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1. STRUCTURE

This service manual has been prepared as an aid to improve the quality of repairs by giving the serviceman an accurate understanding of the product and by showing him the correct way to perform repairs and make judgements. Make sure you understand the contents of this manual and use it to full effect at every opportunity.

This service manual mainly contains the necessary technical information for operations performed in a service workshop.

For ease of understanding, the manual is divided into the following sections.

SECTION 1 GENERAL

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

SECTION 2 STRUCTURE AND FUNCTION

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

SECTION 3 HYDRAULIC SYSTEM

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

SECTION 4 ELECTRICAL SYSTEM

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

SECTION 5 MECHATRONICS SYSTEM

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

SECTION 6 TROUBLESHOOTING

This section explains the troubleshooting charts correlating problems to causes.

SECTION 7 MAINTENANCE STANDARD

This section gives the judgement standards when inspecting disassembled parts.

SECTION 8 DISASSEMBLY AND ASSEMBLY

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

The specifications contained in this shop manual are subject to change at any time and without any advance notice. Contact your HYUNDAI 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 HYUNDAI 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
   - 2: Item number(2. Structure and Function)
   - 3: Consecutive page number for each item.
3. Additional pages : Additional pages are indicated by a hyphen(-) and number after the page number. File as in the example.

   10 - 4
   10 - 4 - 1 ⎤
   10 - 4 - 2 ⎦ Added pages
   10 - 5

Revised edition mark(①②③…)

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

Revisions

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

Symbols

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

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

3. CONVERSION TABLE

Method of using the Conversion Table

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

Example

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

   Convert 55mm into inches.

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

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

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

2. Convert 550mm into inches.

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

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

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

Millimeters to inches

ⓑ

1mm = 0.03937 in

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

Millimeters to inches

1mm = 0.03937in

	0	1	2	3	4	5	6	7	8	9
0		0.039	0.079	0.118	0.157	0.197	0.236	0.276	0.315	0.354
10	0.394	0.433	0.472	0.512	0.551	0.591	0.630	0.669	0.709	0.748
20	0.787	0.827	0.866	0.906	0.945	0.984	1.024	1.063	1.102	1.142
30	1.181	1.220	1.260	1.299	1.339	1.378	1.417	1.457	1.496	1.536
40	1.575	1.614	1.654	1.693	1.732	1.772	1.811	1.850	1.890	1.929
50	1.969	2.008	2.047	2.087	2.126	2.165	2.205	2.244	2.283	2.323
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

1kgf / cm² = 14.2233lbf / in²

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

TEMPERATURE

Fahrenheit-Centigrade Conversion.

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

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

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

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

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

SECTION 1 GENERAL

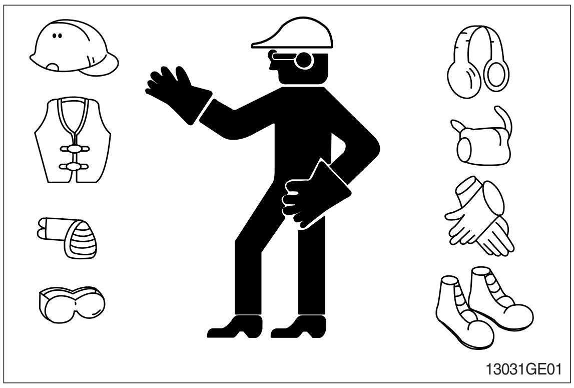
GROUP 1 SAFETY

FOLLOW SAFE PROCEDURE

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

WEAR PROTECTIVE CLOTHING

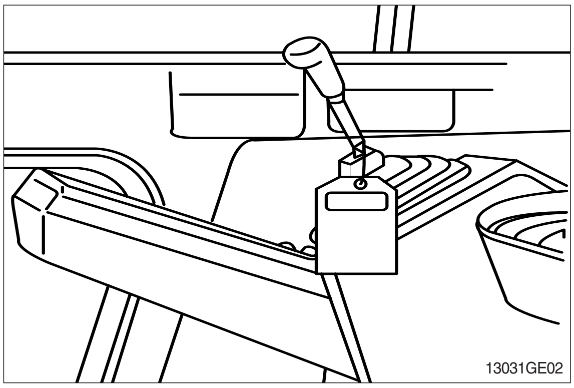
Wear close fitting clothing and safety equipment appropriate to the job.



13031GE01

WARN OTHERS OF SERVICE WORK

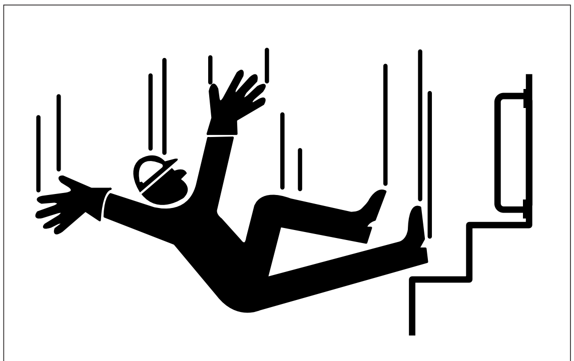
Unexpected machine movement can cause serious injury.
Before performing any work on the excavator, attach a 「Do Not Operate」 tag on the right side control lever.



13031GE02

USE HANDHOLDS AND STEPS

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



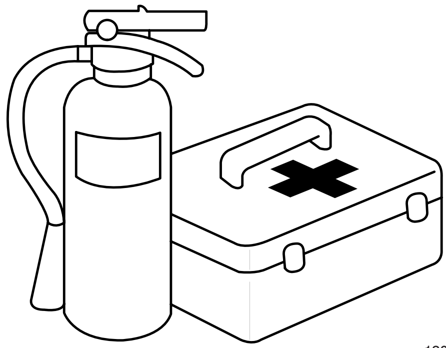
13031GE03

PREPARE FOR EMERGENCIES

Be prepared if a fire starts.

Keep a first aid kit and fire extinguisher handy.

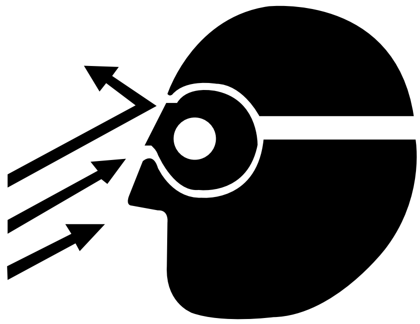
Keep emergency numbers for doctors, ambulance service, hospital, and fire department near your telephone.



13031GE04

PROTECT AGAINST FLYING DEBRIS

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



13031GE05

PROTECT AGAINST NOISE

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

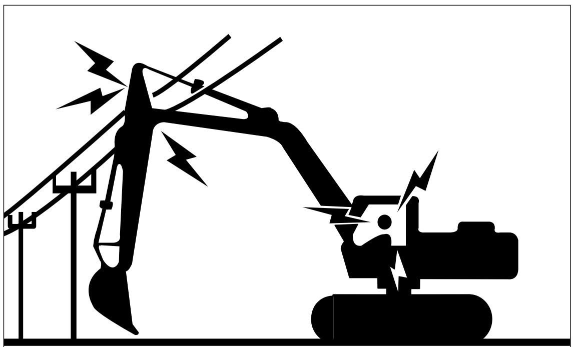
Wear a suitable hearing protective device such as earmuffs or earplugs to protect against objectionable or uncomfortable loud noises.

13031GE06

AVOID POWER LINES

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

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

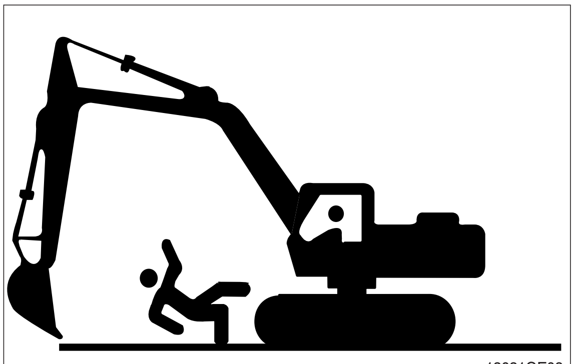


13031GE07

KEEP RIDERS OFF EXCAVATOR

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

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



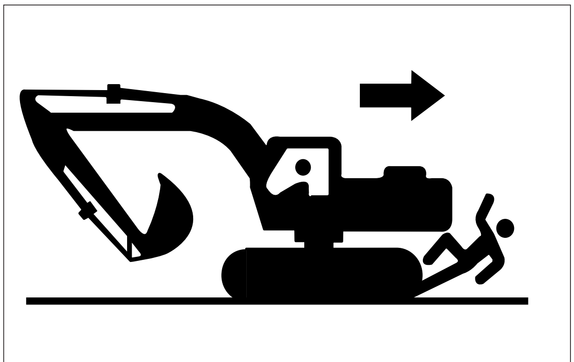
13031GE08

MOVE AND OPERATE MACHINE SAFELY

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

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

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



13031GE09

OPERATE ONLY FORM OPERATOR'S SEAT

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

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

13031GE26

PARK MACHINE SAFELY

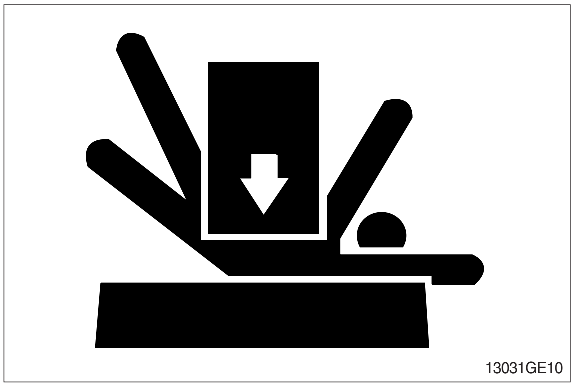
Before working on the machine:

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

SUPPORT MACHINE PROPERLY

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

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

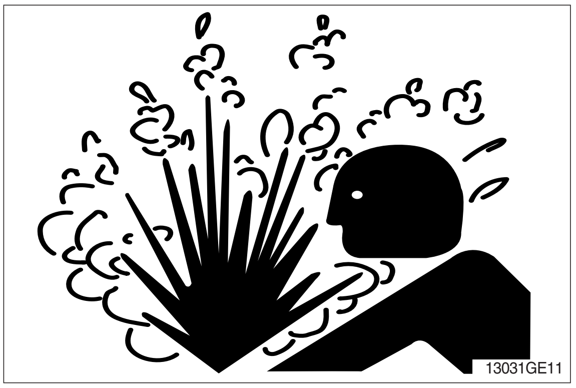


13031GE10

SERVICE COOLING SYSTEM SAFELY

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

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



13031GE11

HANDLE FLUIDS SAFELY-AVOID FIRES

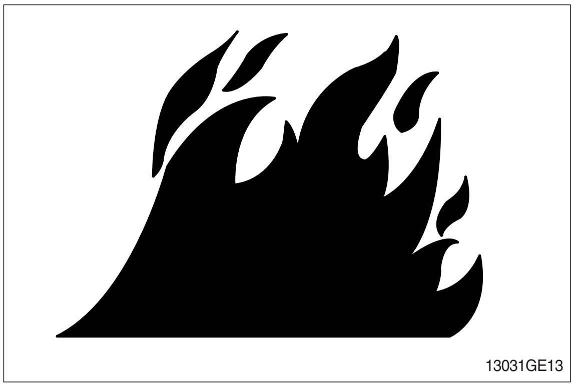
Handle fuel with care; It is highly flammable. Do not refuel the machine while smoking or when near open flame or sparks. Always stop engine before refueling machine.
Fill fuel tank outdoors.

13031GE12

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

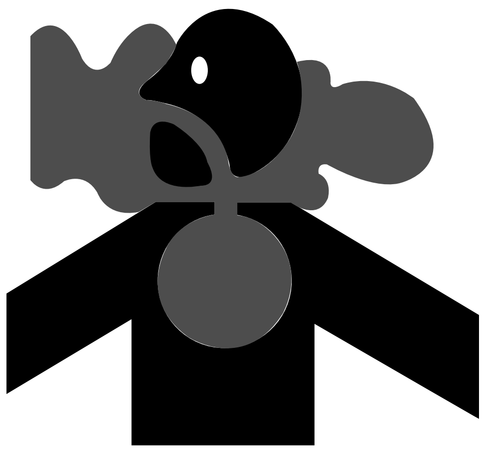
Make sure machine is clean of trash, grease, and debris.

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



13031GE13

BEWARE OF EXHAUST FUMES



13031GE14

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.

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

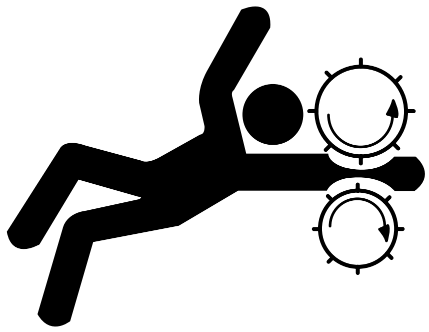
13031GE15

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.

SERVICE MACHINE SAFELY

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

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

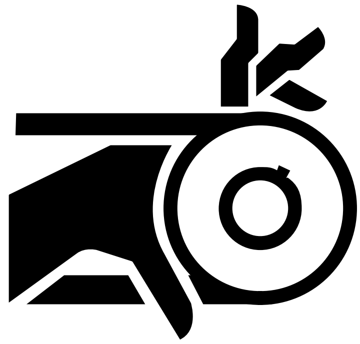


13031GE16

STAY CLEAR OF MOVING PARTS

Entanglements in moving parts can cause serious injury.

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



13031GE17

AVOID HIGH PRESSURE FLUIDS

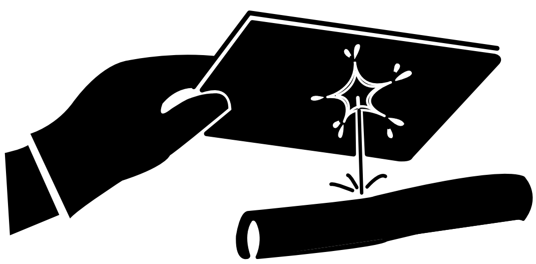
Escaping fluid under pressure can penetrate the skin causing serious injury.

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

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

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

13031GE18



13031GE19

AVOID HEATING NEAR PRESSURIZED FLUID LINES

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

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

13031GE20

PREVENT BATTERY EXPLOSIONS

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

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

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

13031GE21

PREVENT ACID BURNS

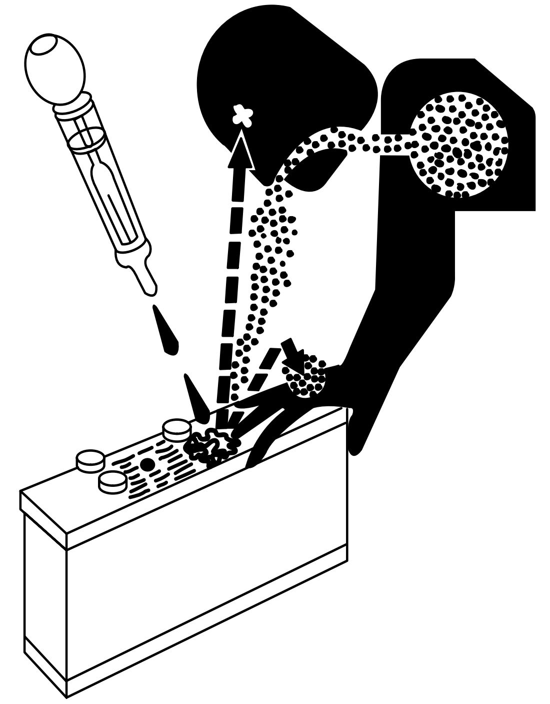
Sulfuric acid in battery electrolyte is poisonous. It is strong enough to burn skin, eat holes in clothing, and cause blindness if splashed into eyes.

Avoid the hazard by:

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

If you spill acid on yourself:

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



13031GE22

If acid is swallowed:

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

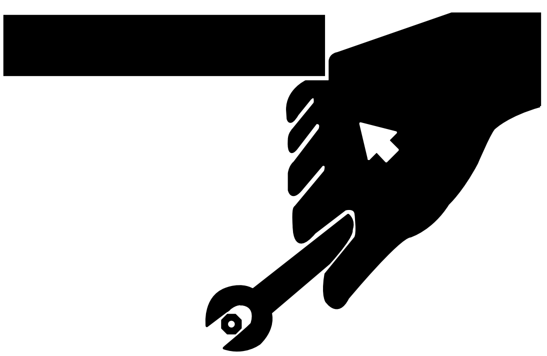
USE TOOLS PROPERLY

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

Use power tools only to loosen threaded tools and fasteners.

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

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



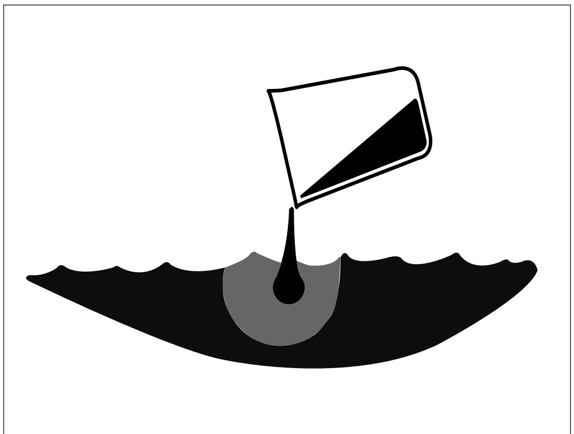
13031GE23

DISPOSE OF FLUIDS PROPERLY

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

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

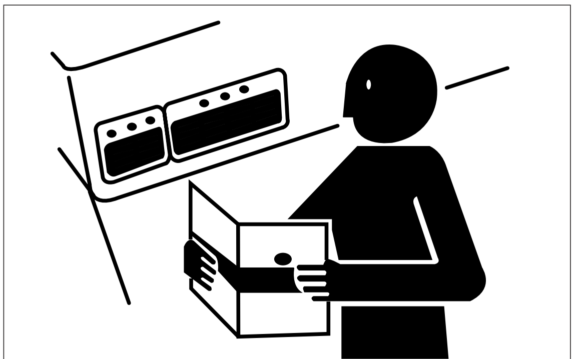
DO NOT pour oil into the ground, down a drain, or into a stream, pond, or lake. Observe relevant environmental protection regulations when disposing of oil, fuel, coolant, brake fluid, filters, batteries, and other harmful waste.



13031GE24

REPLACE SAFETY SIGNS

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



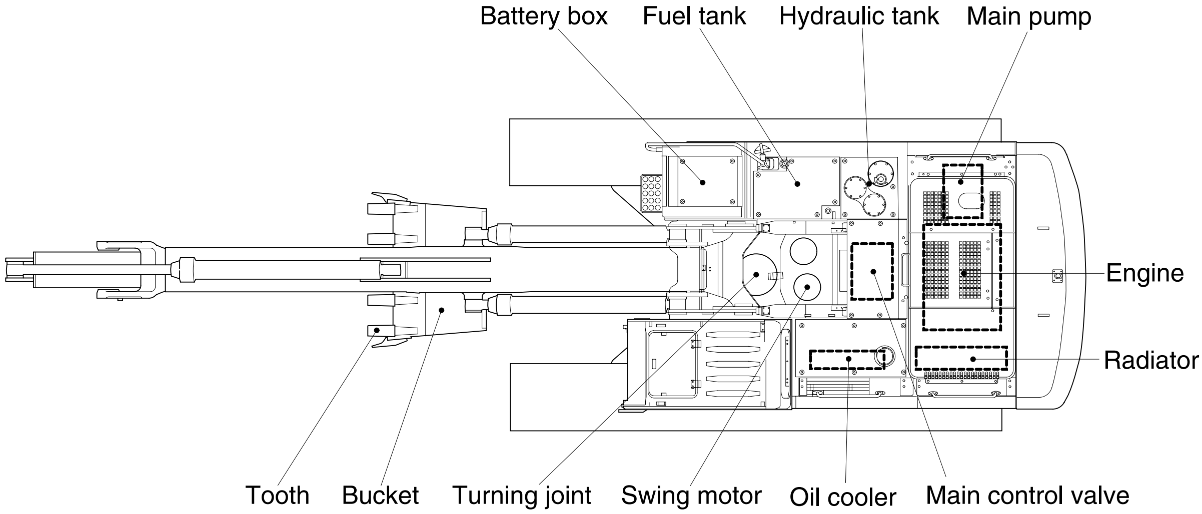
13031GE25

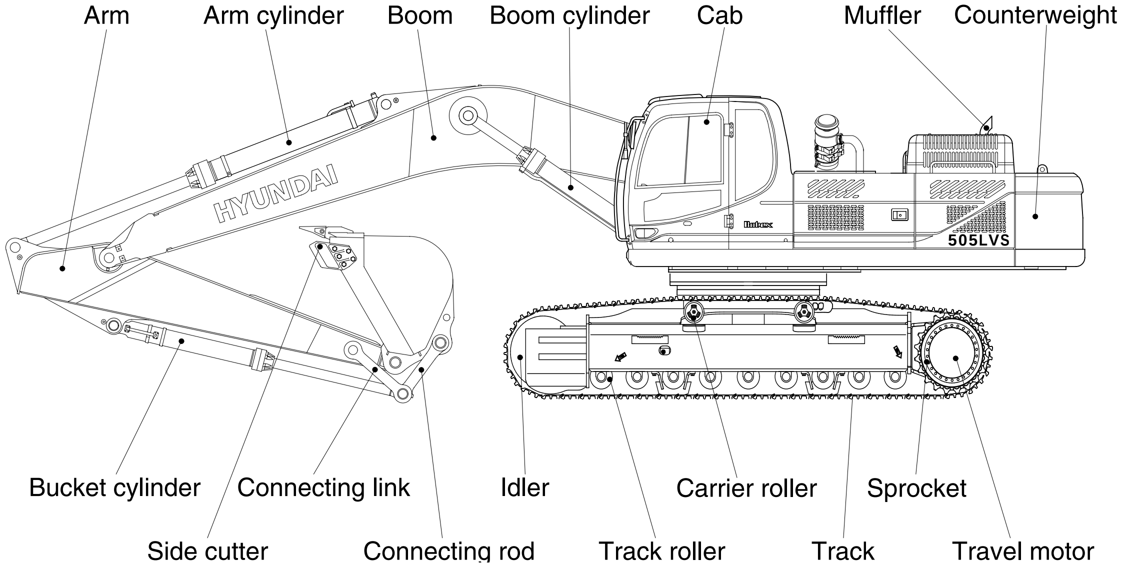
LIVE WITH SAFETY

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

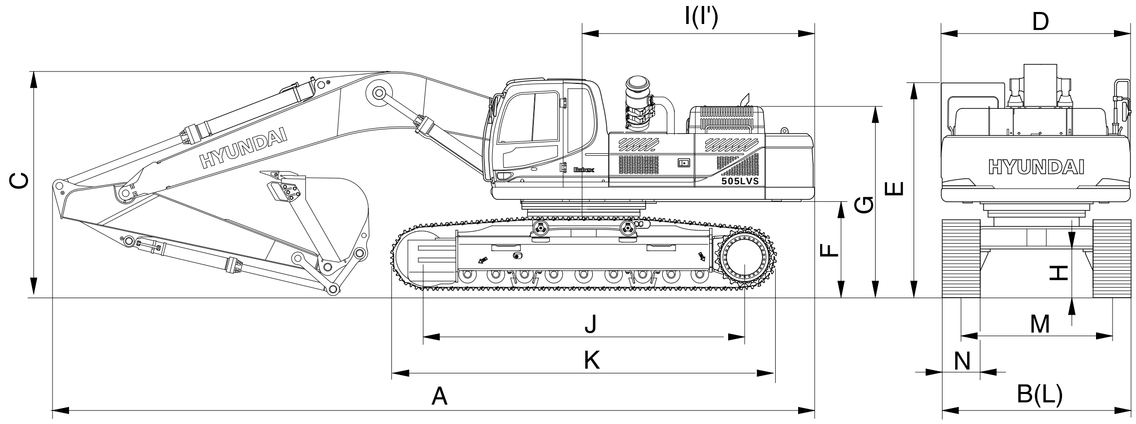




2.SPECIFICATIONS

1) R505LVS

6.55m (21' 6") BOOM, 2.9m (9' 6") ARM

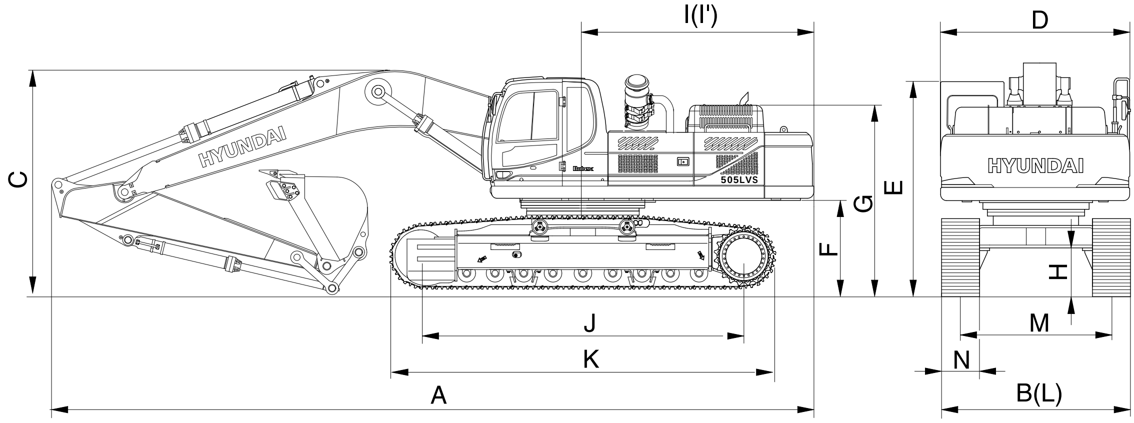


Description		Unit	Specification
Operating weight		kg (lb)	50200 (110673)
Bucket capacity (SAE heaped), standard		m3 (yd3)	2.79(3.65)
Overall length	A	mm (ft-in)	11710 (38' 5")
Overall width, with 600 mm shoe	B		3340 (10' 11")
Overall height	C		3810 (12' 6")
Superstructure width	D		2980 (9' 9")
Overall height of cab	E		3190 (10' 6")
Ground clearance of counterweight	F		1275 (4' 2")
Engine cover height	G		2770 (9' 1")
Minimum ground clearance	H		575(1' 11")
Rear-end distance	I		3750 (12' 4")
Rear-end swing radius	I'		3780(12' 5")
Distance between tumblers	J		4470 (14' 8")
Undercarriage length	K		5510(18' 1")
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	3.4/5.4
Swing speed		rpm	9.2
Gradeability		Degree (%)	35 (70)
Ground pressure (600 mm shoe)		kgf/cm2 (psi)	0.88(12.53)
Max traction force		kg (lb)	34100 (75178)

2.SPECIFICATIONS

1) R505LVS

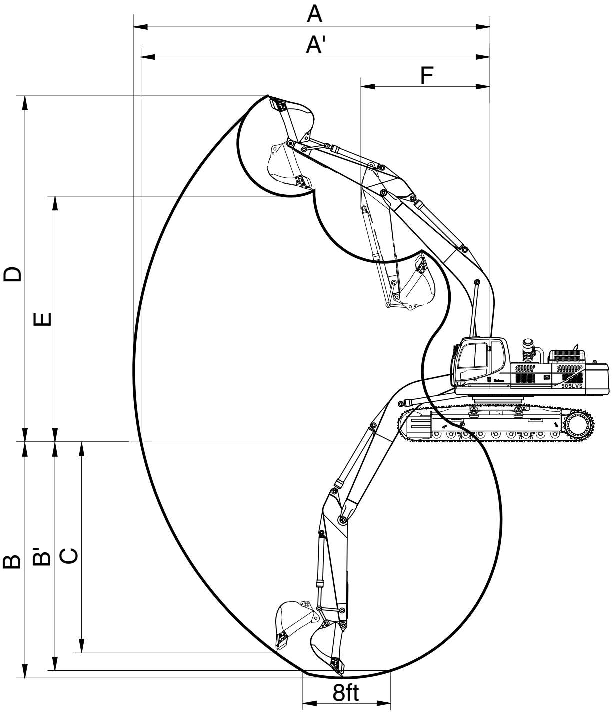
· **7.06m(23' 2") BOOM and 3.38m(11' 1") ARM**



Description		Unit	Specification
Operating weight		kg (lb)	50600 (111554)
Bucket capacity (SAE heaped), standard		m^3 (yd^3)	2.79 (3.65)
Overall length	A	mm (ft-in)	12075 (39' 7")
Overall width, with 600mm shoe	B		3340 (10' 11")
Overall height	C		3870 (12' 8")
Superstructure width	D		2980 (9' 9")
Overall height of cab	E		3325 (10' 11")
Ground clearance of counterweight	F		1305 (4' 4")
Engine cover height	G		2770 (9' 1")
Minimum ground clearance	H		575 (1' 11")
Rear-end distance	I		3750 (12' 4")
Rear-end swing radius	I'		3780 (12' 5")
Distance between tumblers	J		4470 (14' 8")
Undercarriage length	K		5510 (18' 1")
Undercarriage width	L		3340 (10' 11")
Track gauge	M		2740 (8' 12")
Track shoe width, standard	N		600 (24")
Travel speed (low/high)		km/hr (mph)	3.4/5.4 (2.1/3.3)
Swing speed		rpm	9.2
Gradeability		Degree (%)	35 (70)
Ground pressure (600 mm shoe)		kgf/cm^2 (psi)	0.88 (12.53)

3.WORKING RANGE

· 6.55 m (21' 6") BOOM

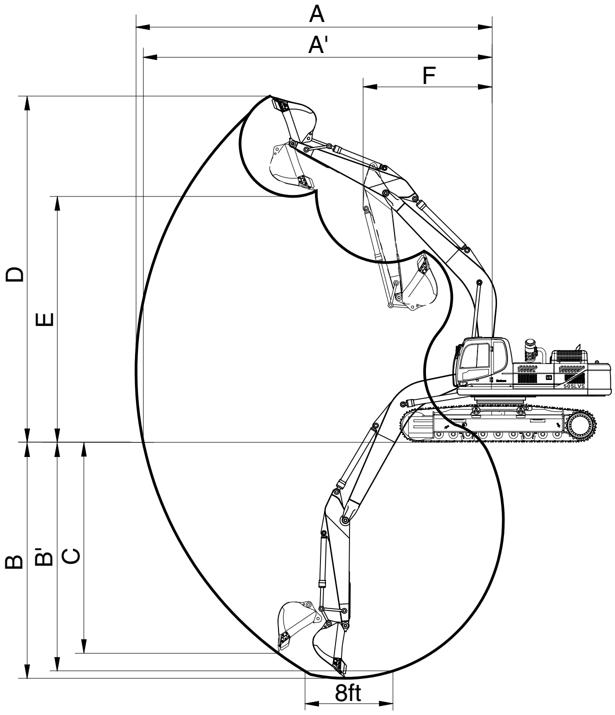


Description		STD *2.9 m (9' 6") Arm
Max digging reach	A	11050mm (36'3")
Max digging reach on ground	A'	10830 mm (35' 6")
Max digging depth	B	6900mm (22'8")
Max digging depth (8ft level)	B'	6740mm (22' 1")
Max vertical wall digging depth	C	4570mm (15' 0")
Max digging height	D	10280 mm (33 9")
Max dumping height	E	6990 mm (22' 11")
Min swing radius	F	4530mm (14' 10")
Bucket digging force	SAE	239.9 [261.7] kN
Arm crowd force	SAE	220.6 [240.7] kN

[ ] : Power boost

3.WORKING RANGE

· **7.06 m (23' 2") BOOM**



Description		STD *3.38m (11' 1") Arm
Max digging reach	A	12015mm (39' 5")
Max digging reach on ground	A'	11821 mm (38' 9")
Max digging depth	B	7777mm (25' 6")
Max digging depth (8ft level)	B'	7633mm (25' 1")
Max vertical wall digging depth	C	4864mm (15' 12")
Max digging height	D	10888mm (35' 9")
Max dumping height	E	7619mm (24' 12")
Min swing radius	F	4773mm (15' 8 ")
Bucket digging force	SAE	243.4[265.6] kN
Arm crowd force	SAE	193.3[210.8] kN

[ ] : Power boost

4. WEIGHT

(1) 6.55 m (21' 6") boom, 2.9 m (9' 6") arm equipped with 2.79 m^3 (SAE heaped) bucket and 600 mm (24") double grouser shoe and 10200 kg counterweight.

Item	R505LVS	
	kg	lb
Upperstructure assembly	20000	44090
Main frame weld assembly	4430	9770
Engine assembly	940	2070
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	10200	22490
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
Carrier roller	80	180
Track roller	80	180
Track-chain assembly (600 mm standard double grouser shoe)	2700	5950
Front attachment assembly (6.55 m boom, 2.9 m arm, 2.79m^3 SAE heaped bucket)	9320	20540
6.55 m boom assembly	3590	7910
2.9m arm assembly	1800	3970
2.79m^3 SAE heaped bucket	2980	6570
Boom cylinder assembly	830	1830
Arm cylinder assembly	630	1390
Bucket cylinder assembly	300	660
Bucket control rod assembly	155	340

4. WEIGHT

(2) 7.06 m (23' 2") boom, 3.38 m (11'1 ") arm equipped with 2.79 m^3 (SAE heaped) bucket and 600 mm (24") double grouser shoe and 10200 kg (22487 lb) counterweight.

Item	R505LVS	
	kg	lb
Upperstructure assembly	20500	45195
Main frame weld assembly	4430	9770
Engine assembly	940	2070
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	10200	22487
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
Carrier roller	80	80
Track roller	80	180
Track-chain assembly (600 mm standard double grouser shoe)	2700	5950
Front attachment assembly (7.06 m boom, 3.38 m arm, 2.79 m^3 SAE heaped bucket)	9998	22042
7.06m boom assembly	3540	7617
3.38 m arm assembly	1755	3869
2.79 m^3 SAE heaped bucket	2980	6570
Boom cylinder assembly	740	1631
Arm cylinder assembly	586	1292
Bucket cylinder assembly	397	875
Bucket control rod assembly	171	377

5. LIFTING CAPACITIES

(1) 6.55 m (21' 6") boom, 2.9 m (9' 6") arm equipped with 2.79 m^3 (SAE heaped) bucket and 600 mm (24") double grouser shoe and 10200 kg counterweight.

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

Lift-point height (m/ft)		Lift-point radius										At max. reach		
		3.0m(9.8ft)		4.5m(14.8ft)		6.0m(19.7ft)		7.5m(24.6ft)		9.0m(29.5ft)		Capacity		Reach
														m (ft)
7.5m	kg											*7000	*7000	7.47
24.6ft	lb											*15430	*15430	(24.5)
6.0m	kg							*9140	8140			*7070	6460	8.35
19.7ft	lb							*20150	17950			*15590	14240	(27.4)
4.5m	kg			*15760	*15760	*11920	11700	*9850	7770			*7470	5440	8.89
14.8ft	lb			*34740	*34740	*26280	25790	*21720	17130			*16470	11990	(29.2)
3.0m	kg			*19350	17100	*13620	10780	*10720	7310	*8970	5090	*8220	4900	9.16
9.8ft	lb			*42660	37700	*30030	23770	*23630	16120	*19780	11220	*18120	10800	(30.1)
1.5m	kg			*21490	15670	*14950	10010	*11430	6880	*9240	4880	*9020	4690	9.17
4.9ft	lb			*47380	34550	*32960	22070	*25200	15170	*20370	10760	*19890	10340	(30.1)
水平面	kg			*21640	15110	*15460	9530	*11730	6580			*9270	4800	8.93
	lb			*47710	33310	*34080	21010	*25860	14510			*20440	10580	(29.3)
-1.5m	kg	*18790	*18790	*20380	15050	*15010	9350	*11350	6460			*9520	5300	8.42
-4.9ft	lb	*41420	*41420	*44930	33180	*33090	20610	*25020	14240			*20990	11680	(27.6)
-3.0m	kg	*23530	*23530	*17840	15300	*13390	9450	*9830	6560			*9650	6450	7.58
-9.8ft	lb	*51870	*51870	*39330	33730	*29520	20830	*21670	14460			*21270	14220	(24.9)
-4.5m	kg	*17160	*17160	*13520	*13520	*9940	9850					*9270	9190	6.27
-14.8ft	lb	*37830	*37830	*29810	*29810	*21910	21720					*20440	20260	(20.6)

Note
1. Lifting capacity are based on SAE J1097 and ISO 10567.
2. Lifting capacity of the ROBEX series does not exceed 75% of tipping load with the machine on firm, level ground or 87% of full hydraulic capacity.
3. The load point is a hook located on the back of the bucket.
4. *indicates load limited by hydraulic capacity.

5. LIFTING CAPACITIES

(2) 7.06 m (23' 2") boom, 3.38 m (11'1 ") arm equipped with 2.79 m^3 (SAE heaped) bucket and 600 mm (24") double grouser shoe and 10200 kg (22487 lb) counterweight.

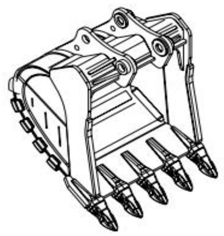
LIFT-POINT HEIGHT (m/ft)		LIFTING-POINT RADIUS										AT MAX. REACH		
		3.0m(9.8ft)		4.5m(14.8ft)		6.0m(19.7ft)		7.5m(24.6ft)		9.0m(29.5ft)		CAPACITY		REACH
														m (ft)
9.0m	kg											*4520	*4520	7.49
29.5ft	lb											*9960	*9960	(24.6)
7.5m	kg							*7670	*7670			*4320	*4320	8.65
24.6ft	lb							*16910	*16910			*9520	*9520	(28.4)
6.0m	kg							*8190	*8190	*6770	*6770	*4370	*4370	9.43
19.7ft	lb							*18060	*18060	*14930	*14930	*9630	*9630	(30.9)
4.5m	kg					*11120	*11120	*9050	*9050	*7790	6690	*4610	*4610	9.92
14.8ft	lb					*24520	*24520	*19950	*19950	*17170	14750	*10160	*10160	(32.5)
3.0m	kg			*18670	*18670	*12940	*12940	*10030	8970	*8290	6400	*5050	4970	10.16
9.8ft	lb			*41160	*41160	*28530	*28530	*22110	19780	*18280	14110	*11130	10960	(33.3)
1.5m	kg			*20950	19120	*14380	12200	*10870	8470	*8740	6120	*5750	4790	10.18
4.9ft	lb			*46190	42150	*31700	26900	*23960	18670	*19270	13490	*12680	10560	(33.4)
0.0m	kg			*20830	18470	*15060	11650	*11350	8110	*8950	5900	*6840	4870	9.97
0.0ft	lb			*45920	40720	*33200	25680	*25020	17880	*19730	13010	*15080	10740	(32.7)
-1.5m	kg	*13550	*13550	*20350	18360	*14880	11400	*11270	7920	*8720	5800	*7930	5250	9.52
-4.9ft	lb	*29870	*29870	*44860	40480	*32800	25130	*24850	17460	*19220	12790	*17480	11570	(31.2)
-3.0m	kg	*19770	*19770	*18390	*18390	*13800	11420	*10460	7910			*8080	6080	8.79
-9.8ft	lb	*43590	*43590	*40540	*40540	*30420	25180	*23060	17440			*17810	13400	(28.8)
-4.5m	kg	*19840	*19840	*15230	*15230	*11580	*11580	*8450	8120			*8010	7780	7.71
-14.8ft	lb	*43740	*43740	*33580	*33580	*25530	*25530	*18630	17900			*17660	17150	(25.3)
-6.0m	kg			*10110	*10110	*7290	*7290					*7150	*7150	6.06
-19.7ft	lb			*22290	*22290	*16070	*16070					*15760	*15760	(19.9)

Note
1. Lifting capacity are based on SAE J1097 and ISO 10567.
2. Lifting capacity of the ROBEX series does not exceed 75% of tipping load with the machine on firm, level ground or 87% of full hydraulic capacity.
3. The load point is a hook (standard equipment) located on the back of the bucket.
4. *indicates load limited by hydraulic capacity.

6.BUCKET SELECTION GUIDE

1）R505LVS

ROCK BUCKET



2.2 m^3 SAE　2.5 m^3 SAE　*2.79m^3 SAE　3.0 m^3 SAE

heaped bucket

Capacity		Weight	Recommendation		REMARK
			6.55 m (21.6") boom		
SAE heaped	CECE heaped		2.4 m arm (7' 10")	*2.9 m arm (9' 6")	
2.2m^3 (2.88 yd^3)	1.93m^3 (2.52yd^3)	2528 kg (5573 lb)			OPT
2.5m^3 (3.27 yd^3)	2.16m^3 (2.83 yd^3)	2660 kg (5864 lb)			OPT
*2.79 m^3 (3.65 yd^3)	2.47 m^3 (3.23 yd^3)	2980 kg (6570 lb)			STD
3.0m^3 (3.92 yd^3)	2.76 m^3 (3.61 yd^3)	3100 kg (6834 lb)			OPT

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

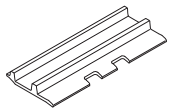
7. UNDERCARRIAGE

1) R505LVS

(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 double grousers.

(2) TYPES OF SHOES

Model	Shapes		Double grouser
			
R505LVS	Shoe width	mm (in)	600 (24)
	Link quantity		53
	Ground pressure	kgf/cm^2 (psi)	0.88 (12.53)
	Overall width	mm (ft-in)	3340 (10' 11")

(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 double 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

8. SPECIFICATIONS FOR MAJOR COMPONENTS

1) ENGINE

Item	Specification
Model	Cummins QSM 11
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	125 × 147.1 mm (4.92" × 5.79")
Piston displacement	10800 cc (659 cu in)
Compression ratio	16.3 : 1
Rated gross horse power (SAE J1995)	407 hp at 1900 rpm (299 kW at 1900 rpm)
Maximum torque	193.6 kgf · m at 1300 rpm
Engine oil quantity	38 l (10 U.S. gal)
Dry weight	942 kg (2077 lb)
Low idling speed	900 ± 50 rpm
High idling speed	1750 ± 50 rpm
Rated fuel consumption	155.4 g/Hp · hr at 1900 rpm
Battery	2 × 12V × 200Ah

2) MAIN PUMP

Item	Specification
Type	Variable displacement tandem axis piston pumps
Capacity	2 × 225 cc/rev
Maximum pressure	330 kgf/cm^2 (4690 psi) [360 kgf/cm^2 (5124 psi)]
Rated oil flow	2 × 405 l/min (107U.S. gpm / 89.1 U.K. gpm)
Rated speed	1800 rpm

[ ]: Power boost

3) GEAR PUMP

Item	Specification
Type	Fixed displacement gear pump single stage
Capacity	15 cc/rev
Maximum pressure	40 kgf/cm^2 (570 psi)
Rated oil flow	27 l /min (7.1 U.S. gpm/5.9 U.K. gpm)

4) MAIN CONTROL VALVE

Item		Specification
Type		9 spools
Operating method		Hydraulic pilot system
Main relief valve pressure		330 kgf/cm^2 (4690 psi) [360 kgf/cm^2 (5120 psi)]
Port relief valve pressure	Boom	380 kgf/cm^2 (5405 psi)
	Arm	380 kgf/cm^2 (5405 psi)
	Bucket	380 kgf/cm^2 (5405 psi)

[ ]: Power boost

5) SWING MOTOR

Item	Specification
Type	Fixed displacement axial piston motor
Capacity	142.8 cc/rev
Relief pressure	285 kgf/cm^2 (4050 psi)
Braking system	Automatic, spring applied hydraulic released
Braking torque	1192 kgf · m (8622 lbf · ft)
Brake release pressure	20.9～35.5 kgf/cm^2 (297～515psi)
Reduction gear type	2 - stage planetary

6) TRAVEL MOTOR

Item	Specification
Type	Variable displacement axial piston motor
Relief pressure	360 kgf/cm^2 (5120 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	15.7kgf/cm^2 (223 psi)
Braking torque	7359 kgf · m (53228 lbf · ft)

7) CYLINDER

Item		Specification
Boom cylinder	Bore dia × Rod dia × Stroke	ø 170 × ø 115 × 1580 mm
	Cushion	Extend only
Arm cylinder	Bore dia × Rod dia × Stroke	ø 190 × ø 130 × 1820 mm
	Cushion	Extend and retract
Bucket cylinder	Bore dia × Rod dia × Stroke	ø 170 × ø 115 × 1370 mm
	Cushion	Extend only

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

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

9. RECOMMENDED OILS

Use only oils listed below. Do not mix different brand oil.
Please use HYUNDAI genuine oil and grease.

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 (10.0)	★SAE 5W-40
			SAE 30
			SAE 10W
			SAE 10W-30
			SAE 15W-40
Swing drive	Gear oil	7.0×2 (1.8×2)	★SAE 75W-90
Final drive		12.0×2 (3.2×2)	SAE 80W-90
Hydraulic tank	Hydraulic oil ★2	Tank: 295 (77.9) System: 486 (128.4)	★ISO VG 15
			ISO VG 32
			ISO VG 46
			ISO VG 68
Fuel tank	Diesel fuel	621 (164)	★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 water	50 (13.2)	Ethylene glycol base permanent type (50 : 50)
			★Ethylene glycol base permanent type (60 : 40)

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

★ : Cold region
Russia, CIS, Mongolia
★2 Hyundai genuine long life hydraulic oil

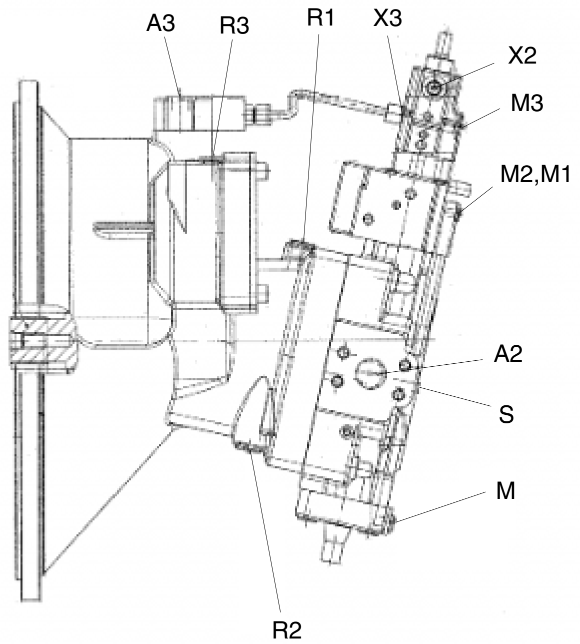
SECTION 2 STRUCTURE AND FUNCTION

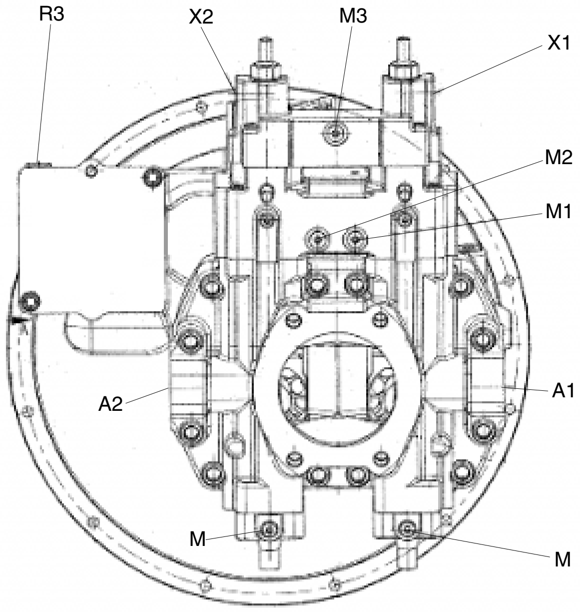
GROUP 1 PUMP DEVICE

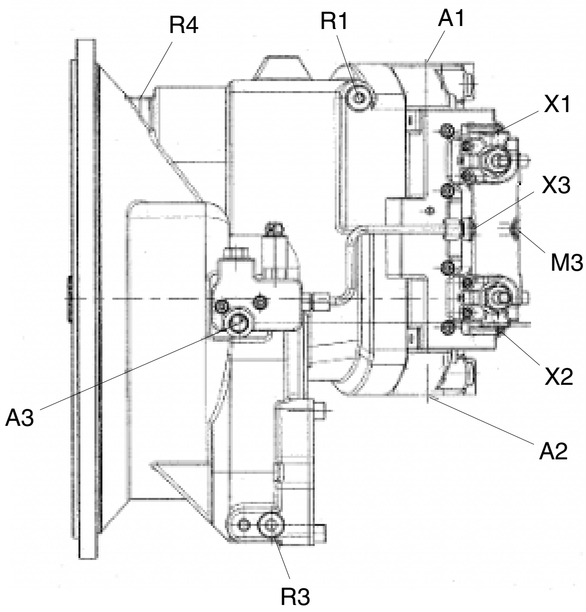
1. STRUCTURE

The pump device consists of main pump, regulator.

· STANDARD

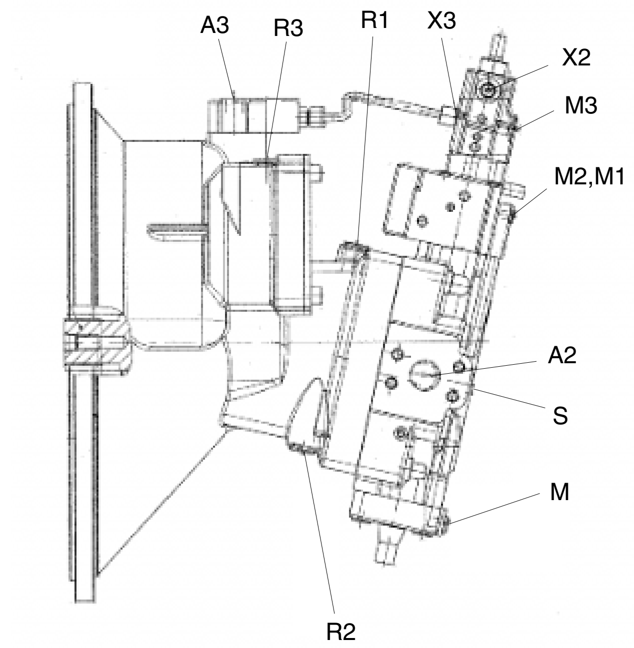


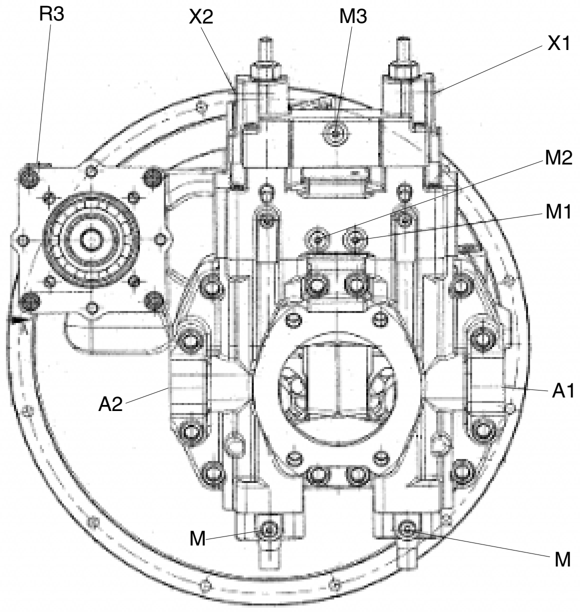


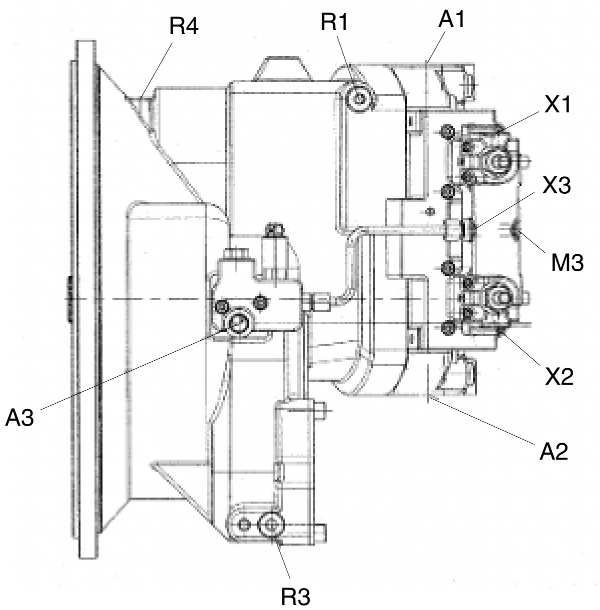


Port	Port name	Port size
A1,A2	Service port	1 1/4"
S	Suction port	5"
A3	Auxiliary pump service port	3/4-16UNF
R1	Bleed port	M22x1.5
R2	Oil drain port	M22x1.5
R3	Bleed port	M22x1.5
R4	Flushing port	3/4-16UNF
X1	Control pressure ports for negative control	9/16-18UNF
X2	Control pressure ports for negative control	9/16-18UNF
X3	Control pressure ports for power override	M14x1.5
M	Measurement port	M12x1.5
M1	Measurement port A1	9/16-18UNF
M2	Measurement port A2	9/16-16UNF
M3	Measurement port for power override	9/16-16UNF

· OPTION-ROTATING WITH PROPORTIONAL

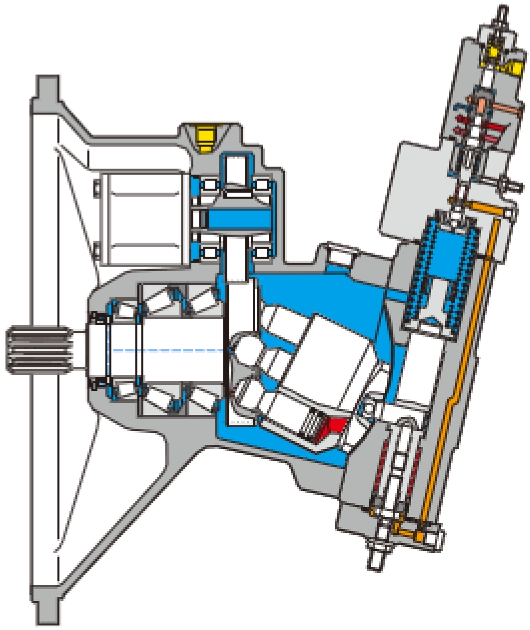


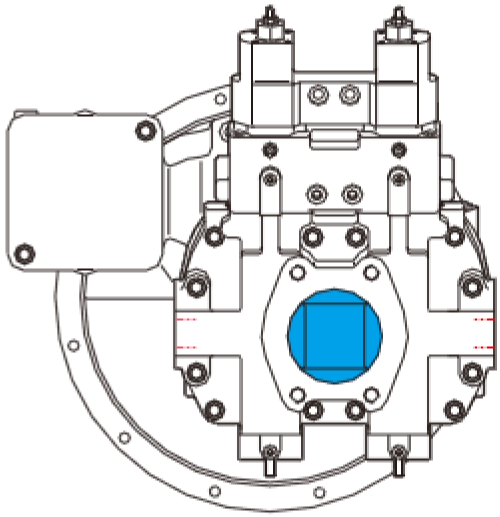


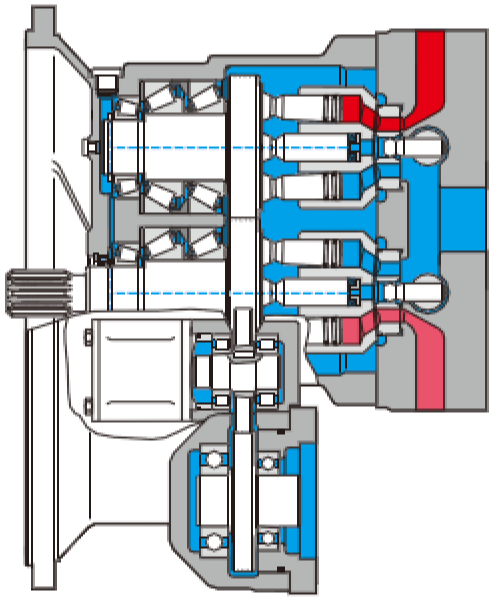


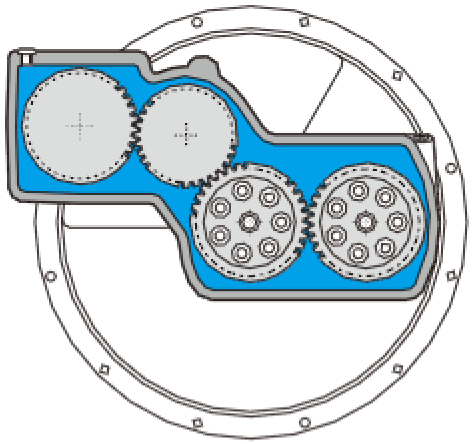
Port	Port name	Port size
A1,A2	Service port	1 1/4"
S	Suction port1	5"
A3	Auxiliary pump service port	3/4-16UNF
R1	Bleed pory	M22x1.5
R2	Oil drain port	M22x1.5
R3	Bleed port	M22x1.5
R4	Flushing port	3/4-16UNF
X1	Control pressure ports for negative control	9/16-18UNF
X2	Control pressure ports for negative control	9/16-18UNF
X3	Control pressure ports for power override	M14x1.5
M	Measurement port	M12x1.5
M1	Measurement port A1	9/16-18UNF
M2	Measurement port A2	9/16-16UNF
M3	Measurement port for power override	9/16-16UNF

2. SCHEMATIC

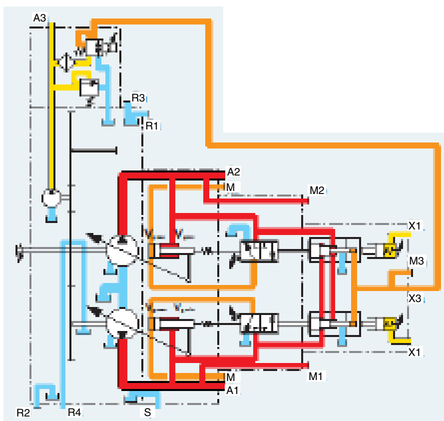


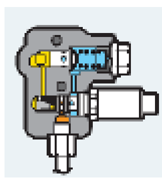




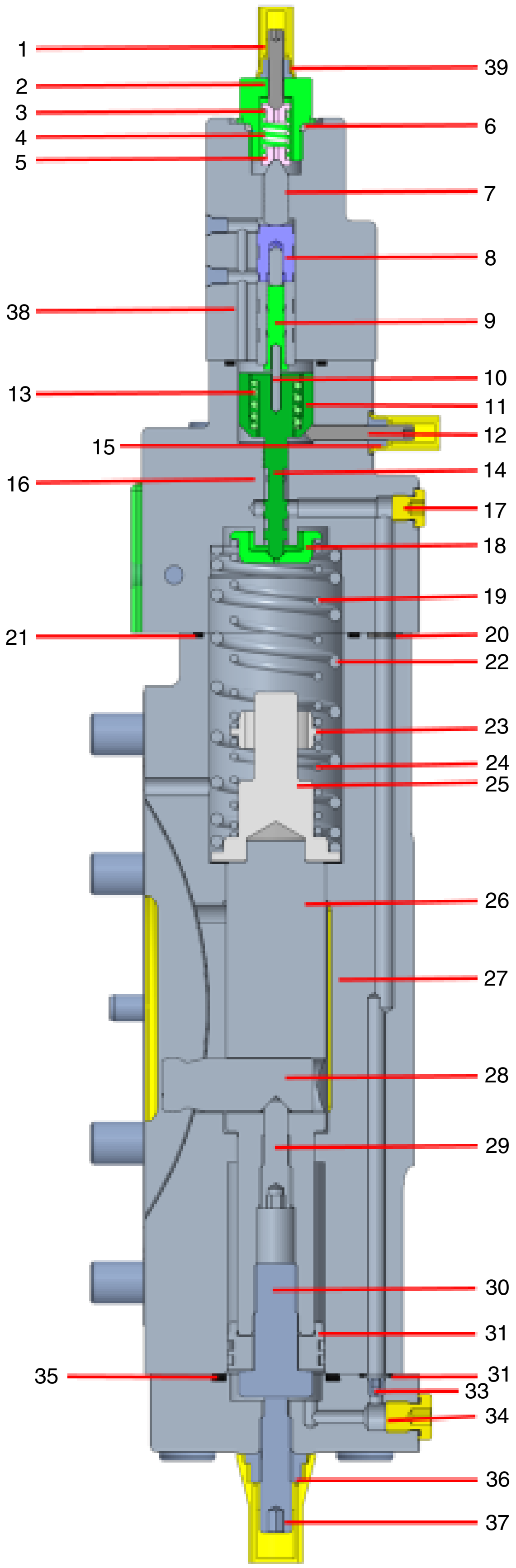


High pressure
Low pressure
Suction pressure
Case drain pressure
Pilot pressure
Control pressure





3. PART LIST (1/3)

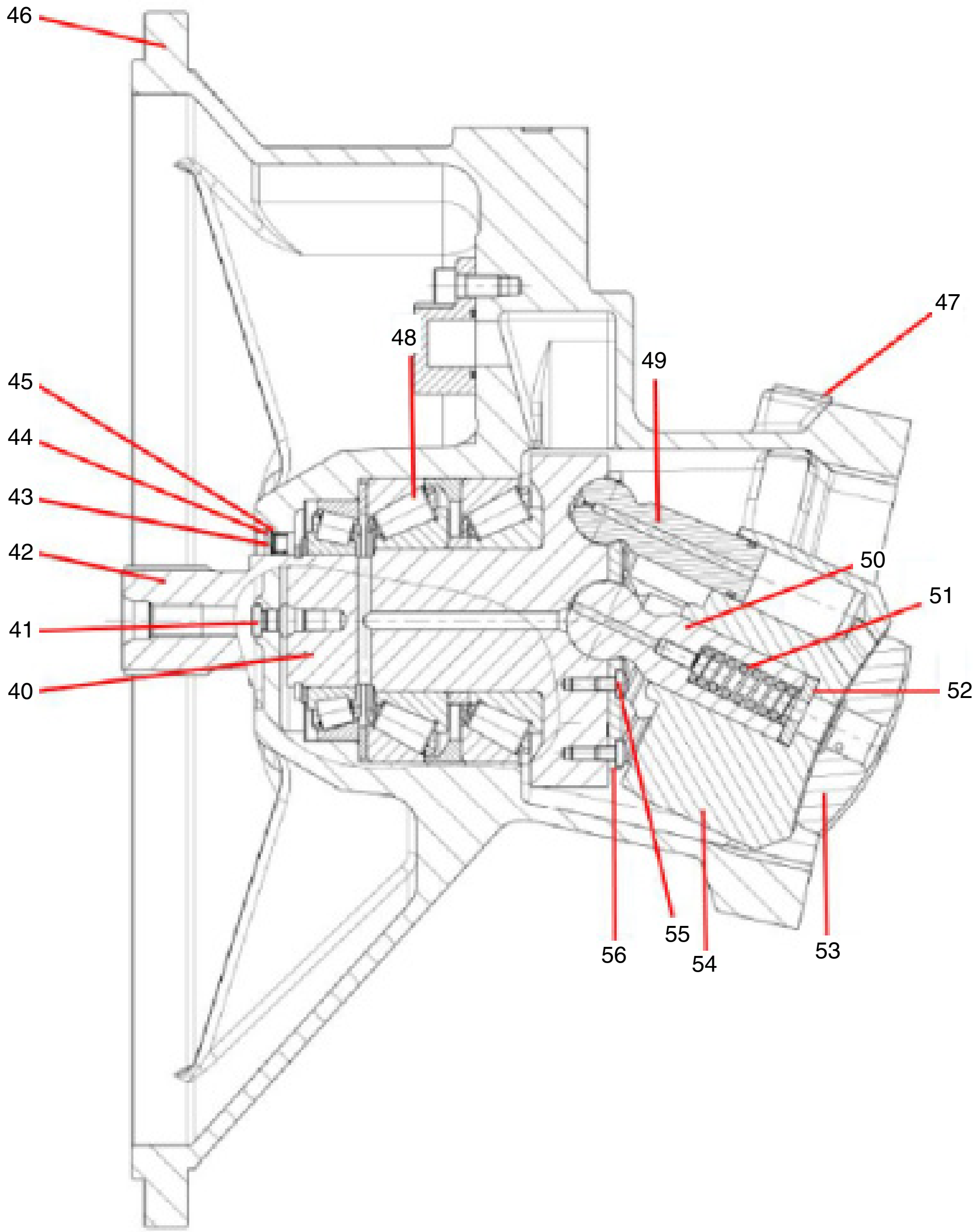


1	Setting screw
2	Screw plug
3	Spring cup
4	Spring
5	Spring cup
6	O-ring
7	HNC control piston
8	Control bushing
9	LLC control piston
10	Pin
11	Spring bushing
12	Adjustment screw
13	Setting screw
14	Control piston for stroking
15	Sealing screw
16	HNC controller housing
17	Sealing screw
18	Spring cup
19	Spring
20	O-ring
21	O-ring
22	Spring
23	Double spring collar
24	Spring
25	Spring collar
26	Stroke piston
27	Port plate
28	Setting pin
29	Locating screws
30	Bolt
31	Piston with steal rings
32	O-ring
33	Orifice
34	Sealing screw
35	O-ring
36	Sealing screw
37	Setting screw
38	Stroke controller housing
39	Sealing screw

※ HNC : Hydraulic Negative Control

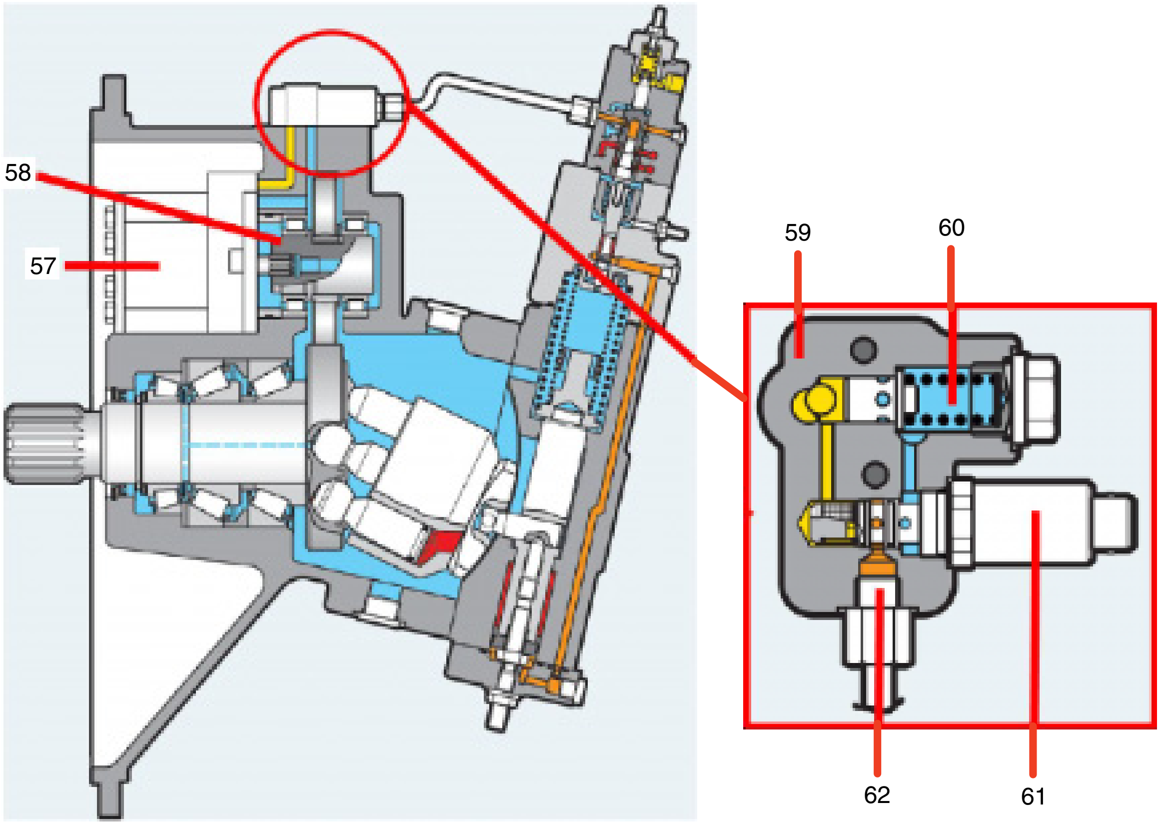
※ LCC : Load Limiting Control

PART LIST (2/3)



40	Rotary group	46	Pump housing	52	Shim
41	Sealing screw	47	Sealing screw	53	Control lense
42	Rotary group	48	Bearings	54	Cylinder
43	Snap ring	49	Piston with steal rings	55	Bolt
44	Shim	50	Center pin	56	Retreat plate
45	Shaft seal ring	51	Spring		

PART LIST (3/3)



57	Gear pump	59	Valve plate	61	EPPR valve
58	Gear wheel	60	Pressure relieve valve	62	Hydraulic pipe

4. FUNCTIONAL EXPLANATIONS OF THE CONTROLLERS

Basically, we can say that there is a priority between the individual controllers. The lowest priority has the flow control (H1). This is directly influenced by the negative control pressure from the MCV.

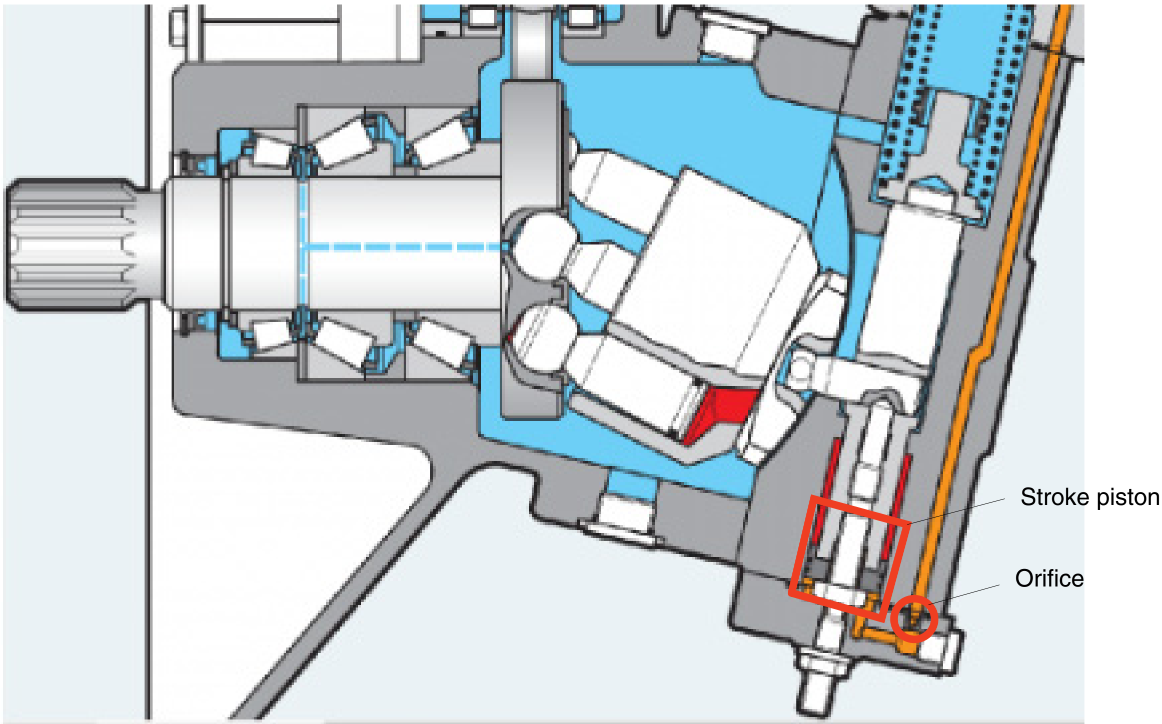
Second priority has the torque control (K). An internal bore in the housing allows a high-pressure signal from each rotary group to be applied to both power controllers. Each individual rotary group considers the high pressure on the regulator individually. If the total power of both rotary groups exceeds the total max. set power, then both rotary groups reduce the flow by swiveling back.

The controller with the highest priority is the power override control (LA1). This protects the diesel engine from overloading. When the diesel engine is over-loaded, it causes the engine speed to decrease and, in the worst case, the diesel engine is being stalled. We counteract the fact, that active the diesel speed is observed. When the diesel speed is too far away from the target speed, e.g. 50 rpm lower. The ECM detects this engine speed drop and provides the pump an electric signal to swivel the pump back, till the engine is recovering to the target speed. This ensures that both rotary groups are reducing their swing angle so far that the speed is recovered back to its target speed.

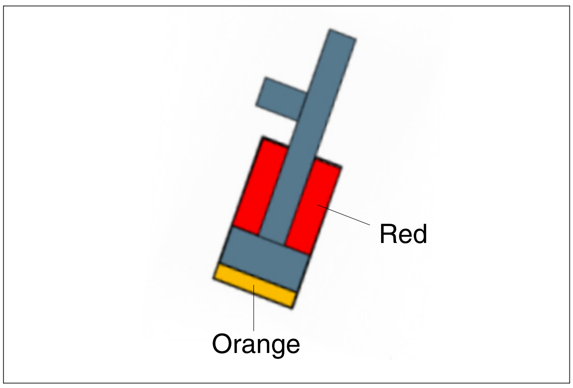
1) BASIC FUNCTION

The pump is an axial piston pump in bent axis design.

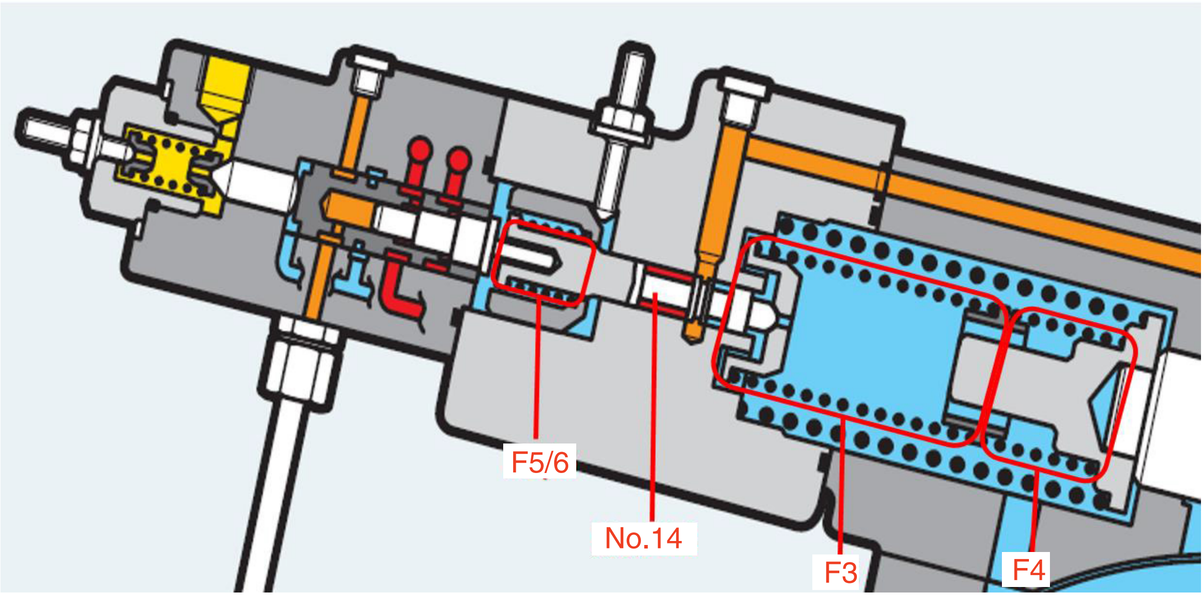
The basic function of each rotary group is as follows.
The high pressure (red) serves for the rotary group as a signal pressure. This causes the rotary group to swivel to Vgmax (large swivel angle). The rotary group remains in this position until it gets a stroke pressure from the regulator. This is ensured by the larger piston area for the stroke pressure, inside the stroke piston we have area ratio of (3 : 1). If the forces of the stroke side are bigger than those of the high pressure side, then the unit swivel from Vgmax (large swivel angle) → Vgmin (small swivel angle). The swivel time can additionally be influenced by the orifice in picture below.



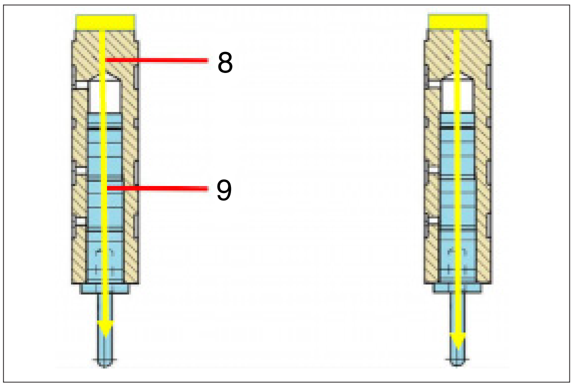
The stroke piston and the piston with steal rings (31) have an area ration of 3 (orange) and 1 (red).



The basic function of the controller is as follows shown in picture above. If the control piston (14) opens the connection area from high pressure to the orange stroke pressure, then the unit swivel from Vgmax to Vgmin. We can say that first the spring force (F5/6) has to be overcome.
When the unit swivels, the spring F3 is compressed until it is limited by the spring cup. Then the spring F4 is compressed. If the flow is interrupted by the connection area, the unit stops at this swivel angle and is holding its position.
These two springs (F3 and F4) compression characteristic leads to the typical two spring control behavior.



There are three ways how the control piston (14) can be pushed for connecting the high pressure with stroke pressure area.



(1) Negative control H1

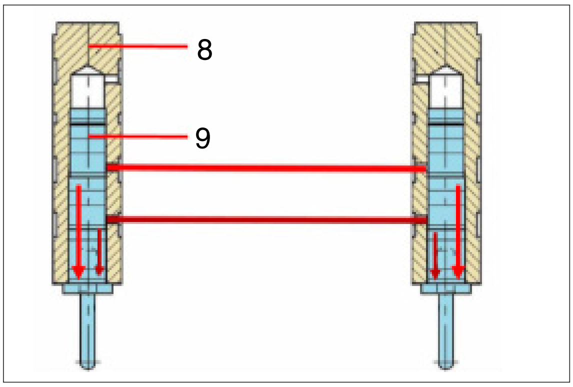
Movement of control bushing (8), via the negative control pressure from main control valve.

The yellow marked control bushing (8) can be operated, until enough power is available. i.e. power control (hydraulic coupling) or LLC (load limiting control) is not active. In this case the blue control piston (9) is pressed down by the control bushing (8).

(2) Hydraulic coupling for power control K

Movement of control piston (9) inside the upper control housing, via high pressure from own rotary group, or hydraulic coupling, via the other rotary group.

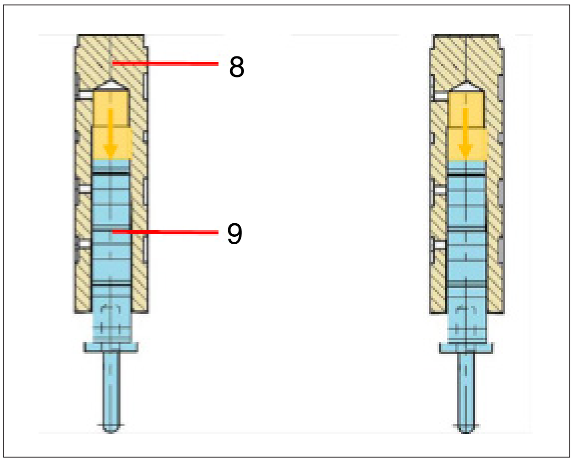
In case the load pressure of consumer is increasing, pressure is given to both control pistons (9) (A1 and A2). The rotary group with higher flow demand (swivel angle) is starting to swivel back at first. Until both rotary groups have the same power demand. up from this point, both rotary groups are swiveling in parallel.



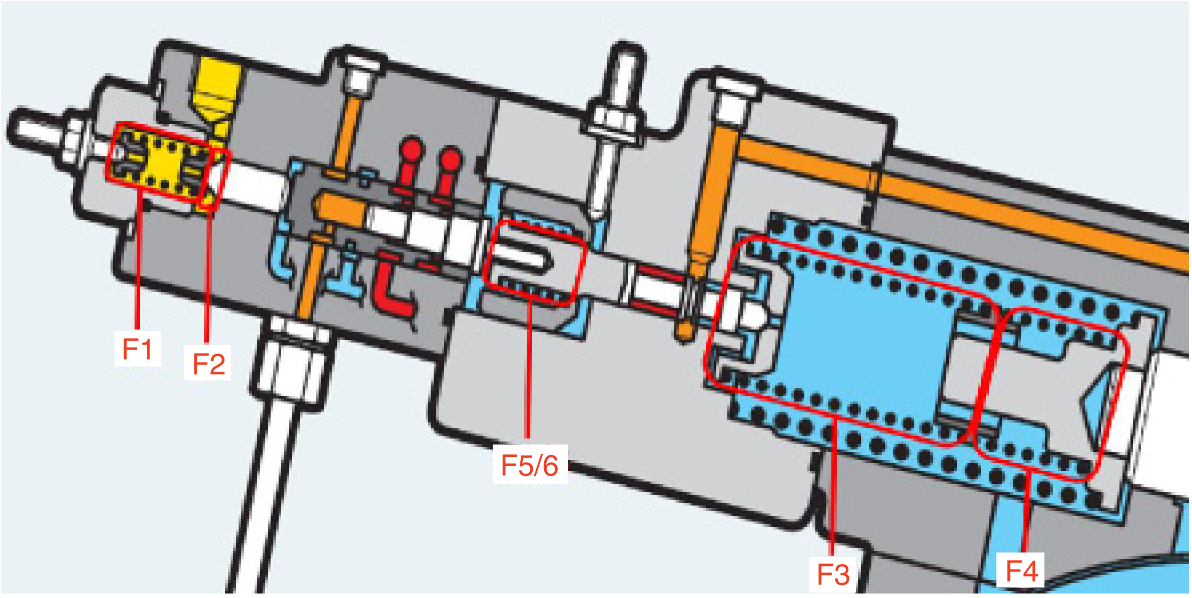
(3) Power override LA1

Movement of control piston (9) inside the upper control housing, via the pilot pressure from the electric proportional pressure-reducing valve, for power control.

In case the engine power is overloaded, the blue marked control piston is moving down, independent from the negative control pressure (control bushing (8)).
In case the high pressure is increasing over the available set power on one or the other rotary group, control piston (9) is also moving downwards and providing stroke pressure for swiveling back the pump.



2) FLOW CONTROL



The flow controller is the regulator with the lowest priority. This becomes dependent on an external control pressure. This control pressure is generated as follows.

The MCV inside the open center system is getting closed, when the operator doesn`t move the joystick. The remaining flow rate of the pump is sent via a metering orifice. This creates a control pressure, e.g. 25 bar.
This ensures that the unit is swiveling to Vgmin. If the operator now requires more volume flow. Then the control pressure is reduced, the unit continues to swivel out to Vgmax.

There are two forces in the marked control chamber.
F1 = spring force
F2 = control pressure multiplied with the area of the control piston

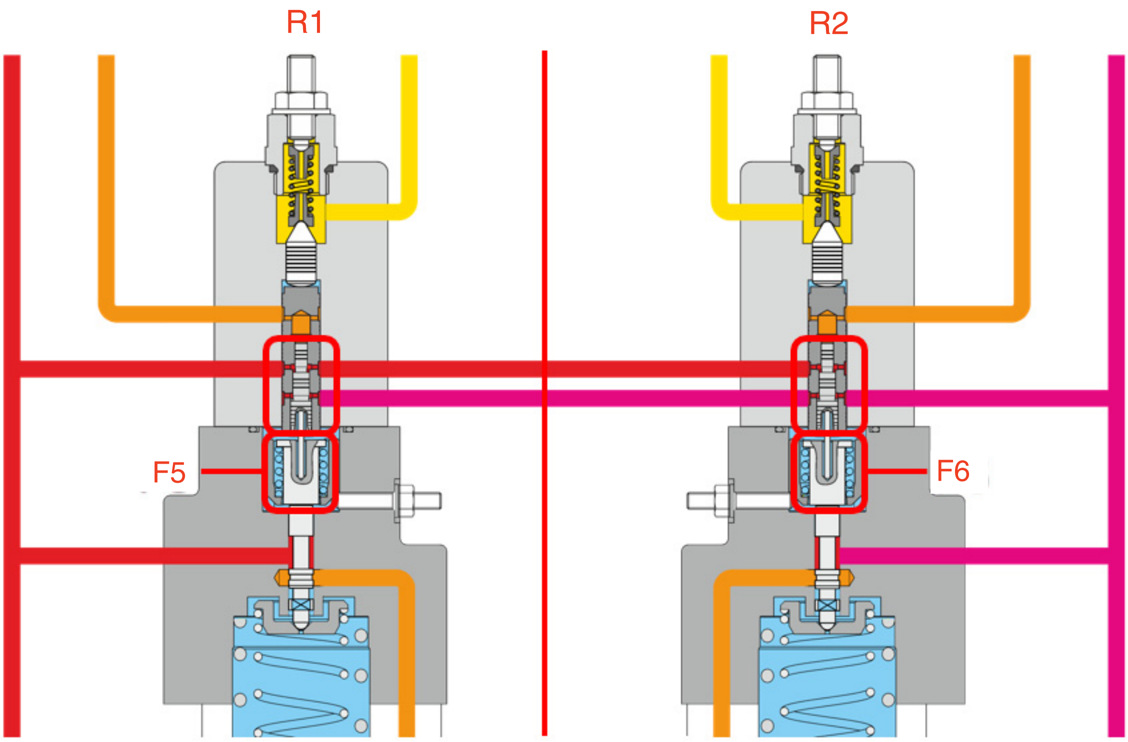
These forces work against the spring forces of the power controller F3 and F4. The important factor is the control pressure.
If the control pressure is increasing, the force of F2 increase too and ensures that the control piston (14) opens the channel between the high pressure and the stroke pressure. Due to that a feedback comes up, that the unit generates too much volume flow. The unit swivel to a smaller swivel angle.

The two compression springs allow us to set up a fine control range. This is realized by installing two differently strong compression springs. The softer compression spring (F4) is compressed until it is limited by the double spring collar (23). At this point, the harder spring (F3) takes over.

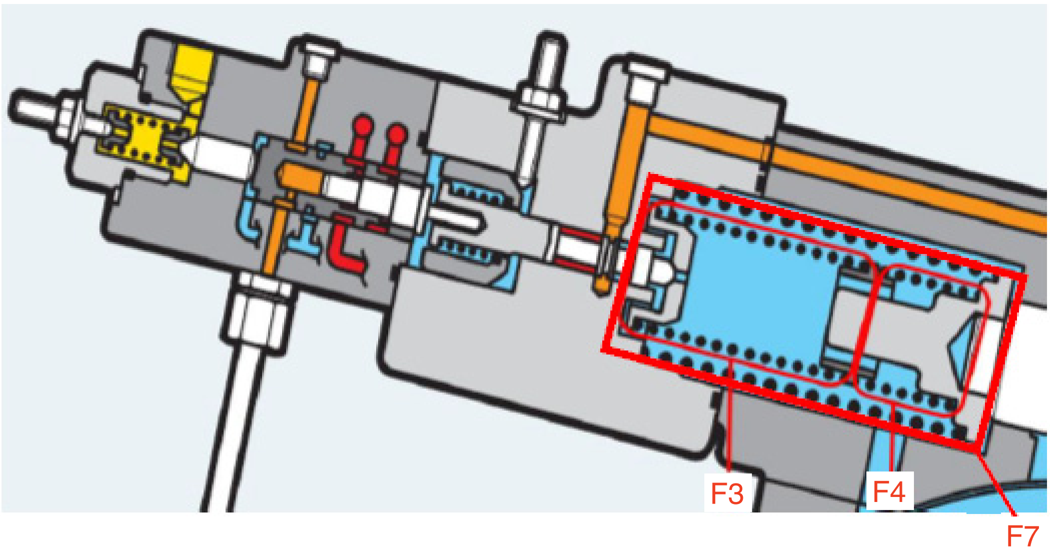
3) POWER CONTROL

Next we take a look at the power controller. The basic understanding is that we have two rotary groups and two independent controllers. The power controller for the rotary group A1 and A2. We connect both power controllers to each other via the hydraulic coupling. In each case, the high pressure of the rotary group A1 and A2 acts on the controller. We look at the picture below. The red line (P1) and the pink line (P2) set the high pressure of the respective rotary group.

Both high pressures are applied to the control piston. Over the surfaces, these pressures generate a force which works against the adjusted spring force (F5/F6). If the force is bigger than the spring force (F5), the control edge opens and the pump swivels back.



Here it is important that the rotary group swivels according to the characteristics of the spring force F3 and F4.
The spring force F7 is pushing every rotary group to maximum swivel angle without high pressure, e.g. engine stopped.

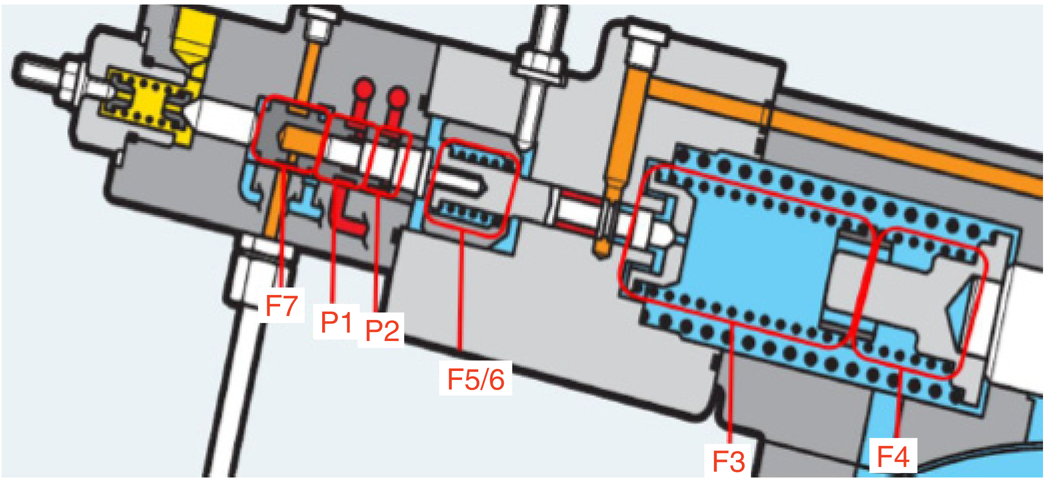


4) ANTI STALL CONTROL OR POWER SHIFTING FUNCTION

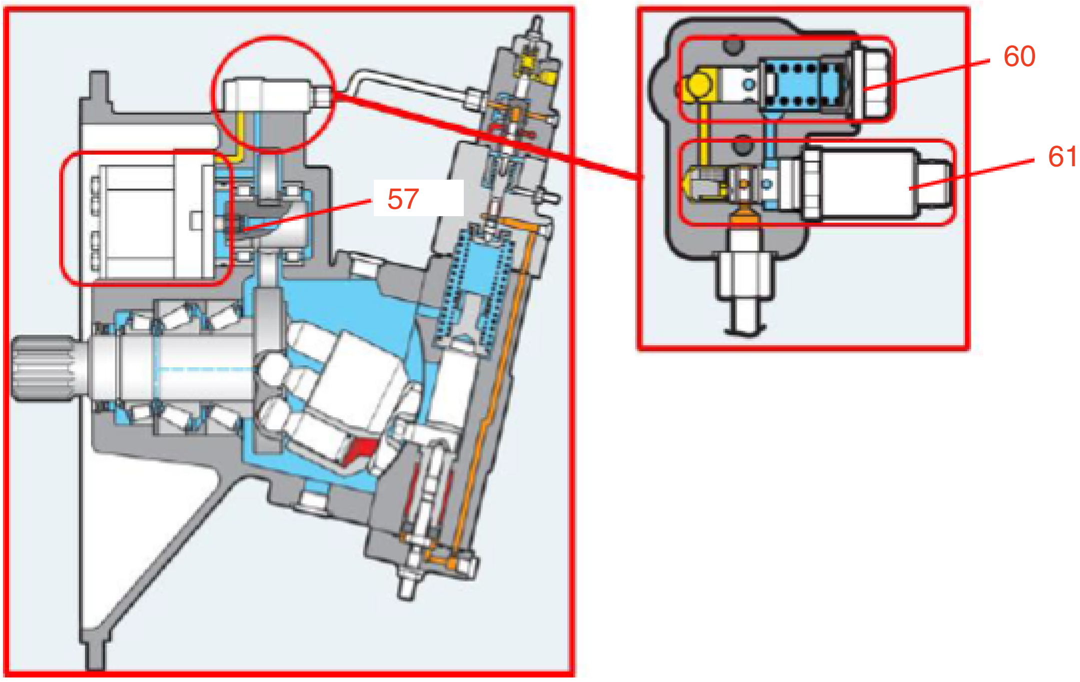
First, let's take a look at the anti-stall function. In this case, the power override is integrated into the pump control. Externally, the diesel engine speed is monitored via the ECM. If the engine is overloaded, e.g. more than 50 rpm and thereby reduces the diesel speed. Then the LLC (load limiting control) activates the anti-stall function of the pump. In this case, an external control pressure is applied to the control piston (9). This force (F7) stand over all other functions and swivel back the unit until the diesel speed recovers.

So second, let's look at the power shifting function. Here it is possible to approach different driving modes.

It can be seen very well in the picture No. 10, that the external control pressure (F7) and the two high pressures (P1/P2) of the hydraulic coupling work together against the springs (F5/6, F3 and F4). If we now increase the external control pressure (F7), less pressure is needed to open the spring F5/6. This gives us a new power setting.



The external control pressure is generated as follows. A gear pump (57) is integrated in the main pump fly wheel housing. The pressure of the gear pump flow is limited by a pressure relief valve (60), this setting is made via shims. This pressure can be used external via A3 port or is used via the electric proportional pressure reducing valve (61), which can be controlled in the two ways mentioned above: 1. LLC (load limiting control) or 2. Power mode controller.



5. ADJUSTMENT OF THE CONTROLLERS

For the adjustment of the controller, you need a power diagram. Please get in touch with your Hyundai dealer.

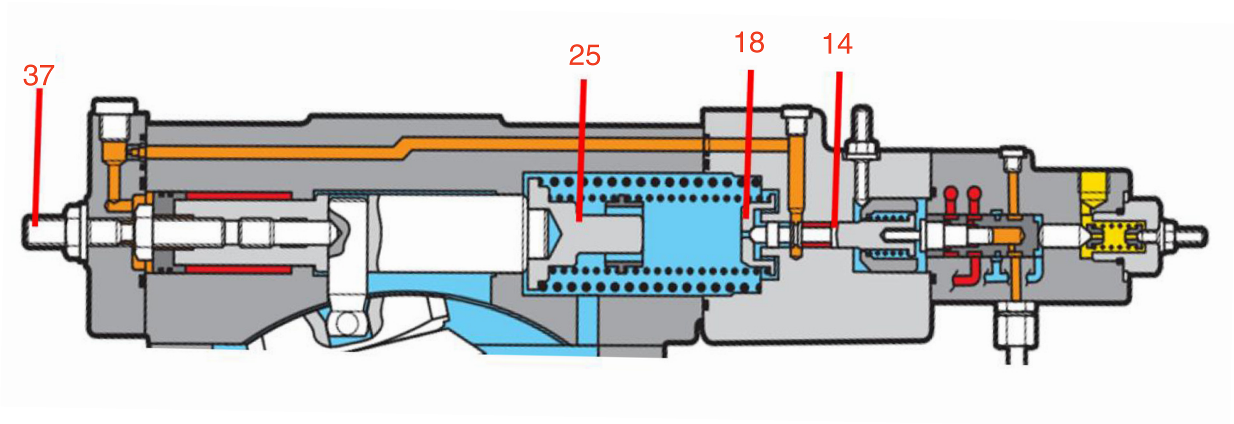
1) FLOW

(1) Maximum flow (mechanical)

The limitation for the maximum flow is done via the setting screw (37)

(2) Minimum flow (hydraulic)

The limitation over the minimum volumetric flow (residual flow) results from the spring collar (25). The spring collar (25) is pressing again the spring cup (18)/control piston (14).

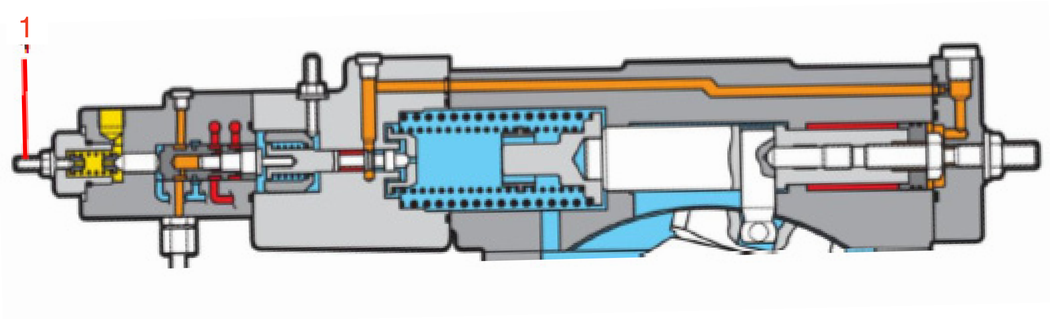


(3) Flow controller

When you turn the setting screw (1) inside you move the px1 downstairs. When you turn the setting screw (1) out than move the px1 upstairs.

※ Adjustment M6x1 : 1 turn = 1 mm = +11 bar (counter-clockwise)

※ Adjustment area piQ : 10~5.1 bar (delta 4.9 bar)

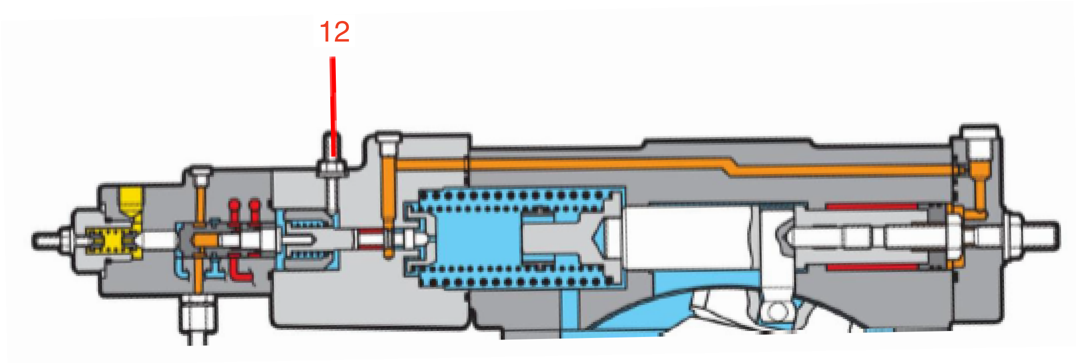


2) POWER CONTROL SETTING

With the volumetric flow controller, fully control the A1 rotary group. Then increase the high pressure to the control point of the power controller. You realize that the power regulator is engaged when the speed of the movement slows down. Use the adjustment screw (12).
Turn the screw inside for a higher power setting, turn it out for a lower power setting.

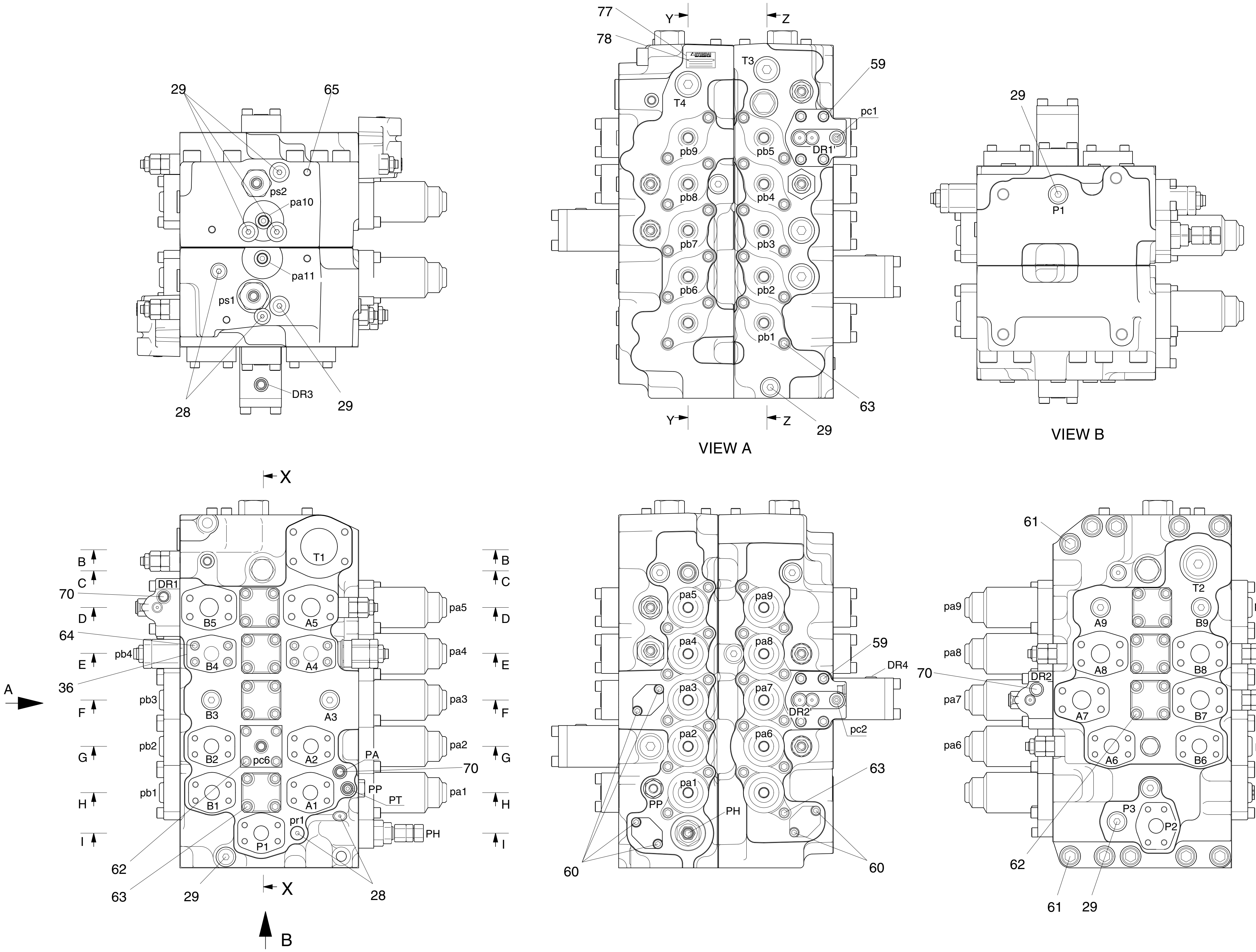
Then repeat the same procedure for the A2 rotary group.

Afterwards, control both rotary group together and check if the hydraulic coupling works.
1. rotary group A1: 100% volume flow (speed), high pressure 300 bar
2. rotary group A2: 100% volume flow (speed), high pressure 300 bar
3. rotary group A1 and A2: 100% volume flow (speed), high pressure 150 bar



※ Adjustment M6x1 : 1 turn = 1 mm = +85.8 bar
(clockwise adjustment range of pQ: 150 ~ 300 bar (delta 150 bar)
(max. input torque 1.788 Nm of pump to be considered,
i.e. Vgmax and delta p = 250 bar, both rotary groups)

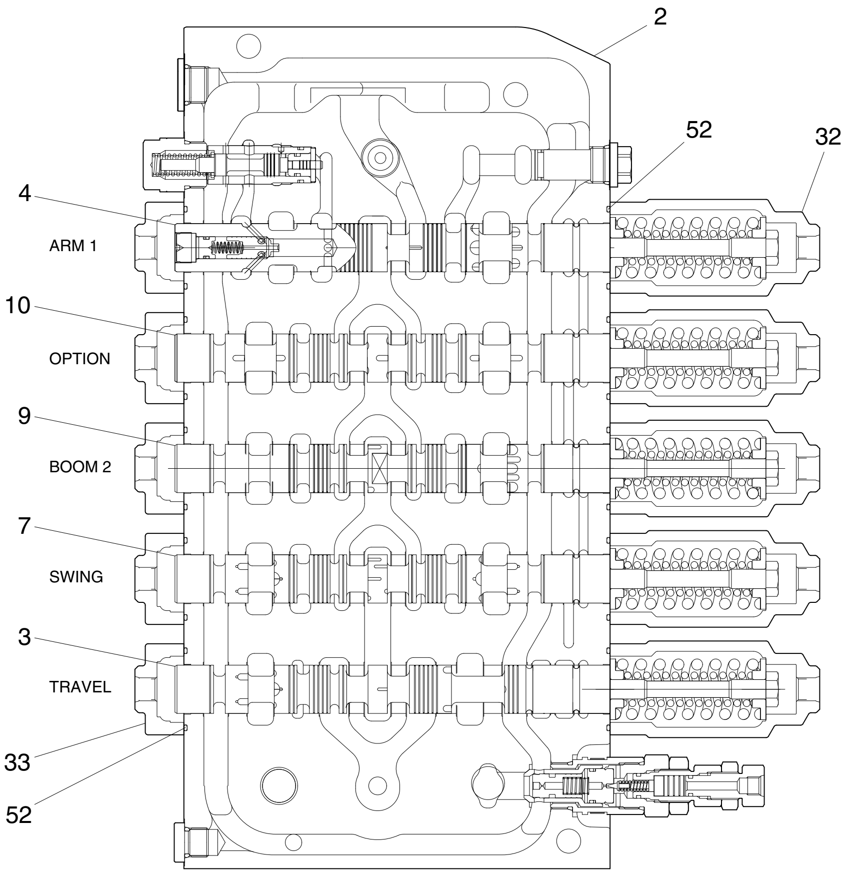
1. STRUCTURE



Port name	Port size	Thread depth (mm)
DR1, DR2, DR3, DR4, DR1', DR2', pr1, ps1, ps2, pc1, pc2, pc6, pc7, 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

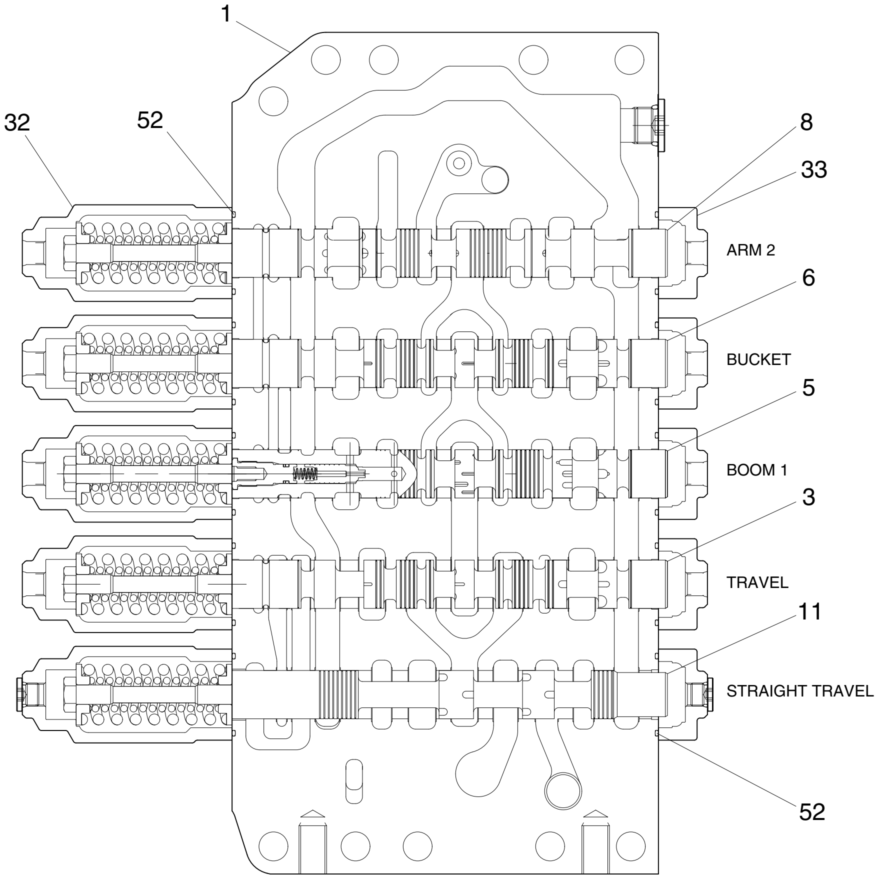
28 Plug assy
29 Plug assy
36 Flange
59 Socket head bolt
60 Socket head bolt
61 Socket head bolt
62 Socket head bolt
63 Socket head bolt
64 Socket head bolt
65 Socket head bolt
70 Dust cap
77 Name plate
78 Rivet

STRUCTURE (2/7)



SECTION Z-Z

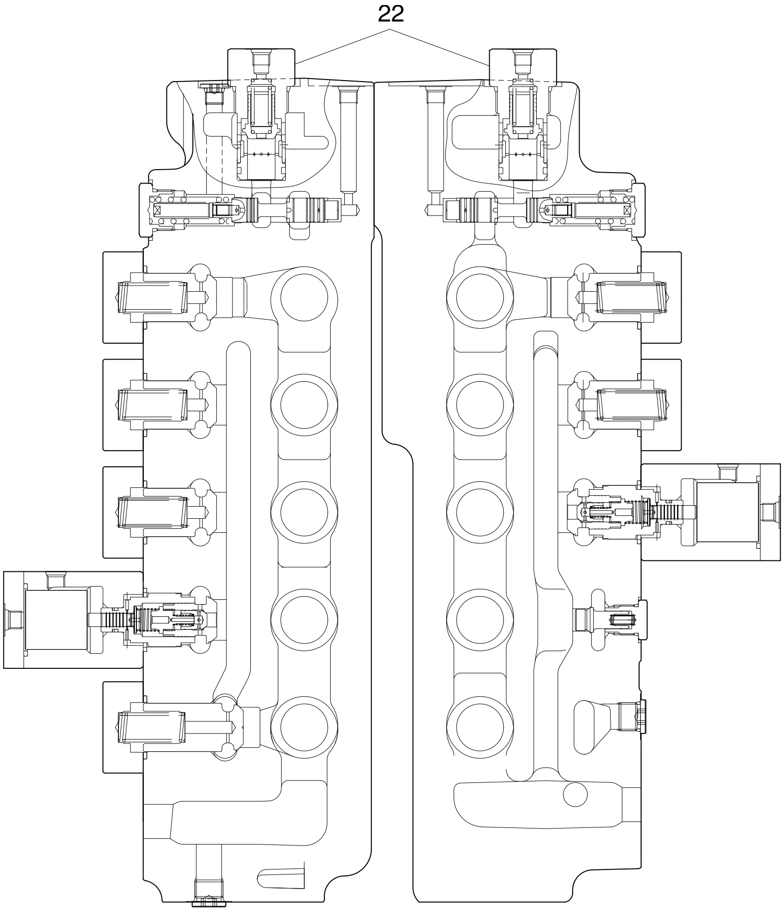
- 2 Housing P2
- 3 Travel spool kit
- 4 Arm 1 spool kit
- 7 Swing spool kit
- 9 Boom 2 spool kit
- 10 Option spool kit
- 32 Spool cap (L)
- 33 Spool cap (S)
- 52 O-ring



SECTION Y-Y

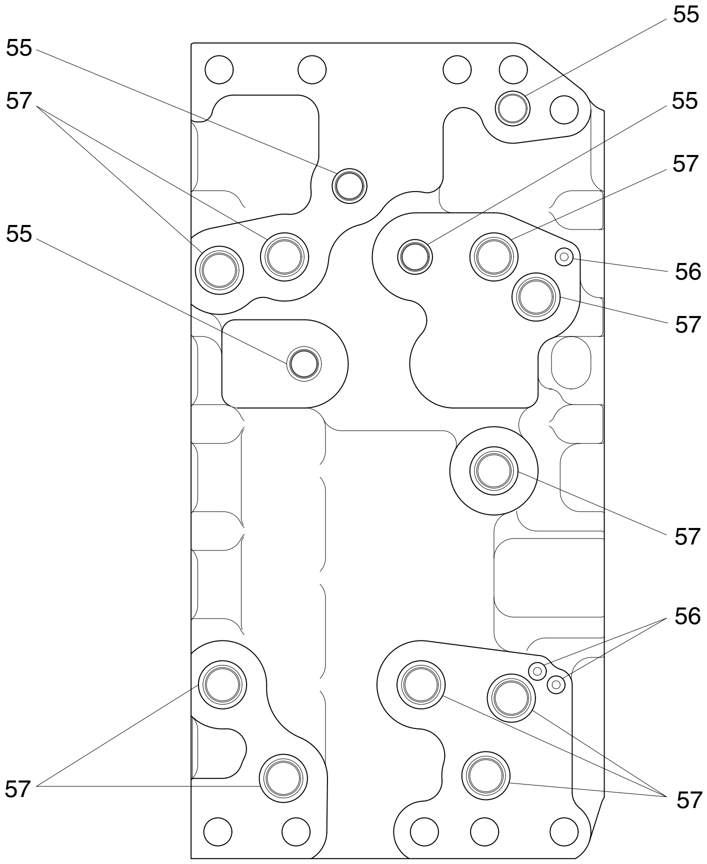
- 1 Housing P1
- 3 Travel spool kit
- 5 Boom 1 spool kit
- 6 Bucket spool kit
- 8 Arm 2 spool kit
- 11 Straight travel spool kit
- 32 Spool cap (L)
- 33 Spool cap (S)
- 52 O-ring

STRUCTURE (3/7)



SECTION X-X

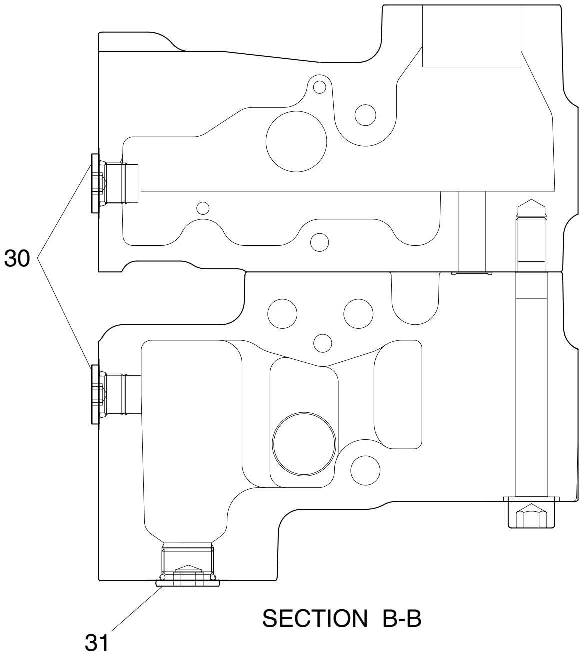
22 Negacon valve assy



DETAIL OF COMBINED PLANE

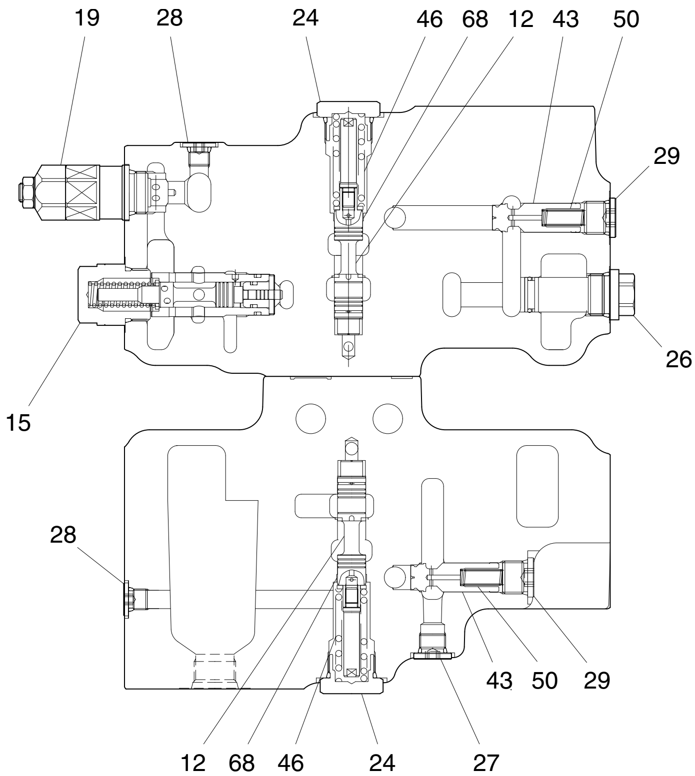
55 O-ring
56 O-ring
57 O-ring

STRUCTURE (4/7)



SECTION B-B

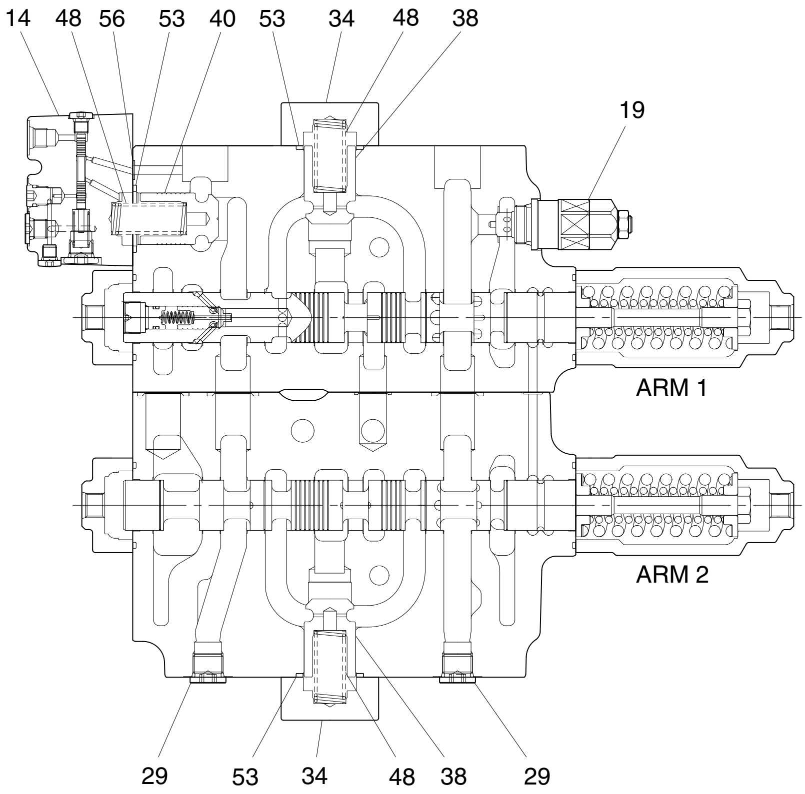
30 Plug assy
31 Plug assy
66 Socket head bolt



SECTION C-C

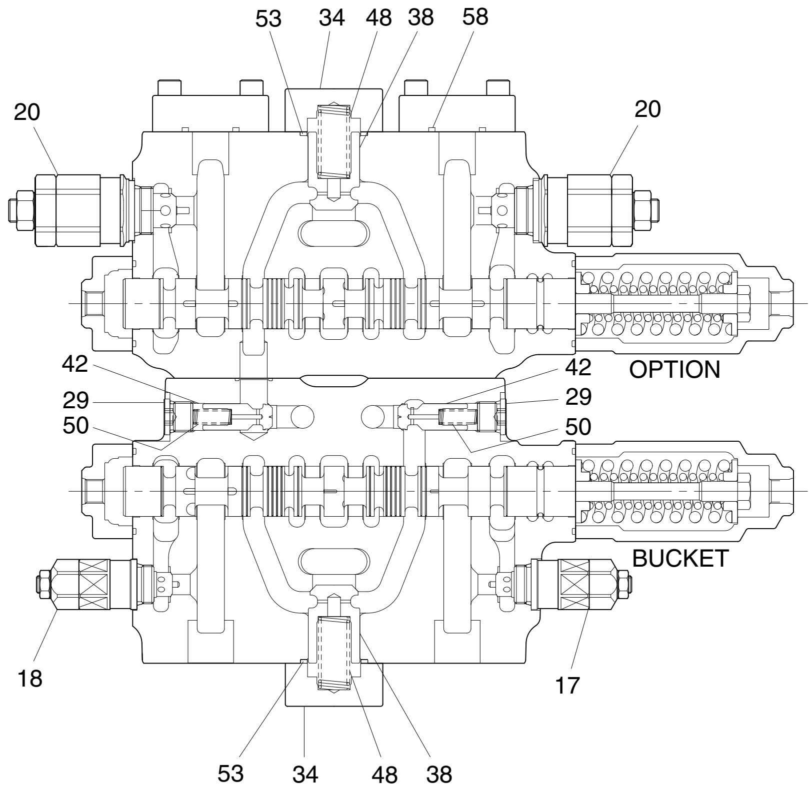
12 Spool kit-BC
15 Arm regen cut valve
19 Overload relief valve assy
24 Plug assy-BC
26 Plug assy
27 Plug assy
28 Plug assy
29 Plug assy
43 Poppet
46 Spring-BC
50 Spring
68 Spring seat-BC

STRUCTURE (5/7)



SECTION D-D

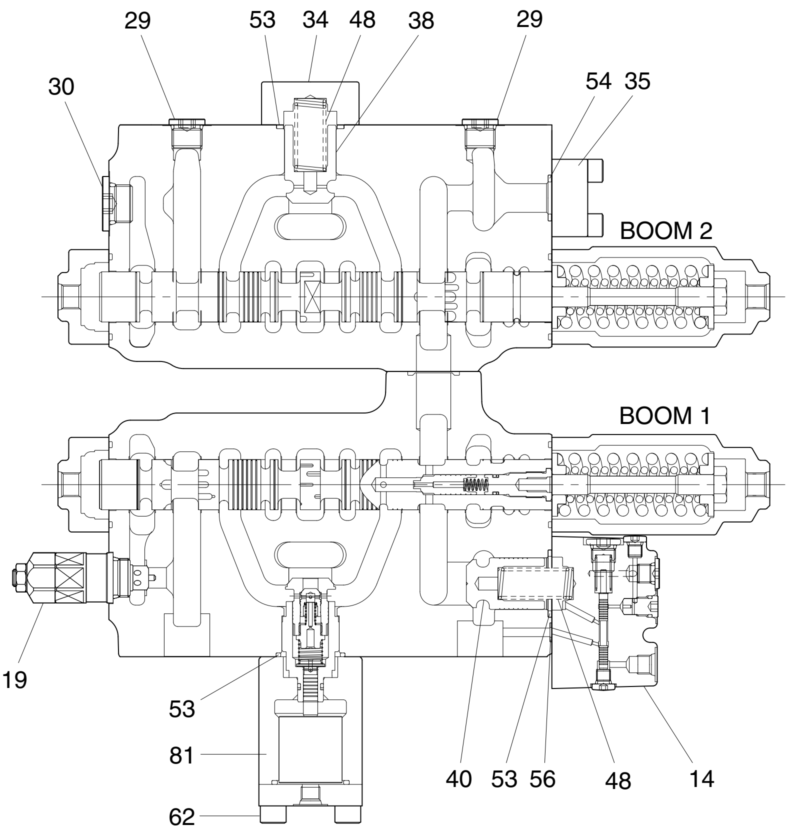
14 Holding valve assy
19 Overload relief valve assy
29 Plug assy
34 Flange-LC
38 Poppet
40 Poppet
48 Spring
53 O-ring
56 O-ring
66 Socket head bolt



SECTION E-E

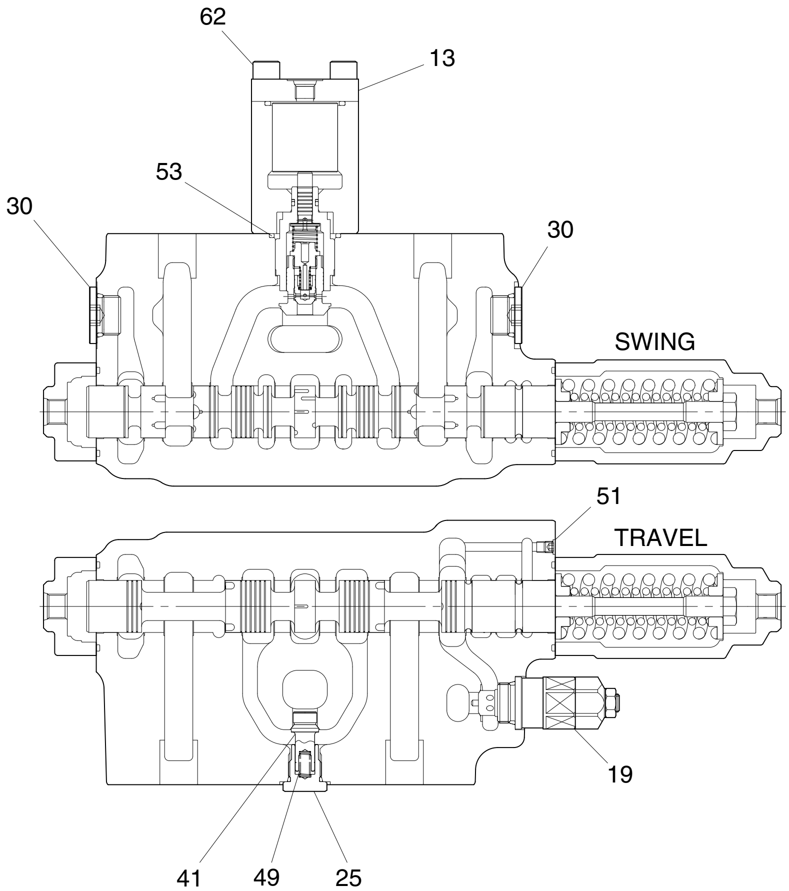
17 Overload relief valve assy
18 Overload relief valve assy
20 Overload relief valve assy
29 Plug assy
34 Flange-LC
38 Poppet
42 Poppet
48 Spring
50 Spring
53 O-ring
58 O-ring

STRUCTURE (6/7)



SECTION F-F

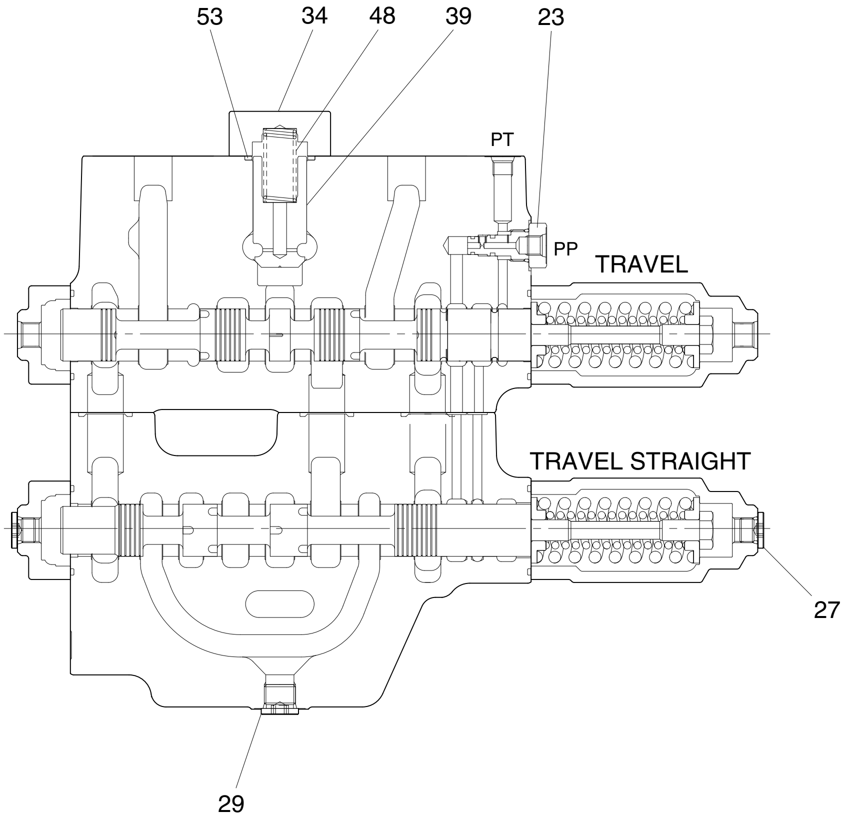
14 Holding valve assy
19 Overload relief valve assy
29 Plug assy
30 Plug assy
34 Spool cap
35 Flange-MR
38 Poppet
40 Poppet
48 Spring
53 O-ring
54 O-ring
56 O-ring
62 Socket head bolt
81 Boom logic valve assy



SECTION G-G

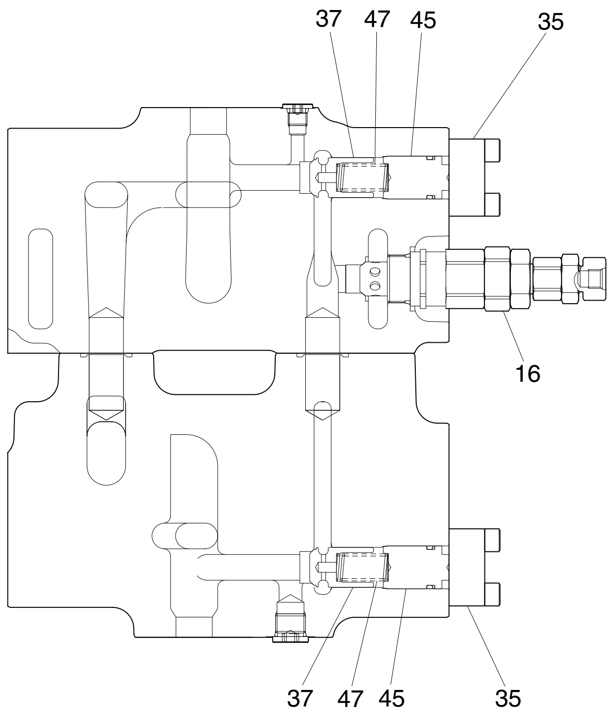
13 Swing logic valve assy
19 Overload relief assy
25 Plug assy
30 Plug assy
41 Poppet
49 Spring
51 O-ring
53 O-ring
62 Socket head bolt

STRUCTURE (7/7)



SECTION H-H

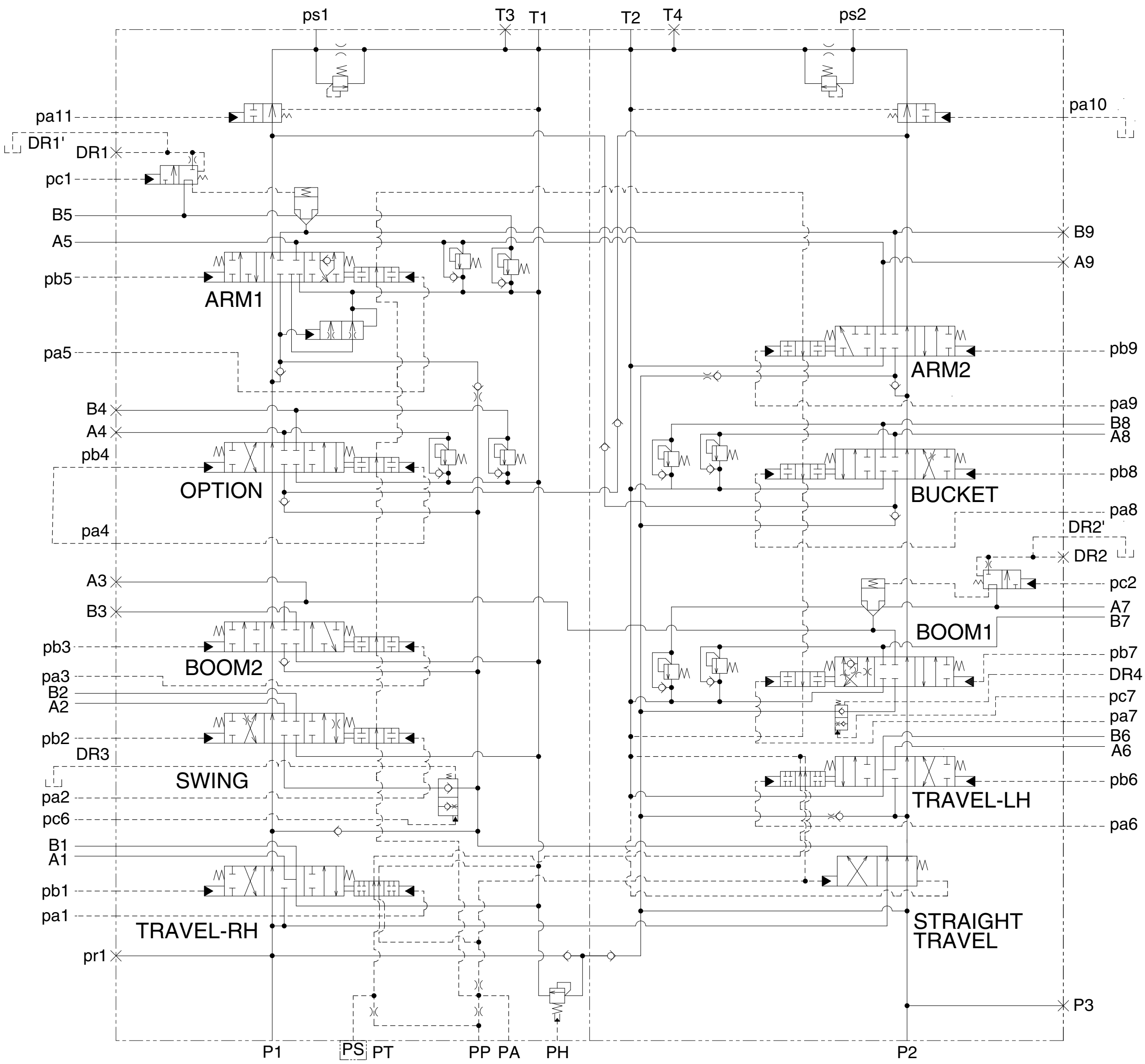
23 Signal plug assy
27 Plug assy
29 Plug assy
34 Flange-LC
39 Poppet
48 Spring
53 O-ring



SECTION I-I

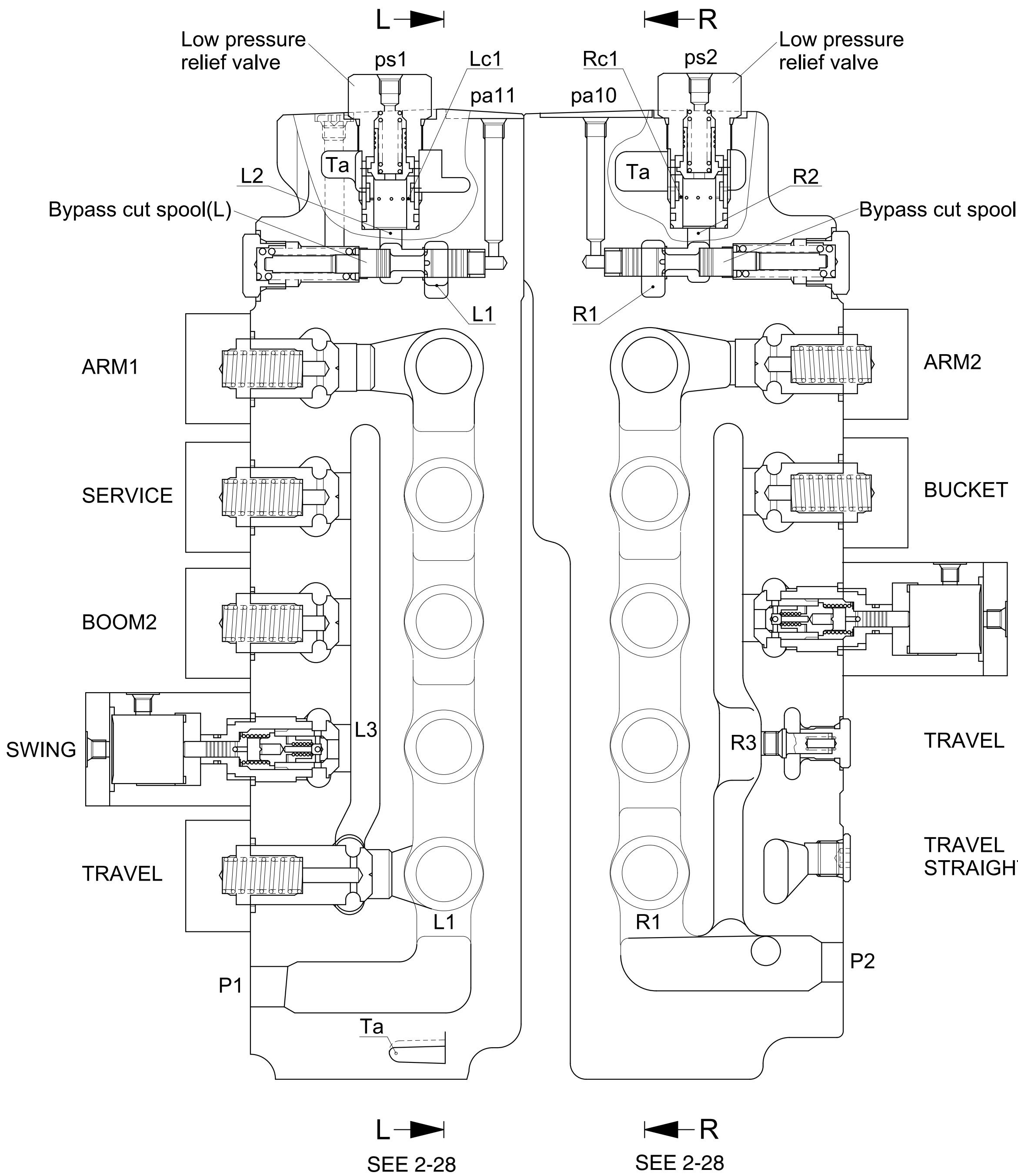
16 Main relief valve assy
35 Flange-MR
37 Poppet
45 Spacer assy-MR
47 Spring

2. HYDRAULIC CIRCUIT



3. OPERATION

1) ALL SPOOL NEUTRAL



(1) Neutral passage

① Oil from pump A1 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 A2 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 A1, A2.

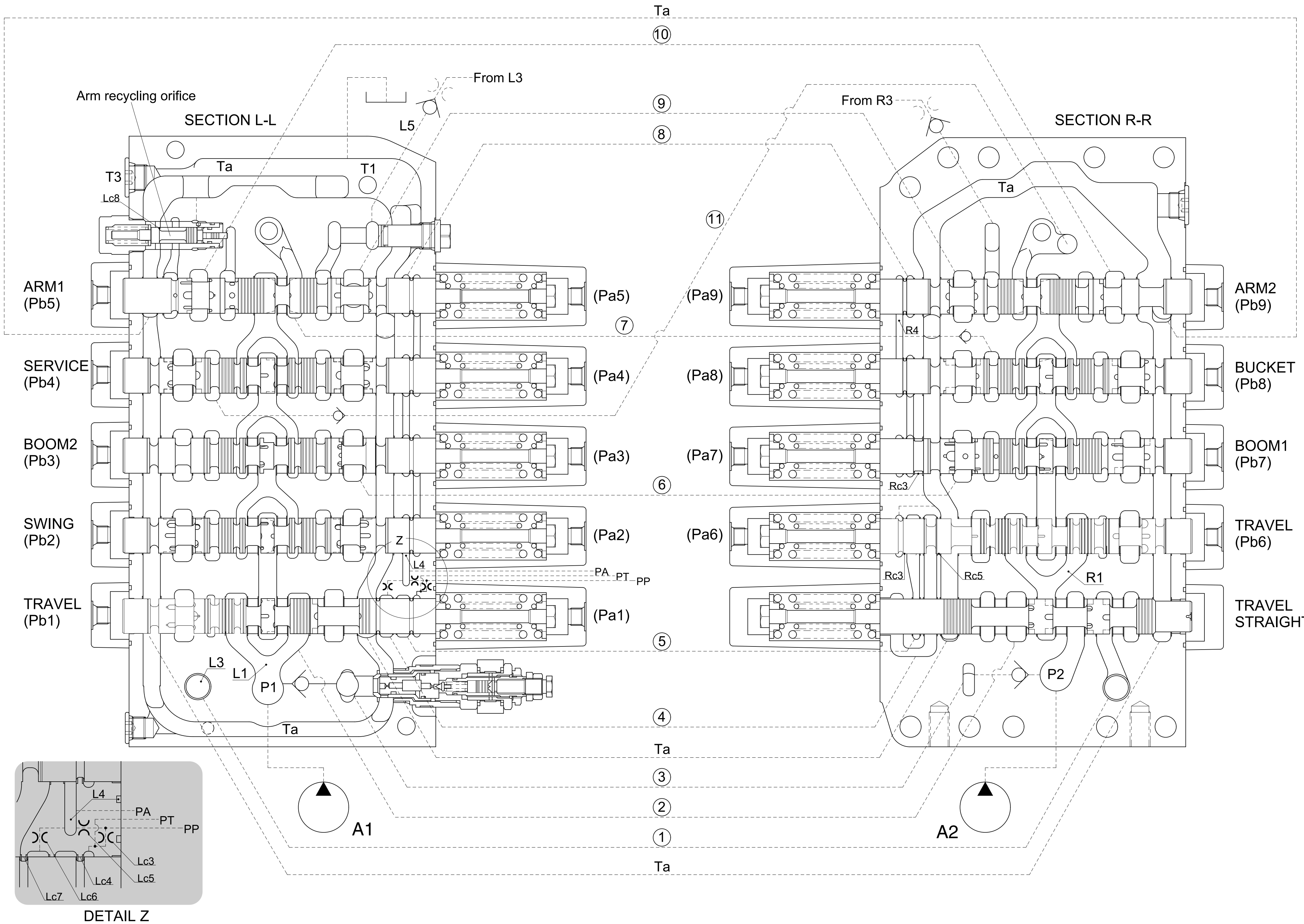
④ When a large amount of oil flows the neutral passage, the low pressure relief valves is operated. As a result, the shock pressure of port ps1, ps2 is prevented.

(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

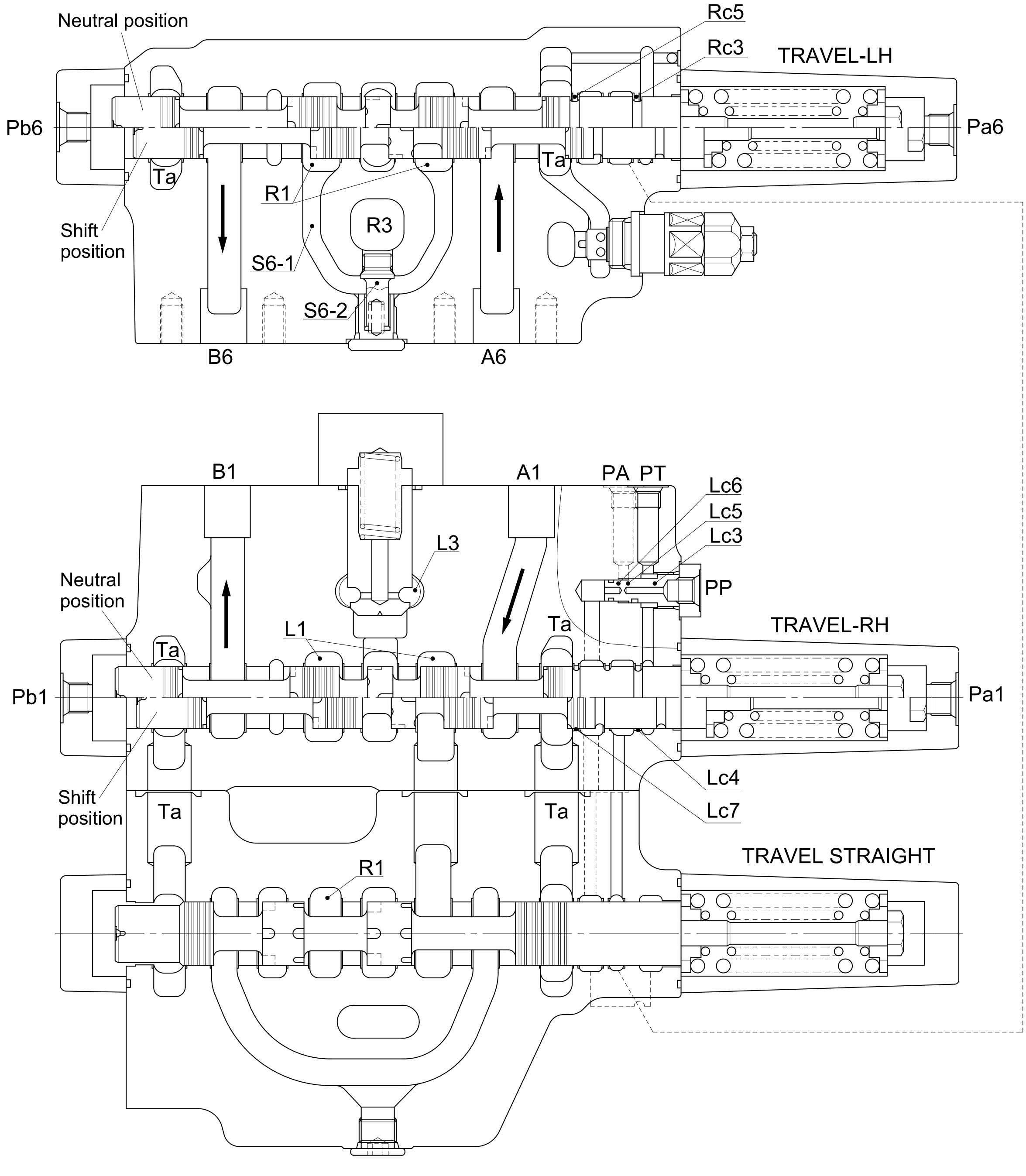
When the RH travel spool is pushed to right by the pilot pressure of port Pb1 the oil discharged from P1 port flows from the neutral passage (L1) to B1 port.

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).

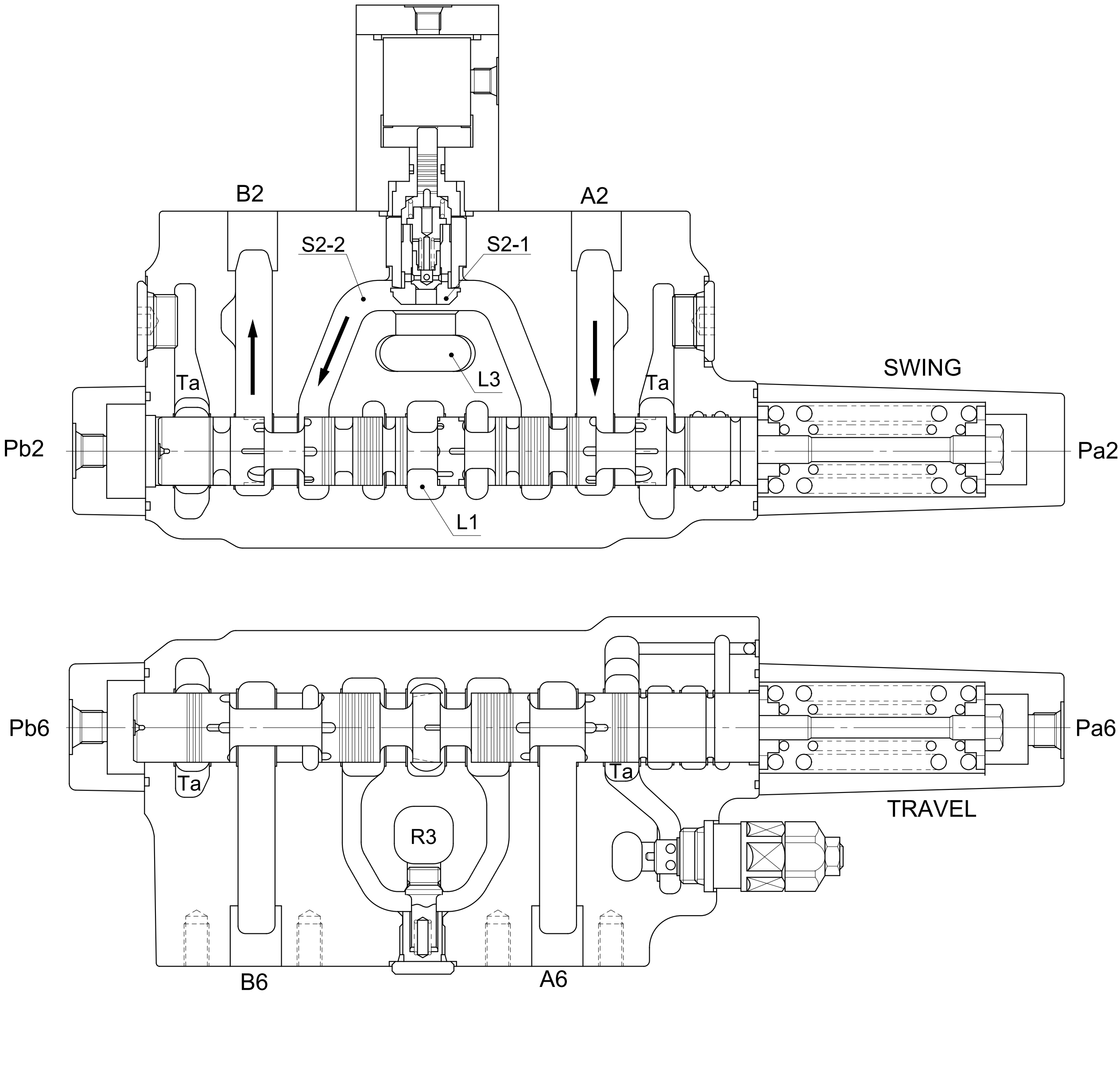
When the travel spool is pushed to the right by the pilot pressure, the land (Lc4, Rc3) is closed and the tank passage of the oil discharged from port PP is closed, and then the pressure of PT port is increased.



(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.

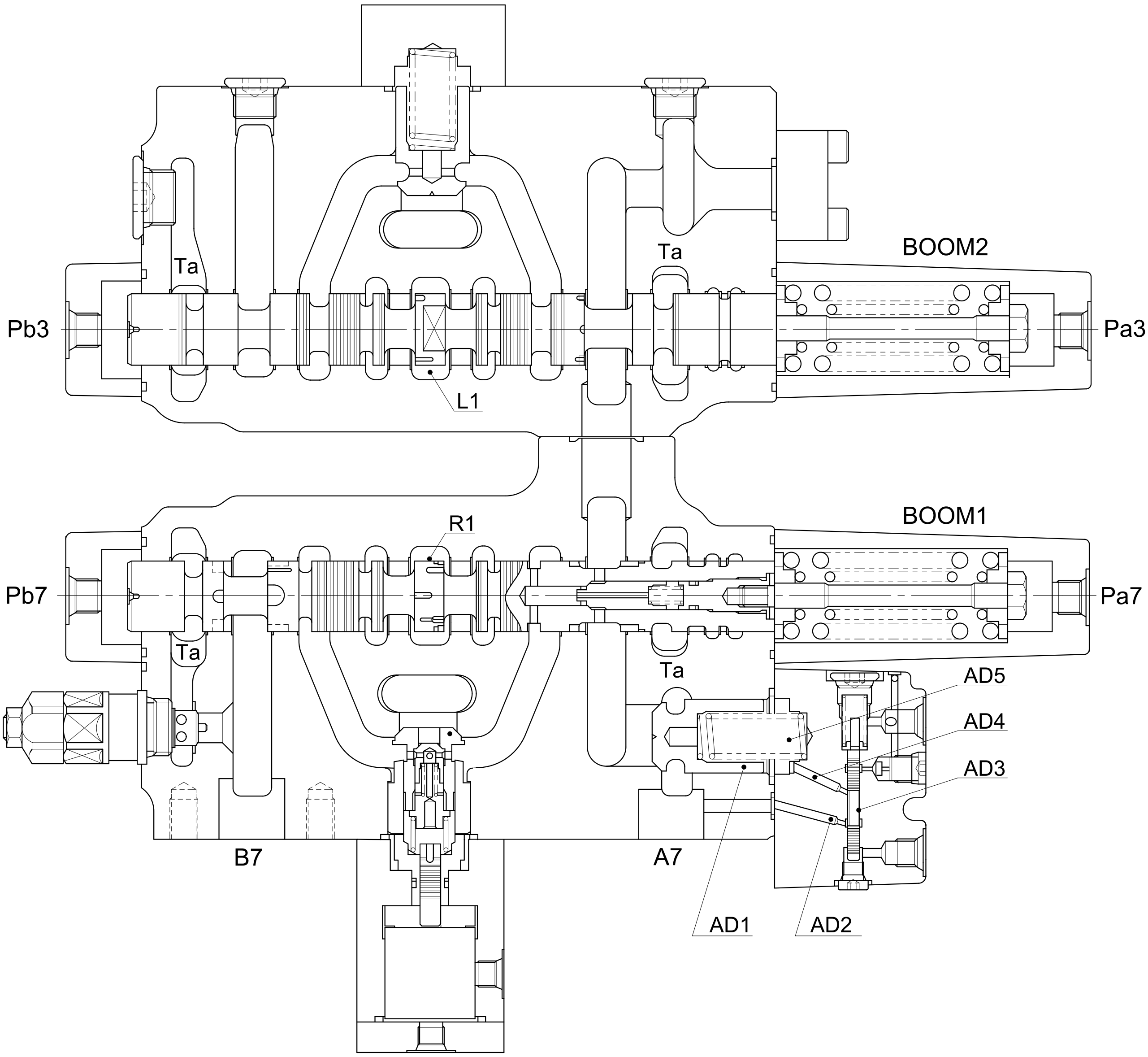
The oil from port A2 return to the tank via the tank passage (Ta).



3) BOOM SPOOL

(1) Neutral

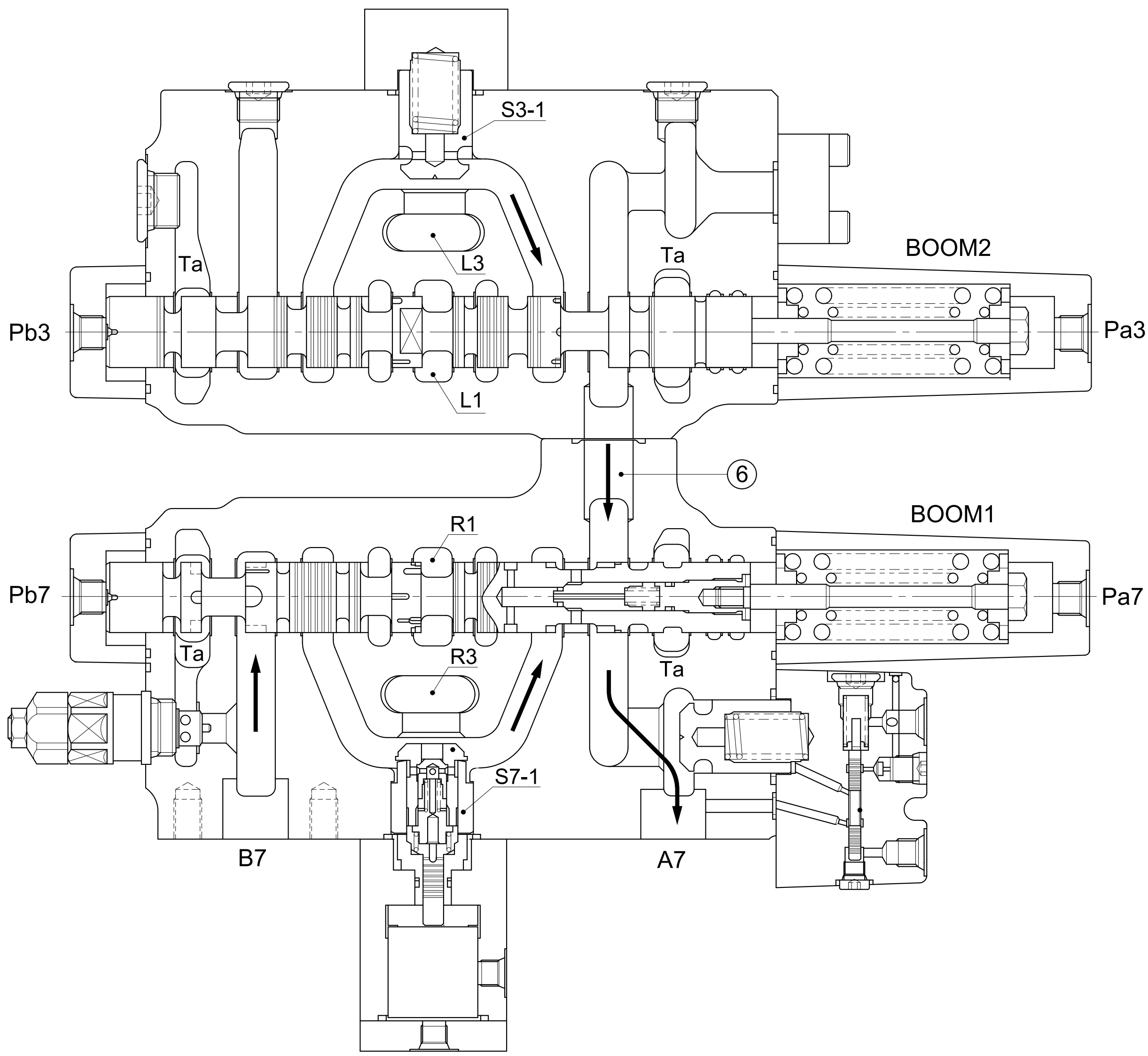
This valve is providing the anti-drift valve on the cylinder bottom side of boom 1 section. In neutral, the poppet (AD1) is seated by the pressure of spring chamber (AD5) because the oil from the port A7 is connection with spring chamber (AD5) via passage (AD2), spool (AD3) and passage (AD4).



