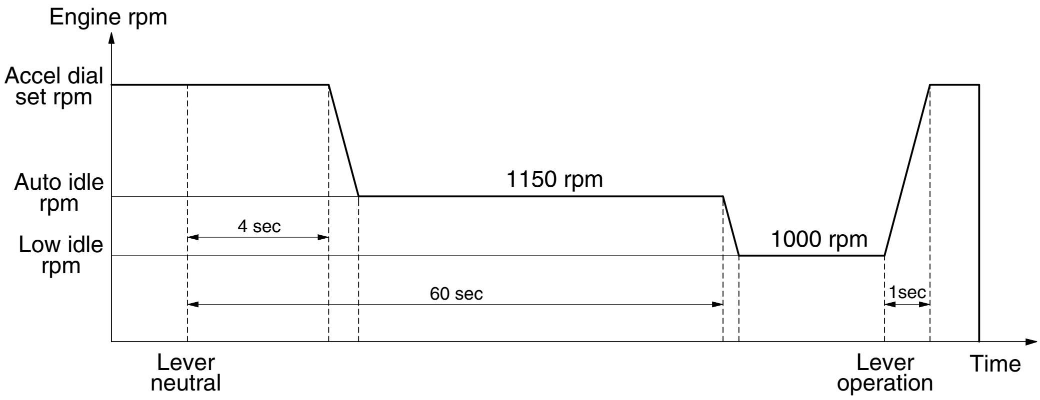


145SA5MS05

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 1150 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.



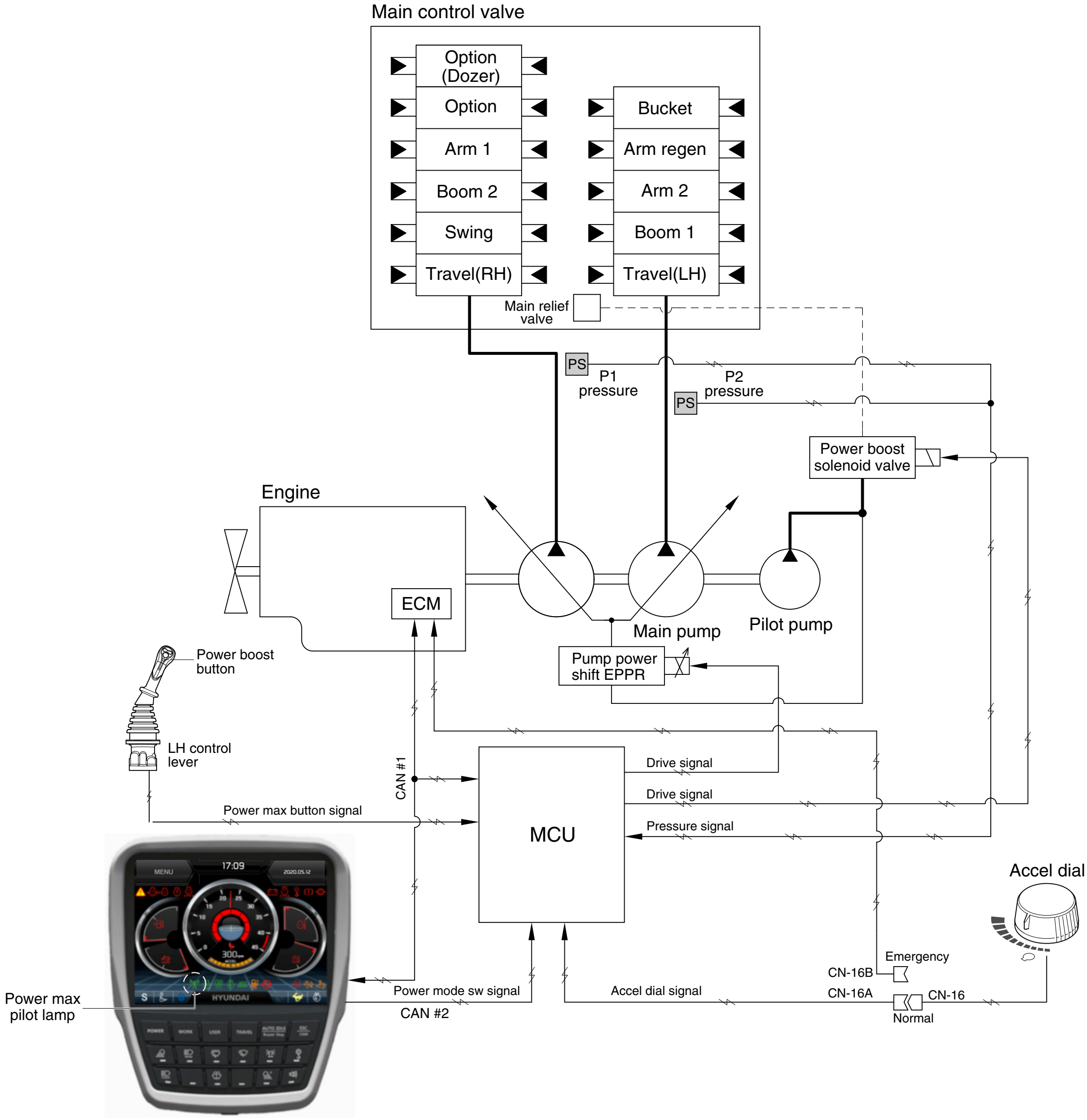
145SA5MS56

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



145SA5MS06

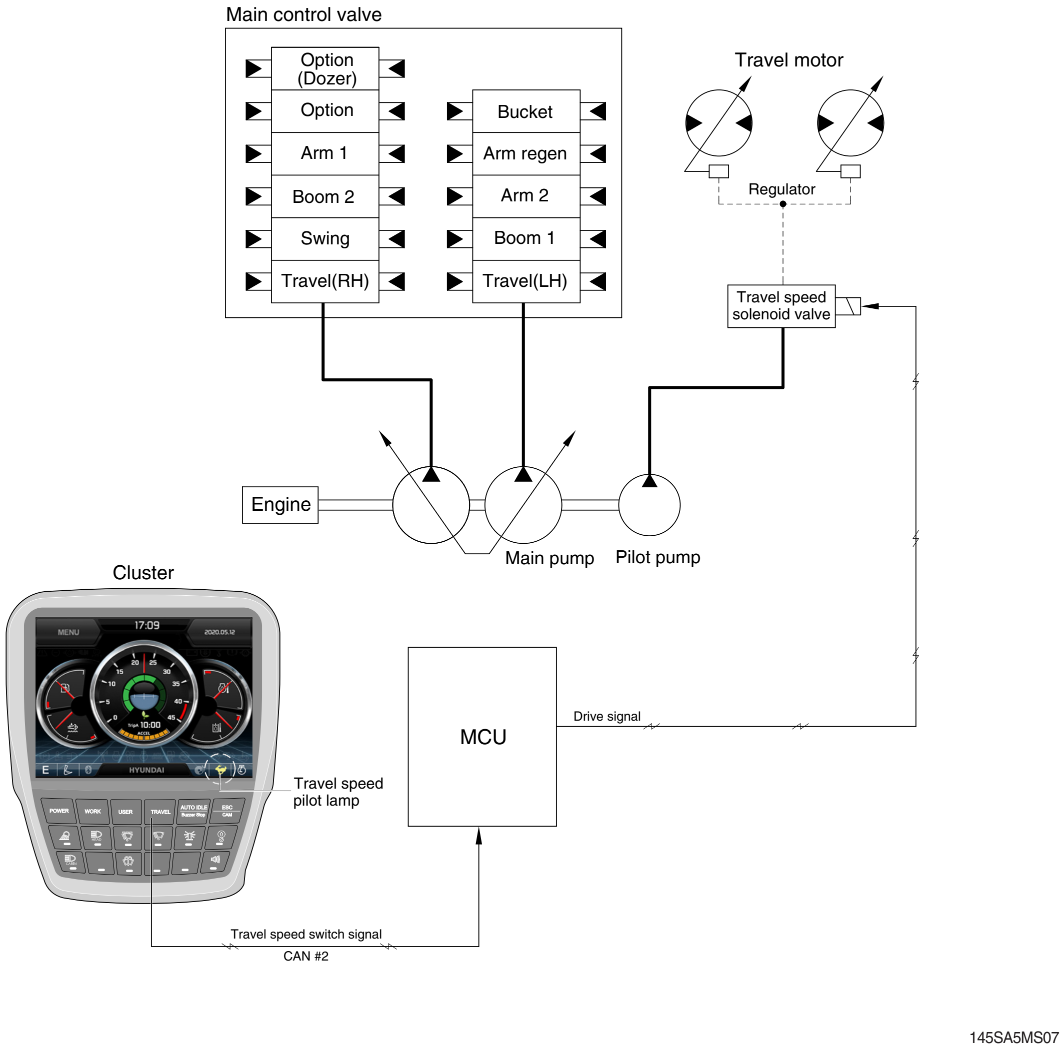
· When the power boost switch on the left control lever is pushed ON, the power mode is set P mode and maximum digging power is increased by 10 %.

· 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

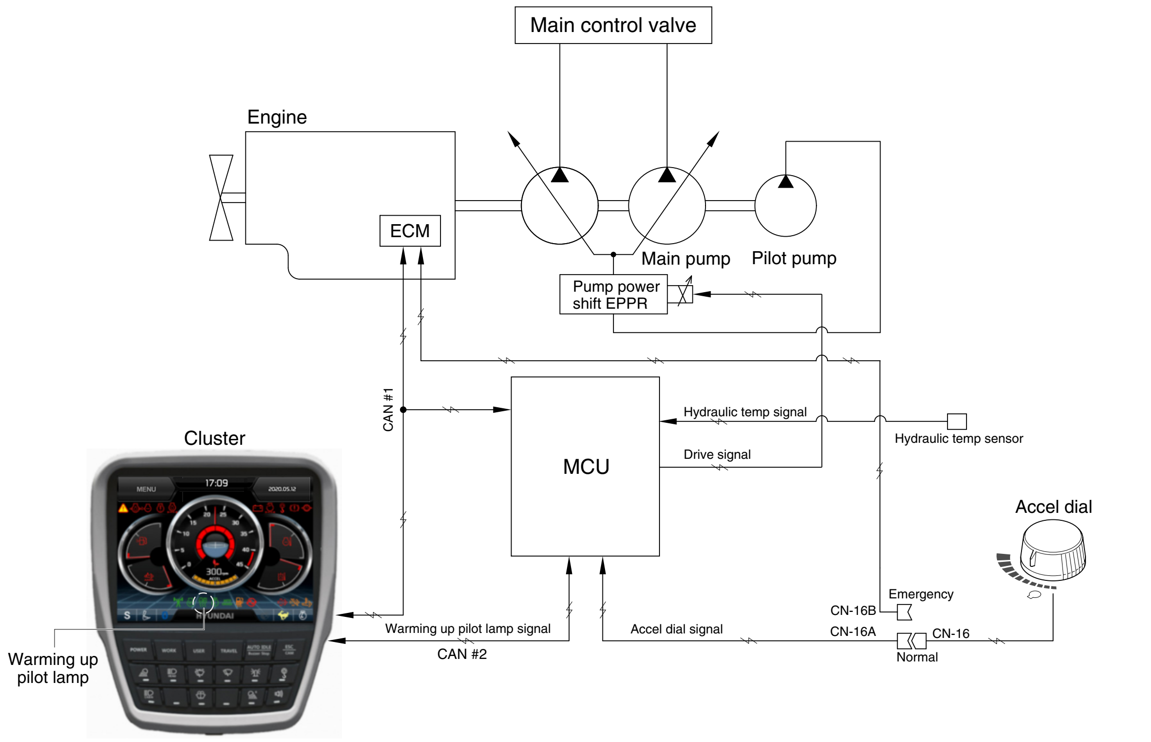


Travel speed can be switched manually by pressing the travel speed switch on the cluster.

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



145SA5MS08

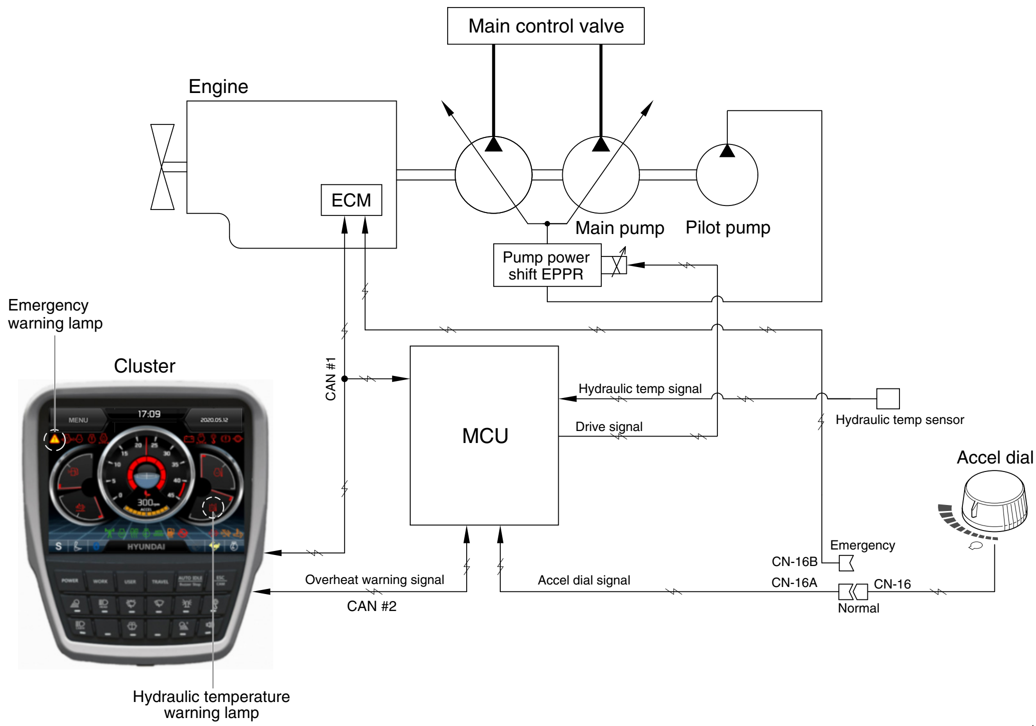
1. The MCU receives the engine coolant temperature from the ECM, and if the coolant temperature is below 30˚C, it increases the engine speed from key start rpm to 1200 rpm. At this time the mode does not change. If the coolant temperature sensor has fault, the hydraulic oil temperature signal is substituted.

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

3. LOGIC TABLE

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

GROUP 7 ENGINE OVERHEAT PREVENTION SYSTEM



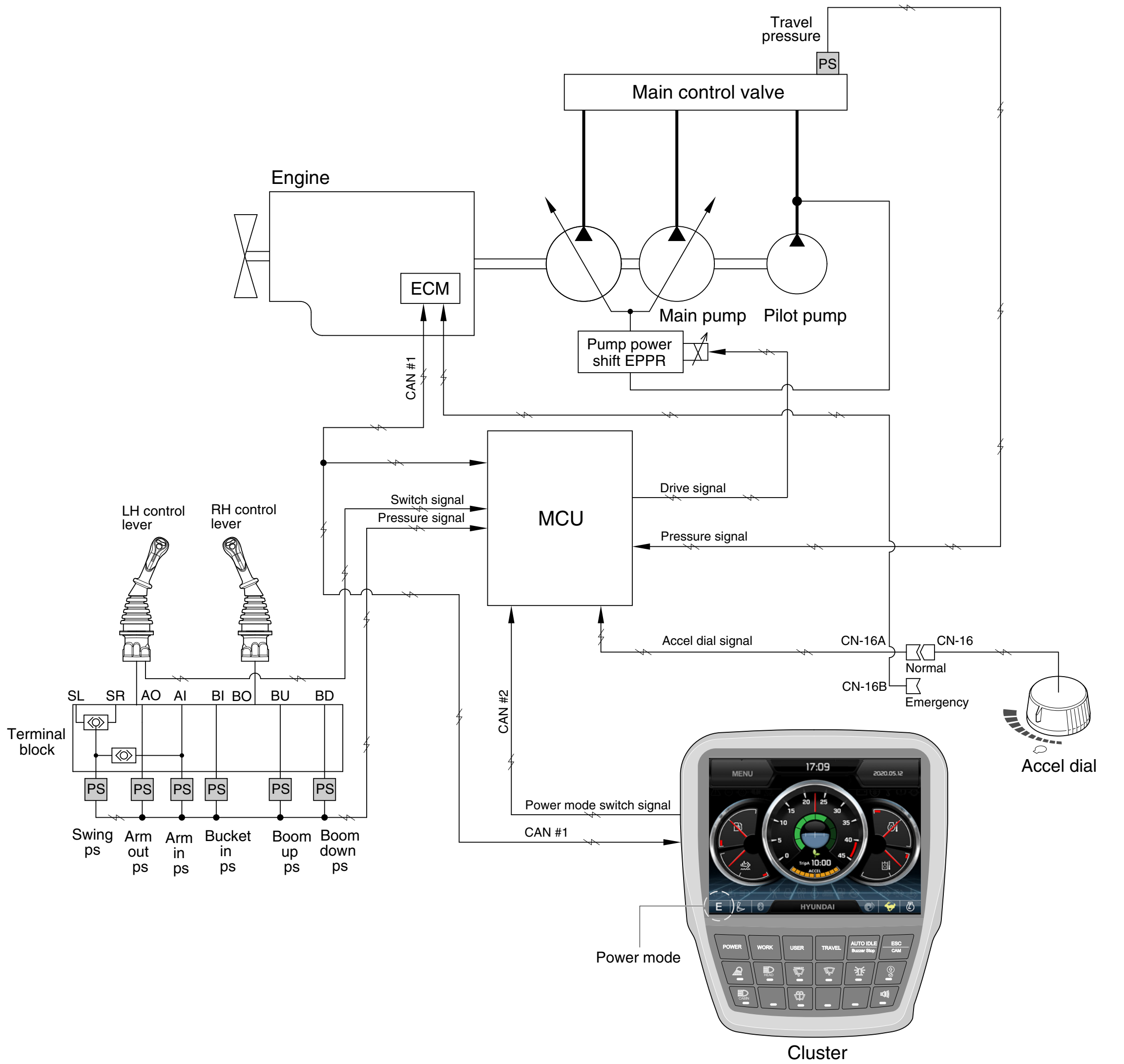
145SA5MS09

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



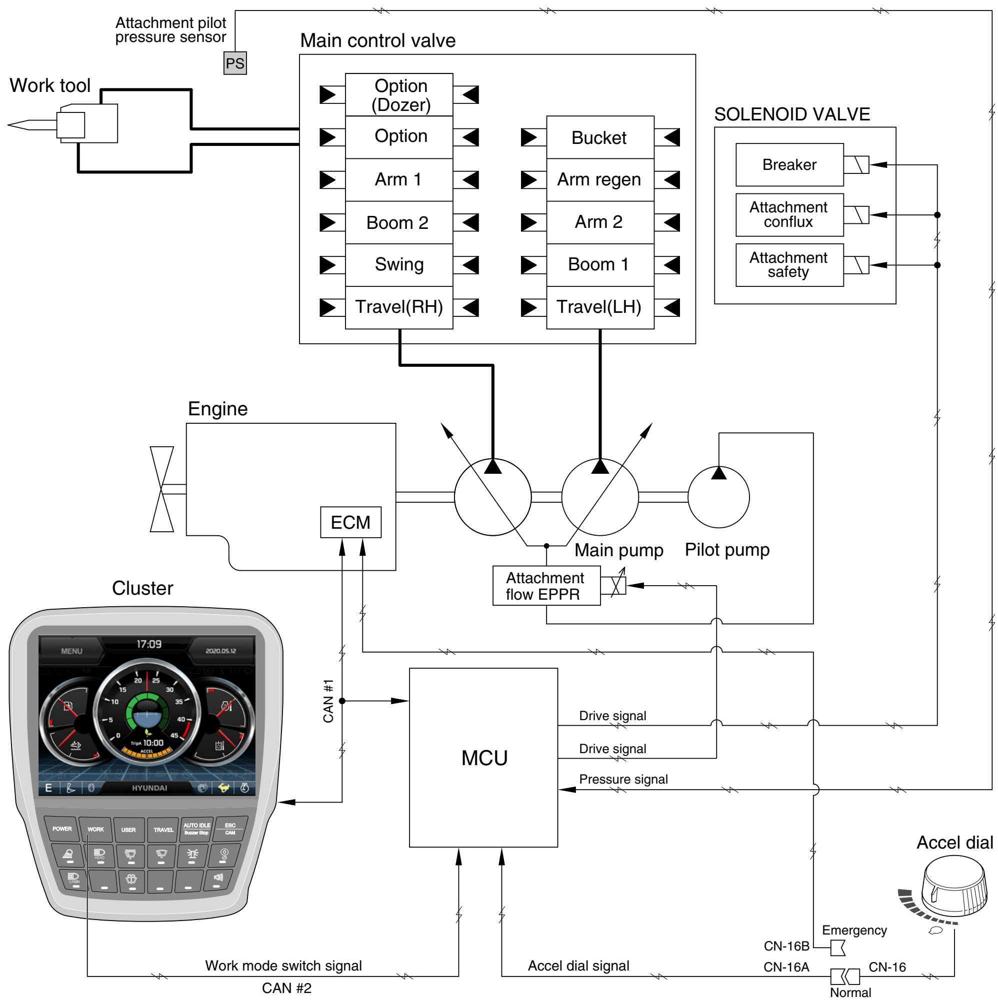
145SA5MS10

· 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



145SA5MS11

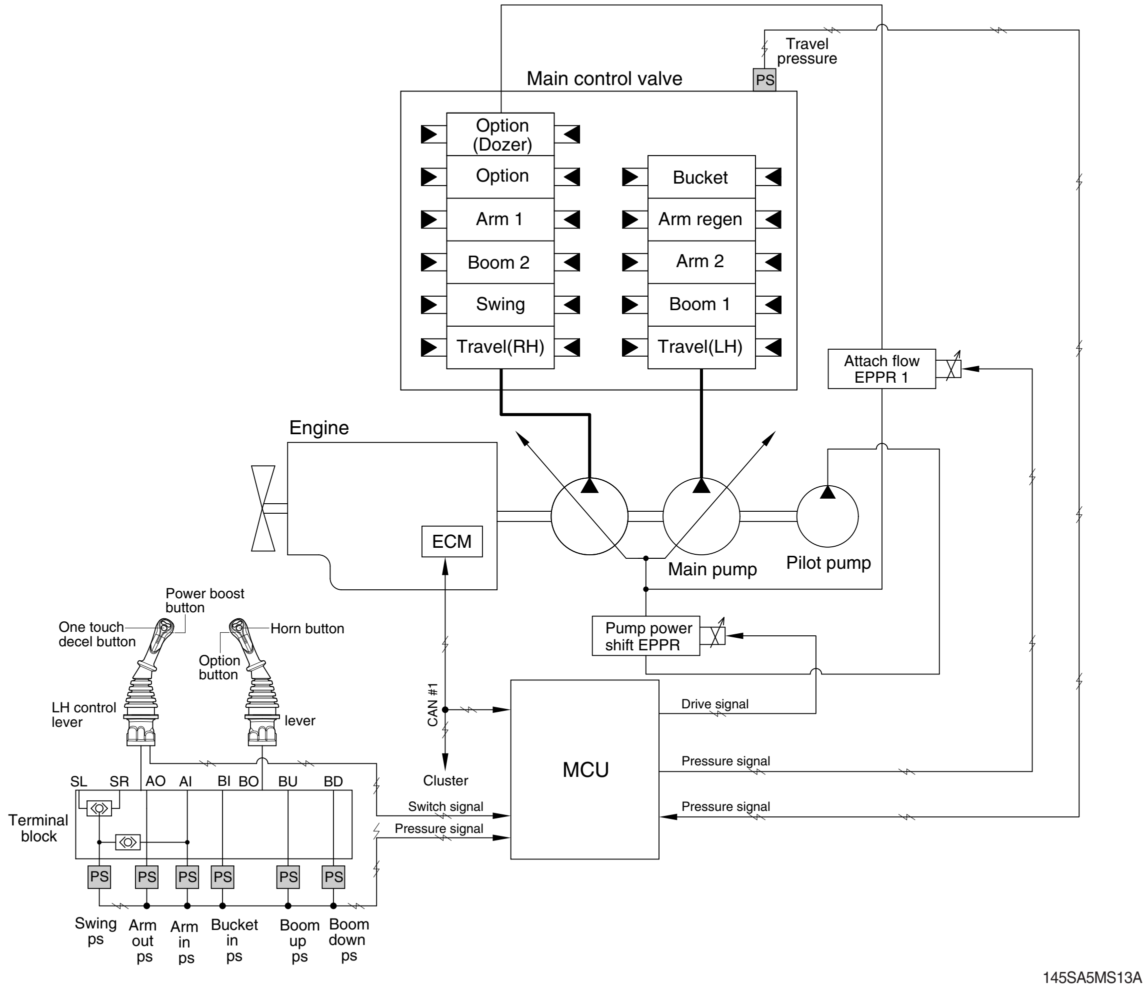
· The system is used to control the pump delivery flow according to set of the work tool on the cluster by the attachment flow EPPR valve.

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

※ Refer to the page 5-77 for the attachment kinds and max flow.

★ When breaker operating switch is pushed.

GROUP 10 INTELLIGENT POWER CONTROL SYSTEM



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

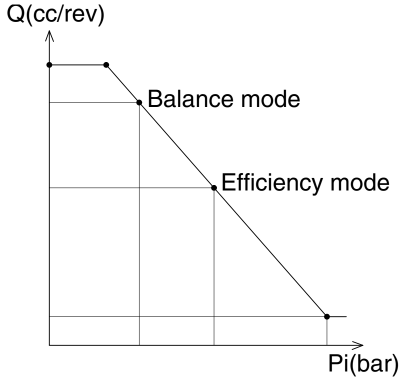
Condition★1	Function
IPC mode : ON★2 Boom up Arm in Not travel motion Not swing motion	Limitation of pump flow rate : Activated
None of upper condition	Limitation of pump flow rate : Canceled

★1 AND condition

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

2. IPC MODE SELECTION

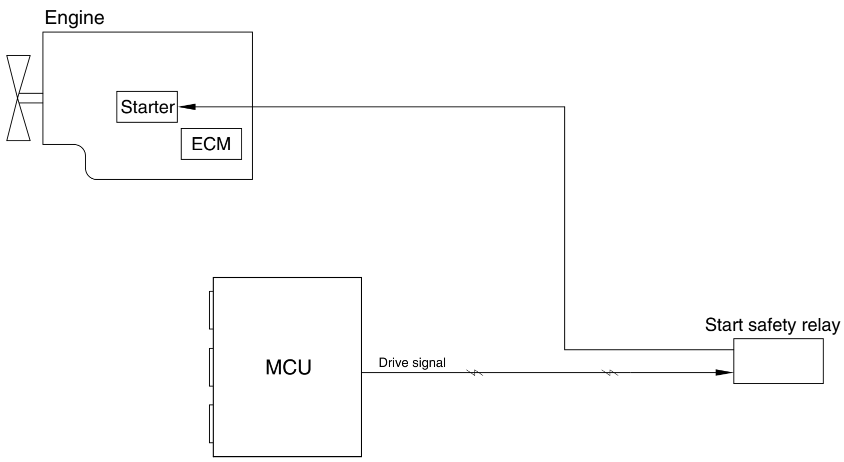
IPC mode ON/OFF and the levels of flow rate limit can be selected at "Mode setup > IPC mode"



145SA5MS19

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

GROUP 11 ANTI-RESTART SYSTEM



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.

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

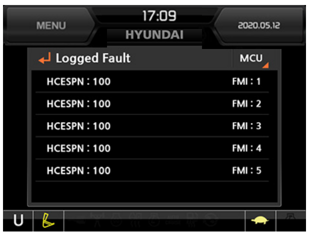
220S3CD120A

220S3CD125A

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

2) Logged fault

220S3CD128A



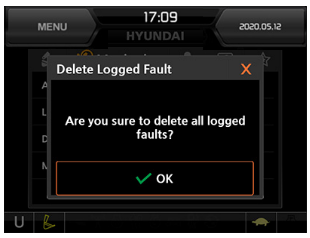
220S3CD124A

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

3) Delete logged fault

220S3CD134A

220S3CD126A



220S3CD127A

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

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 (#30) 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 (#39) 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-51 (#39) Checking Open/Short 2. CD-70 (#A) – CN-51 (#3) Checking Open/Short 3. CD-70 (#C) – CN-51 (#13) Checking Open/Short				
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-51 (#40) Checking Open/Short 2. CD-71 (#A) – CN-51 (#3) Checking Open/Short 3. CD-71 (#C) – CN-51 (#13) Checking Open/Short				
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 (#35) Checking Open/Short 2. CD-32 (#A) – CN-51 (#3) Checking Open/Short 3. CD-32 (#C) – CN-5 1(#13) Checking Open/Short				

※ 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 (#34) 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-51 (#10) Checking Open/Short 2. CD-90 (#A) – CN-51 (#3) Checking Open/Short 3. CD-90 (#C) – CN-51 (#13) Checking Open/Short				
133	0	10 seconds continuous, Bucket In Pilot Press. Sensor Measurement Voltage > 5.2V	●		
	1	10 seconds continuous, 0.3V≤ Bucket In Pilot Press. Sensor Measurement Voltage < 0.8V	●		
	4	10 seconds continuous, Bucket In Pilot Press. Sensor Measurement Voltage < 0.3V	●		
	(Results / Symptoms) 1. Monitor – Bucket In Pilot Press. display failure 2. Control Function – Engine variable horse power control operation failure (Checking list) 1. CD-87 (#B) – CN-52 (#31) Checking Open/Short 2. CD-87 (#A) – CN-51 (#3) Checking Open/Short 3. CD-87 (#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">135</td><td>0</td><td>10 seconds continuous, Swing Pilot Press. Sensor
Measurement Voltage > 5.2V</td><td>●</td><td></td><td></td></tr>
<tr><td>1</td><td>10 seconds continuous, 0.3V≤ Swing Pilot Press. Sensor Measurement Voltage < 0.8V</td><td>●</td><td></td><td></td></tr>
<tr><td>4</td><td>10 seconds continuous, Swing Pilot Press. Sensor
Measurement Voltage < 0.3V</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Monitor – Swing Pilot Press. display failure
2. Control Function – IPC operation, Boom first operation failure
(Checking list)
1. CD-24 (#B) – CN-52 (#36) Checking Open/Short
2. CD-24 (#A) – CN-51 (#3) Checking Open/Short
3. CD-24 (#C) – CN-51 (#13) Checking Open/Short</td></tr>
<tr><td rowspan="4">138</td><td>0</td><td>Monitor – Select Attachment(breaker / crusher)
10 seconds continuous, Attachment Pilot Press. Sensor Measurement Voltage > 5.2V</td><td>●</td><td></td><td></td></tr>
<tr><td>1</td><td>Monitor – Select Attachment(breaker / crusher)
10 seconds continuous, 0.3V≤ Attachment Pilot Press. Sensor Measurement Voltage < 0.8V</td><td>●</td><td></td><td></td></tr>
<tr><td>4</td><td>Monitor – Select Attachment(breaker / crusher)
10 seconds continuous, Attachment Pilot Press. Sensor Measurement Voltage < 0.3V</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Monitor – Attachment Pilot Press. display failure
2. Control Function – Option attachment flow control operation failure
(Checking list)
1. CD-69 (#B) – CN-52 (#33) Checking Open/Short
2. CD-69 (#A) – CN-53 (#3) Checking Open/Short
3. CD-69 (#C) – CN-53 (#13) Checking Open/Short</td></tr>
<tr><td rowspan="3">139
(N.A)</td><td>1</td><td>10 seconds continuous, 0.3V≤ Option Pilot Press. Sensor Measurement Voltage < 0.8V</td><td></td><td></td><td>●</td></tr>
<tr><td>4</td><td>10 seconds continuous, Option Pilot Press. Sensor
Measurement Voltage < 0.3V</td><td></td><td></td><td>●</td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Monitor – Option Pilot Press. display failure
2. Control Function – Auto Idle operation failure
(Checking list)
1. CD-100 (#B) – CN-52 (#21) Checking Open/Short
2. CD-100 (#A) – CN-51 (#3) Checking Open/Short
3. CD-100 (#C) – CN-1 (#6) Checking Open/Short</td></tr>
</table>

※ 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 (#19) 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 (#7) Checking Open/Short 2. CN-133 (#1) – CN-52 (#17) 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">143
(N.A)</td><td>5</td><td>(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</td><td></td><td></td><td>●</td></tr>
<tr><td>6</td><td>(Detection)
10 seconds continuous, Travel EPPR drive current > 1.0 A
(Cancellation)
3 seconds continuous, Travel EPPR drive current ≤ 1.0 A</td><td></td><td></td><td>●</td></tr>
<tr><td colspan="5">(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</td></tr>
<tr><td rowspan="3">145
(N.A)</td><td>5</td><td>(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</td><td>●</td><td></td><td></td></tr>
<tr><td>6</td><td>(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</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(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</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">164
(N.A)</td><td>4</td><td>(Detection)
(When Working Cutoff Relay is Off)
10 seconds continuous, Working Cutoff Relay drive unit Measurement Voltage ≤ 3.0V
(Cancellation)
(When Working Cutoff Relay is Off)
3 seconds continuous, Working Cutoff Relay drive unit Measurement Voltage > 3.0V</td><td></td><td></td><td>●</td></tr>
<tr><td>6</td><td>(Detection)
(When Working Cutoff Relay is On)
10 seconds continuous, Working Cutoff Relay drive current > 6.5 A
(Cancellation)
(When Working Cutoff Relay is On)
3 seconds continuous, Working Cutoff Relay drive current ≤ 6.5 A</td><td></td><td></td><td>●</td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Control Function – (Wheel Excavator) In driving mode, attachment hydraulic pilot pressure cut off failure
(Checking list)
1. CR-47 (#85) – CN-54 (#9) Checking Open/Short
2. CR-47 (#30, #86) – Fuse No (#28) Checking Open/Short</td></tr>
<tr><td rowspan="3">166</td><td>4</td><td>(Detection)
(When Power Max Solenoid is Off)
10 seconds continuous, Power Max Solenoid drive unit Measurement Voltage ≤ 3.0V
(Cancellation)
(When Power Max Solenoid is Off)
3 seconds continuous, Power Max Solenoid drive unit Measurement Voltage > 3.0V</td><td>●</td><td></td><td></td></tr>
<tr><td>6</td><td>(Detection)
(When Power Max Solenoid is On)
5 seconds continuous, Power Max Solenoid drive current > 4.5 A
(Cancellation)
(When Power Max Solenoid is On)
3 seconds continuous, Power Max Solenoid drive current ≤ 4.5 A</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Control Function – Voltage increase operation failure
(Checking list)
1. CN-88 (#1) – CN-52 (#2) Checking Open/Short
2. CN-88 (#2) – Fuse (#24) Checking Open/Short</td></tr>
</table>

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

DTC		Diagnostic Criteria	Application		
HCESPN	FMI		G	C	W
167	4	(Detection) (When Travel Speed Solenoid is Off) 10 seconds continuous, Travel Speed Solenoid drive unit Measurement Voltage ≤ 3.0V (Cancellation) (When Travel Speed Solenoid is Off) 3 seconds continuous, Travel Speed Solenoid drive unit Measurement Voltage > 3.0V		●	
		(When Parking mode is not) (Detection) (When Travel Speed Solenoid is Off) 10 seconds continuous, Travel Speed Solenoid drive unit Measurement Voltage ≤ 3.0V (Cancellation) (When Travel Speed Solenoid is Off) 3 seconds continuous, Travel Speed Solenoid drive unit Measurement Voltage > 3.0V			●
	6	(Detection) (When Travel Speed Solenoid is On) 10 seconds continuous, Travel Speed Solenoid drive current > 4.5 A (Cancellation) (When Travel Speed Solenoid is On) 3 seconds continuous, Travel Speed Solenoid drive current ≤ 4.5 A	●		
	(Results / Symptoms) 1. Control Function – driving in 1/2 transmission operation failure (Checking list) 1. CN-70 (#1) – CN-52 (#3) Checking Open/Short 2. CN-70 (#2) – Fuse (#24) 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">169</td><td>4</td><td>Monitor – Selecting attachment(breaker / crusher)
(Detection)
(When Attachment Conflux Solenoid is Off)
10 seconds continuous, Attachment Conflux Solenoid drive unit Measurement Voltage ≤ 3.0V
(Cancellation)
(When Attachment Conflux Solenoid is Off)
3 seconds continuous, Attachment Conflux Solenoid drive unit Measurement Voltage > 3.0V</td><td>●</td><td></td><td></td></tr>
<tr><td>6</td><td>(Detection)
(When Attachment Conflux Solenoid is On)
10 seconds continuous, Attachment Conflux Solenoid drive Current > 6.5 A
(Cancellation)
(When Attachment Conflux Solenoid is On)
3 seconds continuous, Attachment Conflux Solenoid drive Current ≤ 6.5 A</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(Results / symptoms)
1. Control Function – Option attachment flow control – Joining operation failure
(Eco breaker mode, crusher mode)
(Checking list)
1. CN-66 (#1) – CN-11 (#11) Checking Open/Short
2. CN-66 (#2) – CR-62 (#87) Checking Open/Short</td></tr>
<tr><td rowspan="3">170</td><td>4</td><td>(Model Parameter) mounting Arm Regenerating Solenoid
(Detection)
(When Arm Regeneration Solenoid is Off)
10 seconds continuous, Arm Regeneration Solenoid drive unit Measurement Voltage ≤ 3.0V
(Cancellation)
(When Arm Regeneration Solenoid is Off)
3 seconds continuous, Arm Regeneration Solenoid drive unit Measurement Voltage > 3.0V</td><td>●</td><td></td><td></td></tr>
<tr><td>6</td><td>(Detection)
(When Arm Regeneration Solenoid is On)
10 seconds continuous, Arm Regeneration Solenoid drive current > 4.5 A
(Cancellation)
(When Arm Regeneration Solenoid is On)
3 seconds continuous, Arm Regeneration Solenoid drive current ≤ 4.5 A</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(Detection)
(When Arm Regeneration Solenoid is On)
10 seconds continuous, Arm Regeneration Solenoid drive current > 4.5 A
(Cancellation)
(When Arm Regeneration Solenoid is On)
3 seconds continuous, Arm Regeneration Solenoid drive current ≤ 4.5 A</td></tr>
</table>

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

<table>
<tr><th colspan="2">DTC</th><th rowspan="2">Diagnostic Criteria</th><th colspan="3">Application</th></tr>
<tr><th>HCESPN</th><th>FMI</th><th>G</th><th>C</th><th>W</th></tr>
<tr><td rowspan="3">171</td><td>4</td><td>Monitor – Selecting attachment(crusher)
(Detection)
(When Attachment Safety Solenoid is Off)
10 seconds continuous, Attachment Safety Solenoid drive unit Measurement Voltage ≤ 3.0V
(Cancellation)
(When Attachment Safety Solenoid is Off)
3 seconds continuous, Attachment Safety Solenoid drive unit Measurement Voltage > 3.0V</td><td>●</td><td></td><td></td></tr>
<tr><td>6</td><td>(Detection)
(When Attachment Safety Solenoid is On)
10 seconds continuous, Attachment Safety Solenoid drive current > 6.5 A
(Cancellation)
(When Attachment Safety Solenoid is On)
3 seconds continuous, Attachment Safety Solenoid drive current ≤ 6.5 A</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Control Function – Option attachment flow control – Option spool pilot pressure cut off failure (crusher mode)
(Checking list)
1. CN-149 (#1) – CN-52 (#4) Checking Open/Short
2. CN-149 (#2) – Fuse (#24) Checking Open/Short</td></tr>
<tr><td rowspan="3">179
(N.A)</td><td>4</td><td>Monitor – Selecting attachment(breaker / crusher)
(Detection)
(When Breaker Operating Solenoid is Off)
10 seconds continuous, Attachment Safety Solenoid drive unit Measurement Voltage ≤ 3.0V
(Cancellation)
(When Breaker Operating Solenoid is Off)
3 seconds continuous, Attachment Safety Solenoid drive unit Measurement Voltage > 3.0V</td><td>●</td><td></td><td></td></tr>
<tr><td>6</td><td>(Detection)
(When Breaker Operating Solenoid is On)
10 seconds continuous, Attachment Safety Solenoid drive current > 6.5 A
(Cancellation)
(When Breaker Operating Solenoid is On)
3 seconds continuous, Attachment Safety Solenoid drive current ≤ 6.5 A</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Control Function – Option attachment flow control – Breaker operation failure (breaker mode)
(Checking list)
1. CD-66 (#1) – CN-53 (#9) Checking Open/Short
2. CD-66 (#2) – CN-45 (#B+ term) Checking Open/Short
3. CD-66 (#C) – CN-51 (#13) Checking Open/Short</td></tr>
</table>

※ Some error codes are not applied to this machine.

G : General　　C : Crawler Type　　W : Wheel Type

<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">181
(N.A)</td><td>4</td><td>(Model Parameter) mounting Reverse Cooling Fan Solenoid
(Detection)
(When Reverse Cooling Fan Solenoid is Off)
10 seconds continuous, Reverse Cooling Fan Solenoid drive unit Measurement Voltage ≤ 3.0V
(Cancellation)
(When Reverse Cooling Fan Solenoid is Off)
3 seconds continuous, Reverse Cooling Fan Solenoid drive unit Measurement Voltage > 3.0V</td><td>●</td><td></td><td></td></tr>
<tr><td>6</td><td>(Detection)
(When Reverse Cooling Fan Solenoid is On)
10 seconds continuous, Reverse Cooling Fan Solenoid drive current > 4.5 A
(Cancellation)
(When Reverse Cooling Fan Solenoid is On)
3 seconds continuous, Reverse Cooling Fan Solenoid drive current ≤ 4.5 A</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Control Function – Cooling Fan reverse control operation failure (not applicable)</td></tr>
<tr><td rowspan="3">188</td><td>5</td><td>(Detection)
(When Attachment Flow EPPR 1 current is equal or more than 300 mA)
10 seconds continuous, Attachment Flow EPPR drive current < 100 mA
(Cancellation)
(When Attachment Flow EPPR 1 current is equal or more than 300 mA)
3 seconds continuous, Attachment Flow EPPR drive current ≥ 100 mA</td><td>●</td><td></td><td></td></tr>
<tr><td>6</td><td>(Detection)
10 seconds continuous, Attachment Flow EPPR 1 drive current > 1.0 A
(Cancellation)
3 seconds continuous, Attachment Flow EPPR 1 drive current ≤ 1.0 A</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Control Function – IPC operation failure, Option attachment flow control operation failure
(Checking list)
1. CN-242 (#2) – CN-52 (#10) Checking Open/Short
2. CN-242 (#1) – CN-52 (#20) Checking Open/Short</td></tr>
</table>

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

DTC		Diagnostic Criteria	Application		
HCESPN	FMI		G	C	W
189	5	(Detection) (When Attachment Flow EPPR 2 current is equal or more than 300 mA) 10 seconds continuous, Attachment Flow EPPR drive current < 100 mA (Cancellation) (When Attachment Flow EPPR 2 current is equal or more than 300 mA) 3 seconds continuous, Attachment Flow EPPR drive current ≥ 100 mA	●		
	6	(Detection) 10 seconds continuous, Attachment Flow EPPR 2 drive current > 1.0 A (Cancellation) 3 seconds continuous, Attachment Flow EPPR 2 drive current ≤ 1.0 A	●		
	(Results / Symptoms) 1. Control Function – Option attachment flow control operation failure (Checking list) 1. CN-242A (#2) – CN-52 (#40) Checking Open/Short 2. CN-242A (#1) – CN-52 (#17) Checking Open/Short				
196 (N.A)	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
(N.A)</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
(N.A)</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

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

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

<table>
<tr><th colspan="2">DTC</th><th rowspan="2">Diagnostic Criteria</th><th colspan="3">Application</th></tr>
<tr><th>HCESPN</th><th>FMI</th><th>G</th><th>C</th><th>W</th></tr>
<tr><td rowspan="3">222
(N.A)</td><td>5</td><td>Monitor – Selecting attachment(crusher)
(Detection)
(When ATT Relief Setting EPPR 2 Current is equal or more than 10 mA)
10 seconds continuous, ATT Relief Setting EPPR 2 drive current = 0 mA
(Cancellation)
(When ATT Relief Setting EPPR 2 Current is equal or more than 10 mA)
3 seconds continuous, ATT Relief Setting EPPR 2 drive current ≥ 10mA</td><td>●</td><td></td><td></td></tr>
<tr><td>6</td><td>(Detection)
10 seconds continuous, ATT Relief Setting EPPR 2 drive current > 1.0 A
(Cancellation)
3 seconds continuous, ATT Relief Setting EPPR 2 drive current ≤ 1.0 A</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Control Function – Option attachment flow control – P2 relief pressure setting failure
(Checking list)
1. CD-366 (#2) – CN-53 (#32) Checking Open/Short
2. CD-366 (#1) – CN-53 (#33) Checking Open/Short</td></tr>
<tr><td rowspan="3">301</td><td>3</td><td>10 seconds continuous, Fuel Level Measurement Voltage > 3.8V</td><td>●</td><td></td><td></td></tr>
<tr><td>4</td><td>10 seconds continuous, Fuel Level Measurement Voltage < 0.3V</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Monitor – Fuel remaining display failure
(Checking list)
1. CD-2 (#2) – CN-52 (#26) Checking Open/Short
2. CD-2 (#1) – CN-51 (#5) Checking Open/Short</td></tr>
<tr><td rowspan="3">325</td><td>4</td><td>(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</td><td>●</td><td></td><td></td></tr>
<tr><td>6</td><td>(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</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Control Function – Fuel warmer operation failure
(Checking list)
1. CR-46 (#85) – CN-52 (#12) Checking Open/Short
2. CR-46 (#86) – Fuse (#0) 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
501 (N.A)	0	10 seconds continuous, Transmission Oil Press. Sensor Measurement Voltage > 5.2V			●
	1	10 seconds continuous, 0.3V≤ Transmission Oil Press. Sensor Measurement Voltage < 0.8V			●
	4	10 seconds continuous, Transmission Oil Press. Sensor Measurement Voltage < 0.3V			●
	(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				
503 (N.A)	0	10 seconds continuous, Brake Oil Press. Sensor Measurement Voltage > 5.2V			●
	1	10 seconds continuous, 0.3V≤ Brake Oil Press. Sensor Measurement Voltage < 0.8V			●
	4	10 seconds continuous, Brake Oil Press. Sensor Measurement Voltage < 0.3V			●
	(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				
505 (N.A)	0	10 seconds continuous, Working Brake Press. Sensor Measurement Voltage > 5.2V			●
	1	10 seconds continuous, 0.3V≤ Working Brake Press. Sensor Measurement Voltage < 0.8V			●
	4	10 seconds continuous, Working Brake Press. Sensor Measurement Voltage < 0.3V			●
	(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				

※ 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
(N.A)</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
(N.A)</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 (N.A)	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 (N.A)	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 (N.A)	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 (N.A)	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 (#13) Checking Open/Short
2. CN-81 (#2) – Fuse (#24) 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 (#6) – CR-7 (#85) Checking Open/Short
2. CN-11 (#5) – Fuse (#4) Checking Open/Short</td></tr>
<tr><td rowspan="2">840</td><td>2</td><td>60 seconds continuous, Cluster Communication Data Error</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Control Function – Cluster operation failure
(Checking list)
1. CN-56A (#7) – CN-51 (#32) Checking Open/Short
2. CN-56A (#6) – CN-51 (#22) Checking Open/Short</td></tr>
</table>

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

DTC		Diagnostic Criteria	Application		
HCESPN	FMI		G	C	W
841	2	10 seconds continuous, ECM Communication Data Error	●		
		(Results / Symptoms) 1. Control Function – ECM operation failure (Checking list) 1. CN-93 (#46) – CN-51 (#21) Checking Open/Short 2. CN-93 (#47) – CN-51 (#31) Checking Open/Short			
845 (N.A)	2	(When mounting the I/O Controller 1) 60 seconds continuous, I/O Controller 1 Communication Data Error	●		
		(Results / Symptoms) 1. Control Function – I/O Controller 1 operation failure (Checking list) 1. CN-53 (#21) – CN-51 (#23) Checking Open/Short 2. CN-53 (#31) – CN-51 (#33) Checking Open/Short			
848 (N.A)	2	(When mounting the Haptic Controller) 60 seconds continuous, Haptic Controller Communication Data Error	●		
		(Results / Symptoms) 1. Control Function – Haptic Controller operation failure (Checking list) 1. CN-8 (#2) – CN-51 (#22) Checking Open/Short 2. CN-8 (#3) – CN-51 (#32) Checking Open/Short			
850	2	(When mounting the RMCU) 60 seconds continuous, RMCU communication Data Error	●		
		(Resuluts / Symptoms) 1. Control Function – RMCU operation failure (Checking list) 1. CN-125A (#3) – CN-51 (#22) Checking Open/Short 2. CN-125A (#11) – CN-51 (#32) Checking Open/Short			
861 (N.A)	2	(When mounting the I/O Controller 2) 60 seconds continuous, I/O Controller 2 communication Data Error	●		
		(Results / Symptoms) 1. Control Function – I/O Controller 2 operation failure (Checking list) 1. CN-54 (#21) – CN-51 (#23) Checking Open/Short 2. CN-54 (#31) – CN-51 (#33) Checking Open/Short			

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

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 (#32) Checking Open/Short 2. CN-56A (#6) – CN-51 (#22) 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-02B (#A) – CN-51 (#22) Checking Open/Short 2. CS-02B (#B) – CN-51 (#32) Checking Open/Short				

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

4. ENGINE FAULT CODE

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

※ Some fault codes are not applied to this machine.

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

※ Some fault codes are not applied to this machine.

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

※ Some fault codes are not applied to this machine.

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

※ Some fault codes are not applied to this machine.

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

※ Some fault codes are not applied to this machine.

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

※ Some fault codes are not applied to this machine.

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

※ Some fault codes are not applied to this machine.

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

※ Some fault codes are not applied to this machine.

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

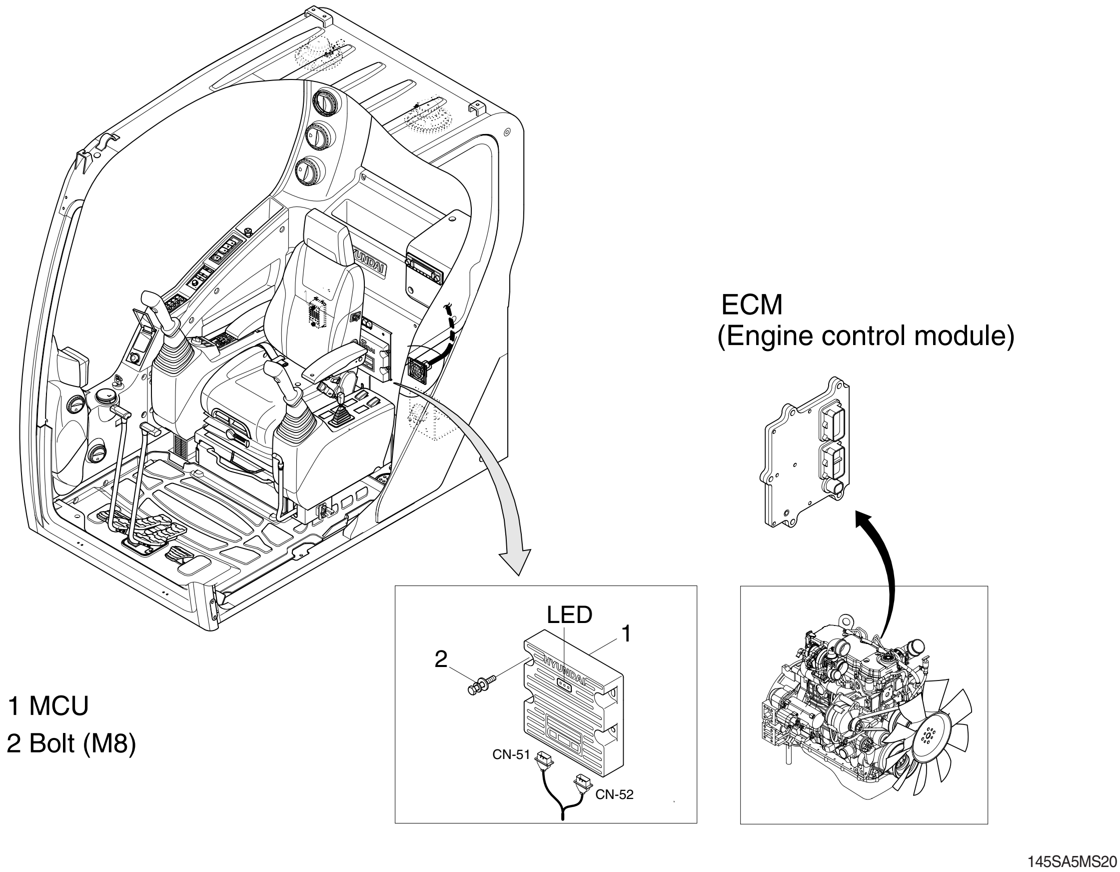
※ Some fault codes are not applied to this machine.

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 13 ENGINE CONTROL SYSTEM

1. MCU and Engine ECM (Electronic Control Module)



2. MCU ASSEMBLY

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

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

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

G : green,   R : red,   Y : yellow

GROUP 14 EPPR VALVE

1. PUMP EPPR VALVE

1) COMPOSITION

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

(1) Electro magnet valve

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

(2) Spool valve

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

(3) Pressure and electric current value for each mode

Mode		Pressure		Engine rpm (at accel dial 10)
		kgf/cm^2	psi	
Standard	P	8 ± 3	114 ± 42.7	1850 ± 50
	S	10 ± 3	142 ± 42.7	1750 ± 50
	E	12 ± 3	171 ± 42.7	1650 ± 50
Option	P	8 ± 3	114 ± 42.7	2000 ± 50
	S	10 ± 3	142 ± 42.7	1900 ± 50
	E	12 ± 3	171 ± 42.7	1800 ± 50

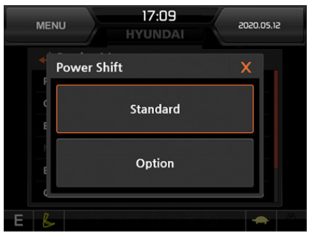
2) HOW TO SWITCH THE POWER SHIFT (STANDARD ↔ OPTION) ON THE CLUSTER

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

- Management
  · Service menu

220S3CD149A

Enter the password 220S3CD150B



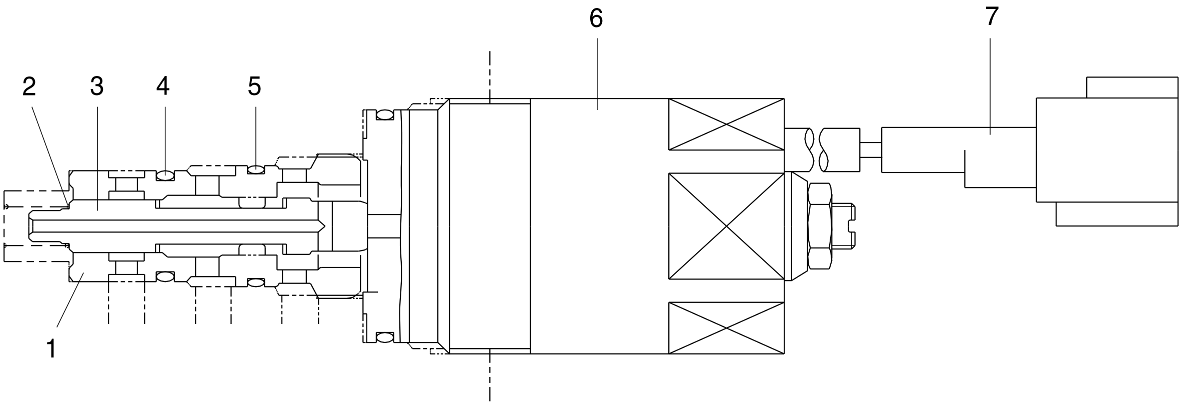
220S3CD251A

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

·

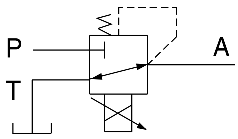
3) OPERATING PRINCIPLE

(1) Structure



5-22(1)

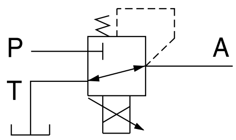
1	Sleeve	4	O-ring	6	Solenoid valve
2	Spring	5	O-ring	7	Connector
3	Spool				

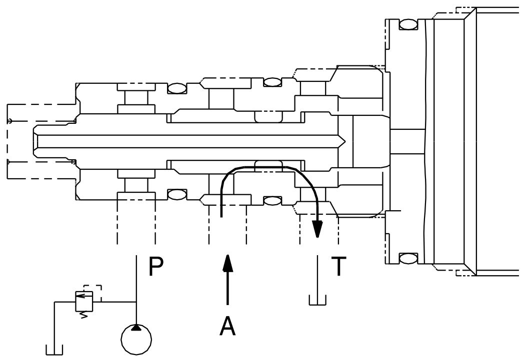


P Pilot oil supply line (pilot pressure)
T Return to tank
A Secondary pressure to flow regulator at main pump

(2) Neutral

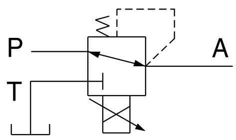
Pressure line is blocked and A oil returns to tank.

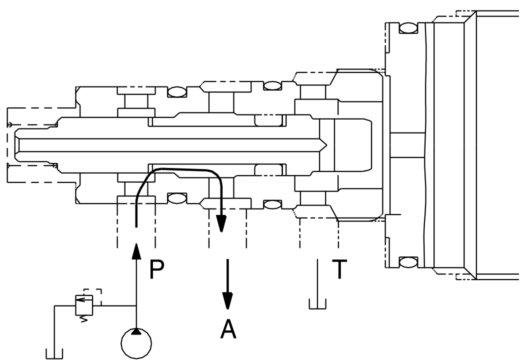




(3) Operating

Secondary pressure enters into A.





5-22(2)

4) EPPR VALVE CHECK PROCEDURE

(1) Check electric current value at EPPR valve

① Disconnect connector CN-75 from EPPR valve.

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

③ Start engine.

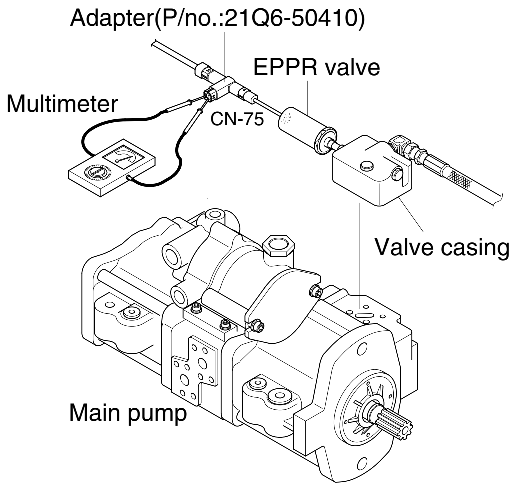
④ Set S-mode and cancel auto decel mode.

⑤ Position the 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.

Spec : 100~700 mA



145ZF5MS21

(2) Check pressure at EPPR valve

① Remove plug and connect pressure gauge as figure.

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

② Start engine.

③ Set S-mode and cancel auto decel mode.

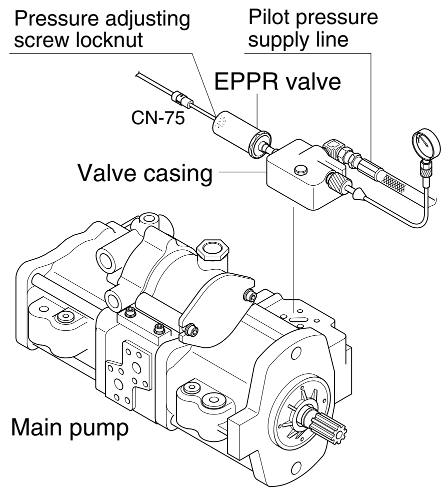
④ Position the accel dial at 10.

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.

Spec : 2~25 kgf/cm2 (30~350 psi)



145ZF5MS22

2. BOOM PRIORITY EPPR VALVE

1) COMPOSITION

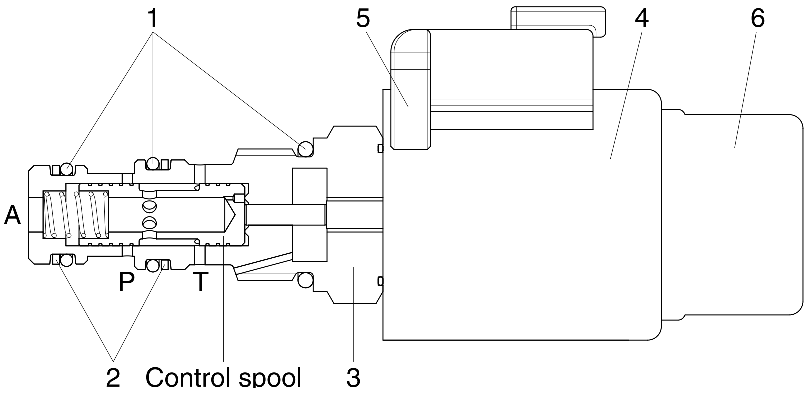
The boom priority EPPR valve is built in a manifold and mainly consisting of valve body and coil. This EPPR valve installed under the solenoid valve.

2) CONTROL

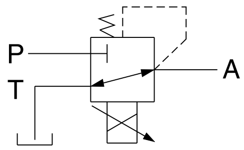
The boom priority EPPR valve has to be controlled by a specific electronic amplifier card, which is supplying the coil with a current 580 mA at 30Ω and 24 V.

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.

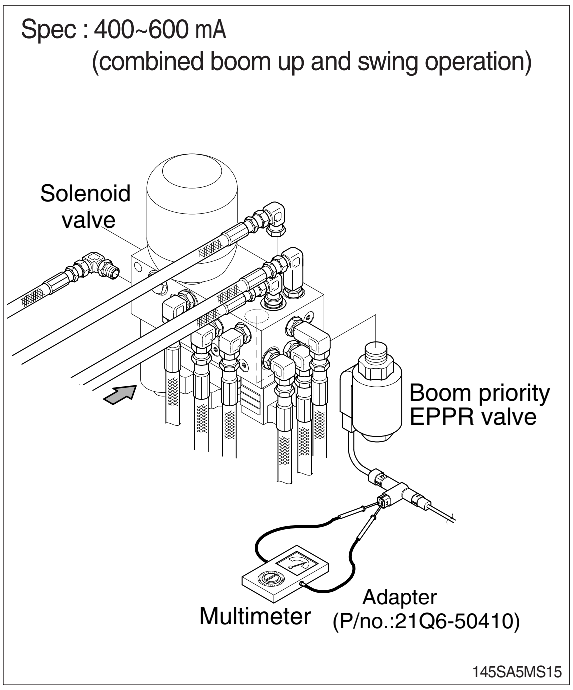
② Insert the adapter to CN-133 and install multimeter as figure.

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)

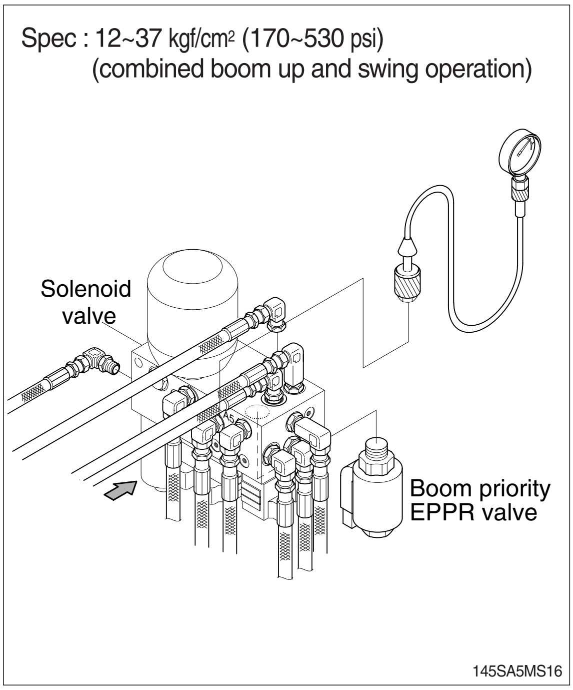
② Start engine.

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.



1. OUTLINE

Monitoring system consists of the monitor part and switch part.

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

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

2. CLUSTER

1) MONITOR PANEL

Normal type

145SA5CD50

Premium type

145SA5CD51

※ The warning lamp pops up and/or blinks and the buzzer sounds when the machine has a problem. The warning lamp blinks until the problem is cleared. Refer to page 3-62 for details.

2) CLUSTER CHECK PROCEDURE

(1) Start key : ON

① Check monitor

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

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

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

a. Engine rpm display : 0 rpm

b. Engine coolant temperature gauge : White range

c. Hydraulic oil temperature gauge : White range

d. Fuel level gauge : White range

③ Indicating lamp state

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

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

c. Travel speed pilot lamp : Low (turtle)

(2) Start of engine

① Check machine condition

a. RPM display indicates at present rpm

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

※ When normal condition : All warning lamp OFF

c. Work mode selection : General work

d. Power mode selection : E mode or U mode

e. Travel speed pilot lamp : Low (turtle)

② When warming up operation

a. Warming up pilot lamp : ON

b. After engine started, engine speed increases to1200 rpm.

※ Others same as above.

③ When abnormal condition

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

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

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

3. CLUSTER CONNECTOR

1) NORMAL TYPE

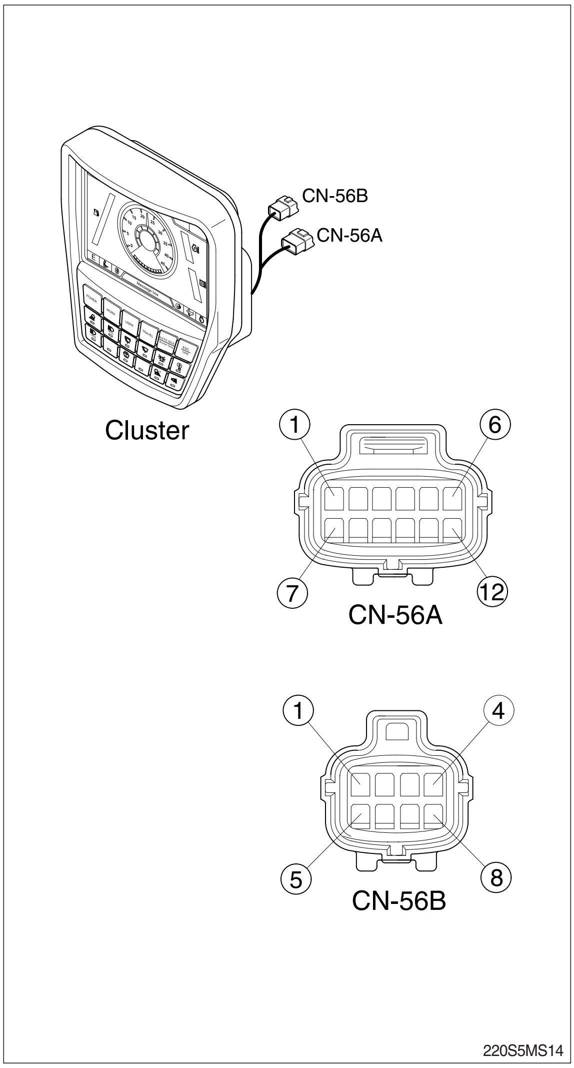
(1) CN-56A

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

(2) CN-56B

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

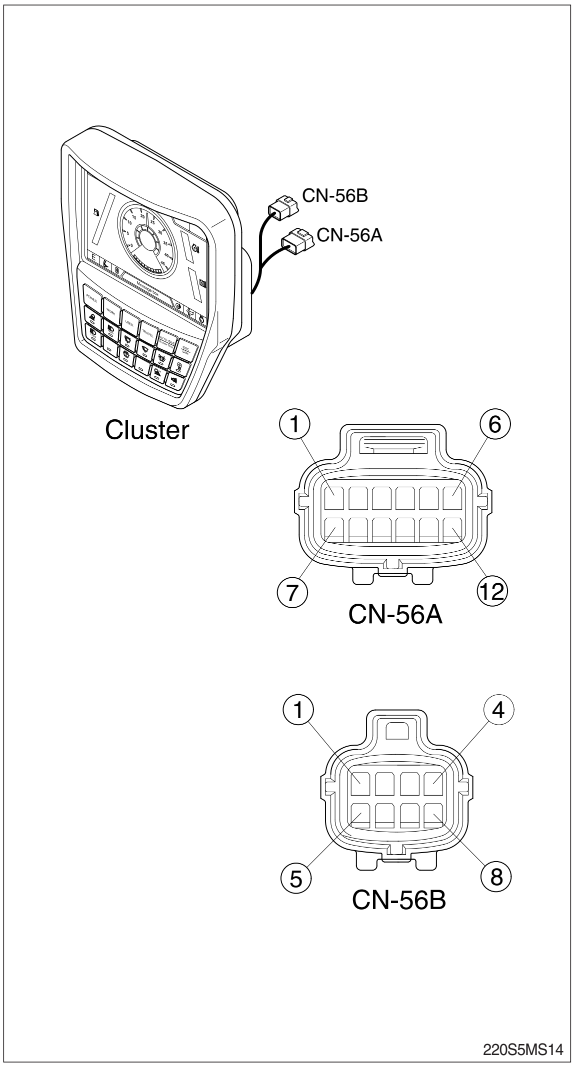
NTSC : National Television System Committee



2) PREMIUM TYPE

(1) CN-56A

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



(2) CN-56B

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

NTSC : National Television System Committee

3) CLUSTER CONNECTOR

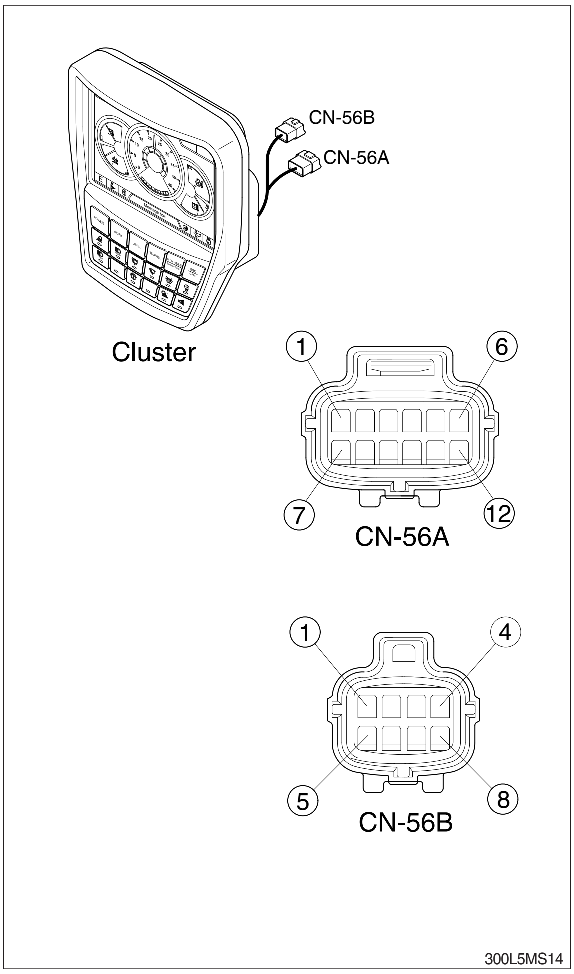
(1) CN-56A

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	NC	-
9	NC	-
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

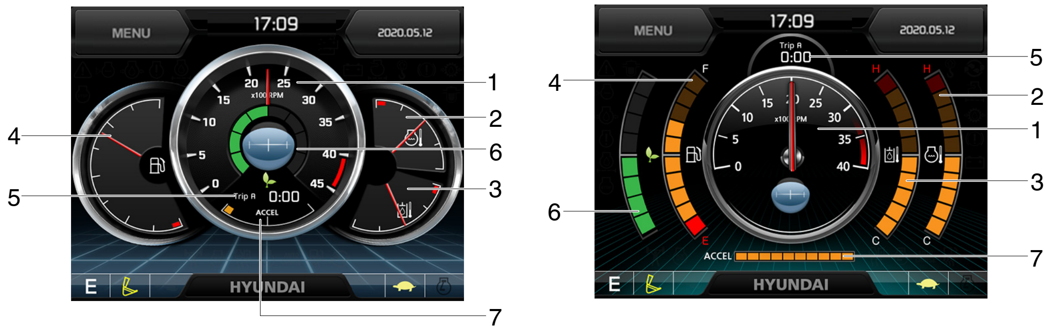
When you first turn starting switch ON, the operation screen will appear.

Normal type

220S3CD551A

Premium type

Default　　　　　　　　　　Option



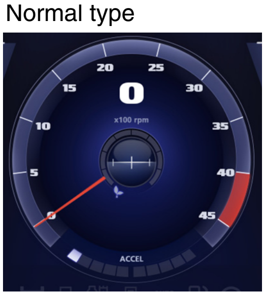
220S3CD151A

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

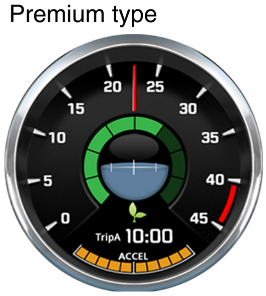
※ Operation screen type can be set by the screen type menu of the display (premium type).
Refer to page 5-88 for details.

(2) RPM / Speed gauge

Normal type



Premium type



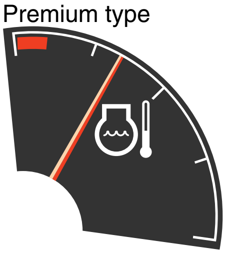
220S3CD549

① This display the engine speed.

(3) Engine coolant temperature gauge

Normal type

Premium type



220S3CD553

① This gauge indicates the temperature of coolant.

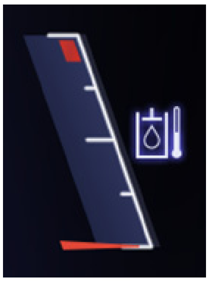
- White range : 40-100˚C (104-212˚F)
- Red range : Above 100˚C (212˚F)

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

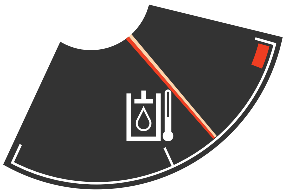
※ If the gauge indicates the red range or lamp blinks in red even though the machine is on the normal condition, check the electric device as that can be caused by the poor connection of electricity or sensor.

(4) Hydraulic oil temperature gauge

Normal type



Premium type



220S3CD554

① This gauge indicates the temperature of hydraulic oil.

- White range : 40-100˚C (104-212˚F)
- Red range : Above 100˚C (212˚F)

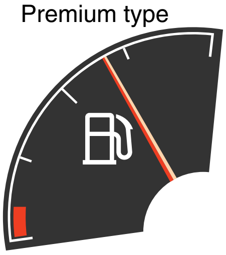
② If the indicator is in the red range or lamp pops up and the buzzer sounds reduce the load on the system. If the gauge stays in the red range, stop the machine and check the cause of the problem.

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

(5) Fuel level gauge

Normal type

Premium type



220S3CD555

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

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

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

(6) Tripmeter display

290F3CD56

① This displays the engine the tripmeter.

※ Refer to page 3-89 for details.

(7) Eco gauge

290F3CD58

① This gauge indicates the fuel consumption rate and machine load status. So that operators can be careful with fuel economy.

② The fuel consumption rate or machine load is higher, the number of segment is increased.

③ The color of Eco gauge indicates operation status.

- White : Idle operation
- Green : Economy operation
- Yellow : Non-economy operation at a medium level.
- Red : Non-economy operation at a high level.

(8) Accel dial gauge

290F3CD59

① This gauge indicates the level of accel dial.

3) WARNING LAMPS

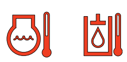
Normal type

220S3CD503A

Premium type

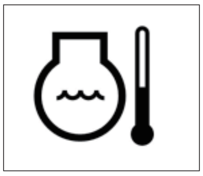
220S3CD03B

※ Warning lamps and buzzer

Warnings	When error happened	Lamps and buzzer
All warning lamps except below	Warning lamp pops up on the center of the LCD and the buzzer sounds	· The pop-up warning lamp moves to the original position and blinks, and the buzzer stops when ; - the buzzer stop switch  is pushed - the lamp of the LCD is touched
	Warning lamp pops up on the center of the LCD and the buzzer sounds	· Cluster displays this pop-up when it has communication error with MCU. · If communication with MCU become normal state, it will disappear automatically.
	Warning lamp pops up on the center of the LCD and the buzzer sounds	※ **Refer to page 5-64 for details.**

※ Refer to page 5-71 for the buzzer stop switch  .

(1) Engine coolant temperature warning lamp



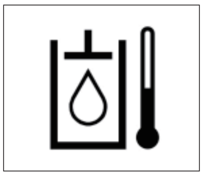
290F3CD61

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



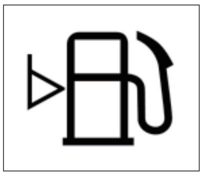
290F3CD62

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 43 ℓ (11.4 U.S. gal).

② Fill the fuel immediately when the lamp blinks.

(4) Emergency warning lamp

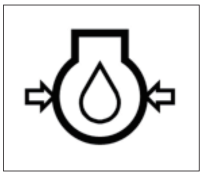
290F3CD64

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.

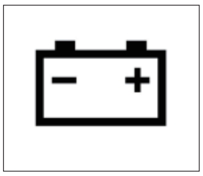
(5) Engine oil pressure warning lamp



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.

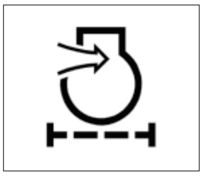
(6) Battery charging warning lamp



290F3CD67

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

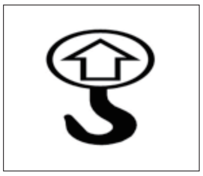
(7) Air cleaner warning lamp



290F3CD68

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

(8) Overload warning lamp (opt)



290F3CD69

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

4) PILOT LAMPS

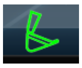
Normal type

220S3CD574A

Premium type

220S3CD74B

(1) Mode pilot lamps

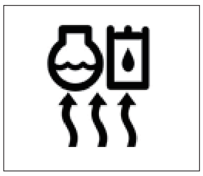
No	Mode	Pilot lamp	Selected mode
1	Power mode	P	Heavy duty power work mode
		S	Standard power mode
		E	Economy power mode
2	User mode	U	User preferable power mode
3	Work mode		General operation - IPC speed mode
			General operation - IPC balance mode
			General operation - IPC efficiency mode
			Breaker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

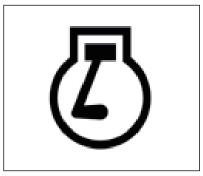
(3) Warming up pilot lamp



290F3CD80

① This lamp is turned ON when the coolant temperature is below 30˚C (86˚F).
② The automatic warming up is cancelled when the engine coolant temperature is above 30˚C, or when 10 minutes have passed since starting the engine.

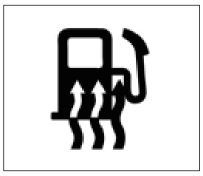
(4) Decel pilot lamp



290F3CD81

① Operating one touch decel switch on the RCV lever makes the lamp ON.
② Also, the lamp will be ON and engine speed will be lowered automatically to save fuel consumption when all levers and pedals are at neutral position, and the auto idle function is selected.
※ One touch decel is not available when the auto idle pilot lamp is turned ON.
※ Refer to the operator's manual page 3-36.

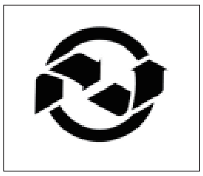
(5) Fuel warmer pilot lamp



290F3CD82

① This lamp is turned ON when the coolant temperature is below 10˚C (50˚F) or the hydraulic oil temperature 20˚C (68˚F).
② The automatic fuel warming is cancelled when the engine coolant temperature is above 60˚C, and the hydraulic oil temperature is above 45˚C since the start switch was ON position.

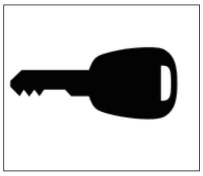
(6) Maintenance pilot lamp



290F3CD83

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

(7) Smart key pilot lamp (premium type, opt)



290F3CD214

① This lamp is ON when the engine is started by the start button.
② This lamp is red when the a authentication fails, green when succeeds.
※ Refer to the page 5-83.

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

220A3CD202A

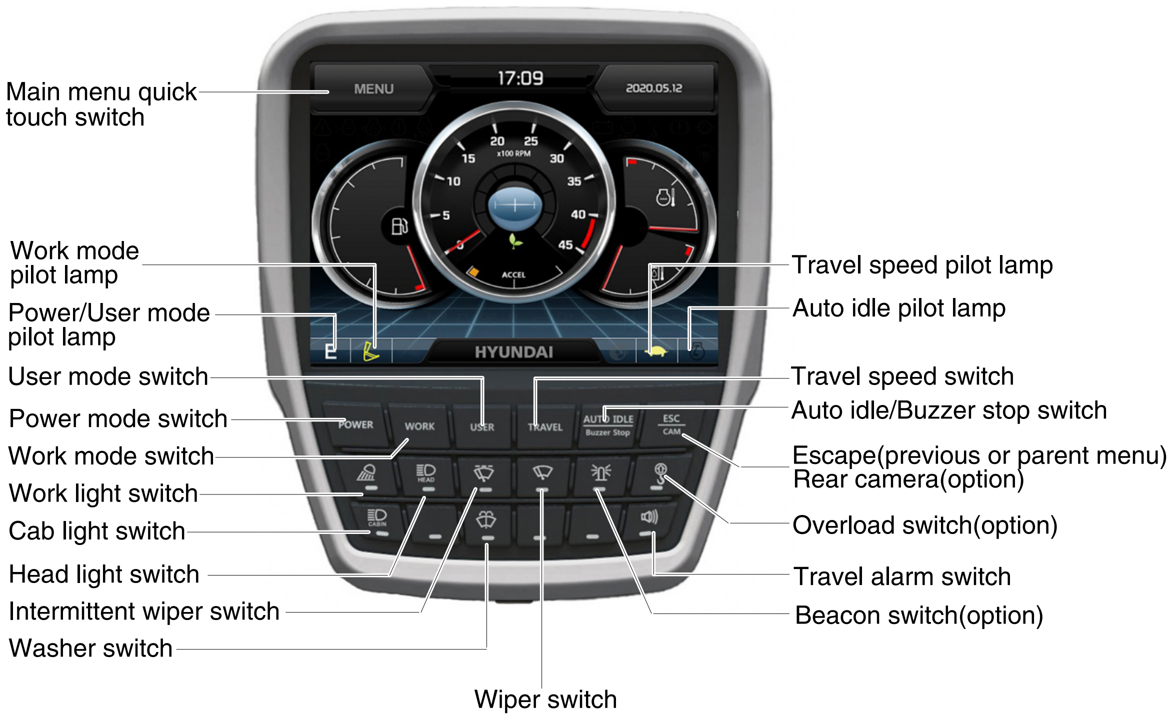
① This lamp is turned ON when the auto engine shutdown is activated
※ Refer to the page 5-79.

5) SWITCHES

Normal type

220S3CD586A

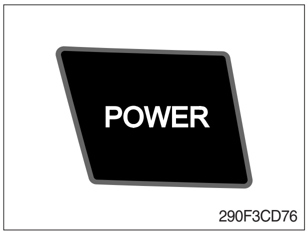
Premium type



220S3CD86B

※ When some of the switches are selected, the pilot lamps are displayed on the LCD. Refer to the page 5-67 for details.

(1) Power mode switch



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.

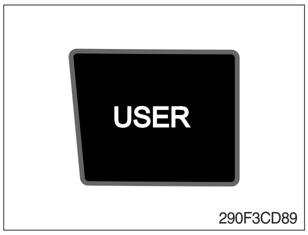
② The pilot lamp changes E → S → P → E in order.

(2) Work mode switch

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 2-7 for details.**

(3) User mode switch



① This switch is used to memorize the current machine operating status in the MCU and activate the memorized user mode.
- · Memory : Push more than 2 seconds.
- · Action : Push within 2 seconds.
- · Cancel : Push this switch once more within 2 seconds.

② Refer to the page 5-77 for another set of user mode.

(4) Travel speed switch

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

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

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

(5) Auto idle/ buzzer stop switch

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

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

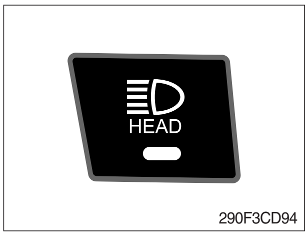
(6) Escape/Camera switch

① This switch is used to return to the previous menu or parent menu.
② In the operation screen, pushing this switch will display the view of the camera on the machine (if equipped).
Please refer to page 5-89 for the camera.
③ If the camera is not installed, this switch is used only ESC function.

(7) Work light switch

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

(8) Head light switch



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

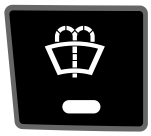
(9) Intermittent wiper switch

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

(10) Wiper switch

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

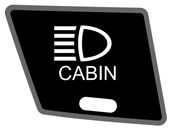
(11) Washer switch



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.

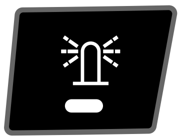
(12) Cab light switch



290F3CD99

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

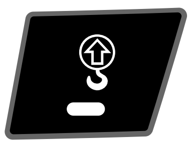
(13) Beacon switch (opt)



290F3CD97

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

(14) Overload switch (opt)



290F3CD98

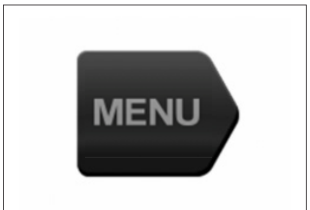
① When this switch turned ON, buzzer makes sound and overload warning lamp comes ON in case that the machine is overload.
② When it turned OFF, buzzer stops and warning lamp goes out.
⚠ **Overloading the machine could impact the machines stability which could result in tipover hazard. A tipover hazard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

(15) Travel alarm switch

290F3CD101

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

(16) Main menu quick touch switch



220S3CD217

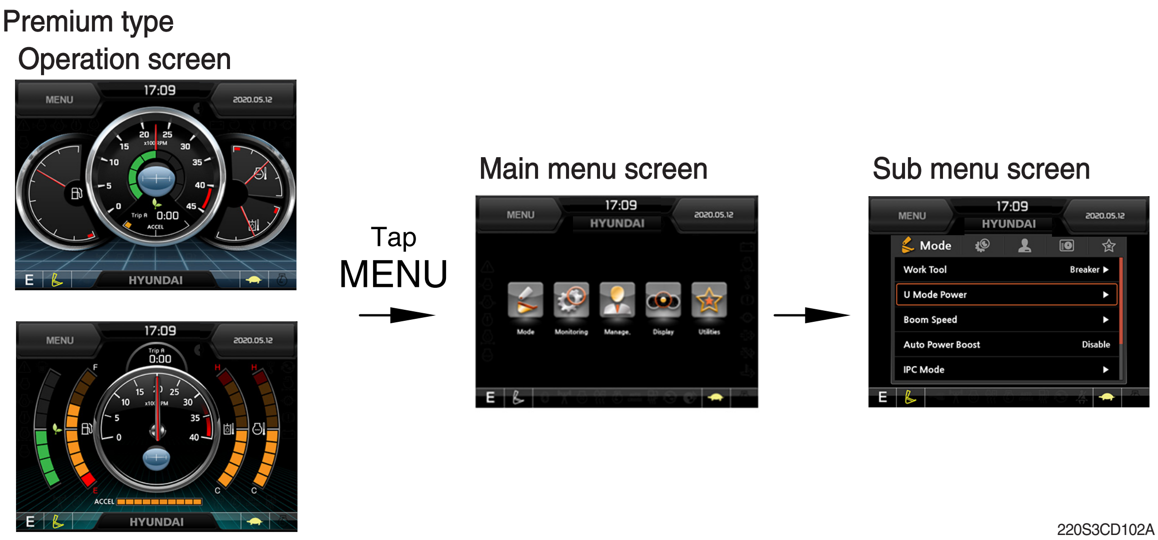
① This switch is to activate the main menu in the cluster.

※ Refer to the page 5-76.

6) MAIN MENU

※ On the operation screen, tap MENU to access the main menu screen.
On the sub menu screen, you can tap the menu bar to access functions or applications.

220S3CD502A



220S3CD102A

(1) Structure

No	Main menu	Sub menu	Description
1	 Mode 220S3CD103	Work mode U mode power Boom/Arm speed Auto power boost IPC mode Auto engine shutdown (opt) Initial mode Emergency mode	Breaker, Crusher, Not installed User mode only Boom speed Enable, Disable Speed mode, Balance mode, Efficiency mode One time, Always, Disable Key on initial mode / initial work mode Switch function
2	 Monitoring 220S3CD104	Active fault Logged fault Delete logged fault Monitoring	MCU, AAVM (opt) MCU, AAVM (opt) All logged fault delete, Initialization canceled Machine information, Switch status, Output status,
3	 Management 220S3CD105	Fuel rate information Maintenance information Machine security Machine information Contact Service menu Clinometer Update	General record, Hourly, Daily, Mode record Replacement, Change interval oils and filters ESL mode setting, Password change Model, MCU, Monitor RMCU, Relay drive unit, AAVM (opt) A/S phone number, A/S phone number change Power shift, Operating hour, Breaker mode pump acting, EPPR current level, Overload pressure Clinometer setting Cluster, ETC device
4	 Display 220S3CD106	Display item Clock Brightness Unit setup Language selection Screen type★	Engine speed, Tripmeter A, Tripmeter B, Tripmeter C Clock Manual, Auto Temperature, Pressure, Flow, Distance, Date format Korean, English, Chinese, ETC A type, B type
5	 Utilities 220S3CD107	Tripmeter Camera setting AUX Manual	3 kinds (A, B, C) Number of active, Display order, AAVM (opt)★

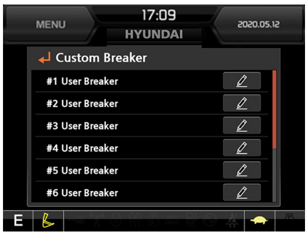
★ : premium type

(2) Mode setup

※ Illustrations are based on the premium type cluster.

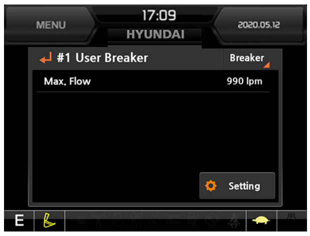
① Work mode

220S3CD108A



220S3CD253A

A



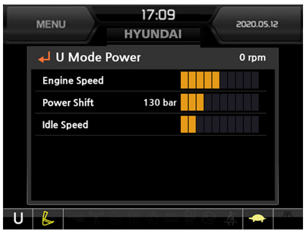
220S3CD254A

B

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

② U mode power

220S3CD111A



220S3CD112A

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

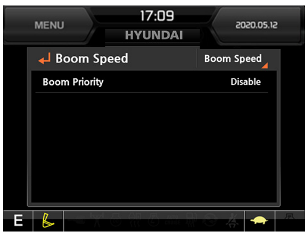
· U-mode can be activated by user mode switch.

