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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.

SECTION 9 COMPONENT MOUNTING TORQUE
This section shows bolt specifications and standard torque values needed when mounting components to the machine.

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

2. HOW TO READ THE SERVICE MANUAL

Distribution and updating

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

Filing method

1. See the page number on the bottom of the page.
   File the pages in correct order.
2. Following examples shows how to read the page number.
   Example 1
   2 - 3
   - Item number(2. Structure and Function)
   - Consecutive page number for each item.
3. Additional pages : Additional pages are indicated by a hyphen(-) and number after the page number. File as in the example.
   10 - 4
   10 - 4 - 1 ┐ Added pages
   10 - 4 - 2 ┘
   10 - 5

Revised edition mark(①②③···)

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

Revisions

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

Symbols

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

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

3. CONVERSION TABLE

Method of using the Conversion Table

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

Example

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

   Convert 55mm into inches.

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

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

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

2. Convert 550mm into inches.

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

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

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

Millimeters to inches

ⓑ

1mm = 0.03937 in

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

Millimeters to inches

1mm = 0.03937in

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

Kilogram to Pound

1kg = 2.2046lb

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

Liter to U.S. Gallon

1 l = 0.2642 U.S.Gal

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

Liter to U.K. Gallon

1 l = 0.21997 U.K.Gal

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

kgf · m to lbf · ft

1kgf · m = 7.233lbf · ft

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

kgf/cm² to lbf/in²

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

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

TEMPERATURE

Fahrenheit-Centigrade Conversion.

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

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

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

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

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

SECTION 1 GENERAL

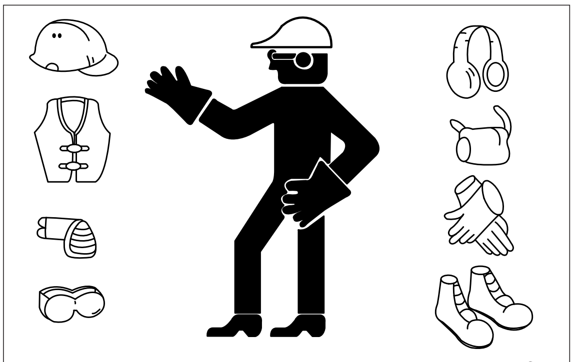
GROUP 1 SAFETY

FOLLOW SAFE PROCEDURE

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

WEAR PROTECTIVE CLOTHING

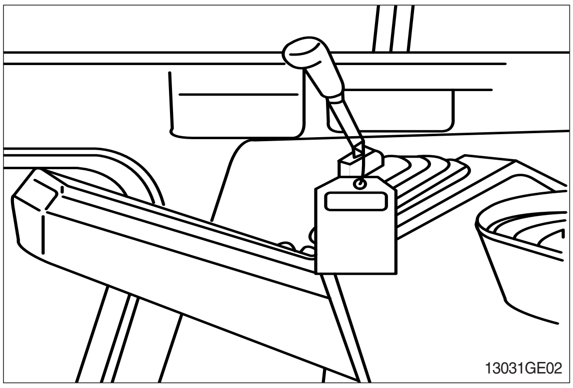
Wear close fitting clothing and safety equipment appropriate to the job.



13031GE01

WARN OTHERS OF SERVICE WORK

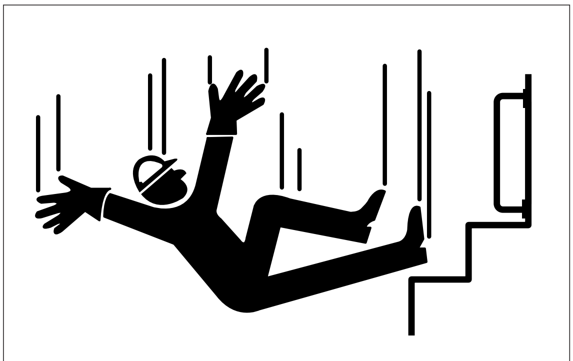
Unexpected machine movement can cause serious injury.
Before performing any work on the excavator, attach a「**Do Not Operate**」tag on the right side control lever.



13031GE02

USE HANDHOLDS AND STEPS

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



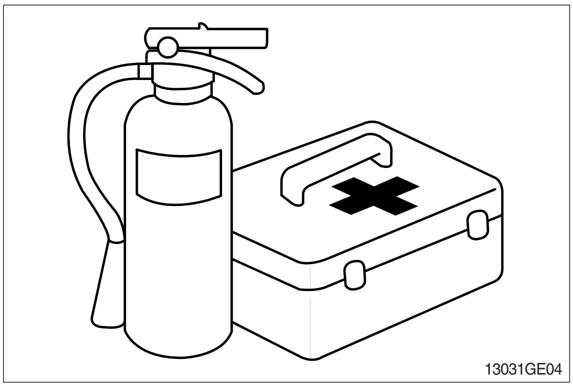
13031GE03

PREPARE FOR EMERGENCIES

Be prepared if a fire starts.

Keep a first aid kit and fire extinguisher handy.

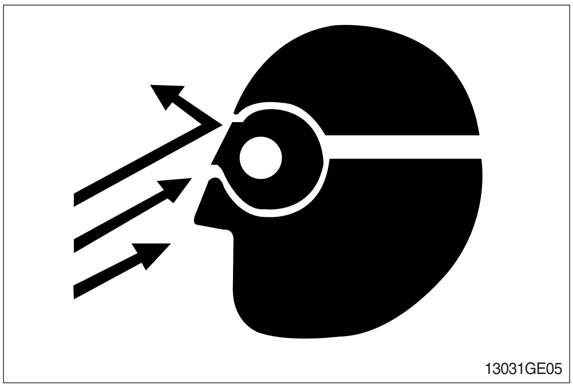
Keep emergency numbers for doctors, ambulance service, hospital, and fire department near your telephone.



13031GE04

PROTECT AGAINST FLYING DEBRIS

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

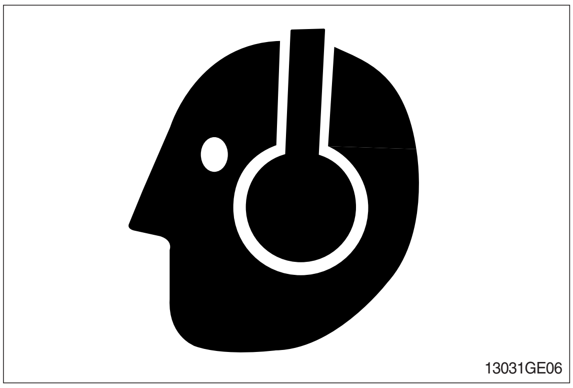


13031GE05

PROTECT AGAINST NOISE

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

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

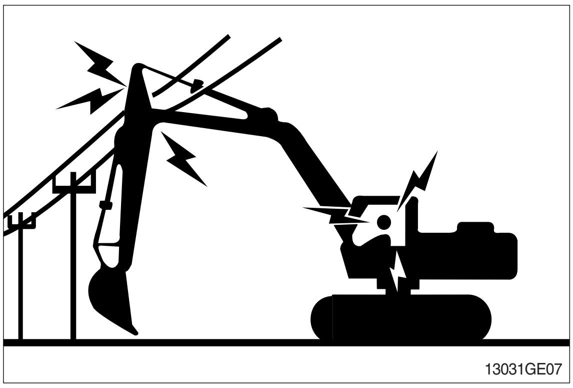


13031GE06

AVOID POWER LINES

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

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

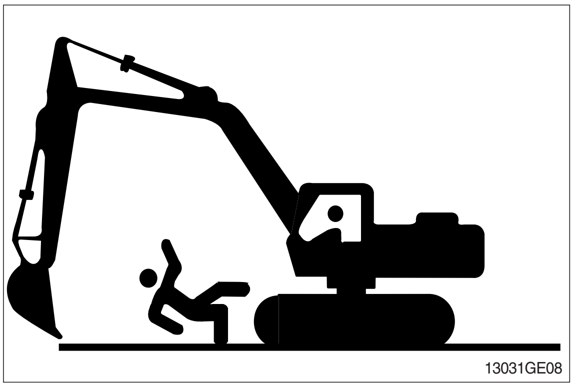


13031GE07

KEEP RIDERS OFF EXCAVATOR

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

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



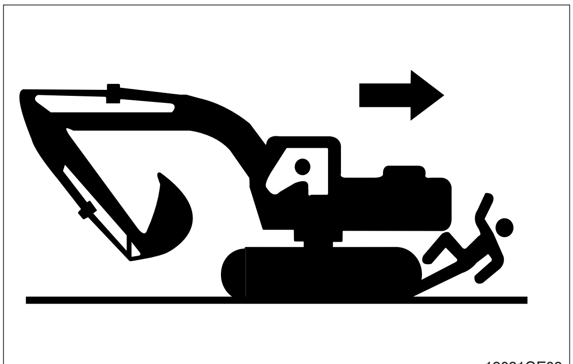
13031GE08

MOVE AND OPERATE MACHINE SAFELY

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

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

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



13031GE09

OPERATE ONLY FORM OPERATOR'S SEAT

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

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

13031GE26

PARK MACHINE SAFELY

Before working on the machine:

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

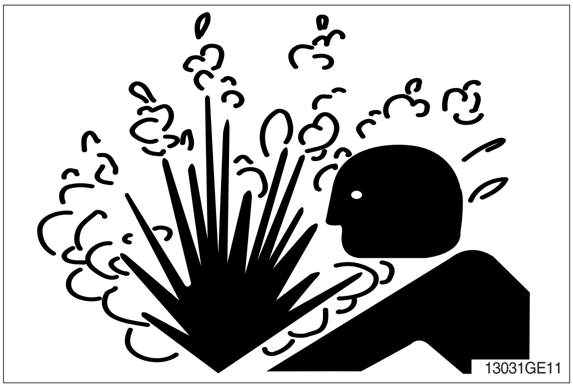
SUPPORT MACHINE PROPERLY

13031GE10

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

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

SERVICE COOLING SYSTEM SAFELY

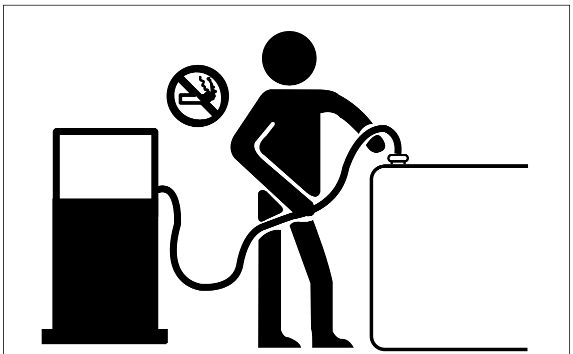


13031GE11

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

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

HANDLE FLUIDS SAFELY-AVOID FIRES



13031GE12

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

13031GE13

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

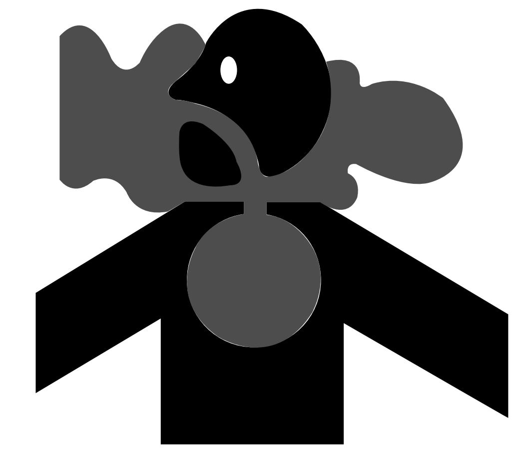
Make sure machine is clean of trash, grease, and debris.

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

BEWARE OF EXHAUST FUMES

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

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



13031GE14

REMOVE PAINT BEFORE WELDING OR HEATING

Avoid potentially toxic fumes and dust.

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

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

Remove paint before welding or heating:

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

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

ILLUMINATE WORK AREA SAFELY

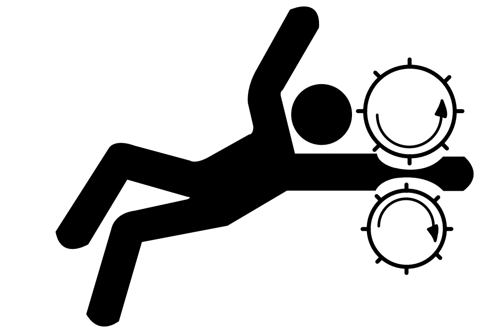
Illuminate your work area adequately but safely. Use a portable safety light for working inside or under the machine. Make sure the bulb is enclosed by a wire cage. The hot filament of an accidentally broken bulb can ignite spilled fuel or oil.

13031GE15

SERVICE MACHINE SAFELY

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

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

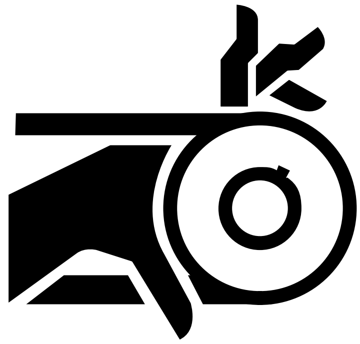


13031GE16

STAY CLEAR OF MOVING PARTS

Entanglements in moving parts can cause serious injury.

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



13031GE17

AVOID HIGH PRESSURE FLUIDS

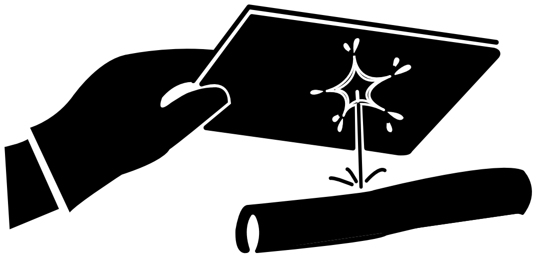
Escaping fluid under pressure can penetrate the skin causing serious injury.

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

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

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

13031GE18



13031GE19

AVOID HEATING NEAR PRESSURIZED FLUID LINES

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

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

13031GE20

PREVENT BATTERY EXPLOSIONS

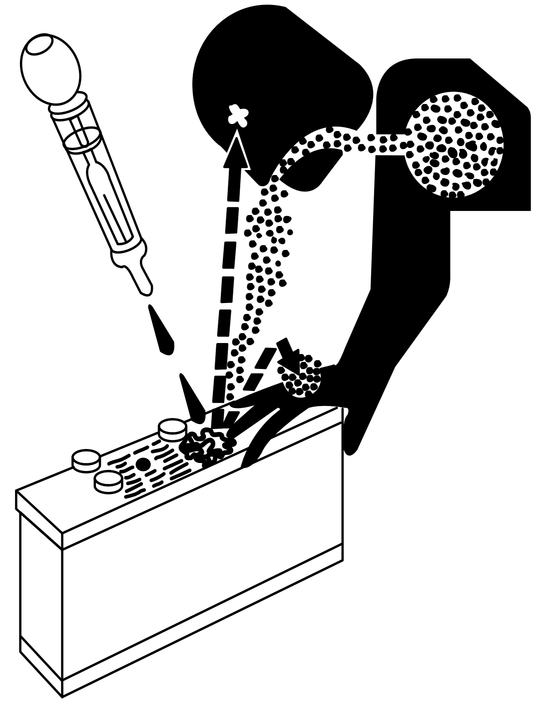
Keep sparks, lighted matches, and flame away from the top of battery. Battery gas can explode.

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

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

13031GE21

PREVENT ACID BURNS


13031GE22

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

Avoid the hazard by:

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

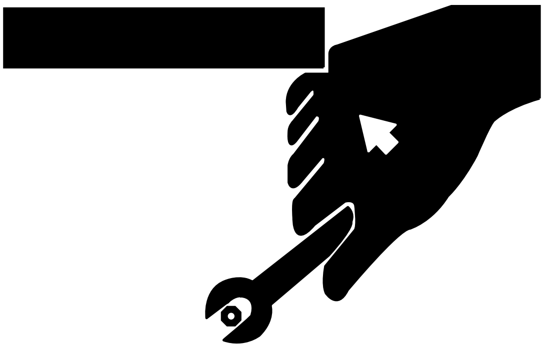
If you spill acid on yourself:

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


13031GE23

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

Use power tools only to loosen threaded tools and fasteners.

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

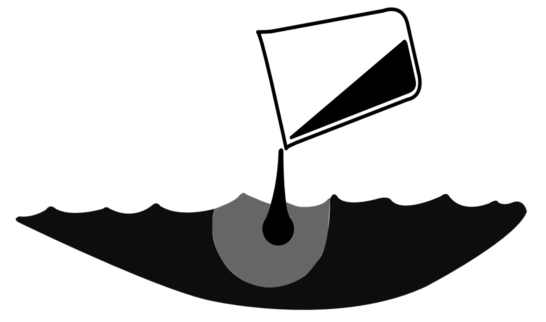
Use only recommended replacement parts. (See Parts catalogue.)

DISPOSE OF FLUIDS PROPERLY

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

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

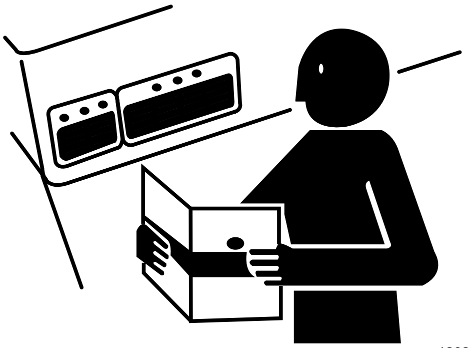
DO NOT pour oil into the ground, down a drain, or into a stream, pond, or lake. Observe relevant environmental protection regulations when disposing of oil, fuel, coolant, brake fluid, filters, batteries, and other harmful waste.



13031GE24

REPLACE SAFETY SIGNS

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



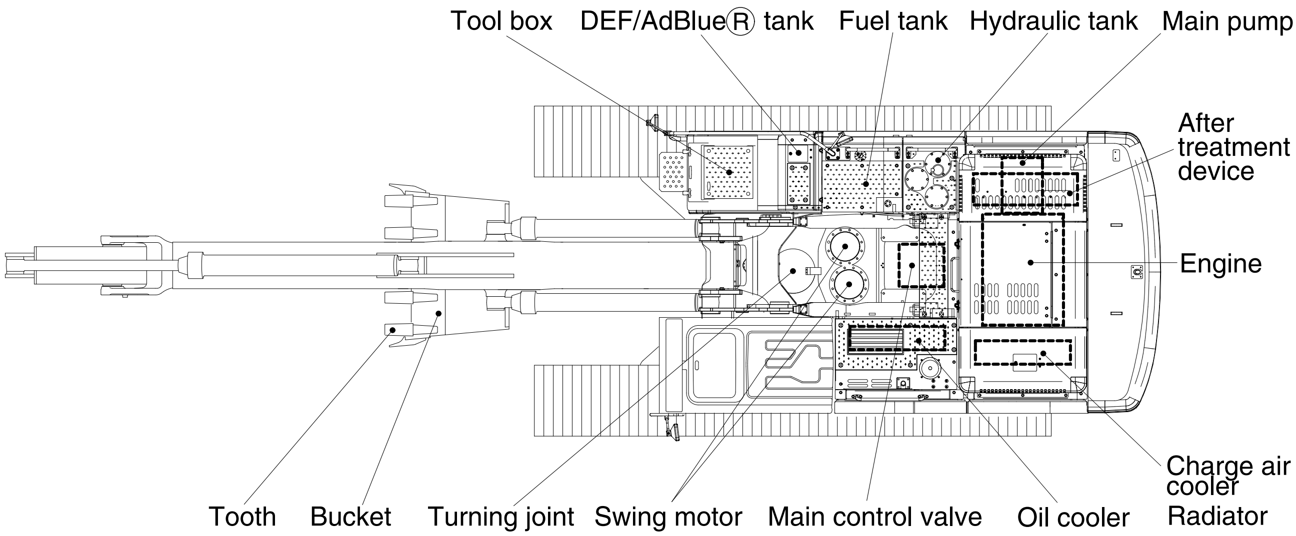
13031GE25

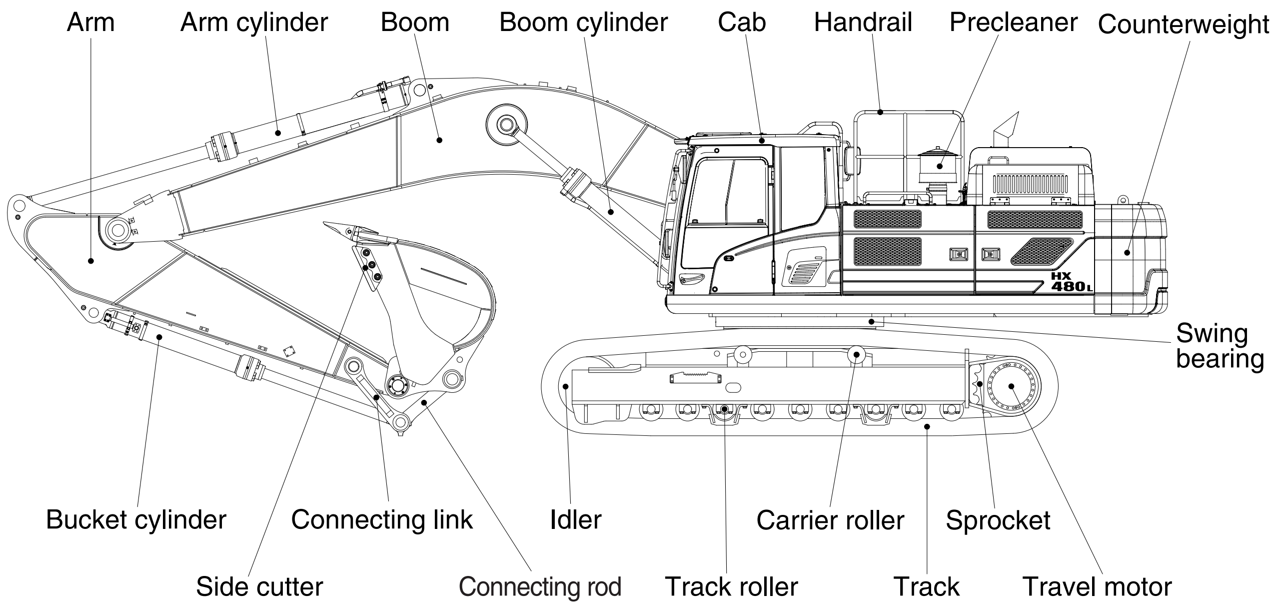
LIVE WITH SAFETY

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

GROUP 2 SPECIFICATIONS

1. MAJOR COMPONENT



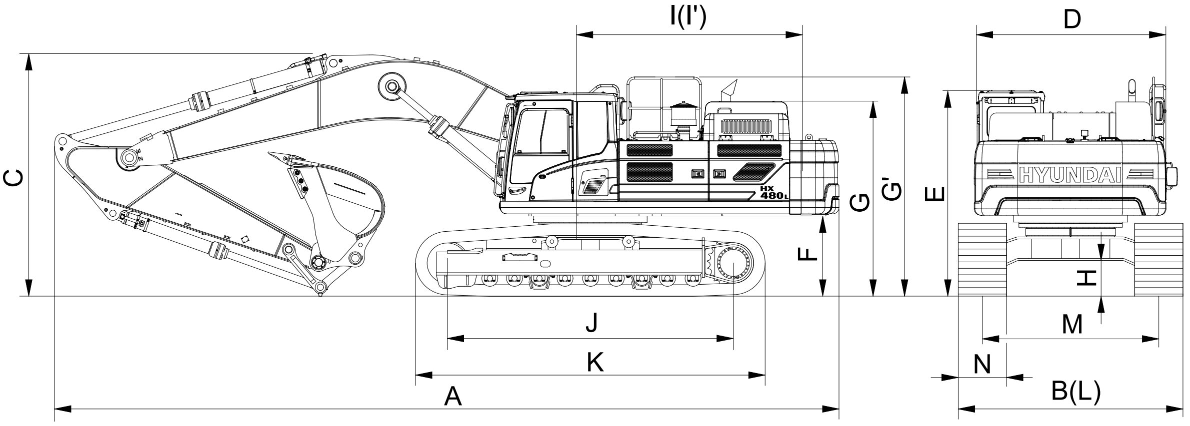


480F2SP01

2. SPECIFICATIONS

1) HX480 L

· 7.06 m (23' 2") BOOM, 3.38 m (11' 1") ARM

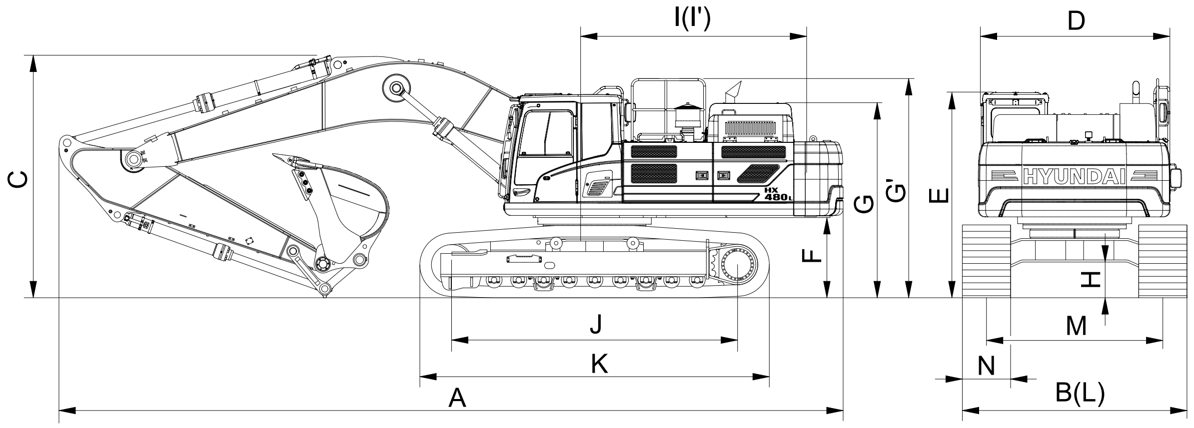


480F2SP02

Description		Unit	Specification
Operating weight		kg (lb)	49500 (109130)
Bucket capacity (SAE heaped), standard		m^3 (yd^3)	2.20 (2.88)
Overall length	A	mm (ft-in)	12260 (40' 3")
Overall width, with 600 mm shoe	B		3340 (10' 11")
Overall height	C		3790 (12' 5")
Superstructure width	D		2980 (9' 9")
Overall height of cab	E		3220 (10' 7")
Ground clearance of counterweight	F		1295 (4' 3")
Engine cover height	G		2890 (9' 6")
Overall height of handrail	G'		3450 (11' 3")
Minimum ground clearance	H		560 (1' 10")
Rear-end distance	I		3885 (12' 9")
Rear-end swing radius	I'		3940 (12' 11")
Distance between tumblers	J		4470 (14' 8")
Undercarriage length	K		5405 (17' 7")
Undercarriage width	L		3340 (10' 11")
Track gauge	M		2740 (9' 0")
Track shoe width, standard	N		600 (24")
Travel speed (low/high)		km/hr (mph)	3.3/5.3 (2.1/3.3)
Swing speed		rpm	8.6
Gradeability		Degree (%)	35 (70)
Ground pressure (600 mm shoe)		kgf/cm^2 (psi)	0.86 (12.23)
Max traction force		kg (lb)	34100 (75180)

2) HX480 L

· 7.06 m (23' 2") BOOM, 2.40 m (7' 10") ARM

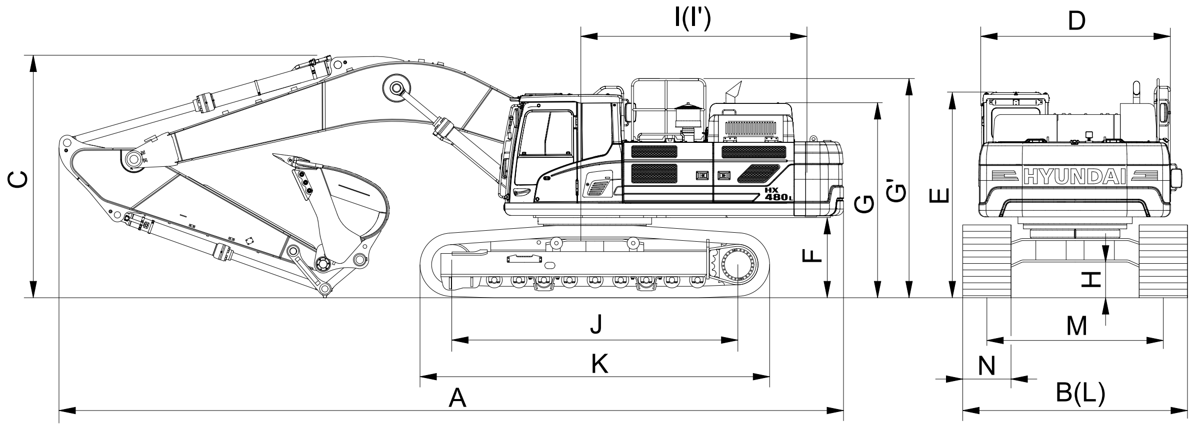


480F2SP02

Description		Unit	Specification
Operating weight		kg (lb)	49260 (108600)
Bucket capacity (SAE heaped), standard		m^3 (yd^3)	2.20 (2.88)
Overall length	A	mm (ft-in)	12510 (41' 1")
Overall width, with 600 mm shoe	B		3340 (10' 11")
Overall height	C		4010 (13' 2")
Superstructure width	D		2980 (9' 9")
Overall height of cab	E		3220 (10' 7")
Ground clearance of counterweight	F		1295 (4' 3")
Engine cover height	G		2890 (9' 6")
Overall height of handrail	G'		3450 (11' 3")
Minimum ground clearance	H		560 (1' 10")
Rear-end distance	I		3885 (12' 9")
Rear-end swing radius	I'		3940 (12' 11")
Distance between tumblers	J		4470 (14' 8")
Undercarriage length	K		5405 (17' 7")
Undercarriage width	L		3340 (10' 11")
Track gauge	M		2740 (9' 0")
Track shoe width, standard	N		600 (24")
Travel speed (low/high)		km/hr (mph)	3.3/5.3 (2.1/3.3)
Swing speed		rpm	8.6
Gradeability		Degree (%)	35 (70)
Ground pressure (600 mm shoe)		kgf/cm^2 (psi)	0.86 (12.23)
Max traction force		kg (lb)	34100 (75180)

3) HX480 L

· 7.06 m (23' 2") BOOM, 2.90 m (9' 6") ARM

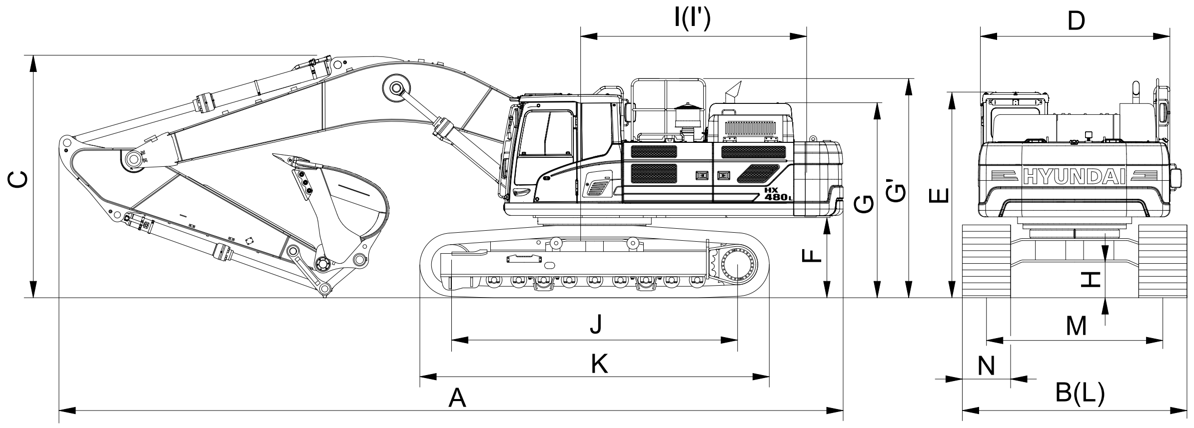


480F2SP02

Description		Unit	Specification
Operating weight		kg (lb)	49460 (109040)
Bucket capacity (SAE heaped), standard		m^3 (yd^3)	2.20 (2.88)
Overall length	A	mm (ft-in)	12390 (40' 8")
Overall width, with 600 mm shoe	B		3340 (10' 11")
Overall height	C		3900 (12' 10")
Superstructure width	D		2980 (9' 9")
Overall height of cab	E		3220 (10' 7")
Ground clearance of counterweight	F		1295 (4' 3")
Engine cover height	G		2890 (9' 6")
Overall height of handrail	G'		3450 (11' 3")
Minimum ground clearance	H		560 (1' 10")
Rear-end distance	I		3885 (12' 9")
Rear-end swing radius	I'		3940 (12' 11")
Distance between tumblers	J		4470 (14' 8")
Undercarriage length	K		5405 (17' 7")
Undercarriage width	L		3340 (10' 11")
Track gauge	M		2740 (9' 0")
Track shoe width, standard	N		600 (24")
Travel speed (low/high)		km/hr (mph)	3.3/5.3 (2.1/3.3)
Swing speed		rpm	8.6
Gradeability		Degree (%)	35 (70)
Ground pressure (600 mm shoe)		kgf/cm^2 (psi)	0.86 (12.23)
Max traction force		kg (lb)	34100 (75180)

4) HX480 L

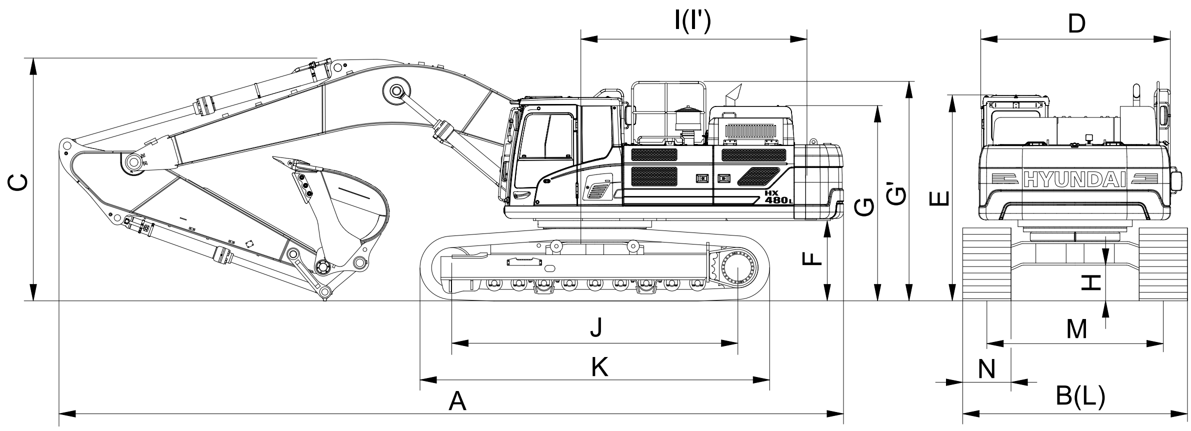
· 7.06 m (23' 2") BOOM, 4.00 m (13' 1") ARM



Description		Unit	Specification
Operating weight		kg (lb)	49600 (109350)
Bucket capacity (SAE heaped), standard		m^3 (yd^3)	2.20 (2.88)
Overall length	A	mm (ft-in)	12230 (40' 1")
Overall width, with 600 mm shoe	B		3340 (10' 11")
Overall height	C		4110 (13' 6")
Superstructure width	D		2980 (9' 9")
Overall height of cab	E		3220 (10' 7")
Ground clearance of counterweight	F		1295 (4' 3")
Engine cover height	G		2890 (9' 6")
Overall height of handrail	G'		3450 (11' 3")
Minimum ground clearance	H		560 (1' 10")
Rear-end distance	I		3885 (12' 9")
Rear-end swing radius	I'		3940 (12' 11")
Distance between tumblers	J		4470 (14' 8")
Undercarriage length	K		5405 (17' 7")
Undercarriage width	L		3340 (10' 11")
Track gauge	M		2740 (9' 0")
Track shoe width, standard	N		600 (24")
Travel speed (low/high)		km/hr (mph)	3.3/5.3 (2.1/3.3)
Swing speed		rpm	8.6
Gradeability		Degree (%)	35 (70)
Ground pressure (600 mm shoe)		kgf/cm^2 (psi)	0.86 (12.23)
Max traction force		kg (lb)	34100 (75180)

5) HX480 L

· 6.55 m (21' 6") BOOM, 2.40 m (7' 10") ARM

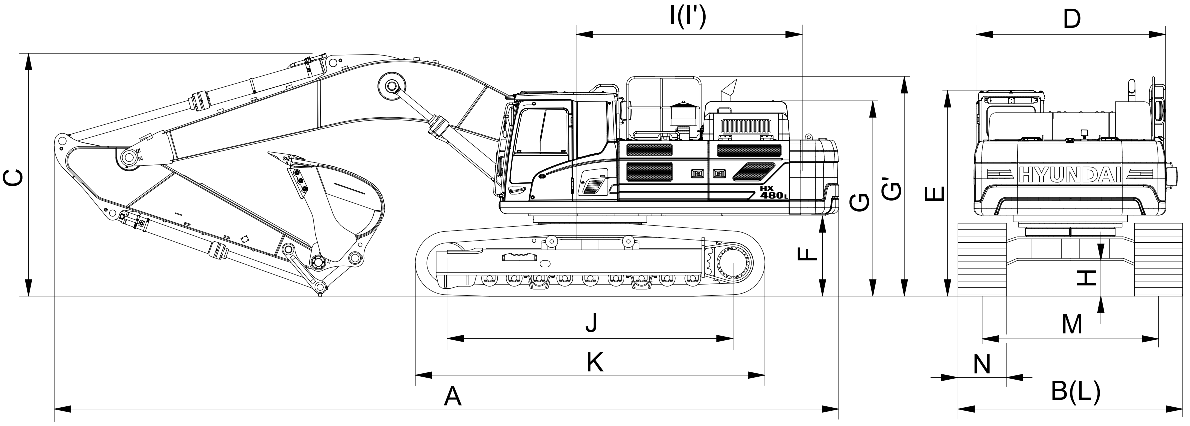


480F2SP02

Description		Unit	Specification
Operating weight		kg (lb)	49220 (108510)
Bucket capacity (SAE heaped), standard		m^3 (yd^3)	2.20 (2.88)
Overall length	A	mm (ft-in)	11990 (39' 4")
Overall width, with 600 mm shoe	B		3340 (10' 11")
Overall height	C		4130 (13' 7")
Superstructure width	D		2980 (9' 9")
Overall height of cab	E		3220 (10' 7")
Ground clearance of counterweight	F		1295 (4' 3")
Engine cover height	G		2890 (9' 6")
Overall height of handrail	G'		3450 (11' 3")
Minimum ground clearance	H		560 (1' 10")
Rear-end distance	I		3885 (12' 9")
Rear-end swing radius	I'		3940 (12' 11")
Distance between tumblers	J		4470 (14' 8")
Undercarriage length	K		5405 (17' 7")
Undercarriage width	L		3340 (10' 11")
Track gauge	M		2740 (9' 0")
Track shoe width, standard	N		600 (24")
Travel speed (low/high)		km/hr (mph)	3.3/5.3 (2.1/3.3)
Swing speed		rpm	8.6
Gradeability		Degree (%)	35 (70)
Ground pressure (600 mm shoe)		kgf/cm^2 (psi)	0.86 (12.23)
Max traction force		kg (lb)	34100 (75180)

6) HX480 L

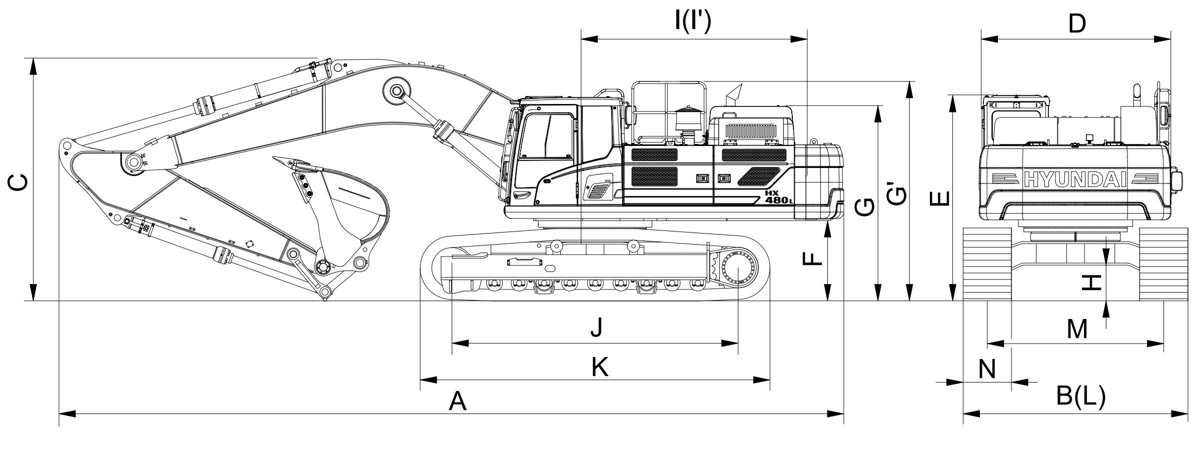
· 6.55 m (21' 6") BOOM, 2.90 m (9' 6") ARM



Description		Unit	Specification
Operating weight		kg (lb)	49420 (108950)
Bucket capacity (SAE heaped), standard		m^3 (yd^3)	2.20 (2.88)
Overall length	A	mm (ft-in)	11870 (38' 11")
Overall width, with 600 mm shoe	B		3340 (10' 11")
Overall height	C		4050 (13' 3")
Superstructure width	D		2980 (9' 9")
Overall height of cab	E		3220 (10' 7")
Ground clearance of counterweight	F		1295 (4' 3")
Engine cover height	G		2890 (9' 6")
Overall height of handrail	G'		3450 (11' 3")
Minimum ground clearance	H		560 (1' 10")
Rear-end distance	I		3885 (12' 9")
Rear-end swing radius	I'		3940 (12' 11")
Distance between tumblers	J		4470 (14' 8")
Undercarriage length	K		5405 (17' 7")
Undercarriage width	L		3340 (10' 11")
Track gauge	M		2740 (9' 0")
Track shoe width, standard	N		600 (24")
Travel speed (low/high)		km/hr (mph)	3.3/5.3 (2.1/3.3)
Swing speed		rpm	8.6
Gradeability		Degree (%)	35 (70)
Ground pressure (600 mm shoe)		kgf/cm^2 (psi)	0.86 (12.23)
Max traction force		kg (lb)	34100 (75180)

7) HX480 L

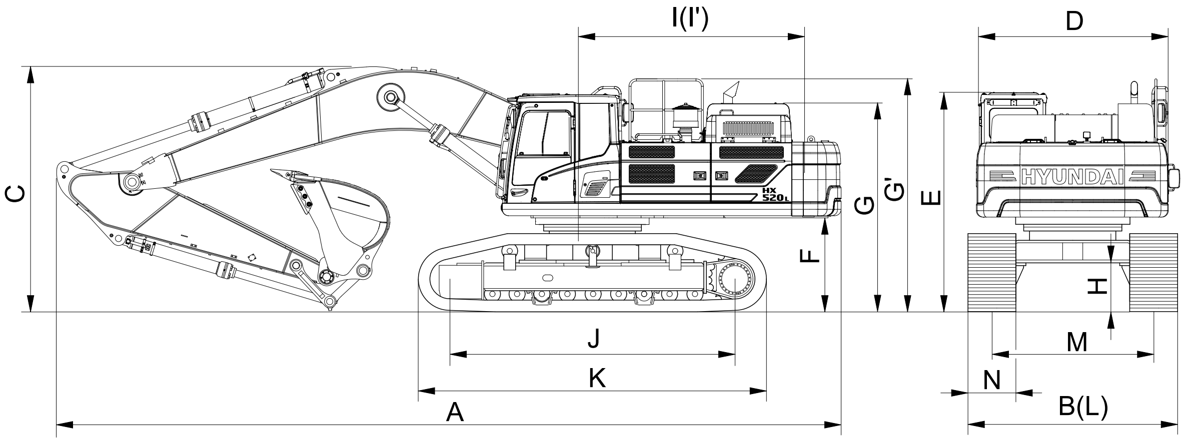
· 9.00 m (29' 6") BOOM, 6.00 m (19' 8") ARM



Description		Unit	Specification
Operating weight		kg (lb)	50550 (111440)
Bucket capacity (SAE heaped), standard		m^3 (yd^3)	1.38 (1.80)
Overall length	A	mm (ft-in)	14230 (46' 8")
Overall width, with 600 mm shoe	B		3640 (11' 11")
Overall height	C		3990 (13' 1")
Superstructure width	D		2980 (9' 9")
Overall height of cab	E		3220 (10' 7")
Ground clearance of counterweight	F		1295 (4' 3")
Engine cover height	G		2890 (9' 6")
Overall height of handrail	G'		3450 (11' 3")
Minimum ground clearance	H		560 (1' 10")
Rear-end distance	I		3885 (12' 9")
Rear-end swing radius	I'		3940 (12' 11")
Distance between tumblers	J		4470 (14' 8")
Undercarriage length	K		5405 (17' 7")
Undercarriage width	L		3340 (10' 11")
Track gauge	M		2740 (9' 0")
Track shoe width, standard	N		600 (24")
Travel speed (low/high)		km/hr (mph)	3.3/5.3 (2.1/3.3)
Swing speed		rpm	8.6
Gradeability		Degree (%)	35 (70)
Ground pressure (600 mm shoe)		kgf/cm^2 (psi)	0.86 (12.23)
Max traction force		kg (lb)	34100 (75180)

8) HX520 L

· 7.06 m (23' 2") BOOM, 3.38 m (11' 1") ARM

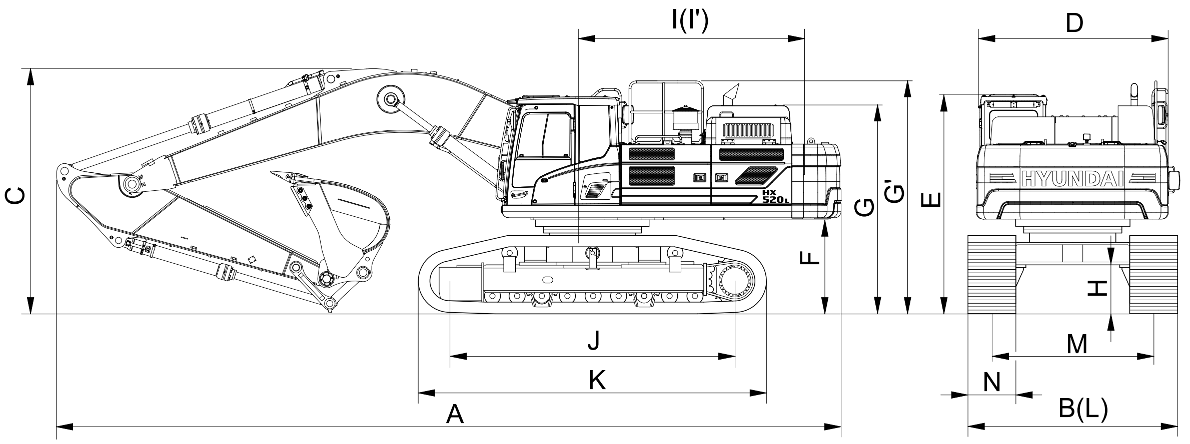


480F2SP03

Description		Unit	Specification
Operating weight		kg (lb)	52400 (115520)
Bucket capacity (SAE heaped), standard		m^3 (yd^3)	2.20 (2.88)
Overall length	A		12260 (40' 3")
Overall width, with 600 mm shoe (transport position / working position)	B		2980/3540 (9' 10"/11' 7")
Overall height	C		3790 (12' 5")
Superstructure width	D		2980 (9' 9")
Overall height of cab	E		3340 (10' 11")
Ground clearance of counterweight	F		1445 (4' 9")
Engine cover height	G		3030 (9' 11")
Overall height of handrail	G'		3595 (11' 8")
Minimum ground clearance	H	mm (ft-in)	770 (2' 6")
Rear-end distance	I		3885 (12' 9")
Rear-end swing radius	I'		3940 (12' 11")
Distance between tumblers	J		4470 (14' 8")
Undercarriage length	K		5405 (17' 7")
Undercarriage width (transport position / working position)	L		2990/3540 (9' 10"/11' 7")
Track gauge (transport position / working position)	M		2380/2940 (7' 10"/9' 8")
Track shoe width, standard	N		600 (24")
Travel speed (low/high)		km/hr (mph)	3.3/5.3 (2.1/3.3)
Swing speed		rpm	8.6
Gradeability		Degree (%)	35 (70)
Ground pressure (600 mm shoe)		kgf/cm^2 (psi)	0.91 (12.94)
Max traction force		kg (lb)	34100 (75180)

9) HX520 L

· 7.06 m (23' 2") BOOM, 2.40 m (7' 10") ARM

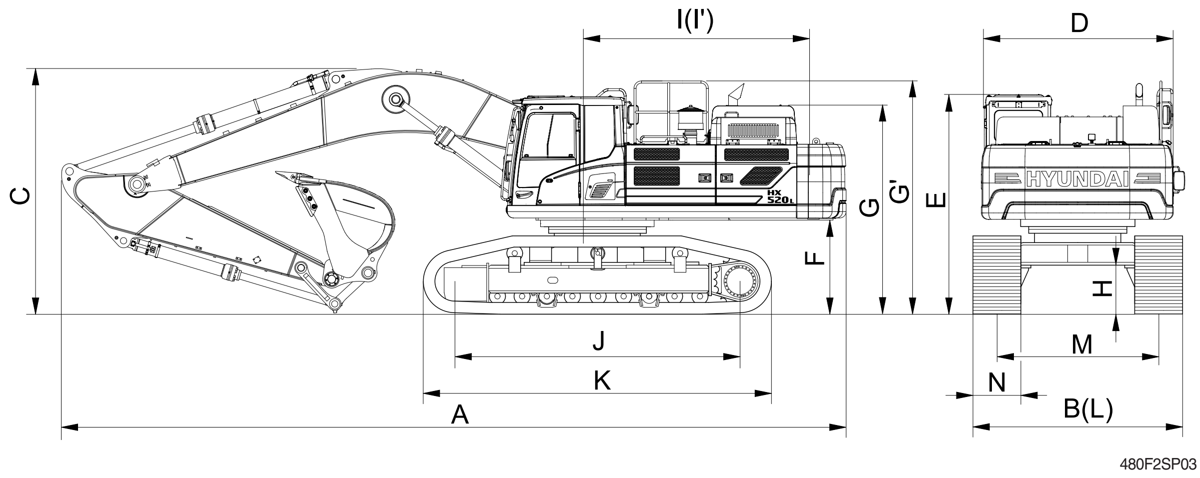


480F2SP03

Description		Unit	Specification
Operating weight		kg (lb)	52160 (114990)
Bucket capacity (SAE heaped), standard		m^3 (yd^3)	2.20 (2.88)
Overall length	A	mm (ft-in)	12510 (41' 1")
Overall width, with 600 mm shoe (transport position / working position)	B		2980/3540 (9' 10"/11' 7")
Overall height	C		4070 (13' 4")
Superstructure width	D		2980 (9' 9")
Overall height of cab	E		3340 (10' 11")
Ground clearance of counterweight	F		1445 (4' 9")
Engine cover height	G		3030 (9' 11")
Overall height of handrail	G'		3595 (11' 8")
Minimum ground clearance	H		770 (2' 6")
Rear-end distance	I		3885 (12' 9")
Rear-end swing radius	I'		3940 (12' 11")
Distance between tumblers	J		4470 (14' 8")
Undercarriage length	K		5405 (17' 7")
Undercarriage width (transport position / working position)	L		2990/3540 (9' 10"/11' 7")
Track gauge (transport position / working position)	M		2380/2940 (7' 10"/9' 8")
Track shoe width, standard	N		600 (24")
Travel speed (low/high)		km/hr (mph)	3.3/5.3 (2.1/3.3)
Swing speed		rpm	8.6
Gradeability		Degree (%)	35 (70)
Ground pressure (600 mm shoe)		kgf/cm^2 (psi)	0.91 (12.94)
Max traction force		kg (lb)	34100 (75180)

10) HX520 L

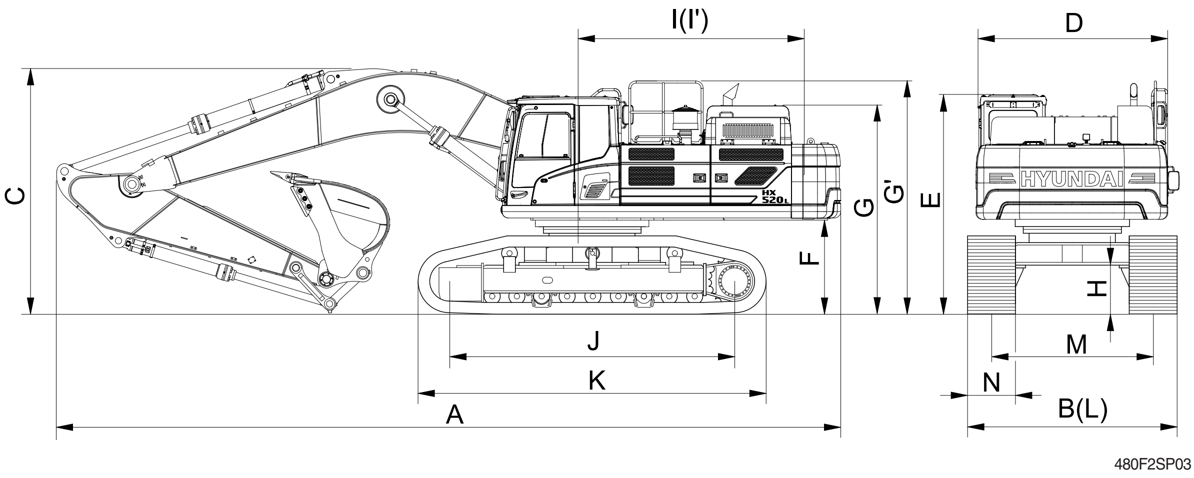
· 7.06 m (23' 2") BOOM, 2.90 m (9' 6") ARM



Description		Unit	Specification
Operating weight		kg (lb)	52360 (115430)
Bucket capacity (SAE heaped), standard		m^3 (yd^3)	2.20 (2.88)
Overall length	A	mm (ft-in)	12380 (40' 7")
Overall width, with 600 mm shoe (transport position / working position)	B		2980/3540 (9' 10"/11' 7")
Overall height	C		3920 (12' 10")
Superstructure width	D		2980 (9' 9")
Overall height of cab	E		3340 (10' 11")
Ground clearance of counterweight	F		1445 (4' 9")
Engine cover height	G		3030 (9' 11")
Overall height of handrail	G'		3595 (11' 8")
Minimum ground clearance	H		770 (2' 6")
Rear-end distance	I		3885 (12' 9")
Rear-end swing radius	I'		3940 (12' 11")
Distance between tumblers	J		4470 (14' 8")
Undercarriage length	K		5405 (17' 7")
Undercarriage width (transport position / working position)	L		2990/3540 (9' 10"/11' 7")
Track gauge (transport position / working position)	M		2380/2940 (7' 10"/9' 8")
Track shoe width, standard	N		600 (24")
Travel speed (low/high)		km/hr (mph)	3.3/5.3 (2.1/3.3)
Swing speed		rpm	8.6
Gradeability		Degree (%)	35 (70)
Ground pressure (600 mm shoe)		kgf/cm^2 (psi)	0.91 (12.94)
Max traction force		kg (lb)	34100 (75180)

11) HX520 L

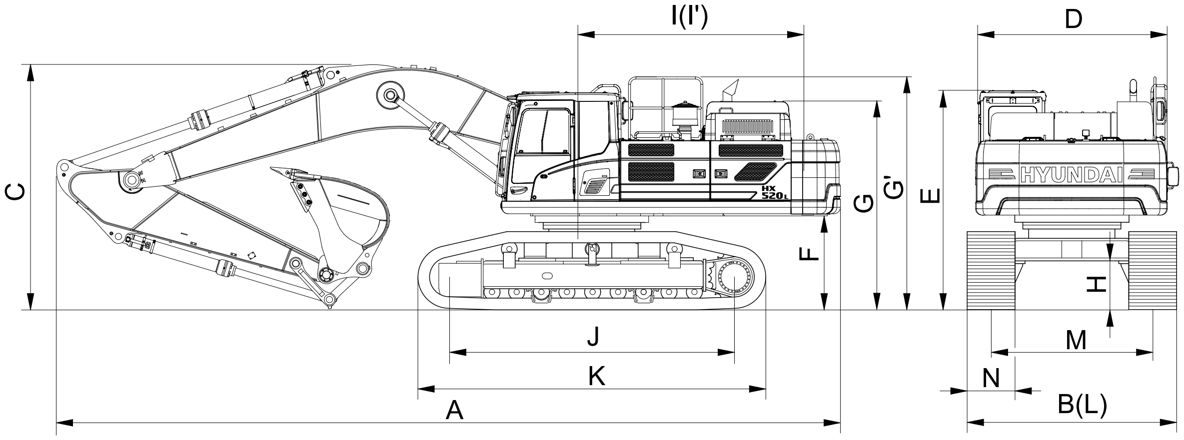
· 7.06 m (23' 2") BOOM, 4.00 m (13' 1") ARM



Description		Unit	Specification
Operating weight		kg (lb)	52500 (115740)
Bucket capacity (SAE heaped), standard		m^3 (yd^3)	2.20 (2.88)
Overall length	A	mm (ft-in)	12250 (40' 2")
Overall width, with 600 mm shoe (transport position / working position)	B		2980/3540 (9' 10"/11' 7")
Overall height	C		4090 (13' 5")
Superstructure width	D		2980 (9' 9")
Overall height of cab	E		3340 (10' 11")
Ground clearance of counterweight	F		1445 (4' 9")
Engine cover height	G		3030 (9' 11")
Overall height of handrail	G'		3595 (11' 8")
Minimum ground clearance	H		770 (2' 6")
Rear-end distance	I		3885 (12' 9")
Rear-end swing radius	I'		3940 (12' 11")
Distance between tumblers	J		4470 (14' 8")
Undercarriage length	K		5405 (17' 7")
Undercarriage width (transport position / working position)	L		2990/3540 (9' 10"/11' 7")
Track gauge (transport position / working position)	M		2380/2940 (7' 10"/9' 8")
Track shoe width, standard	N		600 (24")
Travel speed (low/high)		km/hr (mph)	3.3/5.3 (2.1/3.3)
Swing speed		rpm	8.6
Gradeability		Degree (%)	35 (70)
Ground pressure (600 mm shoe)		kgf/cm^2 (psi)	0.91 (12.94)
Max traction force		kg (lb)	34100 (75180)

12) HX520 L

· 6.55 m (21' 6") BOOM, 2.40 m (7' 10") ARM

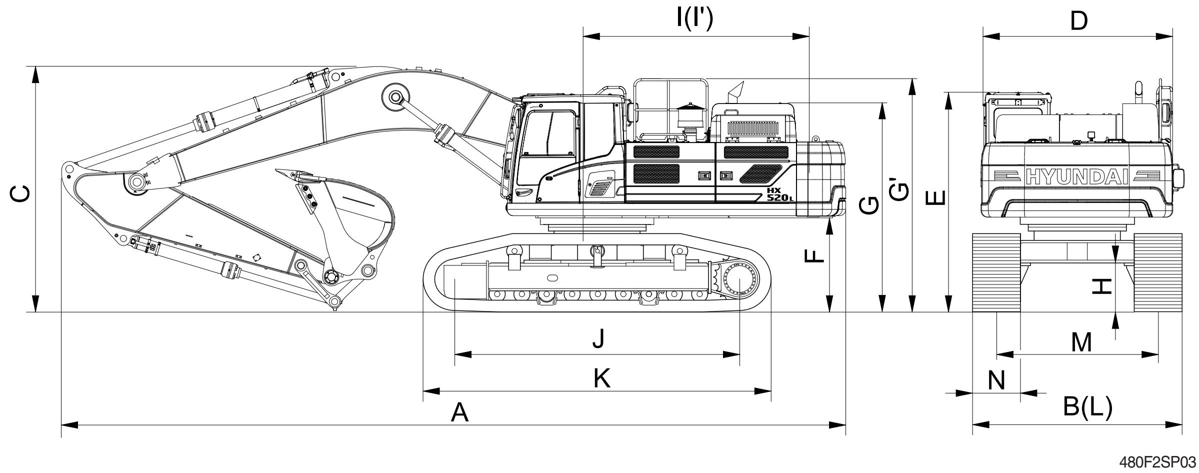


480F2SP03

Description		Unit	Specification
Operating weight		kg (lb)	52120 (114900)
Bucket capacity (SAE heaped), standard		m^3 (yd^3)	2.20 (2.88)
Overall length	A		12000 (39' 4")
Overall width, with 600 mm shoe (transport position / working position)	B		2980/3540 (9' 10"/11' 7")
Overall height	C		4190 (13' 9")
Superstructure width	D		2980 (9' 9")
Overall height of cab	E		3340 (10' 11")
Ground clearance of counterweight	F		1445 (4' 9")
Engine cover height	G		3030 (9' 11")
Overall height of handrail	G'		3595 (11' 8")
Minimum ground clearance	H	mm (ft-in)	770 (2' 6")
Rear-end distance	I		3885 (12' 9")
Rear-end swing radius	I'		3940 (12' 11")
Distance between tumblers	J		4470 (14' 8")
Undercarriage length	K		5405 (17' 7")
Undercarriage width (transport position / working position)	L		2990/3540 (9' 10"/11' 7")
Track gauge (transport position / working position)	M		2380/2940 (7' 10"/9' 8")
Track shoe width, standard	N		600 (24")
Travel speed (low/high)		km/hr (mph)	3.3/5.3 (2.1/3.3)
Swing speed		rpm	8.6
Gradeability		Degree (%)	35 (70)
Ground pressure (600 mm shoe)		kgf/cm^2 (psi)	0.91 (12.94)
Max traction force		kg (lb)	34100 (75180)

13) HX520 L

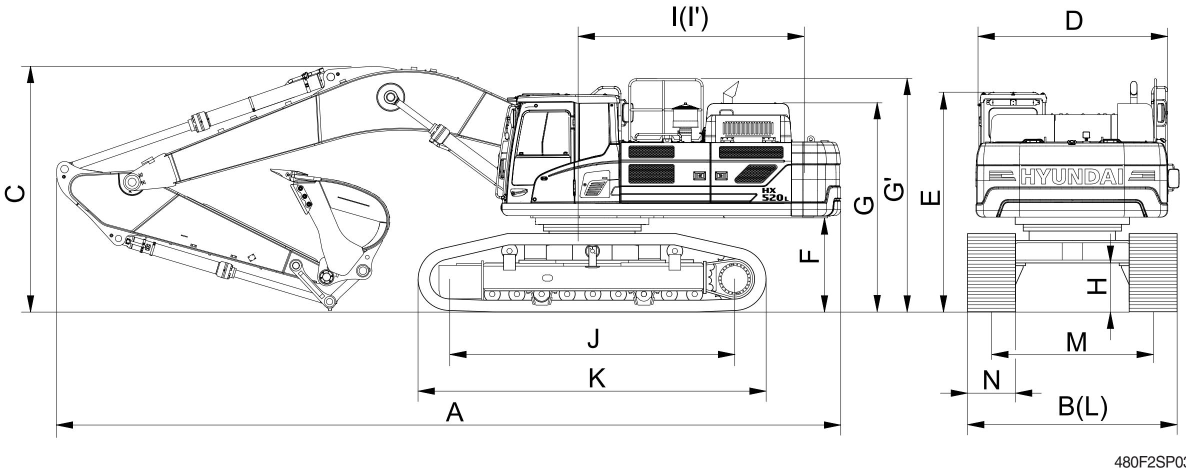
· 6.55 m (21' 6") BOOM, 2.90 m (9' 6") ARM



Description		Unit	Specification
Operating weight		kg (lb)	52320 (115350)
Bucket capacity (SAE heaped), standard		m^3 (yd^3)	2.20 (2.88)
Overall length	A	mm (ft-in)	11870 (38' 11")
Overall width, with 600 mm shoe (transport position / working position)	B		2980/3540 (9' 10"/11' 7")
Overall height	C		4080 (13' 5")
Superstructure width	D		2980 (9' 9")
Overall height of cab	E		3340 (10' 11")
Ground clearance of counterweight	F		1445 (4' 9")
Engine cover height	G		3030 (9' 11")
Overall height of handrail	G'		3595 (11' 8")
Minimum ground clearance	H		770 (2' 6")
Rear-end distance	I		3885 (12' 9")
Rear-end swing radius	I'		3940 (12' 11")
Distance between tumblers	J		4470 (14' 8")
Undercarriage length	K		5405 (17' 7")
Undercarriage width (transport position / working position)	L		2990/3540 (9' 10"/11' 7")
Track gauge (transport position / working position)	M		2380/2940 (7' 10"/9' 8")
Track shoe width, standard	N		600 (24")
Travel speed (low/high)		km/hr (mph)	3.3/5.3 (2.1/3.3)
Swing speed		rpm	8.6
Gradeability		Degree (%)	35 (70)
Ground pressure (600 mm shoe)		kgf/cm^2 (psi)	0.91 (12.94)
Max traction force		kg (lb)	34100 (75180)

14) HX520 L

· 9.00 m (29' 6") BOOM, 6.00 m (19' 8") ARM

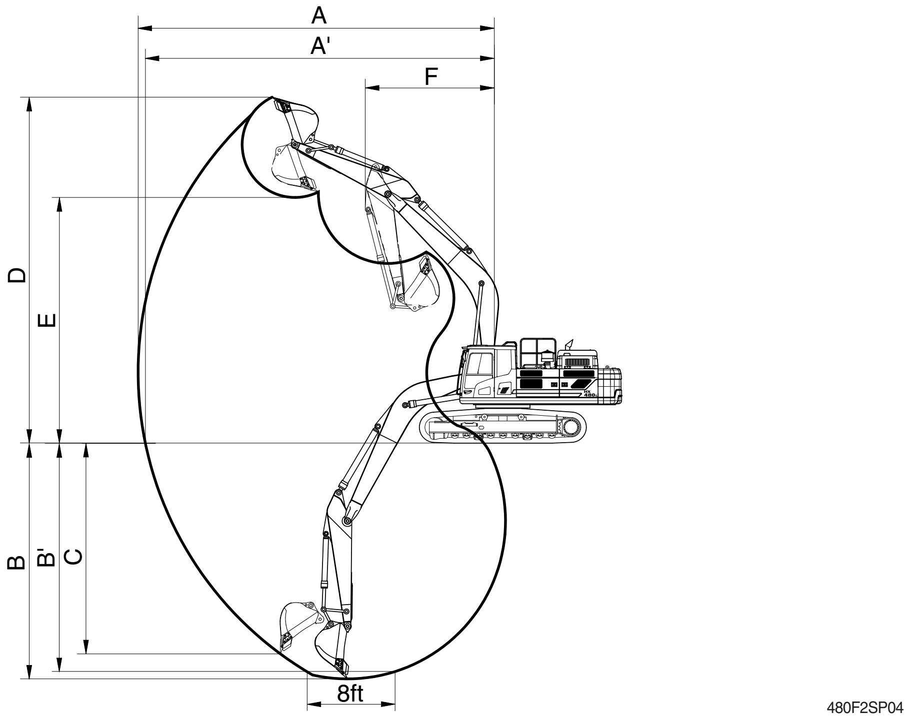


Description		Unit	Specification
Operating weight		kg (lb)	53410 (117750)
Bucket capacity (SAE heaped), standard		m^3 (yd^3)	1.38 (1.80)
Overall length	A	mm (ft-in)	14200 (46' 7")
Overall width, with 600 mm shoe (transport position / working position)	B		2980/3540 (9' 9"/11' 7")
Overall height	C		3960 (13' 0")
Superstructure width	D		2980 (9' 9")
Overall height of cab	E		3390 (11' 2")
Ground clearance of counterweight	F		1445 (4' 9")
Engine cover height	G		2980 (9' 9")
Overall height of handrail	G'		3595 (11' 8")
Minimum ground clearance	H		770 (2' 6")
Rear-end distance	I		3885 (12' 9")
Rear-end swing radius	I'		3940 (12' 11")
Distance between tumblers	J		4470 (14' 8")
Undercarriage length	K		5405 (17' 7")
Undercarriage width (transport position / working position)	L		2980/3540 (9' 9"/11' 7")
Track gauge (transport position / working position)	M		2380/2940 (7' 10"/9' 8")
Track shoe width, standard	N		600 (24")
Travel speed (low/high)		km/hr (mph)	3.3/5.3 (2.1/3.3)
Swing speed		rpm	8.6
Gradeability		Degree (%)	35 (70)
Ground pressure (600 mm shoe)		kgf/cm^2 (psi)	0.91 (12.94)
Max traction force		kg (lb)	34100 (75180)

3. WORKING RANGE

1) HX480 L

· 7.06 m (23' 2") BOOM

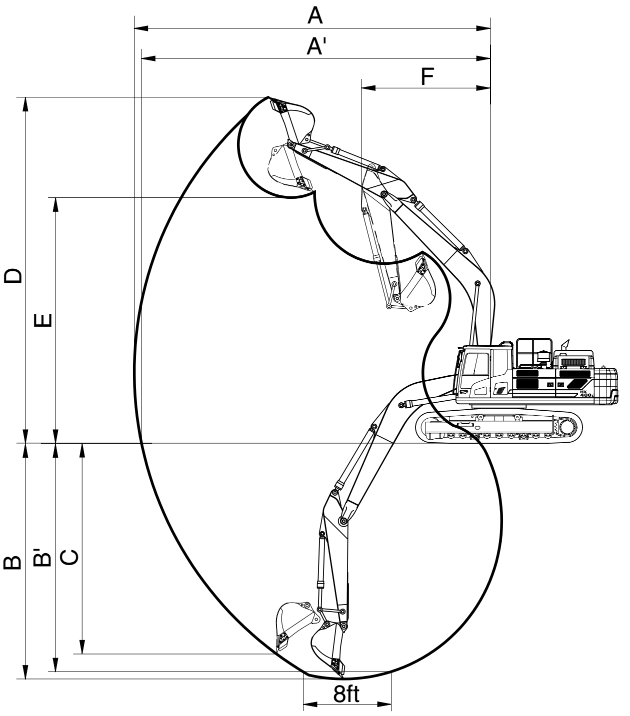


Description		2.40 m (7' 10") Arm	2.90 m (9' 6") Arm	3.38 m (11' 1") Arm	4.00 m (13' 1") Arm
Max digging reach	A	11200 mm (36' 9")	11620 mm (38' 1")	12040 mm (39' 6")	12600 mm (41' 4")
Max digging reach on ground	A'	10980 mm (36' 0")	11410 mm (37' 5")	11840 mm (38'10")	12410 mm (40' 9")
Max digging depth	B	6780 mm (22' 3")	7280 mm (23'11")	7760 mm (25' 6")	8380 mm (27' 6")
Max digging depth (8ft level)	B'	6600 mm (21' 8")	7120 mm (23' 4")	7620 mm (25' 0")	8250 mm (27' 1")
Max vertical wall digging depth	C	4790 mm (15' 9")	5800 mm (19' 0")	5920 mm (19' 5")	6470 mm (21' 3")
Max digging height	D	10600 mm (34' 9")	10830 mm (35' 6")	10910 mm (35'10")	11130 mm (36' 6")
Max dumping height	E	7260 mm (23'10")	7390 mm (24' 3")	7540 mm (24' 9")	7760 mm (25' 6")
Min swing radius	F	5160 mm (16'11")	4890 mm (16' 1")	4850 mm (15'11")	4710 mm (15' 5")
Bucket digging force	SAE	220.7 [240.8] kN	220.7 [240.8] kN	220.7 [240.8] kN	220.7 [240.8] kN
		22500 [24550] kgf	22500 [24550] kgf	22500 [24550] kgf	22500 [24550] kgf
		49600 [54120] lbf	49600 [54120] lbf	49600 [54120] lbf	49600 [54120] lbf
	ISO	255.0 [278.1] kN	255.0 [278.1] kN	255.0 [278.1] kN	255.0 [278.1] kN
		26000 [28360] kgf	26000 [28360] kgf	26000 [28360] kgf	26000 [28360] kgf
		57320 [62520] lbf	57320 [62520] lbf	57320 [62520] lbf	57320 [62520] lbf
Arm crowd force	SAE	276.6 [301.7] kN	224.6 [245.0] kN	191.2 [208.6] kN	170.6 [186.1] kN
		28200 [30760] kgf	22900 [24980] kgf	19500 [21270] kgf	17400 [18980] kgf
		62170 [67810] lbf	50490 [55070] lbf	42990 [46890] lbf	38360 [41840] lbf
	ISO	290.3 [316.7] kN	234.4 [255.7] kN	199.1 [217.2] kN	176.5 [192.6] kN
		29600 [32290] kgf	23900 [26070] kgf	20300 [22150] kgf	18000 [19640] kgf
		65260 [71190] lbf	52690 [57470] lbf	44750 [48830] lbf	39680 [43300] lbf

[ ] : Power boost

2) HX480 L

· 6.55 m (21' 6") BOOM

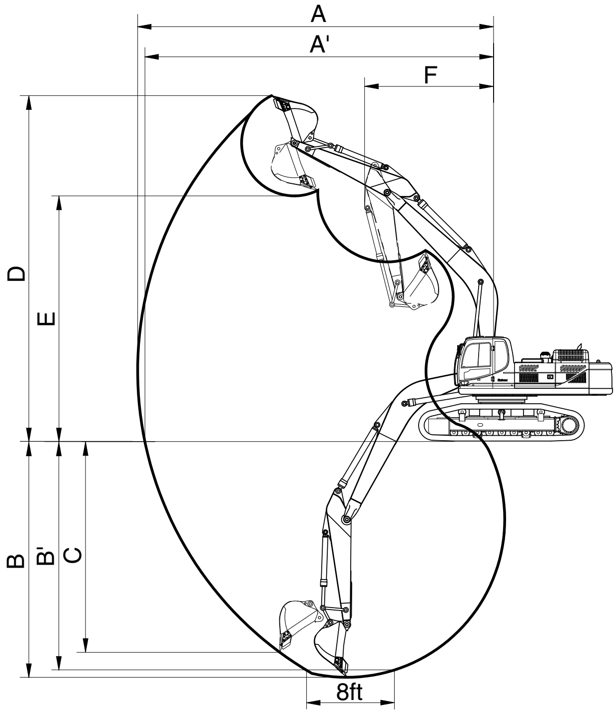


Description		2.40 m (7' 10") Arm	2.90 m (9' 6") Arm
Max digging reach	A	10690 mm (35' 1")	11130 mm (36' 6")
Max digging reach on ground	A'	10470 mm (34' 4")	10910 mm (35'10")
Max digging depth	B	6390 mm (21' 0")	6890 mm (22' 7")
Max digging depth (8ft level)	B'	6210 mm (20' 4")	6730 mm (22' 1")
Max vertical wall digging depth	C	4510 mm (14'10")	5550 mm (18' 3")
Max digging height	D	10240 mm (33' 7")	10510 mm (34' 6")
Max dumping height	E	6890 mm (22' 7")	7060 mm (23' 2")
Min swing radius	F	4870 mm (16' 0")	4540 mm (14'11")
Bucket digging force	SAE	220.7 [240.8] kN	220.7 [240.8] kN
		22500 [24550] kgf	22500 [24550] kgf
		49600 [54120] lbf	49600 [54120] lbf
	ISO	255.0 [278.1] kN	255.0 [278.1] kN
		26000 [28360] kgf	26000 [28360] kgf
		57320 [62520] lbf	57320 [62520] lbf
Arm crowd force	SAE	276.6 [301.7] kN	224.6 [245.0] kN
		28200 [30760] kgf	22900 [24980] kgf
		62170 [67810] lbf	50490 [55070] lbf
	ISO	290.3 [316.7] kN	234.4 [255.7] kN
		29600 [32290] kgf	23900 [26070] kgf
		65260 [71190] lbf	52690 [57470] lbf

[ ] : Power boost

3) HX480 L

· 9.00 m (29' 6") BOOM

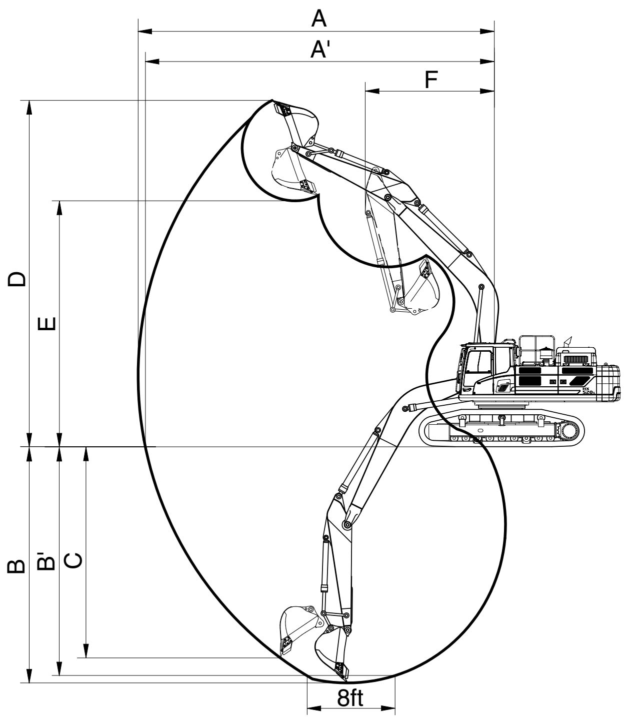


4809A2SP04

Description		6.00 m (19' 8") Arm
Max digging reach	A	16180 mm (53' 1")
Max digging reach on ground	A'	16030 mm (52' 7")
Max digging depth	B	12020 mm (39' 5")
Max digging depth (8ft level)	B'	11920 mm (39' 1")
Max vertical wall digging depth	C	8510 mm (27'11")
Max digging height	D	12440 mm (40'10")
Max dumping height	E	9260 mm (30' 5")
Min swing radius	F	6140 mm (20' 2")
Bucket digging force	SAE	184.4 kN
		18800 kgf
		41450 lbf
	ISO	213.8 kN
		21800 kgf
		48060 lbf
Arm crowd force	SAE	103.0 kN
		10500 kgf
		23150 lbf
	ISO	105.9 kN
		10800 kgf
		23810 lbf

4) HX520 L

· 7.06 m (23' 2") BOOM

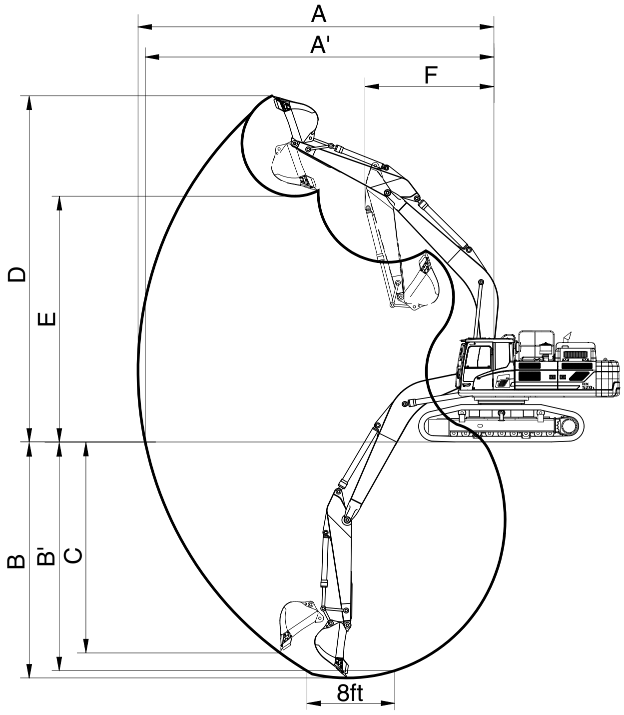


Description		2.40 m (7' 10") Arm	2.90 m (9' 6") Arm	3.38 m (11' 1") Arm	4.00 m (13' 1") Arm
Max digging reach	A	11200 mm (36' 9")	11620 mm (38' 1")	12040 mm (39' 6")	12600 mm (41' 4")
Max digging reach on ground	A'	10950 mm (35'11")	11380 mm (37' 4")	11810 mm (38' 9")	12380 mm (40' 7")
Max digging depth	B	6630 mm (21' 9")	7130 mm (23' 5")	7610 mm (25' 0")	8230 mm (27' 0")
Max digging depth (8ft level)	B'	6460 mm (21' 2")	5980 mm (22'11")	7470 mm (24' 6")	8110 mm (26' 7")
Max vertical wall digging depth	C	4650 mm (15' 3")	5660 mm (18' 7")	5770 mm (18'11")	6320 mm (20' 9")
Max digging height	D	10750 mm (35' 3")	10980 mm (36' 0")	11060 mm (36' 3")	11280 mm (37' 0")
Max dumping height	E	7410 mm (24' 4")	7540 mm (24' 9")	7690 mm (25' 3")	7910 mm (25'11")
Min swing radius	F	5160 mm (16'11")	4890 mm (16' 1")	4850 mm (15'11")	4710 mm (15' 5")
Bucket digging force	SAE	241.2 [263.2] kN	241.2 [263.2] kN	241.2 [263.2] kN	241.2 [263.2] kN
		24600 [26840] kgf	24600 [26840] kgf	24600 [26840] kgf	24600 [26840] kgf
		54230 [59170] lbf	54230 [59170] lbf	54230 [59170] lbf	54230 [59170] lbf
	ISO	280.5 [306.0] kN	280.5 [306.0] kN	280.5 [306.0] kN	280.5 [306.0] kN
		28600 [31200] kgf	28600 [31200] kgf	28600 [31200] kgf	28600 [31200] kgf
		63050 [68780] lbf	63050 [68780] lbf	63050 [68780] lbf	63050 [68780] lbf
Arm crowd force	SAE	278.5 [303.8] kN	225.6 [246.1] kN	192.2 [209.7] kN	171.6 [187.2] kN
		28400 [30980] kgf	23000 [25090] kgf	19600 [21380] kgf	17500 [19090] kgf
		62610 [68300] lbf	50710 [55310] lbf	43210 [47130] lbf	38580 [42090] lbf
	ISO	291.3 [317.7] kN	235.4 [256.7] kN	200.1 [218.2] kN	177.5 [193.7] kN
		29700 [32400] kgf	24000 [26180] kgf	20400 [22250] kgf	18100 [19750] kgf
		65480 [71430] lbf	52910 [57720] lbf	44970 [49050] lbf	39900 [43540] lbf

[ ] : Power boost

5) HX520 L

· 6.55 m (21' 6") BOOM



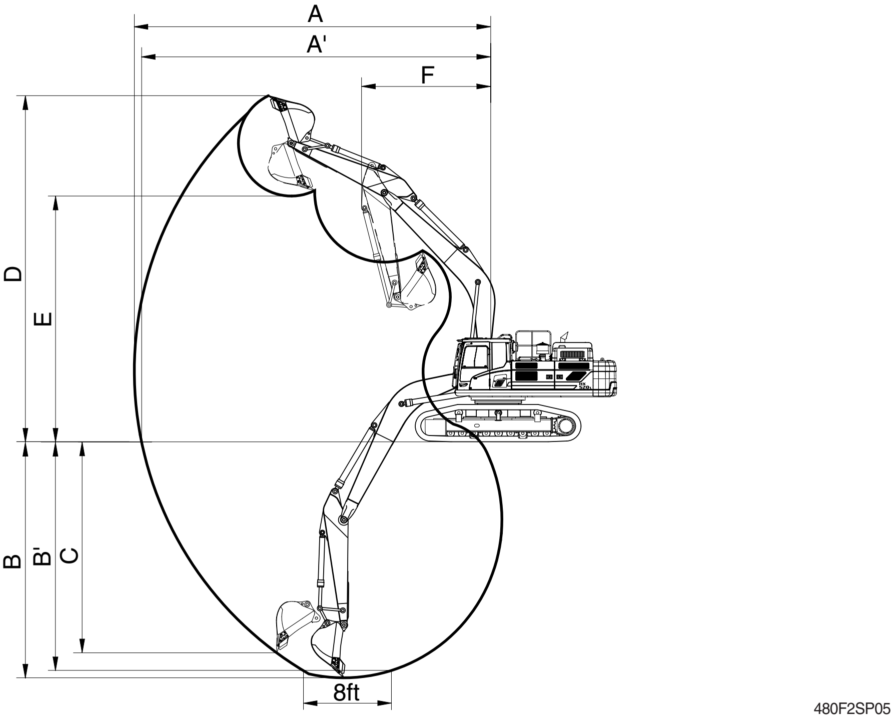
480F2SP05

Description		2.40 m (7' 10") Arm	2.90 m (9' 6") Arm
Max digging reach	A	10690 mm (35' 1")	11130 mm (36' 6")
Max digging reach on ground	A'	10430 mm (34' 3")	10870 mm (35' 8")
Max digging depth	B	6240 mm (20' 6")	6740 mm (22' 1")
Max digging depth (8ft level)	B'	6060 mm (19'11")	6580 mm (21' 7")
Max vertical wall digging depth	C	4370 mm (14' 4")	5420 mm (17' 9")
Max digging height	D	10390 mm (34' 1")	10660 mm (35' 0")
Max dumping height	E	7040 mm (23' 1")	7210 mm (23' 8")
Min swing radius	F	4870 mm (16' 0")	4540 mm (14'11")
Bucket digging force	SAE	241.2 [263.2] kN	241.2 [263.2] kN
		24600 [26840] kgf	24600 [26840] kgf
		54230 [59170] lbf	54230 [59170] lbf
	ISO	280.5 [306.0] kN	280.5 [306.0] kN
		28600 [31200] kgf	28600 [31200] kgf
		63050 [68780] lbf	63050 [68780] lbf
Arm crowd force	SAE	278.5 [303.8] kN	225.6 [246.1] kN
		28400 [30980] kgf	23000 [25090] kgf
		62610 [68300] lbf	50710 [55310] lbf
	ISO	291.3 [317.7] kN	235.4 [256.7] kN
		29700 [32400] kgf	24000 [26180] kgf
		65480 [71430] lbf	52910 [57720] lbf

[ ] : Power boost

6) HX520 L

· 9.00 ㎧ (29' 6") BOOM



Description		6.00 ㎧ (19' 8") Arm
Max digging reach	A	16180 ㎜ (53' 1")
Max digging reach on ground	A'	16010 ㎜ (52' 6")
Max digging depth	B	11870 ㎜ (38'11")
Max digging depth (8ft level)	B'	11770 ㎜ (38' 7")
Max vertical wall digging depth	C	8360 ㎜ (27' 5")
Max digging height	D	12590 ㎜ (41' 4")
Max dumping height	E	9410 ㎜ (30'10")
Min swing radius	F	6140 ㎜ (20' 2")
Bucket digging force	SAE	184.4 kN
		18800 kgf
		41450 lbf
	ISO	213.8 kN
		21800 kgf
		48060 lbf
Arm crowd force	SAE	103.0 kN
		10500 kgf
		23150 lbf
	ISO	105.9 kN
		10800 kgf
		23810 lbf

4. WEIGHT

1) HX480 L

Item		HX480 L	
		kg	lb
Upperstructure assembly		20120	44360
Main frame weld assembly		4640	10230
Engine assembly		1075	2370
Main pump assembly		190	420
Main control valve assembly		420	930
Swing motor assembly		230	510
Hydraulic oil tank assembly		450	990
Fuel tank assembly		270	600
Counterweight	6.55 m, 7.06 m boom	9200	20280
	9.0 m boom	10700	23590
Cab assembly		490	1080
Lower chassis assembly		19000	41890
Track frame weld assembly		7060	15570
Swing bearing		720	1590
Travel motor assembly		440	970
Turning joint		50	110
Track recoil spring		310	680
Idler		250	550
Sprocket		95	210
Carrier roller		40	90
Track roller		87	190
Track-chain assembly (600 mm standard triple grouser shoe)		2700	5950
Front attachment assembly (7.06 m boom, 3.38 m arm, 2.20 m^3 SAE heaped bucket)		10380	22880
7.06 m boom assembly		3570	7870
6.55 m boom assembly		3560	7850
9.0 m boom assembly		4310	9500
3.38 m arm assembly		1820	4010
2.20 m^3 SAE heaped bucket		2030	4480
Boom cylinder assembly		870	1920
Arm cylinder assembly		600	1320
Bucket cylinder assembly		360	790
Bucket control linkage total		185	410

2) HX520 L

Item		HX520 L	
		kg	lb
Upperstructure assembly		21180	46690
Main frame weld assembly		4640	10230
Engine assembly		1075	2370
Main pump assembly		190	420
Main control valve assembly		420	930
Swing motor assembly		230	510
Hydraulic oil tank assembly		450	990
Fuel tank assembly		270	600
Counterweight	6.55 m, 7.06 m boom	10200	22490
	9.0 m boom	10700	23590
Cab assembly		490	1080
Lower chassis assembly		20800	45860
Lower track frame		2130	4700
Center frame support		8070	17790
Swing bearing		720	1590
Travel motor assembly		440	970
Turning joint		50	110
Track recoil spring		310	680
Idler		250	550
Sprocket		95	210
Carrier roller		40	90
Track roller		87	190
Track-chain assembly (600 mm standard triple grouser shoe)		2700	5850
Front attachment assembly (7.06 m boom, 3.38 m arm, 2.20 m^3 SAE heaped bucket)		10420	22970
7.06 m boom assembly		3570	7870
6.55 m boom assembly		3560	7850
9.0 m boom assembly		4310	9500
3.38 m arm assembly		1820	4010
2.20 m^3 SAE heaped bucket		2030	4480
Boom cylinder assembly		870	1920
Arm cylinder assembly		600	1320
Bucket cylinder assembly		400	880
Bucket control linkage total		185	410

5. LIFTING CAPACITIES

1) HX480 L

(1) 6.55 m (21' 6") boom, 2.40 m (7' 10") arm equipped with 2.20 m^3 (SAE heaped) bucket and 600 mm (24") triple grouser shoe and 9,200 kg (20,280 lb) counterweight.

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

Load point height		Load radius								At max. reach		
		3.0 m (9.8 ft)		4.5 m (14.7 ft)		6.0 m (19.6 ft)		7.5 m (24.5 ft)		Capacity		Reach
												m (ft)
6.0 m	kg					*13100	*13100	*12540	9840	10830	6430	9.71
(19.6 ft)	lb					*28880	*28880	*27640	21700	23890	14190	31.72
4.5 m	kg			*18500	*18500	*15010	13670	*13400	9460	9840	5750	10.16
(14.7 ft)	lb			*40800	*40800	*33100	30150	*29530	20850	21690	12680	33.19
3.0 m	kg					*17090	12800	*14450	9010	9410	5440	10.33
(9.8 ft)	lb					*37680	28230	*31850	19860	20740	11980	33.74
1.5 m	kg					*18620	12140	15190	8620	9430	5410	10.24
(4.9 ft)	lb					*41060	26750	33480	19010	20790	11940	33.44
Ground	kg			*24870	18570	*19220	11770	14910	8380	9930	5700	9.88
Line	lb			*54820	40940	*42370	25950	32860	18470	21900	12570	32.28
-1.5 m	kg			*23780	18600	*18850	11680	14840	8320	11150	6430	9.21
(-4.9 ft)	lb			*52420	41000	*41560	25750	32710	18340	24570	14180	30.1
-3.0 m	kg	*27210	*27210	*21680	18870	*17410	11840			*11320	8010	8.15
(-9.8 ft)	lb	*59990	*59990	*47800	41590	*38370	26090			*24960	17650	26.61
-4.5 m	kg			*18000	*18000					*10800	9470	7.4
(-14.7 ft)	lb			*39690	*39690					*23810	20870	24.19

Note
1. Lifting capacity is based on ISO 10567.
2. Load point is the end pin point of front attachment.
3. Lifting capacity does not exceed 75% of tipping load or 87% of hydraulic capacity.
4. *indicates the 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.

(2) 6.55 m (21' 6") boom, 2.90 m (9' 6") arm equipped with 2.20 m³ (SAE heaped) bucket and 600 mm (24") triple grouser shoe and 9,200 kg (20,280 lb) counterweight.

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

Load point height		Load radius										At max. reach		
		3.0 m (9.8 ft)		4.5 m (14.7 ft)		6.0 m (19.6 ft)		7.5 m (24.5 ft)		9.0 m (29.4 ft)		Capacity		Reach
														m (ft)
7.5 m	kg							*11560	10150			*8700	7060	9.39
(24.5 ft)	lb							*25480	22390			*19180	15560	30.67
6.0 m	kg							*12010	9940			*8690	5950	10.12
(19.6 ft)	lb							*26480	21910			*19170	13120	33.06
4.5 m	kg			*17020	*17020	*14310	13870	*12990	9520			*8820	5340	10.55
(14.7 ft)	lb			*37530	*37530	*31560	30580	*28630	20990			*19440	11770	34.45
3.0 m	kg			*21620	20330	*16560	12950	*14170	9040	11500	6600	8810	5040	10.71
(9.8 ft)	lb			*47670	44820	*36500	28550	*31230	19920	25350	14550	19420	11110	34.99
1.5 m	kg			*24550	18980	*18370	12190	15180	8600	11240	6370	8800	5000	10.62
(4.9 ft)	lb			*54130	41850	*40490	26860	33470	18960	24780	14040	19410	11020	34.71
Ground	kg			*25300	18440	*19310	11710	14830	8290			9220	5230	10.28
Line	lb			*55770	40660	*42560	25830	32700	18280			20330	11540	33.59
-1.5 m	kg	*23710	*23710	*24660	18350	*19280	11530	14680	8160			10230	5840	9.65
(-4.9 ft)	lb	*52280	*52280	*54370	40450	*42510	25420	32370	17990			22550	12870	31.52
-3.0 m	kg	*29990	*29990	*22950	18540	*18250	11600	*14760	8250			*11610	7100	8.65
(-9.8 ft)	lb	*66110	*66110	*50590	40860	*40230	25570	*32540	18180			*25590	15650	28.26
-4.5 m	kg	*25460	*25460	*19850	19020	*15750	11960					*10980	9450	7.36
(-14.7 ft)	lb	*56130	*56130	*43770	41930	*34730	26380					*24210	20830	24.05

(3) 7.06 m (23' 2") boom, 3.38 m (11' 1") arm equipped with 2.20 m³ (SAE heaped) bucket and 600 mm (24") triple grouser shoe and 9,200 kg (20,280 lb) counterweight.

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

Load point height		Load radius										At max. reach		
		3.0 m (9.8 ft)		4.5 m (14.7 ft)		6.0 m (19.6 ft)		7.5 m (24.5 ft)		9.0 m (29.4 ft)		Capacity		Reach
														m (ft)
6.0 m	kg							*11510	9900	*11340	7020	*7750	4930	11.05
(19.6 ft)	lb							*25370	21820	*25010	15480	*17090	10870	36.08
4.5 m	kg					*14080	13730	*12700	9410	11690	6770	*7880	4450	11.43
(14.7 ft)	lb					*31040	30270	*28000	20740	25770	14910	*17370	9820	37.34
3.0 m	kg			*21750	19990	*16510	12740	*14050	8870	11350	6460	7570	4210	11.58
(9.8 ft)	lb			*47940	44070	*36390	28080	*30970	19550	25020	14250	16680	9280	37.83
1.5 m	kg			*24850	18580	*18470	11920	14950	8390	11030	6180	7540	4160	11.5
(4.9 ft)	lb			*54780	40950	*40730	26270	32950	18490	24320	13620	16630	9180	37.57
Ground	kg			*25740	18010	*19570	11410	14550	8040	10790	5960	7830	4320	11.19
Line	lb			*56750	39710	*43150	25150	32070	17720	23800	13140	17270	9530	36.55
-1.5 m	kg	*19090	*19090	*25340	17890	*19780	11180	14330	7850	10680	5860	8530	4740	10.62
(-4.9 ft)	lb	*42080	*42080	*55870	39430	*43600	24640	31600	17310	23540	12910	18800	10450	34.69
-3.0 m	kg	*25270	*25270	*24050	18010	*19150	11180	14320	7840			9890	5580	9.74
(-9.8 ft)	lb	*55720	*55720	*53020	39710	*42220	24650	31570	17280			21810	12290	31.82
-4.5 m	kg	*28240	*28240	*21780	18370	*17570	11390	*14330	8040			*11250	7290	8.43
(-14.7 ft)	lb	*62250	*62250	*48020	40490	*38740	25120	*31590	17720			*24800	16080	27.54
-6.0 m	kg			*18000	*18000							*10910	8780	7.61
(-19.6 ft)	lb			*39690	*39690							*24060	19360	24.85

(4) 7.06 m (23' 2") boom, 2.40 m (7' 10") arm equipped with 2.20 m^3 (SAE heaped) bucket and 600 mm (24") triple grouser shoe and 9,200 kg (20,280 lb) counterweight.

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

Load point height		Load radius										At max. reach		
		3.0 m (9.8 ft)		4.5 m (14.7 ft)		6.0 m (19.6 ft)		7.5 m (24.5 ft)		9.0 m (29.4 ft)		Capacity		Reach
														m (ft)
7.5 m	kg							*11920	9980			*10790	6730	9.53
(24.5 ft)	lb							*26280	22010			*23790	14850	31.14
6.0 m	kg					*13370	*13370	*12470	9690			9730	5700	10.26
(19.6 ft)	lb					*29480	*29480	*27490	21370			21450	12560	33.5
4.5 m	kg					*15530	13250	*13530	9230			8903	5120	10.68
(14.7 ft)	lb					*34250	29220	*29830	20340			19630	11290	34.88
3.0 m	kg					*17700	12330	*14680	8740	11330	6460	8540	4850	10.84
(9.8 ft)	lb					*39020	27200	*32370	19260	24980	14250	18820	10690	35.4
1.5 m	kg					*19140	11690	14860	8330	11080	6240	8550	4820	10.75
(4.9 ft)	lb					*42190	25780	32760	18370	24430	13760	18840	10640	35.12
Ground	kg					*19600	11380	14580	8090	10940	6110	8960	5060	10.41
Line	lb					*43210	25090	32140	17830	24120	13470	19750	11160	34.02
-1.5 m	kg			*23820	18210	*19210	11320	14500	8020			9930	5650	9.79
(-4.9 ft)	lb			*52520	40150	*42360	24960	31960	17680			21890	12460	31.98
-3.0 m	kg	*26660	*26660	*22010	18460	*17980	11470	14660	8160			*11270	6860	8.81
(-9.8 ft)	lb	*58780	*58780	*48530	40690	*39630	25290	32320	17980			*24840	15120	28.78
-4.5 m	kg			*19030	18970	*15480	11890					*10630	8730	7.71
(-14.7 ft)	lb			*41950	41820	*34120	26210					*23430	19240	25.19

(5) 7.06 m (23' 2") boom, 2.90 m (9' 6") arm equipped with 2.20 m^3 (SAE heaped) bucket and 600 mm (24") triple grouser shoe and 9,200 kg (20,280 lb) counterweight.

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

Load point height		Load radius										At max. reach		
		3.0 m (9.8 ft)		4.5 m (14.7 ft)		6.0 m (19.6 ft)		7.5 m (24.5 ft)		9.0 m (29.4 ft)		Capacity		Reach
														m (ft)
7.5 m	kg							*11300	10110			*9200	6210	9.96
(24.5 ft)	lb							*24920	22290			*20290	13690	32.54
6.0 m	kg							*12000	9780			9110	5290	10.65
(19.6 ft)	lb							*26450	21560			20090	11660	34.78
4.5 m	kg			*18460	*18460	*14840	13460	*13150	9290	11630	6710	8370	4760	11.05
(14.7 ft)	lb			*40690	*40690	*32720	29680	*28980	20480	25630	14800	18440	10500	36.09
3.0 m	kg			*23200	19320	*17170	12480	*14420	8760	11310	6430	8020	4500	11.2
(9.8 ft)	lb			*51150	42600	*37860	27520	*31790	19320	24930	14170	17680	9920	36.6
1.5 m	kg			*21570	18200	*18920	11730	14850	8310	11020	6170	8010	4460	11.12
(4.9 ft)	lb			*47550	40110	*41710	25860	32750	18320	24290	13590	17650	9830	36.33
Ground	kg			*24530	17880	*19730	11310	14500	8000	10820	5990	8350	4650	10.8
Line	lb			*54090	39420	*43500	24920	31970	17640	23850	13200	18400	10250	35.27
-1.5 m	kg	*19550	*19550	*24880	17880	*19650	11160	14350	7870			9170	5140	10.2
(-4.9 ft)	lb	*43100	*43100	*54840	39430	*43320	24600	31640	17350			20210	11340	33.32
-3.0 m	kg	*27720	*27720	*23290	18090	*18730	11240	14410	7930			10790	6140	9.28
(-9.8 ft)	lb	*61120	*61120	*51340	39890	*41300	24770	31780	17470			23790	13530	30.31
-4.5 m	kg	*26110	*26110	*20660	18540	*16750	11550					*10990	8290	7.87
(-14.7 ft)	lb	*57560	*57560	*45550	40870	*36930	25460					*24220	18270	25.72

(6) 7.06 m (23' 2") boom, 4.00 m (13' 1") arm equipped with 2.20 m^3 (SAE heaped) bucket and 600 mm (24") triple grouser shoe and 9,200 kg (20,280 lb) counterweight.

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

Load point height		Load radius														At max. reach		
		1.5 m (4.9 ft)		3.0 m (9.8 ft)		4.5 m (14.7 ft)		6.0 m (19.6ft)		7.5 m (24.5 ft)		9.0 m (29.4 ft)		10.5 m (34.3 ft)		Capacity		Reach
																		m (ft)
7.5 m	kg											*10200	7350			*7160	5140	11.03
(24.5 ft)	lb											*22500	16210			*15780	11340	36.02
6.0 m	kg											*10730	7180			*7190	4460	11.64
(19.6 ft)	lb											*23660	15830			*15840	9820	38.02
4.5 m	kg									*11990	9630	*11430	6900	8920	5040	7240	4040	12
(14.7 ft)	lb									*26430	21230	*25200	15200	19650	11100	15970	8900	39.21
3.0 m	kg					*19780	*19780	*15510	13090	*13450	9050	11470	6560	8720	4860	6960	3820	12.14
(9.8 ft)	lb					*43610	*43610	*34200	28870	*29650	19960	25280	14460	19220	10710	15340	8420	39.67
1.5 m	kg					*23740	19050	*17790	12160	*14820	8510	11110	6230	8520	4680	6930	3766	12.07
(4.9 ft)	lb					*52340	42000	*39230	26810	*32660	18770	24490	13740	18780	10310	15270	8303	39.43
Ground	kg			*13800	*13800	*25590	18130	*19290	11510	14620	8090	10810	5970	8360	4530	7154	3886	11.77
Line	lb			*30430	*30430	*56410	39970	*42530	25390	32230	17840	23840	13160	18440	9990	15772	8568	38.46
-1.5 m	kg	*14500	*14500	*17930	*17930	*25840	17790	*19900	11170	14320	7830	10630	5810			7706	4217	11.24
(-4.9 ft)	lb	*31970	*31970	*39520	*39520	*56971	39230	*43860	24620	31580	17270	23430	12800			16990	9298	36.73
-3.0 m	kg	*18590	*18590	*22750	*22750	*25020	17790	*19650	11070	14220	7740	10590	5770			8768	4871	10.43
(-9.8 ft)	lb	*40980	*40980	*50160	*50160	*55170	39230	*43320	24400	31350	17070	23350	12720			19329	10738	34.06
-4.5 m	kg			*28640	*28640	*23220	18040	*18520	11190	14330	7830					10836	6139	9.24
(-14.7 ft)	lb			*63150	*63150	*51200	39780	*40830	24660	31580	17270					23890	13534	30.17
-6.0 m	kg			*26350	*26350	*20150	18570	*16170	11560							*10846	8506	7.73
(-19.6 ft)	lb			*58080	*58080	*44430	40950	*35660	25470							*23910	18753	25.26

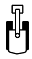
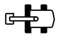
(7) 9.00 m (29' 6") boom, 6.00 m (19' 8") arm equipped with 2.20 m^3 (SAE heaped) bucket and 600 mm (24") triple grouser shoe and 10,200 kg (22,490 lb) counterweight.

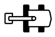
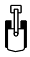
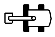
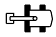
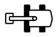
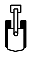
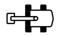
· : Rating over-front · : Rating over-side or 360 degree

Load point height		Load radius												At max. reach		
		3.0 m (9.8 ft)		5.0 m (16.3 ft)		7.0 m (22.9 ft)		9.0 m (29.4ft)		11.0 m (35.9 ft)		13.0 m (42.5 ft)		Capacity		Reach
																m (ft)
8.0 m	kg											*5500	3770	*4660	2920	14.78
(26.1 ft)	lb											*12130	8310	*10280	6440	48.27
6.0 m	kg									*8570	5400	6630	3620	*4700	2460	15.40
(19.6 ft)	lb									*18890	11910	14610	7980	*10370	5430	50.32
4.0 m	kg							*10020	7380	8790	4980	6370	3380	4500	2180	15.72
(13.1 ft)	lb							*22080	16280	19380	10980	14050	7460	9920	4810	51.37
2.0 m	kg			*19230	16740	*13910	10040	*11610	6620	8300	4530	6090	3120	4350	2040	15.76
(6.5 ft)	lb			*42390	36900	*30660	22120	*25600	14580	18300	9990	13430	6880	9590	4500	51.47
Ground	kg	*8600	*8600	*16340	14820	*16100	8930	11010	5960	7870	4130	5840	2880	4380	2030	15.50
Line	lb	*18960	*18960	*36020	32670	*35480	19690	24270	13140	17340	9100	12870	6360	9660	4480	50.64
-2.0 m	kg	*10720	*10720	*16220	14070	15820	8280	10510	5510	7550	3840	5660	2710	4630	2170	14.95
(-6.5 ft)	lb	*23630	*23630	*35750	31010	34870	18260	23160	12140	16640	8460	12470	5980	10210	4780	48.83
-4.0 m	kg	*13060	*13060	*18160	13920	15510	8012	10250	5280	7380	3680			5170	2500	14.06
(-13.1 ft)	lb	*28800	*28800	*40040	30690	34190	17660	22600	11640	16280	8120			11390	5520	45.92
-6.0 m	kg	*15680	*15680	*21300	14130	15540	8037	10230	5260	7400	3700			6120	3160	12.74
(-19.6 ft)	lb	*34570	*34570	*46950	31160	34250	17720	22560	11600	16320	8170			13690	6970	41.61
-8.0 m	kg	*18670	*18670	*20410	14660	*15830	8330	10490	5490					*7810	4550	10.82
(-26.1 ft)	lb	*41160	*41190	*45000	32330	*34890	18370	23120	12100					*17230	10020	35.33
-10.0 m	kg			*16900	15630	*13170	9000							*9870	6980	8.72
(-32.7 ft)	lb			*37270	34450	*29030	19840							*21760	15400	28.48

2) HX520 L

(1) 6.55 m (21' 6") boom, 2.40 m (7' 10") arm equipped with 2.20 m^3 (SAE heaped) bucket and 600 mm (24") triple grouser shoe and 10,200 kg (22,490 lb) counterweight.

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

Load point height		Load radius								At max. reach		
		3.0 m (9.8 ft)		4.5 m (14.7 ft)		6.0 m (19.6 ft)		7.5 m (24.5 ft)		Capacity		Reach
												m (ft)
6.0 m	kg					*13290	*13290	*12630	11600	*11260	7540	9.80
(19.6 ft)	lb					*29290	*29290	*27840	25560	*24840	16610	32.02
4.5 m	kg			*19010	*19010	*15250	*15250	*13520	11190	10630	6840	10.22
(14.7 ft)	lb			*41910	*41910	*33630	*33630	*29820	24660	23430	15070	33.39
3.0 m	kg					*17320	15170	*14580	10730	10240	6540	10.36
(9.8 ft)	lb					*38170	33450	*32140	23650	22560	14410	33.86
1.5 m	kg					*18760	14520	*15410	10350	10320	6560	10.25
(4.9 ft)	lb					*41370	32000	*33970	22810	22740	14460	33.48
Ground	kg			*24850	22470	*19270	14170	*15740	10110	10920	6940	9.86
Line	lb			*54790	49530	*42470	31240	*34690	22290	24080	15310	32.22
-1.5 m	kg	*26490	*26490	*23670	22520	*18800	14100	*15300	10070	*11680	7850	9.17
(-4.9 ft)	lb	*58390	*58390	*52180	49650	*41440	31090	*33740	22210	*25740	17300	29.95
-3.0 m	kg	*26910	*26910	*21450	*21450	*17220	14290			*11150	9790	8.05
(-9.8 ft)	lb	*59330	*59330	*47290	*47290	*37970	31510			*24580	21590	26.31
-4.5 m	kg			*17540	*17540					*10720	*10720	7.49
(-14.7 ft)	lb			*38660	*38660					*23640	*23640	24.46

Note 1. Lifting capacity is based on ISO 10567.
2. Load point is the end pin point of front attachment.
3. Lifting capacity does not exceed 75% of tipping load or 87% of hydraulic capacity.
4. *indicates the 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.

(2) 6.55 m (21' 6") boom, 2.90 m (9' 6") arm equipped with 2.20 m^3 (SAE heaped) bucket and 600 mm (24") triple grouser shoe and 10,200 kg (22,490 lb) counterweight.

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

Load point height		Load radius										At max. reach		
		3.0 m (9.8 ft)		4.5 m (14.7 ft)		6.0 m (19.6 ft)		7.5 m (24.5 ft)		9.0 m (29.4 ft)		Capacity		Reach
														m (ft)
7.5 m	kg							*11640	*11640			*8710	8100	9.54
(24.5 ft)	lb							*25650	*25650			*19200	17850	31.17
6.0 m	kg							*12110	11690			*8690	6970	10.24
(19.6 ft)	lb							*26700	25770			*19170	15360	33.44
4.5 m	kg			*17530	*17530	*14570	*14570	*13130	11250			*8810	6340	10.63
(14.7 ft)	lb			*38640	*38640	*32110	*32110	*28940	24800			*19410	13990	34.73
3.0 m	kg			*22060	*22060	*16800	15320	*14310	10750	12550	7950	*9040	6060	10.77
(9.8 ft)	lb			*48640	*48640	*37040	33770	*31550	23710	27660	17530	*19930	13370	35.18
1.5 m	kg			*24760	22820	*18540	14560	*15320	10320	12290	7720	*9420	6070	10.66
(4.9 ft)	lb			*54590	50310	*40880	32100	*33770	22750	27100	17010	*20770	13380	34.82
Ground	kg			*25340	22320	*19390	14110	*15870	10020			*9990	6380	10.29
Line	lb			*55860	49210	*42740	31100	*34980	22090			*22030	14070	33.62
-1.5 m	kg	*24530	*24530	*24590	22260	*19270	13950	*15750	9910			*10870	7120	9.63
(-4.9 ft)	lb	*54080	*54080	*54220	49070	*42480	30750	*34720	21840			*23960	15700	31.47
-3.0 m	kg	*29690	*29690	*22760	22480	*18120	14040	*14610	10020			*11430	8670	8.59
(-9.8 ft)	lb	*65460	*65460	*50180	49560	*39940	30960	*32200	22100			*25200	19120	28.07
-4.5 m	kg			*19480	*19480	*15400	14460					*10840	*10840	7.50
(-14.7 ft)	lb			*42950	*42950	*33960	31880					*23900	*23900	24.50

(3) 7.06 m (23' 2") boom, 2.40 m (7' 10") arm equipped with 2.20 m^3 (SAE heaped) bucket and 600 mm (24") triple grouser shoe and 10,200 kg (22,490 lb) counterweight.

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

Load point height		Load radius										At max. reach		
		3.0 m (9.8 ft)		4.5 m (14.7 ft)		6.0 m (19.6 ft)		7.5 m (24.5 ft)		9.0 m (29.4 ft)		Capacity		Reach
														m (ft)
7.5 m	kg							*11960	11760			*10860	7810	9.66
(24.5 ft)	lb							*26360	25920			*23940	17210	31.56
6.0 m	kg					*13590	*13590	*12590	11430			10460	6730	10.35
(19.6 ft)	lb					*29970	*29970	*27750	25200			23050	14840	33.80
4.5 m	kg					*15800	15620	*13670	10950	*12580	8060	9650	6150	10.74
(14.7 ft)	lb					*34820	34430	*30150	24130	*27740	17770	21280	13550	35.07
3.0 m	kg					*17920	14690	*14820	10450	12380	7810	9320	5880	10.87
(9.8 ft)	lb					*39510	32390	*32680	23030	27290	17210	20540	12970	35.52
1.5 m	kg					*19270	14070	*15700	10050	12140	7590	9380	5900	10.76
(4.9 ft)	lb					*42480	31010	*34600	22150	26760	16730	20670	13000	35.16
Ground	kg					*19640	13780	15940	9820			9870	6210	10.40
Line	lb					*43300	30370	35140	21640			21760	13700	33.97
-1.5 m	kg			*23730	22120	*19170	13740	*15770	9760			10980	6940	9.75
(-4.9 ft)	lb			*52320	48760	*42270	30290	*34760	21530			24210	15300	31.85
-3.0 m	kg	*26500	*26500	*21830	*21830	*17840	13910	*14540	9930			*11140	8420	8.74
(-9.8 ft)	lb	*58420	*58420	*48130	*48130	*39330	30680	*32060	21900			*24560	18560	28.54
-4.5 m	kg			*18680	*18680	*15140	14380					*10560	10260	7.80
(-14.7 ft)	lb			*41180	*41180	*33380	31710					*23280	22620	25.47

(4) 7.06 m (23' 2") boom, 2.90 m (9' 6") arm equipped with 2.20 m³ (SAE heaped) bucket and 600 mm (24") triple grouser shoe and 10,200 kg (22,490 lb) counterweight.

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

Load point height		Load radius										At max. reach		
		3.0 m (9.8 ft)		4.5 m (14.7 ft)		6.0 m (19.6 ft)		7.5 m (24.5 ft)		9.0 m (29.4 ft)		Capacity		Reach
														m (ft)
7.5 m	kg							*11360	*11360			*9210	7190	10.11
(24.5 ft)	lb							*25050	*25050			*20310	15860	33.03
6.0 m	kg							*12120	11520			*9220	6250	10.76
(19.6 ft)	lb							*26730	25400			*20340	13770	35.15
4.5 m	kg			*19010	*19010	*15110	*15110	*13300	11010	*12330	8060	9050	5720	11.13
(14.7 ft)	lb			*41900	*41900	*33310	*33310	*29320	24270	*27180	17770	19940	12600	36.37
3.0 m	kg			*23620	23090	*17420	14840	*14570	10470	12350	7770	8730	5470	11.26
(9.8 ft)	lb			*52060	50900	*38400	32710	*32120	23090	27230	17130	19250	12050	36.80
1.5 m	kg			*21570	*21570	*19080	14100	*15610	10020	12070	7510	8770	5460	11.16
(4.9 ft)	lb			*47560	*47560	*42070	31080	*34410	22090	26600	16560	19320	12040	36.45
Ground	kg			*25090	21760	*19800	13690	15860	9730	11880	7340	9180	5720	10.81
Line	lb			*55310	47970	*43660	30190	34960	21440	26180	16170	20230	12610	35.32
-1.5 m	kg	*20350	*20350	*24810	21780	*19640	13570	15730	9610			10110	6330	10.19
(-4.9 ft)	lb	*44860	*44860	*54690	48020	*43300	29910	34670	21180			22280	13950	33.30
-3.0 m	kg	*28610	*28610	*23130	22020	*18630	13670	*15310	9690			*11360	7540	9.23
(-9.8 ft)	lb	*63060	*63060	*50990	48550	*41080	30140	*33750	21360			*25040	16620	30.17
-4.5 m	kg			*20370	*20370	*16510	14020					*10730	10170	7.79
(-14.7 ft)	lb			*44910	*44910	*36390	30910					*23650	22430	25.43

(5) 7.06 m (23' 2") boom, 3.38 m (11' 1") arm equipped with 2.20 m³ (SAE heaped) bucket and 600 mm (24") triple grouser shoe and 10,200 kg (22,490 lb) counterweight.

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

Load point height		Load radius										At max. reach		
		3.0 m (9.8 ft)		4.5 m (14.7 ft)		6.0 m (19.6 ft)		7.5 m (24.5 ft)		9.0 m (29.4 ft)		Capacity		Reach
														m (ft)
6.0 m	kg							*11640	*11640	*11410	8380	*7750	5820	11.18
(19.6 ft)	lb							*25650	*25650	*25160	18480	*17080	12840	36.53
4.5 m	kg			*17410	*17410	*14350	*14350	*12860	11130	*12030	8110	*7860	5340	11.54
(14.7 ft)	lb			*38390	*38390	*31640	*31640	*28360	24540	*26530	17890	*17330	11780	37.70
3.0 m	kg			*22210	*22210	*16770	15090	*14210	10580	12390	7800	*8060	5120	11.67
(9.8 ft)	lb			*48960	*48960	*36960	33280	*31330	23320	27320	17200	*17760	11280	38.11
1.5 m	kg			*25070	22400	*18660	14280	*15370	10100	12080	7520	8240	5100	11.57
(4.9 ft)	lb			*55270	49380	*41150	31490	*33880	22260	26630	16570	18160	11250	37.78
Ground	kg			*25800	21880	*19670	13790	15900	9760	11850	7310	8590	5320	11.23
Line	lb			*56880	48230	*43370	30400	35040	21510	26120	16110	18930	11730	36.69
-1.5 m	kg	*19680	*19680	*25300	21780	*19800	13580	15700	9580	11750	7210	9370	5830	10.64
(-4.9 ft)	lb	*43390	*43390	*55780	48010	*43640	29940	34620	21130	25890	15900	20660	12860	34.77
-3.0 m	kg	*25950	*25950	*23920	21930	*19080	13600	15710	9590			*10510	6840	9.74
(-9.8 ft)	lb	*57200	*57200	*52740	48350	*42069	29990	34630	21140			*23180	15080	31.82
-4.5 m	kg	*27870	*27870	*21540	*21540	*17390	13850					*10990	8910	8.39
(-14.7 ft)	lb	*61430	*61430	*47480	*47480	*38330	30530					*24230	19640	27.41

(6) 7.06 m (23' 2") boom, 4.00 m (13' 1") arm equipped with 2.20 m^3 (SAE heaped) bucket and 600 mm (24") triple grouser shoe and 10,200 kg (22,490 lb) counterweight.

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

Load point height		Load radius														At max. reach		
		1.5 m (4.9 ft)		3.0 m (9.8 ft)		4.5 m (14.7 ft)		6.0 m (19.6ft)		7.5 m (24.5 ft)		9.0 m (29.4 ft)		10.5 m (34.3 ft)		Capacity		Reach
																		m (ft)
7.5 m	kg											*10410	8730			*7170	6000	11.19
(24.5 ft)	lb											*22950	19250			*15800	13240	36.54
6.0 m	kg											*10810	8540			*7190	5300	11.77
(19.6 ft)	lb											*23840	18830			*15850	11680	38.45
4.5 m	kg									*12150	11350	*11540	8240	*9510	6140	*7280	4890	12.11
(14.7 ft)	lb									*26800	25030	*25430	18170	*20960	13550	*16050	10770	39.55
3.0 m	kg					*20300	*20300	*15800	15460	*13620	10760	*12390	7900	9570	5960	*7450	4680	12.23
(9.8 ft)	lb					*44750	*44750	*34820	34070	*30040	23730	*27310	17410	21110	13140	*16430	10310	39.94
1.5 m	kg					*24060	22850	*18020	14520	*14970	10220	12150	7570	9380	5780	7590	4650	12.13
(4.9 ft)	lb					*53050	50390	*39730	32020	*33000	22530	26780	16690	20670	12730	16720	10260	39.63
Ground	kg			*14190	*14190	*25720	21980	*19430	13890	*15930	9810	11860	7310	9230	5640	7860	4820	11.82
Line	lb			*31290	*31290	*56710	48450	*42840	30620	*35120	21620	26150	16120	20340	12430	17340	10630	38.60
-1.5 m	kg	*14900	*14900	*18380	*18380	*25860	21670	*19950	13560	15680	9560	11690	7160			8490	5240	11.26
(-4.9 ft)	lb	*32850	*32850	*40520	*40520	*57000	47780	*43980	29900	34570	21070	25770	15770			18730	11550	36.78
-3.0 m	kg	*19020	*19020	*23290	*23290	*24940	21700	*19620	13480	15600	9480	11670	7140			*9460	6020	10.42
(-9.8 ft)	lb	*41940	*41940	*51340	*51340	*54990	47830	*43250	29720	34390	20910	25720	15730			*20850	13280	34.05
-4.5 m	kg			*29320	*29320	*23030	21980	*18390	13630	*15130	9600					*10910	7550	9.20
(-14.7 ft)	lb			*64640	*64640	*50780	48470	*40550	30040	*33350	21160					*24050	16650	30.05
-6.0 m	kg					*19800	*19800	*15870	14040							*10660	9810	7.93
(-19.6 ft)	lb					*43650	*43650	*35000	30950							*23500	21620	25.91

(7) 9.00 m (29' 6") boom, 6.00 m (19' 8") arm equipped with 2.20 m^3 (SAE heaped) bucket and 600 mm (24") triple grouser shoe and 10,200 kg (22,490 lb) counterweight.

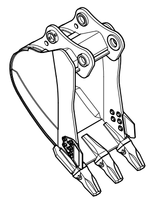
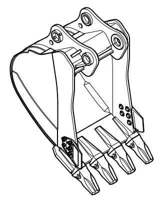
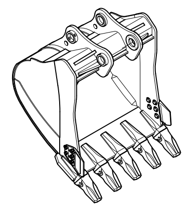
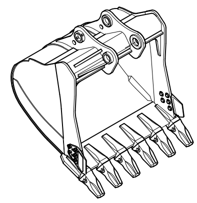
· : Rating over-front · : Rating over-side or 360 degree

Load point height		Load radius												At max. reach		
		3.0 m (9.8 ft)		5.0 m (16.3 ft)		7.0 m (22.9 ft)		9.0 m (29.4ft)		11.0 m (35.9 ft)		13.0 m (42.5 ft)		Capacity		Reach
																m (ft)
8.0 m	kg											*5650	4340	*4660	3370	14.83
(26.1 ft)	lb											*12460	9560	*10280	7430	48.46
6.0 m	kg									*8630	6090	6910	4180	*4710	2900	15.44
(19.6 ft)	lb									*19020	13410	15230	9200	*10380	6390	50.43
4.0 m	kg							*10140	8260	9120	5650	6650	3930	4720	2620	15.74
(13.1 ft)	lb							*22350	18200	20100	12460	14660	8670	10410	5770	51.40
2.0 m	kg			*19580	18830	*14100	11260	*11720	7480	8630	5200	6370	3670	4580	2490	15.75
(6.5 ft)	lb			*43170	41510	*31090	24830	*25850	16500	19030	11470	14040	8090	10100	5480	51.44
Ground	kg	*8750	*8750	*16190	*16190	*16220	10170	11440	6830	8200	4800	6120	3430	4640	2500	15.47
Line	lb	*19290	*19290	*35700	*35700	*35760	22420	25210	15060	18090	10590	13490	7570	10220	5510	50.54
-2.0 m	kg	*10880	*10880	*16310	16250	16450	9540	10950	6390	7900	4520	5950	3270	4910	2670	14.90
(-6.5 ft)	lb	*24000	*24000	*35960	35830	36270	21030	24140	14090	17410	9950	13110	7210	10830	5880	48.66
-4.0 m	kg	*13250	*13250	*18360	16130	16170	9290	10710	6170	7740	4370			5500	3060	13.97
(-13.1 ft)	lb	*29200	*29200	*40470	35570	35650	20480	23620	13610	17070	9640			12120	6740	45.64
-6.0 m	kg	*15890	*15890	*21580	16380	16220	9340	10720	6180	7780	4410			*6510	3820	12.62
(-19.6 ft)	lb	*35030	*35030	*47580	36110	35760	20580	23620	13610	17150	9720			*14360	8420	41.22
-8.0 m	kg	*18910	*18910	*20210	16950	*15890	9660	10990	6430					*7990	5450	10.63
(-26.1 ft)	lb	*41690	*41690	*44550	37370	*34580	21290	24230	14170					*17610	12020	34.72
-10.0 m	kg			*16560	*16560	*12870	10380							*9870	7950	8.72
(-32.7 ft)	lb			*36500	*36500	*28380	22880							*21760	17520	28.48

6. BUCKET SELECTION GUIDE

1) HX480 L

(1) GENERAL BUCKET

			
1.00 m^3 SAE heaped bucket	1.38 m^3 SAE heaped bucket	2.20 m^3, 2.79 m^3 SAE heaped bucket	3.00 m^3 SAE heaped bucket

Capacity		Width	Weight	Recommendation						
				7.06 m (23' 2") boom				6.55 m (21' 6") boom		9.00 m (29' 6") boom
SAE heaped	CECE heaped			2.4 m arm (7' 10")	2.9 m arm (9' 6")	3.38 m arm (11' 1")	4.0 m arm (13' 1")	2.4 m arm (7' 10")	2.9 m arm (9' 6")	6.00 m arm (19' 8")
1.00 m^3 (1.31 yd^3)	0.90 m^3 (1.18 yd^3)	1030 mm (41")	1450 kg (3200 lb)	○	○	○	○	○	○	○
1.38 m^3 (1.80 yd^3)	1.24 m^3 (1.62 yd^3)	1215 mm (48")	1670 kg (3680 lb)	○	○	○	○	○	○	●
2.20 m^3 (2.88 yd^3)	1.93 m^3 (2.52 yd^3)	1685 mm (66")	2030 kg (4480 lb)	○	○	○	⊙	○	○	
2.79 m^3 (3.65 yd^3)	2.47 m^3 (3.23 yd^3)	1865 mm (73")	2300 kg (5070 lb)	⊙	⊙	●	●	○	○	
3.00 m^3 (3.92 yd^3)	2.70 m^3 (3.53 yd^3)	1985 mm (78")	2440 kg (5380 lb)	●	●	●	●	○	○	

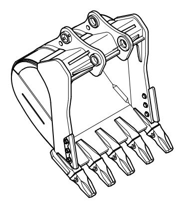
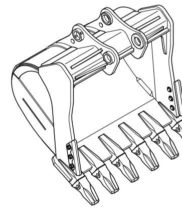
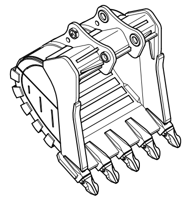
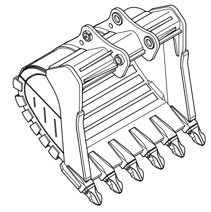
○ Applicable for materials with density of 2000 kg/m^3 (3370 lb/yd^3) or less

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

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

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

(2) HEAVY DUTY AND ROCK-HEAVY DUTY BUCKET

			
◈2.20 m^3 SAE ◈2.43 m^3 SAE ◈2.79 m^3 SAE heaped bucket	◈3.20 m^3 SAE heaped bucket	◆2.20 m^3 SAE ◆2.43 m^3 SAE ◆2.79 m^3 SAE heaped bucket	◆3.20 m^3 SAE heaped bucket

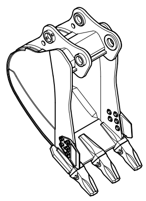
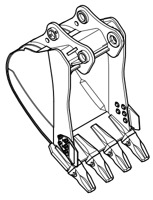
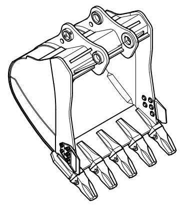
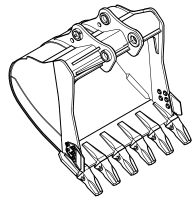
Capacity		With	Weight	Recommendation						
				7.06 m (23' 2") boom				6.55 m (21' 5") boom		9.00 m (29' 6") boom
SAE heaped	CECE heaped			2.4 m arm (7' 10")	2.9 m arm (9' 6")	3.38 m arm (11' 1")	4.0 m arm (13' 1")	2.4 m arm (7' 10")	2.9 m arm (9' 6")	6.00 m arm (19' 8")
◈2.20 m^3 (2.88 yd^3)	1.93 m^3 (2.52 yd^3)	1685 mm (66")	2320 kg (5110 lb)	○	○	⊙	⊙	○	○	
◈2.43 m^3 (3.18 yd^3)	2.11 m^3 (2.76 yd^3)	1830 mm (72")	2450 kg (5400 lb)	⊙	⊙	⊙	●	○	○	
◈2.79 m^3 (3.65 yd^3)	2.47 m^3 (3.23 yd^3)	1865 mm (73")	2630 kg (5800 lb)	⊙	●	●	●	○	○	
◈3.20 m^3 (4.19 yd^3)	2.82 m^3 (3.69 yd^3)	2075 mm (82")	2870 kg (6330 lb)	●	●	●		⊙	⊙	
◆2.20 m^3 (2.88 yd^3)	1.93 m^3 (2.52 yd^3)	1685 mm (66")	2610 kg (5750 lb)	○	⊙	⊙		○	○	
◆2.43 m^3 (3.18 yd^3)	2.11 m^3 (2.76 yd^3)	1830 mm (72")	2730 kg (6020 lb)	⊙	⊙	●		○	○	
◆2.79 m^3 (3.65 yd^3)	2.47 m^3 (3.23 yd^3)	1865 mm (73")	2950 kg (6500 lb)	●	●	●		○	⊙	
◆3.20 m^3 (4.19 yd^3)	2.82 m^3 (3.69 yd^3)	2075 mm (82")	3230 kg (7120 lb)	●	●			⊙	⊙	

◈ : Heavy duty bucket
◆ : Rock-Heavy duty bucket

○	Applicable for materials with density of 2000 kg/m^3 (3370 lb/yd^3) or less
⊙	Applicable for materials with density of 1600 kg/m^3 (2700 lb/yd^3) or less
●	Applicable for materials with density of 1100 kg/m^3 (1850 lb/yd^3) or less

2) HX520 L

(1) GENERAL BUCKET

			
1.00 m³ SAE heaped bucket	1.38 m³ SAE heaped bucket	2.20 m³ SAE 2.79 m³ SAE heaped bucket	3.00 m³ SAE heaped bucket

Capacity		Width	Weight	Recommendation						
				7.06 m (23' 2") boom				6.55 m (21' 6") boom		9.00 m (29' 6") boom
SAE heaped	CECE heaped			2.4 m arm (7' 10")	2.9 m arm (9' 6")	3.38 m arm (11' 1")	4.0 m arm (13' 1")	2.4 m arm (7' 10")	2.9 m arm (9' 6")	6.00 m arm (19' 8")
1.00 m^3 (1.31 yd^3)	0.90 m^3 (1.18 yd^3)	1030 mm (41")	1450 kg (3200 lb)	○	○	○	○	○	○	○
1.38 m^3 (1.80 yd^3)	1.24 m^3 (1.62 yd^3)	1215 mm (48")	1670 kg (3680 lb)	○	○	○	○	○	○	●
2.20 m^3 (2.88 yd^3)	1.93 m^3 (2.52 yd^3)	1685 mm (66")	2030 kg (4480 lb)	○	○	○	○	○	○	
2.79 m^3 (3.65 yd^3)	2.47 m^3 (3.23 yd^3)	1865 mm (73")	2300 kg (5070 lb)	○	⊙	⊙	⊙	○	○	
3.00 m^3 (3.92 yd^3)	2.70 m^3 (3.53 yd^3)	1985 mm (78")	2440 kg (5380 lb)	⊙	⊙	⊙	●	○	○	

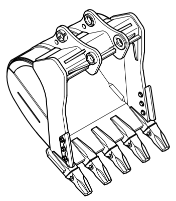
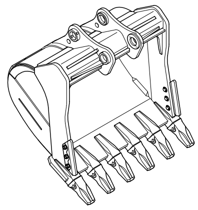
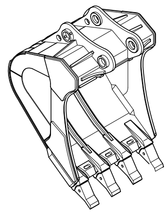
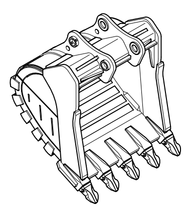
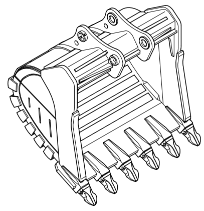
○ Applicable for materials with density of 2000 kg/m^3 (3370 lb/yd^3) or less

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

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

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

(2) HEAVY DUTY AND ROCK-HEAVY DUTY BUCKET

				
◈2.20 m^3 SAE ◈2.43 m^3 SAE ◈2.79 m^3 SAE heaped bucket	◈3.20 m^3 SAE heaped bucket	◆1.81 m^3 SAE heaped bucket	◆2.20 m^3 SAE ◆2.43 m^3 SAE ◆2.70 m^3 SAE ◆2.79 m^3 SAE heaped bucket	◆3.00 m^3 SAE ◆3.20 m^3 SAE heaped bucket

Capacity		With	Weight	Recommendation						
				7.06 m (23' 2") boom				6.55 m (21' 5") boom		9.00 m (29' 6") boom
SAE heaped	CECE heaped			2.4 m arm (7' 10")	2.9 m arm (9' 6")	3.38 m arm (11' 1")	4.0 m arm (13' 1")	2.4 m arm (7' 10")	2.9 m arm (9' 6")	6.00 m arm (19' 8")
◈2.20 m^3 (2.88 yd^3)	1.93 m^3 (2.52 yd^3)	1685 mm (66")	2320 kg (5110 lb)	○	○	○	○	○	○	
◈2.43 m^3 (3.18 yd^3)	2.11 m^3 (2.76 yd^3)	1830 mm (72")	2450 kg (5400 lb)	○	○	○	⊙	○	○	
◈2.79 m^3 (3.65 yd^3)	2.47 m^3 (3.23 yd^3)	1865 mm (73")	2630 kg (5800 lb)	○	⊙	⊙	●	○	○	
◈3.20 m^3 (4.19 yd^3)	2.82 m^3 (3.69 yd^3)	2075 mm (82")	2870 kg (6330 lb)	⊙	●	●	●	⊙	⊙	
◆1.81 m^3 (2.37 yd^3)	1.50 m^3 (1.96 yd^3)	1540 mm (61")	2650 kg (5840 lb)	○	○	○		○	○	
◆2.20 m^3 (2.88 yd^3)	1.93 m^3 (2.52 yd^3)	1685 mm (66")	2610 kg (5750 lb)	○	○	○		○	○	
◆2.43 m^3 (3.18 yd^3)	2.11 m^3 (2.76 yd^3)	1830 mm (72")	2730 kg (6020 lb)	○	○	⊙		○	○	
◆2.70 m^3 (3.53 yd^3)	2.39 m^3 (3.13 yd^3)	1800 mm (71")	2770 kg (6110 lb)	○	⊙	⊙		○	○	
◆2.79 m^3 (3.65 yd^3)	2.47 m^3 (3.23 yd^3)	1865 mm (73")	2950 kg (6500 lb)	⊙	⊙	⊙		○	⊙	
◆3.00 m^3 (3.92 yd^3)	2.76 m^3 (3.61 yd^3)	1995 mm (79")	3040 kg (6700 lb)	⊙	●	●		⊙	⊙	
◆3.20 m^3 (4.19 yd^3)	2.82 m^3 (3.69 yd^3)	2075 mm (82")	3230 kg (7120 lb)	●	●	●		⊙	⊙	

◈ : Heavy duty bucket
◆ : Rock-Heavy duty bucket

○ Applicable for materials with density of 2000 kg/m^3 (3370 lb/yd^3) or less
⊙ Applicable for materials with density of 1600 kg/m^3 (2700 lb/yd^3) or less
● Applicable for materials with density of 1100 kg/m^3 (1850 lb/yd^3) or less

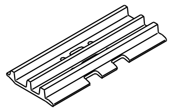
7. UNDERCARRIAGE

1) HX480 L

(1) TRACKS

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

(2) TYPES OF SHOES

Model	Shapes		Triple grouser				
							
HX480 L	Shoe width	mm (in)	600 (24)	700 (28)	750 (30)	800 (32)	900 (36)
	Operating weight	kg (lb)	49500 (109130)	50020 (110280)	50280 (110850)	50540 (111420)	51060 (112570)
	Ground pressure	kgf/cm^2 (psi)	0.86 (12.23)	0.75 (10.67)	0.70 (9.95)	0.66 (9.39)	0.59 (8.39)
	Overall width	mm (ft-in)	3340 (10' 11")	3440 (11' 3")	3490 (11' 5")	3540 (11' 7")	3640 (11' 11")
	Shoe width	mm (in)	★600 (24)	★700 (28)	-	-	-
	Operating weight	kg (lb)	49315 (108720)	49835 (109870)	-	-	-
	Ground pressure	kgf/cm^2 (psi)	0.86 (12.23)	0.74 (10.52)	-	-	-
	Overall width	mm (ft-in)	3340 (10' 11")	3440 (11' 3")	-	-	-
	Shoe width	mm (in)	●600 (24)	●700 (28)	-	-	-
	Operating weight	kg (lb)	49680 (109530)	50230 (110740)	-	-	-
	Ground pressure	kgf/cm^2 (psi)	0.86 (12.23)	0.75 (10.67)	-	-	-
	Overall width	mm (ft-in)	3340 (10' 11")	3440 (11' 3")	-	-	-

★ : Double grouser
● : Heavy duty grouser

(3) NUMBER OF ROLLERS AND SHOES ON EACH SIDE

Item	Quantity
Carrier rollers	2 EA
Track rollers	9 EA
Track shoes	53 EA

(4) SELECTION OF TRACK SHOE

Suitable track shoes should be selected according to operating conditions.

Method of selecting shoes

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

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

※ Table 1

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

※ Table 2

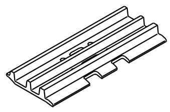
Category	Applications	Applications
A	Rocky ground, river beds, normal soil	· Travel at low speed on rough ground with large obstacles such as boulders or fallen trees
B	Normal soil, soft ground	· These shoes cannot be used on rough ground with large obstacles such as boulders or fallen trees · Travel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

2) HX520 L

(1) TRACKS

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

(2) TYPES OF SHOES

Model	Shapes		Triple grouser			
						
HX520 L	Shoe width	mm (in)	600 (24)	700 (28)	750 (30)	800 (32)
	Operating weight	kg (lb)	52400 (115520)	52920 (116670)	53180 (117240)	53440 (117810)
	Ground pressure	kgf/cm^2 (psi)	0.91 (12.94)	0.79 (11.23)	0.74 (10.52)	0.70 (9.95)
	Overall width	mm (ft-in)	3540 (11' 7")	3640 (11' 11")	3690 (12' 1")	3740 (12' 3")
	Shoe width	mm (in)	★600 (24)	★700 (28)	-	-
	Operating weight	kg (lb)	52215 (115110)	52735 (116260)	-	-
	Ground pressure	kgf/cm^2 (psi)	0.91 (12.94)	0.78 (11.09)	-	-
	Overall width	mm (ft-in)	3540 (11' 7")	3640 (11' 11")	-	-
	Shoe width	mm (in)	●600 (24)	●700 (28)	-	-
	Operating weight	kg (lb)	52580 (115920)	53130 (117130)	-	-
	Ground pressure	kgf/cm^2 (psi)	0.91 (12.94)	0.79 (11.2)	-	-
	Overall width	mm (ft-in)	3540 (11' 7")	3640 (11' 11")	-	-

★ : Double grouser
● : Heavy duty grouser

(3) NUMBER OF ROLLERS AND SHOES ON EACH SIDE

Item	Quantity
Carrier rollers	3 EA
Track rollers	9 EA
Track shoes	53 EA

(4) SELECTION OF TRACK SHOE

Suitable track shoes should be selected according to operating conditions.

Method of selecting shoes

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

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

※ Table 1

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

※ Table 2

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

8. SPECIFICATIONS FOR MAJOR COMPONENTS

1) ENGINE

Item	Specification
Model	Scania DC13
Type	4-cycle turbocharged charger air cooled diesel engine
Cooling method	Water cooling
Number of cylinders and arrangement	6 cylinders, in-line
Firing order	1-5-3-6-2-4
Combustion chamber type	Direct injection type
Cylinder bore × stroke	130 × 160 mm (5.12" × 6.3")
Piston displacement	12700 cc (775 cu in)
Compression ratio	17.5 : 1
Rated net horse power (SAE J1349)	424 Hp at 1900 rpm (316 kW at 1900 rpm)
Rated gross horse power (SAE J1995)	444 Hp at 1900 rpm (331 kW at 1900 rpm)
Maximum torque	232 kgf · m (1678 lbf · ft) at 1300 rpm
Engine oil quantity	38 ℓ (10 U.S. gal)
Dry weight	1075 kg (2370 lb)
Low idling speed	800 ± 50 rpm
High idling speed	1900 + 50 rpm
Rated fuel consumption	152.8 g/Hp · hr at 1900 rpm
Starting motor	24V-5.5kW
Alternator	24V-100A
Battery	2 × 12V × 200Ah

2) MAIN PUMP

Item	Specification
Type	Variable displacement tandem axis piston pumps
Capacity	2 × 200 cc/rev
Maximum pressure	330 kgf/cm^2 (4690 psi) [360 kgf/cm^2 (5120 psi)]
Rated oil flow	2 × 380 ℓ/min (100.4 U.S. gpm / 83.6 U.K. gpm)
Rated speed	1750 rpm

[ ] : Power boost

3) GEAR PUMP

Item	Specification
Type	Fixed displacement gear pump single stage
Capacity	16 cc/rev
Maximum pressure	40 kgf/cm² (570 psi)
Rated oil flow	28 ℓ/min (7.4 U.S. gpm/6.2 U.K. gpm)

4) MAIN CONTROL VALVE

Item		Specification	
		HX480/520 L	HX480/520 L Long reach
Type		9 spools	
Operating method		Hydraulic pilot system	
Main relief valve pressure		330 kgf/cm² (4690 psi) [360 kgf/cm² (5120 psi)]	
Port relief valve pressure	Boom	380 kgf/cm² (5400 psi)	380 kgf/cm² (5400 psi)
	Arm	380 kgf/cm² (5400 psi)	280 kgf/cm² (3980 psi)
	Bucket	380 kgf/cm² (5400 psi)	280 kgf/cm² (3980 psi)

[ ] : Power boost

5) SWING MOTOR

Item	Specification
Type	Fixed displacement axial piston motor
Capacity	142.6 cc/rev
Relief pressure	285 kgf/cm² (4050 psi)
Braking system	Automatic, spring applied hydraulic released
Braking torque	63.3 kgf · m (458 lbf · ft) over
Brake release pressure	Craking : 20.9 kgf/cm² (297 psi) Full stroke : 35.5 kgf/cm² (505 psi)
Reduction gear type	2 - stage planetary

6) TRAVEL MOTOR

Item	Specification
Type	Variable displacement axial piston motor
Relief pressure	330 kgf/cm² (4690 psi)
Capacity (max / min)	281.7/175.9 cc/rev
Reduction gear type	3-stage planetary
Braking system	Automatic, spring applied hydraulic released
Brake release pressure	15.7 kgf/cm² (114 psi) below
Braking torque	120 kgf · m (1707 lbf · ft) over

7) CYLINDER

Item		Specification
Boom cylinder	Bore dia × Rod dia × Stroke	Ø170 × Ø115 × 1570 mm
	Cushion	Extend only
Arm cylinder	Bore dia × Rod dia × Stroke	Ø190 × Ø130 × 1820 mm
	Cushion	Extend and retract
Bucket cylinder	Bore dia × Rod dia × Stroke	Ø160 × Ø110 × 1370 mm (HX480 L) Ø170 × Ø115 × 1370 mm (HX520 L)
	Cushion	Extend only

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

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

8) SHOE

Item		Width	Ground pressure	Link quantity	Overall width
HX480 L	Standard	600 mm (24")	0.86 kgf/cm² (12.23 psi)	53	3340 mm (10' 11")
	Option	700 mm (28")	0.75 kgf/cm² (10.67 psi)	53	3440 mm (11' 3")
		750 mm (30")	0.70 kgf/cm² (9.95 psi)	53	3490 mm (11' 5")
		800 mm (32")	0.66 kgf/cm² (9.39 psi)	53	3540 mm (11' 7")
		900 mm (36")	0.59 kgf/cm² (8.39 psi)	53	3640 mm (11' 11")
		★600 mm (24")	0.86 kgf/cm² (12.23 psi)	53	3340 mm (10' 11")
		★700 mm (28")	0.74 kgf/cm² (10.52 psi)	53	3440 mm (11' 3")
		●600 mm (24")	0.86 kgf/cm² (12.23 psi)	53	3340 mm (10' 11")
		●700 mm (28")	0.75 kgf/cm² (10.67 psi)	53	3440 mm (11' 3")
HX520 L	Standard	600 mm (24")	0.91 kgf/cm² (12.94 psi)	53	3540 mm (11' 7")
	Option	700 mm (28")	0.79 kgf/cm² (11.23 psi)	53	3640 mm (11' 11")
		750 mm (30")	0.74 kgf/cm² (10.52 psi)	53	3690 mm (12' 1")
		800 mm (32")	0.70 kgf/cm² (9.95 psi)	53	3740 mm (12' 3")
		★600 mm (24")	0.91 kgf/cm² (12.94 psi)	53	3540 mm (11' 7")
		★700 mm (28")	0.78 kgf/cm² (11.09 psi)	53	3640 mm (11' 11")
		●600 mm (24")	0.91 kgf/cm² (12.94 psi)	53	3540 mm (11' 7")
		●700 mm (28")	0.79 kgf/cm² (11.2 psi)	53	3640 mm (11' 11")

★ : Double grouser
● : Heavy duty grouser

9) BUCKET

Item	Capacity		Tooth quantity	Width
	SAE heaped	CECE heaped		
HX480 L	1.00 m^3 (1.31 yd^3)	0.90 m^3 (1.18 yd^3)	3	1030 mm (41")
	1.38 m^3 (1.80 yd^3)	1.24 m^3 (1.62 yd^3)	4	1215 mm (48")
	2.20 m^3 (2.88 yd^3)	1.93 m^3 (2.52 yd^3)	5	1685 mm (66")
	2.79 m^3 (3.65 yd^3)	2.47 m^3 (3.23 yd^3)	5	1865 mm (73")
	3.00 m^3 (3.92 yd^3)	2.70 m^3 (3.53 yd^3)	6	1985 mm (78")
	◈2.20 m^3 (2.88 yd^3)	1.93 m^3 (2.52 yd^3)	5	1685 mm (66")
	◈2.43 m^3 (3.18 yd^3)	2.11 m^3 (2.76 yd^3)	5	1830 mm (72")
	◈2.79 m^3 (3.65 yd^3)	2.47 m^3 (3.23 yd^3)	5	1865 mm (73")
	◈3.20 m^3 (4.19 yd^3)	2.82 m^3 (3.69 yd^3)	6	2075 mm (82")
	◆2.20 m^3 (2.88 yd^3)	1.93 m^3 (2.52 yd^3)	5	1685 mm (66")
	◆2.43 m^3 (3.18 yd^3)	2.11 m^3 (2.76 yd^3)	5	1830 mm (72")
	◆2.79 m^3 (3.65 yd^3)	2.47 m^3 (3.23 yd^3)	5	1865 mm (73")
	◆3.20 m^3 (4.19 yd^3)	2.82 m^3 (3.69 yd^3)	6	2075 mm (82")
HX520 L	1.00 m^3 (1.31 yd^3)	0.90 m^3 (1.18 yd^3)	3	1030 mm (41")
	1.38 m^3 (1.80 yd^3)	1.24 m^3 (1.62 yd^3)	4	1215 mm (48")
	2.20 m^3 (2.88 yd^3)	1.93 m^3 (2.52 yd^3)	5	1685 mm (66")
	2.79 m^3 (3.65 yd^3)	2.47 m^3 (3.23 yd^3)	5	1865 mm (73")
	3.00 m^3 (3.92 yd^3)	2.70 m^3 (3.53 yd^3)	6	1985 mm (78")
	◈2.20 m^3 (2.88 yd^3)	1.93 m^3 (2.52 yd^3)	5	1685 mm (66")
	◈2.43 m^3 (3.18 yd^3)	2.11 m^3 (2.76 yd^3)	5	1830 mm (72")
	◈2.79 m^3 (3.65 yd^3)	2.47 m^3 (3.23 yd^3)	5	1865 mm (73")
	◈3.20 m^3 (4.19 yd^3)	2.82 m^3 (3.69 yd^3)	6	2075 mm (82")
	◆1.81 m^3 (2.37 yd^3)	1.50 m^3 (1.96 yd^3)	4	1540 mm (61")
	◆2.20 m^3 (2.88 yd^3)	1.93 m^3 (2.52 yd^3)	5	1685 mm (66")
	◆2.43 m^3 (3.18 yd^3)	2.11 m^3 (2.76 yd^3)	5	1830 mm (72")
	◆2.70 m^3 (3.53 yd^3)	2.39 m^3 (3.13 yd^3)	5	1800 mm (71")
	◆2.79 m^3 (3.65 yd^3)	2.47 m^3 (3.23 yd^3)	5	1865 mm (73")
	◆3.00 m^3 (3.92 yd^3)	2.76 m^3 (3.61 yd^3)	6	1995 mm (79")
	◆3.20 m^3 (4.19 yd^3)	2.82 m^3 (3.69 yd^3)	6	2075 mm (82")

◈ : Heavy duty bucket
◆ : Rock - heavy duty bucket

9. RECOMMENDED OILS

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

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

Service point	Kind of fluid	Capacity ℓ (U.S. gal)	Ambient temperature °C(°F): -50 (-58), -30 (-22), -20 (-4), -10 (14), 0 (32), 10 (50), 20 (68), 30 (86), 40 (104)
Engine oil pan	Engine oil	38.0 (10)	★SAE 5W-40 SAE 30 SAE 10W SAE 10W-30 SAE 15W-40
DEF/ AdBlue® tank	Mixture of urea and deionized water	69 (18.2)	ISO 22241, High-purity urea + deionized water (32.5:67.5)
Swing drive	Gear oil	7.0×2 (1.8×2)	★SAE 75W-90
Final drive	Gear oil	12×2 (3.2×2)	SAE 80W-90
Hydraulic tank	Hydraulic oil	Tank : 262 (69.2) System : 486 (128.4)	★ISO VG 15 ISO VG 32 ISO VG 46, HBHO VG 46★3 ISO VG 68
Fuel tank	Diesel fuel★1	621 (182)	★ASTM D975 NO.1 ASTM D975 NO.2
Fitting (grease nipple)	Grease	As required	★NLGI NO.1 NLGI NO.2
Radiator (reservoir tank)	Mixture of antifreeze and soft water★2	49.0 (13)	Ethylene glycol base permanent type (50 : 50) ★Ethylene glycol base permanent type (60 : 40)

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

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

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

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

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

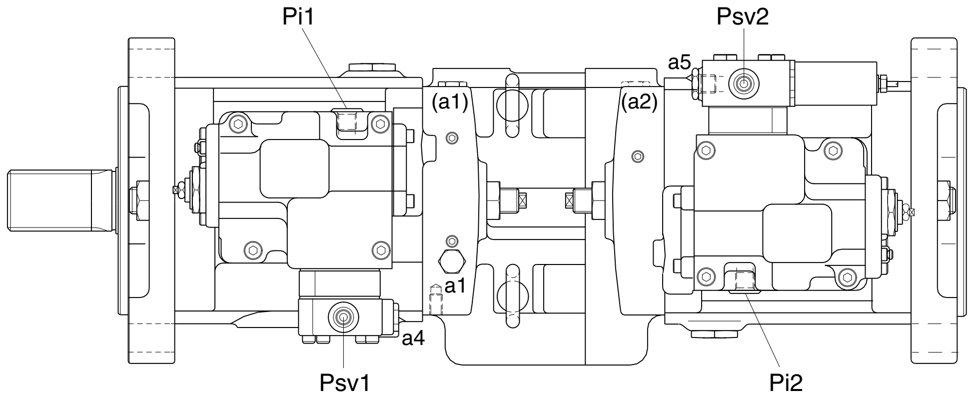
※ For HD Hyundai Construction Equipment genuine lubricating oils and grease for use in regions with extremely low temperatures, please contact HD Hyundai Construction Equipment dealers.

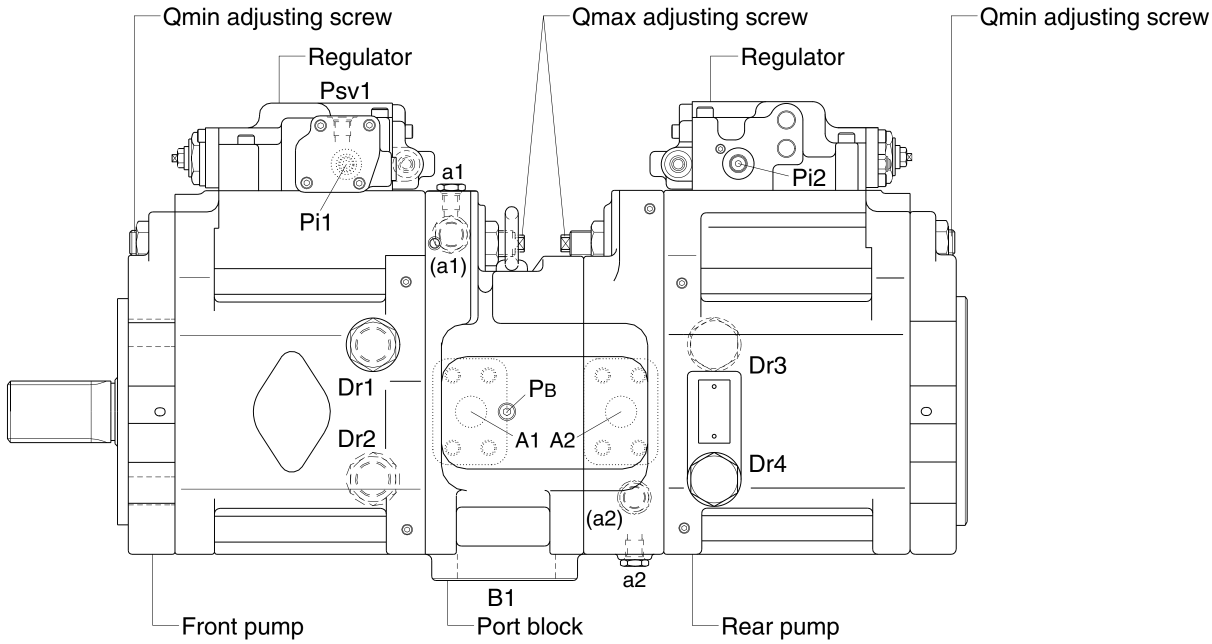
SECTION 2 STRUCTURE AND FUNCTION

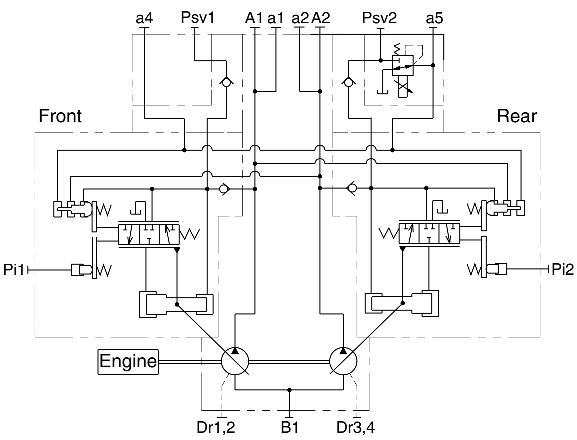
GROUP 1 PUMP DEVICE

1. STRUCTURE

The pump device consists of main pump, regulator.







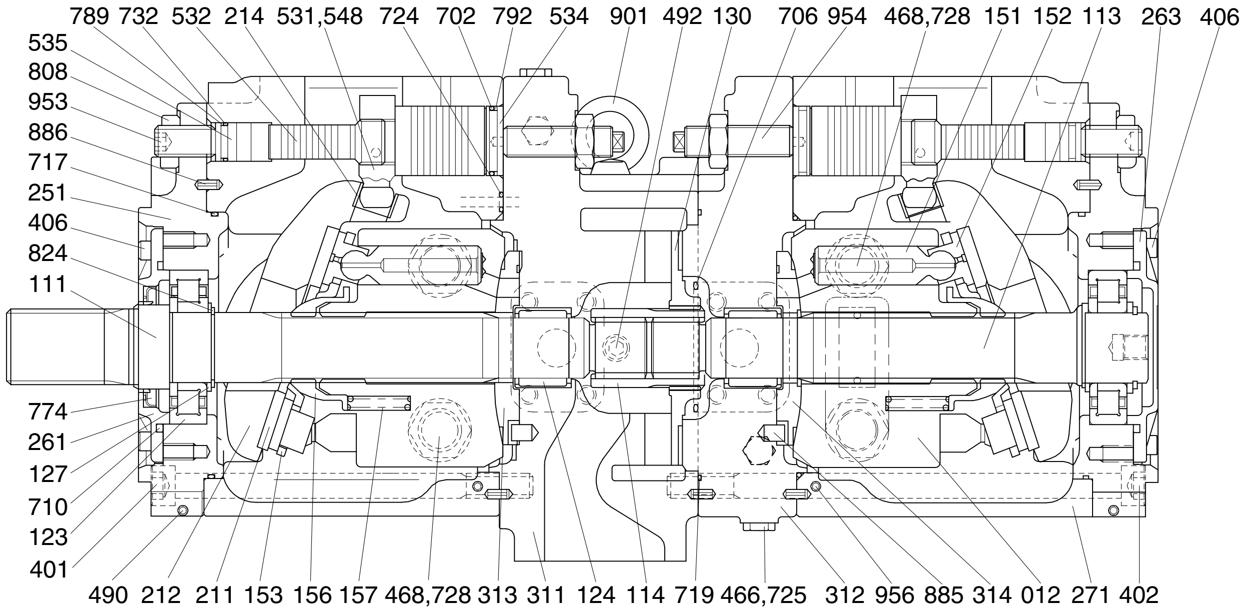
Hvdraulic circuit

480F2MP01

Port	Port name	Port size
A1,A2	Delivery port	SAE6000psi 1"
B1	Suction port	SAE2500psi 3"
Dr1~Dr4	Drain port	PF 3/4 - 23
Pi1,Pi2	Pilot port	PF 1/4 - 15
Psv1, Psv2	Servo assist port	PF 1/4 - 15
a1, a2, a4, a5	Gauge port	PF 1/4 - 15

1) MAIN PUMP(1/2)

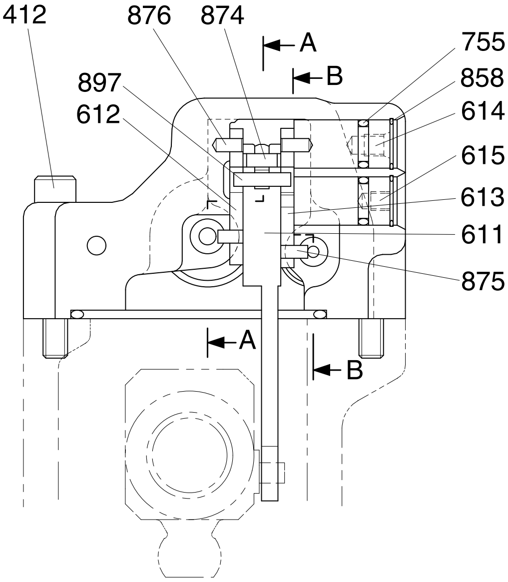
The main pump consists of two piston pumps (front & rear) and valve block.

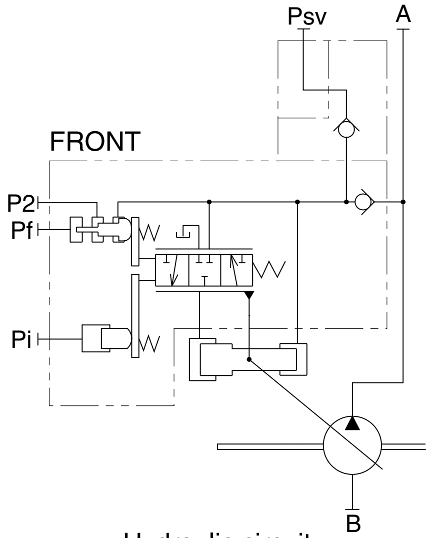


480F2MP02

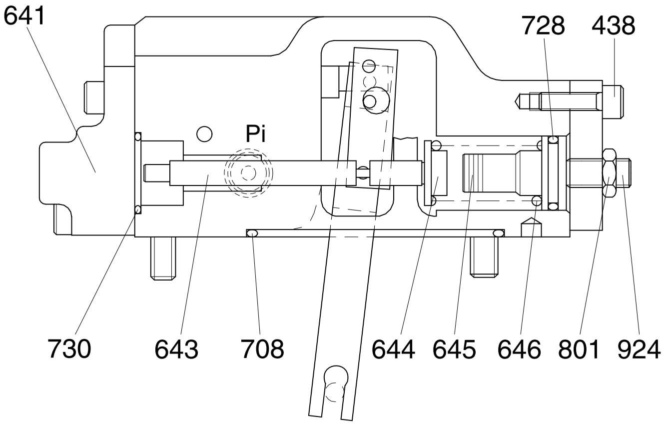
012	Cylinder block	271	Pump casing	710	O-ring
111	Drive shaft (F)	311	Valve cover (F)	717	O-ring
113	Driven shaft (R)	312	Valve cover (R)	719	O-ring
114	Coupling	313	Valve plate (R)	724	Square ring
123	Roller bearing	314	Valve plate (L)	725	O-ring
124	Needle bearing	401	Hexagon socket bolt	728	O-ring
127	Spacer	402	Hexagon socket bolt	732	O-ring
130	Booster	406	Hexagon socket bolt	774	Oil seal
151	Piston	466	VP Plug	789	Back up ring
152	Shoe	468	VP Plug	792	Back up ring
153	Set plate	490	VP Plug	808	Hexagon head nut
156	Bushing	492	VP Plug	824	Snap ring
157	Cylinder spring	531	Tilting pin	885	Valve plate pin
211	Shoe plate	532	Servo piston	886	Spring pin
212	Swash plate	534	Stopper (L)	901	Eye bolt
214	Tilting bushing	535	Stopper (S)	953	Set screw
251	Support plate	548	Feed back pin	954	Set screw
261	Seal cover (F)	702	O-ring	956	Set screw
263	Seal cover (R)	706	O-ring		

2) FRONT REGULATOR (1/2)

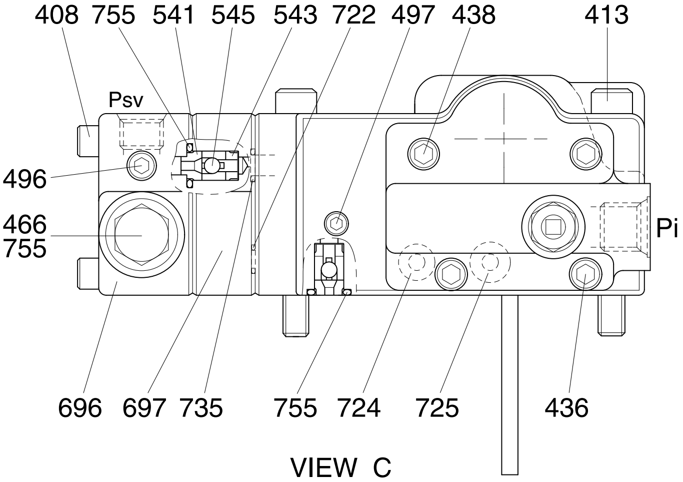




Hydraulic circuit



SECTION B-B

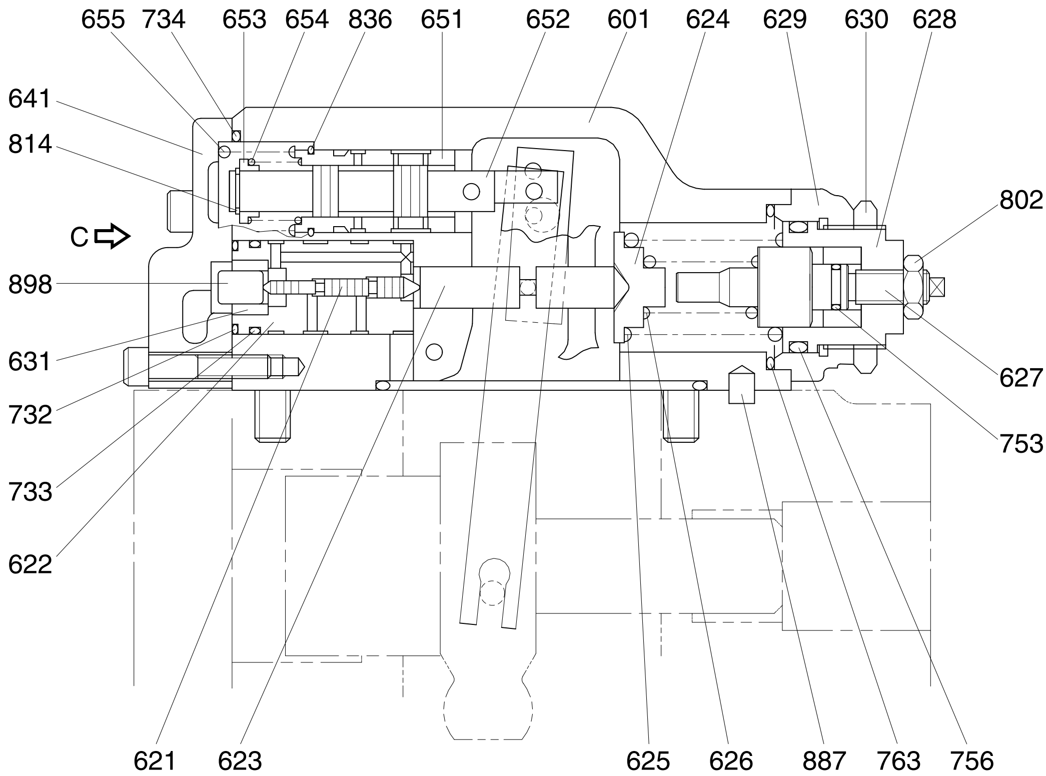


VIEW C

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

480F2RG01

FRONT REGULATOR (2/2)

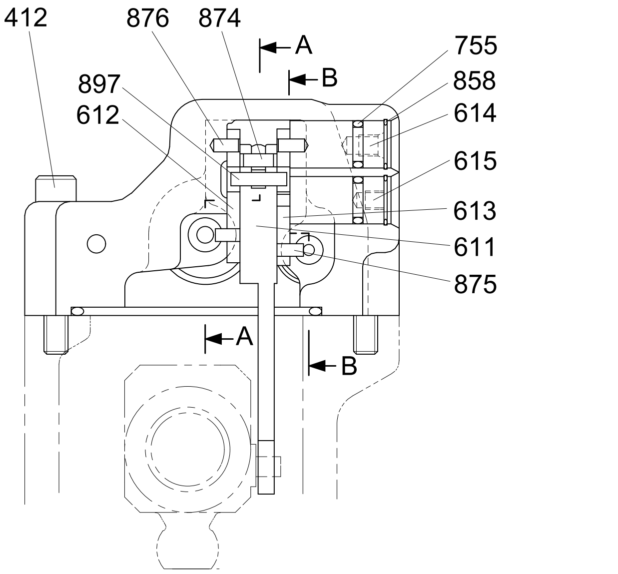


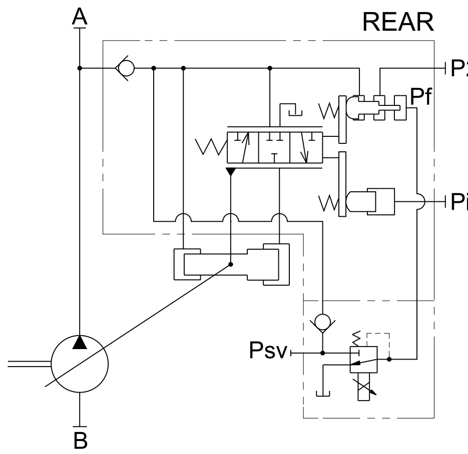
SECTION A-A

48092RG02

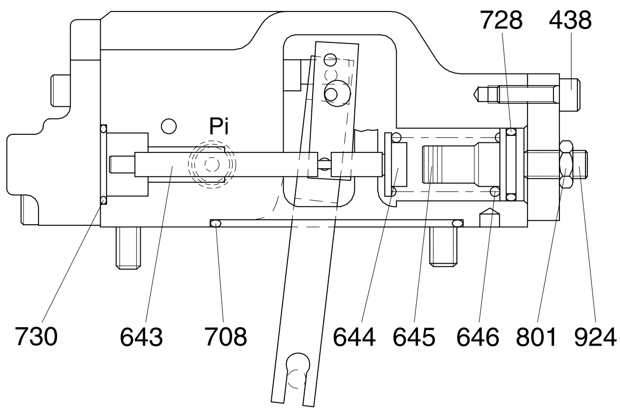
408	Hexagon socket screw	626	Inner spring	728	O-ring
412	Hexagon socket screw	627	Adjust stem (C)	730	O-ring
413	Hexagon socket screw	628	Adjust screw (C)	732	O-ring
436	Hexagon socket screw	629	Cover (C)	733	O-ring
438	Hexagon socket screw	630	Lock nut	734	O-ring
466	Plug	631	Sleeve, pf	735	O-ring
496	Plug	641	Pilot cover	753	O-ring
497	Plug	643	Pilot piston	755	O-ring
541	Seat	644	Spring seat (Q)	756	O-ring
543	Stopper	645	Adjust stem (Q)	763	O-ring
545	Steel ball	646	Pilot spring	801	Nut
601	Casing	651	Sleeve	802	Nut
611	Feed back lever	652	Spool	814	Snap ring
612	Lever (1)	653	Spring seat	836	Snap ring
613	Lever (2)	654	Return spring	858	Snap ring
614	Center plug	655	Set spring	874	Pin
615	Adjust plug	696	Port cover	875	Pin
621	Compensator piston	697	Check valve plate	876	Pin
622	Piston case	708	O-ring	887	Pin
623	Compensator rod	722	O-ring	897	Pin
624	Spring seat (C)	724	Square ring	898	Pin
625	Outer spring	725	O-ring	924	Set screw

3) REAR REGULATOR (1/2)

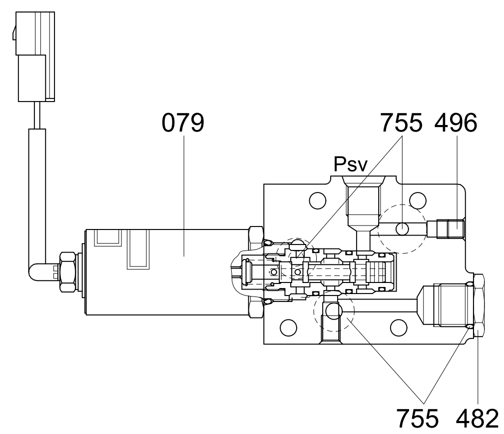




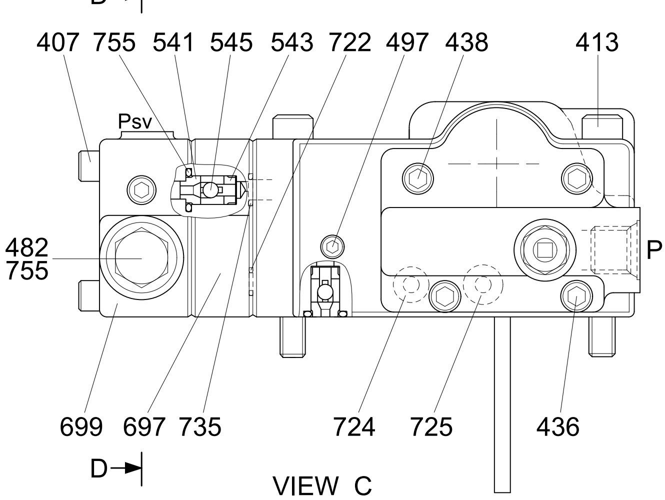
Hydraulic circuit



SECTION B-B



SECTION D-D

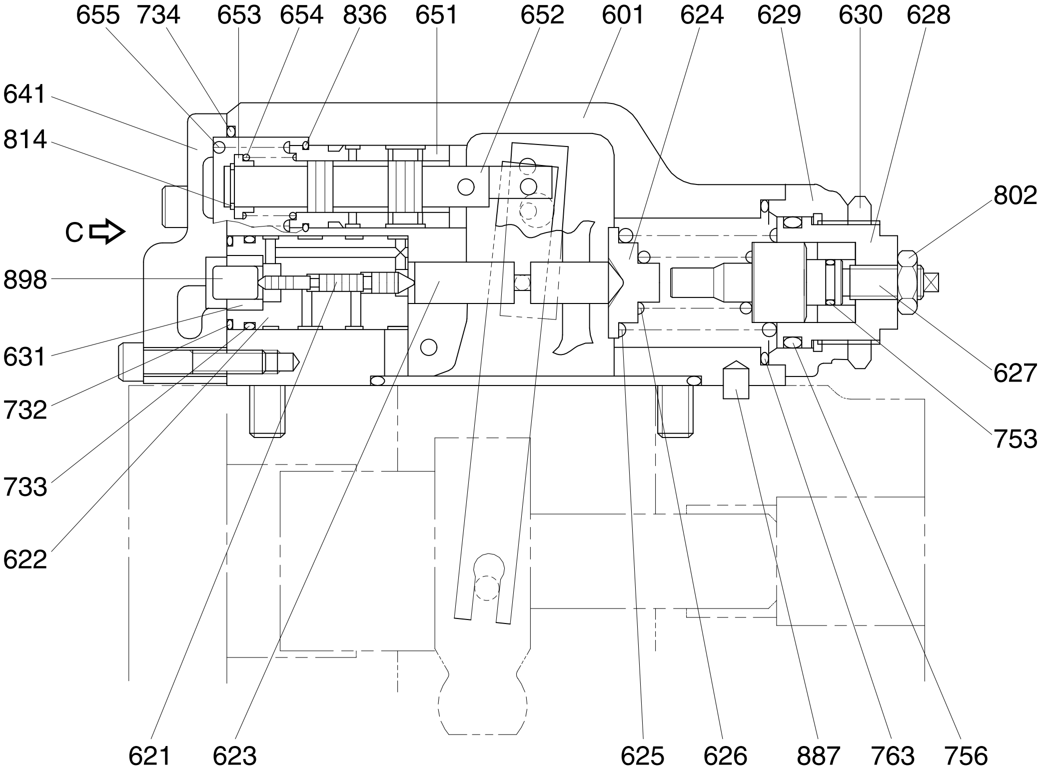


VIEW C

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

480F2RG03

REAR REGULATOR (2/2)

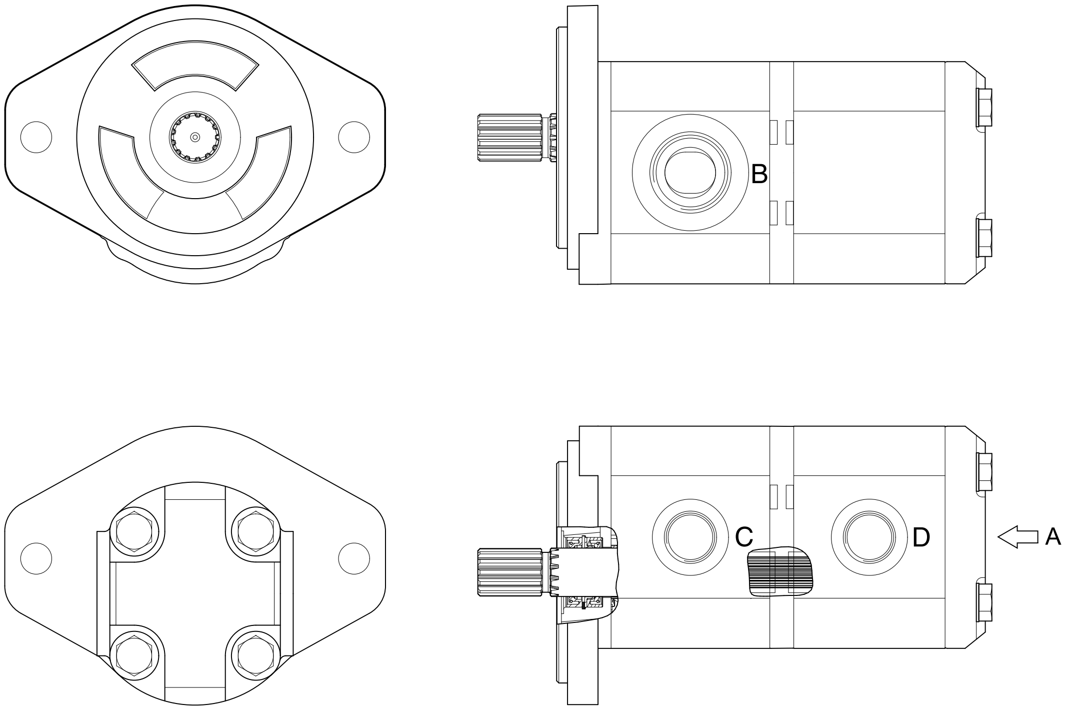


SECTION A-A

48092RG02

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

4) GEAR PUMP (1/2)

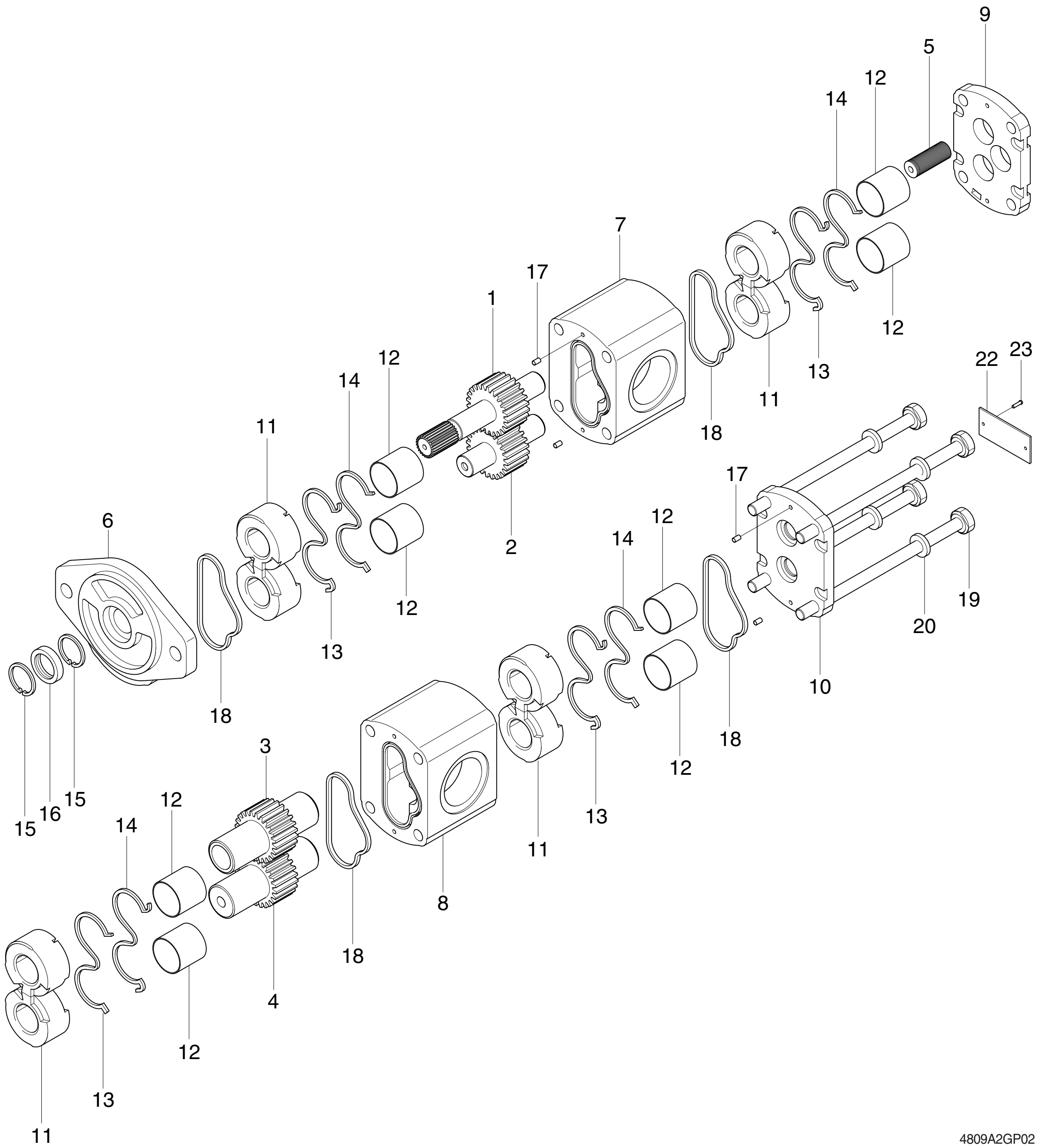


VIEW A　　REAR VIEW

Port	Name	Size
B	Suction port	PF 1"
C	Delivery port (fan motor)	7/8"-14UNF
D	Delivery port (pilot line)	7/8"-14UNF

480F2GP01

GEAR PUMP (2/2)



1	Multi shaft gear 1	9	Multi spacer	17	Dowel pin
2	Driven gear 2	10	Rear cover	18	D-ring
3	Joint driven gear 3	11	Bushing block	19	Bolt
4	Driven gear 4	12	DU-Bushing	20	Washer
5	Connector	13	Channel seal	21	Name plate
6	Front cover	14	Back up seal	23	Rivet
7	Gear housing 1	15	Retainer seal		
8	Gear housing 2	16	Snap ring		

2. FUNCTION

1) MAIN PUMP

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

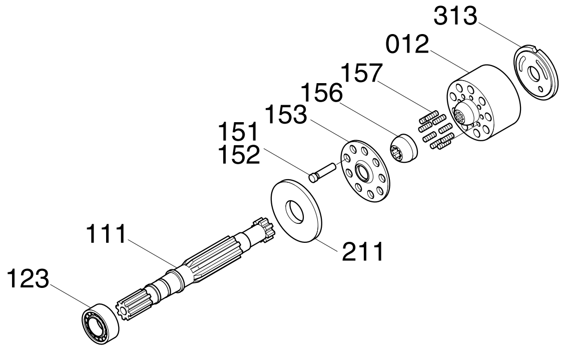
(1) Rotary group

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

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

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

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



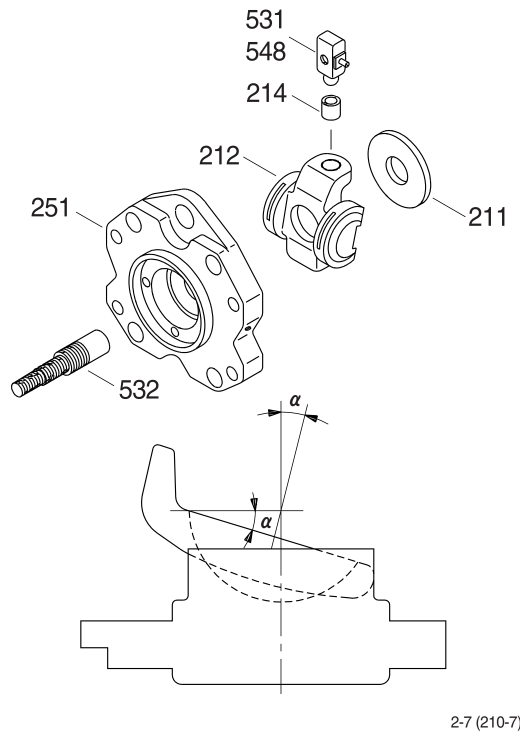
50072MP01

(2) Swash plate group

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

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

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



2-7 (210-7)

(3) Valve block group

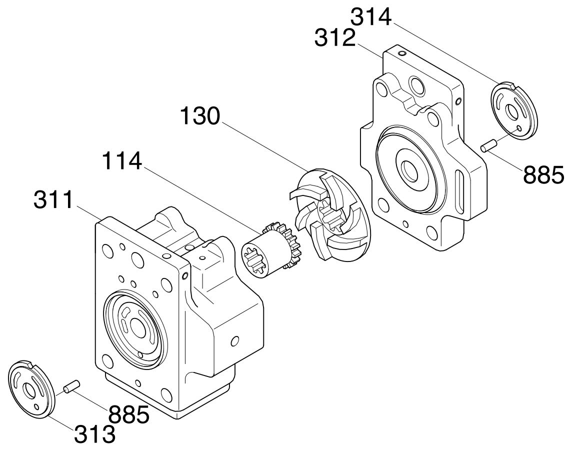
The valve cover group consists of valve cover (F, 311), valve cover (R, 312), valve plate (313, 314), spline coupling (114), booster (130) and valve plate pin (885).

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

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

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

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



36072MP03

2) REGULATOR

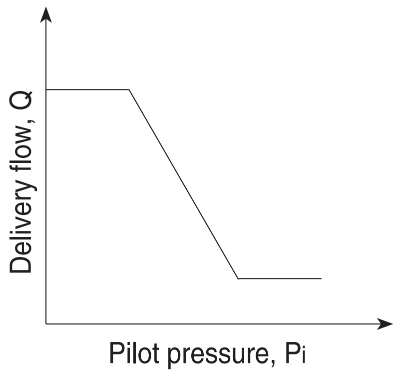
Regulator consists of the negative flow control, total horse power control and power shift control function

(1) Negative flow control

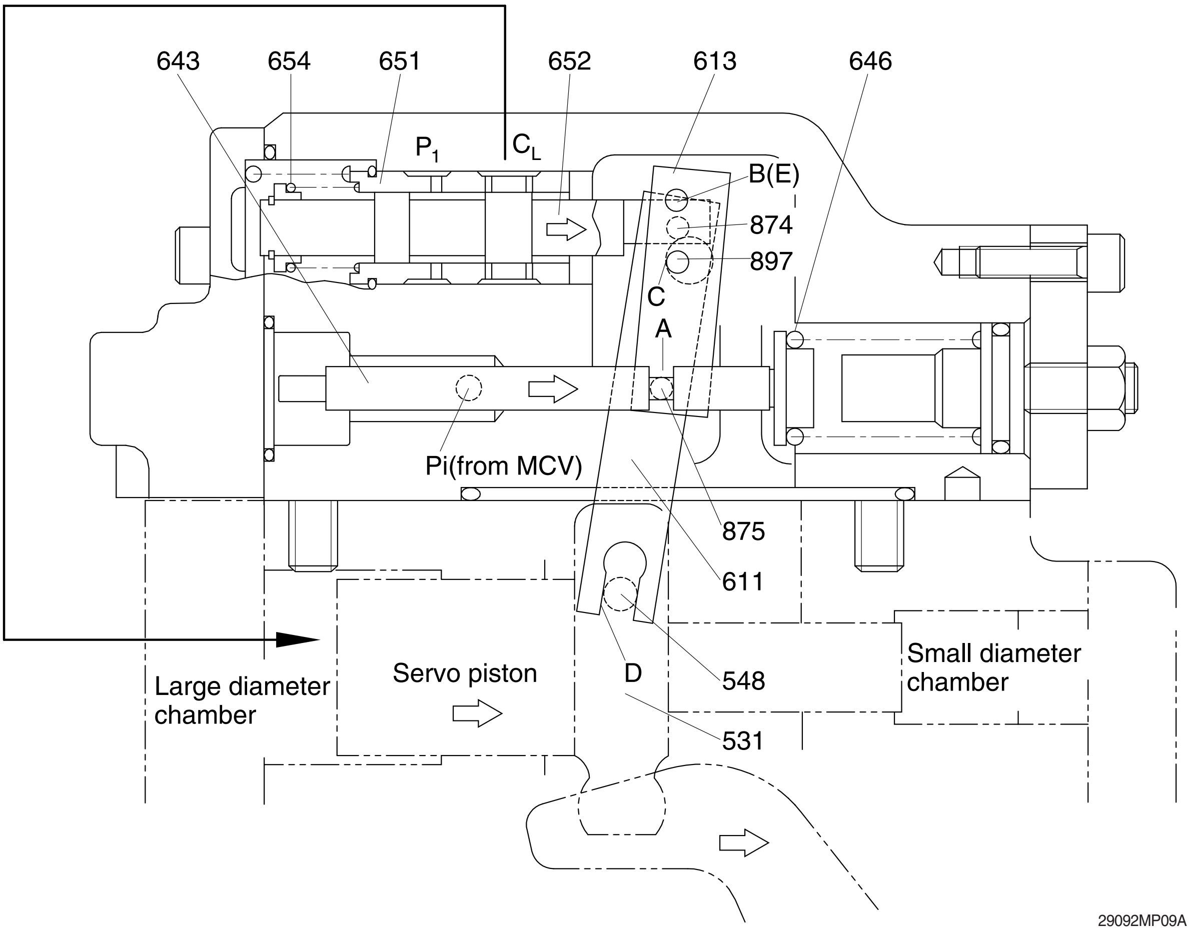
By changing the pilot pressure Pi, the pump tilting angle (delivery flow) is regulated arbitrarily, as shown in the figure.

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

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

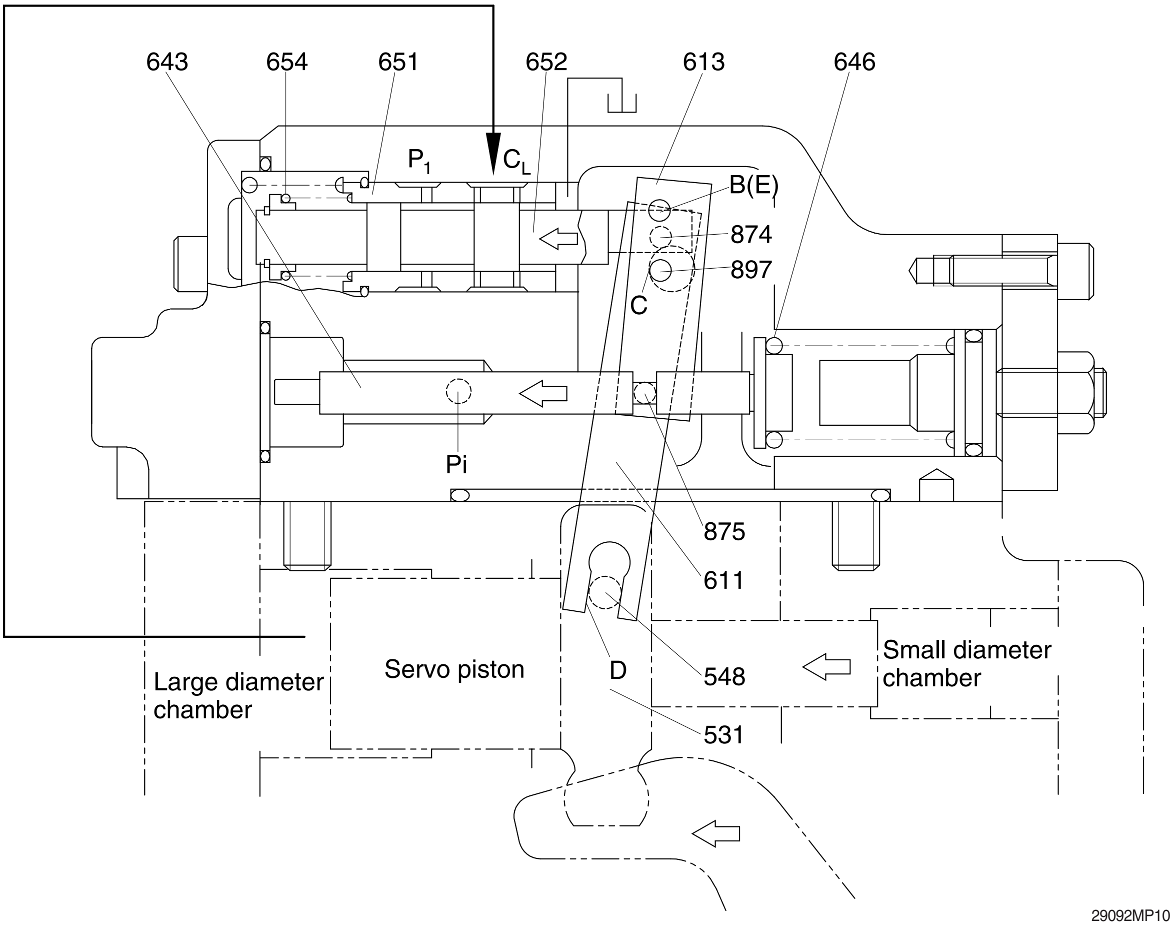


① Flow reducing function



As the pilot pressure Pi rises, the pilot piston (643) moves to the right to a position where the force of the pilot spring (646) balances with the hydraulic force.
The groove (A) in the pilot piston is fitted with the pin (875) that is fixed to lever 2 (613). Therefore, when the pilot piston moves, lever 2 rotates around the fulcrum of point B [Fixed by the fulcrum plug (614) and pin (875)]. Since the large hole section (C) of lever 2 contains a protruding pin (897) fixed to the feedback lever (611), the pin (897) moves to the right as lever 2 rotates. Since the opposing-flat section (D) of the feedback lever is fitted with the pin (548) fixed by the tilting pin (531) that swings the swash plate, the feedback lever rotates around the fulcrum of point D, as the pin (897) moves.
Since the feedback lever is connected with the spool (652) via the pin (874), the spool moves to the right.
The movement of the spool causes the delivery pressure P1 to connect to port CL through the spool and to be admitted to the large diameter section of the servo piston. The delivery pressure P1 that is constantly admitted to the small diameter section of the servo piston moves the servo piston to the right due to the area difference, resulting in decrease of the tilting angle.
When the servo piston moves to the right, point D also moves to the right. The spool is fitted with the return spring (654) and is tensioned to the left at all times, and so the pin (897) is pressed against the large hole section (C) of lever 2.
Therefore, as point D moves, the feedback lever rotates around the fulcrum of point C, and the spool is shifted to the left. This causes the opening between the sleeve (651) and spool (652) to close slowly, and the servo piston comes to a complete stop when it closes completely.

② Flow increasing function



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

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

③ Adjustment of flow control characteristic

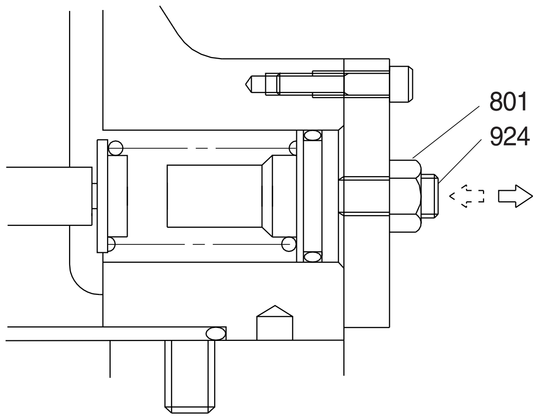
The flow control characteristic can be adjusted with the adjusting screw.

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

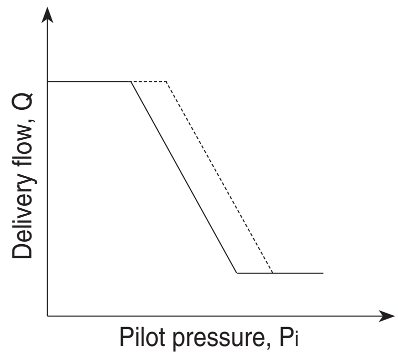
Tightening the screw shifts the control chart to the right as shown in the figure.

※ Adjusting values are shown in table.