(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).

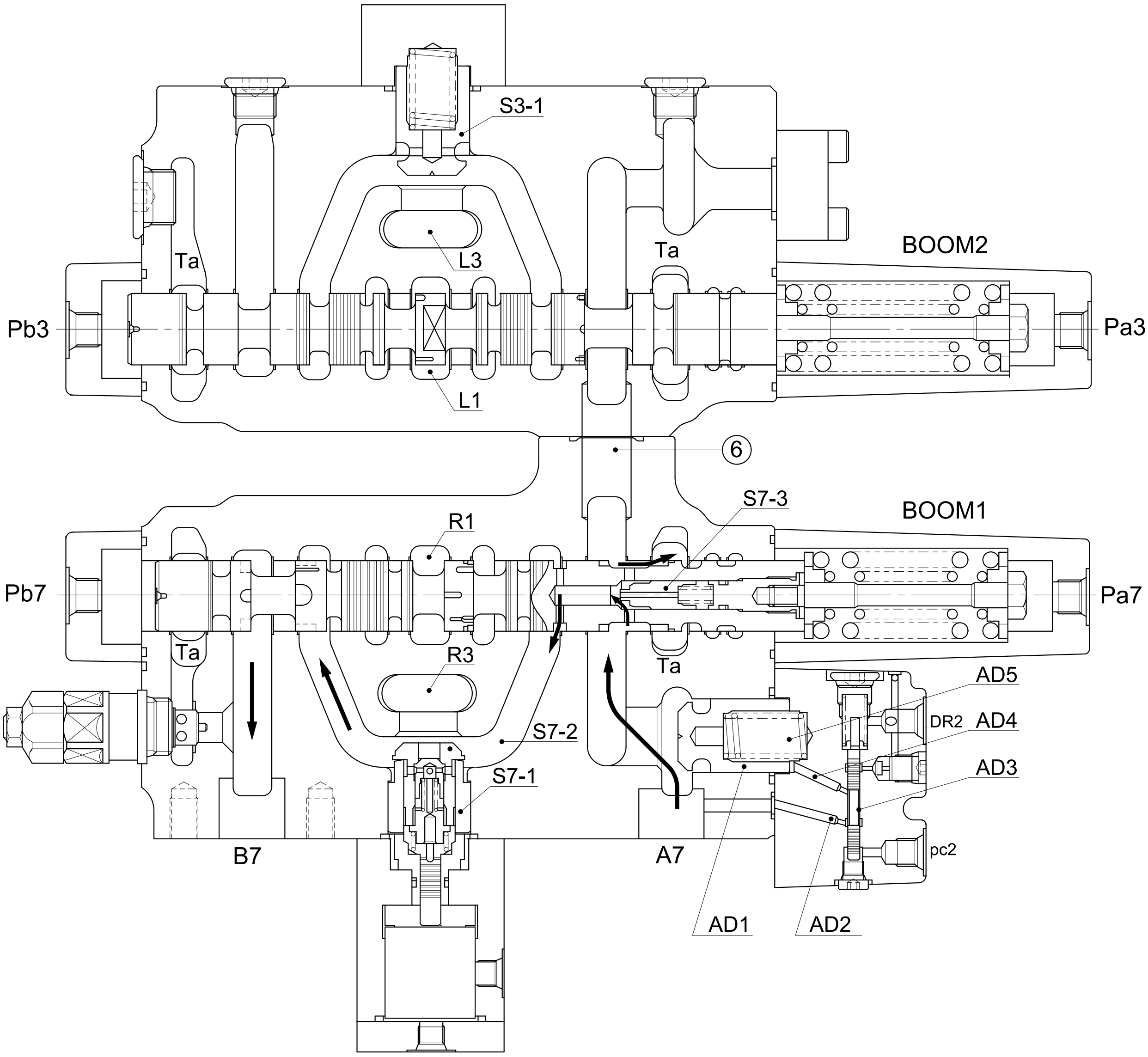
The return oil from port B7 flows into the tank via the tank passage (Ta).



(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.



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).

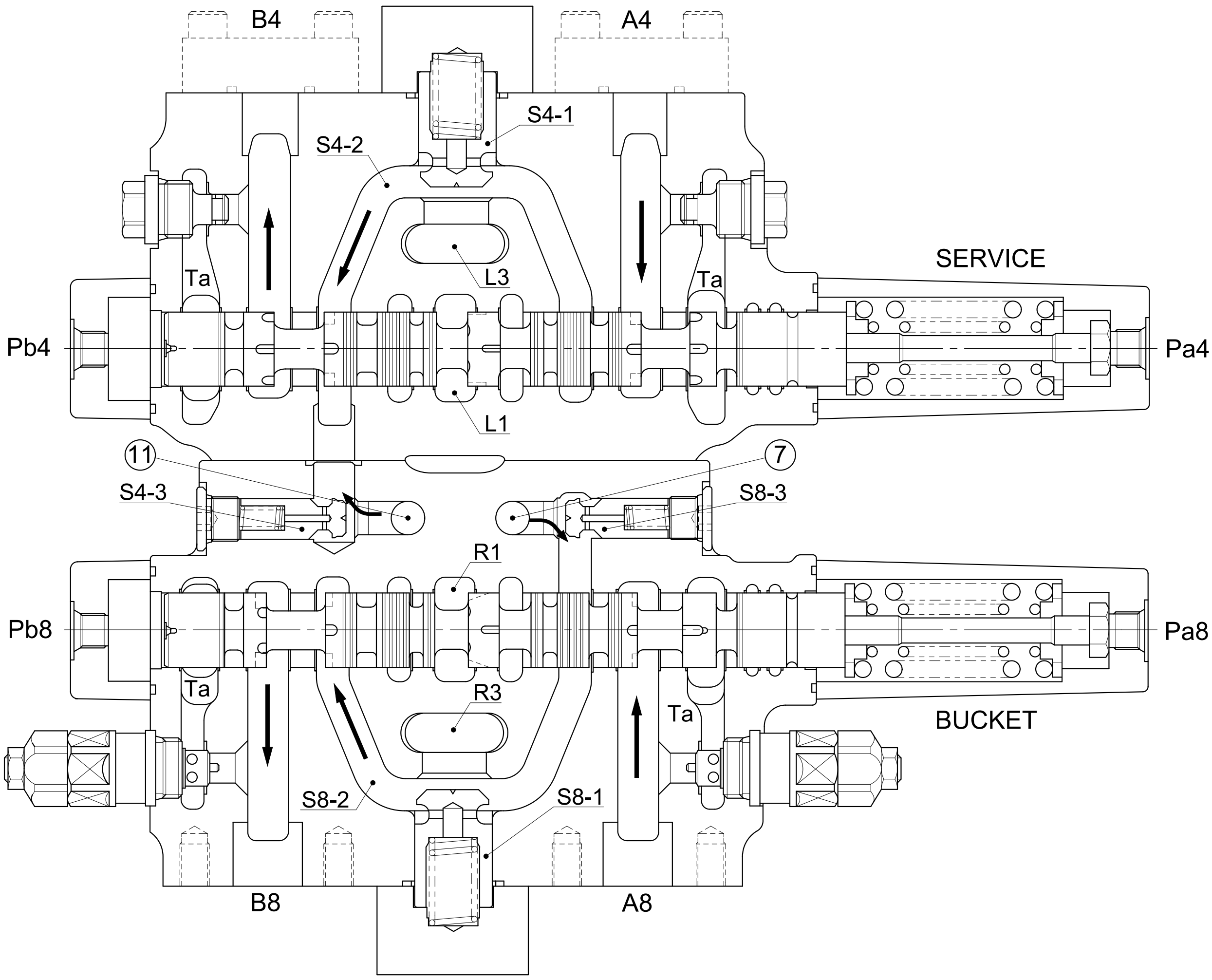
At the same time, as the port pa10 (see 2-24 page) is pressurizing and the bypass cut spool (R) is pushed, the oil discharged from pump P2 flows together into the port B7 via passage (11), poppet (S4-3). The oil returned from port A4 flows into the tank via the tank passage (Ta).

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).



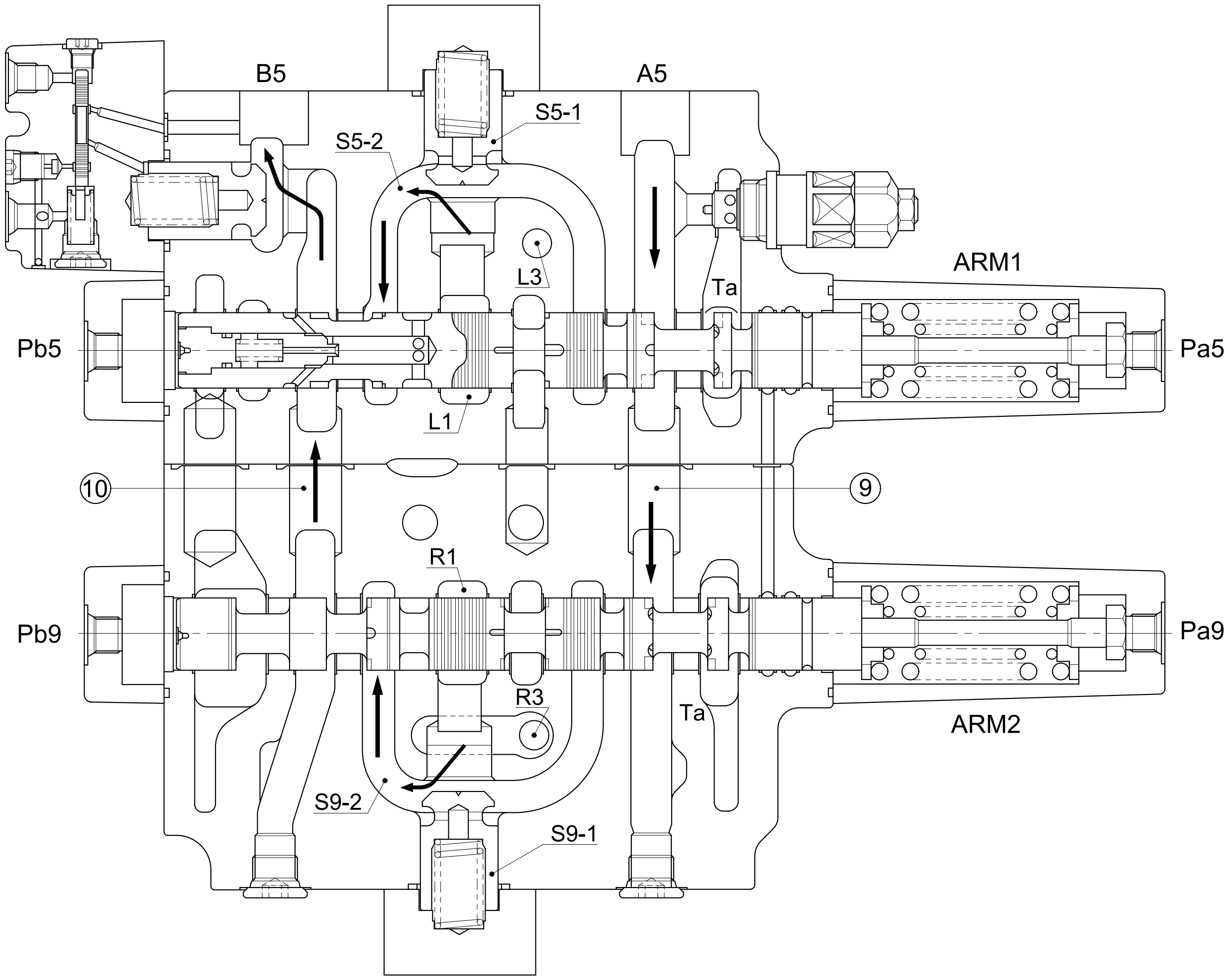
6) ARM SPOOL

(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).

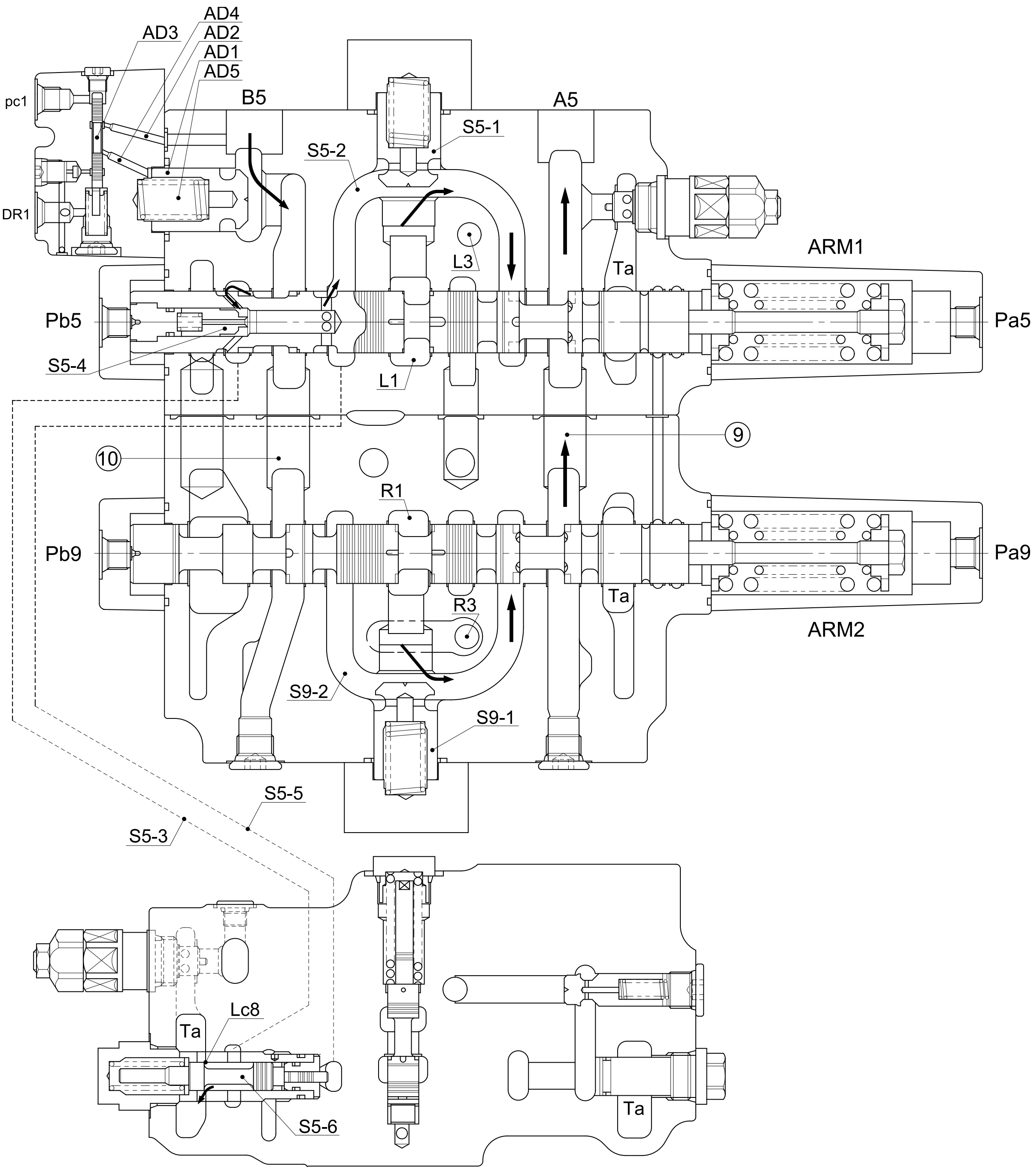


(2) Arm in (flow summation)

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.

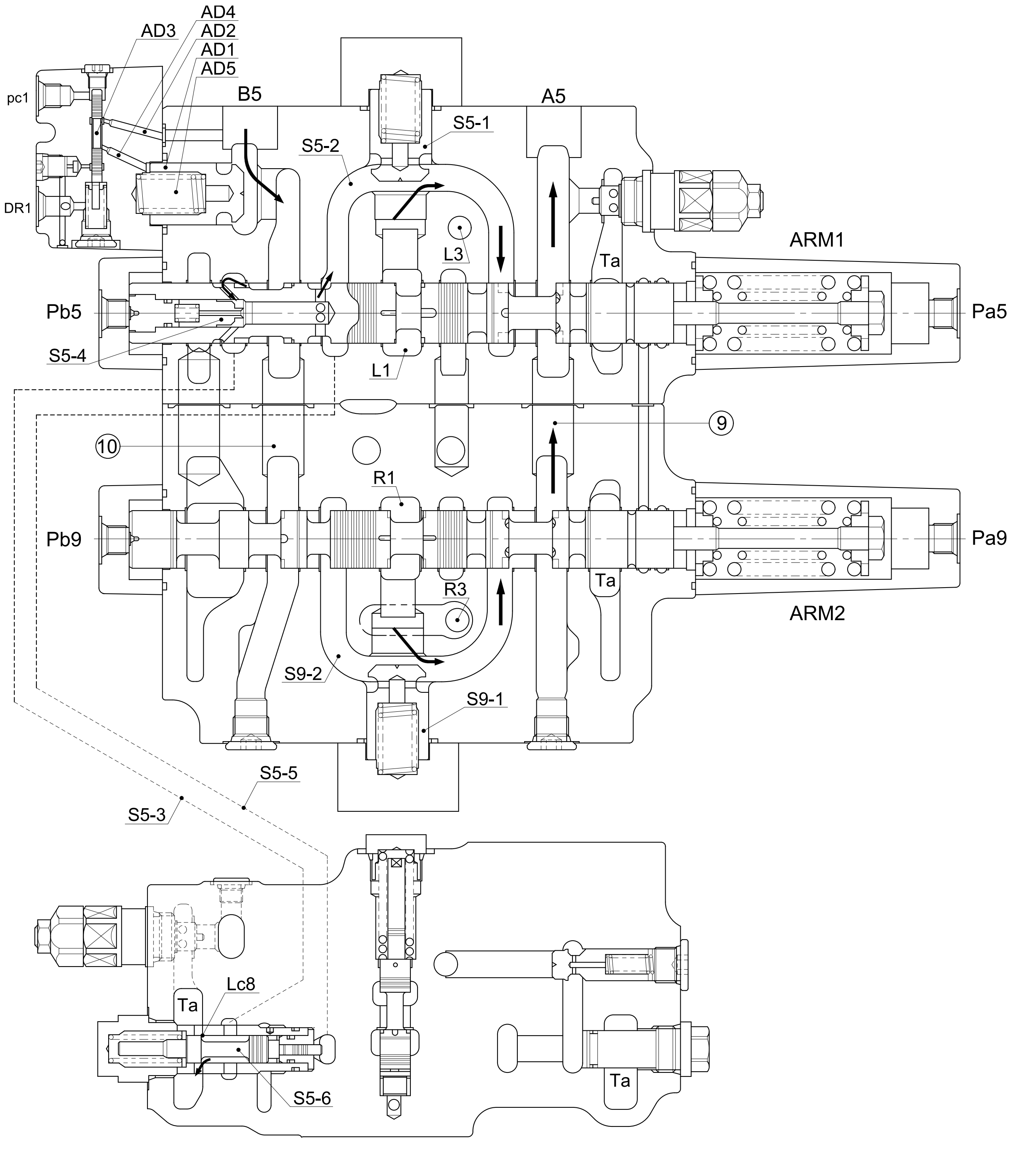


(3) **Arm recycling** (arm in)

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.



7) BYPASS CUT SPOOL

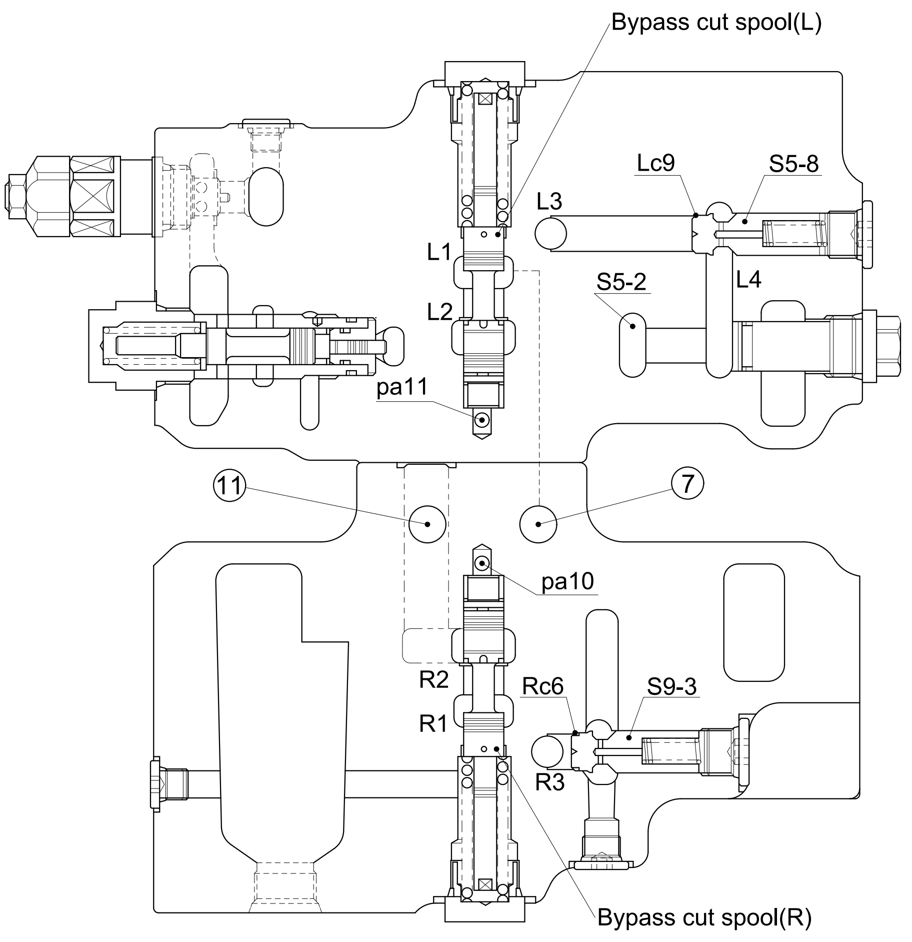
This valve is providing the bypass cut spool at the lowest stream of (upper stream of the low pressure relief valve) the neutral passage (L1, R1).

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 2-34) 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 2-34) through orifice (Lc9) in the edge of the poppet (S5-8) from the parallel passage (L3).



9) RELIEF VALVE

(1) Main relief valve

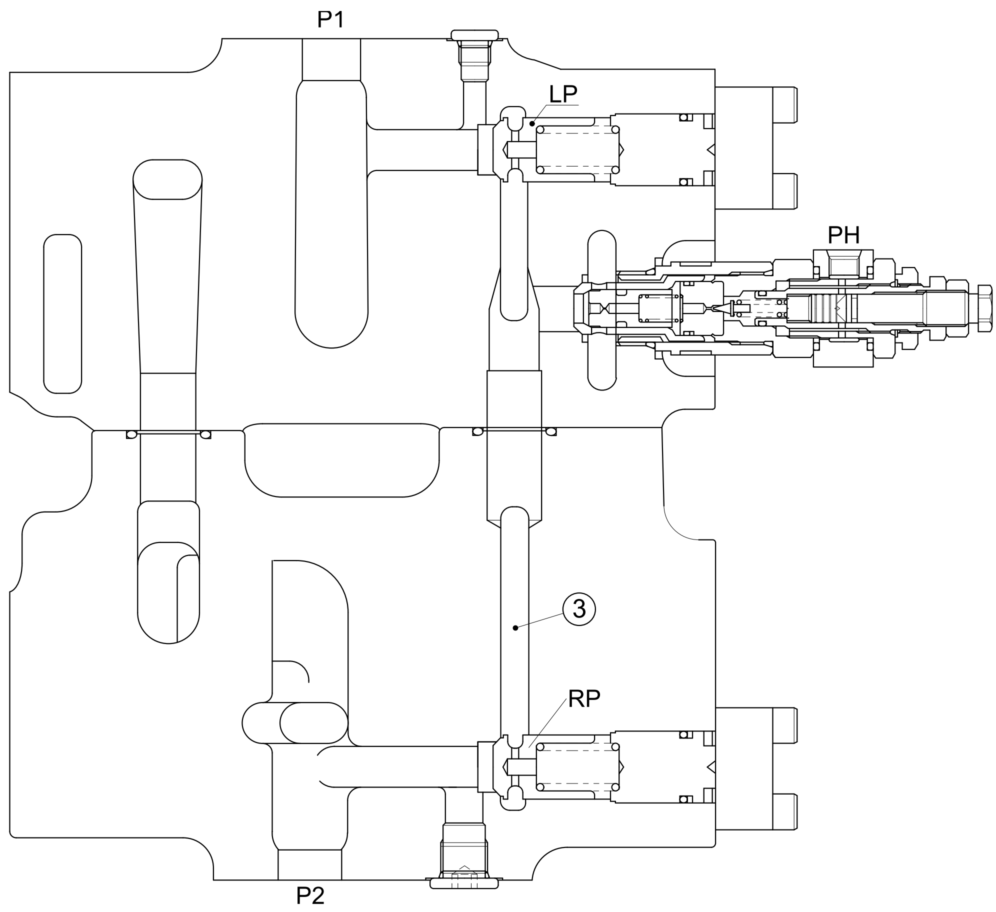
The oil discharged from P1 port via the poppet (LP) and the oil discharged from P2 port via the poppet (RP) flow into the main relief valve through the passage (3).

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.

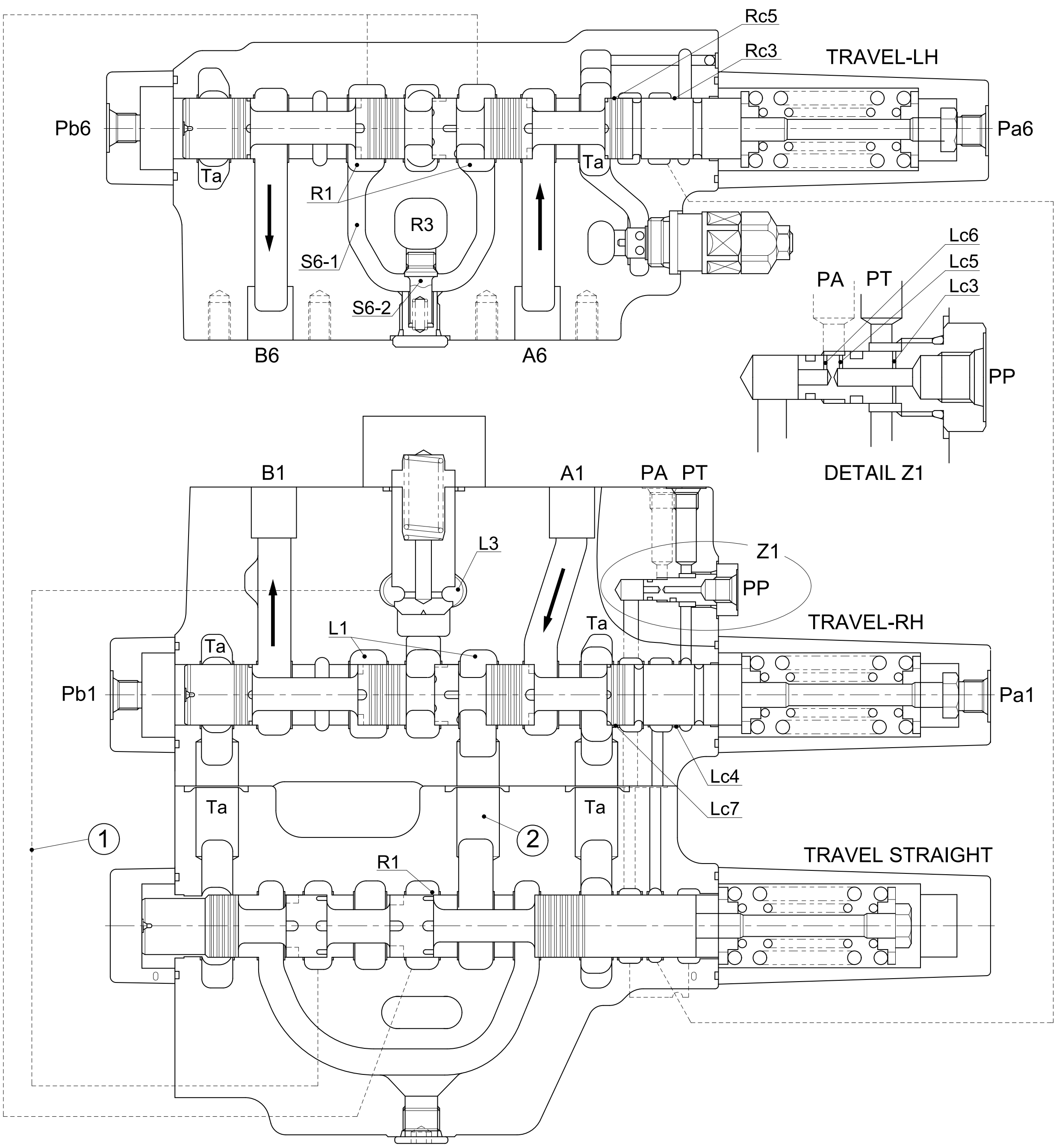
Also, when the pressure of cylinder ports create back pressure, this valve opens allowing oil from tank to cylinder port; and then prevents cavitation.



4. COMBINED OPERATION

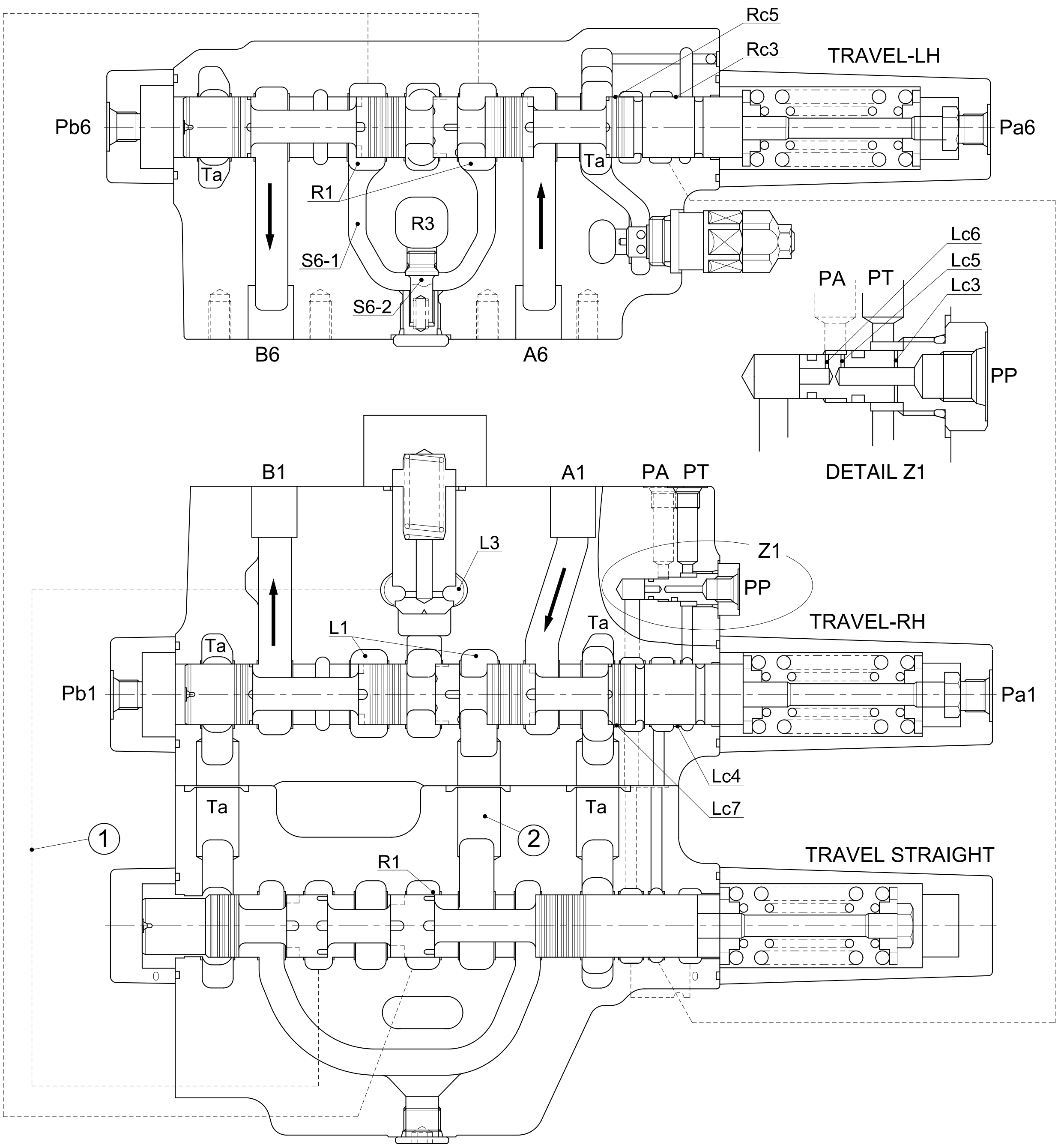
1) TRAVEL COMBINED OPERATION

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).

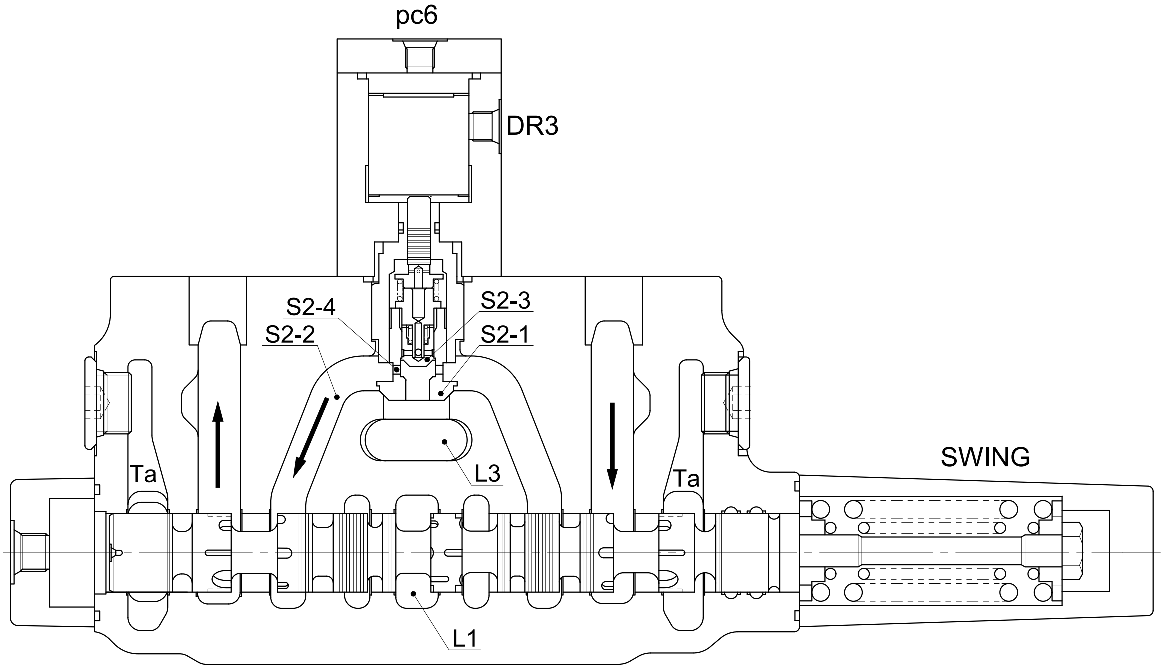
③ In case the load pressure of the section except travel is higher than that of the RH travel section, the partial oil of discharged from port P2 pushes open the poppet (S6-2) and flows together into the passage (S6-1) through the orifice at the edge of poppet. The travel (LH, RH) is operated by the 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.



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.



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

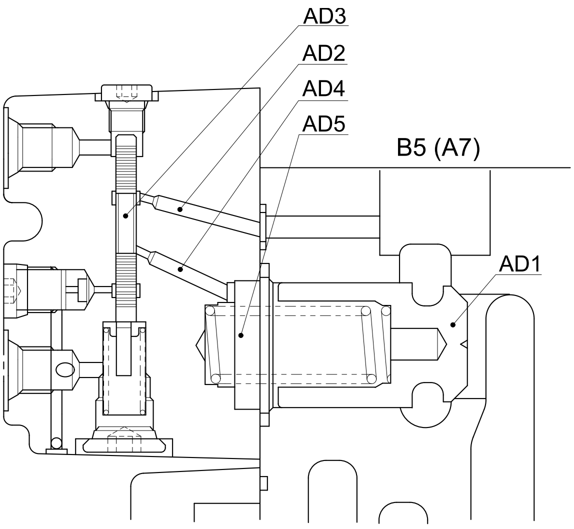
The oil from pump flows into cylinder by pushes open the poppet (AD1).

3) WHEN BOOM DOWN OR ARM IN

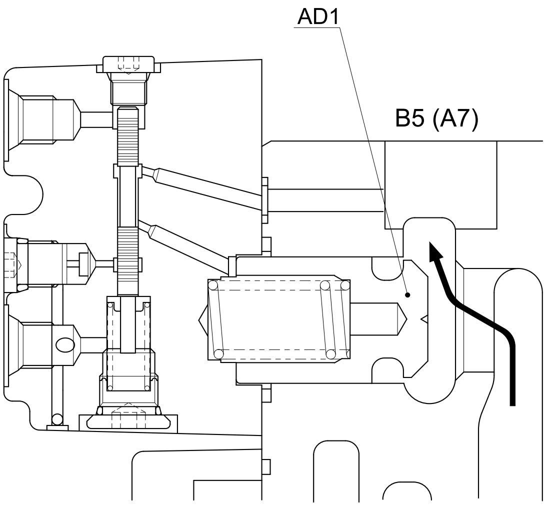
The spool (AD3) is pushed down by the pressure of pc1 (pc2).

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

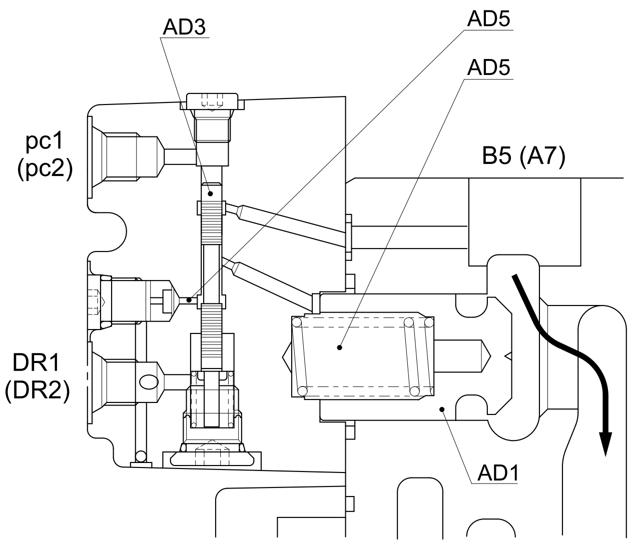
As a result, the oil from the cylinder port returns to tank passage (Ta).



NEUTRAL



ARM OUT
(BOOM UP)

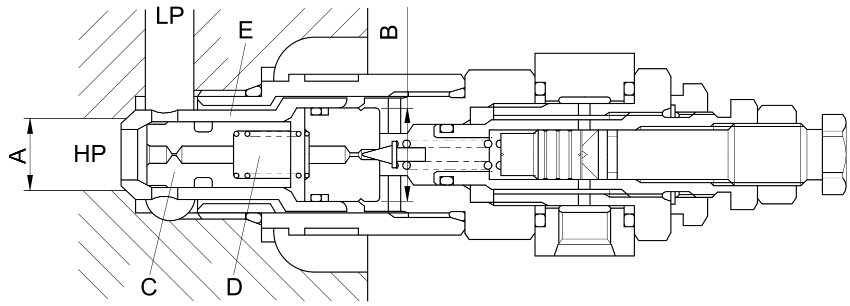


ARM IN
(BOOM DOWN)

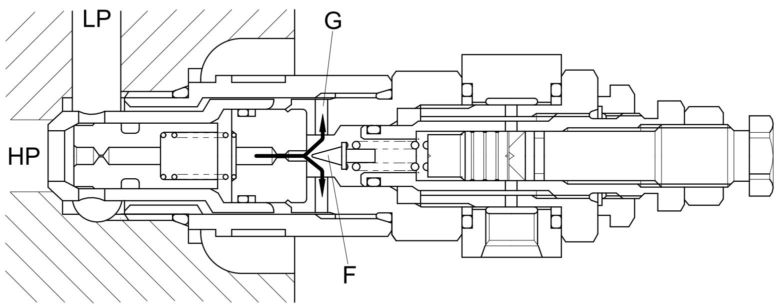
6. RELIEF VALVE OPERATION

1) MAIN RELIEF VALVE

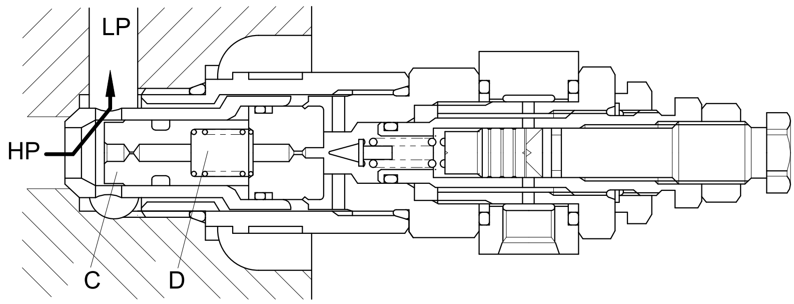
(1) This relief valve is built-in between the neutral passage (HP) and low pressure passage (LP), and the pressure oil fills up chamber (D) inside via orifice of main poppet (C).
Thus the sleeve (E) and the main poppet (C) are securely seated by difference area of A an B.



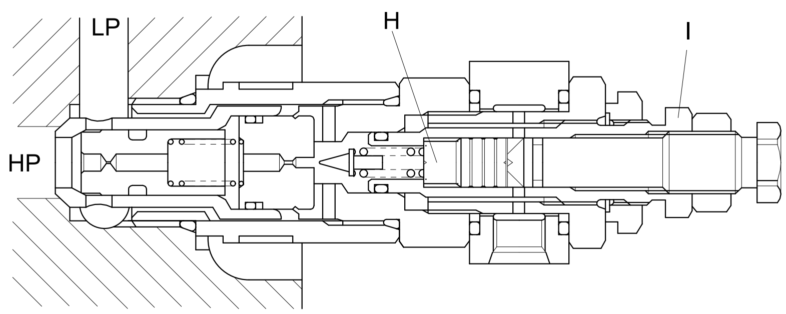
(2) When the pressure in neutral passage (HP) reaches the setting force of spring, pilot poppet (F) is opened. The oil flows around poppet and into the low pressure passage(LP) via hole(G).



(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).

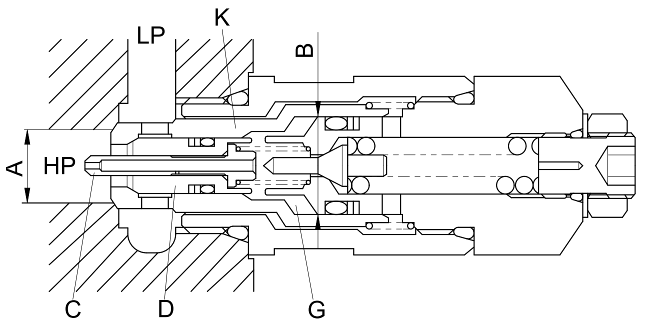


(4) High pressure setting pilot signal (Pi) : ON
The piston (H) moves to left by pilot pressure (Pi); set pressure of spring rises, making high pressure setting.

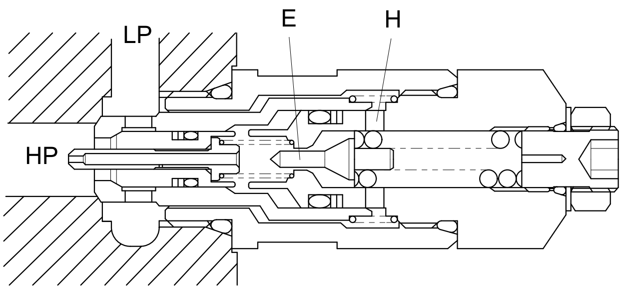


2) OVERLOAD RELIEF VALVE

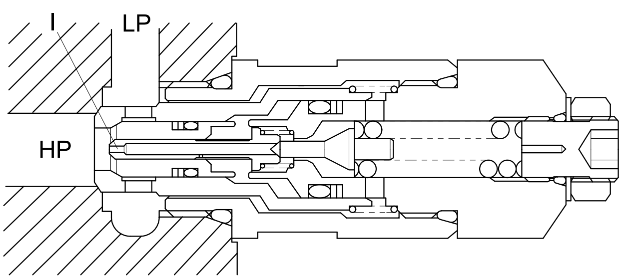
(1) This relief valve is built-in the cylinder port (HP) and the low pressure (LP), and the pressure oil fills up camber (G) inside via hole of piston (C).
Thus the sleeve (K) and the main poppet (D) are securely seated by difference area of A and B.



(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).

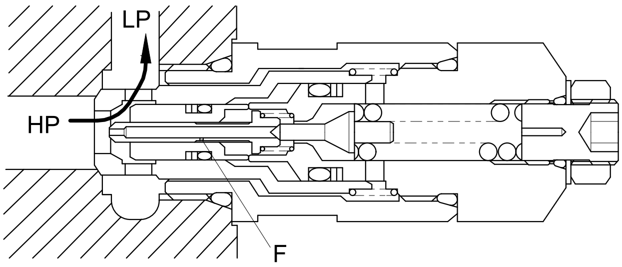


(3) When above flow is formed, the pilot poppet (E) is opened.
The pressure drops before and behind orifice (I); piston (C) moves to right and the piston (C) is seated at the tip of poppet (E).



(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.

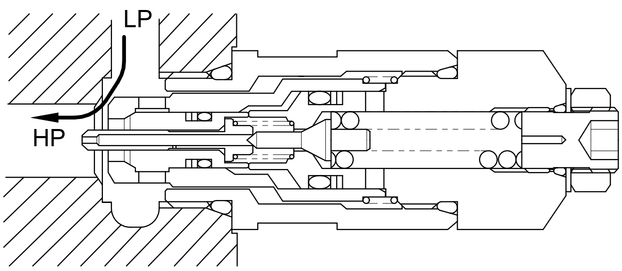
Thus the poppet (D) is pushed open and the oil directly flows into low pressure passage (LP).



(5) Make up operation

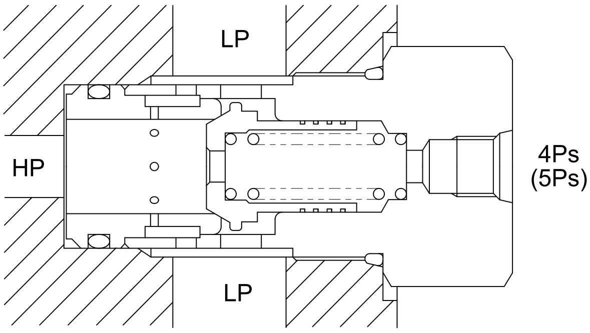
This relief valve is built-in the cylinder port (HP) and the low pressure passage (LP), and the pressure oil fills up camber (G) inside via hole of piston (C).

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



3) LOW PRESSURE RELIEF VALVE

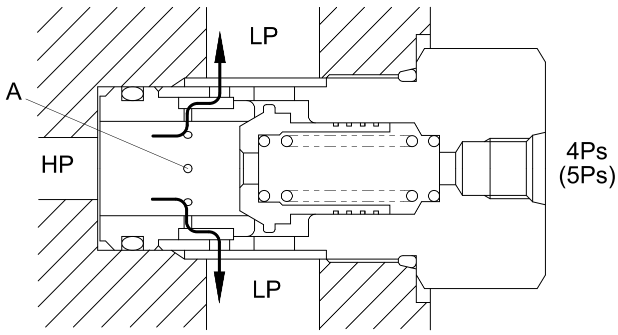
(1) When pump does not operational



(2) When spool neutral

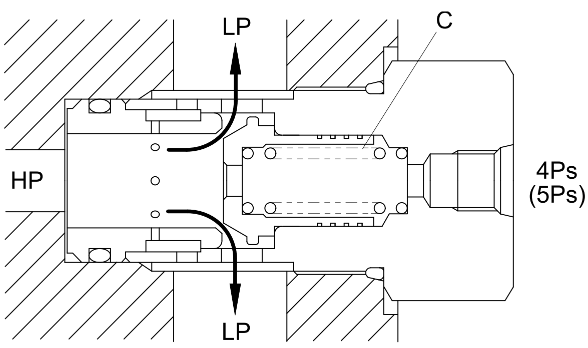
The neutral passage (HP) oil flows into the low pressure passage (LP) via signal orifice (S).

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



(3) Operation of low pressure relief

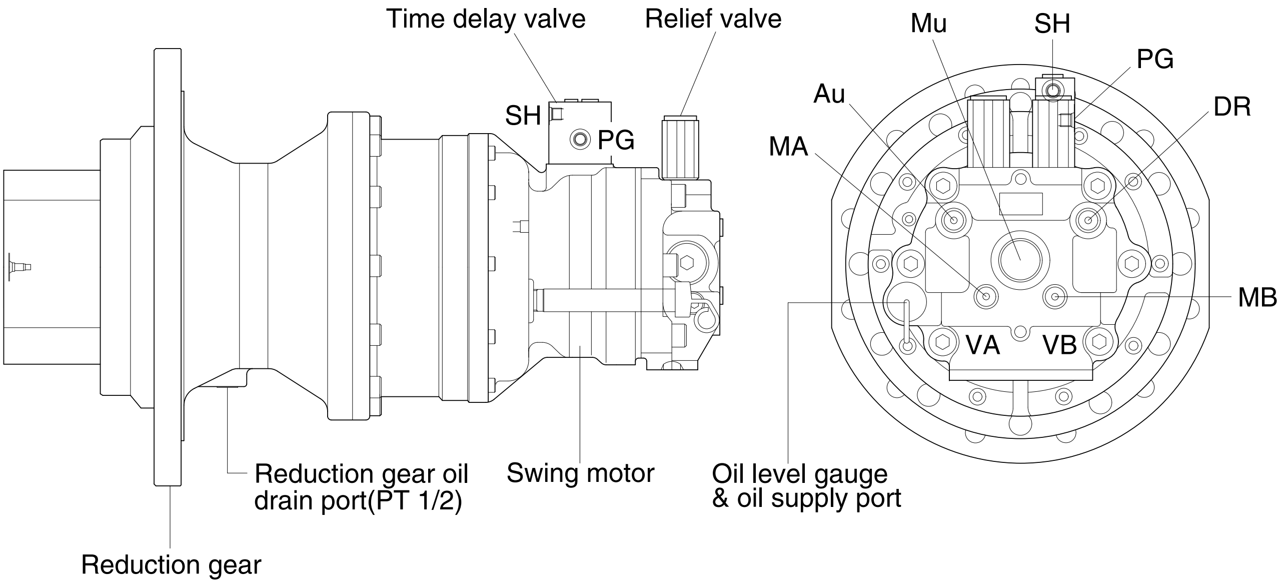
When the oil pressure neutral passage (HP) reaches the setting force of spring, the poppet is pushes open; the oil directly flows through passage (HP) to passage (LP) in order to prevent abnormal pressure.

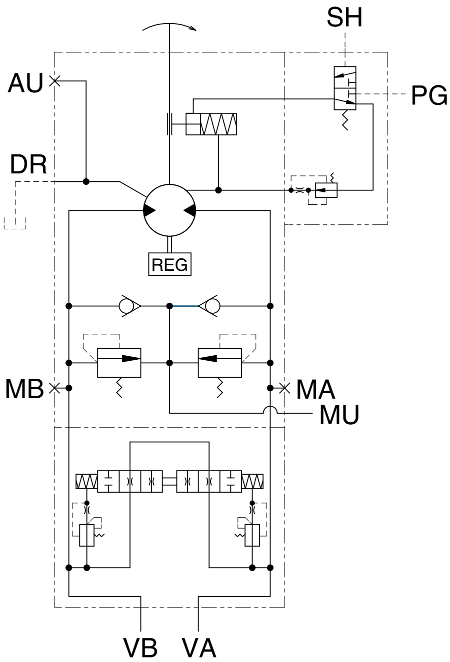


1. STRUCTURE

Swing device consists swing motor, swing reduction gear.

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

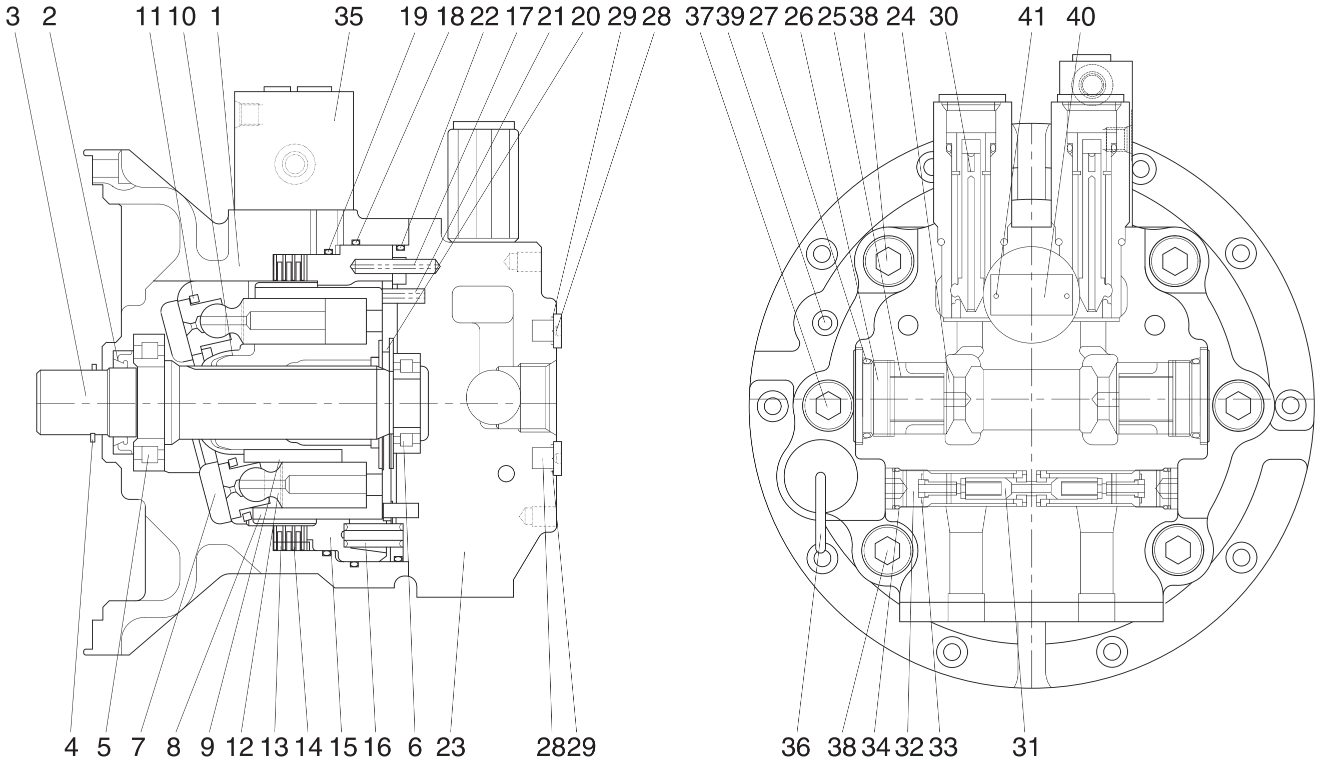




Hydraulic circuit

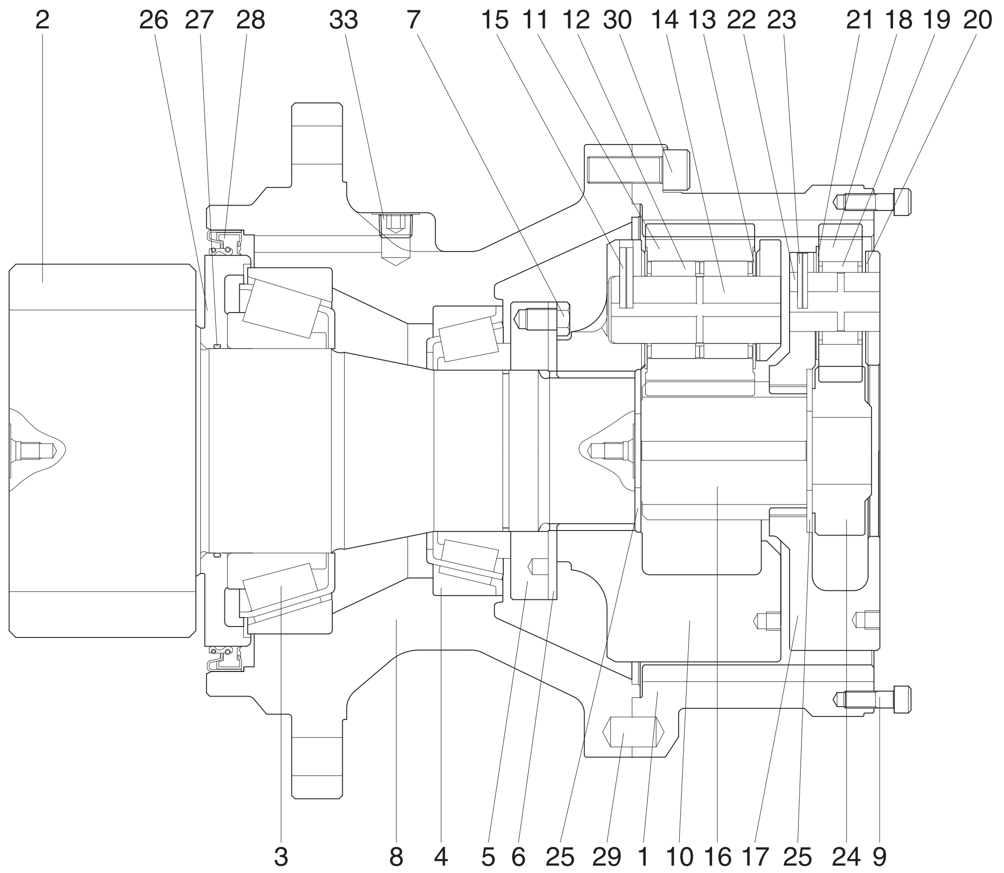
Port	Port name	Port size
VA, VB	Main port	ø 20
Dr	Drain port	PF 1/2
Mu	Make up port	PF 1 1/4
MA, MB	Gauge port	PF 1/4
Au	Air vent port	PF 1/4
PG	Brake release stand by port	PF 1/4
SH	Brake release pilot port	PF 1/4

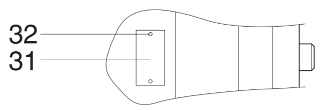
1) SWING MOTOR



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





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).

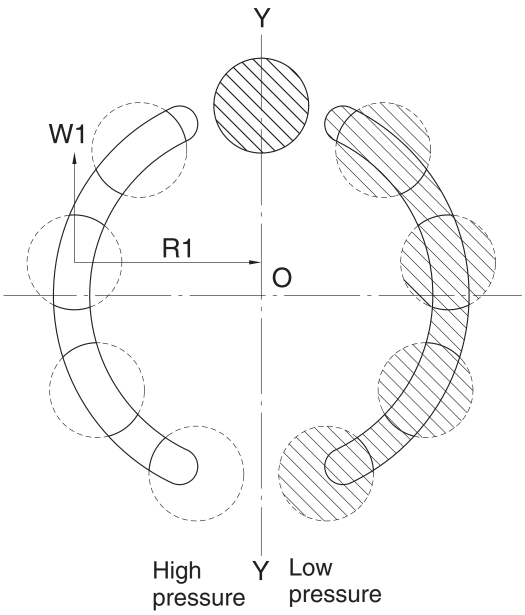
The high hydraulic can generate the force, F1=P×A (P : supplied pressure, A : water pressure area), like following pictures, working on a piston.

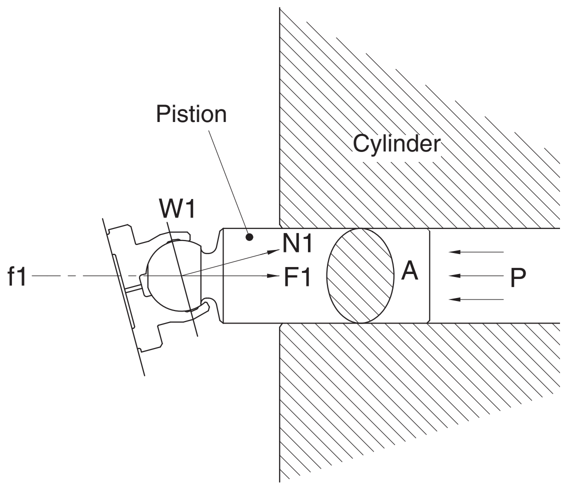
This force, F1, is divided as N1 thrust partial pressure and W1 radial partial pressure, in case of the plate of a tilt angle, α .

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

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

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





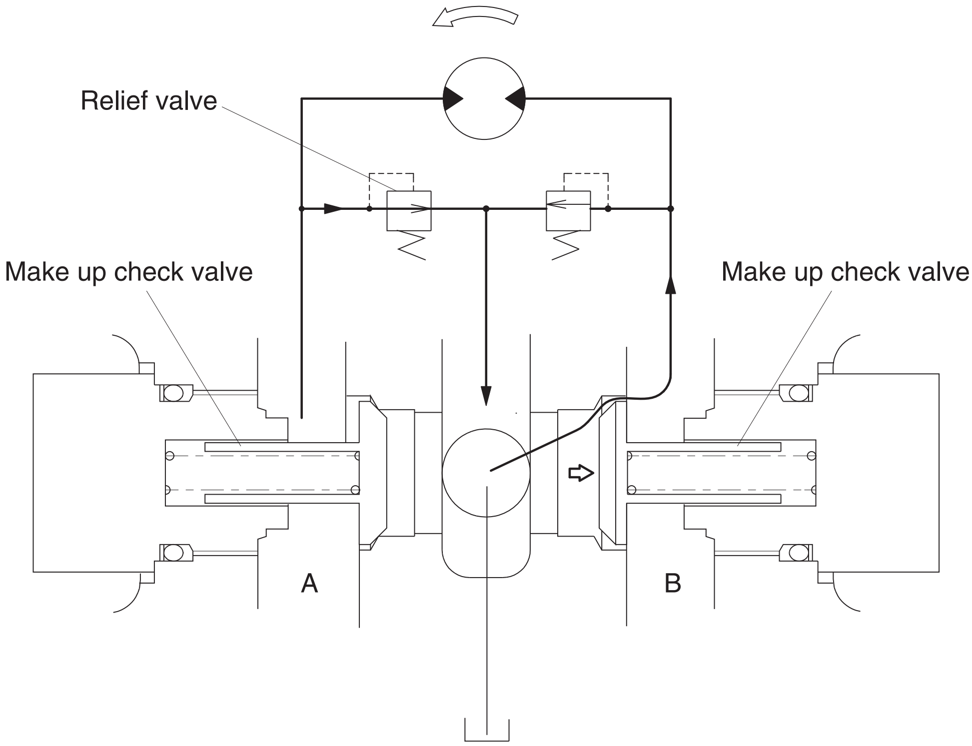
2) MAKE UP VALVE

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

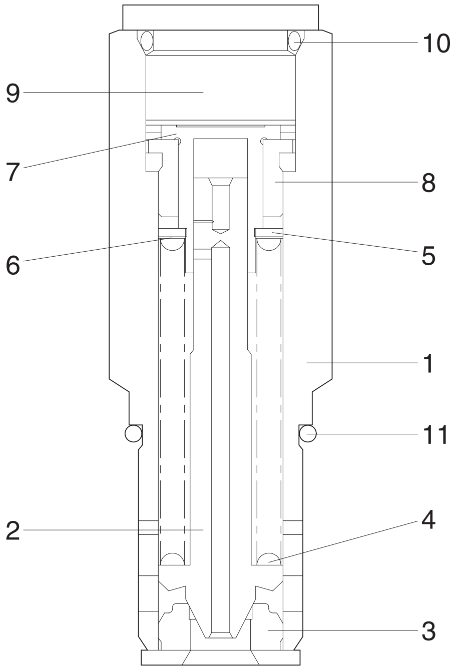
A make up valve is provided immediately before the port leading to the hydraulic oil tank to secure feed pressure required when the hydraulic motor makes a pumping action. The boost pressure acts on the hydraulic motor's feed port via the make up valve.

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

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



3) RELIEF VALVE



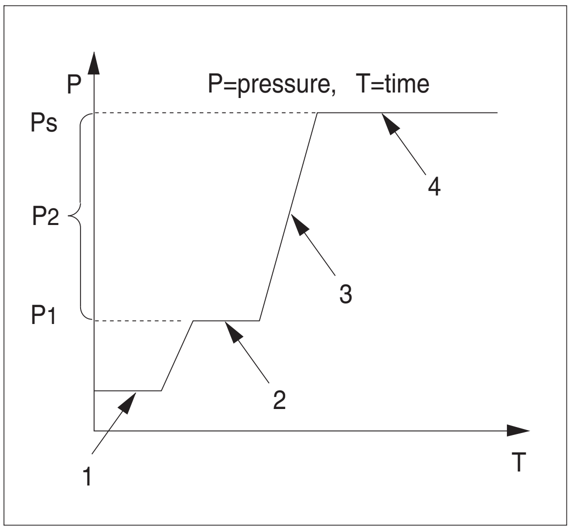
1	Sleeve
2	Poppet
3	Poppet seat
4	Spring
5	Spring seat
6	Shim
7	Piston
8	Stopper
9	Plug
10	O-ring
11	O-ring

(1) Construction of relief valve

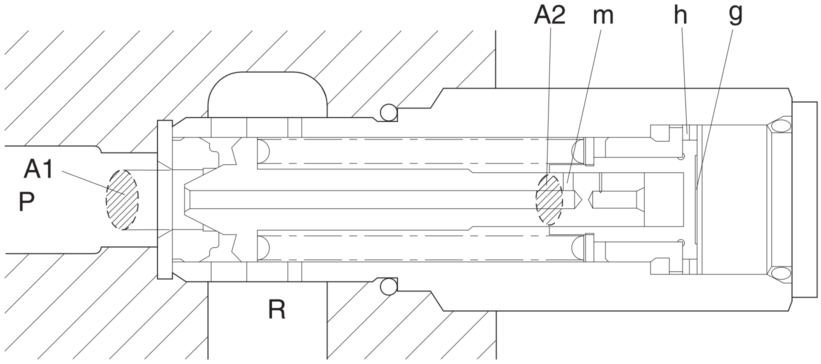
The valve casing contains two cartridge type relief valves that stop the regular and reverse rotations of the hydraulic motor. The relief valves relieve high pressure at start or at stop of swing motion and can control the relief pressure in two steps, high and low, in order to insure smooth operation.

(2) Function of relief valve

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



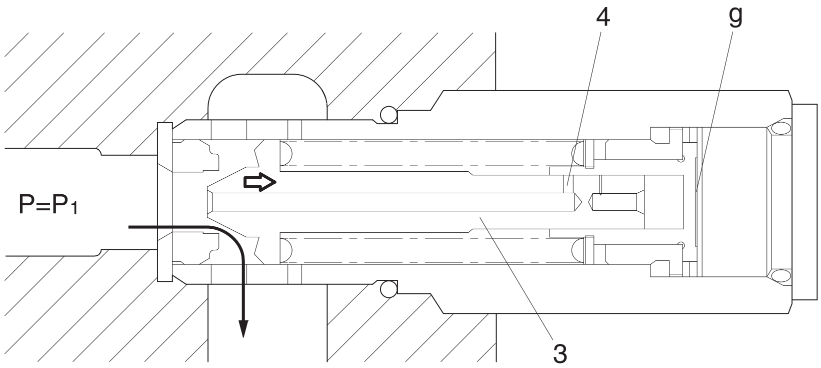
① Ports (P,R) at tank pressure.



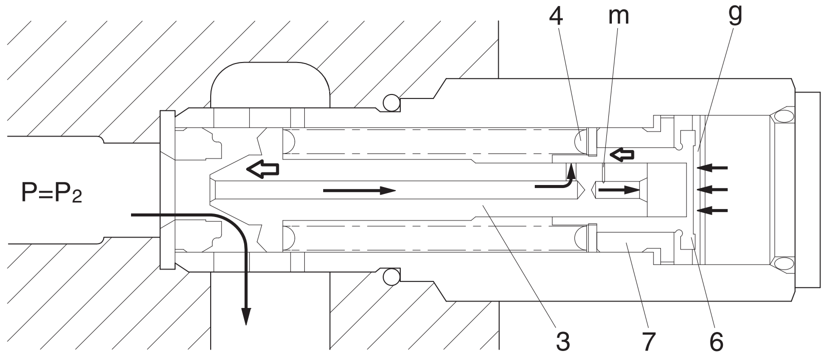
② When hydraulic oil pressure ($P \times A_1$) reaches the preset force (F_{SP}) of spring (4), the plunger (3) moves to the right as shown.

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

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



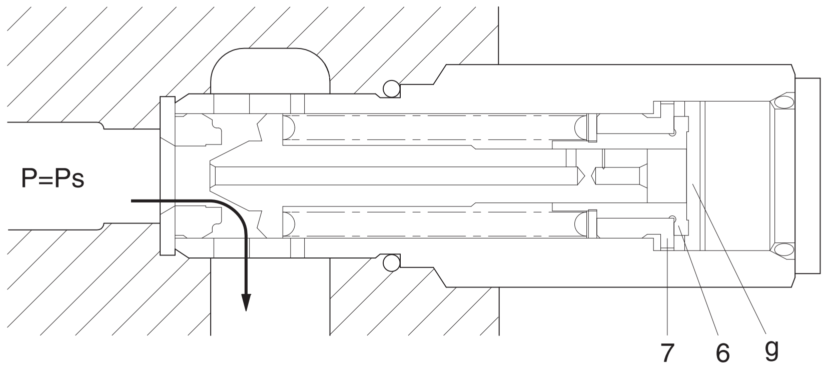
③ The oil flow chamber g via orifice m and n. When the pressure of chamber g reaches the preset force (F_{SP}) of spring (4), the piston (6) moves left and stop the piston (6) hits the bottom of bushing (7).



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).

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

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

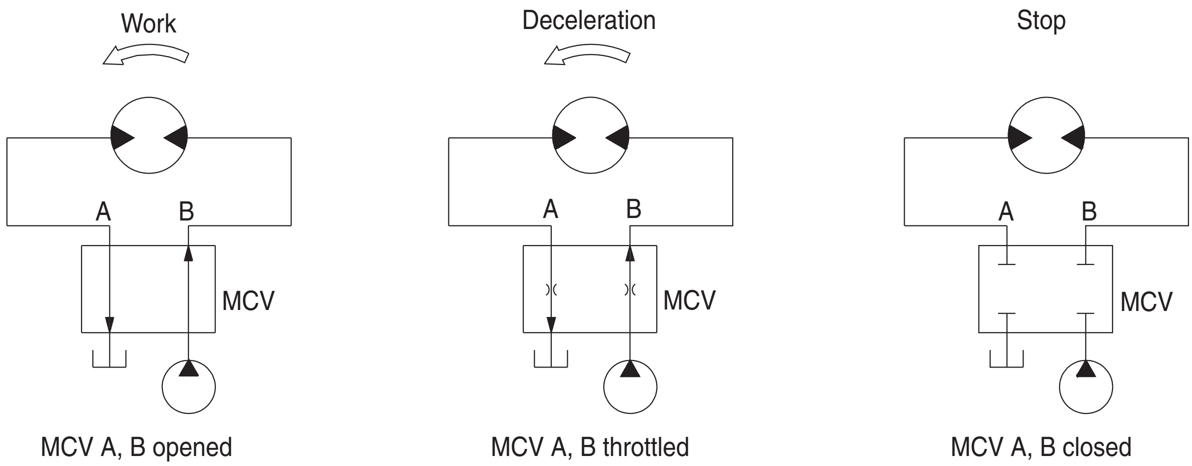


4) BRAKE SYSTEM

(1) Control valve swing brake system

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

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



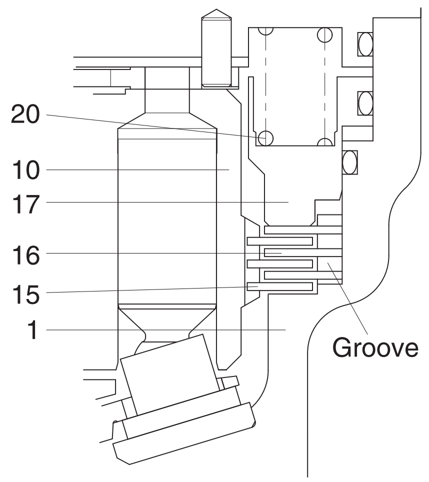
(2) Mechanical swing parking brake system

This is function as a parking brake only when 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.

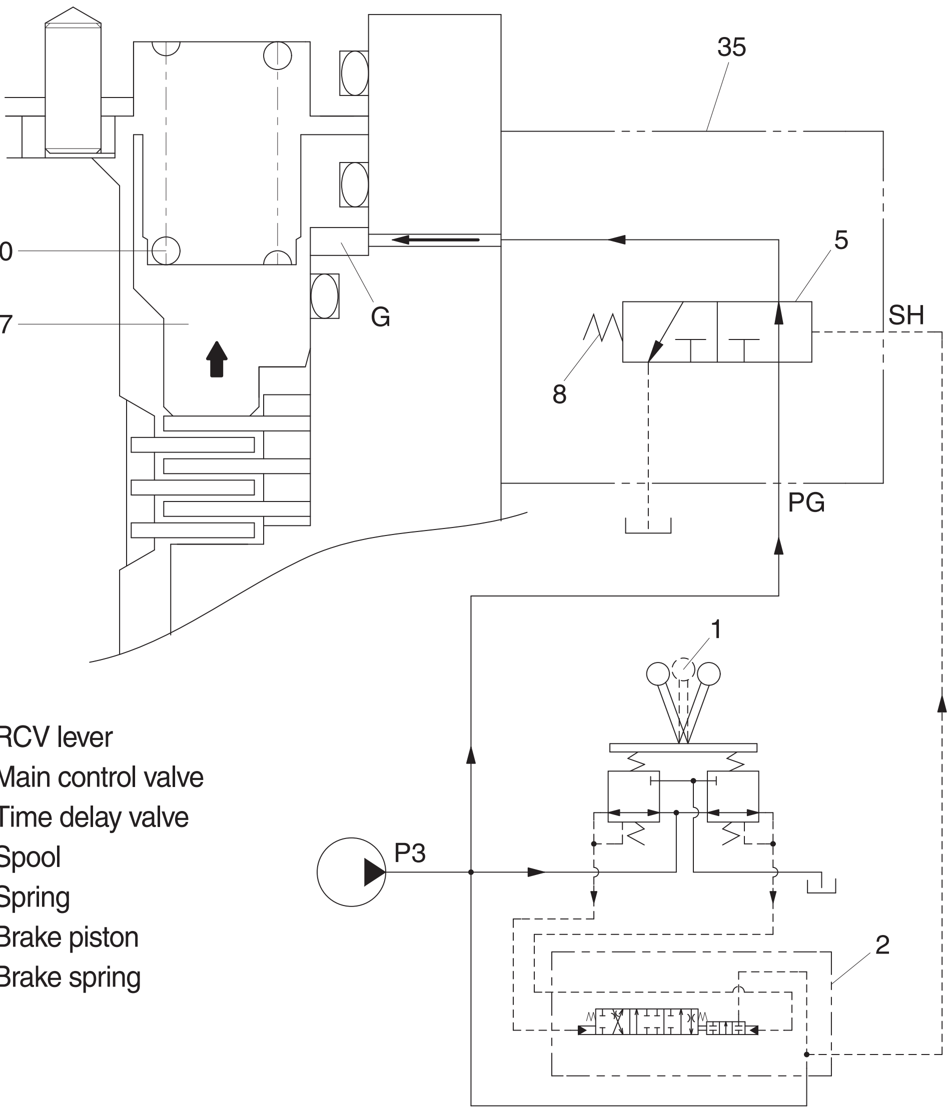
Cylinder block (10) is constrained by this friction force and brake acts, while brake releases when hydraulic force exceeds spring force.



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

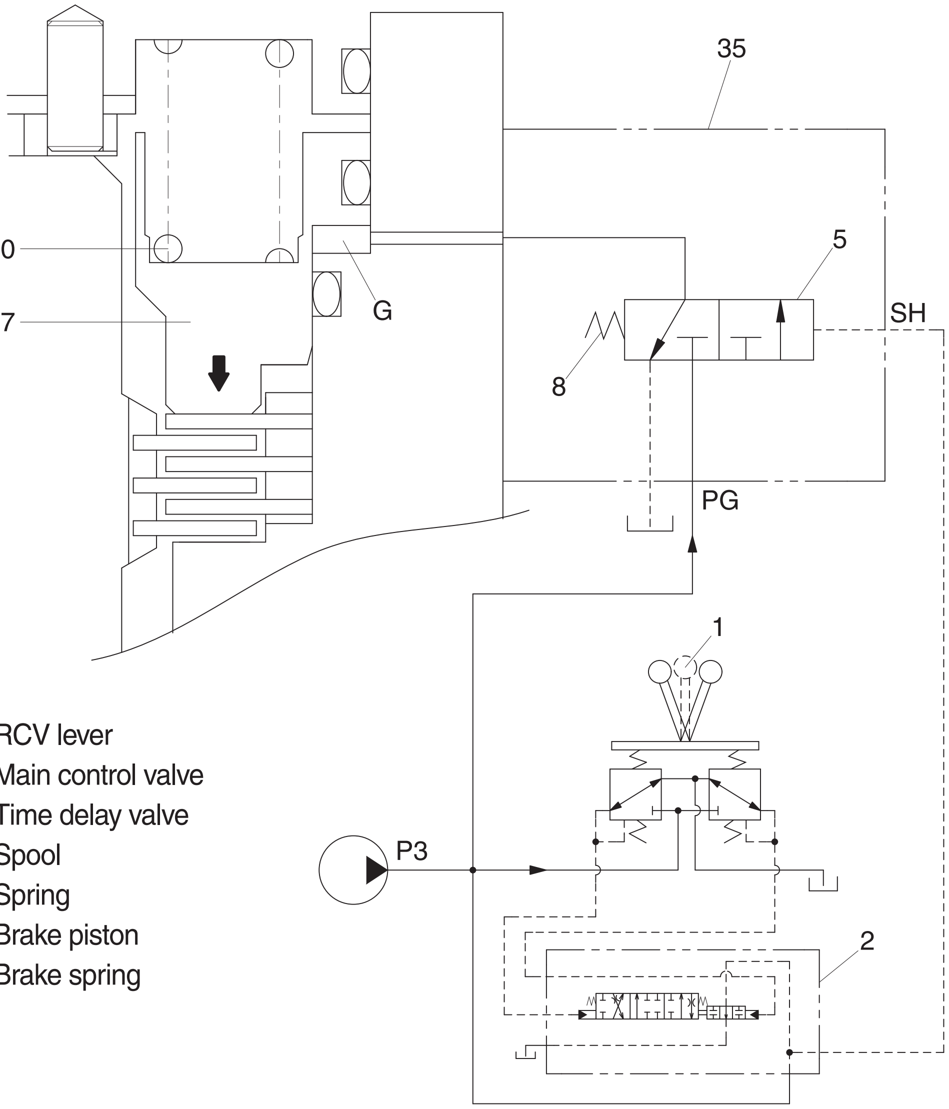
② Operating principle

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

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.

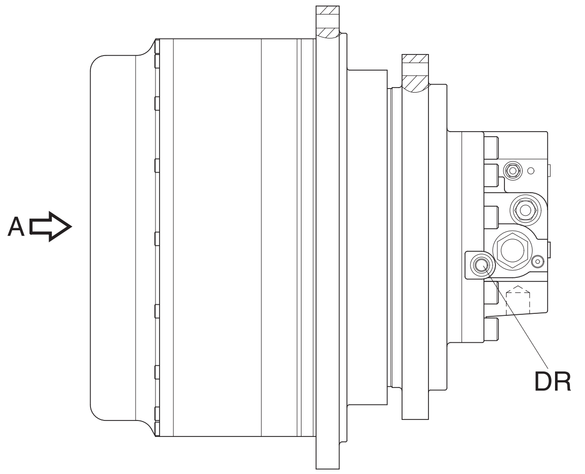


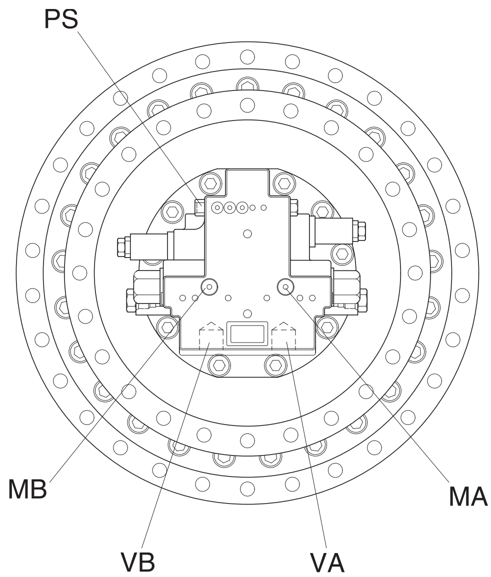
1	RCV lever
2	Main control valve
3	Time delay valve
5	Spool
8	Spring
16	Brake piston
19	Brake spring

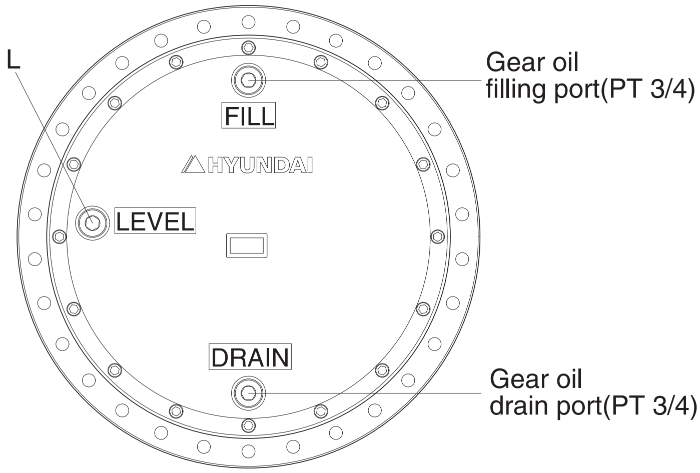
GROUP 4 TRAVEL DEVICE

1. CONSTRUCTION

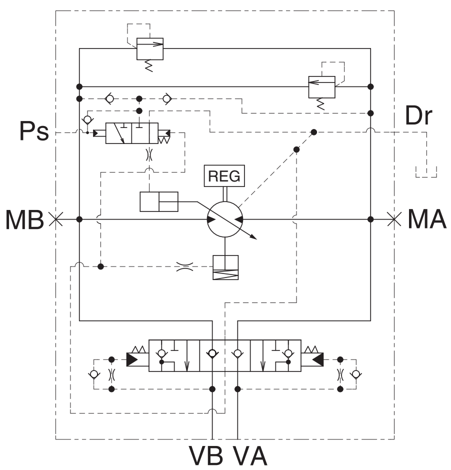
Travel device consists travel motor and gear box.
Travel motor includes brake valve, parking brake and high/low speed changeover mechanism.







VIEW A

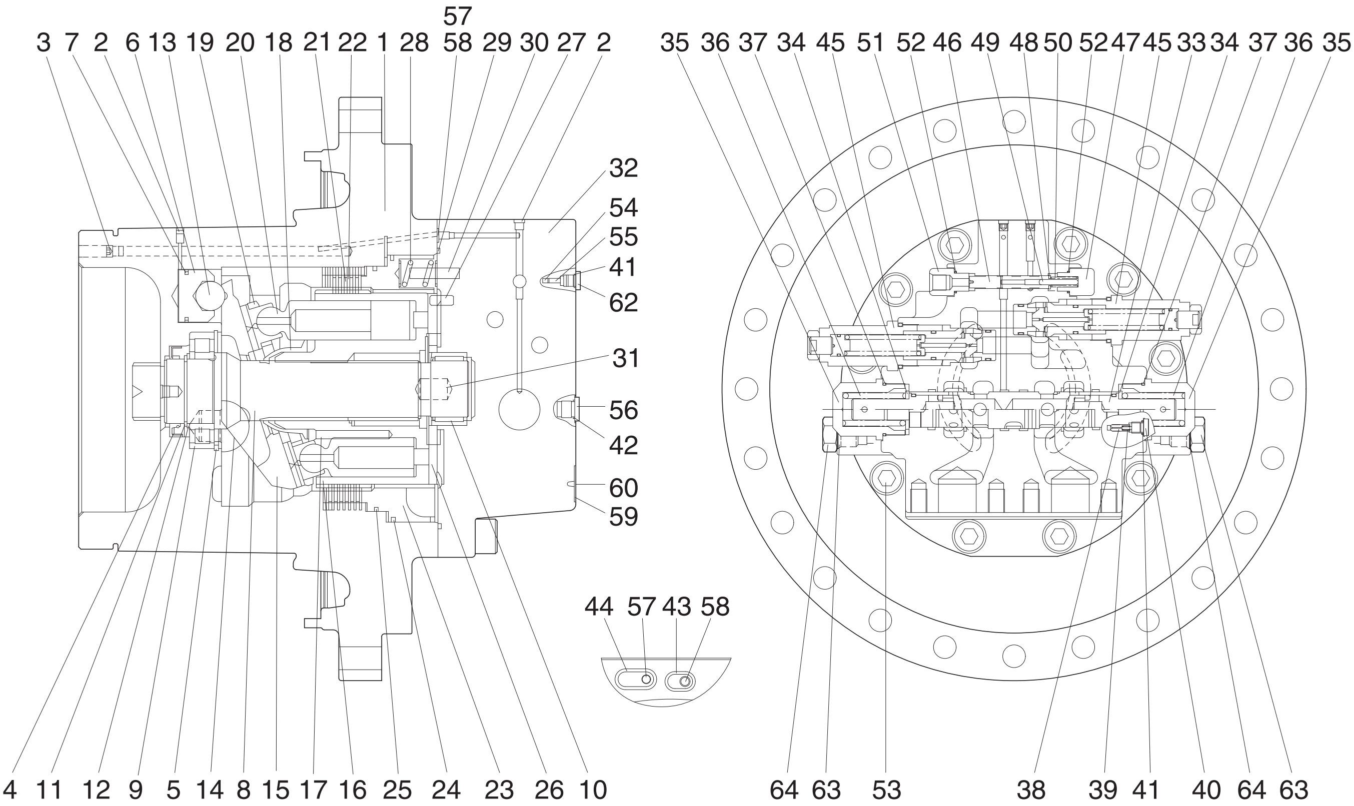


HYDRAULIC CIRCUIT

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

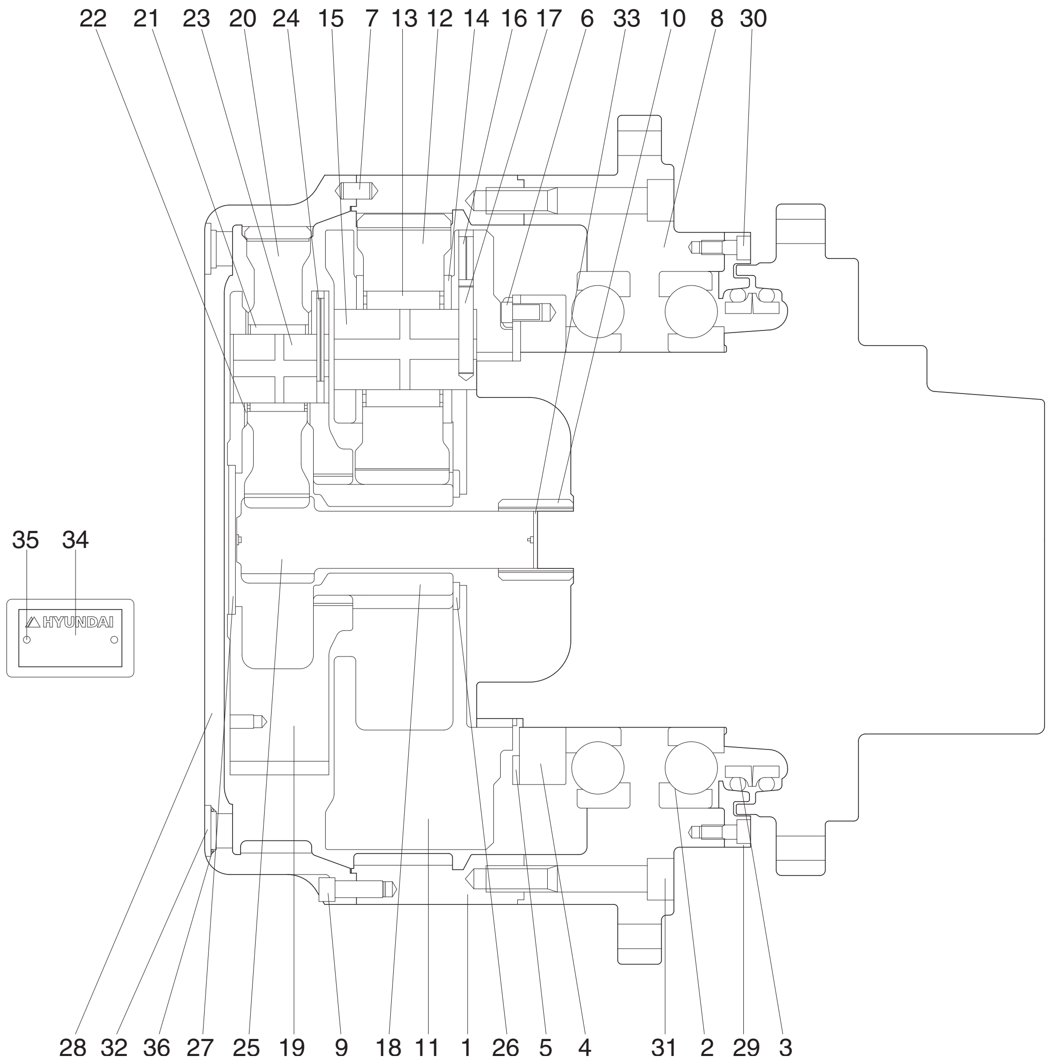
2. STRUCTURE

1) TRAVEL MOTOR



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

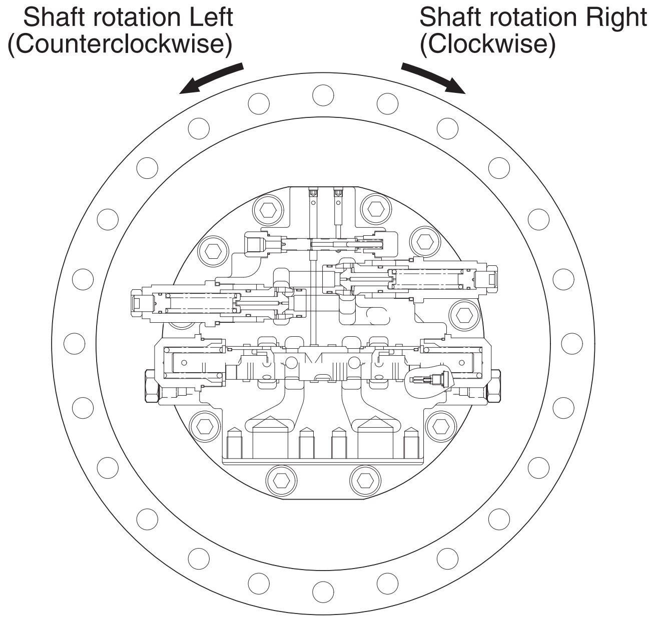


1	Ring gear	13	Needle bearing No. 2	25	Sun gear No. 1
2	Ball bearing	14	Thrust washer No. 2	26	Thrust plate
3	Floating seal assy	15	Carrier pin No. 2	27	Thrust plate
4	Ring nut	16	Spring pin No. 2	28	Cover
5	Lock plate	17	Solid pin No. 2	29	Cover seal
6	Hexagon head bolt	18	Sun gear No. 2	30	Hex socket 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)

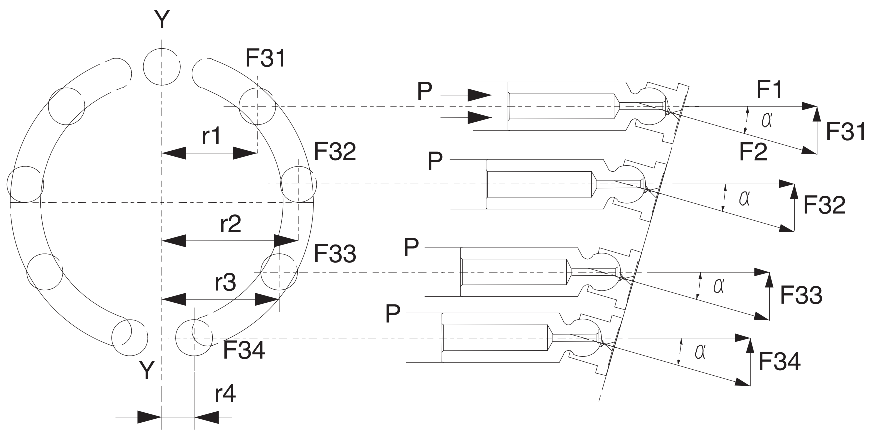
As shown in below figure, high pressure oil is supplied to the pistons which are on one side of the line Y-Y that connects upper and lower dead points and produces force F1.

$F1 = P \times A$ (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.

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

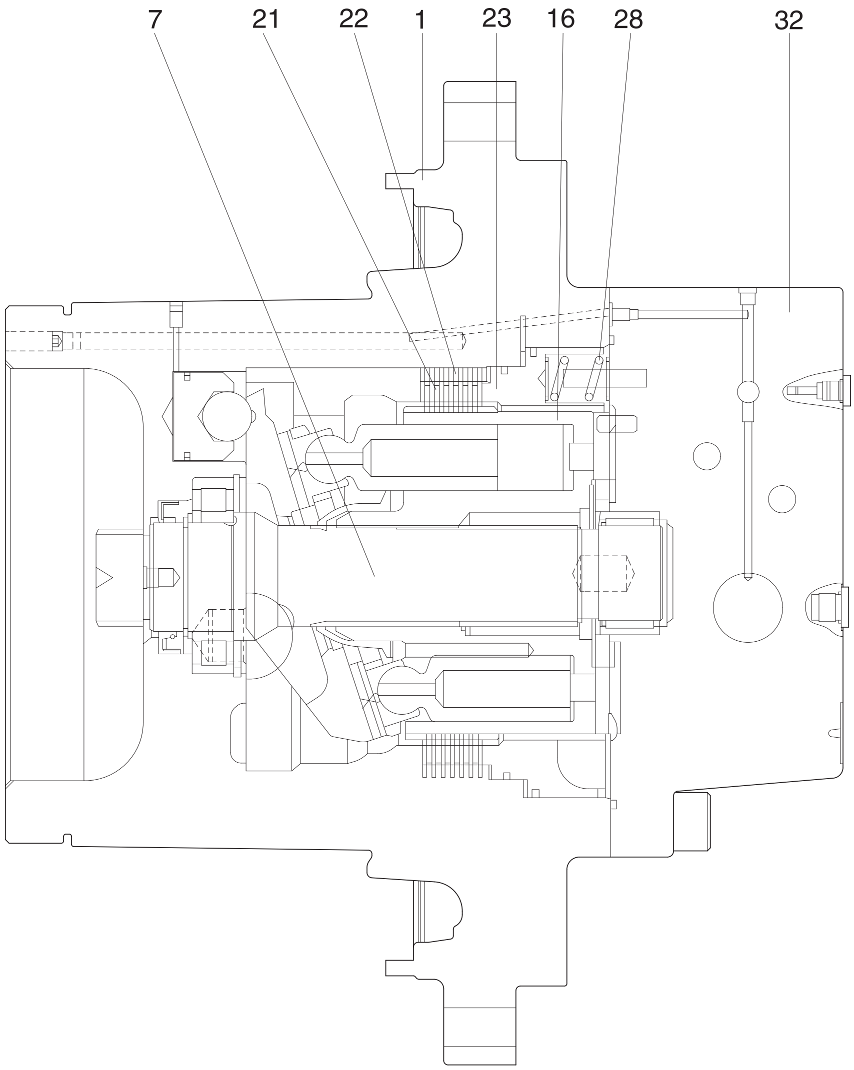
This drive torque is transmitted via cylinder block (18) to driving shaft (9).



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).



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.

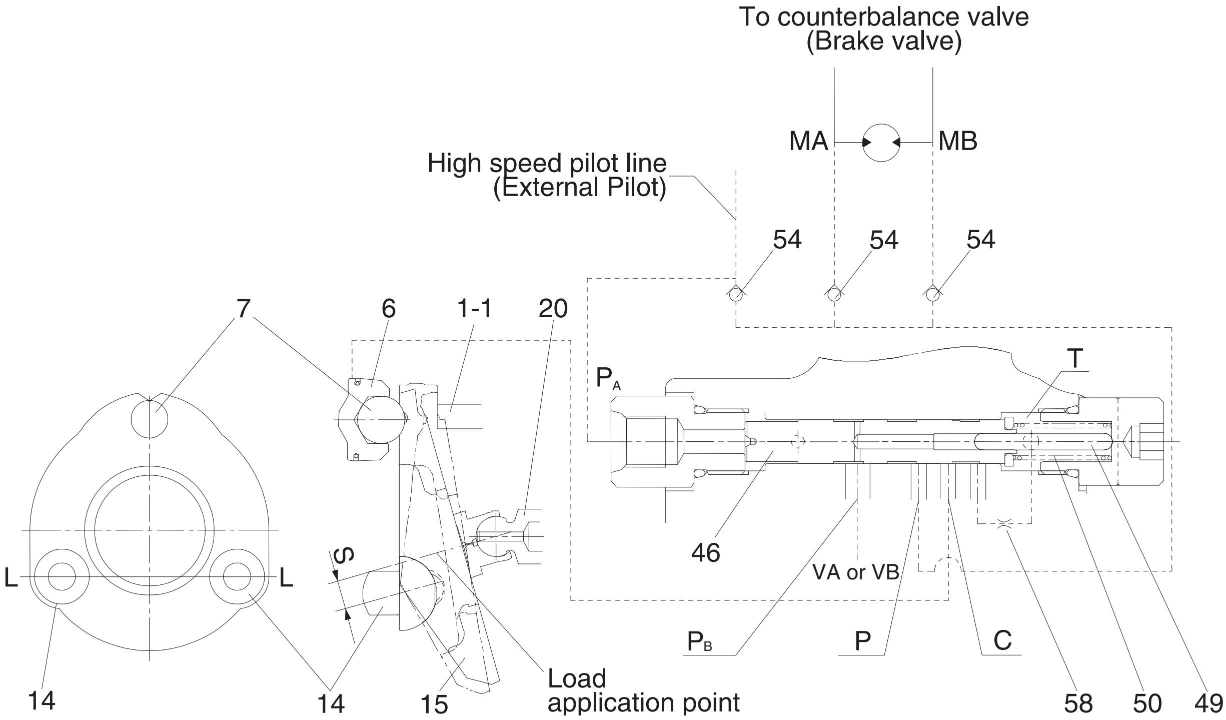
In this case, the piston stroke become shorter and motor capacity become smaller and motor rotates faster, around 1.60 times, by the same volume of oil.

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.

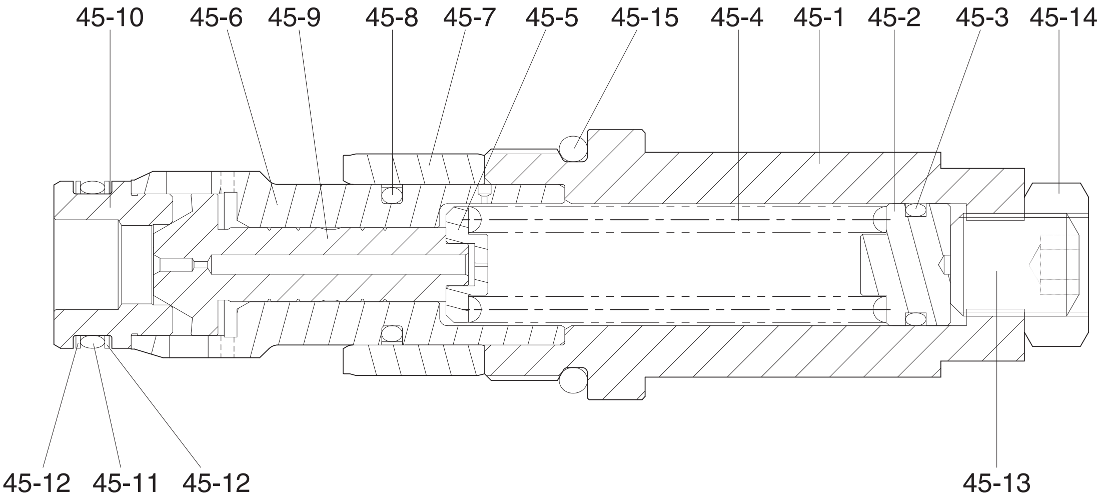
When P_B goes down, the spool (46) moves to the right and the speed become high.



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.



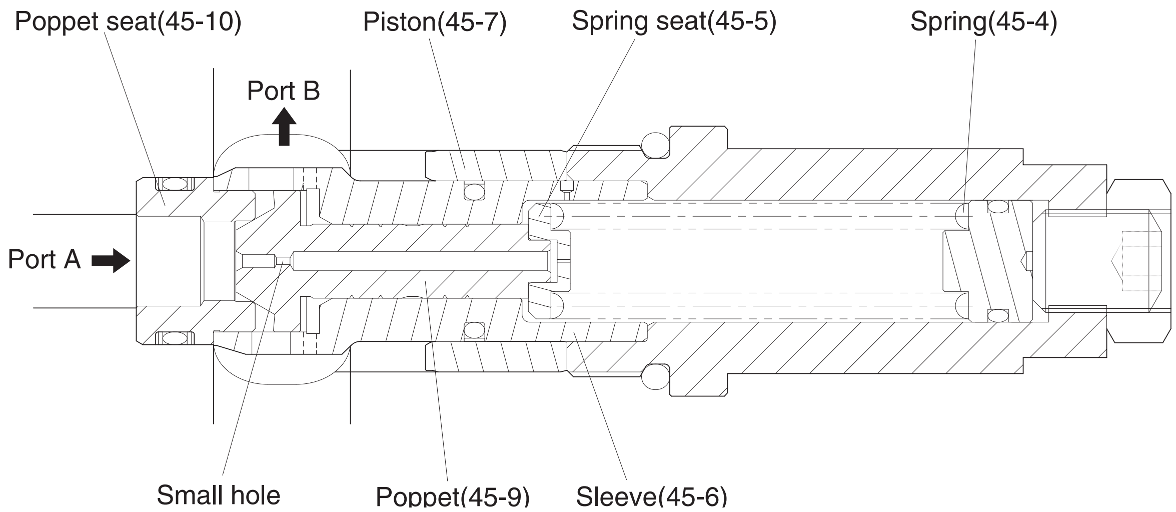
45-1	Plug	45-6	Sleeve	45-11	O-ring
45-2	Guide	45-7	Piston	45-12	Back-up ring
45-3	O-ring	45-8	Seal	45-13	Socket screw
45-4	Spring	45-9	Poppet	45-14	Hexagon nut
45-5	Spring seat	45-10	Poppet seat	45-15	O-ring

(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.



5) BRAKE VALVE

(1) Structure

The brake valve portion mainly consists of the following parts:

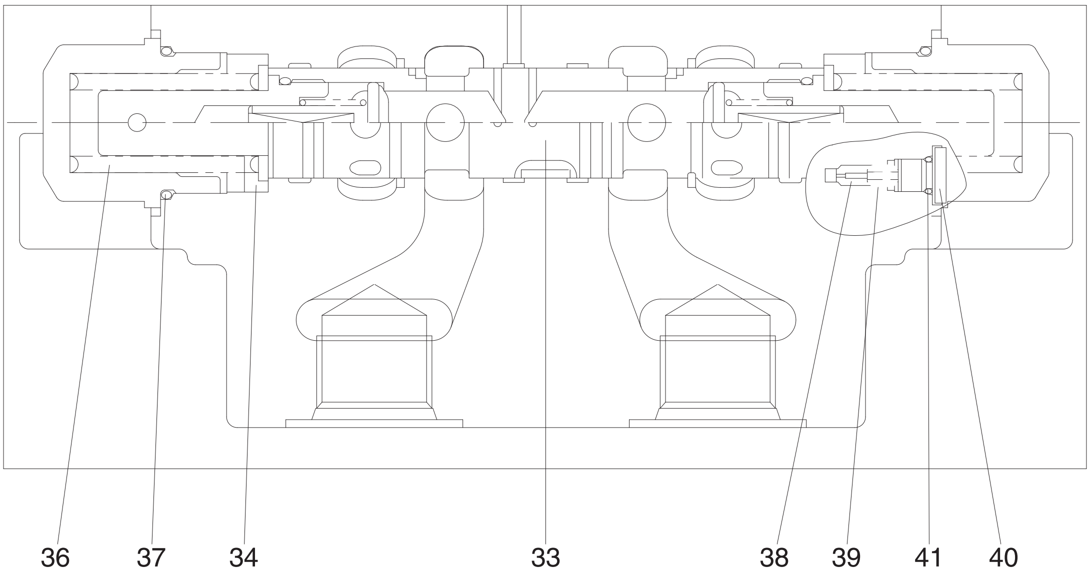
① Spool

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.



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

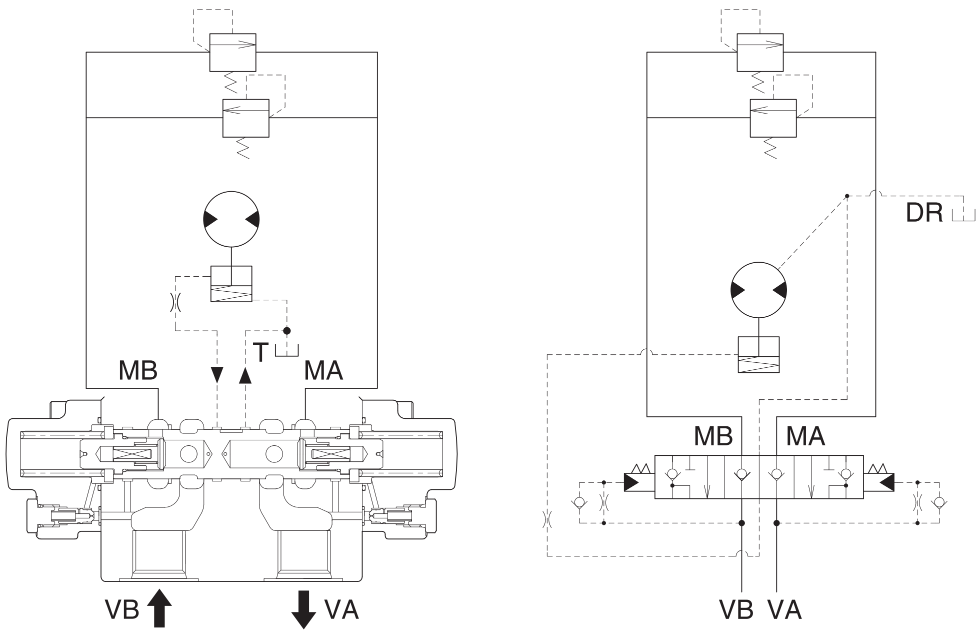
(2) Operation

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.

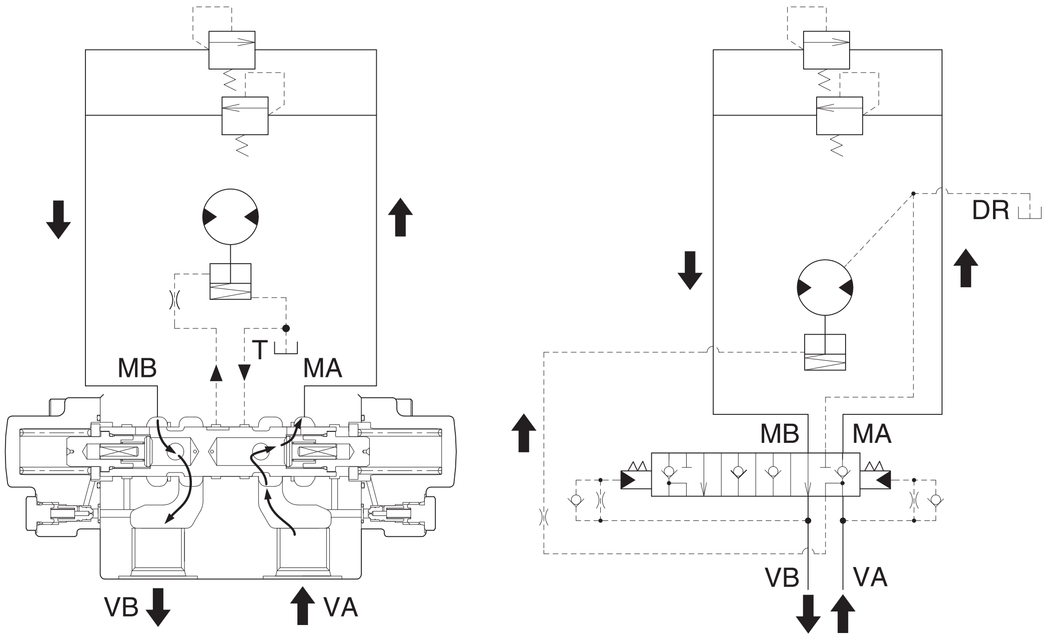


② Accelerating operation

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.

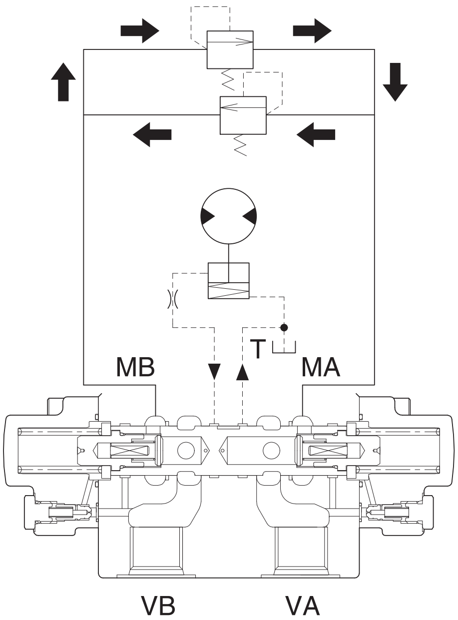


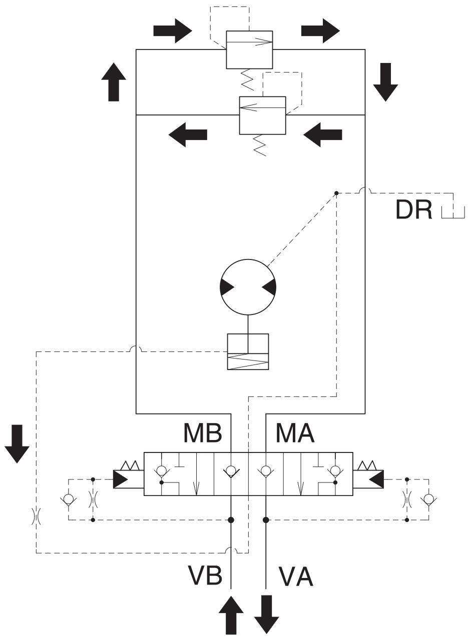
③ Stopping operation

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.



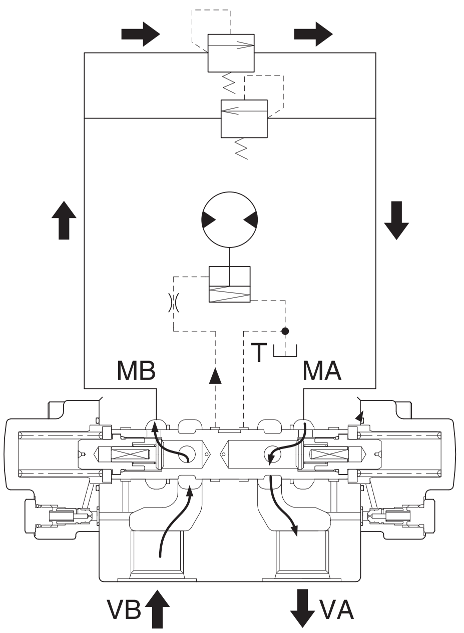


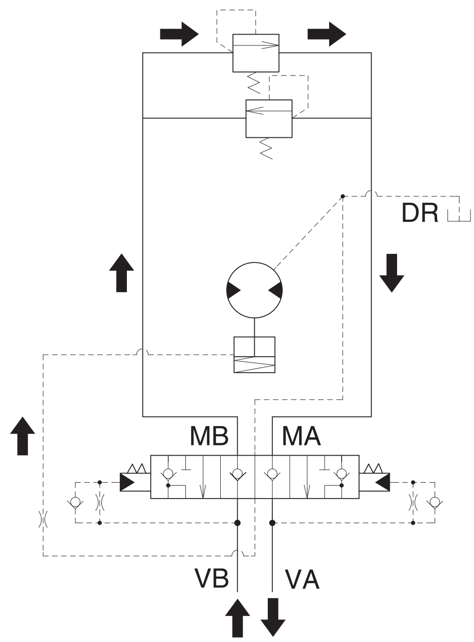
④ **Counterbalance operation**

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.

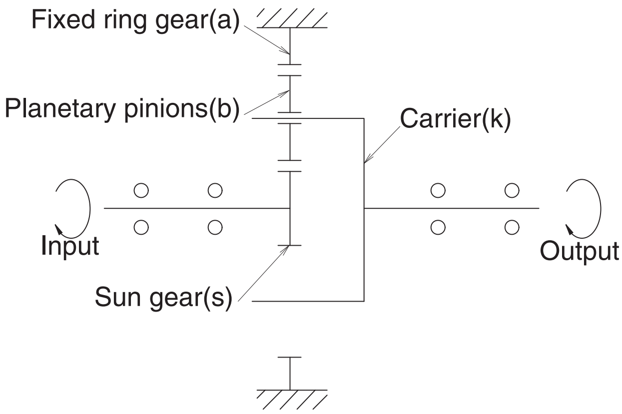
If the motor rotates slower than that matched to the volume of supplied oil, the pilot chamber pressure on VB port increases, and spool (33) moves rightwards to enlarge the area of passage from MA to VA. Therefore the braking effect becomes smaller and the rotational speed of motor is controlled to correspond 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).

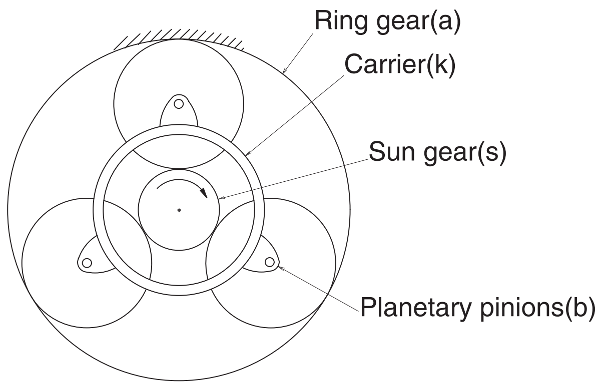




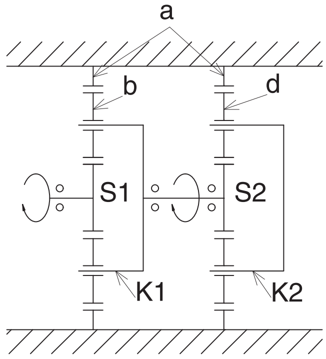
6) REDUCTION GEAR

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.





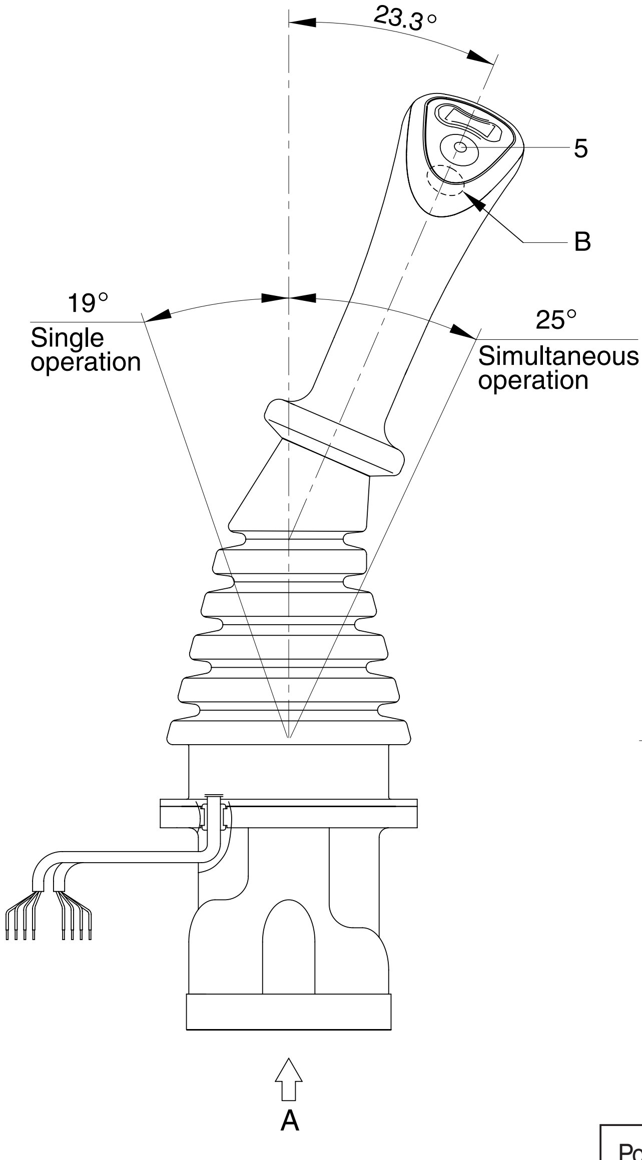
When the sun gear **S1** is driven by input shaft, planetary action occurs among gears **S1**, **a** and **b** and revolution of gear **b** transfers the rotation of carrier **K1** to second sun gear **S2**, and also evokes planetary action between gear **S2, a** and **d**.
This time, because carrier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



GROUP 5 RCV LEVER

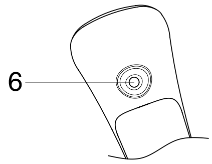
1. STRUCTURE

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.

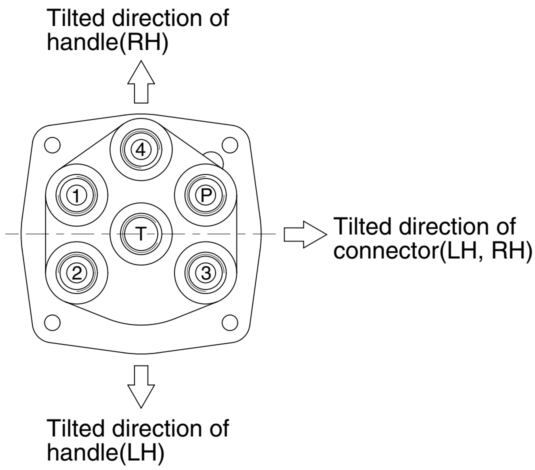


Switches

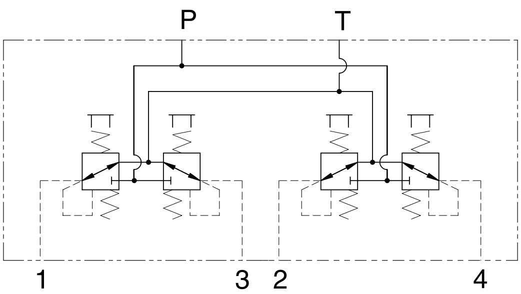
No.	LH	RH
5	One touch decel	Horn
6	Power boost	Breaker



DETAIL B



VIEW A



Hydraulic circuit

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

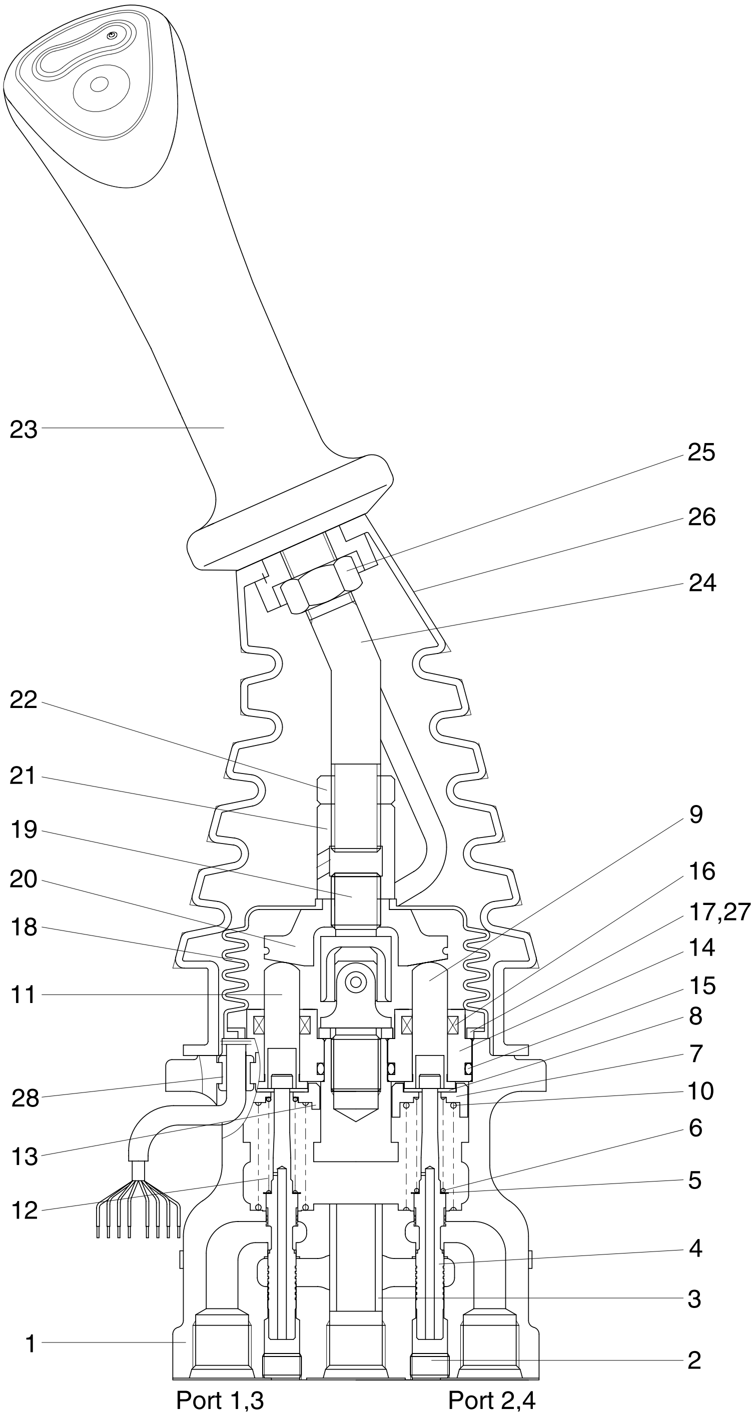
CROSS SECTION

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 (4), spring (6) for setting secondary pressure, return spring (10), stopper (8), spring seat (7, 13) and shim (5). 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, 11) 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.

CROSS SECTION



1	Case	8	Stopper	15	O-ring	22	Lock nut
2	Plug	9	Push rod	16	Rod seal	23	Handle assembly
3	Bushing	10	Spring	17	Plate	24	Handle bar
4	Spool	11	Push rod	18	Boot	25	Nut
5	Shim	12	Spring	19	Joint assembly	26	Boot
6	Spring	13	Spring seat	20	Swash plate	27	Spring pin
7	Spring seat	14	Plug	21	Adjusting nut	28	Bushing

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

The functions of the spool (4) 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 (6) works on this spool to determine the output pressure.

The change the deflection of this spring, the push rod (9,11) is inserted and can slide in the plug (14).

For the purpose of changing the displacement of the push rod through the swash plate (20) and adjusting nut (21) are provided the handle (23) that can be tilted in any direction around the fulcrum of the universal joint (19) center.

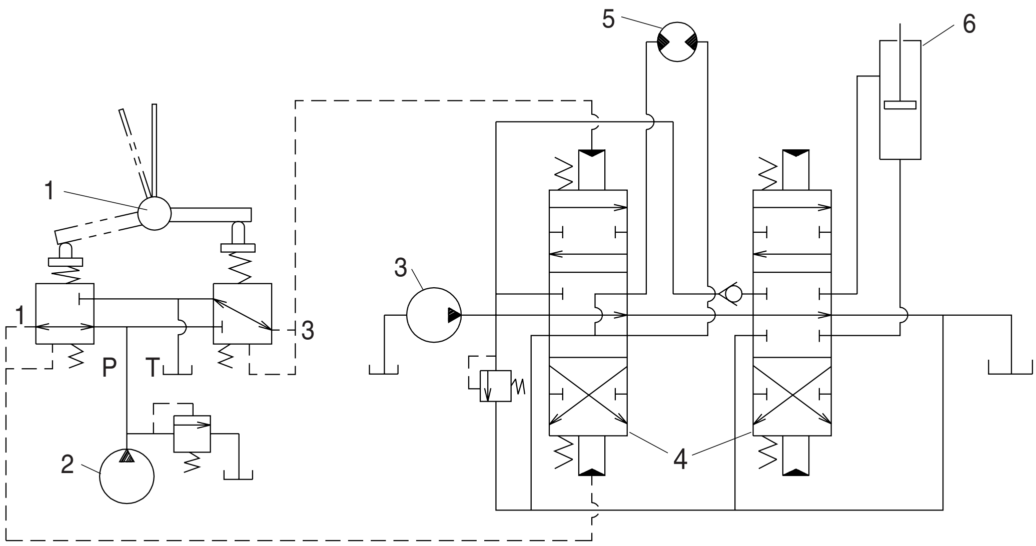
The spring (10) works on the case (1) and spring seat (7, 13) and tries to return the push rod (9,11) to the zero-displacement position irrespective of the output pressure, securing its resetting to the center position.

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

3) OPERATION

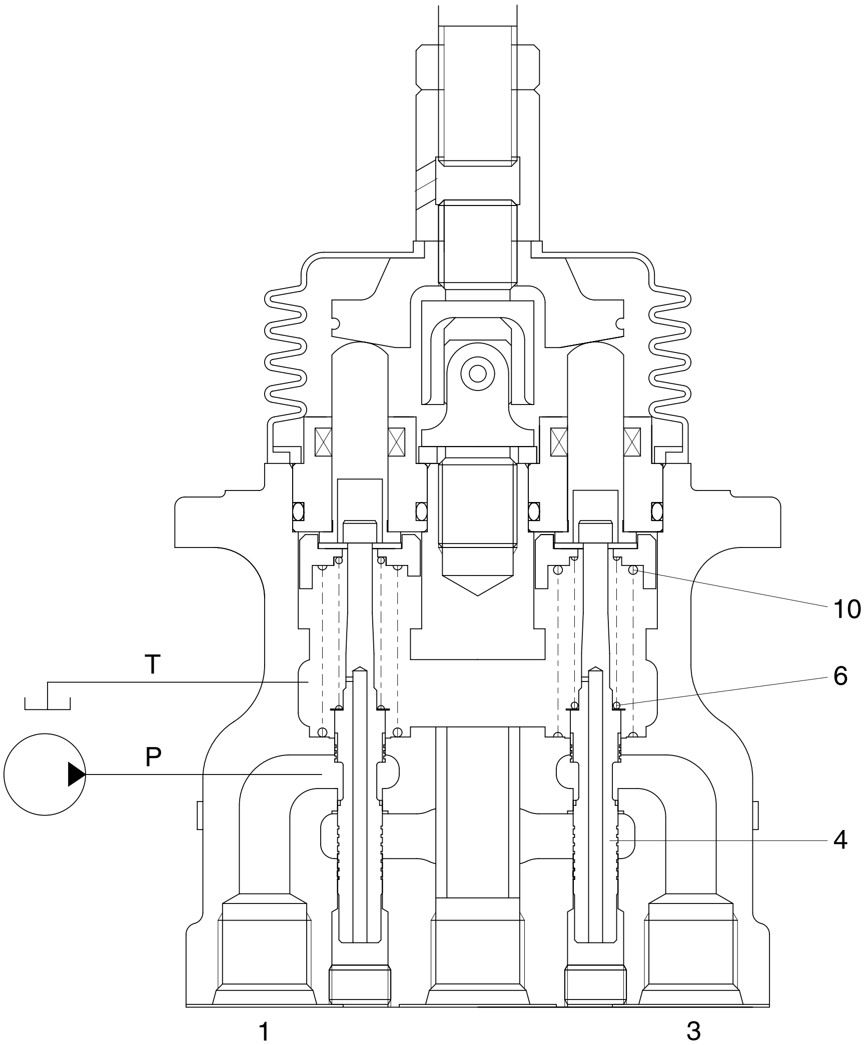
The operation of the pilot valve will be described on the basis of the hydraulic circuit diagram shown below and the attached operation explanation drawing.

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



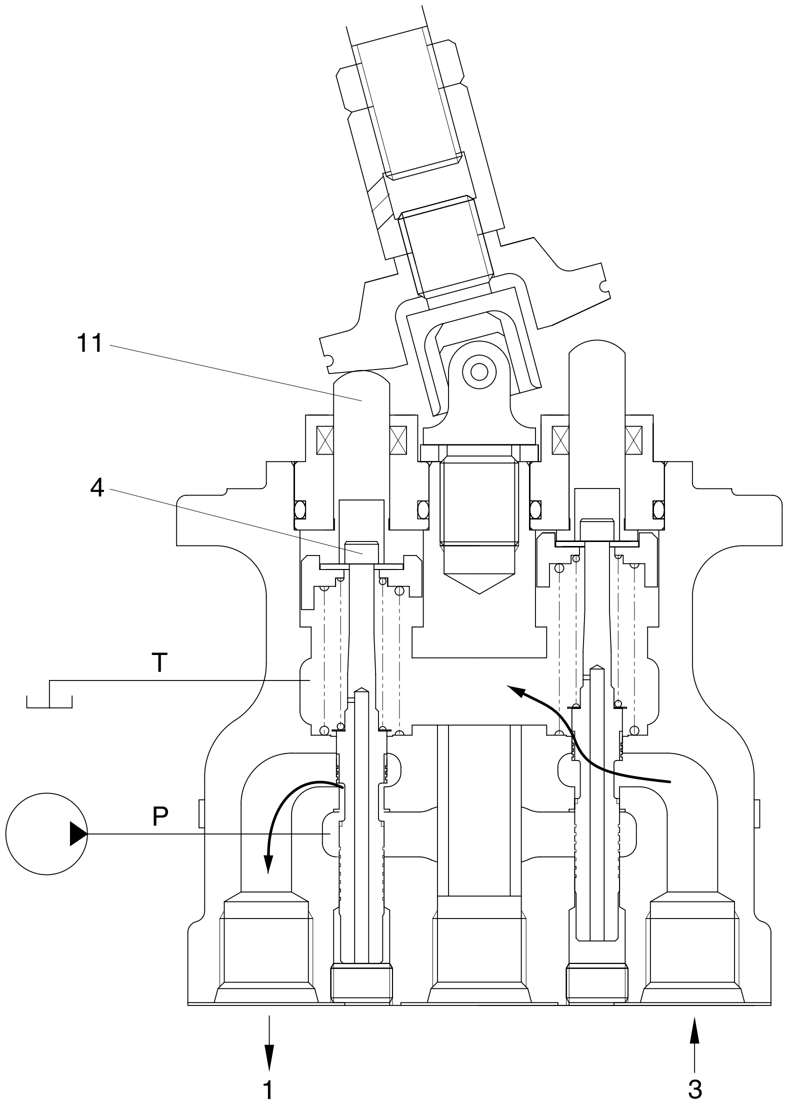
1	Pilot valve	3	Main pump	5	Hydraulic motor
2	Pilot pump	4	Main control valve	6	Hydraulic cylinder

(1) Case where handle 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 (4). Therefore, the spool is pushed up by the spring (10) to the position of port (1, 3) in the operation explanation drawing. Then, since the output port is connected to tank port T only, the output port pressure becomes equal to tank pressure.

(2) Case where handle is tilted



When the push rod (11) is stroked, the spool (4) 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.

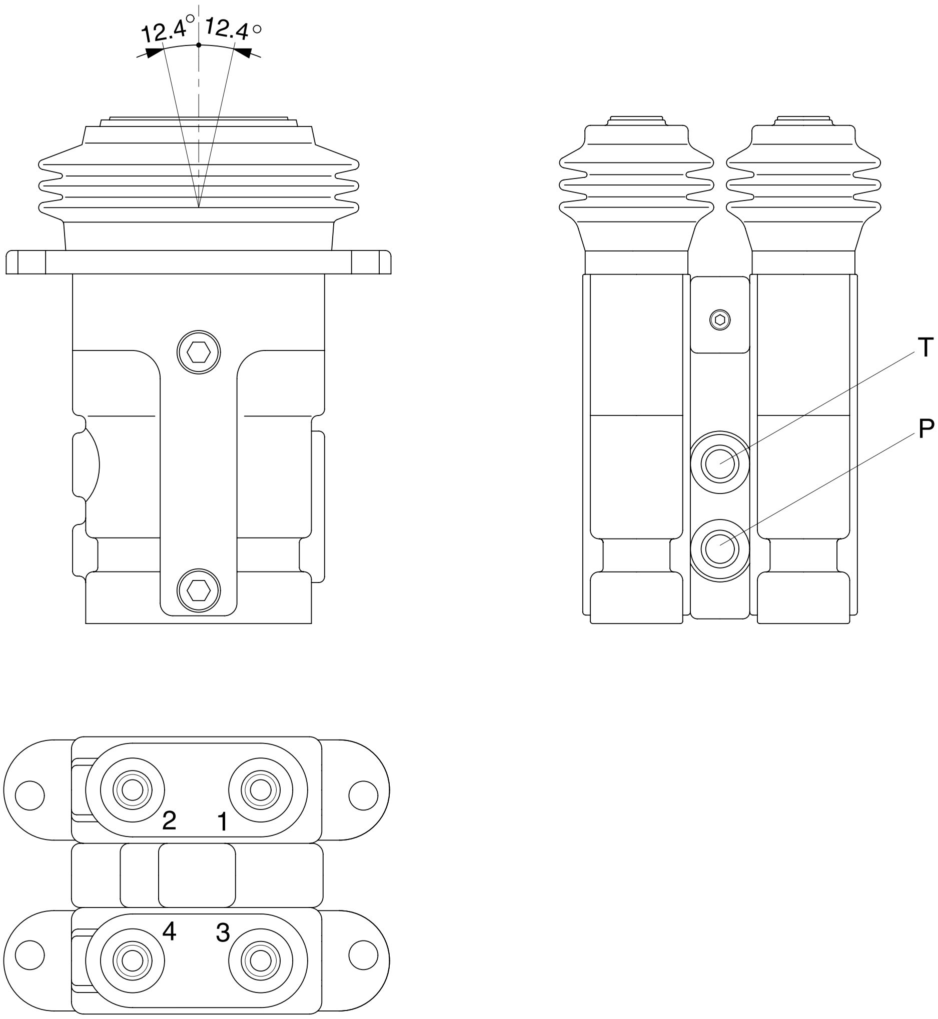
In this manner the secondary pressure is kept at the constant value.

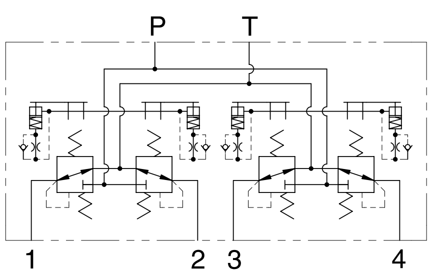
Besides, in some type, when the handle is tilted more than a certain angle, the upper end of the spool contacts with the inside bottom of the push rod and the output pressure is left to be connected with port P.

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

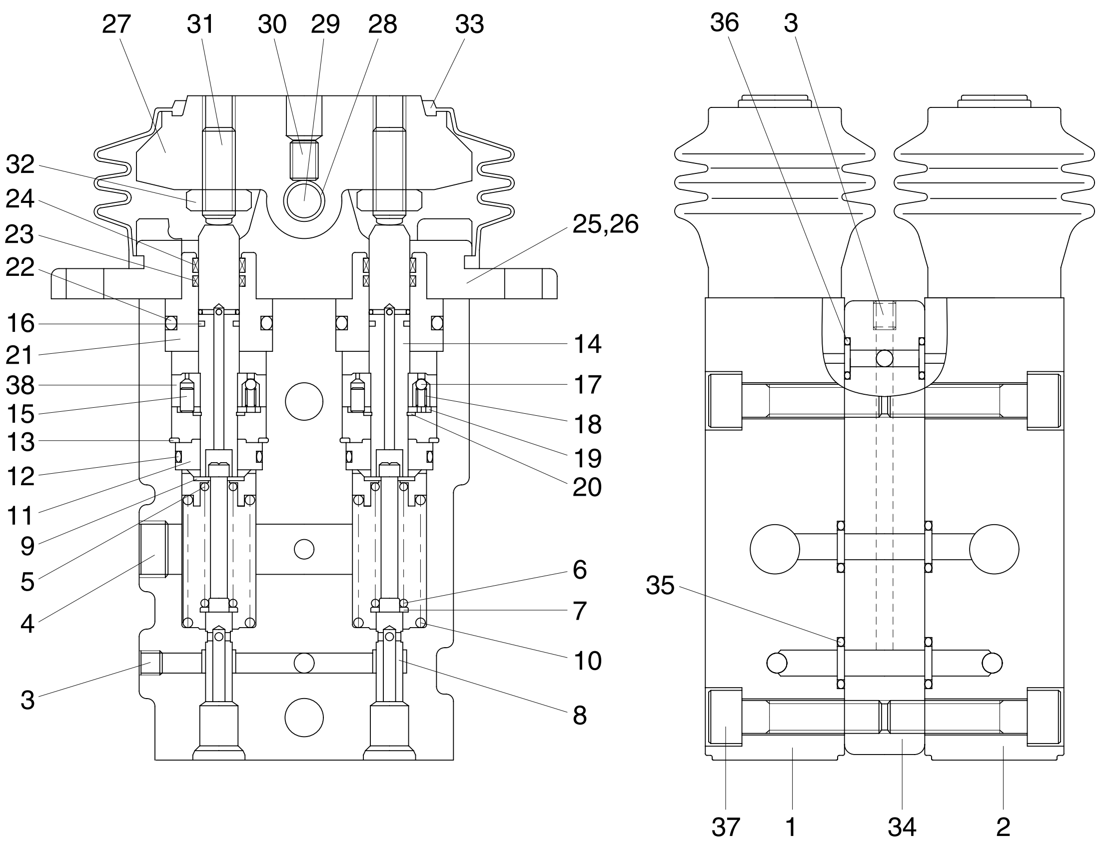
Port	Port	Port size
P	Pilot oil inlet port	PF 1/4
T	Pilot oil return port	
1	Travel (LH, forward)	
2	Travel (LH, backward)	
3	Travel (RH, forward)	
4	Travel (RH, backward)	

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

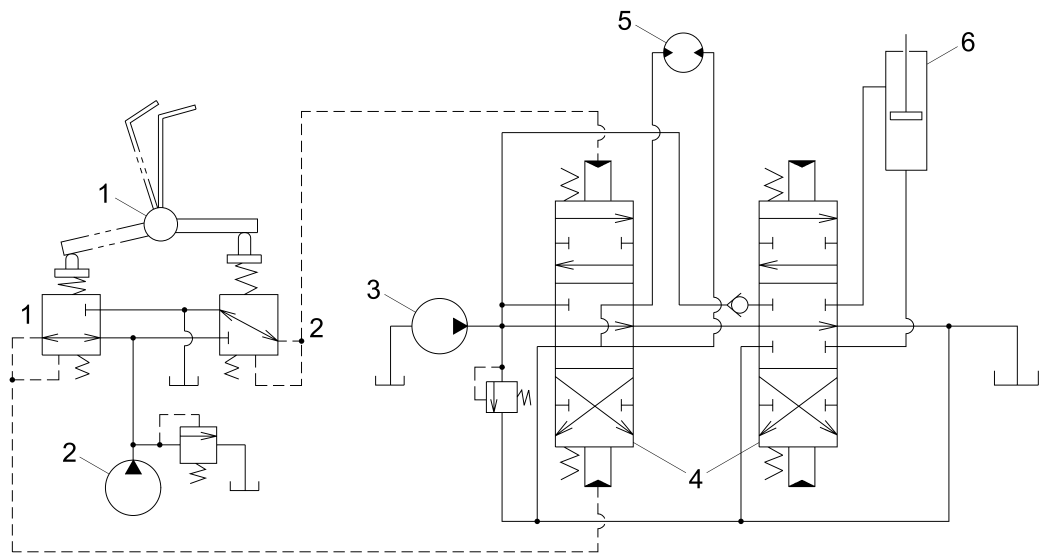
The spring (10) works on the casing (1) and spring seat (7) and tries to return the push rod (14) to the zero-displacement position irrespective of the output pressure, securing its resetting to the center position.

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

3) OPERATION

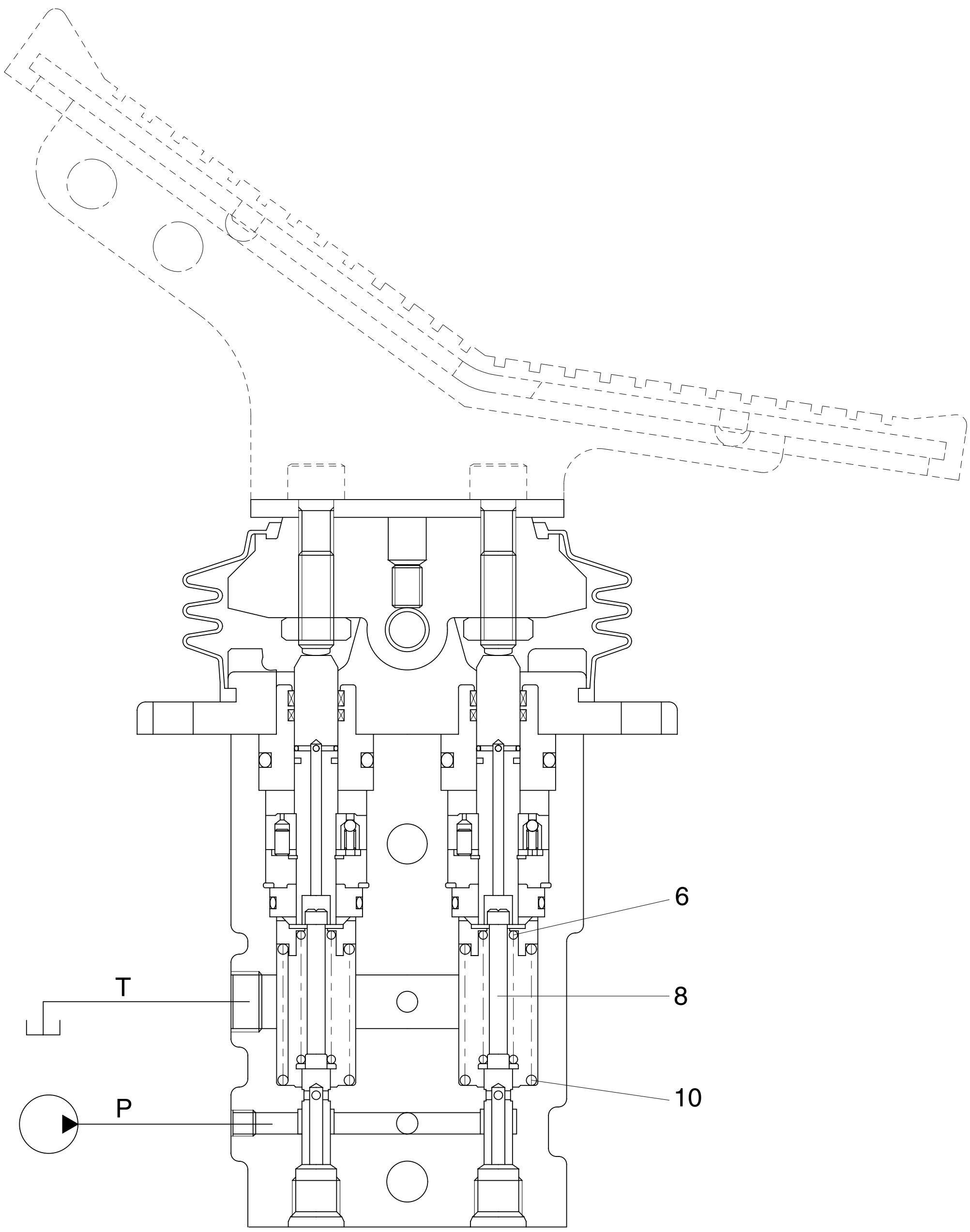
The operation of the pilot valve will be described on the basis of the hydraulic circuit diagram shown below ant the attached operation explanation drawing.

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



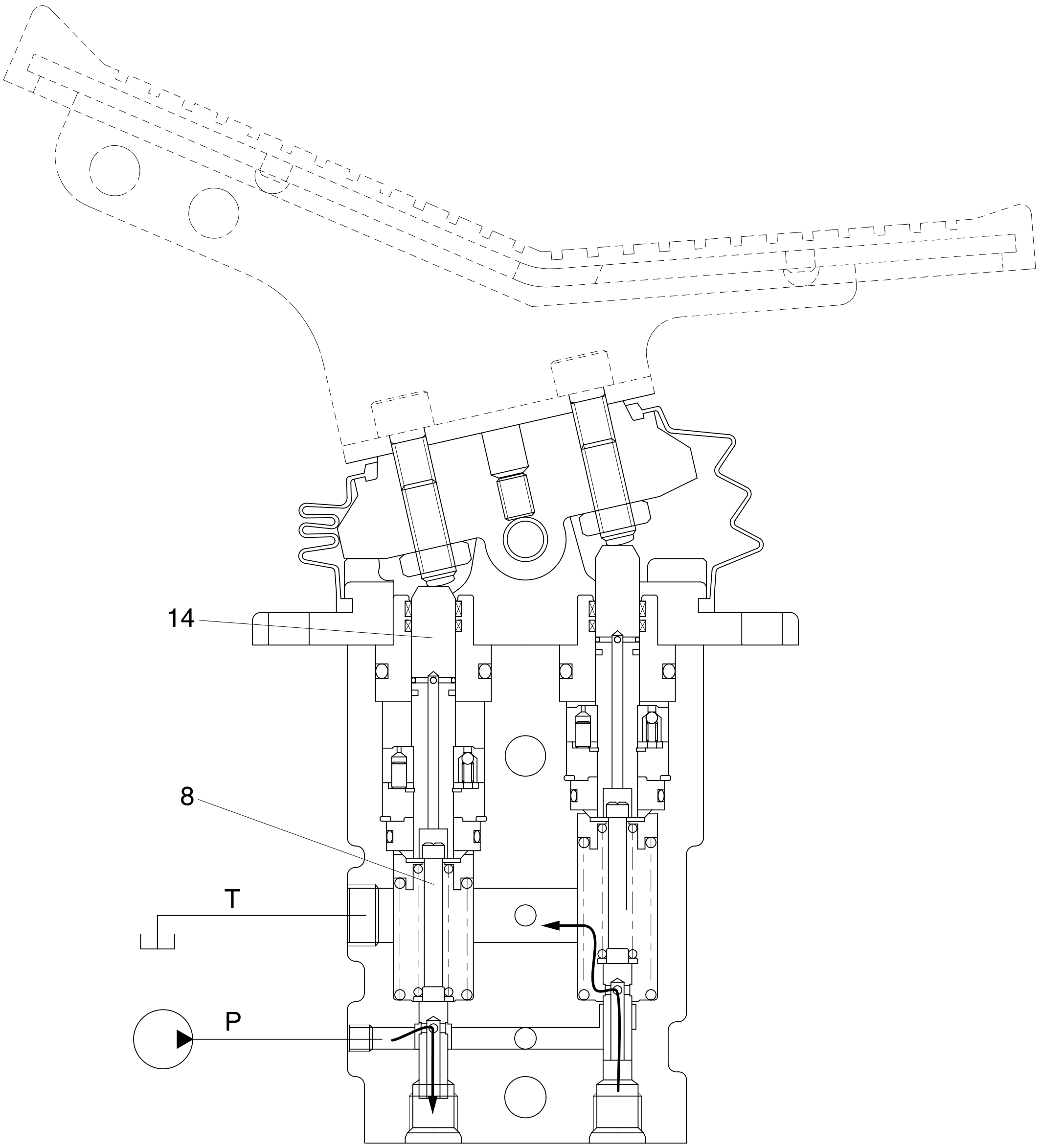
1	Pilot valve	3	Main pump	5	Hydraulic motor
2	Pilot pump	4	Main control valve	6	Hydraulic cylinder

(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 1, and the oil supplied from the pilot pump flows through port 1 to generate the pressure.