Step (▮)	Engine speed (rpm)	Idle speed (rpm)	Power shift (bar)
1	1550	1000	0
2	1600	1050	3
3	1650	1100	6
4	1700	1150 (auto decel)	9
5	1750	1200	12
6	1800	1250	16
7	1850	1300	20
8	1900	1350	26
9	1950	1400	32
10	2000	1450	38

※ One touch decel & low idle : 1000 rpm

③ Boom speed

220S3CD113A



220S3CD115A

· Boom speed
  - Boom priority function can be activated or cancelled
    Enable - Boom up speed is automatically adjusted as working conditions by the MCU.
    Disable - Normal operation

④ Auto power boost

220S3CD118A

220S3CD117A

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

⑤ IPC mode

220S3CD310A

220S3CD311A

220S3CD304A

220S3CD312A

220S3CD305A

220S3CD313A

220S3CD306A

· The IPC mode can be selected by this menu.
- Speed mode
- Balance mode (default)
- Efficiency mode
· This mode is applied only general operation mode of the work mode.

⑥ Automatic engine shutdown (option)

220S3CD91A

220S3CD92A

220S3CD93A

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

⑦ Initial mode

220S3CD122A

220S3CD119A

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

  Key on initial work mode
  - Not installed
  - Last setting
  - Work mode

⑧ Emergency mode

220S3CD248A

220S3CD249A

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

(3) Monitoring

① Active fault

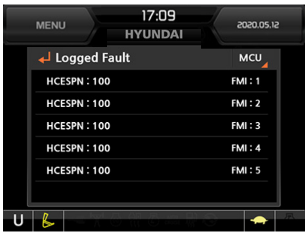
220S3CD120A

220S3CD125A

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

② Logged fault

220S3CD128A

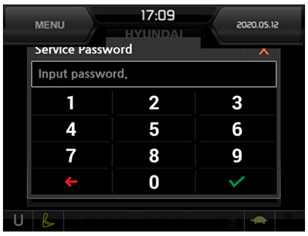


220S3CD124A

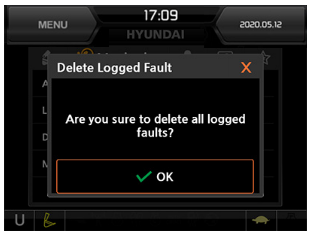
· The logged faults of the MCU can be checked by this menu.

③ Delete logged fault

220S3CD134A



220S3CD126A

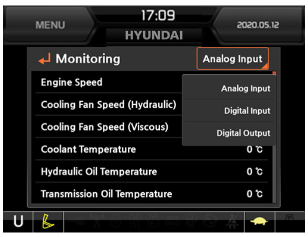


220S3CD127A

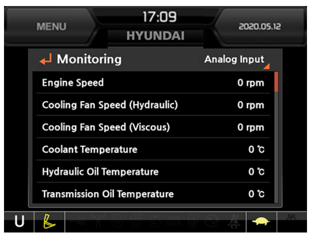
· The logged faults of the MCU can be deleted by this menu.

④ Monitoring

220S3CD172A



220S3CD188A



220S3CD189A

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

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

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

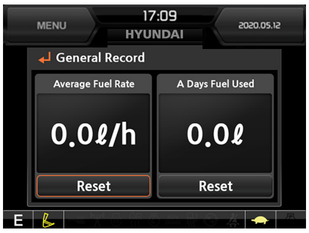
(4) Management

① Fuel rate information

220S3CD14A

220S3CD15A

A



220S3CD16A

· 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

220S3CD17A

· 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

220S3CD18A

· 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

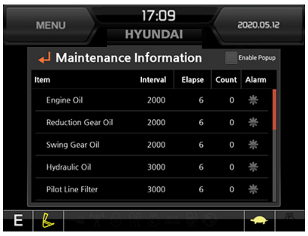
220S3CD19A

· 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

220S3CD131A

→



220S3CD132A

→

220S3CD133A

· Alarm lamp (●) is ON when oil or filter needs to be changed or replaced.
· Replacement : The elapsed time will be reset to zero (0).
· Change interval : The change or replace interval can be changed in the unit of 30 hours.

※ Refer to the maintenance chart for further information of maintenance interval.

③ Machine security

220S3CD190A

220S3CD135A

220S3CD136A

220S3CD137A

220S3CD138A

· ESL mode setting

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

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

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

  ※Default password : 00000＋✓

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

· Password change

- The password is 5~10 digits.

220S3CD190A

220S3CD140A

220S3CD135A

Enter the current password

220S3CD143A

Enter the new password again

220S3CD142A

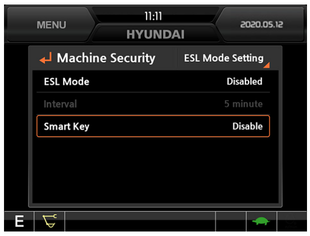
Enter the new password

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

- Smart key

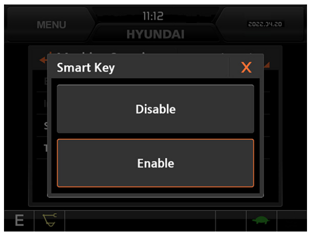
220S3CD190A

220S3CD135A



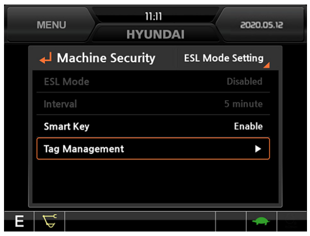
235F3CD001

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

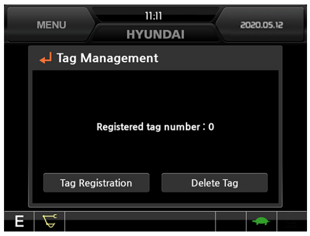


235F3CD002

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

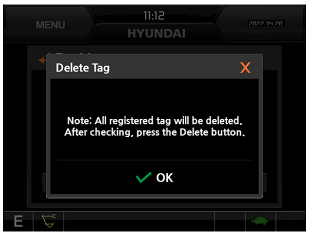


235F3CD003



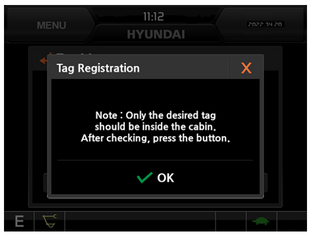
235F3CD004

Deleting



235F3CD006

Registering



235F3CD005

※ Engine Starting Condition

Case	ESL Mode	Smart Key	Condition
1	Disable	Disable	- With registered tag : Engine can be started without password input. - Without registered tag : Engine can be started without password input.
2	Disable	Enable	If Smart Key is enabled, ESL Mode is automatically enabled. This Case 2 work the same as the Case 4.
3	Enable	Disable	- With registered tag : Engine can be started with password input. - Without registered tag : Engine can be started with password input.
4	Enable	Enable	- With registered tag : Engine can be started without password input. - Without registered tag : Engine can be started with password input.

④Machine Information

220S3CD144A

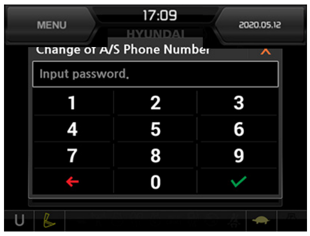
220S3CD145A

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

⑤ Contact (A/S phone number)

220S3CD146A

220S3CD147A



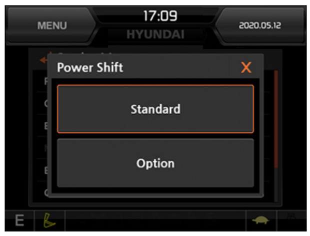
220S3CD148A

Enter the new A/S phone number

⑥ Service menu

220S3CD149A

220S3CD150B



220S3CD251A

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

⑦ Clinometer

220S3CD152A

220S3CD153A

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

⑧ Update (cluster & ETC devices)

220S3CD67A

220S3CD135A

220S3CD280A

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

220S3CD290A

220S3CD281A

220S3CD291A

220S3CD282A

220S3CD299A

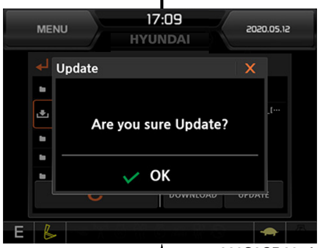
220S3CD292A

220S3CD283A

220S3CD298A

220S3CD293A

220S3CD284A

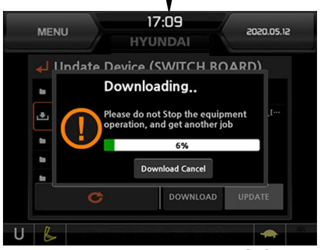


220S3CD297A

220S3CD294A

220S3CD285A

220S3CD296A



220S3CD295A

(5) Display

① Display item

220S3CD154A

220S3CD155A

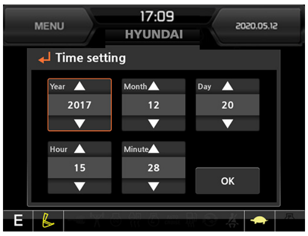
220S3CD156A

· The center display type of the LCD can be selected by this menu.

· The engine speed or each of the tripmeter (A,B,C) is displayed on the center display.

② Clock

220S3CD157A



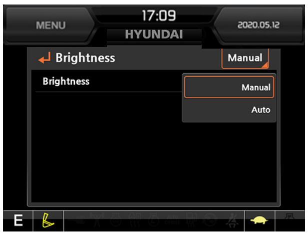
220S3CD158A

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

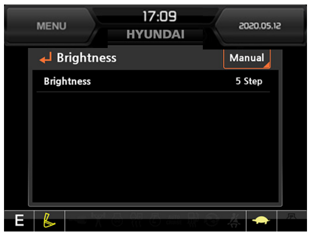
· The second line shows the current time. (0:00~23:59)

③ Brightness

220S3CD159A

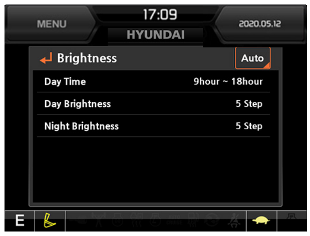


220S3CD160A



220S3CD139A

220S3CD141A



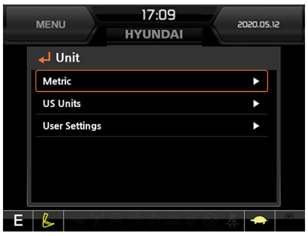
220S3CD191A

220S3CD192A

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

④ Unit

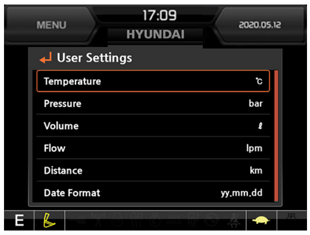
220S3CD161A



220S3CD182A

220S3CD183A

220S3CD186A



220S3CD162A

220F3CD193A

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

⑤ Language

220S3CD163A

220S3CD164A

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

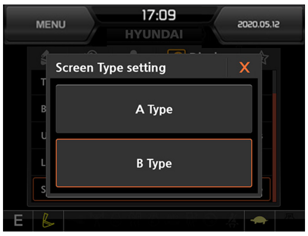
⑥ Screen type (premium type)

220S3CD165A

A Type (Default)

220S3CD166A

220S3CD156A



B Type (Option)

220S3CD174A

220S3CD167A

(6) Utilites

① Tripmeter

220S3CD168A

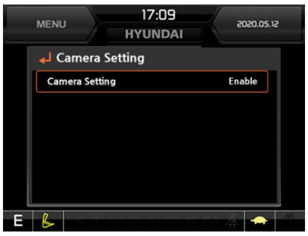
220S3CD169A

- Maximum 3 kinds of tripmeters can be used at the same time.
- Each tripmeter can be turned on by choosing "Start" while it also can be turned off by choosing "Stop".
- If the tripmeter icon is activated in the operation screen, it can be controlled directly there.

② Camera setting

- If the rear camera is not installed on the machine, set disable.
- If the rear camera installed on the machine, set enable.

220S3CD225A



220S3CD255A

220S3CD256A

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

220S3CD222A

290F3CD221

③ AAVM (All Around View Monitoring, premium type, opt)

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

220S3CD244A

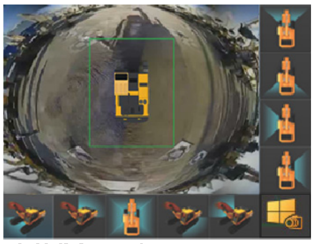
- Escape button

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

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

220S3CD156A

The beginning screen



AAVM mode 235SA3CD222A

- Buzzer stop button

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

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

290F3CD246A

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

290F3CD247A

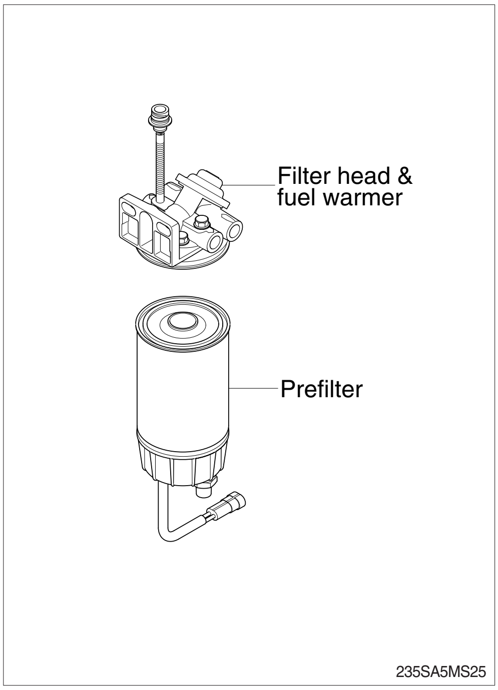
· When the worker or pedestrian go inside of red line (radius 3 m), an internal danger area of equipping on the cluster screen, the warning buzzer sounds and it displays the red rectangular box for the recognition of the worker and pedestrian.
At this time, the operator should stop work immediately,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

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

GROUP 16 FUEL WARMER SYSTEM

1. SPECIFICATION

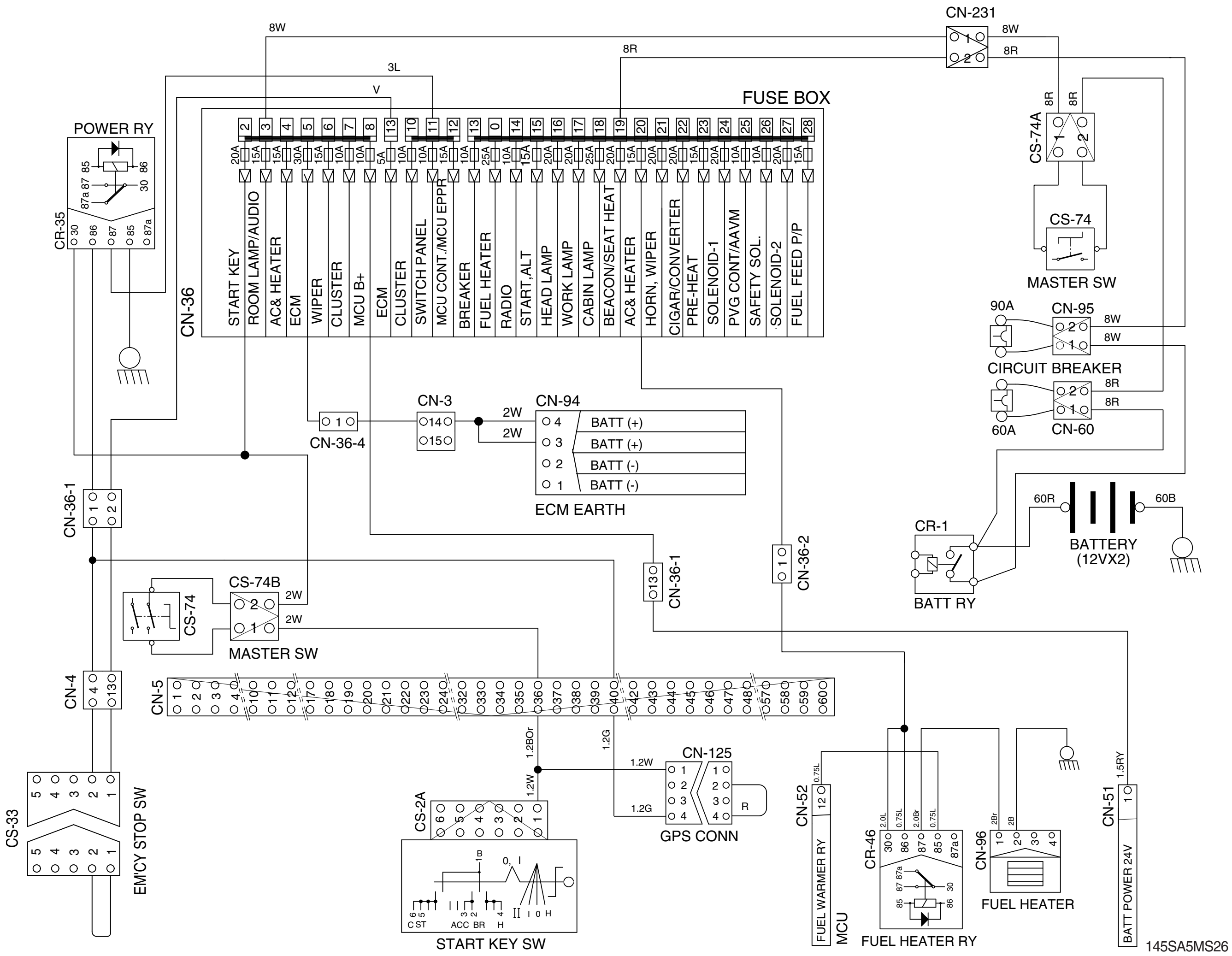
1) Operating voltage : 24±4 V
2) Power : 350±50 W
3) Current : 15 A



2. OPERATION

1) The current of fuel warmer system is automatically controlled without thermostat according to fuel temperature.
2) At the first state, the 15 A current flows to the fuel warmer and engine may be started in 1~2 minutes.
3) If the fuel starts to flow, ceramic-disk in the fuel warmer heater senses the fuel temperature to reduce the current as low as 1.5 A.
   So, fuel is protected from overheating by this mechanism.

3. ELECTRIC CIRCUIT



SECTION 6 TROUBLESHOOTING

SECTION 6 TROUBLESHOOTING

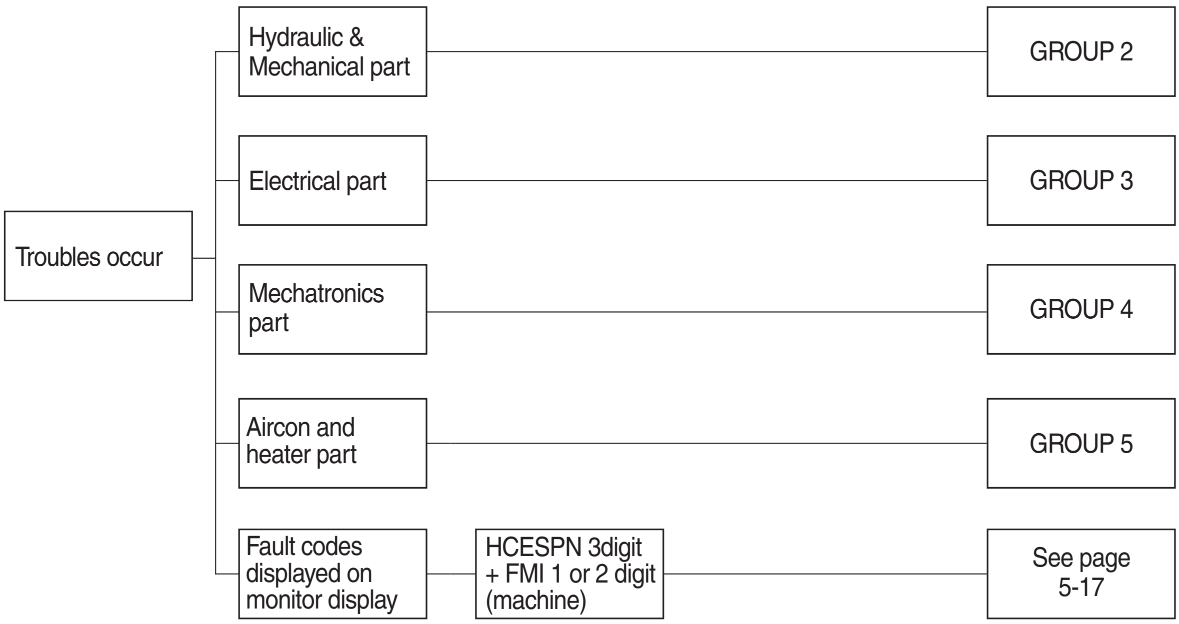
GROUP 1 BEFORE TROUBLESHOOTING

1. INTRODUCTION

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

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

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

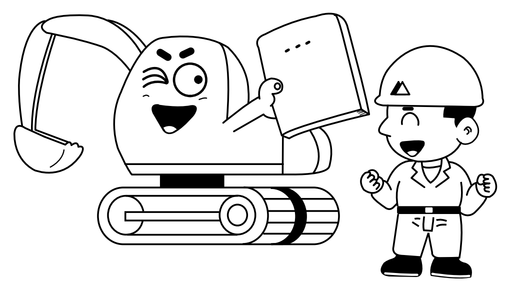


2. DIAGNOSING PROCEDURE

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

STEP 1. Study the machine system

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

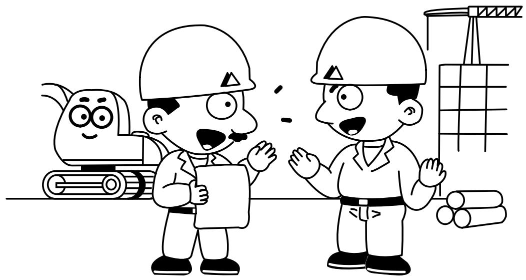


13031SH02

STEP 2. Ask the operator

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

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

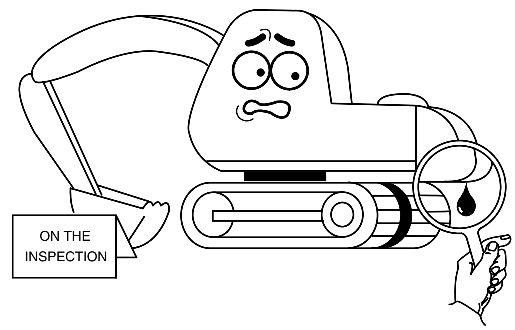


13031SH03

STEP 3. Inspect the machine

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

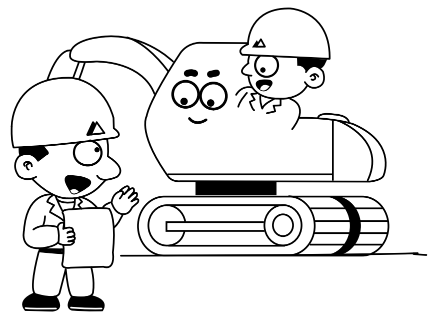
And also check the electrical system including batteries, as the troubles in the electrical system such as low battery voltage, loose connections and blown out fuses will result in malfunction of the controllers causing total operational failures of the machine.



(210-7) 6-2(3)

STEP 4. Inspect the trouble actually on the machine

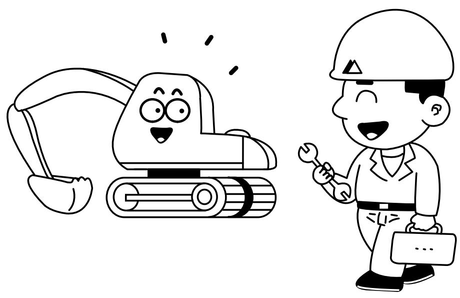
In case that some trouble cannot be confirmed, obtain the details of the malfunction from the operator.
Also, check if there are any in complete connections of the wire harnesses are or not.



(210-7) 6-3(1)

STEP 5. Perform troubleshooting

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

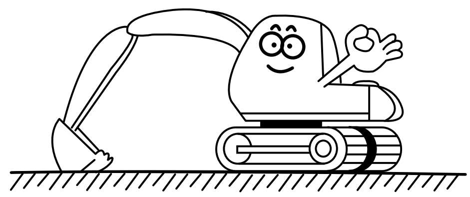


13031SH05

STEP 6. Trace a cause

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

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



(210-7) 6-3(3)

GROUP 2 HYDRAULIC AND MECHANICAL SYSTEM

1. INTRODUCTION

1) MACHINE IN GENERAL

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

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

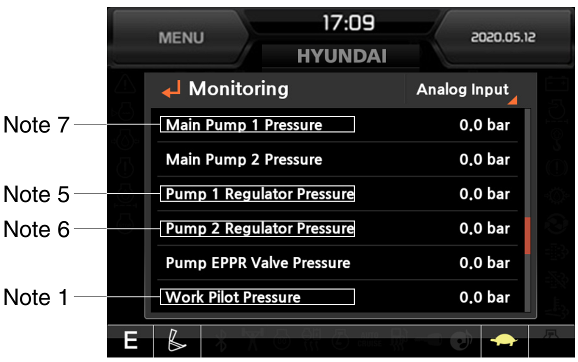
(3) When carrying out troubleshooting, do not hurry to disassemble the components.
It will become impossible to find the cause of the problem.

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

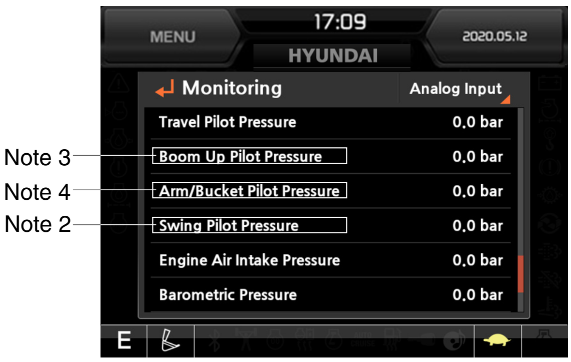
(5) Check before troubleshooting.
① Check oil and fuel level.
② Check for any external leakage of oil from components.
③ Check for loose or damage of wiring and connections.

2) MACHINE STATUS MONITORING ON THE CLUSTER

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



Analog 1



Analog 2

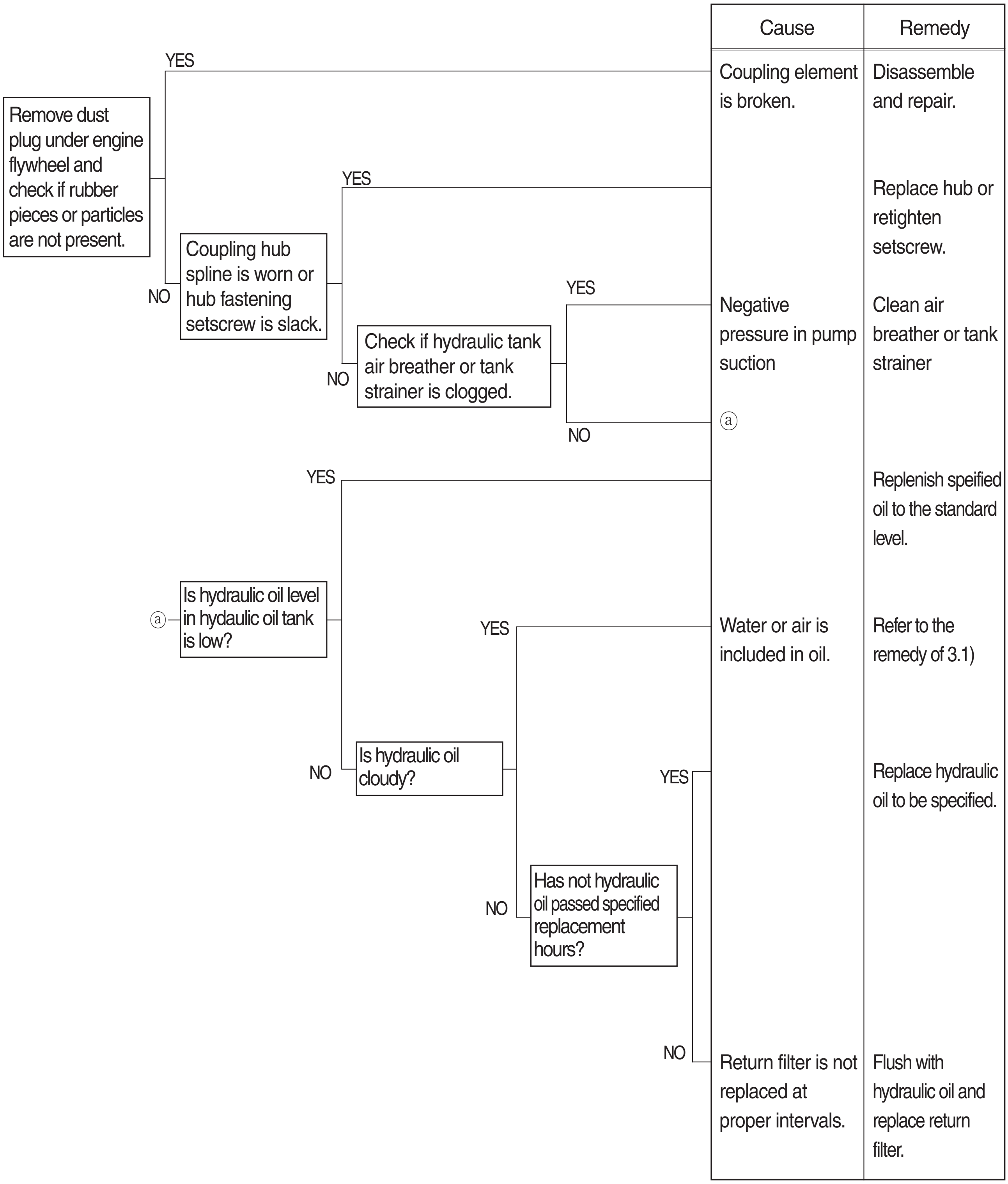
145SA6HS01

(2) Specification

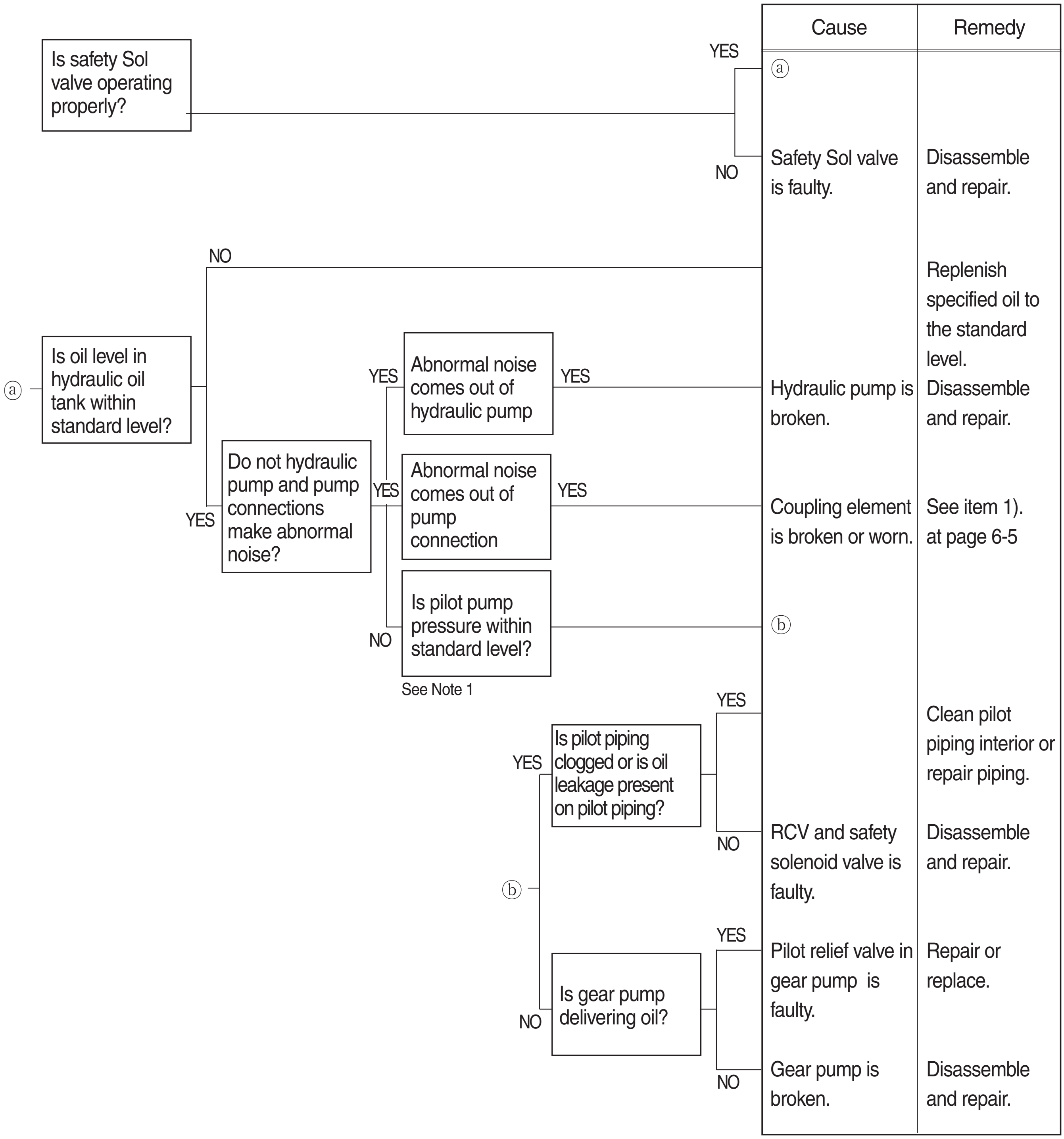
No.	Description	Specification
Note 1	Work pilot pressure	40^{+2}_{0} bar
Note 2	Swing pilot pressure	0~40 bar
Note 3	Boom up pilot pressure	0~40 bar
Note 4	Arm/bucket pilot pressure	0~40 bar
Note 5	Pump 1 regulator pressure	0~50 bar
Note 6	Pump 2 regulator pressure	0~50 bar
Note 7	Pump 1 pressure	350 bar

2. DRIVE SYSTEM

1) UNUSUAL NOISE COMES OUT OF PUMP CONNECTION

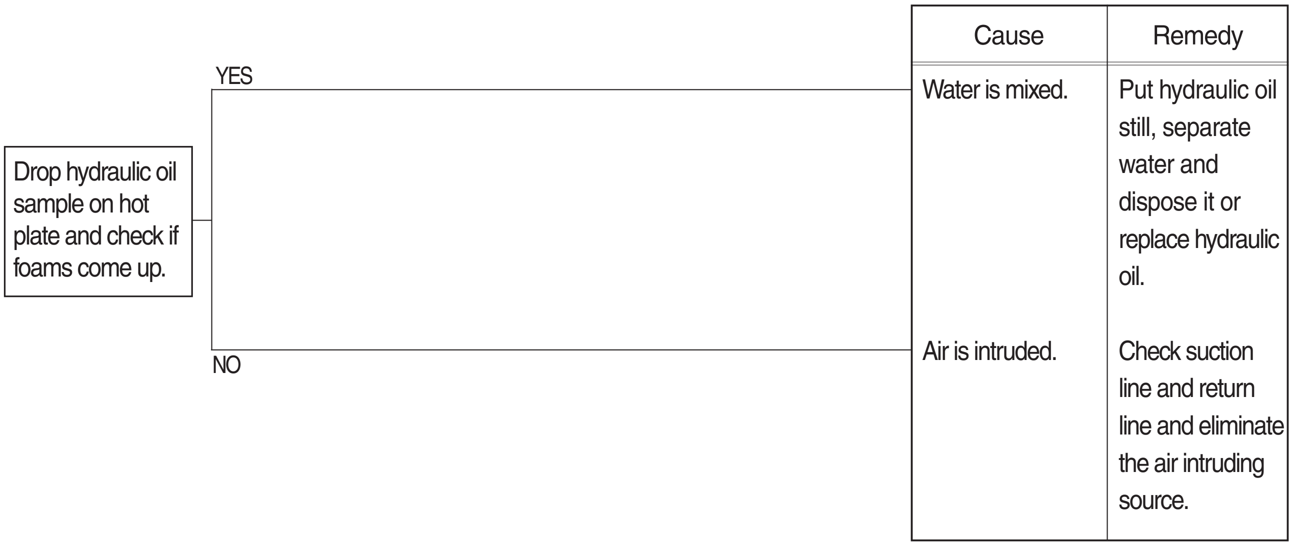


2) ENGINE STARTS BUT MACHINE DOES NOT OPERATE AT ALL

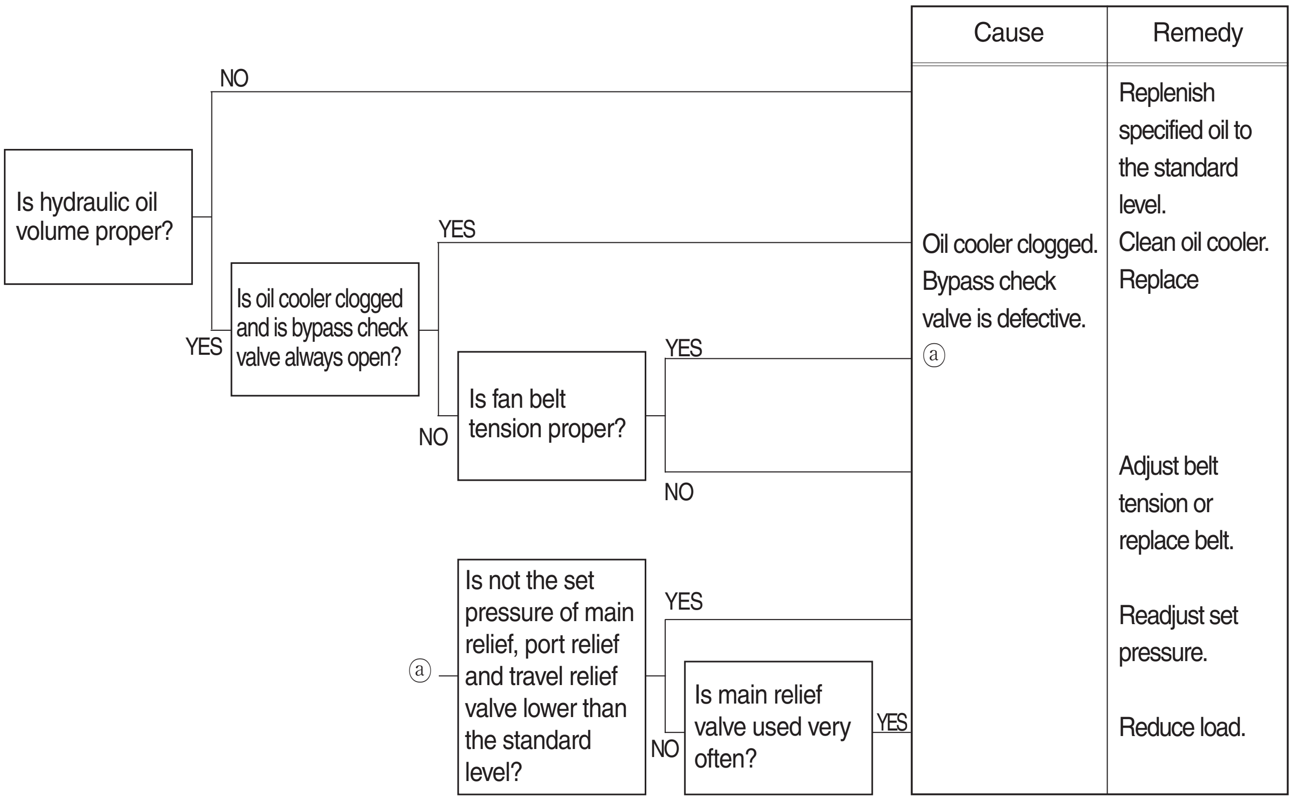


3. HYDRAULIC SYSTEM

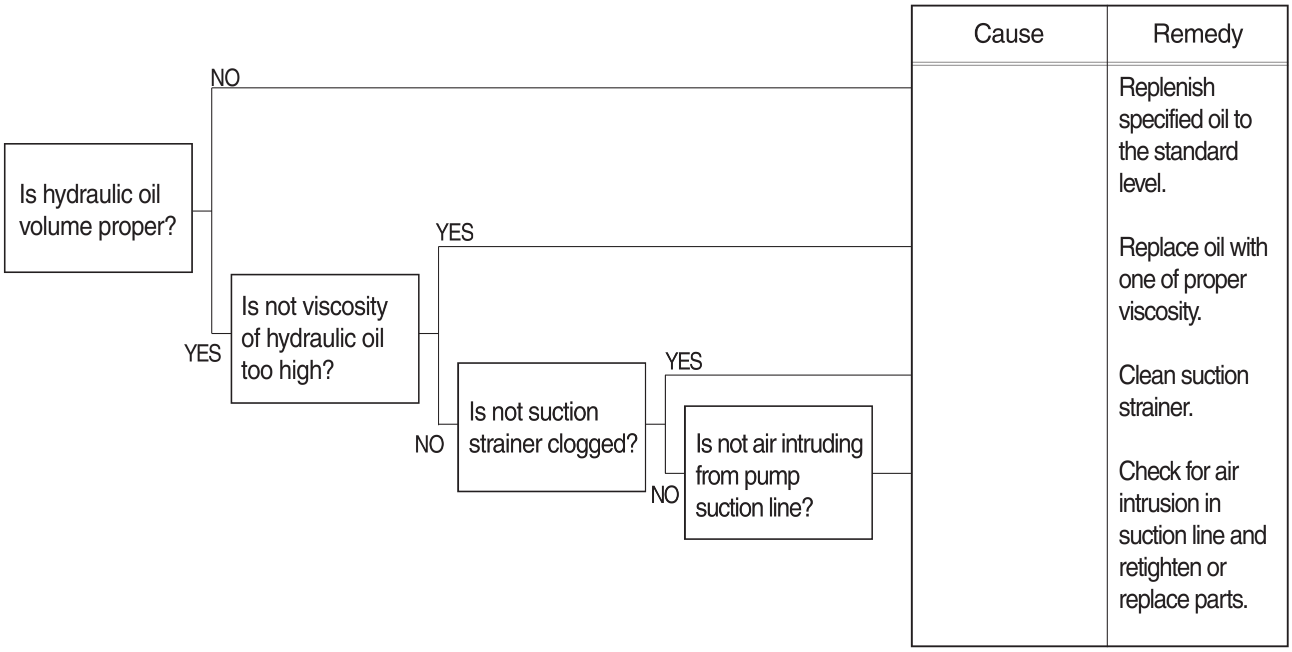
1) HYDRAULIC OIL IS CLOUDY



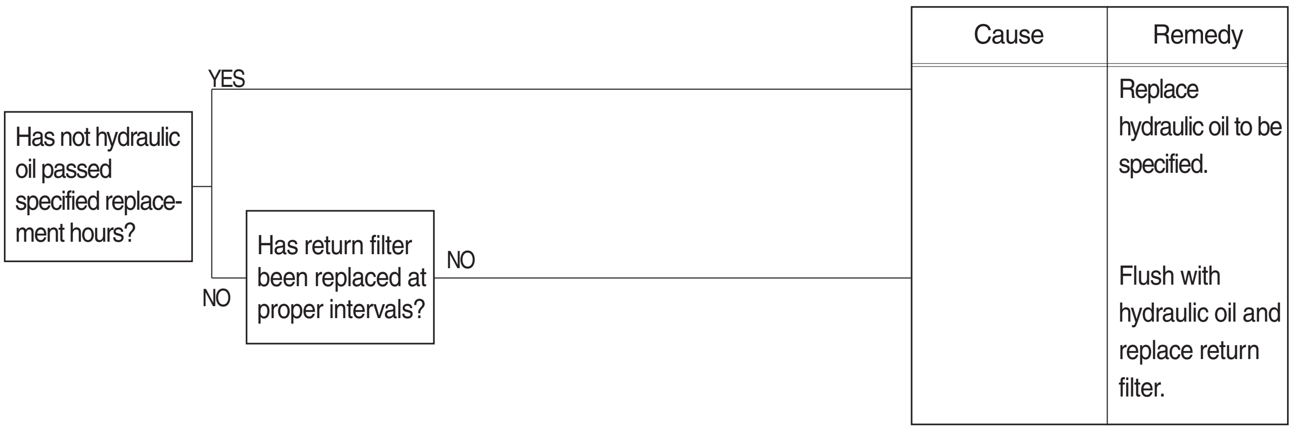
2) HYDRAULIC OIL TEMPERATURE HAS RISEN ABNORMALLY



3) CAVITATION OCCURS WITH PUMP

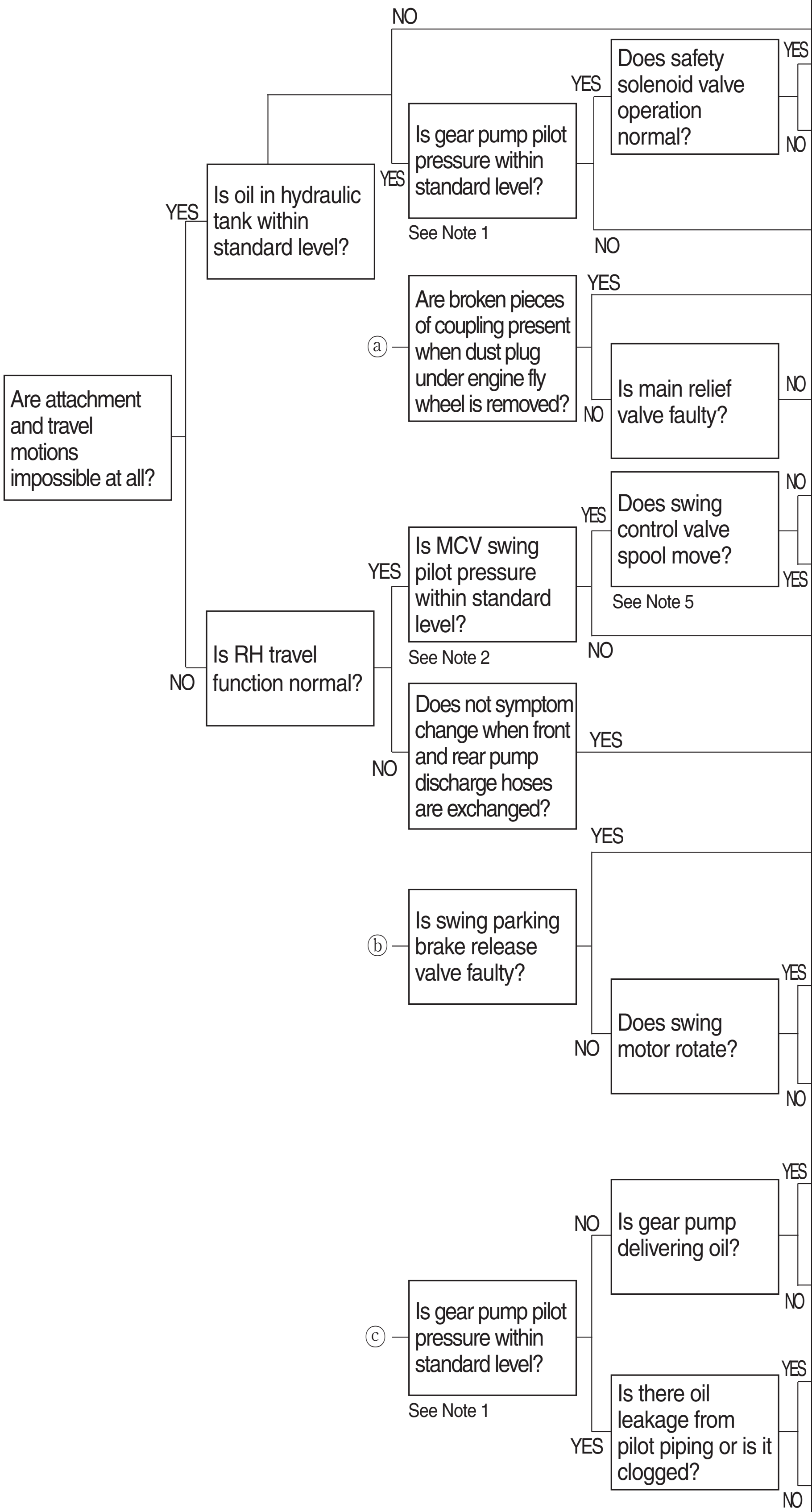


4) HYDRAULIC OIL IS CONTAMINATED



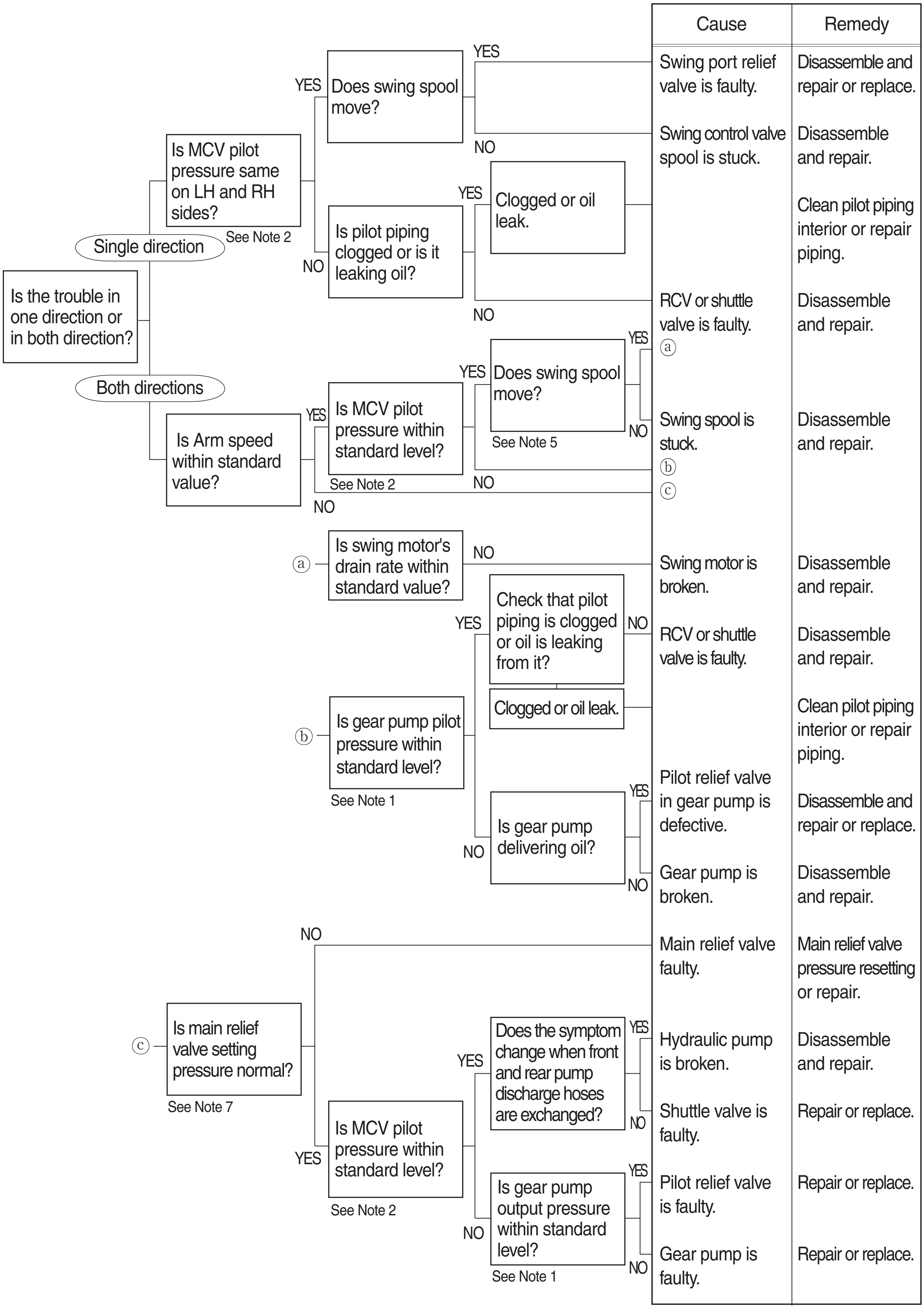
4. SWING SYSTEM

1) BOTH LH AND RH SWING ACTIONS ARE IMPOSSIBLE

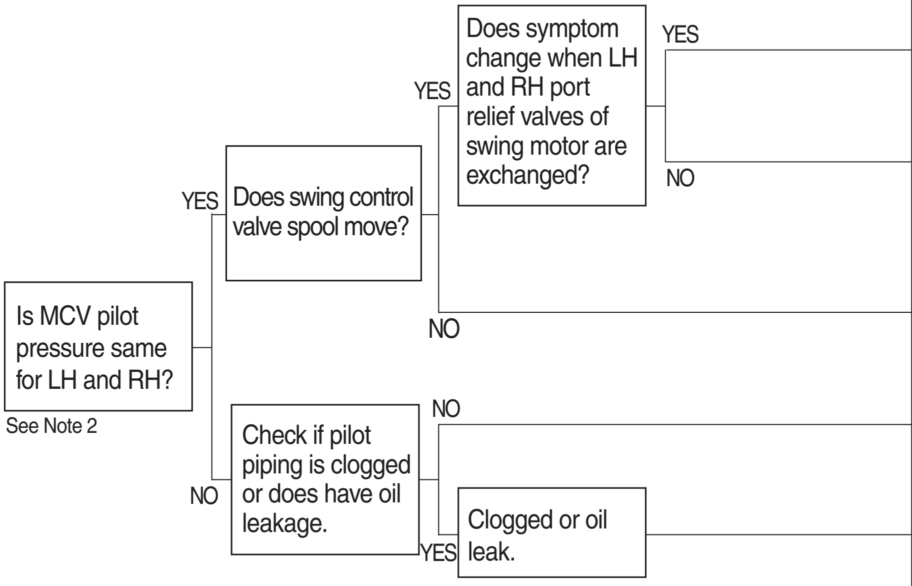


Cause	Remedy
ⓐ	Replenish specified oil to the standard level.
Safety solenoid valve faulty or not operated.	Repair or replace.
Gear pump faulty.	Repair or replace.
Pump connection coupling is broken.	Disassemble and repair.
Hydraulic pump is out of order.	Disassemble and repair.
Swing control valve spool is stuck.	Disassemble and repair.
ⓑ	
ⓒ	
Hydraulic pump is broken.	Disassemble and repair.
Swing parking brake release valve is broken.	Disassemble and repair.
Swing reduction unit is broken.	Disassemble and repair.
Swing motor is broken.	Disassemble and repair.
Pilot relief valve in gear pump is faulty.	Disassemble and repair or replace.
Gear pump is out of order.	Disassemble and repair.
	Clean pilot piping interior or repair piping.
RCV is broken.	Disassemble and repair.

2) SWING SPEED IS LOW

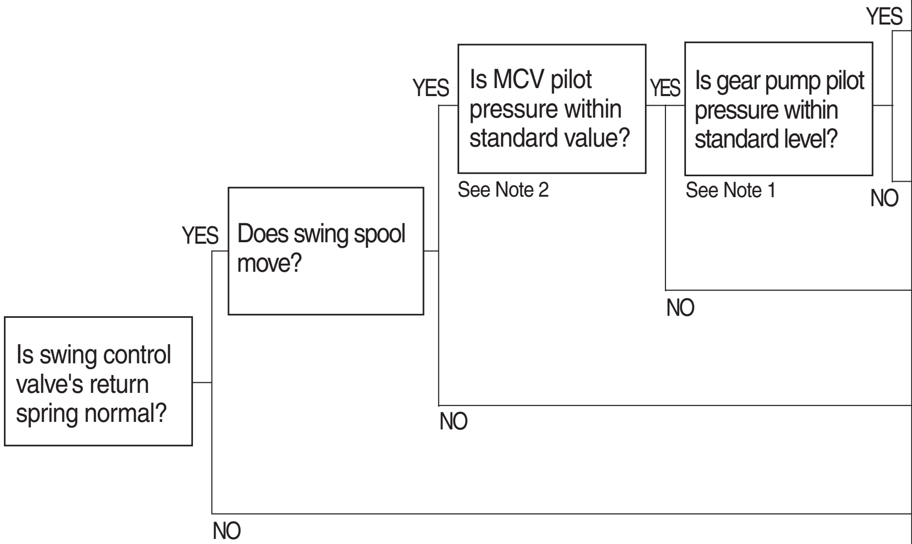


3) SWING MOTION IS IMPOSSIBLE IN ONE DIRECTION



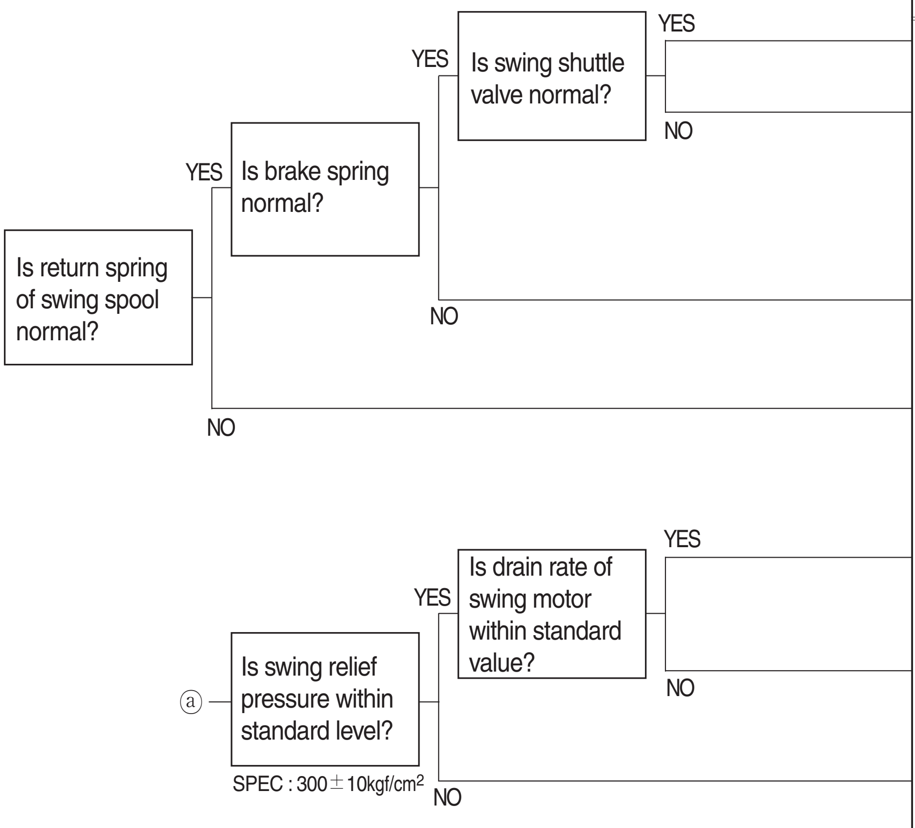
Cause	Remedy
Swing port relief valve is faulty.	Disassemble and repair.
Shuttle valve is faulty.	Disassemble and repair.
Swing control valve spool is stuck.	Disassemble and repair.
RCV is faulty.	Disassemble and repair.
	Clean pilot piping interior or repair piping.

4) MACHINE SWINGS BUT DOES NOT STOP



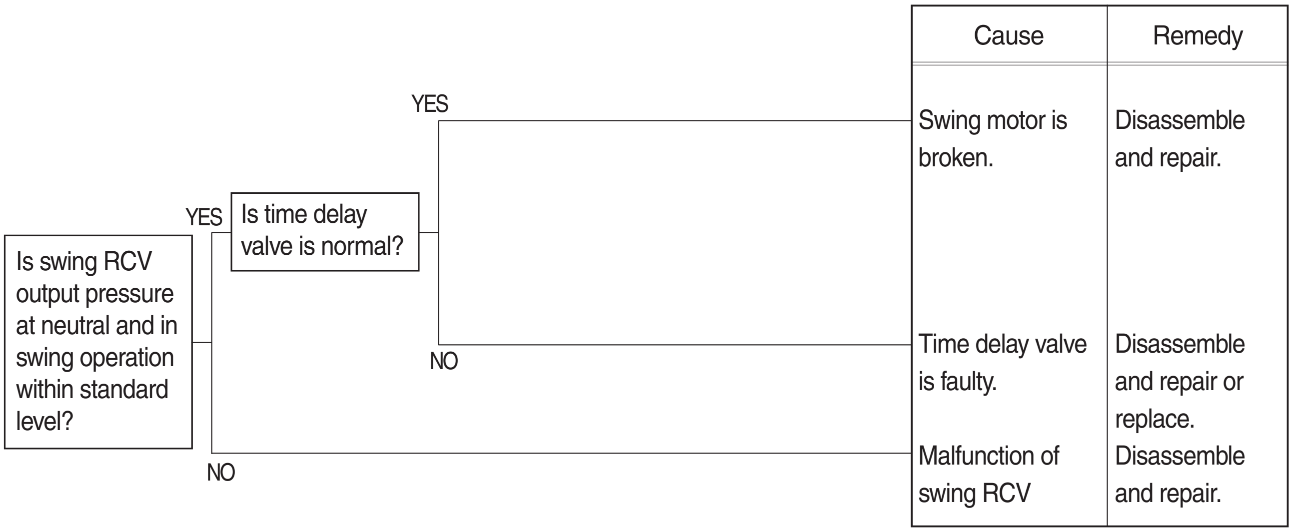
Cause	Remedy
Pilot relief valve is faulty.	Disassemble and repair or replace.
Gear pump is broken.	Disassemble and repair.
RCV is faulty.	Disassemble and repair.
Swing spool is stuck.	Disassemble and repair.
Return spring is faulty.	Disassemble and replace.

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

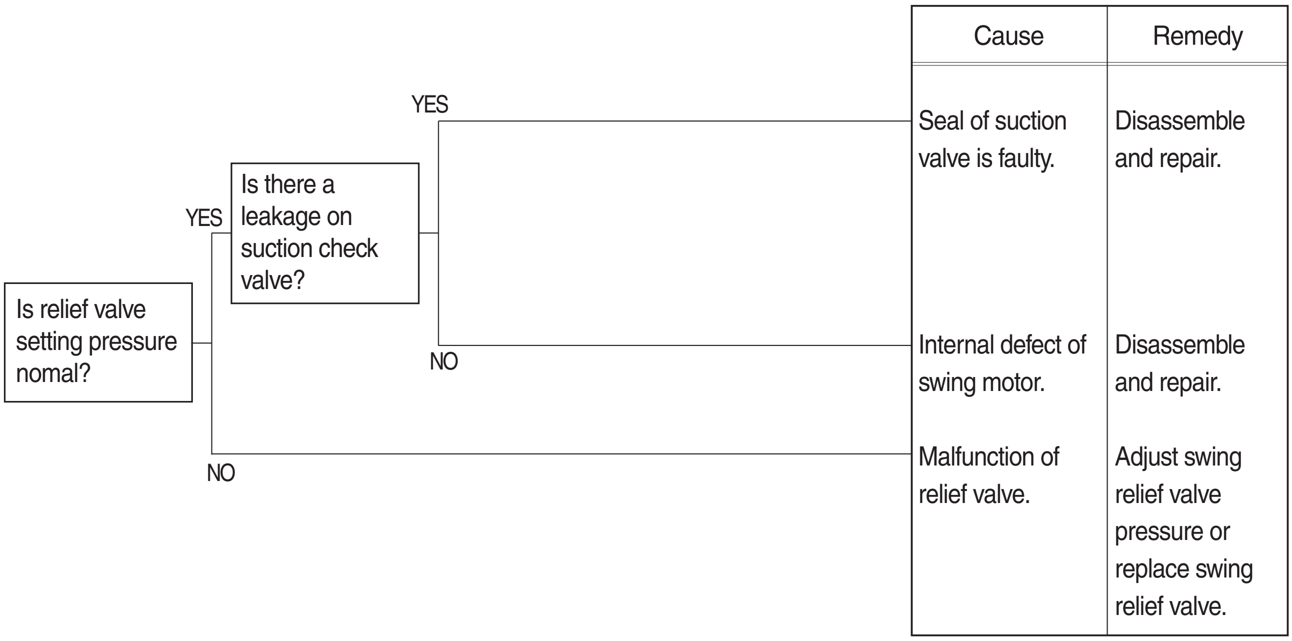


Cause	Remedy
ⓐ	
Shuttle valve is faulty.	Disassemble and replace.
Brake spring is faulty.	Disassemble and replace.
Return spring of swing control valve is faulty.	Disassemble and replace.
Swing port relief valve is faulty.	Disassemble and repair or replace.
Swing motor is broken.	Disassemble and repair.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

6) LARGE SHOCK OCCURS WHEN STOP SWINGING

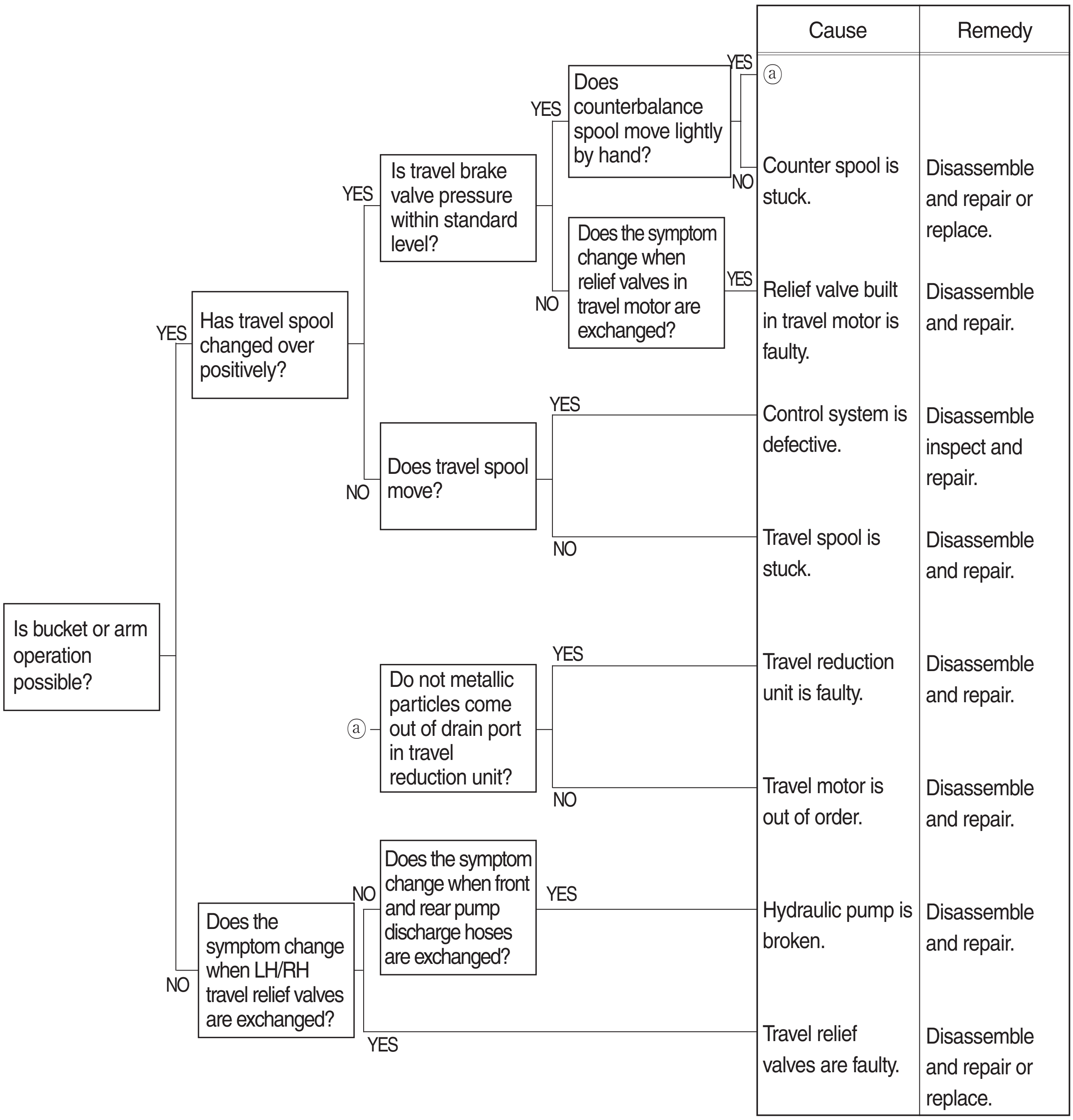


7) LARGE SOUND OCCURS WHEN STOP SWINGING

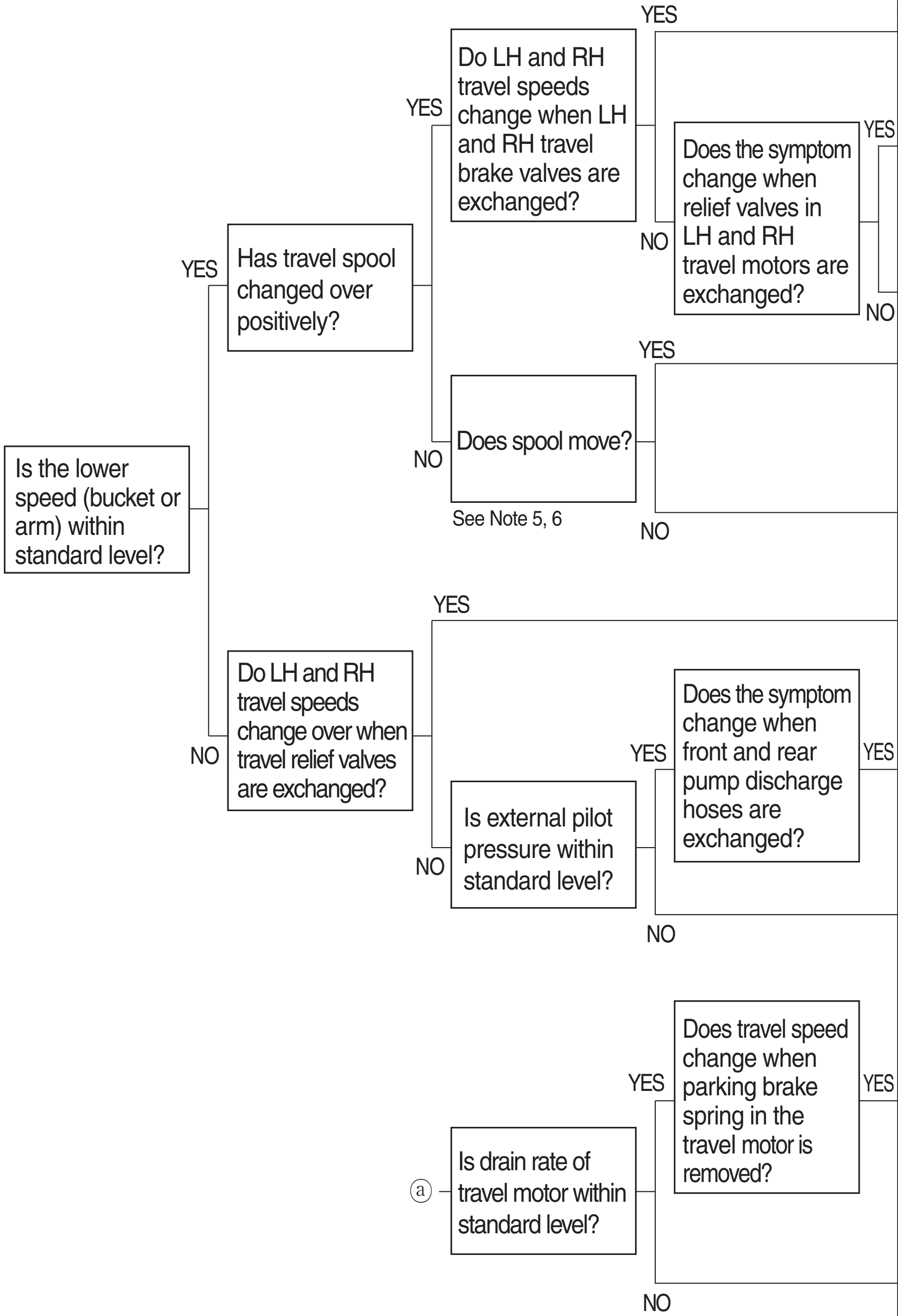


5. TRAVEL SYSTEM

1) TRAVEL DOES NOT FUNCTION AT ALL ON ONE SIDE



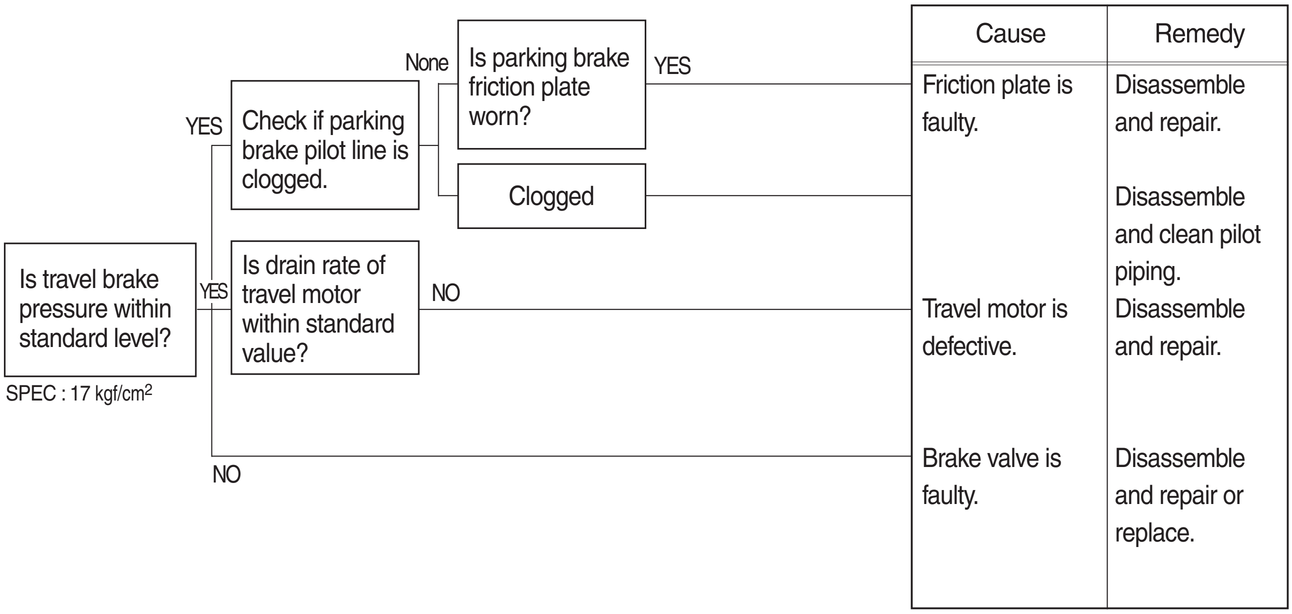
2) SPEED ON ONE SIDE FALLS AND THE MACHINE CURVES



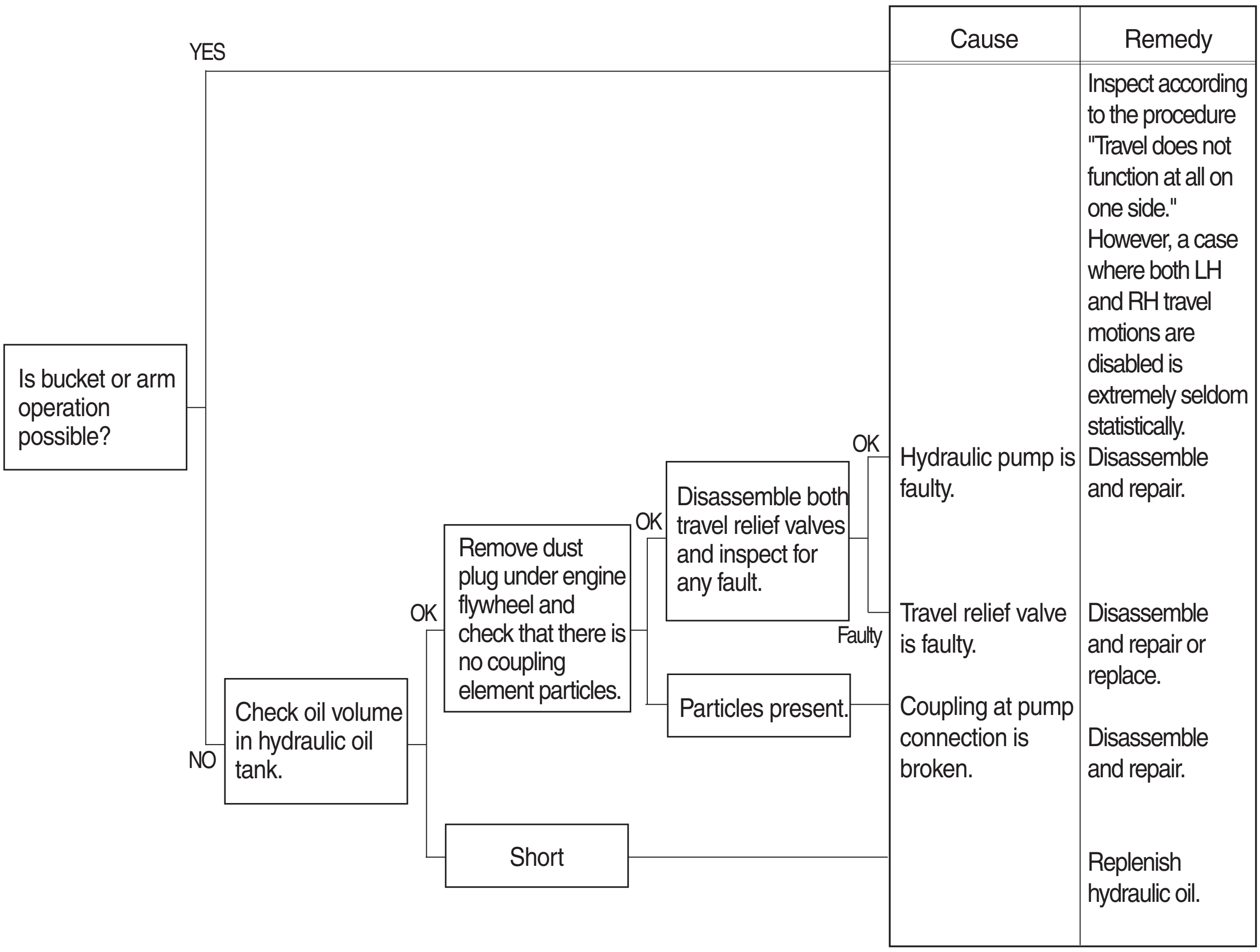
Cause	Remedy
Brake valve is defective.	Disassemble and repair or replace.
Relief valve built in travel motor is faulty.	Disassemble and repair.
Control system is faulty .	Disassemble, inspect and repair.
Control valve spool is stuck.	Disassemble and repair.
Travel relief valve is faulty.	Disassemble and repair or replace.
Hydraulic pump is broken.	Disassemble and repair.
External pilot piping is clogged or oil is leaking from it.	Disassemble and clean.
Travel motor's parking brake is not released properly.	Disassemble and clean pilot piping.
Travel motor is faulty.	Disassemble and repair.

3) MACHINE DOES NOT STOP ON A SLOPE

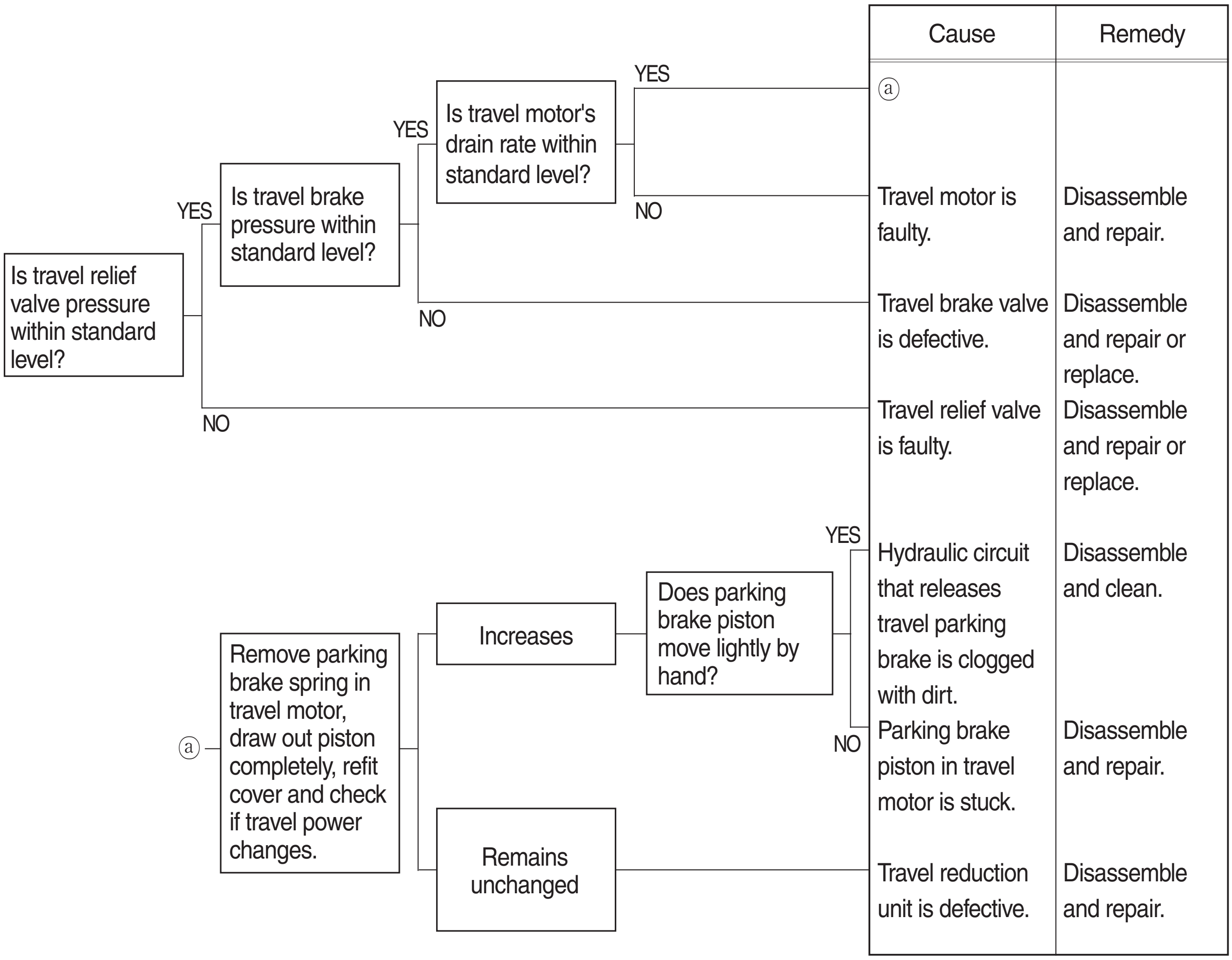
Machine is pulled forward as sprocket rotates during digging operation.



4) LH AND RH TRAVEL MOTIONS ARE IMPOSSIBLE

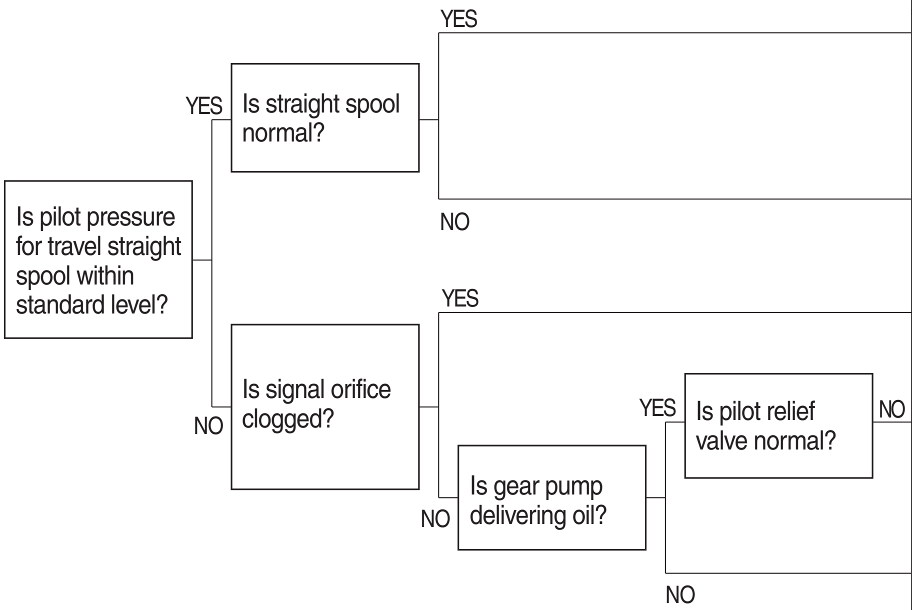


5) TRAVEL ACTION IS POWERLESS (travel only)



6) MACHINE RUNS RECKLESSLY ON A SLOPE

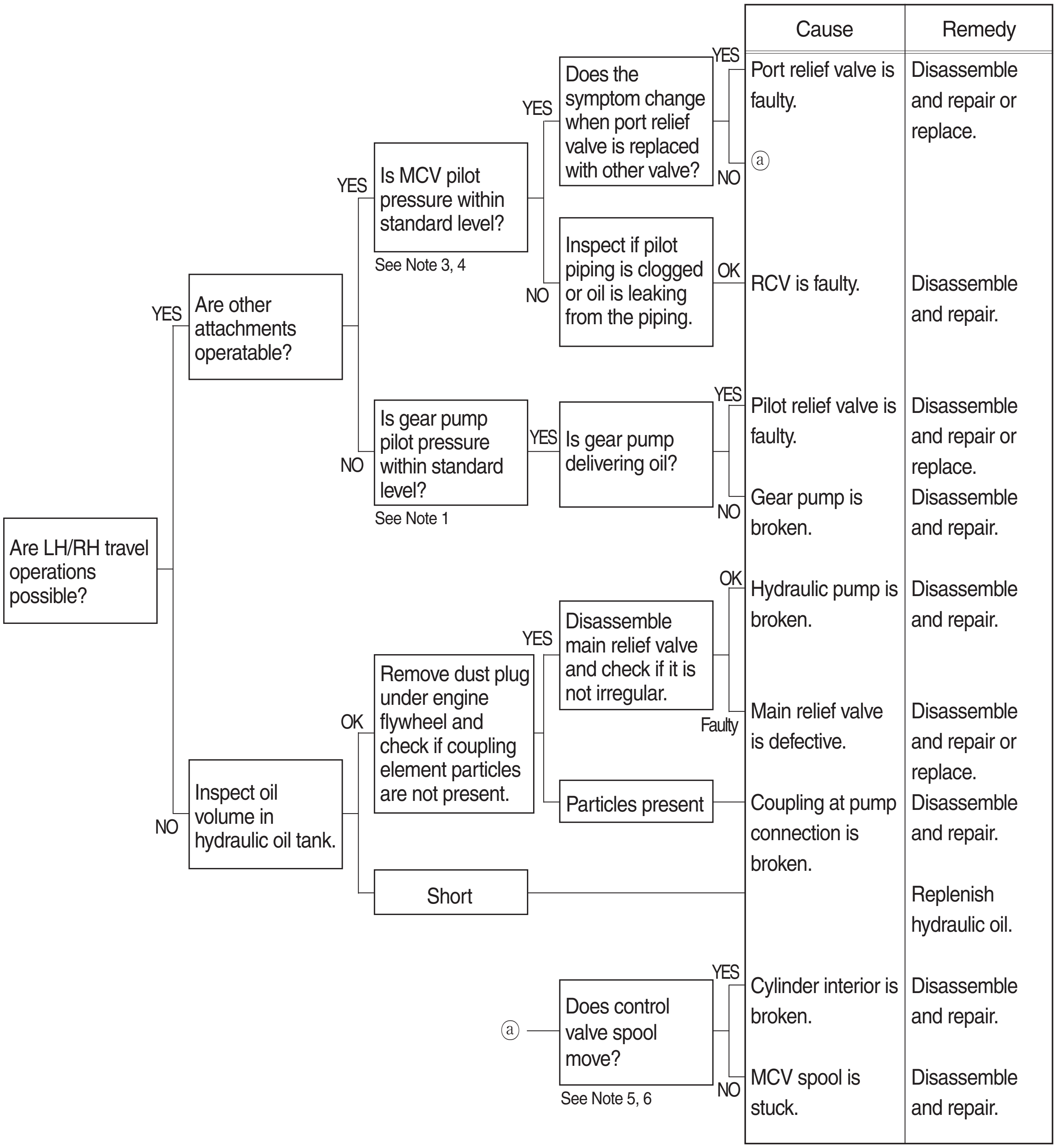
7) MACHINE MAKES A CURVED TRAVEL OR DOES NOT TRAVEL AT ALL WHEN TRAVEL AND ATTACHMENT OPERATIONS ARE EXECUTED AT THE SAME TIME



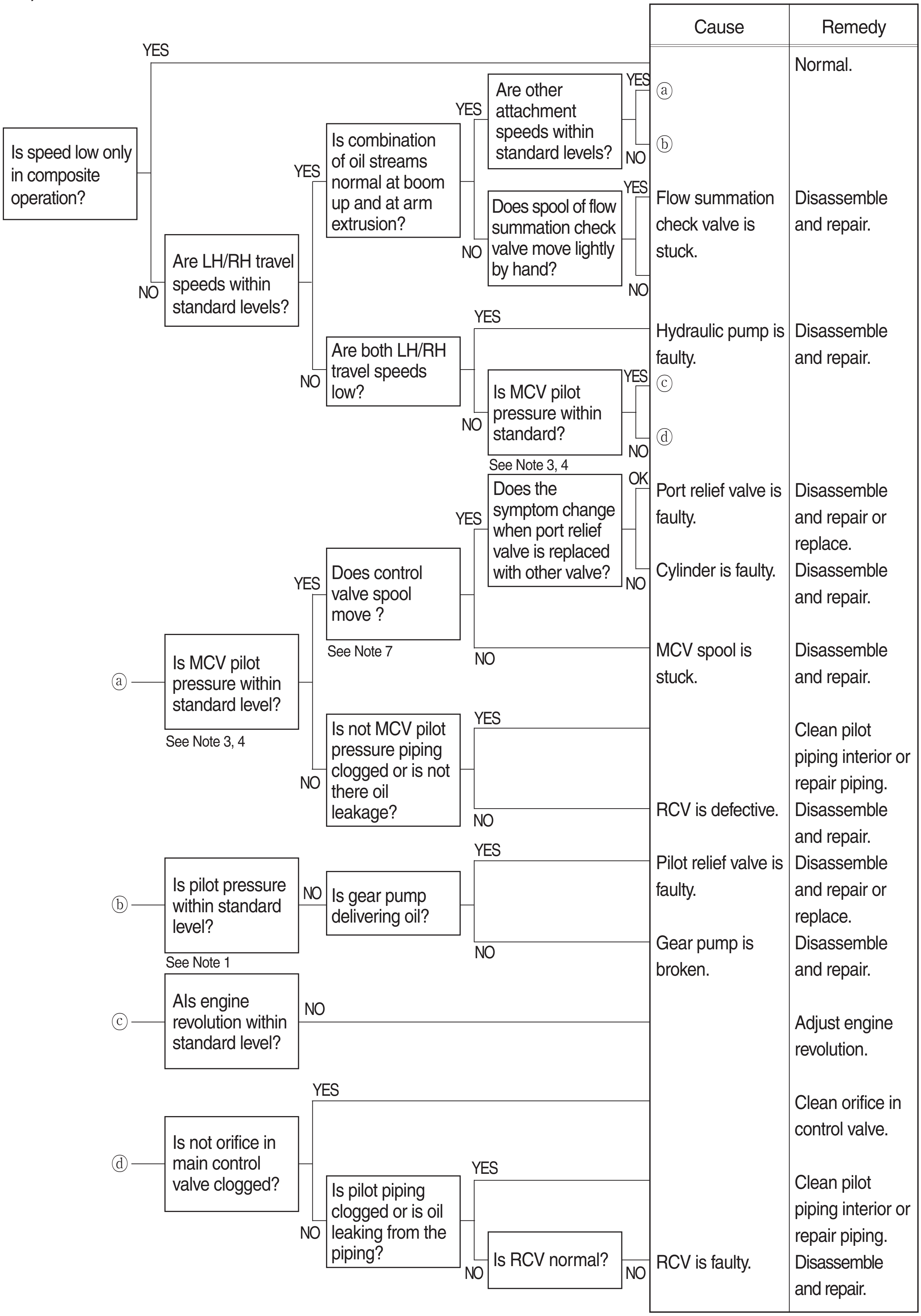
Cause	Remedy
	Normal.
Straight spool is faulty.	Repair or replace.
	Remove dirt on signal orifice.
Pilot relief valve is defective.	Disassemble and repair or replace.
Gear pump is broken.	Disassemble and repair.