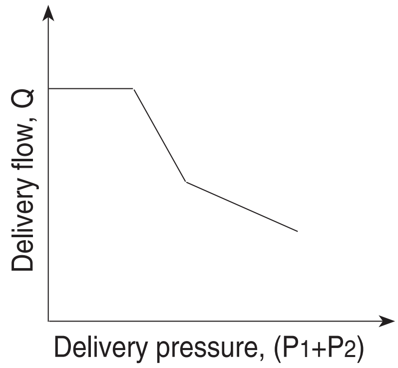
Speed	Adjustment of flow control characteristic		
	Tightening amount of adjusting screw (924)	Flow control starting pressure change amount	Flow change amount
(min $^{-1}$)	(Turn)	(kgf/cm ^{2})	(l /min)
1800	+1/4	+1.02	+21



2-12 (210-7)



(2) Total horsepower control



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

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

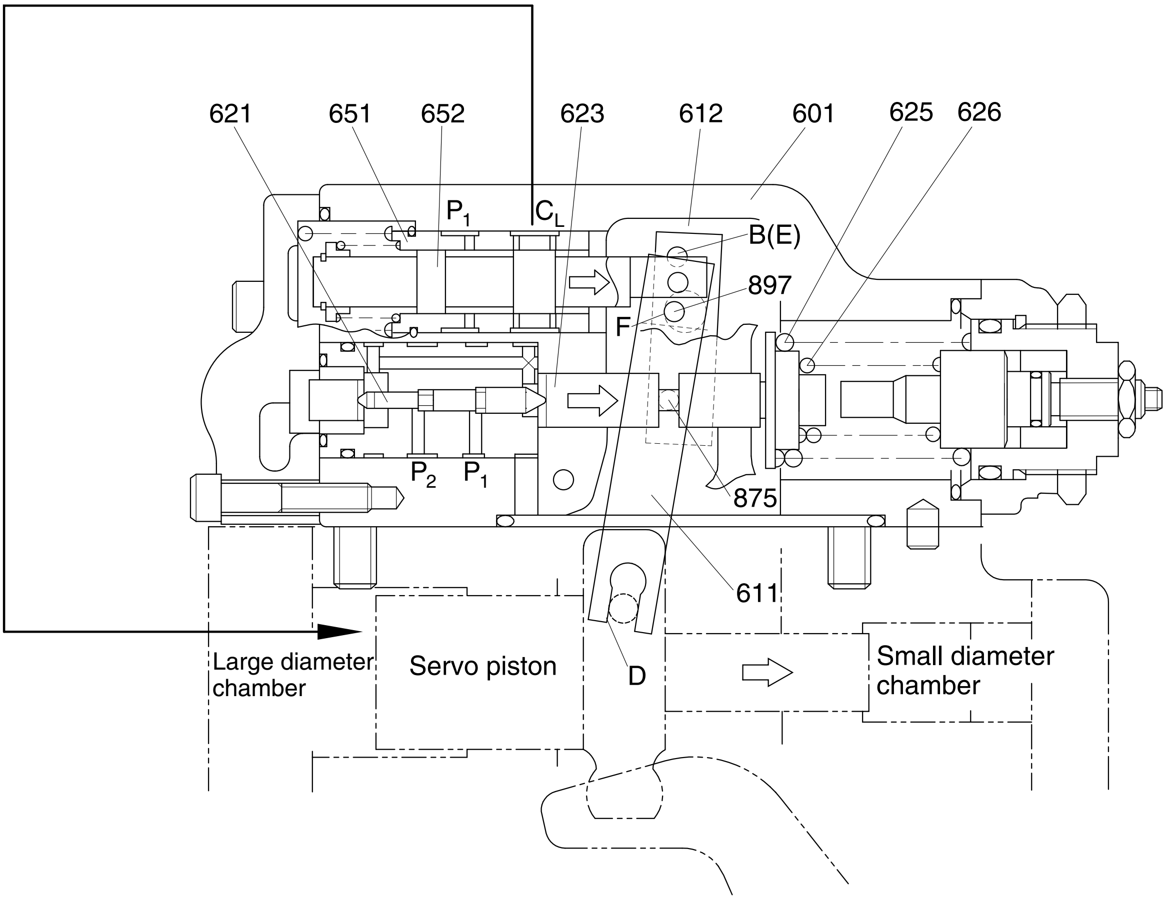
Since the regulator is of the simultaneous total horsepower type that operates by the sum of load pressures of the two pumps in the tandem double-pump system, the prime mover is automatically prevented from being overloaded, irrespective of the load condition of the two pumps, when horsepower control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

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

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

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

① Overload preventive function

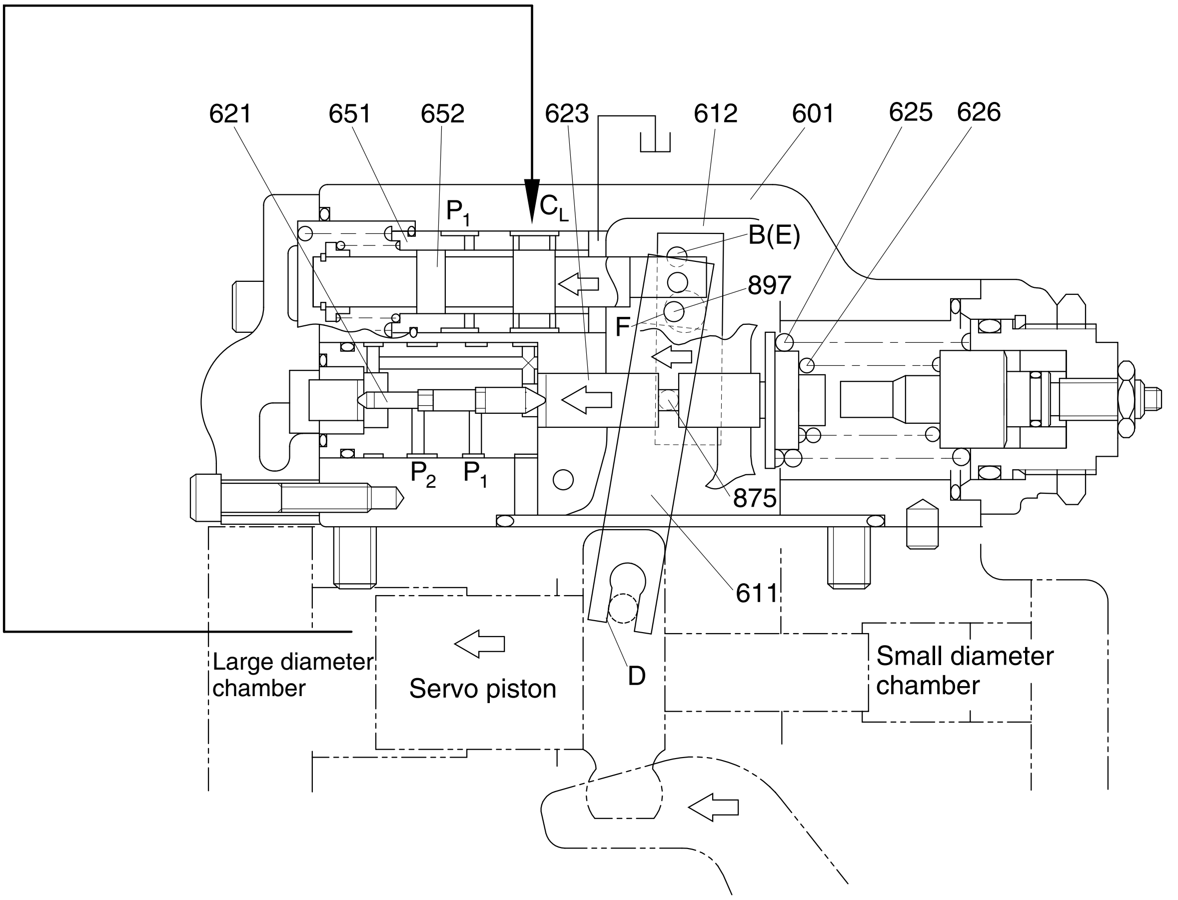


When the self pump delivery pressure P1 or the companion pump delivery pressure P2 rises, it acts on the stepped part of the compensating piston (621). It presses the compensating rod (623) to the right till the force of the outer spring (625) and inner spring (626) balances with the hydraulic force.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

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

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

② Flow reset function



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

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

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

③ **Low tilting angle (low flow) command preferential function**

As mentioned above, flow control and horsepower control tilting angle commands are transmitted to the feedback lever and spool via the large-hole sections (C & F) of levers 1 and 2. However, since sections C and F have the pins (ø4) protruding from the large hole (ø8), only the lever lessening the tilting angle contacts the pin (897) ; the hole (ø8) in the lever of a larger tilting angle command is freed without contacting the pin (897). Such a mechanical selection method permits preference of the lower tilting angle command of the flow control and horsepower control.

④ **Adjustment of input horsepower**

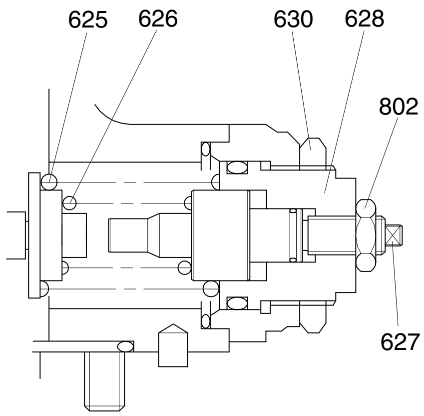
Since the regulator is of total cumulative horsepower type, adjust the adjusting screws of both the front and rear pumps, when changing the horsepower set values. The pressure change values by adjustment are based on two pumps pressurized at the same time, and the values will be doubled when only one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

a. **Adjustment of outer spring**

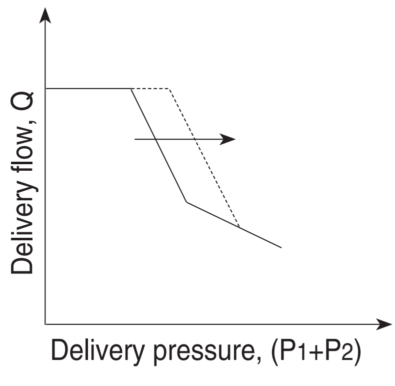
Adjust it by loosening the hexagon nut (630) and by tightening (or loosening) the adjusting screw C (628). Tightening the screw shifts the control chart to the right and increases the input horsepower as shown in the figure. Since turning the adjusting screw C by N turns changes the setting of the inner spring (626), return the adjusting screw QI (627) by N×A turns at first. (A=1.85)

※ **Adjusting values are shown in table.**

Speed	Adjustment of outer spring		
	Tightening amount of adjusting screw (C) (628)	Compensating control starting pressure change amount	Input torque change amount
(min^{-1})	(Turn)	(kgf/cm^2)	(kgf · m)
1800	+1/4	+17.8	+9.7



8007A2MP03



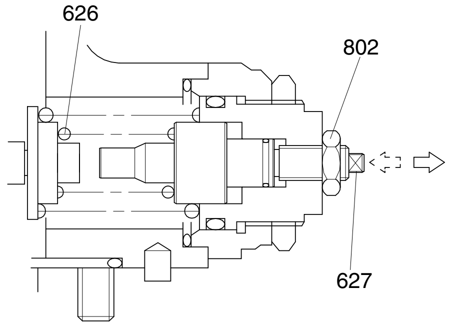
b. Adjustment of inner spring

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

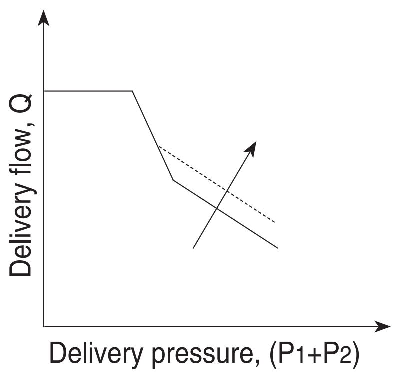
Tightening the screw increases the flow and then the input horsepower as shown in the figure.

※ Adjusting valves are shown in table.

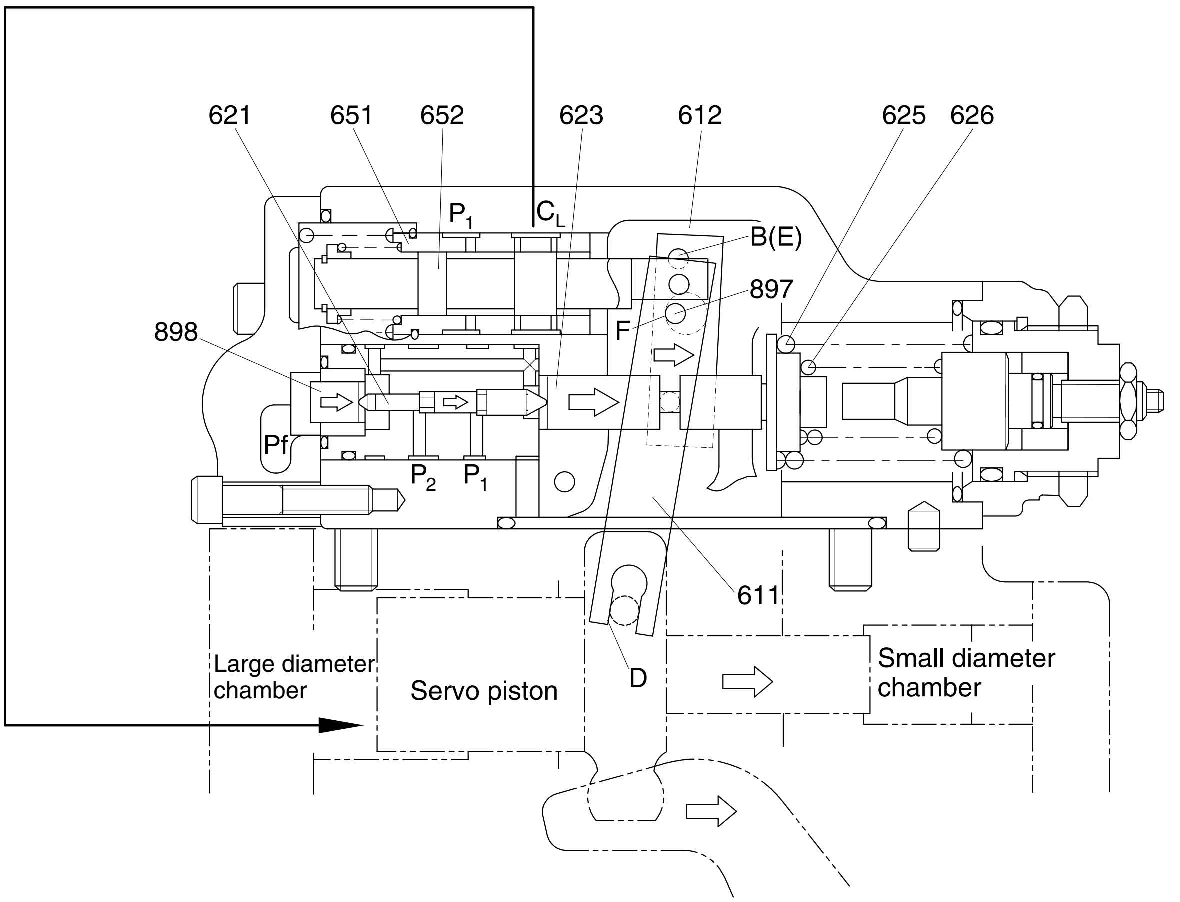
Speed	Adjustment of inner spring		
	Tightening amount of adjusting screw (QI) (627)	Flow change amount (lpm)	Input torque change amount
(min $^{-1}$)	(Turn)	(l /min)	(kgf · m)
1800	+1/4	+18.6	+10.4



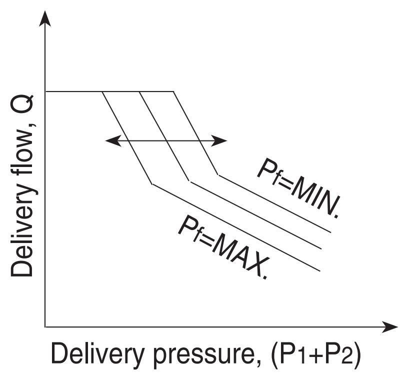
8007A2MP04



(3) Power shift control



29092MP13



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

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

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

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

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

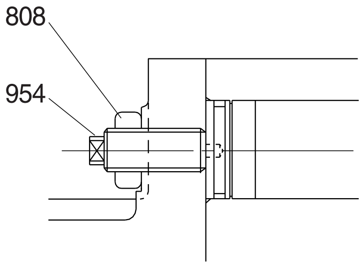
This decreases the pump tilting angle and then the set horsepower in the same way as explained in the overload preventive function of the horsepower control. On the contrary, the set horsepower rises as the power shift pressure Pf falls.

(4) Adjustment of maximum and minimum flows

① Adjustment of maximum flow

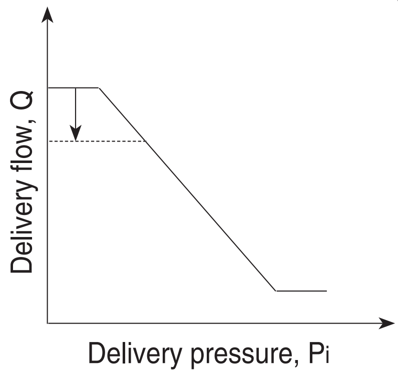
Adjust it by loosening the hexagon nut (808) and by tightening (or loosening) the set screw (954).

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



2-19 (1)

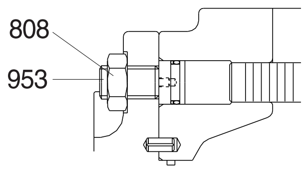
Speed	Adjustment of max flow spring	
	Tightening amount of adjusting screw (954)	Flow change amount
(min $^{-1}$)	(Turn)	(l/min)
1800	+1/4	-6.9



② Adjustment of minimum flow

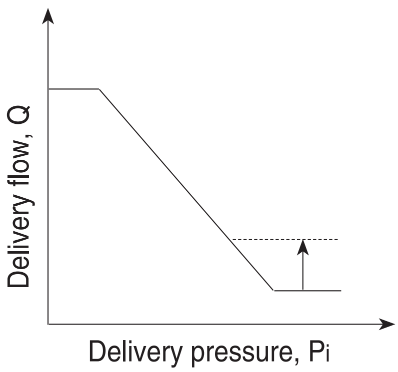
Adjust it by loosening the hexagon nut(808) and by tightening (or loosening) the hexagonal socket head set screw (953). Similarly to the adjustment of the maximum flow, other characteristics are not changed.

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

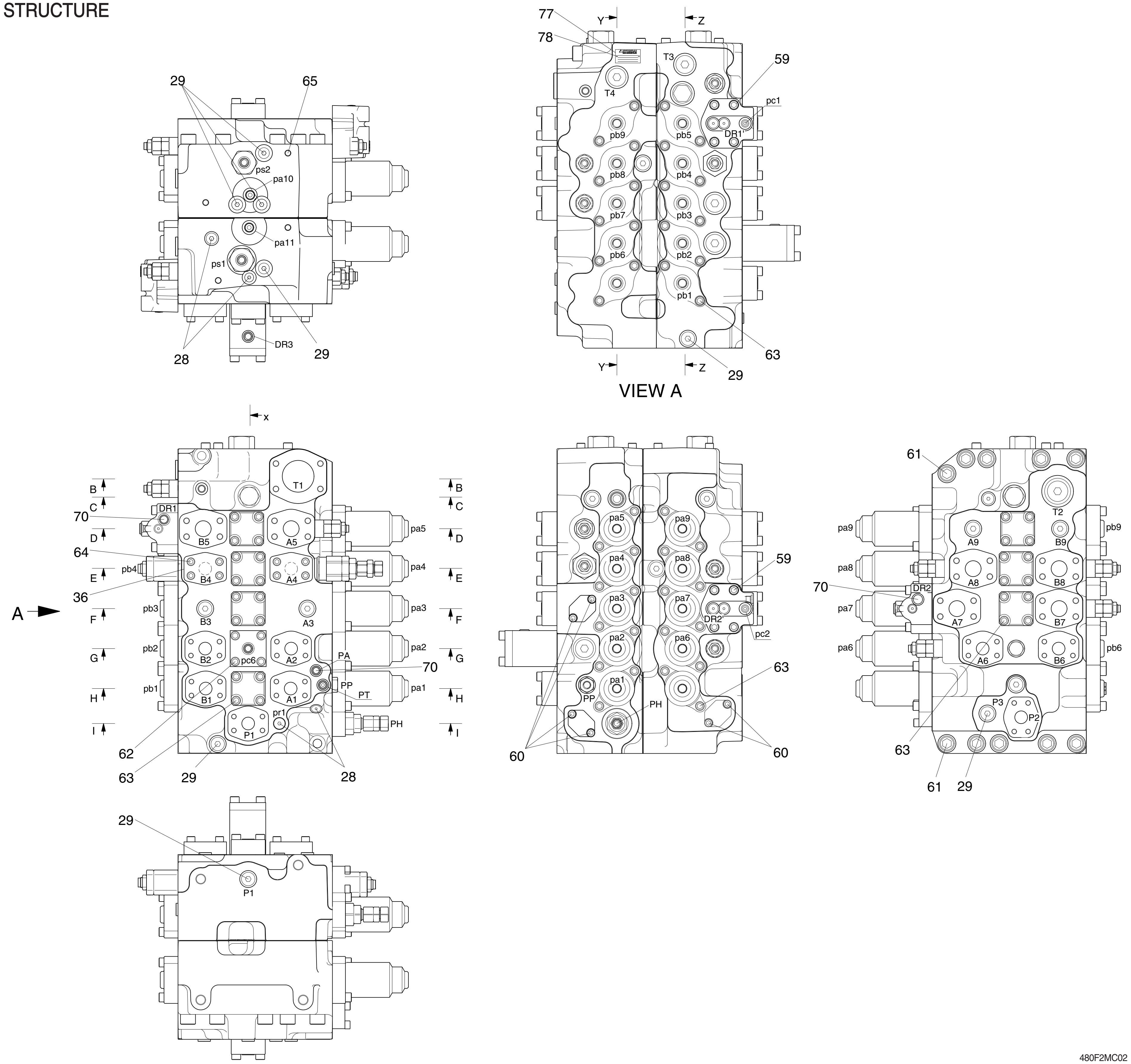


2-19 (2)

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



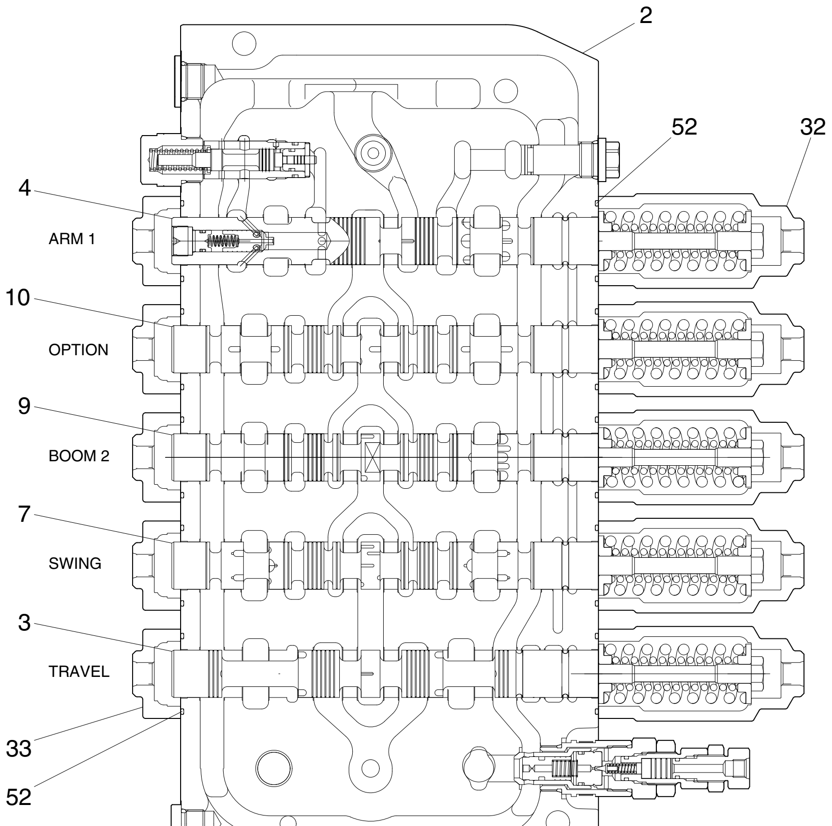
1. STRUCTURE



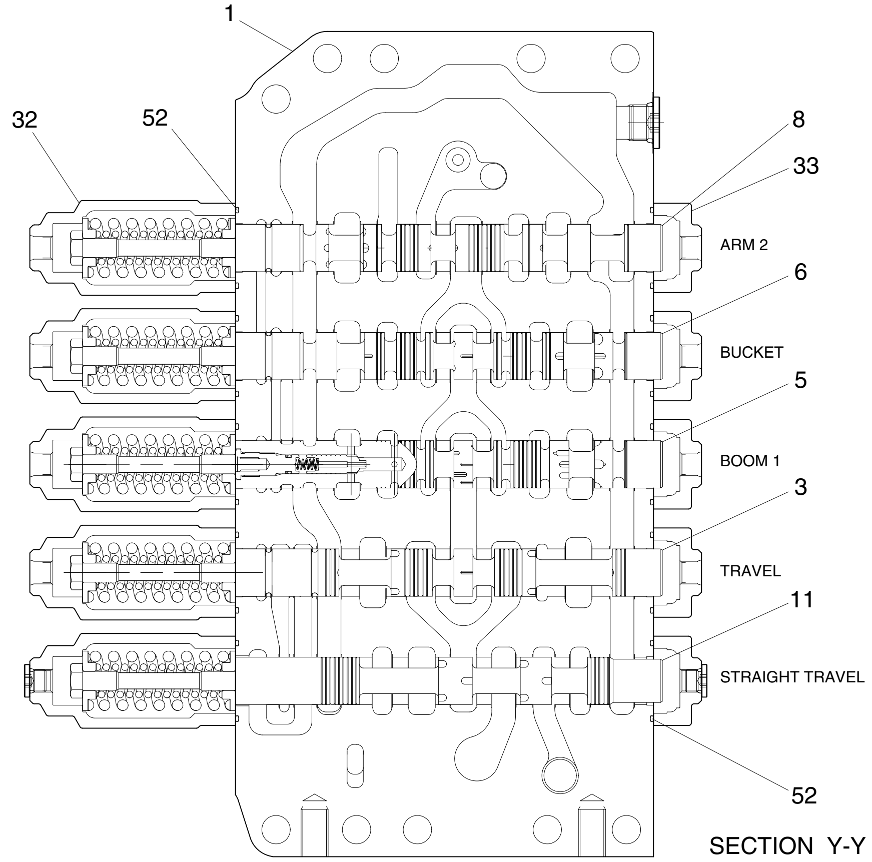
480F2MC02

Mark	Port size	Thread depth (mm)
DR1, DR2, DR3, DR1', DR2', pr1, ps1, ps2, pc1, pc2, pc6, pa10, pa11, PA, PP, PH, PT	PF 1/4	12
pa1~pa9, pb1~pb9	PF 3/8	14
A3, A9, B3, B9, P1, P3	PF 1/2	16
T3, T4	PF 3/4	17
T2	PF 1	21

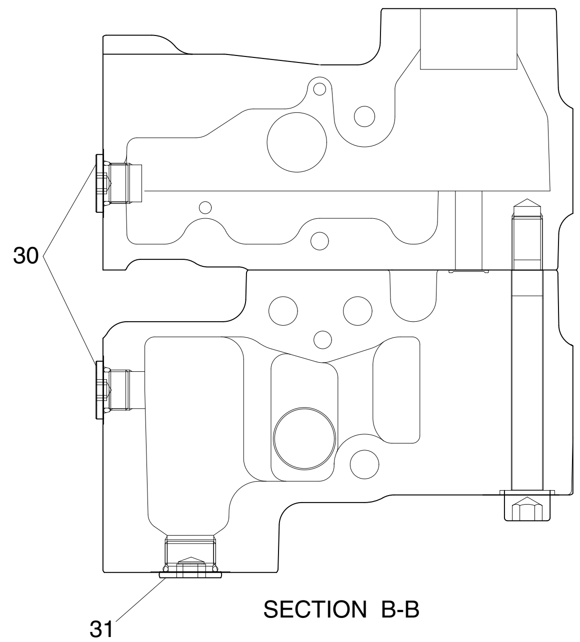
1 Housing (P1)
2 Housing (P2)
3 Travel spool assy
4 Arm 1 spool assy
5 Boom 1 spool assy
6 Bucket spool assy
7 Swing spool assy
8 Arm 2 spool assy
9 Boom 2 spool assy
10 Option spool assy
11 Straight travel spool assy
12 BC spool assy
13 Swing logic valve assy
14 Holding valve assy
15 Arm regen cut valve
16 Main relief valve assy
17 Overload relief valve assy
18 Overload relief valve assy
19 Overload relief valve assy
20 Overload relief valve assy
21 Overload relief valve assy
22 Negacon valve assy
23 Signal plug assy
24 BC plug assy
25 Plug assy
26 Plug assy
27 Plug assy (PF3/8)
28 Plug assy (PF1/4)
29 Plug assy (PF1/2)
30 Plug assy (PF3/4)
31 Plug assy (PF1)
32 Spool cap (L)
33 Spool cap (S)
34 Flange (LC)
35 Flange (MR)
36 Flange (OPT)
37 Poppet
38 Poppet
39 Poppet
40 Poppet
41 Poppet
42 Poppet
43 Poppet
45 MR spacer assy
46 BC spring
47 Spring
48 Spring
49 Spring
50 Spring
51 Plug (NPT 1/16)
52 O-ring (G55 18)
53 O-ring (G41 18)
54 O-ring (P26 18)
55 O-ring (P22 18)
56 O-ring (P10 18)
57 O-ring (P30 18)
58 O-ring (AN6227)
59 Socket head bolt (M12)
60 Socket head bolt (M10)
61 Socket head bolt (M20)
62 Socket head bolt (M12)
63 Socket head bolt (M12)
64 Socket head bolt (M10)
65 Socket head bolt (M12)
68 BC spring seat



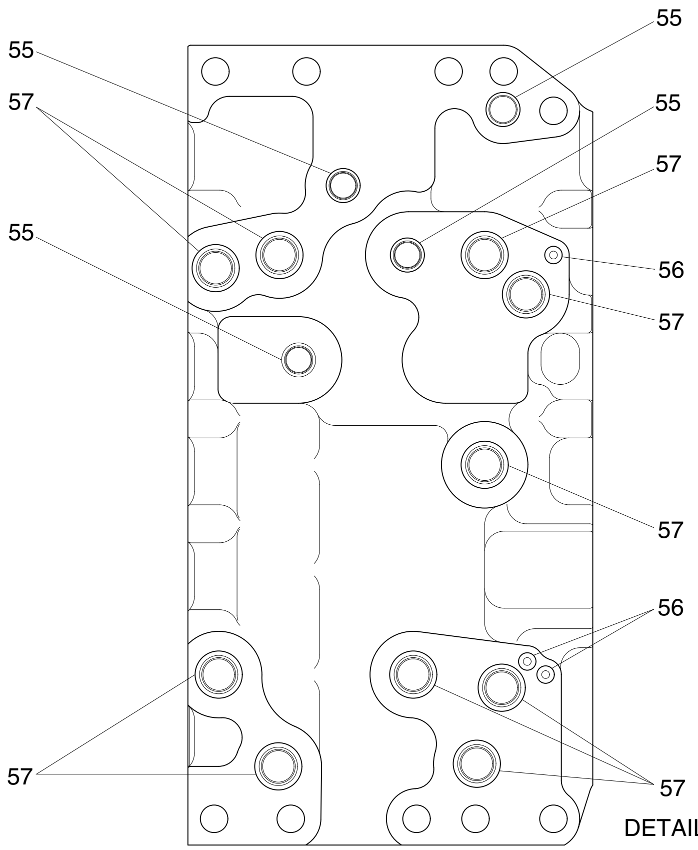
SECTION Z-Z



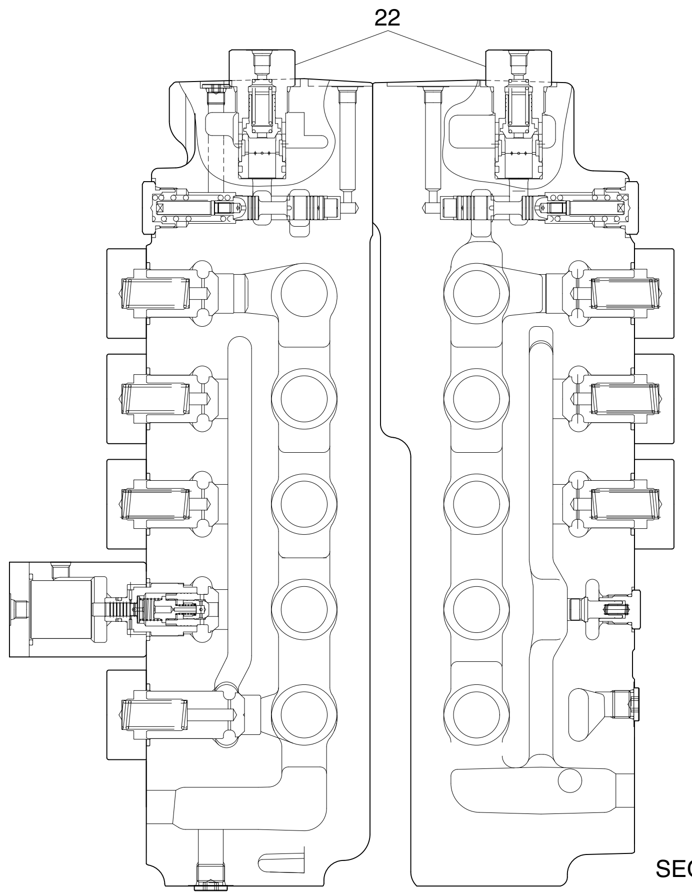
SECTION Y-Y



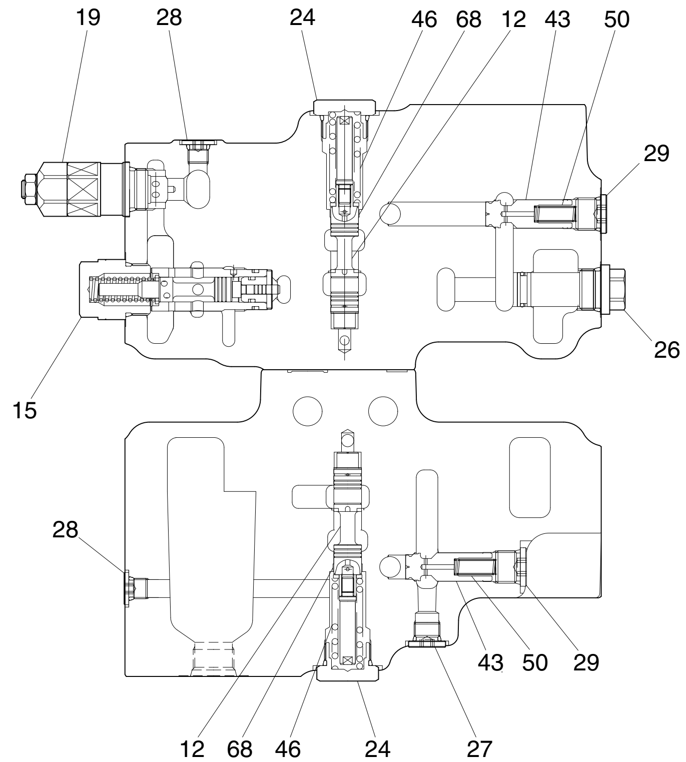
SECTION B-B



DETAIL OF COMBINED PLANE

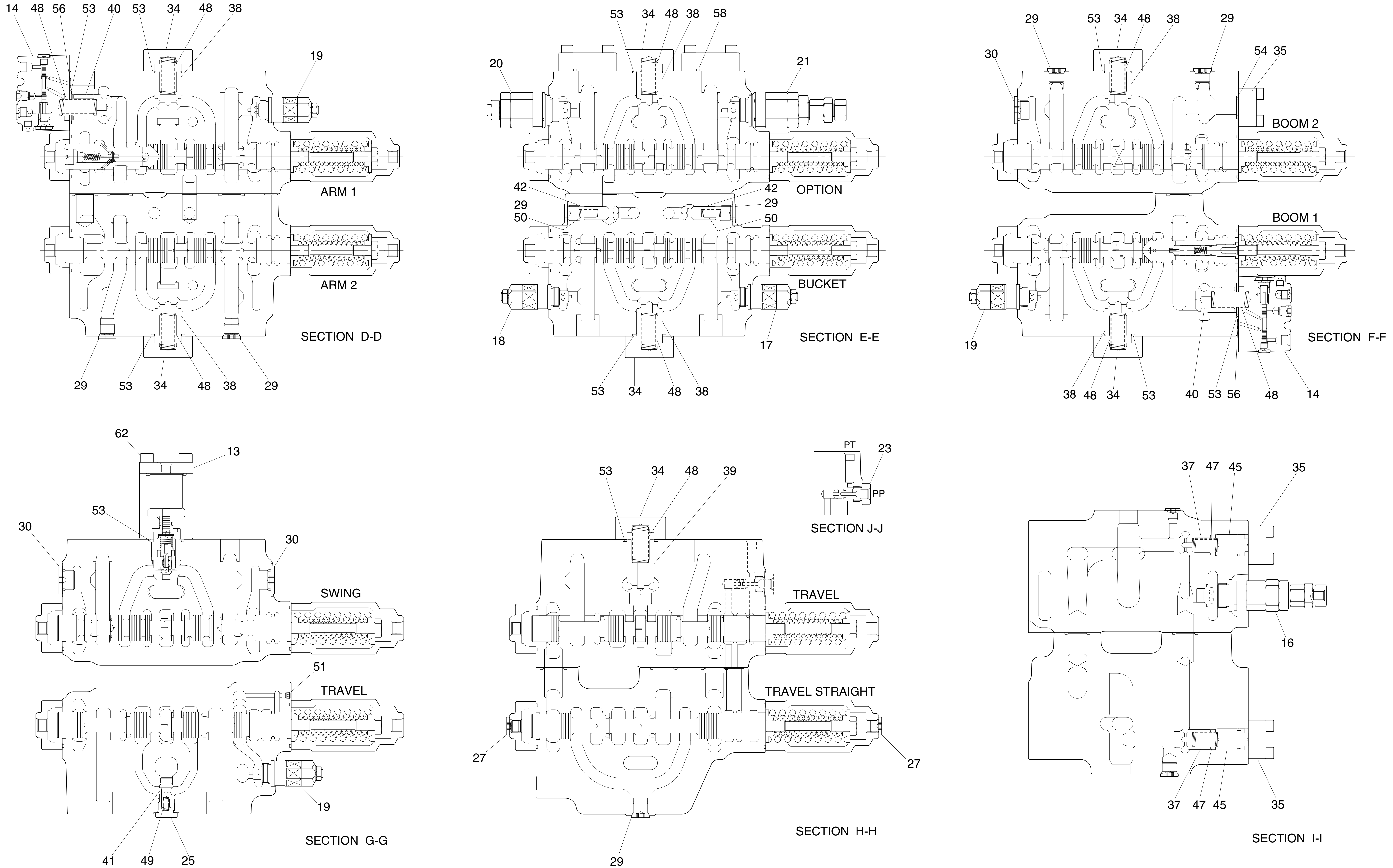


SECTION X-X



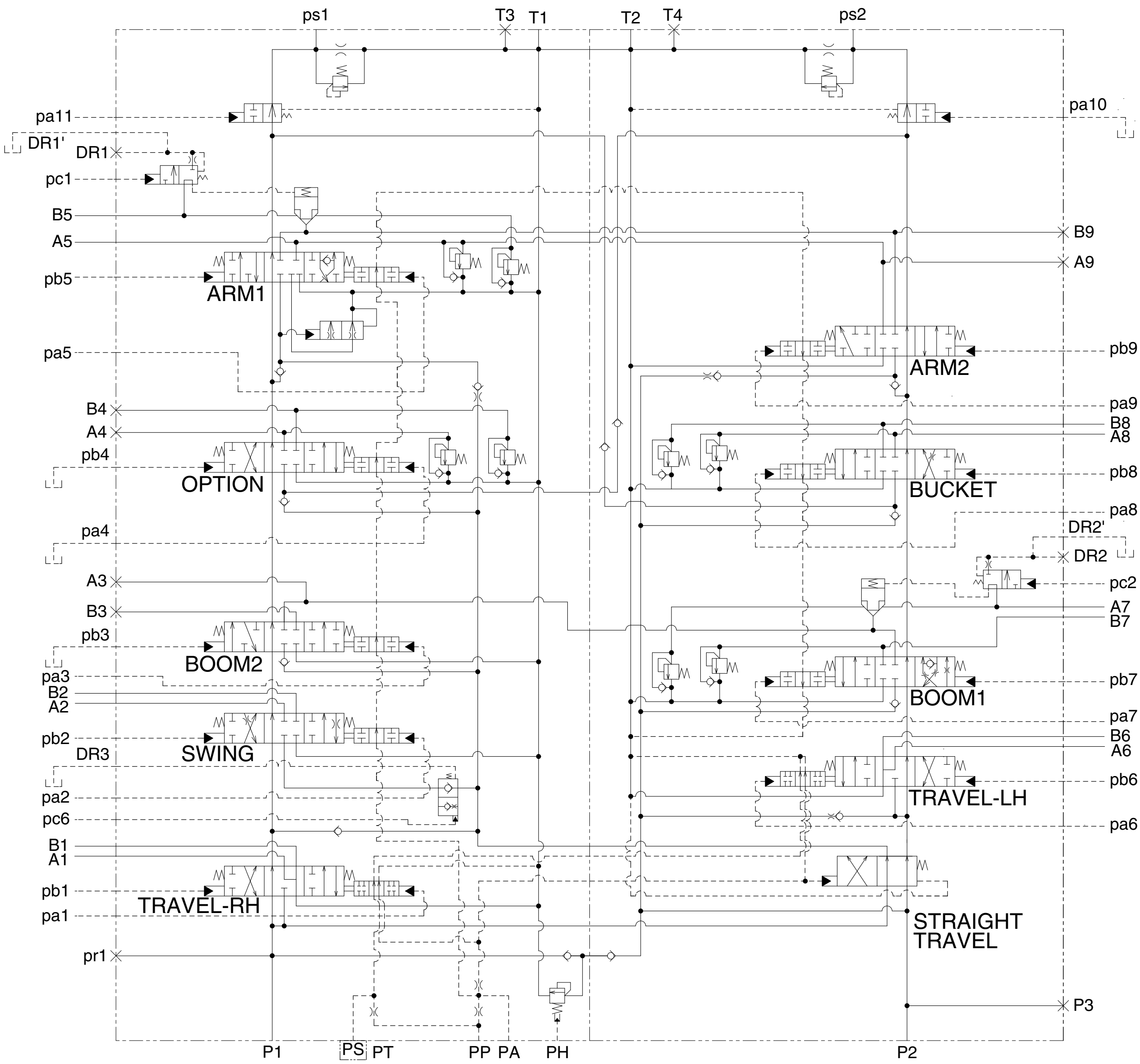
SECTION C-C

480F2MC03


14 48 56 53 40 53 34 48 38
19
ARM 1
ARM 2
29 53 34 48 38 29
SECTION D-D
53 34 48 38 58
20
21
42
29
50
42
29
50
OPTION
BUCKET
18
17
53 34 48 38
SECTION E-E
29 53 34 48 38 29
30
54 35
BOOM 2
BOOM 1
19
38 48 34 53 40 53 56 48 14
SECTION F-F
62
13
53
30
30
SWING
51
TRAVEL
19
41 49 25
SECTION G-G
53 34 48 39
TRAVEL
TRAVEL STRAIGHT
27
27
29
SECTION H-H
PT
23
PP
SECTION J-J
37 47 45 35
16
37 47 45 35
SECTION I-I

480F2MC04

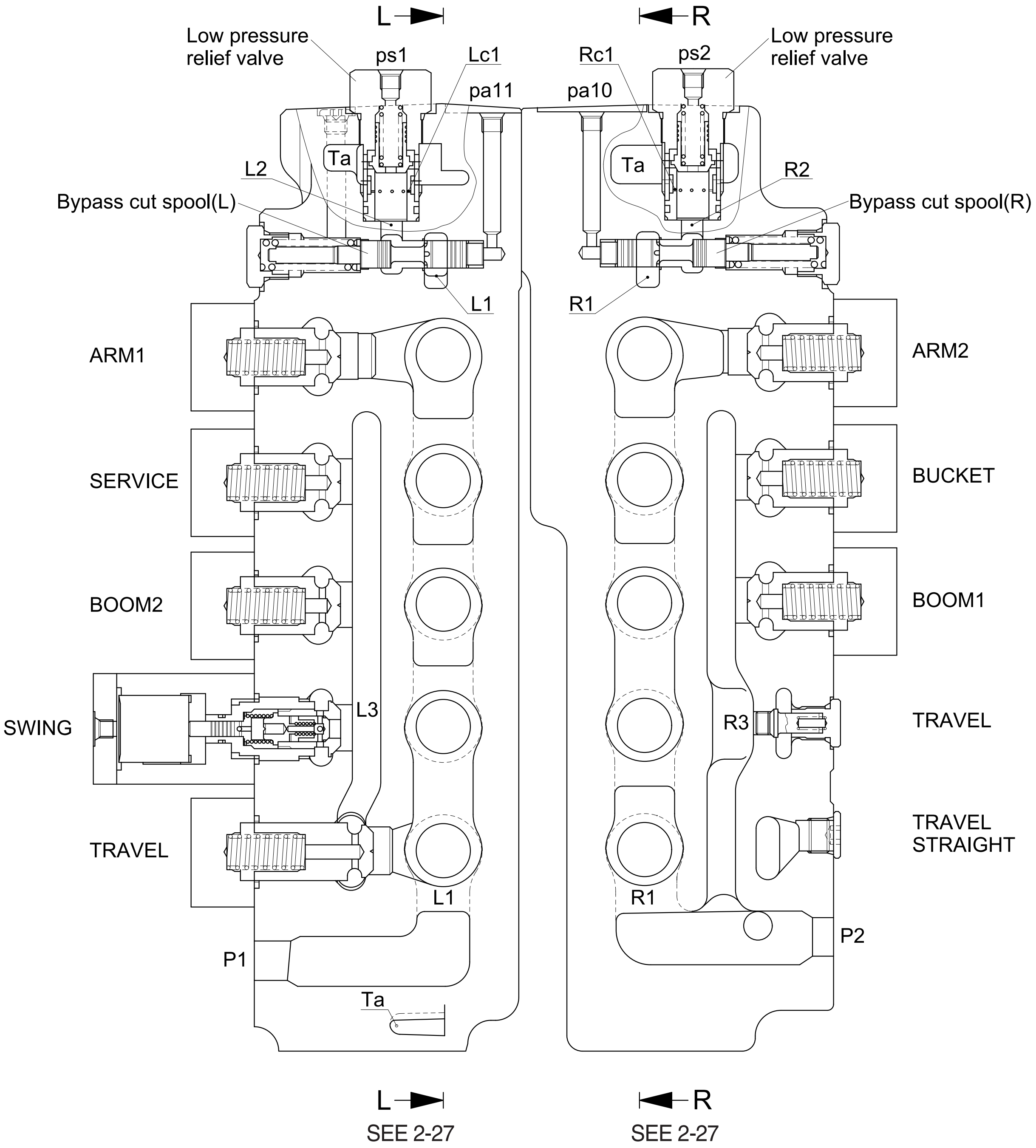
2. HYDRAULIC CIRCUIT



480F2MC05

3. OPERATION

1) ALL SPOOL NEUTRAL



(1) Neutral passage

① Oil from pump P1 goes through neutral passage (L1) to the orifice (Lc1) of the low pressure relief valve and then oil returns to port T1 and T3 via tank passage (Ta).

② Oil from pump P2 goes through neutral passage (R1) to the orifice (Rc1) of the low pressure relief valve and then oil returns to port T1 and T3 via tank passage (Ta).

③ The pressure of upper chamber (L2), (R2) for the low pressure relief valve flow into pump through port ps1, ps2 and then controls the discharge of pump P1, P2.

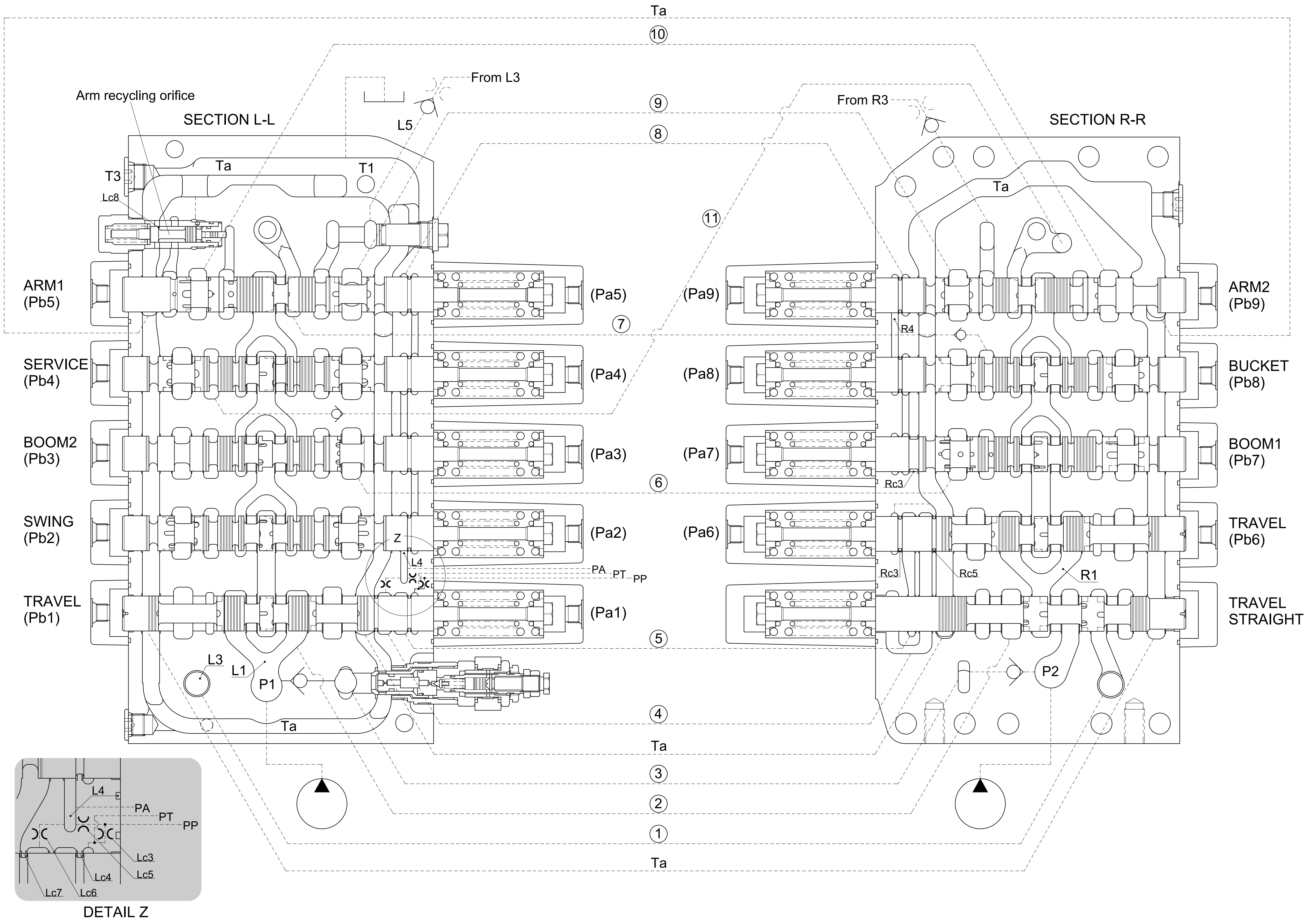
④ When a large amount of oil flows the neutral passage, the low pressure relief valves is operated. As a result, the shock pressure of port ps1, ps2 is prevented.

(2) Signal passage

① Oil from port PP flows into port PT via orifice (Lc3). At the same time, after passing through passage (⑤) via land (Lc4), oil returns to the tank passage (Ta) via land (Rc3).

② Meanwhile, some of oil from port PP flows into port PA via orifice (Lc5) and return to the tank passage (Ta) from boom 1 spool land (Rc4) via passage (L4,⑧ , R4).

③ Oil via orifice (Lc6) flows into the tank passage (Ta) from land (Lc7) and return to the tank passage (Ta) via travel spool land (Rc5) through the passage ④.



2) SINGLE OPERATION

(1) Travel spool

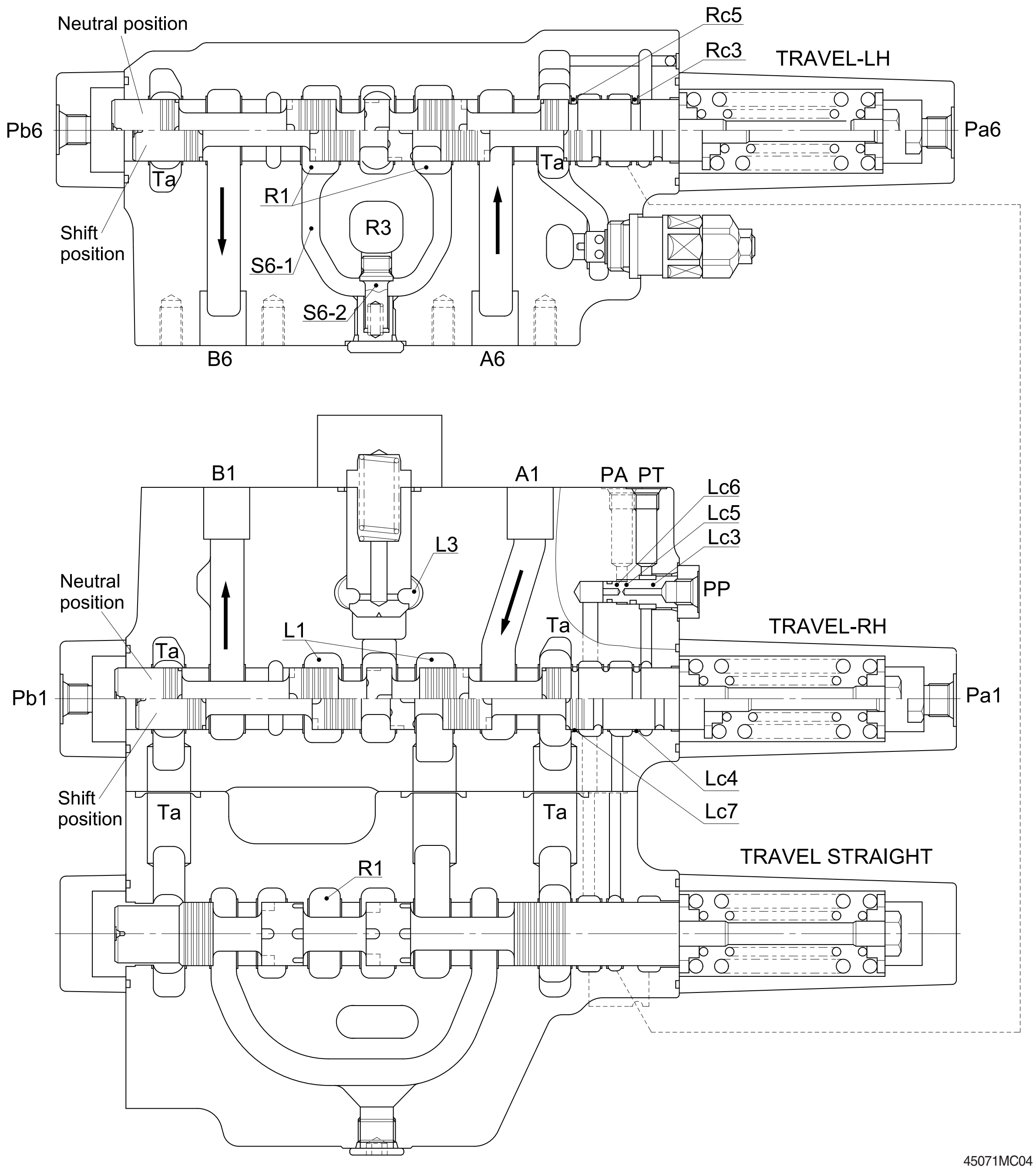
When the RH travel spool is pushed to right by the pilot pressure of port Pb1 the oil discharged from P1 port flows from the neutral passage (L1) to B1 port.

The oil from port A1 return to the tank via the tank passage (Ta).

When the LH travel spool is pushed to right by the pilot pressure of port Pb6 the oil discharged from P2 port flows from the neutral passage (R1) to B6 port through the passage S6-1.

At this time, the parallel passage (R3) and passage (S6-1) are to be maintained as same pressure as poppet (S6-2) is closed. The oil from A6 returns to the tank via the tank passage (Ta).

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

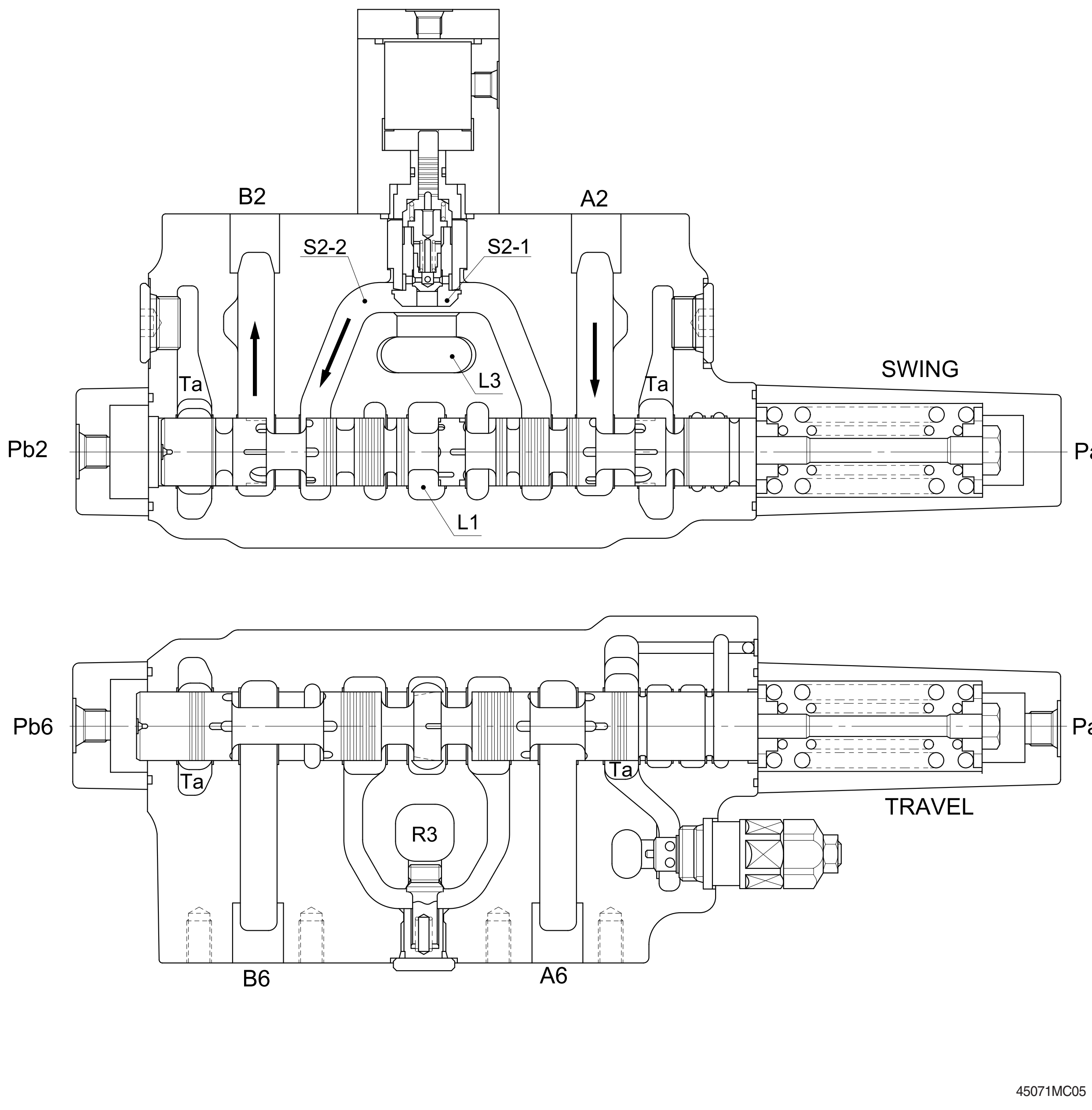


45071MC04

(2) Swing spool

When the swing spool is pushed to the right by the pilot pressure of port Pb2, the neutral passage (L1) is closed, the oil discharged from pump P1 pushes up the load check valve (S2-1), passage (S2-2) via parallel passage (L3) and then flows into port B2.

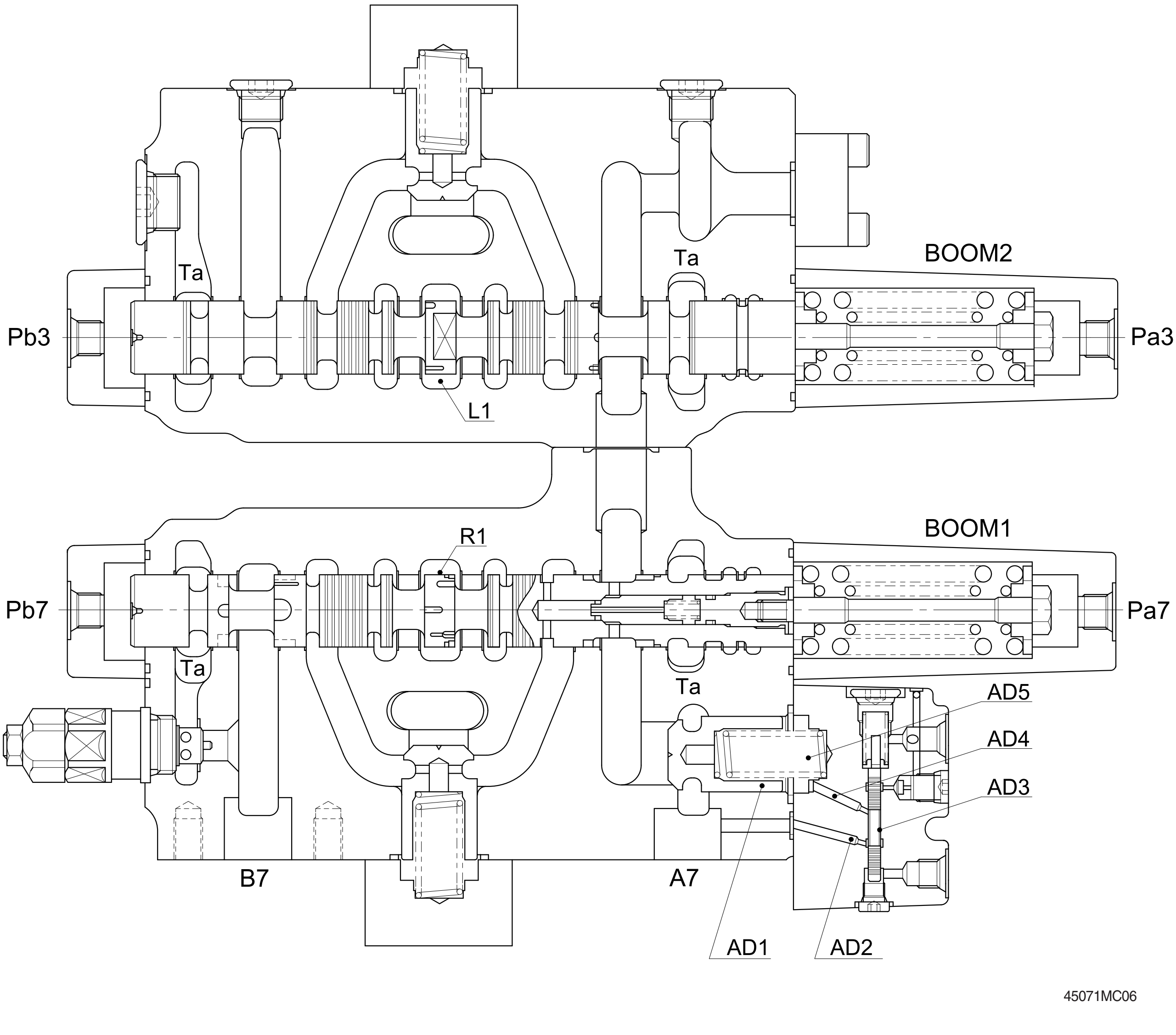
The oil from port A2 return to the tank via the tank passage (Ta).



3) BOOM SPOOL

(1) Neutral

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

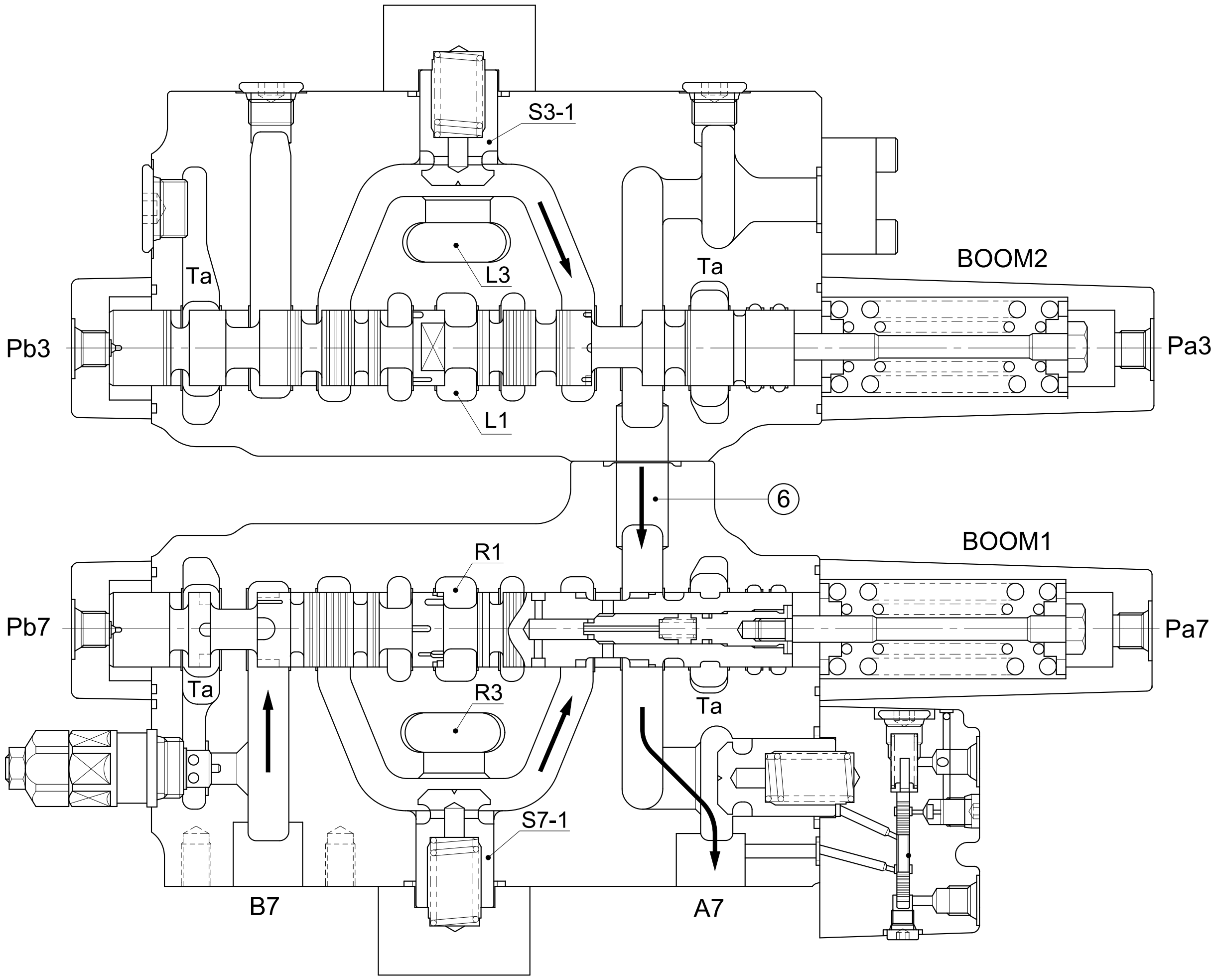


45071MC06

(2) **Boom up** (flow summation)

When the boom 1 spool is pushed to the left by the pilot pressure of port Pa7, the neutral passage (R1) is closed, the oil discharged from pump P2 flows into the port A7 via parallel passage (R3), the load check valve (S7-1). At the same time, the boom 2 spool is pushed to the left by the pilot pressure of port Pa3, the neutral passage (L1) is closed, the oil discharged from pump P1 flows into the port A7 via parallel passage (L3), the load check valve (S3-1) and then joins to the passage (⑥).

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

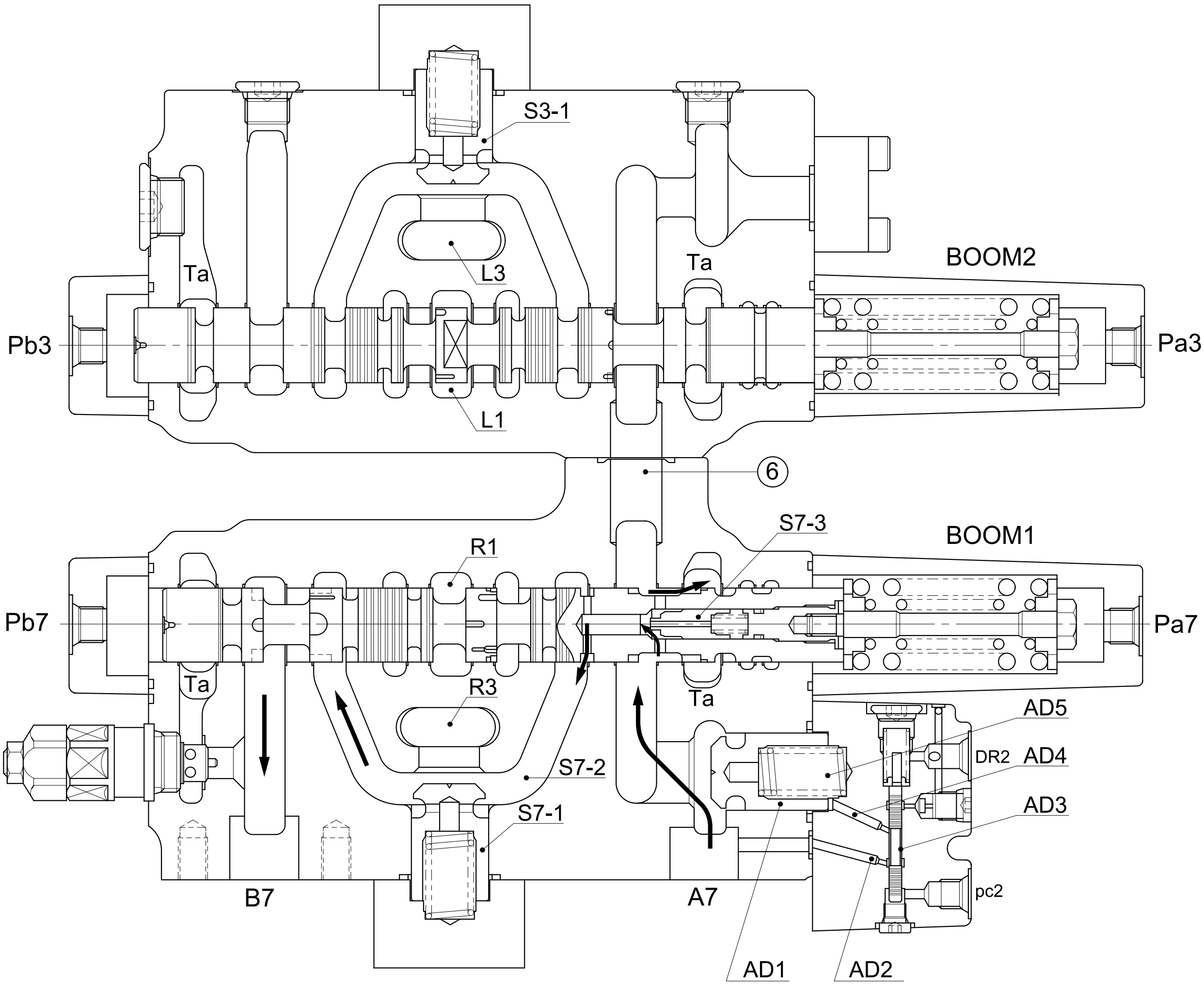


45071MC07

(3) Boom down (recycling)

When the boom 1 spool is pushed to the right by the pilot pressure of port Pb7, the neutral passage (R1) is closed, the oil discharged from pump P2 flows into the port B7 via parallel passage (R3) and the load check valve (S7-1). At the same time, as the port pc2 is pressurizing, the spool (AD3) of anti-drift valve is pushed up, the pressure of spring chamber (AD5) is released and the poppet (AD1) is opened and then the oil from port A7 flows into the tank passage (Ta). Some of returned oil makes the poppet (S7-3) inside boom 1 spool to open and is connected to the passage (S7-2) and flows together into the port B7.

This prevents the cavitation of cylinder rod side.



45071MC08

4) SERVICE SPOOL

When the service spool is pushed to the left by the pilot pressure of port Pb4, the neutral passage (L1) is closed, the oil discharged from pump P1 flows into the port B4 via parallel passage (L3), the load check valve (S4-1) and passage (S4-2).

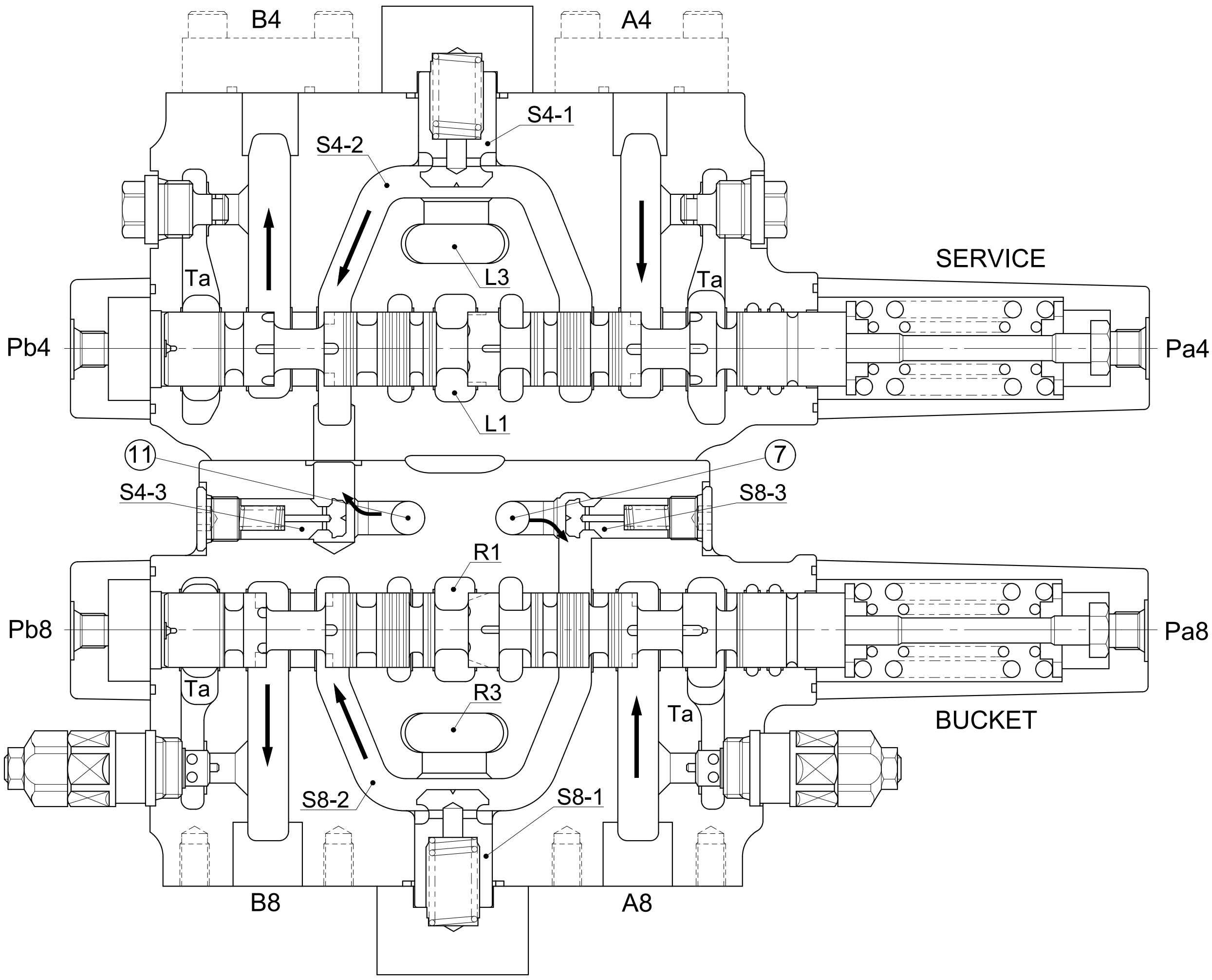
At the same time, as the port pa10 (see 2-25 page) is pressurizing and the bypass cut spool (R) is pushed, the oil discharged from pump P2 flows together into the port B7 via passage (11), poppet (S4-3). The oil returned from port A4 flows into the tank via the tank passage (Ta).

5) BUCKET SPOOL

When the bucket spool is pushed to the left by the pilot pressure of port Pb8, the neutral passage (R1) is closed, the oil discharged from pump P2 flows into the port B8 via parallel passage (R3), the load check valve (S8-1) and passage (S8-2).

At the same time, as the port pa11 is pressurizing and the bypass cut spool (R) is pushed, the oil discharged from pump P1 flows together the passage (S8-2) via passage (7), poppet (S8-3).

The return oil from port A8 flows into the tank via the tank passage (Ta).



45071MC09

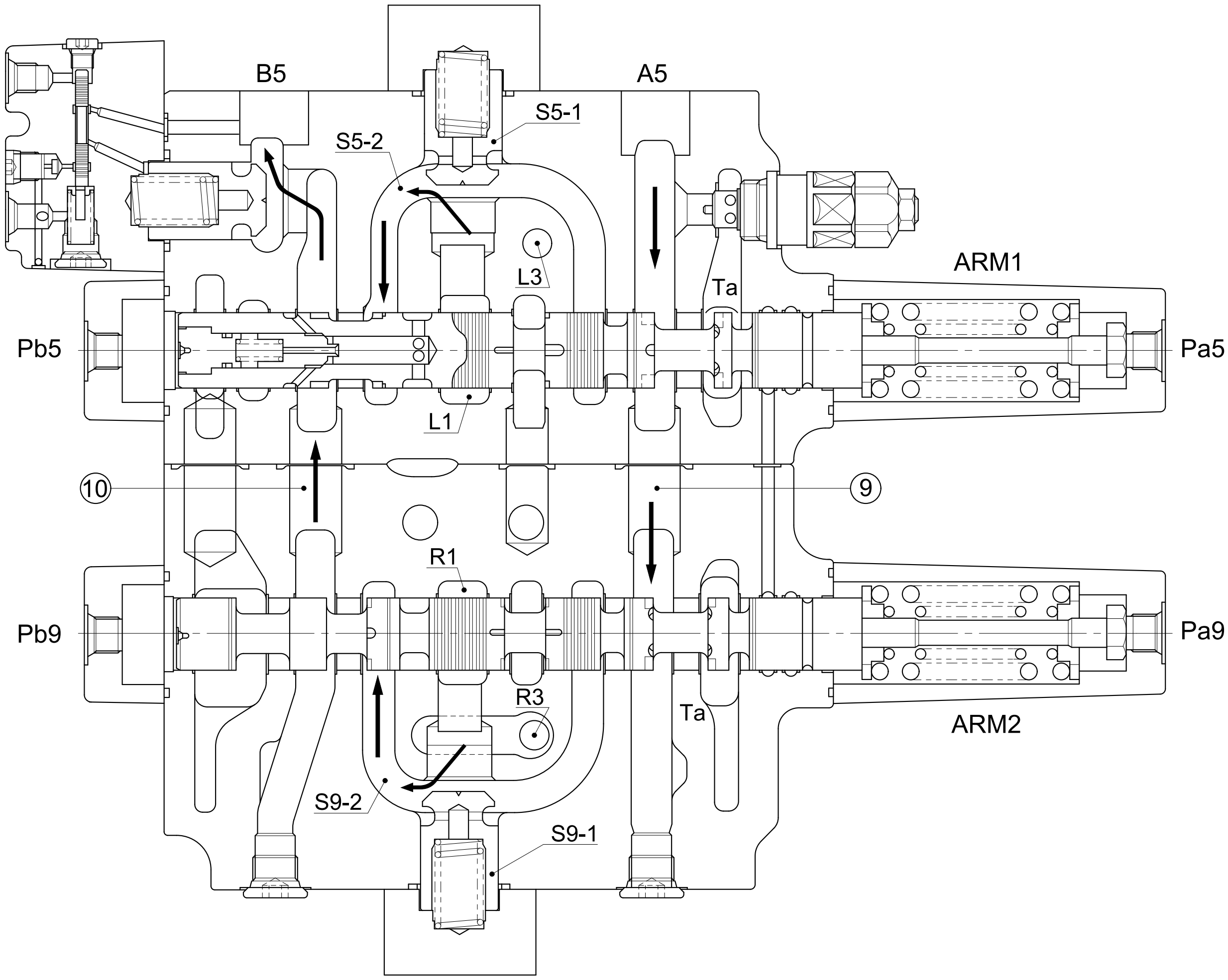
6) ARM SPOOL

(1) Arm out (flow summation)

When the arm 1 spool is pushed to the right by the pilot pressure of port Pb5, the oil discharged from pump P1 flows into the port B5 via neutral passage (L1), the load check valve (S5-1) and passage (S5-2).

When the arm 2 spool is pushed to the right by the pilot pressure of port Pb9, the oil discharged from pump P2 flows together the port B5 the passage (⑩) via the neutral passage (R1), the load check valve (S9-1) and passage (S9-2).

The return oil from port A5 flows into the tank via the tank passage (Ta).



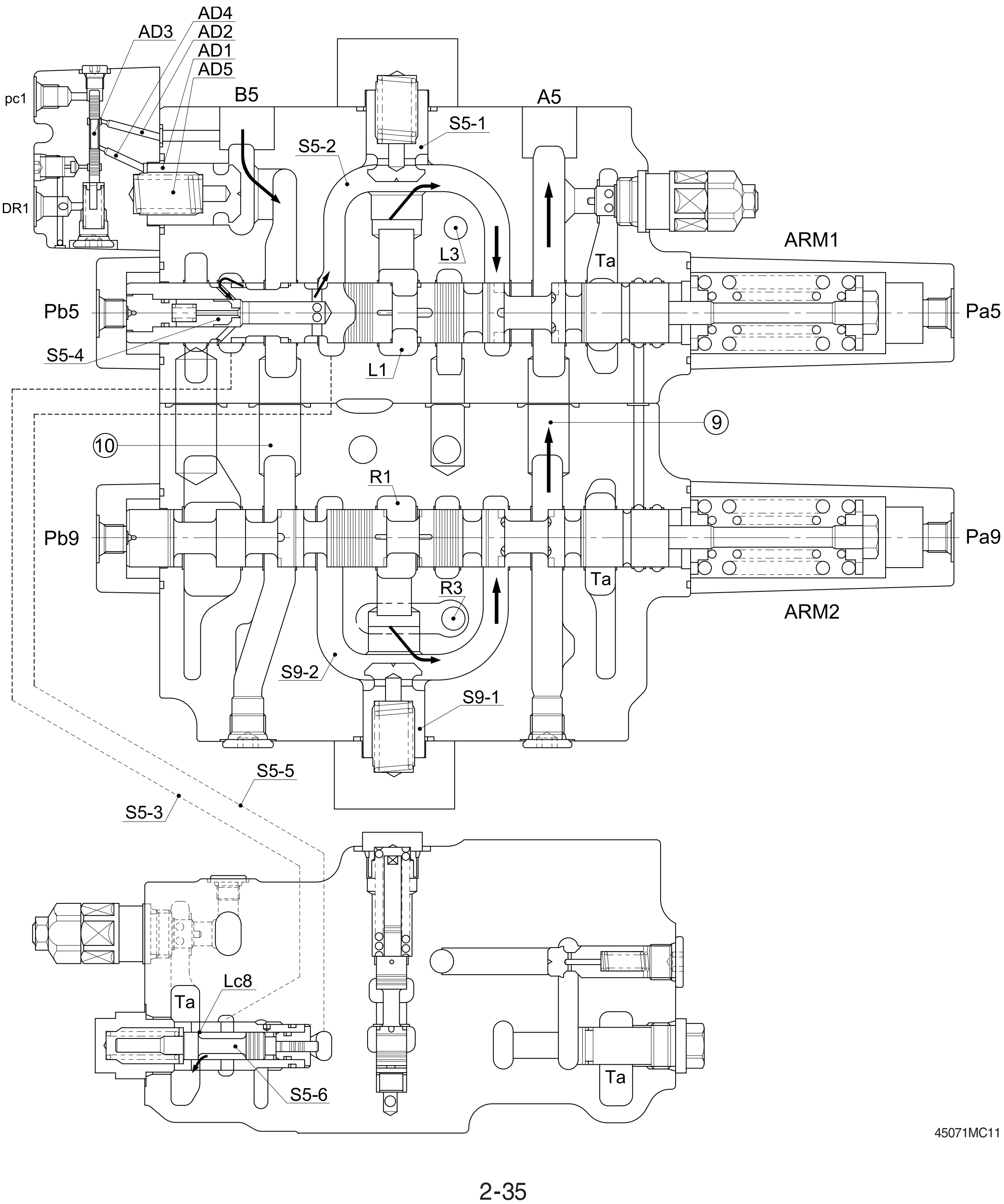
45071MC10

(2) Arm in (flow summation)

When the arm 1 spool is pushed to the left by the pilot pressure of port Pa5, the oil discharged from pump P1 flow into the port A5 via neutral passage (L1), the load check valve (S5-1) and passage (S5-2).

When the arm 2 spool is pushed to the left by the pilot pressure of port Pa9, the oil discharged from pump P2 flows together into the port A5 via neutral passage (R1), the load check valve (S9-1) and passage (S9-2).

At the same time, as the port pc1 is pressurizing and the spool (AD3) of anti-drift valve is pushed down, the pressure of spring chamber (AD5) is released and the poppet (AD1) is opened and then the oil returned from port B5 flows into the tank passage (Ta) through the passage (S5-4) inside arm 1 spool to open and is connected to the passage (S5-2) and flows together into the port A5, the cylinder speed is raised and also is prevents the cavitation of bottom side.

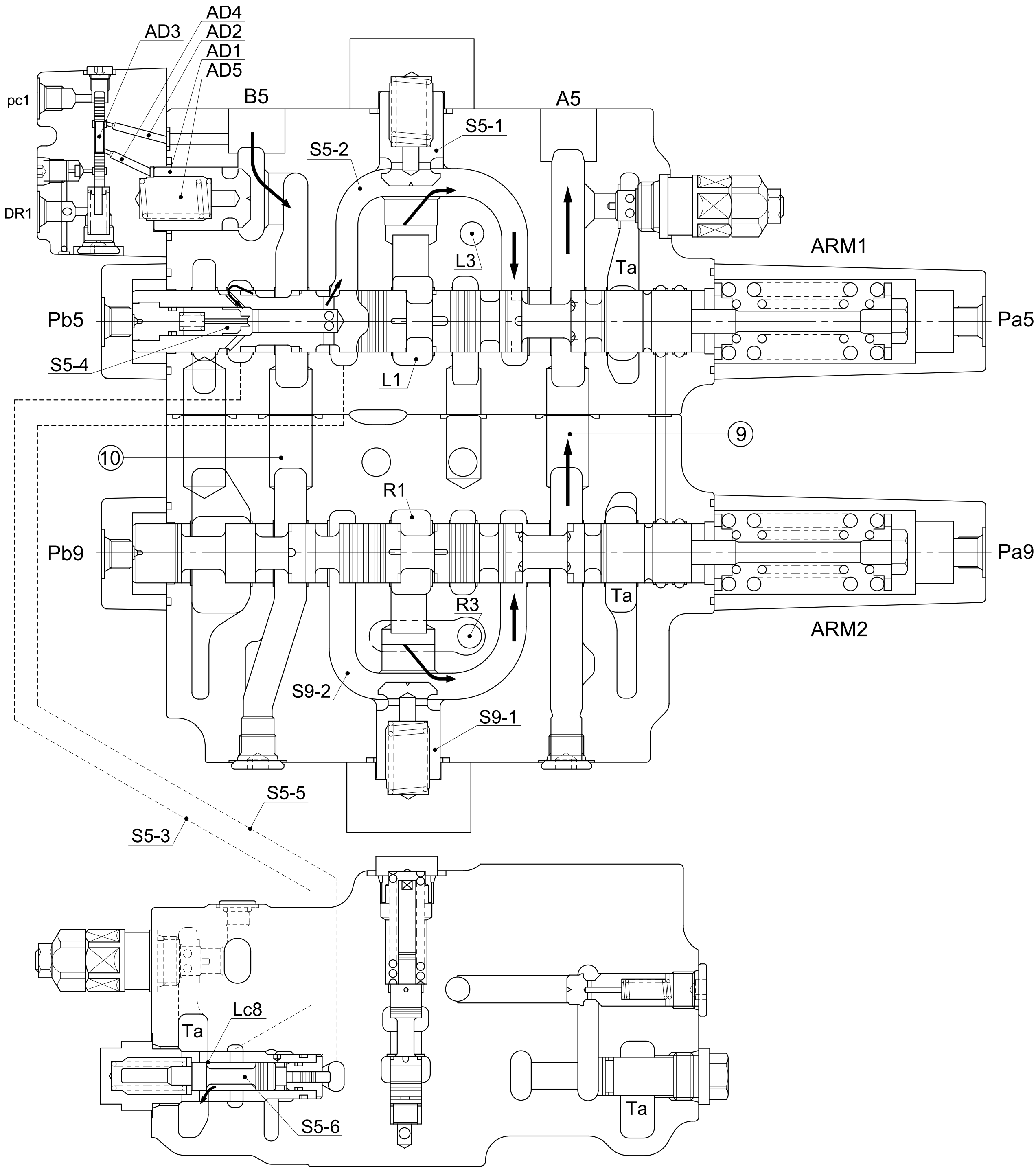


(3) **Arm recycling** (arm in)

When the arm is at in position, the spool (S5-6) stroke against the passage (S5-2) pressure guided from the passage (S5-5) is changed according to the opening angle of arm recycling orifice (Lc8).

When the pressure of the passage (S5-2) is high and this stroke is increased, the opening angle of orifice (Lc8) become large. On the contrary, when the pressure of passage (S5-2) is low, this stroke is decreased, the opening angle of orifice (Lc8) become small.

Therefore, the flow rate for arm recycling is changed by the pressure in bottom side of arm cylinder.



45071MC11

7) BYPASS CUT SPOOL

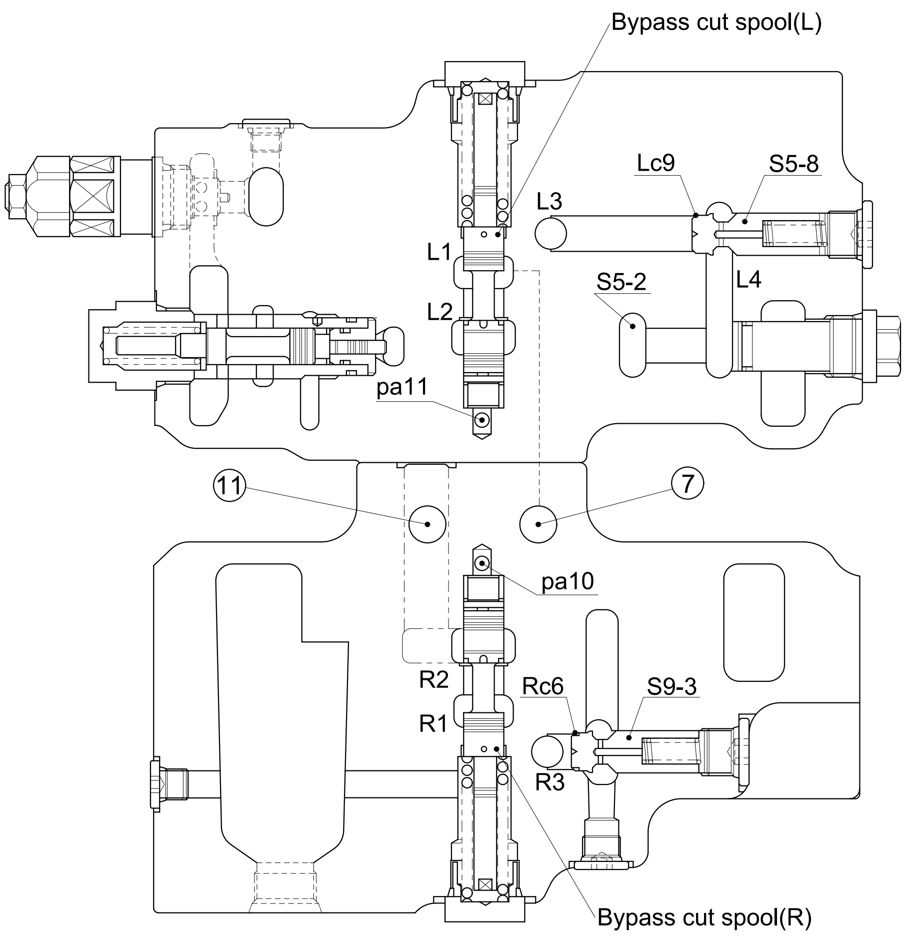
This valve is providing the bypass cut spool at the lowest stream of (upper stream of the low pressure relief valve) the neutral passage (L1, R1).

As the port pa10 (pa11) is pressurizing and the bypass cut spool (L, R) is pushed, the neutral passage (L1, R1) is closed. The oil discharged from port P1 flows together into the passage (S8-2, see 2-32 page) of bucket section via passage (⑦), poppet (S8-3) and the oil discharged from P2 port flows together into the passage (S4-2) of service section via the passage (⑪) and poppet (S4-3, see 2-32 page).

8) PARALLEL ORIFICE FOR ARM

The arm 1 and arm 2 section of this valve has orifices in the parallel circuit for arm. These orifices controls the speed of arm at combined operation.

The parallel circuit of arm 2 section is connected to the passage (S9-2, see 2-35) through orifice (Rc6) in the edge of the poppet (S9-3) from the parallel passage (R3), the parallel circuit of arm 1 section is connected to the passage (S5-2, see 2-35) through orifice (Lc9) in the edge of the poppet (S5-8) from the parallel passage (L3).



45071MC12

9) RELIEF VALVE

(1) Main relief valve

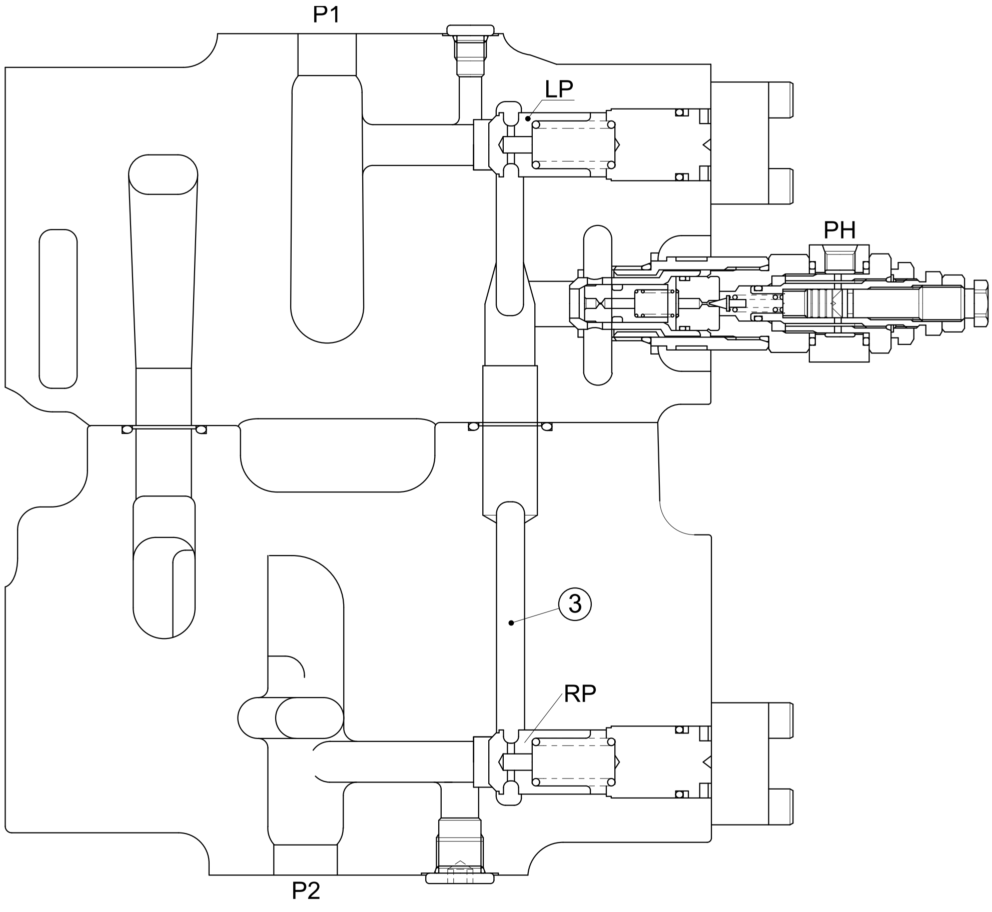
The oil discharged from P1 port via the poppet (LP) and the oil discharged from P2 port via the poppet (RP) flow into the main relief valve through the passage (3).

When the main relief valve is operating, the maximum pressure of pump P1, P2 is controlled.

(2) Overload relief valve

Overload relief valves are provided each cylinder ports of boom1, arm1 and bucket. These prevents the abnormal high pressure of actuators by external force.

Also, when the pressure of cylinder ports create back pressure, this valve opens allowing oil from tank to cylinder port; and then prevents cavitation.

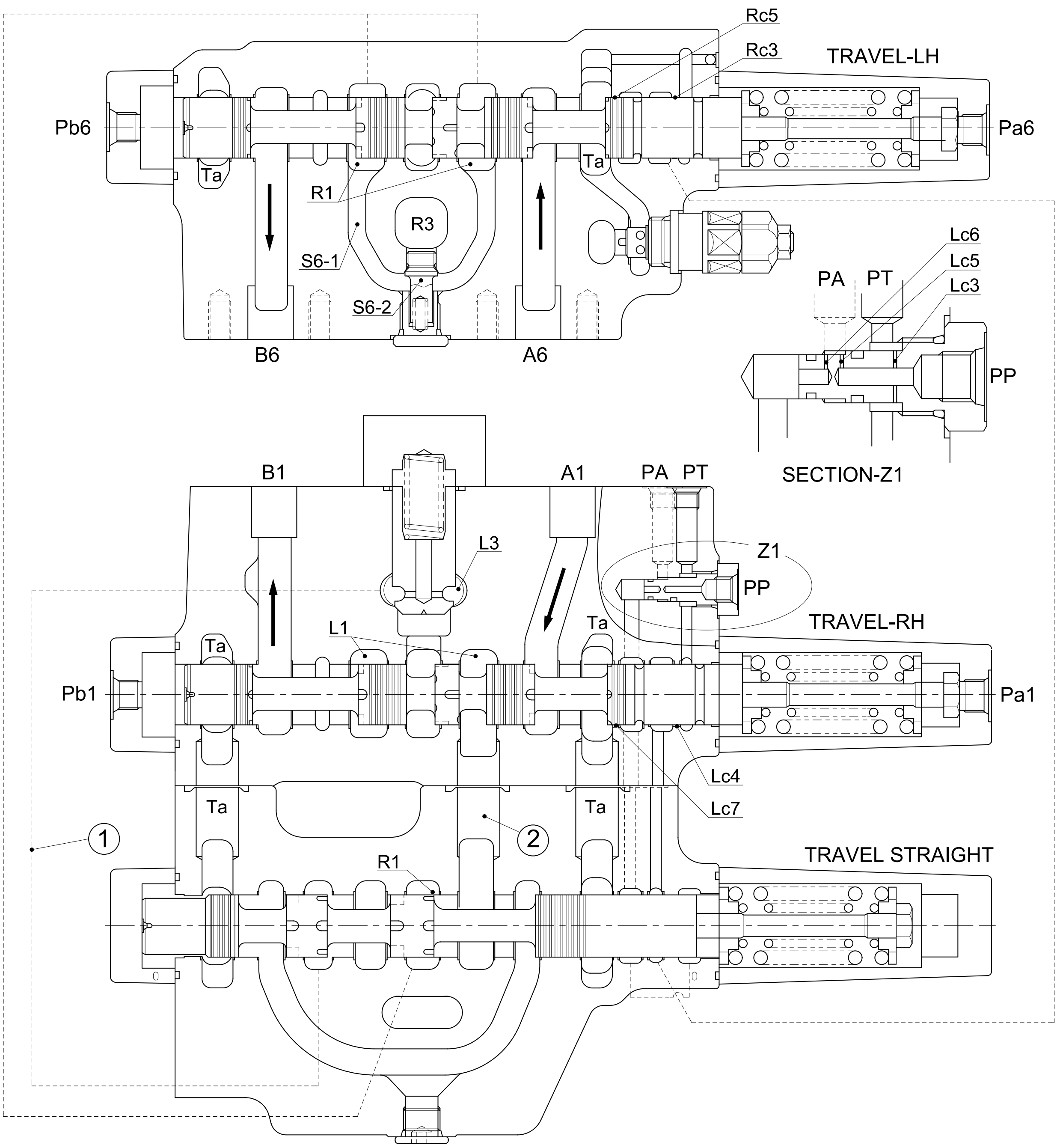


45071MC13

4. COMBINED OPERATION

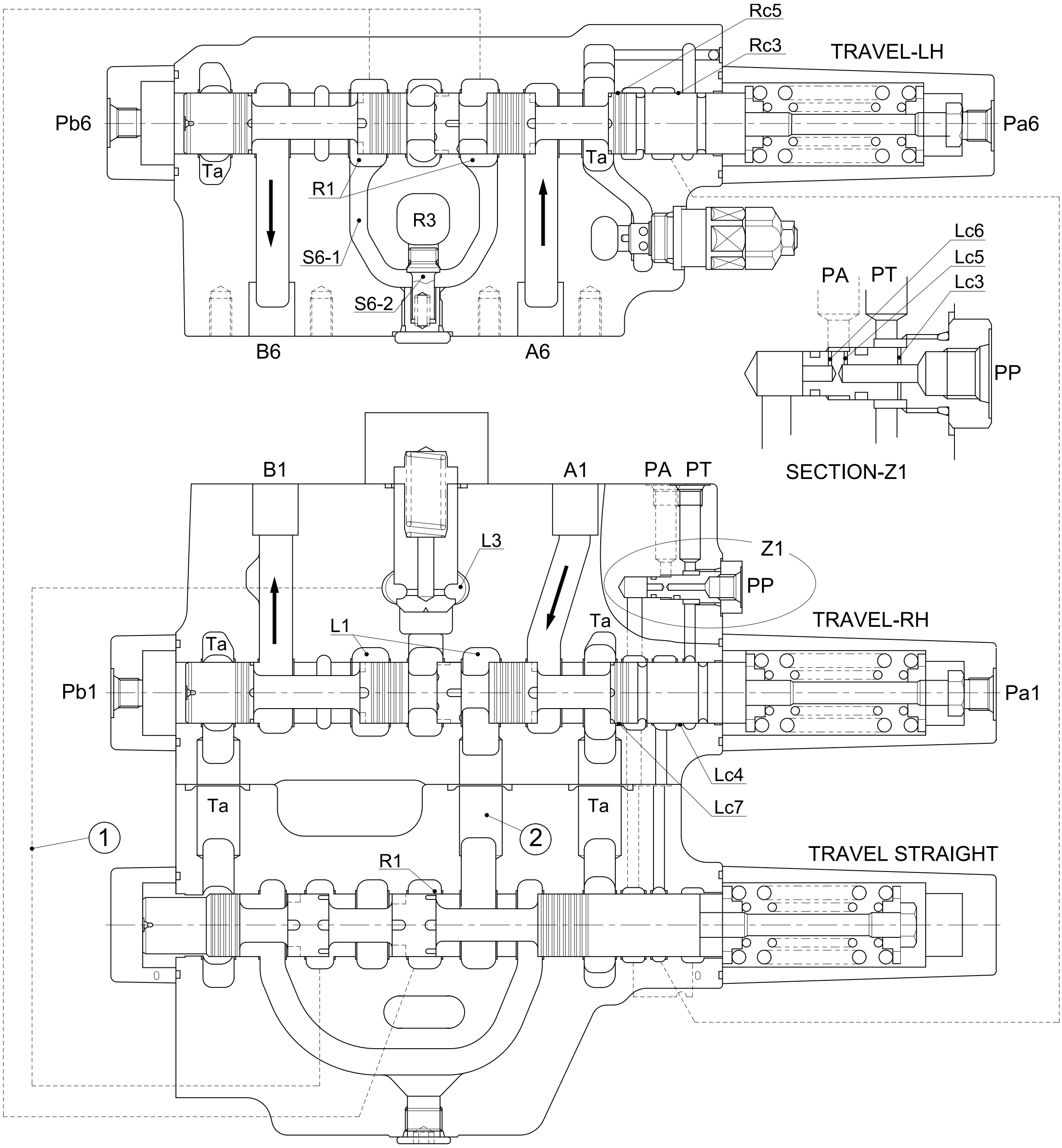
1) TRAVEL COMBINED OPERATION

① While travel (forward, reverse and pivot turn) and front attachment (except travel section) functions are operated, the oil discharged from port PP is cut via land (Lc4, Lc7, Rc3, Rc5) and blocked from signal land except travel section to tank passage (Ta), the pressure of signal passage rises to the relief setting pressure of pilot pump and the straight travel spool is pushed to the left by raising of signal pressure and also, the pressure of port PT, PA port rises.



② When the straight travel spool is operated, the oil discharged from port P1 flows into RH travel section through the neutral passage (L1) and also flows into LH travel section via the neutral passage (R1) and passage (②). The oil discharged from port P2 flows into the parallel passage (L3) via passage (①).

③ In case the load pressure of the section except travel is higher than that of the RH travel section, the partial oil of discharged from port P2 pushes open the poppet (S6-2) and flows together into the passage (S6-1) through the orifice at the edge of poppet. The travel (LH, RH) is operated by the discharged oil from port P1 and the other actuators are operated by the discharged oil from port P2. Thus, when travel and front attachment functions are operated simultaneously, keeps the straight travel.

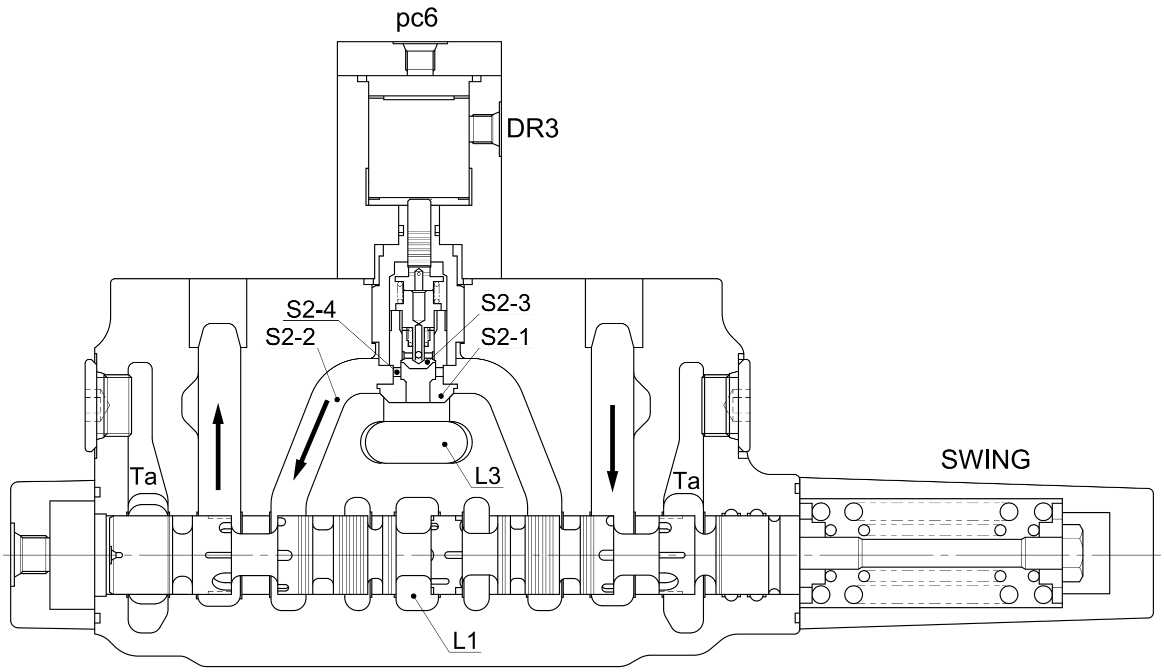


45071MC14

2) SWING COMBINED OPERATION

When swing and boom up functions are operated, the poppet(S2-1) is seated by pressure of port pc6 and the poppet (S2-3) only opened and the supply pressure of the parallel passage (L3) is rises by orifice (S2-4).

As a result, boom and swing simultaneous operation is ensured even if lower load of swing section.



45071MC15

5. ANTI-DRIFT VALVE

The anti-drift valve is provided the boom bottom and arm rod side of cylinder port for prevention of self drifting by boom weight or bucket loads.

1) WHEN NEUTRAL

The oil from cylinder port flows into spring chamber (AD5) via passage (AD2), the around of spool (AD3) and passage (AD4).

Because of the difference of poppet area and spring force, the poppet (AD1) is seated certainly.

2) WHEN BOOM UP OR ARM OUT

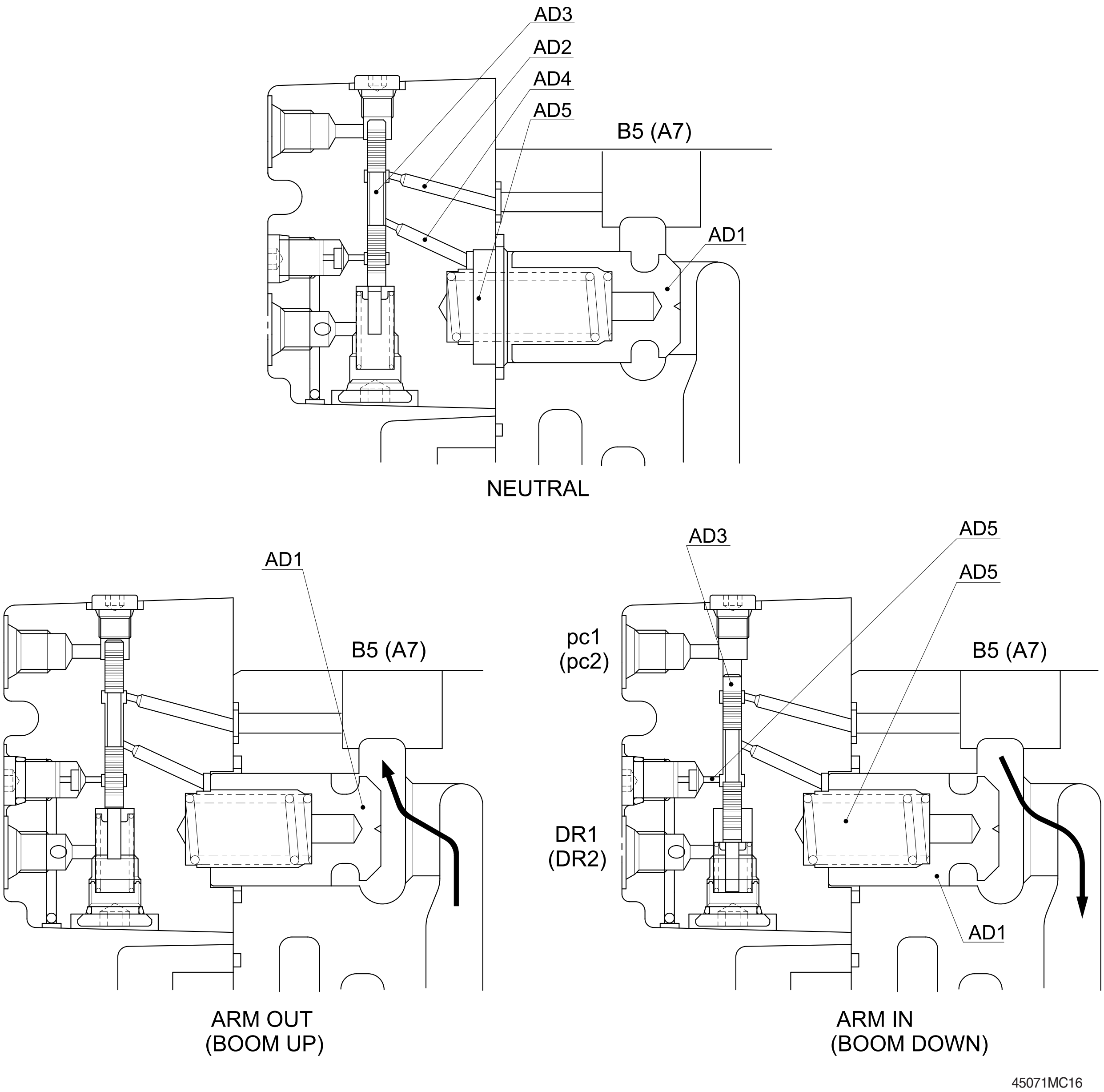
The oil from pump flows into cylinder by pushes open the poppet (AD1).

3) WHEN BOOM DOWN OR ARM IN

The spool (AD3) is pushed down by the pressure of pc1 (pc2).

Then the oil of spring chamber (AD5) flows into the drain port DR1 (DR2) and pushes open the poppet (AD1).

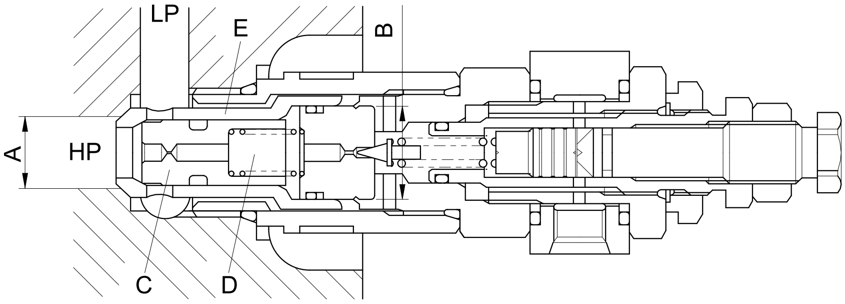
As a result, the oil from the cylinder port returns to tank passage (Ta).



6. RELIEF VALVE OPERATION

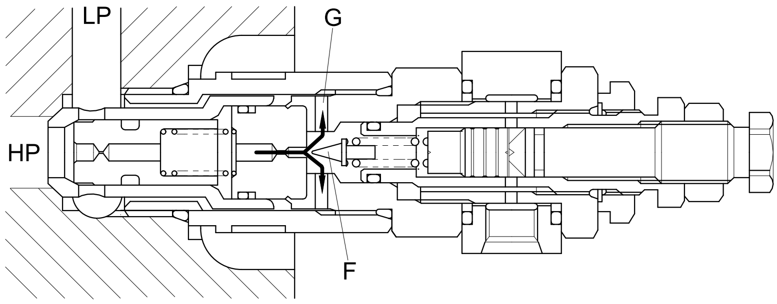
1) MAIN RELIEF VALVE

(1) This relief valve is built-in between the neutral passage (HP) and low pressure passage (LP), and the pressure oil fills up chamber (D) inside via orifice of main poppet (C).
Thus the sleeve (E) and the main poppet (C) are securely seated by difference area of A an B.



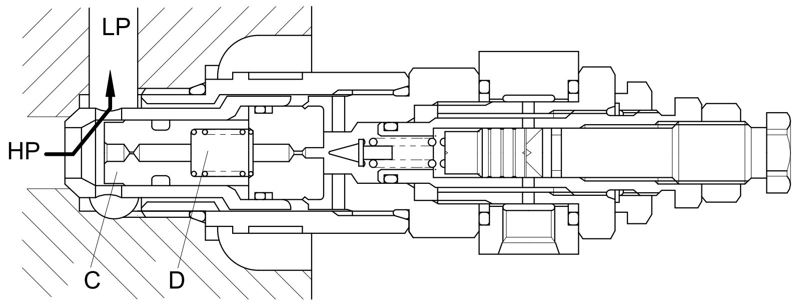
45071MC17

(2) When the pressure in neutral passage (HP) reaches the setting force of spring, pilot poppet (F) is opened. The oil flows around poppet and into the low pressure passage(LP) via hole(G).



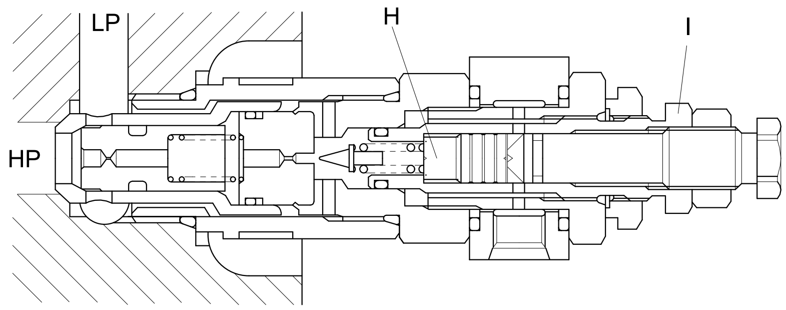
45071MC17-1

(3) When above flow is formed, the pilot poppet is opened; the pressure of chamber (D) drops, the main poppet (C) is opened and then the oil directly flows into the low pressure passage (LP).



45071MC17-2

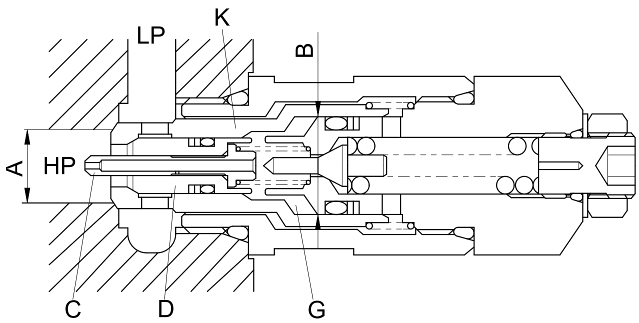
(4) High pressure setting pilot signal (Pi) : ON
The piston (H) moves to left by pilot pressure (Pi); set pressure of spring rises, making high pressure setting.



45071MC17-3

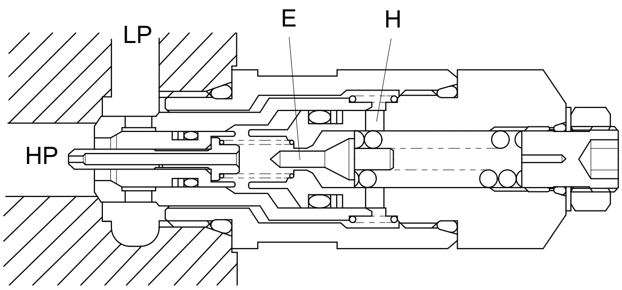
2) OVERLOAD RELIEF VALVE

(1) This relief valve is built-in the cylinder port (HP) and the low pressure (LP), and the pressure oil fills up camber (G) inside via hole of piston (C).
Thus the sleeve (K) and the main poppet (D) are securely seated by difference area of A and B.



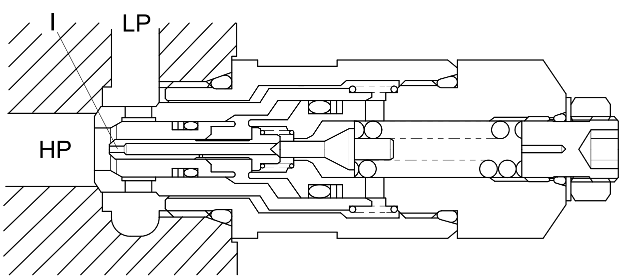
45071MC18

(2) When the pressure in cylinder port (HP) reaches the setting force of spring, the pilot poppet (E) is opened.
The oil flows around poppet and into the low pressure passage (LP) via hole (H).



45071MC18-1

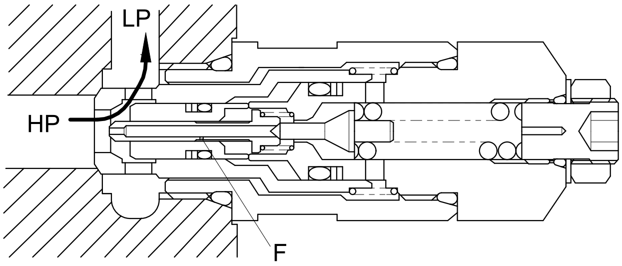
(3) When above flow is formed, the pilot poppet (E) is opened.
The pressure drops before and behind orifice (I); piston (C) moves to right and the piston (C) is seated at the tip of poppet (E).



45071MC18-2

(4) The oil flow from the high pressure passage (HP) to the poppet (D) behind is only around poppet and orifice (F); then the high pressure passage (HP) is higher than the poppet (D)behind pressure.

Thus the poppet (D) is pushed open and the oil directly flows into low pressure passage (LP).

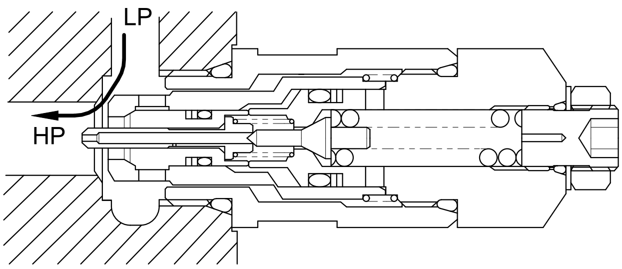


45071MC18-3

(5) Make up operation

This relief valve is built-in the cylinder port (HP) and the low pressure passage (LP), and the pressure oil fills up camber (G) inside via hole of piston (C).

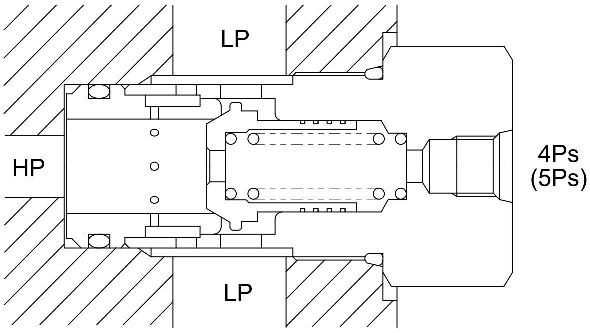
Thus the sleeve (K) and the main poppet (D) are securely seated by difference area of A and B.



45071MC18-4

3) LOW PRESSURE RELIEF VALVE

(1) When pump does not operational

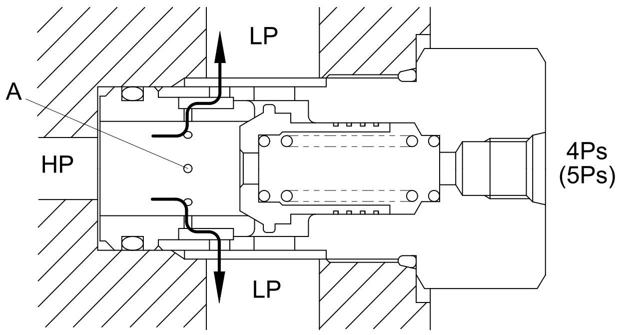


45071MC19

(2) When spool neutral

The neutral passage (HP) oil flows into the low pressure passage (LP) via signal orifice (S).

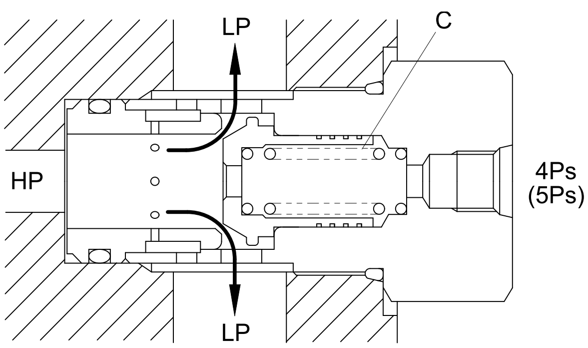
The signal port 4Ps (5Ps) pressure is raise by negative control orifice (A).



45071MC19-1

(3) Operation of low pressure relief

When the oil pressure neutral passage (HP) reaches the setting force of spring, the poppet is pushes open; the oil directly flows through passage (HP) to passage (LP) in order to prevent abnormal pressure.



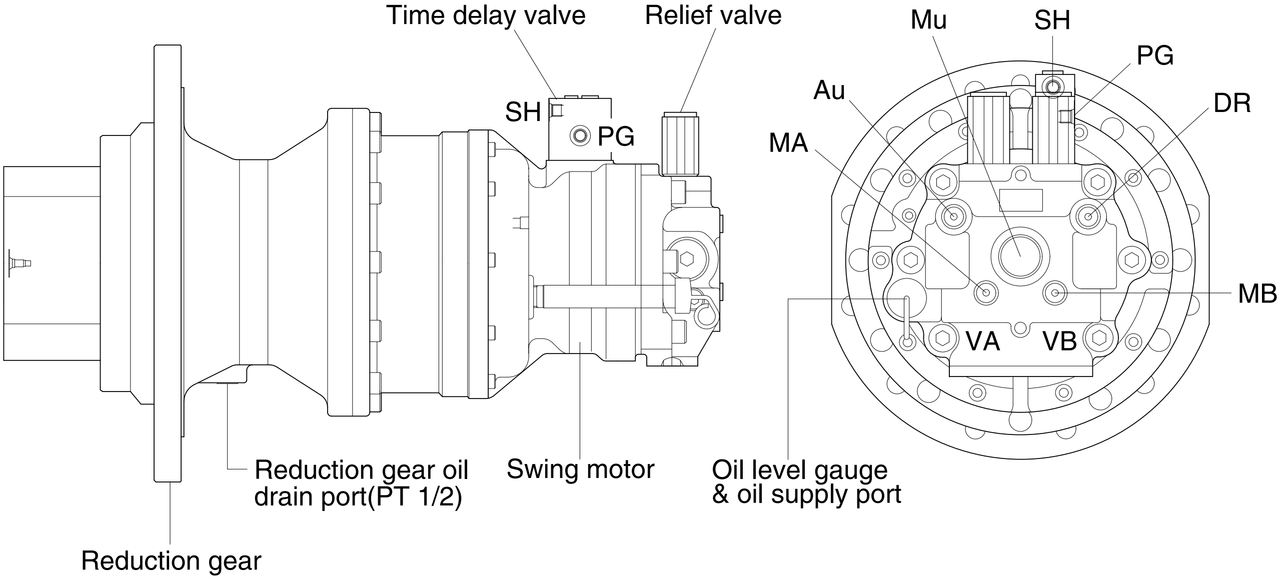
45071MC19-2

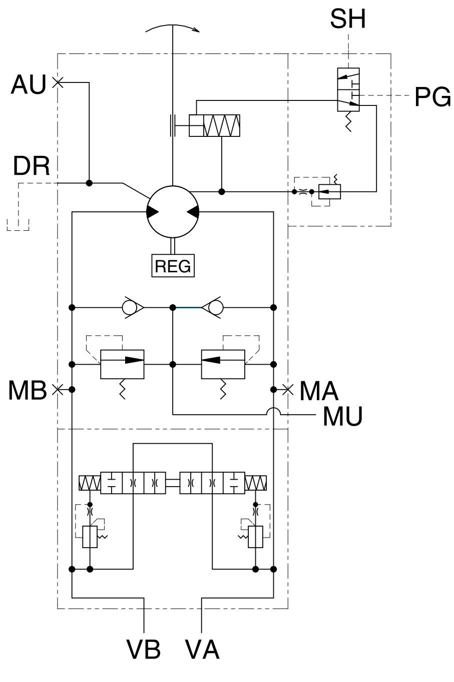
GROUP 3 SWING DEVICE

1. STRUCTURE

Swing device consists swing motor, swing reduction gear.

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



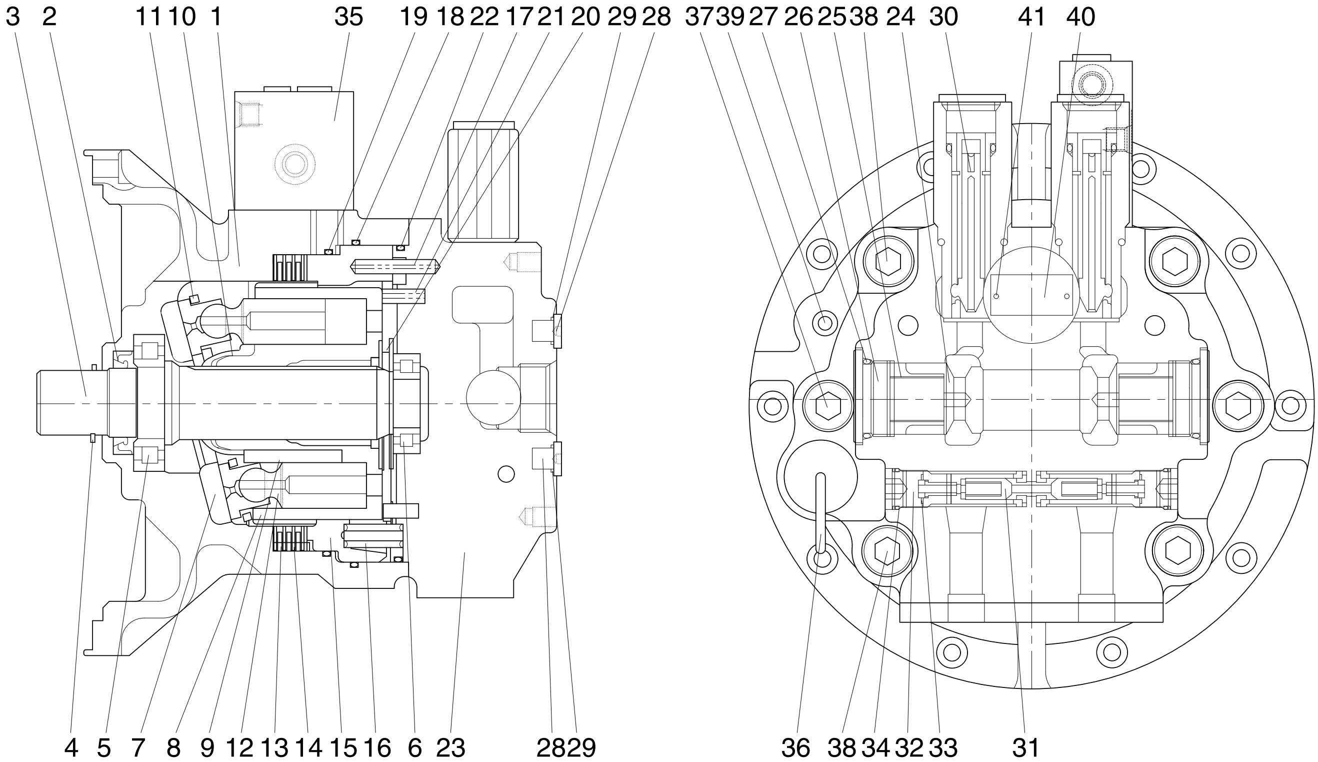


Hydraulic circuit

480F2SM01

Port	Port name	Port size
VA, VB	Main port	ø 20
Dr	Drain port	PF 1/2
Mu	Make up port	PF 1 1/4
MA, MB	Gauge port	PF 1/4
Au	Air vent port	PF 1/4
PG	Brake release stand by port	PF 1/4
SH	Brake release pilot port	PF 1/4

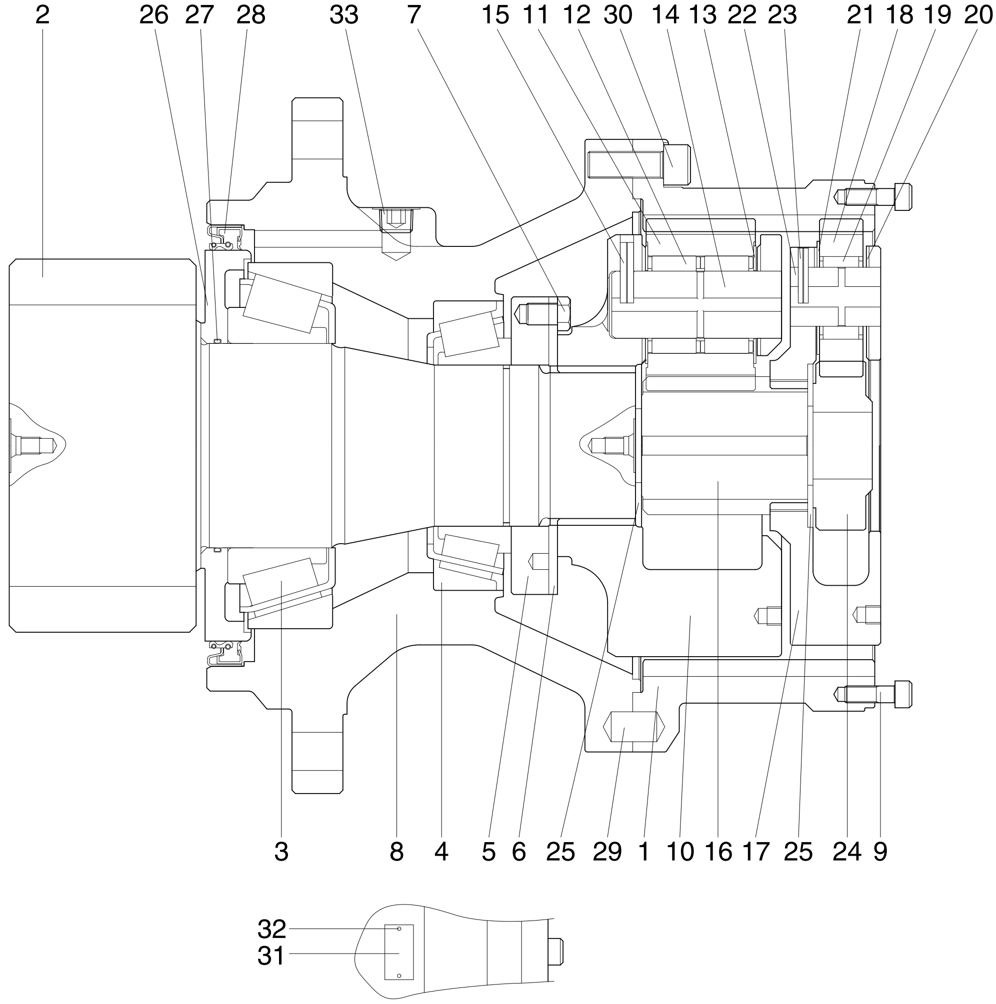
1) SWING MOTOR



480F2SM02

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

2) REDUCTION GEAR



480F2SM03

1	Ring gear	12	Needle bearing No. 2	23	Spring pin No. 1
2	Drive shaft	13	Thrust washer No. 2	24	Sun gear No. 1
3	Taper bearing	14	Carrier pin No. 2	25	Thrust plate
4	Taper bearing	15	Spring pin No. 2	26	Sleeve
5	Ring nut	16	Sun gear No. 2	27	O-ring
6	Lock plate	17	Carrier No. 1	28	Oil seal
7	Hexagon head bolt	18	Planetary gear No. 1	29	Parallel pin
8	Casing	19	Needle bearing No. 1	30	Hexagon socket head bolt
9	Hexagon socket head bolt	20	Thrust washer No. 1-upper	31	Name plate
10	Carrier No. 2	21	Thrust washer No. 1-lower	32	Rivet
11	Planetary gear No. 2	22	Carrier pin No. 1	33	Plug

2. PRINCIPLE OF DRIVING

2.1 Generating the turning force

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

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

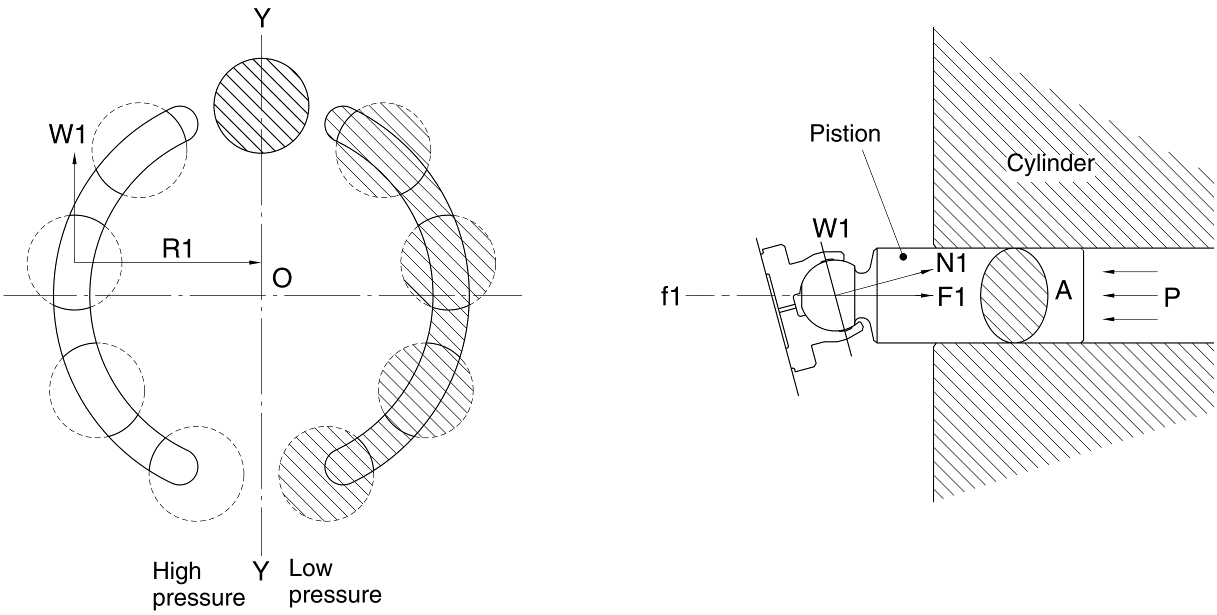
The high hydraulic can generate the force, $F1=P \times A$ (P : supplied pressure, A : water pressure area), like following pictures, working on a piston.

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

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

The sum of torque ($\Sigma W1 \times R1$), generated from each piston (4~5 pieces) on the side of a high hydraulic, generates the turning force.

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



21078TM05

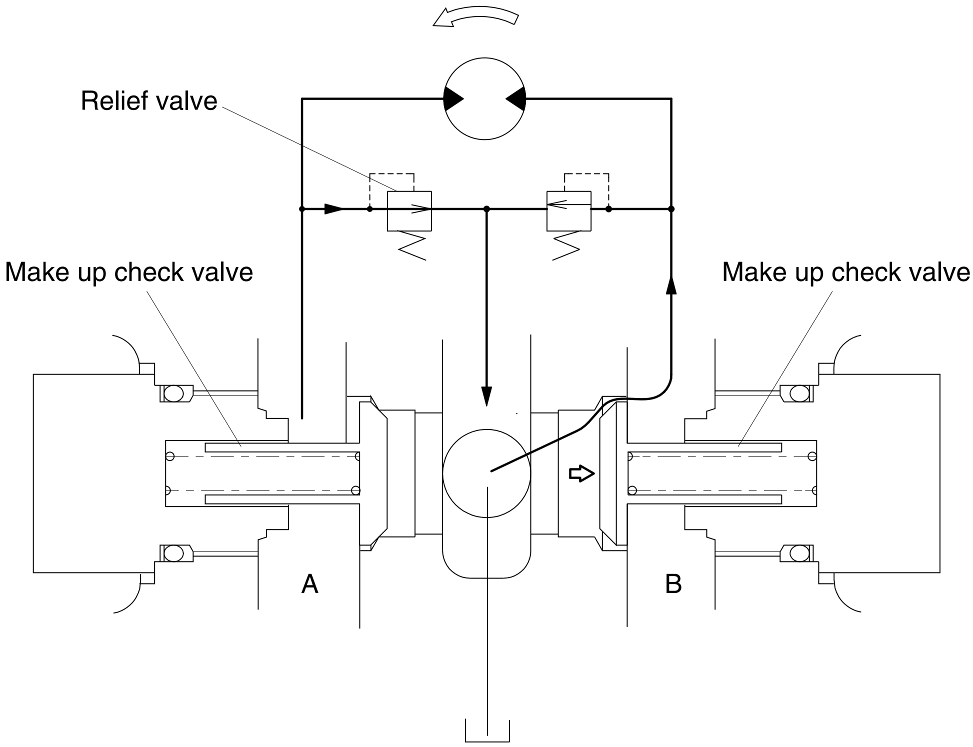
2) MAKE UP VALVE

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

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

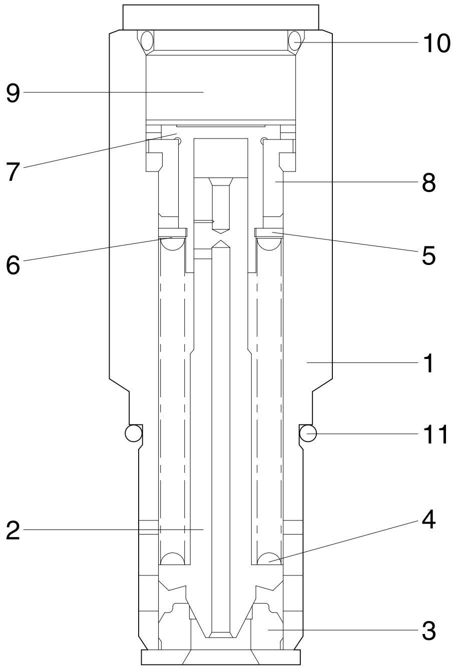
Pressurized oil into the port B, the motor rotate counterclockwise.

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



21092SM04

3) RELIEF VALVE



480F2SM05

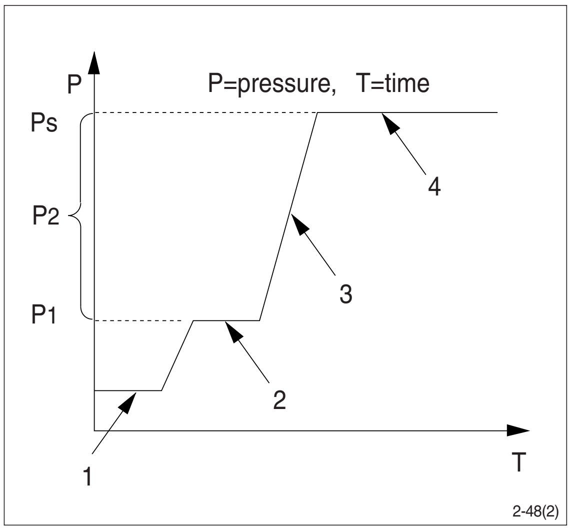
1	Sleeve
2	Poppet
3	Poppet seat
4	Spring
5	Spring seat
6	Shim
7	Piston
8	Stopper
9	Plug
10	O-ring
11	O-ring

(1) Construction of relief valve

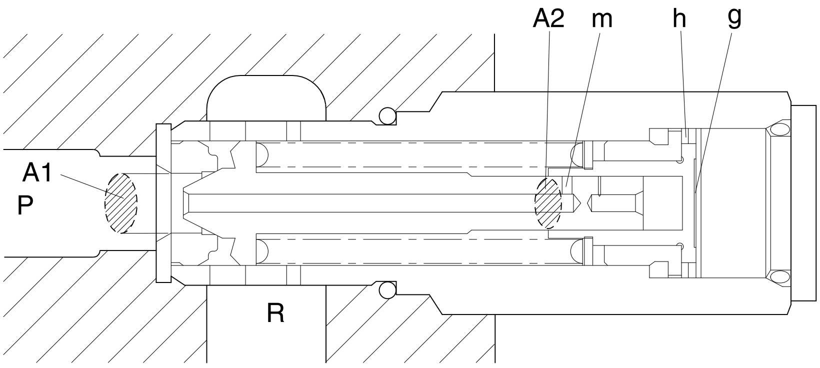
The valve casing contains two cartridge type relief valves that stop the regular and reverse rotations of the hydraulic motor. The relief valves relieve high pressure at start or at stop of swing motion and can control the relief pressure in two steps, high and low, in order to insure smooth operation.

(2) Function of relief valve

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



① Ports (P,R) at tank pressure.

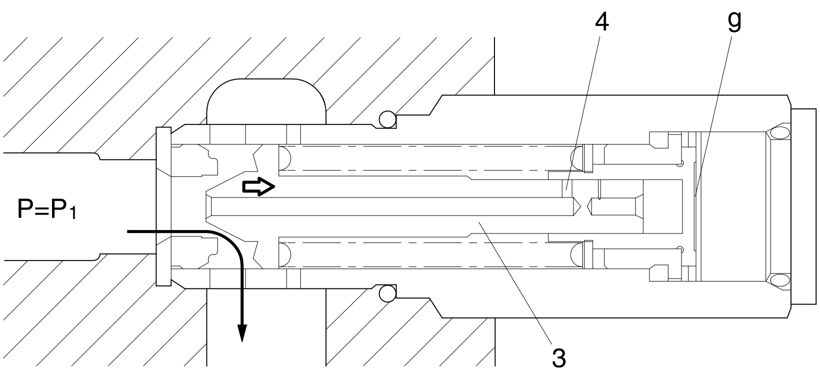


480F2SM06

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

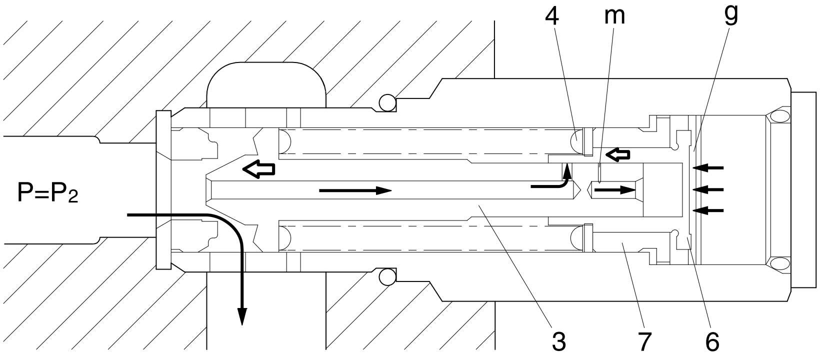
$P_1 \times A_1 = Fsp + Pg \times A_2$

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



480F2SM07

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



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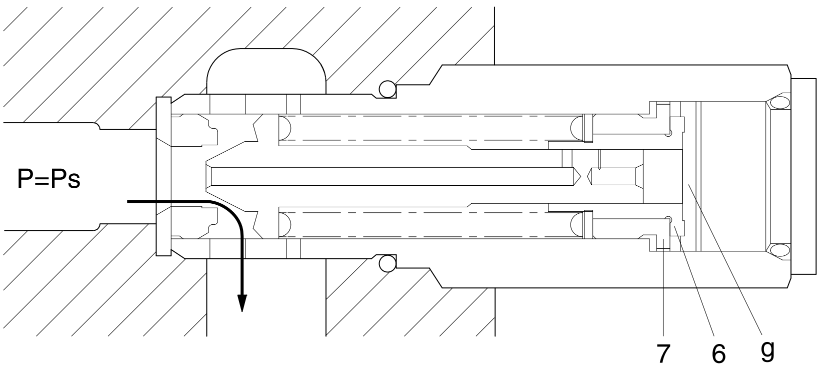
④ When piston (6) hits the bottom of bushing (7), it stops moving to the left any further. As the result, the pressure in chamber (g) equals (Ps).

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

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



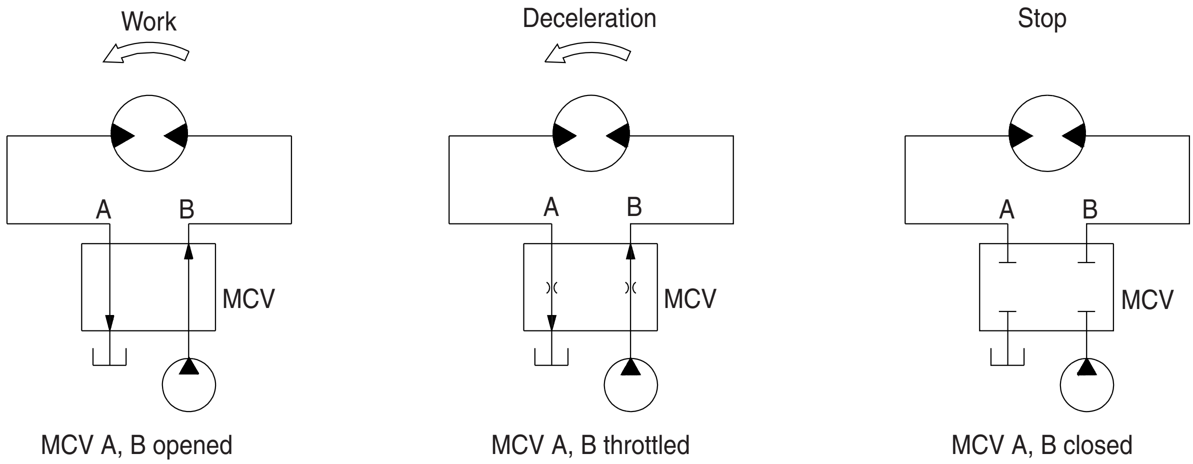
480F2SM09

4) BRAKE SYSTEM

(1) Control valve swing brake system

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

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



2-48(1)

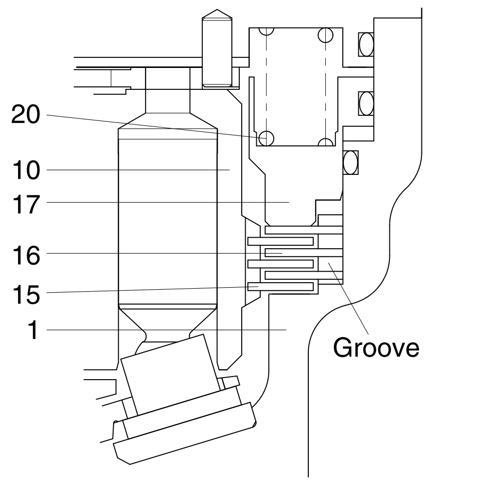
(2) Mechanical swing parking brake system

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

① Brake assembly

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

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

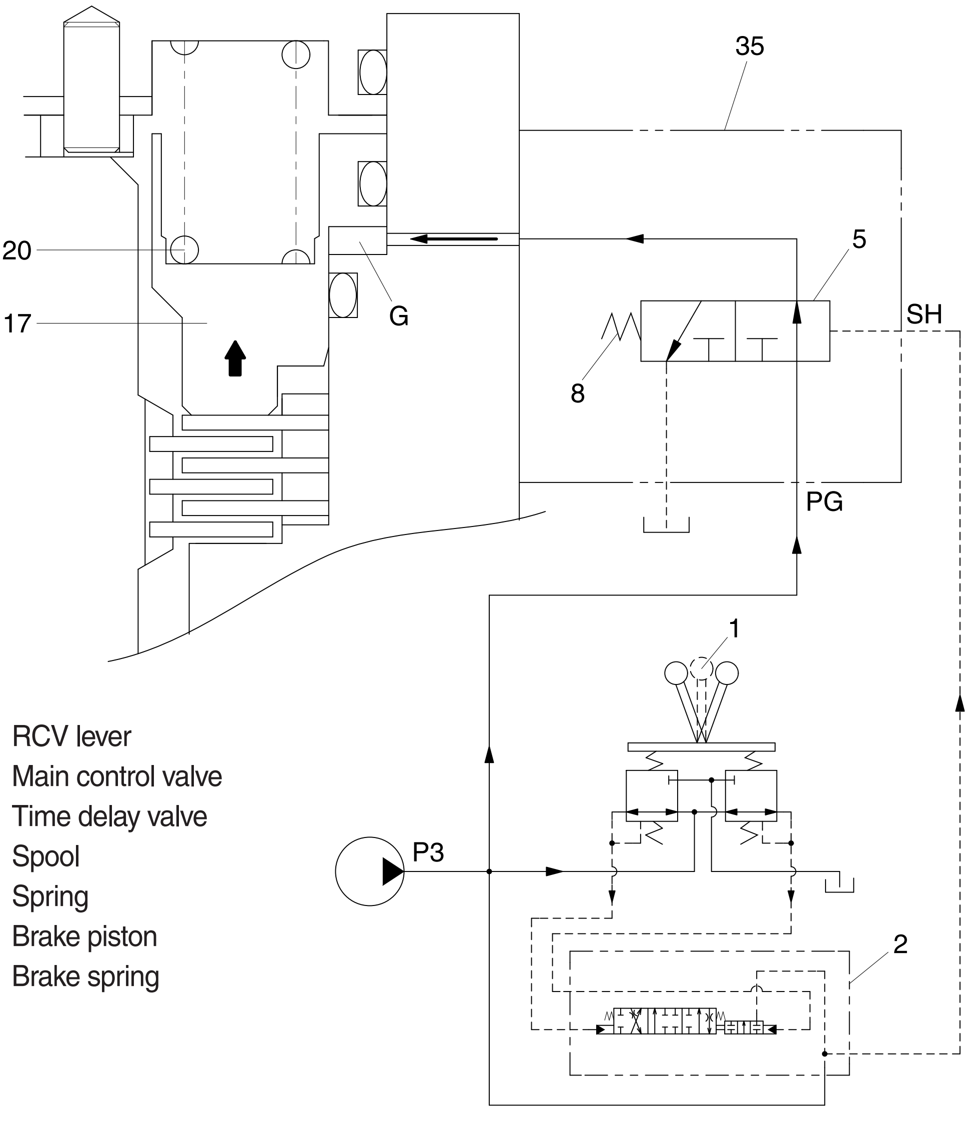


21092SM15

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

② Operating principle

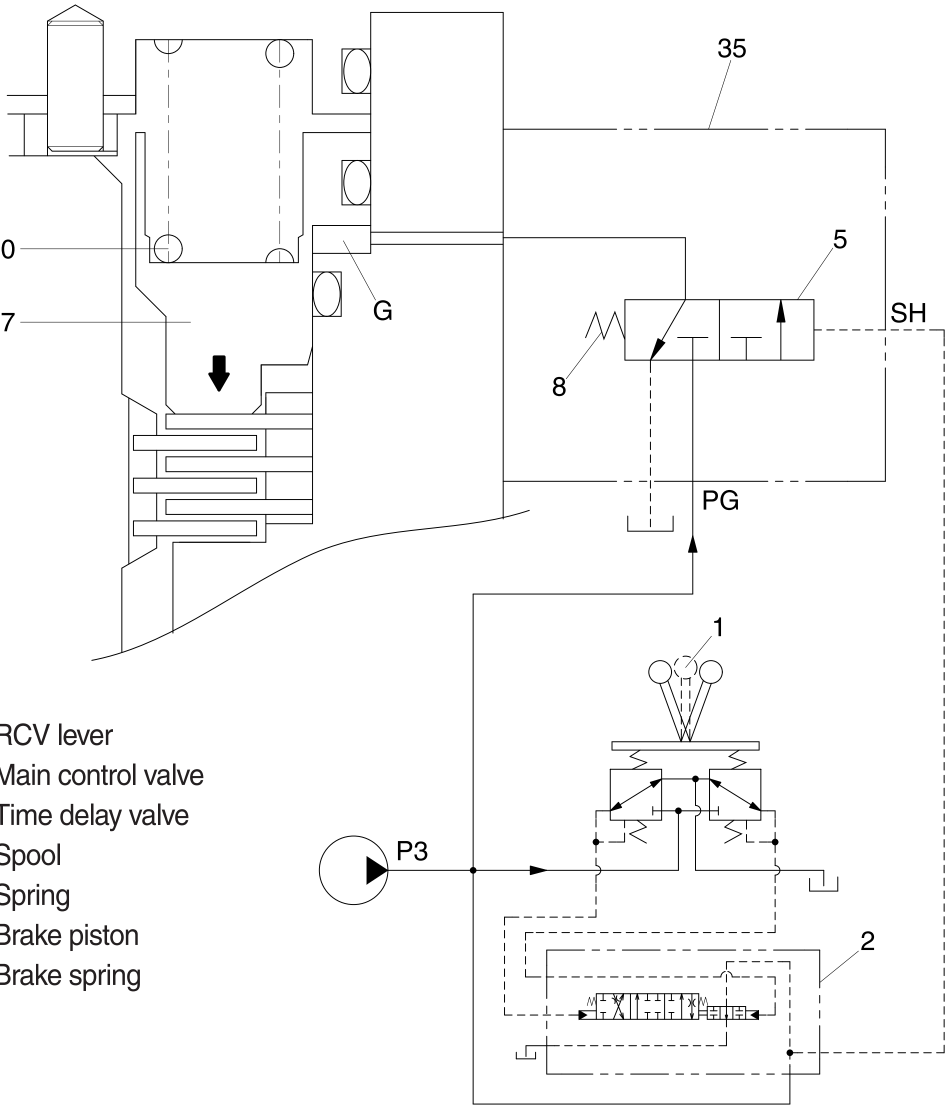
a. When one of the RCV lever (1) is set to the operation position, the each spool is shifted to left or right and the pilot oil flow is blocked. Then the pilot oil go to SH of the time delay valve (3).
   This pressure moves spool (5) to the leftward against the force of the spring(8), so pilot pump charged oil (P3) goes to the chamber G through port PG.
   This pressure is applied to move the piston (16) to the upward against the force of the spring (19). Thus, it releases the brake force.



1 RCV lever
2 Main control valve
3 Time delay valve
5 Spool
8 Spring
16 Brake piston
19 Brake spring

48092SM04

b. When all of the RCV lever (1) are set the neutral position, the spool (5) returns to right.
Then, the piston (16) is moved lower by spring force and the return oil from the chamber G flows back to tank port.
At this time, the brake works.



1	RCV lever
2	Main control valve
3	Time delay valve
5	Spool
8	Spring
16	Brake piston
19	Brake spring

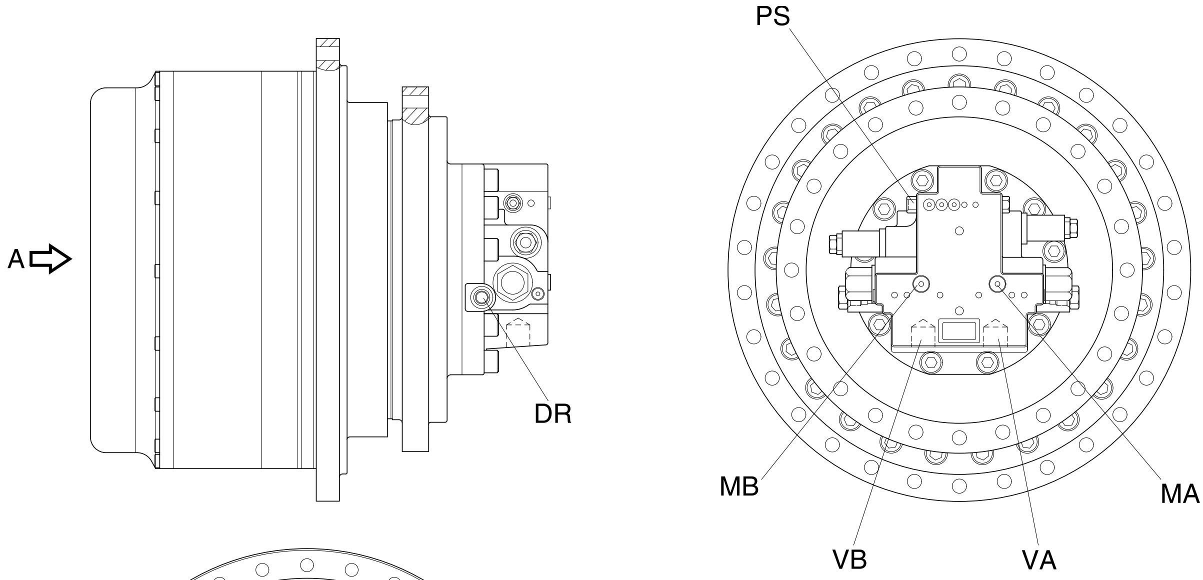
48092SM05

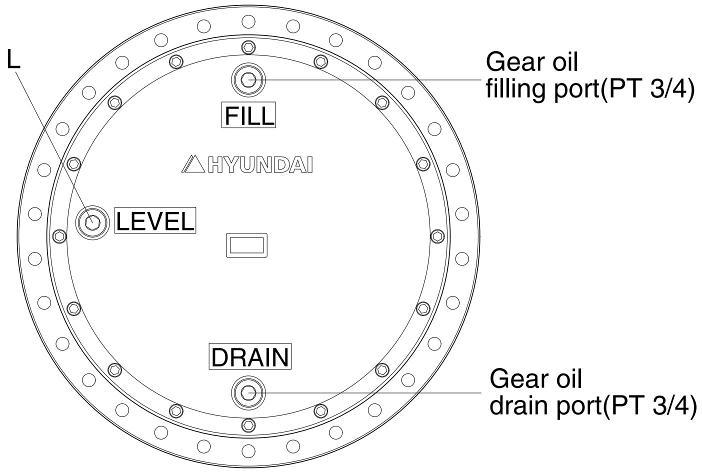
GROUP 4 TRAVEL DEVICE

1. CONSTRUCTION

Travel device consists travel motor and gear box.

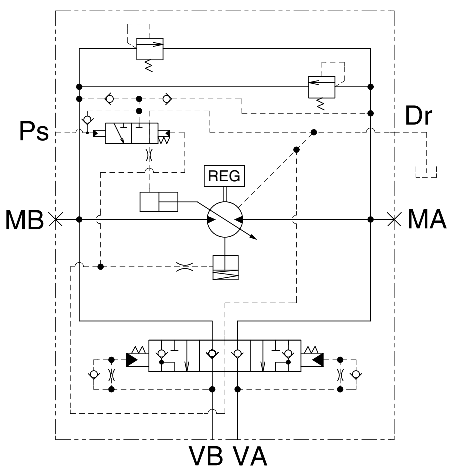
Travel motor includes brake valve, parking brake and high/low speed changeover mechanism.





VIEW A

480F2TM01

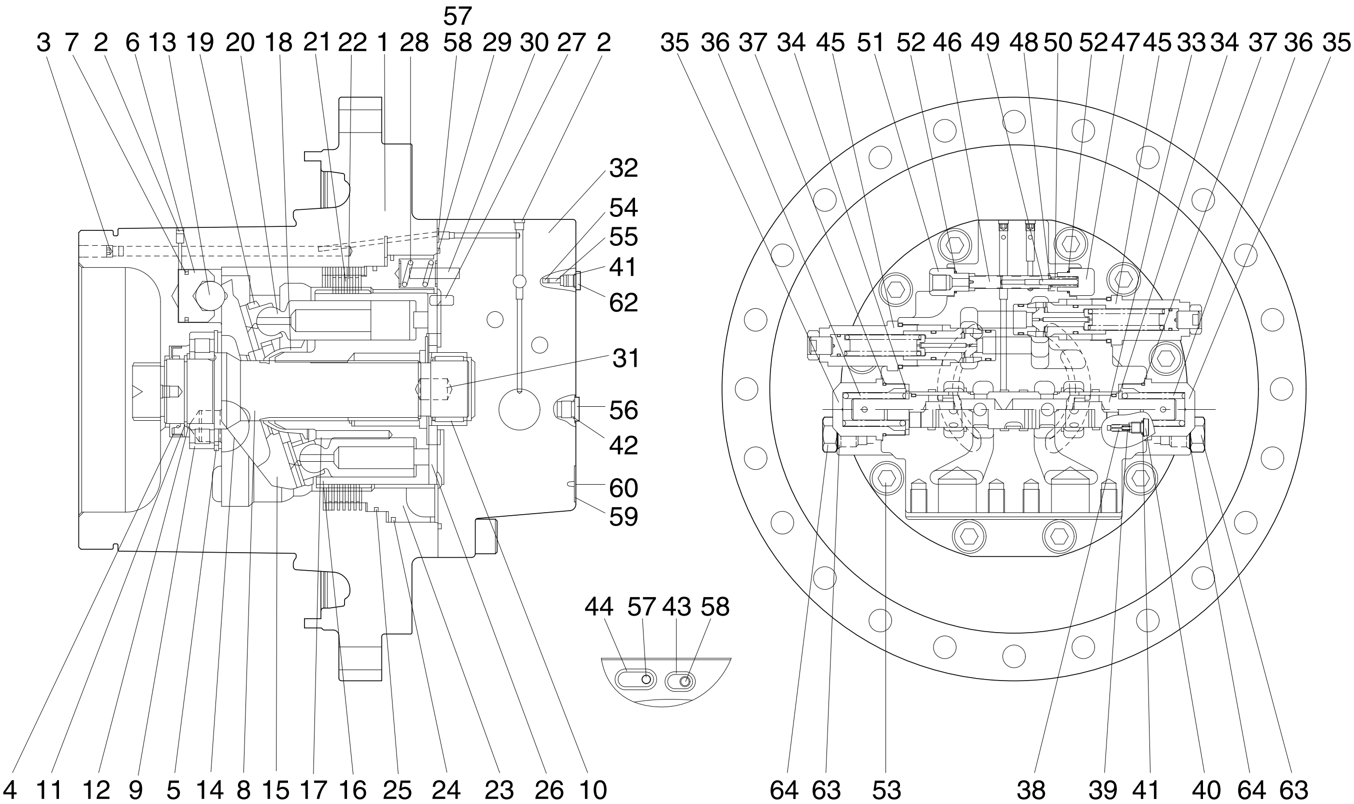


HYDRAULIC CIRCUIT

Port	Port name	Port size
VA, VB	Main port	PF1
MA, MB	Pressure gauge port	PF 1/4
PS	Pilot port	PF 1/4
DR	Drain port	PF 1/2
L	Level gauge	PF 3/4

2. STRUCTURE

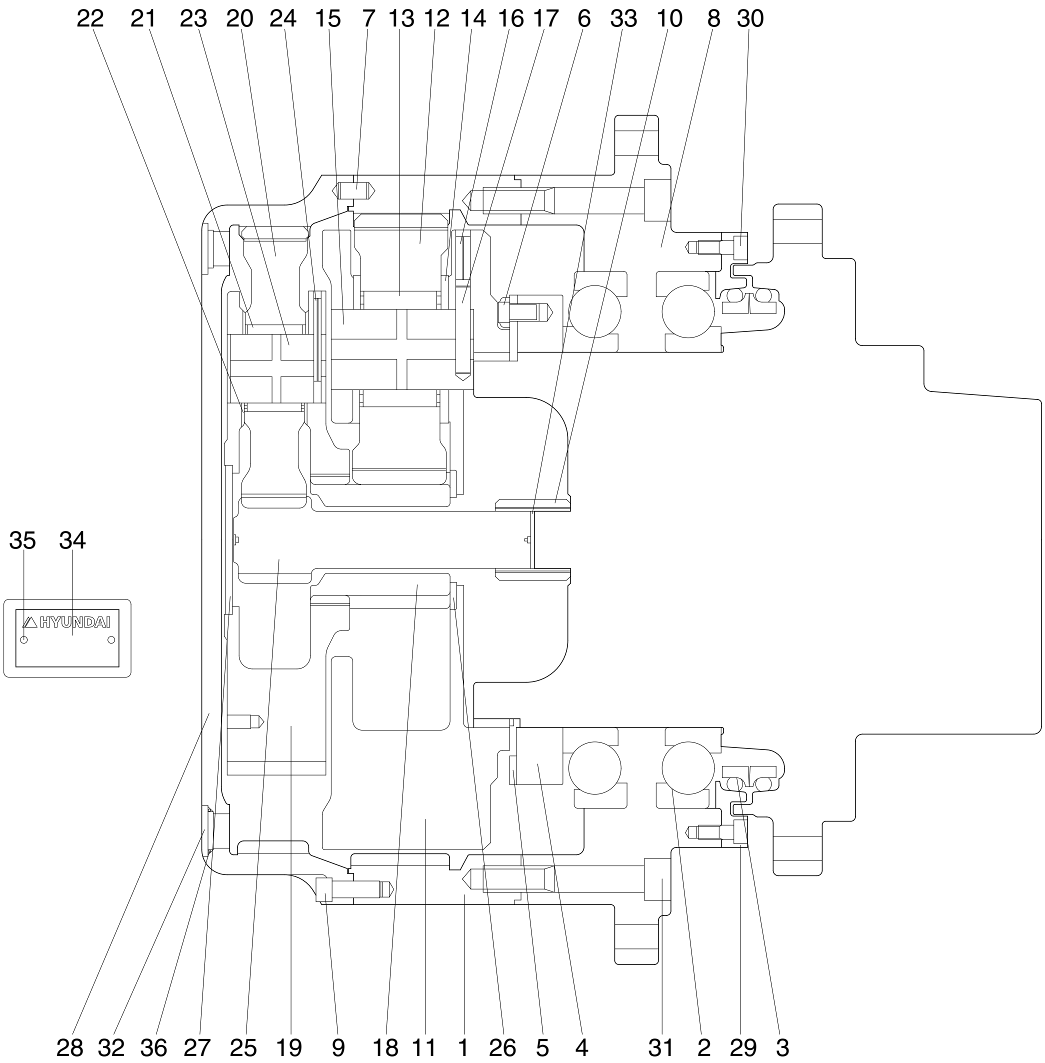
1) TRAVEL MOTOR



480F2TM02

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

2) REDUCTION GEAR



480F2TM03

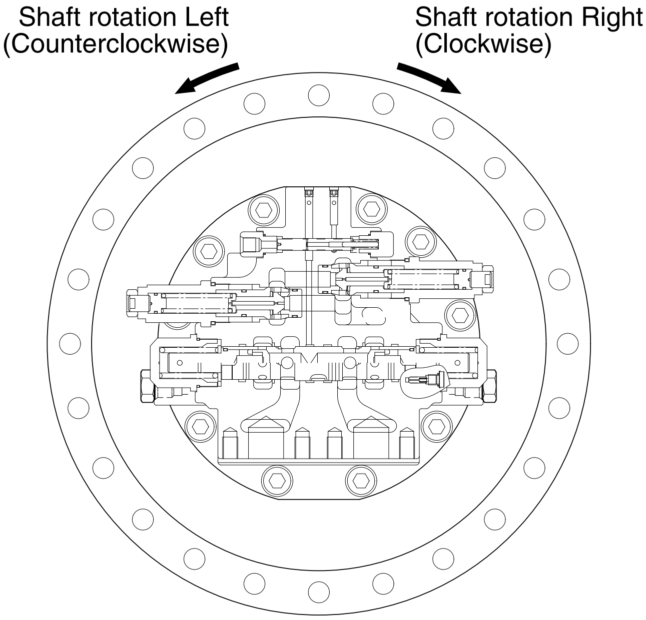
1	Ring gear	13	Needle bearing No. 2	25	Sun gear No. 1
2	Ball bearing	14	Thrust washer No. 2	26	Thrust plate
3	Floating seal assy	15	Carrier pin No. 2	27	Thrust plate
4	Ring nut	16	Spring pin No. 2	28	Cover
5	Lock plate	17	Solid pin No. 2	29	Cover seal
6	Hexagon head bolt	18	Sun gear No. 2	30	Hex socket head bolt
7	Parallel pin	19	Carrier No. 1	31	Hex socket head bolt
8	Housing	20	Planetary gear No. 1	32	Plug
9	Hexagon socket head bolt	21	Needle bearing No. 1	33	Snap ring
10	Coupling	22	Thrust washer No. 2	34	Name plate
11	Carrier No. 2	23	Carrier pin No. 1	35	Rivet
12	Planetary gear No. 2	24	Spring pin No. 1	36	O-ring

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 (32) and valve plate (26), led to cylinder block (16).

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)

480F2TM04

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

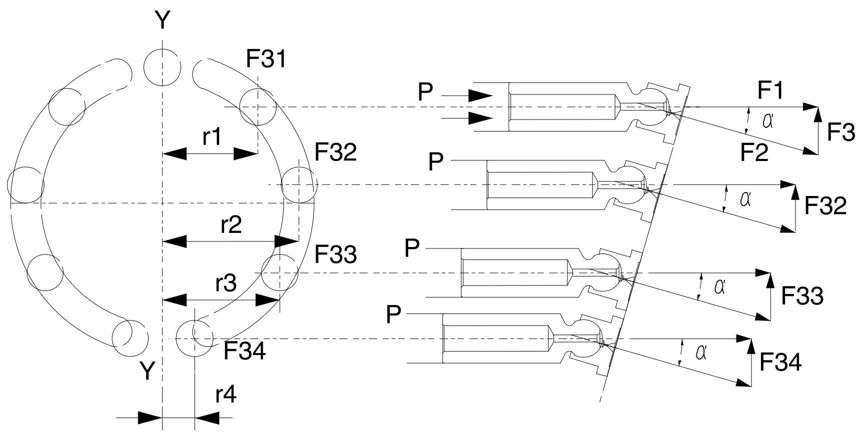
F1 = P $\times$ A (P : pressure, A : area of piston section)

The swash plate (15) with inclined angle of α divides this force F1 into thrust force F2 and radial force F31-34.

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

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

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

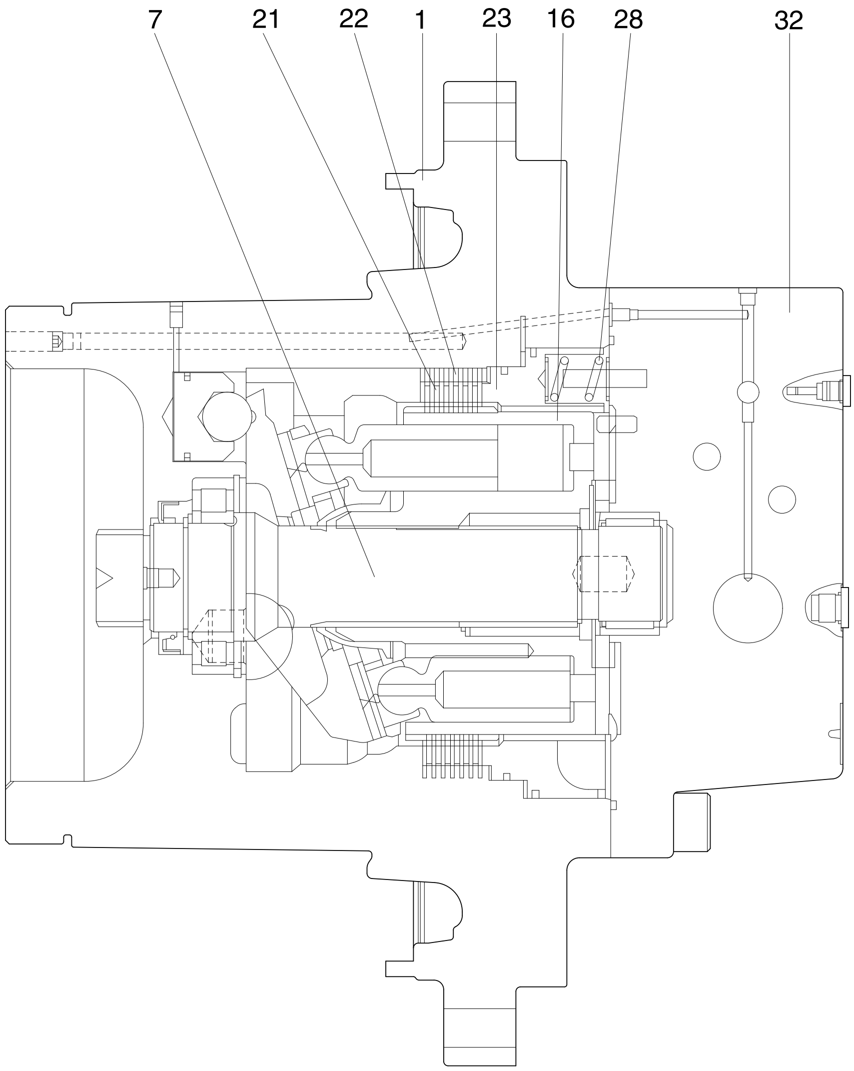


29092TM07

2) PARKING BRAKE

Parking brake is released when high pressure oil selected by the brake valve portion that is connected directly to the rear cover (32), is applied to the parking piston (23).
Otherwise the braking torque is always applied.

This braking torque is generated by the friction between the separated plates (22), inserted into the casing (1), and friction plates (21), coupled to cylinder block (16) by the outer splines.
When no pressure is activated on the parking piston (23), it is pushed by the brake springs (28) and it pushes friction plates (21) and separated plates (22) towards casing (1) and generates the friction force which brakes the rotation of cylinder block (16) and hence the shaft (7).



480F2TM05

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 (50), the spring (50) is compressed and spool (46) shifts to the right to connect the port P and port C.

Then, the highest pressure is selected by the check valve (54) from inlet and outlet pressure of the motor and high speed pilot line pressure and pushes shifter piston (6). As a result, swash plate (15) turns around the line L which connect the two pivots (14) as shown by dotted lines. The turn stops at the stopper (1-1) of casing and swash plate (15) keeps the position.

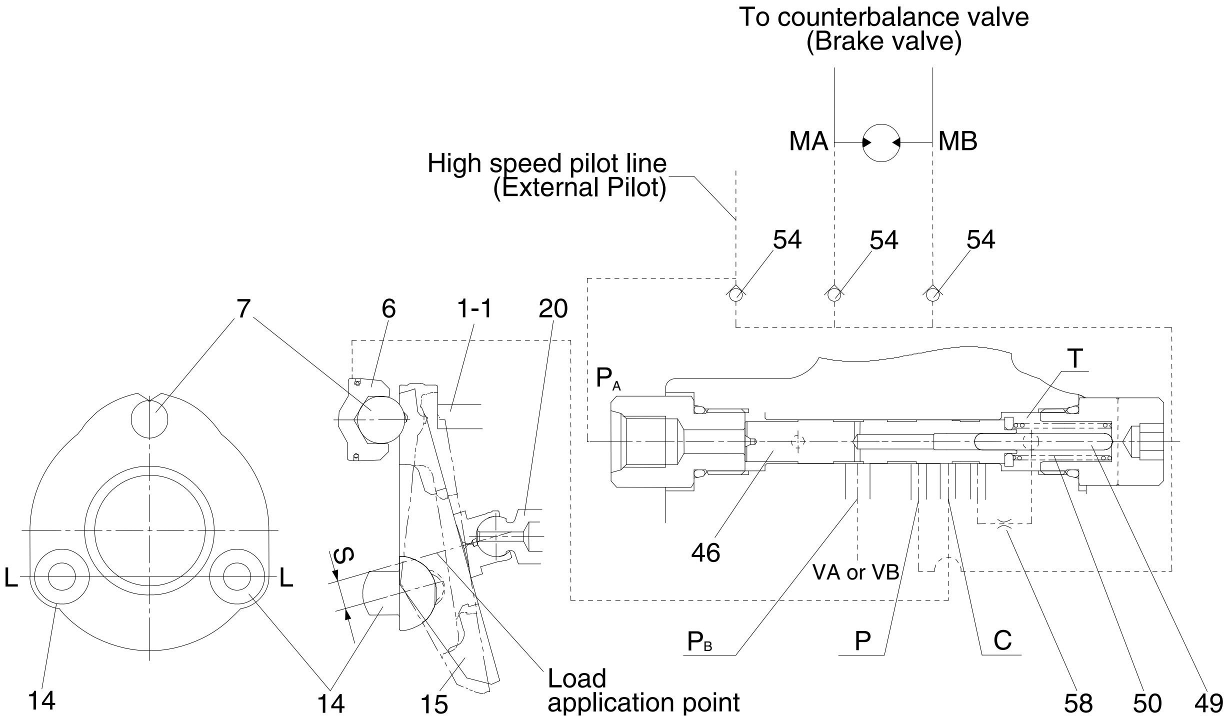
In this case, the piston stroke become shorter and motor capacity become smaller and motor rotates faster, around 1.60 times, by the same volume of oil.

When no pressure is in the high speed pilot line P_A, spool (33) is pushed back by the spring (50) and pressure that pressed the shifter piston (6) is released to the hydraulic tank through restrictor (58).

Here, nine pistons are there and they equally spaced on the swash plate (15). The force that summed up those of pistons comes to almost the center of the swash plate (15) as shown. Since the pivots (14) are off-set by S from the center, the rotating force of product S and the force moves swash plate (15) 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 (49). When the pressure at P_B exceeds predetermined value, spool (46) returns to the left by the counter-pressure against pin (49) and the pressure on the shifter piston (5) through port C is released to the tank and the motor comes to low speed.

When P_B goes down, the spool (46) moves to the right and the speed become high.

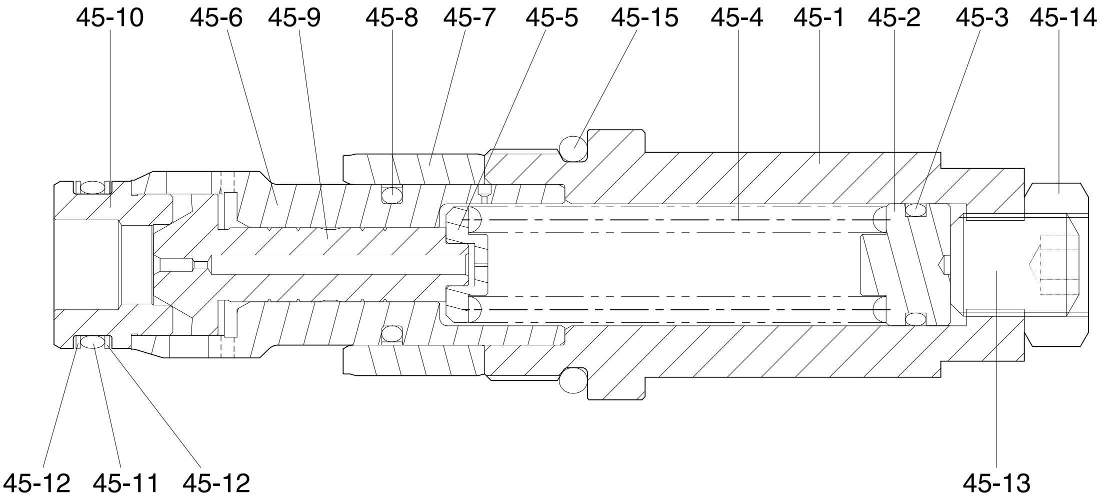


480F2TM06

4) OVERLOAD RELIEF VALVE

(1) Structure

This valve is screwed in the motor rear cover (32) and consists of : plug (45-1) that is screwed and fixed in the rear cover (32), poppet (45-9) and supports the poppet seat (45-10), spring (45-4) that is operating relief valve setting pressure and supports the spring seat (45-5), that is inserted in the sleeve (45-6), screw (45-13) that is adjust the spring force, nut (45-14) that fix screw (45-13), piston (45-7) that reduce the shock.



480F2TM07

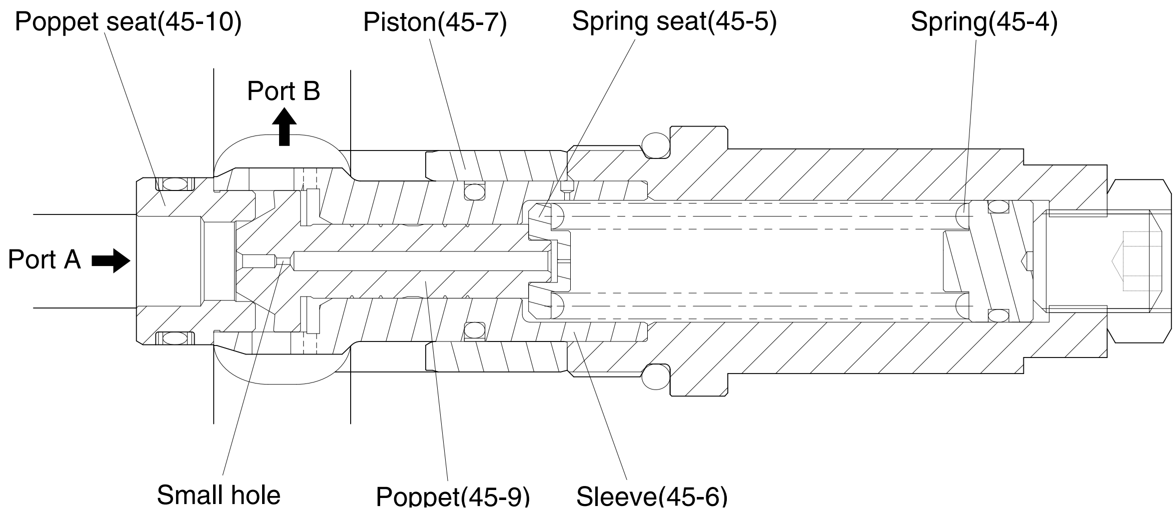
45-1	Plug	45-6	Sleeve	45-11	O-ring
45-2	Guide	45-7	Piston	45-12	Back-up ring
45-3	O-ring	45-8	Seal	45-13	Socket screw
45-4	Spring	45-9	Poppet	45-14	Hexagon nut
45-5	Spring seat	45-10	Poppet seat	45-15	O-ring

(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 (45-9) which seats on the poppet seat (45-10) and, at the same time, is delivered, via small hole, to the spring seat (45-5) located inside the sleeve (45-6) and the seat bore pressure increases up to "A" port pressure. The poppet (45-9) opposes to spring (45-4) by the force of the pressure exerted on the area difference between poppet seat's effective diameter and spring seat bore and keep the predetermined pressure.
When hydraulically braking, the piston (45-7) is at the left position by the driving pressure, and when "A" port pressure increases, the pressure is applied also to the piston (45-7) through the small hole in the poppet (45-9) and piston (45-7) moves rightward until it touches the stopper in rear cover. In this while, the poppet (45-9) maintains "A" port pressure at comparatively low against the spring (45-4) force and exhaust oil to "B" port side. After the piston reached to the plug, the valve acts the same as at starting.



480F2TM08

5) BRAKE VALVE

(1) Structure

The brake valve portion mainly consists of the following parts:

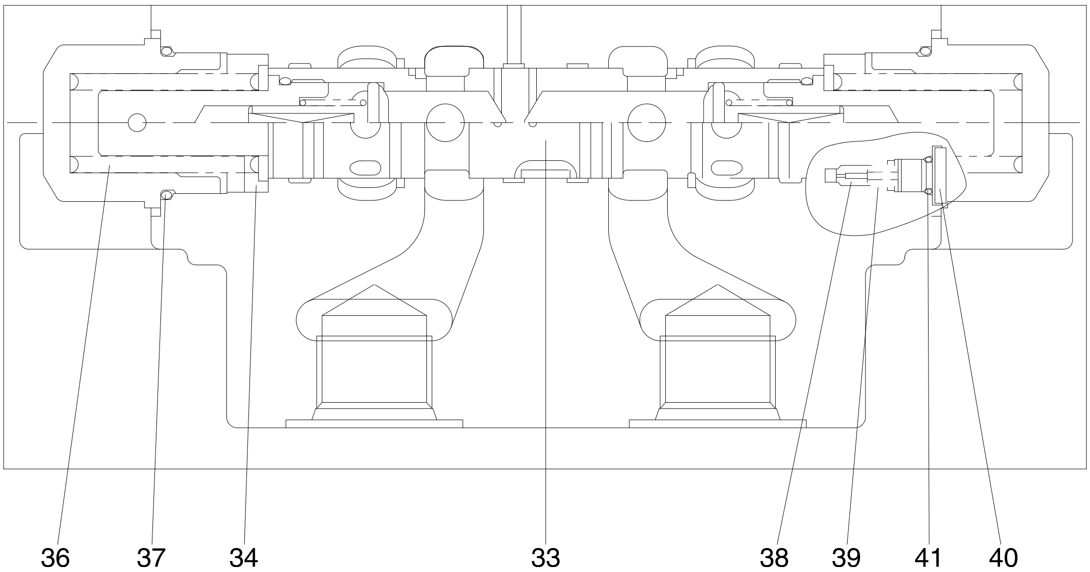
① Spool

By shifting the spool (33), the discharged oil from hydraulic motor is automatically shut off or restricted according to the condition and give the effect of holding, accelerating, stopping and counterbalance operations.

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

② Check valve (built in the spool)

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



480F2TM09

33	Main spool	37	O-ring	40	Plug
34	Spring seat	38	Restrictor	41	O-ring
36	Spring	39	Restrictor spring		

(2) Operation

① Holding operation

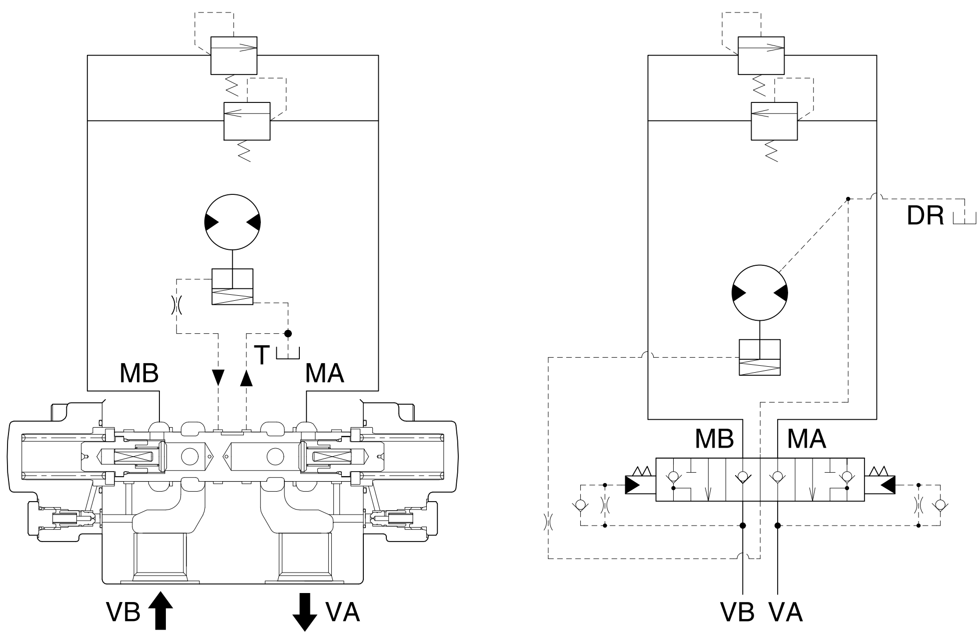
When the control valve is at neutral position, VA and VB ports are connected to the tank, and the spring (36) located on both spool ends holds the spool (33) at central position.

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 (33), operates to avoid the cavitation and opens the passage from VA to MA or from VB to MB. Then the oil equivalent to the leakage is sucked from the tank line to the closed circuit.



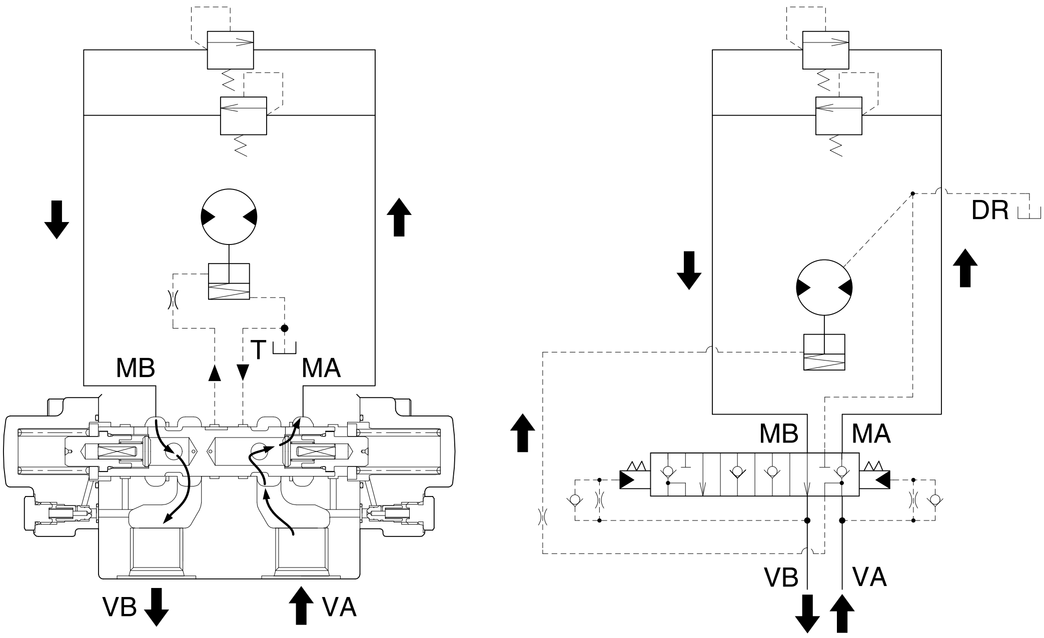
25092TM29

② Accelerating operation

When VA and VB ports are connected respectively to pump and tank by operating the control valve, hydraulic oil from pump is forwarded through VA port to push open the check valve provided inside spool (33), 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 (33) leftwards, overcoming the spring (36) force. Thus, the return line from MB to VB opens to rotate the motor.

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



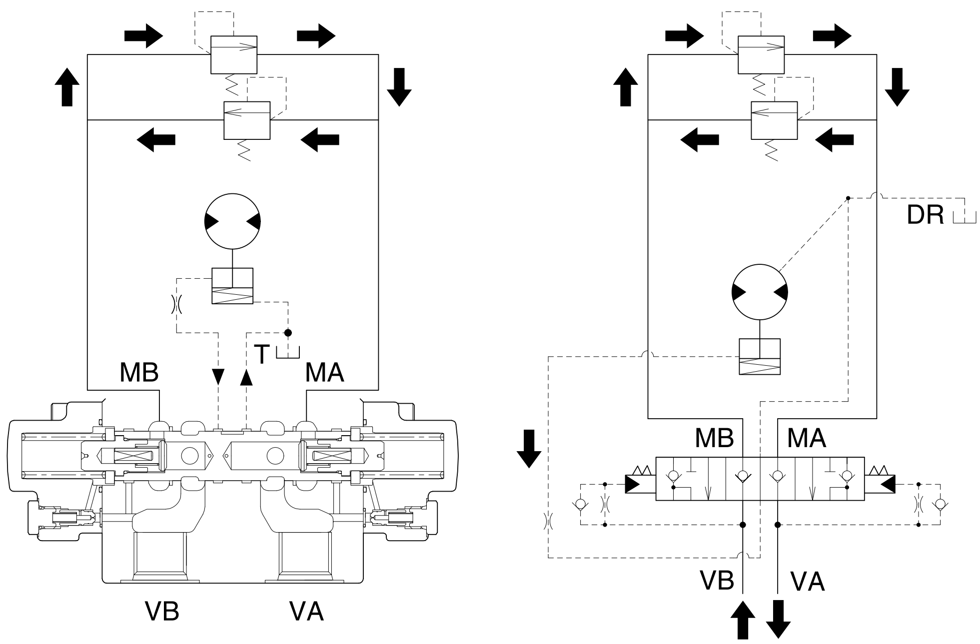
25092TM30

③ Stopping operation

Returning the control valve to neutral position while running the motor, the oil supply is cut off and VA and VB ports are connected to the tank line. Then the pressure of the pilot chamber located on both spool ends become equal, and the spool (33) returns to the neutral position by spring (36) force. Thus, the passage from MA to VA is closed.

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

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



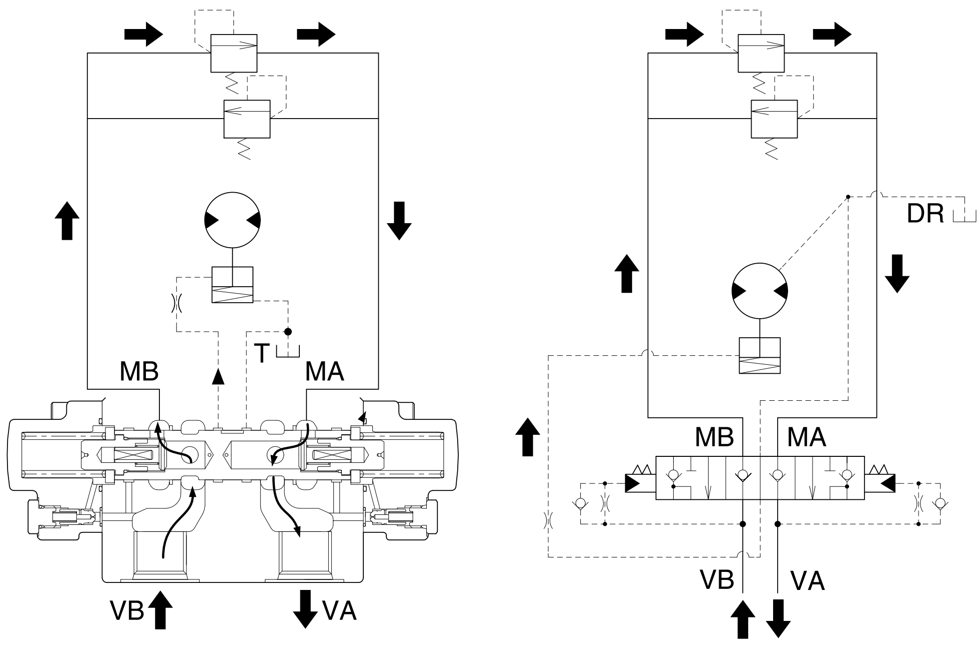
25092TM31

④ Counterbalance operation

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

In case the hydraulic oil is gradually decreased from pump to VB port, the drive shaft of hydraulic motor tends to rotate faster than that matched to the volume of oil supply.
Consequently, the pilot chamber pressure on MB to VB side decreases and the spring (38) force moves the spool (33) 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 (33) 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 (38) are set in the pilot chamber to damp the spool (33) movement.
The parking brake is released during pressure adjusting action of the spool (33).



25092TM32

6) REDUCTION GEAR

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

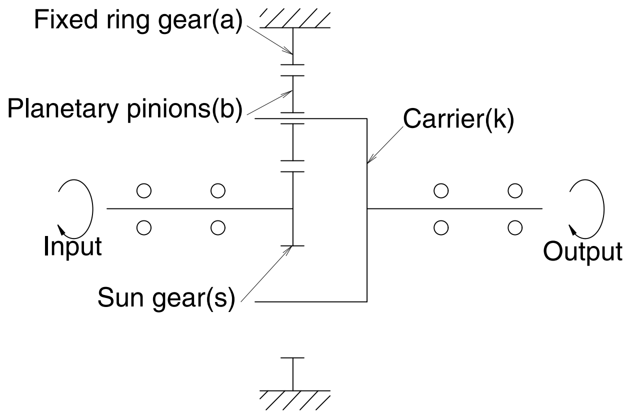
This reduction unit utilizes two stages, planetary reduction system.

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

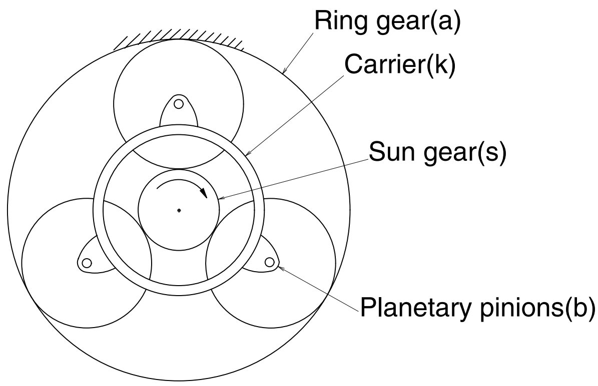
When the sun gear (s) is driven through input shaft, planetary pinions (b), rotating on their center, also move, meshing with fixed ring gear (a), around sun gear (s).

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

This mechanism is called planetary gear mechanism.