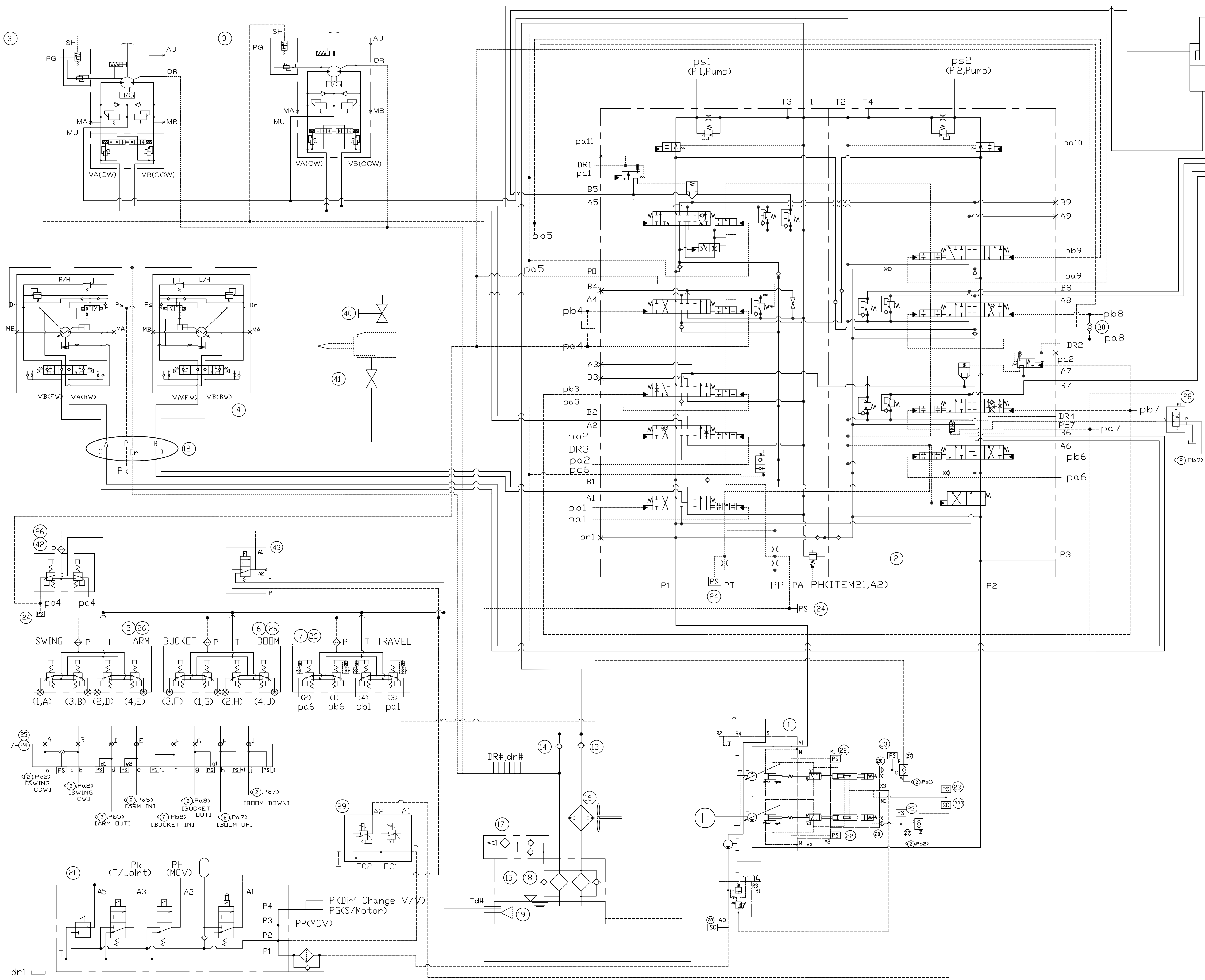
When the pressure at port 1 increases to the value corresponding to the spring force set by tilting the handle, the hydraulic pressure force balances with the spring force. If the pressure at port 1 increases higher than the set pressure, port P is disconnected from port 1 and port T is connected with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

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

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

SECTION 3 HYDRAULIC SYSTEM

GROUP 1 HYDRAULIC CIRCUIT

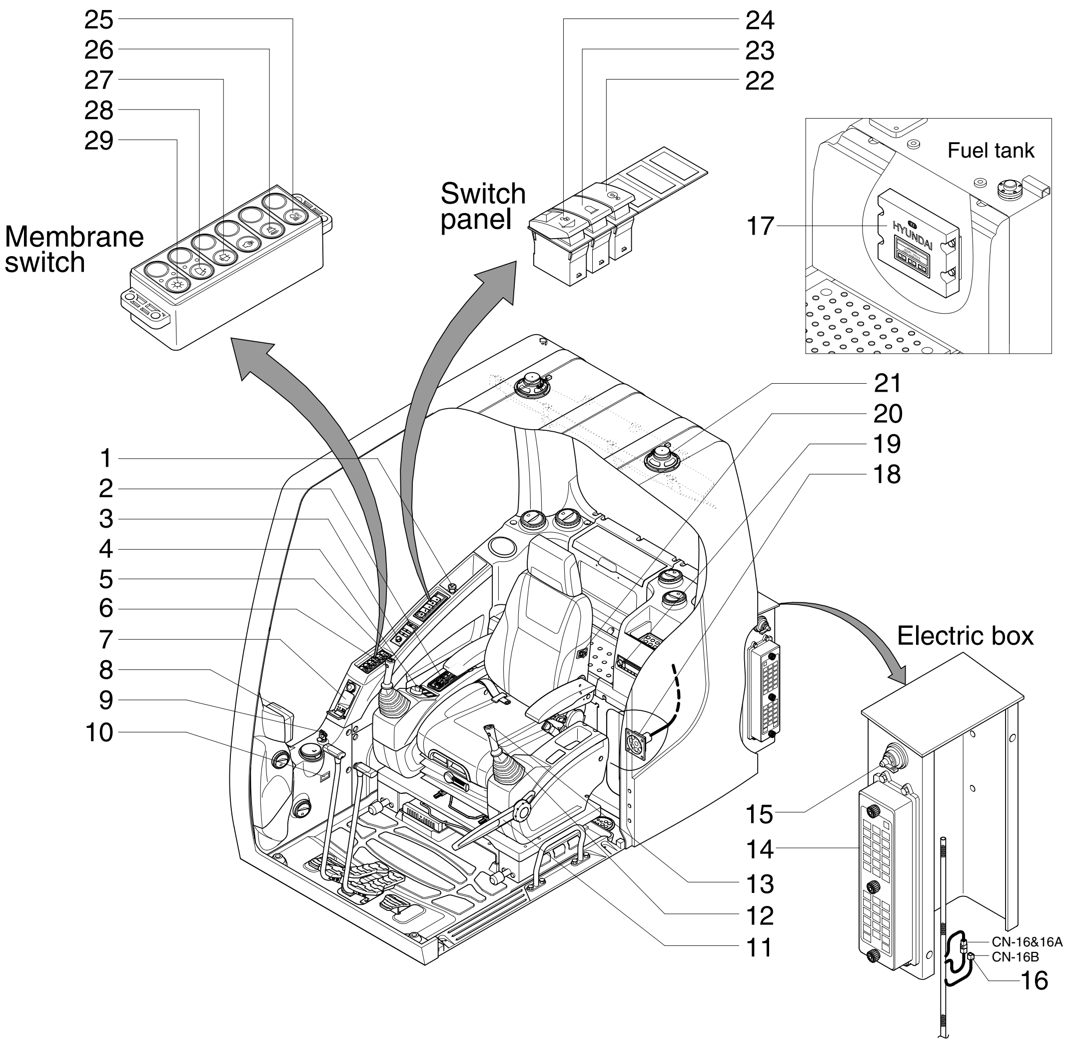


	ITEM	PARTS NO	PARTS NAME	QTY	
OPTION	43	31Q6-91220	SOLENOID V	1	
	42	31Q6-20300	PEDAL-2WAY	1	
	41	31Q8-92560	STOP V-RH	1	
	40	31Q8-92550	STOP V-LH	1	
	26	31N6-25070	LAST G-FILTER	1	
	24	31Q4-40830	PS.SENSOR	1	50K
STANDARD	30	31N6-30130	SHUTTLE S-NUT	1	
	29	31K6-20520	2 EPPR VALVE	1	
	28	31Q6-20150	P.SELECTOR V/V	1	
	27	31Q6-20180	SHUTTLE V-TEE	2	
	26	31N6-25070	LAST G-FILTER	3	
	25	31K9-20250	BLOCK SHUTTLE	1	
	24	31Q4-40830	PS.SENSOR	9	50K
	23	31Q4-40820	PS.SENSOR	3	100K
	22	31Q4-40800	PS.SENSOR	2	500K
	21	31K6-23240	ACCUMULATOR	1	
			4-CARTR'V	1	1 EPPR
			PILOT FILTER	1	
	20	3BQB-29310	TEE-BRANCE FILTER	2	
	19	31Q6-01130	STRAINER ASSY	1	
	18	31RF-10400	RETURN ELEMENT	2	
		E131-0256	BYPASS V	2	
	17	32QA-00040	AIR BREATHER	1	
	16	11QB-45030	OIL COOLER	1	
	15	3BQB-09110	HYD TANK ASSY	1	
	14	31ND-11130	CHECK VALVE	1	
	13	31ND-11110	CHECK VALVE	1	
	12	31QB-40502	TURNING JOINT	1	5K
	11	31KB-63110C	BKT CYL	1	1.5K
	10	31QB-50130CGG	ARM CYL	1	
	9	31QB-50123CGG	BOOM CYL-RH	1	
	8	31QB-50113CGG	BOOM CYL-LH	1	
	7	31Q6-20101	RCV PEDAL	1	
	6	31Q8-20065	RCV LEVEL-RH	1	
	5	31Q8-20055	RCV LEVEL-LH	1	
	4	38QB-40102	TRAVEL MOTOR	2	HM07
		39QB-40102	TRAVEL MOTOR	2	HM06
		34E7-03051	TRAVEL MOTOR	2	HM02
	3	38KB-10151	SWING MOTOR	2	HCE
	2	New(31QB-17151)	MCV	1	HCE
	1	31KB-10030	MAIN PUMP	1	Rexroth

SECTION 4 ELECTRICAL SYSTEM

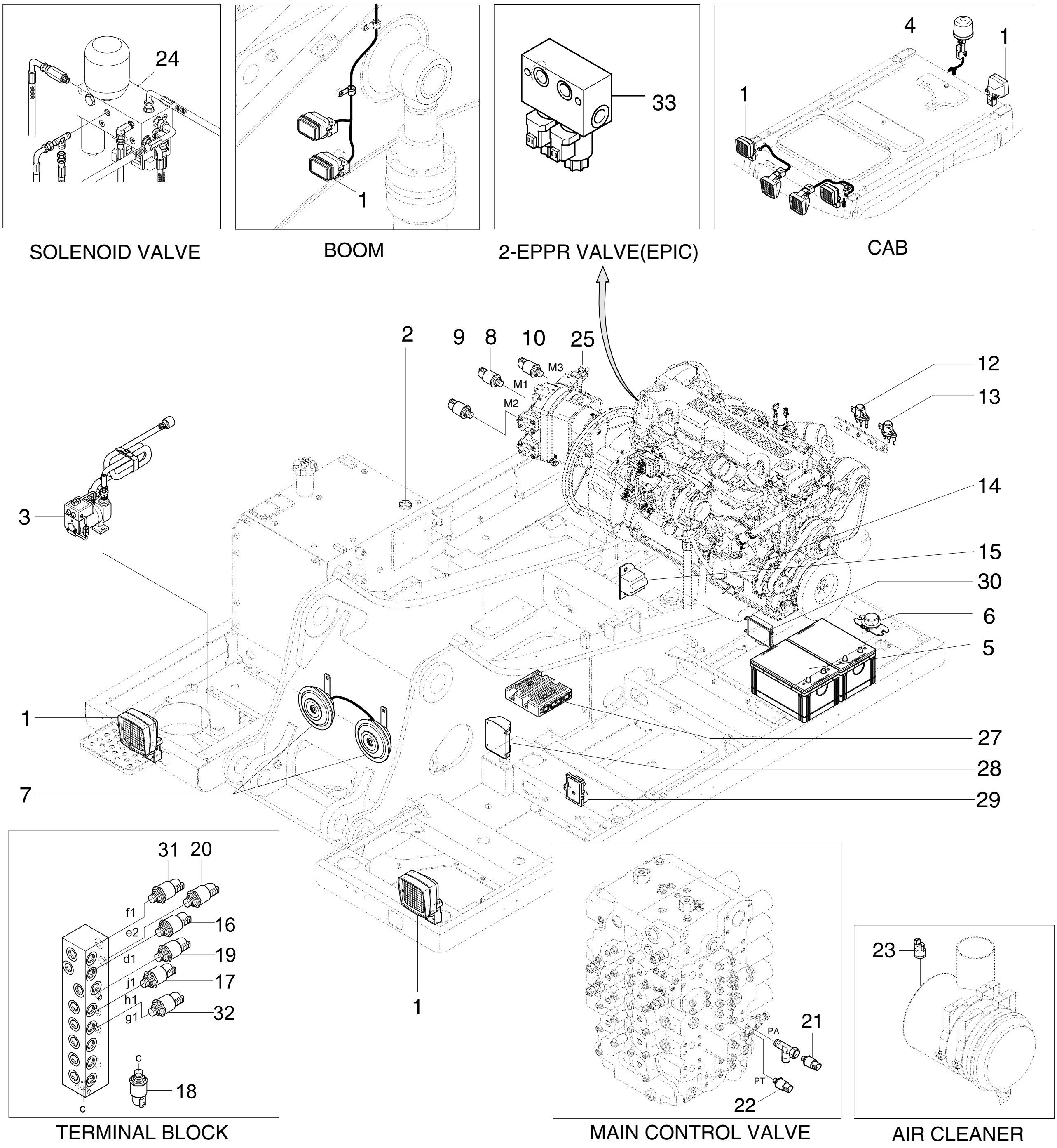
GROUP 1 COMPONENT LOCATION

1. LOCATION 1



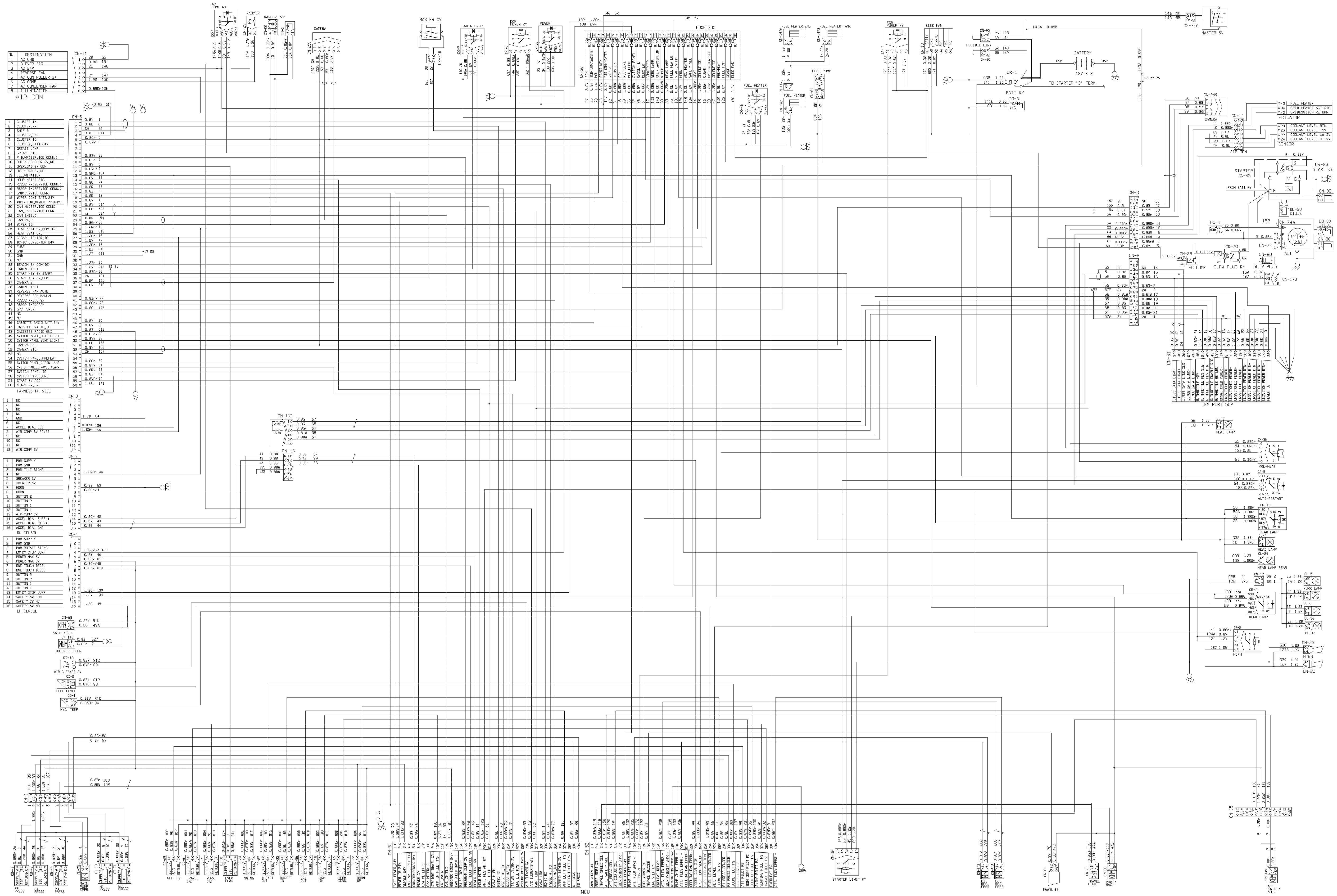
1	Cigar light	11	Safety lever	21	Speaker
2	Aircon & heater switch panel	12	Power max switch	22	Overload switch(opt)
3	Remote controller	13	One touch decel switch	23	Beacon switch(opt)
4	Accel dial switch	14	Fuse box	24	Quick clamp switch(opt)
5	Horn switch	15	Master switch	25	Cab light switch
6	Breaker operation switch	16	Emergency engine connector	26	Travel alarm switch
7	Handsfree	17	MCU	27	Washer switch
8	Cluster	18	RS232 & J1939 service socket	28	Wiper switch
9	Starting switch	19	Radio & CD/MP3 player	29	Main light switch
10	Service meter	20	Heated seat switch		

2. LOCATION 2

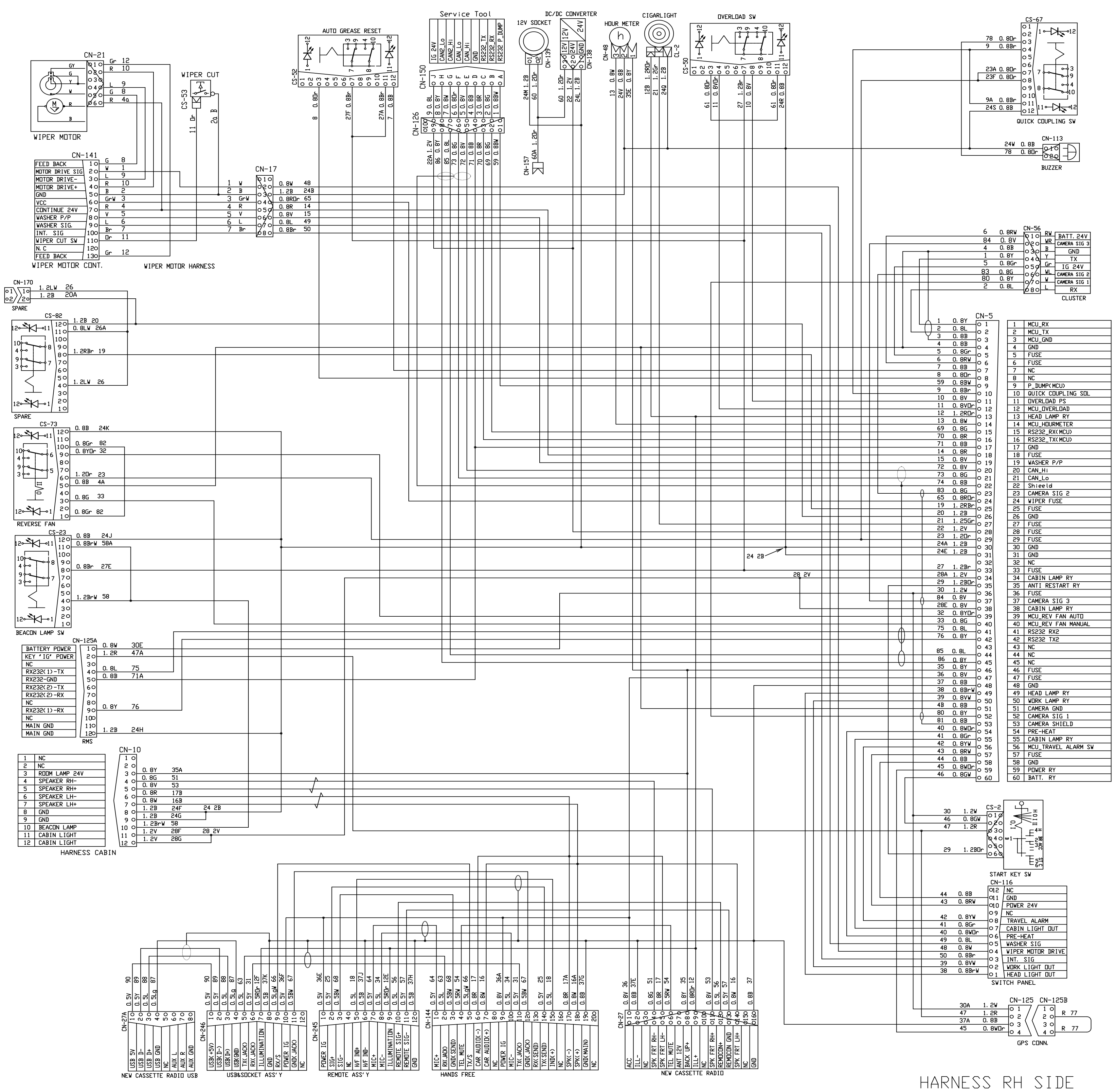


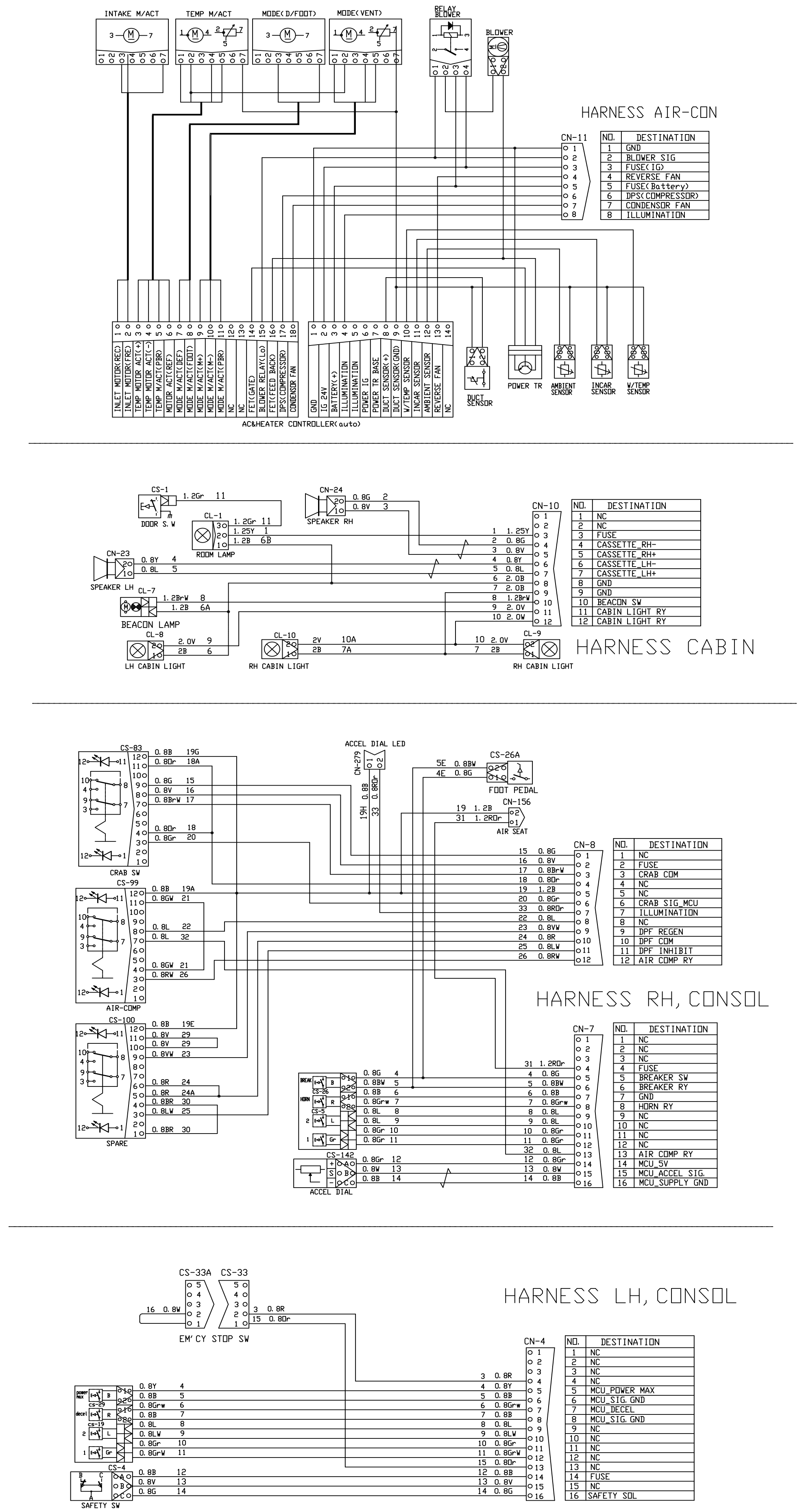
1 Lamp
2 Fuel sender
3 Fuel filler pump
4 Beacon lamp
5 Battery
6 Battery relay
7 Horn
8 A1 pump pressure sensor
9 A2 pump pressure sensor
10 EPPR pressure sensor
12 Start relay
13 Heater relay
14 Alternator
15 Travel alarm buzzer
16 Arm in pressure sensor
17 Boom up pressure sensor
18 Swing pressure sensor
19 Boom down pressure sensor
20 Arm out pressure sensor
21 Attach pressure sensor
22 Travel pressure sensor
23 Air cleaner sensor
24 4 cartridge valve
25 Pump EPPR valve
27 United MCU
28 RMCU assy
29 RDU assy
30 View controller
31 Bucket in pressure sensor
32 Bucket out pressure sensor
33 2 EPPR cartridge valve

· ELECTRICAL CIRCUIT (1/2)



· ELECTRICAL CIRCUIT (2/2)





MEMORANDUM

HYUNDAI HEAVY INDUSTRIES CO., LTD
CONSTRUCTION EQUIPMENT DIV.

1. POWER CIRCUIT

The negative terminal of battery is grounded to the machine chassis through master switch.
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 → Fusible link [CN-60] → Master switch [CS-74A]

- → Fuse box [No.1] → I/conn [CN-2 (8, 14)] → Engine ECM [CN -91]
- → Fuse box [No.2] → I/conn [CN-5 (46)]
  - → I/conn [CN -10 (3)] → Room lamp [CL-1 (2)]
    - → Door switch [CS-1]
  - → Radio & CD/MP3 player [CN-27 (8)]
  - → Hour meter [CN-48 (1)]
- → Fuse box [No.3] → MCU [CN-51 (1)]
- → Fuse box [No.4]
  - → Master switch [CS-74B] → I/conn [CN-5 (36)]
    - → Start switch [CS-2 (1)]
    - → RMS controller [CN-125A(1)]
    - → GPS connection [CN-125 (1)]
  - → Power relay [CR-35 (30)]
  - → ECM power relay [CR-45 (3)]
- → Fuse box [No.5] → I/conn [CN-11 (5)]
  - → AC & Heater controller (3)
  - → Blower relay (3)
- → Fuse box [No.6] → I/conn [CN - 5 (18)] → I/conn [CN -17 (5)]
  - → Wiper motor controller [CN-141 (7)]
  - → Wiper motor [CN-21 (6)]
- → Fuse box [No.7] → I/conn [CN - 5 (6)] → Cluster [CN -56 (1)]

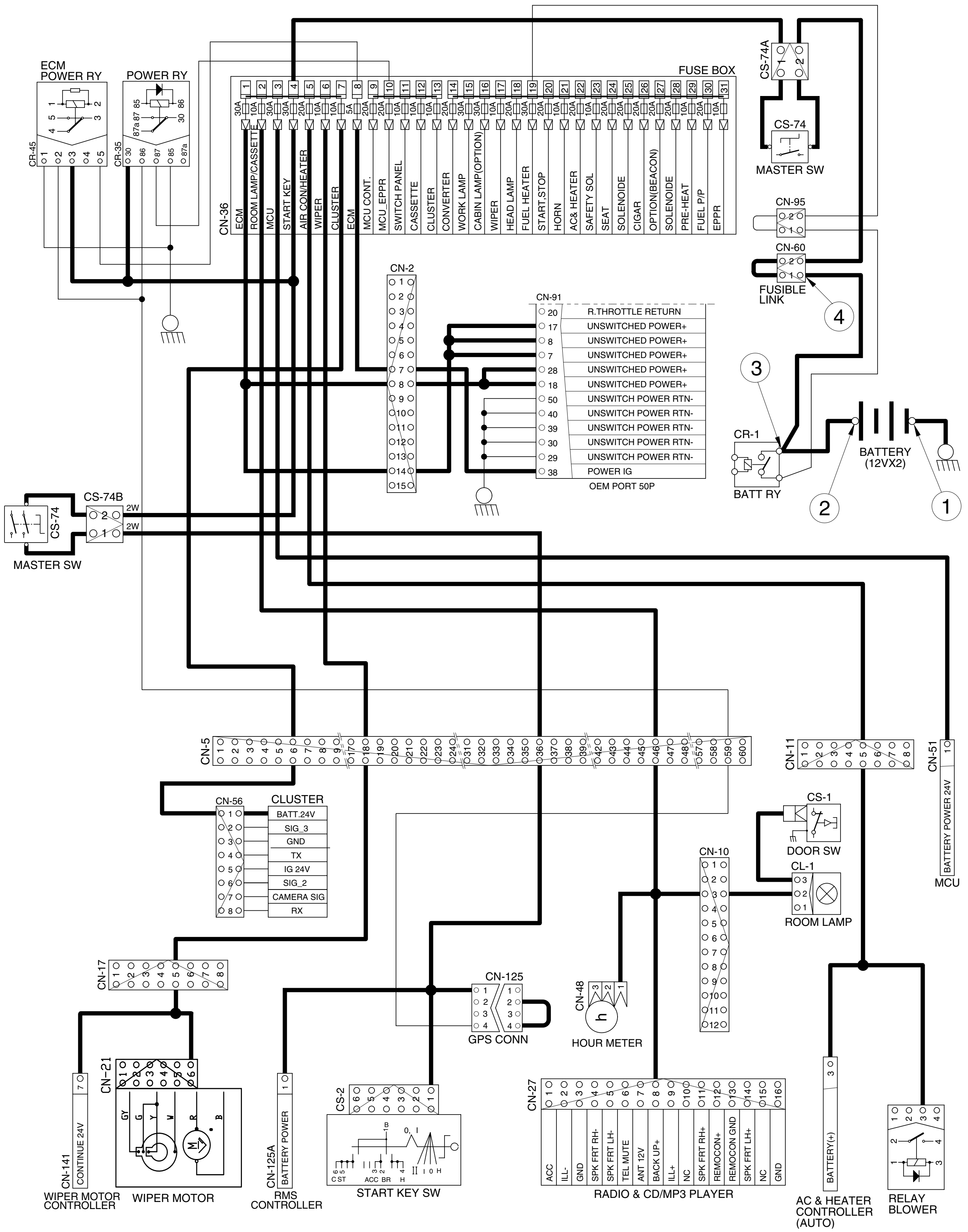
※ I/conn : Intermediate connector

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



2. STARTING CIRCUIT

1) OPERATING FLOW

Battery(+) terminal → Battery relay [CR-1] → Fusible link [CN-60] → Master switch [CS-74A] → Fuse box [No.4] → Master switch [CS-74B] → I/conn [CN-5(36)] → Start switch [CS-2(1)]

(1) When start key switch is in ON position

→ Start switch ON [CS-2 (2)] → I/conn [CN-5 (60)] → Battery relay [CR-1]
→ Battery relay operating (all power is supplied with the electric component)
→ Start switch ON [CS-2 (3)] → GPS conn [CN-125 (2)→(4)] → I/conn [CN-5 (59)]
→ Power relay [CR-35 (86) → (87)] → Fuse box [No.10]
→ I/conn [CN-4 (4)] → EM CY STOP SW [CS-33(2)→(1)]
→ ECM power relay [CR-45 (2) → (5)] → Fuse box [No.8]

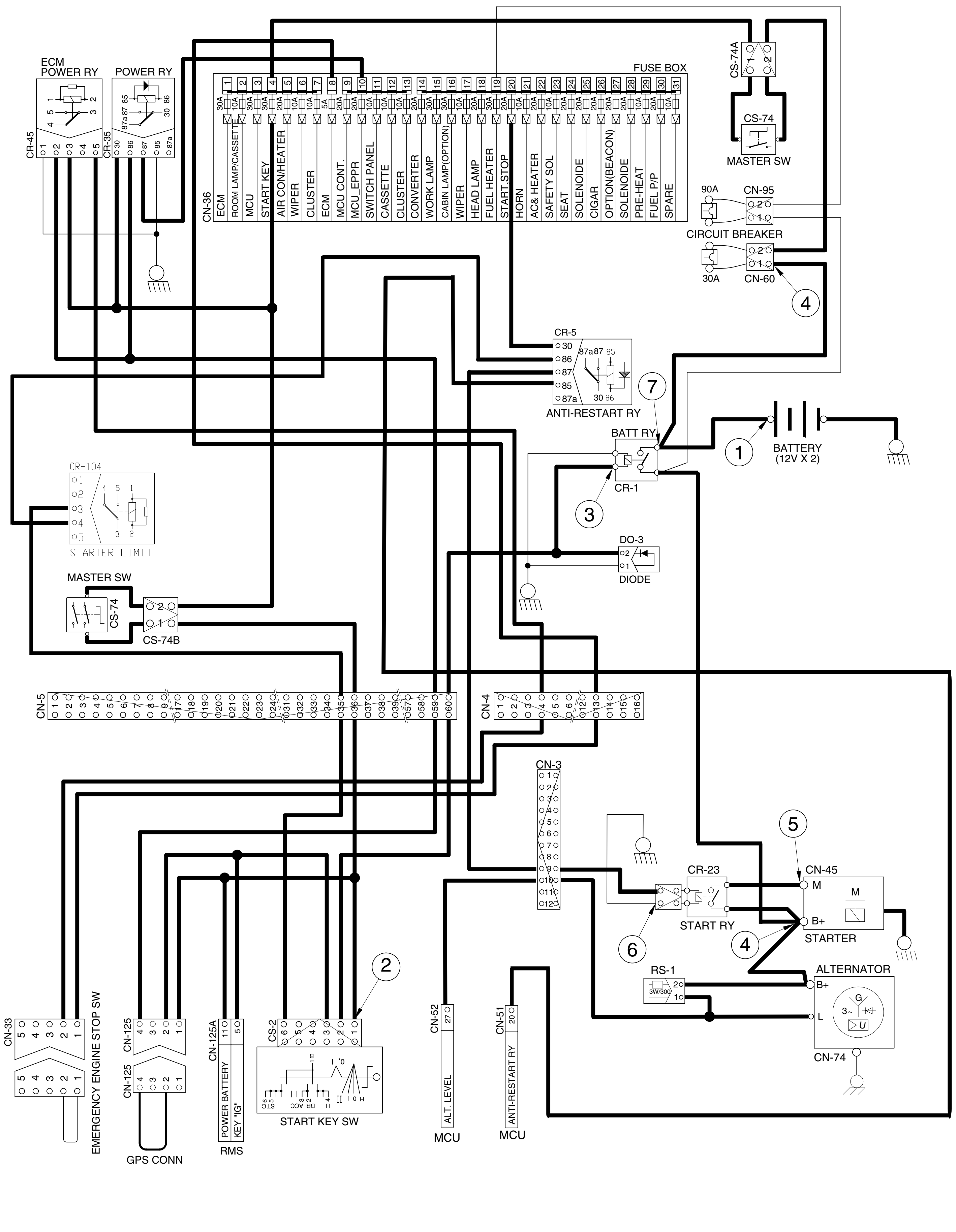
(2) When start key switch is in START position

Start switch START [CS-2 (6)] → I/conn [CN-5 (35)] → Stater limit relay[CR-104(3)→(4)]
→ Anti-restart relay [CR-5 (86)]
Anti-restart relay [CR-5 (30) →(87)] → I/conn [CN-3 (9)] → 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

STARTING CIRCUIT



3. CHARGING CIRCUIT

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

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

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

1) OPERATING FLOW

(1) Warning flow

Alternator "I" terminal → I/conn [CN-3 (10)] → MCU alternator level [CN-52 (27)]
→ Cluster charging warning lamp(Via serial interface)

(2) Charging flow

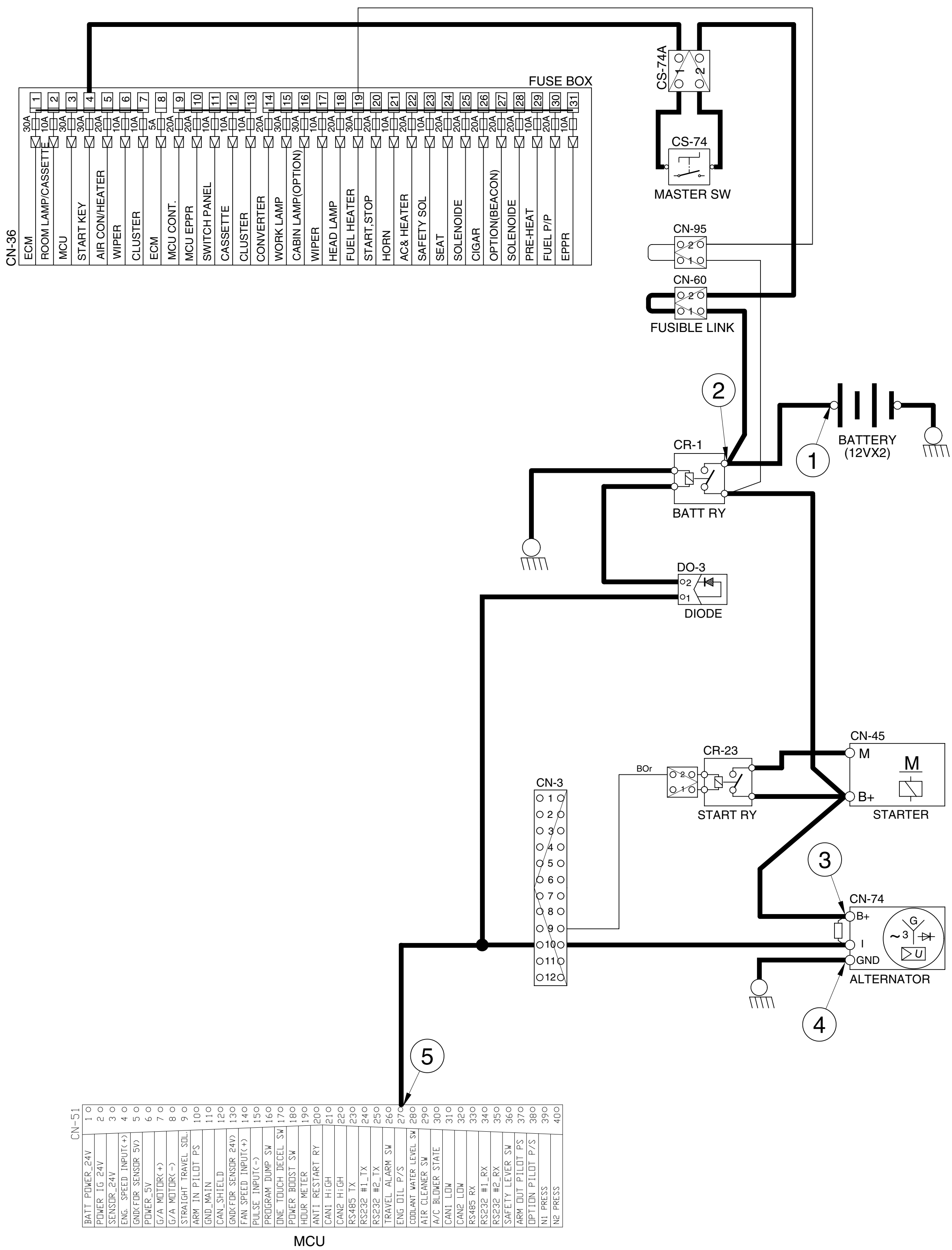
Alternator "B^+" terminal → Battery relay(M8) → Battery(+) terminal
→ Fusible link [CN-60] → Master switch [CS-74A]
→ Fuse box

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) ⑤ - GND (MCU)	20~25V

※ GND : Ground

CHARGING CIRCUIT



4. HEAD AND WORK LIGHT CIRCUIT

1) OPERATING FLOW

Fuse box (No.15) → Work light relay [CR-4 (30,86)]
Fuse box (No.18) → Head light relay [CR-13 (30,86)]

(1) Head light switch ON

Head light switch ON [CN-116 (1)] → I/conn [CN-5 (49)] → Head light relay [CR-13 (85) → (87)]
- → Head light ON [CL-3 (1), CL-4 (1), CL-24 (1)]
- → I/conn [CN-11 (8)] → AC & Heater controller illumination ON [4]
- → I/conn [CN-5 (13)]
  - → Remote controller illumination ON [CN-245 (9)]
  - → Cigar light [CL-2]
  - → USB & Socket illumination ON [CN-246 (7)]
  - → Radio & CD/MP3 player illumination ON [CN-27 (9)]

(2) Work light switch ON

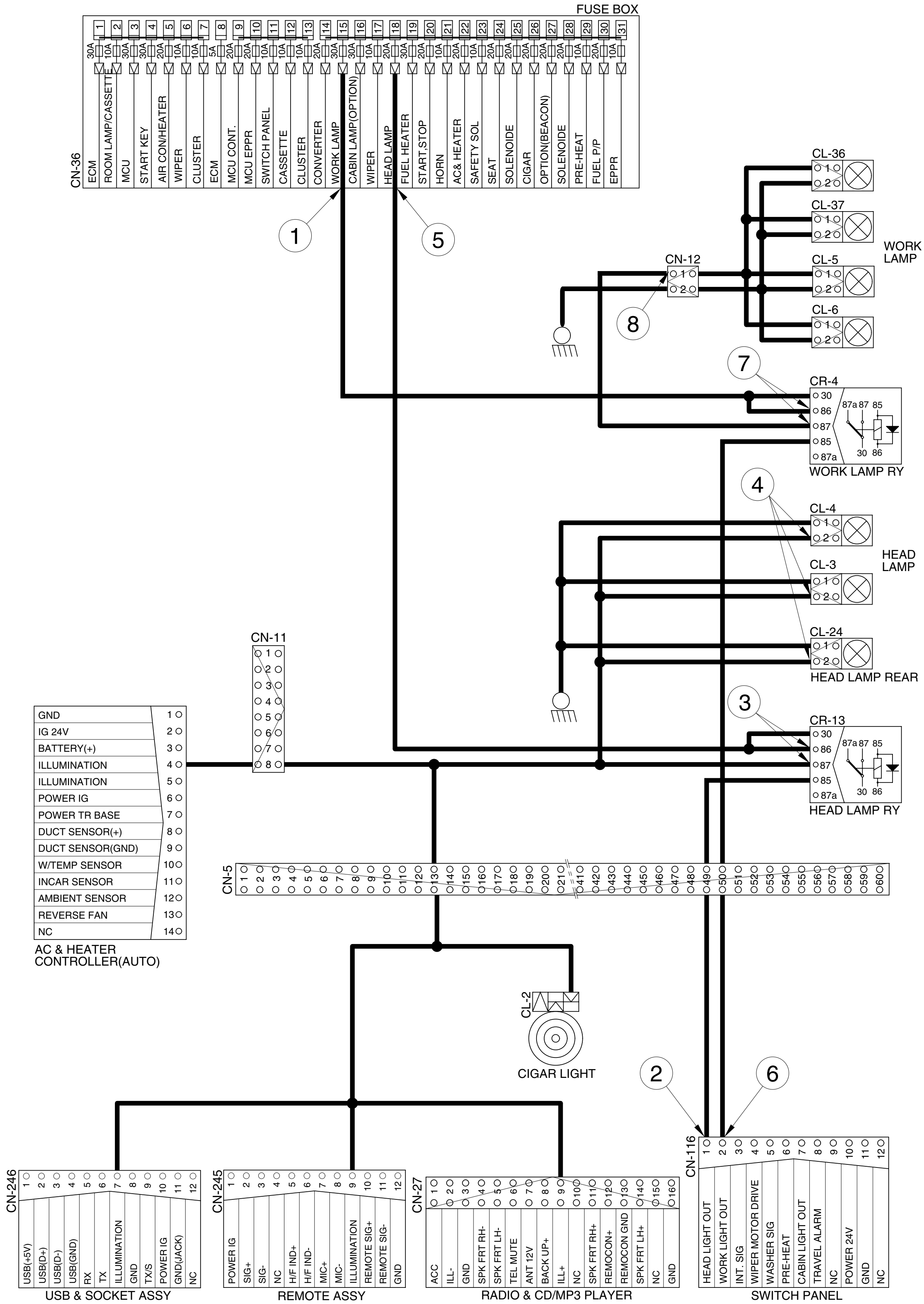
Work light switch ON [CN-116 (2)] → I/conn [CN-5 (50)] → Work light relay [CR-4 (85) → (87)]
→ I/conn [CN-12 (1)] → Work light ON [CL-5 (1), CL-6 (1), CL-36 (1), CL-37 (1)]

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

HEAD AND WORK LIGHT CIRCUIT



5. BEACON LAMP AND CAB LIGHT CIRCUIT

1) OPERATING FLOW

Fuse box (No.27) → I/conn [CN-5 (33)] → Beacon lamp switch [CN-23 (8)]
Fuse box (No.16) → Cab light relay [CR-9 (30, 86)]

(1) Beacon lamp switch ON

Beacon lamp switch ON [CS-23 (4)] → Switch indicator lamp ON [CS-23 (11)]
→ I/conn [CN-10 (10)] → Beacon lamp ON [CL-7]

(2) Cab light switch ON

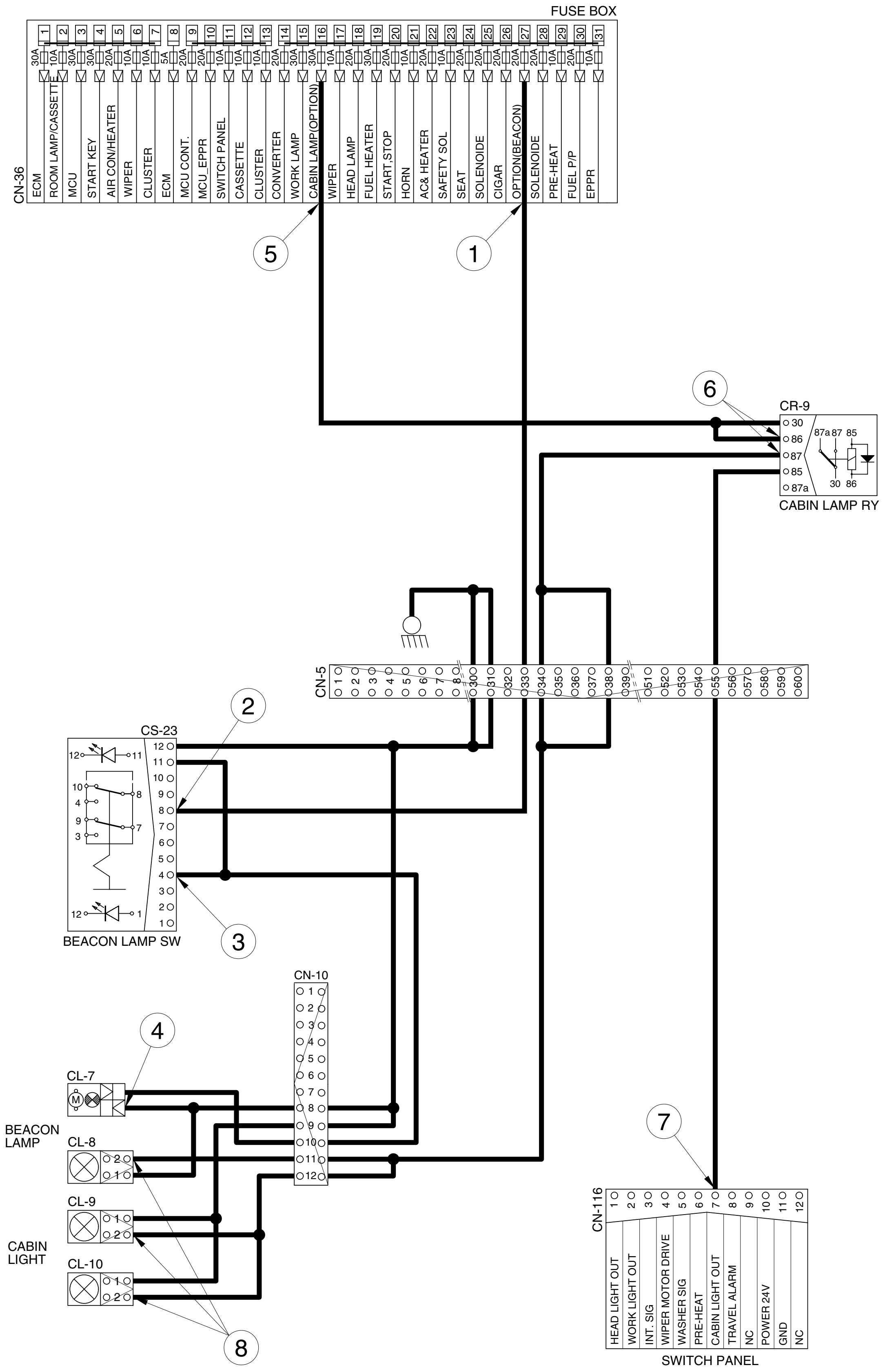
Cab light switch ON [CN-116 (7)] → I/conn [CN-5 (55)] → Cab lamp relay [CR-9 (85) → (87)]
→ I/conn [CN-5 (34, 38)] → I/conn [CN-10 (11)] → Cab light ON [CL-8 (2)]
→ I/conn [CN-10 (12)] → Cab light ON [CL-9 (2), CL-10 (2)]

2) CHECK POINT

Engine	Start switch	Check point	Voltage
STOP	ON	① - GND (fuse box) ② - GND (switch power input) 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

BEACON LAMP AND CAB LIGHT CIRCUIT



6. WIPER AND WASHER CIRCUIT

1) OPERATING FLOW

(1) Key switch ON

Fuse box (No.11) → I/conn [CN-5 (57)] → Switch panel [CN-116 (10)]

Fuse box (No.6) → I/conn [CN-5 (18)] → I/conn [CN-17 (5)] ┬→ Wiper motor controller [CN-141(7)]
└→ Wiper motor [CN-21(6)]

Fuse box (No.17) ┬→ I/conn [CN-5 (24)] → I/conn [CN-17 (4)] → Wiper motor controller [CN-141 (6)]
└→ Washer pump [CN-22 (2)]

(2) Wiper switch ON : 1st step (Intermittent)

Wiper switch ON [CN-116 (3)] → I/conn [CN-17 (8)] → Wiper motor controller [CN-141 (10) → (4)]
→ Wiper motor intermittently operating [CN-21 (2)]

(3) Wiper switch ON : 2nd step (continual)

Wiper switch ON [CN-116(4)] → I/conn[CN-17(2)] → Wiper motor controller [CN-141(2) → (4)]
→ Wiper motor operating [CN-21(2)]

(4) Washer switch ON

Washer switch ON [CN-116 (5)] → 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-116 (4)] → I/conn[CN-17 (2)] → Wiper motor controller [CN-141 (2) → (4)]
→ Wiper motor operating [CN-21 (2)]

(5) Auto parking(when switch OFF)

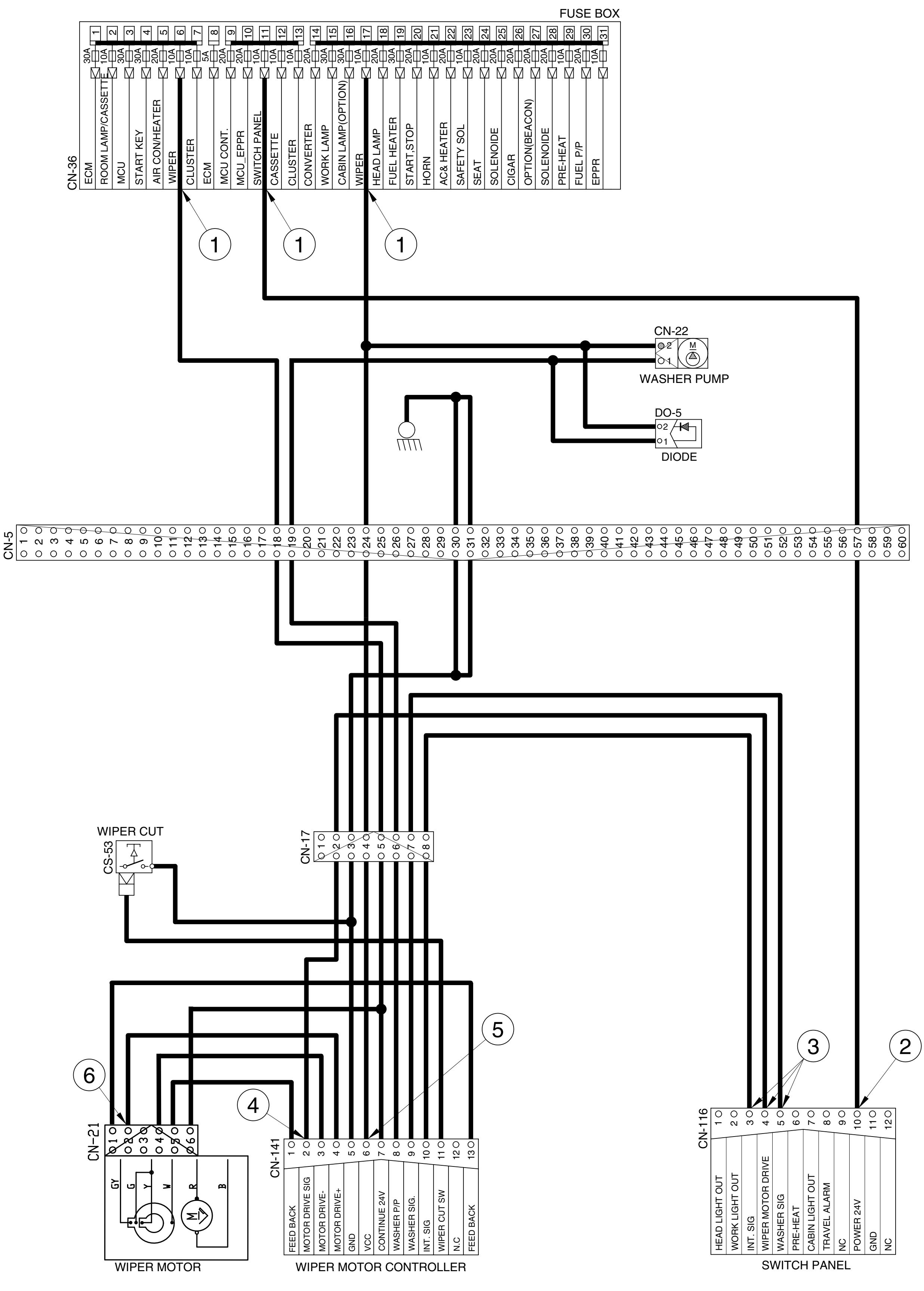
Switch OFF [CN-116 (4)] → Wiper motor parking position by wiper motor controller

2) CHECK POINT

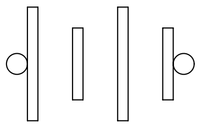
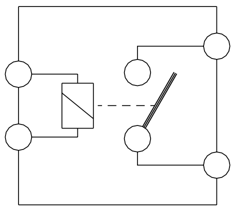
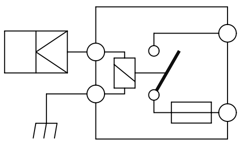
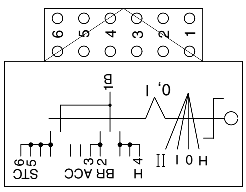
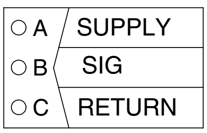
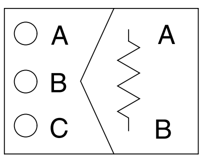
Engine	Start switch	Check point	Voltage
STOP	ON	① - GND (fuse box) ② - GND (switch power input)	24V
		③ - GND (switch power output) ④ - GND (wiper power input)	0 ~ 5V
		⑤ - GND (wiper power output)	24V
		⑥ - GND (wiper motor)	0 or 24V

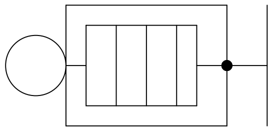
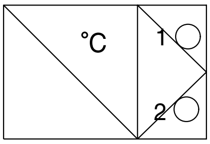
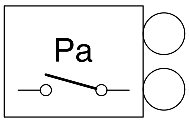
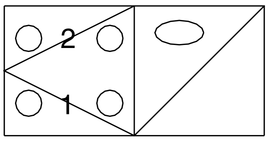
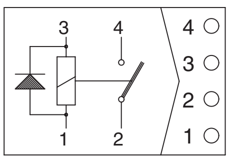
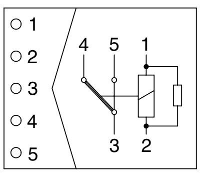
※ GND : Ground

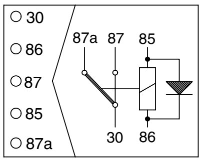
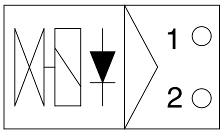
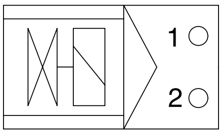
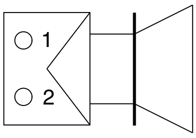
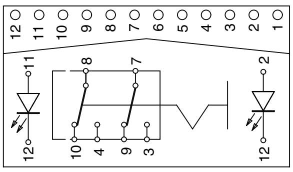
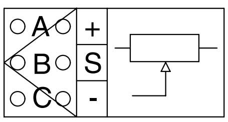
WIPER AND WASHER CIRCUIT

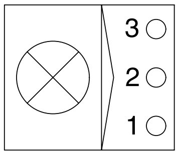
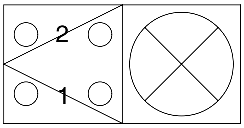
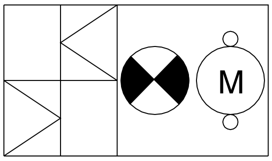
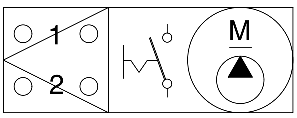
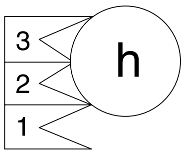
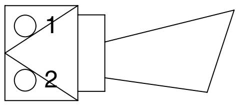


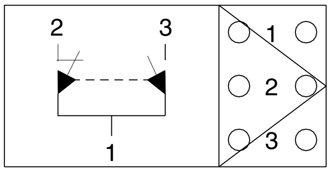
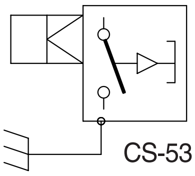
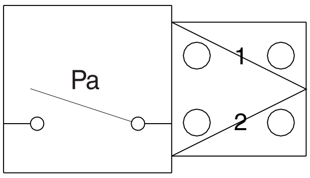
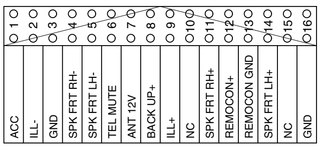
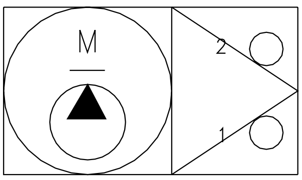
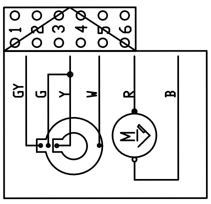
GROUP 3 ELECTRICAL COMPONENT SPECIFICATION

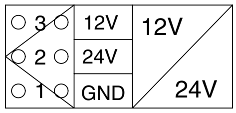
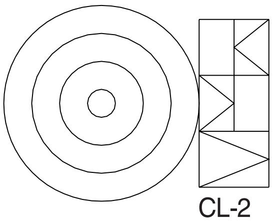
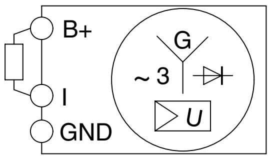
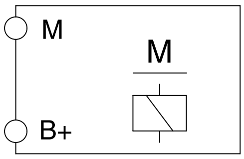
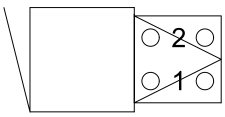
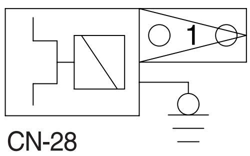
Part name	Symbol	Specifications	Check
Battery		12V × 100Ah (2EA)	※ Check specific gravity 1.280 over : Over charged 1.280 ~ 1.250 : Normal 1.250 below : Recharging
Battery relay	 CR-1	Rated load : 24V 100A (continuity) 1000A (30seconds)	※ Check coil resistance(M4 to M4) Normal : About 50 Ω ※ Check contact Normal : ∞ Ω
Glow plug relay	 CR-24	24V 200A	※ Check contact Normal : 0.942 Ω (For terminal 1-GND)
Start key	 CS-2	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-87	8~30V	※ Check contact Normal : 0.1 Ω
Resistor	 CN-173	4W	※ Check resistance A-B : 120 Ω

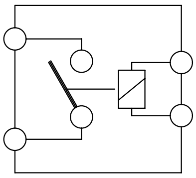
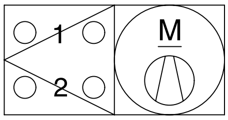
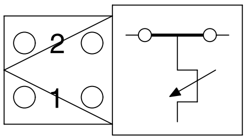
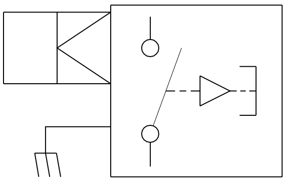
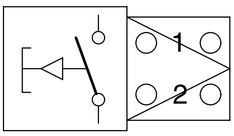
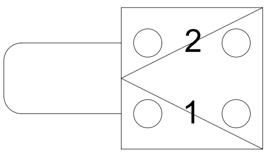
Part name	Symbol	Specifications	Check
Glow plug	 CN-80	24V 200A	※ Check resistance 0.25~0.12 Ω
Temperature sensor (hydraulic)	 CD-1	-	※ Check resistance 50˚C : 804 Ω 80˚C : 310 Ω 100˚C : 180 Ω
Air cleaner pressure switch	 CD-10	(N.O TYPE)	※ Check contact High level : ∞ Ω Low level : 0 Ω
Fuel level	 CD-2	-	※ 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-36 CR-45 CR-104	24V 16A	※ Check resistance Normal : About 160 Ω (for terminal 1-2) 0 Ω (for terminal 3-4) ∞ Ω (for terminal 3-5)

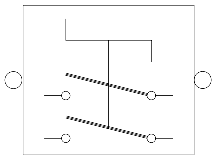
Part name	Symbol	Specifications	Check
Relay	 CR-4 CR-5 CR-7 CR-9 CR-13 CR-35 CR-46	24V 16A	※ Check resistance Normal : About 160 Ω (for terminal 85-86) 0 Ω (for terminal 30-87a) ∞ Ω (for terminal 30-87)
Solenoid valve	 CN-68 CN-70 CN-88 CN-140 CN-149	24V 1A	※ Check resistance Normal : 15~25 Ω (for terminal 1-2)
EPPR valve	 CN-75 CN-241 CN-242	700mA	※ Check resistance Normal : 15~25 Ω (for terminal 1-2)
Speaker	 CN-23(LH) CN-24(RH)	20W	※ Check resistance Normal : A few Ω
Switch (locking type)	 CS-23 CS-50 CS-52 CS-67 CS-73 CS-82 CS-83 CS-99 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)
Accel dial	 CN-142	-	※ Check resist Normal : About 5k Ω (for terminal A-C) ※ Check voltage Normal : About 5V (for terminal A-C) : 2~4.5V (for terminal C-B)

Part name	Symbol	Specifications	Check
Room lamp	 CL-1	24V 10W	※ Check disconnection Normal : 1.0 Ω ON : 0 Ω (For terminal 1-2) ∞ Ω (For terminal 1-3) OFF : ∞ Ω (For terminal 1-2) 0 Ω (For terminal 1-3)
Head lamp, Work lamp, Cab lamp	 CL-3 CL-4 CL-5 CL-6 CL-8 CL-9 CL-10 CL-24 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
Hour meter	 CN-48	16~32V	※Check operation Supply power(24V) to terminal No.2 and connect terminal No.1 and ground
Horn	 CN-20 CN-25	DC22~28V 2A	※Check operation Supply power(24V) to each terminal and connect ground.

Part name	Symbol	Specifications	Check
Safety switch	 CS-4	24V 15A (N.C TYPE)	※Check contact Normal : 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 & CD/MP3 player	 CN-27	24V 2A	※Check voltage 20~25V (for terminal 1-3, 3-8)
Washer pump	 CN-22	24V 3.8A	※Check contact Normal : 10.7 Ω (for terminal 1-2)
Wiper motor	 CN-21	24V 2A	※Check disconnection Normal : 7 Ω (for terminal 2-6)

Part name	Symbol	Specifications	Check
DC/DC Converter	 CN-138	12V 3A	24V (1-2) 12V (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 55A	※Check contact Normal : 0 Ω (for terminal B^+-I) Normal : 24~27.5V
Starter	 CN-45	Denso 24V 4.5kW	※Check contact Normal : 0.1 Ω
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

Part name	Symbol	Specifications	Check
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
Switch (power max, one touch decel, horn, breaker)	 CS-5 CS-19 CS-26 CS-29	24V 6A	※Check resistance Normal : ∞ Ω
Fusible link	 CN-60 CN-95	60A	※Check disconnection Normal : 0 Ω (connect ring terminal and check resist between terminal 1 and 2)

Part name	Symbol	Specifications	Check
Master switch	 CS-74	6-36V	※Check disconnection Normal : 0.1 Ω

GROUP 4 CONNECTORS

1. CONNECTOR DESTINATION

Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CN-1	AMP	10	I/conn (Frame harness-Pump PS harness)	S816-010002	S816-110002
CN-2	AMP	15	I/conn (Frame harness-Engine harness)	2-85262-1	S816-112002
CN-3	AMP	12	I/conn (Frame harness-Engine harness)	S816-012002	368301-1
CN-4	AMP	16	I/conn (Console harness LH-Frame harness)	S816-012002	S816-116002
CN-5	DEUTSCH	60	I/conn (Side harness RH-Frame harness)	DRB16-60SAE-L018	DRB12-60PAE-L018
CN-7	AMP	16	I/conn (Console harness RH-Frame harness)	368047-1	S816-116002
CN-8	AMP	12	I/conn (Console harness RH-Frame harness)	S816-012002	174663-2
CN-10	DEUTSCH	12	I/conn (Cab harness-Side harness RH)	DT06-12S-EP06	DT04-12P-BE02
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-E004
CN-14	AMP	31	I/conn (Frame harness-ECM OEM)	S816-008002	S816-108002
CN-15	AMP	12	I/conn (Frame harness-Breaker solenoid)	S816-012002	S816-112002
CN-16	AMP	6	Emergency engine start & speed control	S816-006002	S816-106002
CN-17	DEUTSCH	8	I/conn (Wiper harness-Side harness RH)	DT06-8S-EP06	DT04-8P
CN-20	MOLEX	2	Horn	DT06-2S-EP06	-
CN-21	AMP	6	Wiper motor	925276-0	-
CN-22	KET	2	Washer tank	MG640605	-
CN-23	KET	2	Speaker-LH	MG610070	-
CN-24	KET	2	Speaker-RH	MG610070	-
CN-25	MOLEX	2	Horn	DT06-2S-EP06	-
CN-27	KUM	16	Radio & CD/MP3 player	PK145-16017	-
CN-28	KUM	1	Aircon compressor	NMWP01F-B	-
CN-29	KET	2	Receiver dryer	MG640795	-
CN-36	AMP	12	Fuse & relay box	3-1393292-8	-
CN-45	RING-TERM	-	Starter motor B^+	S820-308000	-
CN-48	AMP	1	Hour meter	2-520193-2	-
CN-51	DEUTSCH	40	MCU	DRC26-40SA	-
CN-52	DEUTSCH	40	MCU	DRC26-40SB	-
CN-56	DEUTSCH	8	Cluster	-	DT04-6P-E005
CN-60	YAZAKI	2	Fusible link	21N4-01320	7122-4125-50
CN-61	DEUTSCH	2	Fuel filler pump	DT06-2S-EP06	DT-04-2P-E005
CN-68	DEUTSCH	2	Safety solenoid	DT06-2S-EP06	-
CN-70	DEUTSCH	2	Travel high solenoid	DT06-2S-EP06	-
CN-74	RING-TERM	2	Alternator "I" terminal	S820-105000	-
CN-75	AMP	2	Pump EPPR	S816-002002	-

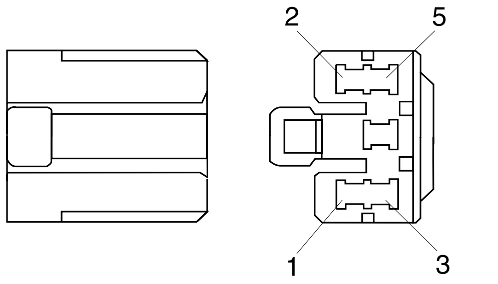
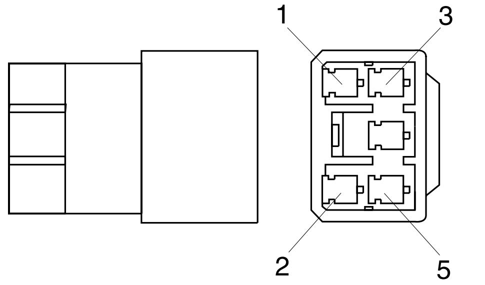
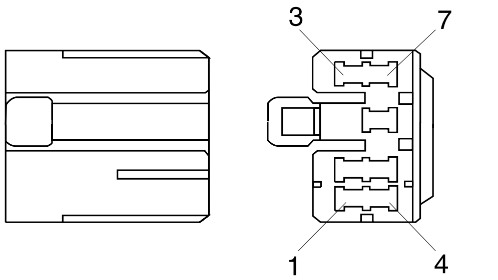
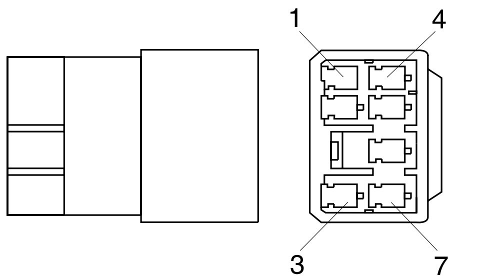
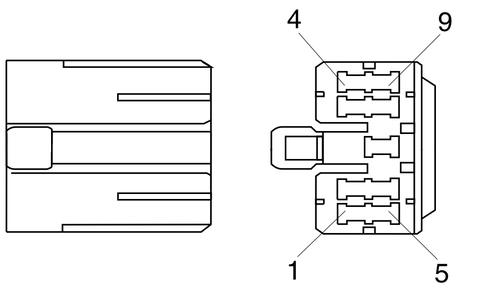
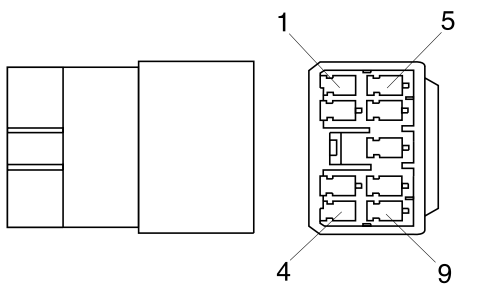
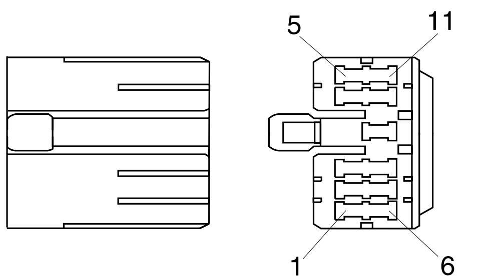
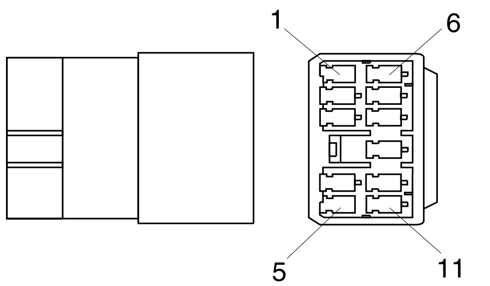
Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CN-80	RING-TERM	-	Glow plug	S820-306000	-
CN-81	DEUTSCH	2	Travel buzzer solenoid	DT06-2S-EP06	-
CN-88	DEUTSCH	2	Power max solenoid	DT06-2S-EP06	-
CN-91	DEUTSCH	50	ECM	DRC26-50S-04	-
CN-95	KET	2	Fusible link	21N4-01311	S813-130201
CN-116	AMP	12	Switch panel	176116	-
CN-125	Econoseal J	4	GPS connector	S816-004002	S816-104002
CN-126	AMP	10	Service tool	S816-010002	S816-110002
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	DT04-3P-EP10
CN-144	KET	20	Handsfree	MG610240	-
CN-147	PACKARD	2	Fuel-heater	1530-0027	-
CN-149	DEUTSCH	2	Attach safety solenoid	DT06-2S-EP06	-
CN-156	DEUTSCH	2	Air seat	DT06-2S-EP06	DT04-2P-E005
CN-170	AMP	2	Heated seat	174352-2	174354-2
CN-173	DEUTSCH	3	Resistor	DT06-3S-EP06	DT04-3P-EP10
CN-242	DEUTSCH	2	Attach flow solenoid 1	DT06-2S-EP06	DT04-2P-E005
CN-243	DEUTSCH	2	Attach flow solenoid 2	DT06-2S-EP06	DT04-2P-E005
CN-245	AMP	12	Remocon	368542-1	-
CN-246	KET	12	USB & Socket assy	MG610240	-
CN-249	DEUTSCH	4	Rear view camera	DT06-4S-EP06	DT04-4P-E005
CN-259	DEUTSCH	6	Camera	DT06-2S-EP06	DT04-2P-E005

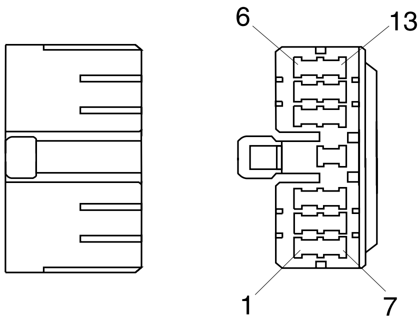
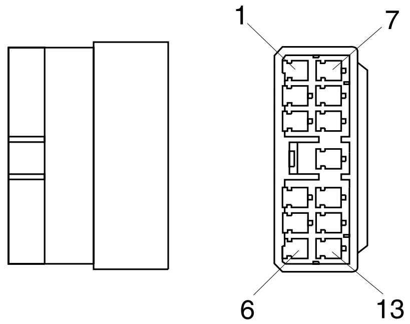
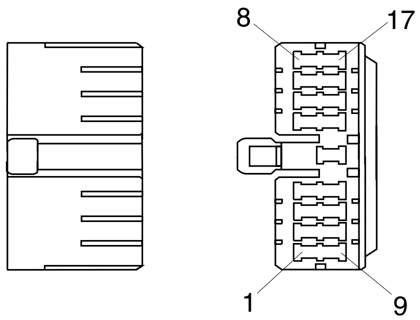
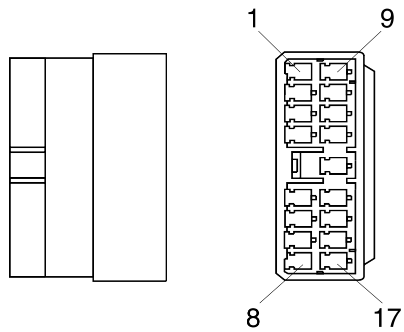
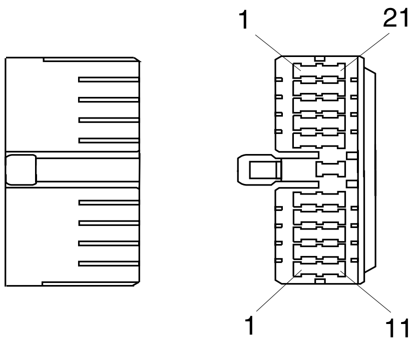
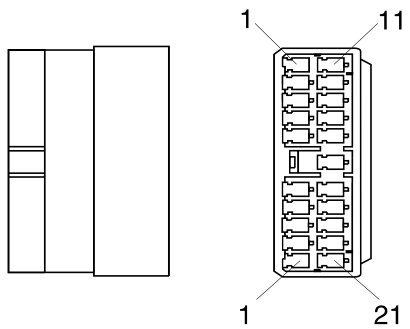
Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
· Relay					
CR-1	RING-TERM	-	Battery relay	ST710285-2	-
CR-2	-	5	Horn relay	-	-
CR-4	-	5	Working lamp relay	-	-
CR-5	-	5	Anti restart relay	-	-
CR-7	-	5	Aircon compressor relay	-	-
CR-9	-	5	Cabin lamp relay	-	-
CR-13	-	5	Head lamp relay	-	-
CR-23	KET	4	Start relay	S814-002001	S814-102001
CR-24	RING TERM	4	Preheat relay	S822-014000	-
CR-35	-	5	Power relay	-	-
CR-36	-	5	Preheat relay	-	-
CR-45	-	5	ECM power relay	-	-
CR-46	-	5	Fuel warmer relay	-	-
· Switch					
CS-1	SHUR	1	Door switch	S822-014002	S822-114002
CS-2	DEUTSCH	6	Start key switch	DT06-12S	-
CS-4	DEUTSCH	3	Safety switch	DT06-3S-EP06	-
CS-5	DEUTSCH	2	Horn switch	-	DT04-2P-E005
CS-19	DEUTSCH	2	One touch decel switch	-	DT04-2P-E005
CS-23	SWF	12	Beacon lamp switch	SWF589790	-
CS-26	DEUTSCH	2	Breaker switch	DT06-2S-EP06	-
CS-26A	AMP	2	Breaker pedal switch	S816-002002	S816-102002
CS-29	DEUTSCH	2	Power max switch	DT06-2S-EP06	-
CS-33	AMP	5	Emergency engine stop switch(opt)	S816-006002	S816-106002
CS-50	SWF	12	Overload switch(opt)	SWF589790	-
CS-52	SWF	10	Auto grease reset switch(opt)	SWF 593757	-
CS-53	AMP	1	Wiper cut switch	S822-014002	-
CS-67	SWF	12	Quick clamp switch(opt)	SWF 589790	-
CS-73	SWF	12	Reverse fan switch(opt)	SWF 589790	-
CS-74A	AMP	2	Master switch	S813-030201	-
CS-74B	DEUTSCH	2	Master switch	DT06-2S-EP06	-
CS-82	SWF	12	Spare switch	SWF 589790	-
CS-83	SWF	12	Spare switch	SWF 589790	-
CS-99	SWF	12	Spare switch	SWF 589790	-
CS-100	SWF	12	Spare switch	SWF 589790	-
CS-142	DEUTSCH	3	Accel dial switch	DT06-3S-EP06	-

Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
· 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	-
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
CL-6	DEUTSCH	2	Work lamp-RH	DT06-2S-EP06	DT04-2P
CL-7	SHUR	2	Beacon lamp	S822-014002	S822-114002
CL-8	DEUTSCH	2	Cab lamp-LH	DT06-2S-EP06	DT04-2P
CL-9	DEUTSCH	2	Cab lamp-RH	DT06-2S-EP06	DT04-2P
CL-10	DEUTSCH	2	Cab lamp-RH	DT06-2S-EP06	DT04-2P
CL-24	DEUTSCH	2	Rear work lamp	DT06-2S-EP06	DT04-2P-E005
CL-36	DEUTSCH	2	Work lamp-LH	DT06-2S-EP06	DT04-2P
CL-37	DEUTSCH	2	Work lamp-RH	DT06-2S-EP06	DT04-2P
· Sensor, sendor					
CD-1	AMP	2	Hydraulic oil temp sender	85202-1	-
CD-2	DEUTSCH	2	Fuel sender	DT06-2S-EP06	-
CD-6	DEUTSCH	3	Travel pressure switch	DT06-3S-EP06	-
CD-7	DEUTSCH	3	Working pressure switch	DT06-3S-EP06	-
CD-10	RING TERM	-	Air cleaner switch	ST730135-3	S820-104002
CD-24	DEUTSCH	3	Swing sensor	DT06-3S-EP06	-
CD-31	DEUTSCH	3	Overload sensor(opt)	DT06-3S-EP06	DT04-3P-E005
CD-32	DEUTSCH	3	Boom up sensor	DT06-3S-EP06	-
CD-35	DEUTSCH	3	Arm & bucket in sensor	DT06-3S-EP06	-
CD-42	DEUTSCH	3	Pump pressure 1	DT06-3S-EP06	-
CD-43	DEUTSCH	3	Pump pressure 2	DT06-3S-EP06	-
CD-44	DEUTSCH	3	Pump pressure 3	DT06-3S-EP06	-
CD-45	DEUTSCH	2	WIF sensor	DT06-2S-EP06	-
CD-69	DEUTSCH	3	Attach pressure sensor	DT06-3S-EP06	-
CD-70	DEUTSCH	3	N1 pressure sensor	DT06-3S-EP06	-
CD-71	DEUTSCH	3	N2 pressure sensor	DT06-3S-EP06	-

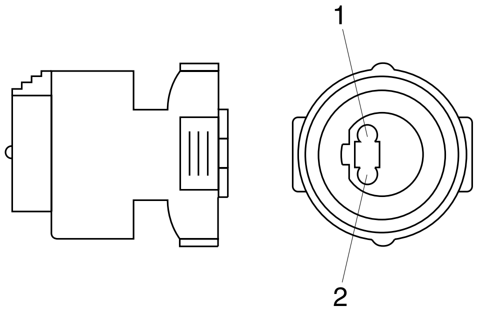
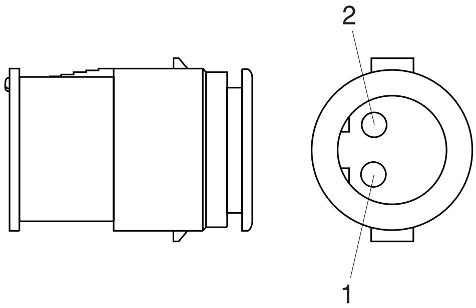
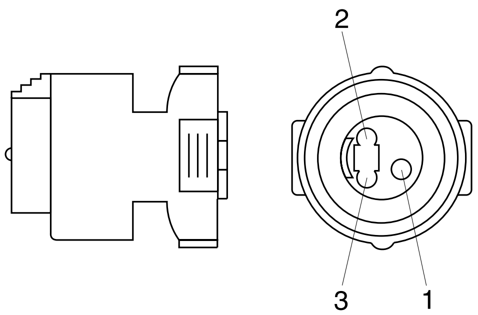
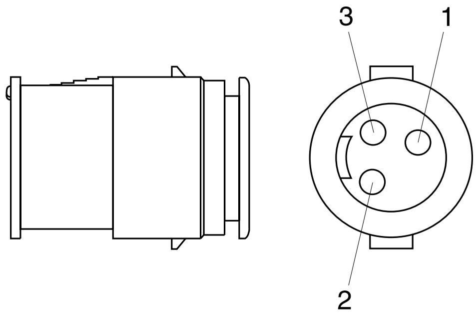
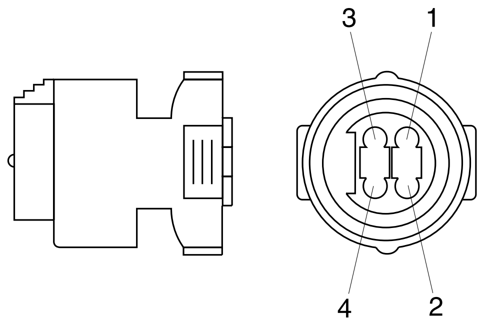
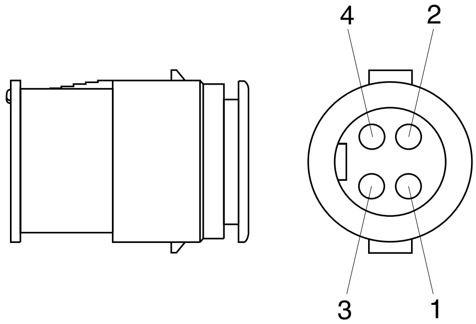
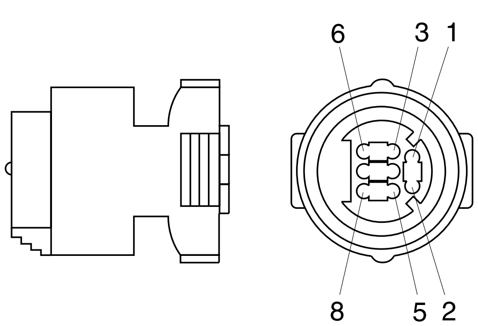
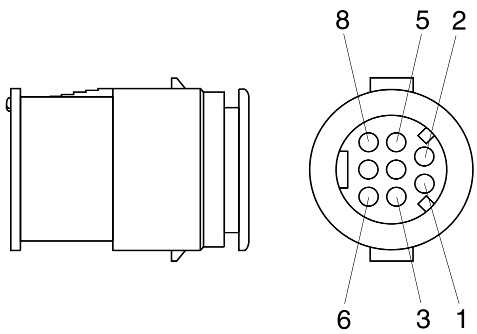
2. CONNECTION TABLE FOR CONNECTORS

1) PA TYPE CONNECTOR

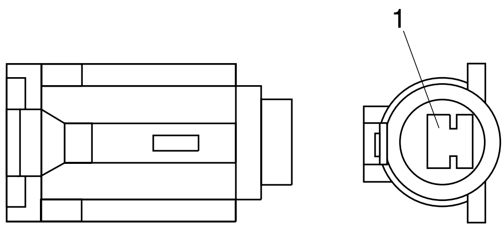
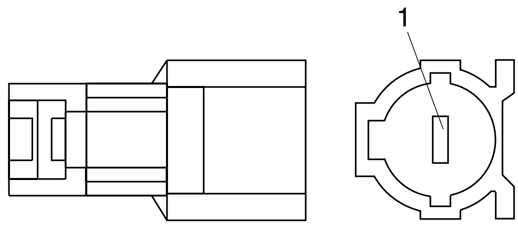
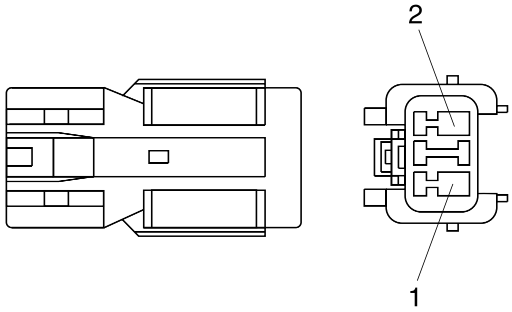
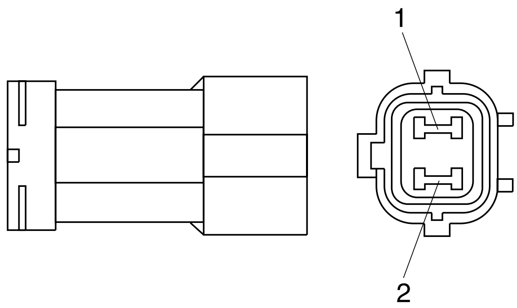
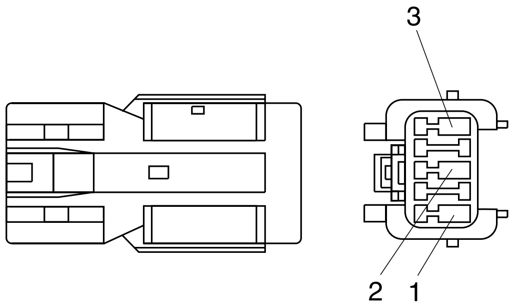
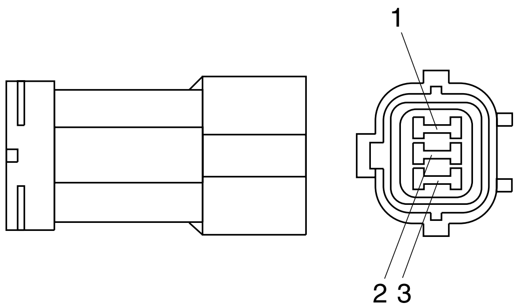
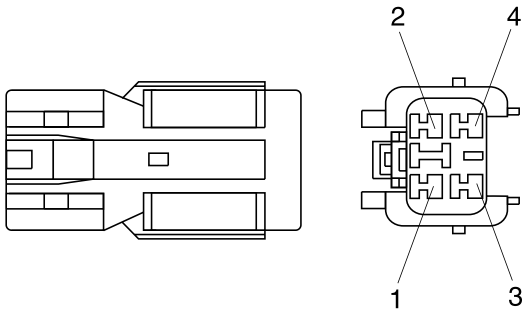
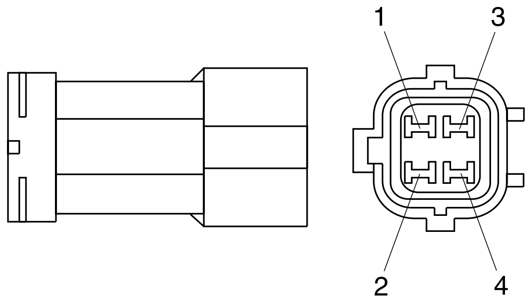
No. of pin	Receptacle connector (female)	Plug connector (male)
5	 S811-005002	 S811-105002
7	 S811-007002	 S811-107002
9	 S811-009002	 3S811-109002
11	 S811-011002	 S811-111002

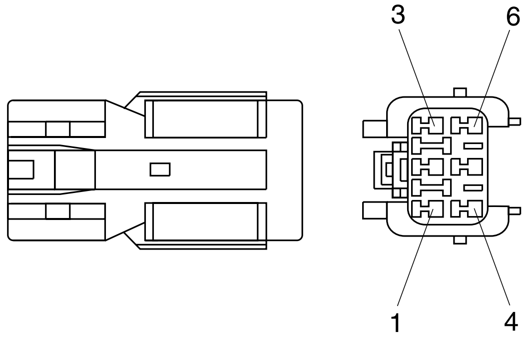
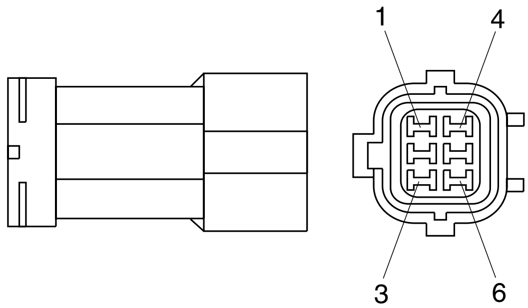
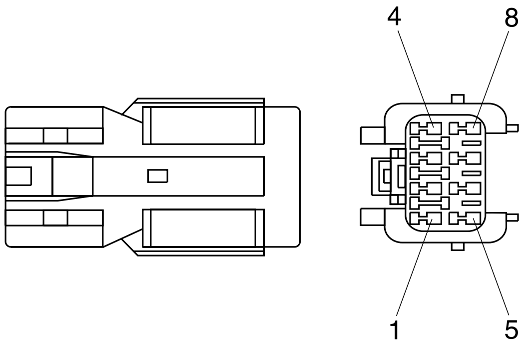
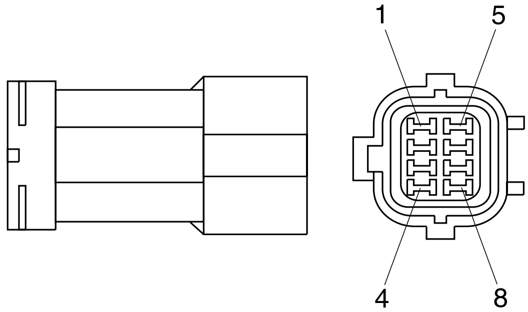
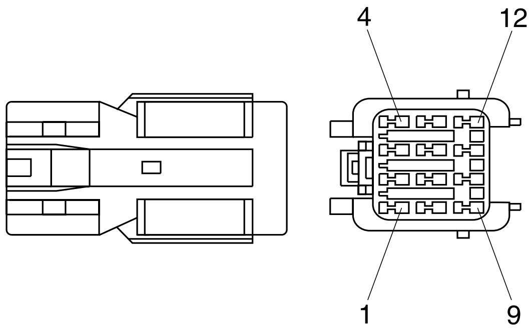
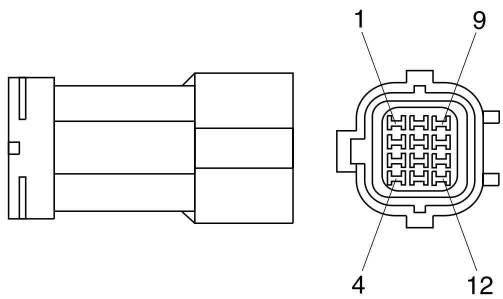
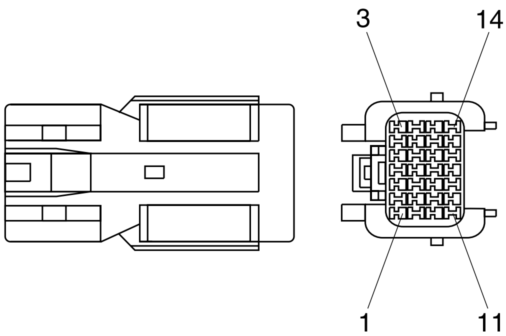
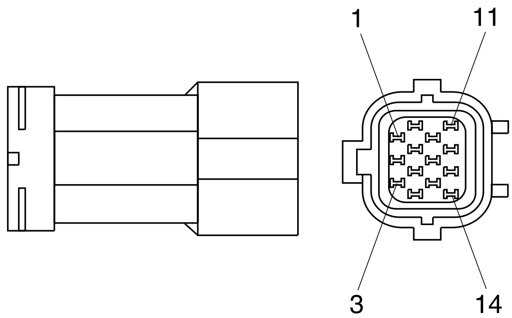
No. of pin	Receptacle connector (female)	Plug connector (male)
13	 S811-013002	 S811-113002
17	 S811-017002	 S811-117002
21	 S811-021002	 S811-121002

2) J TYPE CONNECTOR

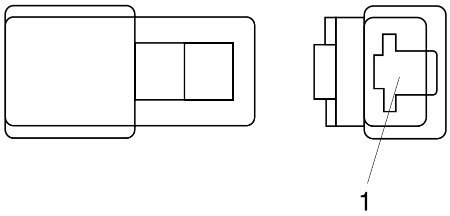
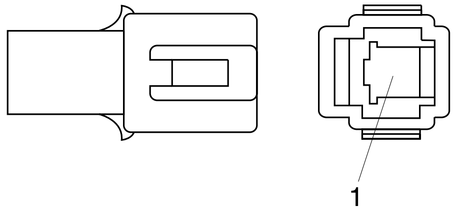
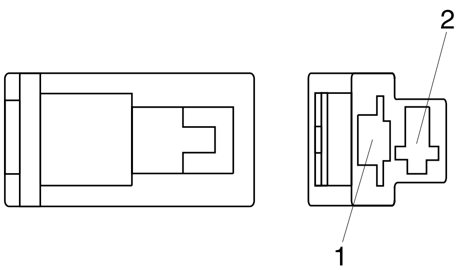
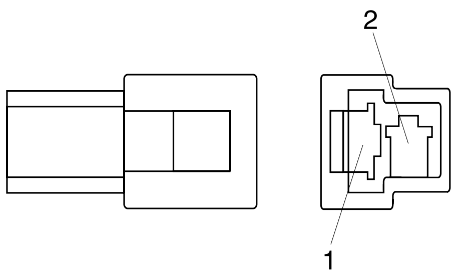
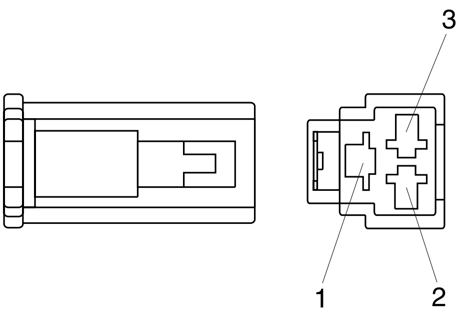
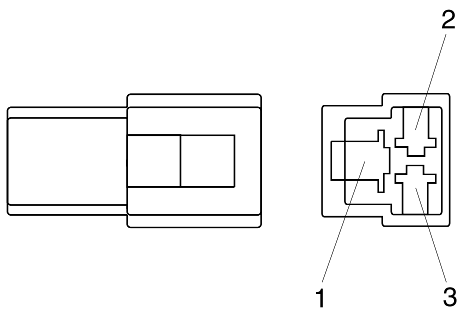
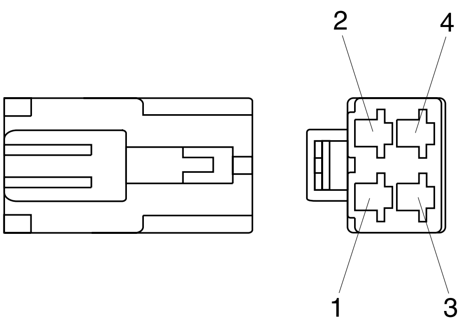
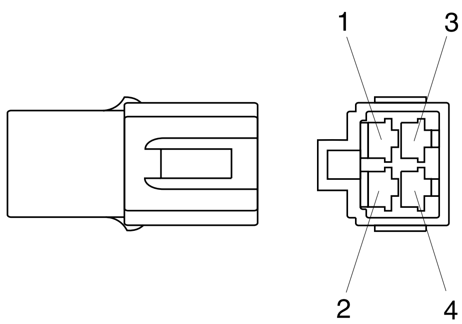
No. of pin	Receptacle connector (female)	Plug connector (male)
2	 S816-002001	 S816-102001
3	 S816-003001	 S816-103001
4	 S816-004001	 S816-104001
8	 S816-008001	 S816-108001

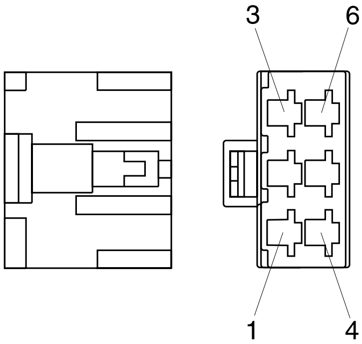
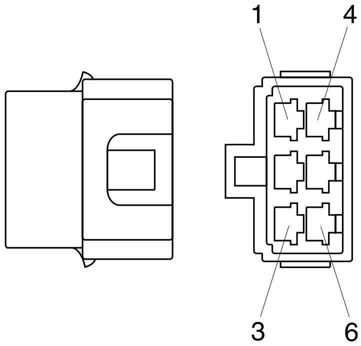
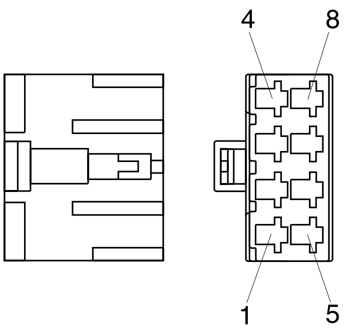
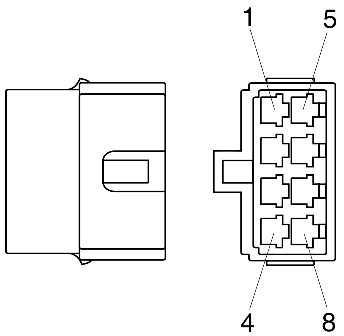
3) SWP TYPE CONNECTOR

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

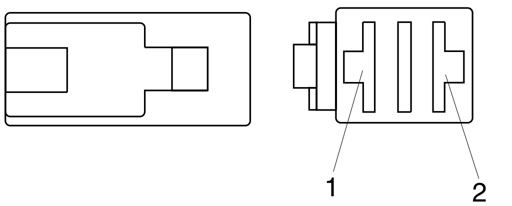
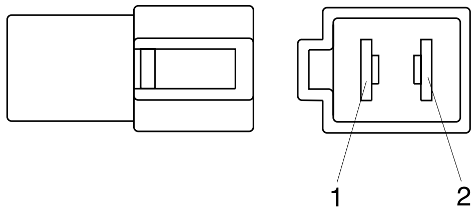
No. of pin	Receptacle connector (female)	Plug connector (male)
6	 S814-006000	 S814-106000
8	 S814-008000	 S814-108000
12	 S814-012000	 S814-112000
14	 S814-014000	 S814-114000

4) CN TYPE CONNECTOR

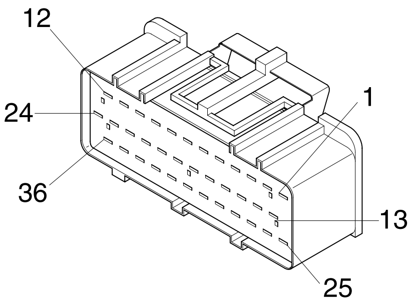
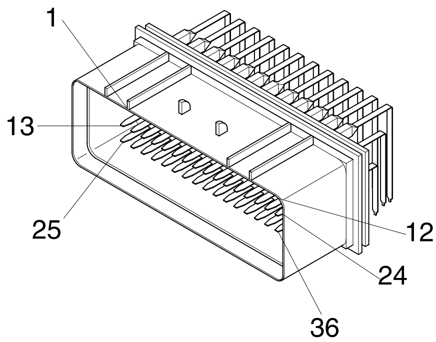
No. of pin	Receptacle connector (female)	Plug connector (male)
1	 S810-001202	 S810-101202
2	 S810-002202	 S810-102202
3	 S810-003202	 S810-103202
4	 S810-004202	 S810-104202

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

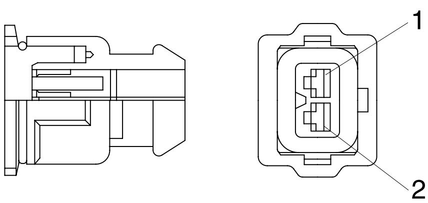
5) 375 FASTEN TYPE CONNECTOR

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

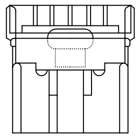
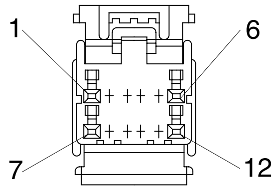
6) AMP ECONOSEAL CONNECTOR

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

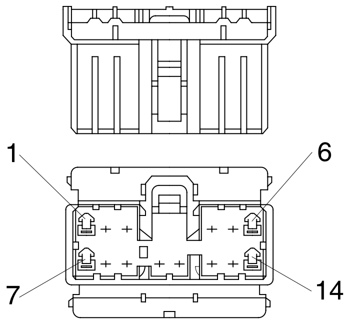
7) AMP TIMER CONNECTOR

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

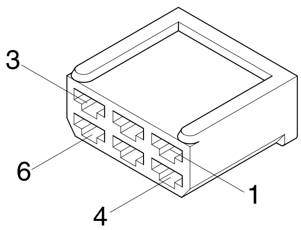
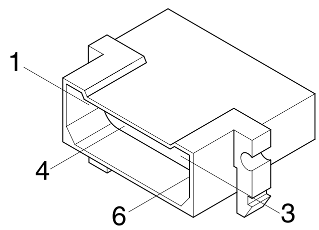
8) AMP 040 MULTILOCK CONNECTOR

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

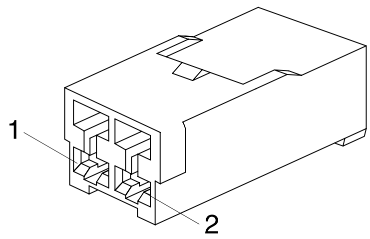
9) AMP 070 MULTILOCK CONNECTOR

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

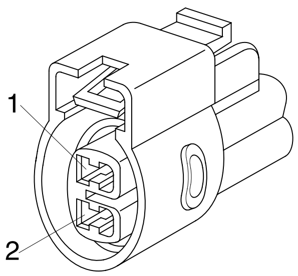
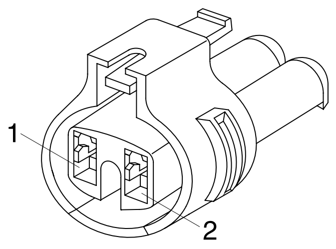
10) AMP FASTIN - FASTON CONNECTOR

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

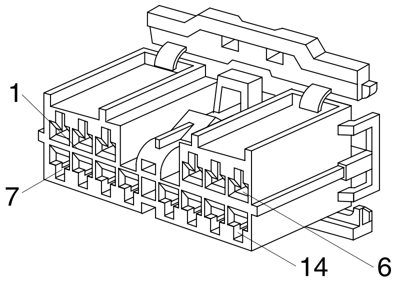
11) KET 090 CONNECTOR

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	

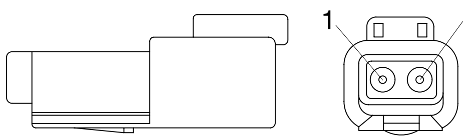
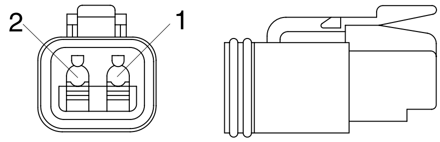
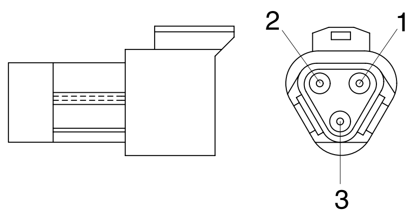
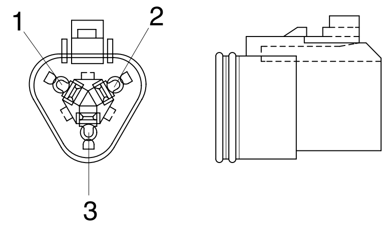
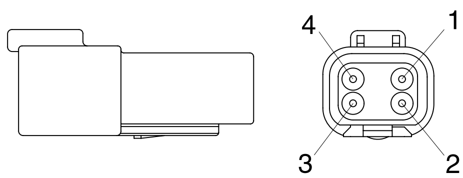
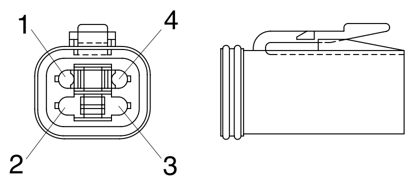
14) DEUTSCH DT CONNECTORS

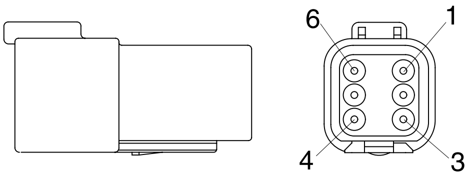
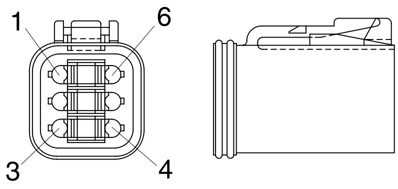
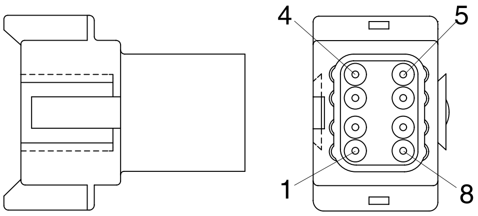
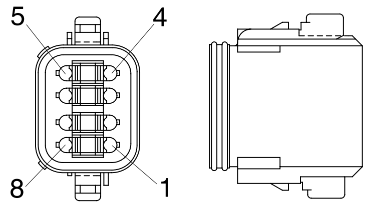
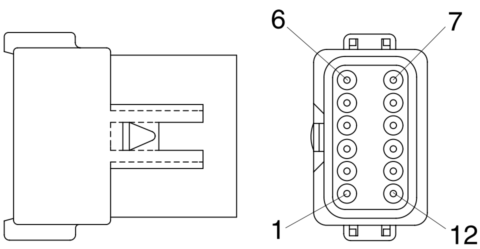
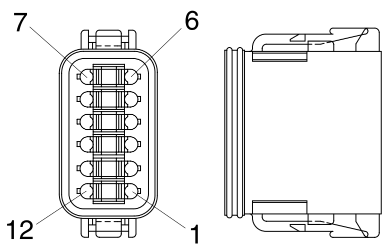
DT 06 - 3S - ★★★★

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

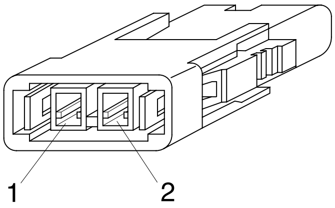
※ Modification

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

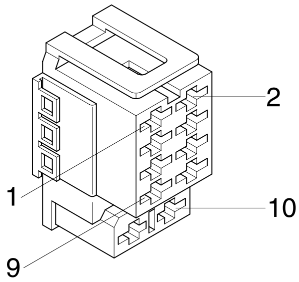
No. of pin	Receptacle connector (female)	Plug connector (male)
2	 DT06-2S	 DT04-2P
3	 DT06-3S	 DT04-3P
4	 DT06-4S	 DT04-4P

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

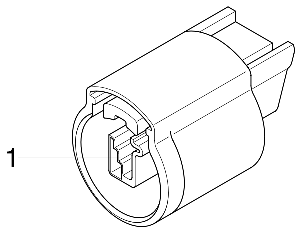
15) MOLEX 2CKTS CONNECTOR

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

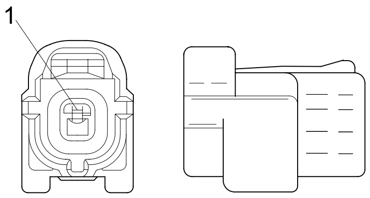
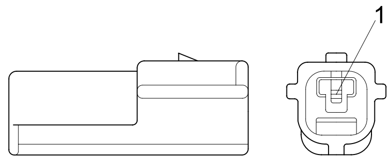
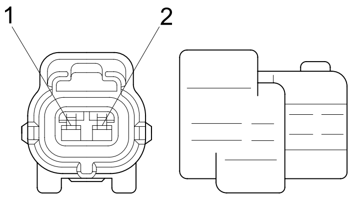
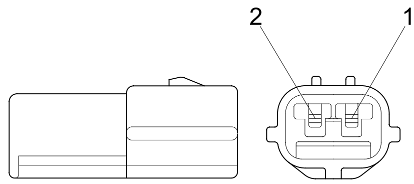
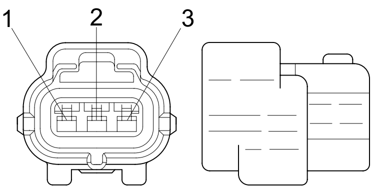
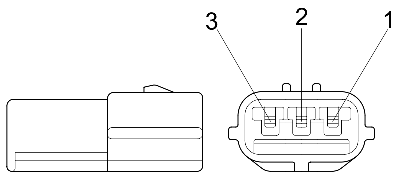
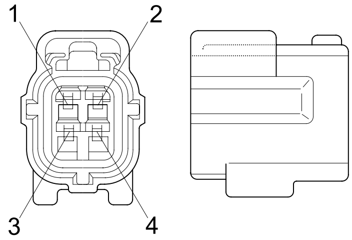
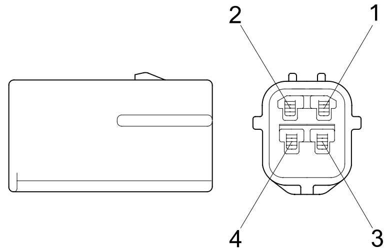
16) ITT SWF CONNECTOR

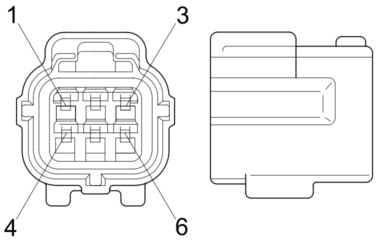
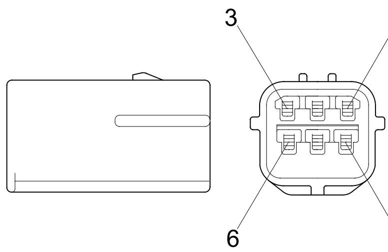
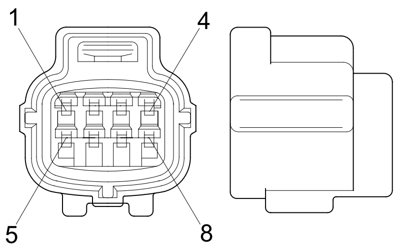
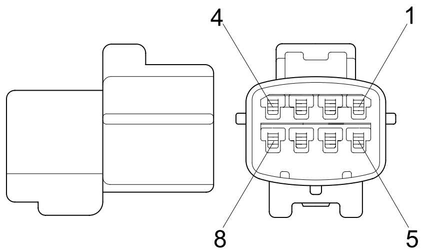
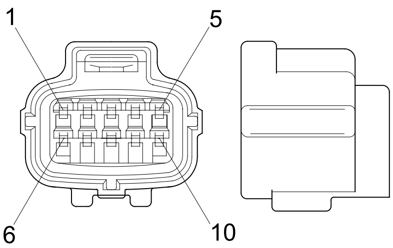
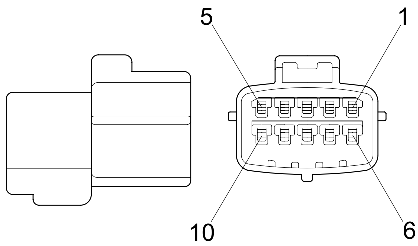
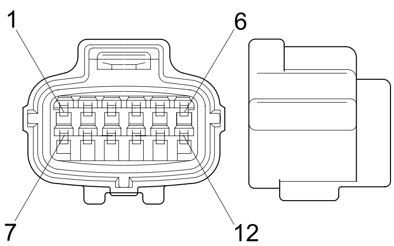
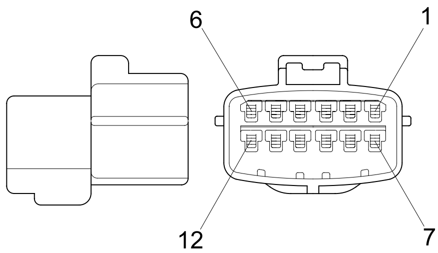
No. of pin	Receptacle connector (female)	Plug connector (male)
10	 SWF593757	

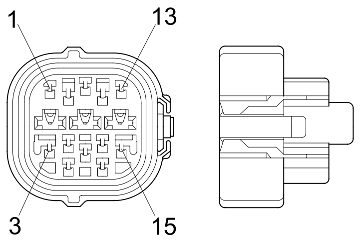
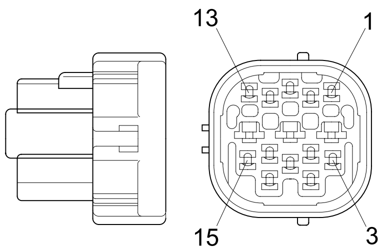
17) MWP NMWP CONNECTOR

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

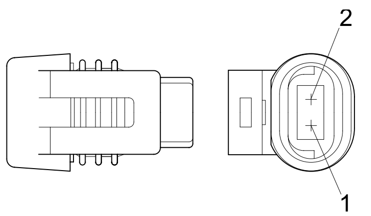
18) ECONOSEAL J TYPE CONNECTORS

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

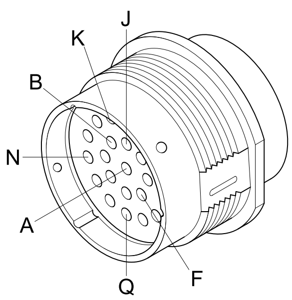
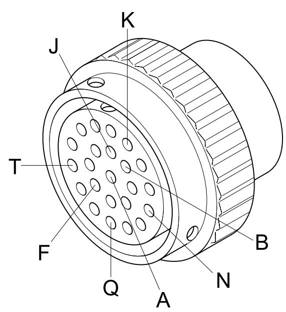
No. of pin	Receptacle connector (female)	Plug connector (male)
6	 S816-006002	 S816-106002
8	 S816-008002	 S816-108002
10	 S816-010002	 S816-110002
12	 S816-012002	 S816-112002

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

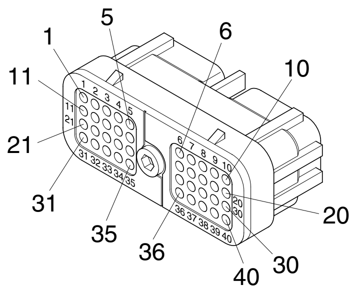
19) METRI-PACK TYPE CONNECTOR

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

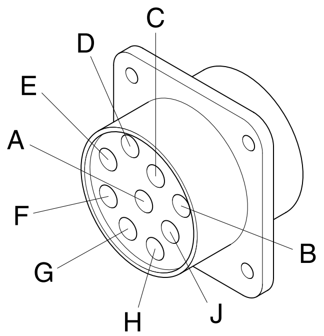
20) DEUTSCH HD30 CONNECTOR

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

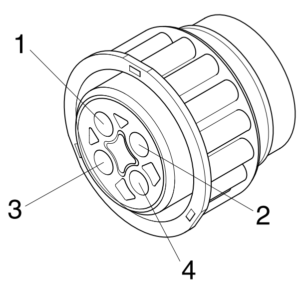
21) DEUTSCH MCU CONNECTOR

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

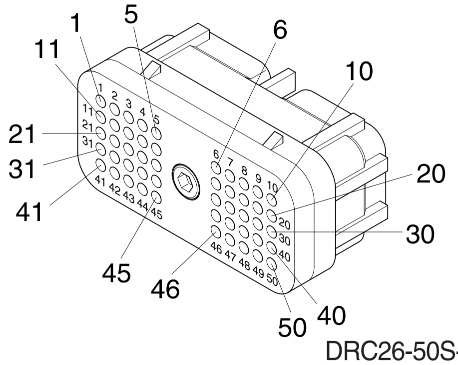
22) DEUTSCH SERVICE TOOL CONNECTOR

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

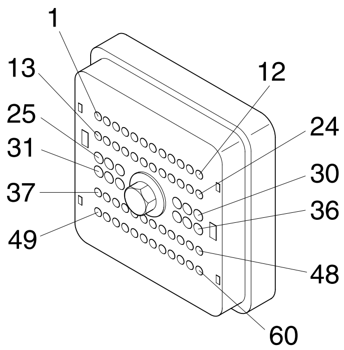
23) AMP FUEL WARMER CONNECTOR

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

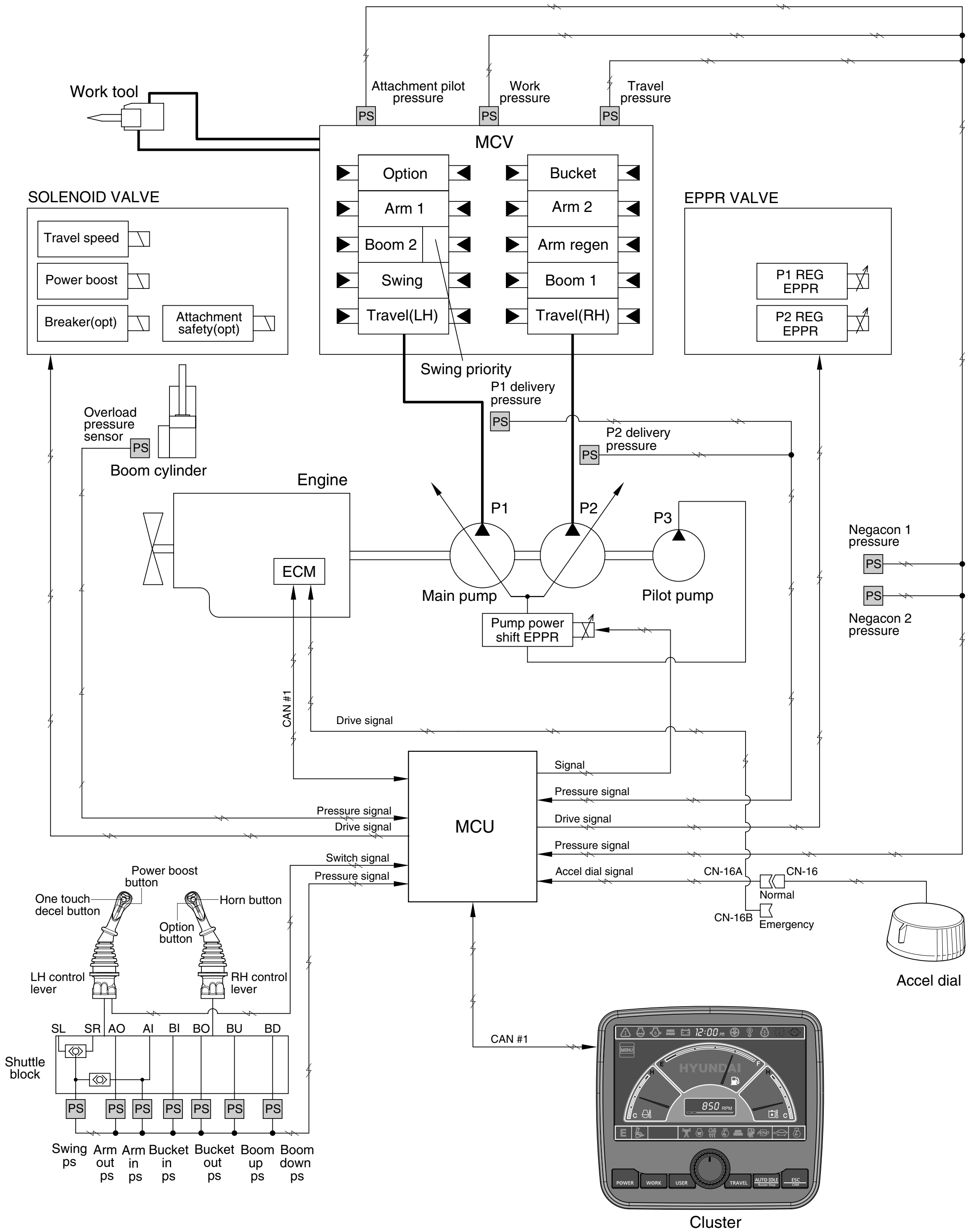
SECTION 5 MECHATRONICS SYSTEM

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.

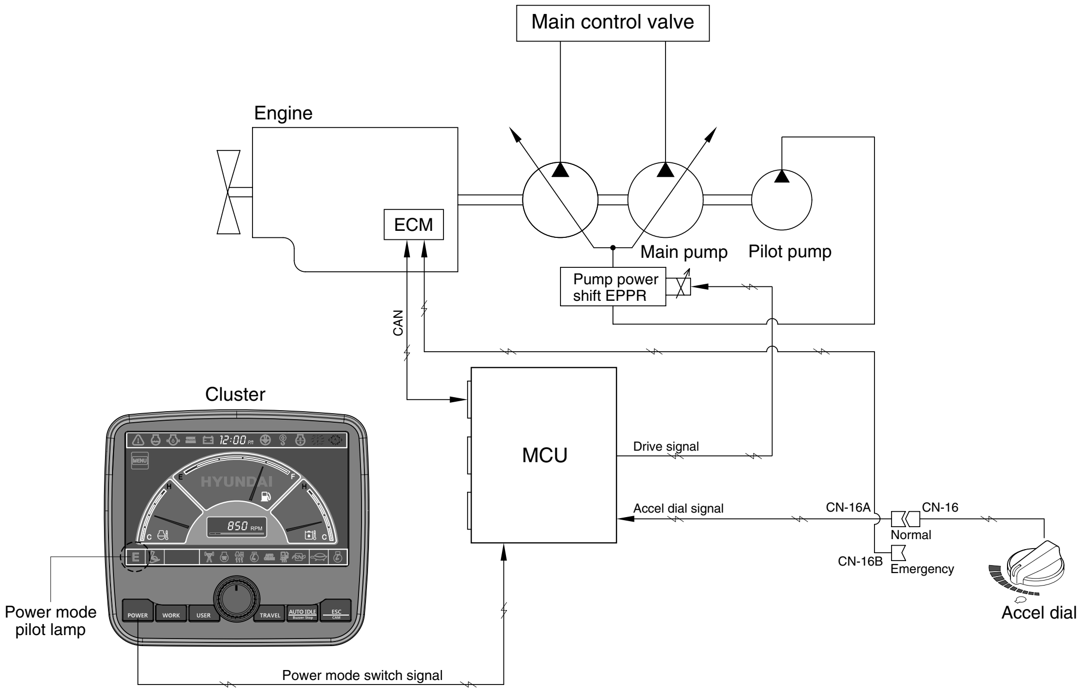
- ADVANCED CAPO SYSTEM
  - Mode selection system
    - Power mode selection (P, S, E)
    - Work mode selection
    - User mode system (U)
  - Auto deceleration system
  - Power boost system
  - Travel speed control system
  - Automatic warming up system
  - Overheat prevention system
  - Variable power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

SYSTEM DIAGRAM



GROUP 2 MODE SELECTION SYSTEM

1. POWER MODE SELECTION SYSTEM



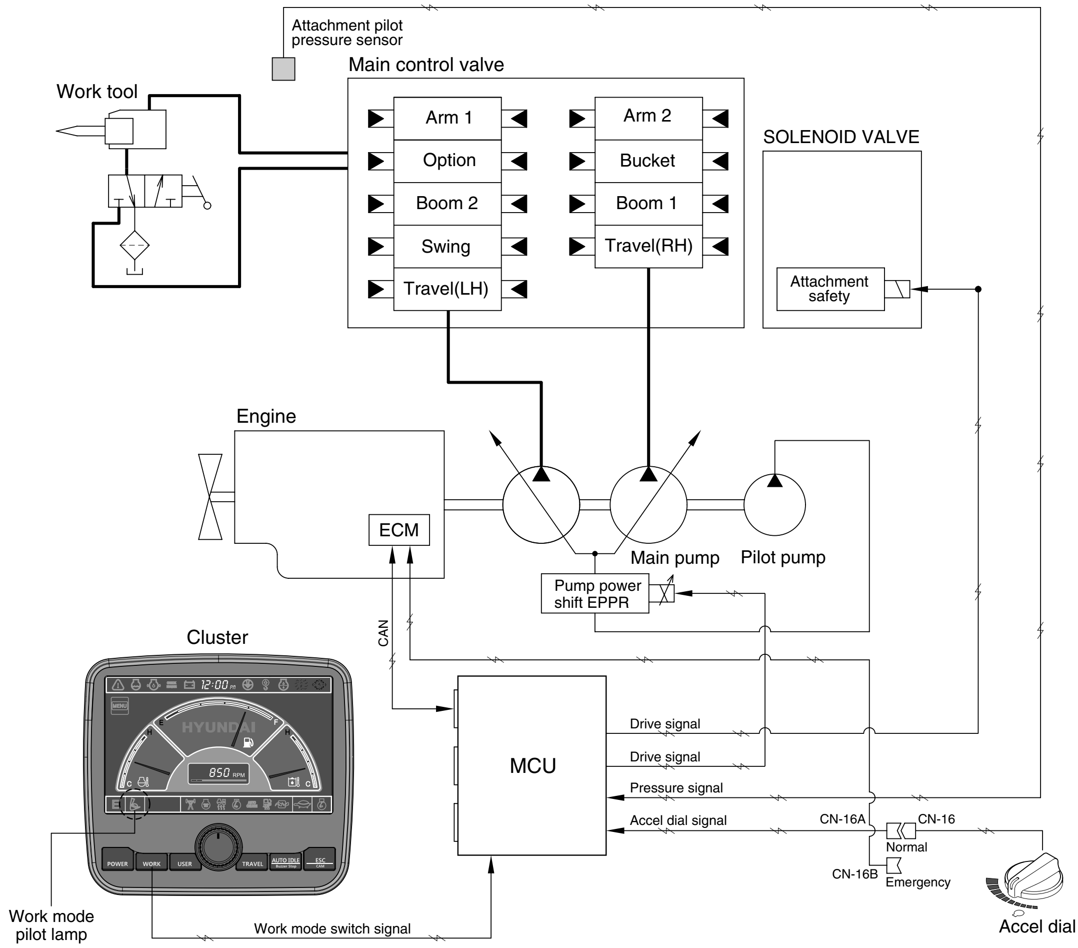
Mode selection system (micro computer based electro-hydraulic pump and engine mutual control system) optimizes the engine and pump performance.
The combination of 3 power modes (P, S, E) and accel dial position (10 set) makes it possible to use the engine and pump power more effectively corresponding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

Power mode	Application	Engine rpm				Power shift by EPPR valve			
		Standard		Option		Standard		Option	
		Unload	Load	Unload	Load	Current (mA)	Pressure (kgf/cm^2)	Current (mA)	Pressure (kgf/cm^2)
P	Heavy duty power	1750±50		1800±50			7(~4)		7(~4)
S	Standard power	1650±50		1700±50			9(~6)		9(~6)
E	Economy operation	1600±50		1600±50			10(~7)		12(~9)
AUTO DECEL	Engine deceleration	1000±50					40±2		
One touch decel	Engine quick deceleration	900±50					40±2		
KEY START	Key switch start position	900±50					40±2		

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

2. WORK MODE SELECTION SYSTEM

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



1) GENERAL WORK MODE (bucket)

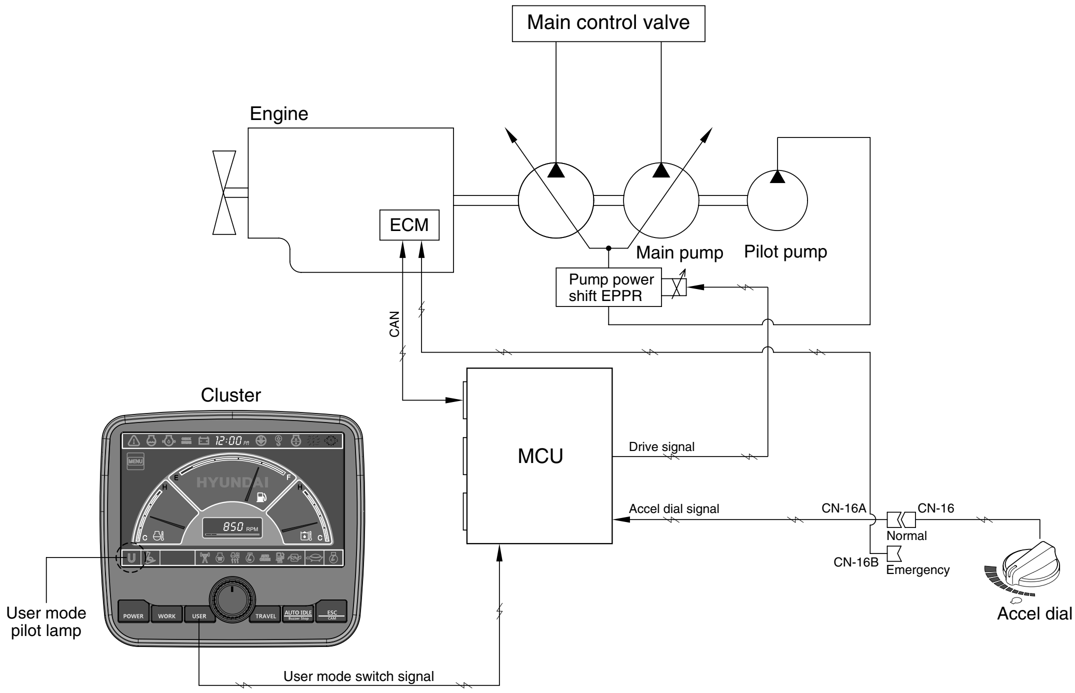
This mode is used to general digging work.

2) ATT WORK MODE (breaker, crusher)

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

Description	General mode	Work tool	
	Bucket	Breaker	Crusher
Attachment safety solenoid	OFF	ON	ON

3. USER MODE SELECTION SYSTEM

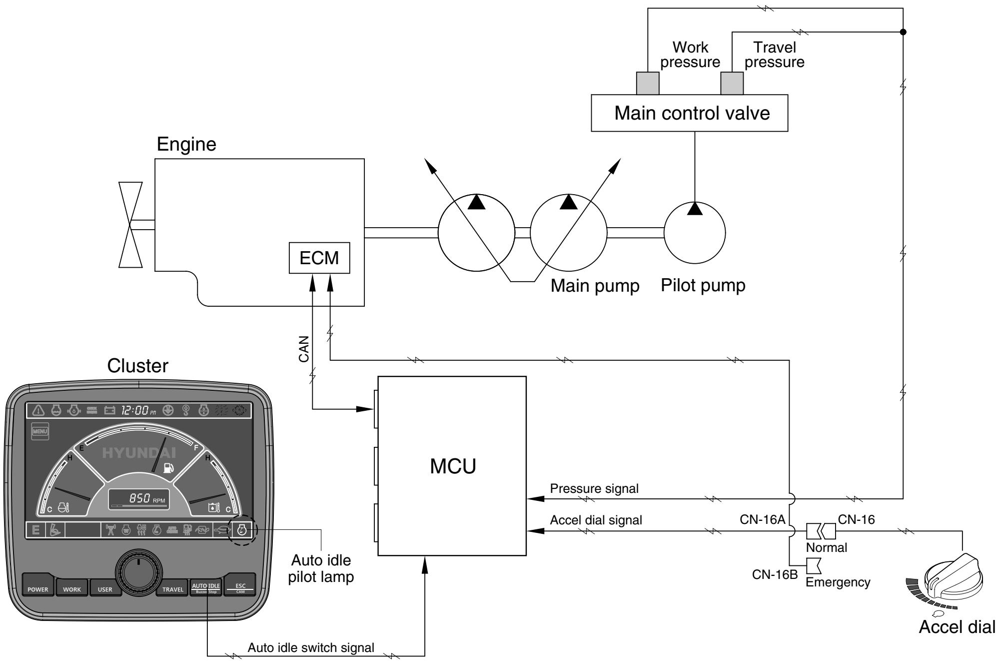


1) High idle rpm, auto idle rpm and EPPR pressure can be adjusted and memorized in the U-mode.

2) LCD segment vs parameter setting

Step (▮)	Engine speed (rpm)	Idle speed (rpm)	Power shift (bar)
1	1400	850	0
2	1450	900	3
3	1500	950	6
4	1550	1000	9
5	1600	1050	12
6	1650	1100	16
7	1700	1150	20
8	1750	1200	26
9	1800	1250	32
10	1850	1300	38

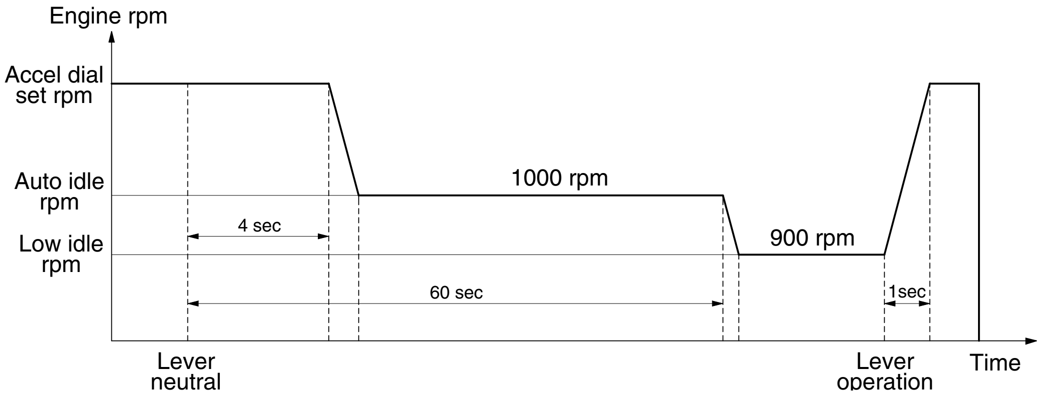
GROUP 3 AUTOMATIC DECELERATION SYSTEM



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 950 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.

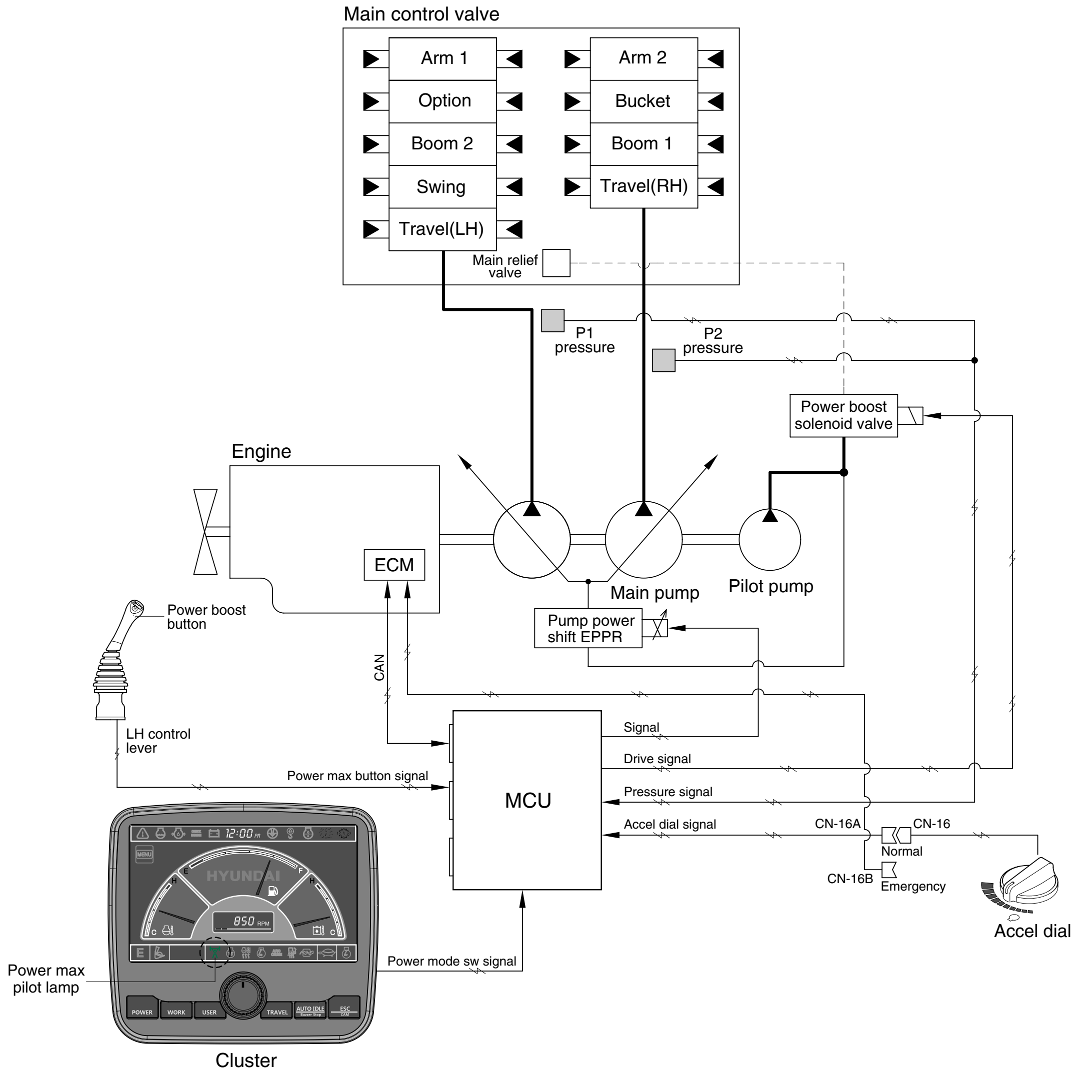


2. WHEN AUTO IDLE PILOT LAMP OFF

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

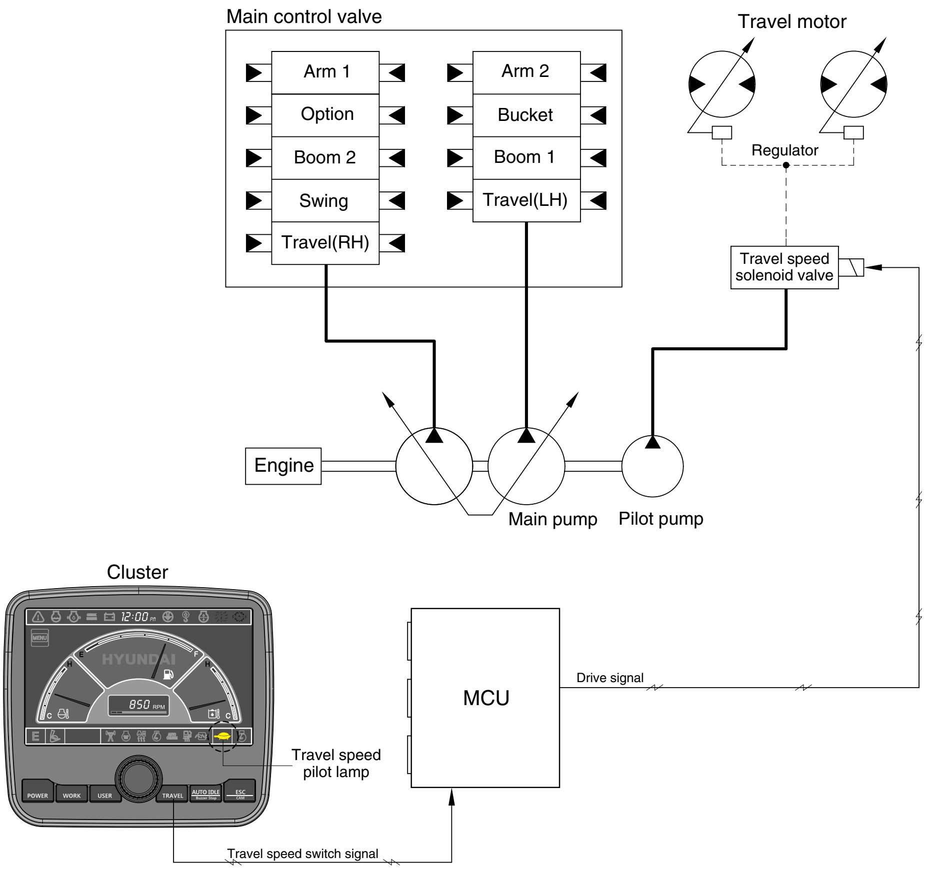


- When the power boost switch on the left control lever knob is pushed ON, the power mode is set P mode and maximum digging power is increased by 10 %.
- When the power boost function is activated, the power boost solenoid valve pilot pressure raises the set pressure of the main relief valve to increase 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 lamp : ON - Operating time : max 8 seconds
Canceled	Power boost switch : OFF	- Pre-set power mode - Power boost solenoid : OFF - Power boost pilot lamp : OFF

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

GROUP 5 TRAVEL SPEED CONTROL SYSTEM

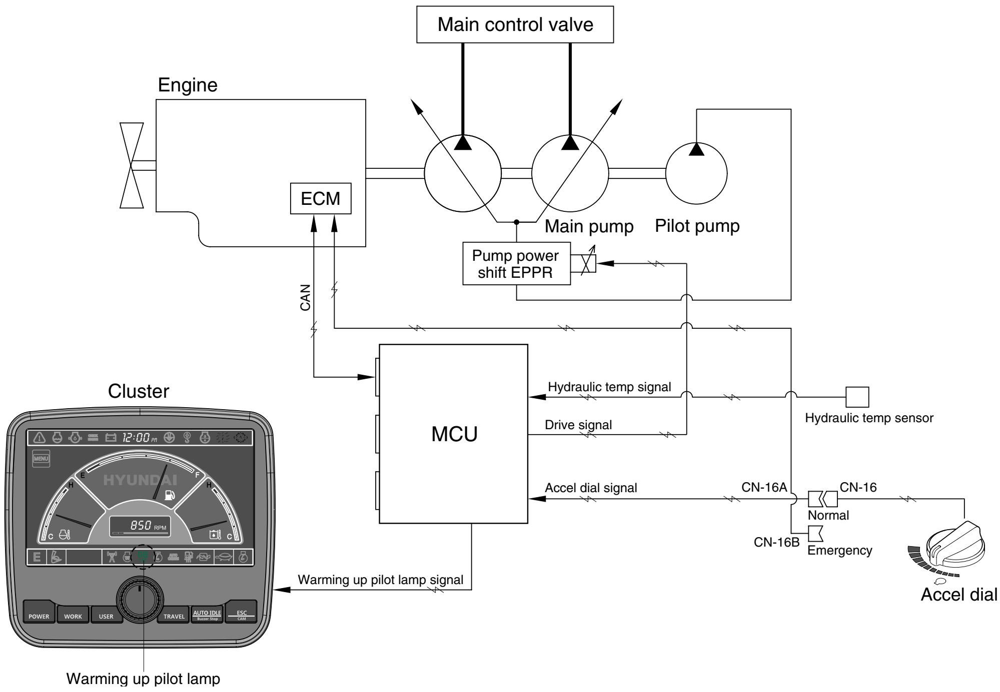


Travel speed can be switched manually by pressing the travel speed switch on the cluster.

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

※ Default : Turtle (Low)

GROUP 6 AUTOMATIC WARMING UP SYSTEM



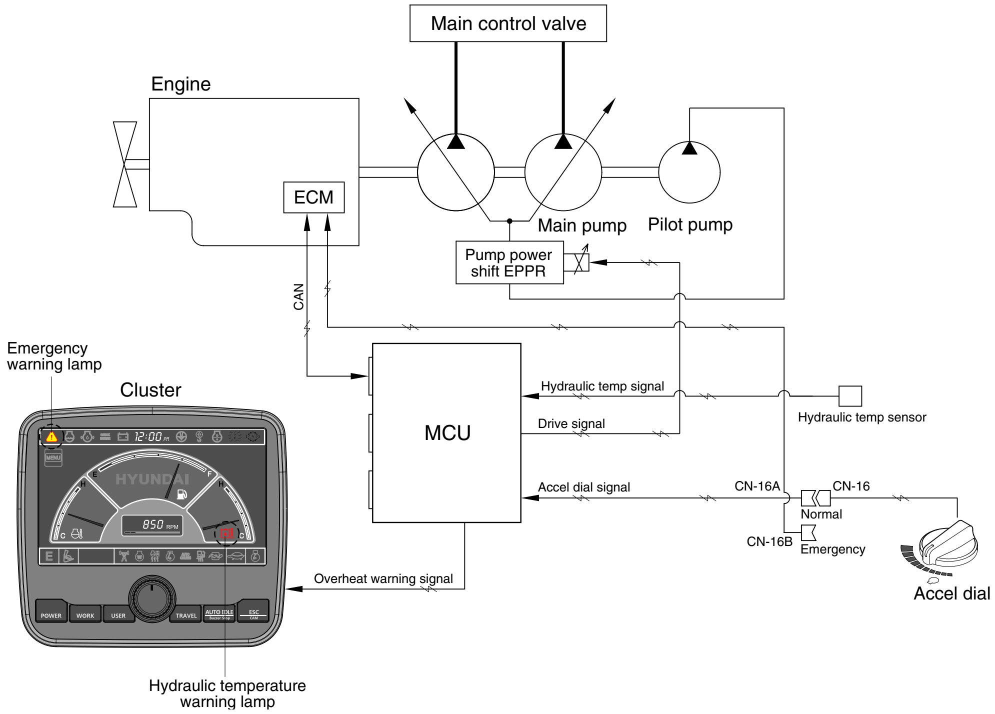
1. The MCU receives the engine coolant temperature from the ECM, and if the coolant temperature is below 30˚C, it increases the engine speed from key start rpm to 1200rpm. At this time the mode does not change. If the coolant temperature sensor has fault, the hydraulic oil temperature signal is substituted.

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

3. LOGIC TABLE

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

GROUP 7 ENGINE OVERHEAT PREVENTION SYSTEM

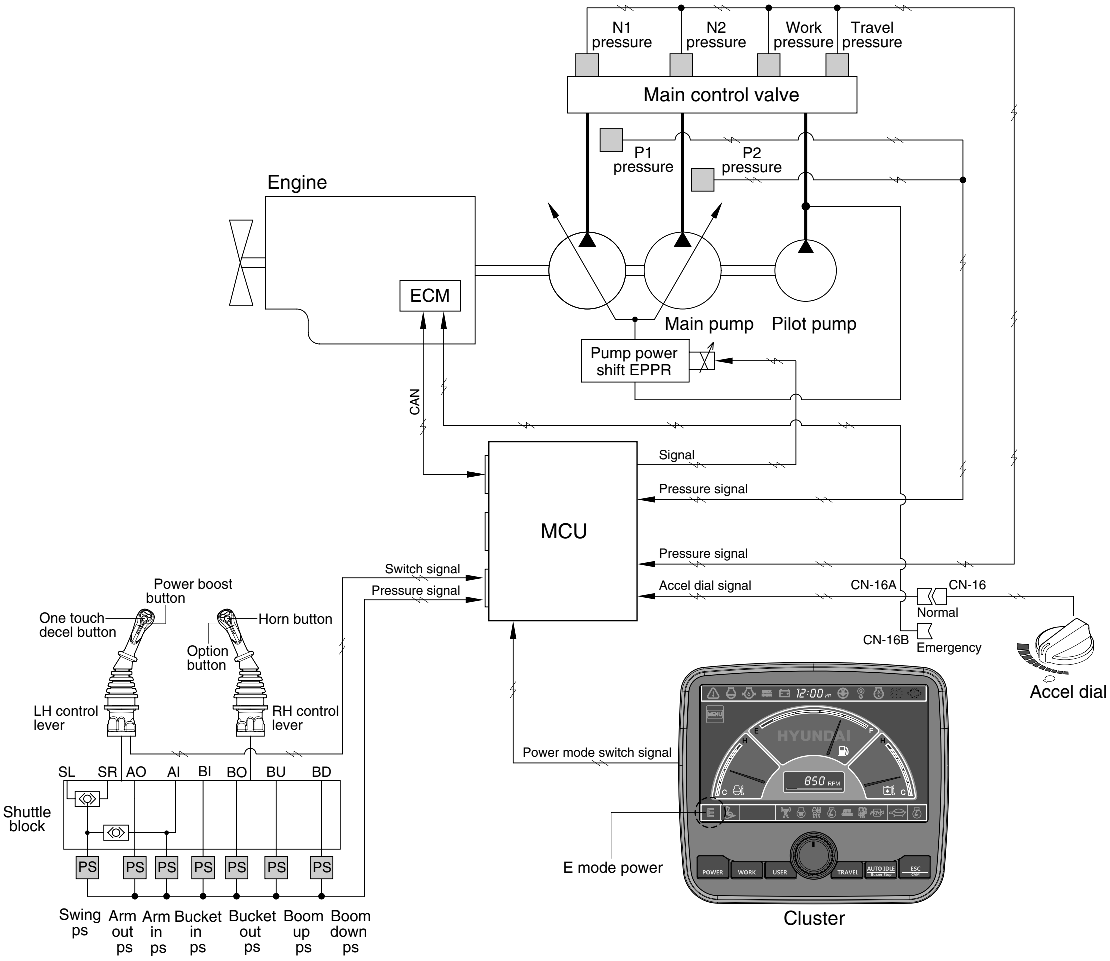


1. The engine coolant temperature or the hydraulic oil temperature is overheated over 100˚C, the warning lamp is ON and the pump input torque or the engine speed is reduced as below logic table.

2. LOGIC TABLE

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

GROUP 8 VARIABLE POWER CONTROL SYSTEM

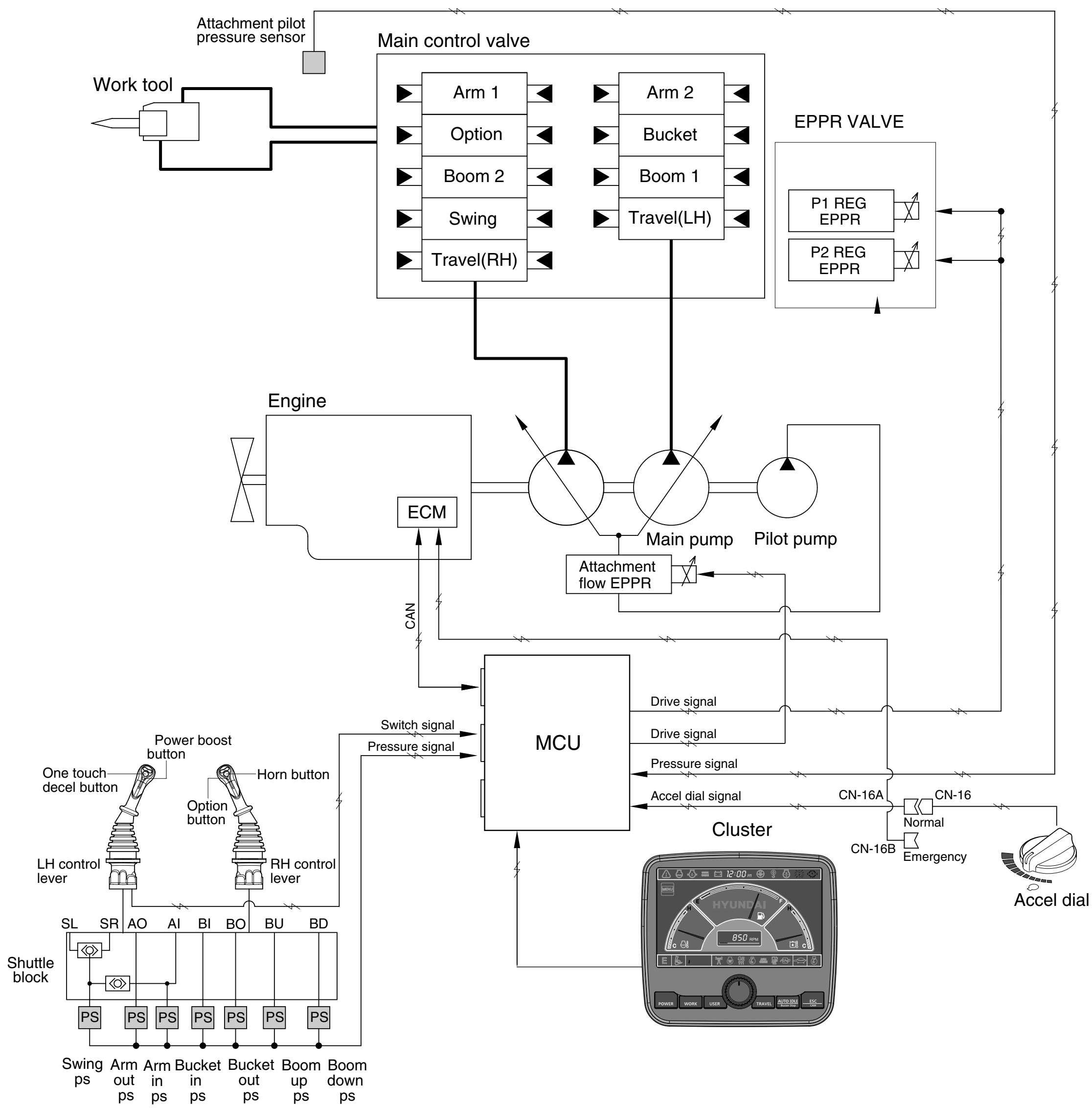


- The variable power control system controls the engine and pump mutual power according to RCV lever stroke and pump load.
  It makes fuel saving and smooth control at precise work.

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

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

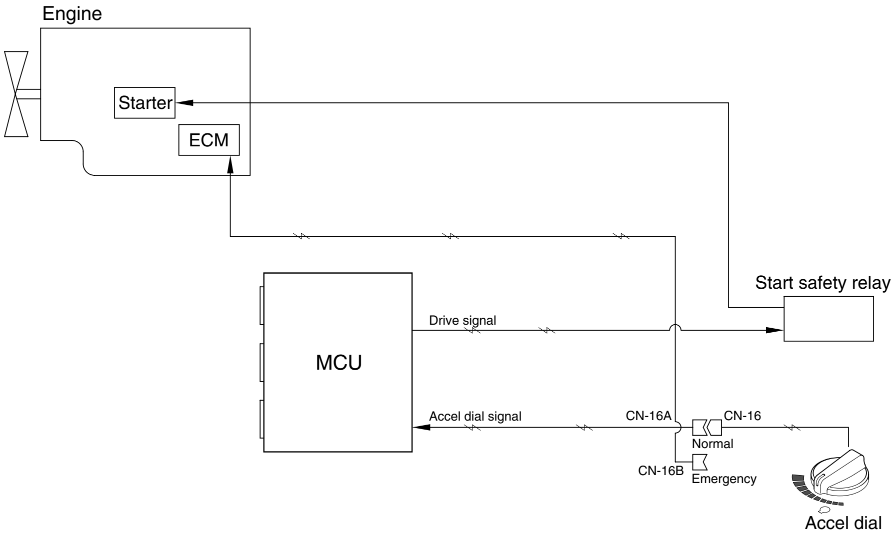
GROUP 9 ELECTRONIC PUMP INDEPENDENT CONTROL SYSTEM (EPIC)



· When the requirement operate in Composite actions，auto idle， EPIC function controls pump flow rate to improve fuel efficiency.

Condition	Function
boom up + arm in swing & boom up + swing boom down + arm out auto idle Operating at lower engine speed	Limitation of pump flow rate : Activated (p1 reg eppr or p2 reg eppr)
None of upper condition	Limitation of pump flow rate : Canceled

GROUP 10 ANTI-RESTART SYSTEM



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.

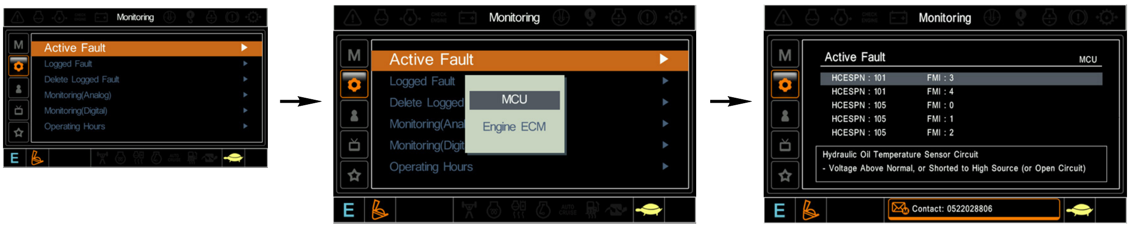
2. When a replacement or taking-off of the MCU is needed, connect CN-16 and CN-16B to ensure the engine start without the MCU.

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.

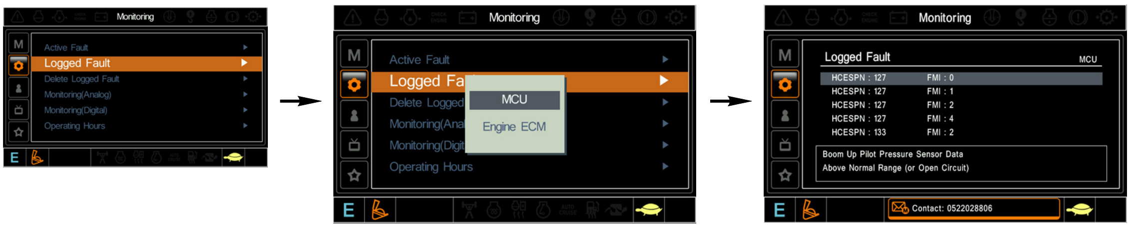
2. MONITORING

1) Active fault



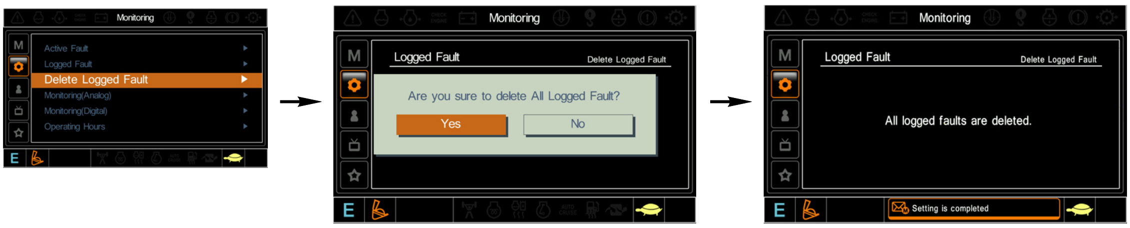
· The active faults of the MCU or engine ECM can be checked by this menu.