6. ATTACHMENT SYSTEM

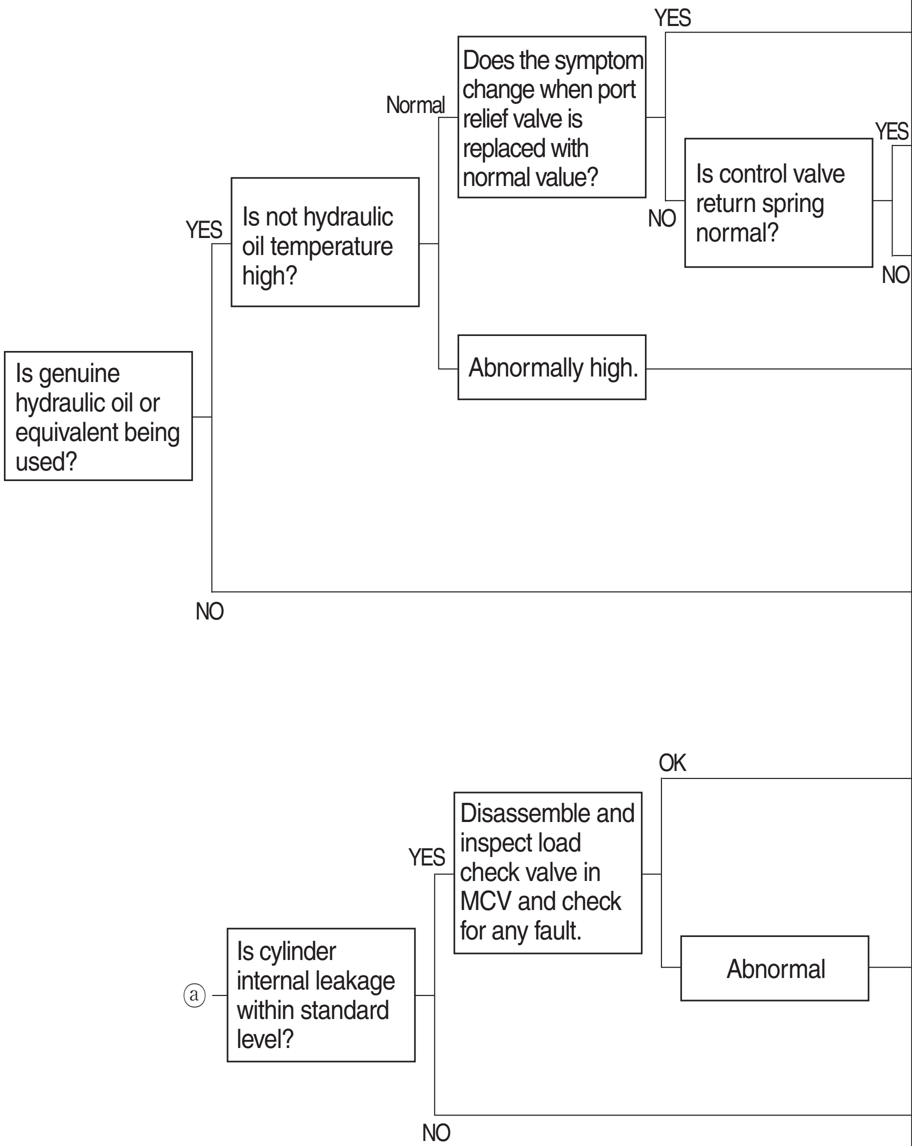
1) BOOM OR ARM ACTION IS IMPOSSIBLE AT ALL



2) BOOM, ARM OR BUCKET SPEED IS LOW

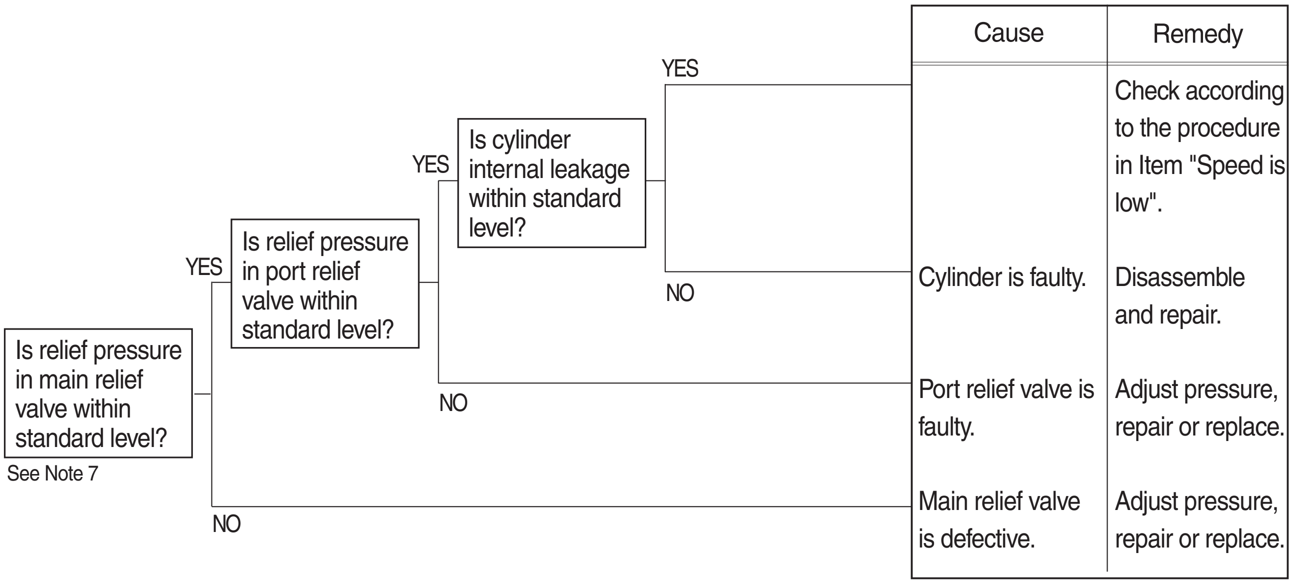


3) BOOM, ARM OR BUCKET CYLINDER EXTENDS OR CONTRACTS ITSELF AND ATTACHMENT FALLS

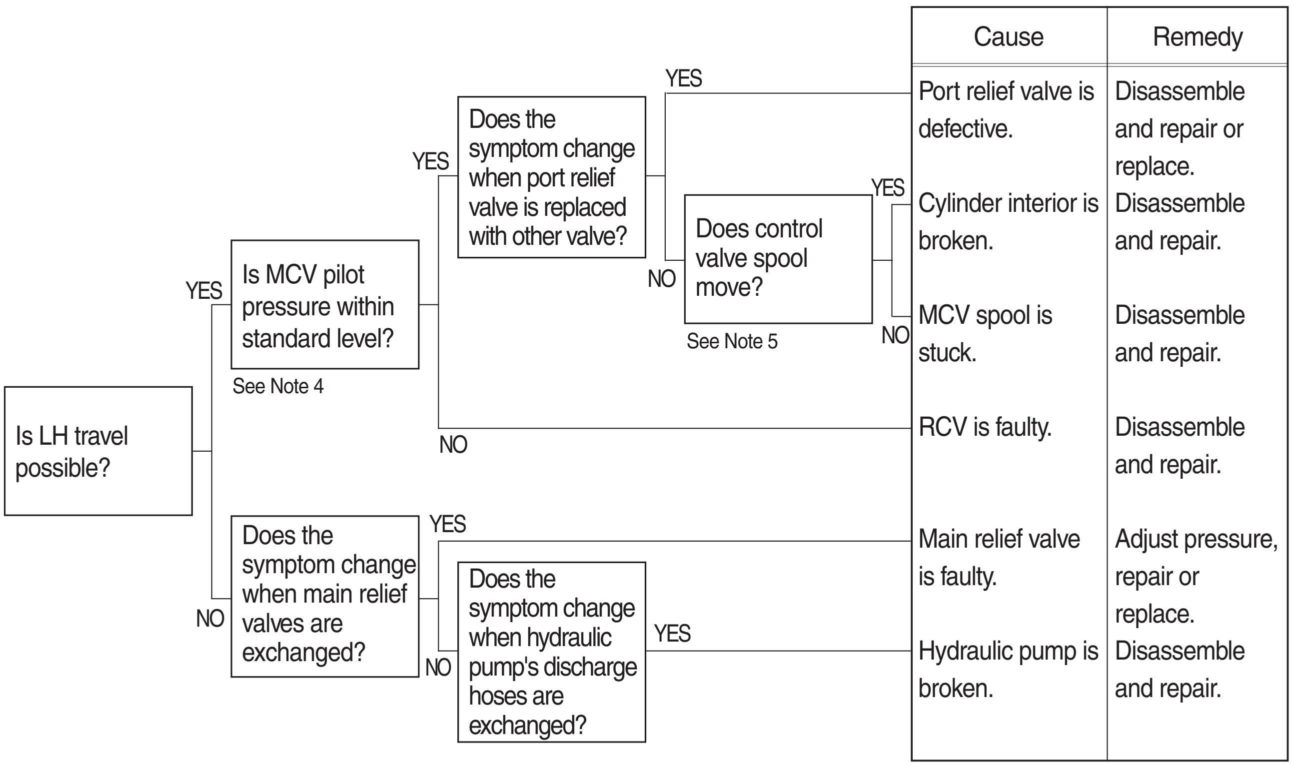


Cause	Remedy
Port relief valve is faulty.	Disassemble and repair or replace.
Control valve's return spring is faulty.	Disassemble and replace.
	Locate the cause of hydraulic oil temperature rise and lower it to proper level.
	Replace with genuine hydraulic oil or equivalent.
Pressure tightness between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

4) BOOM, ARM OR BUCKET POWER IS WEAK



5) ONLY BUCKET OPERATION IS TOTALLY IMPOSSIBLE



6) BOOM MAKES A SQUEAKING NOISE WHEN BOOM IS OPERATED

Is boom foot pin greased sufficiently?

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

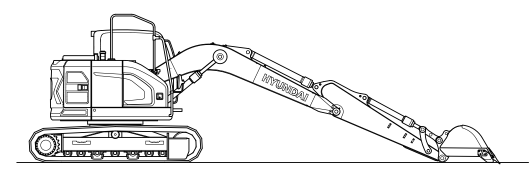
7) TIME LAG OF MACHINE WORKING IS LARGE.

Is overload relief valve for each spool working properly?

	Cause	Remedy
YES		Refer to 2)
NO	Overload relief valve is faulty.	Disassemble and repair.

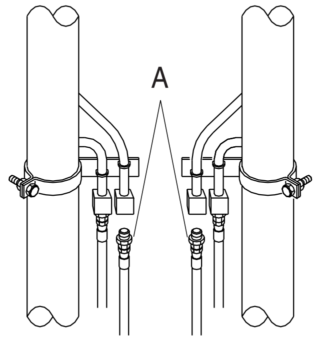
※ HOW TO CHECK INTERNAL BOOM CYLINDER LEAKAGE

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



145ZF6TS01

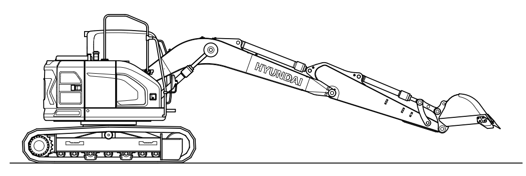
2. Disconnect hose (A) from rod side of boom cylinder and drain oil from cylinders and hose. (put cups on piping and hose ends)



(210-7) 6-20(2)

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

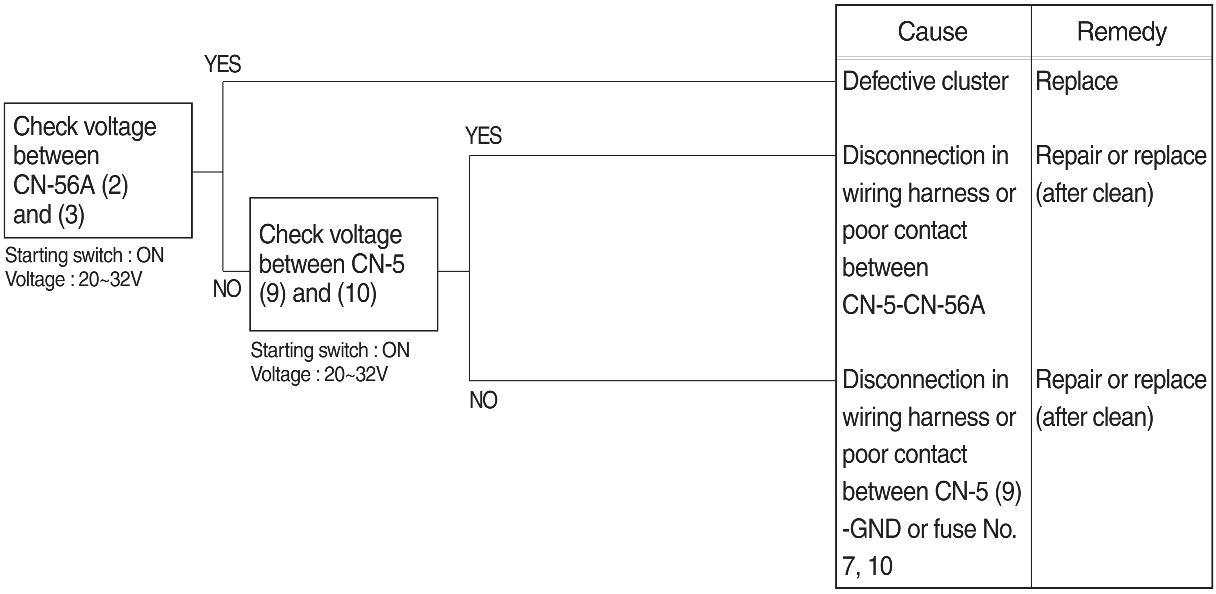
   If oil leaks from piping side and boom cylinder rod is retracted there is an internal leak in the cylinder.
   If no oil leaks from piping side and boom cylinder rod is retracted, there is an internal leak in the control valve.



145ZF6TS02

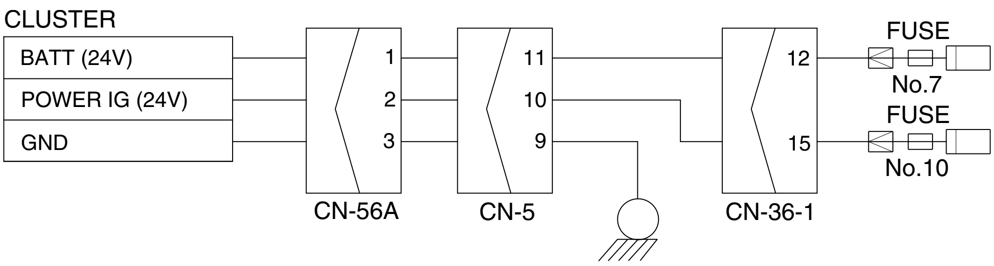
1. WHEN STARTING SWITCH IS TURNED ON, MONITOR PANEL DISPLAY DOES NOT APPEAR

· 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.



Check voltage

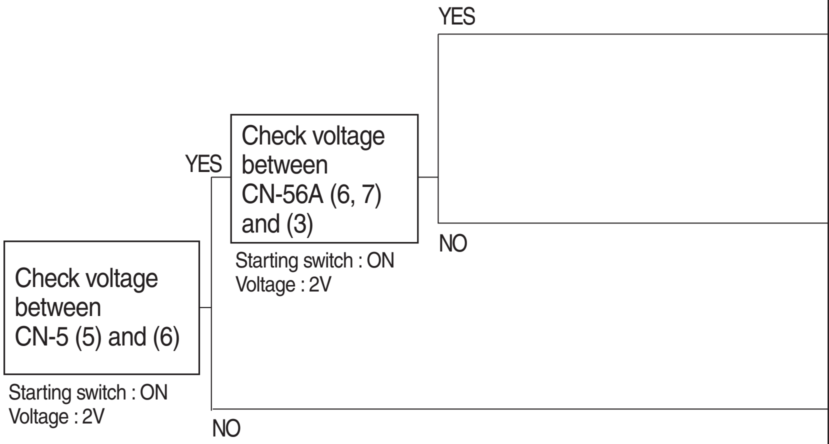
YES	20~32V
NO	0V



145SA6ES01

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

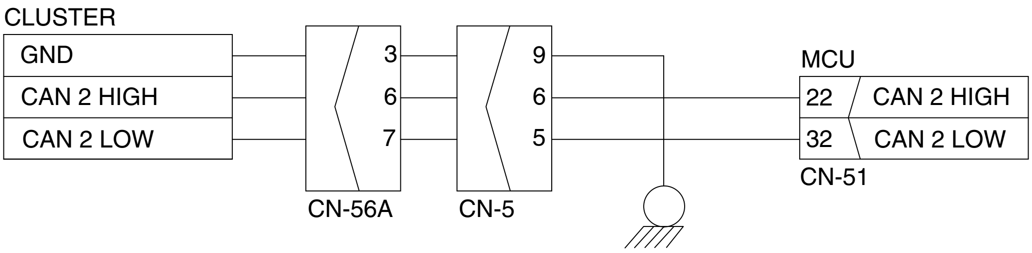
· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.



Cause	Remedy
Defective cluster	Replace
Disconnection in wiring harness or poor contact between CN-56A (6, 7)-CN-5 (5, 6)	Repair or replace (after clean)
Defective MCU Disconnection in wiring harness or poor contact between CN-5 (5, 6)- CN-51 (22, 32)	Replace Repair or replace (after clean)

Check voltage

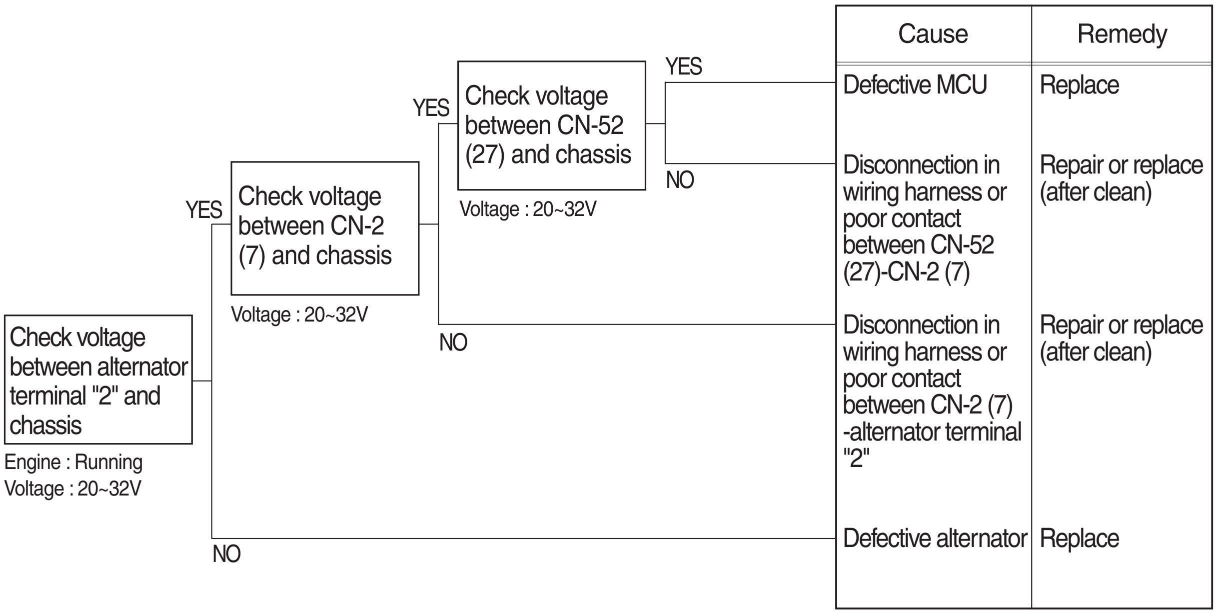
YES	2V
NO	0V



300L6ES02

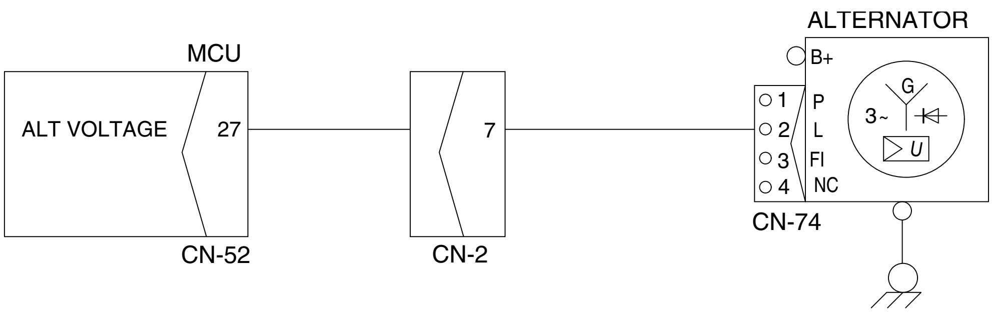
3. BATTERY CHARGING WARNING LAMP LIGHTS UP (Starting switch : ON)

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



Check voltage

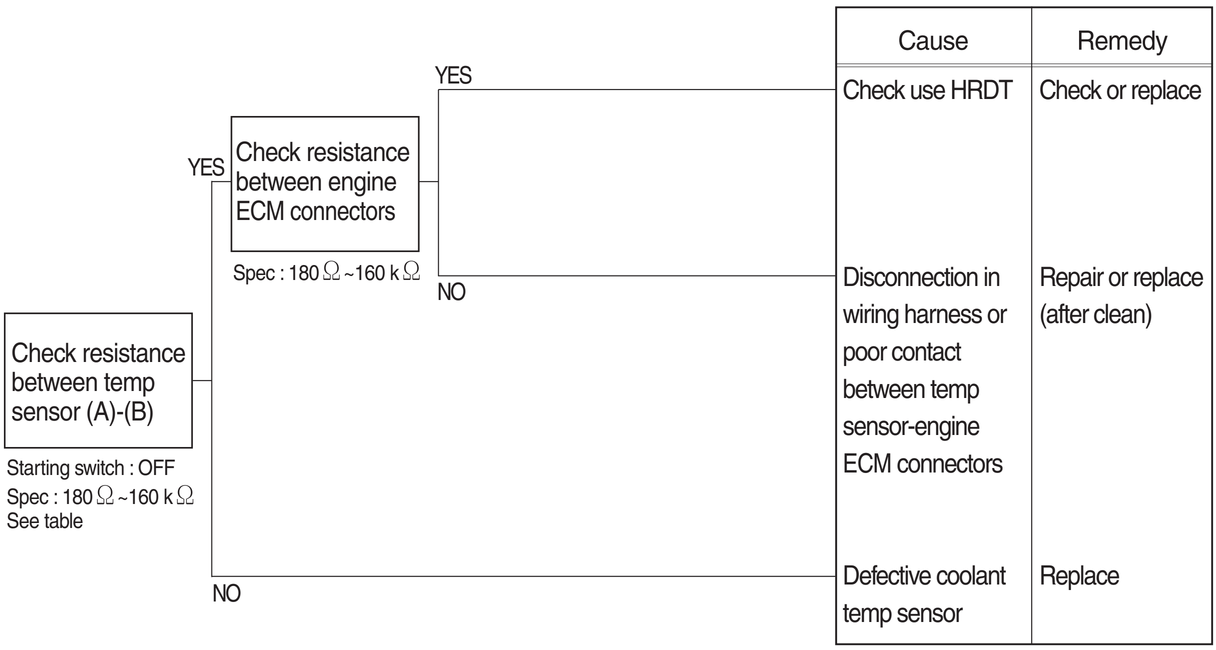
YES	20~32V
NO	0V



145SA6ES03

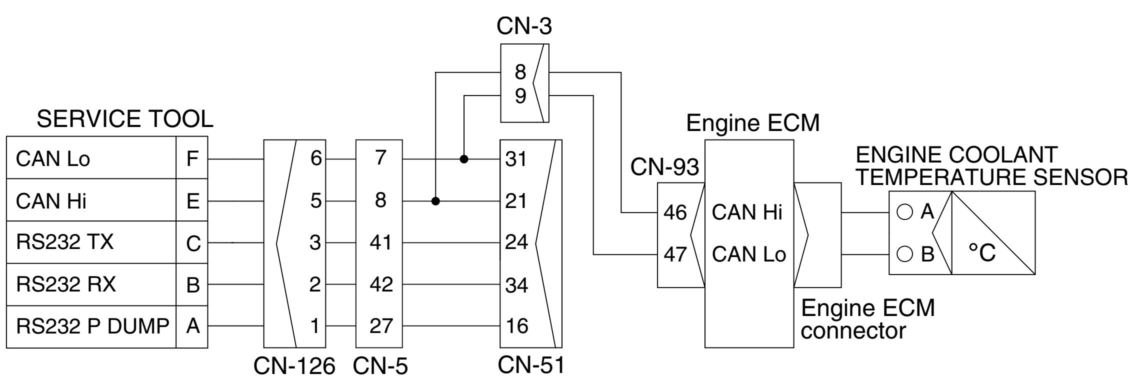
4. WHEN COOLANT OVERHEAT WARNING LAMP LIGHTS UP (engine is started)

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



Check Table

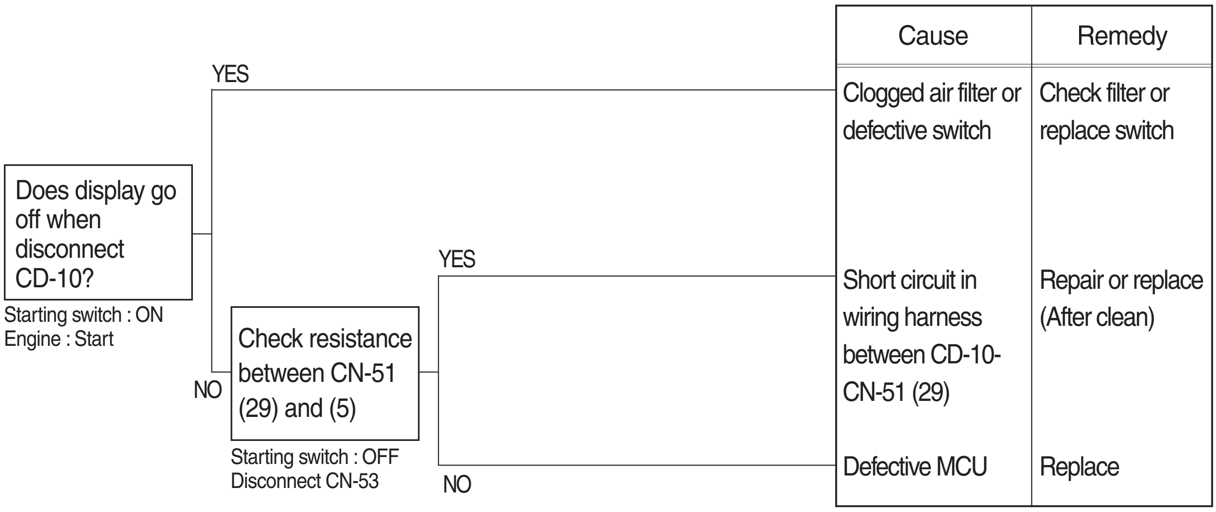
Temperature (˚C)	0	25	50	80	95
Resistance (kΩ)	30~37	9.3~10.7	3.2~3.8	1.0~1.3	0.7~0.8



145SA6ES04

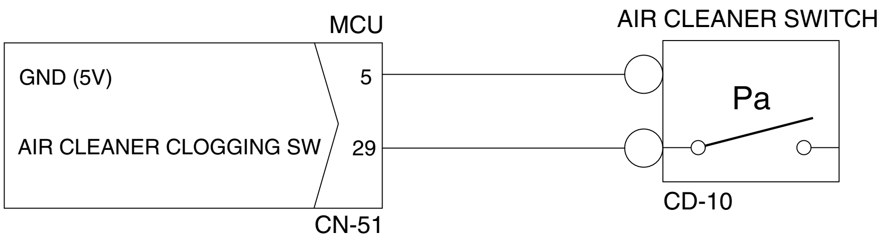
5. WHEN AIR CLEANER WARNING LAMP LIGHTS UP (engine is started)

· 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

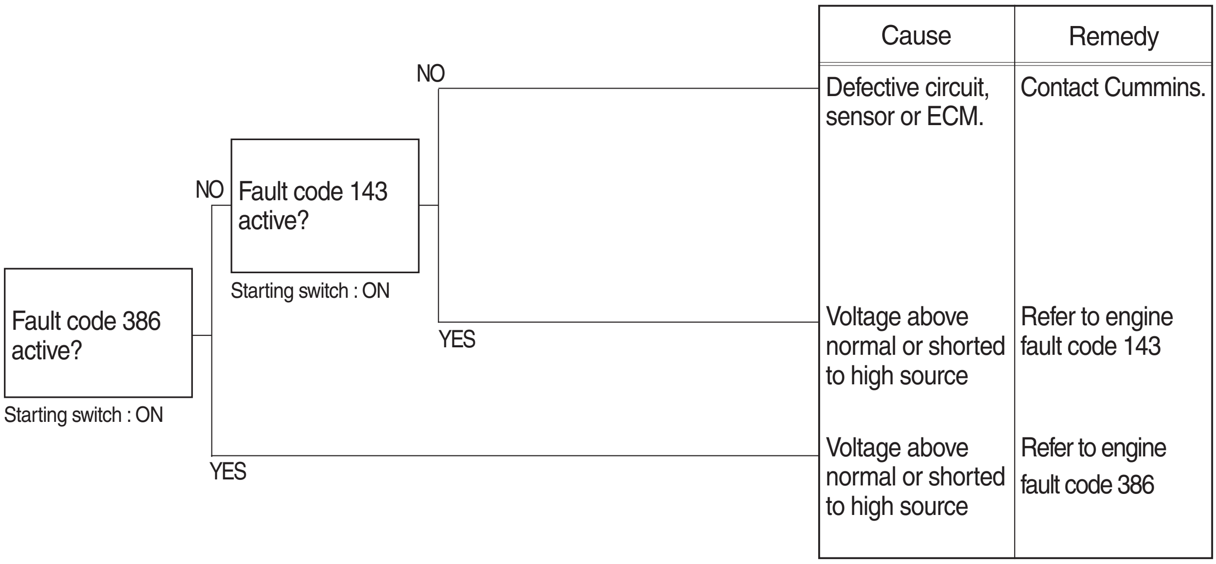
YES	MAX 1Ω
NO	MIN 1MΩ

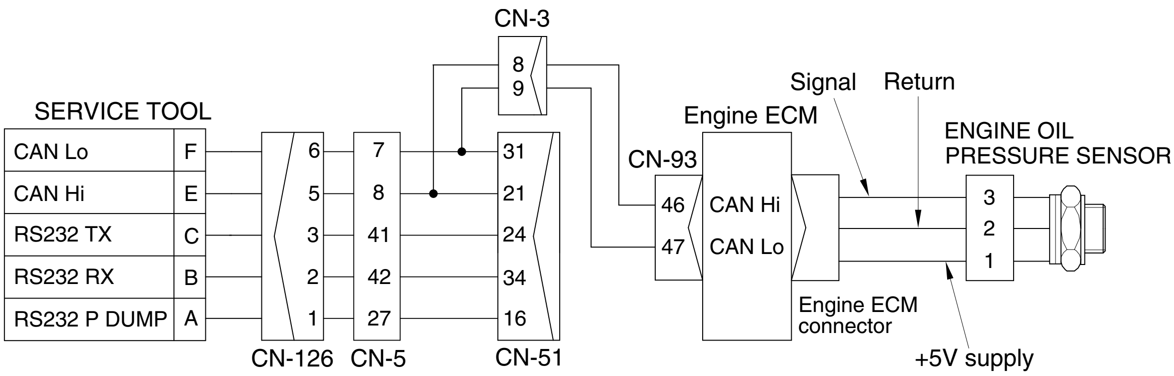


235SA6ES05

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.

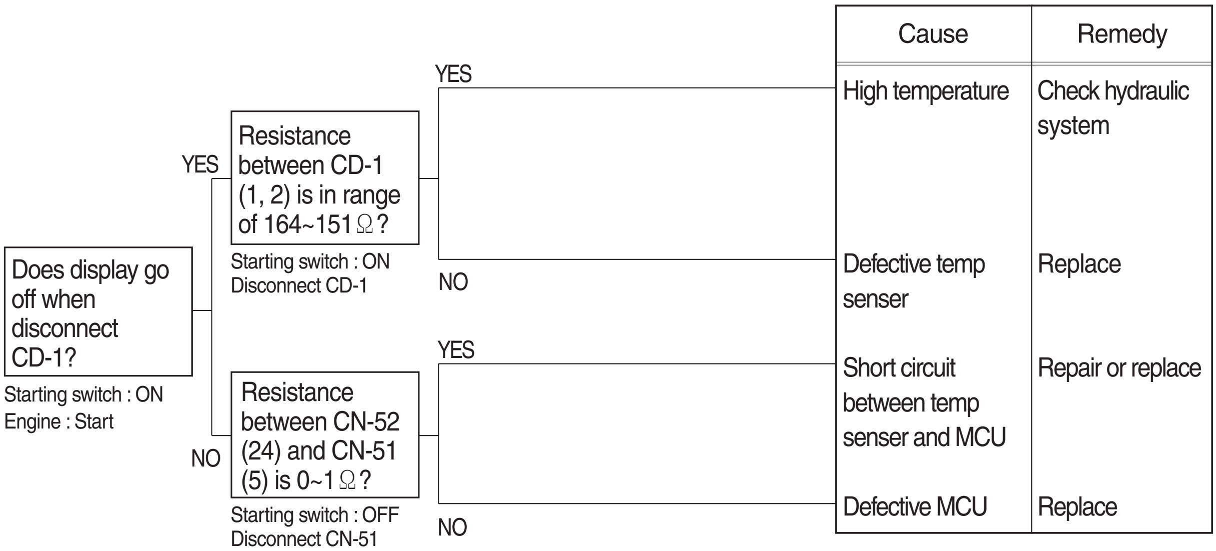




145SA6ES07

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

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

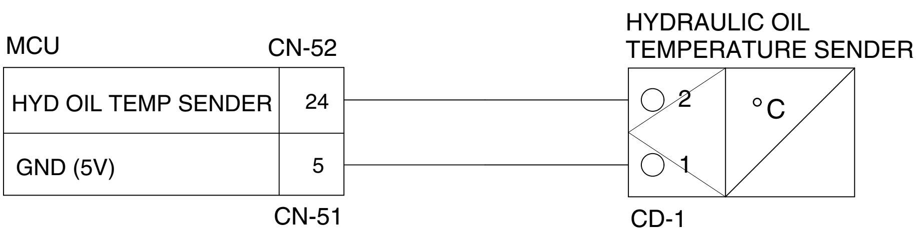


Normal type

Premium type

Check Table

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



145SA6ES08

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

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

Check resistance between temp sensor (A)-(B)

Starting switch : OFF
Spec : 180 Ω ~160 kΩ
See table

YES → Check resistance between engine ECM connectors

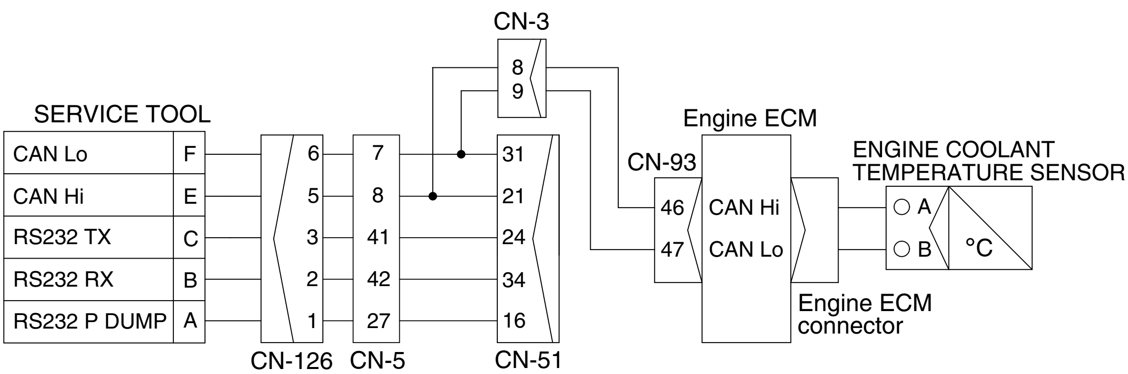
Spec : 180 Ω ~160 kΩ

YES / NO / NO

Cause	Remedy
Check use HRDT	Check or replace
Disconnection in wiring harness or poor contact between temp sensor-engine ECM connectors	Repair or replace (after clean)
Defective coolant temp sensor	Replace

Check Table

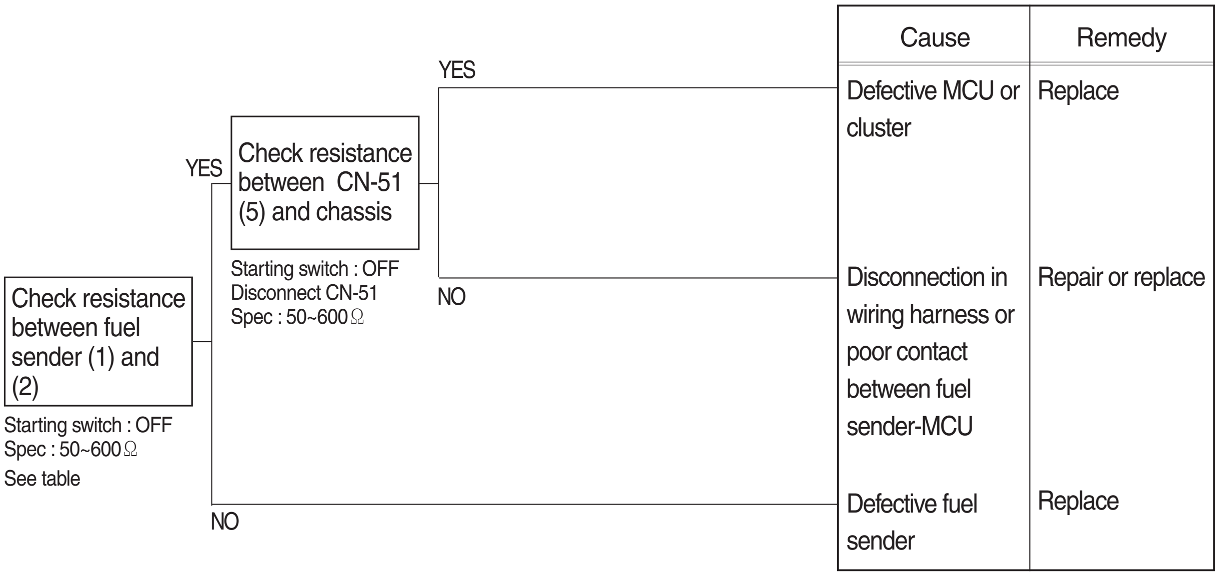
Temperature (˚C)	0	25	50	80	95
Resistance (kΩ)	30~37	9.3~10.7	3.2~3.8	1.0~1.3	0.7~0.8



145SA6ES04

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

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

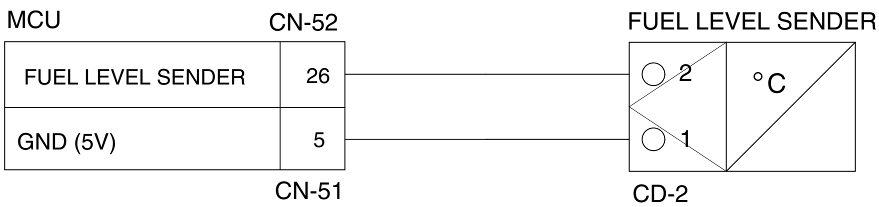


Normal type

Premium type

Check Table

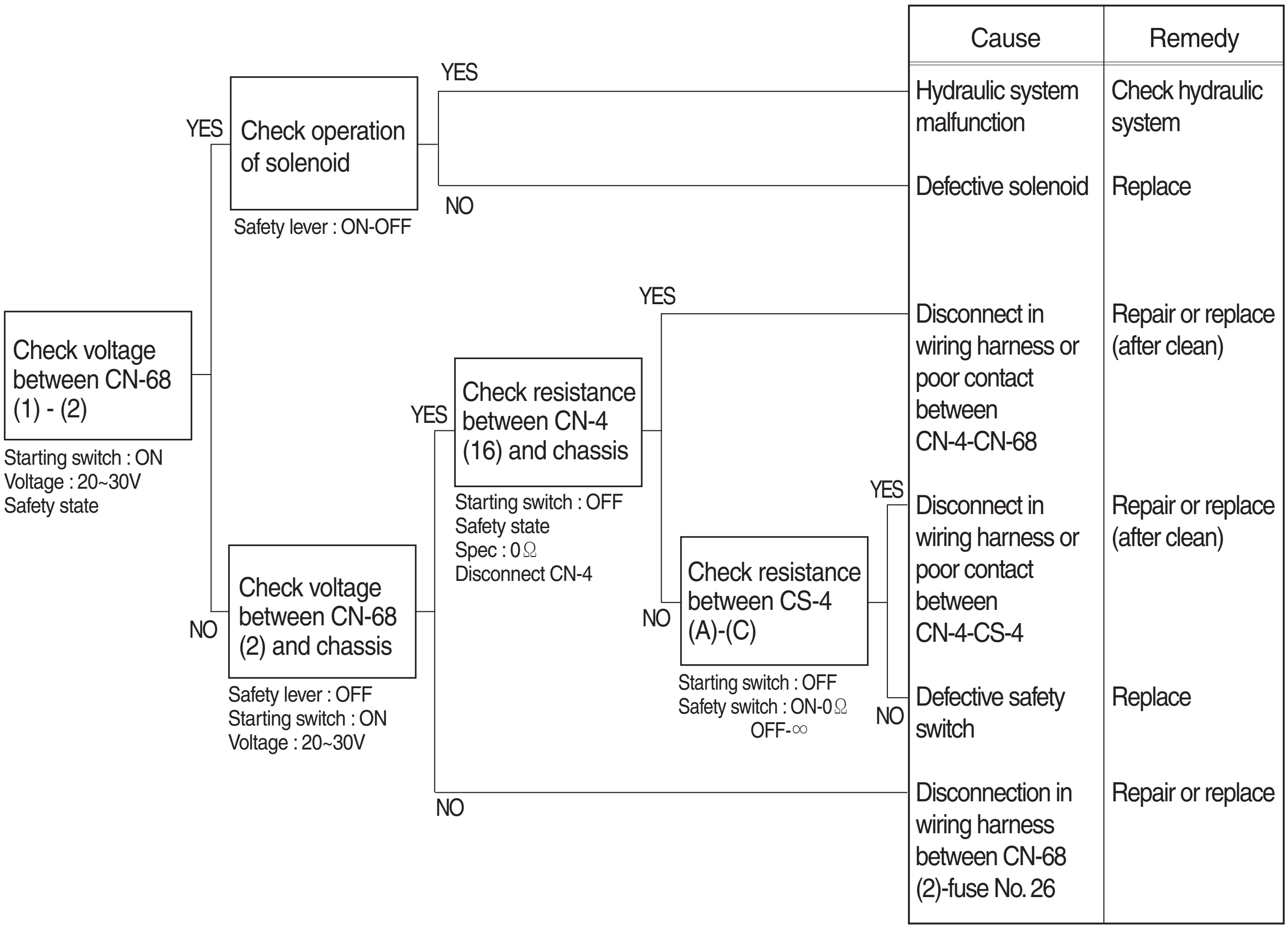
Range	Resistance (Ω)	Range	Resistance (Ω)
Full	50	5/12	400
11/12	100	4/12	450
10/12	150	3/12	500
9/12	200	2/12	550
8/12	250	1/12	600
7/12	300	Empty warning	700
6/12	350	-	-

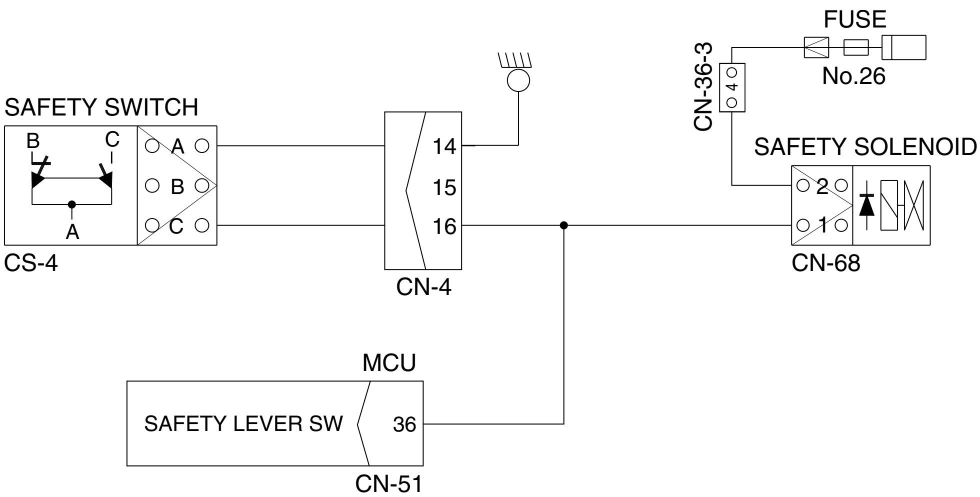


145SA6ES10

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.

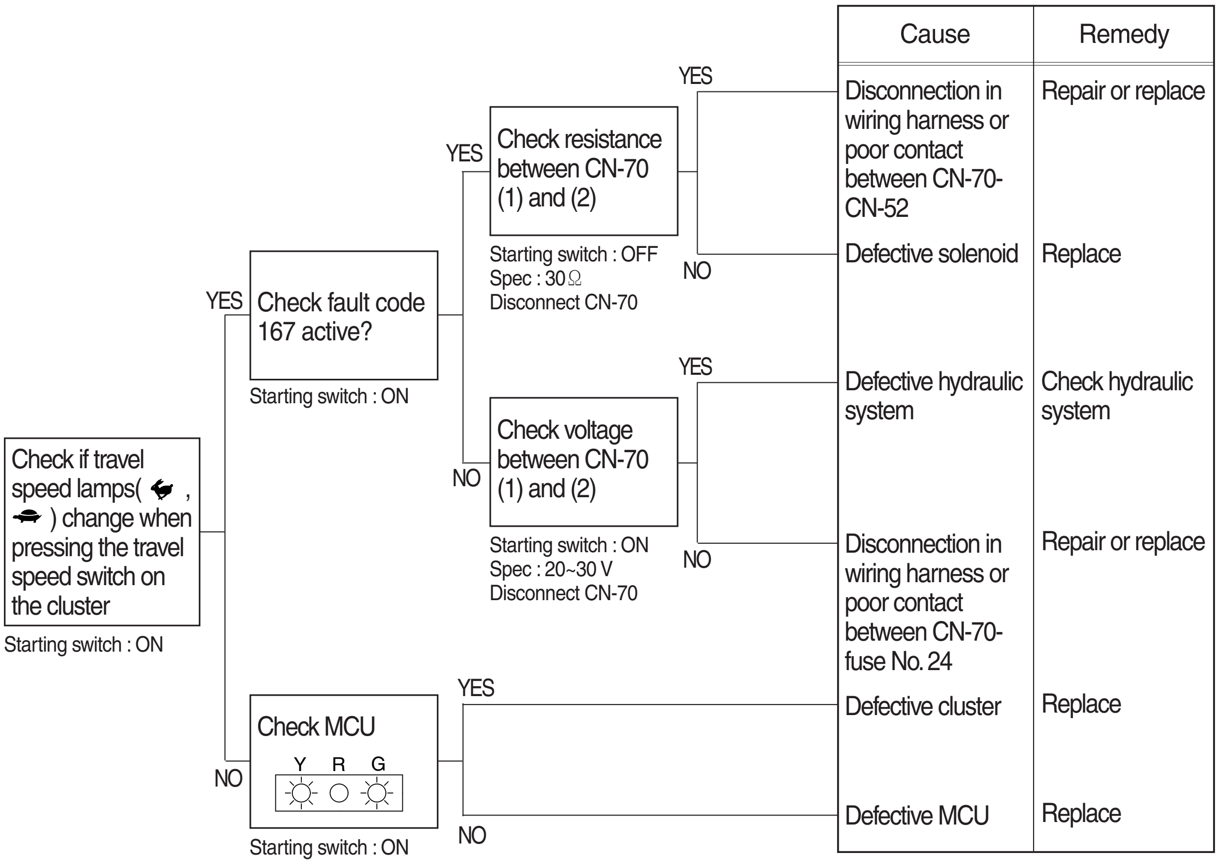


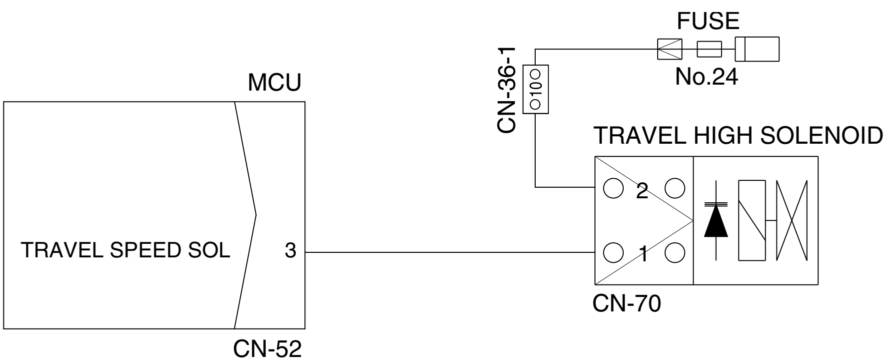


145SA6ES12

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.





145SA6ES13

12. TRAVEL ALARM DOES NOT SOUND OR DOES NOT STOP SOUNDING

Check the fuse for travel alarm inside fuse box whether fuse No.24 is blown or not

YES → The fuse is blown / Replace the fuse

NO → Check the signal of MCU's pin for back buzzer whether ground signal (DO) generate or not when machine travel mode.

YES → The travel alarm signal of united MCU is defective / Check the united MCU program

NO → * Prepare with starting switch OFF, then turn start engine and carry out troubleshooting : Between CN-81 (2) - chassis ground : 20-30 voltage . Between CN-81 (1) - chassis ground : Max 1 Ω (resistance) Is the above value normal?

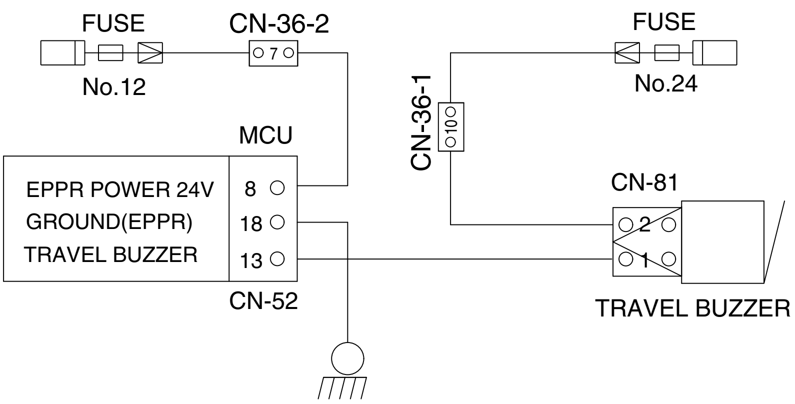
** Note : Since voltage value , connector number and pin number varies with each model, should refer to the electric circuit of each model.

YES → The travel buzzer is defective / Replace the travel buzzer

NO → * Prepare with starting switch OFF, then carry out trouble-shooting without turning starting switch ON : 1. Disconnection in wiring or defective contact in connector between CN-81 (2) inline connector-end connector : Max 1 Ω (resistance) 2. Short circuit with ground circuit between CN-81 (2) inline connector-end connector - chassis ground : Min 1MΩ (resistance)

NO → In case of the value of resistance, disconnection in wiring or defective contact in connector or short circuit with ground circuit / Replace connector Connect the wire

Cause	Remedy
The fuse is blown	Replace the fuse
The travel alarm signal of united MCU is defective	Check the united MCU program
The travel buzzer is defective	Replace the travel buzzer
In case of the value of resistance, disconnection in wiring or defective contact in connector or short circuit with ground circuit	Replace connector Connect the wire



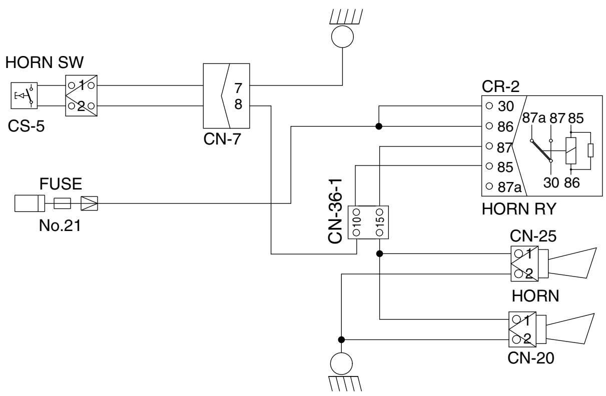
145SA6ES25

13. HORN DOES NOT SOUND

Check the fuse for horn inside fuse box whether fuse No.21 is blown or not

- YES → The fuse is blown → Replace the fuse
- NO → After replacing the relay for horn, check the horn operate
  - YES → The relay is broken → Replace the relay
  - NO → * Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting : Between CN-20 (1) or CN-25 (1) - chassis ground (with horn switch turned ON) : 20-30 voltage
    * Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON : Between CN-20 (2) or CN-25 (2)- chassis ground : Max 1 Ω (resistance)
    Is the above value normal?
    ** Note : Since voltage value , connector number and pin number varies with each model, should refer to the wiring diagram of each model.
    <CN-20 (1)/ CN-25 (1) : Horn connector (+) terminal CN-20 (2) /CN-25 (2) : Horn connector (-) terminal>
    - YES → The horn is defective → Replace the horn
    - NO → * Prepare with starting switch OFF, then carry out trouble-shooting without turning starting switch ON : 1. Disconnection in wiring or defective contact in connector between CN-20 (1) or CN-25 (1) - inline connector-end connector : Max 1 Ω (resistance) 2. Short circuit with ground circuit between CN-20 (1) or CN-25 (1) - inline connector-end connector - chassis ground : Min 1M Ω (resistance)
      - NO → In case of the value of resistance, disconnection in wiring or defective contact in connector or short circuit with ground circuit → Replace connector. Connect the wire

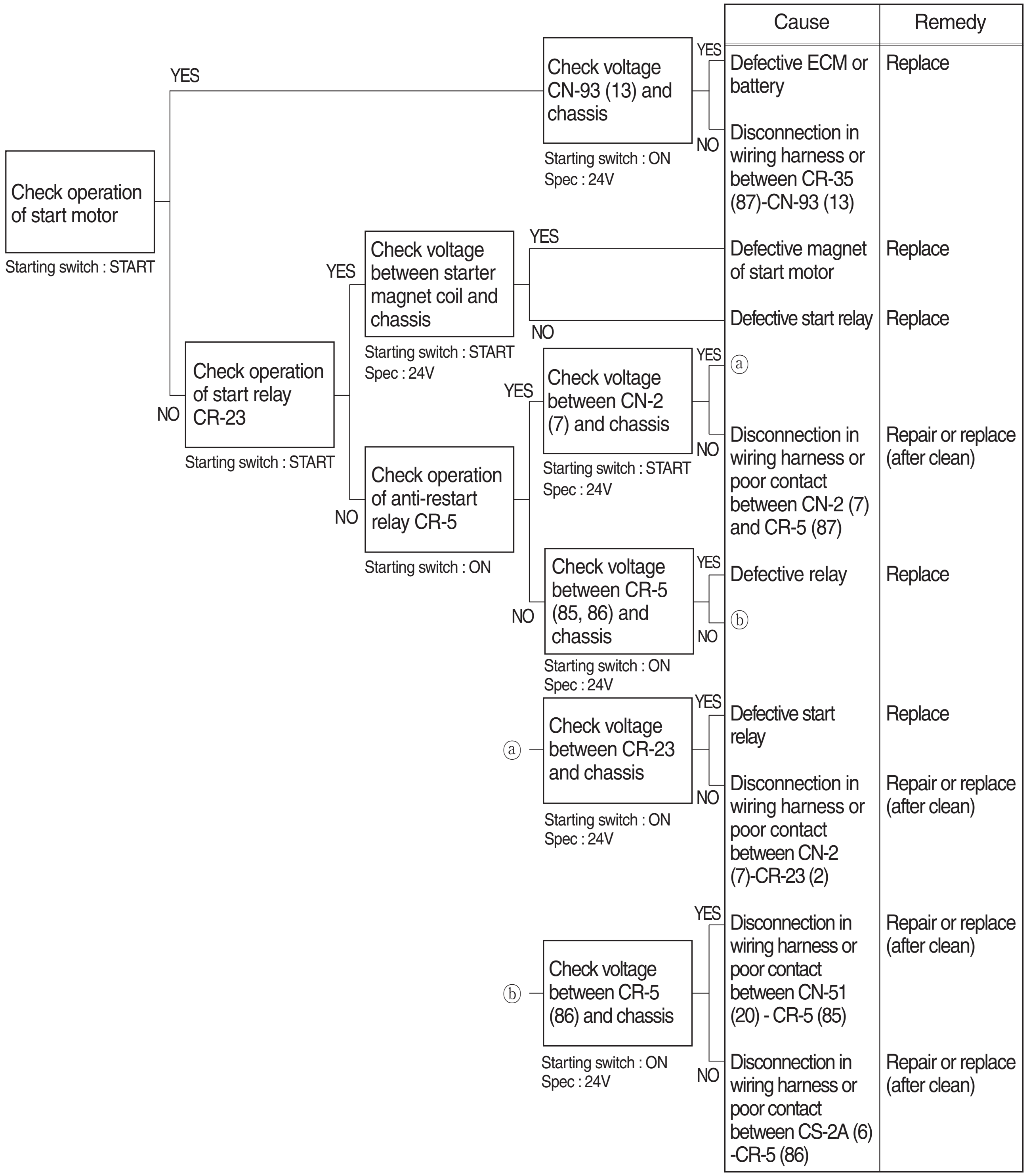
Cause	Remedy
The fuse is blown	Replace the fuse
The relay is broken	Replace the relay
The horn is defective	Replace the horn
In case of the value of resistance, disconnection in wiring or defective contact in connector or short circuit with ground circuit	Replace connector. Connect the wire

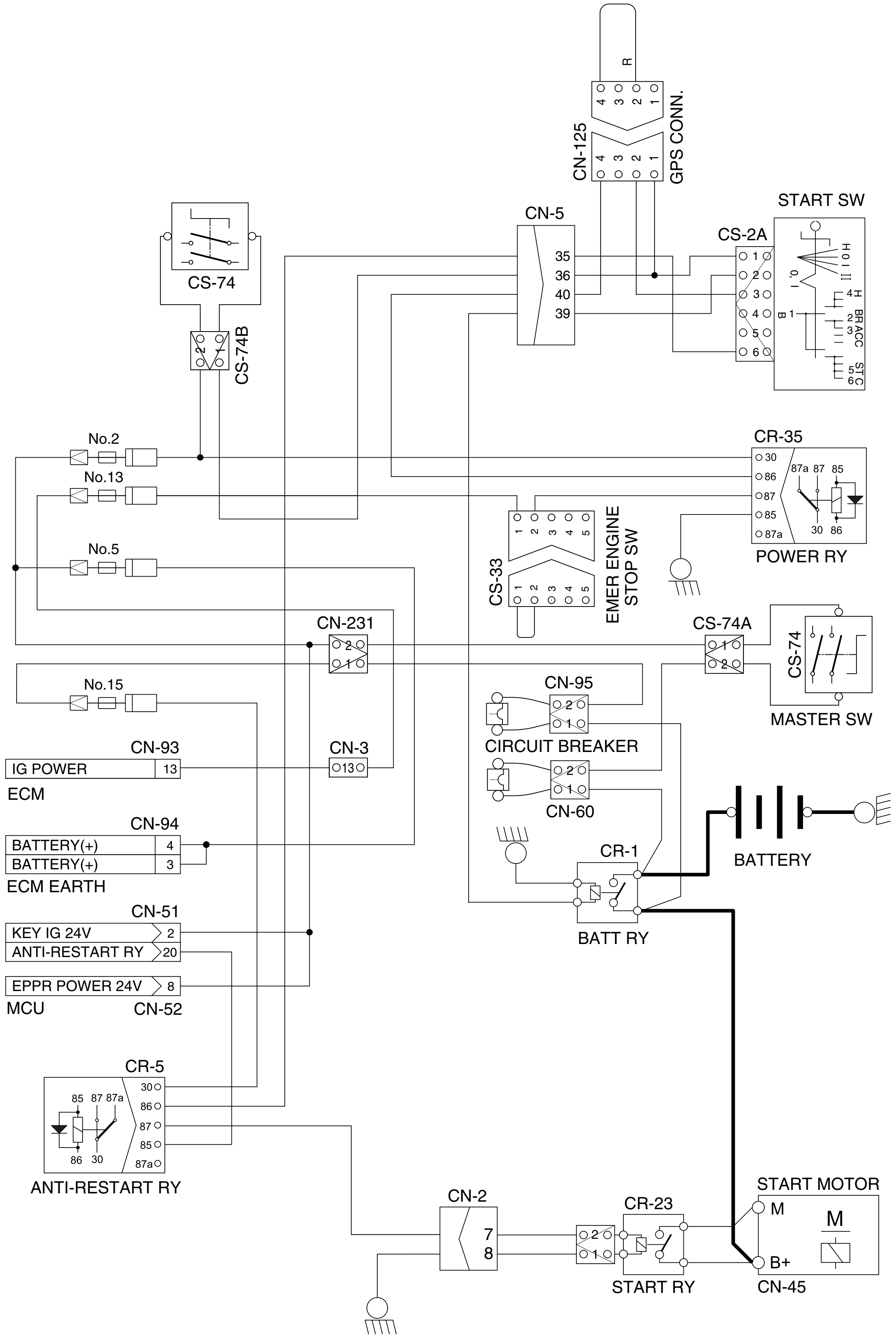


145SA6ES26

14. WHEN ENGINE DOES NOT START ([battery symbol] lights up condition)

· Check supply of the power at engine stop solenoid while starting switch is ON.
· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted and fuse No. 2, 5, 13 and 15 burnt out.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.

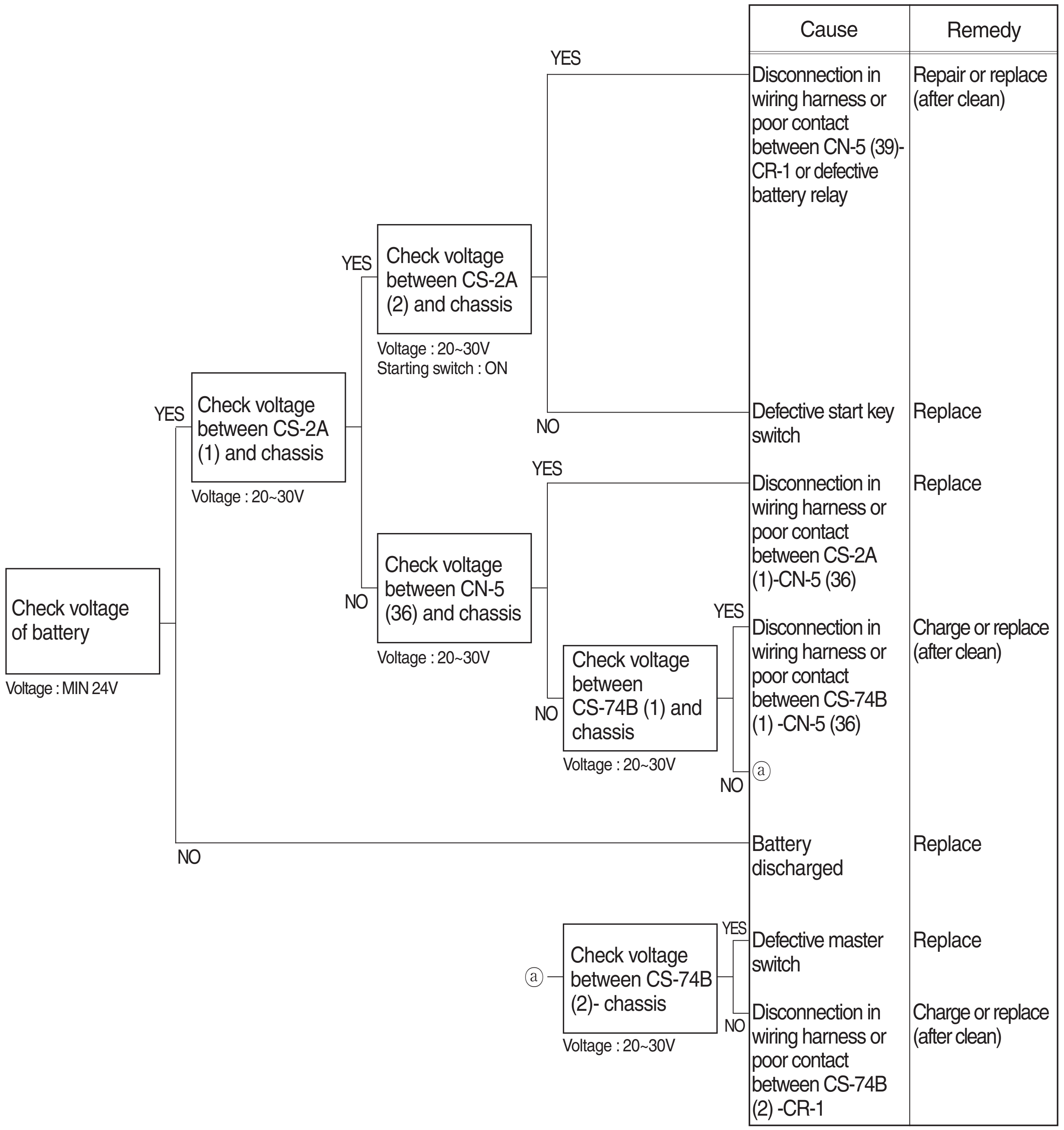


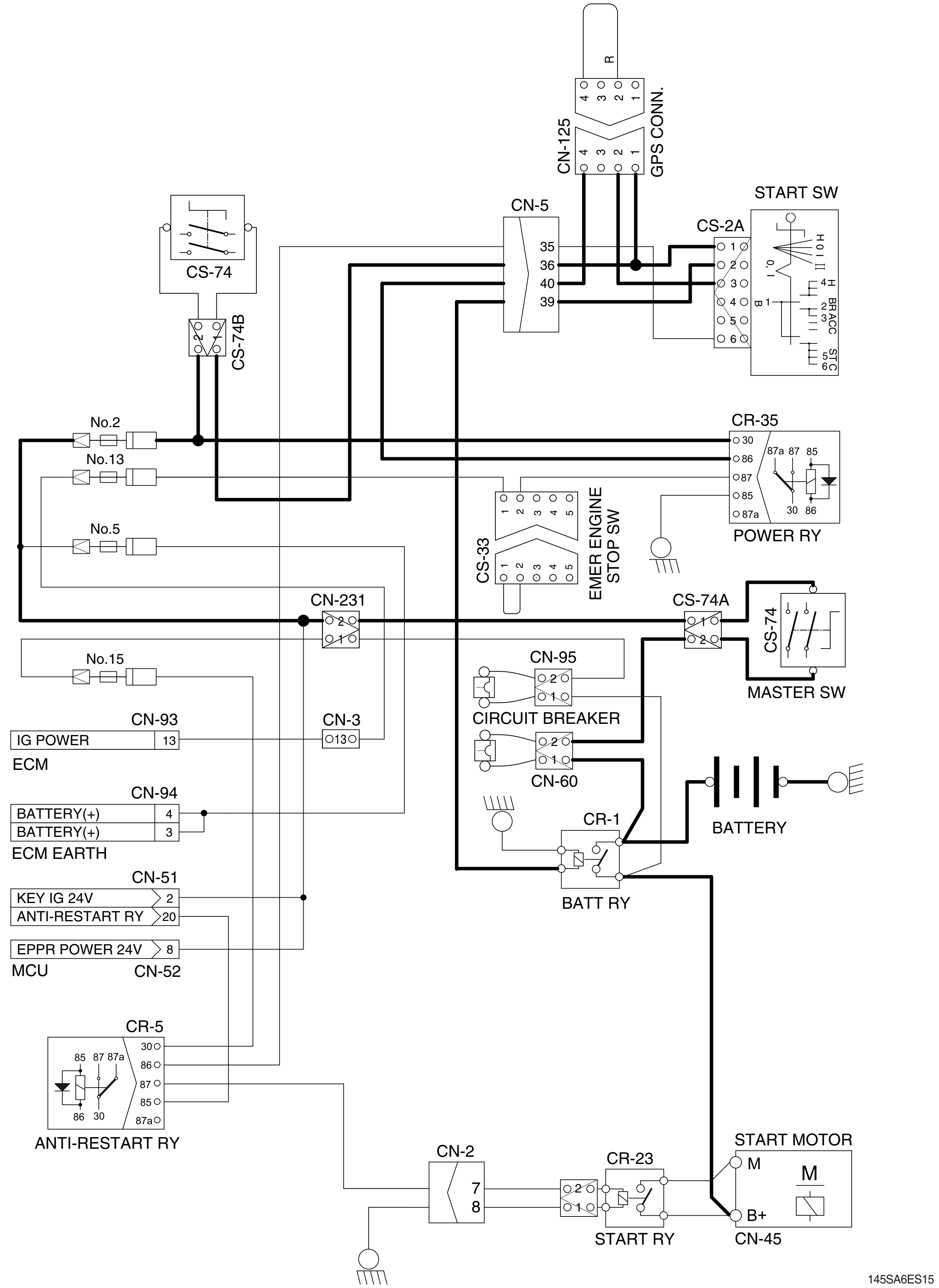


145SA6ES14

15. WHEN STARTING SWITCH ON DOES NOT OPERATE

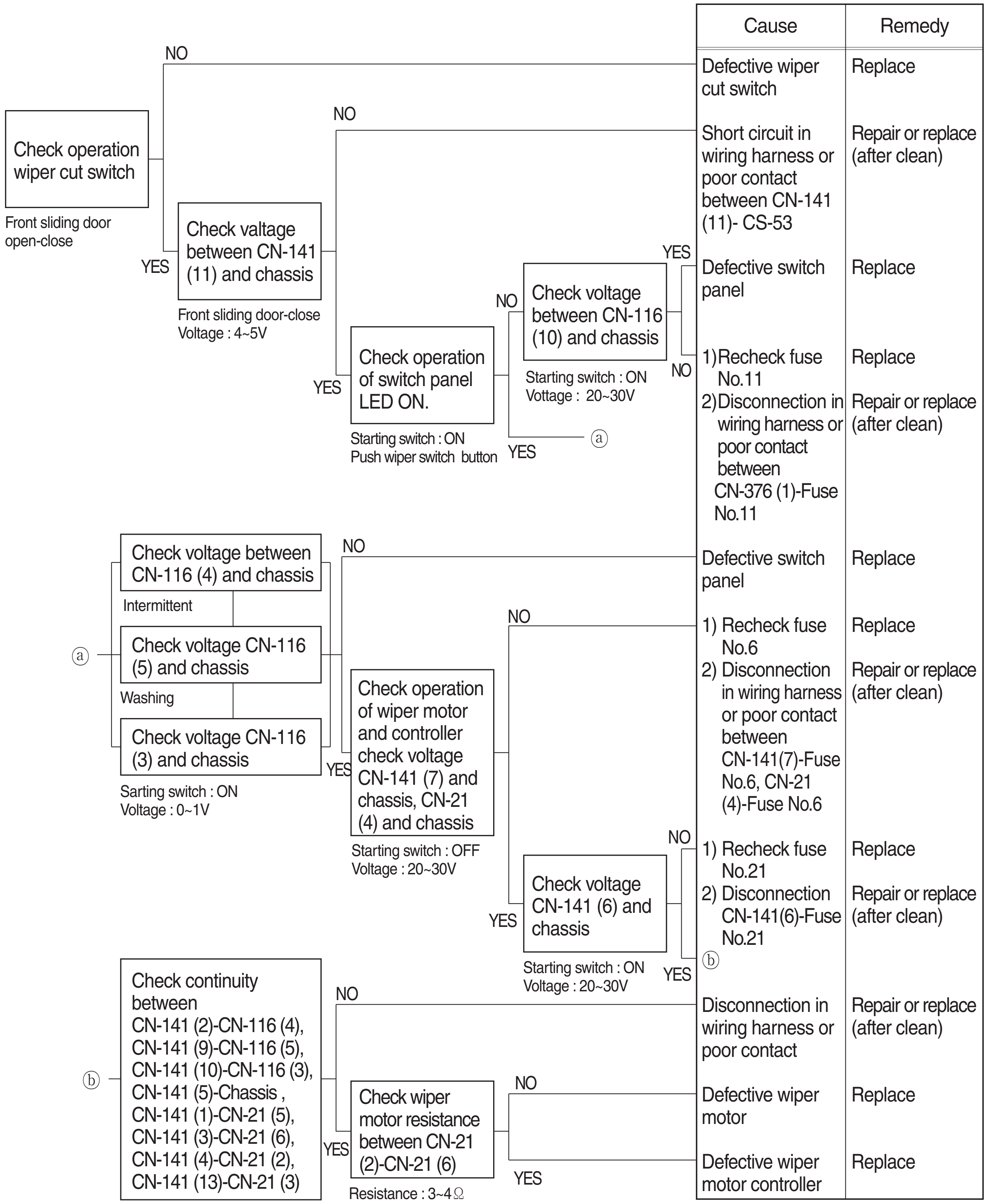
· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted, master switch ON and check blown out of the circuit breaker (CN-60).
· After checking, insert the disconnected connectors again immediately unless otherwise specified.

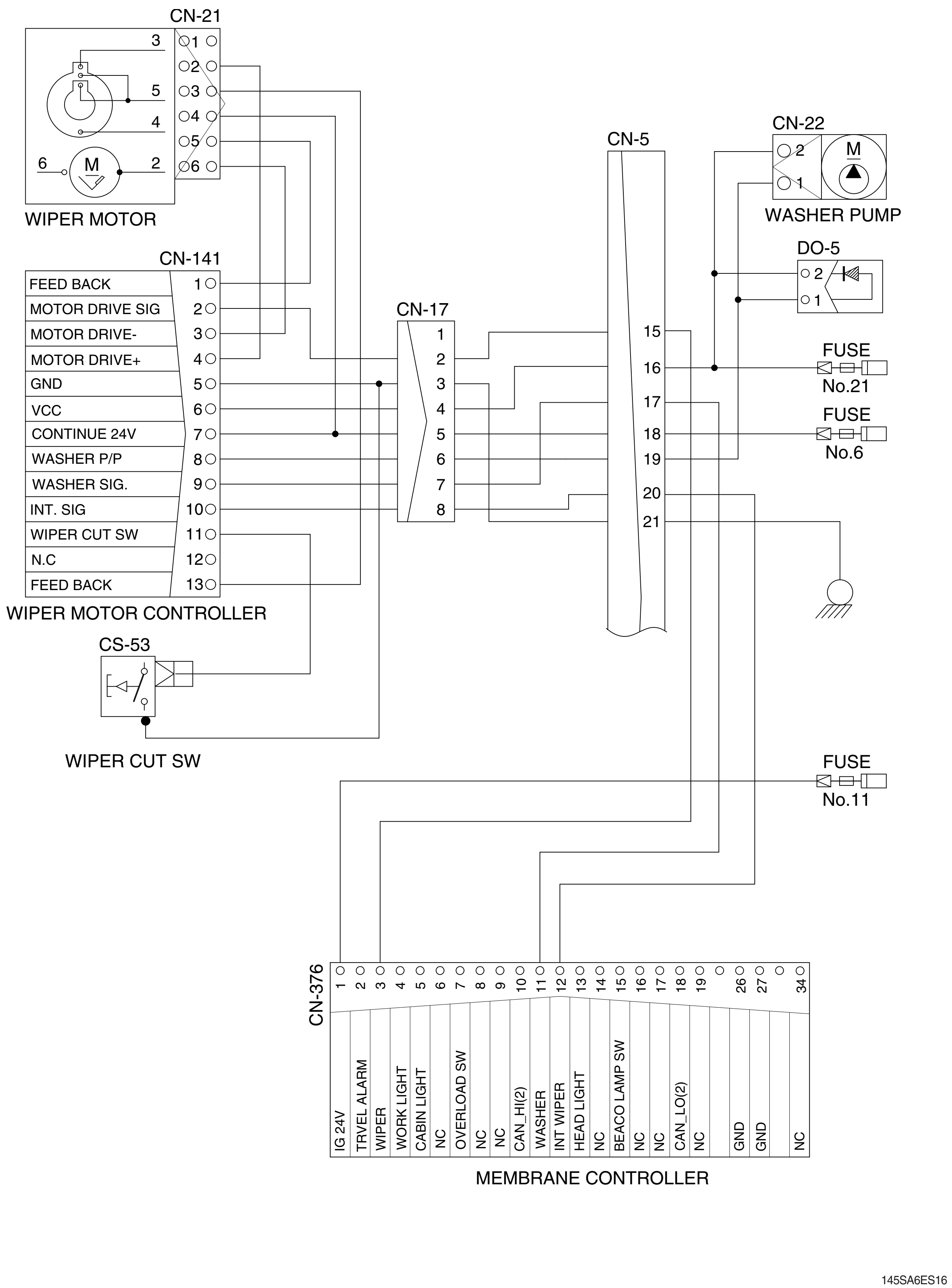




16. WHEN STARTING SWITCH IS TURNED ON, WIPER MOTOR DOES NOT OPERATE

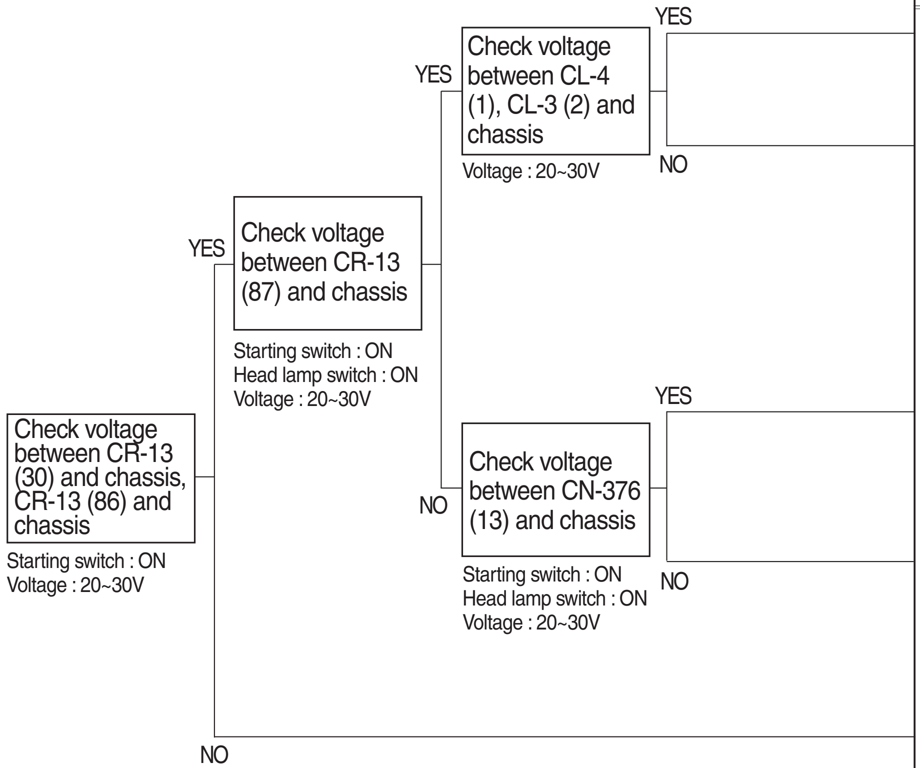
· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted and fuse No. 6, 11 and 21 is not blown out.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.



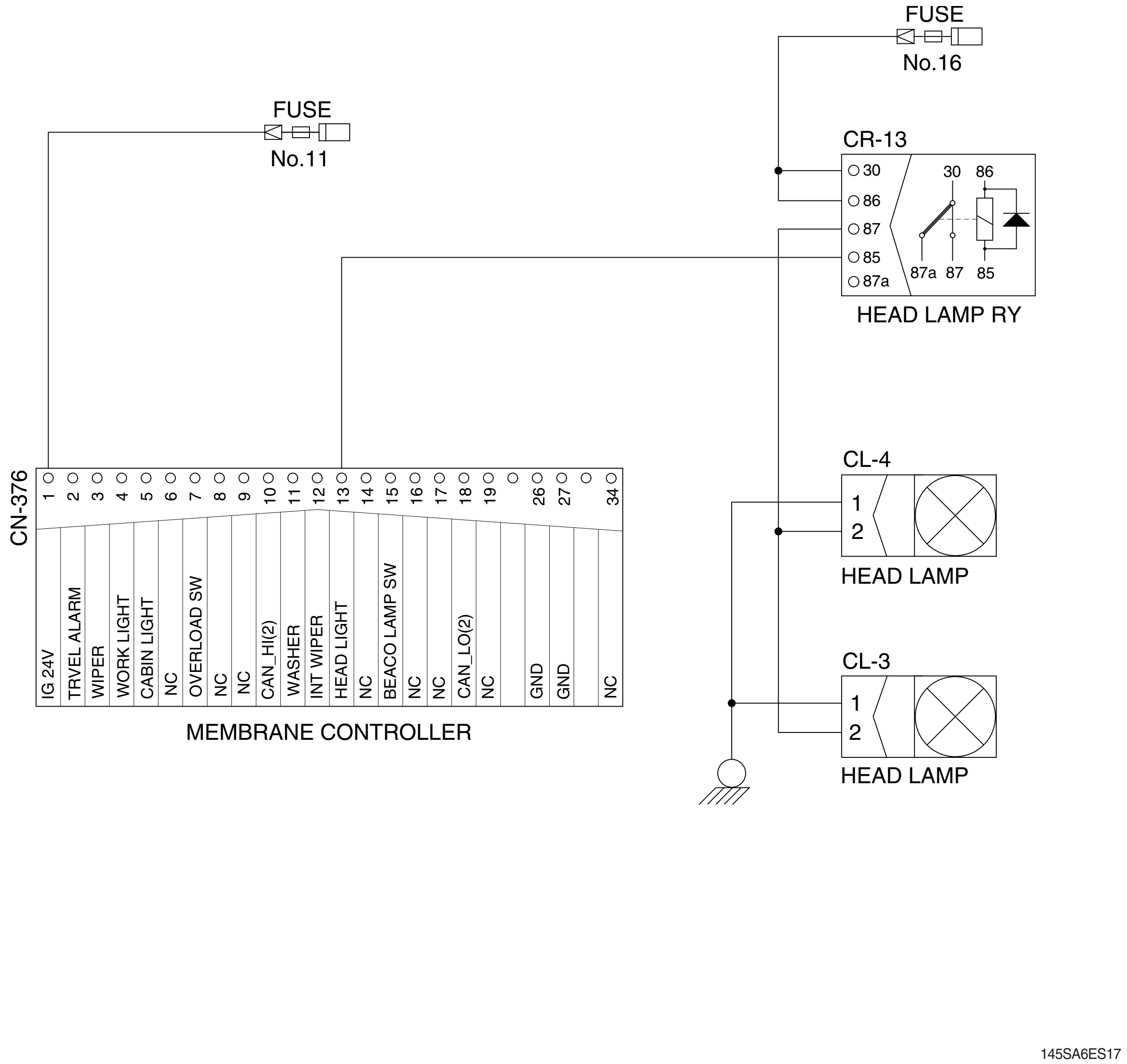


17. WHEN STARTING SWITCH IS TURNED ON, HEAD LAMP DOES NOT LIGHTS UP

· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted and short of fuse No.11 and 16.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.

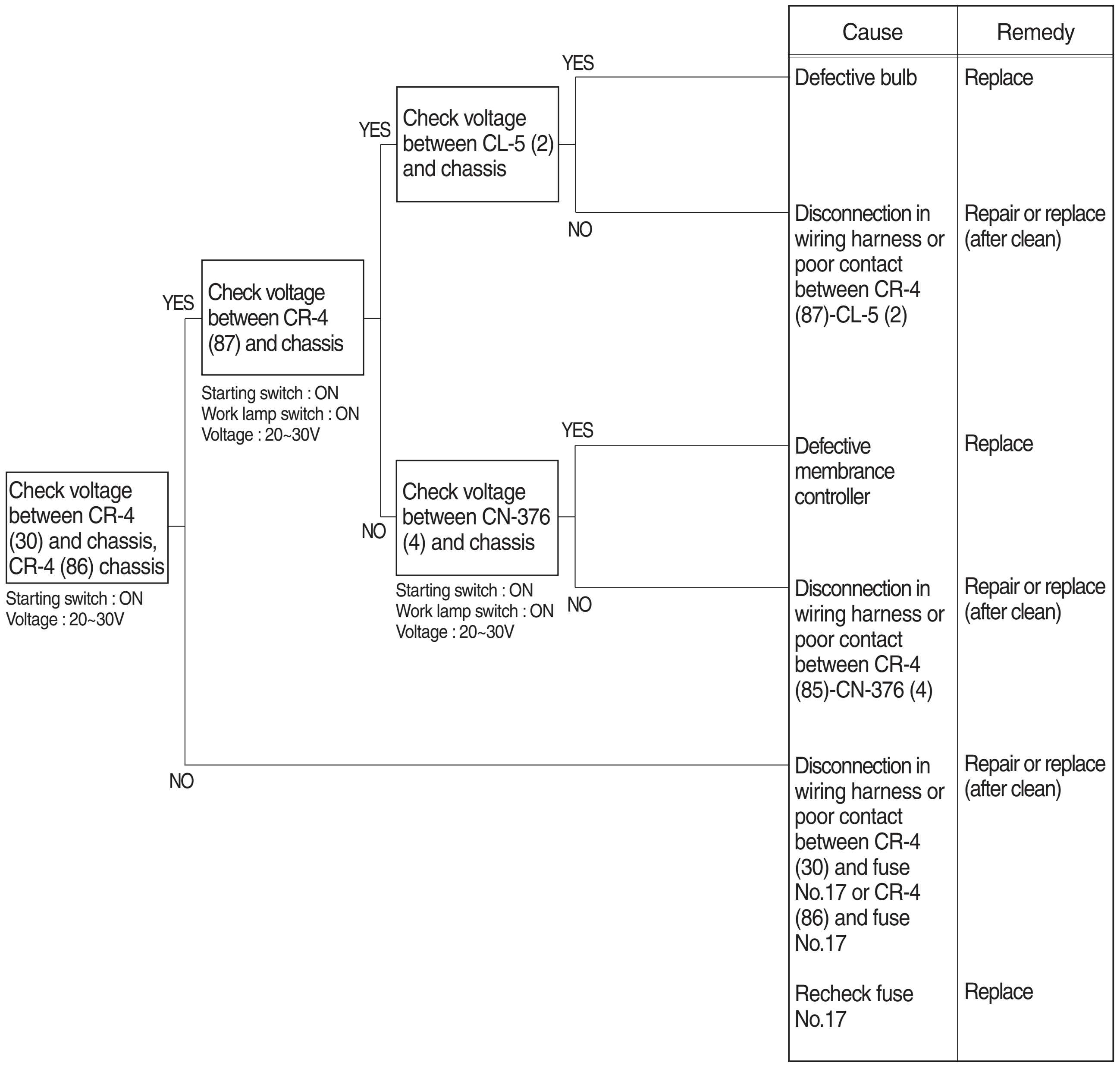


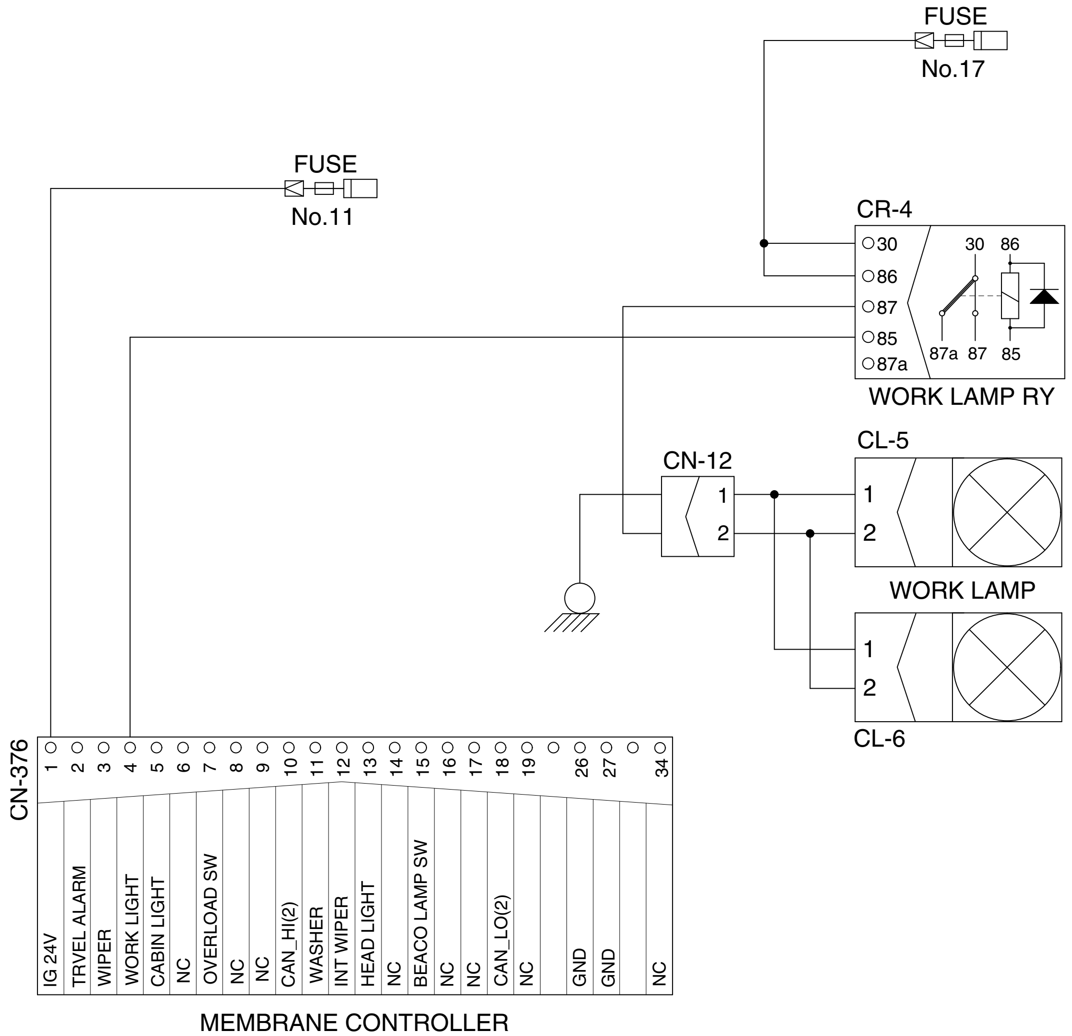
Cause	Remedy
Defective bulb	Replace
Disconnection in wiring harness or poor contact between CR-13 (87)-CL-4 (1) or CR-13 (87)-CL-3 (2)	Repair or replace (after clean)
Defective membrance controller	Replace
Disconnection in wiring harness or poor contact between CN-376 (13)-CR-13 (85)	Repair or replace (after clean)
Disconnection in wiring harness or poor contact between CR-13 (30) and fuse No.16 or CR-13 (86) - fuse No.16	Repair or replace (after clean)
Recheck fuse No. 16	Replace



18. WHEN STARTING SWITCH IS TURNED ON, WORK LAMP DOES NOT LIGHTS UP

· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted and short of fuse 11 and 17.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.