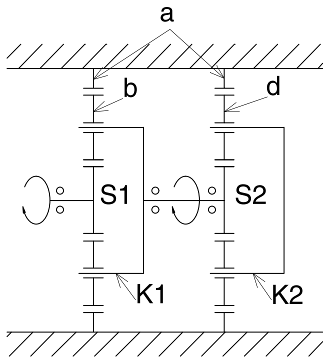
29072TM10



29072TM11

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

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



29072TM12

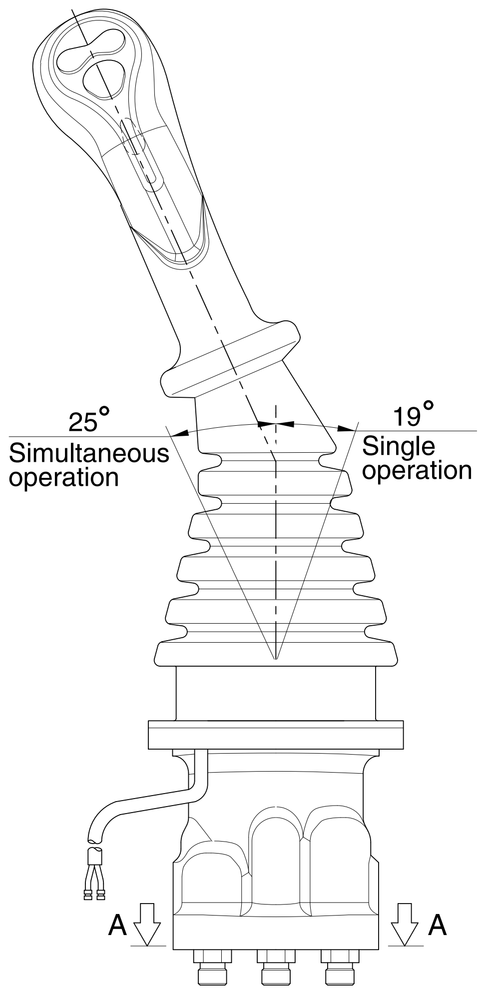
GROUP 5 RCV LEVER

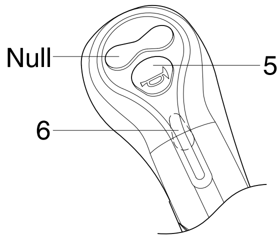
1. STRUCTURE

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

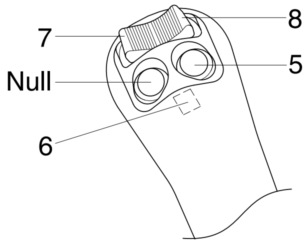
※ **Refer to the parts manual for the types of the RCV lever.**

1) TYPE L1, L3, L5





TYPE L1, L3

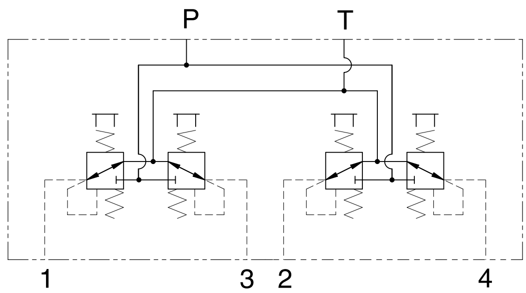


TYPE L5

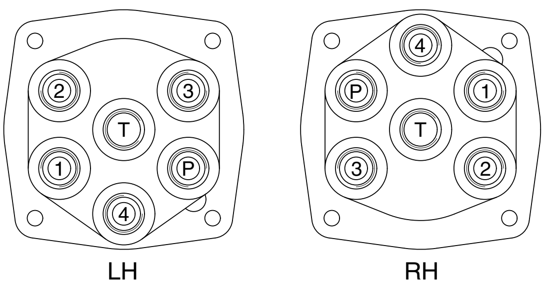
Switches

Type	No.	LH	RH
L1, L3	5	One touch decel	Horn
	6	Power boost	Breaker
L5	5	One touch decel	Horn
	6	Power boost	Null
	7	CCW rotation	Close
	8	CW rotation	Open

※ Number 7 and 8 : Option attachment



Hydraulic circuit



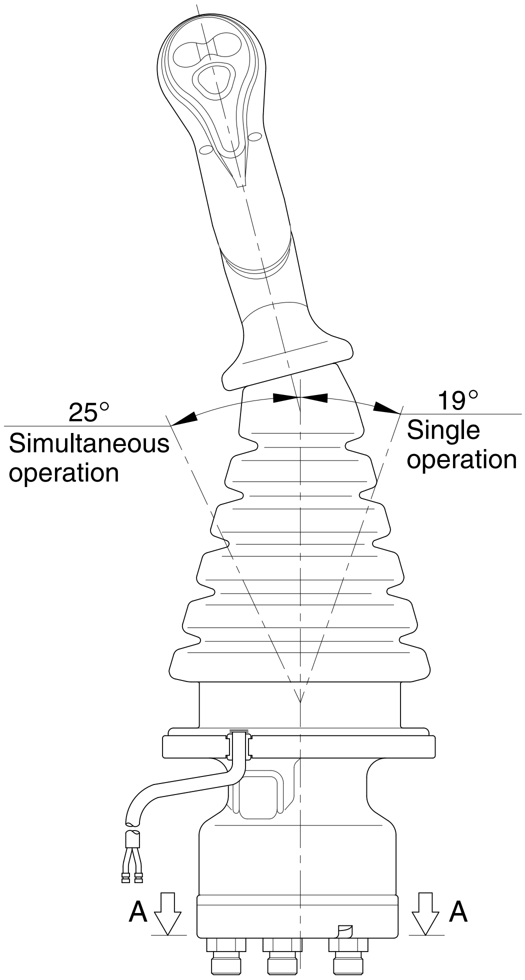
VIEW A-A

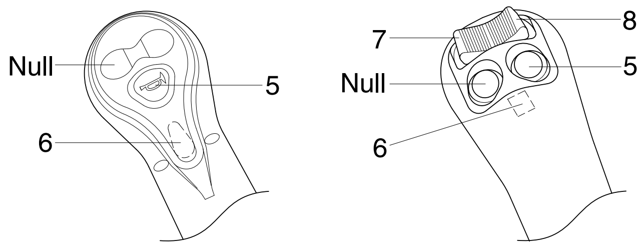
Pilot ports

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

300L2RL01

2) TYPE L2, L4, L6

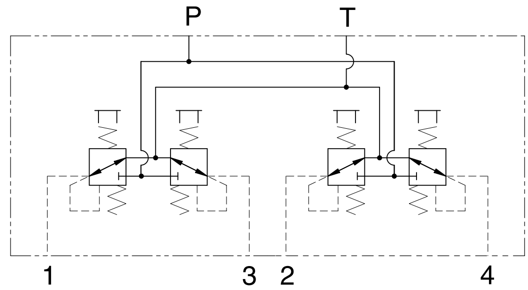




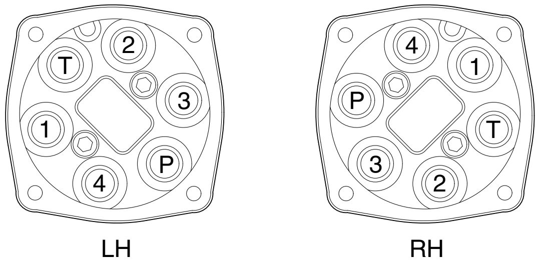
Switches

Type	No.	LH	RH
L2, L4	5	One touch decel	Horn
	6	Power boost	Breaker
L6	5	One touch decel	Horn
	6	Power boost	Null
	7	CCW rotation	Close
	8	CW rotation	Open

※ Number 7 and 8 : Option attachment



Hydraulic circuit



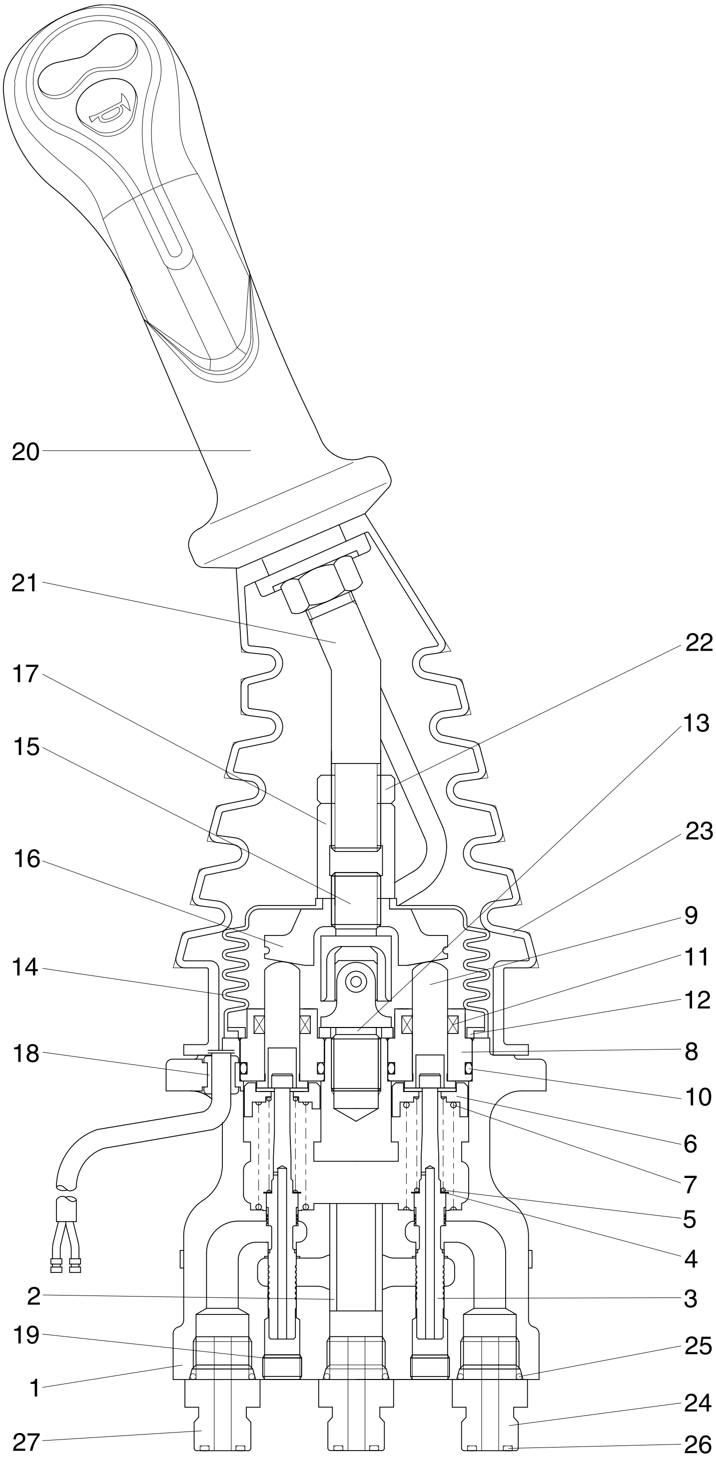
VIEW A-A

Pilot ports

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

300L2RL05

3) CROSS SECTION



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

300L2RL06

Item numbers are based on the type L1.

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

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

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

2. FUNCTIONS

1) FUNDAMENTAL FUNCTIONS

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

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

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

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

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

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

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

2) FUNCTIONS OF MAJOR SECTIONS

Item numbers are based on the type L1.

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

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

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

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

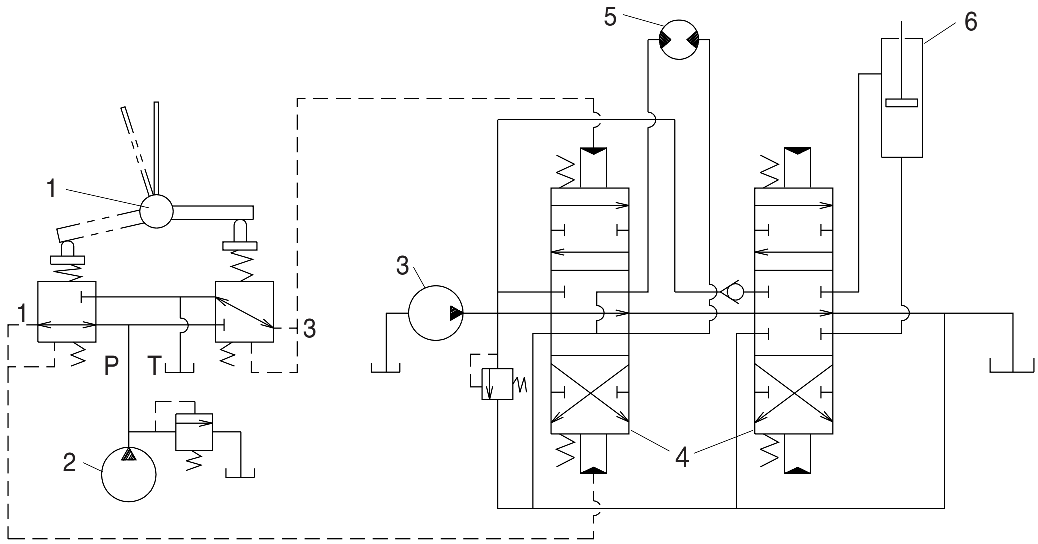
The spring (7) works on the case (1) and spring seat (6) and tries to return the push rod (9) to the zero-displacement position irrespective of the output pressure, securing its resetting to the center position.

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

3) OPERATION

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

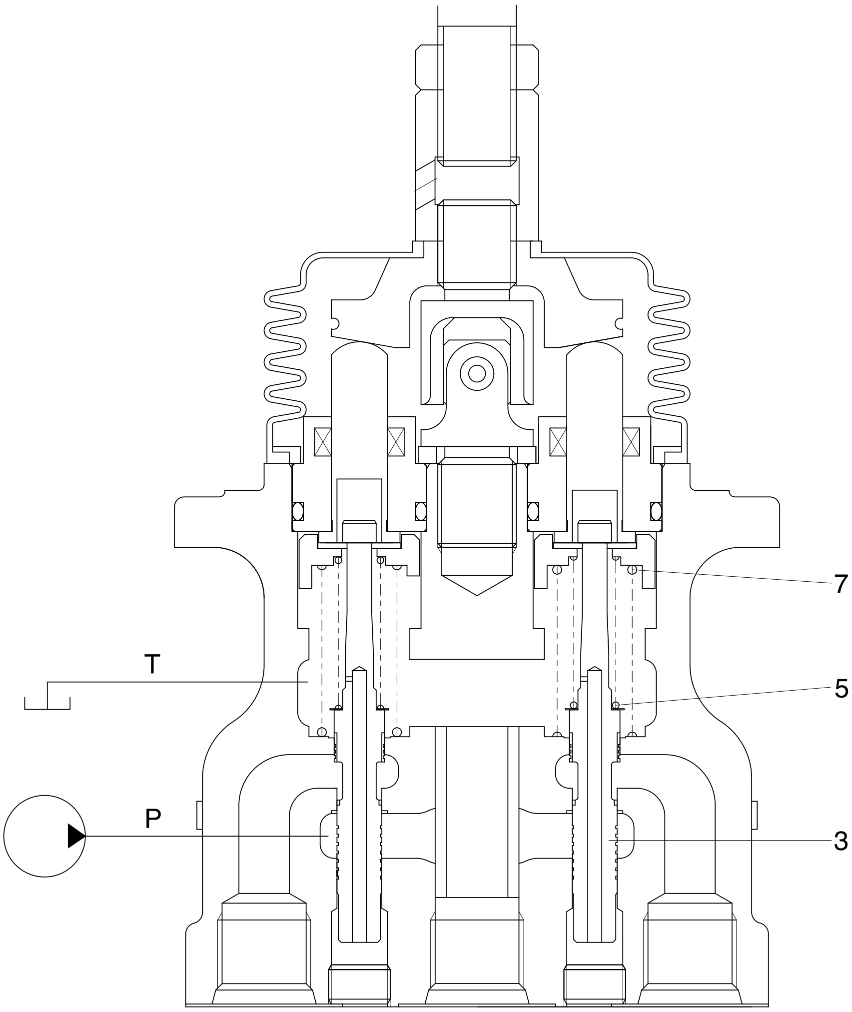
The diagram shown below is the typical application example of the pilot valve.



2-70

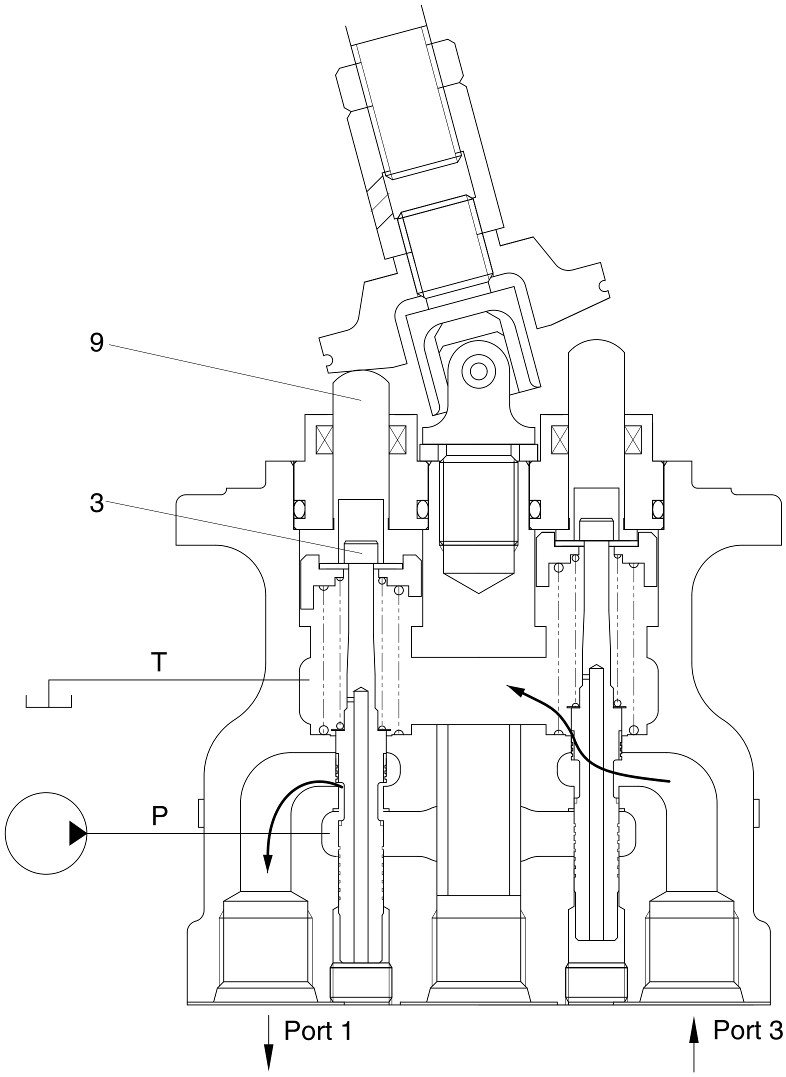
1	Pilot valve	3	Main pump	5	Hydraulic motor
2	Pilot pump	4	Main control valve	6	Hydraulic cylinder

(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



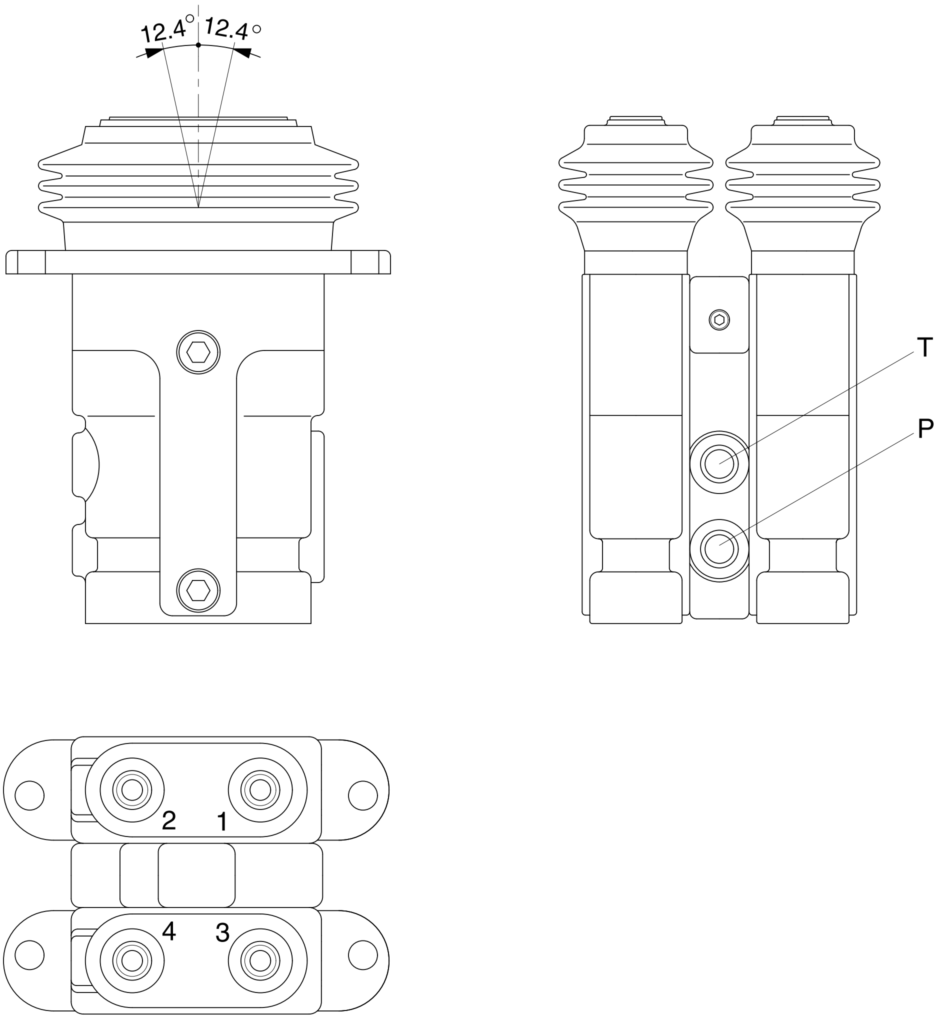
300L2RL04

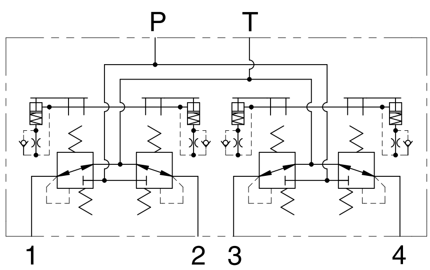
When the push rod (9) is stroked, the spool (3) moves downwards.
Then port P is connected with port (1) and the oil supplied from the pilot pump flows through port (1) to generate the pressure.
When the pressure at port (1) increases to the value corresponding to the spring force set by tilting the handle,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

GROUP 6 RCV PEDAL

1. STRUCTURE

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





Hydraulic circuit

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

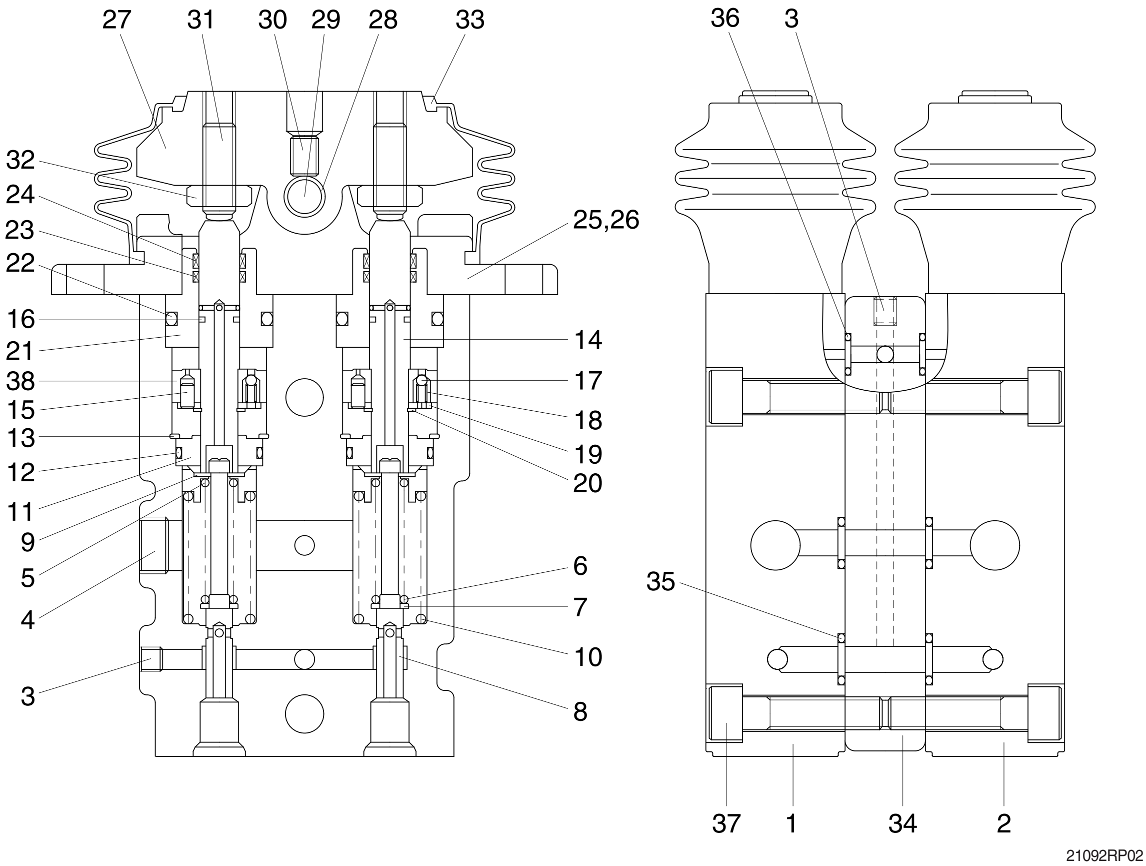
21092RP01

CROSS SECTION

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

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

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



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

2. FUNCTION

1) FUNDAMENTAL FUNCTIONS

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

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

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

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

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

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

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

2) FUNCTIONS OF MAJOR SECTIONS

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

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

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

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

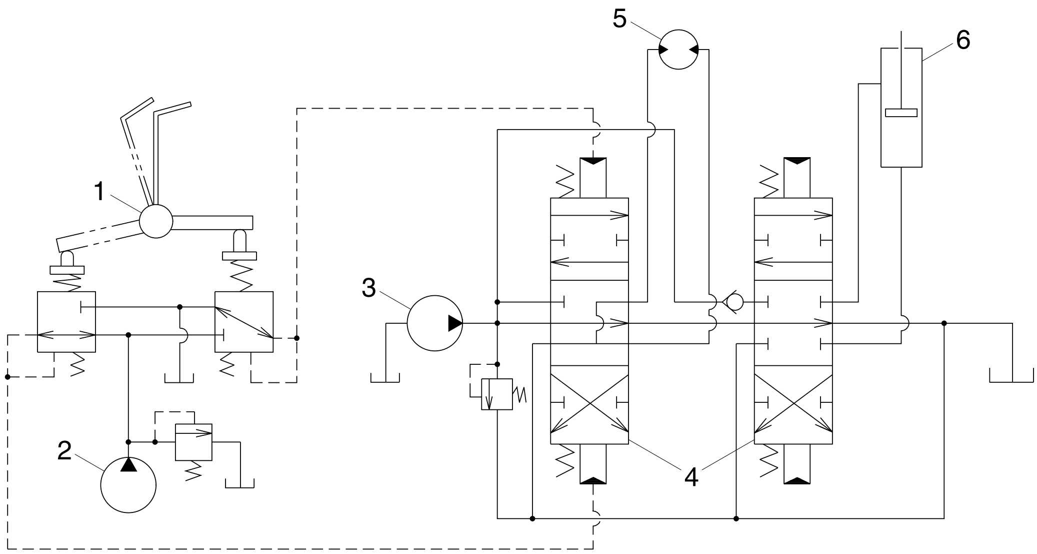
The spring (10) works on the casing (1) and spring seat (7) and tries to return the push rod (14) to the zero-displacement position irrespective of the output pressure, securing its resetting to the center position.

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

3) OPERATION

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

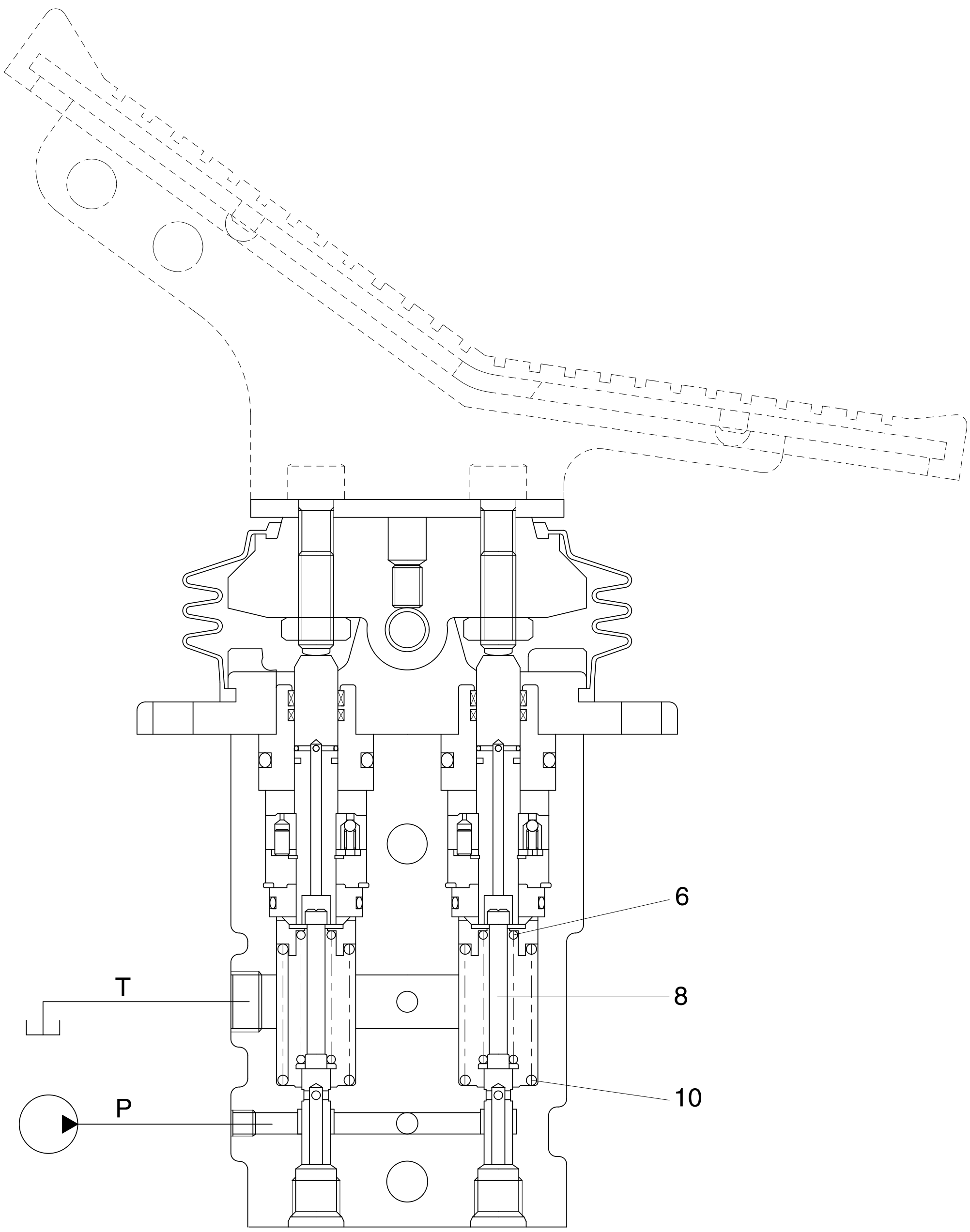
The diagram shown below is the typical application example of the pilot valve.



36072SF01

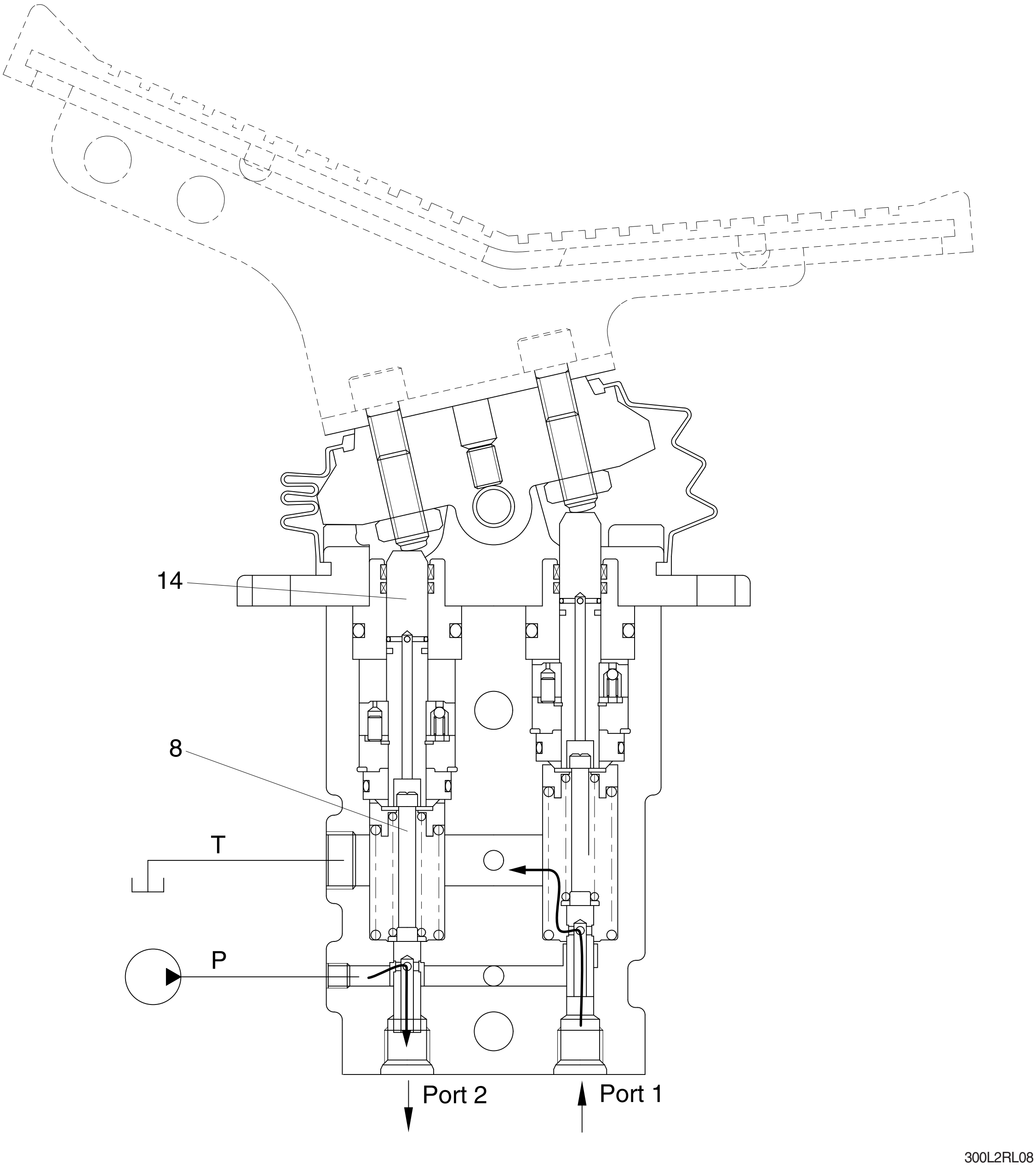
1	Pilot valve	3	Main pump	5	Hydraulic motor
2	Pilot pump	4	Main control valve	6	Hydraulic cylinder

(1) Case where pedal is in neutral position



The force of the spring (6) that determines the output pressure of the pilot valve is not applied to the spool (8). Therefore, the spool is pushed up by the spring (10) to the position of port 2 in the operation explanation drawing. Then, since the output port is connected to tank port T only, the output port pressure becomes equal to tank pressure.

(2) Case where pedal is tilted



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

Then port P is connected with port (2), and the oil supplied from the pilot pump flows through port 1 to generate the pressure.

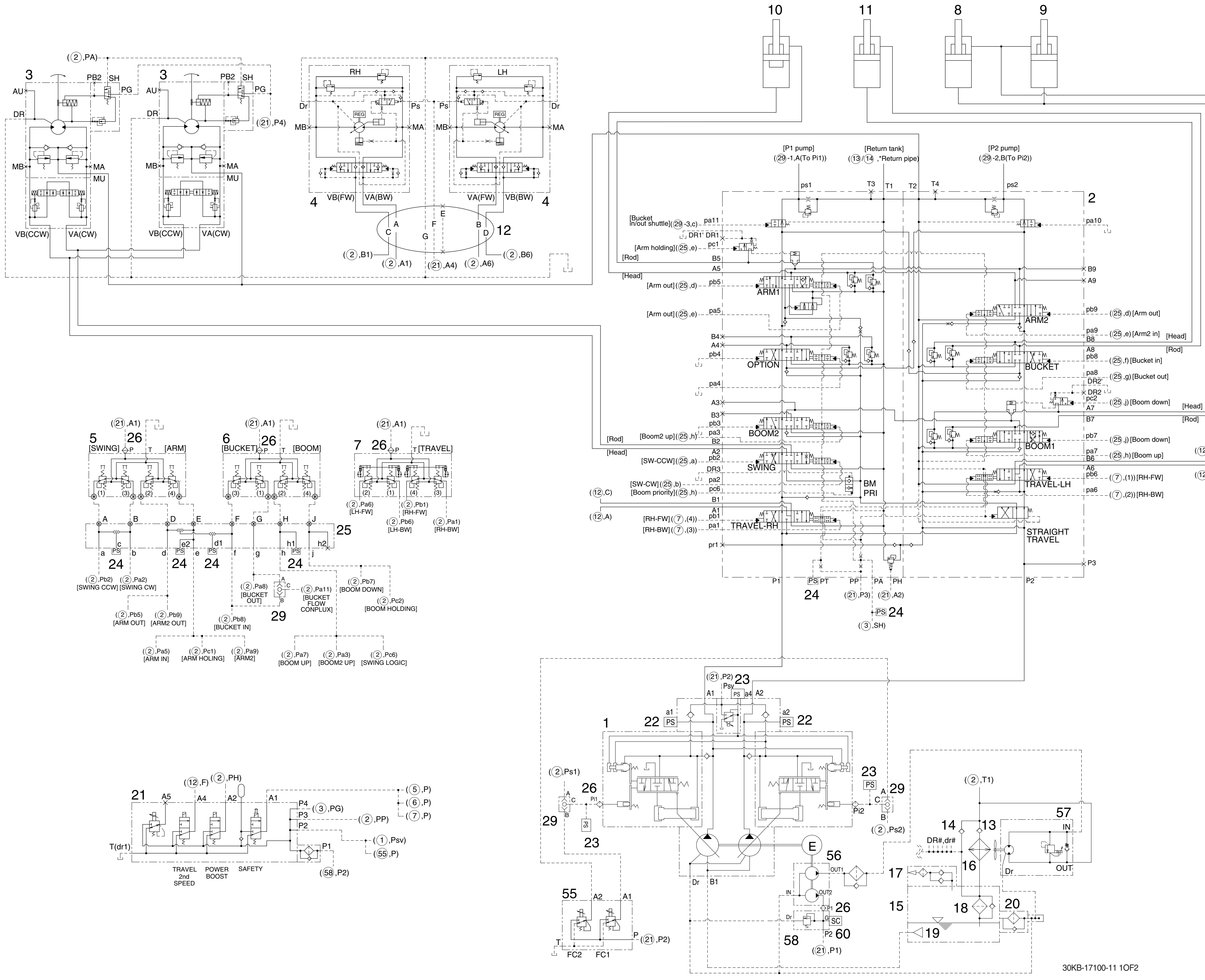
When the pressure at port (2) increases to the value corresponding to the spring force set by tilting the pedal, the hydraulic pressure force balances with the spring force. If the pressure at port (1) increases higher than the set pressure, port P is disconnected from port (1) and port T is connected with port (2). If it decreases lower than the set pressure, port P is connected with port (2) and port T is disconnected from port (2).

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

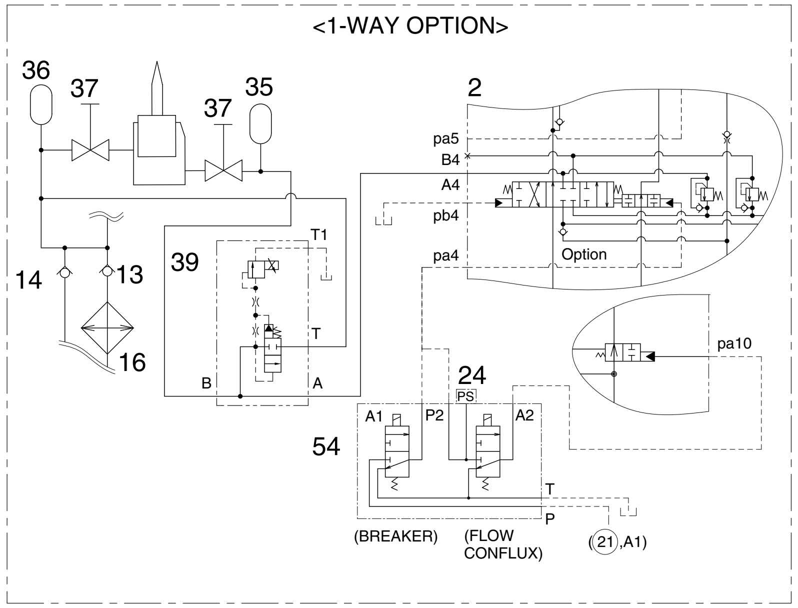
Besides, in some type, when the pedal is tilted more than a certain angle, the upper end of the spool contacts with inside bottom of the push rod and the output pressure is left to be connected with port P.

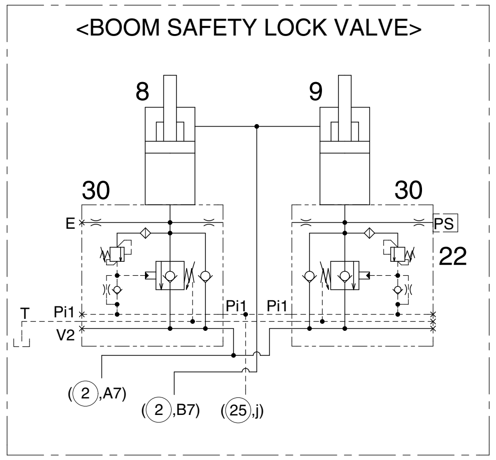
SECTION 3 HYDRAULIC SYSTEM

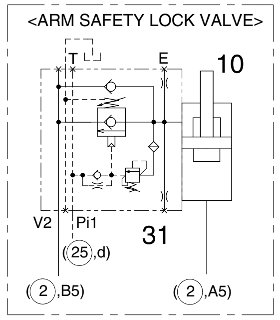
GROUP 1 HYDRAULIC CIRCUIT

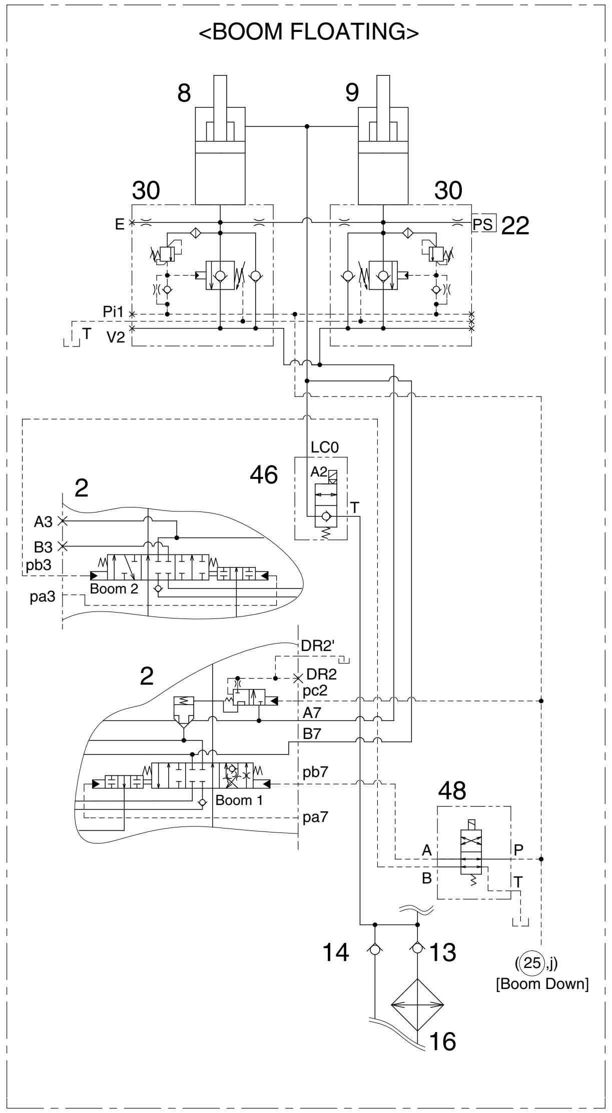


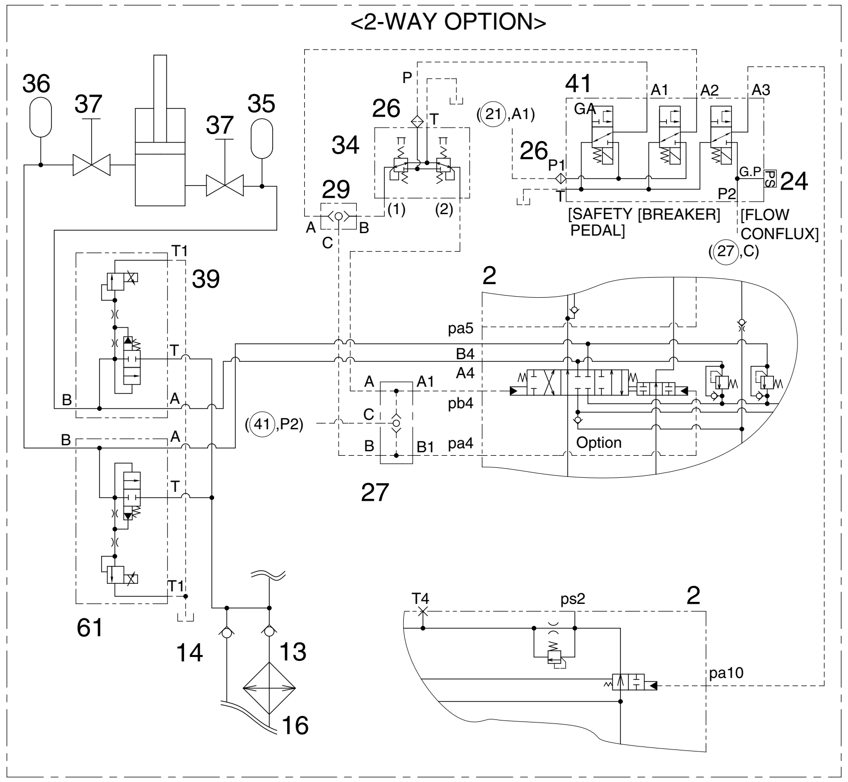
1	Main pump
2	Main control valve
3	Swing motor
4	Travel motor
5	RCV lever(LH)
6	RCV lever(RH)
7	RCV pedal
8	Boom cylinder(LH)
9	Boom cylinder(RH)
10	Arm cylinder
11	Bucket cylinder
12	Turning joint
13	Check valve
14	Check valve
15	Hydraulic tank
16	Oil cooler
17	Air breather
18	Return filter w/bypass valve
19	Strainer
20	Drain filter
21	Solenoid valve
22	Pressure sensor
23	Pressure sensor
24	Pressure sensor
25	Shuttle block
26	Last guard filter
29	Tee shuttle
55	2-EPPR valve(option)
56	Remote fan pump(option)
57	Remote fan motor(option)
58	Relief valve(option)
61	Screw coupling(option)

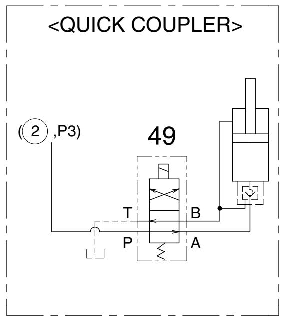


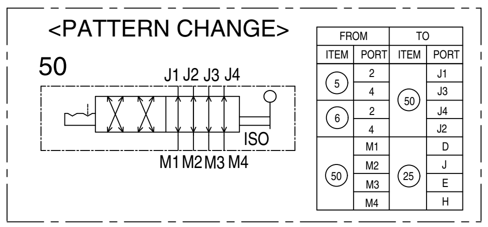


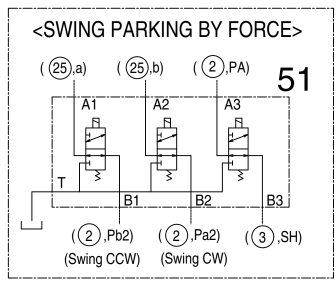












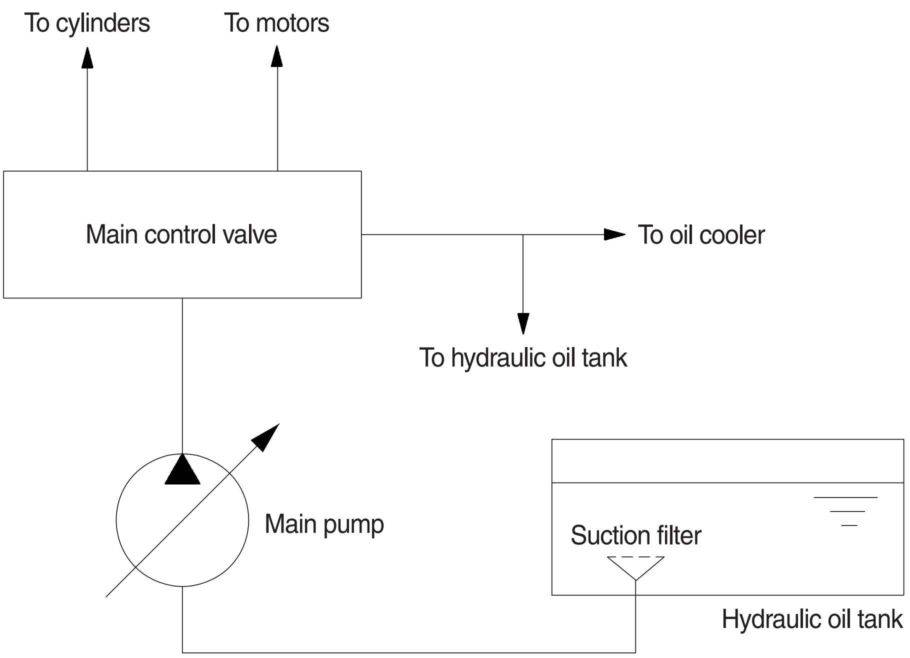
30KB-17100-11 2OF2

1	Main pump
2	Main control valve
8	Boom cylinder(LH)
9	Boom cylinder(RH)
10	Arm cylinder
13	Check valve
14	Check valve
16	Oil cooler
22	Pressure sensor
24	Pressure sensor
26	Last guard filter
27	5-Shuttle assy(option)
29	Tee shuttle
30	Boom safety valve(option)
31	Arm safety valve(option)
34	2-Way pedal(option)
35	Accumulator(option)
36	Accumulator(option)
37	Stop valve(option)
39	Proportional relief valve(option)
41	3-solenoid valve(option)
46	Boom floating valve(option)
48	Solenoid valve(option)
49	Solenoid valve(option)
50	Pattern change valve(option)
51	Solenoid valve(option)
54	Solenoid valve(option)
59	Stop valve(option)
60	Proportional valve(option)
62	Proportional valve(option)

GROUP 2 MAIN CIRCUIT

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

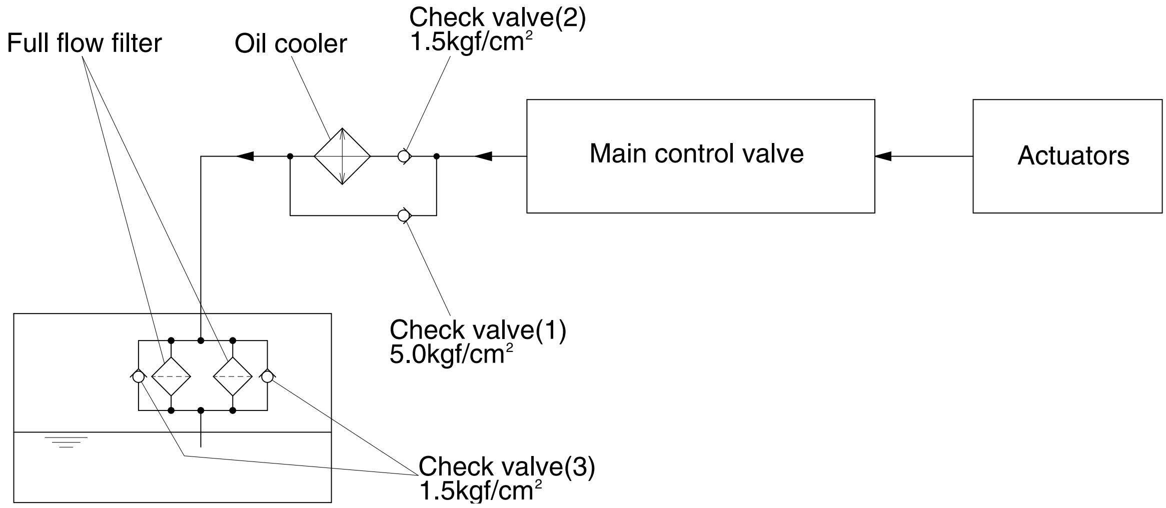
1. SUCTION AND DELIVERY CIRCUIT



3-02

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

2. RETURN CIRCUIT



45073CI02

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

The bypass check valves are provided in the return circuit.

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

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

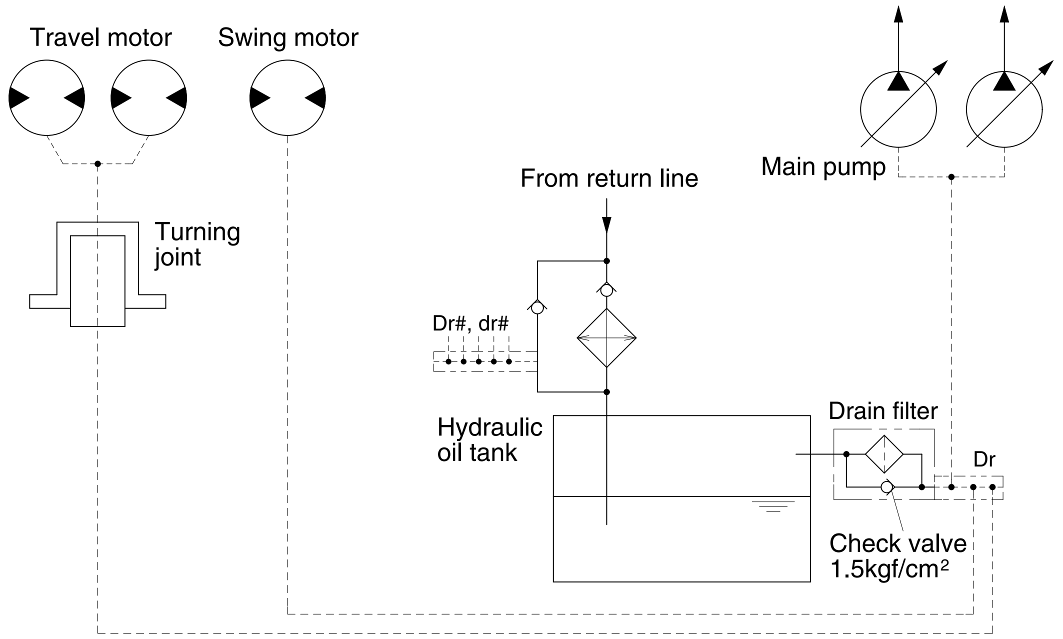
When the oil cooler is clogged, the oil returns directly to the hydraulic tank through bypass check valve (1).

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

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

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

3. DRAIN CIRCUIT



21093CI02

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

1) TRAVEL MOTOR DRAIN CIRCUIT

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

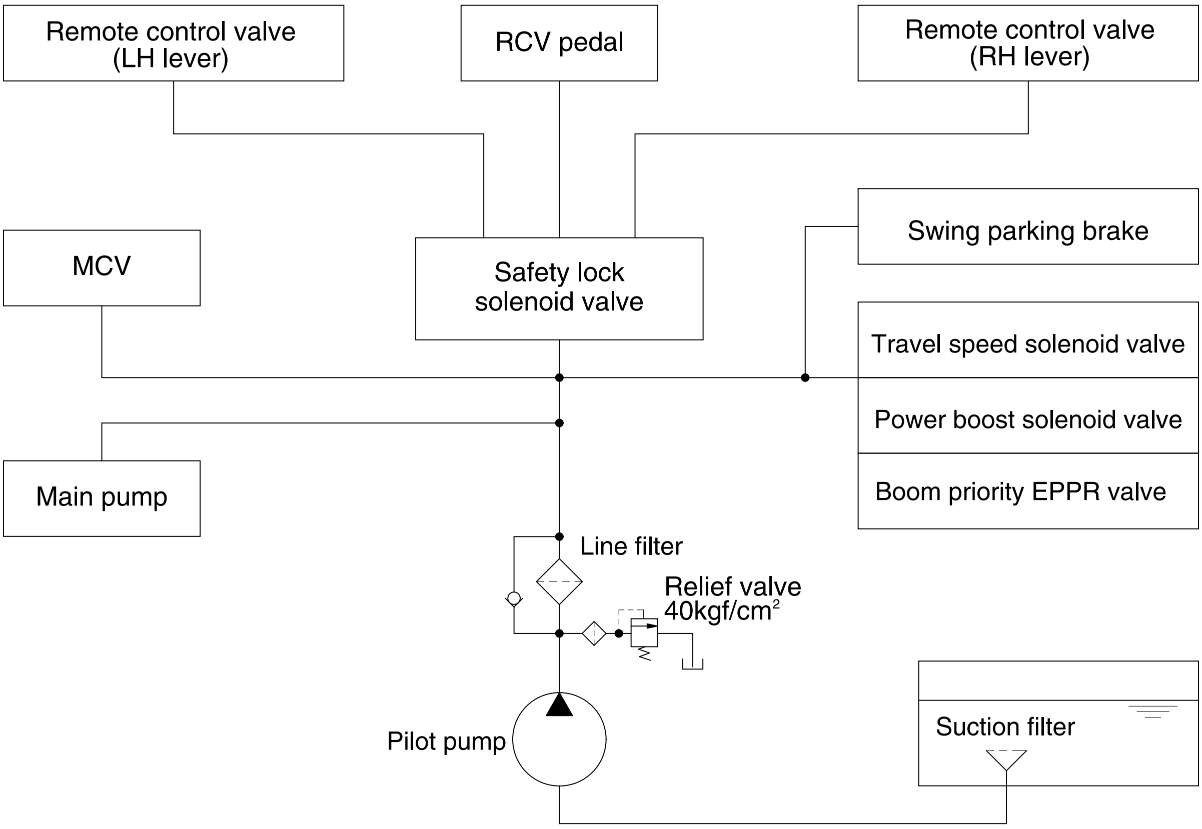
2) SWING MOTOR DRAIN CIRCUIT

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

3) MAIN PUMP DRAIN CIRCUIT

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

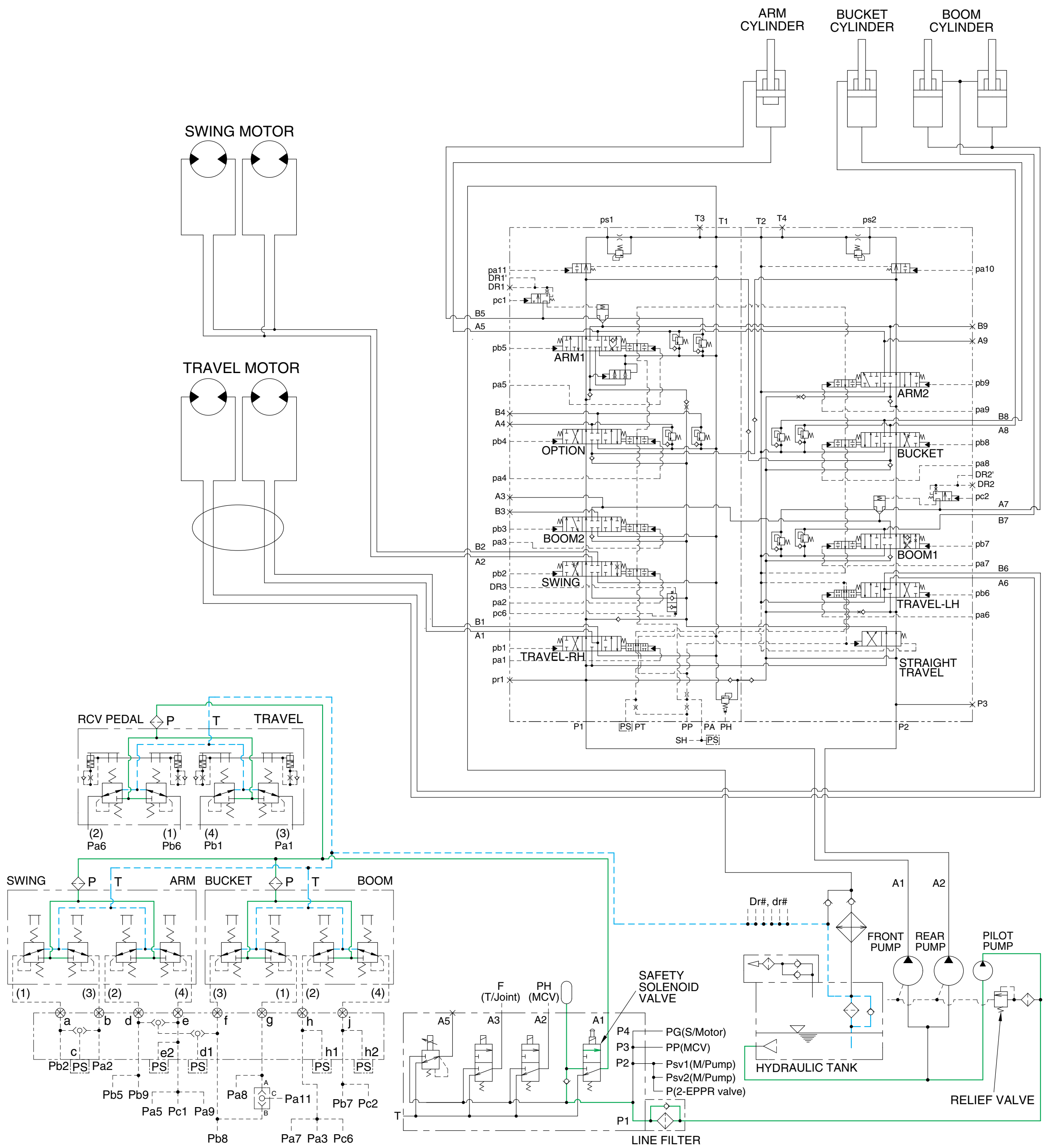
GROUP 3 PILOT CIRCUIT



48093CI01

The pilot circuit consists of suction circuit, delivery circuit and return circuit.
The pilot pump is provided with relief valve, receives the oil from the hydraulic tank through the suction filter.
The discharged oil from the pilot pump flows to the remote control valve through line filter, EPPR valve, solenoid valve assemblies, swing parking brake, main control valve and safety lock solenoid valve.

1. SUCTION, DELIVERY AND RETURN CIRCUIT



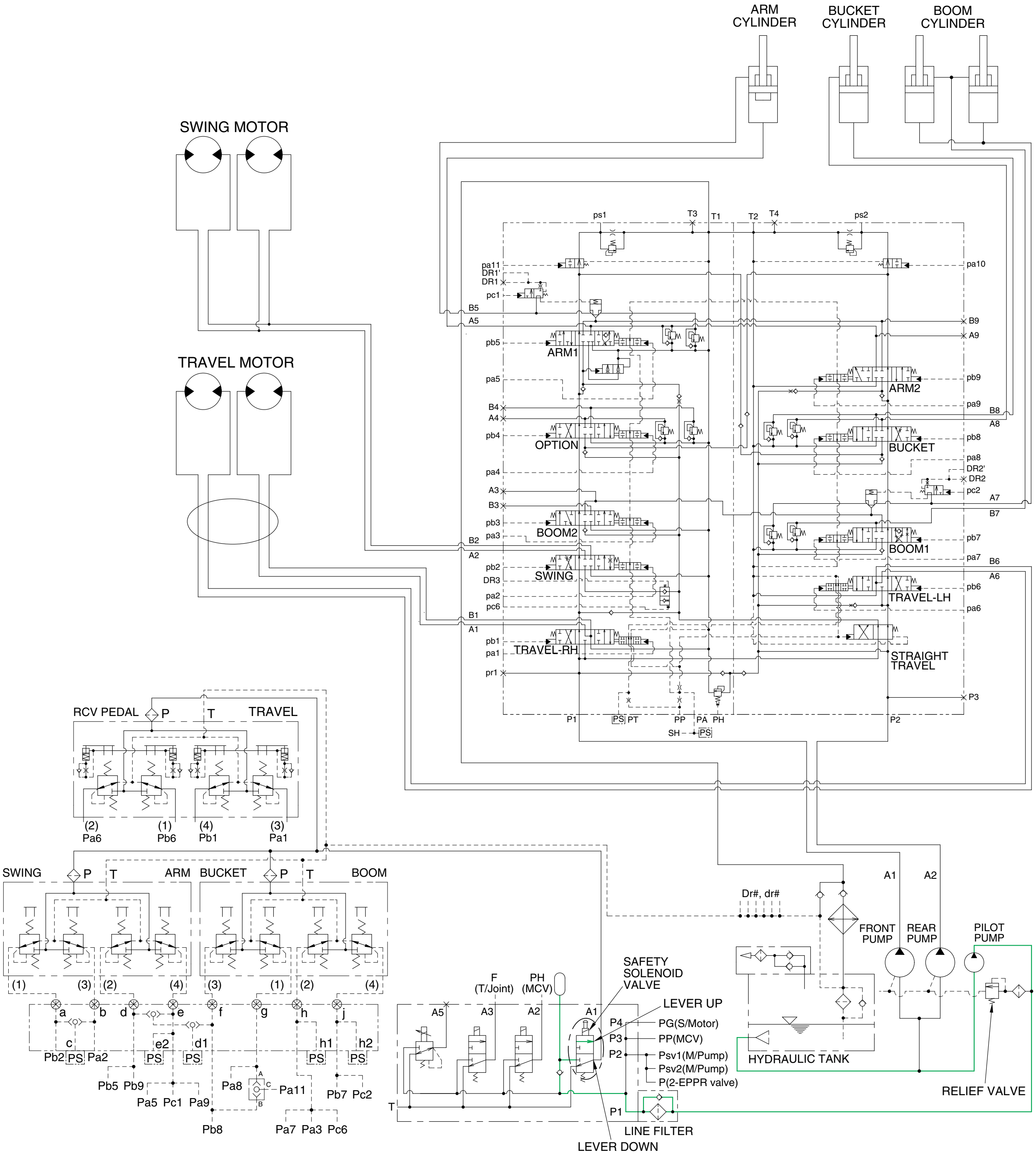
480F3HC02

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

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

The return oil from remote control valve returned to hydraulic tank.

2. SAFETY SOLENOID VALVE (SAFETY LEVER)

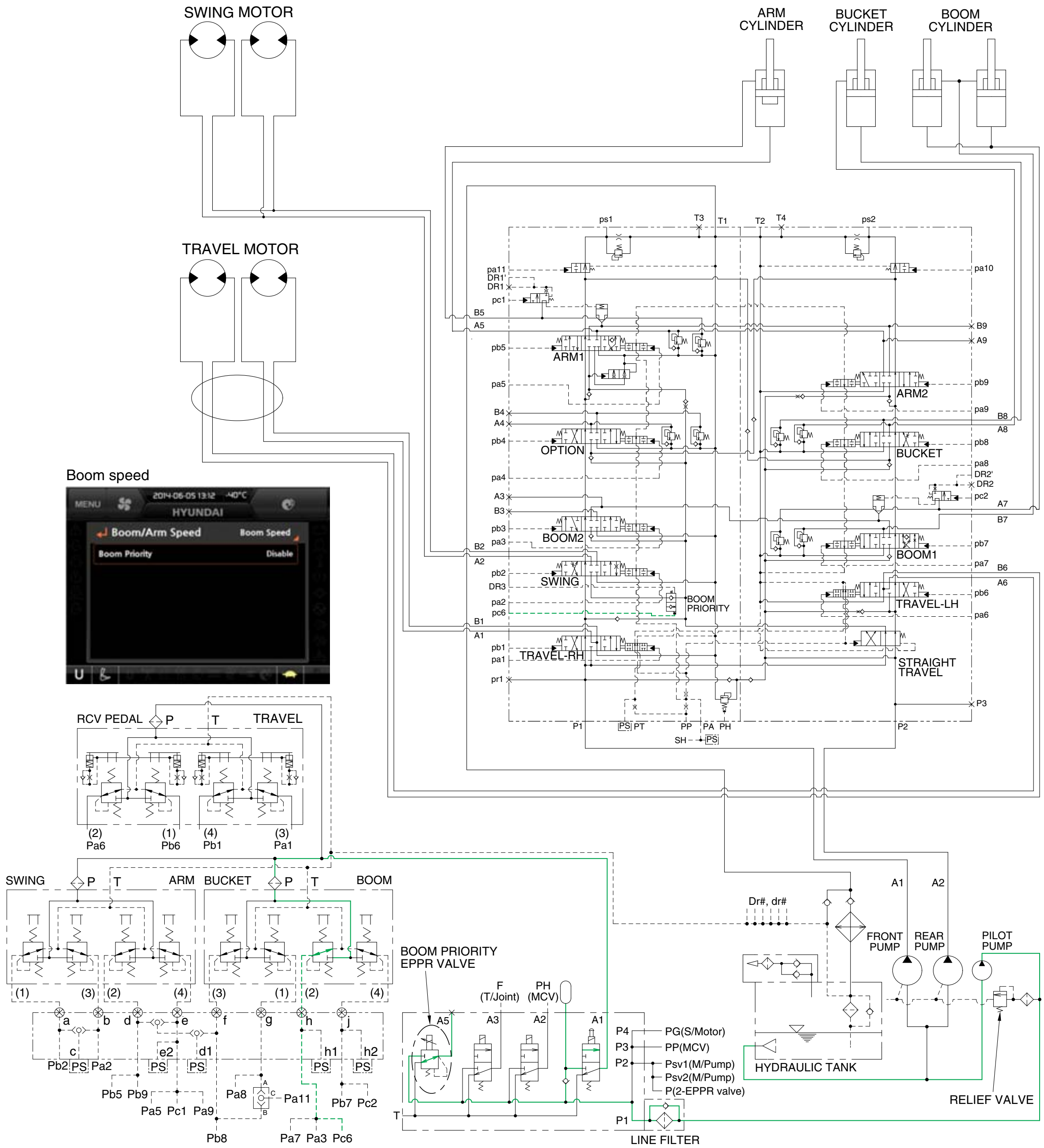


480F3HC03

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

When the lever of the safety solenoid valve moved upward, oil does not flows into the remote control valve, because of blocked by the spool.

3. BOOM PRIORITY SYSTEM



480F3HC04

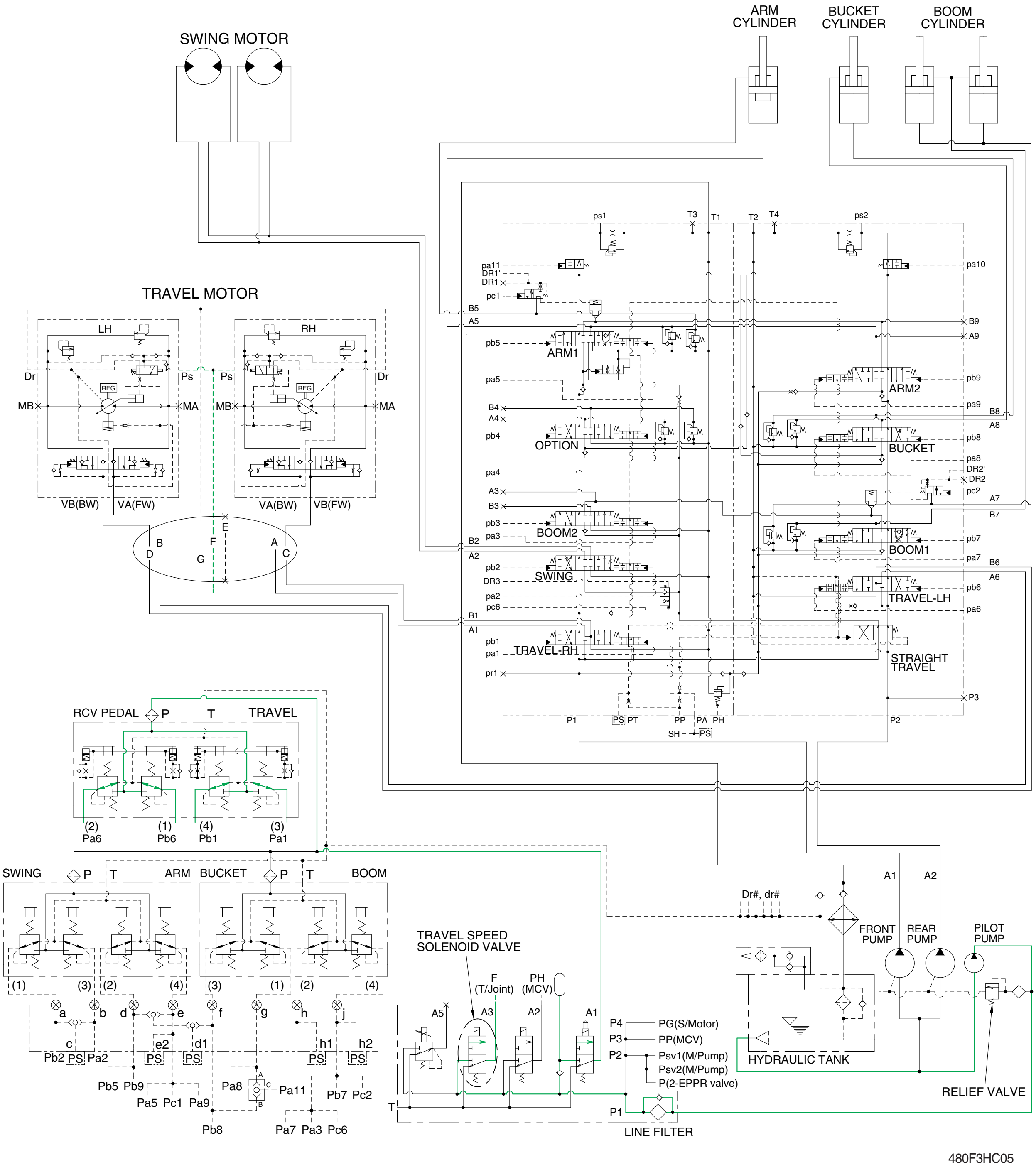
When carrying out the combined operation of swing and boom up, the boom up operating speed is lowered then normal operation.

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

The pilot oil from pilot pump flow into Pc6 port in main control valve through boom EPPR valve. Pc6 oil pressure moves swing reducing spool to upper position and oil flow rate to the swing motor decreased.

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

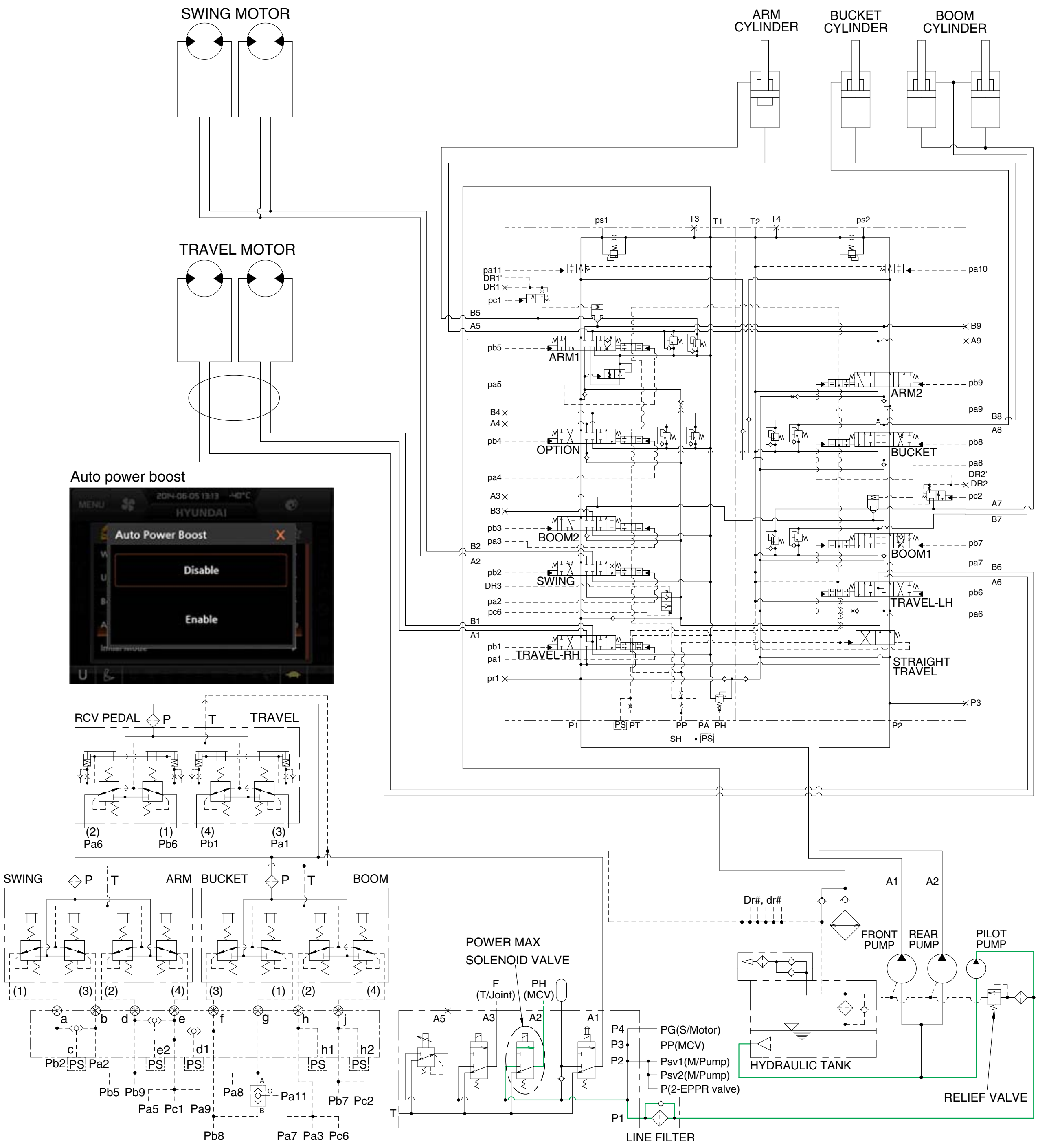
4. TRAVEL SPEED CONTROL SYSTEM



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

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

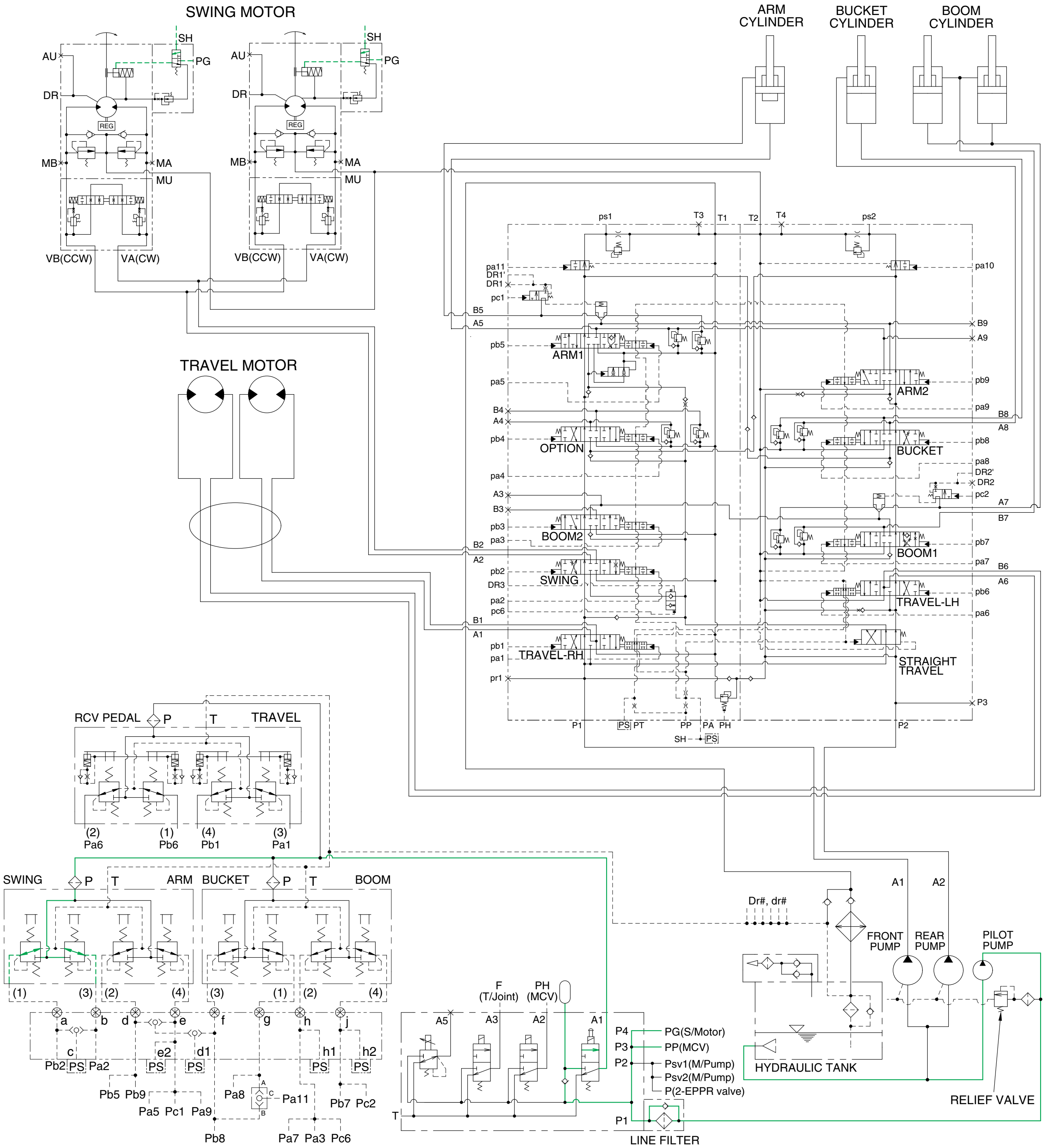
5. MAIN RELIEF PRESSURE CHANGE CIRCUIT



480F3HC06

When the power max switch on the left control lever is pushed ON, the power max solenoid valve is actuated, the discharged oil from the pilot pump into PH port of the main relief valve of main control valve ; Then the setting pressure of the main control valve is raises from 330 kgf/cm2 to 360 kgf/cm2 for increasing the digging power. And even when press continuously, it is canceled after 8 seconds.

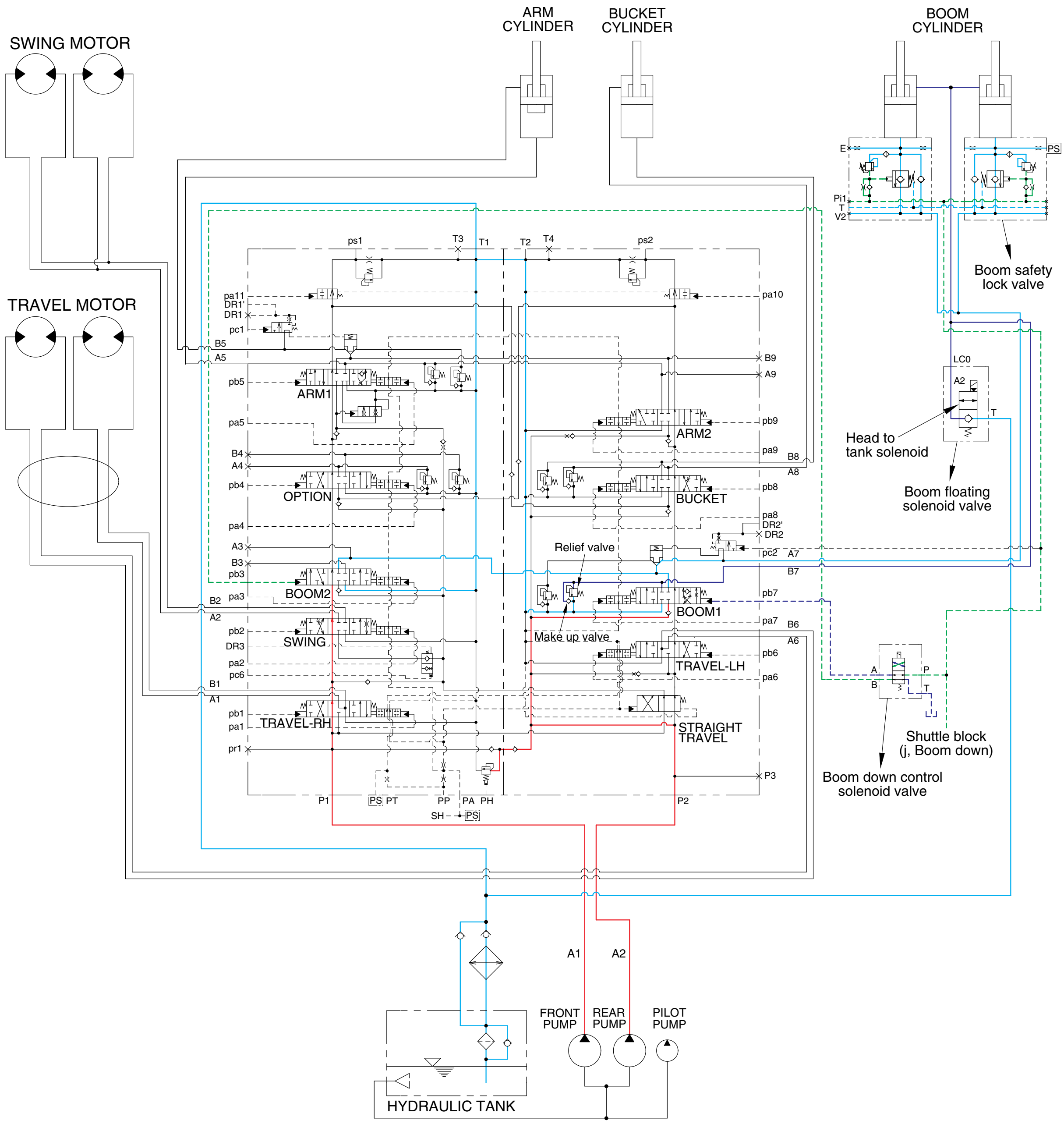
6. SWING PARKING BRAKE RELEASE



480F3HC07

When one of the RCV lever (except travel lever) is tilted, the pilot oil flows into SH port through main control valve.
This pressure moves spool so, discharged oil from pilot valve flows to swing motor PG port.
This pressure is applied to swing motor disc, thus the brake is released.
When all of the RCV lever are set in the neutral position, oil in the swing motor disc cylinder is drained, thus the brake is applied.

7. BOOM FLOATING SYSTEM



480F3HC08

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

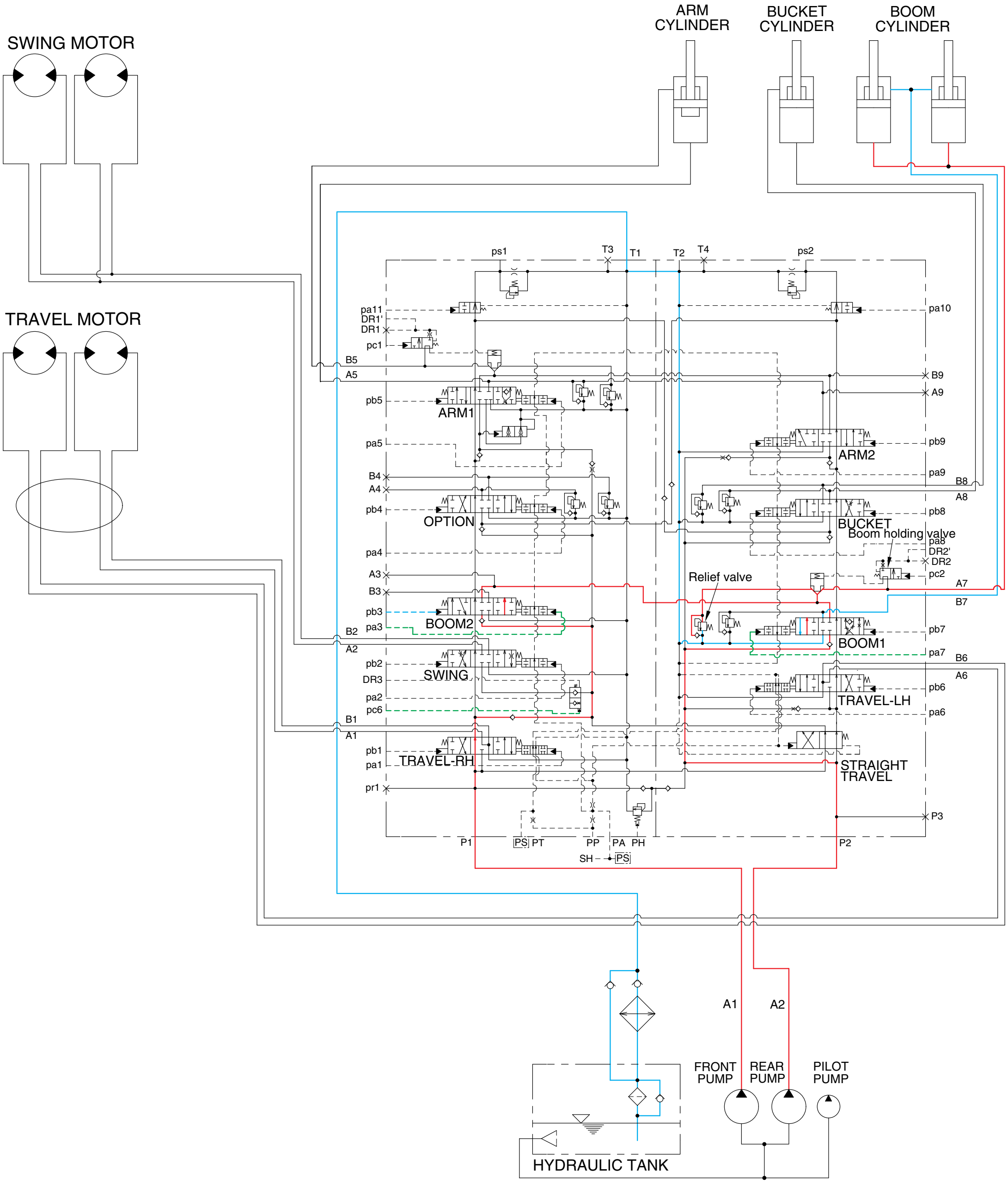
The boom floating solenoid values are equipped in the rod and head of boom cylinder that are controlled to act as floating mode.

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

For more details, refer to page 5-13.

GROUP 4 SINGLE OPERATION

1. BOOM UP OPERATION



480F3HC10

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

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

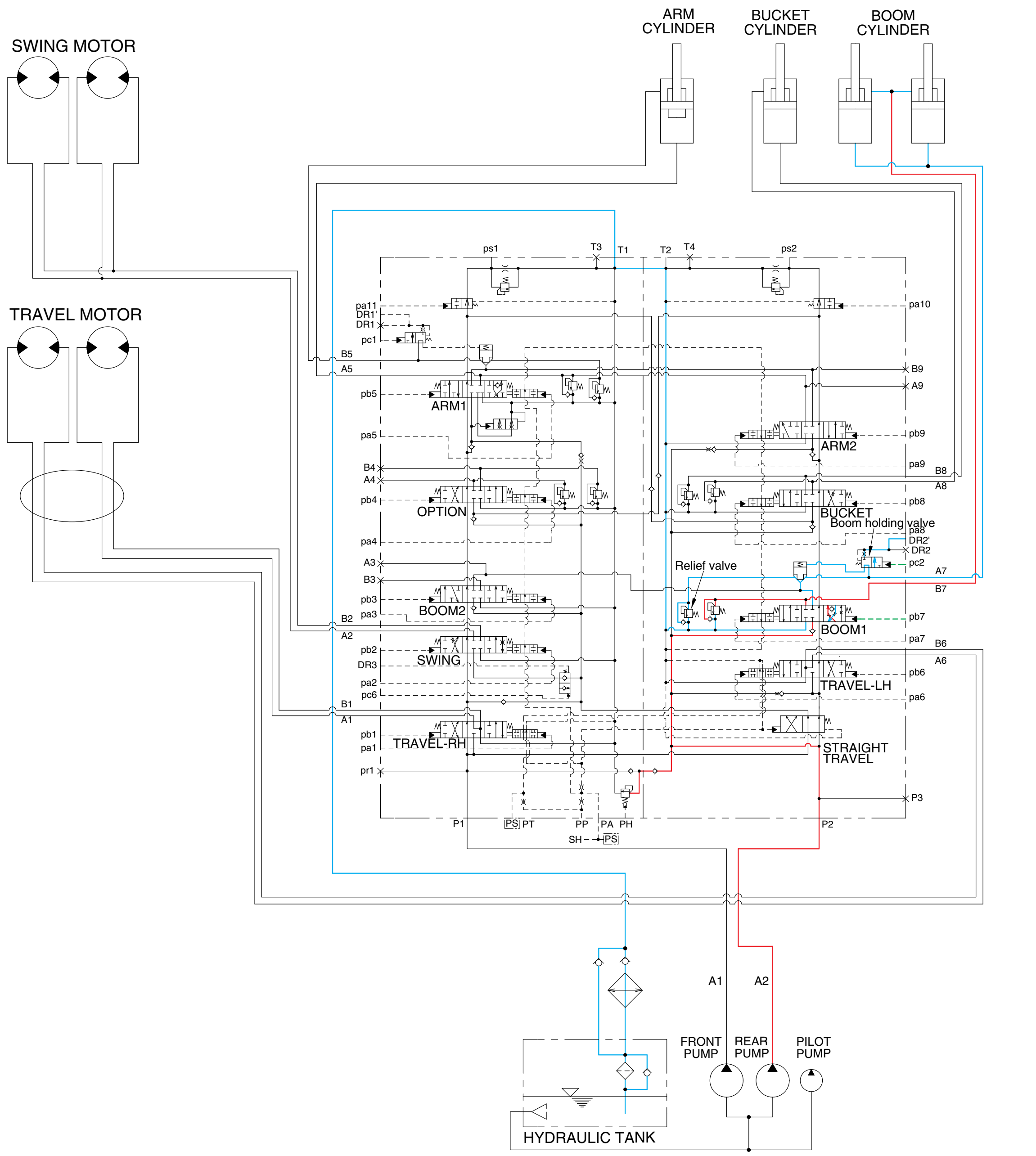
At the same time, the oil from the small chamber of boom cylinders returns to the hydraulic oil tank through the boom spool in the main control valve. When this happens, the boom goes up.

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

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

This prevents the hydraulic drift of boom cylinder.

2. BOOM DOWN OPERATION



480F3HC11

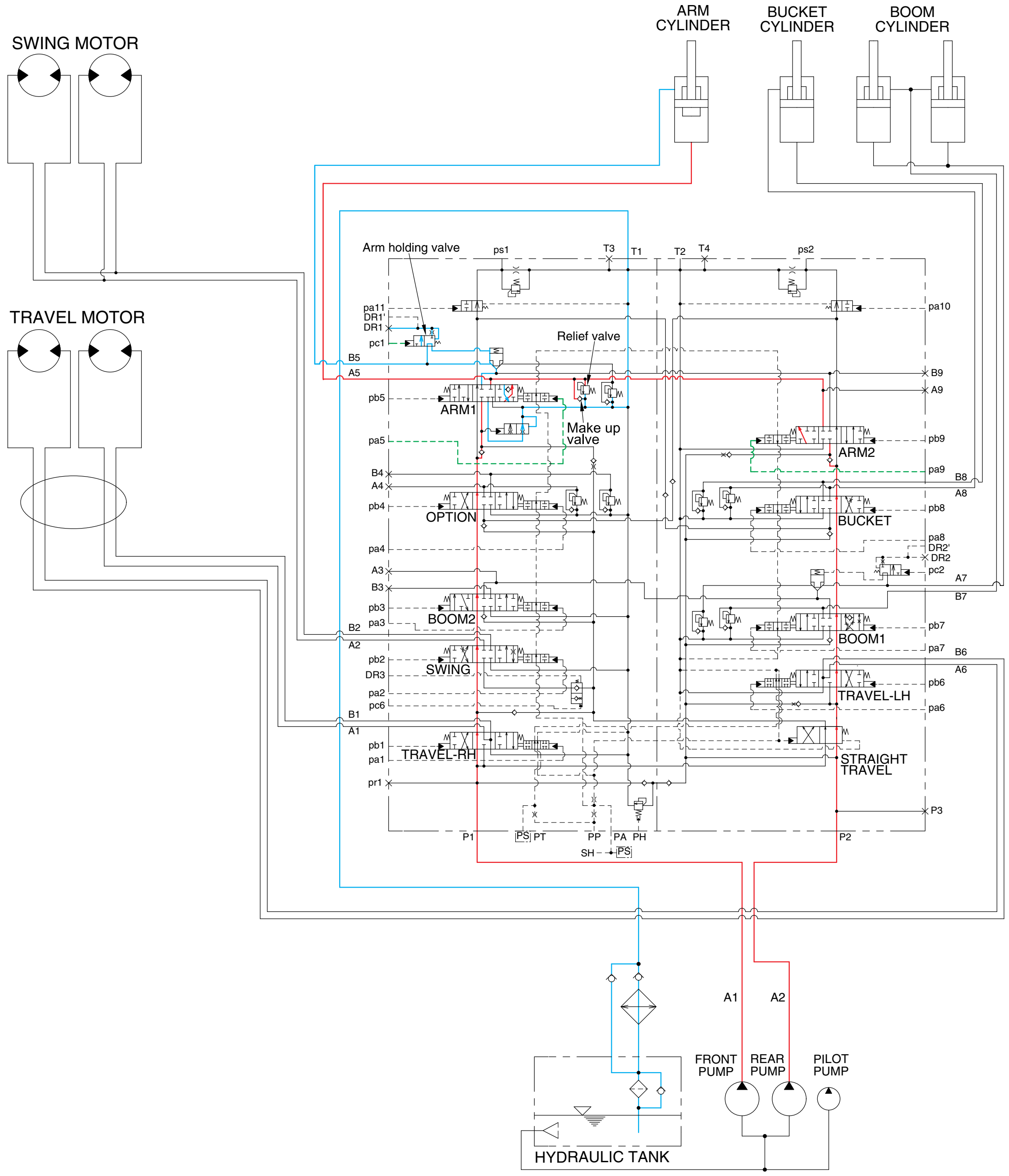
When the RH control lever is pushed forward, the boom spools in the main control valve are moved to the down position by the pilot oil pressure from the remote control valve.

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

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

3. ARM IN OPERATION



480F3HC12

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

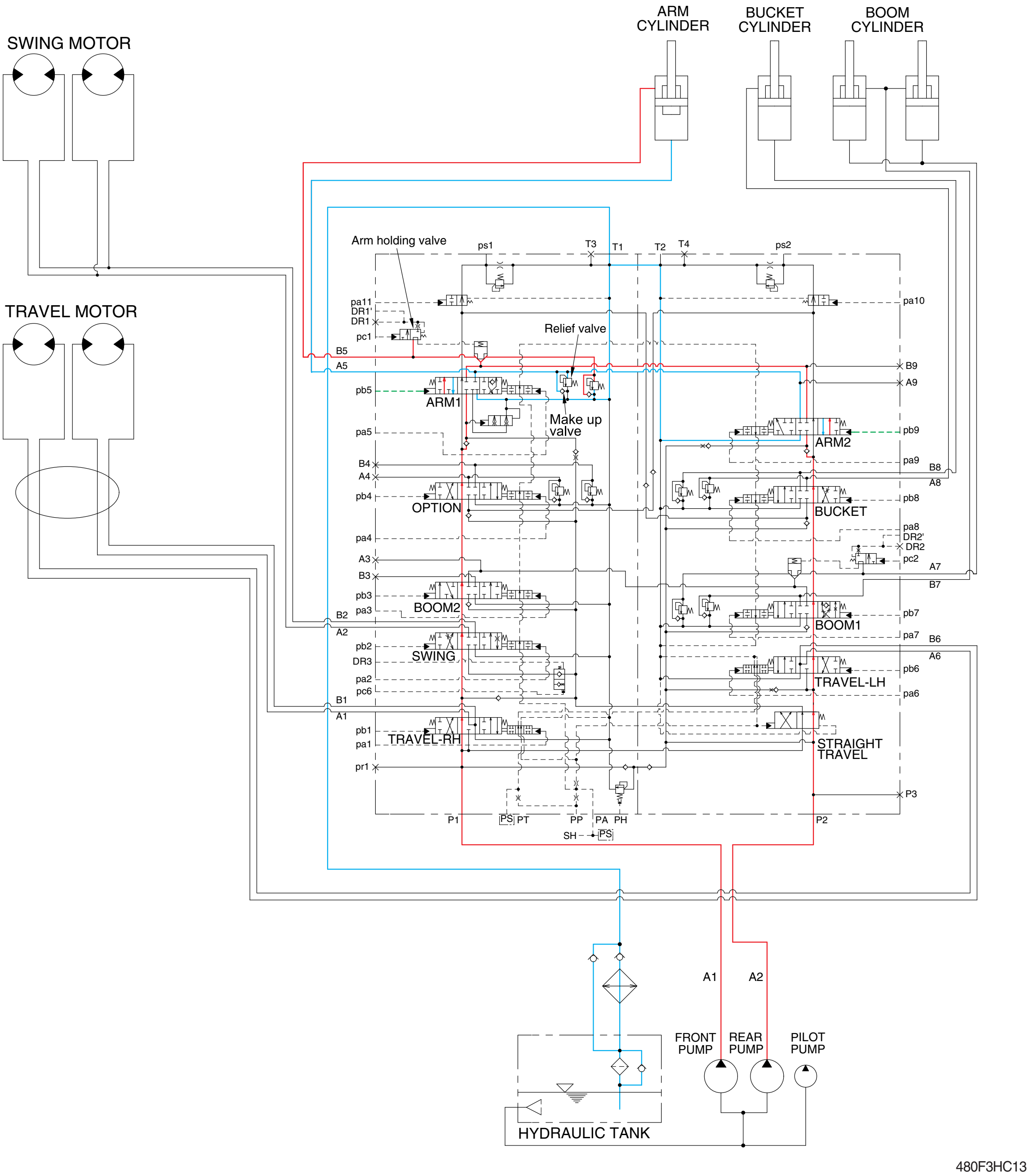
The oil from the A1 and A2 pump flows into the main control valve and then goes to the large chamber of arm cylinder.

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

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

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

4. ARM OUT OPERATION



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

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

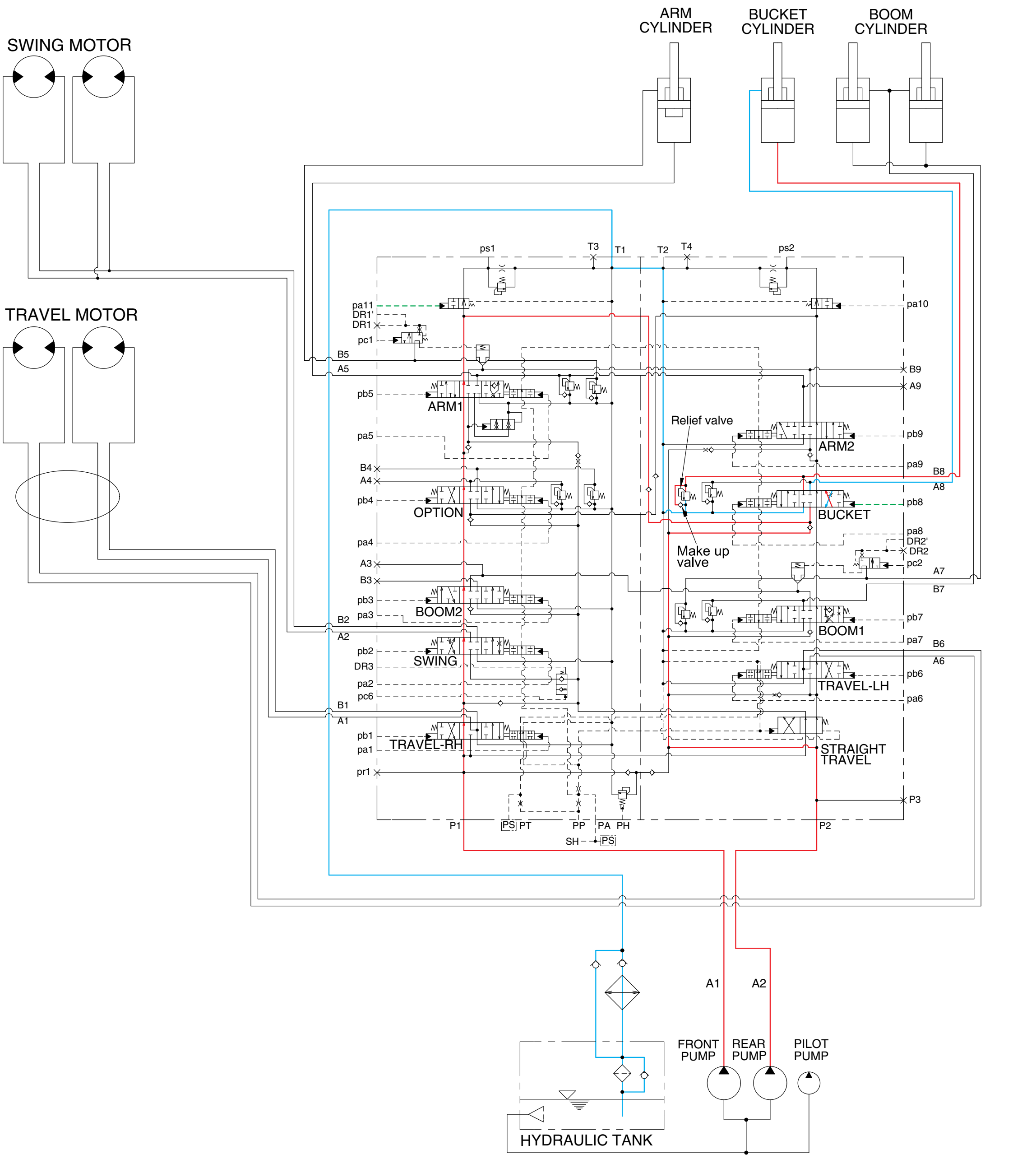
At the same time, the oil from the large chamber of arm cylinder returns to the hydraulic oil tank through the arm spools in the main control valve. When this happens, the arm rolls out.

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

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

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

5. BUCKET IN OPERATION



480F3HC14

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

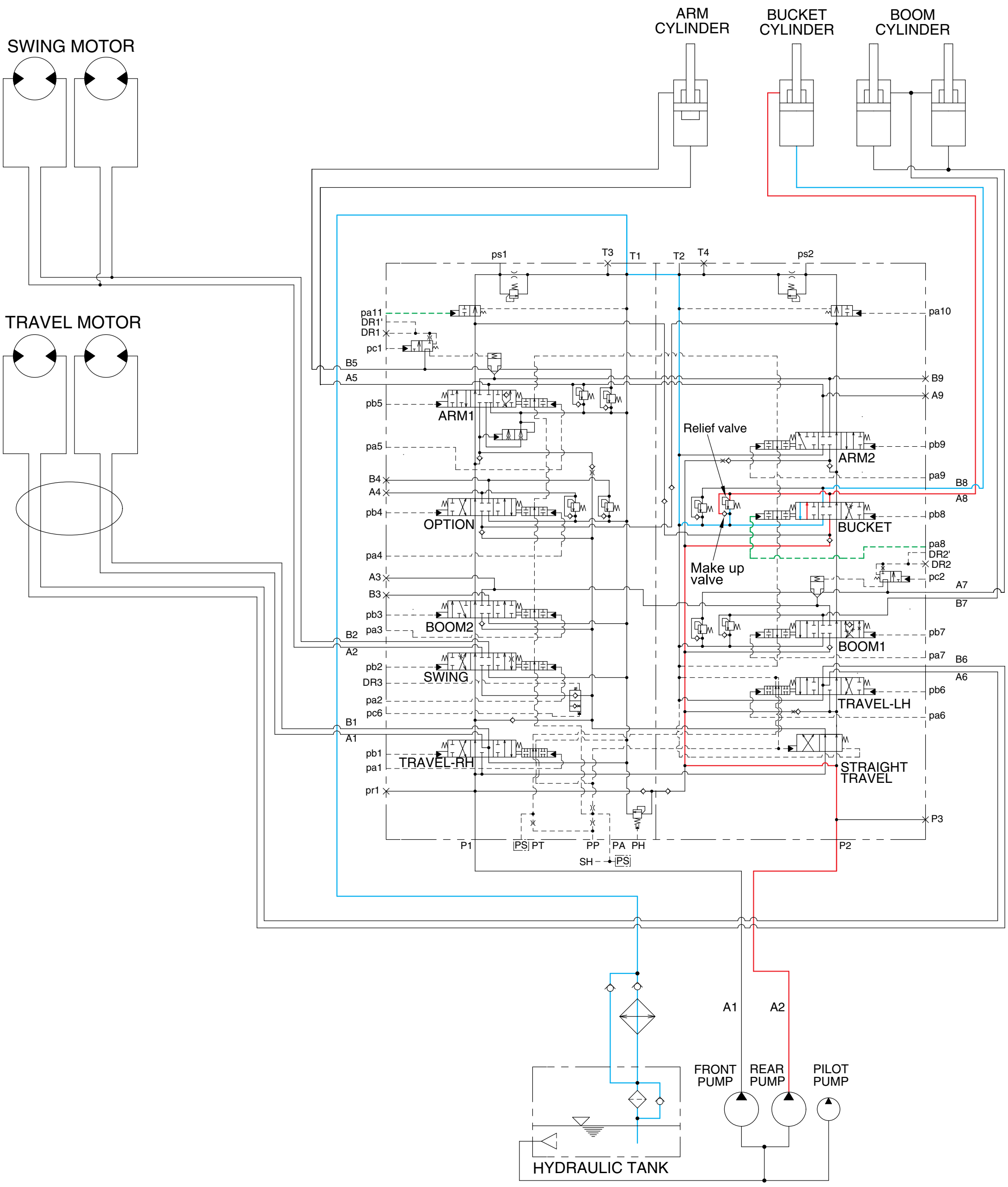
The oil from the A2 pump flows into the main control valve and then goes to the large chamber of bucket cylinder. The oil form the A1 pump flows into the large chamber of bucket cylinder through confluence oil passage in the main control valve by bypass cut pilot pressure (pa11).

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

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

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

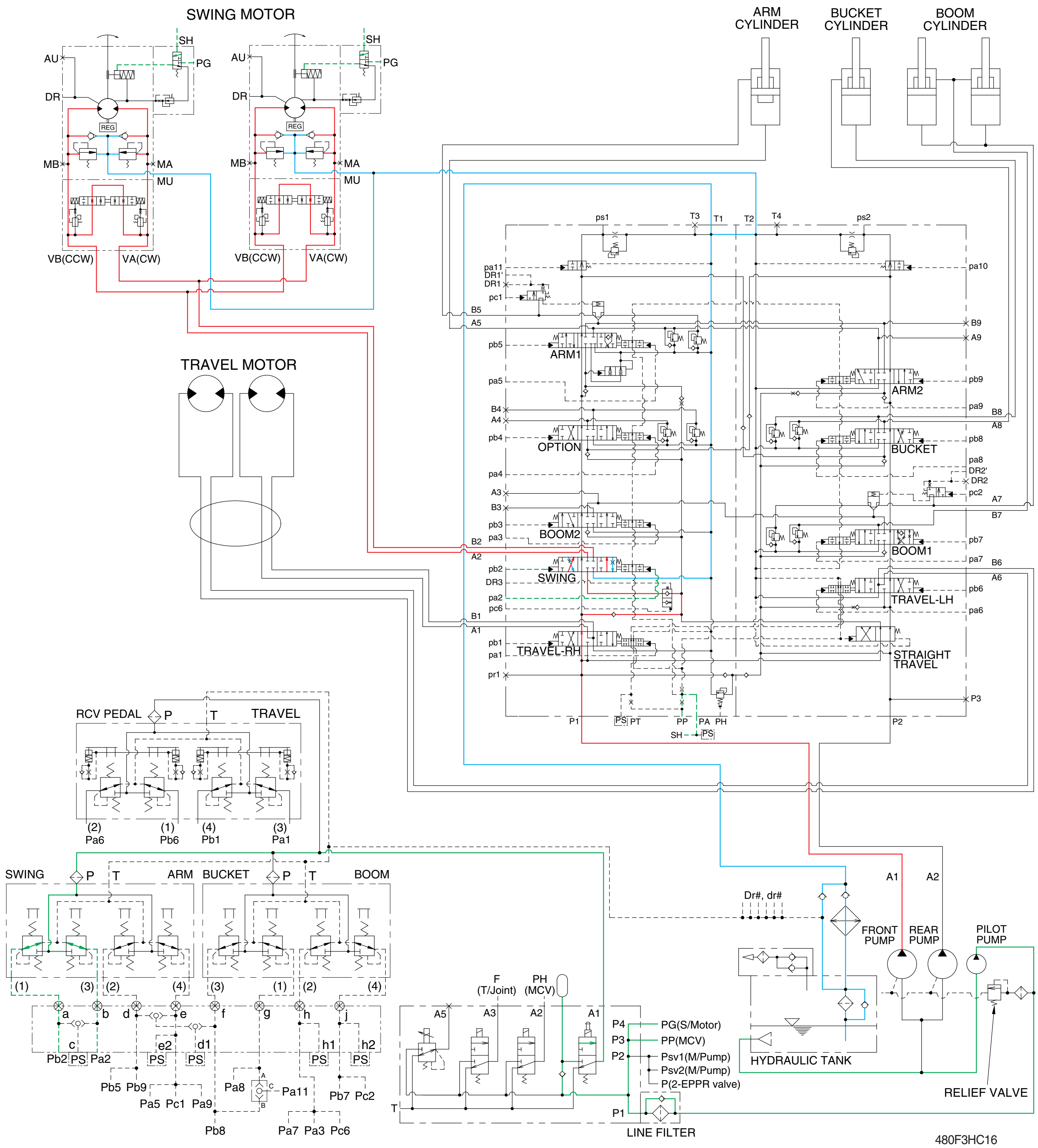
6. BUCKET OUT OPERATION



480F3HC15

When the RH control lever is pushed right, the bucket spool in the main control valve is moved to the roll out position by the pilot oil pressure from the remote control valve.
The oil from the A2 pump flows into the main control valve and then goes to the small chamber of bucket cylinder.
At the same time, the oil from the large chamber of bucket cylinder returns to the hydraulic oil tank through the bucket spool in the main control valve. When this happens, the bucket rolls out.
The excessive pressure in the bucket cylinder rod side is prevented by relief valve.
The cavitation which will happen to the rod side of the bucket cylinder is also prevented by the make-up valve in the main control valve.

7. SWING OPERATION



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

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

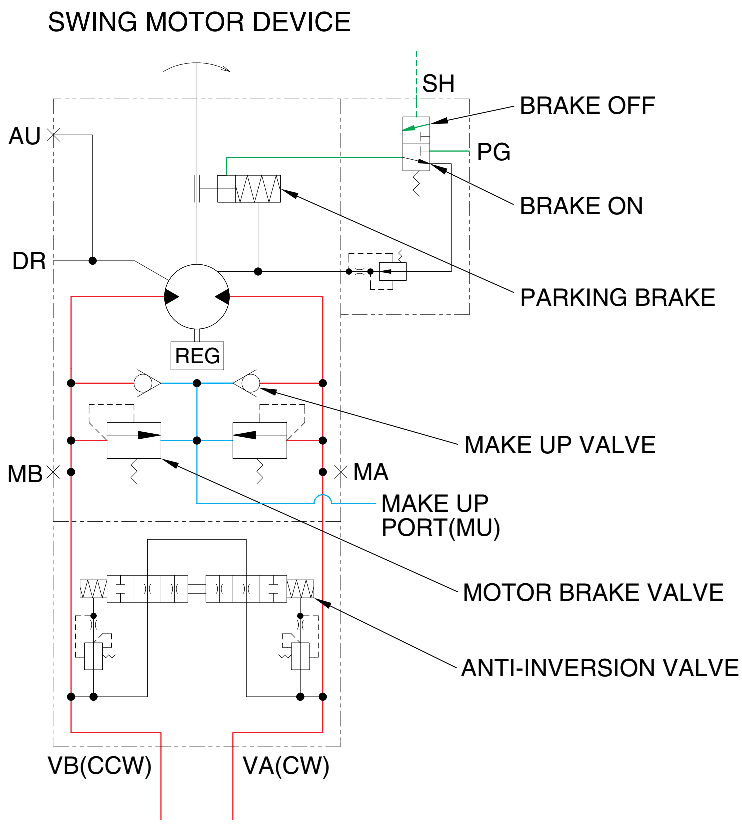
At the same time, the return oil from the swing motor returns to the hydraulic oil tank through the swing spool in the main control valve.

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

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

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

SWING CIRCUIT OPERATION



480F3HC17

1) MOTOR BRAKE VALVE

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

2) MAKE UP VALVE

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

3) PARKING BRAKE

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

PARKING BRAKE "OFF" OPERATION

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

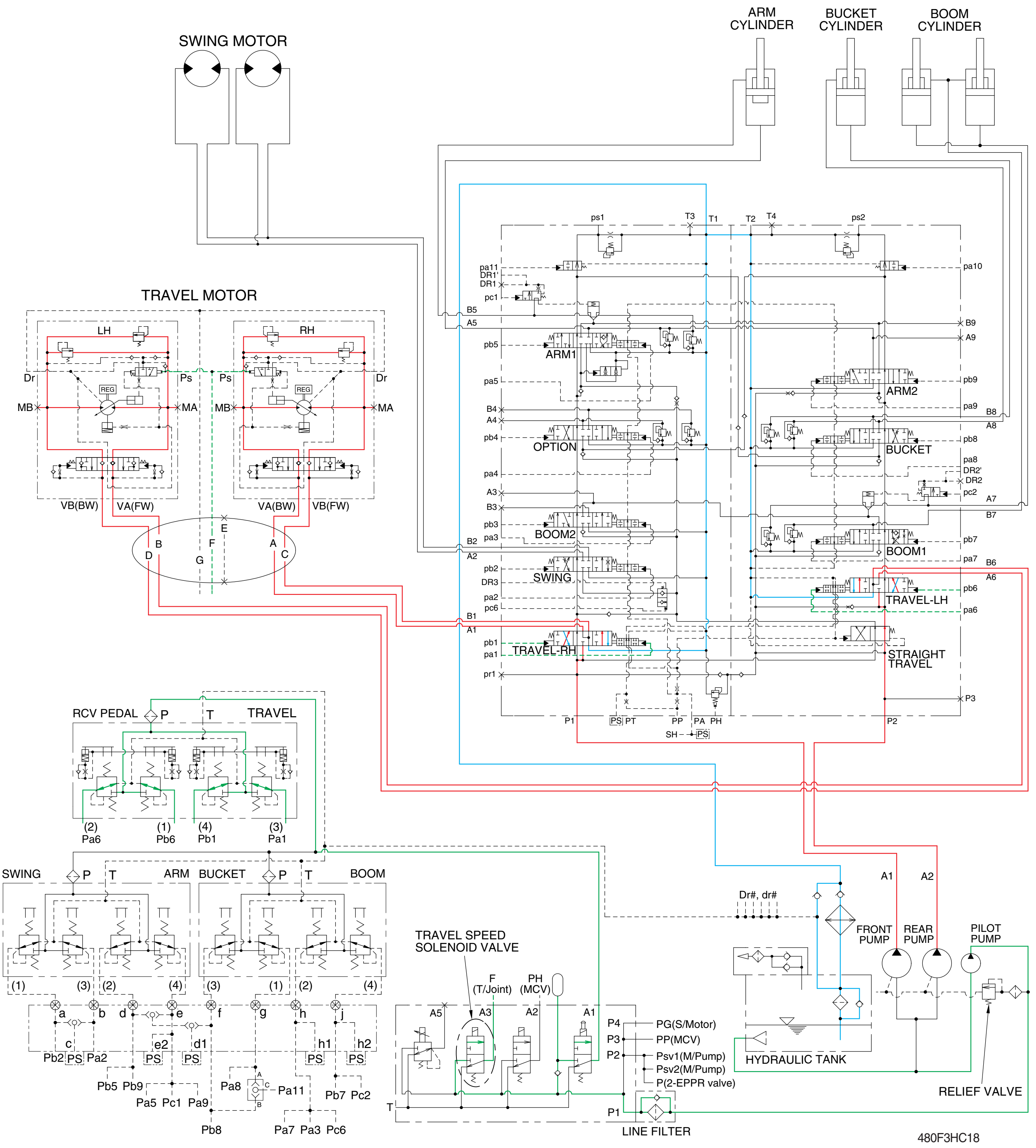
PARKING BRAKE "ON" OPERATION

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

4) ANTI-INVERSION VALVE

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

8. TRAVEL FORWARD AND REVERSE OPERATION



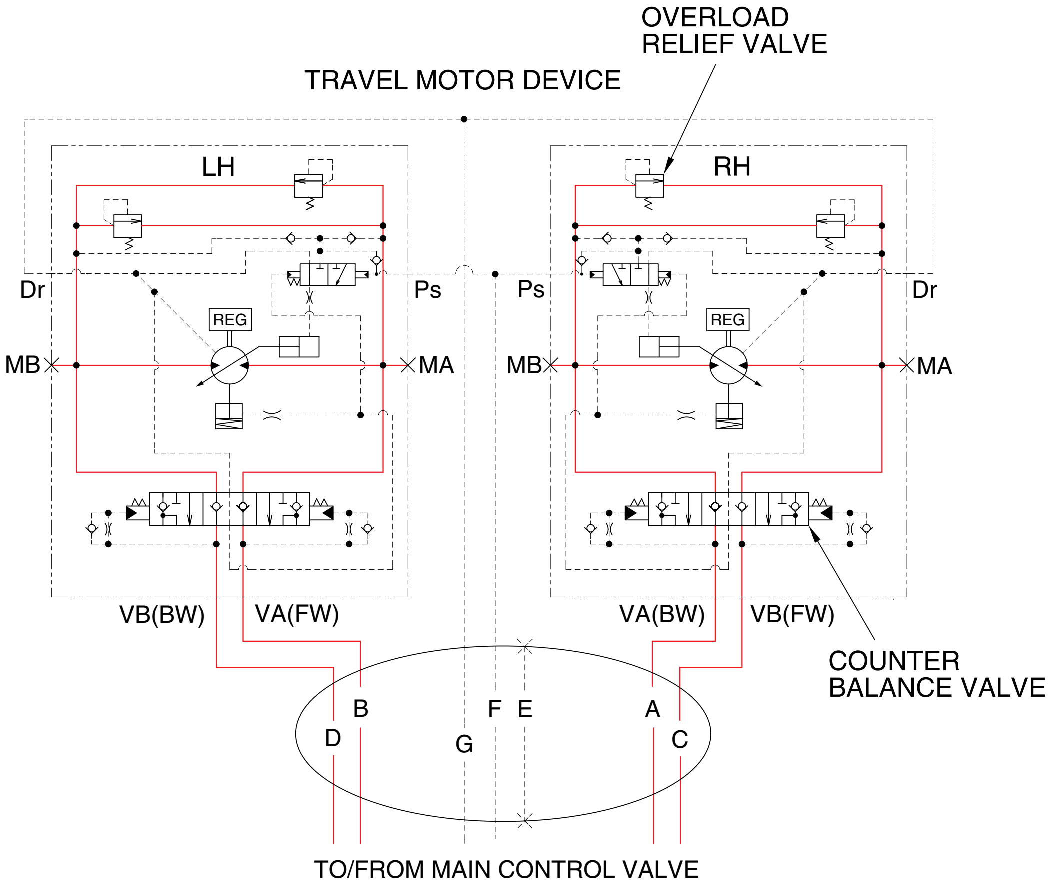
When the travel levers are pushed forward or reverse position, the travel spools in the main control valve are moved to the forward or reverse travel position by the pilot oil pressure from the remote control valve.

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

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

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

TRAVEL CIRCUIT OPERATION



480F3HC19

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

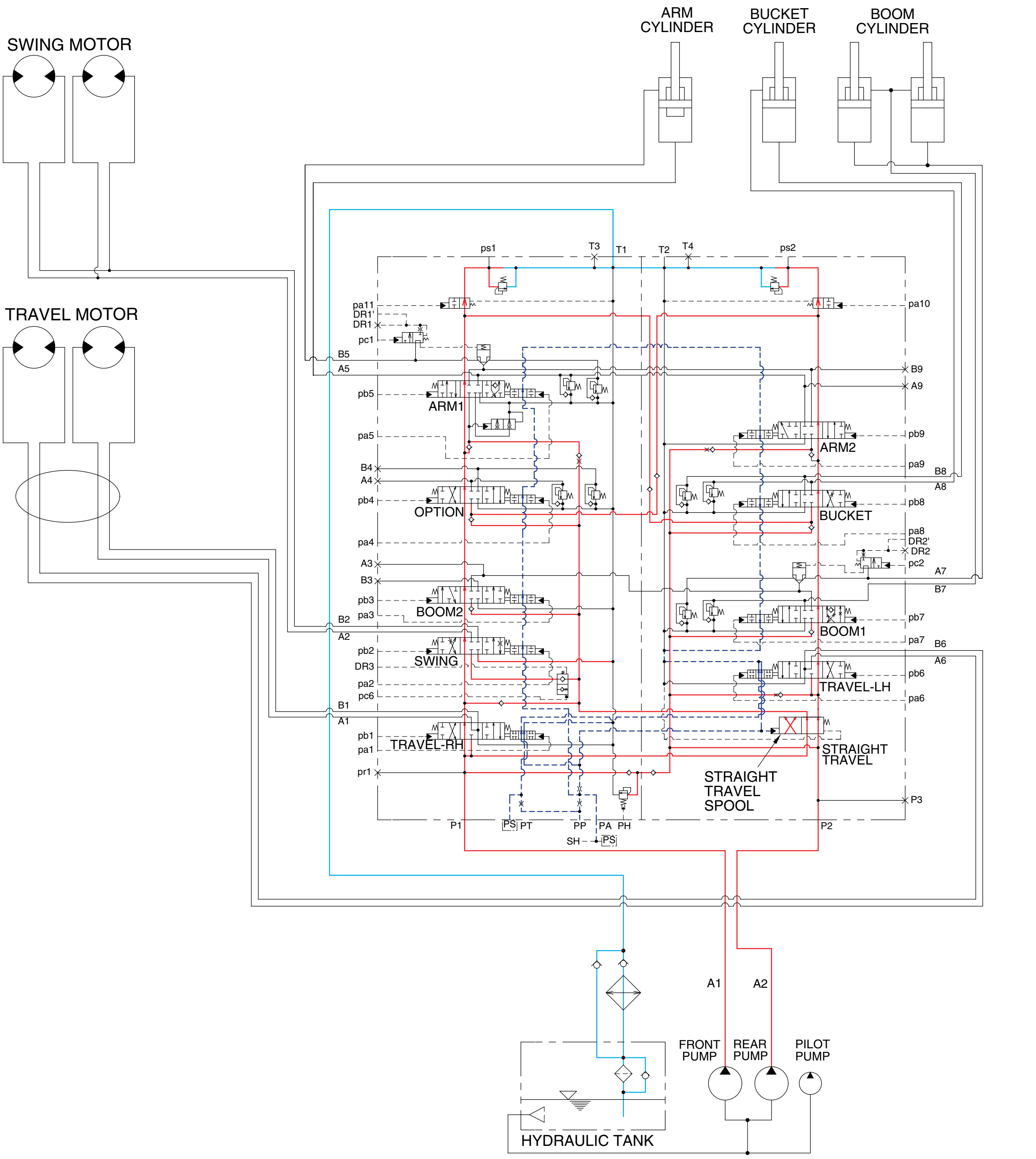
1) COUNTER BALANCE VALVE

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 345 kgf/cm^2 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.

1. OUTLINE



480F3HC20

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

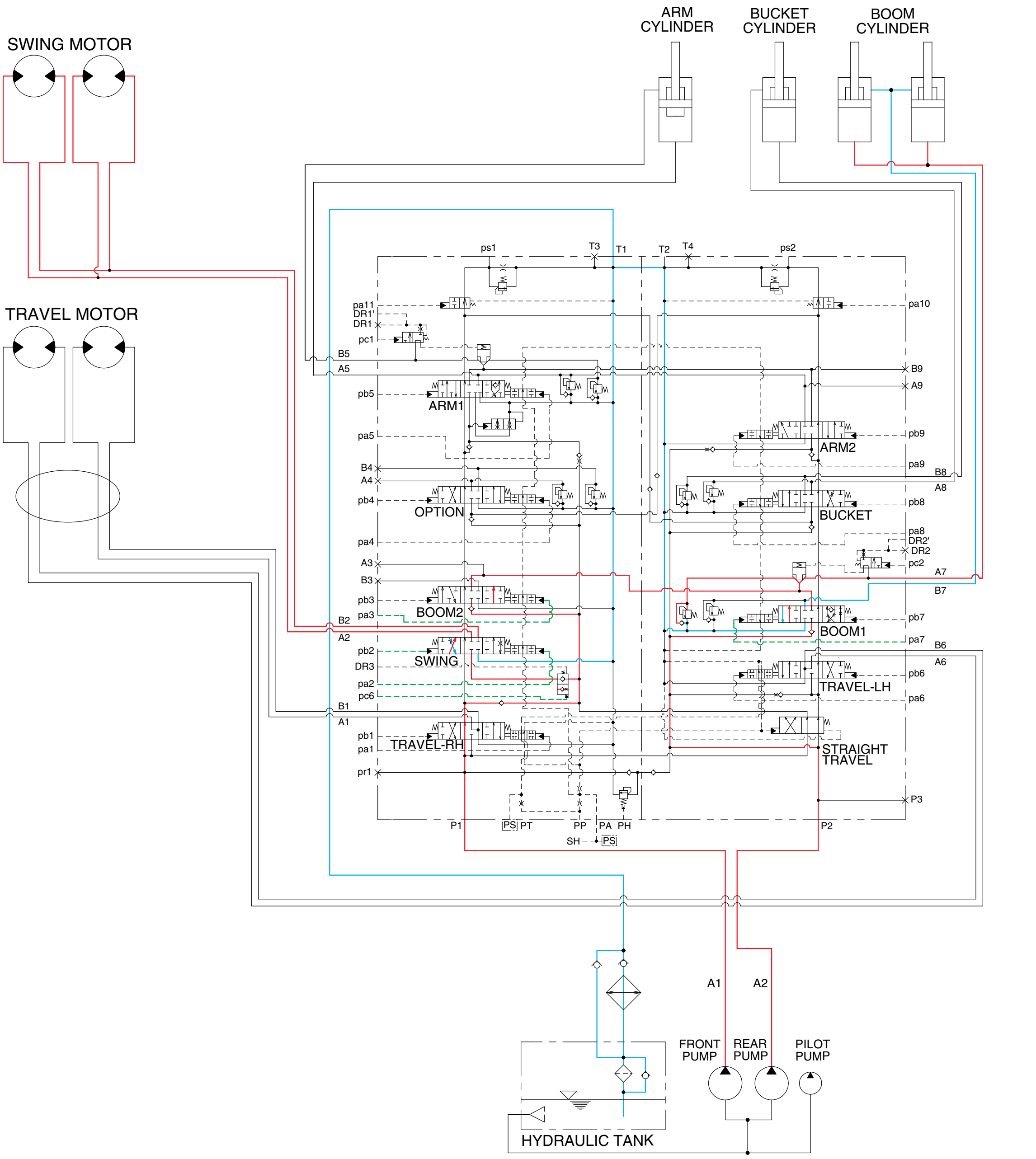
STRAIGHT TRAVEL SPOOL

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

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

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

2. COMBINED SWING AND BOOM UP OPERATION



480F3HC21

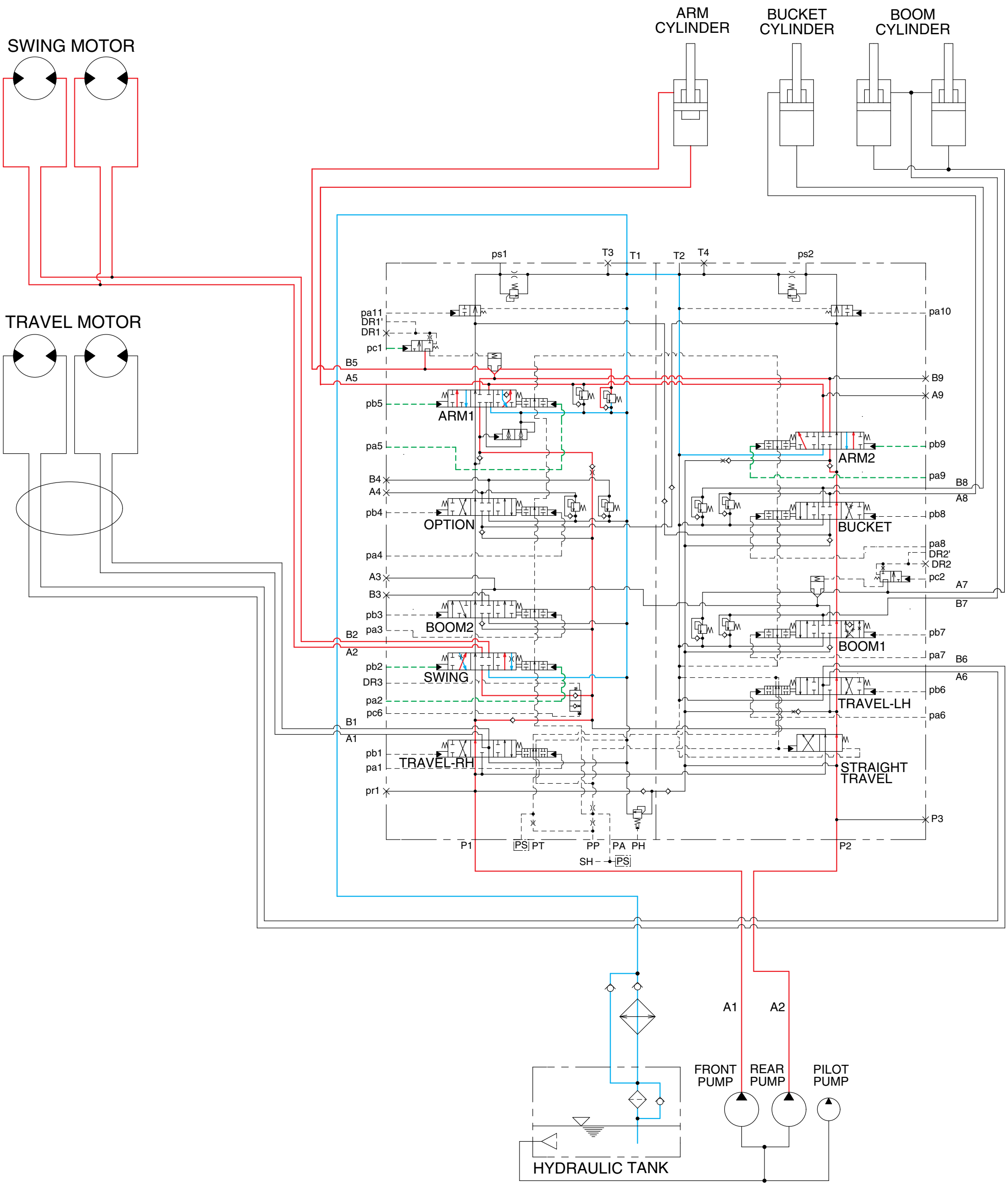
When the swing and boom up functions are operated, simultaneously the swing spool and boom spools in the main control valve are moved to the functional position by the pilot oil pressure from the remote control valve.

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

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

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

3. COMBINED SWING AND ARM OPERATION



480F3HC22

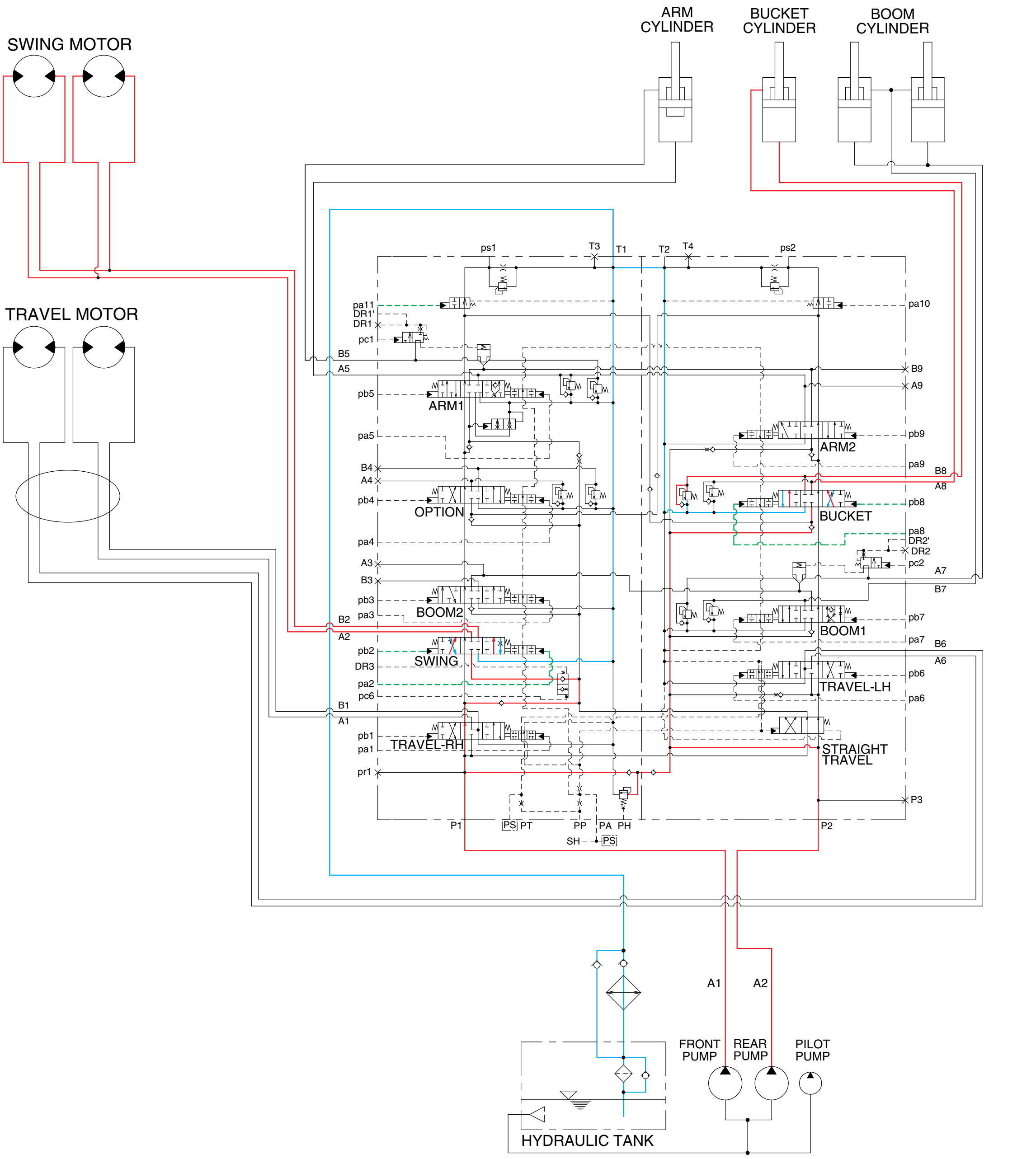
When the swing and arm functions are operated, simultaneously the swing spool and arm spools in the main control valve are moved to the functional position by the pilot oil pressure from the remote control valve.

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

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

Refer to page 2-35 for the swing operation preference function.

4. COMBINED SWING AND BUCKET OPERATION



480F3HC23

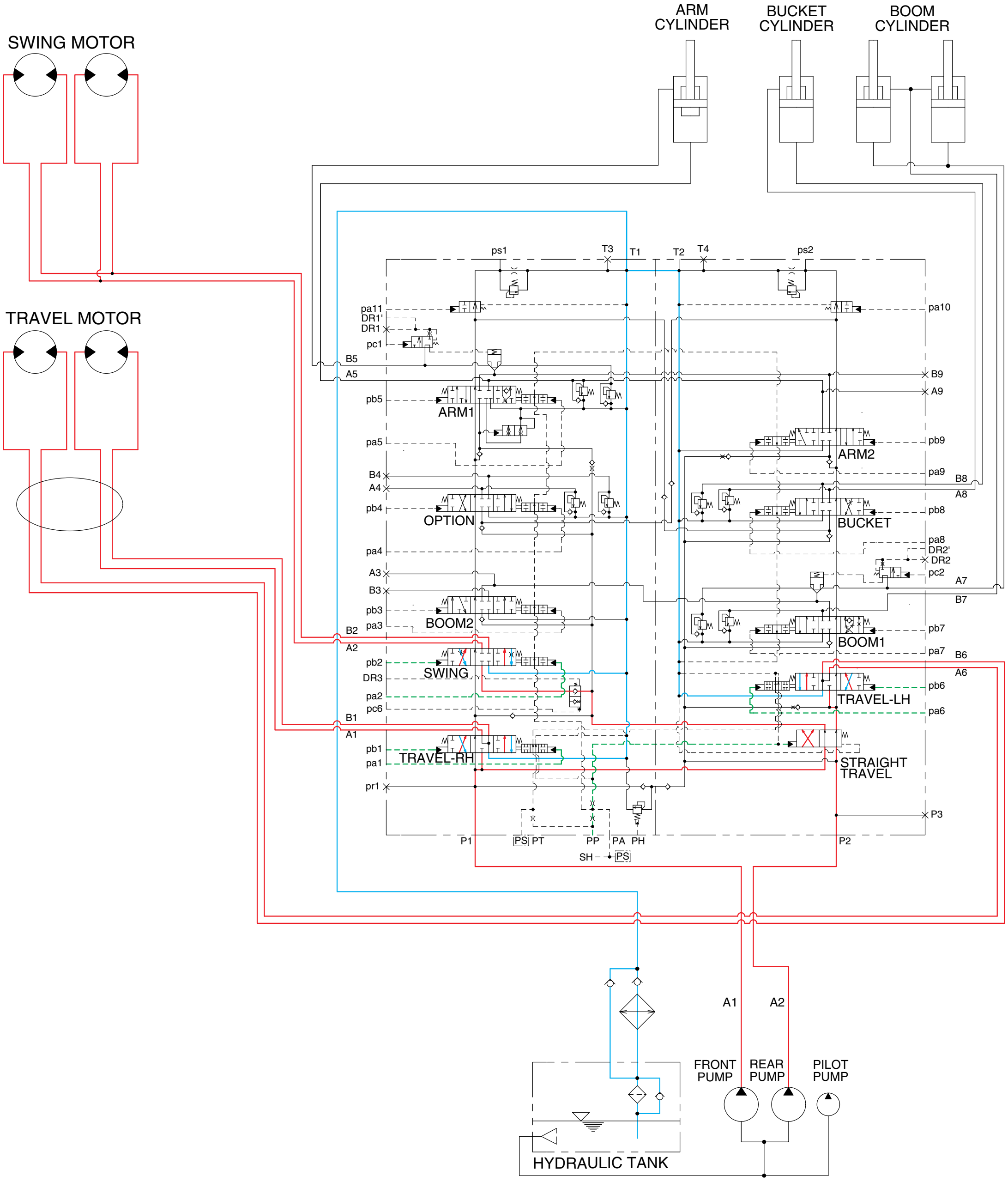
When the swing and bucket functions are operated, simultaneously the swing spool and bucket spool in the main control valve are moved to the functional position by the pilot oil pressure from the remote control valve.

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

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

The upper structure swings and the bucket is operated.

5. COMBINED SWING AND TRAVEL OPERATION



480F3HC24

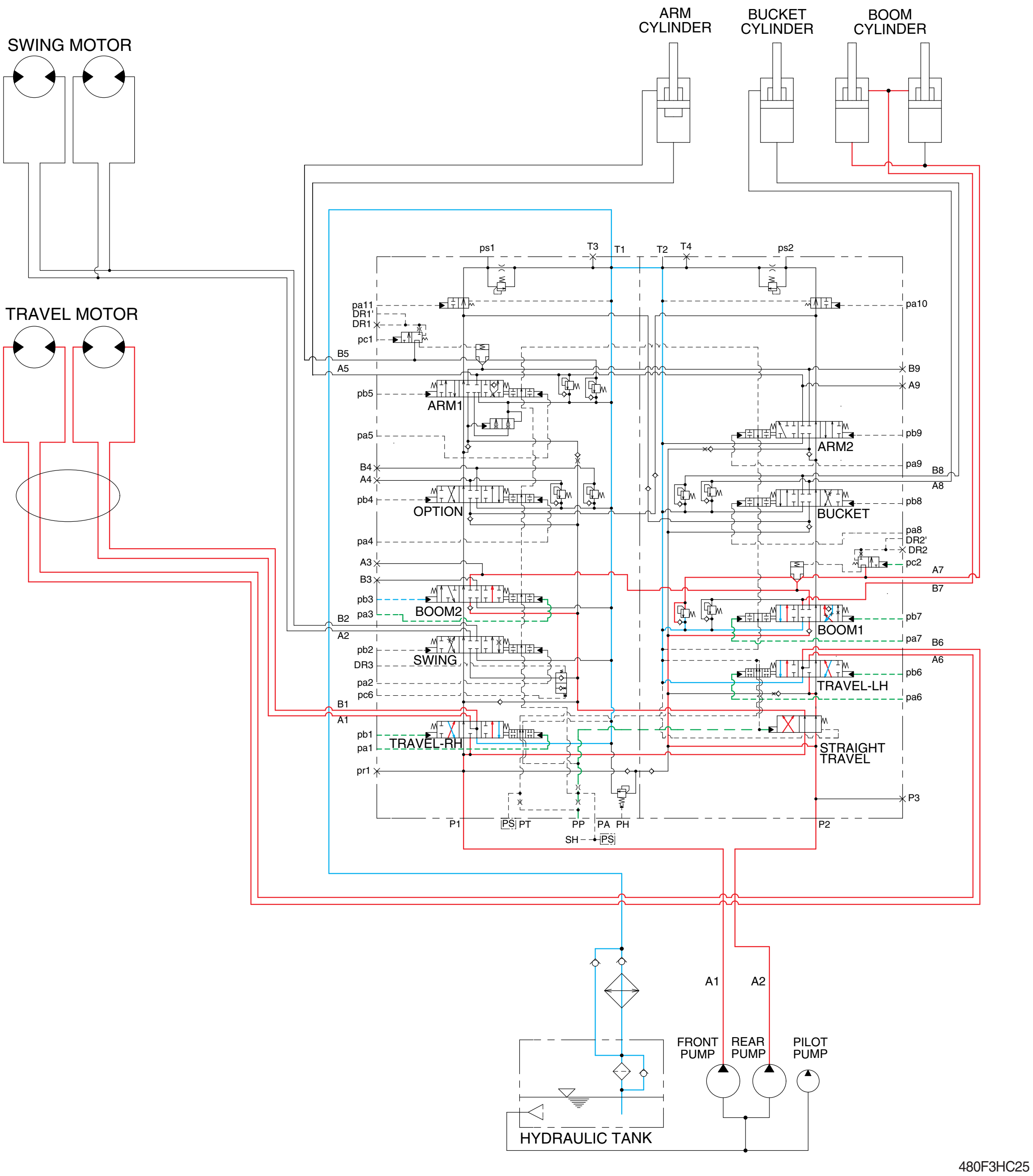
When the swing and travel functions are operated, simultaneously the swing spool and travel spools in the main control valve are moved to the functional position by the pilot oil pressure from the remote control valve and straight travel spool is pushed to the right by the pilot oil pressure from the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

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

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

The upper structure swings and the machine travels straight.

6. COMBINED BOOM AND TRAVEL OPERATION



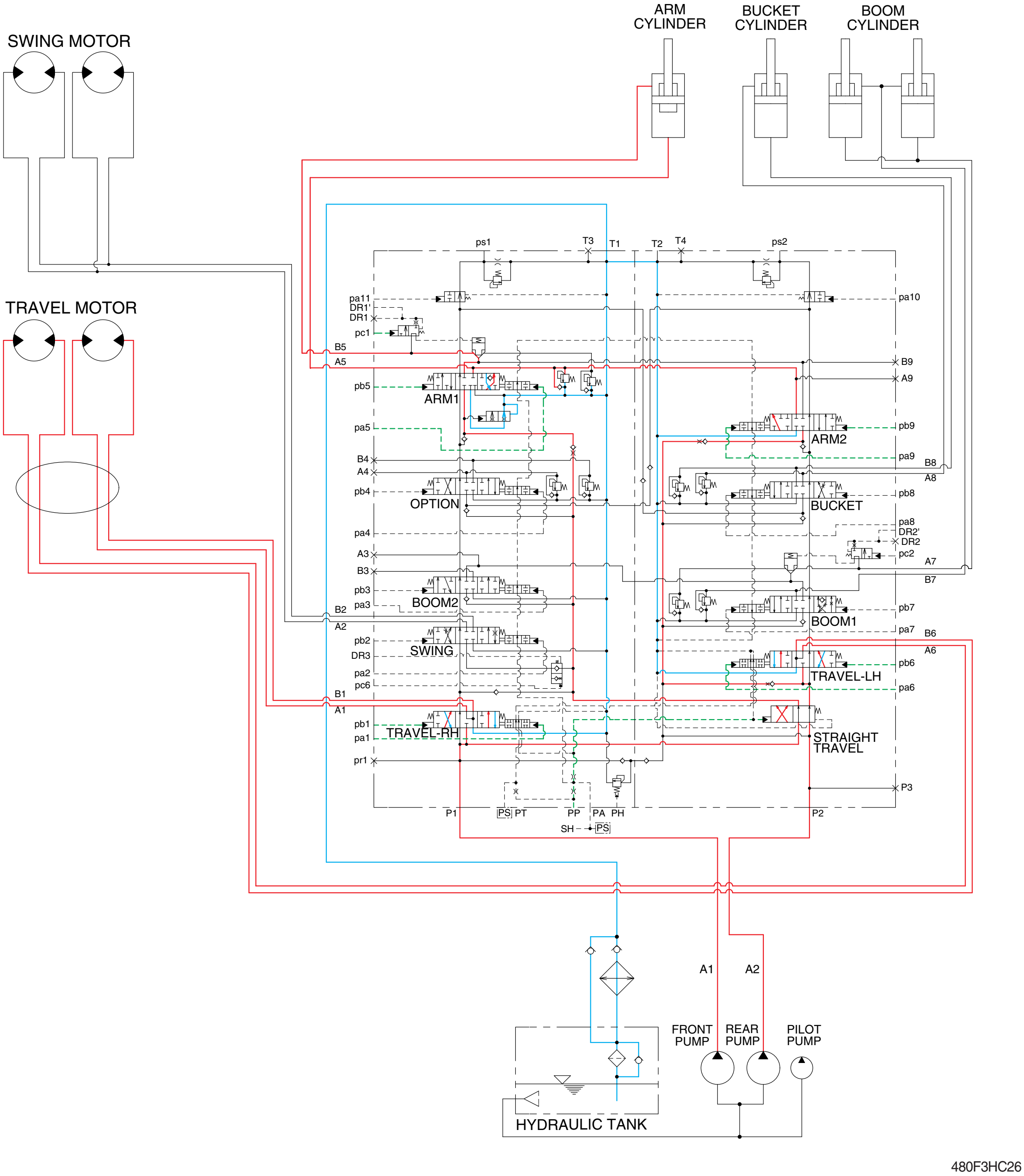
When the boom and travel functions are operated, simultaneously the boom spools and travel spools in the main control valve are moved to the functional position by the pilot oil pressure from the remote control valve and the straight travel spool is pushed to the right by the oil pressure from pilot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

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

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

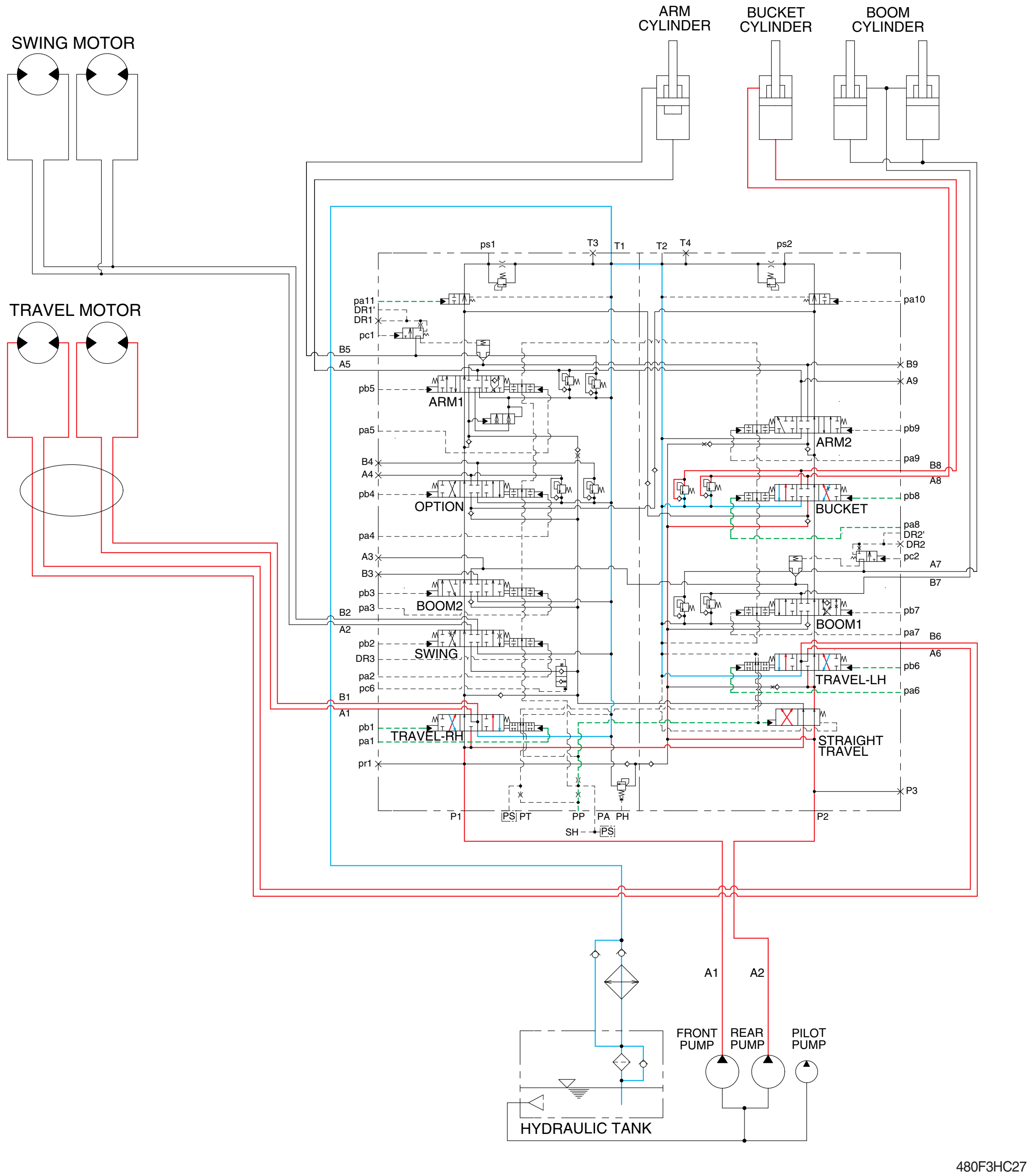
The boom is operated and the machine travels straight.

7. COMBINED ARM AND TRAVEL OPERATION



When the arm and travel functions are operated, simultaneously the arm spools and travel spools in the main control valve are moved to the functional position by the pilot oil pressure from the remote control valve and the straight travel spool is pushed to the right by the oil pressure from pilot pump.
The oil from the A1 pump flows into the travel motors through the RH travel spool of the left control valve and the LH travel spool of the right control valve via the straight travel spool.
The oil from the A2 pump flows into the arm cylinders through the arm 1 spool and arm 2 spool via the parallel and confluence oil passage.
The arm is operated and the machine travels straight.

8. COMBINED BUCKET AND TRAVEL OPERATION



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

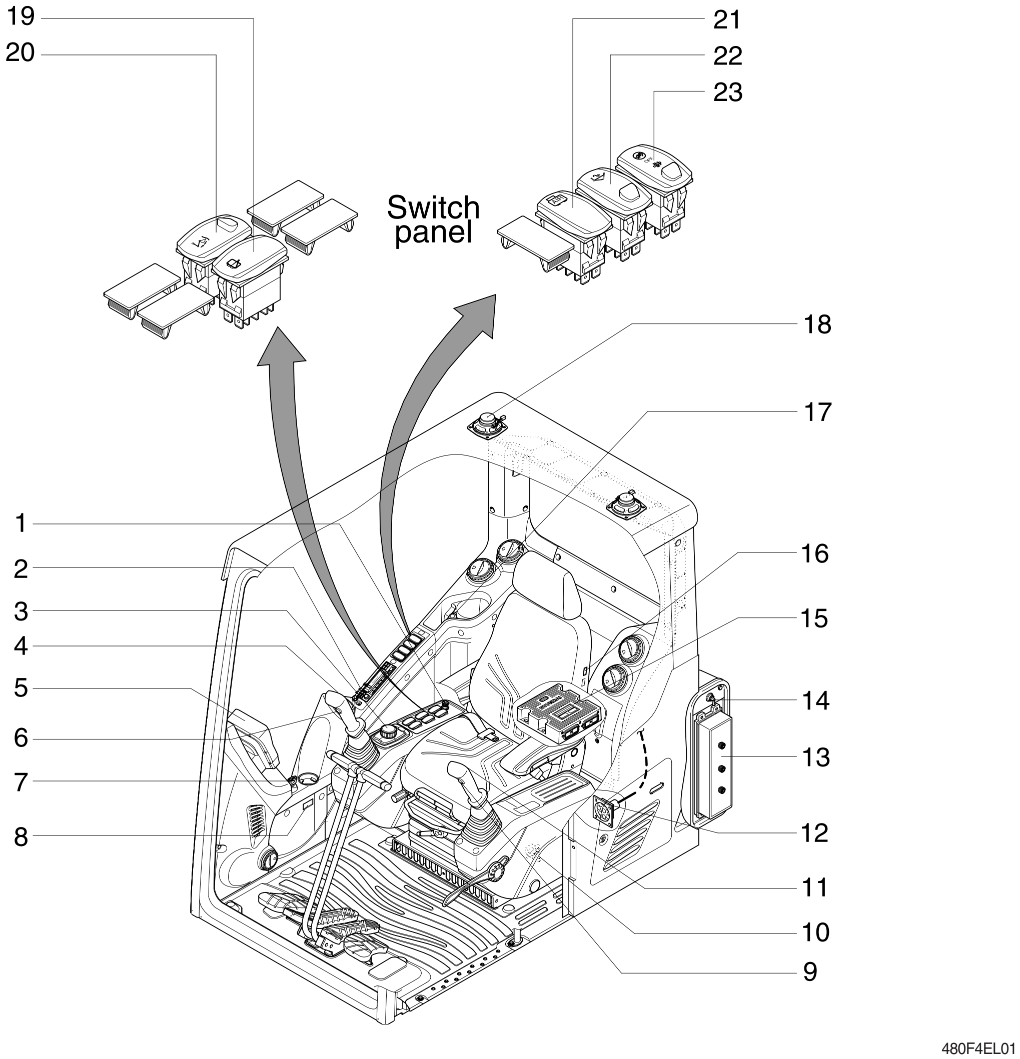
The oil from the A2 pump flows into the bucket cylinder through the bucket spool via the confluence oil passage.

The bucket is operated and the machine travels straight.

SECTION 4 ELECTRICAL SYSTEM

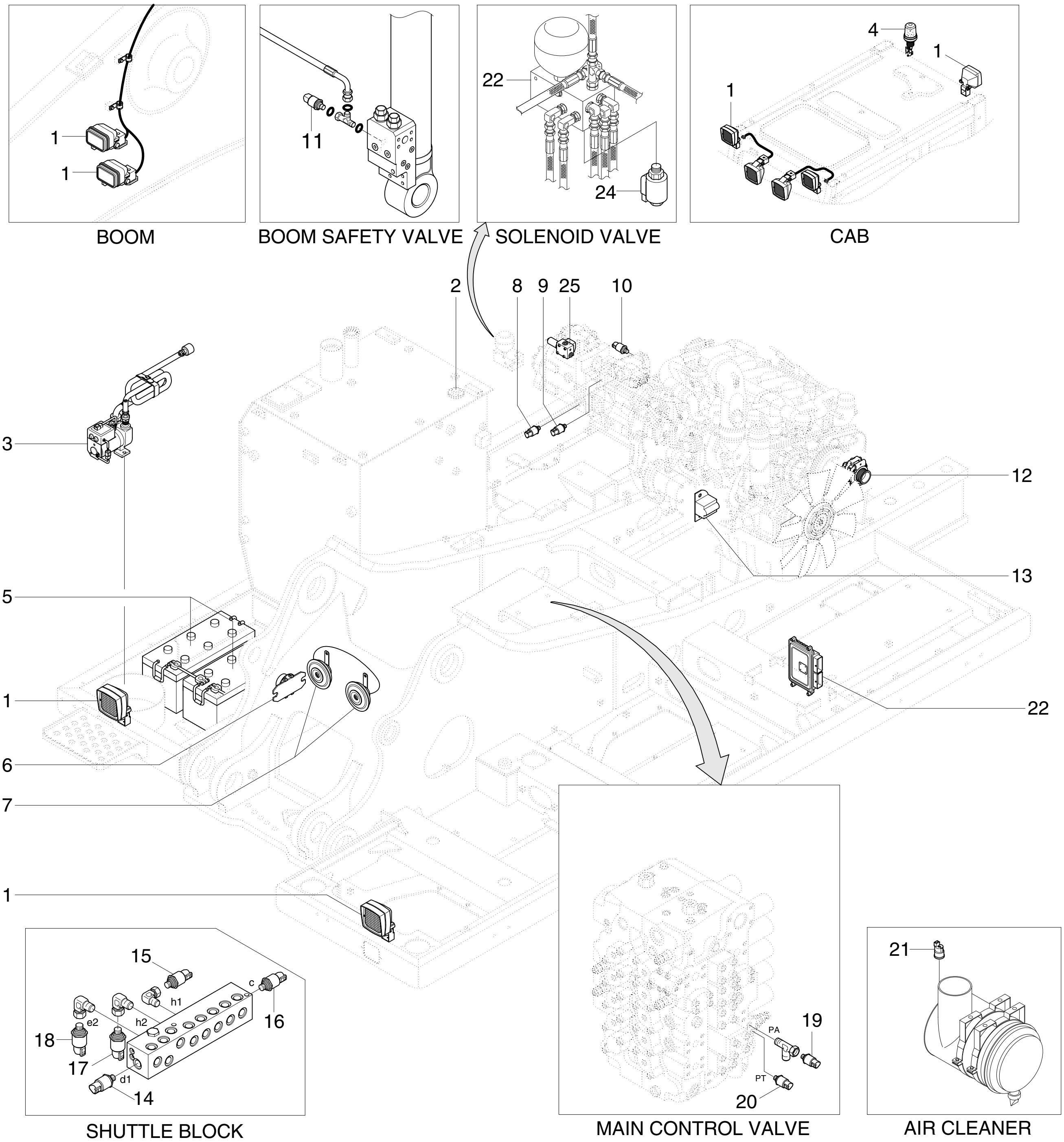
GROUP 1 COMPONENT LOCATION

1. LOCATION 1



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

2. LOCATION 2

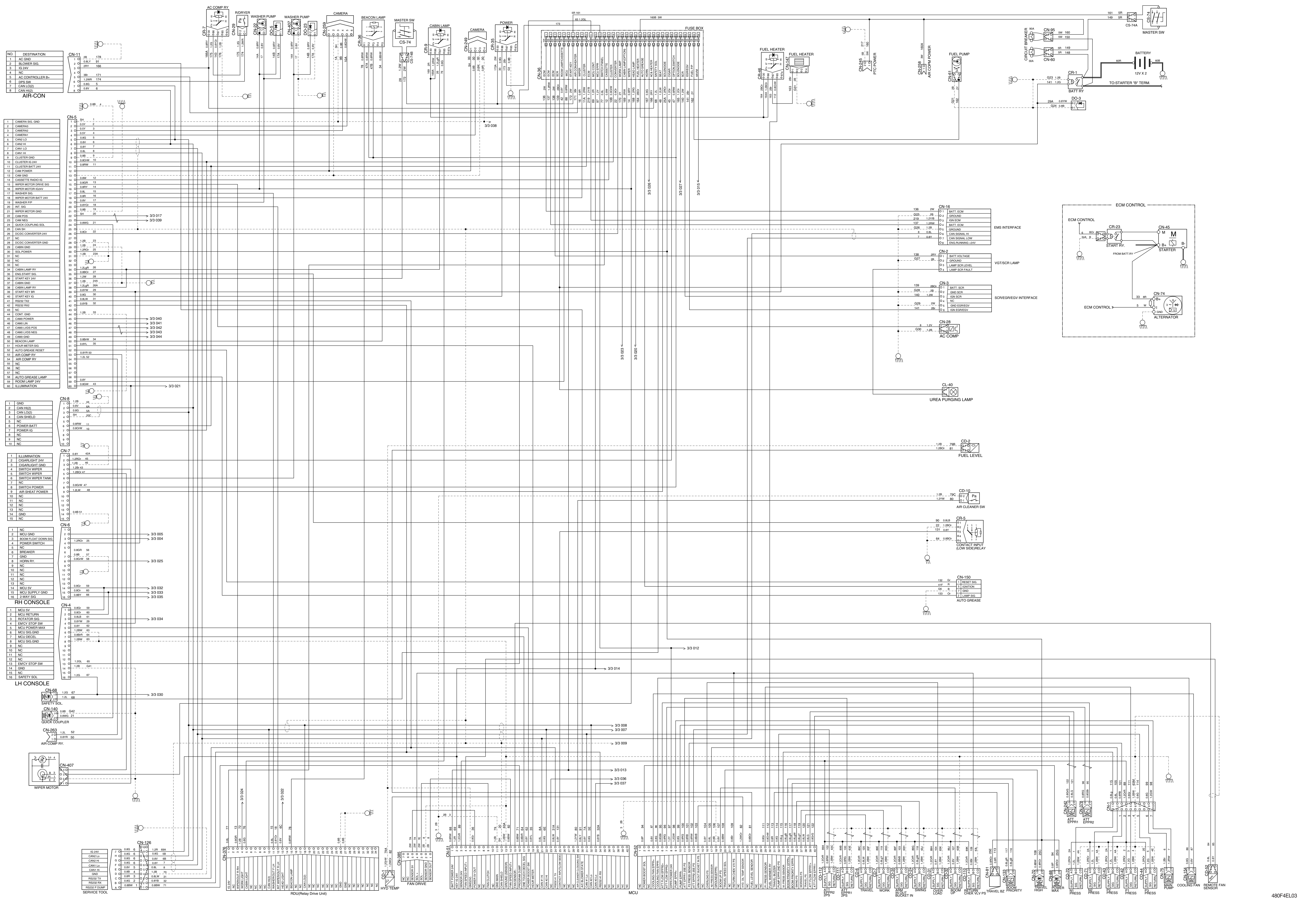


480F4EL02

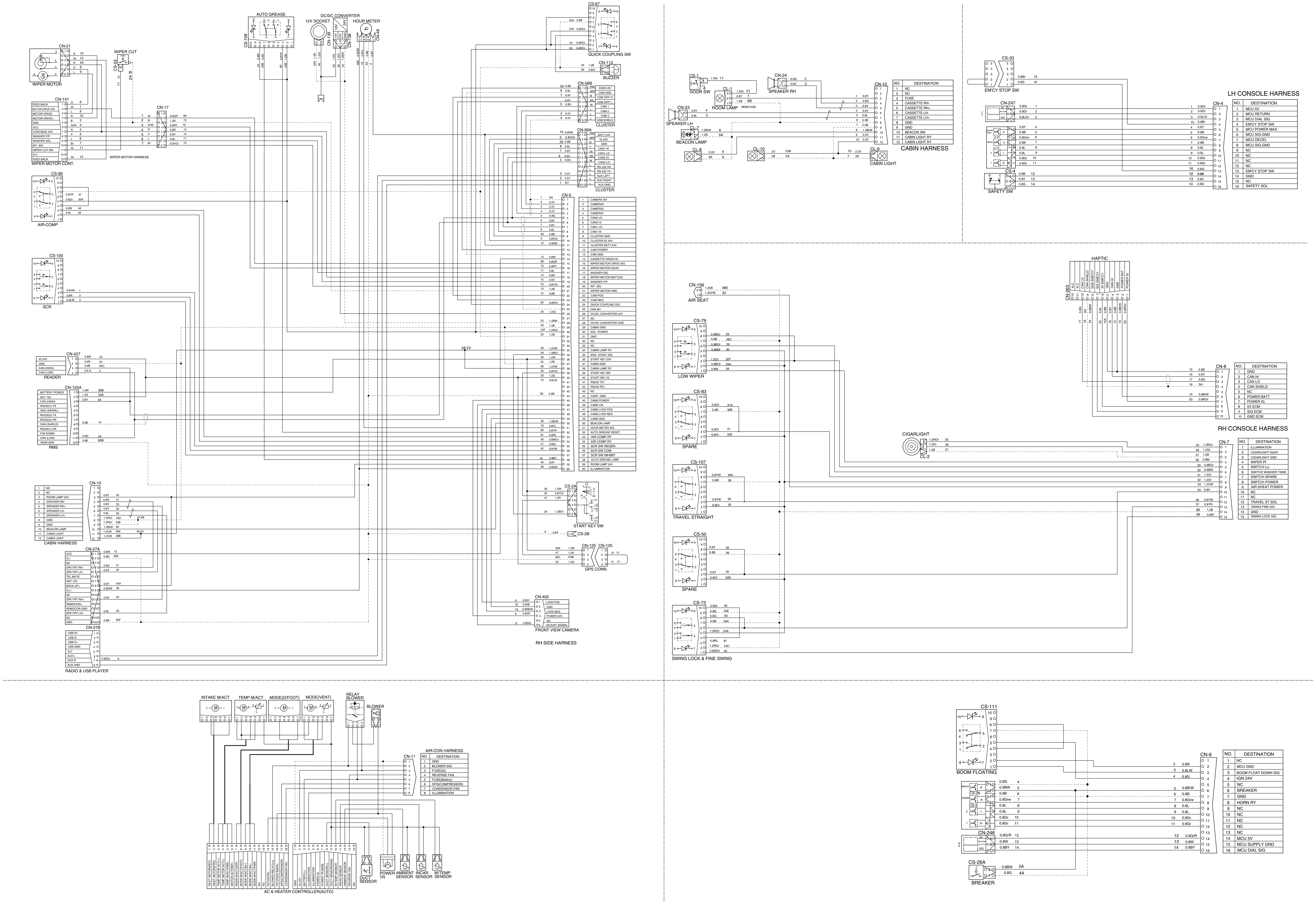
1	Lamp	9	P2 pressure sensor	17	Boom down pressure sensor
2	Fuel sender	10	EPPR pressure sensor	18	Arm in pressure sensor
3	Fuel filler pump	11	Overload pressure sensor	19	Attach pressure sensor
4	Beacon lamp	12	Alternator	20	Travel pressure sensor
5	Battery	13	Travel alarm buzzer	21	Air cleaner sensor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

GROUP 2 ELECTRICAL CIRCUIT

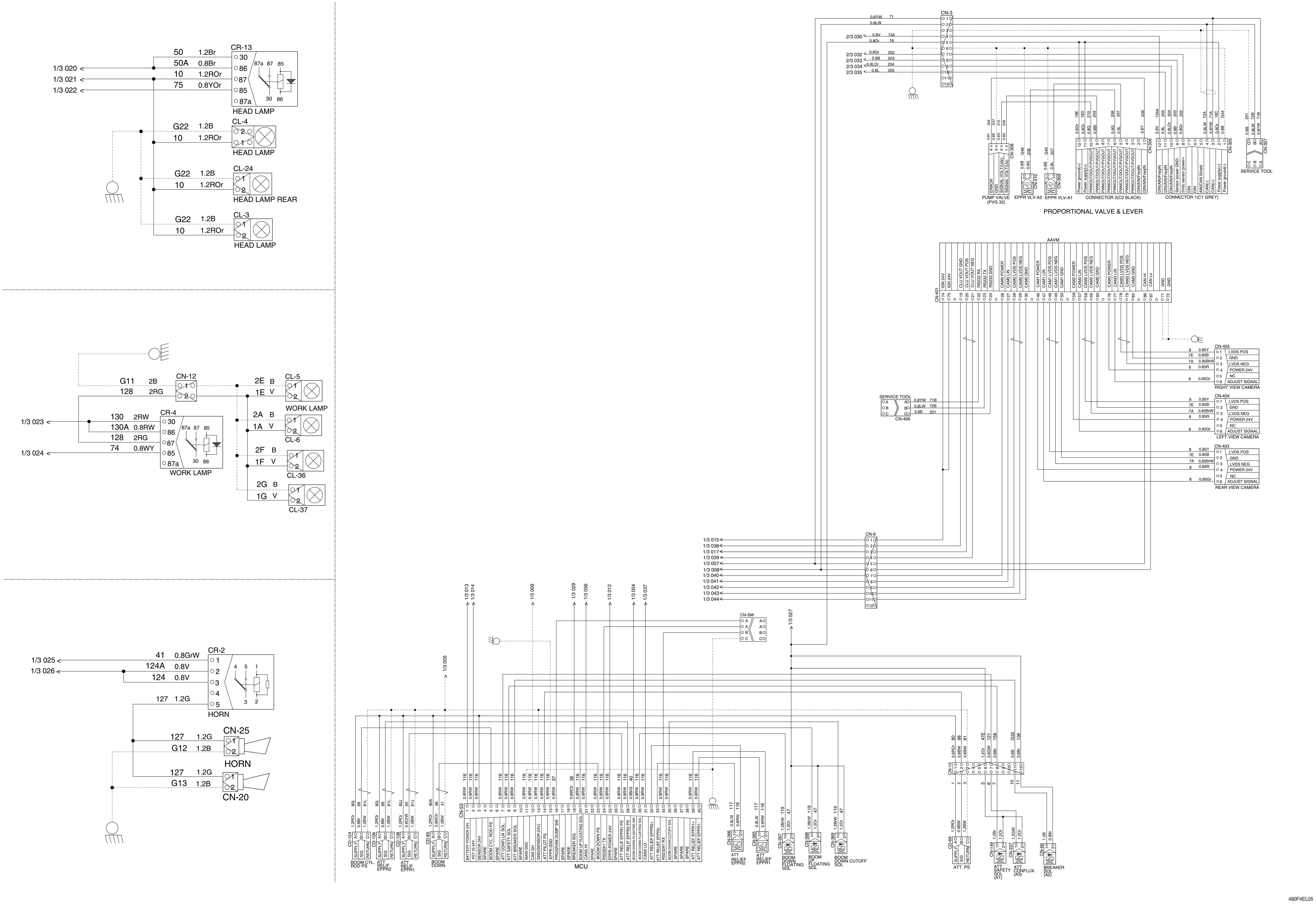
· ELECTRICAL CIRCUIT (1/6, SERIAL NO. HX480 L : -#0162 / HX520 L : -#0171)



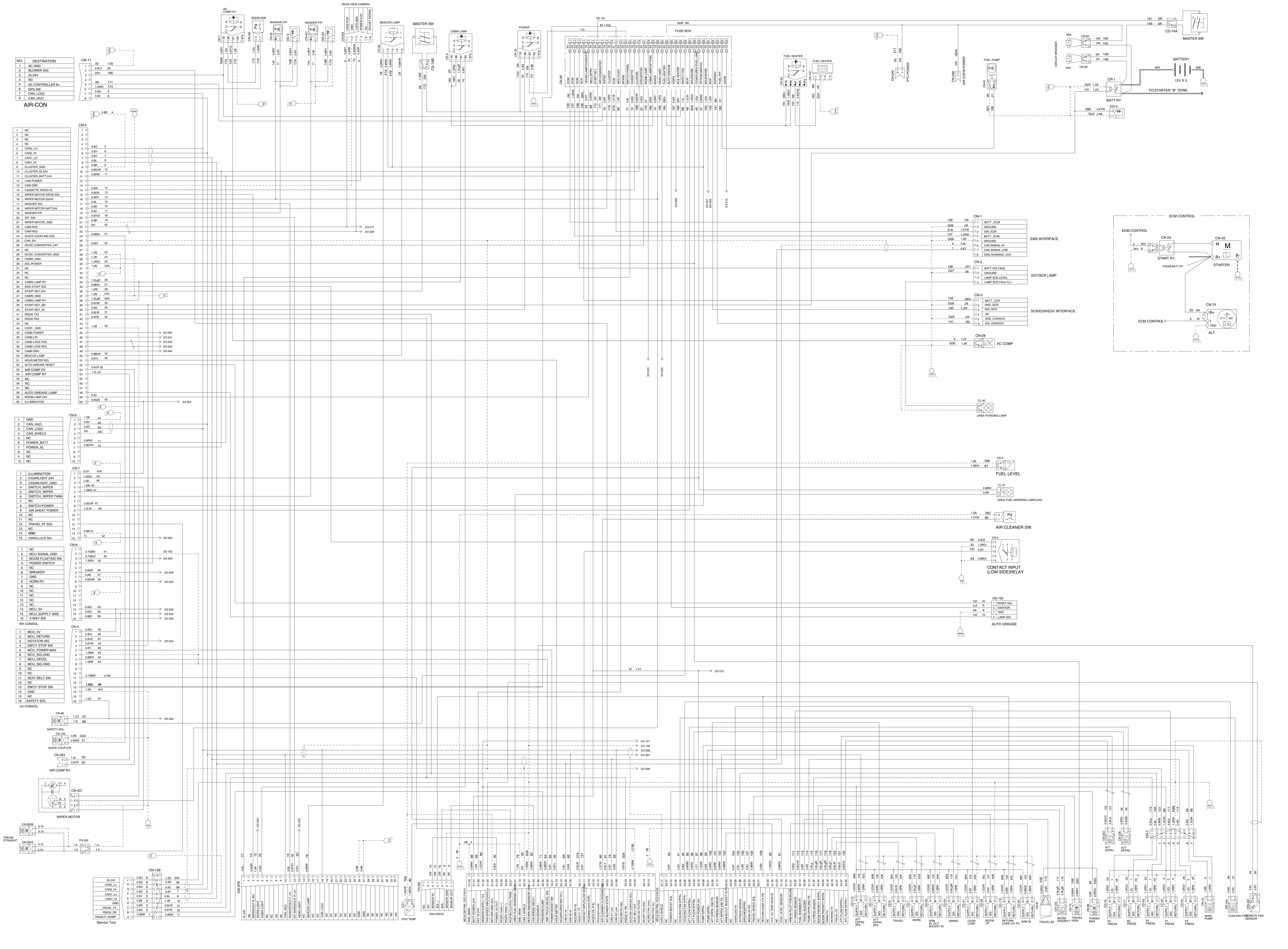
· ELECTRICAL CIRCUIT (2/6, SERIAL NO. HX480 L : -#0162 / HX520 L : -#0171)



· ELECTRICAL CIRCUIT (3/6, SERIAL NO. HX480 L : -#0162 / HX520 L : -#0171)

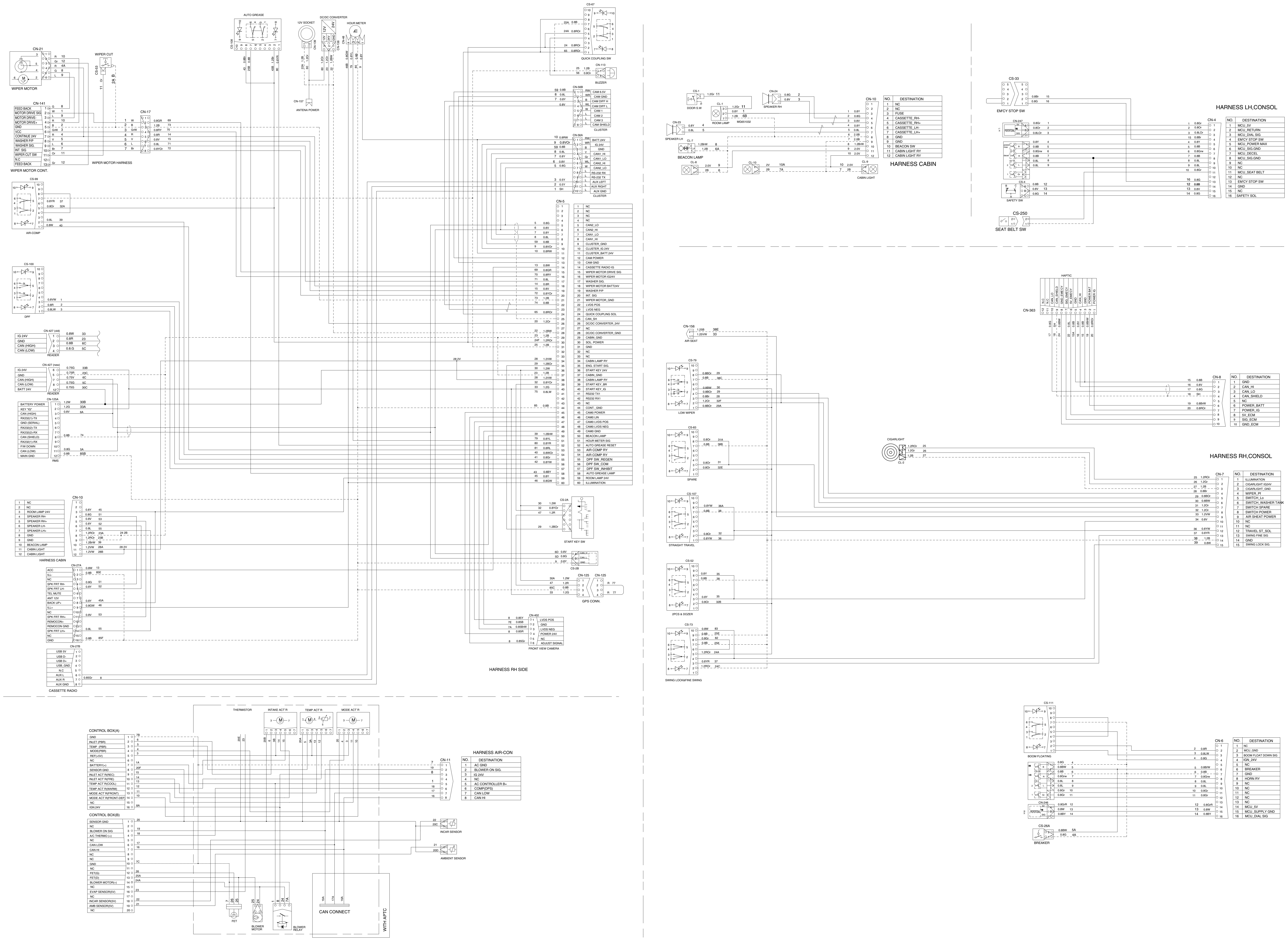


· ELECTRICAL CIRCUIT (4/6, SERIAL NO. HX480 L : #0163- / HX520 L : #0172-)



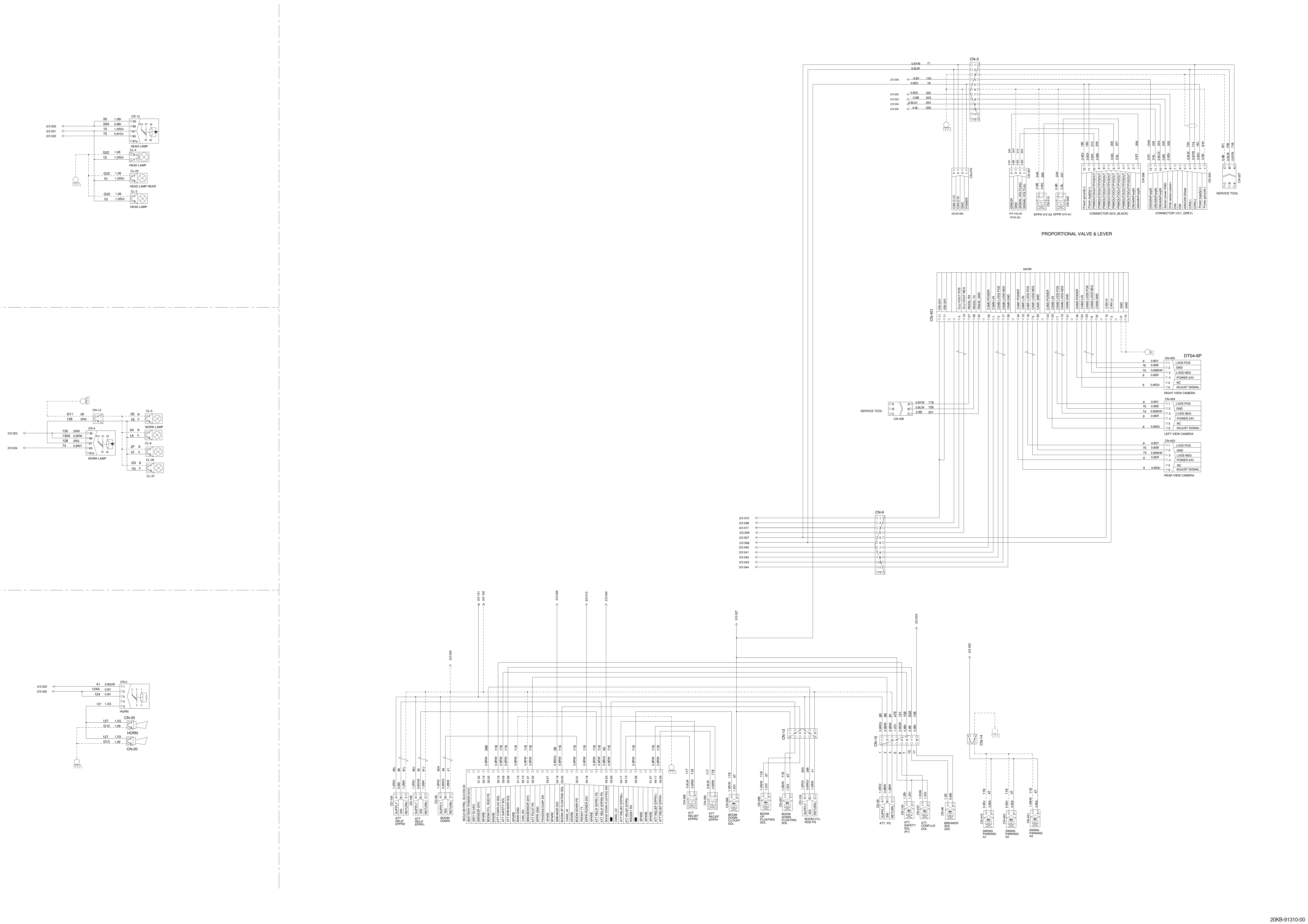
20KB-91210-00

· ELECTRICAL CIRCUIT (5/6, SERIAL NO. HX480 L : #0163- / HX520 L : #0172-)



20KB-91102-00

· ELECTRICAL CIRCUIT (6/6, SERIAL NO. HX480 L : #0163- / HX520 L : #0172-)



MEMORANDUM

1. POWER CIRCUIT

OLD VERSION

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

1) OPERATING FLOW

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

- → Fuse box [No.1] → Engine EMS interface [CN-16 (1)]
- → Fuse box [No.2] → Engine EMS interface [CN-16 (4)]
- → Fuse box [No.3] → Engine VGT/SCR lmap [CN-2 (1)]
- → Fuse box [No.4] → Urea purging lamp [CL-40 (1)→(2)] → Engine VGT/SCR lmap [CN-2 (4)]
- → Fuse box [No.5] → I/conn [CN-5 (59)]
  - → I/conn [CN-10 (3)] → Room lamp [CL-1 (2)]
    - → Door switch [CS-1]
  - → Radio & USB player [CN-27A (8)]
- → Fuse box [No.6]
  - → MCU [CN-51 (1)]
  - → MCU [CN-53 (1)]
- → Fuse box [No.7]
  - → Master switch [CS-74B] → I/conn [CN-5 (36)]
    - → Start switch [CS-2 (1)]
    - → RMS [CN-125A(1)]
    - → RMS connection [CN-125 (1)]
  - → Power relay [CR-35 (30)]
- → Fuse box [No.8] → I/conn [CN-11 (5)]
  - → AC & Heater controller (3)
  - → Blower relay (3)
- → Fuse box [No.9] → I/conn [CN - 5 (18)] → I/conn [CN -17 (5)]
  - → Wiper motor controller [CN-141 (7)]
  - → Wiper motor [CN-21 (4)]
- → Fuse box [No.10] → I/conn [CN - 5 (11)]
  - → Cluster [CN -56 (1)]
  - → Hour meter [CN-48 (1)]

※ I/conn : Intermediate connector

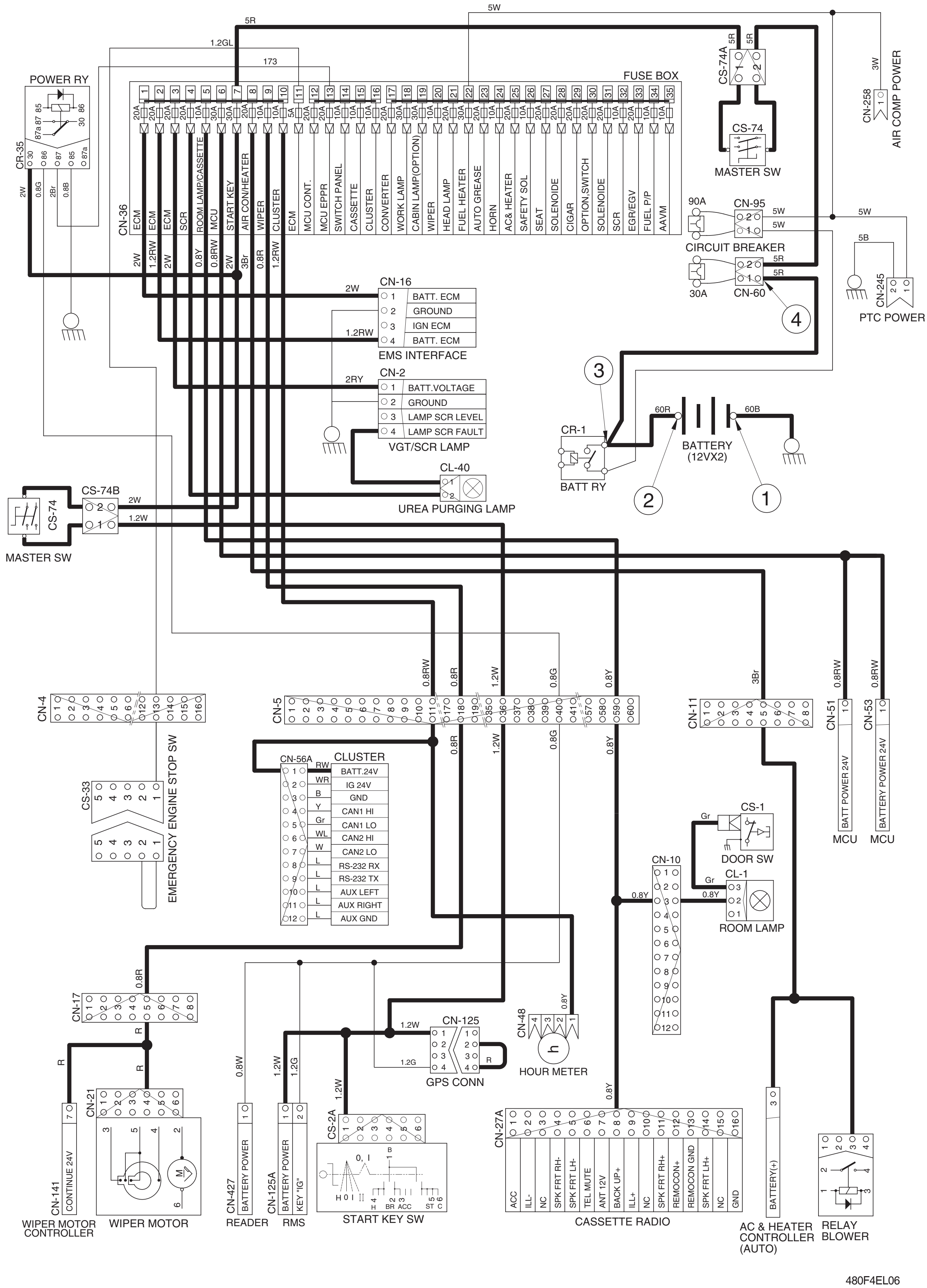
2) CHECK POINT

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

※ GND : Ground

POWER CIRCUIT

OLD VERSION



POWER CIRCUIT CURRENT VERSION

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

1) OPERATING FLOW

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

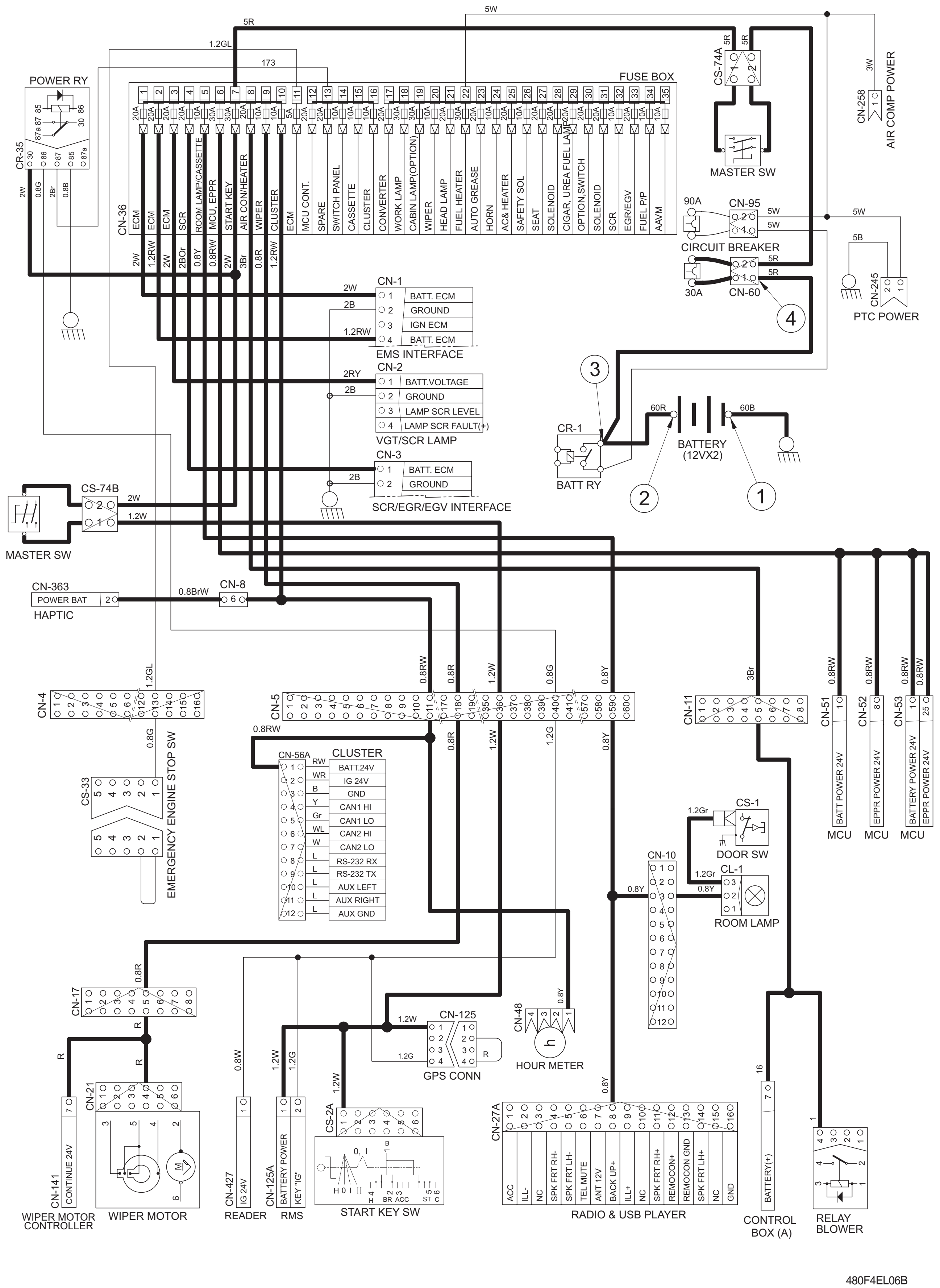
- → Fuse box [No.1] → Engine EMS interface [CN-1 (1)]
- → Fuse box [No.2] → Engine EMS interface [CN-1 (4)]
- → Fuse box [No.3] → Engine VGT/SCR Imap [CN-2 (1)]
- → Fuse box [No.4] → Engine SCR/EGR/EGV interface [CN-3 (1)]
- → Fuse box [No.5] → I/conn [CN-5 (59)]
  - → I/conn [CN-10 (3)] → Room lamp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

※ I/conn : Intermediate connector

2) CHECK POINT

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

※ GND : Ground


POWER RY
CR-35
FUSE BOX
CN-36
ECM
ECM
ECM
SCR
ROOM LAMP/CASSETTE
MCU, EPPR
START KEY
AIR CON/HEATER
WIPER
CLUSTER
ECM
MCU CONT.
SPARE
SWITCH PANEL
CASSETTE
CLUSTER
CONVERTER
WORK LAMP
CABIN LAMP(OPTION)
WIPER
HEAD LAMP
FUEL HEATER
AUTO GREASE
HORN
AC& HEATER
SAFETY SOL
SEAT
SOLENOID
CIGAR, UREA FUEL LAMP
OPTION,SWITCH
SOLENOID
SCR
EGR/EGV
FUEL P/P
AAVM
CS-74A
MASTER SW
CN-258
AIR COMP POWER
CN-95
CIRCUIT BREAKER
CN-60
CN-245
PTC POWER
CN-1
BATT. ECM
GROUND
IGN ECM
BATT. ECM
EMS INTERFACE
CN-2
BATT.VOLTAGE
GROUND
LAMP SCR LEVEL
LAMP SCR FAULT(+)
VGT/SCR LAMP
CN-3
BATT. ECM
GROUND
SCR/EGR/EGV INTERFACE
CR-1
BATT RY
BATTERY
(12VX2)
CS-74B
MASTER SW
CN-363
POWER BAT
HAPTIC
CN-8
CN-4
CN-5
CN-11
CN-51
CN-52
CN-53
BATT POWER 24V
EPPR POWER 24V
BATTERY POWER 24V
EPPR POWER 24V
MCU
MCU
MCU
CS-33
EMERGENCY ENGINE STOP SW
CN-56A
CLUSTER
BATT.24V
IG 24V
GND
CAN1 HI
CAN1 LO
CAN2 HI
CAN2 LO
RS-232 RX
RS-232 TX
AUX LEFT
AUX RIGHT
AUX GND
CS-1
DOOR SW
CN-10
CL-1
ROOM LAMP
CN-17
CN-21
CN-141
CONTINUE 24V
WIPER MOTOR CONTROLLER
WIPER MOTOR
CN-427
IG 24V
READER
CN-125A
BATTERY POWER
KEY "IG"
RMS
CS-2A
START KEY SW
CN-125
GPS CONN
CN-48
HOUR METER
CN-27A
ACC
ILL-
NC
SPK FRT RH-
SPK FRT LH-
TEL MUTE
ANT 12V
BACK UP+
ILL+
NC
SPK FRT RH+
REMOCON+
REMOCON GND
SPK FRT LH+
NC
GND
RADIO & USB PLAYER
BATTERY(+)
CONTROL BOX (A)
RELAY BLOWER
480F4EL06B