2) Logged fault



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

3) Delete fault



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

3. MACHINE ERROR CODES TABLE

Error code HCESPN	Error code FMI	Description
101	3	Hydraulic oil temperature sensor circuit - Voltage above normal, or shorted to high source.
	4	Hydraulic oil temperature circuit - Voltage below normal, or shorted to low source.
105	0	Working pressure sensor data above normal range.
	1	Working pressure sensor data below normal range.
	2	Working pressure sensor data error.
	4	Working pressure sensor circuit - Voltage below normal, or shorted to Low source.
108	0	Travel oil pressure sensor data above normal range.
	1	Travel oil pressure sensor data below normal range.
	2	Travel oil pressure sensor data error.
	4	Travel oil pressure sensor circuit - Voltage below normal, or shorted to low source.
120	0	Main pump 1 (P1) pressure sensor data above normal range.
	1	Main pump 1 (P1) pressure sensor data below normal range.
	2	Main pump 1 (P1) pressure sensor data error.
	4	Main pump 1 (P1) pressure sensor circuit - Voltage below normal, or shorted to low source.
121	0	Main pump 2 (P2) pressure sensor data above normal range.
	1	Main pump 2 (P2) pressure sensor data below normal range.
	2	Main pump 2 (P2) pressure sensor data error.
	4	Main pump 2 (P2) pressure sensor circuit - Voltage below normal, or shorted to low source.
122	0	Overhead pressure sensor data above normal range.
	1	Overhead pressure sensor data below normal range.
	2	Overhead pressure sensor data error.
	4	Overhead pressure sensor circuit - Voltage below normal, or shorted to low source.
123	0	Negative 1 pressure sensor data above normal range.
	1	Negative 1 pressure sensor data below normal range.
	2	Negative 1 pressure sensor data error.
	4	Negative 1 pressure sensor circuit - Voltage below normal, or shorted to low source.
124	0	Negative 2 Pressure sensor data above normal range.
	1	Negative 2 Pressure sensor data below normal range.
	2	Negative 2 Pressure sensor data error.
	4	Negative 2 Pressure sensor circuit - Voltage below normal, or shorted to low source.
125	0	Pilot pump (P3) pressure sensor data above normal range.
	1	Pilot pump (P3) pressure sensor data below normal range.
	2	Pilot pump (P3) pressure sensor data error.
	4	Pilot pump (P3) pressure sensor circuit - Voltage below normal, or shorted to low source.
127	0	Boom up pilot pressure sensor data above normal range.
	1	Boom up pilot pressure sensor data below normal range.
	2	Boom up pilot pressure sensor data error.
	4	Boom up pilot pressure sensor circuit - Voltage below normal, or shorted to low source.
128	0	Boom down Pilot Pressure Data sensor valid but above normal operational range.
	1	Boom down Pilot Pressure Data sensor Data valid but below normal operational range.
	2	Boom down Pilot Pressure Data sensor Data erratic, intermittent or incorrect.
	4	Boom down Pilot Pressure Data sensor Voltage below normal, or shorted to low source

※ Some error codes are not applied to this machine.

Error code		Description
HCESPN	FMI	
129	0	Arm in Pilot Pressure data valid but above normal operational range.
	1	Arm in Pilot Pressure data valid but below normal operational range.
	2	Arm in Pilot Pressure data erratic, intermittent or incorrect.
	4	Arm in Pilot Pressure Voltage below normal, or shorted to low source.
130	0	Arm out Pilot Pressure data valid but above normal operational range.
	1	Arm out Pilot Pressure data valid but below normal operational range.
	2	Arm out Pilot Pressure data erratic, intermittent or incorrect.
	4	Arm out Pilot Pressure Voltage below normal, or shorted to low source.
131	0	Bucket in Pilot Pressure data valid but above normal operational range.
	1	Bucket in Pilot Pressure data valid but below normal operational range.
	2	Bucket in Pilot Pressure data erratic, intermittent or incorrect.
	4	Bucket in Pilot Pressure Voltage below normal, or shorted to low source.
132	0	Bucket out Pilot Pressure data valid but above normal operational range.
	1	Bucket out Pilot Pressure data valid but below normal operational range.
	2	Bucket out Pilot Pressure data erratic, intermittent or incorrect.
	4	Bucket out Pilot Pressure Voltage below normal, or shorted to low source.
133	0	Arm In/Out & Bucket In Pilot Pressure data valid but above normal operational range.
	1	Arm In/Out & Bucket In Pilot Pressure data valid but below normal operational range.
	2	Arm In/Out & Bucket In Pilot Pressure data erratic, intermittent or incorrect.
	4	Arm In/Out & Bucket In Pilot Pressure Voltage below normal, or shorted to low source.
135	0	Swing pilot pressure sensor data above normal range.
	1	Swing pilot pressure sensor data below normal range.
	2	Swing pilot pressure sensor data error.
	4	Swing pilot pressure sensor circuit - Voltage below normal, or shorted to low source.
138	0	Attachment pilot pressure sensor data above normal range.
	1	Attachment pilot pressure sensor data below normal range.
	2	Attachment pilot pressure sensor data error.
	4	Attachment pilot pressure sensor circuit - Voltage below normal, or shorted to low source.

Error code		Description
HCESPN	FMI	
139	0	Option pilot pressure sensor data above normal range.
	1	Option pilot pressure sensor data below normal range.
	2	Option pilot pressure sensor data error.
	4	Option pilot pressure sensor circuit - Voltage below normal, or shorted to low source.
140	5	Pump EPPR valve circuit - Current below normal, or open circuit.
	6	Pump EPPR valve circuit - Current above normal.
141	5	Boom priority EPPR valve circuit - Current below normal, or open circuit.
	6	Boom priority EPPR valve circuit - Current above normal.
143	5	Travel EPPR valve circuit - Current below normal, or open circuit.
	6	Travel EPPR valve circuit - Current above normal.
144	5	Attachment flow EPPR valve circuit - Current below normal, or open circuit.
	6	Attachment flow EPPR valve circuit - Current above normal.
145	5	Remote cooling fan EPPR valve circuit - Current below normal, or open circuit.
	6	Remote cooling fan EPPR valve circuit - Current above normal.
150	5	Left rotate EPPR valve circuit - Current below normal, or open circuit.
	6	Left rotate EPPR valve circuit - Current above normal.
151	5	Right rotate EPPR valve circuit - Current below normal, or open circuit.
	6	Right rotate EPPR valve circuit - Current above normal.
152	5	Left tilt EPPR valve circuit - Current below normal, or open circuit.
	6	Left tilt EPPR valve circuit - Current above normal.
153	5	Right tilt EPPR valve circuit - Current below normal, or open circuit.
	6	Right tilt EPPR valve circuit - Current above normal.
166	5	Power max solenoid circuit - Current below normal, or open circuit.
	6	Power max solenoid circuit - Current above normal.
167	5	Travel speed solenoid circuit - Current below normal, or open circuit.
	6	Travel speed solenoid circuit - Current above normal.
168	5	Attachment pressure solenoid circuit - Current below normal, or open circuit.
	6	Attachment pressure solenoid circuit - Current above normal.
169	5	Attachment conflux solenoid circuit - Current below normal, or open circuit.
	6	Attachment conflux solenoid circuit - Current above normal.
170	5	Arm regeneration solenoid circuit - Current below normal, or open circuit.
	6	Arm regeneration solenoid circuit - Current above normal.
171	5	Attachment safety solenoid circuit - Current below normal, or open circuit.
	6	Attachment safety solenoid circuit - Current above normal.
181	5	Remote cooling fan reverse solenoid circuit - Current below normal, or open circuit.
	6	Remote cooling fan reverse solenoid circuit - Current above normal.
188	5	Attachment flow EPPR 1 valve - Current below normal, or open circuit.
	6	Attachment flow EPPR 1 valve - Current above normal.
189	5	Attachment flow EPPR 2 valve - Current below normal, or open circuit.
	6	Attachment flow EPPR 2 valve - Current above normal.
301	5	Fuel level sensor circuit - Voltage above normal, or shorted to high source.
	6	Fuel level sensor circuit - Voltage below normal, or shorted to low source.
304	3	Engine coolant temperature sensor circuit - Voltage above normal, or shorted to high source.
	4	Engine coolant temperature sensor circuit - Voltage below normal, or shorted to low source.
310	8	Engine speed signal error - Abnormal frequency or pulse width.
322	3	Engine preheat relay circuit - Voltage above normal, or shorted to high source.
	4	Engine preheat relay circuit - Voltage below normal, or shorted to low source.
325	3	Fuel warmer relay circuit - Voltage above normal, or shorted to high source.
	4	Fuel warmer relay circuit - Voltage below normal, or shorted to low source.

※ Some error codes are not applied to this machine·

Error code		Description
HCESPN	FMI	
340	3	Potentiometer (G/A) circuit - Voltage above normal, or shorted to high source.
	4	Potentiometer (G/A) circuit - Voltage below normal, or shorted to low source.
341	5	Governor actuator circuit - Current below normal, or open circuit.
	6	Governor actuator circuit - Current above normal.
501	0	Transmission oil pressure sensor data above normal range.
	1	Transmission oil pressure sensor data below normal range.
	2	Transmission oil pressure sensor data error.
	4	Transmission oil pressure sensor circuit - Voltage below normal, or shorted to low source.
503	0	Brake pressure sensor data above normal range.
	1	Brake pressure sensor data below normal range.
	2	Brake pressure sensor data error.
	4	Brake pressure sensor circuit - Voltage below normal, or shorted to low source.
505	0	Working brake pressure sensor data above normal range.
	1	Working brake pressure sensor data below normal range.
	2	Working brake pressure sensor data error.
	4	Working brake pressure sensor circuit - Voltage below normal, or shorted to low source.
506	3	Working brake lamp circuit - Voltage above normal, or shorted to high source.
	4	Working brake lamp circuit - Voltage below normal, or shorted to low source.
520	3	Ram lock lamp circuit - Voltage above normal, or shorted to high source.
	4	Ram lock lamp circuit - Voltage below normal, or shorted to low source.
525	5	Ram lock solenoid circuit - Current below normal, or open circuit.
	6	Ram lock solenoid circuit - Current above normal.
530	0	Travel F pilot pressure sensor data above normal range.
	1	Travel F pilot pressure sensor data below normal range.
	2	Travel F pilot pressure sensor data error.
	4	Travel F pilot pressure sensor circuit - Voltage below normal, or shorted to low source.
531	0	Travel R pilot pressure sensor data above normal range.
	1	Travel R pilot pressure sensor data below normal range.
	2	Travel R pilot pressure sensor data error.
	4	Travel R pilot pressure sensor circuit - Voltage below normal, or shorted to low source.
701	3	Hourmeter circuit - Voltage above normal, or shorted to high source.
	4	Hourmeter circuit - Voltage below normal, or shorted to low source.
705	0	MCU input voltage high.
	1	MCU input voltage low.
707	1	Alternator node I voltage low.
714	3	Acc. dial circuit - Voltage above normal, or shorted to high source.
	4	Acc. dial circuit - Voltage below normal, or shorted to low source.
715	3	Rotate signal input circuit - Voltage above normal, or shorted to high source.
	4	Rotate signal input circuit - Voltage below normal, or shorted to low source.
716	3	Tilt signal input circuit - Voltage above normal, or shorted to high source.
	4	Tilt signal input circuit - Voltage below normal, or shorted to low source.
722	3	Travel alarm (buzzer) circuit - Voltage above normal, or shorted to high source.
	4	Travel alarm (buzzer) circuit - Voltage below normal, or shorted to low source.
830	12	MCU internal memory error.
840	2	Cluster communication data error.
841	2	ECM communication data error.
843	2	Option #1 (CAN 2) communication data error.
850	2	RCM communication data error.

※ Some error codes are not applied to this machine.

4. ENGINE FAULT CODE

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
111 629 12	Error internal to the ECM related to memory hardware failures or internal ECM voltage supply circuits.	Engine will not start.
115 190 2	No engine speed signal detected at both engine position sensor circuits.	Engine will die and will not start.
121 190 10	No engine speed signal detected from one of the engine position sensor circuits.	None on performance.
122 102 3	High voltage detected on the intake manifold pressure circuit.	Derate in power output of the engine.
123 102 4	Low voltage detected on the intake manifold pressure circuit.	Derate in power output of the engine.
131 91 3	High voltage detected at the throttle position signal circuit.	Severe derate (power and speed). Limp home power only.
132 91 4	Low voltage detected at the throttle position signal circuit.	Severe derate (power and speed). Limp home power only.
133 974 3	High voltage detected at the remote throttle position signal circuit.	None on performance if remote throttle is not used.
134 974 4	Low voltage detected at the remote throttle position signal circuit.	None on performance if remote throttle is not used.
135 100 3	High voltage detected at the oil pressure circuit.	No engine protection for oil pressure.
141 100 4	Low voltage detected at the oil pressure circuit.	No engine protection for oil pressure.
143 100 18	Oil pressure signal indicates oil pressure below the low oil pressure engine protection limit.	Progressive power and speed derate with increasing time after alert. If engine protection shutdown feature is enable, engine will shut down 30 seconds after red lamp starts flashing.
144 110 3	High voltage detected at the coolant temperature circuit.	Possible white smoke. Fan will stay on if controlled by the electronic control module (ECM). No engine protection for coolant temperature.
145 110 4	Low voltage detected at the coolant temperature circuit.	Possible white smoke. Fan will stay on if controlled by electronic control module (ECM). No engine protection for coolant temperature.
147 91 8	A frequency of less then 100Hz was detected at the frequency throttle signal pin of the actuator harness connector at the ECM.	Calibration dependent power and speed derate.
148 91 8	A frequency of more than 100Hz was detected at the frequency throttle signal pin of the actuator harness connector at the ECM.	Calibration dependent power and speed derate.
151 110 0	Coolant temperature signal indicates coolant temperature above 104˚C (220˚F).	Progressive power derate with increasing time after alert. If engine protection shutdown feature is enabled, engine will shut down 30 seconds after red lamp starts flashing.

※ Some fault codes are not applied to this machine.

111Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
153 105 3	High voltage detected at the intake manifold temperature circuit.	Possible white smoke. Fan will stay on if controlled by electronic control module (ECM). No engine protection for coolant temperature.
154 105 4	Low voltage detected at the intake manifold temperature circuit.	Possible white smoke. Fan will stay on if controlled by electronic control module (ECM). No engine protection for coolant temperature.
155 105 0	Intake manifold temperature signal indicates temperature above 87.8˚C (190˚F).	Progressive power derate with increasing time after alert. If engine protection shutdown feature is enabled, engine will shut down 30 seconds after red lamp starts flashing.
187 620 4	Low voltage detected on the ECM voltage supply line to some sensors (VSEN2 supply).	Engine will run derated. No engine protection for oil pressure and coolant level.
198 612 3	High voltage detected at the ICON lamp circuit when low voltage was expected by the ECM.	The ICON system will be disabled. Only mandatory shutdown will be enabled.
199 612 4	Less than 6 VDC (low voltage) detected at the ICON lamp circuit when high voltage was expected by the ECM.	The ICON system will be disabled. Only mandatory shutdown will be enabled.
211 1484 31	Additional machine diagnostic codes have been logged. Check other ECM's for diagnostic codes.	None on engine performance.
212 175 3	High voltage detected at the oil temperature circuit.	No engine protection for oil temperature.
213 175 4	Low voltage detected at the oil temperature circuit.Low voltage detected at the oil temperature circuit.	No engine protection for oil temperature.
214 175 0	Oil temperature signal indicates oil temperate above 123.9˚C (225˚F).	Progressive power derate with increasing time after alert. If engine protection shutdown feature is enabled, engine will shut down 30sec after the red lamp starts flashing.
219 1380 17	Low oil level was detected in the CentinelTM makeup oil tank.	None on performance. CentinelTM deactivated.
221 108 3	High voltage detected at the ambient air pressure circuit.	Derate in power output of the engine.
222 108 4	Low voltage detected at the ambient air pressure circuit.	Derate in power output of the engine.
223 1265 4	Incorrect voltage detected at the CentinalTM actuator circuit by the ECM.	None on performance. CentinelTM deactivated.
227 620 3	High voltage detected on the ECM voltage supply line to some sensors (VSEN2 supply).	Engine will run derated. No engine protection for oil pressure and coolant level.
234 190 0	Engine speed signal indicates engine speed is greater than 2650 rpm.	Fuel shutoff valve is closed unit the engine speed drops. The fuel shutoff valve will open when engine speed falls below 2000 rpm.
235 111 1	Coolant level signal indicates coolant level is below the normal range.	Progressive power derate with increasing time after alert. If engine protection shutdown feature is enabled, engine will shut down 30 seconds after red lamp starts flashing.

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
237 644 2	Duty cycle of the throttle input signal to the primary or secondary engine for multiple unit synchronization is less than 3 percent or more than 97 percent.	All engines(primary and secondary) are shut down with increasing time after alert if hard-coupled. Only secondary engines are shut down with increasing time after alert if soft-coupled.
241 84 2	The ECM lost the vehicle speed signal.	Engine speed limited to maximum engine speed without vehicle speed sensor parameter value Cruise Control. Gear-Down Protection and Road Speed Governor will not work (automotive only).
242 84 10	Invalid or inappropriate vehicle speed signal detected. Signal indicates an intermittent connection or VSS tampering.	Engine speed limited to maximum engine speed without vehicle speed sensor parameter value Cruise Control. Gear-Down Protection and Road Speed Governor will not work (automotive only).
245 632 4	Less than 6 VDC detected at fan clutch circuit when on. Indicates an excessive current draw from the ECM or faulty ECM output circuit.	The fan may stay on at all times.
254 647 4	Less than 6 VDC detected at FSO circuit when on. Indicates an excessive current draw from the ECM or a faulty ECM output circuit.	The ECM turns off the FSO supply voltage. The engine will shut down.
255 632 3	Externally supplied voltage detected going to the fuel shutoff solenoid supply circuit.	None on performance. Fuel shutoff valve stays open.
285 639 9	The ECM expected information from a multiplexed device but did not receive it soon enough or did not receive it at all.	At least one multiplexed device will not operate properly.
286 639 13	The ECM expected info from a multiplexed device but only received a portion of the necessary information.	At least on multiplexed device will not operate properly.
287 91 19	The machine vehicle electronic control unit (VECU) detected a fault with its throttle pedal.	The engine will only idle.
288 974 19	The machine vehicle electronic control unit (VECU) detected a fault with its remote throttle.	The engine will not respond to the remote throttle.
293 1083 3	High voltage detected at the machine temperature sensor signal pin of the 31-pin machine connector.	No engine protection for machine temperature.
294 1083 4	Low voltage detected at the machine temperature sensor signal pin of the 31-pin machine connector.	No engine protection for machine temperature.
295 108 2	An error in the ambient air pressure sensor signal was detected by the ECM.	Engine is derated to no air setting.
297 1084 3	High voltage detected at the machine pressure sensor signal pin of the 31-pin machine connector.	No engine protection for machine pressure.
298 1084 4	Low voltage detected at the machine pressure sensor signal pin of the 31-pin machine connector.	No engine protection for machine pressure.
299 1384 31	Engine shutdown by device other than key switch before proper engine cool down resulting in filtered load factor above maximum shutdown threshold.	No action taken by the ECM.

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
311 651 6	Current detected at No.1 injector when voltage is turned off.	The injector for cylinder number 1 is turned off.
312 655 6	Current detected at No.5 injector when voltage is turned off.	The injector for cylinder number 5 is turned off.
313 653 6	Current detected at No.3 injector when the voltage is turned off	The injector for cylinder number 3 is turned off.
314 656 6	Current detected at No 6 injector when the voltage is turned off.	The injector for cylinder number 6 is turned off.
315 652 6	Current detected at No.2 injector when the voltage is turned off.	The injector for cylinder number 2 is turned off.
319 251 2	Real time clock lost power.	None on performance. Data in the ECM will not have accurate time and date information.
321 654 6	Current detected at No.4 injector when the voltage is turned on.	The injector for cylinder number 4 is turned off.
322 656 5	Injector solenoid driver cylinder 1 circuit-current below normal, or open circuit. Current detected at injector number 1 when voltage is turned off.	The current to the injector is shut off. The engine can possibly misfire or run rough.
323 656 5	Injector solenoid driver cylinder 5 circuit-current below normal, or open circuit. Current detected at injector number 5 when voltage is turned off.	The current to the injector is shut off. The engine can possibly misfire or run rough.
324 656 5	Injector solenoid driver cylinder 3 circuit-current below normal, or open circuit. Current detected at injector number 3 when voltage is turned off.	The current to the injector is shut off. The engine can possibly misfire or run rough.
325 656 5	Injector solenoid driver cylinder 6 circuit-current below normal, or open circuit. Current detected at injector number 6 when voltage is turned off.	The current to the injector is shut off. The engine can possibly misfire or run rough.
331 656 5	Injector solenoid driver cylinder 2 circuit-current below normal, or open circuit. Current detected at injector number 2 when voltage is turned off.	The current to the injector is shut off. The engine can possibly misfire or run rough.
332 656 5	Injector solenoid driver cylinder 4 circuit-current below normal, or open circuit. Current detected at injector number 4 when voltage is turned off.	The current to the injector is shut off. The engine can possibly misfire or run rough.
341 630 2	Severe loss of data from the ECM.	Possible no noticeable performance effects OR engine dying OR hard starting. Fault information, trip information and maintenance monitor data may be inaccurate.
343 629 12	Internal ECM error.	Possible none on performance or severe derate.
349 191 16	A frequency greater than calibrated threshold was detected at the tail shaft governor signal pin of the 31-pin machine connector.	Calibration dependent power and speed derate.
352 620 4	Low voltage detected on the ECM voltage supply line to some sensors (VSEN 1 supply).	Engine is derated to no air setting.
386 620 3	High voltage detected on the ECM voltage supply line to some sensors (VSEN 1 supply).	Engine is derated to no air setting.

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
387 1043 3	High voltage detected on the ECM voltage supply line to the throttle (VTP supply)	Engine will only idle.
388 1072 11	Less than 6 VDC detected at the engine brake circuit 1 when on indicates an excessive current draw from the electronic control module (ECM) or faulty ECM output circuit.	Engine brake 1 can not be activated.
392 1073 11	Less than 6 VDC detected at the engine brake circuit 2 when on indicates an excessive current draw from the electronic control module (ECM) or faulty ECM output circuit.	Engine brake 2 can not be activated.
415 100 1	Oil pressure signal indicates oil pressure below the very low oil pressure engine protection limit.	Progressive power derate with increasing time from alert. If engine protection shutdown feature is enabled, engine will shut down 30 seconds after red lamp starts flashing.
418 097 15	Water has been detected in the fuel filter.	Possible white smoke, loss of power, or hard starting.
419 1319 2	An error in the intake manifold pressure sensor signal was detected by the ECM.	Engine is derated to no air setting.
422 111 2	Voltage detected simultaneously on both the coolant level high and low signal circuits OR no voltage detected on both circuits.	No engine protection for coolant level.
426 639 2	Communication between the ECM and the J1939 data link has been lost.	None on performance. J1939 devices may not operate.
428 97 3	High voltage detected at water-in-fuel sensor.	None on performance.
429 97 4	Low voltage detected at water-in-fuel sensor.	None on performance.
431 558 2	Voltage detected simultaneously on both the idle validation off-idle and on-idle circuits.	None on performance.
432 558 13	Voltage detected at idle validation on-idle circuit when voltage at throttle position circuit indicates the pedal is not at idle OR voltage detected at idle validation off-idle circuit when voltage at throttle position circuit indicates the pedal is at idle.	Engine will only idle.
433 102 2	Voltage signal at intake manifold pressure circuit indicates high intake manifold pressure but other engine characteristics indicate intake manifold pressure must be low.	Derate to no air setting.
434 627 2	Supply voltage to the ECM fell below 6.2 VDC for a fraction of a second OR the ECM was not allowed to power down correctly (retain battery voltage for 30 seconds after key off).	Possible no noticeable performance effects OR possibility of engine dying OR hard starting. Fault information, trip information and maintenance monitor data may be inaccurate.
435 100 2	An error in the oil pressure sensor signal was detected by the ECM.	None on performance. No engine protection for oil pressure.
441 168 18	Battery voltage below normal operating level.	Possible no noticeable performance effects OR possibility of rough idle.

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
442 168 16	Battery voltage below normal operating level.	None on performance.
443 1043 4	Low voltage detected on the ECM voltage supply line to the throttle(s) (VTP supply).	Engine will only idle.
465 1188 3	High voltage detected at the wastegate actuator number 1 circuit when no voltage was being supplied by the electronic control module (ECM).	Engine will run derated.
466 1188 4	Less than +6 VDC detected at the wastegate actuator number 1 circuit when on indicates an excessive current draw from the electronic control module (ECM) or faulty ECM output circuit.	Engine will run derated.
472 1380 2	Either high or low voltage detected on the crankcase oil level sensor circuit by the electronic control module (ECM).	None on performance. Centinel system deactivated.
474 1321 2	Either low voltage detected when +12 VDC are commanded or voltage detected when no voltafe is commanded.	Either the engine will not start or the engine will not have starter lockout protection.
475 1351 4	Low voltage was detected on the electronic air compressor circuit when high voltage was expected.	Air compressor will not shut off.
476 1351 3	High voltage or an open circuit detected at the electronic air compressor governor actuator circuit.	Air compressor runs continuously or not at all.
489 191 18	Auxiliary speed frequency on input pin indicated that the frequency is below a calibration dependent threshold.	Engine will only idle.
491 1189 3	High voltage detected at the wastegate actuator number 2 circuit when no voltage was being supplied by the electronic control module (ECM).	Engine will run derated.
492 1189 4	Less than +6 VDC detected at the wastegate actuator number 2 circuit when activated indicates an excessive current draw from the electronic control module (ECM) or faulty ECM output circuit.	Engine will run derated.
527 702 3	Less than 17.0 VDC detected at the dual output A signal pin of the 31-pin machine connector.	No action taken by the ECM.
528 093 2	Less than 17.0 VDC detected at the dual output B signal pin of the 31-pin machine connector.	No action taken by the ECM.
529 703 3	Less than 17.0 VDC detected at the dual output B signal pin at the ECM.	No action taken by the ECM.
536 718 11	Either low voltage detected on autoshift low gear actuator circuit when +12 VDC are commanded or voltage detected when no voltage is commanded.	Top 2 lockout solenoid will not function properly. Transmission will not shift properly.
537 717 11	Either low voltage detected on autoshift high gear actuator circuit when (+) 12 VDC are commanded or voltage detected when no voltage is commanded.	Top 2 shift solenoid will not function properly. Transmission will not shift properly.

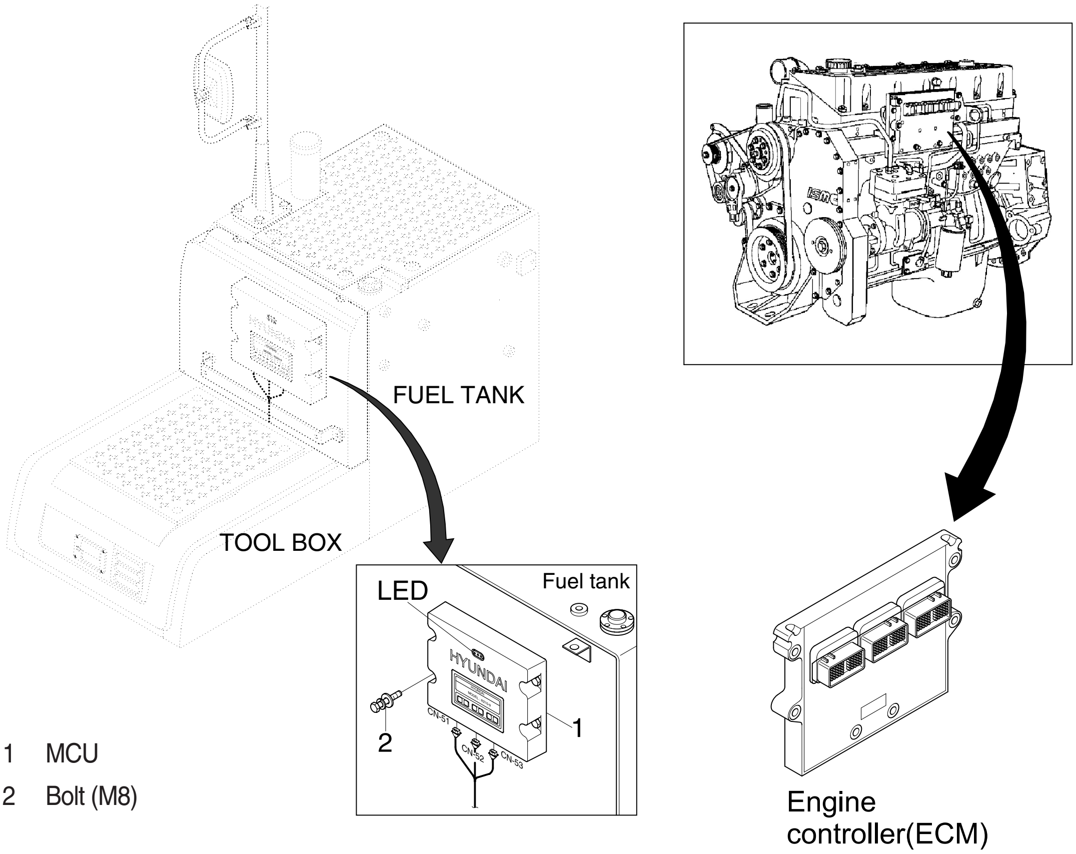
※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
538 719 11	Either low voltage detected on autoshift neutral gear actuator circuit when +12 VDC are commanded or voltage detected when no voltage is commanded.	Top 2 neutral actuator will not function properly. Transmission will not shift properly.
544 611 7	Autoshift failure ; at least three shift attempts were missed.	Top 2 transmission will not be controlled correctly. Transmission remains in manual mode.
551 558 4	No voltage detected simultaneously on both the idle validation off-idle and on-idle circuits.	Engine will only idle.
581 1381 3	High voltage detected at the fuel inlet restriction sensor signal pin.	Fuel inlet restriction monitor deactivated.
582 1381 4	Low voltage detected at the fuel inlet restriction sensor signal pin	Fuel inlet restriction monitor deactivated.
583 1381 18	Restriction has been detected at the fuel pump inlet.	Fuel inlet restriction monitor warning is set.
588 611 3	High voltage detected at the alarm circuit when low voltage was expected by the ECM.	The ICON system will be disabled. Only mandatory shutdown will be enabled. Engine can be started normally.
589 611 4	Less than +6 VDC detected at the engine start alarm circuit when high voltage was expected by the ECM.	The ICON idle control system will be disabled. Only mandatory shutdown will be enabled. Engine can be started normally.
596 167 16	High battery voltage detected by the battery voltage monitor feature.	Yellow lamp will be lit until high battery voltage condition is corrected.
597 167 16	ICONTM has restarted the engine three times within three hours due to low battery voltage (automotive only) OR low battery voltage detected by the battery voltage monitor feature.	Yellow lamp will be lit until low battery voltage condition is corrected. The ECM may increase idle speed and deactivate idle decrement switch if idle speedup is enabled. The engine will run continuously if ICONTM is active (automotive only).
598 167 1	Very low battery voltage detected by the battery voltage monitor feature.	Red lamp lit until very low battery voltage condition is corrected.
611 1383 31	Engine shutdown by operator before proper engine cool down resulting in filtered load factor above maximum shutdown threshold.	No action taken by the ECM.
951 166 2	A power imbalance between cylinders was detected by the ECM.	Engine may have rough idle or misfire.

※ Some fault codes are not applied to this machine.

GROUP 12 ENGINE CONTROL SYSTEM

1. MCU and Engine ECM (Electronic Control Module)



1 MCU
2 Bolt (M8)

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 controller and cluster are disconnected
Three LED are turned OFF	Trouble on MCU power	· Check if the input power wire (24 V, GND) of controller is disconnected · Check the fuse

G : green, R : red, Y : yellow

GROUP 13 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.

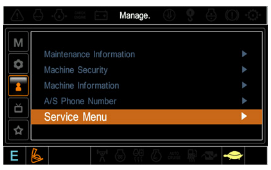
(3) Pressure and electric current value for each mode

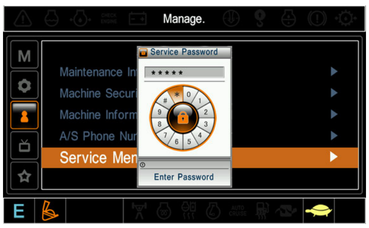
Mode		Pressure		Electric current (mA)	Engine rpm (at accel dial 10)
		kgf/cm²	psi		
Standard (Stage : 1.0)	P	7(~4)	101(~58)	-	1750 ± 50
	S	9(~6)	130(~87)	-	1650 ± 50
	E	10(~7)	145(~101)	-	1600 ± 50
Option (Stage : 2.0)	P	7(~4)	101(~58)	-	1800 ± 50
	S	9(~6)	130(~87)	-	1700 ± 50
	E	12(~9)	174(~130)	-	1600 ± 50

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

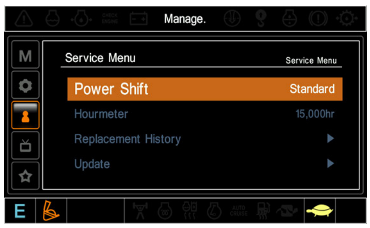
You can switch the EPPR valve pressure set by selecting the stage (1.0↔2.0).

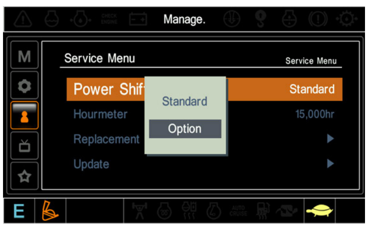
- Management
  · Service menu





Enter the password



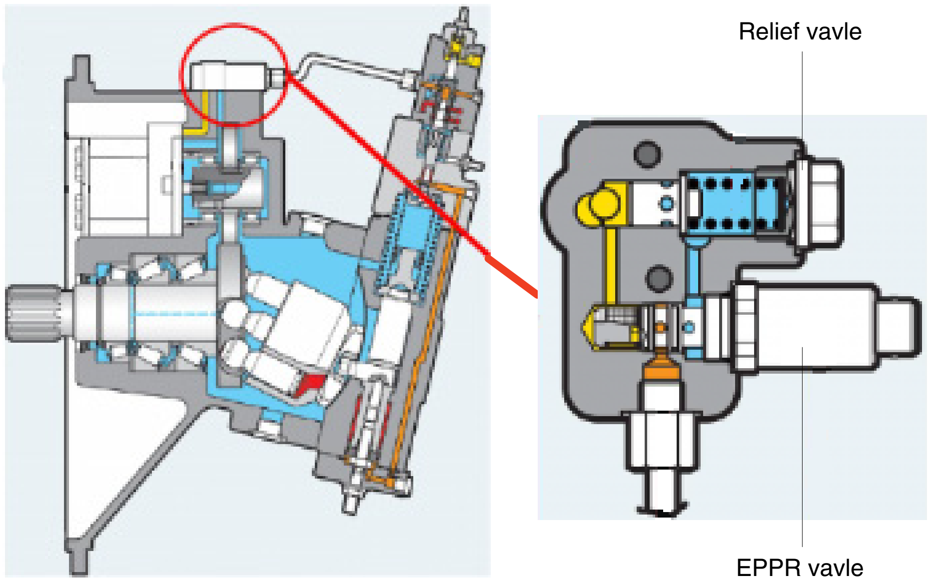


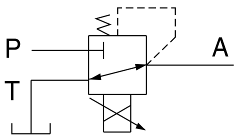
· Power shift (standard/option) : Power shift pressure can be set by option menu.

3) OPERATING PRINCIPLE (pump EPPR valve)

(1) Structure

(1) Structure

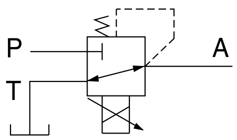


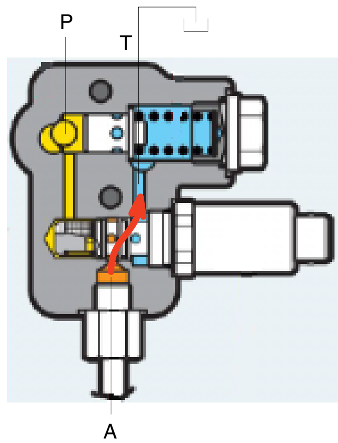


P Pilot oil supply line (pilot pressure)
T Return to tank
A Negative control pressure to main pump

(2) Neutral

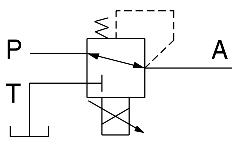
Pressure line is blocked and A oil returns to tank.

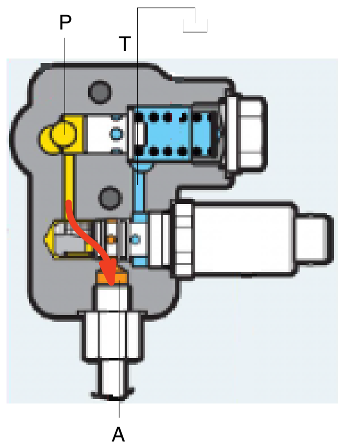




(3) Operating

Negative control pressure enters into A.





4) EPPR VALVE CHECK PROCEDURE

(1) Check electric current value at EPPR valve

① Disconnect connector CN-75 from EPPR valve.

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

③ Start engine.

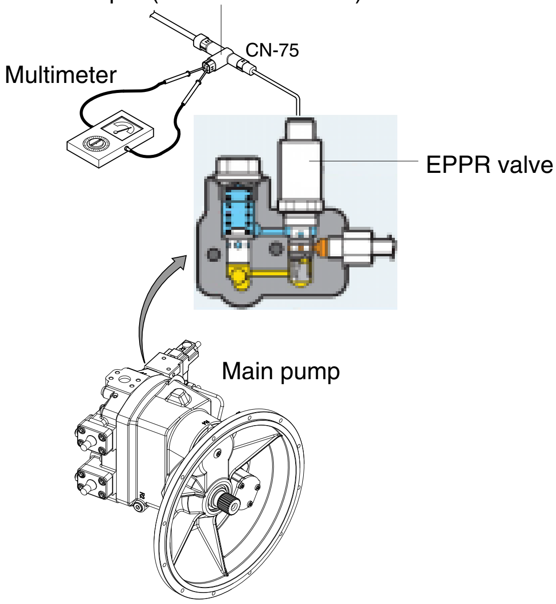
④ Set S-mode and cancel auto decel mode.

⑤ Position the accel dial at 10.

⑥ If rpm display show approx 1750±50 rpm check electric current at bucket circuit relief position.

⑦ Check electric current at bucket circuit relief position.

Spec : 100~700 mA



(2) Check pressure at EPPR valve

① Start engine.

② Set S-mode and cancel auto decel mode.

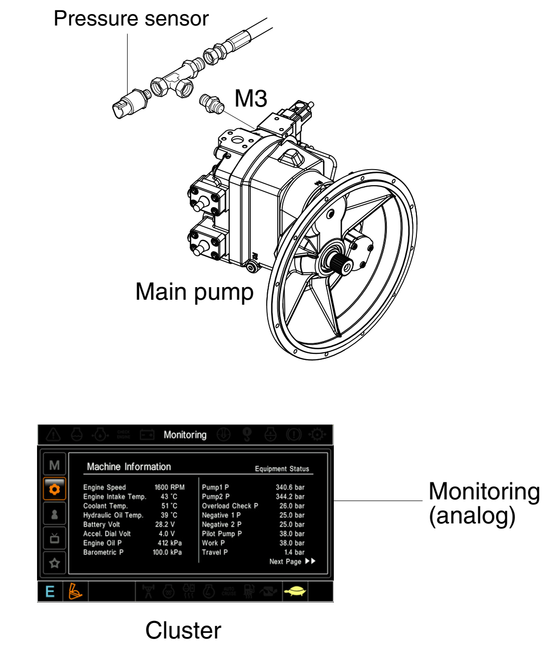
③ Position the accel dial at 10.

④ If tachometer show approx 1750±50 rpm check pressure at relief position of bucket circuit by operating bucket control lever.

⑤ If pressure is not correct, adjust it.

⑥ After adjust, test the machine.

Spec : 2~40 kgf/cm^2 (30~580 psi)



2. EPIC EPPR VALVE

1) COMPOSITION

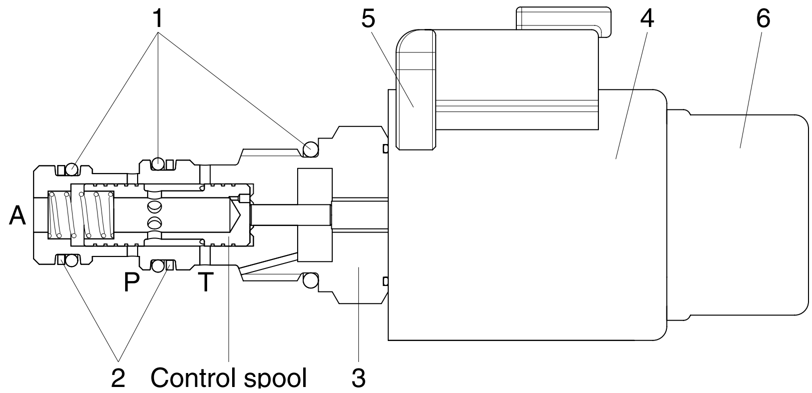
The boom priority EPPR valve is built in a manifold and mainly consisting of valve body and coil. This EPPR valve installed under the solenoid valve.

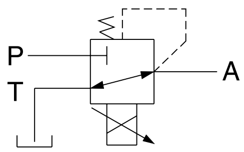
2) CONTROL

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





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-242,243 from EPPR valve.

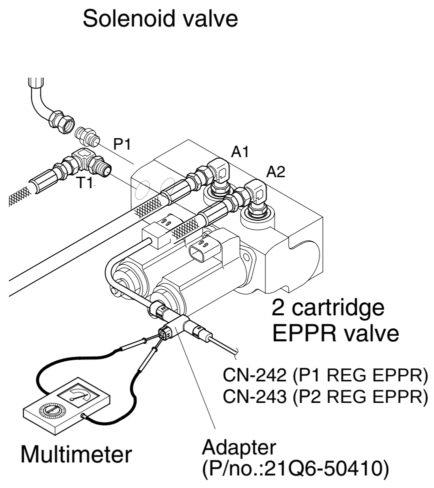
② Insert the adapter to CN-242,243 and install multimeter as figure.

③ Start engine.

④ If rpm display approx 1750±50 rpm disconnect one wire harness from EPPR valve.

⑤ Check electric current in case of combined boom up and swing operation.

Spec : 0~600 mA



(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)

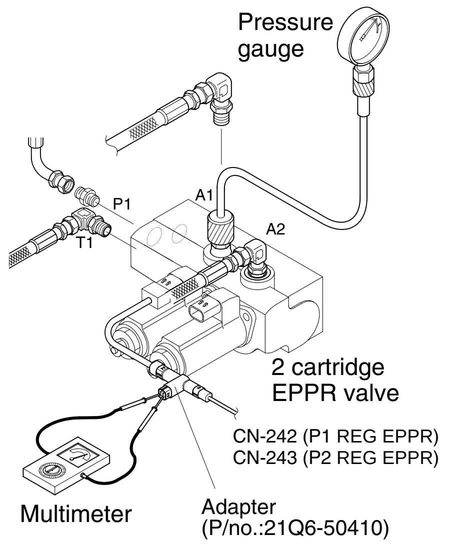
② Start engine.

③ If rpm display approx 1750±50 rpm check pressure at relief position of bucket circuit by operating bucket control lever.

④ If pressure is not correct, adjust it.

⑤ After adjust, test the machine.

Spec : 0~38 kgf/cm² (0~530 psi)



GROUP 14 MONITORING SYSTEM

1. OUTLINE

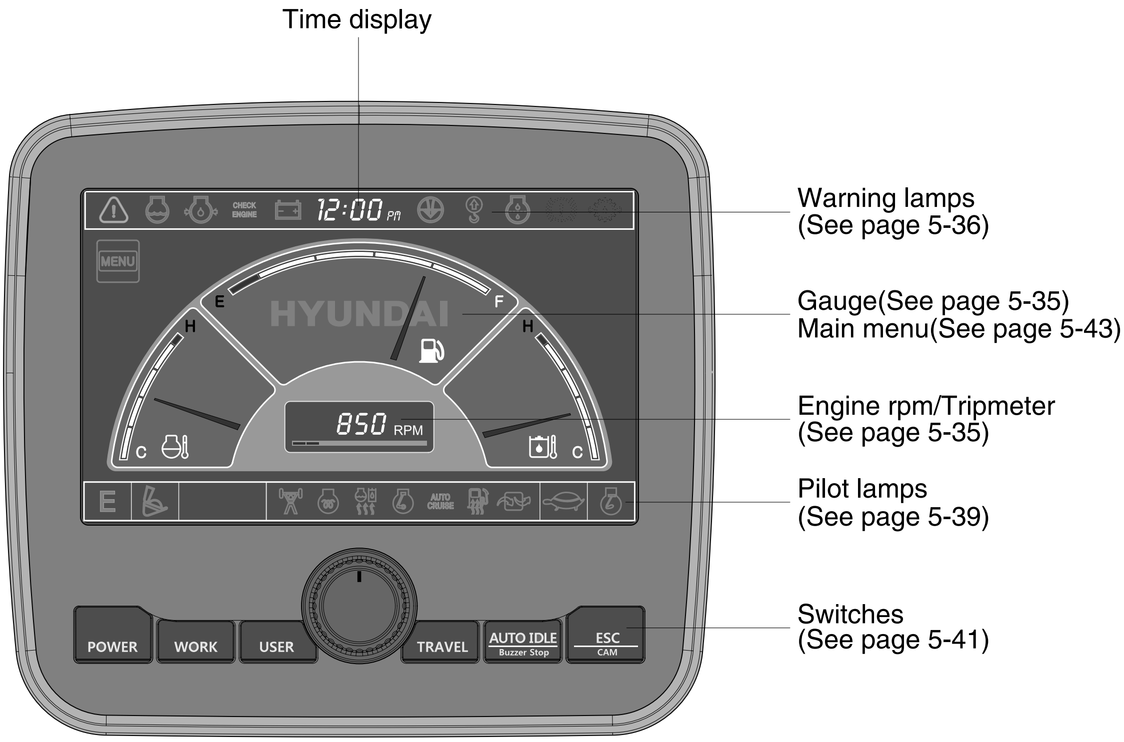
Monitoring system consists of the monitor part and switch part.

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



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 to 1200 rpm.

※ Others same as above.

③ When abnormal condition

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

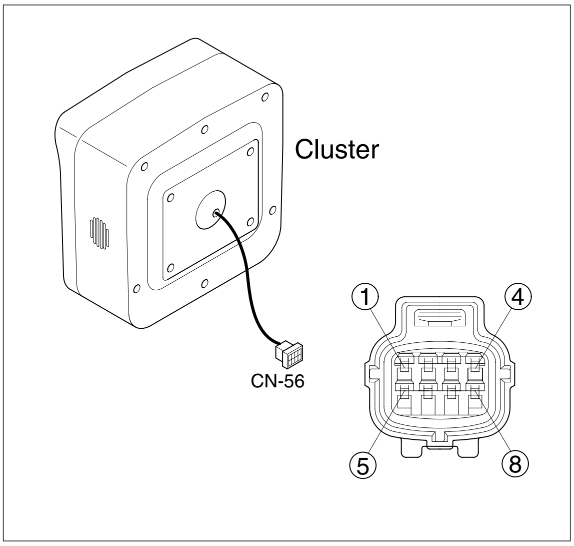
b. If BUZZER STOP switch is pressed, buzzer sound is canceled but the lamp warning lights up until normal condition.

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

3. CLUSTER CONNECTOR

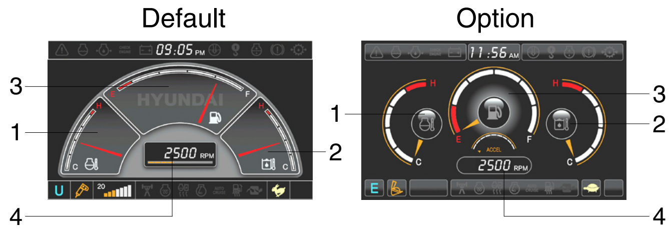
No.	Name	Signal
1	Battery 24V	20~32V
2	Signal 3	NTSC
3	GND	-
4	Serial + (TX)	0~5V
5	Power IG (24V)	20~32V
6	Signal 2	NTSC
7	Camera signal	NTSC
8	Serial - (RX)	0~5V

※ NTSC : the united states National Television Systems Committee



2) GAUGE

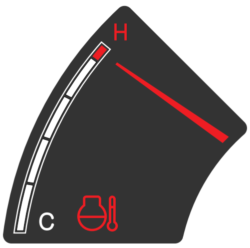
(1) Operation screen



1 Engine coolant temperature gauge
2 Hydraulic oil temperature gauge
3 Fuel level gauge
4 RPM / Tripmeter display

※ Operation screen type can be set by the screen type menu of the display.
Refer to page 5-54 for details.

(2) Engine coolant temperature gauge

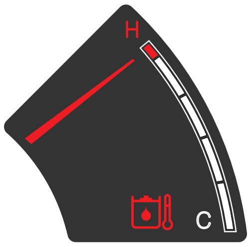


① This gauge indicates the temperature of coolant.
- White range : 40-107˚C (104-225˚F)
- Red range : Above 107˚C (225˚F)

② If the indicator is in the red range or lamp blinks in red, 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.

(3) Hydraulic oil temperature gauge

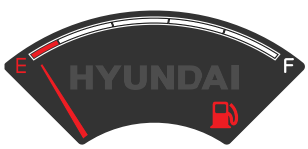


① This gauge indicates the temperature of hydraulic oil.
- White range : 40-105˚C(104-221˚F)
- Red range : Above 105˚C(221˚F)

② If the indicator is in the red range or lamp blinks is red, 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.

(4) Fuel level gauge



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

② Fill the fuel when the red range, or lamp blinks in red.

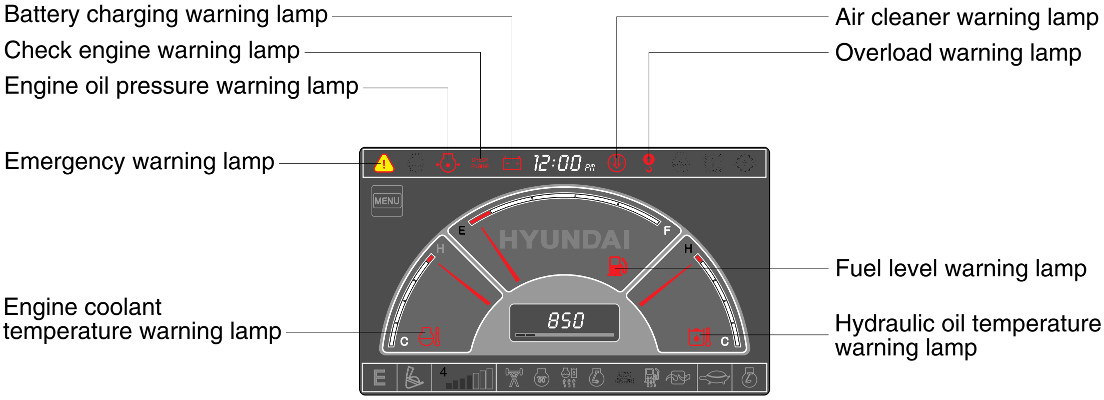
※ If the gauge indicates the red range or lamp blinks in red even though the machine is on the normal condition, check the electric device as that can be caused by the poor connection of electricity or sensor.

(5) RPM / Tripmeter display

① This displays the engine speed or the tripmeter.

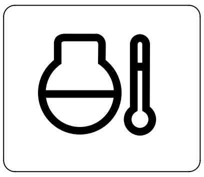
※ Refer to page 5-53 for details.

3) WARNING LAMPS



※ Each warning lamp on the top of the LCD pops up on the center of LCD and the buzzer sounds when the each warning is happened. The pop-up warning lamp moves to the original position and blinks when the select switch is pushed. And the buzzer stops.

(1) Engine coolant temperature

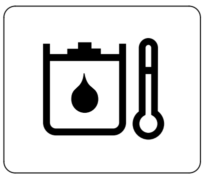


① Engine coolant temperature warning is indicated two steps.
- 103˚C over : The lamp blinks and the buzzer sounds.
- 107˚C over : The lamp pops up on the center of LCD and the buzzer sounds.

② The pop-up lamp moves to the original position and blinks when the select switch is pushed. Also, the buzzer stops and lamp keeps blink.

③ Check the cooling system when the lamp keeps ON.

(2) Hydraulic oil temperature



① Hydraulic oil temperature warning is indicated two steps.
- 100˚C over : The lamp blinks and the buzzer sounds.
- 105˚C over : The lamp pops up on the center of LCD and the buzzer sounds.

② The pop-up lamp moves to the original position and blinks when the select switch is pushed. Also, the buzzer stops and lamp keeps blink.

③ Check the hydraulic oil level and hydraulic oil cooling system.

(3) Fuel level

① This warning lamp blinks and the buzzer sounds when the level of fuel is below 61 ℓ (16.1 U.S. gal).

② Fill the fuel immediately when the lamp blinks.

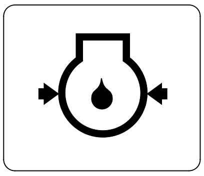
(4) Emergency warning lamp

① This 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)
- Pump EPPR circuit abnormal or open
- Attachment flow EPPR circuit abnormal or open
- MCU input voltage abnormal
- Accel dial circuit abnormal or open
- Cluster communication data error
- Engine ECM communication data error

※ **The pop-up warning lamp moves to the original position and blinks when the select switch is pushed. Also the buzzer stops. This is same as following warning lamps.**

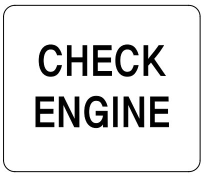
② When this warning lamp blinks, machine must be checked and serviced immediately.

(5) Engine oil pressure warning lamp



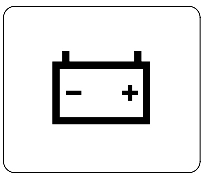
① This lamp blinks when the engine oil pressure is low.
② If the lamp blinks, shut OFF the engine immediately. Check oil level.

(6) Check engine warning lamp



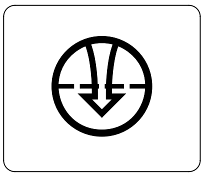
① This lamp blinks when the communication between MCU and engine ECM on the engine is abnormal, or if the cluster received any fault code from engine ECM.
② Check the communication line between them.
If the communication line is OK, then check the fault codes on the cluster.
③ This lamp blinks when "Engine check water in fuel" is displayed in the message box then check water separator.

(7) Battery charging warning lamp



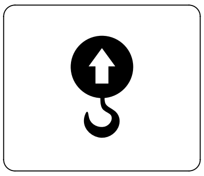
① This lamp blinks when the battery charging voltage is low.
② Check the battery charging circuit when this lamp blinks.

(8) Air cleaner warning lamp



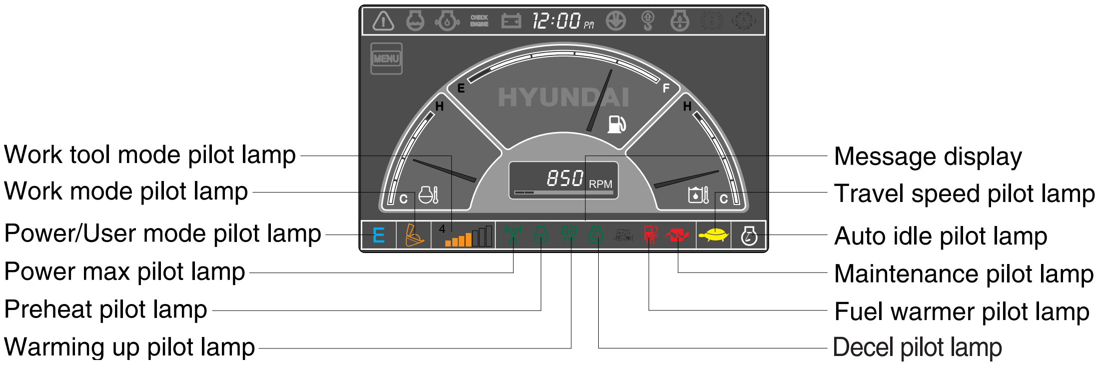
① This lamp blinks when the filter of air cleaner is clogged.
② Check the filter and clean or replace it.

(9) Overload warning lamp (opt)

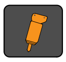


① When the machine is overload, the overload warning lamp blinks during the overload switch is ON. (if equipped)
② Reduce the machine load.

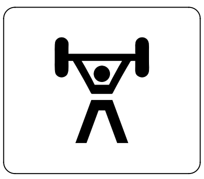
4) PILOT LAMPS



(1) Mode pilot lamps

No	Mode	Pilot lamp	Selected mode
1	Power mode	P S E	Heavy duty power work mode Standard power mode Economy power mode
2	User mode	U	User preferable power mode
3	Work mode	  	General operation mode Breaker operation mode Crusher operation mode
4	Travel mode	 	Low speed traveling High speed traveling
5	Auto idle mode		Auto idle
6	Work tool mode		Oil flow level of breaker or crusher mode
7	Message display		"Setting is completed" display after selection

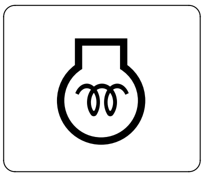
(2) Power max pilot lamp



① The lamp will be ON when pushing power max switch on the LH RCV lever.

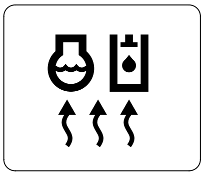
② The power max function is operated maximum 8 seconds.

(3) Preheat pilot lamp



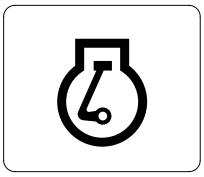
① Turning the start key switch ON position starts preheating in cold weather.
② Start the engine after this lamp is OFF.

(4) Warming up pilot lamp



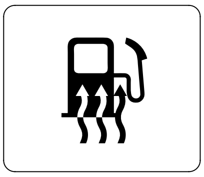
① This lamp is turned ON when the coolant temperature is below 30˚C(86˚F).
② The automatic warming up is cancelled when the engine coolant temperature is above 30˚C, or when 10 minutes have passed since starting the engine.

(5) Decel pilot lamp



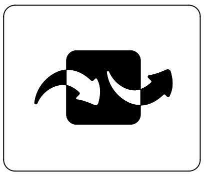
① Operating one touch decel switch on the RCV lever makes the lamp ON.
② Also, the lamp will be ON and engine speed will be lowered automatically to save fuel consumption when all levers and pedals are at neutral position, and the auto idle function is selected.
※ **One touch decel is not available when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

(6) Fuel warmer pilot lamp



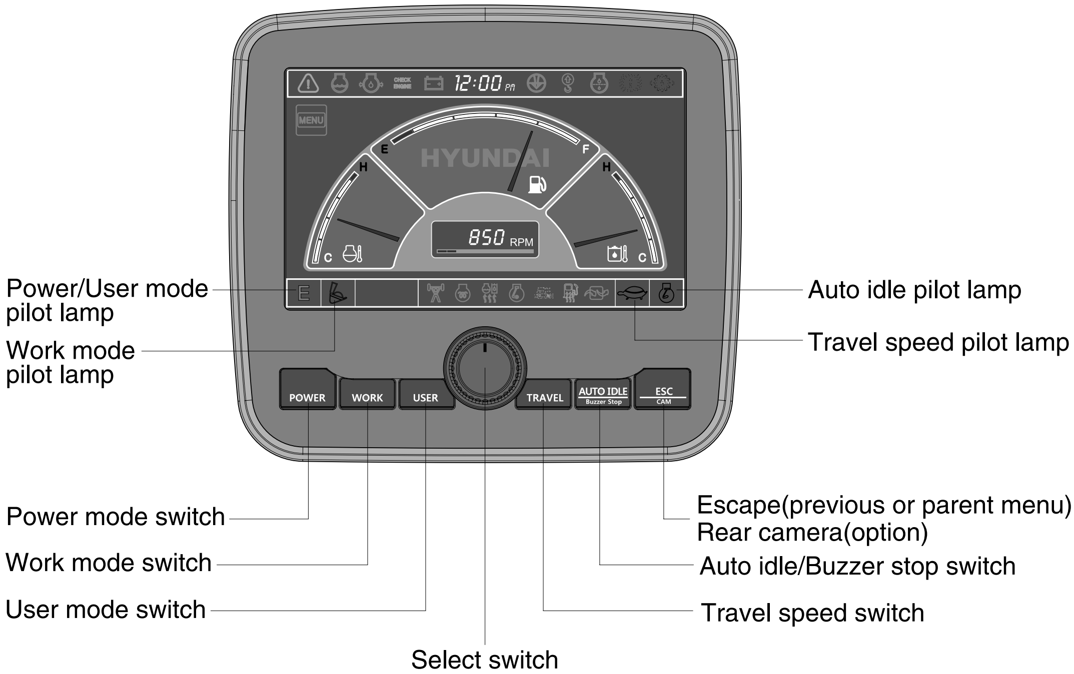
① This lamp is turned ON when the coolant temperature is below 10˚C (50˚F) or the hydraulic oil temperature 20˚C (68˚F).
② The automatic fuel warming is cancelled when the engine coolant temperature is above 60˚C, or the hydraulic oil temperature is above 45˚C since the start switch was ON position.

(7) Maintenance pilot lamp



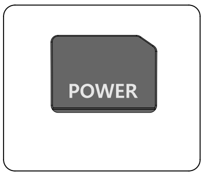
① This lamp will be ON when the consuming parts are needed to change or replace. It means that the change or replacement interval of the consuming parts remains below 30 hours.
② Check the message in maintenance information of main menu. Also, this lamp lights ON for 3 minutes when the start switch is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

5) SWITCHES



※ When the switches are selected, the pilot lamps are displayed on the LCD. Refer to the page 5-40 for details.

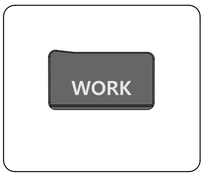
(1) Power mode switch



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

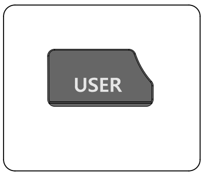
② The pilot lamp changes E → S → P → E in order.

(2) Work mode switch



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

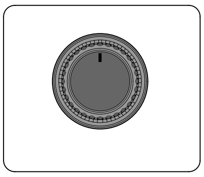
(3) User mode switch



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

② Refer to the page 5-44 for another set of user mode.

(4) Select switch

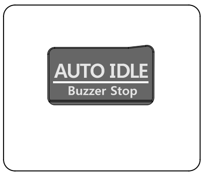


① This switch is used to select or change the menu and input value.

② Knob push
 · Long (over 2 sec) : Return to the operation screen
 · Medium (0.5~2 sec) : Return to the previous screen
 · Short (below 0.5 sec) : Select menu

③ Knob rotation
This knob changes menu and input value.
 · Right turning : Down direction / Increase input value
 · Left turning : Up direction / Decreased input value

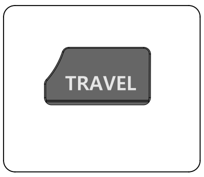
(5) Auto idle/ buzzer stop switch



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

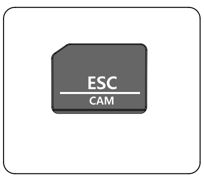
② The buzzer sounds when the machine has a problem.
In this case, push this switch and buzzer stops, but the warning lamp blinks until the problem is cleared.

(6) Travel speed control switch



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

(7) Escape/Camera switch

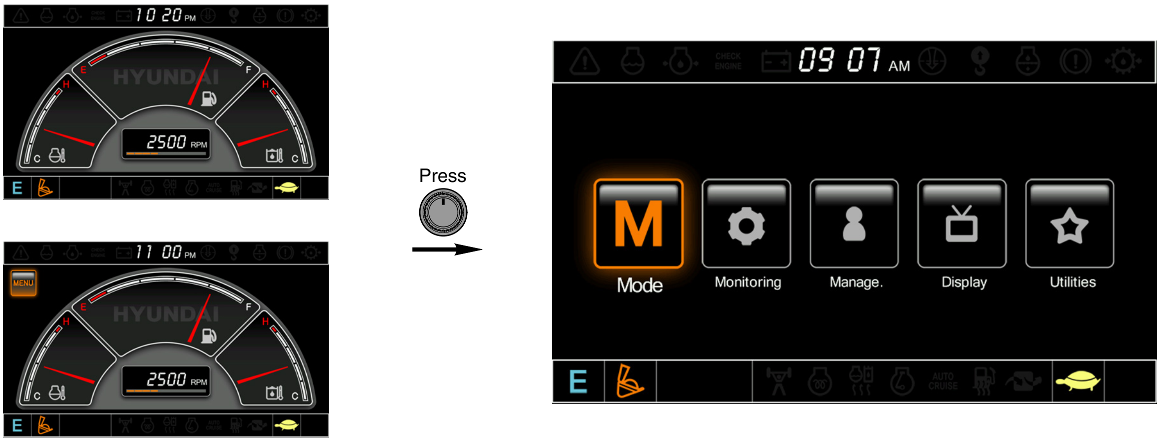


① This switch is used to return to the previous menu or parent menu.

② In the operation screen, pushing this switch will display the view of the camera on the machine (if equipped).
Please refer to page 5-54 for the camera.

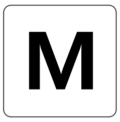
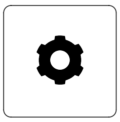
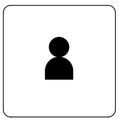
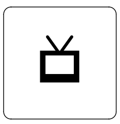
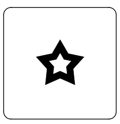
③ If the camera is not installed, this switch is used only ESC function.

6) MAIN MENU



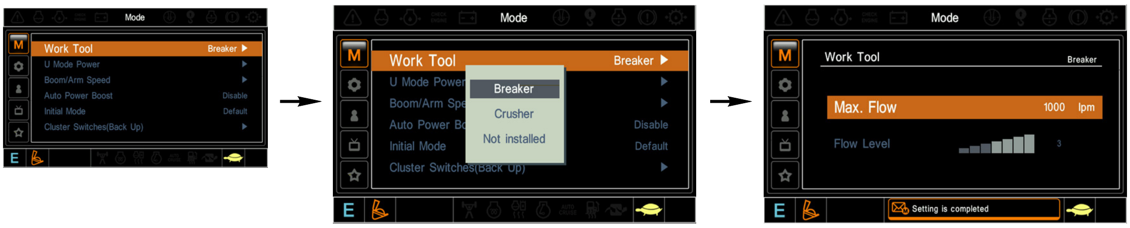
※ Please refer to select switch, page 5-43 for selection and change of menu and input value.

(1) Structure

No	Main menu	Sub menu	Description
1	 Mode 21093CD64D	Work tool U mode power Boom/Arm speed Auto power boost Initial mode Cluster switch (back up)	Breaker, Crusher, Not installed User mode only Boom speed, Arm speed Enable, Disable Default, U mode Switch function
2	 Monitoring 21093CD64E	Active fault Logged fault Delete logged fault Monitoring (analog) Monitoring (digital) Operating hours	MCU, Engine ECM MCU, Engine ECM All logged fault delete, Initialization canceled Machine information Switch status, Output status Operating hours for each mode
3	 Management 21093CD64F	Maintenance information Machine security Machine Information A/S phone number Service menu	Replacement, Change interval oils and filters ESL mode setting, Password change Cluster, MCU, Engine, Machine A/S phone number, A/S phone number change Power shift, Hourmeter, Replacement history, Update
4	 Display 21093CD64G	Display item Clock Brightness Unit Language Screen type	Engine speed, Tripmeter A, Tripmeter B, Tripmeter C Clock Manual, Auto Temperature, Pressure, Flow, Date format Korean, English, Chinese A type, B type
5	 Utilities 21093CD64H	Tripmeter DMB Entertainment Camera setting Message box	3 kinds (A, B, C) DMB select, DAB select, Channel scan, Exit Play MP4, codec. Basic direction, Display switching, Full screen Record for fault, attachment etc.

(2) Mode setup

① Work tool

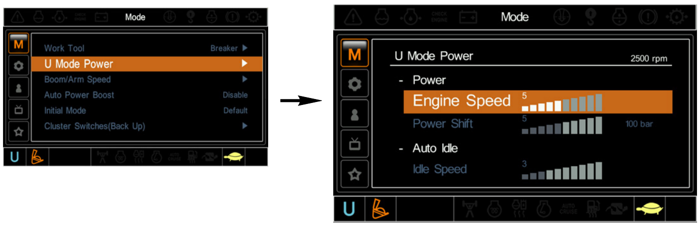


A B

- A : Select one installed optional attachment.
- B : Max flow - Set the maximum flow for the attachment.
  Flow level - Reduce the operating flow from maximum flow.
  Breaker - Max 7 steps, Reduced 10 lpm each step.
  Crusher - Max 4 steps, Reduced 20 lpm each step.

※ The flow level is displayed with the work mode pilot lamp.

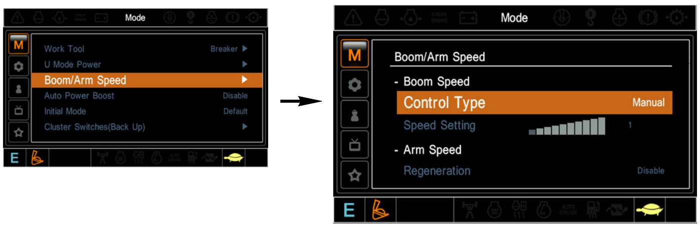
② U mode power



Step (▮)	Engine speed (rpm)	Idle speed (rpm)	Power shift (bar)
1	1400	850	0
2	1450	900	3
3	1500	950	6
4	1550	1000	9
5	1600	1050	12
6	1650	1100	16
7	1700	1150	20
8	1750	1200	26
9	1800	1250	32
10	1850	1300	38

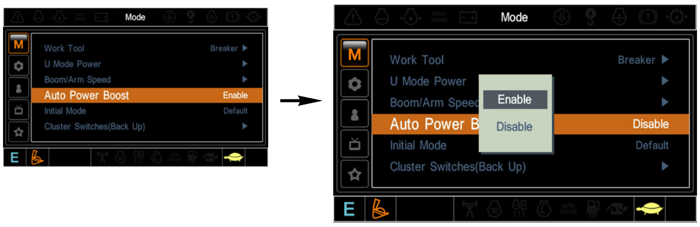
- Engine high idle rpm, auto idle rpm and pump torque (power shift) can be modulated and memorized separately in U-mode.
- U-mode can be activated by user mode switch.

③ Boom/Arm speed



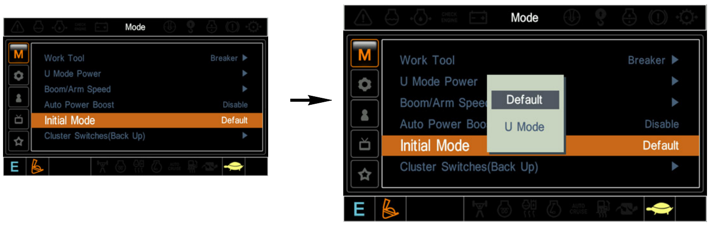
- Boom speed
  - Control type
    Manual - Boom up speed is fixed as set steps.
    Auto - Boom up speed is automatically adjusted as working conditions by the MCU.
  - Speed setting - Boom up speed is increased as much as activated steps.
- Arm speed
  - Regeneration - Arm regeneration function can be activated or cancelled.
    Enable - Arm in speed is up.
    Disable - Fine operation.

④ Auto power boost



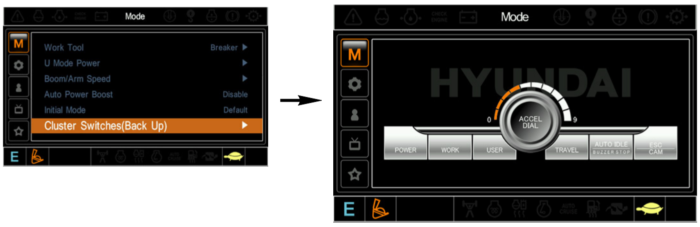
· The power boost function can be activated or cancelled.
· Enable - The digging power is automatically increased as working conditions by the MCU. It is operated max 8 seconds.
· Disable - Not operated.

⑤ Initial mode



· Default - The initial power mode is set E mode when the engine is started.
· U mode - The initial power mode is set U mode when the engine is started.

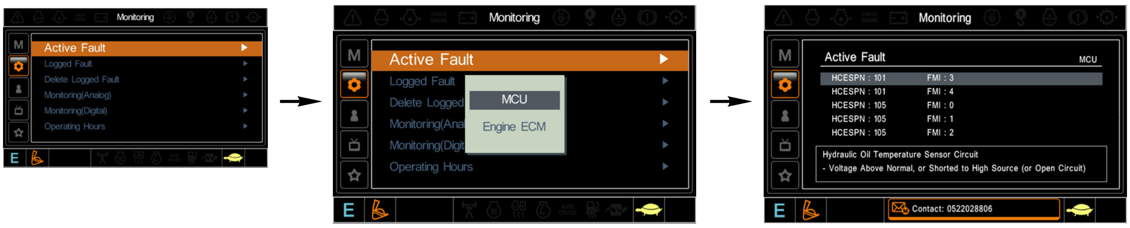
⑥ Cluster switch (back up)



- The cluster switch can be selected and changed by this menu when the switches are abnormal on the cluster.
- In order to exit "Cluster switch" mode, please put the cursor on the ESC/CAM switch by turning the select switch and push the select switch.
- In "Cluster switch", other switches except "Select switch" do not work.

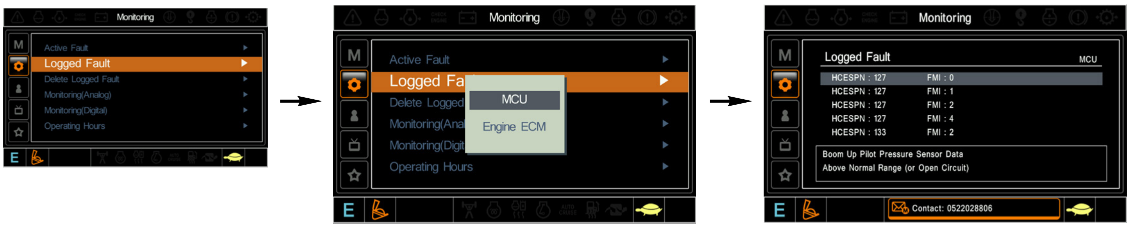
(3) Monitoring

① Active fault



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

② Logged fault

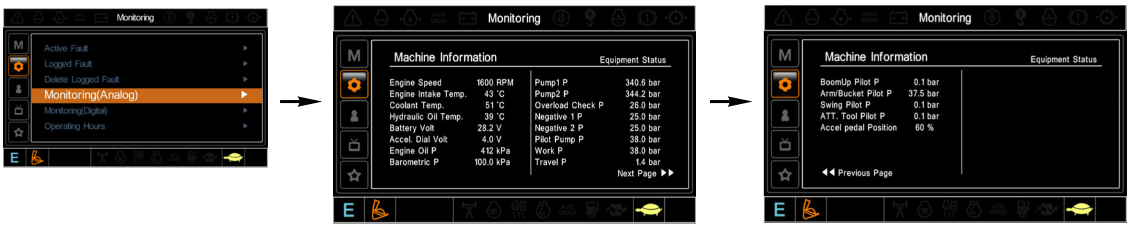


· The logged faults of the MCU or engine ECM can be checked by this menu.

③ Delete logged fault

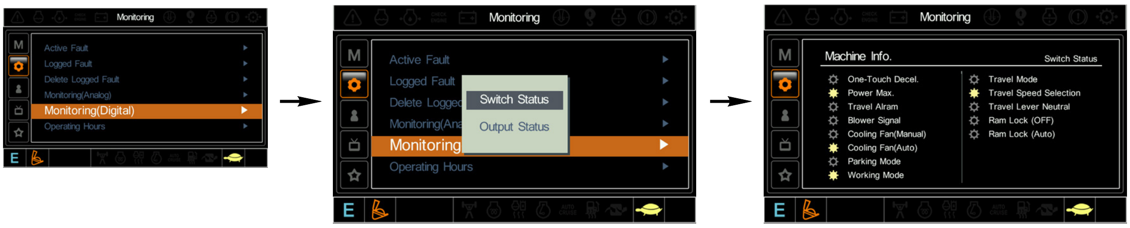
· The logged faults of the MCU or engine ECM can be deleted by this menu.

④ Monitoring (analog)



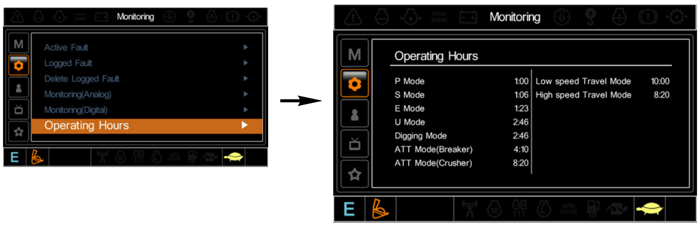
· The machine status such as the engine rpm, oil temperature, voltage and pressure etc. can be checked by this menu.

⑤ Monitoring (digital)



· The switch status or output status can be confirmed by this menu.
· The activated switch or output pilot lamps ✸ are light ON.

⑥ Operating hours



· The operating hour of each mode can be confirmed by this menu.

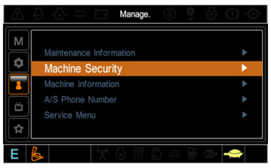
(4) Management

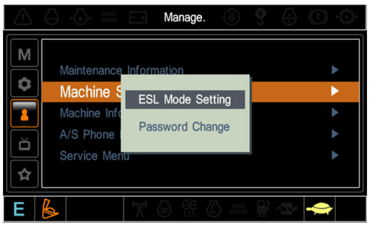
① Maintenance information

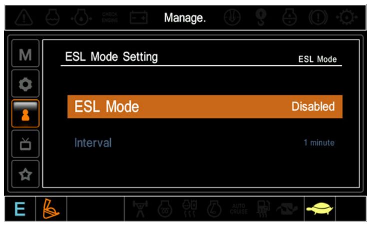
- Alarm( ) : Gray - Normal
  Yellow - First warning
  Red - Second warning
- Replacement : The elapsed time will be reset to zero (0).
- Change interval : The change or replace interval can be changed in the unit of 50 hours.
- OK : Return to the item list screen.
- Change or replace interval

No	Item	Interval
1	Engine oil	500
2	Final gear oil	1000
3	Swing gear oil	1000
4	Hydraulic oil	2000
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(filter)	1000
12	Air cleaner (inner)	500
13	Radiator coolant	2000
14	Swing gear pinion grease	1000

② Machine security



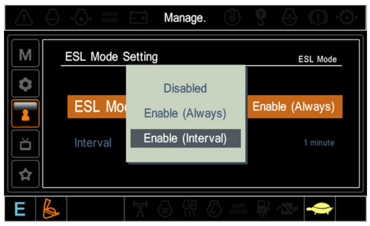


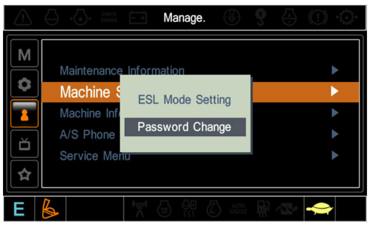


· ESL mode
- ESL : Engine Starting Limit
- ESL mode is designed to be a theft deterrent or will prevent the unauthorized operation of the machine.
- If the ESL mode was selected Enable, the password will be required when the start switch is turned ON.
- Disable : Not used ESL function

  Enable (always) : The password is required whenever the operator start engine.

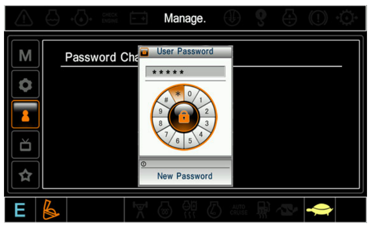
  Enable (interval) : The password is required when the operator start engine first. But the operator can restart the engine within the interval time without in putting the password. The interval time can be set maximum 4 hours.



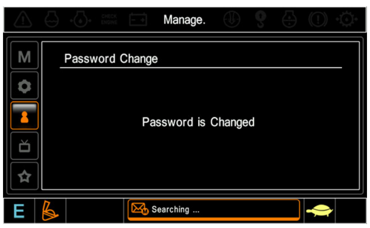


Enter the current password

· Password change
- The password is 5~10 digits.



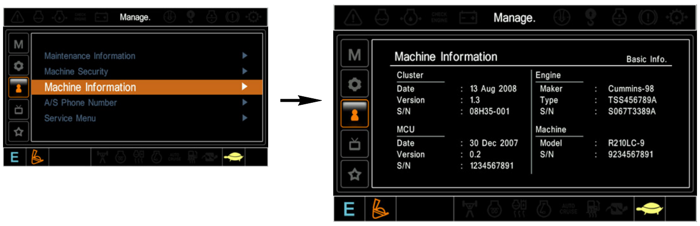
Enter the new password



The new password is stored in the MCU.

Enter the new password again

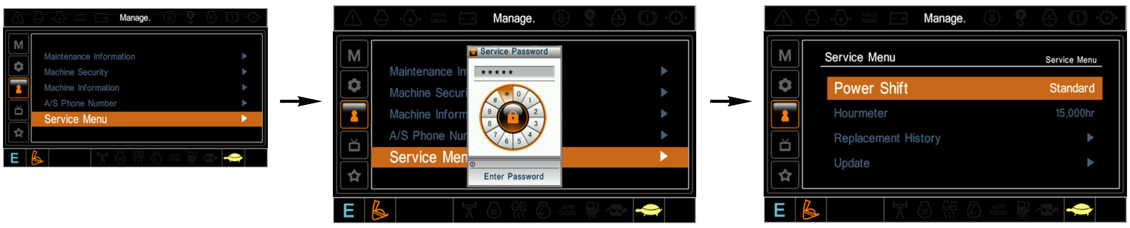
③ Machine Information



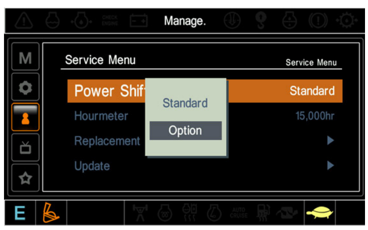
· This can confirm the identification of the cluster, MCU, engine and machine.

④ A/S phone number

⑤ Service menu



Enter the password



· Power shift (standard/option) : Power shift pressure can be set by option menu.
· Hourmeter : Operating hours since the machine line out can be checked by this menu.
· Replacement history : Replacement history of the MCU and cluster can be checked by this menu.
· Update : Firm ware can be upgraded by this menu. (the USB port is located under the cluster)

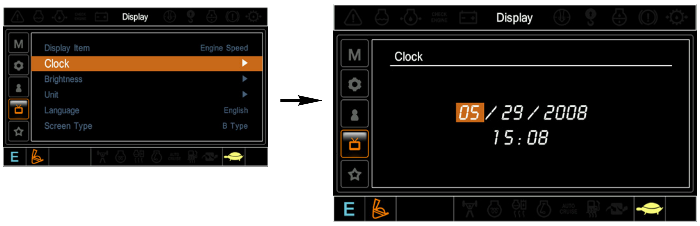
(5) Display

① Display item

Center display

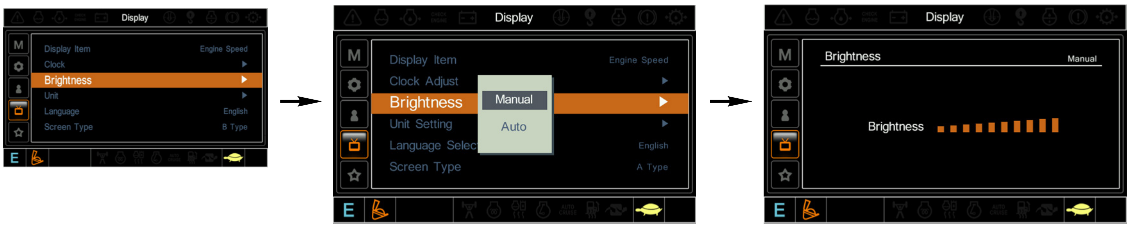
· The center display type of the LCD can be selected by this menu.
· The engine speed or each of the tripmeter (A,B,C) is displayed on the center display.

② Clock

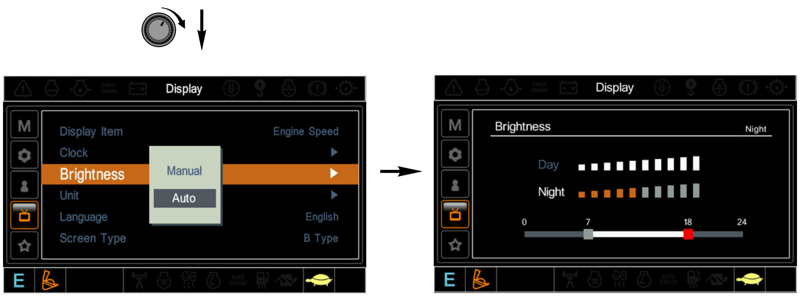


· The first line's three spots "**/**/****" represent Month/Day/Year each.
· The second line shows the current time. (0:00~23:59)

③ Brightness



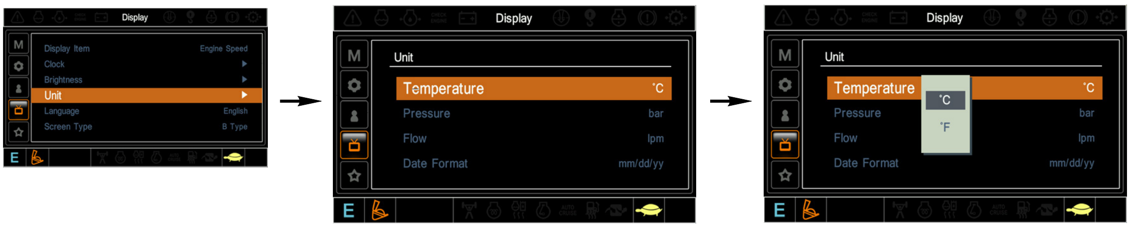
Manual (1st~10th step)



Auto (day/night)

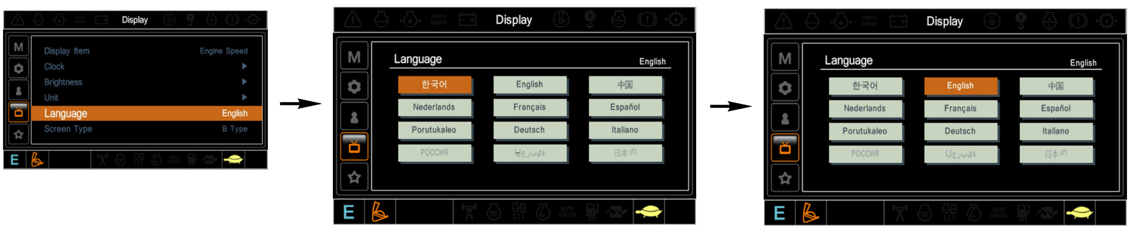
※ If "Auto" is chosen, brightness for day and night can be differently set up. Also by using the bar in lower side, users can define which time interval belongs to day and night.
(in bar figure, gray area represents night time while white shows day time)

④ Unit



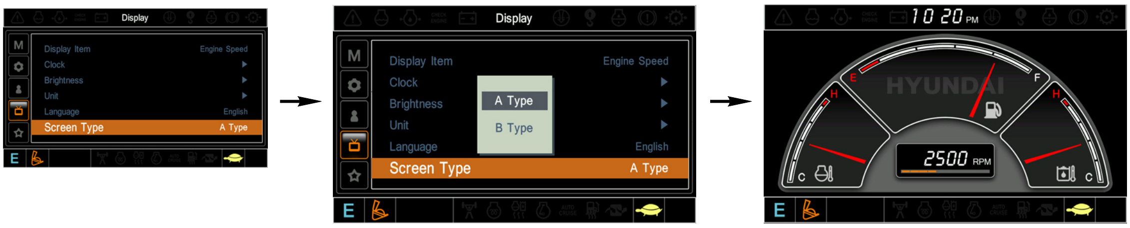
- Temperature : ˚C ↔ ˚F
- Pressure : bar ↔ MPa ↔ kgf/cm²
- Flow : lpm ↔ gpm
- Date format : yy/mm/dd ↔ mm/dd/yy ↔ dd-Mar-yy

⑤ Language



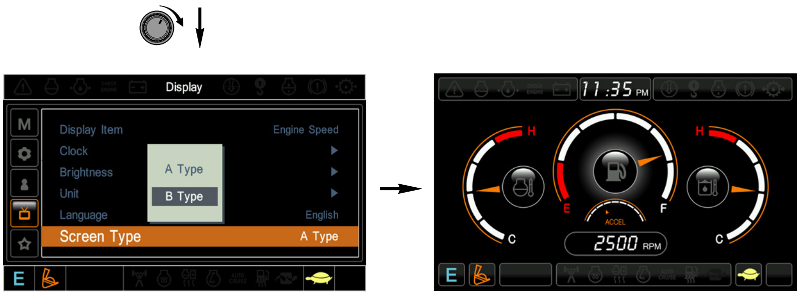
- User can select preferable language and all displays are changed the selected language.

⑥ Screen type



A Type

Standard

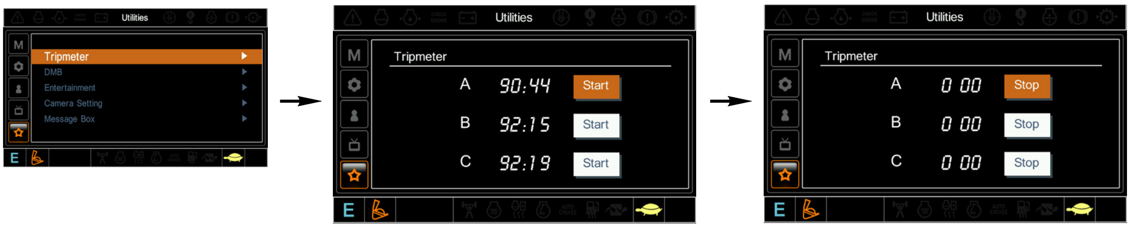


B Type

Option

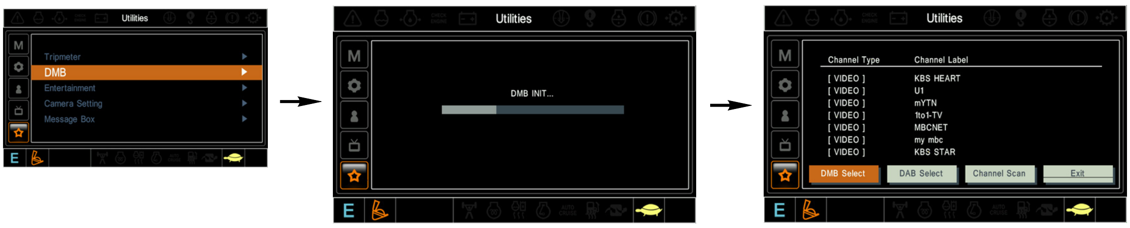
(6) Utilities

① Tripmeter



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

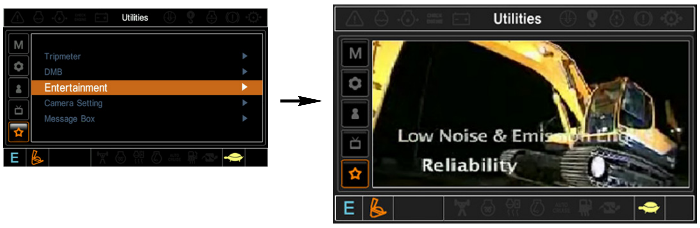
② DMB



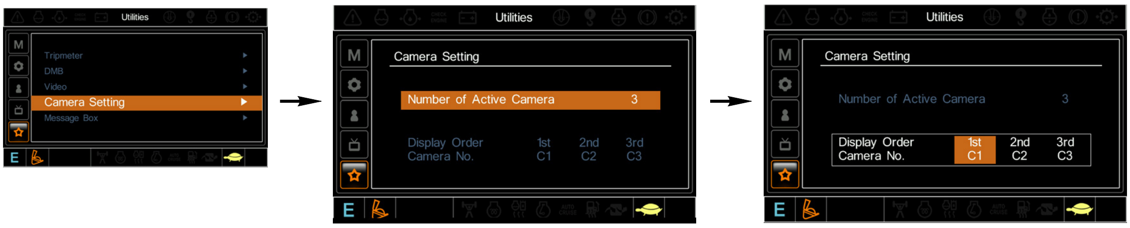
- DMB select : TV channel can be selected by this menu.
- DAB select : Audio channel can be selected by this menu.
- Channel scan : This menu can be used other region for TV/Audio.
- Exit : Exit DMB menu

③ Entertainment

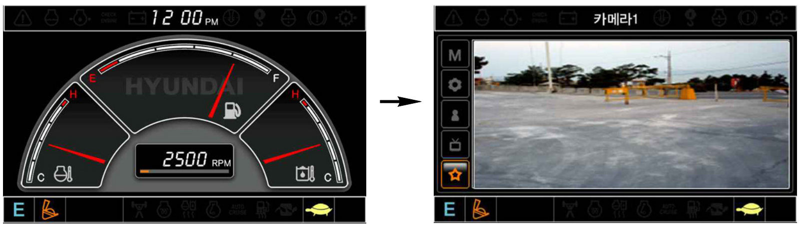
· Play MP4 or codec file of external hard disk through USB port.
· The USB port is located under the cluster.



④ Camera setting



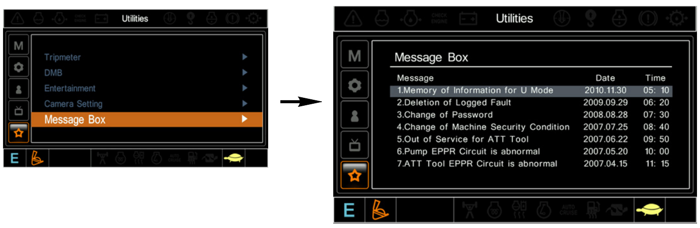
· Three cameras can be installed on the machine.
· The display order can be set by this menu.



· If the camera was not equipped, this menu is not useful.
· In the operation screen, if the ESC/CAM switch is pushed, the first ordered display camera will be viewed.
· Turning the select switch in clockwise direction, the next ordered will be shown and in counter-clockwise direction, the previously ordered will be shown.
· Push the select switch, the displayed screen will be enlargement.

⑤ Message box

· The history of the machine operating status can be checked by this menu.



SECTION 6 TROUBLESHOOTING

SECTION 6 TROUBLESHOOTING

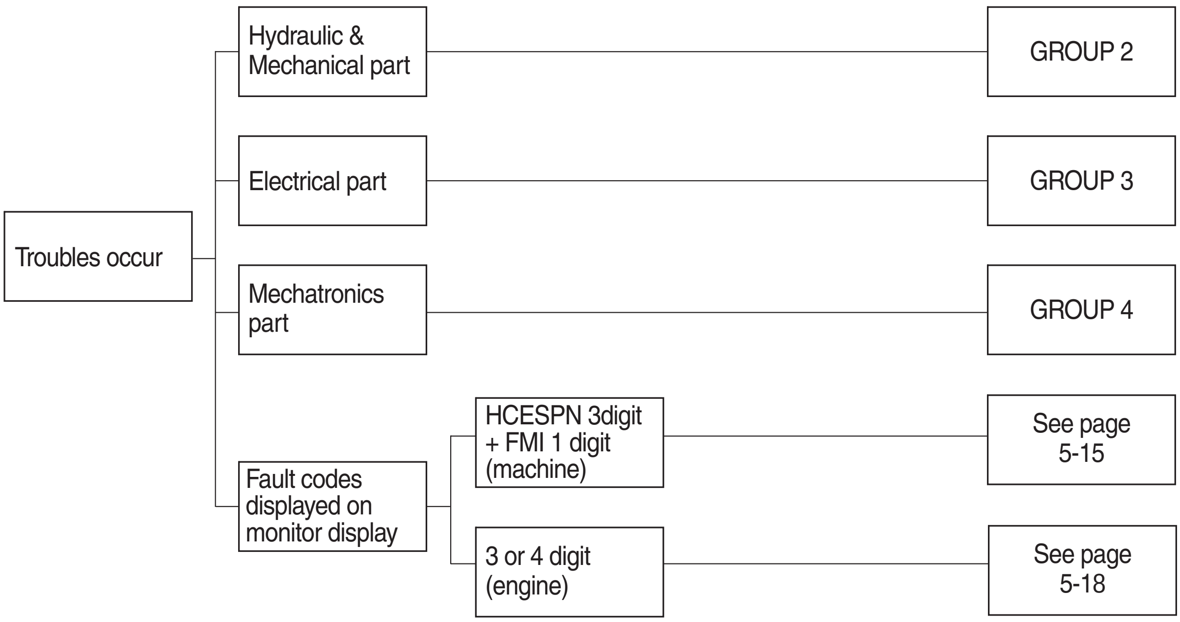
GROUP 1 BEFORE TROUBLESHOOTING

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.

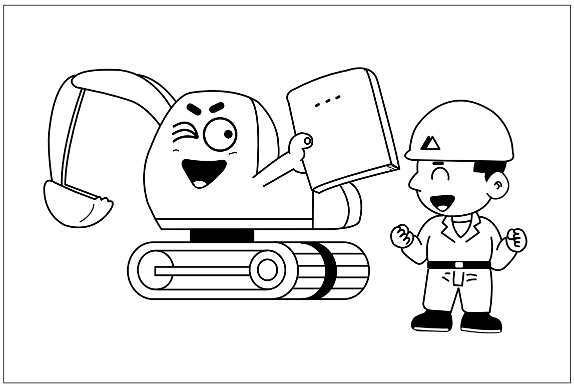
※ **Before carring out troubleshooting procedure, check monitoring menu in the cluster.**



2. DIAGNOSING PROCEDURE

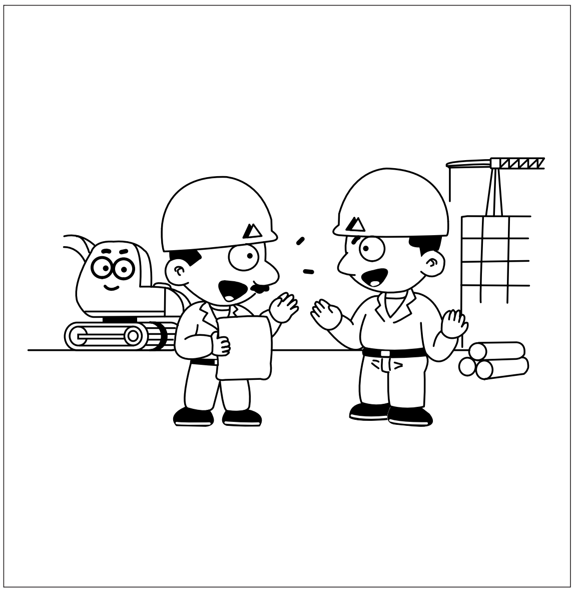
To carry out troubleshooting efficiently, the following steps must be observed.

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.

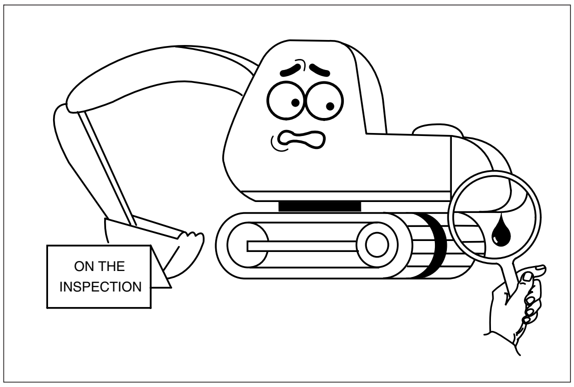
STEP 2. Ask the operator



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.

STEP 3. Inspect the machine

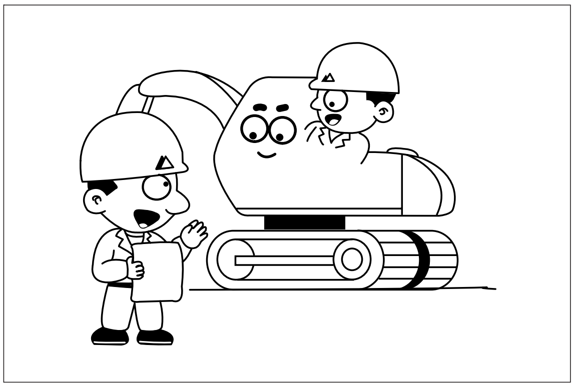


Before starting troubleshooting, check the machine for the daily maintenance points as shown in the operator's manual.

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.

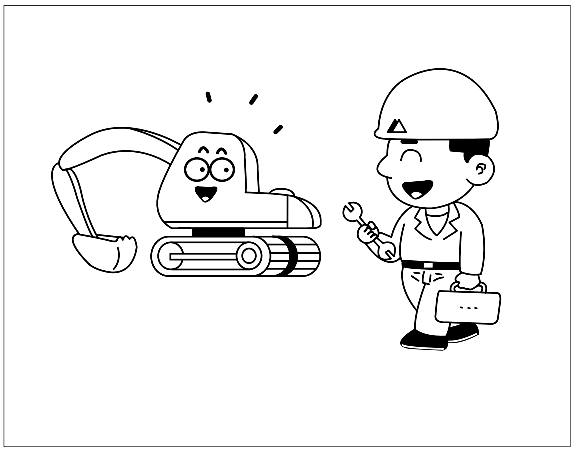
STEP 4. Inspect the trouble actually on the machine

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.



STEP 5. Perform troubleshooting

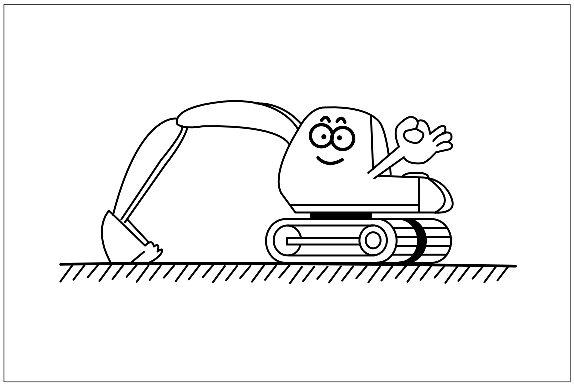
According to where the trouble parts are located, hydraulic & mechanical system part or electrical system part or mechatronics system part, perform troubleshooting the machine refer to the each system part's troubleshooting process diagram.



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.



GROUP 2 HYDRAULIC AND MECHANICAL SYSTEM

1. INTRODUCTION

1) MACHINE IN GENERAL

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

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

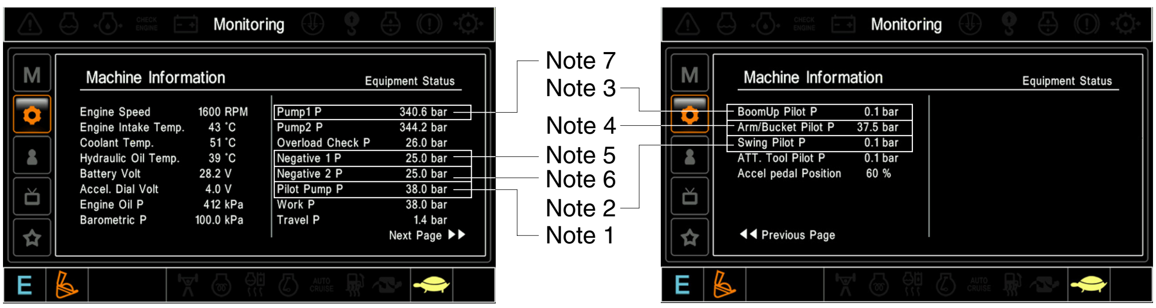
(3) When carrying out troubleshooting, do not hurry to disassemble the components.
It will become impossible to find the cause of the problem.

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

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

2) MACHINE STATUS MONITORING ON THE CLUSTER

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



Analog 1 Analog 2

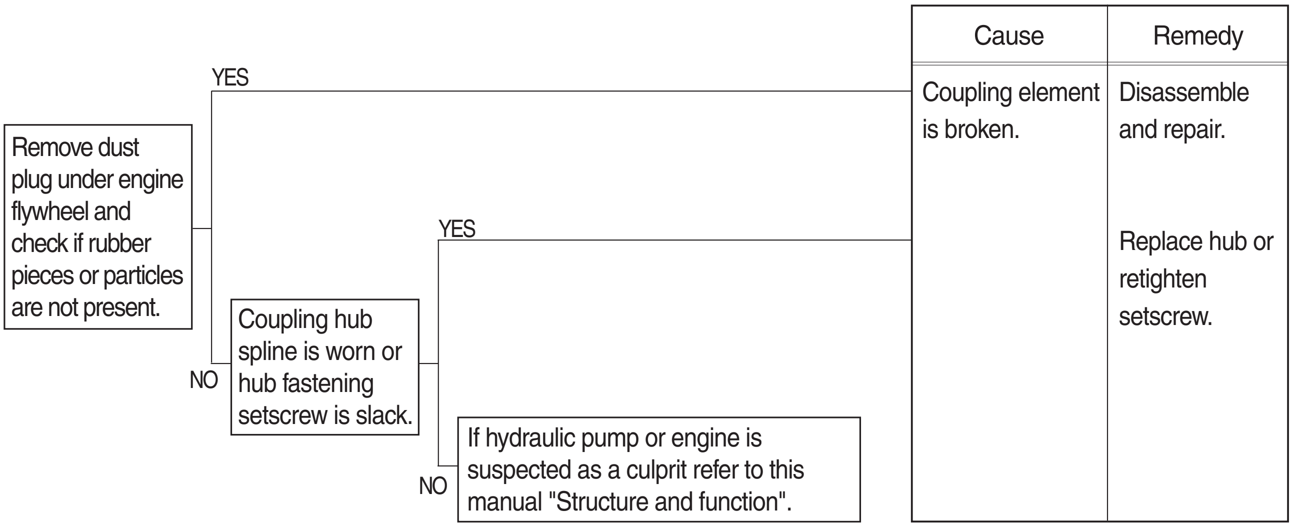
21096HS01

(2) Specification

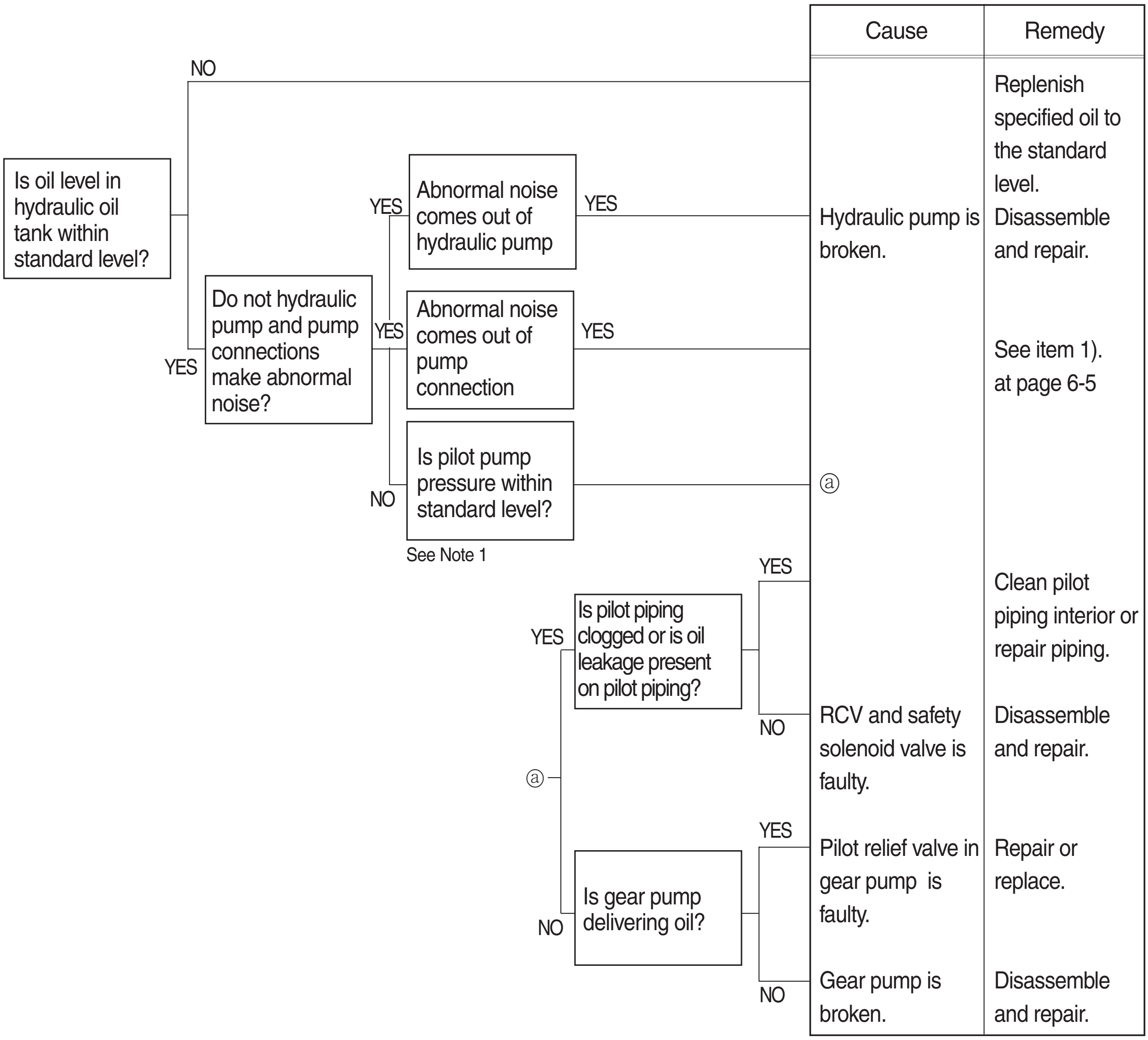
No.	Description	Specification
Note 1	Pilot pump pressure	40^{+2}_{0} bar
Note 2	Swing pilot pressure	0~40 bar
Note 3	Boom up pilot pressure	0~40 bar
Note 4	Arm/bucket pilot pressure	0~40 bar
Note 5	P1 pump control pressure	0~25 bar
Note 6	P2 pump control pressure	0~25 bar
Note 7	Pump 1 pressure	330 bar

2. DRIVE SYSTEM

1) UNUSUAL NOISE COMES OUT OF PUMP CONNECTION

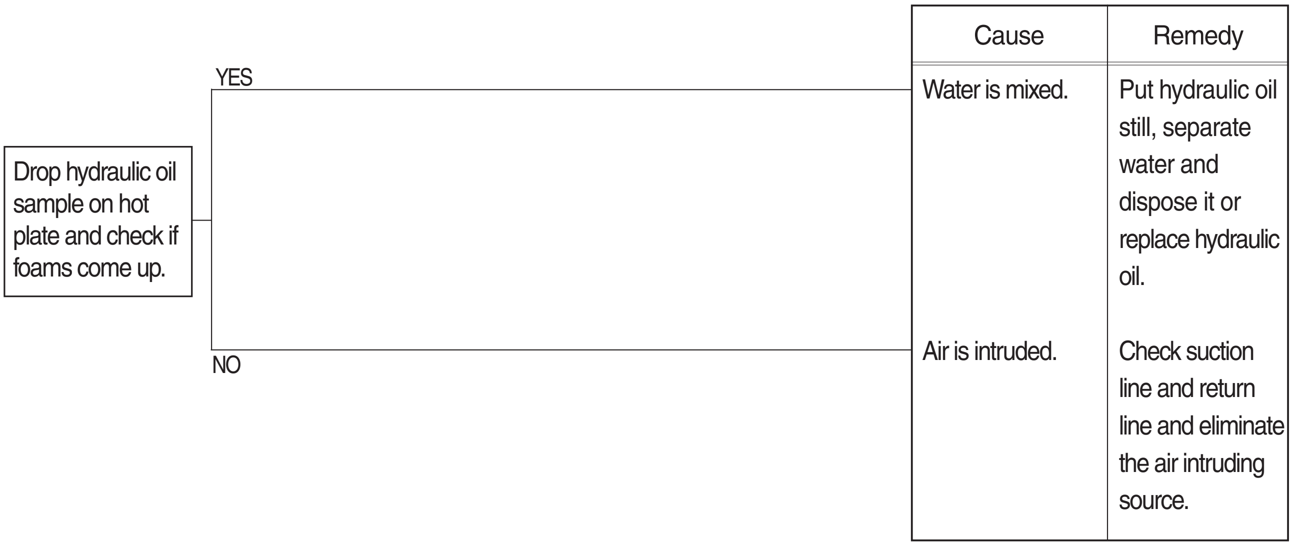


2) ENGINE STARTS BUT MACHINE DOES NOT OPERATE AT ALL

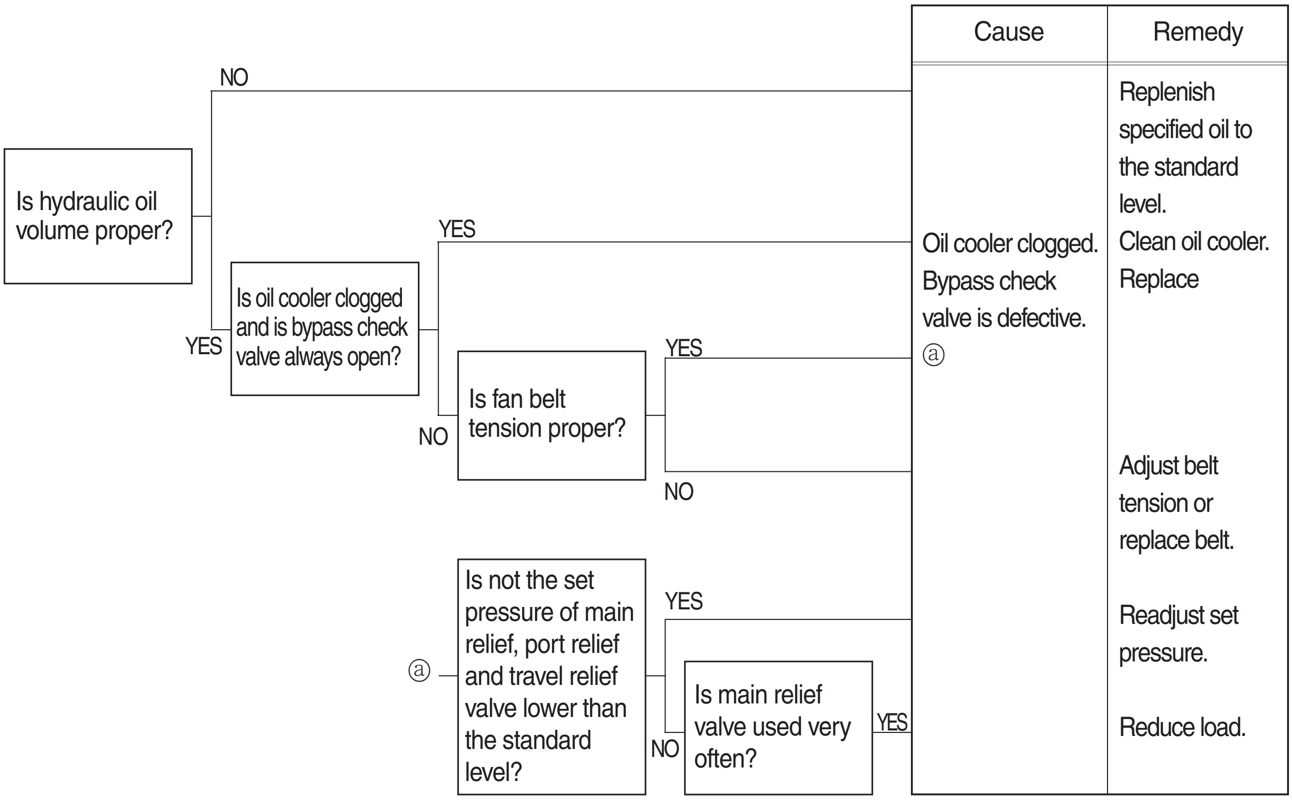


3. HYDRAULIC SYSTEM

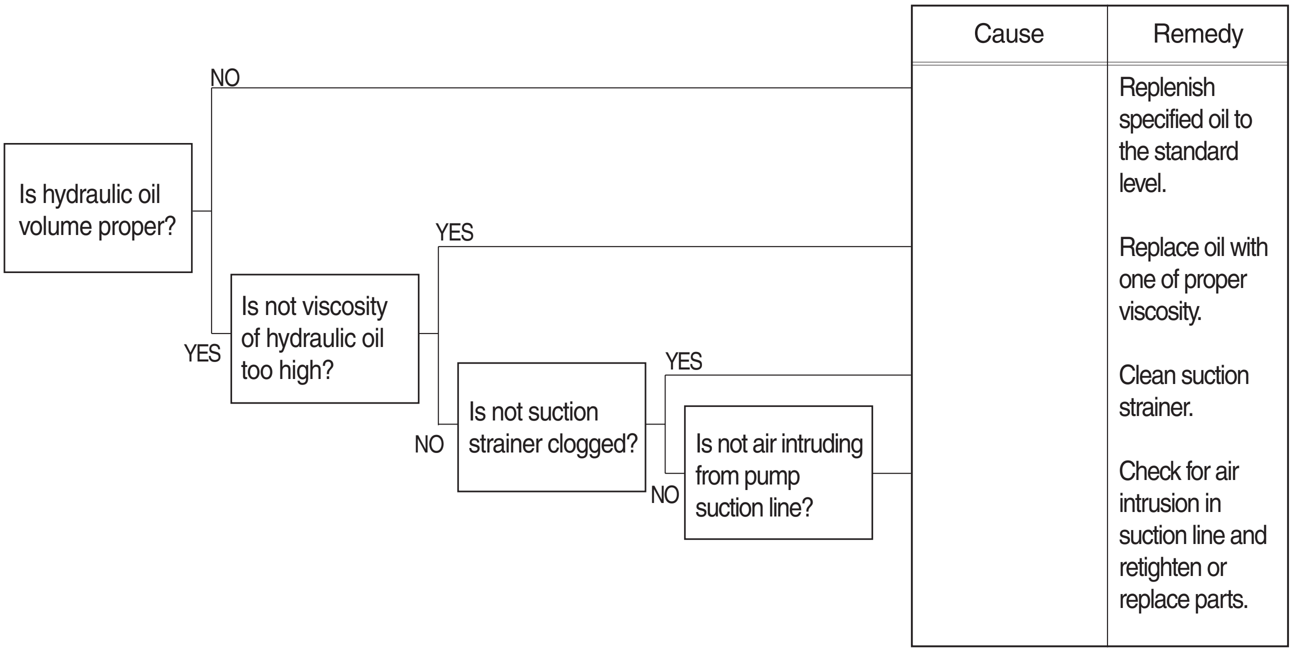
1) HYDRAULIC OIL IS CLOUDY



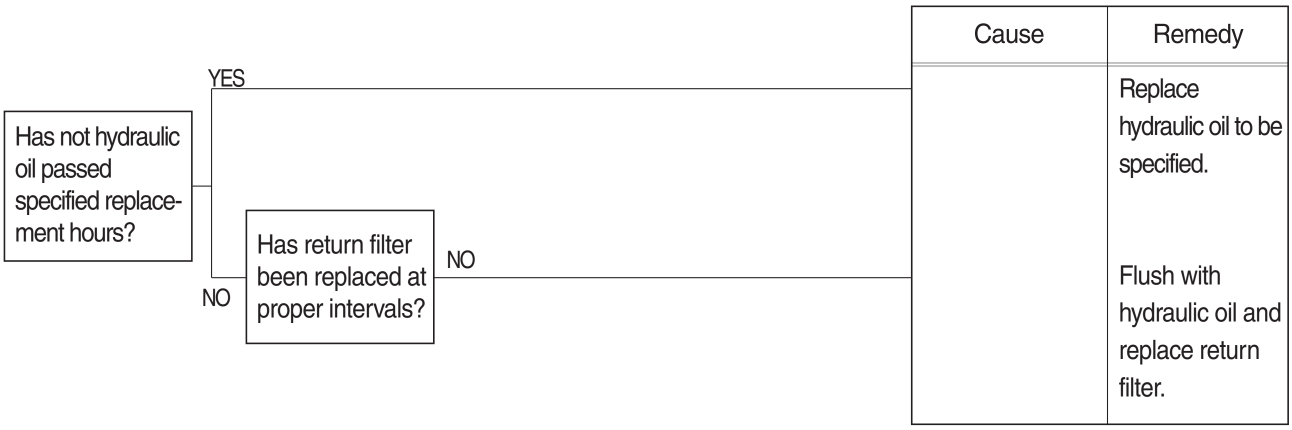
2) HYDRAULIC OIL TEMPERATURE HAS RISEN ABNORMALLY



3) CAVITATION OCCURS WITH PUMP

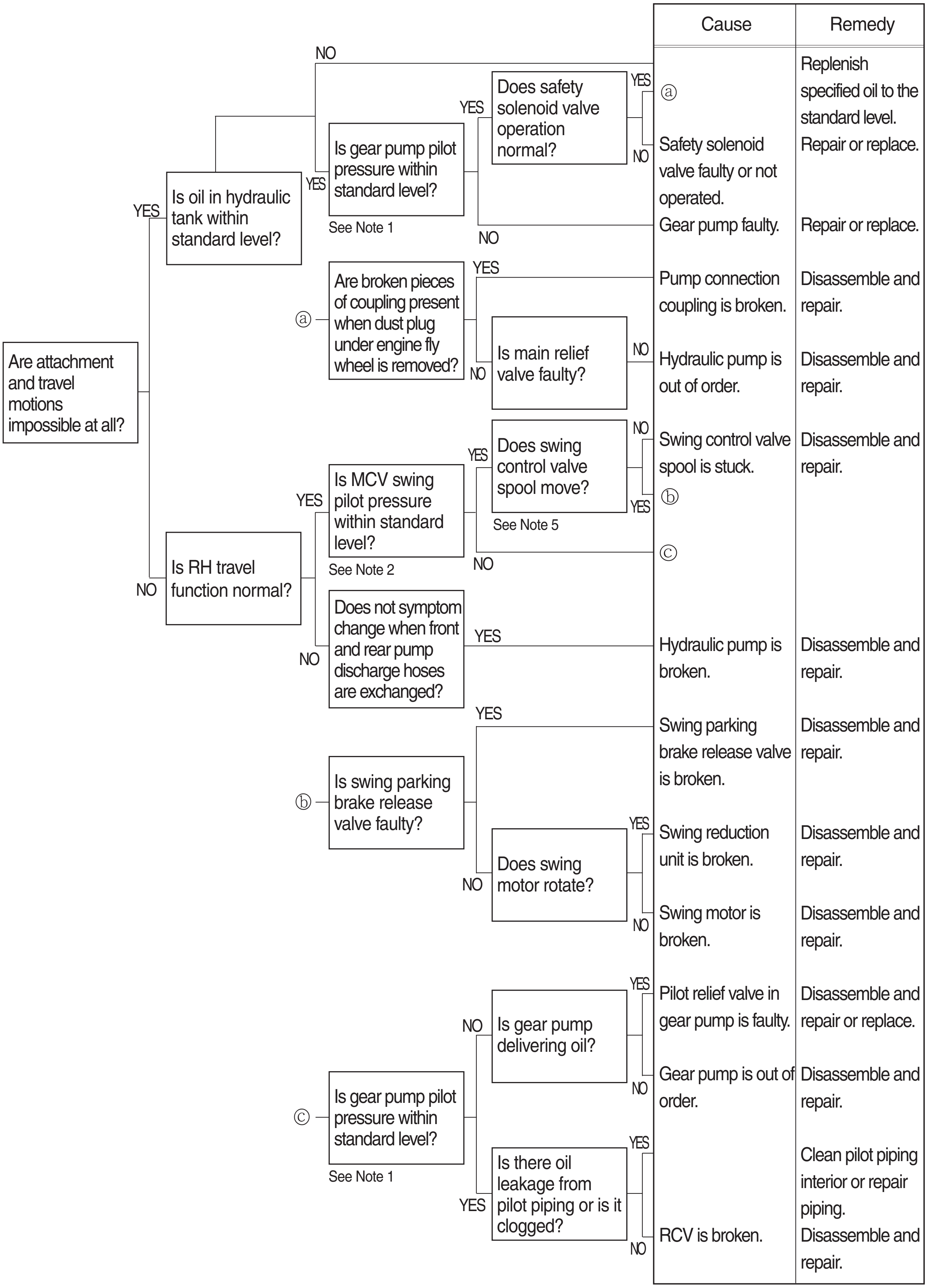


4) HYDRAULIC OIL IS CONTAMINATED

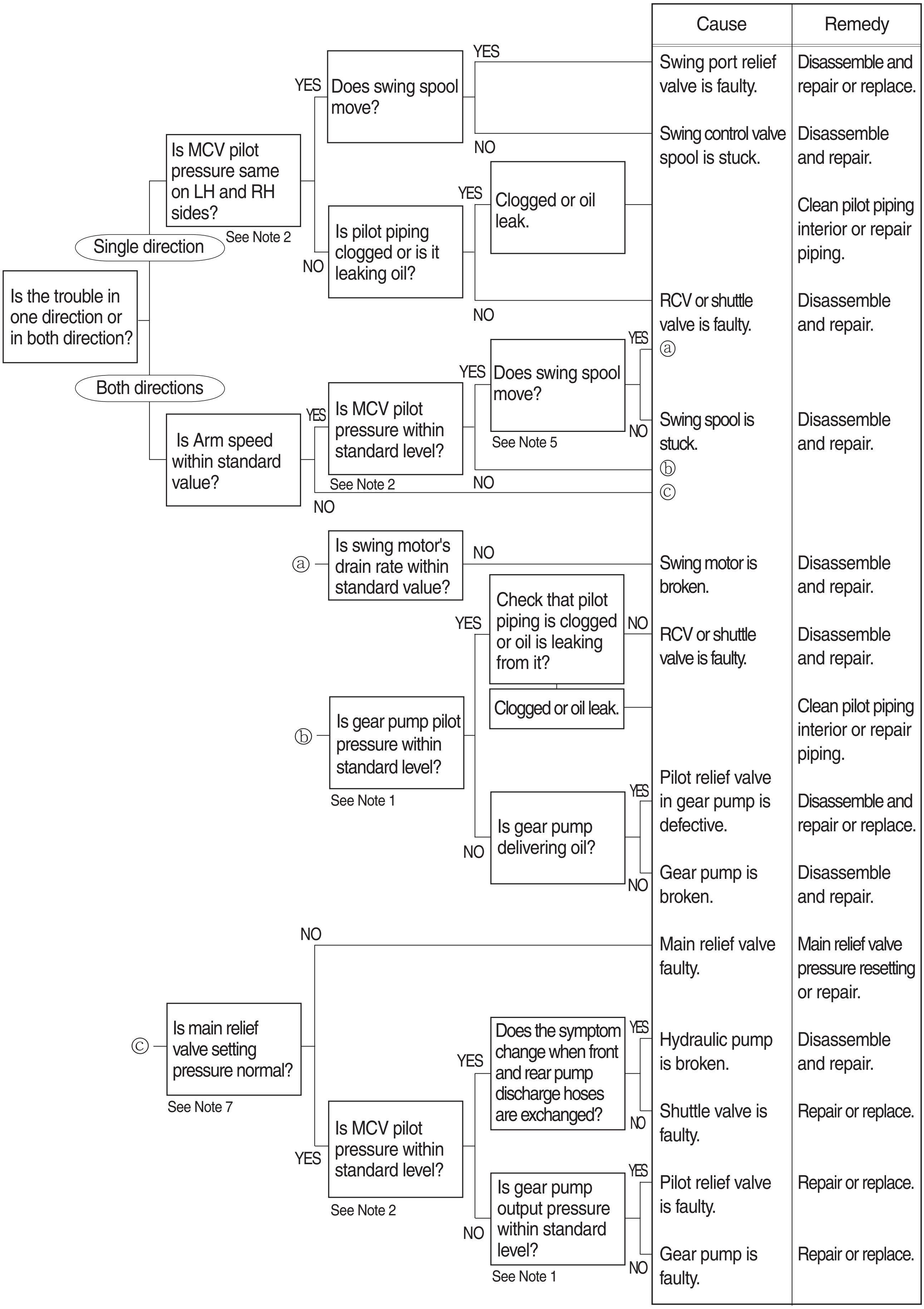


4. SWING SYSTEM

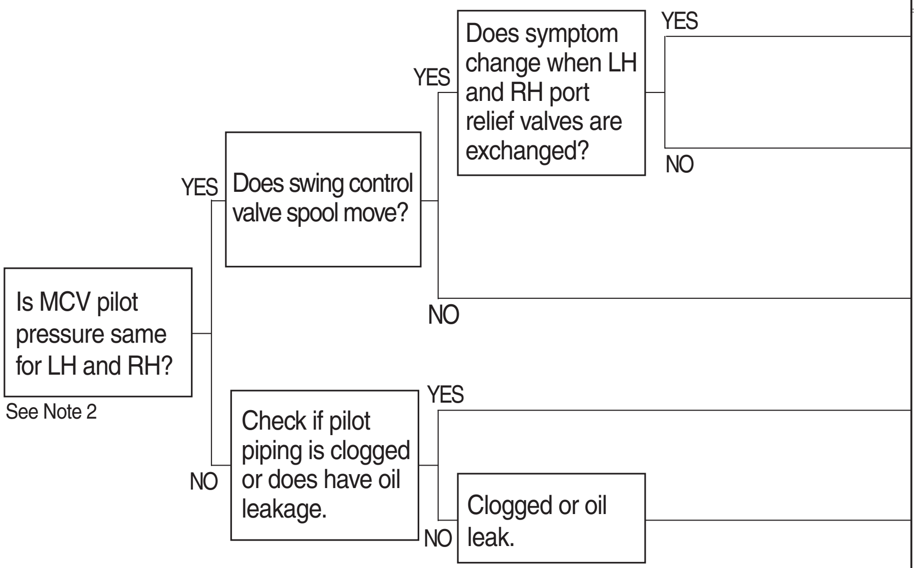
1) BOTH LH AND RH SWING ACTIONS ARE IMPOSSIBLE



2) SWING SPEED IS LOW

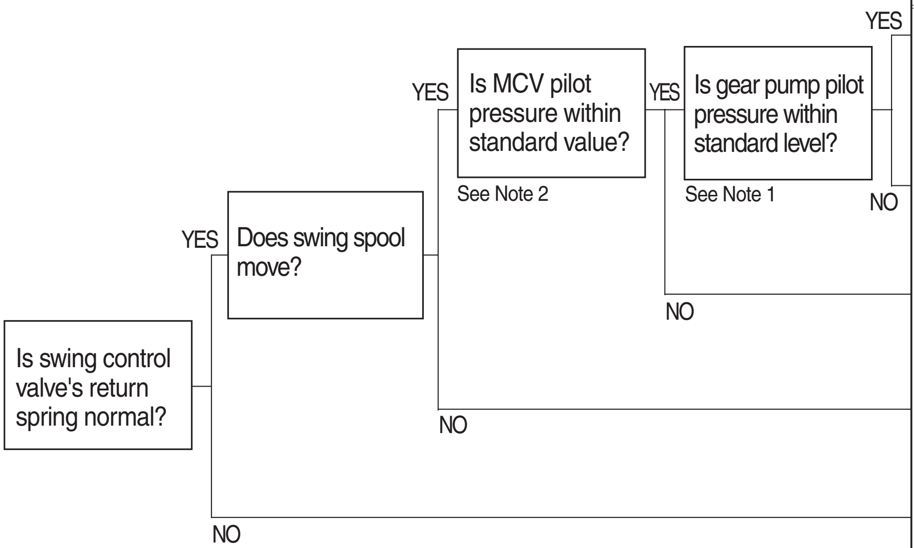


3) SWING MOTION IS IMPOSSIBLE IN ONE DIRECTION



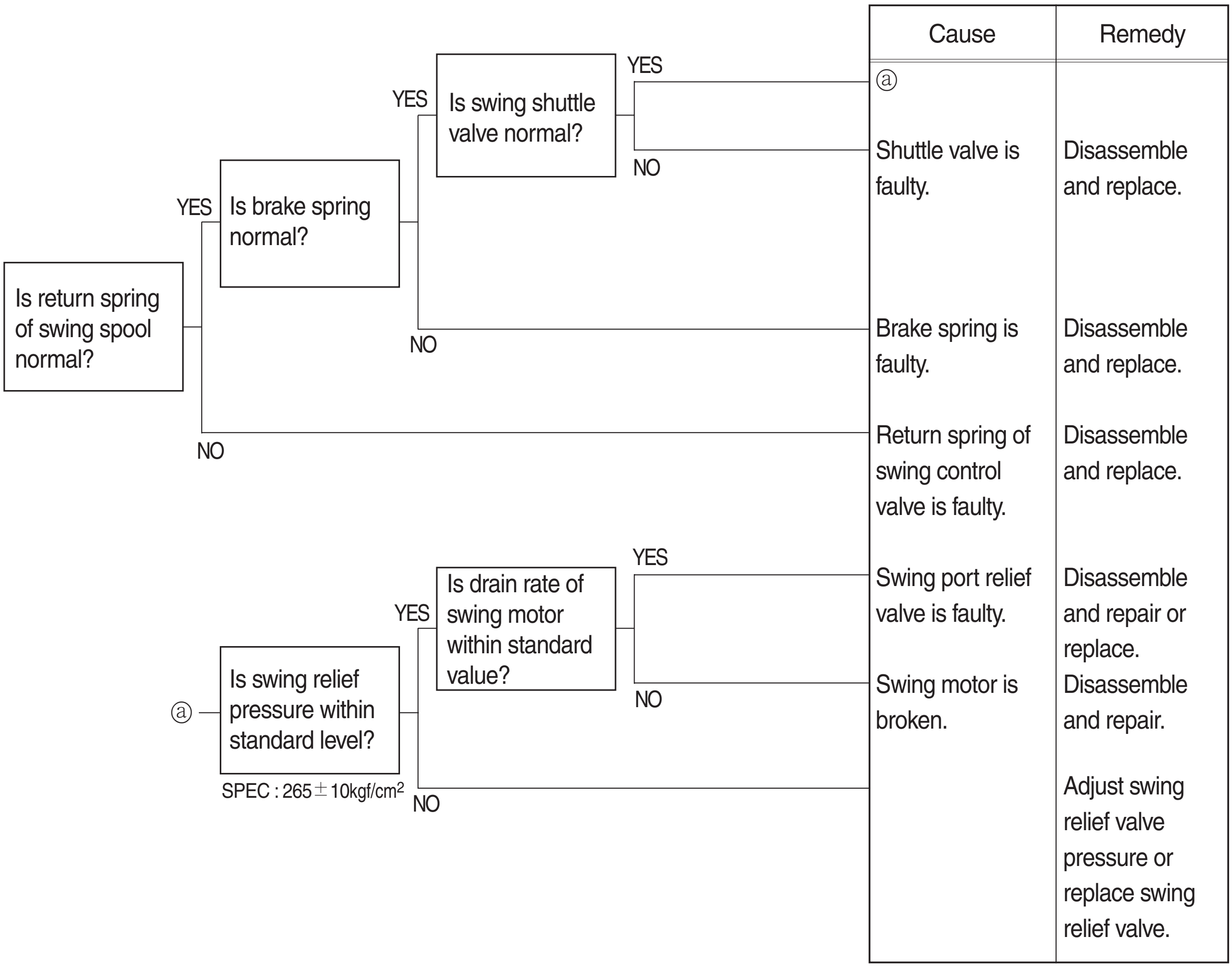
Cause	Remedy
Swing port relief valve is faulty.	Disassemble and repair.
Shuttle valve is faulty.	Disassemble and repair.
Swing control valve spool is stuck.	Disassemble and repair.
RCV is faulty.	Disassemble and repair.
	Clean pilot piping interior or repair piping.

4) MACHINE SWINGS BUT DOES NOT STOP



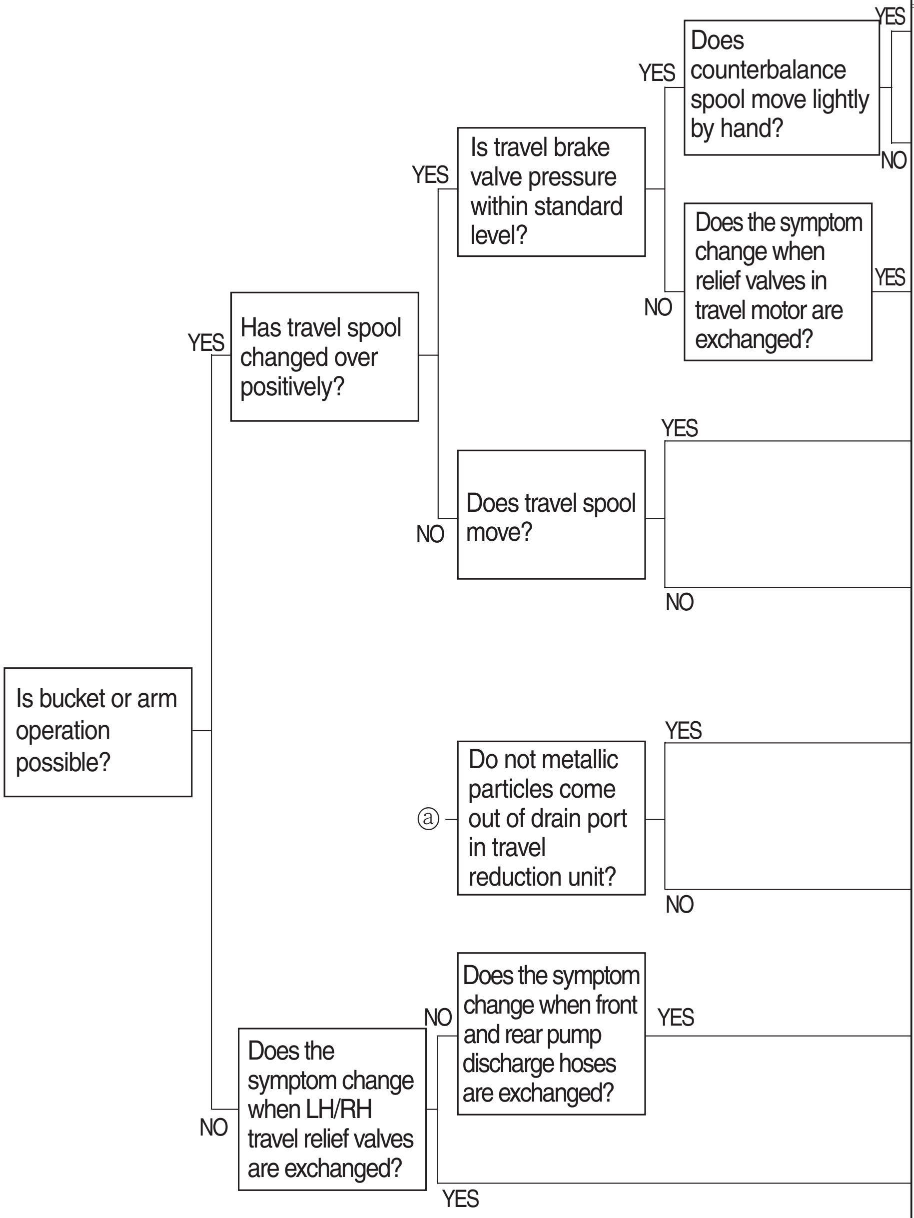
Cause	Remedy
Pilot relief valve is faulty.	Disassemble and repair or replace.
Gear pump is broken.	Disassemble and repair.
RCV is faulty.	Disassemble and repair.
Swing spool is stuck.	Disassemble and repair.
Return spring is faulty.	Disassemble and replace.

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



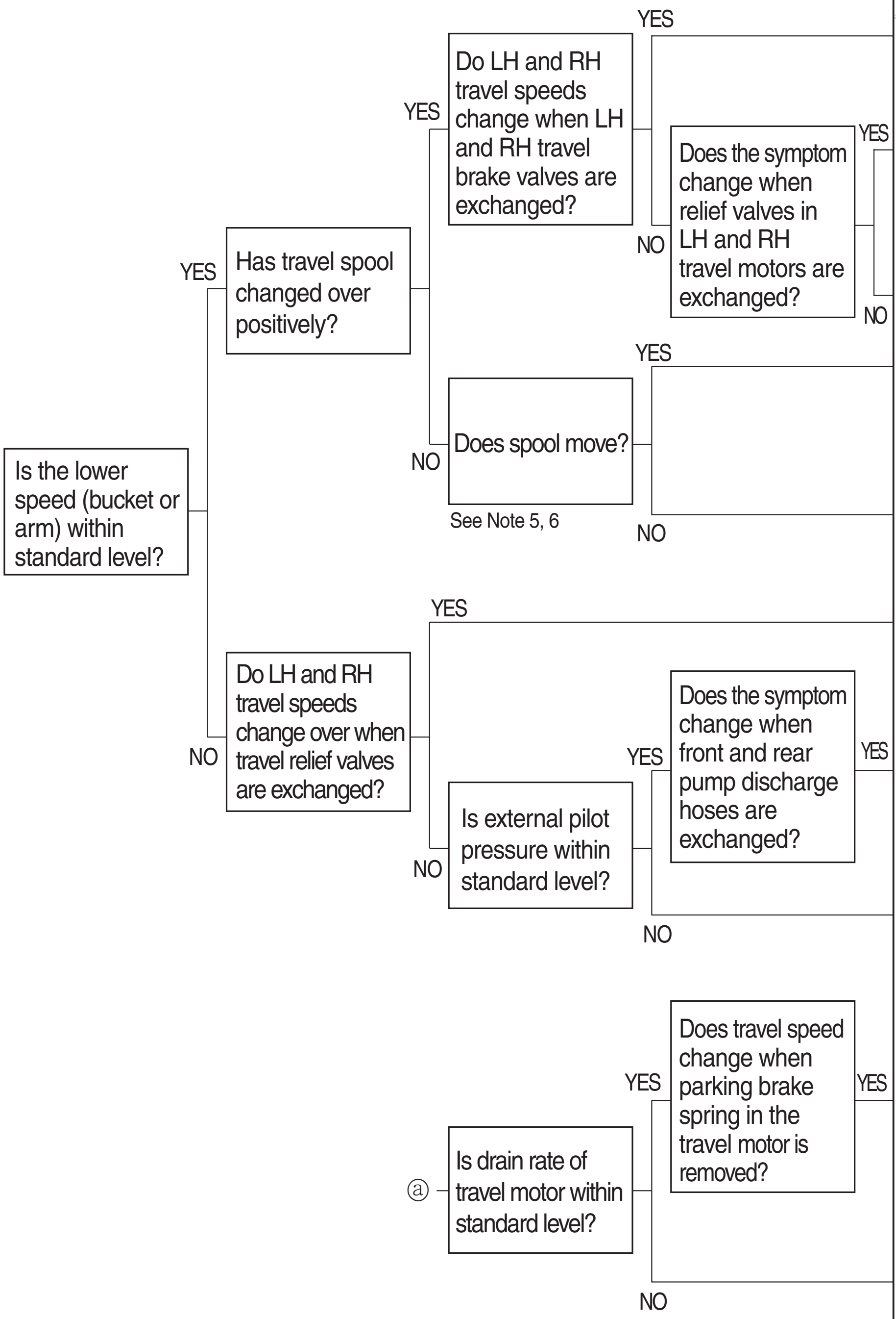
5. TRAVEL SYSTEM

1) TRAVEL DOES NOT FUNCTION AT ALL ON ONE SIDE



Cause	Remedy
ⓐ	
Counter spool is stuck.	Disassemble and repair or replace.
Relief valve built in travel motor is faulty.	Disassemble and repair.
Control system is defective.	Disassemble inspect and repair.
Travel spool is stuck.	Disassemble and repair.
Travel reduction unit is faulty.	Disassemble and repair.
Travel motor is out of order.	Disassemble and repair.
Hydraulic pump is broken.	Disassemble and repair.
Travel relief valves are faulty.	Disassemble and repair or replace.

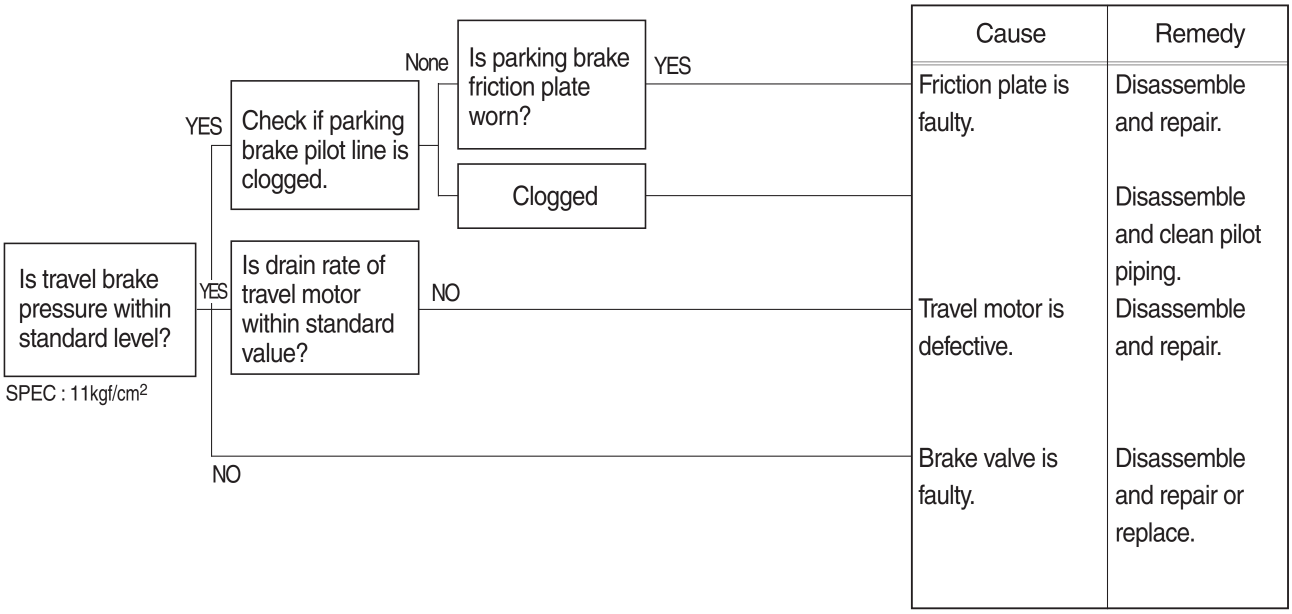
2) SPEED ON ONE SIDE FALLS AND THE MACHINE CURVES



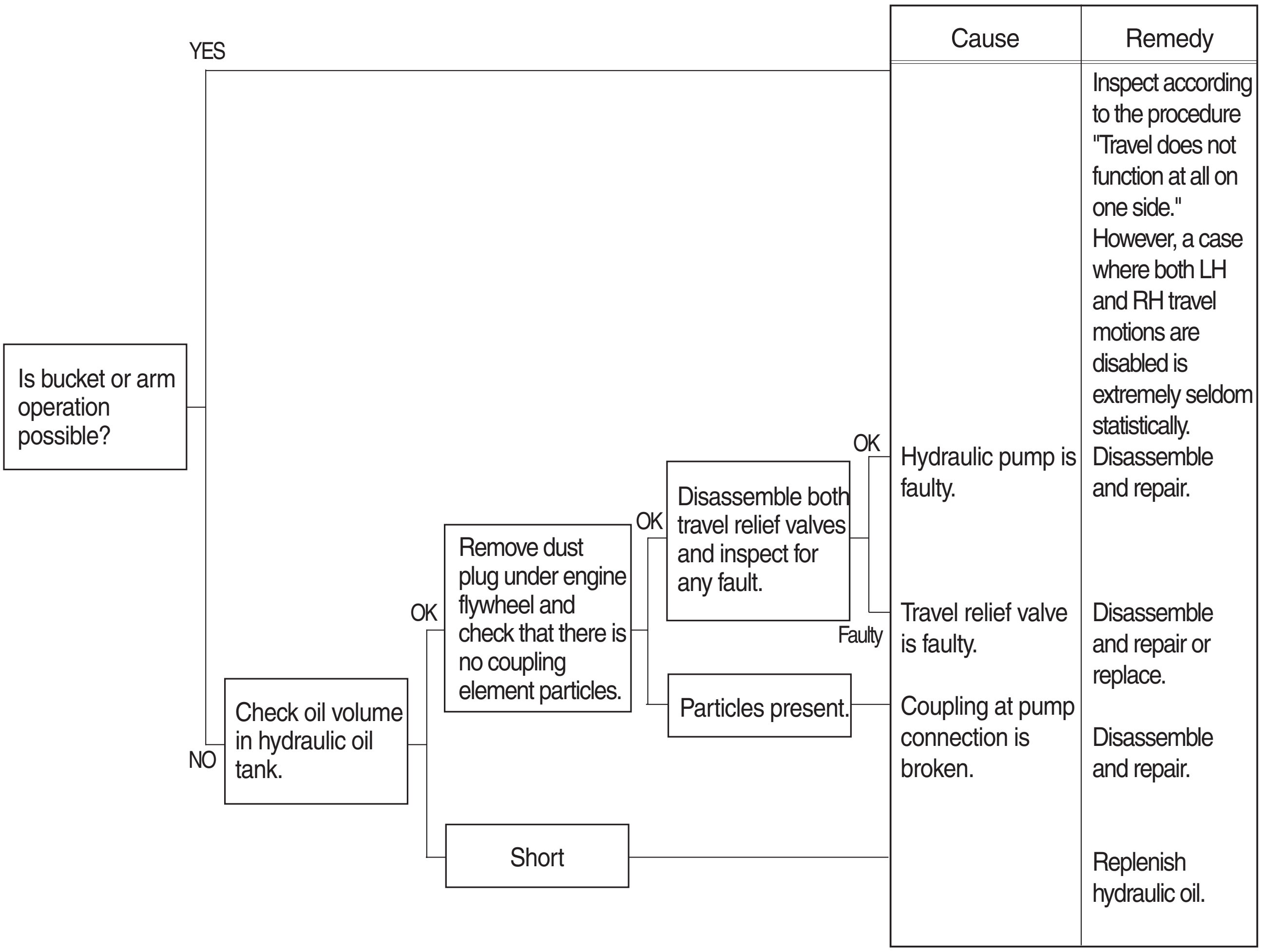
Cause	Remedy
Brake valve is defective.	Disassemble and repair or replace.
Relief valve built in travel motor is faulty.	Disassemble and repair.
Control system is faulty .	Disassemble, inspect and repair.
Control valve spool is stuck.	Disassemble and repair.
Travel relief valve is faulty.	Disassemble 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

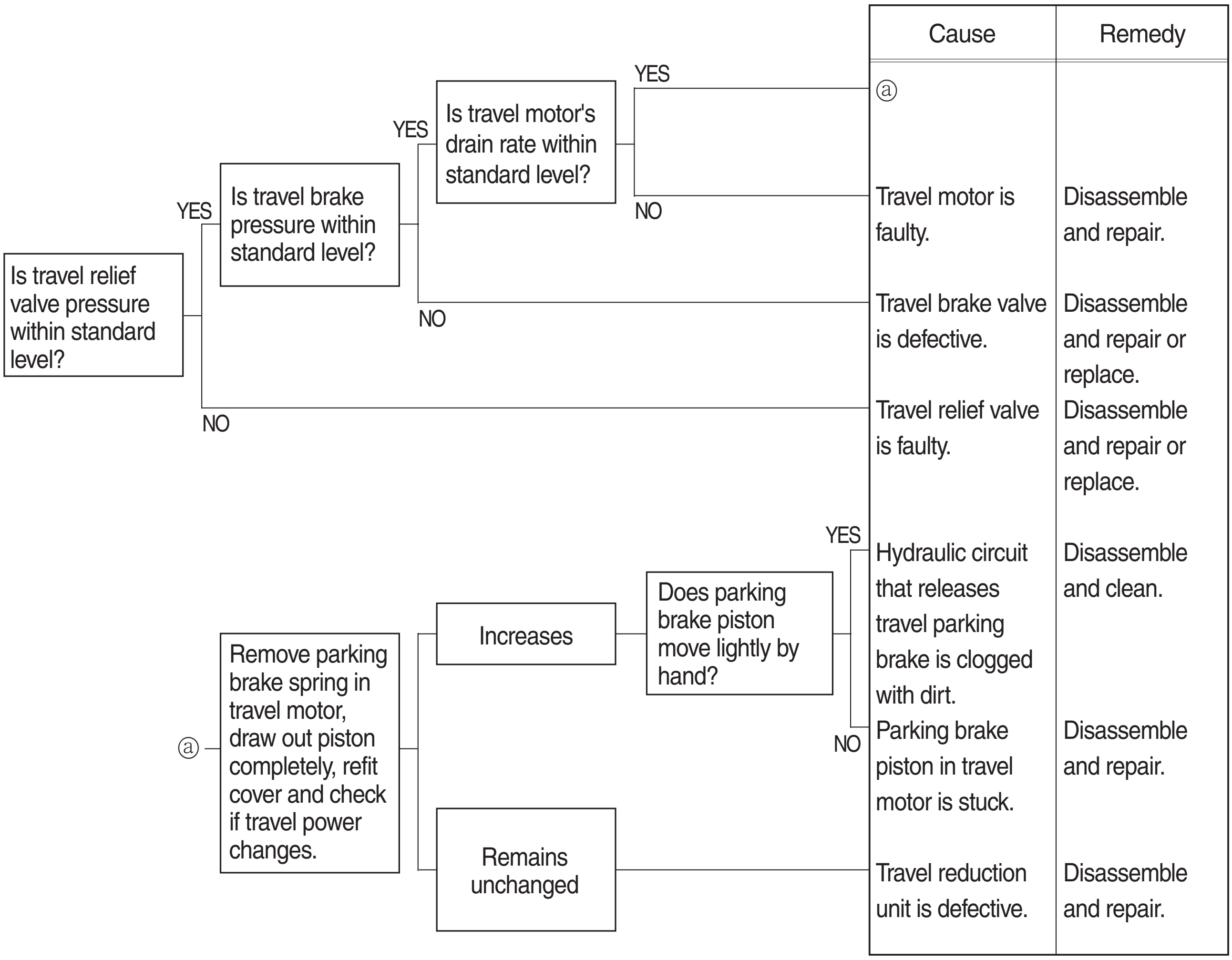
Machine is pulled forward as sprocket rotates during digging operation.