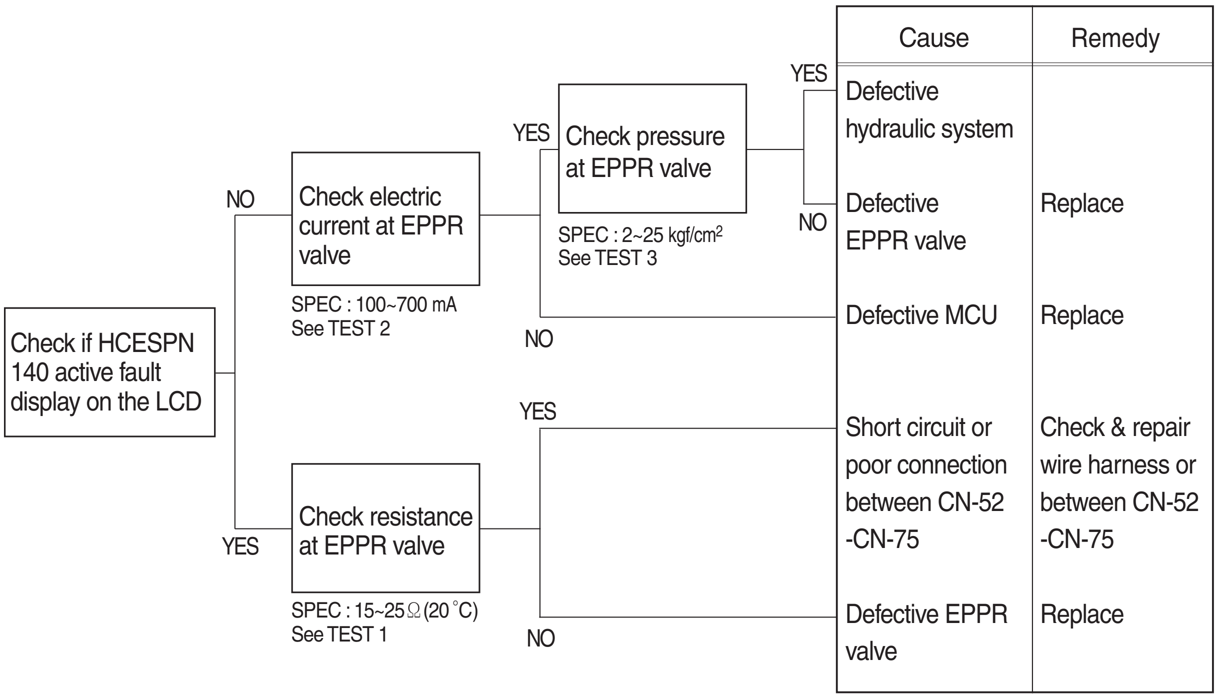
145SA6ES18

GROUP 4 MECHATRONICS SYSTEM

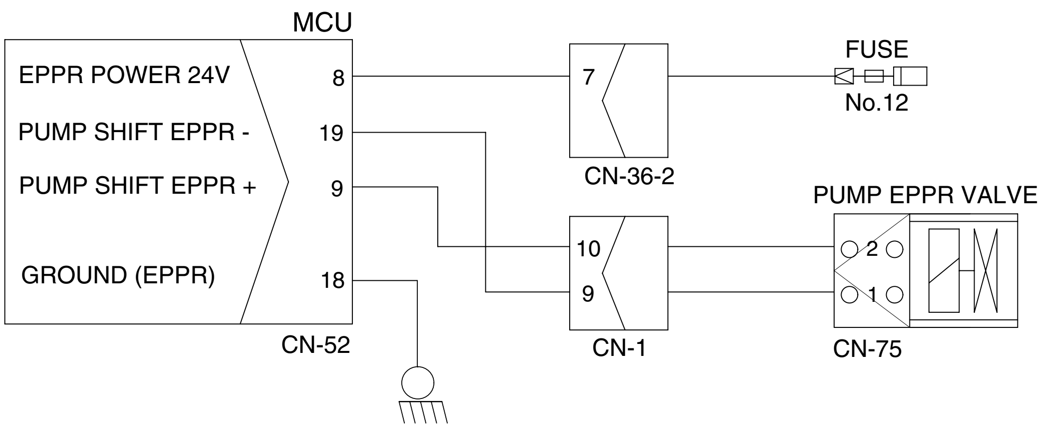
1. ALL ACTUATORS SPEED ARE SLOW

※ Boom, Arm, Bucket, Swing and travel speed are slow, but engine speed is good.
※ Spec : P-mode 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

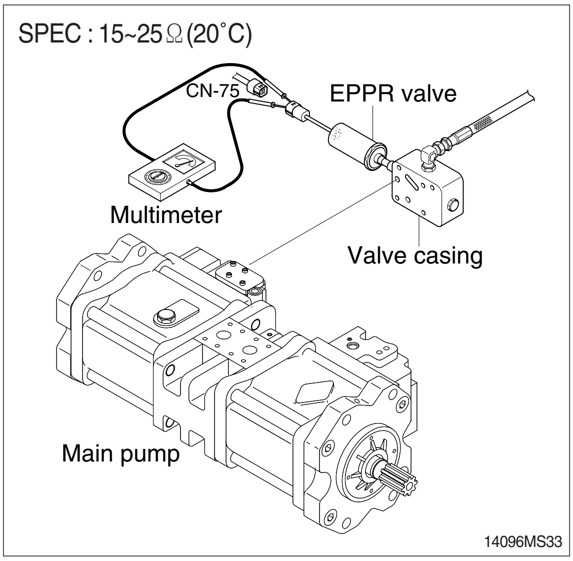


145SA6MS01

2) TEST PROCEDURE

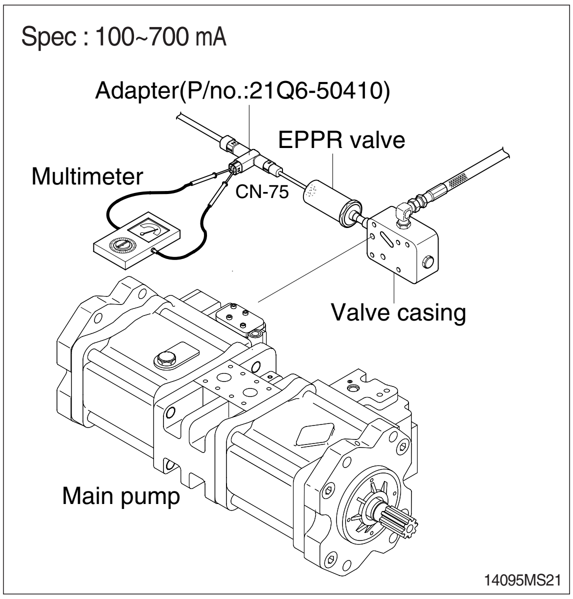
(1) Test 1 : Check resistance at connector CN-75.

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



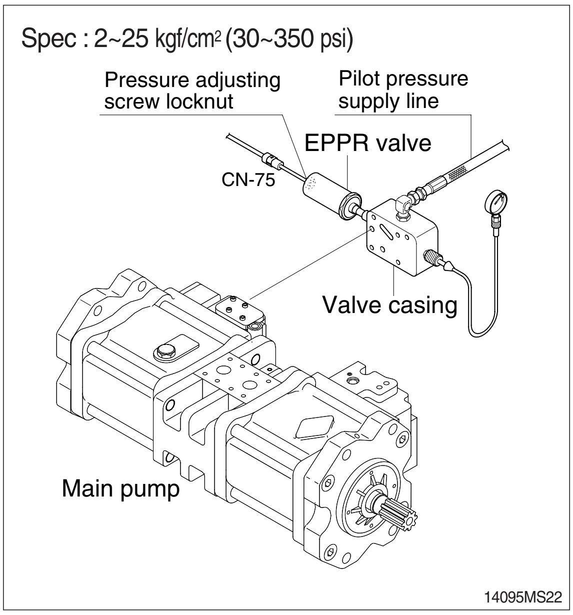
(2) Test 2 : Check electric current at EPPR valve.

① Disconnect connector CN-75 from EPPR valve.
② Insert the adapter to CN-75 and install multimeter as figure.
③ Start engine.
④ Set S-mode and cancel auto decel mode.
⑤ Position the accel dial at 10.
⑥ If tachometer show approx 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.

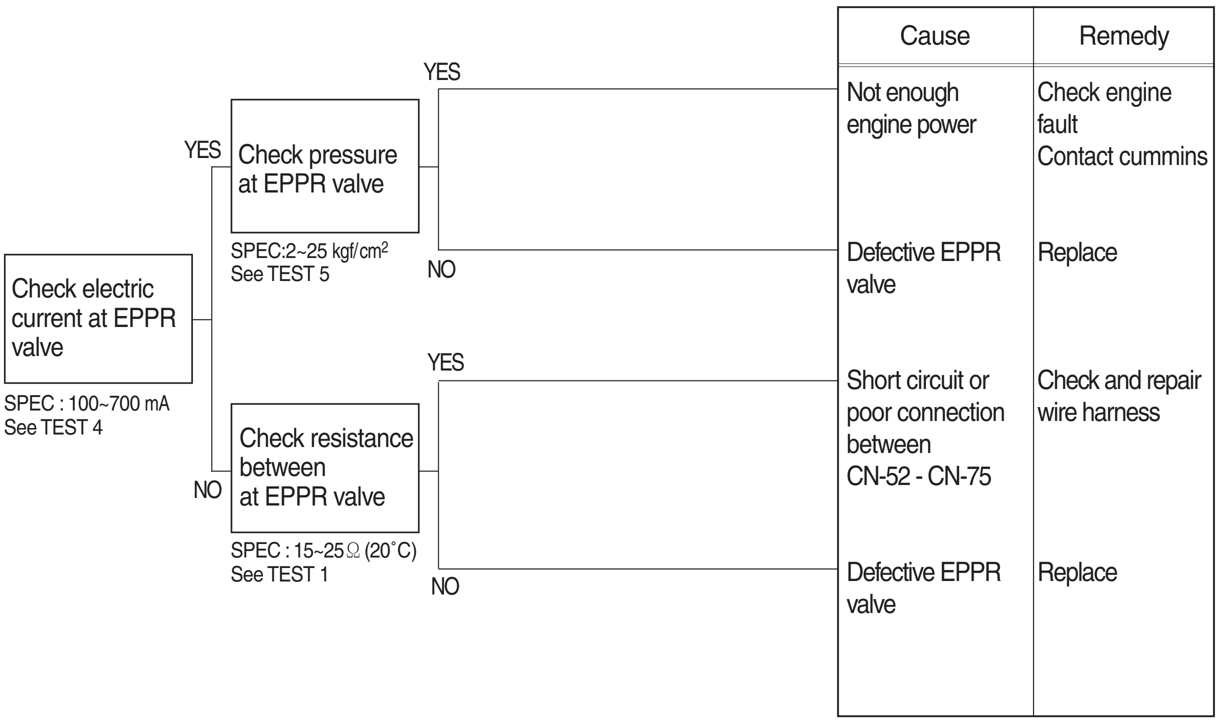
① Remove plug and connect pressure gauge as figure.
  · Gauge capacity : 0 to 50 kgf/cm^2 (0 to 725 psi)
② Start engine.
③ Set S-mode and cancel auto decel mode.
④ Position the accel dial at 10.
⑤ If tachometer show approx 1750±50 rpm check pressure at relief position of bucket circuit by operating bucket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



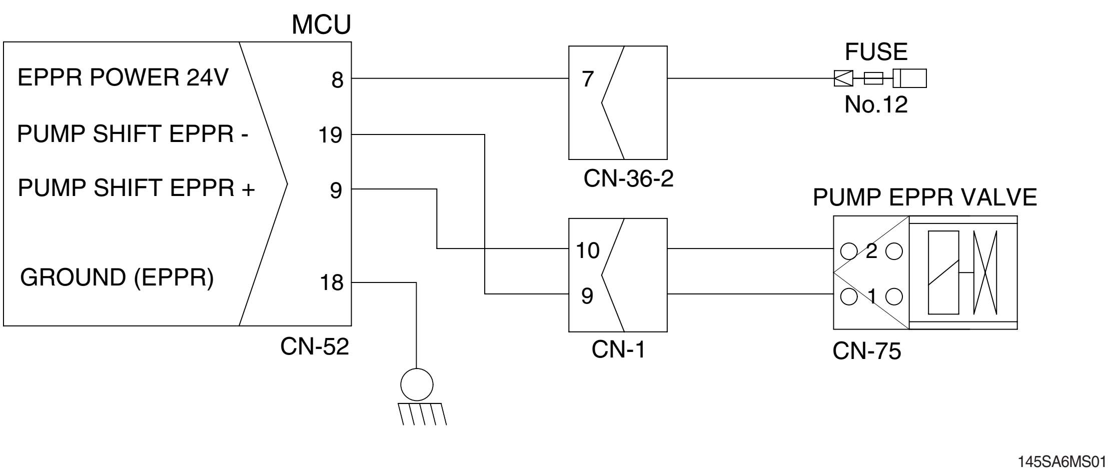
2. ENGINE STALL

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

1) INSPECTION PROCEDURE



Wiring diagram



2) TEST PROCEDURE

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

① Disconnect connector CN-75 from EPPR valve.

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

③ Start engine.

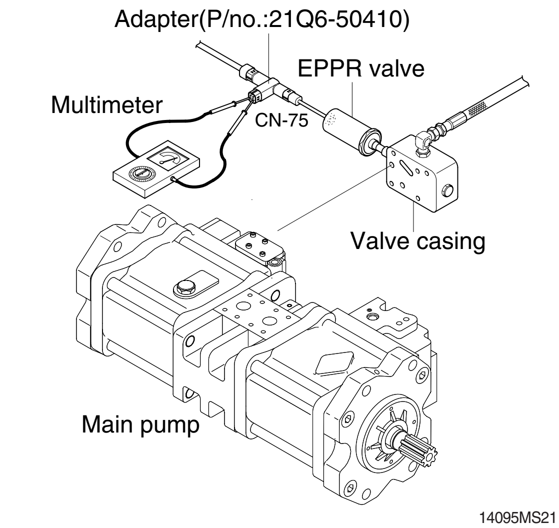
④ Set S-mode and cancel auto decel mode.

⑤ Position the accel dial at 10.

⑥ If rpm show approx 1750±50 rpm disconnect one wire harness from EPPR valve.

⑦ Check electric current at bucket circuit relief position.

Spec : 100~700 mA



(2) Test 5 : Check pressure at EPPR valve.

① Remove plug and connect pressure gauge as figure.

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

② Start engine.

③ Set S-mode and cancel auto decel mode.

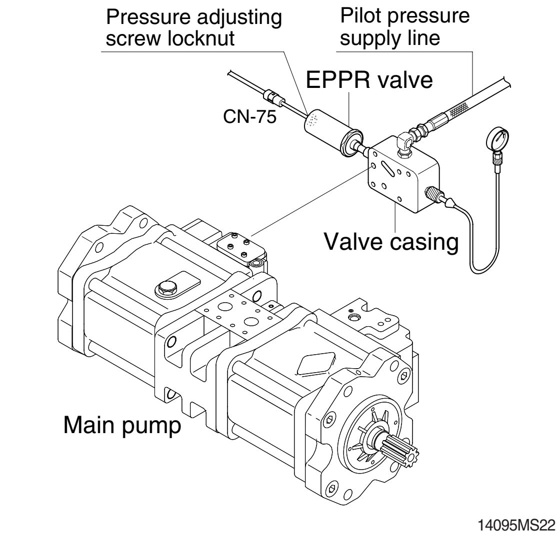
④ Position the accel dial at 10.

⑤ If rpm show approx 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.

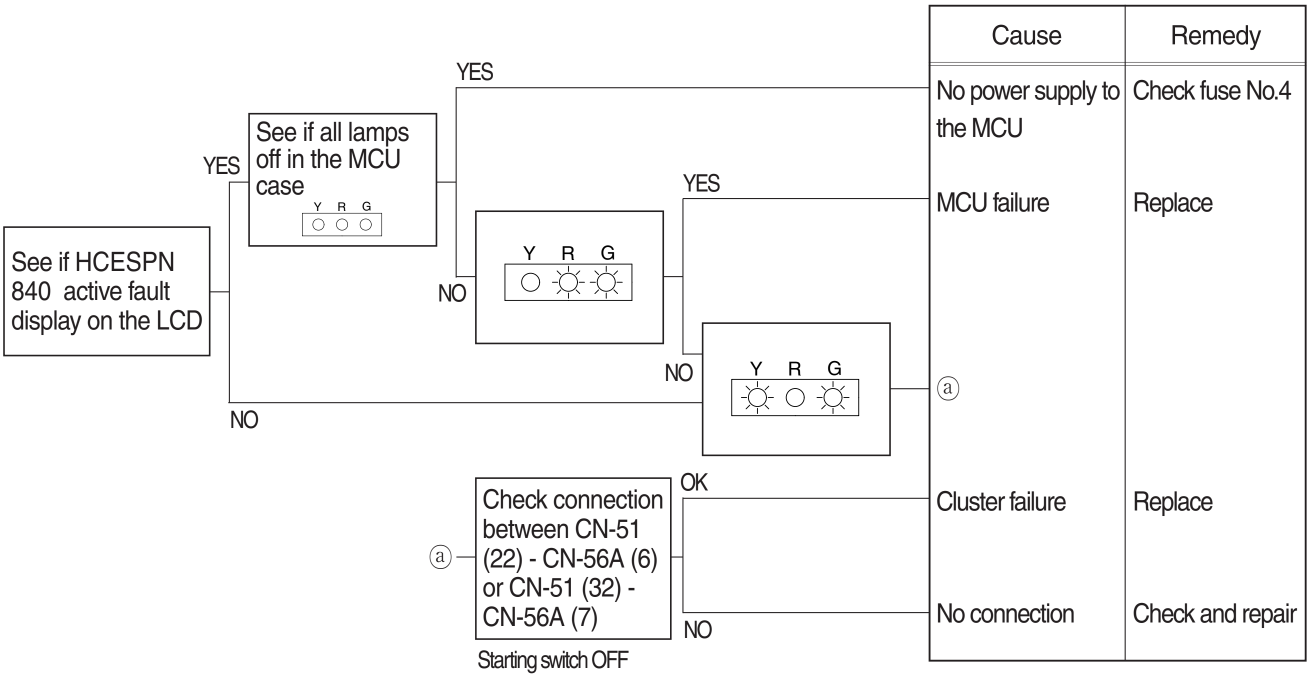
SPEC : 2~25 kgf/cm^2 (30~350 psi)



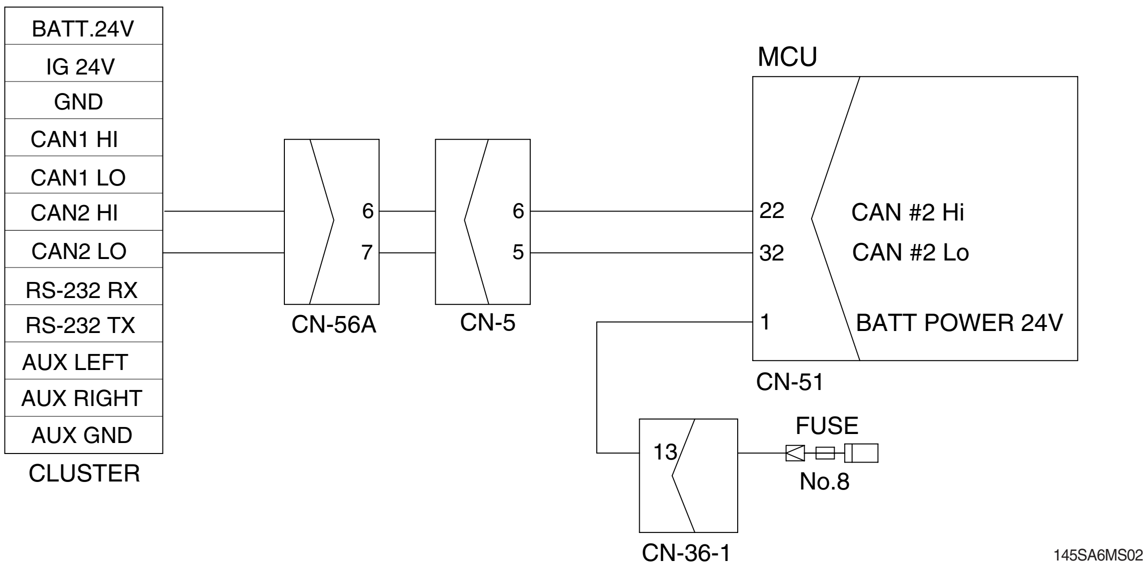
3. MALFUNCTION OF CLUSTER OR MODE SELECTION SYSTEM

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

1) INSPECTION PROCEDURE



Wiring diagram

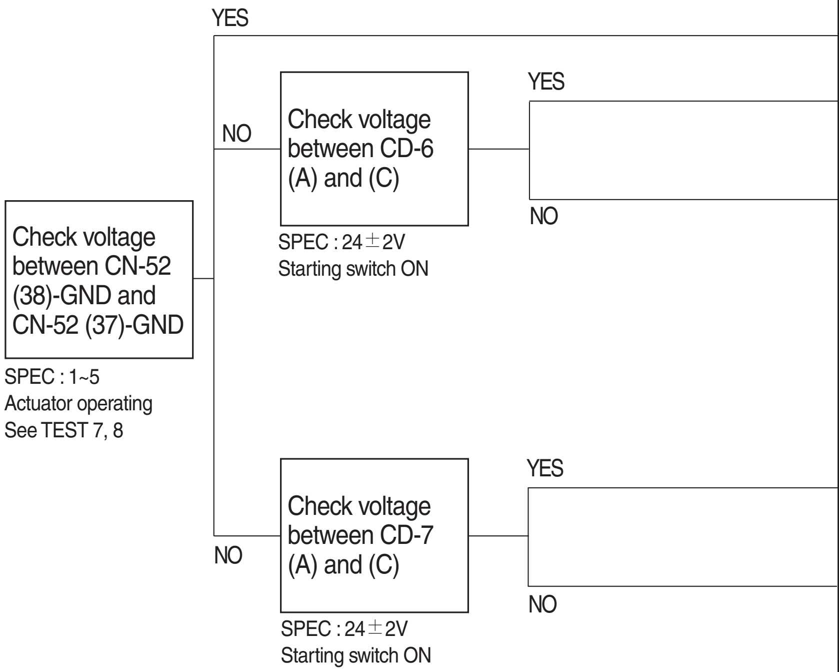


4. AUTO DECEL SYSTEM DOES NOT WORK

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

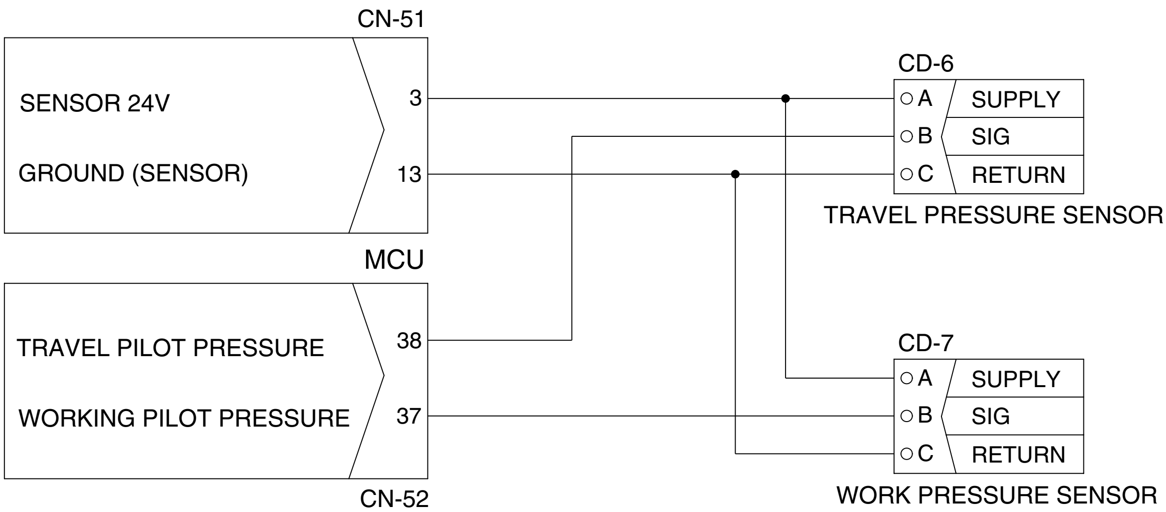
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



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

Wiring diagram



220S6MS03

2) TEST PROCEDURE

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

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

② Insert prepared pin to rear side of connectors : One pin to (38) of CN-52.

③ Starting switch key ON.

④ Check voltage as figure.

(2) Test 8 : Check voltage at CN-52 (37) and ground.

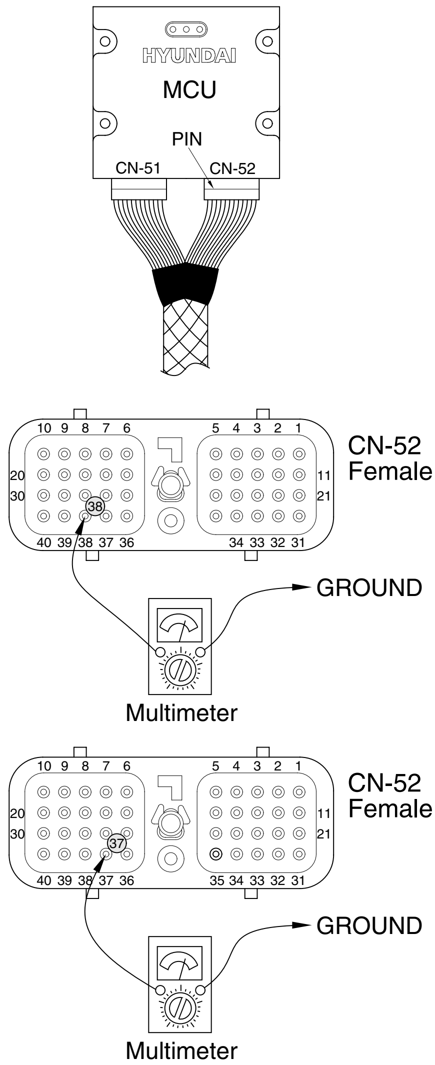
① Prepare 1 piece of thin sharp pin, steel or copper

② Insert prepared pin to rear side of connectors : One pin to (37) of CN-52.

③ Starting switch ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V



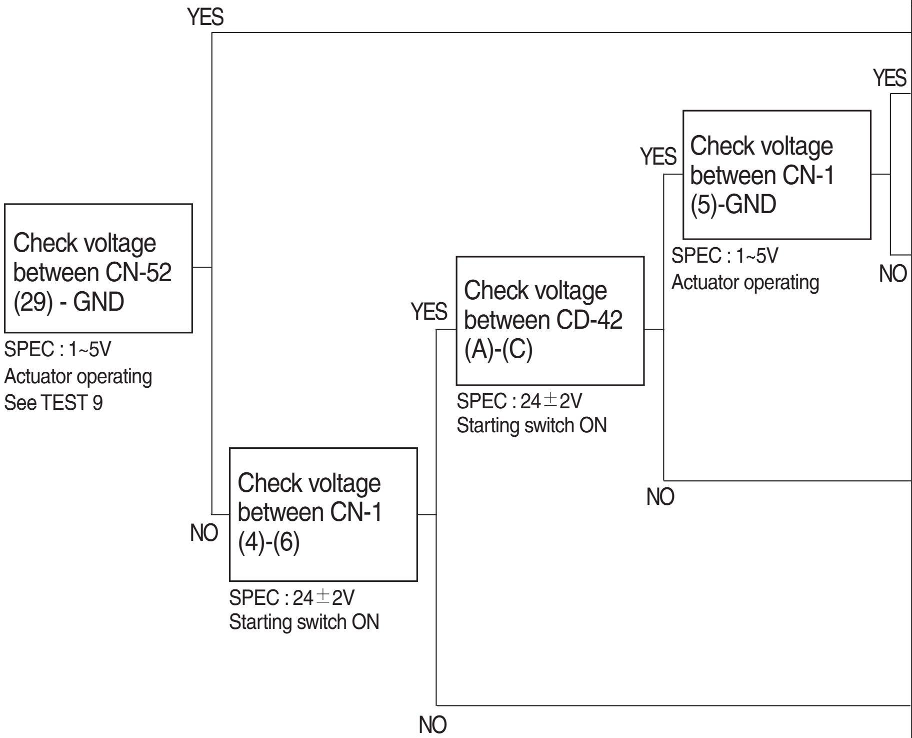
300L6MS04

5. MALFUNCTION OF PUMP 1 PRESSURE SENSOR

· Fault code : HCESPN 120, FMI 0~4

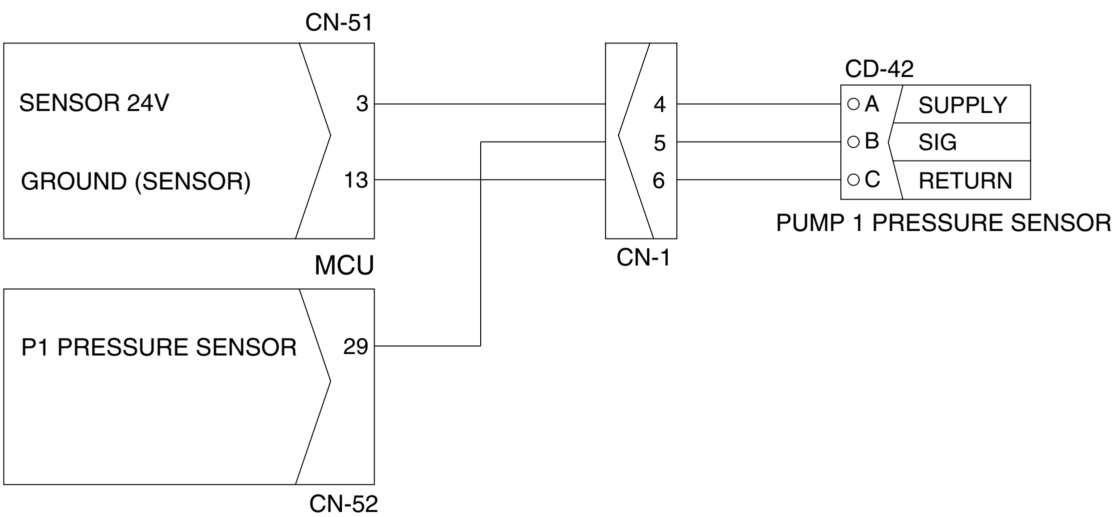
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective MCU	Replace
Short circuit or poor connection between CN-52-(29)-CN-1 (5)	Replace or repair
Detective P1 pressure sensor	Replace or repair
Short circuit or poor connection between CN-1 (5)-CD-42 (B)	Replace or repair
Short circuit or poor connection between CD-42 (A)-CN-1 (4) or CD-42 (C)-CN-1 (6)	Replace or repair
Short circuit or poor connection between CN-1 (4)-CN-51 (3) or CN-1 (6) - CN-51 (13)	Replace or repair

Wiring diagram



145SA6MS05

2) TEST PROCEDURE

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

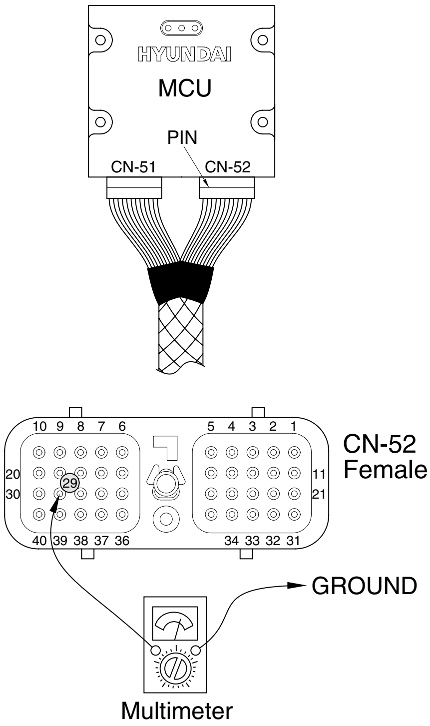
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (29) of CN-52.

③ Starting switch ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V



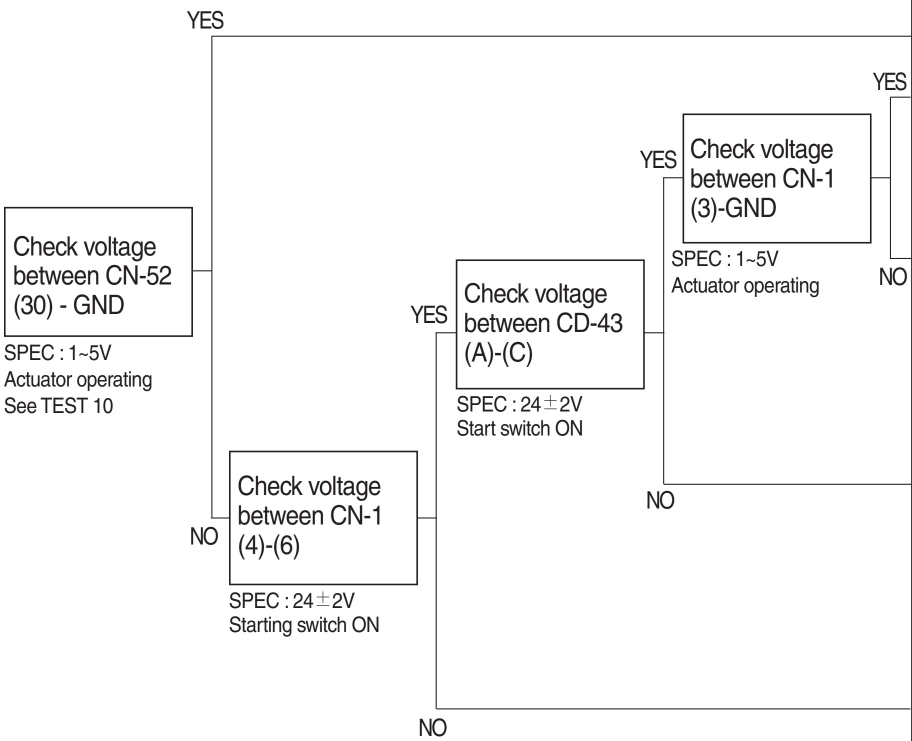
300L6MS06

6. MALFUNCTION OF PUMP 2 PRESSURE SENSOR

· Fault code : HCESPN 121, FMI 0~4

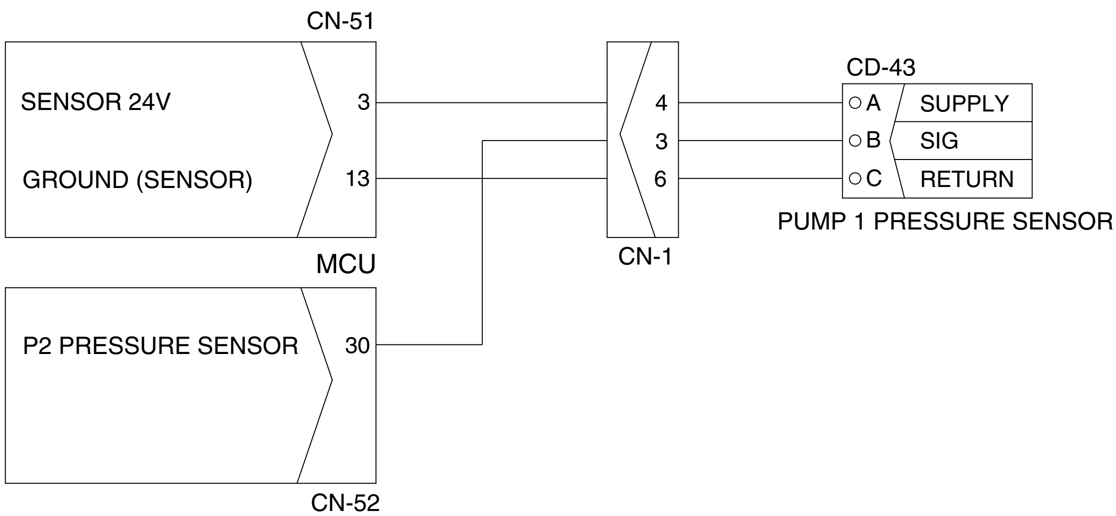
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective MCU	Replace
Short circuit or poor connection between CN-52-(30)-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



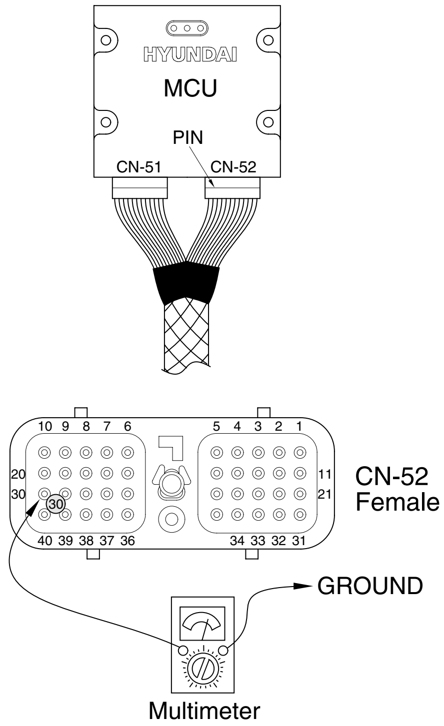
145SA6MS07

2) TEST PROCEDURE

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

① Prepare 1 piece of thin sharp pin, steel or copper.
② Insert prepared pin to rear side of connectors : One pin to (30) of CN-52.
③ Starting switch ON.
④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V



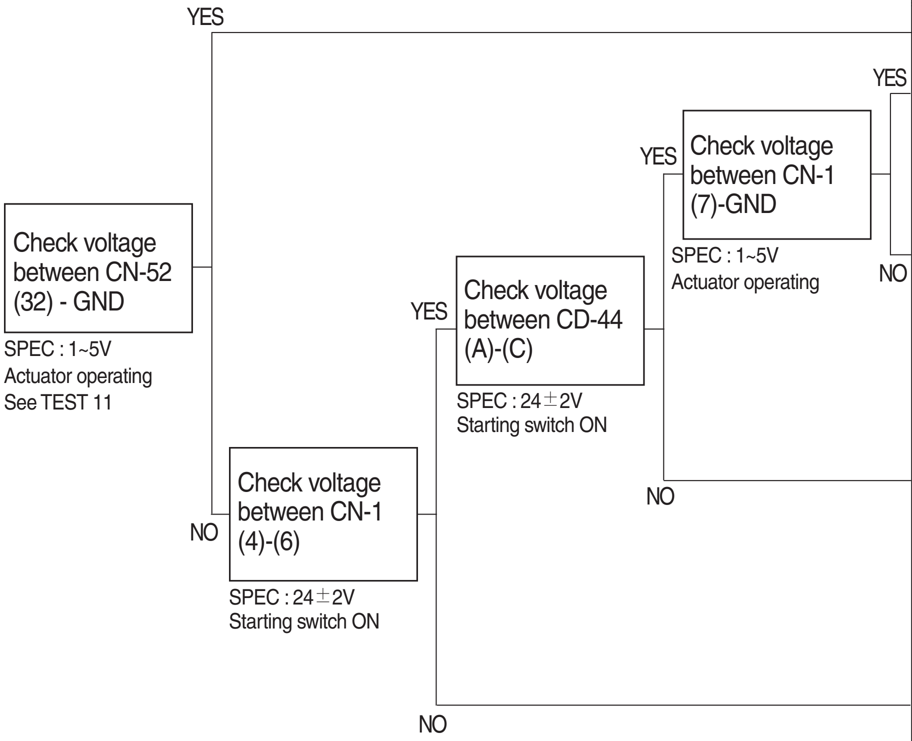
220S6MS08

7. MALFUNCTION OF PUMP 3 PRESSURE SENSOR

· Fault code : HCESPN 125, FMI 0~4

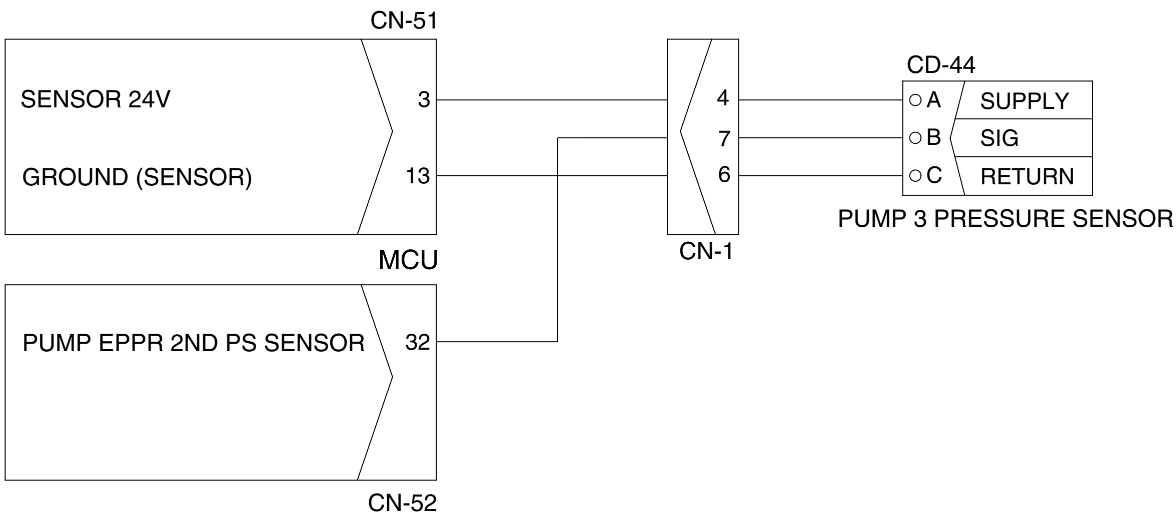
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



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



145SA6MS09

2) TEST PROCEDURE

(1) Test 11 : Check voltage at CN-52 (32) and ground.

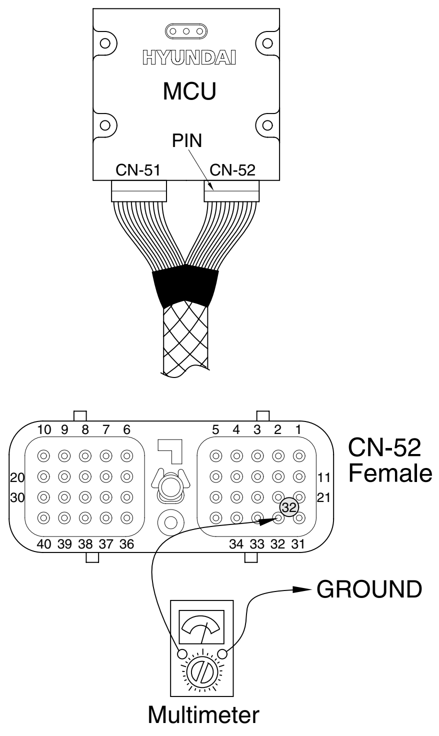
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (32) of CN-52.

③ Starting switch ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V



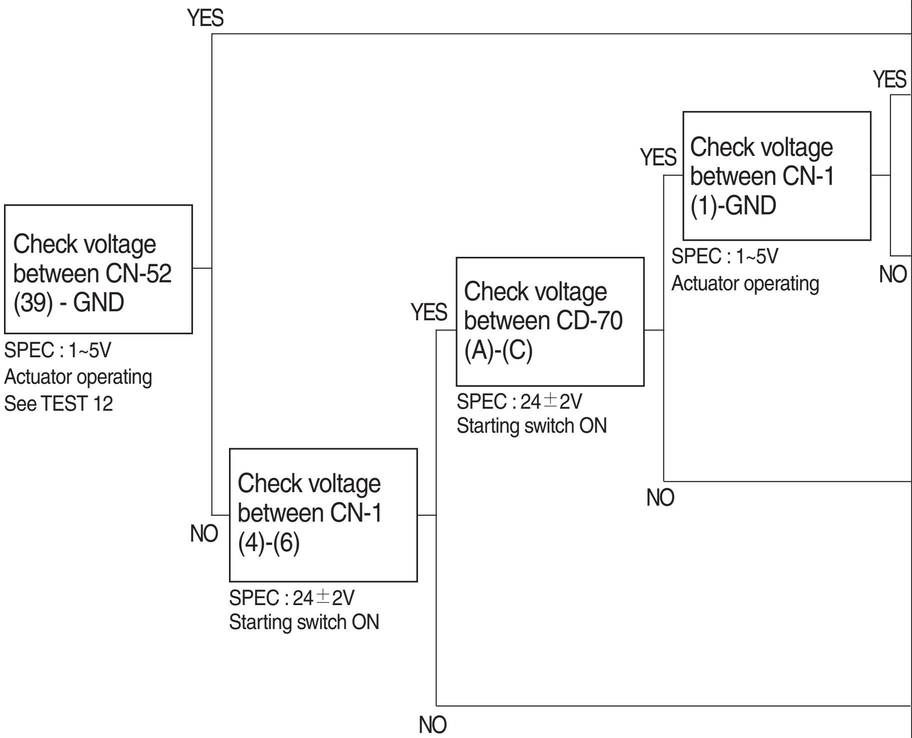
300L6MS10

8. MALFUNCTION OF NEGATIVE 1 PRESSURE SENSOR

· Fault code : HCESPN 123, FMI 0~4

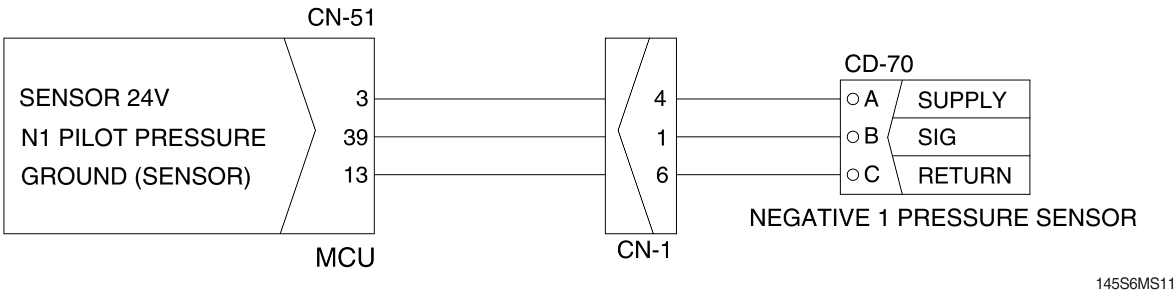
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective MCU	Replace
Short circuit or poor connection between CN-52-(39)-CN-1 (1)	Replace or repair
Detective N1 pressure sensor	Replace or repair
Short circuit or poor connection between CN-1 (1)-CD-70 (B)	Replace or repair
Short circuit or poor connection between CD-70 (A)-CN-1 (4) or CD-70 (C)-CN-1 (6)	Replace or repair
Short circuit or poor connection between CN-1 (4)-CN-51 (3) or CN-1 (6)-CN-51 (13)	Replace or repair

Wiring diagram



2) TEST PROCEDURE

(1) Test 12 : Check voltage at CN-52 (39) and ground.

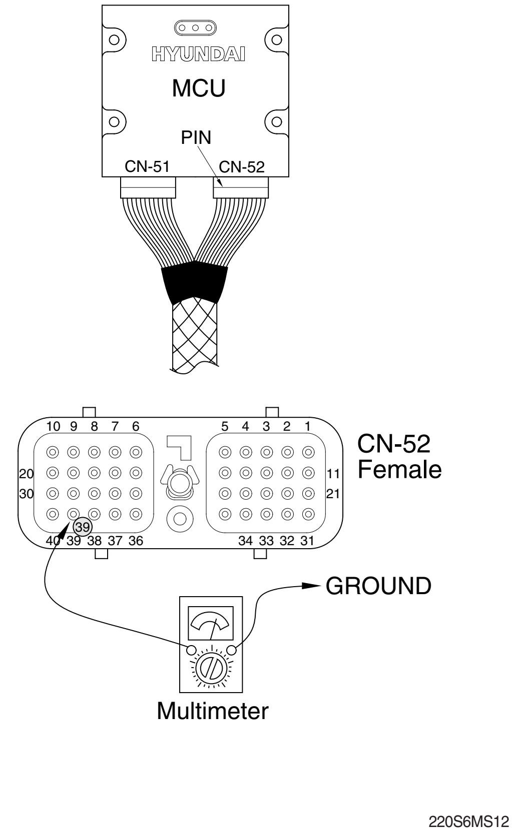
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (39) of CN-52.

③ Starting switch ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V

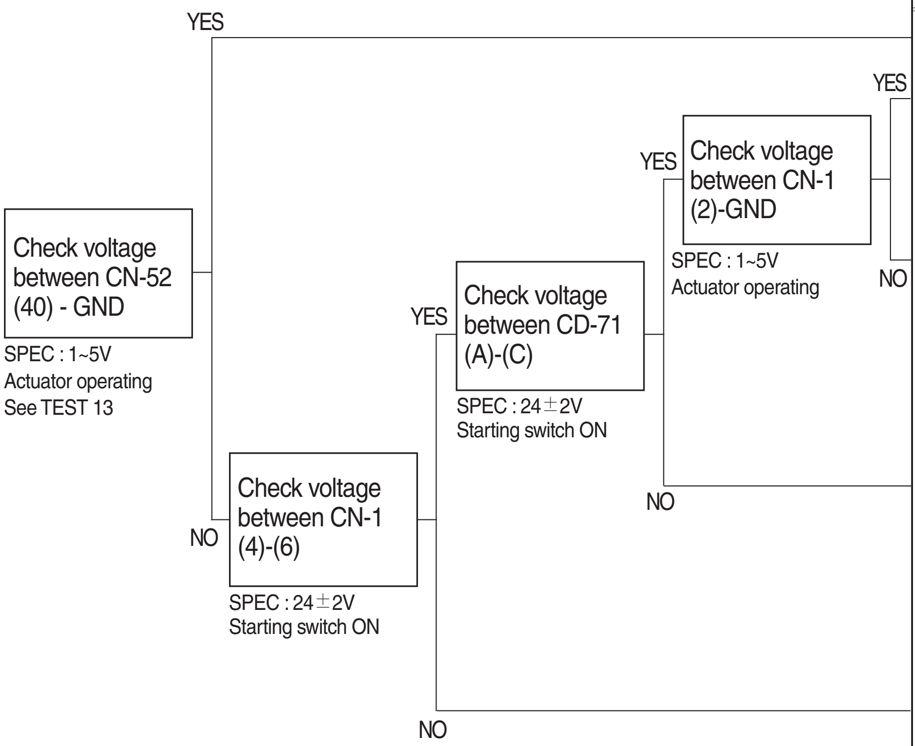


9. MALFUNCTION OF NEGATIVE 2 PRESSURE SENSOR

· Fault code : HCESPN 124, FMI 0~4

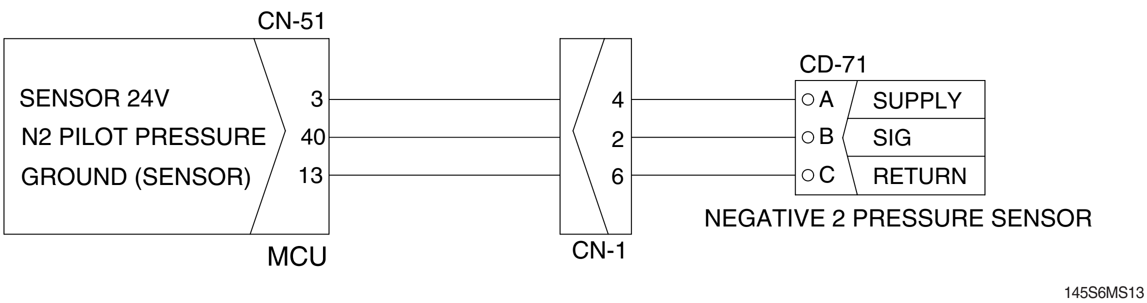
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective MCU	Replace
Short circuit or poor connection between CN-52-(40)-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



2) TEST PROCEDURE

(1) Test 13 : Check voltage at CN-52 (40) and ground.

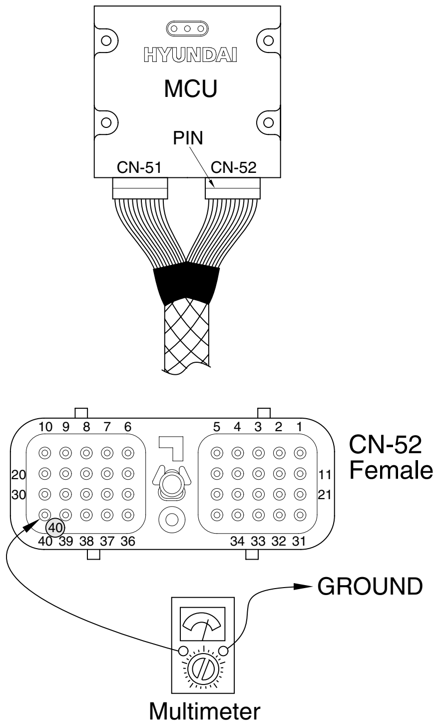
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (40) of CN-52.

③ Starting switch ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V



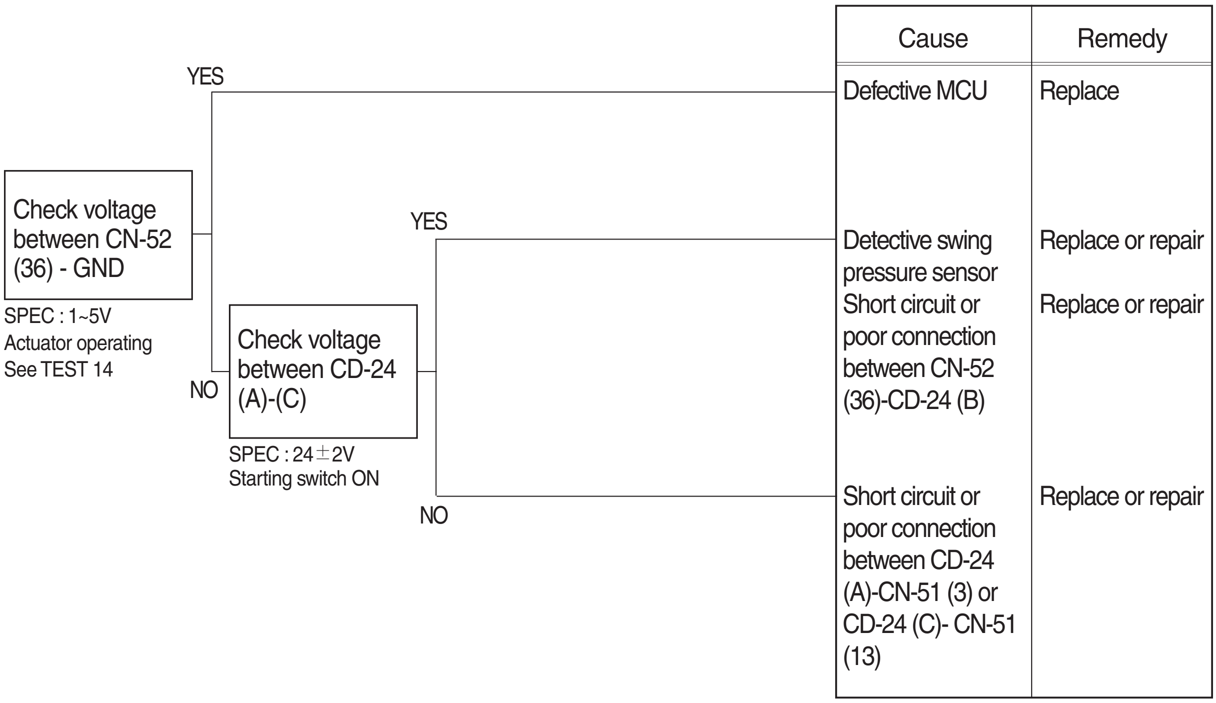
220S6MS14

10. MALFUNCTION OF SWING PRESSURE SENSOR

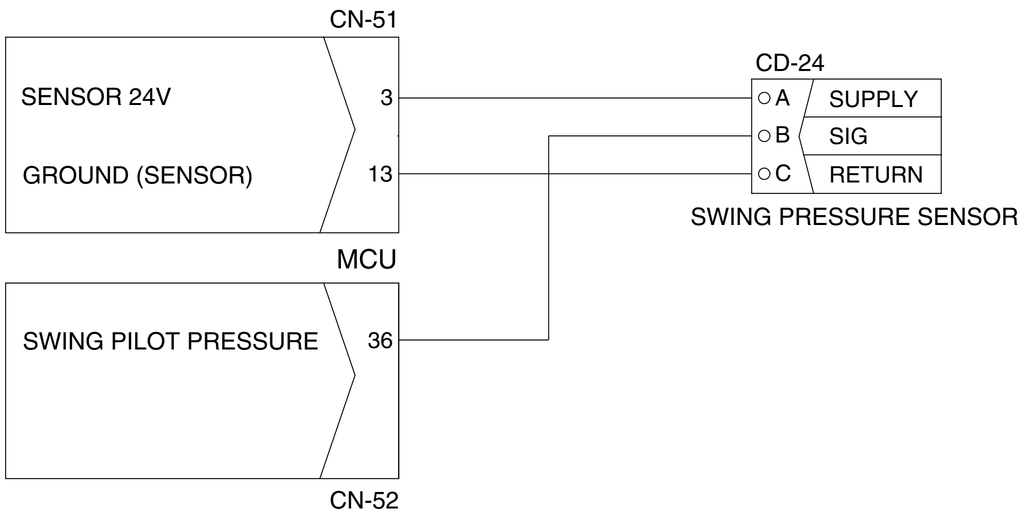
· Fault code : HCESPN 135, FMI 0~4

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

1) INSPECTION PROCEDURE



Wiring diagram



220S6MS15

2) TEST PROCEDURE

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

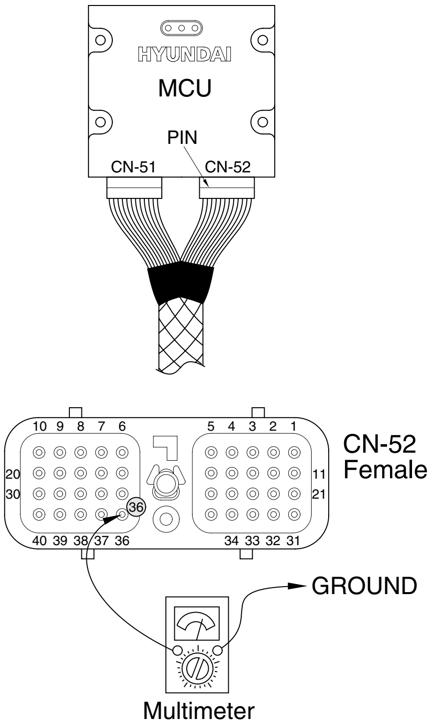
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (36) of CN-52.

③ Starting switch ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V



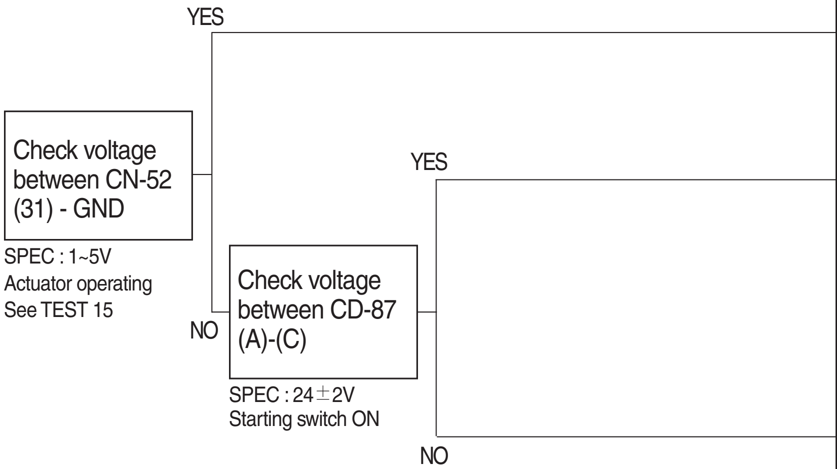
300L6MS16

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

· Fault code : HCESPN 133, FMI 0~4

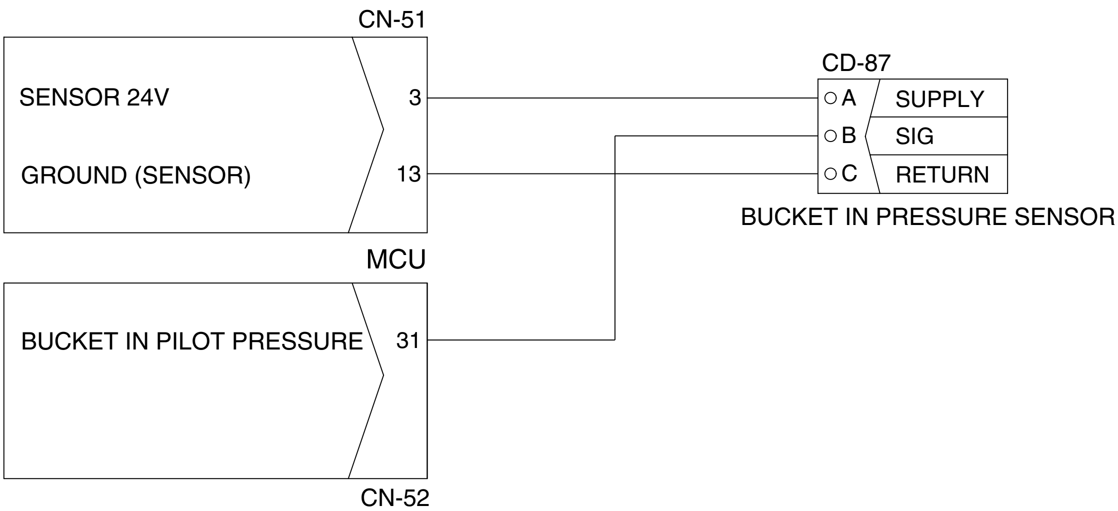
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective MCU	Replace
Detective bucket in pressure sensor	Replace or repair
Short circuit or poor connection between CN-52 (31)-CD-87 (B)	Replace or repair
Short circuit or poor connection between CD-87 (A)-CN-51 (3) or CD-87 (C)- CN- 51 (13)	Replace or repair

Wiring diagram



145SA6MS17

2) TEST PROCEDURE

(1) Test 15 : Check voltage at CN-52 (31) and ground.

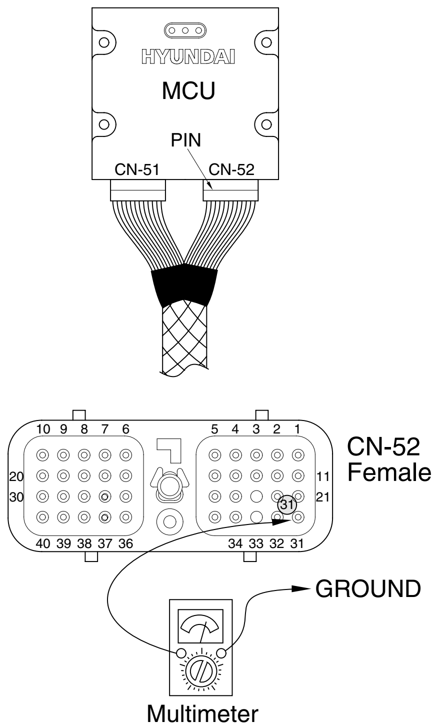
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (31) of CN-52.

③ Starting key ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V



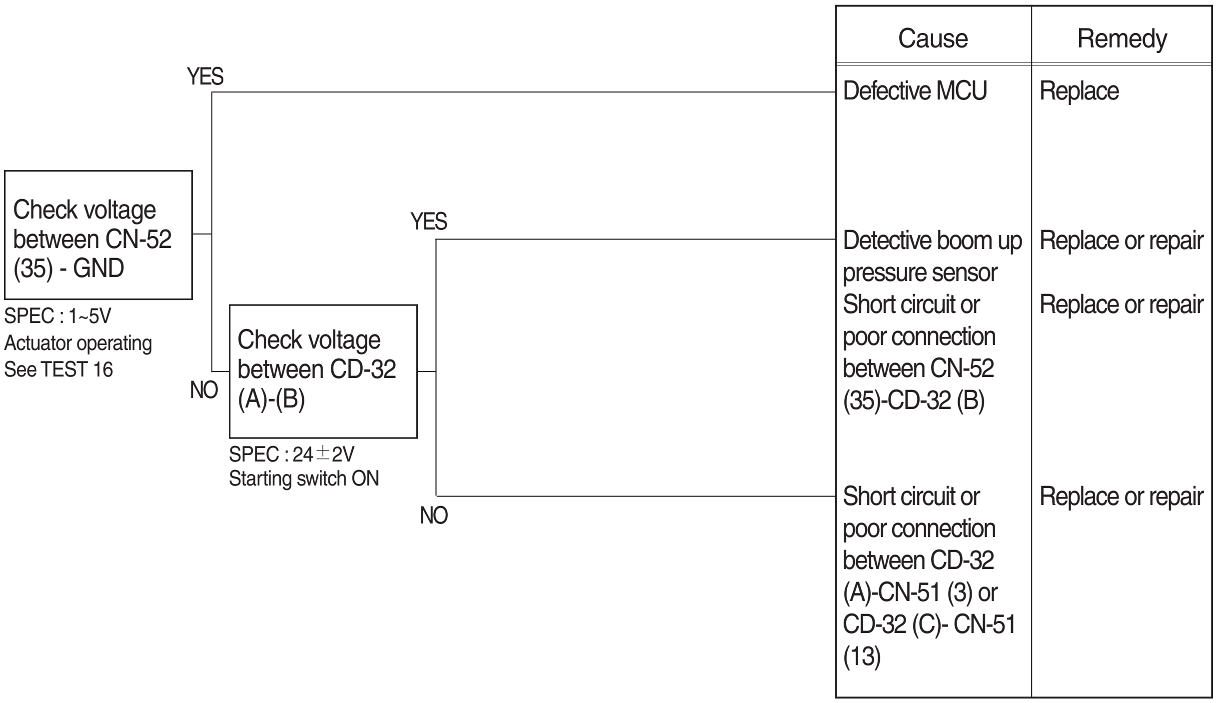
145SA6MS18

12. MALFUNCTION OF BOOM UP PRESSURE SENSOR

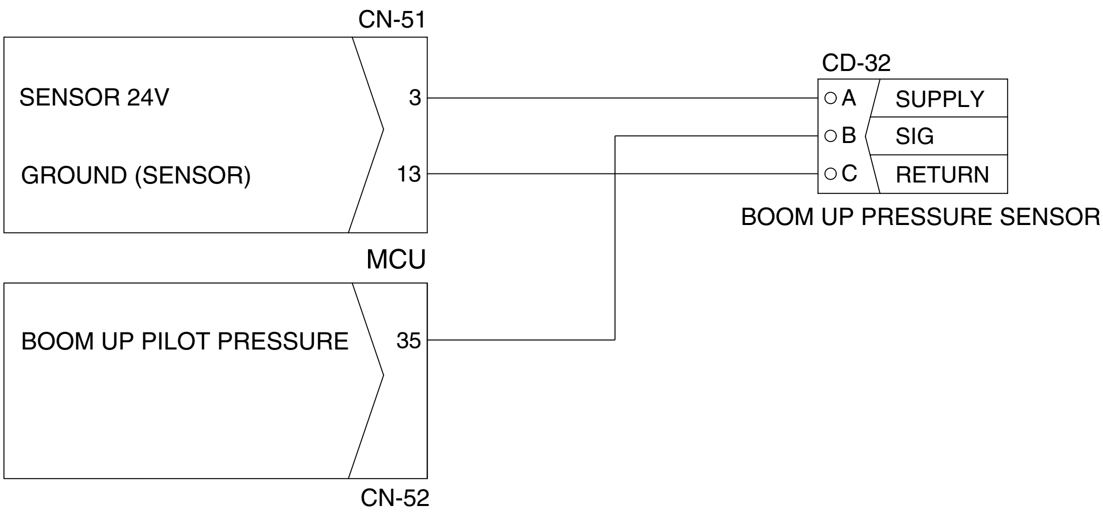
· Fault code : HCESPN 127, FMI 0~4

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

1) INSPECTION PROCEDURE



Wiring diagram



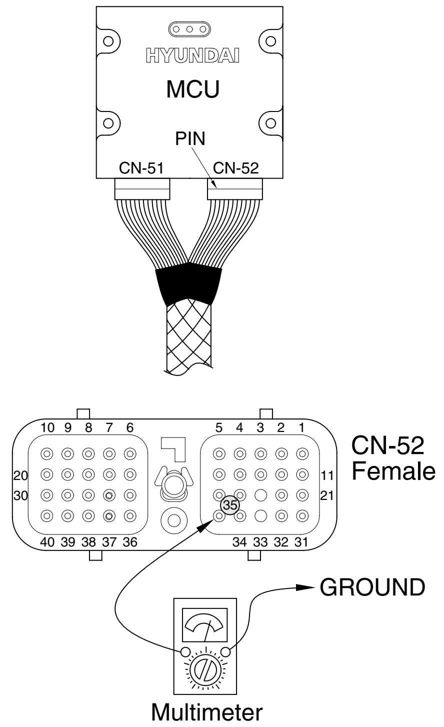
220S6MS19

2) TEST PROCEDURE

(1) Test 16 : Check voltage at CN-52 (35) and ground.

① Prepare 1 piece of thin sharp pin, steel or copper.
② Insert prepared pin to rear side of connectors : One pin to (35) of CN-52.
③ Starting switch ON.
④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V



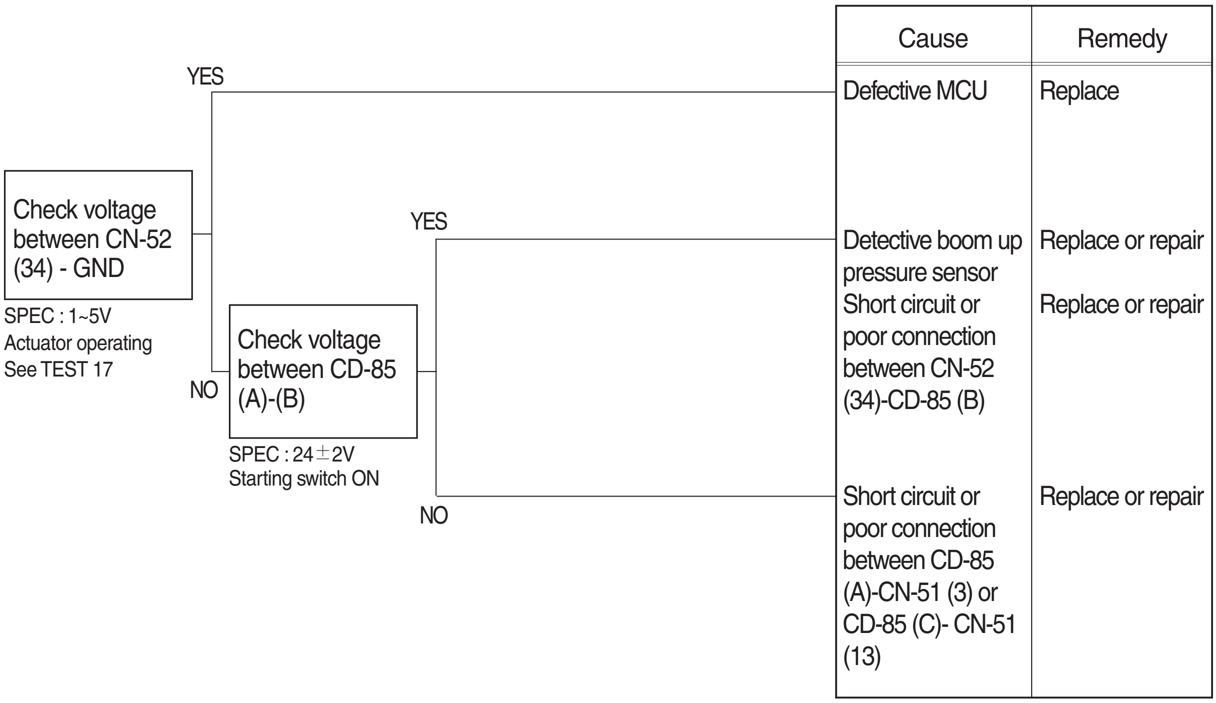
220S6MS20

13. MALFUNCTION OF BOOM DOWN PRESSURE SENSOR

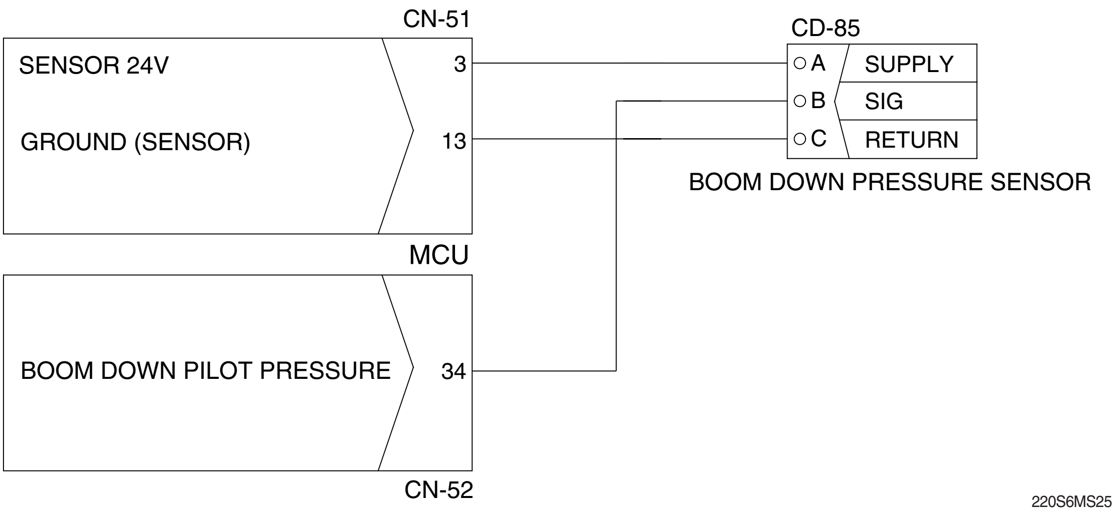
· Fault code : HCESPN 128, FMI 0~4

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

1) INSPECTION PROCEDURE



Wiring diagram

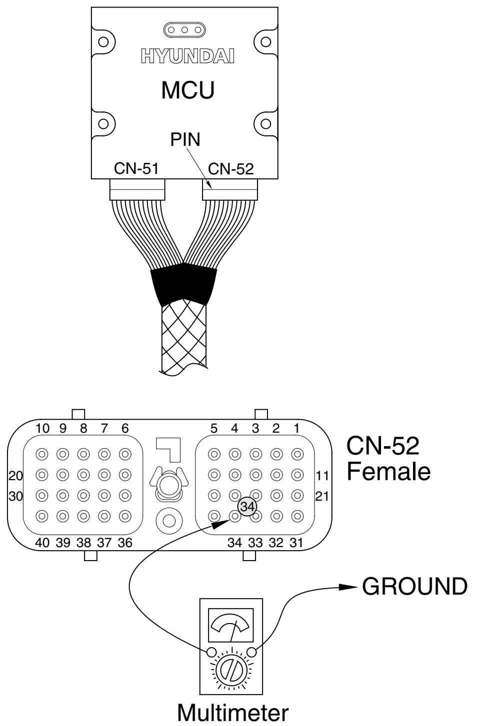


2) TEST PROCEDURE

(1) Test 17 : Check voltage at CN-52 (34) and ground.

① Prepare 1 piece of thin sharp pin, steel or copper.
② Insert prepared pin to rear side of connectors : One pin to (34) of CN-52.
③ Starting switch ON.
④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V



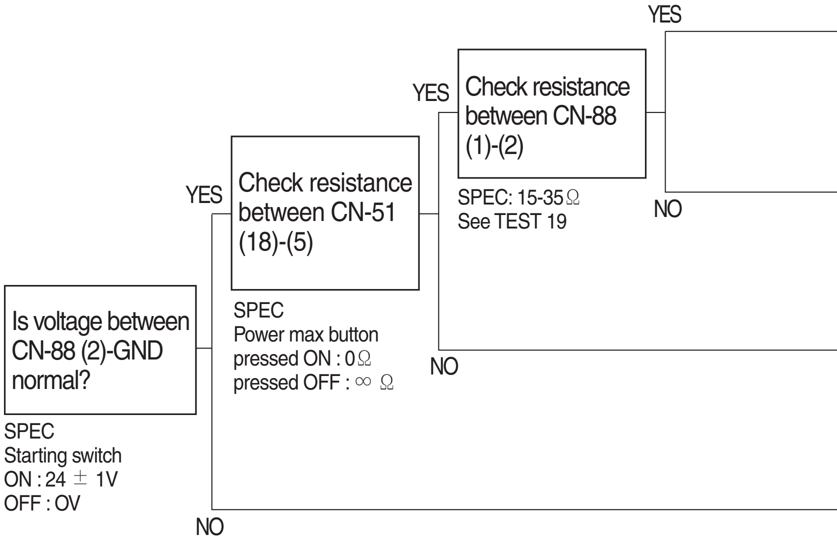
220S6MS26

14. MALFUNCTION OF POWER MAX

· Fault code : HCESPN 166, FMI 4 or 6

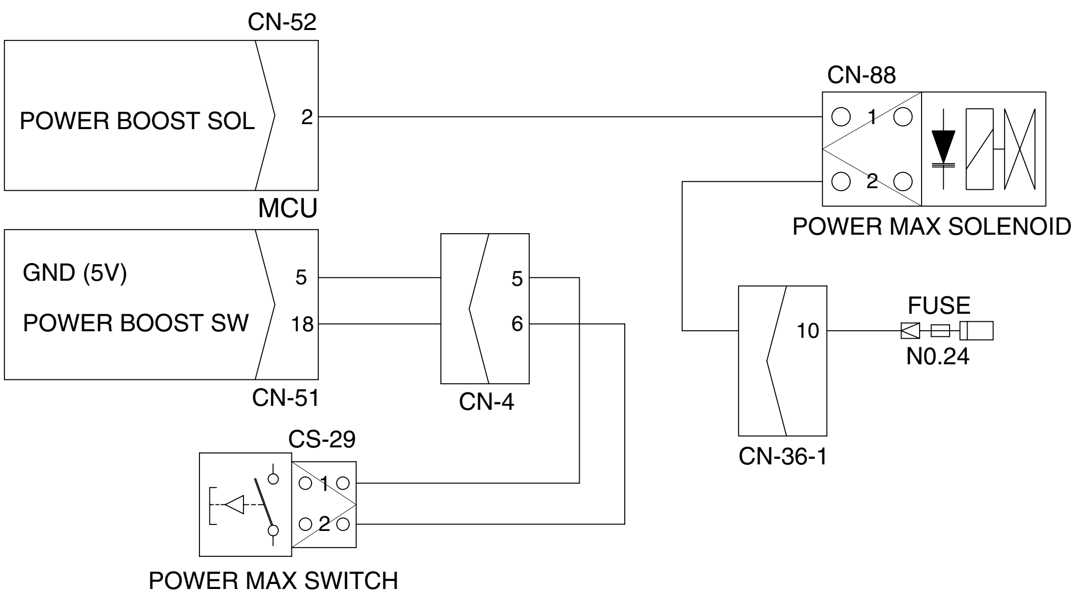
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Short circuit or poor connection between CN-88 (1)-CN-52 (2)	Repair or replace
Defective power max. solenoid valve Check hydraulic system	Repair or replace
Short circuit or poor connection between CN-51 (18)-CS-29 (2)	Repair or replace
Short circuit or poor connection between CN-88 (2)-Fuse No. 24	Repair or replace

Wiring diagram



145SA6MS21

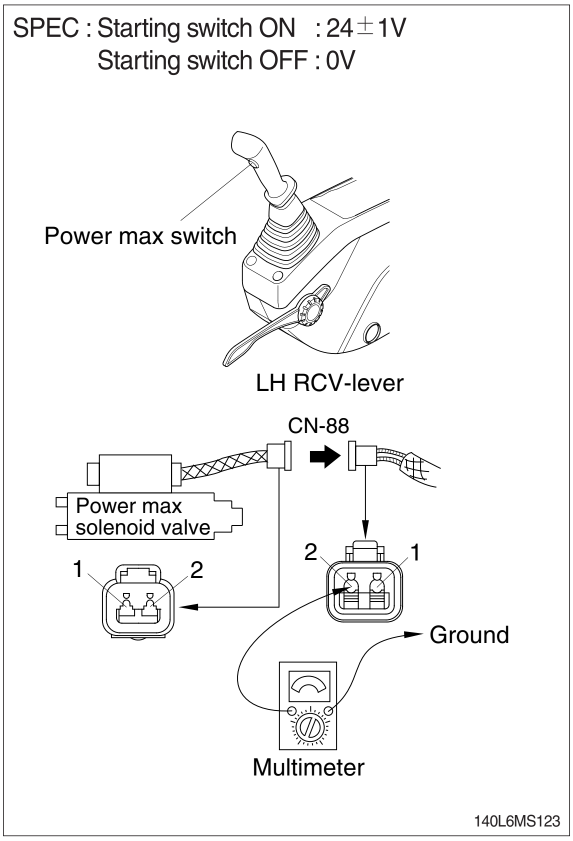
2) TEST PROCEDURE

(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.

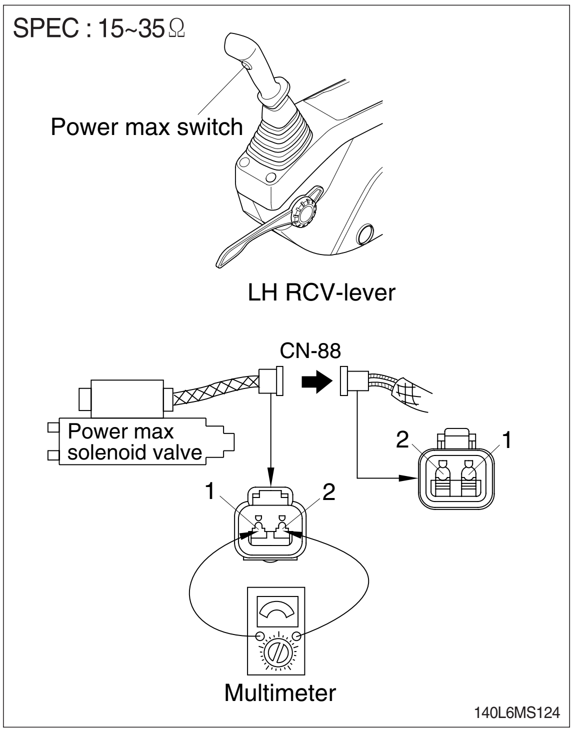


(2) Test 19: Check resistance of the solenoid valve between CN-88 (1)-(2).

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.

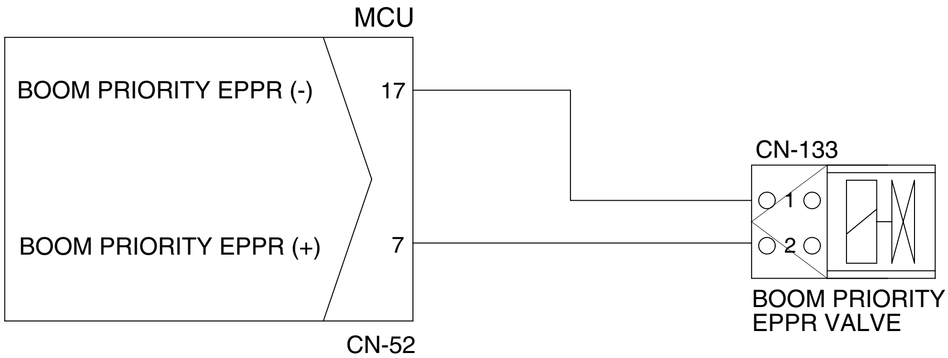
1) INSPECTION PROCEDURE

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

SPEC : 20~30V
Starting switch : ON

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

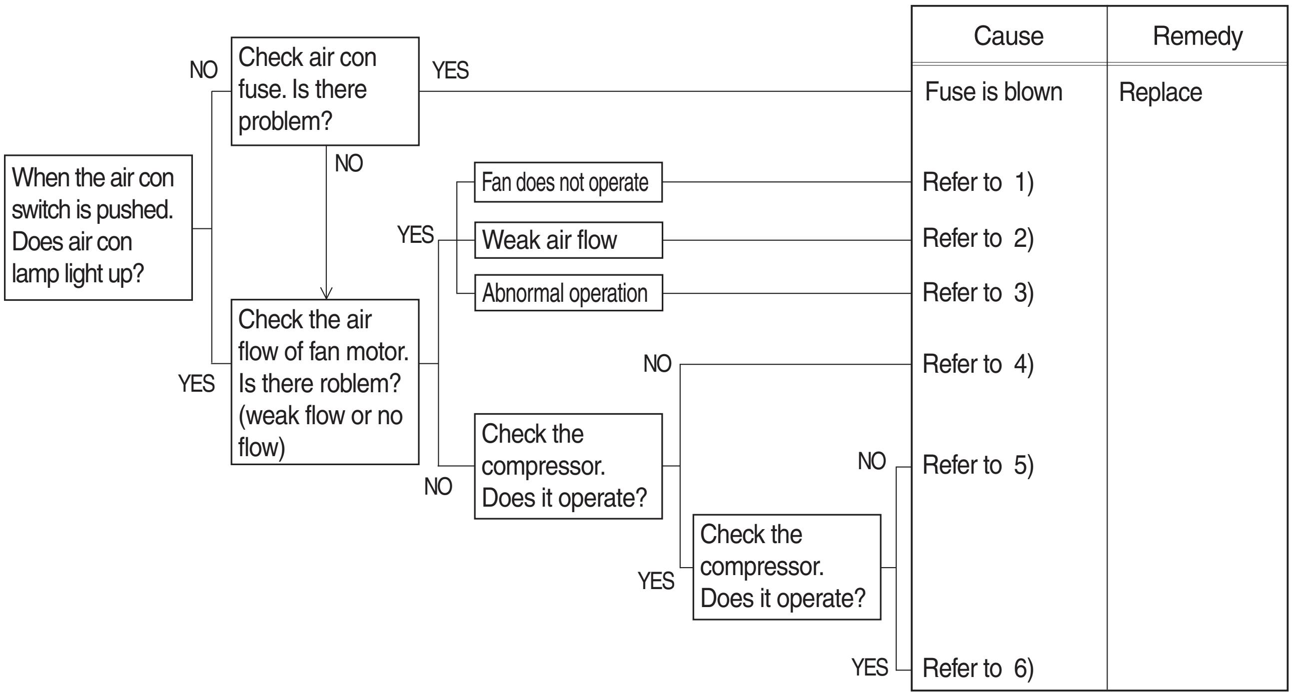
Wiring diagram



220S6MS23

GROUP 5 AIR CONDITIONER & HEATER SYSTEM

1. AIR CONDITIONER DOES NOT OPERATE



1) FAN DOES NOT OPERATE

Cause	Check	Remedy
Fuse is blown or abnormal relay operation	* Fuse * Does relay normally operate?	Replace
Harness short or poor contact	Check any harness short or abnormal contact of connnector	Repair shortage
Fan motor failure	Supply 24V to 2 lead wire from motor and check the operation	Replace
Resistor is broken	Check current flow of resistor with tester	Replace
Fan switch failure	Push fan switch by turn and check the operation	Replace

2) WEAK AIR FLOW FROM FAN MOTOR

Cause	Check	Remedy
Clogged evaporator or obstacles around air inlet	Check if evaporator is contaminated	Clean
Leakage of air flow	Check HVAC case assembly	Adjust
Duct sensor failure	Check if evaporator is frozen	Replace

3) ABNORMAL OPERATION OF FAN MOTOR

Cause	Check	Remedy
Abnormal operation of each step of control	4 step only operate	Replace resistor
	1 or 2 step does not operate	Replace control
	3 or 4 step does not operate	Replace relay

4) COMPRESSOR DOES NOT ROTATE OR HARDLY ROTATE

Cause	Check	Remedy
Loose belt	Belt shaking is severe	Adjust tension
Failure of compressor itself	Belt slip	Repair or Replace
Low voltage of battery	Slip when rotate	Charge battery
Fieldcoil short	Slip when rotate	Replace magnetic clutch
Oily clutch face	Contamination around clutch	Replace magnetic clutch, clean
Fieldcoil is broken	Magnetic clutch does not operate or "∞" resistance	Replace compressor
Leakage of refrigerant or oil inside	Check if wet with oil	Replace compressor Charge refrigerant

5) COMPRESSOR OPERATE NORMALLY AND AIR FLOW IS NORMAL

Cause	Check	Remedy
Shortage of refrigerant	When air con operate during 5~10 min small temperature difference between high and low pressure pipes.	Repair leakage joint Charge refrigerant
Overcharge of refrigerant	*Magnetic clutch on/off rapidly *High pressure over specification *Lukewarm air from nozzle	Recharge refrigerant following specification
Lower pressure than normal condition at low side	Shortage of refrigerant	Make up refrigerant
	Clogged receive dryer	Replace receive dryer
	Clogged expansion valve	Replace expansion valve
	Clogged or crushed pipe	Replace pipe or clean
	Failure of duct sensor	Replace duct sensor

6) COMPRESSOR OPERATE NORMALLY AND AIR FLOW IS NORMAL

Cause	Check	Remedy
Lower pressure than normal condition at low side	Failure of duct sensor Magnetic clutch off before air temperature sufficiently down	Replace duct sensor or adjust location
	Defective compressor gasket When compressor off, high and low pressure balance immediatly	Repair compressor or Replace
Higher pressure than normal condition at high side	Failure of condensing Contamination on condenser or insufficient air flow from fan	Clean the condenser Repair fan
	Overcharge of refrigerant	Adjust refrigerant
	Entrained air	Vacuum and recharge
Lower pressure than normal condition at high side	Shortage of refrigerant	Make up refrigerant

SECTION 7 MAINTENANCE STANDARD

GROUP 1 OPERATIONAL PERFORMANCE TEST

1. PURPOSE

Performance tests are used to check:

1) OPERATIONAL PERFORMANCE OF A NEW MACHINE

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

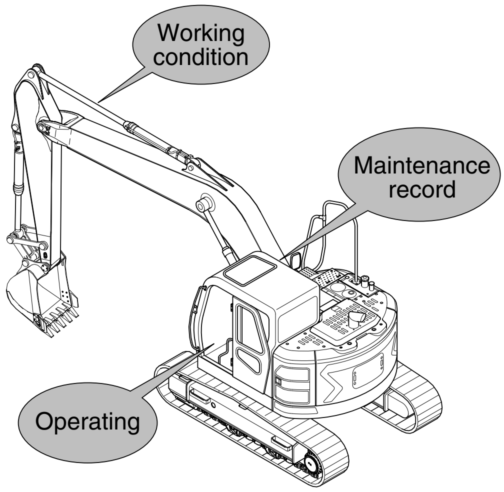
2) OPERATIONAL PERFORMANCE OF A WORKING MACHINE

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

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

3) OPERATIONAL PERFORMANCE OF A REPAIRED MACHINE

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



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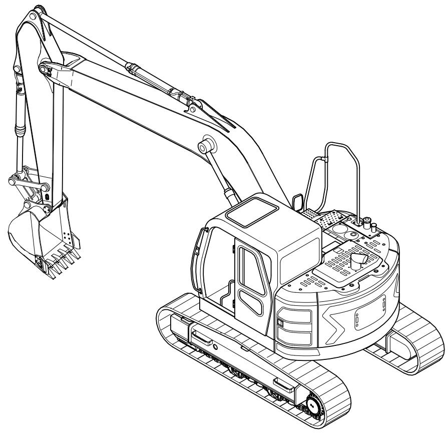
2. TERMINOLOGY

1) STANDARD

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



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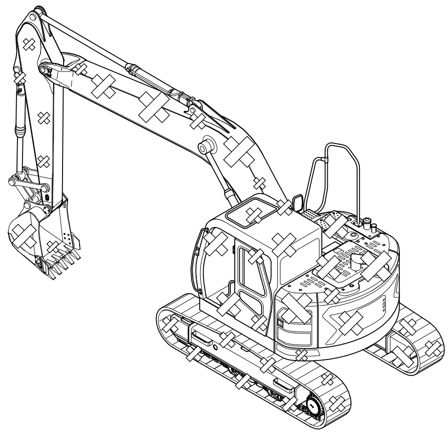
2) SERVICE LIMIT

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.