2. STARTING CIRCUIT

OLD VERSION

1) OPERATING FLOW

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

(1) When start key switch is in ON position

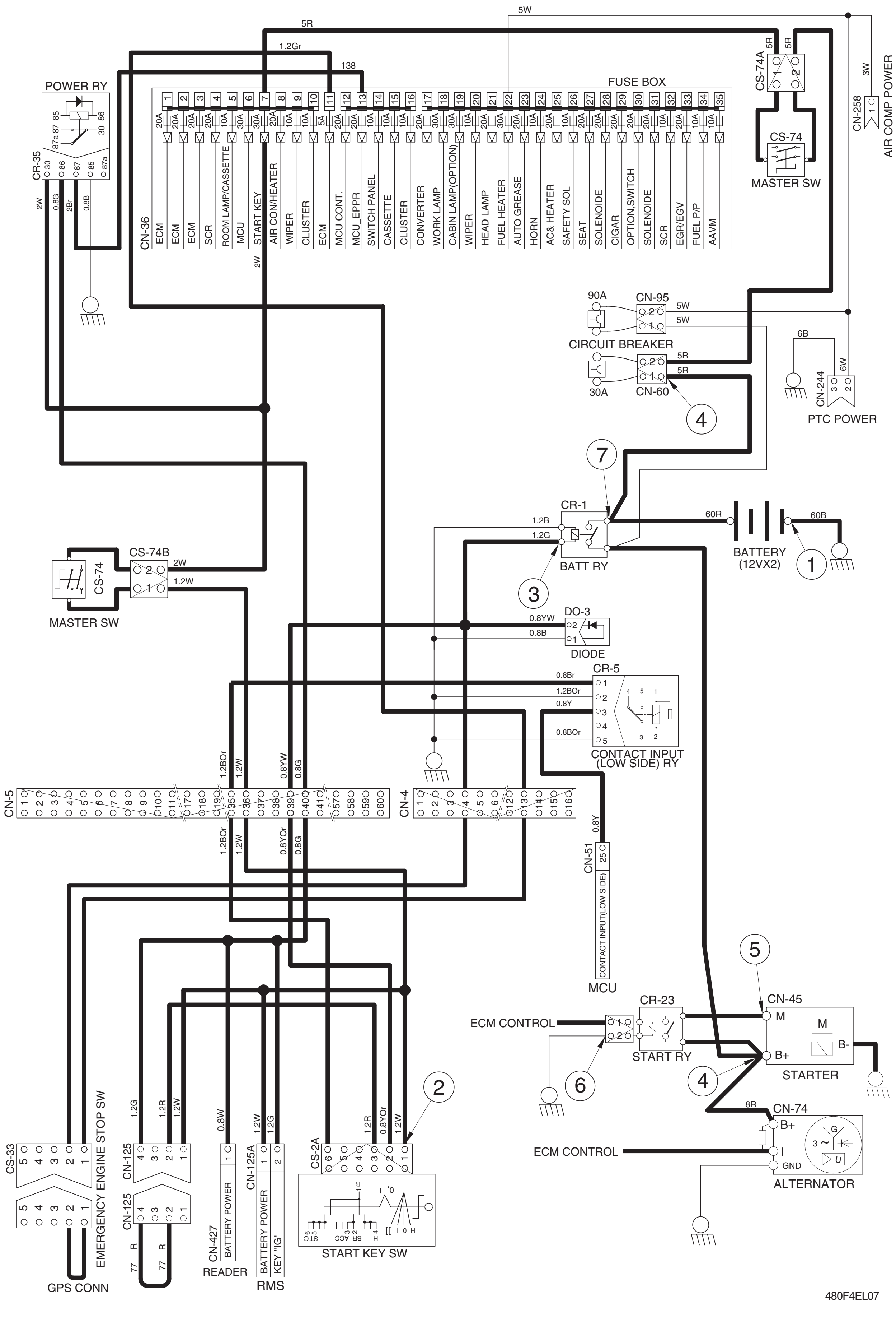
→ Start switch ON [CS-2A (2)] → I/conn [CN-5 (39)]
  → Battery relay [CR-1] → Battery relay operating (all power is supplied with the electric component)
  → I/conn [CN-4 (4)] → Emergency engine stop sw [CS-33 (2)→(1)] → I/conn [CN-4 (13)]
    → Fuse box [No. 11]
→ Start switch ON [CS-2A (3)] → RMS conn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

(2) When start key switch is in START position

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

2) CHECK POINT

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



POWER RY
CR-35
FUSE BOX
CN-36
ECM
SCR
ROOM LAMP/CASSETTE
MCU
START KEY
AIR CON/HEATER
WIPER
CLUSTER
MCU CONT.
MCU_EPPR
SWITCH PANEL
CASSETTE
CONVERTER
WORK LAMP
CABIN LAMP(OPTION)
HEAD LAMP
FUEL HEATER
AUTO GREASE
HORN
AC& HEATER
SAFETY SOL
SEAT
SOLENOIDE
CIGAR
OPTION,SWITCH
EGR/EGV
FUEL P/P
AAVM
CS-74A
CS-74
MASTER SW
CN-258
AIR COMP POWER
CN-95
CIRCUIT BREAKER
CN-60
CN-244
PTC POWER
CR-1
BATT RY
BATTERY (12VX2)
CS-74B
DO-3
DIODE
CR-5
CONTACT INPUT (LOW SIDE) RY
CN-5
CN-4
CN-51
CONTACT INPUT(LOW SIDE)
MCU
CR-23
START RY
ECM CONTROL
CN-45
STARTER
CN-74
ALTERNATOR
CS-33
EMERGENCY ENGINE STOP SW
GPS CONN
CN-125
CN-427
BATTERY POWER
READER
CN-125A
KEY "IG"
RMS
CS-2A
START KEY SW
480F4EL07

1) OPERATING FLOW

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

(1) When start key switch is in ON position

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

(2) When start key switch is in START position

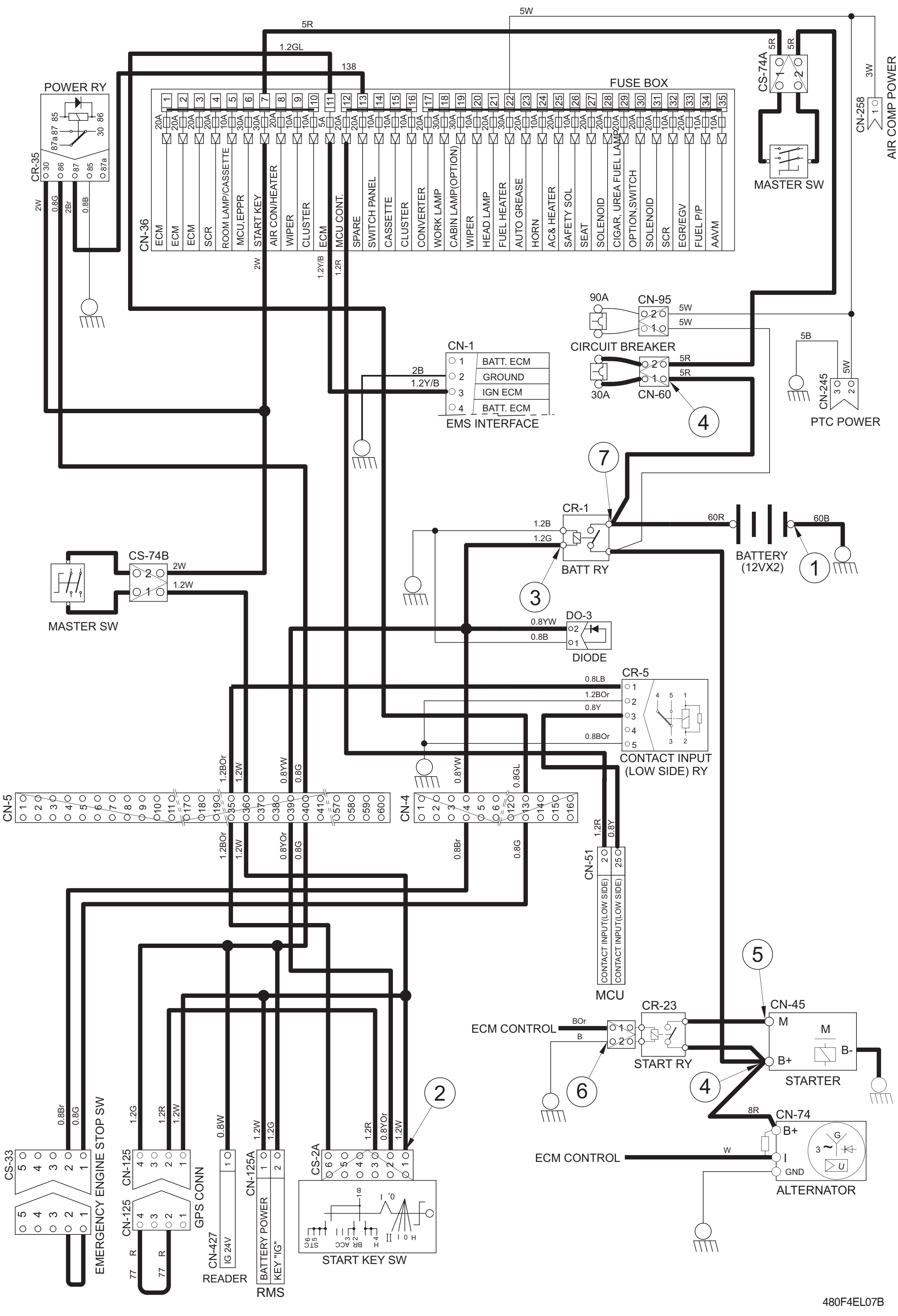
Start switch START [CS-2A (6)] → I/conn [CN-5 (35)] → Contact input relay [CR-5 (1)→(3)] → MCU [CN-51 (25)] → ECM control → Start relay [CR-23 (1)] → Starter operating

2) CHECK POINT

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

STARTING CIRCUIT

CURRENT VERSION



3. CHARGING CIRCUIT

OLD VERSION

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

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

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

1) OPERATING FLOW

(1) Warning flow

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

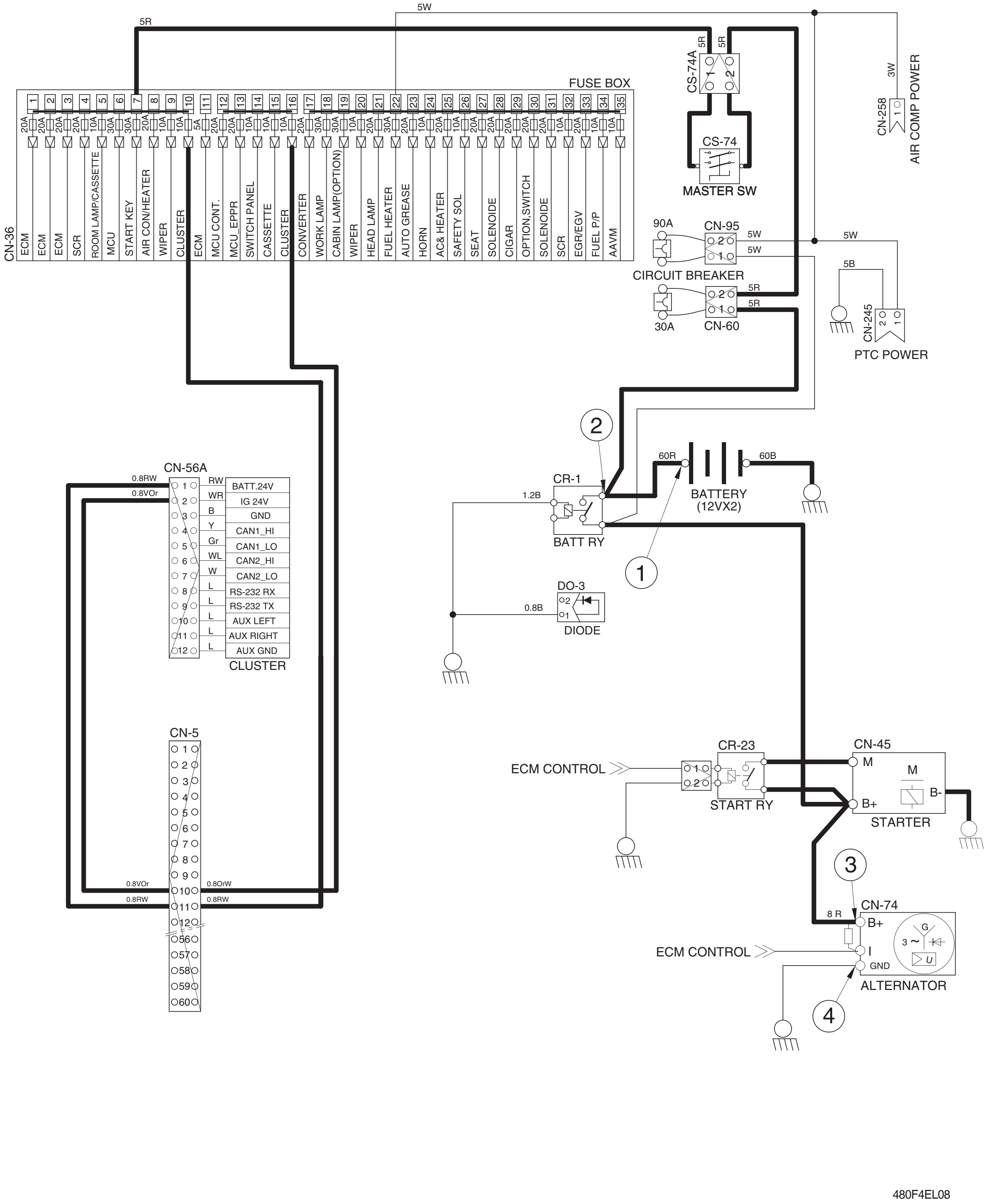
(2) Charging flow

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

2) CHECK POINT

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

※ GND : Ground


FUSE BOX
CN-36
ECM
ECM
ECM
SCR
ROOM LAMP/CASSETTE
MCU
START KEY
AIR CON/HEATER
WIPER
CLUSTER
ECM
MCU CONT.
MCU_EPPR
SWITCH PANEL
CASSETTE
CLUSTER
CONVERTER
WORK LAMP
CABIN LAMP(OPTION)
WIPER
HEAD LAMP
FUEL HEATER
AUTO GREASE
HORN
AC& HEATER
SAFETY SOL
SEAT
SOLENOIDE
CIGAR
OPTION,SWITCH
SOLENOIDE
SCR
EGR/EGV
FUEL P/P
AAVM
CS-74A
CS-74
MASTER SW
CN-258
AIR COMP POWER
CN-95
90A
CIRCUIT BREAKER
CN-60
30A
CN-245
PTC POWER
CR-1
BATT RY
BATTERY
(12VX2)
DO-3
DIODE
CN-56A
BATT.24V
IG 24V
GND
CAN1_HI
CAN1_LO
CAN2_HI
CAN2_LO
RS-232 RX
RS-232 TX
AUX LEFT
AUX RIGHT
AUX GND
CLUSTER
CN-5
ECM CONTROL
CR-23
START RY
CN-45
STARTER
CN-74
ECM CONTROL
ALTERNATOR
480F4EL08

CHARGING CIRCUIT

CURRENT VERSION

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

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

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

1) OPERATING FLOW

(1) Warning flow

Alternator [CN-74 (I)] → ECM control

→ Cluster charging warning lamp (Via CAN interface)

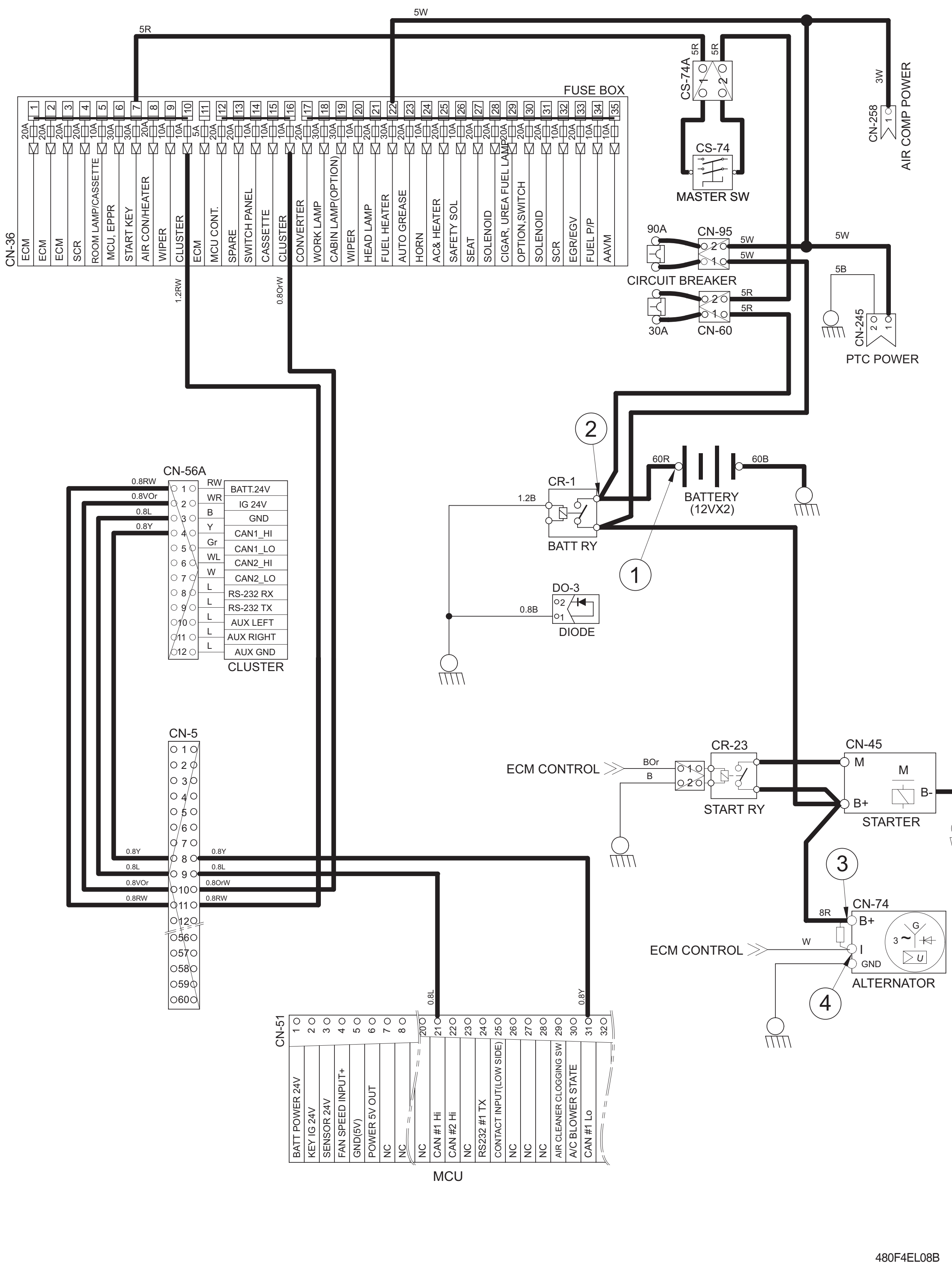
(2) Charging flow

Alternator [CN-74 (B+)] → Battery relay (M8)
- → Battery(+) terminal
- → Circuit breaker [CN-60] → Master switch [CS-74A] → Fuse box [No. 1~10]
- → Circuit breaker [CN-95] → Fuse box [No. 17~35]

2) CHECK POINT

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

※ GND : Ground


FUSE BOX
CN-36
CS-74A
CS-74
MASTER SW
CN-258
AIR COMP POWER
CN-95
90A
CIRCUIT BREAKER
30A
CN-60
CN-245
PTC POWER
CR-1
BATT RY
BATTERY (12VX2)
DO-3
DIODE
CN-56A
CLUSTER
CN-5
CR-23
ECM CONTROL
START RY
CN-45
STARTER
CN-74
ALTERNATOR
CN-51
MCU
480F4EL08B

4. HEAD AND WORK LIGHT CIRCUIT

OLD VERSION

1) OPERATING FLOW

Fuse box (No.21) → Head light relay [CR-13 (30,86)]
Fuse box (No.18) → Work light relay [CR-4 (30,86)]

(1) Head light switch ON

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

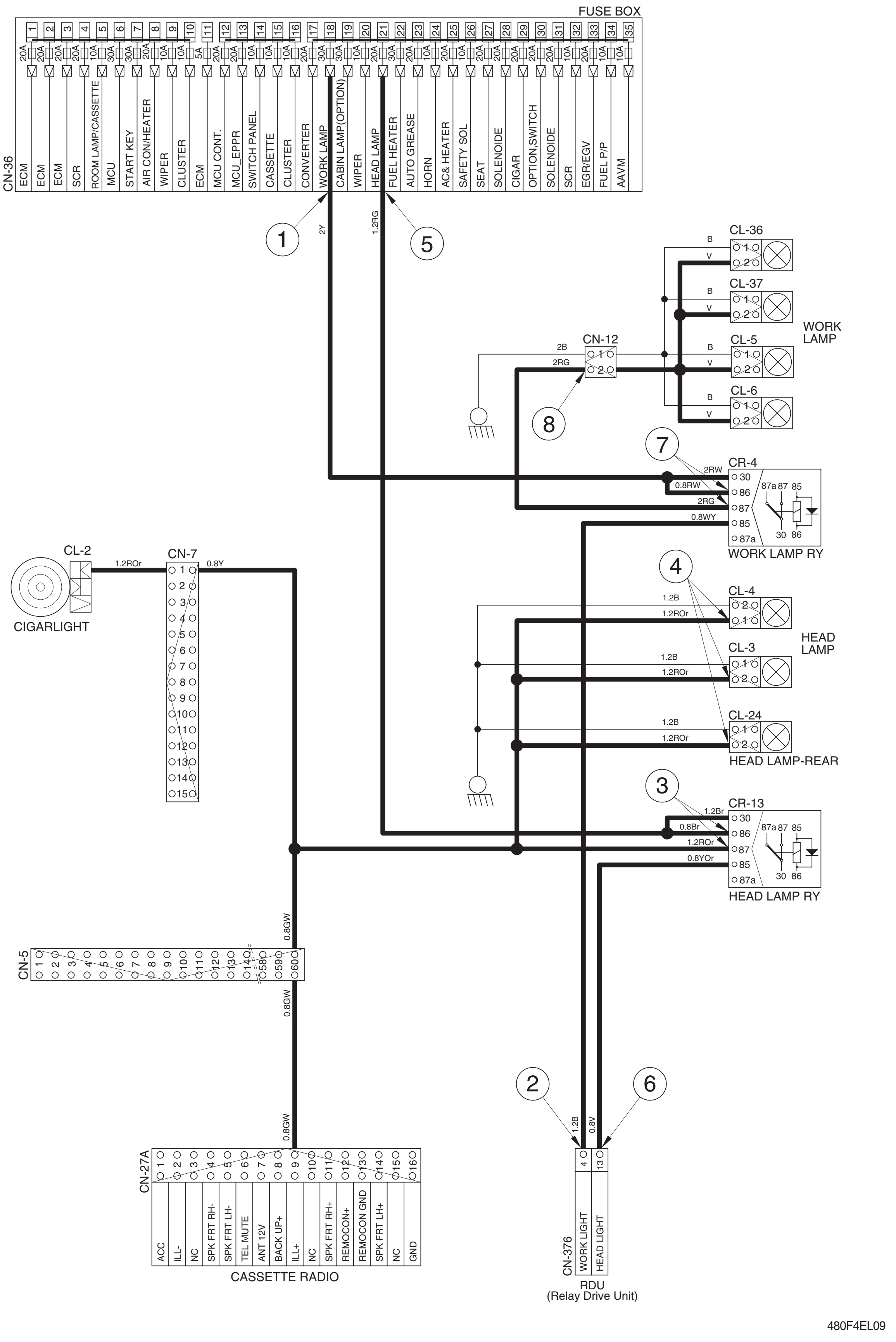
(2) Work light switch ON

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

2) CHECK POINT

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

※ GND : Ground


FUSE BOX
CN-36
ECM
ECM
ECM
SCR
ROOM LAMP/CASSETTE
MCU
START KEY
AIR CON/HEATER
WIPER
CLUSTER
ECM
MCU CONT.
MCU_EPPR
SWITCH PANEL
CASSETTE
CLUSTER
CONVERTER
WORK LAMP
CABIN LAMP(OPTION)
WIPER
HEAD LAMP
FUEL HEATER
AUTO GREASE
HORN
AC& HEATER
SAFETY SOL
SEAT
SOLENOIDE
CIGAR
OPTION,SWITCH
SOLENOIDE
SCR
EGR/EGV
FUEL P/P
AAVM
CL-36
CL-37
CL-5
CL-6
WORK LAMP
CN-12
CR-4
WORK LAMP RY
CL-2
CN-7
CIGARLIGHT
CL-4
CL-3
CL-24
HEAD LAMP
HEAD LAMP-REAR
CR-13
HEAD LAMP RY
CN-5
CN-27A
ACC
ILL-
NC
SPK FRT RH-
SPK FRT LH-
TEL MUTE
ANT 12V
BACK UP+
ILL+
NC
SPK FRT RH+
REMOCON+
REMOCON GND
SPK FRT LH+
NC
GND
CASSETTE RADIO
CN-376
WORK LIGHT
HEAD LIGHT
RDU
(Relay Drive Unit)
480F4EL09

1) OPERATING FLOW

Fuse box (No.21) → Head light relay [CR-13 (30, 86)]
Fuse box (No.18) → Work light relay [CR-4 (30, 86)]
Fuse box (No.14) → Relay drive unit [CN-376 (1)]

(1) Head light switch ON

Head light switch ON [CN-376 (13)] → Head light relay [CR-13 (85) → (87)]
→ Head light ON [CL-3 (2), CL-4 (1), CL-24 (2)]
→ I/conn [CN-7 (1)] → Cigar lighter [CL-2]
→ I/conn [CN-5 (60)] → Radio & USB player illumination ON [CN-27A (9)]
→ Hour meter [CN-48 (4)]

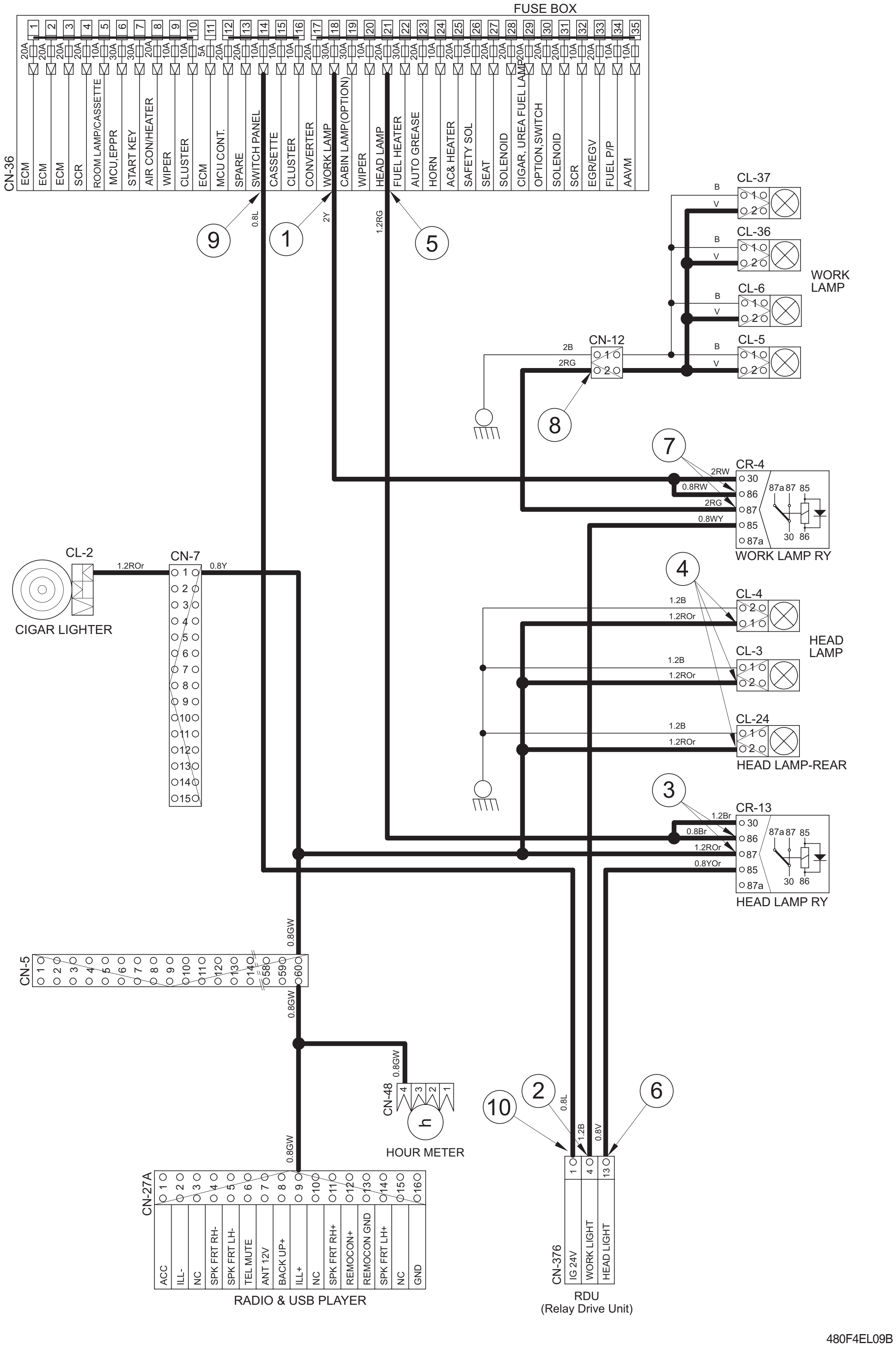
(2) Work light switch ON

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

2) CHECK POINT

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

※ GND : Ground


FUSE BOX
CN-36
ECM
SCR
ROOM LAMP/CASSETTE
MCU,EPPR
START KEY
AIR CON/HEATER
WIPER
CLUSTER
MCU CONT.
SPARE
SWITCH PANEL
CASSETTE
CONVERTER
WORK LAMP
CABIN LAMP(OPTION)
HEAD LAMP
FUEL HEATER
AUTO GREASE
HORN
AC& HEATER
SAFETY SOL
SEAT
SOLENOID
CIGAR, UREA FUEL LAMP
OPTION,SWITCH
EGR/EGV
FUEL P/P
AAVM
CL-37
CL-36
CL-6
CL-5
WORK LAMP
CN-12
CR-4
WORK LAMP RY
CL-2
CIGAR LIGHTER
CN-7
CL-4
CL-3
HEAD LAMP
CL-24
HEAD LAMP-REAR
CR-13
HEAD LAMP RY
CN-5
CN-48
HOUR METER
CN-27A
ACC
ILL-
NC
SPK FRT RH-
SPK FRT LH-
TEL MUTE
ANT 12V
BACK UP+
ILL+
SPK FRT RH+
REMOCON+
REMOCON GND
SPK FRT LH+
GND
RADIO & USB PLAYER
CN-376
IG 24V
WORK LIGHT
HEAD LIGHT
RDU
(Relay Drive Unit)
480F4EL09B

5. BEACON LAMP AND CAB LIGHT CIRCUIT OLD VERSION

1) OPERATING FLOW

Fuse box (No.30) → Beacon lamp relay [CR-36 (2, 3)]
Fuse box (No.19) → Cab light relay [CR-9 (30, 86)]

(1) Beacon lamp switch ON

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

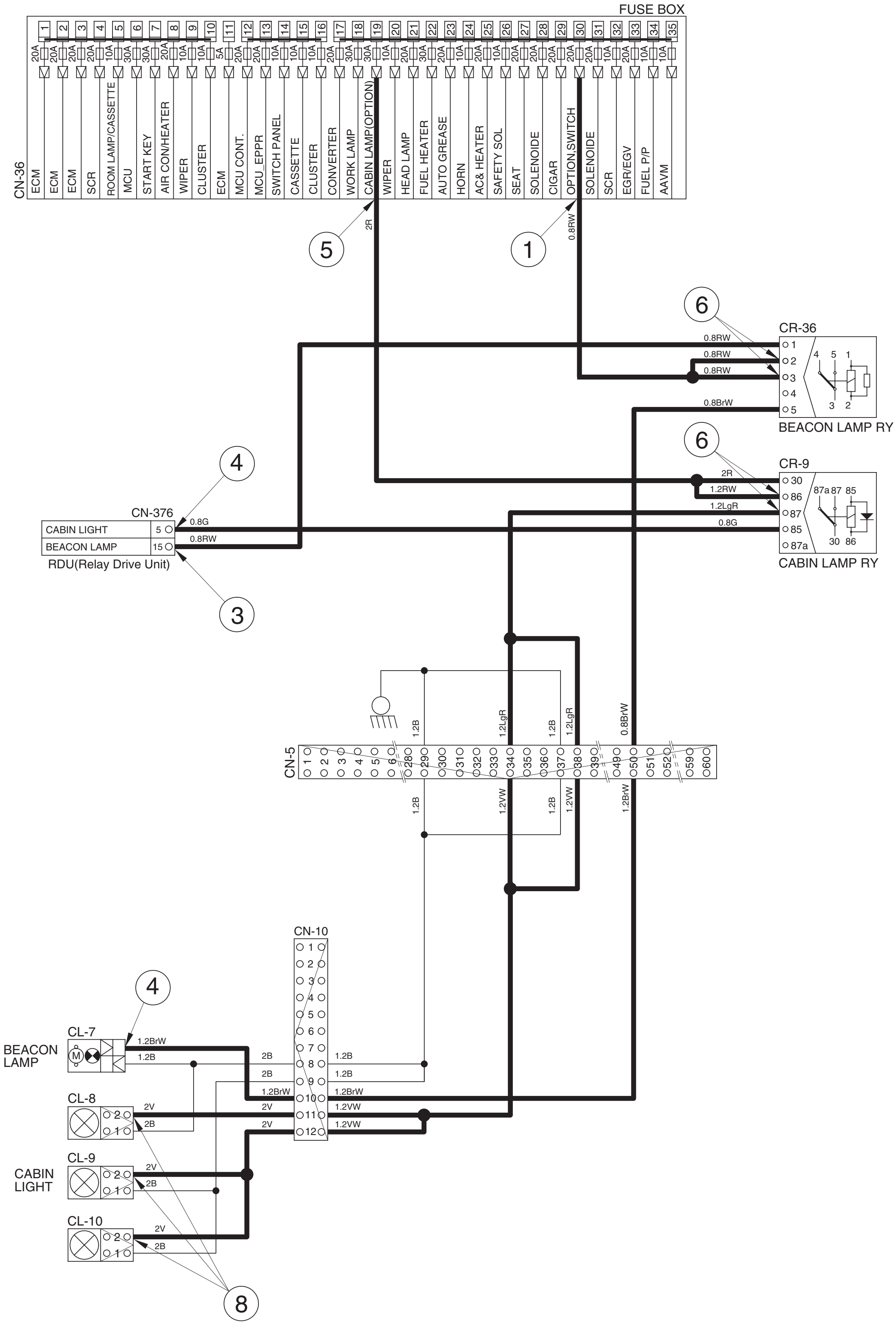
(2) Cab light switch ON

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

2) CHECK POINT

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

※ GND : Ground


FUSE BOX
CN-36
ECM
ECM
ECM
SCR
ROOM LAMP/CASSETTE
MCU
START KEY
AIR CON/HEATER
WIPER
CLUSTER
ECM
MCU CONT.
MCU_EPPR
SWITCH PANEL
CASSETTE
CLUSTER
CONVERTER
WORK LAMP
CABIN LAMP(OPTION)
WIPER
HEAD LAMP
FUEL HEATER
AUTO GREASE
HORN
AC& HEATER
SAFETY SOL
SEAT
SOLENOIDE
CIGAR
OPTION.SWITCH
SOLENOIDE
SCR
EGR/EGV
FUEL P/P
AAVM
CR-36
BEACON LAMP RY
CR-9
CABIN LAMP RY
CN-376
CABIN LIGHT
BEACON LAMP
RDU(Relay Drive Unit)
CN-5
CN-10
CL-7
BEACON LAMP
CL-8
CL-9
CABIN LIGHT
CL-10

480F4EL10

BEACON LAMP AND CAB LIGHT CIRCUIT   CURRENT VERSION

1) OPERATING FLOW

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

(1) Beacon lamp switch ON

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

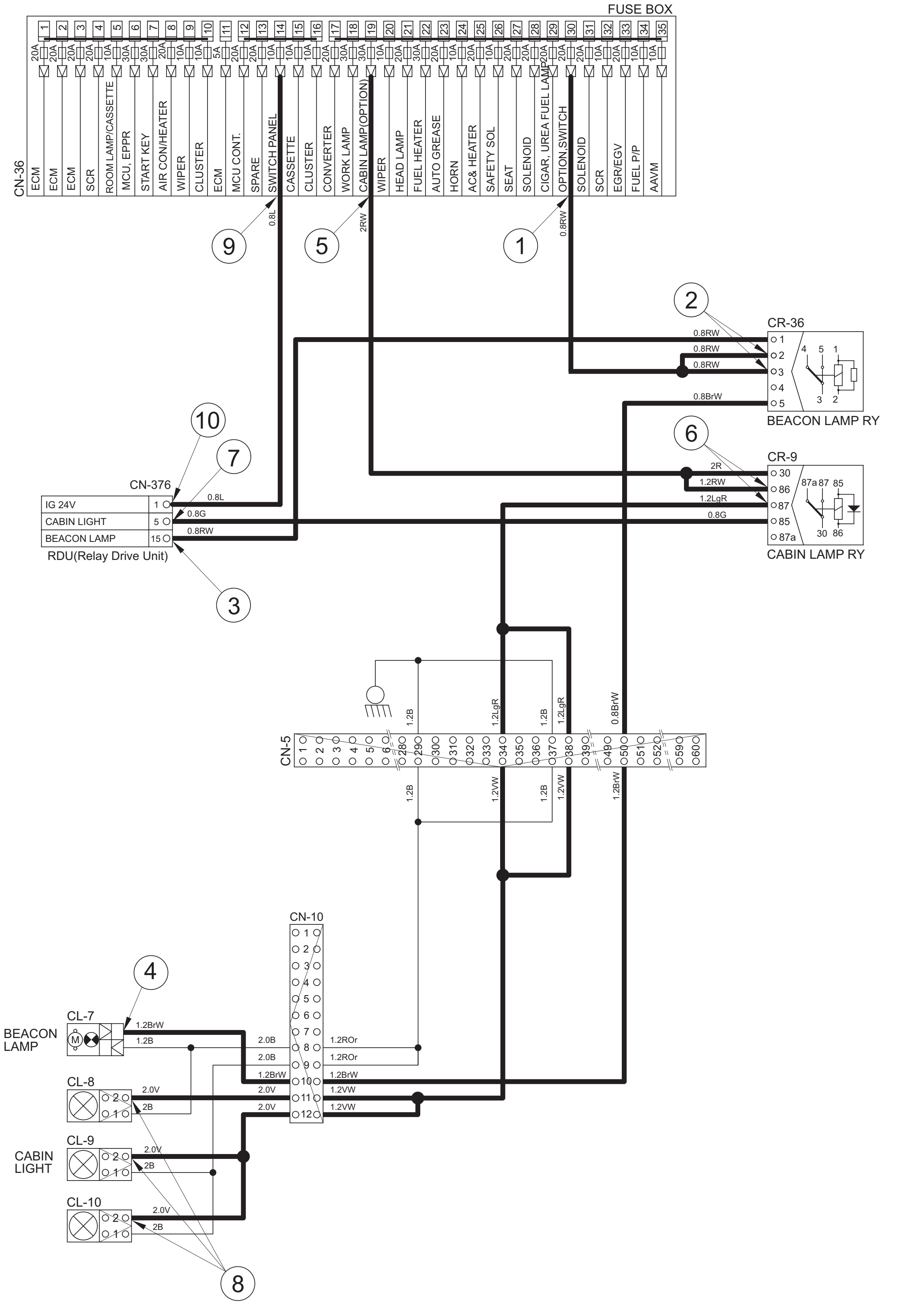
(2) Cab light switch ON

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

2) CHECK POINT

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

※ GND : Ground


FUSE BOX
CN-36
ECM
ECM
ECM
SCR
ROOM LAMP/CASSETTE
MCU, EPPR
START KEY
AIR CON/HEATER
WIPER
CLUSTER
ECM
MCU CONT.
SPARE
SWITCH PANEL
CASSETTE
CLUSTER
CONVERTER
WORK LAMP
CABIN LAMP(OPTION)
WIPER
HEAD LAMP
FUEL HEATER
AUTO GREASE
HORN
AC& HEATER
SAFETY SOL
SEAT
SOLENOID
CIGAR, UREA FUEL LAMP
OPTION,SWITCH
SOLENOID
SCR
EGR/EGV
FUEL P/P
AAVM
CR-36
BEACON LAMP RY
CR-9
CABIN LAMP RY
CN-376
IG 24V
CABIN LIGHT
BEACON LAMP
RDU(Relay Drive Unit)
CN-5
CN-10
CL-7
BEACON LAMP
CL-8
CL-9
CABIN LIGHT
CL-10
480F4EL10B

6. WIPER AND WASHER CIRCUIT

OLD VERSION

1) OPERATING FLOW

(1) Key switch ON

Fuse box (No.14) → RDU (Relay drive unit) [CN-376 (1)]
└→ Washer pump [CN-22 (2)]

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

Fuse box (No.20) → I/conn [CN-5 (16)] → I/conn [CN-17 (4)] → Wiper motor controller [CN-141 (6)]
└→ Wiper motor [CN-407 (3)]

(2) Wiper switch ON (Intermittent)

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

(3) Wiper switch ON (continual)

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

(4) Washer switch ON

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

(5) Auto parking (when switch OFF)

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

2) OPERATING FLOW (LOW WIPER)

(1) Key switch ON

Fuse box (No. 30) → I/conn [CN-7 (8)] → Low wiper switch [CS-79 (2, 5)]

(2) Wiper switch ON (1st)

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

(3) Wiper switch ON (2nd)

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

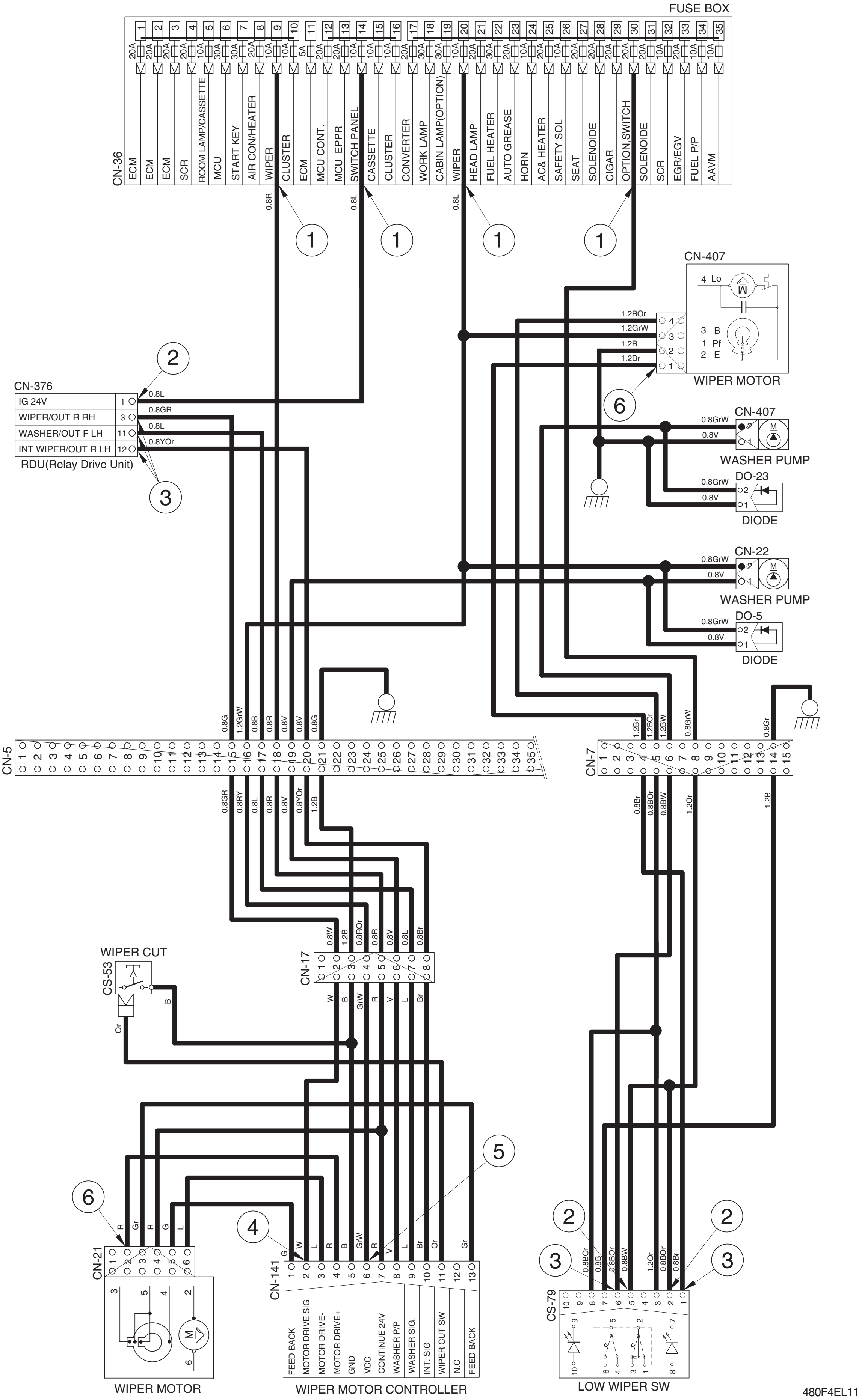
3) CHECK POINT

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

※ GND : Ground

WIPER AND WASHER CIRCUIT

OLD VERSION



WIPER AND WASHER CIRCUIT CURRENT VERSION

1) OPERATING FLOW

(1) Key switch ON

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

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

Fuse box (No.20) ┬→ I/conn [CN-5 (16)] → I/conn [CN-17 (4)] → Wiper motor controller [CN-141 (6)]
├→ Wiper motor [CN-407 (3)]
└→ Washer pump [CN-22 (2)]

(2) Intermittent wiper switch ON

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

(3) Wiper switch ON

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

(4) Washer switch ON

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

(5) Auto parking (when switch OFF)

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

2) OPERATING FLOW (LOW WIPER)

(1) Key switch ON

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

(2) Wiper switch ON (1st)

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

(3) Wiper switch ON (2nd)

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

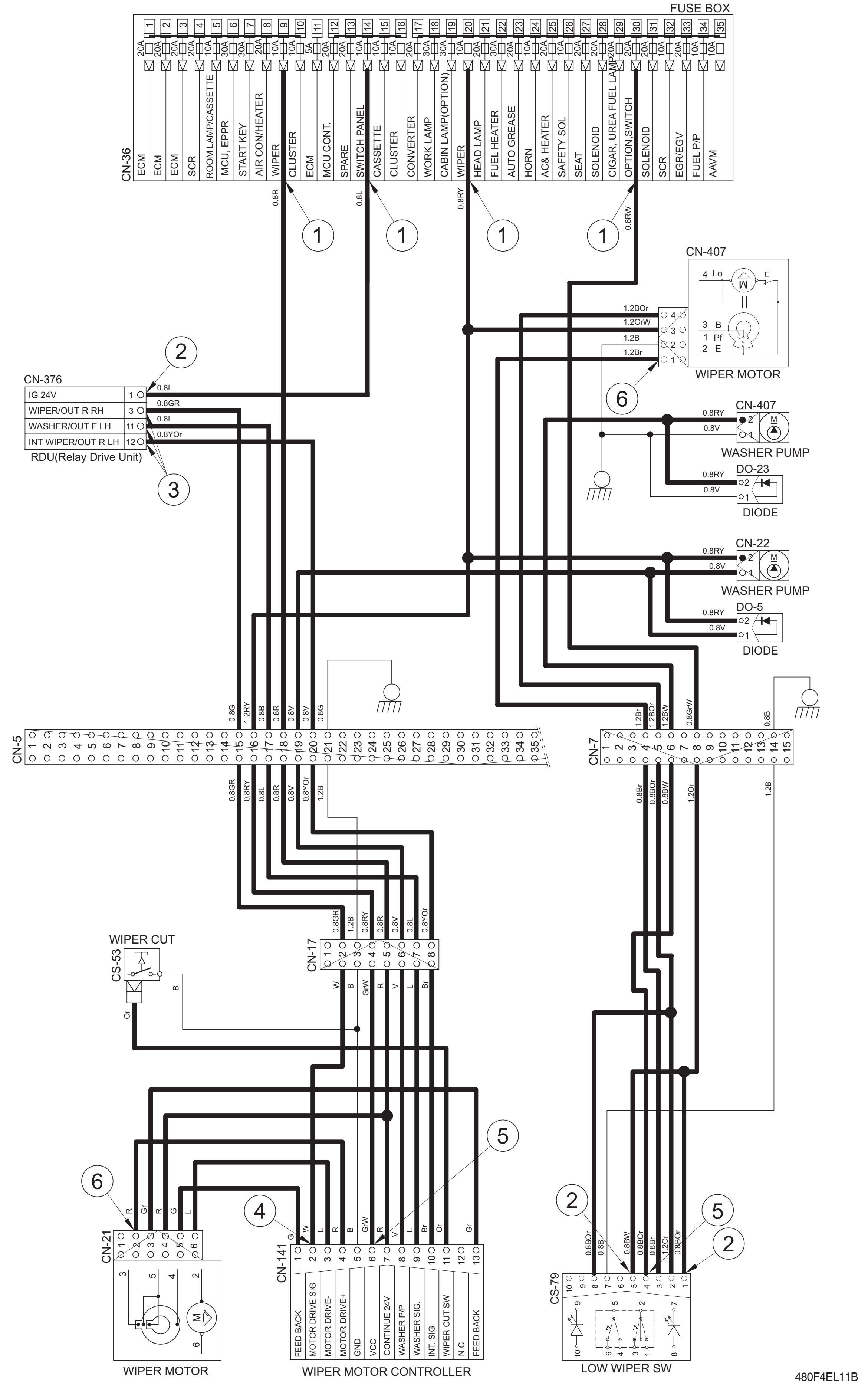
3) CHECK POINT

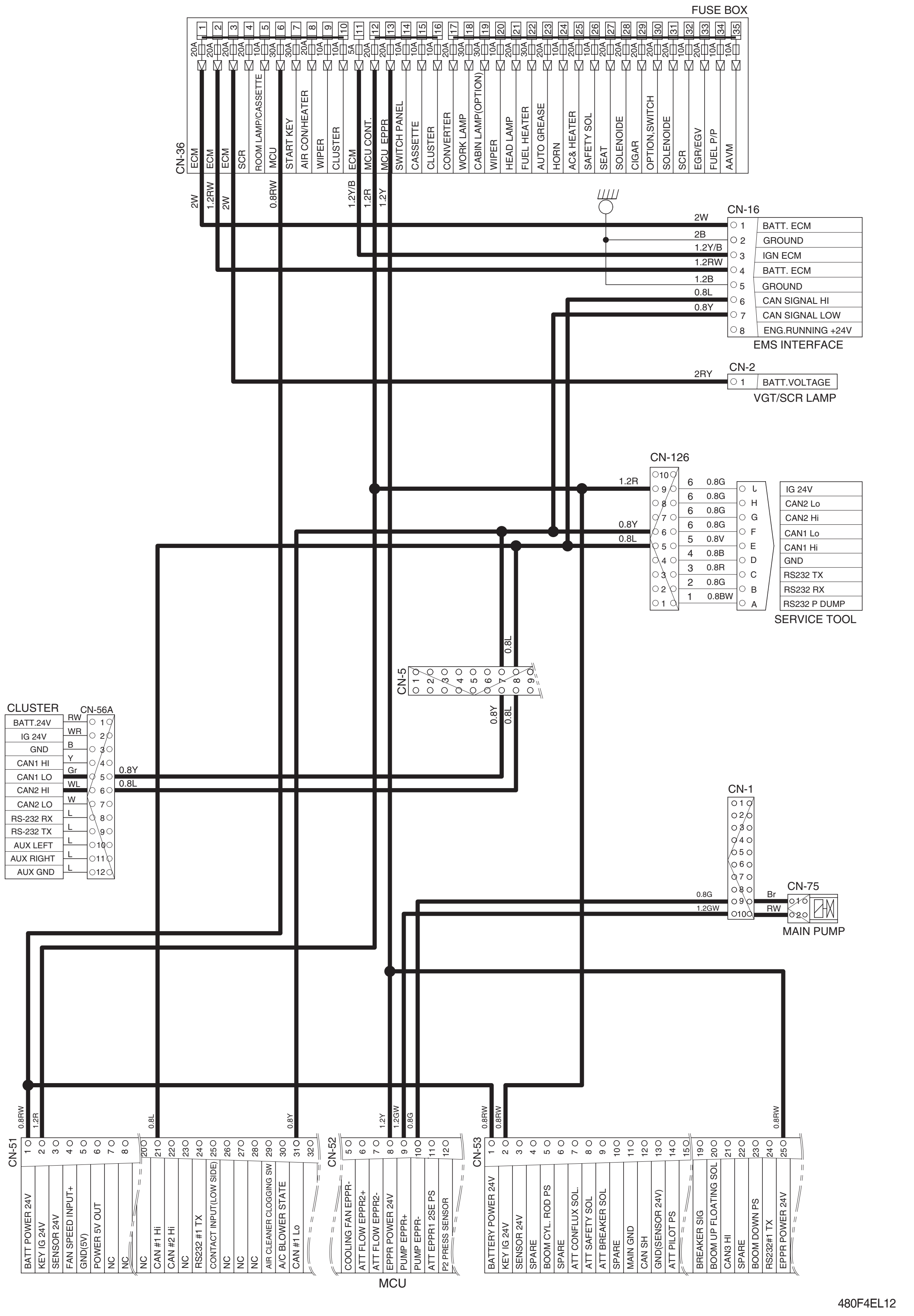
Engine	Start switch	Check point	Voltage
STOP	ON	① - GND (fuse box) ② - GND (switch power input)	20~25V
		③ - GND (switch power output) ④ - GND (wiper power input)	0 ~ 5V
		⑤ - GND (wiper power output)	24V
		⑥ - GND (wiper motor)	0 or 24V

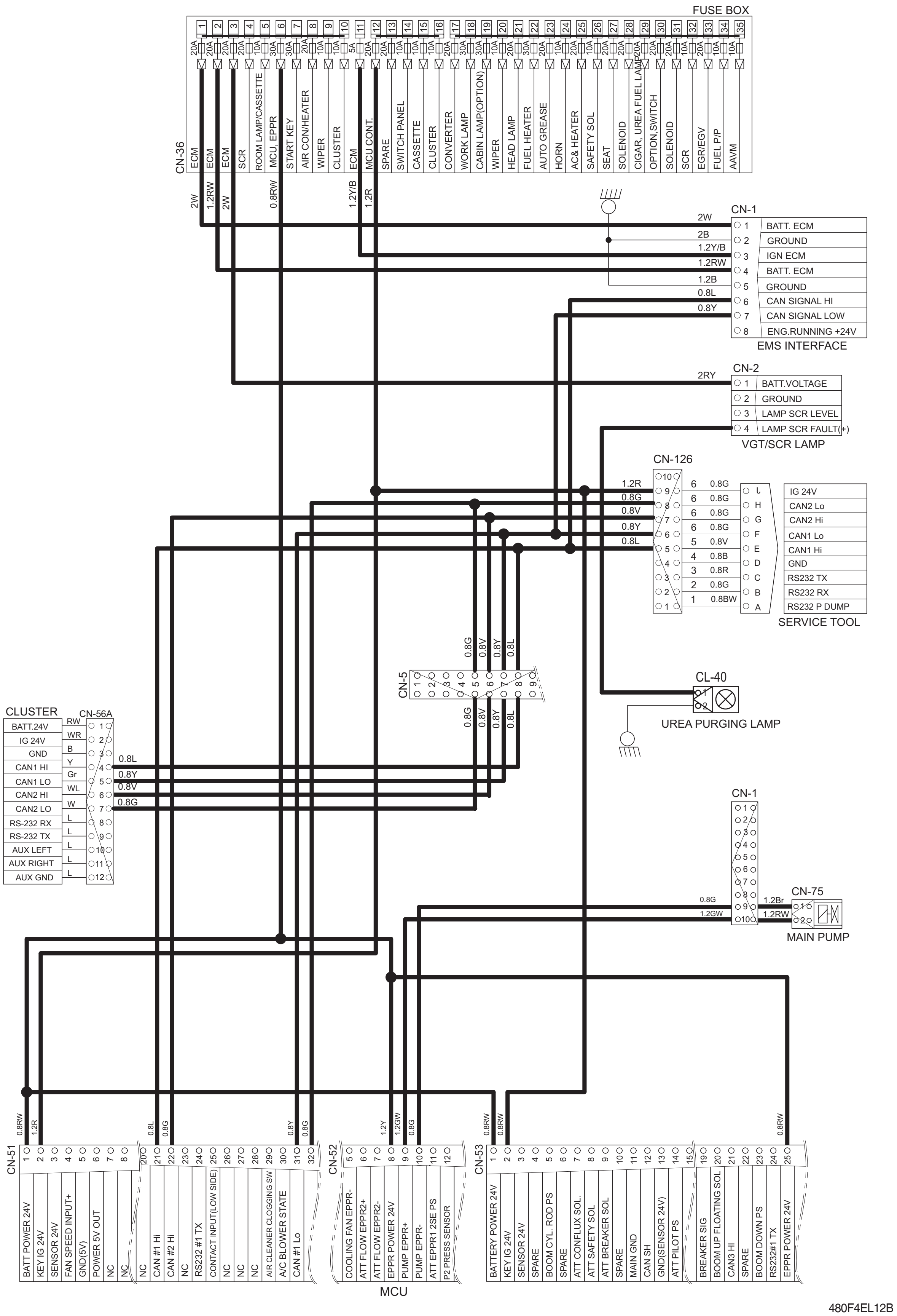
※ GND : Ground

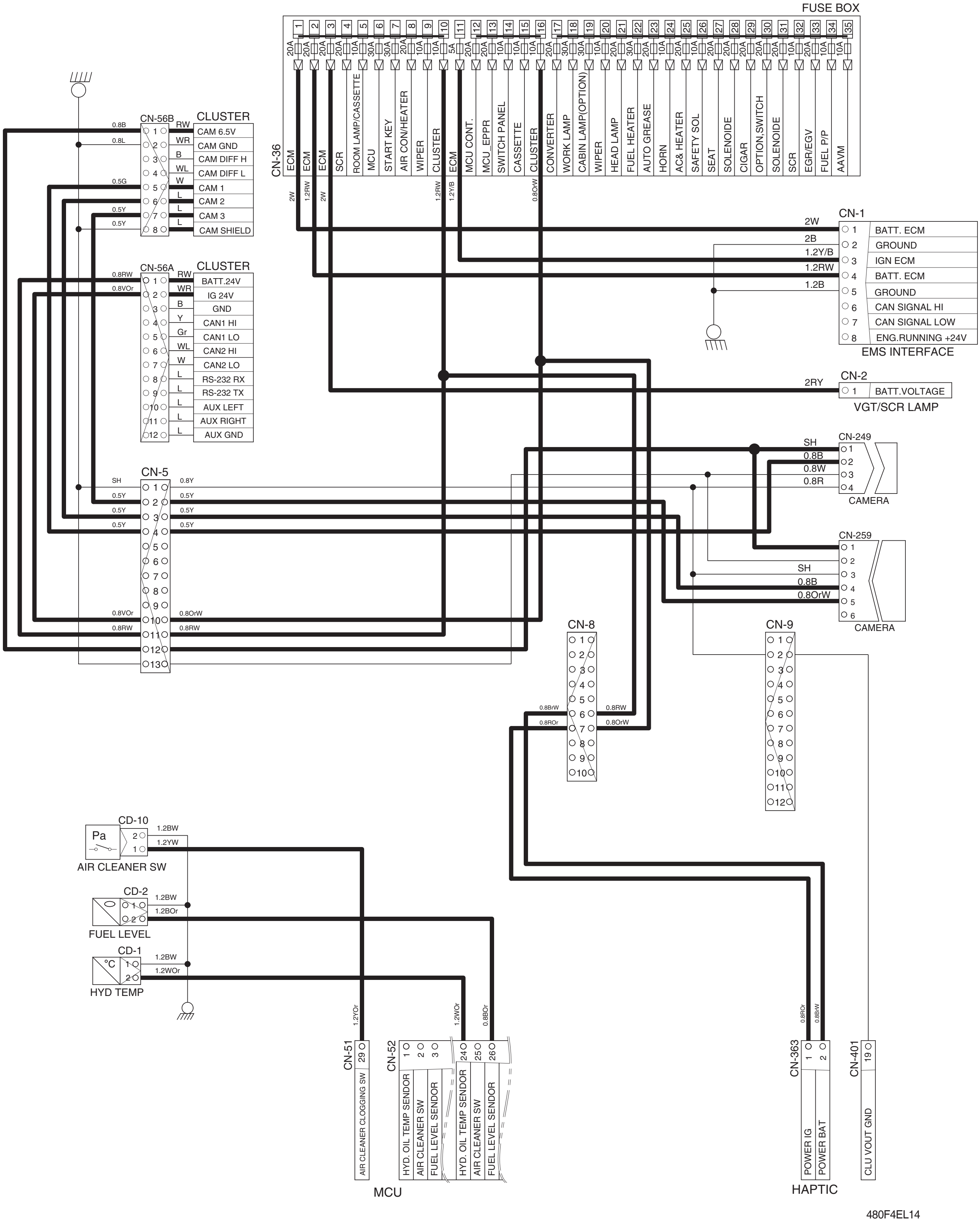
WIPER AND WASHER CIRCUIT

CURRENT VERSION



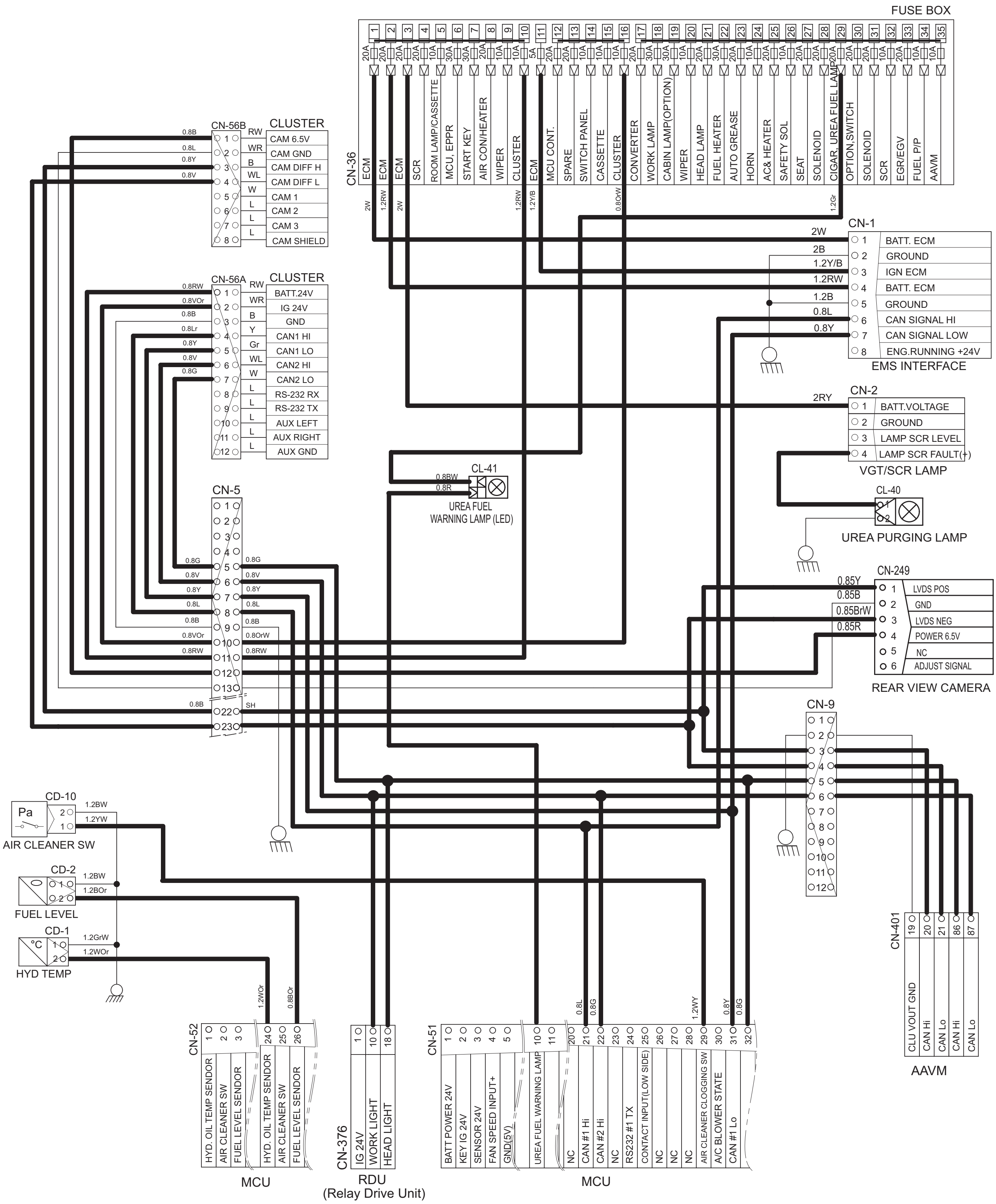

FUSE BOX
CN-36
CN-16
EMS INTERFACE
CN-2
VGT/SCR LAMP
CN-126
SERVICE TOOL
CN-5
CLUSTER
CN-56A
CN-1
CN-75
MAIN PUMP
CN-51
CN-52
CN-53
MCU
480F4EL12

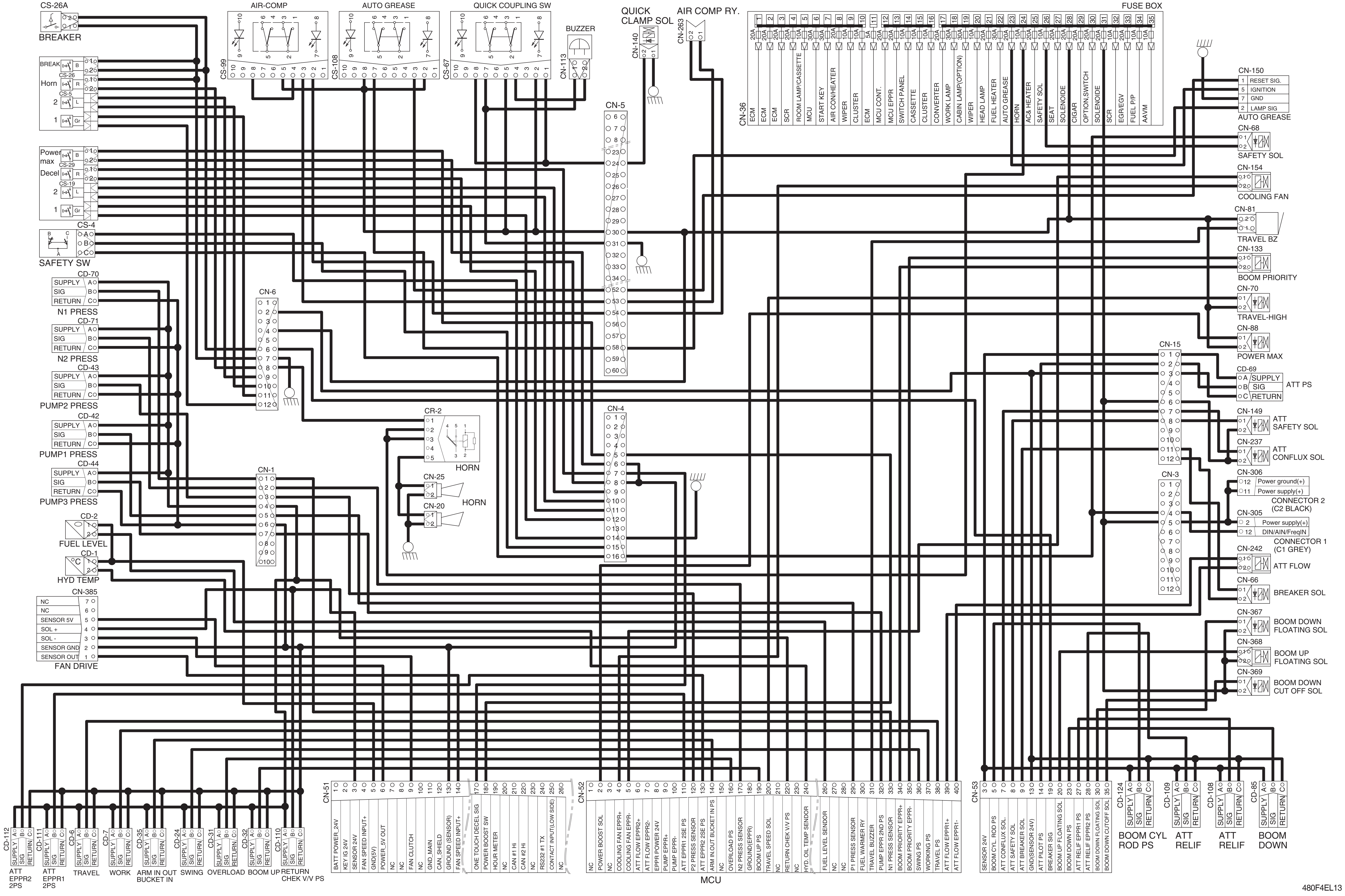

FUSE BOX
CN-36
CN-1
EMS INTERFACE
CN-2
VGT/SCR LAMP
CN-126
SERVICE TOOL
CN-5
CL-40
UREA PURGING LAMP
CLUSTER
CN-56A
CN-75
MAIN PUMP
CN-51
CN-52
CN-53
MCU
480F4EL12B


FUSE BOX
CN-36
ECM
ECM
ECM
SCR
ROOM LAMP/CASSETTE
MCU
START KEY
AIR CON/HEATER
WIPER
CLUSTER
ECM
MCU CONT.
MCU_EPPR
SWITCH PANEL
CASSETTE
CLUSTER
CONVERTER
WORK LAMP
CABIN LAMP(OPTION)
WIPER
HEAD LAMP
FUEL HEATER
AUTO GREASE
HORN
AC& HEATER
SAFETY SOL
SEAT
SOLENOIDE
CIGAR
OPTION,SWITCH
SOLENOIDE
SCR
EGR/EGV
FUEL P/P
AAVM
CN-56B
CLUSTER
CAM 6.5V
CAM GND
CAM DIFF H
CAM DIFF L
CAM 1
CAM 2
CAM 3
CAM SHIELD
CN-56A
CLUSTER
BATT.24V
IG 24V
GND
CAN1 HI
CAN1 LO
CAN2 HI
CAN2 LO
RS-232 RX
RS-232 TX
AUX LEFT
AUX RIGHT
AUX GND
CN-5
CN-1
BATT. ECM
GROUND
IGN ECM
BATT. ECM
GROUND
CAN SIGNAL HI
CAN SIGNAL LOW
ENG.RUNNING +24V
EMS INTERFACE
CN-2
BATT.VOLTAGE
VGT/SCR LAMP
CN-249
CAMERA
CN-259
CAMERA
CN-8
CN-9
CD-10
AIR CLEANER SW
CD-2
FUEL LEVEL
CD-1
HYD TEMP
CN-51
AIR CLEANER CLOGGING SW
CN-52
HYD. OIL TEMP SENDOR
AIR CLEANER SW
FUEL LEVEL SENDOR
MCU
CN-363
POWER IG
POWER BAT
HAPTIC
CN-401
CLU VOUT GND
480F4EL14

MONITORING CIRCUIT

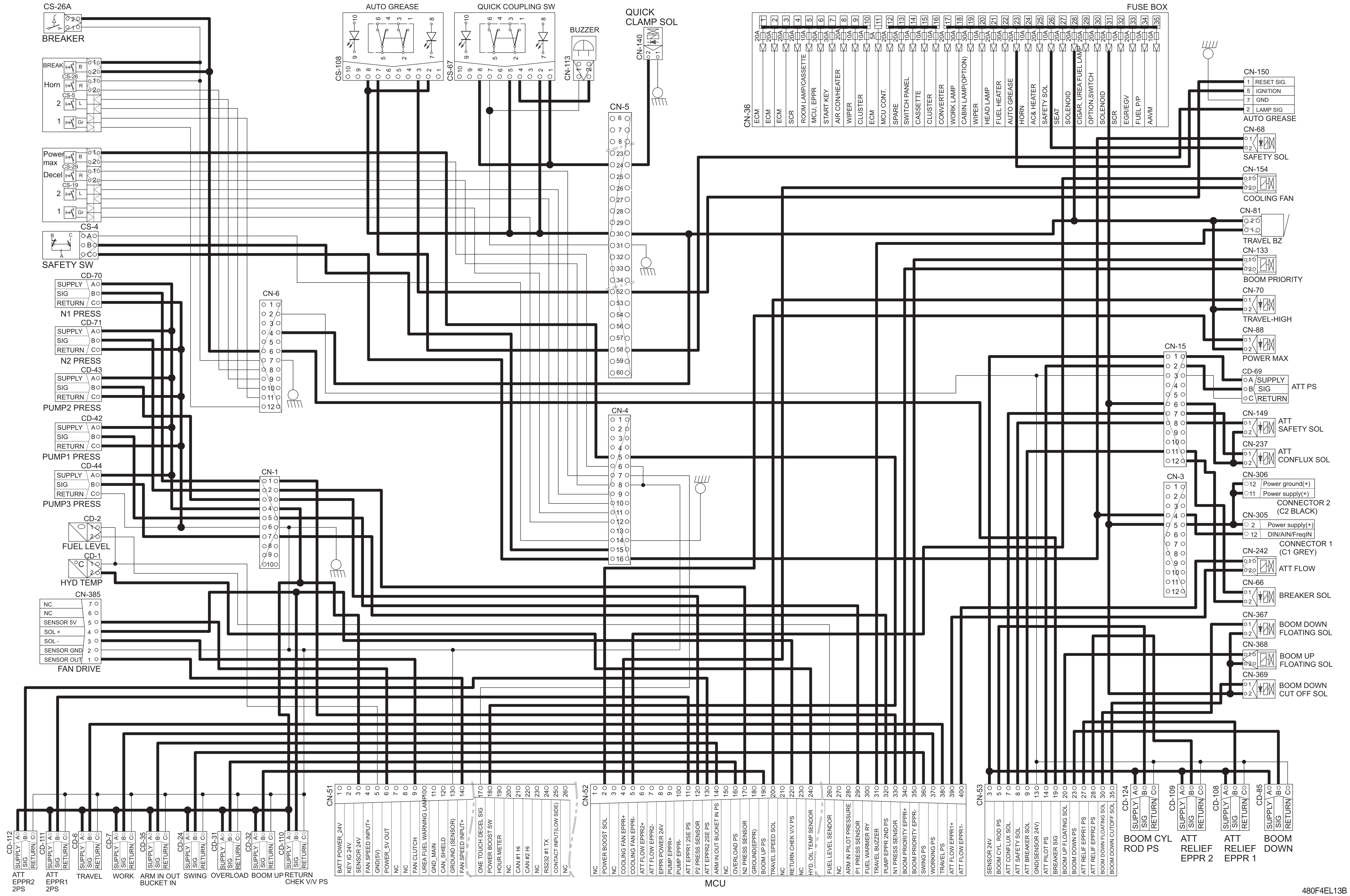
CURRENT VERSION



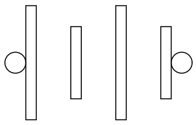
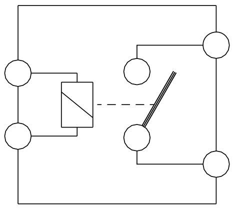
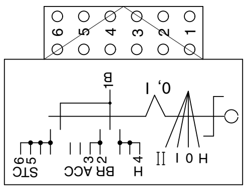
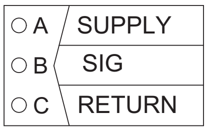
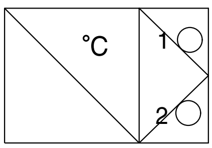
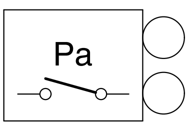

CS-26A
BREAKER
AIR-COMP
AUTO GREASE
QUICK COUPLING SW
BUZZER
QUICK CLAMP SOL
AIR COMP RY.
FUSE BOX
CS-99
CS-108
CS-67
CN-113
CN-140
CN-263
CN-36
CN-5
CN-150
RESET SIG.
IGNITION
GND
LAMP SIG
AUTO GREASE
CN-68
SAFETY SOL
CN-154
COOLING FAN
CN-81
TRAVEL BZ
CN-133
BOOM PRIORITY
CN-70
TRAVEL-HIGH
CN-88
POWER MAX
CN-15
CD-69
ATT PS
CN-149
ATT SAFETY SOL
CN-237
ATT CONFLUX SOL
CN-306
Power ground(+)
Power supply(+)
CONNECTOR 2 (C2 BLACK)
CN-305
DIN/AIN/FreqIN
CONNECTOR 1 (C1 GREY)
CN-242
ATT FLOW
CN-66
BREAKER SOL
CN-367
BOOM DOWN FLOATING SOL
CN-368
BOOM UP FLOATING SOL
CN-369
BOOM DOWN CUT OFF SOL
CN-3
Horn
CS-26
CS-5
Power max
Decel
CS-29
CS-19
CS-4
SAFETY SW
CD-70
N1 PRESS
CD-71
N2 PRESS
CD-43
PUMP2 PRESS
CD-42
PUMP1 PRESS
CD-44
PUMP3 PRESS
SUPPLY
SIG
RETURN
CN-6
CN-4
CR-2
HORN
CN-25
CN-20
CN-1
CD-2
FUEL LEVEL
CD-1
HYD TEMP
CN-385
NC
SENSOR 5V
SOL +
SOL -
SENSOR GND
SENSOR OUT
FAN DRIVE
CD-112
ATT EPPR2 2PS
CD-111
ATT EPPR1 2PS
CD-6
TRAVEL
CD-7
WORK
CD-35
ARM IN OUT BUCKET IN
CD-24
SWING
CD-31
OVERLOAD
CD-32
BOOM UP
CD-110
RETURN CHEK V/V PS
CN-51
CN-52
CN-53
MCU
CD-124
BOOM CYL ROD PS
CD-109
ATT RELIF
CD-108
ATT RELIF
CD-85
BOOM DOWN
480F4EL13

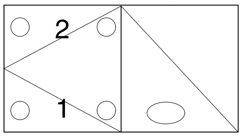
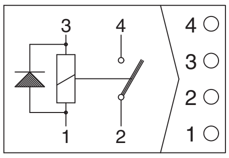
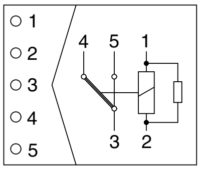
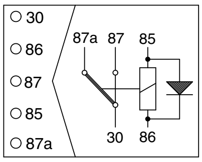
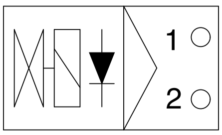
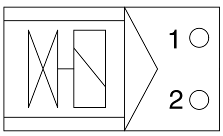
ELECTRIC CIRCUIT FOR HYDRAULIC

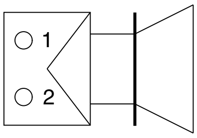
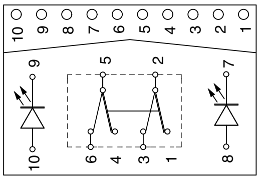
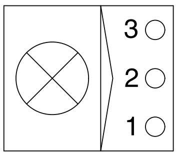
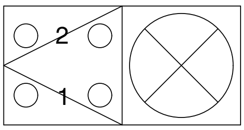
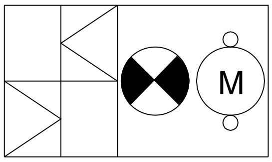
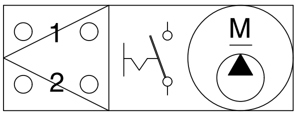
CURRENT VERSION

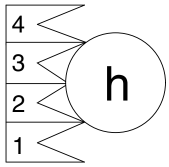
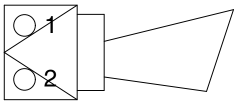
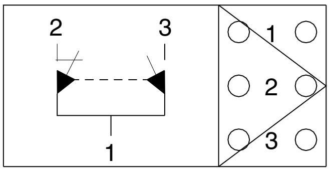
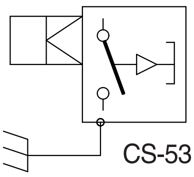
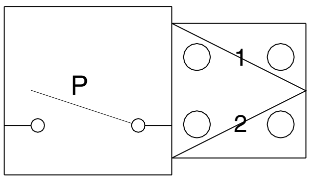
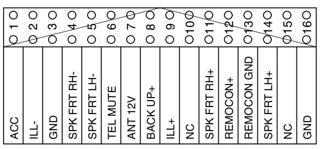


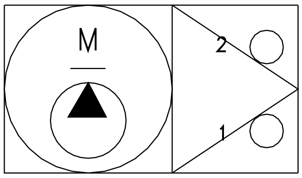
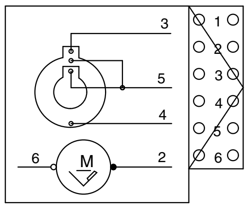
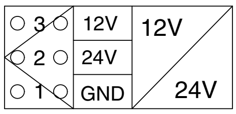
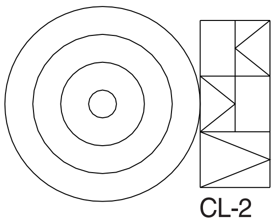
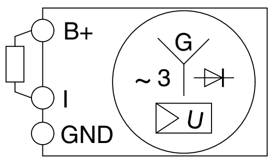
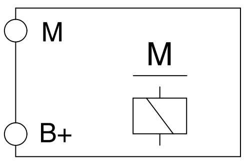
GROUP 3 ELECTRICAL COMPONENT SPECIFICATION

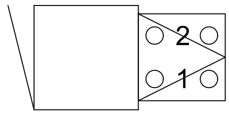
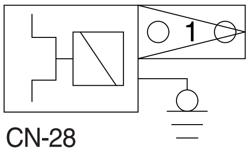
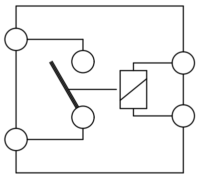
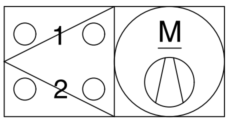
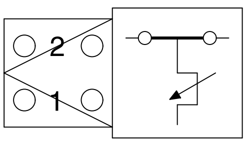
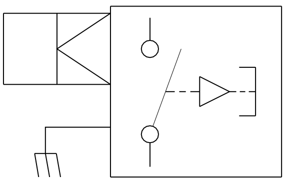
Part name	Symbol	Specifications	Check
Battery		12V × 160Ah (2EA)	※ Check specific gravity 1.280 over : Over charged 1.280 ~ 1.250 : Normal 1.250 below : Recharging
Battery relay	 CR-1	Rated load : 24V 100A (continuity) 1000A (30seconds)	※ Check coil resistance(M4 to M4) Normal : About 50 Ω ※ Check contact Normal : ∞ Ω
Start key	 CS-2A	B-BR : 24V 1A B-ACC : 24V 10A B-ST : 24V 40A	※ Check contact OFF : ∞ Ω (for each terminal) ON : 0 Ω (for terminal 1-3 and 1-2) START : 0 Ω (for terminal 1-5)
Pressure sensor	 CD-6 CD-7 CD-24 CD-31 CD-32 CD-35 CD-42 CD-43 CD-44 CD-69 CD-70 CD-71 CD-85 CD-108 CD-109 CD-110 CD-111 CD-112 CD-124	8~30V	※ Check contact Normal : 0.1 Ω
Temperature sensor (hydraulic)	 CD-1	-	※ Check resistance 50°C : 804 Ω 80°C : 310 Ω 100°C : 180 Ω
Air cleaner pressure switch	 CD-10	(N.O TYPE)	※ Check contact High level : ∞ Ω Low level : 0 Ω

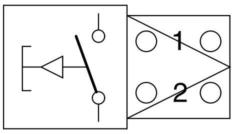
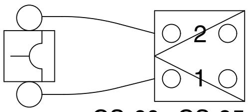
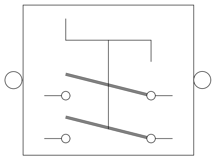
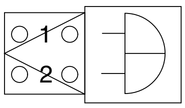
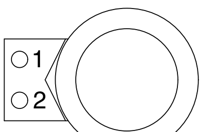
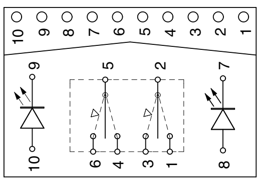
Part name	Symbol	Specifications	Check
Fuel sender	 CD-2	-	※ Check resistance Full : 50 Ω　6/12 : 350 Ω 11/12 : 100 Ω　5/12 : 400 Ω 10/12 : 150 Ω　4/12 : 450 Ω 9/12 : 200 Ω　3/12 : 500 Ω 8/12 : 250 Ω　2/12 : 550 Ω 7/12 : 300 Ω　1/12 : 600 Ω Empty warning : 700 Ω
Relay (air con blower)		24V 20A	※ Check resistance Normal : About 200 Ω (for terminal 1-3) 0 Ω (for terminal 2-4)
Relay	 CR-2 CR-5 CR-36	24V 16A	※ Check resistance Normal : About 160 Ω (for terminal 1-2) 0 Ω (for terminal 3-4) ∞ Ω (for terminal 3-5)
Relay	 CR-4 CR-7 CR-9 CR-13 CR-35 CR-46	24V 16A	※ Check resistance Normal : About 160 Ω (for terminal 85-86) 0 Ω (for terminal 30-87a) ∞ Ω (for terminal 30-87)
Solenoid valve	 CN-66 CN-70 CN-88 CN-140 CN-149 CN-237 CN-367 CN-368 CN-369	24V 1A	※ Check resistance Normal : 15~25 Ω (for terminal 1-2)
EPPR valve	 CN-75 CN-133 CN-154 CN-242 CN-309 CN-310 CN-365 CN-366 CN-378	700mA	※ Check resistance Normal : 15~25 Ω (for terminal 1-2)

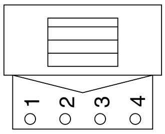
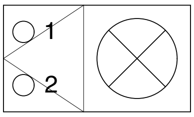
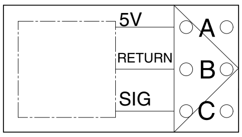
Part name	Symbol	Specifications	Check
Speaker	 CN-23(LH) CN-24(RH)	20W	※ Check resistance Normal : A few Ω
Switch (locking type)	 CS-50 CS-67 CS-83 CS-99 CS-107 CS-108 CS-111	24V 1.5A	※ Check contact Normal ON : 0 Ω (for terminal 3-7, 4-8) ∞ Ω (for terminal 7-9, 8-10) OFF : ∞ Ω (for terminal 3-7, 4-8) 0 Ω (for terminal 7-9, 8-10)
Room lamp	 CL-1	24V 10W	※ Check disconnection Normal : 1.0 Ω ON : 0 Ω (For terminal 1-2) ∞ Ω (For terminal 1-3) OFF : ∞ Ω (For terminal 1-2) 0 Ω (For terminal 1-3)
Head lamp, Work lamp, Cab lamp	 CL-3 CL-4 CL-5 CL-6 CL-8 CL-9 CL-10 CL-24 CL-36 CL-37	24V 65W (H3 Type)	※ Check disconnection Normal : 1.2 Ω
Beacon lamp	 CL-7	21V 70W (H1 Type)	※ Check disconnection Normal : A few Ω
Fuel filler pump	 CN-61	24V 10A 35 *l* /min	※ Check resistance Normal : 1.0 Ω

Part name	Symbol	Specifications	Check
Hour meter	 CN-48	16~32V	※ Check operation Supply power(24V) to terminal No.2 and connect terminal No.1 and ground
Horn	 CN-20 CN-25	DC22~28V 2A	※ Check operation Supply power(24V) to each terminal and connect ground.
Safety switch	 CS-4	24V 15A (N.C TYPE)	※ Check contact Normal : 0 Ω (for terminal 1-2) ∞ Ω (for terminal 1-3) Operating : ∞ Ω (for terminal 1-2) 0 Ω (for terminal 1-3)
Wiper cut switch	 CS-53	24V (N.O TYPE)	※ Check contact Normal : 0 Ω (one pin to ground)
Receiver dryer	 CN-29	24V 2.5A	※ Check contact Normal : ∞ Ω
Radio & USB player	 CN-27	24V 2A	※ Check voltage 20~25V (for terminal 1-3, 3-8)

Part name	Symbol	Specifications	Check
Washer pump	 CN-22 CN-407	24V 3.8A	※ Check contact Normal : 10.7 Ω (for terminal 1-2)
Wiper motor	 CN-21	24V 2A	※ Check disconnection Normal : 7 Ω (for terminal 2-6)
DC/DC Converter	 CN-138	12V 3A	※ Check voltage 24V (for terminal 1-2) 12V (for terminal 1-3)
Cigar lighter	 CL-2	24V 5A 1.4W	※ Check coil resistance Normal : About 1M Ω ※ Check contact Normal : ∞ Ω Operating time : 5~15sec
Alternator	 CN-74	Delco Remy 24V 100A	※ Check contact Normal : 0 Ω (for terminal B^{+}-I) Normal : 24~27.5V
Starter	 CN-45	Denso 24V 5.5kW	※ Check contact Normal : 0.1 Ω

Part name	Symbol	Specifications	Check
Travel alarm	 CN-81	24V 0.5A	※ Check contact Normal : 5.2 Ω
Aircon compressor	 CN-28	24V 79W	※ Check contact Normal : 13.4 Ω
Start relay	 CR-23	24V 300A	※ Check contact Normal : 0.94 Ω (for terminal 1-2)
Blower motor		24V 9.5A	※ Check resistance Normal : 2.5 Ω (for terminal 1-2)
Duct sensor (switch)		1˚C OFF 4˚C ON	※ Check resistance Normal : 0 Ω (for terminal 1-2), the atmosphere temp : Over 4˚C
Door switch	 CS-1	24V 2W	※ Check resistance Normal : About 5M Ω

Part name	Symbol	Specifications	Check
Switch (power max, one touch decel, horn, breaker)	 CS-5 CS-19 CS-26 CS-29	24V 6A	※ Check resistance Normal : ∞ Ω
Circuit breaker	 CS-60 CS-95	60A	※ Check disconnection Normal : 0 Ω (connect ring terminal and check resist between terminal 1 and 2)
Master switch	 CS-74A, CS-74B	6-36V	※ Check disconnection Normal : 0.1 Ω
Quick clamp buzzer	 CN-113	24V 200mA 107±4dB	
Socket	 CN-139	12V 10A	
Switch	 CS-73 CS-79 CS-100	24V 8A	※ Check contact Normal ON : 0 Ω (for terminal 3-7, 4-8) ∞ Ω (for terminal 7-9, 8-10) OFF : ∞ Ω (for terminal 3-7, 4-8) 0 Ω (for terminal 7-9, 8-10)

Part name	Symbol	Specifications	Check
Fuel heater	 CN-147	-	
DEF/AdBlue® fill up warning lamp (LED)	 CL-40	-	
Proportional valve sensor	 CN-246 CN-247	-	

GROUP 4 CONNECTORS

1. CONNECTOR DESTINATION

Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CN-1	AMP	10	I/conn (Frame harness-Pump PS harness)	S816-010002	S816-110002
CN-2	DEUTSCH	4	I/conn (Frame harness-Engine harness)	DT06-4S-EP06	DT06-4P-E005
CN-3	DEUTSCH	6	I/conn (Frame harness-Engine harness)	DT06-4S-EP06	DT06-4P-E005
CN-4	AMP	16	I/conn (Console harness LH-Frame harness)	368047-1	368050-1
CN-5	DEUTSCH	60	I/conn (Side harness RH-Frame harness)	DRB16-60SAE-L018	DRB12-60P-L018
CN-6	AMP	16	I/conn (Console harness RH-Frame harness)	368047-1	368050-1
CN-7	AMP	15	I/conn (Console harness RH-Frame harness)	2-85262-1	368301-1
CN-8	AMP	10	I/conn (Console harness RH-Frame harness)	S816-010002	S816-110002
CN-9	DEUTSCH	12	I/conn (AAVM harness-Frame harness)	DT06-12SA-P021	DT04-12PA-P021
CN-10	DEUTSCH	12	I/conn (Cab harness-Side harness RH)	DT06-12S-EP06	DT04-12PA-P021
CN-11	DEUTSCH	8	I/conn (Frame harness-Aircon harness)	DT06-8S-EP06	-
CN-12	DEUTSCH	2	I/conn (Frame harness-Boom wire harness)	DT06-2S-EP06	DT04-2P-E005
CN-15	AMP	12	I/conn (Frame harness-Breaker sol)	S816-012002	S816-112002
CN-16	DEUTSCH	8	I/conn (Frame harness-Engine harness)	DT06-8S-EP06	-
CN-17	AMP	8	I/conn (Wiper harness-Side harness RH)	S816-008002	S816-108002
CN-20	DEUTSCH	2	Horn	DT06-2S-EP06	DT04-2P-E005
CN-21	AMP	6	Wiper motor	S810-006202	-
CN-22	KET	2	Washer pump	MG640605	-
CN-23	KET	2	Speaker-LH	MG610070	-
CN-24	KET	2	Speaker-RH	MG610070	-
CN-25	DEUTSCH	2	Horn	DT06-2S-EP06	-
CN-27A	KUM	16	Radio & USB player	PK145-16017	-
CN-27B	AMP	8	Radio & USB player	-	174984-2
CN-28	DEUTSCH	2	Aircon compressor	-	DT04-2P-E005
CN-29	KET	2	Receiver dryer	MG640795	-
CN-36	-	-	Fuse & relay box	21Q7-10910	-
CN-45	RING-TERM	-	Starter motor B^+	S820-108000	-
CN-48	KET	1	Hour meter	2-520193-2	-
CN-51	DEUTSCH	40	MCU	DRC26-40SA	-
CN-52	DEUTSCH	40	MCU	DRC26-40SB	-
CN-53	DEUTSCH	40	MCU	DRC26-40SC	-
CN-56A	AMP	12	Cluster	-	174663-2
CN-56B	AMP	8	Cluster	-	174984-2
CN-60	YAZAKI	4	Circuit breaker	-	7222-4220-30
CN-61	DEUTSCH	2	Fuel filler pump	DT06-2S-EP06	DT04-2P-E005

Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CN-66	DEUTSCH	2	Breaker solenoid	DT06-2S-EP06	-
CN-68	DEUTSCH	2	Safety solenoid	DT06-2S-EP06	-
CN-70	DEUTSCH	2	Travel high solenoid	DT06-2S-EP06	-
CN-74	RING-TERM	1	Alternator "I" terminal	S820-108000	-
CN-75	AMP	2	Pump EPPR	S816-002002	-
CN-81	DEUTSCH	2	Travel buzzer solenoid	DT06-2S-EP06	-
CN-88	DEUTSCH	2	Power max solenoid	DT06-2S-EP06	-
CN-95	YAZAKI	2	Circuit breaker	-	7222-4220-30
CN-113	KET	2	Buzzer	MG651205-5	-
CN-125	Econoseal J	4	RMS connector	S816-004002	S816-104002
CN-125A	DEUTSCH	12	RMS	DT06-12S-P021	DT04-12PA-P021
CN-126	AMP	10	Service tool	S816-010002	S816-110002
CN-133	DEUTSCH	2	Boom priority solenoid	DT06-2S-EP06	-
CN-138	FASTEN	3	DC/DC Converter	S810-003202	-
CN-139	FASTEN	2	12V socket	172434-2	-
CN-140	DEUTSCH	2	Quick clamp solenoid	DT06-2S-EP06	DT04-2P-E005
CN-141	AMP	13	Wiper motor controller	172498-1	-
CN-147	DEUTSCH	4	Fuel heater	DT06-2S-E003	-
CN-149	DEUTSCH	2	Attach safety solenoid	DT06-2S-EP06	-
CN-150	AMP	4	Auto grease	S816-004002	S816-104002
CN-154	DEUTSCH	2	Cooling fan	DT06-2S-EP06	DT04-2P-E005
CN-156	DEUTSCH	2	Air seat	DT06-2S-EP06	DT04-2P-E005
CN-157	AMP	1	Antena power	S822-014002	-
CN-237	DEUTSCH	2	Attach conflux solenoid	DT06-2S-EP06	-
CN-242	DEUTSCH	2	Attach EPPR 1	DT06-2S-EP06	-
CN-245	-	4	PTC power	4-1437290-1	-
CN-246	DEUTSCH	3	Proportional valve-RH	DT06-3S	DT04-3P
CN-247	DEUTSCH	3	Proportional valve-LH	DT06-3S	DT04-3P
CN-249	DEUTSCH	4	Rear view camera	DT06-4S-EP06	DT04-4P-E005
CN-258	KET	1	Air compressor power	MG640944-5	MG650943-5
CN-259	DEUTSCH	6	Camera	DT06-6S-EP06	DT04-6P-E005
CN-263	DEUTSCH	2	Air compressor relay	DT06-2S-EP06	DT04-2P-E005
CN-305	DEUTSCH	12	Proportional-Connector-1	DTM06-12SA	-
CN-306	DEUTSCH	12	Proportional-Connector-2	DTM06-12SB	-
CN-307	DEUTSCH	3	Proportional-Service tool	DT06-3S-E005	DT06-3P-EP06
CN-308	AMP	4	Proportional-PVG32	2-967056-1	-
CN-309	DEUTSCH	2	Proportional-EPPR valve-A1	DT06-2S-EP06	-
CN-310	DEUTSCH	2	Proportional-EPPR valve-A2	DT06-2S-EP06	-

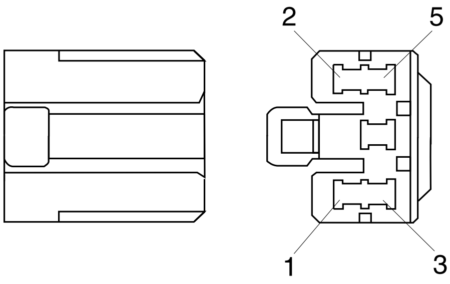
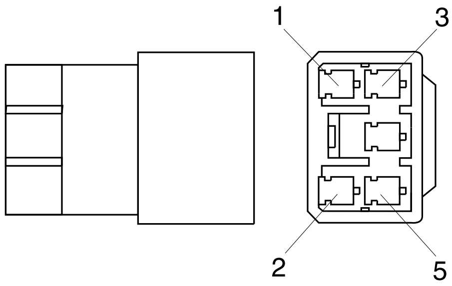
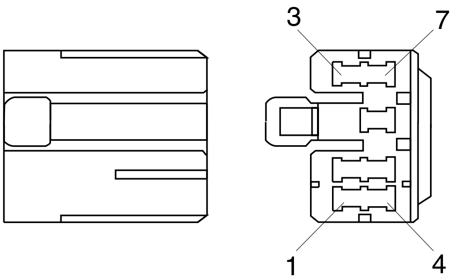
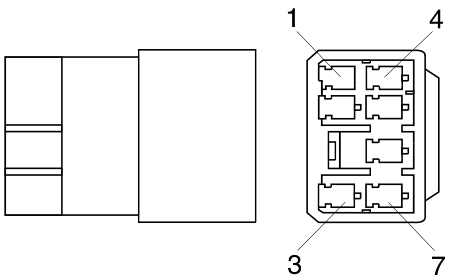
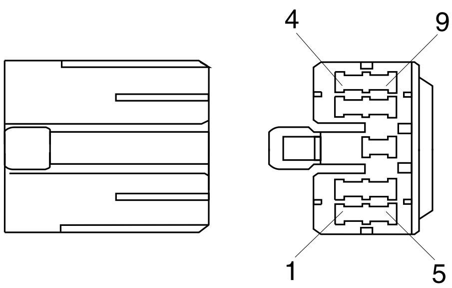
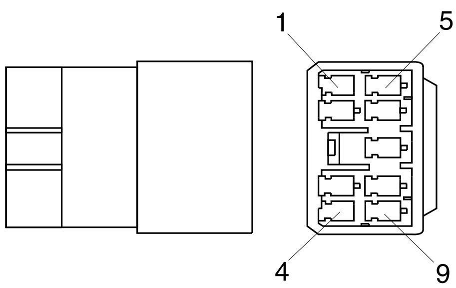
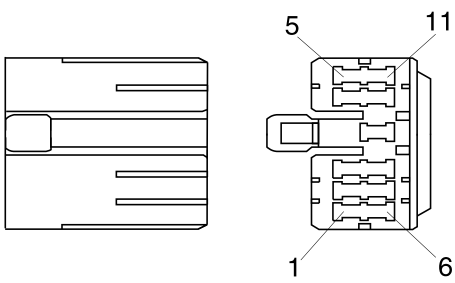
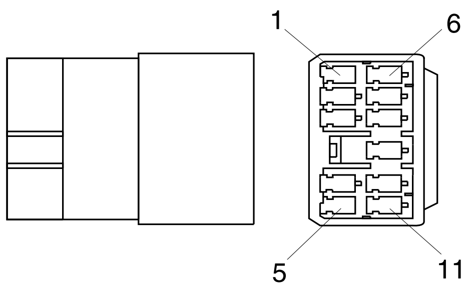
Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CN-363	AMP	12	Haptic controller	174045-2	-
CN-365	DEUTSCH	2	Attach EPPR valve-LH	DT06-2S-EP06	DT04-2P-E005
CN-366	DEUTSCH	3	Attach EPPR valve-RH	DT06-2S-EP06	DT04-2P-E005
CN-367	DEUTSCH	2	Boom down floating solenoid	DT06-2S-EP06	DT04-2P-E005
CN-368	DEUTSCH	2	Boom up floating solenoid	DT06-2S-EP06	DT04-2P-E005
CN-369	DEUTSCH	2	Boom down cut off solenoid	DT06-2S-EP06	DT04-2P-E005
CN-376	TYCO	34	Membrane controller	4-1437290-1	-
CN-378	DEUTSCH	2	Attach EPPR 2	DT06-2S-EP06	-
CN-398	DEUTSCH	4	RS232	DT06-4S-EP06	DT06-4P-E005
CN-399	TYCO	4	DEF/AdBlue® tank level sensor	1-967325-1	-
CN-402	DEUTSCH	6	Front view camera	DT06-6S-EP06	DT04-6P-EP14
CN-403	DEUTSCH	6	Rear view camera	DT06-6S-EP06	DT04-6P-EP14
CN-404	DEUTSCH	6	RH view camera	DT06-6S-EP06	DT04-6P-EP14
CN-405	DEUTSCH	6	LH view camera	DT06-6S-EP06	DT04-6P-EP14
CN-406	DEUTSCH	3	RS232	DT06-3S-EP06	DT06-3P-E005
CN-407	FCI	4	Low wiper motor	180900-0	-
CN-408	FCI	4	Washer tank	MG640795	-
CN-427	MOLEX	4	Reader-RMS	039012040	026013096
		12		5557-12R	5559-12P
· Relay					
CR-1	RING-TERM	-	Battery relay	ST710289-2	-
CR-2	-	5	Horn relay	-	-
CR-4	-	5	Working lamp relay	-	-
CR-5	-	5	Anti restart relay	-	-
CR-7	-	5	Aircon compressor relay	-	-
CR-9	-	5	Cabin lamp relay	-	-
CR-13	-	5	Head lamp relay	-	-
CR-23	KET	2	Start relay	S814-002001	S814-102001
CR-35	-	5	Power relay	-	-
CR-36	-	5	Preheat relay	-	-
CR-46	-	5	Fuel warmer relay	-	-
· Switch					
CS-1	SHUR	1	Door switch	S822-014002	S822-114002
CS-2	WP	6	Start key switch	S814-006100	-
CS-4	DEUTSCH	3	Safety switch	DT06-3S-EP06	-
CS-5	DEUTSCH	2	Horn switch	DT06-3S-EP06	DT04-2P-E005
CS-19	DEUTSCH	2	One touch decel switch	DT06-3S-EP06	DT04-2P-E005
CS-26	DEUTSCH	2	Breaker switch	DT06-2S-EP06	DT04-2P-E005
CS-26A	AMP	2	Breaker pedal switch	S816-002002	S816-102002
CS-29	DEUTSCH	2	Power max switch	DT06-2S-EP06	DT04-2P-E005

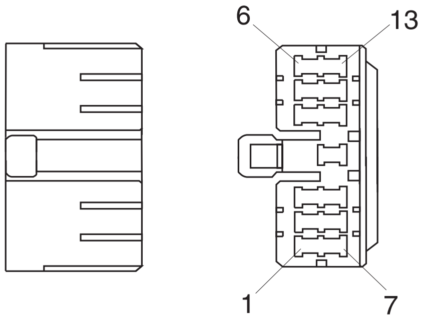
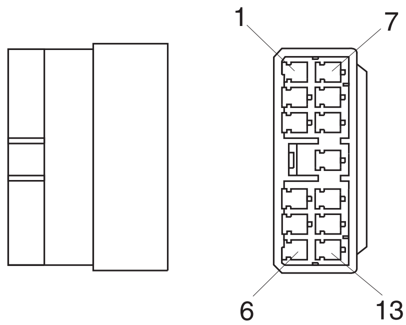
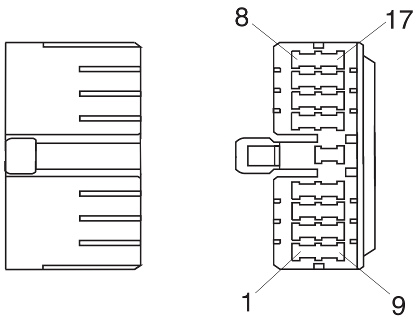
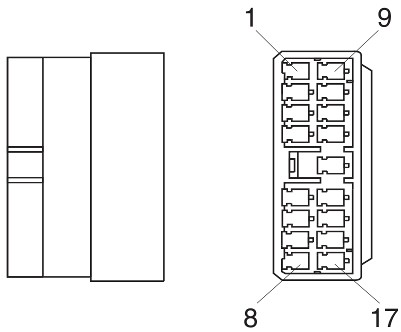
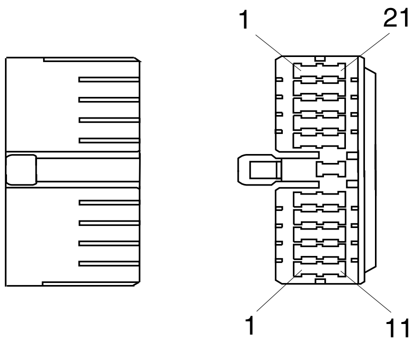
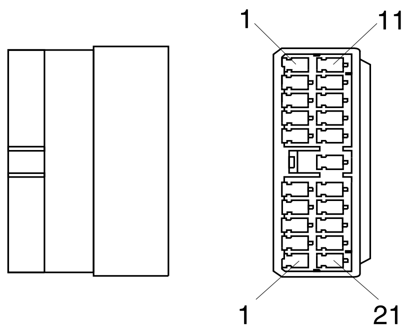
Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CS-33	AMP	6	Emergency engine stop switch	S816-006002	S816-106002
CS-50	CARLING	10	Travel priority switch	VC2-01	-
CS-53	AMP	1	Wiper cut switch	S822-014002	-
CS-67	CARLING	10	Quick clamp switch	VC2-01	-
CS-73	CARLING	10	Swing lock & fine switch	VC2-01	-
CS-74A	KET	2	Master switch	MG610557-5	-
CS-74B	DEUTSCH	2	Master switch	DT06-2S-EP06	DT04-2P-E005
CS-78	CARLING	10	Lower wiper switch	VC2-01	-
CS-83	CARLING	10	Spare switch	VC2-01	-
CS-99	CARLING	10	Air compressor switch	VC2-01	-
CS-100	CARLING	10	SCR system cleaning switch	VC2-01	-
CS-107	CARLING	10	Travel straight switch	VC2-01	-
CS-108	CARLING	10	Auto grease switch	VC2-01	-
CS-111	CARLING	10	Boom floating switch	VC2-01	-
· Light					
CL-1	KET	3	Room lamp	MG651032	-
CL-2	AMP	1	Cigar light	S822-014002	S822-114002
CL-3	DEUTSCH	2	Head lamp-LH	DT06-2S-EP06	DT04-2P-E005
CL-4	DEUTSCH	2	Head lamp-RH	DT06-2S-EP06	DT04-2P-E005
CL-5	DEUTSCH	2	Work lamp-LH	DT06-2S-EP06	DT04-2P-E005
CL-6	DEUTSCH	2	Work lamp-RH	DT06-2S-EP06	DT04-2P-E005
CL-7	SHUR	1	Beacon lamp	S822-014002	S822-114002
CL-8	DEUTSCH	2	Cab light-LH	DT06-2S-EP06	DT04-2P-E005
CL-9	DEUTSCH	2	Cab light-RH	DT06-2S-EP06	DT04-2P-E005
CL-10	DEUTSCH	2	Cab light	DT06-2S-EP06	DT04-2P-E005
CL-24	DEUTSCH	2	Head lamp	DT06-2S-EP06	DT04-2P-E005
CL-36	DEUTSCH	2	Work lamp	DT06-2S-EP06	DT04-2P-E005
CL-37	DEUTSCH	2	Work lamp	DT06-2S-EP06	DT04-2P-E005
CL-40	DEUTSCH	2	DEF/AdBlue® lamp	DT06-2S-EP06	DT04-2P-E005
· Sensor, sendor					
CD-1	AMP	2	Hydraulic oil temp sender	85202-1	-
CD-2	DEUTSCH	2	Fuel sender	DT06-2S-EP06	DT06-4P-E005
CD-6	DEUTSCH	3	Travel pressure switch	DT06-3S-EP06	DT06-4P-E005
CD-7	DEUTSCH	3	Working pressure switch	DT06-3S-EP06	DT06-4P-E005
CD-10	AMP	2	Air cleaner switch	85202-1	-
CD-24	DEUTSCH	3	Swing sensor	DT06-3S-EP06	DT06-4P-E005
CD-31	DEUTSCH	3	Overload sensor	DT06-3S-EP06	DT06-4P-E005
CD-32	DEUTSCH	3	Boom up sensor	DT06-3S-EP06	DT06-4P-E005

Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CD-35	DEUTSCH	3	Arm & bucket in sensor	DT06-3S-EP06	DT06-4P-E005
CD-42	DEUTSCH	3	Pump pressure 1	DT06-3S-EP06	DT06-4P-E005
CD-43	DEUTSCH	3	Pump pressure 2	DT06-3S-EP06	DT06-4P-E005
CD-44	DEUTSCH	3	Pump pressure 3	DT06-3S-EP06	DT06-4P-E005
CD-45	DEUTSCH	2	WIF sensor	DT06-2S-EP06	DT06-4P-E005
CD-52	AMP	2	Fan sensor	S816-002002	-
CD-69	DEUTSCH	3	Attach pressure sensor	DT06-3S-EP06	DT06-4P-E005
CD-70	DEUTSCH	3	N1 pressure sensor	DT06-3S-EP06	DT06-4P-E005
CD-71	DEUTSCH	3	N2 pressure sensor	DT06-3S-EP06	DT06-4P-E005
CD-85	DEUTSCH	3	Boom down sensor	DT06-3S-EP06	DT06-3P-E005
CD-108	DEUTSCH	3	Attach relief EPPR 1	DT06-3S-EP06	DT06-4P-E005
CD-109	DEUTSCH	3	Attach relief EPPR 2	DT06-3S-EP06	DT06-4P-E005
CD-111	DEUTSCH	3	Attach EPPR 1 pressure sensor	DT06-3S-EP06	DT06-4P-E005
CD-112	DEUTSCH	3	Attach EPPR 2 pressure sensor	DT06-3S-EP06	DT06-4P-E005
CD-124	DEUTSCH	3	Boom cylinder rod pressure snensor	DT06-3S-EP06	DT06-3P-E005

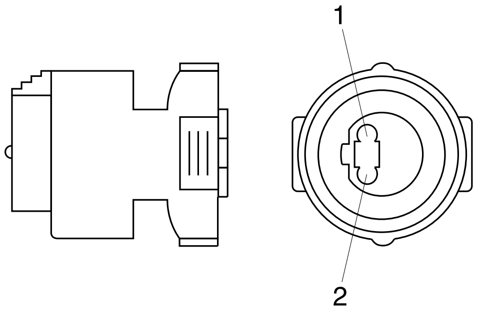
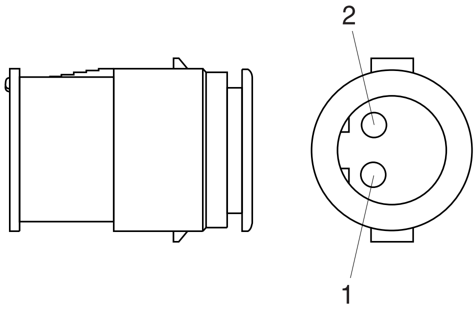
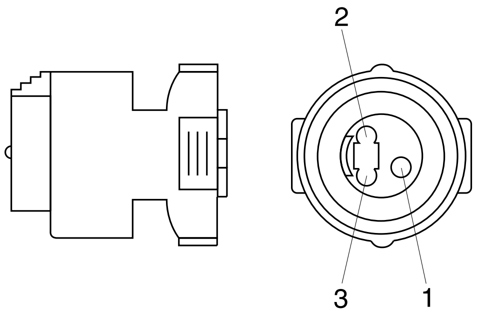
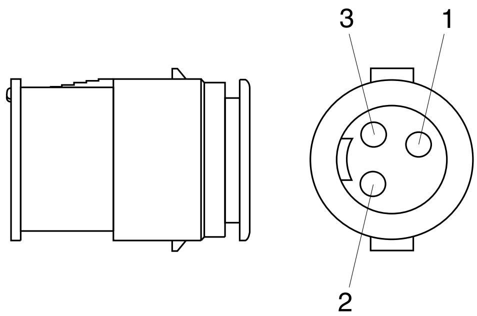
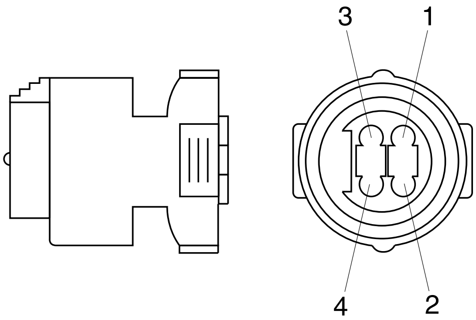
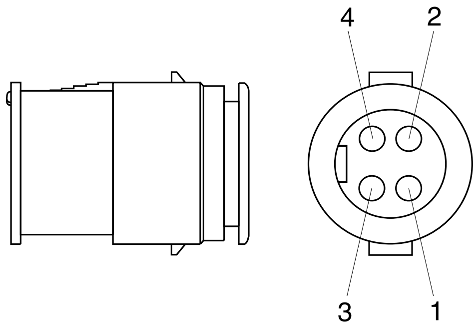
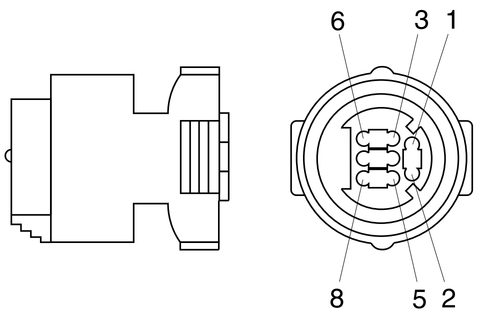
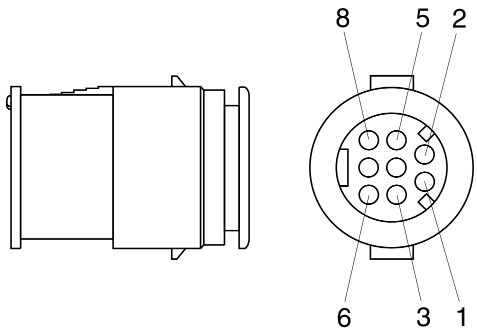
2. CONNECTION TABLE FOR CONNECTORS

1) PA TYPE CONNECTOR

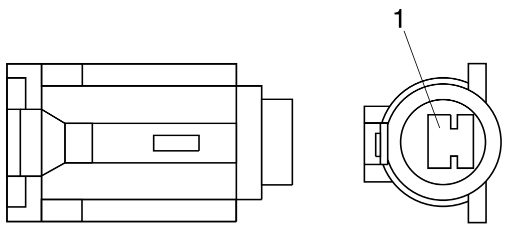
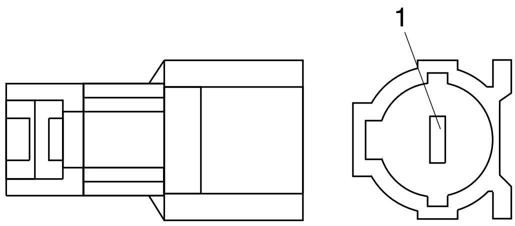
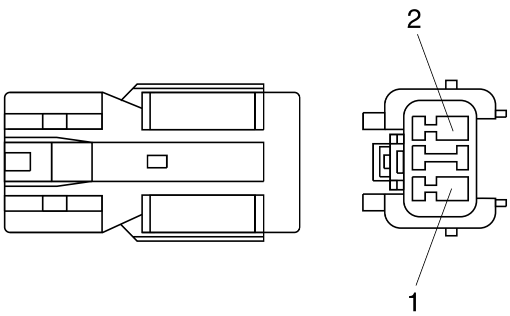
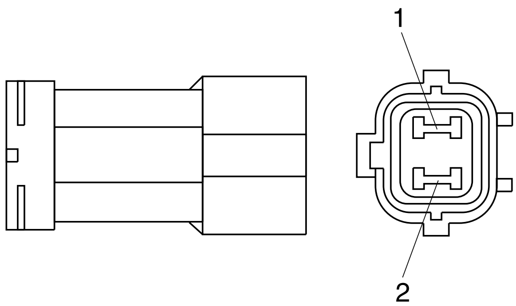
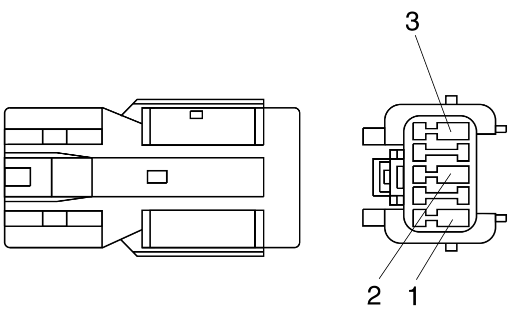
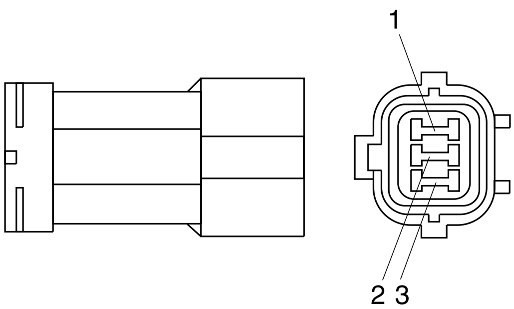
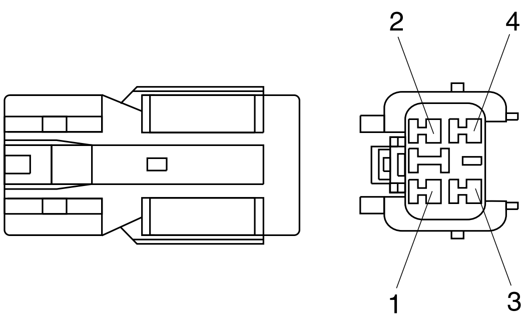
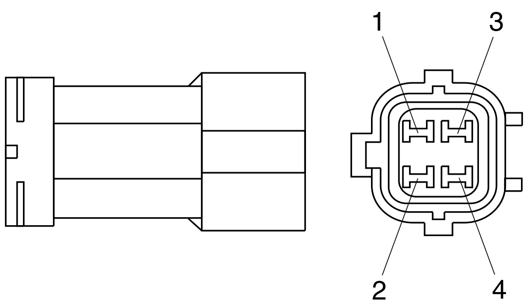
No. of pin	Receptacle connector (female)	Plug connector (male)
5	 S811-005002	 S811-105002
7	 S811-007002	 S811-107002
9	 S811-009002	 3S811-109002
11	 S811-011002	 S811-111002

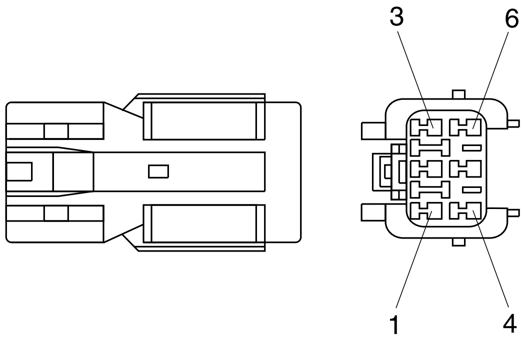
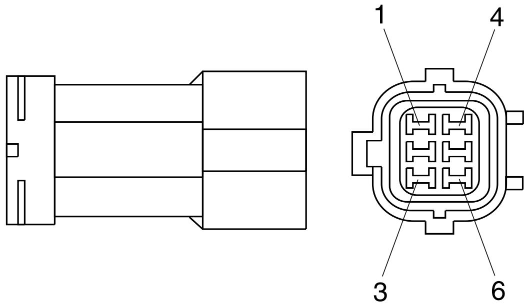
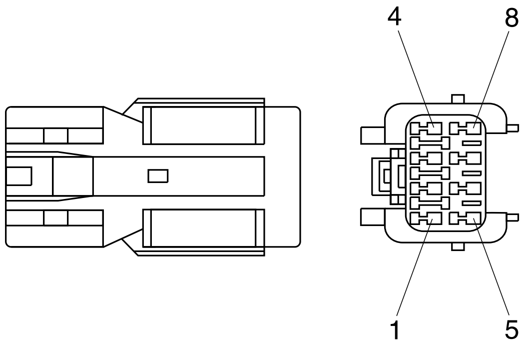
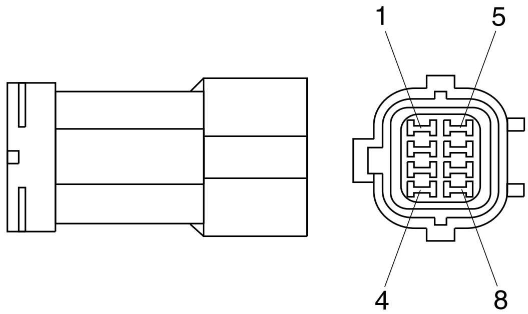
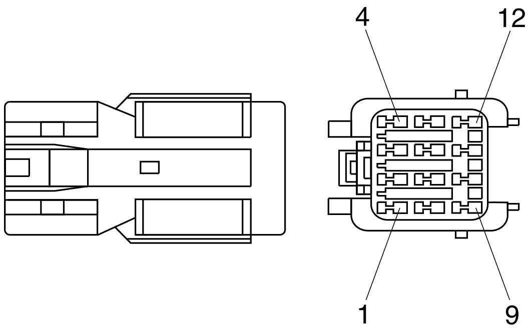
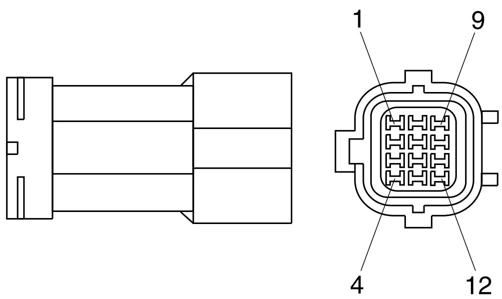
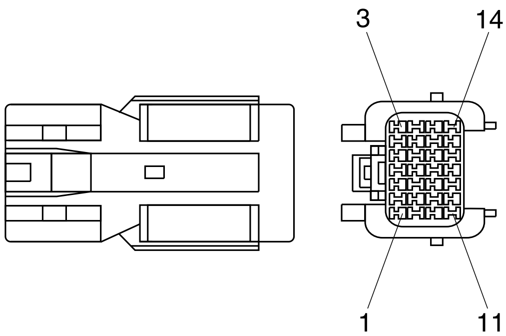
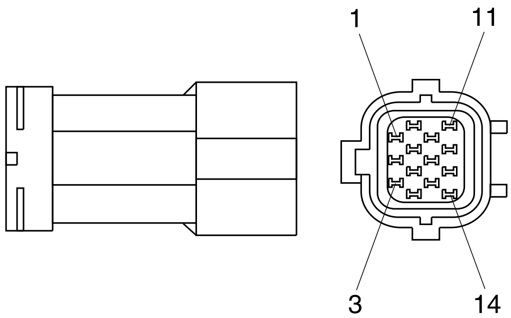
No. of pin	Receptacle connector (female)	Plug connector (male)
13	 S811-013002	 S811-113002
17	 S811-017002	 S811-117002
21	 S811-021002	 S811-121002

2) J TYPE CONNECTOR

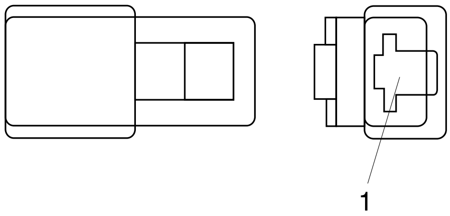
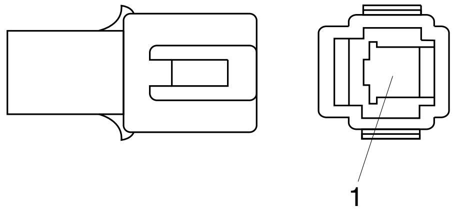
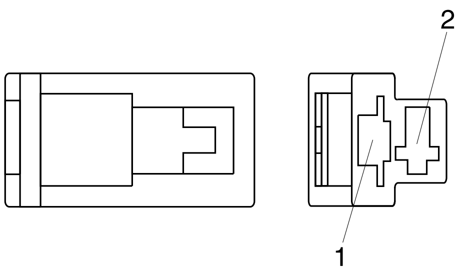
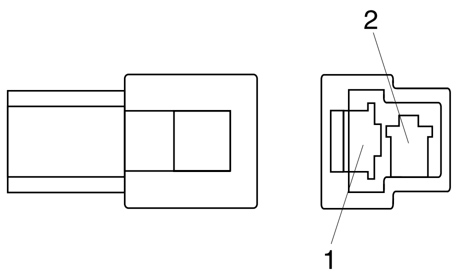
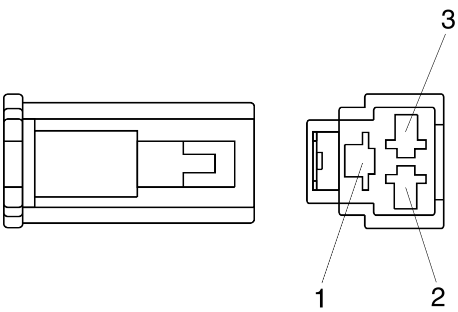
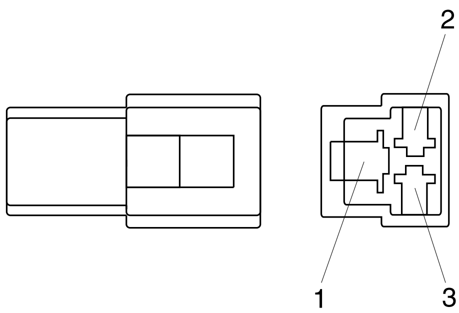
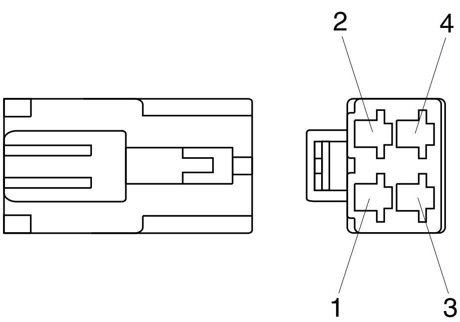
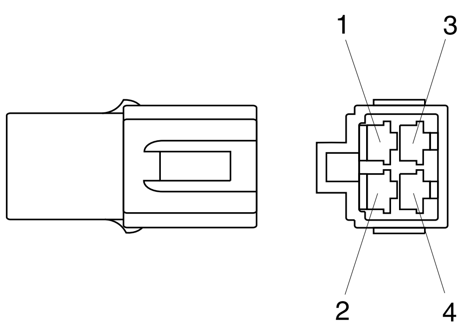
No. of pin	Receptacle connector (female)	Plug connector (male)
2	 S816-002001	 S816-102001
3	 S816-003001	 S816-103001
4	 S816-004001	 S816-104001
8	 S816-008001	 S816-108001

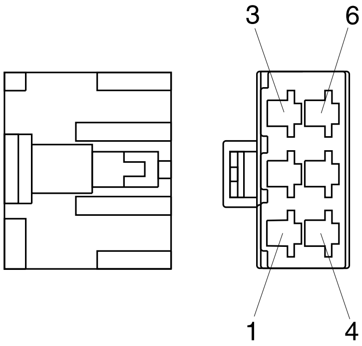
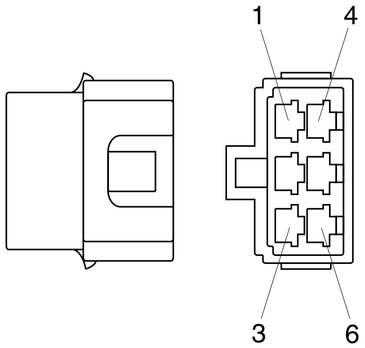
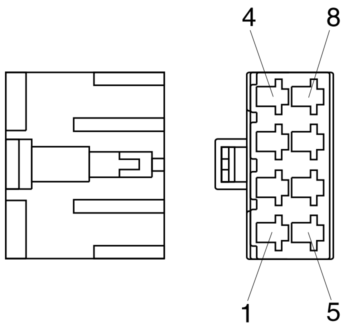
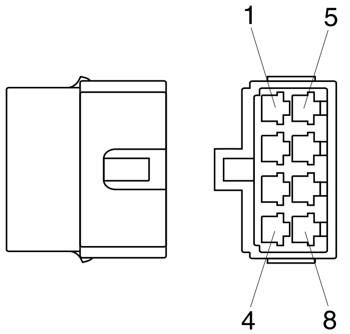
3) SWP TYPE CONNECTOR

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

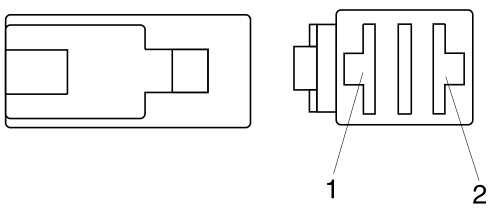
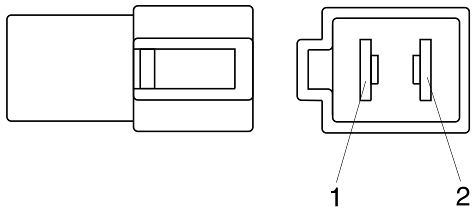
No. of pin	Receptacle connector (female)	Plug connector (male)
6	 S814-006000	 S814-106000
8	 S814-008000	 S814-108000
12	 S814-012000	 S814-112000
14	 S814-014000	 S814-114000

4) CN TYPE CONNECTOR

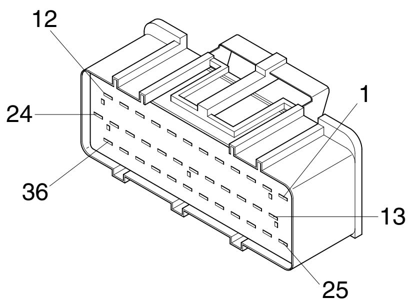
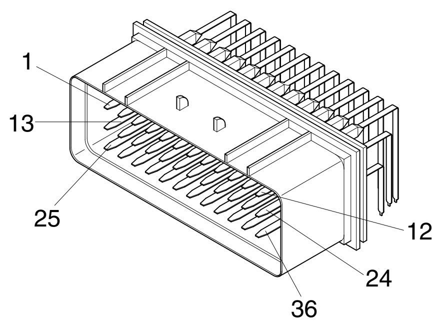
No. of pin	Receptacle connector (female)	Plug connector (male)
1	 S810-001202	 S810-101202
2	 S810-002202	 S810-102202
3	 S810-003202	 S810-103202
4	 S810-004202	 S810-104202

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

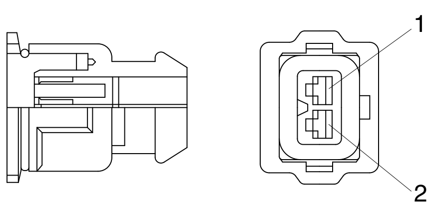
5) 375 FASTEN TYPE CONNECTOR

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

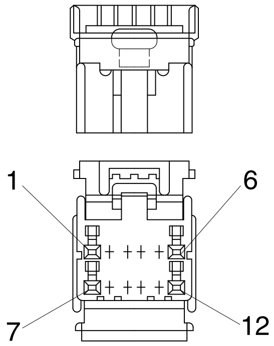
6) AMP ECONOSEAL CONNECTOR

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

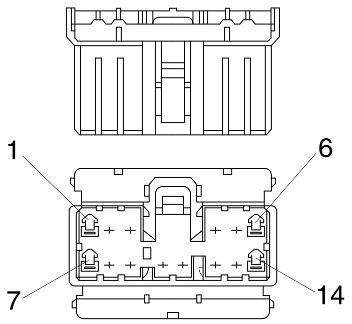
7) AMP TIMER CONNECTOR

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

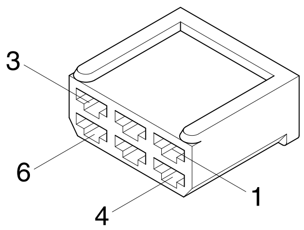
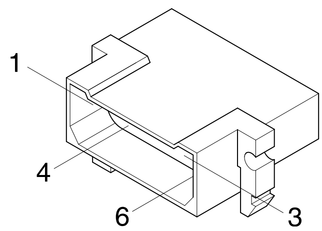
8) AMP 040 MULTILOCK CONNECTOR

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

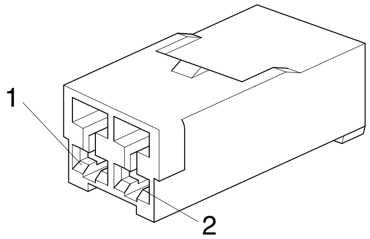
9) AMP 070 MULTILOCK CONNECTOR

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

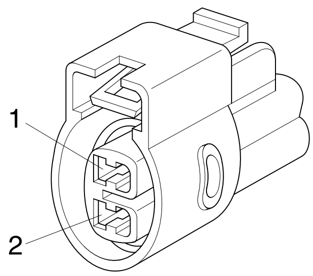
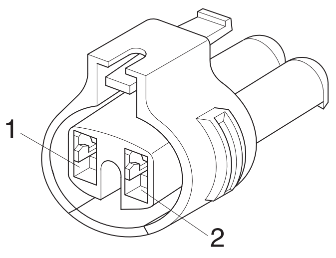
10) AMP FASTIN - FASTON CONNECTOR

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

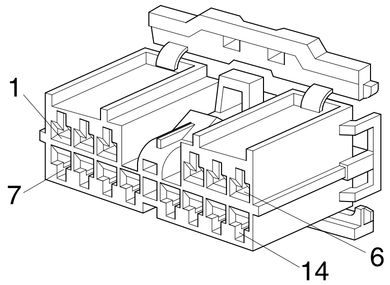
11) KET 090 CONNECTOR

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

12) KET 090 WP CONNECTORS

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

13) KET SDL CONNECTOR

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

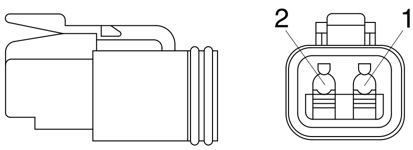
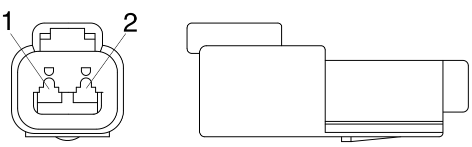
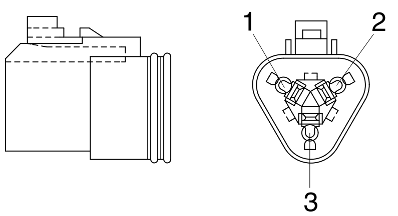
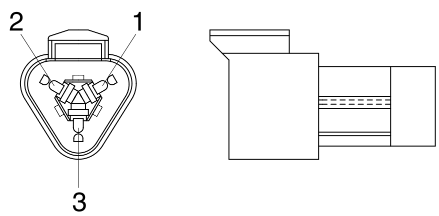
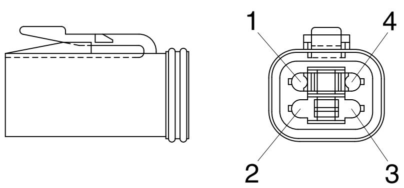
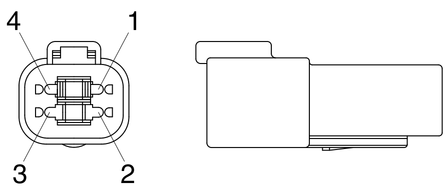
14) DEUTSCH DT CONNECTORS

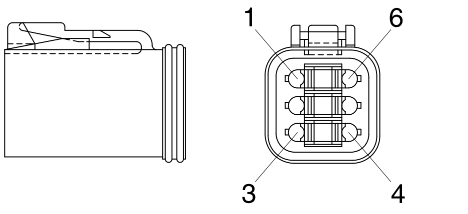
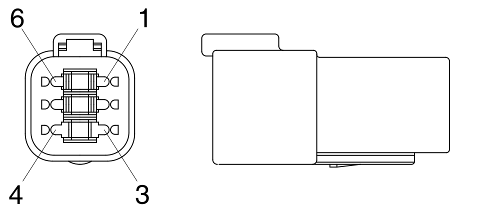
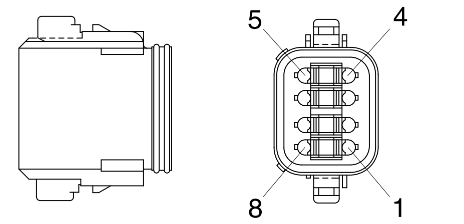
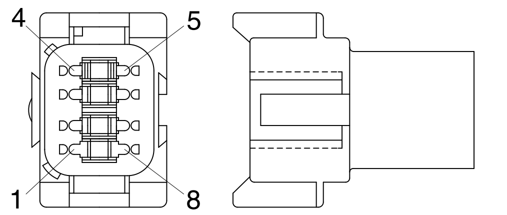
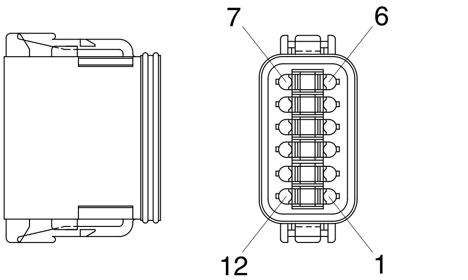
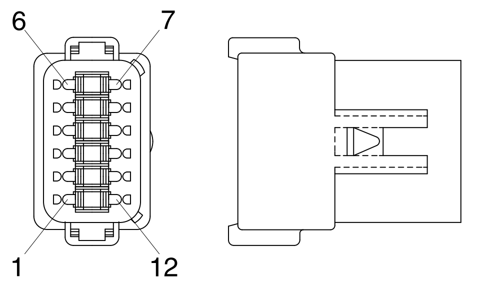
DT 06 - 3S - ★★★★

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

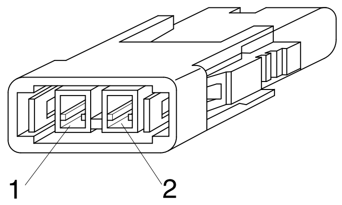
※ Modification

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

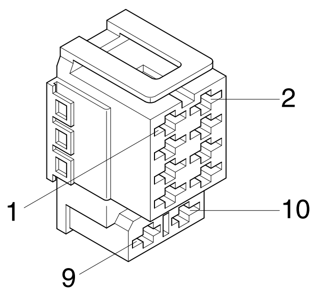
No. of pin	Receptacle connector (female)	Plug connector (male)
2	 DT06-2S	 DT04-2P
3	 DT06-3S	 DT04-3P
4	 DT06-4S	 DT04-4P

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

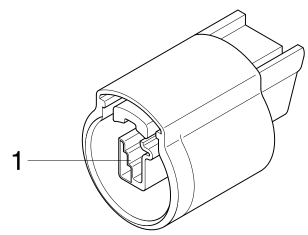
15) MOLEX 2CKTS CONNECTOR

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

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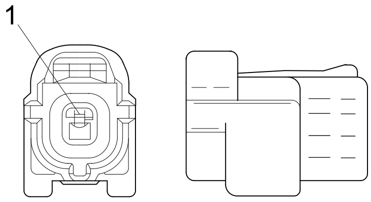
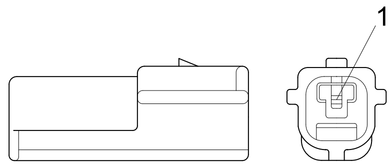
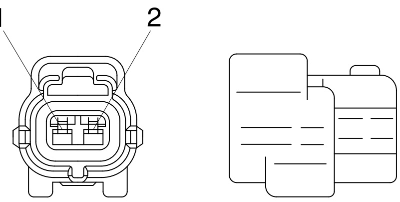
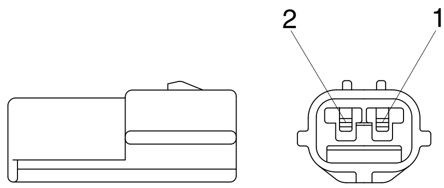
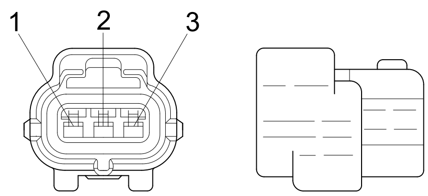
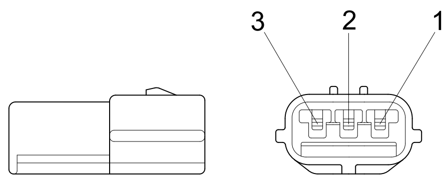
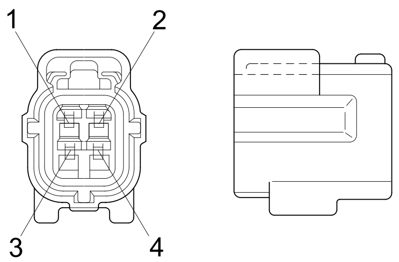
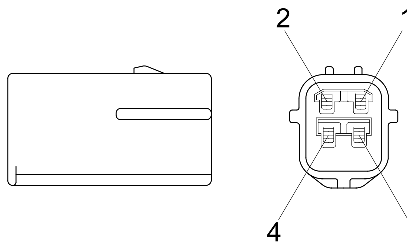
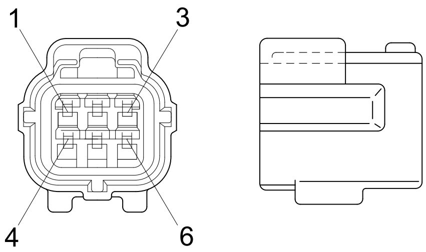
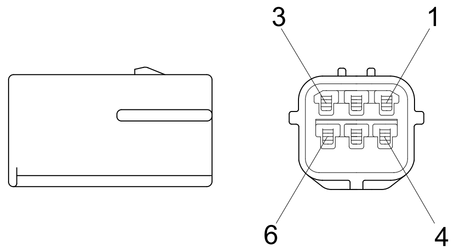
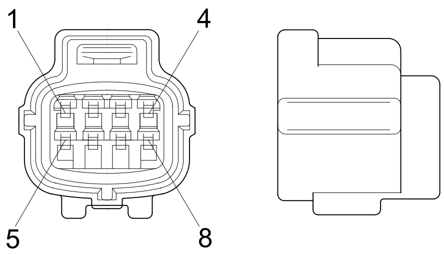
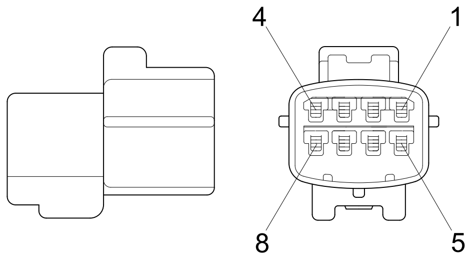
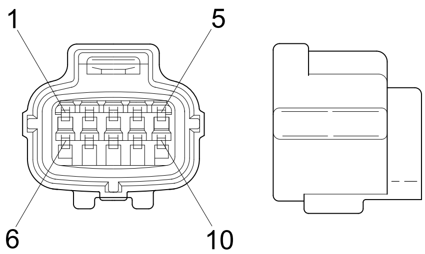
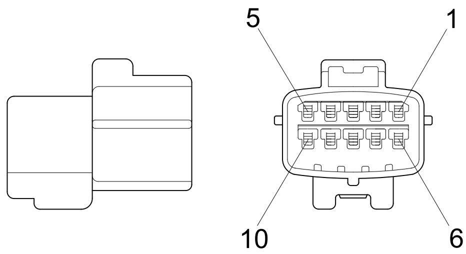
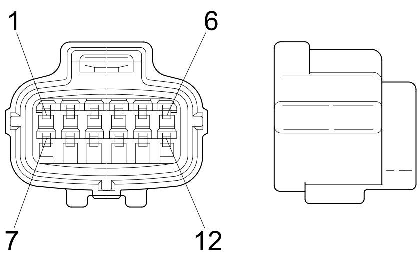
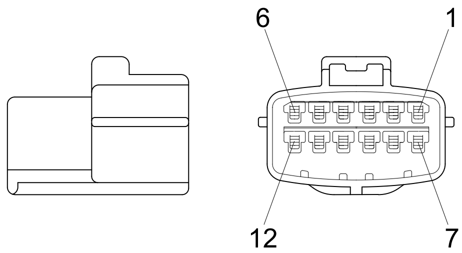
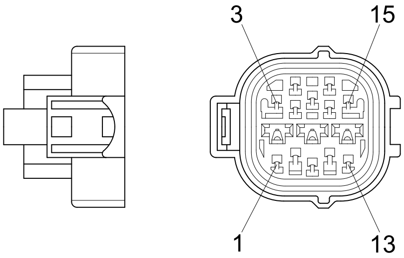
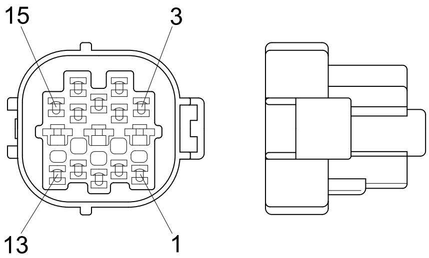
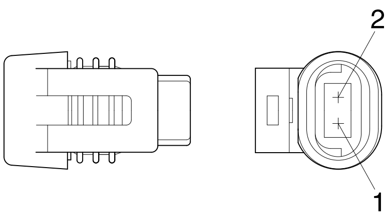
1	 S816-001002	 S816-101002
2	 S816-002002	 S816-102002
3	 S816-003002	 S816-103002
4	 S816-004002	 S816-104002

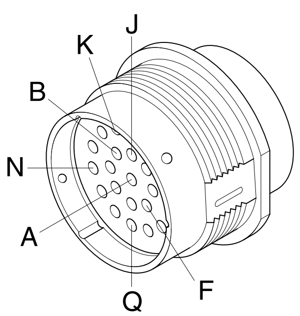
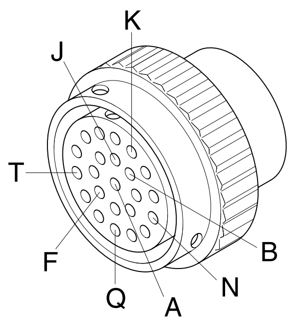
No. of pin	Receptacle connector (female)	Plug connector (male)
6	 S816-006002	 S816-106002
8	 S816-008002	 S816-108002
10	 S816-010002	 S816-110002
12	 S816-012002	 S816-112002

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

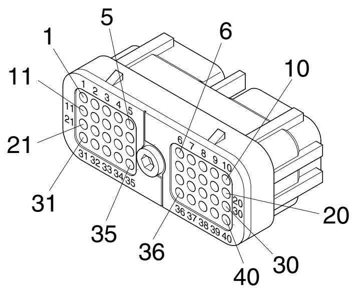
19) METRI-PACK TYPE CONNECTOR

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

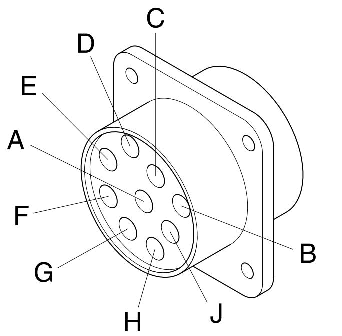
20) DEUTSCH HD30 CONNECTOR

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

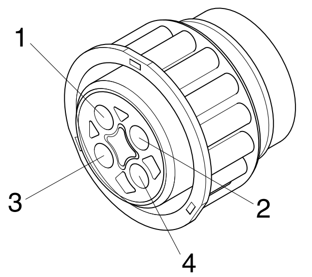
21) DEUTSCH MCU CONNECTOR

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

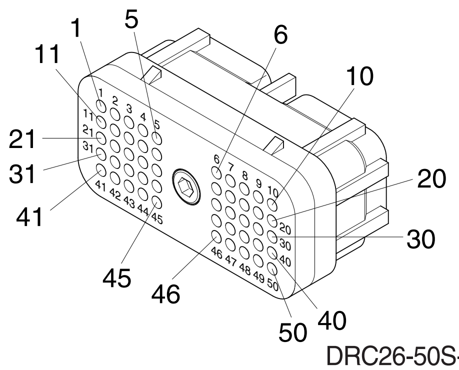
22) DEUTSCH SERVICE TOOL CONNECTOR

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

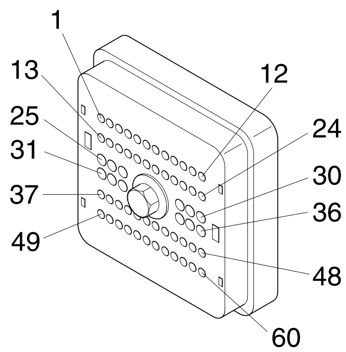
23) AMP FUEL WARMER CONNECTOR

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

24) DEUTSCH ENGINE ECM CONNECTOR

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

25) DEUTSCH INTERMEDIATE CONNECTOR

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

SECTION 5 MECHATRONICS SYSTEM

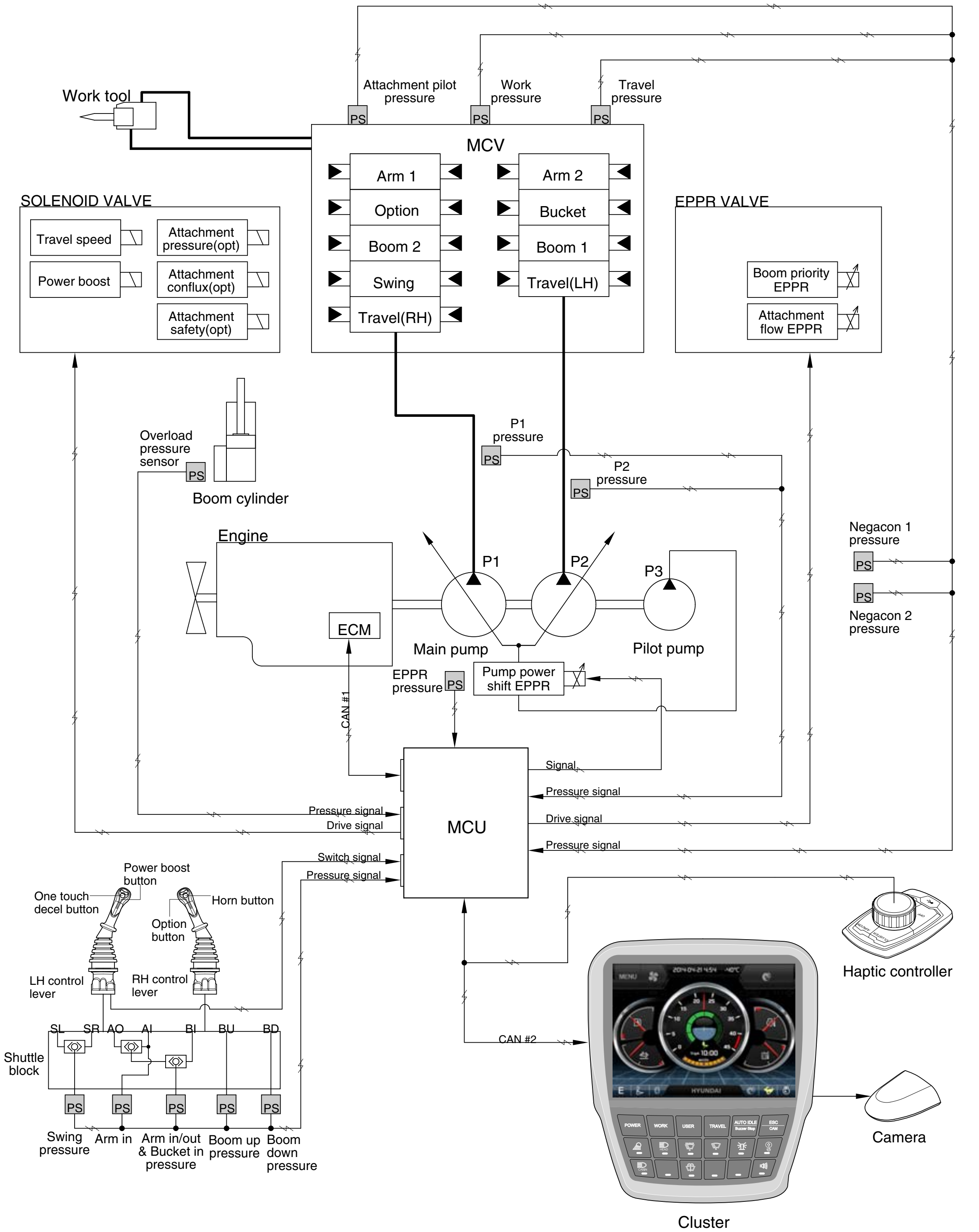
SECTION 5 MECHATRONICS SYSTEM

GROUP 1 OUTLINE

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

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

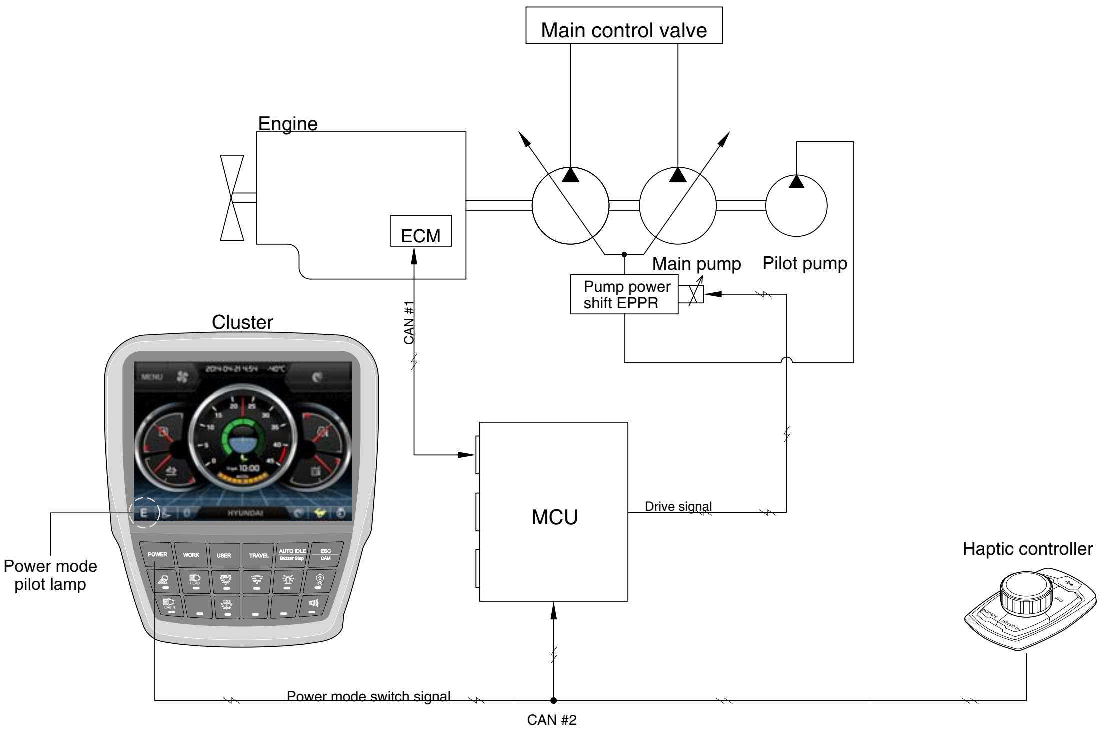
SYSTEM DIAGRAM



480F5MS01

GROUP 2 MODE SELECTION SYSTEM

1. POWER MODE SELECTION SYSTEM



480F5MS14

Mode selection system (micro computer based electro-hydraulic pump and engine mutual control system) optimizes the engine and pump performance.

The combination of 3 power modes (P, S, E) and acceleration mode (10 set) of haptic controller makes it possible to use the engine and pump power more effectively corresponding to the work conditions from a heavy and great power requesting work to a light and precise work.

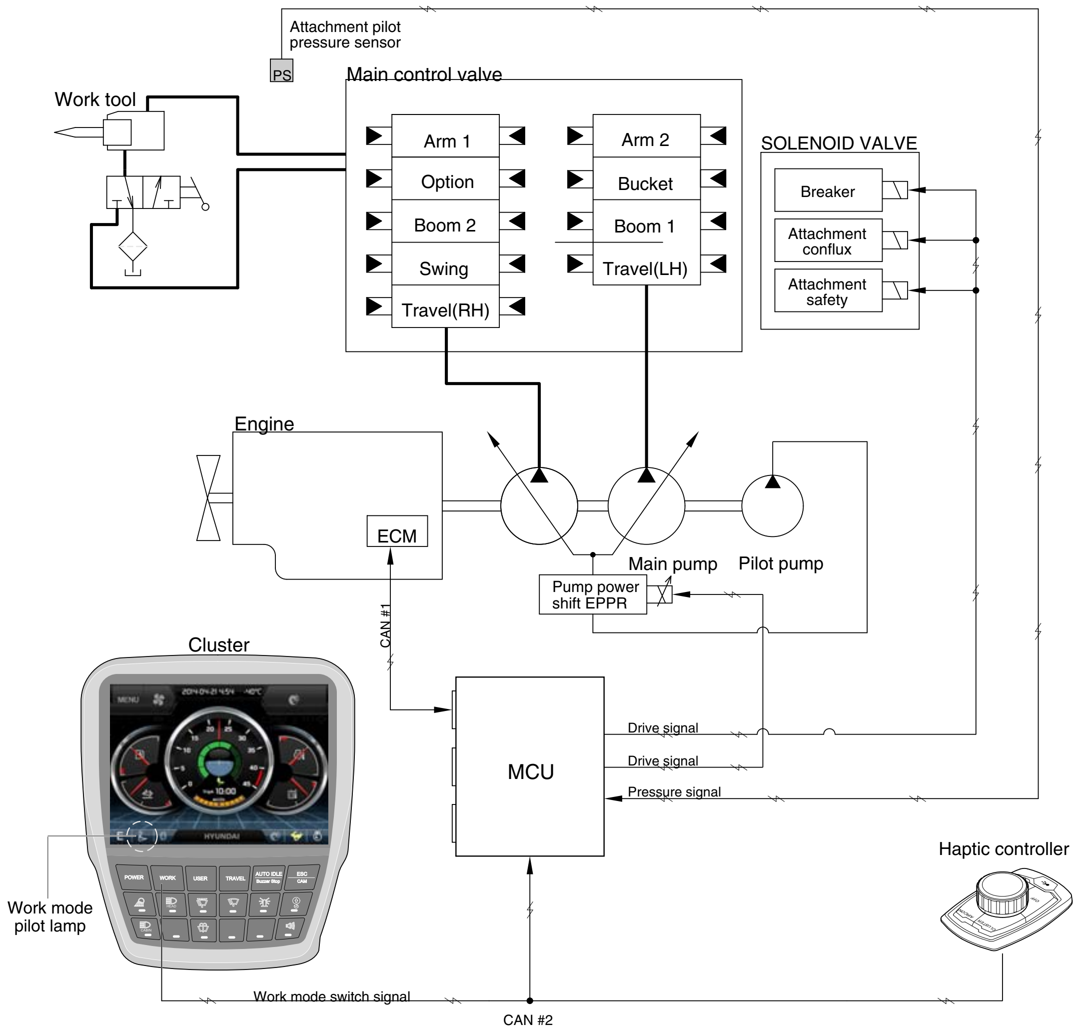
Power mode	Application	Engine rpm				Power shift by EPPR valve			
		Standard		Option		Standard		Option	
		Unload	Load	Unload	Load	Current (mA)	Pressure (kgf/cm^2)	Current (mA)	Pressure (kgf/cm^2)
P	Heavy duty power	1850±50	1900±50	1750±50	1800±50	290±30	8 (~3)	250±30	5 (~5)
S	Standard power	1750±50	1800±50	1700±50	1750±50	360±30	12 (~7)±3	280±30	7 (~7)±3
E	Economy operation	1650±50	1700±50	1600±50	1650±50	360±30	12 (~7)±3	360±30	12 (~7)±3
AUTO DECEL	Engine deceleration	1000±100	-	1000±100	-	700±30	38±3	700±30	38±3
One touch decel	Engine quick deceleration	800±100	-	800±100	-	700±30	38±3	700±30	38±3
KEY START	Key switch start position	800±100	-	800±100	-	700±30	38±3	700±30	38±3

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

※ (~*) : Load

2. WORK MODE SELECTION SYSTEM

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



480F5MS02

1) GENERAL WORK MODE (bucket)

This mode is used to general digging work.

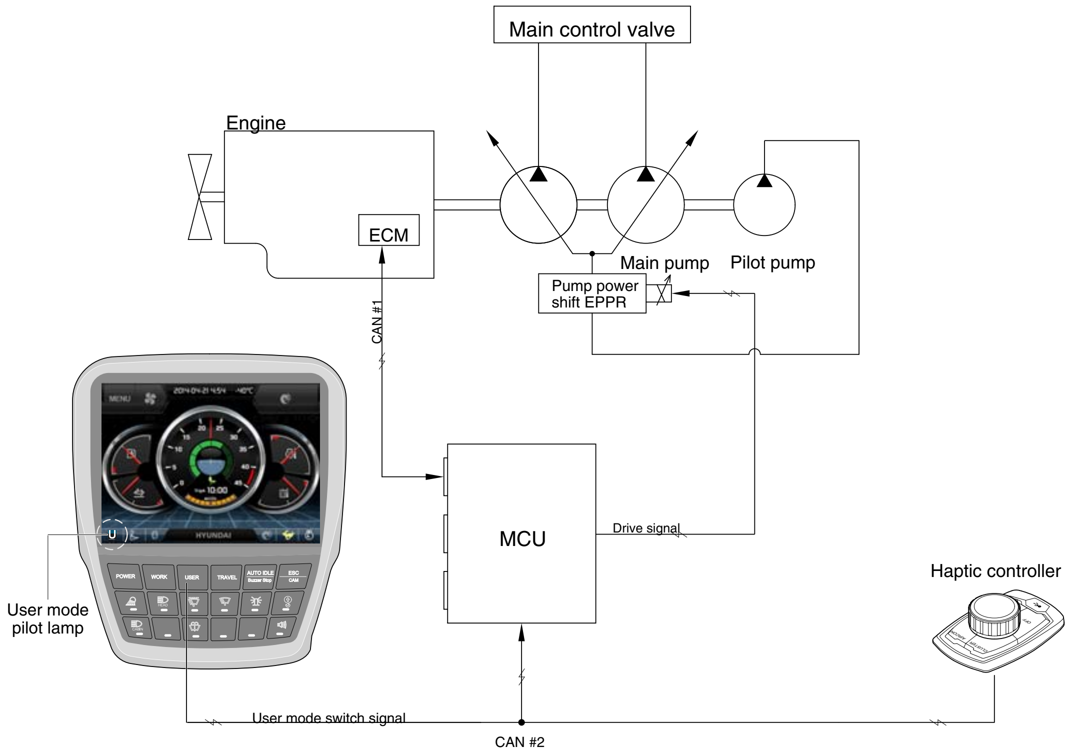
2) ATT WORK MODE (breaker, crusher)

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



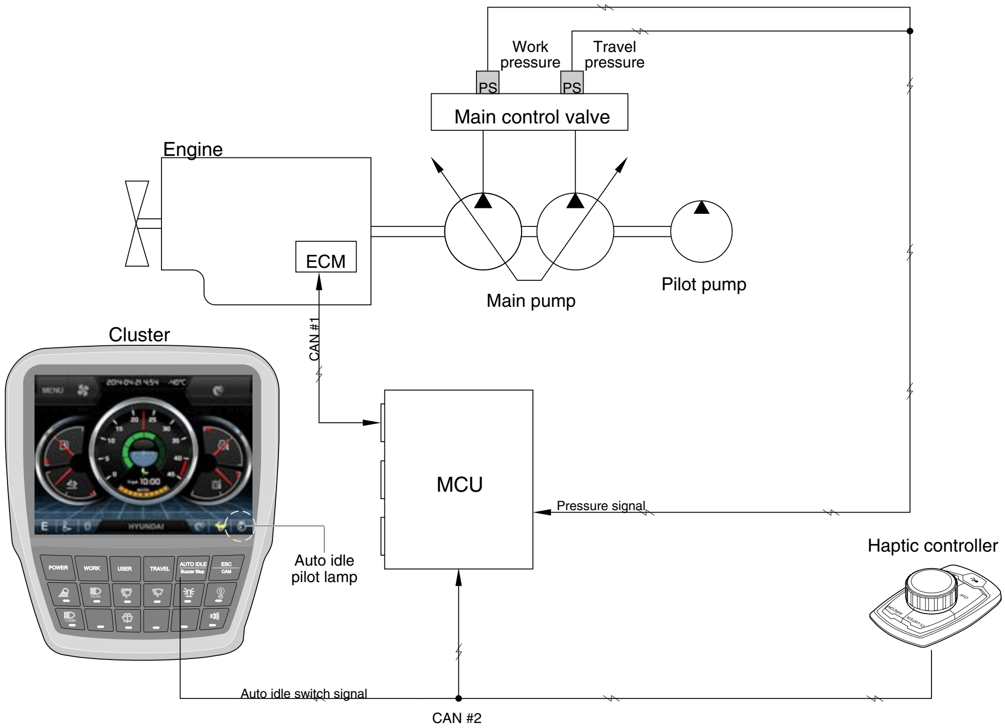
480F5MS15

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

2) LCD segment vs parameter setting

Step (▮)	Engine speed (rpm)	Idle speed (rpm)	Power shift (bar)
1	1300	800	0
2	1400	850	3
3	1500	900	6
4	1600	950	9
5	1700	1000 (auto decel)	12
6	1800	1050	16
7	1850	1100	20
8	1900	1150	26
9	1950	1200	32
10	2000	1250	38

GROUP 3 AUTOMATIC DECELERATION SYSTEM

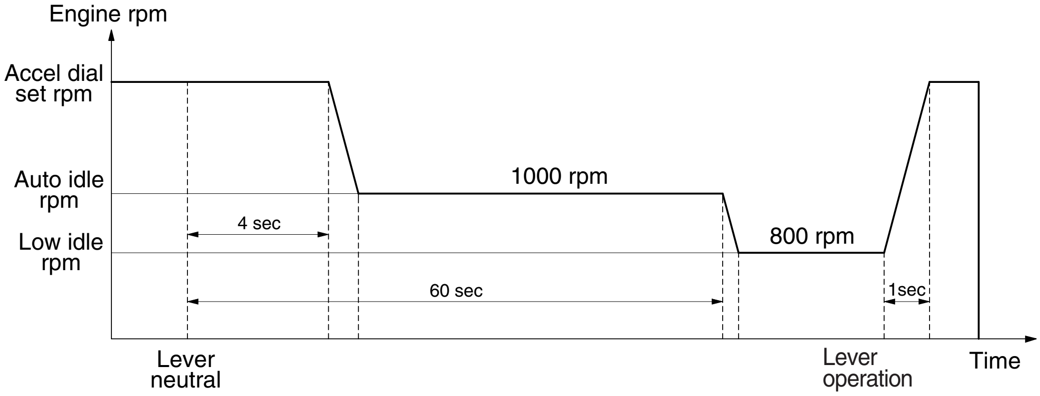


480F5MS16

1. WHEN AUTO IDLE PILOT LAMP ON

When all of the work equipment control levers including swing and travel levers are at neutral for 4 seconds, MCU sends throttle command to ECM to reduce the engine speed to 1000 rpm. If the control levers are at neutral for 1 minute, MCU reduces the engine speed to 800 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.



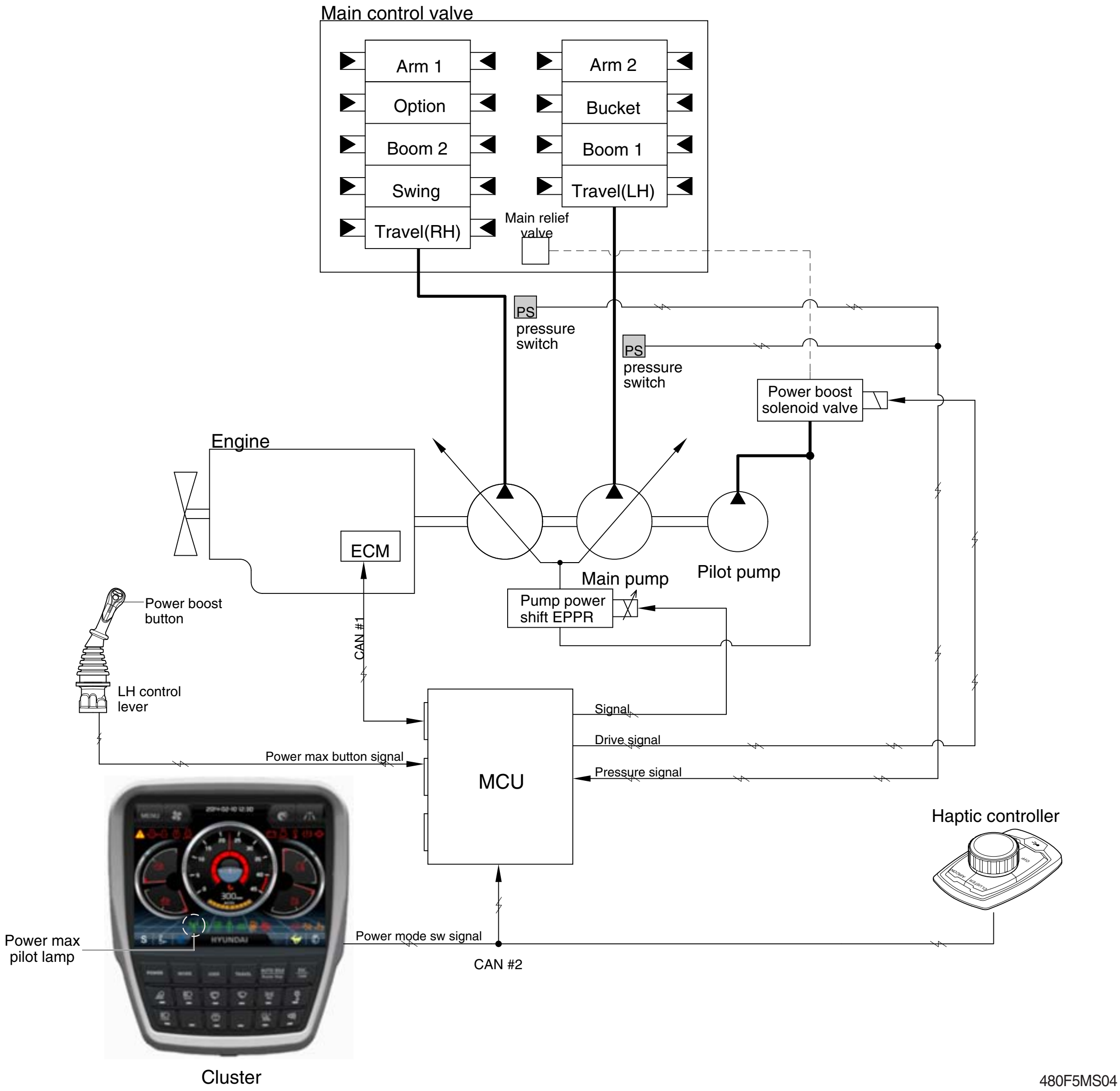
480F5MS03

2. WHEN AUTO IDLE PILOT LAMP OFF

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

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

GROUP 4 POWER BOOST SYSTEM



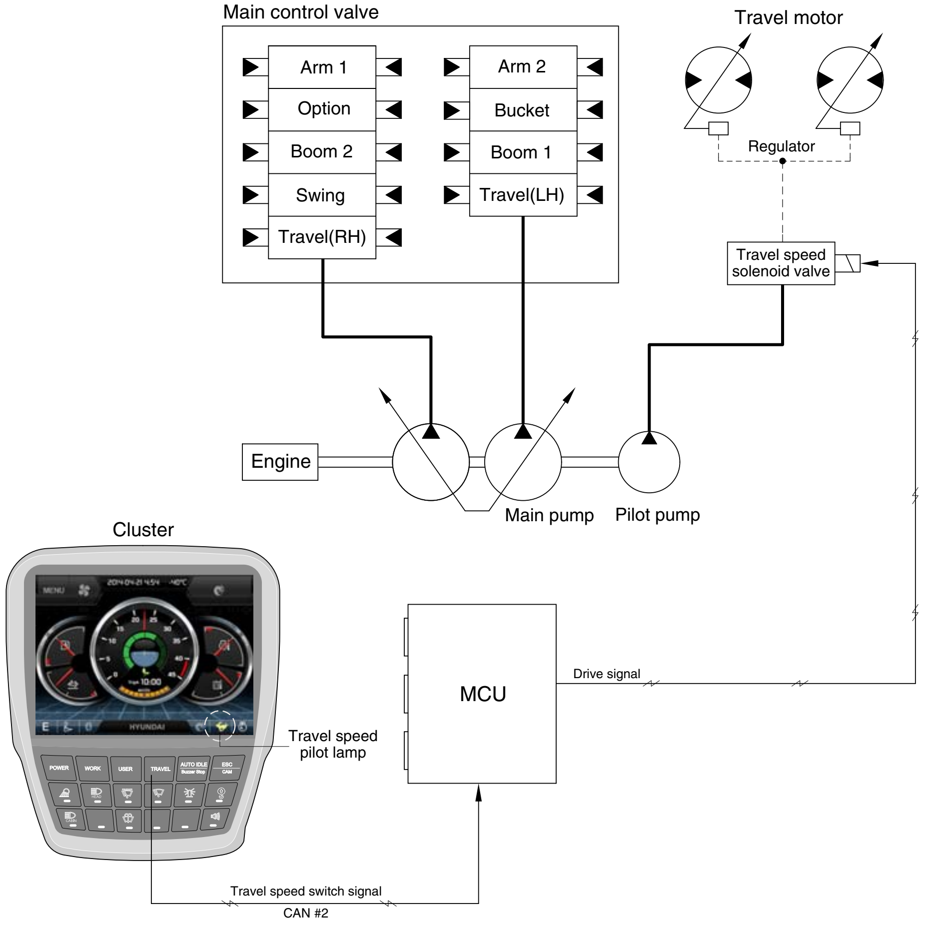
· When the power boost switch on the left control lever knob is pushed ON, the power mode is set P mode and maximum digging power is increased by 10 %.

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

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

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

GROUP 5 TRAVEL SPEED CONTROL SYSTEM



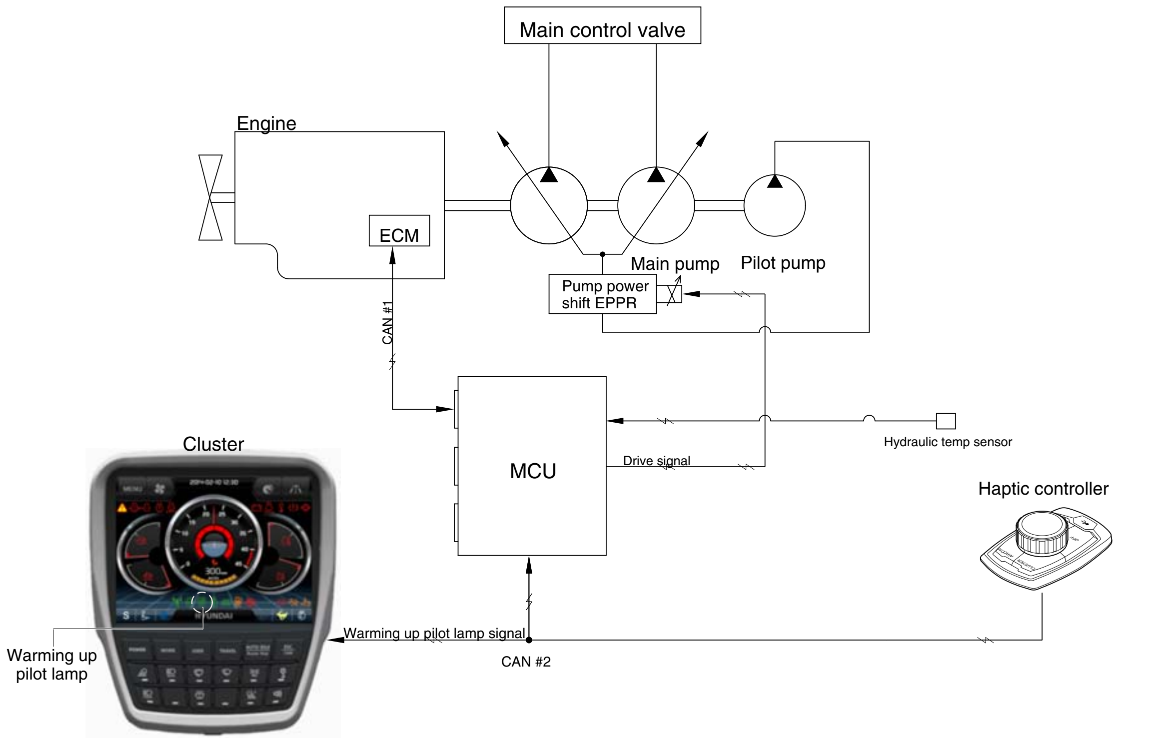
480F5MS05

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

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

※ Default : Turtle (Low)

GROUP 6 AUTOMATIC WARMING UP SYSTEM



480F5MS17

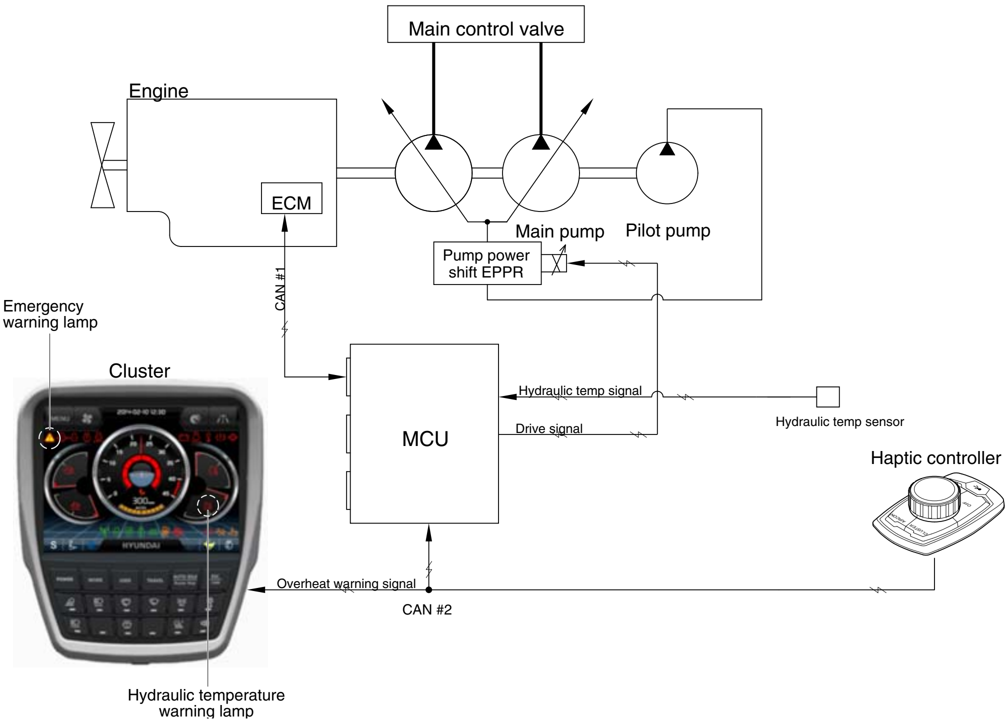
1. The MCU receives the engine coolant temperature from the ECM, and if the coolant temperature is below 30˚C, it increases the engine speed from key start rpm to 1000 rpm. At this time the mode does not change. If the coolant temperature sensor has fault, the hydraulic oil temperature signal is substituted.

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

3. LOGIC TABLE

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

GROUP 7 ENGINE OVERHEAT PREVENTION SYSTEM



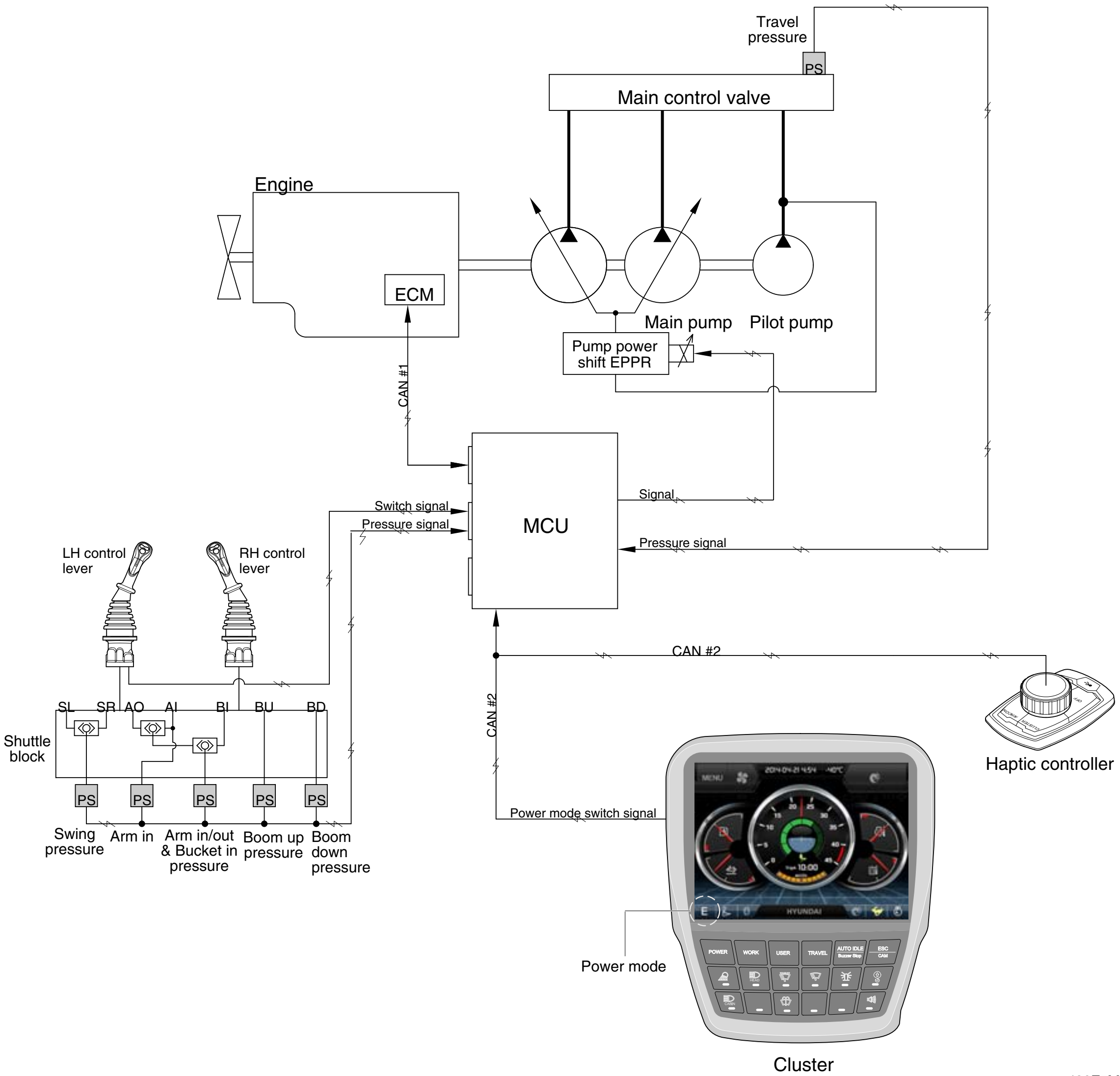
480F5MS18

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

2. LOGIC TABLE

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

GROUP 8 VARIABLE POWER CONTROL SYSTEM



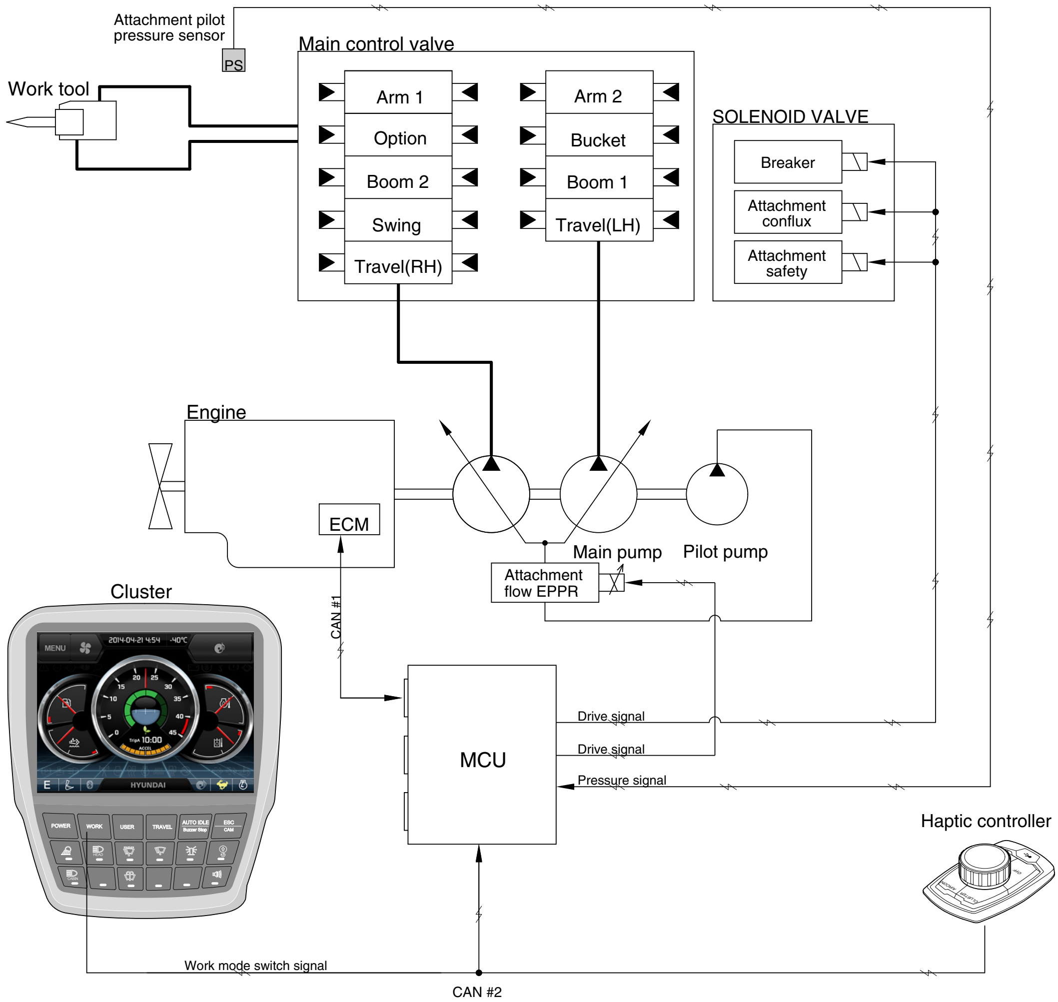
480F5MS06

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

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

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

GROUP 9 ATTACHMENT FLOW CONTROL SYSTEM



480F5MS07

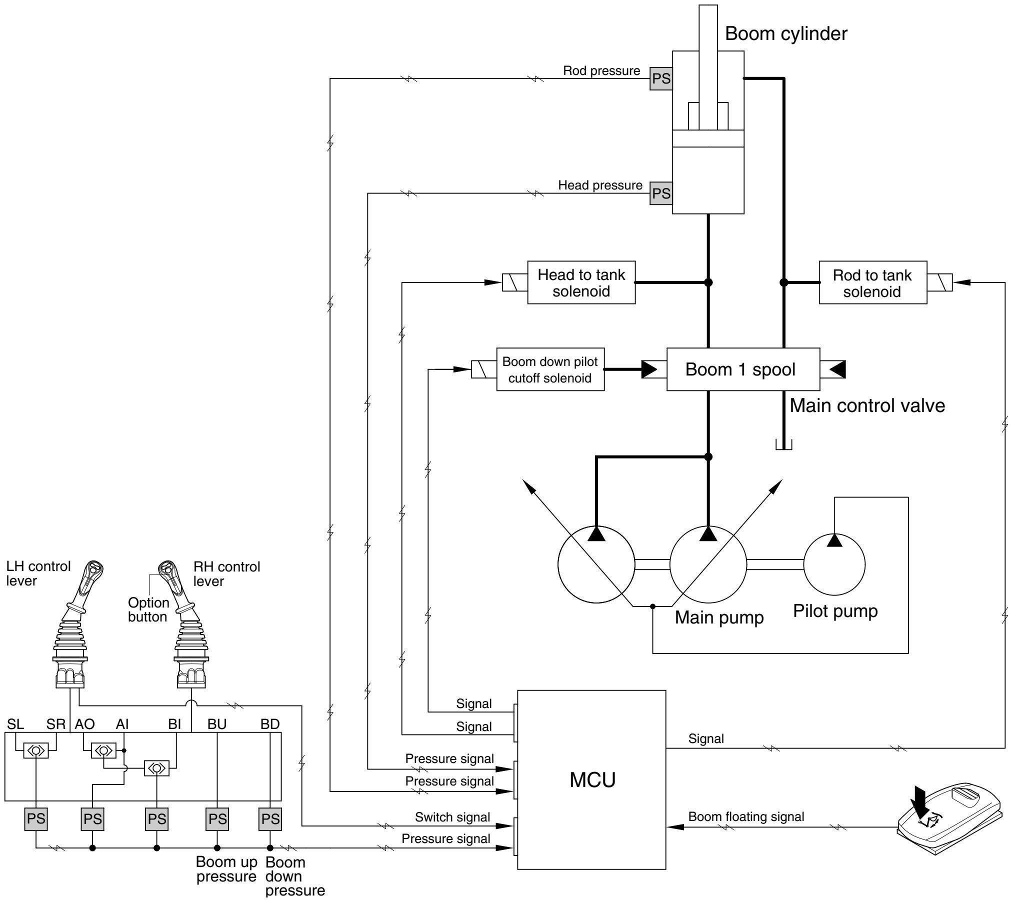
· The system is used to control the pump delivery flow according to set of the work tool on the cluster by the attachment flow EPPR valve.

Description	Work tool	
	Breaker	Crusher
Flow level	100 ~ 320 lpm	100 ~ 760 lpm
Attach safety solenoid	-	ON
Attach conflux solenoid	ON/OFF	ON/OFF
Breaker solenoid★	ON	-

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

★ When breaker operating button is pushed.

GROUP 10 BOOM FLOATING CONTROL SYSTEM



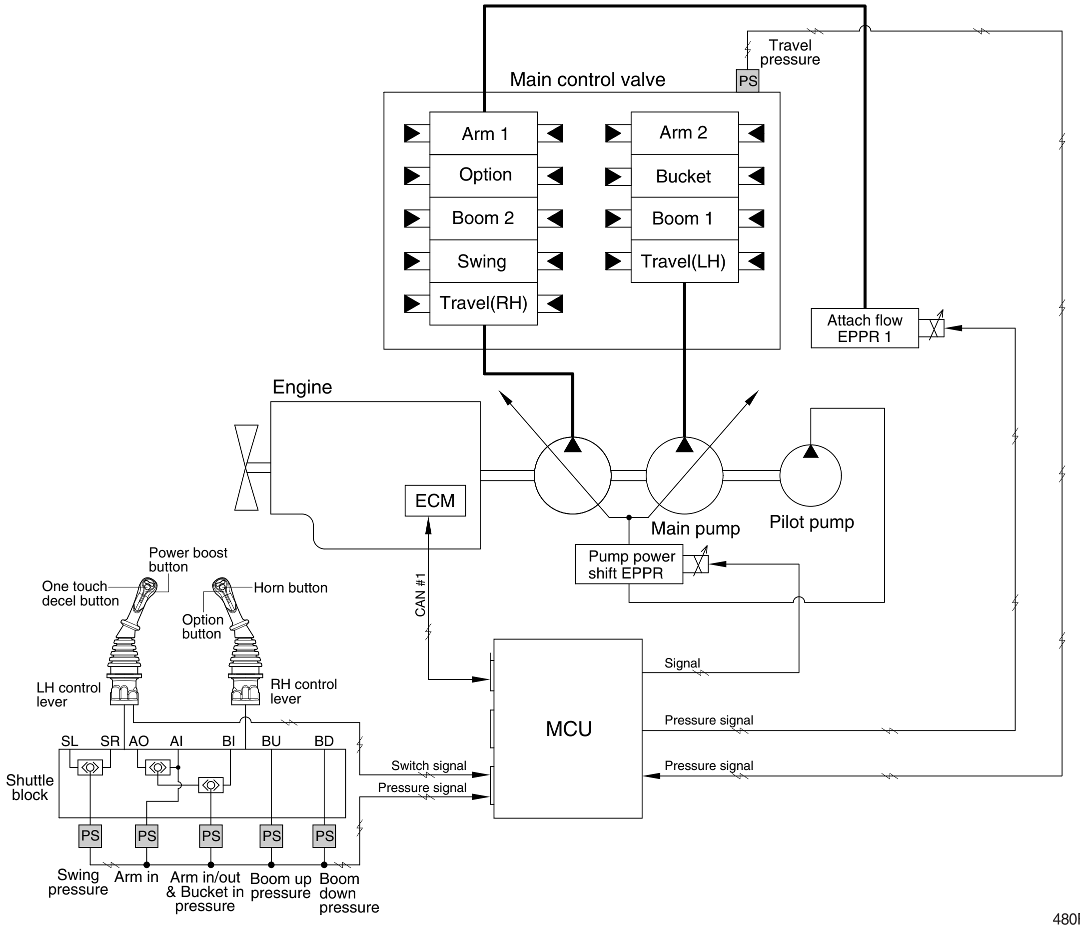
480F5MS08

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

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

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

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



480F5MS09

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

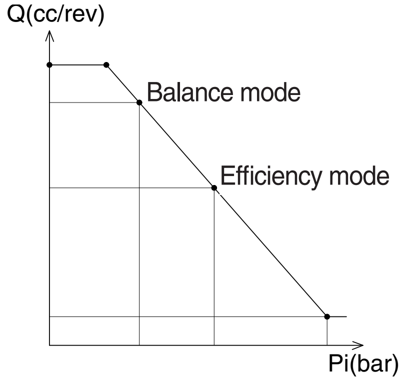
Condition★1	Function
IPC mode : ON★2 Boom up Arm in Not travel motion Not swing motion	Limitation of pump flow rate : Activated
None of upper condition	Limitation of pump flow rate : Canceled

★1 AND condition

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

2. IPC MODE SELECTION

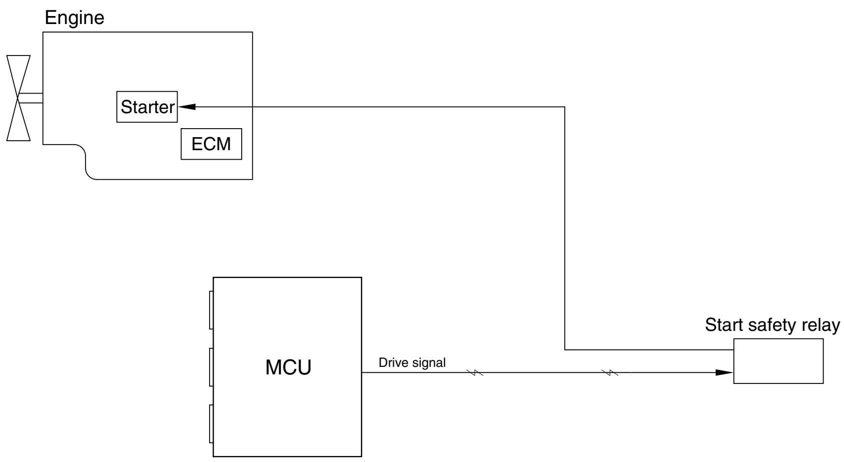
IPC mode ON/OFF and the levels of flow rate limit can be selected at "Mode setup > IPC mode"



290F3CD311

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

GROUP 12 ANTI-RESTART SYSTEM



300L5MS12

1. ANTI-RESTART FUNCTION

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

GROUP 13 SELF-DIAGNOSTIC SYSTEM

1. OUTLINE

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

2. MONITORING

1) Active fault


290F3CD120

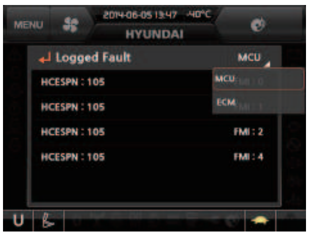
290F3CD121

290F3CD125

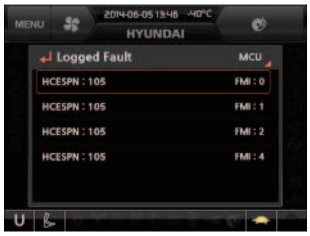
· The active faults of the MCU, engine ECM or air conditioner can be checked by this menu.

2) Logged fault


290F3CD128



290F3CD123

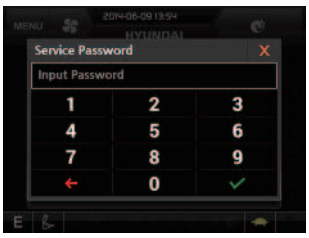


290F3CD124

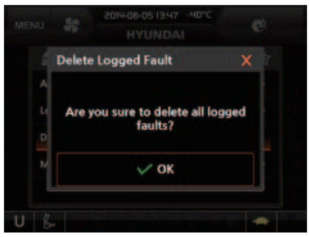
· The logged faults of the MCU, engine ECM or air conditioner can be checked by this menu.