4) LH AND RH TRAVEL MOTIONS ARE IMPOSSIBLE

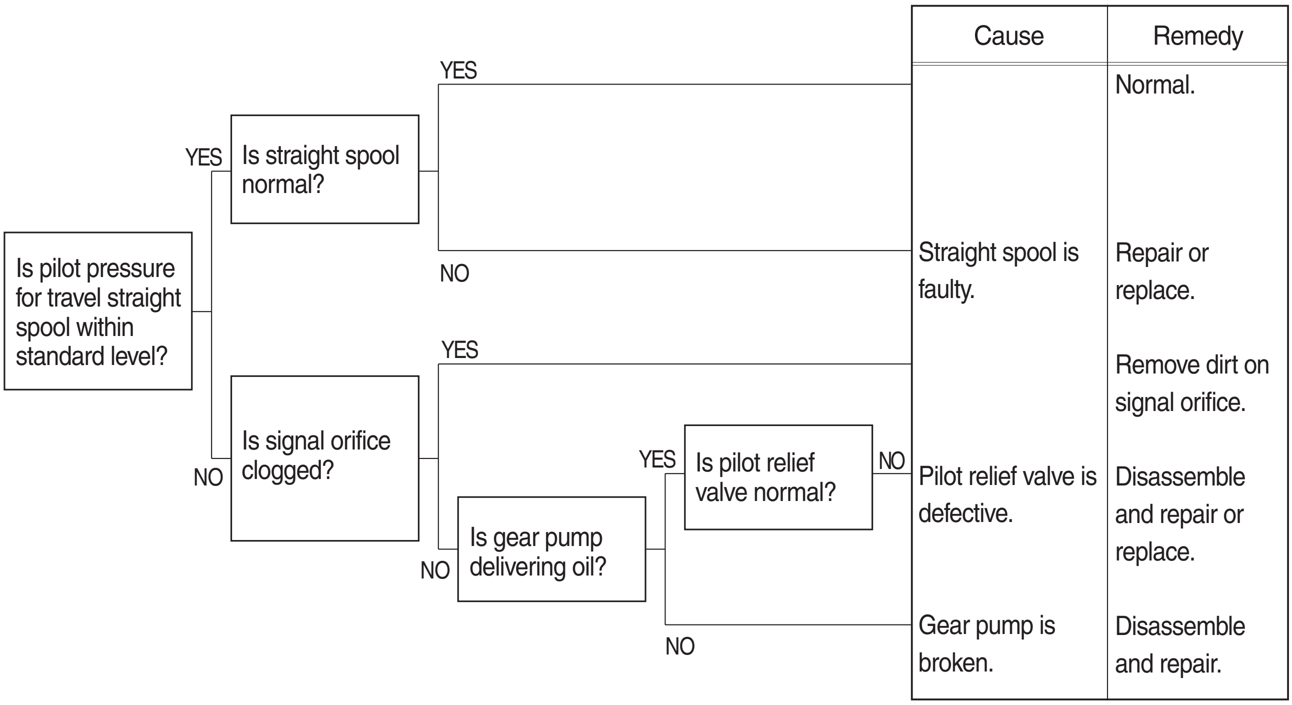


5) TRAVEL ACTION IS POWERLESS (travel only)



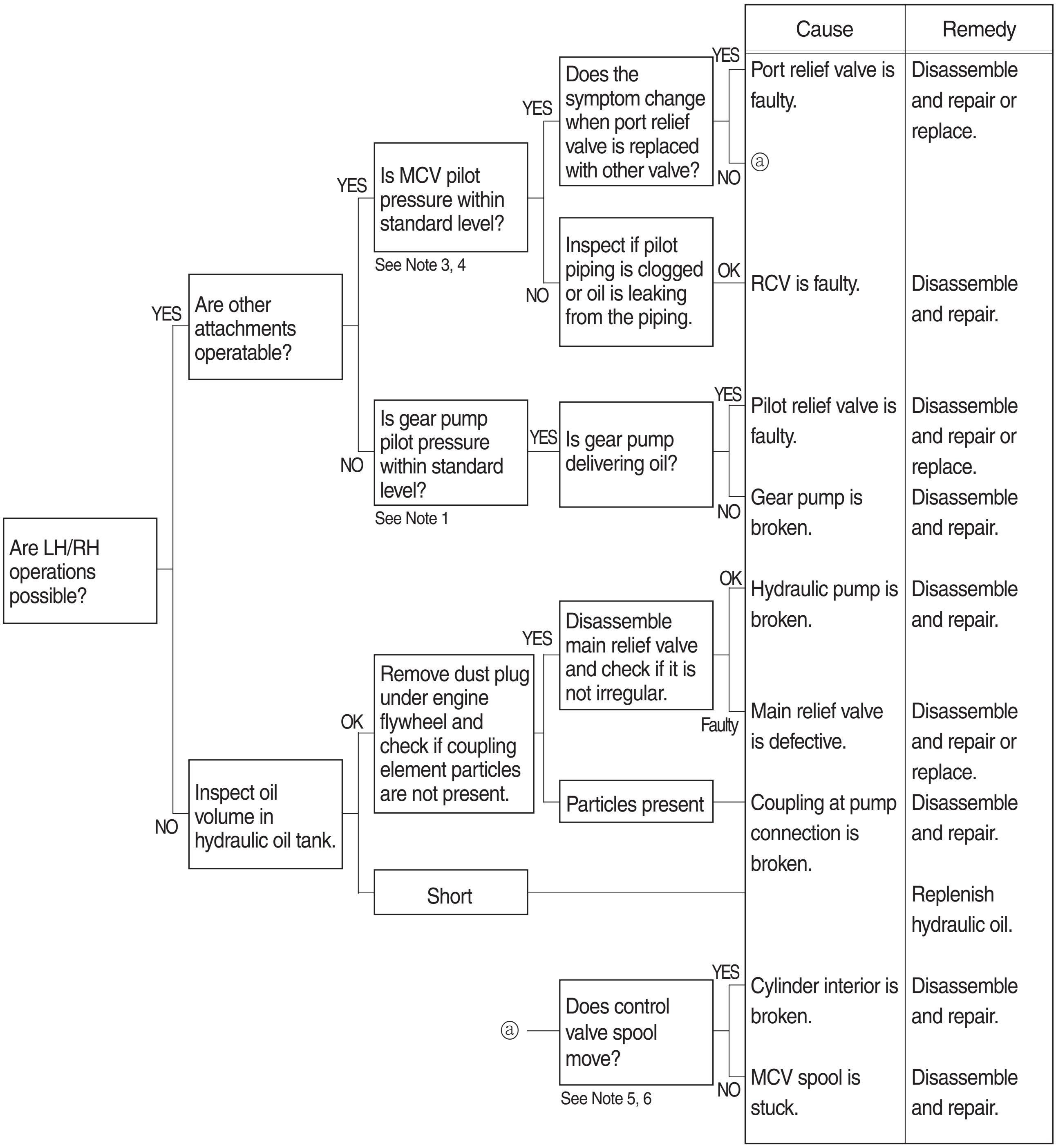
6) MACHINE RUNS RECKLESSLY ON A SLOPE

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

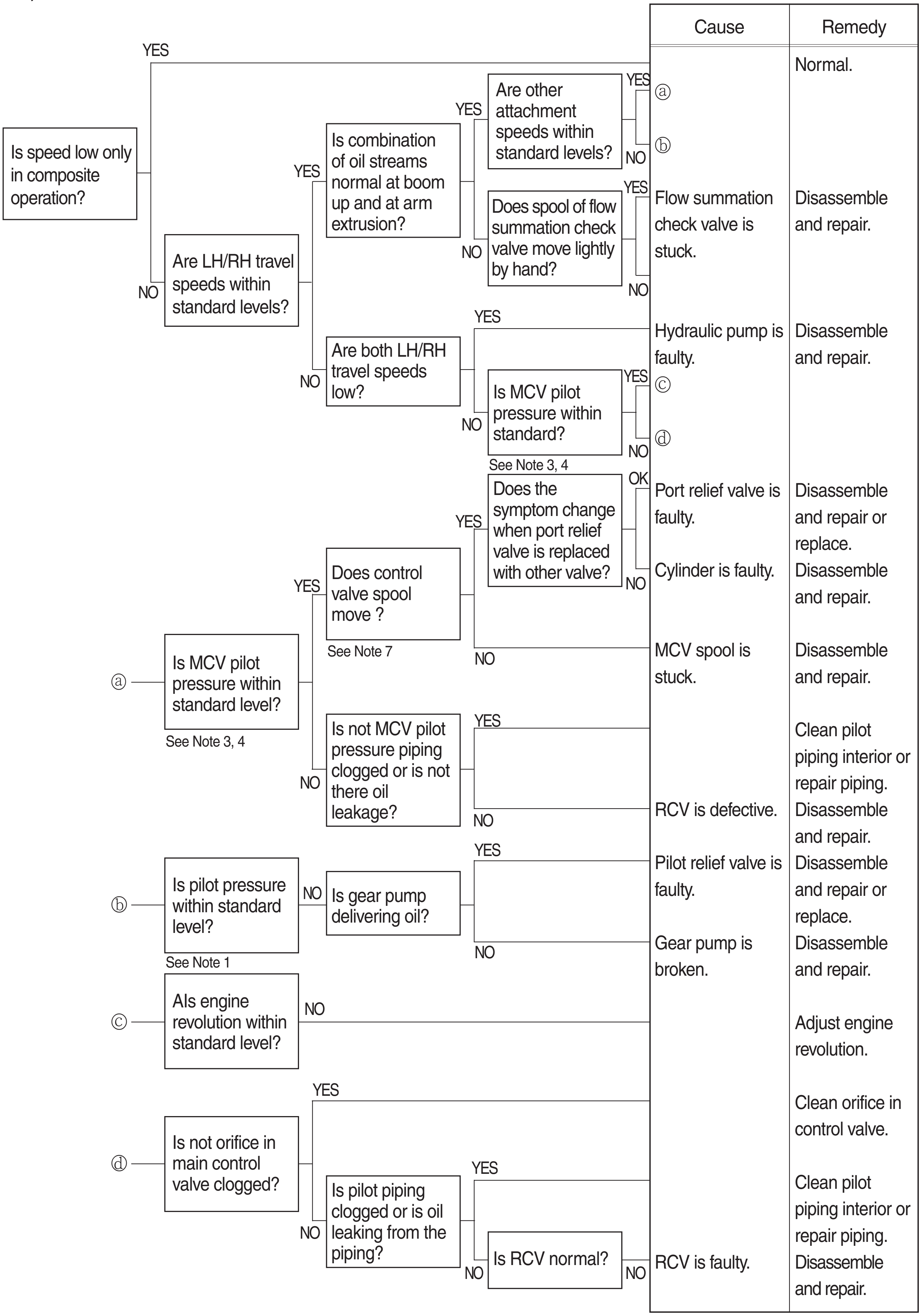


6. ATTACHMENT SYSTEM

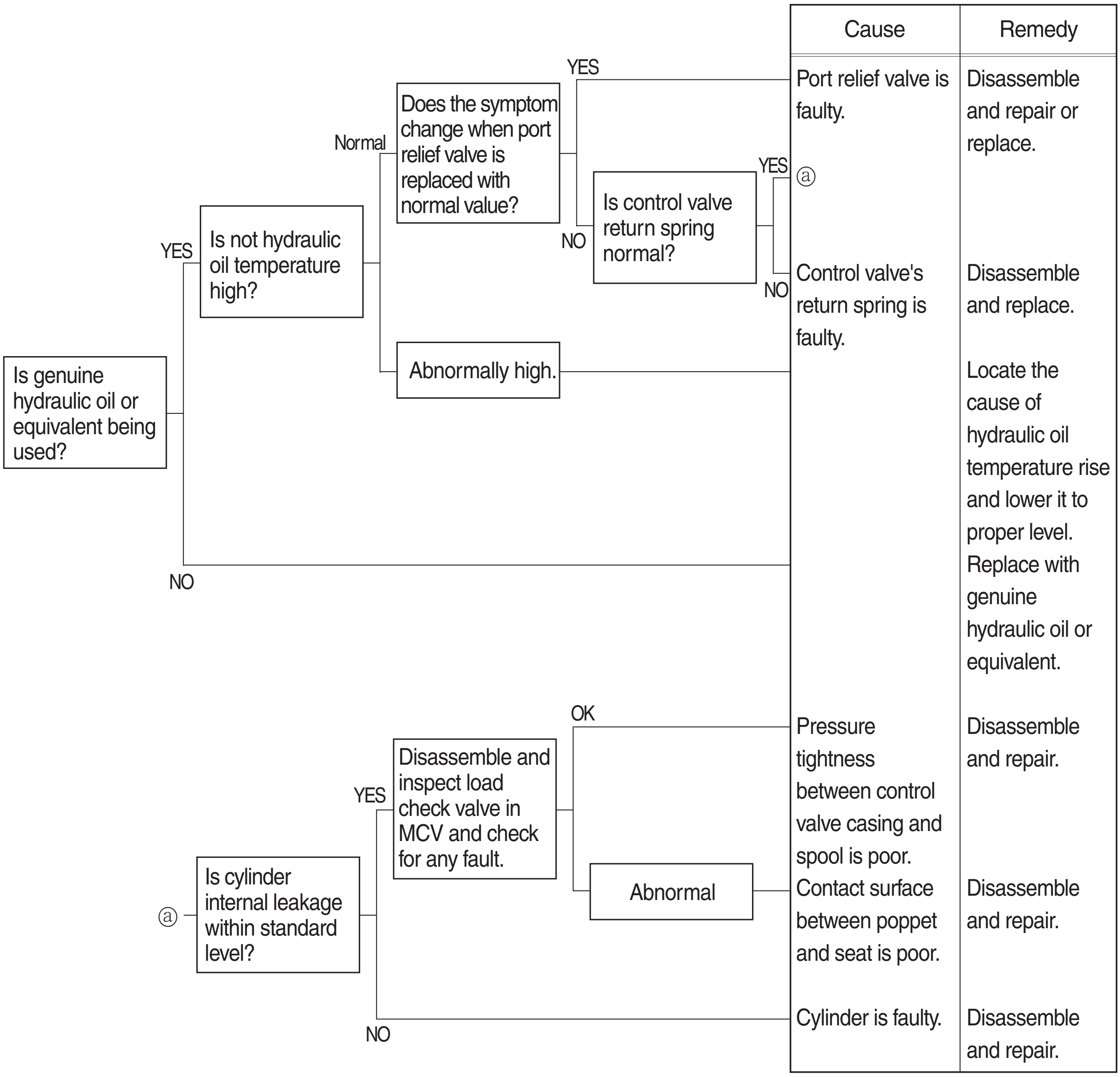
1) BOOM OR ARM ACTION IS IMPOSSIBLE AT ALL



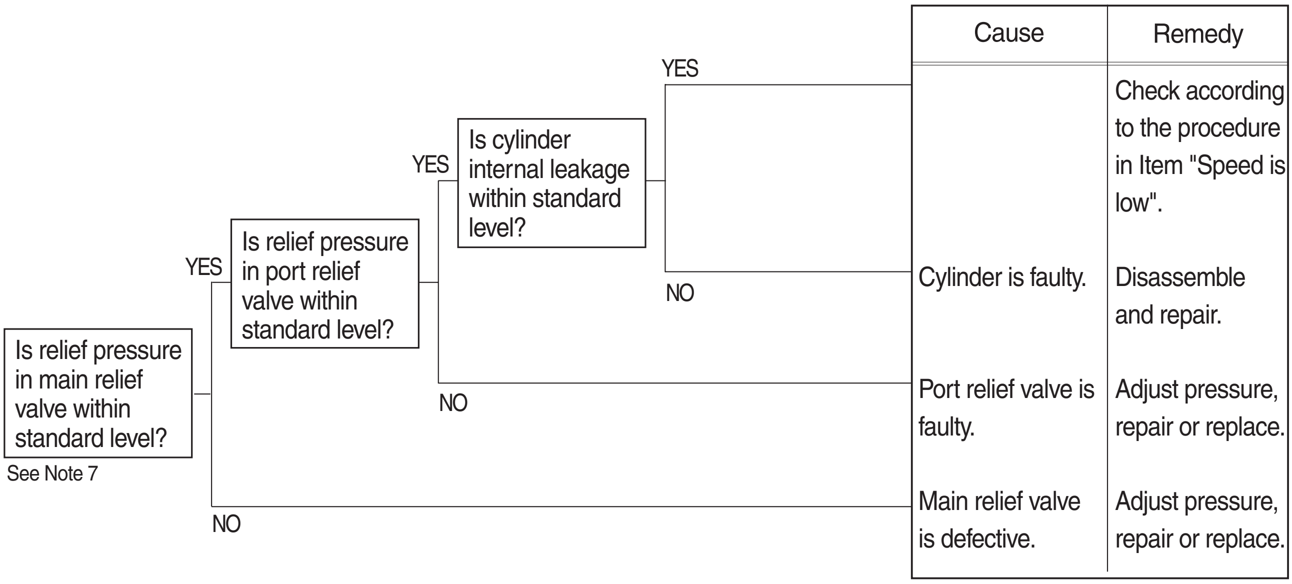
2) BOOM, ARM OR BUCKET SPEED IS LOW



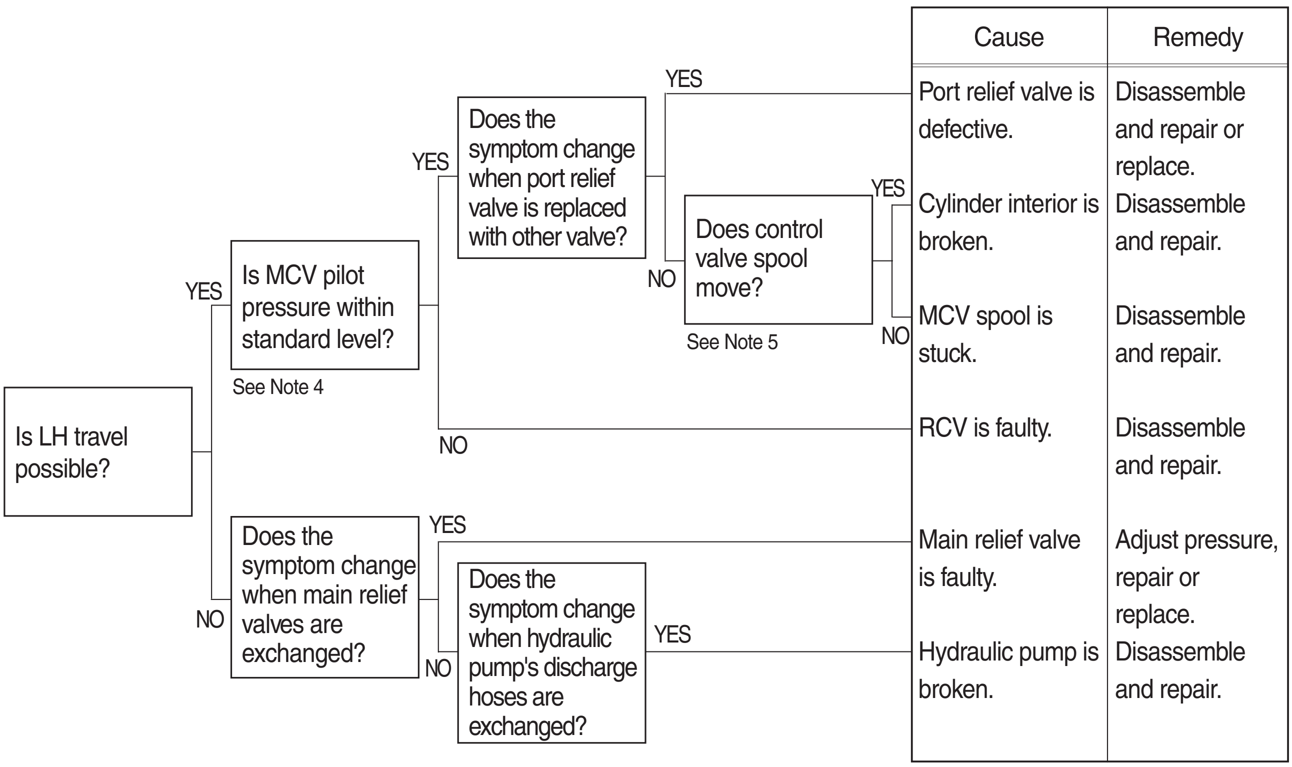
3) BOOM, ARM OR BUCKET CYLINDER EXTENDS OR CONTRACTS ITSELF AND ATTACHMENT FALLS



4) BOOM, ARM OR BUCKET POWER IS WEAK



5) ONLY BUCKET OPERATION IS TOTALLY IMPOSSIBLE



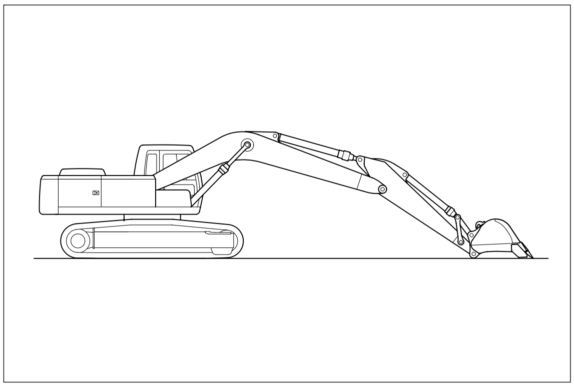
6) BOOM MAKES A SQUEAKING NOISE WHEN BOOM IS OPERATED

Is boom foot pin greased sufficiently?

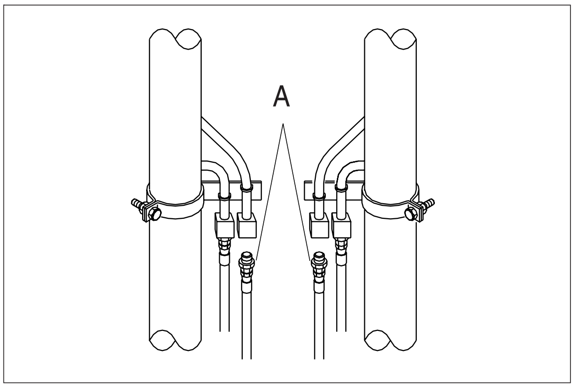
	Cause	Remedy
YES		Frictional noise occurs between the sliding faces of boom cylinder's oil seal and boom proper. ※ Frictional noise will disappear if they are kept used.
NO	Boom foot pin has run out of grease.	Supply grease to it. ※ If seizure is in an initial stage, supply sufficient grease. If seizure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

※ HOW TO CHECK INTERNAL BOOM CYLINDER LEAKAGE

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

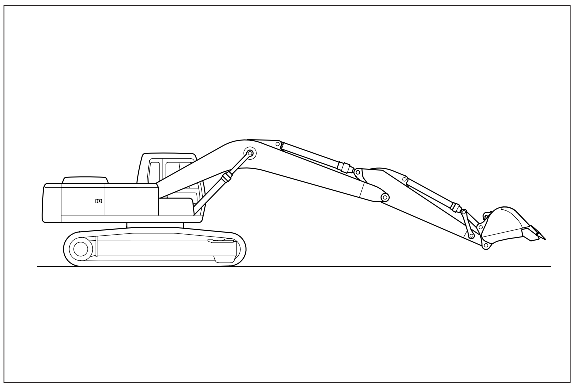


2. Disconnect hose (A) from rod side of boom cylinder and drain oil from cylinders and hose. (put cups on piping and hose ends)



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.

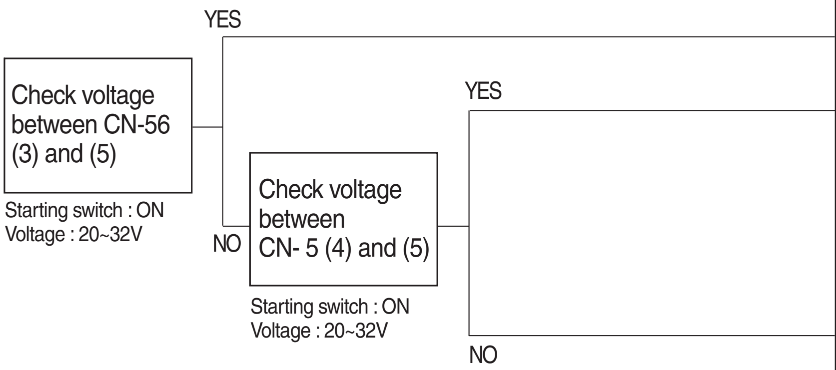


1. WHEN STARTING SWITCH IS TURNED ON, MONITOR PANEL DISPLAY DOES NOT APPEAR

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

· Before carrying out below procedure, check all the related connectors are properly inserted and short of fuse No.7, 13.

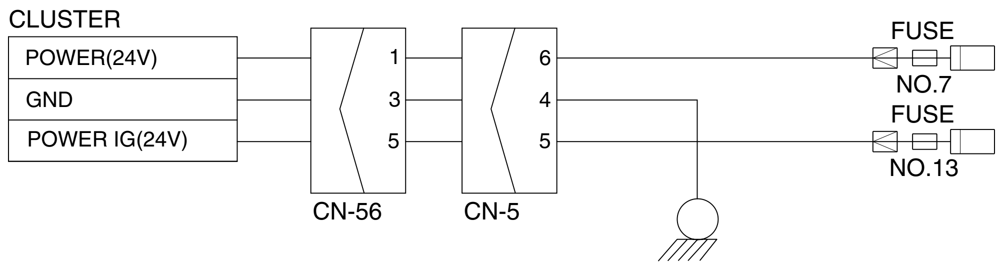
· After checking, insert the disconnected connectors again immediately unless otherwise specified.



Cause	Remedy
Defective cluster	Replace
Disconnection in wiring harness or poor contact between CN-5-CN-56	Repair or replace (after clean)
Disconnection in wiring harness or poor contact between CN-5 (4) -GND or fuse No.7, 13	Repair or replace (after clean)

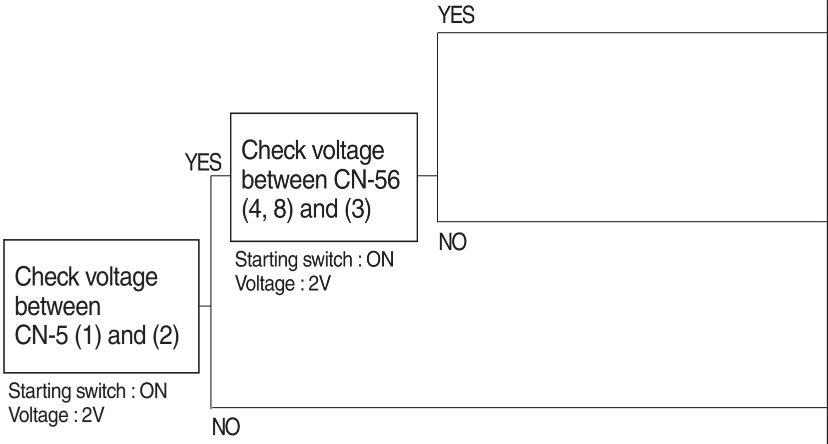
Check voltage

YES	20~32V
NO	0V



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

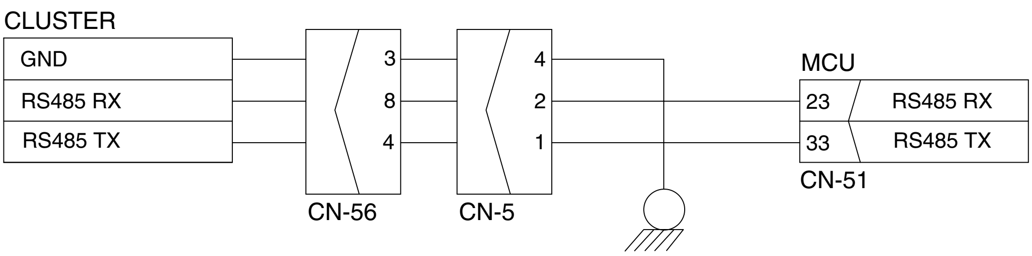
· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.



Cause	Remedy
Defective cluster	Replace
Disconnection in wiring harness or poor contact between CN-56 (4, 8)-CN-5 (1, 2)	Repair or replace (after clean)
Defective MCU	Replace
Disconnection in wiring harness or poor contact between CN-5 (1, 2)- CN-51(23, 33)	Repair or replace (after clean)

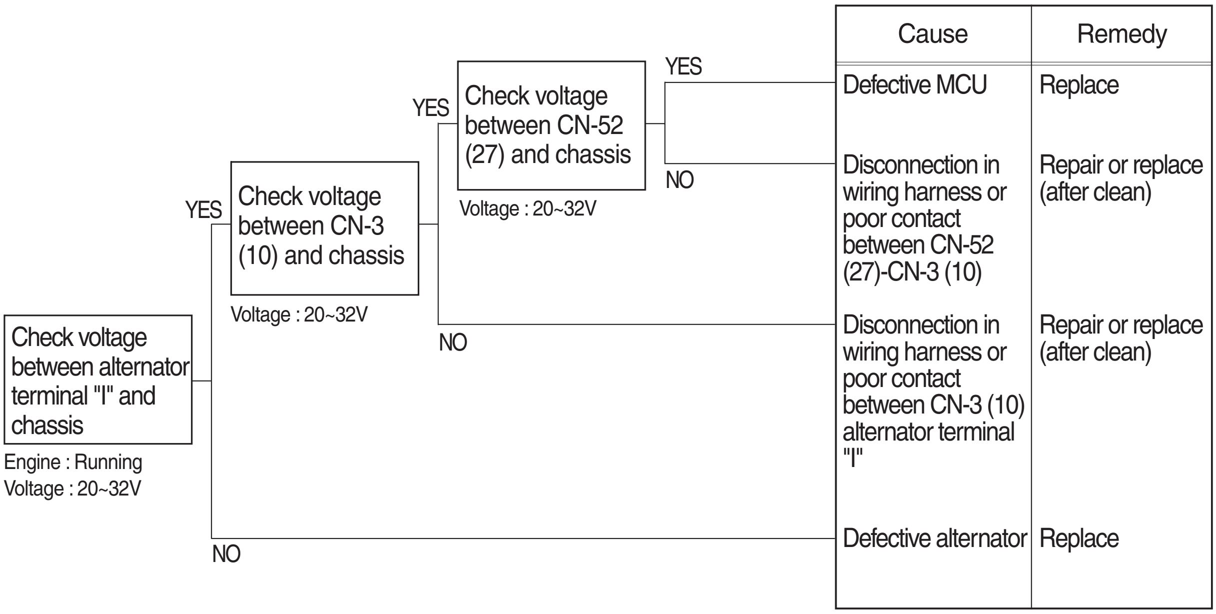
Check voltage

YES	2V
NO	0V



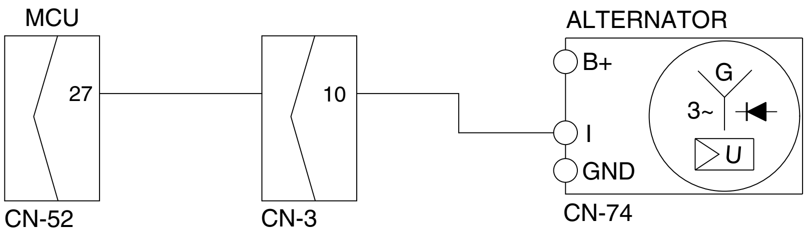
3. BATTERY CHARGING WARNING LAMP LIGHTS UP(Starting switch : ON)

· 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.



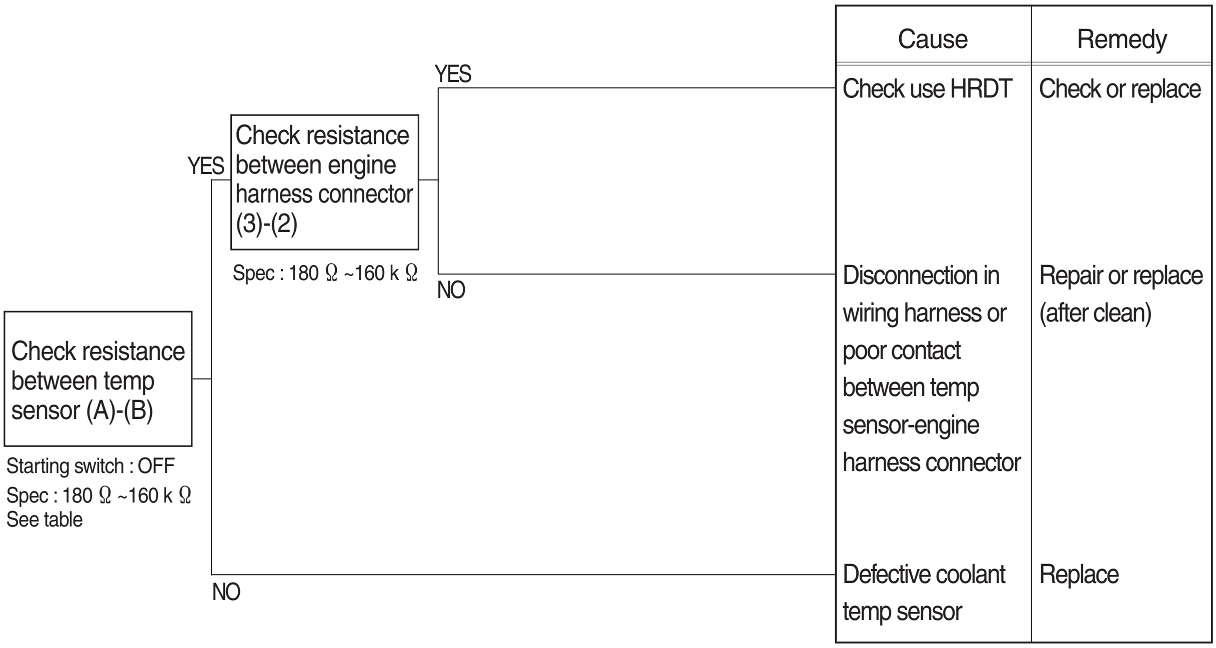
Check voltage

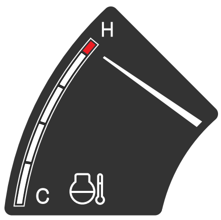
YES	20~32V
NO	0V



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

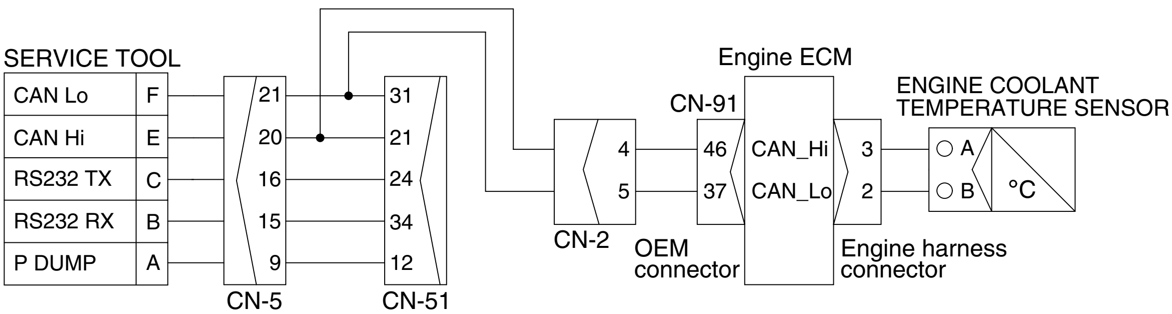
· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.





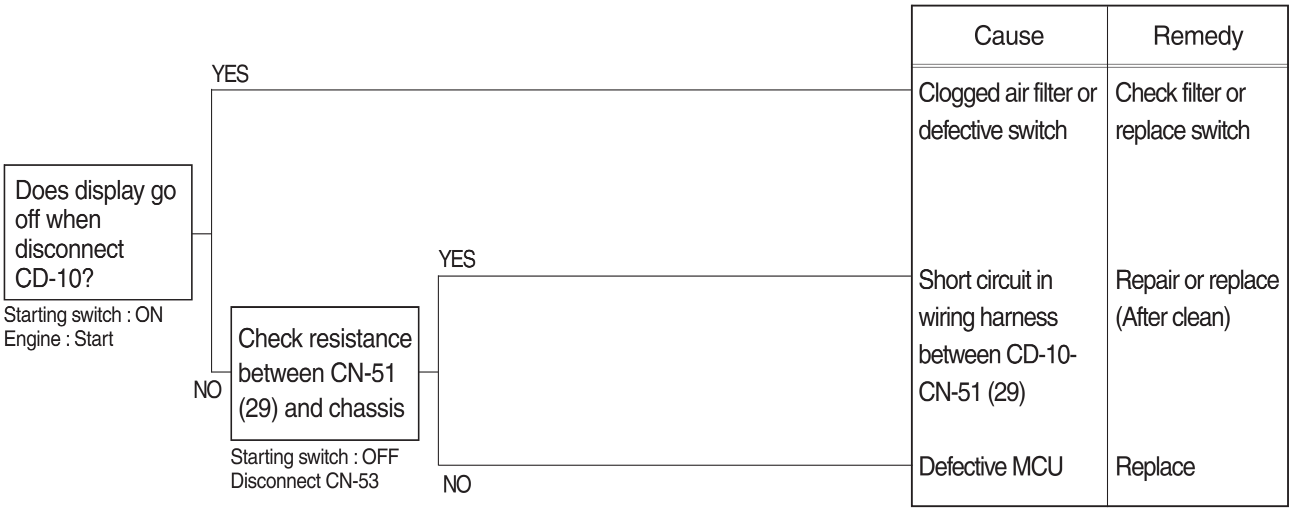
Check Table

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



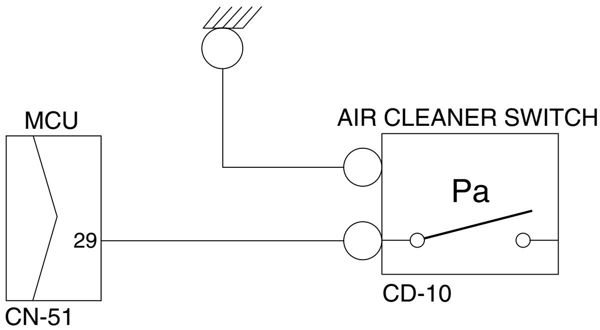
5. WHEN AIR CLEANER WARNING LAMP LIGHTS UP (engine is started)

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



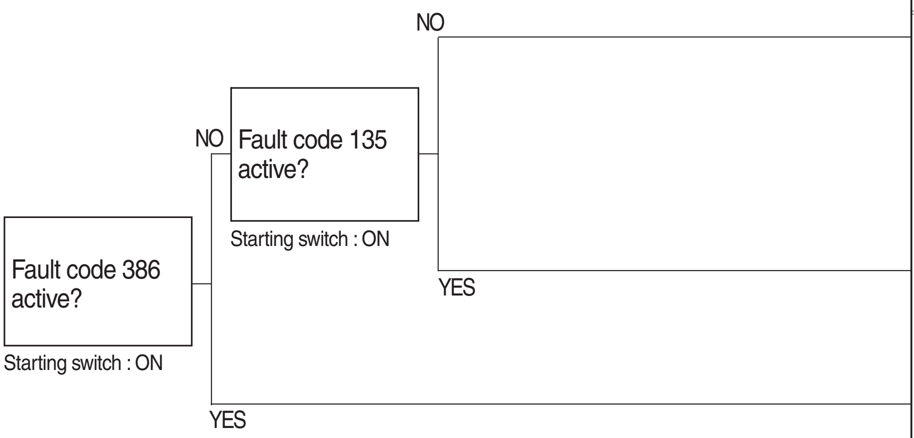
Check resistance

YES	MAX 1Ω
NO	MIN 1MΩ

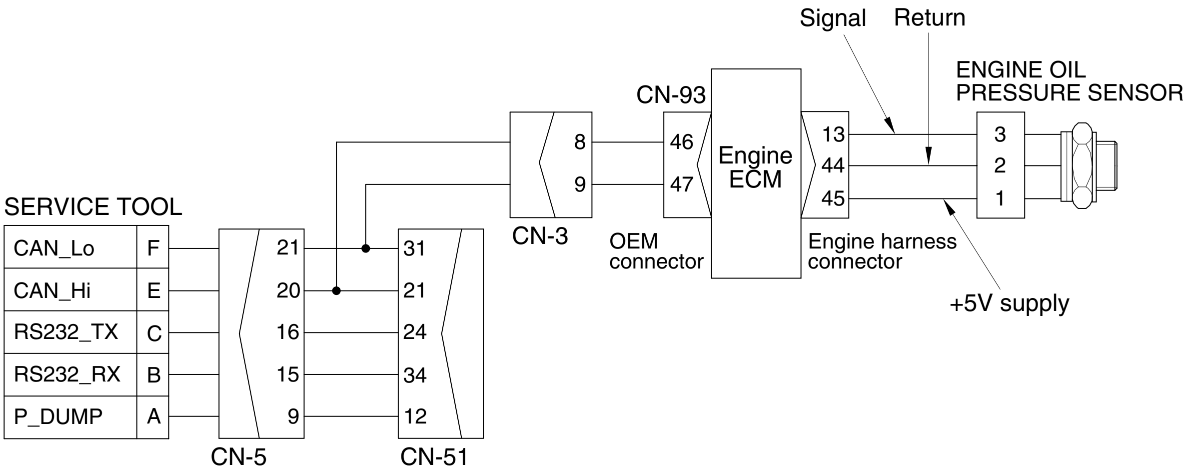


6. WHEN ENGINE OIL PRESSURE WARNING LAMP LIGHTS UP (engine is started)

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

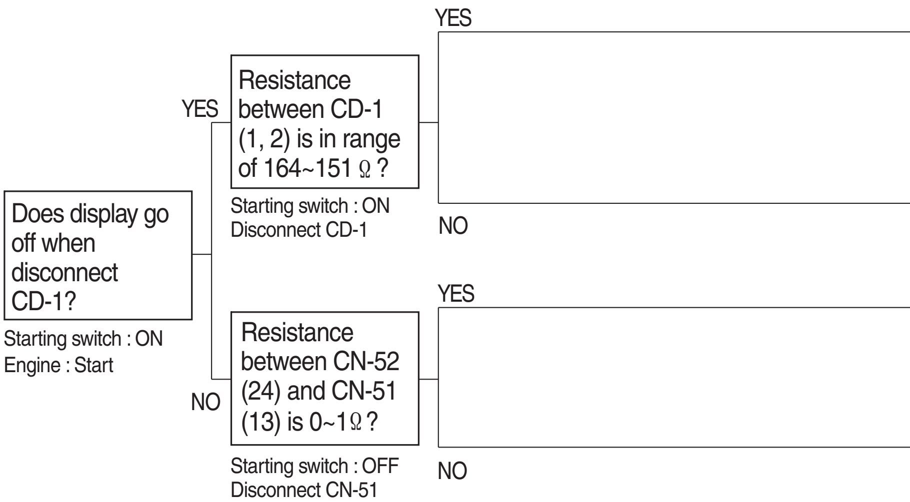


Cause	Remedy
Defective circuit, sensor or ECM.	Contact Cummins.
Voltage above normal or shorted to high source	Refer to engine fault code 135
Voltage above normal or shorted to high source	Refer to engine fault code 386

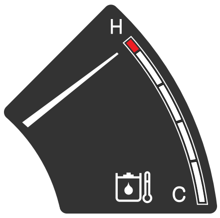


7. WHEN HYDRAULIC OIL TEMPERATURE WARNING LAMP LIGHTS UP (engine is started)

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

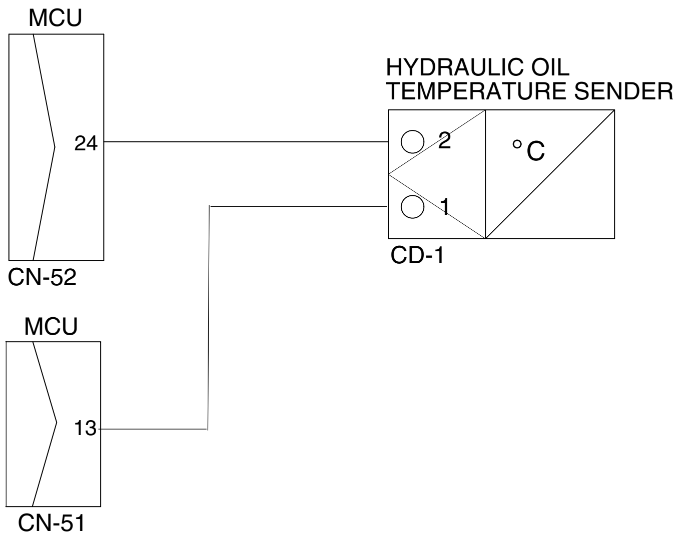


Cause	Remedy
High temperature	Check hydraulic oil temperature (105˚C±2˚C),
Defective temp sensor	Replace
Short circuit between temp sensor and MCU	Repair or replace
Defective controller	Replace



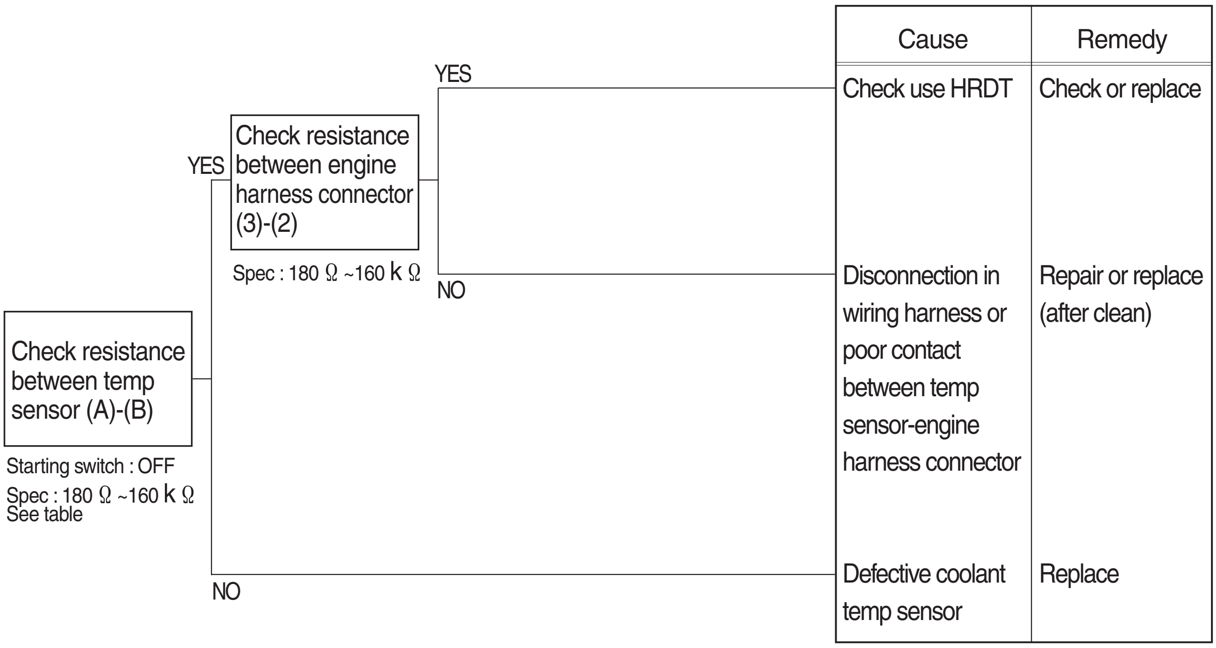
Check Table

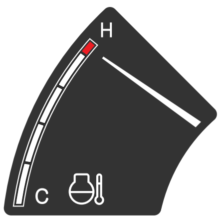
Temperature (˚C)	~ -30	~ -10	~ 0	~ 40	~ 70	~ 80	~ 90	~ 100	105~
Resistance (kΩ)	22.22 ~31.78	8.16 ~10.74	5.18 ~ 6.6	1.06 ~1.28	0.39 ~0.476	0.322 ~0.298	0.243 ~0.219	0.185 ~0.167	0.164 0.151



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

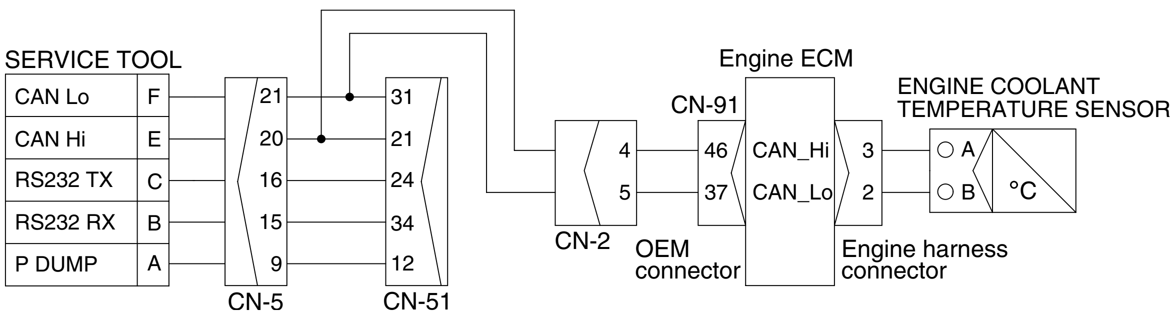
- Before disconnecting the connector, always turn the starting switch OFF.
- Before carrying out below procedure, check all the related connectors are properly inserted.
- After checking, insert the disconnected connectors again immediately unless otherwise specified.





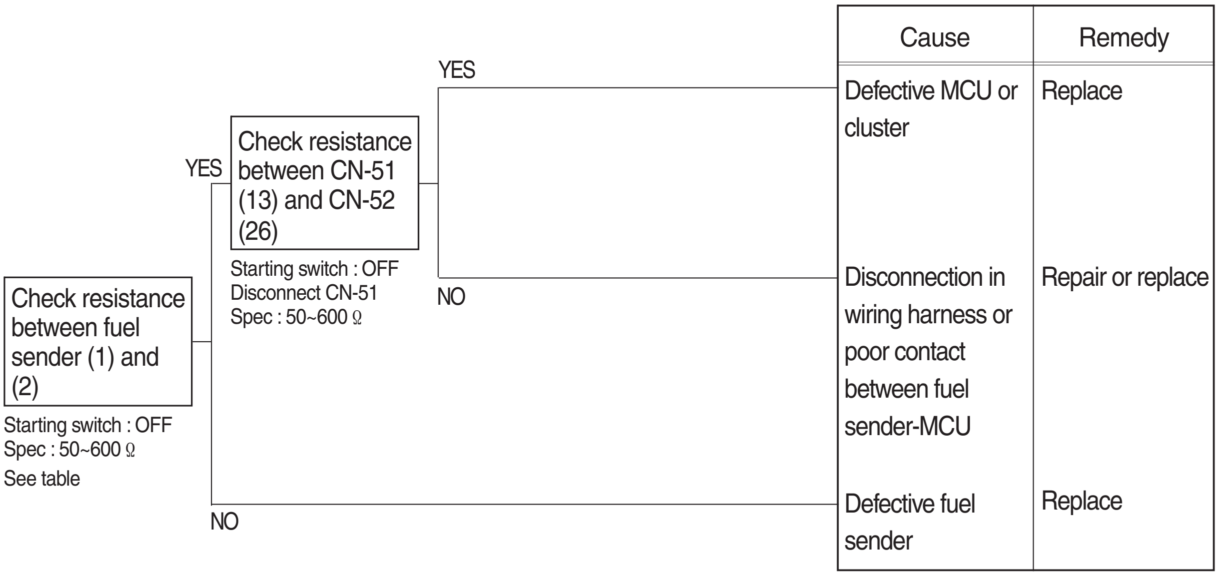
Check Table

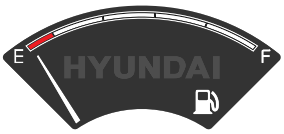
Temperature (˚C)	0	25	50	80	95
Resistance (k Ω)	30~37	9.3~10.7	3.2~3.8	1.0~1.3	0.7~0.8



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

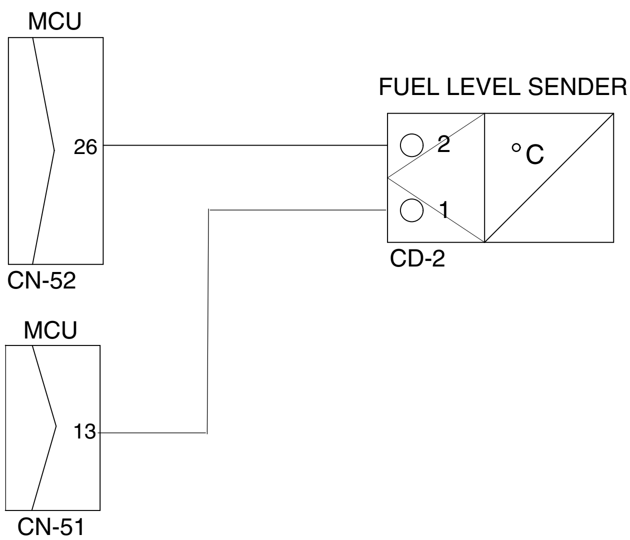
- Before disconnecting the connector, always turn the starting switch OFF.
- Before carrying out below procedure, check all the related connectors are properly inserted.
- After checking, insert the disconnected connectors again immediately unless otherwise specified.





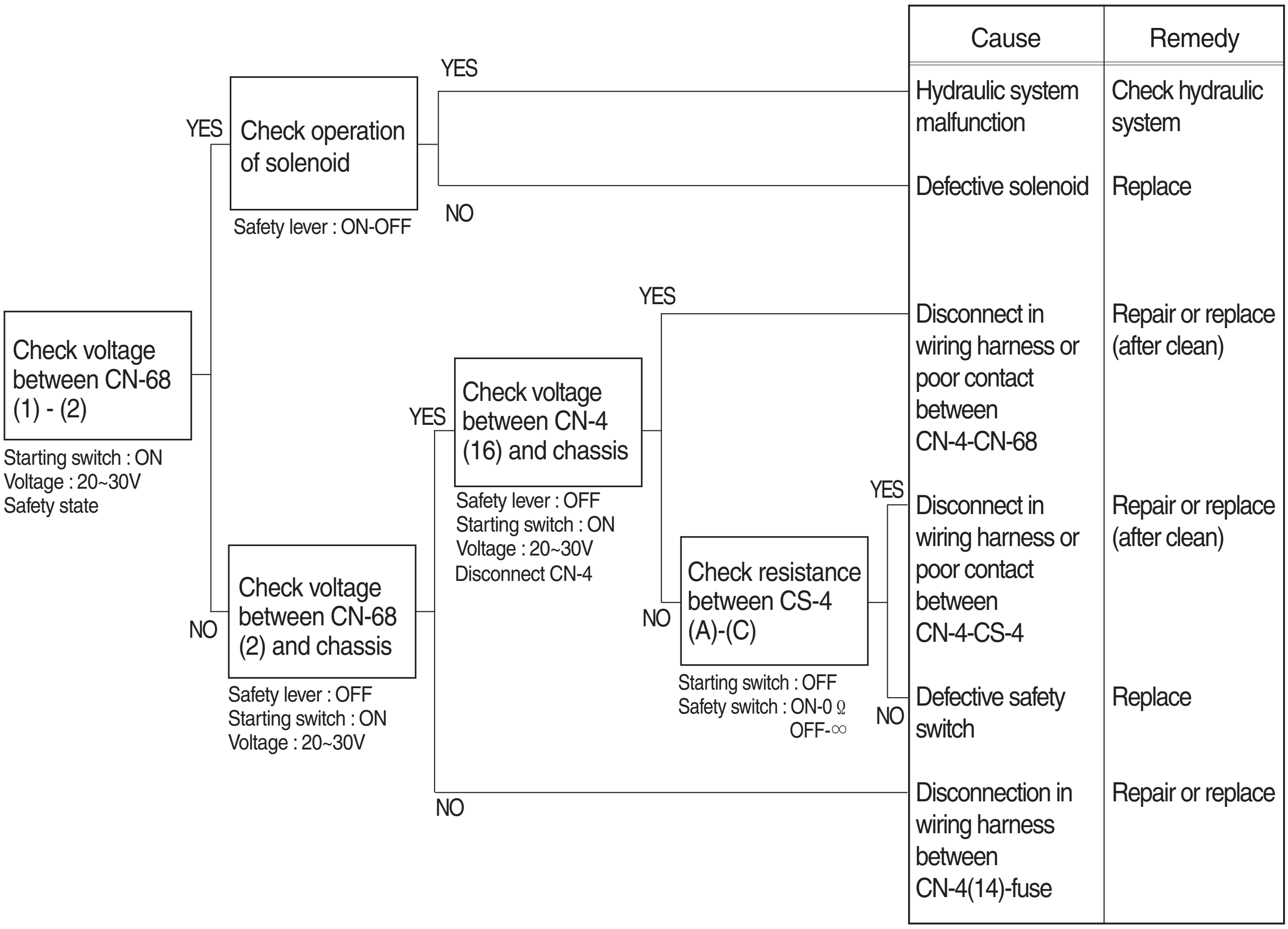
Check Table

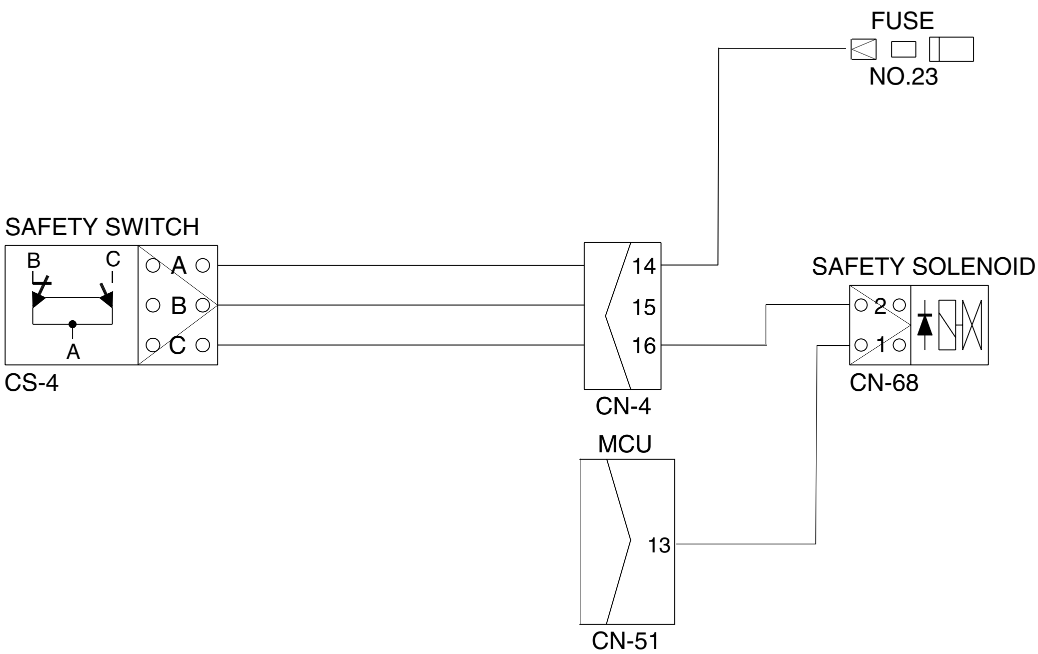
Range	Resistance (Ω)	Range	Resistance (Ω)
Full	50	5/12	400
11/12	100	4/12	450
10/12	150	3/12	500
9/12	200	2/12	550
8/12	250	1/12	600
7/12	300	Empty warning	700
6/12	350	-	-



10. WHEN SAFETY SOLENOID DOES NOT OPERATE

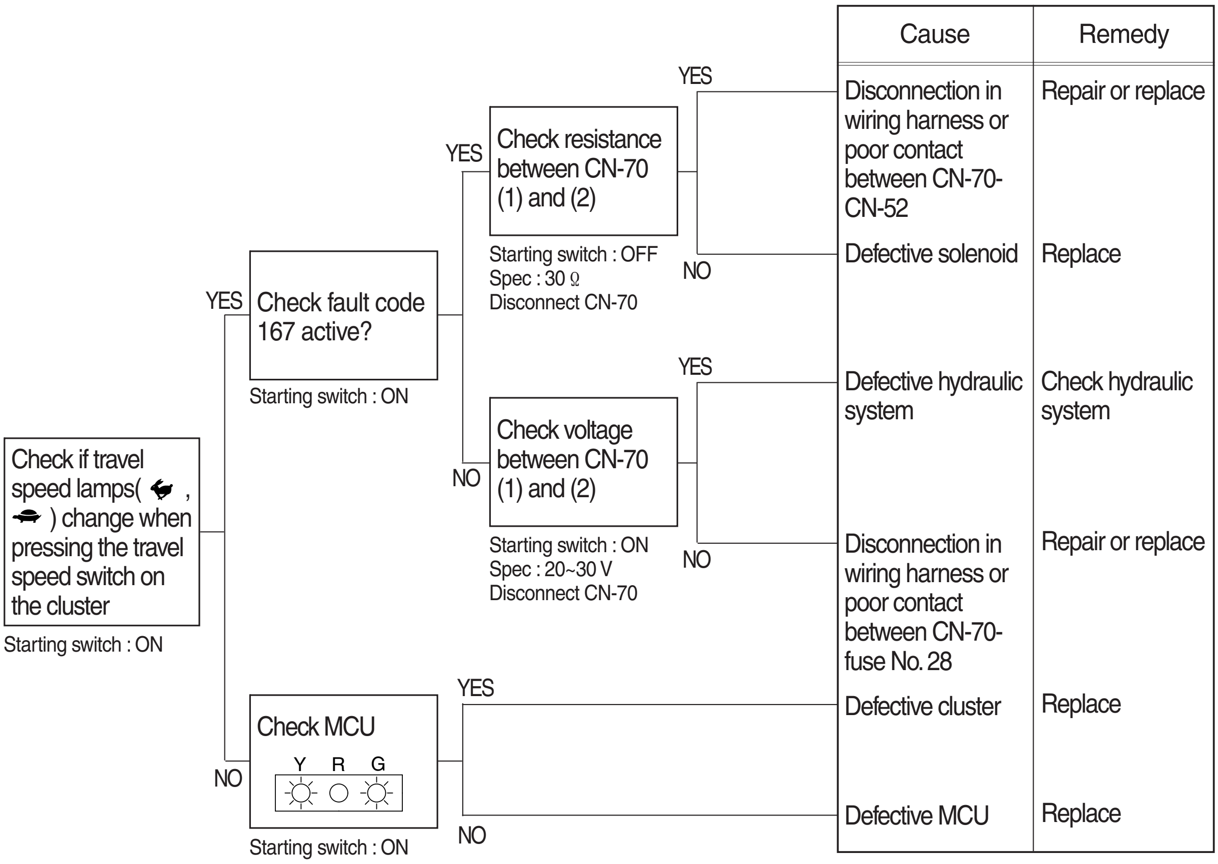
· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted and short of fuse No.23.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.

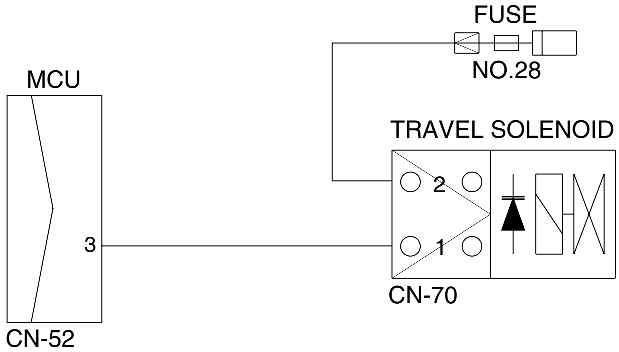




11. WHEN TRAVEL SPEED 1, 2 DOES NOT OPERATE (HCESPN 167, FMI 5 or 6)

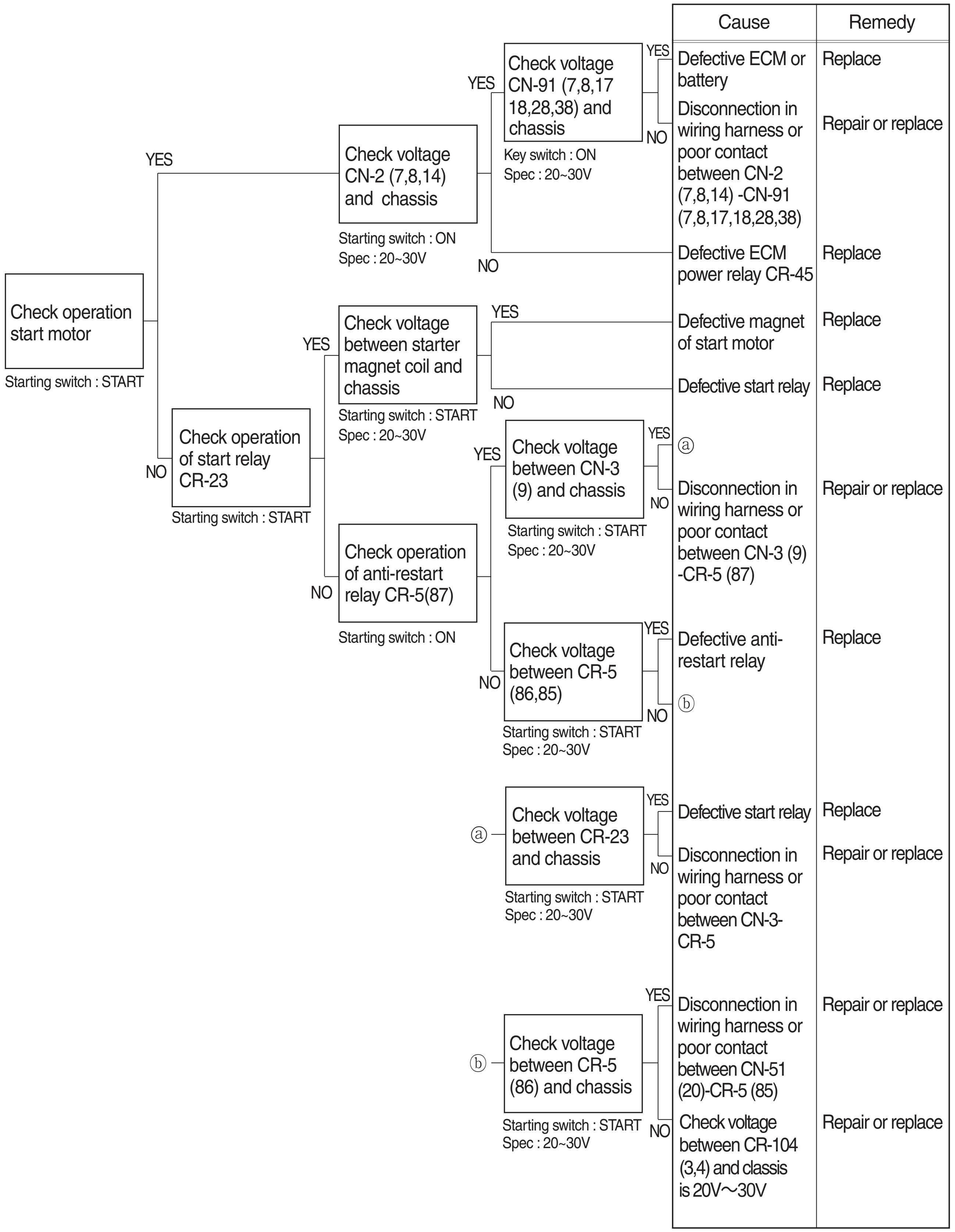
· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted and short of fuse No.28 .
· After checking, insert the disconnected connectors again immediately unless otherwise specified.

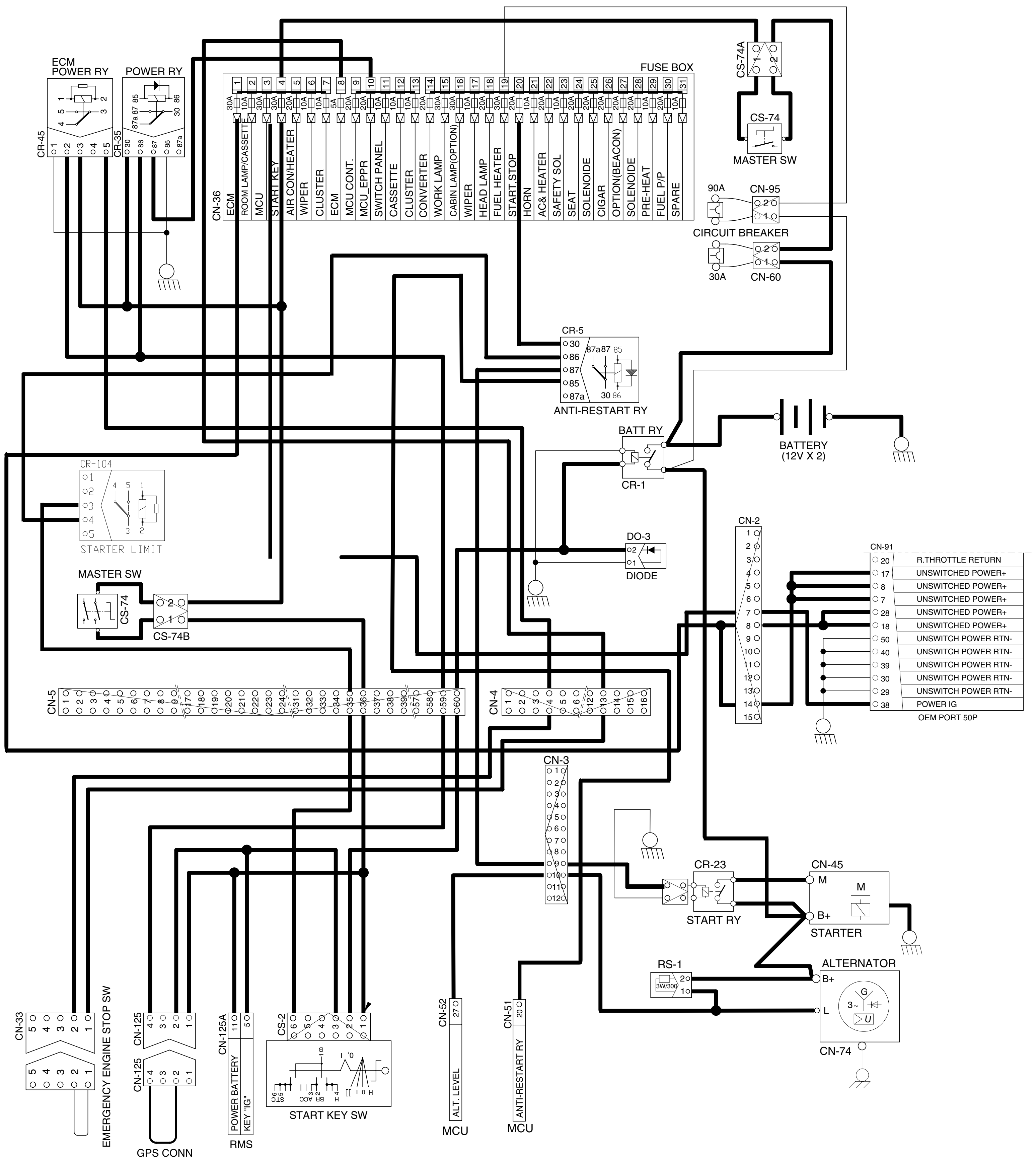




12. WHEN ENGINE DOES NOT START ([battery symbol] lights up condition)

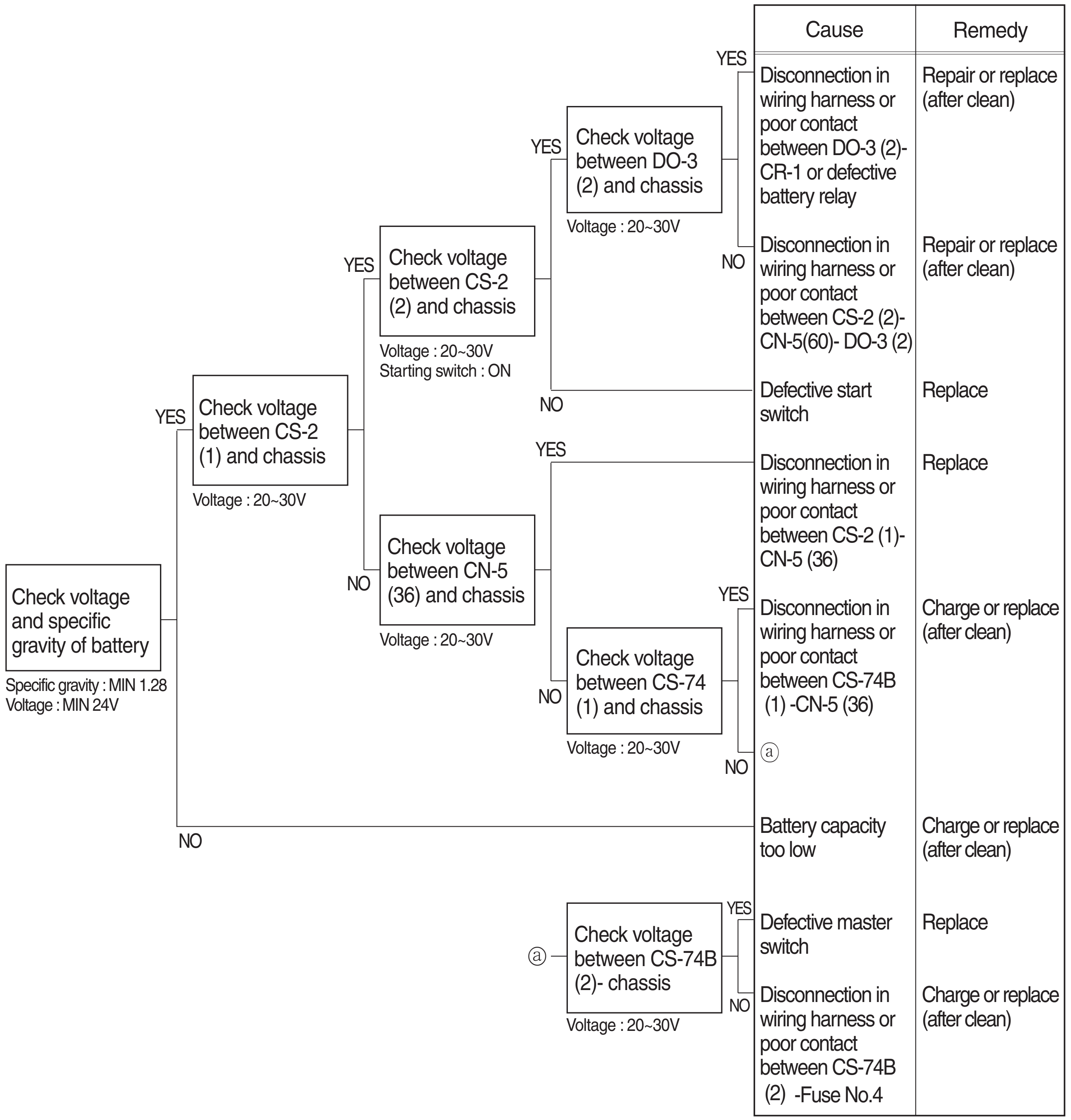
· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted and short of fuse No. 1, 4, 8, 20.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.

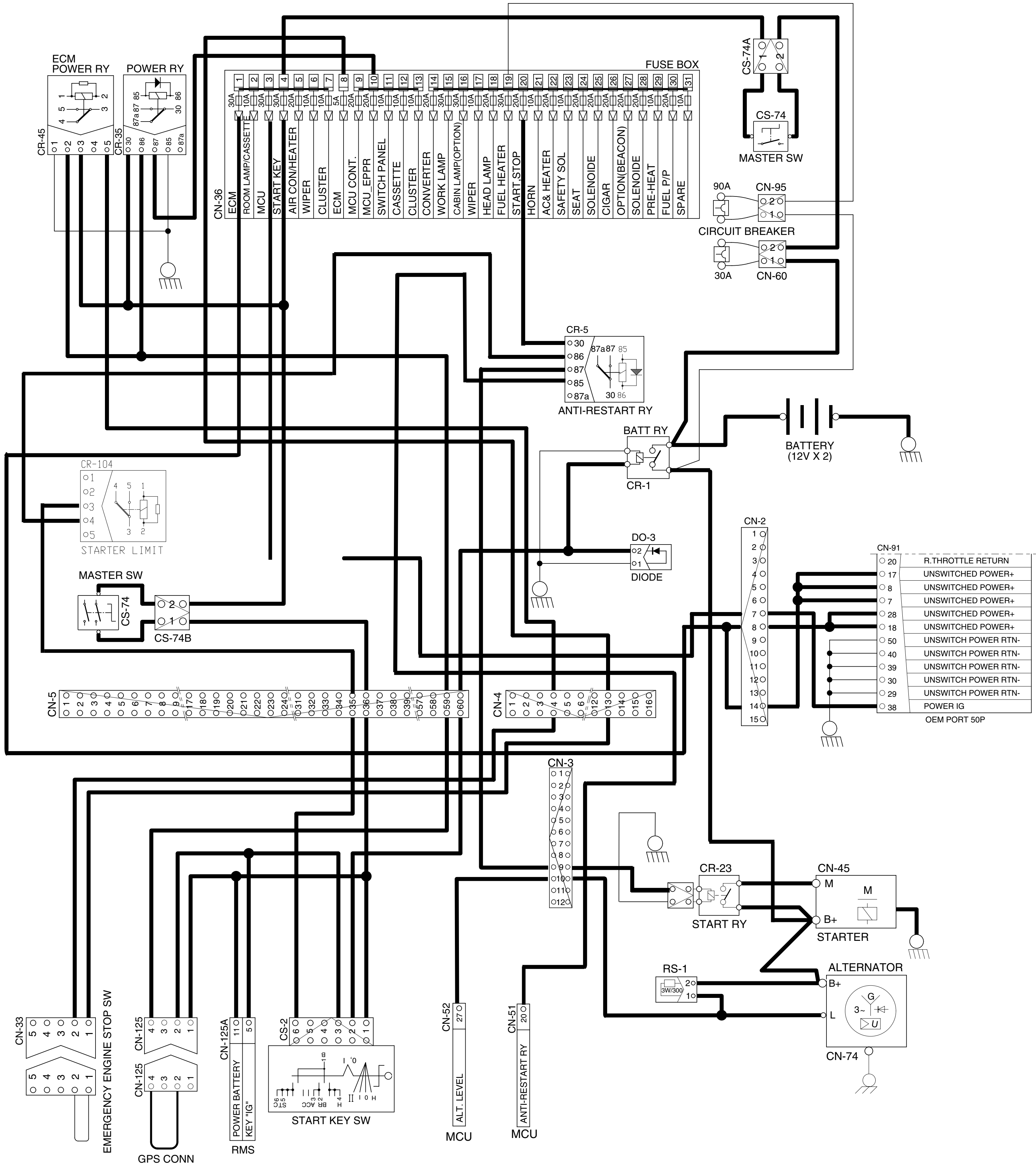




13. WHEN STARTING SWITCH ON DOES NOT OPERATE

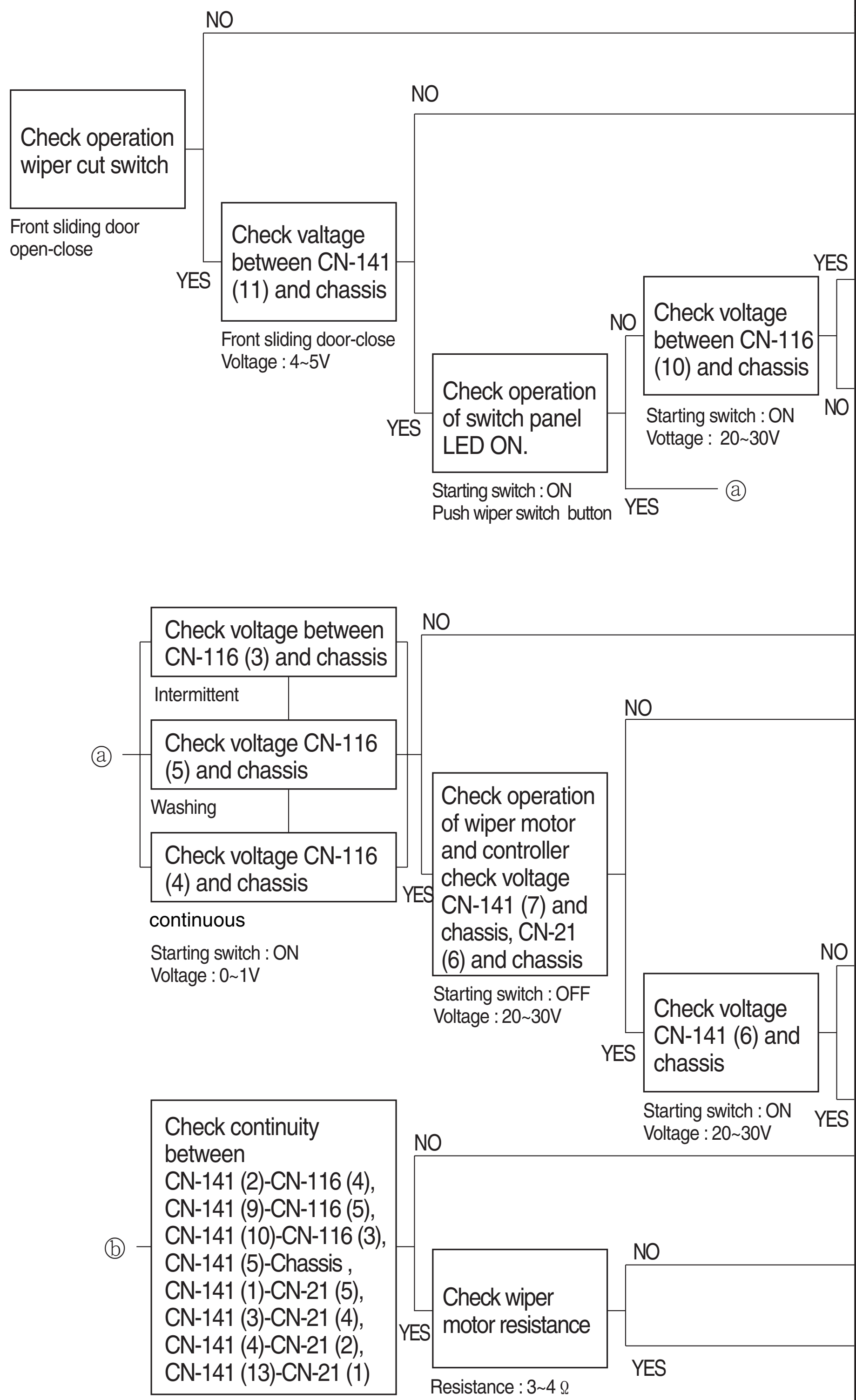
- Before disconnecting the connector, always turn the starting switch OFF.
- Before carrying out below procedure, check all the related connectors are properly inserted, master switch ON and check open circuit of fusible link (CN-60).
- After checking, insert the disconnected connectors again immediately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



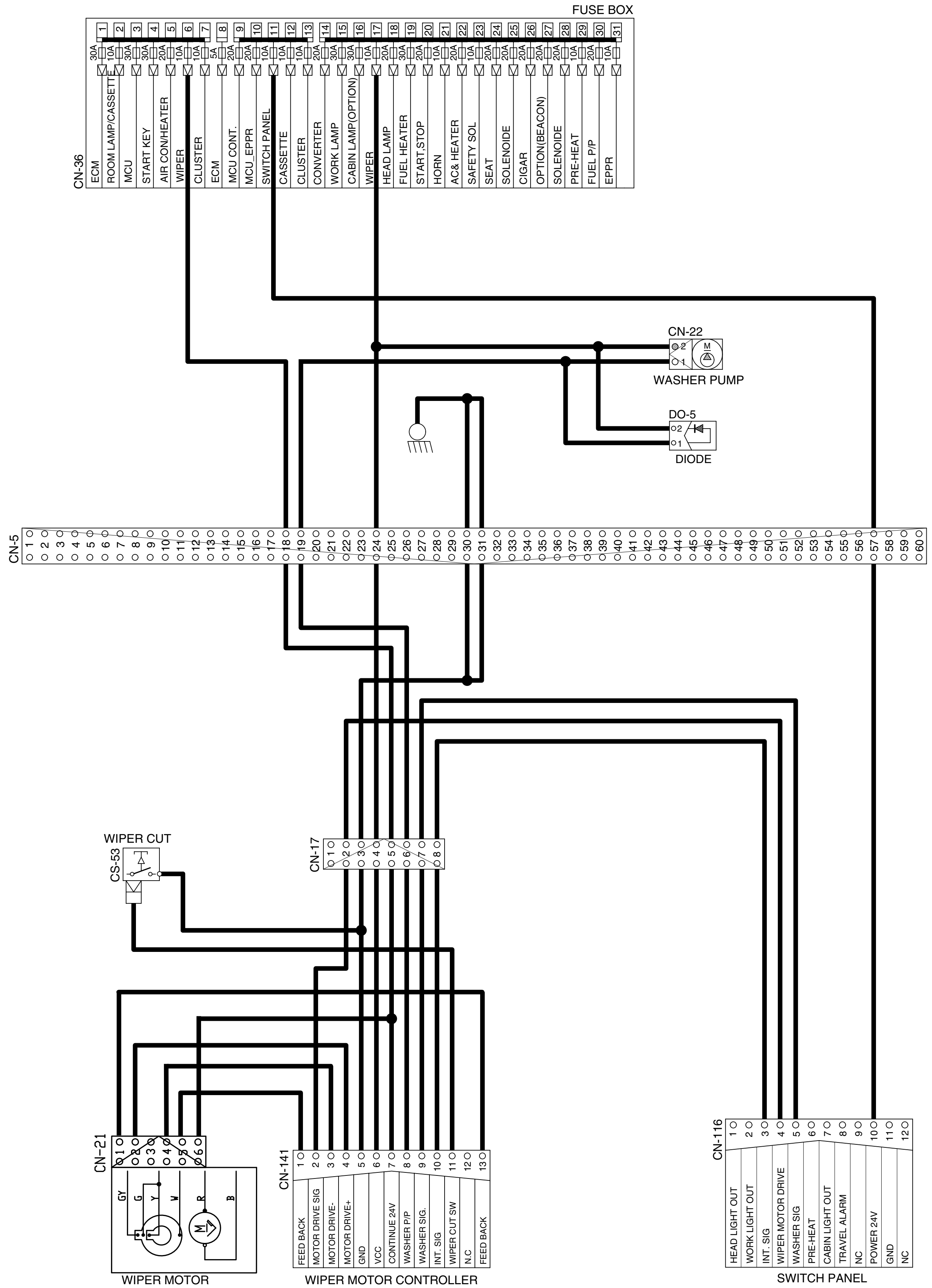


14. WHEN STARTING SWITCH IS TURNED ON, WIPER MOTOR DOES NOT OPERATE

· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted and the fuse No. 6, 11 and 17 is not blown out.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.

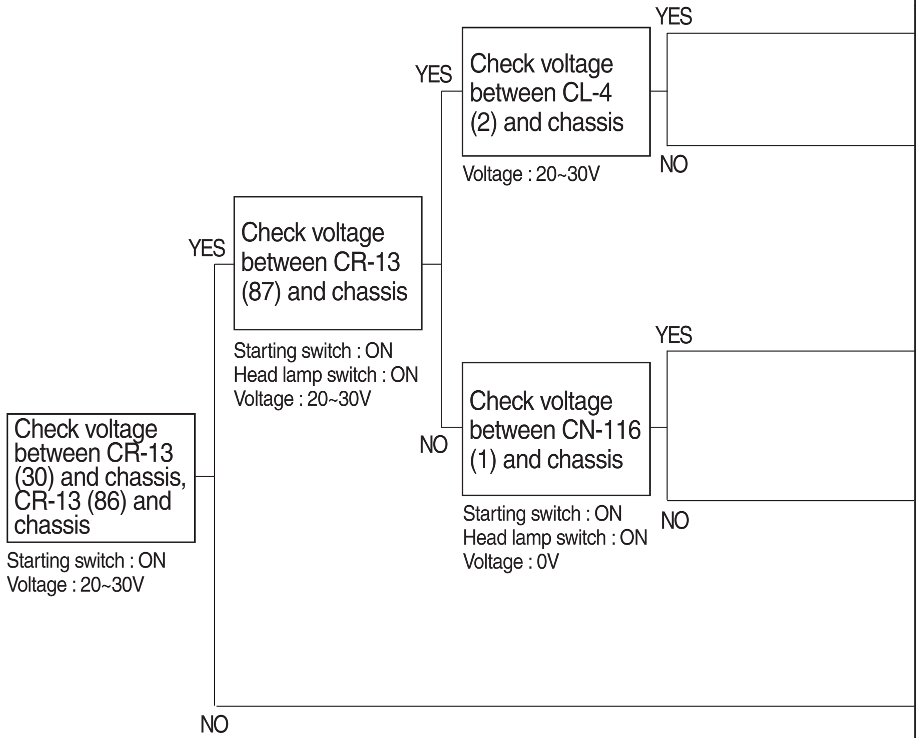


Cause	Remedy
Defective wiper cut switch	Replace
Short circuit in wiring harness or poor contact between CN-141 (11)- CS-53	Repair or replace (after clean)
Defective switch panel	Replace
1)Recheck fuse No.11 2)Disconnection in wiring harness or poor contact between CN-116(10)-Fuse	Replace Repair or replace (after clean)
Defective switch panel	Replace
1) Recheck fuse No.6 2) Disconnection in wiring harness or poor contact between CN-141(7)-Fuse, CN-21(4)-Fuse	Replace Repair or replace (after clean)
1) Recheck fuse No.17 2) Disconnection CN-141(6)-Fuse	Replace Repair or replace (after clean)
ⓑ	
Disconnection in wiring harness or poor contact	Repair or replace (after clean)
Defective wiper motor	Replace
Defective wiper motor controller	Replace

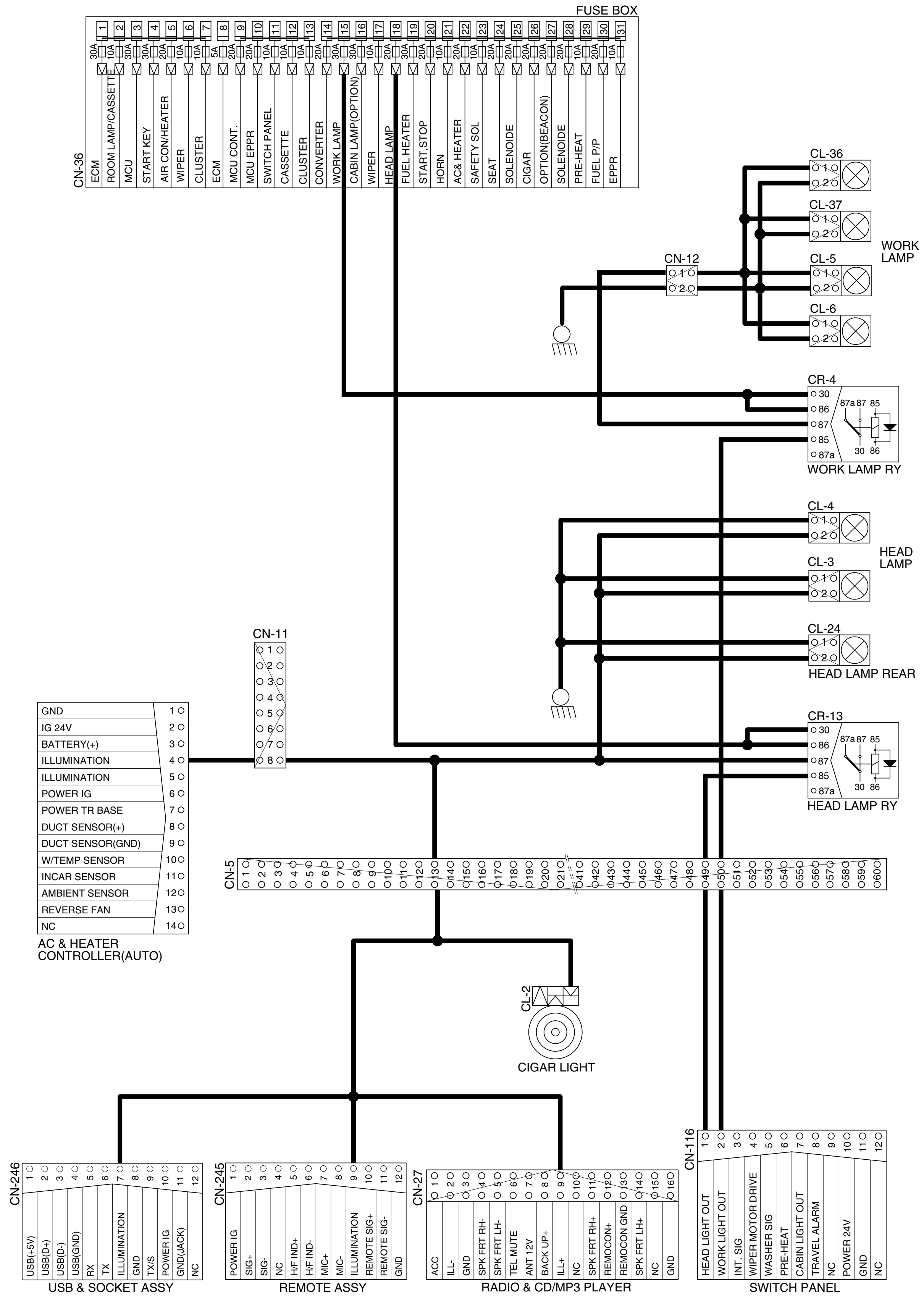


15. WHEN STARTING SWITCH IS TURNED ON, HEAD LAMP DOES NOT LIGHTS UP

· 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.18.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.

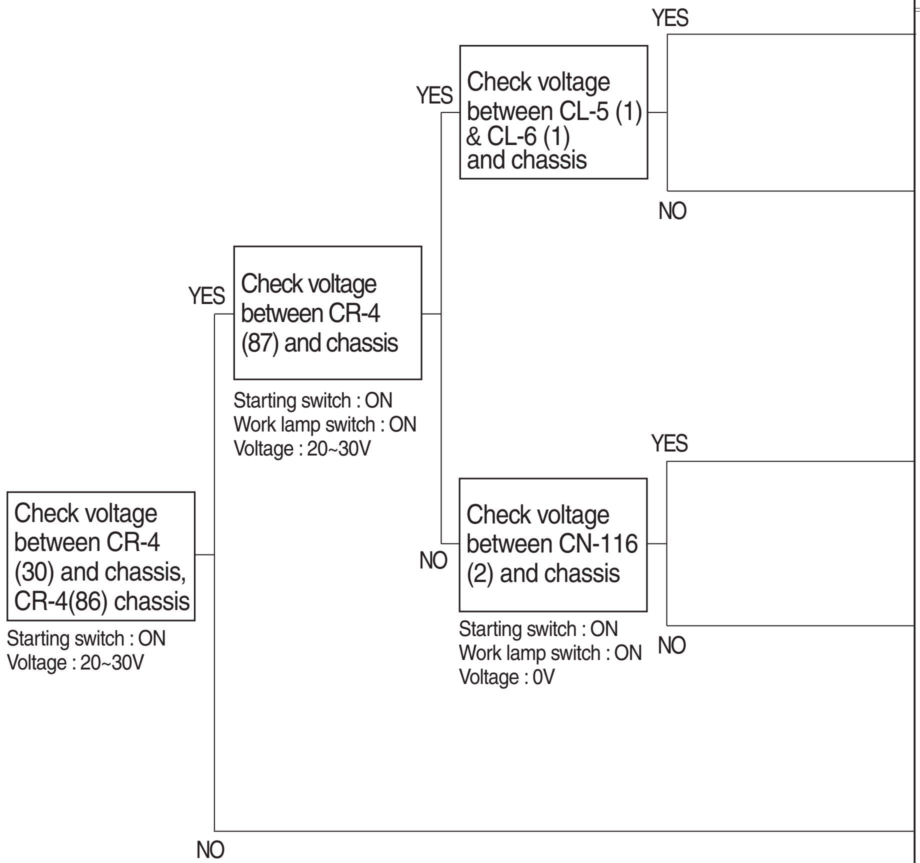


Cause	Remedy
Defective bulb	Replace
Disconnection in wiring harness or poor contact between CR-13 (87)-CL-4 (1)	Repair or replace (after clean)
Defective switch panel	Replace
Disconnection in wiring harness or poor contact between CN-116 (1)-CR-13 (85)	Repair or replace (after clean)
Disconnection in wiring harness or poor contact between CR-13 (30) and chassis or CR-13 (86) - chassis	Repair or replace (after clean)
Recheck fuse No. 18	Replace

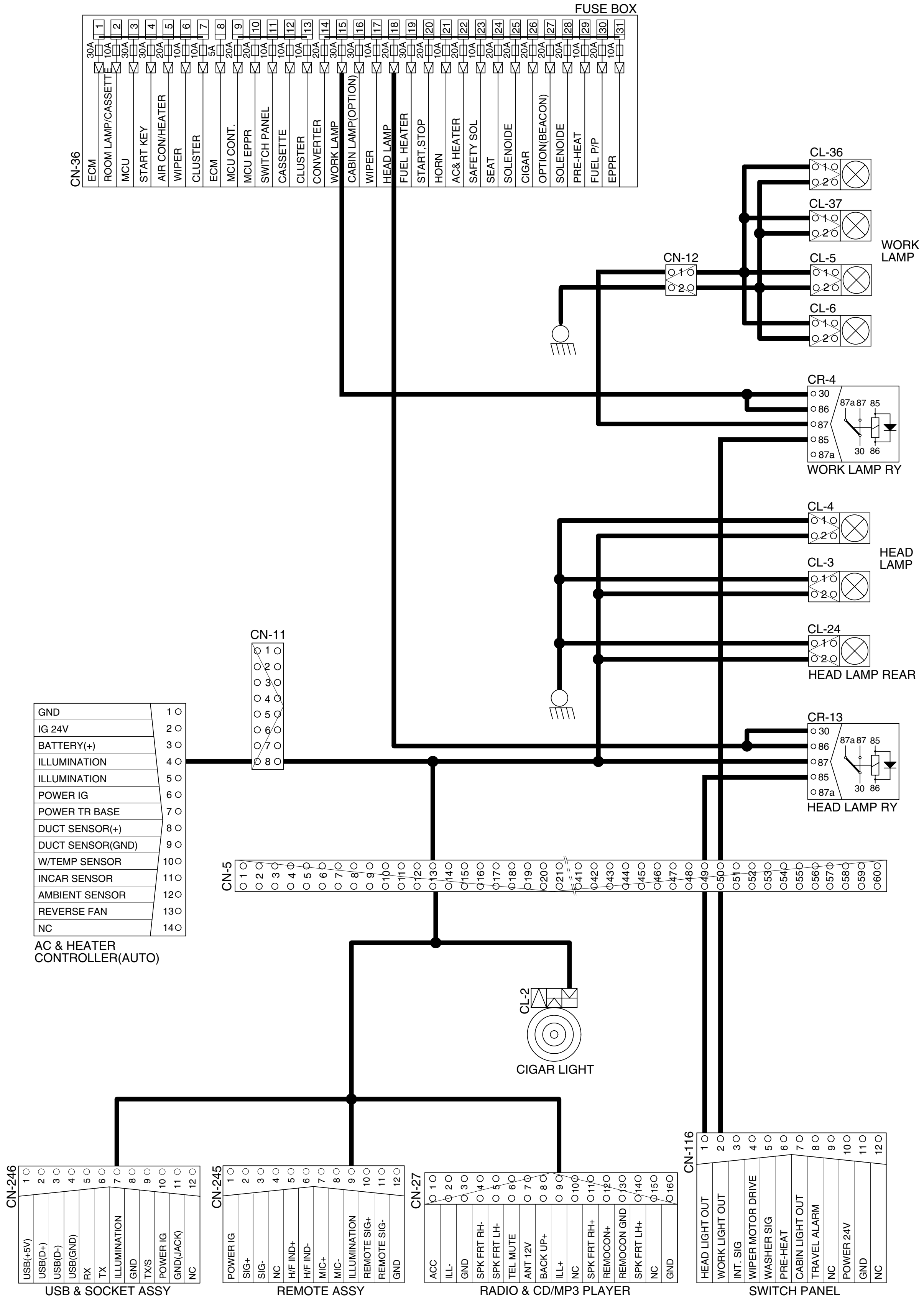


16. WHEN STARTING SWITCH IS TURNED ON, WORK LAMP DOES NOT LIGHTS UP

- 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.15.
- 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 (1) & CL-6(1)	Repair or replace (after clean)
Defective switch panel	Replace
Disconnection in wiring harness or poor contact between CR-4 (85)-CN-116 (2)	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.15	Replace



GROUP 4 MECHATRONICS SYSTEM

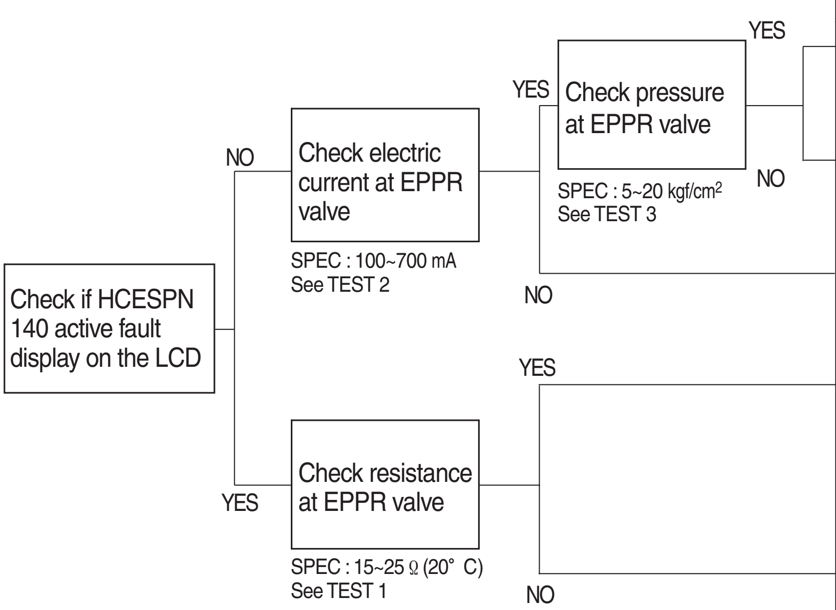
1. ALL ACTUATORS SPEED ARE SLOW

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

※ Spec : P-mode 1750 ± 50 rpm S -mode 1650 ± 50 rpm E-mode 1600 ± 50 rpm

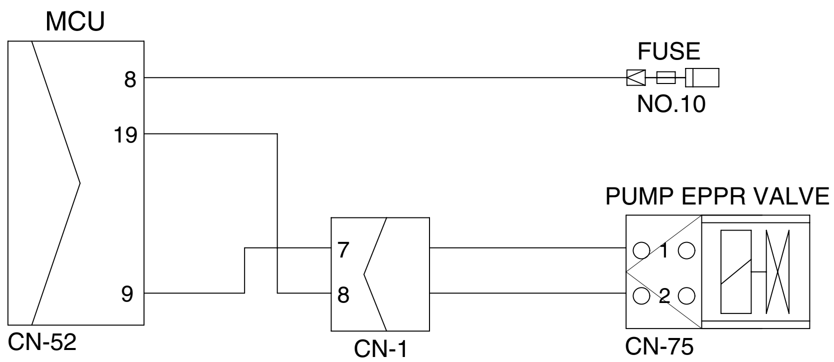
※ Before carrying out below procedure, check all the related connectors are properly inserted and fault code on the cluster.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective hydraulic system	
Defective EPPR valve	Replace
Defective MCU	Replace
Short circuit or poor connection between CN-52 -CN-75	Check & repair wire harness or between CN-52 -CN-75
Defective EPPR valve	Replace

Wiring diagram



2) TEST PROCEDURE

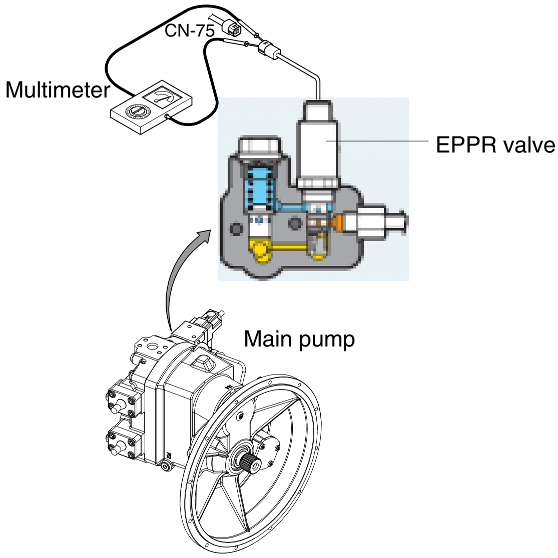
(1) Test 1 : Check resistance at connector CN-75.

① Starting switch OFF.

② Disconnect connector CN-75 from EPPR valve at main hydraulic pump.

③ Check resistance between 2 lines as figure.

SPEC : 15~25Ω (20˚C)



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

① Disconnect connector CN-75 from EPPR valve.

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

③ Start engine.

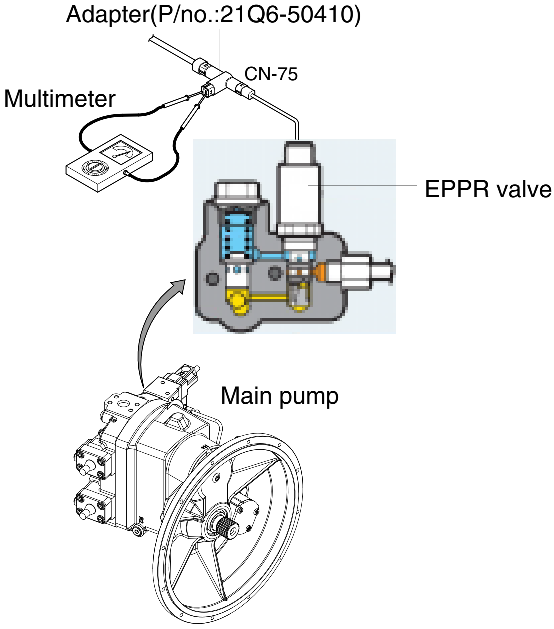
④ Set S-mode and cancel auto decel mode.

⑤ Position the multimodal dial at 10.

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

⑦ Check electric current at bucket circuit relief position.

Spec : 100~700 mA



(3) **Test 3** : Check pressure at EPPR valve.

① Start engine.

② Set S-mode and cancel auto decel

③ mode.

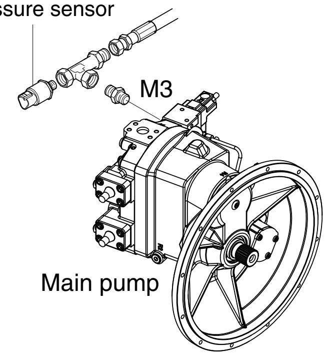
Position the multimodal dial at 10.

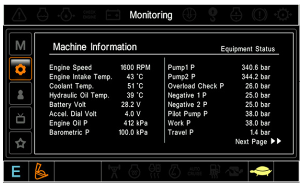
④ If tachometer show approx 1750±50 rpm check pressure at relief position of bucket circuit by operating bucket control lever.

⑤ If pressure is not correct, adjust it.

⑥ After adjust, test the machine.

Spec : 2~40 kgf/cm^2 (30~580 psi)



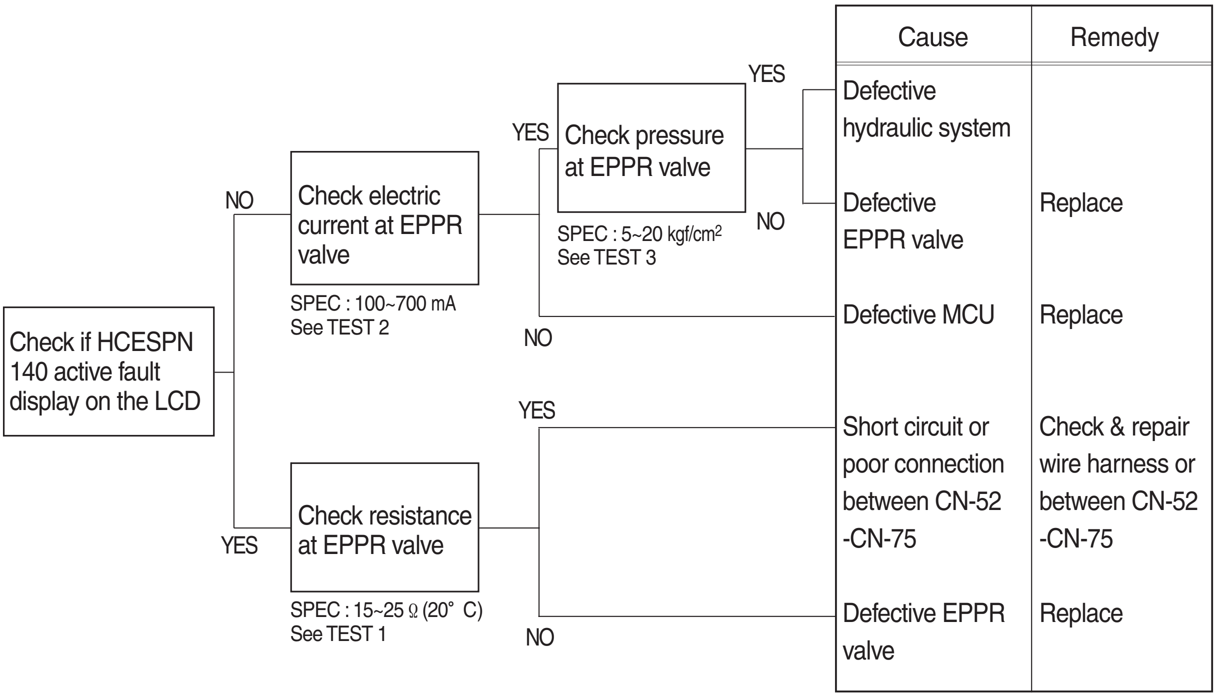


Cluster

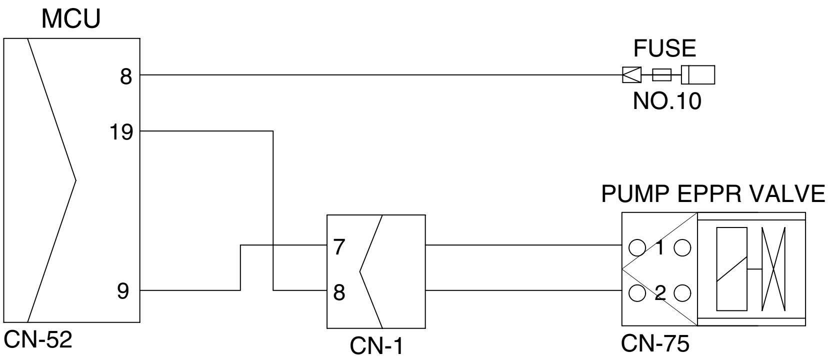
2. ENGINE STALL

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

1) INSPECTION PROCEDURE



Wiring diagram



2) TEST PROCEDURE

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

① Disconnect connector CN-75 from EPPR valve.

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

③ Start engine.

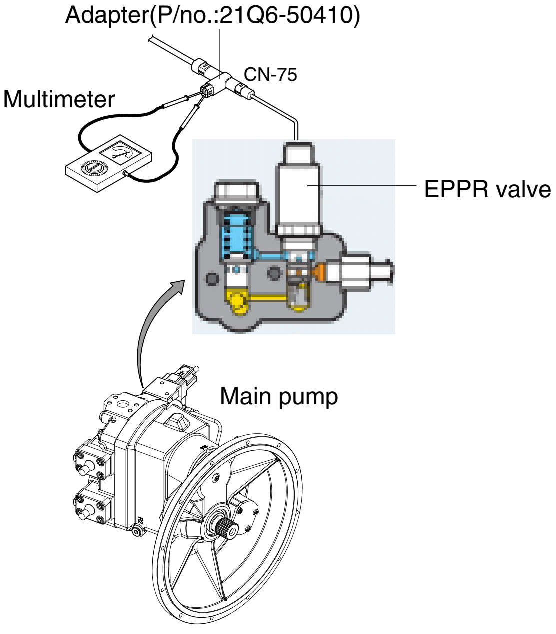
④ Set S-mode and cancel auto decel mode.

⑤ Position the multimodal dial at 10.

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

⑦ Check electric current at bucket circuit relief position.

Spec : 100~700 mA



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

① Start engine.

② Set S-mode and cancel auto decel mode.

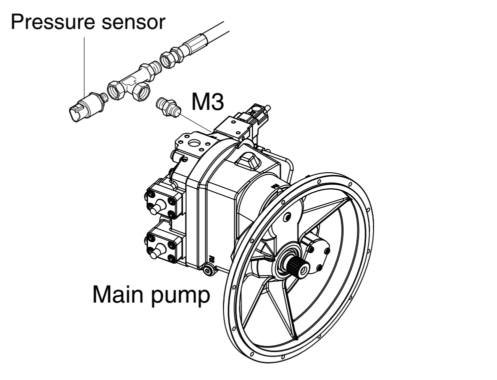
③ Position the multimodal dial at 10.

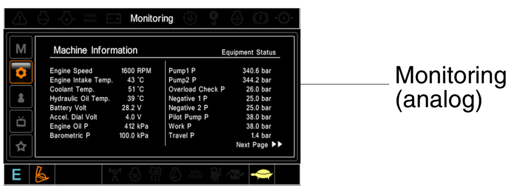
④ If rpm show approx 1750±50 rpm check pressure at relief position of bucket circuit by operating bucket control lever.

⑤ If pressure is not correct, adjust it.

⑥ After adjust, test the machine.

Spec : 2~40 kgf/cm^2 (30~580 psi)



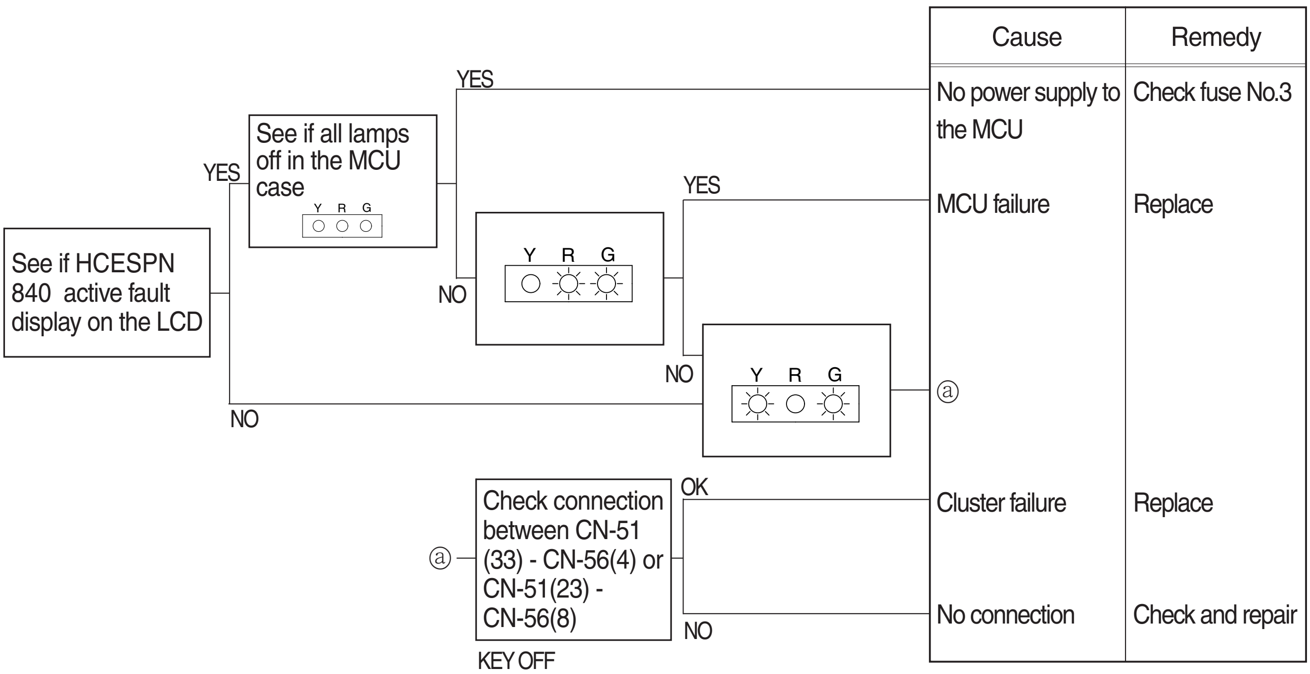


Cluster

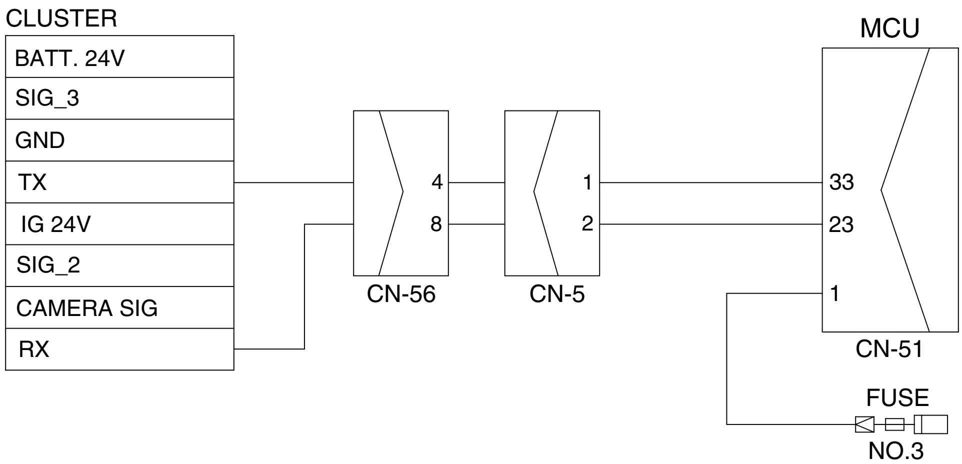
3. MALFUNCTION OF CLUSTER OR MODE SELECTION SYSTEM

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

1) INSPECTION PROCEDURE



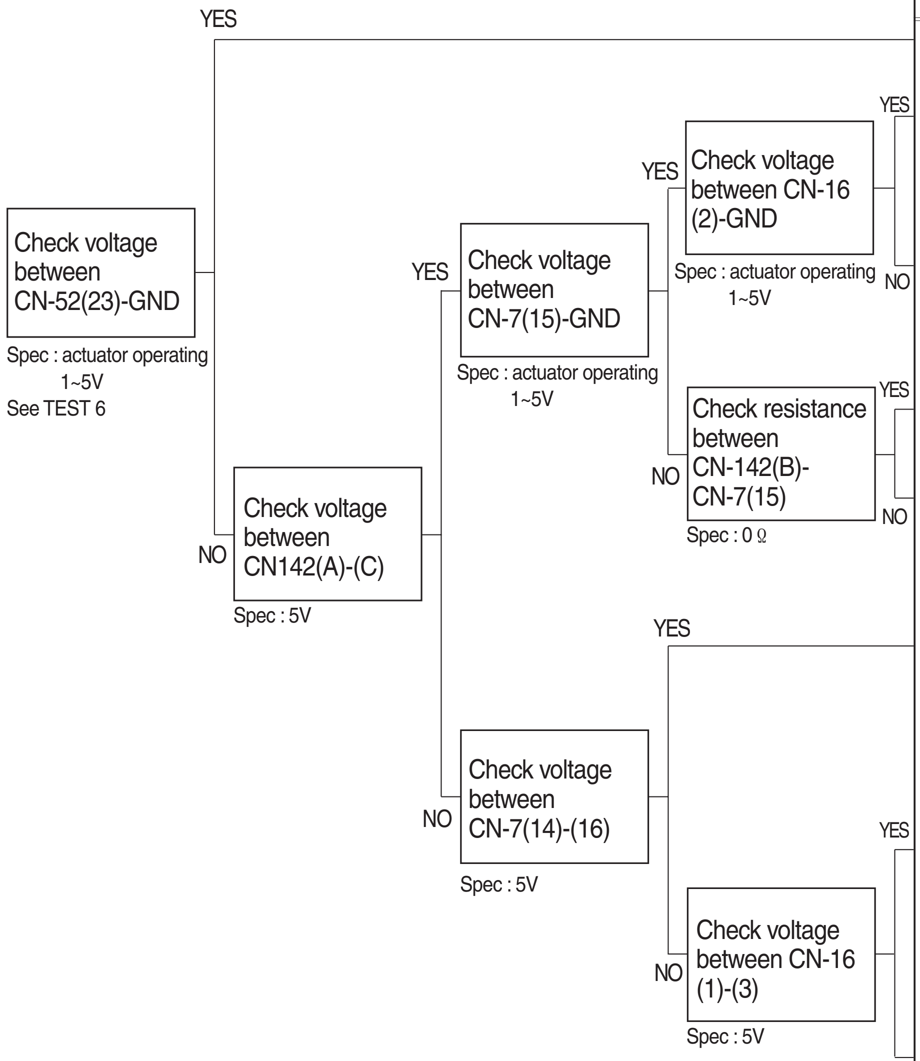
Wiring diagram



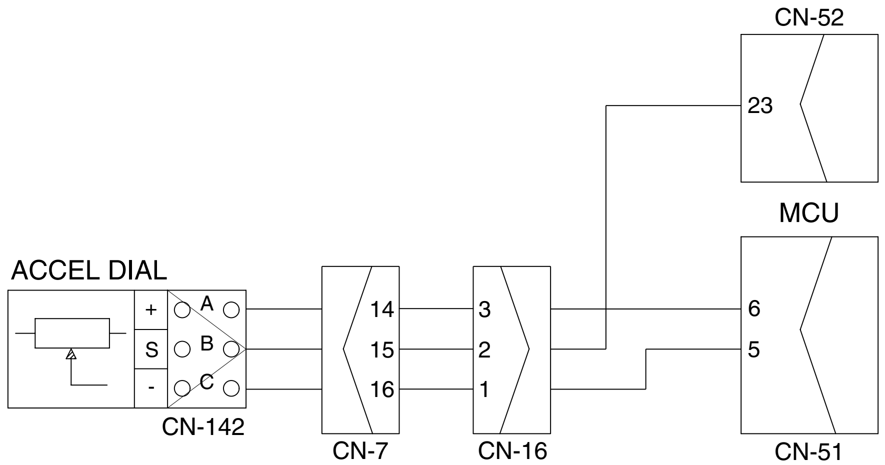
4. MALFUNCTION OF ACCEL DIAL

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

1) INSPECTION PROCEDURE



Cause	Remedy
Defective MCU	Replace
Open circuit or poor connection between CN-16 (2) -CN-52 (23)	Replace or repair
Open circuit or poor connection between CN-7 (15) -CN-16 (2)	Replace or repair
Defective accel dial	Replace
Open circuit or poor connection between CN-142 (B) -CN-7 (15)	Replace or repair
Open circuit or poor connection between CN-142 (A) -CN-7 (14) or CN-142 (C)-CN-7 (16)	Replace or repair
Open circuit or poor connection between CN-7 (14) -CN-16 (3) or CN-7 (16)-CN-16 (1)	Replace or repair
Open circuit or poor connection between CN-16 (3) -CN-51 (6) or CN-16 (1)-CN-51 (5)	Replace or repair



2) TEST PROCEDURE

(1) Test 6 : Check voltage at CN-52(23) and ground.

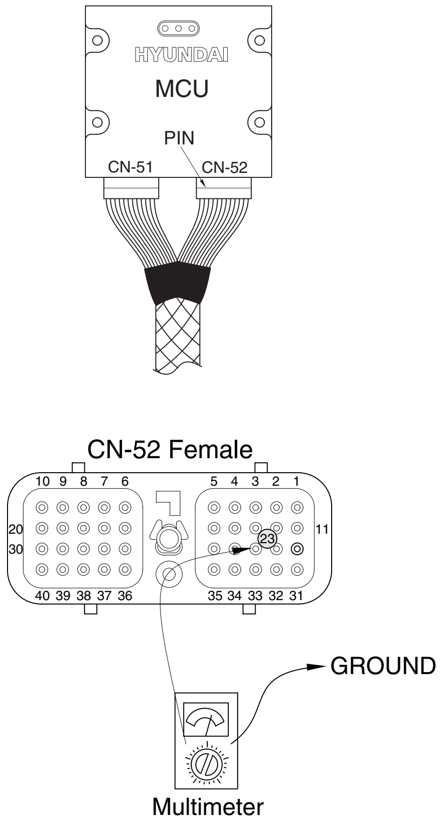
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (23) of CN-52.

③ Starting key ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V

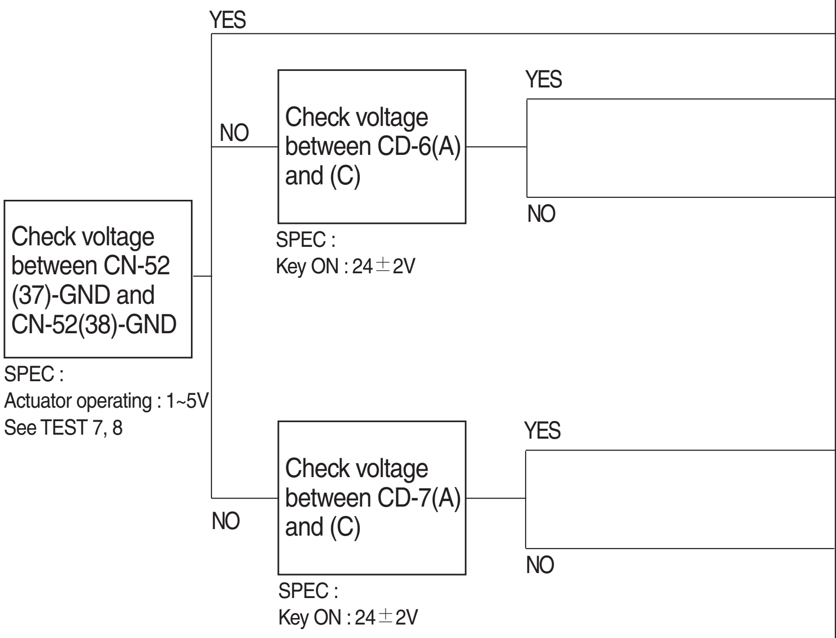


5. AUTO DECEL SYSTEM DOES NOT WORK

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

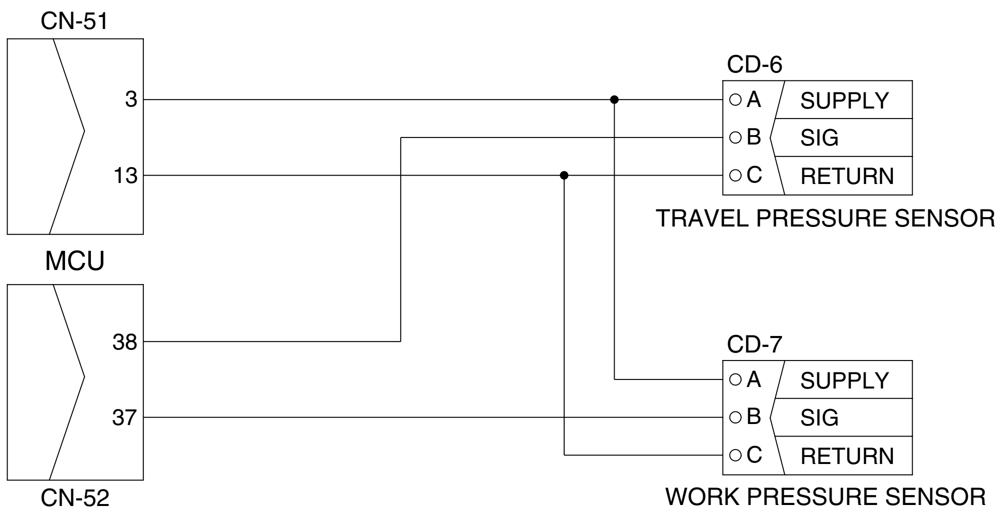
※ Before carrying out below procedure, check all the related connectors are properly inserted.

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

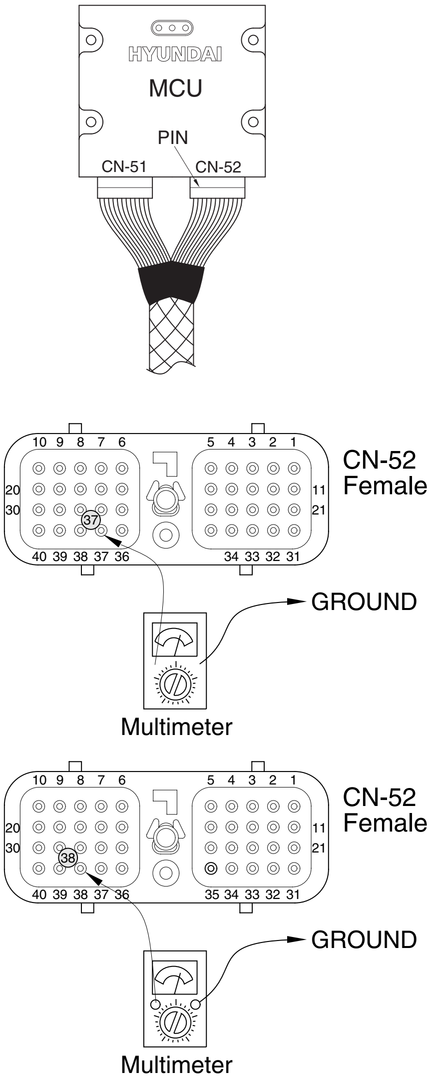
(1) Test 7 : Check voltage at CN-52(37) and ground.

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.

(2) Test 8 : 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.

SPEC : Actuator operating : 1~5 V

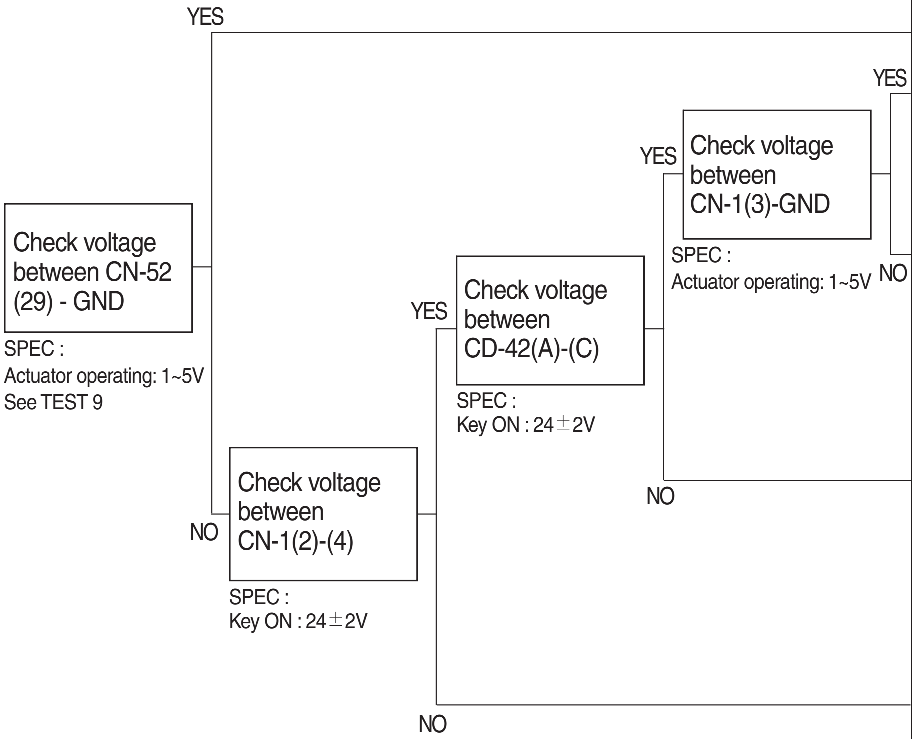


6. MALFUNCTION OF PUMP 1 PRESSURE SENSOR

· Fault code : HCESPN 120, FMI 0~4

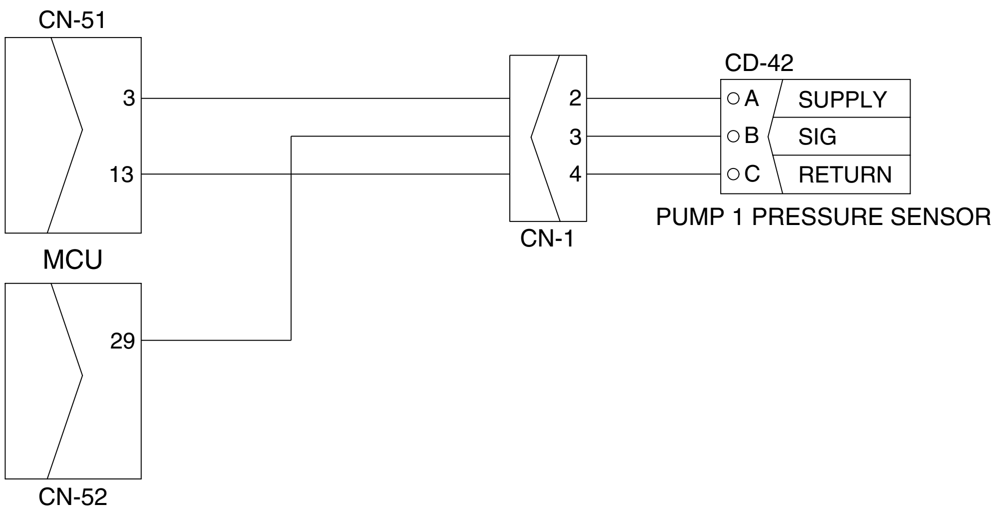
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective MCU	Replace
Short circuit or poor connection between CN-52-(29)-CN-1(3)	Replace or repair
Detective P1 pressure sensor	Replace or repair
Short circuit or poor connection between CN-1(3)-CD-42(B)	Replace or repair
Short circuit or poor connection between CD-42(A)-CN-1(2) or CD-42(C)-CN-1(4)	Replace or repair
Short circuit or poor connection between CN-1(2)-CN-51(3) or CN-1 (4) - CN-51(13)	Replace or repair

Wiring diagram

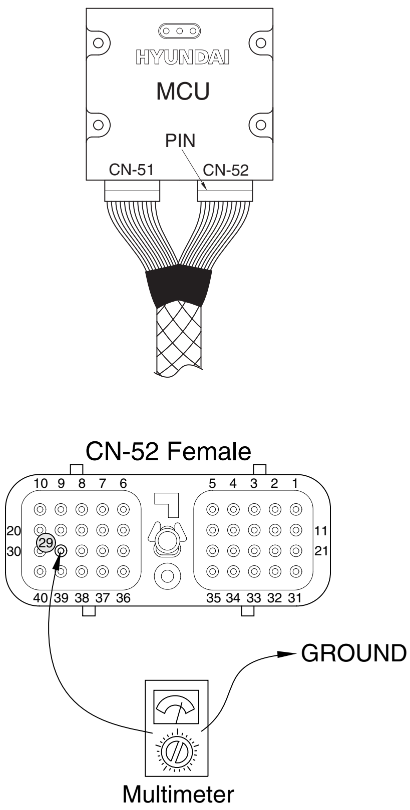


2) TEST PROCEDURE

(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

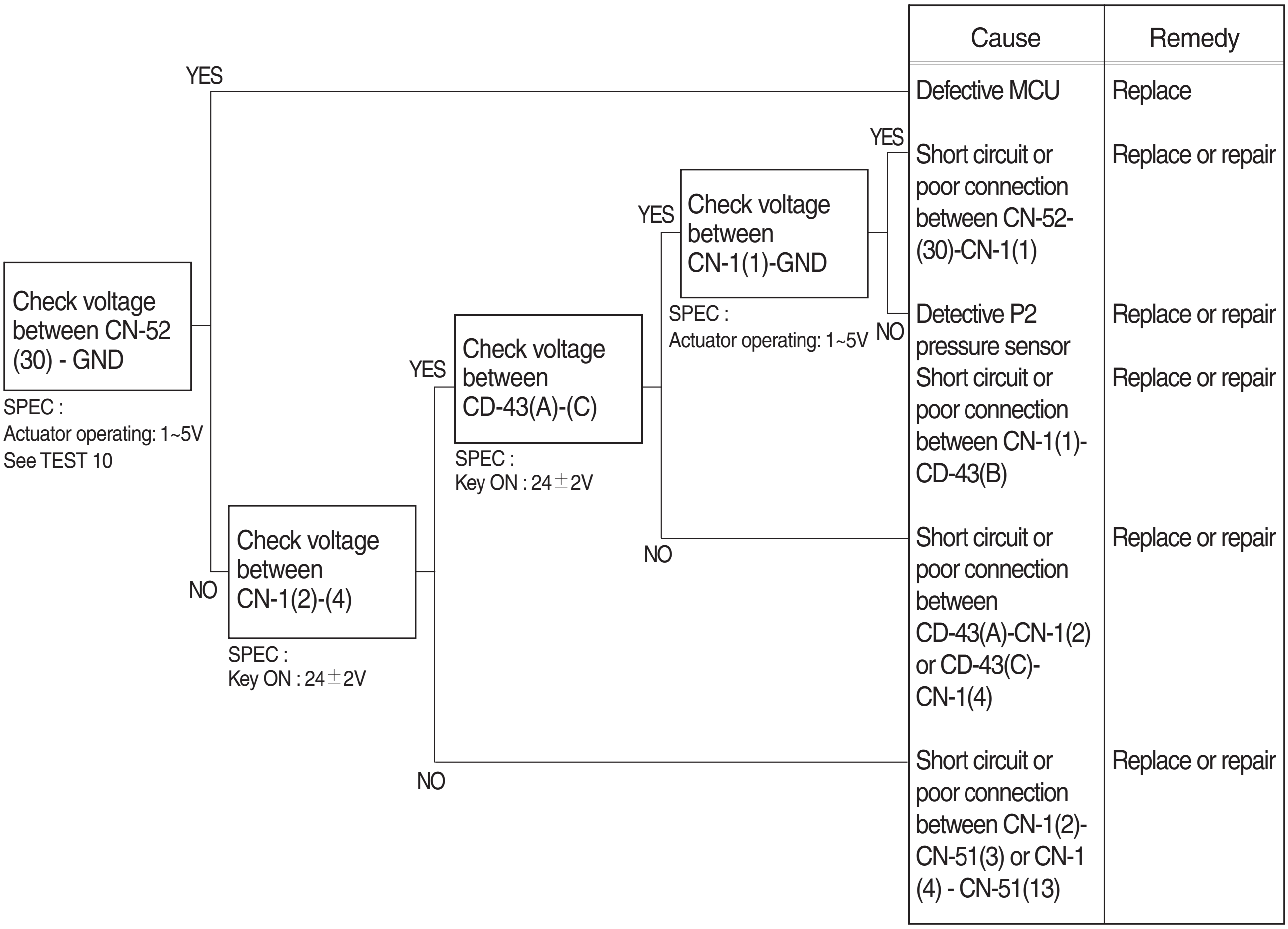


7. MALFUNCTION OF PUMP 2 PRESSURE SENSOR

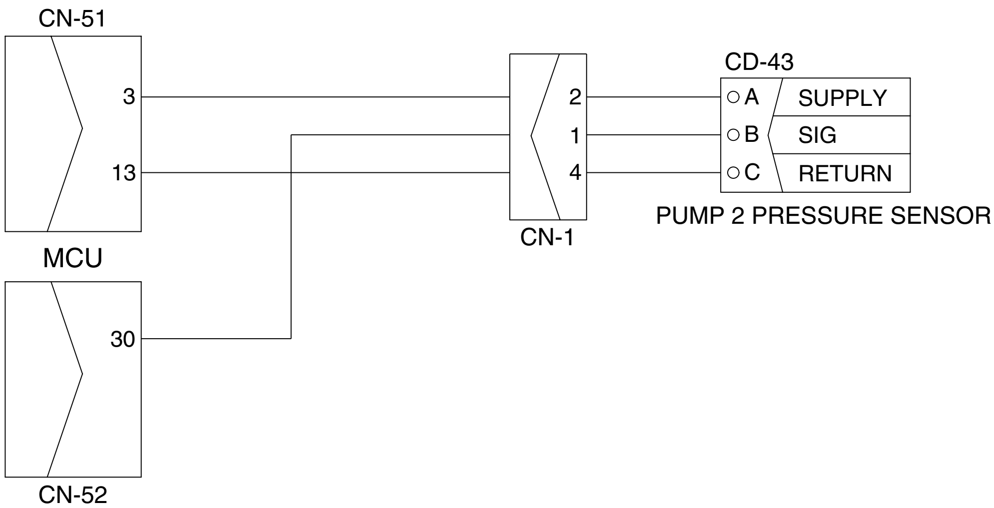
· Fault code : HCESPN 121, FMI 0~4

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

1) INSPECTION PROCEDURE



Wiring diagram



2) TEST PROCEDURE

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

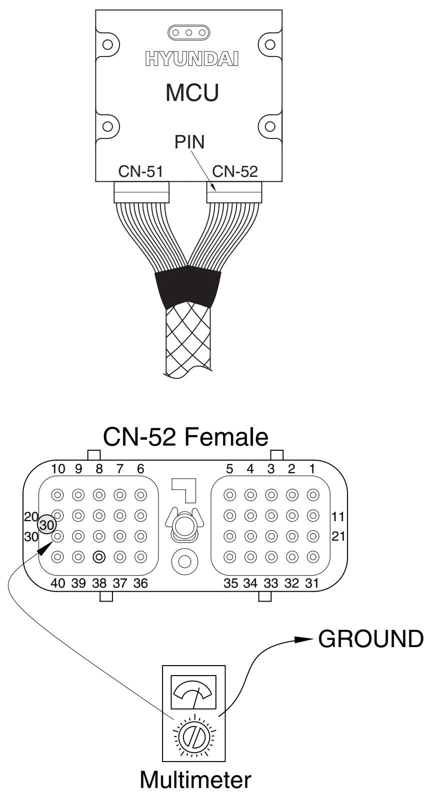
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (30) of CN-52.

③ Starting key ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V

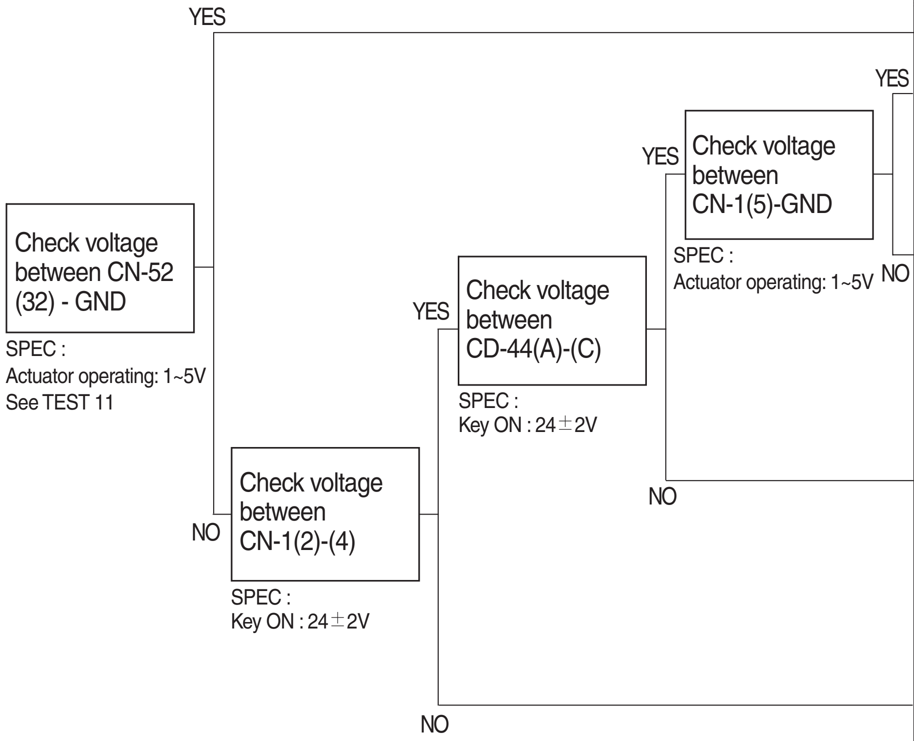


8. MALFUNCTION OF PUMP 3 PRESSURE SENSOR

· Fault code : HCESPN 125, FMI 0~4

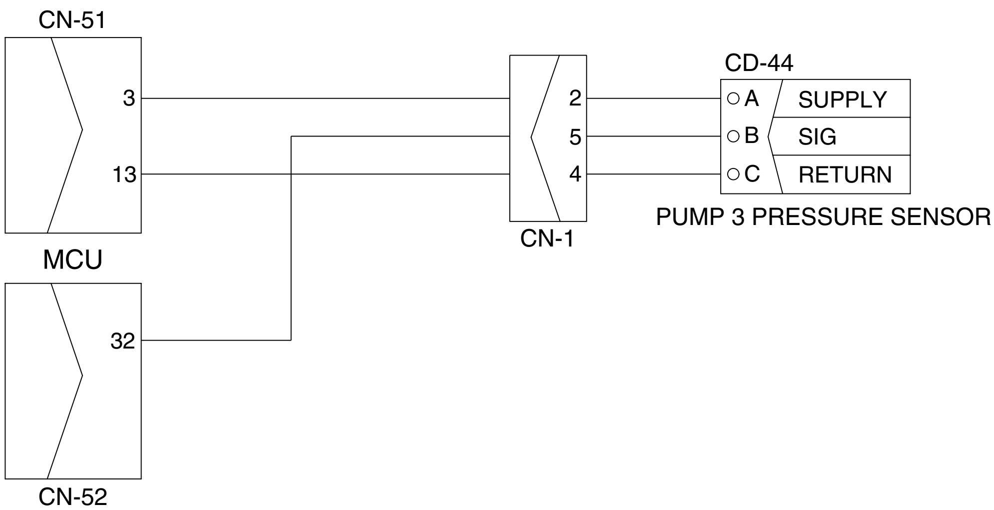
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective MCU	Replace
Short circuit or poor connection between CN-52-(32)-CN-1(5)	Replace or repair
Detective P3 pressure sensor	Replace or repair
Short circuit or poor connection between CN-1(5)-CD-44(B)	Replace or repair
Short circuit or poor connection between CD-44(A)-CN-1(2) or CD-44(C)-CN-1(4)	Replace or repair
Short circuit or poor connection between CN-1(2)-CN-51(3) or CN-1 (4) - CN-51(13)	Replace or repair

Wiring diagram



2) TEST PROCEDURE

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

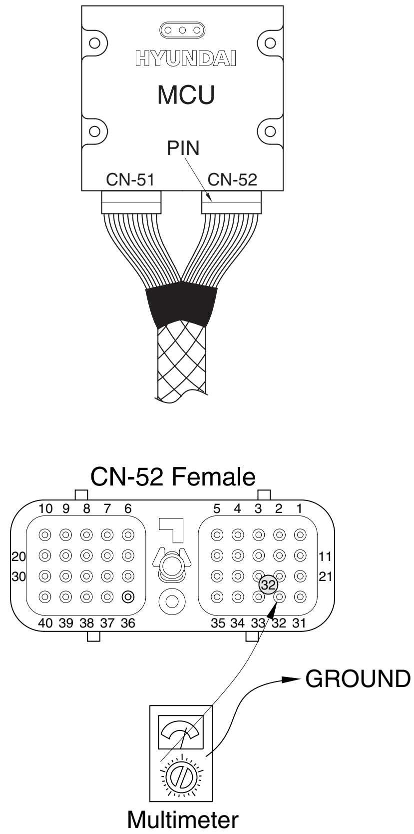
① Prepare 1 piece of thin sharp pin, steel or copper.

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

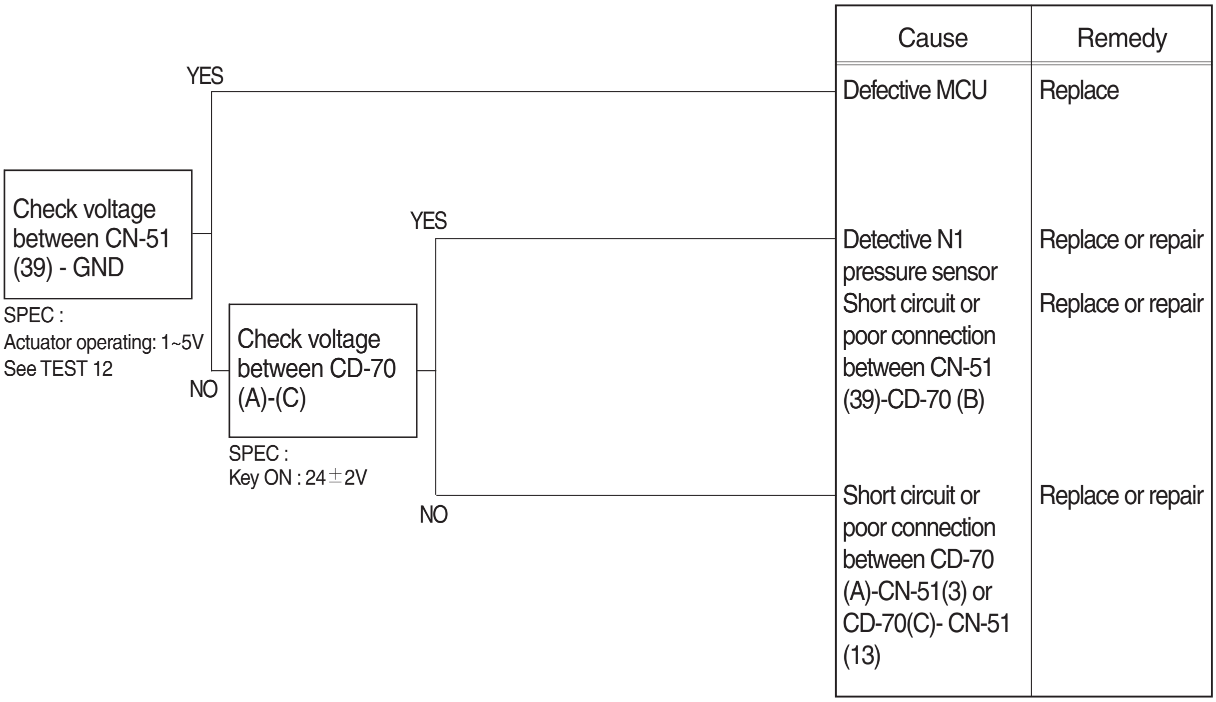


9. MALFUNCTION OF NEGATIVE 1 PRESSURE SENSOR

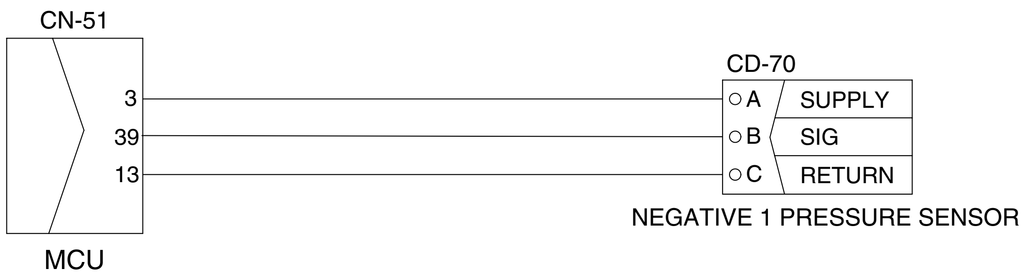
· Fault code : HCESPN 123, FMI 0~4

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

1) INSPECTION PROCEDURE



Wiring diagram



2) TEST PROCEDURE

(1) Test 12 : Check voltage at CN-51(39) and ground.

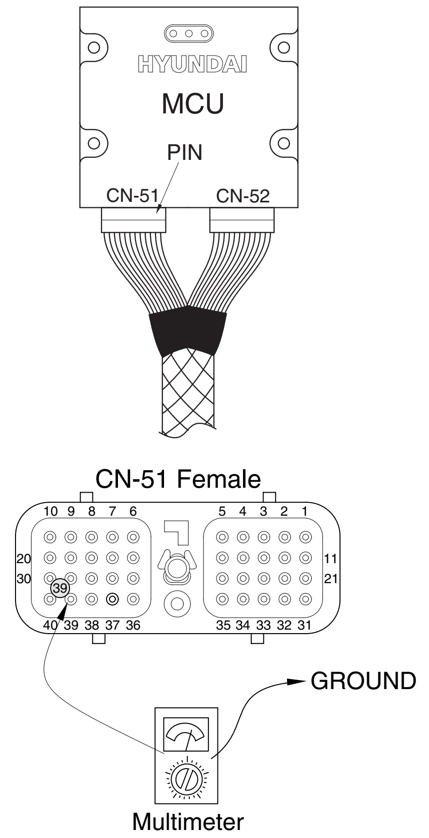
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (39) of CN-51.

③ Starting key ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V

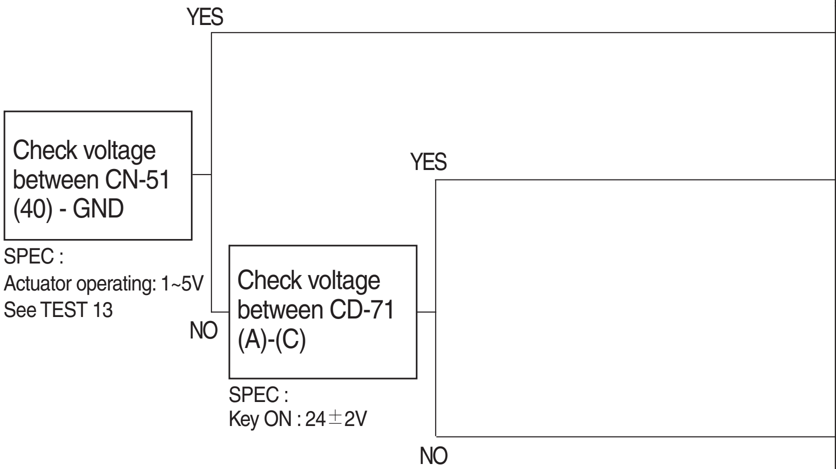


10. MALFUNCTION OF NEGATIVE 2 PRESSURE SENSOR

· Fault code : HCESPN 124, FMI 0~4

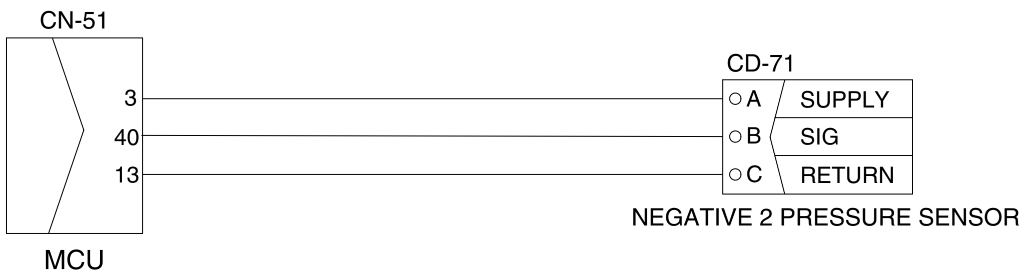
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective MCU	Replace
Detective N2 pressure sensor	Replace or repair
Short circuit or poor connection between CN-51 (40)-CD-71 (B)	Replace or repair
Short circuit or poor connection between CD-71 (A)-CN-51(3) or CD-71(C)- CN-51 (13)	Replace or repair

Wiring diagram



2) TEST PROCEDURE

(1) Test 13 : Check voltage at CN-51(40) and ground.

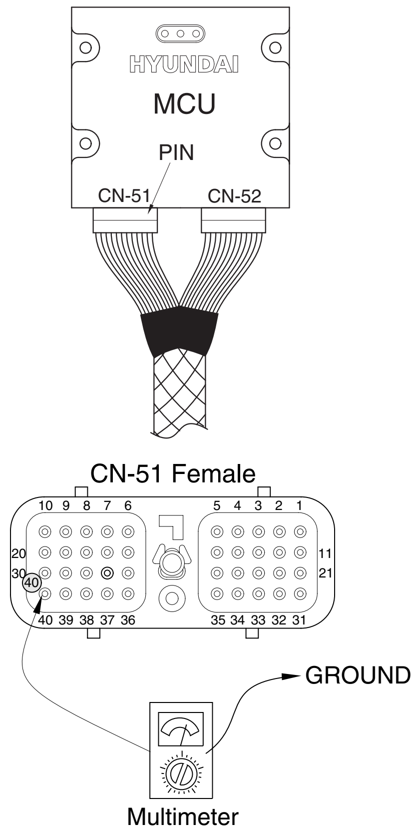
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (40) of CN-51.