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3. OPERATION FOR PERFORMANCE TESTS

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

(1) The machine

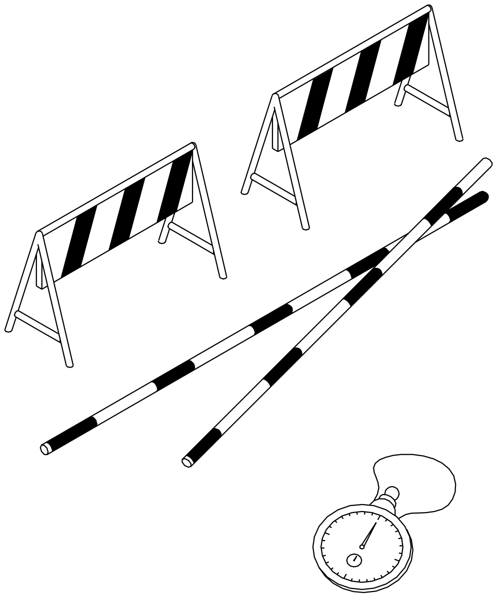
Repair any defects and damage found, such as oil or water leaks, loose bolts, cracks and so on, before starting to test.

(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.



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(3) Precautions

① Before starting to test, agree upon the signals to be employed for communication among coworkers. Once the test is started, be sure to communicate with each other using these signals, and to follow them without fail.

② Operate the machine carefully and always give first priority to safety.

③ While testing, always take care to avoid accidents due to landslides or contact with high voltage power lines. Always confirm that there is sufficient space for full swings.

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

(4) Make precise measurements

① Accurately calibrate test instruments in advance to obtain correct data.

② Carry out tests under the exact test conditions prescribed for each test item.

③ Repeat the same test and confirm that the test data obtained can be procured repeatedly.Use mean values of measurements if necessary.

2) ENGINE SPEED

(1) Measure the engine speed at each power mode

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

(2) Preparation

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

② Set the 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.

(4) Evaluation

The measured speeds should meet the following specifications.

Unit : rpm

Model	Engine speed	Standard	Remarks
HX145LCRT3	Start idle	1000±50	
	P mode	1850±50	
	S mode	1750±50	
	E mode	1650±50	
	Auto decel	1200±100	
	One touch decel	1000±50	

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

3) TRAVEL SPEED

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

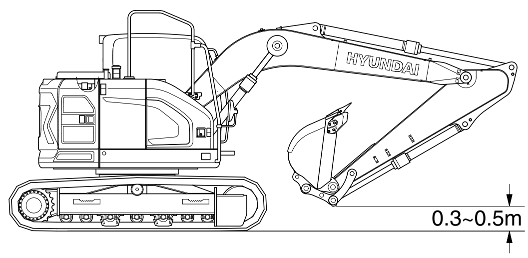
(2) Preparation

① Adjust the tension of both tracks to be equal.

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

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

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



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(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.

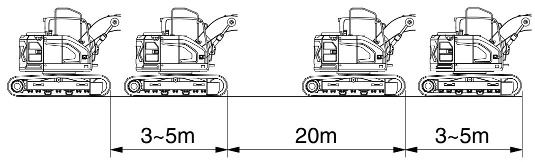
· Power mode switch : P mode

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

④ Measure the time required to travel 20 ㎙.

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.



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(4) Evaluation

The average measured time should meet the following specifications.

Unit : Seconds / 20 ㎙

Model	Travel speed	Standard	Maximum allowable	Remarks
HX145LCRT3	1 Speed	21.7±2.0	27.1	
	2 Speed	13.1±1.0	16.4	

4) TRACK REVOLUTION SPEED

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

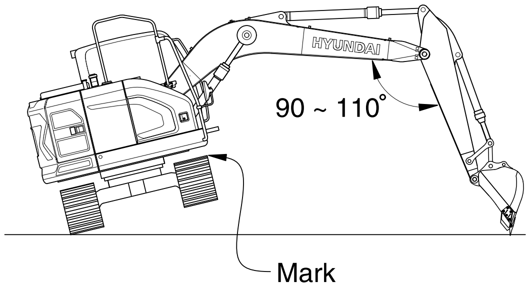
(2) Preparation

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.



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(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
HX145LCRT3	1 Speed	26.3±2.0	32.9
	2 Speed	15.6±2.0	19.5

5) TRAVEL DEVIATION

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

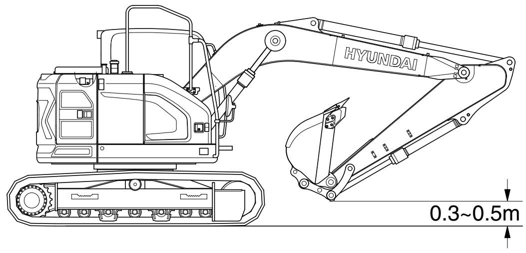
(2) Preparation

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.



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(3) Measurement

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

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

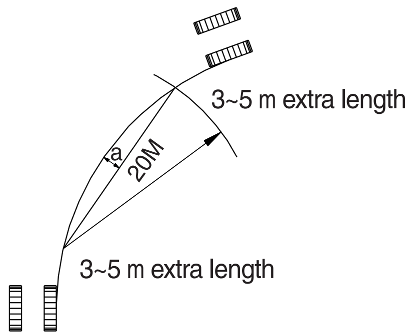
· Power mode switch : P mode

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.



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(4) Evaluation

Mistrack should be within the following specifications.

Unit : mm / 20 m

Model	Standard	Maximum allowable	Remarks
HX145LCRT3	200 below	240	

6) SWING SPEED

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

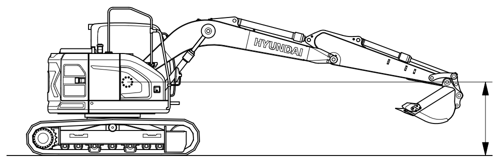
(2) Preparation

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.



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(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
HX145LCRT3	P mode	15.8±1.5	19.6

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.

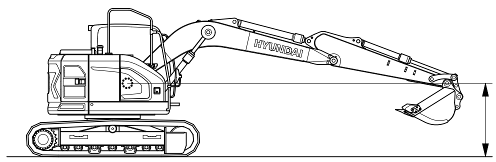
② Place the machine on flat, solid ground with ample space for swinging. Do not conduct this test on slopes.

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.



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(3) Measurement

① Conduct this test in the M mode.

② Select the following switch positions.

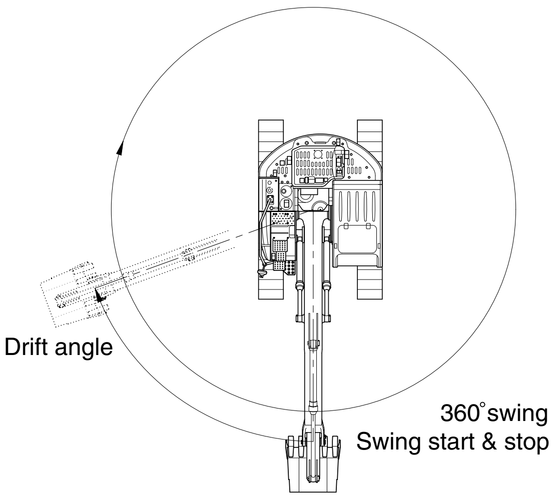
· Power mode switch : P mode

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.



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(4) Evaluation

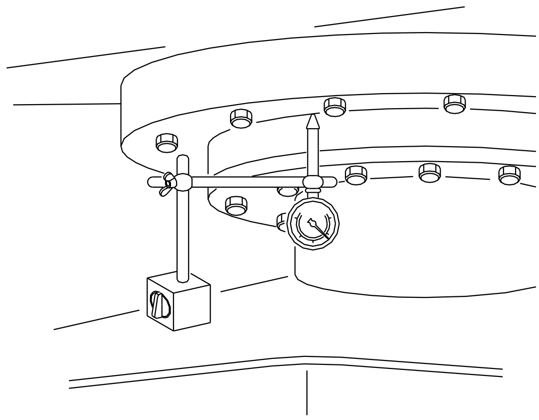
The measured drift angle should be within the following specifications.

Unit : Degree

Model	Power mode switch	Standard	Maximum allowable	Remarks
HX145LCRT3	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.



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(2) Preparation

① Check swing bearing mounting cap screws for loosening.

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

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

④ Position the upperstructure so that the boom aligns with the tracks facing towards the front idlers.

⑤ Position the dial gauge so that its needle point comes into contact with the bottom face of the bearing outer race.

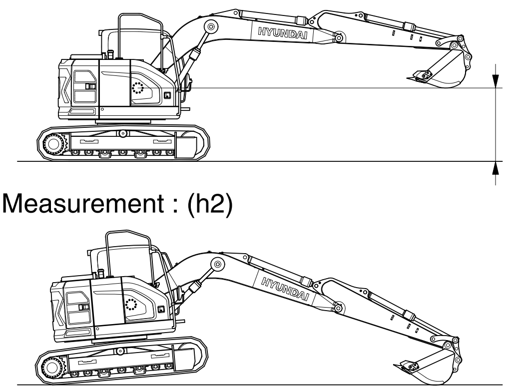
⑥ Bucket should be empty.

(3) Measurement

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

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

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



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(4) Evaluation

The measured drift should be within the following specifications.

Unit : mm

Model	Standard	Maximum allowable	Remarks
HX145LCRT3	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

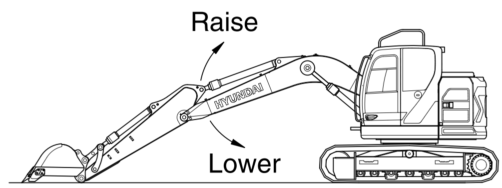
① Select the following switch positions.

· Power mode switch : P mode

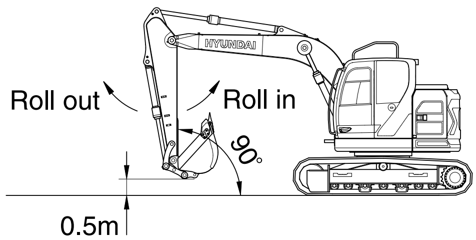
② To measure cylinder cycle times.

- 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.

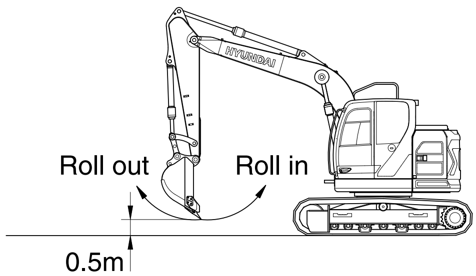
Boom cylinder



Arm cylinder



Bucket cylinder



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- 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
HX145LCRT3	Boom raise		4.0±0.4	5.2	
	Boom lower		3.4±0.4	4.4	
	Arm in	Regen ON	2.5±0.4	3.3	
		Regen OFF	2.9±0.4	3.8	
	Arm out		2.6±0.4	3.4	
	Bucket in		3.4±0.4	4.4	
	Bucket out		2.2±0.4	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)

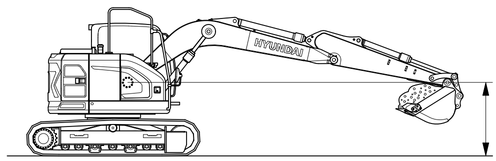
1.5 = Soil specific gravity

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.



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(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
HX145LCRT3	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
HX145LCRT3	Boom lever	1.6 or below	2.0	
	Arm lever	1.6 or below	2.0	
	Bucket lever	1.6 or below	2.0	
	Swing lever	1.6 or below	2.0	
	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
HX145LCRT3	Boom lever	82±10	103	
	Arm lever	82±10	103	
	Bucket lever	82±10	103	
	Swing lever	82±10	103	
	Travel lever	142±10	178	

13) PILOT PRIMARY PRESSURE

(1) Preparation

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

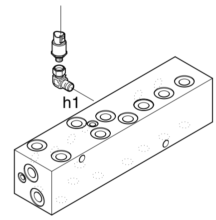
(2) Measurement

① Select the following switch positions.

· Power mode switch : P mode

· Auto decel switch : OFF

② Slowly operate the boom control lever of boom up functions at full stroke over relief and measure the primary pilot pressure by the monitoring menu of the cluster.



Terminal block

Cluster

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(3) Evaluation

The average measured pressure should meet the following specifications:

Unit : kgf / cm^2

Model	Engine speed	Standard	Allowable limits	Remarks
HX145LCRT3	P mode	40^{+2}_{-2}	-	

14) FOR TRAVEL SPEED SELECTING PRESSURE:

(1) Preparation

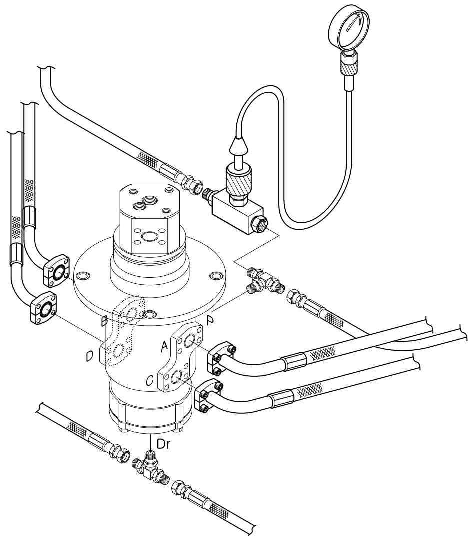
① Stop the engine.

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.



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(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.

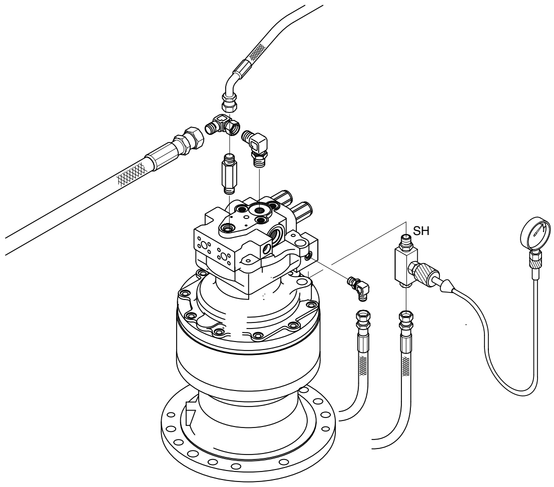
Unit : kgf / cm^2

Model	Travel speed mode	Standard	Maximum allowable	Remarks
HX145LCRT3	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.



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(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
HX145LCRT3	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).

145SA7MS15

(3) Evaluation

The average measured pressure should meet the following specifications.

Unit : kgf / cm^2

Model	Engine speed	Standard	Allowable limits	Remarks
HX145LCRT3	High idle	30^{+4}_{-4}	-	

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.

(3) Evaluation

The average measured pressure should be within the following specifications.

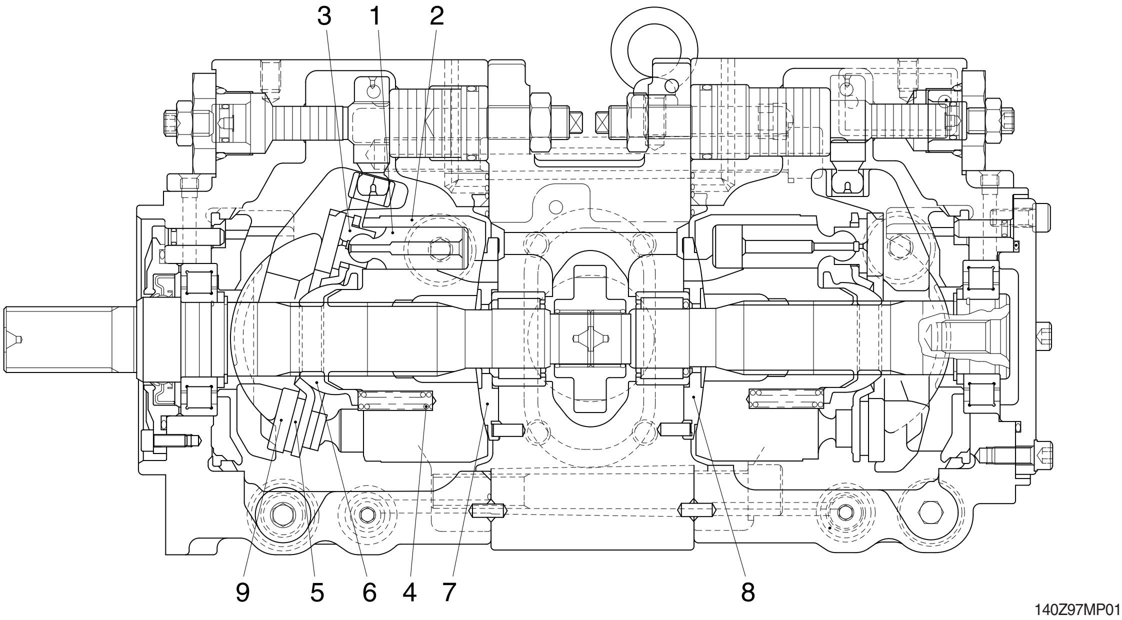
Unit : kgf / cm^2

Model	Function to be tested	Standard	Port relief setting at 20 lpm
HX145LCRT3	Boom, Arm, Bucket	350 (380)±10	400±10
	Travel	350±10	-
	Swing	300±20	-

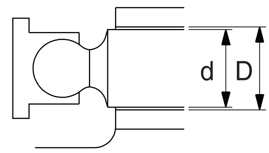
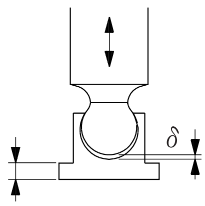
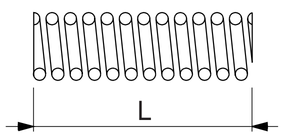
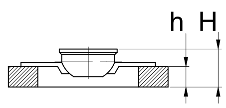
(　) : Power boost

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		

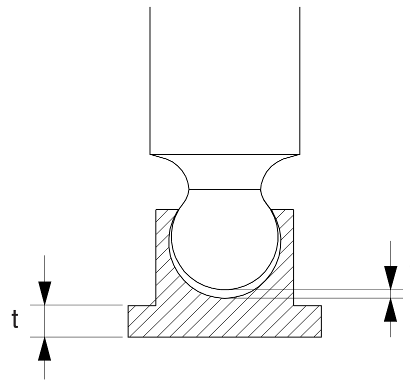
2. MAIN CONTROL VALVE

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	Standard dimension	Counter measures
Clearance between piston and cylinder block bore	0.028	0.058	Replace piston or cylinder block
Play between piston and shoe caulking section (δ)	0	0.3	Replace assembly of piston and shoe
Thickness of shoe (t)	5.5	5.3	Replace assembly of piston and shoe
Combined height of retainer plate and spherical bushing (H-h)	6.5	6.0	Replace set of retainer plate and spherical bushing
Thickness of friction plate	4.0	3.6	Replace



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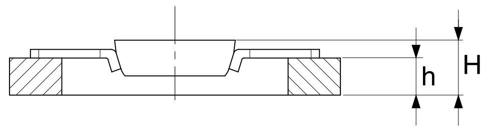

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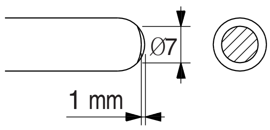
2) SLIDING PARTS

Part name	Standard roughness	Allowable roughness	Remark
Shoe	0.8-Z (Ra=0.2) (LAPPING)	3-Z (Ra=0.8)	
Shoe plate	0.4-Z (Ra=0.1) (LAPPING)	3-Z (Ra=0.8)	
Cylinder	1.6-Z (Ra=0.4) (LAPPING)	12.5-Z (Ra=3.2)	
Valve plate	0.8-Z (Ra=0.2) (LAPPING)	6.3-Z (Ra=1.6)	

4. TRAVEL MOTOR

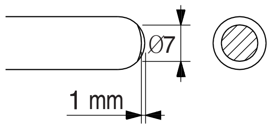
Problem		Cause	Remedy
Does not start	Pressure is not developed	· Pump failure · Control valve malfunction	· Check if action other than traveling is available. If faulty, repair. · Check if spool moves correctly. Repair if necessary.
	Pressure is developed	· Brake valve failure -Sleeve stick -Check valve 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

5. RCV LEVER

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

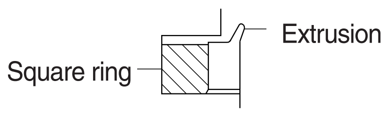
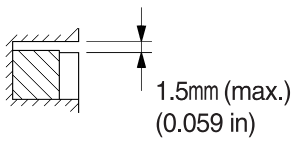
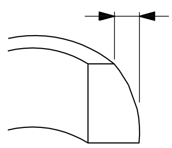
Notes 1. It is desirable to replace seal materials, such as O-rings, every disassembling. However, they may be reused, after being confirmed to be free of damage.

6. RCV PEDAL

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

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

7. TURNING JOINT

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

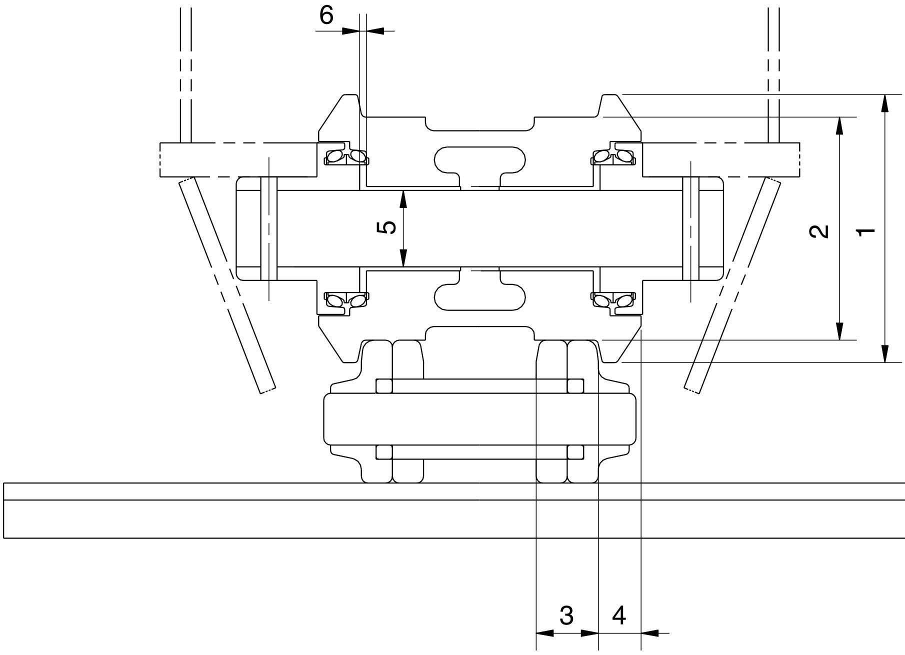
8. CYLINDER

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

GROUP 3 TRACK AND WORK EQUIPMENT

1. TRACK

1) TRACK ROLLER

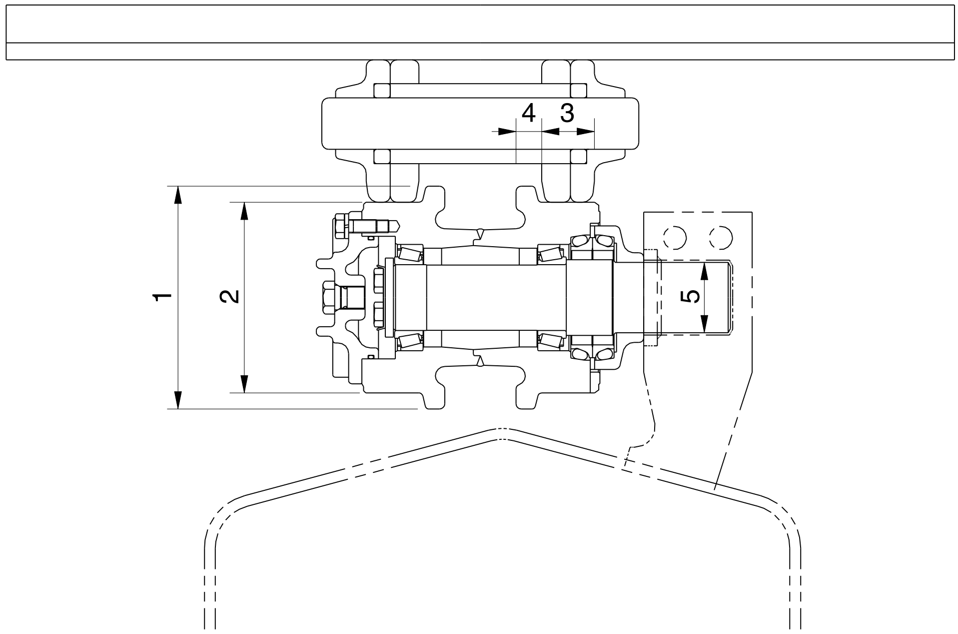


21037MS01

Unit : ㎜

No.	Check item	Criteria					Remedy
1	Outside diameter of flange	Standard size			Repair limit		Rebuild or replace
		Ø190			–		
2	Outside diameter of tread	Ø150			Ø138		
3	Width of tread	36.5			42.5		
4	Width of flange	26.5			-		
5	Clearance between shaft and bushing	Standard size	tolerance		Standard clearance	Clearance limit	Replace bushing
			Shaft	Hole			
		Ø65	-0.25 -0.35	+0.12 +0.075	0.325 to 0.47	2.0	
6	Side clearance of roller (both side)	Standard clearance			Clearance limit		Replace
		0.1 to 1.3			2.0		

2) CARRIER ROLLER

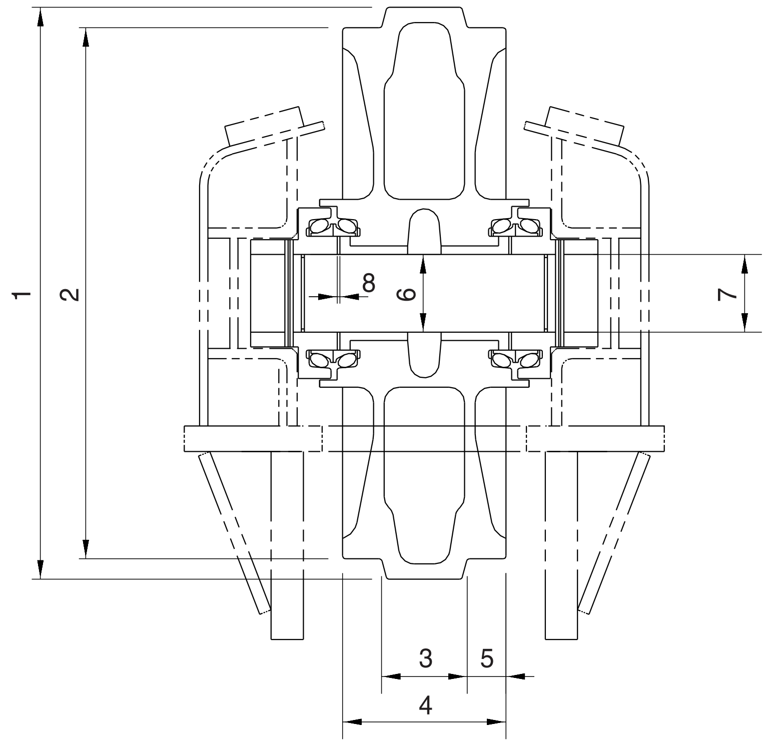


21037MS02

Unit : ㎜

<table>
<tr><th>No.</th><th>Check item</th><th colspan="4">Criteria</th><th>Remedy</th></tr>
<tr><td rowspan="2">1</td><td rowspan="2">Outside diameter of flange</td><td colspan="2">Standard size</td><td colspan="2">Repair limit</td><td rowspan="5">Rebuild or replace</td></tr>
<tr><td colspan="2">Ø175</td><td colspan="2">–</td></tr>
<tr><td>2</td><td>Outside diameter of tread</td><td colspan="2">Ø151</td><td colspan="2">Ø141</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>Ø41.27 $^{0}_{+0.05}$</td><td>Ø41.5 $^{+0.2}_{-0.1}$</td><td>0.13 to 0.48</td><td>1.2</td></tr>
</table>

3) IDLER

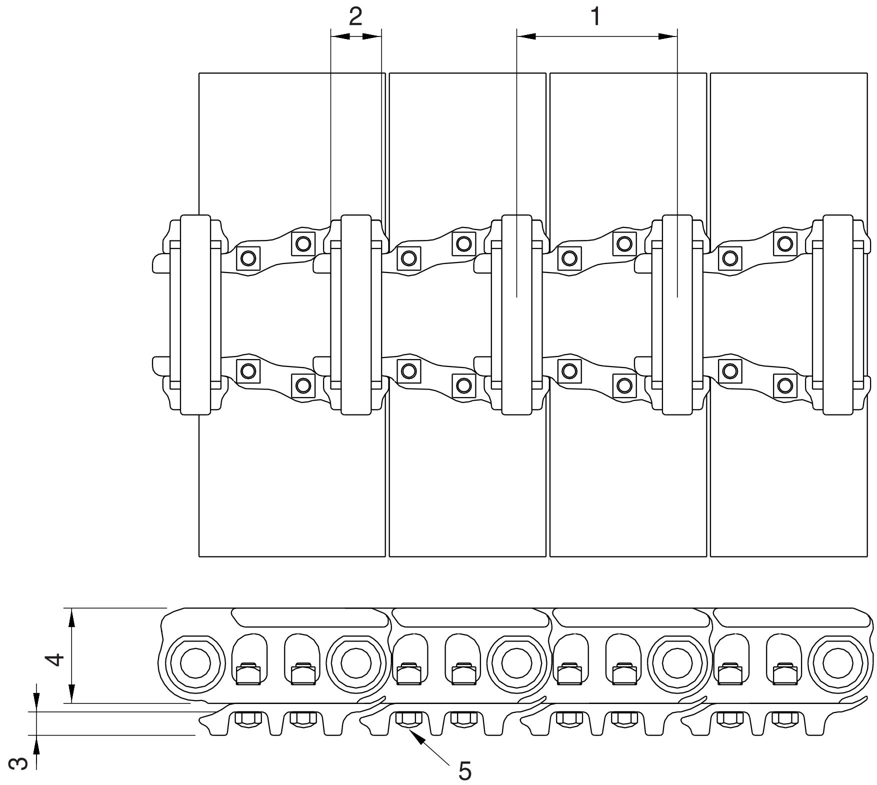


21037MS03

Unit : mm

<table>
<tr><th>No.</th><th>Check item</th><th colspan="4">Criteria</th><th>Remedy</th></tr>
<tr><td rowspan="2">1</td><td rowspan="2">Outside diameter of flange</td><td colspan="2">Standard size</td><td colspan="2">Repair limit</td><td rowspan="6">Rebuild or replace</td></tr>
<tr><td colspan="2">Ø552</td><td colspan="2">-</td></tr>
<tr><td>2</td><td>Outside diameter of tread</td><td colspan="2">Ø507</td><td colspan="2">Ø497</td></tr>
<tr><td>3</td><td>Width of protrusion</td><td colspan="2">67</td><td colspan="2">-</td></tr>
<tr><td>4</td><td>Total width</td><td colspan="2">135</td><td colspan="2">-</td></tr>
<tr><td>5</td><td>Width of tread</td><td colspan="2">34</td><td colspan="2">39</td></tr>
<tr><td rowspan="3">6</td><td rowspan="3">Clearance between shaft and bushing</td><td colspan="2">Standard size & Tolerance</td><td rowspan="2">Standard clearance</td><td rowspan="2">Clearance limit</td><td rowspan="3">Replace bushing</td></tr>
<tr><td>Shaft</td><td>Hole</td></tr>
<tr><td>$\varnothing 70^{\ 0}_{-0.03}$</td><td>$\varnothing 70.3^{+0.05}_{\ 0}$</td><td>0.3 to 0.38</td><td>2.0</td></tr>
<tr><td>7</td><td>Clearance between shaft and support</td><td>$\varnothing 70^{\ 0}_{-0.03}$</td><td>$\varnothing 70^{+0.07}_{+0.03}$</td><td>0.03 to 0.1</td><td>1.2</td><td>Replace</td></tr>
<tr><td rowspan="2">8</td><td rowspan="2">Side clearance of idler (both side)</td><td colspan="2">Standard clearance</td><td colspan="2">Clearance limit</td><td rowspan="2">Replace bushing</td></tr>
<tr><td colspan="2">0.25 to 1.15</td><td colspan="2">2.0</td></tr>
</table>

4) TRACK

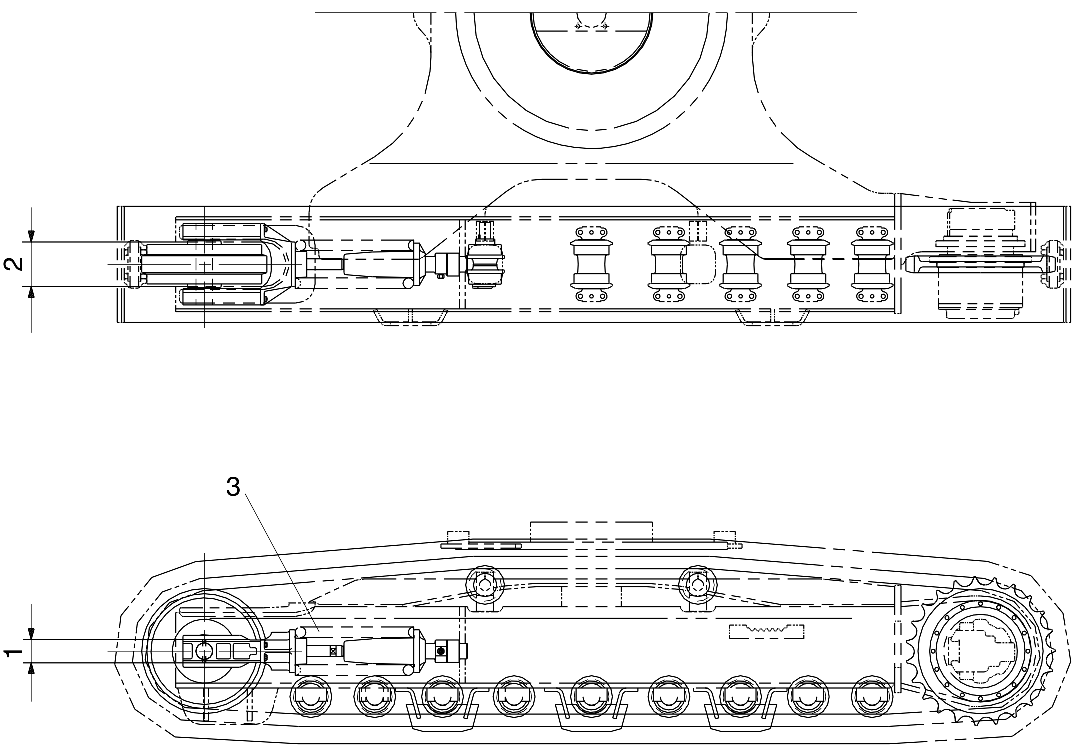


21037MS04

Unit : mm

No.	Check item	Criteria		Remedy
1	Link pitch	Standard size	Repair limit	Turn or replace
		171.45	175.65	
2	Outside diameter of bushing	Ø53.75	Ø43.95	Rebuild or replace
3	Height of grouser	25	16	
4	Height of link	94.5	86.5	
5	Tightening torque	Initial tightening torque : 45±3 kgf · m		Retighten

5) TRACK FRAME AND RECOIL SPRING



21037MS05

Unit : ㎜

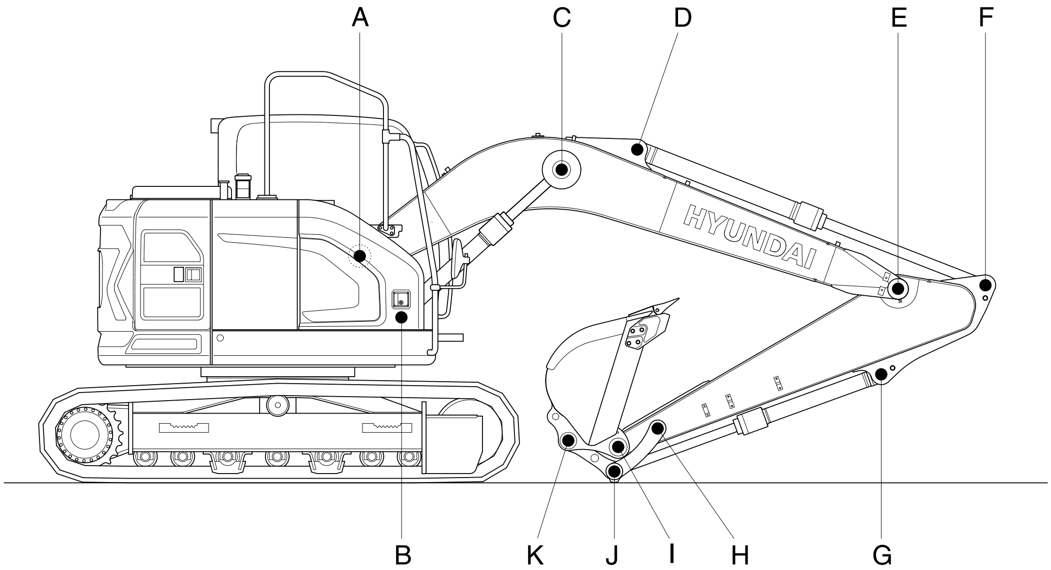
No.	Check item	Criteria					Remedy
1	Vertical width of idler guide			Standard size	Tolerance	Repair limit	Rebuild or replace
		Track frame		103	2.0 0	107	
		Idler support		100	0.3 -0.3	98	
2	Horizontal width of idler guide	Track frame		192	2.0 0	196	
		Idler support		190	-	188	
3	Recoil spring	Standard size			Repair limit		Replace
		Free length	Installation length	Installation load	Free length	Installation load	
		470	405	8497 ㎏	-	6978 ㎏	

(Mahcine Serial No. #0247-)

Unit : ㎜

No.	Check item	Criteria					Remedy
1	Vertical width of idler guide			Standard size	Tolerance	Repair limit	Rebuild or replace
		Track frame		112	2.0 0	116	
		Idler support		110	0.3 -0.3	108	
2	Horizontal width of idler guide	Track frame		210	2.0 0	214	
		Idler support		207.6	0.75 -1.25	205.6	
3	Recoil spring	Standard size			Repair limit		Replace
		Free length	Installation length	Installation load	Free length	Installation load	
		470	400	9220 ㎏	-	7560 ㎏	

2. WORK EQUIPMENT



Unit : ㎜

Mark	Measuring point (Pin and Bushing)	Normal value	Pin		Bushing		Remedy & Remark
			Recomm. service limit	Limit of use	Recomm. service limit	Limit of use	
A	Boom Rear	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

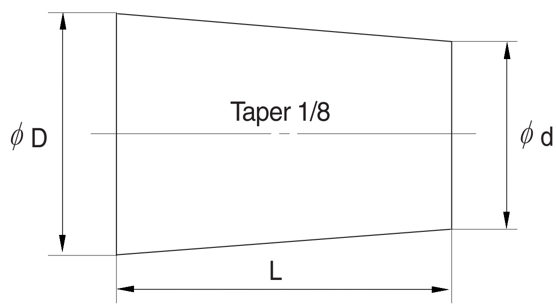
SECTION 8 DISASSEMBLY AND ASSEMBLY

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	11.5 ± 1.0	83.2 ± 7.2
2		Engine mounting bolt (engine-bracket, RR)	M12 × 1.75	11.5 ± 1.0	83.2 ± 7.2
3		Engine mounting bolt (bracket-frame, FR)	M16 × 2.0	29.7 ± 4.5	215 ± 32.5
4		Engine mounting bolt (bracket-frame, RR)	M16 × 2.0	29.7 ± 4.5	215 ± 32.5
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	23 ± 2.0	166 ± 14.5
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	57.8 ± 5.8	418 ± 42.0
11		Hydraulic oil tank mounting bolt	M20 × 2.5	57.8 ± 5.8	418 ± 42.0
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	29.7 ± 4.5	215 ± 32.5
17		Sprocket mounting bolt	M16 × 2.0	29.7 ± 3.0	215 ± 21.7
18	Under carriage	Upper roller mounting bolt, nut	M16 × 2.0	29.7 ± 4.4	215 ± 31.8
19		Lower 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	29.7 ± 3.0	215 ± 21.7
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
26		Under cover mounting bolt	M10 × 1.5	6.9 ± 1.4	49.9 ± 10.1

※ **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.

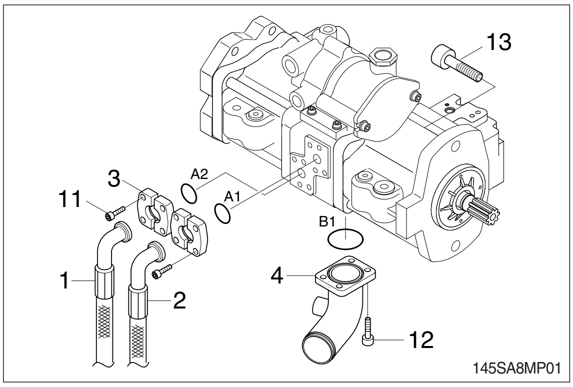
(8) Sling the pump assembly and remove the pump mounting bolts (13).

· Weight : 88 kg (190 lb)

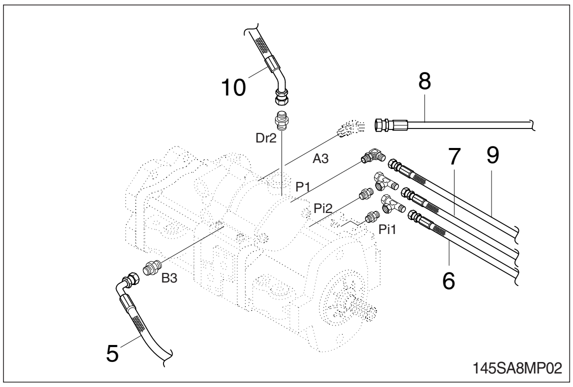
· Tightening torque : 23±2.0 kgf · m (166±14.5 lbf · ft)

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

13031GE18



145SA8MP01



145SA8MP02

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.

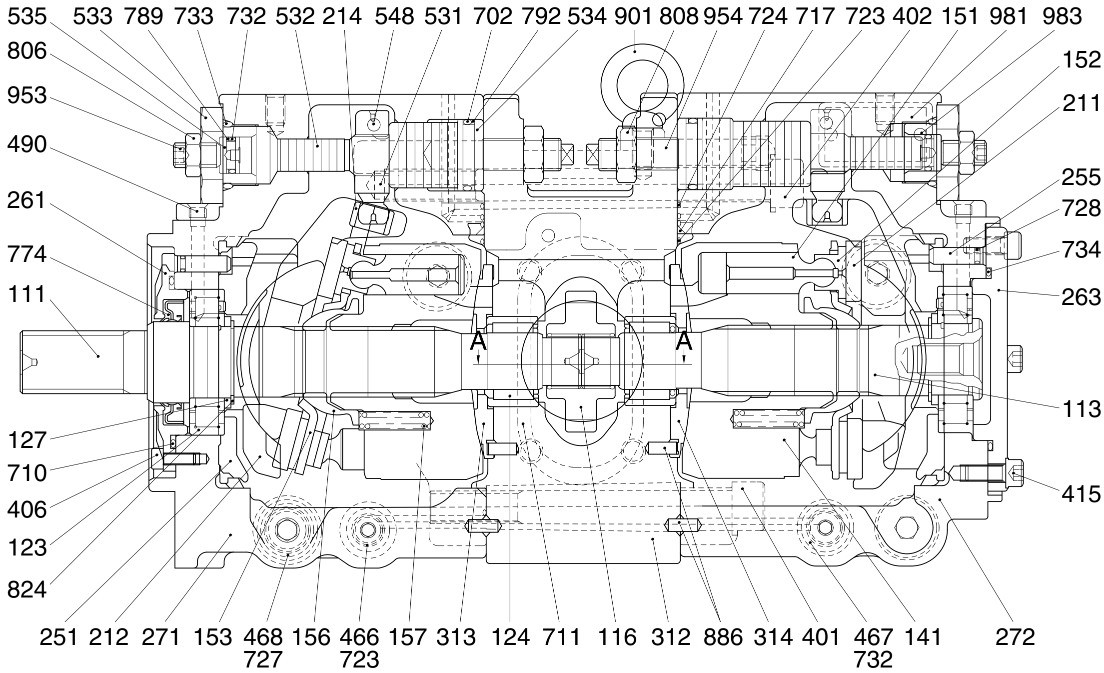
(6) Bleed the air from the hydraulic pump.
 ① Remove the air vent plug (2EA).
 ② Tighten plug lightly.
 ③ Start the engine, run at low idling, and check oil come out from plug.
 ④ Tighten plug.

(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

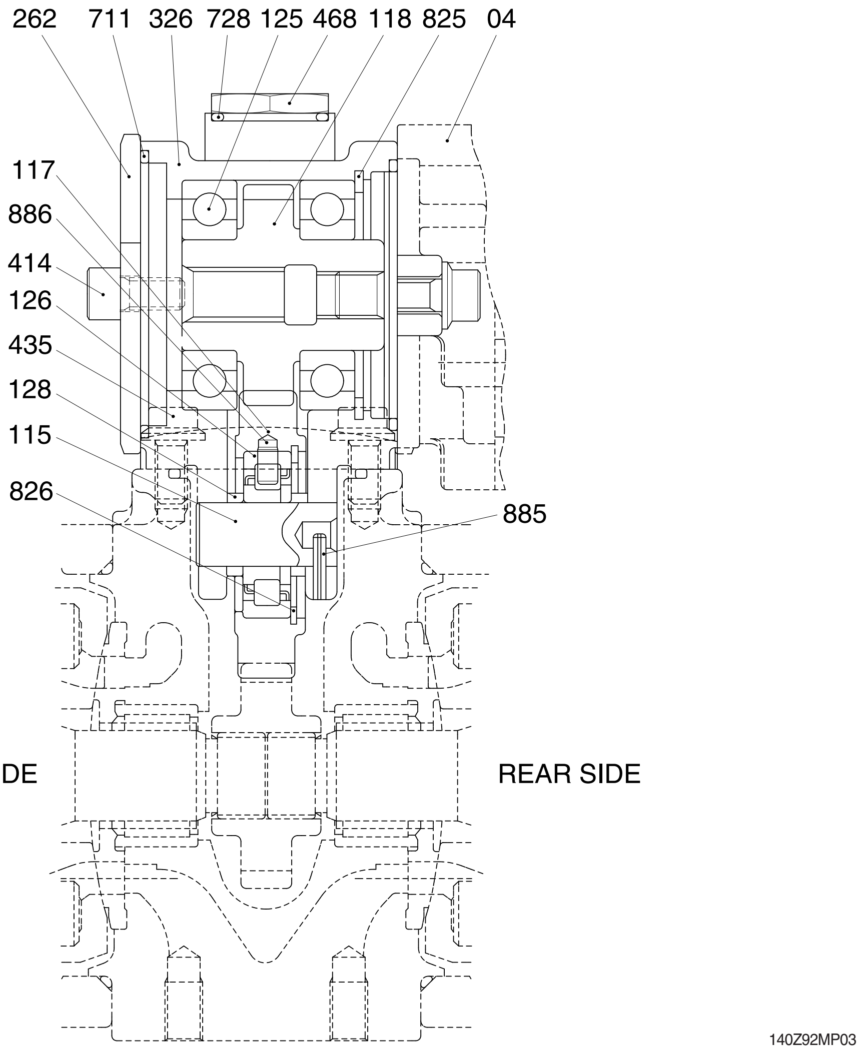
1) STRUCTURE (1/2)



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)

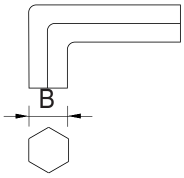
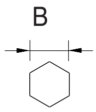


04	Gear pump	128	Bearing spacer	711	O-ring
115	Shaft	262	Cover	728	O-ring
117	Gear No. 2	326	Gear case	825	Retainer ring
118	Gear No. 3	414	Hexagon socket bolt	826	Retainer ring
125	Ball bearing	435	Flange socket bolt	885	Spring pin
126	Roller bearing	468	Plug	886	Pin

2) TOOLS AND TIGHTENING TORQUE

(1) Tools

The tools necessary to disassemble/reassemble the pump are shown in the follow list.

<table>
<tr><th colspan="2">Tool name & size</th><th colspan="6">Part name</th></tr>
<tr><th>Name</th><th>B</th><th colspan="2">Hexagon socket head bolt</th><th>PT plug (PT thread)</th><th colspan="2">ROH/VP/UNF plug (PF screw)</th><th>Hexagon socket head setscrew</th></tr>
<tr><td rowspan="7">Allen wrench
</td><td>4</td><td colspan="2">M 5</td><td>BP-1/16</td><td colspan="2">-</td><td>M 8</td></tr>
<tr><td>5</td><td colspan="2">M 6</td><td>BP-1/8</td><td colspan="2">-</td><td>M10</td></tr>
<tr><td>6</td><td colspan="2">M 8</td><td>BP-1/4</td><td colspan="2">PF-1/4</td><td>M12, M14</td></tr>
<tr><td>8</td><td colspan="2">M10</td><td>BP-3/8</td><td colspan="2">PF-3/8</td><td>M16, M18</td></tr>
<tr><td>10</td><td colspan="2">M12</td><td>BP-1/2</td><td colspan="2">PF-1/2</td><td>M20</td></tr>
<tr><td>14</td><td colspan="2">M16, M18</td><td>BP-3/4</td><td colspan="2">PF-3/4</td><td>-</td></tr>
<tr><td>17</td><td colspan="2">M20, M22</td><td>BP-1</td><td colspan="2">PF-1</td><td>-</td></tr>
<tr><td rowspan="6">Double ring spanner, socket wrench, double (single) open end spanner
</td><td>-</td><td colspan="2">Hexagon bolt</td><td colspan="2">Hexagon nut</td><td colspan="2">VP plug (PF screw)</td></tr>
<tr><td>19</td><td colspan="2">M12</td><td colspan="2">M12</td><td colspan="2">PF-1/4</td></tr>
<tr><td>24</td><td colspan="2">M16</td><td colspan="2">M16</td><td colspan="2">-</td></tr>
<tr><td>27</td><td colspan="2">M18</td><td colspan="2">M18</td><td colspan="2">PF-1/2</td></tr>
<tr><td>30</td><td colspan="2">M20</td><td colspan="2">M20</td><td colspan="2">-</td></tr>
<tr><td>41</td><td colspan="2">-</td><td colspan="2">-</td><td colspan="2">PF-1</td></tr>
<tr><td colspan="2">Adjustable angle wrench</td><td colspan="6">Medium size, 1 set</td></tr>
<tr><td colspan="2">Screw driver</td><td colspan="6">Minus type screw driver, Medium size, 2 sets</td></tr>
<tr><td colspan="2">Hammer</td><td colspan="6">Plastic hammer, 1 set</td></tr>
<tr><td colspan="2">Pliers</td><td colspan="6">For snap ring, TSR-160</td></tr>
<tr><td colspan="2">Steel bar</td><td colspan="6">Steel bar of key material approx. 10×8×200</td></tr>
<tr><td colspan="2">Torque wrench</td><td colspan="6">Capable of tightening with the specified torques</td></tr>
</table>

(2) Tightening torque

Part name	Bolt size	Torque		Wrench size	
		kgf · m	lbf · ft	in	mm
Hexagon socket head bolt (material : SCM435)	M 5	0.7	5.1	0.16	4
	M 6	1.2	8.7	0.20	5
	M 8	3.0	21.7	0.24	6
	M10	5.8	42.0	0.31	8
	M12	10.0	72.3	0.39	10
	M14	16.0	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

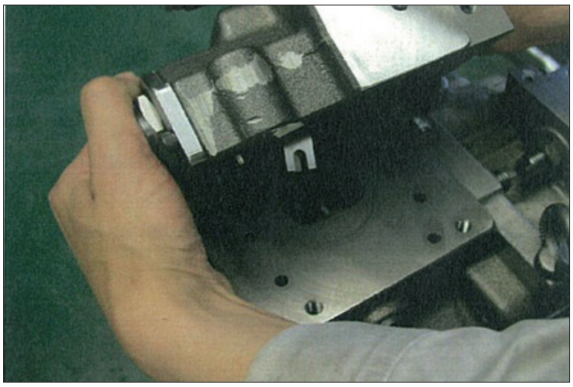
3) DISASSEMBLY

(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.

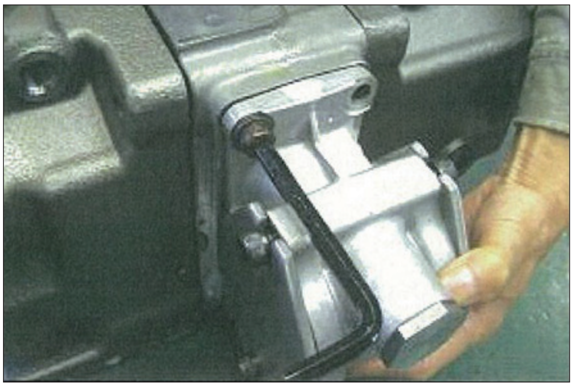
(3) Remove drain port plug (468) and drain oil pump casing (271, 272).

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



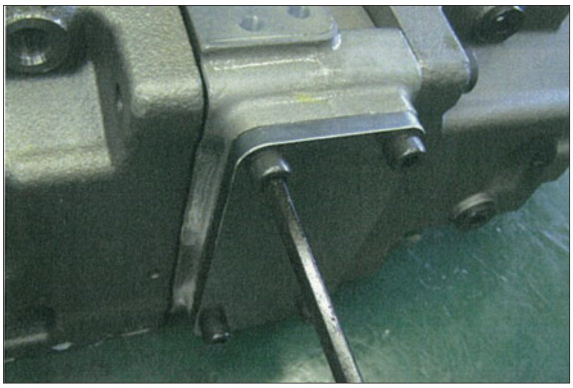
140Z98MP11

(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.



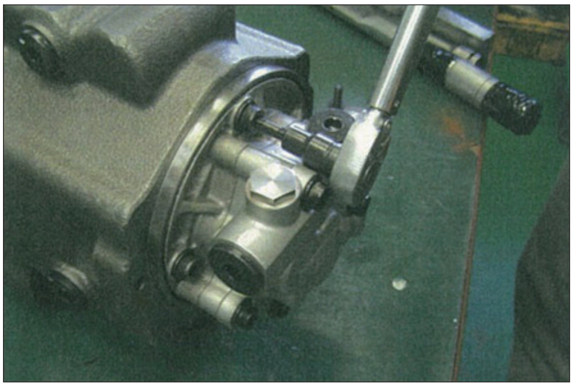
140Z98MP12

(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).

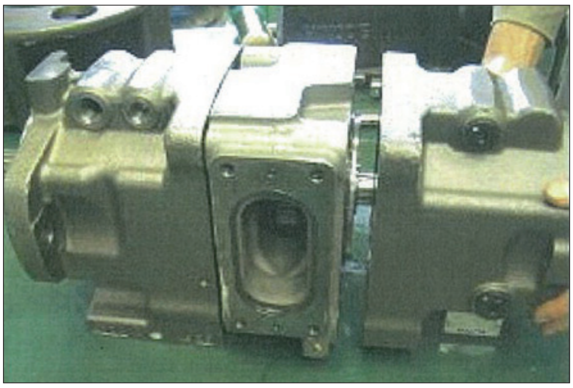


140Z98MP14

(8) Loosen hexagon socket head bolt (401) which tighten pump casing (271, 272) and valve block (312).

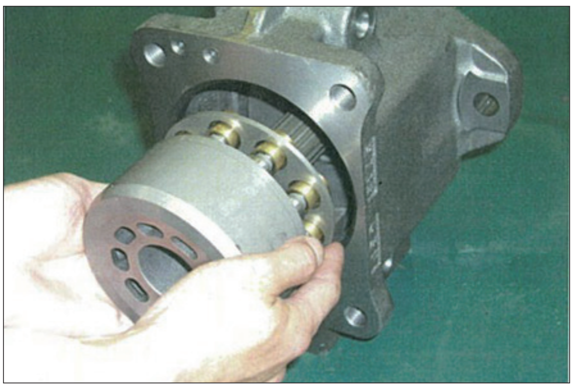
140Z98MP15

(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.



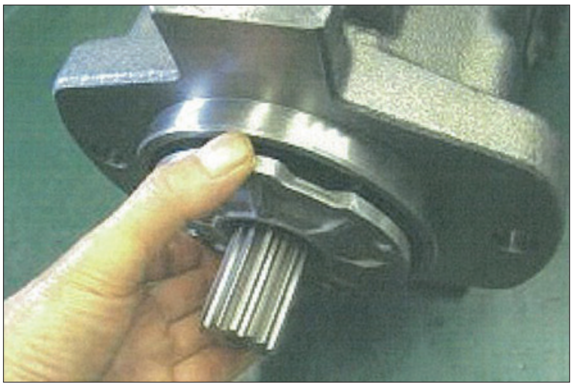
140Z98MP16

(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.



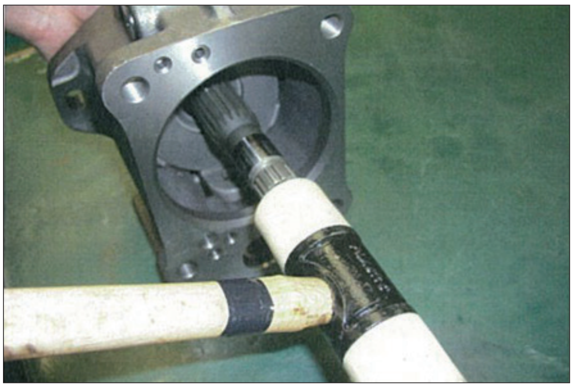
140Z98MP17

(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.



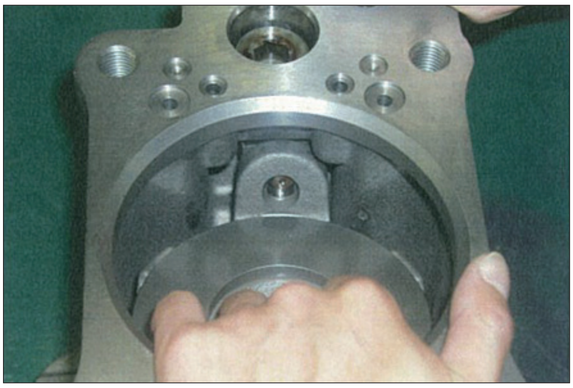
140Z98MP18

(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).



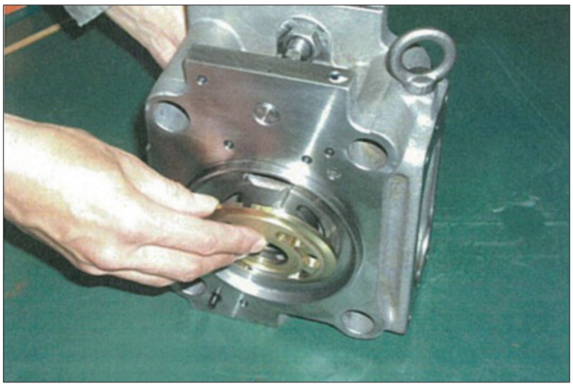
140Z98MP20

(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.

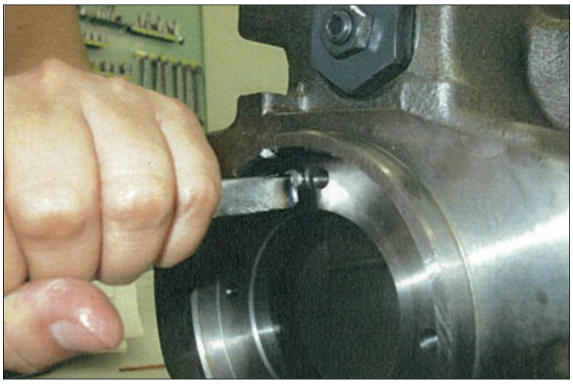
⑤ For fitting bolts, plug, etc., prepare a torque wrench or so on, and tighten them with torques shown in page 8-11, 12.

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.

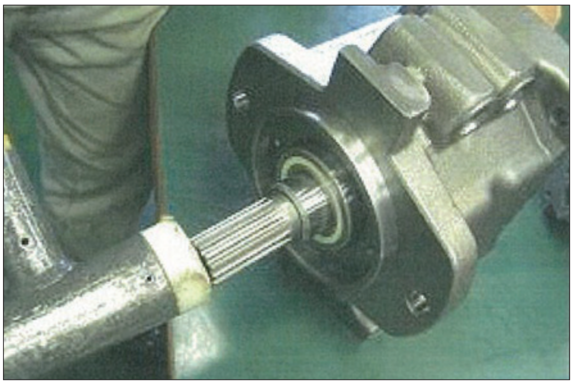
※ Confirm with fingers of both hands that swash plate can be removed smoothly.

※ 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).

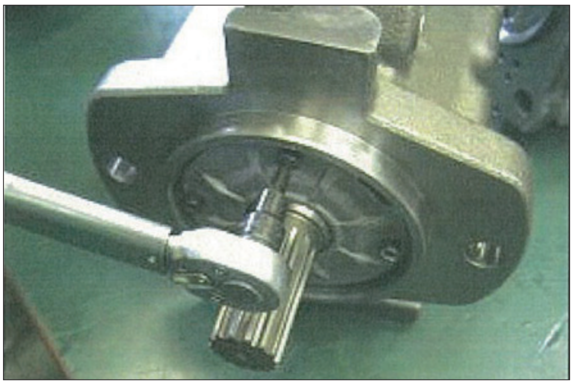


140Z98MP25

(5) In assemble of front pump, assemble seal cover (F) (261) to pump casing (271) and fix it with hexagon socket head bolt (406).

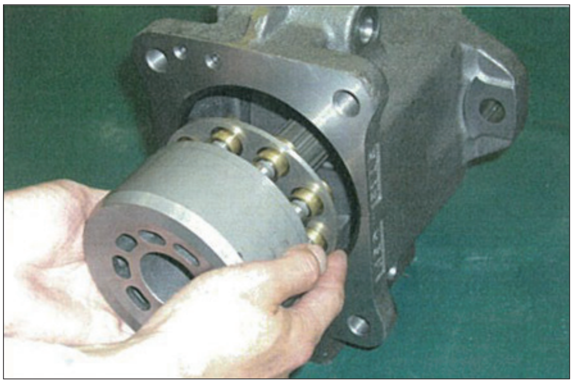
※ Apply grease lightly to oil seal in seal cover (F) (261).

※ For assemble oil seal (774), taking full care not to damage it.



140Z98MP26

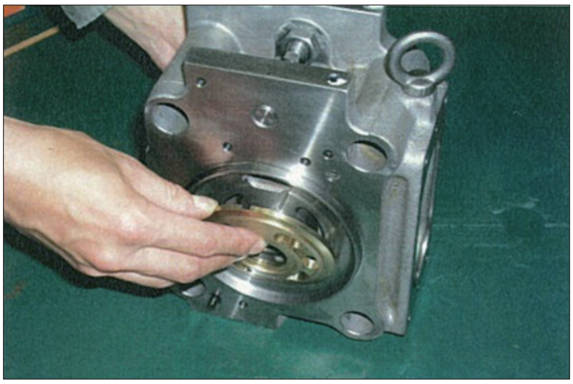
(6) Assemble piston cylinder subassembly [cylinder (141), piston subassembly (151, 152), set plate (153), spherical bush (156) and cylinder spring (157)]. Fitting spline phases of cylinder, spherical bush (156) and drive shaft (111, 113), insert piston cylinder subassembly into pump casing (271, 272).



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).

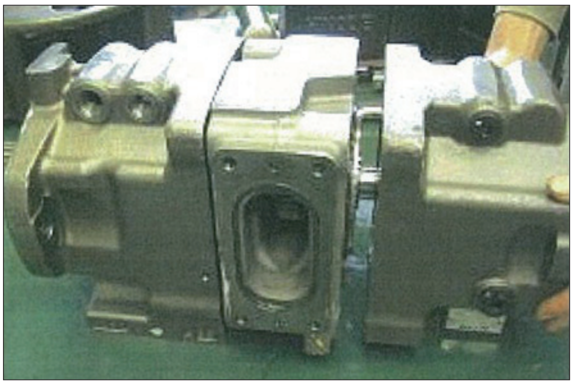


140Z98MP28

(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.

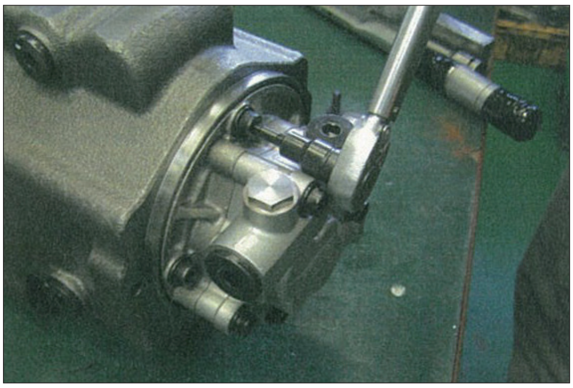


140Z98MP29

(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).

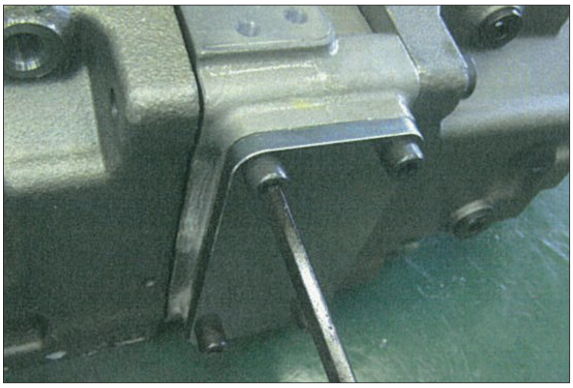


140Z98MP31

(11) Attach the PTO unit (05) by fastening the flange socket (435) to the valve block (312).

140Z98MP32

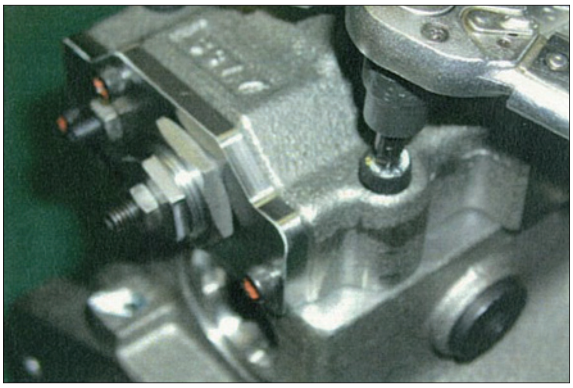
(12) In case the pump is not provided with the PTO unit (05), attach the cover (262) with the hexagon socket head cap screw (414).



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.



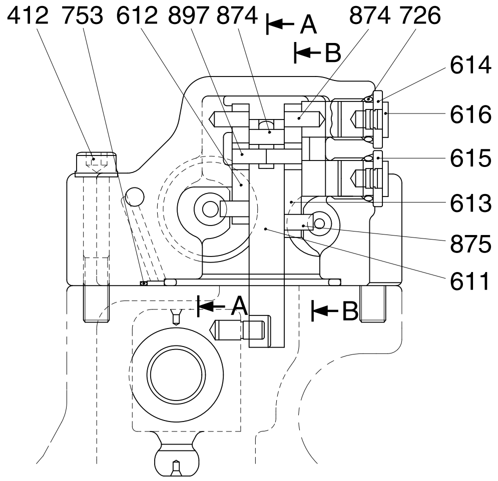
140Z98MP34

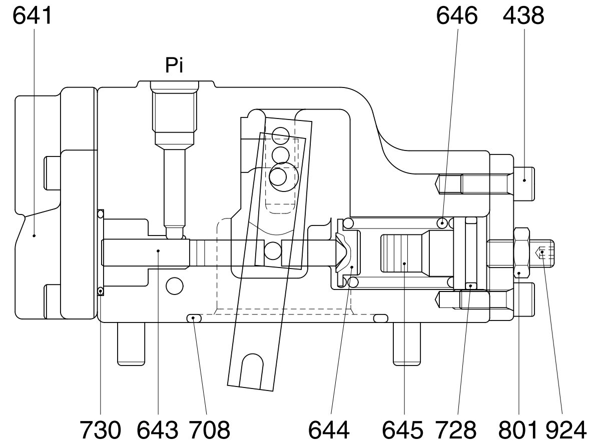
(14) Fit drain port plug (468).

This is the end of reassembling procedures.

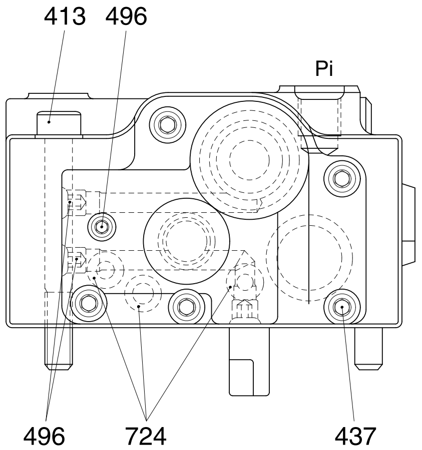
3. REGULATOR

1) STRUCTURE (1/2)

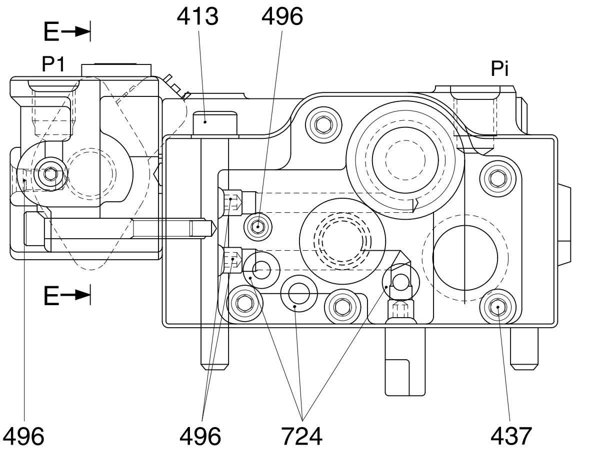




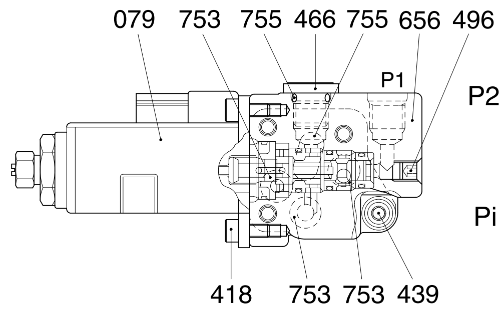
SECTION B-B



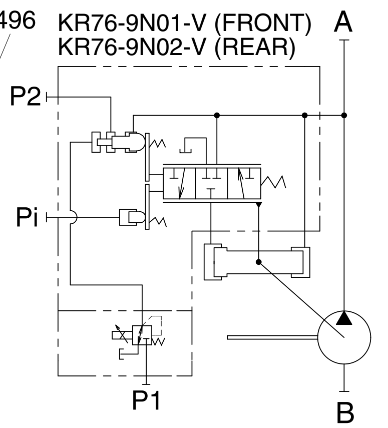
VIEW C (FRONT)



VIEW C (REAR)

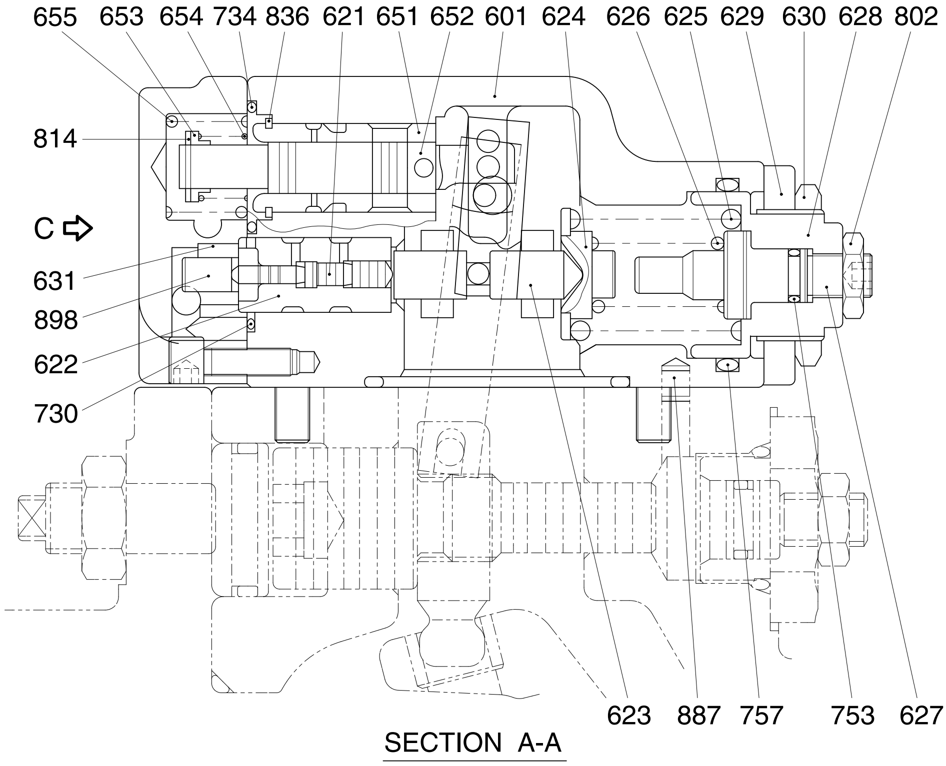


SECTION E-E (REAR)



140Z92MP04

STRUCTURE (2/2)

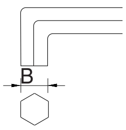
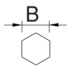


079	EPPR valve assembly	624	Spring seat (C)	708	O-ring
412	Hexagon socket screw	625	Outer spring	724	O-ring
413	Hexagon socket screw	626	Inner spring	725	O-ring
418	Hexagon socket screw	627	Adjust stem (C)	728	O-ring
437	Hexagon socket screw	628	Adjust screw (C)	730	O-ring
438	Hexagon socket screw	629	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><th colspan="2">Tool name & size</th><th colspan="12">Part name</th></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.

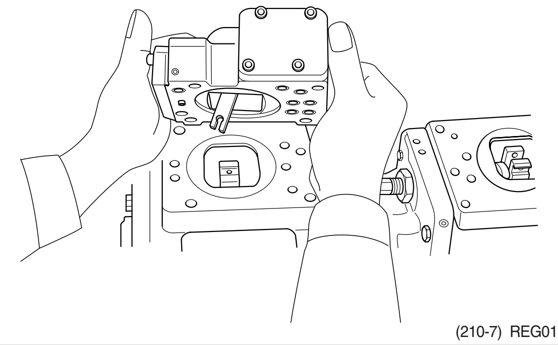
※ Choose a clean place.

※ 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.



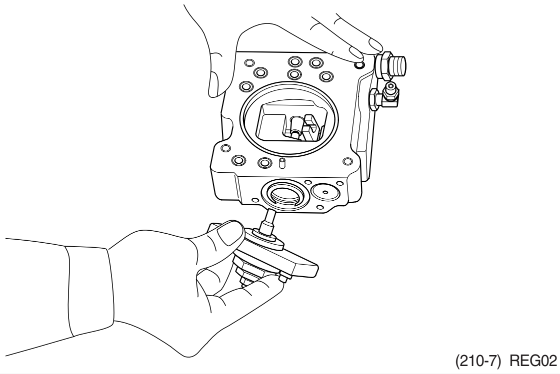
(210-7) REG01

(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).

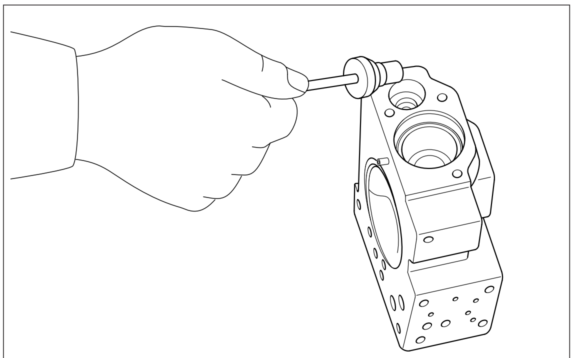
※ Do not loosen these screws and nuts.

If they are loosened, adjusted pressure-flow setting will vary.



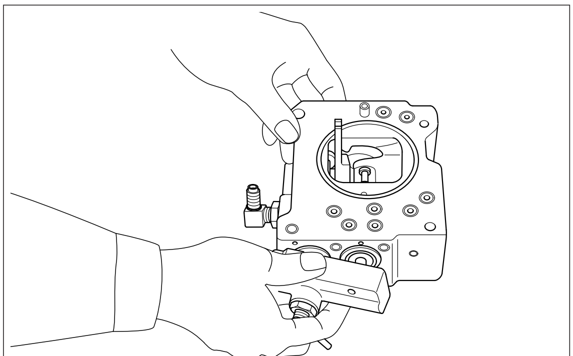
(210-7) REG02

(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.



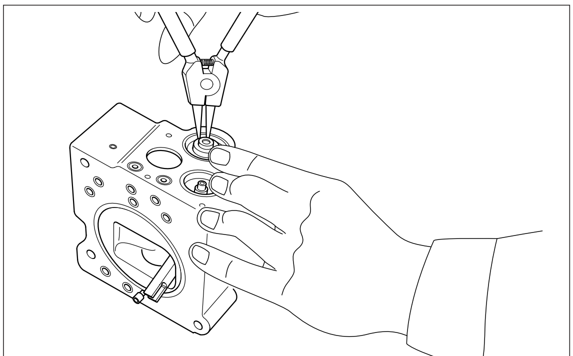
(210-7) REG03

(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.



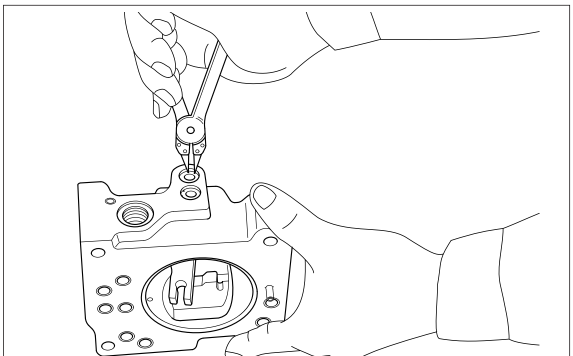
(210-7) REG04

(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.

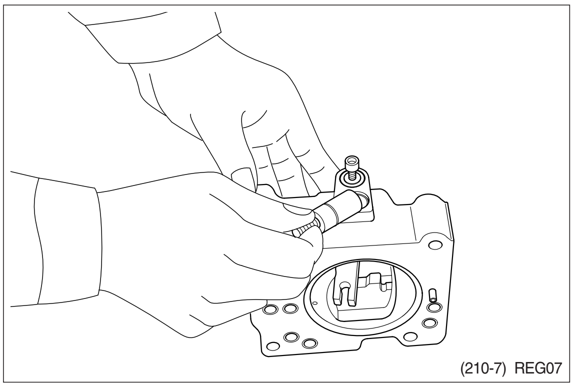


(210-7) REG05

(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.

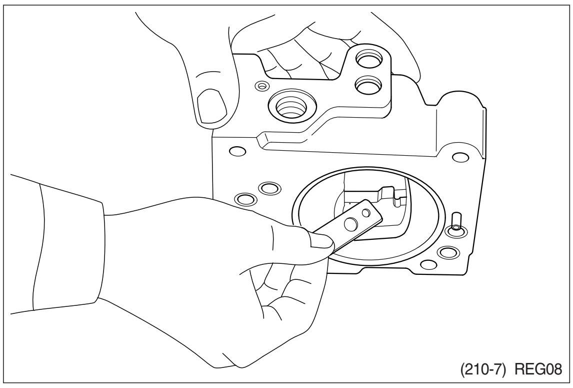


(210-7) REG06


(210-7) REG07

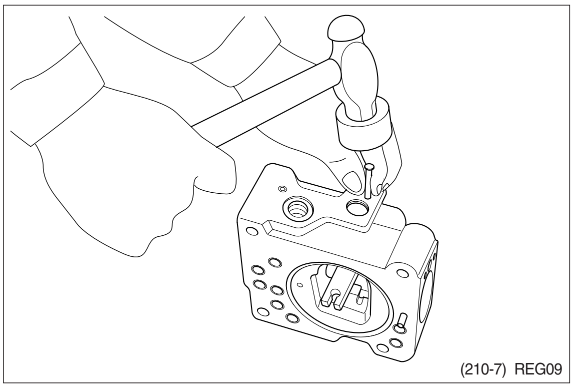
(9) Remove lever (2, 613). Do not draw out pin (875).

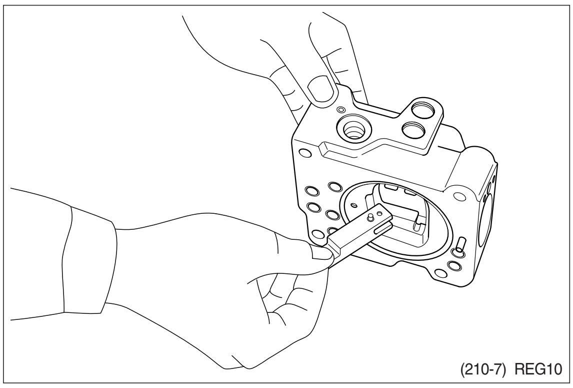
※ Work will be promoted by using pincers or so on.


(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.

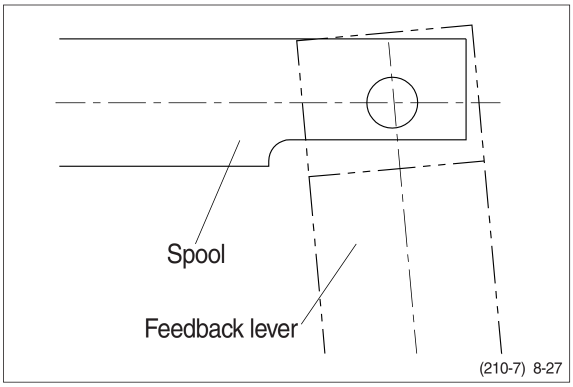
(2) Put compensating rod (623) into compensating hole of casing (601).

(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.

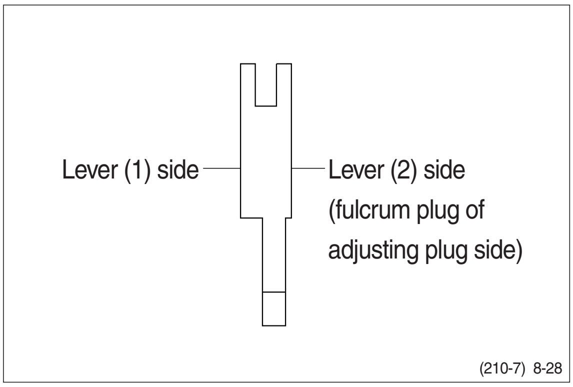
※ Confirm that spool and sleeve slide smoothly in casing without binding.

※ Pay attention to orientation of spool.



(210-7) 8-27

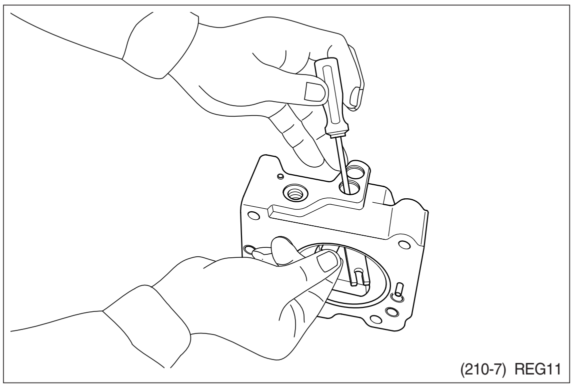
(5) Fit feedback lever (611), matching its pin hole with pin hole in spool.
Then insert pin (874).
※ Insert pin in feedback lever a little to ease operation.
※ Take care not to mistake direction of feedback lever.



(210-7) 8-28

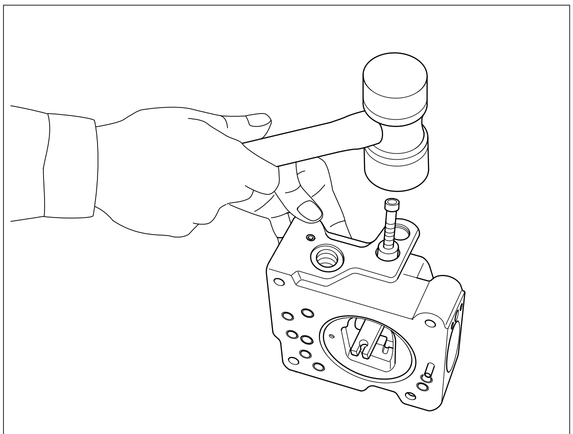
(6) Put pilot piston (643) into pilot hole of casing.
※ Confirm that pilot piston slides smoothly without binding.

(7) Put pin force-fitted in lever (2, 613) into groove of pilot piston.
Then fix lever (2).

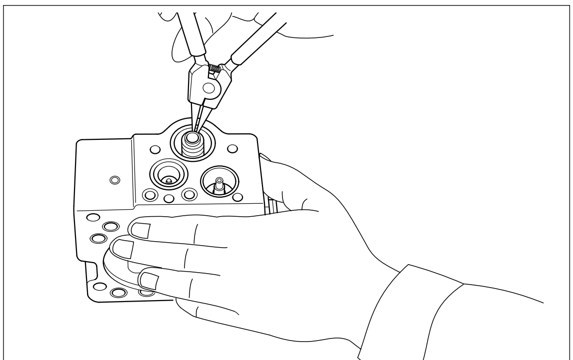

(210-7) REG11

(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).

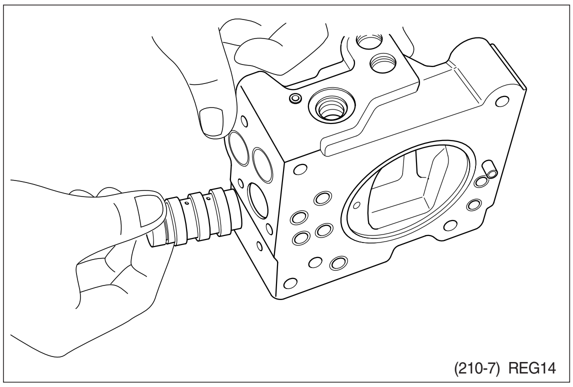
(9) Insert adjusting plug (615) and fit locking ring.
※ Take care not to mistake inserting holes for fulcrum plug and adjusting plug.
At this point in time move feedback lever to confirm that it has no large play and is free from binding.