3) Delete logged fault


290F3CD134



290F3CD126



290F3CD127

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

3. MACHINE ERROR CODES TABLE

<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">101</td><td>3</td><td>10 seconds continuous, Hydraulic Oil Temp. Measurement Voltage > 3.8V</td><td>●</td><td></td><td></td></tr>
<tr><td>4</td><td>10 seconds continuous, Hydraulic Oil Temp. Measurement Voltage < 0.3V</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(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</td></tr>
<tr><td rowspan="4">105</td><td>0</td><td>10 seconds continuous, Working Press. Sensor Measurement Voltage > 5.2V</td><td>●</td><td></td><td></td></tr>
<tr><td>1</td><td>10 seconds continuous, 0.3V≤ Working Press. Sensor Measurement Voltage < 0.8V</td><td>●</td><td></td><td></td></tr>
<tr><td>4</td><td>10 seconds continuous, Working Press. Sensor Measurement Voltage < 0.3V</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(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</td></tr>
<tr><td rowspan="4">108</td><td>0</td><td>10 seconds continuous, Travel Oil Press. Sensor Measurement Voltage > 5.2V</td><td></td><td>●</td><td></td></tr>
<tr><td>1</td><td>10 seconds continuous, 0.3V ≤ Travel Oil Press. Sensor Measurement Voltage < 0.8V</td><td>●</td><td></td><td></td></tr>
<tr><td>4</td><td>10 seconds continuous, Travel Oil Press. Sensor Measurement Voltage < 0.3V</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(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</td></tr>
</table>

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

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

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

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

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

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

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

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

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

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

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

DTC		Diagnostic Criteria	Application		
HCESPN	FMI		G	C	W
143	5	(Detection) (When Travel EPPR Current is more than 10 mA) 10 seconds continuous, Travel EPPR drive current = 0 mA (Cancellation) (When Travel EPPR Current is more than 100 mA) 3 seconds continuous, Travel EPPR drive current ≥ 10 mA			●
	6	(Detection) 10 seconds continuous, Travel EPPR drive current > 1.0 A (Cancellation) 3 seconds continuous, Travel EPPR drive current ≤ 1.0 A			●
	(Results / Symptoms) 1. Control Function – cruise control operation failure (Checking list) 1. CN-246 (#2) – CN-54 (#39) Checking Open/Short 2. CN-246 (#1) – CN-51 (#40) Checking Open/Short				
145	5	(Model Parameter) mounting Remote Cooling Fan EPPR (Detection) (When Remote Cooling Fan EPPR Current is more than 10 mA) 10 seconds continuous, Remote Cooling Fan EPPR drive current = 0 mA (Cancellation) (When Remote Cooling Fan EPPR Current is more than 10 mA) 3 seconds continuous, Remote Cooling Fan EPPR drive current ≥ 10 mA	●		
	6	(Detection) 10 seconds continuous, Remote Cooling Fan EPPR drive current > 1.0 A (Cancellation) 3 seconds continuous, Remote Cooling Fan EPPR drive current ≤ 1.0 A	●		
	(Results / Symptoms) 1. Control Function – Remote fan control operation failure (Checking list) 1. CD-52 (#1) – CN-51 (#9) Checking Open/Short 2. CD-52 (#2) – CN-51 (#14) Checking Open/Short				

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

DTC		Diagnostic Criteria	Application		
HCESPN	FMI		G	C	W
164	4	(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			●
	6	(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			●
	(Results / Symptoms) 1. Control Function – (Wheel Excavator) In driving mode, attachment hydraulic pilot pressure cut off failure (Checking list) 1. CR-47 (#85) – CN-54 (#9) Checking Open/Short 2. CR-47 (#30, #86) – CN-45 (#B+ term) Checking Open/Short				
166	4	(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	●		
	6	(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	●		
	(Results / Symptoms) 1. Control Function – Voltage increase operation failure (Checking list) 1. CN-88 (#1) – CN-52 (#2) Checking Open/Short 2. CN-88 (#2) – CN-45 (#B+ term) Checking Open/Short				

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

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

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

<table>
<tr><th colspan="2">DTC</th><th rowspan="2">Diagnostic Criteria</th><th colspan="3">Application</th></tr>
<tr><th>HCESPN</th><th>FMI</th><th>G</th><th>C</th><th>W</th></tr>
<tr><td rowspan="3">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 $\leq$ 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 $\leq$ 6.5 A</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(Results / symptoms)
1. Control Function – Option attachment flow control – Joining operation failure
(Eco breaker mode, crusher mode)
(Checking list)
1. CD-237 (#1) – CN-53 (#7) Checking Open/Short
2. CD-237 (#2) – CR-35 (#87) Checking Open/Short</td></tr>
<tr><td rowspan="3">170</td><td>4</td><td>(Model Parameter) mounting Arm Regenerating Solenoid
(Detection)
(When Arm Regeneration Solenoid is Off)
10 seconds continuous, Arm Regeneration Solenoid drive unit Measurement Voltage $\leq$ 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 $\leq$ 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 $\leq$ 4.5 A</td></tr>
</table>

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

<table>
<tr><th colspan="2">DTC</th><th rowspan="2">Diagnostic Criteria</th><th colspan="3">Application</th></tr>
<tr><th>HCESPN</th><th>FMI</th><th>G</th><th>C</th><th>W</th></tr>
<tr><td rowspan="3">171</td><td>4</td><td>Monitor – Selecting attachment(crusher)
(Detection)
(When Attachment Safety Solenoid is Off)
10 seconds continuous, Attachment Safety Solenoid drive unit Measurement Voltage ≤ 3.0V
(Cancellation)
(When Attachment Safety Solenoid is Off)
3 seconds continuous, Attachment Safety Solenoid drive unit Measurement Voltage > 3.0V</td><td>●</td><td></td><td></td></tr>
<tr><td>6</td><td>(Detection)
(When Attachment Safety Solenoid is On)
10 seconds continuous, Attachment Safety Solenoid drive current > 6.5 A
(Cancellation)
(When Attachment Safety Solenoid is On)
3 seconds continuous, Attachment Safety Solenoid drive current ≤ 6.5 A</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Control Function – Option attachment flow control – Option spool pilot pressure cut off failure (crusher mode)
(Checking list)
1. CD-149 (#1) – CN-53 (#8) Checking Open/Short
2. CD-149 (#2) – CR-35 (#87) Checking Open/Short</td></tr>
<tr><td rowspan="3">179</td><td>4</td><td>Monitor – Selecting attachment(breaker / crusher)
(Detection)
(When Breaker Operating Solenoid is Off)
10 seconds continuous, Attachment Safety Solenoid drive unit Measurement Voltage ≤ 3.0V
(Cancellation)
(When Breaker Operating Solenoid is Off)
3 seconds continuous, Attachment Safety Solenoid drive unit Measurement Voltage > 3.0V</td><td>●</td><td></td><td></td></tr>
<tr><td>6</td><td>(Detection)
(When Breaker Operating Solenoid is On)
10 seconds continuous, Attachment Safety Solenoid drive current > 6.5 A
(Cancellation)
(When Breaker Operating Solenoid is On)
3 seconds continuous, Attachment Safety Solenoid drive current ≤ 6.5 A</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Control Function – Option attachment flow control – Breaker operation failure (breaker mode)
(Checking list)
1. CD-66 (#1) – CN-53 (#9) Checking Open/Short
2. CD-66 (#2) – CN-45 (#B+ term) Checking Open/Short
3. CD-66 (#C) – CN-51 (#13) Checking Open/Short</td></tr>
</table>

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<tr><th colspan="2">DTC</th><th rowspan="2">Diagnostic Criteria</th><th colspan="3">Application</th></tr>
<tr><th>HCESPN</th><th>FMI</th><th>G</th><th>C</th><th>W</th></tr>
<tr><td rowspan="3">181</td><td>4</td><td>(Model Parameter) mounting Reverse Cooling Fan Solenoid
(Detection)
(When Reverse Cooling Fan Solenoid is Off)
10 seconds continuous, Reverse Cooling Fan Solenoid drive unit Measurement Voltage ≤ 3.0V
(Cancellation)
(When Reverse Cooling Fan Solenoid is Off)
3 seconds continuous, Reverse Cooling Fan Solenoid drive unit Measurement Voltage > 3.0V</td><td>●</td><td></td><td></td></tr>
<tr><td>6</td><td>(Detection)
(When Reverse Cooling Fan Solenoid is On)
10 seconds continuous, Reverse Cooling Fan Solenoid drive current > 4.5 A
(Cancellation)
(When Reverse Cooling Fan Solenoid is On)
3 seconds continuous, Reverse Cooling Fan Solenoid drive current ≤ 4.5 A</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Control Function – Cooling Fan reverse control operation failure (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 (#39) Checking Open/Short
2. CN-242 (#1) – CN-52 (#40) Checking Open/Short</td></tr>
</table>

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<table>
<tr><th colspan="2">DTC</th><th rowspan="2">Diagnostic Criteria</th><th colspan="3">Application</th></tr>
<tr><th>HCESPN</th><th>FMI</th><th>G</th><th>C</th><th>W</th></tr>
<tr><td rowspan="3">189</td><td>5</td><td>(Detection)
(When Attachment Flow EPPR 2 current is equal or more than 300 mA)
10 seconds continuous, Attachment Flow EPPR drive current < 100 mA
(Cancellation)
(When Attachment Flow EPPR 2 current is equal or more than 300 mA)
3 seconds continuous, Attachment Flow EPPR drive current ≥ 100 mA</td><td>●</td><td></td><td></td></tr>
<tr><td>6</td><td>(Detection)
10 seconds continuous, Attachment Flow EPPR 2 drive current > 1.0 A
(Cancellation)
3 seconds continuous, Attachment Flow EPPR 2 drive current ≤ 1.0 A</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Control Function – Option attachment flow control operation failure
(Checking list)
1. CN-243 (#2) – CN-52 (#6) Checking Open/Short
2. CN-243 (#1) – CN-52 (#7) Checking Open/Short</td></tr>
<tr><td rowspan="4">196</td><td>0</td><td>HW145
10 seconds continuous,
Attachment flow control EPPR 1 press. Sensor Measurement Voltage > 5.2V</td><td></td><td></td><td></td></tr>
<tr><td>1</td><td>HW145
10 seconds continuous,
0.3V≤ Attachment flow control EPPR 1 press. Sensor Measurement Voltage < 0.8V</td><td></td><td></td><td></td></tr>
<tr><td>4</td><td>HW145
10 seconds continuous,
Attachment flow control EPPR 1 press. Sensor Measurement Voltage < 0.3V</td><td></td><td></td><td></td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Control Function – Driving second pump joining function operation failure
(Checking list)
1. CD-33 (#B) – CN-52 (#11) Checking Open/Short
2. CD-33 (#A) – CN-51 (#3) Checking Open/Short
3. CD-33 (#C) – CN-51 (#13) Checking Open/Short</td></tr>
<tr><td rowspan="4">200</td><td>0</td><td>10 seconds continuous, Pump EPPR Press. Sensor Measurement Voltage > 5.2V</td><td>●</td><td></td><td></td></tr>
<tr><td>1</td><td>10 seconds continuous, 0.3V≤ Pump EPPR Press. Sensor Measurement Voltage < 0.8V</td><td>●</td><td></td><td></td></tr>
<tr><td>4</td><td>10 seconds continuous, Pump EPPR Press. Sensor Measurement Voltage < 0.3V</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Monitor – Pump EPPR Press. display failure
2. Control Function – Pump input horse power control failure, Overload at compensation control operation failure
(Fuel efficiency/speed performance failure)
(Checking list)
1. CD-44 (#B) – CN-52 (#32) Checking Open/Short
2. CD-44 (#A) – CN-51 (#3) Checking Open/Short
3. CD-44 (#C) – CN-51 (#13) Checking Open/Short</td></tr>
</table>

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G : General C : Crawler Type W : Wheel Type

<table>
<tr><th colspan="2">DTC</th><th rowspan="2">Diagnostic Criteria</th><th colspan="3">Application</th></tr>
<tr><th>HCESPN</th><th>FMI</th><th>G</th><th>C</th><th>W</th></tr>
<tr><td rowspan="4">205</td><td>0</td><td>(Mounting pressure sensor)
10 seconds continuous, Boom Cylinder Rod Press. Sensor Measurement Voltage > 5.2V</td><td>●</td><td></td><td></td></tr>
<tr><td>1</td><td>(Mounting pressure sensor)
10 seconds continuous, 0.3V$\le$ Boom Cylinder Rod Press. Sensor Measurement Voltage < 0.8V</td><td>●</td><td></td><td></td></tr>
<tr><td>4</td><td>(Mounting pressure sensor)
10 seconds continuous, Boom Cylinder Rod Press. Sensor Measurement Voltage < 0.3V</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Monitor – Boom Cylinder Rod Press. display failure
2. Control Function – Boom floating control operation failure
(Checking list)
1. CD-124 (#B) – CN-53 (#5) Checking Open/Short
2. CD-124 (#A) – CN-53 (#3) Checking Open/Short
3. CD-124 (#C) – CN-53 (#13) Checking Open/Short</td></tr>
<tr><td rowspan="3">218</td><td>4</td><td>Mounting pressure sensor (HCESPN128 or HCESPN 205)
(Detection)
(When Boom Up Floating Solenoid is Off)
10 seconds continuous, Boom Up Floating Solenoid drive unit Measurement Voltage ≤ 3.0V
(Cancellation)
(When Boom Up Floating Solenoid is Off)
3 seconds continuous, Boom Up Floating Solenoid drive unit Measurement Voltage > 3.0V</td><td>●</td><td></td><td></td></tr>
<tr><td>6</td><td>(Detection)
(When Boom Up Floating Solenoid is On)
10 seconds continuous, Boom Up Floating Solenoid drive current > 6.5 A
(Cancellation)
(When Boom Up Floating Solenoid is On)
3 seconds continuous, Boom Up Floating Solenoid drive current ≤ 6.5 A</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Control Function – Boom floating control operation failure
(Checking list)
1. CD-368 (#1) – CN-53 (#20) Checking Open/Short
2. CD-368 (#2) – CR-35 (#87) Checking Open/Short</td></tr>
</table>

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<tr><th colspan="2">DTC</th><th rowspan="2">Diagnostic Criteria</th><th colspan="3">Application</th></tr>
<tr><th>HCESPN</th><th>FMI</th><th>G</th><th>C</th><th>W</th></tr>
<tr><td rowspan="3">220</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</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>

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<tr><th colspan="2">DTC</th><th rowspan="2">Diagnostic Criteria</th><th colspan="3">Application</th></tr>
<tr><th>HCESPN</th><th>FMI</th><th>G</th><th>C</th><th>W</th></tr>
<tr><td rowspan="3">222</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 (#30) Checking Open/Short
2. CR-46 (#86) – CN-45 (#B+ term) Checking Open/Short</td></tr>
</table>

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G : General C : Crawler Type W : Wheel Type

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

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G : General C : Crawler Type W : Wheel Type

DTC		Diagnostic Criteria	Application		
HCESPN	FMI		G	C	W
514	4	(Detection) (When Parking Relay is Off) 10 seconds continuous, Parking Relay drive unit Measurement Voltage ≤ 3.0V (Cancellation) (When Parking Relay is Off) 3 seconds continuous, Parking Relay drive unit Measurement Voltage > 3.0V			●
	6	(Detection) (When Parking Relay is On) 10 seconds continuous, Parking Relay drive current > 6.5 A (Cancellation) (When Parking Relay is On) 3 seconds continuous, Parking Relay drive current ≤ 6.5 A			●
	(Results / Symptoms) 1. Control Function – Parking Relay operation failure (Checking list) 1. CR-66 (#1) – CN-54 (#20) Checking Open/Short 2. CR-66 (#2) – CN-45 (#B+ term) Checking Open/Short				
517	4	(Detection) (When Traveling Cutoff Relay is Off) 10 seconds continuous, Traveling Cutoff Relay drive unit Measurement Voltage ≤ 3.0V (Cancellation) (When Traveling Cutoff Relay is Off) 3 seconds continuous, Traveling Cutoff Relay drive unit Measurement Voltage > 3.0V			●
	6	(Detection) (When Traveling Cutoff Relay is On) 10 seconds continuous, Traveling Cutoff Relay drive current > 6.5 A (Cancellation) (When Traveling Cutoff Relay is On) 3 seconds continuous, Traveling Cutoff Relay drive current ≤ 6.5 A			●
	(Results / Symptoms) 1. Control Function – Traveling Cutoff Relay operation failure (Checking list) 1. CR-47 (#85) – CN-54 (#9) Checking Open/Short 2. CR-47 (#86) – CN-45 (#B+ term) Checking Open/Short				

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G : General C : Crawler Type W : Wheel Type

DTC		Diagnostic Criteria	Application		
HCESPN	FMI		G	C	W
525	4	(Detection) (When Ram Lock Solenoid is Off) 10 seconds continuous, Ram Lock Solenoid drive unit Measurement Voltage ≤ 3.0V (Cancellation) (When Ram Lock Solenoid is Off) 3 seconds continuous, Ram Lock Solenoid drive unit Measurement Voltage > 3.0V			●
	6	(Detection) (When Ram Lock Solenoid is On) 10 seconds continuous, Ram Lock Solenoid drive current > 6.5 A (Cancellation) (When Ram Lock Solenoid is On) 3 seconds continuous, Ram Lock Solenoid drive current ≤ 6.5 A			●
	(Results / Symptoms) 1. Control Function – Ram lock control operation failure (Checking list) 1. CN-69 (#1) – CN-54 (#8) Checking Open/Short 2. CN-69 (#2) – CN-45 (#B+ term) Checking Open/Short				
527	4	(Detection) (When Creep Solenoid is Off) 10 seconds continuous, Creep Solenoid drive unit Measurement Voltage ≤ 3.0V (Cancellation) (When Creep Solenoid is Off) 3 seconds continuous, Creep Solenoid drive unit Measurement Voltage > 3.0V			●
	6	(Detection) (When Creep Solenoid is On) 10 seconds continuous, Creep Solenoid drive current > 6.5 A (Cancellation) (When Creep Solenoid is On) 3 seconds continuous, Creep Solenoid drive current ≤ 6.5 A			●
	(Results / Symptoms) 1. Control Function – Creep mode operation failure (Checking list) 1. CN-206 (#1) – CN-54 (#7) Checking Open/Short 2. CN-206 (#2) – CN-45 (#B+ term) Checking Open/Short				

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<tr><th colspan="2">DTC</th><th rowspan="2">Diagnostic Criteria</th><th colspan="3">Application</th></tr>
<tr><th>HCESPN</th><th>FMI</th><th>G</th><th>C</th><th>W</th></tr>
<tr><td rowspan="4">530</td><td>0</td><td>10 seconds continuous, Travel Forward Press. Sensor Measurement Voltage > 5.2V</td><td></td><td></td><td>●</td></tr>
<tr><td>1</td><td>10 seconds continuous, 0.3V≤ Travel Forward Press. Sensor Measurement Voltage < 0.8V</td><td></td><td></td><td>●</td></tr>
<tr><td>4</td><td>10 seconds continuous, Travel Forward Press. Sensor Measurement Voltage < 0.3V</td><td></td><td></td><td>●</td></tr>
<tr><td colspan="5">(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</td></tr>
<tr><td rowspan="3">531</td><td>1</td><td>10 seconds continuous, 0.3V≤ Travel Reverse Press. Sensor Measurement Voltage < 0.8V</td><td></td><td></td><td>●</td></tr>
<tr><td>4</td><td>10 seconds continuous, Travel Reverse Press. Sensor Measurement Voltage < 0.3V</td><td></td><td></td><td>●</td></tr>
<tr><td colspan="5">(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</td></tr>
<tr><td rowspan="3">705</td><td>0</td><td>10 seconds continuous, Battery input Voltage > 35V</td><td>●</td><td></td><td></td></tr>
<tr><td>1</td><td>10 seconds continuous, Battery input Voltage < 18V</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Control Function – Startup impossibility
(Checking list)
1. CS-74A (#1) – CN-51 (#1) Checking Open/Short</td></tr>
<tr><td rowspan="2">707</td><td>1</td><td>(When Engine is equal or more than 400 rpm) 10 seconds continuous, Alternator Node I Measurement Voltage < 18V
(In case 12v goods, Alternator Node I Measurement Voltage < 9V)</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Control Function – Battery charging circuit failure
(Checking list)
1. CS-74A (#1) – CN-51 (#2) Checking Open/Short</td></tr>
</table>

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

DTC HCESPN	FMI	Diagnostic Criteria	Application G	C	W
714	3	(Model Parameter) Mounting Acc. Dial 10 seconds continuous, Acc. Dial Measurement Voltage > 5.2V	●		
	4	(Model Parameter) Mounting Acc. Dial 10 seconds continuous, Acc. Dial Measurement Voltage < 0.3V	●		
	(Results / Symptoms) 1. Monitor – Acc. Dial Voltage display failure 2. Control Function – Engine rpm control failure (Checking list) 1. CN-7 (#15) – CN-52 (#23) Checking Open/Short				
722	4	(Detection) (When Travel Alarm (Buzzer) Sound is Off) 10 seconds continuous, Travel Alarm (Buzzer) Sound Relay drive unit Measurement Voltage ≤ 3.0V (Cancellation) (When Travel Alarm (Buzzer) Sound Relay is Off) 3 seconds continuous, Travel Alarm (Buzzer) Sound Relay drive unit Measurement Voltage > 3.0V		●	
	6	(Detection) (When Travel Alarm (Buzzer) Sound is On) 10 seconds continuous, Travel Alarm (Buzzer) Sound Relay drive current > 4.5 A (Cancellation) (When Travel Alarm (Buzzer) Sound is On) 3 seconds continuous, Travel Alarm (Buzzer) Sound Relay drive current ≤ 4.5 A		●	
	(Results / Symptoms) 1. Control Function – Driving alarm operation failure (Checking list) 1. CN-81 (#1) – CN-52 (#31) Checking Open/Short 2. CN-81 (#2) – CN-45 (#B+ term) Checking Open/Short				
831	2	(When mounting the A/C Controller) 60 seconds continuous, A/C Controller Communication Data Error	●		
	(Results / Symptoms) 1. Control Function – A/C Controller operation failure (Checking list) 1. CN-11 (#8) – CN-51 (#22) Checking Open/Short 2. CN-11 (#7) – CN-51 (#32) Checking Open/Short				
840	2	60 seconds continuous, Cluster Communication Data Error	●		
	(Results / Symptoms) 1. Control Function – Cluster operation failure (Checking list) 1. CN-56A (#7) – CN-51 (#22) Checking Open/Short 2. CN-56A (#6) – CN-51 (#32) Checking Open/Short				

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

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

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

<table>
<tr><th colspan="2">DTC</th><th rowspan="2">Diagnostic Criteria</th><th colspan="3">Application</th></tr>
<tr><th>HCESPN</th><th>FMI</th><th>G</th><th>C</th><th>W</th></tr>
<tr><td rowspan="2">866</td><td>2</td><td>(When mounting the AAVM)
60 seconds continuous, AAVM communication Data Error</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Control Function – AAVM operation failure
(Checking list)
1. CN-401 (#86) – CN-51 (#22) Checking Open/Short
2. CN-401 (#87) – CN-51 (#32) Checking Open/Short</td></tr>
<tr><td rowspan="2">867</td><td>2</td><td>60 seconds continuous, RDU communication Data Error</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Control Function – RDU operation failure
(Checking list)
1. CN-376 (#10) – CN-51 (#22) Checking Open/Short
2. CN-376 (#18) – CN-51 (#32) Checking Open/Short</td></tr>
<tr><td rowspan="2">868</td><td>2</td><td>60 seconds continuous, Switch Controller communication Data Error</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Control Function – Switch Controller operation failure
(Checking list)
1. CN-56A (#7) – CN-51 (#22) Checking Open/Short
2. CN-56A (#6) – CN-51 (#32) Checking Open/Short</td></tr>
<tr><td rowspan="2">869</td><td>2</td><td>(When mounting the BKCU)
60 seconds continuous, BKCU communication Data Error</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Control Function – BKCU operation failure
(Checking list)
1. CS-2B (#A) – CN-51 (#22) Checking Open/Short
2. CS-2B (#B) – CN-51 (#32) Checking Open/Short</td></tr>
</table>

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

4. ENGINE FAULT CODE

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

※ Some fault codes are not applied to this machine.

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

※ Some fault codes are not applied to this machine.

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

※ Some fault codes are not applied to this machine.

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

※ Some fault codes are not applied to this machine.

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

※ Some fault codes are not applied to this machine.

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

※ Some fault codes are not applied to this machine.

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

※ Some fault codes are not applied to this machine.

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

※ Some fault codes are not applied to this machine.

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

※ Some fault codes are not applied to this machine.

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

※ Some fault codes are not applied to this machine.

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

※ Some fault codes are not applied to this machine.

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

※ Some fault codes are not applied to this machine.

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

※ Some fault codes are not applied to this machine.

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

※ Some fault codes are not applied to this machine.

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

※ Some fault codes are not applied to this machine.

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

※ Some fault codes are not applied to this machine.

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

※ Some fault codes are not applied to this machine.

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

※ Some fault codes are not applied to this machine.

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

※ Some fault codes are not applied to this machine.

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

※ Some fault codes are not applied to this machine.

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

※ Some fault codes are not applied to this machine.

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

※ Some fault codes are not applied to this machine.

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

※ Some fault codes are not applied to this machine.

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

※ Some fault codes are not applied to this machine.

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

※ Some fault codes are not applied to this machine.

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

※ Some fault codes are not applied to this machine.

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

※ Some fault codes are not applied to this machine.

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

※ Some fault codes are not applied to this machine.

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

※ Some fault codes are not applied to this machine.

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

※ Some fault codes are not applied to this machine.

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

※ Some fault codes are not applied to this machine.

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

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

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

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

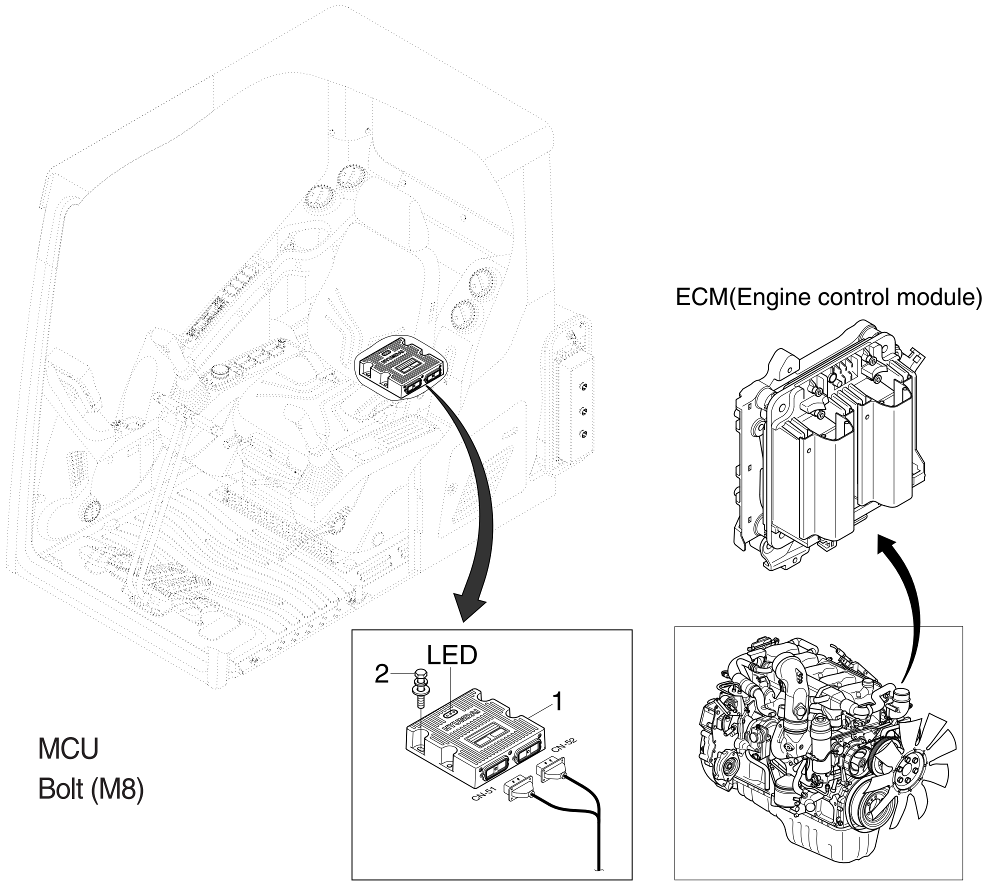
Fault code J1939 SPN J1939 FMI	Name	Description
0475 5543 6	Engine Exhaust Brake Actuator Command	Exhaust brake actuator, faulty
1411 5543 7	Engine Exhaust Brake Actuator Command	Exhaust brake actuator, stuck in closed position
1428 5543 12	Engine Exhaust Brake Actuator Command	Exhaust brake actuator,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

5. AAVM FAULT CODE

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

GROUP 14 ENGINE CONTROL SYSTEM

1. MCU and Engine ECM (Electronic Control Module)



1 MCU
2 Bolt (M8)

480F5MS10

2. MCU ASSEMBLY

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

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

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

G : green, R : red, Y : yellow

GROUP 15 EPPR VALVE

1. PUMP EPPR VALVE

1) COMPOSITION

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

(1) Electro magnet valve

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

(2) Spool valve

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

(3) Pressure and electric current value for each mode

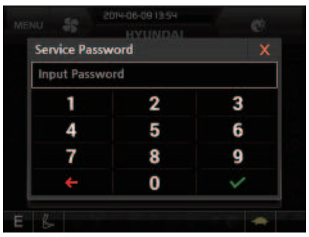
Mode		Pressure		Electric current (mA)	Engine rpm (at accel dial 10)
		kgf/cm²	psi		
Standard	P	8	114	290 ± 30	1850 ± 50
	S	12 ± 3	171 ± 40	360 ± 30	1750 ± 50
	E	12 ± 3	171 ± 40	360 ± 30	1650 ± 50
Option	P	5	71	250 ± 30	1750 ± 50
	S	7 ± 3	100 ± 40	280 ± 30	1700 ± 50
	E	12 ± 3	171 ± 40	360 ± 30	1600 ± 50

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

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

- Management
  · Service menu

290F3CD149



Enter the password

290F3CD126

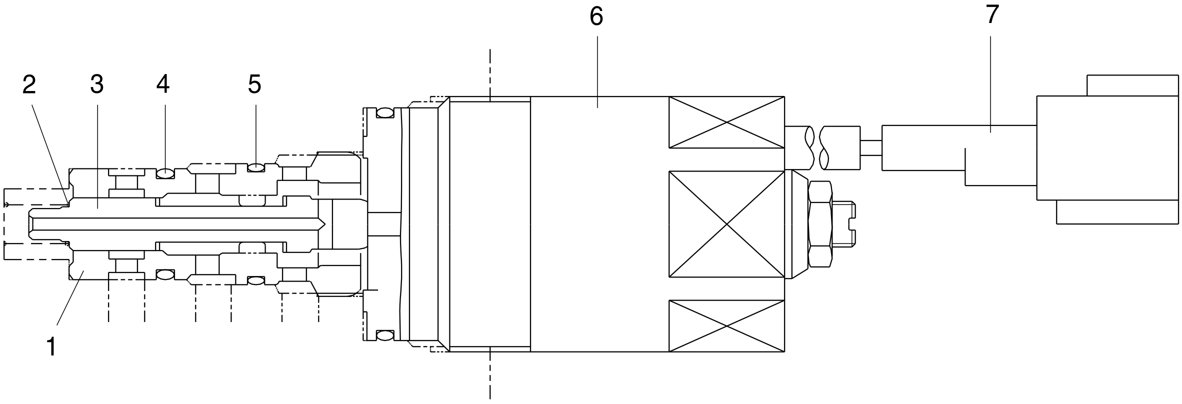
290F3CD150

290F3CD151

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

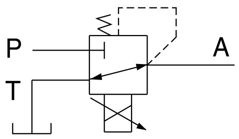
3) OPERATING PRINCIPLE (pump EPPR valve)

(1) Structure



5-22(1)

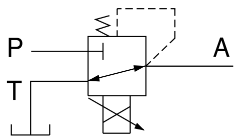
1	Sleeve	4	O-ring	6	Solenoid valve
2	Spring	5	O-ring	7	Connector
3	Spool				

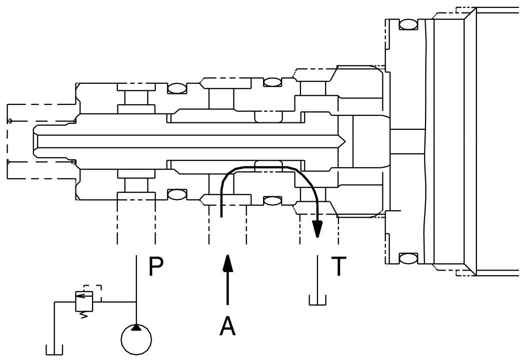


P Pilot oil supply line (pilot pressure)
T Return to tank
A Secondary pressure to flow regulator at main pump

(2) Neutral

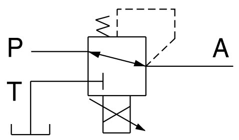
Pressure line is blocked and A oil returns to tank.

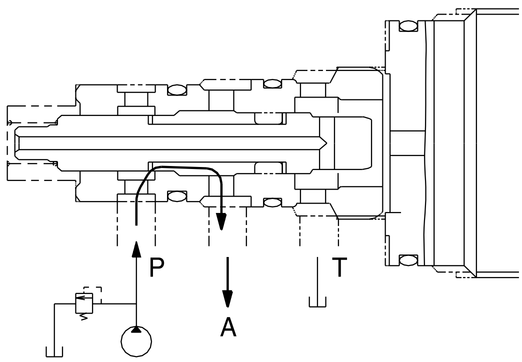




(3) Operating

Secondary pressure enters into A.

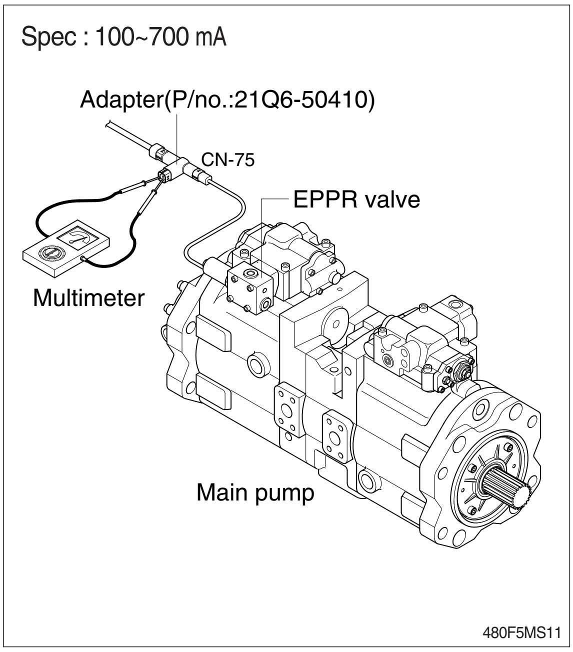




5-22(2)

4) EPPR VALVE CHECK PROCEDURE

(1) Check electric current value at EPPR valve



① Disconnect connector CN-75 from EPPR valve.

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

③ Start engine.

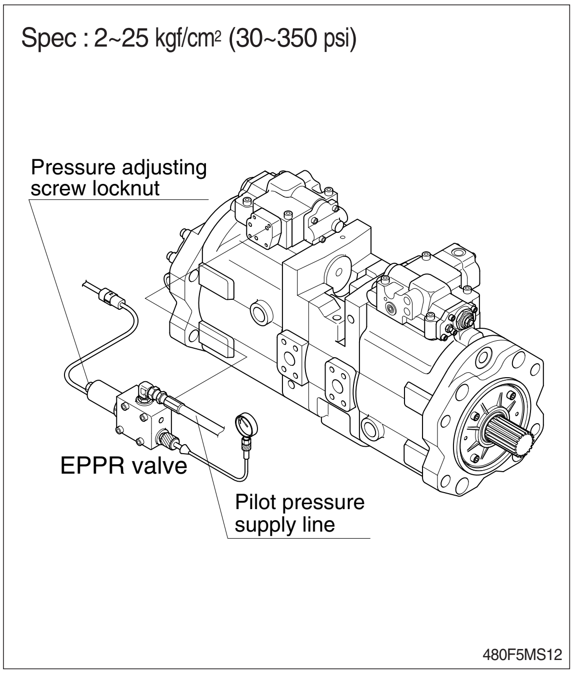
④ Set S-mode and cancel auto decel mode.

⑤ Position the accel dial at 10.

⑥ If rpm display show approx 1750±50 rpm check electric current at bucket circuit relief position.

⑦ Check electric current at bucket circuit relief position.

(2) Check pressure at EPPR valve



① Remove plug and connect pressure gauge as figure.

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

② Start engine.

③ Set S-mode and cancel auto decel mode.

④ Position the accel dial at 10.

⑤ If tachometer show approx 1750±50 rpm check pressure at relief position of bucket circuit by operating bucket control lever.

⑥ If pressure is not correct, adjust it.

⑦ After adjust, test the machine.

2. BOOM PRIORITY EPPR VALVE

1) COMPOSITION

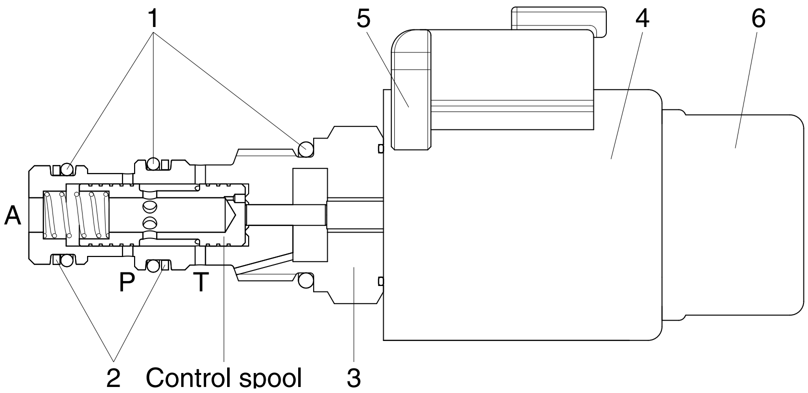
The boom priority EPPR valve is built in a manifold and mainly consisting of valve body and coil. This EPPR valve installed under the solenoid valve.

2) CONTROL

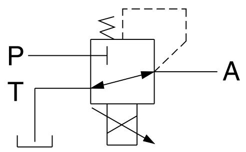
The boom priority EPPR valve has to be controlled by a specific electronic amplifier card, which is supplying the coil with a current 580 mA at 30 Ω and 24 V.

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.

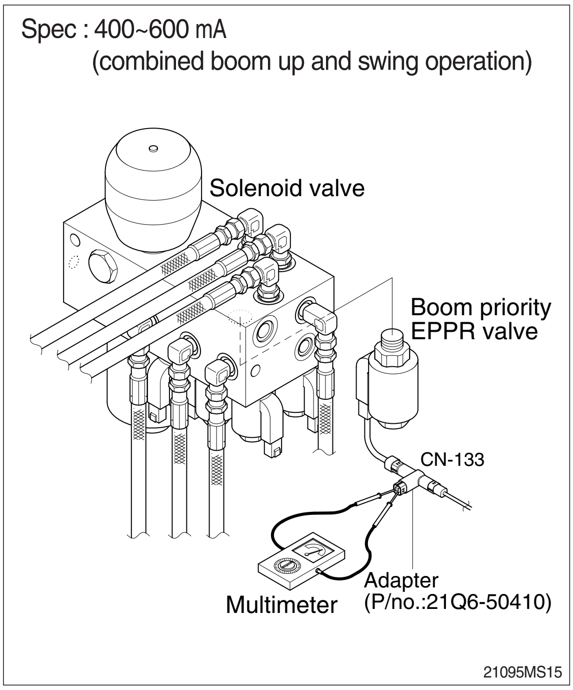
② Insert the adapter to CN-133 and install multimeter as figure.

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/cm² (0 to 725 psi)

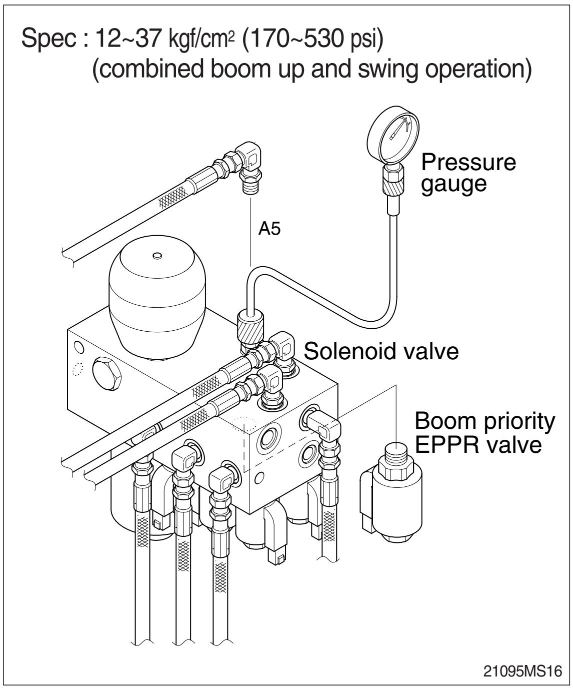
② Start engine.

③ Set S-mode and cancel auto decel mode.

④ If rpm display approx 1750±50 rpm check pressure (In case of combined boom up and swing operation).

⑤ If pressure is not correct, adjust it.

⑥ After adjust, test the machine.



GROUP 16 MONITORING SYSTEM

1. OUTLINE

Monitoring system consists of the monitor part and switch part.

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

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

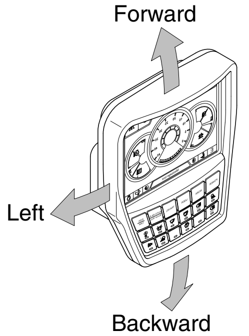
2. CLUSTER

1) MONITOR PANEL

480F5MS13

※ The warning lamp pops up and/or blinks and the buzzer sounds when the machine has a problem.
The warning lamp blinks until the problem is cleared. Refer to page 5-70 for details.

※ This cluster is adjustable.
- Vertical (forward/backward) : each 15°
- Horizontal (left only) : 8°



290F3CD47

2) CLUSTER CHECK PROCEDURE

(1) Start key : ON

① Check monitor

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

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

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

a. Engine rpm display : 0 rpm

b. Engine coolant temperature gauge : White range

c. Hydraulic oil temperature gauge : White range

d. Fuel level gauge : White range

③ Indicating lamp state

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

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

c. Travel speed pilot lamp : Low (turtle)

(2) Start of engine

① Check machine condition

a. RPM display indicates at present rpm

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

※ When normal condition : All warning lamp OFF

c. Work mode selection : General work

d. Power mode selection : E mode or U mode

e. Travel speed pilot lamp : Low (turtle)

② When warming up operation

a. Warming up pilot lamp : ON

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

※ Others same as above.

③ When abnormal condition

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

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

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

3. CLUSTER CONNECTOR

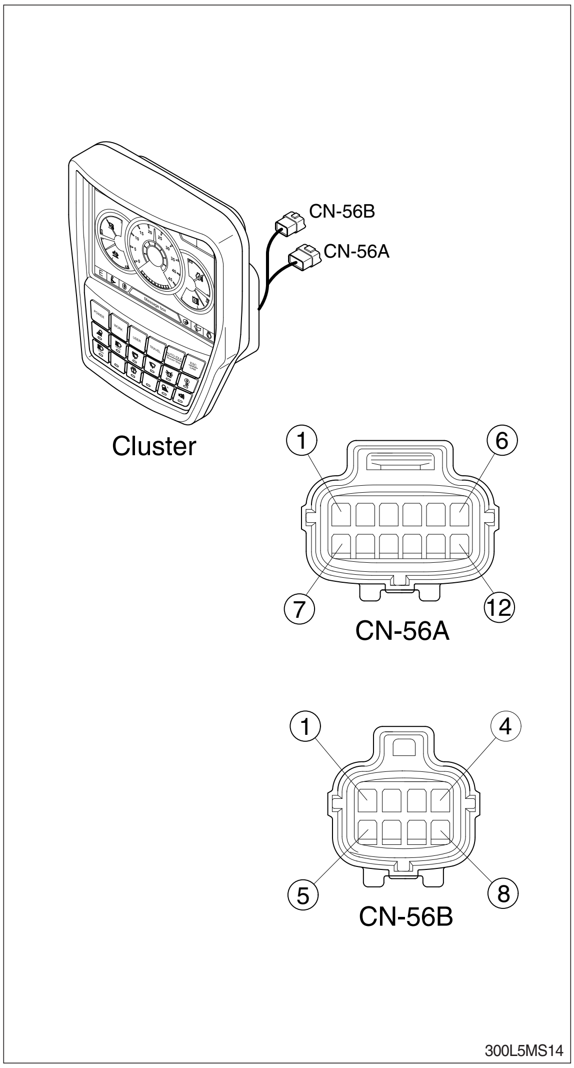
1) CN-56A

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

2) CN-56B

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

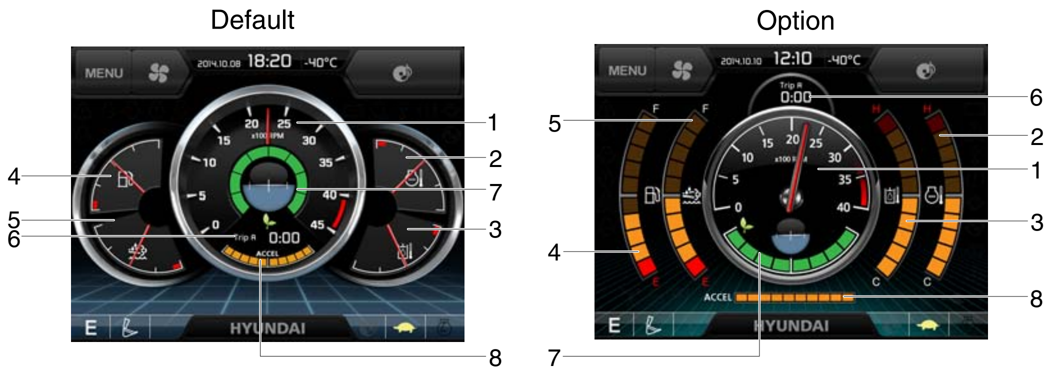
NTSC : National Television System Committee



2) GAUGE

(1) Operation screen

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



290F3CD51

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

※ **Operation screen type can be set by the screen type menu of the display.**
Refer to page 5-91 for details.

(2) RPM / Speed gauge

290F3CD49

① This display the engine speed.

(3) Engine coolant temperature gauge

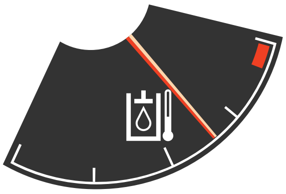
290F3CD53

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

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

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

(4) Hydraulic oil temperature gauge



290F3CD54

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

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

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

(5) Fuel level gauge

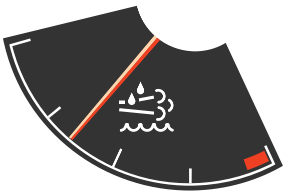
290F3CD55

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

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

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

(6) DEF/AdBlue® Level gauge



290F3CD57

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

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

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

※ Refer to page 5-75.

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

(7) Tripmeter display

290F3CD56

① This displays the engine the tripmeter.

※ Refer to page 5-93 for details.

(8) Eco gauge

290F3CD58

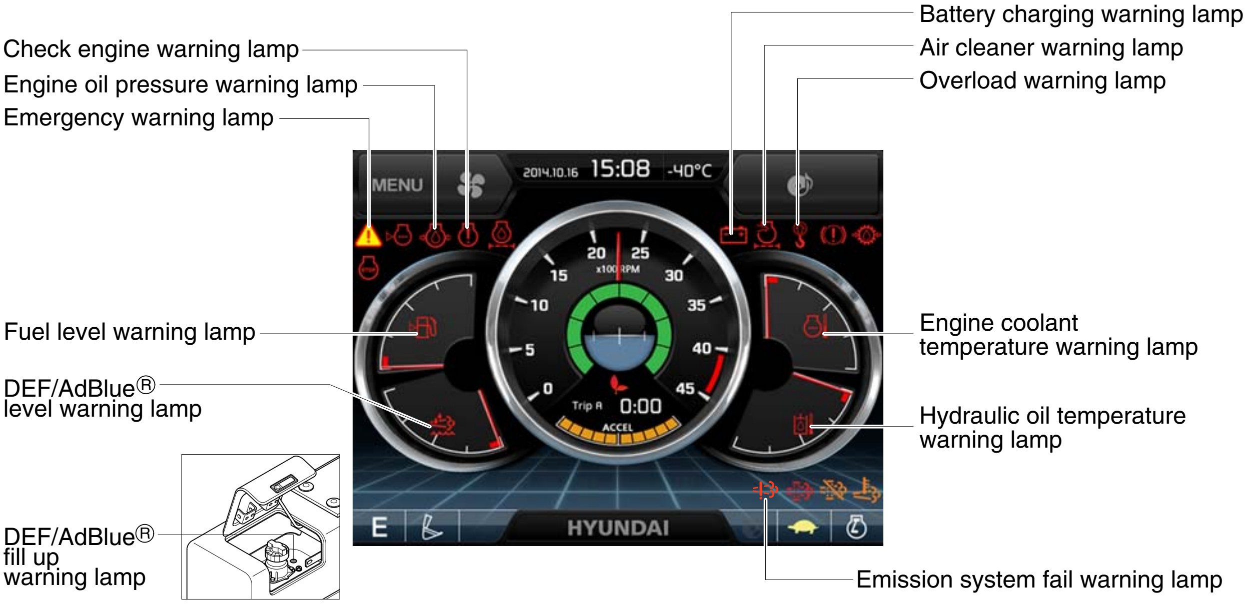
① This gauge indicates the fuel consumption rate and machine load status. So that operators can be careful with fuel economy.
② The fuel consumption rate or machine load is higher, the number of segment is increased.
③ The color of Eco gauge indicates operation status.
- White : Idle operation
- Green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

(9) Accel dial gauge

290F3CD59

① This gauge indicates the level of accel dial.

3) WARNING LAMPS



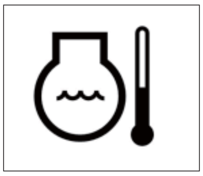
480F3CD60

※ Warning lamps and buzzer

Warnings	When error happened	Lamps and buzzer
All warning lamps except below	Warning lamp pops up on the center of the LCD and the buzzer sounds	· The pop-up warning lamp moves to the original position and blinks, and the buzzer stops when ; - the buzzer stop switch is pushed - the knob of the haptic controller is pushed - the lamp of the LCD is touched
	Warning lamp pops up on the center of the LCD and the buzzer sounds	· The pop-up warning lamp moves to the original position and light ON or blinks, and the buzzer stops when ; - the buzzer stop switch is pushed - the knob of the haptic controller is pushed - the lamp of the LCD is touched ※ **Refer to page 5-74 for details.**
 	Warning lamp pops up on the center of the LCD and the buzzer sounds	※ **Refer to page 5-71 for details.**

※ Refer to page 5-79 for the buzzer stop switch and operator's manual page 3-55 for the haptic controller.

(1) Engine coolant temperature warning lamp



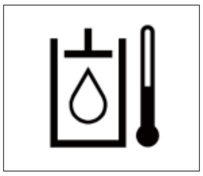
290F3CD61

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

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

③ Check the cooling system when the lamps keep blink.

(2) Hydraulic oil temperature warning lamp



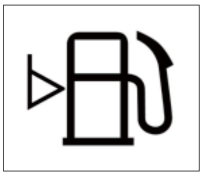
290F3CD62

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

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

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

(3) Fuel level warning lamp



290F3CD63

① This warning lamp pops up and the buzzer sounds when the level of fuel is below 92 ℓ (24.3 U.S. gal).

② Fill the fuel immediately when the lamp blinks.

(4) Emergency warning lamp

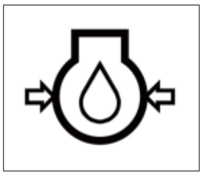
290F3CD64

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

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

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

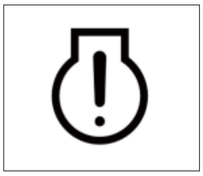
(5) Engine oil pressure warning lamp



290F3CD65

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

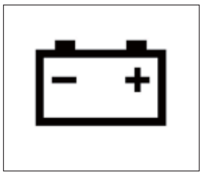
(6) Check engine warning lamp



290F3CD66

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

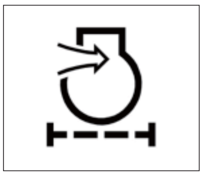
(7) Battery charging warning lamp



290F3CD67

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

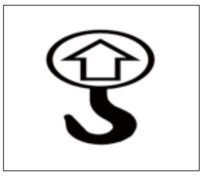
(8) Air cleaner warning lamp



290F3CD68

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

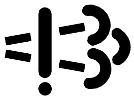
(9) Overload warning lamp (opt)



290F3CD69

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

(10) Emission system fail warning lamp

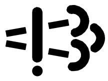


770F3CD70

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

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

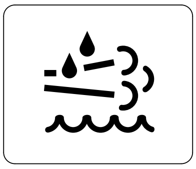
※ Please contact your HD Hyundai Construction Equipment service center or local dealer.

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

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

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

(11) DEF/AdBlue® level warning lamp



290F3CD257

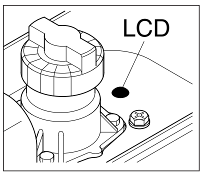
① This warning lamp indicates when ON or blinking, that the DEF/AdBlue® level is low as table below.

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

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

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

(12) DEF/AdBlue® fill up warning lamp



290F3CD272

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

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

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

4) PILOT LAMPS

290F3CD74

(1) Mode pilot lamps

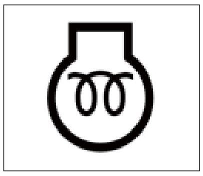
No	Mode	Pilot lamp	Selected mode
1	Power mode	P	Heavy duty power work mode
		S	Standard power mode
		E	Economy power mode
2	User mode	U	User preferable power mode
3	Work tool mode		General operation - IPC speed mode
			General operation - IPC balance mode
			General operation - IPC efficiency mode
	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

(2) Power max pilot lamp

290F3CD78

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

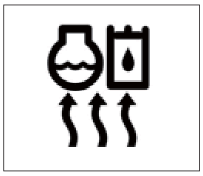
(3) Preheat pilot lamp



290F3CD79

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

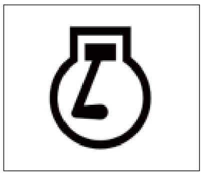
(4) Warming up pilot lamp



290F3CD80

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

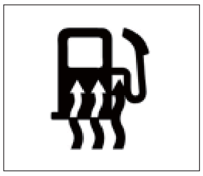
(5) Decel pilot lamp



290F3CD81

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

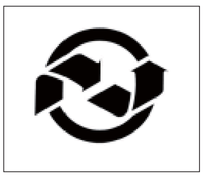
(6) Fuel warmer pilot lamp



290F3CD82

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

(7) Maintenance pilot lamp



290F3CD83

① This lamp will be ON when the consuming parts are needed to change or replace. It means that the change or replacement interval of the consuming parts remains below 30 hours.
② Check the message in maintenance information of main menu. Also, this lamp lights ON for 3 minutes when the start switch is ON position.
※ **Refer to the page 5-86.**

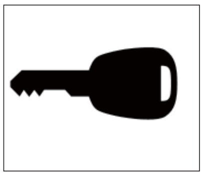
(8) Entertainment pilot lamp

290F3CD84

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

※ Refer to the page 5-91.

(9) Smart key pilot lamp (opt)



290F3CD214

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

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

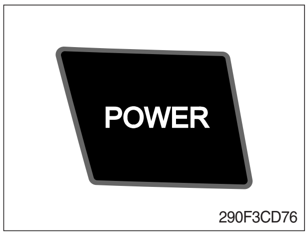
※ Refer to the page 5-87

5) SWITCHES

290F3CD86

※ When some of the switches are selected, the pilot lamps are displayed on the LCD. Refer to the page 5-75 for details.

(1) Power mode switch



290F3CD76

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

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

(2) Work mode switch

290F3CD88

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

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

(3) User mode switch

290F3CD89

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

② Refer to the page 5-83 for another set of user mode.

(4) Travel speed switch

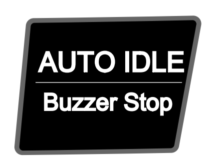
290F3CD91

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

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

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

(5) Auto idle/ buzzer stop switch



290F3CD90

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

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

(6) Escape/Camera switch

290F3CD92

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

② In the operation screen, pushing this switch will display the view of the camera on the machine (if equipped).
Please refer to page 5-92 for the camera.

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

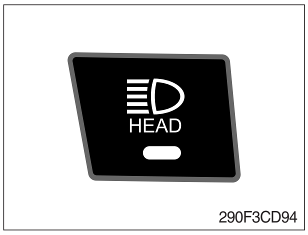
(7) Work light switch


290F3CD93

① This switch is used to operate the work light.

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

(8) Head light switch



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

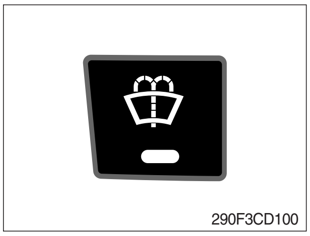
(9) Intermittent wiper switch

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

(10) Wiper switch

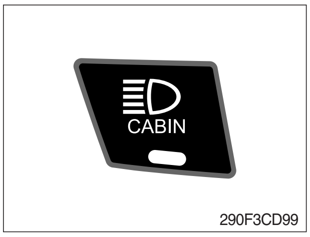
① This switch is used to operate the window wiper.
② Note that the wiper will self-park when switched off.
③ The pilot lamp is turned ON when operating the switch.
※ **If the wiper does not operate with the switch in ON position, turn the switch OFF immediately. Check the cause. If the switch remains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

(11) Washer switch



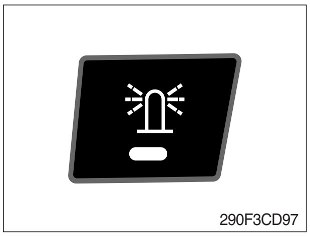
① The washer liquid is sprayed and the wiper is operated only while pressing this switch.
② The pilot lamp is turned ON when operating the switch.

(12) Cab light switch



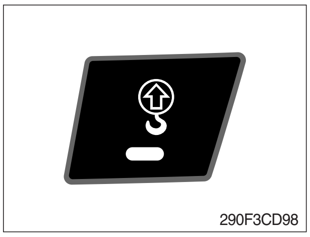
① This switch turns ON the cab light on the cab.
② The pilot lamp is turned ON when operating the switch.

(13) Beacon switch



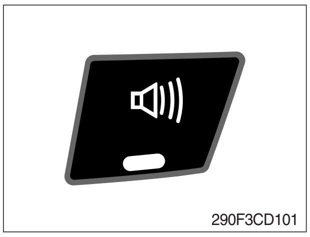
① This switch turns ON the rotary light on the cab.
② The pilot lamp is turned ON when operating the switch.

(14) Overload switch



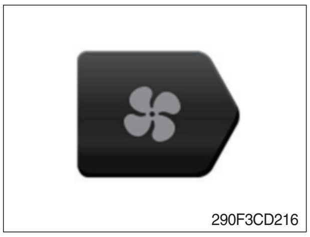
① When this switch turned ON, buzzer makes sound and overload warning lamp comes ON in case that the machine is overload.
② When it turned OFF, buzzer stops and warning lamp goes out.
⚠ **Overloading the machine could impact the machines stability which could result in tipover hazard. A tipover hazard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

(15) Travel alarm switch



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

(16) Air conditioner quick touch switch



① This switch used to select air conditioner control mode.
※ Refer to the page 5-94.

(17) Main menu quick touch switch

① This switch is to activate the main menu in the cluster.
※ Refer to the page 5-82.

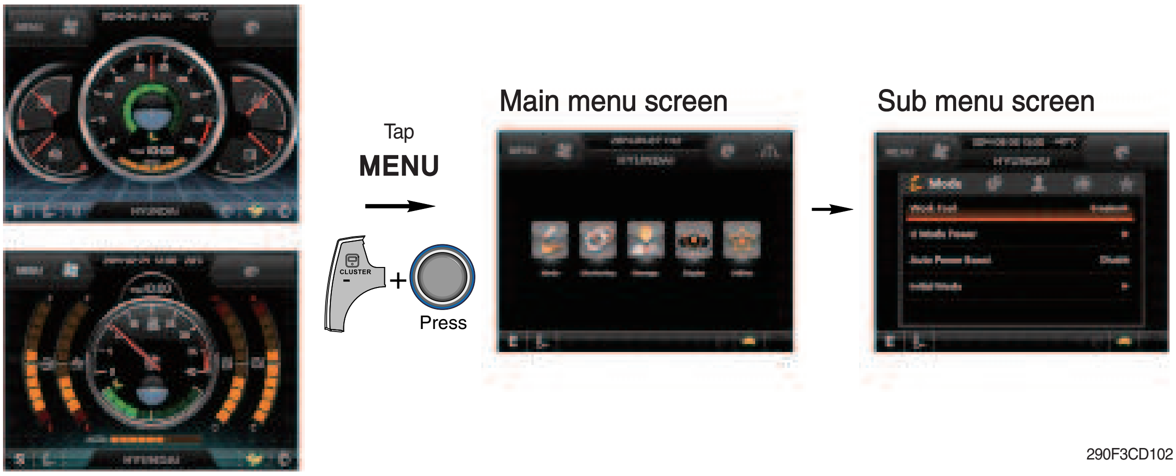
(18) Entertainment quick touch switch

① This switch is to activate the entertainment control menu in the cluster.
※ Refer to the page 5-91.

6) MAIN MENU

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

· Operation screen



290F3CD102

※ Please refer to the haptic controller, operator's manual page 3-55 for selection and change of menu and input value.

(1) Structure

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

(2) Mode setup

① Work tool

210WF3CD108

290F3CD253

A

290F3CD254

B

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

② U mode power

210WF3CD111

290F3CD112

Step (▮)	Engine speed (rpm)	Idle speed (rpm)	Power shift (bar)
1	1200	800	0
2	1300	850	3
3	1350	900	6
4	1450	950	9
5	1550	1000 (auto decel)	12
6	1650	1050	16
7	1700	1100	20
8	1750	1150	26
9	1800	1200	32
10	1850	1250	38

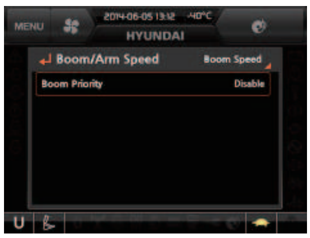
※One touch decel & low idle : 800 rpm

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

③ Boom speed

210WF3CD113

290F3CD114



290F3CD115

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

④ Auto power boost

210WF3CD118

290F3CD117

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

⑤ IPC mode

290F3CD310

290F3CD311

290F3CD304

290F3CD312

290F3CD305

290F3CD313

290F3CD306

· The IPC mode can be selected by this menu.
 - Speed mode
 - Balance mode (default)
 - Efficiency mode
· This mode is applied only general operation mode of the work tool mode.
※ Please update the cluster programs if this mode is not displayed in the mode setup menu. Refer to the operator's manual page 3-24-1.

⑥ Automatic engine shutdown (option)

210WF3CD11

210WF3CD12

210WF3CD13

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

⑦ Initial mode

290F3CD122

290F3CD119

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

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

· Accel initial step
  - 0~9 step

⑧ Emergency mode

290F3CD248

290F3CD249

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

(3) Monitoring

① Active fault

290F3CD120

290F3CD121

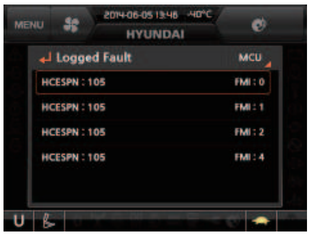
290F3CD125

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

② Logged fault

290F3CD128

290F3CD123

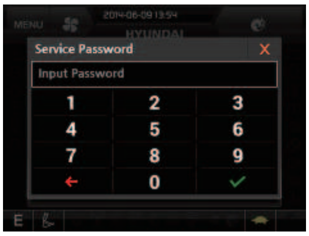


290F3CD124

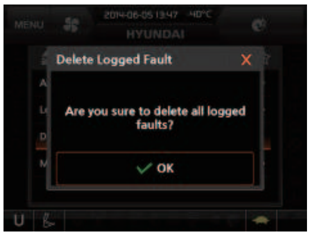
· The logged faults of the MCU, engine ECM or air conditioner can be checked by this menu.

③ Delete logged fault

290F3CD134



290F3CD126

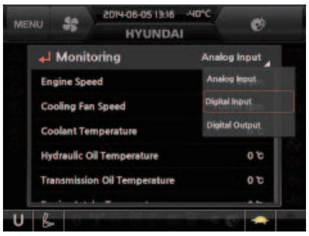


290F3CD127

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

④ Monitoring

290F3CD172



290F3CD188

290F3CD189

· The machine status such as the engine rpm, oil temperature, voltage and pressure etc. can be checked by this menu (Analog input).
· The switch status or output status can be confirmed by this menu (Digital input & Digital output).
· The activated switch or output pilot lamps ● are light ON.

(4) Management

① Fuel rate information

210WF3CD14

210WF3CD15

A

· General record (A)

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

B

· Hourly record (B)

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

C

· Daily record (C)

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

D

210WF3CD16

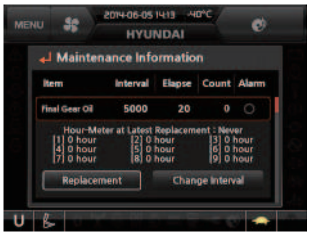
· Mode record (D)

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

② Maintenance information

210WF3CD131

290F3CD132



290F3CD133

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

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

③ Machine security

210WF3CD190B

290F3CD135B

290F3CD136A

· ESL mode setting

- ESL : Engine Starting Limit
- ESL mode is desingned to be a theft deterrent or will prevent the unauthorized operation of the machine.
- When you Enable the ESL mode, the password will be required when the starting switch is turned to the on position.
- Machine security
  Disable : ESL function is disabled and password is not required to start engine.
  Enable (always) : The password is required whenever the operator starts engine.
- Interval : The password is required when the operator starts engine first. But the operator can restart the engine within the interval time without inputting the password. The interval time can be set to a maximum 4 hours.

  ※Default password : 00000+☑
  ※Password length : (5~10 digits)+☑
- Smart key (option) : Refer to next page.

290F3CD137A

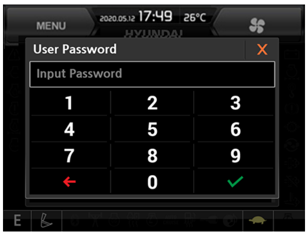
290F3CD138A

· Password change

- The password is 5~10 digits.

210WF3CD190A

290F3CD140B



290F3CD135C

Enter the current password

290F3CD143B

Enter the new password again

290F3CD142B

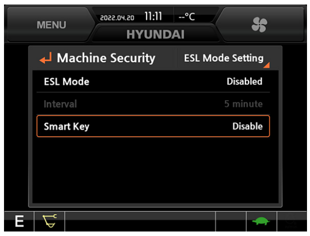
Enter the new password

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

- Smart key

210WF3CD190A

290F3CD135C



290F3CD001

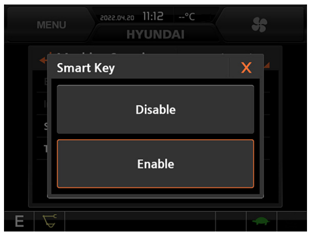
· Smart key is registered when equipped with optional smart key. If smart key is not inside of the cabin, authentication process fails and the password is needed.

· Tag management menu is activated when the Smart key menu is Enabled.
You can register and delete the tags.

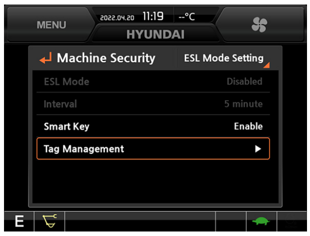
- Tag management

· When registering a tag : Only the tag you want to register must be in the cabin.

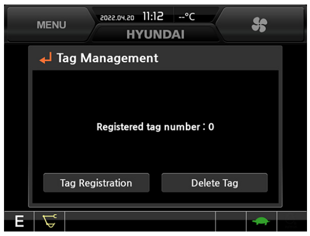
· When deleting a tag : All registered tags are deleted.



290F3CD002

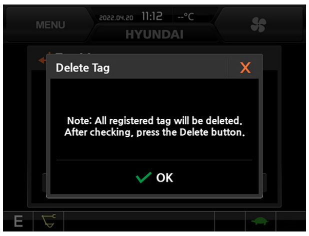


290F3CD003



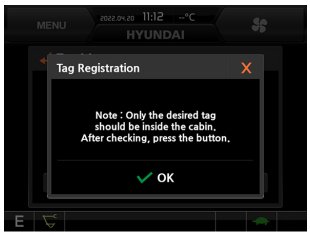
290F3CD004

Deleting



290F3CD006

Registering



290F3CD005

④ Machine Information

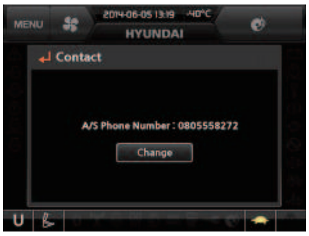

290F3CD144


290F3CD145

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

⑤ Contact (A/S phone number)


290F3CD146



290F3CD147

290F3CD148

Enter the new A/S phone number

⑥ Service menu


290F3CD149


290F3CD250

290F3CD151

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

⑦ Clinometer


290F3CD152


290F3CD153

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

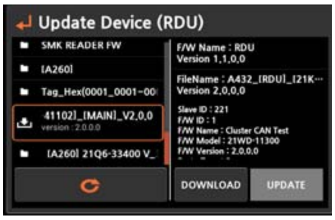
⑧ Update (cluster & ETC devices)

210WF3CD17

210WF3CD18

210WF3CD19

380F3CD04

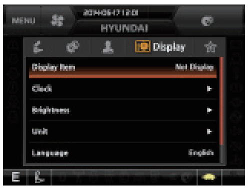


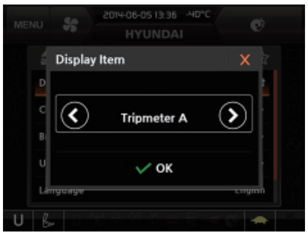
380F3CD06

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

(5) Display

① Display item


290F3CD154

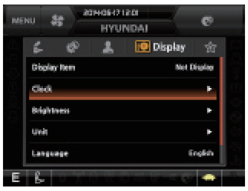


290F3CD155

290F3CD156

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

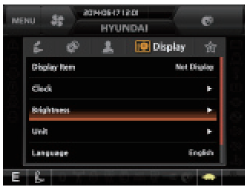
② Clock


290F3CD157

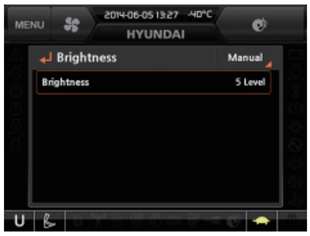
290F3CD158

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

③ Brightness


290F3CD159

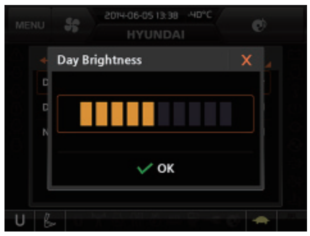
290F3CD160



290F3CD139

290F3CD141

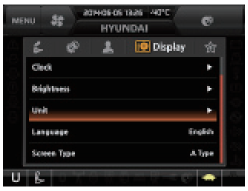
290F3CD191



290F3CD192

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

④ Unit



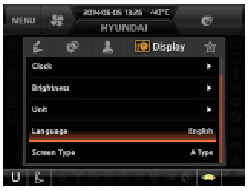
290F3CD161

210WF3CD162

290F3CD193

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

⑤ Language

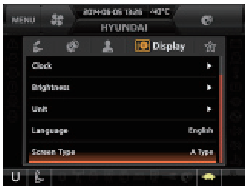


290F3CD163

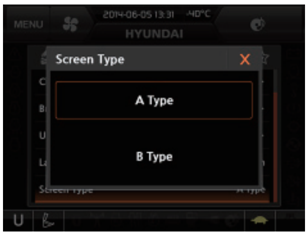
290F3CD164

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

⑥ Screen type

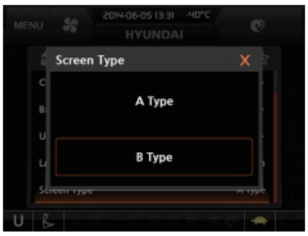


290F3CD165



A Type (Default) 290F3CD166

290F3CD156A



B Type (Option) 290F3CD194

290F3CD167A

(6) Utilities

① Entertainment

290F3CD195

A

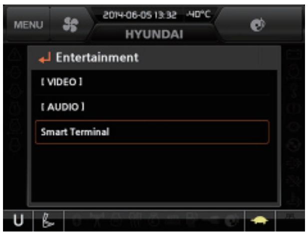
290F3CD196

210WF3CD219

B

290F3CD197

210WF3CD220



C

290F3CD198

210WF3CD199

210WF3CD22

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

② Tripmeter

290F3CD168

290F3CD169

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

③ Camera setting

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

290F3CD200

290F3CD255

290F3CD256

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

290F3CD156

290F3CD221

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

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

290F3CD244

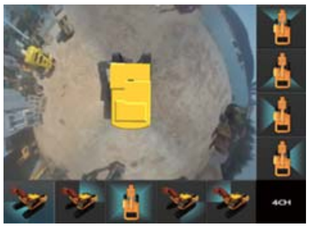
- **Escape button**

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

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

290F3CD156

The beginning screen



AAVM mode 290F3CD222

- **Buzzer stop button**

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

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

290F3CD246

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

290F3CD247

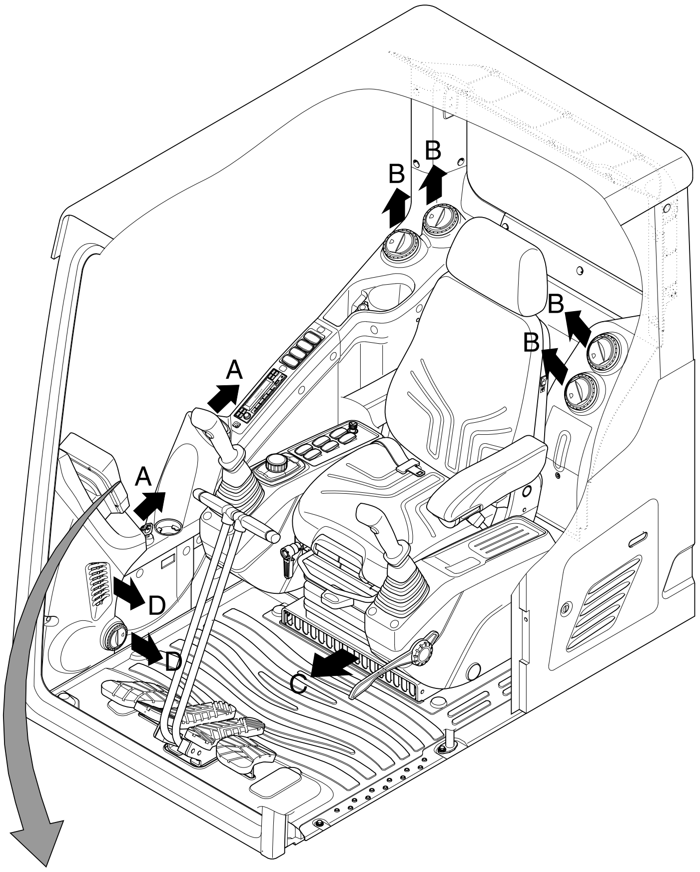
· When the worker or pedestrian go inside of red line (radius 3 m), an internal danger area of equipping on the cluster screen, the warning buzzer sounds and it displays the red rectangular box for the recognition of the worker and pedestrian.
At this time, the operator should stop work immediately,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

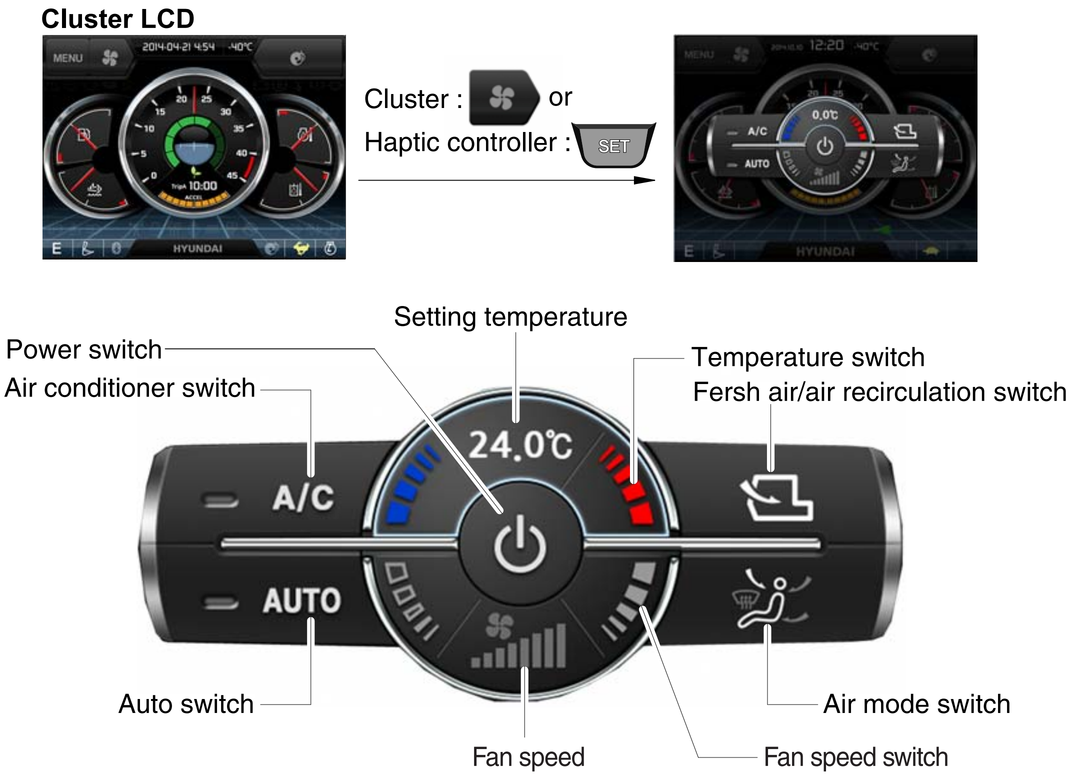
※ **In AAVM mode, a touch screen of the LCD is available only. The multimodal dial of the haptic controller is not available.**

7) AIR CONDITIONER AND HEATER

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

· Location of air flow ducts





290F3CD201

※ Haptic controller : Refer to the operator's manual page 3-55.

(1) Power switch

290F3CD251

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

② Default setting values

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

(2) Air conditioner switch

290F3CD203

① This switch turns the compressor ON/OFF.

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

(3) Auto switch

290F3CD223

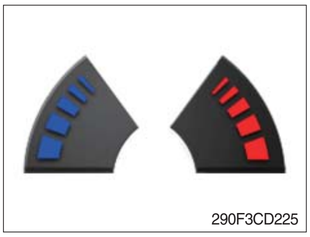
① Auto air conditiner and heater system automatically keeps the optimum condition in accordance with operator's temperature configuration sensing ambient and cabin inside temperature.

(4) Setting temperature

290F3CD224

① Display the temperature setting out.

(5) Temperature switch



290F3CD225

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

② Max cool and max warm beeps 5 times.

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

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

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

a. Default status (˚C)

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

(6) Fan speed switch

290F3CD226

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

(7) Fan speed

290F3CD227

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

(8) Fresh air/air recirculation switch

290F3CD228

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

(9) Air mode switch

290F3CD229

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

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

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

8) SELF DIAGNOSIS FUNCTION

(1) Diagnostic methods : Diagnostic information window, select

(2) Diagnostic indication (Displays fault)

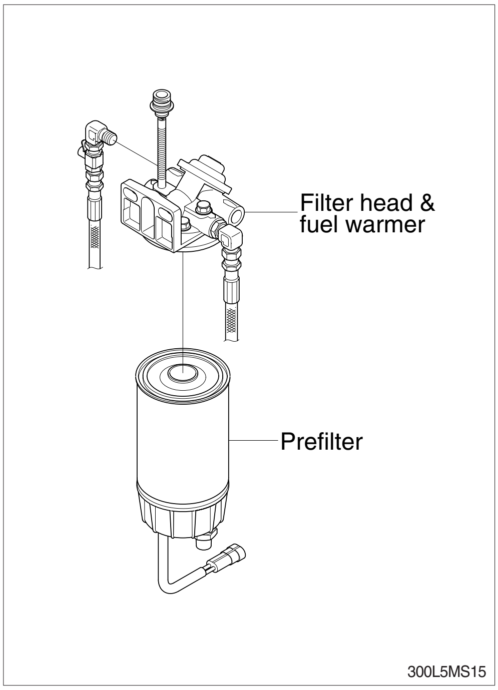
Fault code	Description	Fail safe function
F01	Ambient temperature sensor open	20˚C alternate value control
F02	Ambient temperature sensor short	
F03	Cab inside temperature sensor open	25˚C alternate value control
F04	Cab inside temperature sensor short	
F05	Evaporate temperature sensor open	0˚C alternate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

1. SPECIFICATION

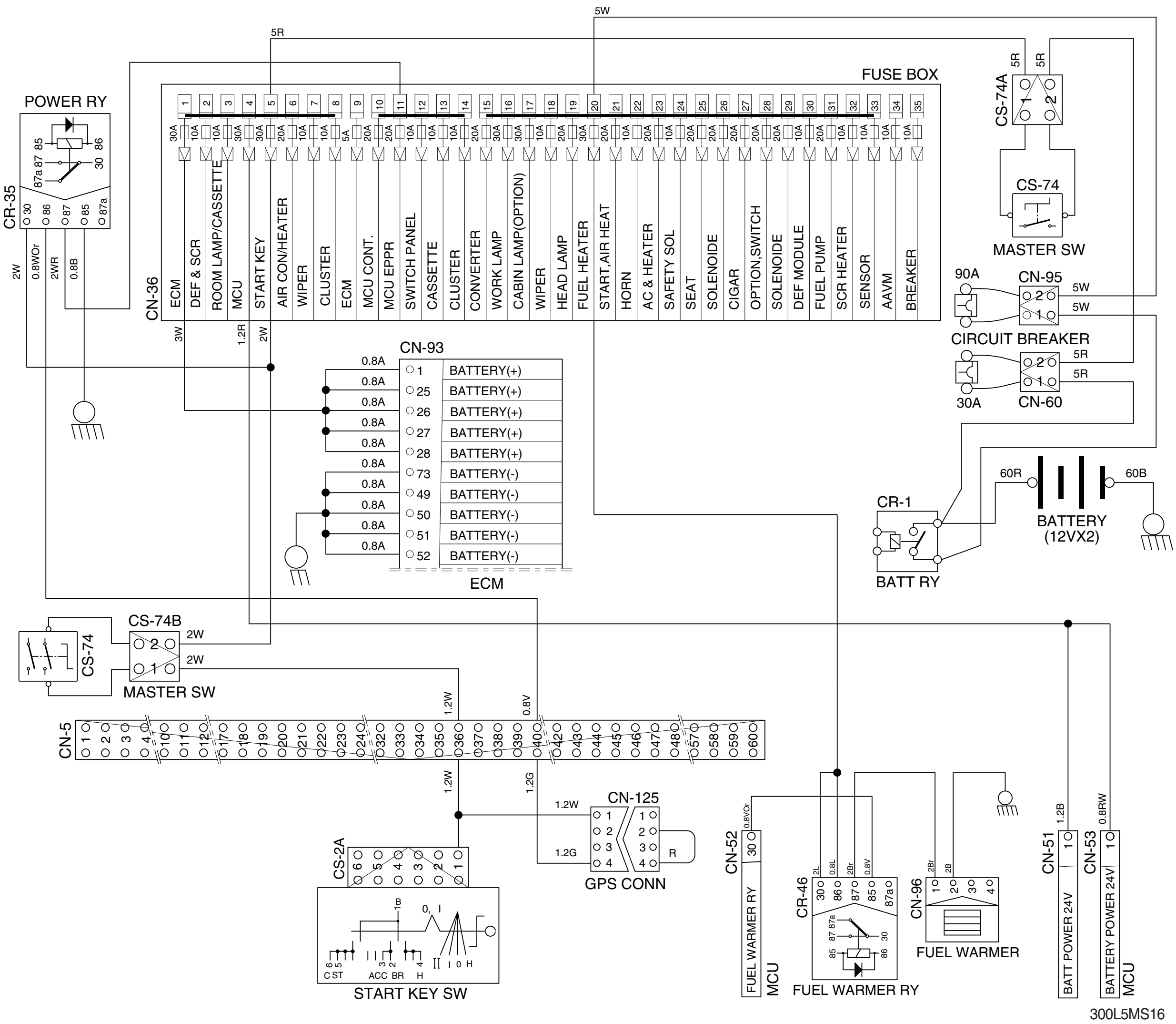
1) Operating voltage : 24±4 V
2) Power : 350±50 W
3) Current : 15 A

2. OPERATION

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



3. ELECTRIC CIRCUIT



SECTION 6 TROUBLESHOOTING

SECTION 6 TROUBLESHOOTING

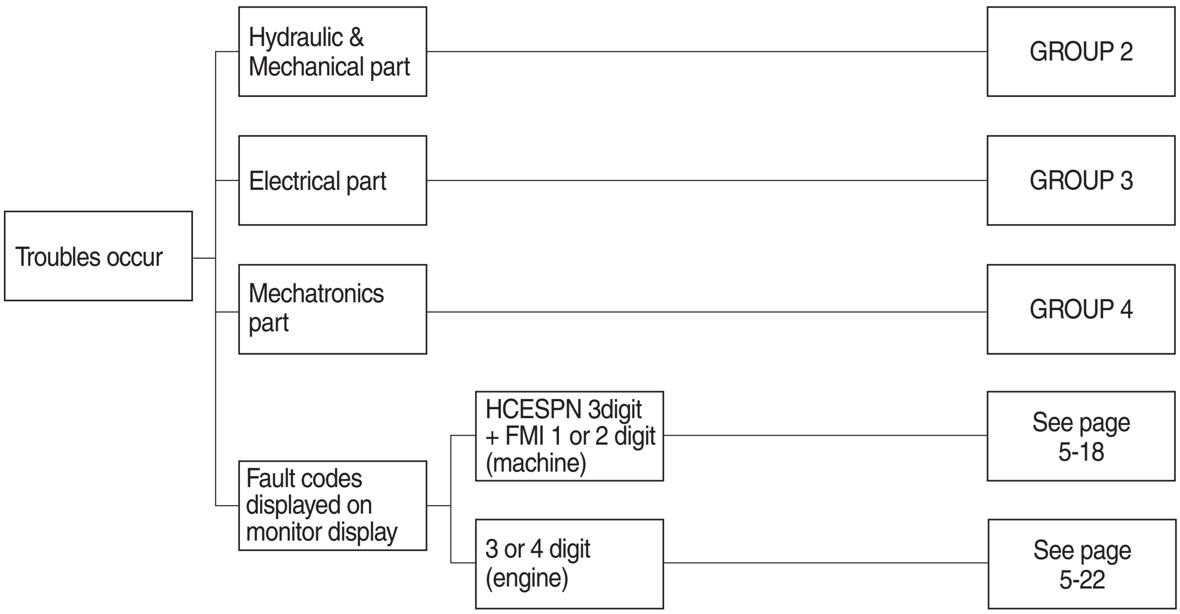
GROUP 1 BEFORE TROUBLESHOOTING

1. INTRODUCTION

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

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

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

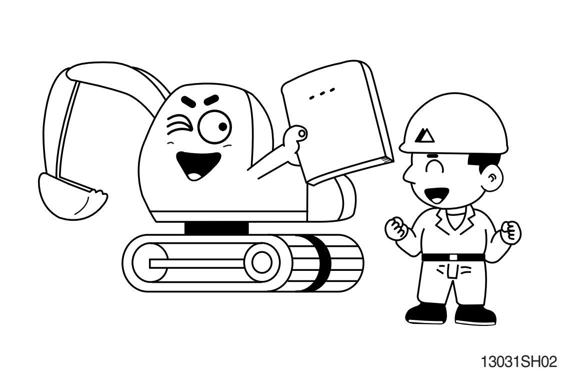


2. DIAGNOSING PROCEDURE

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

STEP 1. Study the machine system

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

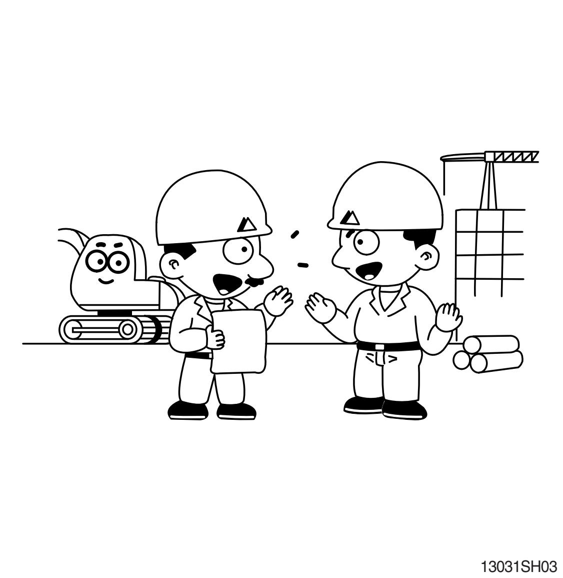


13031SH02

STEP 2. Ask the operator

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

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

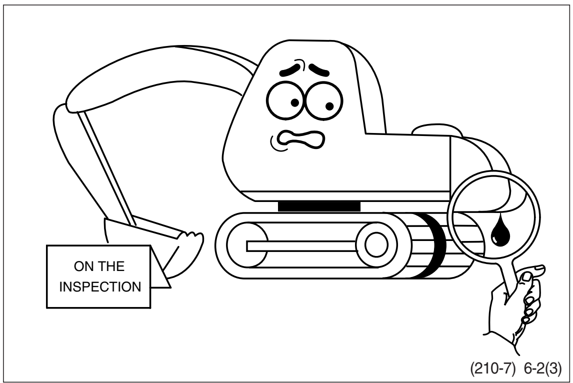


13031SH03

STEP 3. Inspect the machine

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

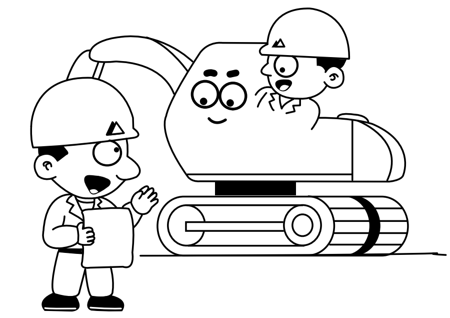
And also check the electrical system including batteries, as the troubles in the electrical system such as low battery voltage, loose connections and blown out fuses will result in malfunction of the controllers causing total operational failures of the machine.



(210-7) 6-2(3)

STEP 4. Inspect the trouble actually on the machine

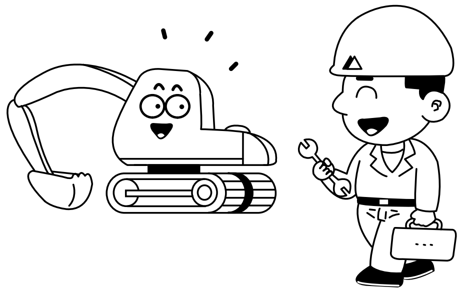
In case that some trouble cannot be confirmed, obtain the details of the malfunction from the operator.
Also, check if there are any in complete connections of the wire harnesses are or not.



(210-7) 6-3(1)

STEP 5. Perform troubleshooting

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

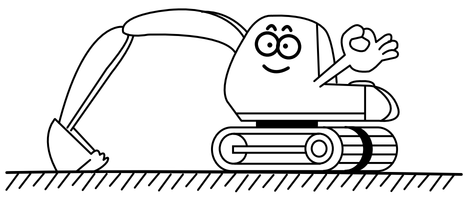


13031SH05

STEP 6. Trace a cause

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

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



(210-7) 6-3(3)

1. INTRODUCTION

1) MACHINE IN GENERAL

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

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

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

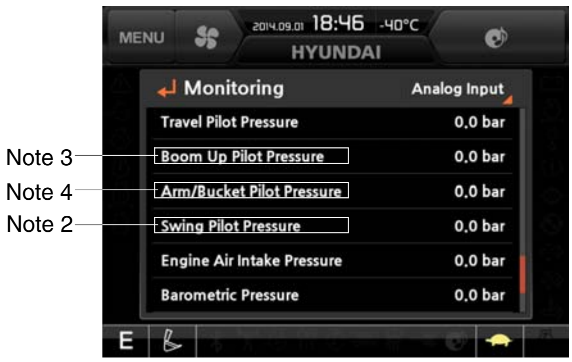
(4) Ask user or operator the following.
① Was there any strange thing about machine before failure occurred?
② Under what conditions did the failure occur?
③ Have any repairs been carried out before the failure?

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

2) MACHINE STATUS MONITORING ON THE CLUSTER

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

Analog 1



Analog 2

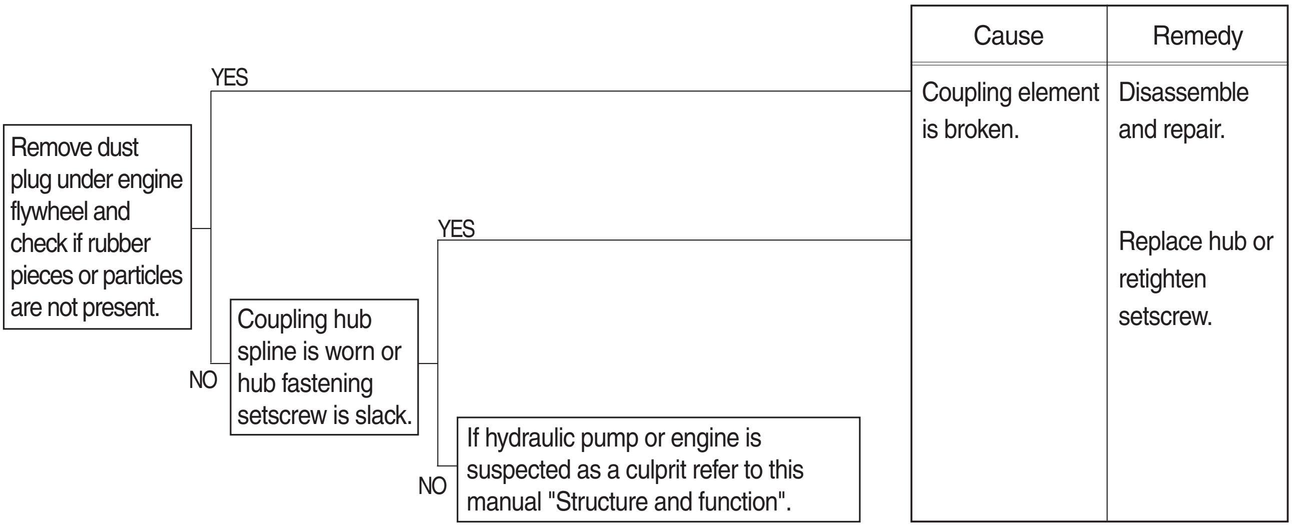
300L6HS01

(2) Specification

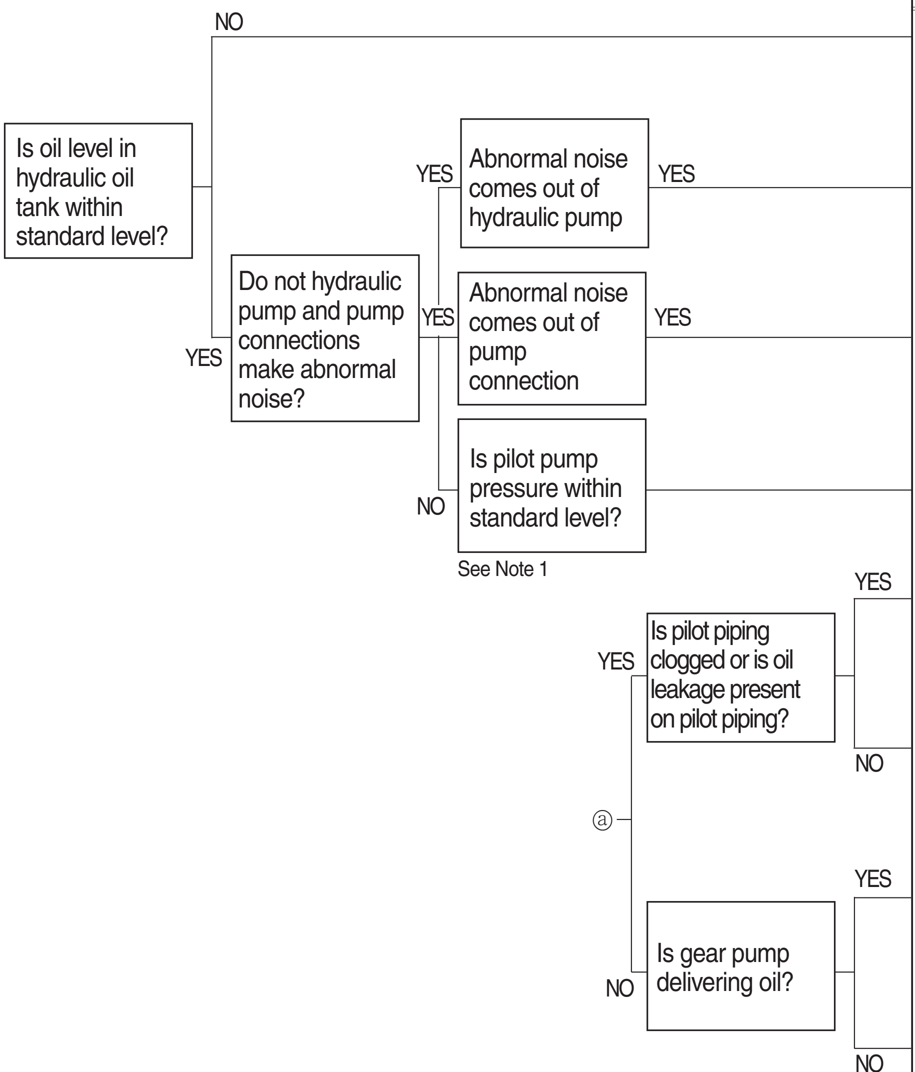
No.	Description	Specification
Note 1	Work pilot pressure	40^{+2}_{0} bar
Note 2	Swing pilot pressure	0~40 bar
Note 3	Boom up pilot pressure	0~40 bar
Note 4	Arm/bucket pilot pressure	0~40 bar
Note 5	Pump 1 regulator pressure	0~50 bar
Note 6	Pump 2 regulator pressure	0~50 bar
Note 7	Pump 1 pressure	330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

2. DRIVE SYSTEM

1) UNUSUAL NOISE COMES OUT OF PUMP CONNECTION



2) ENGINE STARTS BUT MACHINE DOES NOT OPERATE AT ALL



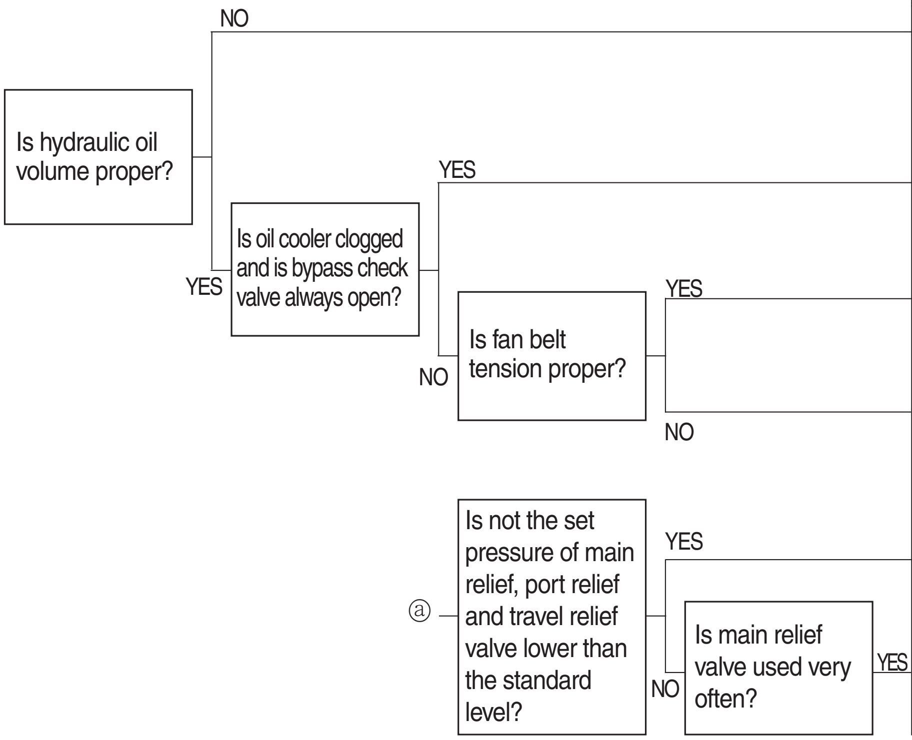
Cause	Remedy
	Replenish specified oil to the standard level.
Hydraulic pump is broken.	Disassemble and repair.
	See item 1). at page 6-5
ⓐ	
	Clean pilot piping interior or repair piping.
RCV and safety solenoid valve is faulty.	Disassemble and repair.
Pilot relief valve in gear pump is faulty.	Repair or replace.
Gear pump is broken.	Disassemble and repair.

3. HYDRAULIC SYSTEM

1) HYDRAULIC OIL IS CLOUDY

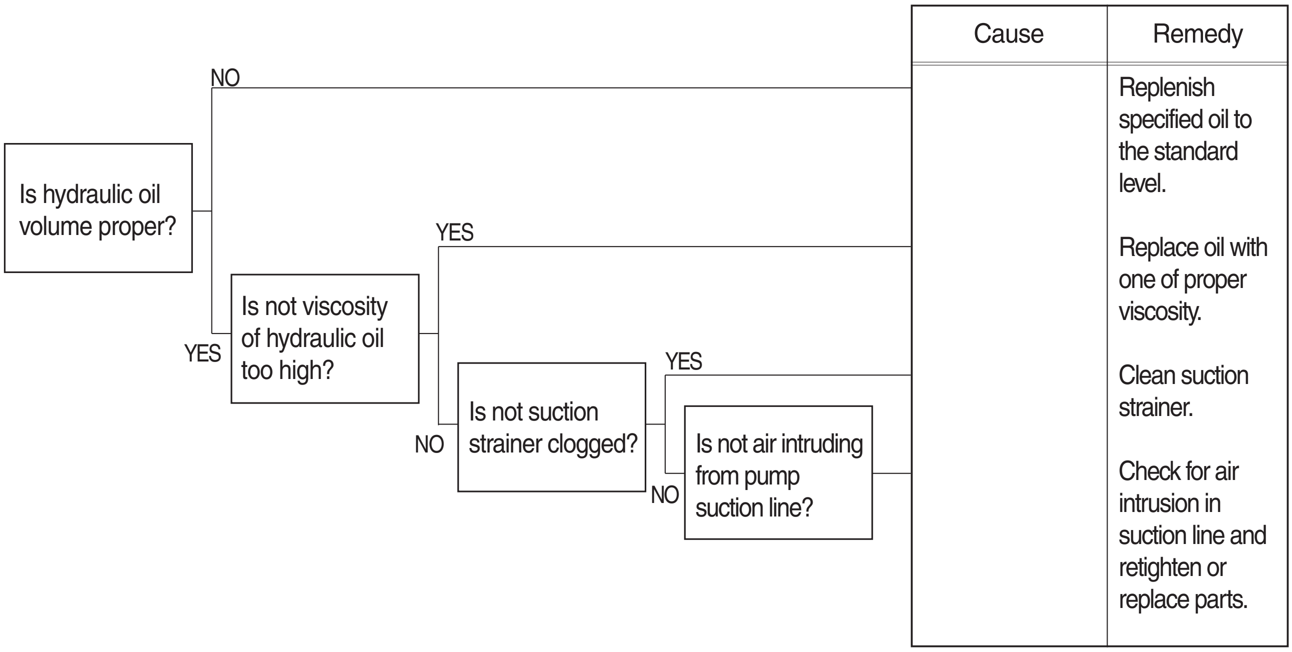
Cause	Remedy
Water is mixed.	Put hydraulic oil still, separate water and dispose it or replace hydraulic oil.
Air is intruded.	Check suction line and return line and eliminate the air intruding source.

2) HYDRAULIC OIL TEMPERATURE HAS RISEN ABNORMALLY

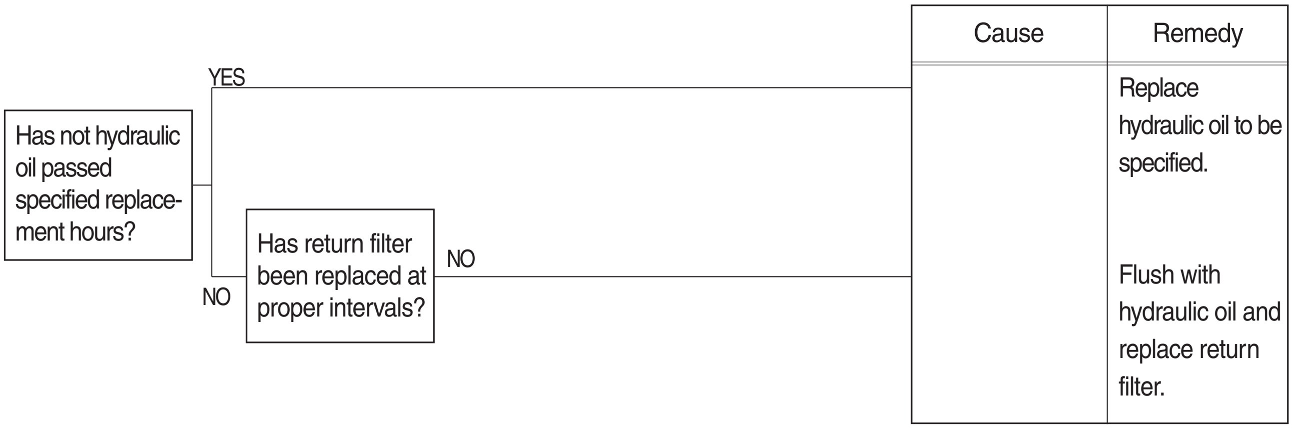


Cause	Remedy
	Replenish specified oil to the standard level.
Oil cooler clogged.	Clean oil cooler.
Bypass check valve is defective. ⓐ	Replace
	Adjust belt tension or replace belt.
	Readjust set pressure.
	Reduce load.

3) CAVITATION OCCURS WITH PUMP

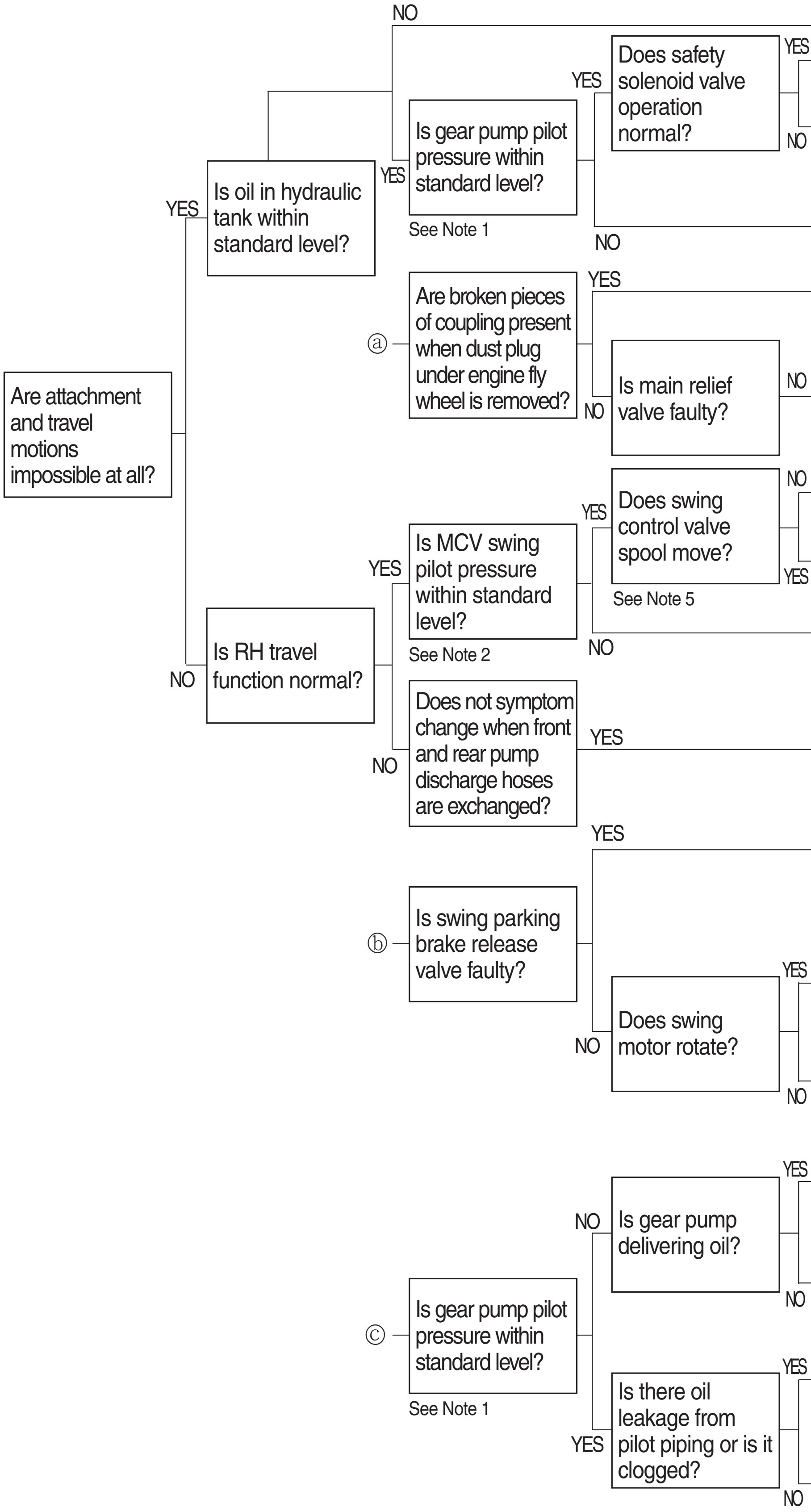


4) HYDRAULIC OIL IS CONTAMINATED



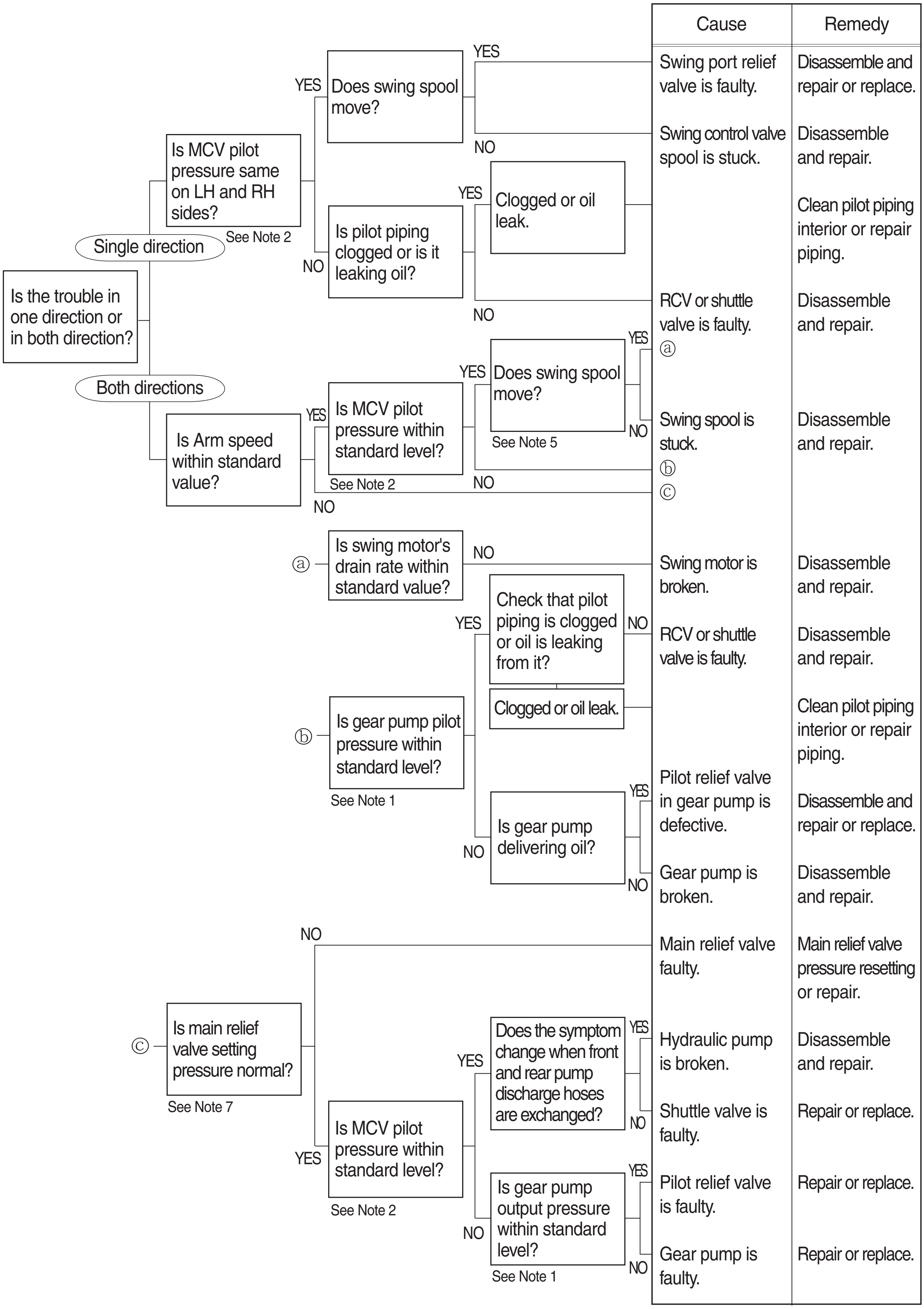
4. SWING SYSTEM

1) BOTH LH AND RH SWING ACTIONS ARE IMPOSSIBLE

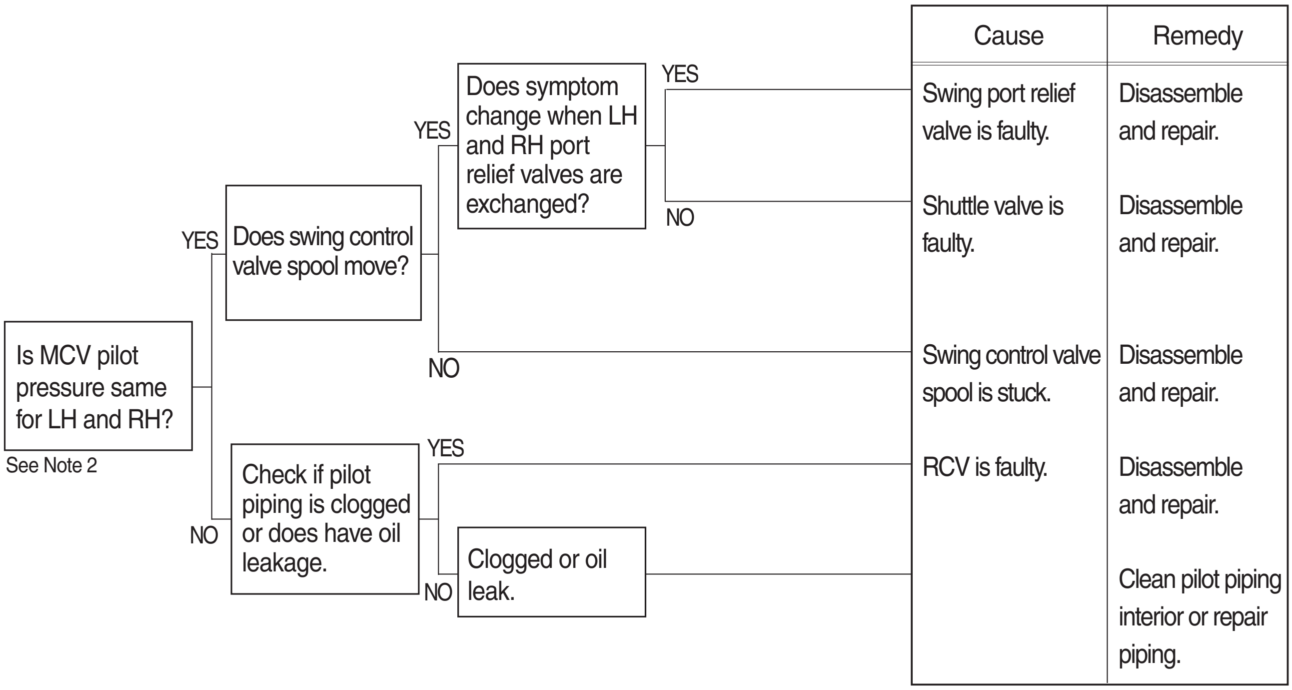


Cause	Remedy
ⓐ	Replenish specified oil to the standard level.
Safety solenoid valve faulty or not operated.	Repair or replace.
Gear pump faulty.	Repair or replace.
Pump connection coupling is broken.	Disassemble and repair.
Hydraulic pump is out of order.	Disassemble and repair.
Swing control valve spool 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.

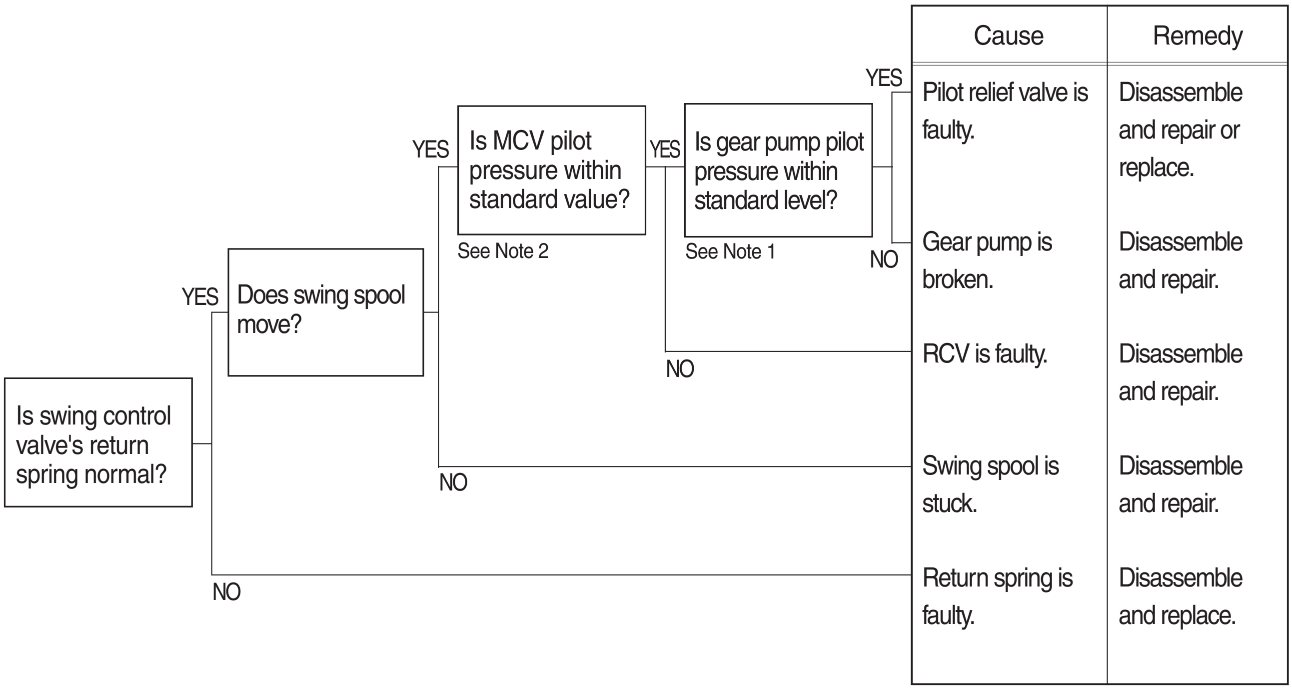
2) SWING SPEED IS LOW



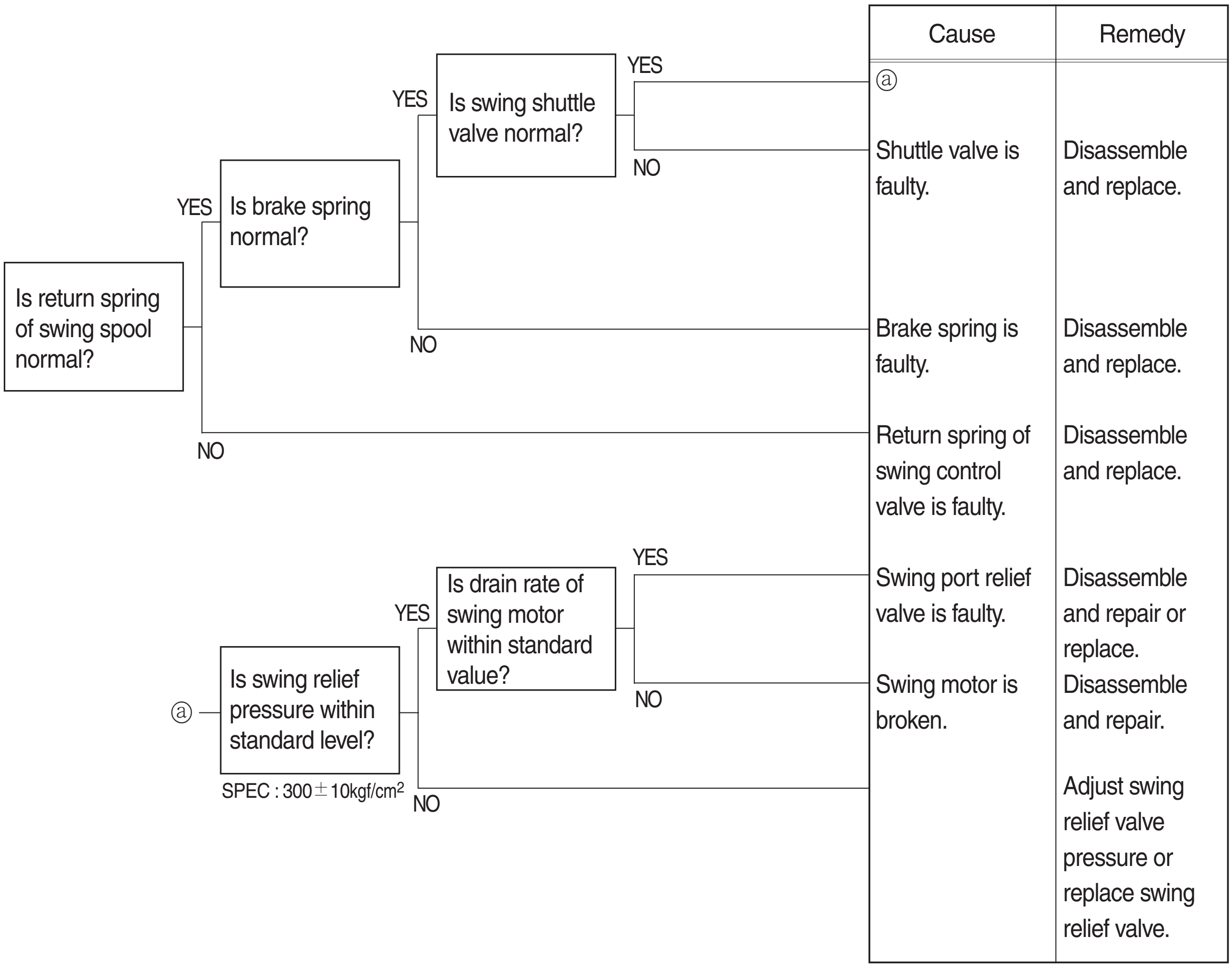
3) SWING MOTION IS IMPOSSIBLE IN ONE DIRECTION



4) MACHINE SWINGS BUT DOES NOT STOP

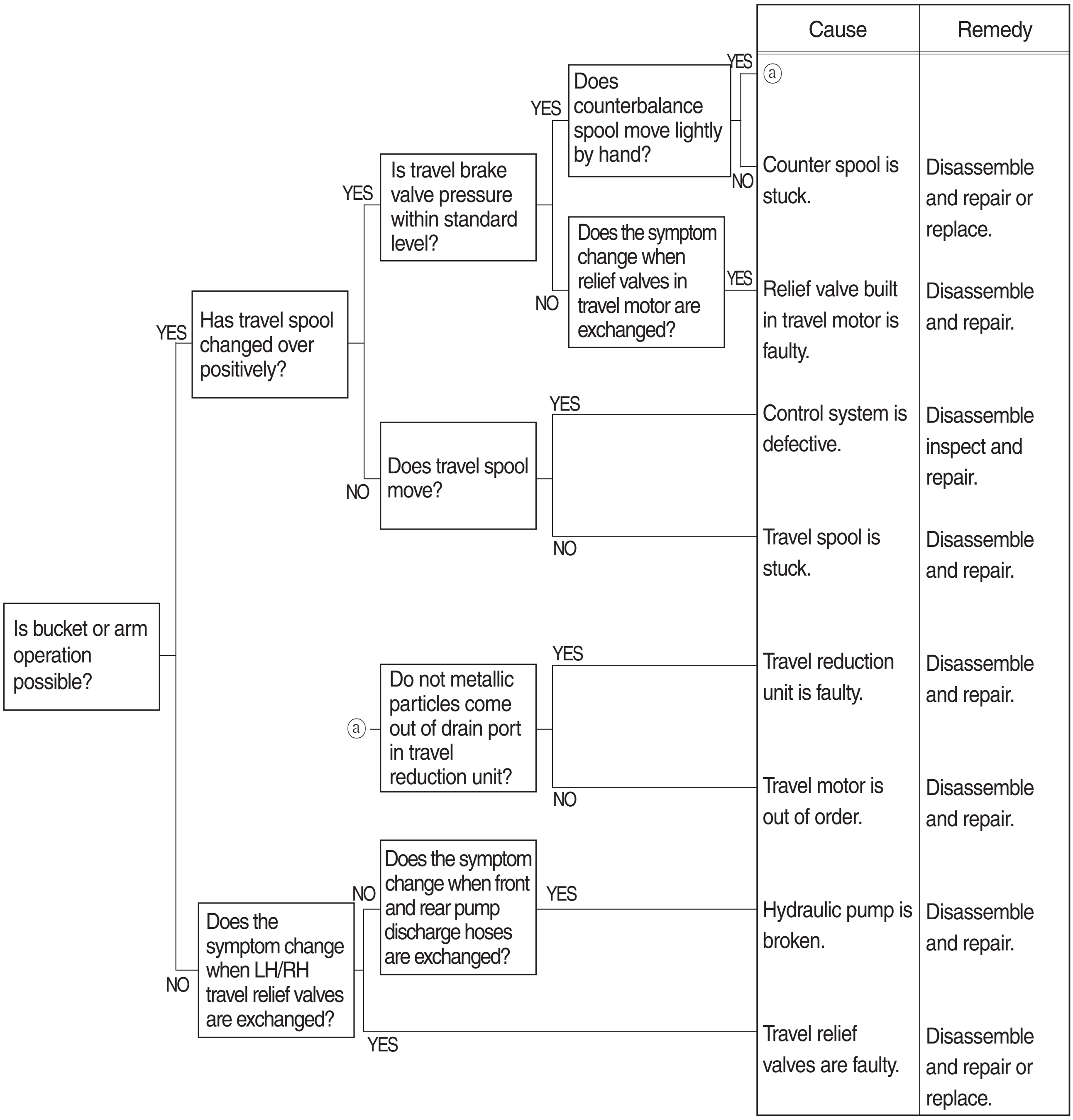


5) THE SWING UNIT DRIFTS WHEN THE MACHINE IS AT REST ON A SLOPE

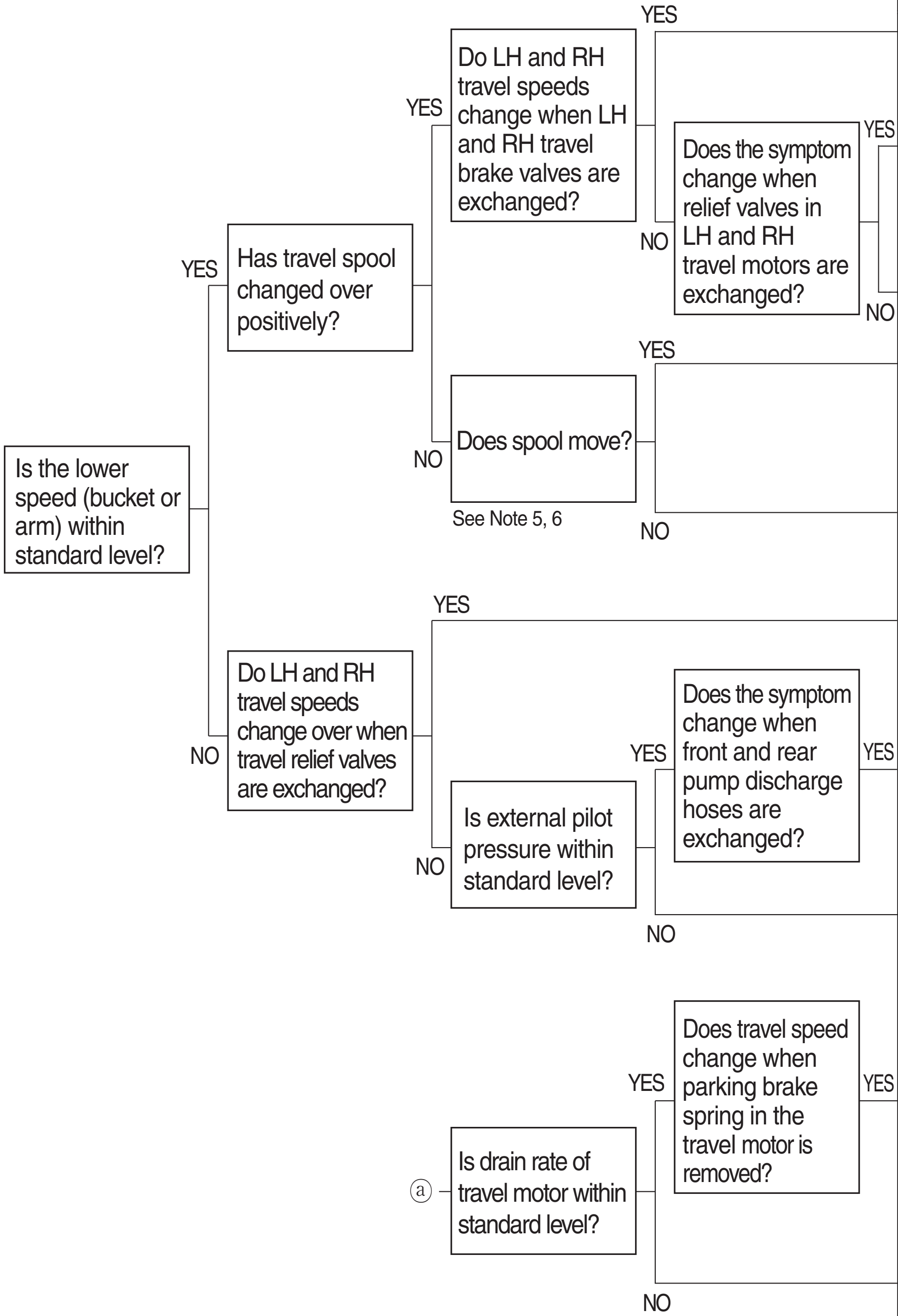


5. TRAVEL SYSTEM

1) TRAVEL DOES NOT FUNCTION AT ALL ON ONE SIDE



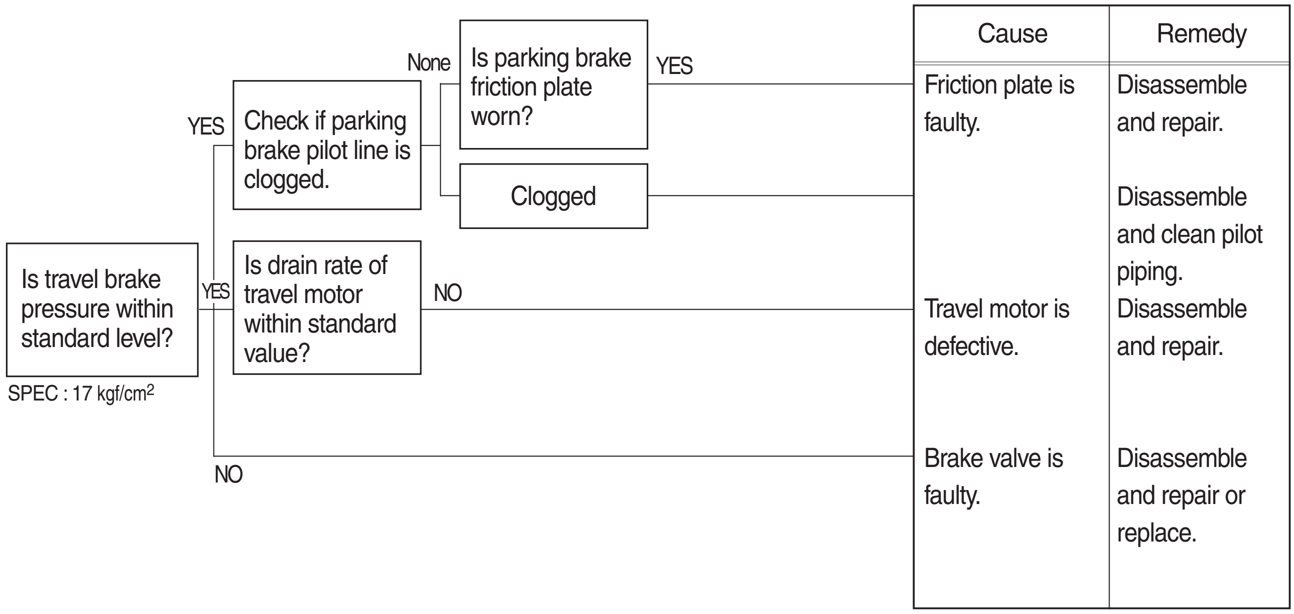
2) SPEED ON ONE SIDE FALLS AND THE MACHINE CURVES



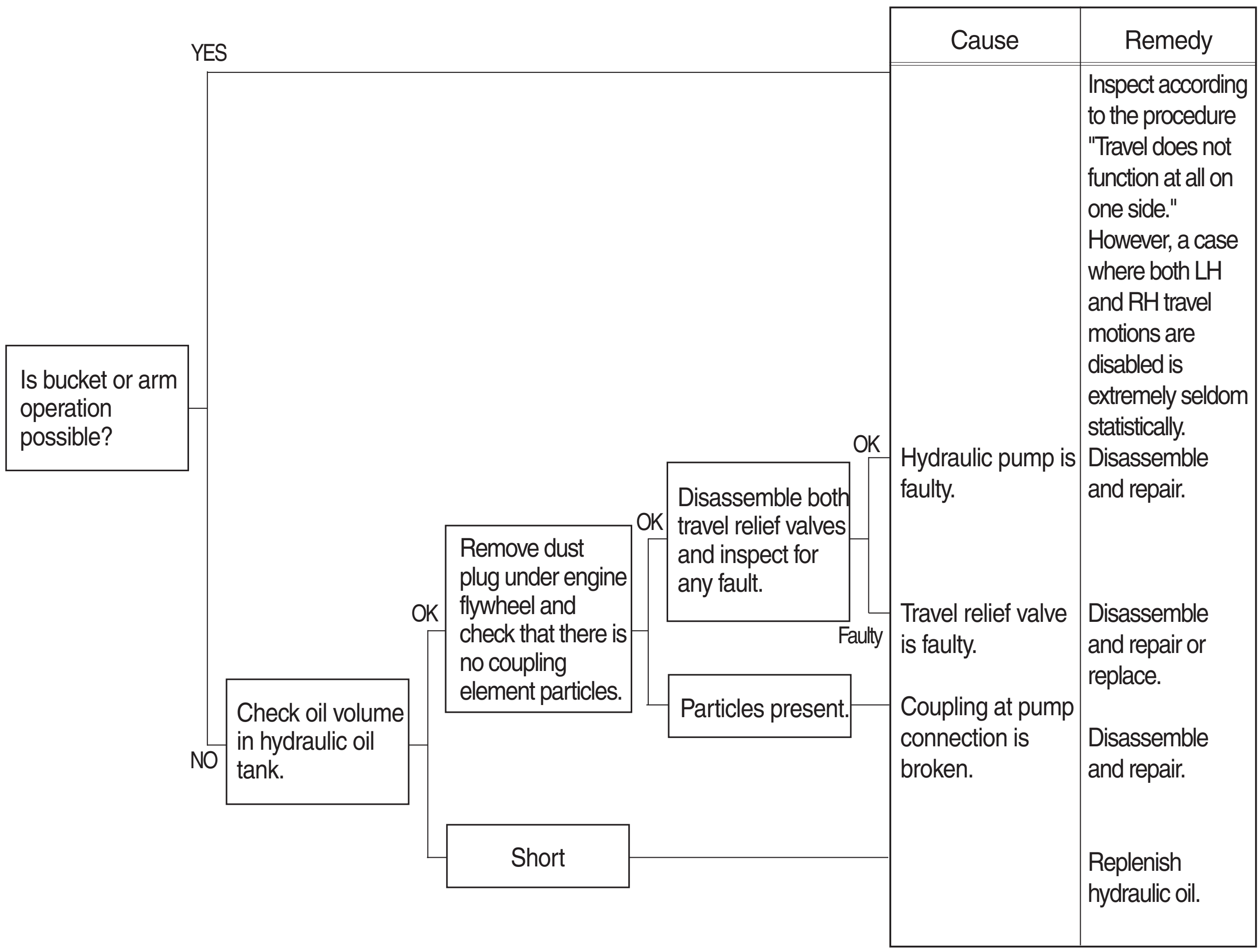
Cause	Remedy
Brake valve is defective.	Disassemble and repair or replace.
Relief valve built in travel motor is faulty.	Disassemble and repair.
ⓐ	
Control system is faulty .	Disassemble, inspect and repair.
Control valve spool is stuck.	Disassemble and repair.
Travel relief valve is faulty.	Disassemble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

3) MACHINE DOES NOT STOP ON A SLOPE

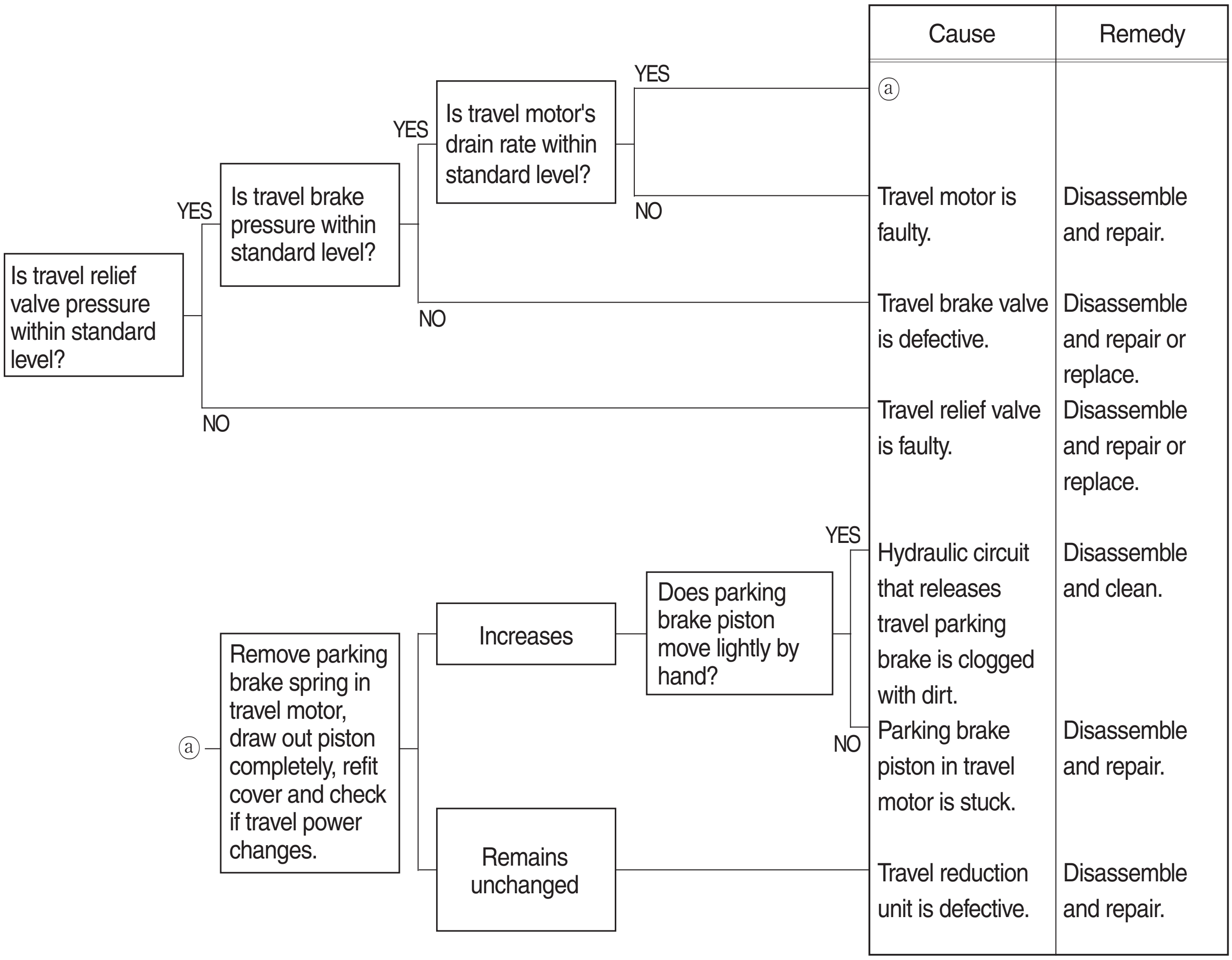
Machine is pulled forward as sprocket rotates during digging operation.



4) LH AND RH TRAVEL MOTIONS ARE IMPOSSIBLE

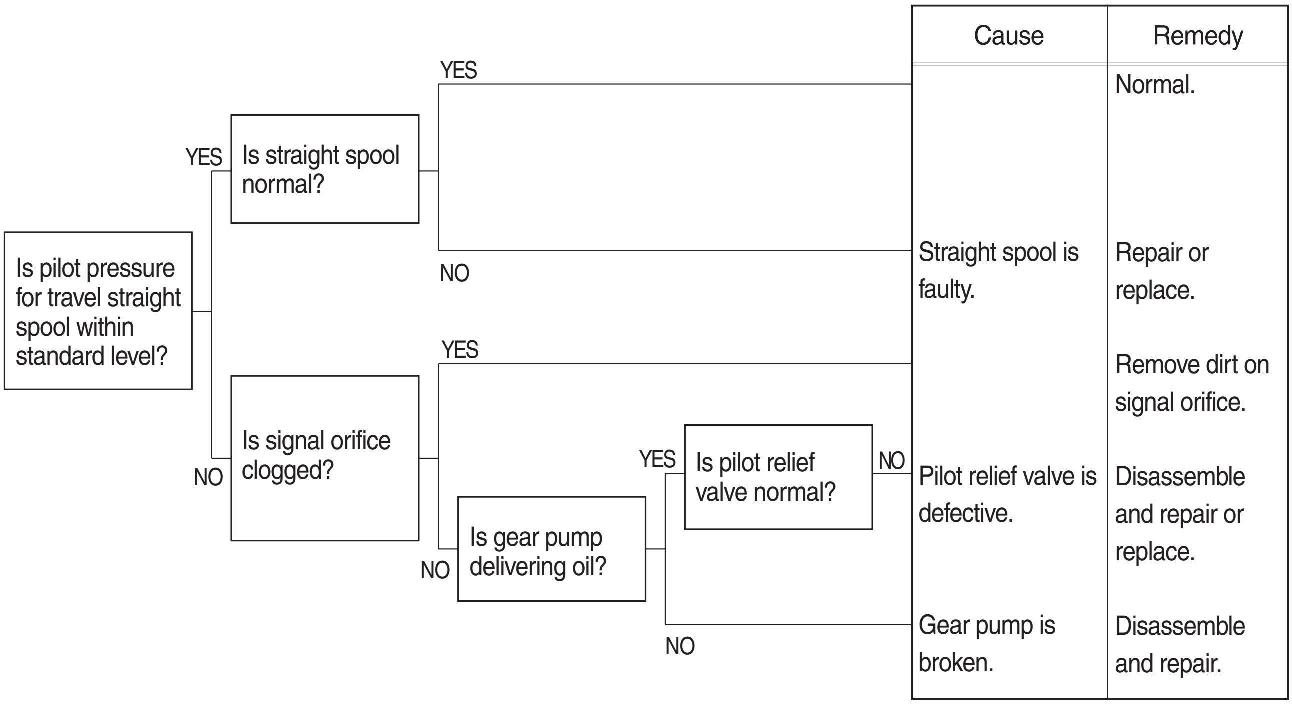


5) TRAVEL ACTION IS POWERLESS (travel only)



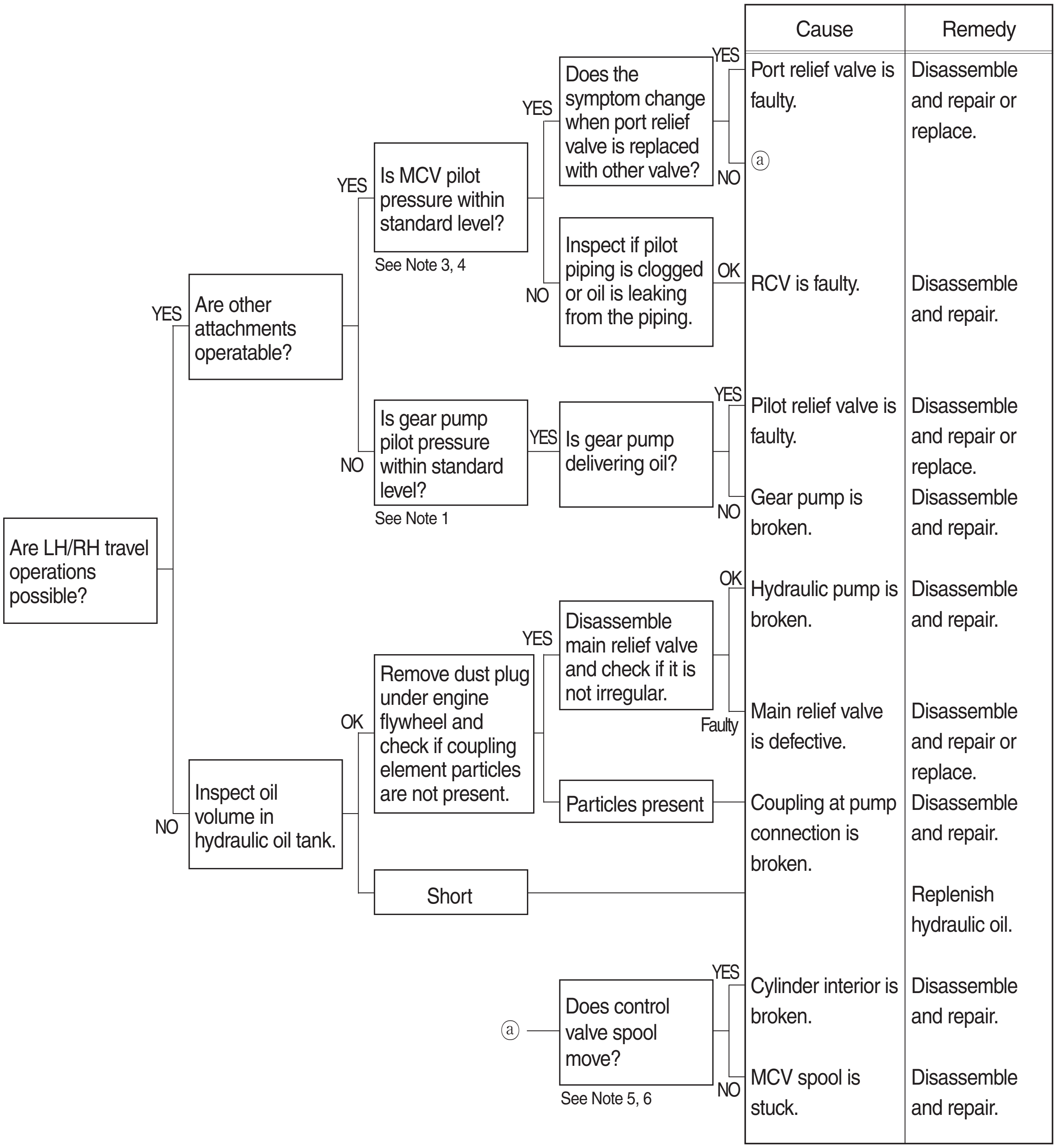
6) MACHINE RUNS RECKLESSLY ON A SLOPE

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

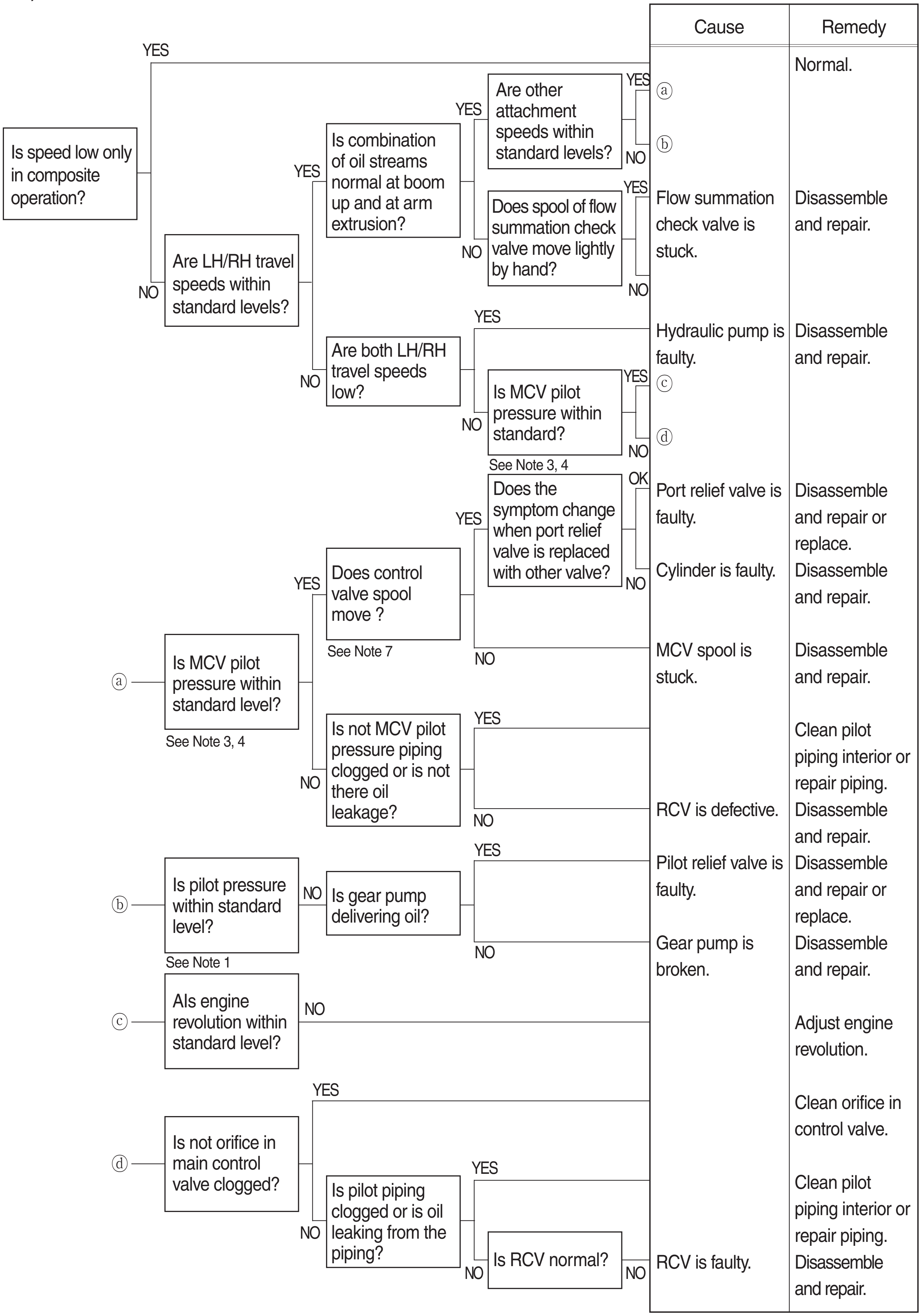


6. ATTACHMENT SYSTEM

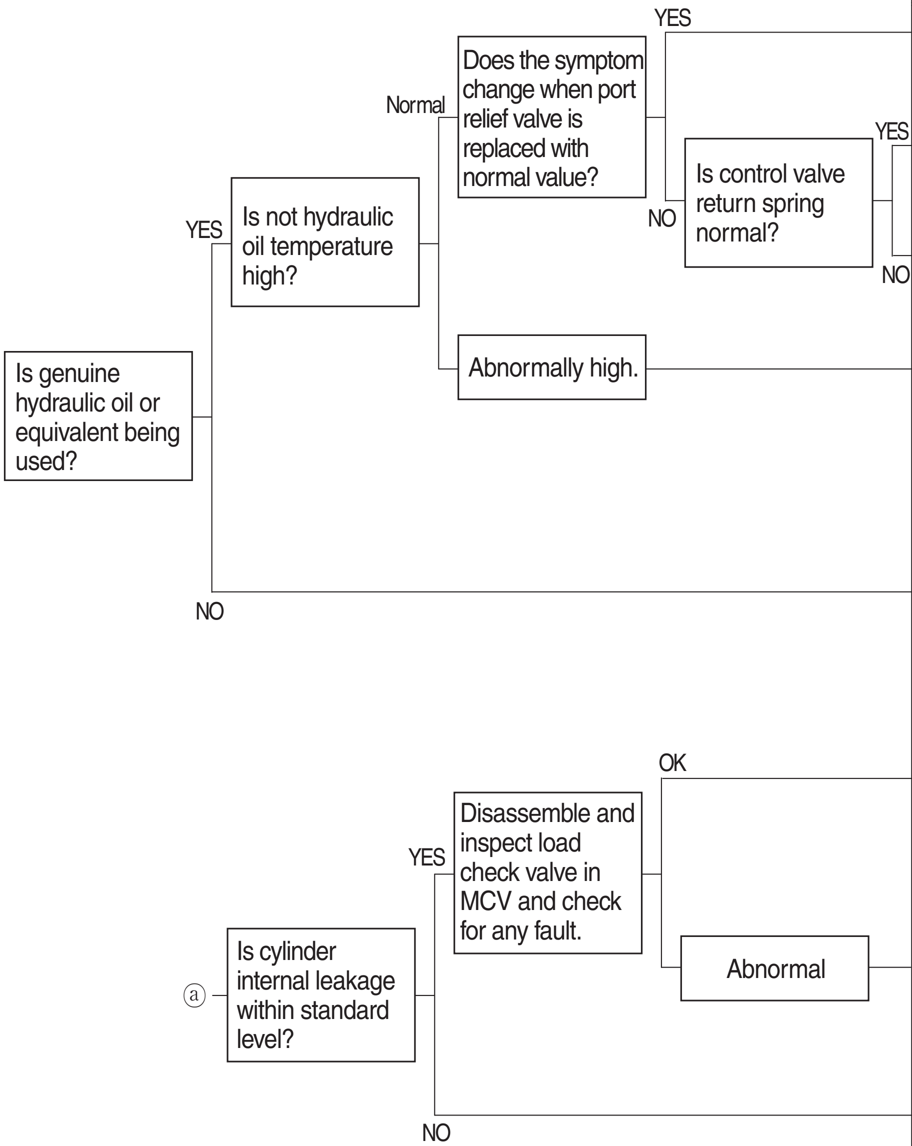
1) BOOM OR ARM ACTION IS IMPOSSIBLE AT ALL



2) BOOM, ARM OR BUCKET SPEED IS LOW

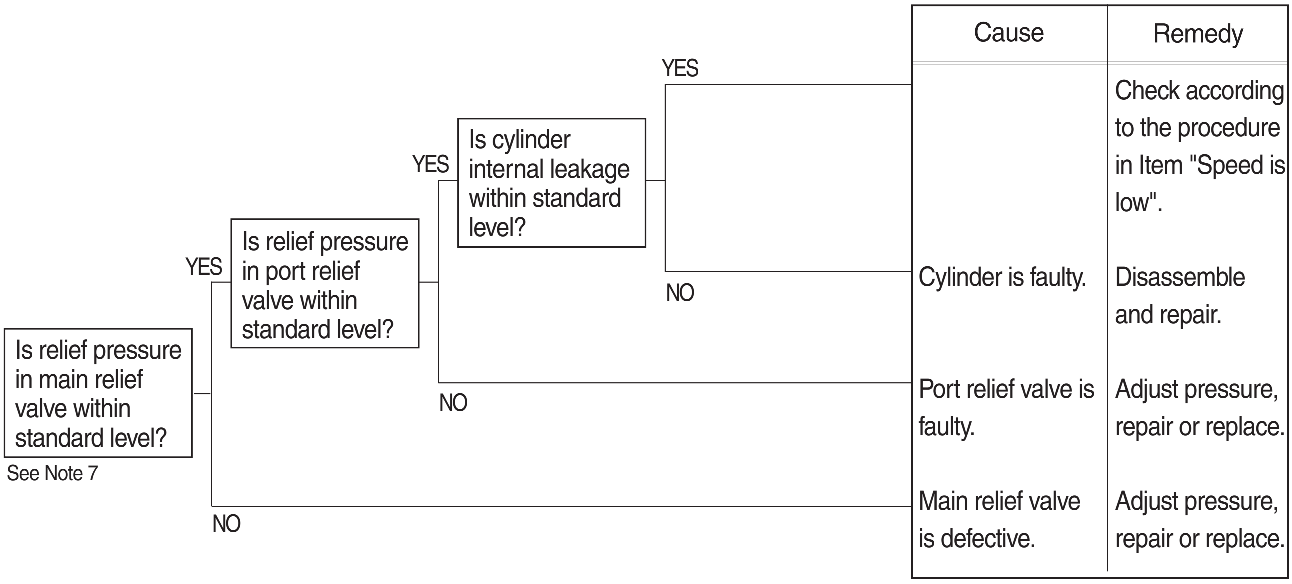


3) BOOM, ARM OR BUCKET CYLINDER EXTENDS OR CONTRACTS ITSELF AND ATTACHMENT FALLS

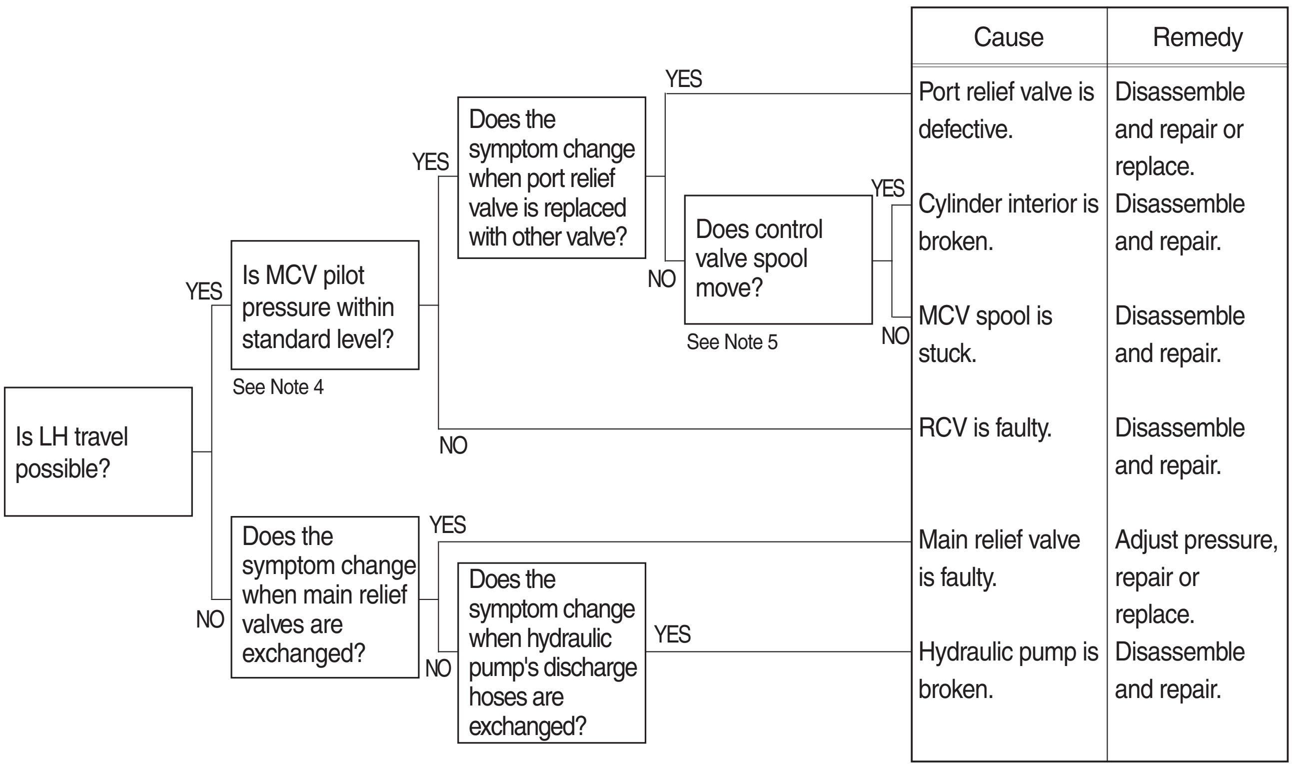


Cause	Remedy
Port relief valve is faulty.	Disassemble and repair or replace.
Control valve's return spring is faulty.	Disassemble and replace.
	Locate the cause of hydraulic oil temperature rise and lower it to proper level.
	Replace with genuine hydraulic oil or equivalent.
Pressure tightness between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

4) BOOM, ARM OR BUCKET POWER IS WEAK



5) ONLY BUCKET OPERATION IS TOTALLY IMPOSSIBLE

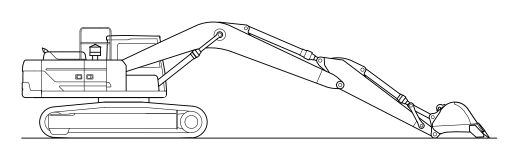


6) BOOM MAKES A SQUEAKING NOISE WHEN BOOM IS OPERATED

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

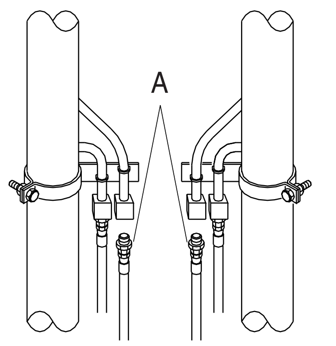
※ HOW TO CHECK INTERNAL BOOM CYLINDER LEAKAGE

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



300L6TS01

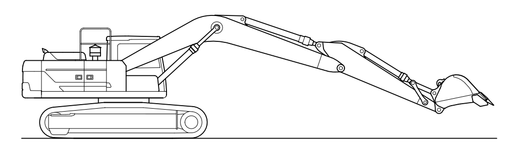
2. Disconnect hose (A) from rod side of boom cylinder and drain oil from cylinders and hose. (put cups on piping and hose ends)



(210-7) 6-20(2)

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

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



300L6TS02

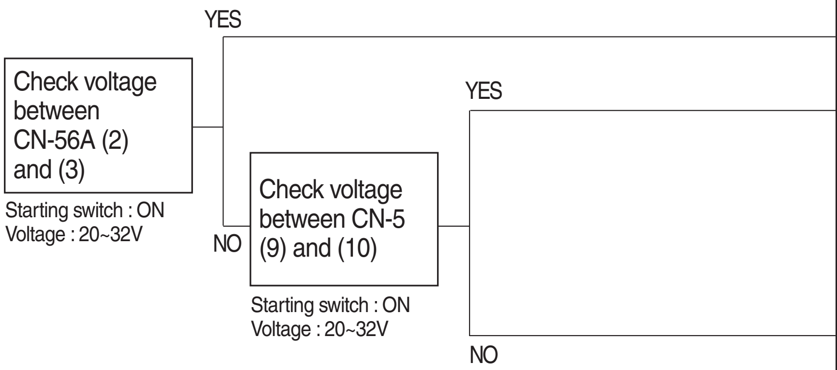
GROUP 3 ELECTRICAL SYSTEM

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

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

· Before carrying out below procedure, check all the related connectors are properly inserted and short of fuse No. 10, 16.

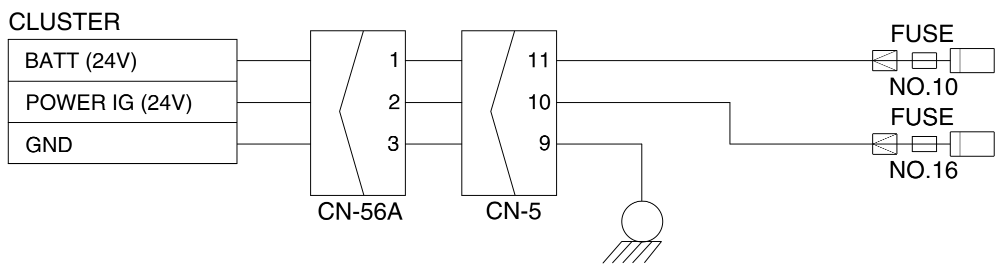
· After checking, insert the disconnected connectors again immediately unless otherwise specified.



Cause	Remedy
Defective cluster	Replace
Disconnection in wiring harness or poor contact between CN-5-CN-56A	Repair or replace (after clean)
Disconnection in wiring harness or poor contact between CN-5 (9) -GND or fuse No. 10, 16	Repair or replace (after clean)

Check voltage

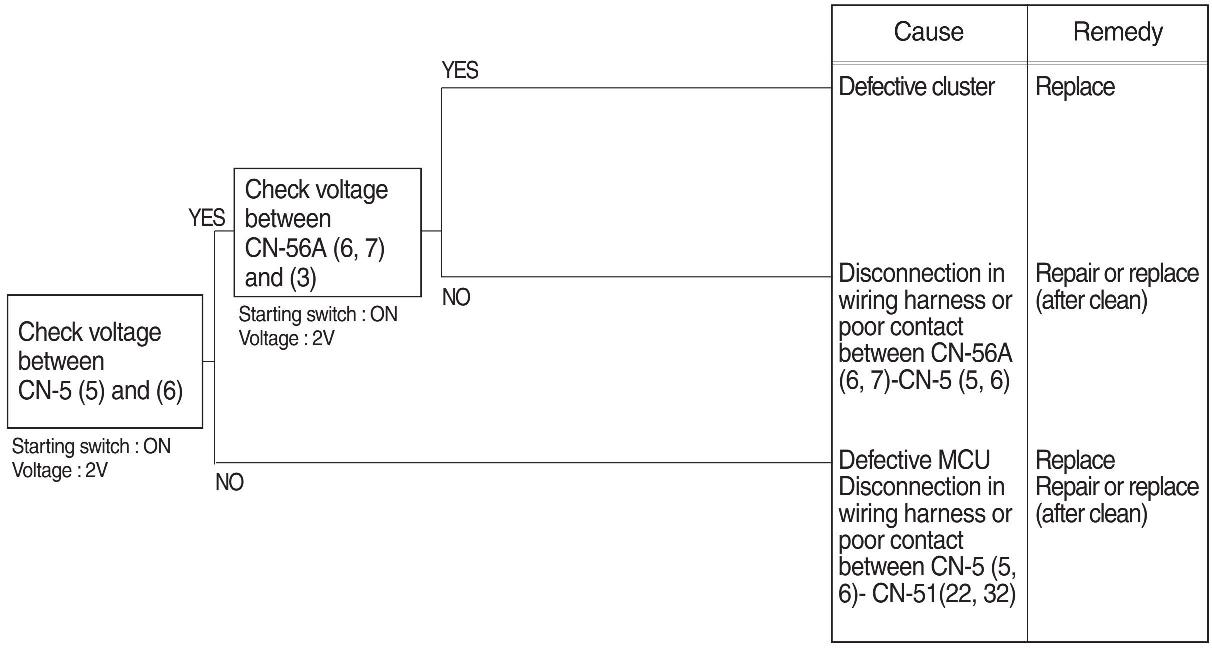
YES	20~32V
NO	0V



480L6ES01

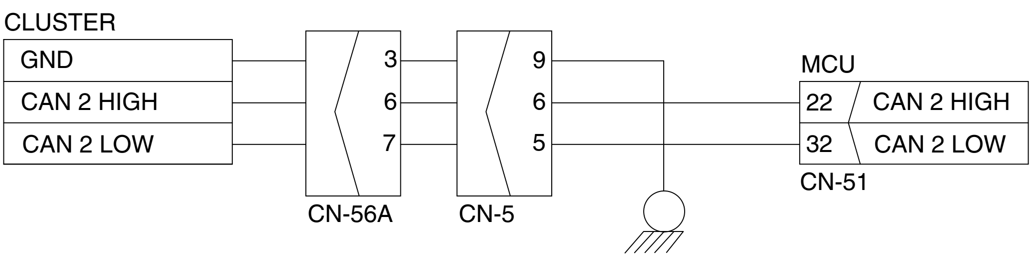
2. COMMUNICATION ERROR FLASHES ON THE CLUSTER (HCESPN 840, FMI 2)

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



Check voltage

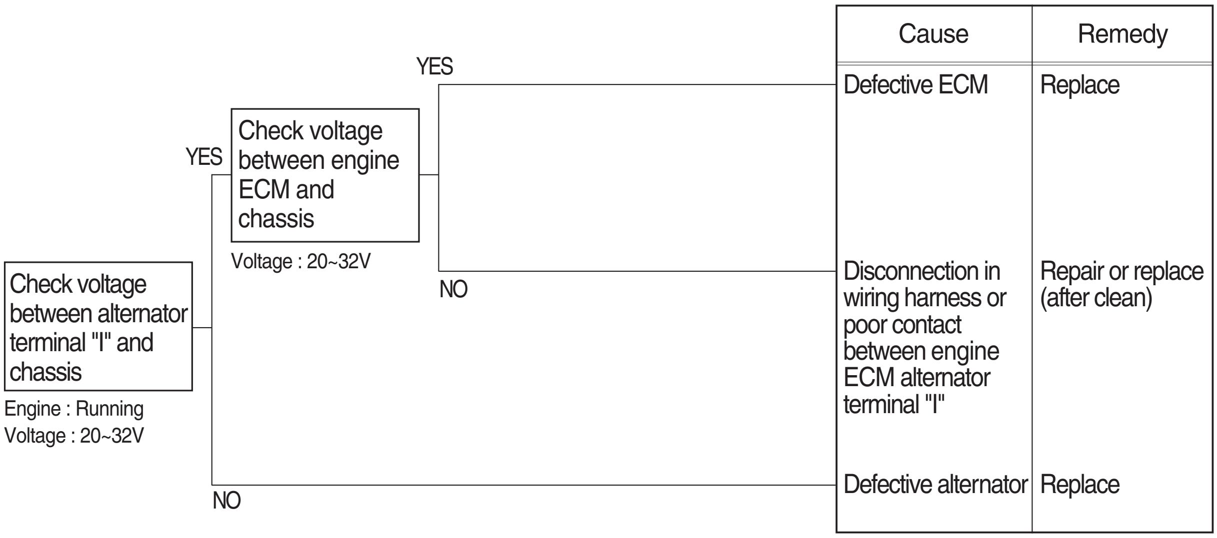
YES	2V
NO	0V



300L6ES02

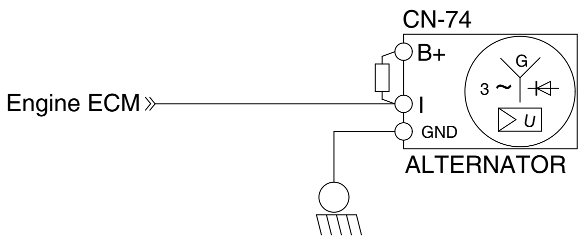
3. BATTERY CHARGING WARNING LAMP LIGHTS UP (Starting switch : ON)

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



Check voltage

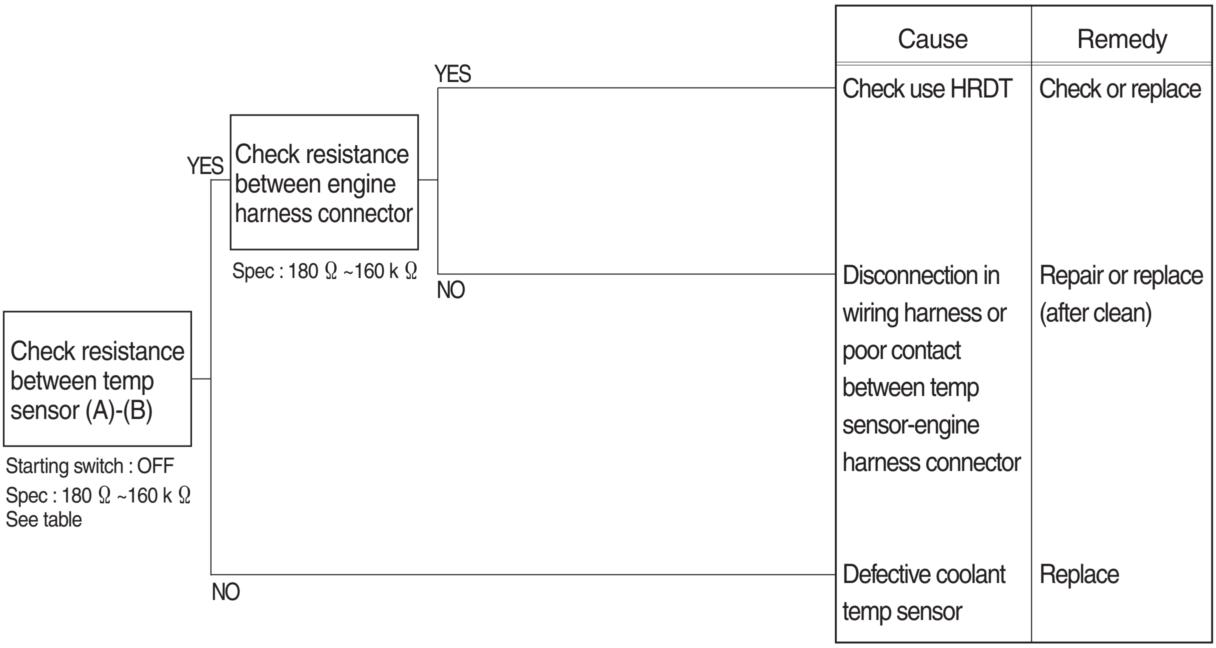
YES	20~32V
NO	0V



480L6ES09

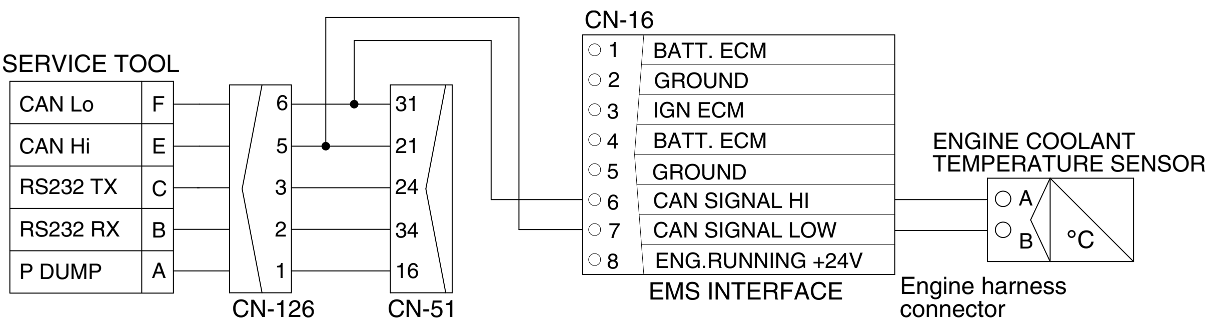
4. WHEN COOLANT OVERHEAT WARNING LAMP LIGHTS UP (engine is started)

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



Check Table

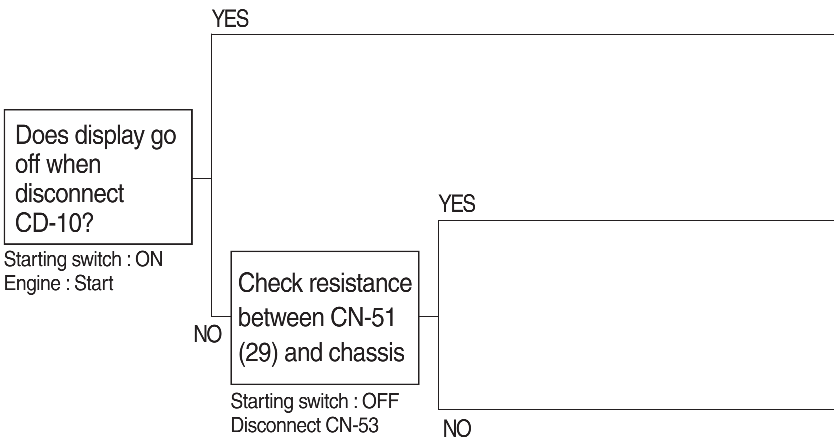
Temperature (˚C)	0	25	50	80	95
Resistance (k Ω)	30~37	9.3~10.7	3.2~3.8	1.0~1.3	0.7~0.8



480L6ES02

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

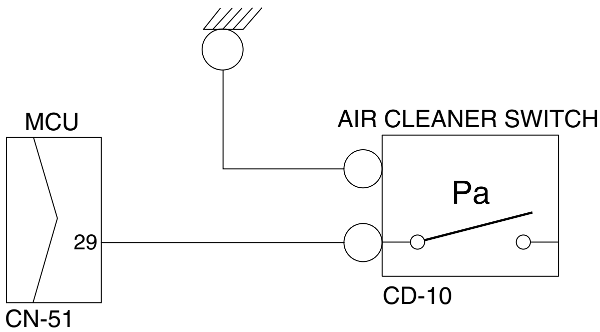
· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.



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

Check resistance

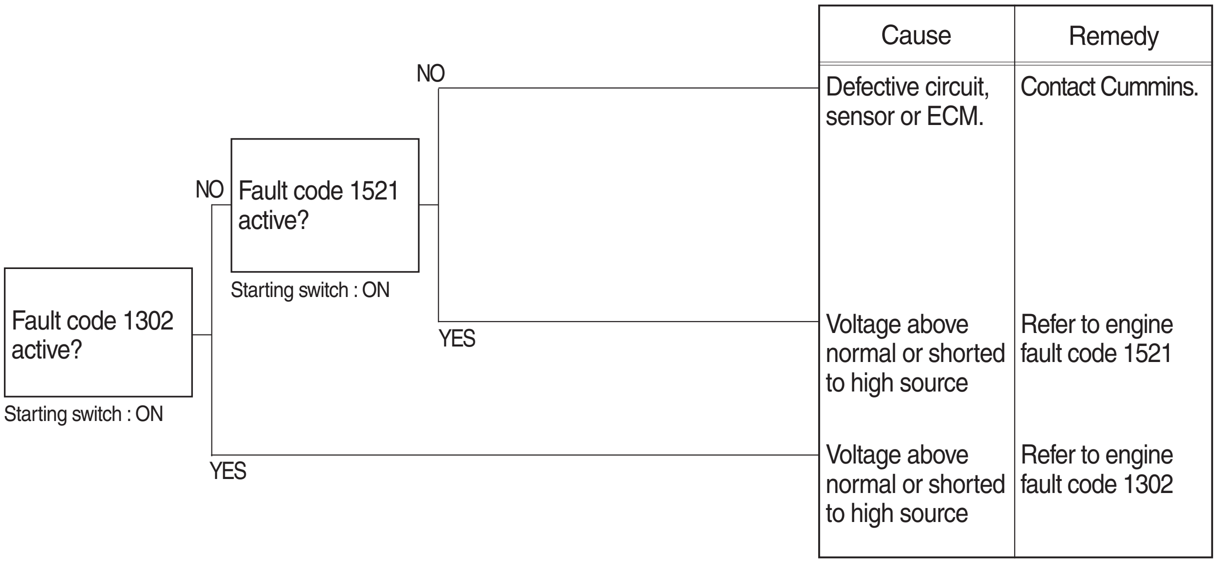
YES	MAX 1Ω
NO	MIN 1MΩ

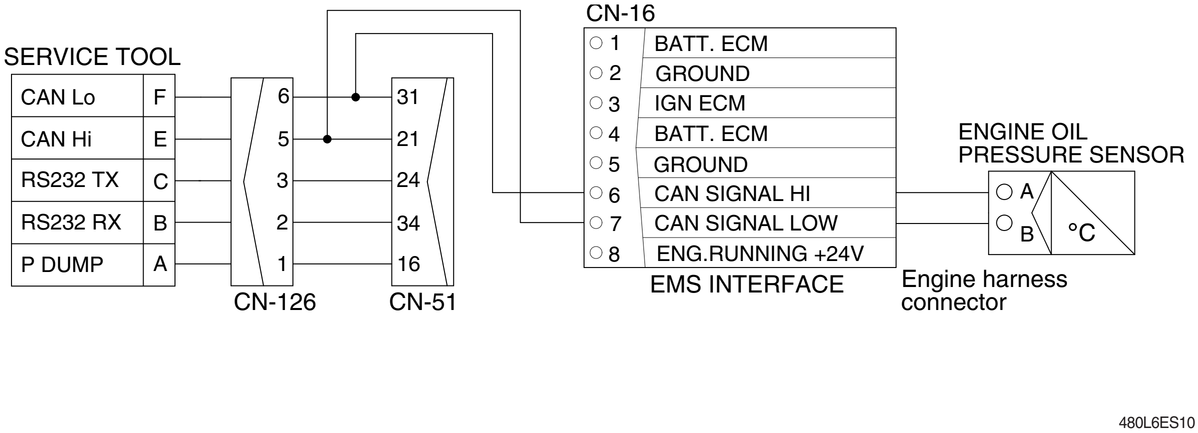


300L6ES06

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

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





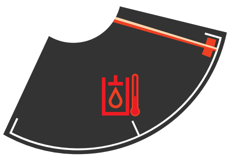
7. WHEN HYDRAULIC OIL TEMPERATURE WARNING LAMP LIGHTS UP (engine is started)

· 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.

Does display go off when disconnect CD-1?
Starting switch : ON
Engine : Start

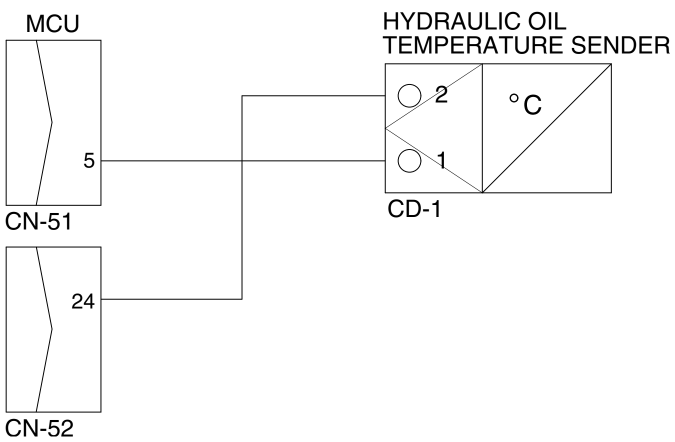
- YES → Resistance between CD-1 (1, 2) is in range of 164~151 Ω ?
  Starting switch : ON
  Disconnect CD-1
  - YES → High temperature
  - NO → Defective temp sensor
- NO → Resistance between CN-51 (5) and CN-52 (24) is 0~1 Ω ?
  Starting switch : OFF
  Disconnect CN-51
  - YES → Short circuit between temp sensor and MCU
  - NO → Defective controller

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



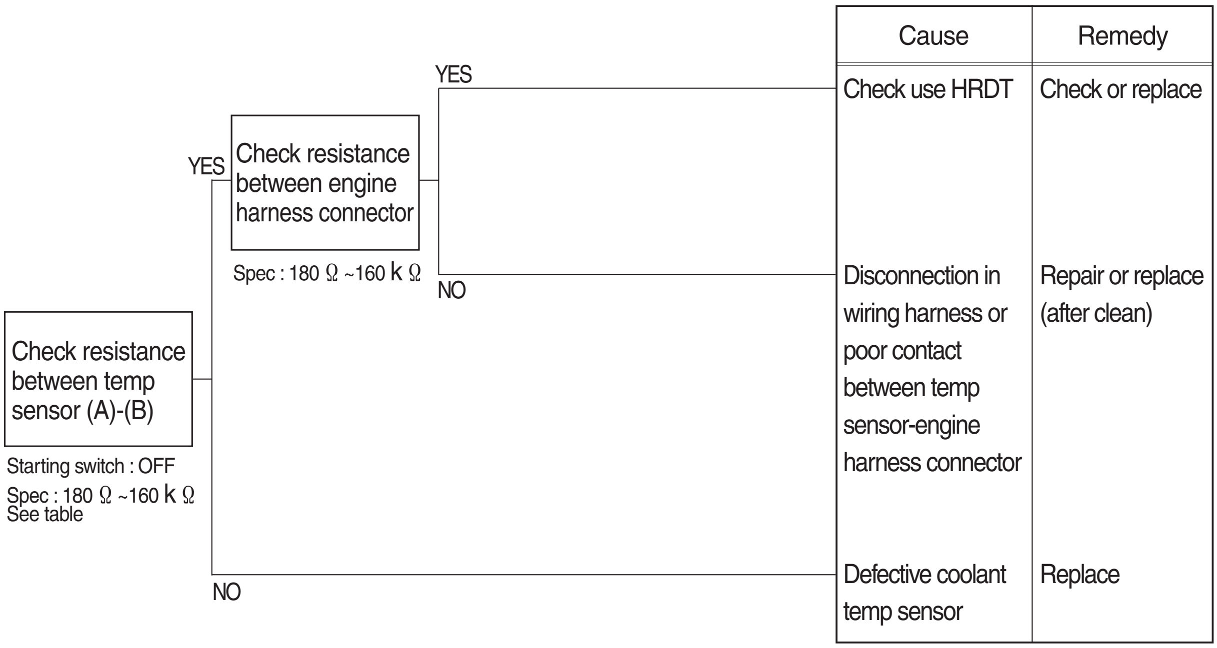
Check Table

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



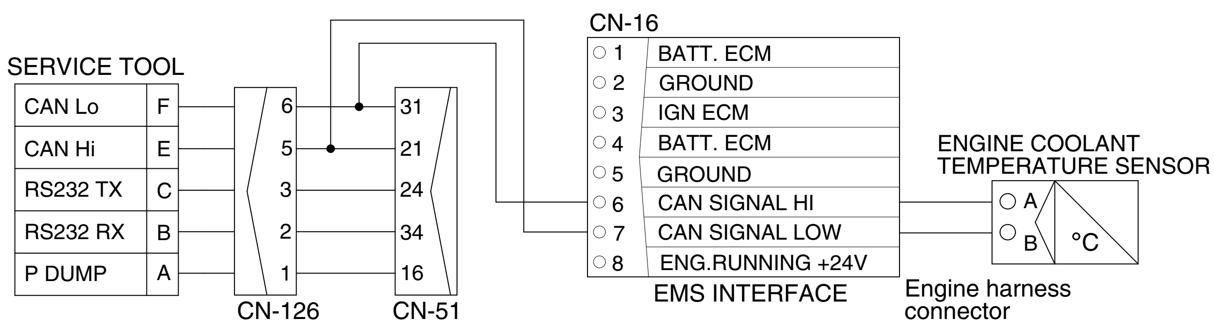
8. WHEN COOLANT TEMPERATURE GAUGE DOES NOT OPERATE

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



Check Table

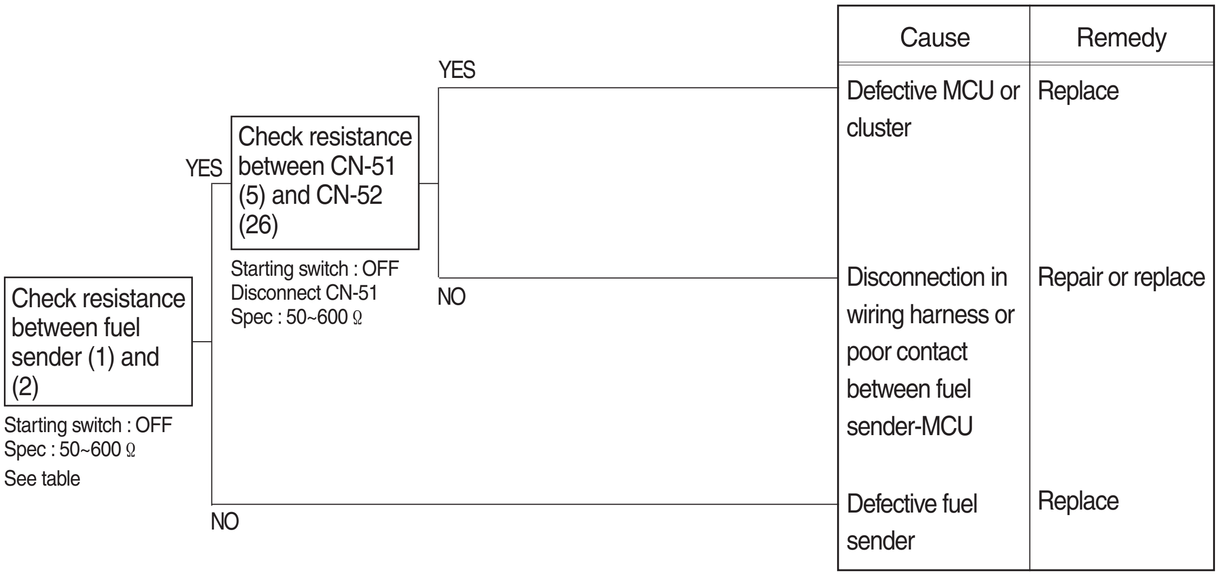
Temperature (˚C)	0	25	50	80	95
Resistance (k Ω)	30~37	9.3~10.7	3.2~3.8	1.0~1.3	0.7~0.8

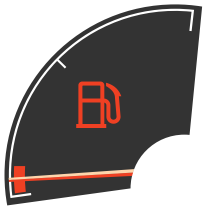


480L6ES02

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

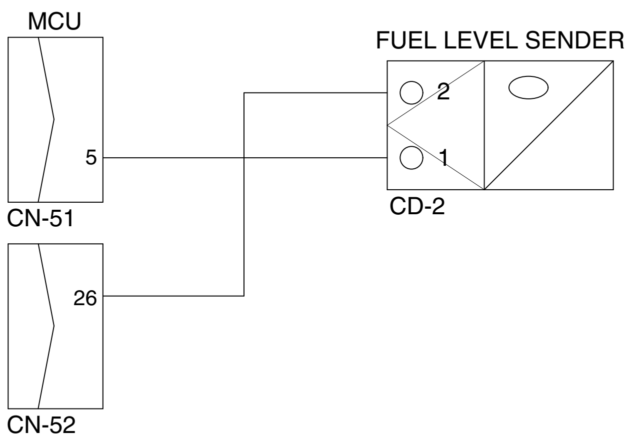
· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.





Check Table

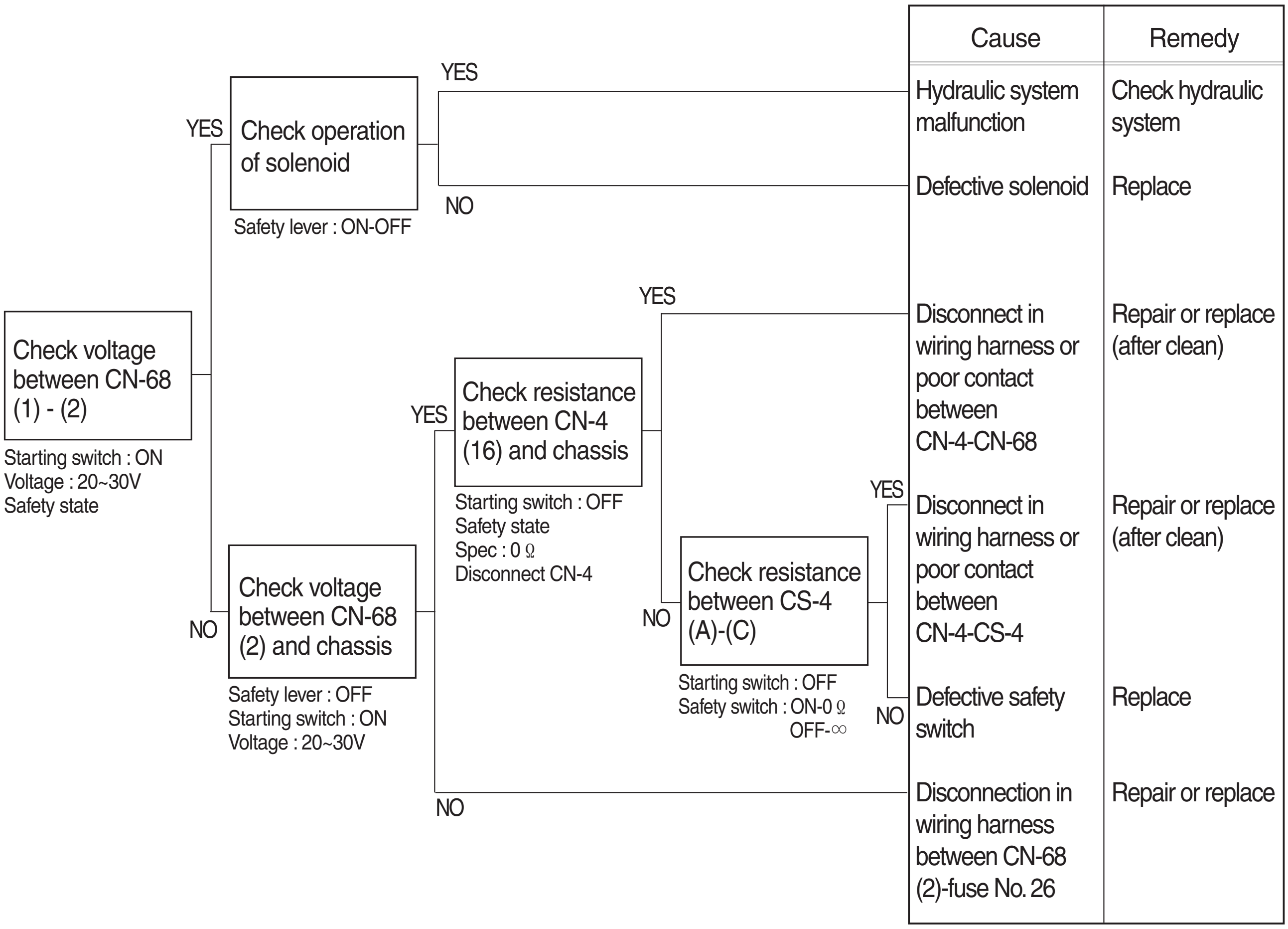
Range	Resistance (Ω)	Range	Resistance (Ω)
Full	50	5/12	400
11/12	100	4/12	450
10/12	150	3/12	500
9/12	200	2/12	550
8/12	250	1/12	600
7/12	300	Empty warning	700
6/12	350	-	-

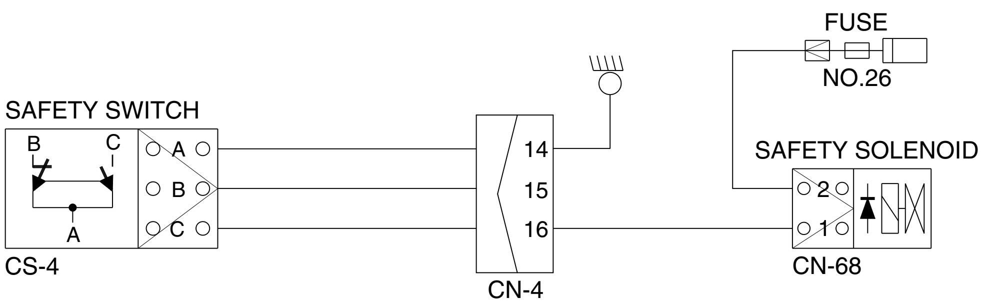


300L6ES10

10. WHEN SAFETY SOLENOID DOES NOT OPERATE

- Before disconnecting the connector, always turn the starting switch OFF.
- Before carrying out below procedure, check all the related connectors are properly inserted and short of fuse No. 26.
- After checking, insert the disconnected connectors again immediately unless otherwise specified.