③ Starting key ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V

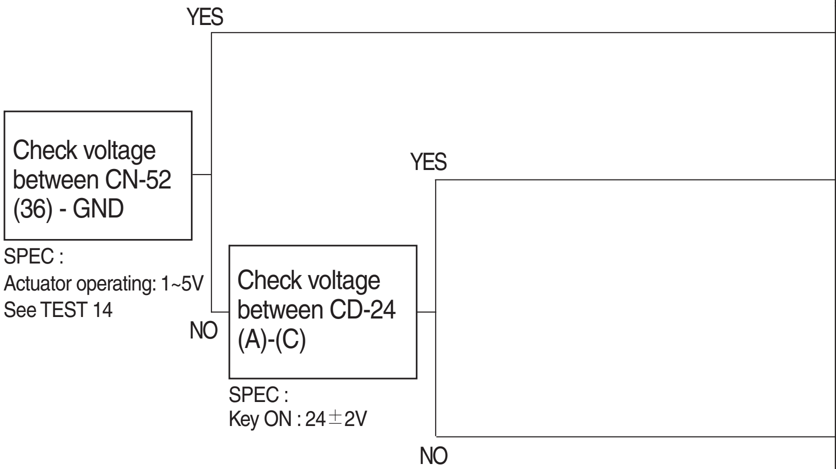


11. MALFUNCTION OF SWING PRESSURE SENSOR

· Fault code : HCESPN 135, FMI 0~4

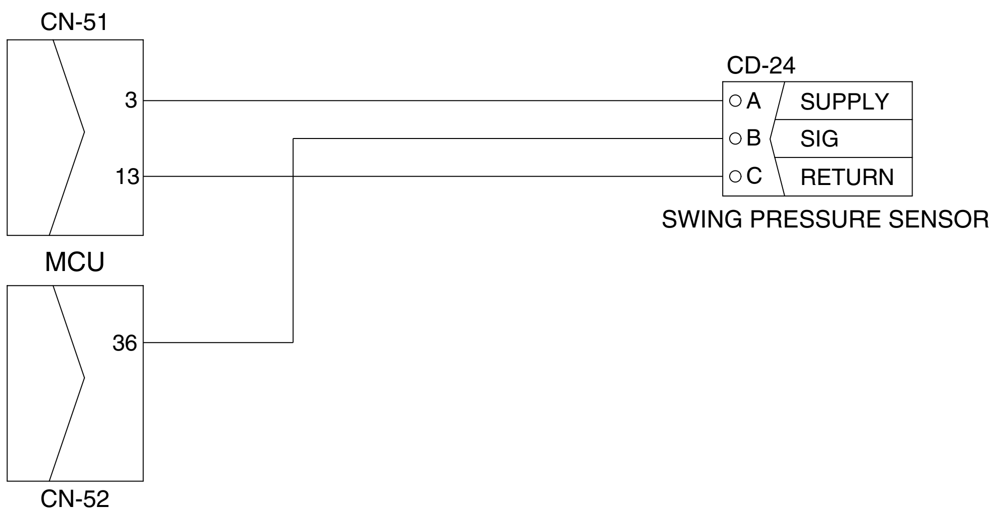
※ Before carrying out below procedure, check all the related connectors are properly inserted.

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



2) TEST PROCEDURE

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

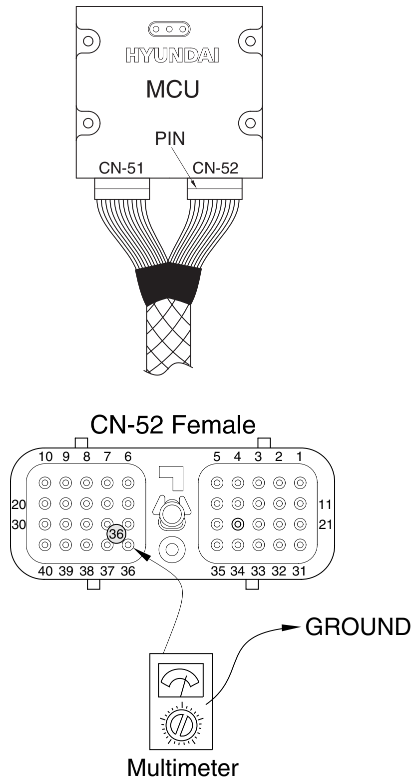
① Prepare 1 piece of thin sharp pin, steel or copper.

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

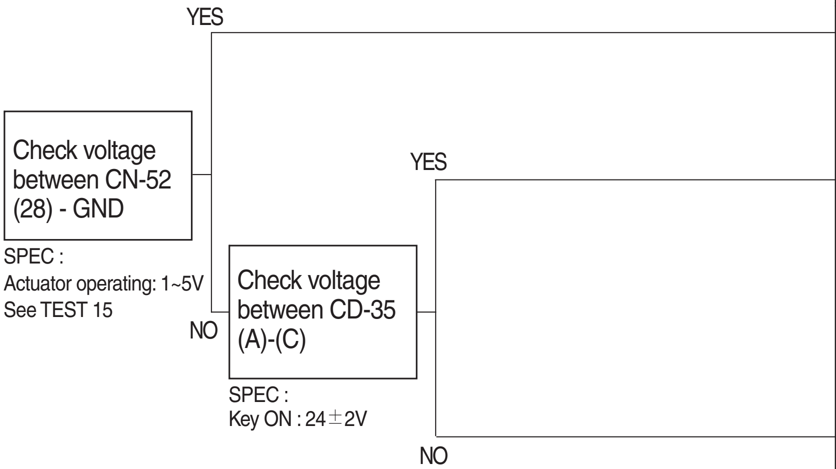


12. MALFUNCTION OF BUCKET IN PRESSURE SENSOR

· Fault code : HCESPN 133, FMI 0~4

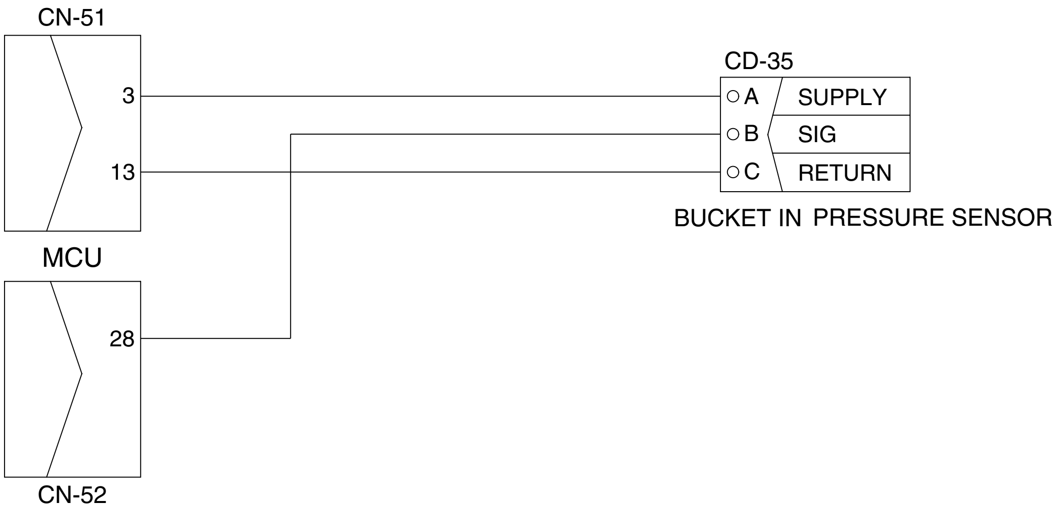
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective MCU	Replace
Detective arm in/out & bucket in pressure sensor	Replace or repair
Short circuit or poor connection between CN-52 (28)-CD-35 (B)	Replace or repair
Short circuit or poor connection between CD-35 (A)-CN-51(3) or CD-35(C)- CN-51 (13)	Replace or repair

Wiring diagram



2) TEST PROCEDURE

(1) Test 15 : Check voltage at CN-52(28) and ground.

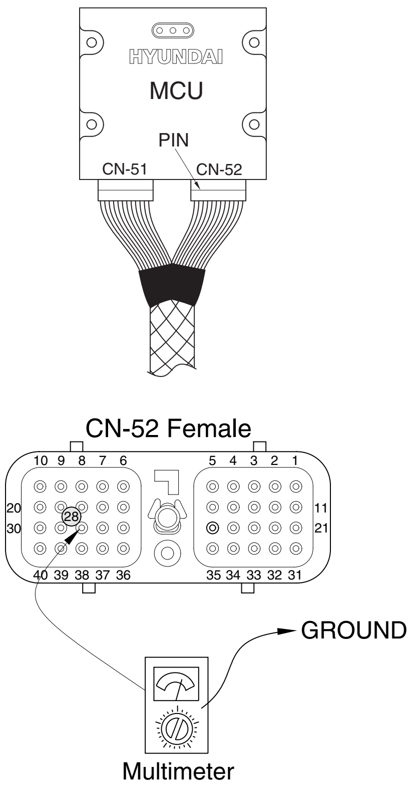
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (28) of CN-52.

③ Starting key ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V

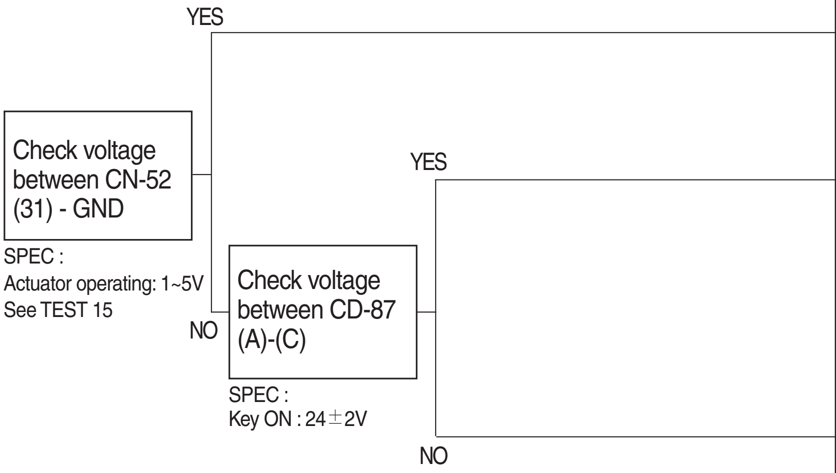


13. MALFUNCTION OF BUCKET OUT PRESSURE SENSOR

· Fault code : HCESPN 132, FMI 0~4

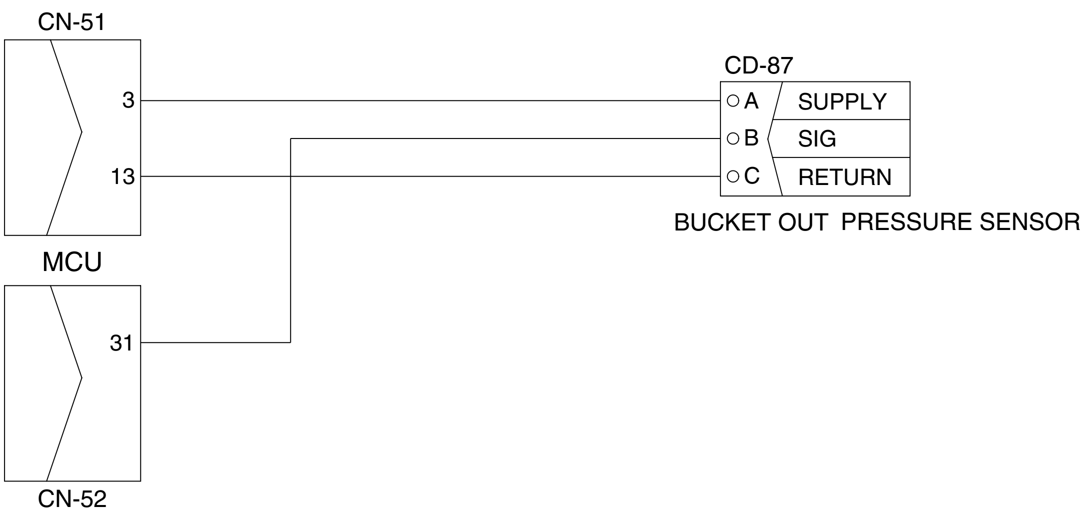
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



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

Wiring diagram



2) TEST PROCEDURE

(1) Test 16 : Check voltage at CN-52(31) and ground.

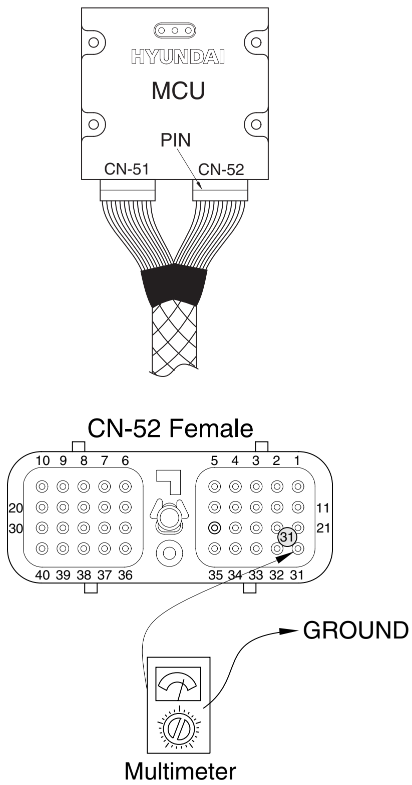
① Prepare 1 piece of thin sharp pin, steel or copper.

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

③ Starting key ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V

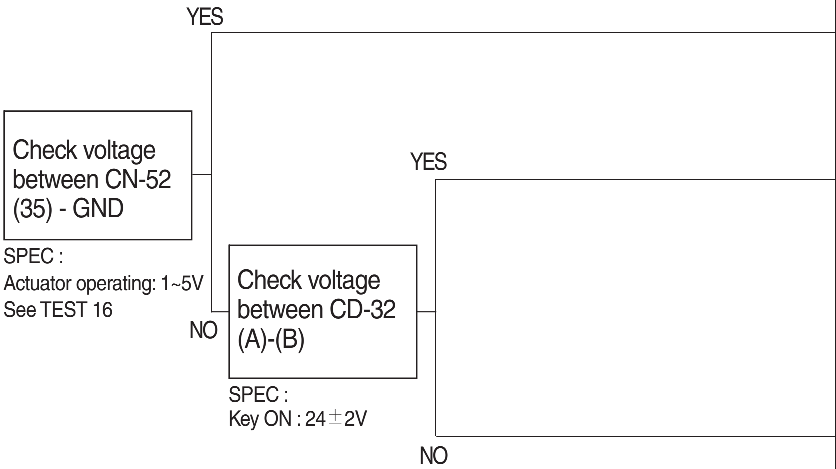


14. MALFUNCTION OF BOOM UP PRESSURE SENSOR

· Fault code : HCESPN 127, FMI 0~4

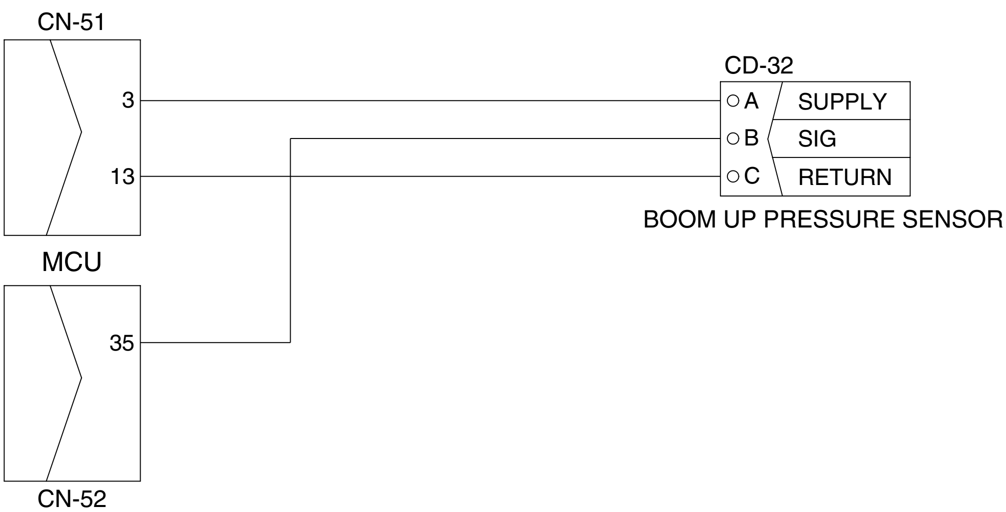
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective MCU	Replace
Detective boom up pressure sensor	Replace or repair
Short circuit or poor connection between CN-52 (35)-CD-32 (B)	Replace or repair
Short circuit or poor connection between CD-32 (A)-CN-51(3) or CD-32(C)- CN-51 (13)	Replace or repair

Wiring diagram



2) TEST PROCEDURE

(1) Test 17 : Check voltage at CN-52(35) and ground.

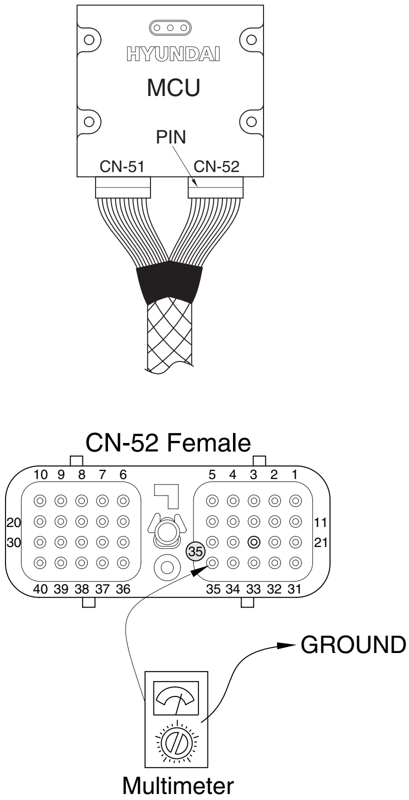
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (35) of CN-52.

③ Starting key ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V

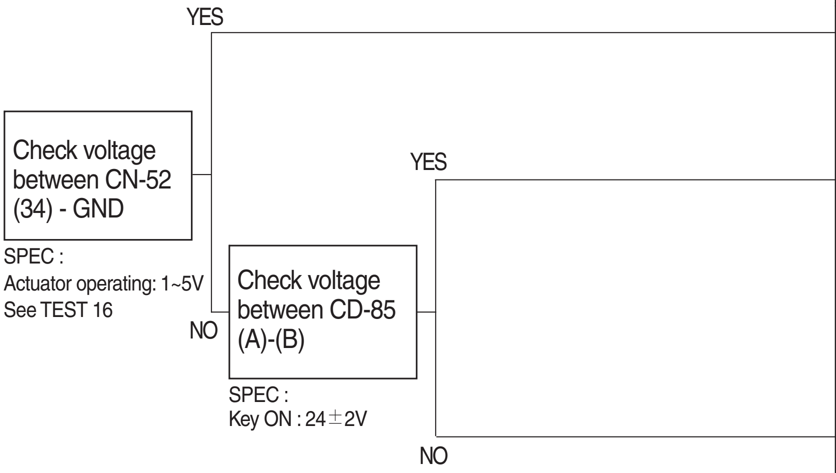


15. MALFUNCTION OF BOOM DOWN PRESSURE SENSOR

· Fault code : HCESPN 128, FMI 0~4

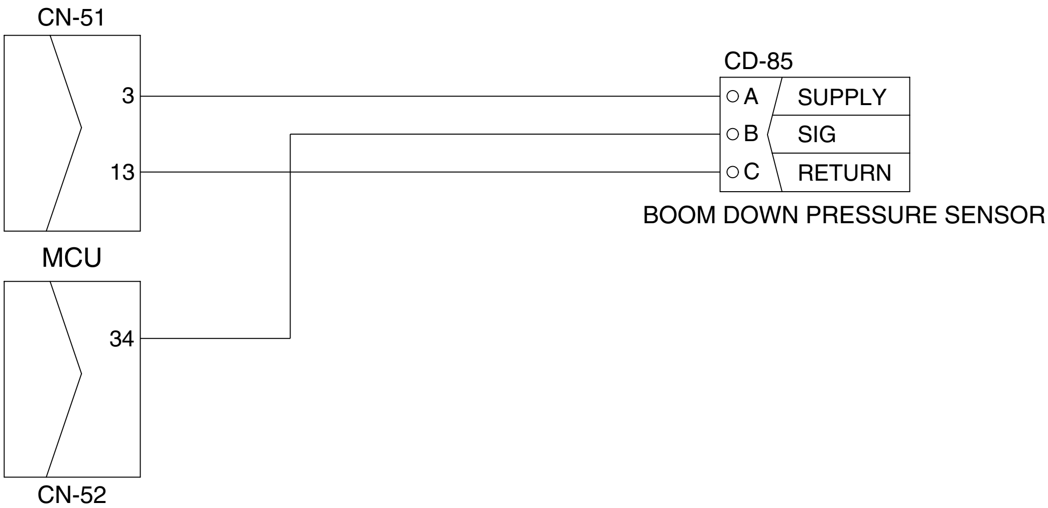
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective MCU	Replace
Detective boom up pressure sensor	Replace or repair
Short circuit or poor connection between CN-52 (34)-CD-85 (B)	Replace or repair
Short circuit or poor connection between CD-85 (A)-CN-51(3) or CD-85(C)- CN-51 (13)	Replace or repair

Wiring diagram



2) TEST PROCEDURE

(1) Test 18 : Check voltage at CN-52(34) and ground.

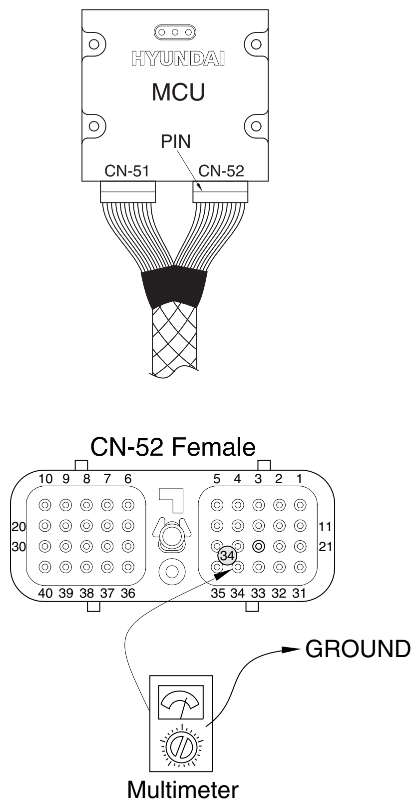
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (34) of CN-52.

③ Starting key ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V

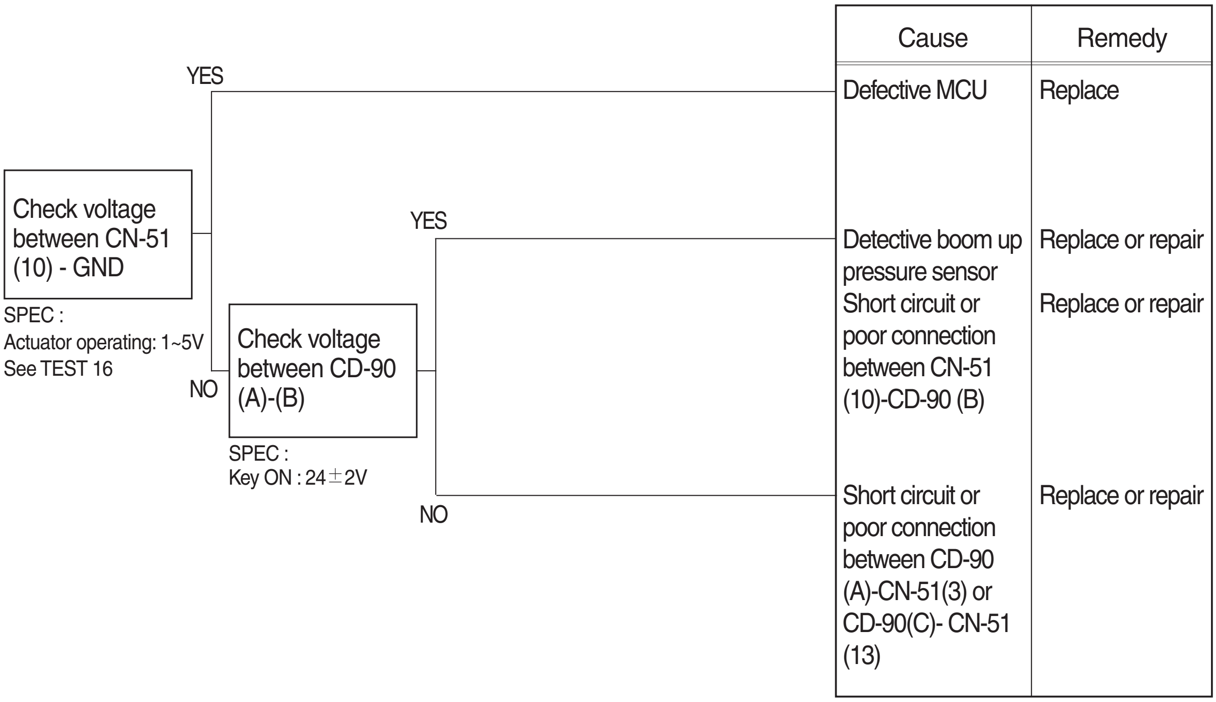


16. MALFUNCTION OF ARM IN PRESSURE SENSOR

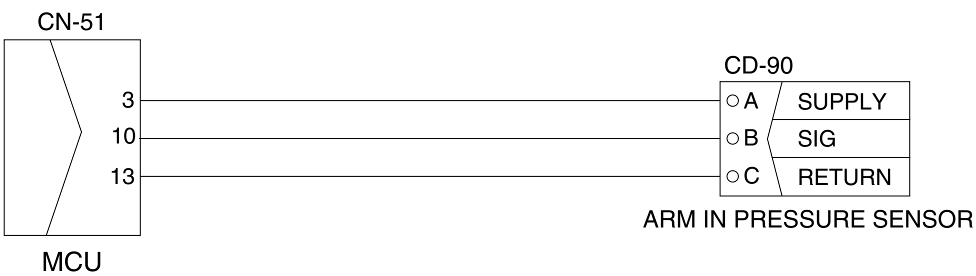
· Fault code : HCESPN 129, FMI 0~4

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

1) INSPECTION PROCEDURE



Wiring diagram

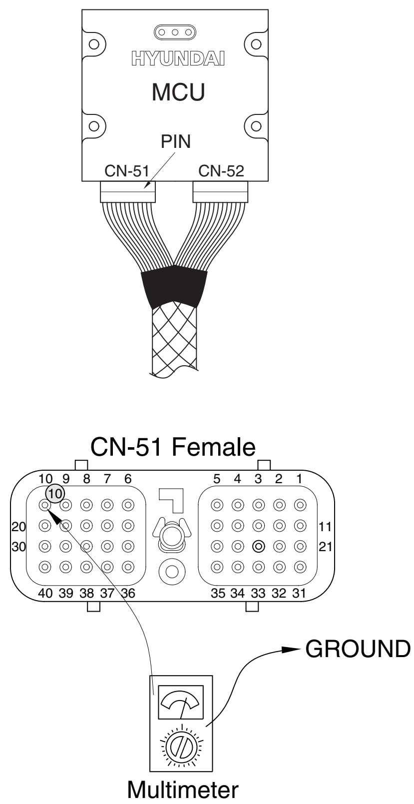


2) TEST PROCEDURE

(1) Test 19 : Check voltage at CN-51(10) 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 (10) of CN-51.
③ Starting key ON.
④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V

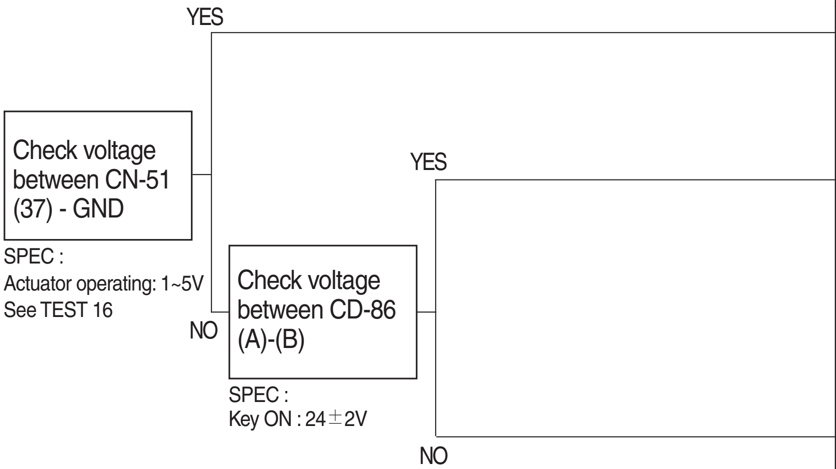


17. MALFUNCTION OF ARM OUT PRESSURE SENSOR

· Fault code : HCESPN 130, FMI 0~4

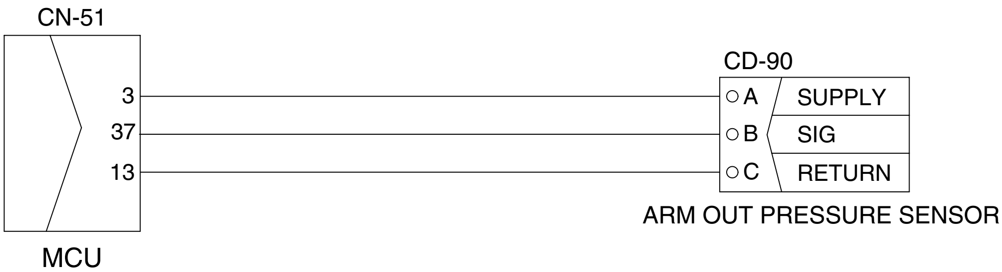
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective MCU	Replace
Detective boom up pressure sensor	Replace or repair
Short circuit or poor connection between CN-51 (37)-CD-86 (B)	Replace or repair
Short circuit or poor connection between CD-86 (A)-CN-51(3) or CD-86(C)- CN-51 (13)	Replace or repair

Wiring diagram



2) TEST PROCEDURE

(1) Test 20 : Check voltage at CN-51(37) and ground.

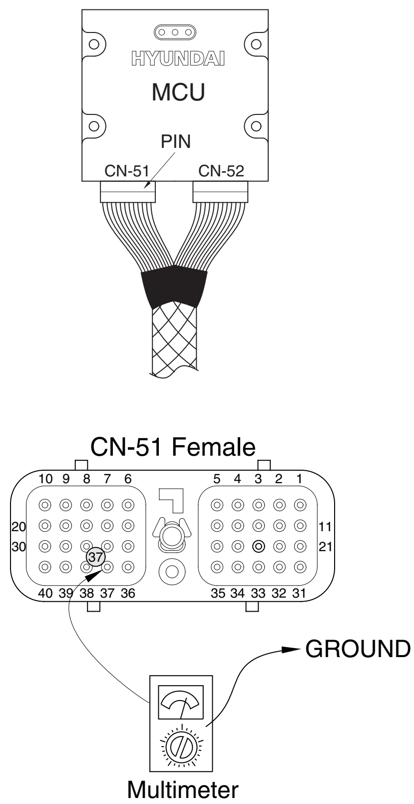
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (37) of CN-51.

③ Starting key ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V

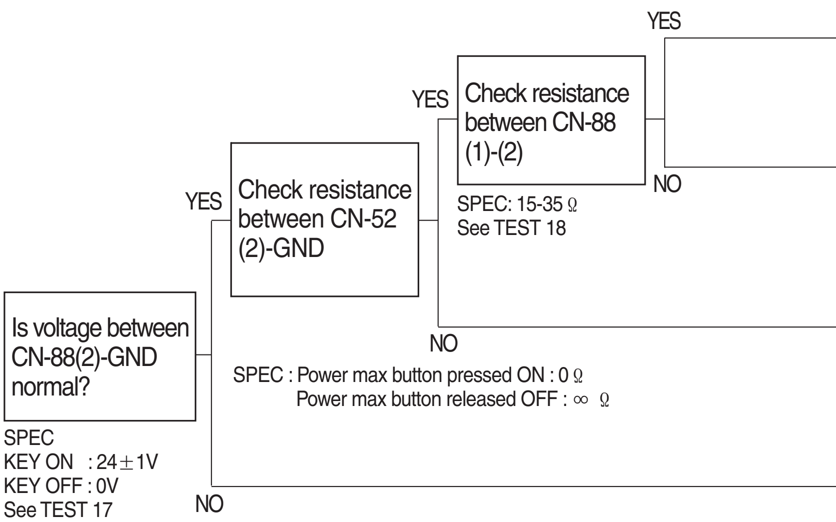


18. MALFUNCTION OF POWER MAX

· Fault code : HCESPN 166, FMI 4 or 6

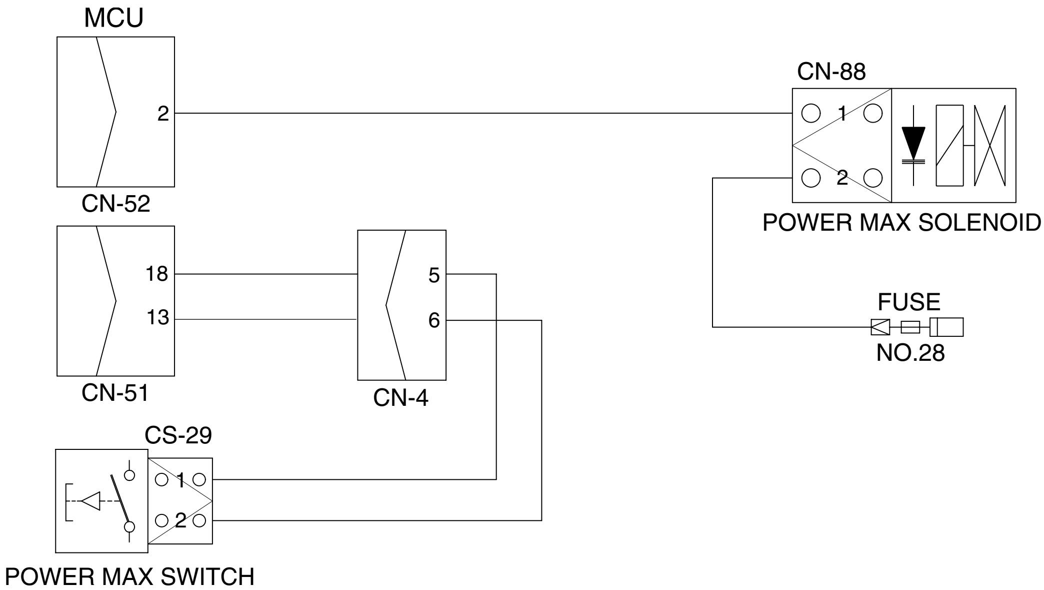
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Short circuit or poor connection between CN-88(1)-CN-52 (2)	Repair or replace
Defective power max. solenoid valve Check hydraulic system	Repair or replace
Short circuit or poor connection between CN-51(18)-CS-29 and CN-51(13)-CS-29	Repair or replace
Short circuit or poor connection between CN-88(2)-Fuse No. 28	Repair or replace

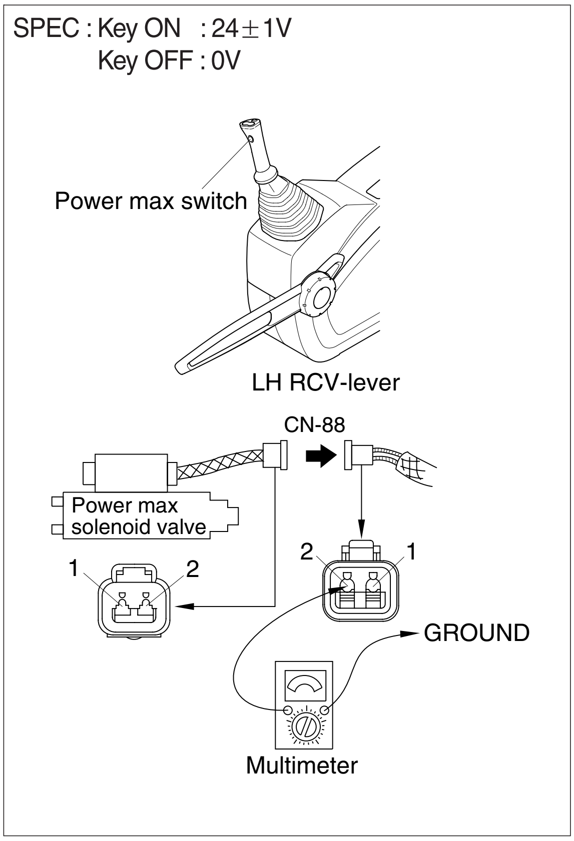
Wiring diagram



2) TEST PROCEDURE

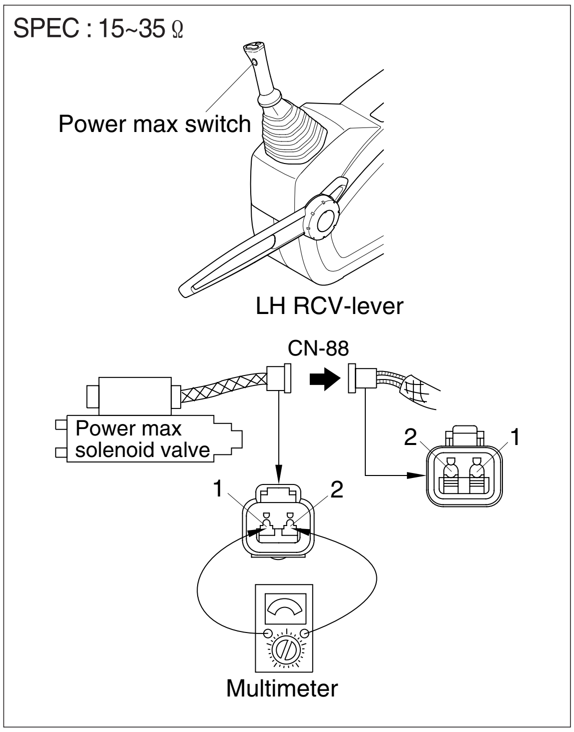
(1) Test 21: Check voltage between connector CN-88(2) - GND.

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



(2) Test 22: 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.

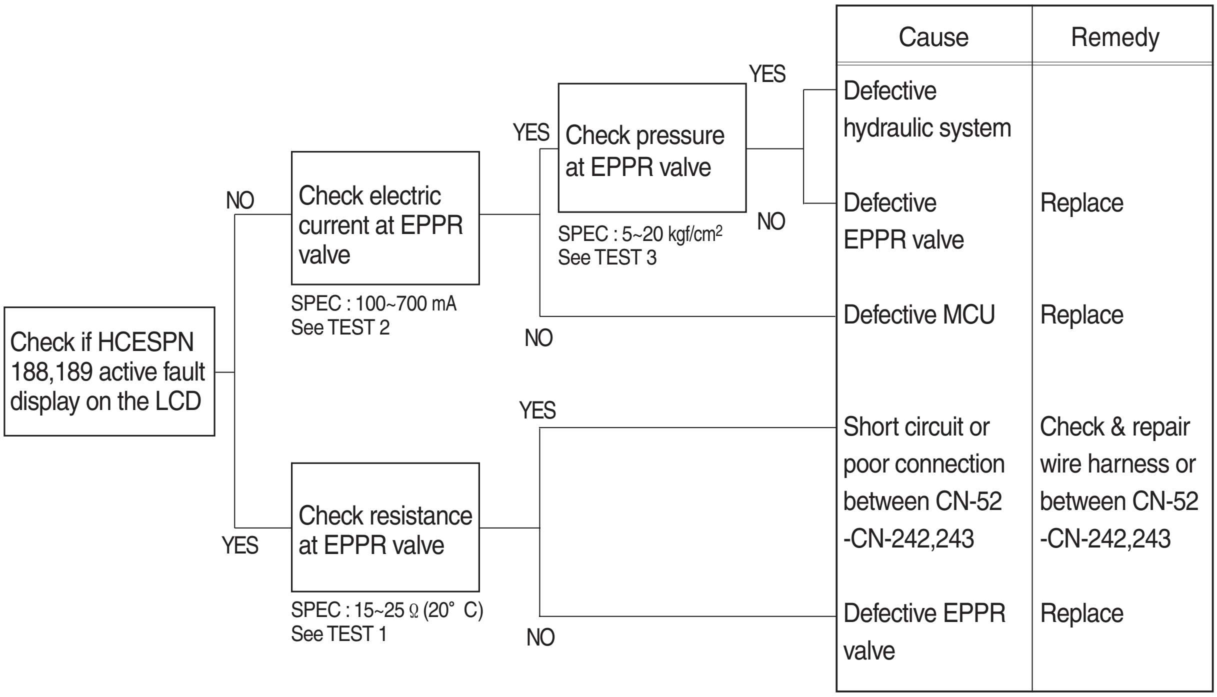


19. MALFUNCTION OF ATTACHMENT FLOW EPPR 1,2 VALVE

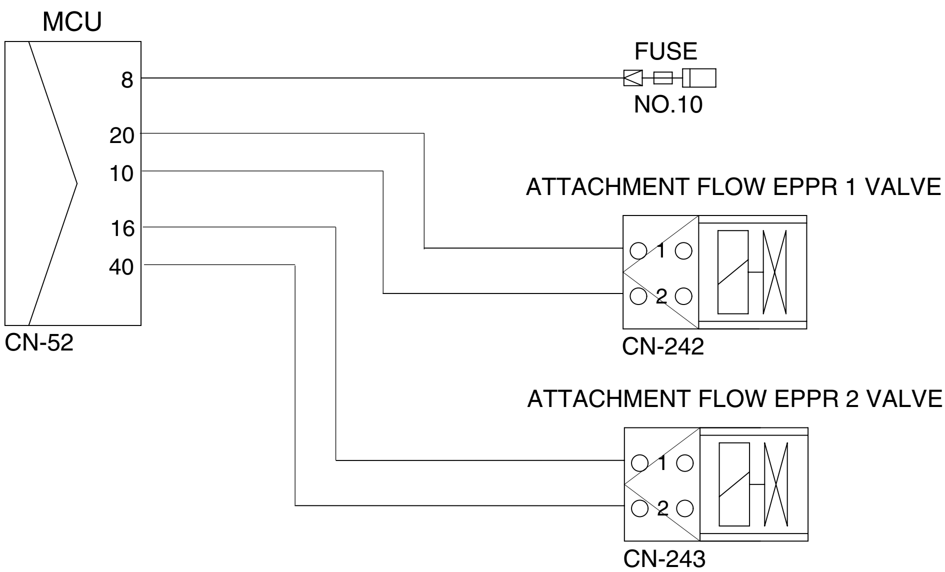
· Fault code : HCESPN 188, 189 FMI 5 or 6

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

1) INSPECTION PROCEDURE



Wiring diagram



2) EPPR VALVE CHECK PROCEDURE

(1) Check electric current value at EPPR valve

① Disconnect connector CN-242,243 from EPPR valve.

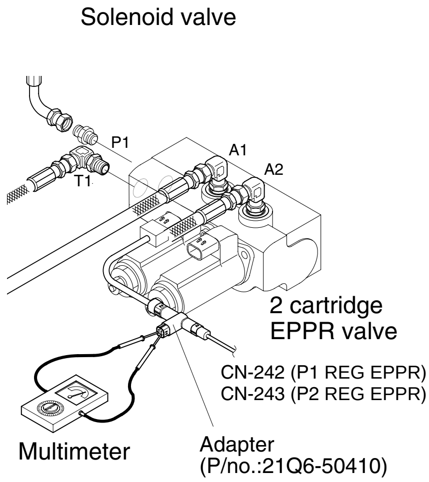
② Insert the adapter to CN-242,243 and install multimeter as figure.

③ Start engine.

④ If rpm display approx 1750±50 rpm disconnect one wire harness from EPPR valve.

⑤ Check electric current in case of combined boom up and swing operation.

Spec : 0~600 mA



(2) Check pressure at EPPR valve

① Remove hose from A5 port and connect pressure gauge as figure.

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

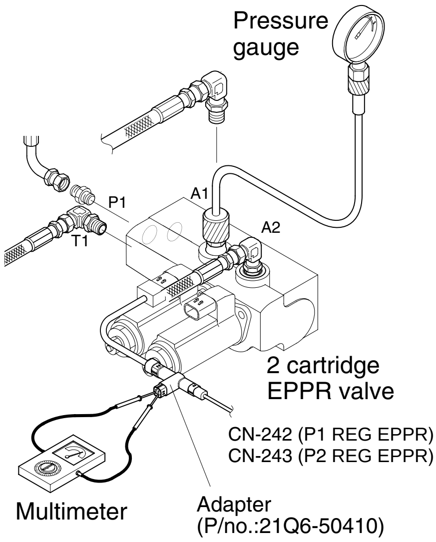
② Start engine.

③ If rpm display approx 1750±50 rpm check pressure at relief position of bucket circuit by operating bucket control lever.

④ If pressure is not correct, adjust it.

⑤ After adjust, test the machine.

Spec : 0~38 kgf/cm^2 (0~530 psi)



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.

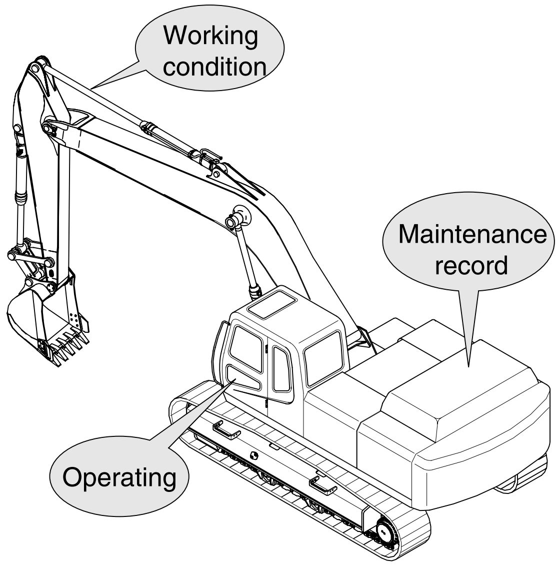
2) OPERATIONAL PERFORMANCE OF A WORKING MACHINE

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

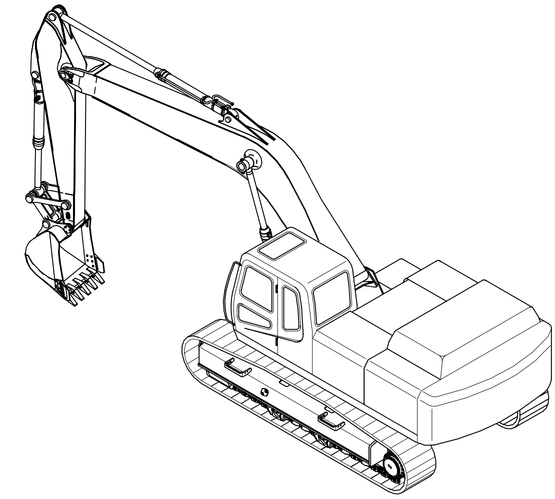
After the machine is repaired or serviced, it must be tested to confirm that its operational performance was restored by the repair and/or service work done.



2. TERMINOLOGY

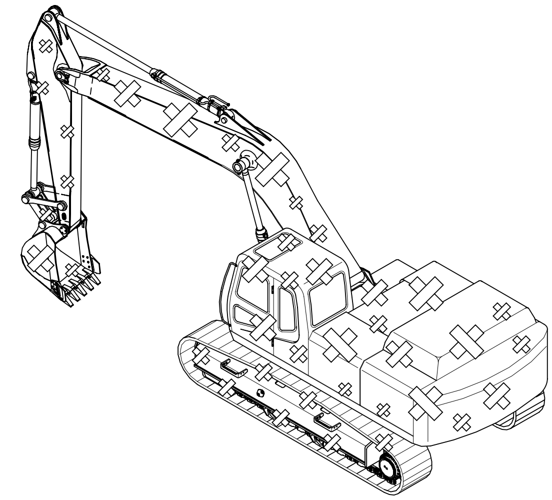
1) STANDARD

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



2) SERVICE LIMIT

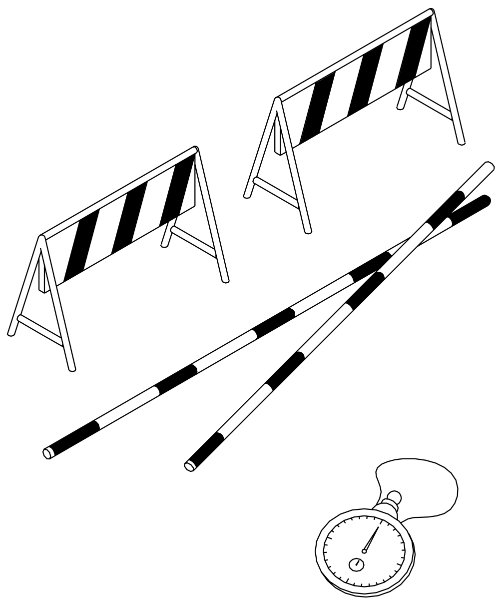
The lowest acceptable performance level. When the performance level of the machine falls below this level, the machine must be removed from work and repaired. Necessary parts and components must be replaced.



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.

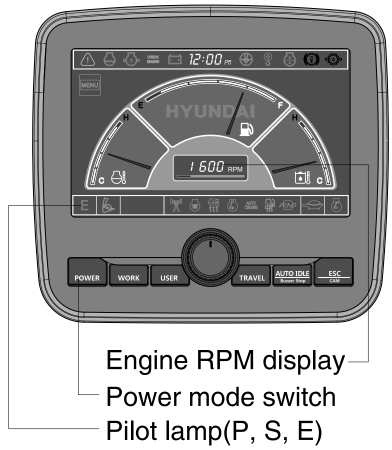
(4) Make precise measurements
① Accurately calibrate test instruments in advance to obtain correct data.
② Carry out tests under the exact test conditions prescribed for each test item.
③ Repeat the same test and confirm that the test data obtained can be procured repeatedly. Use mean values of measurements if necessary.

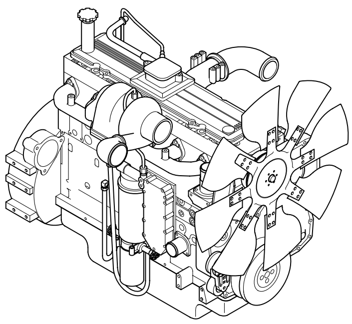
2) ENGINE SPEED

(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





(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 Select the P-mode switch.

④ 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
R505LVS	Start idle	900±50	
	P mode	1750±50	
	S mode	1650±50	
	E mode	1600±50	
	Auto decel	1000±50	
	One touch decel	900±50	

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

3) TRAVEL SPEED

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

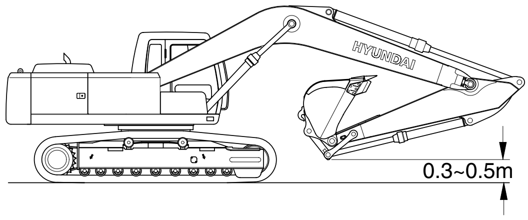
(2) Preparation

① Adjust the tension of both tracks to be equal.

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

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

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



(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.

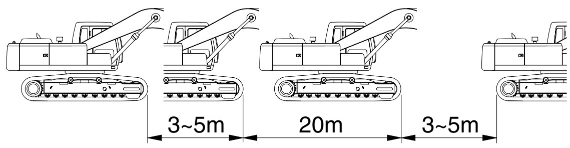
· Power mode switch : P mode

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.



(4) Evaluation

The average measured time should meet the following specifications.

Unit : Seconds / 3 revolutions

Model	Travel speed	Standard
R505LVS	1 Speed	22.6±2.0
	2 Speed	14.0±1.0

4) TRACK REVOLUTION SPEED

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

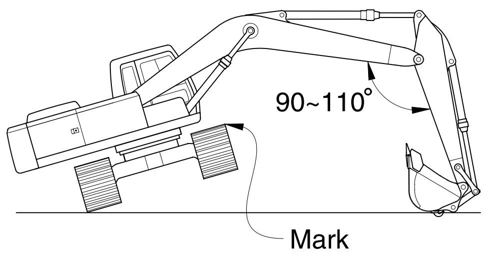
(2) Preparation

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.



(3) Measurement

① Select the following switch positions.

· Travel mode switch : 1 or 2 speed
· Power mode switch : P mode
· Auto decel 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
R505LVS	1 Speed	38.4±2.0
	2 Speed	24.0±1.0

5) TRAVEL DEVIATION

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

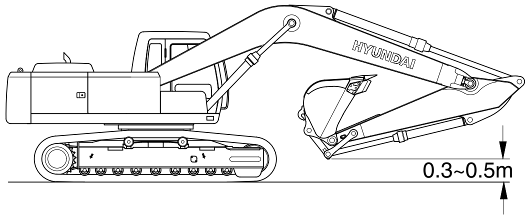
(2) Preparation

① Adjust the tension of both tracks to be equal.

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

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

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



(3) Measurement

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

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

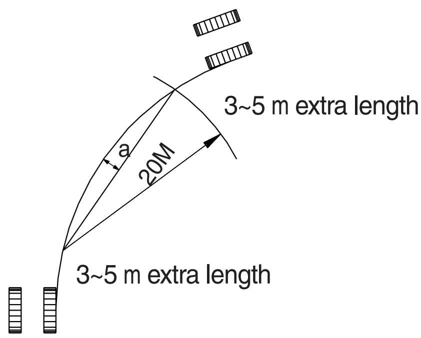
· Power mode switch : P mode

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

④ Measure the distance between a straight 20m 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.



(4) Evaluation

Mistrack should be within the following specifications.

Unit : mm / 20 m

Model	Standard	Maximum allowable	Remarks
R505LVS	200 below	600	

6) SWING SPEED

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

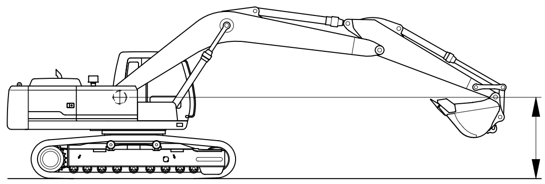
(2) Preparation

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.



(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
R505LVS	P mode	19.8±1.5

7) SWING FUNCTION DRIFT CHECK

(1) Measure the swing drift on the bearing outer circumference when stopping after a 360° full speed swing.

(2) Preparation

① Check the lubrication of the swing gear and swing bearing.

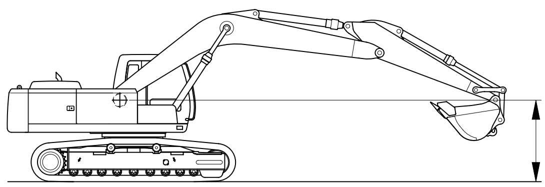
② Place the machine on flat, solid ground with ample space for swinging. Do not conduct this test on slopes.

③ With the arm rolled out and bucket rolled in, hold the bucket so that the height of the bucket pin is the same as the boom foot pin. The bucket must be empty.

④ Make two chalk marks: one on the swing bearing and one directly below it on the track frame.

⑤ Swing the upperstructure 360˚.

⑥ Keep the hydraulic oil temperature at 50±5˚C.



(3) Measurement

① Conduct this test in the P mode.

② Select the following switch positions.

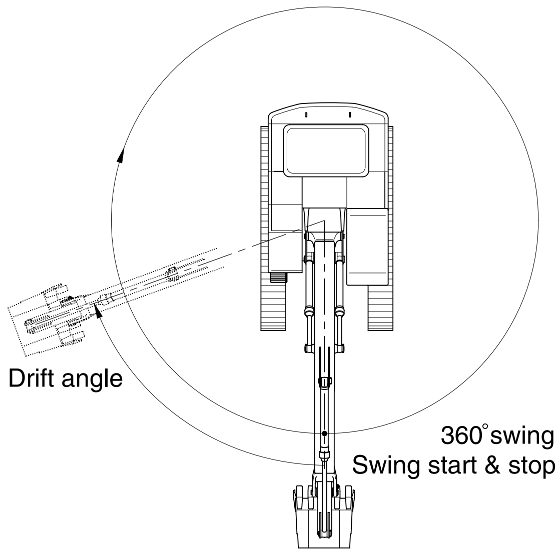
· Power mode switch : P mode

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.



(4) Evaluation

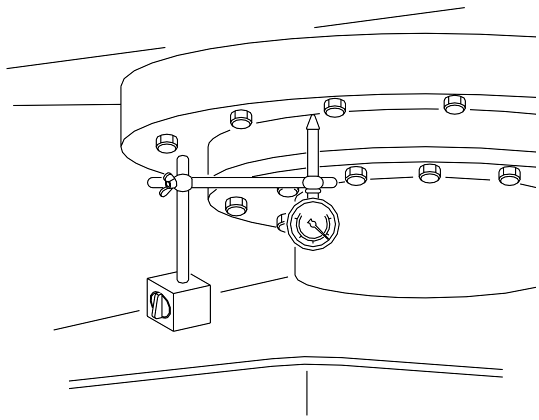
The measured drift angle should be within the following specifications.

Unit : Degree

Model	Power mode switch	Standard	Maximum allowable	Remarks
R505LVS	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.



(2) Preparation

① Check swing bearing mounting cap screws for loosening.

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

③ Install a dial gauge on the track frame as shown, using a magnetic base.

④ Position the upperstructure so that the boom aligns with the tracks facing towards the front idlers.

⑤ Position the dial gauge so that its needle point comes into contact with the bottom face of the bearing outer race.

⑥ Bucket should be empty.

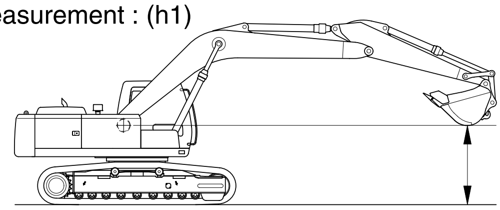
(3) Measurement

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

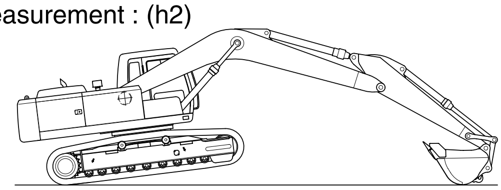
② Lower the bucket to the ground and use it to raise the front idler 50cm.
Record the dial gauge reading (h2).

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

Measurement : (h1)



Measurement : (h2)



(4) Evaluation

The measured drift should be within the following specifications.

Unit : mm

Model	Standard	Maximum allowable	Remarks
R505LVS	0.5~1.5	5	

9) HYDRAULIC CYLINDER CYCLE TIME

(1) Measure the cycle time of the boom, standard arm, and standard bucket cylinders.

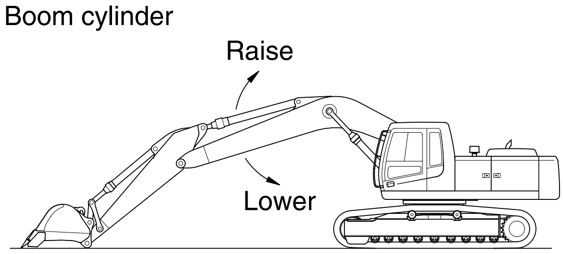
(2) Preparation

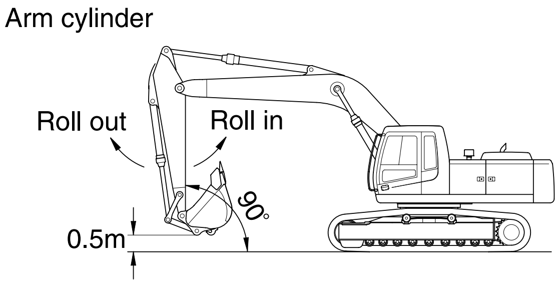
① To measure the cycle time of the boom cylinders:
With the arm rolled out and the empty bucket rolled out, lower the bucket to the ground, as shown.

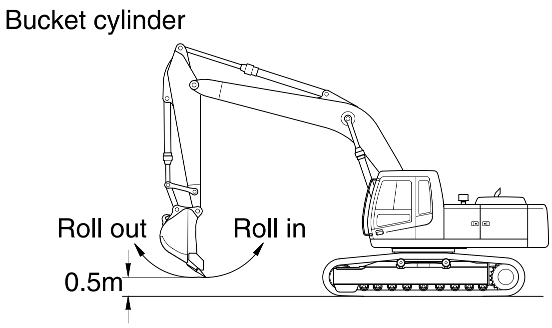
② To measure the cycle time of the arm cylinder.
With the empty bucket rolled in, position the arm so that it is vertical to the ground. Lower the boom until the bucket is 0.5 m above the ground.

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	Remarks
R505LVS	Boom raise	4.3 ± 0.4	
	Boom lower	2.2 ± 0.4	
	Arm in	3.5 ± 0.4	
	Arm out	3.3 ± 0.3	
	Bucket load	3.9 ± 0.4	
	Bucket dump	2.9 ± 0.4	

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)

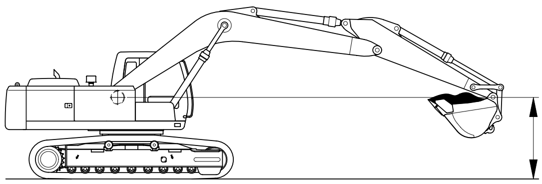
1.5 = Soil specific gravity

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.



(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	Remarks
R505LVS	Boom cylinder	10 below	
	Arm cylinder	10 below	
	Bucket cylinder	40 below	

13) PILOT PRIMARY PRESSURE

(1) Preparation

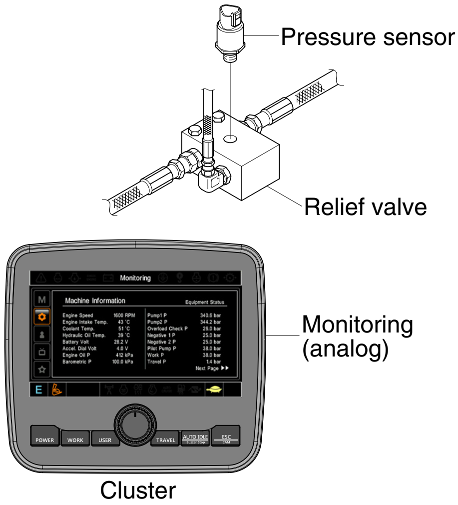
① Keep the hydraulic oil temperature at 50±5˚C.

(2) Measurement

① Select the following switch positions.

- Power mode switch : P mode
- Auto decel switch : OFF

② Measure the primary pilot pressure by the monitoring menu of the cluster.



(3) Evaluation

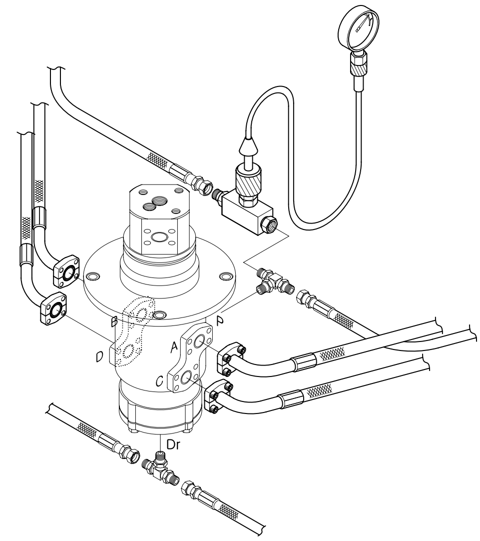
The average measured pressure should meet the following specifications:

Unit : kgf / cm²

Model	Engine speed	Standard	Allowable limits	Remarks
R505LVS	P mode	40±2	-	

14) FOR TRAVEL SPEED SELECTING PRESSURE

(1) Preparation



① Stop the engine.
② Remove the top cover of the hydraulic tank oil supply port with a wrench.
③ Push the pressure release button to bleed air.
④ To measure the speed selecting pressure: Install a connector and pressure gauge assembly to turning joint P port as shown.
⑤ Start the engine and check for on leakage from the adapter.
⑥ Keep the hydraulic oil temperature at 50±5˚C.

(2) Measurement

① Select the following switch positions.
Travel mode switch : 1 speed
2 speed
· Power mode switch : P mode
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.

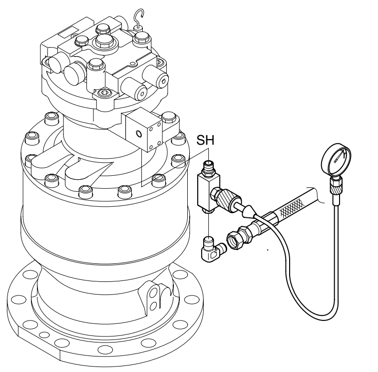
Unit : kgf / cm^2

Model	Travel speed mode	Standard	Maximum allowable	Remarks
R505LVS	1 Speed	0	-	
	2 Speed	40±2	-	

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 Install a connector and pressure gauge assembly to swing motor SH port, as shown.
④ Start the engine and check for oil leakage from the adapter.
⑤ Keep the hydraulic oil temperature at 50±5˚C.



(2) Measurement

① Select the following switch positions.
· Power mode switch: P mode
② Operate the swing function or arm roll in function and measure the swing brake control pressure with the brake disengaged. Release the control lever to return to neutral and measure the control pressure when the brake is applied.
Repeat step ② three times and calculate the average values.

(3) Evaluation

The average measured pressure should be within the following specifications.

Unit : kgf / cm^2

Model	Description	Standard	Remarks
R505LVS	Cracking	20.9	
	Full stroke	35.5	

16) MAIN PUMP DELIVERY PRESSURE

(1) Preparation

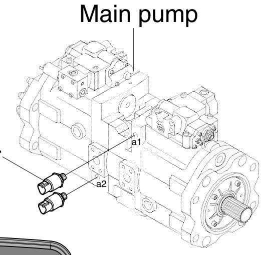
① Keep the hydraulic oil temperature at 50±5˚C.

(2) Measurement

① Select the following switch positions.

· Power mode switch : P mode

② Measure the main pump delivery pressure 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
R505LVS	High idle	40± 2	-	

17) SYSTEM PRESSURE REGULATOR RELIEF SETTING

(1) Preparation

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

(2) Measurement

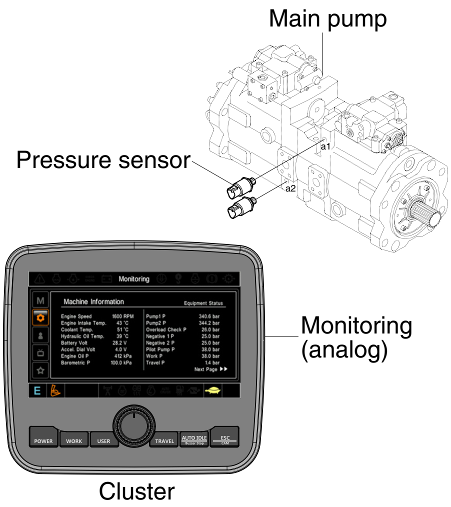
① Select the following switch positions.

· 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
R505LVS	Boom, Arm, Bucket	330 (360)±10
	Travel	360 ±10
	Swing	330 ±10

(   ) : Power boost

GROUP 2 MAJOR COMPONENT

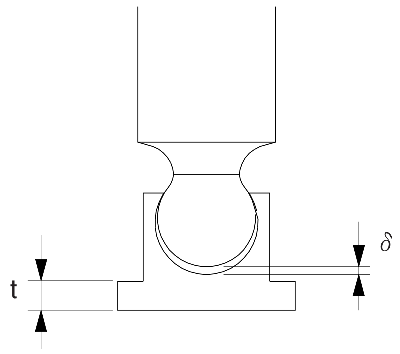
1. MAIN CONTROL VALVE

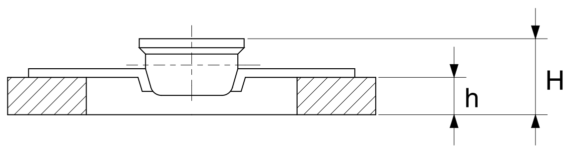
Part name	Inspection item	Criteria & measure
Casing	· Existence of scratch, rusting or corrosion.	· In case of damage in following section, replace part. - Sliding sections of casing fore and spool, especially land sections applied with holded pressure. - Seal pocket section where spool is inserted. - Sealing section of port where O-ring contacts. - Sealing section of each relief valve for main, travel and port. - Other damages that may damage normal functions.
Spool	· Existence of scratch, gnawing, rusting or corrosion. · O-ring seal sections at both ends. · Insert spool 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 poppet or spring. · Insert poppet into casing and function it.	· Correction or replacement when sealing is incomplete. · Normal when it can function lightly without being caught.
Around spring	· Rusting, corrosion, deformation or breaking of spring, spring seat, plug or cover.	· Replacement for significant damage.
Around seal for spool	· External oil leakage. · Rusting, corrosion or deformation of seal plate.	· Correction or replacement. · Correction or replacement.
Main relief valve, port relief valve & negative control relief valve	· External rusting or damage. · Contacting face of valve seat. · Contacting face of poppet. · Abnormal spring. · O-rings, back up rings and seals.	· Replacement. · Replacement when damaged. · Replacement when damaged. · Replacement. · 100% replacement in general.

2. SWING DEVICE

1) WEARING PARTS

Inspection item	Standard dimension	Recommended replacement value	Counter measures
Clearance between piston and cylinder block bore	0.028	0.058	Replace piston or cylinder block
Play between piston and shoe caulking section (δ)	0	0.3	Replace assembly of piston and shoe
Thickness of shoe (t)	5.5	5.3	Replace assembly of piston and shoe
Combined height of retainer plate and spherical bushing (H-h)	6.5	6.0	Replace set of retainer plate and sperical bushing
Thickness of friction plate	4.0	3.6	Replace



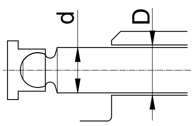


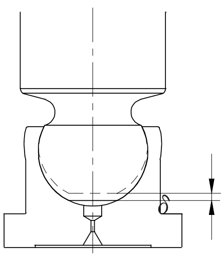
2) SLIDING PARTS

Part name	Standard roughness	Allowable roughness	Remark
Shoe	0.8-Z (Ra=0.2) (LAPPING)	3-Z (Ra=0.8)	
Shoe plate	0.4-Z (Ra=0.1) (LAPPING)	3-Z (Ra=0.8)	
Cylinder	1.6-Z (Ra=0.4) (LAPPING)	12.5-Z (Ra=3.2)	
Valve plate	0.8-Z (Ra=0.2) (LAPPING)	6.3-Z (Ra=1.6)	

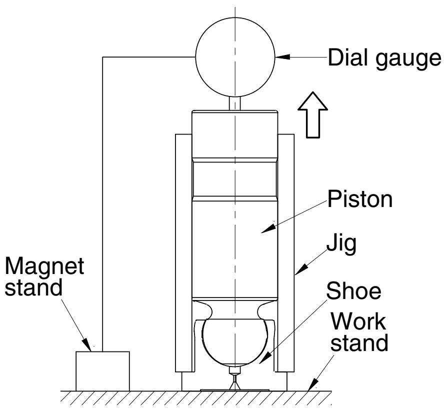
3. TRAVEL MOTOR

The followings are the general maintenance standards. However, it is the most important to determine which parts should be replaced, depending on the characteristics before disassembling, damages and discoloration of exterior view, the purpose of disassembling, the expected remaining service life. etc..

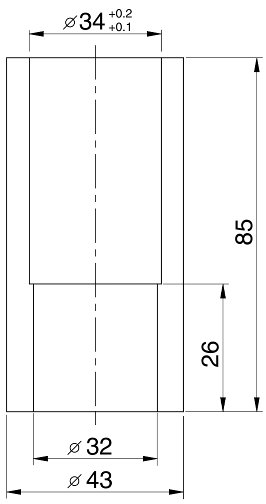
Check item		Measuring method	Criteria	Allowable	Remedy
Sliding surface of cylinder block, valve plate and swash plate	Surface roughness of cylinder block, valve plate and swas plate	Measure the surface roughness by roughness tester	Below 0.4 Zμ	Below 3.0 Zμ	Replace or repair ※ Lap together the surfaces of both cylinder block and valve plate to remedy their roughness (# 1200 power)
	Swash plate - hardness of sliding surface	Measure the surface hardness of swash plate by hardness tester	Over HS78	HS74	Replace
Clearance between piston and cylinder block  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 micrometer and obtain : max outer dia = d max min outer dia = d min max inner dia = D max min inner dia = D min	0.01 mm	0.05 mm	Replace piston or cylinder block ※ In exchanging pistons, replace all of nine pistons at the same time
	Inner dia of cylinder bore D max - D min		0.01 mm	0.022 mm	
	Clearance D-d		0.037~ 0.047 mm	0.065 mm	
Play between piston and shoe	Play between calked piston and shoe (δ)	With the jig, hold down the shoe on work stand and pull up the piston vertical direction to measure the play between piston and shoe	0~0.1 mm	0.3 mm	Replace piston



Play



Method

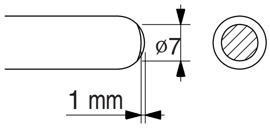


Jig for measuring play

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.

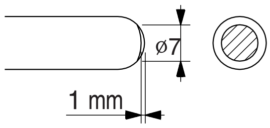
4. RCV LEVER

Maintenance check item	Criteria	Remark
Leakage	The valve is to be replaced when the leakage becomes more than 1000cc/m at neutral handle position, or more than 2000cc/m during operation.	Conditions : Primary pressure : 30 kgf/cm^2 Oil viscosity : 23cSt
Spool	This is to be replaced when the sliding surface has worn more than 10μm, compared with the non-sliding surface.	The leakage at the left condition is estimated to be nearly equal to the above leakage.
Push rod	 This is to be replaced when the top end has worn more than 1mm.	
Play at operating section	The pin, shaft, and joint of the operating section are to be replaced when their plays become more than 2mm 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.

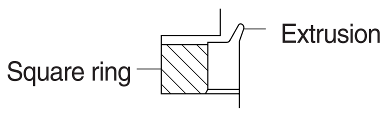
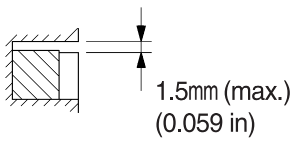
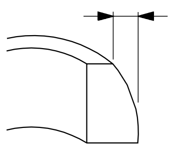
2. When loosening the hexagon socket head cap screw(125), replace the seal washers(121) without fail.

5. 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 : 23cSt
Spool	This is to be replaced when the sliding surface has worn more than 10μm, 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 2mm due to wears or so on.	When a play is due to looseness of a tightened section, adjust it.
Operation stability	When abnormal noises, hunting, primary pressure drop, etc. are generated during operation, and these cannot be remedied, referring to section 6. Troubleshooting, replace the related parts.	

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

6. 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

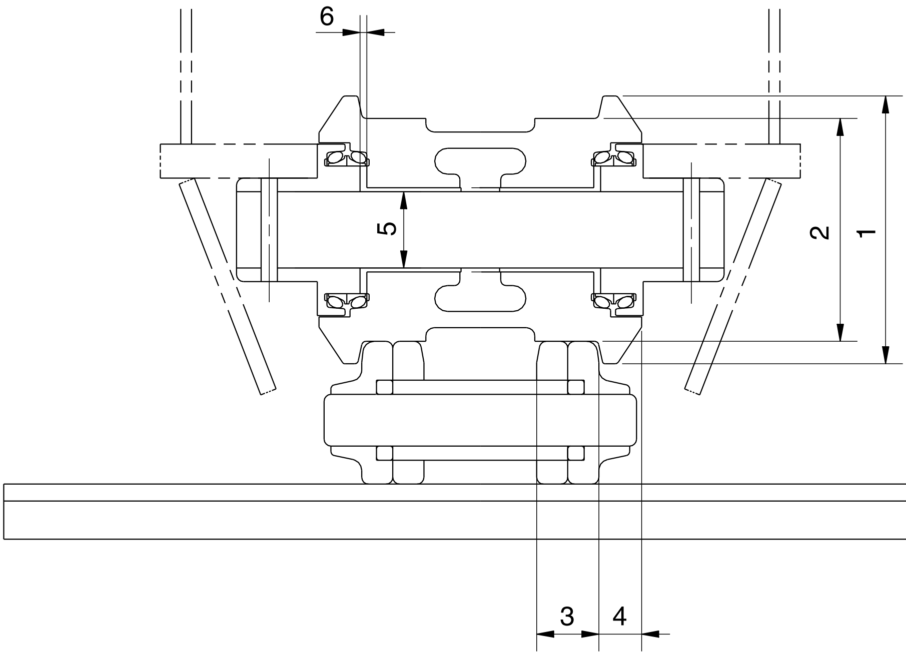
7. CYLINDER

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

GROUP 3 TRACK AND WORK EQUIPMENT

1. TRACK

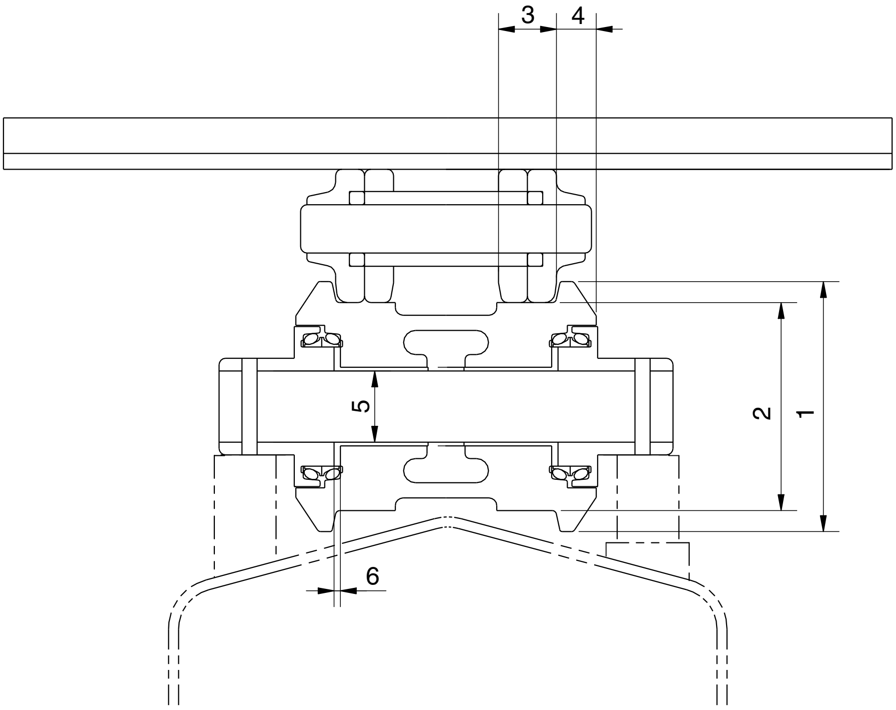
1) TRACK ROLLER



Unit : mm

No.	Check item	Criteria				Remedy
1	Outside diameter of flange	Standard size		Repair limit		Rebuild or replace
		Ø260		–		
2	Outside diameter of tread	Ø210		Ø198		
3	Width of tread	57		63		
4	Width of flange	37.5		-		
5	Clearance between shaft and bushing	Standard size & tolerance		Standard clearance	Clearance limit	Replace bushing
		Shaft	Hole			
		Ø90 $^{0}_{-0.03}$	Ø90.37 $^{+0.05}_{0}$	0.37 to 0.45	2.0	
6	Side clearance of roller (both side)	Standard clearance		Clearance limit		Replace
		0.36~1.14		2.0		

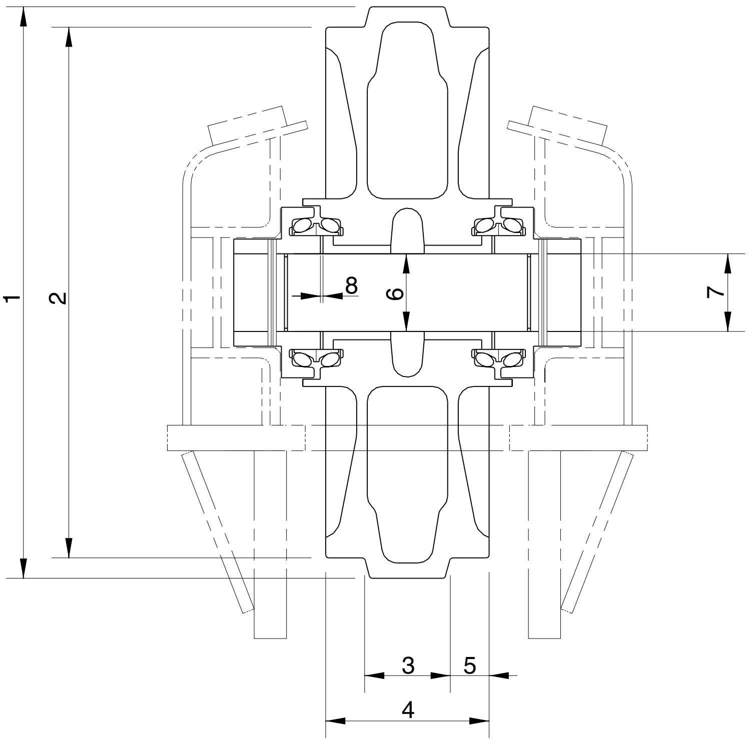
2) CARRIER ROLLER



Unit : ㎜

No.	Check item	Criteria				Remedy
1	Outside diameter of flange	Standard size		Repair limit		Rebuild or replace
		Ø260		–		
2	Outside diameter of tread	Ø210		Ø198		
3	Width of tread	57		63		
4	Width of flange	37.5		–		
5	Clearance between shaft and bushing	Standard size & tolerance		Standard clearance	Clearance limit	Replace bushing
		Shaft	Hole			
		$\varnothing 90^{\ 0}_{-0.03}$	$\varnothing 90^{+0.32}_{+0.254}$	0.254~0.35	2.0	
6	Side clearance of roller (both side)	0.36~1.14		2.0		Replace

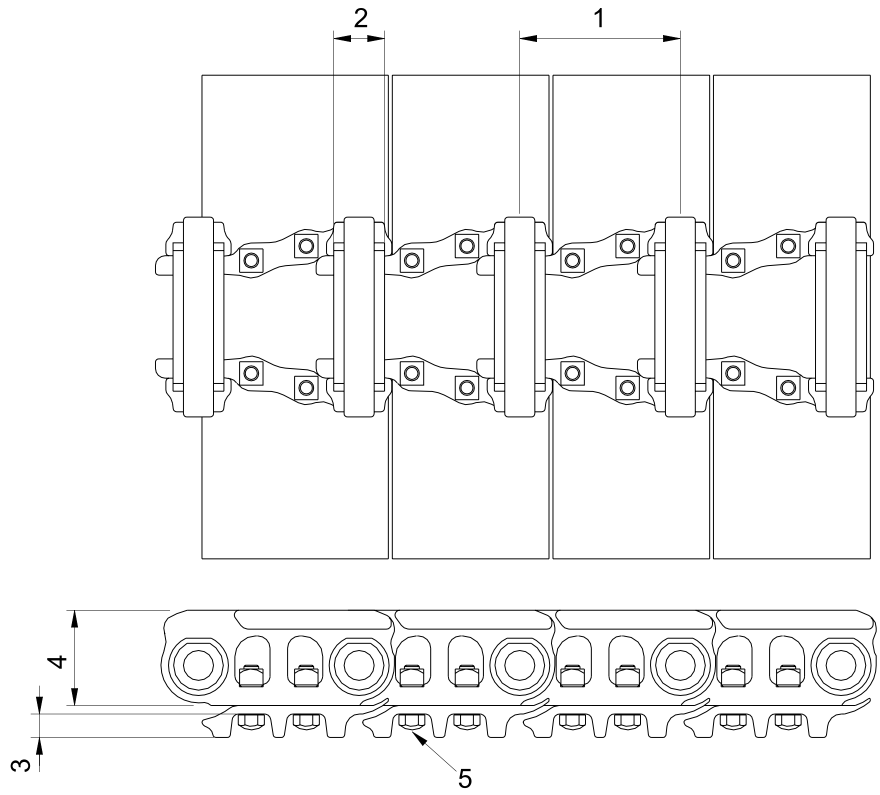
3) IDLER



Unit : ㎜

No.	Check item	Criteria				Remedy
1	Outside diameter of protrusion	Standard size		Repair limit		Rebuild or replace
		ø 682		-		
2	Outside diameter of tread	ø 630		ø 616		
3	Width of protrusion	102		-		
4	Total width	203		-		
5	Width of tread	50.5		57.5		
6	Clearance between shaft and support	Standard size & tolerance		Standard clearance	Clearance limit	Replace bushing
		Shaft	Hole			
		ø 95 $^{0}_{-0.035}$	ø 95.45 $^{+0.05}_{0}$	0.45 to 0.535	2.0	
7	Clearance between shaft and support	ø 95 $^{0}_{-0.035}$	ø 95 $^{+0.126}_{+0.072}$	0.072 to 0.161	1.2	Replace
8	Side clearance of idler (Both side)	Standard clearance		Clearance limit		Replace
		0.25 to 1.2		2.0		

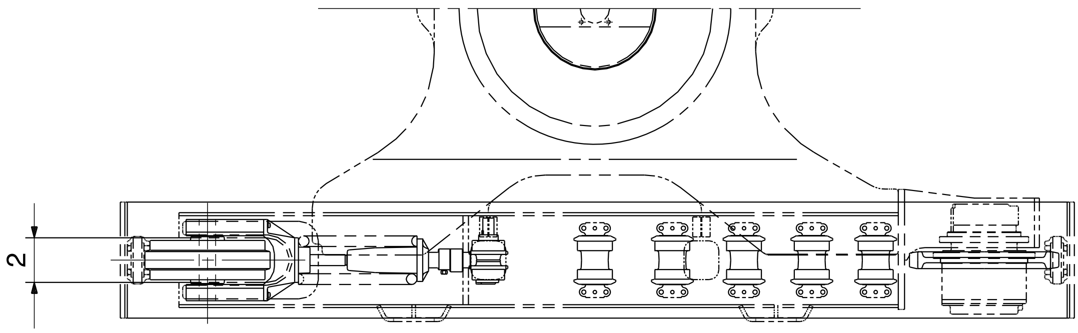
4) TRACK

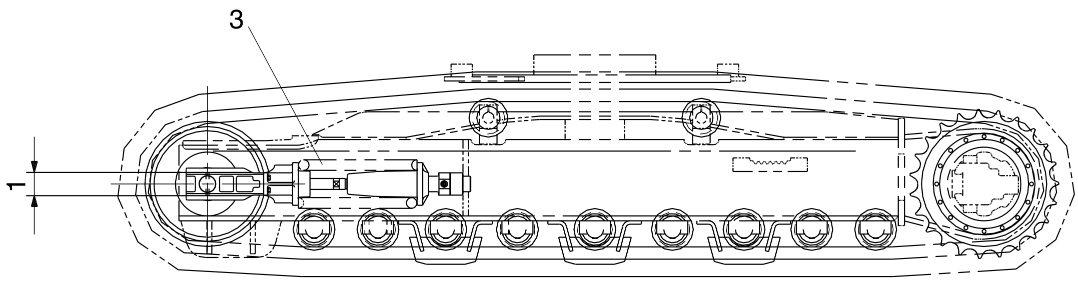


Unit : ㎜

No.	Check item	Criteria		Remedy
1	Link pitch	Standard size	Repair limit	Turn or replace
		215.9	226.7	
2	Outside diameter of bushing	ø 71	ø 60.4	Rebuild or replace
3	Height of grouser	36	21	
4	Height of link	129	115	
5	Tightening torque	Initial tightening torque : 105 ± 5 kgf · m		Retighten

5) TRACK FRAME AND RECOIL SPRING





Unit : mm

<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>Standard size</td><td>Tolerance</td><td colspan="2">Repair limit</td><td rowspan="5">Rebuild or replace</td></tr>
<tr><td>Track frame</td><td>132</td><td>+2
0</td><td colspan="2">136</td></tr>
<tr><td>Idler support</td><td>130</td><td>0
- 1.5</td><td colspan="2">126</td></tr>
<tr><td rowspan="2">2</td><td rowspan="2">Horizontal width of idler guide</td><td>Track frame</td><td>292</td><td>+2
0</td><td colspan="2">297</td></tr>
<tr><td>Idler support</td><td>290</td><td>-</td><td colspan="2">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>Ø276×865</td><td>707</td><td>28840 kg</td><td>–</td><td>23073 kg</td></tr>
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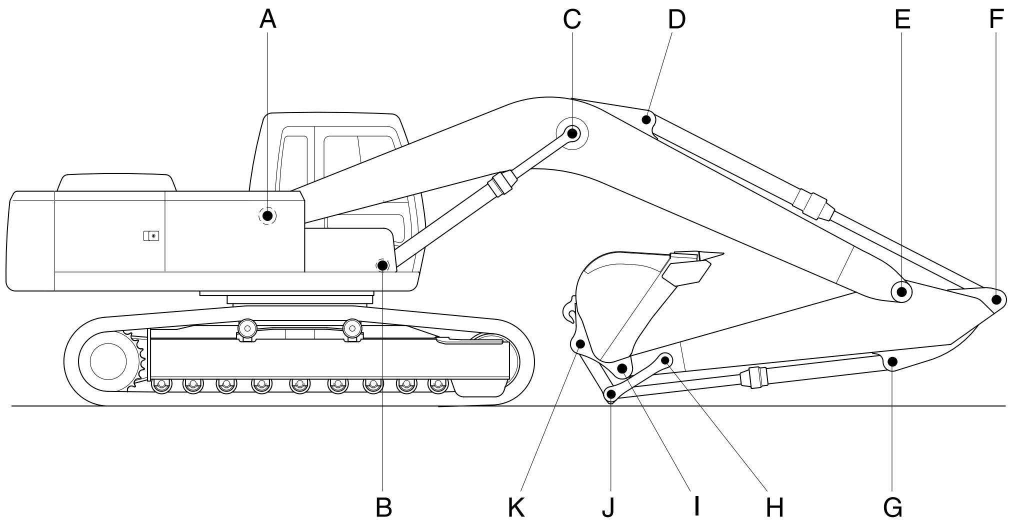
2. WORK EQUIPMENT



Unit : mm

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	110	109	108.5	110.5	111	
H	Arm Link	100	99	98.5	100.5	101	
I	Bucket and Arm Link	120	119	118.5	120.5	121	
J	Bucket Cylinder Rod	110	109	108.5	110.5	111	
K	Bucket Link	120	119	118.5	120.5	121	

SECTION 8 DISASSEMBLY AND ASSEMBLY

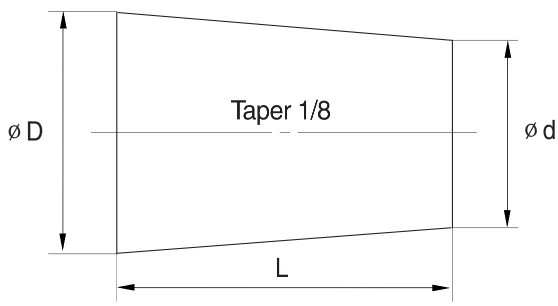
SECTION 8 DISASSEMBLY AND ASSEMBLY

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 100 mm 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

R505LVS

No.	Descriptions		Bolt size	Torque	
				kgf · m	lbf · ft
1	Engine	Engine mounting bolt, nut (FR, bracket)	M20 × 2.5	55 ± 5.5	398 ± 39.8
2		Engine mounting bolt, nut (RR, bracket)	M16 × 2.0	28 ± 3.0	202 ± 21.7
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 ± 2.0	333 ± 14.5
6		Main pump housing mounting bolt	M10 × 1.5	4.8 ± 0.3	35 ± 2.2
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	45 ± 5.1	325 ± 36.8
10		Hydraulic oil tank mounting bolt	M20 × 2.5	45 ± 5.1	325 ± 36.8
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	58.4 ± 6.4	422 ± 46.2
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 (-#0201)	M20 × 2.5	57.9 ± 6.0	419 ± 43.4
		Sprocket mounting bolt (#0202-)	M22 × 2.5	77.4 ± 7.5	560 ± 54.2
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
20		Track shoe mounting bolt, nut	M24 × 3.0	140 ± 5.0	1012 ± 36
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.

2. TORQUE CHART

Use following table for unspecified torque.

1) BOLT AND NUT

(1) Coarse thread

Bolt size	8T		10T	
	kg · m	lb · ft	kg · m	lb · 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	2.73 ~ 4.12	19.7 ~ 29.8
M10 × 1.5	4.0 ~ 6.0	28.9 ~ 43.4	5.5 ~ 8.3	39.8 ~ 60
M12 × 1.75	7.4 ~ 11.2	53.5 ~ 79.5	9.8 ~ 15.8	71 ~ 114
M14 × 2.0	12.2 ~ 16.6	88.2 ~ 120	16.7 ~ 22.5	121 ~ 167
M16 × 2.0	18.6 ~ 25.2	135 ~ 182	25.2 ~ 34.2	182 ~ 247
M18 × 2.5	25.8 ~ 35.0	187 ~ 253	35.1 ~ 47.5	254 ~ 343
M20 × 2.5	36.2 ~ 49.0	262 ~ 354	49.2 ~ 66.6	356 ~ 482
M22 × 2.5	48.3 ~ 63.3	350 ~ 457	65.8 ~ 98.0	476 ~ 709
M24 × 3.0	62.5 ~ 84.5	452 ~ 611	85.0 ~ 115	615 ~ 832
M30 × 3.5	124 ~ 168	898 ~ 1214	169 ~ 229	1223 ~ 1655
M36 × 4.0	174 ~ 236	1261 ~ 1703	250 ~ 310	1808 ~ 2242

(2) Fine thread

Bolt size	8T		10T	
	kg · m	lb · ft	kg · m	lb · ft
M 8 × 1.0	2.17 ~ 3.37	15.7 ~ 24.3	3.04 ~ 4.44	22.0 ~ 32.0
M10 × 1.25	4.46 ~ 6.66	32.3 ~ 48.2	5.93 ~ 8.93	42.9 ~ 64.6
M12 × 1.25	7.78 ~ 11.58	76.3 ~ 83.7	10.6 ~ 16.0	76.6 ~ 115
M14 × 1.5	13.3 ~ 18.1	96.2 ~ 130	17.9 ~ 24.1	130 ~ 174
M16 × 1.5	19.9 ~ 26.9	144 ~ 194	26.6 ~ 36.0	193 ~ 260
M18 × 1.5	28.6 ~ 43.6	207 ~ 315	38.4 ~ 52.0	278 ~ 376
M20 × 1.5	40.0 ~ 54.0	289 ~ 390	53.4 ~ 72.2	386 ~ 522
M22 × 1.5	52.7 ~ 71.3	381 ~ 515	70.7 ~ 95.7	512 ~ 692
M24 × 2.0	67.9 ~ 91.9	491 ~ 664	90.9 ~ 123	658 ~ 890
M30 × 2.0	137 ~ 185	990 ~ 1338	182 ~ 248	1314 ~ 1795
M36 × 3.0	192 ~ 260	1389 ~ 1879	262 ~ 354	1893 ~ 2561

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.**

(4) Loosen the drain plug under the hydraulic tank and drain the oil from the hydraulic tank.

· Hydraulic tank quantity : 275 ℓ

(5) Remove socket bolts (3, 4) and disconnect block with hoses (1, 2).

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

(7) Remove socket bolts (6) and disconnect pump suction tube (5).

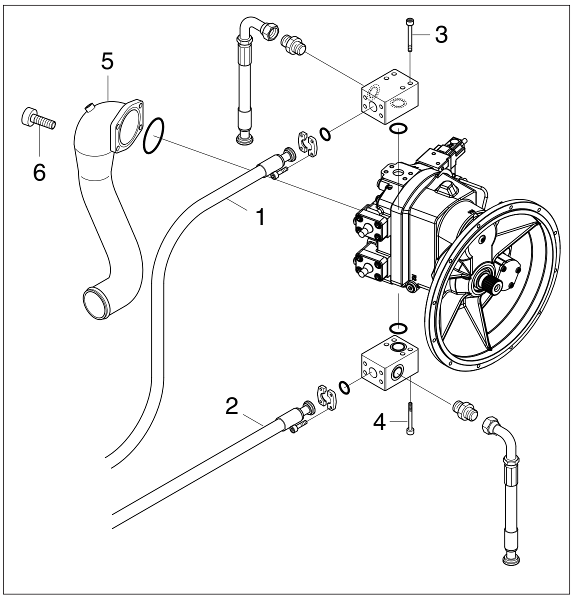
※ When pump suction tube is disconnected, the oil inside the piping will flow out, so catch it in oil pan.

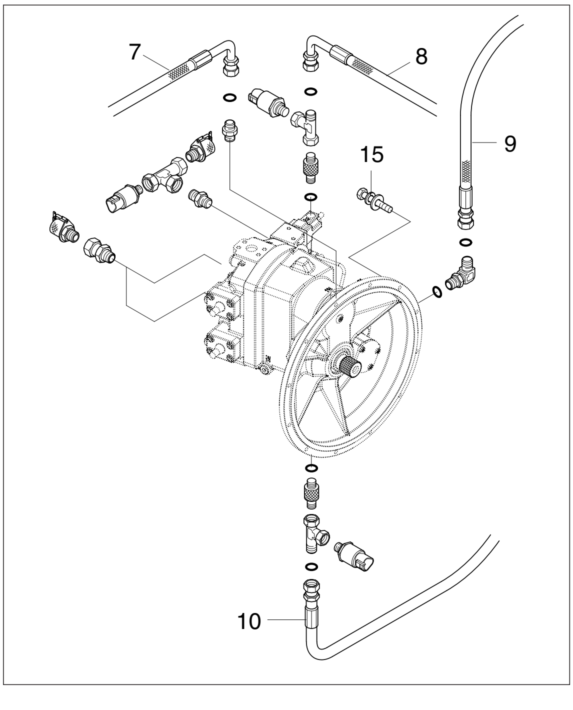
(8) Sling the pump assembly and remove the pump mounting bolts (15).

· Weight : 194 kg (428 lb)

· Tightening torque : 6.7±1.0 kgf · m (48.5±7.2 lbf · ft)

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





2) INSTALL

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

(2) Remove the suction strainer and clean it.

(3) Replace return filter with new one.

(4) Remove breather and clean it.

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

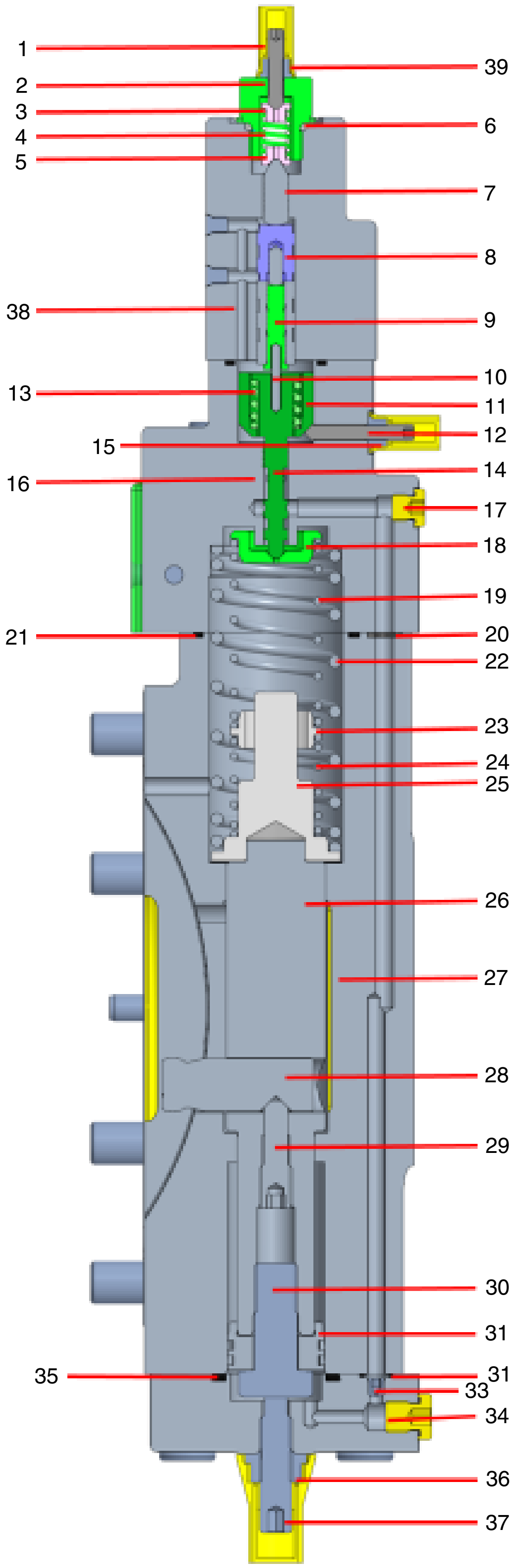
(6) Bleed the air from the hydraulic pump.
① Remove the air vent plug (2EA).
② Tighten plug lightly.
③ Start the engine, run at low idling, and check oil come out from plug.
④ Tighten plug.

(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. REPAIR GUIDELINES

1) PART LIST (1/3)

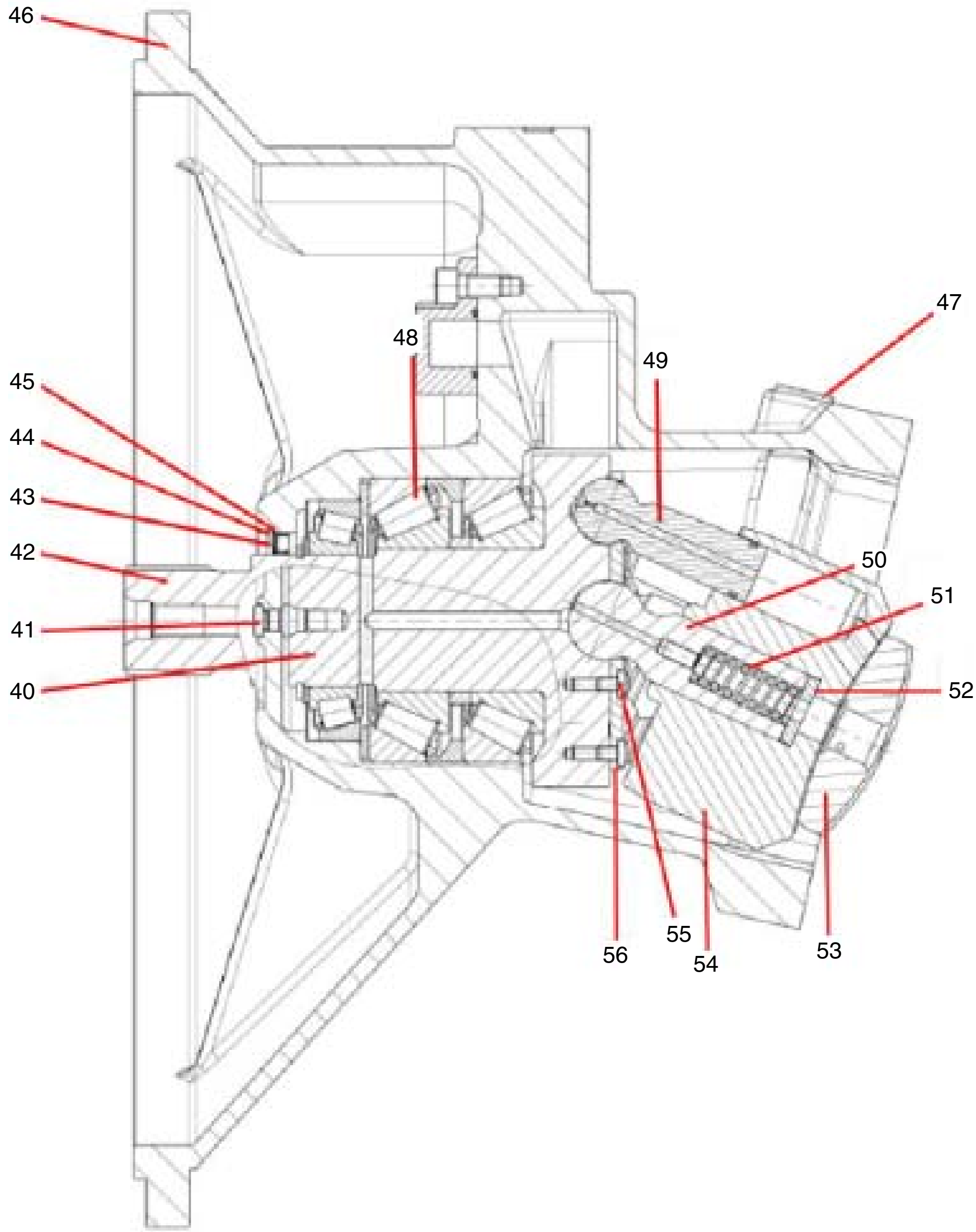


1	Setting screw
2	Screw plug
3	Spring cup
4	Spring
5	Spring cup
6	O-ring
7	HNC control piston
8	Control bushing
9	LLC control piston
10	Pin
11	Spring bushing
12	Adjustment screw
13	Setting screw
14	Control piston for stroking
15	Sealing screw
16	HNC controller housing
17	Sealing screw
18	Spring cup
19	Spring
20	O-ring
21	O-ring
22	Spring
23	Double spring collar
24	Spring
25	Spring collar
26	Stroke piston
27	Port plate
28	Setting pin
29	Locating screws
30	Bolt
31	Piston with steal rings
32	O-ring
33	Orifice
34	Sealing screw
35	O-ring
36	Sealing screw
37	Setting screw
38	Stroke controller housing
39	Sealing screw

※ HNC : Hydraulic Negative Control

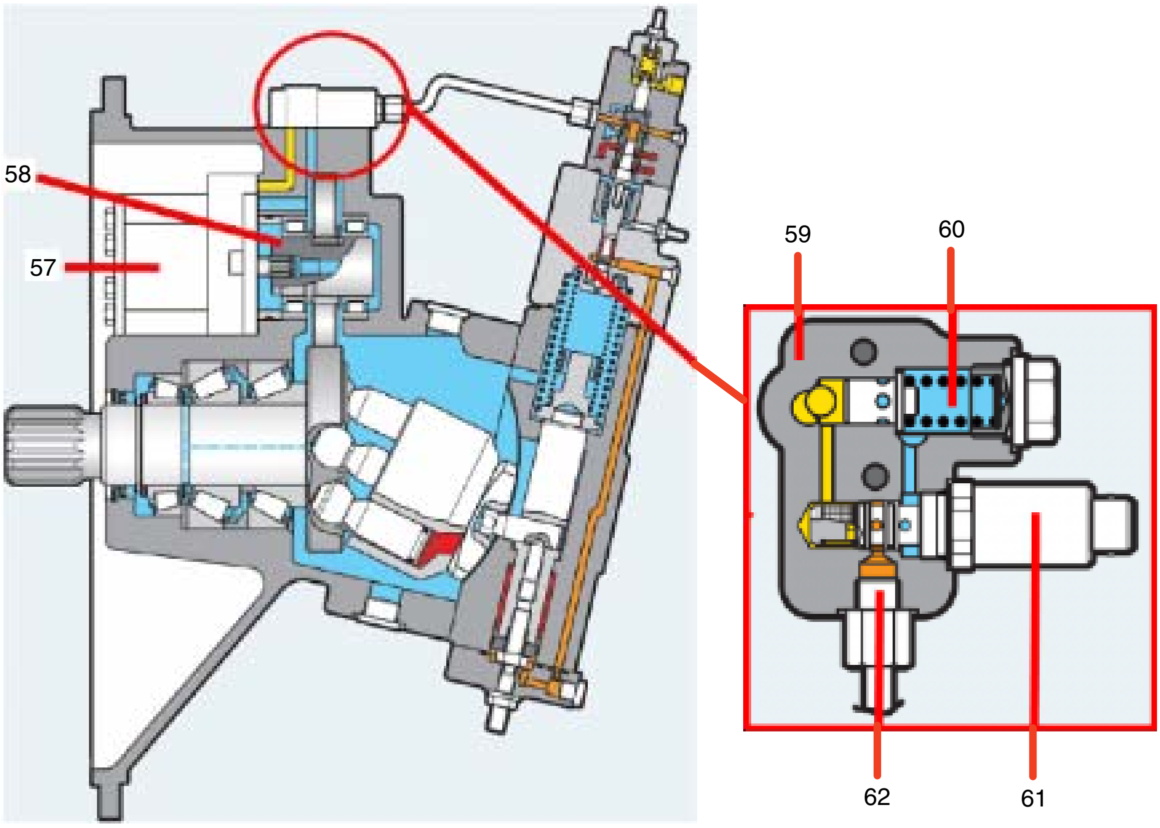
※ LCC : Load Limiting Control

PART LIST (2/3)



40	Rotary group	46	Pump housing	52	Shim
41	Sealing screw	47	Sealing screw	53	Control lense
42	Rotary group	48	Bearings	54	Cylinder
43	Snap ring	49	Piston with steal rings	55	Bolt
44	Shim	50	Center pin	56	Retreat plate
45	Shaft seal ring	51	Spring		

PART LIST (3/3)

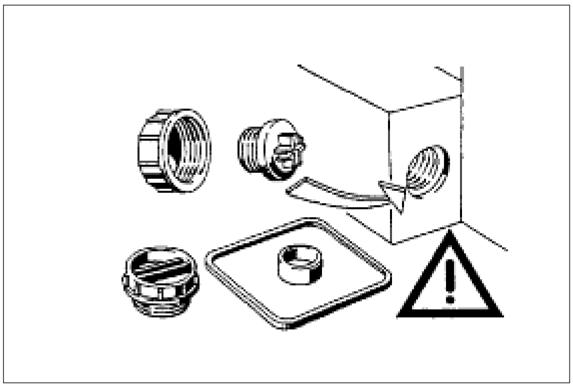


57 Gear pump
58 Gear wheel
59 Valve plate
60 Pressure relieve valve
61 EPPR valve
62 Hydraulic pipe

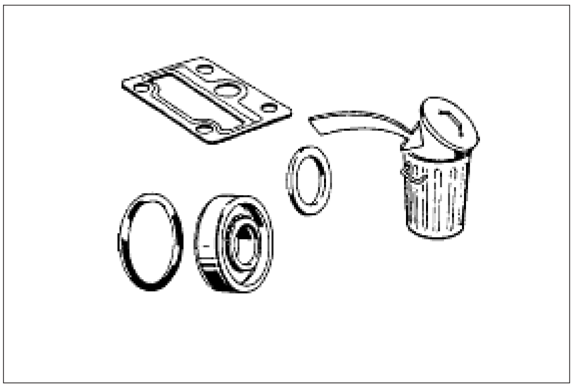
2) GENERAL REPAIR GUIDELINES

※ Observe the following notices when carrying out repairs on hydraulic pumps.

(1) Close off all openings of the hydraulic unit.

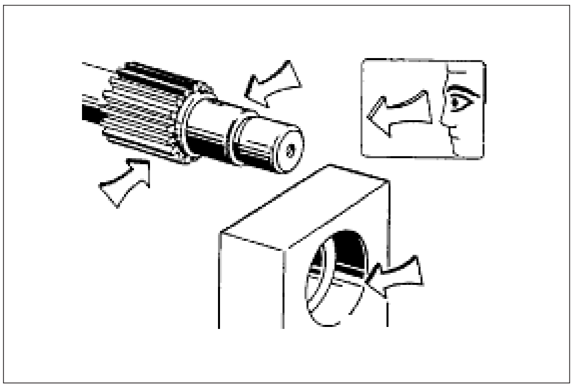


(2) Replace all of the seals.
Use only HYUNDAI spare parts.

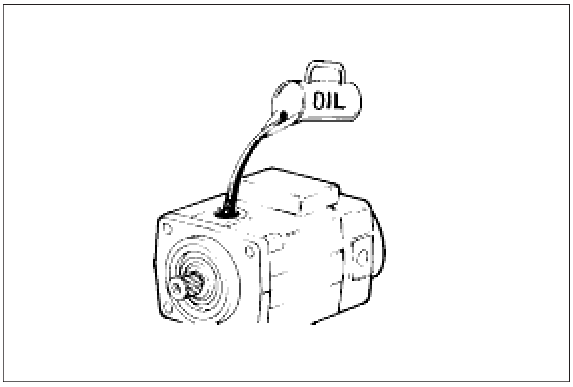


(3) Check all sealing and sliding surfaces for wear.

※ Re-work of the sliding surfaces by using, for example with abrasive paper, can damage the surface.

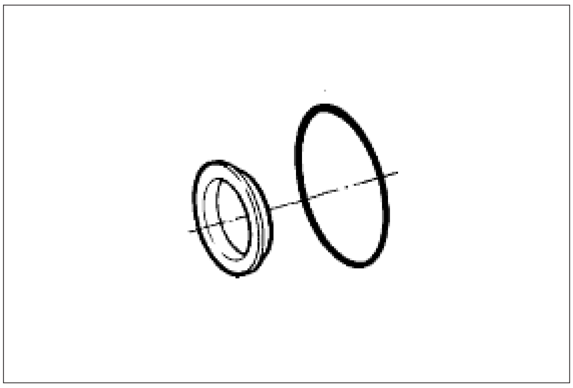


(4) Fill the hydraulic unit with hydraulic oil before commissioning.

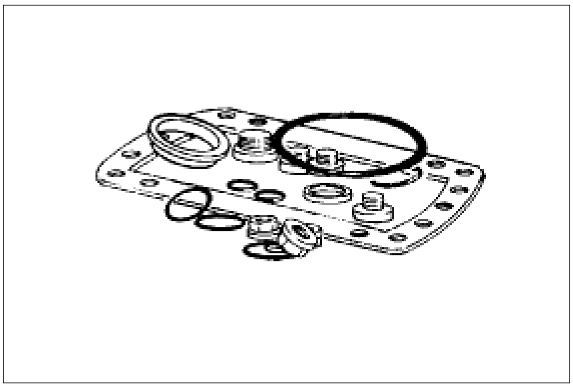


3) SEAL KITS AND SUB ASSEMBLIES

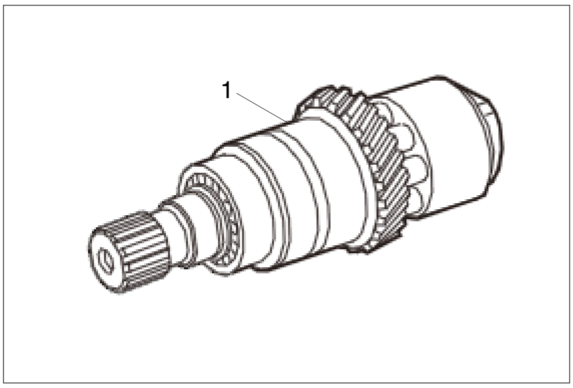
(1) Seal kit for drive shaft.



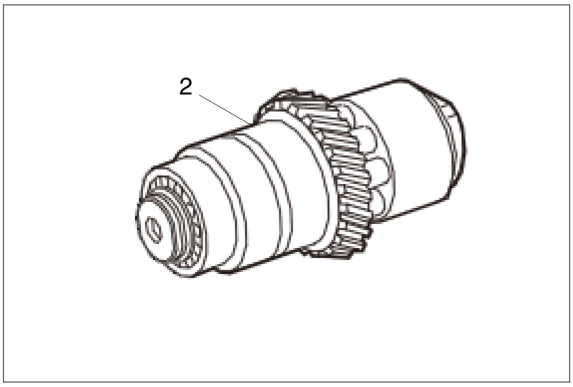
(2) Peripheral seal kit.



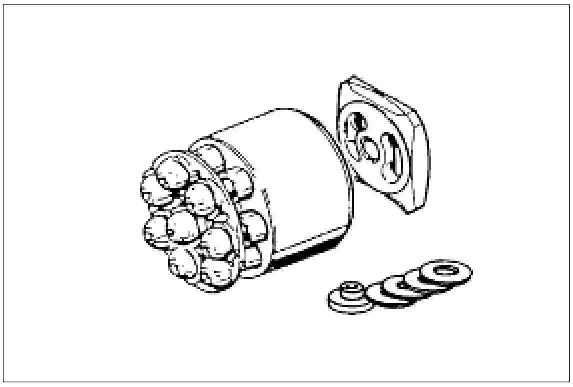
(3) Rotary group (1) ready to install.



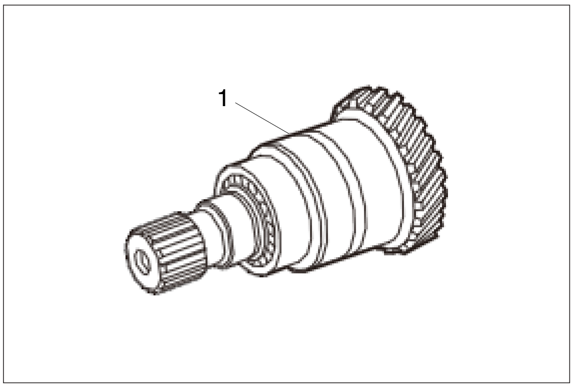
(4) Rotary group (2) ready to install.



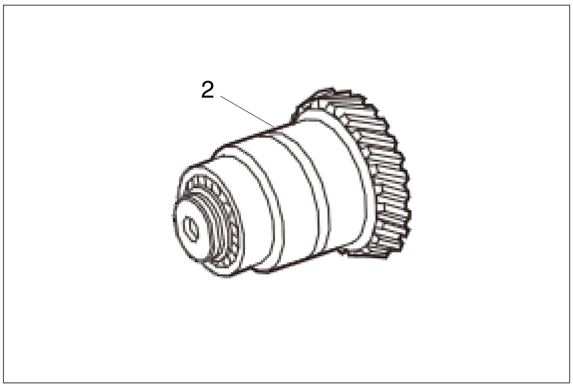
(5) Rotary group, hydraulic component (order rotary groups (1) and (2) separately). Adjustment is necessary.
※ Direction of rotation



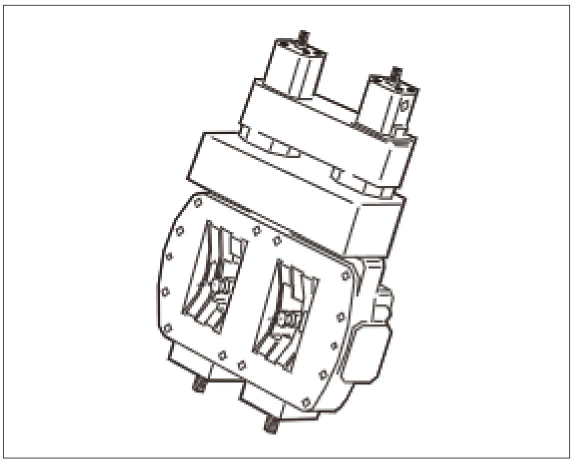
(6) Rotary group (1) mechanical section, ready to install.



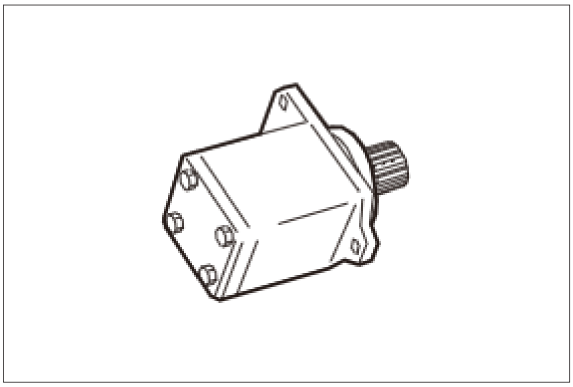
(7) Rotary group (2) mechanical section, ready to install.



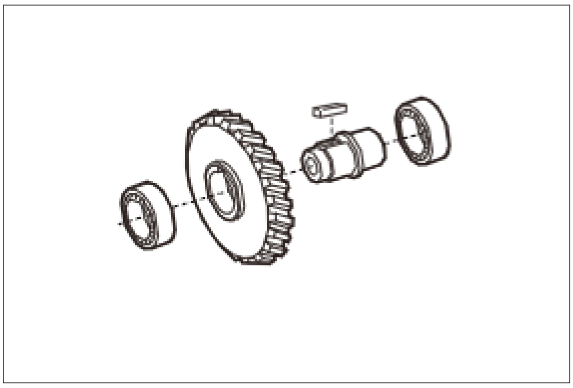
(8) Control, pre-adjusted.



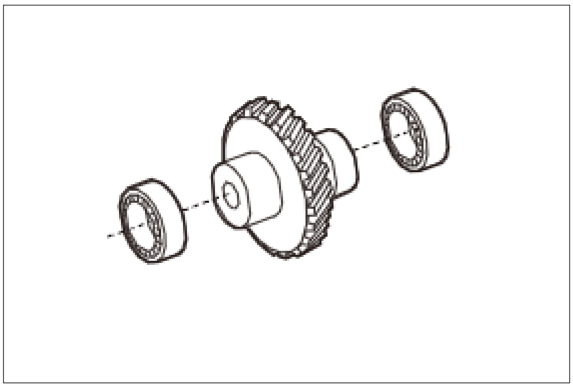
(9) Gear pump, complete.



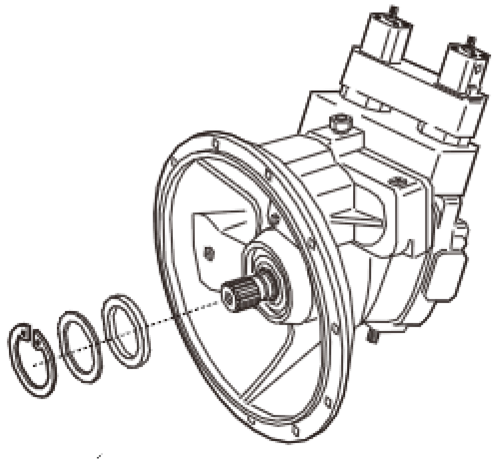
(10) Intermediate gear



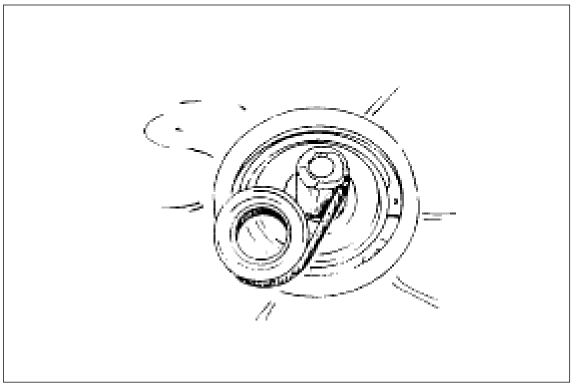
(11) Auxiliary drive



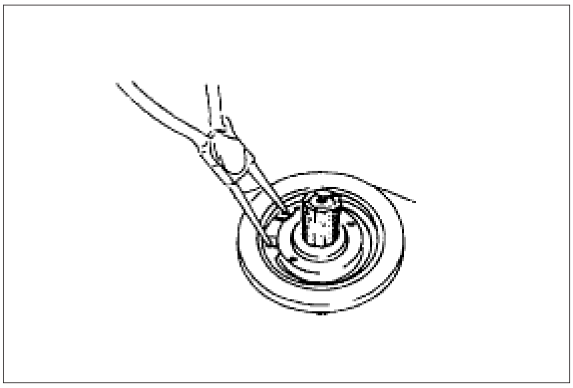
4) SEALING THE DRIVE SHAFT



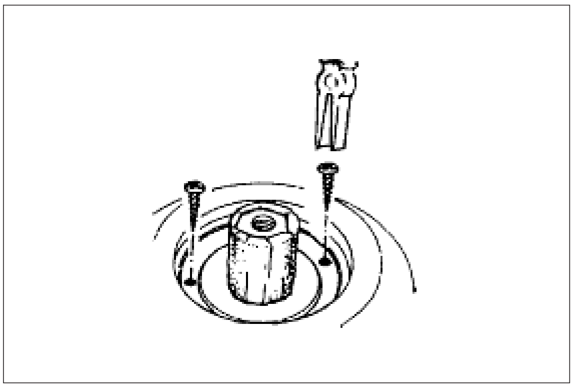
(1) Protect drive shaft. (e.g. tape).



(2) Remove retaining ring and shim.

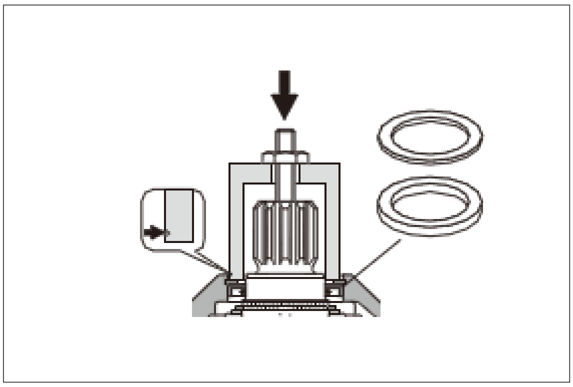


(3) Screw in sheet metal screw into the holes fitted with rubber.
Pull out seal with pliers.

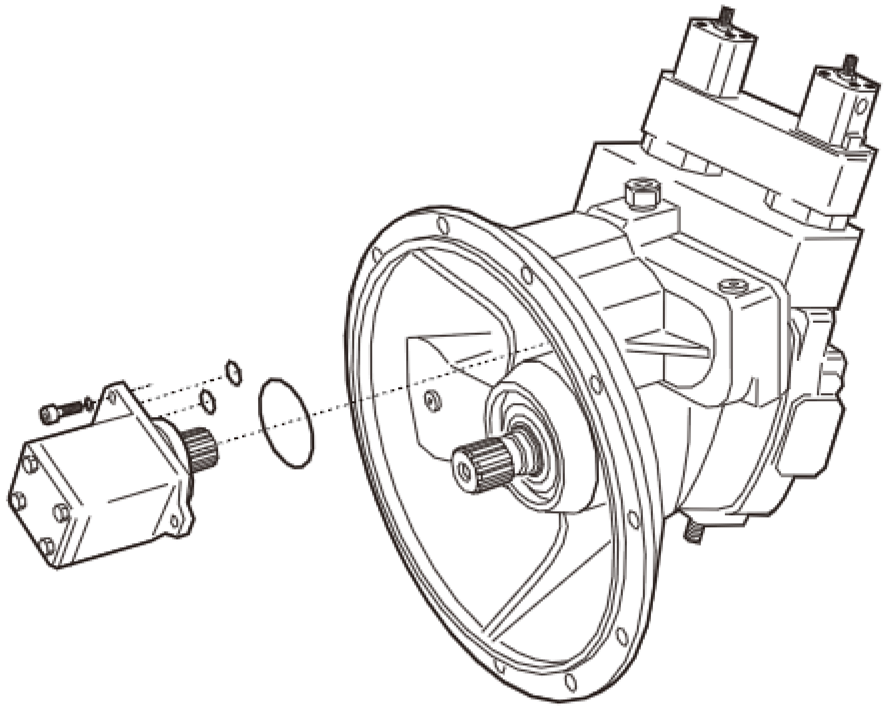


(4) Press in shaft seal ring and shim with bush to stop.
Take note of press-in depth.

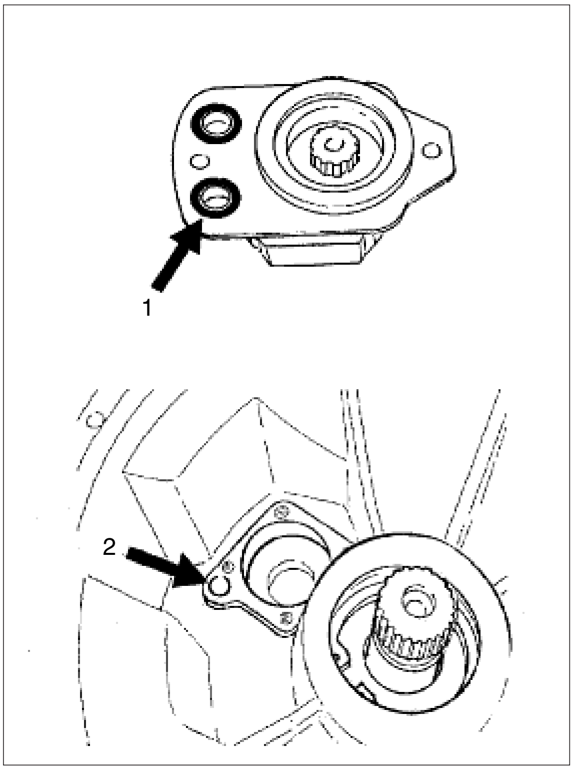
※ Install mark for press-in depth of safety ring.



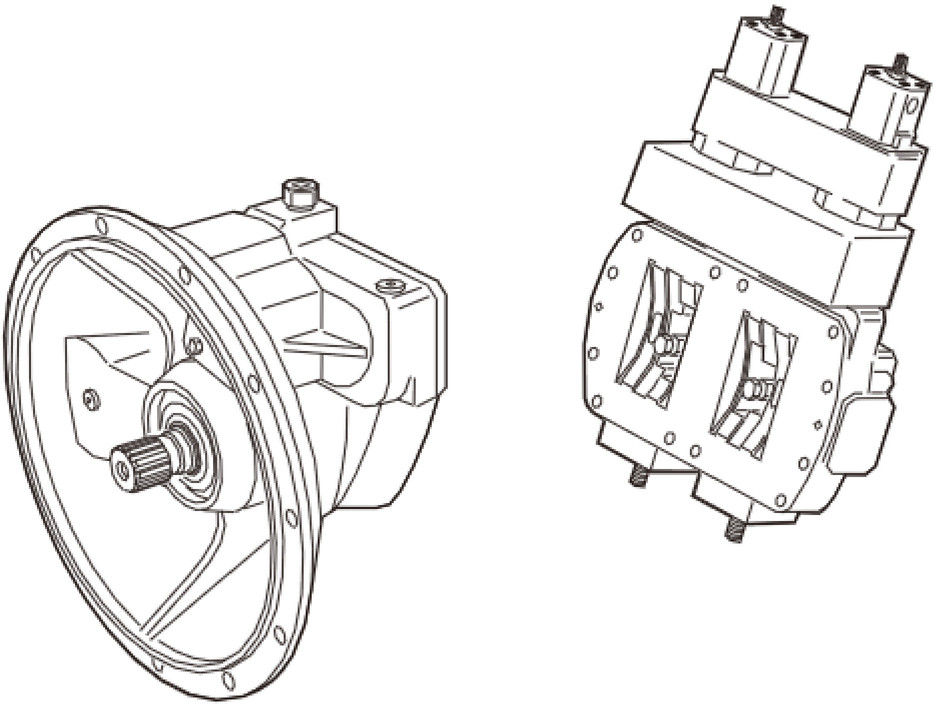
5) GEAR PUMP SEALING



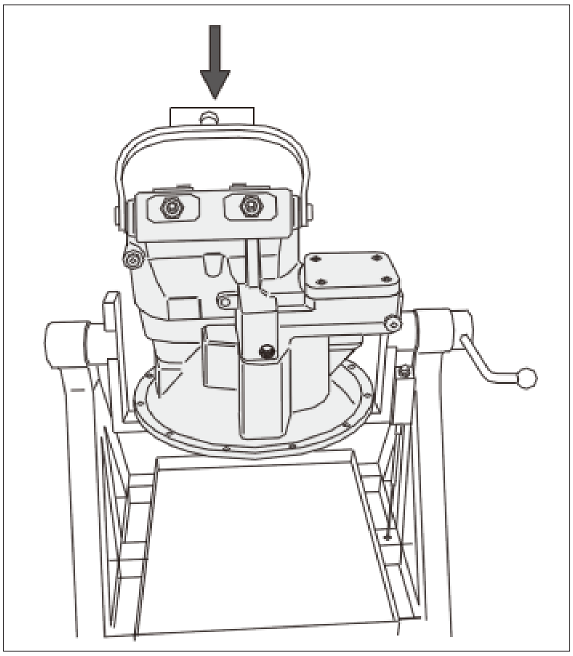
(1) Remove gear pump.
Visual check:
1 O-ring
2 Sealing surface of the housing.



6) REMOVE THE CONTROL HOUSING



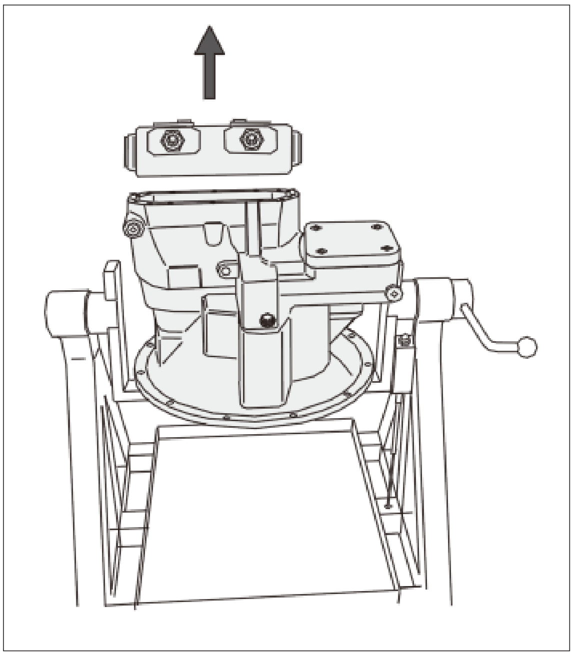
(1) Place the pump into a disassembly/ assembly device with a crane and fix it.



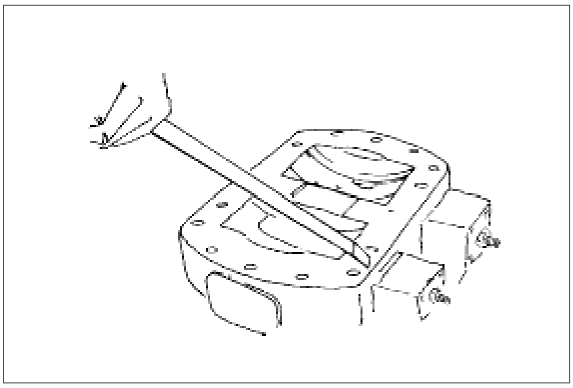
※ Mark installation position.

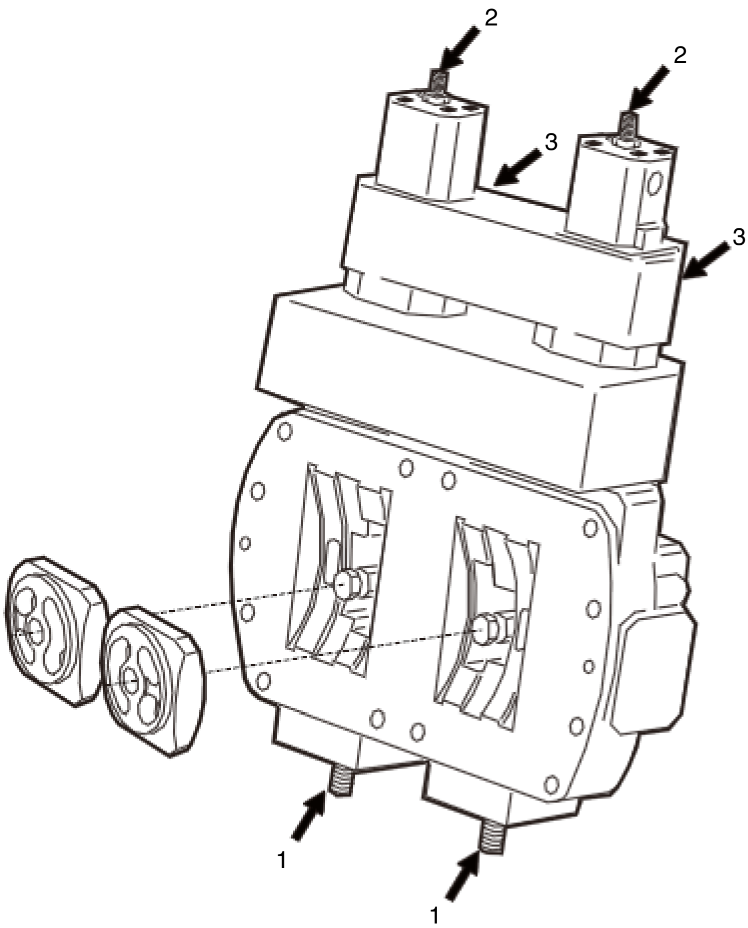
(2) Loosen fixing screws of port plate and remove the port plate.
Lift the port plate away with a crane.

※ Control lenses can fall down.



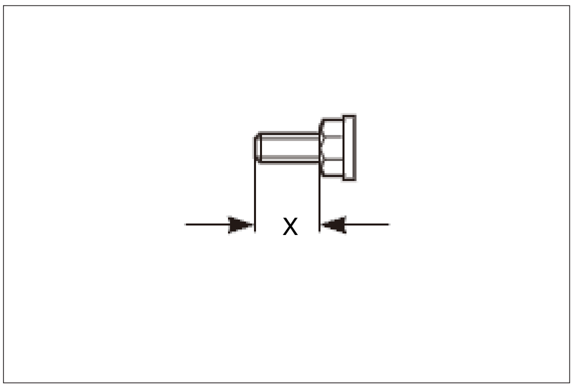
(3) Remove paper seal, clean sealing surface.



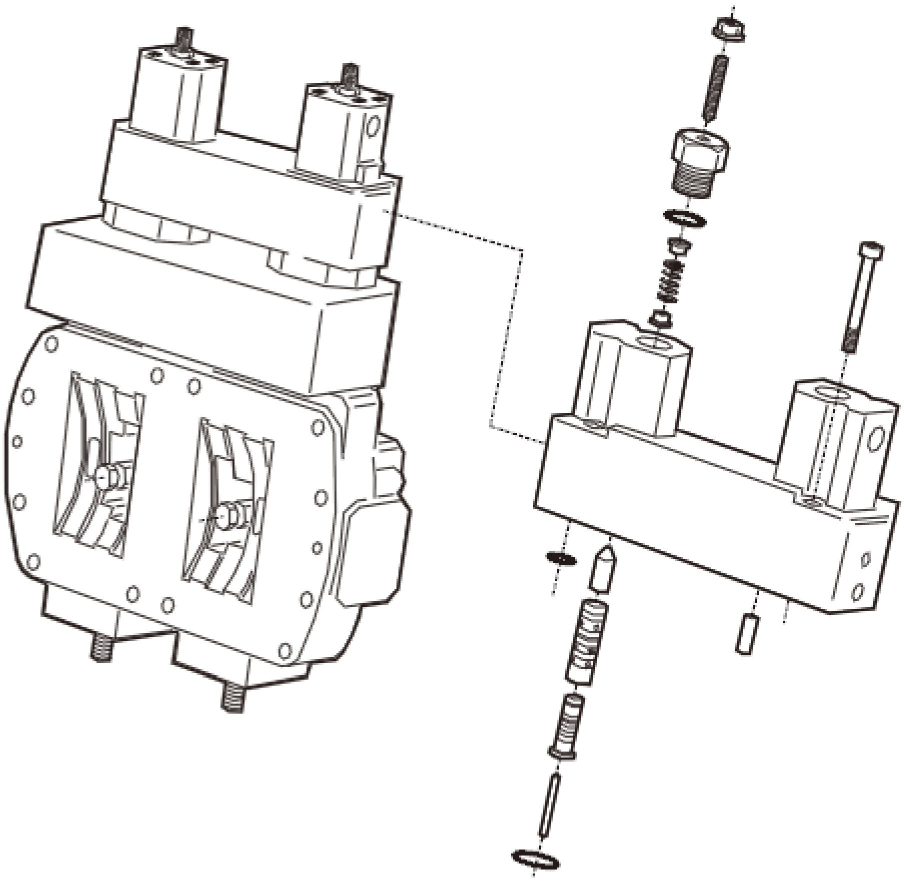


Item 1 ⇒ setting screw Qmax
Item 2 ⇒ setting screw Hydraulic stroke limitation
Item 3 ⇒ setting screw Power characteristic (begin of regulation)

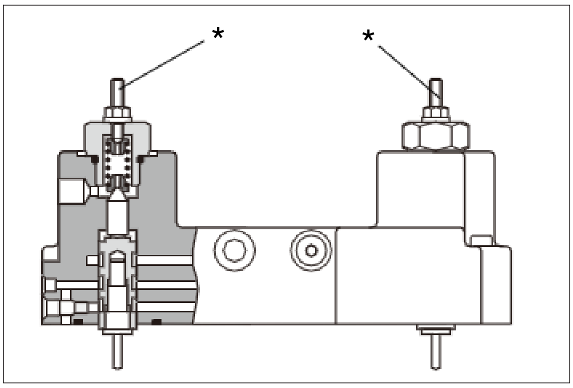
※ Before carrying out a setting or disassembly of the regulator, measure the measurement (X) and note of the setting screw.



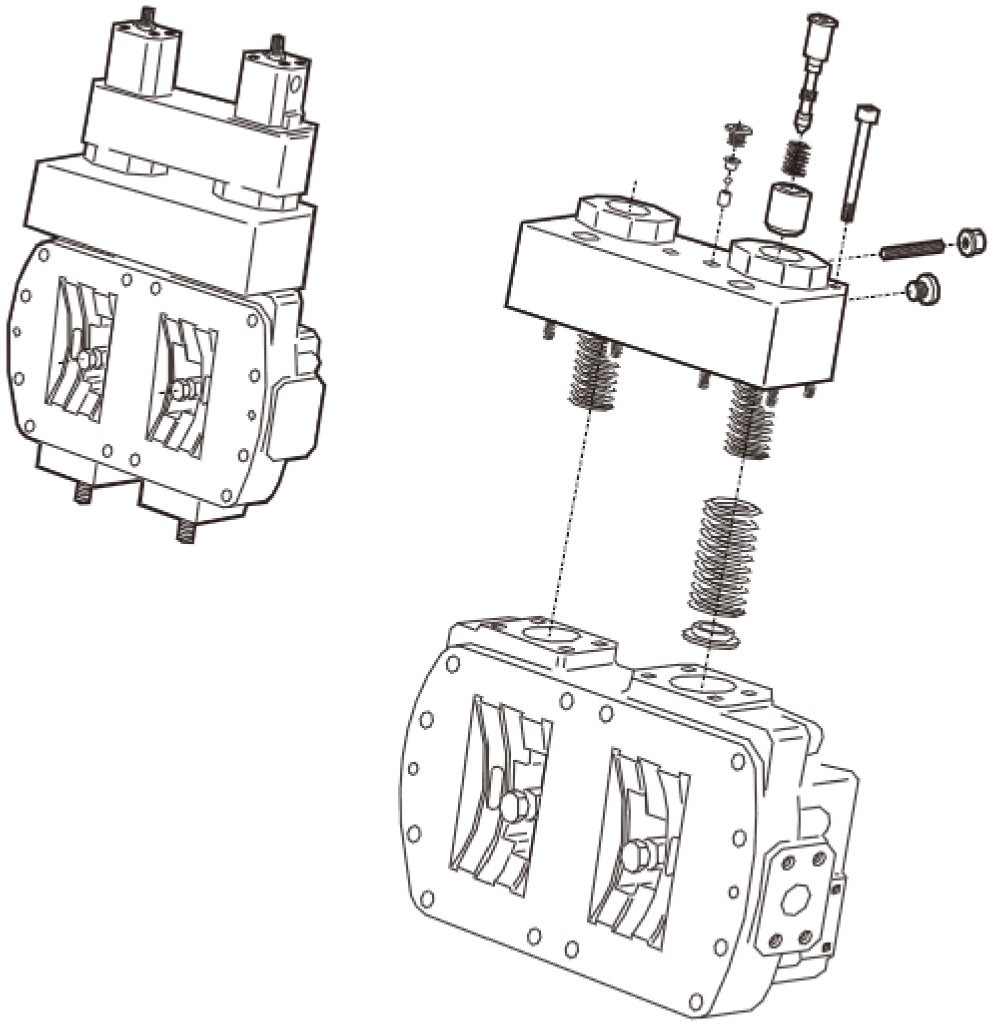
7) CONTROL MODULE LR



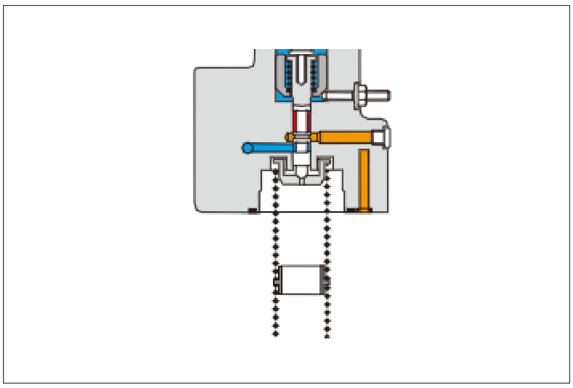
＊ Remove and disassemble control module LR.



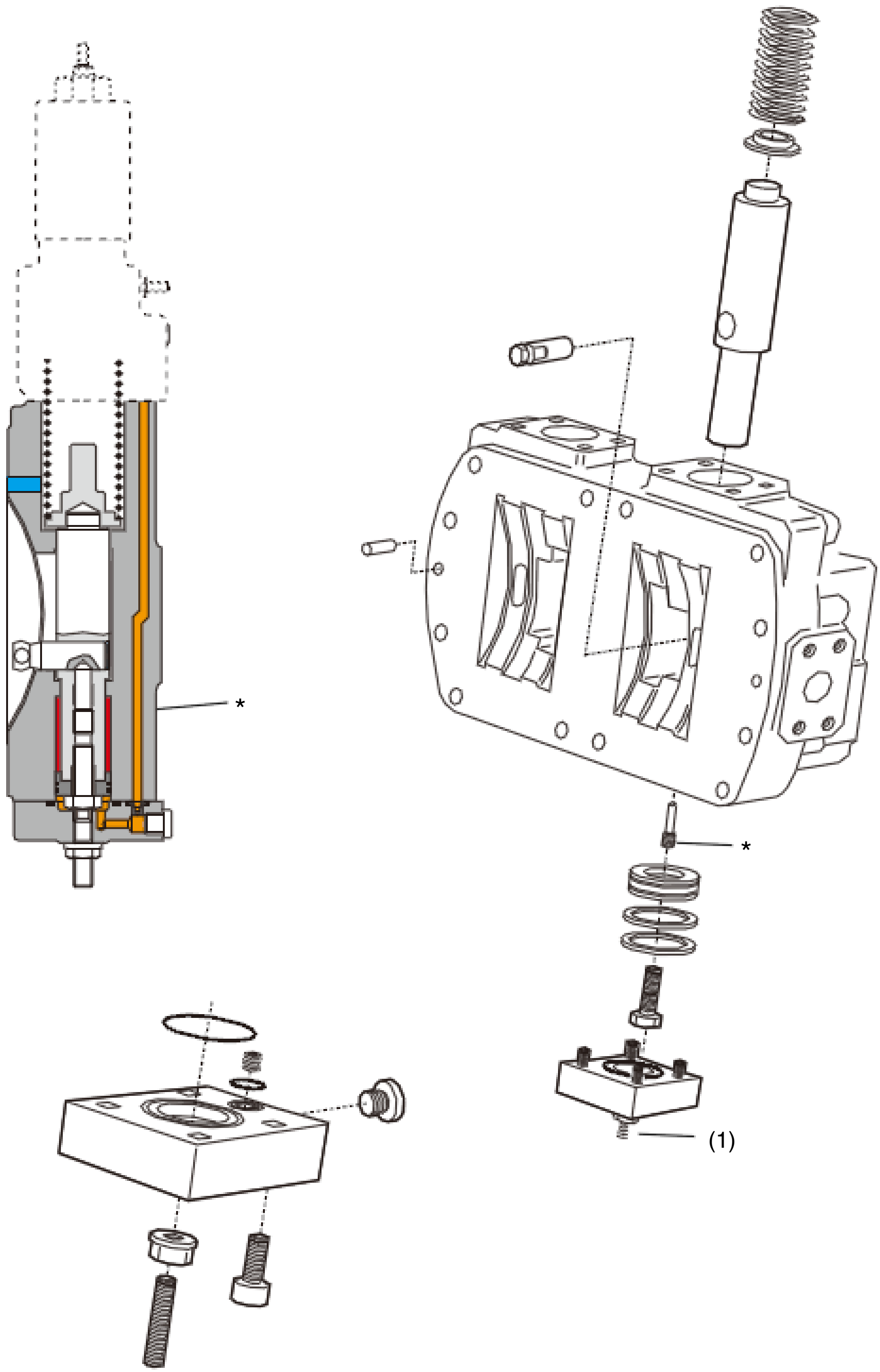
8) CONTROL MODULE H



※ Remove and disassemble control module H.



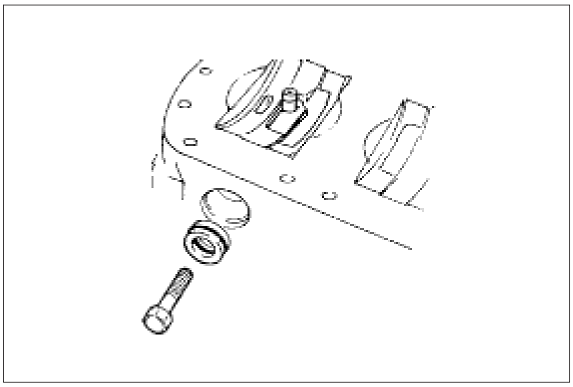
9) REMOVING THE CONTROLLER



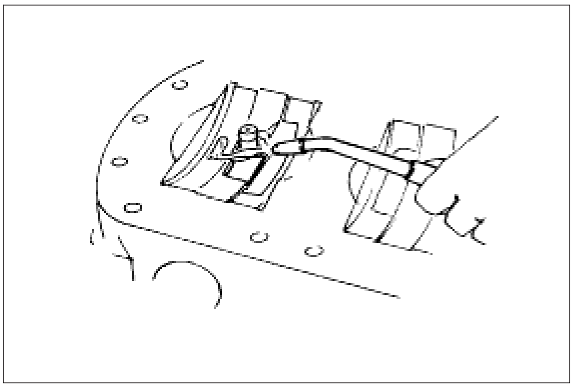
(1) Remove cover.

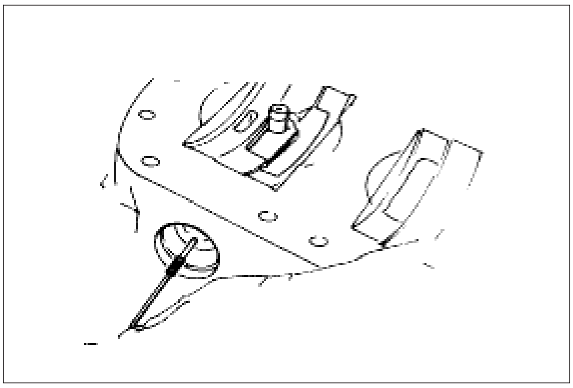
※ Do not change the setting screw (1).

(2) Loosen fixing screws.
※ Fit control lens - torque support.

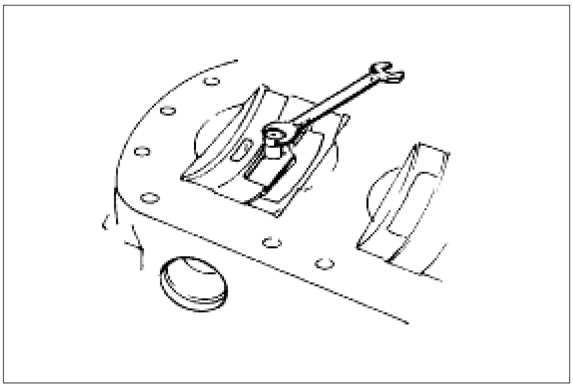


(3) Remove locking screw and replace with a new locking screw.
※ Loosen adhesive with a "gentle" flame (approx. 120℃).

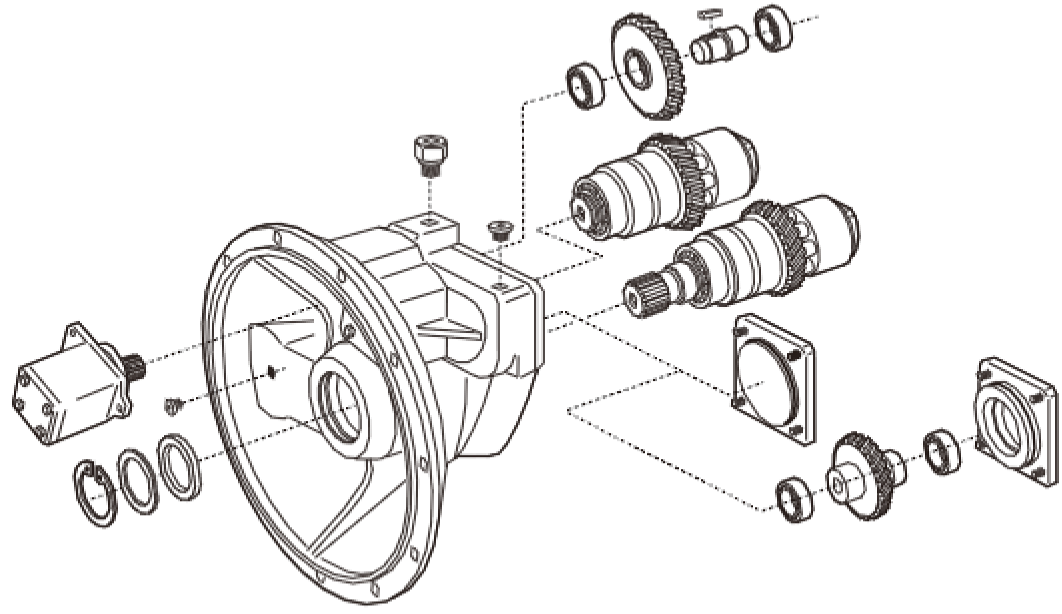




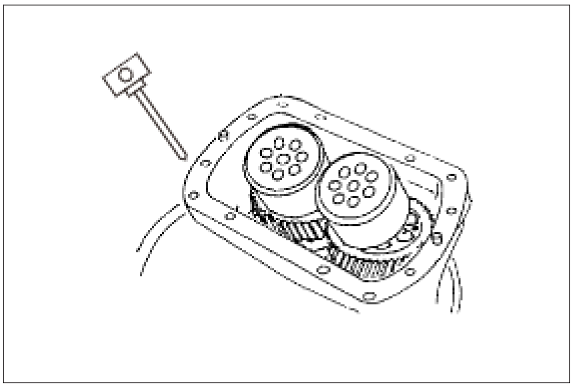
(4) Loosen swivel pin and then remove it



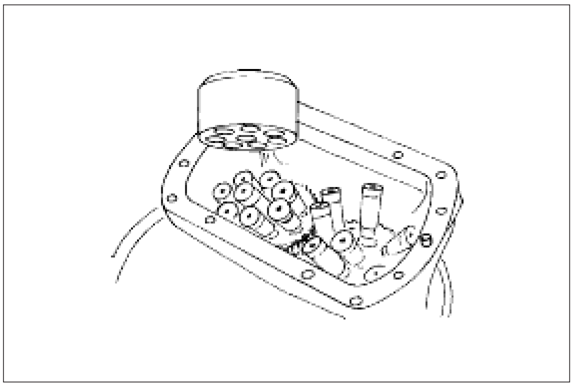
10) REMOVE THE ROTARY GROUPS



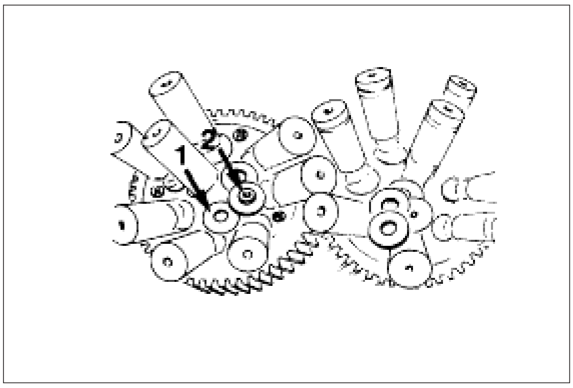
(1) Keep the cylinder with a device (remove it completely with the drive shaft).



(2) Remove cylinder (take out the drive shaft without cylinder).



(3) Remove spring cup (1) and spring cup (2).