(210-7) REG12

(10) Fit return spring (654) and spring seat (653) into spool hole and attach snap ring (814).

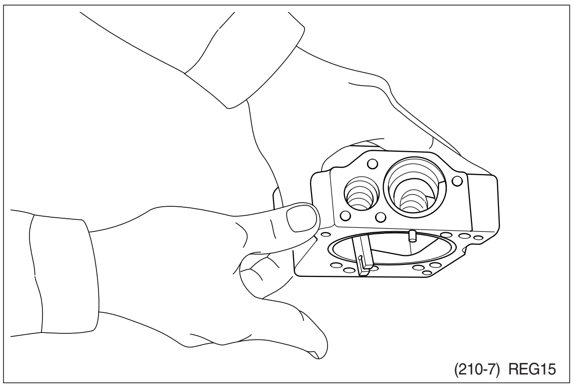

(210-7) REG13

(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).



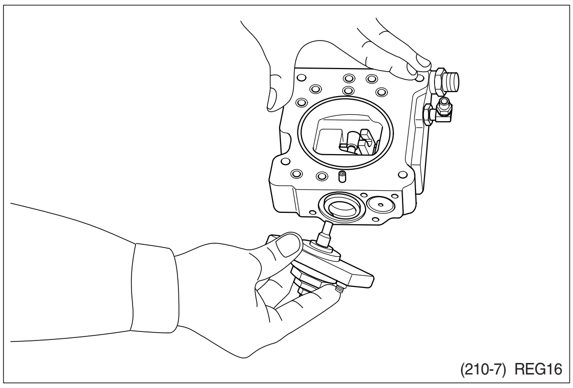
(210-7) REG14

(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).



(210-7) REG16

This completes assembly.

GROUP 4 MAIN CONTROL VALVE

1. REMOVAL AND INSTALL OF MOTOR

1) REMOVAL

(1) Lower the work equipment to the ground and stop the engine.

(2) Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

(3) Loosen the breather slowly to release the pressure inside the hydraulic tank.

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

※ When pipes and hoses are disconnected, the oil inside the piping will flow out, so catch it in oil pan.

(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)

· Tightening torque : 12.3 ± 1.3 kgf · m (88.2 ± 9.3 lbf · ft)

(9) Remove the control valve assembly. When removing the control valve assembly, check that all the piping have been disconnected.

2) INSTALL

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

(2) Bleed the air from below items.

① Cylinder (Boom, arm, bucket)

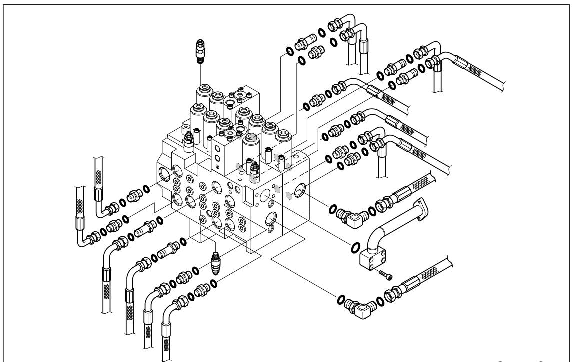
② Swing motor

③ Travel motor

※ See each item removal and install.

(3) Confirm the hydraulic oil level and recheck the hydraulic oil leak or not.

13031GE18



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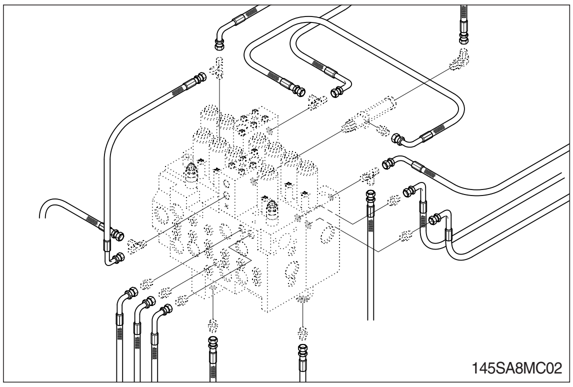

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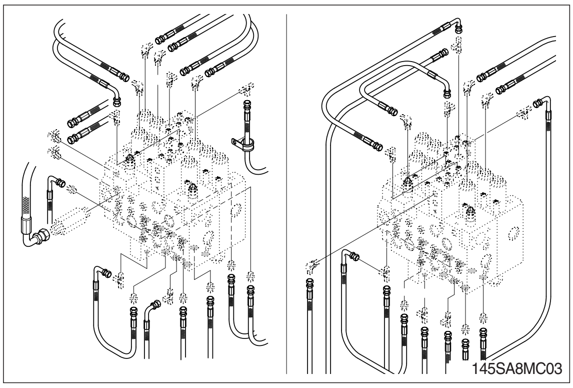
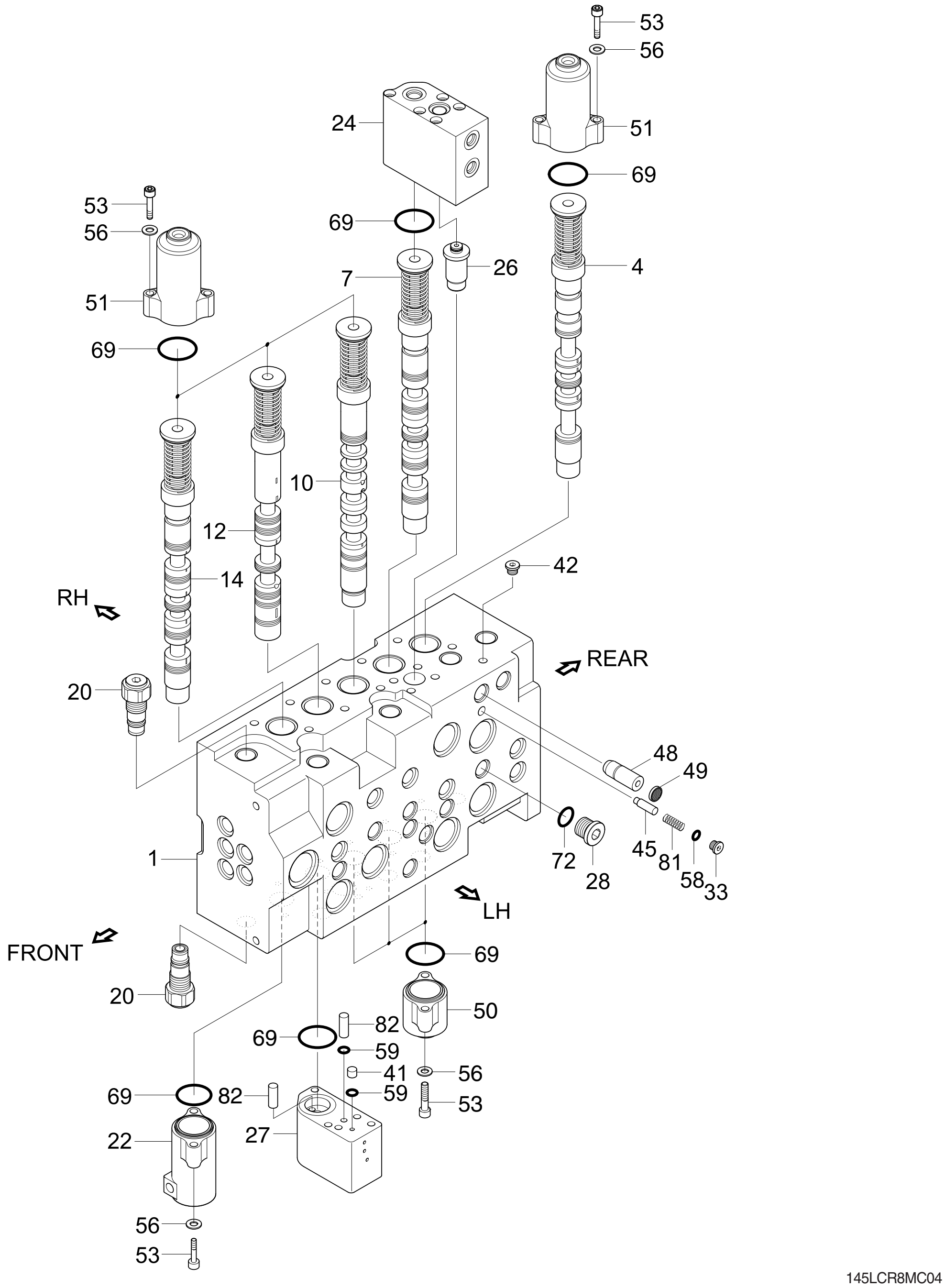


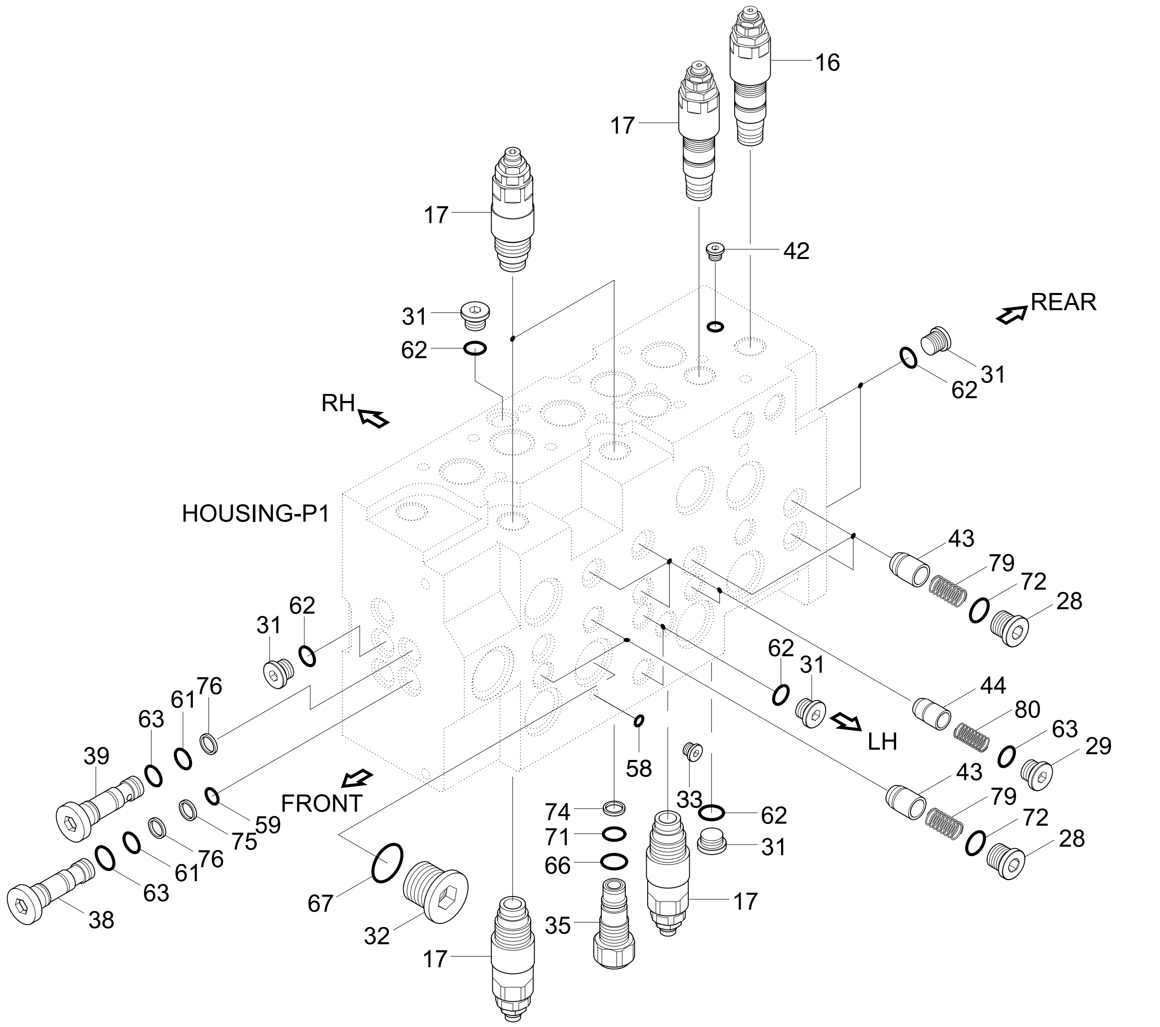
145SA8MC03

2. STRUCTURE (1/4)



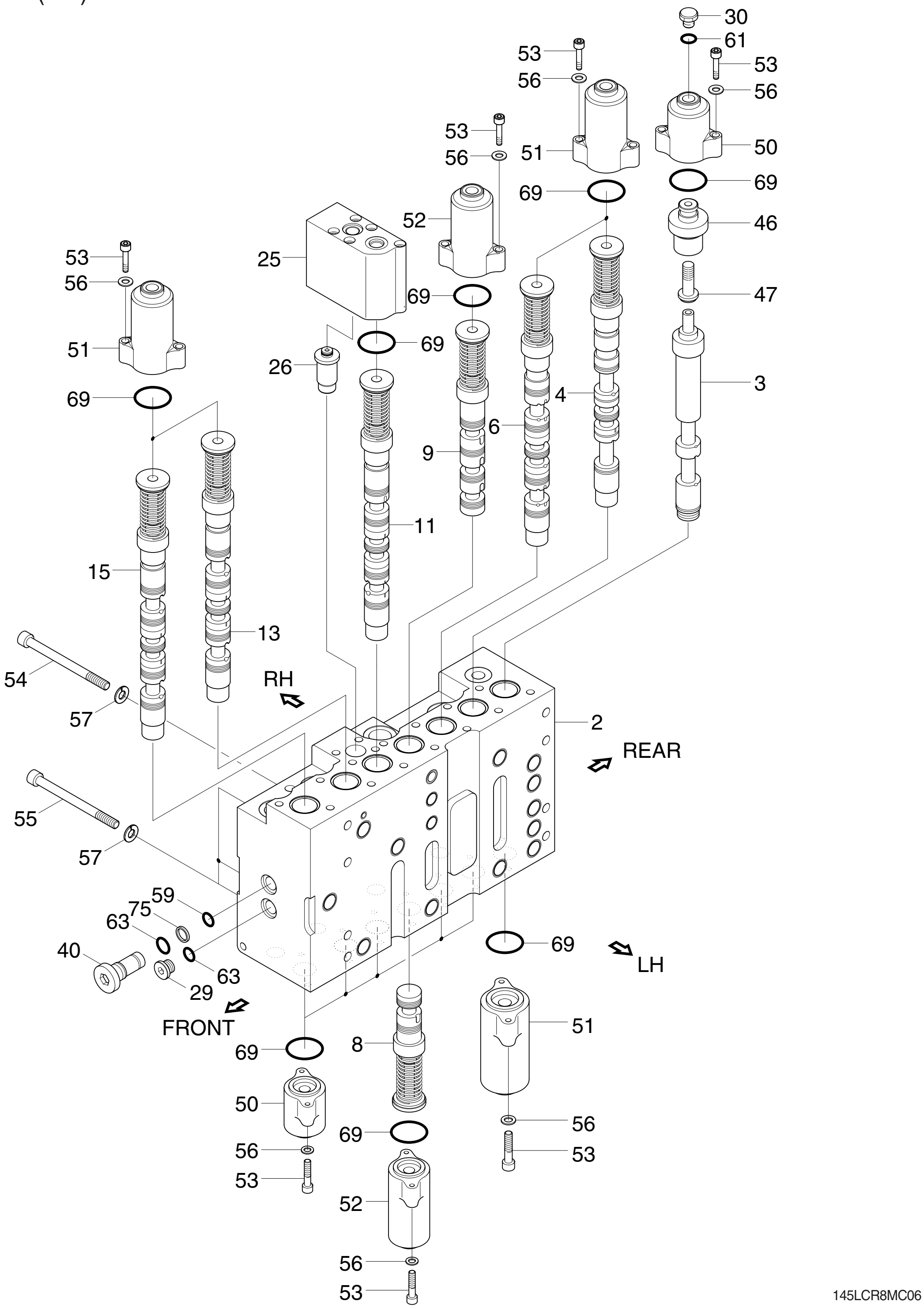
1	Housing-P1	27	Regeneration block assy	53	Socket head bolt
4	Spool assy-travel LH	28	Plug	56	Plain washer
7	Spool assy-boom 1	33	Plug	58	O-ring
10	Spool assy-arm 2	41	Plug	59	O-ring
12	Spool assy-arm regen	42	Plug	69	O-ring
14	Spool kit-bucket	45	Poppet	72	O-ring
20	Nega con relief valve assy	48	Orifice	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)



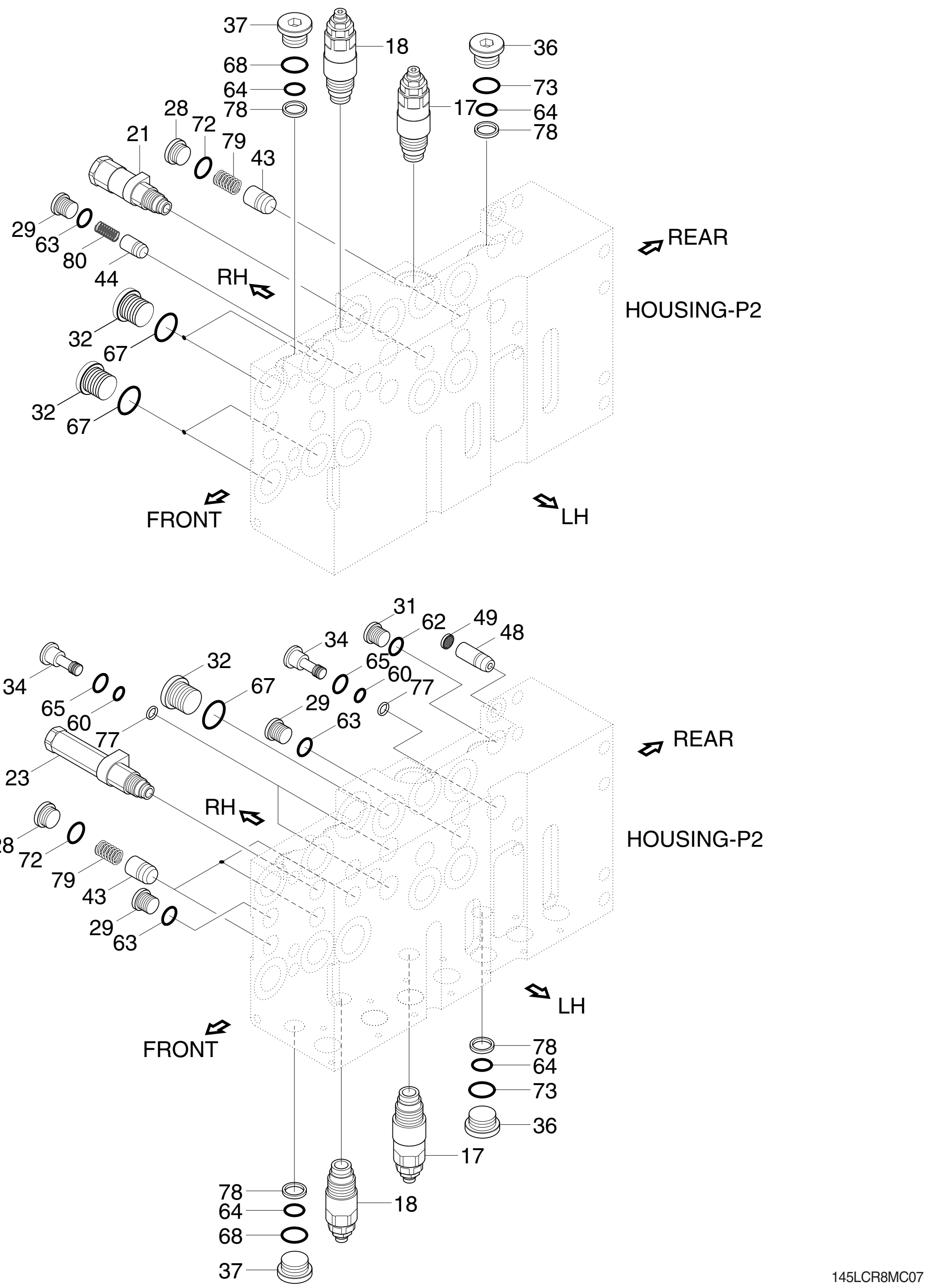
16	Main relief valve assy	39	Plug	66	O-ring
17	Overload relief valve assy	42	Plug	67	O-ring
28	Plug	43	Poppet 1	71	O-ring
29	Plug	44	Poppet 2	72	O-ring
31	Plug	58	O-ring	74	Back up ring
32	Plug	59	O-ring	75	Back up ring
33	Plug	61	O-ring	76	Back up ring
35	Plug	62	O-ring	79	Spring
38	Plug	63	O-ring	80	Spring

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 assy	37	Plug	67	O-ring
18	Overload relief valve assy	43	Poppet 1	68	O-ring
21	Swing logic valve	44	Poppet 2	72	O-ring
23	ON/OFF valve assy-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

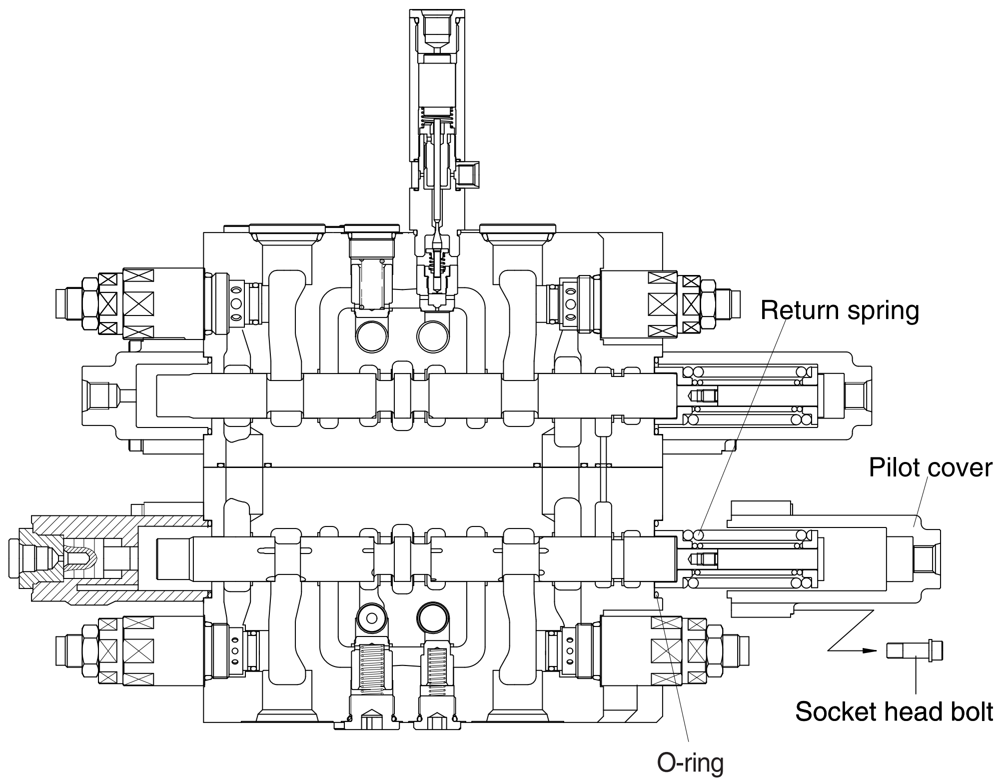
① Loosen hexagon socket head bolts with washer.
(hexagon wrench : 5 ㎜)

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)

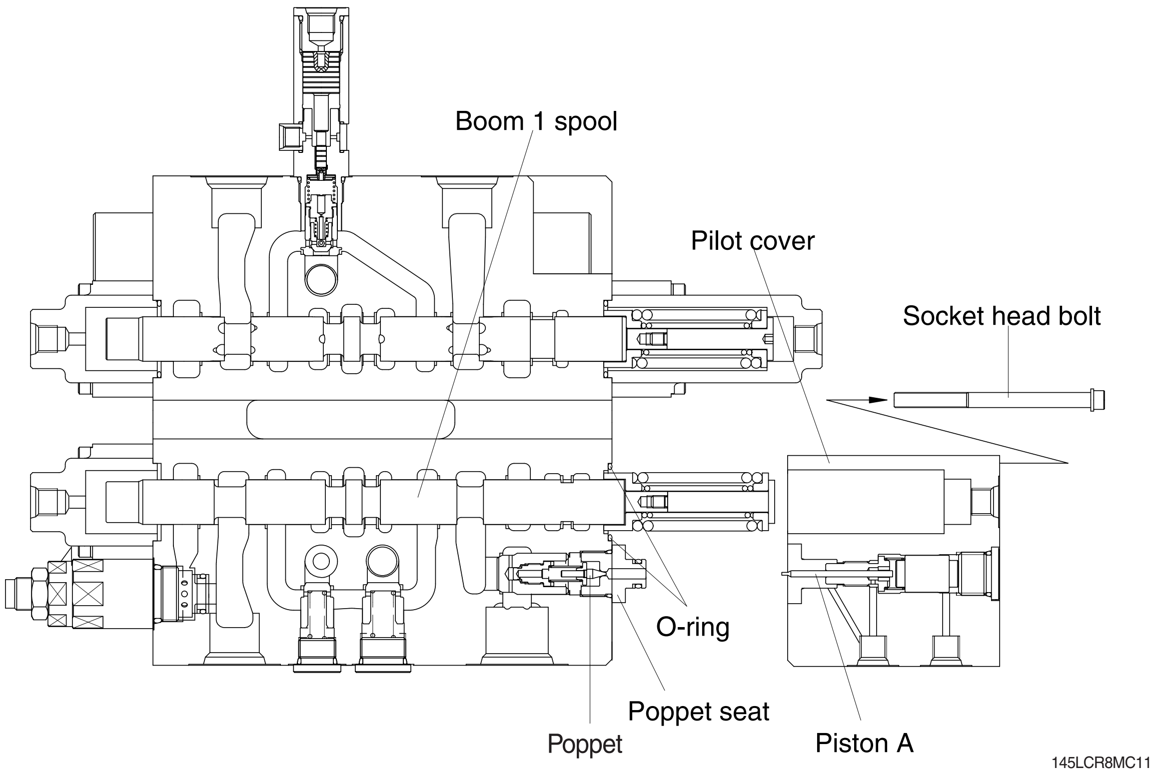
① Loosen hexagon socket head bolts with washer.
(hexagon wrench : 5 mm)

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.



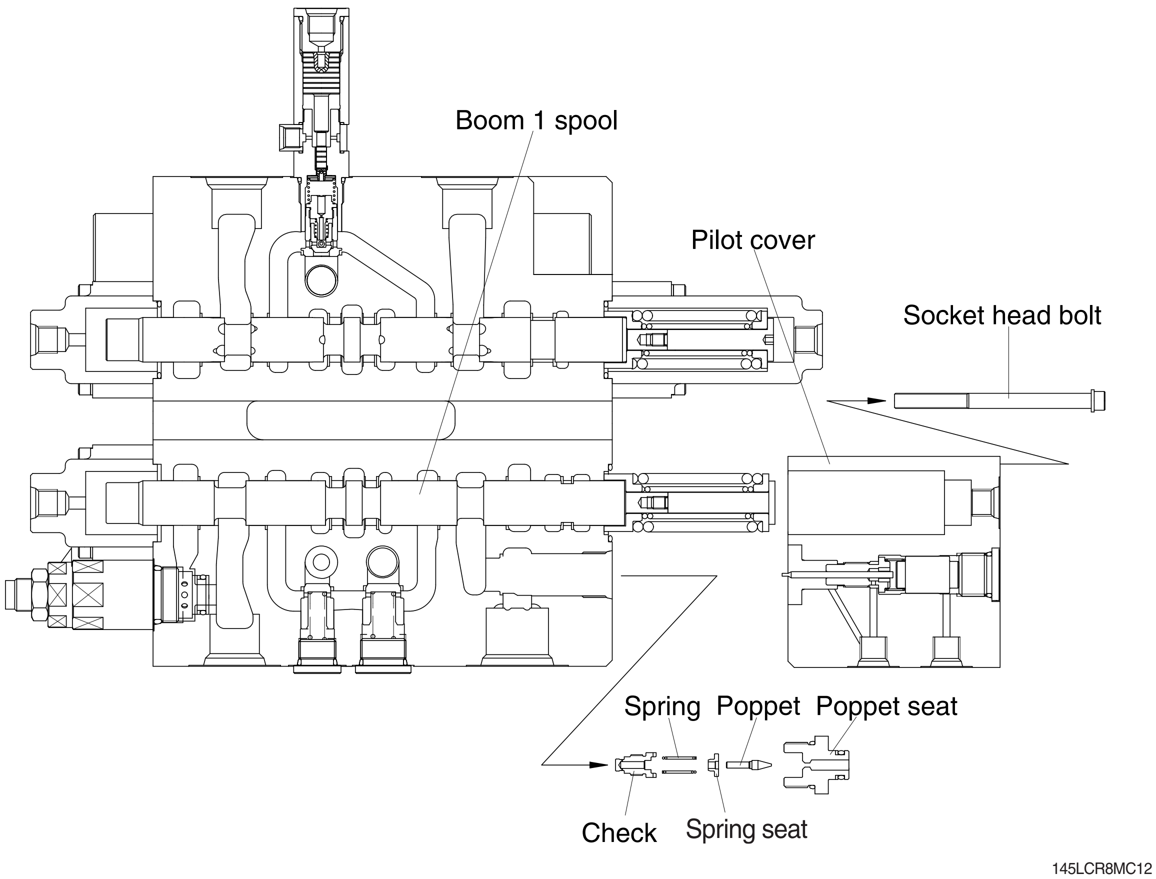
(3) Disassembly of the holding valve

① Remove the pilot cover with the holding valve as described on previous page.

※ Do not disassembled internal parts of the pilot cover.

② Loosen the poppet seat and remove the poppet, spring seat, spring and check.
(spanner : 26 ㎜)

※ Pay attention not to lose the poppet.
※ Do not disassembled internal parts of the check.



(4) Disassembly of the load check valve and the negative relief valve

① The load check valve

a. Fix the body to suitable work bench.

※ Pay attention not to damage the body.

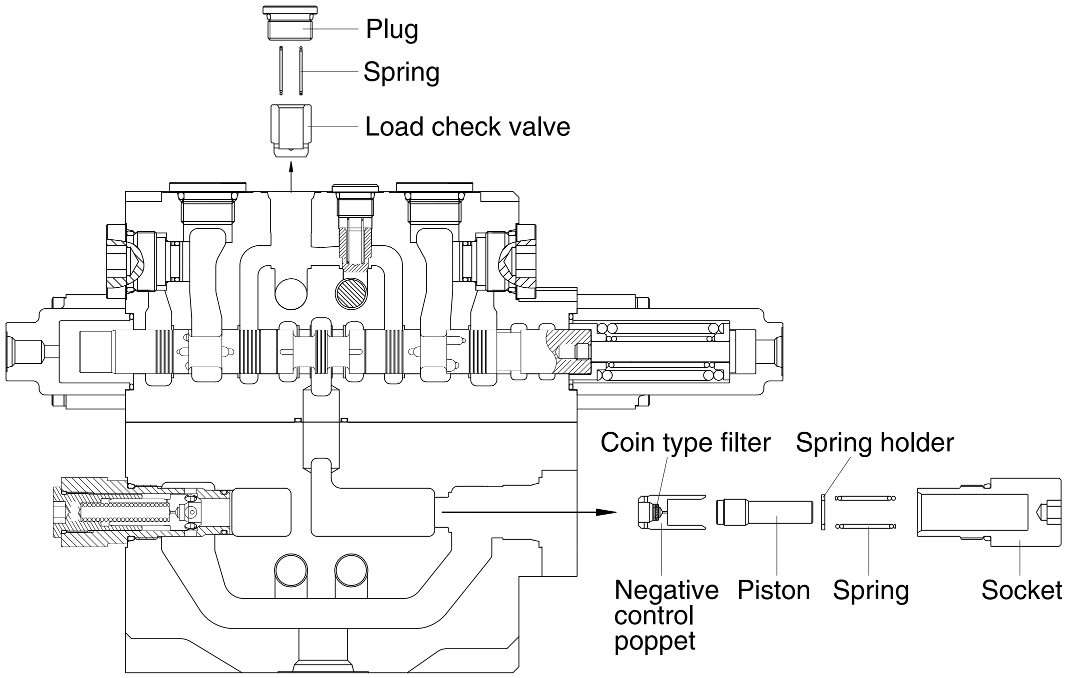
b. Loosen the plug (hexagon wrench : 10 mm).

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

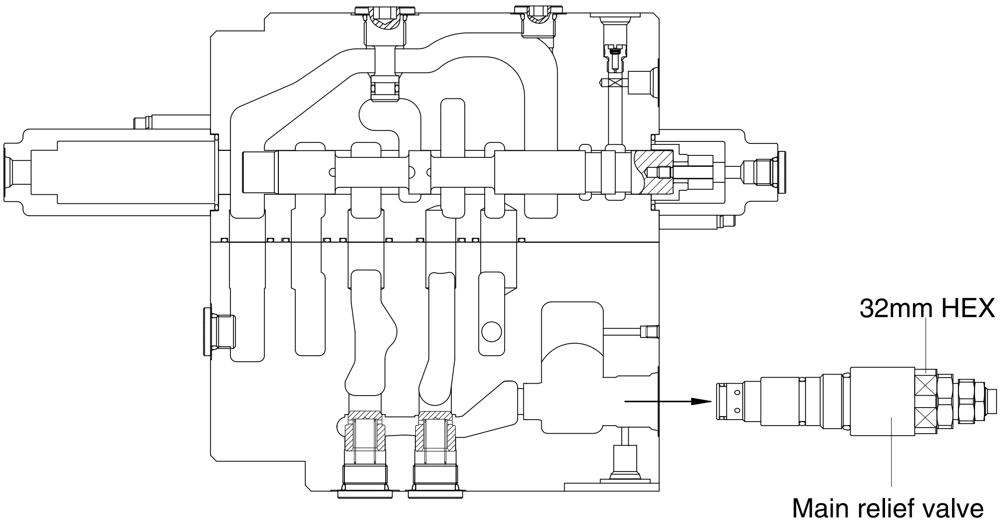
(5) Disassembly of the main and overload relief valve

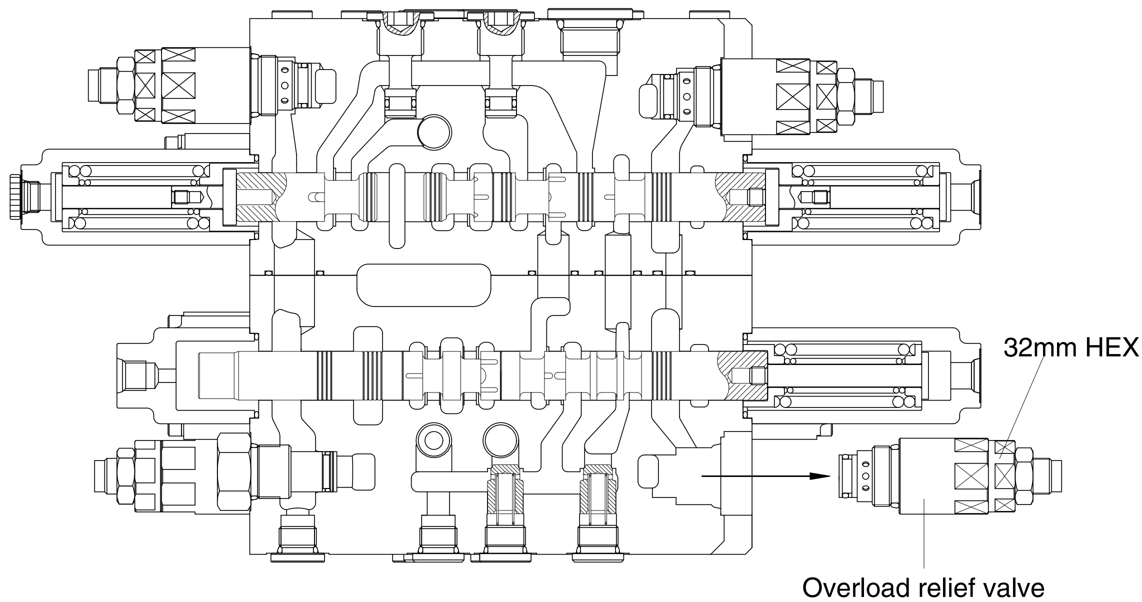
① Fix the body to suitable work bench.

② Remove the main relief valve.
(spanner : 32 ㎜)

③ Remove the overload relief valve.
(spanner : 32 ㎜)

※ 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

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.

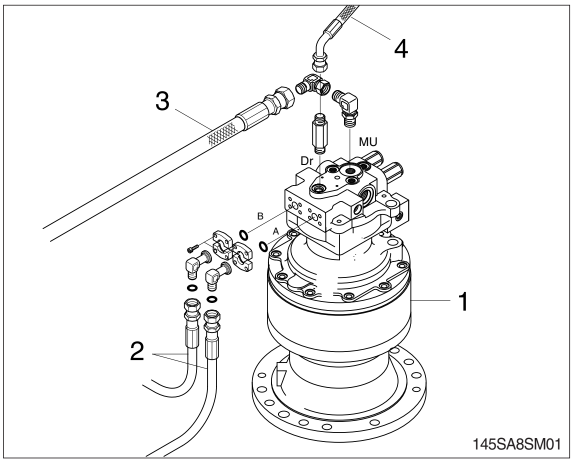
(4) Disconnect hose assembly (2).

(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).

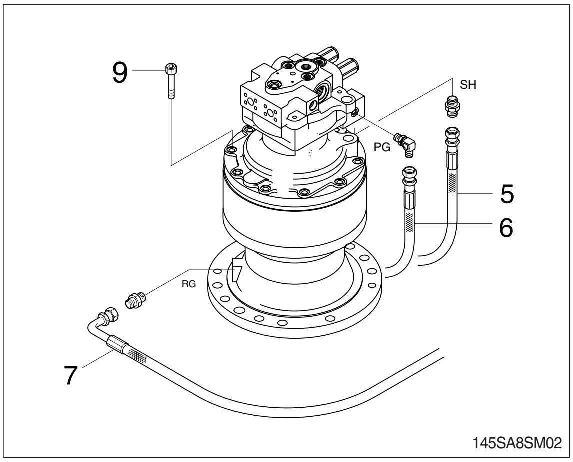
· Motor device weight : 43 kg (94.8 lb)

· Tightening torque : 17.5±1.8 kgf · m (127±13.0 lbf · ft)



(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.

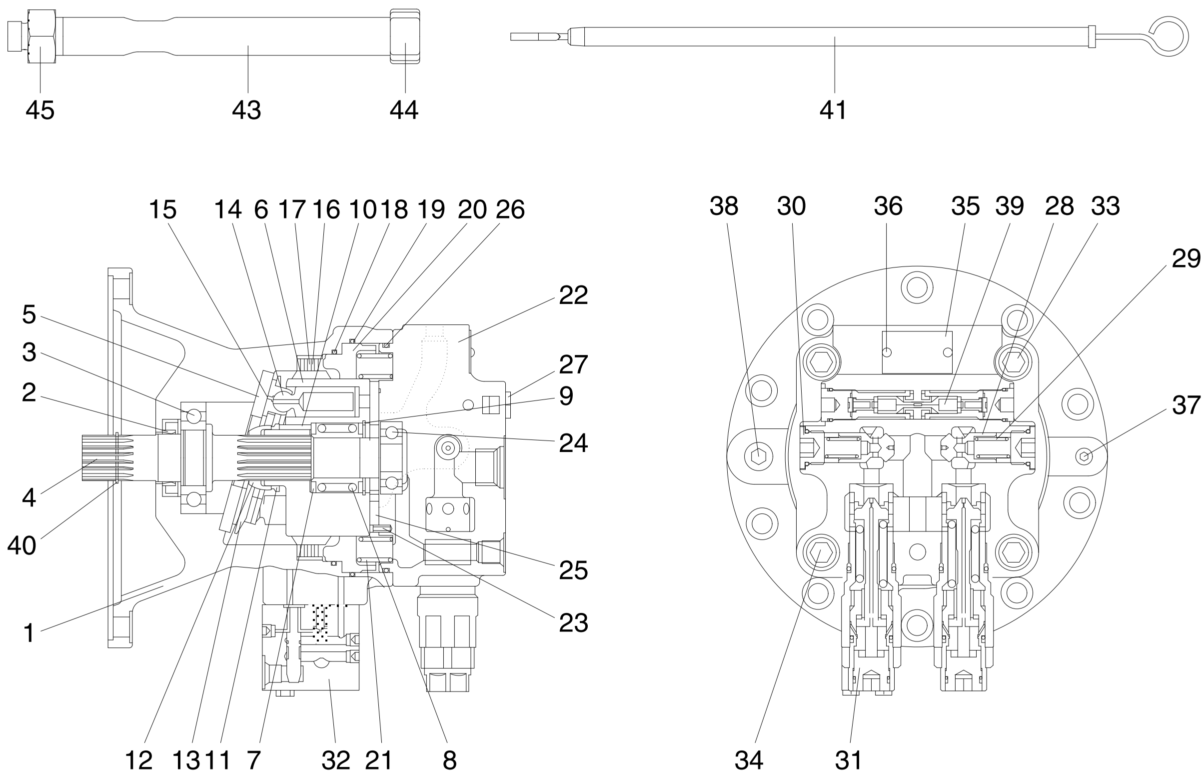
④ Start the engine, run at low idling and check oil come out from plug.

⑤ Tighten plug fully.

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

2. DISASSEMBLY AND ASSEMBLY OF SWING MOTOR

1) STRUCTURE



145WF2SM81

1	Casing	16	Separate plate	31	Relief valve assy
2	Oil seal	17	Friction plate	32	Brake valve assy
3	Ball bearing	18	O-ring	33	Socket bolt
4	Drive shaft	19	O-ring	34	Socket bolt
5	Shoe plate	20	Brake piston	35	Name plate
6	Cylinder block	21	Spring	36	Screw
7	Washer	22	Valve casing	37	Plug
8	Spring	23	Spring pin	38	Plug
9	Snap ring	24	Ball bearing	39	Reactionless valve assy
10	Roller	25	Valve plate	40	Snap ring
11	Collar washer	26	O-ring	41	Level gauge
12	Thrust ball	27	Plug	42	pipe
13	Retainer plate	28	Plunger	43	Bar
14	Piston	29	Spring	44	Cap
15	Shoe	30	Plug	45	Reducer

3. REMOVAL AND INSTALL OF REDUCTION GEAR

1) REMOVAL

(1) Remove the swing motor assembly.
For details, see removal of swing motor assembly.

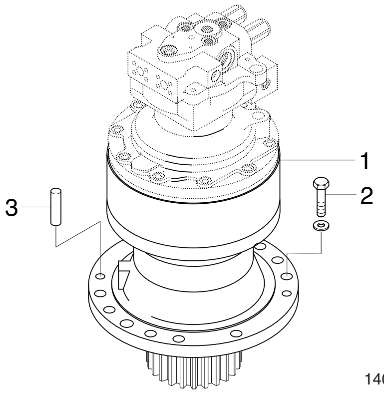
(2) Sling reduction gear assembly (1) and remove dowel pin (3) and mounting bolts (2).

(3) Remove the reduction gear assembly.
· Reduction gear weight : 75 kg
(165 lb)

13031GE18

2) INSTALL

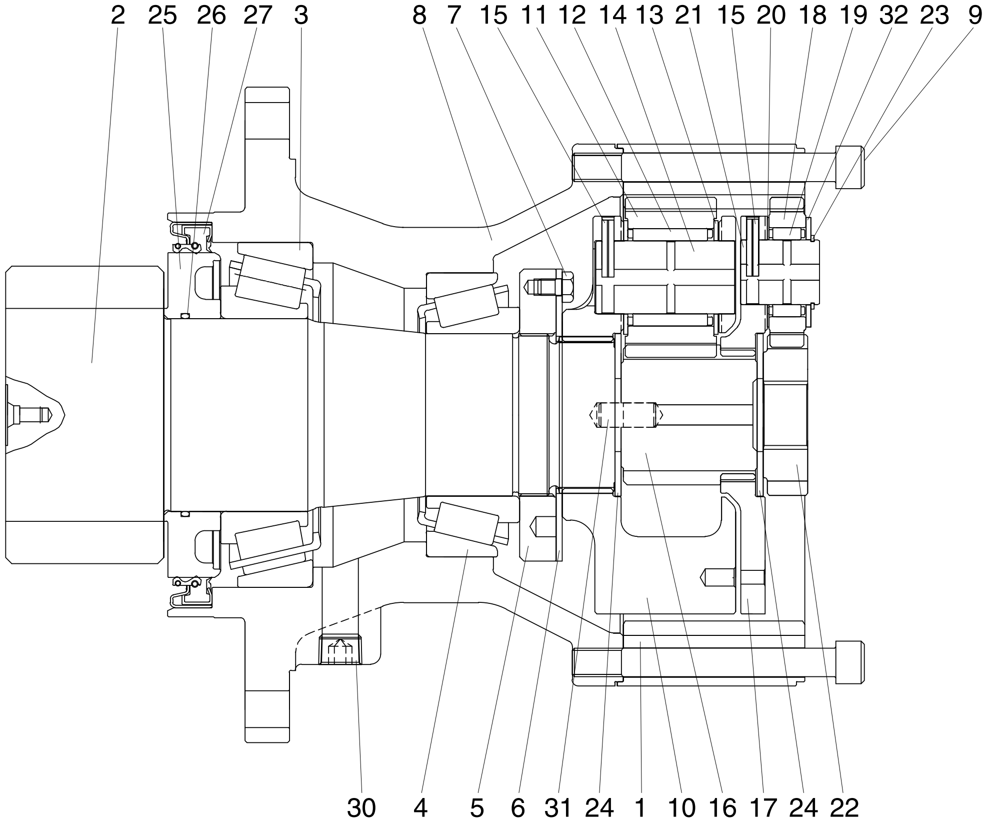
(1) Carry out installation in the reverse order to removal.
· Tightening torque : 29.6±3.2 kgf · m
(214±23.1 lbf · ft)



140LC8SM23

4. DISASSEMBLY AND ASSEMBLY OF REDUCTION GEAR

1) STRUCTURE

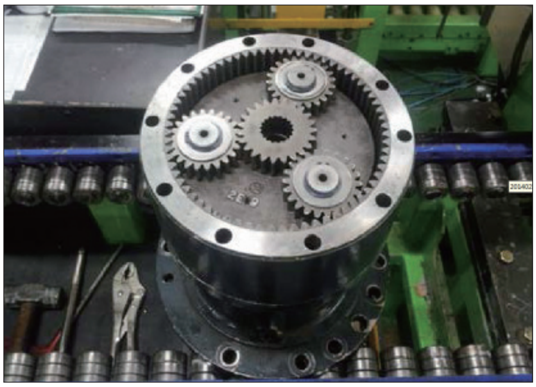


125LCR2SM23

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	Taper roller bearing	13	Thrust washer No. 2	23	Snap ring
4	Taper roller 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

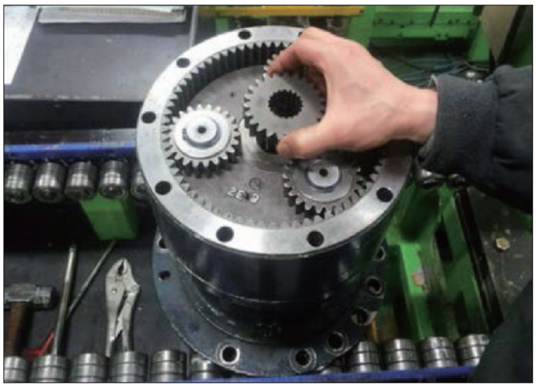
2) DISASSEMBLY

(1) Remove the swing motor, and then place swing reduction gear on the bench.



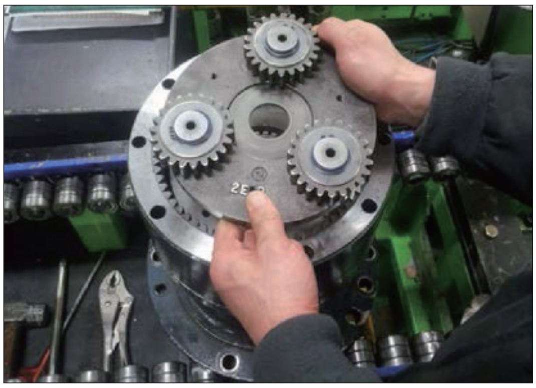
125LCR8SM60

(2) Disassemble sun gear No.1 (22).



125LCR8SM61

(3) Disassemble carrier No.1 sub assembly.



125LCR8SM62

Carrier No.1 sub assy disassembly

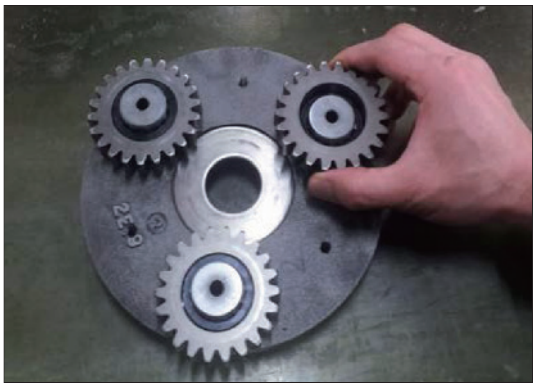
(4) Put carrier No.1 sub assembly on the bench, then remove the snap ring (23).

125LCR8SM63

(5) Disassemble thrust washer No.1 (upper) (32).(3 pcs)

125LCR8SM64

(6) Disassemble planetary gear No.1 (18). (3 pcs)

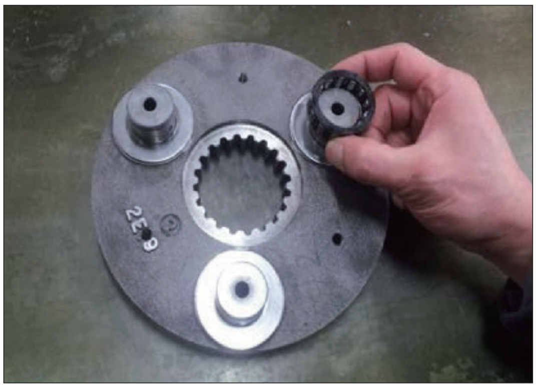


125LCR8SM65

(7) Disassemble thrust plate (24).

125LCR8SM66

(8) Disassemble needle bearing No.1 (19). (3 pcs)



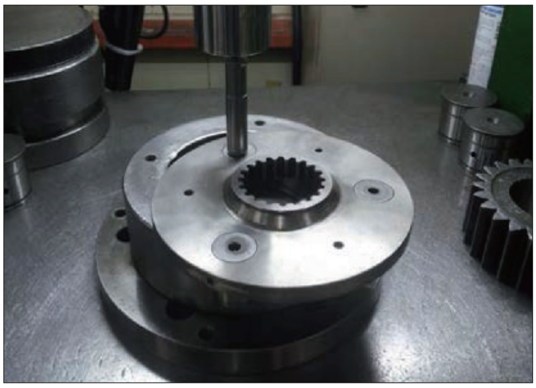
125LCR8SM67

(9) Disassemble thrust washer No.1 (lower) (20). (3 pcs)

125LCR8SM68

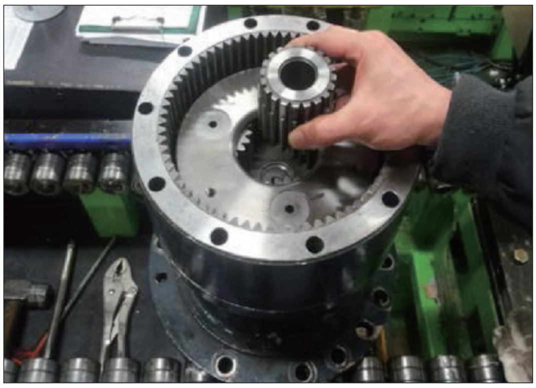
(10) After placing spring pin (15) to center of carrier pin No.1 (21) with a jig, disassemble it. (3 pcs)

※ Do not reuse spring pin, carrier and carrier pin.



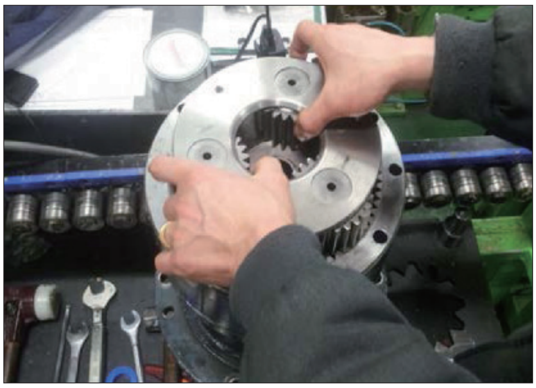
125LCR8SM69

(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

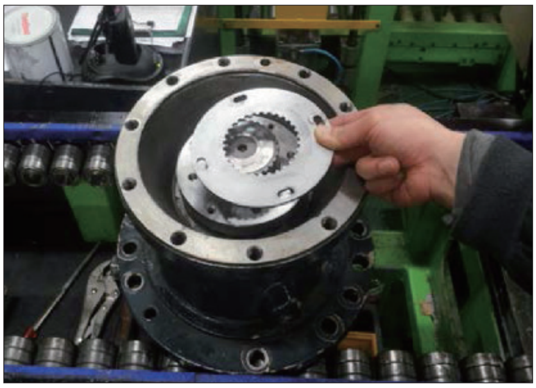
(17) Disassemble needle bearing No.2 (12). (3 pcs)

125LCR8SM76

(18) Separate ring gear (1) from casing (8).

125LCR8SM77

(19) Loosen bolt (7) (4 pcs), and disassemble lock plate (6).



125LCR8SM78

(20) Disassemble ring nut (5) by using the jig.

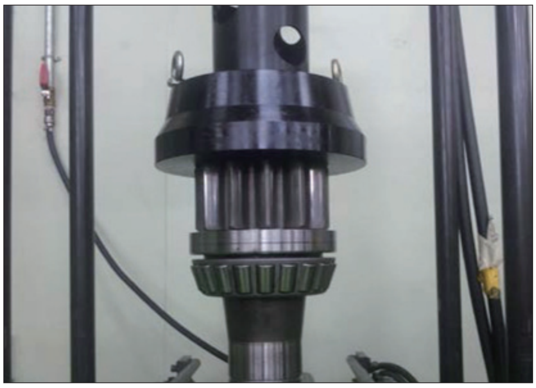
125LCR8SM79

Drive shaft sub assy disassembly

(21) Separate drive shaft sub assembly from casing (8).

125LCR8SM80

(22) Disassemble taper roller 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 roller 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.

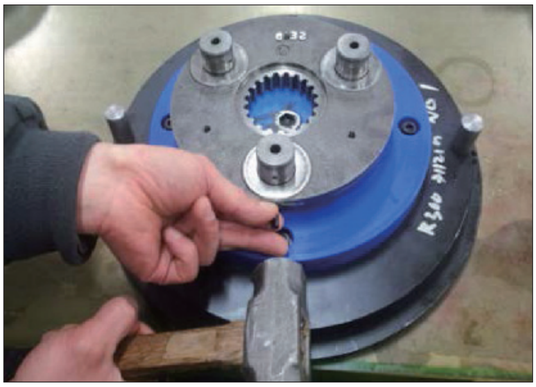
① Repair the damaged part when disassemblying and prepare parts for exchange in advance.
② All parts should be cleaned with cleaner, dried with compressed air.
③ Sliding surface, O-ring, bearing and oil seal should be lubricated with clean hydraulic oil, prior to final assembly.
④ Replacement of O-ring 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

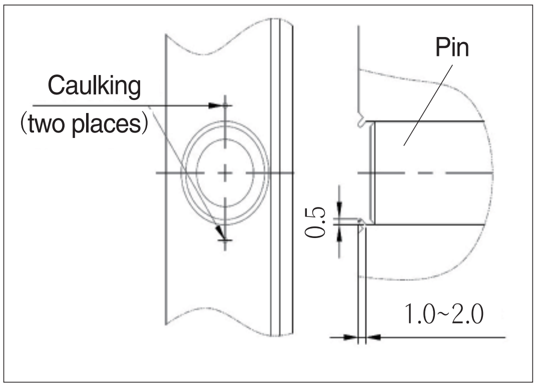
(2) After drilling Ø6 hole, assemble spring pin (15).(3 pcs)



125LCR8SM85

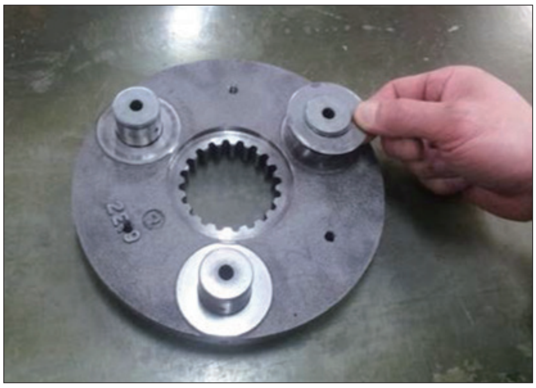
(3) Caulking is performed on the assembled spring pin unit.

※ To cover pins, implement the caulking in two places that are located direction of 180 degrees around assembled spring pin.



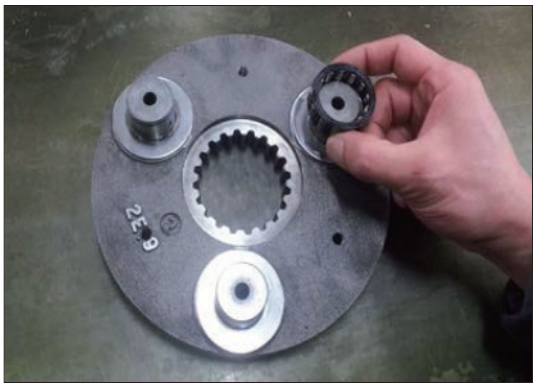
125LCR8SM86

(4) Assemble thrust washer No.1 (lower) (20). (3 pcs)



125LCR8SM87

(5) Assemble needle bearing No.1 (19).(3 pcs)

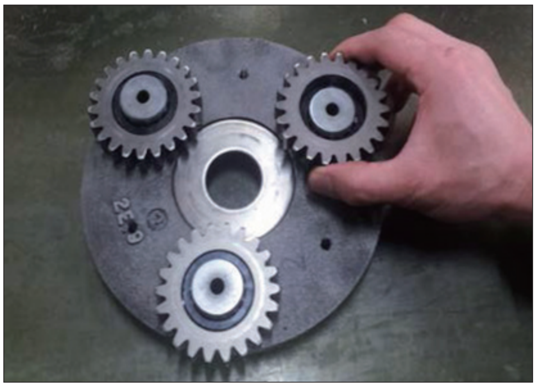


125LCR8SM88

(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)

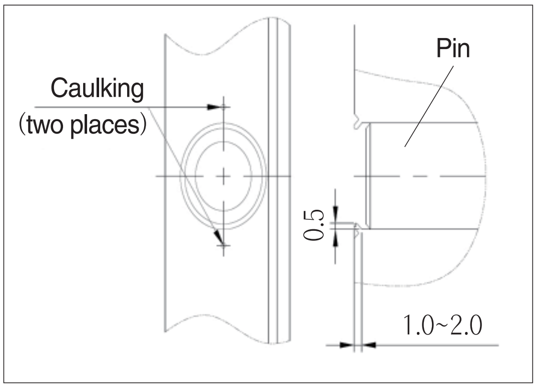
125LCR8SM97

(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.

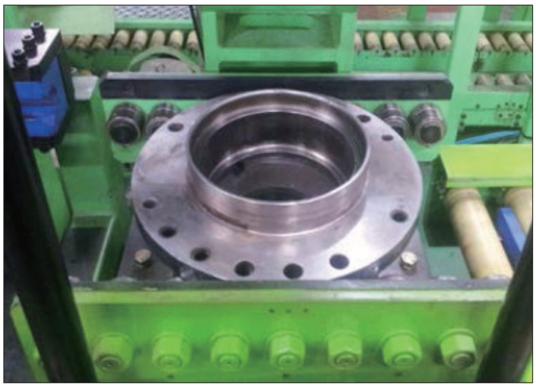
125LCR8SM101

(19) Shrink fit taper roller bearing (3) on drive shaft, complete drive shaft sub assembly.

125LCR8SM102

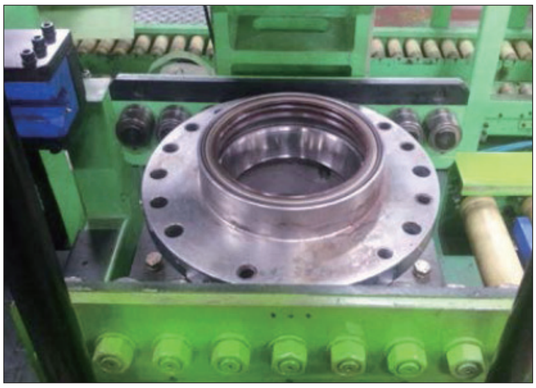
Casing assembly

(20) Press outer ring of the taper roller bearing in the casing (8) by using the jig.



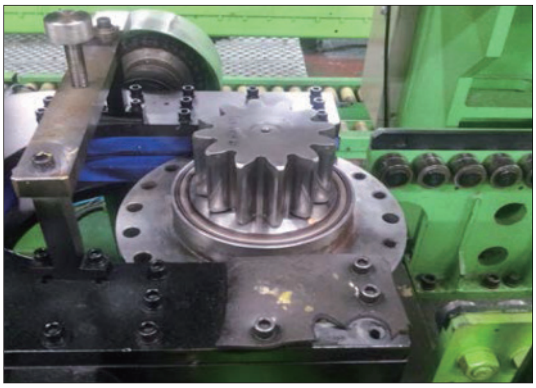
125LCR8SM103

(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.

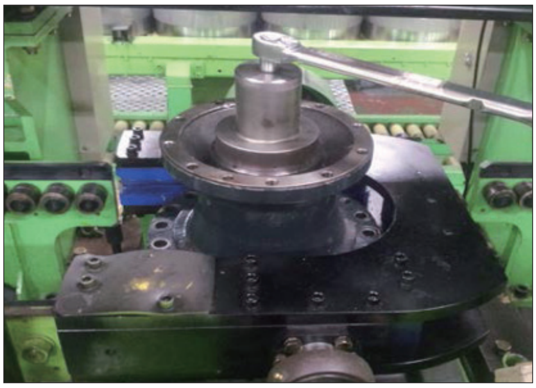


125LCR8SM105

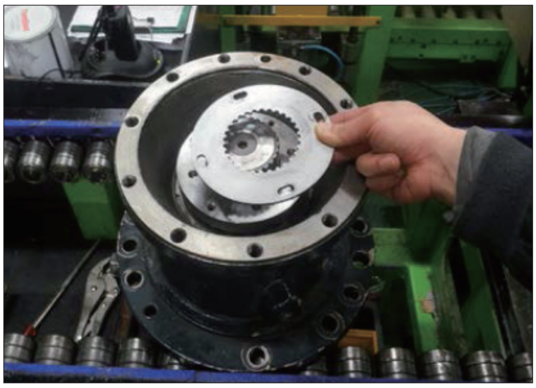
(23) After fixing drive shaft so that it does not fall, and then turn it over, press taper bearing (4).


125LCR8SM106

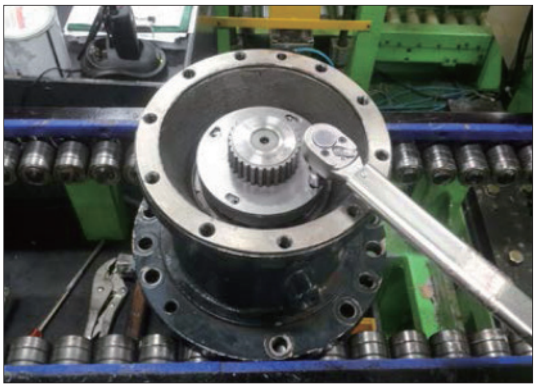
(24) Assemble nut ring (5) by using the jig.
※ Tightening torque : 3.5±0.4 kgf · m
(25.3±2.9 lbf · ft)


125LCR8SM107

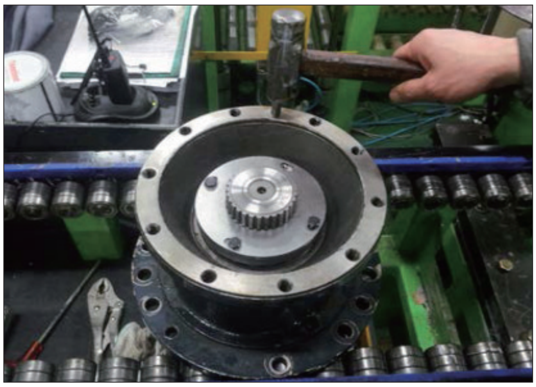
(25) Place lock plate (6) on the nut ring.


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)

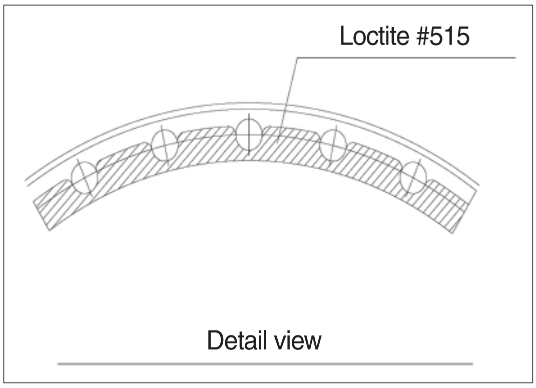

125LCR8SM109

(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.

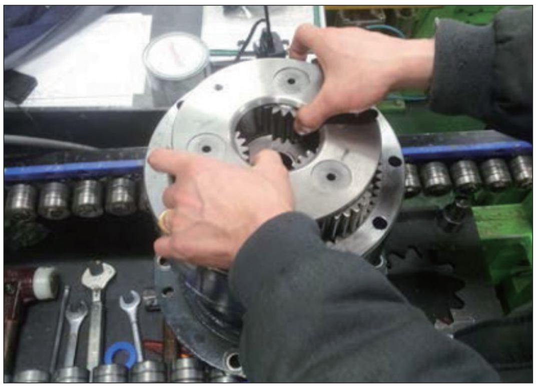


125LCR8SM111

(29) Assemble ring gear (1) in accordance with a pin hole on casing.
※ Be careful of damage of the ring gear.

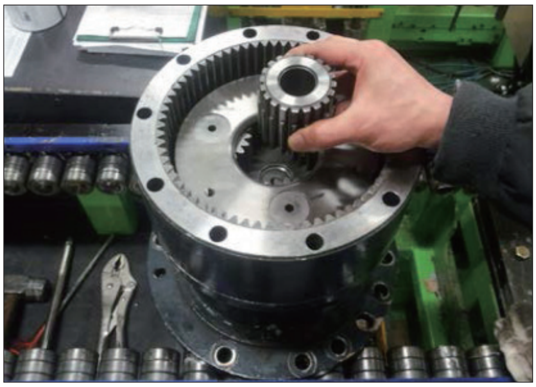
125LCR8SM112

(30) Assemble carrier No.2 sub assembly.



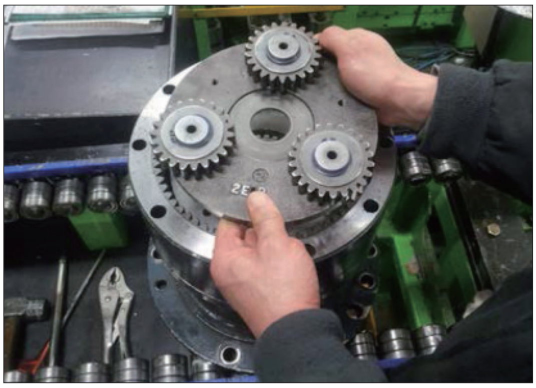
125LCR8SM113

(31) Assemble sun gear No.2 (16).



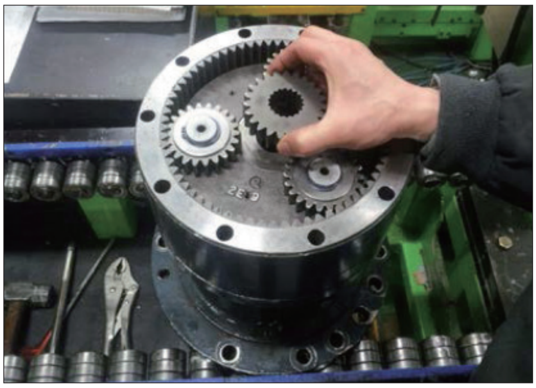
125LCR8SM114

(32) Assemble carrier No.1 sub assembly.



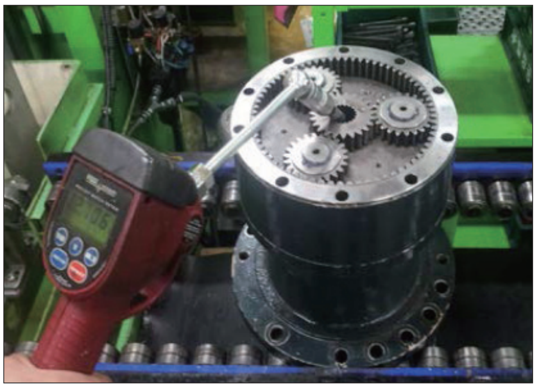
125LCR8SM115

(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 6 TRAVEL DEVICE

1. REMOVAL AND INSTALL

1) REMOVAL

(1) Swing the work equipment 90˚and lower it completely to the ground.

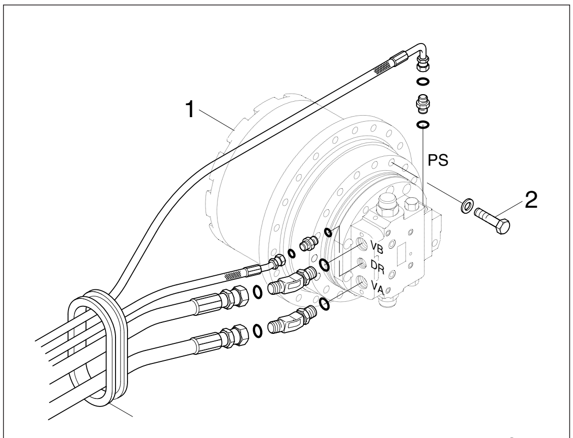
13031GE18

(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.



140LC8TM01

(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.
 · Tightening torque : 29.7±3.0 kgf · m
 (215±21.7 lbf · ft)

(8) Sling travel device assembly (1).

(9) Remove the mounting bolts (2), then remove the travel device assembly.
 · Weight : 140 kg (310 lb)
 · Tightening torque : 25.7±4.0 kgf · m
 (186±28.9 lbf · ft)

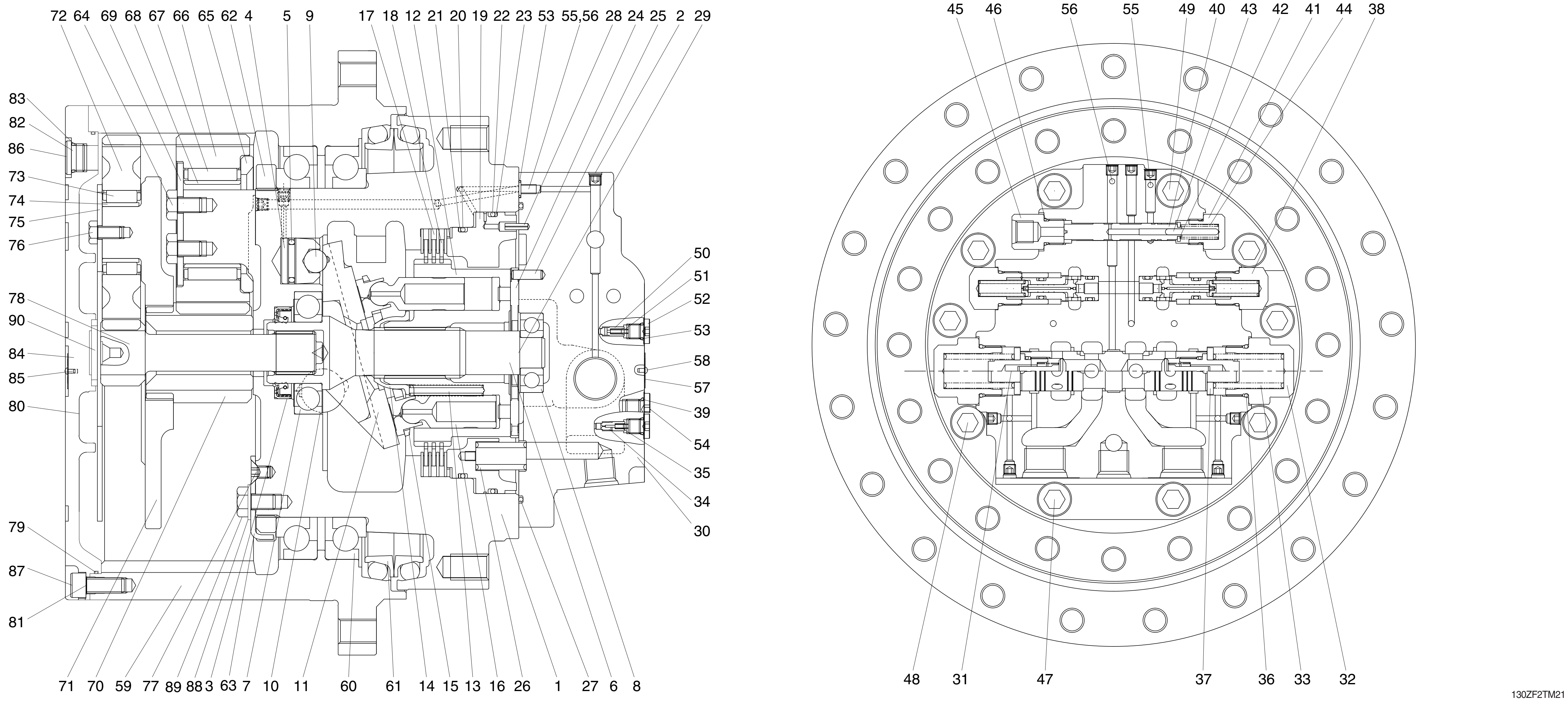
2) INSTALL

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

(2) Bleed the air from the travel motor.
 ① Remove the air vent plug.
 ② Pour in hydraulic oil until it overflows from the port.
 ③ Tighten plug lightly.
 ④ Start the engine, run at low idling, and check oil come out from plug.
 ⑤ Tighten plug fully.

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

2. TRAVEL MOTOR

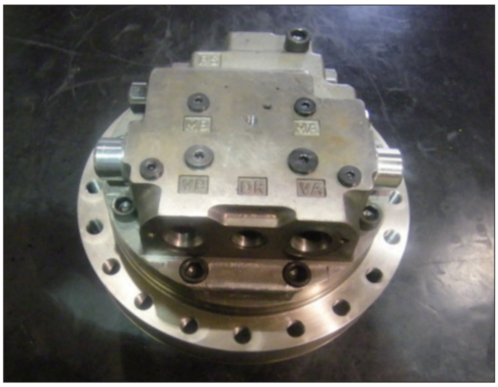


1	Casing	19	Parking piston	37	Spring seat	55	Restrictor	73	Needle bearing No.1
2	Plug	20	O-ring	38	Relief valve assy	56	Restrictor	74	Inner race No. 1
3	Oil seal	21	Back up ring	39	O-ring	57	Name plate	75	Thrust plate No. 1
4	Piston	22	O-ring	40	Spool	58	Rivet	76	Hexagon head bolt
5	Piston seal	23	Back up ring	41	Plug	59	Ring gear	77	Countersunk head screw
6	Shaft	24	Valve plate	42	Spring seat	60	Bearing	78	Sun gear No.1
7	Front ball bearing	25	Spring pin	43	Parallel pin	61	Floating seal assy	79	O-ring
8	Rear ball bearing	26	Spring	44	Spring	62	Nut ring	80	Cover
9	Steel ball	27	O-ring	45	Connector	63	Lock plate	81	Hex socket head bolt
10	Pivot	28	Spring pin	46	O-ring	64	Hexagon head bolt	82	Plug
11	Swash plate	29	Parallel pin	47	Hexagon socket head bolt	65	Thrust plate No. 2	83	O-ring
12	Cylinder block	30	Rear cover	48	Hexagon socket head bolt	66	Planetary gear No.2	84	Name plate
13	Spring	31	Main spool assy	49	Hexagon socket head bolt	67	Needle bearing No.2	85	Rivet
14	Ball guide	32	Cover	50	Check valve	68	Inner race No. 2	86	Rubber cap
15	Retainer plate	33	Spring	51	Spring	69	Thrust washer No. 2	87	Rubber cap
16	Piston assy	34	Restrictor	52	Plug	70	Sun gear No.2	88	Plain washer
17	Friction plate	35	Spring	53	O-ring	71	Carrier No.1	89	Hexagon bolt
18	Separated plate	36	O-ring	54	Plug	72	Planetary gear No.1	90	Thrust plate

2) DISASSEMBLY

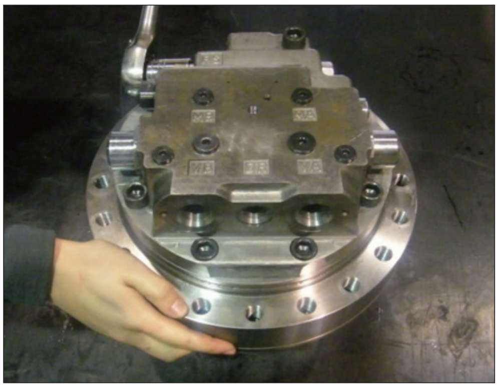
(1) Choose a clean place, remove contaminants (dust, etc) and cleans motor before placing it on worktable.

※ Lay the rubber plate on worktable and take care not to damage the component.



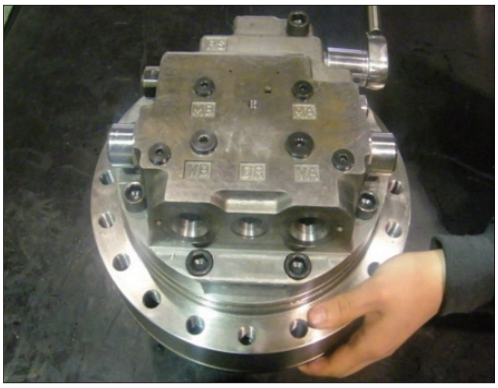
125LCR8TM02

(2) Remove the connector (45) using 21 mm socket wrench.



125LCR8TM03

(3) Remove plug (41) using 21 mm socket wrench.

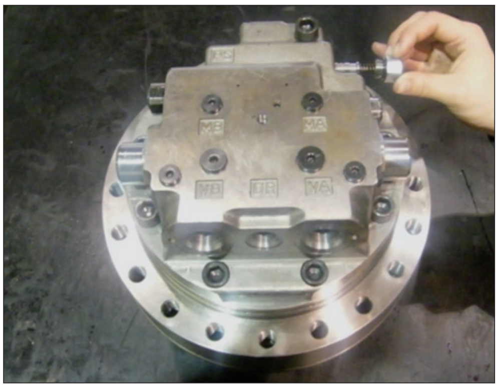


125LCR8TM04

(4) Disassemble parallel pin (43) and spring (44).

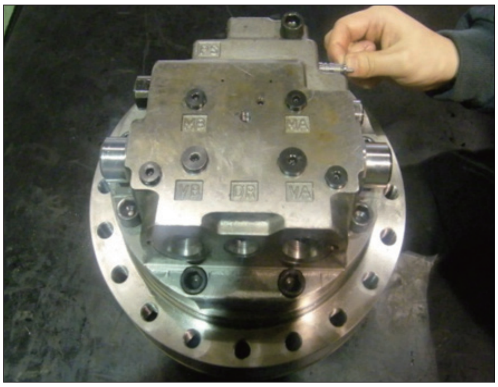
※ Do not lose spring.

※ Do not mix spring with other springs.



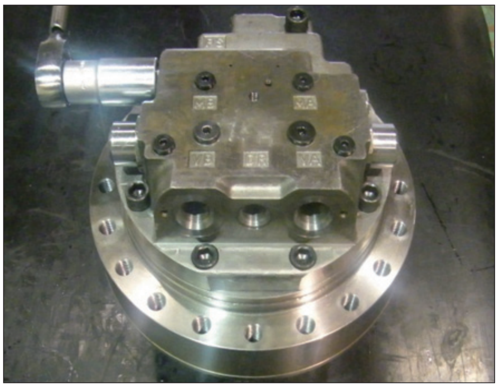
125LCR8TM05

(5) Remove spring seat (42) and spool (40).



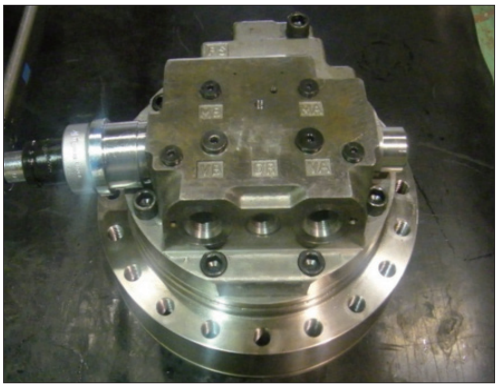
125LCR8TM06

(6) Disassemble relief valve assembly (38) using 26 mm socket wrench. (2 sets)



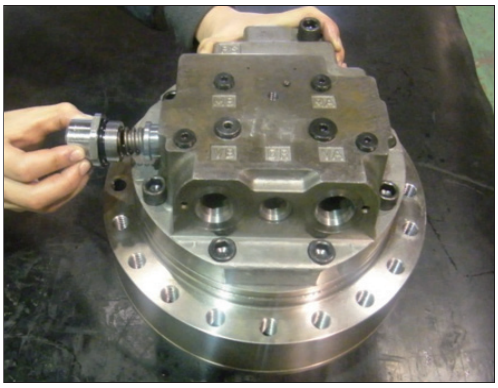
125LCR8TM07

(7) Disassemble cover (32) using 41 mm socket wrench.



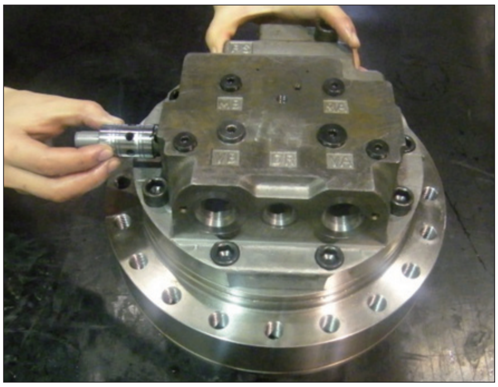
125LCR8TM08

(8) Disassemble spring seat (37) and spring (33). (2 sets)



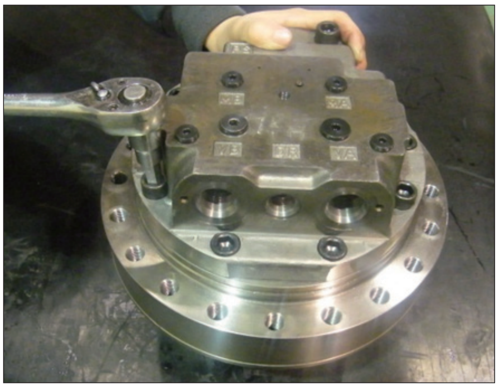
125LCR8TM09

(9) Separate main spool assembly (31) from rear cover.



125LCR8TM10

(10) Unscrew socket bolt (47) (1EA), (48) (3EA), (49) (6EA) from rear cover.



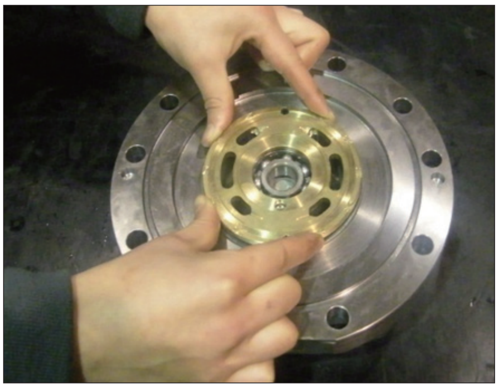
125LCR8TM11

(11) Remove parallel pin (29).

125LCR8TM12

(12) From rear cover, disassemble valve plate (24) and O-ring (27).

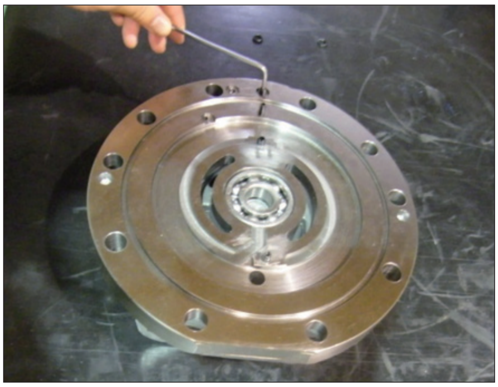
※ Take care not to damage assembly surface of rear cover.



125LCR8TM13

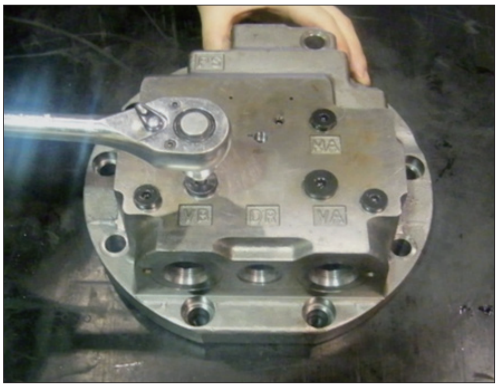
(13) Disassemble restrictor (55, 56) (2EA).

※ Mark the number on restrictor and its hole to avoid confusing (55) and (56).



125LCR8TM14

(14) Remove plug (52).



125LCR8TM15

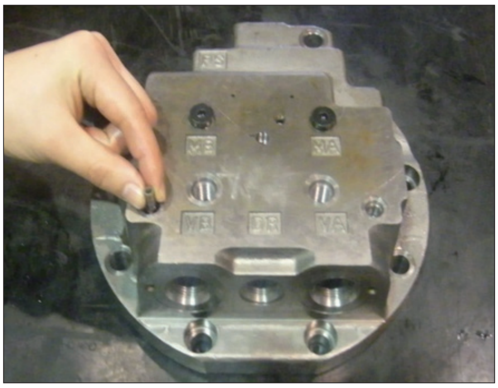
(15) Remove restrictor (34) and spring (35). (2 sets)

※ Do not confuse restrictor (34) and check valve (50).

※ Do not confuse spring (35) and spring (51).

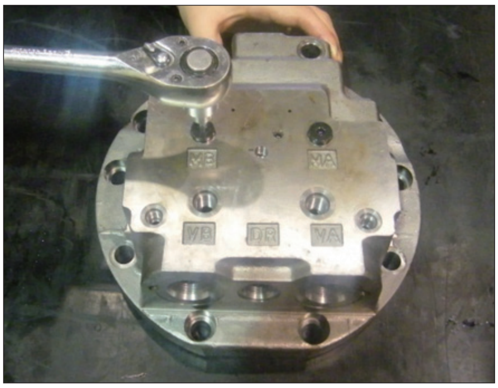
※ Do not lose spring.

※ Do not mix spring with other springs.



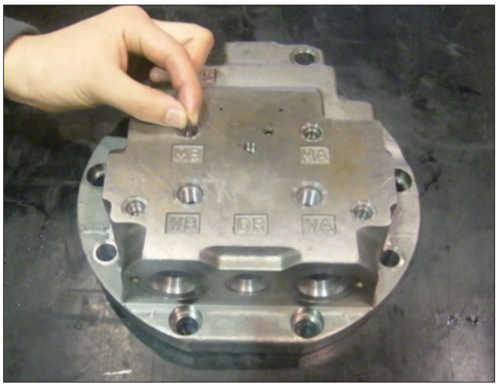
125LCR8TM16

(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

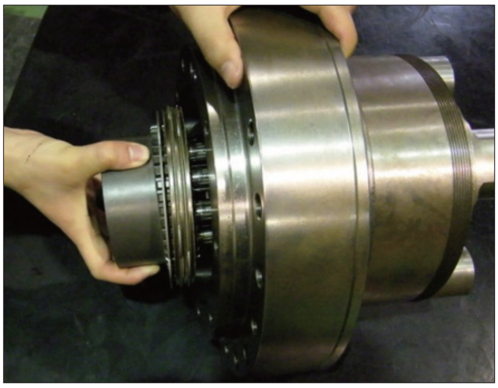
(20) From parking piston, separate O-ring (22) and back-up ring (23).


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).

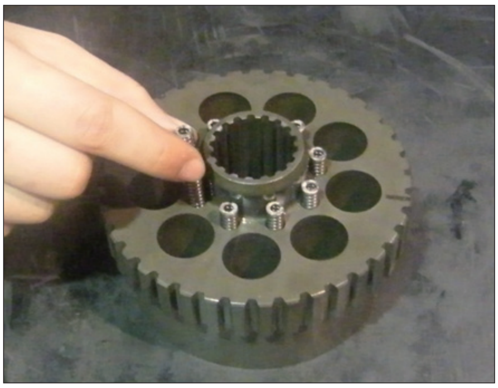
※ Take care not to damage sliding surface of each component.

125LCR8TM24

(24) Disassemble ball guide (14) and spring (13) (9EA).

※ Do not lose spring.

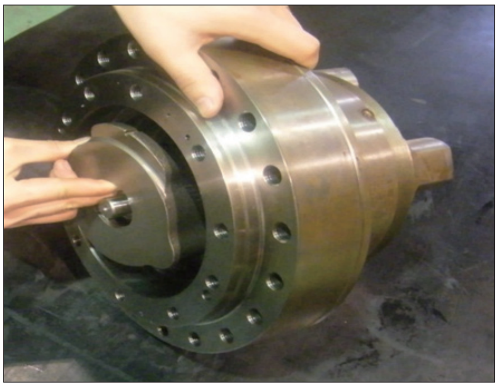
※ Do not mix spring with other springs.



125LCR8TM25

(25) Disassemble swash plate (11) and pivot (10).

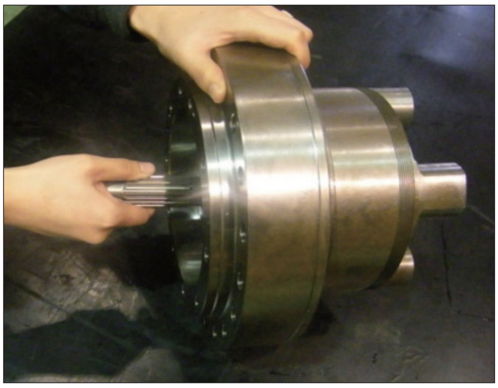
※ Take care not to damage sliding surface.