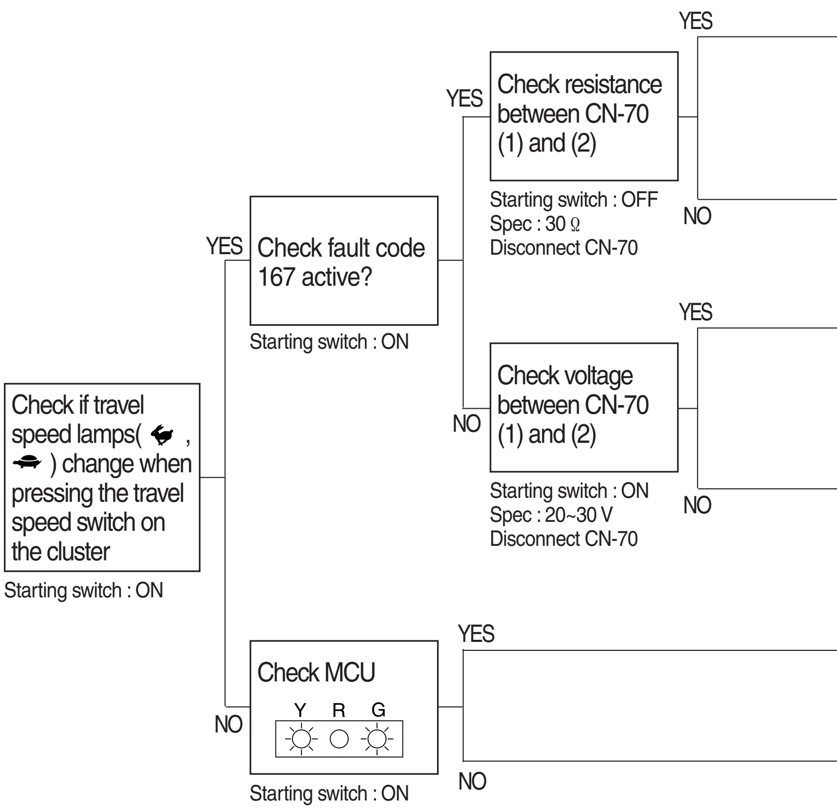




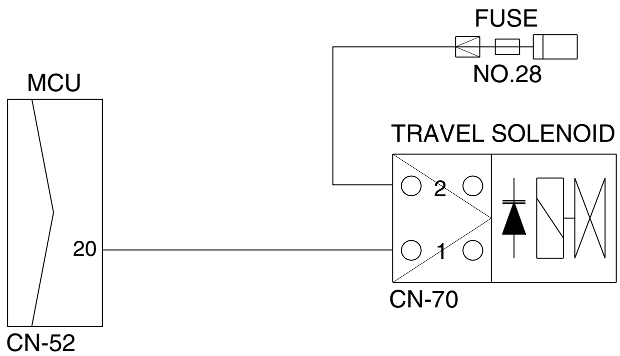
480L6ES03

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

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



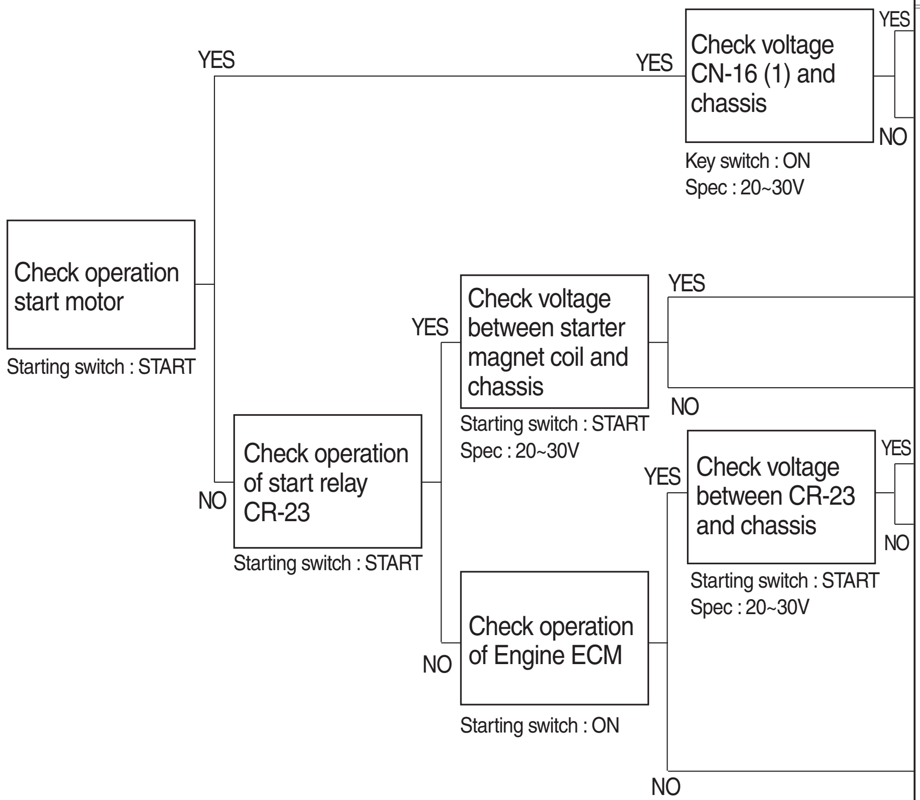
Cause	Remedy
Disconnection in wiring harness or poor contact between CN-70-CN-52	Repair or replace
Defective solenoid	Replace
Defective hydraulic system	Check hydraulic system
Disconnection in wiring harness or poor contact between CN-70-fuse No. 28	Repair or replace
Defective cluster	Replace
Defective MCU	Replace



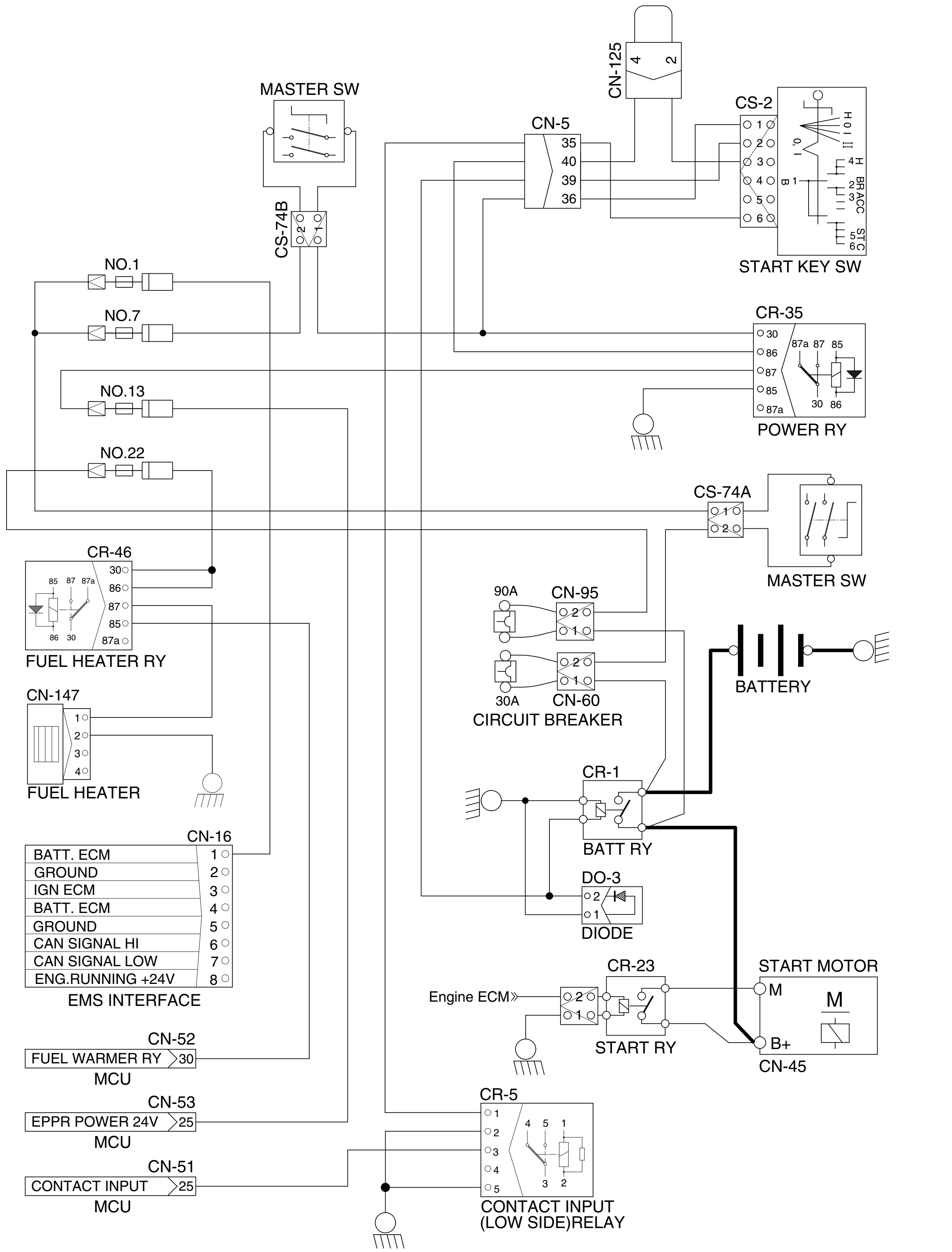
480L6ES04

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

· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted and short of fuse No. 1, 7, 13, 22.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.



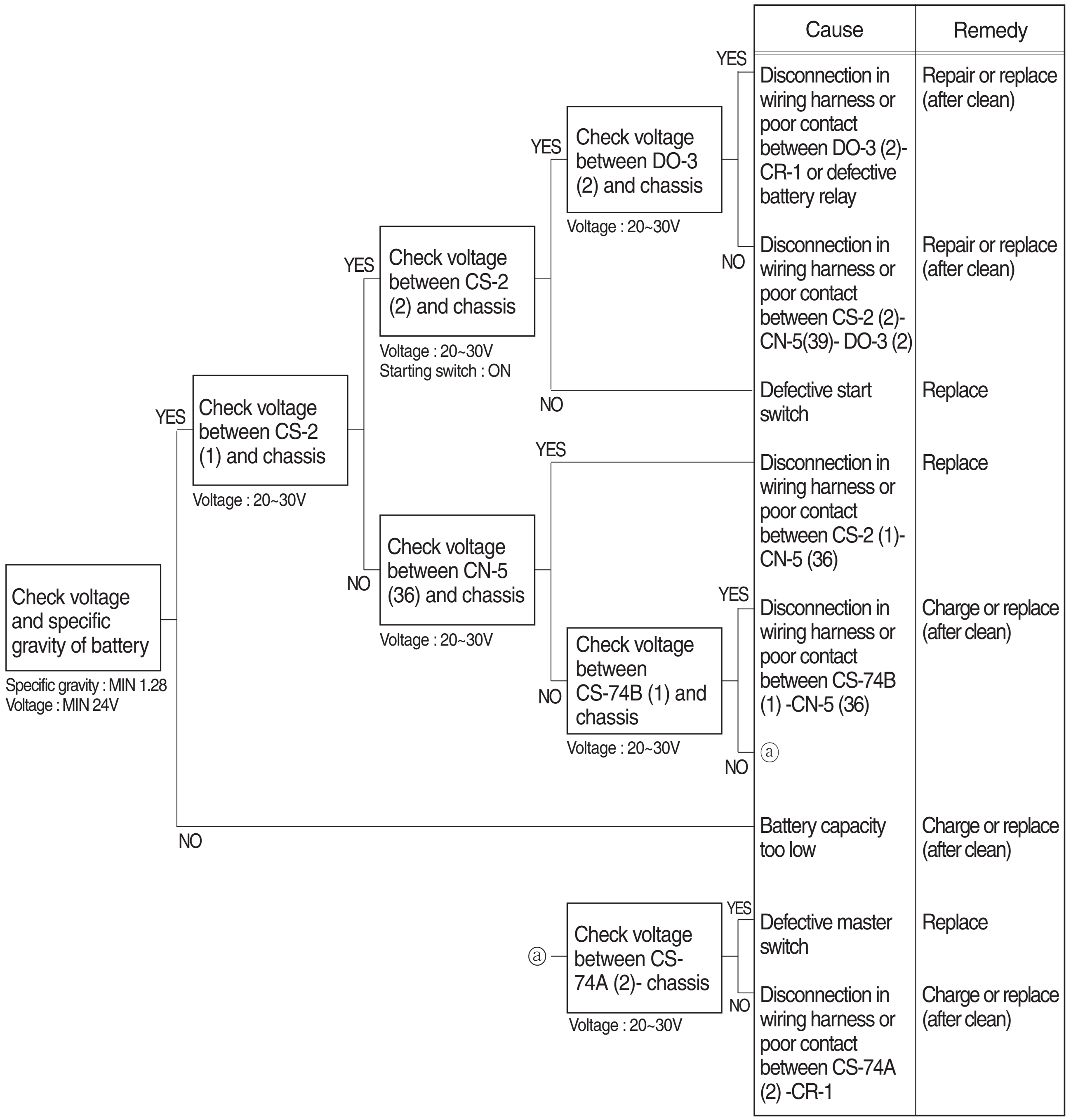
Cause	Remedy
Defective ECM or battery	Replace
Disconnection in wiring harness or poor contact between CR-35 (30) -CN-16 (1)	Repair or replace
Defective magnet of start motor	Replace
Defective start relay	Replace
Defective start relay	Replace
Disconnection in wiring harness or poor contact between CR-23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



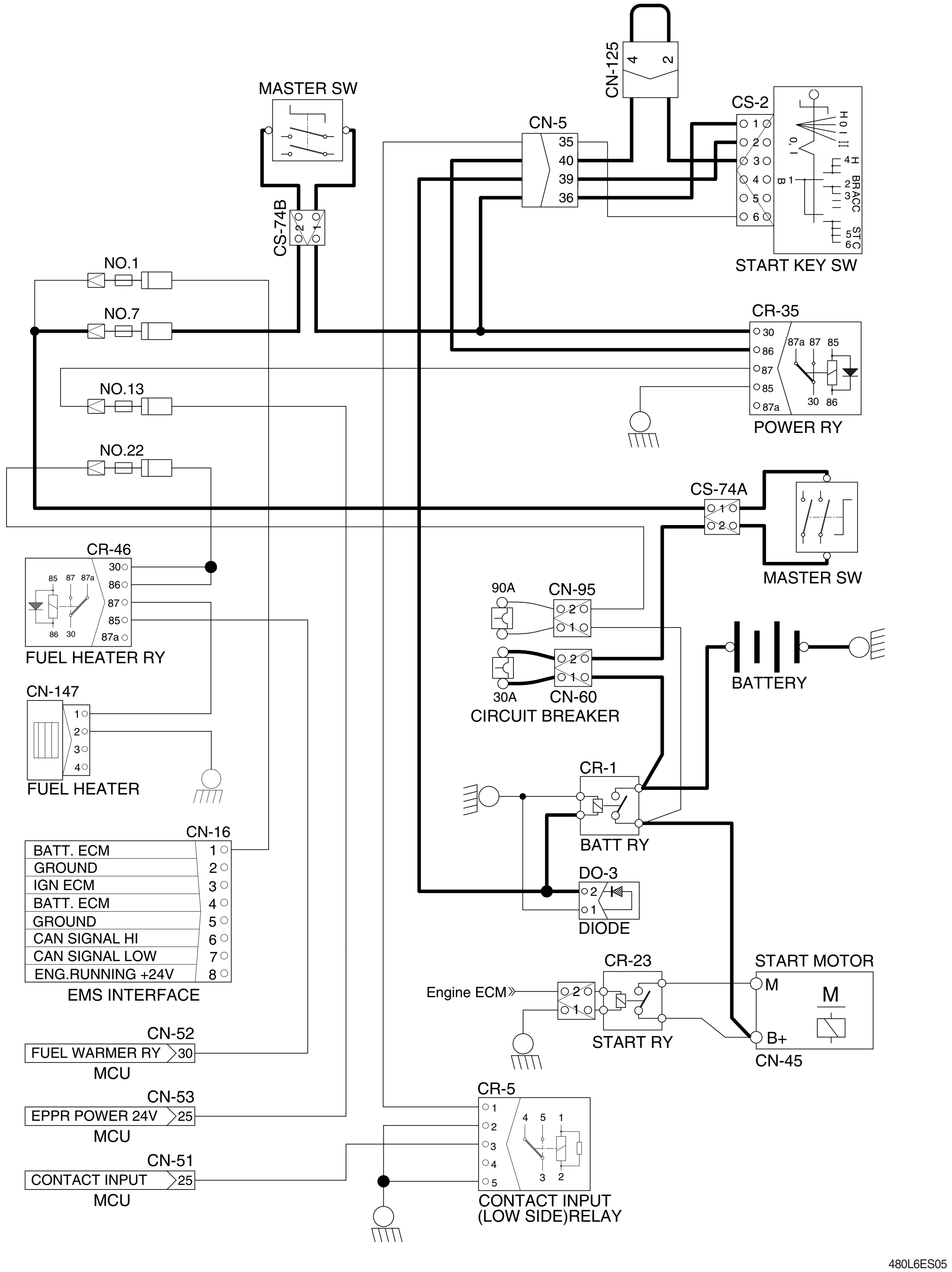
480L6ES11

13. WHEN STARTING SWITCH ON DOES NOT OPERATE

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

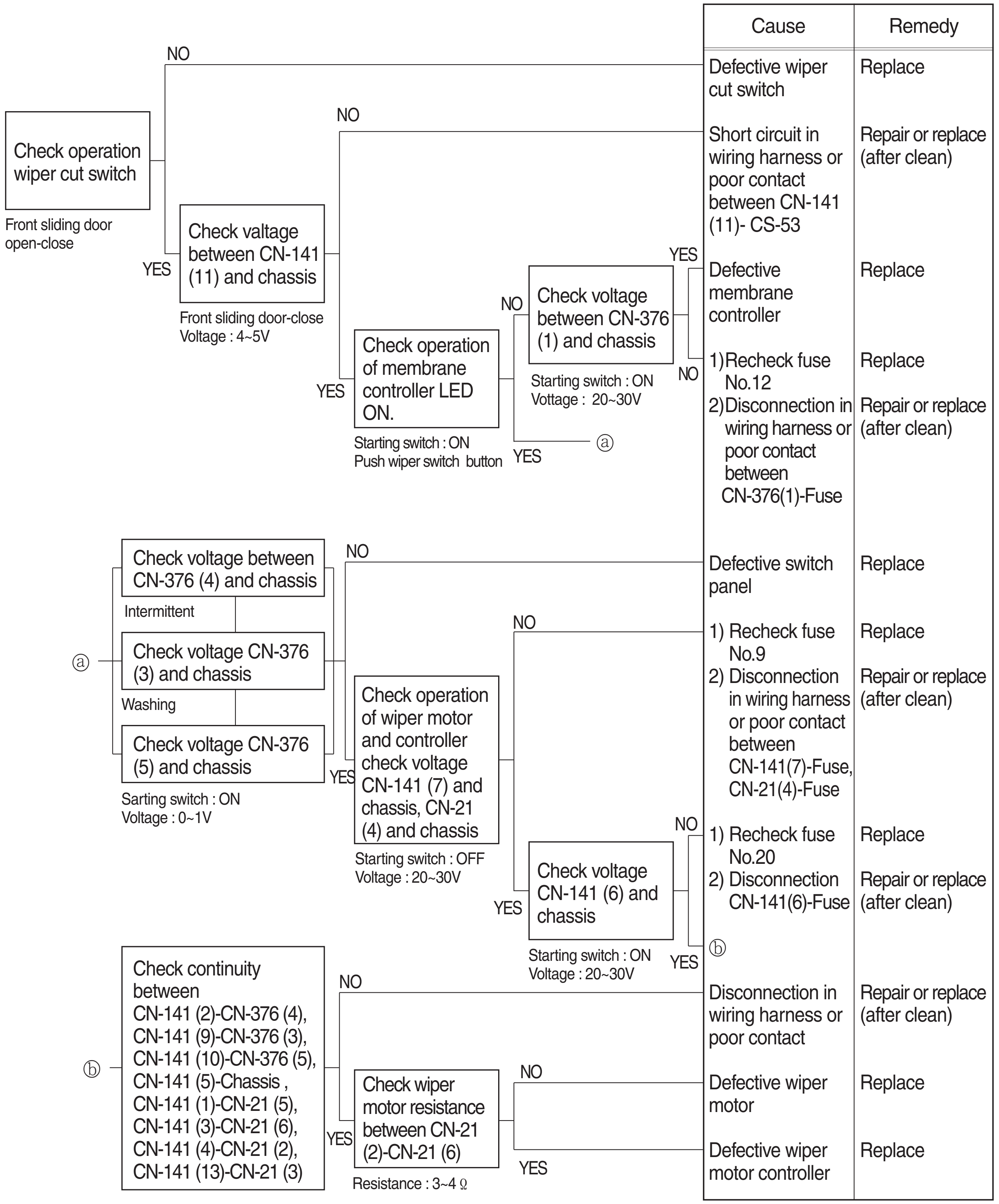


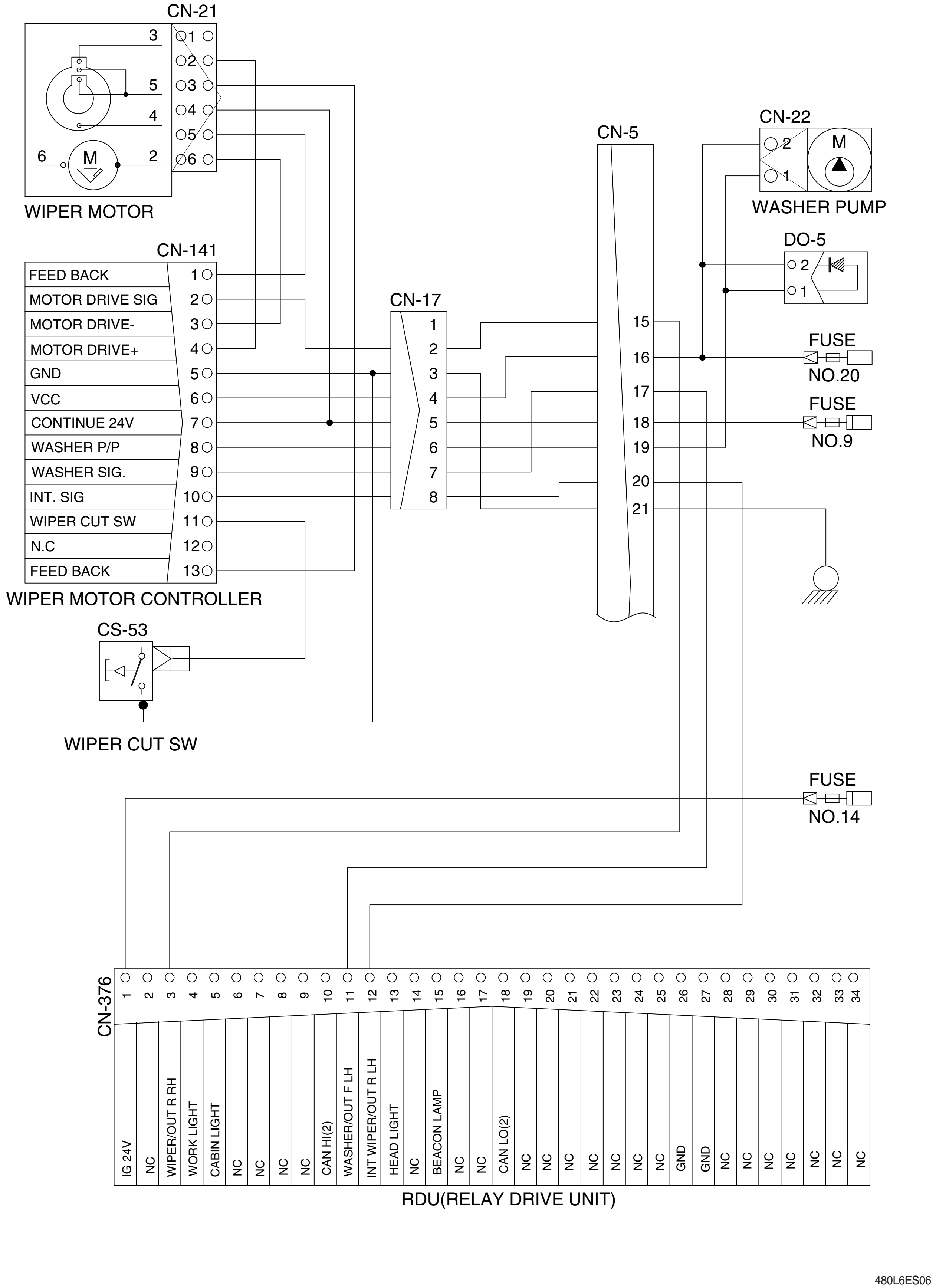
Cause	Remedy
Disconnection in wiring harness or poor contact between DO-3 (2)-CR-1 or defective battery relay	Repair or replace (after clean)
Disconnection in wiring harness or poor contact between CS-2 (2)-CN-5(39)- DO-3 (2)	Repair or replace (after clean)
Defective start switch	Replace
Disconnection in wiring harness or poor contact between CS-2 (1)-CN-5 (36)	Replace
Disconnection in wiring harness or poor contact between CS-74B (1) -CN-5 (36)	Charge or replace (after clean)
ⓐ	
Battery capacity too low	Charge or replace (after clean)
Defective master switch	Replace
Disconnection in wiring harness or poor contact between CS-74A (2) -CR-1	Charge or replace (after clean)



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

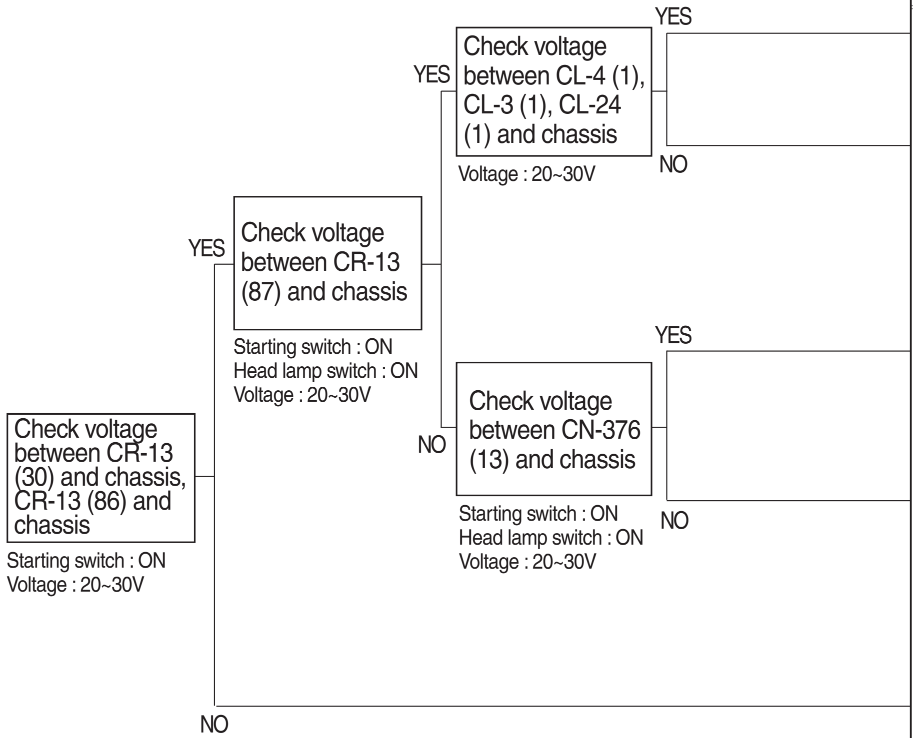
· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted and the fuse No. 9, 14 and 20 is not blown out.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.



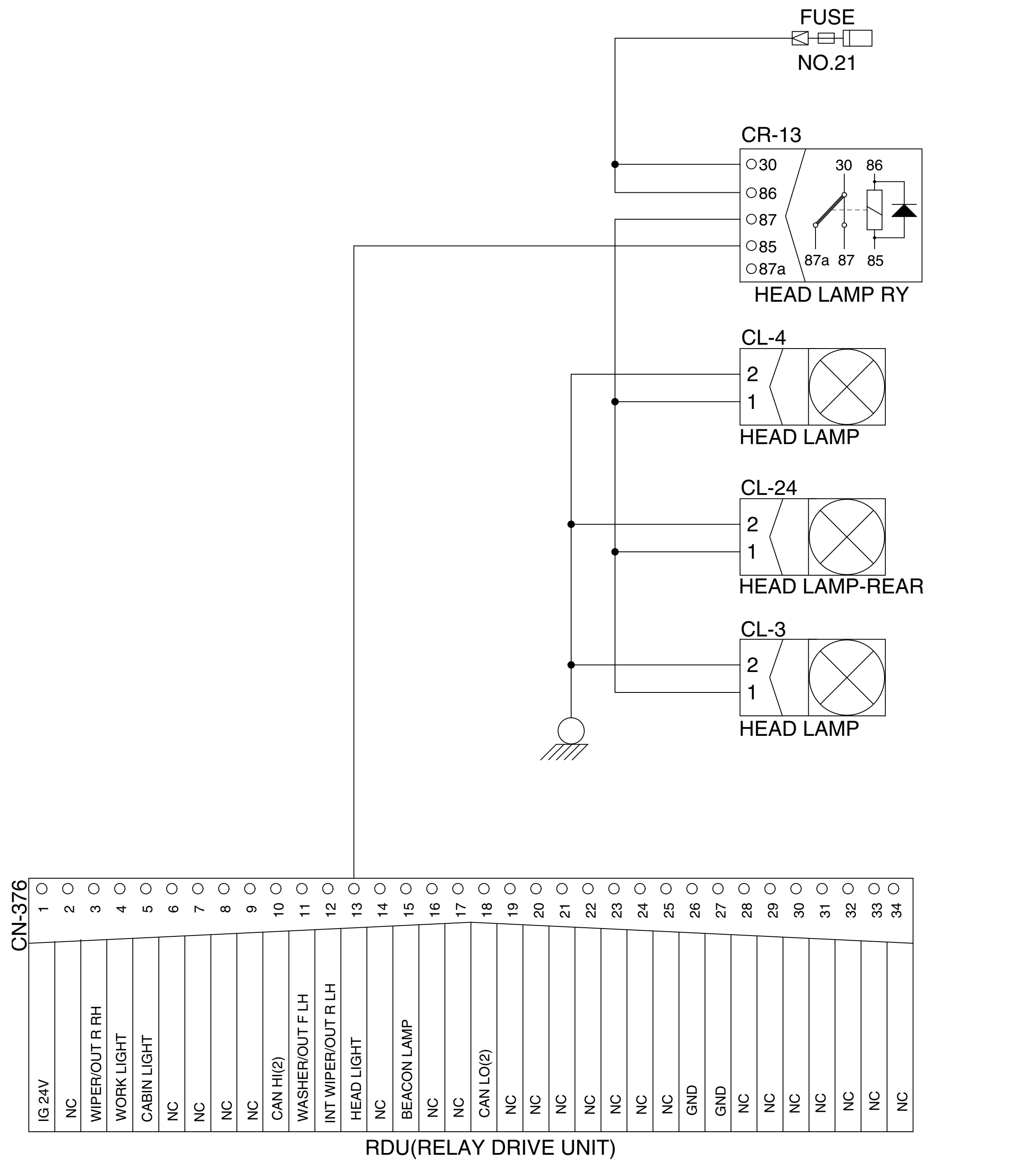


15. WHEN STARTING SWITCH IS TURNED ON, HEAD LAMP DOES NOT LIGHTS UP

· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted and short of fuse No.21.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.



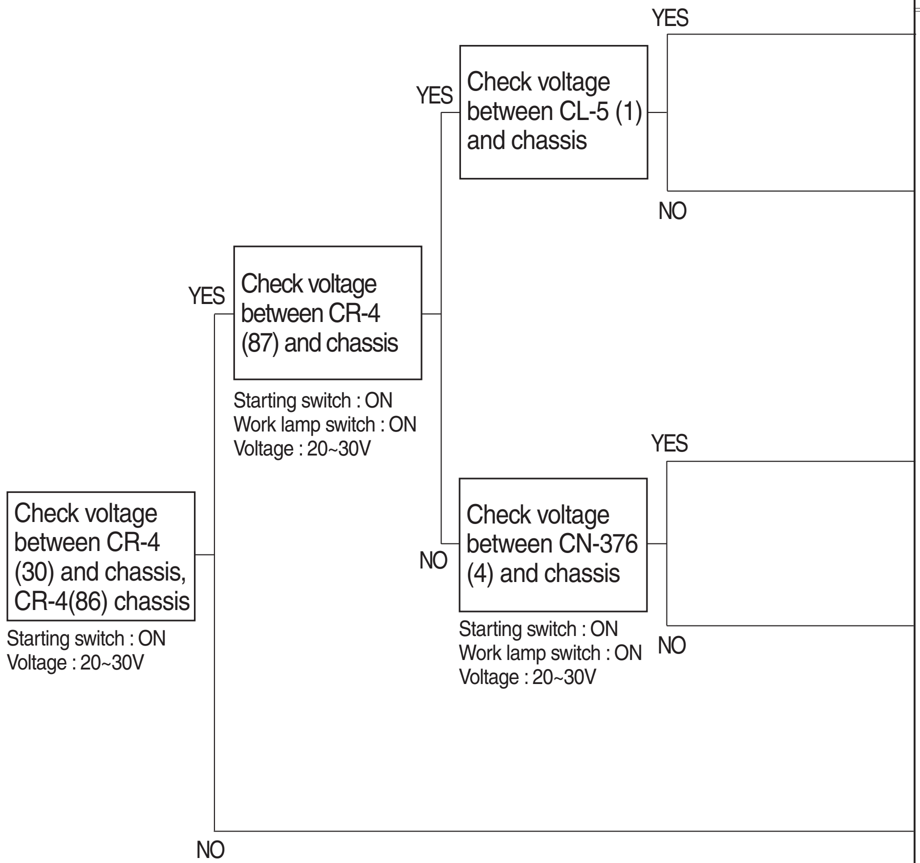
Cause	Remedy
Defective bulb	Replace
Disconnection in wiring harness or poor contact between CR-13 (87)-CL-4 (1) or CR -13 (87)-CL-3 (1)	Repair or replace (after clean)
Defective switch panel	Replace
Disconnection in wiring harness or poor contact between CN-376 (13)-CR-13 (87)	Repair or replace (after clean)
Disconnection in wiring harness or poor contact between CR-13 (30) and chassis or CR-13 (86) - chassis	Repair or replace (after clean)
Recheck fuse No. 21	Replace



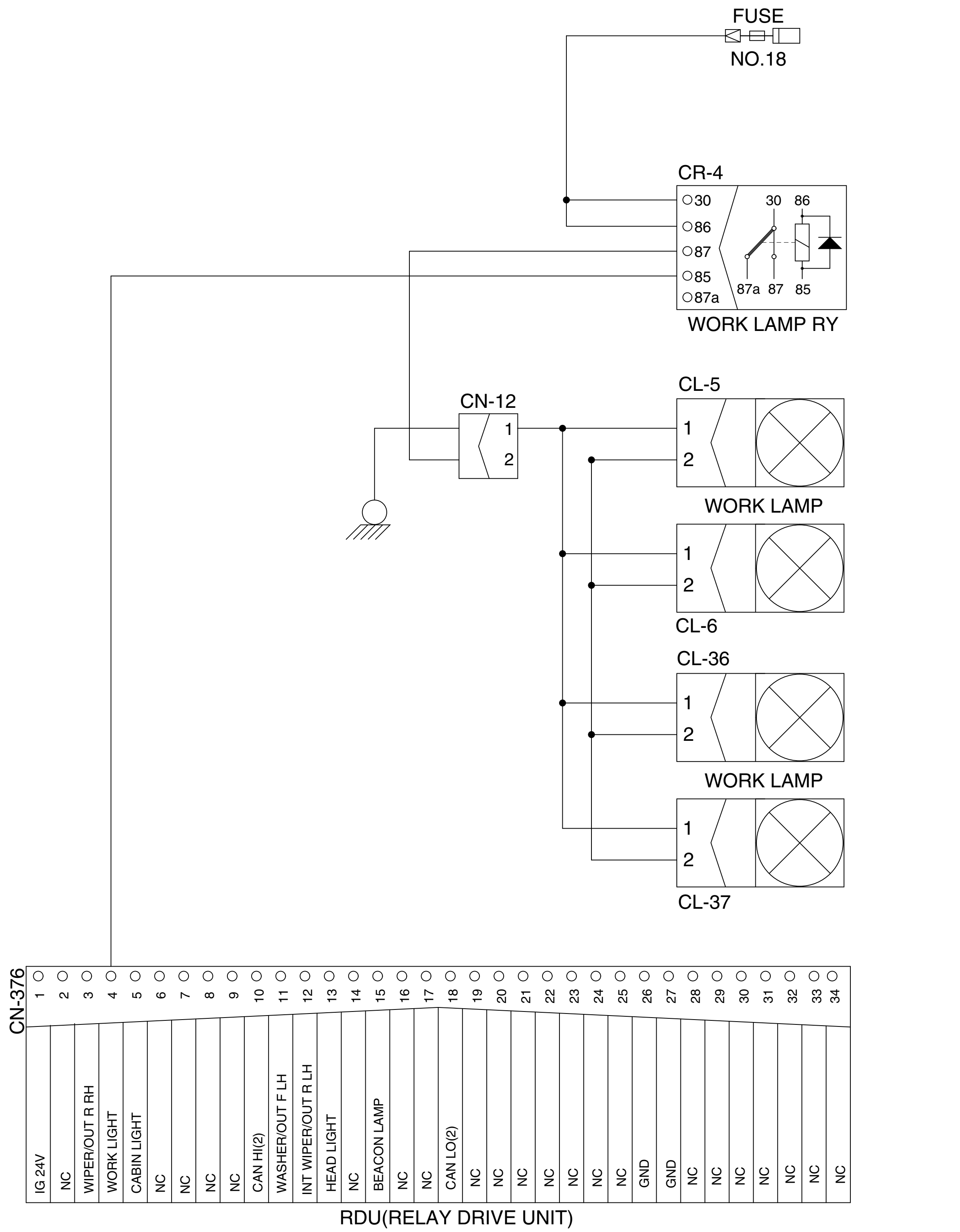
480L6ES07

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

· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted and short of fuse No.18.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.



Cause	Remedy
Defective bulb	Replace
Disconnection in wiring harness or poor contact between CR-4 (87)-CL-5 (2)	Repair or replace (after clean)
Defective switch panel	Replace
Disconnection in wiring harness or poor contact between CR-4 (87)-CN-376 (4)	Repair or replace (after clean)
Disconnection in wiring harness or poor contact between CR-4 (30) and chassis or CR-4 (86) and chassis	Repair or replace (after clean)
Recheck fuse No.18	Replace



480L6ES08

GROUP 4 MECHATRONICS SYSTEM

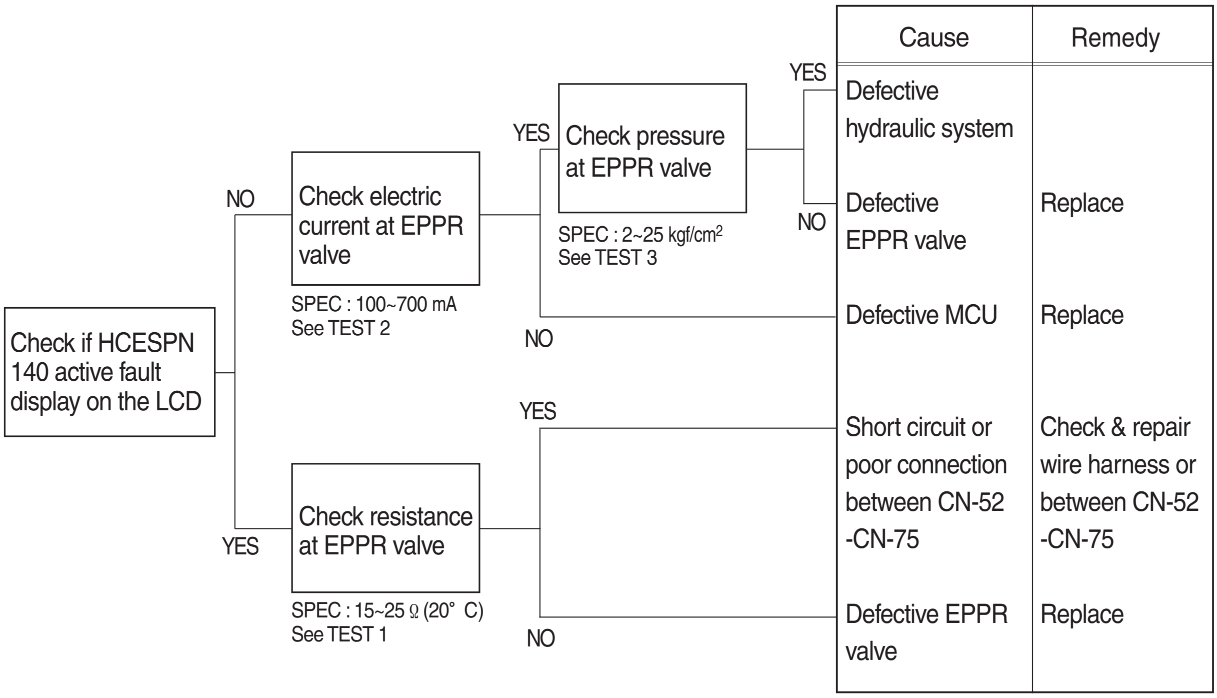
1. ALL ACTUATORS SPEED ARE SLOW

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

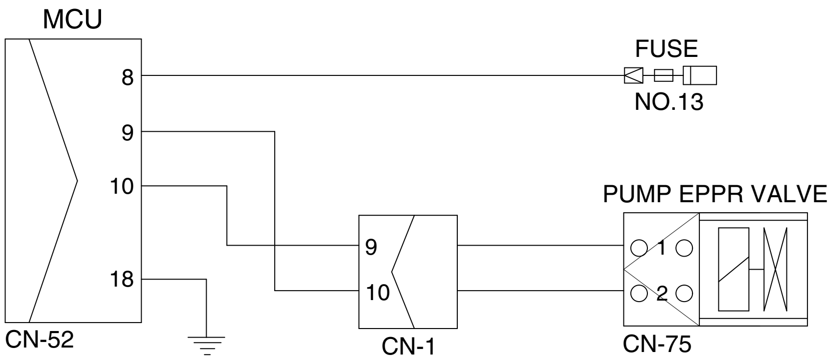
※ Spec : P-mode 1850 ± 50 rpm S -mode 1750 ± 50 rpm E-mode 1650 ± 50 rpm

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

1) INSPECTION PROCEDURE



Wiring diagram



480L6MS01

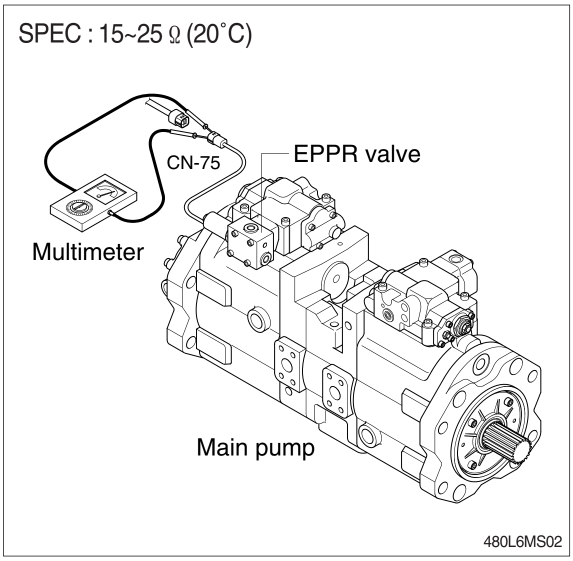
2) TEST PROCEDURE

(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.

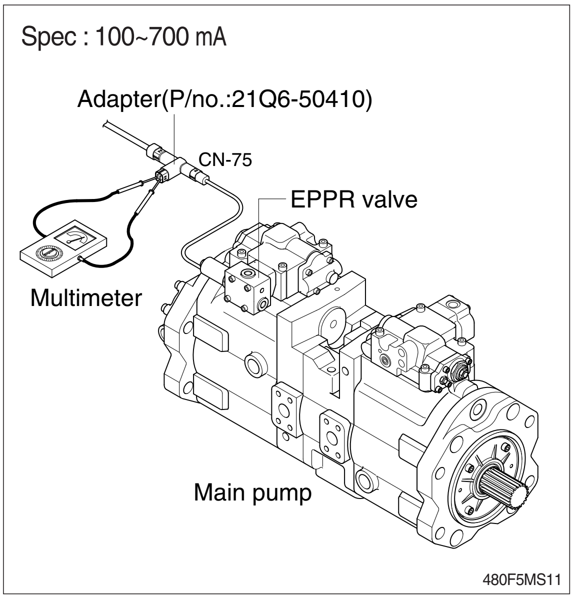
③ Start engine.

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/cm²
(0 to 725 psi)

② Start engine.

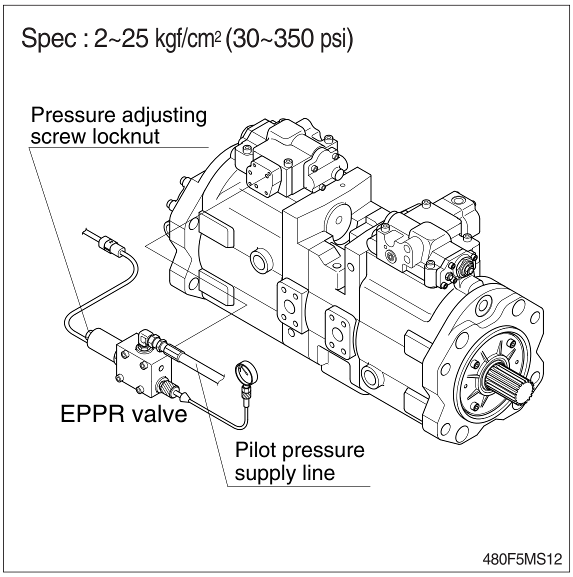
③ Set S-mode and cancel auto decel mode.

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.

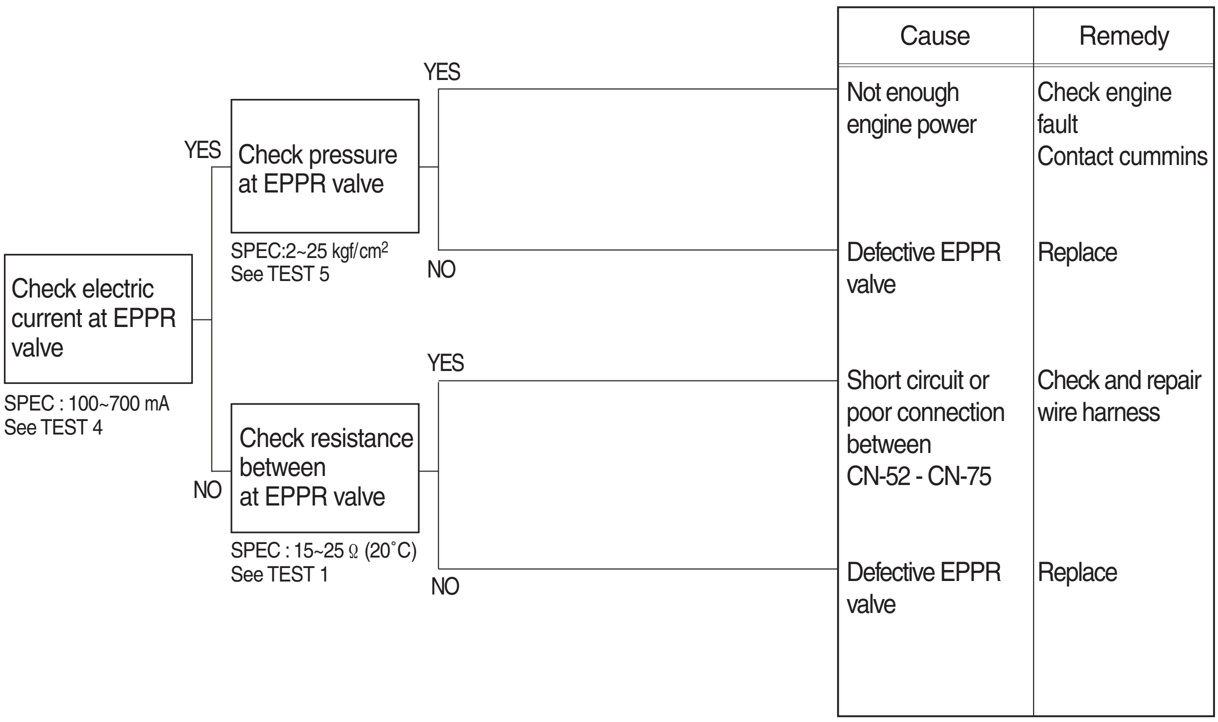
⑦ After adjust, test the machine.



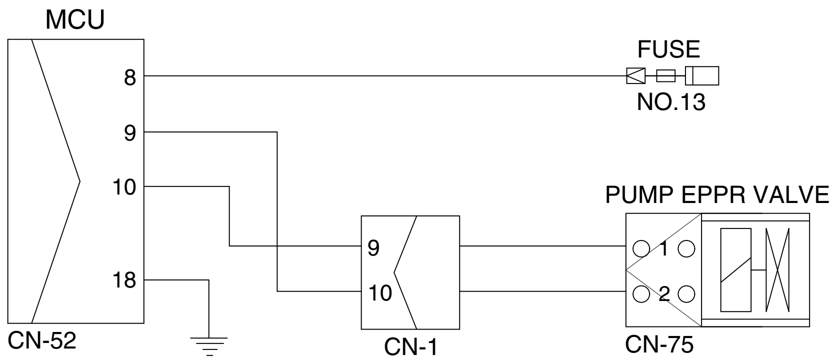
2. ENGINE STALL

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

1) INSPECTION PROCEDURE



Wiring diagram

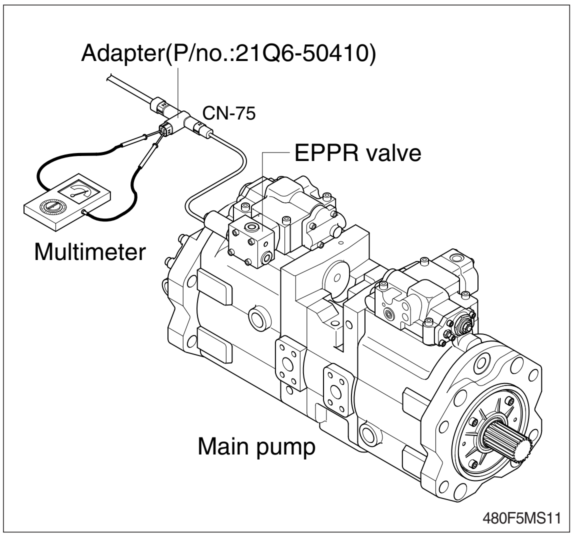


480L6MS01

2) TEST PROCEDURE

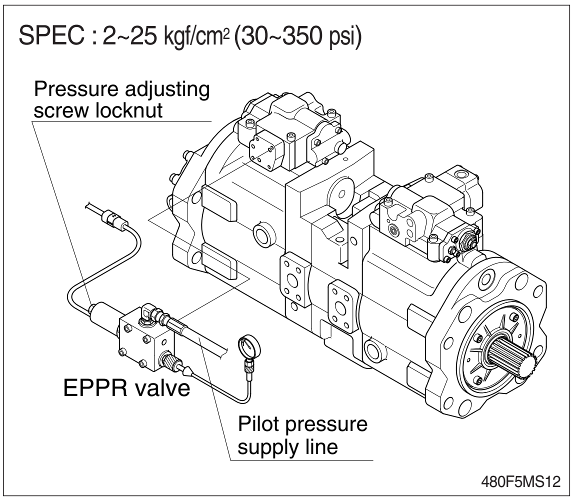
(1) Test 4 : Check electric current at EPPR valve.

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.



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

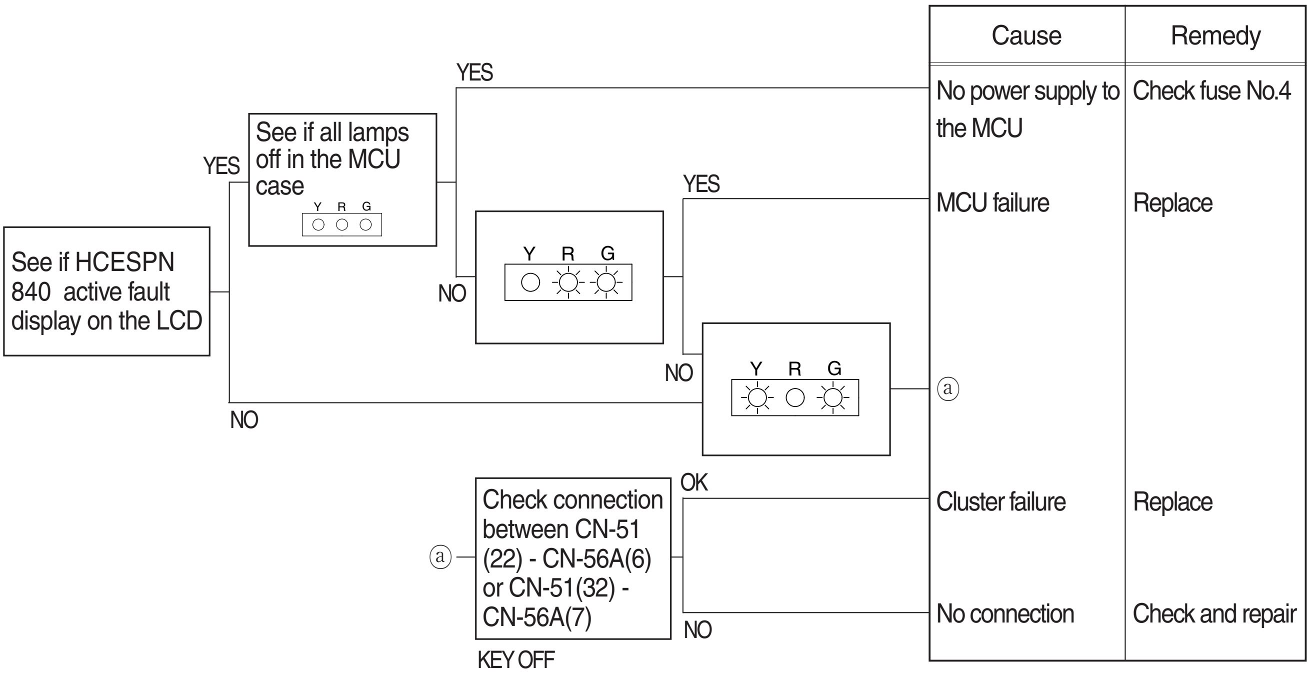
① Remove plug and connect pressure gauge as figure.
   · Gauge capacity : 0 to 50 kgf/cm2 (0 to 725 psi)
② Start engine.
③ Set S-mode and cancel auto decel mode.
④ Position the accel dial at 10.
⑤ If rpm show approx 1750±50 rpm check pressure at relief position of bucket circuit by operating bucket control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



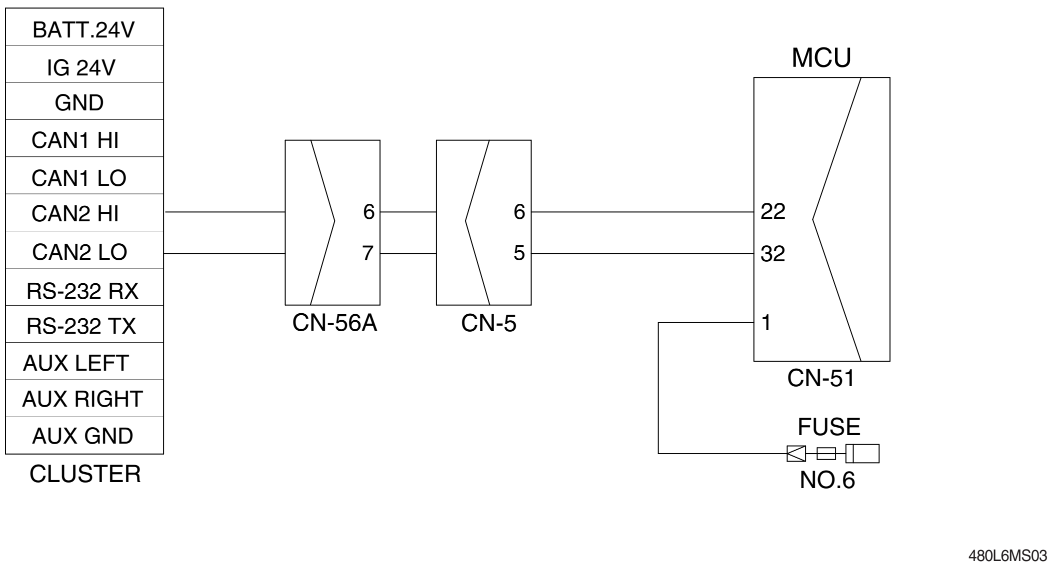
3. MALFUNCTION OF CLUSTER OR MODE SELECTION SYSTEM

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

1) INSPECTION PROCEDURE



Wiring diagram

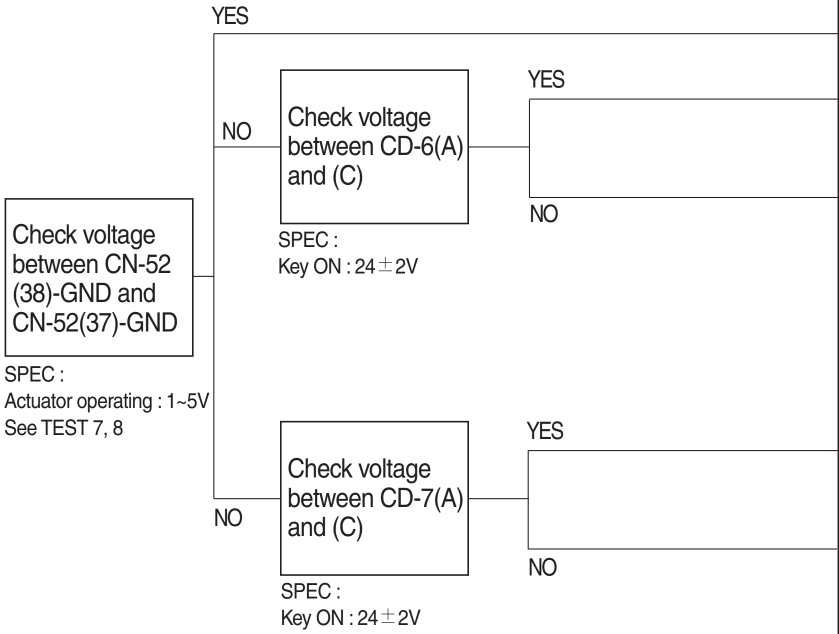


4. AUTO DECEL SYSTEM DOES NOT WORK

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

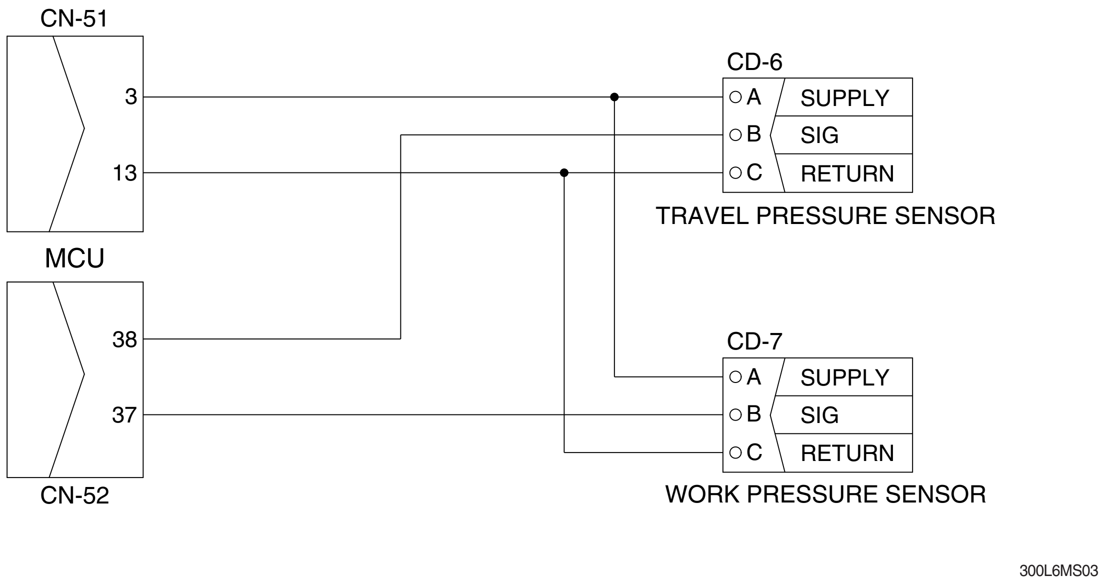
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



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

Wiring diagram



2) TEST PROCEDURE

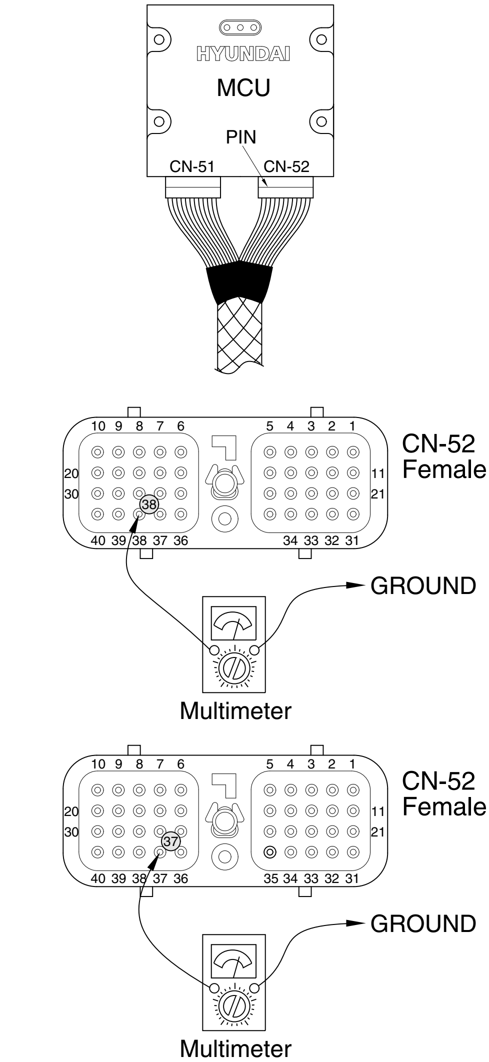
(1) Test 7 : Check voltage at CN-52 (38) and ground.

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 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 key ON.
④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V



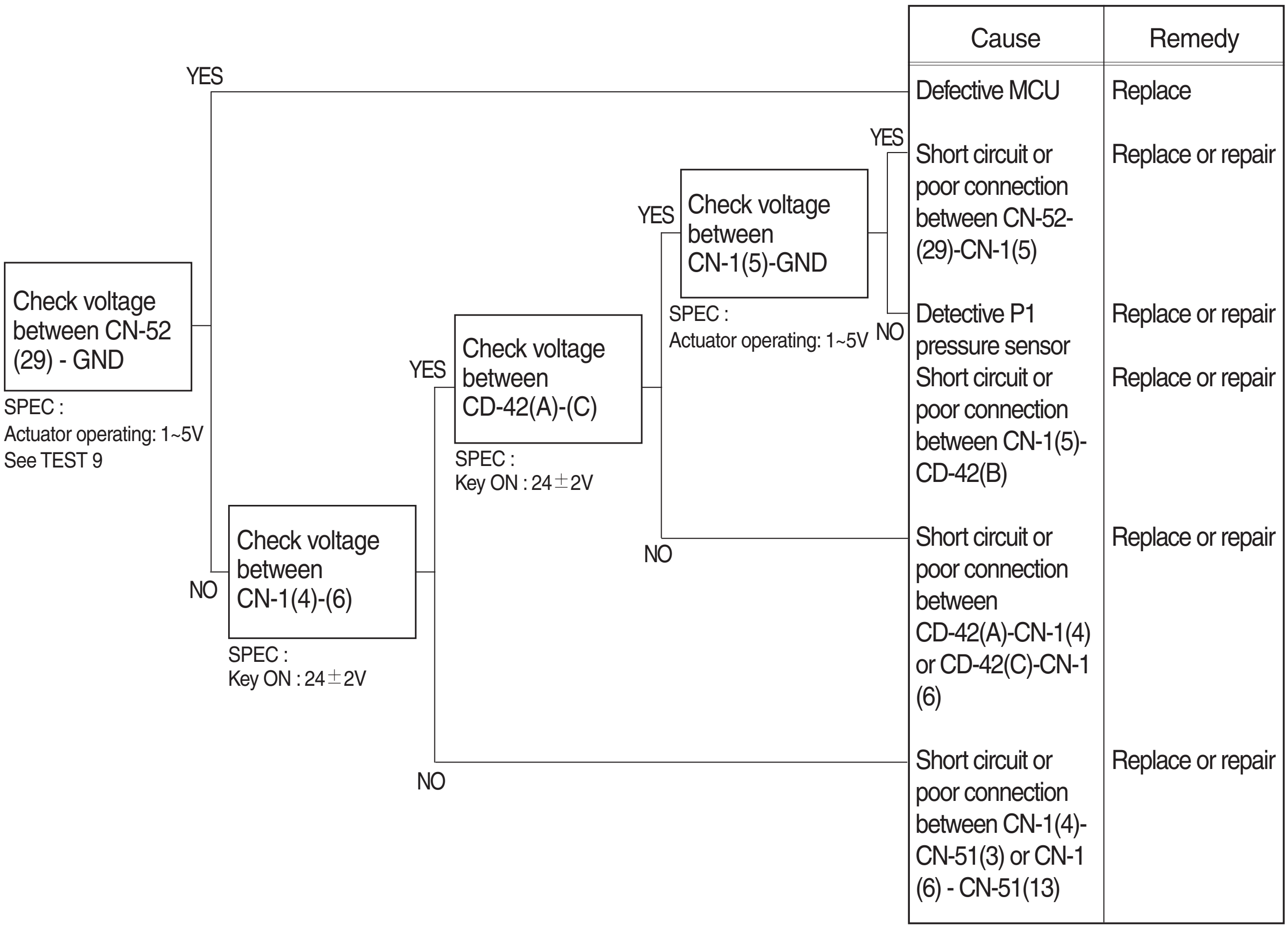
300L6MS04

5. MALFUNCTION OF PUMP 1 PRESSURE SENSOR

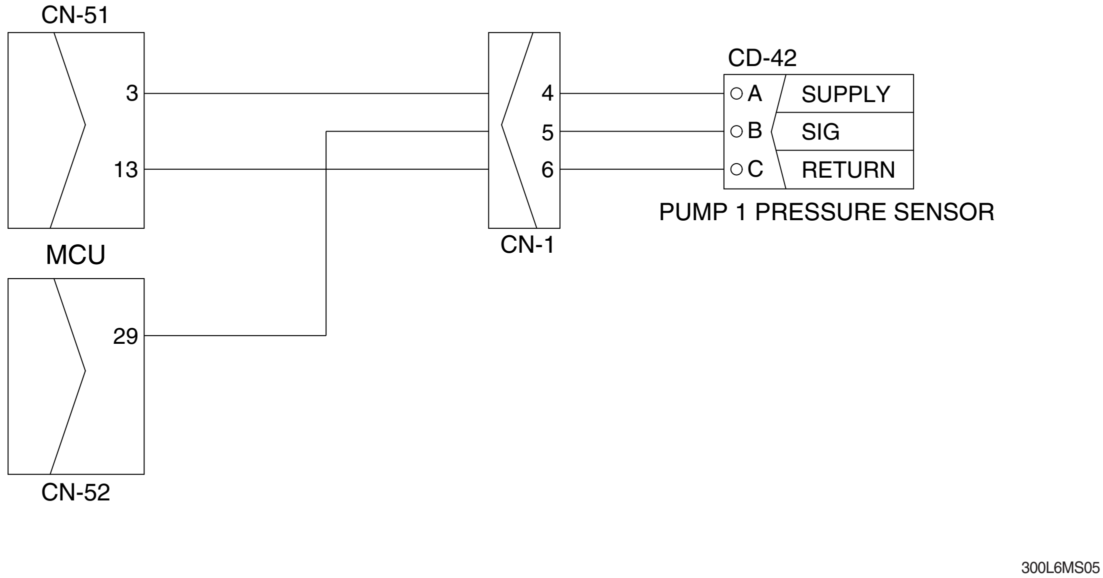
· Fault code : HCESPN 120, FMI 0~4

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

1) INSPECTION PROCEDURE



Wiring diagram



2) TEST PROCEDURE

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

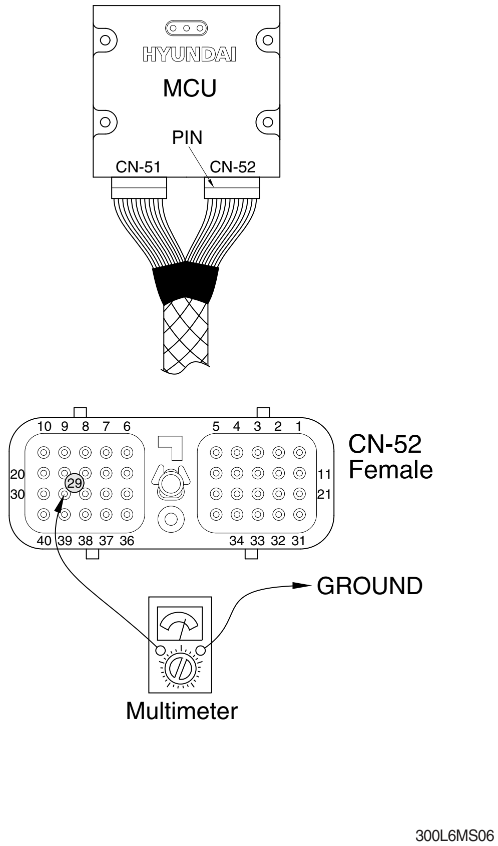
① Prepare 1 piece of thin sharp pin, steel or copper.

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

③ Starting key ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V

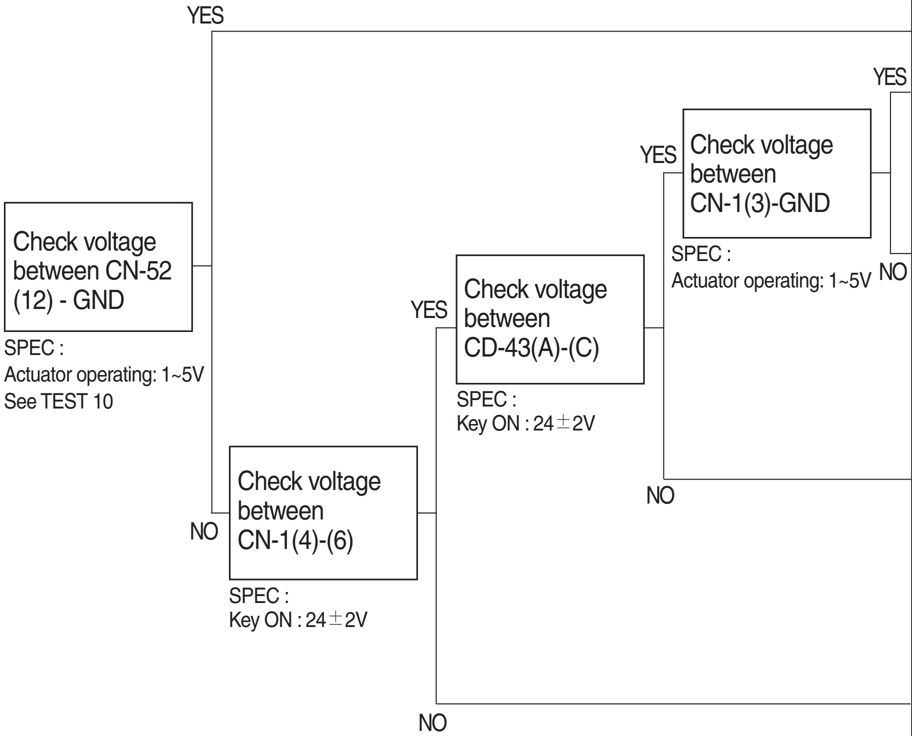


6. MALFUNCTION OF PUMP 2 PRESSURE SENSOR

· Fault code : HCESPN 121, FMI 0~4

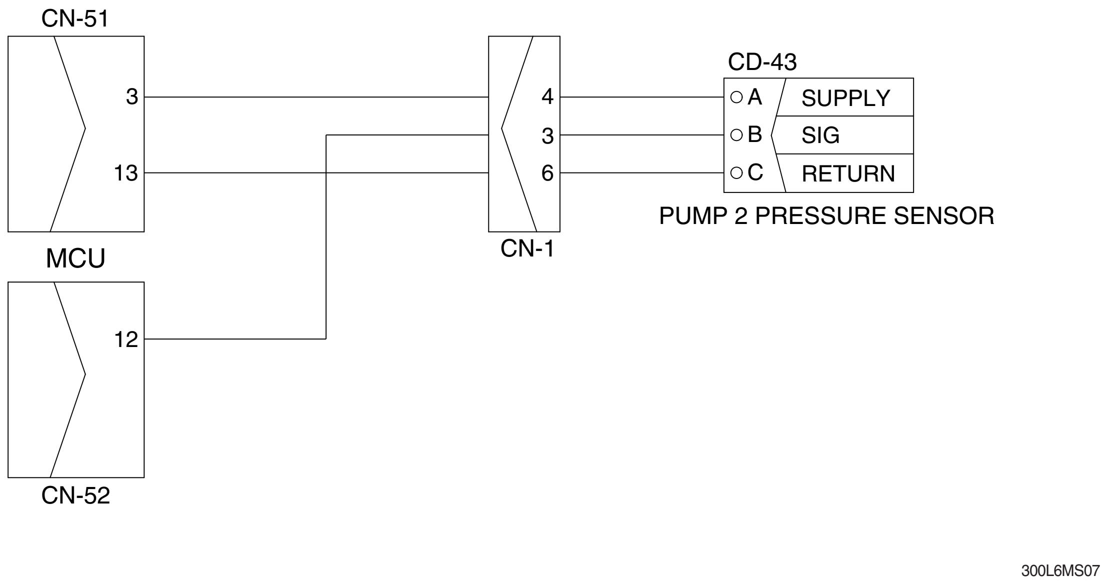
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



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

Wiring diagram



2) TEST PROCEDURE

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

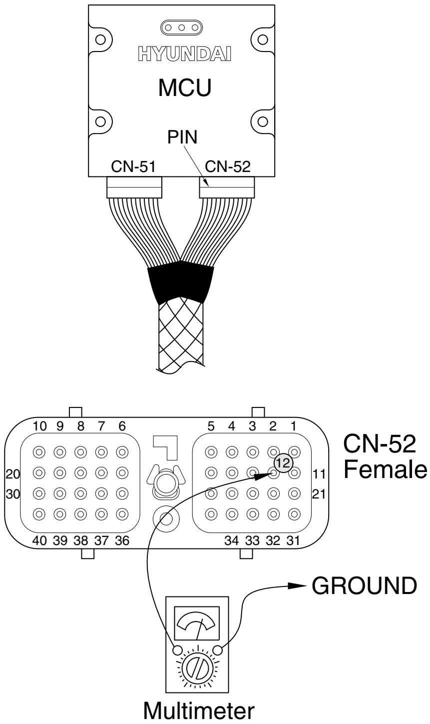
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (12) of CN-52.

③ Starting key ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V

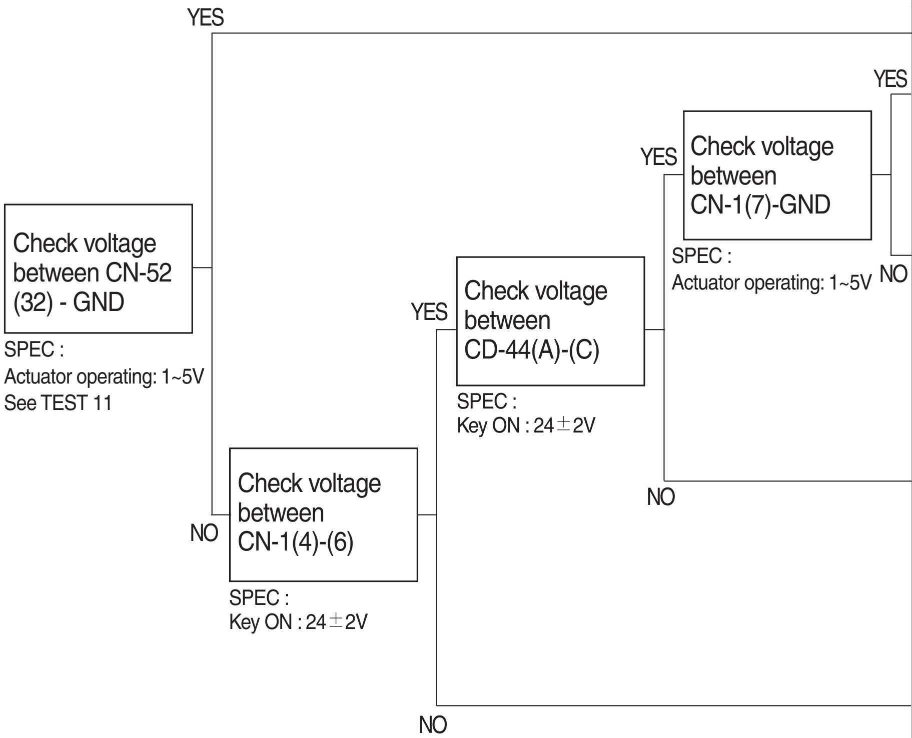


300L6MS08

7. MALFUNCTION OF PUMP 3 PRESSURE SENSOR

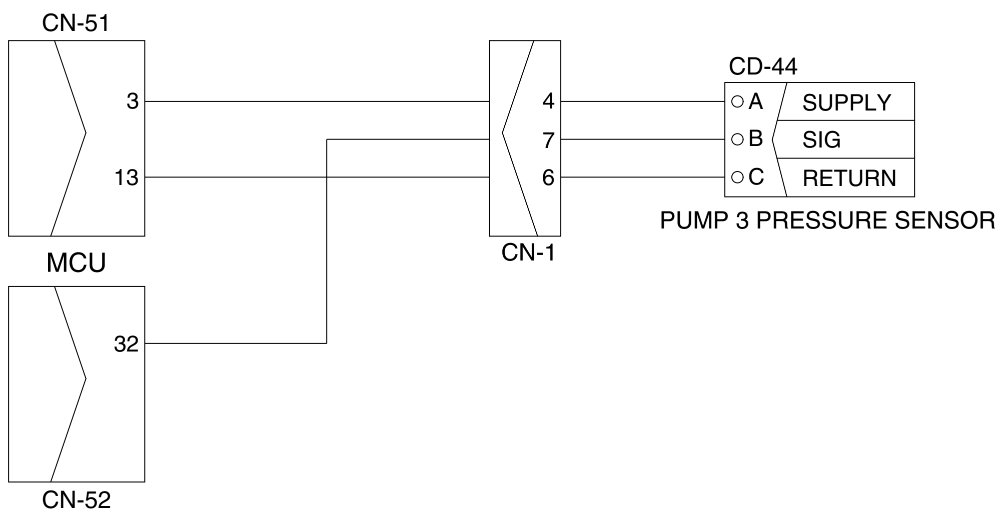
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective MCU	Replace
Short circuit or poor connection between CN-52-(32)-CN-1(7)	Replace or repair
Detective P3 pressure sensor	Replace or repair
Short circuit or poor connection between CN-1(7)-CD-44(B)	Replace or repair
Short circuit or poor connection between CD-44(A)-CN-1(4) or CD-44(C)-CN-1 (6)	Replace or repair
Short circuit or poor connection between CN-1(4)-CN-51(3) or CN-1 (6) - CN-51(13)	Replace or repair

Wiring diagram



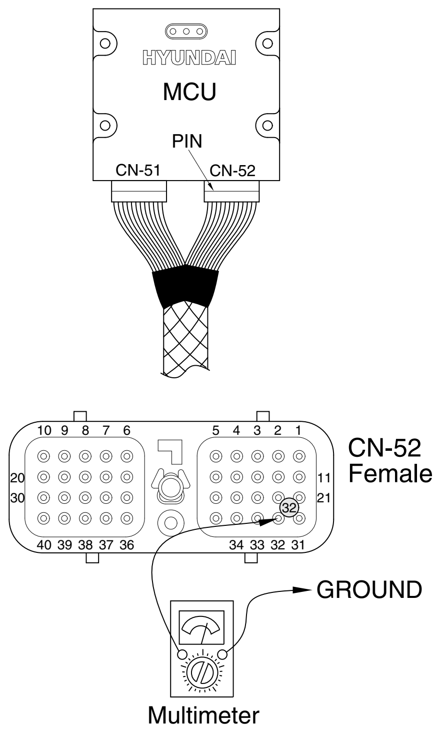
300L6MS09

2) TEST PROCEDURE

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

① Prepare 1 piece of thin sharp pin, steel or copper.
② Insert prepared pin to rear side of connectors : One pin to (32) of CN-52.
③ Starting key ON.
④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V



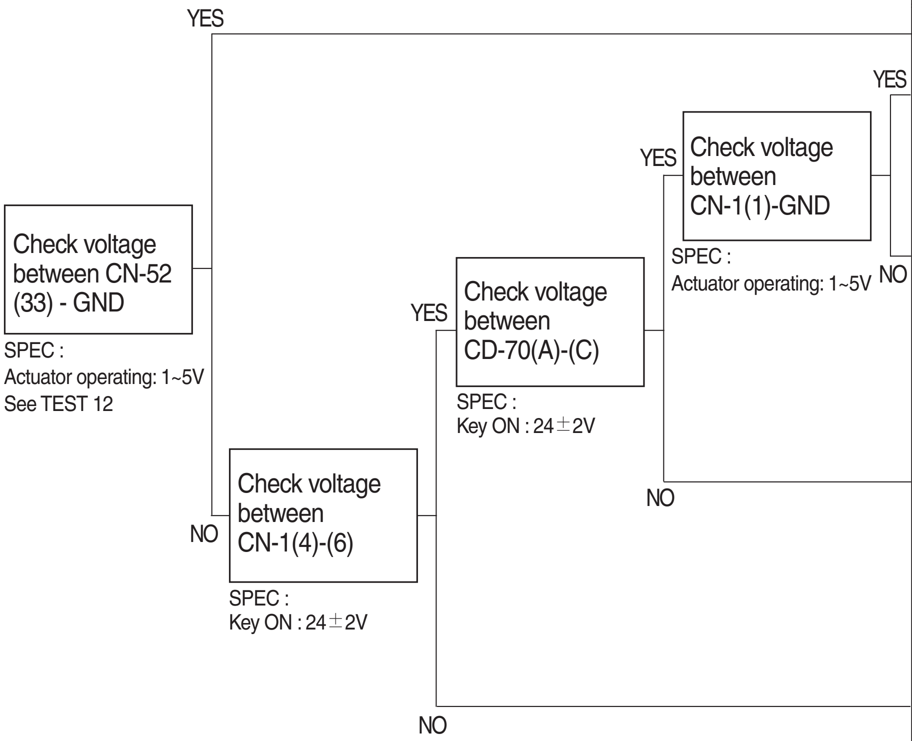
300L6MS10

8. MALFUNCTION OF NEGATIVE 1 PRESSURE SENSOR

· Fault code : HCESPN 123, FMI 0~4

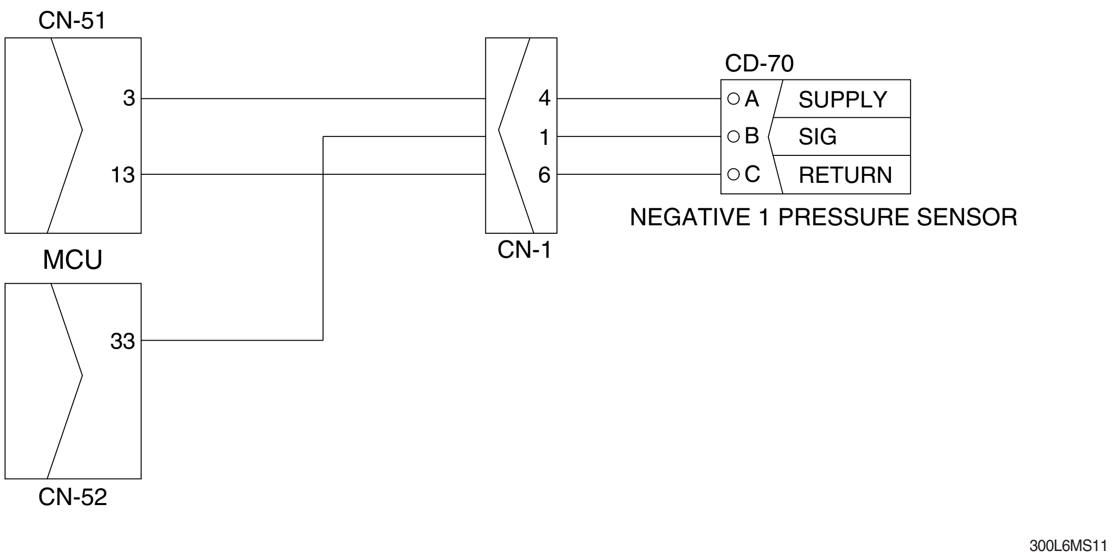
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective MCU	Replace
Short circuit or poor connection between CN-52-(33)-CN-1(1)	Replace or repair
Detective N1 pressure sensor	Replace or repair
Short circuit or poor connection between CN-1(1)-CD-70(B)	Replace or repair
Short circuit or poor connection between CD-70(A)-CN-1(4) or CD-70(C)-CN-1 (6)	Replace or repair
Short circuit or poor connection between CN-1(4)-CN-51(3) or CN-1 (6) - CN-51(13)	Replace or repair

Wiring diagram



2) TEST PROCEDURE

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

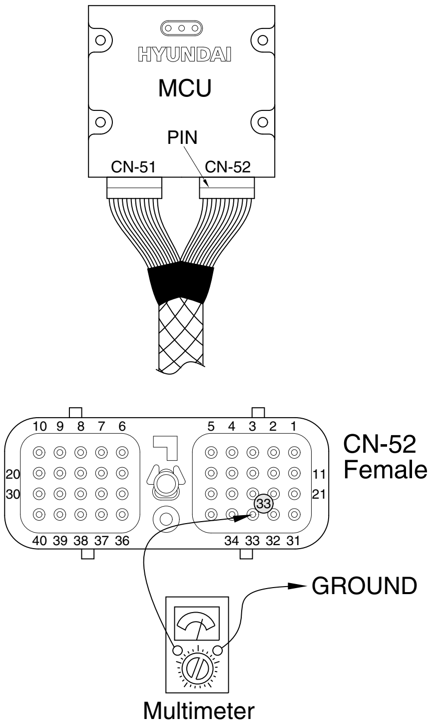
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (33) of CN-52.

③ Starting key ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V



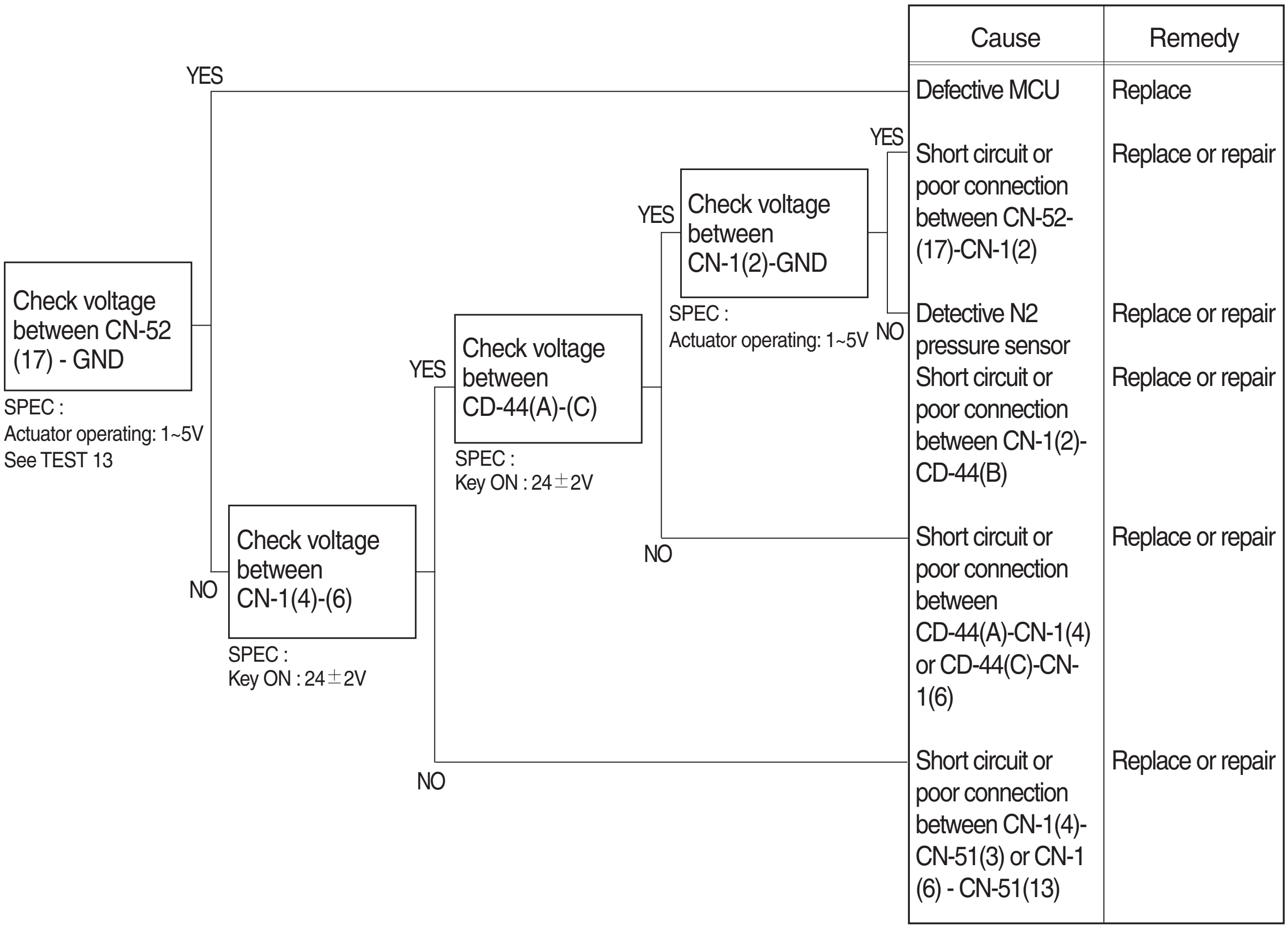
300L6MS12

9. MALFUNCTION OF NEGATIVE 2 PRESSURE SENSOR

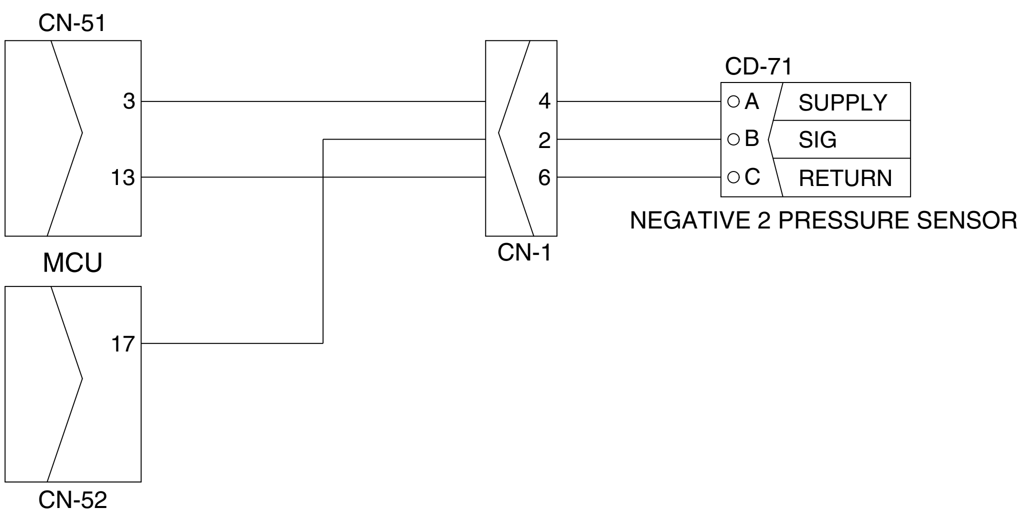
· Fault code : HCESPN 124, FMI 0~4

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

1) INSPECTION PROCEDURE



Wiring diagram



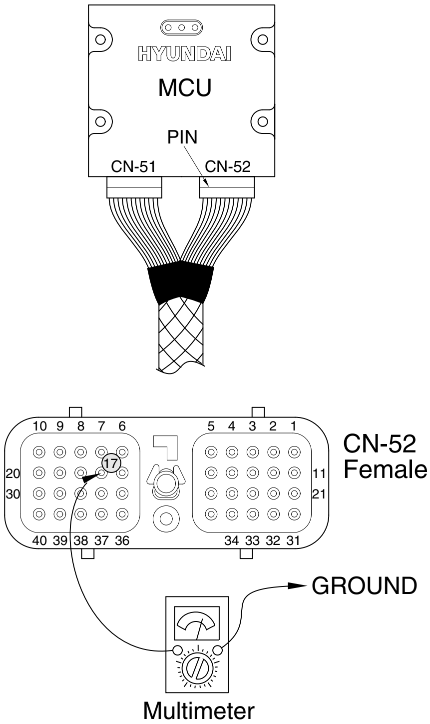
300L6MS13

2) TEST PROCEDURE

(1) Test 13 : Check voltage at CN-52 (17) and ground.

① Prepare 1 piece of thin sharp pin, steel or copper.
② Insert prepared pin to rear side of connectors : One pin to (17) of CN-52.
③ Starting key ON.
④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V



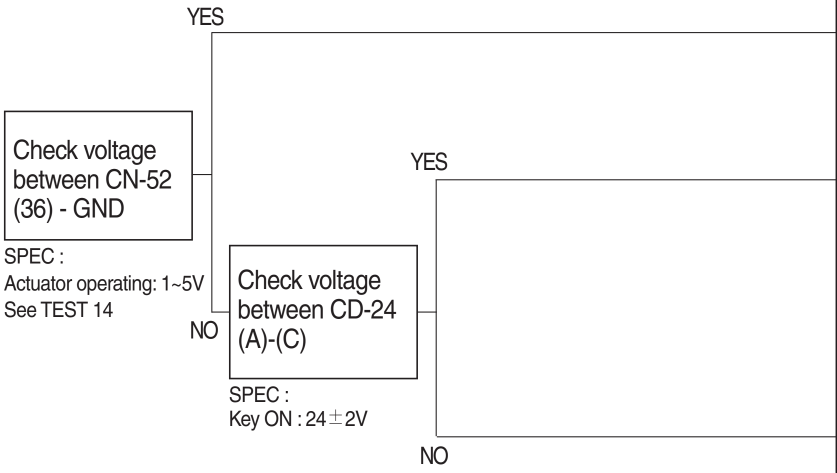
300L6MS14

10. MALFUNCTION OF SWING PRESSURE SENSOR

· Fault code : HCESPN 135, FMI 0~4

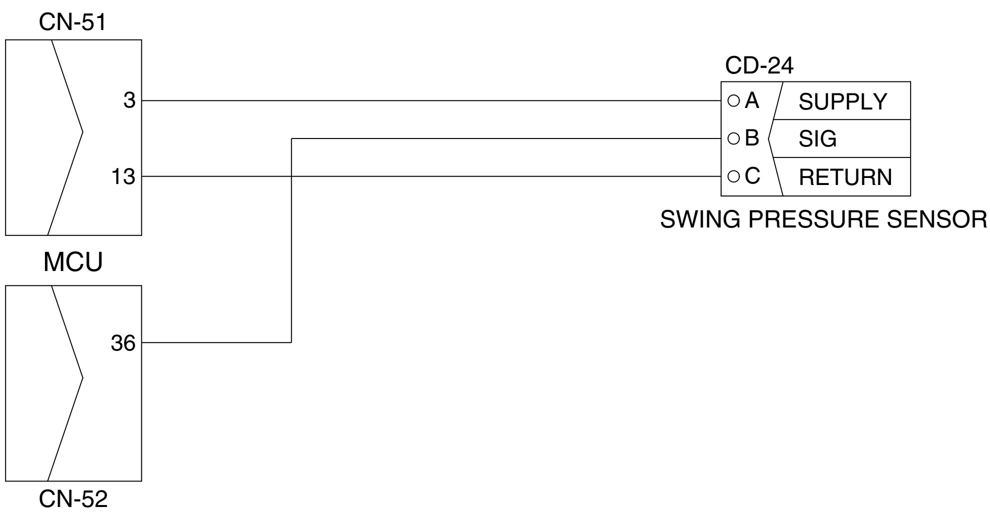
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



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

Wiring diagram



300L6MS15

2) TEST PROCEDURE

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

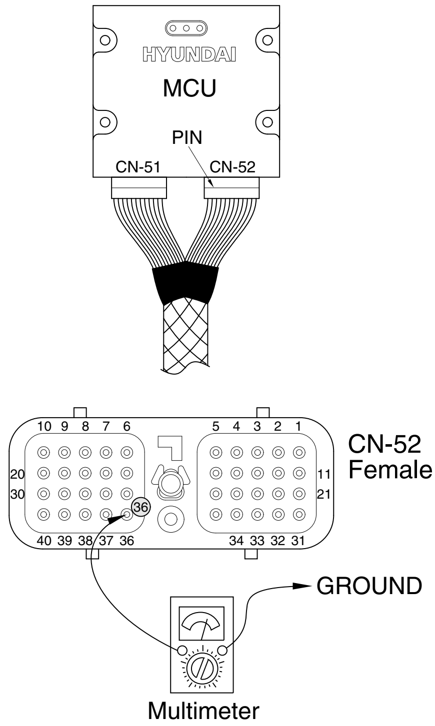
① Prepare 1 piece of thin sharp pin, steel or copper.

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

③ Starting key ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V



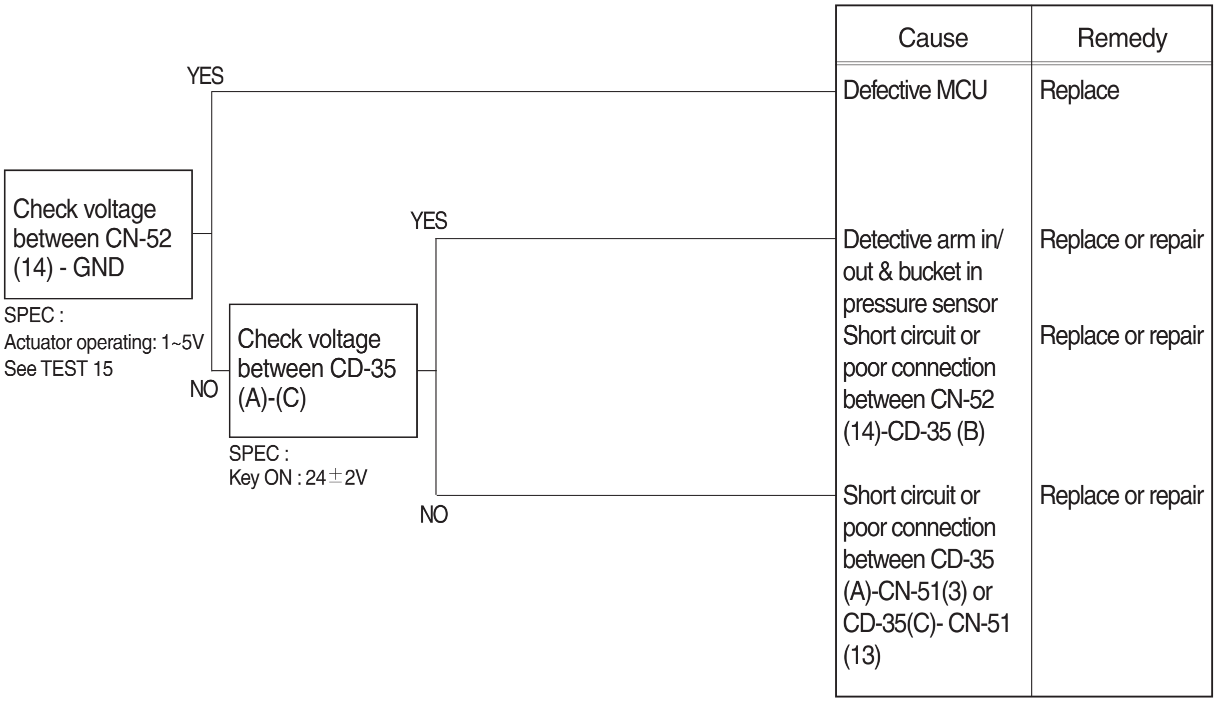
300L6MS16

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

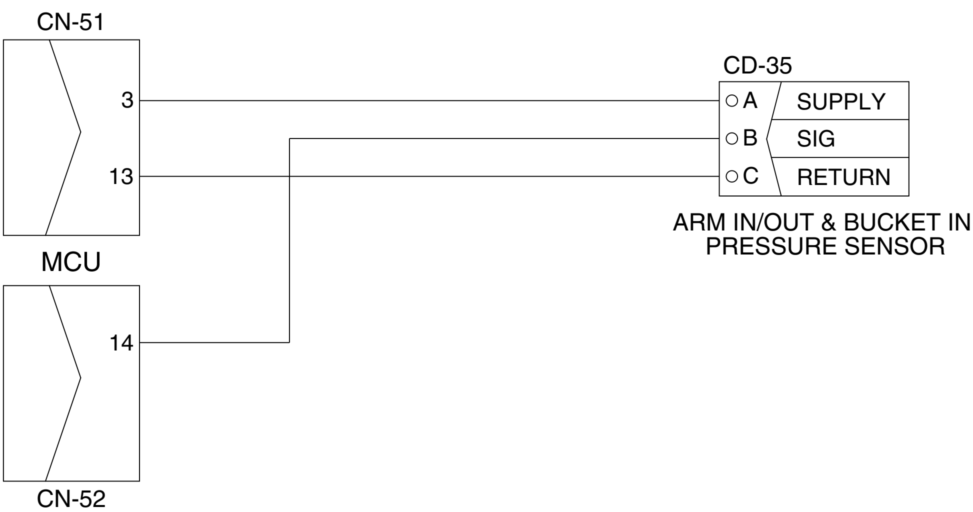
· Fault code : HCESPN 133, FMI 0~4

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

1) INSPECTION PROCEDURE



Wiring diagram



300L6MS17

2) TEST PROCEDURE

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

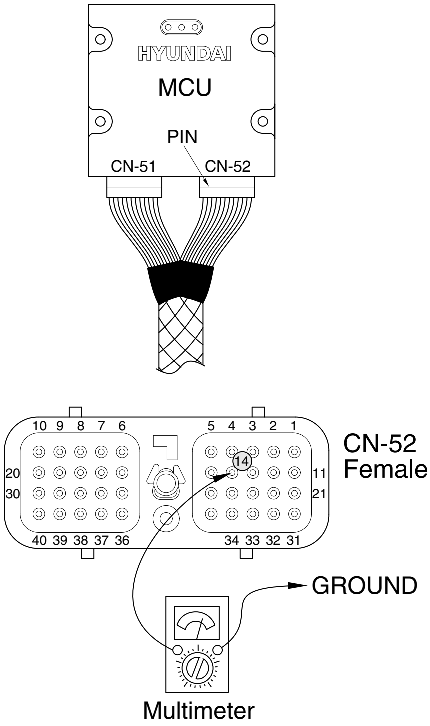
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (14) of CN-52.

③ Starting key ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V



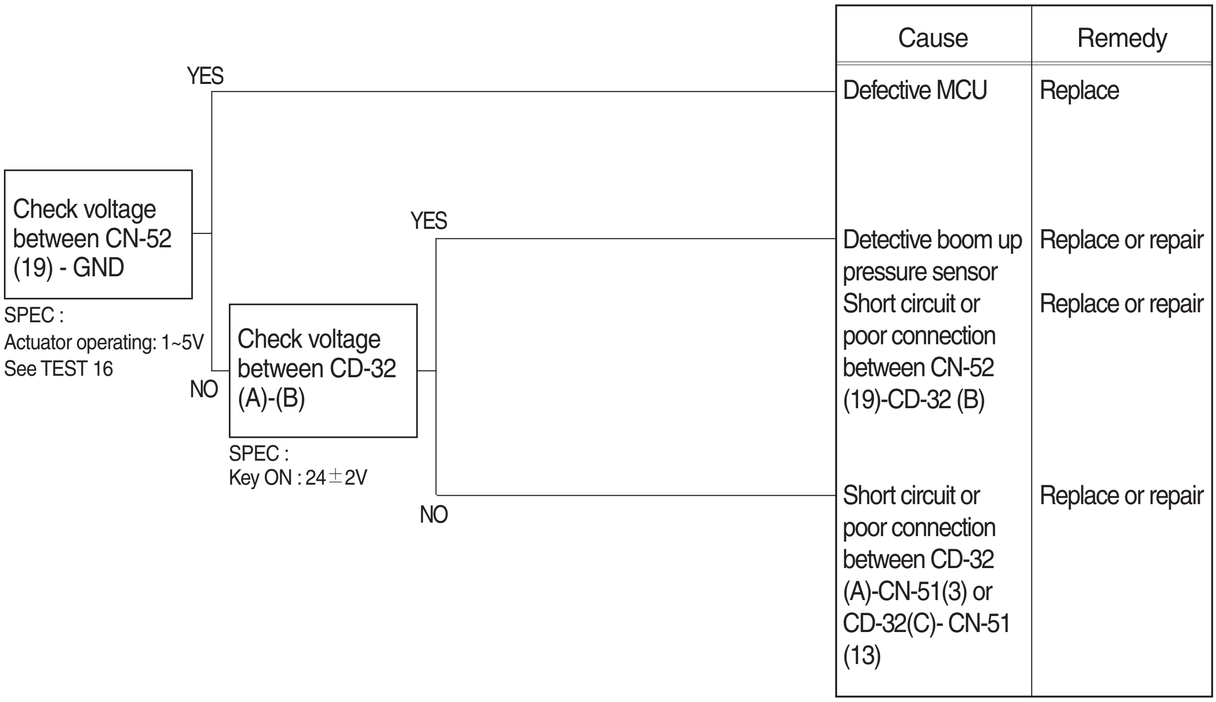
300L6MS18

12. MALFUNCTION OF BOOM UP PRESSURE SENSOR

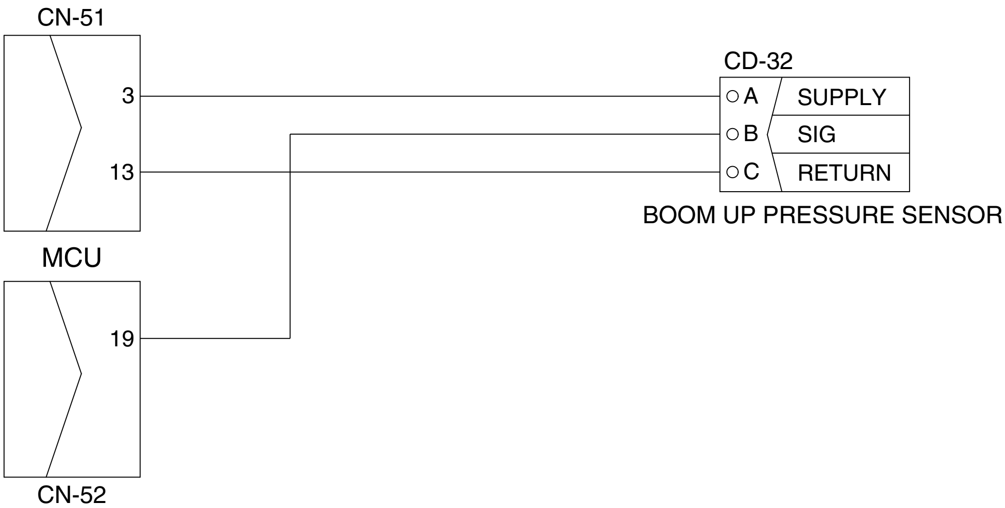
· Fault code : HCESPN 127, FMI 0~4

※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Wiring diagram



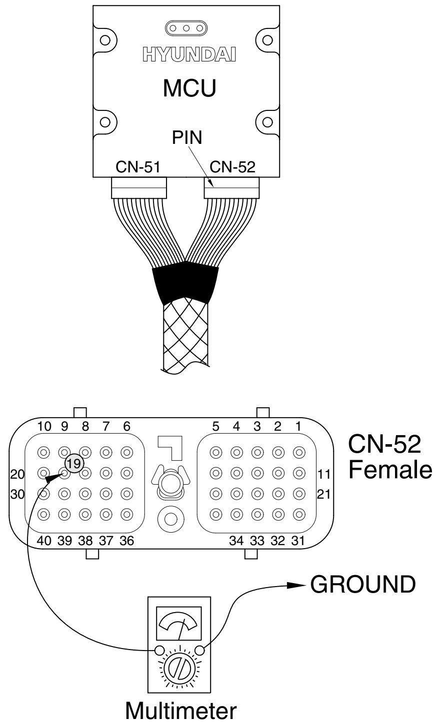
300L6MS19

2) TEST PROCEDURE

(1) Test 16 : Check voltage at CN-52 (19) and ground.

① Prepare 1 piece of thin sharp pin, steel or copper.
② Insert prepared pin to rear side of connectors : One pin to (19) of CN-52.
③ Starting key ON.
④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V



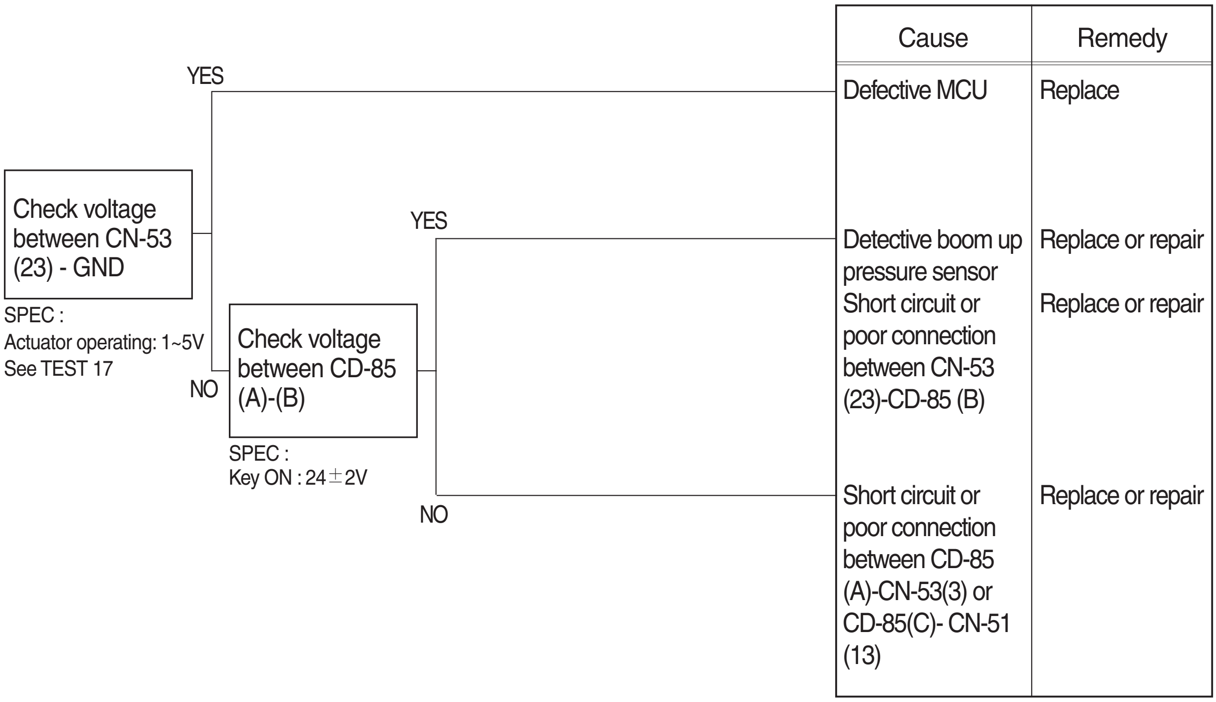
300L6MS20

13. MALFUNCTION OF BOOM DOWN PRESSURE SENSOR

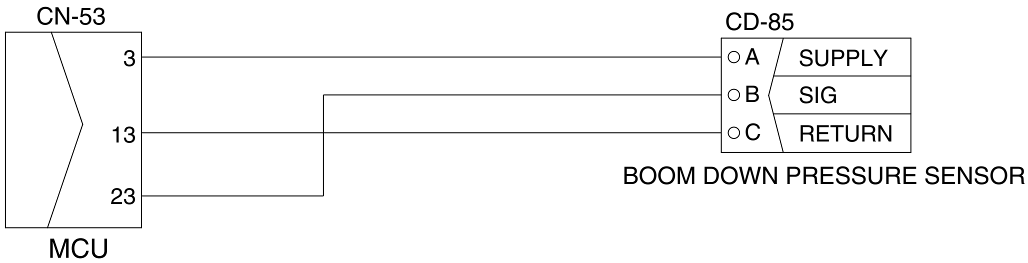
· Fault code : HCESPN 128, FMI 0~4

※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Wiring diagram



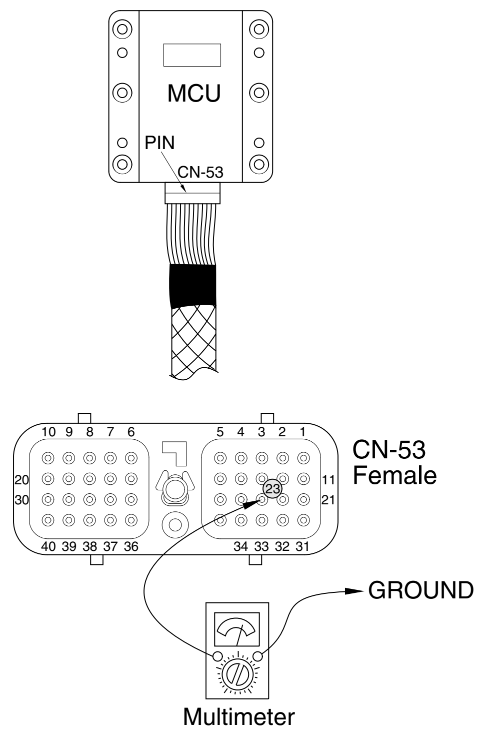
300L6MS25

2) TEST PROCEDURE

(1) Test 17 : Check voltage at CN-53 (23) and ground.

① Prepare 1 piece of thin sharp pin, steel or copper.
② Insert prepared pin to rear side of connectors : One pin to (23) of CN-53.
③ Starting key ON.
④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V



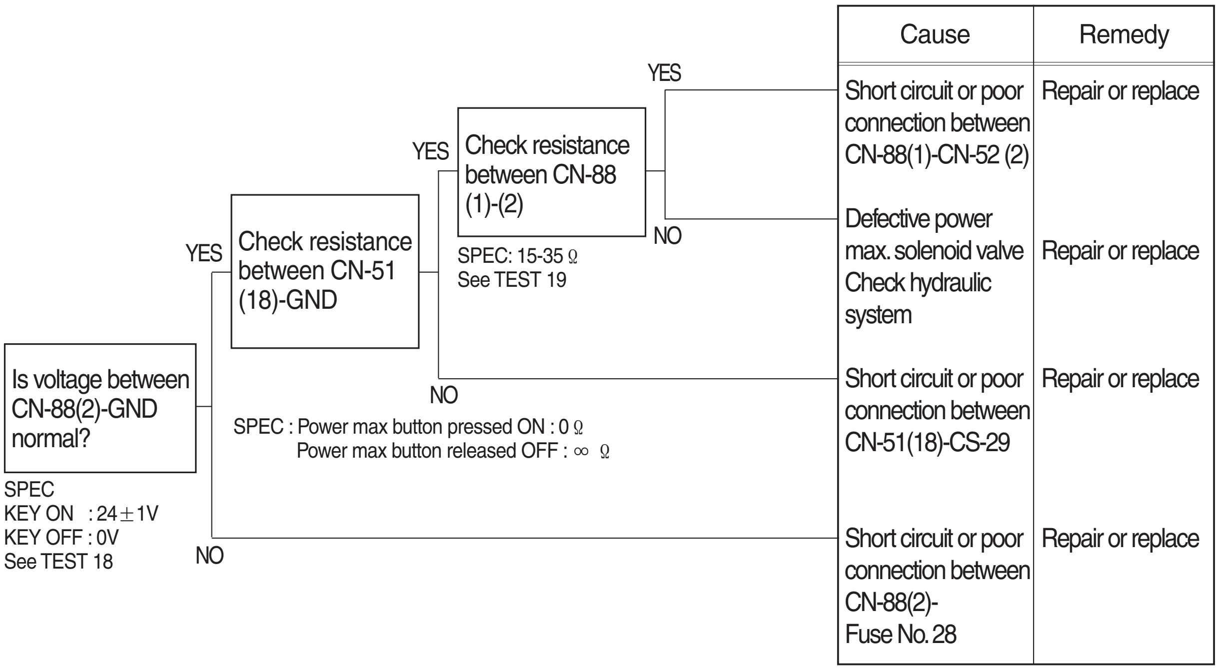
300L6MS26

14. MALFUNCTION OF POWER MAX

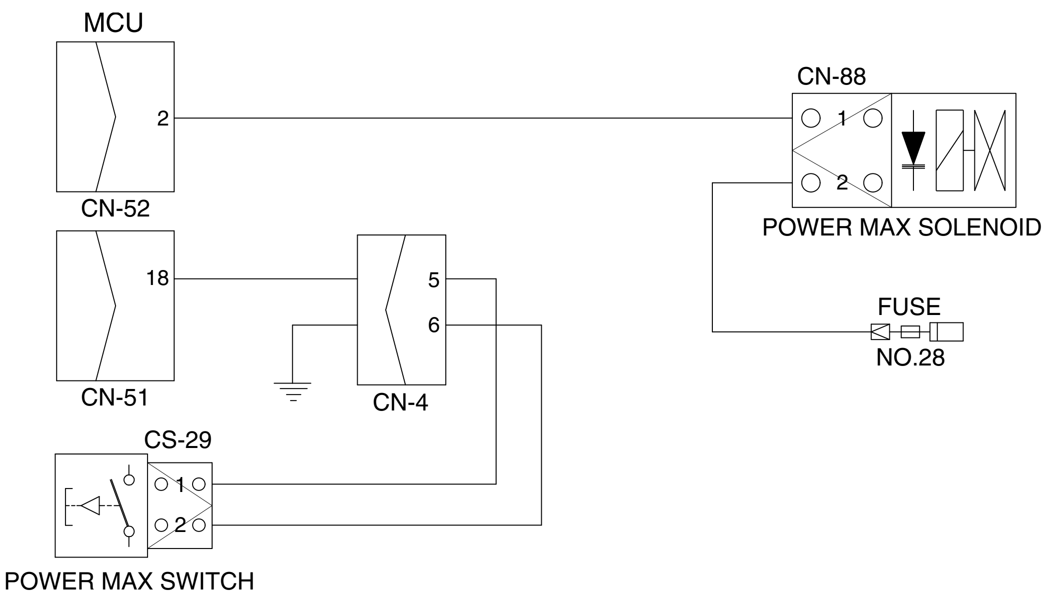
· Fault code : HCESPN 166, FMI 4 or 6

※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Wiring diagram

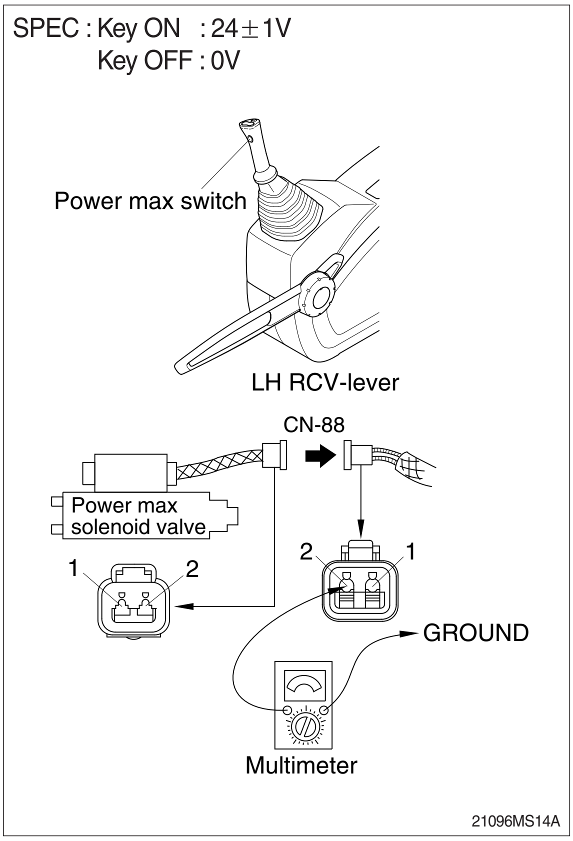


480L6MS04

2) TEST PROCEDURE

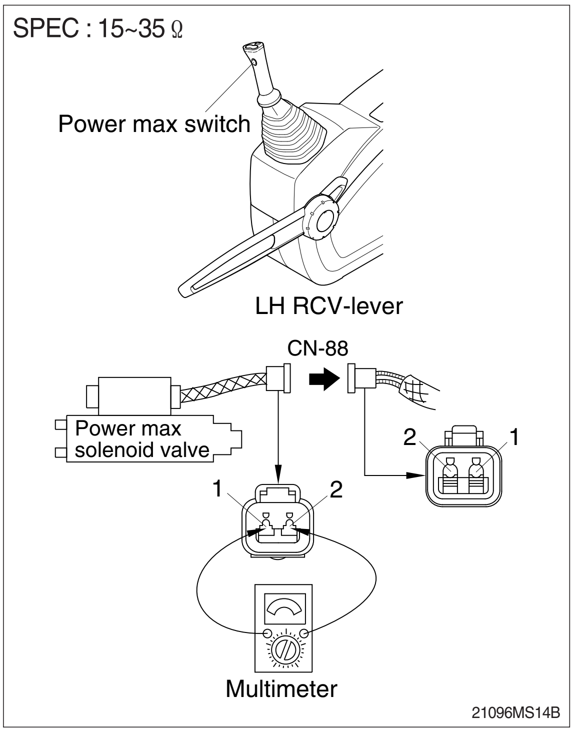
(1) Test 18: Check voltage between connector CN-88 (2) - GND.

① Disconnect connector CN-88 from power max solenoid valve.
② Start key ON.
③ Check voltage as figure.



(2) Test 19: Check resistance of the solenoid valve between CN-88 (1)-(2).

① Starting key 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.

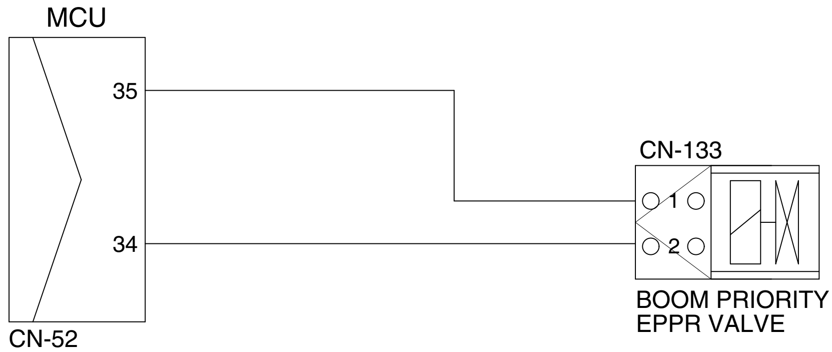
1) INSPECTION PROCEDURE

Check resistance between CN-133(1)-(2)

SPEC : 20~30V
KEY : ON

	Cause	Remedy
YES	Short circuit or poor connection between CN-52(35)-CN-133 (1) or CN-52(34)-CN-133(2)	Repair or replace
NO	Defective EPPR valve	Repair or replace

Wiring diagram



300L6MS23

SECTION 7 MAINTENANCE STANDARD

GROUP 1 OPERATIONAL PERFORMANCE TEST

1. PURPOSE

Performance tests are used to check :

1) OPERATIONAL PERFORMANCE OF A NEW MACHINE

Whenever a new machine is delivered in parts and reassembled at a customer's site, it must be tested to confirm that the operational performance of the machine meets Hyundai spec.

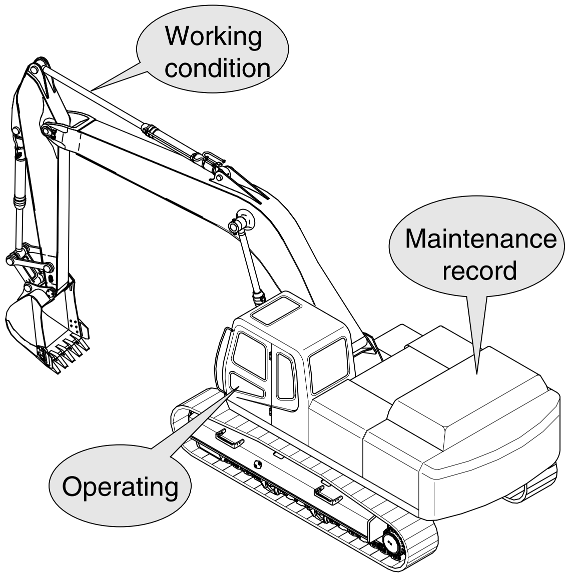
2) OPERATIONAL PERFORMANCE OF A WORKING MACHINE

With the passage of time, the machine's operational performance deteriorates, so that the machine needs to be serviced periodically to restore it to its original performance level.

Before servicing the machine, conduct performance tests to check the extent of deterioration, and to decide what kind of service needs to be done(by referring to the "Service Limits" in this manual).

3) OPERATIONAL PERFORMANCE OF A REPAIRED MACHINE

After the machine is repaired or serviced, it must be tested to confirm that its operational performance was restored by the repair and/or service work done.

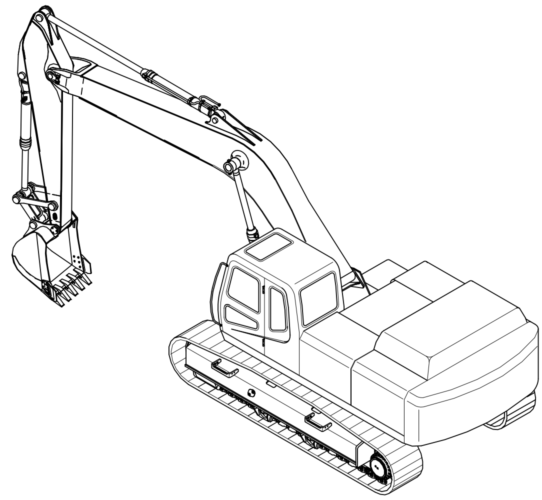


21077MS01

2. TERMINOLOGY

1) STANDARD

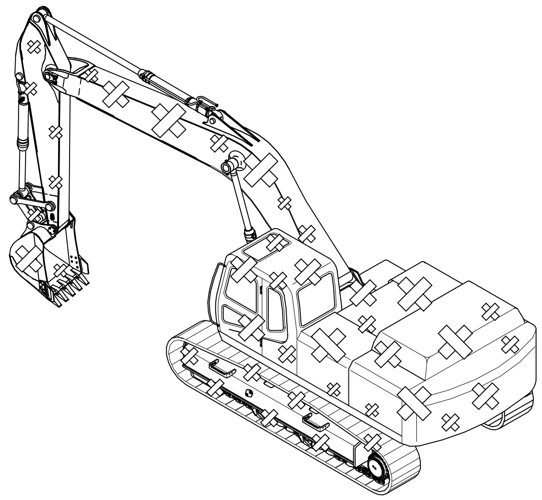
Specifications applied to the brand-new machine, components and parts.



21077MS02

2) SERVICE LIMIT

The lowest acceptable performance level. When the performance level of the machine falls below this level, the machine must be removed from work and repaired. Necessary parts and components must be replaced.



21077MS03

3. OPERATION FOR PERFORMANCE TESTS

1) Observe the following rules in order to carry out performance tests accurately and safely.

(1) The machine

Repair any defects and damage found, such as oil or water leaks, loose bolts, cracks and so on, before starting to test.

(2) Test area

① Select a hard, flat surface.

② Secure enough space to allow the machine to run straight more than 20 m, and to make a full swing with the front attachment extended.

③ If required, rope off the test area and provide signboards to keep unauthorized personnel away.

(3) Precautions

① Before starting to test, agree upon the signals to be employed for communication among coworkers. Once the test is started, be sure to communicate with each other using these signals, and to follow them without fail.

② Operate the machine carefully and always give first priority to safety.

③ While testing, always take care to avoid accidents due to landslides or contact with high voltage power lines. Always confirm that there is sufficient space for full swings.

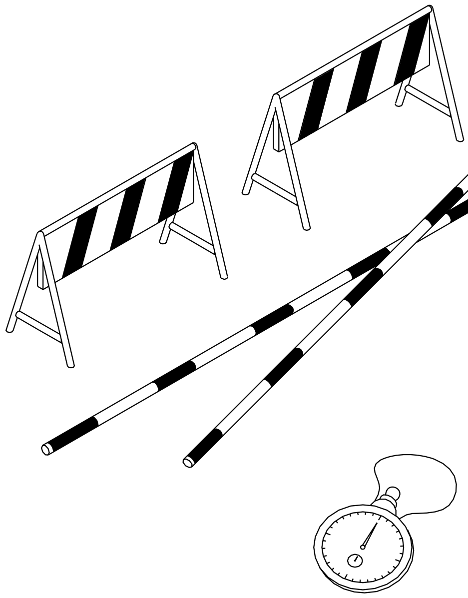
④ Avoid polluting the machine and the ground with leaking oil. Use oil pans to catch escaping oil. Pay special attention to this when removing hydraulic pipings.

(4) Make precise measurements

① Accurately calibrate test instruments in advance to obtain correct data.

② Carry out tests under the exact test conditions prescribed for each test item.

③ Repeat the same test and confirm that the test data obtained can be procured repeatedly. Use mean values of measurements if necessary.



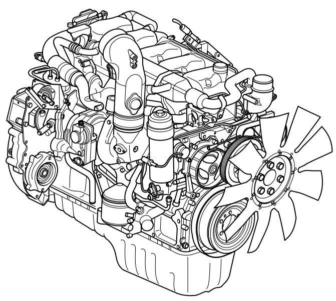
(210-7) 7-3

2) ENGINE SPEED

(1) Measure the engine speed at each power mode

※ The engine speed at each power mode must meet standard RPM; if not, all other operational performance data will be unreliable. It is essential to perform this test first.

CLUSTER



480L7MS01

(2) Preparation

① Warm up the machine, until the engine coolant temperature reaches 50˚C or more, and the hydraulic oil is 50±5˚C.

② Set the accel dial at 10 (Max) position.

③ Measure the engine RPM.

(3) Measurement

① Start the engine. The engine will run at start idle speed. Measure engine speed with a engine rpm display.

② Measure and record the engine speed at each mode (P, S, E).

③ Select the P-mode.

④ Lightly operate the bucket control lever a few times, then return the control lever to neutral; The engine will automatically enter the auto-idle speed after 4 seconds.

⑤ Measure and record the auto deceleration speed.

(4) Evaluation

The measured speeds should meet the following specifications.

Unit : rpm

Model	Engine speed	Standard	Remarks
HX480 L HX520 L	Start idle	800±100	
	P mode	1850±50	
	S mode	1750±50	
	E mode	1650±50	
	Auto decel	1000±100	
	One touch decel	800±100	

Condition : Set the accel dial at 10 (Max) position.

3) TRAVEL SPEED

(1) Measure the time required for the excavator to travel a 20 ㎙ test track.

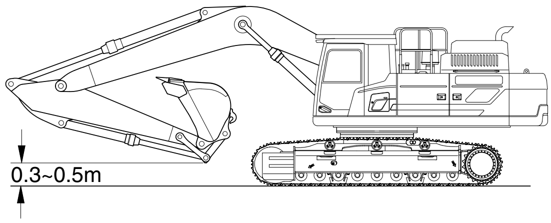
(2) Preparation

① Adjust the tension of both tracks to be equal.

② Prepare a flat and solid test track 20㎙ in length, with extra length of 3 to 5 ㎙ on both ends for machine acceleration and deceleration.

③ Hold the bucket 0.3 to 0.5 ㎙ above the ground with the arm and bucket rolled in.

④ Keep the hydraulic oil temperature at 50±5˚C.



480A7MS02

(3) Measurement

① Measure both the low and high speeds of the machine.

② Before starting either the low or high speed tests, adjust the travel mode switch to the speed to be tested, then select the following switch positions.

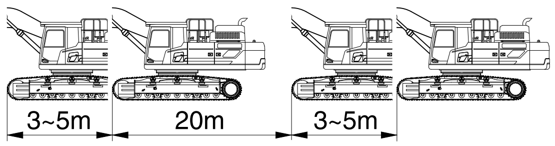
· Power mode switch : P mode

③ Start traveling the machine in the acceleration zone with the travel levers at full stroke.

④ Measure the time required to travel 20 m.

⑤ After measuring the forward travel speed, turn the upperstructure 180˚ and measure the reverse travel speed.

⑥ Repeat steps ④ and ⑤ three times in each direction and calculate the average values.



480A7MS03

(4) Evaluation

The average measured time should meet the following specifications.

Unit : Seconds / 20 ㎙

Model	Travel speed	Standard	Maximum allowable	Remarks
HX480 L HX520 L	1 Speed	21.2±2.0	29	
	2 Speed	13.2±1.0	18.7	

4) TRACK REVOLUTION SPEED

(1) Measure the track revolution cycle time with the track raised off ground.

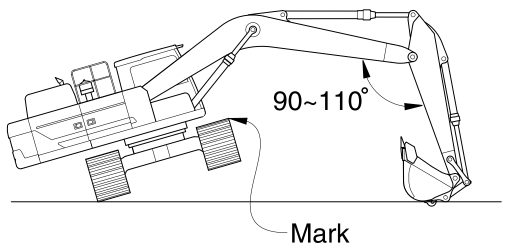
(2) Preparation

① Adjust the tension of both side tracks to be equal.

② On the track to be measured, mark one shoe with chalk.

③ Swing the upperstructure 90˚ and lower the bucket to raise the track off ground. Keep the boom-arm angle between 90 to 110˚ as shown. Place blocks under machine frame.

④ Keep the hydraulic oil temperature at 50±5˚C.



480L7MS04

(3) Measurement

① Select the following switch positions.

· Travel mode switch : 1 or 2 speed

· Power mode switch : P mode

· Auto idle switch : OFF

② Operate the travel control lever of the raised track in full forward and reverse.

③ Rotate 1 turn, then measure time taken for next 3 revolutions.

④ Raise the other side of machine and repeat the procedure.

⑤ Repeat steps ③ and ④ three times and calculate the average values.

(4) Evaluation

The revolution cycle time of each track should meet the following specifications.

Unit : Seconds / 3 revolutions

Model	Travel speed	Standard	Maximum allowable
HX480 L HX520 L	1 Speed	36.0±2.0	49.5
	2 Speed	23.0±1.0	31.9

5) TRAVEL DEVIATION

(1) Measure the deviation by the tracks from a 20 m straight line.

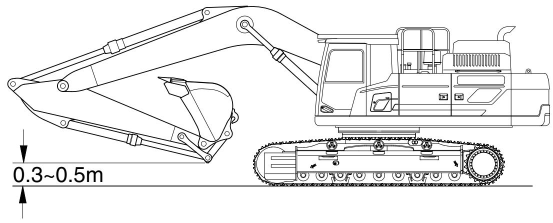
(2) Preparation

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.



480A7MS02

(3) Measurement

① Measure the amount of mistracking at high and low travel speeds.

② Before beginning each test, select the following switch positions.

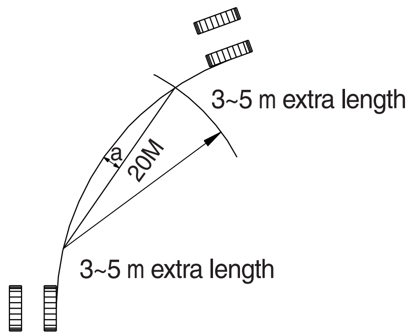
· Power mode switch : P mode

③ Start traveling the machine in the acceleration zone with the travel levers at full stroke.

④ Measure the distance between a straight 20 m line and the track made by the machine. (Dimension a)

⑤ After measuring the tracking in forward travel, turn the upperstructure 180˚ and measure that in reverse travel.

⑥ Repeat steps ④ and ⑤ three times and calculate the average values.



(210-7) 7-7(2)

(4) Evaluation

Mistrack should be within the following specifications.

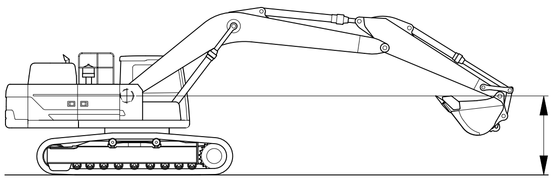
Unit : mm / 20 m

Model	Standard	Maximum allowable	Remarks
HX480 L HX520 L	200 below	250	-

6) SWING SPEED

(1) Measure the time required to swing three complete turns.

(2) Preparation
① Check the lubrication of the swing gear and swing bearing.
② Place the machine on flat, solid ground with ample space for swinging. Do not conduct this test on slopes.
③ With the arm rolled out and bucket rolled in, hold the bucket so that the height of the bucket pin is the same as the boom foot pin. The bucket must be empty.
④ Keep the hydraulic oil temperature at 50±5˚C.


480L7MS05

(3) Measurement
① Select the following switch positions.
· Power mode switch : P mode
② Operate swing control lever fully.
③ Swing 1 turn and measure time taken to swing next 3 revolutions.
④ Repeat steps ② and ③ three time and calculate the average values.

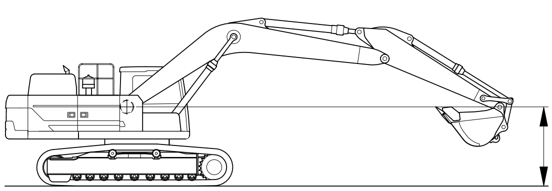
(4) Evaluation
The time required for 3 swings should meet the following specifications.

Unit : Seconds / 3 revolutions

Model	Power mode switch	Standard	Maximum allowable
HX480 L HX520 L	P mode	21.0±1.5	27.8

7) SWING FUNCTION DRIFT CHECK

(1) Measure the swing drift on the bearing outer circumference when stopping after a 360˚ full speed swing.



480L7MS05

(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.

(3) Measurement

① Conduct this test in the M mode.

② Select the following switch positions.

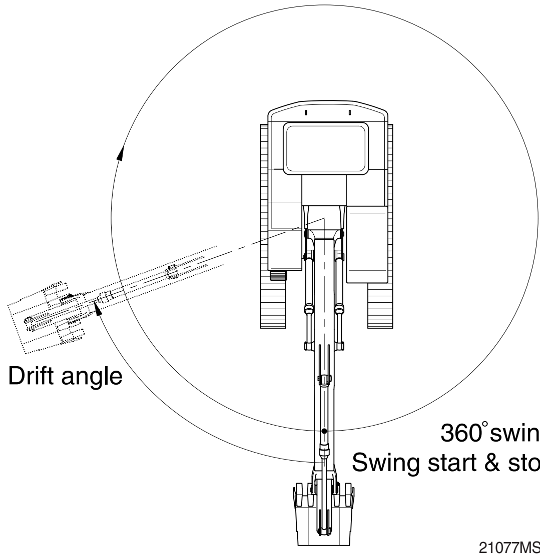
· Power mode switch : P mode

③ Operate the swing control lever fully and return it to the neutral position when the mark on the upperstructure aligns with that on track frame after swinging 360°

④ Measure the distance between the two marks.

⑤ Align the marks again, swing 360° , then test the opposite direction.

⑥ Repeat steps ④ and ⑤ three times each and calculate the average values.



21077MS08

(4) Evaluation

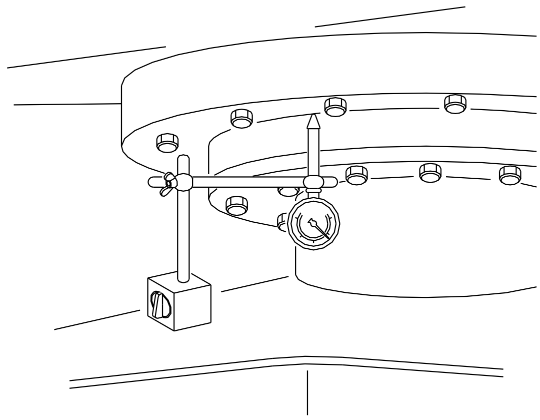
The measured drift angle should be within the following specifications.

Unit : Degree

Model	Power mode switch	Standard	Maximum allowable	Remarks
HX480 L HX520 L	P mode	90 below	112.5	

8) SWING BEARING PLAY

(1) Measure the swing bearing play using a dial gauge to check the wear of bearing races and balls.



(210-7) 7-10(1)

(2) Preparation

① Check swing bearing mounting cap screws for loosening.

② Check the lubrication of the swing bearing. Confirm that bearing rotation is smooth and without noise.

③ Install a dial gauge on the track frame as shown, using a magnetic base.

④ Position the upperstructure so that the boom aligns with the tracks facing towards the front idlers.

⑤ Position the dial gauge so that its needle point comes into contact with the bottom face of the bearing outer race.

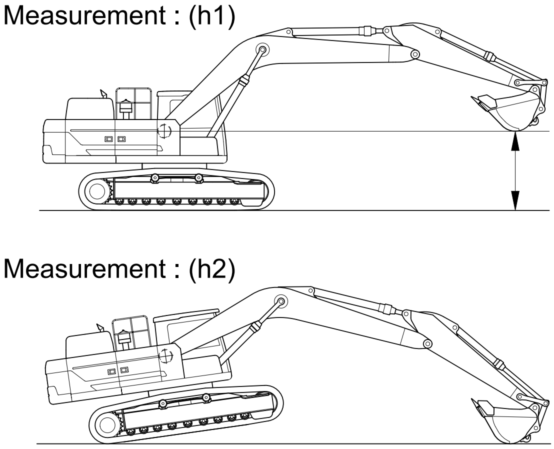
⑥ Bucket should be empty.

(3) Measurement

① With the arm rolled out and bucket rolled in, hold the bottom face of the bucket to the same height of the boom foot pin.
Record the dial gauge reading (h1).

② Lower the bucket to the ground and use it to raise the front idler 50 cm.
Record the dial gauge reading (h2).

③ Calculate bearing play (H) from this data (h1 and h2) as follows.
H=h2-h1



480L7MS06

(4) Evaluation

The measured drift should be within the following specifications.

Unit : mm

Model	Standard	Maximum allowable	Remarks
HX480 L HX520 L	0.5 ~ 1.5	3.0	

9) HYDRAULIC CYLINDER CYCLE TIME

(1) Measure the cycle time of the boom, standard arm, and standard bucket cylinders.

(2) Preparation

① To measure the cycle time of the boom cylinders:
With the arm rolled out and the empty bucket rolled out, lower the bucket to the ground, as shown.

② To measure the cycle time of the arm cylinder.
With the empty bucket rolled in, position the arm so that it is vertical to the ground. Lower the boom until the bucket is 0.5 m above the ground.

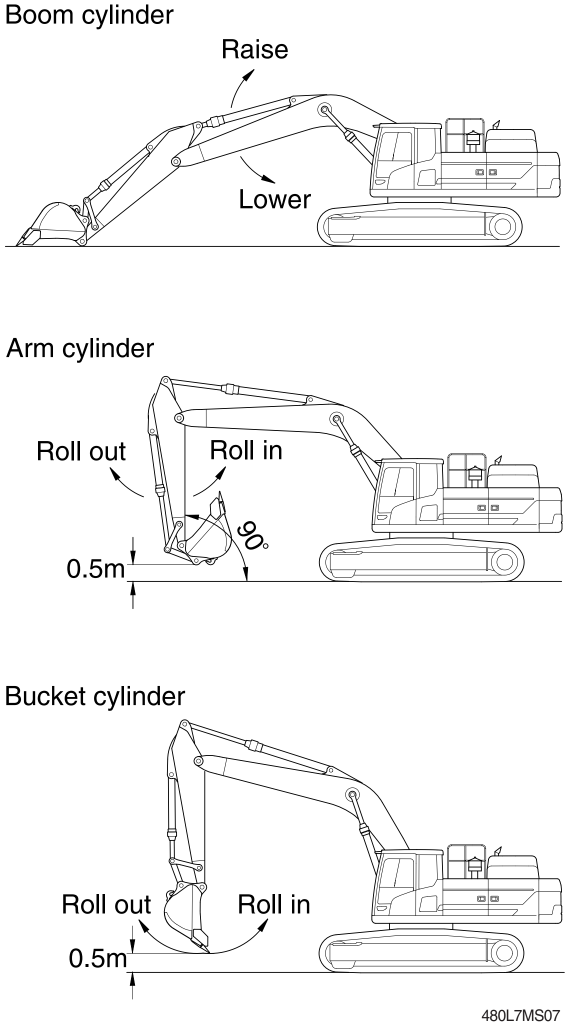
③ To measure the cycle time of the bucket cylinder.
The empty bucket should be positioned at midstroke between roll-in and roll-out, so that the sideplate edges are vertical to the ground.

④ Keep the hydraulic oil temperature at 50±5˚C.

(3) Measurement

① Select the following switch positions.
· Power mode switch : P mode

② To measure cylinder cycle times.
- Boom cylinders.
Measure the time it takes to raise the boom, and the time it takes to lower the boom. To do so, position the boom at one stroke end then move the control lever to the other stroke end as quickly as possible.
- Arm cylinder.
Measure the time it takes to roll in the arm, and the time it takes to roll out the arm. To do so, position the bucket at one stroke end, then move the control lever to the other stroke end as quickly as possible.



- Bucket cylinders
  Measure the time it takes to roll in the bucket, and the time it takes to roll out the bucket. To do so, position the bucket at one stroke end, then move the control lever to the other stroke end as quickly as possible.
- Repeat each measurement 3 times and calculate the average values.

(4) Evaluation

The average measured time should meet the following specifications.

Unit : Seconds

Model	Function	Standard	Maximum allowable	Remarks
HX480 L	Boom raise	4.2±0.4	5.1	
	Boom lower	2.9±0.4	3.6	
	Arm in	3.2±0.4	4.3	
	Arm out	3.4±0.4	4.0	
	Bucket load	2.8±0.4	3.5	
	Bucket dump	2.4±0.4	3.1	
HX520 L	Boom raise	4.4±0.4	5.1	
	Boom lower	2.7±0.4	3.6	
	Arm in	3.4±0.4	4.3	
	Arm out	3.2±0.4	4.0	
	Bucket load	3.0±0.4	3.5	
	Bucket dump	2.4±0.4	3.1	

10) DIG FUNCTION DRIFT CHECK

(1) Measure dig function drift, which can be caused by oil leakage in the control valve and boom, standard arm, and standard bucket cylinders, with the loaded bucket. When testing the dig function drift just after cylinder replacement, slowly operate each cylinder to its stroke end to purge air.

(2) Preparation

① Load bucket fully. Instead of loading the bucket, weight(W) of the following specification can be used.

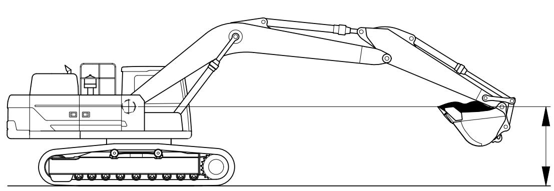
· $W = M^3 \times 1.5$
Where :
M^3 = Bucket heaped capacity (m^3)
1.5 = Soil specific gravity

② Position the arm cylinder with the rod 20 to 30 mm extended from the fully retracted position.

③ Position the bucket cylinder with the rod 20 to 30 mm retracted from the fully extended position.

④ With the arm rolled out and bucket rolled in, hold the bucket so that the height of the bucket pin is the same as the boom foot pin.

⑤ Keep the hydraulic oil temperature at 50±5˚C.



480L7MS08

(3) Measurement

① Stop the engine.

② Five minutes after the engine has been stopped, measure the changes in the positions of the boom, arm and bucket cylinders.

③ Repeat step ② three times and calculate the average values.

(4) The measured drift should be within the following specifications.

Unit : mm / 5min

Model	Drift to be measured	Standard	Maximum allowable	Remarks
HX480 L HX520 L	Boom cylinder	10 below	15	
	Arm cylinder	10 below	15	
	Bucket cylinder	40 below	50	

11) CONTROL LEVER OPERATING FORCE

(1) Use a spring scale to measure the maximum resistance of each control lever at the middle of the grip.

(2) Preparation

① Keep the hydraulic oil temperature at 50±5˚C.

(3) Measurement

① Start the engine.

② Select the following switch positions.

· Power mode switch : P mode

③ Operate each boom, arm, bucket and swing lever at full stroke and measure the maximum operating force for each.

④ Lower the bucket to the ground to raise one track off the ground. Operate the travel lever at full stroke and measure the maximum operating force required. When finished, lower the track and then jack-up the other track.

⑤ Repeat steps ③ and ④ three times and calculate the average values.

(4) Evaluation

The measured operating force should be within the following specifications.

Unit : kgf

Model	Kind of lever	Standard	Maximum allowable	Remarks
HX480 L HX520 L	Boom lever	1.3 or below	1.7	
	Arm lever	1.3 or below	1.7	
	Bucket lever	1.3 or below	1.7	
	Swing lever	1.3 or below	1.7	
	Travel lever	2.1 or below	3.15	

12) CONTROL LEVER STROKE

(1) Measure each lever stroke at the lever top using a ruler.

※ When the lever has play, take a half of this value and add it to the measured stroke.

(2) Preparation

Keep the hydraulic oil temperature at 50±5˚C.

(3) Measurement

① Stop the engine.

② Measure each lever stroke at the lever top from neutral to the stroke end using a ruler.

③ Repeat step ② three times and calculate the average values.

(4) Evaluation

The measured drift should be within the following specifications.

Unit : mm

Model	Kind of lever	Standard	Maximum allowable	Remarks
HX480 L HX520 L	Boom lever	90±10	115	
	Arm lever	90±10	115	
	Bucket lever	90±10	115	
	Swing lever	90±10	115	
	Travel lever	142±10	178	

13) PILOT PRIMARY PRESSURE

(1) Preparation

① Keep the hydraulic oil temperature at 50±5˚C.

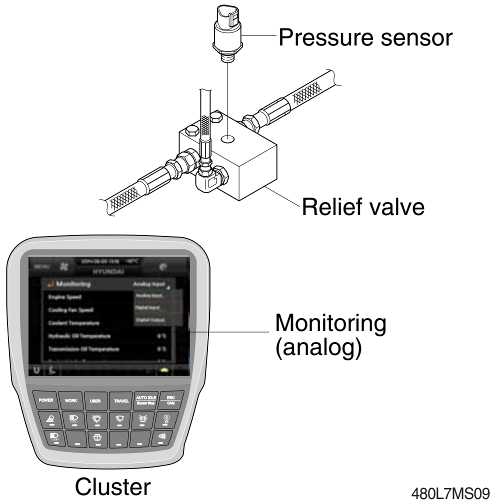
(2) Measurement

① Select the following switch positions.

· Power mode switch : P mode

· Auto decel switch : OFF

② Measure the primary pilot pressure by the monitoring menu of the cluster.



(3) Evaluation

The average measured pressure should meet the following specifications:

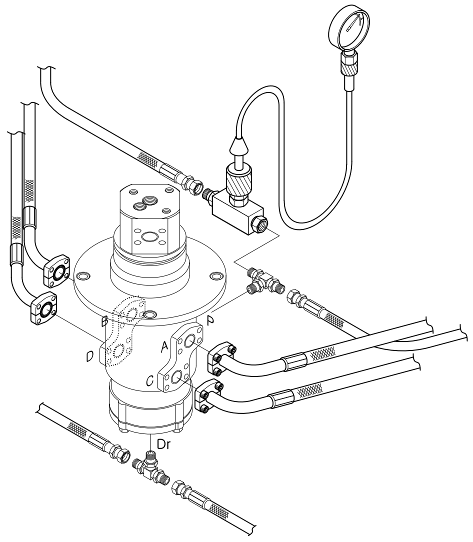
Unit : kgf / cm^2

Model	Engine speed	Standard	Allowable limits	Remarks
HX480 L HX520 L	P mode	$40^{+2}_{\ 0}$	-	

14) FOR TRAVEL SPEED SELECTING PRESSURE:

(1) Preparation

① Stop the engine.
② Loosen the cap and relieve the pressure in the tank by pushing the top of the air breather.
③ To measure the speed selecting pressure: Install a connector and pressure gauge assembly to turning joint P port as shown.
④ Start the engine and check for on leakage from the adapter.
⑤ Keep the hydraulic oil temperature at 50±5˚C.



21077MS13

(2) Measurement

① Select the following switch positions.
· Power mode switch : P mode
· Travel mode switch : 1 speed
2 speed
② Measure the travel speed selecting pressure in the Hi or Lo mode.
③ Lower the bucket to the ground to raise the track off the ground. Operate the travel lever at full stroke and measure the fast speed pressure.
④ Repeat steps ② and ③ three times and calculate the average values.

(3) Evaluation

The average measured pressure should be within the following specifications.

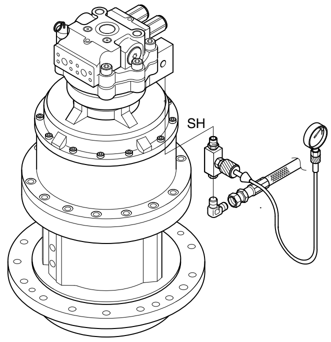
Unit : kgf / cm^2

Model	Travel speed mode	Standard	Maximum allowable	Remarks
HX480 L HX520 L	1 Speed	0	-	
	2 Speed	40±5	-	

15) SWING PARKING BRAKE RELEASING PRESSURE

(1) Preparation

① Stop the engine.
② Loosen the cap and relieve the pressure in the tank by pushing the top of the air breather.
③ The pressure release L wrench to bleed air.
④ Install a connector and pressure gauge assembly to swing motor SH port, as shown.
⑤ Start the engine and check for oil leakage from the adapter.
⑥ Keep the hydraulic oil temperature at 50±5˚C.



480L7MS10

(2) Measurement

① Select the following switch positions.
· Power mode switch : P mode
② Operate the swing function or arm roll in function and measure the swing brake control pressure with the brake disengaged. Release the control lever to return to neutral and measure the control pressure when the brake is applied.
Repeat step ② three times and calculate the average values.

(3) Evaluation

The average measured pressure should be within the following specifications.

Unit : kgf / cm²

Model	Description	Standard	Allowable limits	Remarks
HX480 L HX520 L	Brake disengaged	40	31~42	
	Brake applied	0	-	

16) MAIN PUMP DELIVERY PRESSURE

(1) Preparation

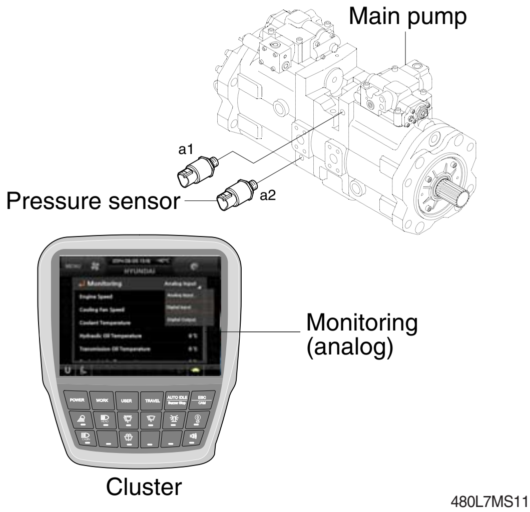
① Keep the hydraulic oil temperature at 50±5˚C.

(2) Measurement

① Select the following switch positions.

· Power mode switch : P mode

② Measure the main pump delivery pressure in the P mode (high idle).



(3) Evaluation

The average measured pressure should meet the following specifications.

Unit : kgf / cm2

Model	Engine speed	Standard	Allowable limits	Remarks
HX480 L HX520 L	High idle	40±5	-	

17) SYSTEM PRESSURE REGULATOR RELIEF SETTING

(1) Preparation

① Keep the hydraulic oil temperature at 50±5˚C.

(2) Measurement

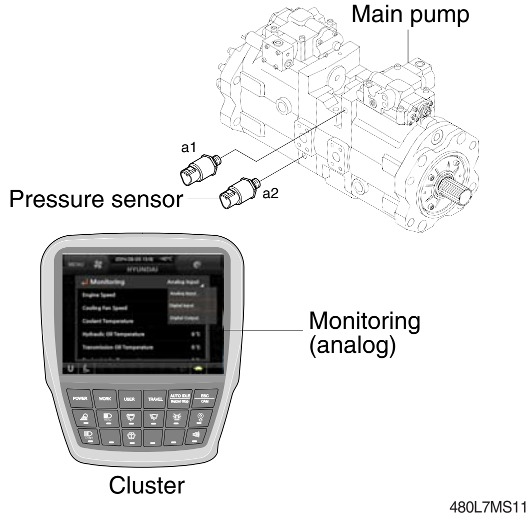
① Select the following switch positions.

· Power mode switch : P mode

② Slowly operate each control lever of boom, arm and bucket functions at full stroke over relief and measure the pressure.

③ In the swing function, place bucket against an immovable object and measure the relief pressure.

④ In the travel function, lock undercarriage with an immovable object and measure the relief pressure.



(3) Evaluation

The average measured pressure should be within the following specifications.

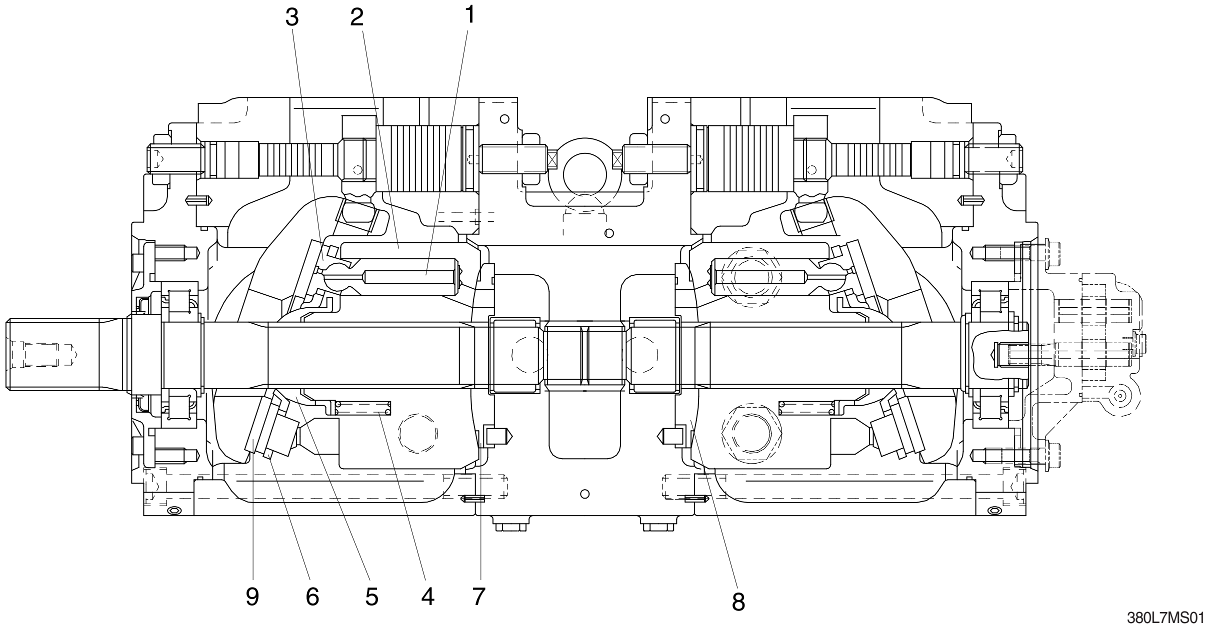
Unit : kgf / cm^2

Model	Function to be tested	Standard	Port relief setting
HX480 L HX520 L	Boom	330(360)±10	380
	Arm	330(360)±10	380
	Bucket	330(360)±10	380
	Arm (long reach)	280±10	280
	Bucket (long reach)	280±10	280
	Travel	345±10	345
	Swing	285±10	285

(　) : Power boost

GROUP 2 MAJOR COMPONENT

1. MAIN PUMP



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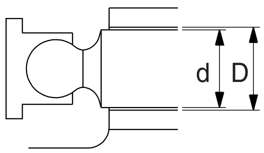
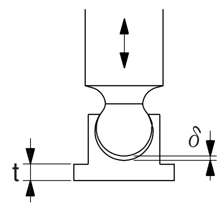
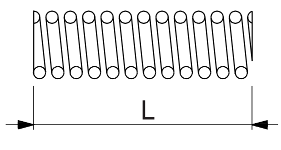
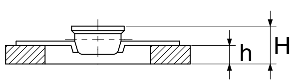
Part name & inspection item		Standard dimension	Recommended replacement value	Counter measures
Clearance between piston(1) & cylinder bore(2) (D-d)		0.043	0.070	Replace piston or cylinder.
Play between piston(1) & shoe caulking section(3) (δ)		0-0.1	0.3	Replace assembly of piston & shoe.
Thickness of shoe (t)		5.4	5.0	
Free height of cylinder spring(4) (L)		47.9	47.1	Replace cylinder spring.
Combined height of set plate(5) & spherical bushing(6) (H-h)		23.8	22.8	Replace retainer or set plate.
Surface roughness for valve plate (sliding face) (7,8), swash plate (shoe plate area) (9), & cylinder(2) (sliding face)	Surface roughness necessary to be corrected	3z		Lapping
	Standard surface roughness (corrected value)	0.4z or lower		

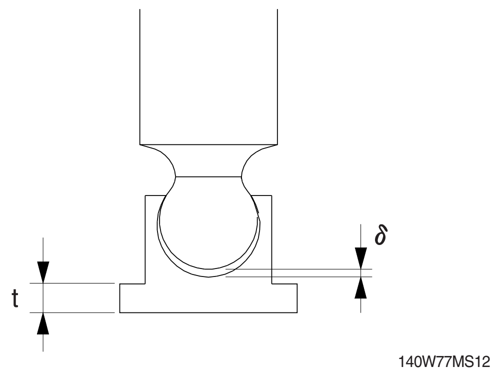
2. MAIN CONTROL VALVE

Part name	Inspection item	Criteria & measure
Casing	· Existence of scratches, rust or corrosion.	· In case of damage in following section, replace casing. - Sliding sections of casing hole and spool, especially land sections applied with held pressure. - Seal pocket section where spool is inserted. - Sealing section of port where O-ring contacts. - Sealing section of each relief valve for main and port. - Sealing section of plug. - Other damages that may damage normal function.
Spool	· Existence of scratch, gnawing, rusting or corrosion. · O-ring seal sections at both ends. · Insert spool into casing hole, rotate and reciprocate it.	· Replacement when its outside sliding section has scratch (especially on seals-contacting section). · Replacement when its sliding section has scratch. · Correction or replacement when O-ring is damaged or when spool does not move smoothly.
Poppet	· Damage of spring · Damage of poppet · Insert poppet into casing and function it.	· Replacement. · Correction or replacement when sealing is incomplete. · Normal when it can function lightly and smoothly without sticking.
Spring and related parts	· Rusting, corrosion, deformation or breakage of spring, spring seat, plug or cover.	· Replacement for significant damage.
Around seal for spool	· External oil leakage. · Rusting, corrosion or deformation of seal plate.	· Correction or replacement. · Correction or replacement.
Main relief valve, port relief valve & negative control valve	· External rusting or damage. · Contacting face of valve seat. · Contacting face of poppet. · O-rings and back up rings.	· Replacement. · Replacement when damaged. · Replacement when damaged. · Replacement in principle.

3. SWING DEVICE

1) WEARING PARTS

Inspection item	Standard dimension	Recommended replacement value	Counter measures
Clearance between piston and cylinder block bore	0.041	0.060	Replace piston or cylinder block
Thickness of valve plate	6	5.88	Replace
Play between piston and shoe caulking section (δ)	0.025	0.1	Replace assembly of piston and shoe
Thickness of shoe (t)	6.6	6.5	Replace assembly of piston and shoe
Combined height of retainer plate and spherical bushing (H-h)	17.6	17.3	Replace set of retainer plate and sperical bushing
Thickness of friction plate	2.94	2.7	Replace



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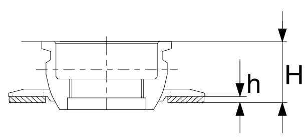

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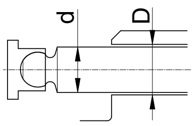
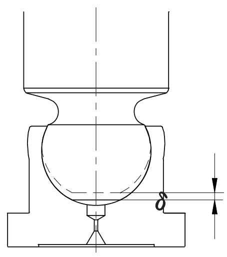
2) SLIDING PARTS

Part name	Standard roughness	Allowable roughness	Remark
Shoe	Rmax=1S (Ra=0.2a) (LAPPING)	4S (Ra=0.1a)	
Shoe plate	Rmax=0.4S (Ra=0.1a) (LAPPING)	3S (Ra=0.8a)	
Cylinder	Rmax=0.4S (Ra=0.1a) (LAPPING)	3S (Ra=0.8a)	
Valve plate	Rmax=0.4S (Ra=0.1a) (LAPPING)	2S (Ra=0.5a)	

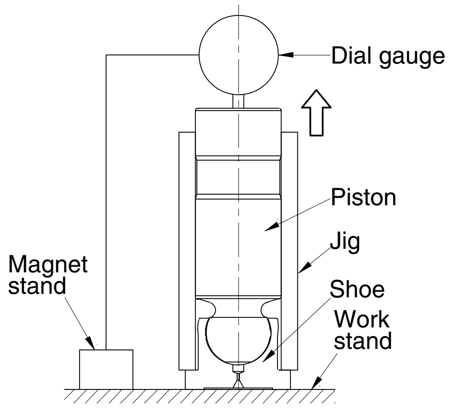
4. TRAVEL MOTOR

The followings are the general maintenance standards. However, it is the most important to determine which parts should be replaced, depending on the characteristics before disassembling, damages and discoloration of exterior view, the purpose of disassembling, the expected remaining service life. etc..

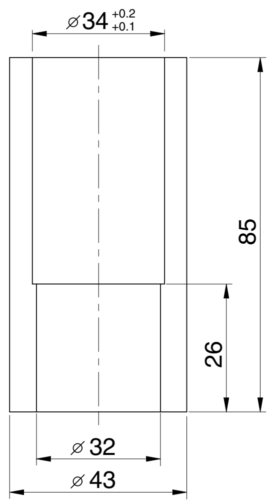
Check item		Measuring method	Criteria	Allowable	Remedy
Sliding surface of cylinder block, valve plate and swash plate	Surface roughness of cylinder block, valve plate and swas plate	Measure the surface roughness by rough-ness tester	Below 0.4 Zμ	Below 3.0 Zμ	Replace or repair ※ Lap together the surfaces of both cylinder block and valve plate to remedy their roughness (# 1200 power)
	Swash plate - hardness of sliding surface	Measure the surface hardness of swash plate by hardness tes-ter	Over HS78	HS74	Replace
Clearance between piston and cylinder block  d D Measurement position	Outer dia of piston d max - d min	Measure outer dia of piston and bore of cylinder block at least 3 places in the longitudinal direction with microme-ter and obtain : max outer dia = d max min outer dia = d min max inner dia = D max min inner dia = D min	0.01 mm	0.05 mm	Replace piston or cylinder block ※ In exchanging pistons, replace all of nine pis-tons at the same time
	Inner dia of cylinder bore D max - D min		0.01 mm	0.022 mm	
	Clearance D-d		0.037~ 0.047 mm	0.065 mm	
Play between pis-ton and shoe	Play between calked piston and shoe (δ)	With the jig, hold down the shoe on work stand and pull up the piston vertical direction to measure the play between piston and shoe	0~0.1 mm	0.3 mm	Replace piston



Play



Method



Jig for measuring play

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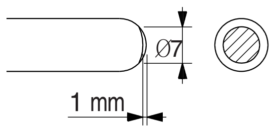
Check item	Measuring method	Criteria	Allowable	Remedy
Parking brake torque	After completion of assembly, set the torque wrench on the shaft end, and measure the braking torque generated when the shaft starts to rotate	92.6 kgf · m (670 lbf · ft)	82.8 kgf · m (599 lbf · ft)	Replace all of separator, friction plates and springs
Standard of replacing friction and separating plate. When measuring parking brake torque, it needs to disassemble traveling unit to motor and reduction gear portion, and it's so hard. The right allowable value is a standard of replacing friction and separating plate. If it is impossible to disassemble traveling unit, refer to the right value.	Measure the total thickness of 4 pieces of friction plate and 5 pieces of separating plate.	22.76 mm	Thickness : 21.3 mm	Replace all separating and friction plates and springs.

Check item	Measuring method	Judging criteria and remedy
Shaft	Measure the wear at contacting surface of oil seal (3) with the surface roughness tester	If the depth of shaft wear is less than 0.05 mm, the shaft is reusable. ※ In case of replacing the shaft (9), replace oil seal (3) at the same time.
Bearings	Replace bearings (10, 51) after decided hours	Replace bearings (10, 51) before hour meter of host machine indicates 10,000 hours. ※ In case replacing the bearings (10, 51), replace both inner and outer races at the same time. ※ Also the bearing shims (52) must be readjusted when replaced shaft (9) and/or bearings (10, 51). Contact dealers for jigs and tools required.
Splines	Replace if the wear of splines exceeds the allowable value	If the wear of splines is less than 0.3 mm, the spline is reusable.
Overload relief valve	Do not try to adjust the valve, since special hydraulic test bench is required for inspecting and adjusting the pressure	Replace relief valve part as an assembly each time the host machine works for 10,000 hours.

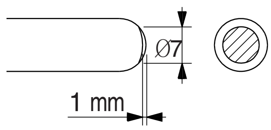
5. RCV LEVER

Maintenance check item	Criteria	Remark
Leakage	The valve is to be replaced when the leakage becomes more than 1000 cc/m at neutral handle position, or more than 2000 cc/m during operation.	Conditions : Primary pressure : 30 kgf/cm^2 Oil viscosity : 23 cSt
Spool	This is to be replaced when the sliding surface has worn more than 10 μm, compared with the non-sliding surface.	The leakage at the left condition is estimated to be nearly equal to the above leakage.
Push rod	 This is to be replaced when the top end has worn more than 1 mm.	
Play at operating section	The pin, shaft, and joint of the operating section are to be replaced when their plays become more than 2 mm due to wears or so on.	When a play is due to looseness of a tightened section, adjust it.
Operation stability	When abnormal noises, hunting, primary pressure drop, etc. are generated during operation, and these cannot be remedied, referring to section 6. Troubleshooting, replace the related parts.	

Notes 1. It is desirable to replace seal materials, such as O-rings, every disassembling. However, they may be reused, after being confirmed to be free of damage.

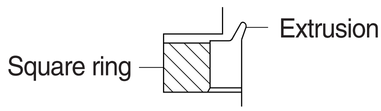
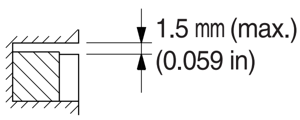
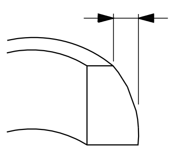
2. When loosening the hexagon socket head cap screw (125), replace the seal washers (121) without fail.

6. RCV PEDAL

Maintenance check item	Criteria	Remark
Leakage	The valve is to be replaced when the leakage effect to the system. For example, the primary pressure drop.	Conditions : Primary pressure : 30 kgf/cm^2 Oil viscosity : 23 cSt
Spool	This is to be replaced when the sliding surface has worn more than 10 μm, compared with the non-sliding surface.	The leakage at the left condition is estimated to be nearly equal to the above leakage.
Push rod	 This is to be replaced when the top end has worn more than 1 mm.	
Play at operating section	The pin, shaft, and joint of the operating section are to be replaced when their plays become more than 2 mm due to wears or so on.	When a play is due to looseness of a tightened section, adjust it.
Operation stability	When abnormal noises, hunting, primary pressure drop, etc. are generated during operation, and these cannot be remedied, referring to section 6. Troubleshooting, replace the related parts.	

Notes 1. It is desirable to replace seal materials, such as O-rings, every disassembling. However, they may be reused, after being confirmed to be free of damage.

7. TURNING JOINT

Part name		Maintenance standards	Remedy
Body, Stem	Sliding surface with sealing sections.	Plating worn or peeled due to seizure or contamination.	Replace
	Sliding surface between body and stem other than sealing section.	· Worn abnormality or damaged more than 0.1 mm (0.0039 in) in depth due to seizure contamination.	Replace
		· Damaged more than 0.1 mm (0.0039 in) in depth.	Smooth with oilstone.
	Sliding surface with thrust plate.	· Worn more than 0.5 mm (0.02 in) or abnormality.	Replace
		· Worn less than 0.5 mm (0.02 in).	Smooth
		· Damage due to seizure or contamination remediable within wear limit (0.5 mm) (0.02 in).	Smooth
Cover	Sliding surface with thrust plate.	· Worn more than 0.5 mm (0.02 in) or abnormality.	Replace
		· Worn less than 0.5 mm (0.02 in).	Smooth
		· Damage due to seizure or contamination remediable within wear limit (0.5 mm) (0.02 in).	Replace
Seal set	-	· Extruded excessively from seal groove square ring.  	Replace
	-	· Slipper ring 1.5 mm (0.059 in) narrower than seal groove, or narrower than back ring.  	Replace
	-	· Worn more than 0.5 mm (0.02 in) ~ 1.5 mm (MAX.) (0.059 in) 	Replace

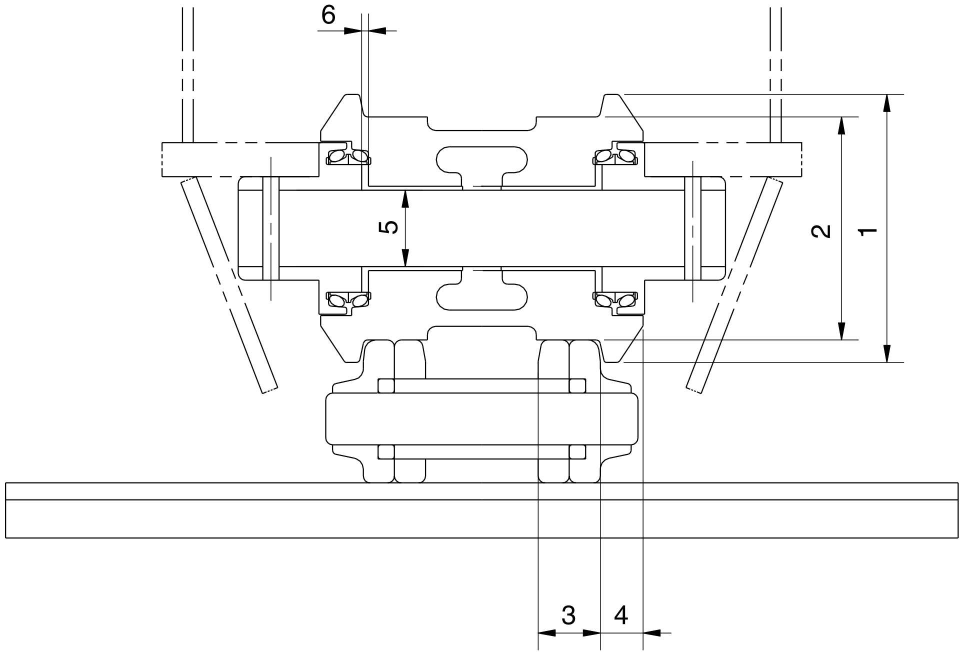
8. CYLINDER

Part name	Inspecting section	Inspection item	Remedy
Piston rod	· Neck of rod pin	· Presence of crack	· Replace
	· Weld on rod hub	· Presence of crack	· Replace
	· Stepped part to which piston is attached.	· Presence of crack	· Replace
	· Threads	· Presence of crack	· Recondition or replace
	· Plated surface	· Plating is not worn off to base metal.	· Replace or replate
		· Rust is not present on plating.	· Replace or replate
		· Scratches are not present.	· Recondition, replate or replace
	· Rod	· Wear of O.D.	· Recondition, replate or replace
	· Bushing at mounting part	· Wear of I.D.	· Replace
Cylinder tube	· Weld on bottom	· Presence of crack	· Replace
	· Weld on head	· Presence of crack	· Replace
	· Weld on hub	· Presence of crack	· Replace
	· Tube interior	· Presence of faults	· Replace if oil leak is seen
	· Bushing at mounting part	· Wear on inner surface	· Replace
Gland	· Bushing	· Flaw on inner surface	· Replace if flaw is deeper than coating

GROUP 3 TRACK AND WORK EQUIPMENT

1. TRACK

1) TRACK ROLLER



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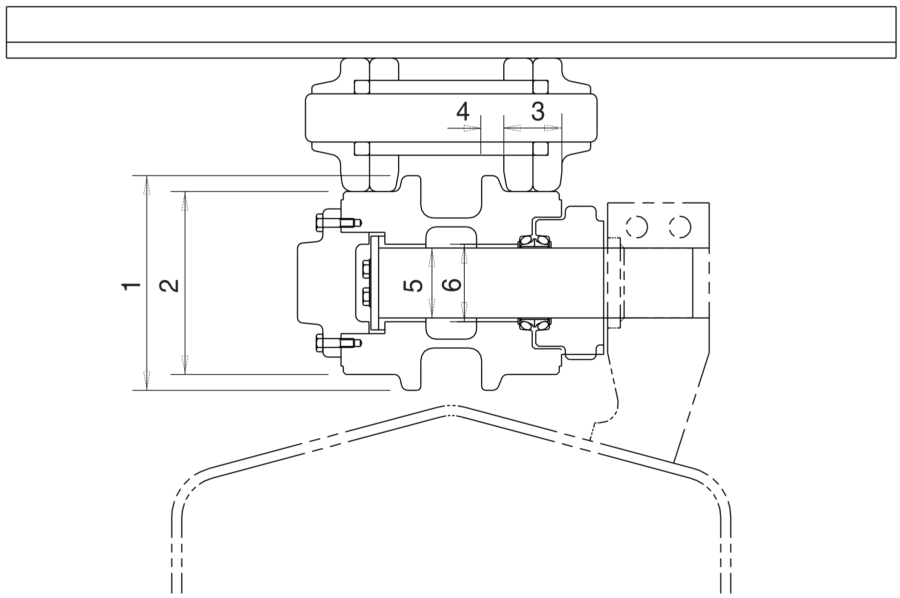
Unit : mm

<table>
<tr><th>No.</th><th>Check item</th><th colspan="4">Criteria</th><th>Remedy</th></tr>
<tr><td rowspan="2">1</td><td rowspan="2">Outside diameter of flange</td><td colspan="2">Standard size</td><td colspan="2">Repair limit</td><td rowspan="5">Rebuild or replace</td></tr>
<tr><td colspan="2">ø 216</td><td colspan="2">–</td></tr>
<tr><td>2</td><td>Outside diameter of tread</td><td colspan="2">ø 180</td><td colspan="2">ø 168</td></tr>
<tr><td>3</td><td>Width of tread</td><td colspan="2">50</td><td colspan="2">56</td></tr>
<tr><td>4</td><td>Width of flange</td><td colspan="2">57</td><td colspan="2">21</td></tr>
<tr><td rowspan="3">5</td><td rowspan="3">Clearance between shaft and bushing</td><td colspan="2">Standard size & tolerance</td><td rowspan="2">Standard clearance</td><td rowspan="2">Clearance limit</td><td rowspan="3">Replace bushing</td></tr>
<tr><td>Shaft</td><td>Hole</td></tr>
<tr><td>$\varnothing 75^{\ 0}_{-0.03}$</td><td>$\varnothing 75.35^{+0.05}_{\ 0}$</td><td>0.35 to 0.40</td><td>2.0</td></tr>
<tr><td rowspan="2">6</td><td rowspan="2">Side clearance of roller (both side)</td><td colspan="2">Standard clearance</td><td colspan="2">Clearance limit</td><td rowspan="2">Replace</td></tr>
<tr><td colspan="2">0.16~1.24</td><td colspan="2">2.0</td></tr>
</table>

2) CARRIER ROLLER



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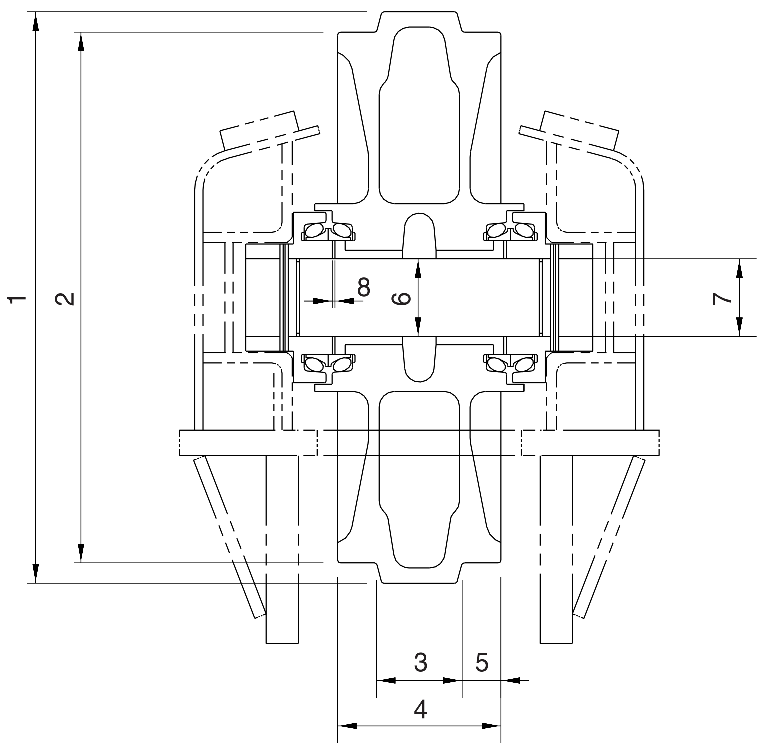
Unit : mm

No.	Check item	Criteria				Remedy
1	Outside diameter of flange	Standard size		Repair limit		Rebuild or replace
		ø 200		–		
2	Outside diameter of tread	ø 168		ø 158		
3	Width of tread	54		59		
4	Width of flange	19		–		
5	Clearance between shaft and bushing	Standard size & tolerance		Standard clearance	Clearance limit	Replace bushing
		Shaft	Hole			
		ø 55 $^{+0.085}_{+0.066}$	ø 55 $^{+0.37}_{+0.33}$	0.245 to 0.304	2.0	
6	Clearance between shaft and support	ø 58 $^{0}_{-0.1}$	ø 58 $^{+0.5}_{+0.3}$	0.3 to 0.6	1.2	Replace

3) IDLER



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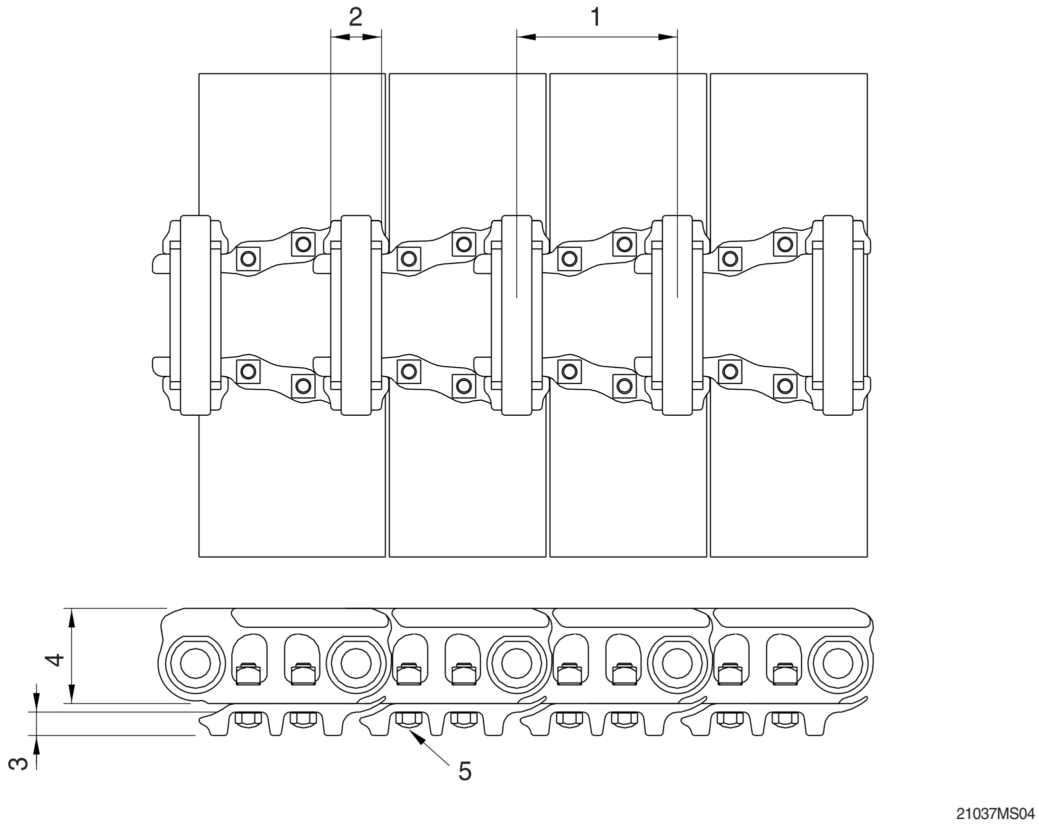
Unit : ㎜

<table>
<tr><th>No.</th><th>Check item</th><th colspan="4">Criteria</th><th>Remedy</th></tr>
<tr><td rowspan="2">1</td><td rowspan="2">Outside diameter of protrusion</td><td colspan="2">Standard size</td><td colspan="2">Repair limit</td><td rowspan="6">Rebuild or replace</td></tr>
<tr><td colspan="2">ø 646</td><td colspan="2">–</td></tr>
<tr><td>2</td><td>Outside diameter of tread</td><td colspan="2">ø 594</td><td colspan="2">ø 588</td></tr>
<tr><td>3</td><td>Width of protrusion</td><td colspan="2">102</td><td colspan="2">–</td></tr>
<tr><td>4</td><td>Total width</td><td colspan="2">203</td><td colspan="2">–</td></tr>
<tr><td>5</td><td>Width of tread</td><td colspan="2">50.5</td><td colspan="2">56.5</td></tr>
<tr><td rowspan="3">6</td><td rowspan="3">Clearance between shaft and bushing</td><td colspan="2">Standard size & tolerance</td><td rowspan="2">Standard clearance</td><td rowspan="2">Clearance limit</td><td rowspan="3">Replace bushing</td></tr>
<tr><td>Shaft</td><td>Hole</td></tr>
<tr><td>ø 90 $^{0}_{-0.035}$</td><td>ø 90.35 $^{+0.05}_{0}$</td><td>0.35 to 0.435</td><td>2.0</td></tr>
<tr><td>7</td><td>Clearance between shaft and support</td><td>ø 90 $^{0}_{-0.035}$</td><td>ø 90 $^{+0.09}_{+0.036}$</td><td>0.036 to 0.125</td><td>1.2</td><td>Replace</td></tr>
<tr><td>8</td><td>Side clearance of idler (both side)</td><td colspan="2">Standard clearance
0.4 to 1.2</td><td colspan="2">Clearance limit
2.0</td><td>Replace</td></tr>
</table>

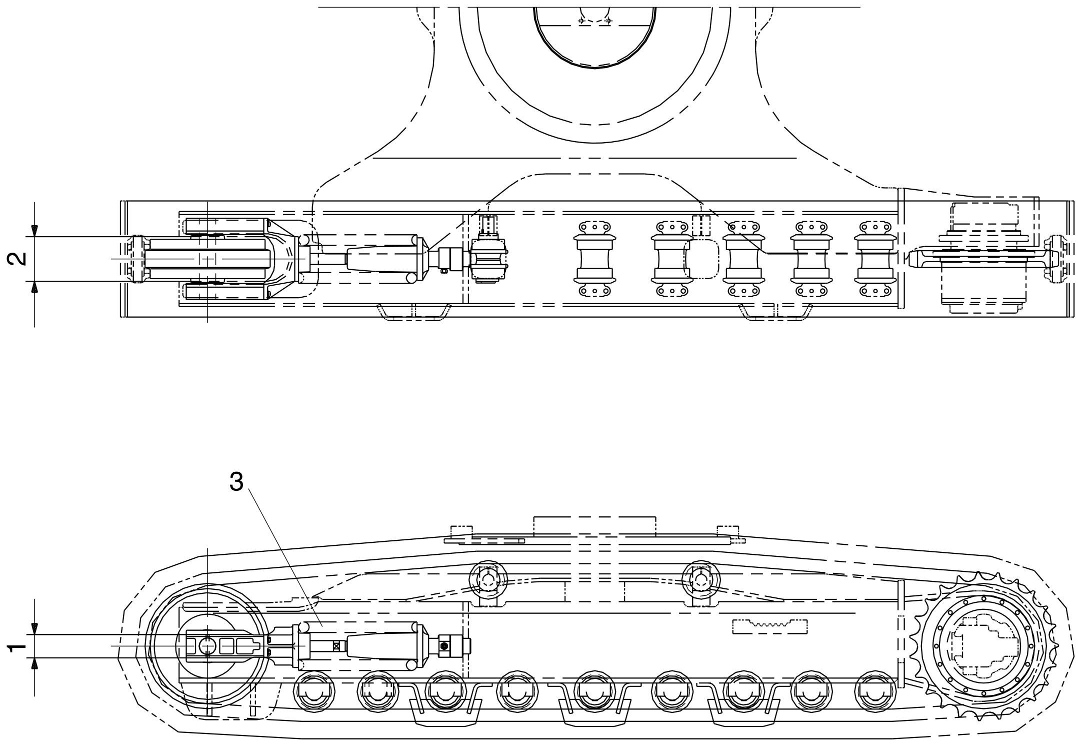
4) TRACK



Unit : mm

No.	Check item	Criteria		Remedy
1	Link pitch	Standard size	Repair limit	Turn or replace
		216	221	
2	Outside diameter of bushing	ø 66.5	ø 60.9	Rebuild or replace
3	Height of grouser	30	23	
4	Height of link	116	111	
5	Tightening torque	Initial tightening torque : 115±5 kgf · m		Retighten

5) TRACK FRAME AND RECOIL SPRING

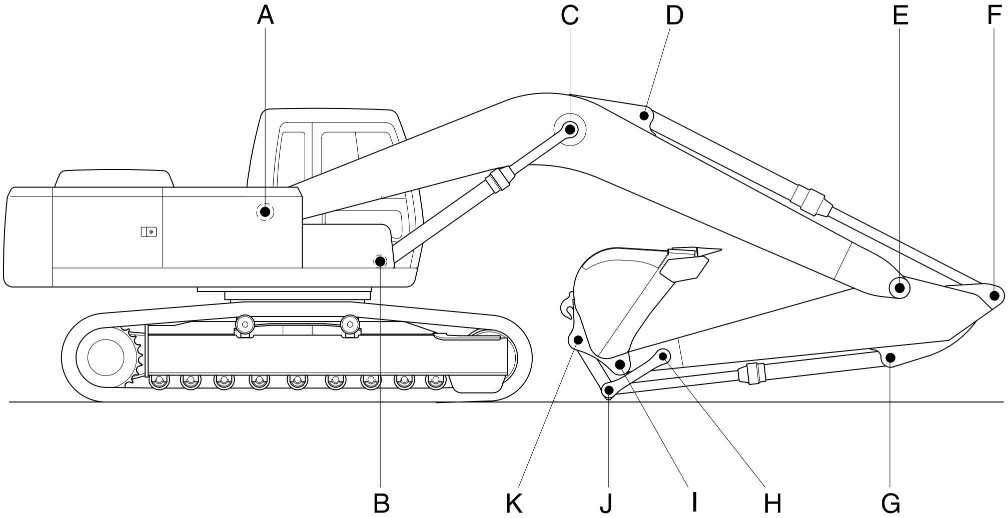


21037MS05

Unit : ㎜

<table>
<tr><th>No.</th><th>Check item</th><th colspan="5">Criteria</th><th>Remedy</th></tr>
<tr><td rowspan="3">1</td><td rowspan="3">Vertical width of idler guide</td><td></td><td colspan="2">Standard size</td><td colspan="1">Tolerance</td><td>Repair limit</td><td rowspan="5">Rebuild or replace</td></tr>
<tr><td>Track frame</td><td colspan="2">132</td><td>+2
0</td><td>136</td></tr>
<tr><td>Idler support</td><td colspan="2">130</td><td>0
- 1.5</td><td>126</td></tr>
<tr><td rowspan="2">2</td><td rowspan="2">Horizontal width of idler guide</td><td>Track frame</td><td colspan="2">292</td><td>+2
0</td><td>297</td></tr>
<tr><td>Idler support</td><td colspan="2">290</td><td>-</td><td>288</td></tr>
<tr><td rowspan="3">3</td><td rowspan="3">Recoil spring</td><td colspan="3">Standard size</td><td colspan="2">Repair limit</td><td rowspan="3">Replace</td></tr>
<tr><td>Free length</td><td>Installation length</td><td>Installation load</td><td>Free length</td><td>Installation load</td></tr>
<tr><td>Ø 253×710</td><td>580</td><td>19012 kg</td><td>–</td><td>15210 kg</td></tr>
</table>

2. WORK EQUIPMENT



21077MS20

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	125	124	123.5	125.5	126	Replacement
B	Boom Cylinder Head	120	119	118.5	120.5	121	
C	Boom Cylinder Rod	120	119	118.5	120.5	121	
D	Arm Cylinder Head	120	119	118.5	120.5	121	
E	Boom Front	125	124	123.5	125.5	126	
F	Arm Cylinder Rod	120	119	118.5	120.5	121	
G	Bucket Cylinder Head (HX480 L)	100	99	98.5	100.5	101	
	Bucket Cylinder Head (HX520 L)	110	109	108.5	110.5	111	
H	Arm Link	100	99	98.5	100.5	101	
I	Bucket and Arm Link (HX480 L)	100	99	98.5	100.5	101	
	Bucket and Arm Link (HX520 L)	120	119	118.5	120.5	121	
J	Bucket Cylinder Rod (HX480 L)	100	99	98.5	100.5	101	
	Bucket Cylinder Rod (HX520 L)	110	109	108.5	110.5	111	
K	Bucket Link (HX480 L)	100	99	98.5	100.5	101	
	Bucket Link (HX520 L)	120	119	118.5	120.5	121	

SECTION 8 DISASSEMBLY AND ASSEMBLY

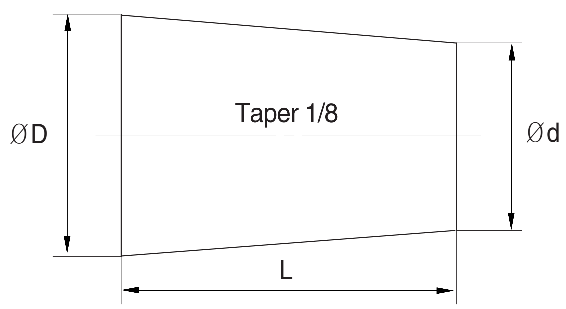
SECTION 8 DISASSEMBLY AND ASSEMBLY

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

· HX480 L

No.	Descriptions		Bolt size	Torque	
				kgf · m	lbf · ft
1	Engine	Engine mounting bolt (FR, bracket)	M16 × 1.5	28 ± 3.0	203 ± 21.7
2		Engine mounting bolt (RR, bracket)	M14 × 2.0	18 ± 2.0	130 ± 14.5
3		Engine mounting bolt (frame)	M22 × 2.5	69.6 ± 7.0	503 ± 50.6
4		Radiator mounting bolt	M16 × 2.0	29.7 ± 4.5	215 ± 32.5
5		Coupling mounting socket bolt	M20 × 2.5	46.5 ± 2.5	336 ± 18.1
6		Main pump housing mounting bolt	M10 × 1.5	6.7 ± 1.0	48.7 ± 7.2
7	Hydraulic system	Main pump mounting bolt	M20 × 2.5	44 ± 6.6	318 ± 47.7
8		Main control valve mounting nut	M20 × 2.5	57.9 ± 8.7	419 ± 62.9
9		Fuel tank mounting bolt	M20 × 2.5	46 ± 5.1	333 ± 63.8
10		Hydraulic oil tank mounting bolt	M20 × 2.5	57.9 ± 8.0	419 ± 57.9
11		Turning joint mounting bolt, nut	M16 × 2.0	29.7 ± 4.5	215 ± 32.5
12	Power train system	Swing motor mounting bolt	M20 × 2.5	57.9 ± 8.7	419 ± 62.9
13		Swing bearing upper part mounting bolt	M24 × 3.0	100 ± 10	723 ± 72.3
14		Swing bearing lower part mounting bolt	M24 × 3.0	100 ± 10	723 ± 72.3
15		Travel motor mounting bolt	M20 × 2.5	57.9 ± 8.7	419 ± 62.9
16		Sprocket mounting bolt	M20 × 2.5	57.9 ± 6.0	419 ± 43.4
17	Under carriage	Carrier roller mounting bolt, nut	M16 × 2.0	29.7 ± 3.0	215 ± 21.7
18		Track roller mounting bolt	M24 × 3.0	100 ± 10	723 ± 72.3
19		Track tension cylinder mounting bolt	M22 × 1.5	87.2 ± 12.5	631 ±90.4
20		Track shoe mounting bolt, nut	M24 × 3.0	140 ± 14	1012 ± 101
21		Track guard mounting bolt	M24 × 3.0	100 ± 15	723 ±108
22	Others	Counterweight mounting bolt	M42 × 3.0	390 ± 40	2821 ± 289
23		Cab mounting bolt	M12 × 1.75	12.8 ± 3.0	92.6 ± 21.7
24		Operator's seat mounting bolt	M 8 × 1.25	4.05 ± 0.8	29.3 ± 5.8

※ For tightening torque of engine and hydraulic components, see engine maintenance guide and service manual.