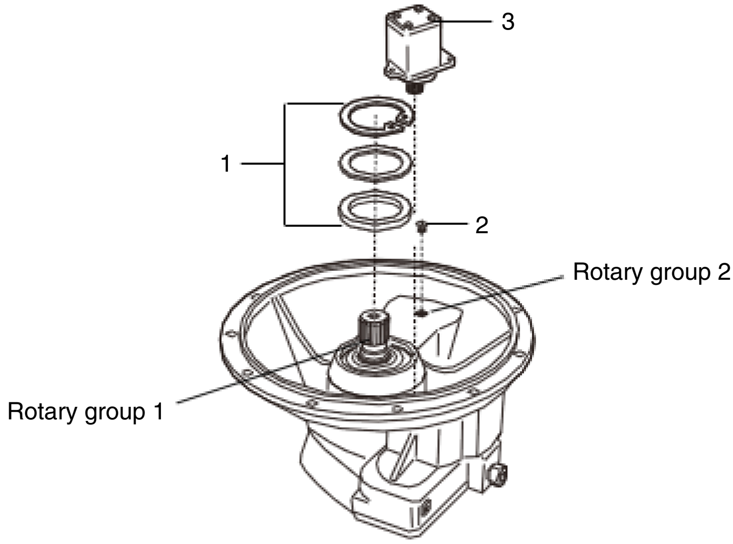


(4) New disassembly position

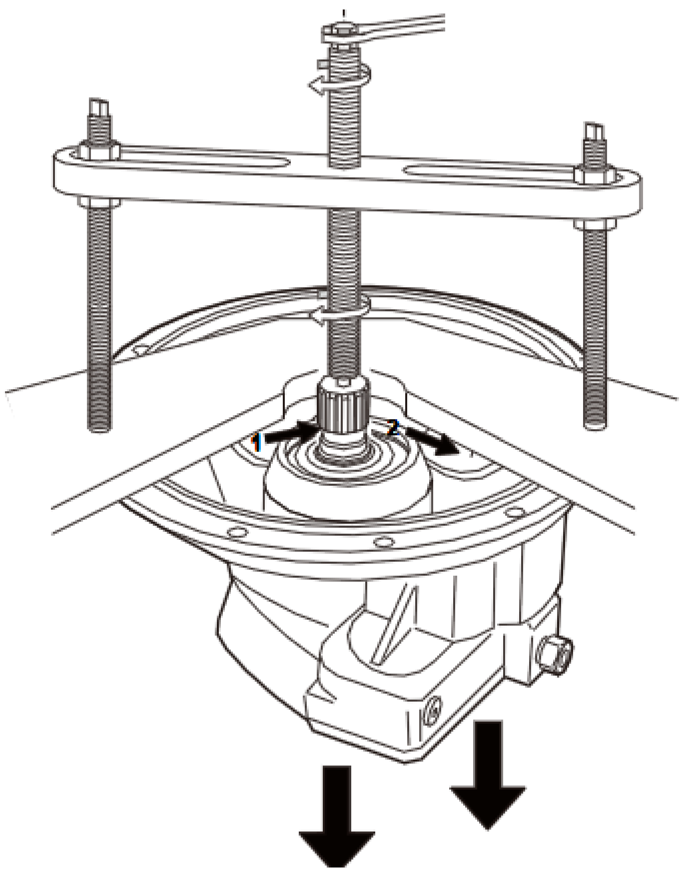
Pos.1 Remove

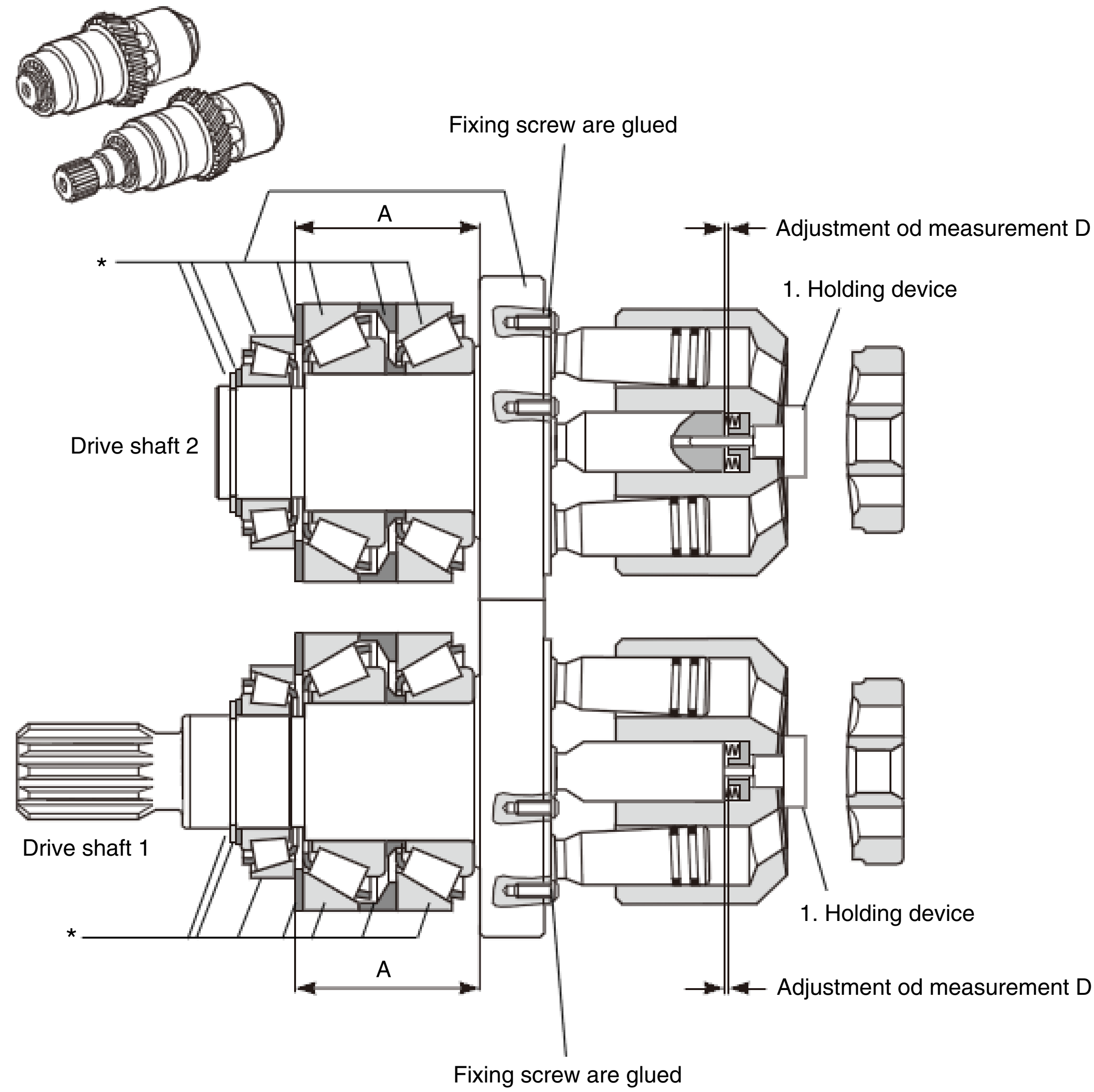
Pos.2 Remove

Pos.3 Remove



(5) Press out hydraulically or mechanically rotary group with a tool device.





※ Pos. * Drive shafts with bearing set are the smallest assembly group.

(1) The assembly group is adjusted to measurement (A)
The tapered roller bearings are adjusted to the specified through-torque.

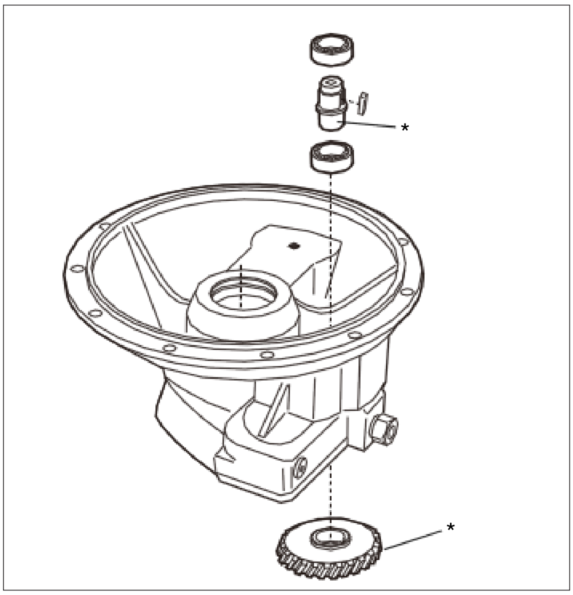
※ Fixing screw - Retaining device

(2) Loosen of the screws is only possible if the drive shaft is warmed up at a temperature of approx. 120℃,1/2 hour in an oil bath or heat air furnace.
Screw out the screw quickly.

12) REMOVE THE INTERMEDIATE WHEEL

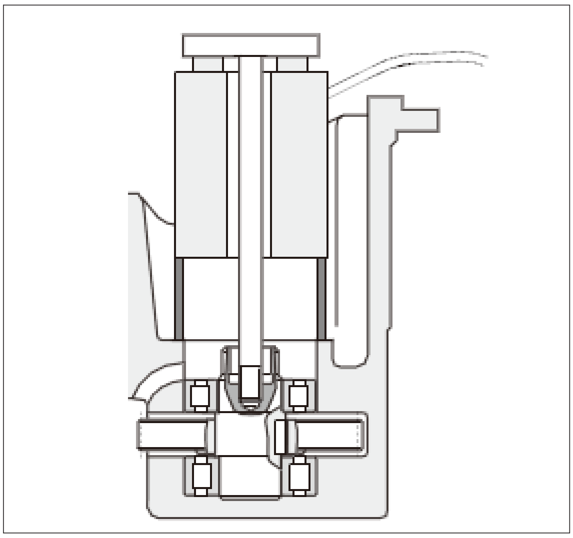
※ Press in bolt into the gear wheel.
(Fixed pressing fit).

(1) Can only be disassembled with a hydraulic press.

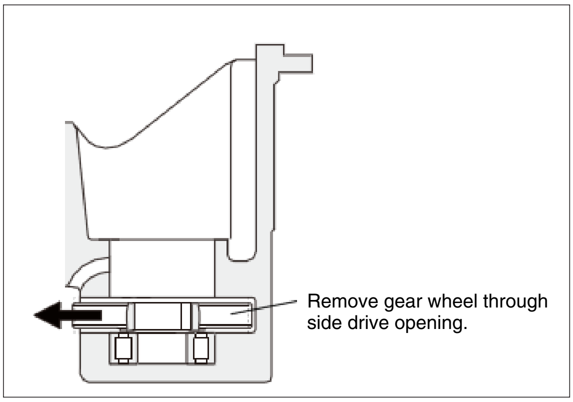


(2) Install sleeve.

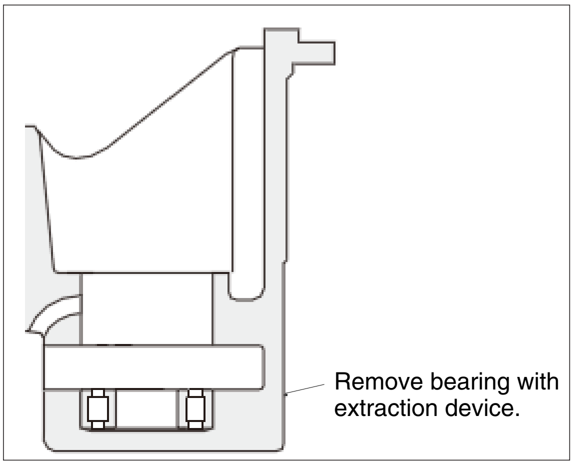
⚠ Press out bolt with a hydraulic manual press.



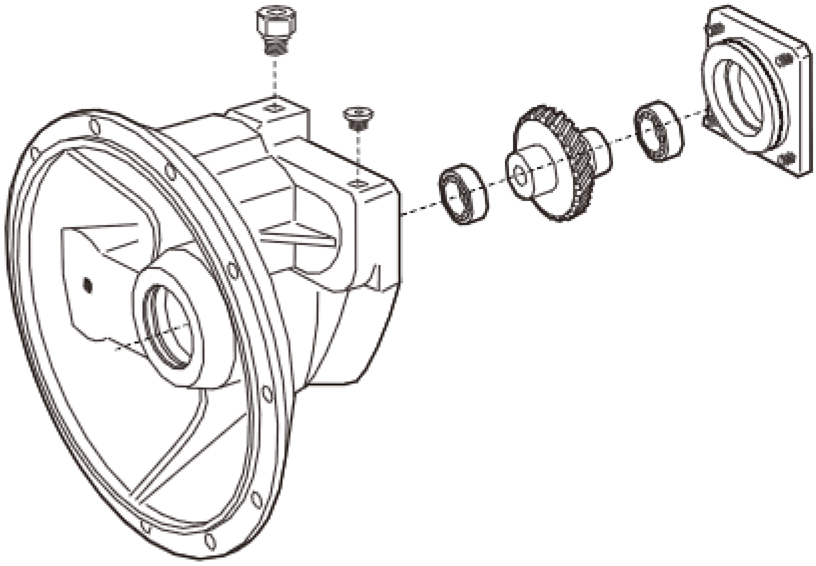
(3) Remove gear wheel through side drive opening.



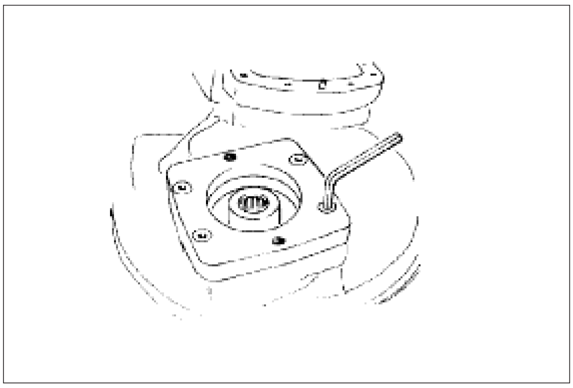
(4) Remove bearing with extraction device.



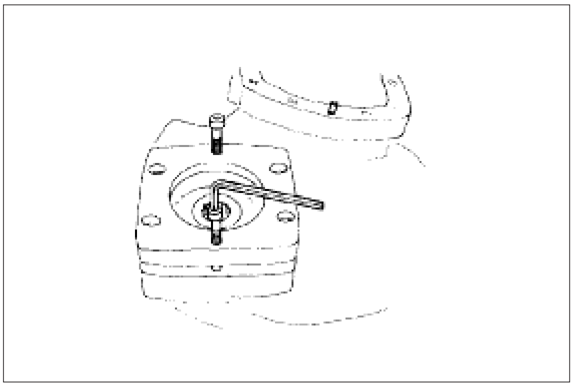
14) REMOVE AUXILIARY DRIVE



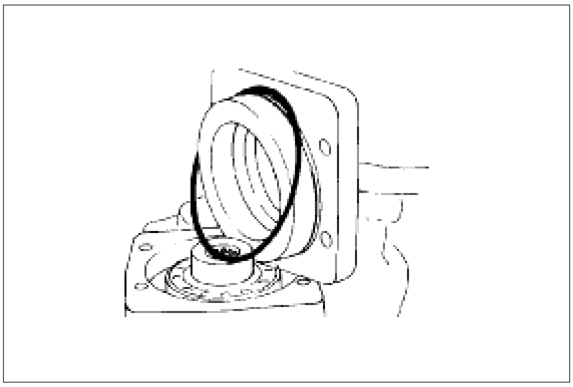
(1) Remove fixing screws - auxiliary drive.



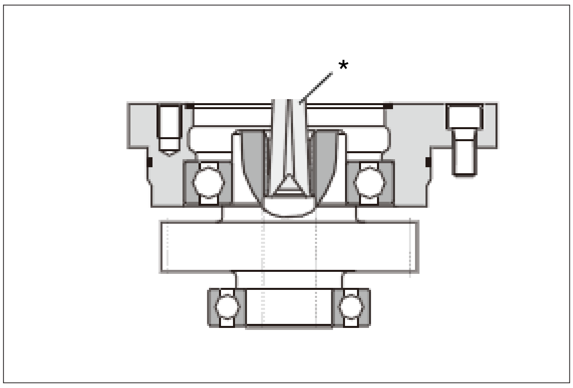
(2) Press off bearing cap.

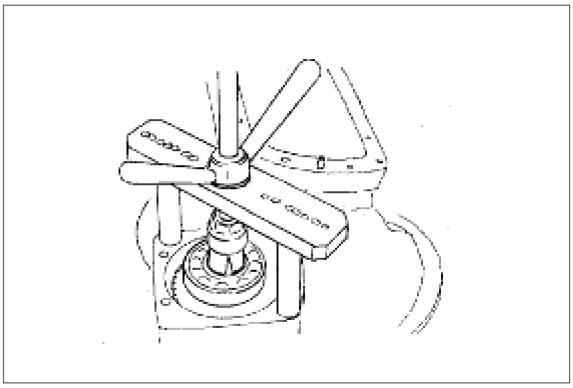


(3) In the event of leakage, visual check of O-ring, housing and groove.

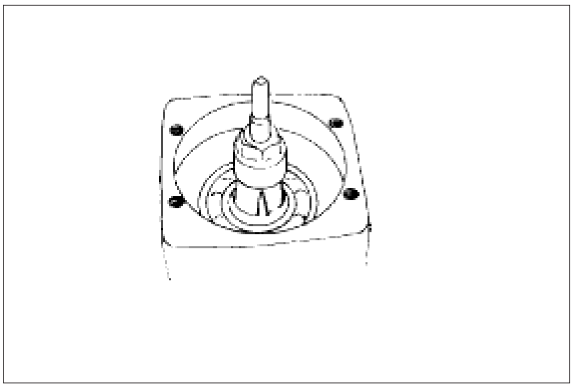


(4) Fit extractor device (*).
Pull out output pinion.

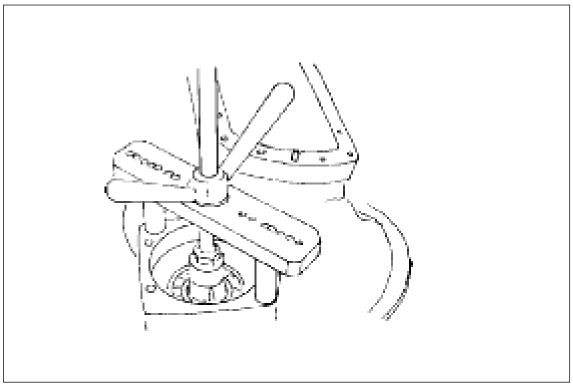




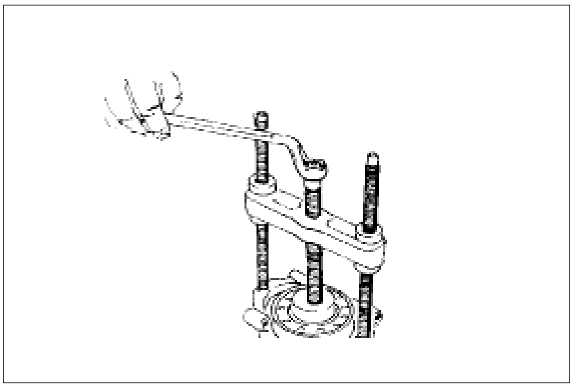
(5) Fit bearing extractor device.



(6) Completely mount device and pull out bearing.

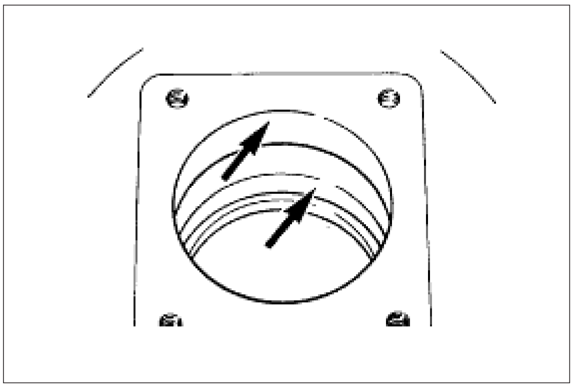


(7) Pull out pinion bearing.

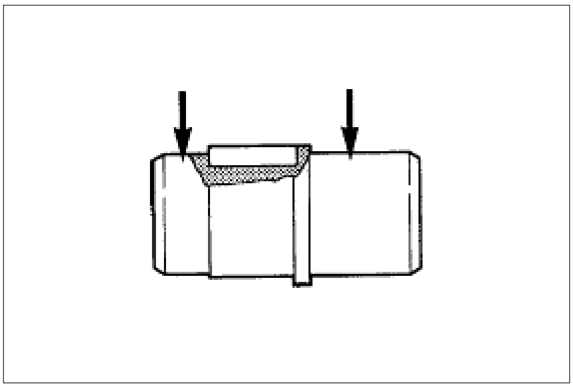


15) INSPECTION HINTS

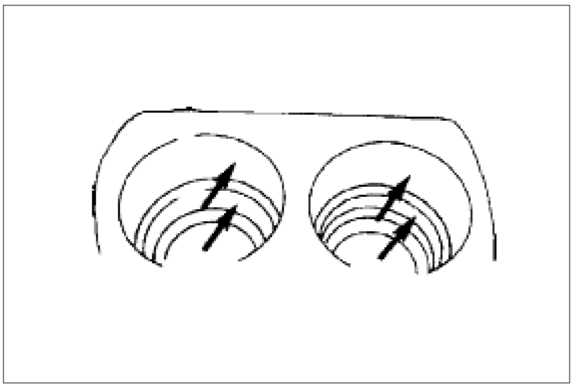
(1) Check to see that the bearing area is free of scores and that there is no evidence of wear.



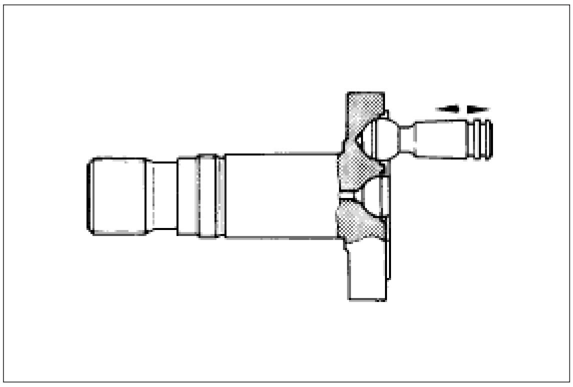
(2) Visual check
To ensure that the bearing seats are free of scores.



(3) Visual check
Check to see that the bearing area is free of scores and that there is no evidence of wear.



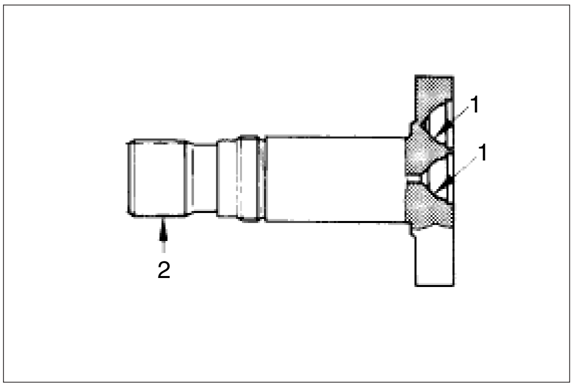
(4) Axial piston play
Checked with the retaining plate fitted.



(5) Drive shafts

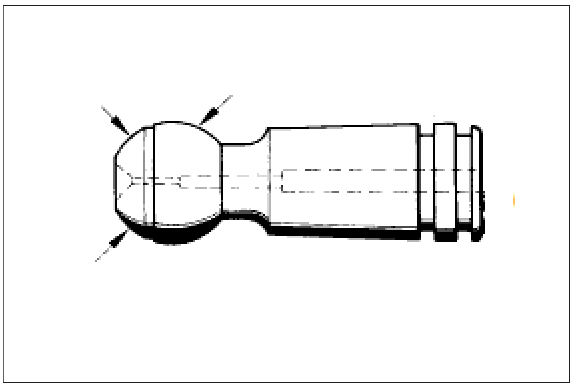
1 Check to ensure that the cups are free of scores and that there are no pittings.

2 Check to see that there is no evidence of corrosion and wear steps.



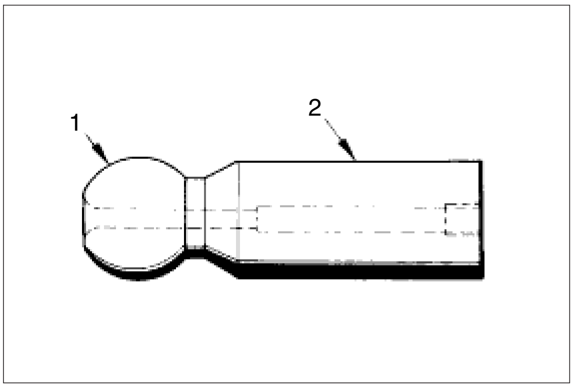
(6) Piston

Check to ensure that they are free of scores and that there are no pittings.



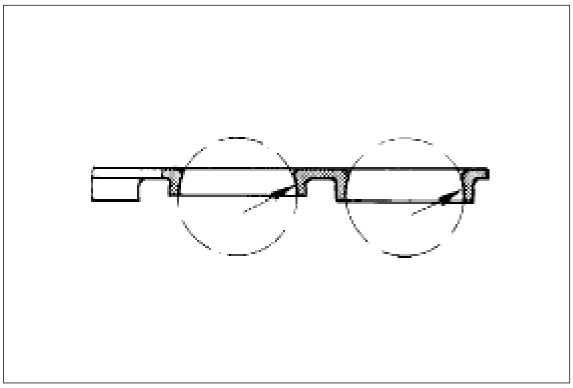
(7) Central pin

Check to ensure that it is free of scores and that there are no pittings.

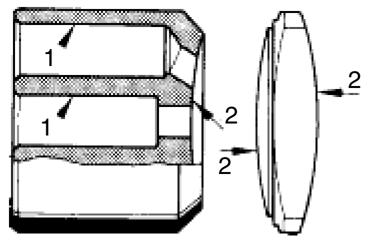


(8) Retaining plate

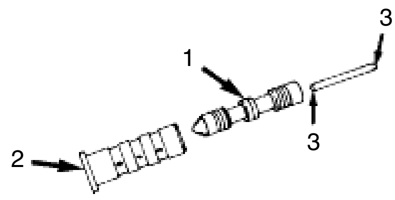
Check to ensure that it is free of scores and that there is no evidence of wear.



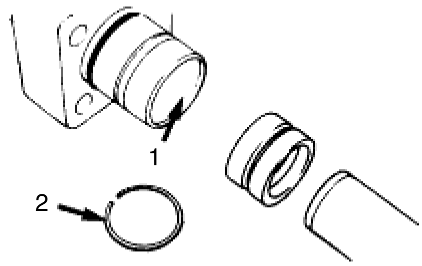
(9) Cylinder block / control lens
Check to ensure that :
- The bores (1) are free of scores, no evidence of wear.
- The faces (2) are even, that there are no cracks, no scores.
- The side guides (3) show no evidence of wear, fre of scores.



(10) Check
1 Control land
2 Internal control drilling
3 Pin cups



(11) Check
That sliding surfaces (1) are free of scores, seal (2).



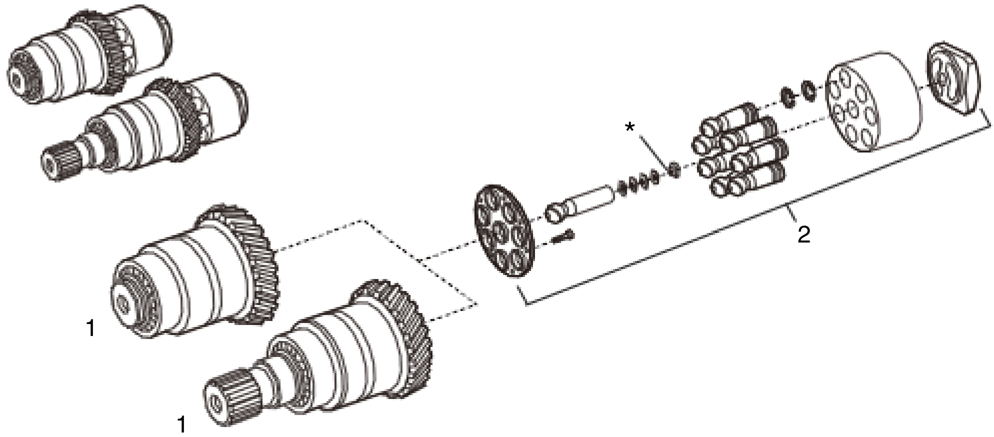
(12) Complete rotary group

※ Adjustment of the hydraulic component is necessary

① Rotary group

1 Mechanical component: drive shaft is adjusted with the bearing

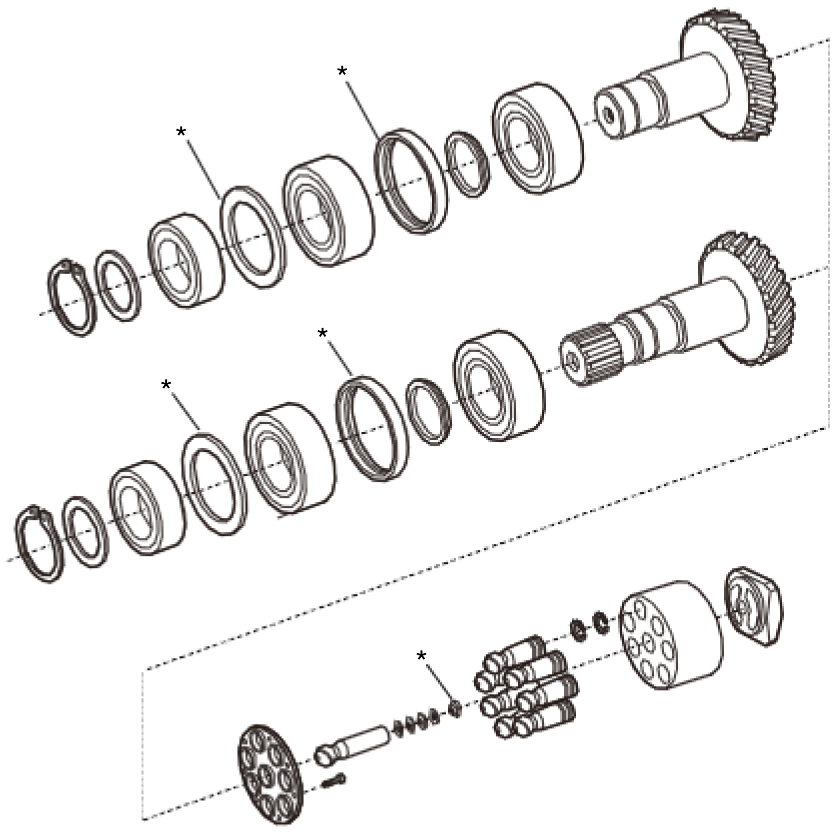
2 Hydraulic component: Adjustment (*) is necessary.



② Rotary group : All of the components

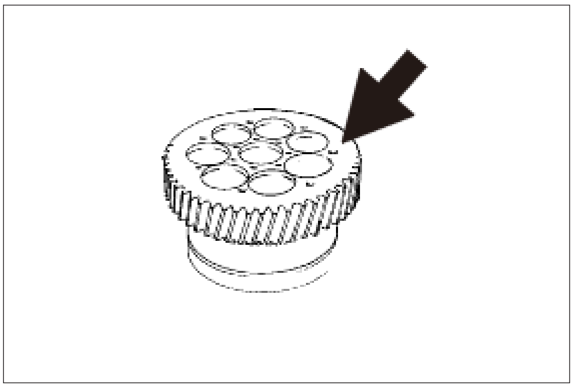
Adjustment (*)

For adjustment values, torque values, see service information

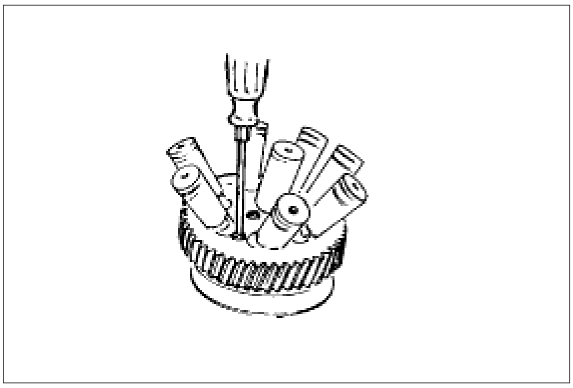


16) RE-FITTING THE ROTARY GROUP

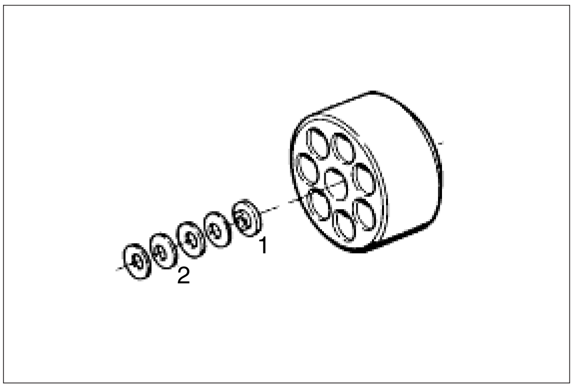
(1) The threads must be free of oil, grease, dust or any other contaminants which may impair the locking of the screws.



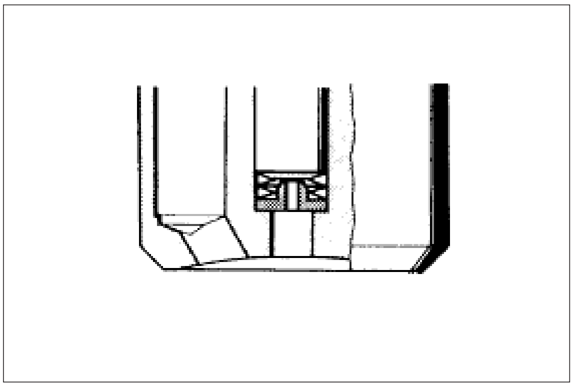
(2) Fit the retaining plate with pistons and centre pin into place.
Use screws that have a Precote coating.
※ For tightening torques, see service information.



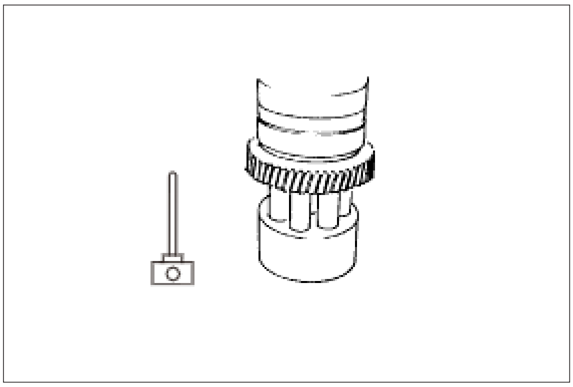
(3) Fit the spring plate (1) and cup springs (2) into their correct position (and orientation) using grease to hold them into place.



(4) Ensure that all of te parts are assembled in correct order and orientation.

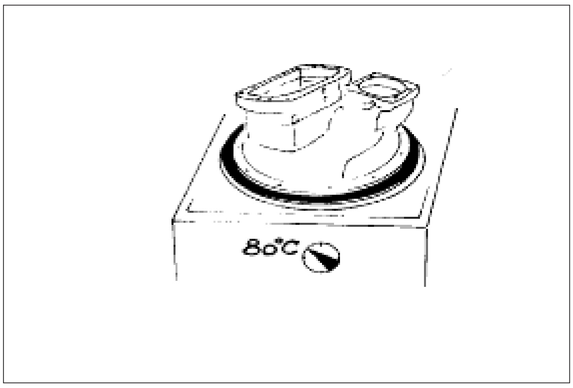


(5) Insert pistons into the cylinder. Using a soft surface as a support to prevent the sliding surfaces from being damaged. Pre-assemble both of the rotary groups in this manner.

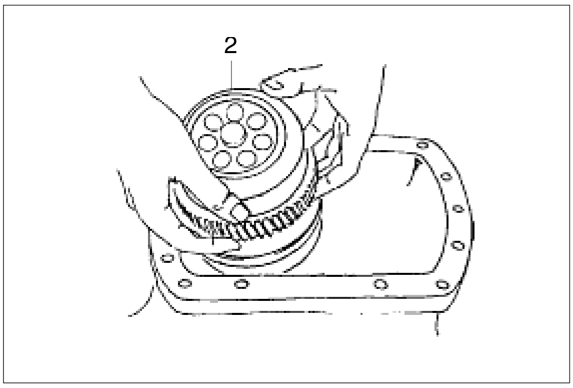


17) PUMP ASSEMBLY

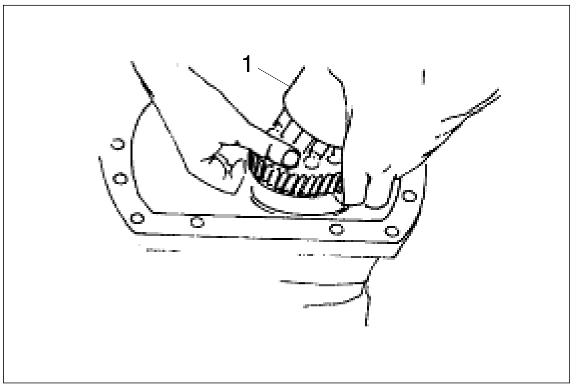
(1) Warm up the housing to approx. 80℃.



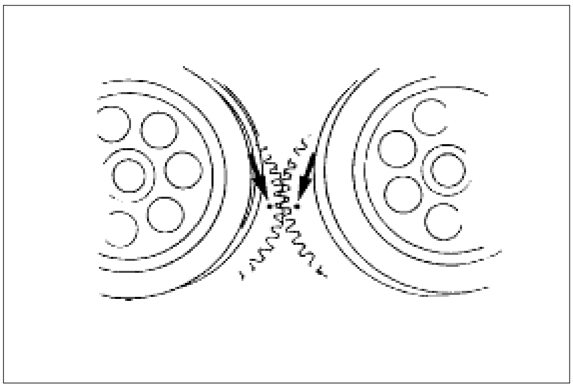
(2) Insert the pre-assembled rotary group (2) taking into account gear tooth markers.



(3) Insert rotary group (1). Align the marked gear teeth.

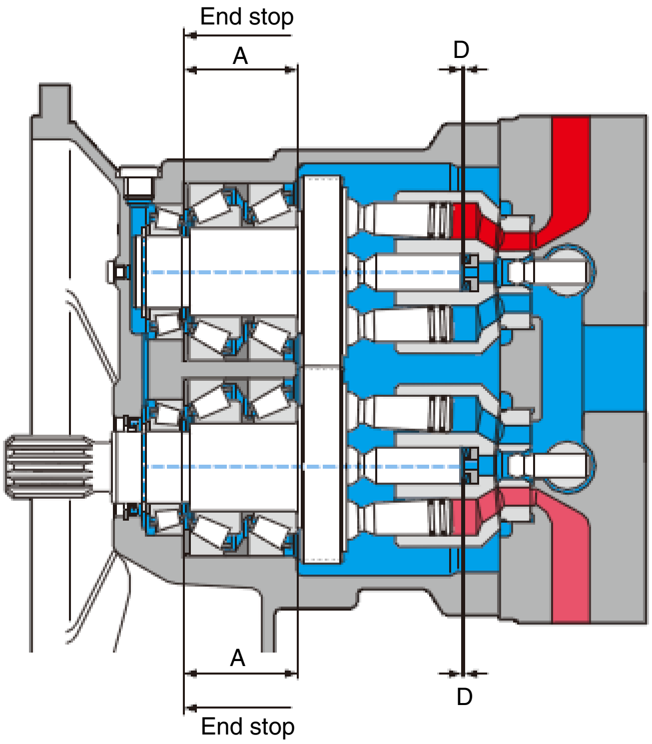


(4) The gear tooth markers must coincide.



(5) Adjustment of measurement D

Control hydraulic part.



※ Drive shafts with bearing set

The assembly group is adjusted to dimension (A). The tapered roller bearings are adjusted to the stipulated breakaway torque.

① Assembly guideline

Retaining force

After the rotary group has been fitted into the housing, it has to be pressed in until the end stop is reached.

Allow the housing to cool down from its assembly temperature (approx.80℃) to room temperature.

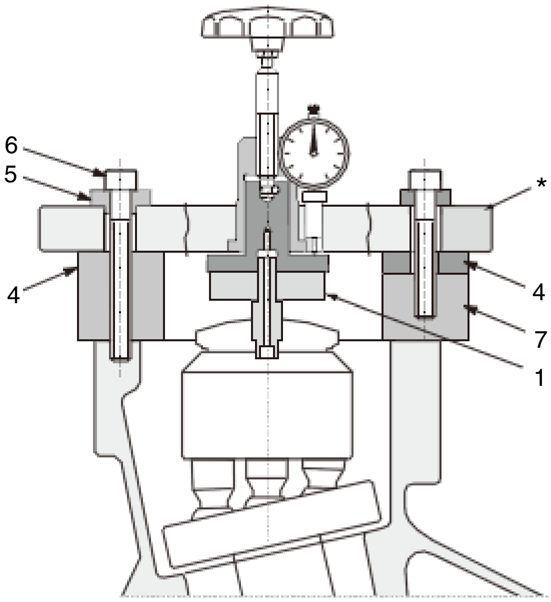
② Adjustment of the hydraulic component of the rotary group

The adjustment of dimension (D) is carried out using spring plates of differing thickness, so that the correct clearance is achieved between the rotary group which is fitted in the housing and the centre pin and spring plates.

Dimension (D) = 0.4 ± 0.1 mm

③ After assembly of the complete unit the breakaway torque of the rotary group has to be checked with the torque wrench.

④ Measuring device

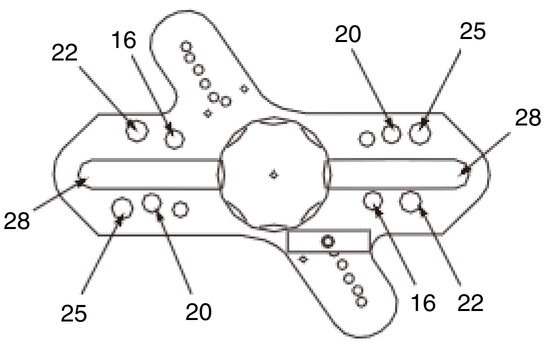


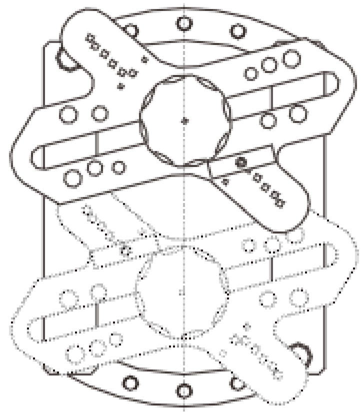
*	Measuring device
1	Centering device
4	Intermediate ring
5	Shim
6	Socket screw
7	Intermediate plate

⑤ Mounting position

Ensure that the correct mounting position is used.

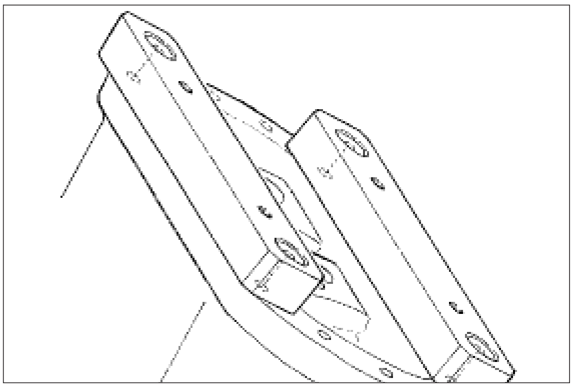
The numbers on the top of the measuring device (*) refer to the piston diameter.



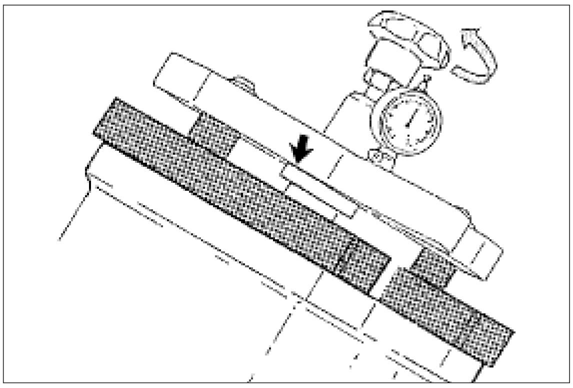


Mounting position (28)

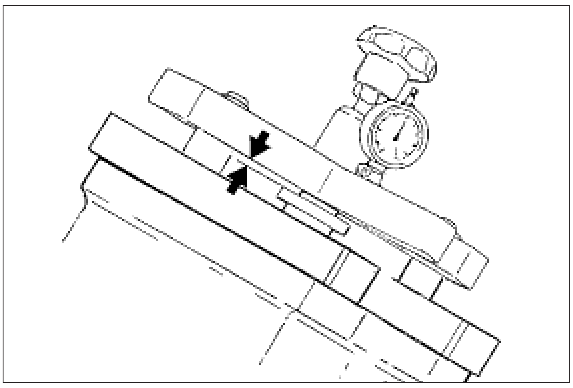
⑥ Fit the intermediate plates onto the housing.



⑦ Zero adjustment - measuring device
Turn using the hand wheel until the stop is reached.
- Set dial gauge to zero

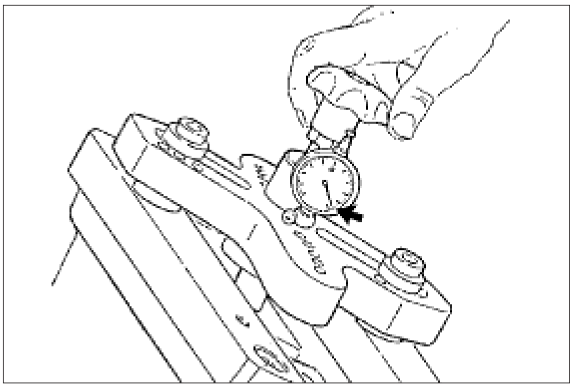


⑧ Measuring procedure
Turn down by 4 turns on the dial gauge.
Check:
2 mm clearance, set dial gauge to "Zero".
Clearance : 0.4 ± 0.1 ㎜

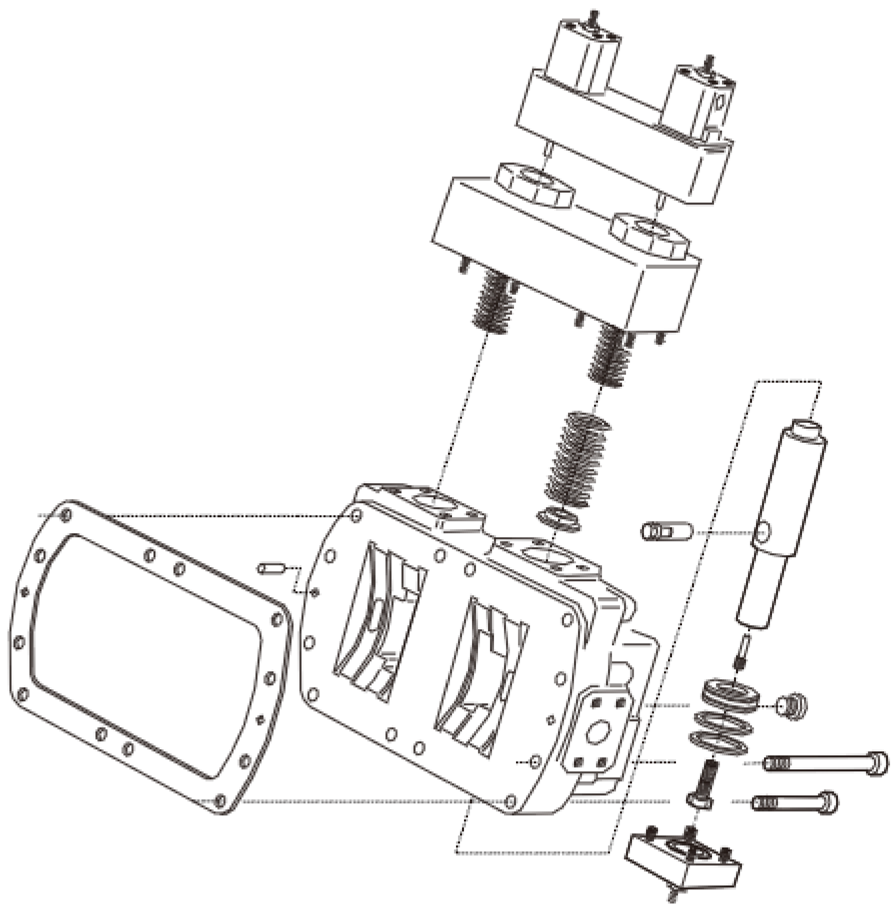


⑨ Measuring procedure
Turn down, using the hand wheel, until resistance is met.
Read the measured value.

※ Don't use excessive force.



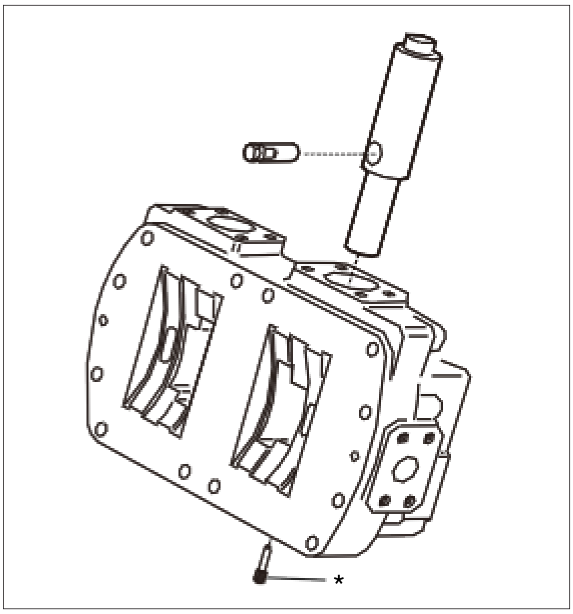
18) FIT CONTROL HOUSING



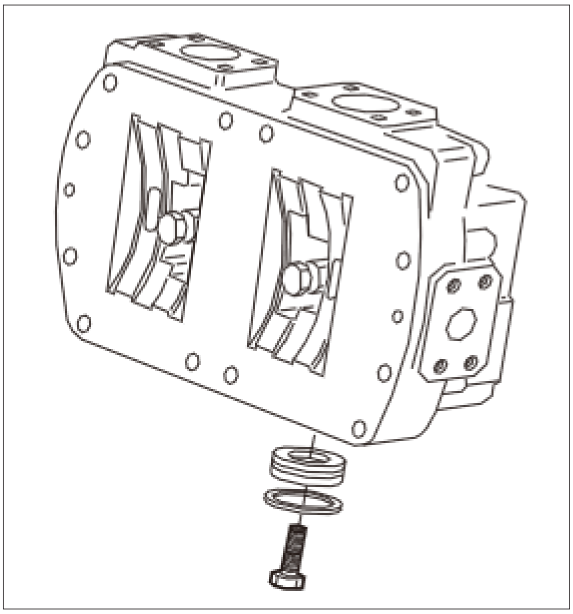
(1) Fit the swivel pin into correct position and orientation.

(2) Take the hardening time and tightening torque into account.

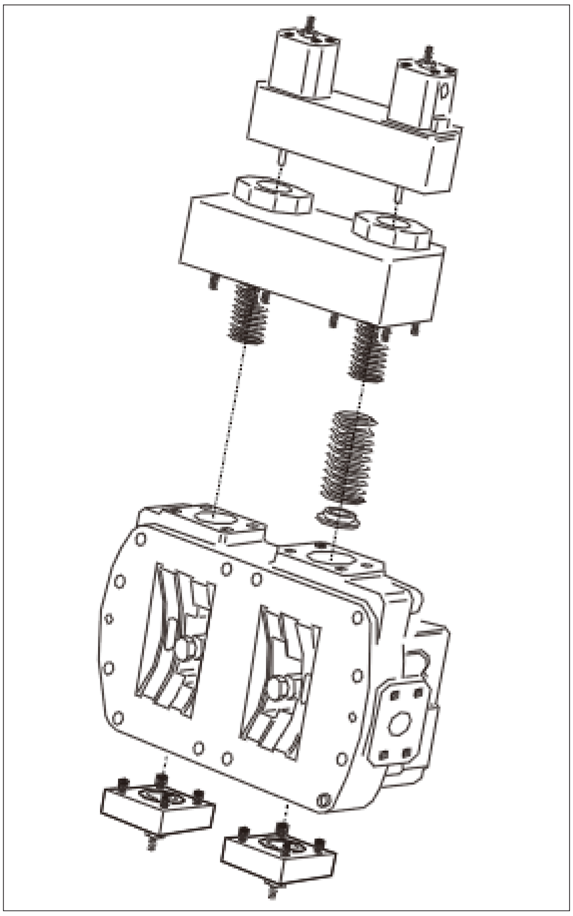
M6 : 0.9 kgf · m (6.3 lbf · ft)
M8 : 1.4 kgf · m (10.3 lbf · ft)
M10 : 3.6 kgf · m (25.8 lbf · ft)
M12 : 7.0 kgf · m (50.9 lbf · ft)



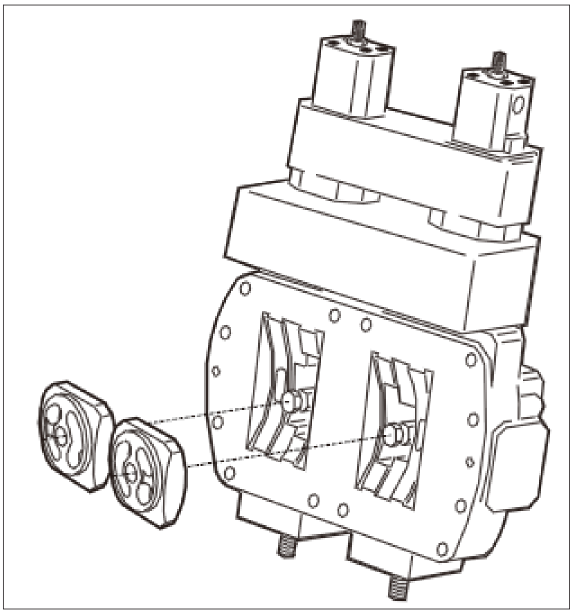
(3) Push on the piston ring by hand.
(4) Fix adjustment piston.
(5) Take the tightening torques into account.

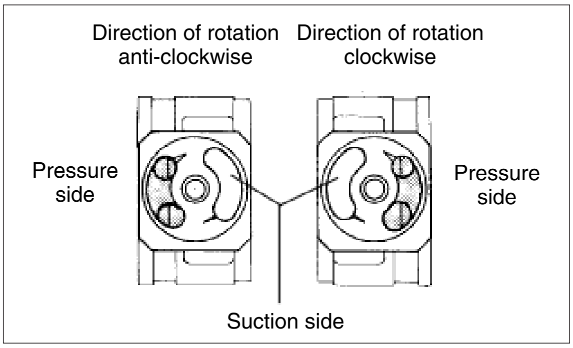


(6) Fit control housing.

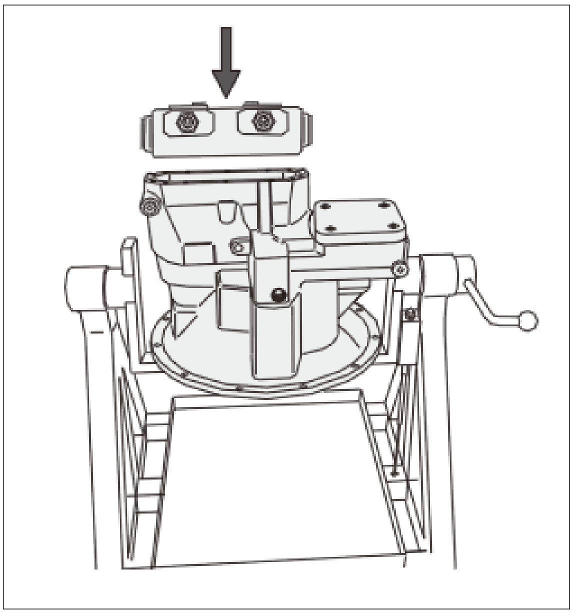


(7) Fit the control lens in its correct position using grease to hold it in place.

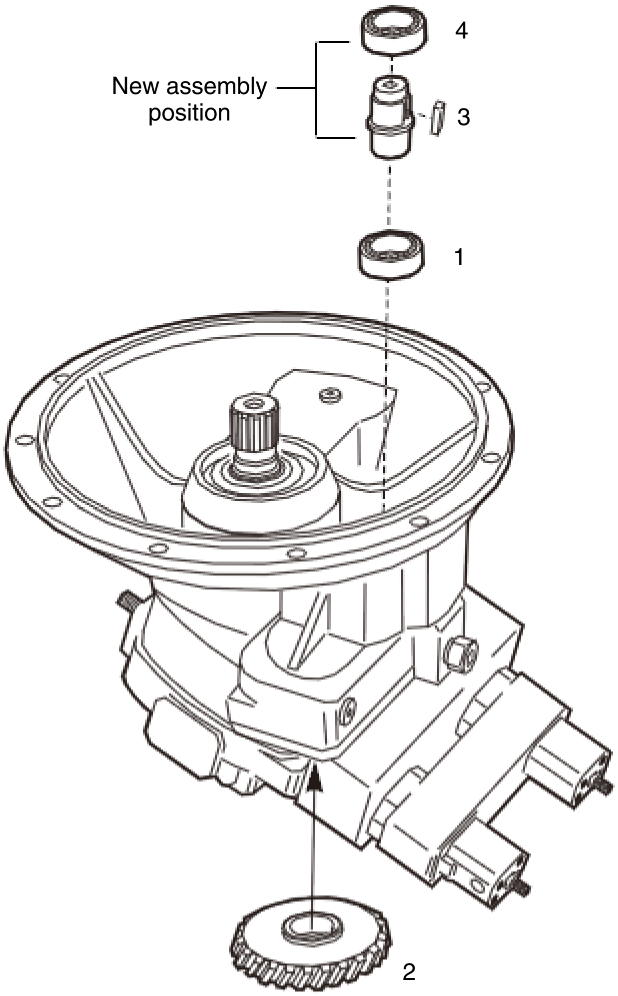




(8) Fit seal and controller.

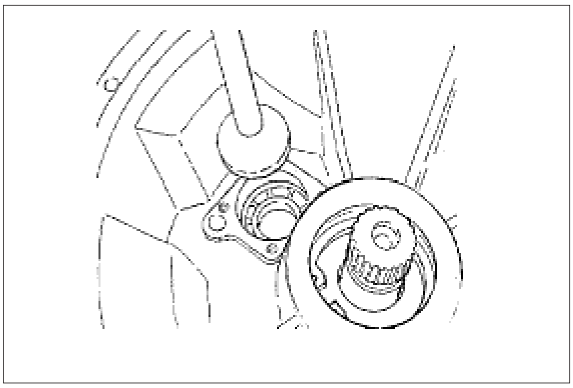


19) ASSEMBLY OF THE INTERMEDIATE WHEEL

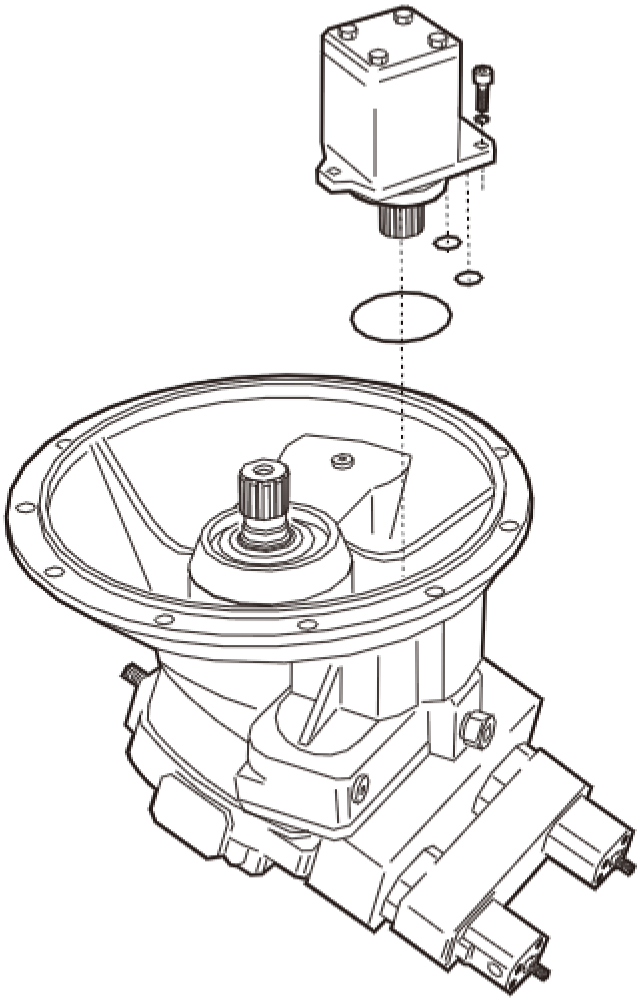


(1) Press in bearing into housing.
(2) Install and align the intermediate wheel through side drive opening.
(3) Cool down the bolt with nitrogen and place it.
(4) Press in bearing.

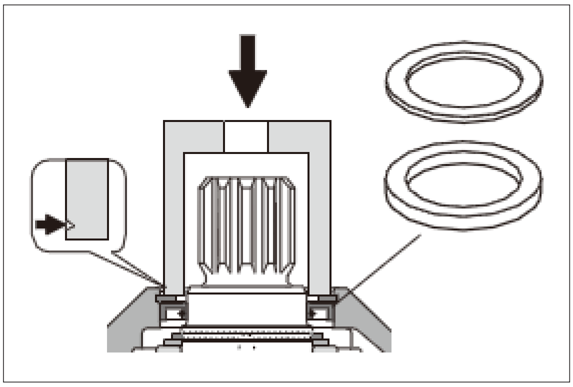
(5) Press in the bearing into the housing.



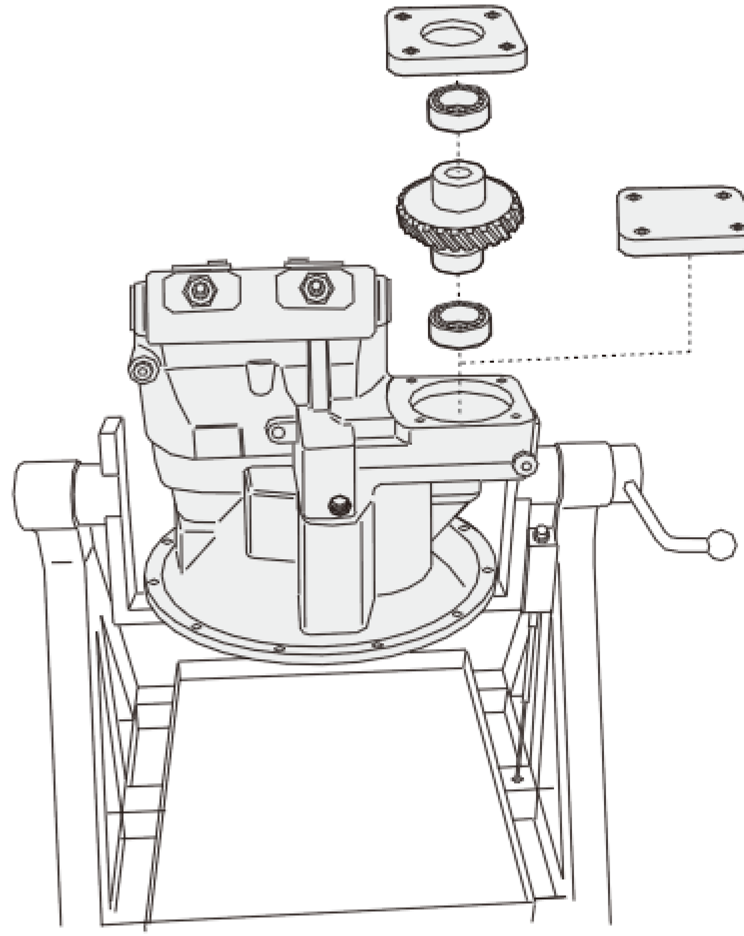
20) FIT THE GEAR PUMP



(1) Assemble shaft seal, disc and safety ring.
(2) Press-in with assemble sleeve.
※ Take care of press-in depth.



21) FIT THE COVER AND AUXILARY DRIVE



GROUP 4 MAIN CONTROL VALVE

1. REMOVAL AND INSTALL

1) REMOVAL

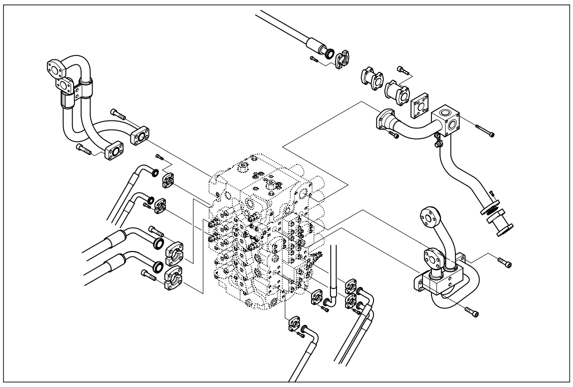
(1) Lower the work equipment to the ground and stop the engine.

(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.

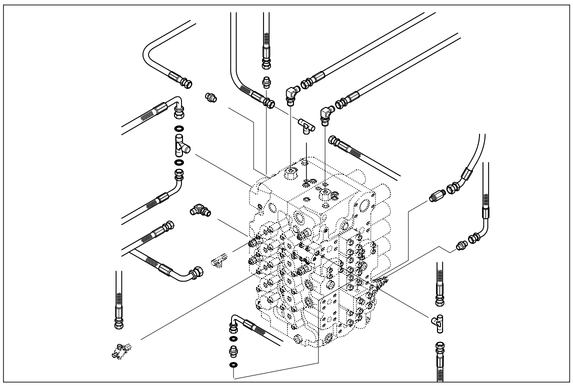


(4) Remove the wirings for the pressure sensor and so on.

(5) Remove bolts and disconnect pipe.

(6) Disconnect pilot line hoses.

(7) Disconnect pilot piping.



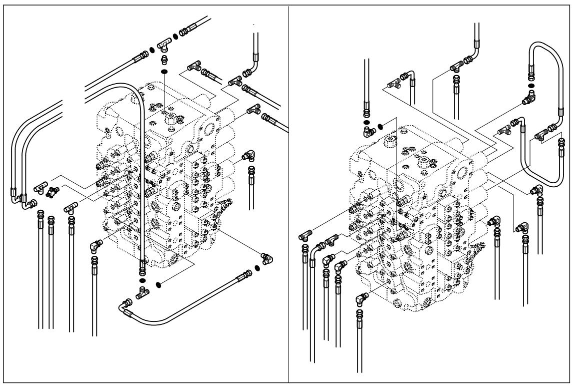
(8) Sling the control valve assembly and remove the control valve mounting bolt.

· Weight : 421 ㎏ (928 ㏊)

· Tightening torque : 57.9 ± 8.7 kgf·m (419 ± 62.9 lbf·ft)

(9) Remove the control valve assembly. When removing the control valve assembly, check that all the piping have been disconnected.

2) INSTALL



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

(2) Bleed the air from below items.

① Cylinder (boom, arm, bucket)

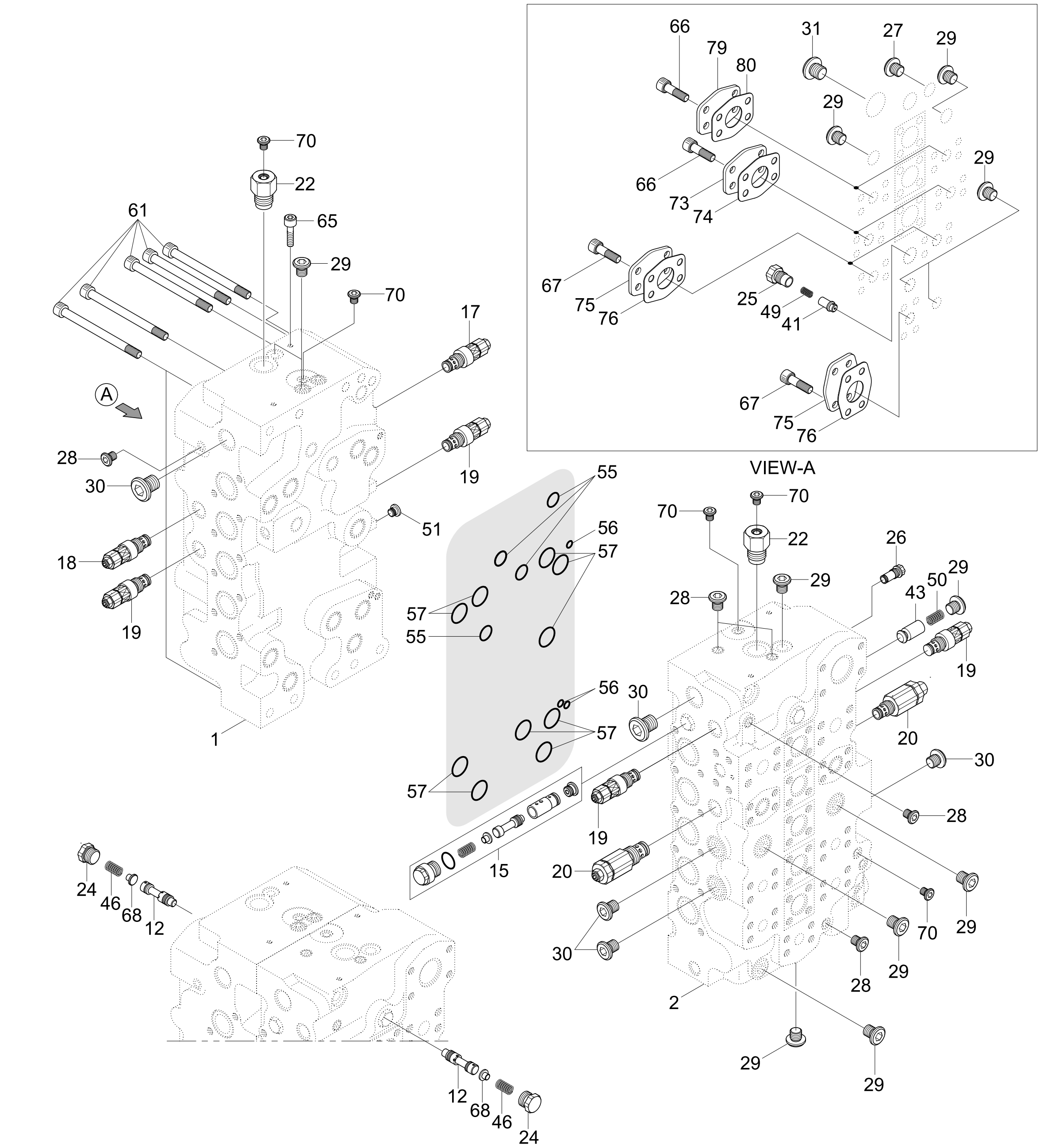
② Swing motor

③ Travel motor

※ See each item removal and install.

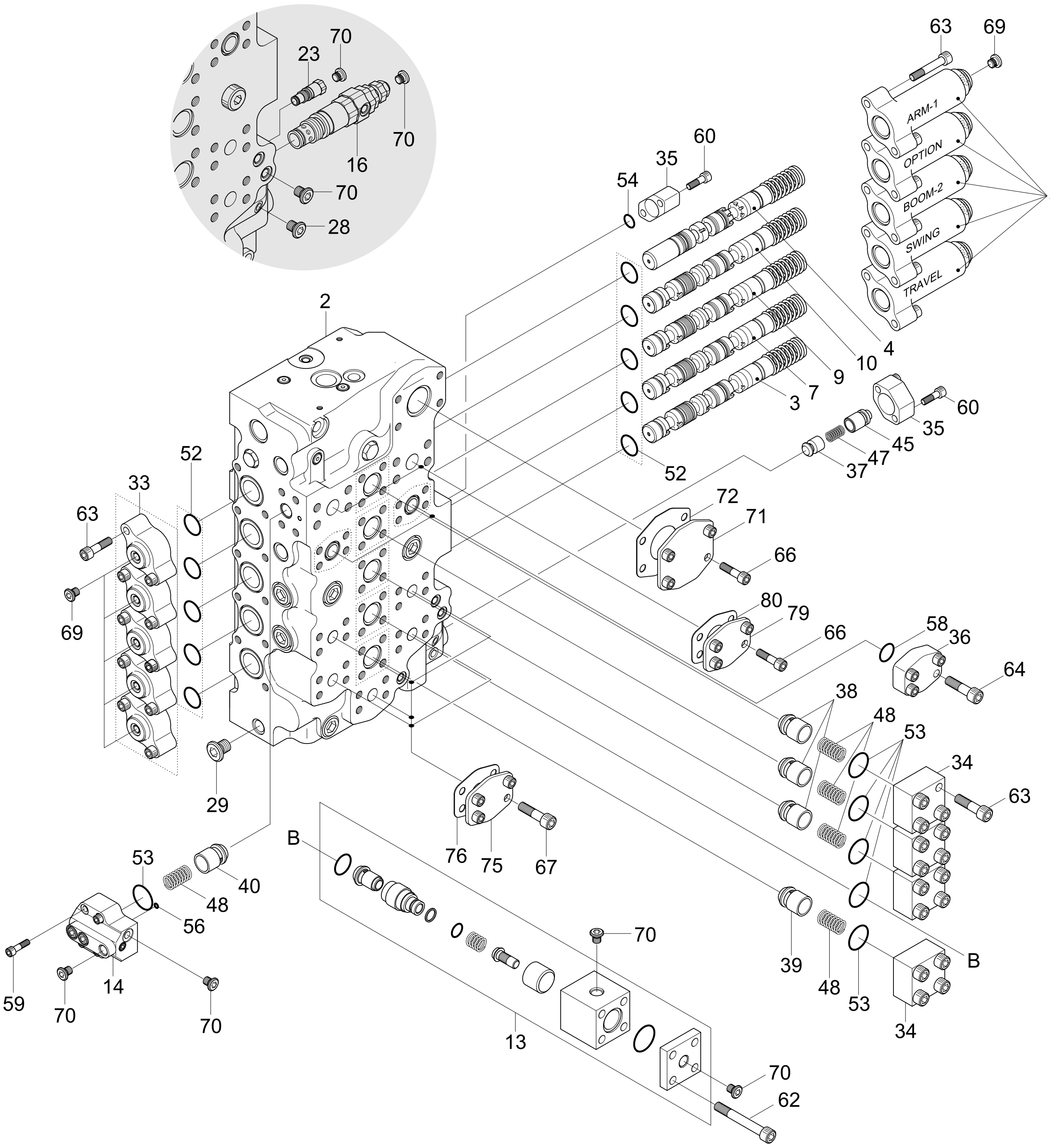
(3) Confirm the hydraulic oil level and recheck the hydraulic oil leak or not.

2. STRUCTURE (1/3)



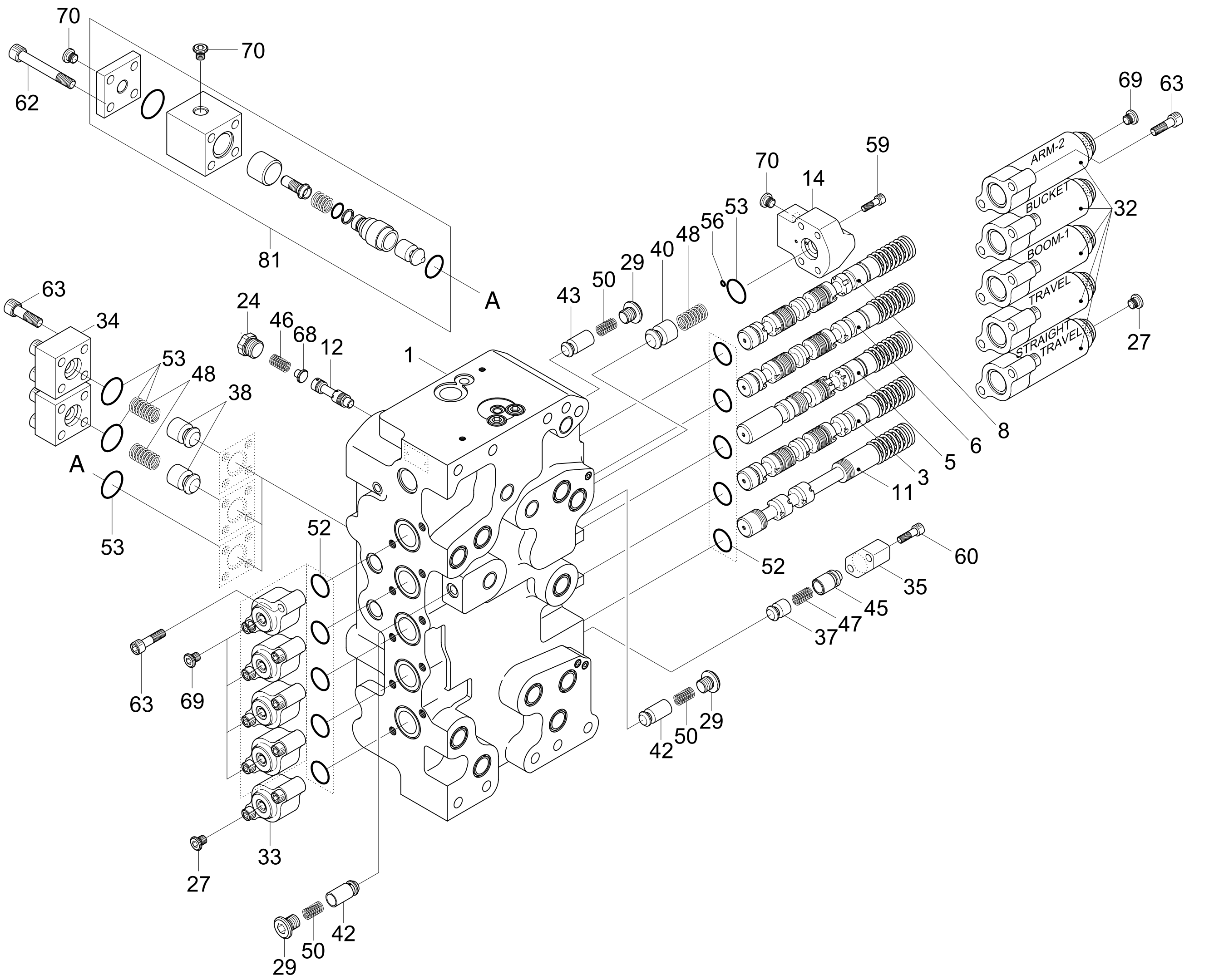
12	Spool assy	29	Plug	65	Socket bolt
15	Arm regen cut spool kit	30	Plug	66	Socket bolt
17	Port relief valve	31	Plug	67	Socket bolt
18	Port relief valve	41	Poppet	68	Socket bolt
19	Port relief valve	43	Poppet	70	Dust cap
20	Port relief valve	46	Spring	73	Cover
21	Port relief valve	49	Spring	74	Gasket
22	Relief valve	50	Spring	75	Cover
24	Plug assy	51	Plug	76	Gasket
25	Plug	55	O-ring	79	Cover
26	Plug	56	O-ring	80	Gasket
27	Plug	57	O-ring		
28	Plug	61	Socket bolt		

STRUCTURE (2/3)



2	Housing	35	Flange	60	Socket bolt
3	Travel spool kit	36	Flange	62	Socket bolt
4	Arm 1 spool kit	37	Poppet	63	Socket bolt
7	Swing spool kit	38	Poppet	64	Socket bolt
9	Boom 2 spool kit	39	Poppet	66	Socket bolt
10	Option spool kit	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	75	Cover
29	Plug	54	O-ring	76	Gasket
32	Pilot cap-large	56	O-ring	79	Cover
33	Pilot cap-small	58	O-ring	80	Gasket
34	Flange	59	Socket bolt		

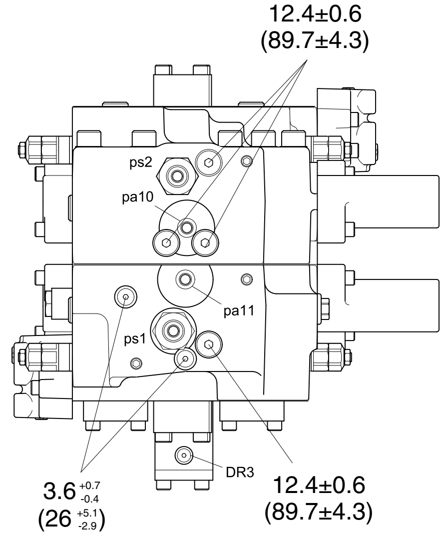
STRUCTURE (3/3)

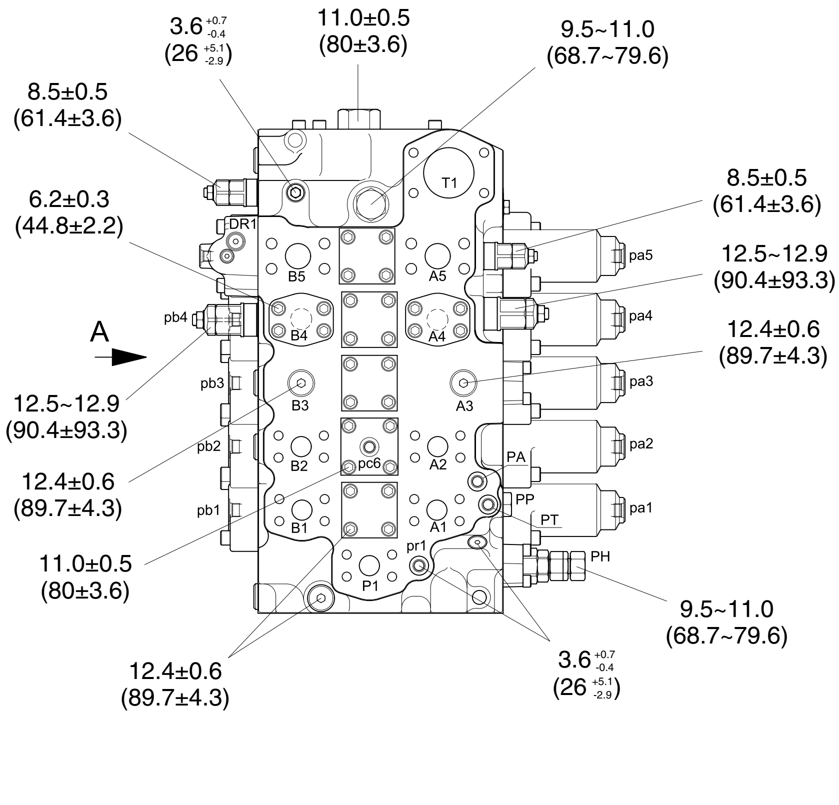


1	Housing	33	Pilot cap-small	50	Spring
3	Travel spool kit	34	Flange	52	O-ring
5	Boom 1 spool kit	35	Flange	53	O-ring
6	Bucket spool kit	37	Poppet	56	O-ring
8	Arm 2 spool kit	38	Poppet	59	Socket bolt
11	Straight travel spool kit	40	Poppet	60	Socket bolt
12	Bypass cut spool kit	42	Poppet	62	Socket bolt
14	Holding valve	43	Poppet	63	Socket bolt
24	Bypass plug	45	Spacer	68	Spring seat
27	Plug	46	Spring	69	Dust cap
29	Plug	47	Spring	70	Dust cap
32	Pilot cap-large	48	Spring	81	Boom 1 logic valve

3. TIGHTENING TORQUE (1/2)

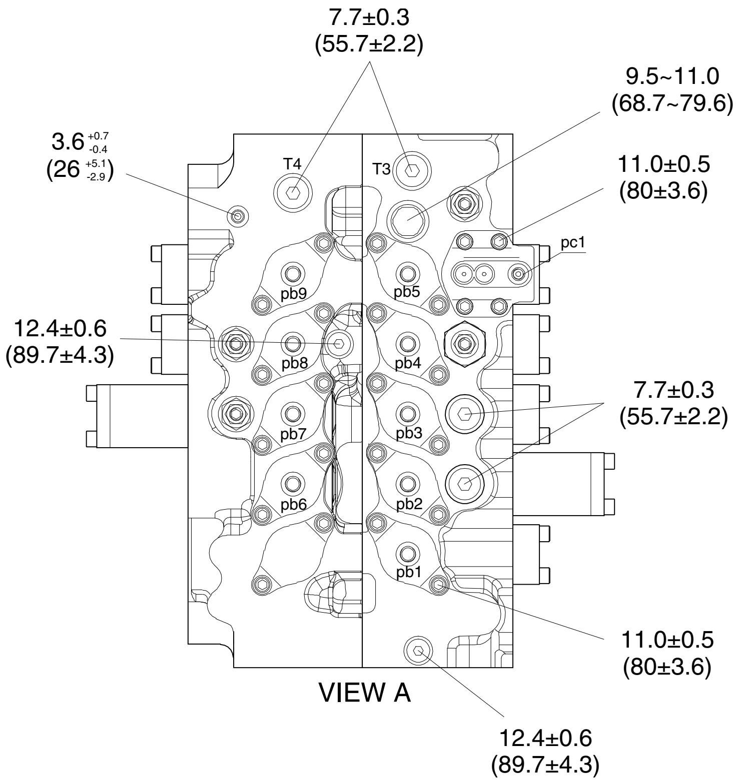
※ Unit : kgf · m (lbf · ft)

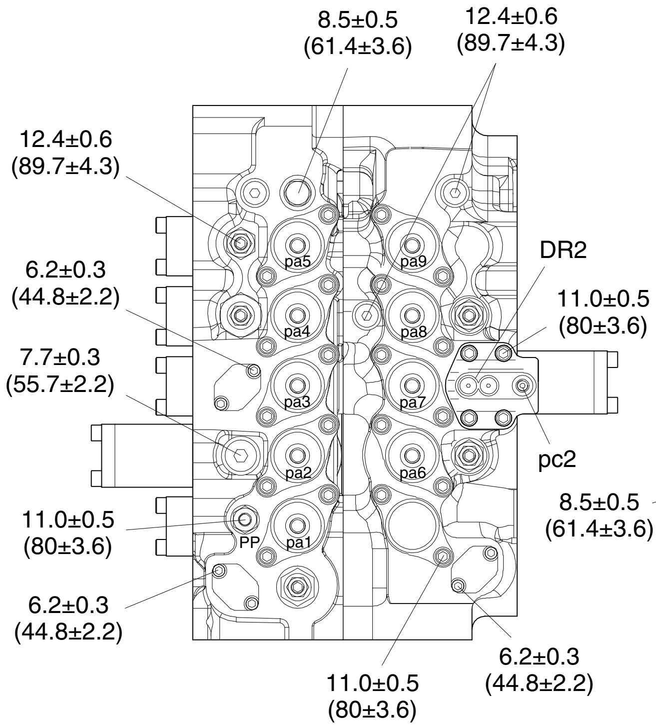


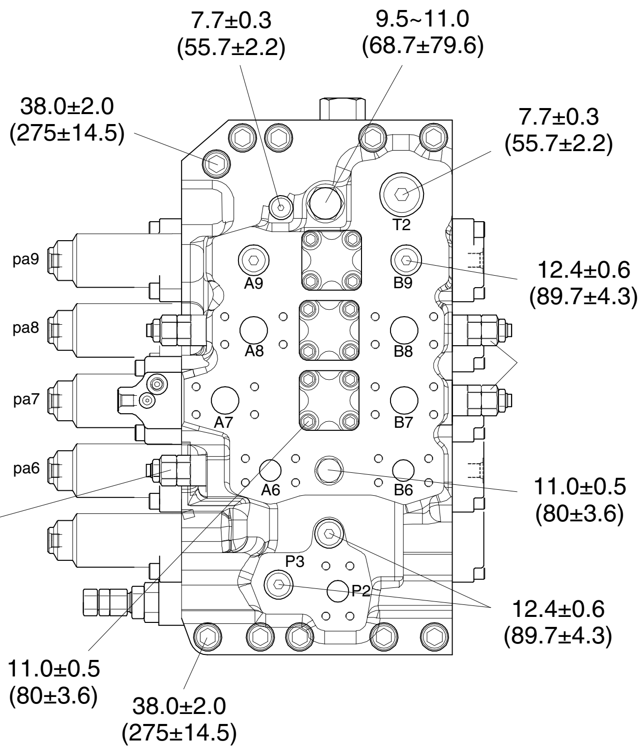


TIGHTENING TORQUE (2/2)

※ 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

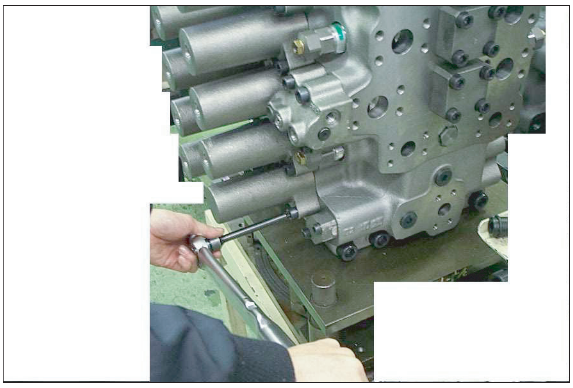
The figure in ( ) shown after the part name in explanation sentence shows its number in the construction figures.

(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.

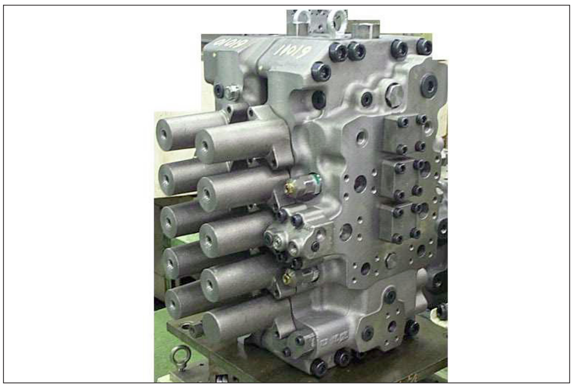
(2) Main spool

① Loosen socket head bolts (63) and remove the pilot cap (32).
Pull out O-ring (52) from valve housing.



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.



③ Spools sub assy (3, 4, 5, 6, 7, 8, 9, 10, 11).

④ Spool sub assy (5).

⑤ Spool sub assy (4).

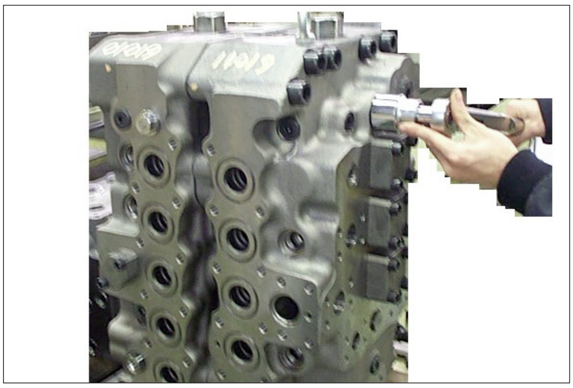
※ When disassemble the spool assembly, fix the spool with vise. On this occasion attach wood between vise blades to prevent the spool from damaging.

※ Heat the outer race of spool with industrial drier and then loosen easily. (Temperature : 200~250˚C)

⑥ Loosen the socket head bolt (63) and remove the small pilot cap (33). Pull out O-ring (14) from valve housing.

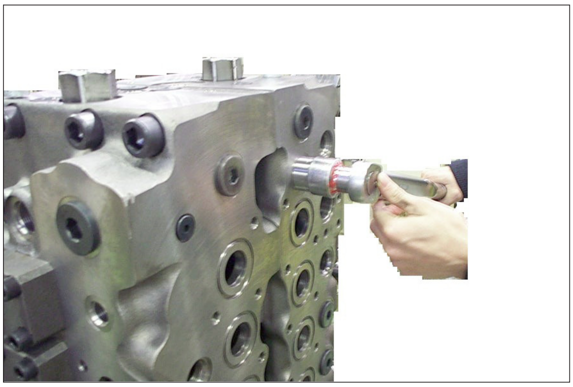
(3) Center bypass cut spool assy (12)

① Loosen the plug (24) and remove spring (46), spring seat (68) and the spool (12).

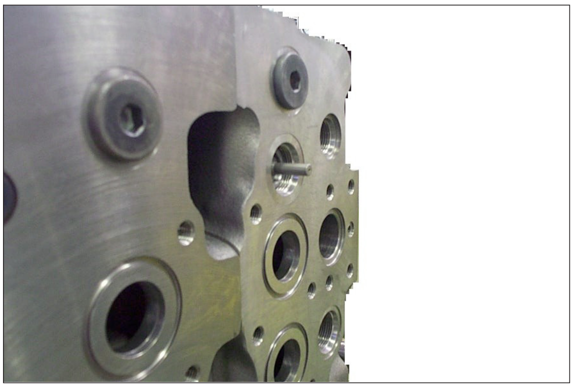


(4) Arm1 regeneration spool assy (15)

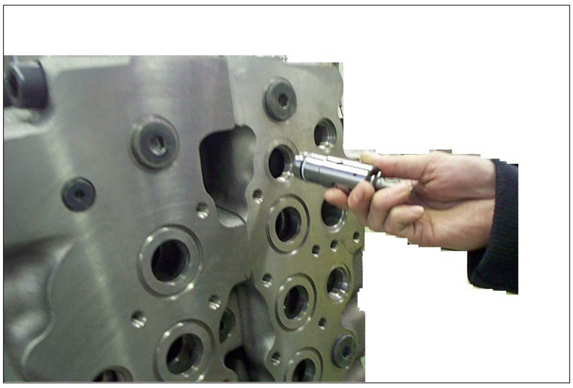
① Loosen the plug and pull out O-ring.



② Disassemble spring, spring seat and spool.



③ Pull out sleeve of hole inside at same time, disassemble sleeve and piston.



(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

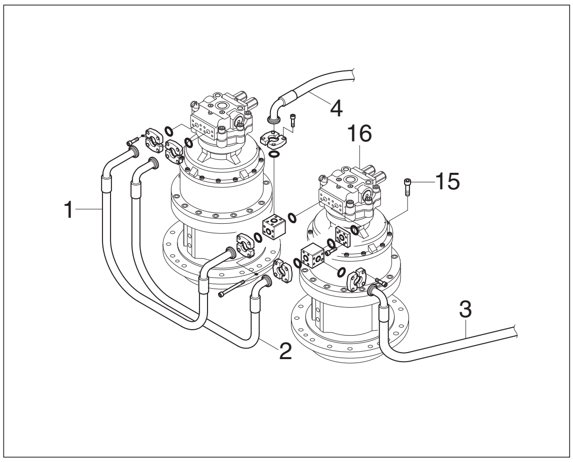
(1) Lower the work equipment to the ground and stop the engine.

(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.



(4) Disconnect hose assembly (1, 2, 3, 4).

(5) Disconnect pilot line hoses (5, 6, 7, 8, 9, 10, 11, 12, 13, 14).

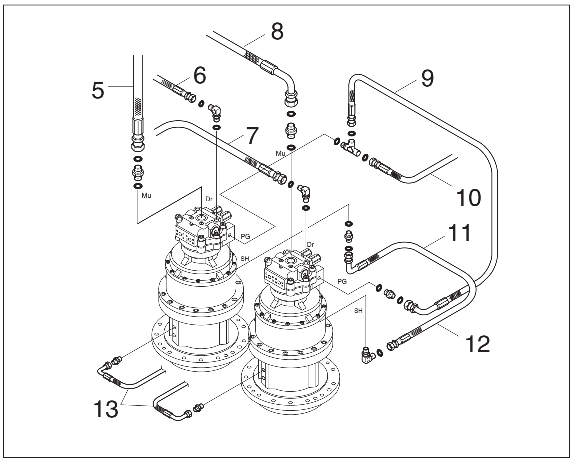
(6) Sling the swing motor assembly (16) and remove the swing motor mounting socket bolts (15).

· Motor device weight : 61 ㎏ (135 ㏐)

· Tightening torque : 8.27 ± 1.7 kgf · m (59.8 ± 12.3lbf · ft)

(7) Remove the swing motor assembly.

※ When removing the swing motor assembly, check that all the piping have been disconnected.



2) INSTALL

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

(2) Bleed the air from the swing motor.

① Remove the air vent plug.

② Pour in hydraulic oil until it overflows from the port.

③ Tighten plug lightly.

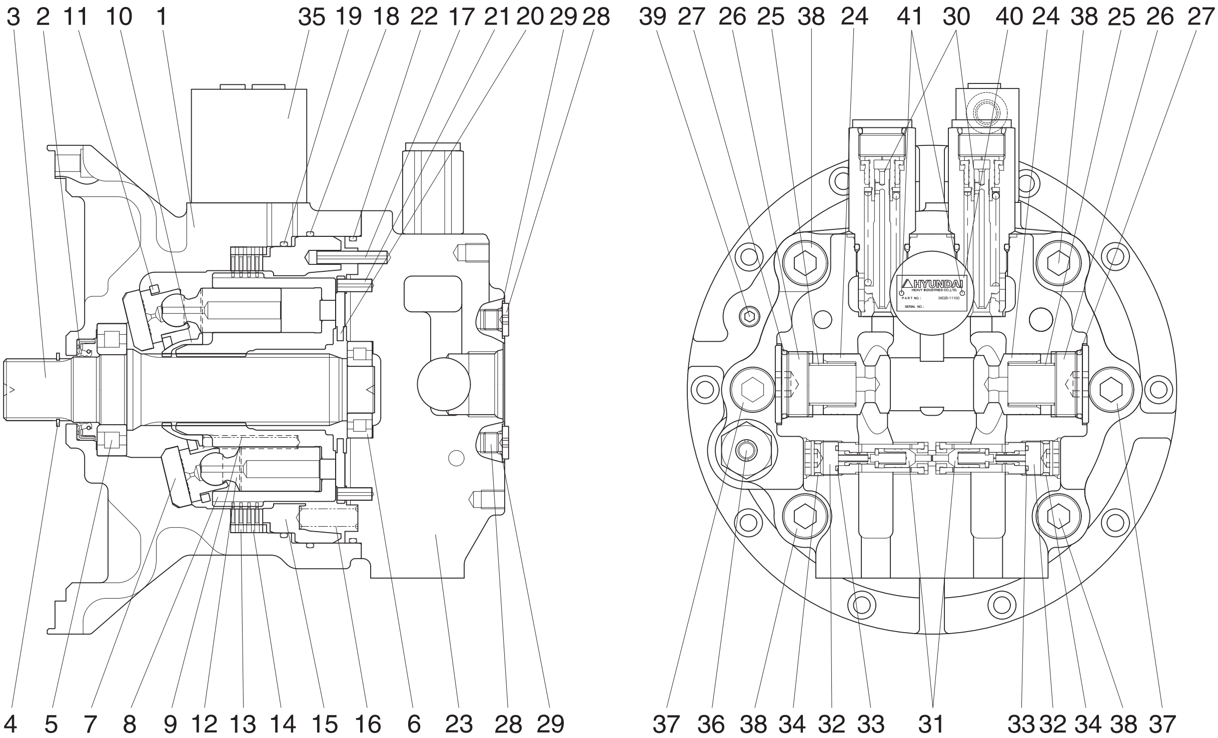
④ Start the engine, run at low idling and check oil come out from plug.

⑤ Tighten plug fully.

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

2. DISASSEMBLY AND ASSEMBLY OF SWING MOTOR

1) STRUCTURE



1	Casing	15	Parking piston	29	O-ring
2	Oil seal	16	Brake spring	30	Relief valve assy
3	Shaft	17	Spring pin	31	Reactionless valve assy
4	Snap ring	18	O-ring	32	Plug
5	Cylinder roller bearing	19	O-ring	33	O-ring
6	Cylinder needle bearing	20	Valve plate	34	O-ring
7	Swash plate	21	Spring pin	35	Time delay valve assy
8	Cylinder block	22	O-ring	36	Level gauge 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	Check valve 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

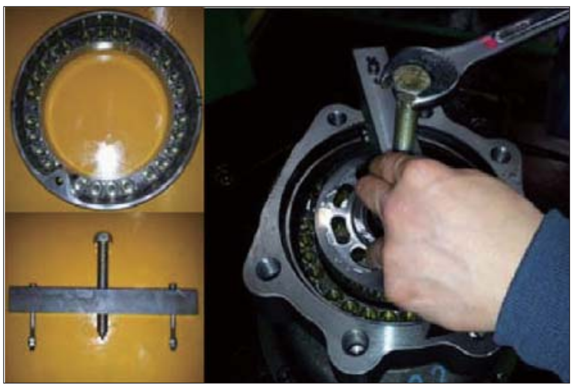
(1) Disassembly the sub of a turning axis

① Unloosing wrench bolt and disassemble time delay valve assy (35) from casing (1).

② Disassemble level gauge (36) from casing (1).

③ Hang buckles on valve casing (23) and unloose the bolt-hex (37, 38) from casing (1).

④ Take springs (16) out of parking piston (15) and disassemble a parking piston (15) from casing (1) using a jig.



⑤ Take cylinder block sub assy (8), friction plates (13), seperated plates (14) out of casing (1) in order.

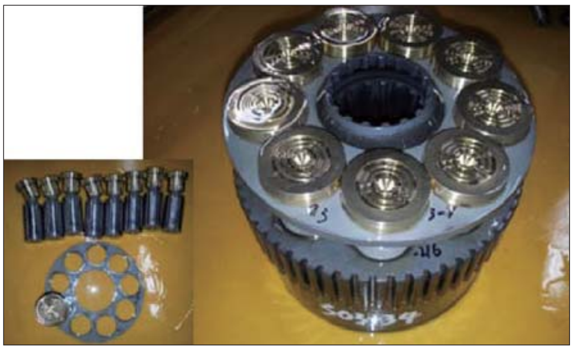
⑥ Disassemble swash plate (7) from casing (1).

⑦ Using a pair of pliers, take snap-ring out of casing (1).

⑧ Disassemble shaft sub assy (3), oil seal (2), O-rings (18, 22) from casing (1).

(2) Disassemble cylinder block assy

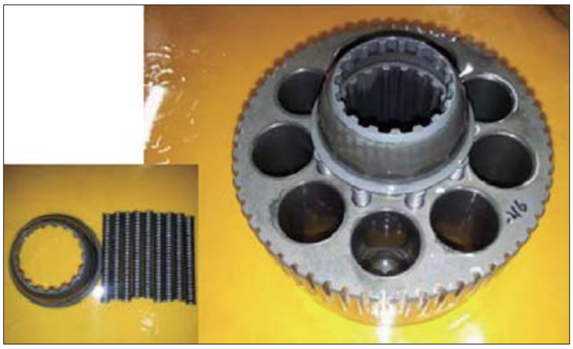
① Disassemble pistion assy (12) from cylinder block assy (8).



② Disassemble ball guide (10) and springs (9) (cylinder block) from cylinder block assy (8).

· Ball guide × 1EA

· Spring × 9EA



(3) Disassemble valve casing assy

① Take pin spring (17, 21), valve plate (20), O-ring (22) out of valve casing (23) in order.

② Using a torque wrench, disassemble relief valve (30) from valve casing (23).

③ Disassemble plug (32), O-rings (33, 34) and reactionless valves (31) from valve casing (23) in order with torque wrench.

④ Disassemble plug (26), O-rings (27) and check valve (24) from casing in order with torque wrench.

⑤ Disassemble plug (28), O-ring (29) from valve casing (23).

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)

② Using robot M/C, heated inner bearing is assembled on shaft with pressure.

(2) Assemble the sub of cylinder block assy

① Put springs (9, cylinder block) on holes of cylinder block.

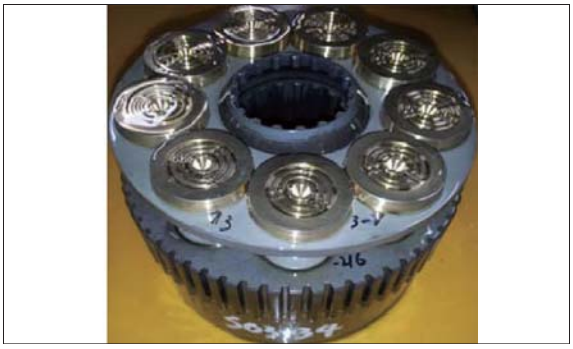
· Spring×9EA

② Put ball guide (10) on cylinder block (8).

· Ball guide×1EA

③ Assemble piston assy (12) with retainer plate (11).
- · Piston assy × 9EA
- · Retainer plate × 1EA

④ Put ② and ③ together as one.



(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

② Assemble the sub of reactionless valve assy.
Assemble reactionless valve (31), O-ring (33, 34), and plug (32) into valve casing (23) in order.
- · Reactionless valve assy (31) × 2EA
- · Plug (32) × 2EA
- · O-ring (33, 34) × 2EA

③ Assemble relief valve assy (30) 2set into valve casing (23) with torque wrench (bilateral symmetry assembling).

· Relief valve assy (30)×2EA

④ Assemble plug (28) and O-ring (23) into valve casing with a torque wrench.

· Plug (28)×3EA

· O-ring (27)×3EA

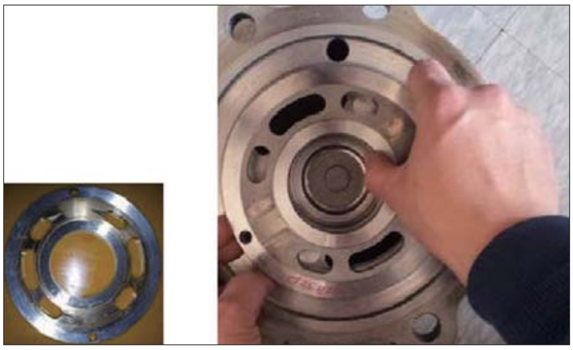
⑤ After assembling needle bearing (6) into valve casing, assemble pin spring (17, 21).

· Needle bearing (6) ×1EA

· Pin spring (17, 21) ×1EA

⑥ After applying grease on valve plate (20), attach it to valve casing (23).

· Valve plate (20) ×1EA



(4) Assemble the sub of moving axis

① Using jig and compressing tool, assemble oil seal into casing.

· Oil seal (2)×1EA

② Insert above shaft sub into casing (1) and assemble it with a jig.

③ Fix snap ring (4) to shaft with a pair of plier jig.

· Snap ring×1EA

④ Apply grease on swash plate (7) and assemble it on the casing.

· Swash plate×1EA

⑤ Put O-ring (18, 19) into a casing.
  · O-ring (18) × 1EA
  · O-ring (19) × 1EA

⑥ Insert cylinder block assy (8) into casing (1).

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

⑧ After putting grease on contact surface of spring, assemble spring (16) into parking piston (15).
  · Spring × 26EA

⑨ After hang valve casing (23) on hook, assemble it on casing (1) gently, then , tighten hex bolt (37, 38) tightly.

⑩ Assemble level gauge assy (36) and plug (39) into casing (1).

⑪ After assembling time delay valve assy (35) into valve casing (23), tighten hex bolt (42).

· Time delay valve assy × 1EA
· Hex bolt × 3EA

⑫ Air leak test

After putting assembled swing motor into test tank, excute the air leak test for 2 min at 2k.

⑬ Leakage test
After putting assembled motor into bench tester, spraying the color check and be sure of leakage.

⑭ Mount test bench
Mount assembled motor on bench tester, check the availability of each specified tests.

3. REMOVAL AND INSTALL OF REDUCTION GEAR

1) REMOVAL

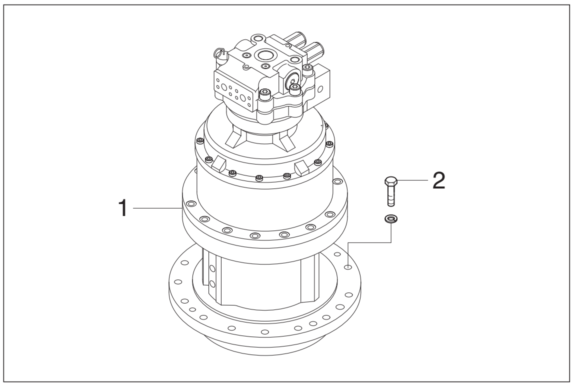
(1) Remove the swing motor assembly.
For details, see removal of swing motor assembly.

(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)

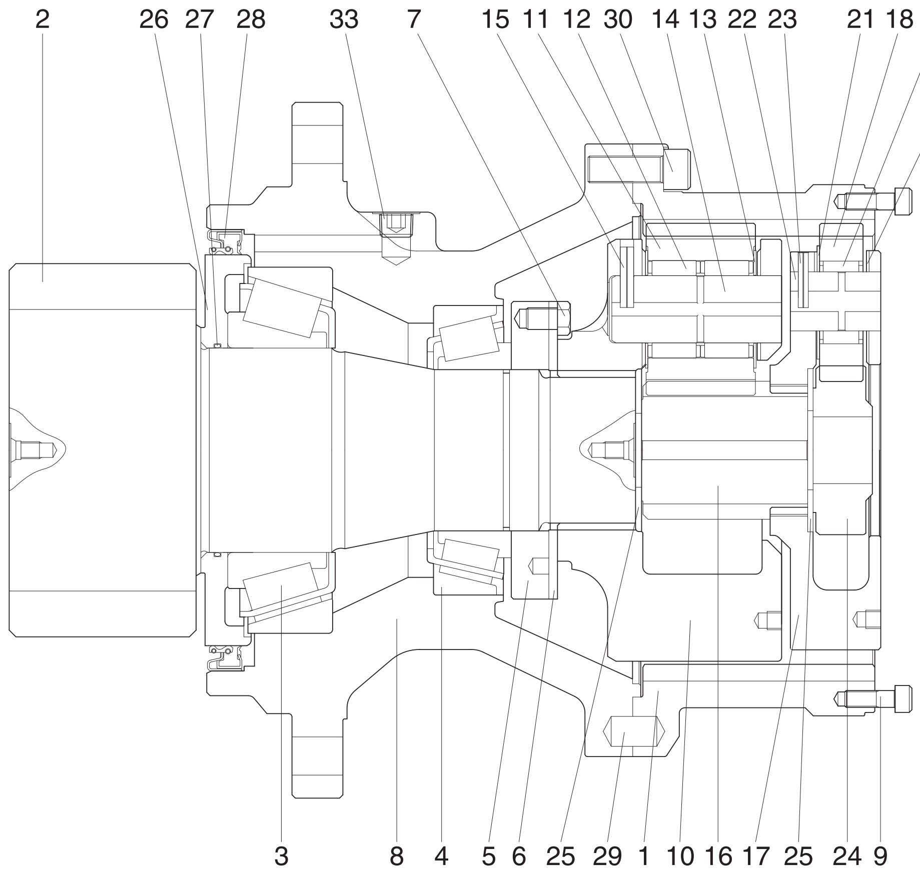
2) INSTALL

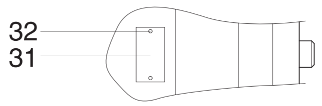
(1) Carry out installation in the reverse order to removal.
· Tightening torque : 57.9±8.7 kgf · m
(419±62.9 lbf · ft)



4. DISASSEMBLY AND ASSEMBLY OF REDUCTION GEAR

1) STRUCTURE





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

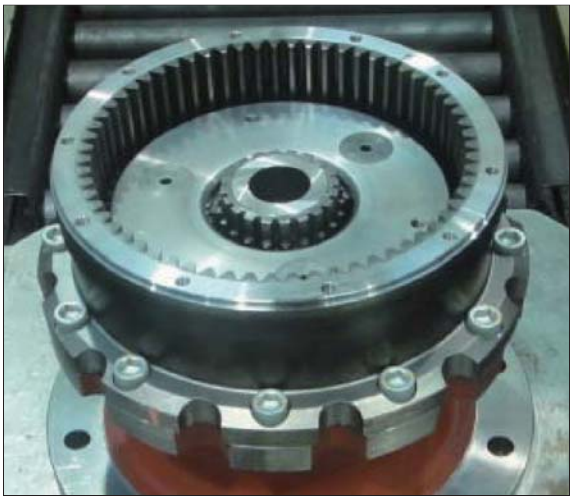
2) PREPARATION FOR DISASSEMBLING

(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.**

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.)



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 .

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.)

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.)

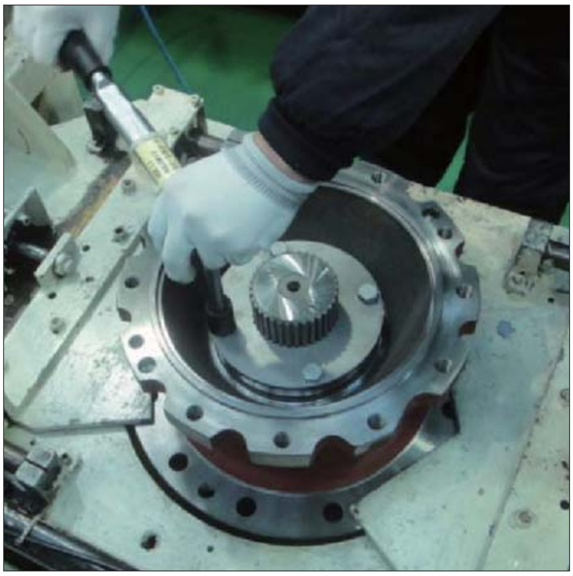
※ It's impossible to disassemble No.2 pin spring. If No.2 pin spring has problem, change whole No.2 carrier sub assy.

(3) Removing ring gear

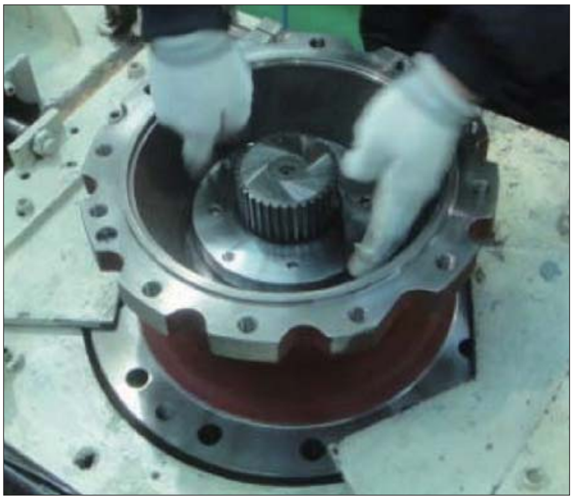
After unscrewing every socket bolt (M16), remove ring gear from casing.
(Because of liquid gaskets between ring gear and casing, put sharp punch between ring gear and casing and tapping it to remove them.)

(4) Removing drive shaft sub assy

① Unscrew every hex head bolt (M12) to remove lock plate.



② Rolling nut ring for removing them from drive shaft sub assy.
(Use special tool to roll nut ring to counter clock wise.)



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.)

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.)

4) ASSEMBLY

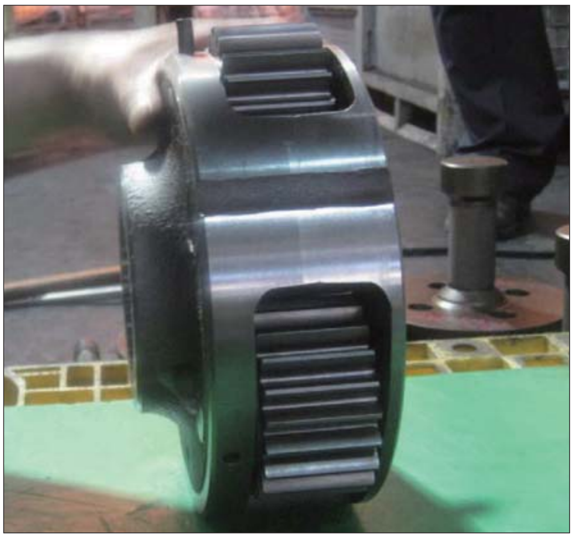
(1) General notes

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.

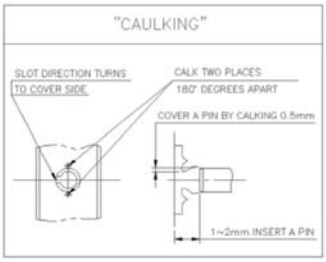
(2) Assembling No.1 carrier sub assy

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.

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.)



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.



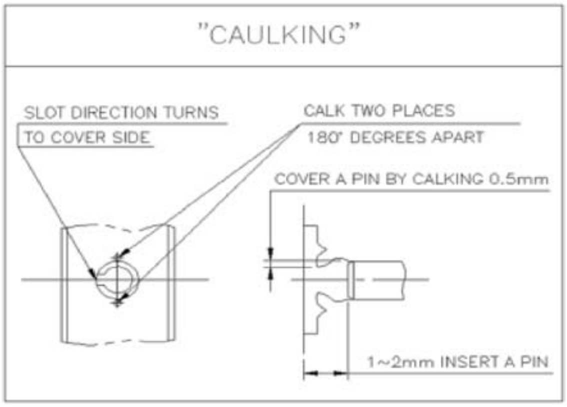
(3) Assembling No.2 carrier sub assy
① Put thrust plate in firmly No.2 carrier.

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.

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.)

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.

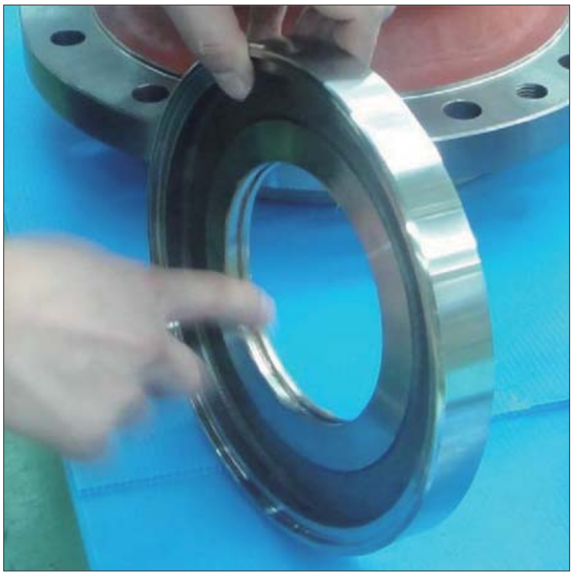


(4) Assembling pinion gear sub assy

① Prepare drive shaft pinion gear vertical with ground.

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.)



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.)

(5) Assembling bearing cup & oil seal

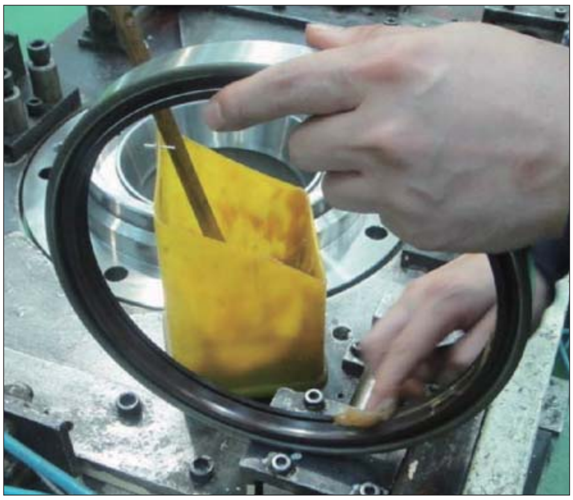
① Put top, bottom bearing cup into casing. (Use special jig for pressing. Pay attention to foreign materials while assembling bearing cup.)

※ Flip over casing to assemble oil seal.

② Assemble oil seal to casing.
(Use special jig for pressing. Pay attention to direction of dust seal and dent.)

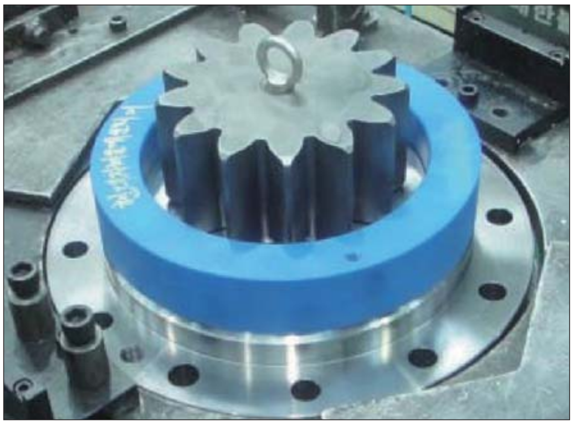
While assembling oil seal

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.



(6) Assembling shaft sub assy & nut ring

① After assembling casing & drive shaft sub assy, flip it over.



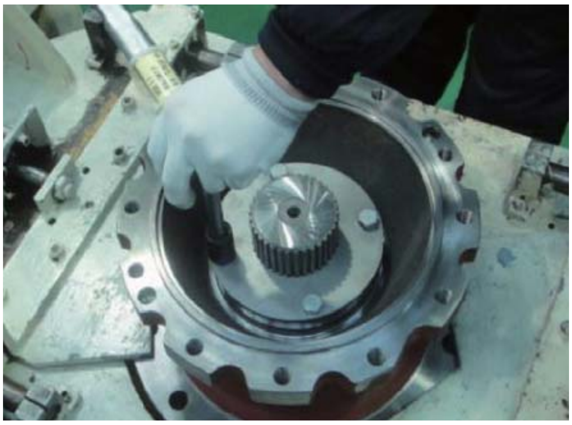
② Put drive shaft sub assy into casing. (Be sure to maintain it vertical with ground when assembling it.)

③ Put bearing taper into it.
(Rotate bearing by hands for checking after assembly.)

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.

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.)

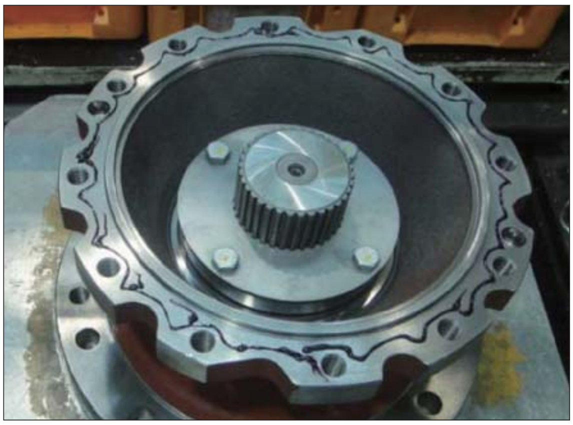
⑥ Screw 4 bolts (M12×16) to connect nut ring and lock plate by using torque wrench.
· 4-M12 / bolt = 12.9T
· The tightening torque :
8.8±0.9 kgf · m (63.7±6.5 lbf · ft)
※ Apply enough loctite #242 before screwing bolts.



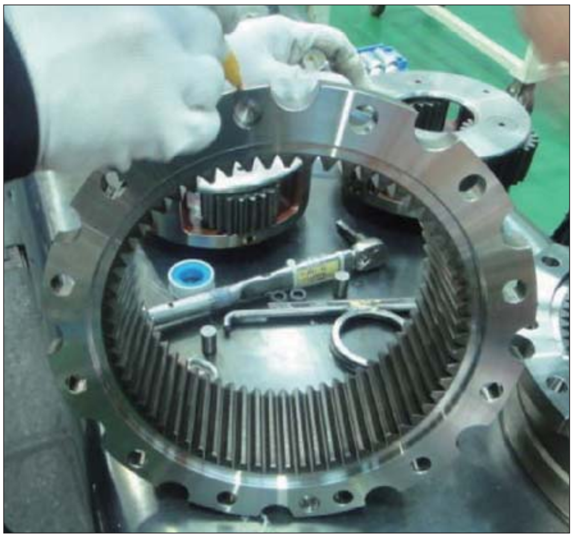
⑦ Use paint marker for checking surplus parts after assembling.

(7) Assembling ring gear

① Apply loctite #515 bottom of casing sub assy contacting with ring gear without disconnection. (Refer to loctite detail)



② Put pin parallel into casing sub assy hole. (Mark pin parallel position using paint marker.)



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.)

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.

⑤ Use paint marker for checking surplus parts after assembling.

(8) Assembling carrier sub assy & sun gear

① Put No.2 carrier sub assy along drive shaft's spline.

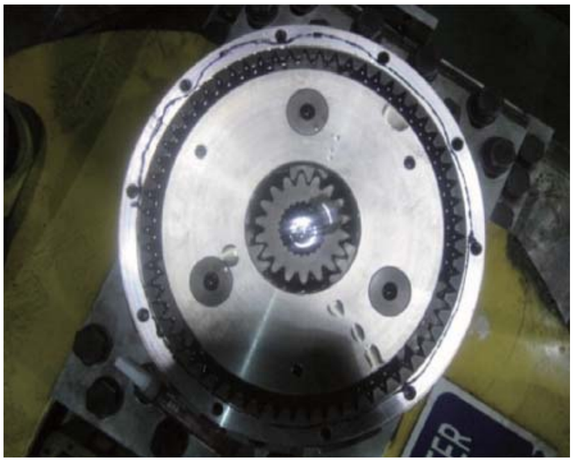
- Screw M10 I-bolt to No.2 carrier sub assy.
- Lifting up No.2 carrier sub assy and align planetary gear and ring gear’s tooth by rotating planetary gear by hands.
- Rotate No.2 carrier sub assy by hands to fit No.2 carrier sub assy into drive shaft spline.

② Put No.2 sun gear into No.2 carrier sub assy.

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.

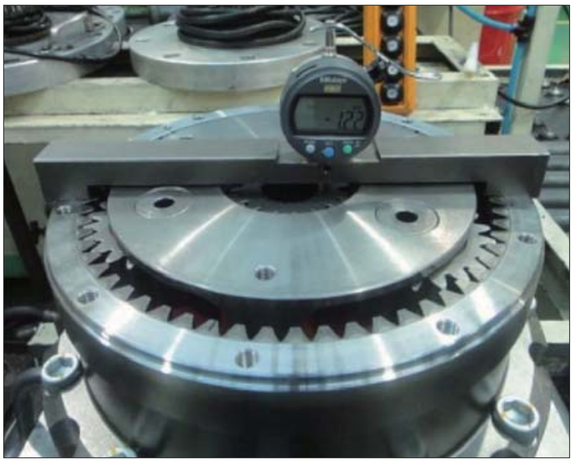
④ Put No.1 sun gear into No.1 carrier sub assy.
(Be sure to maintain it vertical with ground. And align with No.1 planetary gear spline.)

⑤ Rotate No.1 carrier sub assy by hands to check noise.



(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)



GROUP 6 TRAVEL DEVICE

1. REMOVAL AND INSTALL

1) REMOVAL

(1) Swing the work equipment 90° and lower it completely to the ground.

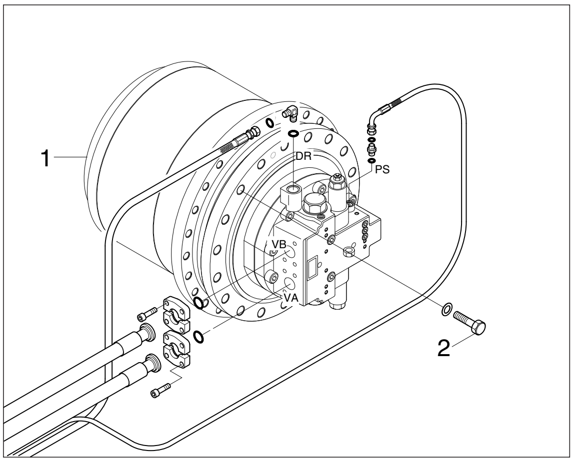
(2) Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

(3) Loosen the breather slowly to release the pressure inside the hydraulic tank.

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

※ When pipes and hoses are disconnected, the oil inside the piping will flow out, so catch it in oil pan.

(4) Remove the track shoe assembly.
For details, see removal of track shoe assembly.



(5) Remove the cover.

(6) Remove the hoses.
※ Fit blind plugs to the disconnected hoses.

(7) Remove the bolts and the sprocket.

(8) Sling travel device assembly (1).

(9) Remove the mounting bolts (2), then remove the travel device assembly.
- Weight : 632 kg (1393 lb)
- Tightening torque : 57.9±8.7 kgf · m (419±62.9 lbf · ft)

2) INSTALL

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

(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.

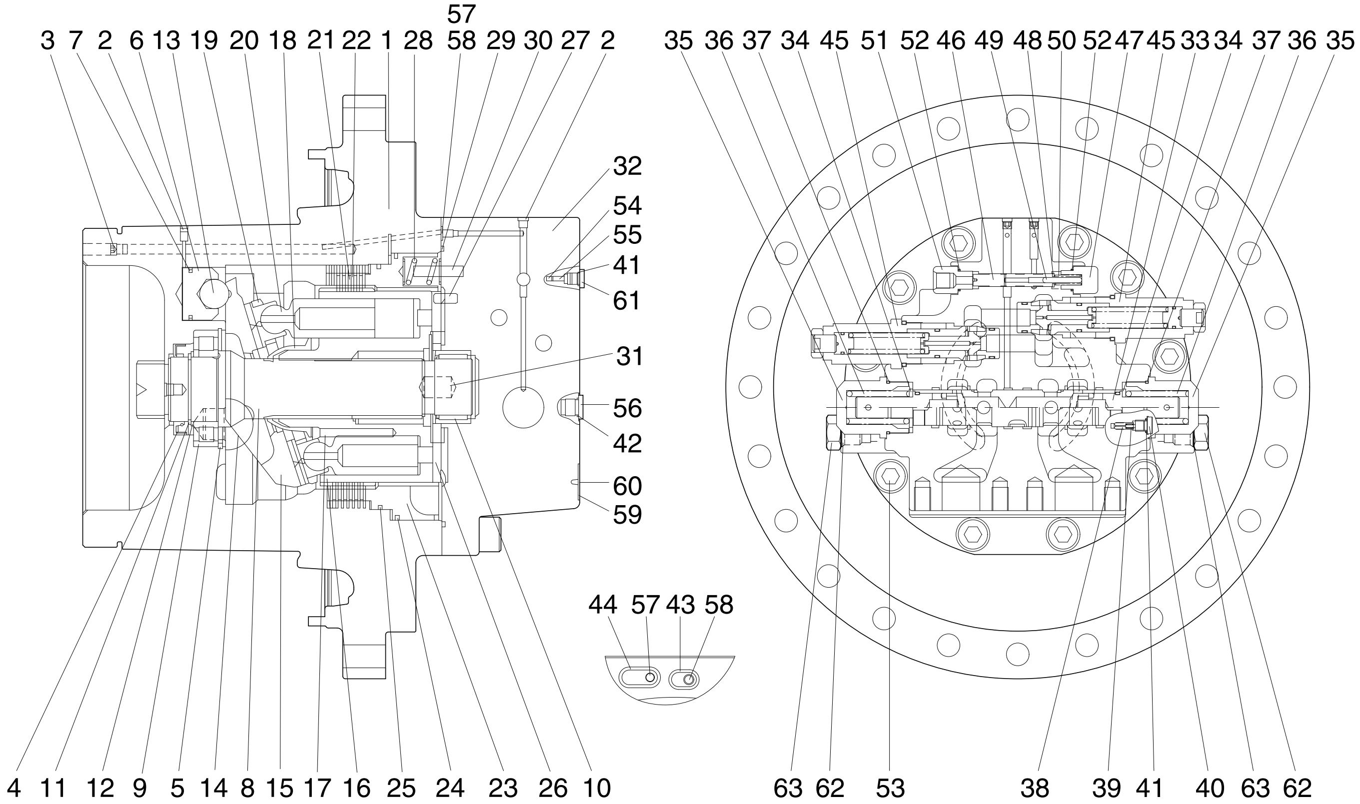
④ Start the engine, run at low idling, and check oil come out from plug.

⑤ Tighten plug fully.

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

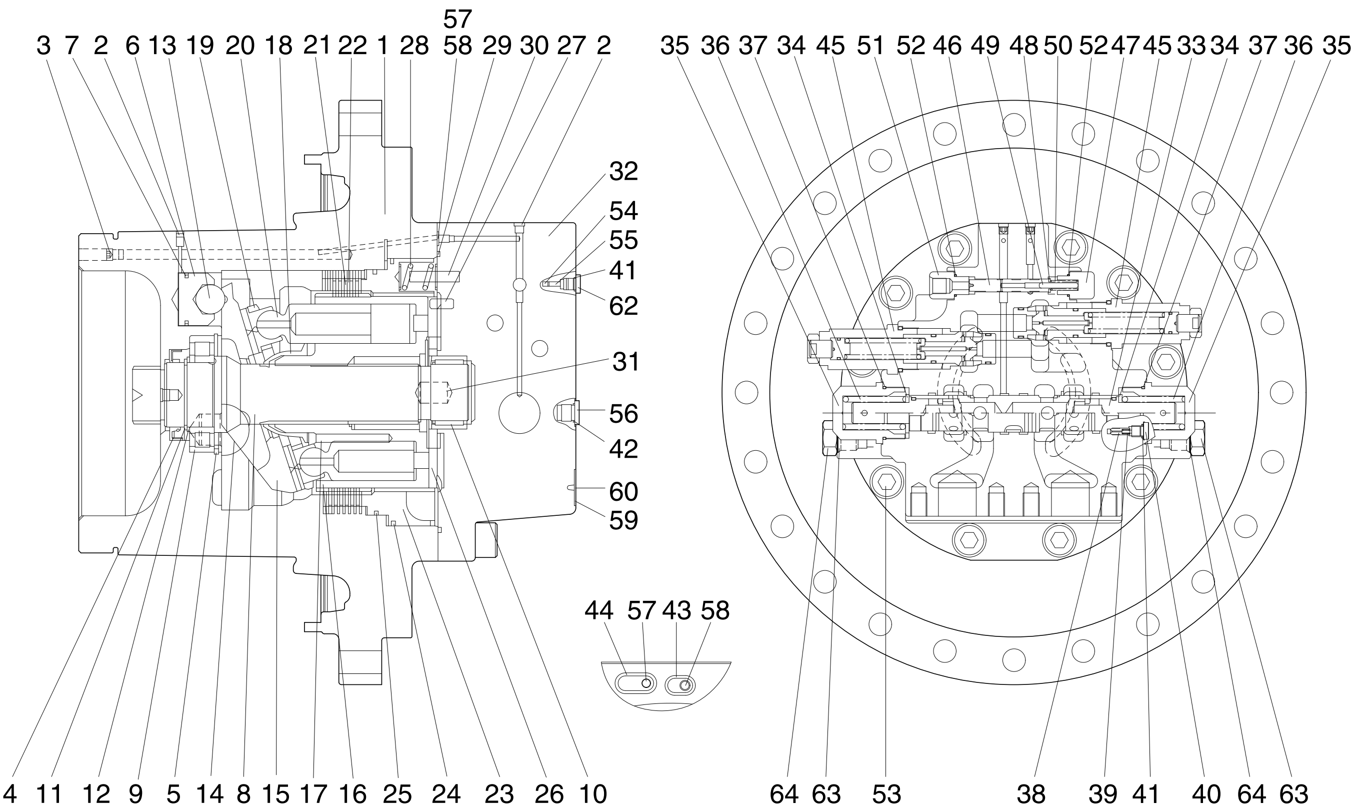
2. TRAVEL MOTOR

1) STRUCTURE (TYPE 1)



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	Retainer 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	Roller bearing	30	Spring pin	51	Connector
10	Needle bearing	31	Parallel pin	52	O-ring
11	Retainer ring	32	Rear cover	53	Hex socket head bolt
12	Thrust plate	33	Main spool kit	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	Rotary block	37	O-ring	58	Restrictor
17	Spring	38	Restrictor	59	Name plate
18	Ball guide	39	Spring	60	Rivet
19	Retainer plate	40	Plug	61	Plug
20	Piston and shoe	41	O-ring	62	Plug
21	Friction plate	42	O-ring	63	O-ring

STRUCTURE (TYPE 2)



1	Casing	22	Separate plate	43	O-ring
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11	Retainer ring	32	Rear cover	53	Hex socket head bolt
12	Thrust plate	33	Main spool kit	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	Rotary block	37	O-ring	58	Restrictor
17	Spring	38	Restrictor	59	Name plate
18	Ball guide	39	Spring	60	Rivet
19	Retainer plate	40	Plug	62	Plug
20	Piston and shoe	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.

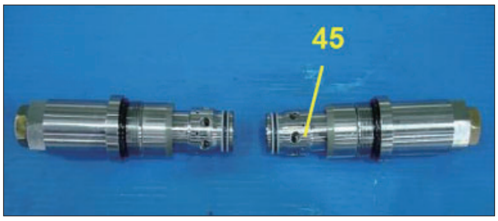
(2) This motor can be disassembled even in a state on the reduction gear.
However, in that case, pay full attention to preventing mud, dust, etc. from entering in it.

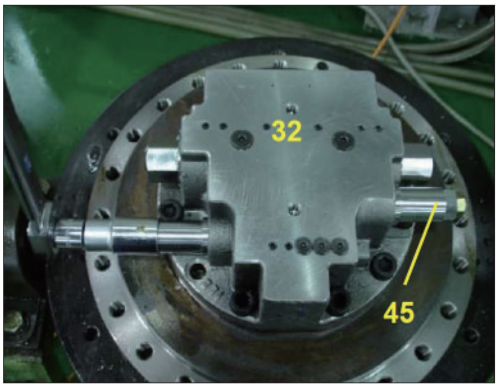
(3) The numerical in parentheses following each part name indicates its part number shown in the attached **assembly drawings.**

(4) The piping side of the motor is referred to as the rear side, and the output side as the front side.

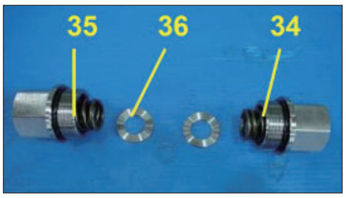
2) DISASSEMBLY OF REDUCTION GEAR

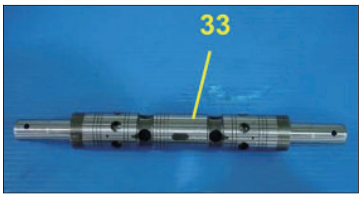
(1) Disassemble relief valve assy (45) from rear cover (32) using spanner and torque wrench.

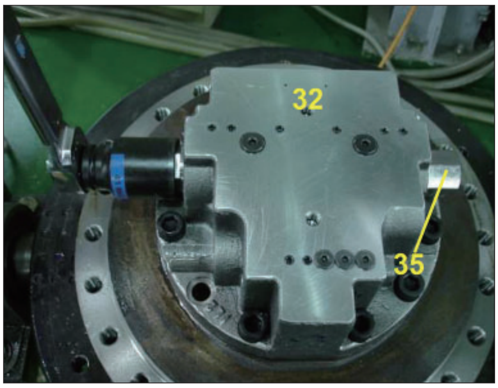




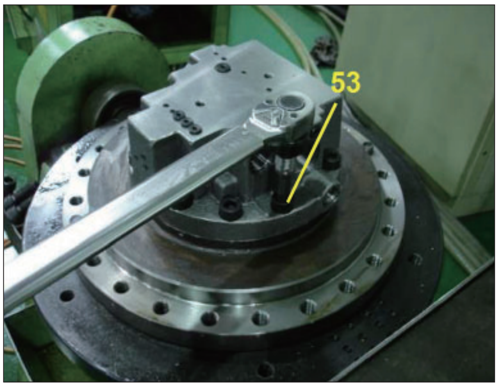
(2) Disassemble plug (35) from rear cover (32) and then disassemble spring (36), spring seat (34), main spool kit (33) in regular sequence.



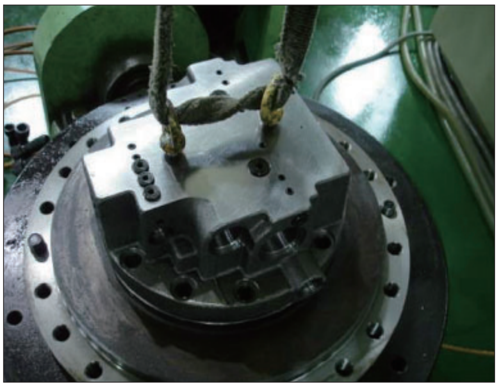




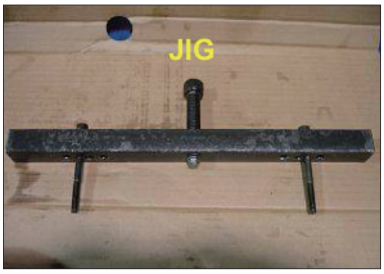
(3) Disassemble socket bolt (53)-10EA using torque wrench.

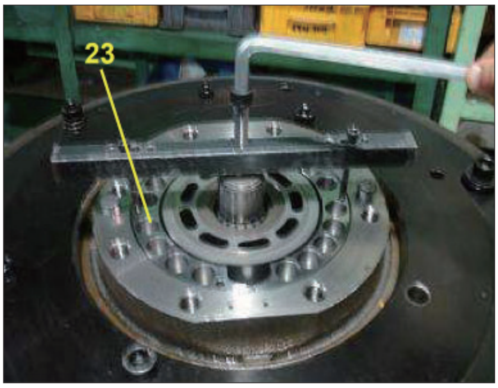


(4) Take out rear cover (32) from casing (1).

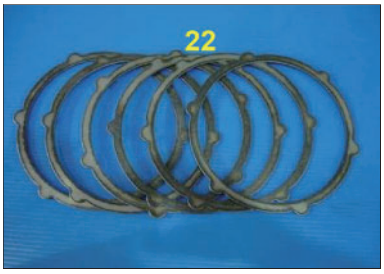


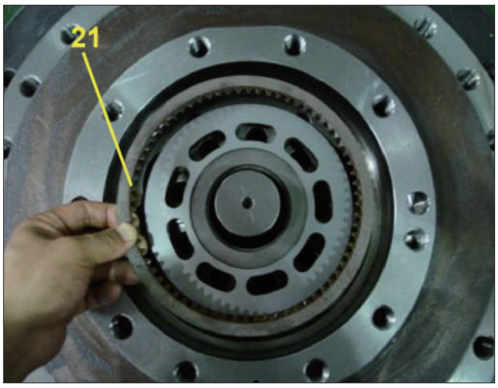
(5) Disassemble parking piston (23) using jig.

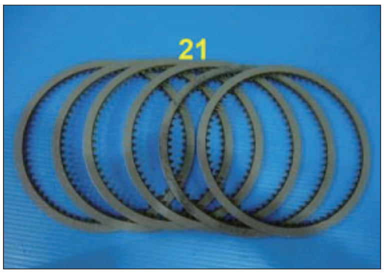


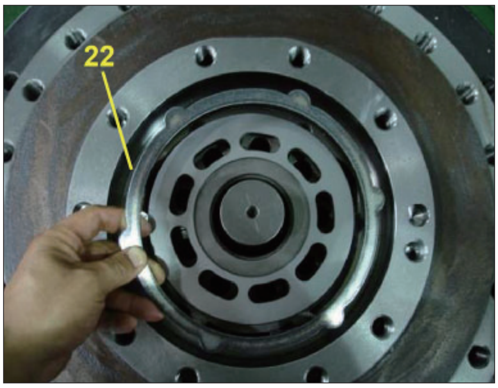


(6) Disassemble separate plate (22)-7EA, friction plate (21)-6EA

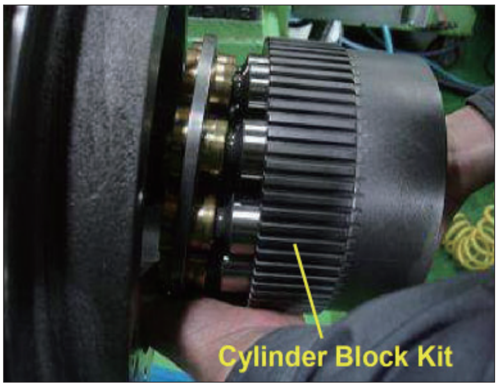




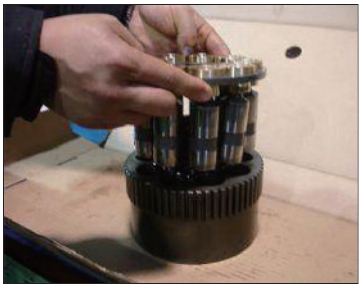


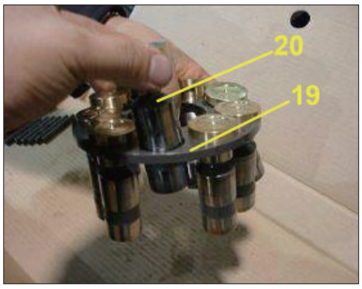


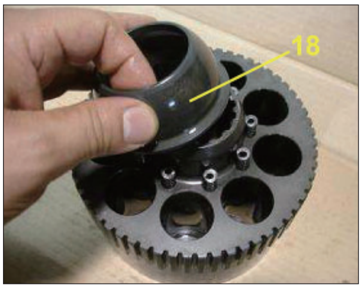
(7) Remove rotary block kit.
It is easier to work by placing the casing (1) horizontal.

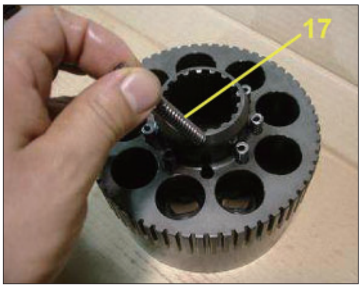


(8) Disassemble rotary block (16), retaner plate (19), piston and shoe (20), ball guide (18), spring (17) from rotary block kit.



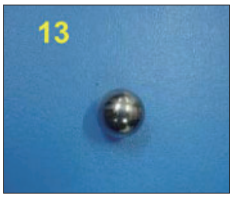


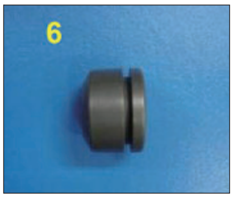




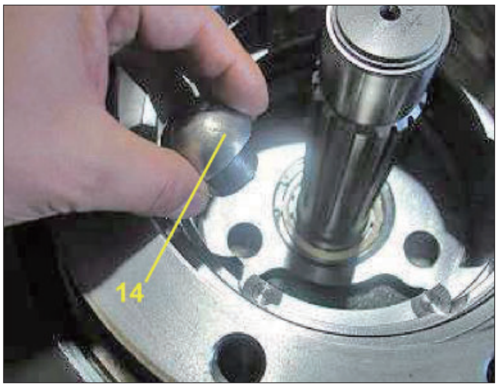
(9) Disassemble swash plate (15) from shaft casing (1).

(10) Disassemble steel ball (13), swash piston (6) Hole in the casing (1) of two speed line is decomposed by injecting oil.

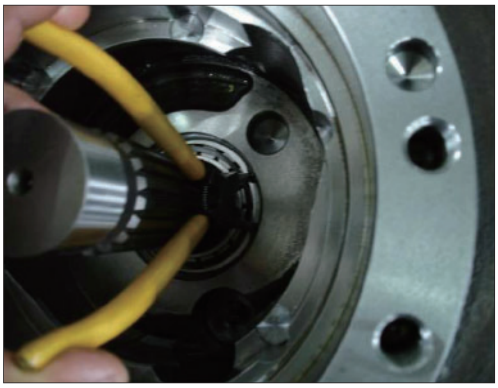




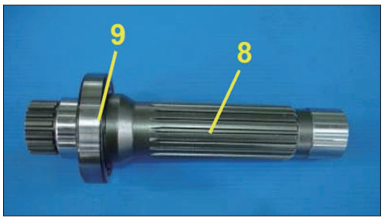
(11) Disassemble pivot (14)-2EA from casing (1).

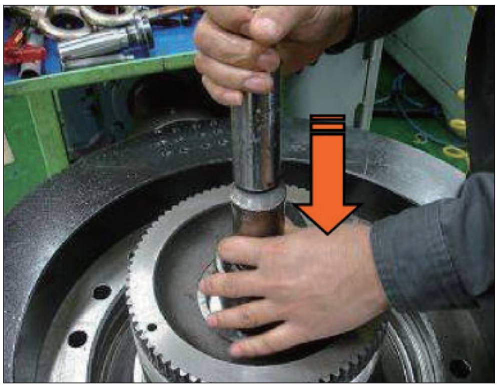


(12) Disassemble retainer ring (5) using pliers.

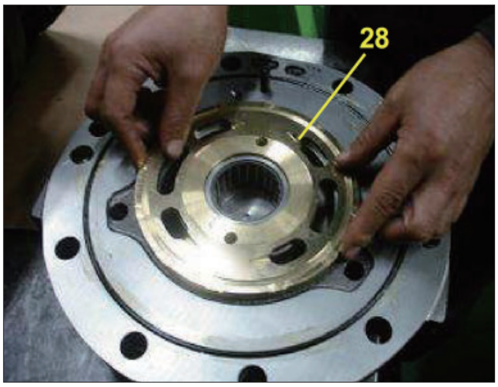


(13) In the casing (1), the arrow part of the shaft (8) using a rubber mallet taps and then disassemble the shaft (8) and roller bearing (9) to the other side.

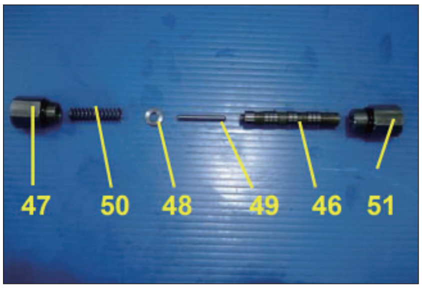


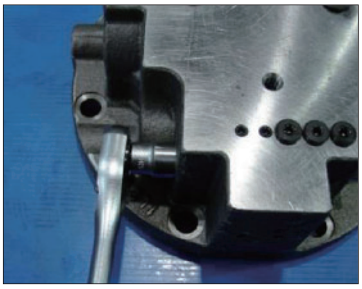


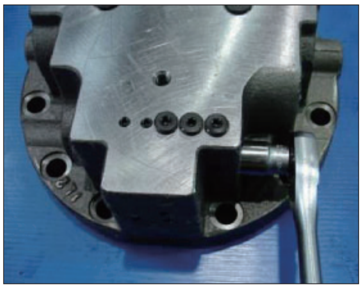
(14) Disassemble valve plate (36) from rear cover (32).



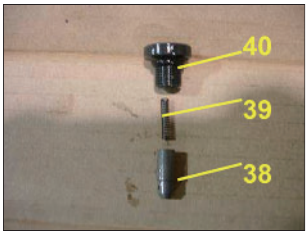
(15) Disassemble plug (47), connector (51) from rear cover (32) and then disassemble spring (50), spring seat (48), parallel pin (49), spool (46) in regular sequence.

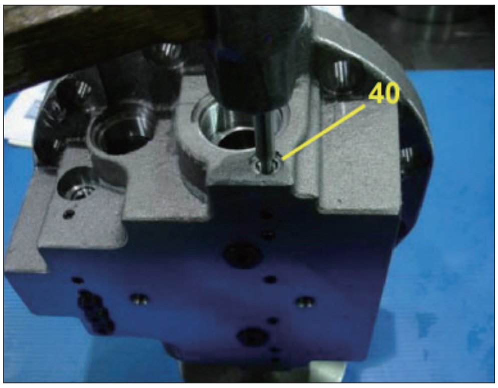




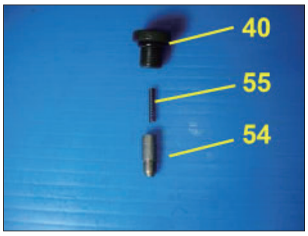


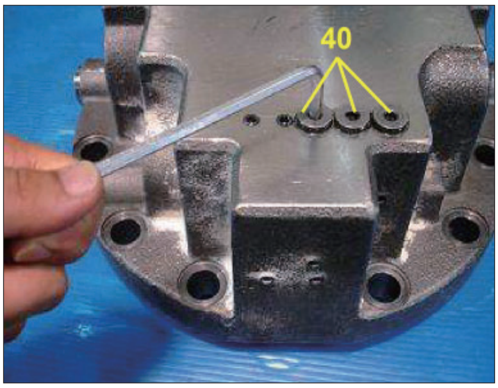
(16) Disassemble plug (40) from rear cover (32) and then disassemble spring (39), restictor (38) from rear cover (34) in regular sequence.



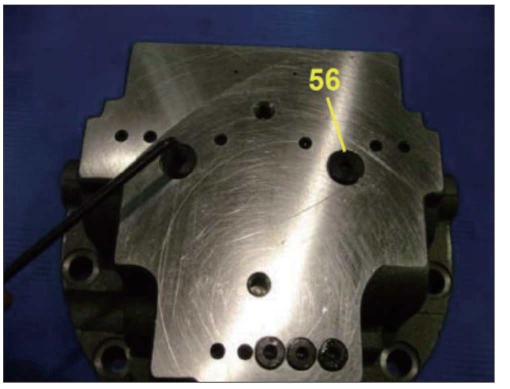


(17) Disassemble plug (40) from rear cover (32) and then disassemble spring (55), check valve (54) from rear cover (32) in regular sequence.





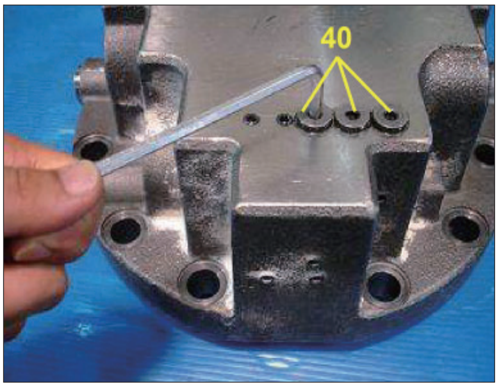
(18) Disassemble plug (56) from rear cover (32).

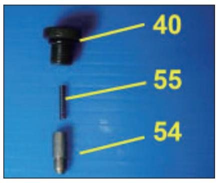


2) ASSEMBLY OF MOTOR

(1) Insert check valve (54), spring (55) into rear cover (32) and then assemble plug (40) using torque wrench.

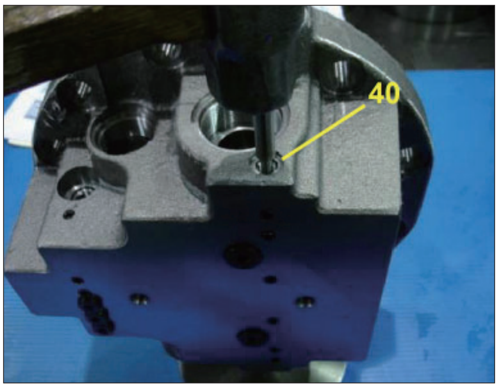
· Tightening torque : 3.0±0.3 kgf · m
(21.7±2.2 lbf · ft)

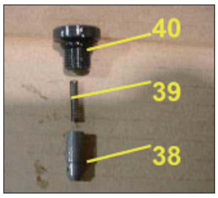




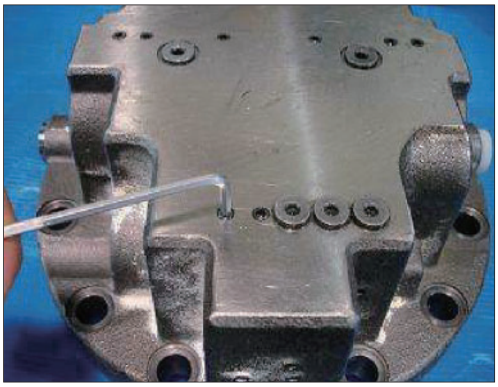
(2) Insert restrictor (38), spring (39) into rear cover (32) and then assemble plug (40) using torque-wrench.

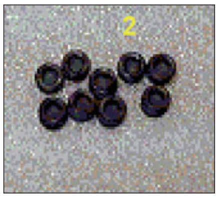
· Tightening torque : 3.0±0.3 kgf · m
(21.7±2.2 lbf · ft)





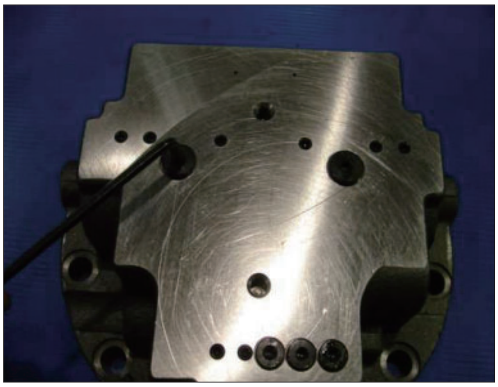
(3) Apply loctitle #242 on the 14-NPTF 1/16 plug (2) and then assemble 14-NPTF 1/16 plug (2) into rear cover (32).





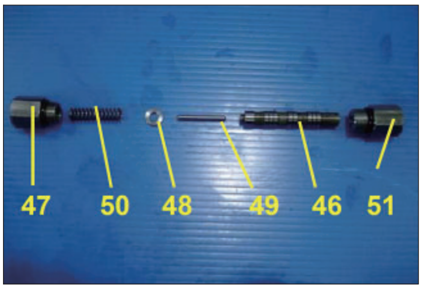
(4) Assemble 2-PF1/4 plug (56, 61) using torque-wrench.