125LCR8TM26

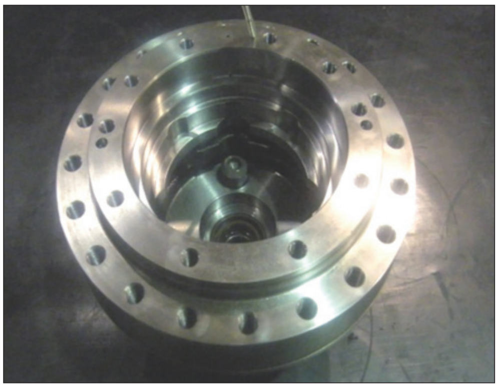
(26) Disassemble shaft (6) and ball bearing (7).

※ 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

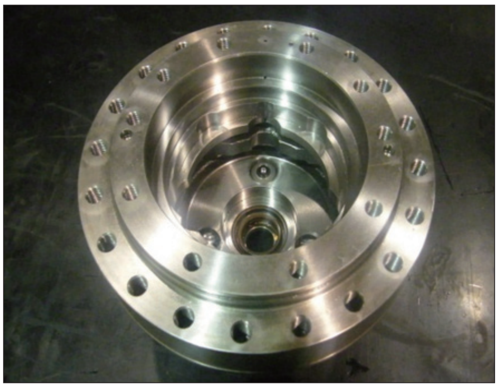
(3) After applying grease on pivot (10), insert steel ball in casing.

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.

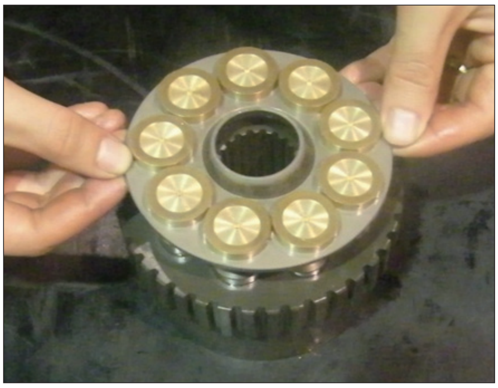
※ Take care not to damage sliding surface.

125LCR8TM36

(7) Assemble spring (13) (9ea) and ball guide (14) in cylinder block (12) in that order.

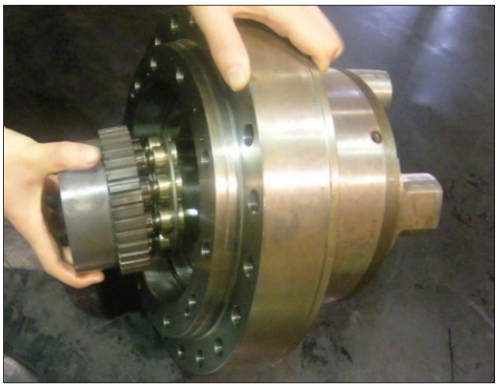
125LCR8TM37

(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.



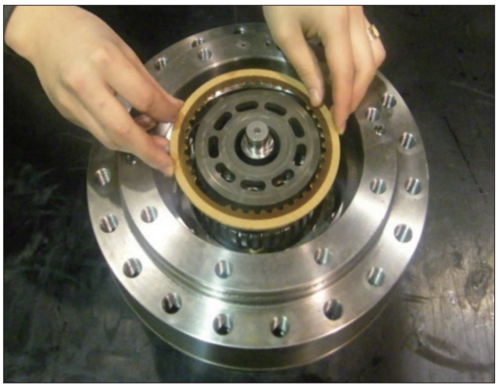
125LCR8TM38

(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

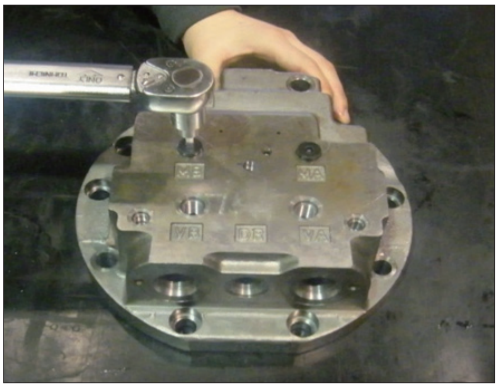
(14) Insert parallel pin (29) (2EA) in casing.

125LCR8TM44

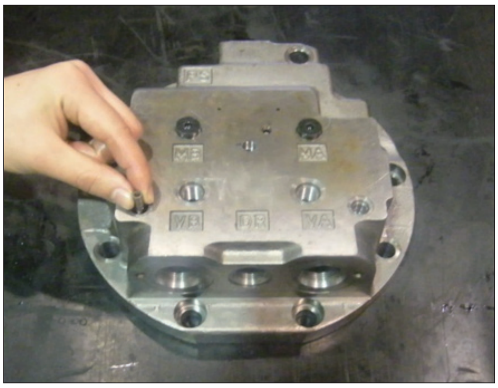
(15) Assemble check valve (50) and spring (51) in order.
※ Do not confuse check valve (50) and restrictor (34).
※ Do not confuse spring (51) and spring (35)


125LCR8TM45

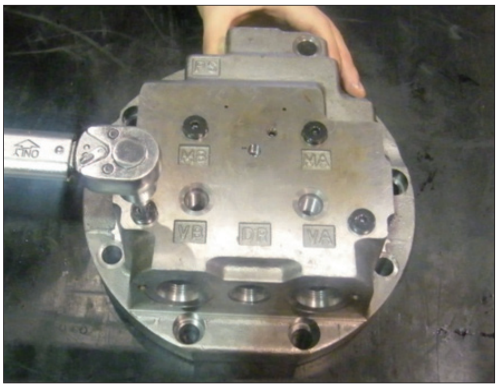
(16) Clamp plug (52) using 5 mm hexagon wrench.
※ Tightening torque : 3.0±0.3 kgf · m
(21.7±2.2 lbf · ft)


125LCR8TM46

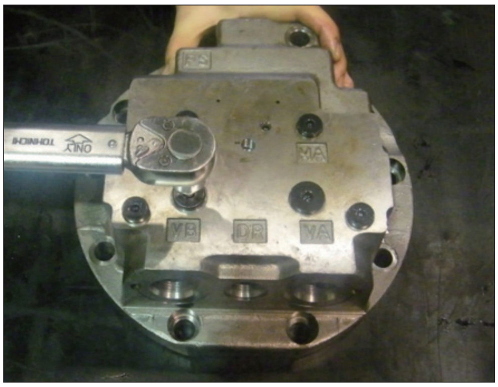
(17) Assemble restrictor (34) and spring (35) in order.
※ Do not confuse check valve (50) and restrictor (34).
※ Do not confuse spring (51) and spring (35).


125LCR8TM47

(18) Clamp plug (52).
※ Tightening torque : 3.0±0.3 kgf · m
(21.7±2.2 lbf · ft)

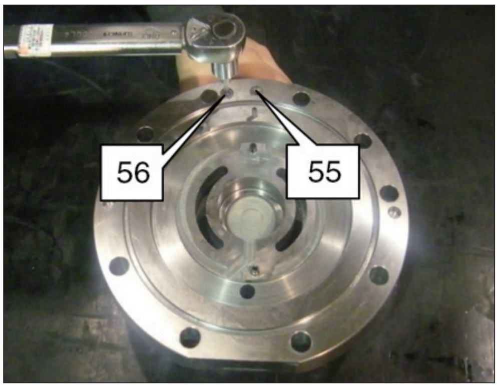

125LCR8TM48

(19) Clamp plug (54).
※ Tightening torque : 4.5±0.5 kgf · m
(32.5±3.6 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

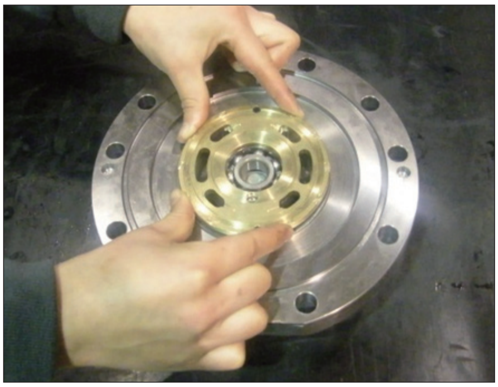
(22) Insert spring pin (25) (2ea) and (28) in rear cover using jig.

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.

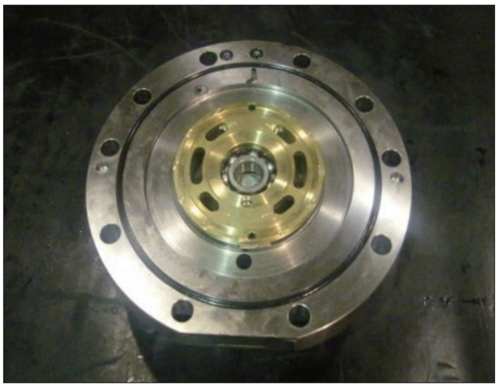
※ Pay attention to the assembly direction.



125LCR8TM53

(24) Assemble O-ring (27) in rear cover.

※ Spread grease on O-ring.



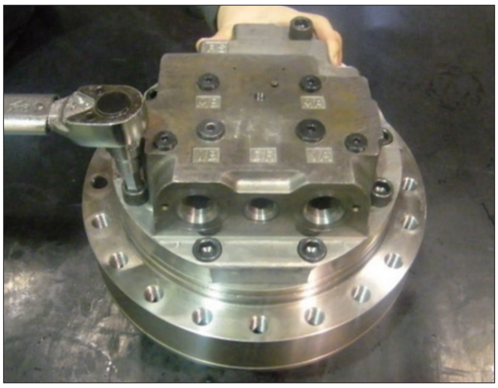
125LCR8TM54

(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±1.8 kgf · m
(127±13.0 lbf · ft)

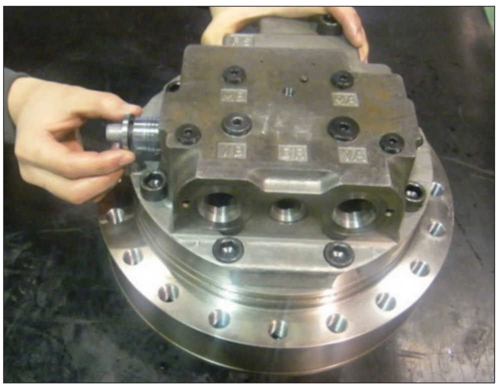
※ Make sure valve plate stays in place.

※ Check bolt position.



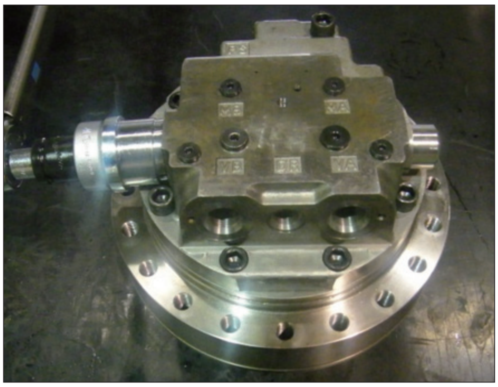
125LCR8TM55

(26) Assemble main spool assembly (31), spring seat (37) and spring (33) in rear cover.

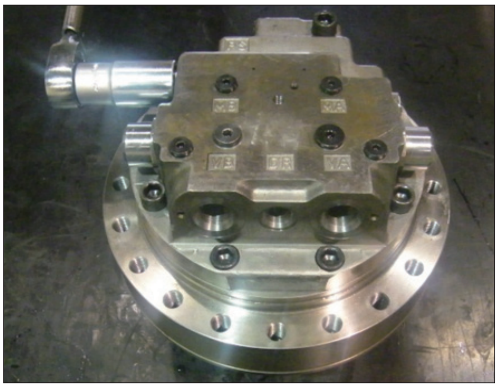


125LCR8TM56

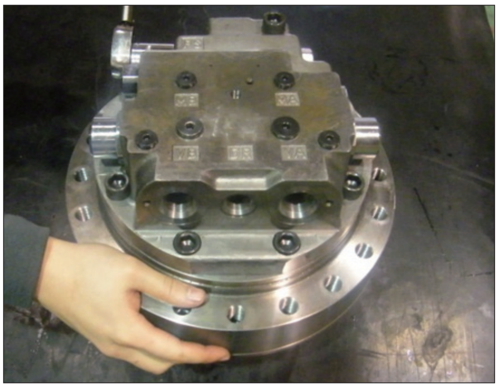
(27) Settle cover (32).
※ Tightening torque : 15±1.5 kgf · m
(108±10.8 lbf · ft)


125LCR8TM57

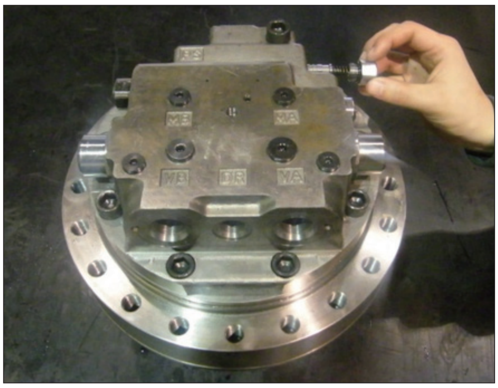
(28) Insert relief valve (38) in rear cover.
※ Tightening torque : 15±1.8 kgf · m
(108±13.0 lbf · ft)


125LCR8TM58

(29) After clamping connector (45) to rear cover, assemble spool (40).
※ Tightening torque : 5.5±0.5 kgf · m
(39.8±3.6 lbf · ft)

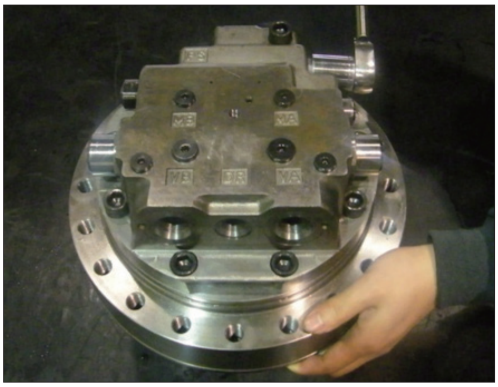

125LCR8TM59

(30) After inserting parallel pin (43), assemble seat-spring (42).


125LCR8TM60

(31) After assembling spring (44) in order, clamp plug (41).

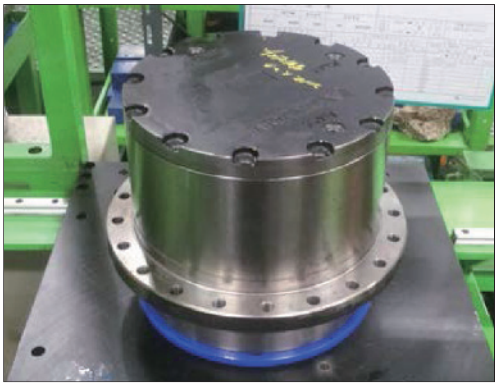
※ Tightening torque : 5.5±0.5 kgf · m (39.8±3.6 lbf · ft)



125LCR8TM61

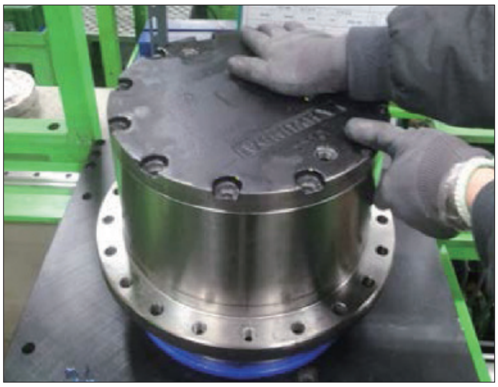
3. TRAVEL REDUCTION GEAR DISASSEMBLY

1) While travel reduction gear is tilted to one side disassemble PF3/8 plug (82), remove gear oil and place motor sideto the bench.



125LCR8TM70

2) Disassemble cover (80) by unscrewing the M10 bolts (81) (12 pcs).



125LCR8TM71

3) Disassemble sun gear No.1 (78).

125LCR8TM72

4) Disassemble carrier No.1 assembly.

125LCR8TM73

Carrier No. 1 sub assy disassembly

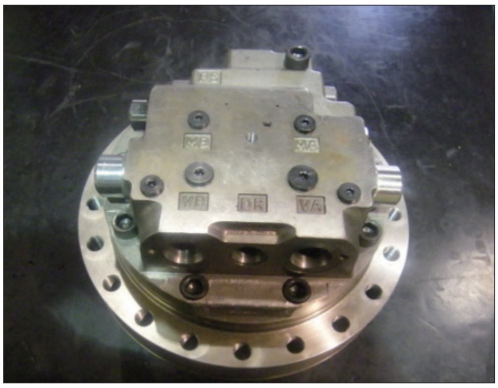
5) Disassemble M8 bolt (76) from the carrier assembly. (3 pcs)

125LCR8TM74

6) Disassemble thrust plate No.1 (75) from the carrier assembly.

125LCR8TM75

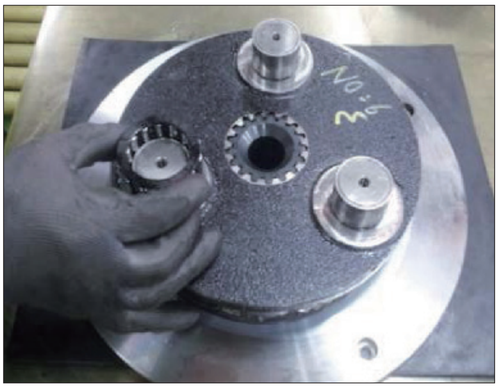
7) Disassemble planetary gear No.1 (72).(3 pcs)



125LCR8TM76

8) Disassemble needle bearing (73).(3 pcs)

※ Do not disassemble inner race in the absence of abnormalities.

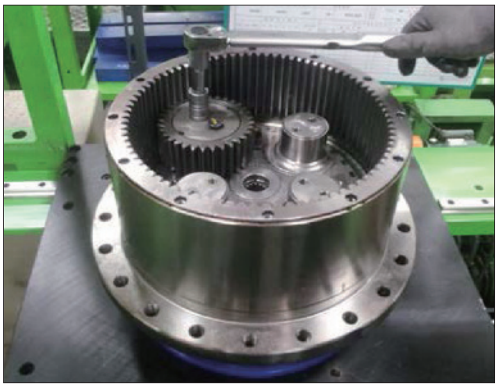


125LCR8TM77

9) Disassemble Sun gear No.2 (70).

125LCR8TM78

10) Disassemble M10 bolt (64).(4 pcs)



125LCR8TM79

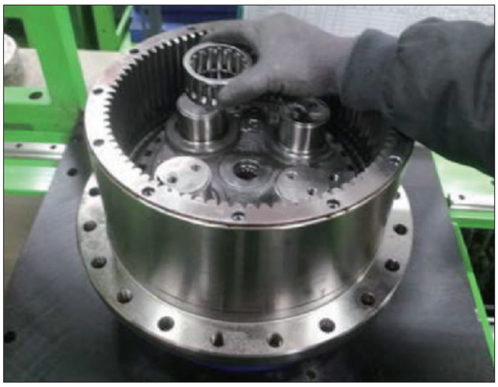
11) Disassemble thrust washer No.2 (65).(4 pcs)

125LCR8TM80

12) Disassemble planetary gear No.2 (66).(4 pcs)

125LCR8TM81

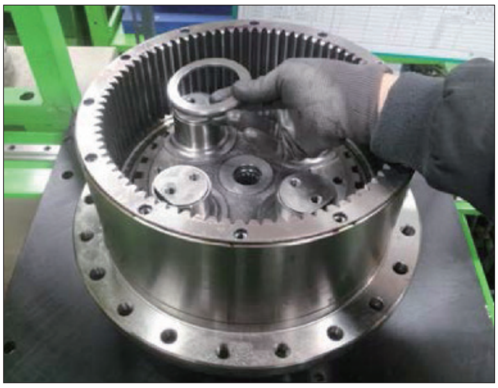
13) Disassemble needle bearing No.2 (67).(4 pcs)



125LCR8TM82

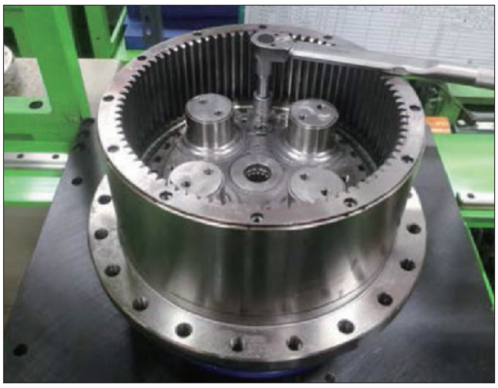
14) Disassemble thrust plate No.2 (69).(4 pcs)

※ Do not disassemble inner race in the absence of abnormalities.



125LCR8TM83

15) Disassemble M10 bolt (89), plain washer (88) and M8 screw (77).

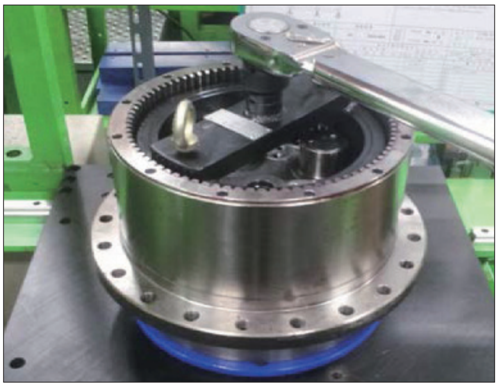


125LCR8TM84

16) Disassemble lock plate (63).

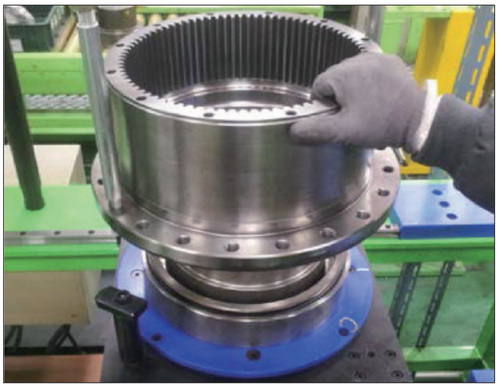
125LCR8TM85

17) Disassemble nut ring (62) by using the jig.



125LCR8TM86

18) Disassemble ring gear assembly (59) from motor assembly.



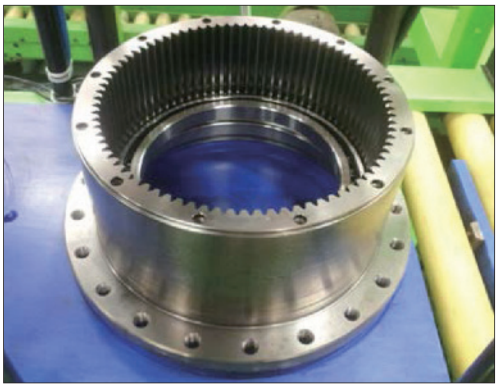
125LCR8TM87

19) Disassemble folating seal assembly (61) from ring gear assembly and motor assembly.

125LCR8TM88

20) Disassemble bearing (60) (2ea) from ring gear assembly.

※ Do not disassemble bearing in the absence of abnormalities.



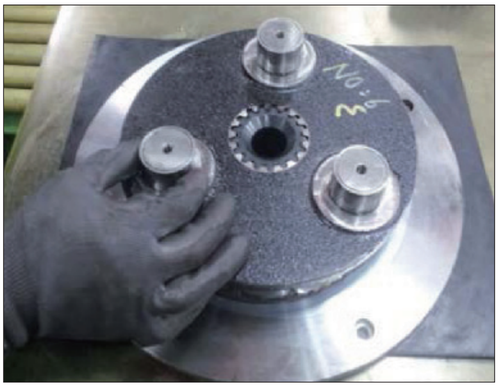
125LCR8TM89

4. TRAVEL REDUCTION GEAR ASSEMBLY

※ Even though assembly is accomplished by reversing disassembly steps, be careful of the following.

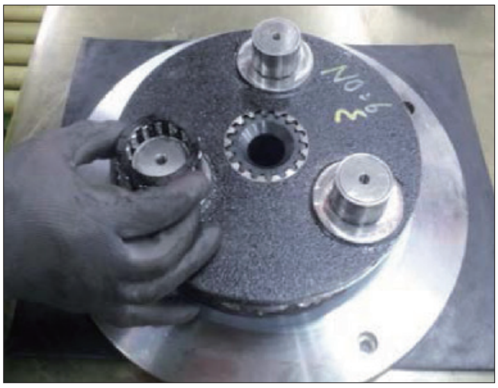
① Repair the damaged part when disassemblying and prepare parts for exchange in advance.
② All parts should be cleaned with cleaner, dried with compressed air.
③ Sliding surface, O-ring, bearing and oil seal should be lubricated with clean hydraulic oil, prior to final assembly.
④ Replacement of O-ring 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 (71) on the jig, and shrink-fit inner race No.1 (74) to carrier pin.(3 places)
※ Do not tilt inner race to one side.
※ Match inner race and end of carrier pin.



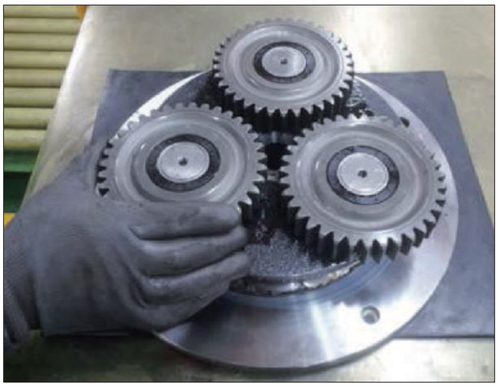
125LCR8TM90

2) Assemble needle bearing No.1 (73).(3 pcs)



125LCR8TM91

3) Assemble planetary gear No.1 (72) of which groove is faced downward. (3 places)



125LCR8TM92

4) Assemble thrust plate No.1 (75).

125LCR8TM93

5) After spreading loctite #242, assemble the M8 bolt (76).(3 pcs)

※ Tightening torque : 2.7 ± 0.3 kgf · m

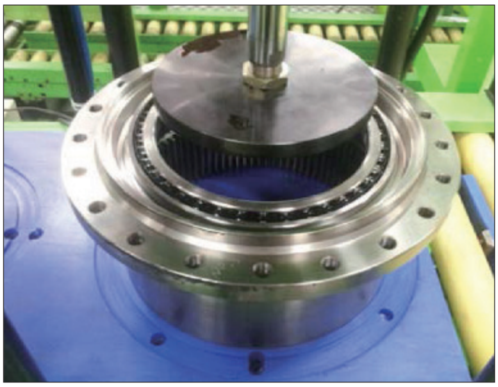
※ After the assembly, instantly check the noise and interference by rotatong the gear.

125LCR8TM94

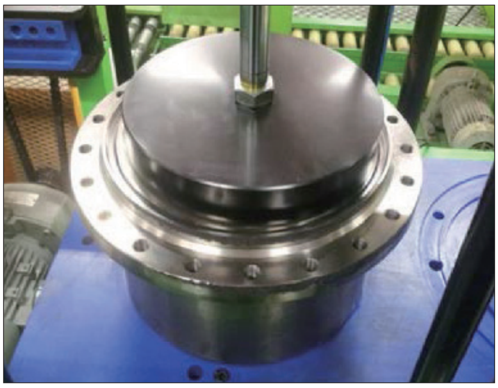
6) First, place bearing (60) on the ring gear (59), then put jig on it, then press it with press machine.

125LCR8TM95

7) After turning ring gear over, assemble bearing the same way.
※ Be care of nick and safety when turn ring gear over.


125LCR8TM96

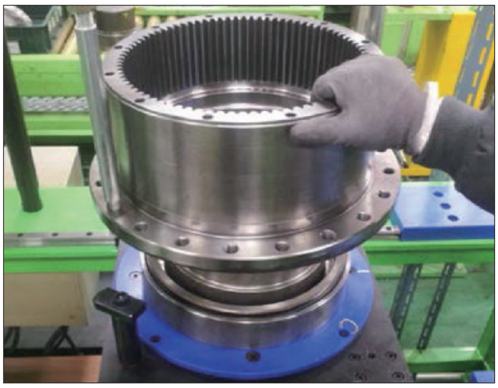
8) Assemble folating seal assembly (61) by usingthe jig.
※ After assembling, wipe steel-lined section with alcohol.
※ Flatness deviation has to be less than 1 mm.


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 assembly in the 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

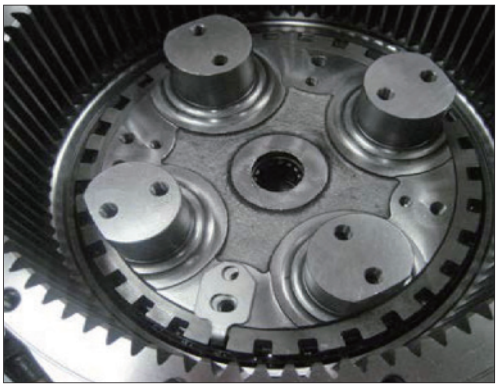
11) After assembling nut ring (62) by using the jig, disassemble the clamping.

※ Tightening torque : 60 kgf · m (434 lbf · ft)

125LCR8TM100

12) Place lock plate (63) on the nut ring groove.

※ Select best position from one of 4 casing hole to assemble lock plate.



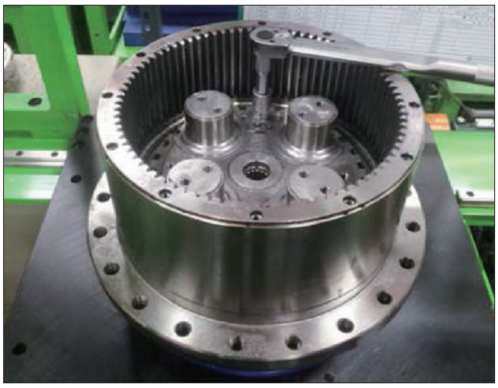
125LCR8TM101

13) Place lock plate th the direction which nut ring is loosed and then assemble M10 bolt (89) with M8 screw (77) after spreading loctite #242. (Refer to assembly detail drawing)

※ Tightening torque (M10) : 5.5 ± 0.6 kgf · m (39.8 ± 4.3 lbf · ft)

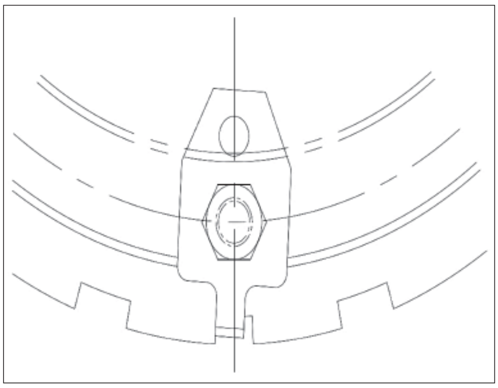
※ Tightening torque (M8) : 2.7 ± 0.3 kgf · m (19.5 ± 2.2 lbf · ft)

※ Make sure that M8 screw doesn't stick out of lock plate.



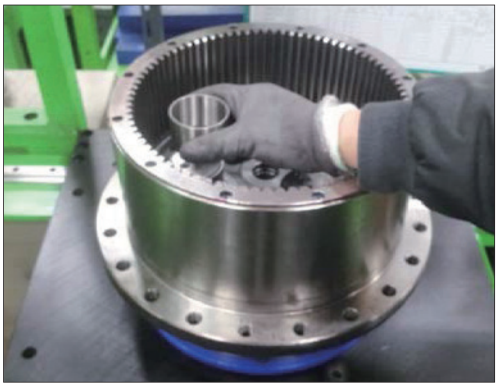
125LCR8TM102

※ Assembly detail drawing lock plate.



125LCR8TM103

14) Shrink fit the inner race No.2 (68).(4 pcs)



125LCR8TM104

15) Assemble thrust plate No.2 (69).(4 pcs)

125LCR8TM105

16) Assemble needle bearing No.2 (67).(4 pcs)

125LCR8TM106

17) Assemble planetary gear No.2 (66).(4 pcs)

※ Grooves of planetary gear will be facingup.

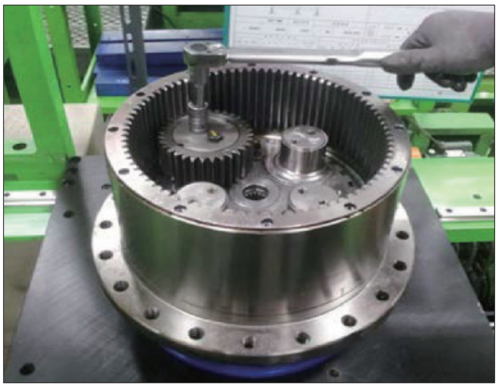
125LCR8TM107

18) Assemble thrust washer No.2 (65).(4 pcs)

125LCR8TM108

19) After spreading loctite #242, assemble the M10 bolt (64).(4 pcs)

※ Tightening torque : 5.5 ± 0.6 kgf · m (39.8 ± 4.3 lbf · ft)

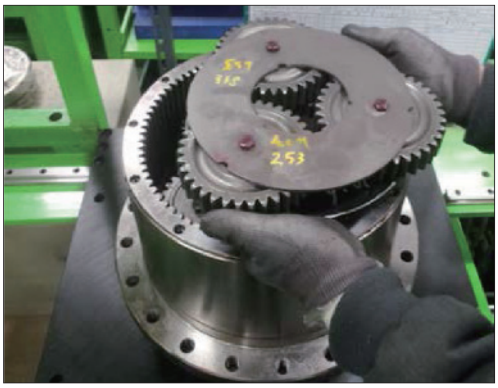


125LCR8TM109

20) Assemble sun gear No.2 (70).

125LCR8TM110

21) Assemble carrier No.1 assembly.

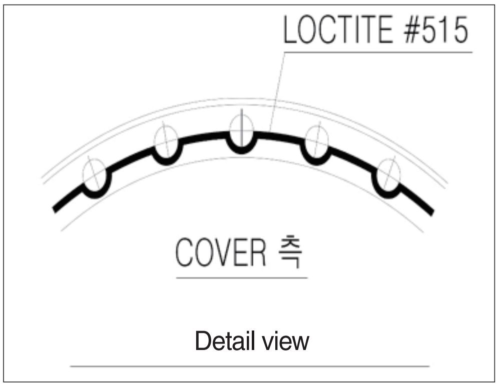


125LCR8TM111

22) Assemble sun gear No.1 (72).

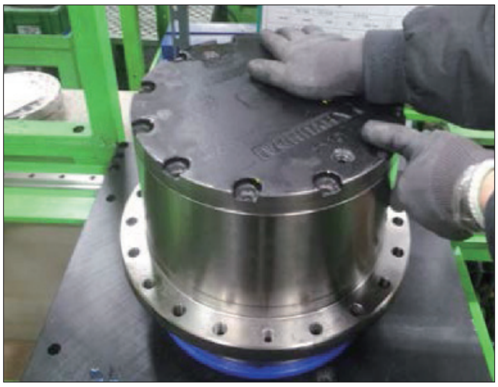
125LCR8TM112

23) Spread the loctite #515 on the cover (80) with reference to the right detail view.



125LCR8TM114

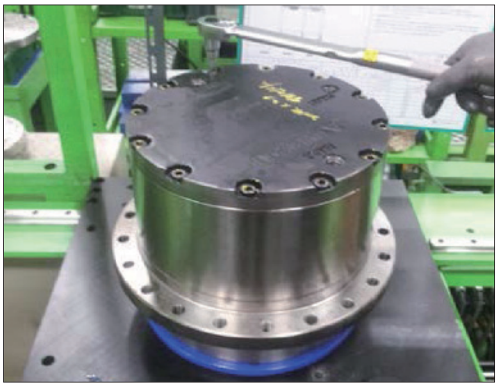
24) Place cover (80) to fit the bolt holes.



125LCR8TM115

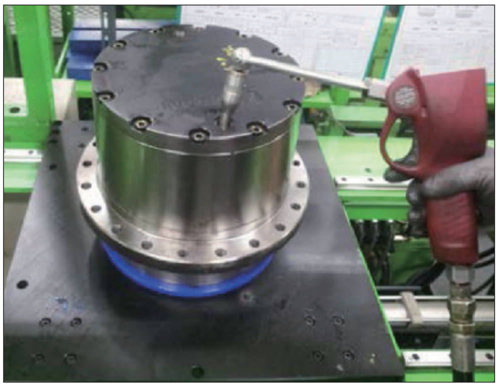
25) After spreading loctite #242, assemble the M10 bolt (81).(12 pcs)

※ Tightening torque : 6.3 ± 0.7 kgf · m (45.6 ± 5.1 lbf · ft)



125LCR8TM116

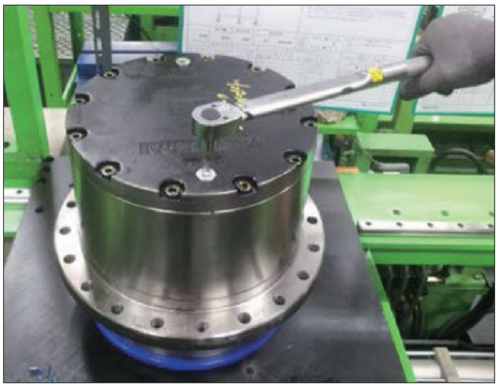
26) Inject the 2.3 ± 0.3 liter gear oil to PF3/8 tap section.



125LCR8TM117

27) After assembling the O-ring (83) to the plug (82), assemble it to the cover. (3 pcs)

※ Tightening torque : 5.5 ± 0.5 kgf · m
(39.8 ± 3.6 lbf · ft)



125LCR8TM118

GROUP 7 RCV LEVER

1. REMOVAL AND INSTALL

1) REMOVAL

(1) Lower the work equipment to the ground and stop the engine.

(2) Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

(3) Loosen the breather slowly to release the pressure inside the hydraulic tank.

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

13031GE18

(4) Loosen the washer with bolt (1).

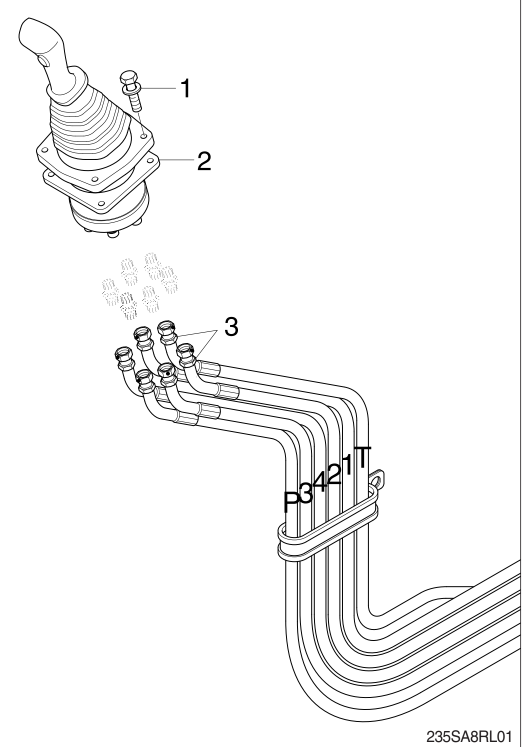
· Tightening torque : 1.05±0.2 kgf · m (7.6±1.45 lbf · ft)

(5) Remove the cover of the console box.

(6) Disconnect pilot line hoses (3).

(7) Remove the pilot valve assembly (2).

※ When removing the pilot valve assembly, check that all the hoses have been disconnected.



235SA8RL01

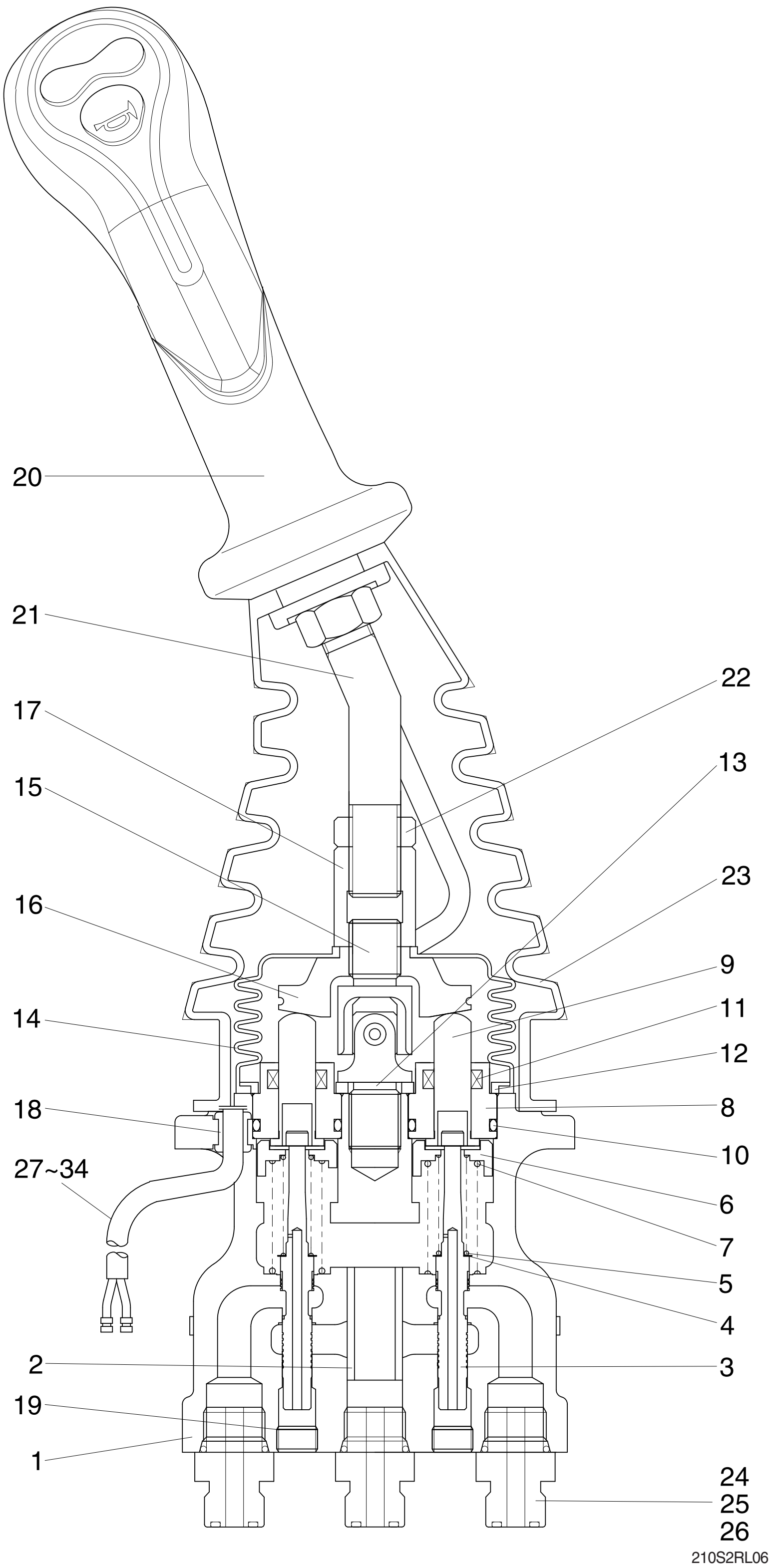
2) INSTALL

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

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

2. DISASSEMBLY AND ASSEMBLY

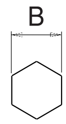
1) STRUCTURE



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

2) TOOLS AND TIGHTENING TORQUE

(1) Tools

Tool name	Remark	
Allen wrench	6	
Spanner	22	
	27	
(+) Driver	Length 150	
(-) Driver	Width 4~5	
Torque wrench	Capable of tightening with the specified torques	

(2) Tightening torque

Part name	Item	Size	Torque	
			kgf · m	lbf · ft
Joint	15	M14	3.8	27.5
Swash plate	16	M14	7.0±0.40	50.6±2.9
Adjusting nut	17	M14	7.0±0.40	50.6±2.9
Lock nut	22	M14	5.0±0.35	36.2±2.5

3) DISASSEMBLY

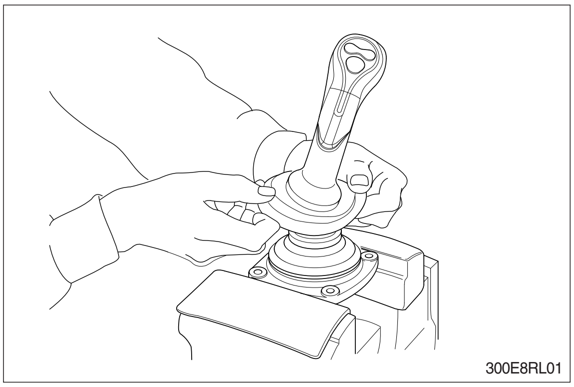
※ Procedures are based on the type M1.

(1) Clean pilot valve with kerosene.

※ Put blind plugs into all ports

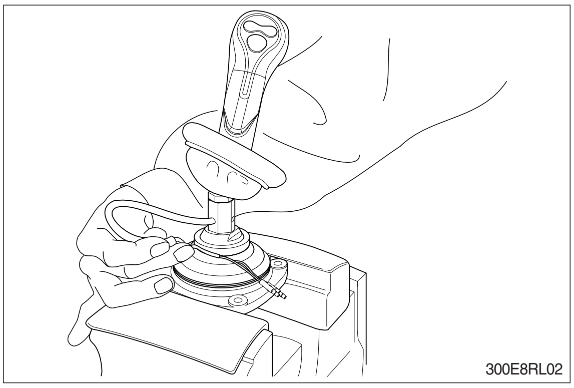
(2) Fix pilot valve in a vise with copper (or lead) sheets.

(3) Remove end of boot (23) from case (1) and take it out upwards.



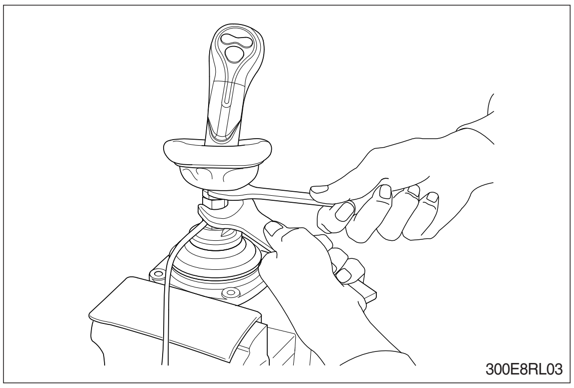
300E8RL01

※ For valve with switch, remove cord also through hole of casing.



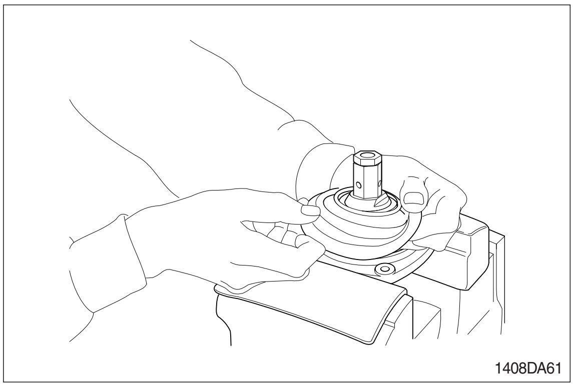
300E8RL02

(4) Loosen lock nut (22) and adjusting nut (17) with spanners on them respectively, and take out handle section as one body.



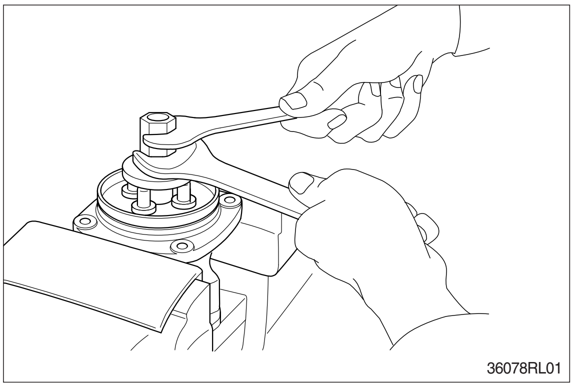
300E8RL03

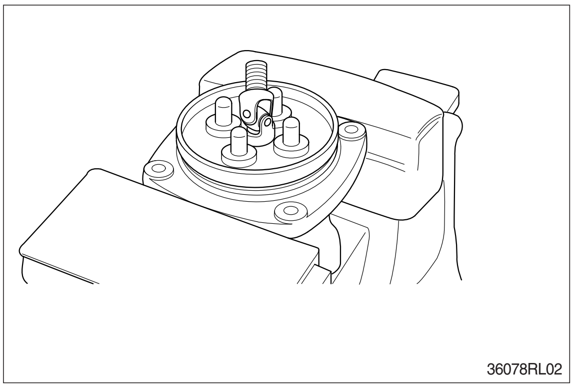
(5) Remove the boot (14).



1408DA61

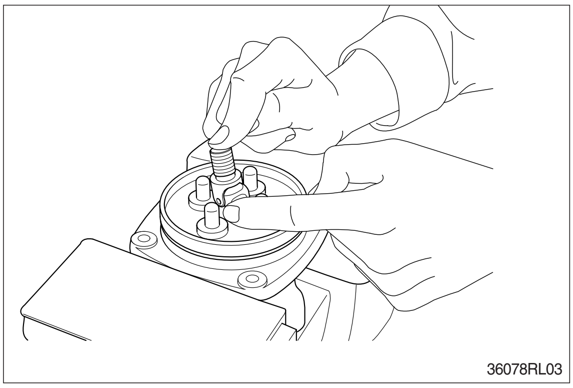
(6) Loosen adjusting nut (17) and swash plate (16) with spanners on them respectively, and remove them.

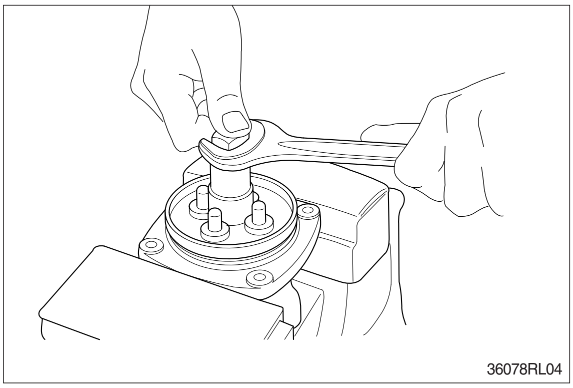




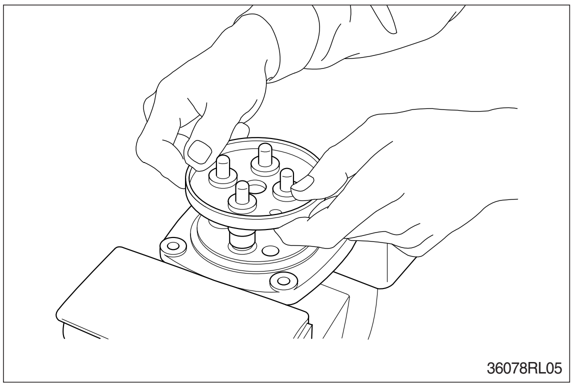
(7) Turn joint anticlockwise to loosen it, utilizing jig (special tool).

※ When return spring (7) is strong in force, plate (12), plug (8) and push rod (9) will come up on loosening joint.
Pay attention to this.





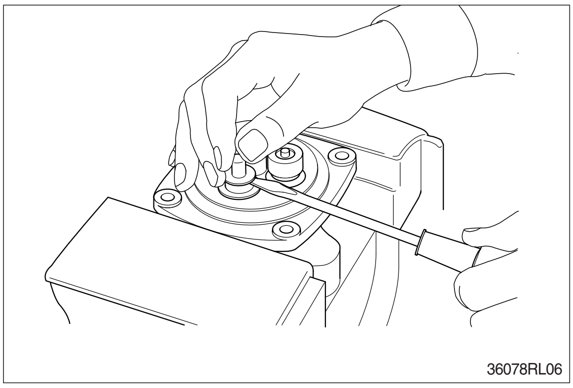
(8) Remove plate (12).



(9) When return spring (7) is weak in force, plug (8) stays in casing because of sliding resistance of O-ring.

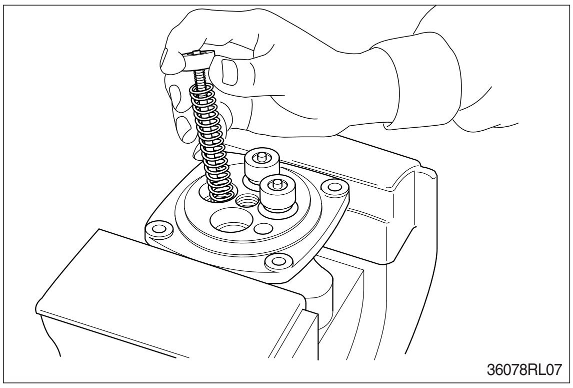
※ Take it out with minus screwdriver.
Take it out, utilizing external periphery groove of plug and paying attention not to damage it by partial loading.

※ During taking out, plug may jump up due to return spring (7) force.
Pay attention to this.



(10) Remove reducing valve subassembly and return spring (7) out of casing.

※ Record relative position of reducing valve subassembly and return springs.

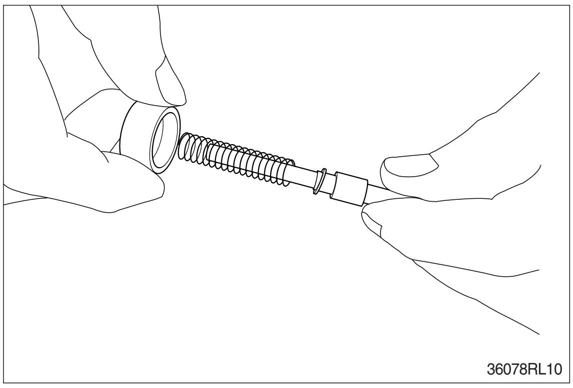


(11) Separate spool (3), spring seat (6), spring (5) and shim (4) individually.

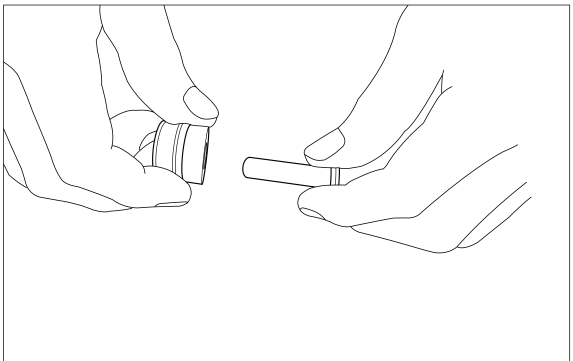
※ Pay attention not to damage spool surface.

※ Record original position of spring seat (6).

※ Until being assembled, they should be handled as one subassembly group.

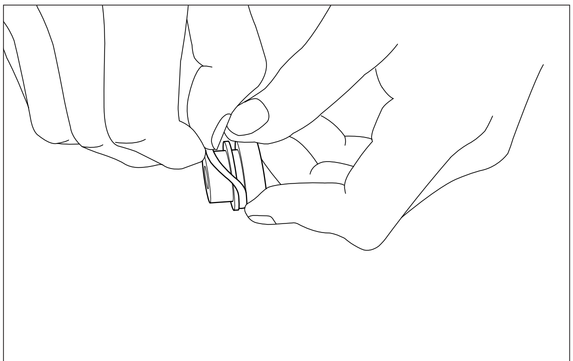


(12) Take push rod (9) out of plug (8).

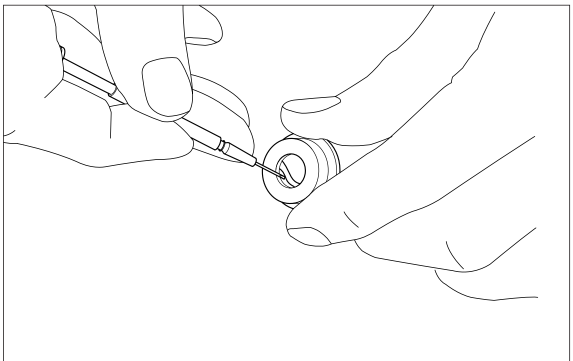


36078RL11

(13) Remove O-ring (10) and seal (11) from plug (8).
Use small minus screwdriver or so on to remove this seal.

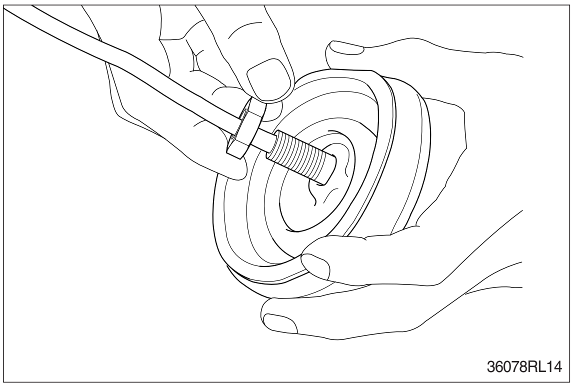


36078RL12

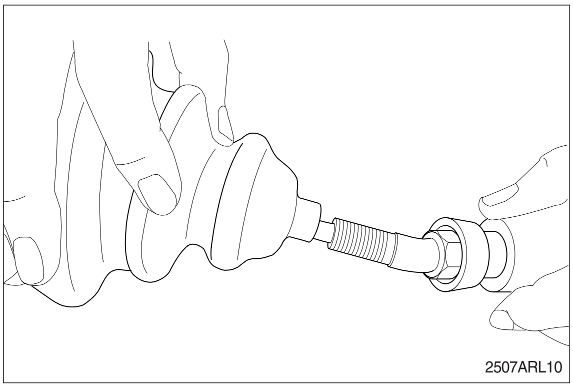


36078RL13

(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.

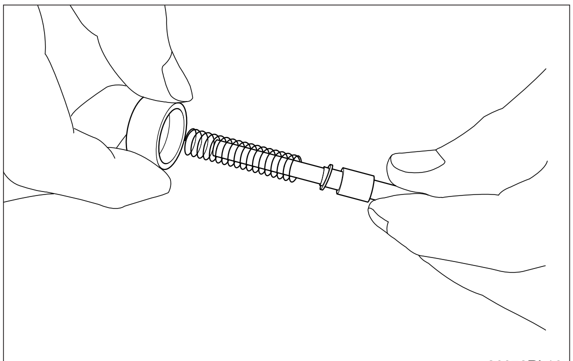
(16) Rust prevention of parts

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.

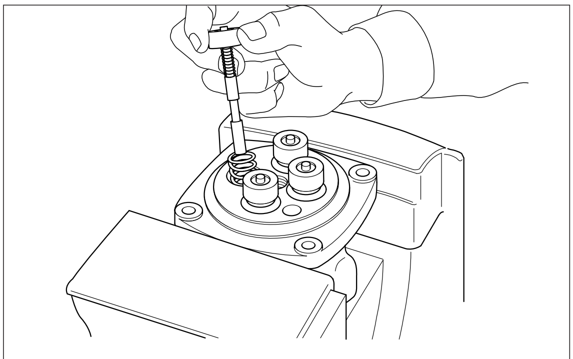
4) ASSEMBLY

(1) Put shim (4), springs (5) and spring seat (6) onto spool (3) in this order.



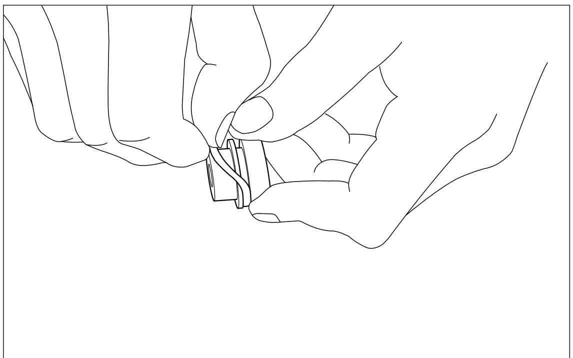
36078RL16

(2) Assemble spring (7) into casing (1).
Assemble reducing valve subassembly into casing.
※ Assemble them to their original positions.



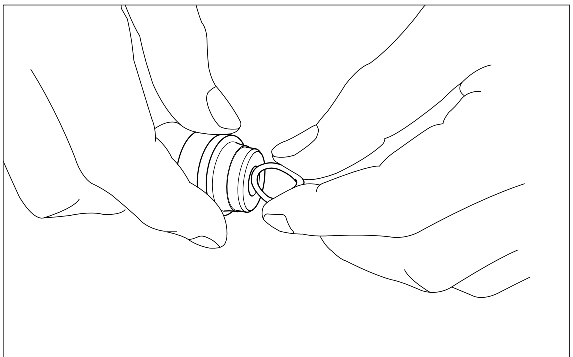
36078RL18

(3) Assemble O-ring (10) onto plug (8).



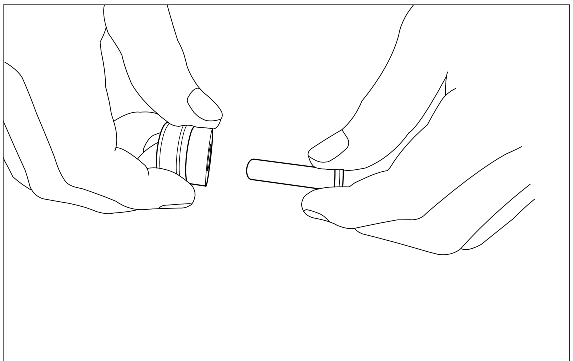
36078RL19

(4) Assemble seal (11) to plug (8).
※ Assemble seal in such lip direction as shown below.



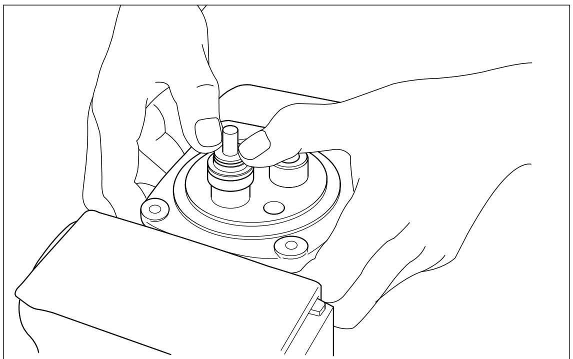
36078RL20

(5) Assemble push rod (9) to plug (8).
※ Apply working oil on push-rod surface.



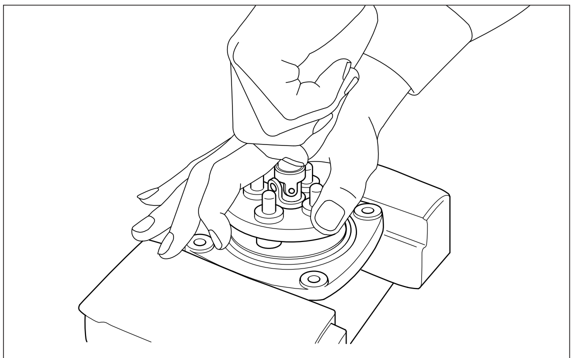
36078RL21

(6) Assemble plug subassembly to casing.
※ When return spring is weak in force, subassembly stops due to resistance of O-ring.



36078RL22

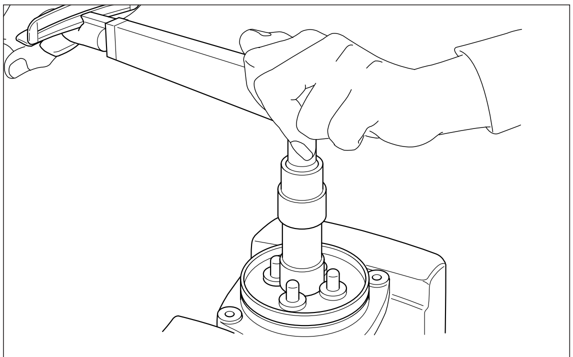
(7) When return spring is strong in force, assemble 4 sets at the same time, utilizing plate (12), and tighten joint (15) temporarily.



36078RL23

(8) Fit plate (12).

(9) Tighten joint (15) with the specified torque to casing, utilizing jig.

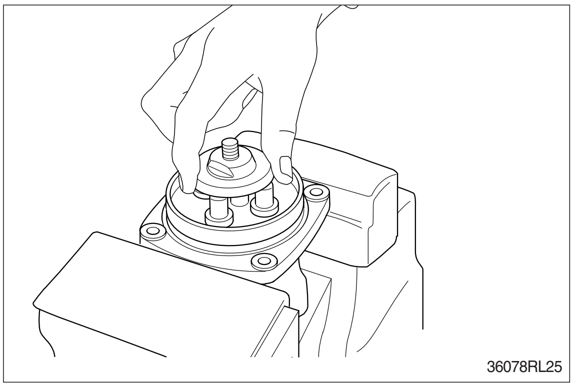


36078RL24

(10) Assemble swash plate (16) to joint (15).

※ Screw it to position that it contacts with 4 push rods evenly.

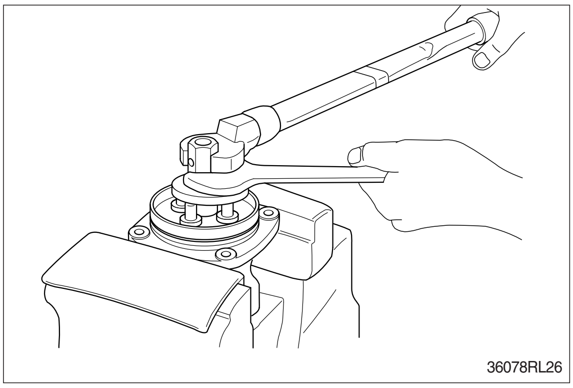
※ Do not screw it over.



36078RL25

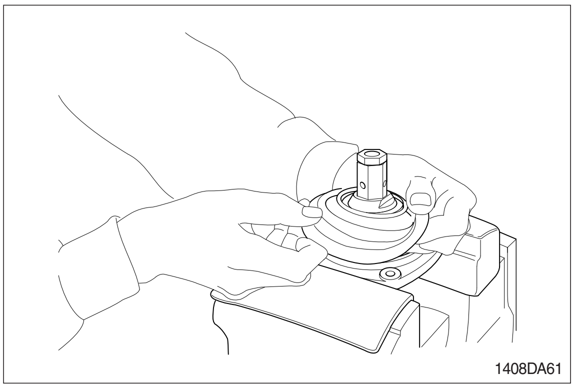
(11) Assemble adjusting nut (17), apply spanner to width across flat of plate (16) to fix it, and tighten adjusting nut to the specified torque.

※ During tightening, do not change position of disk.



36078RL26

(12) Fit boot (14) to plate.



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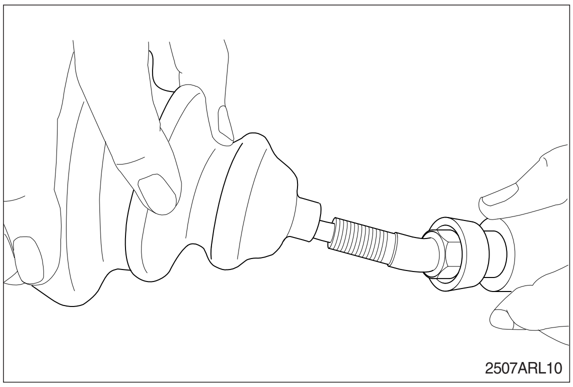
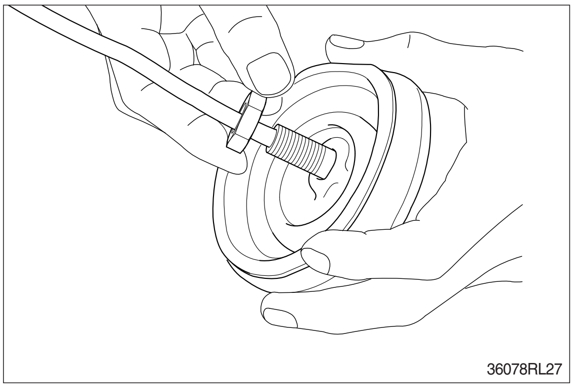
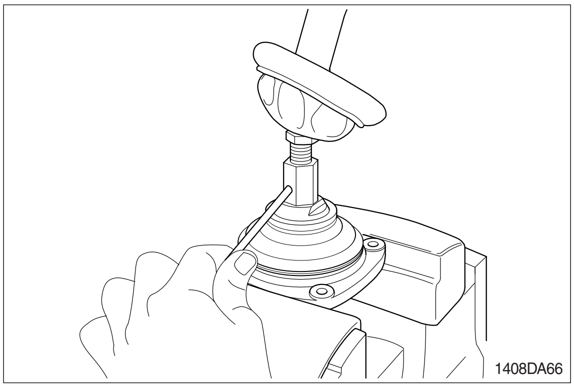
(13) Fit boot (23) and lock nut (22), and handle subassembly is assembled completely.



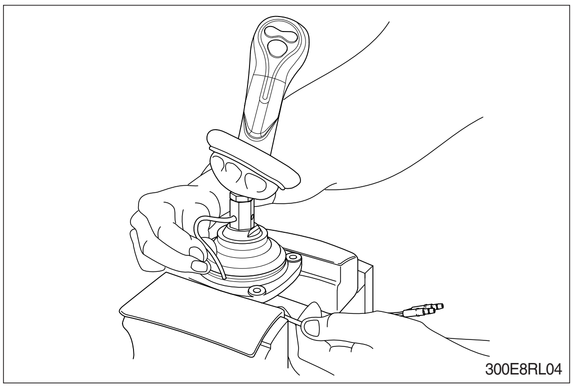


(14) Pull out cord and tube through adjusting nut hole provided in direction 60 °to 120 °from casing hole.

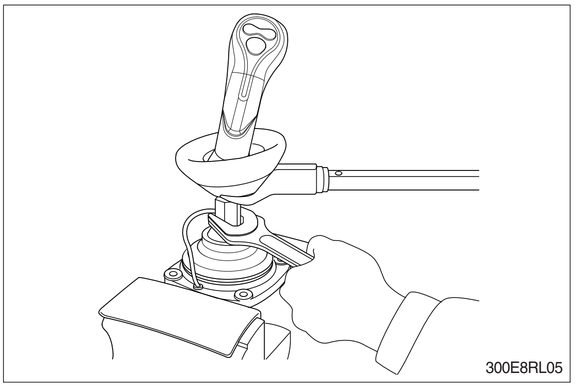


(15) Assemble bushing (18) to plate and pass cord and tube through it.

※ Provide margin necessary to operation.

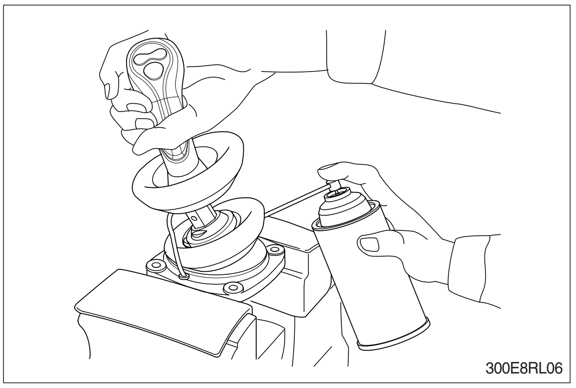


(16) Determine handle direction, tighten lock nut (22) to specified torque to fix handle.



300E8RL05

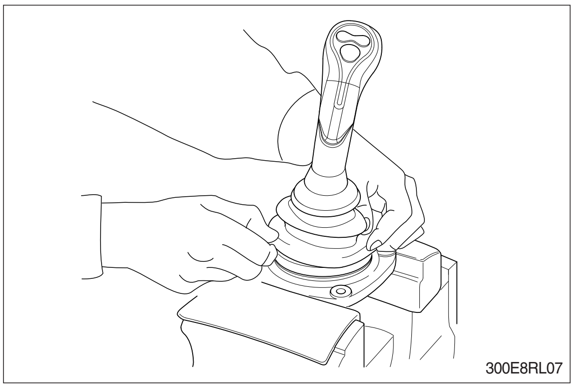
(17) Apply grease to rotating section of joint and contacting faces of disk and push rod.



300E8RL06

(18) Assemble lower end of bellows to casing.

(19) Inject volatile rust-preventives through all ports and then put blind plugs in ports.



300E8RL07

GROUP 8 TURNING JOINT

1. REMOVAL AND INSTALL

1) REMOVAL

(1) Lower the work equipment to the ground and stop the engine.

(2) Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

(3) Loosen the breather slowly to release the pressure inside the hydraulic tank.

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

※ When pipes and hoses are disconnected, the oil inside the piping will flow out, so catch it in oil pan.

(4) Disconnect all hoses.

(5) Sling the turning joint assembly (1) and remove the mounting bolt (2).

· Weight : 60 kg (130 lb)

· Tightening torque : 12.8±3.0 kgf · m (92.6±21.7 lbf · ft)

(6) Remove the turning joint assembly.

※ When removing the turning joint, check that all the hoses have been disconnected.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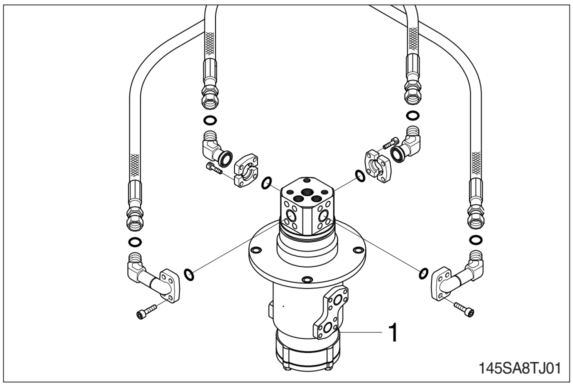
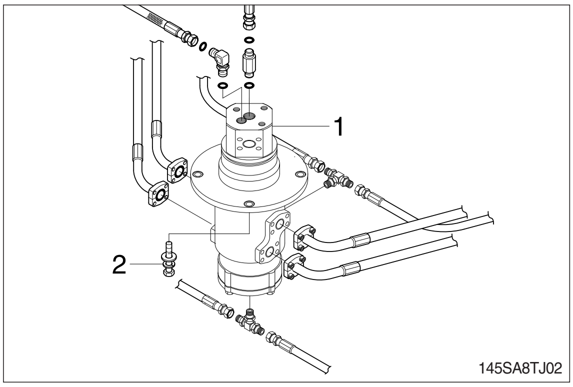


145SA8TJ01



145SA8TJ02

2) INSTALL

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

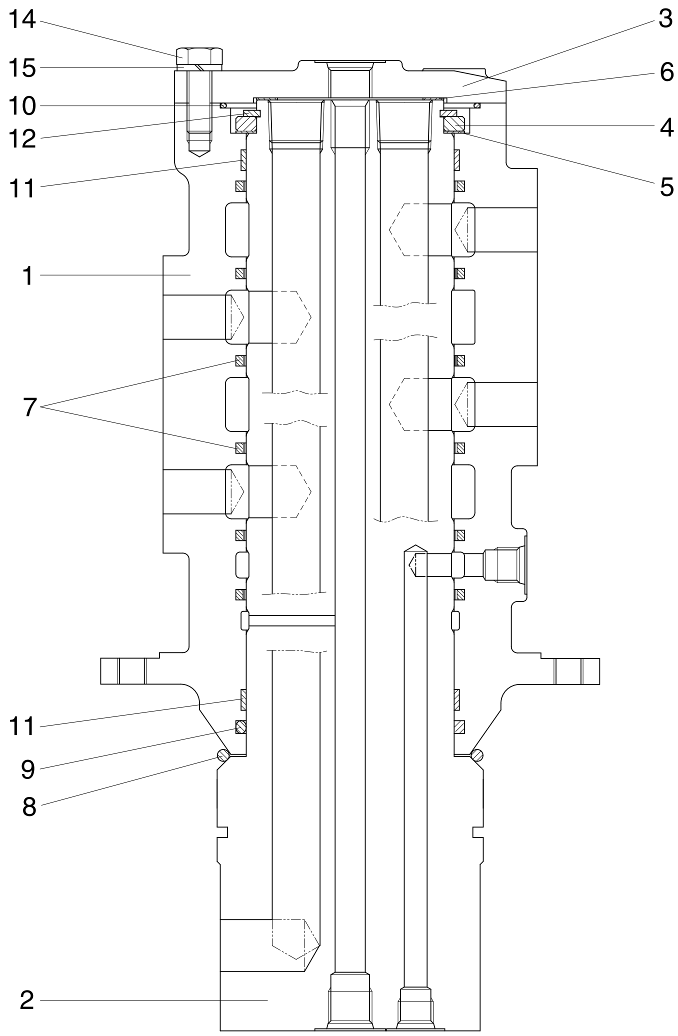
※ Take care of turning joint direction.

※ Assemble hoses to their original positions.

※ Confirm the hydraulic oil level and check the hydraulic oil leak or not.

2. DISASSEMBLY AND ASSEMBLY

1) STRUCTURE



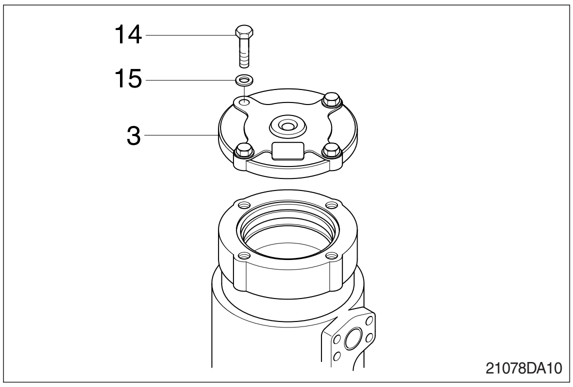
14098TJ03

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.

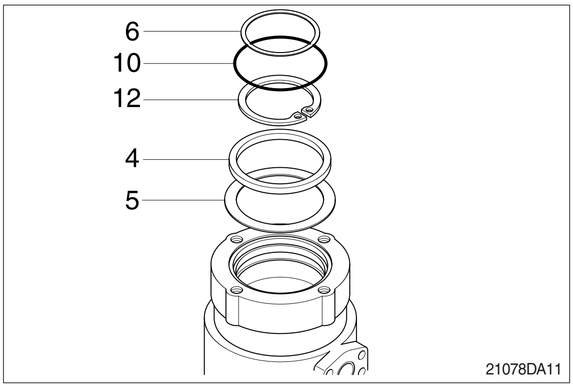
(1) Remove bolts (14), washer (15) and cover (3).



21078DA10

(2) Remove shim (6) and O-ring (10).

(3) Remove retainer ring (12), spacer (4) and shim (5).

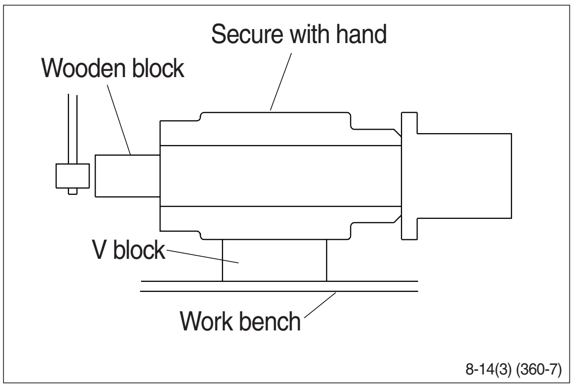


21078DA11

(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.

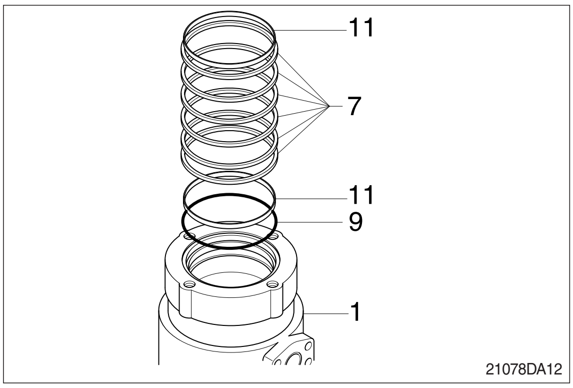
※ Take care not to damage the shaft (2) when remove hub (1) or rest it sideway.

※ Put a fitting mark on hub (1) and shaft (2).



8-14(3) (360-7)

(5) Remove six slipper seals (7) and O-ring (9), two wear ring (11) from hub (1).



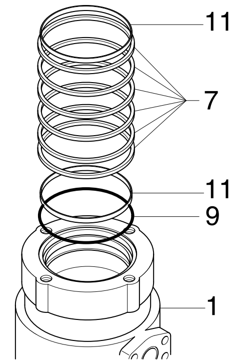
21078DA12

3) ASSEMBLY

※ Clean all parts.
※ As a general rule, replace oil seals and O-ring.
※ Coat the sliding surfaces of all parts with engine oil or grease before installing.

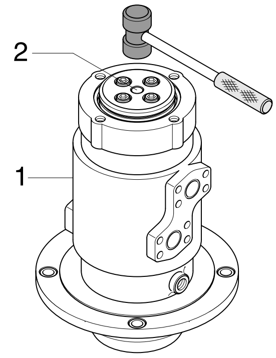
(1) Fix seven slipper seal (7) and O-ring (9), two wear ring (11) to hub (1).

(2) Fit O-ring (8) to shaft (2).



21078DA12

(3) Set shaft (2) on block, tap hub (1) with a plastic hammer to install.

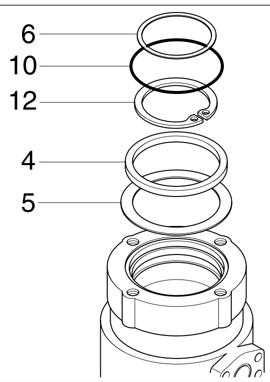


21078DA13

(4) Fit shim (5), spacer (4) and retainer ring (12) to shaft (2).

(5) Fit O-ring (10) to hub (1).

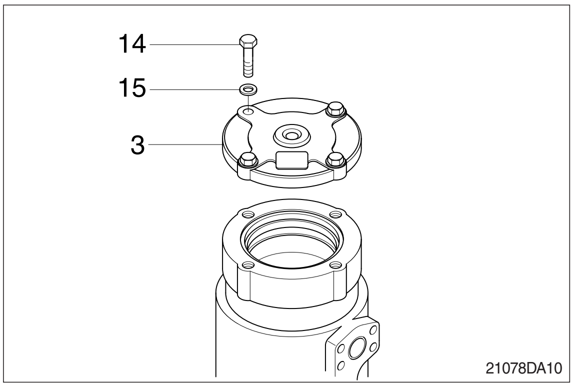
(6) Fit shim (6) to shaft (2).



21078DA11

(7) Install cover (3) to body (1) and tighten bolts (14).

· Torque : 10~12.5 kgf · m
(72.3~90.4 lbf · ft)



GROUP 9 BOOM, ARM, BUCKET AND DOZER CYLINDERS

1. REMOVAL AND INSTALL

1) BUCKET CYLINDER

(1) Removal

※ Expand the arm and bucket fully, lower the work equipment to the ground and stop the engine.

※ Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

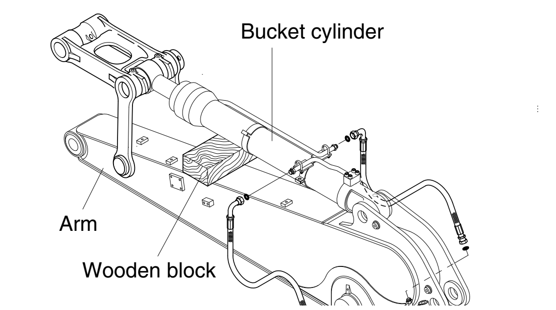
※ Loosen the breather slowly to release the pressure inside the hydraulic tank.

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

※ Fit blind plugs in the hoses after disconnecting them, to prevent dirt or dust from entering.

13031GE18

① Set block between bucket cylinder and arm.

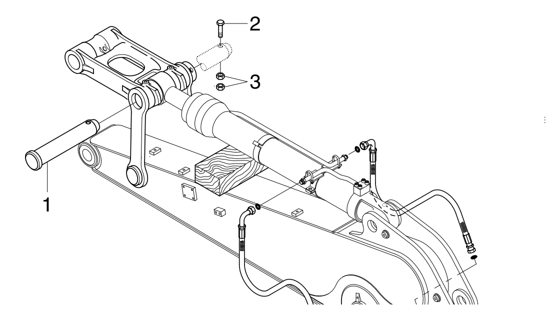


130ZF8DA80

② Remove bolt (2), nut (3) and pull out pin (1).

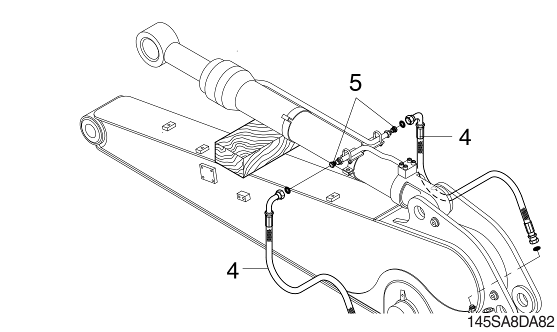
· Tightening torque (2) : 29.7±4.5 kgf·m (215±32.5 lbf · ft)

※ Tie the rod with wire to prevent it from coming out.



130ZF8DA81

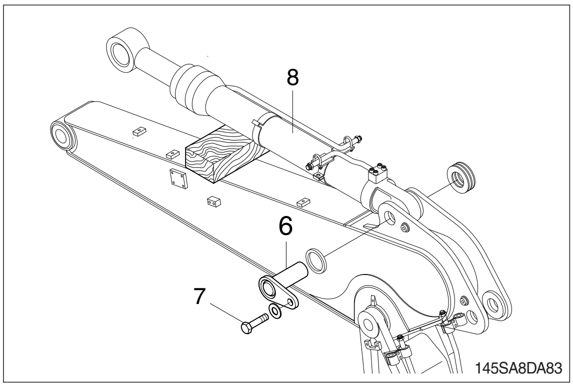
③ Disconnect bucket cylinder hoses (4) and put plugs (5) on cylinder pipe.



145SA8DA82

④ Sling bucket cylinder assembly (8) and remove bolt (7) then pull out pin (6).
   · Tightening torque (7) : 29.7±4.5 kgf·m (215±32.5 lbf · ft)

⑤ 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.

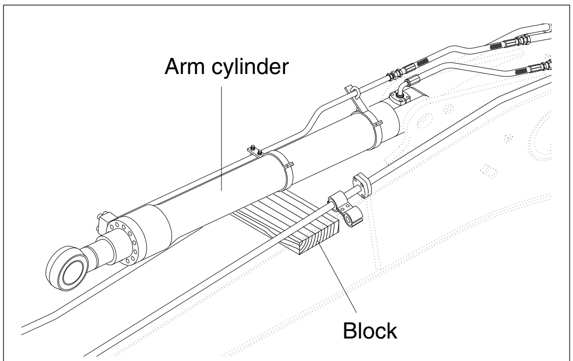
※ Loosen the breather slowly to release the pressure inside the hydraulic tank.

⚠ 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.


13031GE18

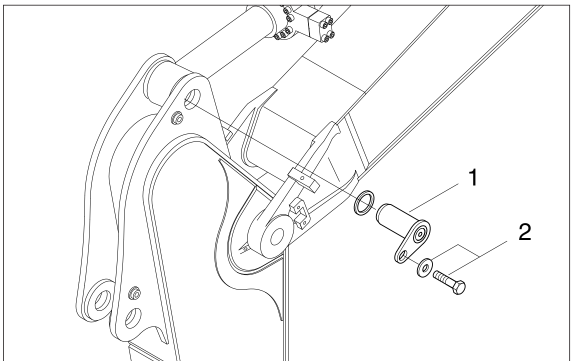


130ZF8CY18

② Remove bolt (2) and pull out pin (1).

· Tightening torque (2) : 29.7±4.5 kgf·m (215±32.5 lbf · ft)

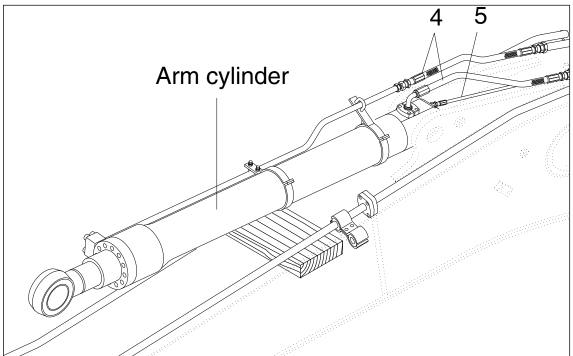
※ Tie the rod with wire to prevent it from coming out.



130ZF8CY19

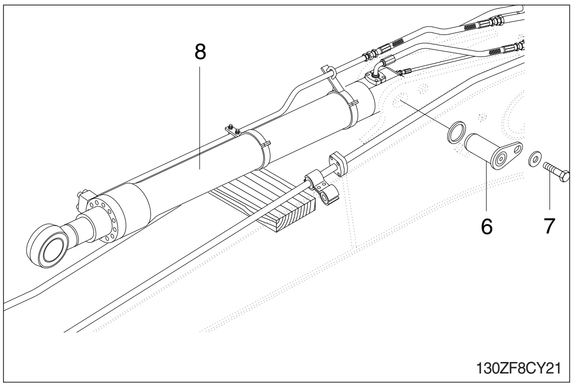
③ Disconnect arm cylinder hoses (4) and put plugs on cylinder pipe.

④ Disconnect greasing pipings (5).



130ZF8CY20

⑤ Sling arm cylinder assembly (8) and remove bolt (7) then pull out pin (6).
  · Tightening torque (7) : 29.7±4.5 kgf·m (215±32.5 lbf · ft)
⑥ Remove arm cylinder assembly (8).
  · Weight : 160 kg (350 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 arm cylinder.
※ Confirm the hydraulic oil level and check the hydraulic oil leak or not.

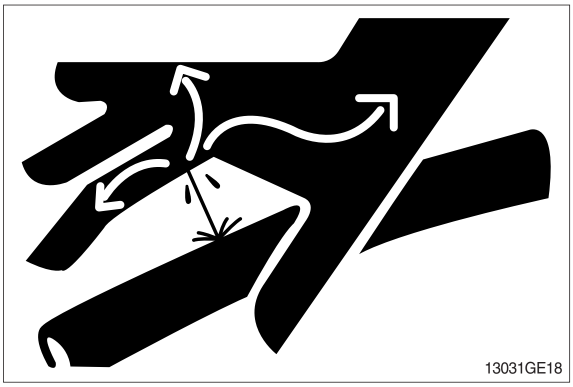
3) BOOM CYLINDER

(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.



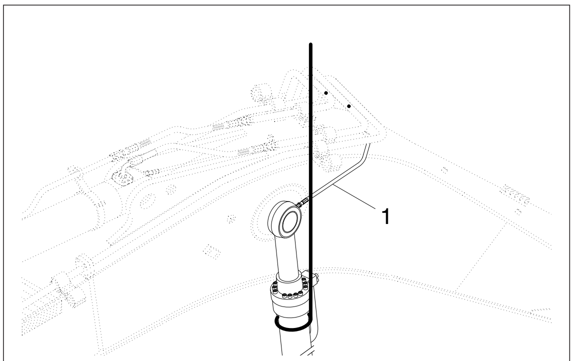
13031GE18

⚠ 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.