· HX520 L

No.	Descriptions		Bolt size	Torque	
				kgf · m	lbf · ft
1	Engine	Engine mounting bolt (FR, bracket)	M16 × 1.5	28 ± 3.0	203 ± 21.7
2		Engine mounting bolt (RR, bracket)	M14 × 2.0	18 ± 2.0	130 ± 14.5
3		Engine mounting bolt (frame)	M22 × 2.5	69.6 ± 7.0	503 ± 50.6
4		Radiator mounting bolt	M16 × 2.0	29.7 ± 4.5	215 ± 32.5
5		Coupling mounting socket bolt	M20 × 2.5	46.5 ± 2.5	336 ± 18.1
6		Main pump housing mounting bolt	M10 × 1.5	6.7 ± 1.0	48.7 ± 7.2
7	Hydraulic system	Main pump mounting bolt	M20 × 2.5	44 ± 6.6	318 ± 47.7
8		Main control valve mounting nut	M20 × 2.5	57.9 ± 8.7	419 ± 62.9
9		Fuel tank mounting bolt	M20 × 2.5	46 ± 5.1	333 ± 63.8
10		Hydraulic oil tank mounting bolt	M20 × 2.5	57.9 ± 8.0	419 ± 57.9
11		Turning joint mounting bolt, nut	M16 × 2.0	29.7 ± 4.5	215 ± 32.5
12	Power train system	Swing motor mounting bolt	M20 × 2.5	57.9 ± 8.7	419 ± 62.9
13		Swing bearing upper part mounting bolt	M24 × 3.0	100 ± 10	723 ± 72.3
14		Swing bearing lower part mounting bolt	M24 × 3.0	100 ± 10	723 ± 72.3
15		Travel motor mounting bolt	M20 × 2.5	57.9 ± 8.7	419 ± 62.9
16		Sprocket mounting bolt	M20 × 2.5	57.9 ± 6.0	419 ± 43.4
17	Under carriage	Carrier roller mounting bolt, nut	M16 × 2.0	29.7 ± 3.0	215 ± 21.7
18		Track roller mounting bolt	M24 × 3.0	100 ± 10	723 ± 72.3
19		Track tension cylinder mounting bolt	M22 × 1.5	87.2 ± 12.5	631±90.4
20		Track shoe mounting bolt, nut	M24 × 3.0	140 ± 14	1012 ± 101
21		Track guard mounting bolt	M24 × 3.0	100 ± 15	723 ±108
22		Adjustable track gauge bolt	M33 × 3.5	220 ± 20	1590 ±145
23	Others	Counterweight mounting bolt	M42 × 3.0	390 ± 40	2821 ± 289
24		Center frame support & lower track mounting bolt	M33 × 3.5	220 ± 20	1591 ±145
25		Cab mounting bolt	M12 × 1.75	12.8 ± 3.0	92.6 ± 21.7
26		Operator's seat mounting bolt	M 8 × 1.25	4.05 ± 0.8	29.3 ± 5.8

※ 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	8T		10T	
	kgf · m	lbf · ft	kgf · m	lbf · ft
M 6×1.0	0.85 ~ 1.25	6.15 ~ 9.04	1.14 ~ 1.74	8.2 ~ 12.6
M 8×1.25	2.0 ~ 3.0	14.5 ~ 21.7	2.7 ~ 4.1	19.5 ~ 29.7
M10×1.5	4.0 ~ 6.0	28.9 ~ 43.4	5.5 ~ 8.3	39.8 ~ 60.0
M12×1.75	7.4 ~ 11.2	53.5 ~ 81.0	9.8 ~ 15.8	70.9 ~ 114
M14×2.0	12.2 ~ 16.6	88.2 ~ 120	16.7 ~ 22.5	121 ~ 163
M16×2.0	18.6 ~ 25.2	135 ~ 182	25.2 ~ 34.2	182 ~ 247
M18×2.0	25.8 ~ 35.0	187 ~ 253	35.1 ~ 47.5	254 ~ 344
M20×2.5	36.2 ~ 49.0	262 ~ 354	49.2 ~ 66.6	356 ~ 482
M22×2.5	48.3 ~ 63.3	349 ~ 458	65.8 ~ 98.0	476 ~ 709
M24×3.0	62.5 ~ 84.5	452 ~ 611	85.0 ~ 115	615 ~ 832
M30×3.0	124 ~ 168	898 ~ 1214	169 ~ 229	1223 ~ 1656
M36×4.0	174 ~ 236	1261 ~ 1704	250 ~ 310	1808 ~ 2242

(2) Fine thread

Bolt size	8T		10T	
	kgf · m	lbf · ft	kgf · m	lbf · ft
M 8×1.0	2.2 ~ 3.4	15.9 ~ 24.6	3.0 ~ 4.4	21.7 ~ 31.8
M10×1.2	4.5 ~ 6.7	32.5 ~ 48.5	5.9 ~ 8.9	42.7 ~ 64.4
M12×1.25	7.8 ~ 11.6	56.4 ~ 83.9	10.6 ~ 16.0	76.7 ~ 116
M14×1.5	13.3 ~ 18.1	96.2 ~ 131	17.9 ~ 24.1	130 ~ 174
M16×1.5	19.9 ~ 26.9	144 ~ 195	26.6 ~ 36.0	192 ~ 260
M18×1.5	28.6 ~ 43.6	207 ~ 315	38.4 ~ 52.0	278 ~ 376
M20×1.5	40.0 ~ 54.0	289 ~ 391	53.4 ~ 72.2	386 ~ 522
M22×1.5	52.7 ~ 71.3	381 ~ 516	70.7 ~ 95.7	511 ~ 692
M24×2.0	67.9 ~ 91.9	491 ~ 665	90.9 ~ 123	658 ~ 890
M30×2.0	137 ~ 185	990 ~ 1339	182 ~ 248	1314 ~ 1796
M36×3.0	192 ~ 260	1390 ~ 1880	262 ~ 354	1894 ~ 2562

2) PIPE AND HOSE (FLARE TYPE)

Thread size (PF)	Width across flat (mm)	kgf · m	lbf · ft
1/4"	19	4	28.9
3/8"	22	5	36.2
1/2"	27	9.5	68.7
3/4"	36	18	130.2
1"	41	21	151.9
1-1/4"	50	35	253.2

3) PIPE AND HOSE (ORFS TYPE)

Thread size (UNF)	Width across flat (mm)	kgf · m	lbf · ft
9/16-18	19	4	28.9
11/16-16	22	5	36.2
13/16-16	27	9.5	68.7
1-3/16-12	36	18	130.2
1-7/16-12	41	21	151.9
1-11/16-12	50	35	253.2

4) FITTING

Thread size	Width across flat (mm)	kgf · m	lbf · ft
1/4"	19	4	28.9
3/8"	22	5	36.2
1/2"	27	9.5	68.7
3/4"	36	18	130.2
1"	41	21	151.9
1-1/4"	50	35	253.2

GROUP 3 PUMP DEVICE

1. REMOVAL AND INSTALL

1) REMOVAL

(1) Lower the work equipment to the ground and stop the engine.

(2) Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping

(3) Loosen the breather slowly to release the pressure inside the hydraulic tank.

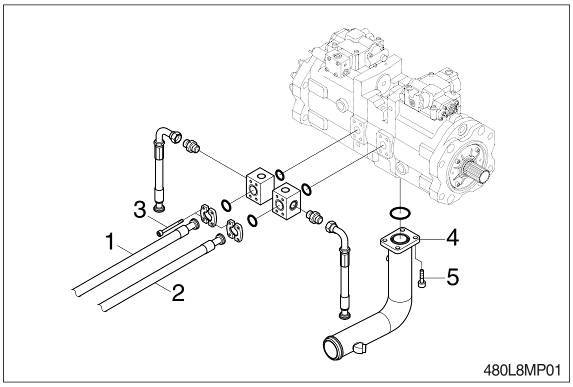
⚠ **Escaping fluid under pressure can penetrate the skin causing serious injury.**

13031GE18

(4) Loosen the drain plug under the hydraulic tank and drain the oil from the hydraulic tank.

· Hydraulic tank quantity : 250 ℓ

(5) Remove socket bolts (3) and disconnect block with hoses (1, 2).

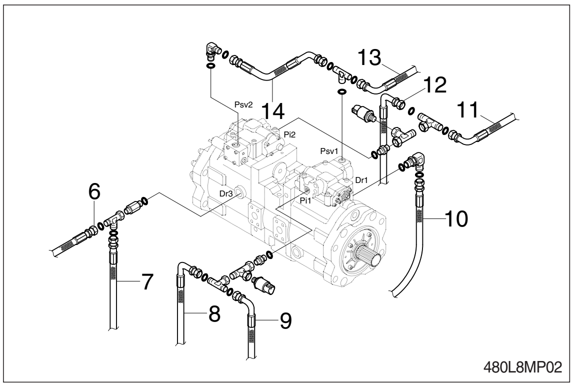


480L8MP01

(6) Disconnect pilot line hoses (6, 7, 8, 9, 10, 11, 12, 13, 14).

(7) Remove socket bolts (5) and disconnect pump suction tube (4).

※ When pump suction tube is disconnected, the oil inside the piping will flow out, so catch it in oil pan.



480L8MP02

(8) Sling the pump assembly and remove the pump mounting bolts.

· Weight : 190 kg (420 lb)

※ Pull out the pump assembly from housing. When removing the pump assembly, check that all the hoses have been disconnected.

2) INSTALL

(1) Carry out installation in the reverse order to removal.

(2) Remove the suction strainer and clean it.

(3) Replace return filter with new one.

(4) Remove breather and clean it.

(5) After adding oil to the hydraulic tank to the specified level.

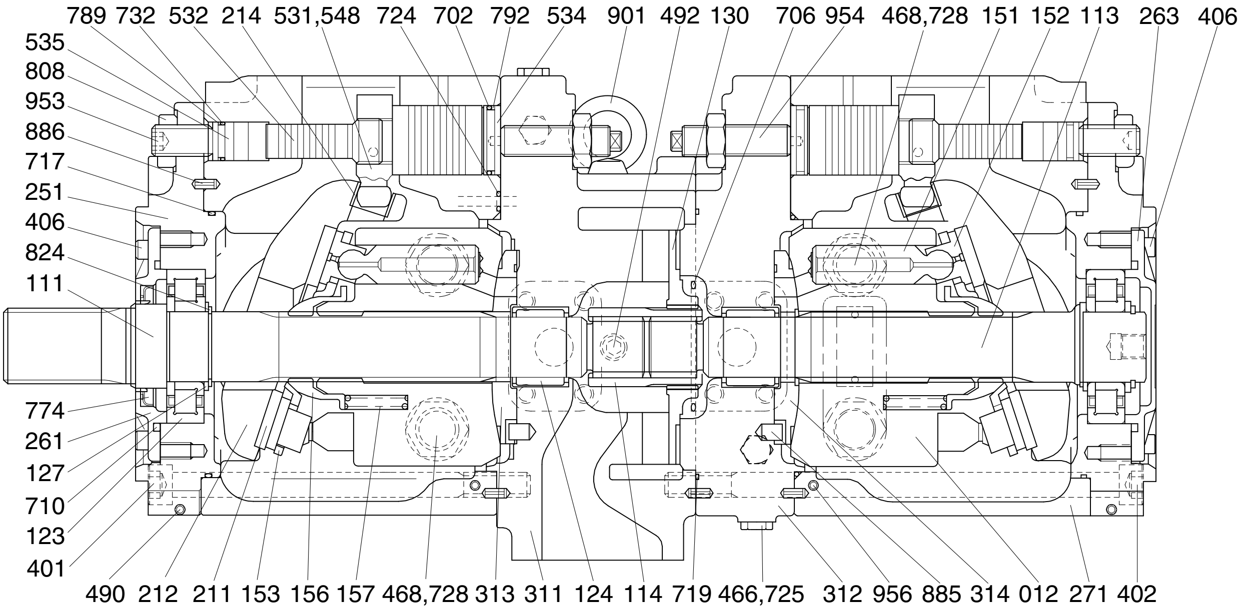
(6) Bleed the air from the hydraulic pump.
① Remove the air vent plug (2EA).
② Tighten plug lightly.
③ Start the engine, run at low idling, and check oil come out from plug.
④ Tighten plug.

(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 (1/2)

1) STRUCTURE



480F2MP02

012 Cylinder block
111 Drive shaft (F)
113 Driven shaft (R)
114 Coupling
123 Roller bearing
124 Needle bearing
127 Spacer
130 Booster
151 Piston
152 Shoe
153 Set plate
156 Bushing
157 Cylinder spring
211 Shoe plate
212 Swash plate
214 Tilting bearing
251 Support plate
261 Seal cover (F)
263 Seal cover (R)

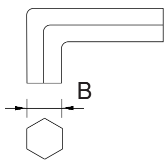
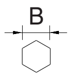
271 Pump casing
311 Valve cover (F)
312 Valve cover (R)
313 Valve plate (R)
314 Valve plate (L)
401 Hexagon socket bolt
402 Hexagon socket bolt
406 Hexagon socket bolt
466 VP Plug
468 VP Plug
490 VP Plug
492 VP Plug
531 Tilting pin
532 Servo piston
534 Stopper (L)
535 Stopper (S)
548 Feed back pin
702 O-ring
706 O-ring

710 O-ring
717 O-ring
719 O-ring
724 Square ring
725 O-ring
728 O-ring
732 O-ring
774 Oil seal
789 Back up ring
792 Back up ring
808 Hexagon head nut
824 Snap ring
885 Valve plate pin
886 Spring pin
901 Eye bolt
953 Set screw
954 Set screw
956 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="4">Part name</th></tr>
<tr><td rowspan="6">Allen wrench
</td><td>B</td><td>Hexagon socket head bolt</td><td>PT plug (PT thread)</td><td>PO plug (PF thread)</td><td>Hexagon socket head setscrew</td></tr>
<tr><td>4</td><td>M 5</td><td>BP-1/16</td><td>-</td><td>M 8</td></tr>
<tr><td>5</td><td>M 6</td><td>BP1/ 8</td><td>-</td><td>M10</td></tr>
<tr><td>6</td><td>M 8</td><td>BP-1/ 4</td><td>PO-1/4</td><td>M12, M14</td></tr>
<tr><td>8</td><td>M10</td><td>BP-3/ 8</td><td>PO-3/8</td><td>M16, M18</td></tr>
<tr><td>17</td><td>M20, M22</td><td>BP-1</td><td>PO-1, 1 1/4, 1 1/2</td><td>-</td></tr>
<tr><td rowspan="6">Double ring spanner, socket wrench, double (single) open end spanner
</td><td>-</td><td>Hexagon head bolt</td><td colspan="2">Hexagon head bolt</td><td>VP plug (PF thread)</td></tr>
<tr><td>19</td><td>M12</td><td colspan="2">M12</td><td>VP-1/4</td></tr>
<tr><td>24</td><td>M16</td><td colspan="2">M16</td><td>-</td></tr>
<tr><td>27</td><td>M18</td><td colspan="2">M18</td><td>VP-1/2</td></tr>
<tr><td>30</td><td>M20</td><td colspan="2">M20</td><td>-</td></tr>
<tr><td>36</td><td>-</td><td colspan="2">-</td><td>VP-3/4</td></tr>
<tr><td colspan="2">Adjustable angle wrench</td><td colspan="4">Medium size, 1 set</td></tr>
<tr><td colspan="2">Screw driver</td><td colspan="4">Minus type screw driver, Medium size, 2 sets</td></tr>
<tr><td colspan="2">Hammer</td><td colspan="4">Plastic hammer, 1 set</td></tr>
<tr><td colspan="2">Pliers</td><td colspan="4">For snap ring, TSR-160</td></tr>
<tr><td colspan="2">Steel bar</td><td colspan="4">Steel bar of key material approx. 10×8×200</td></tr>
<tr><td colspan="2">Torque wrench</td><td colspan="4">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 1/2 to 2 turns round the plug	PT1/16	0.7	5.1	0.16	4
	PT 1/8	1.05	7.59	0.20	5
	PT 1/4	1.75	12.7	0.24	6
	PT 3/8	3.5	25.3	0.31	8
	PT 1/2	5.0	36.2	0.39	10
PF plug (material : S45C)	PF 1/4	3.0	21.7	0.24	6
	PF 1/2	10.0	72.3	0.39	10
	PF 3/4	15.0	109	0.55	14
	PF 1	19.0	137	0.67	17
	PF 1 1/4	27.0	195	0.67	17
	PF 1 1/2	28.0	203	0.67	17

3) DISASSEMBLY

(1) Select place suitable to disassembling.

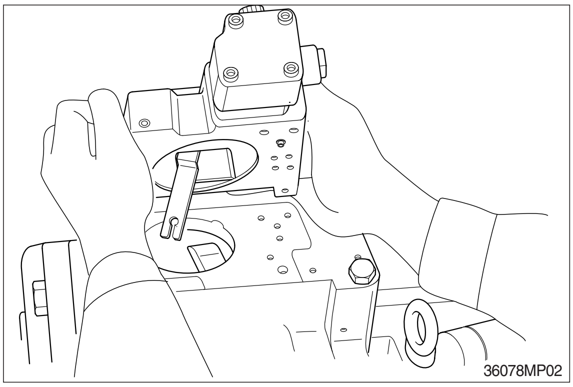
※ Select clean place.

※ Spread rubber sheet, cloth or so on on overhaul workbench top to prevent parts from being damaged.

(2) Remove dust, rust, etc, from pump surfaces with cleaning oil or so on.

(3) Remove drain port plug (468) and let oil out of pump casing (front and rear pump).

(4) Remove hexagon socket head bolts (412, 413) and remove regulator.


36078MP02

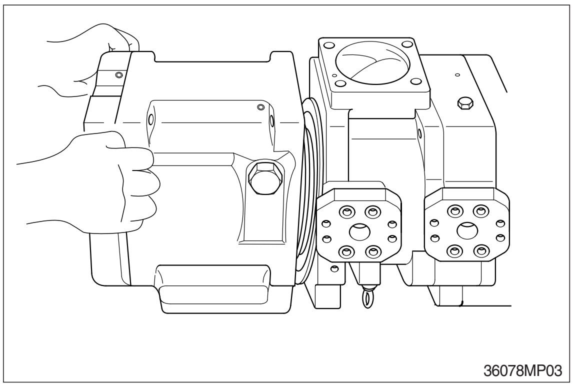
(5) Loosen hexagon socket head bolts (401) which tighten swash plate support (251), pump casing (271) and valve cover (F, 311).

※ If gear pump and so on are fitted to rear face of pump, remove them before starting this work.

(6) Loosen hexagon socket head bolts (402) which tighten swash plate support (251), pump casing (271) and valve cover (R, 312).

(7) Place pump horizontally on workbench with its regulator-fitting surface down, and separate pump casing (271) from valve cover (F, 311).

※ Before bringing this surface down, spread rubber sheet on workbench without fail to prevent this surface from being damaged.

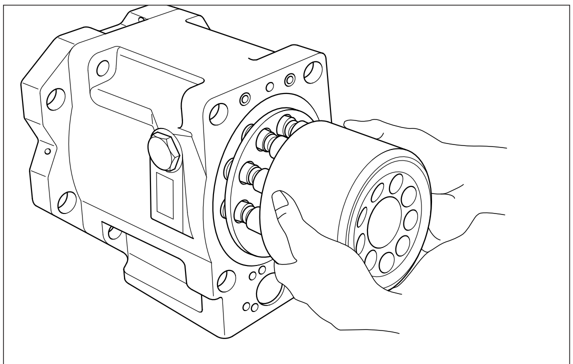


36078MP03

(8) Separate valve cover (F, 311) from valve cover (R, 312) and pull out booster (130), spline coupling (114).

(9) Separate valve cover (R, 312) from pump casing and then pull out the cylinder block (012) of pump casing (271) straightly over drive shaft (R, 113). Pull out also pistons (151), set plate (153), spherical bush (156) and cylinder springs (157) simultaneously.

※ Take care not to damage sliding surfaces of cylinder, spherical bushing, shoes, swash plate, etc.

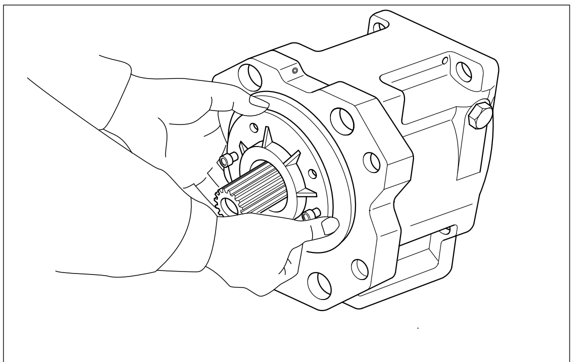


36078MP04

(10) Remove hexagon socket head bolts (406) and then seal cover (F, 261).

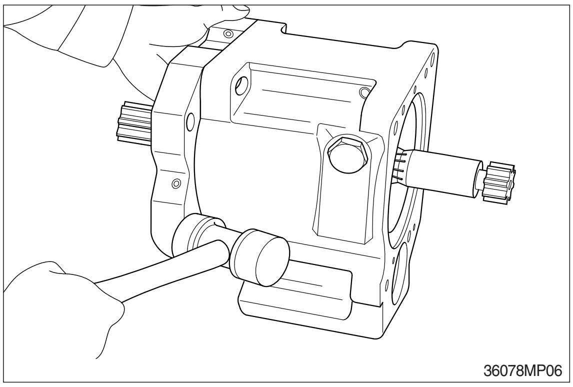
※ Fit bolt into pulling-out tapped hole of seal cover (F), and cover can be removed easily.

※ Since oil seal is fitted on seal cover (F), take care not to damage it when removing cover.



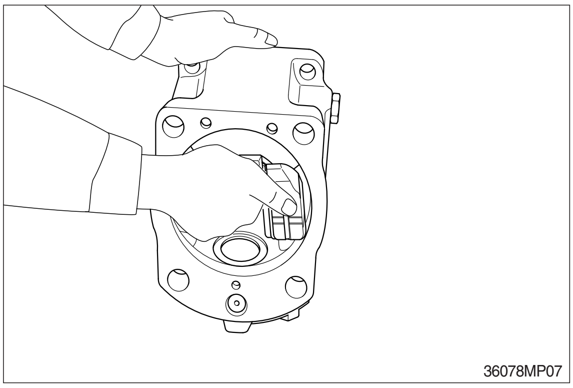
36078MP05

(11) Tapping lightly fitting flange section of swash plate support (251) on its pump casing side, separate swash plate support from pump casing.



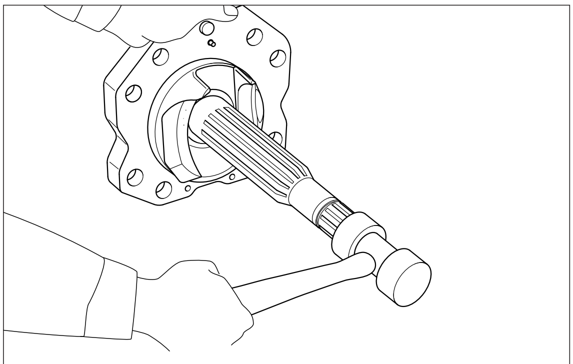
36078MP06

(12) Remove shoe plate (211) and swash plate (212) from pump casing (271).



36078MP07

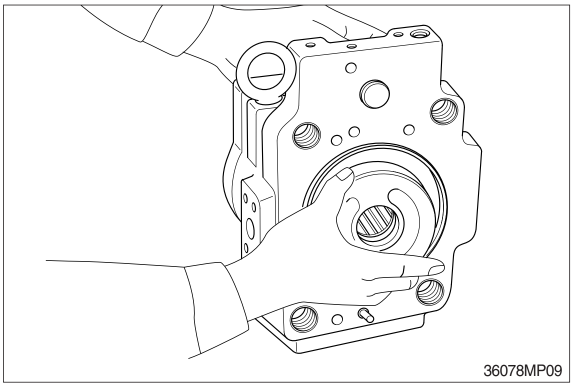
(13) Tapping lightly shaft ends of drive shafts (111, 113) with plastic hammer, take out drive shafts from swash plate supports.



36078MP08

(14) Remove valve plates (313, 314) from valve cover (311, 312).

※ These may be removed in work 7, 9.



36078MP09

(15) If necessary, remove stopper (L, 534), stopper (S, 535), servo piston (532) and tilting pin(531) from pump casing (271), and needle bearing (124) from valve cover (311, 312).

※ In removing tilting pin, use a protector to prevent pin head from being damaged.

※ Since loctite is applied to fitting areas of tilting pin and servo piston, take care not to damage servo piston.

※ Do not remove needle bearing as far as possible, except when it is considered to be out of its life span.

※ Do not loosen hexagon nuts of valve cover and swash plate support.
If loosened, flow setting will be changed.

(16) This is the end of disassembling procedures.

4) ASSEMBLY

(1) For reassembling reverse the disassembling procedures, paying attention to the following items.

① Do not fail to repair the parts damaged during disassembling, and prepare replacement parts in advance.

② Clean each part fully with cleaning oil and dry it with compressed air.

③ Do not fail to apply clean working oil to sliding sections, bearings, etc. before assembling them.

④ In principle, replace seal parts, such as O-rings, oil seals, etc.

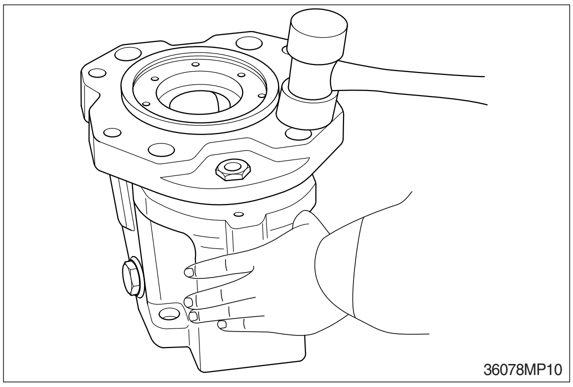
⑤ For fitting bolts, plug, etc., prepare a torque wrench or so on, and tighten them with torques shown in page 8-11, 12.

⑥ For the double-pump, take care not to mix up parts of the front pump with those of the rear pump.

(2) Fit swash plate support (251) to pump casing (271), tapping the former lightly with a hammer.

※ After servo piston, tilting pin, stopper (L) and stopper (S) are removed, fit them soon to pump casing in advance for reassembling.

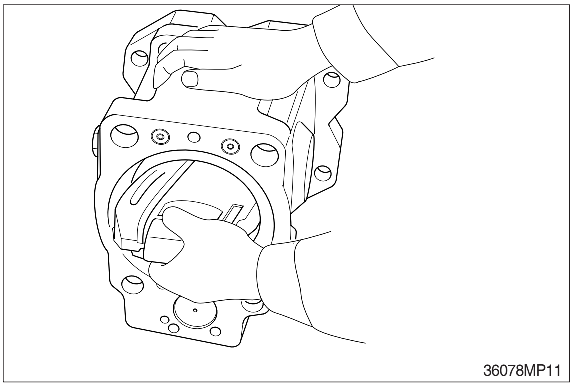
※ In tightening servo piston and tilting pin, use a protector to prevent tilting pin head and feedback pin from being damaged. In addition, apply loctite (medium strength) to their threaded sections.



(3) Place pump casing with its regulator fitting surface down, fit tilting bush of swash plate to tilting pin (531) and fit swash plate (212) to swash plate support (251) correctly.

※ Confirm with fingers of both hands that swash plate can be removed smoothly.

※ Apply grease to sliding sections of swash plate and swash plate support, and drive shaft can be fitted easily.

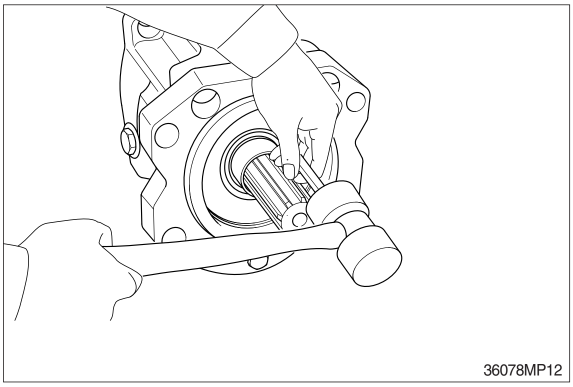


(4) To swash plate support (251), fit drive shaft (111) set with bearing (123), bearing spacer (127) and snap ring (824).

※ Do not tap drive shaft with hammer or so on.

※ Assemble them into support, tapping outer race of bearing lightly with plastic hammer.

Fit them fully, using steel bar or so on.

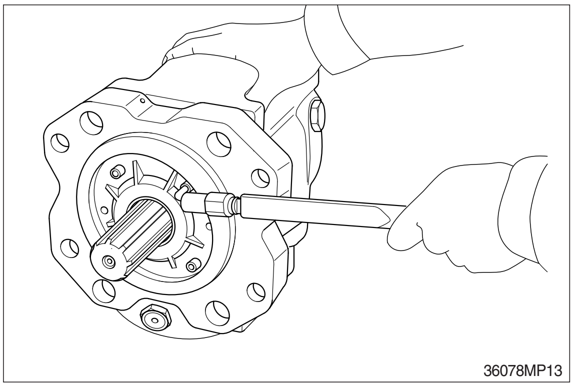


(5) Assemble seal cover (F, 261) to pump casing (271) and fix it with hexagon socket head bolts (406).

※ Apply grease lightly to oil seal in seal cover (F).

※ Assemble oil seal, taking full care not to damage it.

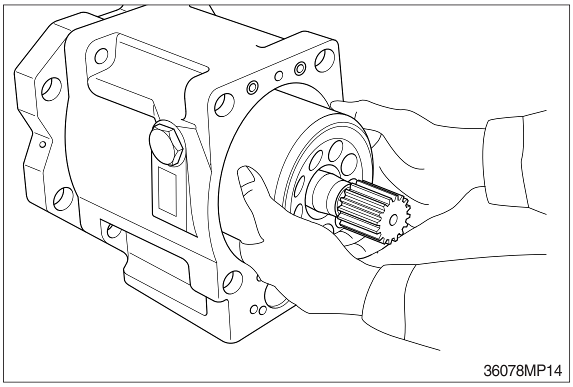
※ For tandem type pump, fit rear cover (263) and seal cover (262) similarly.



(6) Assemble piston cylinder subassembly 〔cylinder block (012), piston subassembly (151, 152), set plate (153), spherical bushing (156) and cylinder spring (157)〕.

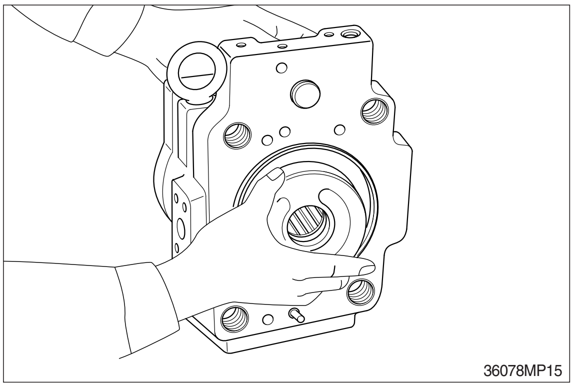
Fit spline phases of retainer and cylinder.

Then, insert piston cylinder subassembly into pump casing (271).



(7) Fit valve plate (313) to valve cover (F, 311), and fit valve plate (314) to valve cover (R, 312), entering pin into pin hole.

※ Take care not to mistake suction / delivery directions of valve plate.



36078MP15

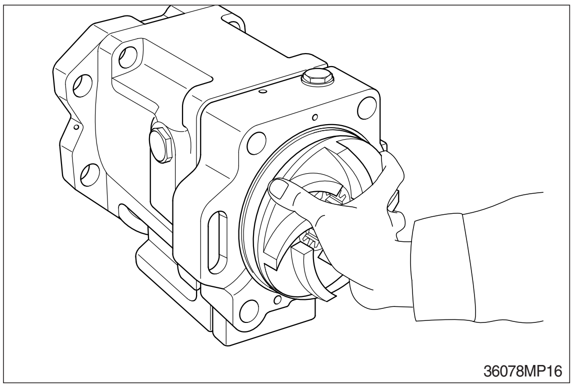
(8) Fit valve block (R, 312) to pump casing (271) and fit spline coupling (114) and booster (130) to shaft (R, 113).

※ Take care not to mistake direction of valve cover.

Fit valve cover with regulator up and with delivery flange left, viewed from front side.

※ Take care not to mistake direction of booster (130).

(refer to the sectional drawing)

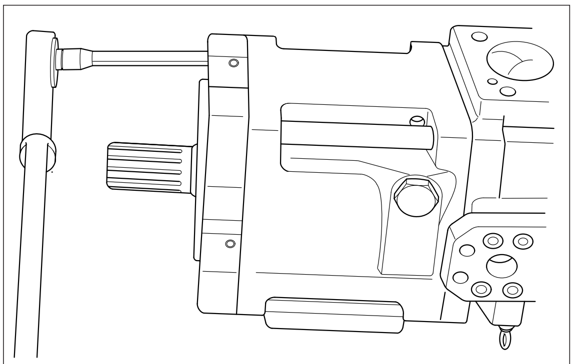


36078MP16

(9) Fit valve cover (F, 311) to valve cover (R) and tighten hexagon socket head bolts (402).

(10) Fit pump casing (271) with shaft (F, 111) to valve cover (F, 311) and tighten hexagon socket head bolts (401).

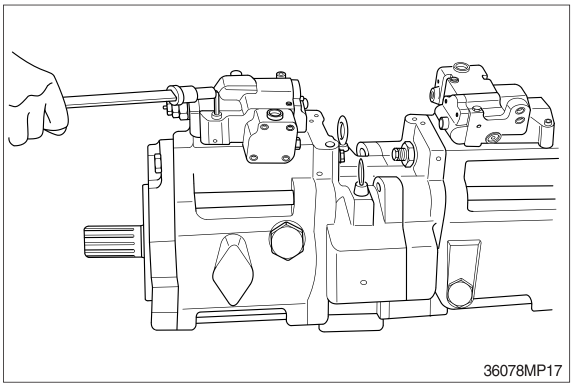
※ Mate spline phases of shaft (F) and spline coupling, with shaft (F) been rotating.



36078MP18

(11) Putting feedback pin of tilting pin into feedback lever of regulator, fit regulator and tighten hexagon socket head bolts (412,413).

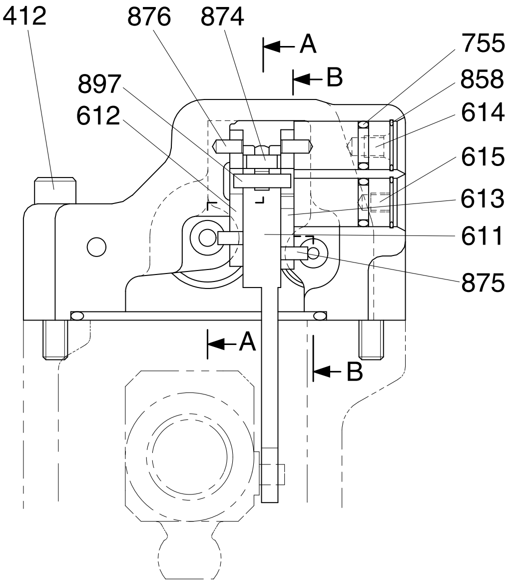
※ Take care not to mistake regulator of front pump for that of rear pump.

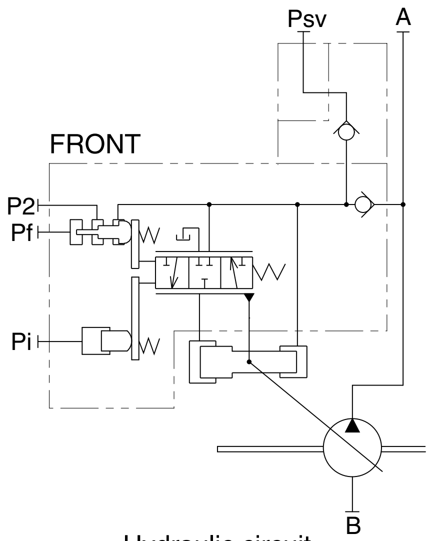


(12) Fit drain port plug (468).

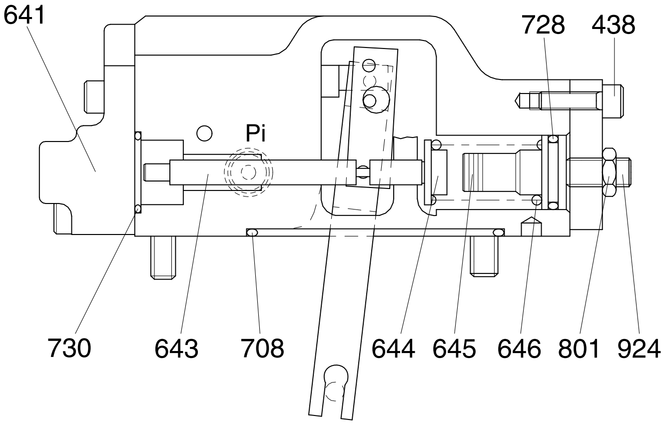
This is the end of reassembling procedures.

5) REGULATOR (1/2)

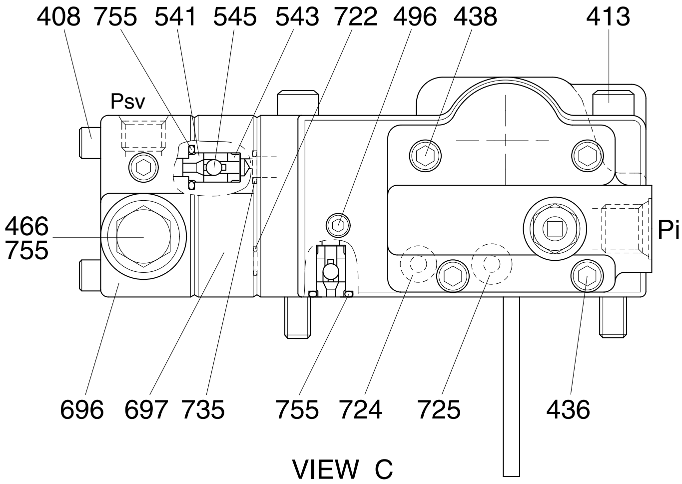




Hydraulic circuit



SECTION B-B

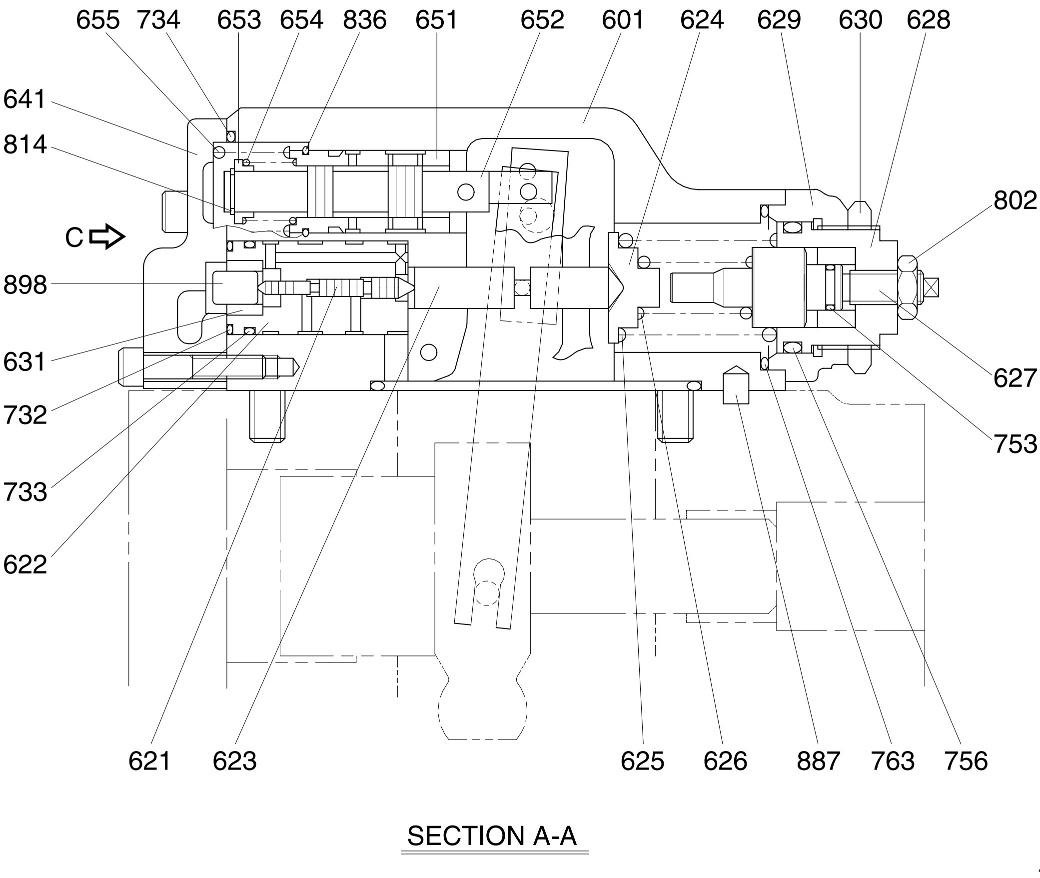


VIEW C

Port	Port name	Port size
Pi	Pilot port	PF 1/4 - 15
Psv	Servo assist port	PF 1/4 - 15
P2	Companion delivery port	-
Pf	Powershift port	-

48092RG01

REGULATOR(2/2)

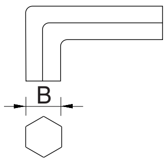
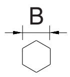


408	Hexagon socket screw	626	Inner spring	728	O-ring
412	Hexagon socket screw	627	Adjust stem (C)	730	O-ring
413	Hexagon socket screw	628	Adjust screw (C)	732	O-ring
436	Hexagon socket screw	629	Cover (C)	733	O-ring
438	Hexagon socket screw	630	Lock nut	734	O-ring
466	Plug	631	Sleeve, pf	735	O-ring
496	Plug	641	Pilot cover	753	O-ring
497	Plug	643	Pilot piston	755	O-ring
541	Seat	644	Spring seat (Q)	756	O-ring
543	Stopper	645	Adjust stem (Q)	763	O-ring
545	Steel ball	646	Pilot spring	801	Nut
601	Casing	651	Sleeve	802	Nut
611	Feed back lever	652	Spool	814	Snap ring
612	Lever (1)	653	Spring seat	836	Snap ring
613	Lever (2)	654	Return spring	858	Snap ring
614	Center plug	655	Set spring	874	Pin
615	Adjust plug	696	Port cover	875	Pin
621	Compensator piston	697	Check valve plate	876	Pin
622	Piston case	708	O-ring	887	Pin
623	Compensator rod	722	O-ring	897	Pin
624	Spring seat (C)	724	Square ring	898	Pin
625	Outer spring	725	O-ring	924	Set screw

6) 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">M 5</td><td colspan="3">BP-1/16</td><td colspan="3">-</td><td colspan="3">M 8</td></tr>
<tr><td>5</td><td colspan="3">M 6</td><td colspan="3">BP1/ 8</td><td colspan="3">-</td><td colspan="3">M10</td></tr>
<tr><td>6</td><td colspan="3">M 8</td><td colspan="3">BP-1/ 4</td><td colspan="3">PO-1/4</td><td colspan="3">M12, M14</td></tr>
<tr><td rowspan="2">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 Plut(Materal : 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 Plut(Materal : S35C)	PF 1/4	3.0	21.7	0.24	6
	PF 1/2	10.0	72.3	0.39	10
	PF 3/4	15.0	109	0.55	14
	PF 1	19.0	137	0.67	17
	PF 1 1/4	27.0	195	0.67	17
	PF 1 1/2	28.0	203	0.67	17

3) DISASSEMBLY

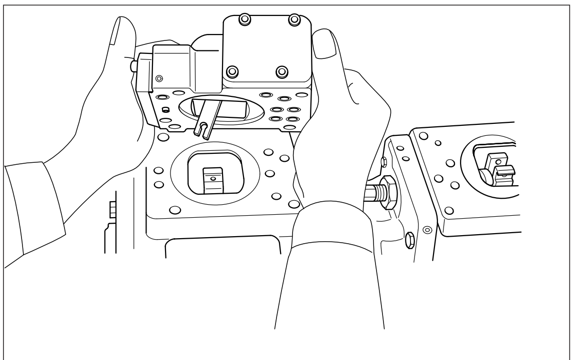
Since the regulator consists of small precision finished parts, disassembly and assembly are rather complicated.

For this reason, replacement of a regulator assembly is recommended, unless there is a special reason, but in case disassembly is necessary for an unavoidable reason, read through this manual to the end before starting disassembly.

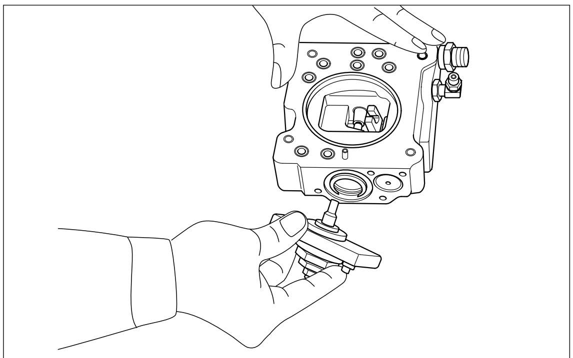
(1) Choose a place for disassembly.
※ Choose a clean place.
※ Spread rubber sheet, cloth, or so on on top of work-bench to prevent parts from being damaged.

(2) Remove dust, rust, etc. from surfaces of regulator with clean oil.

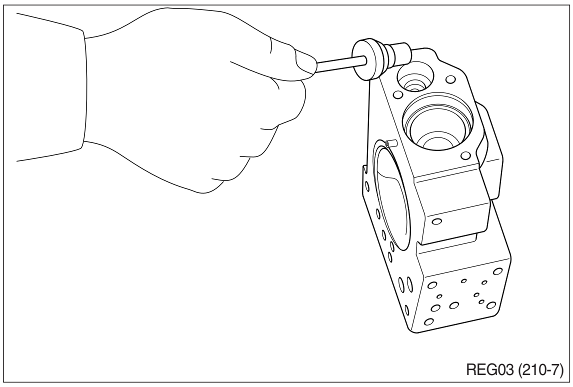
(3) Remove hexagon socket head screw (412, 413) and remove regulator main body from pump main body.
※ Take care not to lose O-ring.


REG01 (210-7)

(4) Remove hexagon socket head screw (438) and remove cover (C,629)
※ Cover (C) is fitted with adjusting screw (C,QI) (628), adjusting ring (C, 627), lock nut (630), hexagon nut (801) and adjusting screw (924).
Do not loosen these screws and nuts.
If they are loosened, adjusted pressure-flow setting will vary.

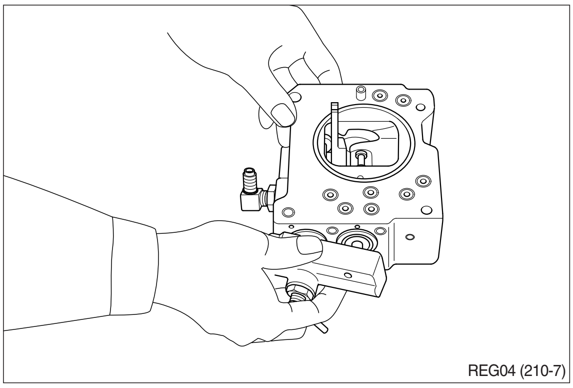

REG02 (210-7)

(5) After removing cover (C, 629) subassemb-ly, take out outer spring (625), inner spring (626) and spring seat (C, 624) from compensating section.
Then draw out adjusting ring (Q, 645), pilot spring (646) and spring seat (644) from pilot section.
※ Adjusting ring (Q,645) can easily be drawn out with M4 bolt.



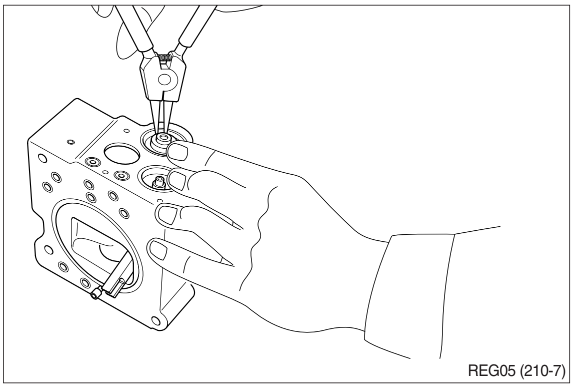
REG03 (210-7)

(6) Remove hexagon socket head screws (436, 438) and remove pilot cover (641).
After removing pilot cover, take out set spring (655) from pilot section.



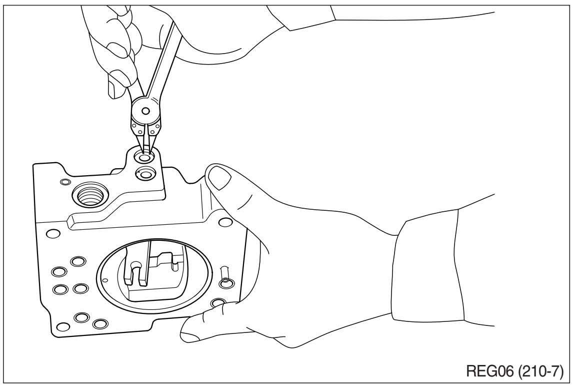
REG04 (210-7)

(7) Remove snap ring (814) and take out spring seat (653), return spring (654) and sleeve (651).
※ Sleeve (651) is fitted with snap ring (836).
※ When removing snap ring (814), return spring (654) may pop out.
Take care not to lose it.

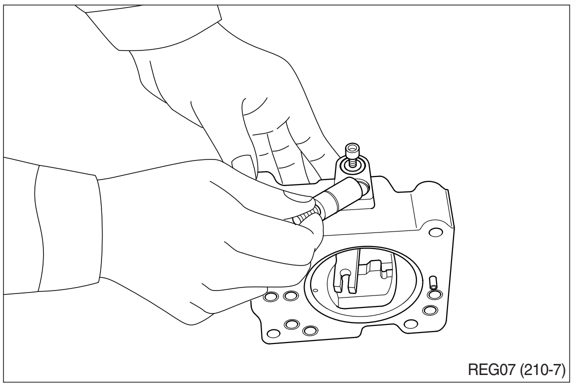


REG05 (210-7)

(8) Remove locking ring (858) and take out fulcrum plug (614) and adjusting plug (615).
※ Fulcrum plug (614) and adjusting plug (615) can easily be taken out with M6 bolt.



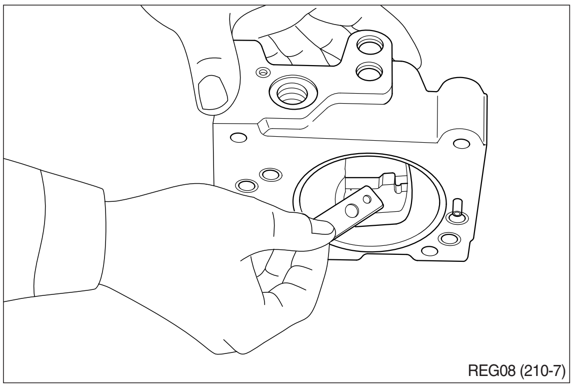
REG06 (210-7)



REG07 (210-7)

(9) Remove lever 2 (613). Do not draw out pin (875).

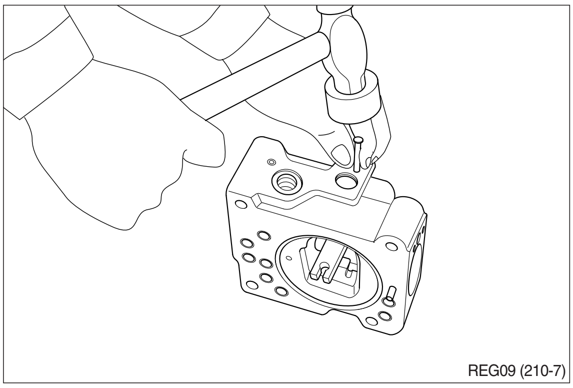
※ Work will be promoted by using pincers or so on.



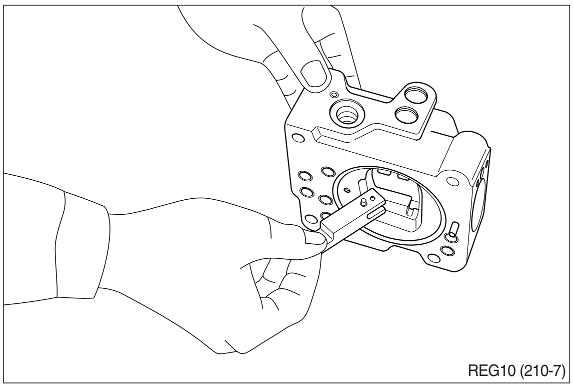
REG08 (210-7)

(10) Draw out pin (874) and remove feedback lever (611).

Push out pin (874, 4 mm in dia.) from above with slender steel bar so that it may not interfere with lever 1 (612).



REG09 (210-7)



REG10 (210-7)

(11) Remove lever (1, 612). Do not draw out pin (875).

(12) Draw out pilot piston (643) and spool (652).

(13) Draw out piston case (622), compensating piston (621) and compensating rod (623).

※ Piston case (622) can be taken out by pushing compensating rod (623) at opposite side of piston case.

This completes disassembly.

4) ASSEMBLY

(1) For assembly, reverse disassembly procedures, but pay attention to the following items.

① Always repair parts that were scored at disassembly.

② Get replacement parts ready beforehand.

Mixing of foreign matter will cause malfunction.

Therefore, wash parts well with cleaning oil, let them dry with jet air and handle them in clean place.

③ Always tighten bolts, plugs, etc. to their specified torques.

④ Do not fail to coat sliding surfaces with clean hydraulic oil before assembly.

⑤ Replace seals such as O-ring with new ones as a rule.

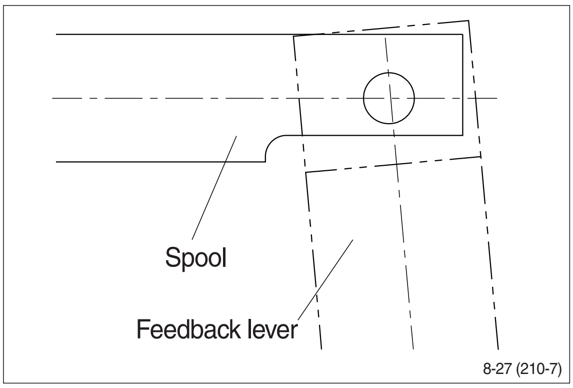
(2) Put compensating rod (623) into compensating hole of casing (601).

(3) Put pin force-fitted in lever 1 (612) into groove of compensating rod and fit lever 1 to pin force-fitted in casing.

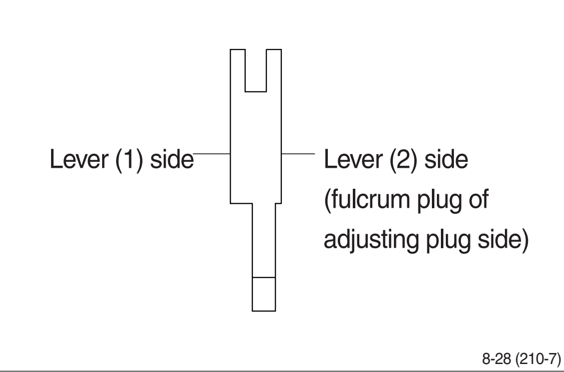
(4) Fit spool (652) and sleeve (651) into hole in spool of casing.

※ Confirm that spool and sleeve slide smoothly in casing without binding.

※ Pay attention to orientation of spool.



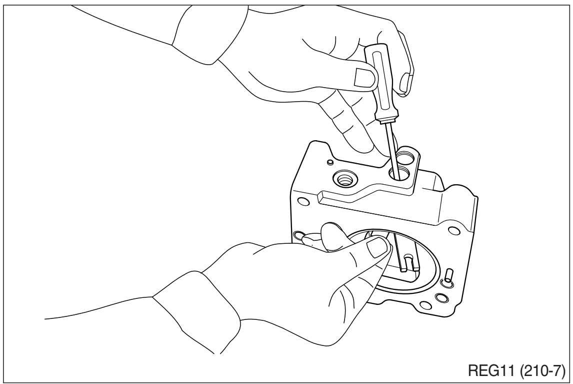
(5) Fit feedback lever (611), matching its pin hole with pin hole in spool.
Then insert pin (874).
※ Insert pin in feedback lever a little to ease operation.
※ Take care not to mistake direction of feedback lever.



8-28 (210-7)

(6) Put pilot piston (643) into pilot hole of casing.
※ Confirm that pilot piston slides smoothly without binding.

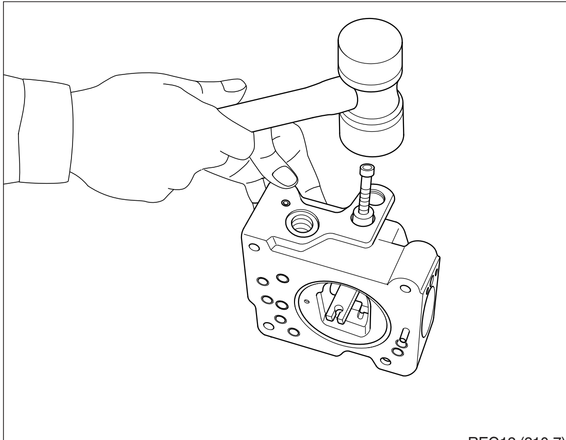
(7) Put pin force-fitted in lever 2 (613) into groove of pilot piston.
Then fix lever (2).



REG11 (210-7)

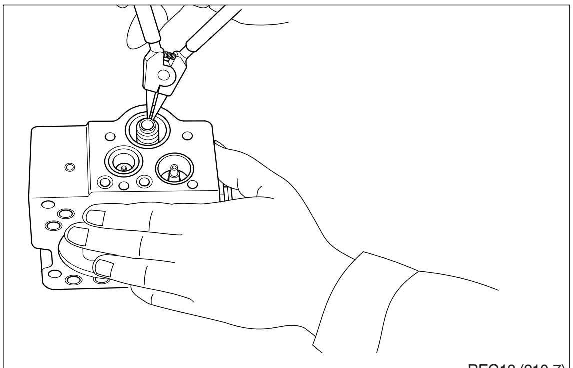
(8) Fit fulcrum plug (614) so that pin force-fitted in fulcrum plug (614) can be put into pin hole of lever 2.
Then fix locking ring (858).

(9) Insert adjusting plug (615) and fit locking ring.
※ Take care not to mistake inserting holes for fulcrum plug and adjusting plug.
At this point in time move feedback lever to confirm that it has no large play and is free from binding.



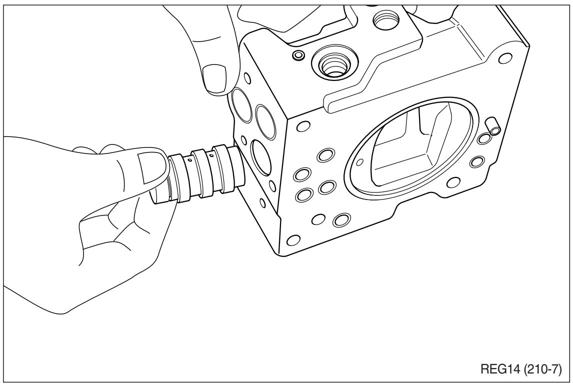
REG12 (210-7)

(10) Fit return spring (654) and spring seat (653) into spool hole and attach snap ring (814).



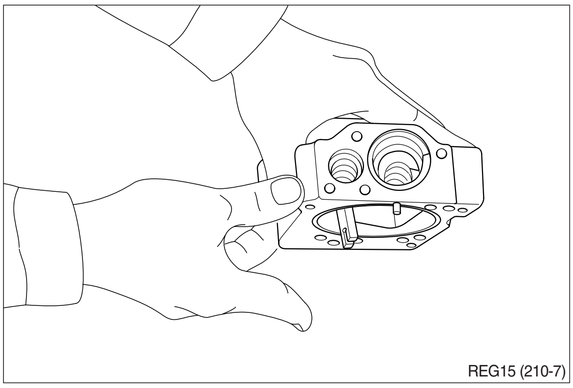
REG13 (210-7)

(11) Fit set spring (655) to spool hole and put compensating piston (621) and piston case (622) into compensating hole.
Fit pilot cover (641) and tighten it with hexagonal socket head screws (436, 438).



REG14 (210-7)

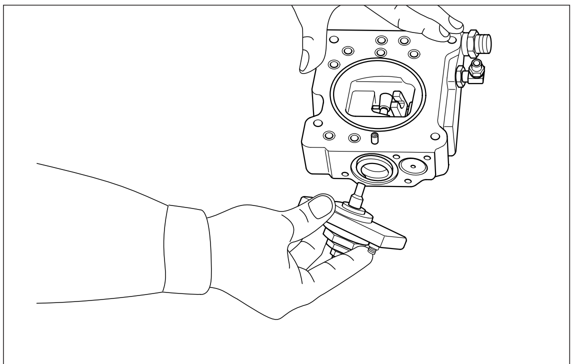
(12) Put spring seat (644), pilot spring (646) and adjusting ring (Q, 645) into pilot hole.
Then fix spring seat (624), inner spring (626) and outer spring (625) into compensating hole.
※ When fitting spring seat, take care not to mistake direction of spring seat.



REG15 (210-7)

(13) Install cover (C, 629) fitted with adjusting screws (628, 925), adjusting ring (C, 627), lock nut (630), hexagon nut (802) and adjusting screw (924).
Then tighten them with hexagonal socket head screws (438).

This completes assembly.



REG16 (210-7)

GROUP 4 MAIN CONTROL VALVE

1. REMOVAL AND INSTALL

1) REMOVAL

(1) Lower the work equipment to the ground and stop the engine.

(2) Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

(3) Loosen the breather slowly to release the pressure inside the hydraulic tank.

⚠ **Escaping fluid under pressure can penetrate the skin causing serious injury.**

※ When pipes and hoses are disconnected, the oil inside the piping will flow out, so catch it in oil pan.

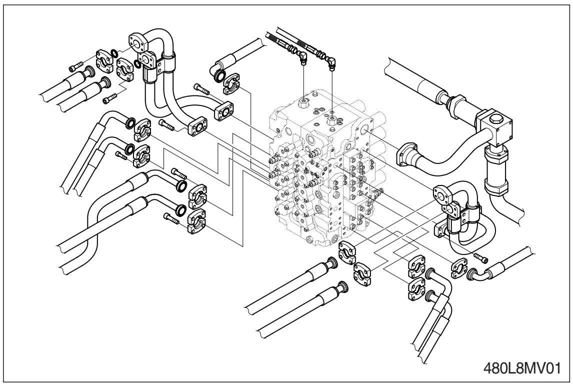
13031GE18

(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.

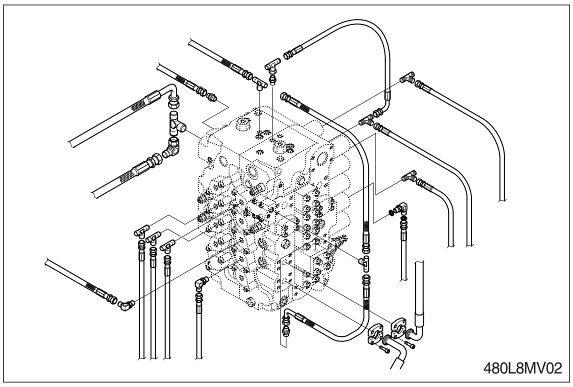


480L8MV01

(8) Sling the control valve assembly and remove the control valve mounting bolt.

 · Weight : 420 kg (930 lb)

(9) Remove the control valve assembly. When removing the control valve assembly, check that all the piping have been disconnected.



480L8MV02

2) INSTALL

(1) Carry out installation in the reverse order to removal.

(2) Bleed the air from below items.

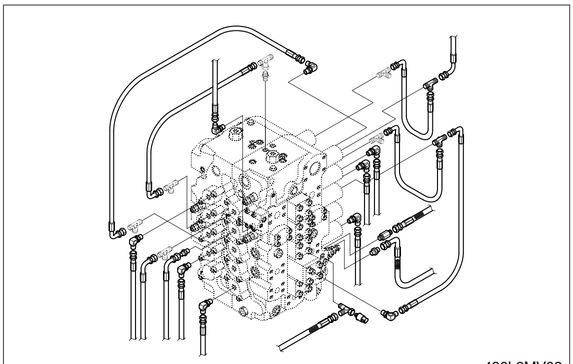
① Cylinder (boom, arm, bucket)

② Swing motor

③ Travel motor

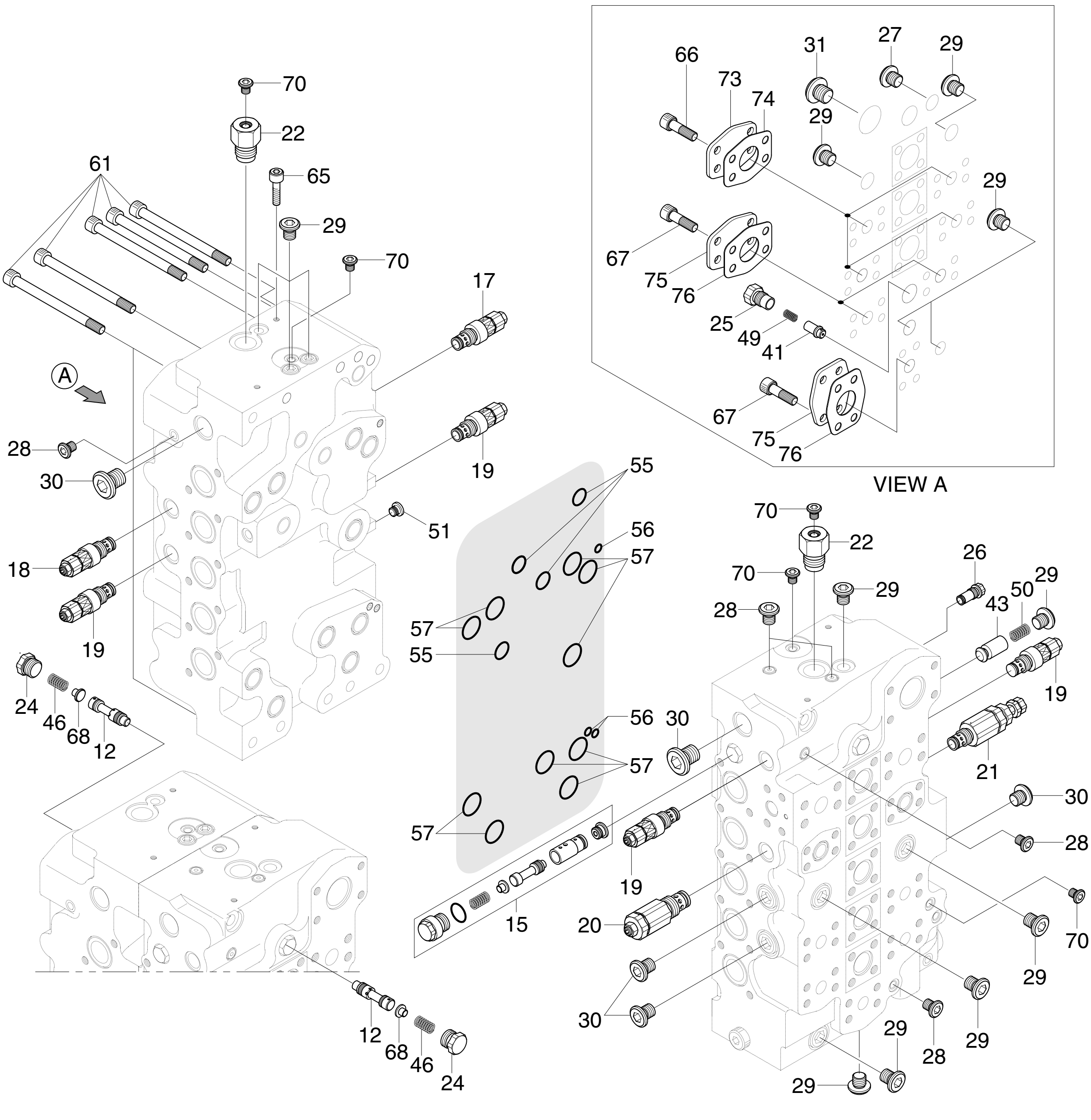
※ See each item removal and install.

(3) Confirm the hydraulic oil level and recheck the hydraulic oil leak or not.



480L8MV03

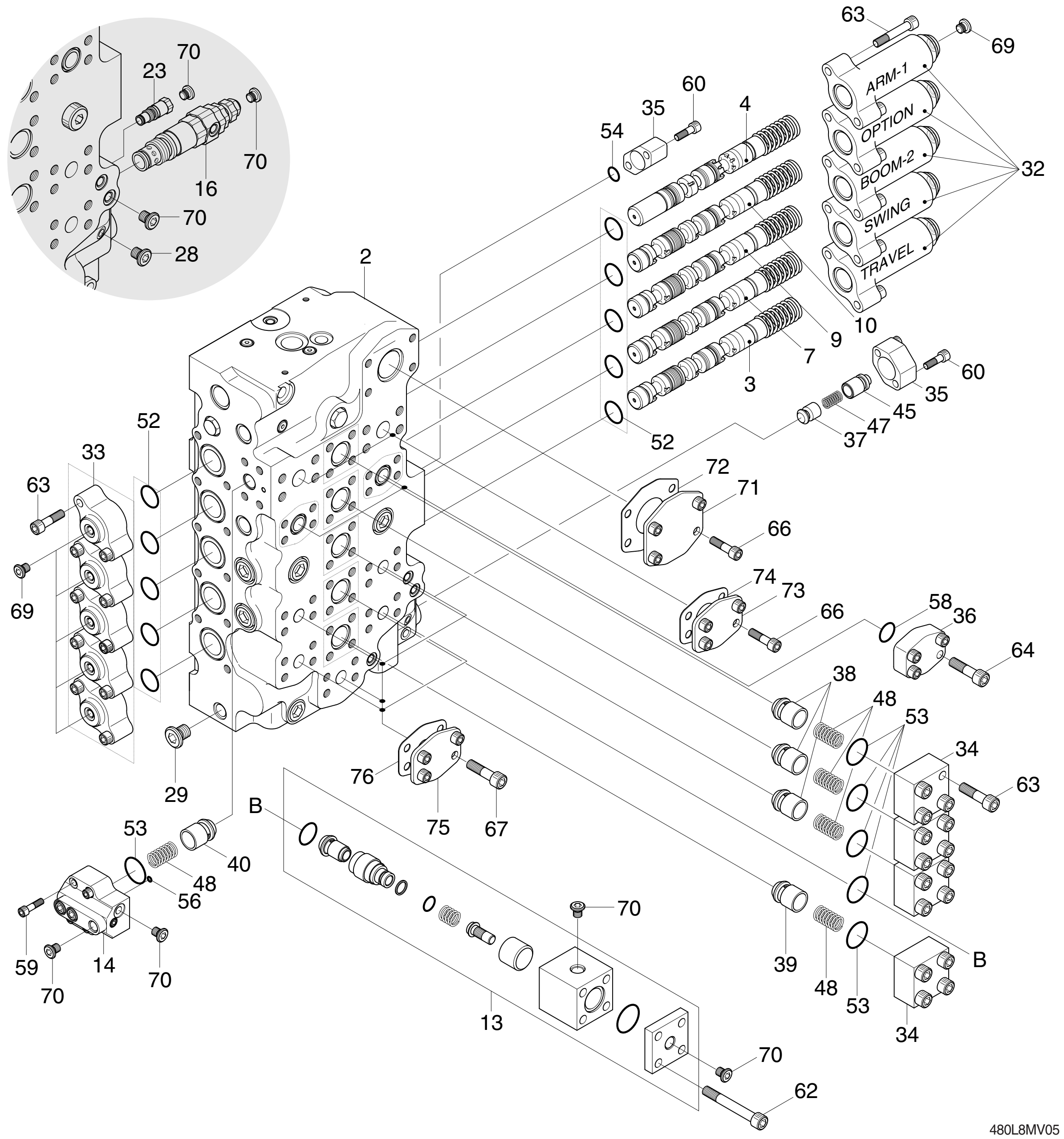
2. STRUCTURE (1/3)



480L8MV04

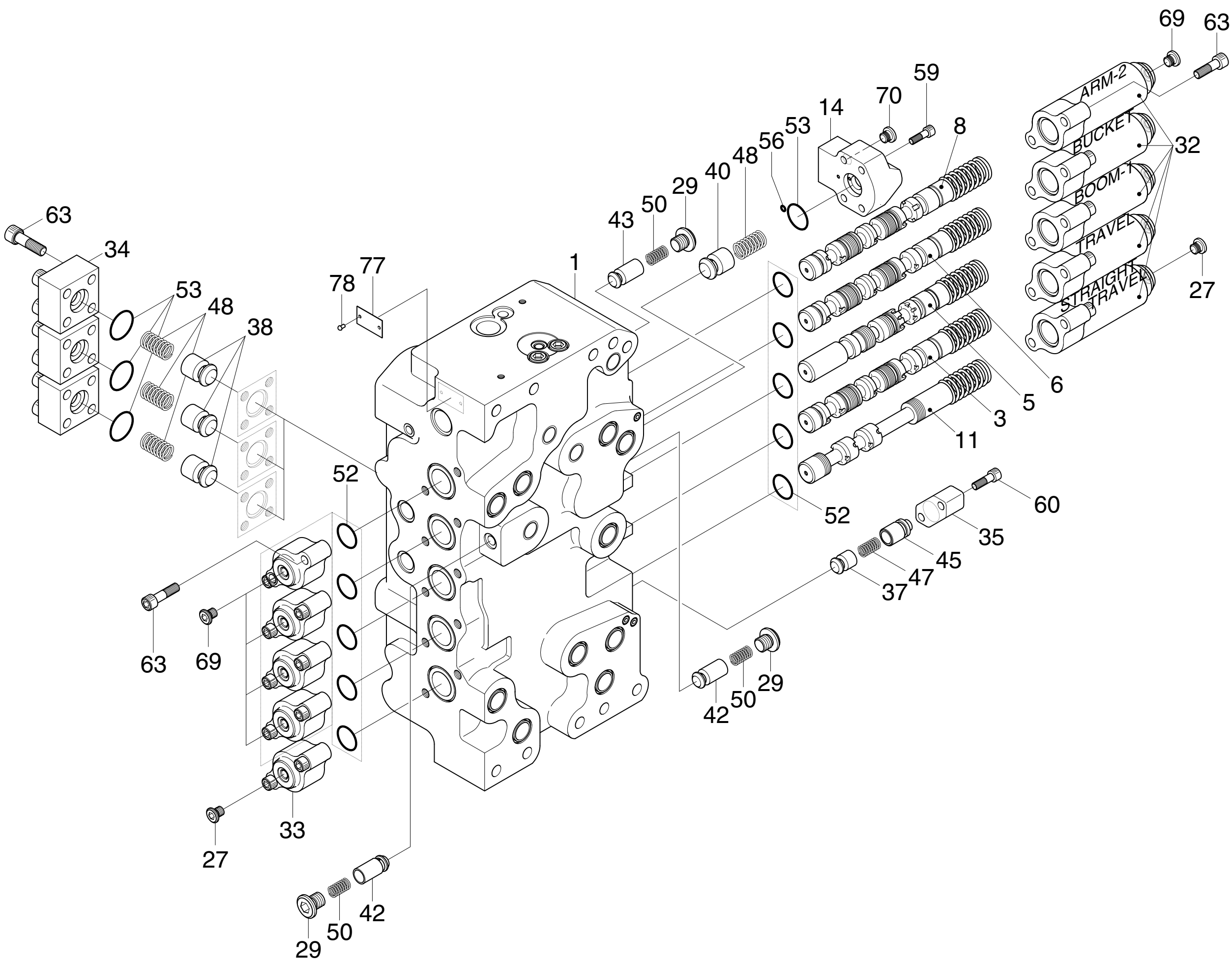
12	Spool assy	28	Plug	57	O-ring
15	Arm regen cut assy	29	Plug	61	Socket bolt
17	Port relief valve	30	Plug	65	Socket bolt
18	Port relief valve	31	Plug	66	Socket bolt
19	Port relief valve	41	Poppet	67	Socket bolt
20	Port relief valve	43	Poppet	68	Spring seat
21	Port relief valve	46	Spring	70	Dust cap
22	Relief valve	49	Spring	73	Cover
24	Plug assy	50	Spring	74	Gasket
25	Plug	51	Plug	75	Cover
26	Plug	55	O-ring	76	Gasket
27	Plug	56	O-ring		

STRUCTURE (2/3)



2	Housing	35	Flange	60	Socket bolt
3	Travel spool assy	36	Flange	62	Socket bolt
4	Arm 1 spool assy	37	Poppet	63	Socket bolt
7	Swing spool assy	38	Poppet	64	Socket bolt
9	Boom 2 spool assy	39	Poppet	66	Socket bolt
10	Option spool assy	40	Poppet	67	Socket bolt
13	Swing logic valve	45	Spacer	69	Dust cap
14	Holding valve	47	Spring	70	Dust cap
16	Main relief valve	48	Spring	71	Cover
23	Plug assy	52	O-ring	72	Gasket
28	Plug	53	O-ring	73	Cover
29	Plug	54	O-ring	74	Gasket
32	Pilot cap-large	56	O-ring	75	Cover
33	Pilot cap-small	58	O-ring	76	Gasket
34	Flange	59	Socket bolt		

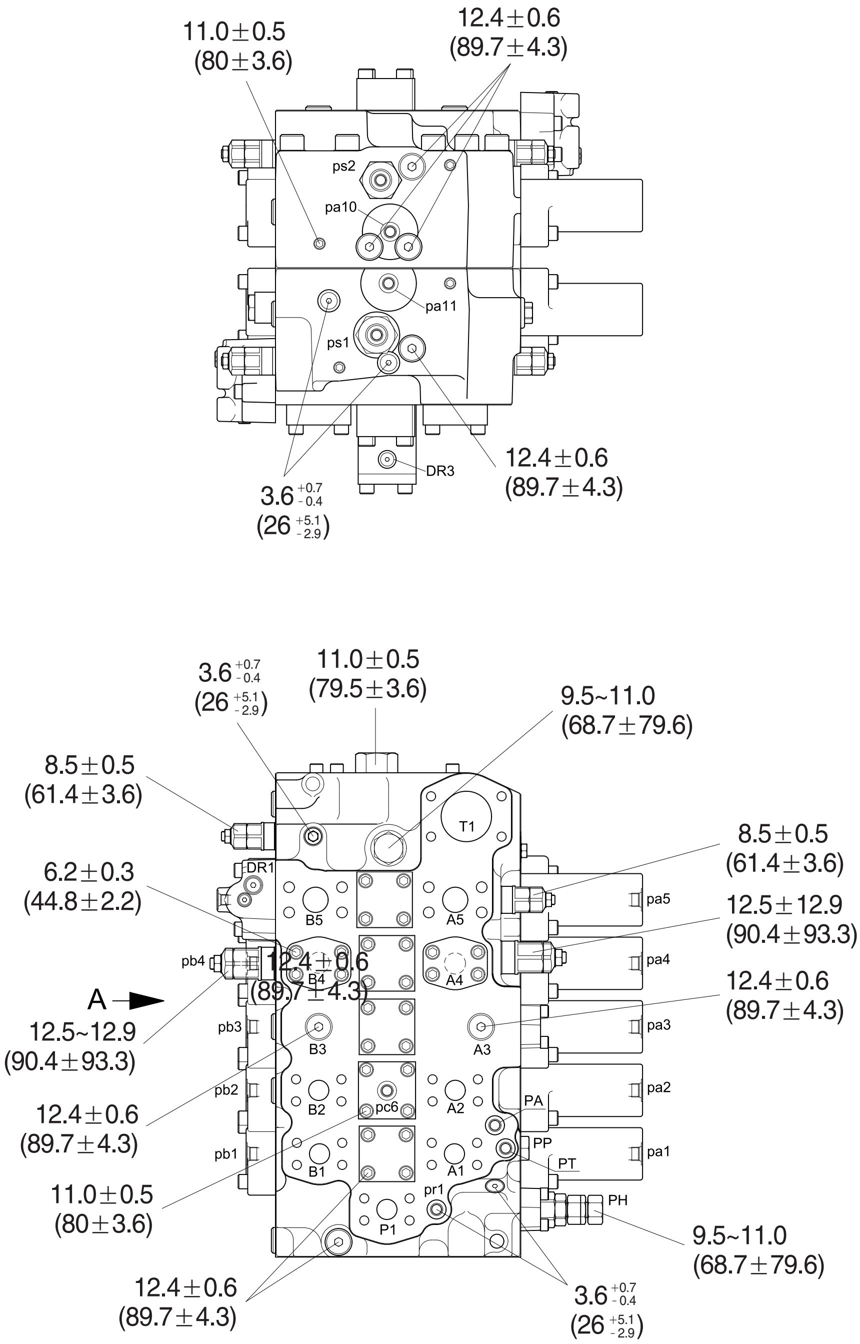
STRUCTURE (3/3)



1	Housing	34	Flange	52	O-ring
3	Travel spool assy	35	Flange	53	O-ring
5	Boom 1 spool assy	37	Poppet	56	O-ring
6	Bucket spool assy	38	Poppet	59	Socket bolt
8	Arm 2 spool assy	40	Poppet	60	Socket bolt
11	Straight travel spool assy	42	Poppet	63	Socket bolt
14	Holding valve	43	Poppet	69	Dust cap
27	Plug	45	Spacer	70	Dust cap
29	Plug	47	Spring	77	Name plate
32	Pilot cap-large	48	Spring	78	Rivet
33	Pilot cap-small	50	Spring		

3. TIGHTENING TORQUE (1/2)

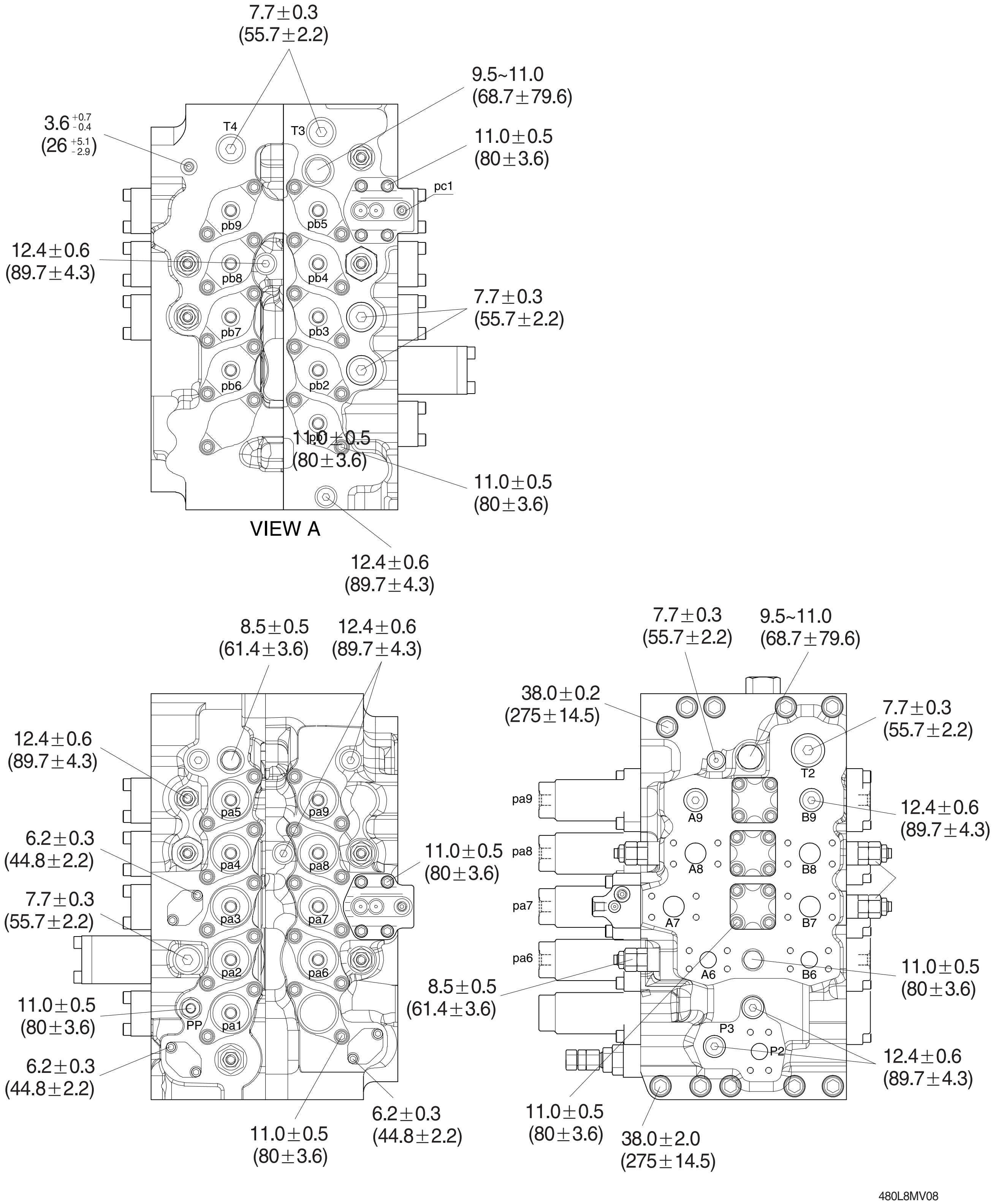
※ Unit : kgf · m (lbf · ft)



480L8MV07

TIGHTENING TORQUE (2/2)

※ Unit : kgf · m (lbf · ft)



4. DISASSEMBLY AND ASSEMBLY

1) GENERAL PRECAUTIONS

(1) All hydraulic components are manufactured to a high precision. Consequently, before disassembling and assembling them, it is essential to select an especially clean place.

(2) In handling a control valve, pay full attention to prevent dust, sand, etc. from entering into it.

(3) When a control valve is to be remove from the machine, apply caps and masking seals to all ports. Before disassembling the valve, recheck that these caps and masking seals are fitted completely, and then clean the outside of the assembly. Use a proper bench for working. Spread paper or a rubber mat on the bench, and disassemble the valve on it.

(4) Support the body section carefully when carrying or transferring the control valve. Do not lift by the exposed spool, end cover section etc.

(5) After disassembling and assembling of the component it is desired to carry out various tests (for the relief characteristics, leakage, flow resistance, etc.), but the hydraulic test equipment is necessary for these tests. Therefore, even when its disassembling can be carried out technically, do not disassemble such components that cannot be tested, adjusted, and so on. Additionally one should always prepare clean cleaning oil, hydraulic oil, grease, etc. beforehand.

2) DISASSEMBLY

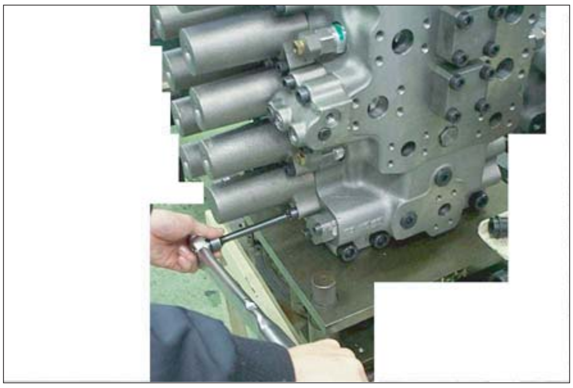
The figure in ( ) shown after the part name in explanation sentence shows its number in the construction figures.

(1) Place control valve on working bench

※ Disassemble the valve in a clean and dry environment and pay careful attention not to damage the sealing flange faces.

(2) Main spool

① Loosen socket head bolts (63) and remove the pilot cap (32).
Pull out O-ring (52) from valve housing.



45078MC07

② Remove all spool (3~11) of subassembly itself from valve housing.

※ Be careful not to be damaged while pulling out spools. Identify them with a tag to prevent from being mistaken at disassembly.

45078MC08

③ Spools sub assy (3, 4, 5, 6, 7, 8, 9, 10, 11).

45078MC10

④ Spool sub assy (5).

45078MC11

⑤ Spool sub assy (4).

※ When disassemble the spool assembly, fix the spool with vise. On this occasion attach wood between vise blades to prevent the spool from damaging.

※ Heat the outer race of spool with industrial drier and then loosen easily. (Temperature : 200~250˚C)

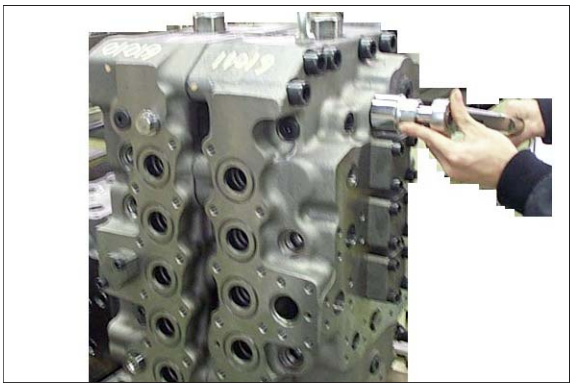
45078MC12

⑥ Loosen the socket head bolt (63) and remove the small pilot cap (33).
Pull out O-ring (14) from valve housing.

45078MC09

(3) Center bypass cut spool assy (12)

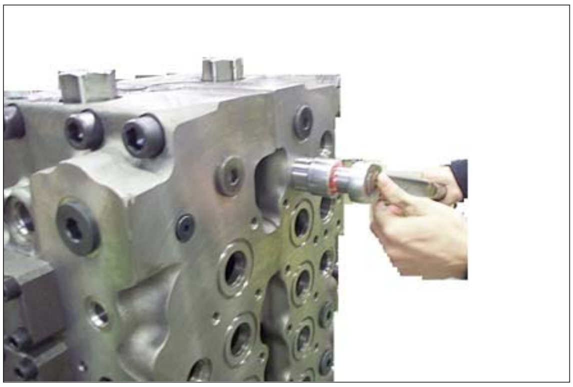
① Loosen the plug (24) and remove spring (46), spring seat (68) and the spool (12).



45078MC13

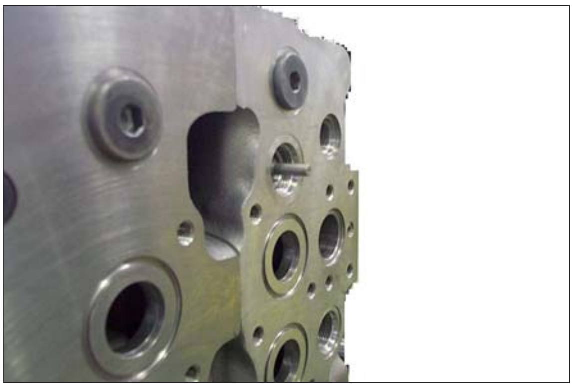
(4) Arm1 regeneration spool assy (15)

① Loosen the plug and pull out O-ring.



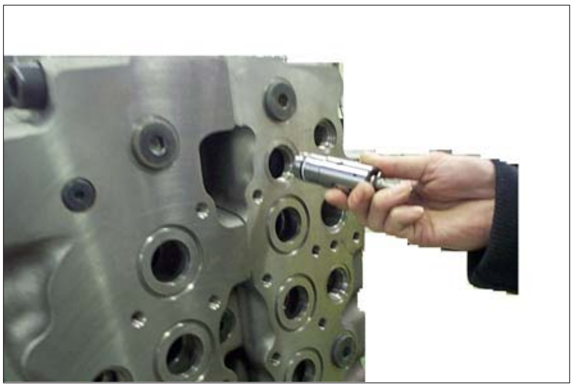
45078MC15

② Disassemble spring, spring seat and spool.



45078MC16

③ Pull out sleeve of hole inside at same time, disassemble sleeve and piston.



45078MC18

(5) General precautions

Clean all disassembled parts with clean mineral oil fully, and dry them with compressed air. Then, place them on clean papers or cloths for inspection.

① Control valve

a. Check whole surfaces of all parts for burrs, scratches, notches and other defects.

b. Confirm that seal groove faces of casing and block are smooth and free of dust, dent, rust etc.

c. Correct dents and damages and check seat faces within the casing, if any, by lapping.

※ Pay careful attention not to leave any lapping agent within the casing.

d. Confirm that all sliding and fitting parts can be moved manually and that all grooves and paths are free from foreign matter.

e. If any spring is broken or deformed, replace it with new one.

f. When a relief valve does not function properly, repair it, following the prescribed disassembly and assembly procedures.

g. Replace all seals and O-rings with new ones.

② Relief valve

a. Confirm that all seat faces at ends of all poppets and seats are free of defects and show uniform and consistent contact faces.

b. Confirm manually that main poppet and seat can slide lightly and smoothly.

c. Confirm that outside face of main poppet and inside face of seat are free from scratches and so on.

d. Confirm that springs are free from breakage, deformation, and wear.

e. Confirm that orifices of main poppet and seat section are not clogged with foreign matter.

f. Replace all O-rings with new ones.

g. When any light damage is found in above inspections, correct it by lapping.

h. When any abnormal part is found, replace it with a completely new relief valve assembly.

3) ASSEMBLY

(1) General comments

① In this assembly section, explanation only is shown.
For further understanding, please refer to the figures and photographs shown in the previous disassembly section.

② Figure in ( ) shown after the part name in the explanation refers to the reference identity number shown on the construction figure shown in the spares section.

③ Cautions in assembling seal

a. Pay close attention to keeping all seals free from handling damage and inspect carefully for damage before using them.

b. Apply clean grease or hydraulic oil to the seal so as to ensure it is fully lubricated before assembly.

c. Do not stretch seals so much as to deform them permanently.

d. In fitting O-rings, pay close attention not to roll them into their final position in addition, a twisted O-ring cannot easily untwist itself naturally and could thereby cause inadequate sealing and thereby both internal and external oil leakage.

e. Tighten fitting bolts for all sections with a torque wrench adjusted to the respective tightening torque as shown on the corss section drawings of the spares section.

(2) Main spool

① Apply loctite to thread of spools (3, 4, 5, 6, 7, 8, 9, 10, 11) and assemble spring seat, spring and spool end. Assemble spool end to spool after fixing spool with a vise attached wood.

※ Be careful not to applying loctite too much.

· Tightening torque : 2.5 ~ 2.7 kgf · m (18.1 ~ 19.5 lbf · ft)

Fit O-ring into housing and assemble spools (3, 4, 5, 6, 7, 8, 9, 10, 11) into housing.

Assemble lock cap on housing and tighten hex socket bolt.

· Tightening torque : 11±0.5 kgf · m (79.7±3.7 lbf · ft)

② Insert poppet, spring into spool (5) and then apply loctite to thread of spool.

Fit O-ring and backup ring on the plug and then tighten plug.

Assemble spring seat, spring, and spool end and then assemble spool end sub assy to spool after fixing spool with a vise attached wood.

· Tightening torque : 2.5 ~ 2.7 kgf · m (18.1 ~ 19.5 lbf · ft)

Fit O-ring into housing and assemble spool (5) into housing.

Assemble lock cap on housing and tighten hex socket bolt.

· Tightening torque : 11±0.5 kgf · m (79.7±3.7 lbf · ft)

③ Insert poppet, spring into spool (4) and then apply loctite to thread for spool.

Fit O-ring and backup ring on the plug and then tighten plug.

Assemble spring seat, spring, and spool end and then assemble spool end sub assy to spool after fixing spool with a vise attached wood.

· Tightening torque : 2.5 ~ 2.7 kgf · m (18.1 ~ 19.5 lbf · ft)

Fit O-ring into housing and assemble spool (4) into housing.

Assemble lock cap on housing and tighten hex socket bolt.

· Tightening torque : 2.5±2.7 kgf · m (18.1±19.5 lbf · ft)

④ Assemble short cap on housing and tighten hex socket bolt.

· Tightening torque : 11±0.5 kgf · m (79.7±3.7 lbf · ft)

(3) Center bypass cut spool assy (12)

① Apply loctite to thread of spool, assemble spool end to spool.
※ Be careful not to appling loctite too much.
② Assemble spool assy, spring seat, spring and tighten plug with O-ring.
· Tightening torque : 9.5 ~ 11.0 kgf · m (68.6 ~ 79.7 lbf · ft)

(4) Arm1 regeneration spool assy (15)

① Assemble backup rings and O-rings to sleeve respectively.
② Assemble piston to sleeve which seal is assemble, and insert spool into sleeve.
③ Assemble spool assy, spring seat, spring and tighten plug with O-ring.
· Tightening torque : 9.5 ~ 11.0 kgf · m (68.6 ~ 79.7 lbf · ft)

GROUP 5 SWING DEVICE

1. REMOVAL AND INSTALL OF MOTOR

1) REMOVAL

(1) Lower the work equipment to the ground and stop the engine.

(2) Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

(3) Loosen the breather slowly to release the pressure inside the hydraulic tank.

⚠ **Escaping fluid under pressure can penetrate the skin causing serious injury.**

※ When pipes and hoses are disconnected, the oil inside the piping will flow out, so catch it in oil pan.

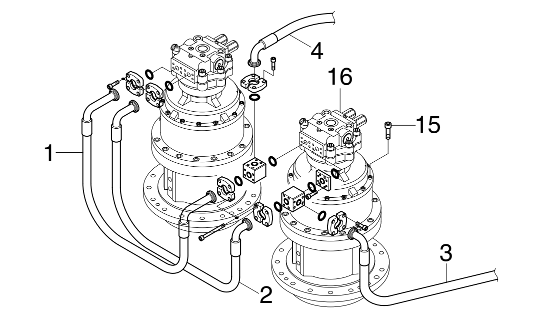

13031GE18

(4) Disconnect hose assembly (1, 2, 3, 4).

(5) Disconnect pilot line hoses (5, 6, 7, 8, 9, 10, 11, 12, 13, 14).

(6) Sling the swing motor assembly (16) and remove the swing motor mounting socket bolts (15).

· Motor device weight : 61 ㎏ (135 ℔)



480L8SM01

(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.

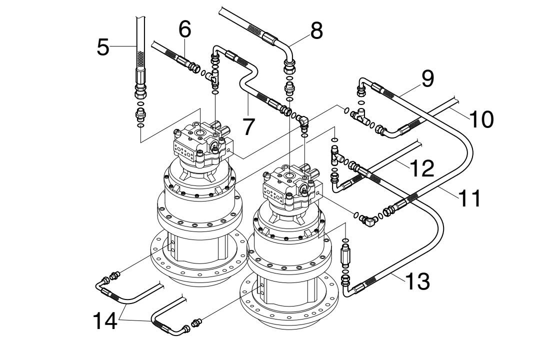
① Remove the air vent plug.

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.

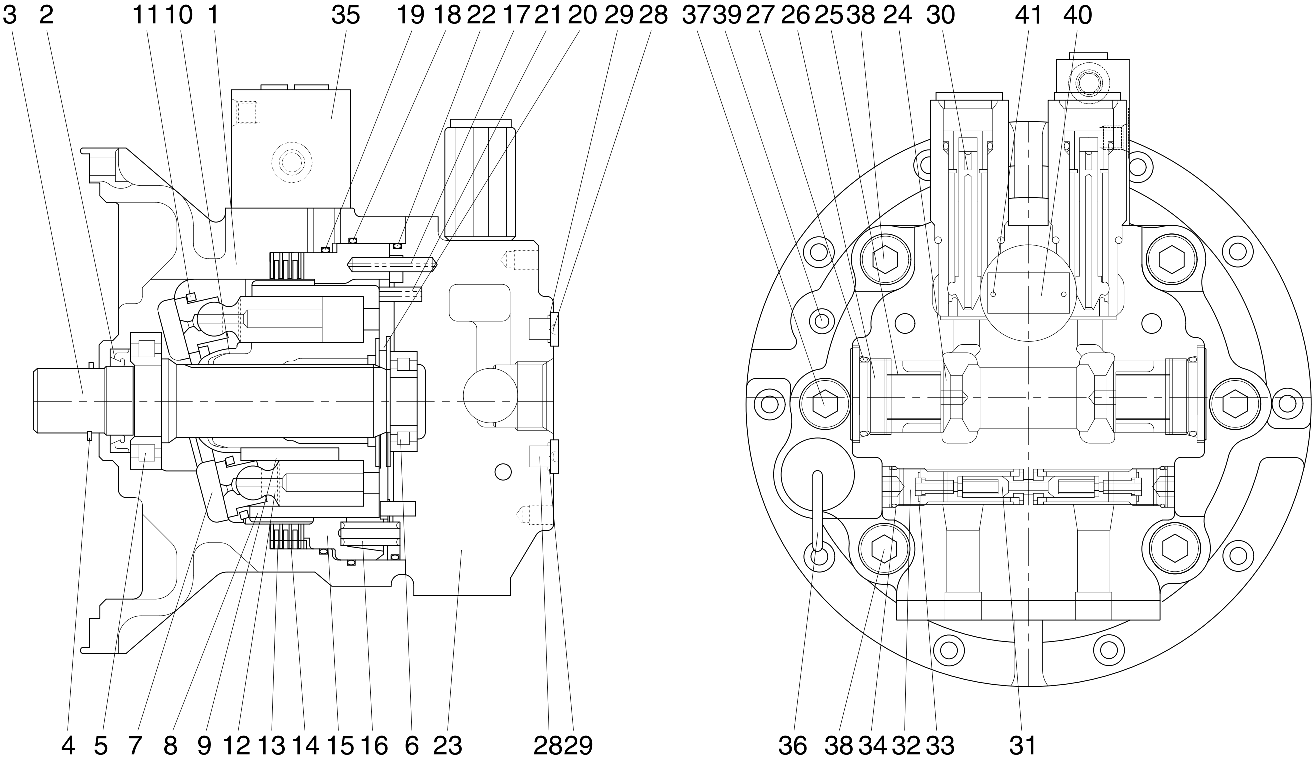


480L8SM02

(3) Confirm the hydraulic oil level and check the hydraulic oil leak or not.

2. DISASSEMBLY AND ASSEMBLY OF SWING MOTOR

1) STRUCTURE



480F2SM02

1	Casing	15	Parking piston	29	O-ring
2	Oil seal	16	Spring	30	Relief valve assy
3	Shaft	17	Spring pin	31	Anti-rotating valve assy
4	Snap ring	18	O-ring	32	Plug
5	Cylinder roller bearing	19	O-ring	33	O-ring
6	Cylinder roller bearing	20	Valve plate	34	O-ring
7	Swash plate	21	Spring pin	35	Time delay valve assy
8	Cylinder block	22	O-ring	36	Level gauge assy
9	Spring	23	Valve casing	37	Hexagon socket head bolt
10	Ball guide	24	Check valve	38	Hexagon socket head bolt
11	Retainer plate	25	Spring	39	Plug
12	Piston assy	26	Plug	40	Name plate
13	Friction plate	27	O-ring	41	Rivet
14	Separate plate	28	Plug		

2) DISASSEMBLING

(1) Disassembly the sub of a turning axis

① Unloosing wrench bolt and disassemble time delay valve assy (35) from casing (1).

480L2SM10

② Disassemble level gauge (36) from casing (1).

480L2SM11

③ Hang buckles on valve casing (23) and unloose the bolt-hex (37, 38) from casing (1).

480L2SM12

④ Take springs (16) out of parking piston (15) and disassemble a parking piston (15) from casing (1) using a jig.

480L2SM13

⑤ Take cylinder block sub assy (8), friction plates (13), seperated plates (14) out of casing (1) in order.

480L2SM14

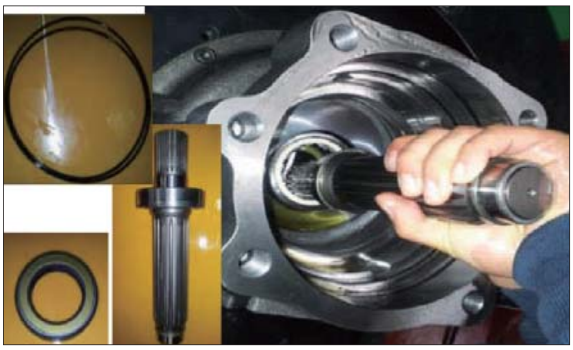
⑥ Disassemble swash plate (7) from casing (1).

480L2SM15

⑦ Using a pair of pliers, take snap-ring out of casing (1).

480L2SM16

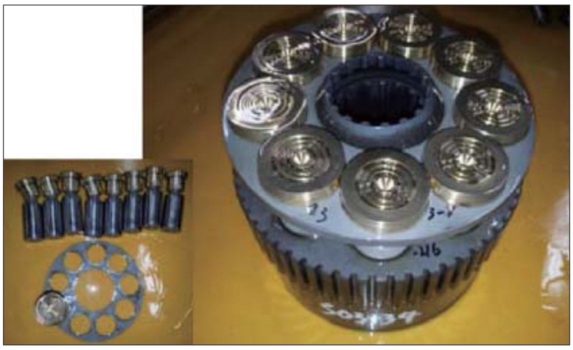
⑧ Disassemble shaft sub assy (3), oil seal (2), O-rings (18, 22) from casing (1).



480L2SM17

(2) Disassemble cylinder block assy

① Disassemble pistion assy (12) from cylinder block assy (8).

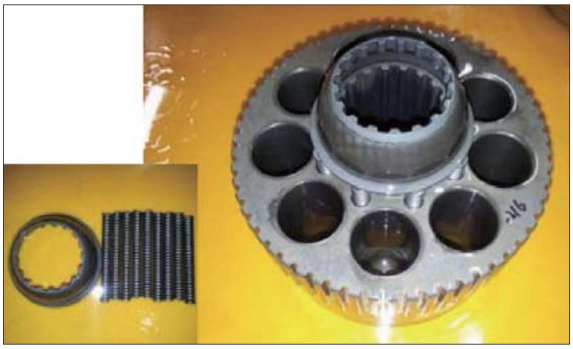


480L2SM18

② Disassemble ball guide (10) and springs (9) (cylinder block) from cylinder block assy (8).

· Ball guide × 1EA

· Spring × 9EA



480L2SM19

(3) Disassemble valve casing assy

① Take pin spring (17, 21), valve plate (20), O-ring (22) out of valve casing (23) in order.

480L2SM20

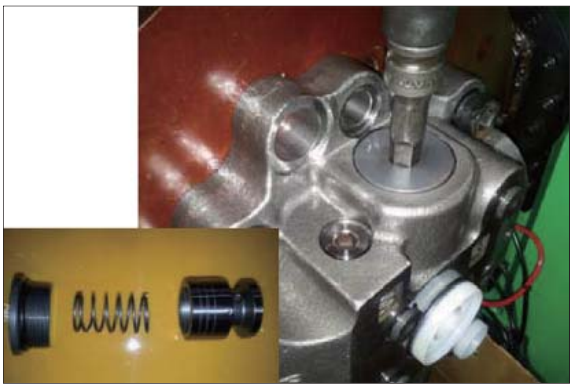
② Using a torque wrench, disassemble relief valve (30) from valve casing (23).

480L2SM21

③ Disassemble plug (32), O-rings (33, 34) and anti-rotating valves (31) from valve casing (23) in order with torque wrench.

480L2SM22

④ Disassemble plug (26), O-rings (27) and check valve (24) from casing in order with torque wrench.



480L2SM23

⑤ Disassemble plug (28), O-ring (29) from valve casing (23).

480L2SM24

3) ASSEMBLING

(1) Assemble the sub of a shaft assy

① Put bearing-cylinder roller on heating conveyor, inner bearings is being heated around 5 min (Temperature on conveyor : 120˚C, 3~5 min)

480L2SM25

② Using robot M/C, heated inner bearing is assembled on shaft with pressure.

480L2SM26

(2) Assemble the sub of cylinder block assy

① Put springs (9, cylinder block) on holes of cylinder block.

· Spring × 9EA

480L2SM27

② Put ball guide (10) on cylinder block (8).

· Ball guide × 1EA

480L2SM28

③ Assemble piston assy (12) with retainer plate (11).
- Piston assy × 9EA
- Retainer plate × 1EA

480L2SM29

④ Put ② and ③ together as one.

480L2SM30

(3) Assemble the sub of valve casing assy

① Assemble the sub of check valve assy.
Assemble check valve (24), spring (25), O-ring (27), and plug (26) into valve casing (23) in order.
- Check valve (24) × 2EA
- Spring (25) × 2EA
- Plug (26) × 2EA
- O-ring (27) × 2EA

480L2SM31

② Assemble the sub of anti-rotating valve assy.
Assemble anti-rotating valve (31), O-ring (33, 34), and plug (32) into valve casing (23) in order.
- Anti-rotating valve assy (31) × 2EA
- Plug (32) × 2EA
- O-ring (33, 34) × 2EA

480L2SM32

③ Assemble relief valve assy (30) 2set into valve casing (23) with torque wrench (bilateral symmetry assembling).
  · Relief valve assy (30) × 2EA


480L2SM33

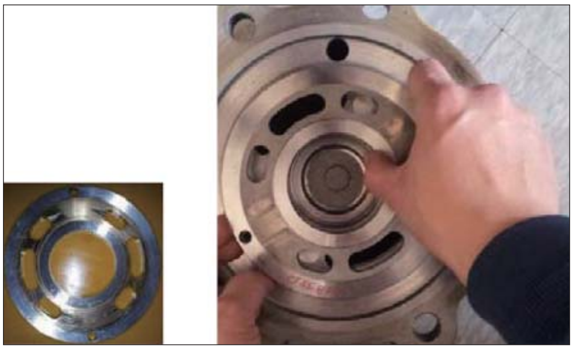
④ Assemble plug (28) and O-ring (23) into valve casing with a torque wrench.
  · Plug (28) × 3EA
  · O-ring (27) × 3EA


480L2SM34

⑤ After assembling needle bearing (6) into valve casing, assemble pin spring (17, 21).
  · Needle bearing (6) × 1EA
  · Pin spring (17, 21) × 1EA


480L2SM35

⑥ After applying grease on valve plate (20), attach it to valve casing (23).
  · Valve plate (20) × 1EA


480L2SM36

(4) Assemble the sub of moving axis

① Using jig and compressing tool, assemble oil seal into casing.
 · Oil seal (2) × 1EA

480L2SM37

② Insert above shaft sub into casing (1) and assemble it with a jig.

480L2SM38

③ Fix snap ring (4) to shaft with a pair of plier jig.
 · Snap ring × 1EA

480L2SM39

④ Apply grease on swash plate (7) and assemble it on the casing.
 · Swash plate × 1EA

480L2SM40

⑤ Put O-ring (18, 19) into a casing.
· O-ring (18) × 1EA
· O-ring (19) × 1EA

480L2SM41

⑥ Insert cylinder block assy (8) into casing (1).

480L2SM42

⑦ After assemble 4 set of seperated plates (14), friction plate (13) step by step into casing, put parking piston (15) with compressing tool.
· Seperated plate × 4EA
· Friction plate × 4EA
· Parking piston × 1EA

480L2SM43

⑧ After putting grease on contact surface of spring, assemble spring (16) into parking piston (15).
· Spring × 26EA

480L2SM44

⑨ After hang valve casing (23) on hook, assemble it on casing (1) gently, then , tighten hex bolt (37, 38) tightly.

480L2SM45

⑩ Assemble level gauge assy (36) and plug (39) into casing (1).

480L2SM46

⑪ After assembling time delay valve assy (35) into valve casing (23), tighten hex bolt (42).

- Time delay valve assy × 1EA
- Hex bolt × 3EA

480L2SM47

⑫ Air leak test

After putting assembled swing motor into test tank, excute the air leak test for 2 min at 2k.

480L2SM48

⑬ Leakage test
After putting assembled motor into bench tester, spraying the color check and be sure of leakage.

480L2SM49

⑭ Mount test bench
Mount assembled motor on bench tester, check the availability of each specified tests.

480L2SM50

3. REMOVAL AND INSTALL OF REDUCTION GEAR

1) REMOVAL

(1) Remove the swing motor assembly.
For details, see removal of swing motor assembly.

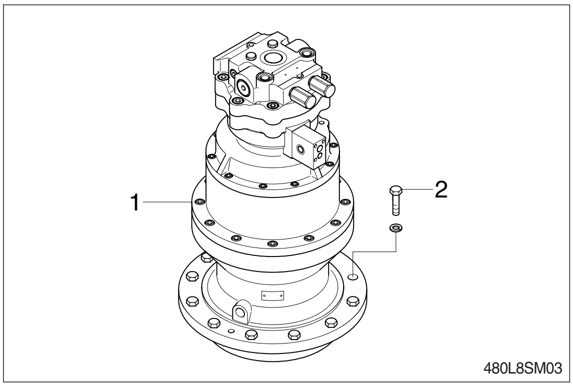
(2) Sling reduction gear assembly (1) and remove mounting bolts (2).

(3) Remove the reduction gear assembly.
· Reduction gear device weight : 180 kgf · m
(396 lbf · ft)

13031GE18

2) INSTALL

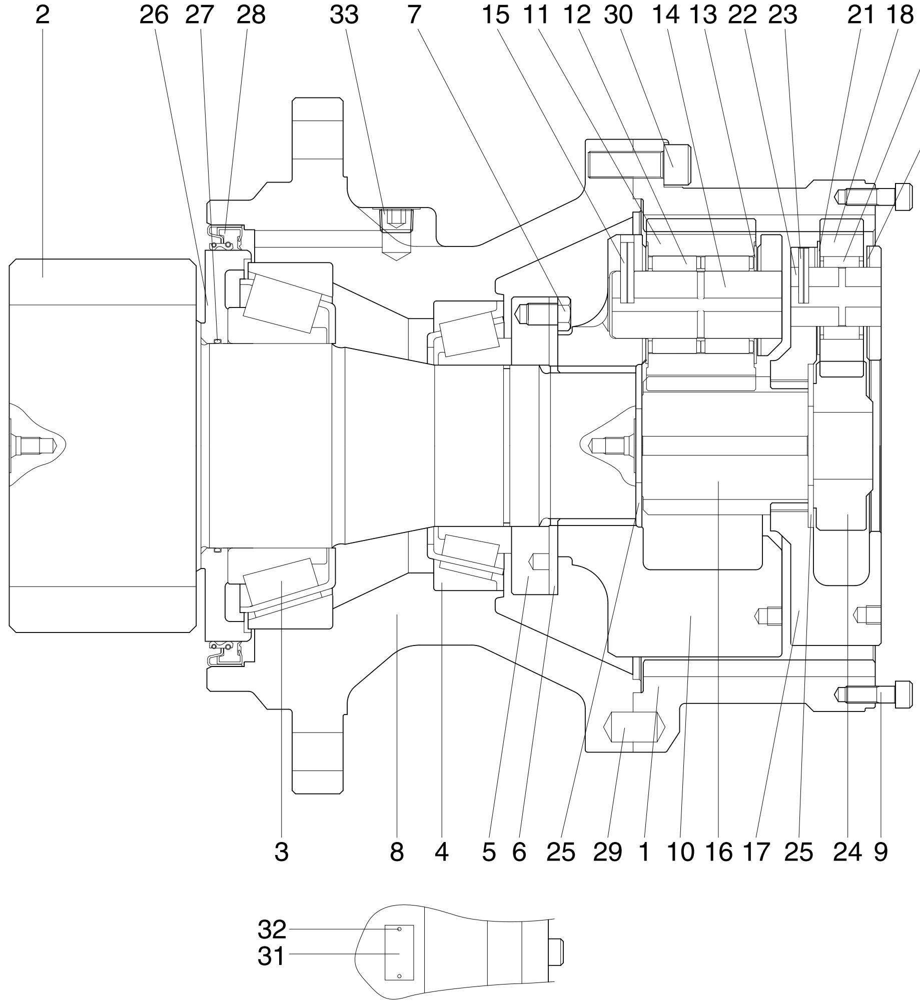
(1) Carry out installation in the reverse order to removal.
· Tightening torque : 57.9±8.7 kgf · m
(419±62.9 lbf · ft)



480L8SM03

4. DISASSEMBLY AND ASSEMBLY OF REDUCTION GEAR

1) STRUCTURE



480F2SM03

1	Ring gear	12	Needle bearing No. 2	23	Spring pin No. 1
2	Drive shaft	13	Thrust washer No. 2	24	Sun gear No. 1
3	Taper bearing	14	Carrier pin No. 2	25	Thrust plate
4	Taper bearing	15	Spring pin No. 2	26	Sleeve
5	Ring nut	16	Sun gear No. 2	27	O-ring
6	Lock plate	17	Carrier No. 1	28	Oil seal
7	Hexagon head bolt	18	Planetary gear No. 1	29	Parallel pin
8	Casing	19	Needle bearing No. 1	30	Hexagon socket head bolt
9	Hexagon socket head bolt	20	Thrust washer No. 1-upper	31	Name plate
10	Carrier No. 2	21	Thrust washer No. 1-lower	32	Rivet
11	Planetary gear No. 2	22	Carrier pin No. 1	33	Plug

2) PREPARATION FOR DISASSEMBLING

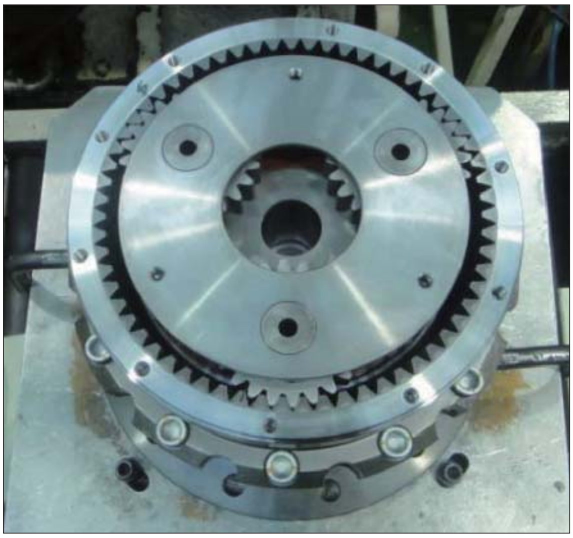
(1) The reduction units removed from excavator are usually covered with mud. Wash out side of unit and dry it.
(2) Setting reduction unit on work stand for disassembling.
(3) Mark for mating
Put marks on each mating parts when disassembling so as to reassemble correctly as before.

⚠ **Take great care not to pinch your hand between parts while disassembling not left fall parts on your foot while lifting them.**

480L2SM51

3) DISASSEMBLY

(1) Remove every "socket bolt (M10)" that secure hydraulic motor and reduction gear.
(2) Removing carrier sub assy & sun gear
① Removing No.1 sun gear from No.1 carrier sub assy. (Be sure maintaining it vertical with ground when disassembling No.1 sun gear.)



480L2SM52

② Removing No.1 carrier sub assy screwing I-bolt to tab hole (M10) in No.1 carrier. (Lifting it gradually maintaining it vertical with ground.)
※ It's impossible to disassemble No.1 pin spring. If No.1 pin spring
has problem, change whole No.1 carrier sub assy .

480L2SM53

③ Removing No.2 sun gear from No.2 carrier sub assy. (Be sure maintaining it vertical with ground when disassembling No.2 sun gear.)

480L2SM54

④ Removing No.2 carrier sub assy screwing I-bolt to tab hole (M10) in No.2 carrier. (Lifting it gradually maintaining it vertical with ground.)

※ It's impossible to disassemble No.2 pin spring. If No.2 pin spring has problem, change whole No.2 carrier sub assy.

480L2SM55

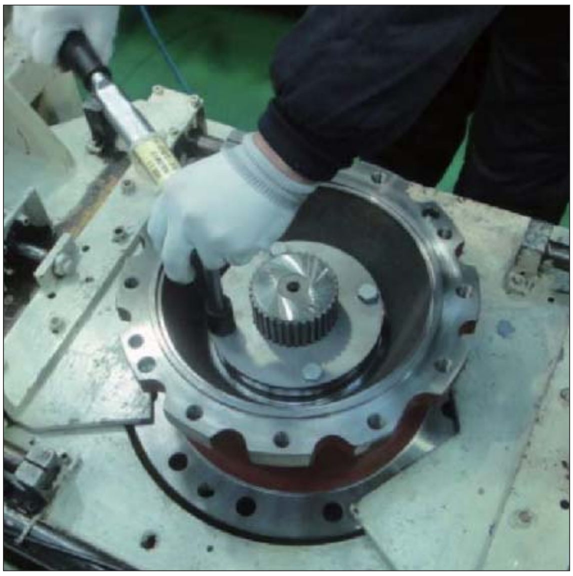
(3) Removing ring gear

After unscrewing every socket bolt (M16), remove ring gear from casing.
(Because of liquid gaskets between ring gear and casing, put sharp punch between ring gear and casing and tapping it to remove them.)

480L2SM56

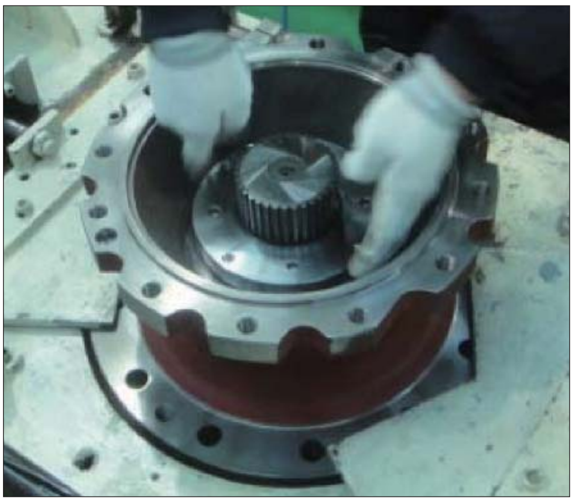
(4) Removing drive shaft sub assy

① Unscrew every hex head bolt (M12) to remove lock plate.



480L2SM57

② Rolling nut ring for removing them from drive shaft sub assy.
(Use special tool to roll nut ring to counter clock wise.)



480L2SM58

③ Remove drive shaft sub assy from casing.
(Set a rack for flange of casing, and remove drive shaft sub assy from casing by using press.)

480L2SM59

④ Remove oil seal & bearing taper (small) from casing.
(Caution, do not re-use oil seal. It is impossible to disassemble drive shaft sub assy.)

480L2SM60

480L2SM61

4) ASSEMBLY

(1) General notes

① Clean every part by kerosene and dry them in a cool and dry place.

② Loctite on surface must be removed by solvent.

③ Check every part for any abnormal.

④ Each hexagon socket head bolt should be used with loctite #242 applied on its threads.

⑤ Apply gear oil slightly on each part before assembling.

⑥ Take great care not to pinch your hand between parts or tools while assembling nor let fall parts on your foot while lifting them.

⑦ Inspection before assembling.

⑧ Thrust washer

· Check the seizure, abnormal wear or uneven wear.

· Check the unallowable wear.

⑨ Gears

· Checnk the pitting or seizure on tooth surface.

· Checnk the cracks on the root of tooth.

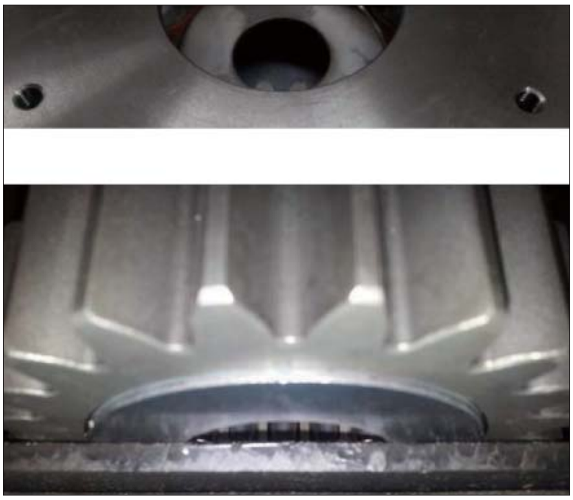
⑩ Bearing

· Rotate it by hands to check such noise or uneven rotation.

(2) Assembling No.1 carrier sub assy

① Put thrust plate firmly in No.1 carrier.

② After assembling No.1 needle bearing to No.1 planetary gear, put a pair of No.1 thrust washer on both sides of bearing and install them to No.1 carrier.



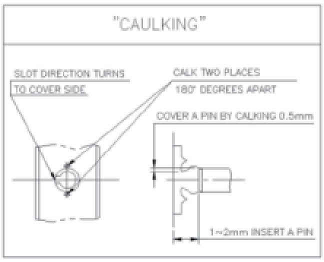
480L2SM62

③ Make No.1 pin spring pin hole and No.1 carrier's spring pin hole in line, press No.1 pin spring into the holes.
(Make No.1 pin spring hole head for No.1 planetary gear.)

480L2SM63

④ Caulk carrier holes to make No.1 pin spring settle down stably.
(Caution : Refer to "caulking details")

※ Use paint marker for marking after caulking.



480L2SM64

480L2SM65

(3) Assembling No.2 carrier sub assy

① Put thrust plate in firmly No.2 carrier.

480L2SM66

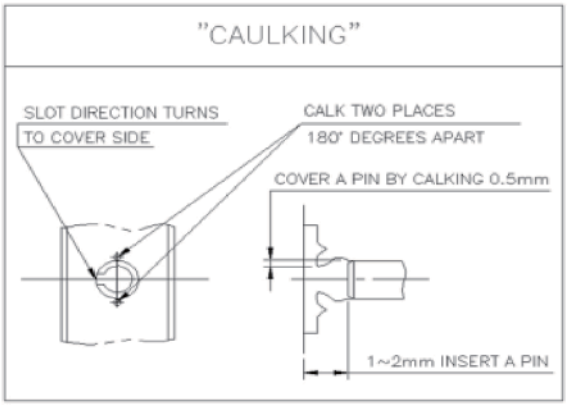
② After assembling No.2 needle bearing to No.2 planetary gear, put 2 pieces of No.2 thrust washer on both sides of bearing and install them to No.2 carrier.

480L2SM67

③ Align No.2 pin spring hole and No.2 carrier spring pin hole, put No.2 pin spring into the holes.
(Make No.2 pin spring cutting line face to No.2 planetary gear.)

480L2SM68

④ Caulk carrier holes to make No.2 pin spring settle down stably.
(Caution : Refer to “caulking details”)
※ Use paint marker for marking after caulking.



480L2SM69

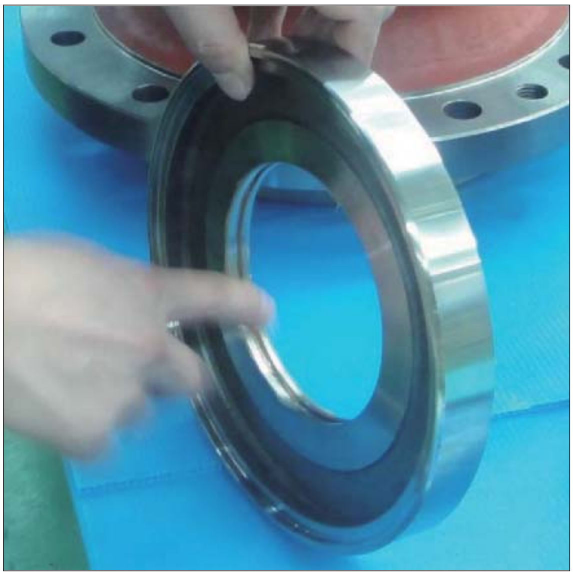
(4) Assembling pinion gear sub assy

① Prepare drive shaft pinion gear vertical with ground.

480L2SM70

② Fully apply grease (albania ep02) to sleeve's O-ring gutter.
(Be sure to maintain it vertical with ground when assembling it.)

③ Put O-ring into sleeve's O-ring gutter.
(Fully apply grease on O-ring.)



480L2SM71

④ Assemble bearing taper and sleeve into drive shaft using press jig.
(Use special jig for pressing. Leave no space between sleeve and bearing taper.)

480L2SM72

480L2SM73

(5) Assembling bearing cup & oil seal

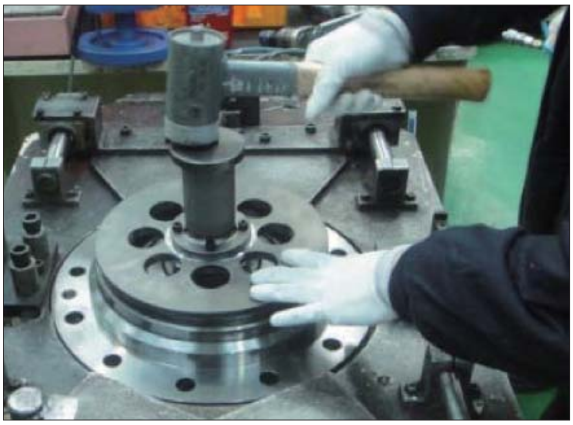
① Put top, bottom bearing cup into casing. (Use special jig for pressing. Pay attention to foreign materials while assembling bearing cup.)

※ Flip over casing to assemble oil seal.

480L2SM74

480L2SM75

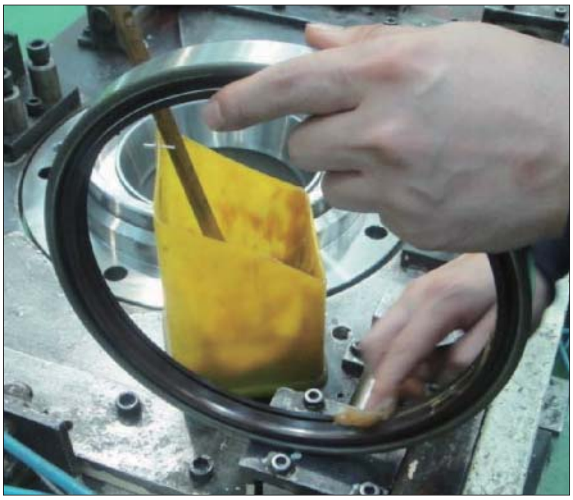
② Assemble oil seal to casing.
(Use special jig for pressing. Pay attention to direction of dust seal and dent.)



480L2SM76

While assembling oil seal

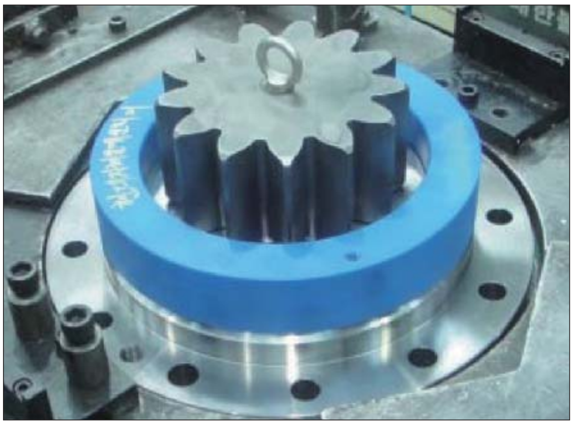
1. Be sure to set dust seal to gear oil.
2. Before assembling, charge enough grease in oil seal.
3. Before assembling, apply enough grease in and outside of oil seal.



480L2SM77

(6) Assembling shaft sub assy & nut ring

① After assembling casing & drive shaft sub assy, flip it over.



480L2SM78

② Put drive shaft sub assy into casing. (Be sure to maintain it vertical with ground when assembling it.)

480L2SM79

③ Put bearing taper into it.
(Rotate bearing by hands for checking after assembly.)

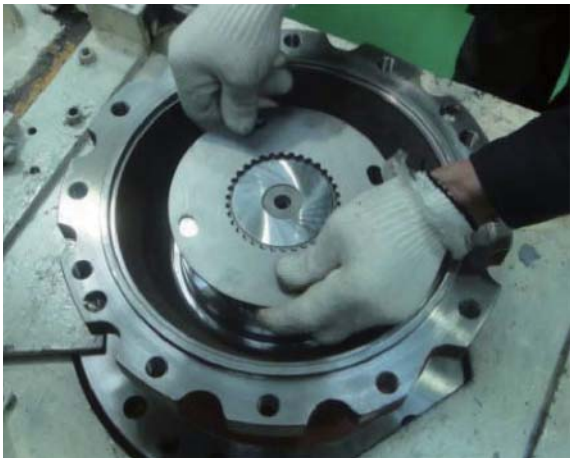
480L2SM80

④ Put nut ring into drive shaft sub assy by using special jig.
· M95 / The tightening torque :
3.5±0.4 kgf · m (25.3±2.9 lbf · ft)
※ Apply enough loctite #242 before screwing bolts.

480L2SM81

480L2SM82

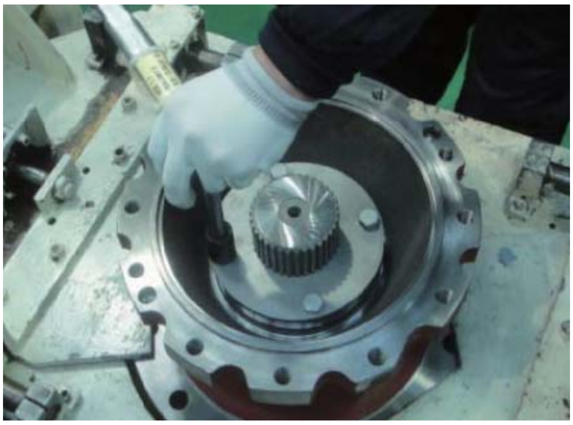
⑤ Align nut ring's bolt screw with lock plate's hole.
(In case of misalign between nut ring's bolt screw and lock plate's hole, put lock plate's hole as near as possible to nut ring's bolt screw and make it in line by increasing tightening torque.)


480L2SM83


480L2SM84

⑥ Screw 4 bolts (M12×16) to connect nut ring and lock plate by using torque wrench.
· 4-M12 / bolt = 12.9T
· The tightening torque :
8.8±0.9 kgf · m (63.7±6.5 lbf · ft)

※ Apply enough loctite #242 before screwing bolts.

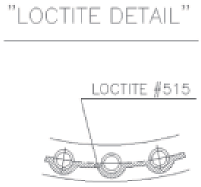

480L2SM85

⑦ Use paint marker for checking surplus parts after assembling.

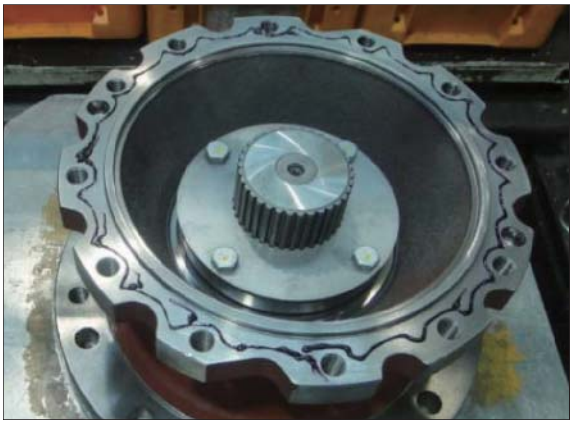

480L2SM86

(7) Assembling ring gear

① Apply loctite #515 bottom of casing sub assy contacting with ring gear without disconnection. (Refer to loctite detail)

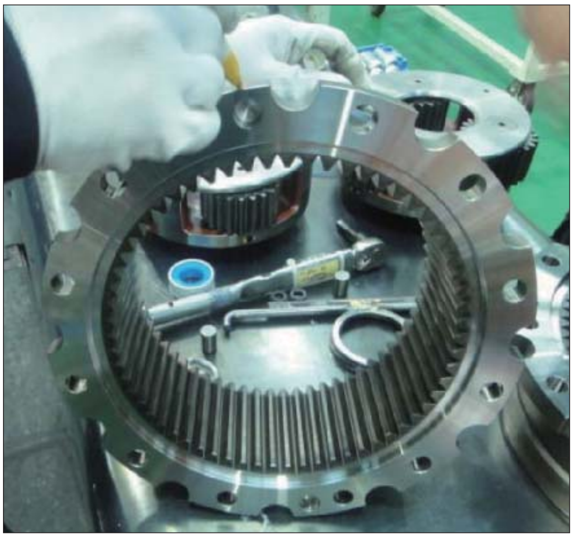


480L2SM87



480L2SM88

② Put pin parallel into casing sub assy hole. (Mark pin parallel position using paint marker.)



480L2SM89

③ Align ring gear with pin parallel to put them into casing sub assy.
(Be sure to maintain them vertical with ground while using press.)

480L2SM90

④ Screw 12 bolts (M16×45) to connect casing sub assy and ring gear (01) by using torque wrench.

- 12-M16 / bolt : 12.9T
- Tightening torque : 27±2.7 kgf · m (195±19.5 lbf · ft)

※ Apply enough loctite #242 before screwing bolts.

480L2SM91

⑤ Use paint marker for checking surplus parts after assembling.

480L2SM92

(8) Assembling carrier sub assy & sun gear

① Put No.2 carrier sub assy along drive shaft's spline.
  - Screw M10 I-bolt to No.2 carrier sub assy.
  - Lifting up No.2 carrier sub assy and align planetary gear and ring gear's tooth by rotating planetary gear by hands.
  - Rotate No.2 carrier sub assy by hands to fit No.2 carrier sub assy into drive shaft spline.

480L2SM93

② Put No.2 sun gear into No.2 carrier sub assy.

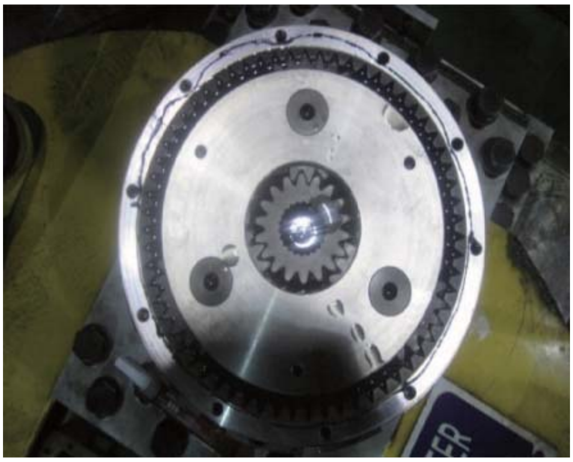
480L2SM94

③ Put No.1 carrier sub assy into No.2 sun gear along spline.
- Screw M10 I-bolt to No.1 carrier sub assy.
- Lifting up No.1 carrier sub assy and align planetary gear and ring gear's tooth by rotating planetary gear by hands.
- Rotate No.1 carrier sub assy by hands to fit No.1 carrier into No.2 sun gear spline.

480L2SM95

④ Put No.1 sun gear into No.1 carrier sub assy.
(Be sure to maintain it vertical with ground. And align with No.1 planetary gear spline.)

⑤ Rotate No.1 carrier sub assy by hands to check noise.



480L2SM96

(9) Measuring clearance & assembling name plate

① Check the clearance between ring gear and No.1 sun gear using a tool with dial gauge.
(Check the clearance / Dial gauge = -0.3 ~ +2.95)

480L2SM97

GROUP 6 TRAVEL DEVICE

1. REMOVAL AND INSTALL

1) REMOVAL

(1) Swing the work equipment 90° and lower it completely to the ground.

(2) Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

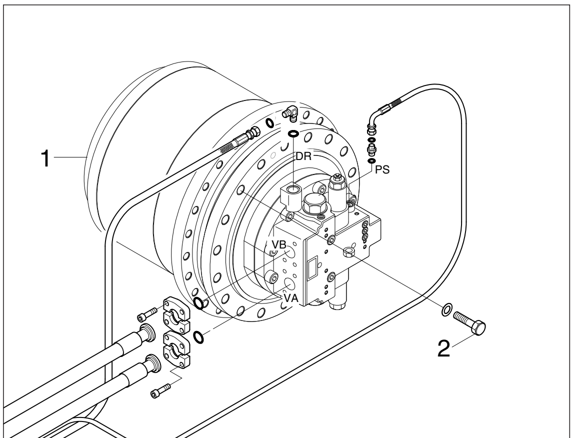
(3) Loosen the breather slowly to release the pressure inside the hydraulic tank.

13031GE18

⚠ **Escaping fluid under pressure can penetrate the skin causing serious injury.**

※ When pipes and hoses are disconnected, the oil inside the piping will flow out, so catch it in oil pan.

(4) Remove the track shoe assembly.
For details, see removal of track shoe assembly.



480L8TM01

(5) Remove the cover.

(6) Remove the hoses.
※ Fit blind plugs to the disconnected hoses.

(7) Remove the bolts and the sprocket.

(8) Sling travel device assembly (1).

(9) Remove the mounting bolts (2), then remove the travel device assembly.
· Weight : 440 kg (970 lb)

2) INSTALL

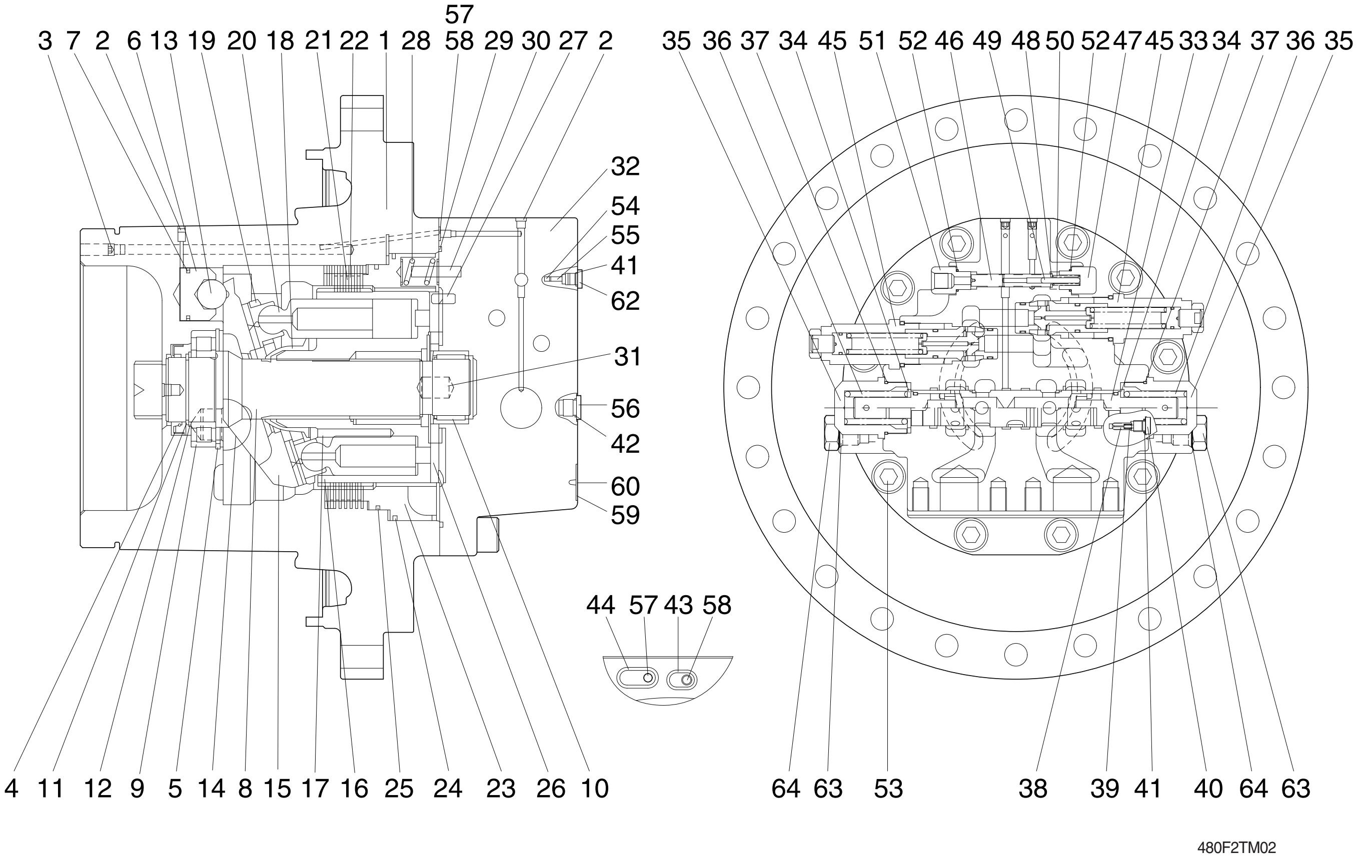
(1) Carry out installation in the reverse order to removal.

(2) Bleed the air from the travel motor.
① Remove the air vent plug.
② Pour in hydraulic oil until it overflows from the port.
③ Tighten plug lightly.
④ Start the engine, run at low idling, and check oil come out from plug.
⑤ Tighten plug fully.

(3) Confirm the hydraulic oil level and check the hydraulic oil leak or not.

2. TRAVEL MOTOR

1) STRUCTURE



1	Casing	22	Separate plate	43	O-ring
2	Plug	23	Parking piston	44	O-ring
3	Plug	24	D-ring	45	Relief valve assy
4	Oil seal	25	D-ring	46	Spool
5	Snap ring	26	Valve plate	47	Plug
6	Piston	27	Parallel pin	48	Spring seat
7	Piston seal	28	Spring	49	Parallel pin
8	Shaft	29	O-ring	50	Spring
9	Cylinder roller bearing	30	Spring pin	51	Connector
10	Needle bearing	31	Parallel pin	52	O-ring
11	Snap ring	32	Rear cover	53	Hex socket head bolt
12	Thrust plate	33	Main spool assy	54	Check valve
13	Steel ball	34	Spring seat	55	Spring
14	Pivot	35	Plug	56	Plug
15	Swash plate	36	Spring	57	Restrictor
16	Cylinder block	37	O-ring	58	Restrictor
17	Spring	38	Restrictor	59	Name plate
18	Guide ball	39	Spring	60	Rivet
19	Retainer plate	40	Plug	62	Plug
20	Piston assy	41	O-ring	63	Plug
21	Friction plate	42	O-ring	64	O-ring

3. DISASSEMBLING OF MOTOR

1) GENERAL PRECAUTIONS

(1) Pay attention to not damaging contact surfaces for O-rings, oil seals, etc. and contact/sliding surfaces for gears, pins, bearings, etc.

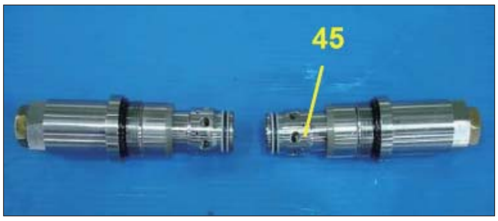
(2) This motor can be disassembled even in a state on the reduction gear.
However, in that case, pay full attention to preventing mud, dust, etc. from entering in it.

(3) The numerical in parentheses following each part name indicates its part number shown in the attached **assembly drawings.**

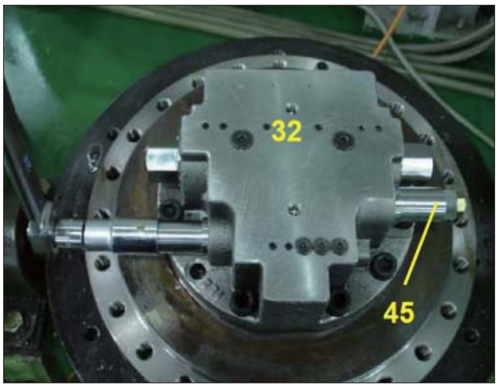
(4) The piping side of the motor is referred to as the rear side, and the output side as the front side.

2) DISASSEMBLY OF REDUCTION GEAR

(1) Disassemble relief valve assy (45) into rear cover (32) using spanner and torque wrench.

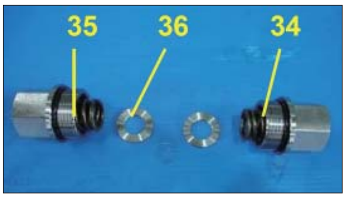


480L2TM11

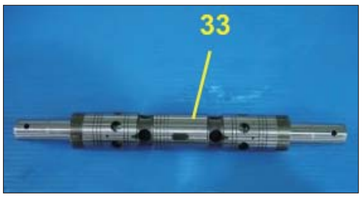


480L2TM12

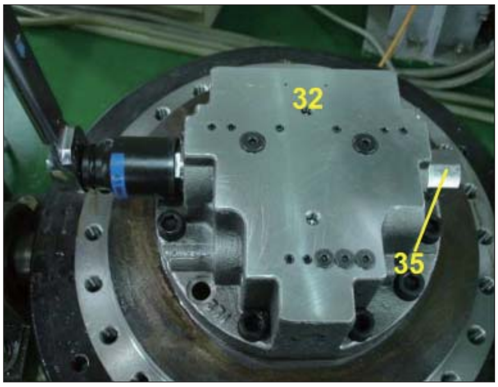
(2) Disassemble main spool cover (35) into rear cover (32) and then disassemble spring (36), spring seat (34), main spool assy (35) in regular sequence.



480L2TM13

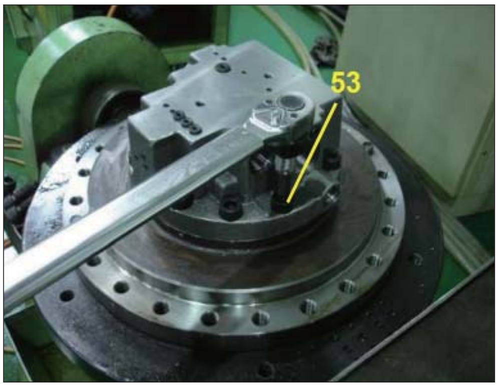


480L2TM14



480L2TM15

(3) Disassemble wrench bolt (53)-10EA using torque wrench.



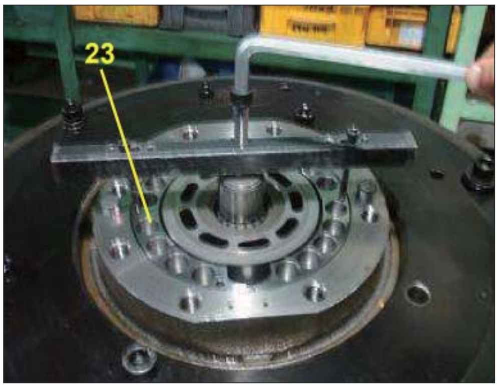
480L2TM16

(4) Take out rear cover (34) into casing (1).

480L2TM17

(5) Disassemble parking piston (23) using jig.

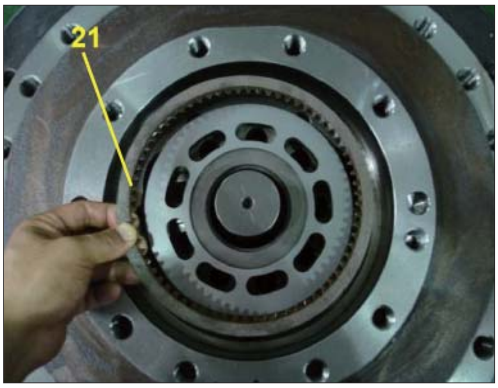
480L2TM18



480L2TM19

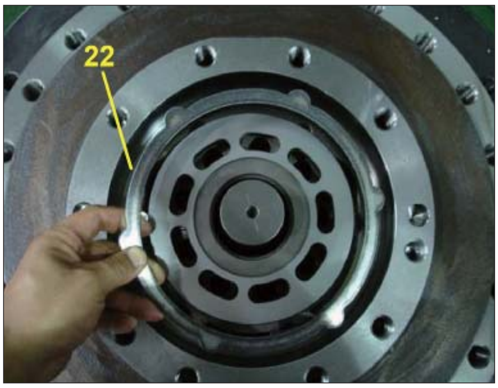
(6) Disassemble separated plate (22)-7EA, friction plate (21)-6EA

480L2TM20



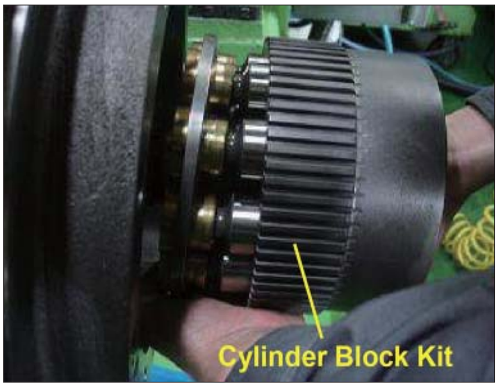
480L2TM21

480L2TM22



480L2TM23

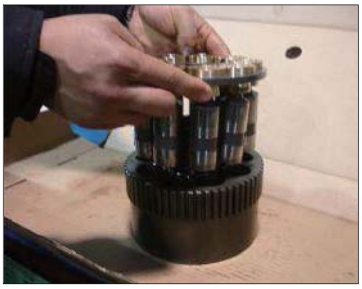
(7) Remove cylinder block kit.
It is easier to work by placing the casing (1) horizontal.

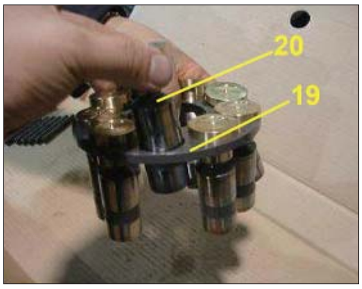


480L2TM24

(8) Disassemble cylinder block (16), retaner plate (19), piston assy (20), ball guide(18), spring (17) into cylinder block kit.

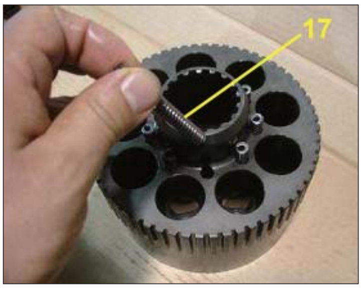

480L2TM25


480L2TM26



480L2TM27

480L2TM28



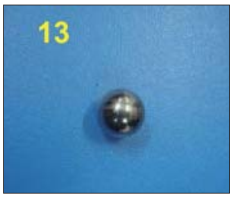
480L2TM29

(9) Disassemble swash plate (15) into shaft casing (1).

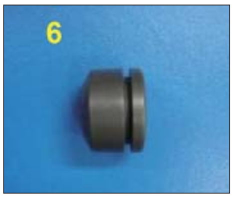
480L2TM30


480L2TM31

(10) Disassemble steel ball (13), swash piston (6) Hole in the casing (1) of two speed line is decomposed by injecting oil.



480L2TM32



480L2TM33


480L2TM34

(11) Disassemble pivot (14)-2EA into casing (1).

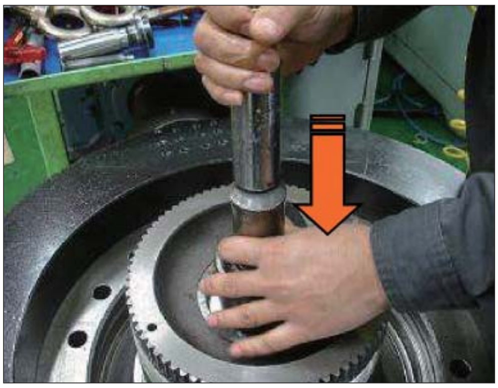
480L2TM35

(12) Disassemble snap ring (5) using pliers.


480L2TM36

(13) In the casing (1), the arrow part of the shaft (8) using a rubber mallet taps and then disassemble the shaft (8) and bearing-roller (9) to the other side.

480L2TM37


480L2TM38

(14) Disassemble valve plate (28) into rear cover (32).

480L2TM39

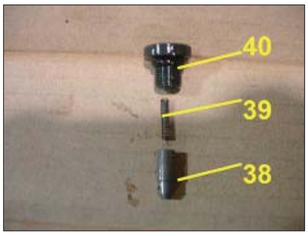
(15) Disassemble plug (47), connector (51) into rear cover (32) and then disassemble spring (48), spring-seat (48), pin –parallel (49), spool (47) in regular sequence.

480L2TM40

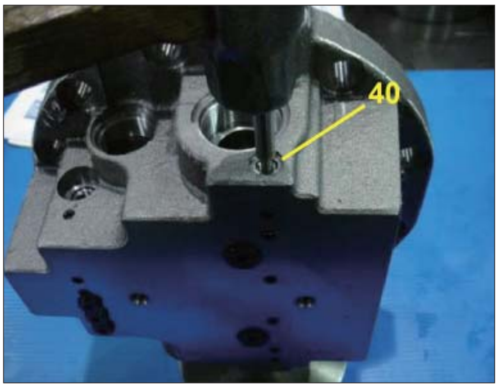

480L2TM41


480L2TM42

(16) Disassemble plug (40) into rear cover (32) and then disassemble spring (39), restictor (38) into rear cover (34) in regular sequence.

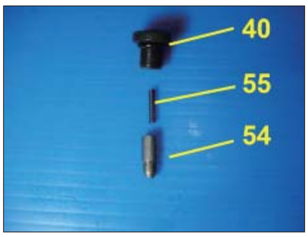


480L2TM43

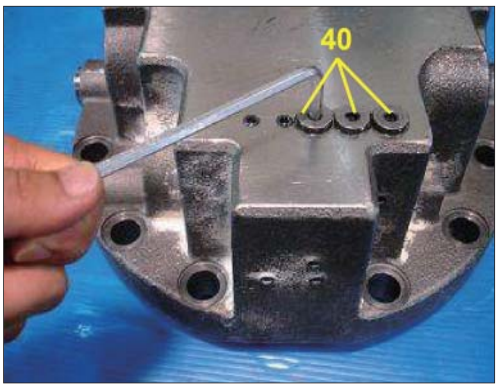


480L2TM44

(17) Disassemble plug (40) into rear cover (34) and then disassemble spring (55), check valve (54) into rear cover (32) in regular sequence.

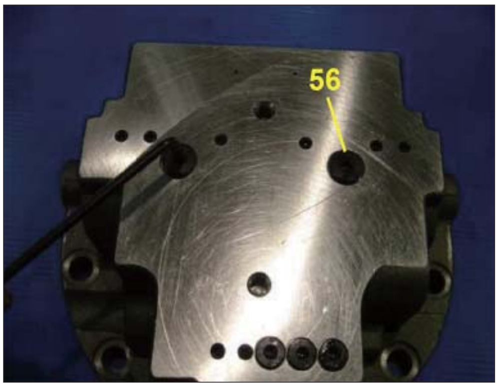


480L2TM45



480L2TM46

(18) Disassemble plug (56) into rear cover (32).

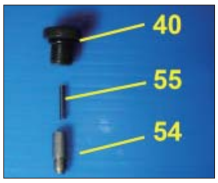


480L2TM47

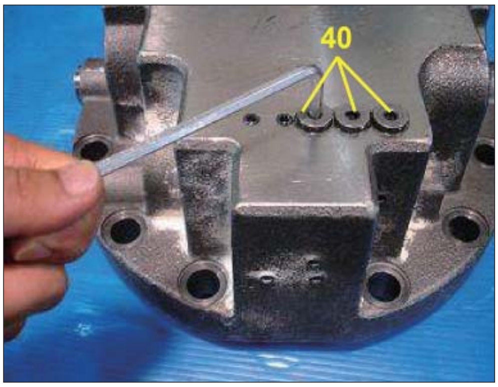
2) ASSEMBLY OF MOTOR

(1) Insert check valve (55), spring (56) into rear cover (32) and then assemble plug (40) using torque wrench.

· Tightening torque : 3.0±0.3 kgf · m (21.7±2.2 lbf · ft)



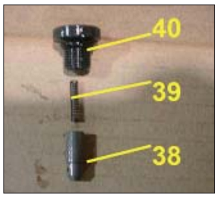
480L2TM48



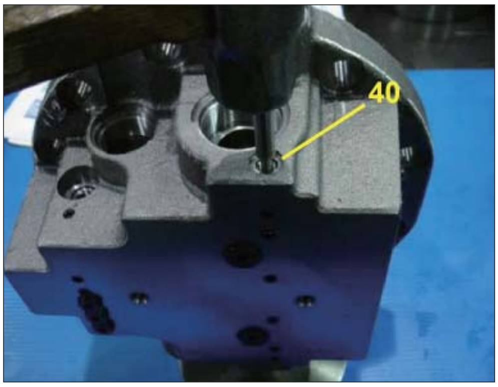
480L2TM49

(2) Insert restrictor (38), spring (39) into rear cover (32) and then assemble plug (40) using torque-wrench.

· Tightening torque : 3.0±0.3 kgf · m (21.7±2.2 lbf · ft)



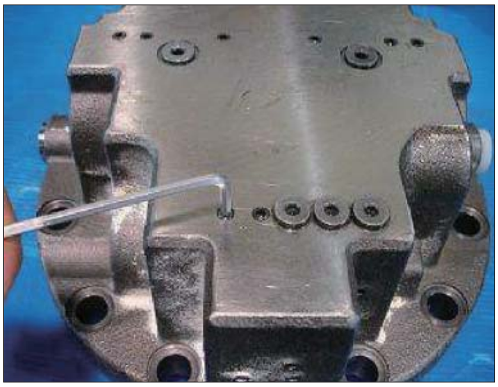
480L2TM50



480L2TM51

(3) Apply loctitle #242 on the 14-NPTF 1/16 plug (2) and then assemble 14-NPTF 1/16 plug (2) into rear cover (32).

480L2TM52


480L2TM53

(4) Assemble 2-PF1/4 plug (42, 56) using torque-wrench.

· Tightening torque : 4.5±0.5 kgf · m (32.5±3.6 lbf · ft)


480L2TM54

(5) Insert spool (46), pin–parallel (49), spring-seat (48), spring (50) in regular sequence and then assemble plug (47), connector (51) using torque-wrench.

 · Tightening torque : 5.5±0.5 kgf · m (40±3.6 lbf · ft)

480L2TM55


480L2TM56


480L2TM57

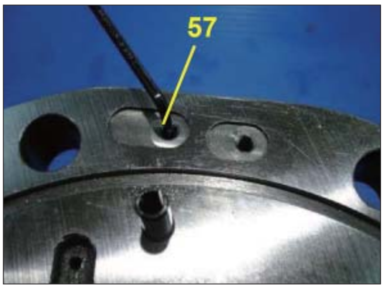
(6) Press needle bearing (10) into rear cover (32) using jig.


480L2TM58

(7) Assemble spring pin (30), pin parallel (27) using small hammer.

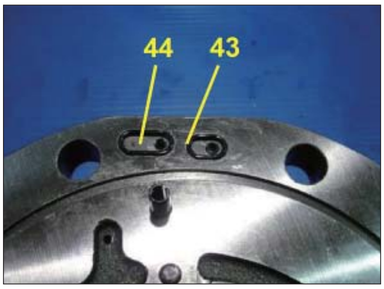

480L2TM59

(8) Apply loctitle #242 on the restrictor (57, 58) and then assemble restrictor (57, 58),O-ring (43, 44) into rear cover (34).



480L2TM60

480L2TM61



480L2TM62

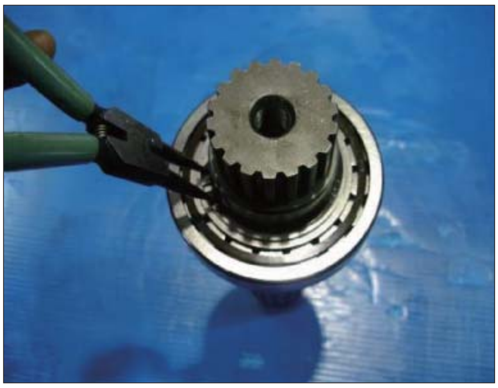
(9) Assemble valve plate (26) into rear cover (32).
Apply grease to the valve plate contact and then assemble valve plate into rear cover (32).


480L2TM63

(10) Apply grease to the O-ring (29), and then assemble O-ring into rear cover (32).


480L2TM64

(11) Assemble the heated roller bearing (9) onto the shaft (8) and then assemble snap ring (6) into shaft (8).
① The temperature of the roller bearing : 100˚C
* Using tool : heater.
② Be careful not to damage the sliding surface for the oil seal on the shaft.

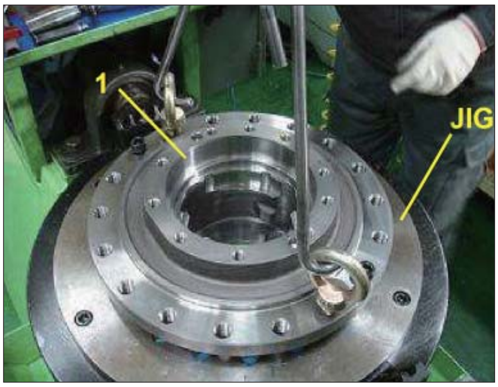

480L2TM65


480L2TM66


480L2TM67


480L2TM68

(12) Install casing (1) into assembling jig.



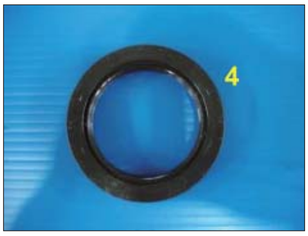
480L2TM69

(13) Assemble plug (2), (3) into casing (1).

480L2TM70

480L2TM71

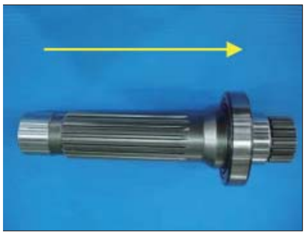
(14) Assemble oil-seal (3) into casing (1) with assembling jig.



480L2TM72

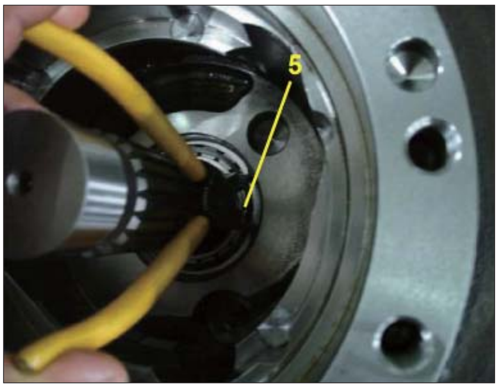
480L2TM73

(15) Insert assembled shaft assy in the direction of the arrow into casing(1) using a rubber mallet.



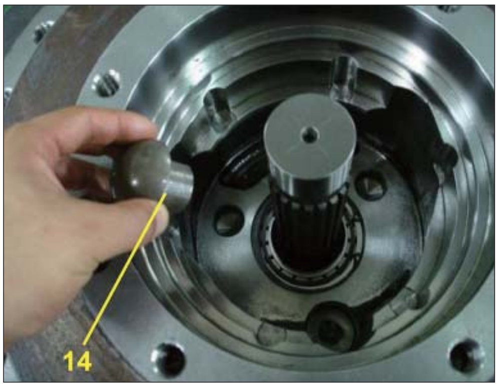
480L2TM74

480L2TM75



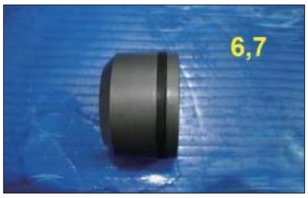
480L2TM76

(16) Apply the grease to pivot (14)-2EA and then assemble pivot (14) into casing(1).

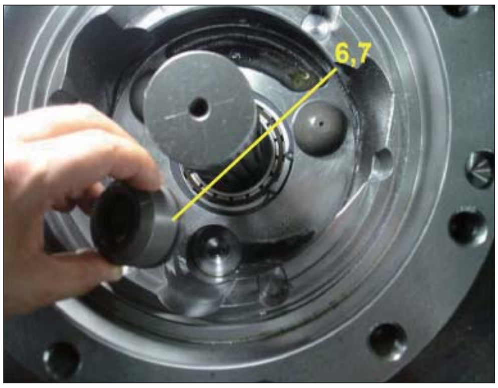


480L2TM77

(17) Warm piston seal (7) and assemble it on swash piston (6) and then bind the piston seal (7) with a bend for a minute.
Remove the bend and assemble it into casing (1).



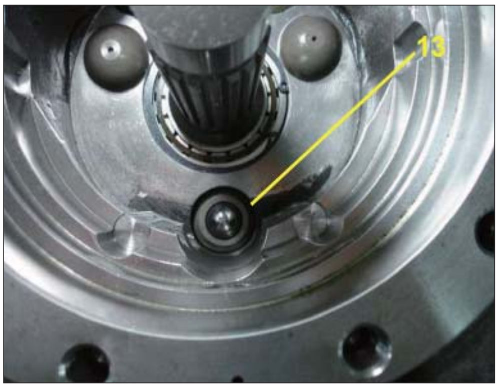
480L2TM78



480L2TM79

(18) Apply the grease to steel ball (15) and then assemble steel ball (15) into casing (1).

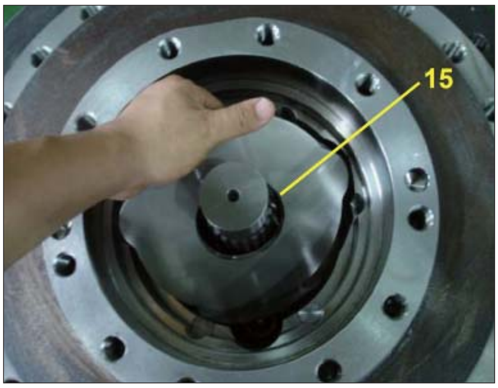
480L2TM80



480L2TM81

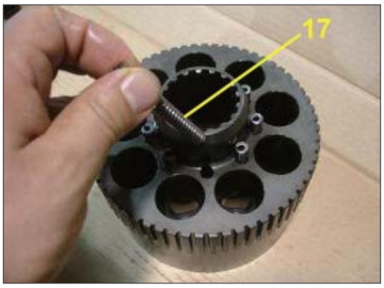
(19) Apply the grease to swash plate (15) and then assemble swash plate (15) into casing (1).

480L2TM82



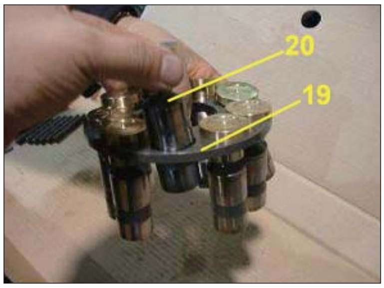
480L2TM83

(20) Assemble spring (17), ball guide (18), retainer plate (19), piston assy (20) into cylinder block (16) in regular sequence.



480L2TM84

480L2TM85

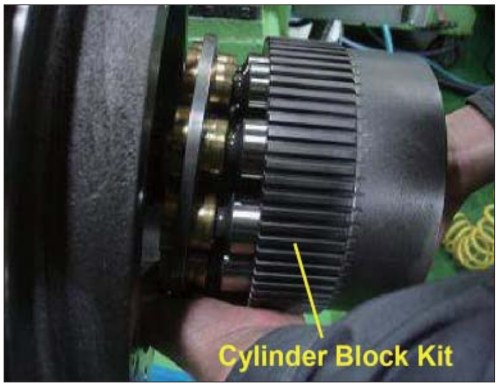


480L2TM86

480L2TM87

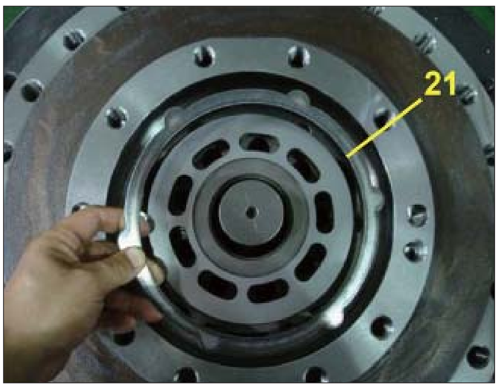
480L2TM88

(21) Assemble cylinder block kit into casing (1).

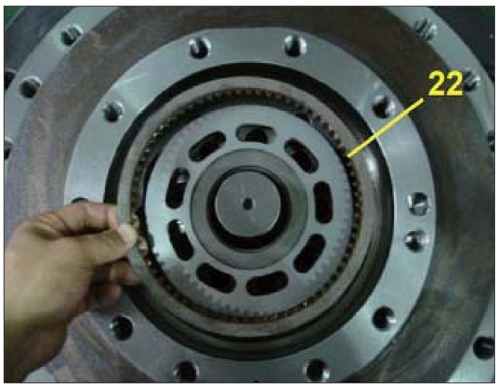


480L2TM89

(22) Assemble separated plate (21), friction plate (22) into cylinder block in regular sequence.
Friction plate : 6 ea
Separated plate : 7 ea



480L2TM90

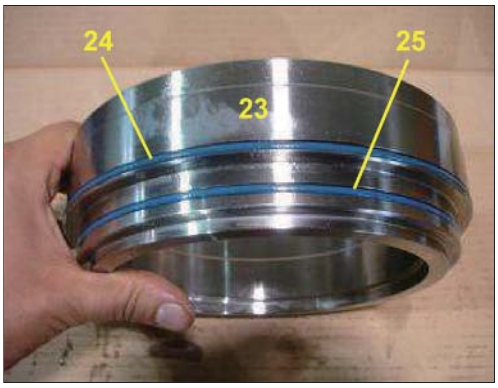


480L2TM91

(23) Assemble pin parallel (31) into casing (1).

480L2TM92

(24) Apply the grease to D-ring (24,25) and then assemble D-ring (24, 25) into parking piston (23)

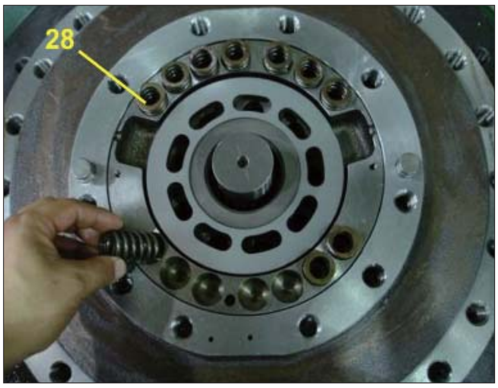


480L2TM93

(25) Assemble parking piston into casing using jig.

480L2TM94

(26) Assemble parking spring (28)-14EA.



480L2TM95

(27) Put on the rear cover (32) on the casing (1).


480L2TM96


480L2TM97

(28) Assemble rear cover (32) into casing (1) and then tighten the wrench bolt (53) using torque wrench.

· Tightening torque : 33±3.3 kgf · m (239±23.9 lbf · ft)


480L2TM98

(29) Assemble main spool assy (33) into rear cover (32) after checking the direction to be correct.


480L2TM99

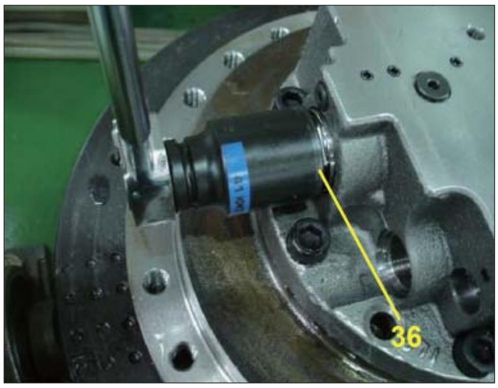

480L2TM100

(30) Assemble spring (36), plug (35) into rear cover (32) in regular sequence and then plug (35) into rear cover (32) using torque wrench.

· Tightening torque : 45±4.5 kgf · m (325±32.5 lbf · ft)


480L2TM101

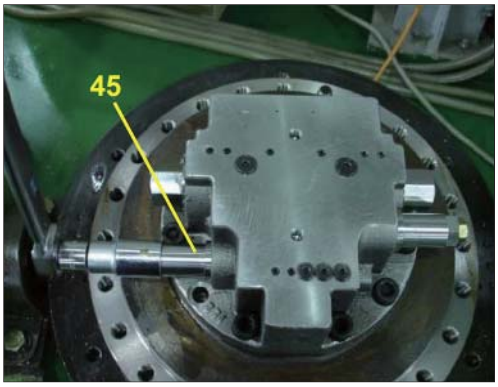

480L2TM102



480L2TM103

(31) Assemble relief valve assy (45) using torque wrench.

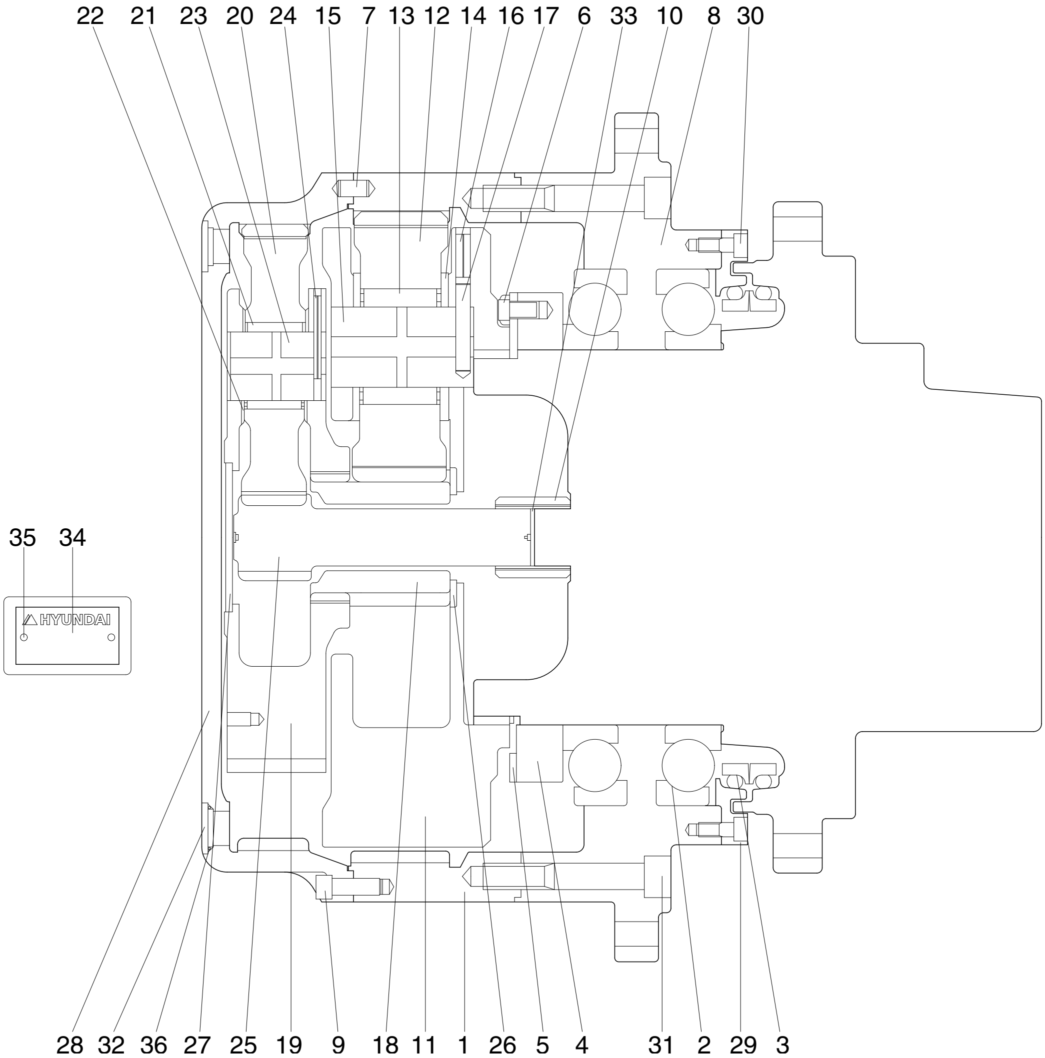
· Tightening torque : 26±2.6 kgf · m (188±18.8 lbf · ft)



480L2TM104

4. TRAVEL REDUCTION GEAR

1) STRUCTURE



480F2TM03

1	Ring gear	13	Needle bearing No. 2	25	Sun gear No. 1
2	Ball bearing	14	Thrust washer No. 2	26	Thrust plate
3	Floating seal assy	15	Carrier pin No. 2	27	Thrust plate
4	Ring nut	16	Spring pin No. 2	28	Cover
5	Lock plate	17	Solid pin No. 2	29	Cover seal
6	Hexagon head bolt	18	Sun gear No. 2	30	Hex socket head bolt
7	Parallel pin	19	Carrier No. 1	31	Hex socket head bolt
8	Housing	20	Planetary gear No. 1	32	Plug
9	Hexagon socket head bolt	21	Needle bearing No. 1	33	Snap ring
10	Coupling	22	Thrust washer No. 2	34	Name plate
11	Carrier No. 2	23	Carrier pin No. 1	35	Rivet
12	Planetary gear No. 2	24	Spring pin No. 1	36	O-ring

5. DISASSEMBLY OF REDUCTION GEAR

1) READY FOR DISASSEMBLING

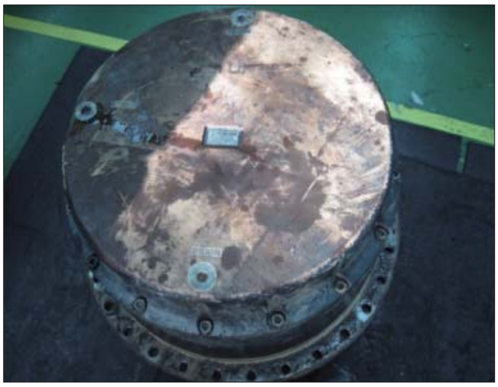
(1) Reduction gear removed from machine usually covered with dirt, so clean it with cleaning liquid and dry it.

(2) Put reduction gear on stable place with drain port down side and remove oil plug (PF3/4) to pull-out gear oil through drain port.

※ When the oil is hot, there are high chance to blow out hot oil because of the pressure difference between container and out side.

(3) Set reduction gear on work table.

(4) Mark surface of cover, ring gear and housing for proper reassembly.



480L2TM201

2) PUT REDUCTION GEAR ON WORK TABLE TO DISASSEMBLE

(1) Set eye bolt (M20) into M20 tap hole on housing flange. Make reduction gear cover upper direction using hoist machine.

⚠ Be aware of safety. There are some chances of accidents when put down the reduction gear. Do not place the part pall on your foot.

480L2TM202

3) COVER REMOVE

(1) Remove 16 of bolt-hex. socket head (M12X35L) connecting cover and ring gear using torque wrench.

(2) Using sharp tools to separate cover and ring gear. Put sharp tools into the gap between ring gear and cover and tap the tool tenderly.

480L2TM203

4) REMOVE THRUST PLATE AND NO.1 CARRIER SUB

(1) Remove thrust plate first, set eye bolt (M10) in No.1 carrier tap hole. After these, pull-up No.1 carrier assy slowly.

480L2TM204

(2) Remove No.1 sun gear from reduction gear slowly.

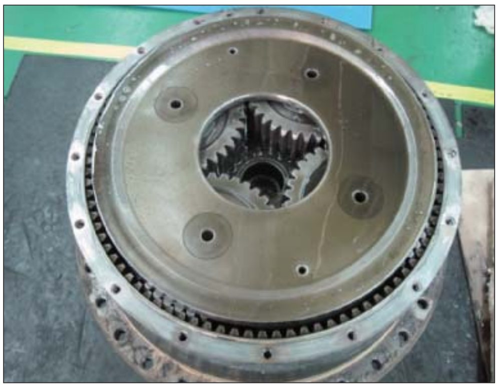
※ When disassemble No.1 sun gear, be sure to keep vertical against ground with No.1 sun gear.

480L2TM205

5) REMOVE NO.2 CARRIER SUB

(1) Remove No.2 sun gear slowly.

※ When disassemble No.2 sun gear, be sure to keep vertical against ground with No.2 sun gear.



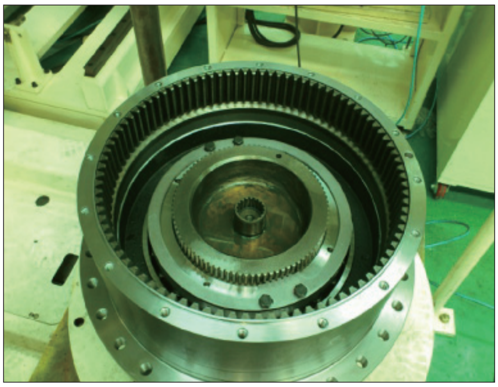
480L2TM206

(2) Set eye bolt (M10) in No.2 carrier assy, pull-up slowly.

480L2TM207

6) REMOVE COUPLING

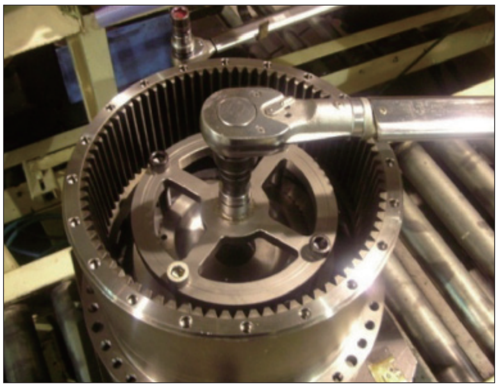
(1) Remove coupling on motor spline.



480L2TM208

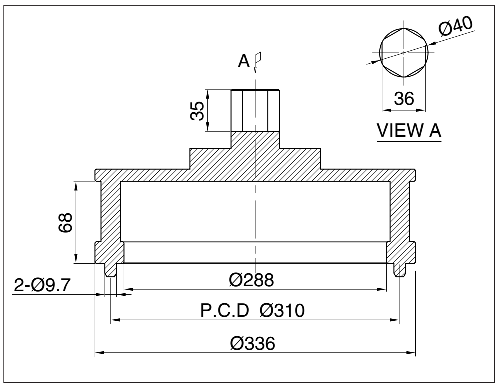
7) REMOVE NUT RING AND LOCK PLATE

(1) Remove bolt-hex head (M12×20L) nut using torque wrench which is connecting ring and lock plate.
(2) Remove lock plate from motor casing spline.



480L2TM209

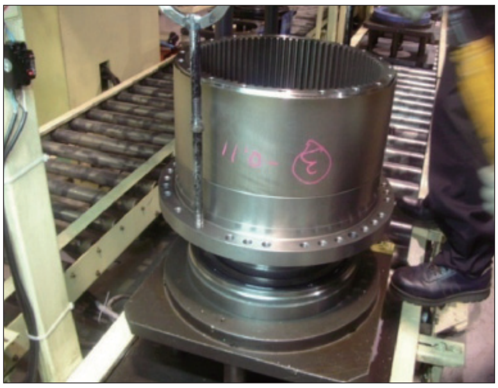
(3) Remove nut ring using designed tools.



480L8TM03

8) DISASSEMBLE RING GEAR AND HOUSING

(1) Set eye bolt (M20) in flange of housing, pulling ring gear and housing from motor.



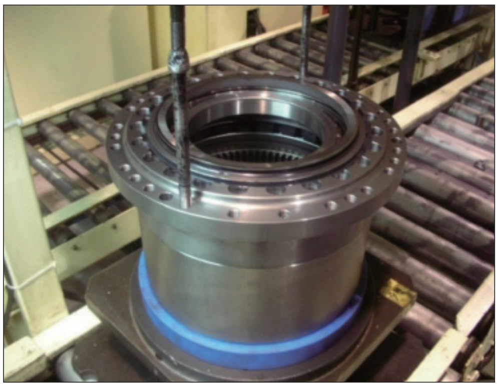
480L2TM210

(2) Put disassembled ring gear and housing on work table. Be sure to set floating seal upper side, and remove floating seal.

※ Do not re-use floating seal.

(3) Remove bolt-hex.socket head (M20×120L) connecting housing and ring gear using torque wrench.

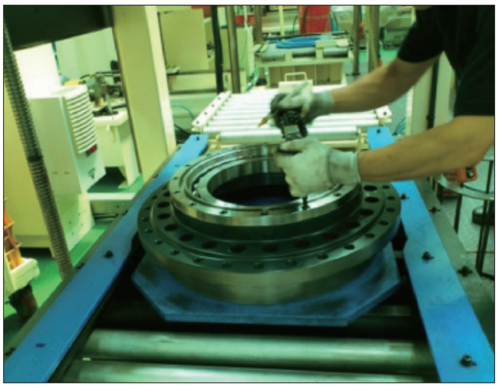
(4) Put sharp tool into gap between ring gear and housing and tap it tenderly to separate gear and housing.



480L2TM212

9) DISASSEMBLE HOUSING COMPONENTS

Bolt-hex.socket head (M10×25L) connecting housing and seal cover using torque wrench, and remove seal cover.

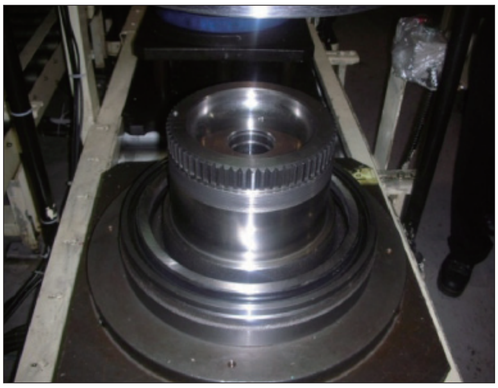


480L2TM213

10) SEPARATE MOTOR CASING AND FLOATING SEAL

Pull floating seal in motor casing slowly and remove floating seal from motor casing.

※ Do not re-use floacting seal.



480L2TM211

11) NO.1 CARRIER ASS'Y DISASSEMBLE

(1) Put spring pin into No.1 pin spring pin hole using specially designed tool.

480L2TM214

(2) Disassemble No.1 planetary gear, thrust washer, No.1 pin, needle bearing form No.1 carrier.

※ Do not re-use No.1 pin.

480L2TM215

12) NO.2 CARRIER ASS'Y DISASSEMBLE

(1) Cut solid pin by pressing No.2 pin using press machine.

⚠ **Be aware of scattering of components when operator use press machine.**

(2) Disassemble No.2 planetary gear, thrust washer, No.2 pin, needle bearing from No.2 carrier.

※ Do not re-use No.2 pin.

480L2TM216

3. ASSEMBLY OF REDUCTION GEAR

1) GENERAL PRECAUTIONS

(1) Clean all components with kerosene and dry them in shade. Remove all loctite with solvent. Check the components.
Apply loctite #262 on thread of bolt-hex.socket head.
Be aware of dropping of parts on foot and safety accident.
Check the quantity of all parts in advance.

(2) Check the abnormality of thrust washer like twist or wear.

(3) Check the surface of every gear. Whether there is pitting or crack on them.

(4) Rolling the bearing and check the rolling condition and the noise.

(5) Check the surface of floating seal and crack of O-ring.

2) NO.1 CARRIER ASSEMBLY

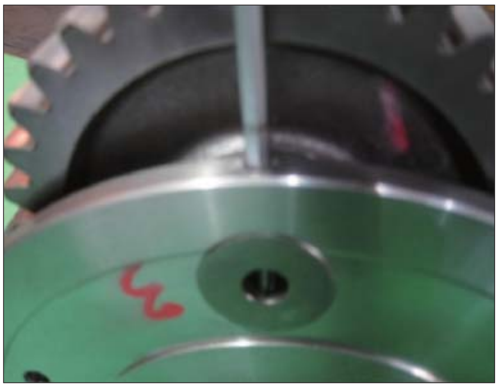
(1) Set No.1 carrier on stable and even place.
(2) Put No.1 needle bearing in No.1 planetary gear and place No.1 thrust washer 2 pcs on both side of gear. Assemble gear in carrier.

480L2TM217

(3) Align spring pin hole of No.1 pin with No.1 carrier spring pin hole and assemble No.1 pin accordingly.

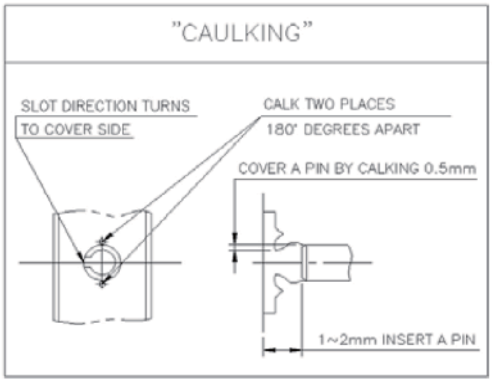
480L2TM218

(4) Put spring pin into No.1 carrier using jig with force.



480L2TM221

(5) Caulking both side of pressed spring pin 180˚ using caulking jig.



480L2TM219

3) NO.2 CARRIER ASSEMBLY

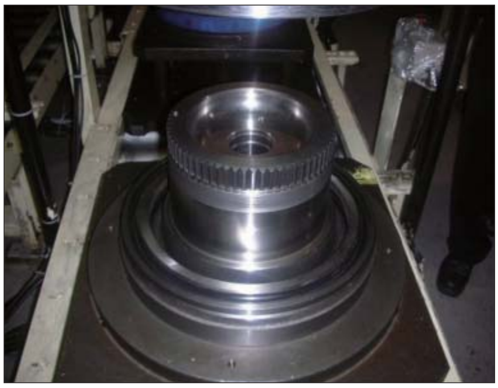
(1) Set No.2 carrier on stable and even place.
(2) Put No.2 needle bearing in No.2 planetary gear and place No.2 thrust washer 2 pcs on both side of gear. Assemble gear in carrier.
(3) Align solid pin hole of No.2 pin and No.2 carrier spring pin hole. and assemble No.2 pin accordingly.
(4) After assembly solide pin, put spring pin with force.
(5) Caulking both sides of pressed spring pin 180˚ using caulking jig.


480L2TM220

4) FLOATING SEAL ASSEMBLY

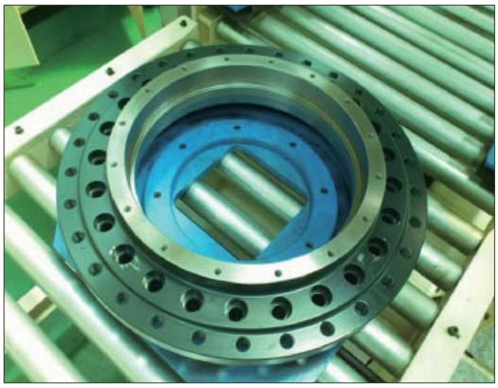
Wipe O-ring side of floating seal and contact surface of floating seal of motor casing with oil applied lint free towel, and press fitting floating seal into motor casing with special jig.

※ Keep the floating seal vertical against ground.


480L2TM222

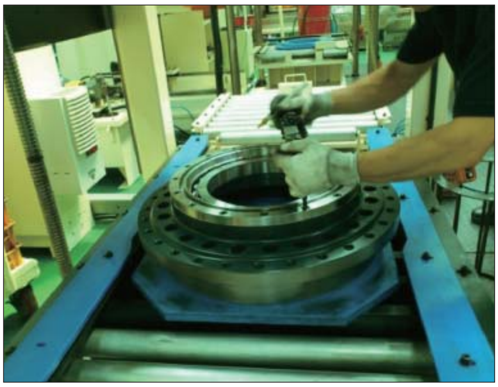
5) HOUSING & MAIN BEARING ASSEMBLY

(1) Heating and cleaning housing with 60~70˚C temperature.
(2) Set the housing on working table safely, press fitting main bearing into both side of housing.


480L2TM224

6) SEAL COVER ASSEMBLY

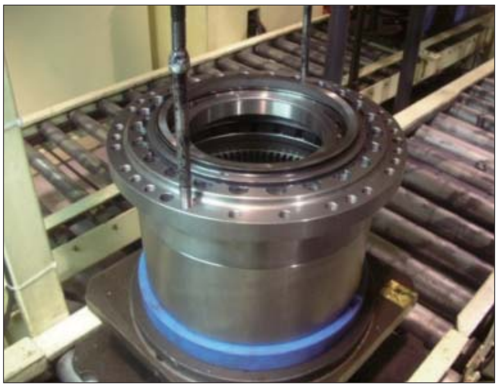
Apply three bond #1194 on contact surface of housing and seal cover, tighten bolt-hex.socket head (M10×25L) with designed torque 6.3±0.6 kgf · m (45.6±4.3 lbf · ft) using torque wrench.


480L2TM225

7) HOUSING COMPONENTS AND RING GEAR ASSEMBLY

(1) Apply three bond #1194 on the surface of ring gear and housing contact surface, tighten bolt-hex.socket head (M20×120L) with designed torque 53±5.3 kgf · m (383±38.3 lbf · ft) using torque wrench.

(2) Wipe O-ring side of floating seal and contact surface of floating seal of seal cover with oil applied lint free towel, and press fitting floating seal into seal cover.

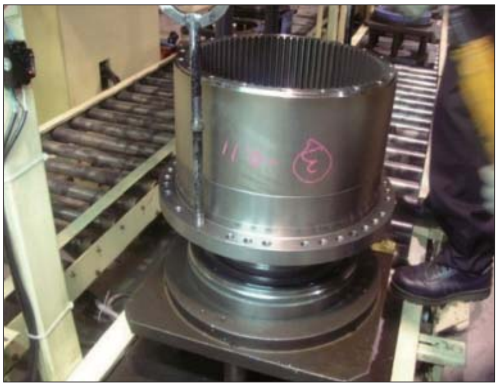

480L2TM223

8) MOTOR & ASSEMBLED HOUSING COMPONENTS ASSEMBLY

(1) Set eye bolt (M20) in housing flange tap hole.

(2) Assemble assembled housing components on motor using hoist.

※ Be sure set eye bolt firmly to keep operator safe.

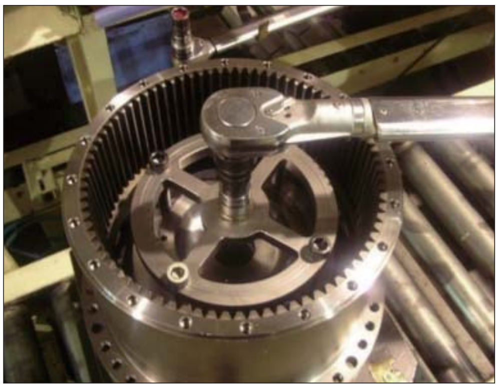

480L2TM226

9) NUT RING AND LOCK PLATE ASSEMBLY

(1) Tighten nut ring with designed torque using torque wrench.

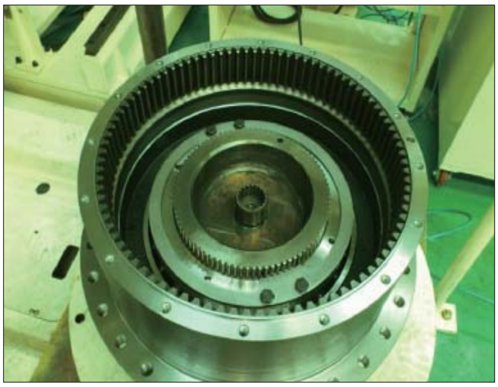
(2) Set lock plate along with bolt hole of nut ring and assemble them.

(3) Tighten bolt-hex head (M12×20L) with designed torque 8.8±0.9 kgf · m (63.6±6.5 lbf · ft).


480L2TM228

10) COUPLING ASSEMBLY

Assemble coupling with motor's spline.



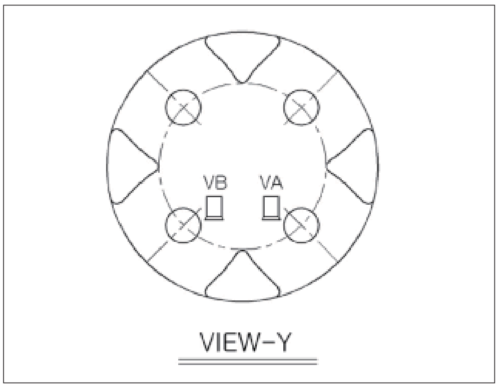
480L2TM230

11) NO.2 CARRIER SUB ASSEMBLY

(1) Set eye bolt (M10) in No.2 carrier assy, lift them using hoist and set down No.2 carrier assy into motor.

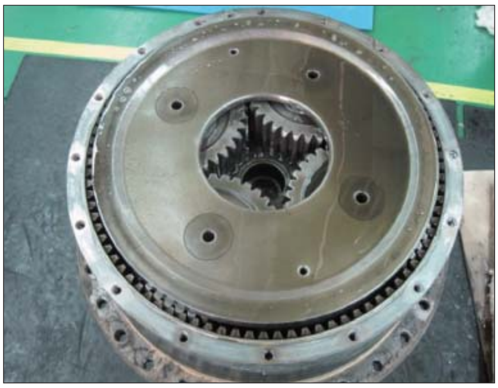
480L2TM229

※ To set the align valve ports, refer to right drawing.



480L2TM231

(2) Assemble No.2 sun gear into No.2 carrier assy.



480L2TM227

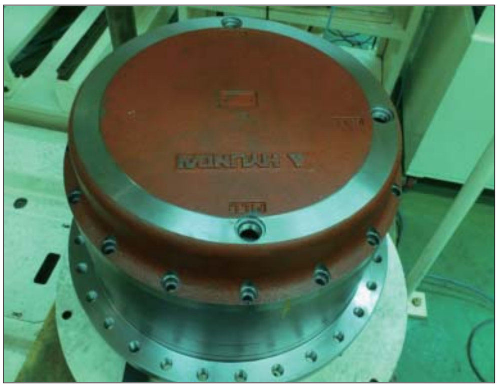
12) NO.1 CARRIER SUB ASSEMBLY

(1) Set eye bolt (M10) in No.1 carrier tap hole and set down No.1 carrier assy slowly.
(2) Assemble No.1 sun gear and No.1 carrier assy.
(3) Assemble thrust plate and carrier.

480L2TM232

13) COVER ASSEMBLY

(1) Put parallel pin (ø13×20L) into parallel pin hole of ring gear with rubber hammer.
(2) Apply three bond #1194 on cover contacting surface of ring gear and assemble cover.
(3) Tighten 16 of bolt-hex.socket head (M12×35L) with designed torque 14.3±1.4 kgf·m (103±10.1 lbf·ft) using torque wrench.



480L2TM233

14) PUTTING GEAR OIL

(1) Put gear oil 12±0.5L through drain port and check the level gage.
(2) Tighten oil plug with torque 10±0.1 kgf·m (72.3±0.7 lbf·ft).

GROUP 7 RCV LEVER

1. REMOVAL AND INSTALL

1) REMOVAL

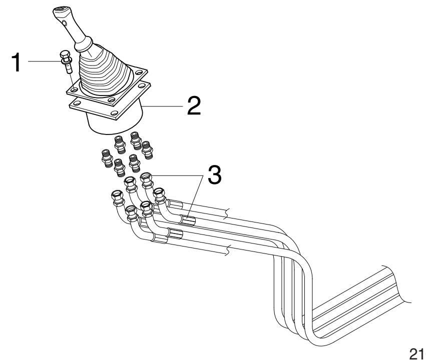
13031GE18

(1) Lower the work equipment to the ground and stop the engine.

(2) Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

(3) Loosen the breather slowly to release the pressure inside the hydraulic tank.

⚠ **Escaping fluid under pressure can penetrate the skin causing serious injury.**



21098RL01

(4) Loosen the socket bolt (1).

(5) Remove the cover of the console box.

(6) Disconnect pilot line hoses (3).

(7) Remove the pilot valve assembly (2).

※ When removing the pilot valve assembly, check that all the hoses have been disconnected.