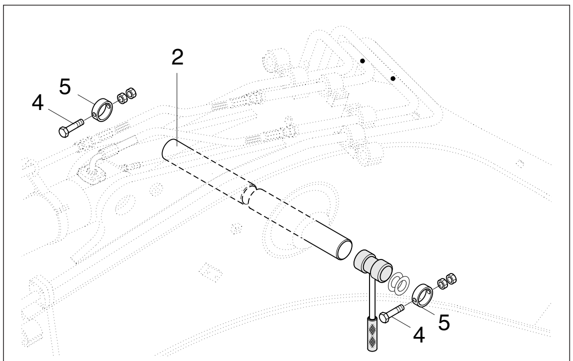


130ZF8CY22

③ Remove bolt (4), stopper (5) and pull out pin (2).

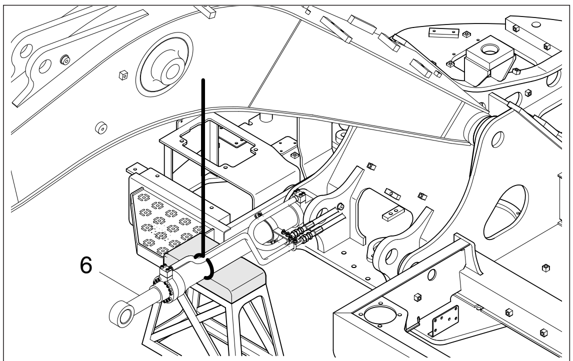
· Tightening torque (8) : 29.7±4.5 kgf·m (215±32.5 lbf · ft)

※ Tie the rod with wire to prevent it from coming out.



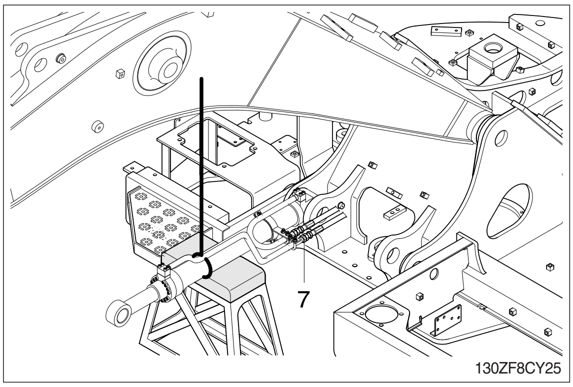
130ZF8CY23

④ Lower the boom cylinder assembly (6) on a stand.



130ZF8CY24

⑤ Disconnect boom cylinder hoses (7) and put plugs on cylinder pipe.

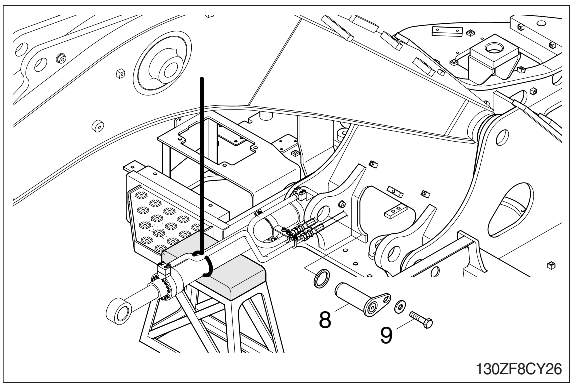


⑥ Remove bolt (9) and pull out pin (8).

· Tightening torque (9) : 29.7±4.5 kgf·m (215±32.5 lbf · ft)

⑦ Remove boom cylinder assembly (6).

· Weight : 130 kg (285 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.**

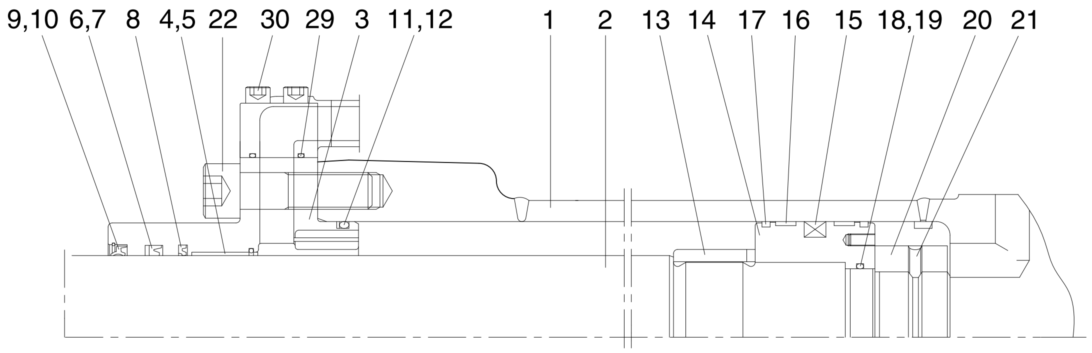
※ Bleed the air from the boom cylinder.

※ Conformed the hydraulic oil level and check the hydraulic oil leak or not.

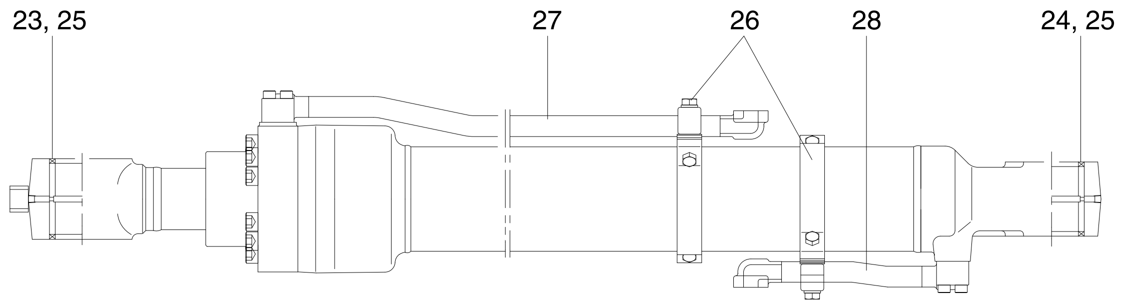
2. DISASSEMBLY AND ASSEMBLY

1) STRUCTURE

(1) Bucket cylinder (CHANGZHOU)



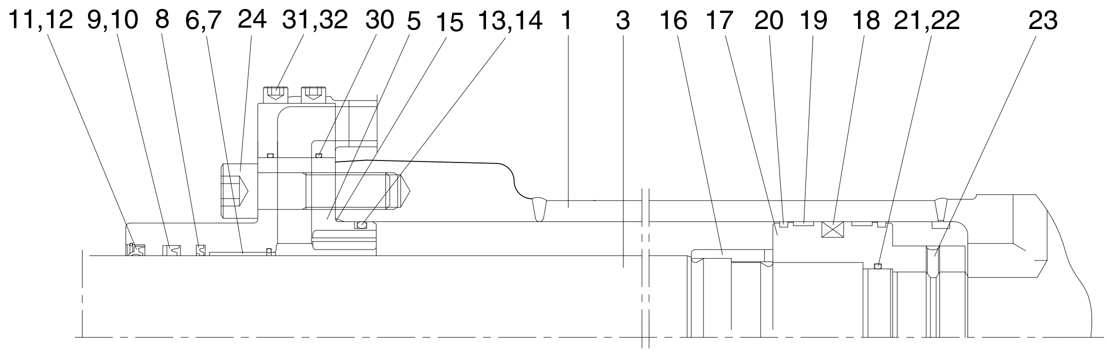
Internal detail



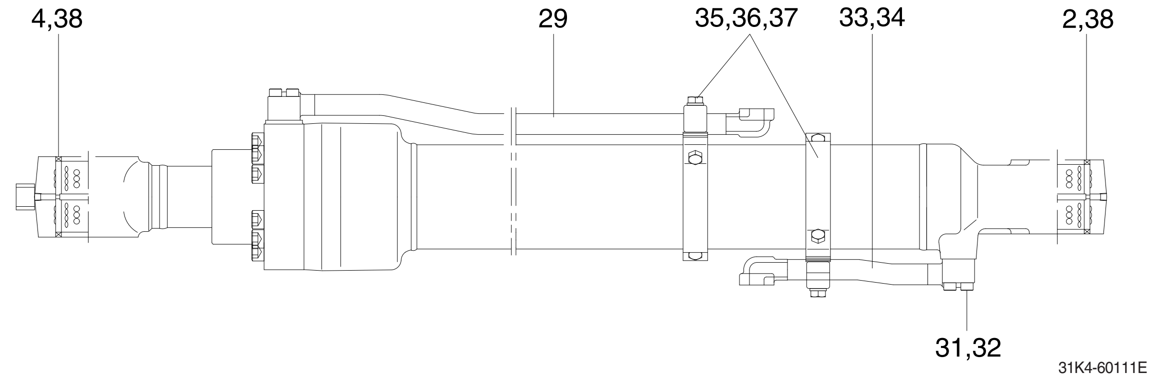
31K4-60111C

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	Dimple bushing
4	DD2 bushing	14	Piston	24	Dimple 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

Bucket cylinder (DY POWER)

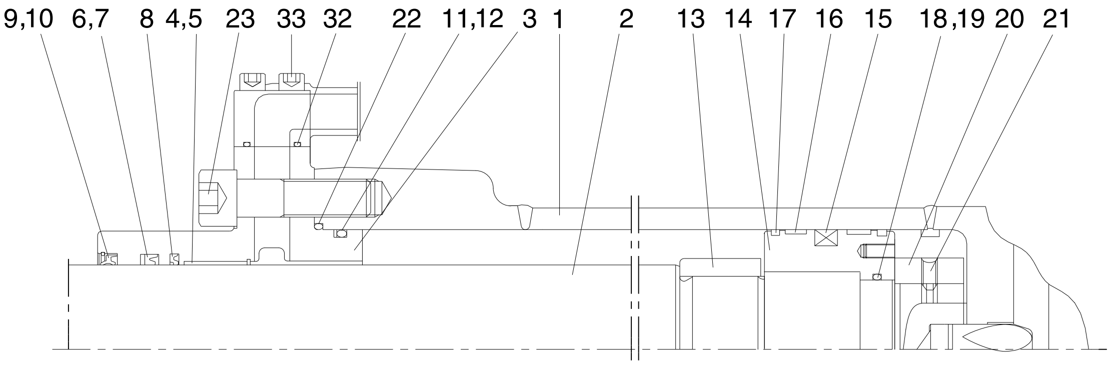


Internal detail

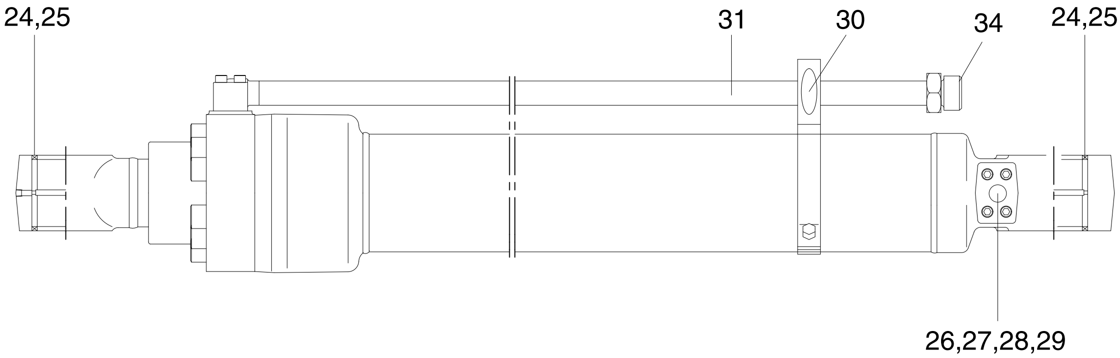


1	Tube assembly	14	Back up ring	27	Hexagon bolt
2	Pin bushing	15	O-ring	28	Spring washer
3	Rod assembly	16	Cushion ring	29	Pipe assy
4	Pin bushing	17	Piston	30	O-ring
5	Rod cover	18	Piston seal	31	Hexagon socket head bolt
6	Rod bushing	19	Wear ring	32	Spring washer
7	Retaining ring	20	Dust ring	33	Pipe assy
8	Buffer seal	21	O-ring	34	O-ring
9	U-packing	22	Back up ring	35	Clamp
10	Back up ring	23	Set screw	36	Spring washer
11	Dust wiper	24	Hexagon socket head bolt	37	Hexagon nut
12	Retaining ring	25	Pipe band assy	38	Pin wiper
13	O-ring	26	Pipe band		

(2) Arm cylinder (CHANGZHOU)

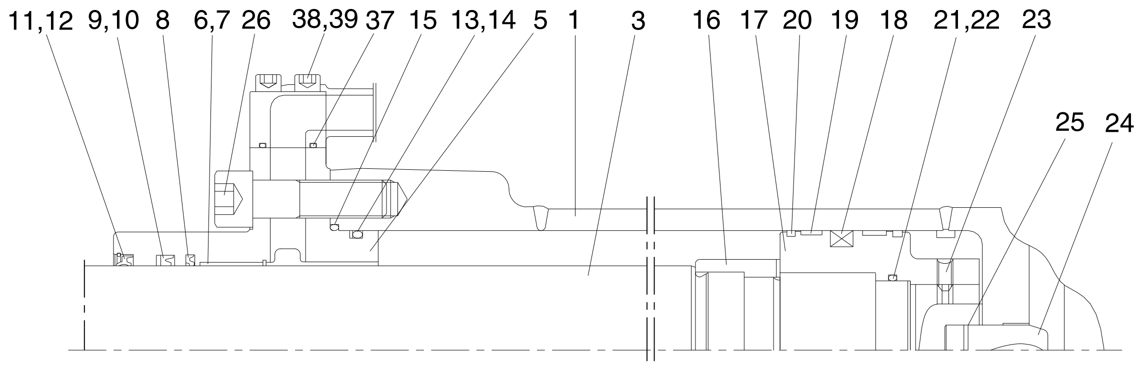


Internal detail

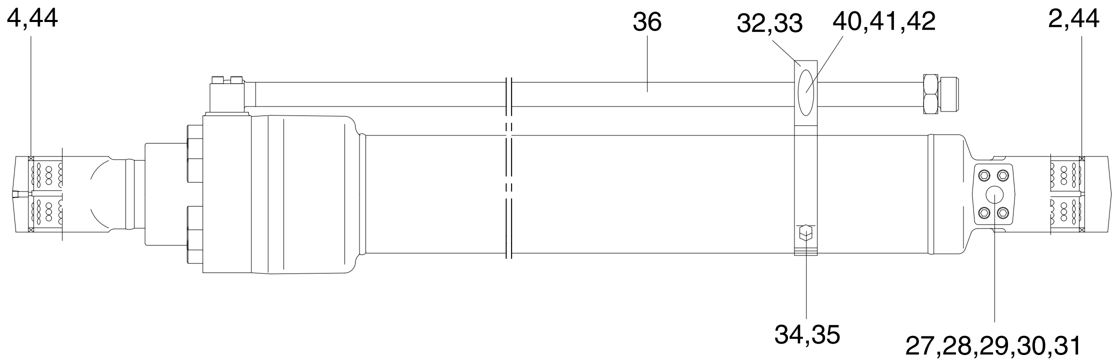


1	Tube assembly	13	Cushion ring	25	Dust seal
2	Rod assembly	14	Piston	26	Check valve
3	Gland	15	Piston seal	27	Coil spring
4	DD2 bushing	16	Wear ring	28	O-ring
5	Snap ring	17	Dust ring	29	Plug
6	Rod seal	18	O-ring	30	Band assembly
7	Back up ring	19	Back up ring	31	Pipe assembly-R
8	Buffer ring	20	Lock nut	32	O-ring
9	Dust wiper	21	Hexagon socket set screw	33	Hexagon socket head bolt
10	Snap ring	22	O-ring	34	O-ring
11	O-ring	23	Hexagon socket head bolt		
12	Back up ring	24	Dimple bushing		

Arm cylinder (DY POWER)



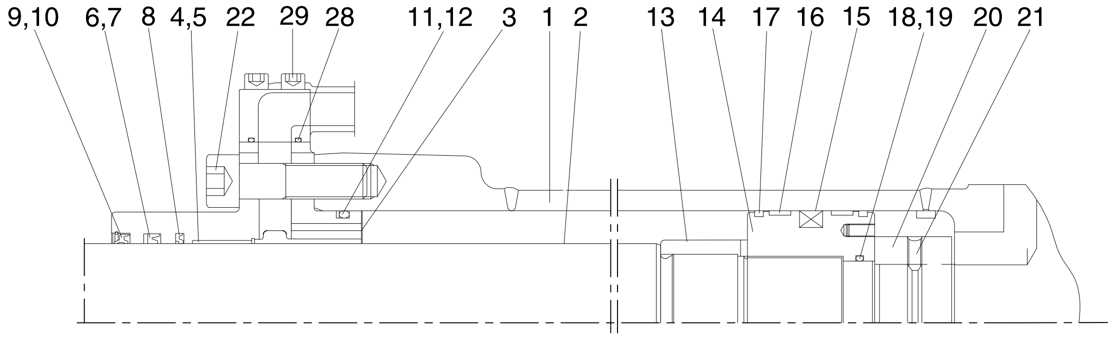
Internal detail



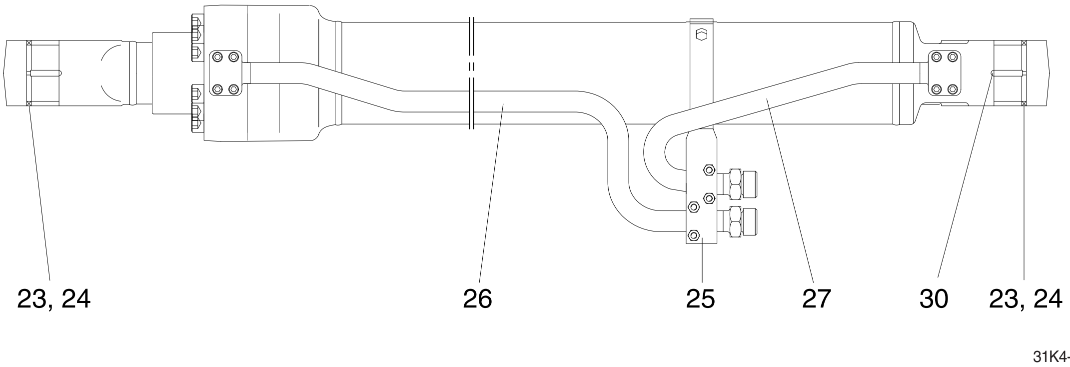
31K4-50130E

1	Tube assembly	16	Cushion ring	31	Plug
2	Pin bushing	17	Piston	32	Pipe band assy
3	Rod assembly	18	Piston seal	33	Pipe band
4	Pin bushing	19	Wear ring	34	Hexagon bolt
5	Rod cover	20	Dust ring	35	Washer
6	Rod bushing	21	O-ring	36	Pipe assy
7	Retaining ring	22	Back up ring	37	O-ring
8	Buffer seal	23	Set screw	38	Hexagon socket head bolt
9	U-packing	24	Cushion plunger	39	Spring washer
10	Back up ring	25	Stop ring	40	U-bolt
11	Dust wiper	26	Hexagon socket head bolt	41	Spring washer
12	Retaining ring	27	Check	42	Hexagon nut
13	O-ring	28	Spring	43	O-ring
14	Back up ring	29	Bracket	44	Pin wiper
15	O-ring	30	O-ring		

(3) Boom cylinder (CHANGZHOU)

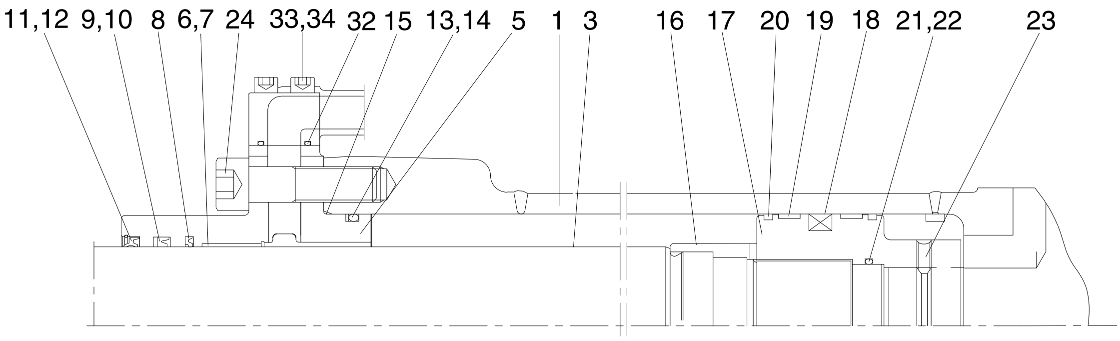


Internal detail

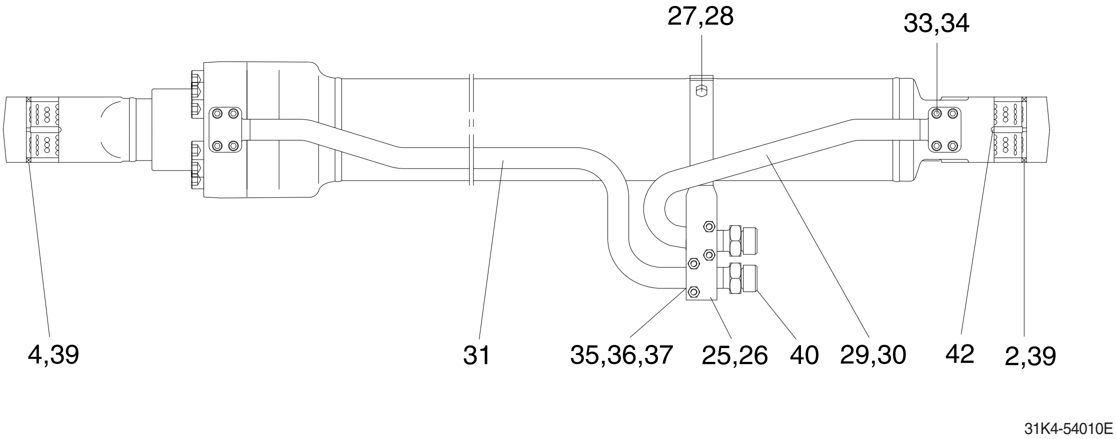


1	Tube assembly	11	O-ring	21	Hexagon socket set screw
2	Rod assembly	12	Back up ring	22	Hexagon socket head bolt
3	Gland	13	Cushion ring	23	Dimple bushing
4	DD2 bushing	14	Piston	24	Dust seal
5	Snap ring	15	Piston seal	25	Band assembly
6	Rod seal	16	Wear ring	26	Pipe assembly-R
7	Back up ring	17	Dust 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

Boom cylinder (DY POWER)

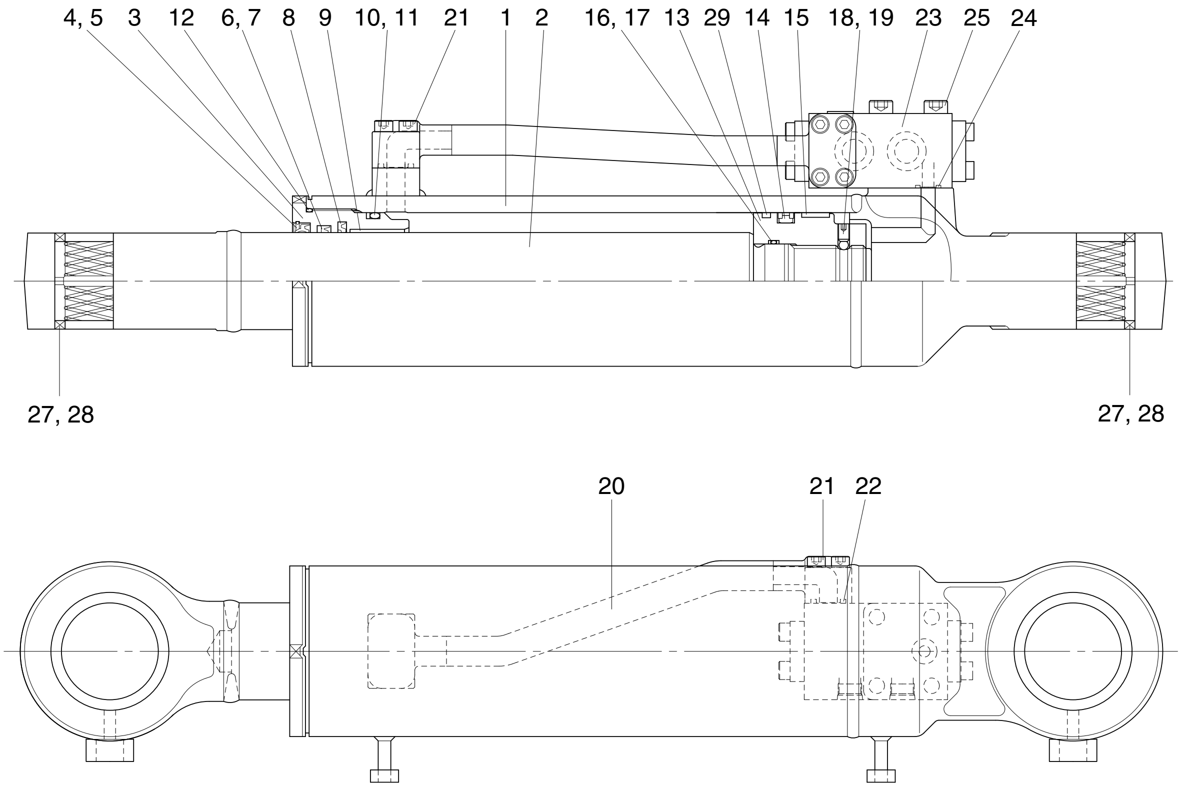


Internal detail



1	Tube assembly	15	O-ring	29	Pipe assy
2	Pin bushing	16	Cushion ring	30	O-ring
3	Rod assembly	17	Piston	31	Pipe assy
4	Pin bushing	18	Piston seal	32	O-ring
5	Rod cover	19	Wear ring	33	Spring washer
6	Rod bushing	20	Dust ring	34	Hexagon socket head bolt
7	Retaining ring	21	O-ring	35	U-bolt
8	Buffer seal	22	Back up ring	36	Spring washer
9	U-packing	23	Set screw	37	Hexagon nut
10	Back up ring	24	Hexagon socket head bolt	38	O-ring
11	Dust wiper	25	Pipe band assy	39	Pin wiper
12	Retaining ring	26	Pipe band	40	O-ring
13	O-ring	27	Hexagon bolt	42	Plug
14	Back up ring	28	Spring washer		

(4) Dozer cylinder (SHPAC)

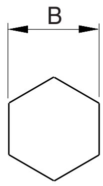


31Q4-70011

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	27	Pin bushing
7	Back up ring	17	Back up ring	28	Dust seal
8	Buffer ring	18	Steel ball	29	Dust ring
9	Dry bearing	19	Set screw		
10	O-ring	20	Pipe assembly		

2) TOOLS AND TIGHTENING TORQUE

(1) Tools

Tools	Remark	
Allen wrench	6	
	8	
	10	
	12	
	14	
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	Torque lbf · ft
Socket head bolt	Bucket cylinder	22★1★3	M14	15±2.0	108±14.5
		24★1★4	M14	19±1.0	137±7.2
		30★3	M10	5.4±0.5	39.1±3.6
		31★4	M10	5.75±0.25	41.6±1.8
	Boom cylinder	22★1★3	M14	15±2.0	108±14.5
		24★1★4	M14	19±1.0	137±7.2
		29★3	M8	2.7±0.3	19.5±2.2
		33★4	M8	3.25±0.25	23.5±1.8
	Arm cylinder	23★1★3	M16	23±2.0	166±14.5
		26★1★4	M16	30±2.0	217±14.5
		33★3	M10	5.4±0.5	39.1±3.6
		38★4	M10	5.75±0.25	41.6±11.8
	Dozer cylinder	21★1★5	M8	3.3±0.3	23.7±2.2

★1 : Apply loctite #243 on the thread of bolt.
★3 : CHANGZHOU
★4 : DY POWER
★5 : SHPAC

Part name		Item	Size	Torque	
				kgf · m	lbf · ft
Lock nut	Bucket cylinder	20★3	-	100±10.0	723±72.3
	Boom cylinder	20★3	-	100±10.0	723±72.3
	Arm cylinder	20★3	-	100±10.0	723±72.3
Piston	Bucket cylinder	14★3 17★4	- M60	150±15.0 130±13	1085±108 940±94.0
	Boom cylinder	14★3 17★4	- M65	150±15.0 130±13	1085±108 940±94.0
	Arm cylinder	14★3 17★4	- M90	150±15 190±19	1085±108 1374±137
	Dozer cylinder	13★5	M52	150±15	1085±108
Set screw	Bucket cylinder	21★3 23★4	M8 M12	2.7±0.3 5.25±0.25	19.5±2.2 38.0±1.8
	Boom cylinder	21★3 23★4	M8 M12	2.7±0.3 5	19.5±2.2 36.2
	Arm cylinder	21★3 23★4	M8 M12	2.7±0.3 5	19.5±2.2 36.2
	Dozer cylinder	19★5	M8	1.7±0.2	12.3±1.4

★1 : Apply loctite #243 on the thread of bolt.

★3 : CHANGZHOU

★4 : DY POWER

★5 : SHPAC

3) DISASSEMBLY

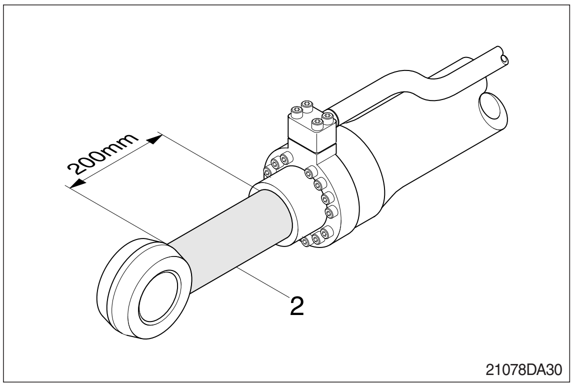
(1) Remove cylinder head and piston rod

※ Procedures are based on the bucket cylinder.

① Hold the clevis section of the tube in a vise.

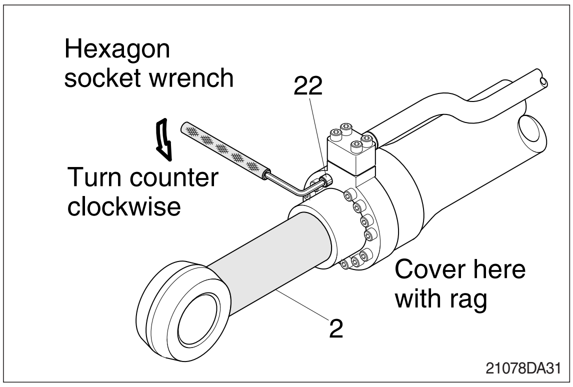
※ Use mouth pieces so as not to damage the machined surface of the cylinder tube. Do not make use of the outside piping as a locking means.

② Pull out rod assembly (2) about 200 ㎜ (7.1in). Because the rod assembly is rather heavy, finish extending it with air pressure after the oil draining operation.



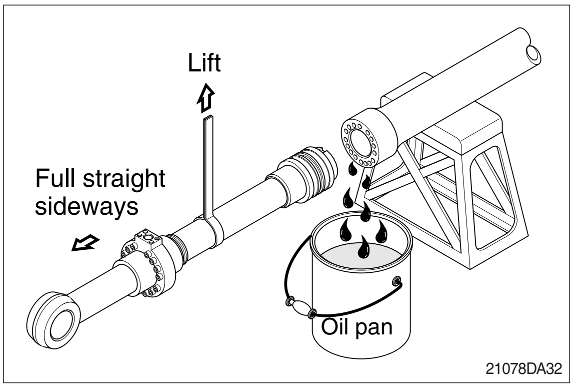
③ Loosen and remove socket bolts (22) of the gland in sequence.

※ Cover the extracted rod assembly (2) with rag to prevent it from being accidentally damaged during operation.



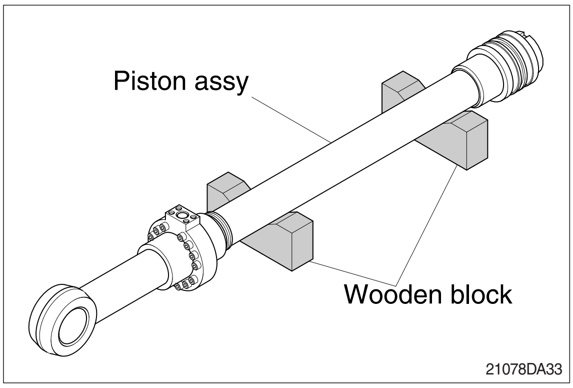
④ Draw out cylinder head and rod assembly together from tube assembly (1).

※ Since the rod assembly is heavy in this case, lift the tip of the rod assembly (2) with a crane or some means and draw it out. However, when rod assembly (2) has been drawn out to approximately two thirds of its length, lift it in its center to draw it completely.

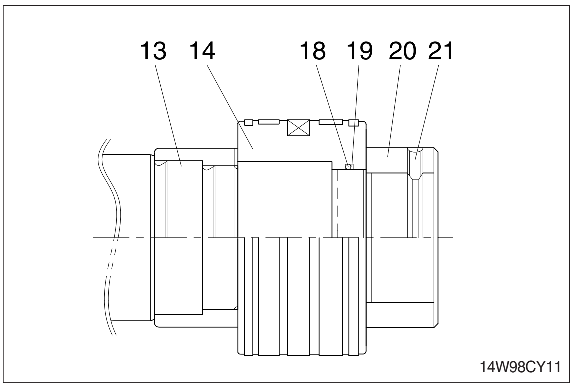


Note that the plated surface of rod assembly (2) is to be lifted. For this reason, do not use a wire sling and others that may damage it, but use a strong cloth belt or a rope.

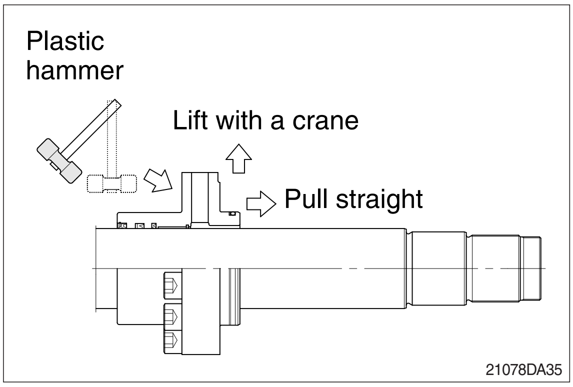
⑤ Place the removed rod assembly on a wooden V-block that is set level.
※ Cover a V-block with soft rag.



(2) Remove piston and cylinder head
① Remove set screw (21).
※ Since set screw (21) and lock nut (20) is tightened to a high torque, use a hydraulic and power wrench that utilizers a hydraulic cylinder, to remove the lock set screw (21) and lock nut (20).
② Remove piston assembly (14), back up ring (19), and O-ring (18).



③ Remove the cylinder head assembly from rod assembly (2).
※ If it is too heavy to move, move it by striking the flanged part of cylinder head with a plastic hammer.
※ Pull it straight with cylinder head assembly lifted with a crane.
Exercise care so as not to damage the lip of rod bushing (4) and packing (5,6,7,8,9,10) by the threads of rod assembly (2).

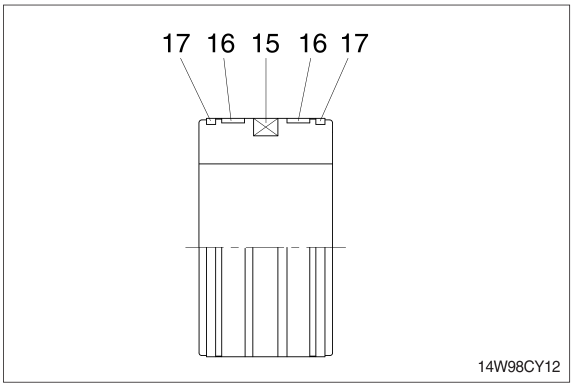


(3) Disassemble the piston assembly

① Remove wear ring (16).

② Remove dust ring (17) and piston seal (15).

※ Exercise care in this operation not to damage the grooves.



(4) Disassemble cylinder head assembly

① Remove back up ring (12) and O-ring (11).

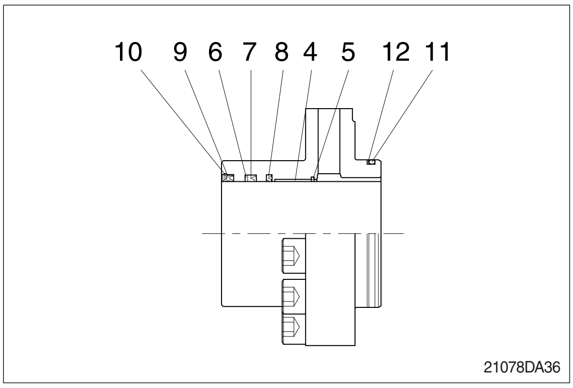
② Remove snap ring (10), dust wiper (9).

③ Remove back up ring (7), rod seal (6) and buffer ring (8).

※ Exercise care in this operation not to damage the grooves.

※ Do not remove seal and ring, if does not damaged.

※ Do not remove bushing (4).

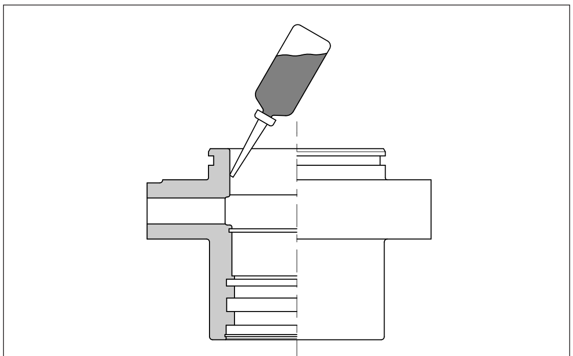


3) ASSEMBLY

(1) Assemble cylinder head assembly

※ Check for scratches or rough surfaces if found smooth with an oil stone.

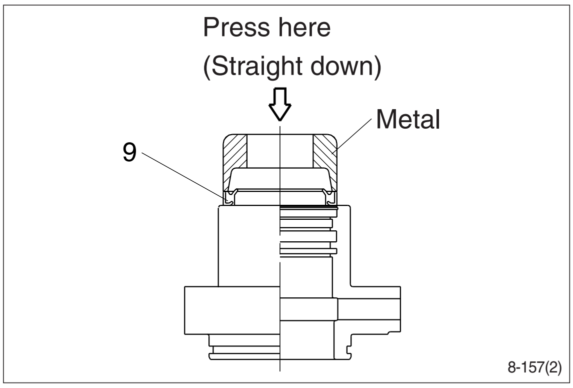
① Coat the inner face of gland (3) with hydraulic oil.



21078DA37

② Coat dust wiper (9) with grease and fit dust wiper (9) to the bottom of the hole of dust wiper.
At this time, press a pad metal to the metal ring of dust wiper.

③ Fit snap ring (10) to the stop face.

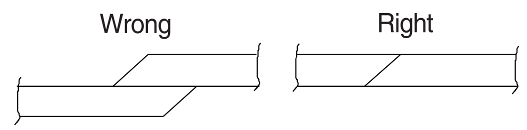


8-157(2)

④ Fit back up ring (7), rod seal (6) and buffer ring (8) to corresponding grooves, in that order.

※ Coat each packing with hydraulic oil before fitting it.

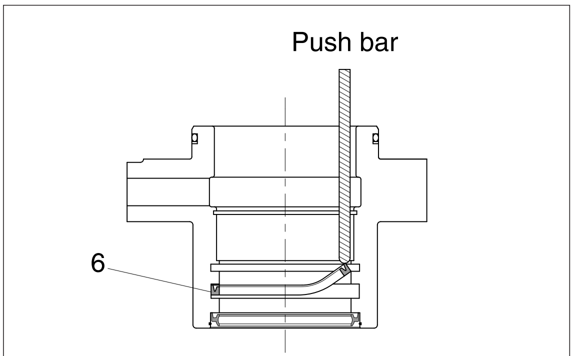
※ Insert the backup ring until one side of it is inserted into groove.



8-157(3)

※ Rod seal (6) has its own fitting direction. Therefore, confirm it before fitting them.

※ Fitting rod seal (6) upside down may damage its lip. Therefore check the correct direction that is shown in fig.

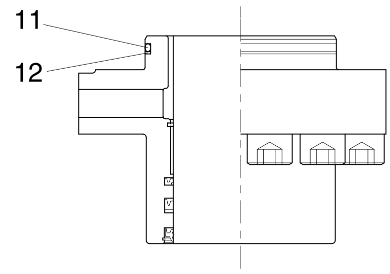


21078DA38

⑤ Fit back up ring (12) to gland (3).

※ Put the backup ring in the warm water of 30~50˚C.

⑥ Fit O-ring (11) to gland (3).

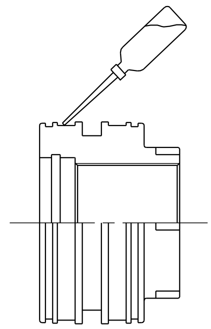


21078DA39

(2) Assemble piston assembly

※ Check for scratches or rough surfaces. If found smooth with an oil stone.

① Coat the outer face of piston (14) with hydraulic oil.

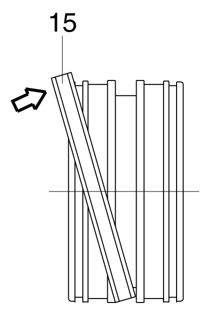


8-158(2)

② Fit piston seal (15) to piston.

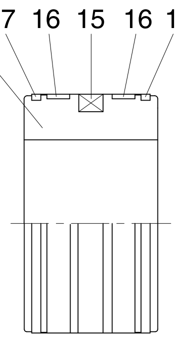
※ Put the piston seal in the warm water of 60~100˚C for more than 5 minutes.

※ After assembling the piston seal, press its outer diameter to fit in.



2907A8CY04

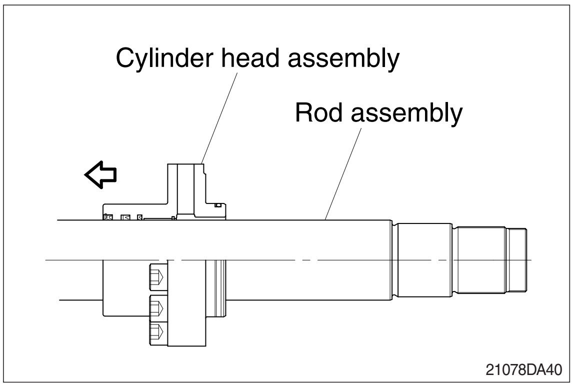
③ Fit wear ring (16) and dust ring (17) to piston (14).



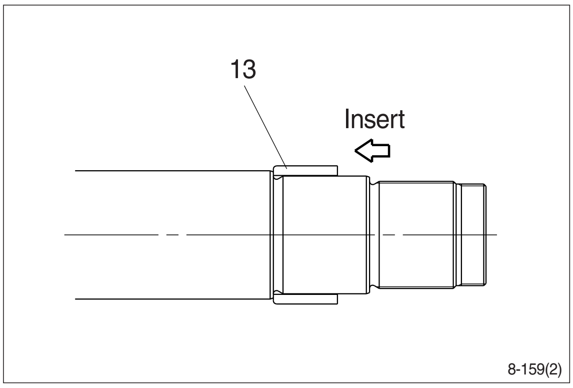
14W98CY13

(3) Install piston and cylinder head

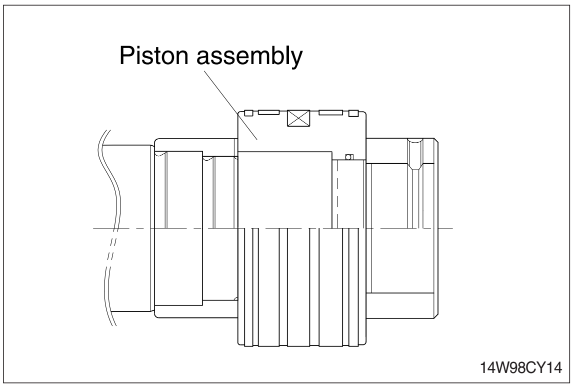
① Fix the rod assembly to the work bench.
② Apply hydraulic oil to the outer surface of rod assembly (2), the inner surface of piston and cylinder head.
③ Insert cylinder head assembly to rod assembly.



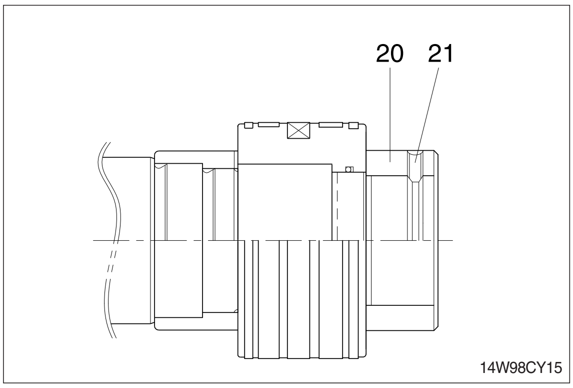
④ Insert cushion ring (13) to rod assembly.
※ Note that cushion ring (13) has a direction in which it should be fitted.



⑤ Fit piston assembly to rod assembly.
· Tightening torque : 150±15 kgf · m
(1085±108 lbf · ft)
※ Refer to page 8-139.



⑥ Fit lock nut (20) and tighten the set screw (21).
· Tightening torque
- item 20 : 100±10.0 kgf · m
(723±72.3 lbf · ft)
- item 21 : 2.7±0.3 kgf · m
(19.5±2.2 lbf · ft)
※ Refer to page 8-139.



(3) Overall assemble

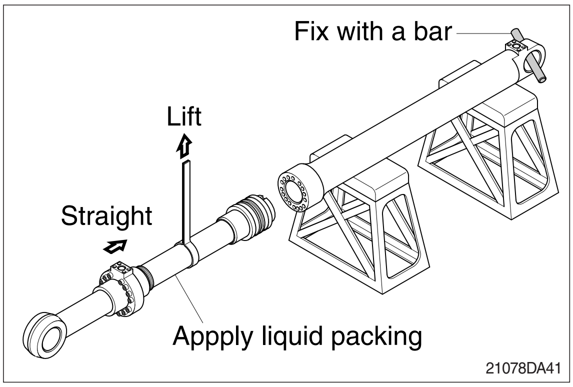
① Place a V-block on a rigid work bench. Mount the tube assembly (1) on it and fix the assembly by passing a bar through the clevis pin hole to lock the assembly.

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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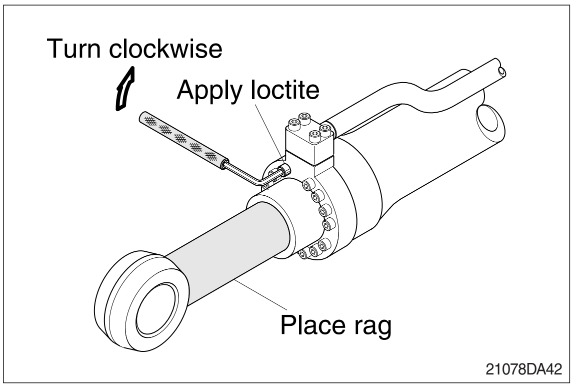


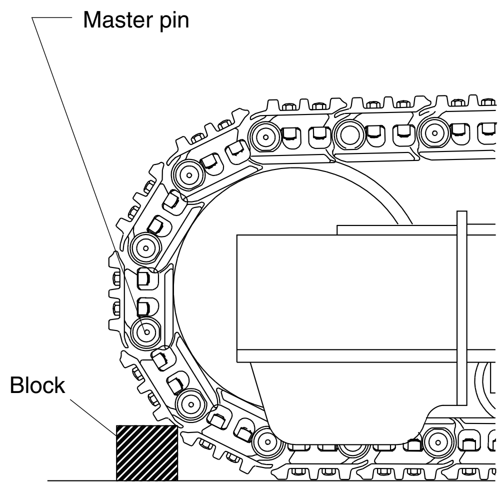
21078DA42

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.



130ZF8UC01

(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.

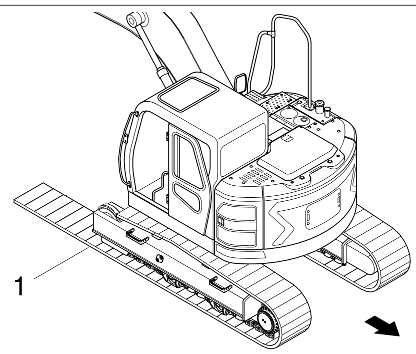
※ Unscrew the grease nipple after release the tension by pushing the poppet only when necessarily required.
Grease leaking hole is not existing. So, while unscrew the grease nipple, grease is not leaking until the grease nipple is completely coming out. If the tension is not released in advance, the 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.

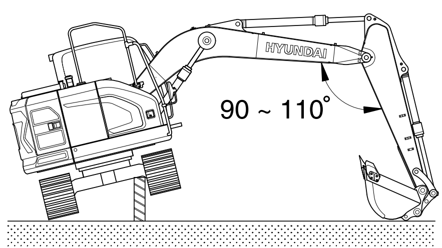


130ZF8UC04

2) INSTALL

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

※ Adjust the tension of the track link.

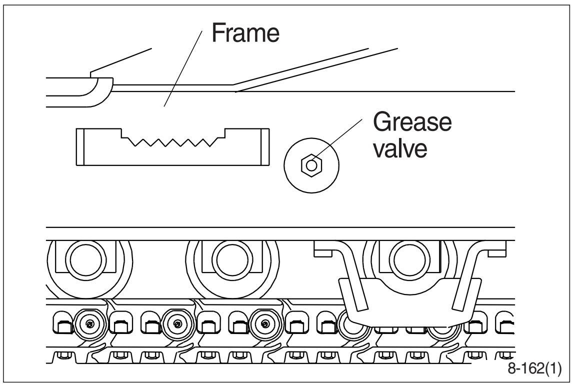


130ZF8UC05

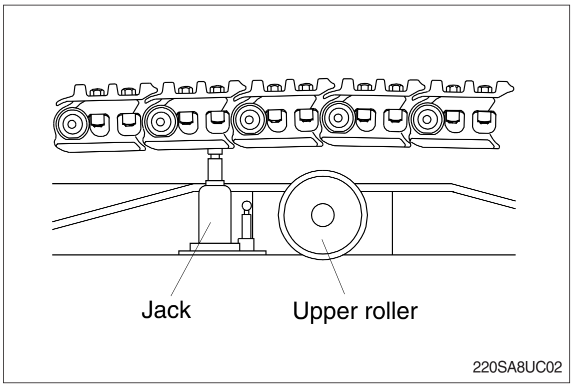
2. UPPER ROLLER

1) REMOVAL

(1) Loosen tension of the track link.



(2) Jack up the track link height enough to permit upper roller removal.

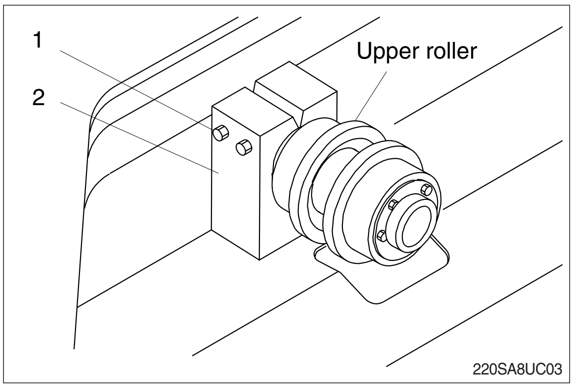


(3) Loosen the lock nut (1).

· Tightening torque (4) : 29.7±4.5 kgf · m (215±32.5 lbf · ft)

(4) Open bracket (2) with a screwdriver, push out from inside, and remove upper roller assembly.

· Weight : 38.5 kg (278 lb)



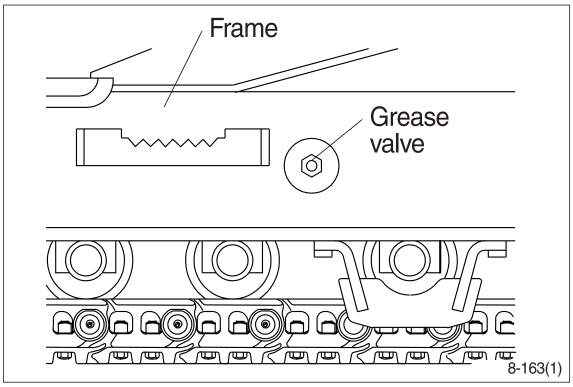
2) INSTALL

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

3. LOWER ROLLER

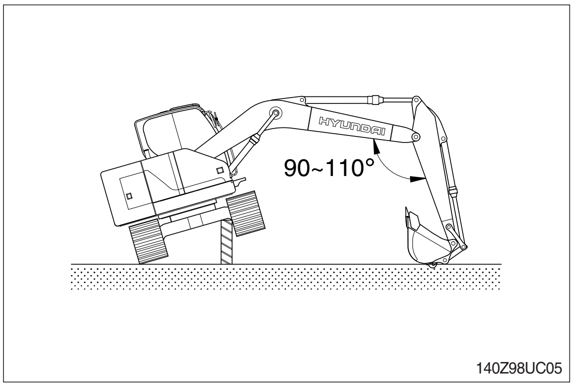
1) REMOVAL

(1) Loosen tension of the track link.



(2) Using the work equipment, push up track frame on side which is to be removed.

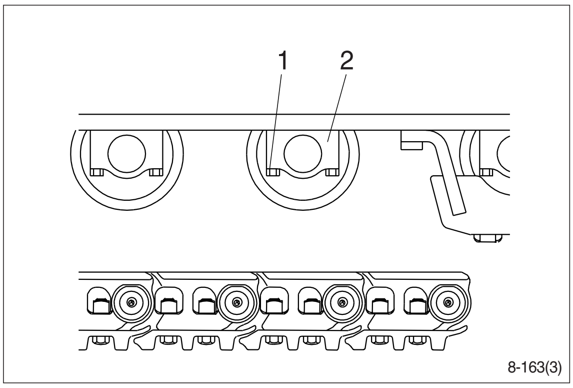
※ After jack up the machine, set a block under the unit.



(3) Remove the mounting bolt (1) and draw out the lower roller (2).

· Weight : 35.1 kg (77.4 lb)

· Tightening torque (1) : 29.7±4.5 kgf · m (215±32.5 lbf · ft)



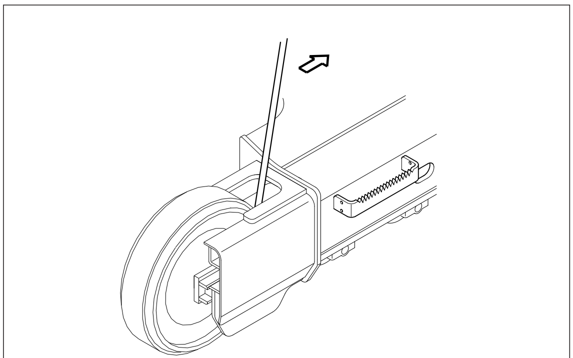
2) INSTALL

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

4. IDLER AND RECOIL SPRING

1) REMOVAL

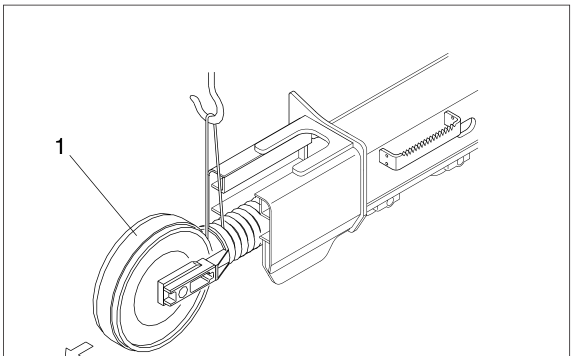
(1) Remove the track link.
For detail, see removal of track link.



145SA8UC10

(2) Sling the recoil spring (1) and pull out idler and recoil spring assembly from track frame, using a pry.

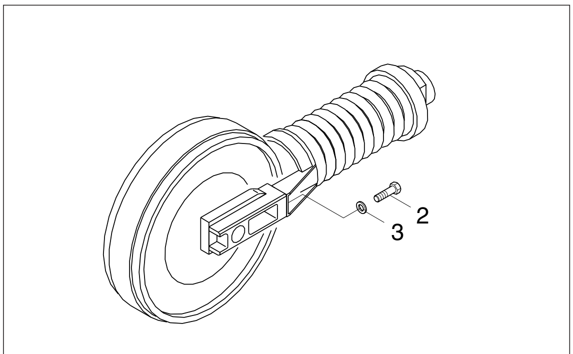
· Weight : 200 kg (441 lb)



145SA8UC11

(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)

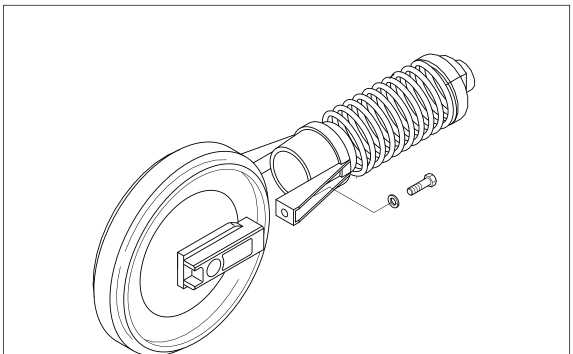


130ZF8UC12

2) INSTALL

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

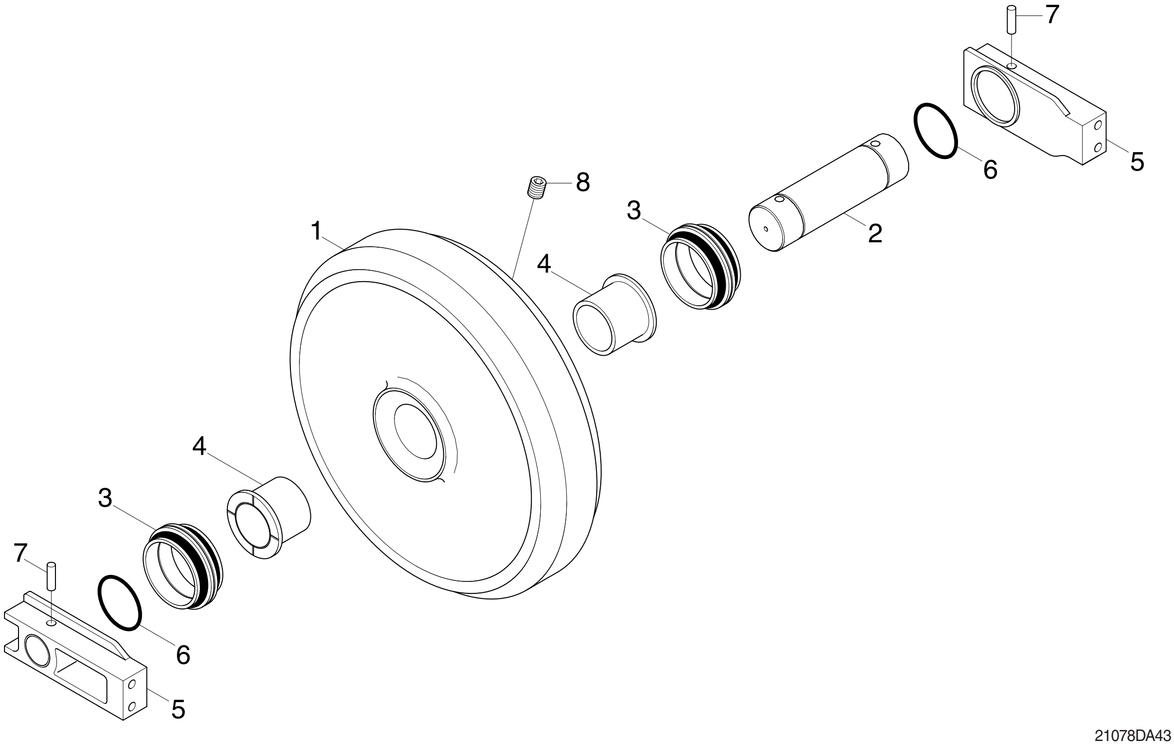
※ Make sure that the boss on the end face of the recoil cylinder rod is in the hole of the track frame.



130ZF8UC13

3) DISASSEMBLY AND ASSEMBLY OF IDLER

(1) Structure

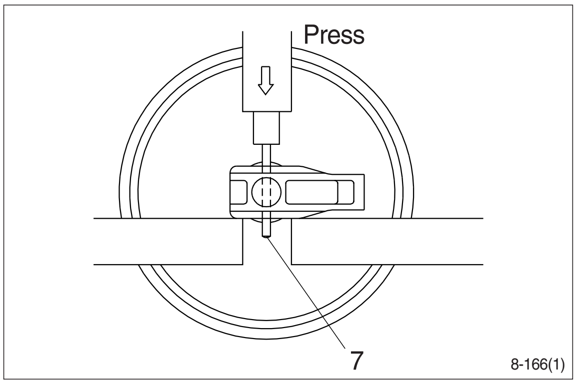


1	Shell	4	Bushing	7	Spring pin
2	Shaft	5	Bracket	8	Plug
3	Seal assembly	6	O-ring		

(2) Disassembly

① Remove plug and drain oil.

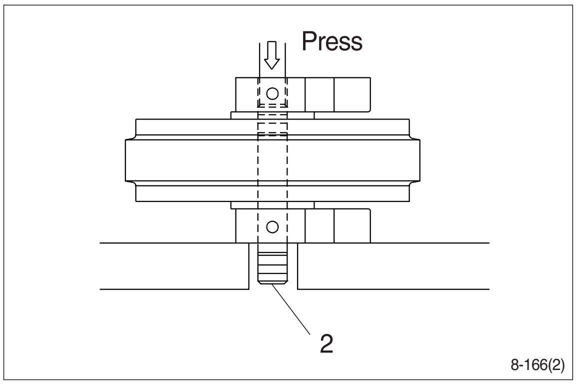
② Draw out the spring pin (7), using a press.



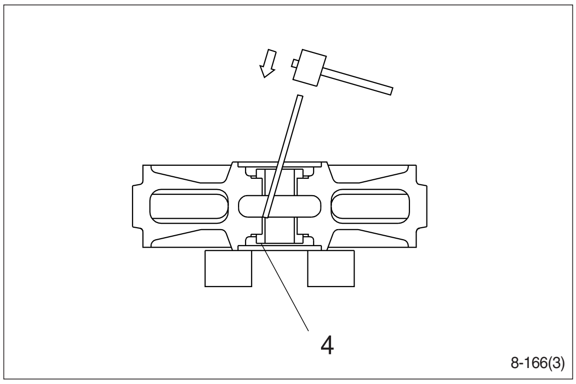
③ Pull out the shaft (2) with a press.

④ Remove seal (3) from idler (1) and bracket (5).

⑤ Remove O-ring (6) from shaft.



⑥ Remove the bushing (4) from idler, using a special tool.
Only remove bushing if replacement is necessity.

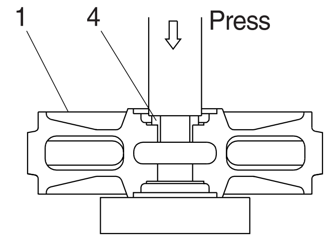


(3) Assembly

※ Before assembly, clean the parts.

※ Coat the sliding surfaces of all parts with oil.

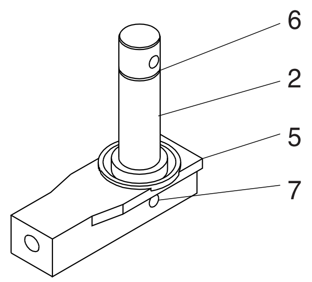
① Cool up bushing (4) fully by some dry ice and press it into shell (1).
Do not press it at the normal temperature, or not knock in with a hammer even after the cooling.



8-167(1)

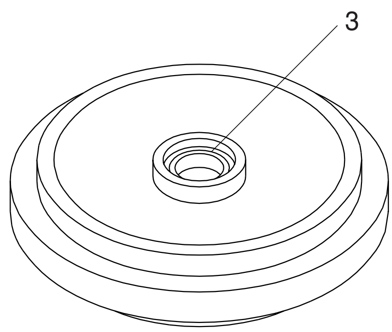
② Coat O-ring (6) with grease thinly, and install it to shaft (2).

③ Insert shaft (2) into bracket (5) and drive in the spring pin (7).



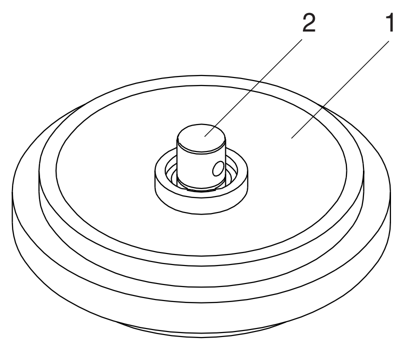
8-167(2)

④ Install seal (3) to shell (1) and bracket (5).



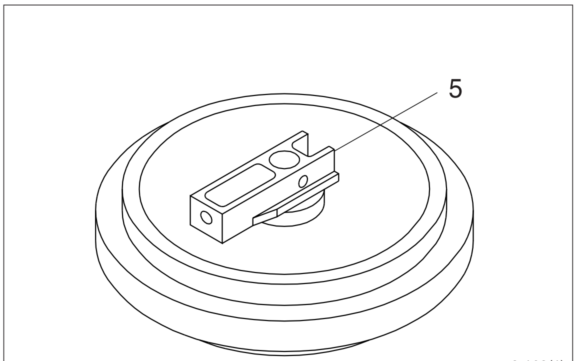
8-167(3)

⑤ Install shaft (2) to shell (1).



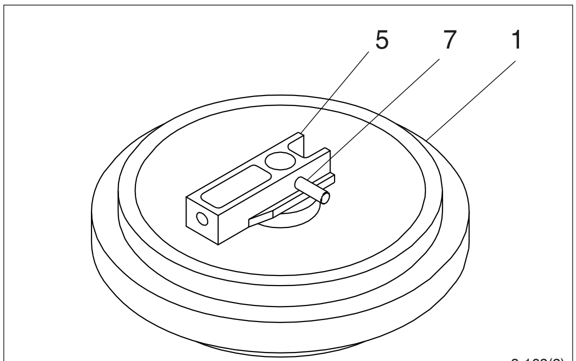
8-167(4)

⑥ Install bracket (5) attached with seal (3).



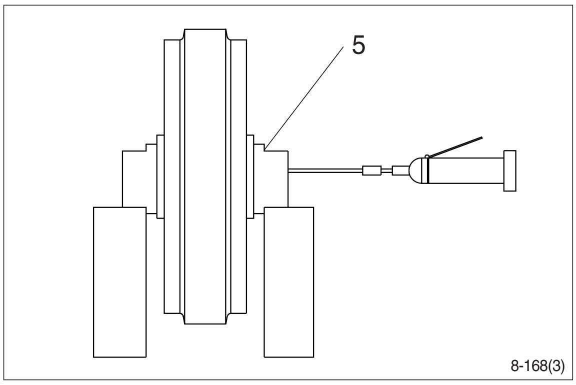
8-168(1)

⑦ Knock in the spring pin (7) with a hammer.



8-168(2)

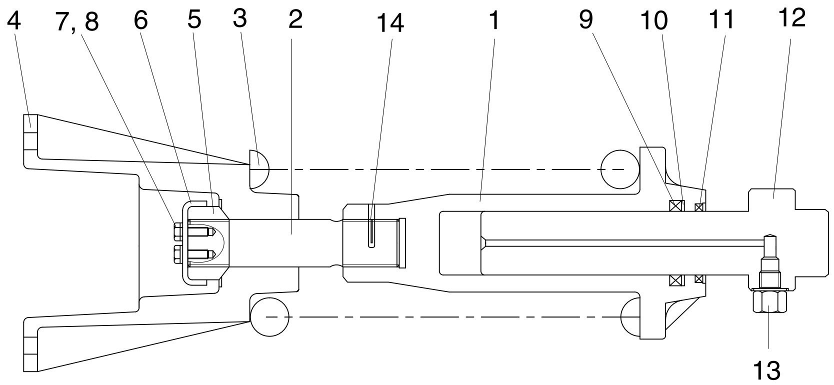
⑧ Lay bracket (5) on its side.
Supply engine oil to the specified level, and tighten plug.



8-168(3)

4) DISASSEMBLY AND ASSEMBLY OF RECOIL SPRING

(1) Structure



130ZF8UC30

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 packing	14	Spring pin
5	Lock nut	10	Back up ring		

(2) Disassembly

① Apply pressure on spring (3) with a press.

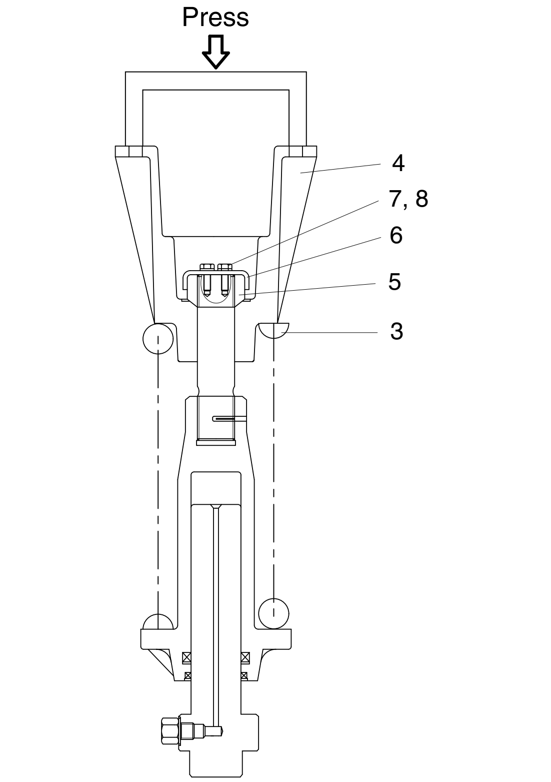
※ The spring is under a large installed load. This is dangerous, so be sure to set properly.

· Spring set load : 8497 ㎏ (18733 ㏁)

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.

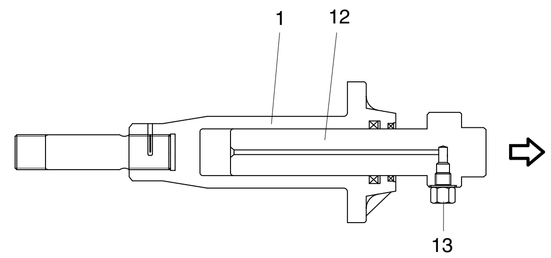
④ Lighten the press load slowly and remove bracket (4) and spring (3).



130ZF8UC31

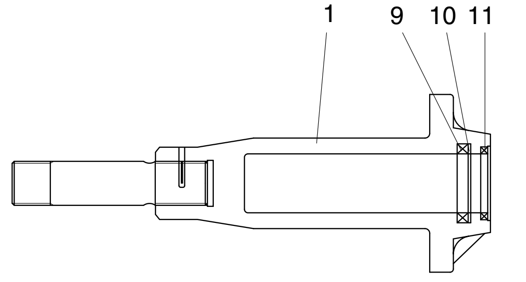
⑤ Remove rod (12) from body (1).

⑥ Remove grease valve (13) from rod (12).



130ZF8UC32

⑦ Remove rod seal (9), back up ring (10) and dust seal (11).

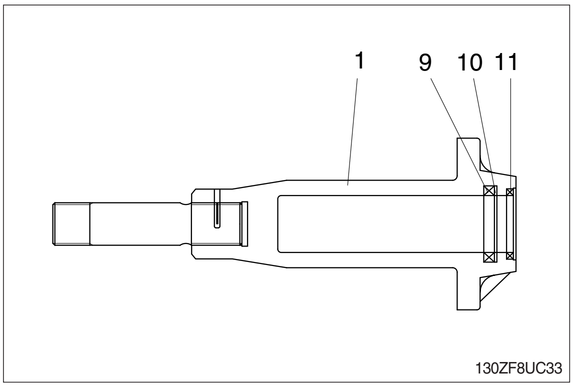


130ZF8UC33

(3) Assembly

Install dust seal (11), back up ring (10) and rod seal (9) to body (1).

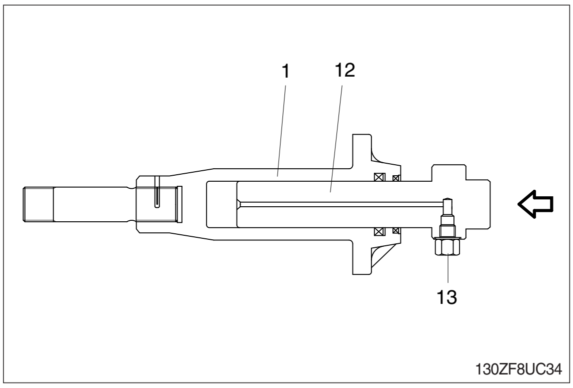
※ When installing dust seal (11) and rod seal (9), take full care so as not to damage the lip.



② Pour grease into body (1), then push in rod (12) by hand.
After take grease out of grease valve mounting hole, let air out.

※ If air letting is not sufficient, it may be difficult to adjust the tension of crawler.

③ Fit grease valve (13) to rod (12).
· Tightening torque : 13.0±0.5 kgf · m
(94.0±3.6 lbf · ft)

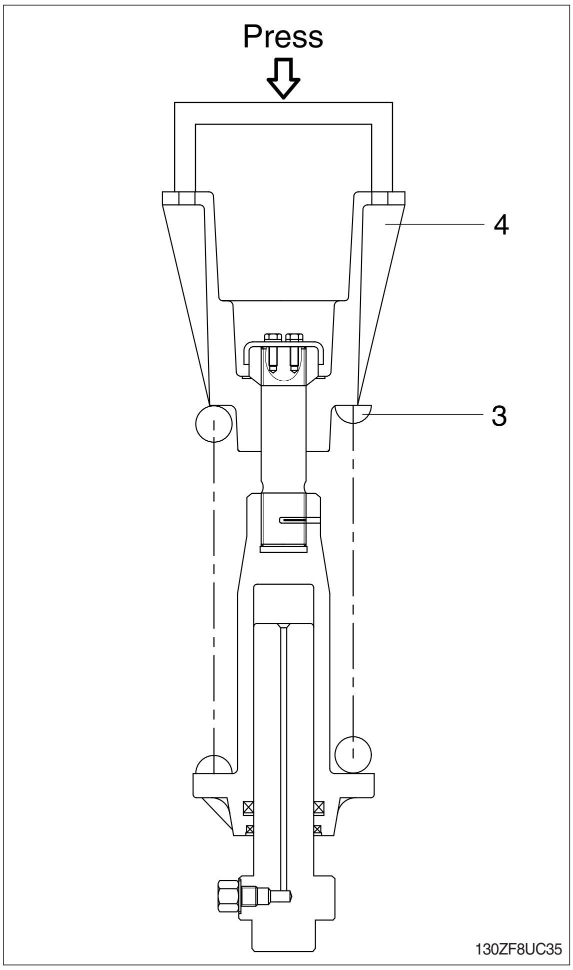


④ Install spring (3) and bracket (4) to body (1).

⑤ Apply pressure to spring (3) with a press and tighten lock nut (5).

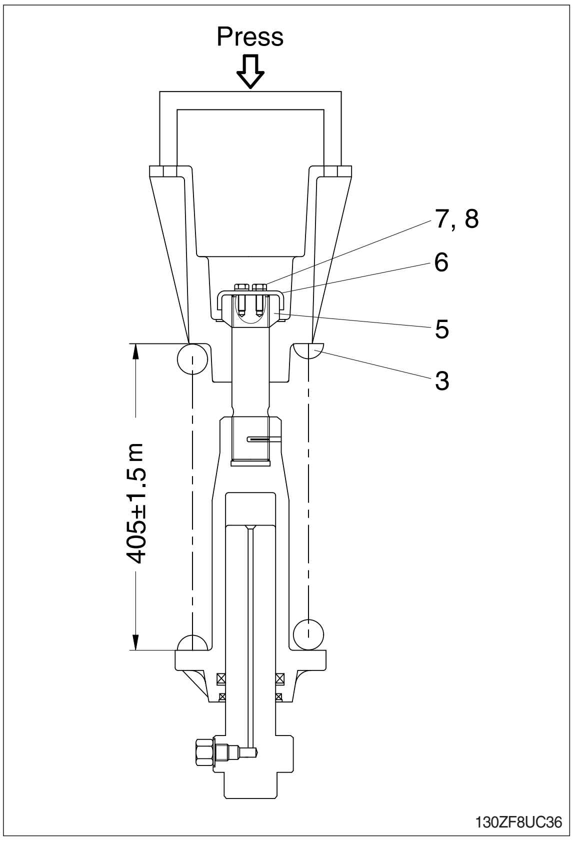
※ Apply sealant before assembling.

※ During the operation, pay attention specially to prevent the press from slipping out.

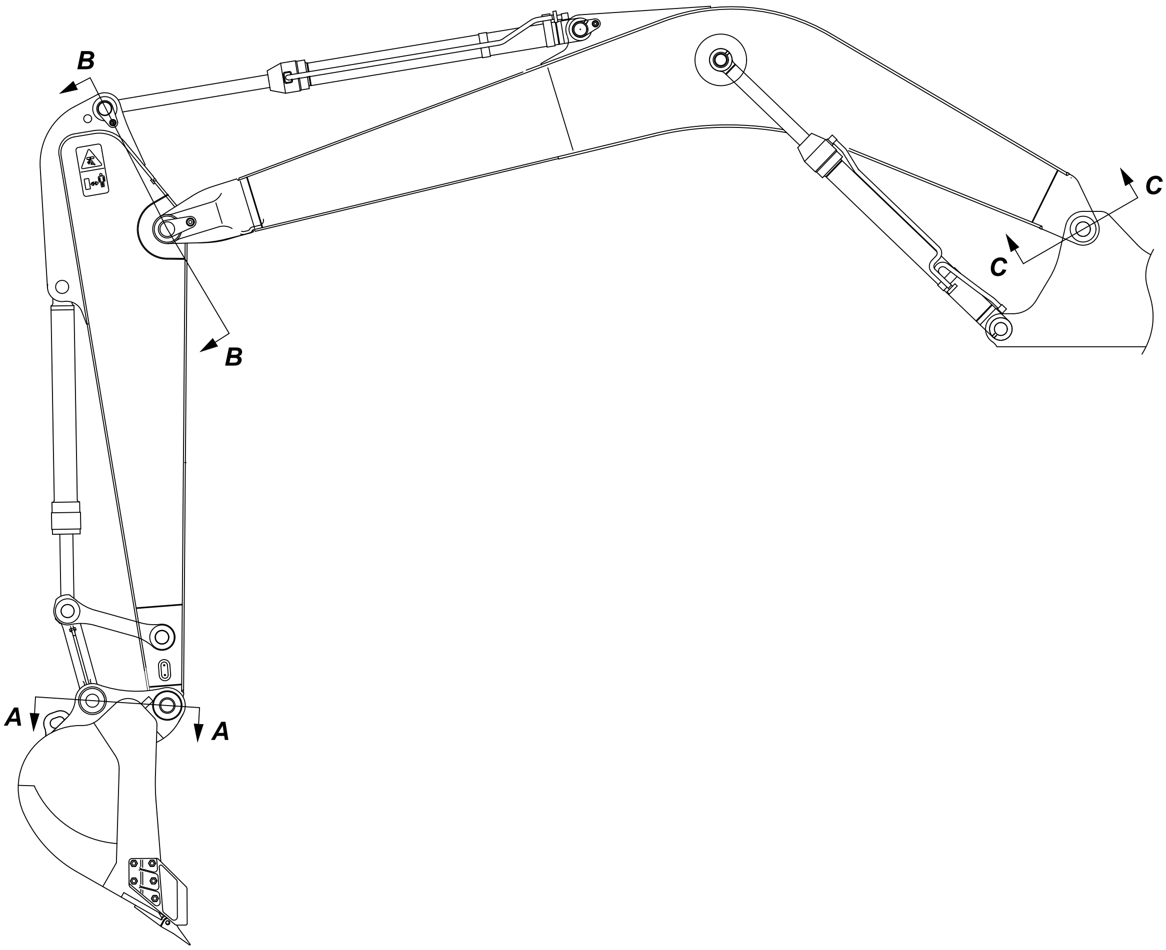


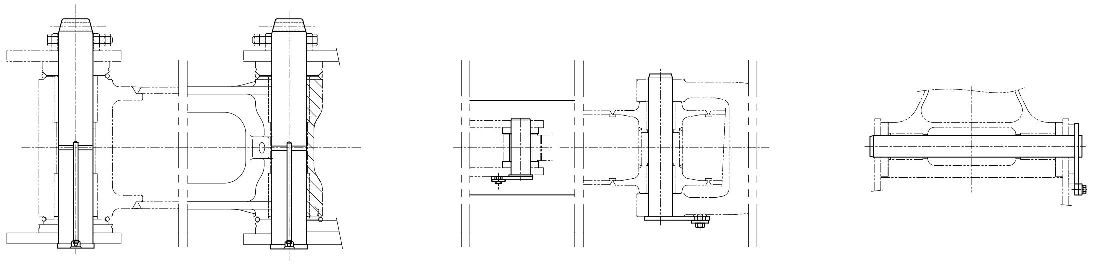
⑥ Lighten the press load and confirm the set length of spring (3).

⑦ After the setting of spring (3), install lock plate (6), spring washer (8) and bolt (7).



1. STRUCTURE





SECTION A SECTION B SECTION C

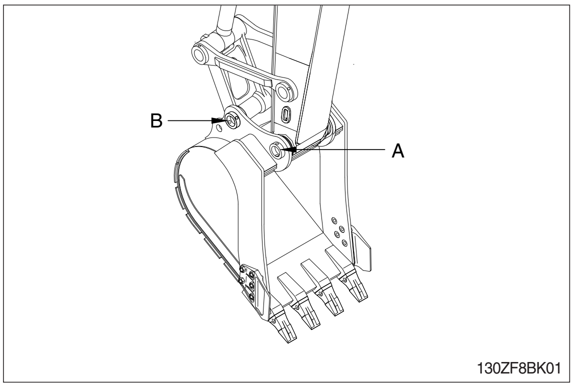
130ZF8DA44

2. REMOVAL AND INSTALL

1) BUCKET ASSEMBLY

(1) Removal

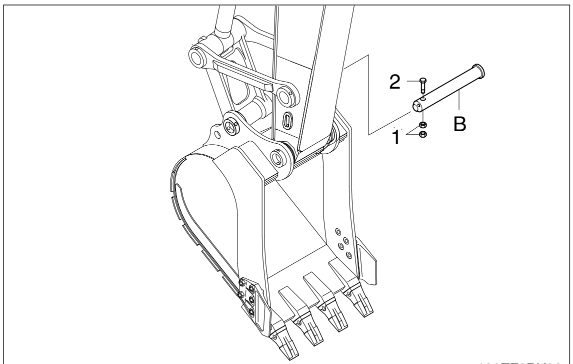
① Lower the work equipment completely to ground with back of bucket facing down.



130ZF8BK01

② Remove nut (1), bolt (2) and draw out the pin (B).

· Tightening torque (2) : 29.7±4.5 kgf · m (215±32.5 lbf · ft)

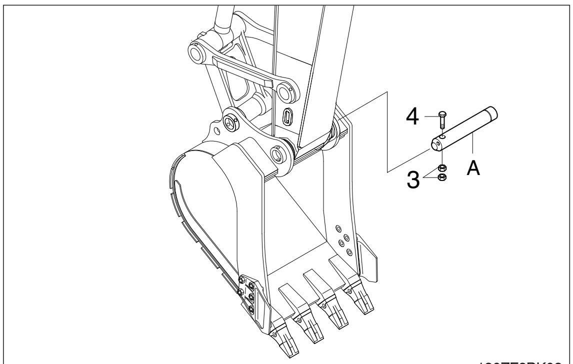


130ZF8BK02

③ Remove nut (3), bolt (4) and draw out the pin (A) then remove the bucket assembly.

· Weight (0.58 m^3) : 465 kg (1030 lb)

· Tightening torque (4) : 29.7±4.5 kgf · m (215±32.5 lbf · ft)



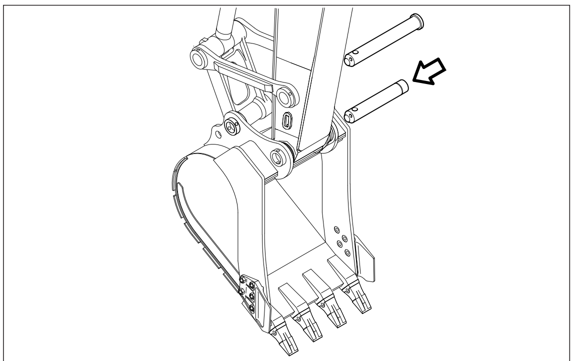
130ZF8BK03

(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.


130ZF8BK04

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 bucket cylinder assembly, remove spring, pin stopper and pull out pin.

※ Tie the rod with wire to prevent it from coming out.

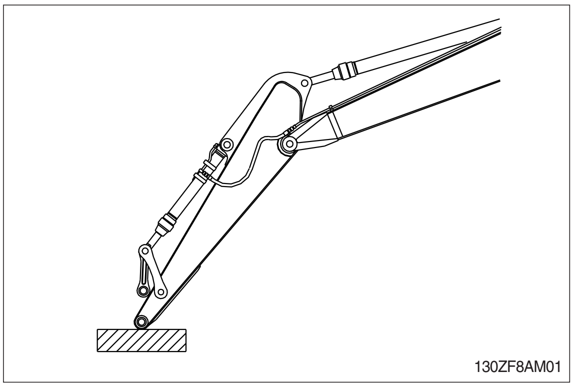
④ For details, see removal of bucket cylinder assembly.
Place a wooden block under the cylinder and bring the cylinder down to it.

⑤ Remove bolt (2), plate (3) and pull out the pin (4) then remove the arm assembly.

· Weight : 660 ㎏ (1460 ㏈)

· Tightening torque (2) : 12.8±3.0 kgf · m (92.6±21.7 lbf · ft)

※ When lifting the arm assembly, always lift the center of gravity.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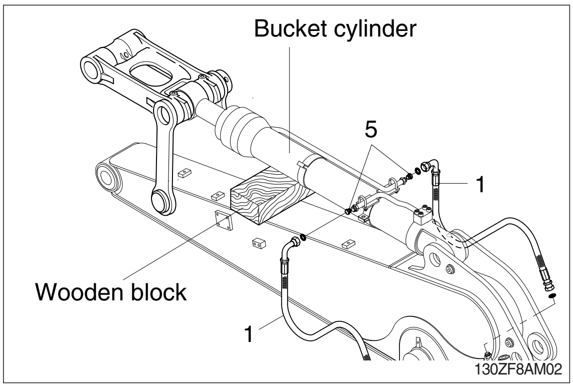

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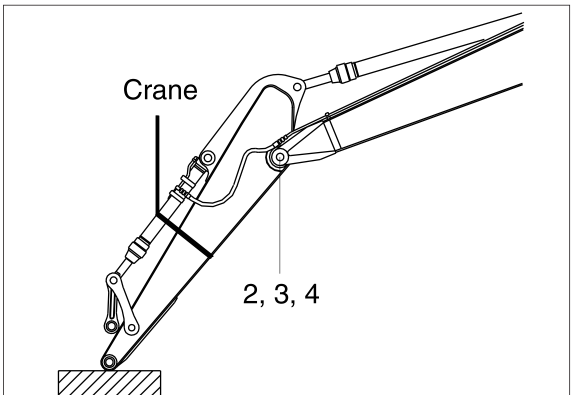


130ZF8AM03

(2) Install

① Carry out installation in the reverse order to removal.

⚠ **When lifting the arm assembly, always lift the center of gravity.**

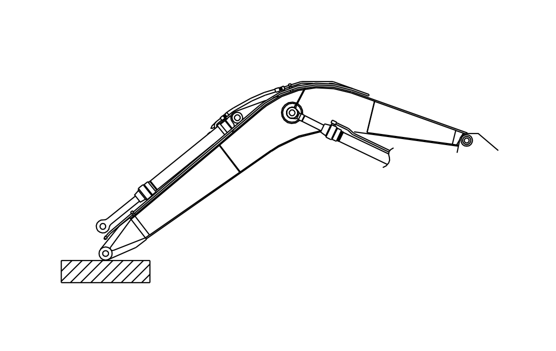
※ Bleed the air from the cylinder.

3) BOOM ASSEMBLY

(1) Removal

① Remove arm and bucket assembly.
For details, see removal of arm and bucket assembly.

② Remove boom cylinder assembly from boom.
For details, see removal of boom cylinder assembly.



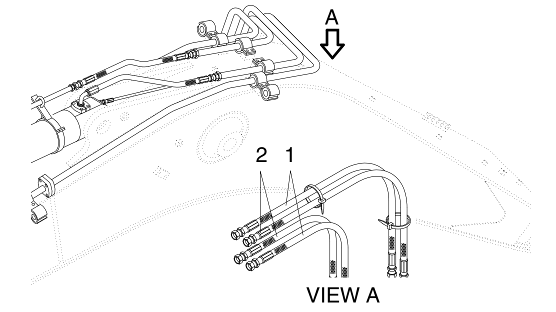
130ZF8BM01

③ Disconnect head lamp wiring.

④ Disconnect bucket cylinder hose (2) and arm cylinder hose (1).

※ When the hose are disconnected, oil may spurt out.

⑤ Sling boom assembly (3).



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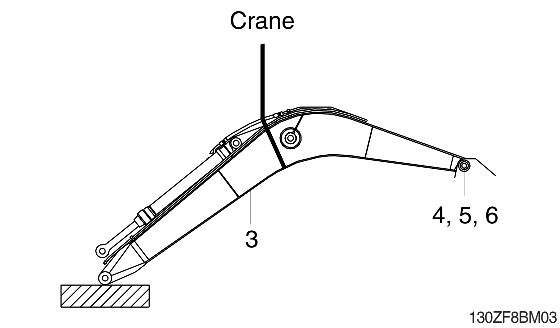
⑥ Remove bolt (4), plate (5) and pull out the pin (6) then remove boom assembly.
· Weight (2.26 m) : 984 kg (2170 lb)
· Tightening torque (2) : 12.8±3.0 kgf · m (92.6±21.7 lbf · ft)

※ When lifting the boom assembly always lift the center of gravity.



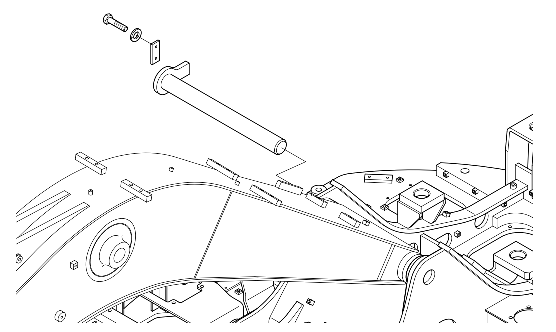
130ZF8BM03

(2) Install

① Carry out installation in the reverse order to removal.

⚠ **When lifting the arm assembly, always lift the center of gravity.**

※ Bleed the air from the cylinder.



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