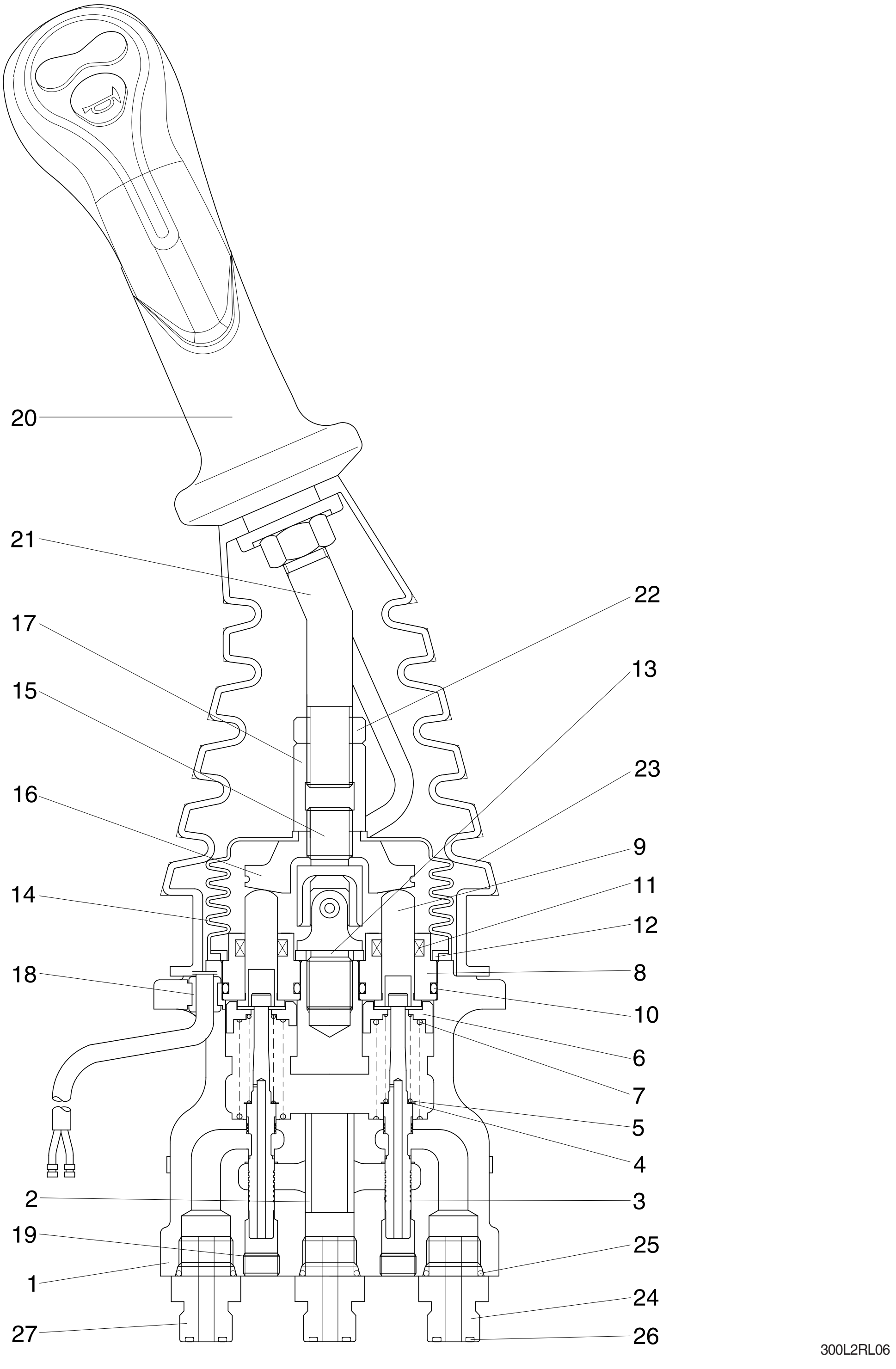
2) INSTALL

(1) Carry out installation in the reverse order to removal.

(2) Confirm the hydraulic oil level and check the hydraulic oil leak or not.

2. DISASSEMBLY AND ASSEMBLY

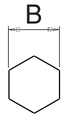
1) STRUCTURE



1	Case	8	Plug	15	Joint assembly	22	Nut
2	Bushing	9	Push rod	16	Swash plate	23	Boot
3	Spool	10	O-ring	17	Adjusting nut	24	Last guard filter
4	Shim	11	Rod seal	18	Bushing	25	O-ring
5	Spring	12	Plate	19	Plug	26	O-ring
6	Spring seat	13	Spacer	20	Handle assembly	27	Connector
7	Spring	14	Boot	21	Handle bar		

2) TOOLS AND TIGHTENING TORQUE

(1) Tools

Tool name	Remark	
Allen wrench	6	B 
Spanne	22	
	27	
(+) Driver	Length 150	
(-) Driver	Width 4~5	
Torque wrench	Capable of tightening with the specified torques	

(2) Tightening torque

Part name	Item	Size	Torque	
			kgf · m	lbf · ft
Joint	15	M14	3.5	25.3
Swash plate	16	M14	5.0±0.35	36.2±2.5
Adjusting nut	17	M14	5.0±0.35	36.2±2.5
Lock nut	22	M14	5.0±0.35	36.2±2.5

3) DISASSEMBLY

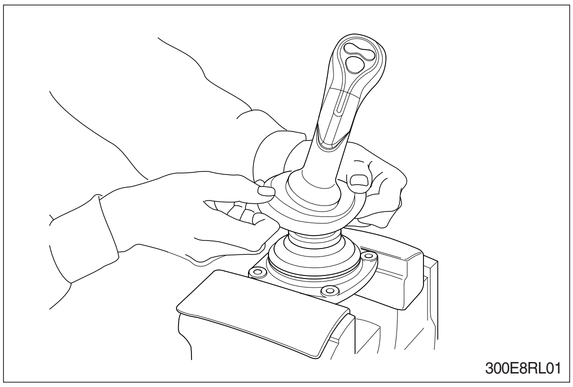
※ Procedures are based on the type L1.

(1) Clean pilot valve with kerosene.

※ Put blind plugs into all ports

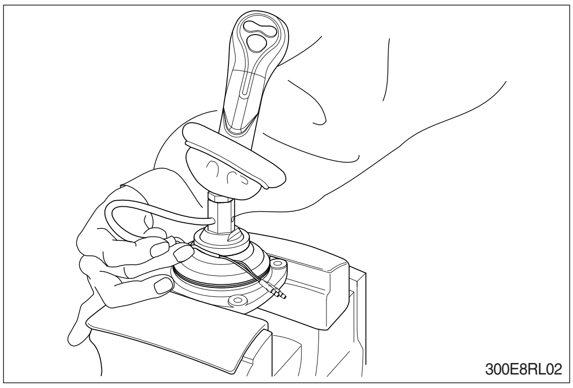
(2) Fix pilot valve in a vise with copper (or lead) sheets.

(3) Remove end of boot (23) from case (1) and take it out upwards.



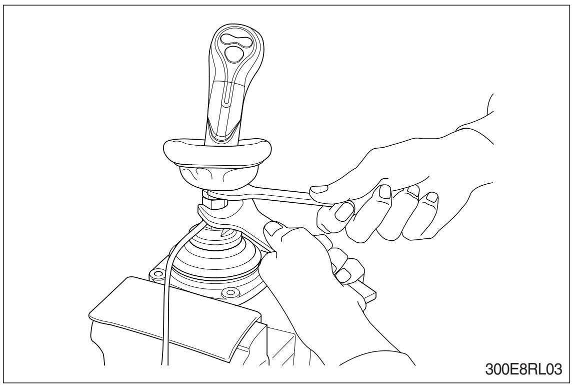
300E8RL01

※ For valve with switch, remove cord also through hole of casing.



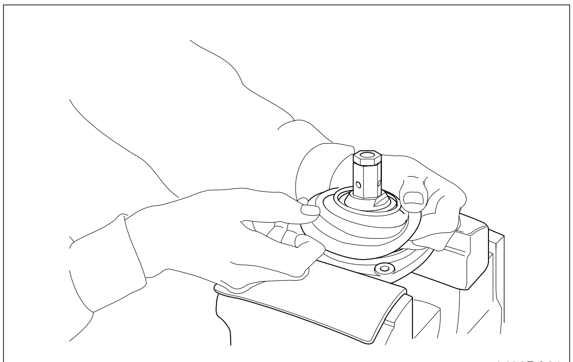
300E8RL02

(4) Loosen lock nut (22) and adjusting nut (17) with spanners on them respectively, and take out handle section as one body.



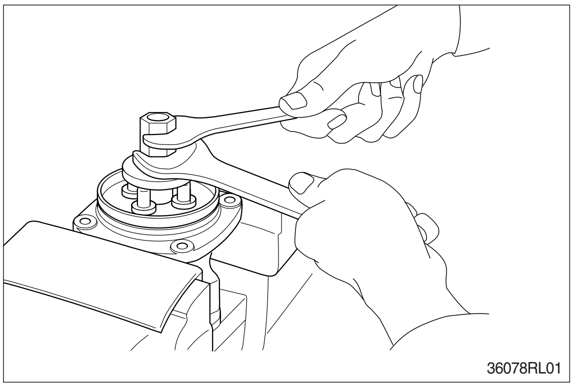
300E8RL03

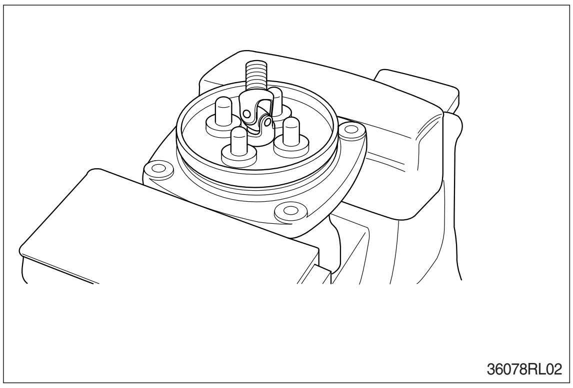
(5) Remove the boot (14).



1408DA61

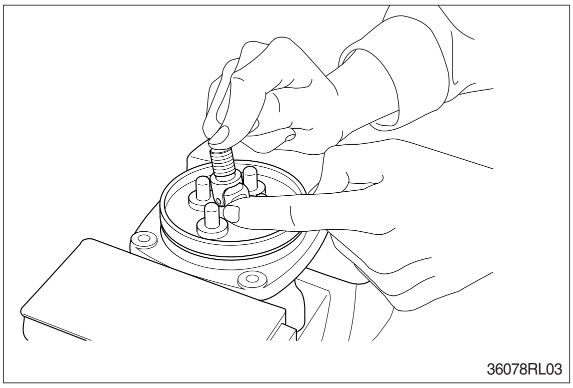
(6) Loosen adjusting nut (17) and swash plate (16) with spanners on them respectively, and remove them.

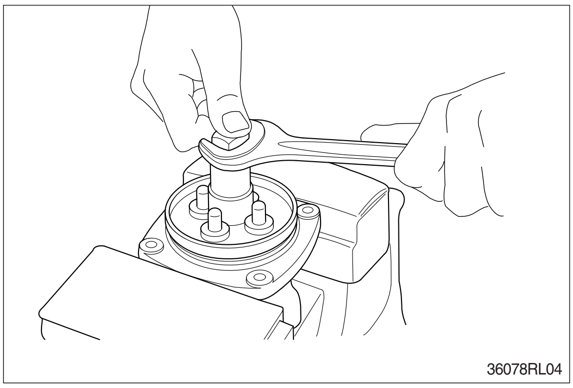




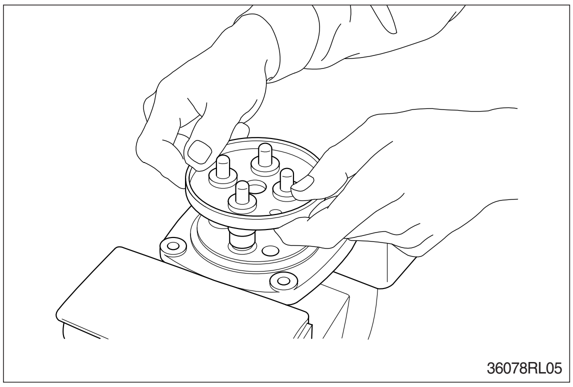
(7) Turn joint anticlockwise to loosen it, utilizing jig (Special tool).

※ When return spring (7) is strong in force, plate (12), plug (8) and push rod (9) will come up on loosening joint.
Pay attention to this.



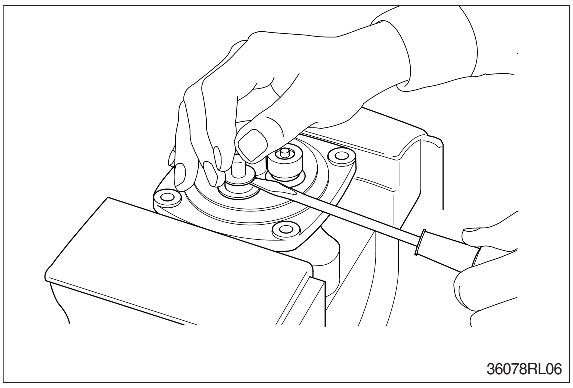


(8) Remove plate (12).



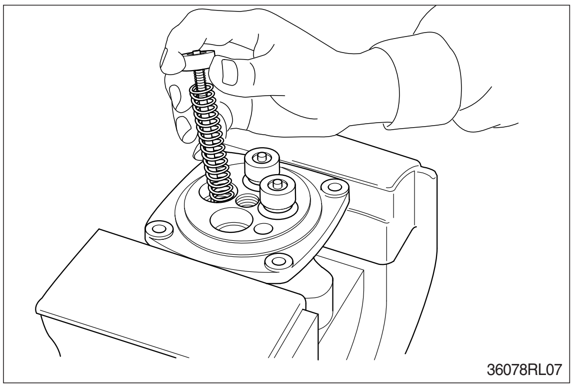
36078RL05

(9) When return spring (7) is weak in force, plug (8) stays in casing because of sliding resistance of O-ring.
※ Take it out with minus screwdriver.
Take it out, utilizing external periphery groove of plug and paying attention not to damage it by partial loading.
※ During taking out, plug may jump up due to return spring (7) force.
Pay attention to this.



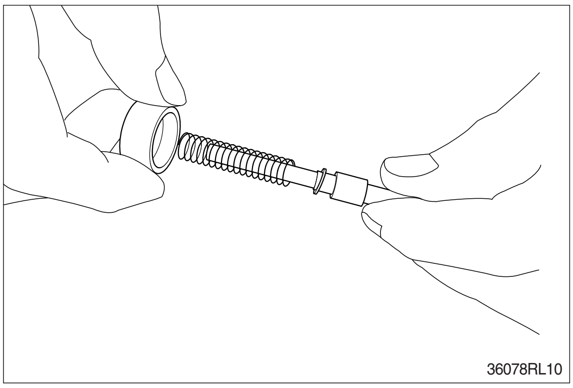
36078RL06

(10) Remove reducing valve subassembly and return spring (7) out of casing.
※ Record relative position of reducing valve subassembly and return springs.



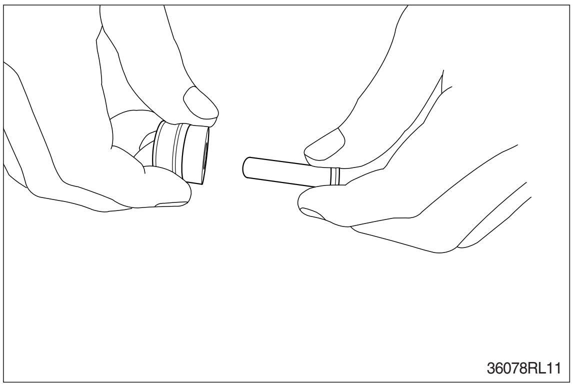
36078RL07

(11) Separate spool (3), spring seat (6), spring (5) and shim (4) individually.
※ Pay attention not to damage spool surface.
※ Record original position of spring seat (6).
※ Until being assembled, they should be handled as one subassembly group.



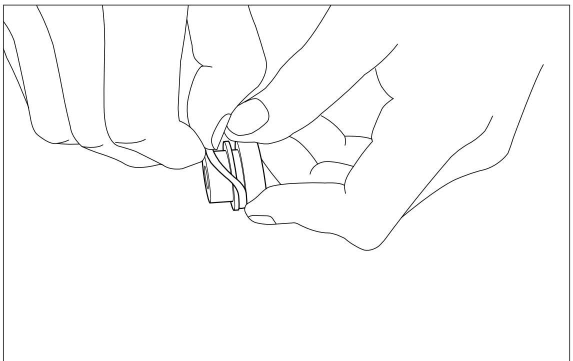
36078RL10

(12) Take push rod (9) out of plug (8).

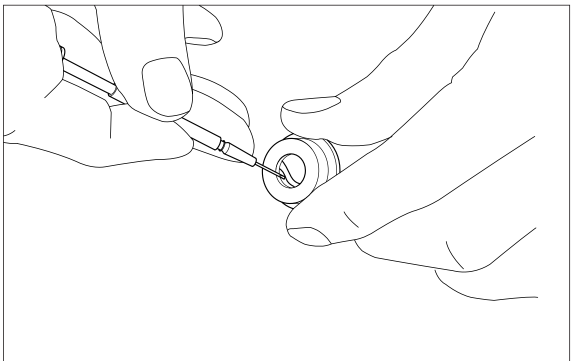


36078RL11

(13) Remove O-ring (10) and seal (11) from plug (8).
Use small minus screwdriver or so on to remove this seal.

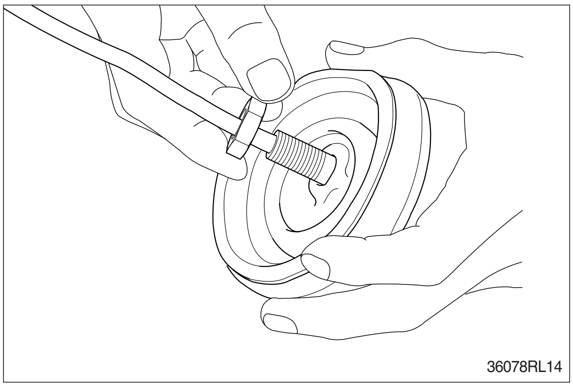


36078RL12

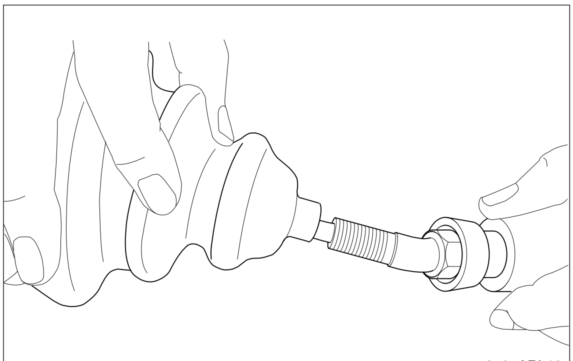


36078RL13

(14) Remove lock nut (22) and then boot (23).



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.

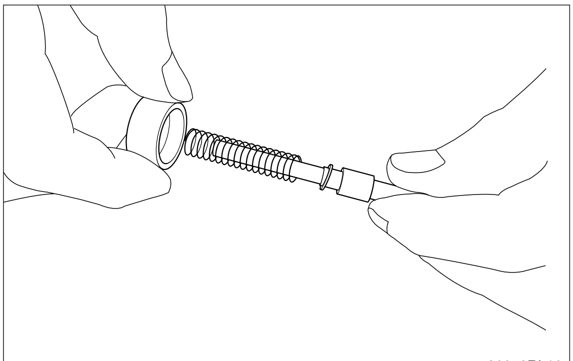
(16) Rust prevention of parts

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

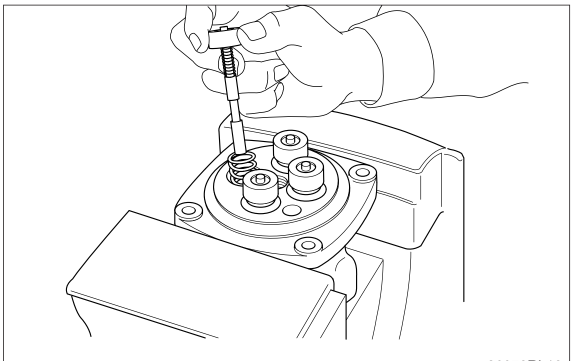
(1) Put shim (4), springs (5) and spring seat (6) onto spool (3) in this order.



36078RL16

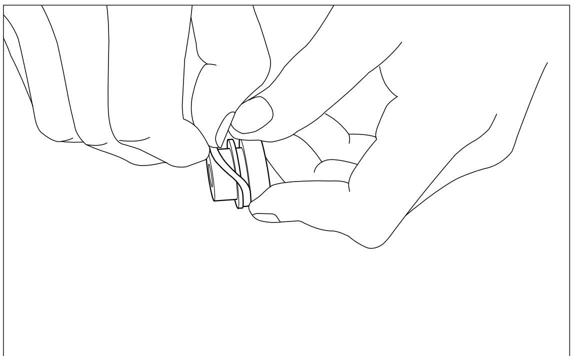
(2) Assemble spring (7) into casing (1). Assemble reducing valve subassembly into casing.

※ Assemble them to their original positions.



36078RL18

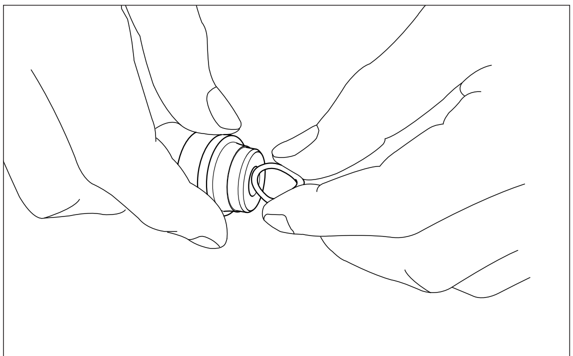
(3) Assemble O-ring (10) onto plug (8).



36078RL19

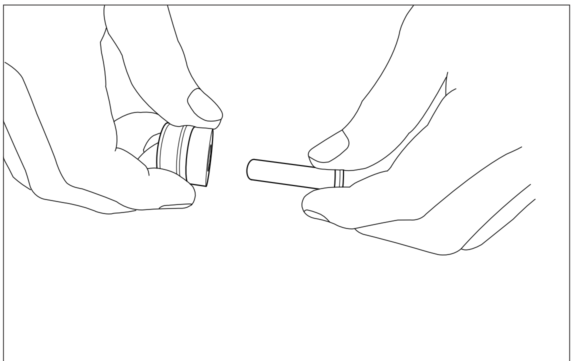
(4) Assemble seal (11) to plug (8).

※ Assemble seal in such lip direction as shown below.

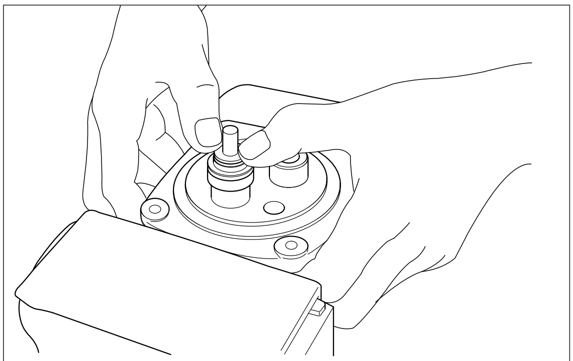


36078RL20

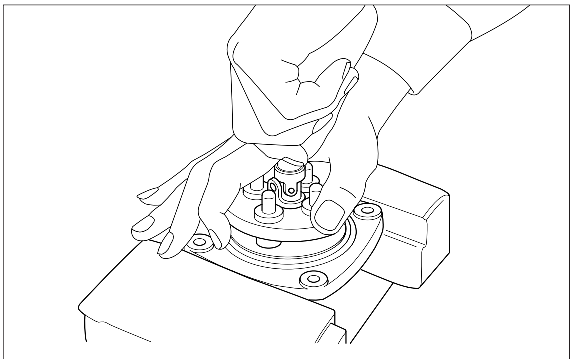
(5) Assemble push rod (9) to plug (8).
※ Apply working oil on push-rod surface.


36078RL21

(6) Assemble plug subassembly to casing.
※ When return spring is weak in force, subassembly stops due to resistance of O-ring.

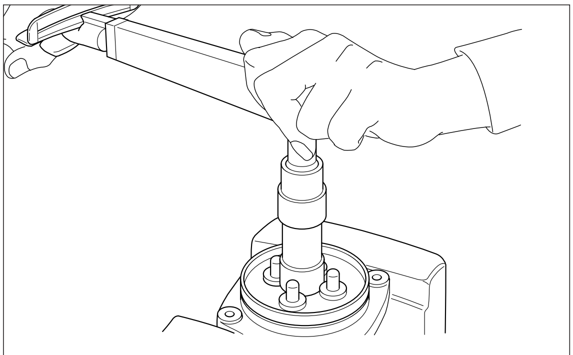

36078RL22

(7) When return spring is strong in force, assemble 4 sets at the same time, utilizing plate (12), and tighten joint (15) temporarily.

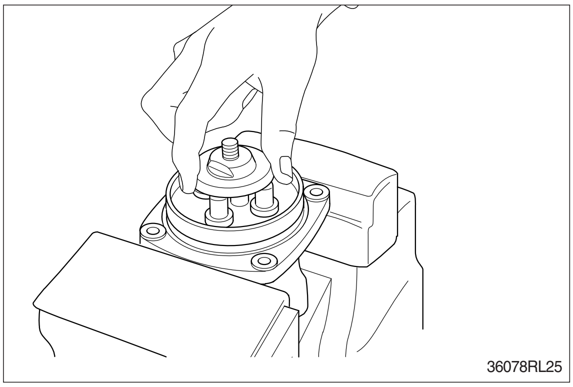

36078RL23

(8) Fit plate (12).

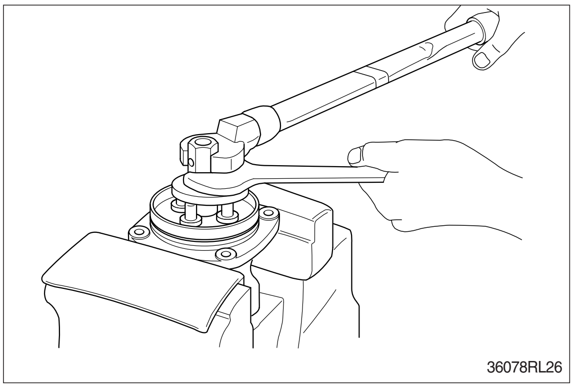
(9) Tighten joint (15) with the specified torque to casing, utilizing jig.


36078RL24

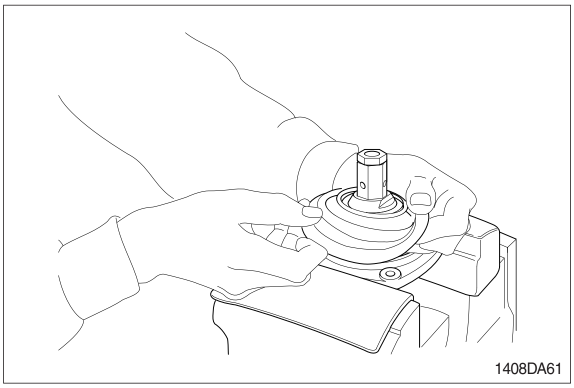
(10) Assemble swash plate (16) to joint (15).
※ Screw it to position that it contacts with 4 push rods evenly.
※ Do not screw it over.


36078RL25

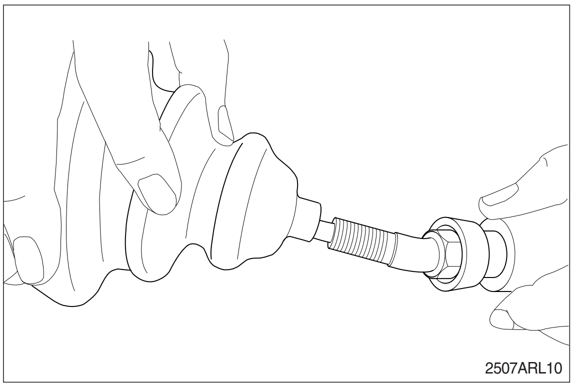
(11) Assemble adjusting nut (17), apply spanner to width across flat of plate (16) to fix it, and tighten adjusting nut to the specified torque.
※ During tightening, do not change position of disk.

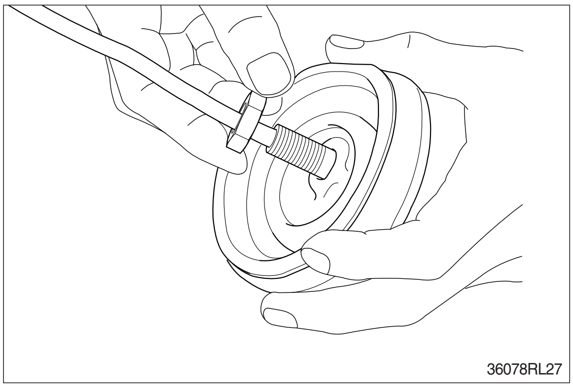

36078RL26

(12) Fit boot (14) to plate.

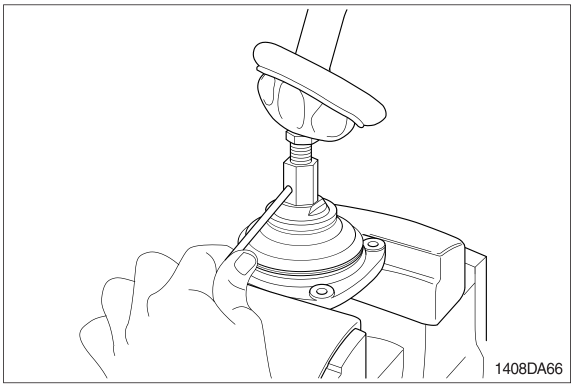

1408DA61

(13) Fit boot (23) and lock nut (22), and handle subassembly is assembled completely.


2507ARL10

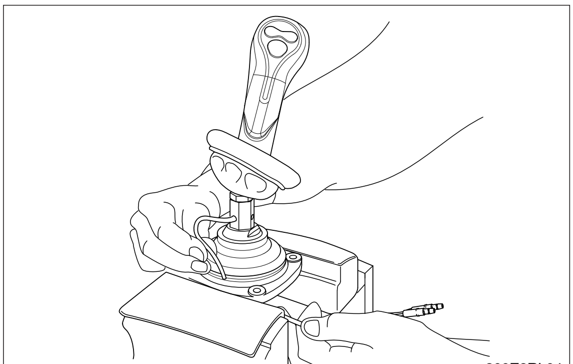

36078RL27

(14) Pull out cord and tube through adjusting nut hole provided in direction 60° to 120° from casing hole.

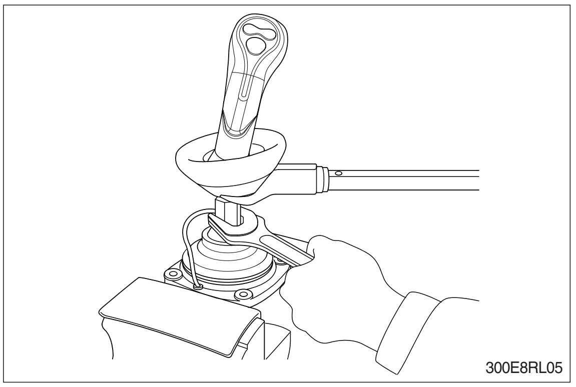

1408DA66

(15) Assemble bushing (18) to plate and pass cord and tube through it.

※ Provide margin necessary to operation.

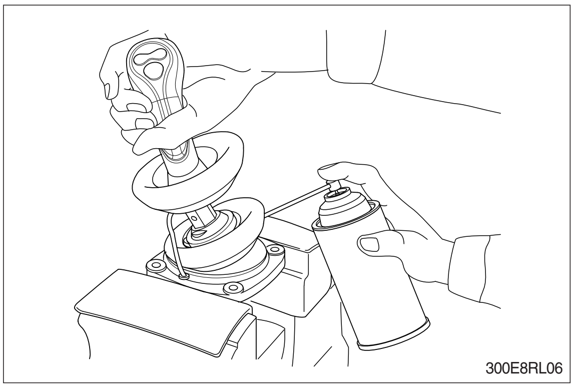

300E8RL04

(16) Determine handle direction, tighten lock nut (22) to specified torque to fix handle.



300E8RL05

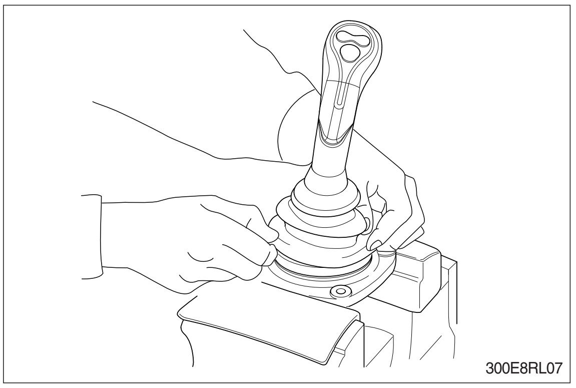
(17) Apply grease to rotating section of joint and contacting faces of disk and push rod.



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.

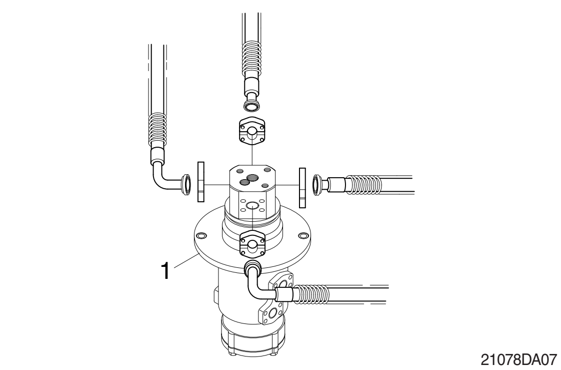
⚠ **Escaping fluid under pressure can penetrate the skin causing serious injury.**

※ When pipes and hoses are disconnected, the oil inside the piping will flow out, so catch it in oil pan.

13031GE18

(4) Disconnect all hoses.

(5) Sling the turning joint assembly (1) and remove the mounting bolt (2).
Weight : 55 kg (120 lb)
Tightening torque : 12.3±1.3 kgf · m
(89.0±9.4 lbf · ft)



21078DA07

(6) Remove the turning joint assembly.

※ When removing the turning joint, check that all the hoses have been disconnected.

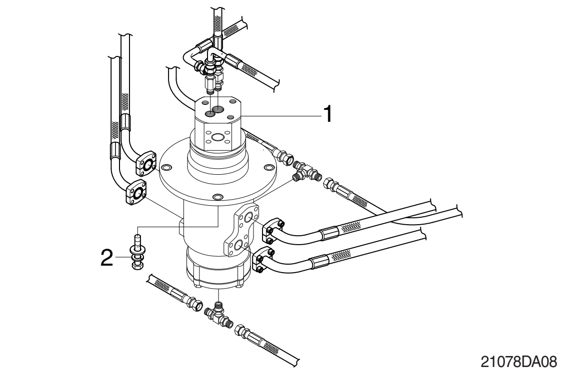
2) INSTALL

(1) Carry out installation in the reverse order to removal.

※ Take care of turning joint direction.

※ Assemble hoses to their original positions.

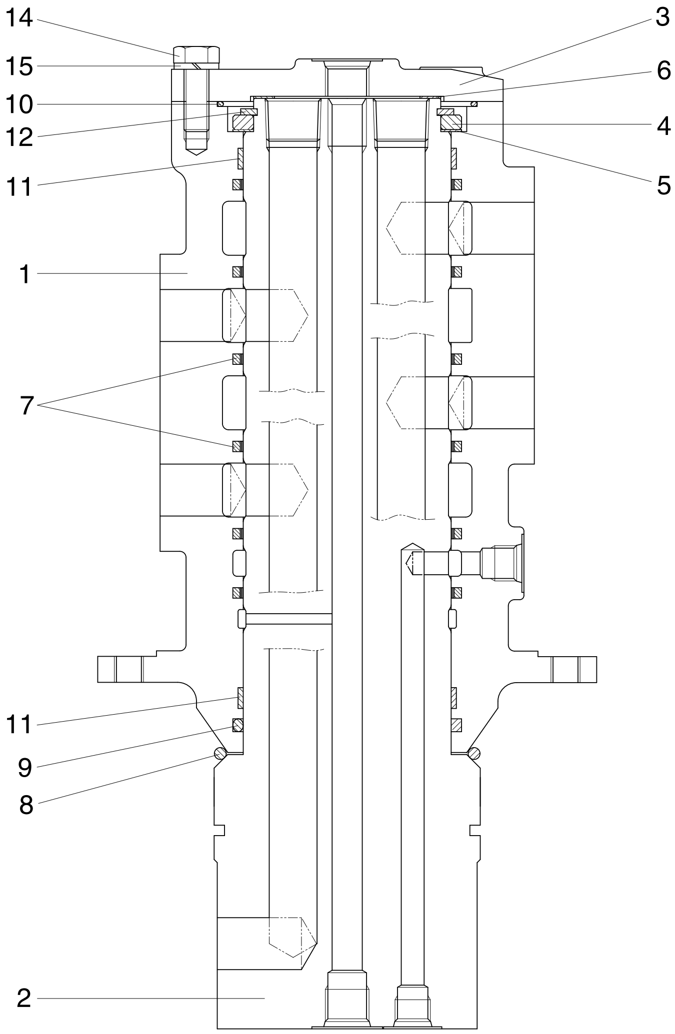
※ Confirm the hydraulic oil level and check the hydraulic oil leak or not.



21078DA08

2. DISASSEMBLY AND ASSEMBLY

1) STRUCTURE



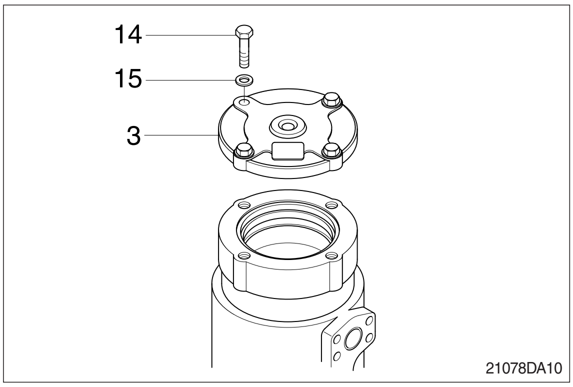
21098TJ01

1	Hub	6	Shim	11	Wear ring
2	Shaft	7	Slipper seal	12	Retainer ring
3	Cover	8	O-ring	13	Plug
4	Spacer	9	O-ring	14	Hexagon bolt
5	Shim	10	O-ring	15	Spring washer

2) DISASSEMBLY

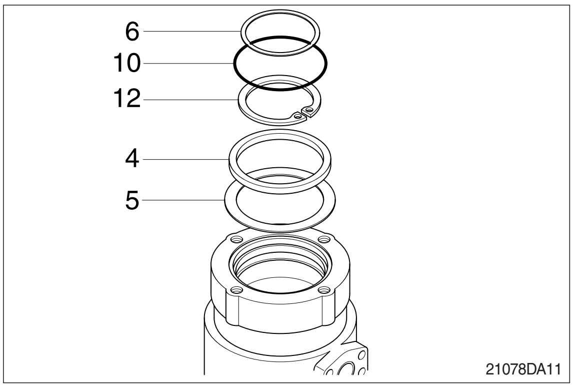
※ Before the disassembly, clean the turning joint.

(1) Remove bolts (14), washer (15) and cover (3).



(2) Remove shim (6) and O-ring (10).

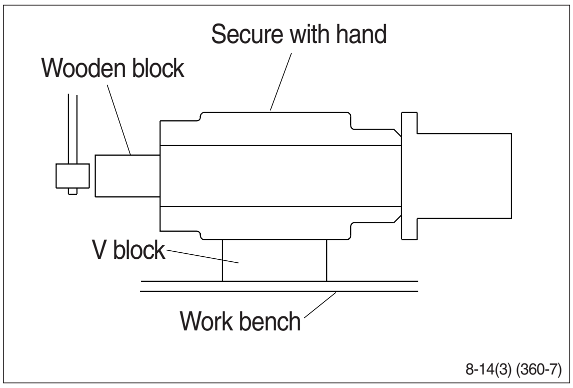
(3) Remove retainer ring (12), spacer (4) and shim (5).



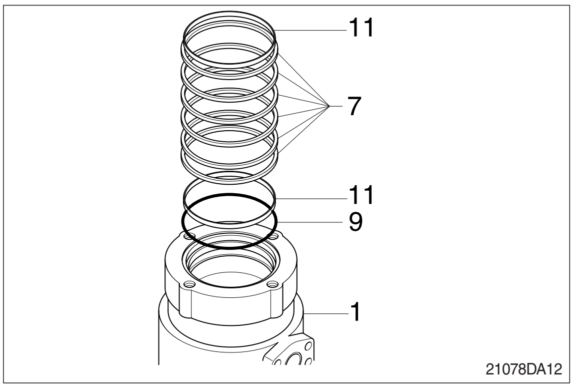
(4) Place hub (1) on a V-block and by using a wood buffer at the shaft end, hit out shaft (2) to about 1/2 from the body with a hammer.

※ Take care not to damage the shaft (2) when remove hub (1) or rest it sideway.

※ Put a fitting mark on hub (1) and shaft (2).



(5) Remove six slipper seals (7) and O-ring (9), two wear ring (11) from hub (1).

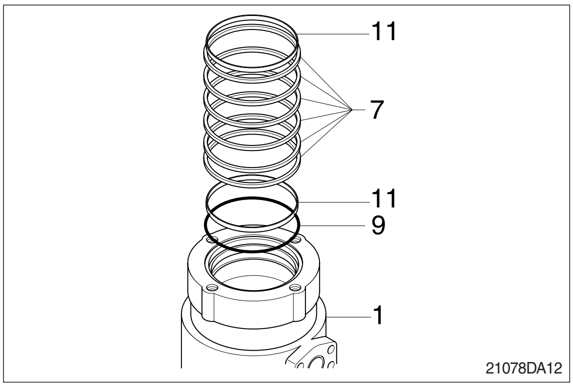


3) ASSEMBLY

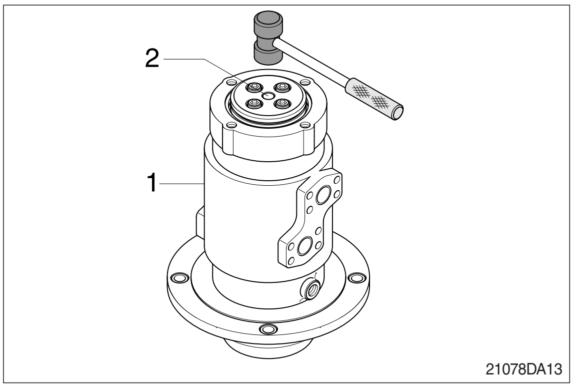
※ Clean all parts.
※ As a general rule, replace oil seals and O-ring.
※ Coat the sliding surfaces of all parts with engine oil or grease before installing.

(1) Fix seven slipper seal (7) and O-ring (9), two wear ring (11) to hub (1).

(2) Fit O-ring (8) to shaft (2).



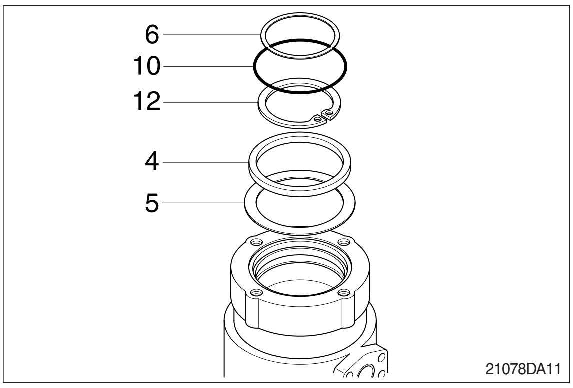
(3) Set shaft (2) on block, tap hub (1) with a plastic hammer to install.



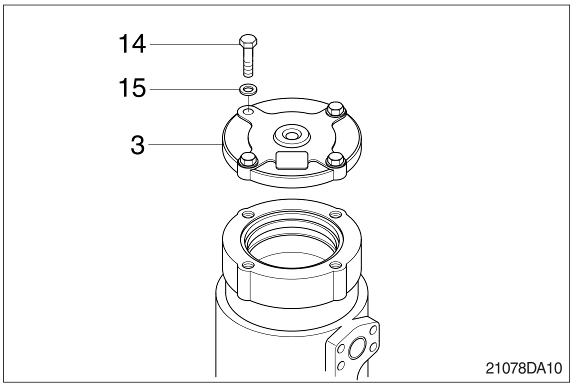
(4) Fit shim (5), spacer (4) and retainer ring (12) to shaft (2).

(5) Fit O-ring (10) to hub (1).

(6) Fit shim (6) to shaft (2).



(7) Install cover (3) to body (1) and tighten bolts (14).
Torque : 10~12.5 kgf · m
(72.3~90.4 lbf · ft)



1. REMOVAL AND INSTALL

1) BUCKET CYLINDER

(1) Removal


13031GE18

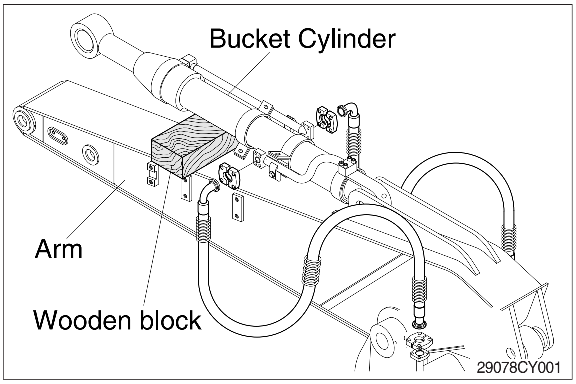
※ Expand the arm and bucket fully, lower the work equipment to the ground and stop the engine.

※ Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

⚠ **Loosen the breather slowly to release the pressure inside the hydraulic tank.**

※ Escaping fluid under pressure can penetrate the skin causing serious injury. Fit blind plugs in the hoses after disconnecting them, to prevent dirt or dust from entering.

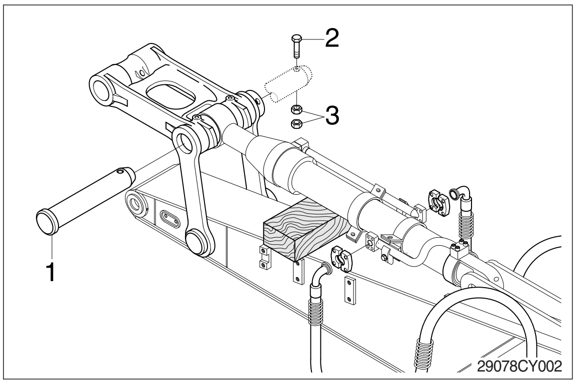
① Set block between bucket cylinder and arm.



29078CY001

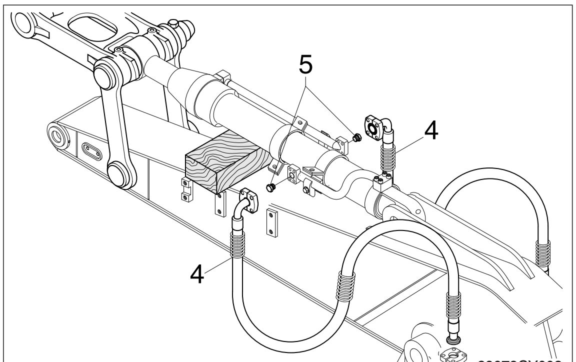
② Remove bolt (2), nut (3) and pull out pin (1).

※ Tie the rod with wire to prevent it from coming out.



29078CY002

③ Disconnect bucket cylinder hoses (4) and put plugs (5) on cylinder pipe.

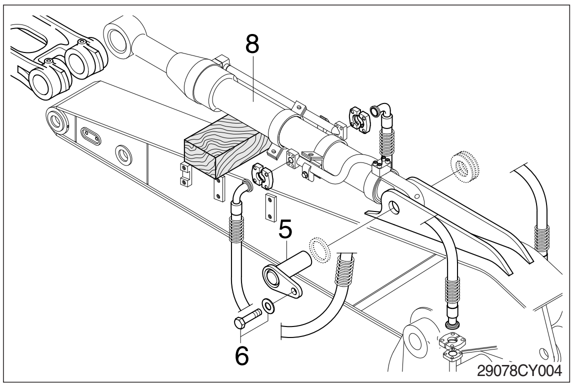


29078CY003

④ Sling bucket cylinder assembly (8) and remove bolt (6) then pull out pin (5).

⑤ Remove bucket cylinder assembly (8).

· Weight : HX480 L : 360 kg (790 lb)
HX520 L : 400 kg (880 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.

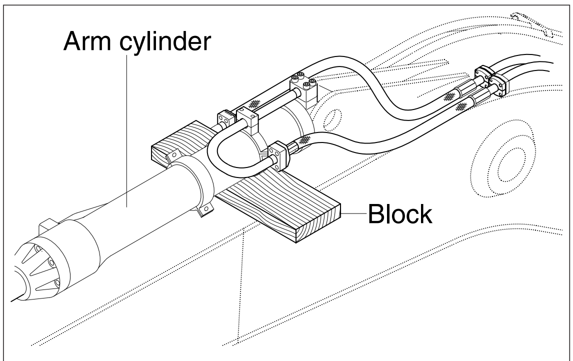
※ Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

⚠ **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.


13031GE18

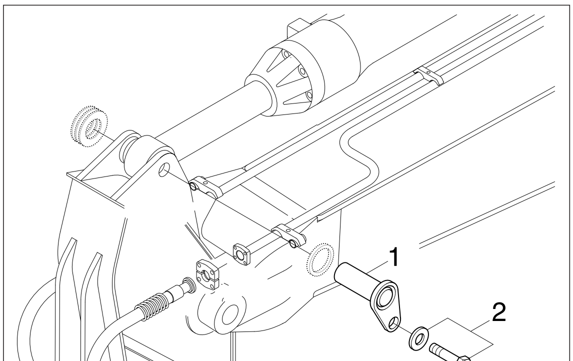
① Set block between arm cylinder and boom.



29078CY01

② Remove bolt (2) and pull out pin (1).

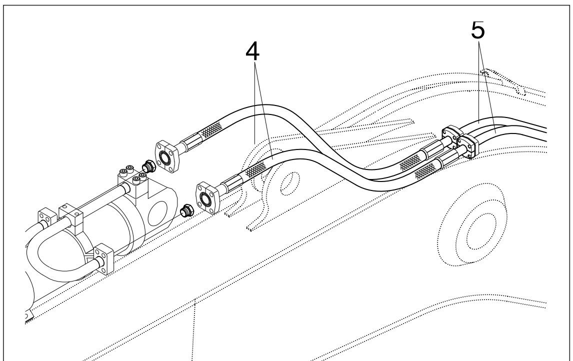
※ Tie the rod with wire to prevent it from coming out.



29078CY02

③ Disconnect arm cylinder hoses (4) and put plugs on cylinder pipe.

④ Disconnect greasing pipings (5).

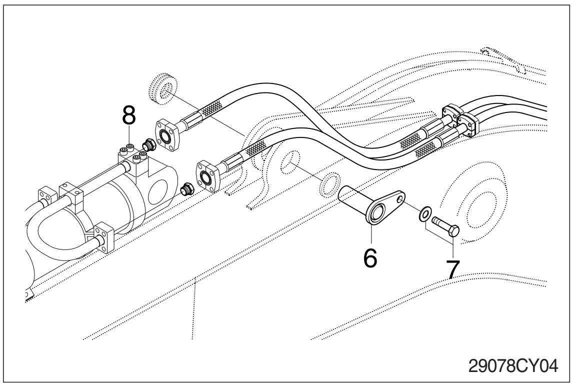


29078CY03

⑤ Sling arm assembly (8) and remove bolt (7) then pull out pin (6).

⑥ Remove arm cylinder assembly (8).

- Weight : 600 ㎏ (1320 ℔)



(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.

13031GE18

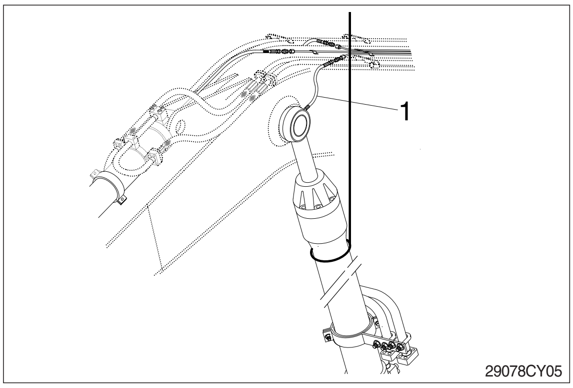
※ Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

⚠ **Loosen the breather slowly to release the pressure inside the hydraulic tank.**

※ Escaping fluid under pressure can penetrate the skin causing serious injury. Fit blind plugs in the hoses after disconnecting them, to prevent dirt or dust from entering.

① Disconnect greasing hoses (1).

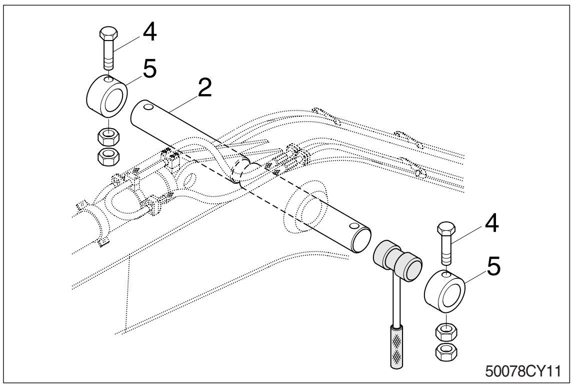
② Sling boom cylinder assembly.



29078CY05

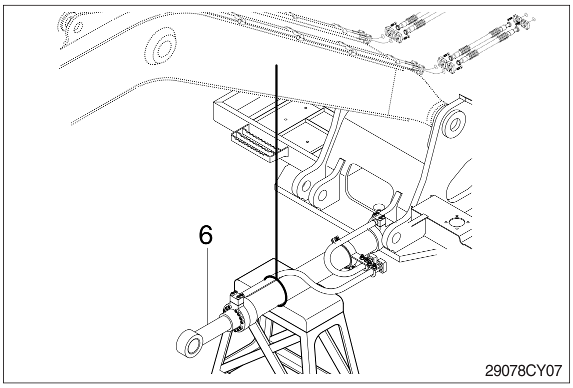
③ Remove bolt (4), pin stopper (5) and pull out pin (2).

※ Tie the rod with wire to prevent it from coming out.



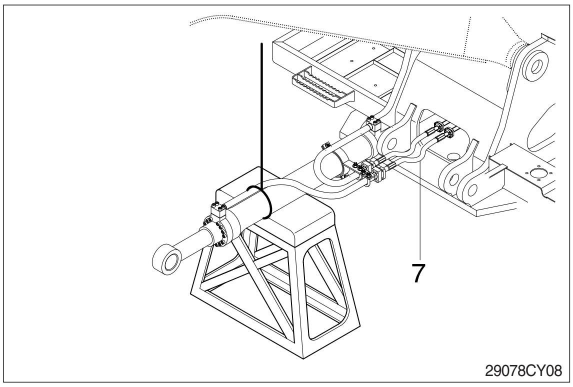
50078CY11

④ Lower the boom cylinder assembly (6) on a stand.



29078CY07

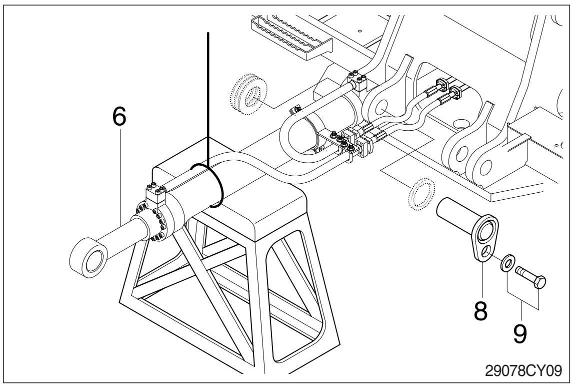
⑤ Disconnect boom cylinder hoses (7) and put plugs on cylinder pipe.



⑥ Remove bolt (9) and pull out pin (8).

⑦ Remove boom cylinder assembly (6).

· Weight : 415 ㎏ (915 ℔)



(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.

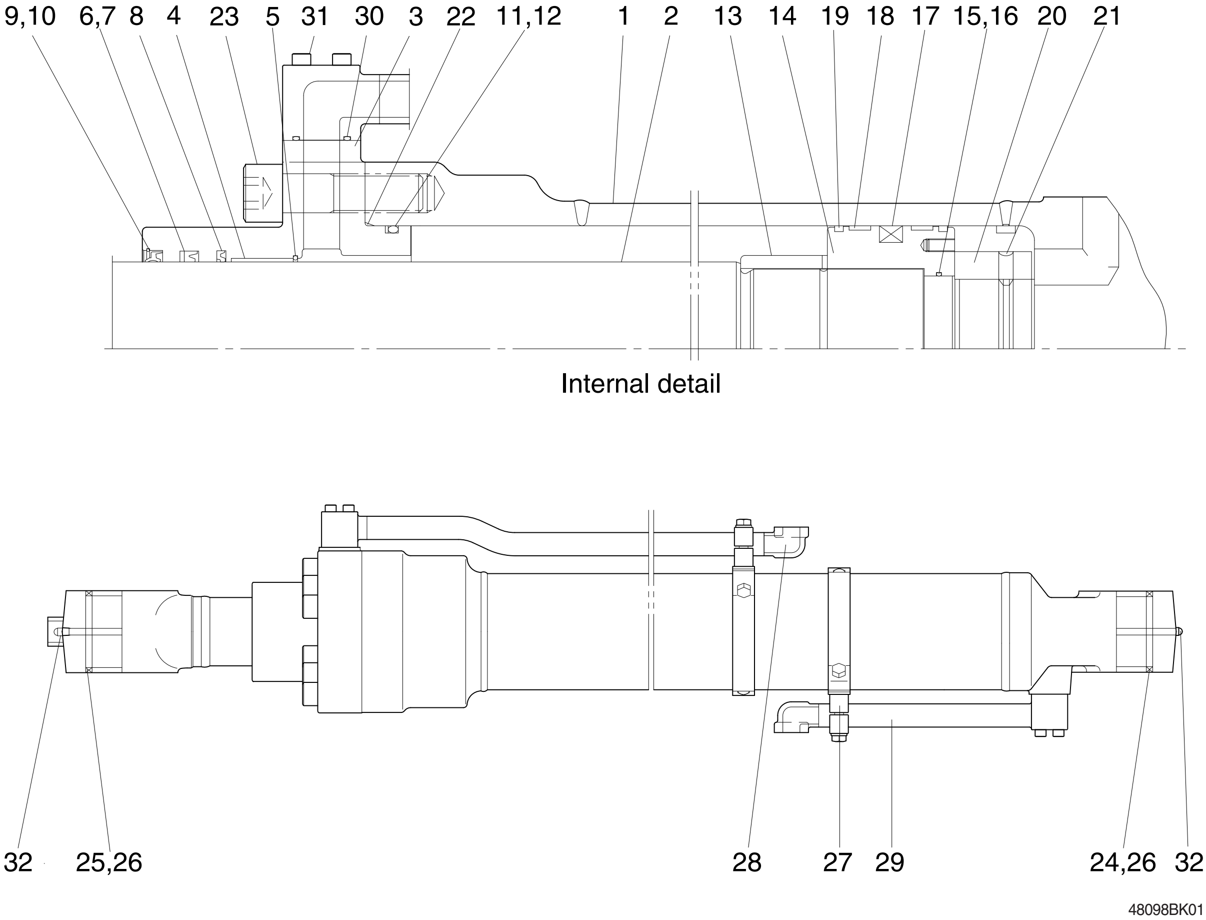
※ Bleed the air from the boom cylinder.

※ Conformed the hydraulic oil level and check the hydraulic oil leak or not.

2. DISASSEMBLY AND ASSEMBLY

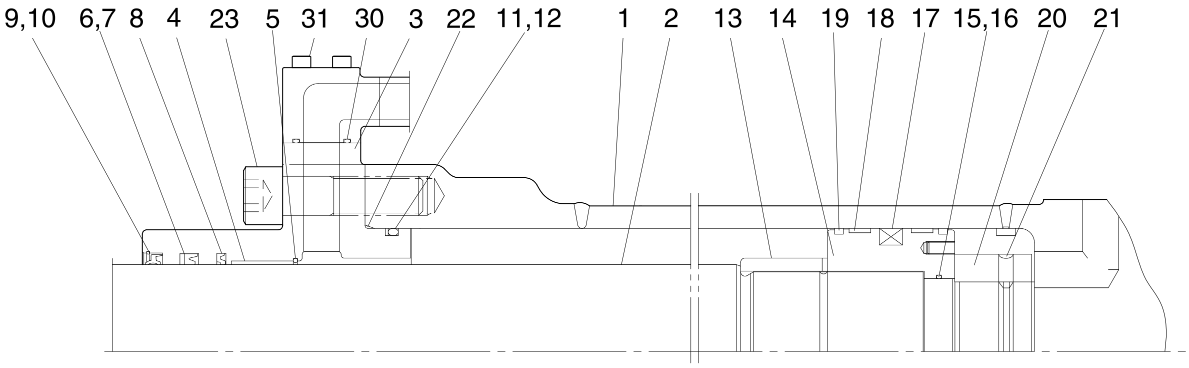
1) STRUCTURE

(1) Bucket cylinder (HX480 L)

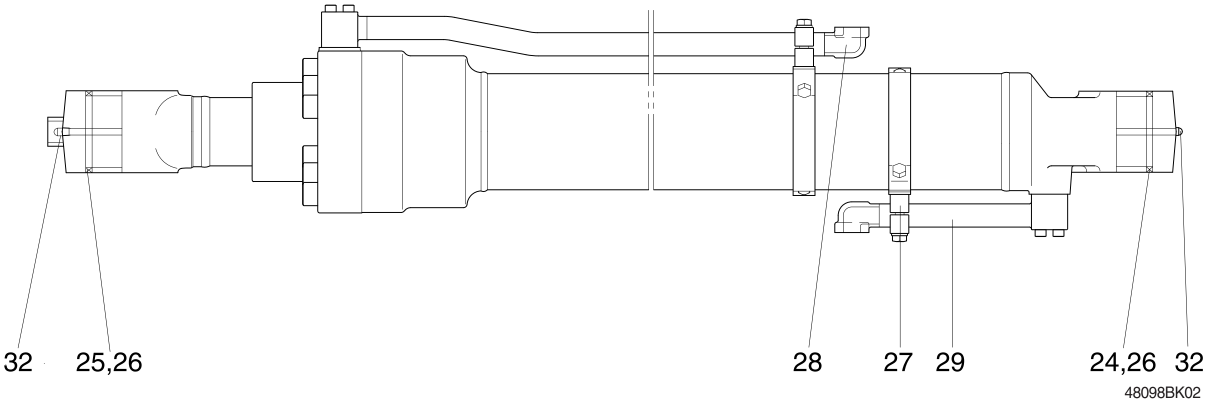


1	Tube assembly	12	Back up ring	23	Hexagon socket head bolt
2	Rod assembly	13	Cushion ring	24	Pin bushing
3	Gland	14	Piston	25	Pin bushing
4	DD2 bushing	15	O-ring	26	Dust seal
5	Snap ring	16	Back up ring	27	Band assembly
6	Rod seal	17	Piston seal	28	Pipe assembly
7	Back up ring	18	Wear ring	29	Pipe assembly
8	Buffer ring	19	Dust ring	30	O-ring
9	Dust wiper	20	Lock nut	31	Hexagon socket head bolt
10	Snap ring	21	Hexagon socket head bolt	32	Grease nipple
11	O-ring	22	O-ring		

(2) Bucket cylinder (HX520 L)

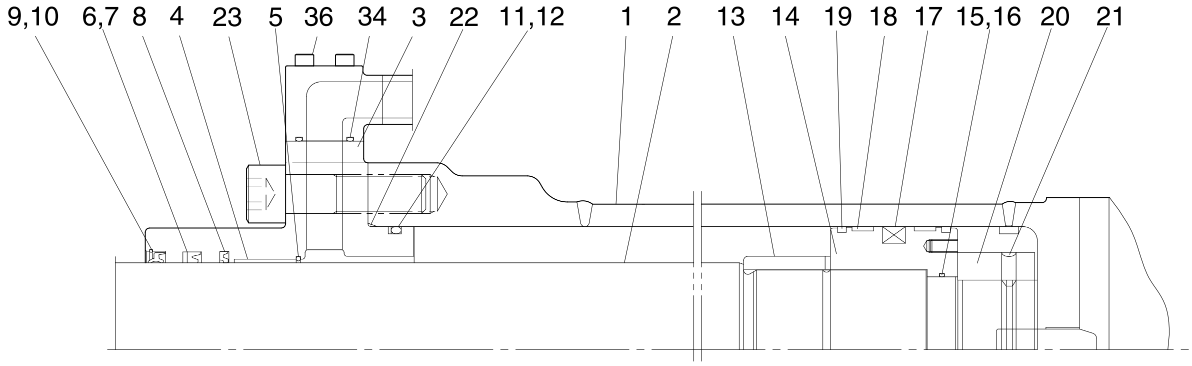


Internal detail

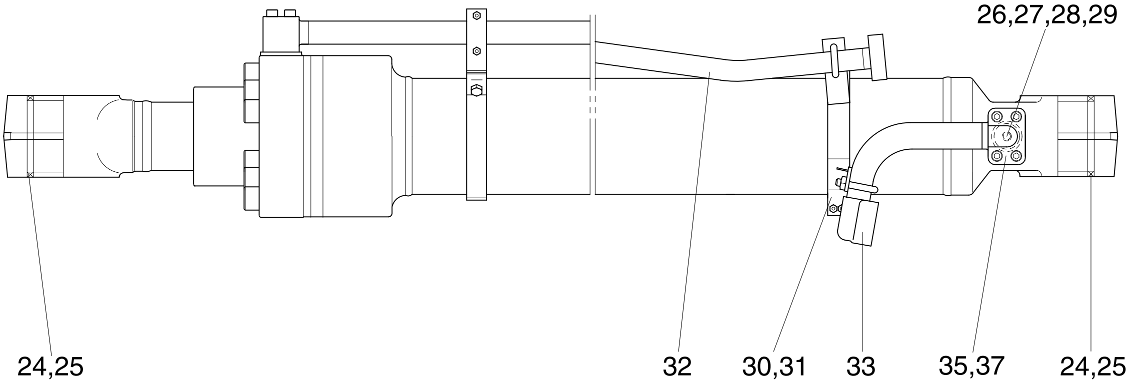


1	Tube assembly	12	Back up ring	23	Hexagon socket head bolt
2	Rod assembly	13	Cushion ring	24	Pin bushing
3	Gland	14	Piston	25	Pin bushing
4	DD2 bushing	15	O-ring	26	Dust seal
5	Snap ring	16	Back up ring	27	Band assembly
6	Rod seal	17	Piston seal	28	Pipe assembly
7	Back up ring	18	Wear ring	29	Pipe assembly
8	Buffer ring	19	Dust ring	30	O-ring
9	Dust wiper	20	Lock nut	31	Hexagon socket head bolt
10	Snap ring	21	Hexagon socket head bolt	32	Grease nipple
11	O-ring	22	O-ring		

(3) Arm cylinder



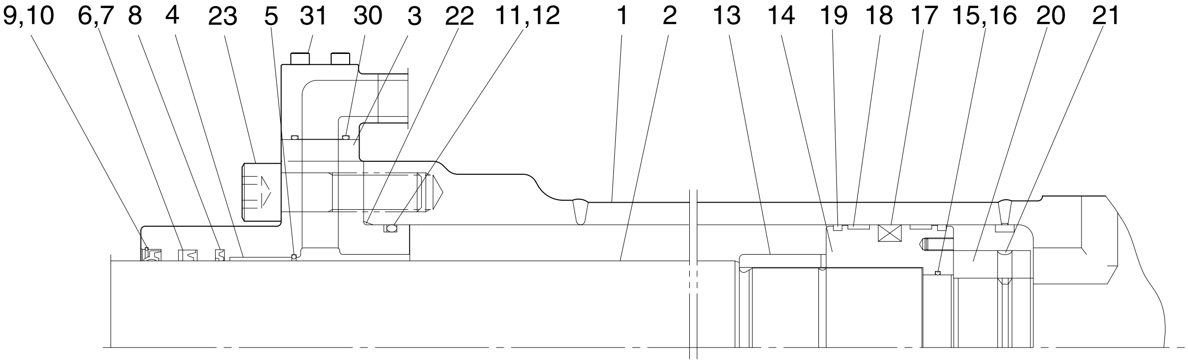
Internal detail



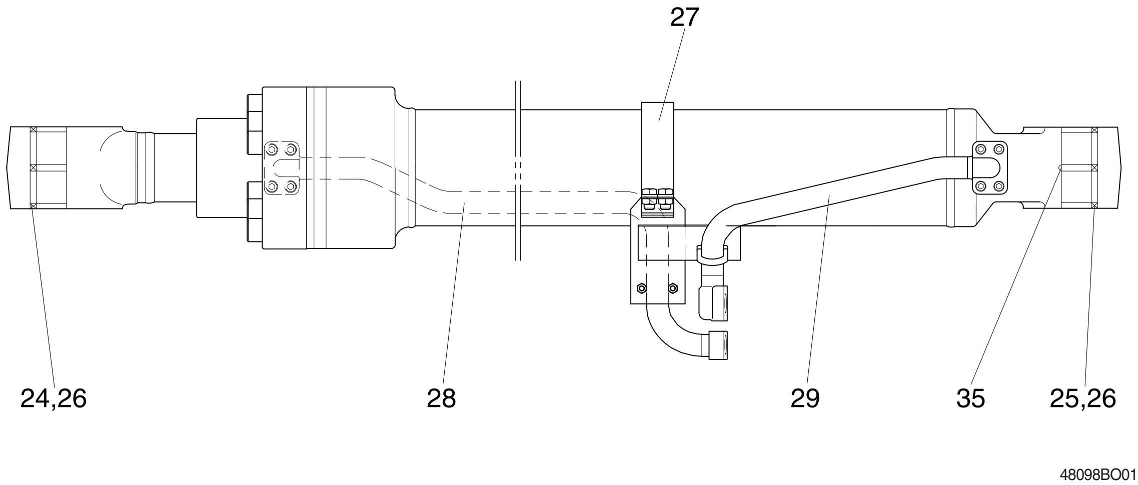
480L8AM01

1	Tube assembly	14	Piston	27	Coil spring
2	Rod assembly	15	O-ring	28	O-ring
3	Gland	16	Back up ring	29	Plug
4	DD2 bushing	17	Piston seal	30	Band assembly
5	Snap ring	18	Wear ring	31	Band assembly
6	Rod seal	19	Dust ring	32	Pipe assembly
7	Back up ring	20	Lock nut	33	Pipe assembly
8	Buffer ring	21	Hexagon socket set screw	34	O-ring
9	Dust wiper	22	O-ring	35	O-ring
10	Snap ring	23	Hexagon socket head bolt	36	Hexagon socket head bolt
11	O-ring	24	Pin bushing	37	Hexagon socket head bolt
12	Back up ring	25	Dust seal		
13	Cushion ring	26	Check valve		

(4) Boom cylinder



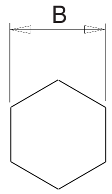
Internal detail



1	Tube assembly	12	Back up ring	23	Hexagon socket head bolt
2	Rod assembly	13	Cushion ring	24	Pin bushing
3	Gland	14	Piston	25	Pin bushing
4	DD2 bushing	15	O-ring	26	Dust seal
5	Snap ring	16	Back up ring	27	Band assembly
6	Rod seal	17	Piston seal	28	Pipe assembly
7	Back up ring	18	Wear ring	29	Pipe assembly
8	Buffer ring	19	Dust ring	30	O-ring
9	Dust wiper	20	Lock nut	31	Hexagon socket head bolt
10	Snap ring	21	Hexagon socket set screw	35	Grease nipple
11	O-ring	22	O-ring		

2) TOOLS AND TIGHTENING TORQUE

(1) Tools

Allen wrench	10	
	14	
	18	
	24	
	30	
(-) Driver	Small and large sizes	
Torque wrench	Capable of tightening with the specified torques	

(2) Tightening torque

Part name		Item	Size	Torque	
				kgf · m	lbf · ft
Piston	Bucket cylinder	14	-	200±20	1447±145
	Boom cylinder	14	-	150±15	1085±108
	Arm cylinder	14	-	200±20	1447±145
Piston lock nut	Bucket cylinder	20	-	150±15	1085±108
	Boom cylinder	20	-	100±10	723±72
	Arm cylinder	20	-	150±15	1085±108
Socket head bolt	Bucket cylinder	23	M22	63.0±6.0	456±43
		31	M12	9.4±1.0	67.9±7.2
	Boom cylinder	23	M22	63.0±6.0	456±43
		31	M12	9.4±1.0	67.9±7.2
	Arm cylinder	23	M24	79.0±8.0	571±58
		36	M12	9.4±1.0	67.9±7.2

3) DISASSEMBLY

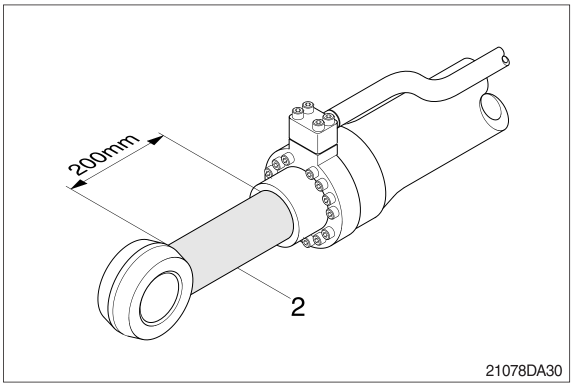
(1) Remove cylinder head and piston rod

※ 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.



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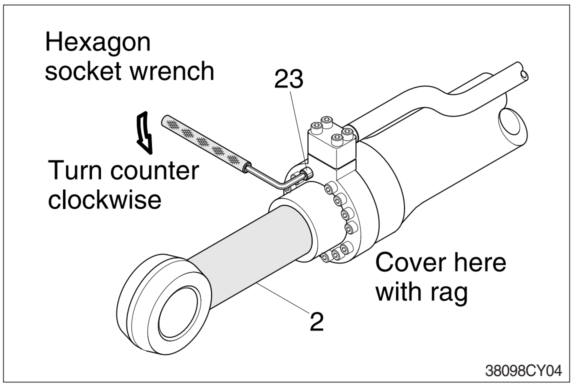
③ Loosen and remove socket bolts (23) of the gland in sequence.

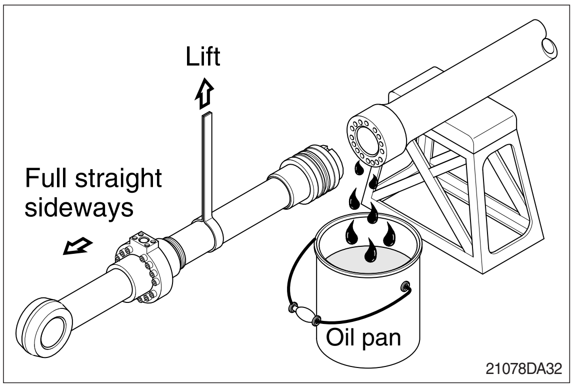
※ Cover the extracted rod assembly (2) with rag to prevent it from being accidentally damaged during operation.



38098CY04

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.

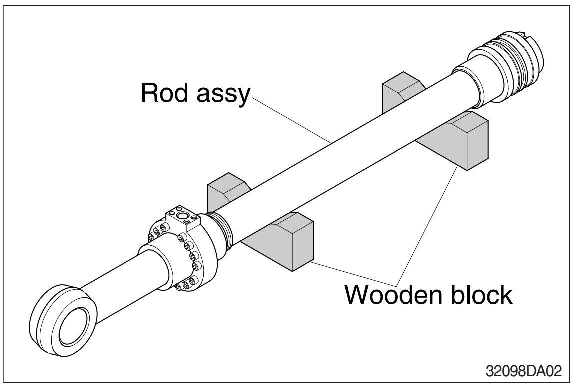


21078DA32

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.

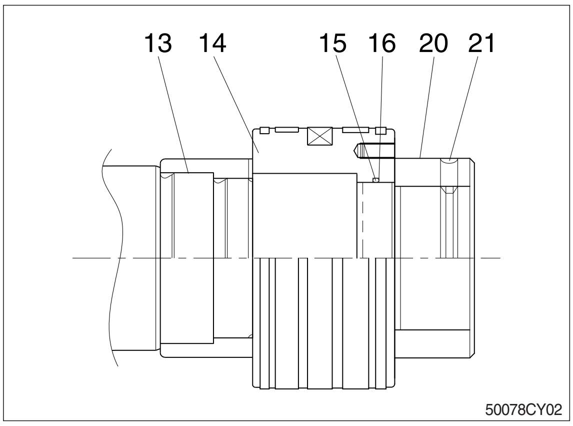


(3) Remove piston and cylinder head

① Loosen socket set screw (21) and remove lock nut (20).

※ Since lock nut (20) is tightened to a high torque use a hydraulic and power wrench that utilizers a hydraulic cylinder, to remove lock nut (20).

② Remove piston assembly (14), back up ring (16), and O-ring (15).

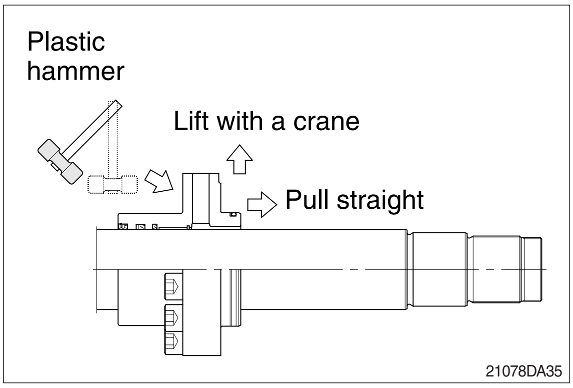


③ Remove the cylinder head assembly from rod assembly (2).

※ 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).

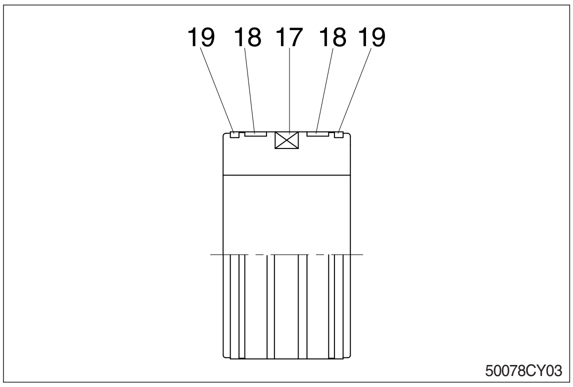


(3) Disassemble the piston assembly

① Remove wear ring (18).

② Remove dust ring (19) and piston seal (17).

※ Exercise care in this operation not to damage the grooves.



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(4) Disassemble cylinder head assembly

① Remove back up ring (12) and O-ring (11).

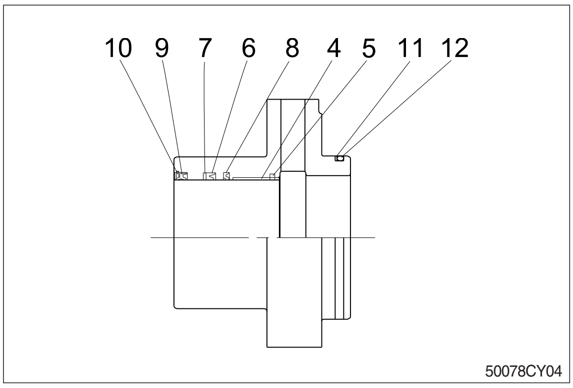
② Remove snap ring (10), dust wiper (9).

③ Remove back up ring (7), rod seal (6) and buffer ring (8) and snap ring (5).

※ 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).



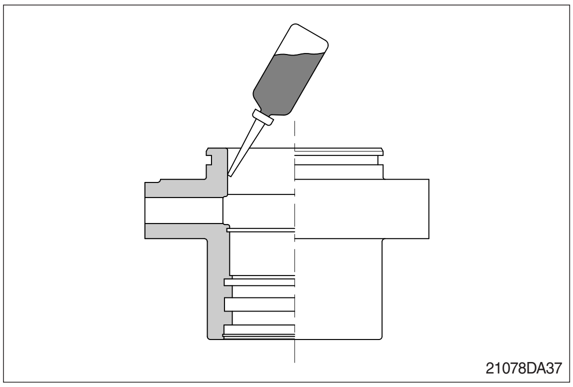
50078CY04

3) ASSEMBLY

(1) Assemble cylinder head assembly

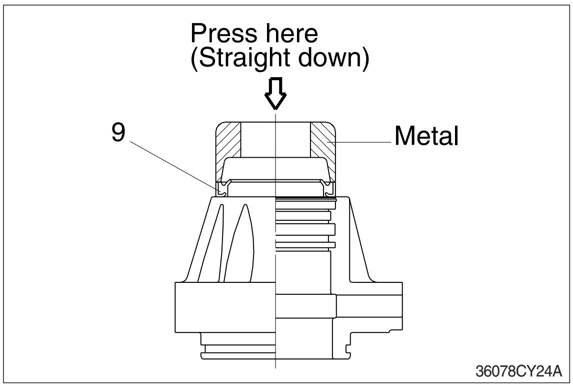
※ Check for scratches or rough surfaces if found smooth with an oil stone.

① Coat the inner face of gland (3) with hydraulic oil.



② Coat dust wiper (9) with grease and fit dust wiper (9) to the bottom of the hole of dust seal.
At this time, press a pad metal to the metal ring of dust seal.

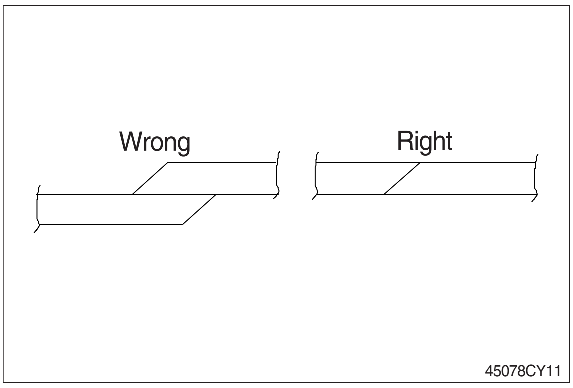
③ Fit snap ring (10) to the stop face.



④ Fit back up ring (7), rod seal (6) and buffer ring (8) to corresponding grooves, in that order.

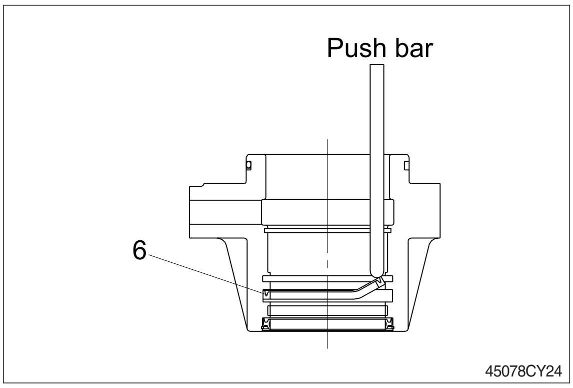
※ Coat each packing with hydraulic oil before fitting it.

※ Insert the backup ring until one side of it is inserted into groove.



※ Rod seal (6) has its own fitting direction. Therefore, confirm it before fitting them.

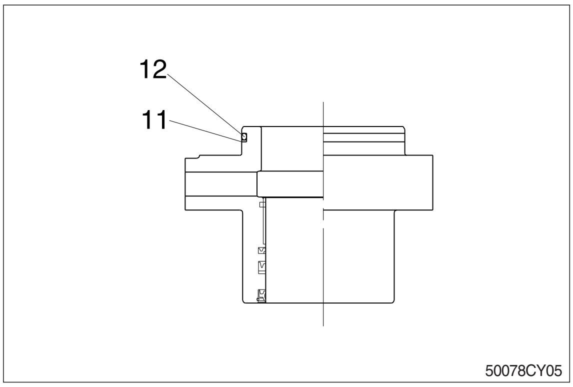
※ Fitting rod seal (6) upside down may damage its lip. Therefore check the correct direction that is shown in fig.



⑤ Fit back up ring (12) to gland (3).

※ Put the backup ring in the warm water of 30~50˚C.

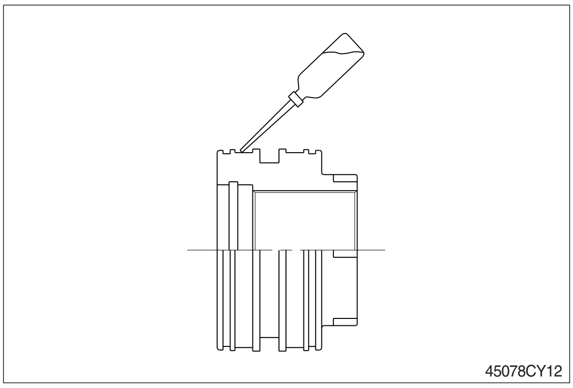
⑥ Fit O-ring (11) to gland (3).



(2) Assemble piston assembly

※ Check for scratches or rough surfaces. If found smooth with an oil stone.

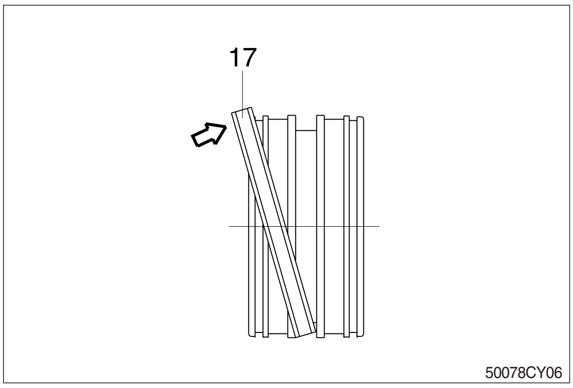
① Coat the outer face of piston (14) with hydraulic oil.



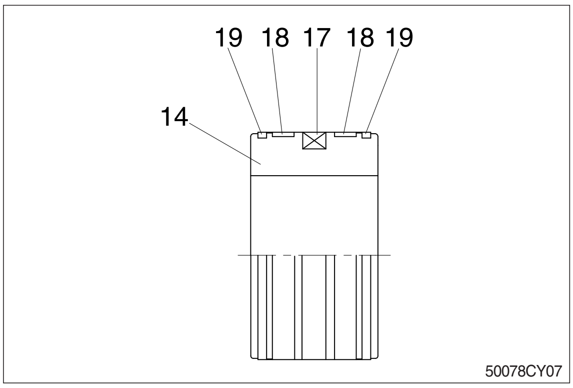
② Fit piston seal (17) to piston.

※ Put the piston seal in the warm water of 60~100˚C for more than 5 minutes.

※ After assembling the piston seal, press its outer diameter to fit in.

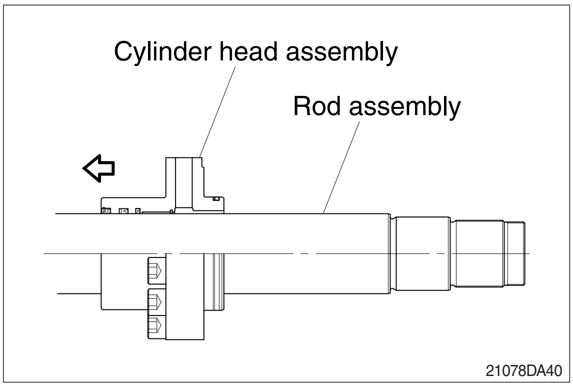


③ Fit wear ring (18) and dust ring (19) to piston (14).

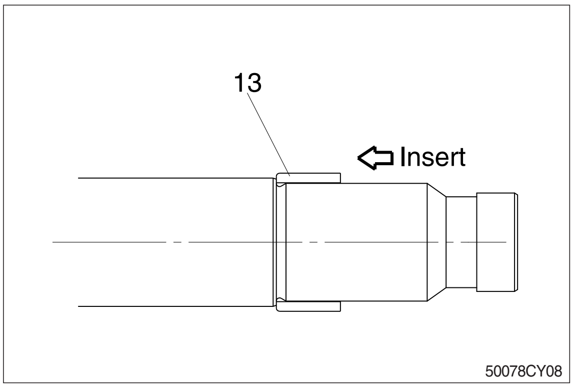


(3) Install piston and cylinder head

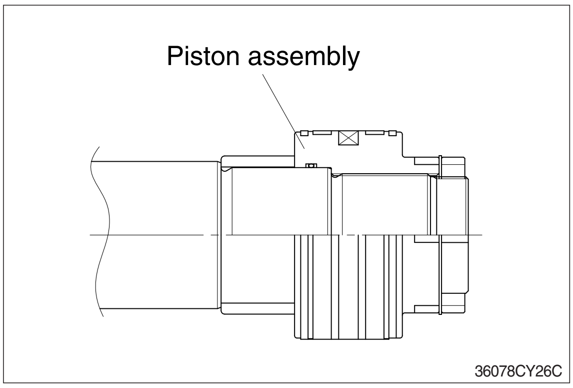
① Fix the rod assembly to the work bench.
② Apply hydraulic oil to the outer surface of rod assembly (2), the inner surface of piston and cylinder head.
③ Insert cylinder head assembly to rod assembly.



④ Insert cushion ring (13) to rod assembly.
※ Note that cushion ring (13) has a direction in which it should be fitted.



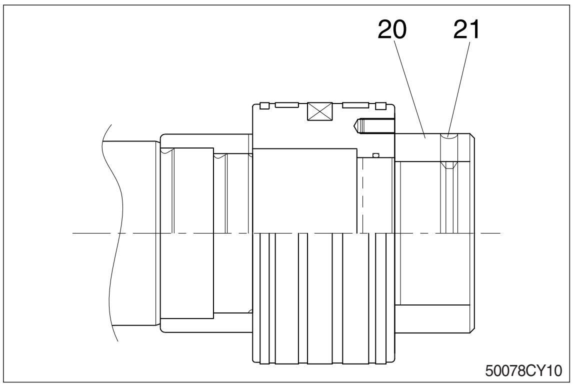
⑤ Fit piston assembly to rod assembly.
· Tightening torque : 200±20 kgf · m
(1447±145 lbf · ft)



⑥ Fit lock nut (20) and tighten the set screw (21).

· Tightening torque :

Item		kgf · m	lbf · ft
Bucket	20	150±15	1085±108
	21	5.4±0.5	39.1±3.6
Boom	20	100±10	723±72
	21	5.4±0.5	39.1±3.6
Arm	20	150±15	1085±108
	21	5.4±0.5	39.1±3.6



50078CY10

(3) Overall assemble

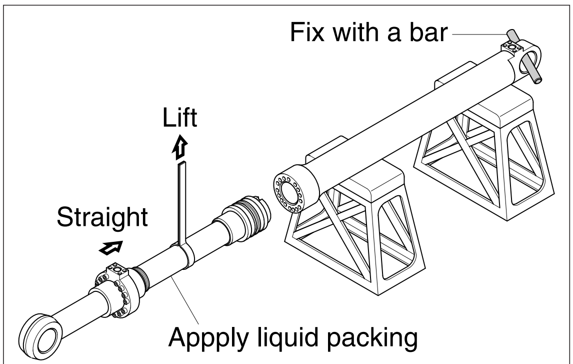
① Place a V-block on a rigid work bench. Mount the tube assembly (1) on it and fix the assembly by passing a bar through the clevis pin hole to lock the assembly.

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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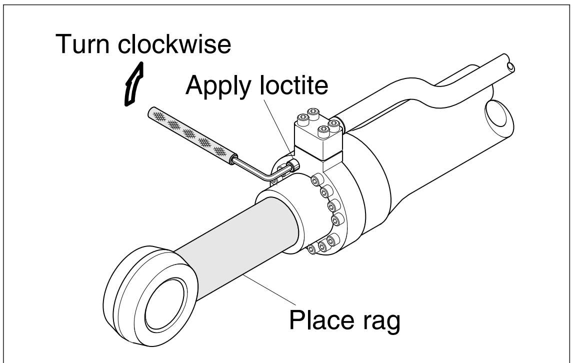


21078DA42

GROUP 10 UNDERCARRIAGE

1. TRACK LINK

1) REMOVAL

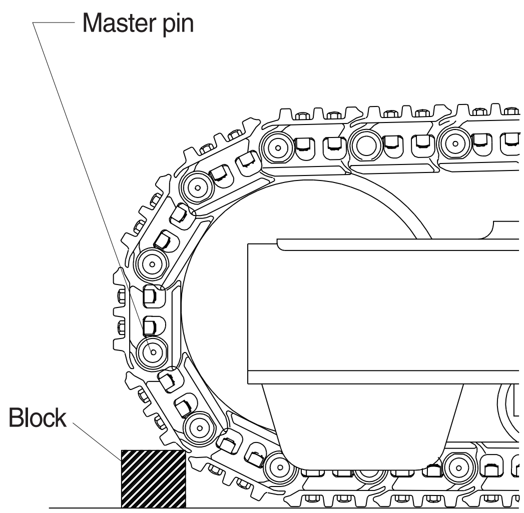
(1) Move track link until master pin is over front idler in the position put wooden block as shown.

(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.

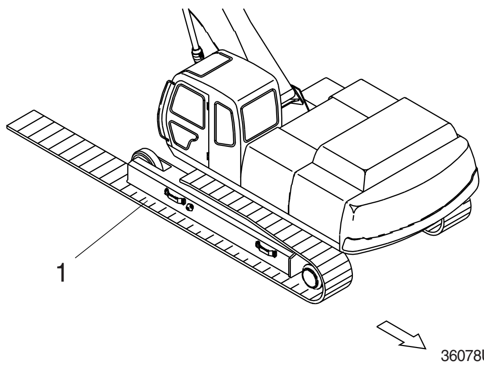


45078UC11

(4) Move the machine slowly in reverse, and lay out track link assembly (1).

※ Jack up the machine and put wooden block under the machine.

※ Don't get close to the sprocket side as the track shoe plate may fall down on your feet.

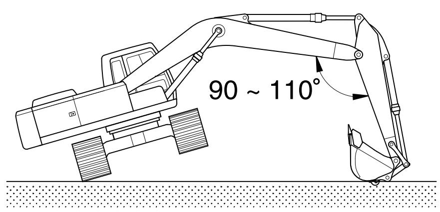


36078UC10

2) INSTALL

(1) Carry out installation in the reverse order to removal.

※ Adjust the tension of the track link.

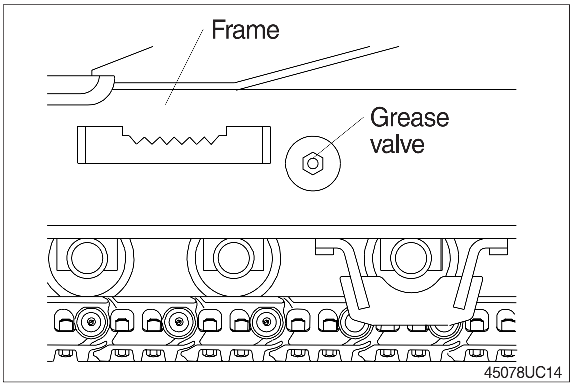


21074OP14

2. CARRIER ROLLER

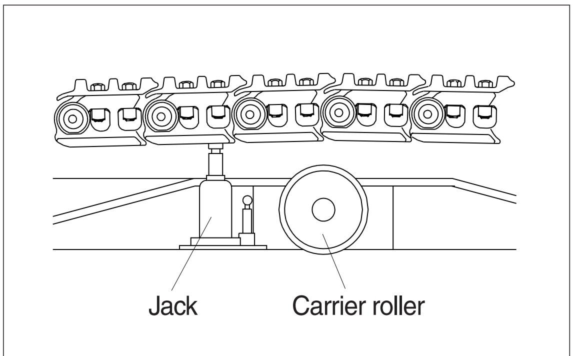
1) REMOVAL

(1) Loosen tension of the track link.



45078UC14

(2) Jack up the track link height enough to permit carrier roller removal.

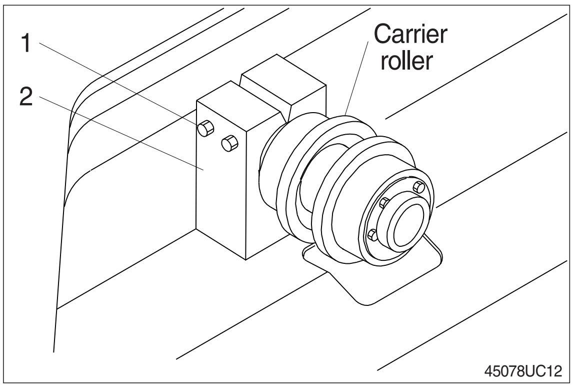


45078UC13

(3) Loosen the lock nut (1).

(4) Open bracket (2) with a screwdriver, push out from inside, and remove carrier roller assembly.

· Weight : 40 ㎏ (90 ℔)



45078UC12

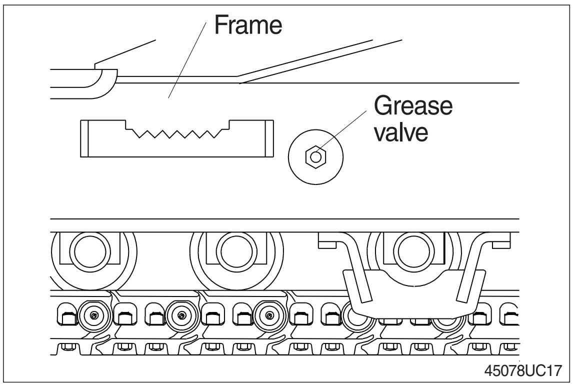
2) INSTALL

(1) Carry out installation in the reverse order to removal.

3. TRACK ROLLER

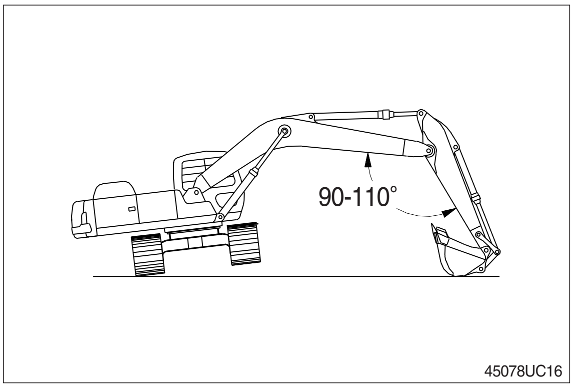
1) REMOVAL

(1) Loosen tension of the track link.



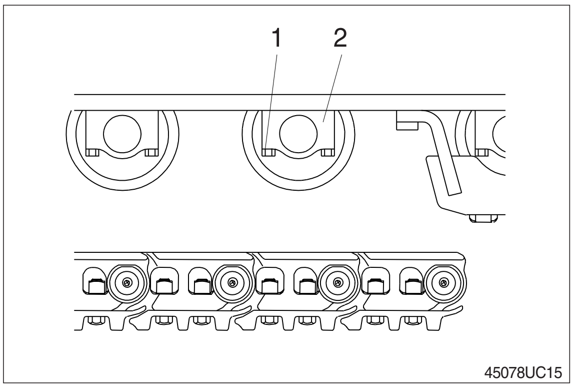
(2) Using the work equipment, push up track frame on side which is to be removed.

※ After jack up the machine, set a block under the unit.



(3) Remove the mounting bolt (1) and draw out the track roller (2).

· Weight : 87 ㎏ (190 ㏈)



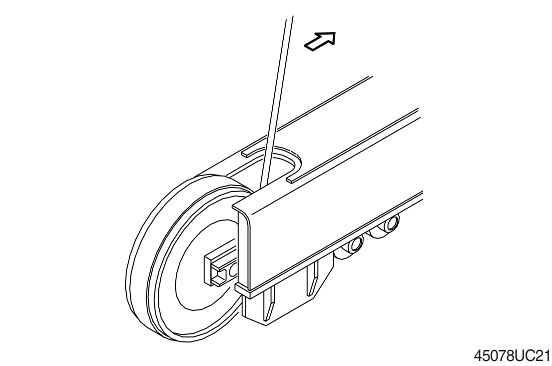
2) INSTALL

(1) Carry out installation in the reverse order to removal.

4. IDLER AND RECOIL SPRING

1) REMOVAL

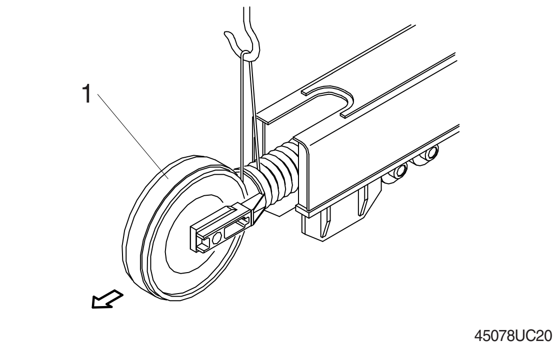
(1) Remove the track link.
For detail, see removal of track link.



45078UC21

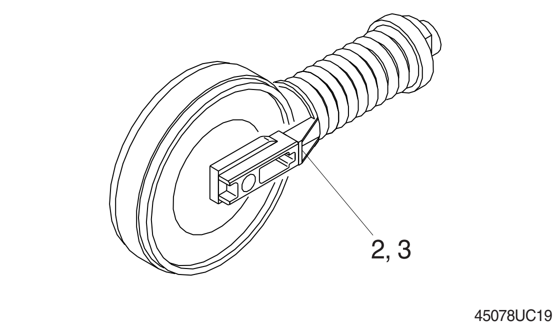
(2) Sling the recoil spring (1) and pull out idler and recoil spring assembly from track frame, using a pry.

· Weight : 550 ㎏ (1210 ℔)



45078UC20

(3) Remove the bolts (2), washers (3) and separate ilder from recoil spring.

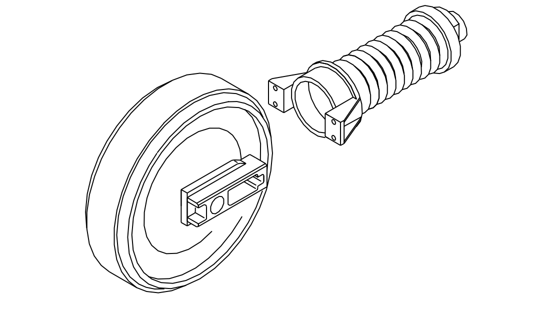


45078UC19

2) INSTALL

(1) Carry out installation in the reverse order to removal.

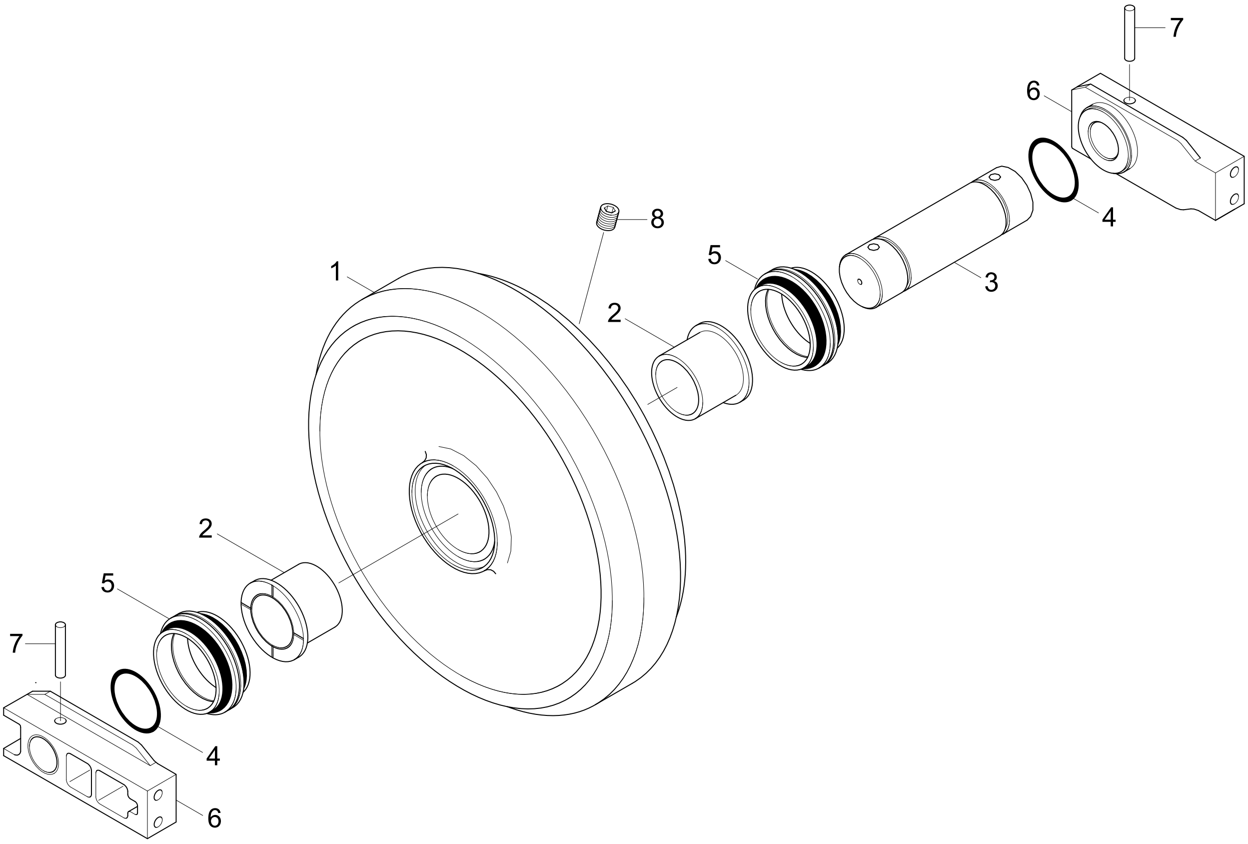
※ Make sure that the boss on the end face of the recoil cylinder rod is in the hole of the track frame.



45078UC18

3) DISASSEMBLY AND ASSEMBLY OF IDLER

(1) Structure



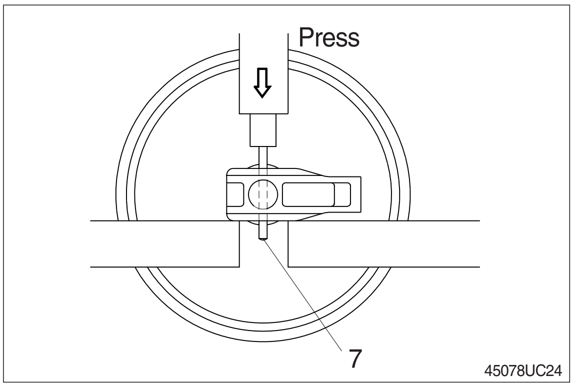
36078UC01

1	Shell	4	O-ring	7	Spring pin
2	Bushing	5	Seal assembly	8	Plug
3	Shaft	6	Bracket		

(2) Disassembly

① Remove plug and drain oil.

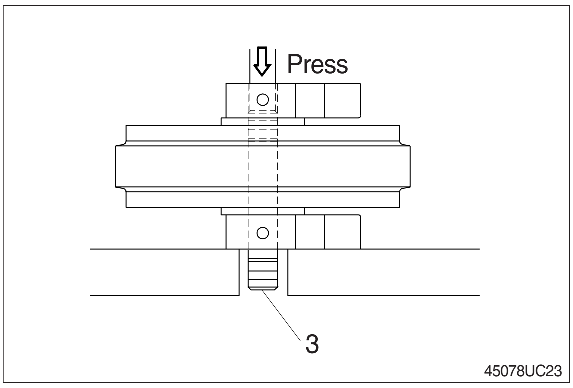
② Draw out the spring pin (7), using a press.



③ Pull out the shaft (2) with a press.

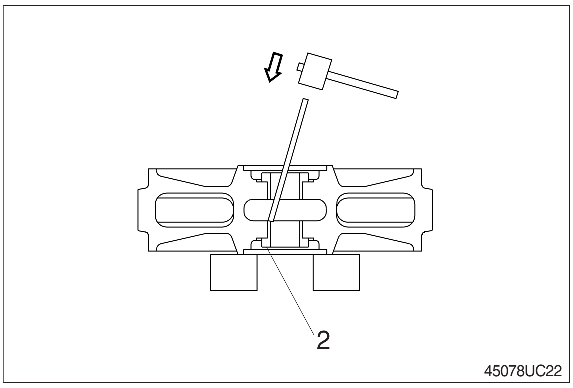
④ Remove seal (5) from shell (1) and bracket (6).

⑤ Remove O-ring (4) from shaft.



⑥ Remove the bushing (2) from idler, using a special tool.

※ Only remove bushing if replacement is necessity.

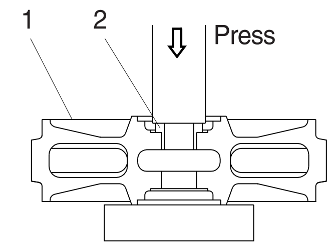


(3) Assembly

※ Before assembly, clean the parts.

※ Coat the sliding surfaces of all parts with oil.

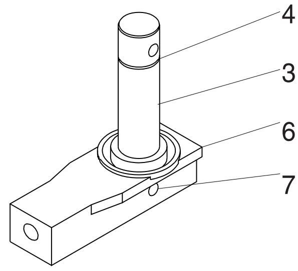
① Cool up bushing (2) fully by some dry ice and press it into shell (1).
Do not press it at the normal temperature, or not knock in with a hammer even after the cooling.



45078UC28

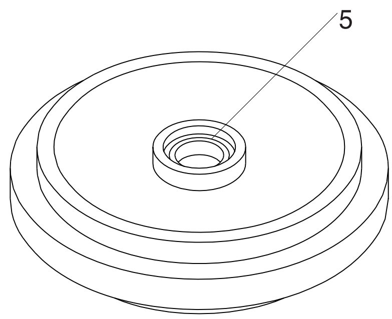
② Coat O-ring (4) with grease thinly, and install it to shaft (3).

③ Insert shaft (3) into bracket (6) and drive in the spring pin (7).



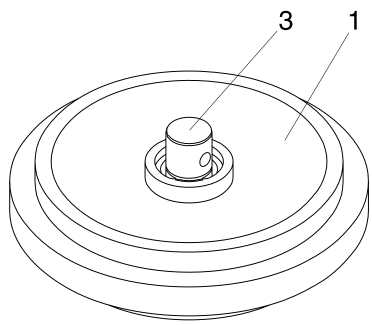
45078UC27

④ Install seal (5) to shell (1) and bracket (6).



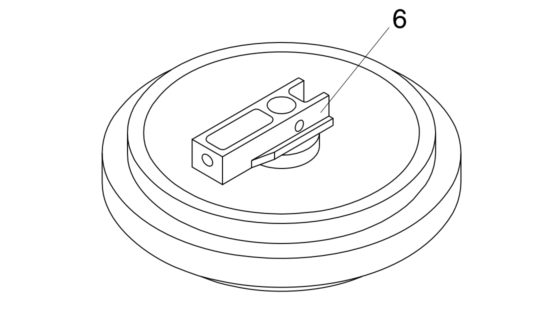
45078UC26

⑤ Install shaft (3) to shell (1).



36078UC27

⑥ Install bracket (6) attached with seal (5).



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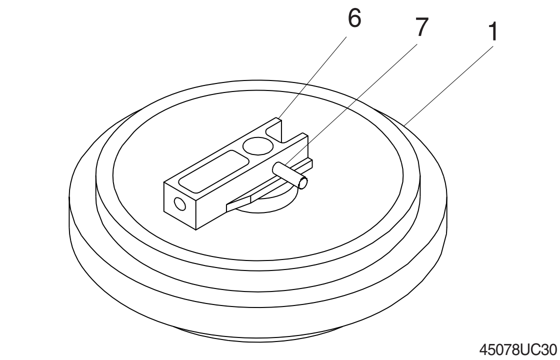
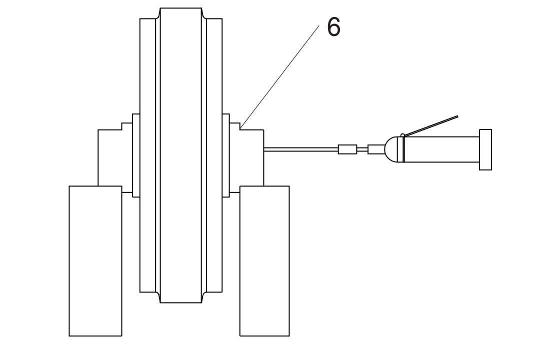
⑦ Knock in the spring pin (7) with a hammer.



45078UC30

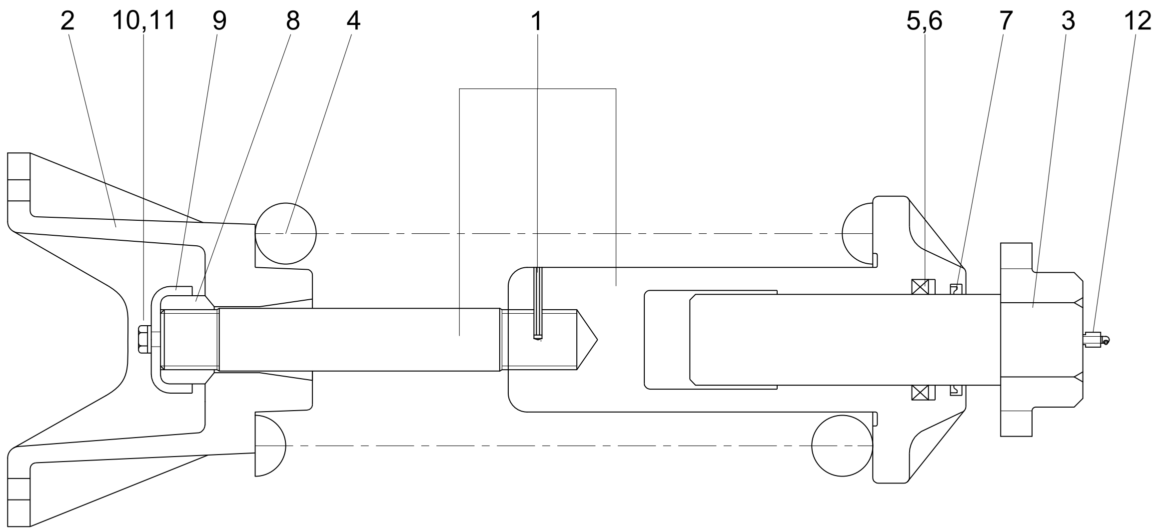
⑧ Lay bracket (6) on its side.
Supply engine oil to the specified level, and tighten plug.



45078UC29

4) DISASSEMBLY AND ASSEMBLY OF RECOIL SPRING

(1) Structure



45078UC02

1	Body	5	Rod seal	9	Lock plate
2	Bracket	6	Back up ring	10	Hex bolt
3	Rod assembly	7	Dust seal	11	Spring washer
4	Spring	8	Lock nut	12	Grease valve

(2) Disassembly

① Apply pressure on spring (4) with a press.

※ The spring is under a large installed load. This is dangerous, so be sure to set properly.

· Spring set load : 28840 kg (63580 lb)

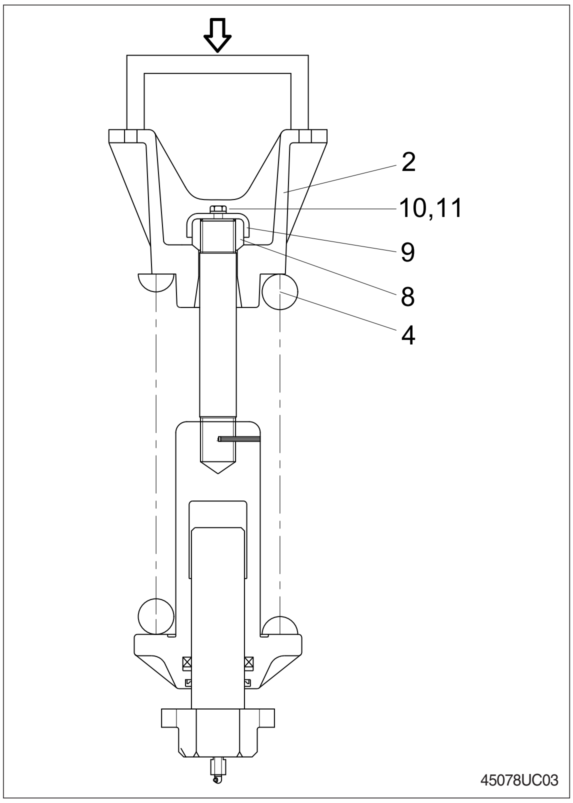
② Remove bolt (10), spring washer (11) and lock plate (9).

③ Remove lock nut (8).

Take enough notice so that the press

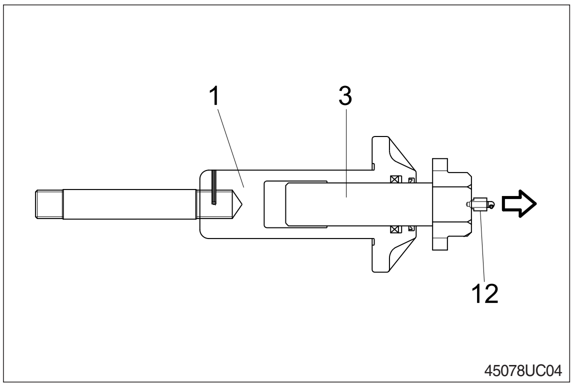
④ which pushes down the spring, should not be slipped out in its operation.

Lighten the press load slowly and remove bracket (2) and spring (4).

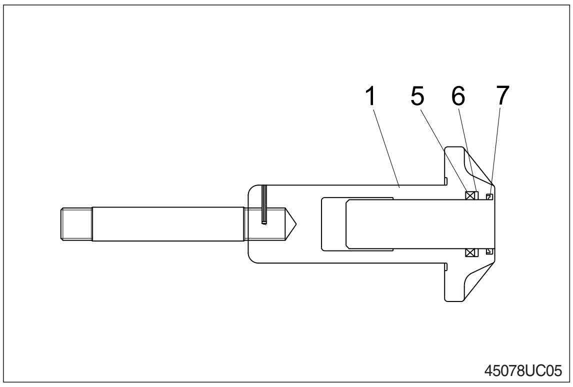


⑤ Remove rod (3) from body (1).

⑥ Remove grease valve (12) from rod (3).



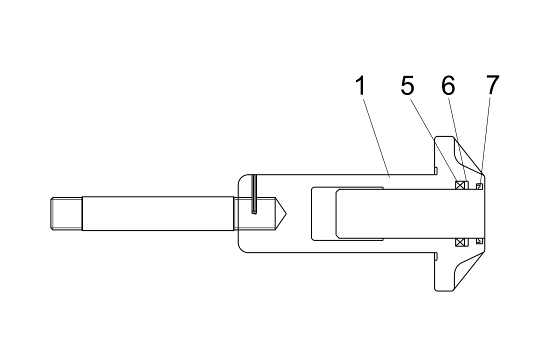
⑦ Remove rod seal (5), back up ring (6) and dust seal (11).



(3) Assembly

① Install dust seal (7), back up ring (6) and rod seal (5) to body (1).

※ When installing dust seal (7) and rod seal (5), take full care so as not to damage the lip.



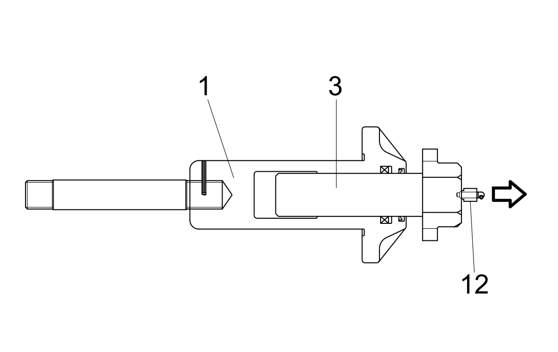
45078UC05

② Pour grease into body (1), then push in rod (3) 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 (12) to rod (3).

· Tightening torque : 13.0±1.0 kgf · m (94±7.2lbf · ft)



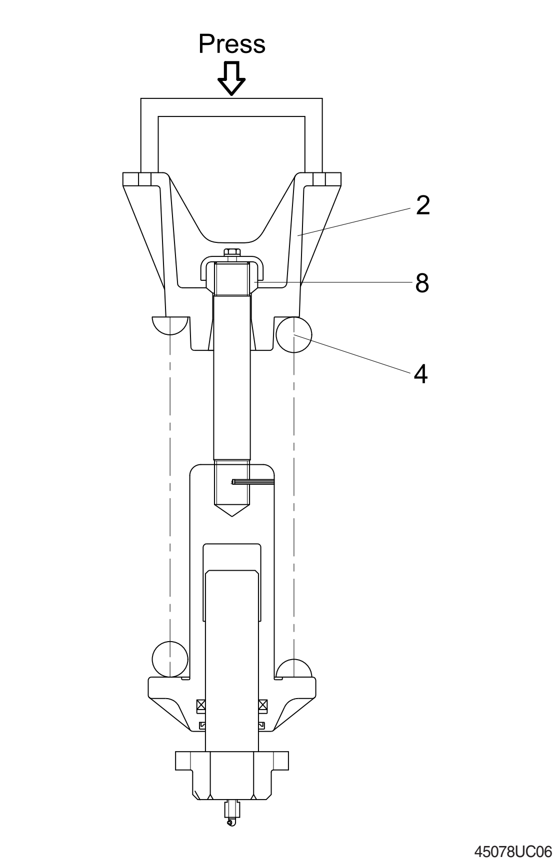
45078UC04

④ Install spring (4) and bracket (2) to body (1).

⑤ Apply pressure to spring (4) with a press and tighten lock nut (8).

※ Apply sealant before assembling.

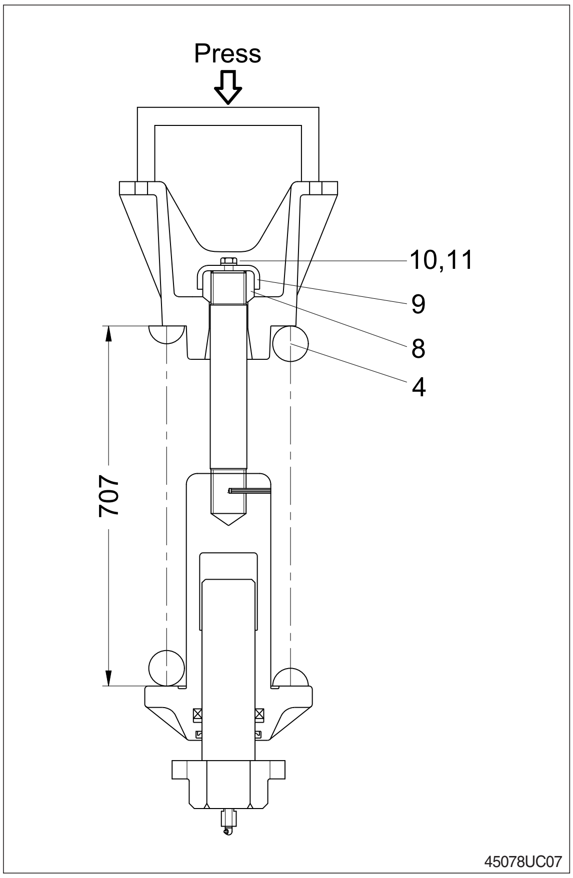
※ During the operation, pay attention specially to prevent the press from slipping out.



45078UC06

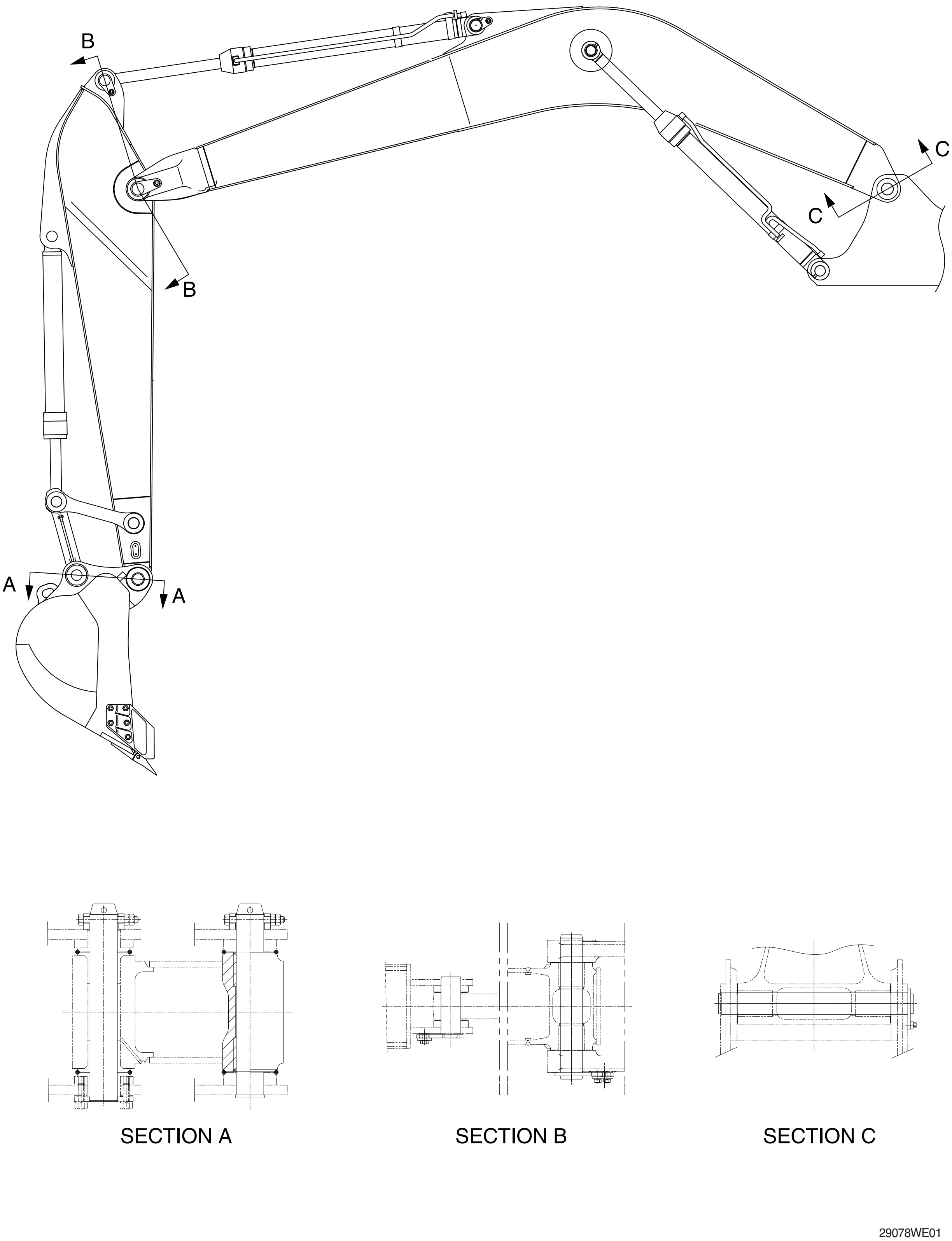
⑥ Lighten the press load and confirm the set length of spring (4).

⑦ After the setting of spring (4), install lock plate (9), spring washer (11) and bolt (10).



GROUP 11 WORK EQUIPMENT

1. STRUCTURE

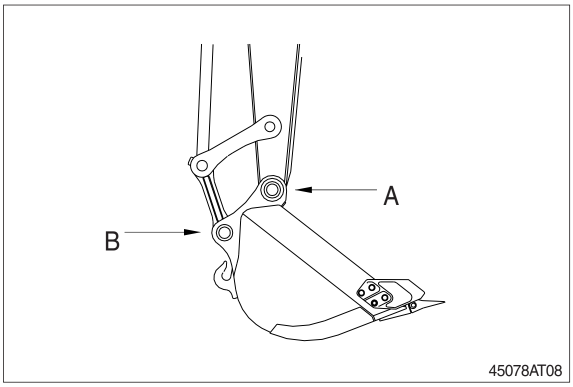


2. REMOVAL AND INSTALL

1) BUCKET ASSEMBLY

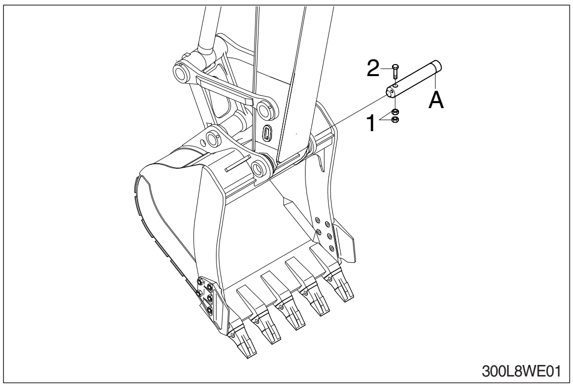
(1) Removal

① Lower the work equipment completely to ground with back of bucket facing down.



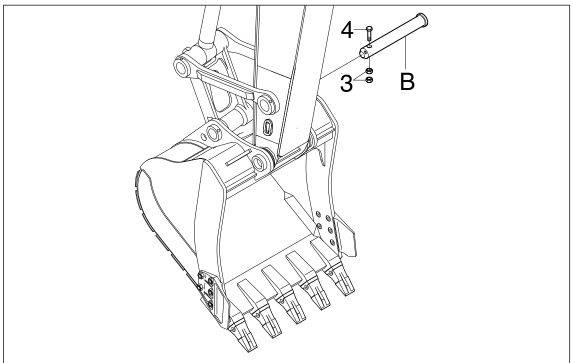
45078AT08

② Remove nut (1), bolt (2) and draw out the pin (A).



300L8WE01

③ Remove nut (3), bolt (4) and draw out the pin (B).



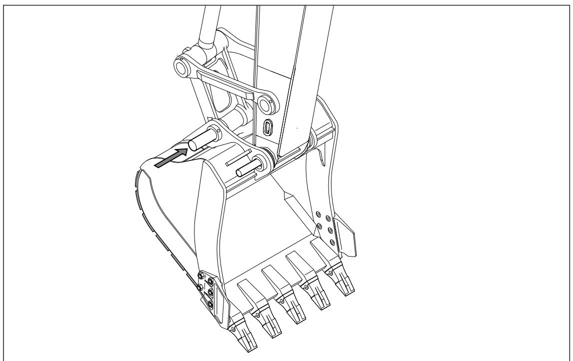
300L8WE02

(2) Install

① Carry out installation in the reverse order to removal.

⚠ **When aligning the mounting position of the pin, do not insert your fingers in the pin hole.**

※ Adjust the bucket clearance.
For detail, see **operation manual**.

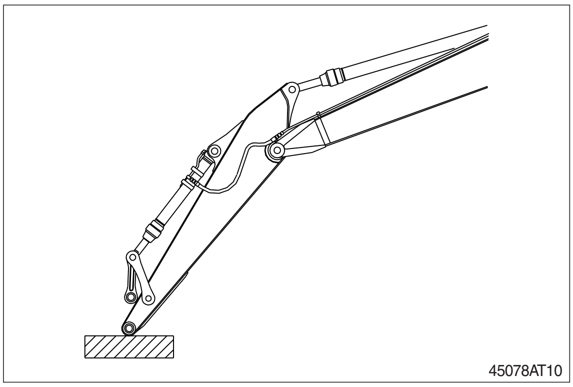

300L8WE03

2) ARM ASSEMBLY

(1) Removal

※ Loosen the breather slowly to release the pressure inside the hydraulic tank.

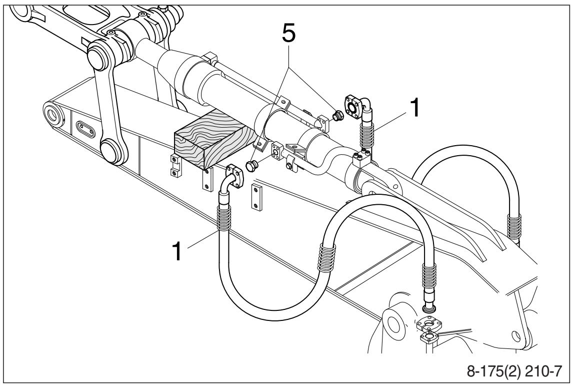
⚠ **Escaping fluid under pressure can penetrated the skin causing serious injury.**


45078AT10

① Remove bucket assembly.
For details, see removal of bucket assembly.

② Disconnect bucket cylinder hose (1).

⚠ **Fit blind plugs in the piping at the chassis end securely to prevent oil from spurting out when the engine is started.**



8-175(2) 210-7

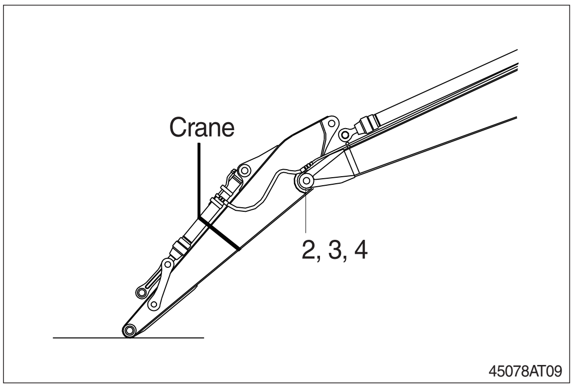
③ Sling arm cylinder assembly, remove spring, pin stopper and pull out pin.

※ Tie the rod with wire to prevent it from coming out.

④ For details, see removal of arm cylinder assembly.
Place a wooden block under the cylinder and bring the cylinder down to it.

⑤ Remove bolt (2), plate (3) and pull out the pin (4) then remove the arm assembly.
・Weight : 1820 ㎏ (4010 ℓb)

※ When lifting the arm assembly, always lift the center of gravity.



45078AT09

(2) Install

① Carry out installation in the reverse order to removal.

⚠ **When lifting the arm assembly, always lift the center of gravity.**

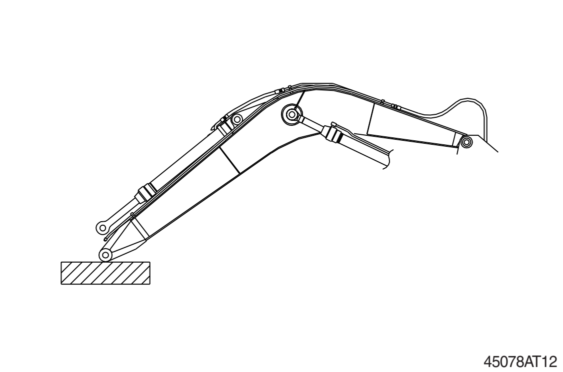
※ Bleed the air from the cylinder.

3) BOOM ASSEMBLY

(1) Removal

① Remove arm and bucket assembly.

② For details, see removal of arm and bucket assembly.
Remove boom cylinder assembly from boom.
For details, see removal of boom cylinder assembly.



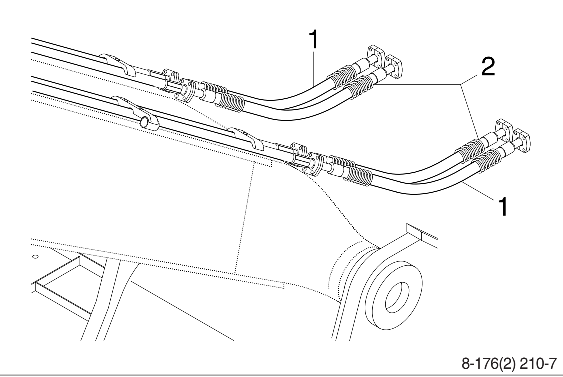
45078AT12

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.

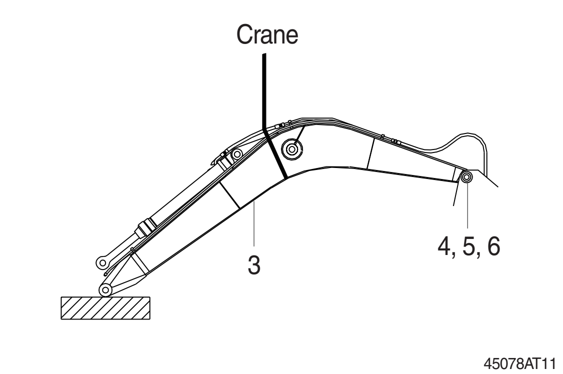
⑤ Sling boom assembly (3).



8-176(2) 210-7

⑥ Remove bolt (4), plate (5) and pull out the pin (6) then remove boom assembly.
・Weight : 3570 ㎏ (7870 ㏈)

※ When lifting the boom assembly always lift the center of gravity.



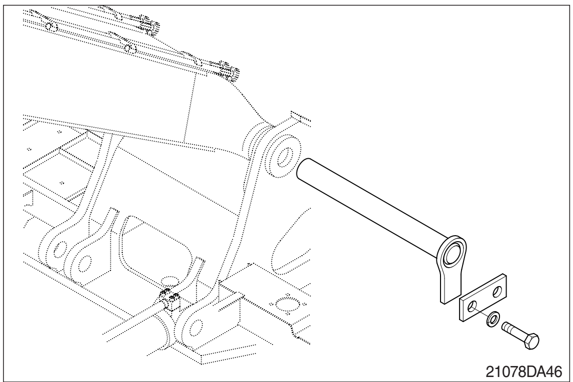
45078AT11

(2) Install

① Carry out installation in the reverse order to removal.

⚠ **When lifting the boom assembly, always lift the center of gravity.**

※ Bleed the air from the cylinder.



21078DA46

SECTION 9 COMPONENT MOUNTING TORQUE

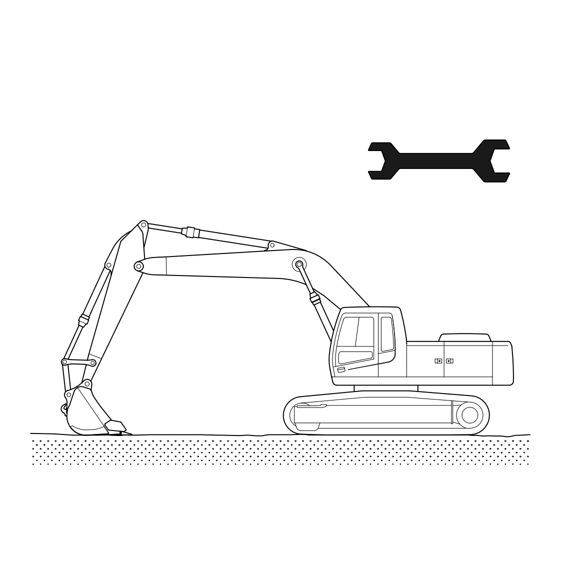
SECTION 9 COMPONENT MOUNTING TORQUE

GROUP 1 INTRODUCTION GUIDE

1. This section shows bolt specifications and standard torque values needed when mounting components to the machine.
2. Use genuine HD Hyundai Construction Equipment spare parts.
   We expressly point out that HD Hyundai Construction Equipment will not accept any responsibility for defects resulted from non-genuine parts.
   In such cases HD Hyundai Construction Equipment cannot assume liability for any damage.

※ Only metric fasteners can be used and incorrect fasteners may result in machine damage or malfunction.

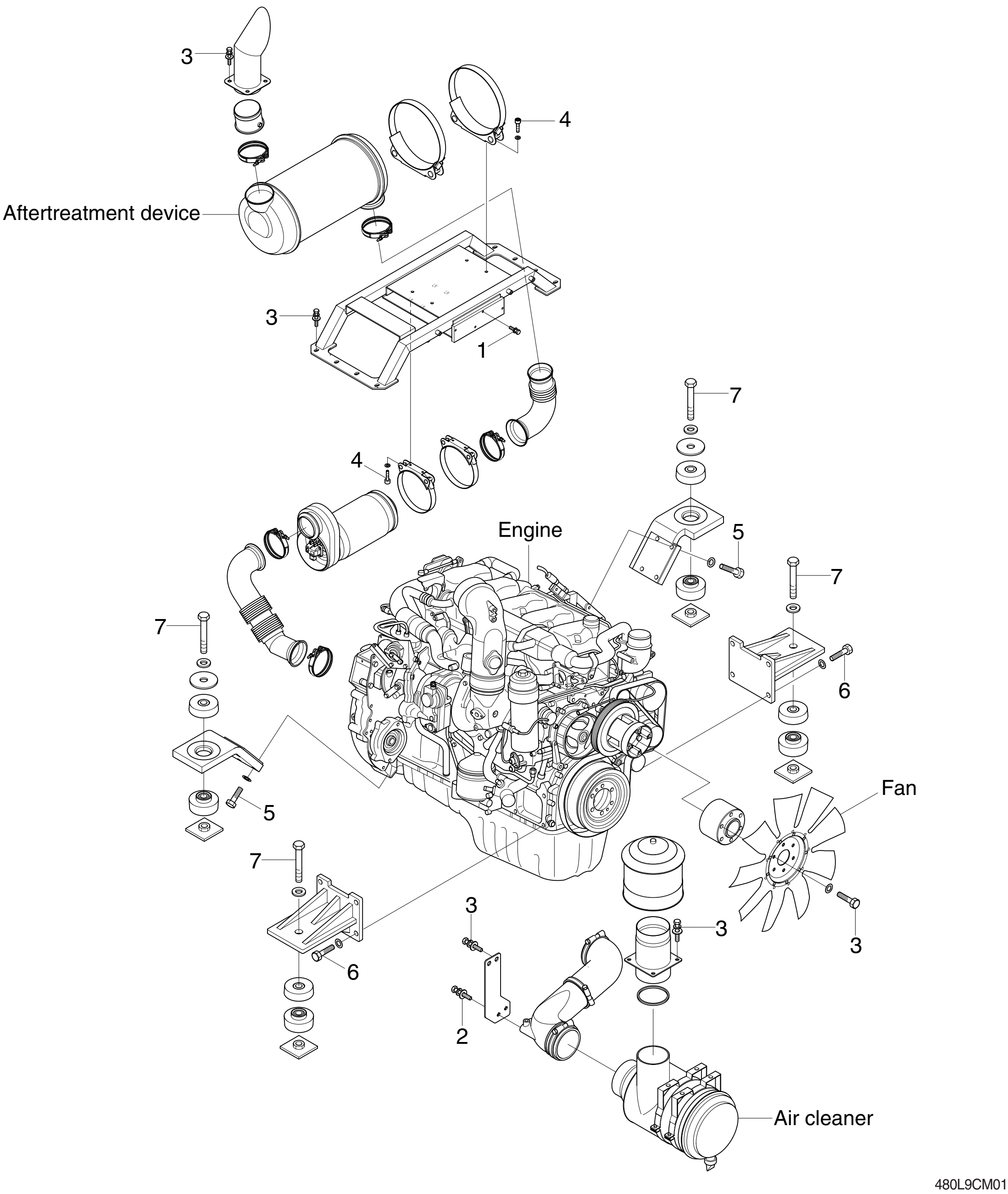
※ Before installation, clean all the components with a non-corrosive cleaner. Bolts and threads must not be worn or damaged.



29079CM00

GROUP 2 ENGINE SYSTEM

ENGINE AND ACCESSORIES MOUNTING

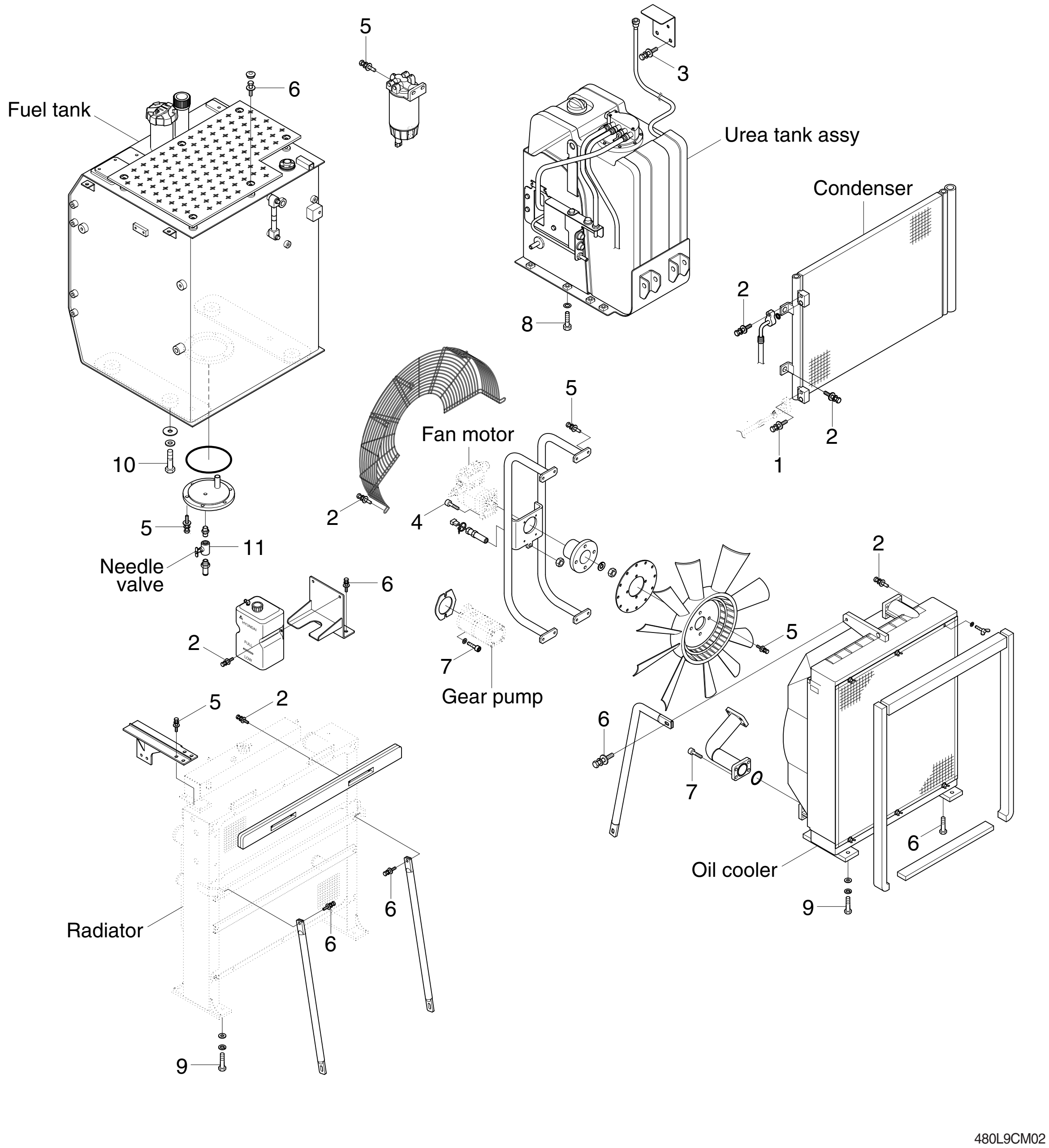


· Tightening torque

Item	Size	kgf · m	lbf · ft
1	M 6×1.0	1.05±0.2	7.6±1.45
2	M 8×1.25	3.43±0.7	24.8±5.1
3	M12×1.75	12.8±3.0	92.6±21.7
4	M12×1.75	14.7±2.2	106±15.9

Item	Size	kgf · m	lbf · ft
5	M14×2.0	18±2.0	13.0±14.5
6	M16×1.5	28±3.0	203±21.7
7	M22×2.5	69.6±7.0	503±50.6
-	-	-	-

COOLING SYSTEM AND FUEL TANK MOUNTING



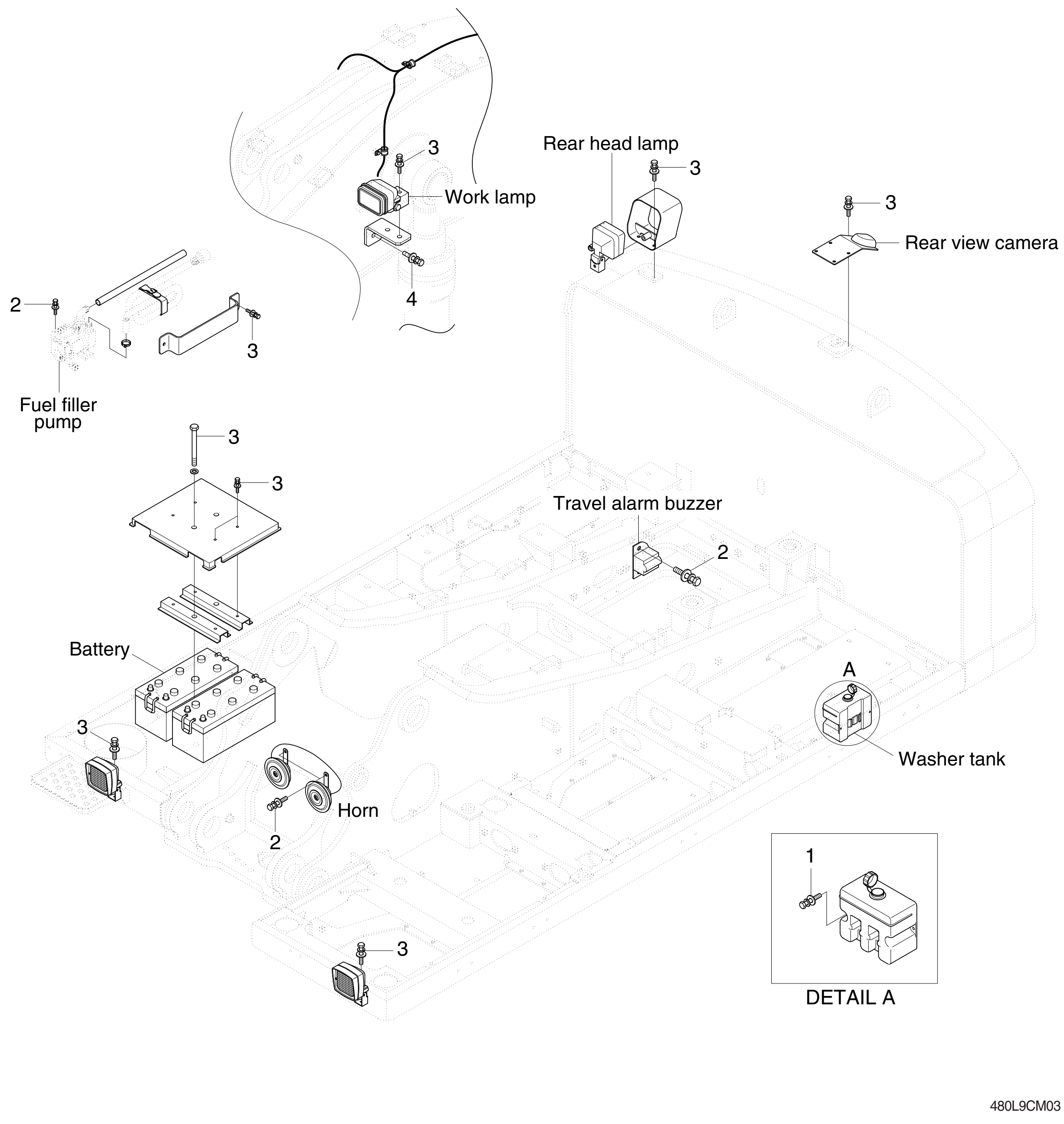
· Tightening torque

Item	Size	kgf · m	lbf · ft
1	M 6×1.0	1.05±0.2	7.6±1.45
2	M 8×1.25	2.5±0.5	18.1±3.6
3	M 8×1.25	3.43±0.7	24.8±5.1
4	M 8×1.25	4.05±0.8	29.3±5.8
5	M10×1.5	6.9±1.4	49.9±10.1
6	M12×1.75	12.8±3.0	92.6±21.7

Item	Size	kgf · m	lbf · ft
7	M12×1.75	14.7±2.2	106±15.9
8	M14×2.0	19.6±2.9	142±21.0
9	M16×2.0	29.7±4.5	215±32.5
10	M20×2.5	46±5.1	333±36.9
11	-	2.3±0.6	16.6±4.3
-	-	-	-

GROUP 3 ELECTRIC SYSTEM

ELECTRIC COMPONENTS MOUNTING 1

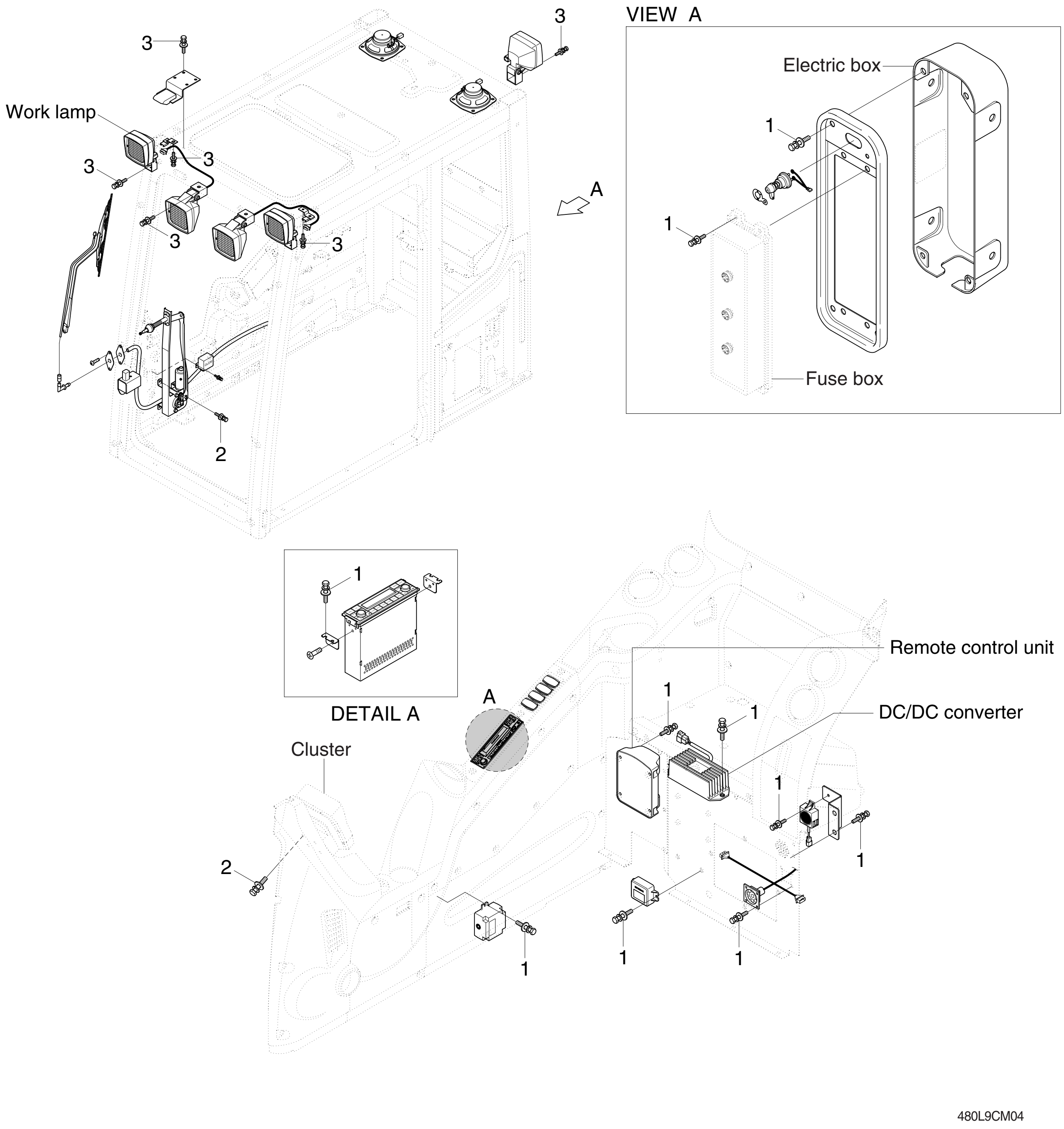


· Tightening torque

Item	Size	kgf · m	lbf · ft
1	M 6×1.0	1.05±0.2	7.6±1.45
2	M 8×1.25	2.5±0.5	18.1±3.6

Item	Size	kgf · m	lbf · ft
3	M10×1.5	6.9±1.4	49.9±10.1
4	M12×1.75	12.8±3.0	92.6±21.7

ELECTRIC COMPONENTS MOUNTING 2



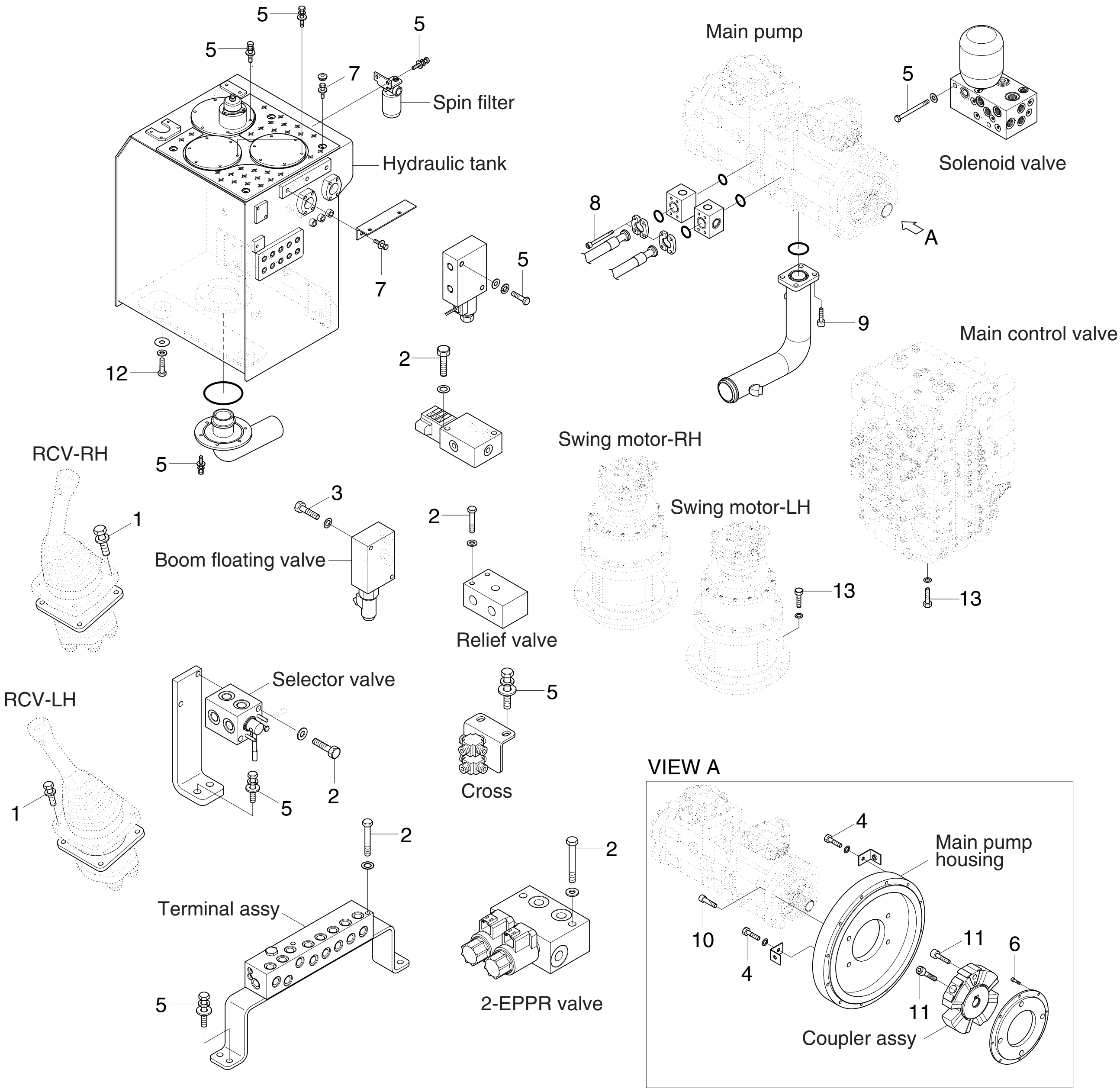
· Tightening torque

Item	Size	kgf · m	lbf · ft
1	M 6×1.0	1.05±0.2	7.6±1.45
2	M 8×1.25	2.5±0.5	18.1±3.6

Item	Size	kgf · m	lbf · ft
3	M10×1.5	6.9±1.4	49.9±10.1

GROUP 4 HYDRAULIC SYSTEM

HYDRAULIC COMPONENTS MOUNTING 1



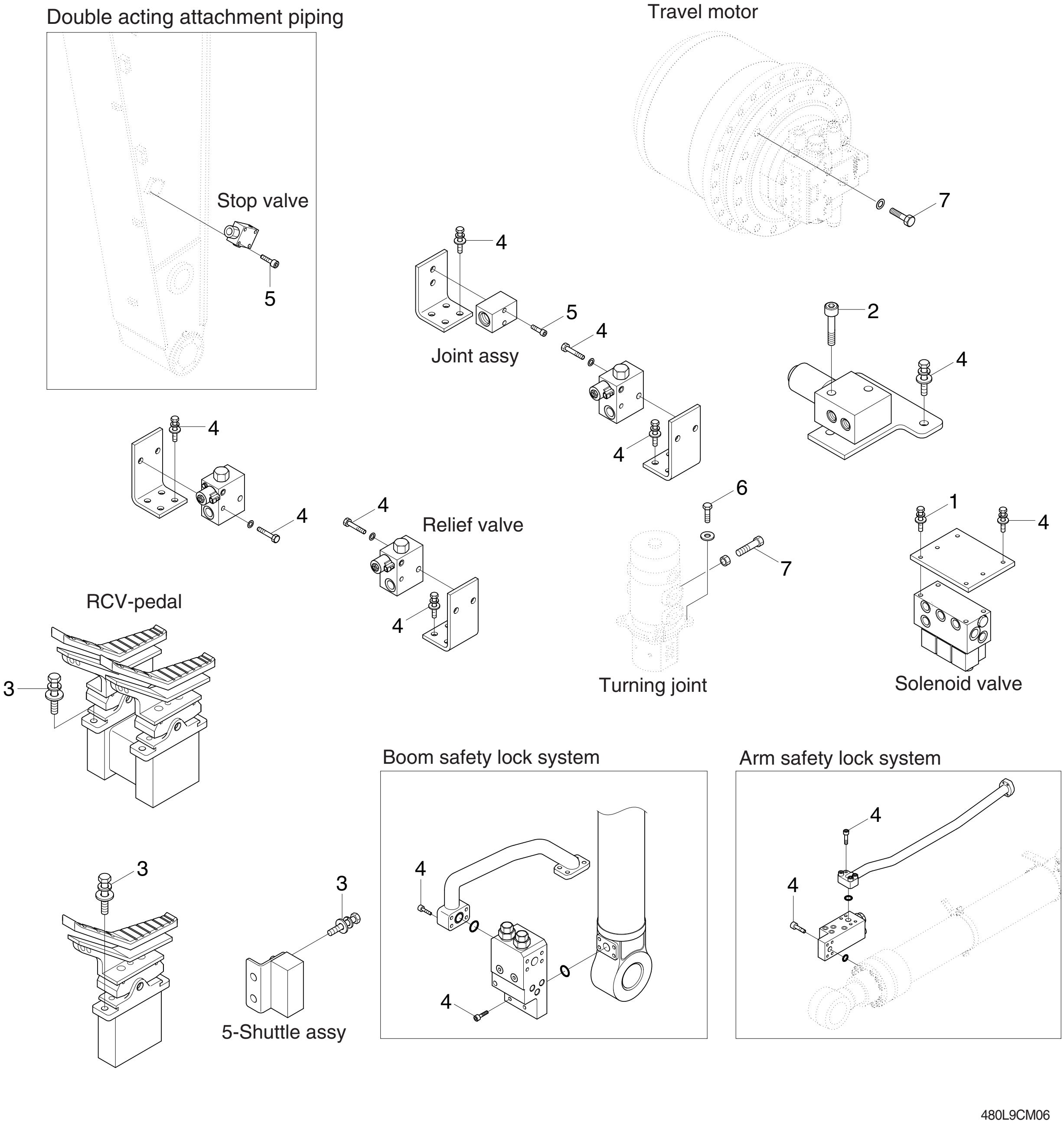
480L9CM05

· Tightening torque

Item	Size	kgf · m	lbf · ft
1	M 6×1.0	1.05±0.2	7.6±1.45
2	M 8×1.25	2.5±0.5	18.1±3.6
3	M 8×1.25	3.43±0.7	24.8±5.1
4	M10×1.5	6.7±1.0	48.7±7.2
5	M10×1.5	6.9±1.4	49.9±10.1
6	M10×1.5	8.27±1.7	59.8±12.3
7	M12×1.75	12.8±3.0	92.6±21.7

Item	Size	kgf · m	lbf · ft
8	M12×1.75	14.7±2.2	106±15.9
9	M16×2.0	35.6±7.1	257±51
10	M20×2.5	44±6.6	318±47.7
11	M20×2.5	46.5±2.5	336±18.1
12	M20×2.5	57.9±8.0	419±57.9
13	M20×2.5	57.9±8.7	419±62.9
-	-	-	-

HYDRAULIC COMPONENTS MOUNTING 2

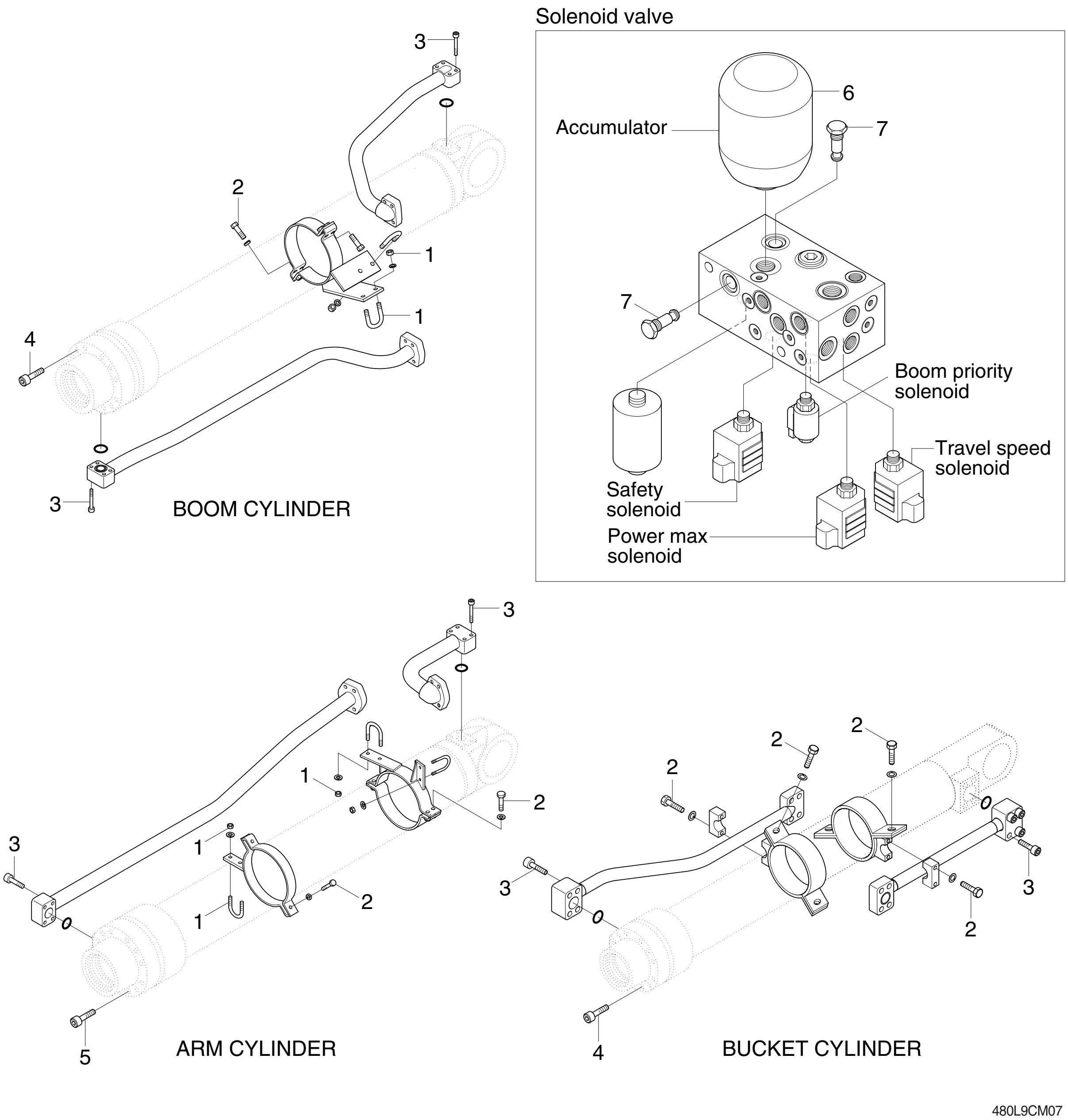


· Tightening torque

Item	Size	kgf · m	lbf · ft
1	M 8×1.25	2.5±0.5	18.1±3.6
2	M 8×1.25	4.05±0.8	29.3±5.8
3	M10×1.5	6.9±1.4	49.9±10.1
4	M12×1.75	12.8±3.0	92.6±21.7

Item	Size	kgf · m	lbf · ft
5	M12×1.75	14.7±2.2	106±15.9
6	M16×2.0	29.7±4.5	215±32.5
7	M20×2.5	57.9±8.7	419±62.9
-	-	-	-

HYDRAULIC COMPONENTS MOUNTING 3



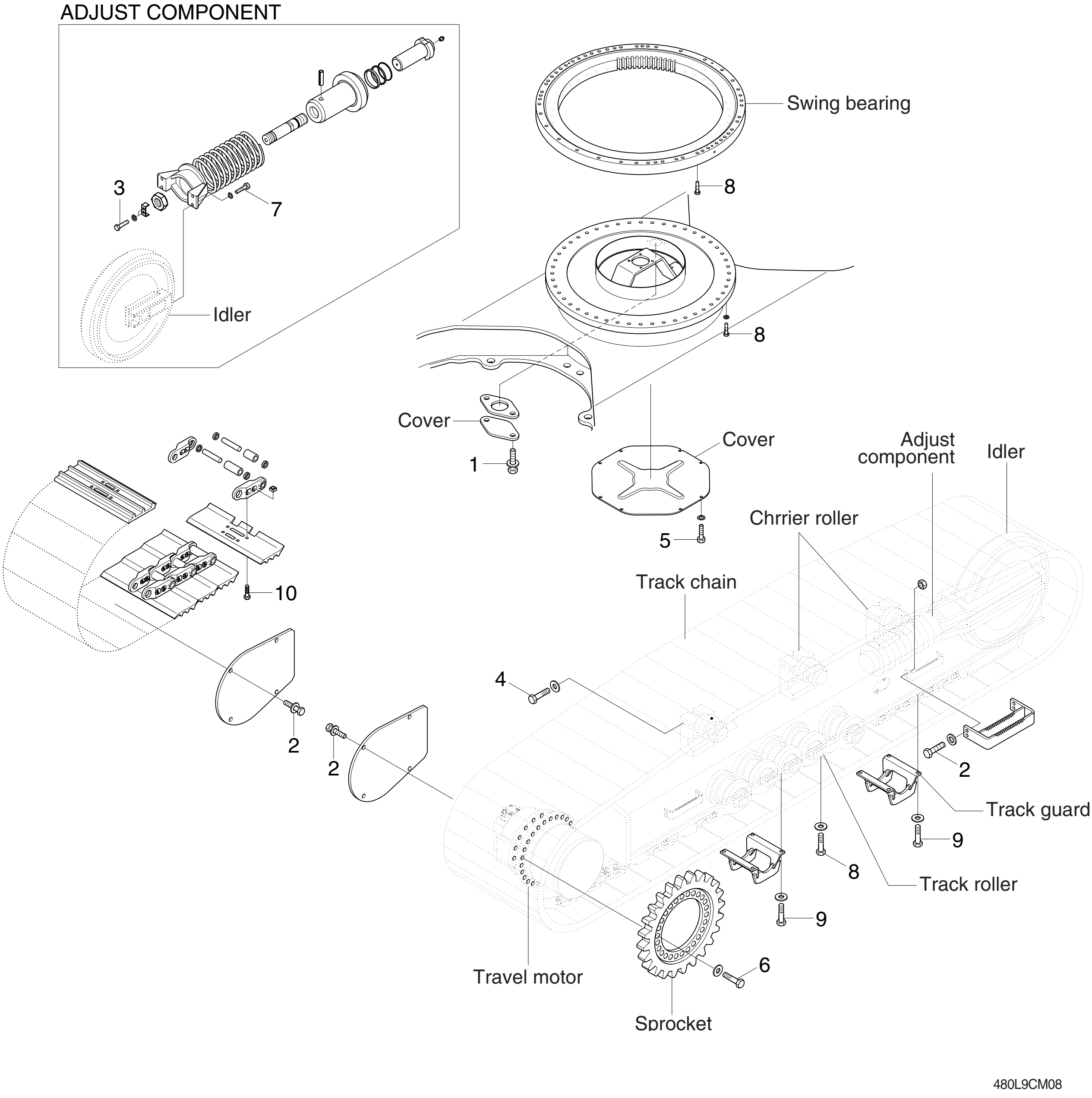
· Tightening torque

Item	Size	kgf · m	lbf · ft
1	M10×1.5	3.2±0.3	23.1±2.2
2	M12×1.75	5.5±0.6	39.8±4.3
3	M12×1.75	9.4±1.0	68.0±7.2
4	M22×2.5	63±6.0	456±43.4

Item	Size	kgf · m	lbf · ft
5	M24×3.0	79±8.0	571±57.9
6	M22×2.5	4.1	29.6
7	M27×3.0	5.1	36.9
-	-	-	-

GROUP 5 UNDERCARRIAGE

· HX480 L

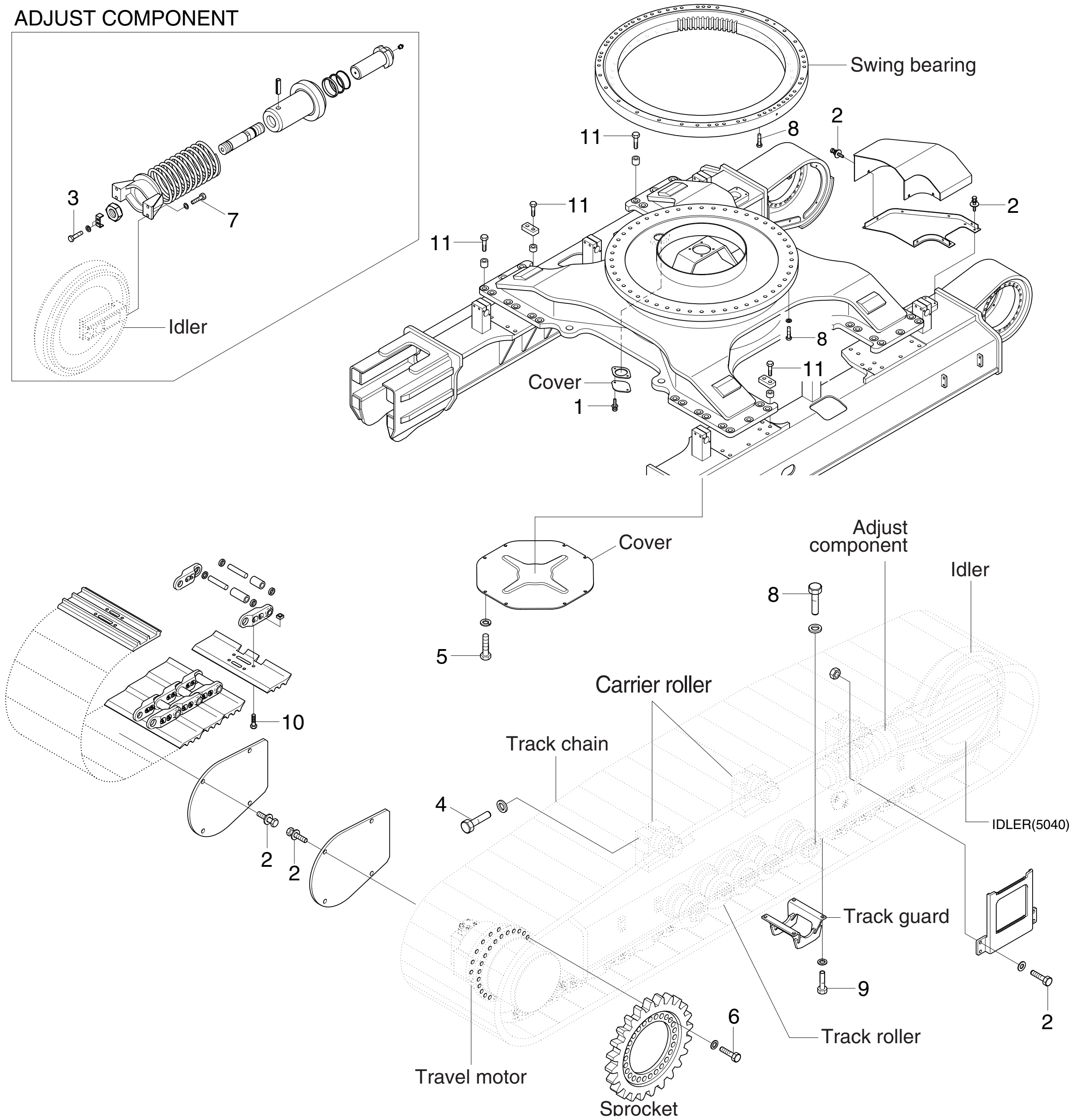


· Tightening torque

Item	Size	kgf · m	lbf · ft
1	M10×1.5	6.9±1.4	49.9±10.1
2	M12×1.75	12.8±3.0	92.6±21.7
3	M14×1.5	21±3.1	152±22.4
4	M16×2.0	29.7±3.0	215±21.7
5	M16×2.0	29.7±4.5	215±32.5

Item	Size	kgf · m	lbf · ft
6	M20×2.5	57.9±6.0	419±43.4
7	M22×1.5	87.2±12.5	631±90.4
8	M24×3.0	100±10	723±72.3
9	M24×3.0	100±15	723±108
10	M24×3.0	140±14	1012±101

· HX520 L



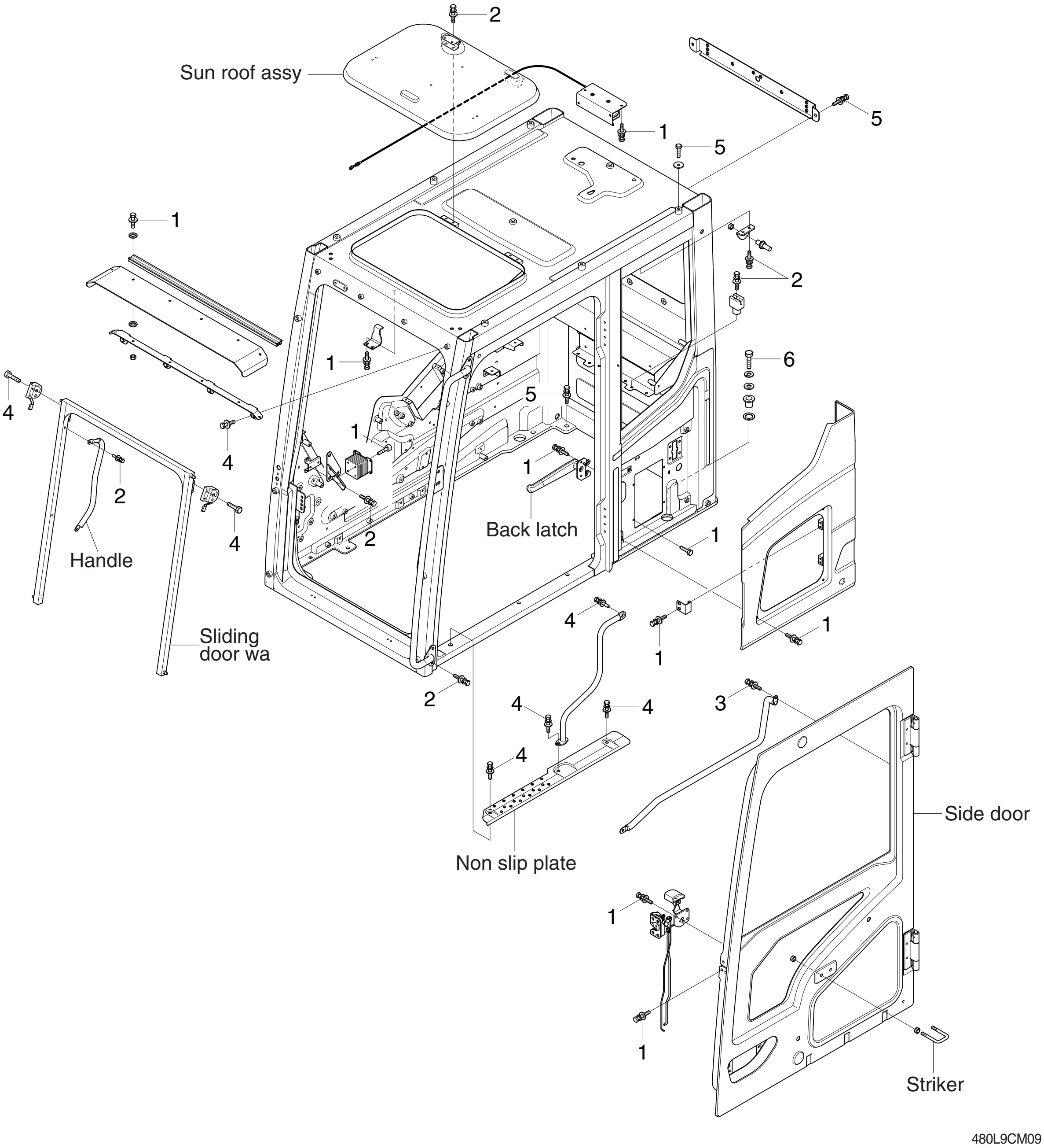
· Tightening torque

Item	Size	kgf · m	lbf · ft
1	M10×1.5	6.9±1.4	49.9±10.1
2	M12×1.75	12.8±3.0	92.6±21.7
3	M14×1.5	21±3.1	152±22.4
4	M16×2.0	29.7±3.0	215±21.7
5	M16×2.0	29.7±4.5	215±32.5
6	M20×2.5	57.9±6.0	419±43.4

Item	Size	kgf · m	lbf · ft
7	M22×1.5	87.2±12.5	631±90.4
8	M24×3.0	100±10	723±72.3
9	M24×3.0	100±15	723±108
10	M24×3.0	140±14	1012±101
11	M33×3.5	220±20	1590±145
-	-	-	-

GROUP 6 STRUCTURE

CAB AND ACCESSORIES MOUNTING

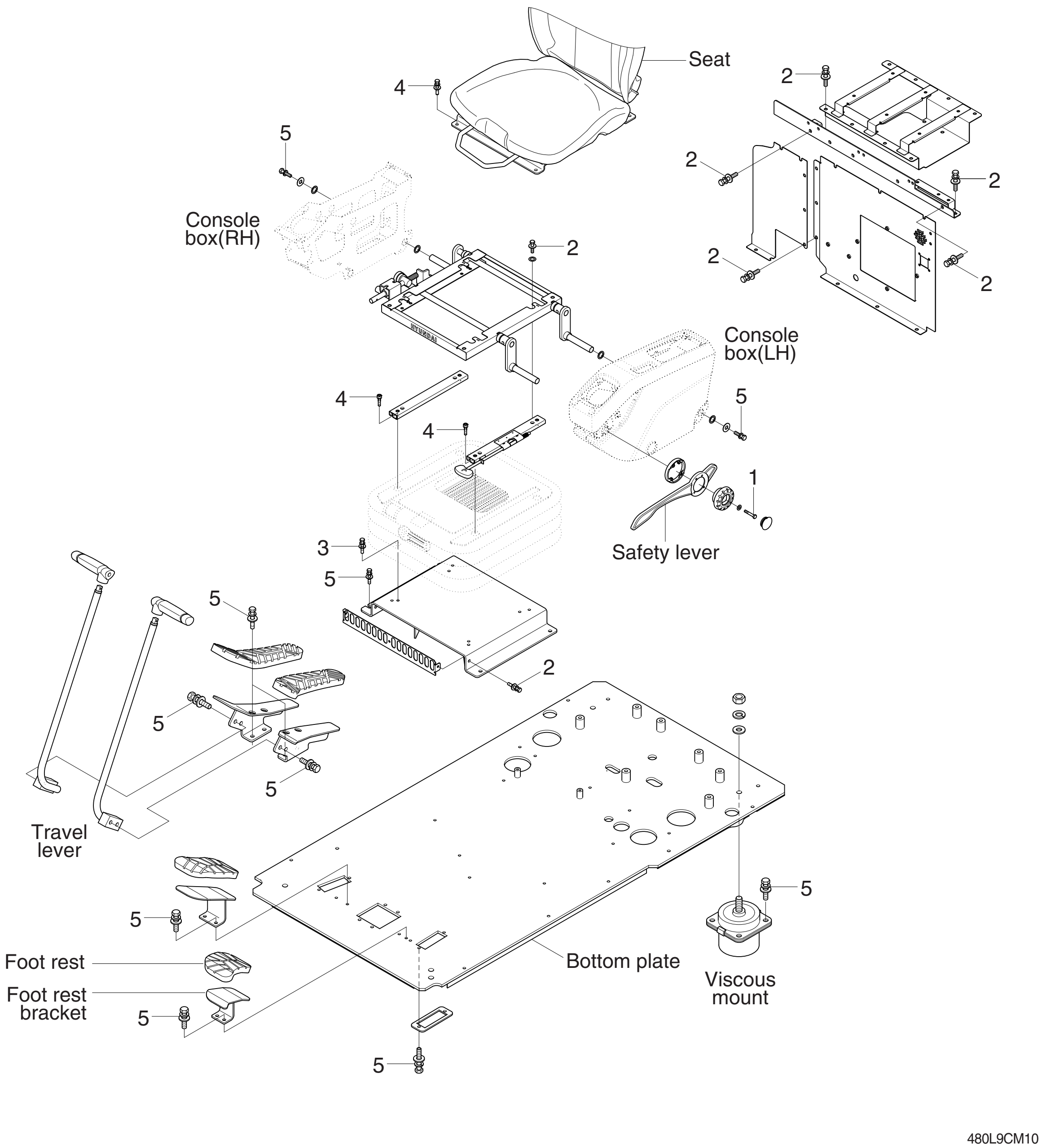


· Tightening torque

Item	Size	kgf · m	lbf · ft
1	M 6×1.0	1.05±0.2	7.6±1.45
2	M 8×1.25	2.5±0.5	18.1±3.6
3	M 8×1.25	3.43±0.7	24.8±5.1

Item	Size	kgf · m	lbf · ft
4	M10×1.5	6.9±1.4	49.9±10.1
5	M12×1.75	12.8±3.0	92.6±21.7
6	M24×3.0	100±15	723±109

CAB INTERIOR MOUNTING

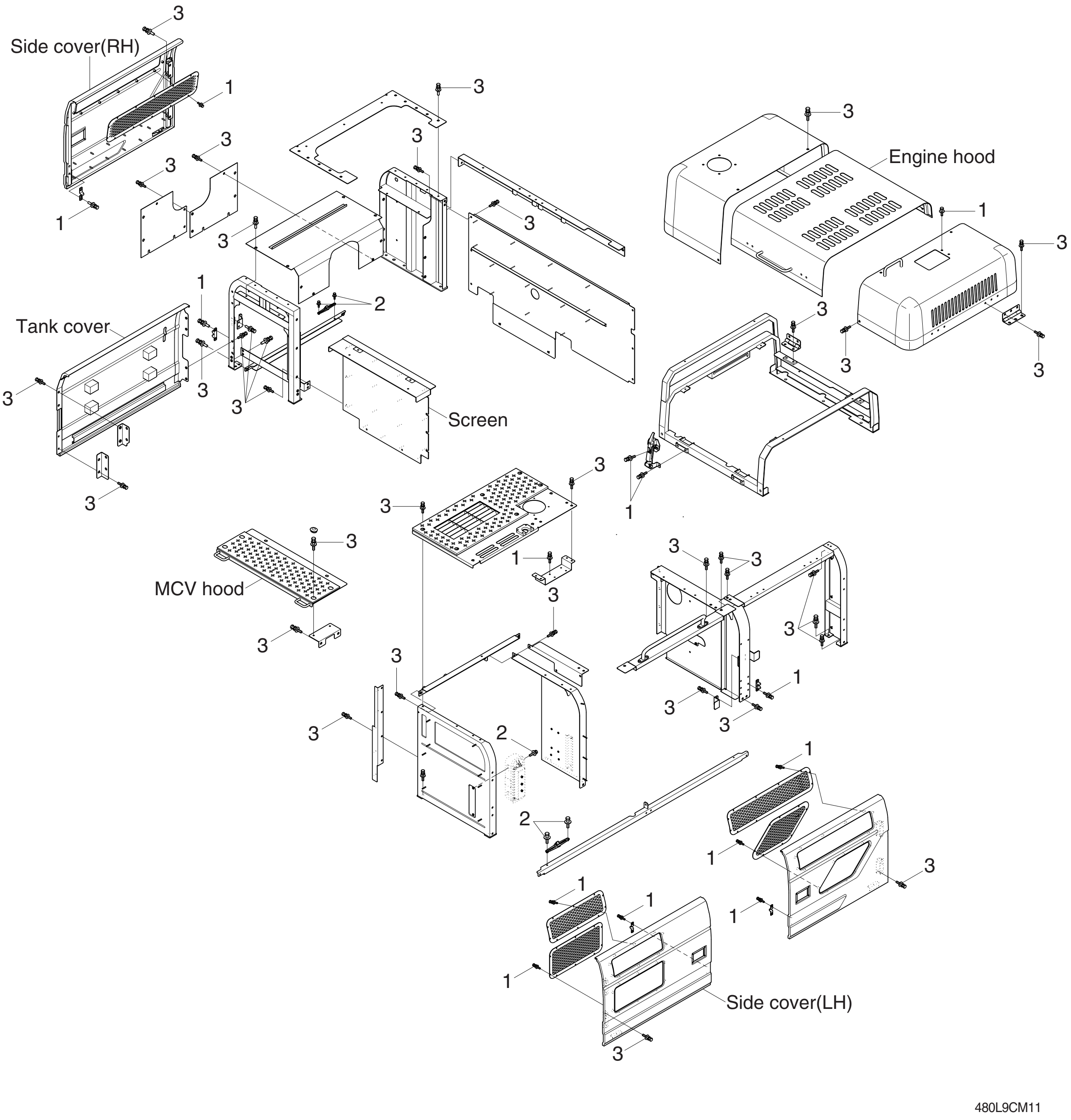


· Tightening torque

Item	Size	kgf · m	lbf · ft
1	M 6×1.0	1.05±0.2	7.6±1.45
2	M 8×1.25	2.5±0.5	18.1±3.6
3	M 8×1.25	3.43±0.7	24.8±5.1

Item	Size	kgf · m	lbf · ft
4	M 8×1.25	4.05±0.8	29.3±5.8
5	M10×1.5	6.9±1.4	49.9±10.1
-	-	-	-

COWLING MOUNTING

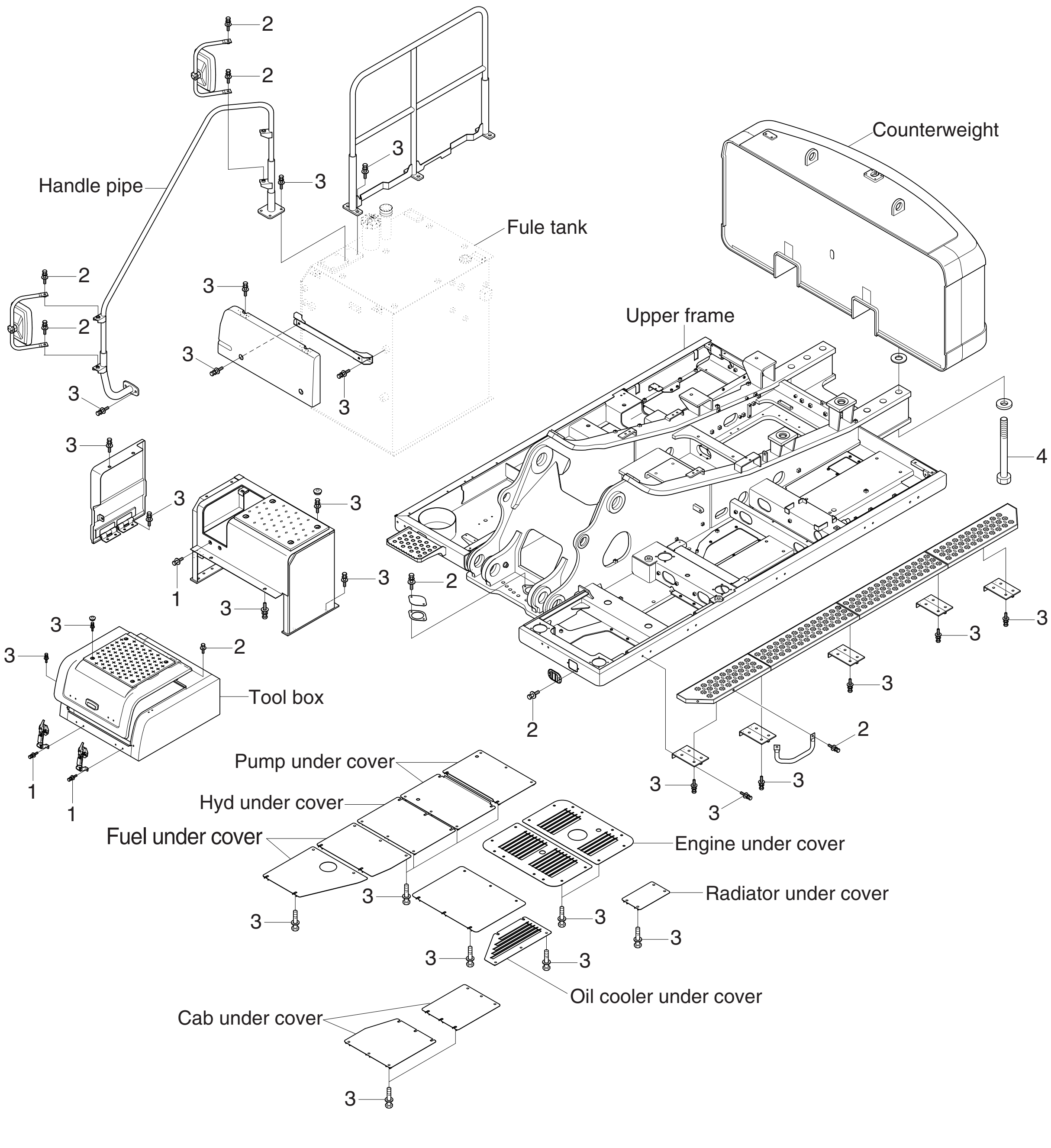


· Tightening torque

Item	Size	kgf · m	lbf · ft
1	M 8×1.25	2.5±0.5	18.1±3.6
2	M10×1.5	6.9±1.4	49.9±10.1

Item	Size	kgf · m	lbf · ft
3	M12×1.75	12.8±3.0	92.6±21.7

COUNTERWEIGHT AND COVERS MOUNTING

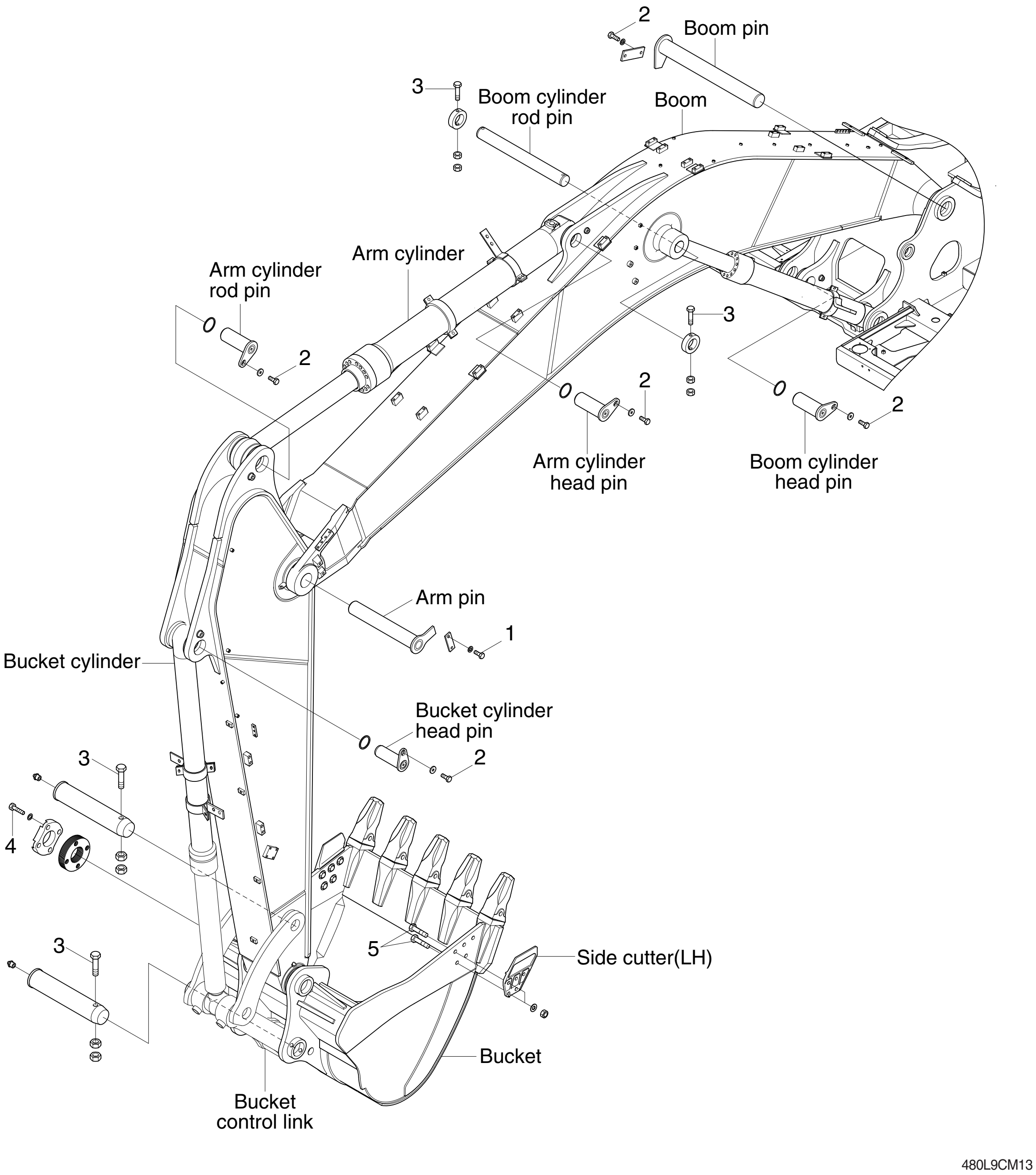


· Tightening torque

Item	Size	kgf · m	lbf · ft
1	M 8×1.25	2.5±0.5	18.1±3.6
2	M10×1.5	6.9±1.4	49.9±10.1

Item	Size	kgf · m	lbf · ft
3	M12×1.75	12.8±3.0	92.6±21.7
4	M42×3.0	390±40	2821±289

GROUP 7 WORK EQUIPMENT



· Tightening torque

Item	Size	kgf · m	lbf · ft
1	M16×2.0	29.7±4.5	215±32.5
2	M20×2.5	57.9±8.7	419±62.9
3	M24×3.0	100±15	723±108

Item	Size	kgf · m	lbf · ft
4	M27×3.0	140±15	1013±108
5	M30×3.5	199±30	1439±217
-	-	-	-