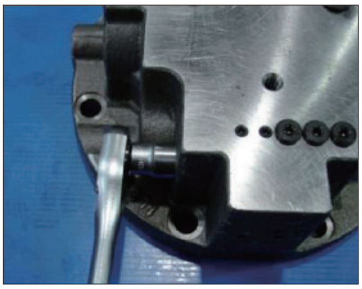
· Tightening torque : 4.5±0.5 kgf · m
(32.5±3.6 lbf · ft)

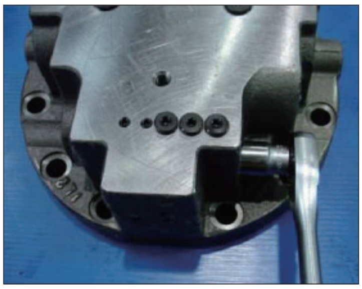


(5) Insert spool (46), parallel pin (49), spring seat (48), spring (50) in regular sequence and then assemble plug (47), connector (51) using torque wrench.

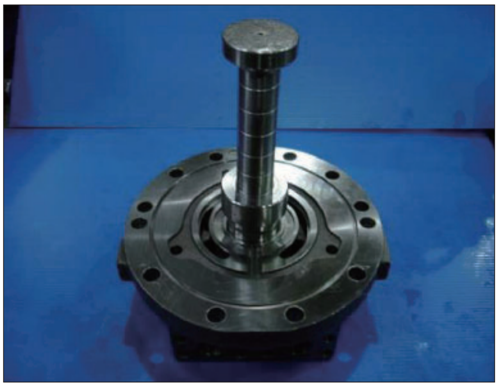
· Tightening torque : 5.5±0.5 kgf · m (40±3.6 lbf · ft)



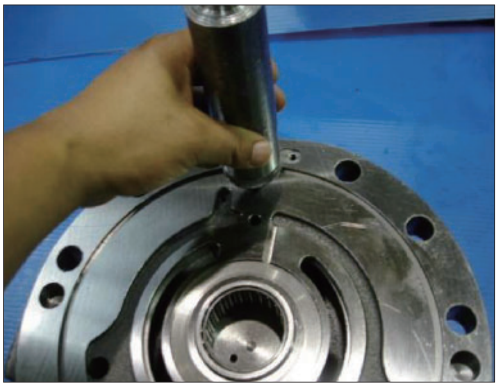




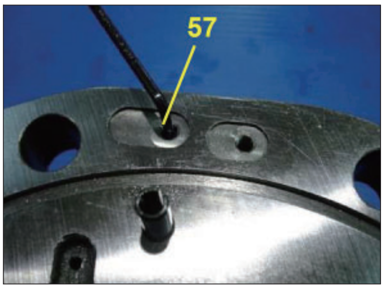
(6) Press needle bearing (10) into rear cover (32) using jig.

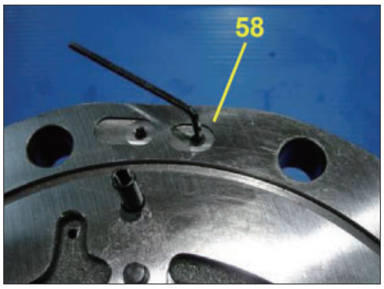


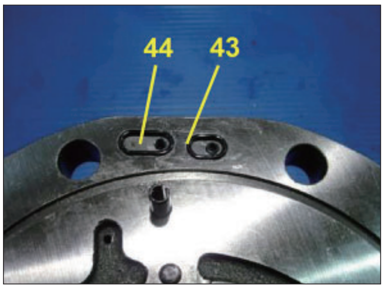
(7) Assemble spring pin (30), parallel pin (27) using small hammer.



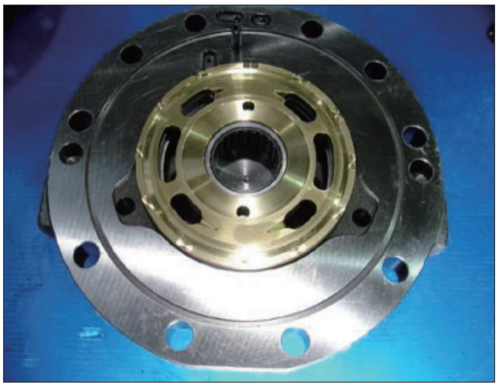
(8) Apply loctitle #242 on the restrictor (57, 58) and then assemble restrictor (57, 58), O-ring (43, 44) into rear cover (32).



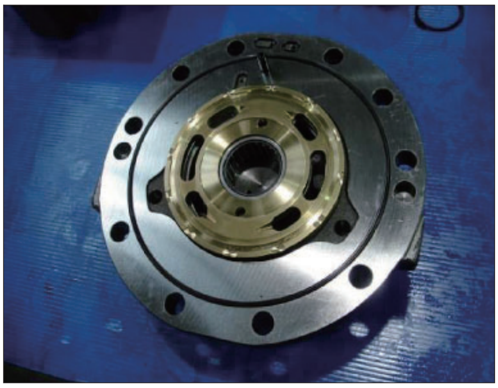




(9) Assemble valve plate (26) into rear cover (32).
Apply grease to the valve plate contact and then assemble valve plate into rear cover (32).



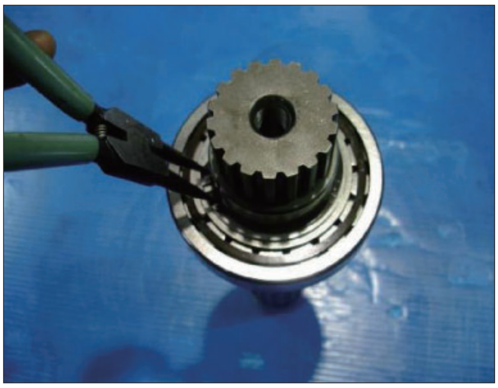
(10) Apply grease to the O-ring (29), and then assemble O-ring into rear cover (32).



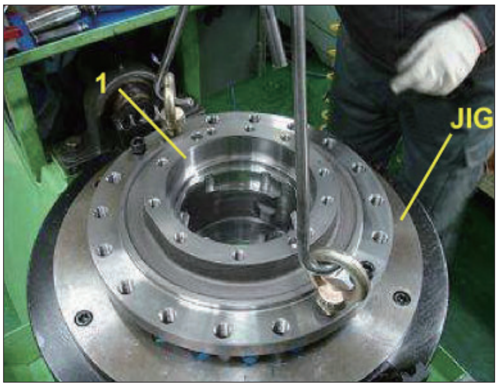
(11) Assemble the heated roller bearing (9) onto the shaft (8) and then assemble retainer ring (5) into shaft (8).

① The temperature of the roller bearing : 100˚C
* Using tool : heater.

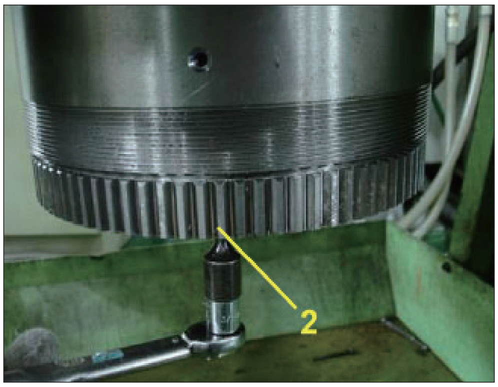
② Be careful not to damage the sliding surface for the oil seal on the shaft.

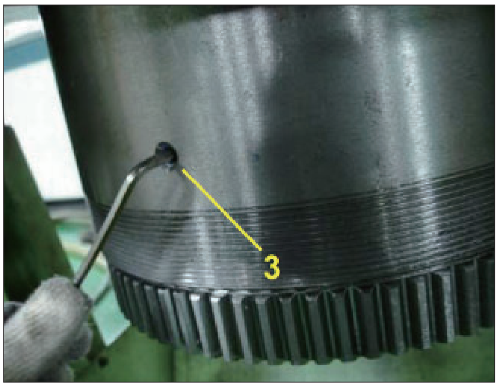


(12) Install casing (1) into assembling jig.

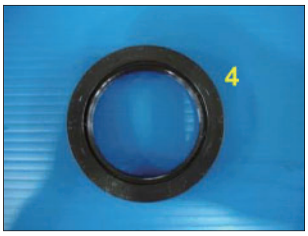


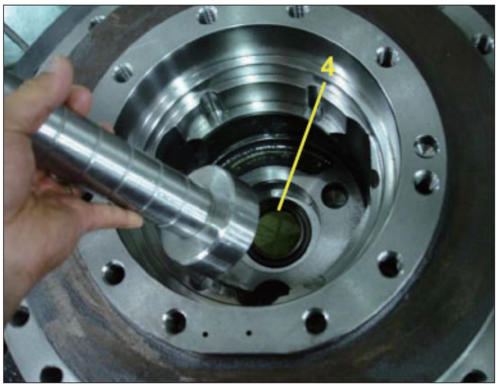
(13) Assemble plug (2), (3) into casing (1).



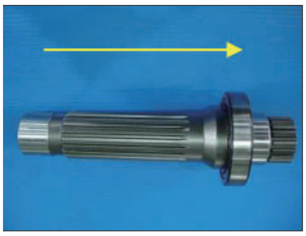


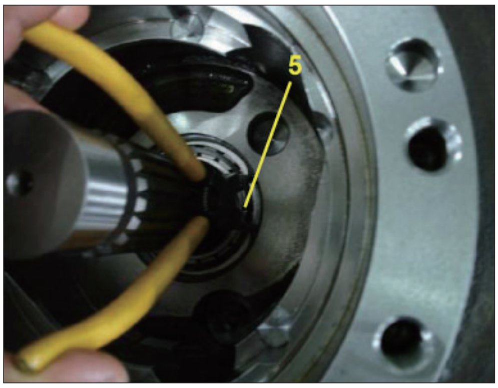
(14) Assemble oil seal (4) into casing (1) with assembling jig.



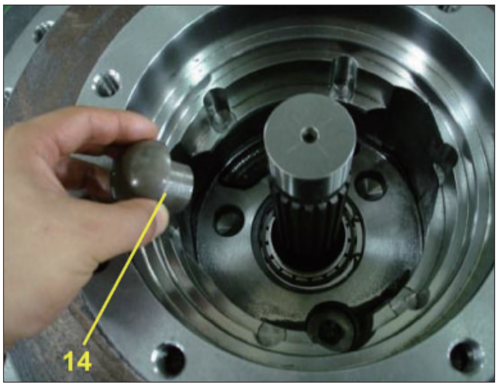


(15) Insert assembled shaft assy in the direction of the arrow into casing (1) using a rubber mallet.

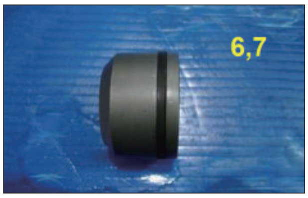


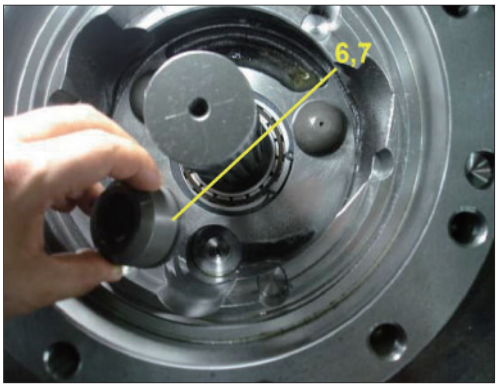


(16) Apply the grease to pivot (14)-2EA and then assemble pivot (14) into casing (1).

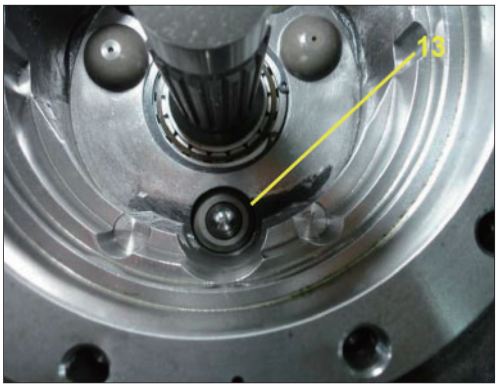


(17) Warm piston seal (7) and assemble it on swash piston (6) and then bind the piston seal (7) with a bend for a minute.
Remove the bend and assemble it into casing (1).

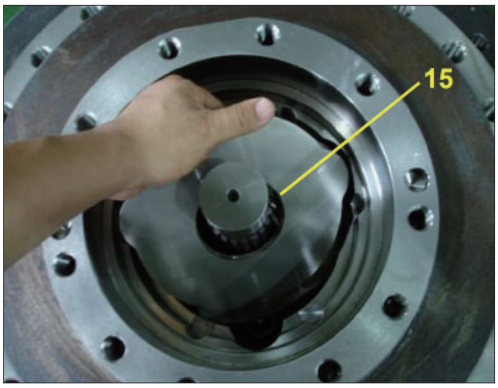




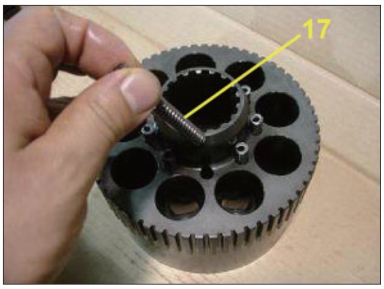
(18) Apply the grease to steel ball (13) and then assemble steel ball (13) into casing (1).

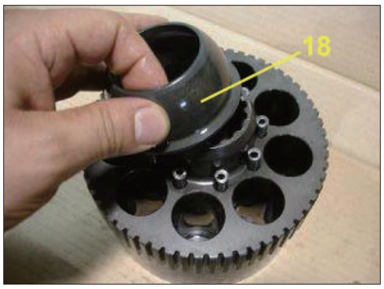


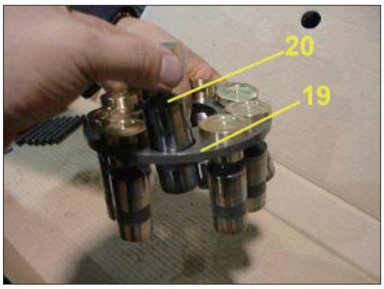
(19) Apply the grease to swash plate (15) and then assemble swash plate (15) into casing (1).

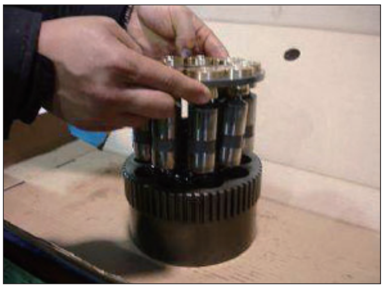


(20) Assemble spring (17), ball guide (18), retainer plate (19), piston and shoe (20) into rotary block (16) in regular sequence.

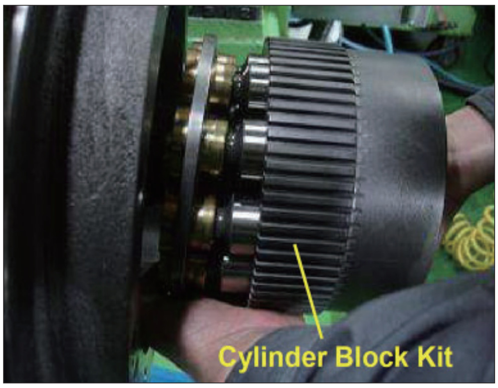




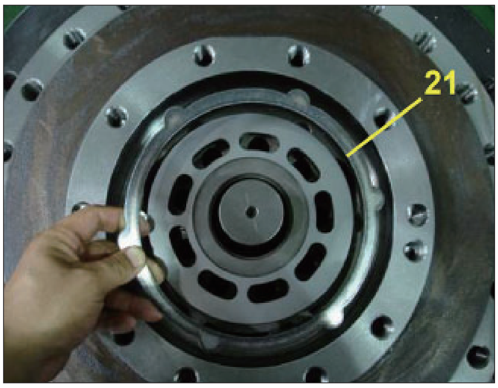


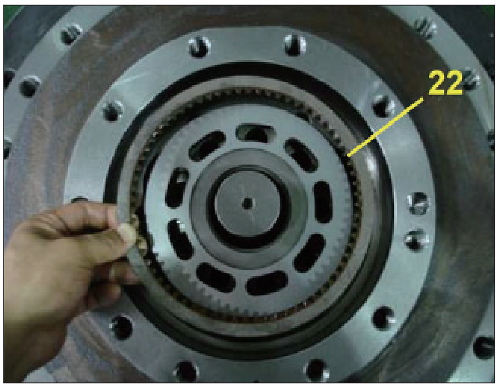



(21) Assemble rotary block kit into casing (1).



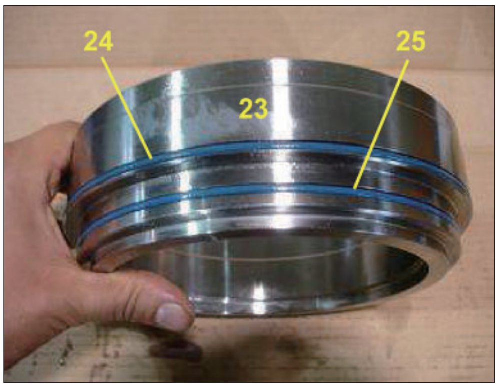
(22) Assemble separate plate (22), friction plate (21) into rotary block in regular sequence.
Friction plate : 6 EA
Separate plate : 7 EA



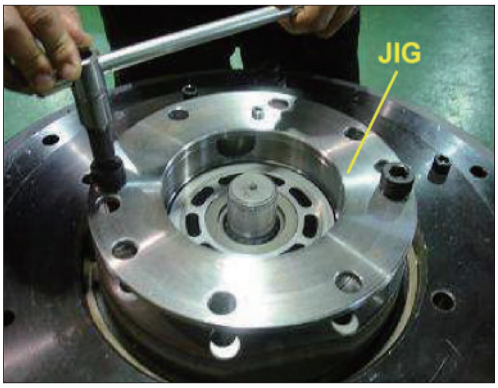


(23) Assemble parallel pin (31) into casing (1).

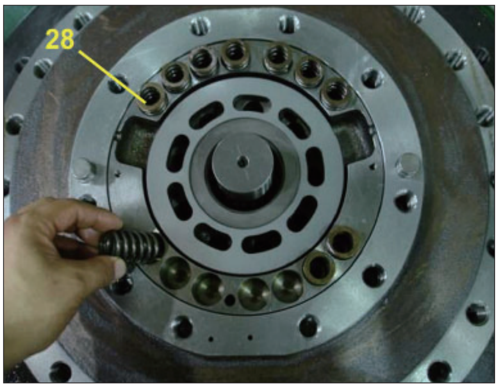
(24) Apply the grease to D-ring (24,25) and then assemble D-ring (24, 25) into parking piston (23)



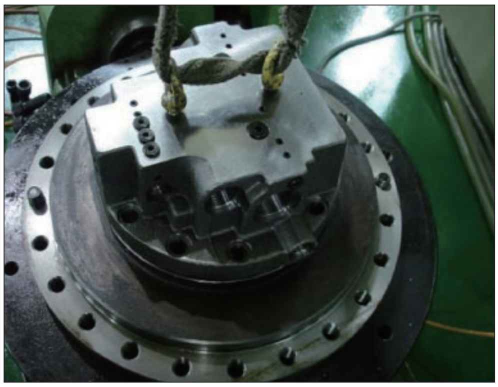
(25) Assemble parking piston (23) into casing using jig.



(26) Assemble parking spring (28)-14EA.



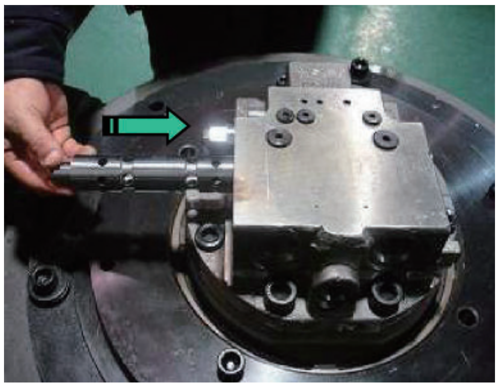
(27) Put on the rear cover (32) on the casing (1).



(28) Assemble rear cover (32) into casing (1) and then tighten the socket bolt (53) using torque wrench.

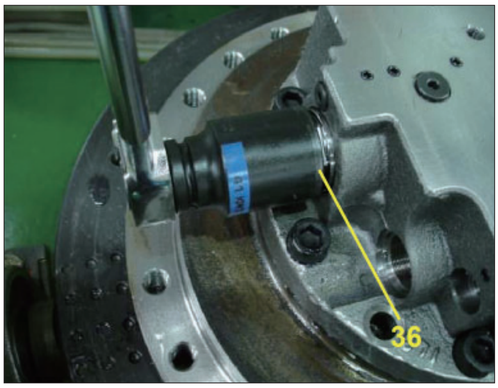
· Tightening torque : 33±3.3 kgf·m
(239±23.9 lbf·ft)

(29) Assemble main spool kit (33) into rear cover (32) after checking the direction to be correct.



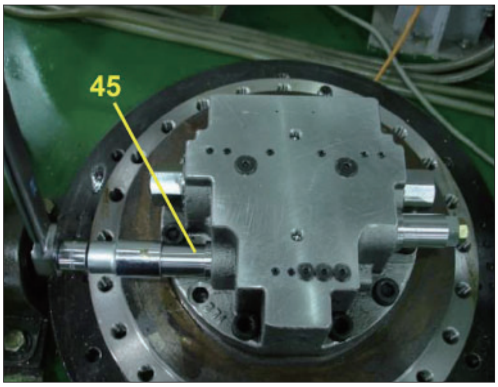
(30) Assemble spring (36), plug (35) into rear cover (32) in regular sequence and then plug (35) into rear cover (32) using torque wrench.

· Tightening torque : 45±4.5 kgf·m (325±32.5 lbf·ft)



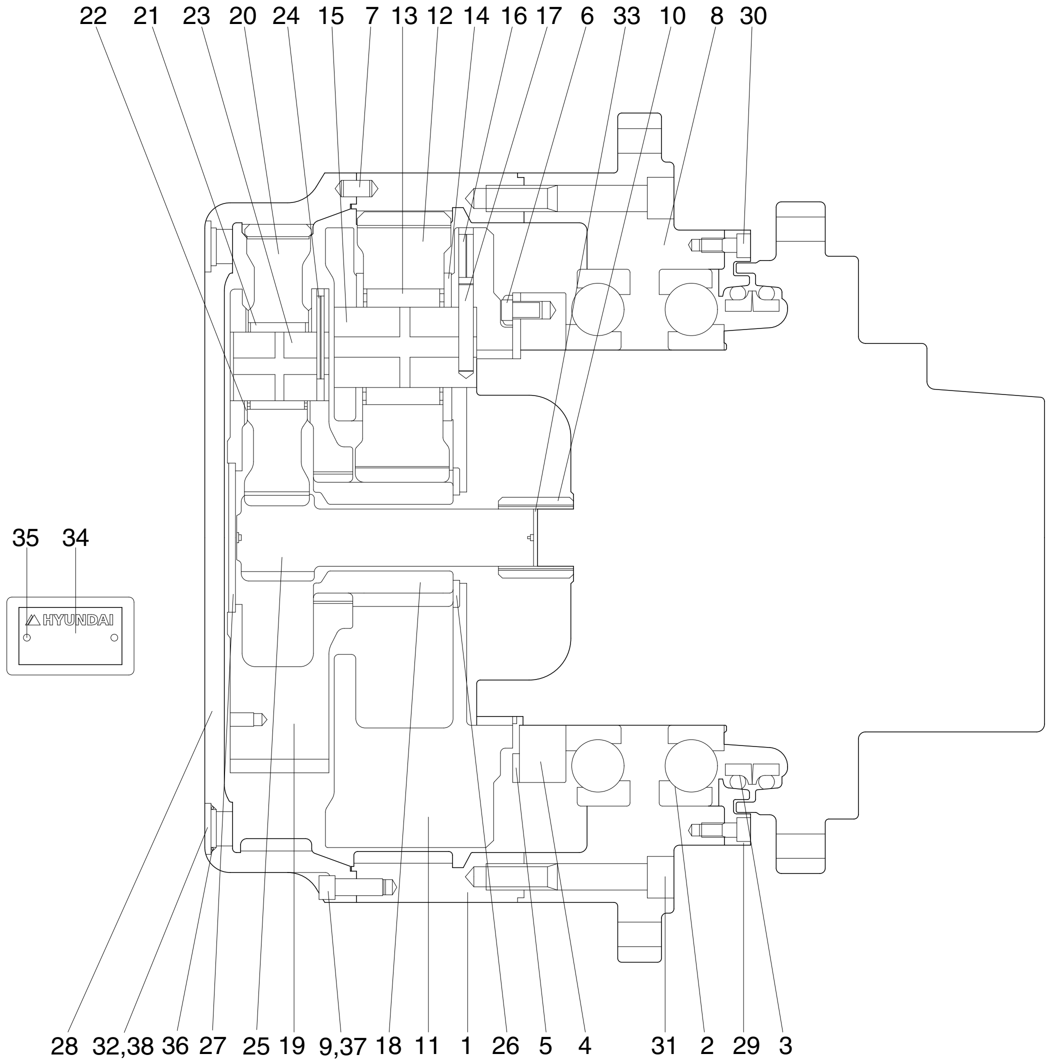
(31) Assemble relief valve assy (45) using torque wrench.

· Tightening torque : 26±2.6 kgf·m
(188±18.8 lbf·ft)



4. TRAVEL REDUCTION GEAR

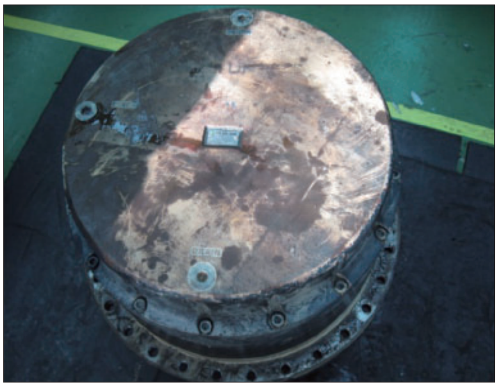
1) STRUCTURE



1	Ring gear	14	Thrust washer	27	Thrust plate
2	Ball bearing	15	Carrier pin No. 2	28	Cover
3	Floating seal assy	16	Spring pin	29	Cover seal
4	Ring nut	17	Solid pin No. 2	30	Hex socket head bolt
5	Lock plate	18	Sun gear No. 2	31	Hex socket head bolt
6	Hexagon head bolt	19	Carrier No. 1	32	Plug
7	Parallel pin	20	Planetary gear No. 1	33	Retainer ring
8	Housing	21	Needle bearing	34	Name plate
9	Hexagon socket head bolt	22	Thrust washer	35	Rivet
10	Coupling	23	Carrier pin No. 1	36	O-ring
11	Carrier No. 2	24	Spring pin	37	Rubber cap
12	Planetary gear No. 2	25	Sun gear No. 1	38	Rubber cap
13	Needle bearing	26	Thrust plate		

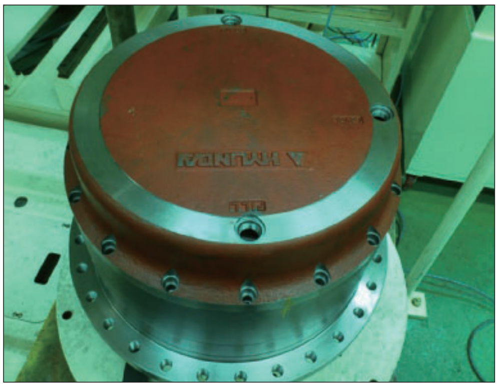
5. DISASSEMBLY OF REDUCTION GEAR

1) READY FOR DISASSEMBLING



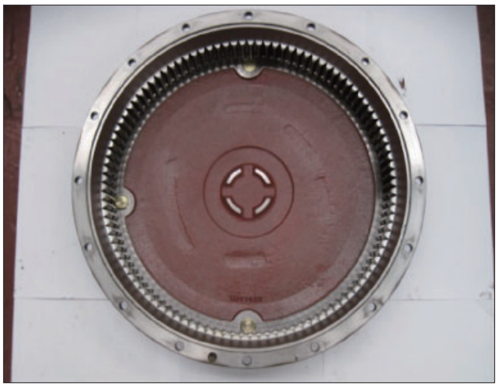
(1) Reduction gear removed from machine usually covered with dirt, so clean it with cleaning liquid and dry it.
(2) Put reduction gear on stable place with drain port down side and remove oil plug (PF3/4) to pull-out gear oil through drain port.
※ When the oil is hot, there are high chance to blow out 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.

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.

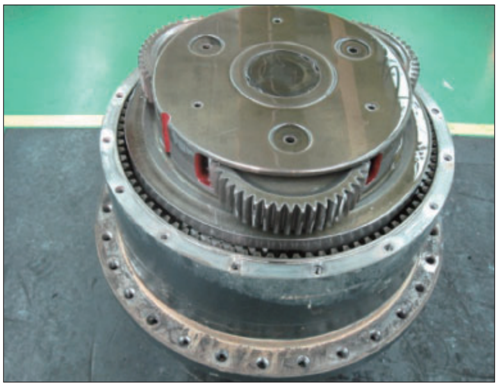
3) COVER REMOVE



(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.

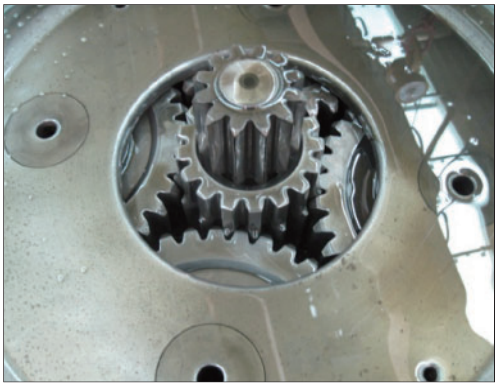
4) REMOVE THRUST PLATE AND NO.1 CARRIER SUB

(1) Remove thrust plate first, set eye bolt (M10) in No.1 carrier tap hole. After these, pull-up No.1 carrier assy slowly.



(2) Remove No.1 sun gear from reduction gear slowly.

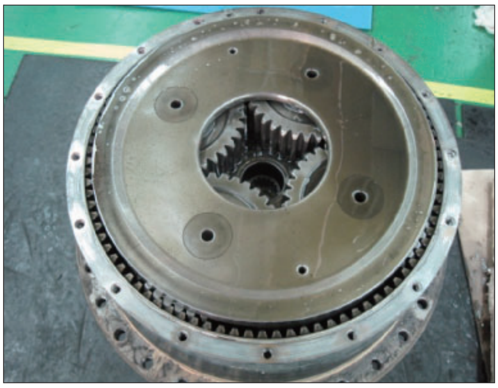
※ When disassemble No.1 sun gear, be sure to keep vertical against ground with No.1 sun gear.



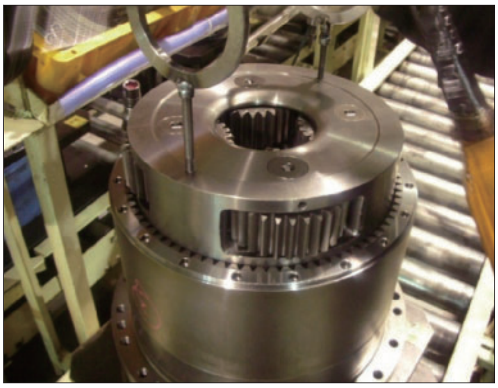
5) REMOVE NO.2 CARRIER SUB

(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.

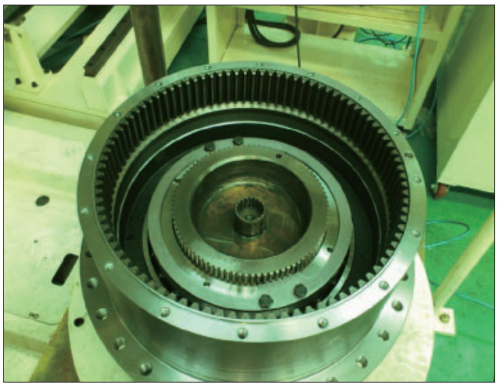


(2) Set eye bolt (M10) in No.2 carrier assy, pull-up slowly.



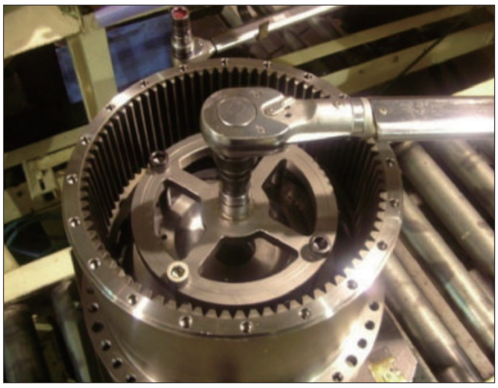
6) REMOVE COUPLING

(1) Remove coupling on motor spline.

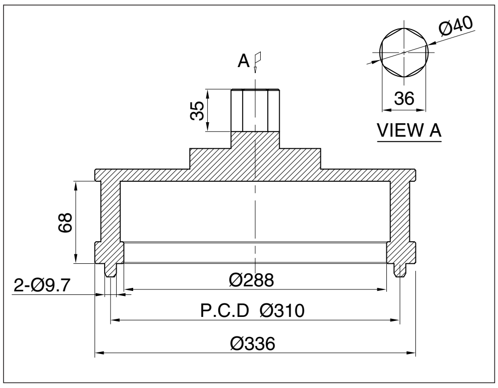


7) REMOVE RING NUT AND LOCK PLATE

(1) Remove hex head bolt (M12×20L) using torque wrench which is connecting ring nut and lock plate.
(2) Remove lock plate from motor casing spline.

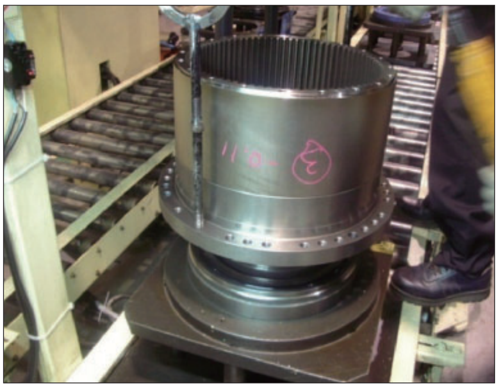


(3) Remove ring nut using designed tools.



8) DISASSEMBLE RING GEAR AND HOUSING

(1) Set eye bolt (M20) in flange of housing, pulling ring gear and housing from motor.

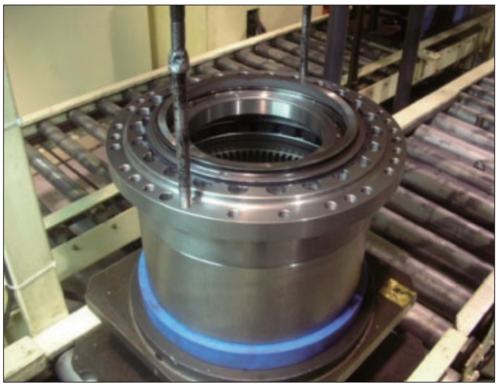


(2) Put disassembled ring gear and housing on work table. Be sure to set floating seal upper side, and remove floating seal.

※ Do not re-use floating seal.

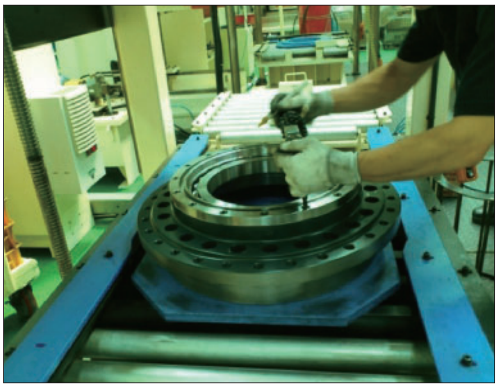
(3) Remove hex socket head bolt (M20×120L) connecting housing and ring gear using torque wrench.

(4) Put sharp tool into gap between ring gear and housing and tap it tenderly to separate gear and housing.



9) DISASSEMBLE HOUSING COMPONENTS

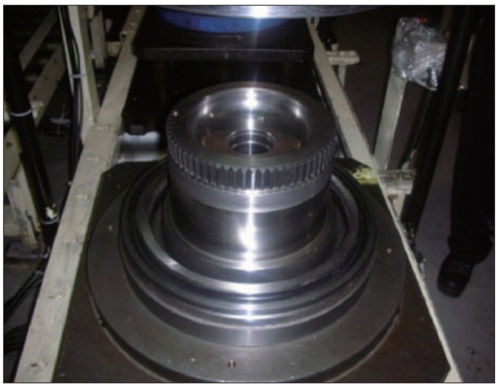
Hex socket head bolt (M10×25L) connecting housing and seal cover using torque wrench, and remove seal cover.



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.



11) NO.1 CARRIER ASS'Y DISASSEMBLE

(1) Put spring pin into spring pin hole using specia-lly designed tool.

(2) Disassemble No.1 planetary gear, thrust washer, spring pin, needle bearing form No.1 carrier.

※ Do not re-use spring pin.

12) NO.2 CARRIER ASS'Y DISASSEMBLE

(1) Cut No.2 solid pin by pressing spring pin using press machine.

⚠ **Be aware of scattering of components when operator use press machine.**

(2) Disassemble No.2 planetary gear, thrust washer, spring pin, needle bearing from No.2 carrier.

※ Do not re-use spring pin.

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.

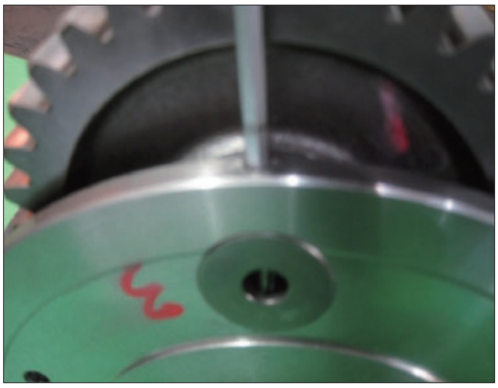
(5) Check the surface of floating seal and crack of O-ring.

2) NO.1 CARRIER ASSEMBLY

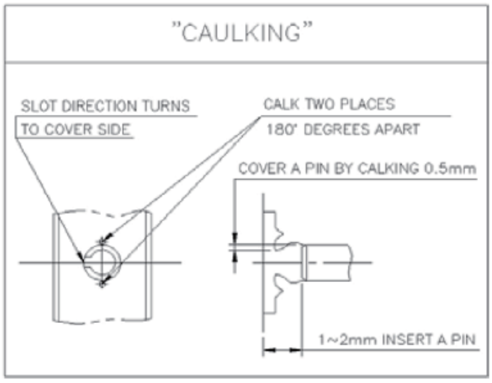
(1) Set No.1 carrier on stable and even place.
(2) Put needle bearing in No.1 planetary gear and place thrust washer 2 pcs on both side of gear. Assemble gear in carrier.

(3) Align spring pin with No.1 carrier spring pin hole and assemble spring pin accordingly.

(4) Put spring pin into No.1 carrier using jig with force.



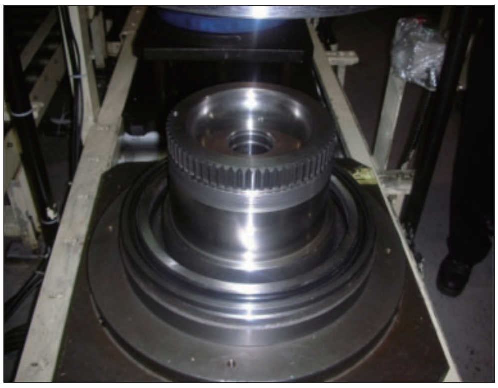
(5) Caulking both side of pressed spring pin 180˚ using caulking jig.



3) NO.2 CARRIER ASSEMBLY

(1) Set No.2 carrier on stable and even place.
(2) Put needle bearing in No.2 planetary gear and place thrust washer 2 pcs on both side of gear. Assemble gear in carrier.
(3) Align solid pin hole of spring pin and No.2 carrier spring pin hole. and assemble spring pin accordingly.
(4) After assembly solid pin, put spring pin with force.
(5) Caulking both sides of pressed spring pin 180˚ using caulking jig.

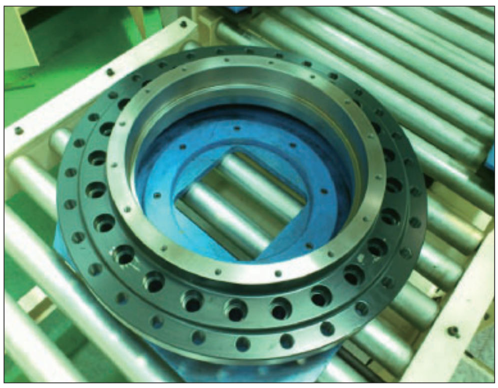
4) FLOATING SEAL ASSEMBLY



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.

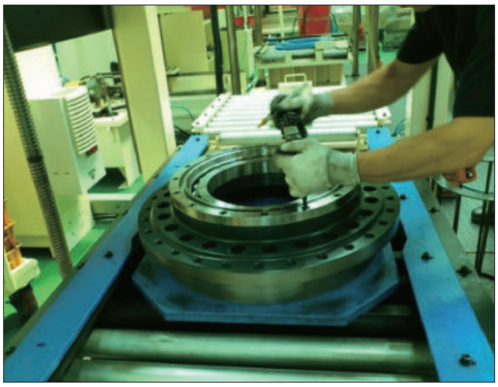
5) HOUSING & MAIN BEARING ASSEMBLY



(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.

6) SEAL COVER ASSEMBLY

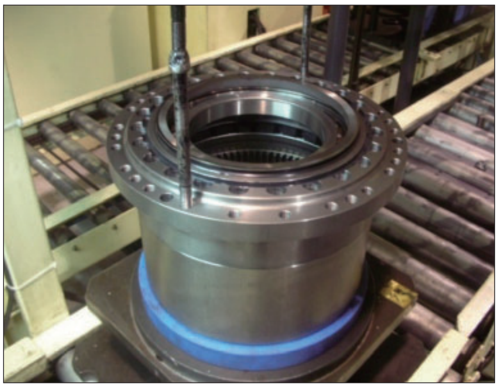
Apply three bond #1194 on contact surface of housing and seal cover, tighten hex socket head bolt (M10×25L) with designed torque 6.3±0.6 kgf · m (45.6±4.3 lbf · ft) using torque wrench.



7) HOUSING COMPONENTS AND RING GEAR ASSEMBLY

(1) Apply three bond #1194 on the surface of ring gear and housing contact surface, tighten hex socket head bolt (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.

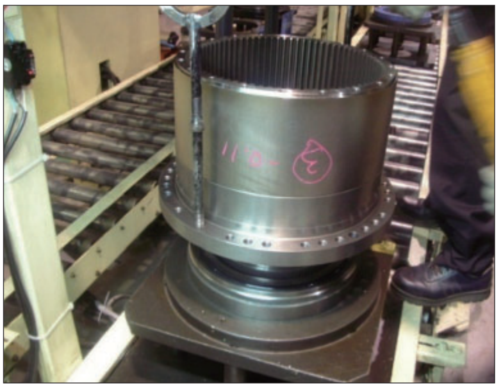


8) MOTOR & ASSEMBLED HOUSING COMPONENTS ASSEMBLY

(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.

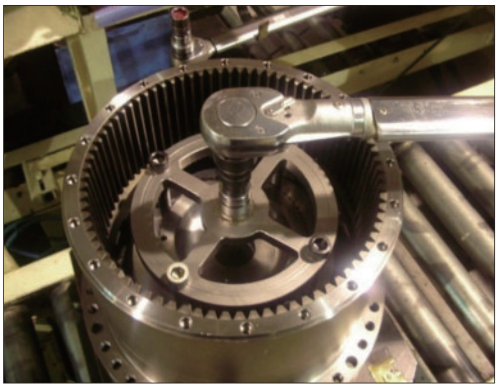


9) NUT RING AND LOCK PLATE ASSEMBLY

(1) Tighten nut ring with designed torque using torque wrench.

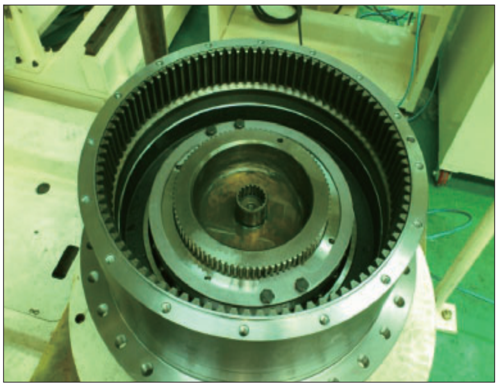
(2) Set lock plate along with bolt hole of nut ring and assemble them.

(3) Tighten hex head bolt (M12×20L) with designed torque 8.8±0.9 kgf · m (63.6±6.5 lbf · ft).



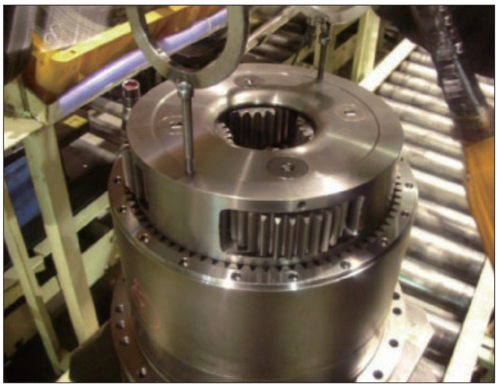
10) COUPLING ASSEMBLY

Assemble coupling with motor's spline.

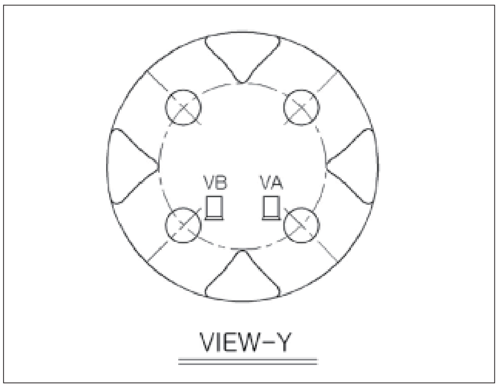


11) NO.2 CARRIER SUB ASSEMBLY

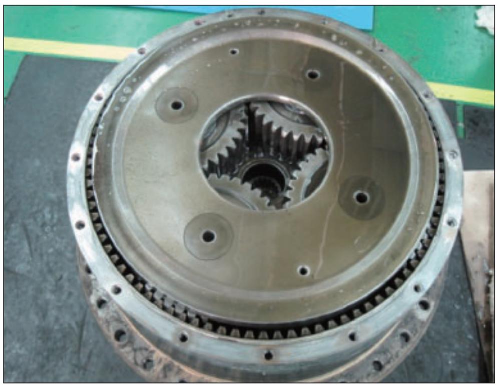
(1) Set eye bolt (M10) in No.2 carrier assy, lift them using hoist and set down No.2 carrier assy into motor.



※ To set the align valve ports, refer to right drawing.

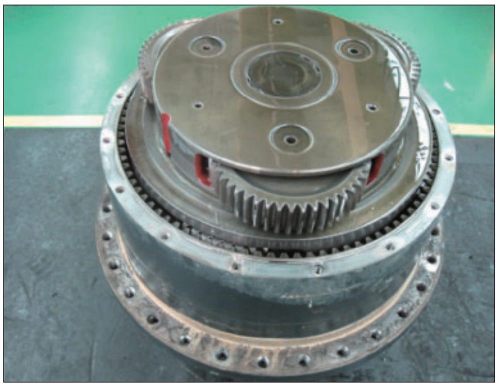


(2) Assemble No.2 sun gear into No.2 carrier assy.



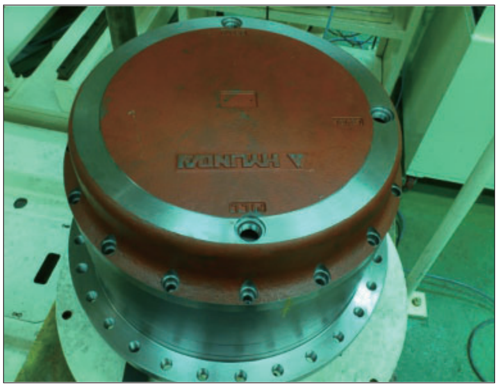
12) NO.1 CARRIER SUB ASSEMBLY

(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.



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 hex socket head bolt (M12×35L) with designed torque 14.3±1.4 kgf · m (103±10.1 lbf · ft) using torque wrench.



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±1.0 kgf · m (72.3±7.2 lbf · ft).

GROUP 7 RCV LEVER

1. REMOVAL AND INSTALL

1) REMOVAL

(1) Lower the work equipment to the ground and stop the engine.

(2) Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

(3) Loosen the breather slowly to release the pressure inside the hydraulic tank.

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

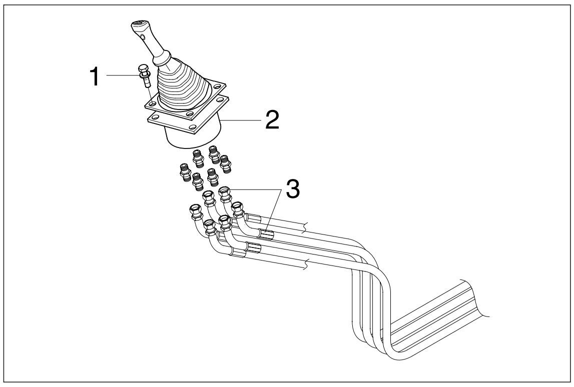
(4) Loosen the socket bolt (1).

(5) Remove the cover of the console box.

(6) Disconnect pilot line hoses (3).

(7) Remove the pilot valve assembly (2).

※ When removing the pilot valve assembly, check that all the hoses have been disconnected.



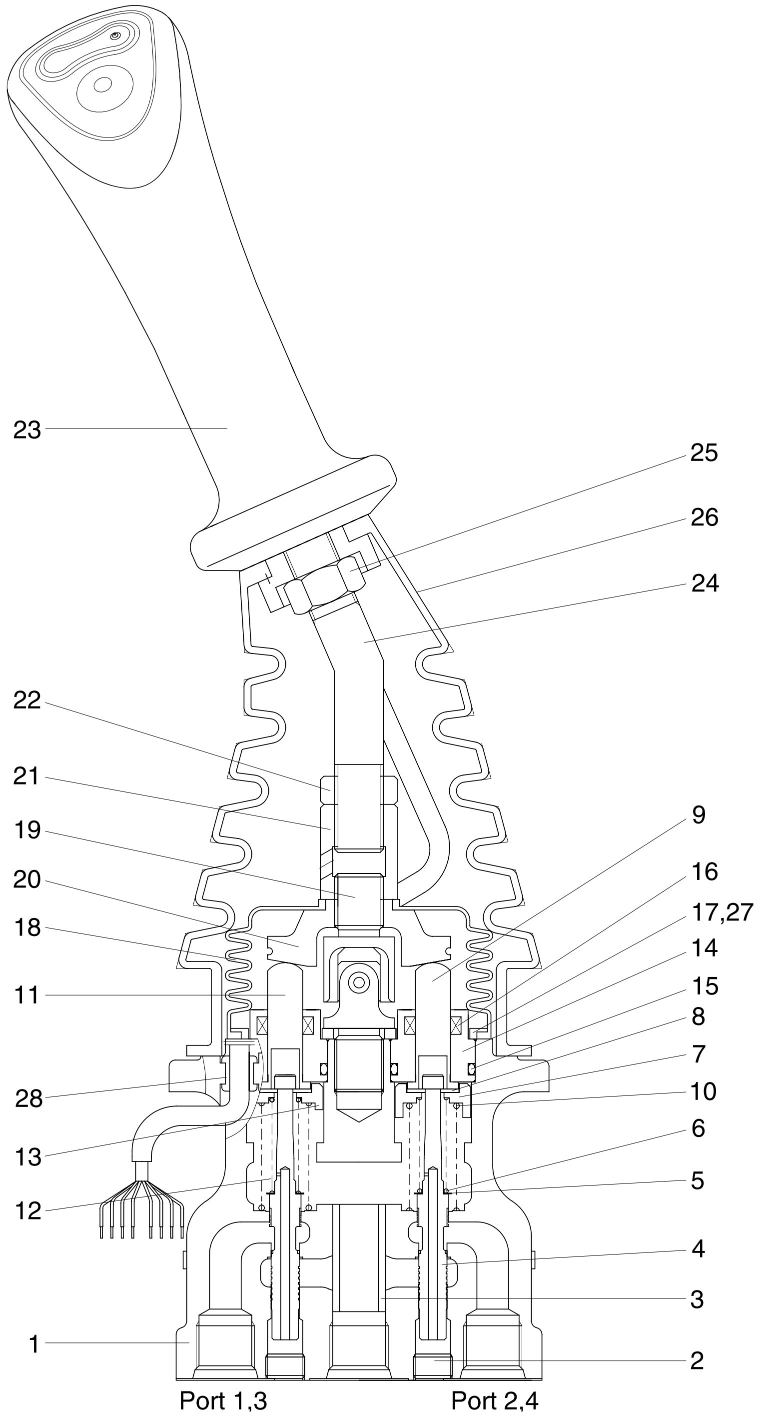
2) INSTALL

(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

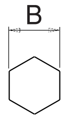
1) STRUCTURE



1	Case	8	Stopper	15	O-ring	22	Lock nut
2	Plug	9	Push rod	16	Rod seal	23	Handle assembly
3	Bushing	10	Spring	17	Plate	24	Handle bar
4	Spool	11	Push rod	18	Boot	25	Nut
5	Shim	12	Spring	19	Joint assembly	26	Boot
6	Spring	13	Spring seat	20	Swash plate	27	Spring pin
7	Spring seat	14	Plug	21	Adjusting nut	28	Bushing

2) TOOLS AND TIGHTENING TORQUE

(1) Tools

Tool name	Remark	
Allen wrench	6	
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
Plug	2	PT 1/8	3.0	21.7
Joint	19	M14	3.5	25.3
Swash plate	20	M14	5.0±0.35	36.2±2.5
Adjusting nut	21	M14	5.0±0.35	36.2±2.5
Lock nut	22	M14	5.0±0.35	36.2±2.5

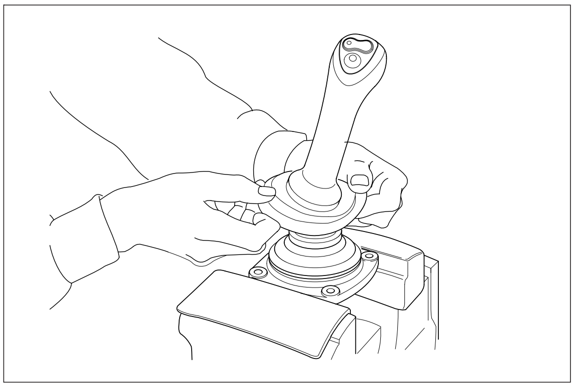
3) DISASSEMBLY

(1) Clean pilot valve with kerosene.

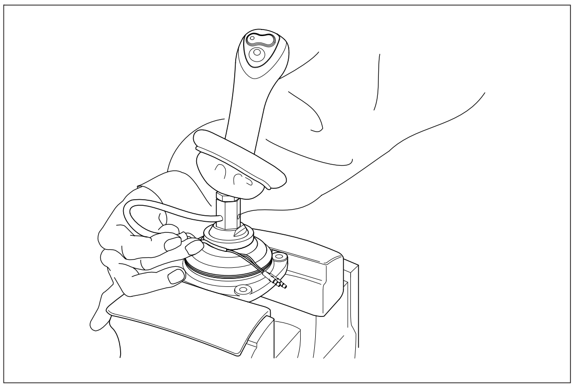
※ Put blind plugs into all ports

(2) Fix pilot valve in a vise with copper (or lead) sheets.

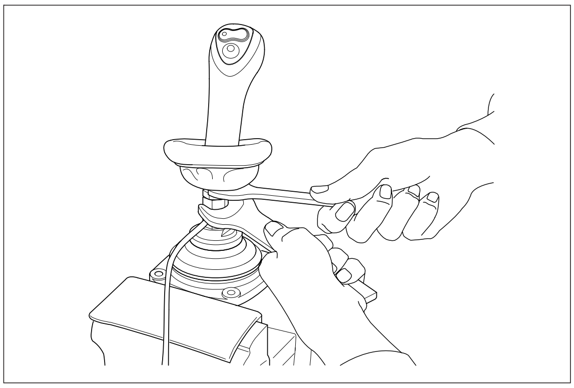
(3) Remove end of boot (26) from case (1) and take it out upwards.



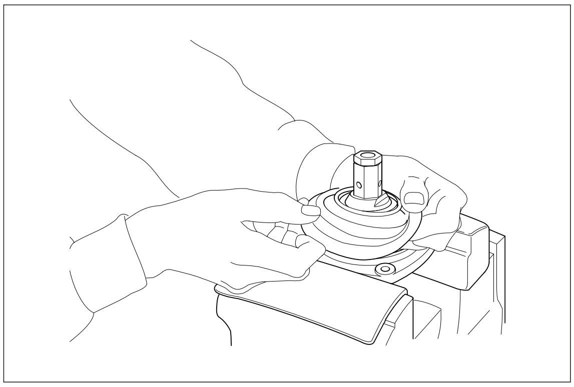
※ For valve with switch, remove cord also through hole of casing.



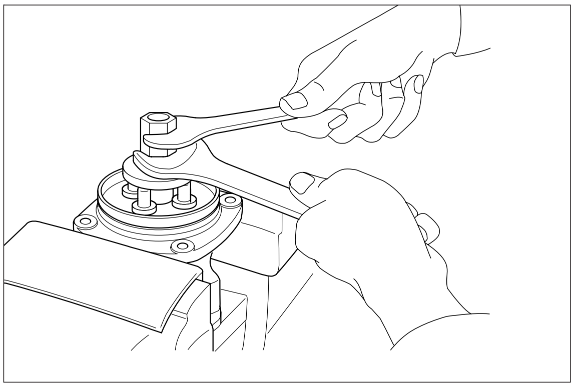
(4) Loosen lock nut (22) and adjusting nut (21) with spanners on them respectively, and take out handle section as one body.

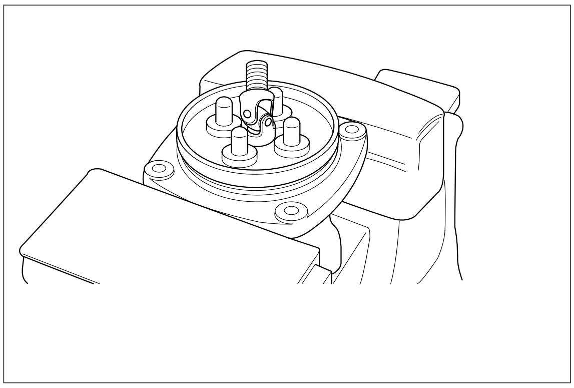


(5) Remove the boot (18).



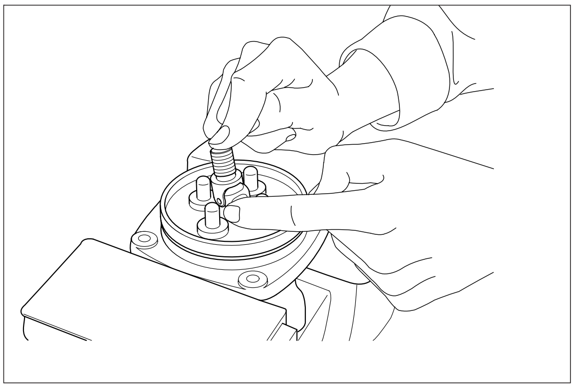
(6) Loosen adjusting nut (21) and swash plate (20) with spanners on them respectively, and remove them.

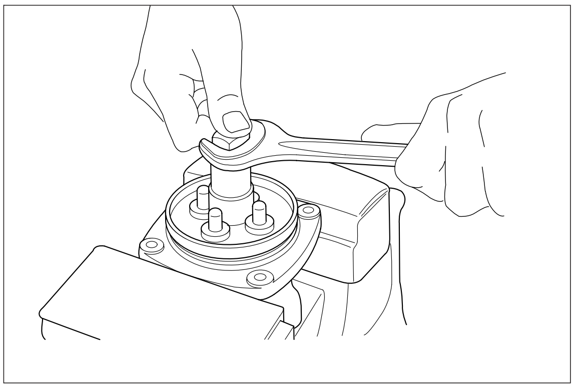




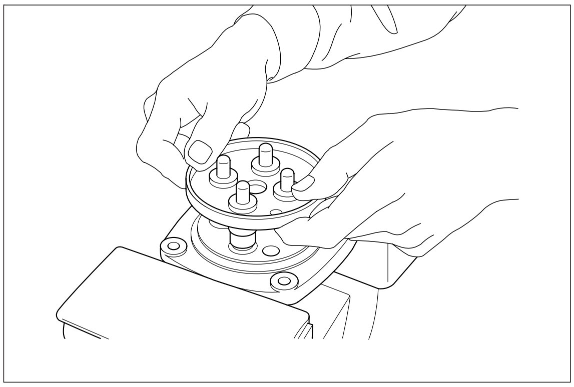
(7) Turn joint anticlockwise to loosen it, utilizing jig (Special tool).

※ When return spring (10) is strong in force, plate (17), plug (14) and push rod (11) will come up on loosening joint.
Pay attention to this.





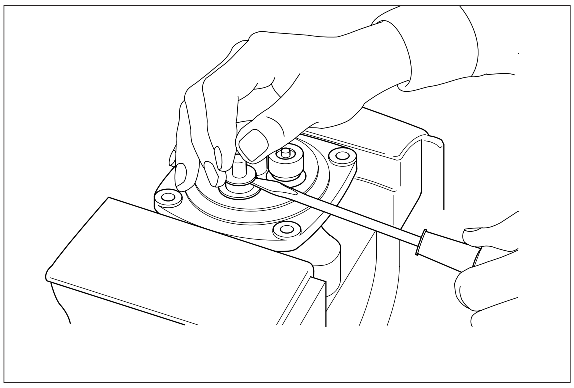
(8) Remove plate (17).



(9) When return spring (10) is weak in force, plug (14) stays in casing because of sliding resistance of O-ring.

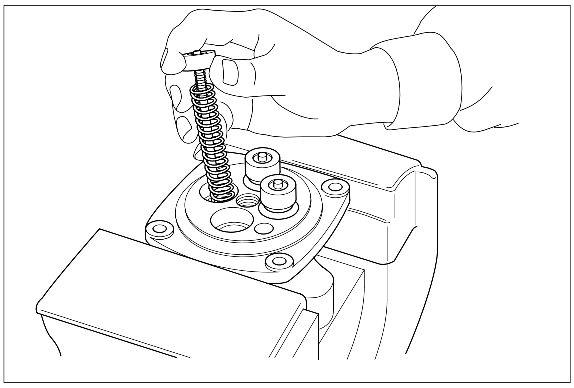
※ Take it out with minus screwdriver. Take it out, utilizing external periphery groove of plug and paying attention not to damage it by partial loading.

※ During taking out, plug may jump up due to return spring (10) force. Pay attention to this.

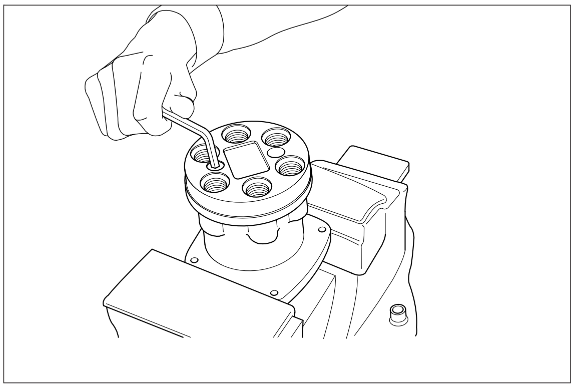


(10) Remove reducing valve subassembly and return spring (10) out of casing.

※ Record relative position of reducing valve subassembly and return springs.



(11) Loosen hexagon socket head plug(2) with hexagon socket screw key.

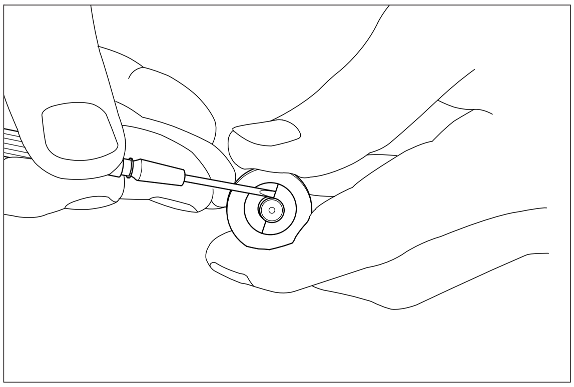


(12) For disassembling reducing valve section, stand it vertically with spool (4) bottom placed on flat workbench. Push down spring seat (7) and remove two pieces of semicircular stopper (8) with tip of small minus screwdriver.

※ Pay attention not to damage spool surface.

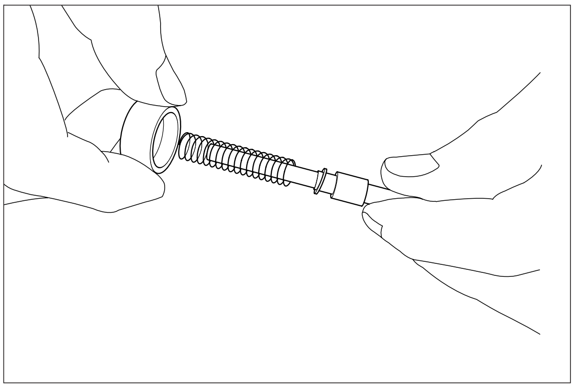
※ Record original position of spring seat (7).

※ Do not push down spring seat more than 6㎜.

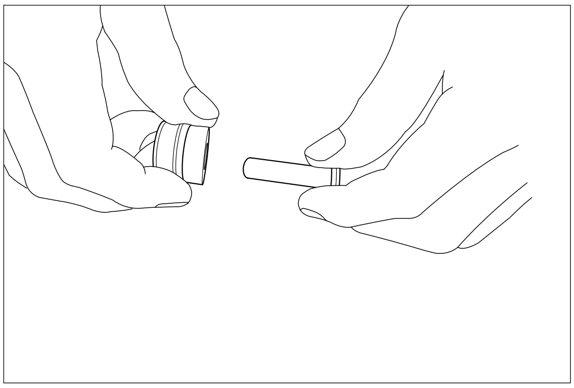


(13) Separate spool (4), spring seat (7), spring (6) and shim (5) individually.

※ Until being assembled, they should be handled as one subassembly group.

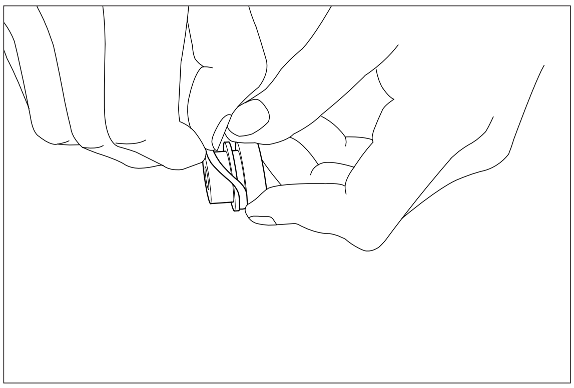


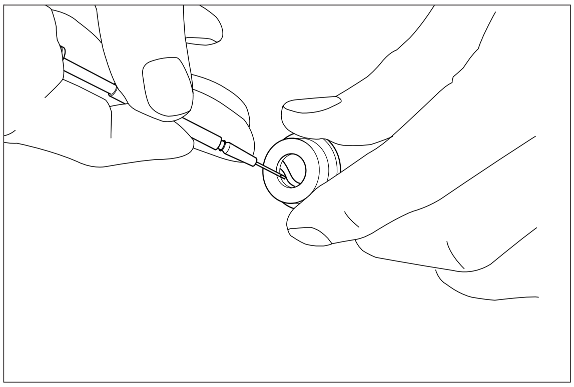
(14) Take push rod (11) out of plug (14).



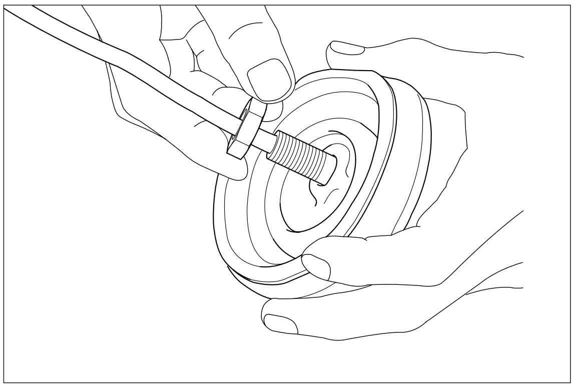
(15) Remove O-ring (15) and seal (16) from plug (14).

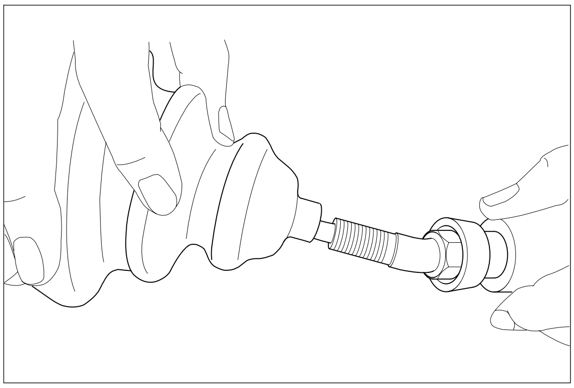
Use small minus screwdriver or so on to remove this seal.





(16) Remove lock nut (22) and then boot (26).





(16) Cleaning of parts

① Put all parts in rough cleaning vessel filled with kerosene and clean them (rough cleaning).

※ If dirty part is cleaned with kerosene just after putting it in vessel, it may be damaged. Leave it in kerosene for a while to loosen dust and dirty oil.

※ If this kerosene is polluted, parts will be damaged and functions of reassembled valve will be degraded.
Therefore, control cleanliness of kerosene fully.

② Put parts in final cleaning vessel filled with kerosene, turning it slowly to clean them even to their insides (finish cleaning).

※ Do not dry parts with compressed air, since they will be damaged and/or rusted by dust and moisture in air.

(17) Rust prevention of parts

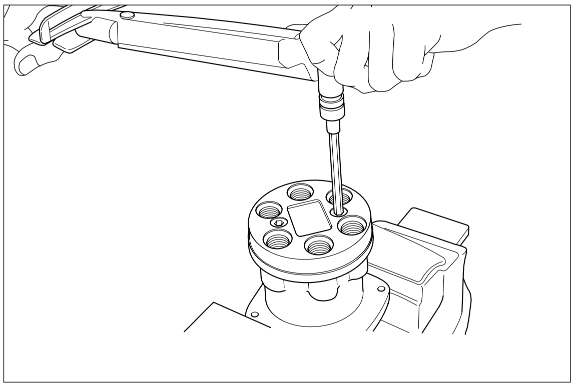
Apply rust-preventives to all parts.

※ If left as they after being cleaned, they will be rusted and will not display their functions fully after being reassembled.

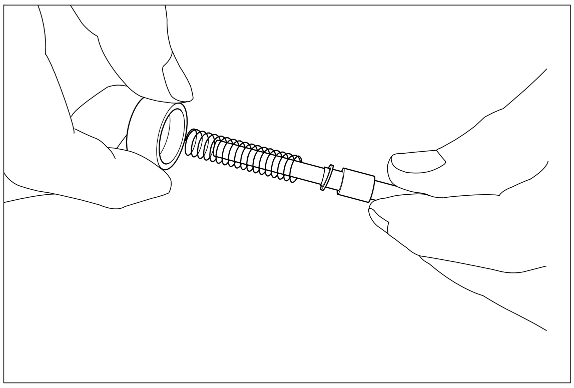
4) ASSEMBLY

(1) Tighten hexagon socket head plug (2) to the specified torque.

※ Tighten two bolts alternately and slowly.

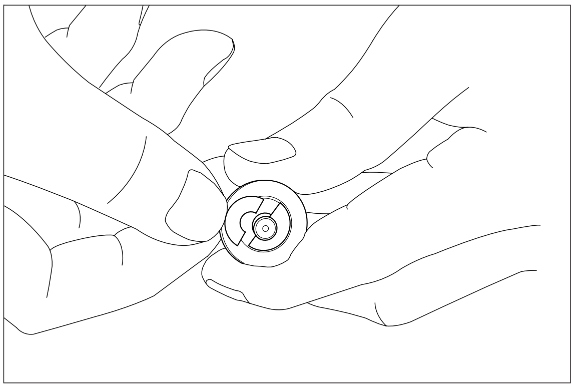


(2) Put shim (5), springs (6) and spring seat (7) onto spool (4) in this order.



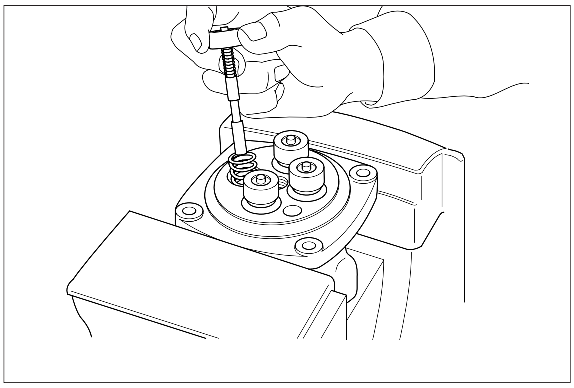
(3) Stand spool vertically with its bottom placed on flat workbench, and with spring seat pushed down, put two pieces of semicircular stopper (8) on spring seat without piling them on.

※ Assemble stopper (8) so that its sharp edge side will be caught by head of spool. Do not push down spring seat more than 6mm.

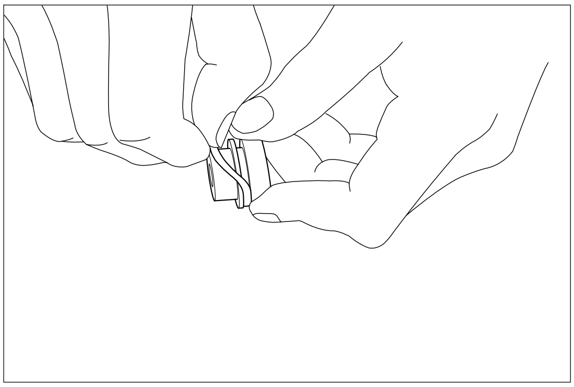


(4) Assemble spring (10) into casing (1). Assemble reducing valve subassembly into casing.

※ Assemble them to their original positions.

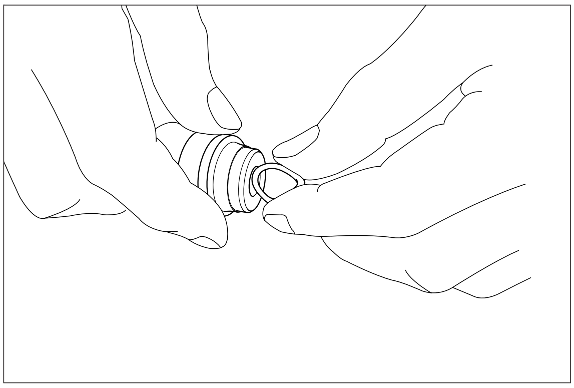


(5) Assemble O-ring (15) onto plug (14).



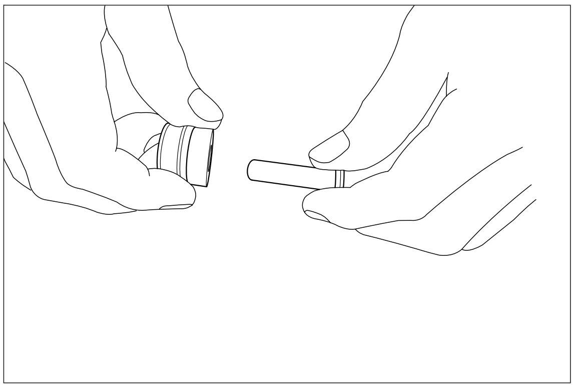
(6) Assemble seal (16) to plug (14).

※ Assemble seal in such lip direction as shown below.



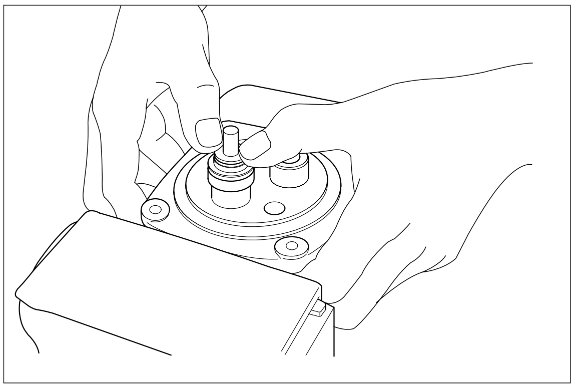
(7) Assemble push rod (11) to plug (14).

※ Apply working oil on push-rod surface.

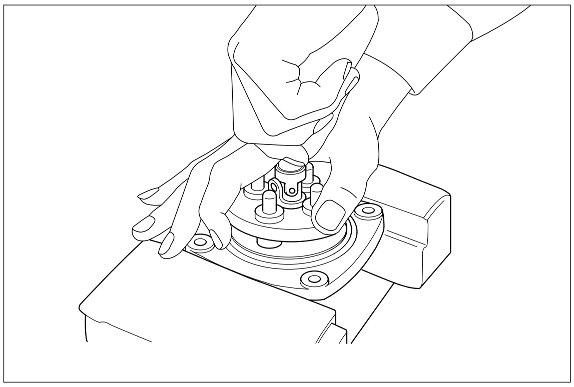


(8) Assemble plug subassembly to casing.

※ When return spring is weak in force, subassembly stops due to resistance of O-ring.

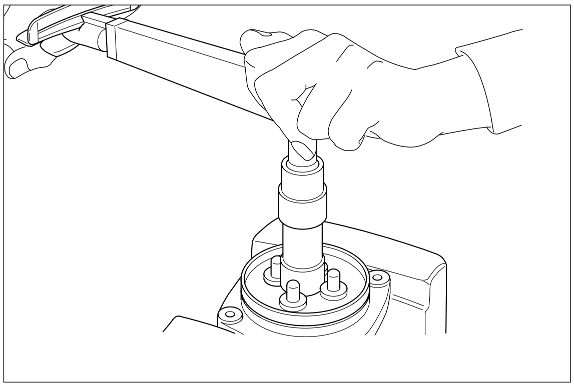


(9) When return spring is strong in force, assemble 4 sets at the same time, utilizing plate (17), and tighten joint (19) temporarily.



(10) Fit plate (17).

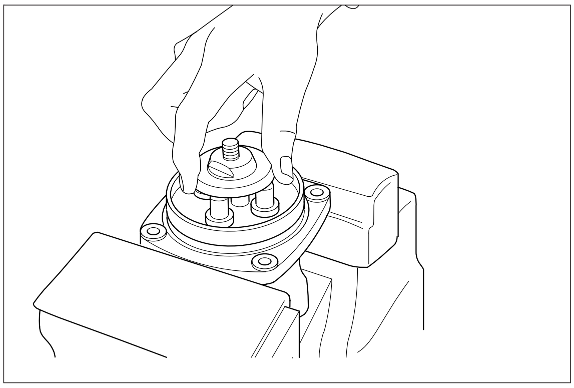
(11) Tighten joint (19) with the specified torque to casing, utilizing jig.



(12) Assemble swash plate (20) to joint (19).

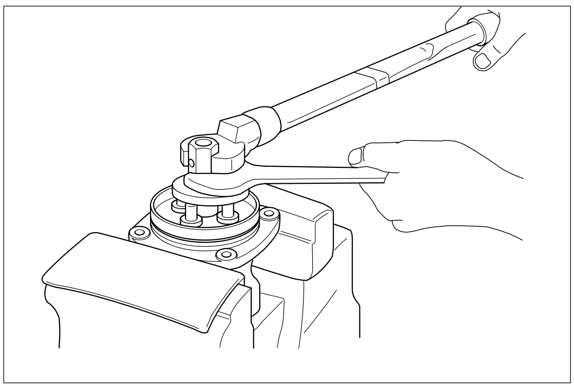
※ Screw it to position that it contacts with 4 push rods evenly.

※ Do not screw it over.

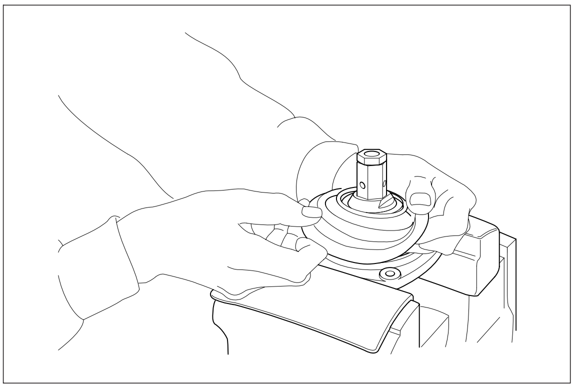


(13) Assemble adjusting nut (21), apply spanner to width across flat of plate (20) to fix it, and tighten adjusting nut to the specified torque.

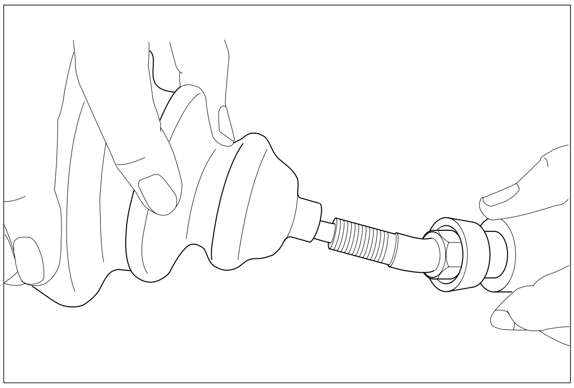
※ During tightening, do not change position of disk.

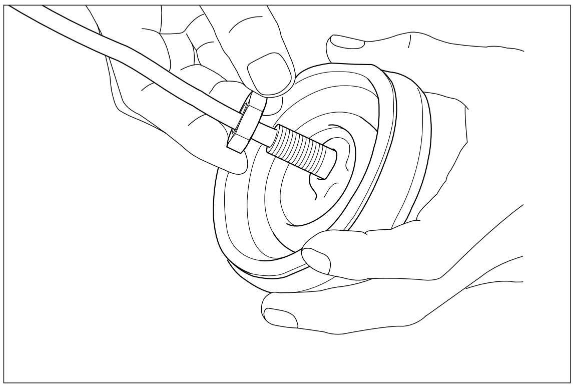


(14) Fit boot (18) to plate.

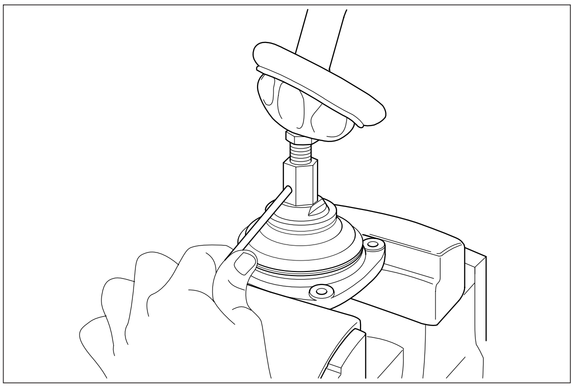


(15) Fit boot (26) and lock nut (22), and handle subassembly is assembled completely.



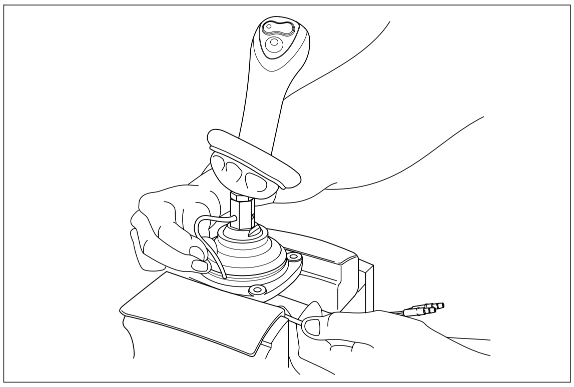


(16) Pull out cord and tube through adjusting nut hole provided in direction 60° to 120° from casing hole.

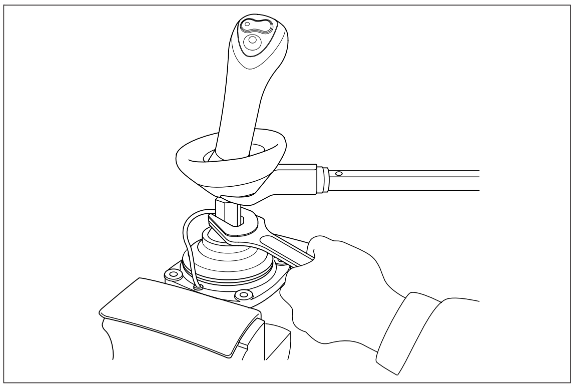


(17) Assemble bushing (27) to plate and pass cord and tube through it.

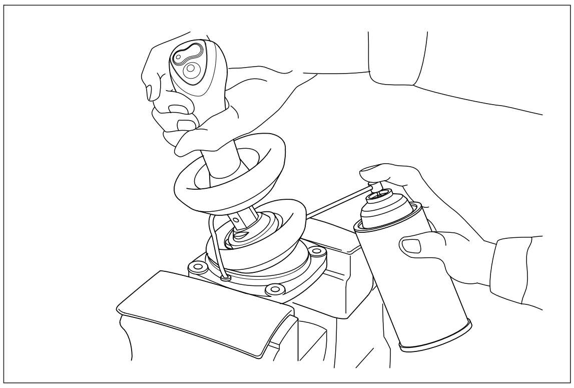
※ Provide margin necessary to operation.



(18) Determine handle direction, tighten lock nut (22) to specified torque to fix handle.

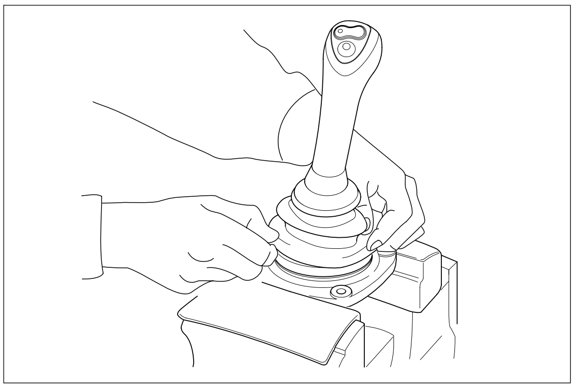


(19) Apply grease to rotating section of joint and contacting faces of disk and push rod.



(20) Assemble lower end of bellows to casing.

(21) Inject volatile rust-preventives through all ports and then put blind plugs in ports.



GROUP 8 TURNING JOINT

1. REMOVAL AND INSTALL

1) REMOVAL

(1) Lower the work equipment to the ground and stop the engine.

(2) Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

(3) Loosen the breather slowly to release the pressure inside the hydraulic tank.

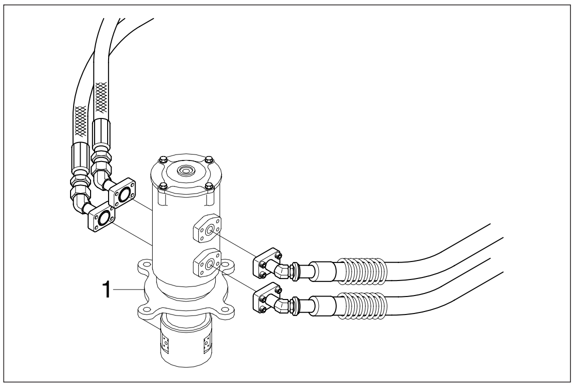
⚠ **Escaping fluid under pressure can penetrate the skin causing serious injury.**

※ When pipes and hoses are disconnected, the oil inside the piping will flow out, so catch it in oil pan.

(4) Disconnect all hoses .

(5) Sling the turning joint assembly (1) and remove the mounting bolt (2).

- Weight : 50 kg (110 lb)
- Tightening torque : 29.7± 45 kgf · m (215± 32.5 lbf · ft)



(6) Remove the turning joint assembly.

※ When removing the turning joint, check that all the hoses have been disconnected.

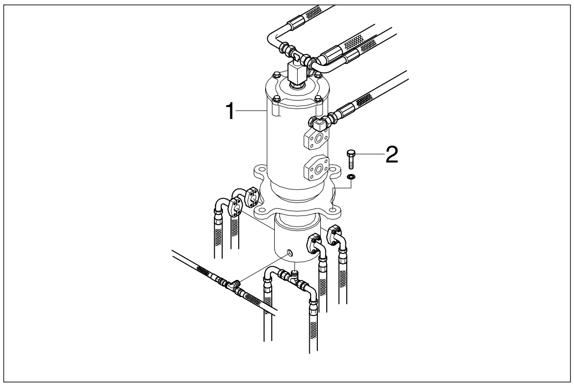
2) INSTALL

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

※ Take care of turning joint direction.

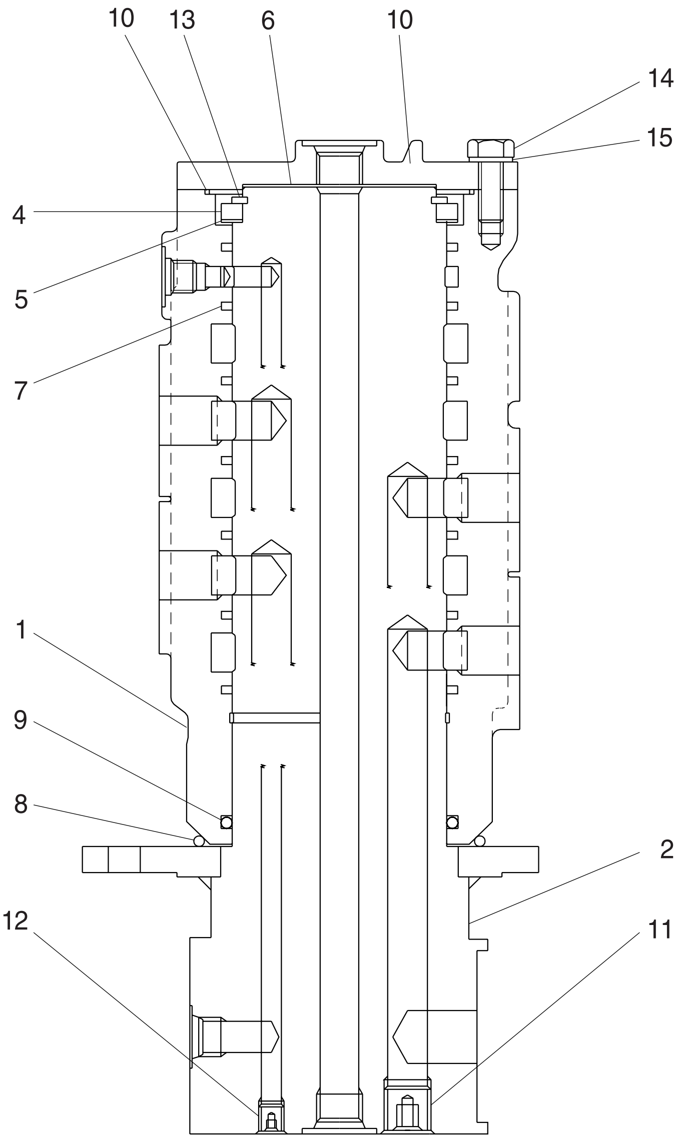
※ Assemble hoses to their original positions.

※ Confirm the hydraulic oil level and check the hydraulic oil leak or not.



2. DISASSEMBLY AND ASSEMBLY

1) STRUCTURE

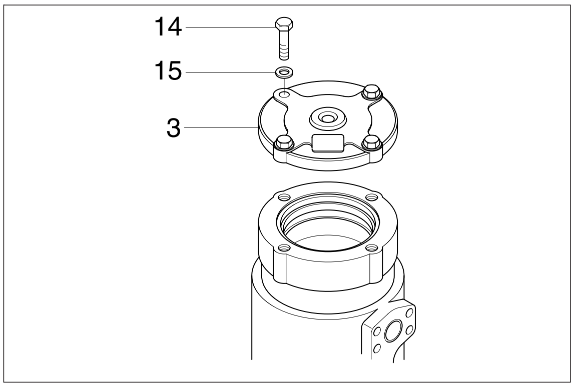


1	Hub	6	Shim	11	Plug
2	Shaft assembly	7	Slipper seal	12	Plug
3	Cover	8	O-ring	13	Retaining ring
4	Spacer	9	O-ring	14	Hexagon bolt
5	Shim	10	O-ring	15	Spring washer

2) DISASSEMBLY

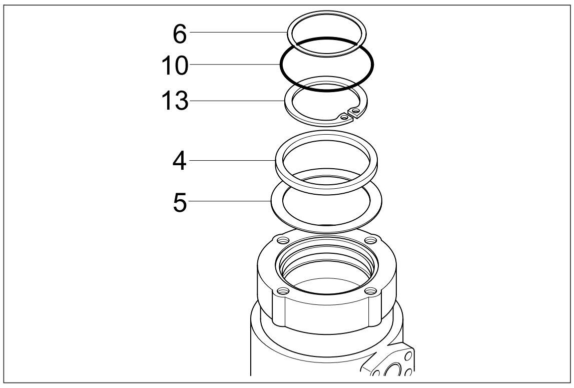
※ Before the disassembly, clean the turning joint.

(1) Remove bolts (14), washer (15) and cover(3).



(2) Remove shim (6) and O-ring (10).

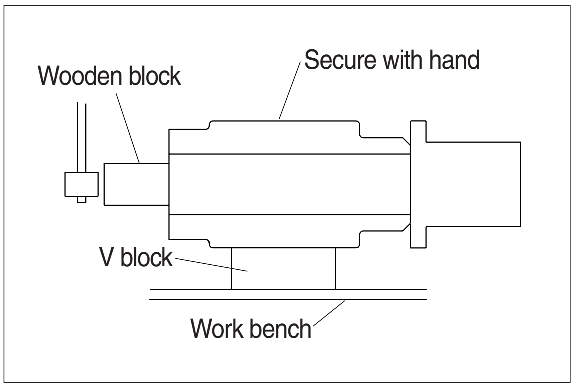
(3) Remove retainer ring (13), spacer (4) and shim (5).



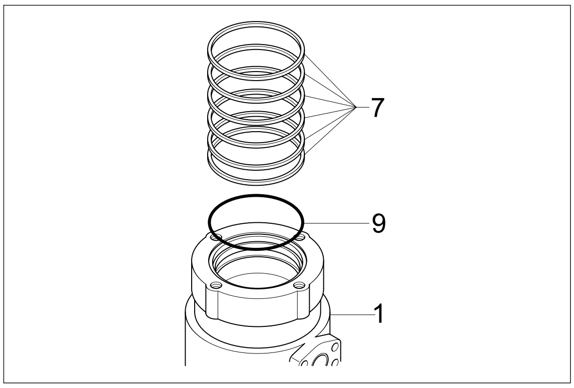
(4) Place body (1) on a V-block and by using a wood buffer at the shaft end, hit out shaft (2) to about 1/2 from the body with a hammer.

※ Take care not to damage the shaft (2) when remove body (1) or rest it sideway.

※ Put a fitting mark on body (1) and shaft (2).



(5) Remove six slipper seals (7) and O-ring (9), from body (1).

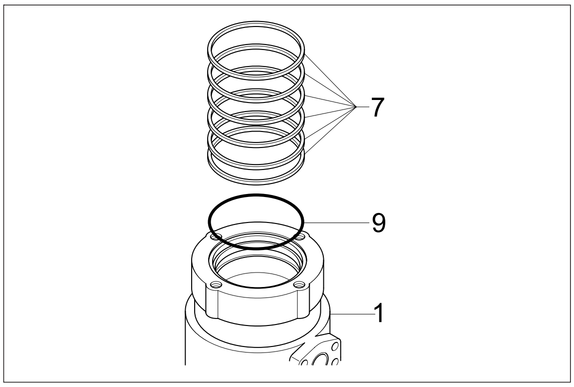


3) ASSEMBLY

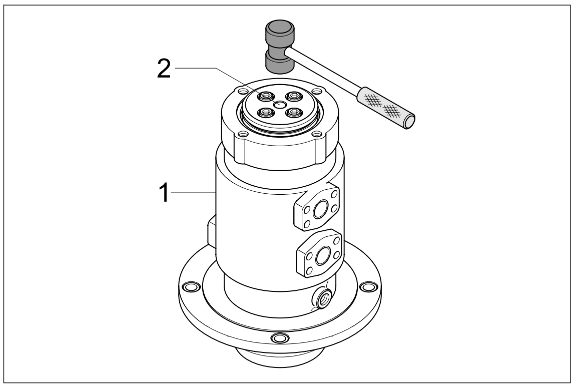
※ Clean all parts.
※ As a general rule, replace oil seals and O-ring.
※ Coat the sliding surfaces of all parts with engine oil or grease before installing.

(1) Fix seven slipper seal (7) and O-ring (9), to body (1).

(2) Fit O-ring (8) to shaft (2).



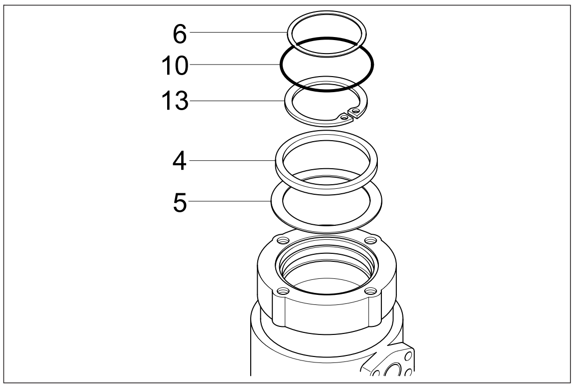
(3) Set shaft (2) on block, tap body (1) with a plastic hammer to install.



(4) Fit shim (5), spacer (4) and retainer ring (13) to shaft (2).

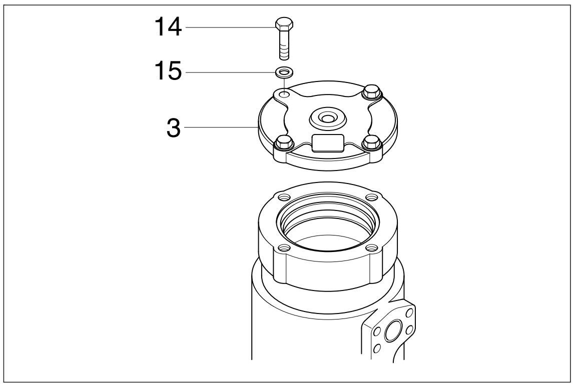
(5) Fit O-ring (10) to body (1).

(6) Fit shim (6) to shaft (2).



(7) Install cover (3) to body (1) and tighten bolts (14).

· Torque : 10~12.5 kgf · m
(72.3~90.4 lbf · ft)



GROUP 9 BOOM, ARM AND BUCKET CYLINDER

1. REMOVAL AND INSTALL

1) BUCKET CYLINDER

(1) Removal

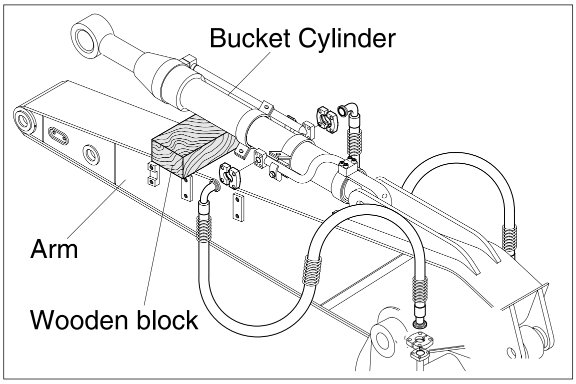
※ Expand the arm and bucket fully, lower the work equipment to the ground and stop the engine.

※ Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

⚠ Loosen the breather slowly to release the pressure inside the hydraulic tank.

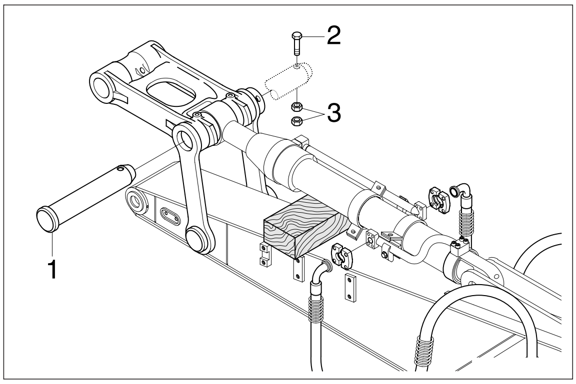
※ Escaping fluid under pressure can penetrate the skin causing serious injury. Fit blind plugs in the hoses after disconnecting them, to prevent dirt or dust from entering.

① Set block between bucket cylinder and arm.

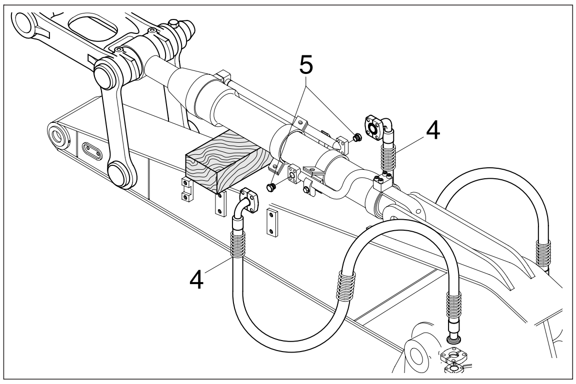


② Remove bolt (2), nut (3) and pull out pin (1).

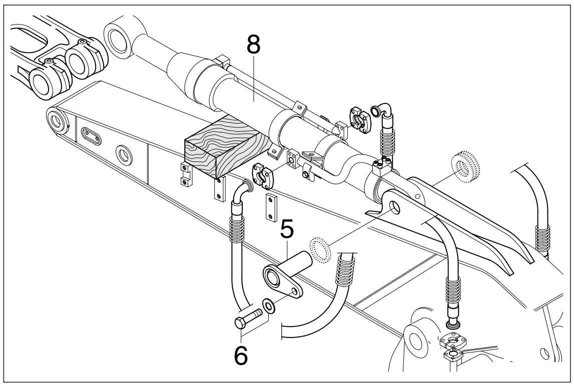
※ Tie the rod with wire to prevent it from coming out.



③ Disconnect bucket cylinder hoses (4) and put plugs (5) on cylinder pipe.



④ Sling bucket cylinder assembly (8) and remove bolt (6) then pull out pin (5).
⑤ Remove bucket cylinder assembly (8).



(2) Install
① Carry out installation in the reverse order to removal.
⚠ **When aligning the mounting position of the pin, do not insert your fingers in the pin hole.**
※ Bleed the air from the bucket cylinder.
※ Confirm the hydraulic oil level and check the hydraulic oil leak or not.

2) ARM CYLINDER

(1) Removal

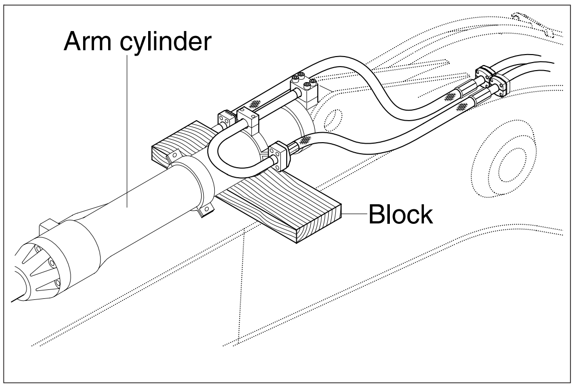
※ Expand the arm and bucket fully, lower the work equipment to the ground and stop the engine.

※ Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

⚠ Loosen the breather slowly to release the pressure inside the hydraulic tank.

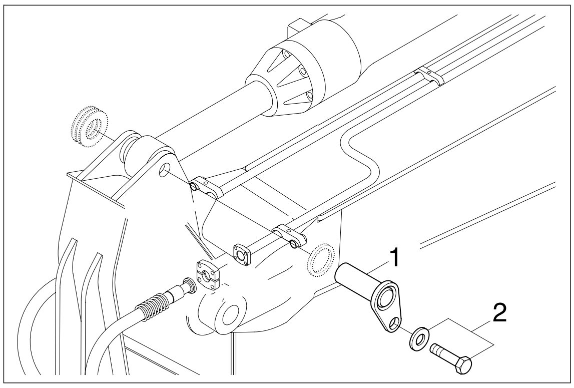
※ Escaping fluid under pressure can penetrate the skin causing serious injury. Fit blind plugs in the hoses after disconnecting them, to prevent dirt or dust from entering.

① Set block between arm cylinder and boom.



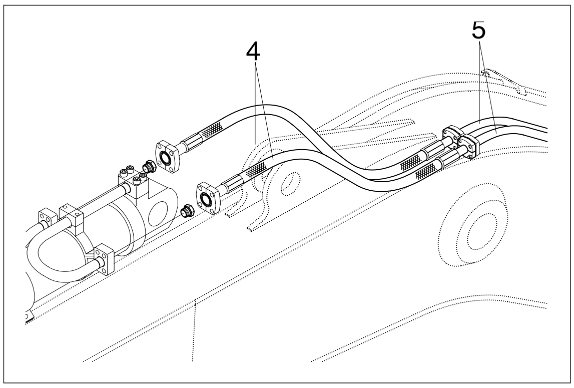
② Remove bolt (2) and pull out pin (1).

※ Tie the rod with wire to prevent it from coming out.



③ Disconnect arm cylinder hoses (4) and put plugs on cylinder pipe.

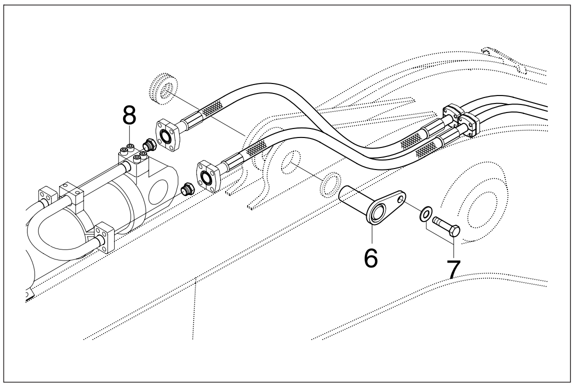
④ Disconnect greasing pipings (5).



⑤ Sling arm assembly (8) and remove bolt (7) then pull out pin (6).

⑥ Remove arm cylinder assembly (8).

· Weight : 630 ㎏ (1390 ℔)



(2) Install

① Carry out installation in the reverse order to removal.

⚠ **When aligning the mounting position of the pin, do not insert your fingers in the pin hole.**

※ Bleed the air from the arm cylinder.

※ Confirm the hydraulic oil level and check the hydraulic oil leak or not.

3) BOOM CYLINDER

(1) Removal

※ Expand the arm and bucket fully, lower the work equipment to the ground and stop the engine.

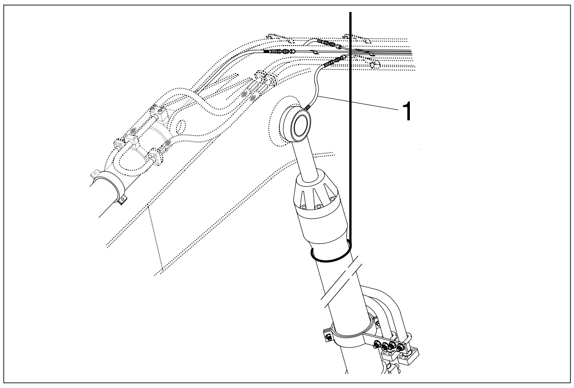
※ Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

⚠ **Loosen the breather slowly to release the pressure inside the hydraulic tank.**

※ Escaping fluid under pressure can penetrate the skin causing serious injury. Fit blind plugs in the hoses after disconnecting them, to prevent dirt or dust from entering.

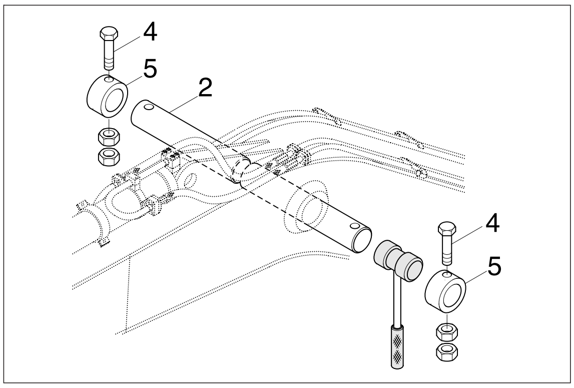
① Disconnect greasing hoses (1).

② Sling boom cylinder assembly.

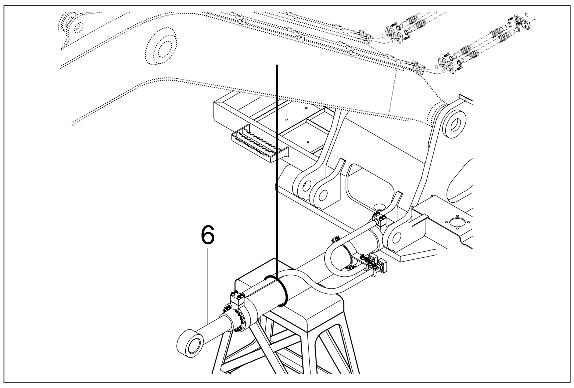


③ Remove bolt (4), pin stopper (5) and pull out pin (2).

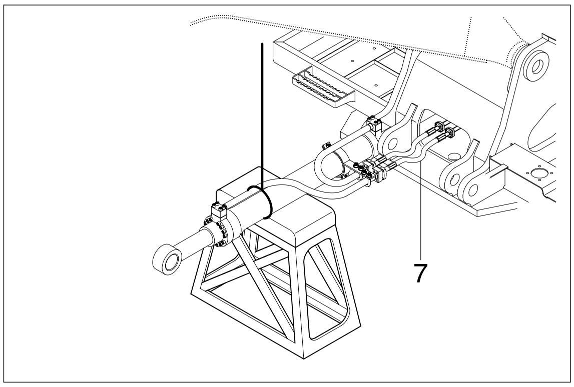
※ Tie the rod with wire to prevent it from coming out.



④ Lower the boom cylinder assembly (6) on a stand.



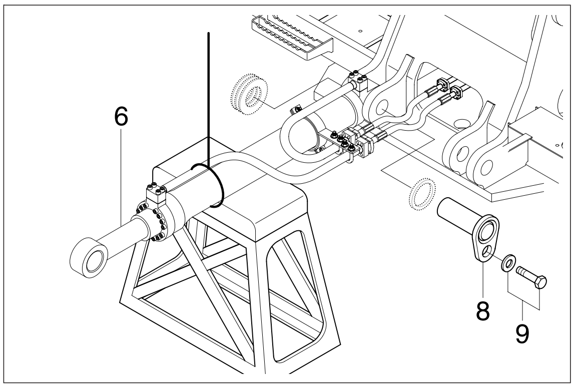
⑤ Disconnect boom cylinder hoses (7) and put plugs on cylinder pipe.



⑥ Remove bolt (9) and pull out pin (8).

⑦ Remove boom cylinder assembly (6).

· Weight : 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.

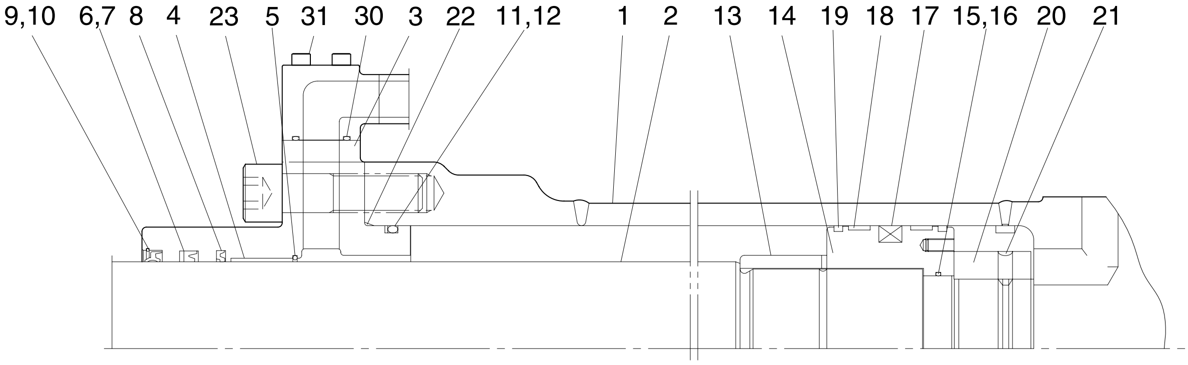
※ Bleed the air from the boom cylinder.

※ Conformed the hydraulic oil level and check the hydraulic oil leak or not.

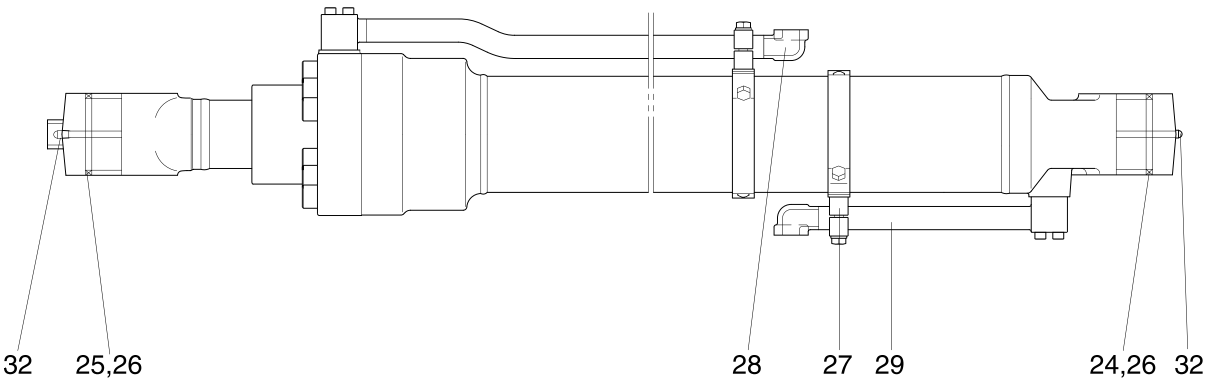
2. DISASSEMBLY AND ASSEMBLY

1) STRUCTURE

(1) Bucket cylinder

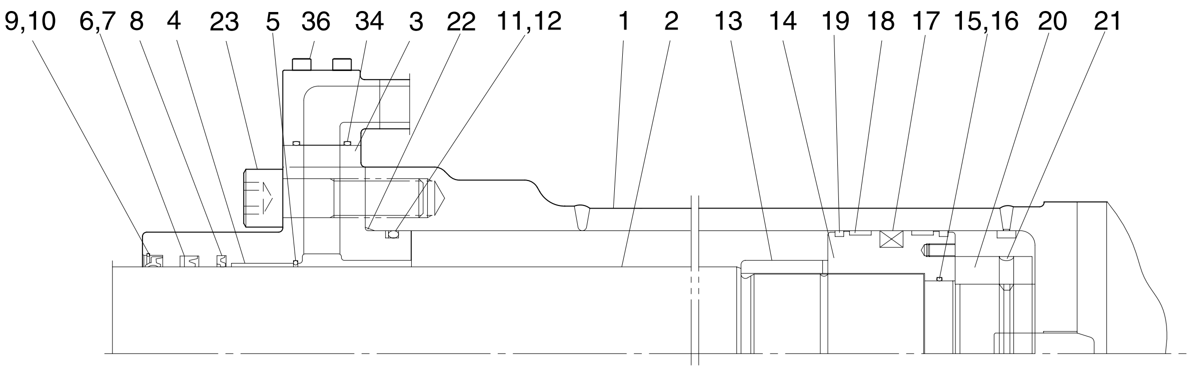


Internal detail

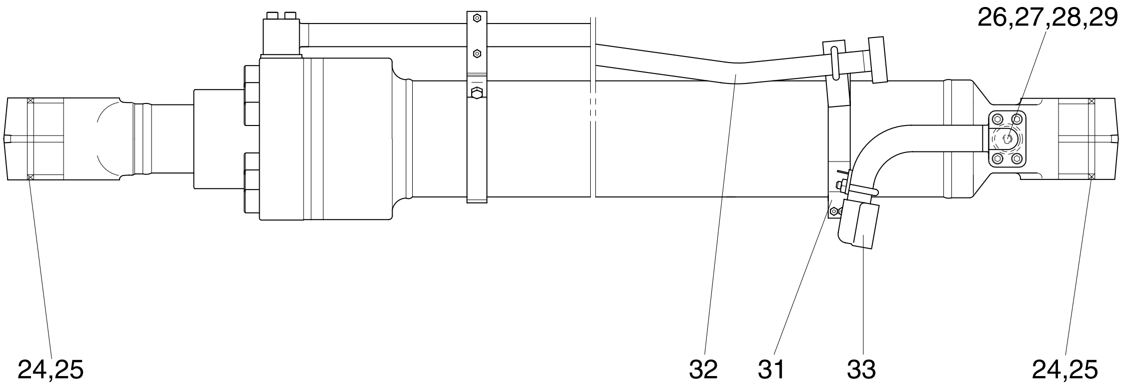


1 Tube assembly
2 Rod assembly
3 Gland
4 DD2 bushing
5 Snap ring
6 Rod seal
7 Back up ring
8 Buffer ring
9 Dust wiper
10 Snap ring
11 O-ring
12 Back up ring
13 Cushion ring
14 Piston
15 O-ring
16 Back up ring
17 Piston seal
18 Wear ring
19 Dust ring
20 Lock nut
21 Hexagon socket head bolt
22 O-ring
23 Hexagon socket head bolt
24 Pin bushing
25 Pin bushing
26 Dust seal
27 Band assembly
28 Pipe assembly
29 Pipe assembly
30 O-ring
31 Hexagon socket head bolt
32 Grease nipple

(3) Arm cylinder

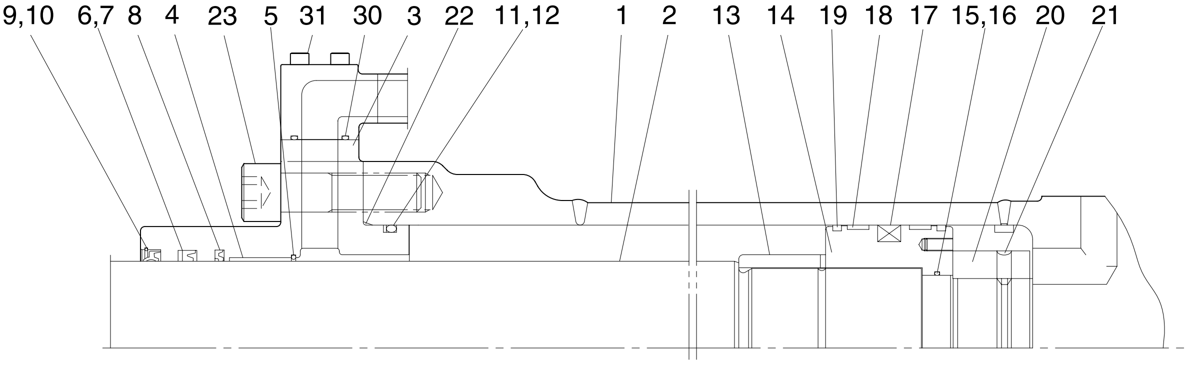


Internal detail

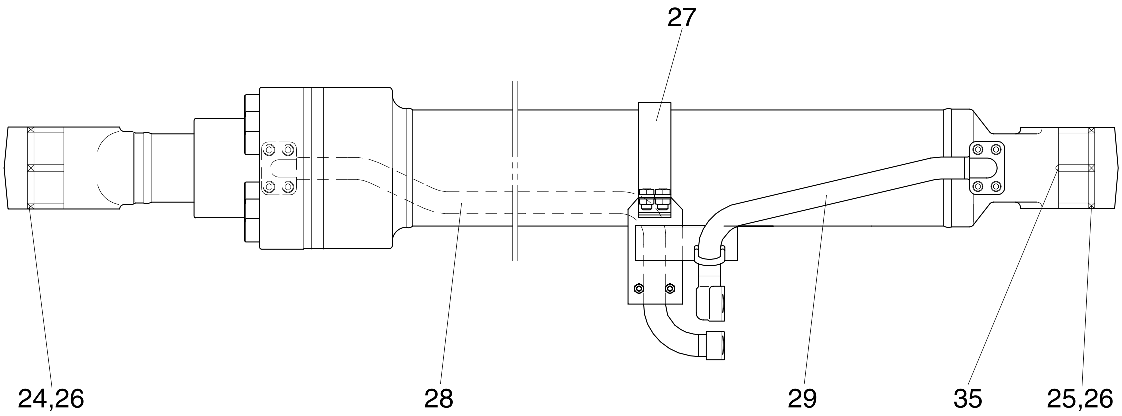


1	Tube assembly	14	Piston	27	Coil spring
2	Rod assembly	15	O-ring	28	O-ring
3	Gland	16	Back up ring	29	Plug
4	DD2 bushing	17	Piston seal	30	Band assembly
5	Snap ring	18	Wear ring	31	Band assembly
6	Rod seal	19	Dust ring	32	Pipe assembly
7	Back up ring	20	Lock nut	33	Pipe assembly
8	Buffer ring	21	Hexagon 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



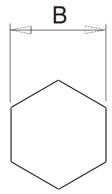
Internal detail



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	-	150±15	1085±108
	Boom cylinder	14	-	150±15	1085±108
	Arm cylinder	14	-	200±20	1447±145
Piston lock nut	Bucket cylinder	20	-	100±10	723±72
	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

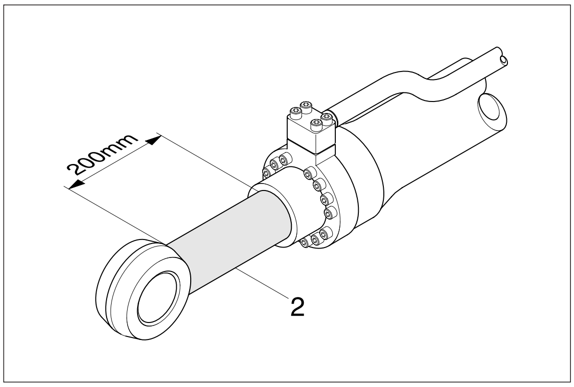
(1) Remove cylinder head and piston rod

※ Procedures are based on the bucket cylinder.

① Hold the clevis section of the tube in a vise.

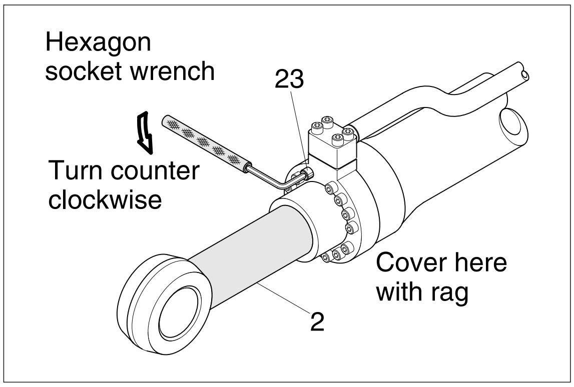
※ Use mouth pieces so as not to damage the machined surface of the cylinder tube. Do not make use of the outside piping as a locking means.

② Pull out rod assembly (2) about 200 mm (7.1in). Because the rod assembly is rather heavy, finish extending it with air pressure after the oil draining operation.



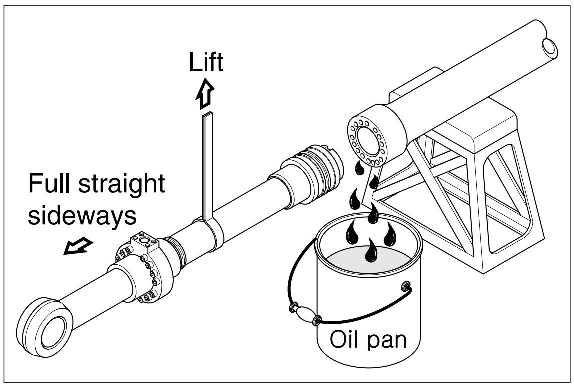
③ Loosen and remove socket bolts (23) of the gland in sequence.

※ Cover the extracted rod assembly (2) with rag to prevent it from being accidentally damaged during operation.



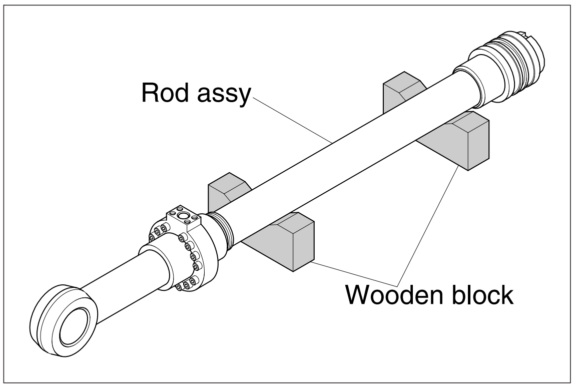
④ Draw out cylinder head and rod assembly together from tube assembly (1).

※ Since the rod assembly is heavy in this case, lift the tip of the rod assembly (2) with a crane or some means and draw it out. However, when rod assembly (2) has been drawn out to approximately two thirds of its length, lift it in its center to draw it completely.



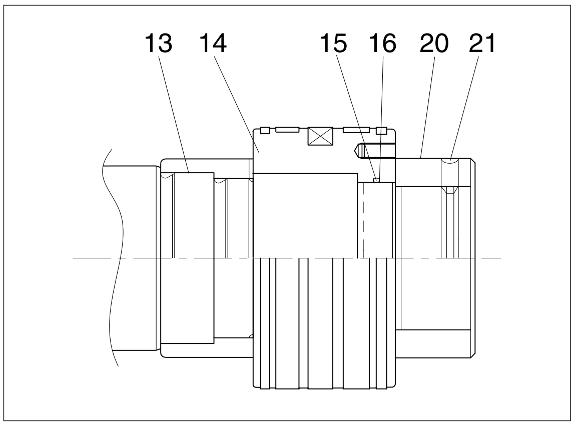
Note that the plated surface of rod assembly (2) is to be lifted. For this reason, do not use a wire sling and others that may damage it, but use a strong cloth belt or a rope.

⑤ Place the removed rod assembly on a wooden V-block that is set level.
※ Cover a V-block with soft rag.

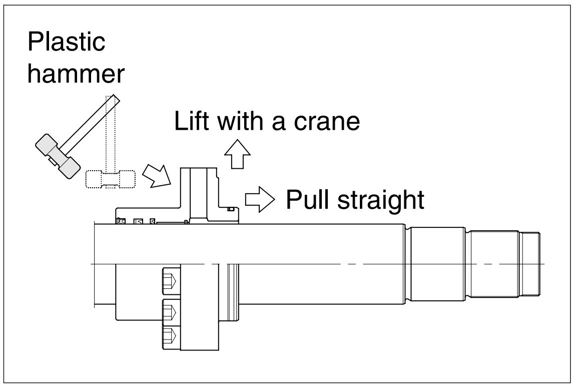


(3) Remove piston and cylinder head

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).

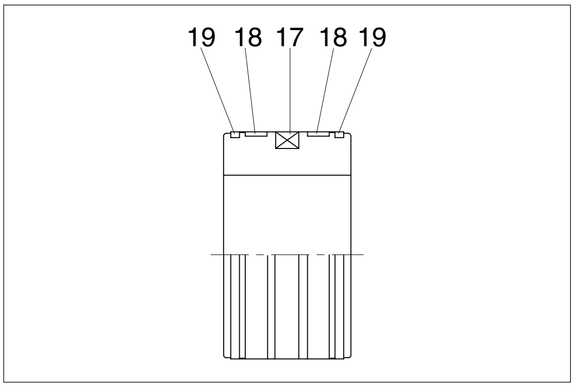


(3) Disassemble the piston assembly

① Remove wear ring (18).

② Remove dust ring (19) and piston seal (17).

※ Exercise care in this operation not to damage the grooves.



(4) Disassemble cylinder head assembly

① Remove back up ring (12) and O-ring (11).

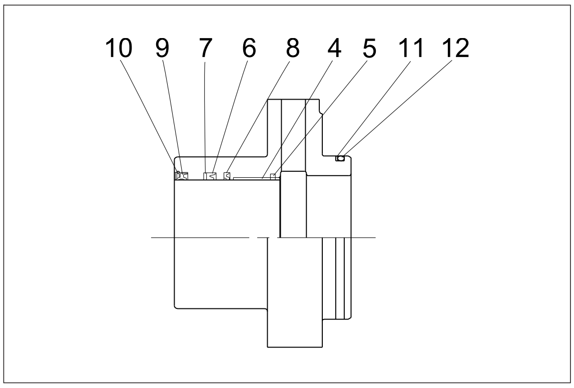
② Remove snap ring (10), dust wiper(9).

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).

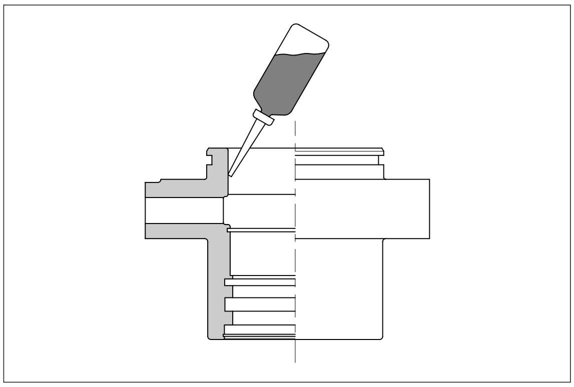


3) ASSEMBLY

(1) Assemble cylinder head assembly

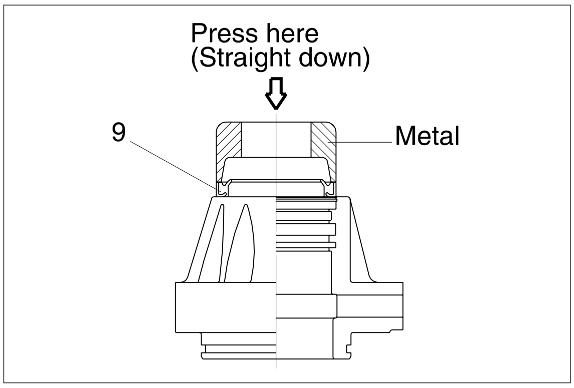
※ Check for scratches or rough surfaces if found smooth with an oil stone.

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.

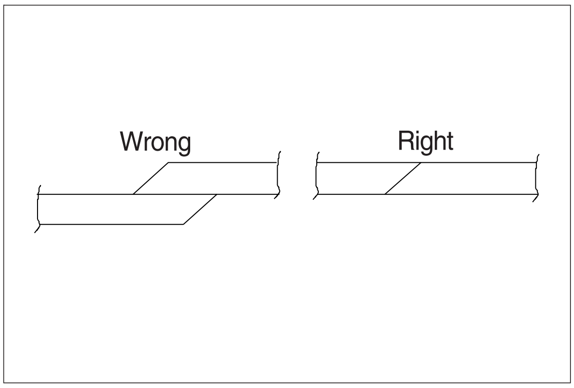
③ Fit snap ring (10) to the stop face.



④ Fit back up ring (7), rod seal (6) and buffer ring (8) to corresponding grooves, in that order.

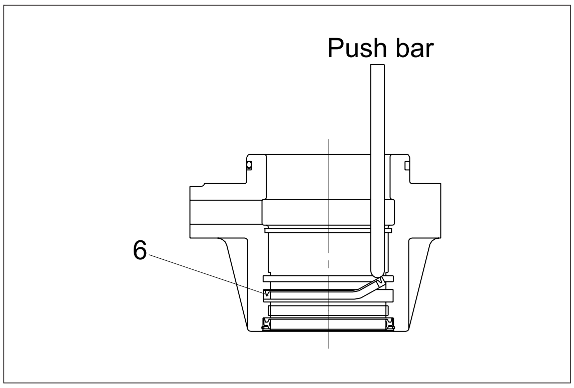
※ Coat each packing with hydraulic oil before fitting it.

※ 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.

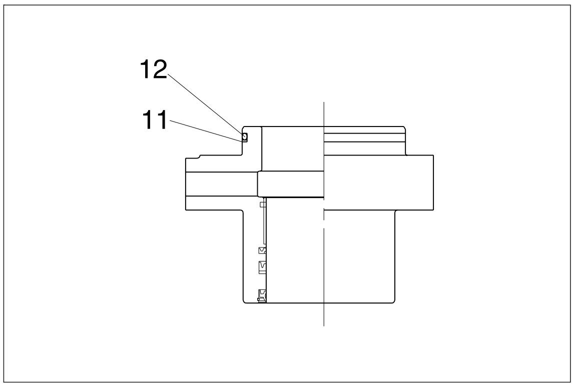
※ Fitting rod seal (6) upside down may damage its lip. Therefore check the correct direction that is shown in fig.



⑤ Fit back up ring (12) to gland (3).

※ Put the backup ring in the warm water of 30~50˚C.

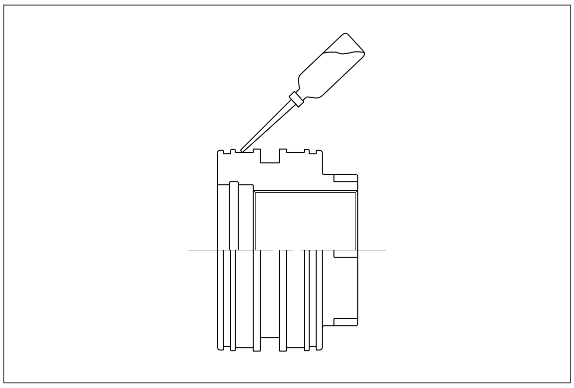
⑥ Fit O-ring (11) to gland (3).



(2) Assemble piston assembly

※ Check for scratches or rough surfaces. If found smooth with an oil stone.

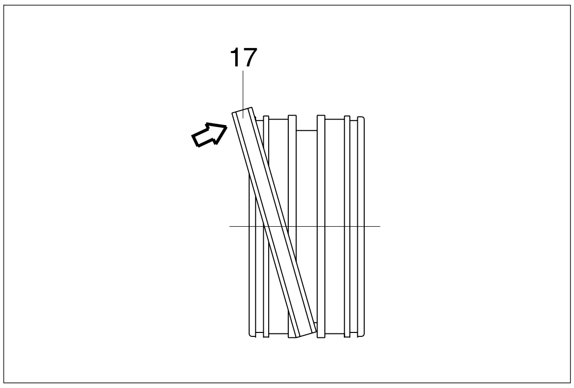
① Coat the outer face of piston (14) with hydraulic oil.



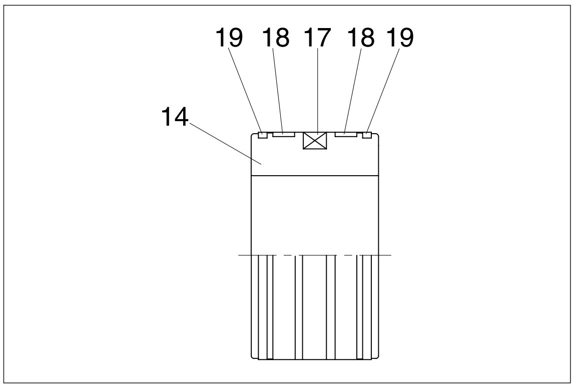
② Fit piston seal (17) to piston.

※ 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.

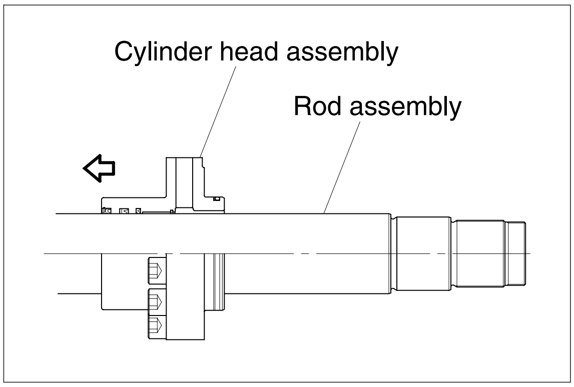


③ Fit wear ring (18) and dust ring (19) to piston (14).

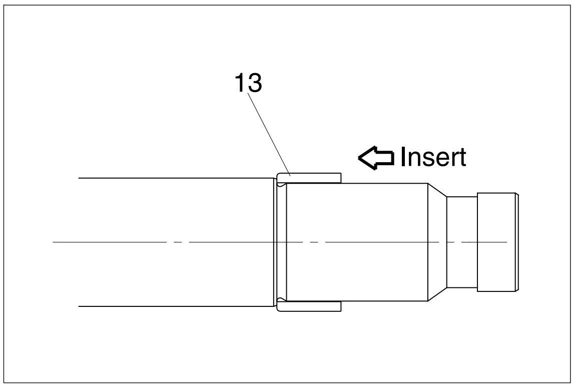


(3) Install piston and cylinder head

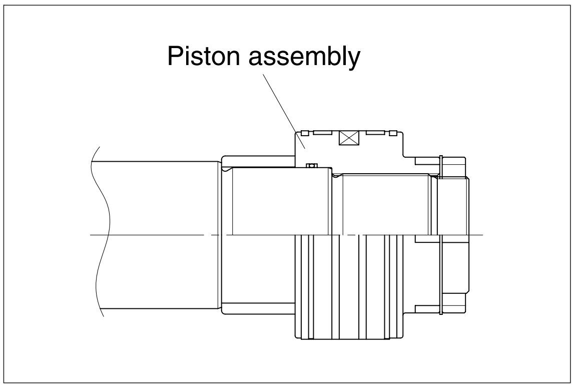
① Fix the rod assembly to the work bench.
② Apply hydraulic oil to the outer surface of rod assembly (2), the inner surface of piston and cylinder head.
③ Insert cylinder head assembly to rod assembly.



④ Insert cushion ring (13) to rod assembly.
※ Note that cushion ring (13) has a direction in which it should be fitted.



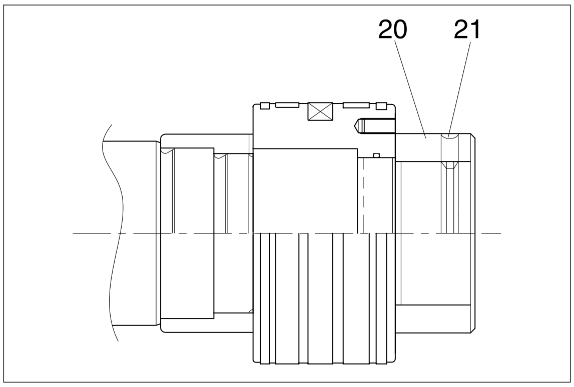
⑤ Fit piston assembly to rod assembly.
· Tightening torque : 150±15.0 kgf · m
(1085±108 lbf · ft)



⑥ Fit lock nut (20) and tighten the set screw (21).

· Tightening torque :

Item		kgf · m	lbf · ft
Bucket	20	100±10	723±72
	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



(3) Overall assemble

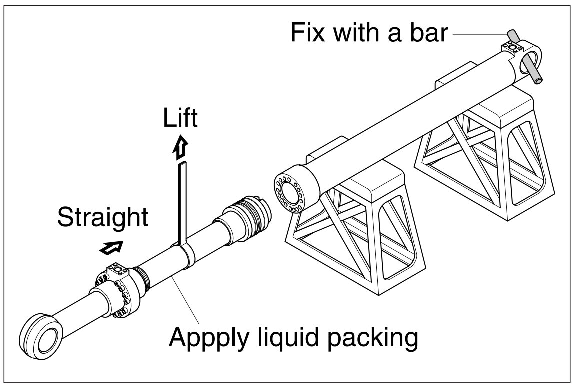
① Place a V-block on a rigid work bench. Mount the tube assembly (1) on it and fix the assembly by passing a bar through the clevis pin hole to lock the assembly.

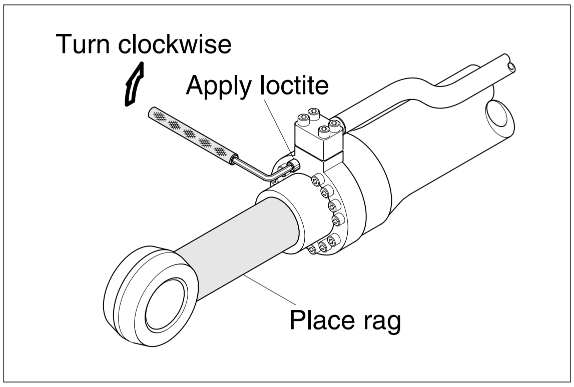
② Insert the rod assembly in to the tube assembly, while lifting and moving the rod assembly with a crane.

※ 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.



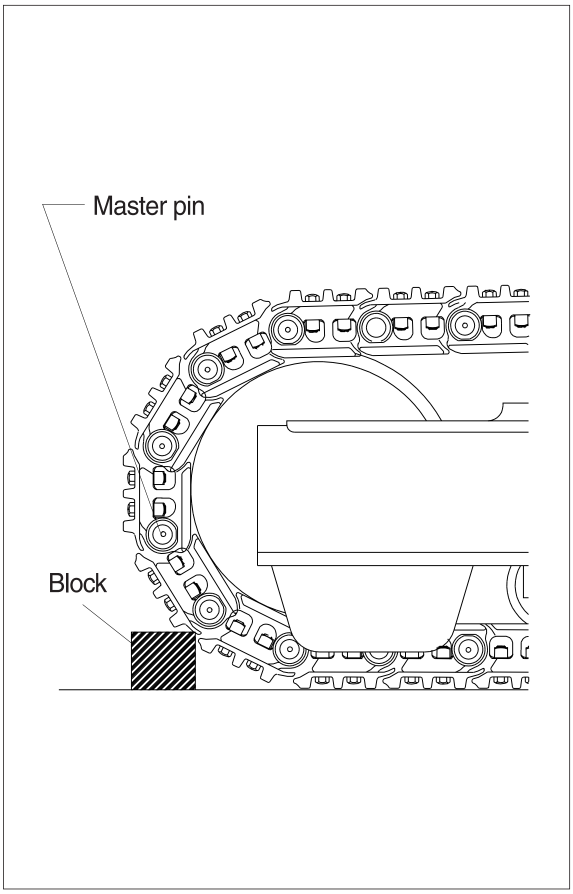


GROUP 10 UNDERCARRIAGE

1. TRACK LINK

1) REMOVAL

(1) Move track link until master pin is over front idler in the position put wooden block as shown.



(2) Loosen tension of the track link.

※ If track tension is not relieved when the grease valve is loosened, move the machine backwards and forwards.

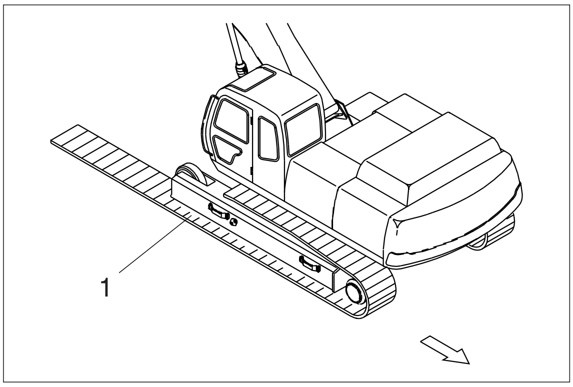
※ Unscrew the grease nipple after release the tension by pushing the poppet only when necessarily required.
Grease leaking hole is not existing. So, while unscrew the grease nipple, grease is not leaking until the grease nipple is completely coming out. If the tension is not released in advance, the grease nipple can be suddenly popped out by pressurized grease.

(3) Push out master pin by using a suitable tool.

(4) Move the machine slowly in reverse, and lay out track link assembly (1).

※ Jack up the machine and put wooden block under the machine.

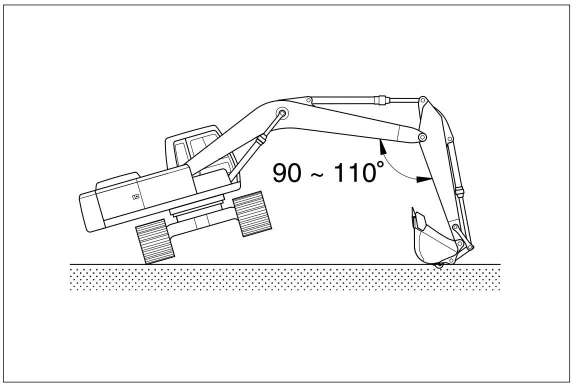
※ Don't get close to the sprocket side as the track shoe plate may fall down on your feet.



2) INSTALL

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

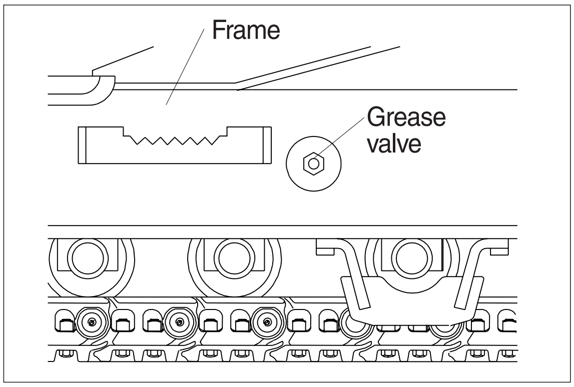
※ Adjust the tension of the track link.



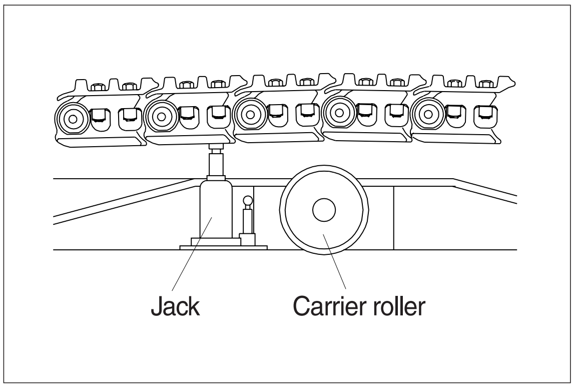
2. CARRIER ROLLER

1) REMOVAL

(1) Loosen tension of the track link.



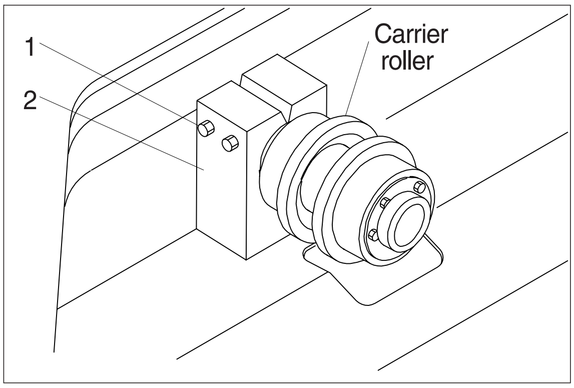
(2) Jack up the track link height enough to permit carrier roller removal.



(3) Loosen the lock nut (1).

(4) Open bracket (2) with a screwdriver, push out from inside, and remove carrier roller assembly.

· Weight : 80 kg (180 lb)



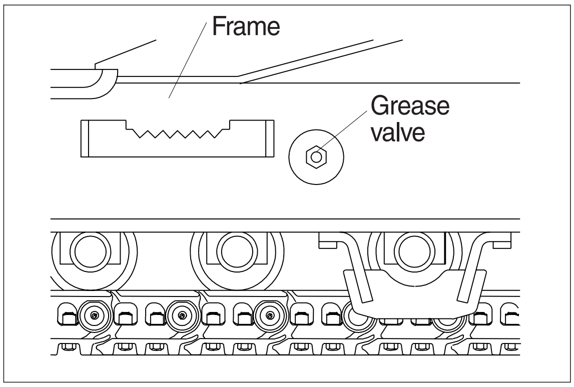
2) INSTALL

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

3. TRACK ROLLER

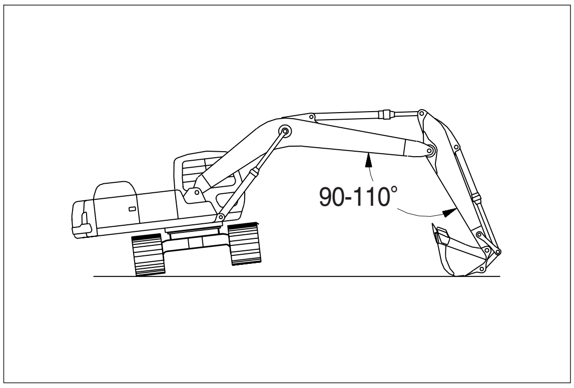
1) REMOVAL

(1) Loosen tension of the track link.



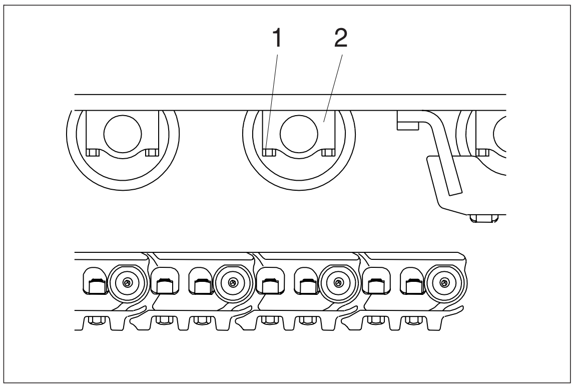
(2) Using the work equipment, push up track frame on side which is to be removed.

※ 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 : 80 kg (180 lb)



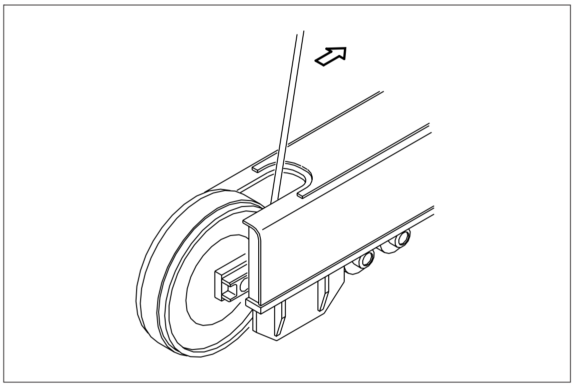
2) INSTALL

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

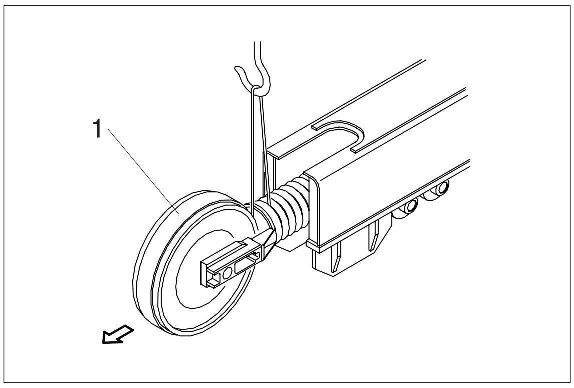
4. IDLER AND RECOIL SPRING

1) REMOVAL

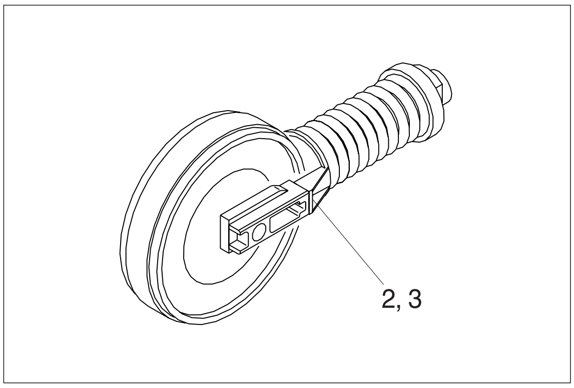
(1) Remove the track link.
For detail, see removal of track link.



(2) Sling the recoil spring (1) and pull out idler and recoil spring assembly from track frame, using a pry.
· Weight : 550 kg (1210 lb)

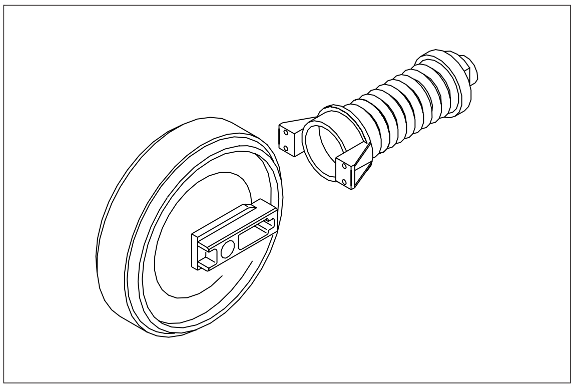


(3) Remove the bolts (2), washers (3) and separate ilder from recoil spring.



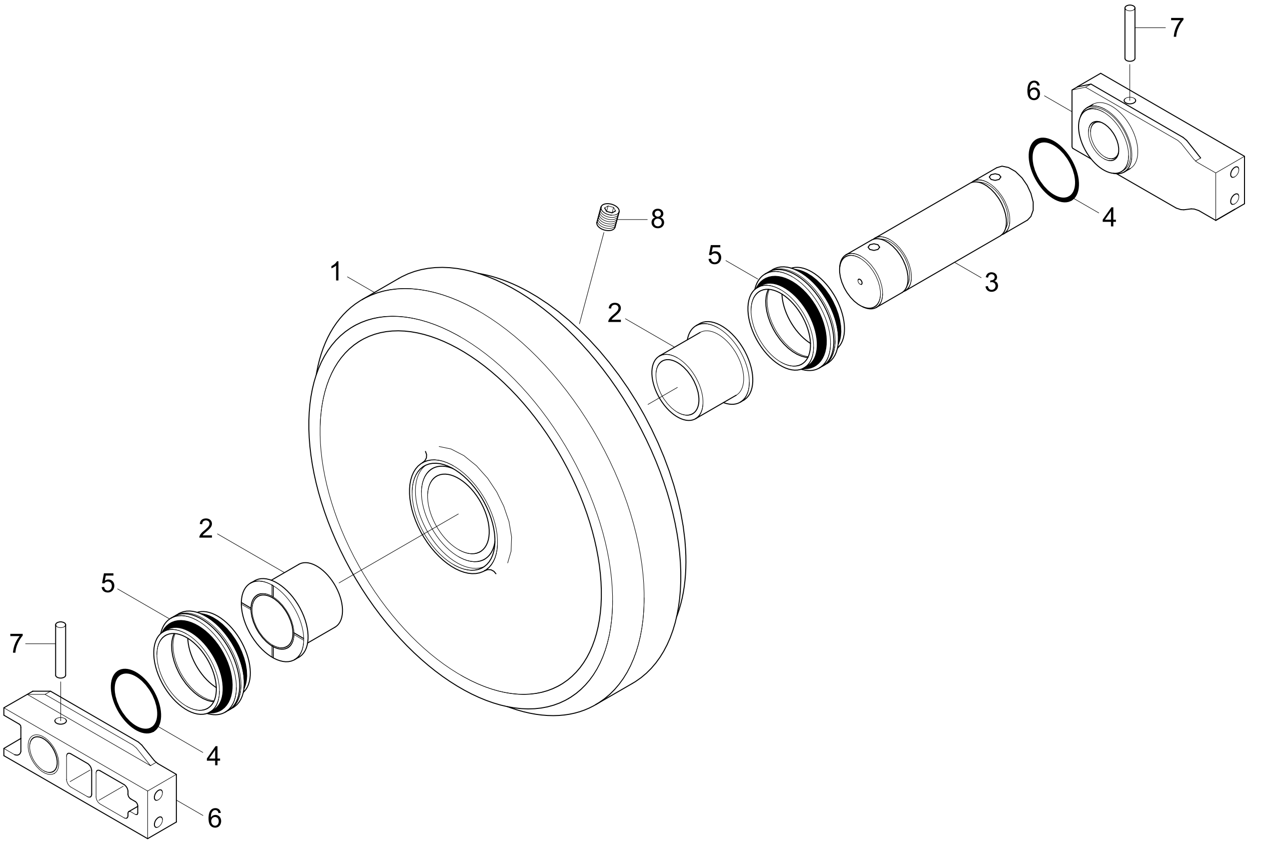
2) INSTALL

(1) Carry out installation in the reverse order to removal.
※ Make sure that the boss on the end face of the recoil cylinder rod is in the hole of the track frame.



3) DISASSEMBLY AND ASSEMBLY OF IDLER

(1) Structure

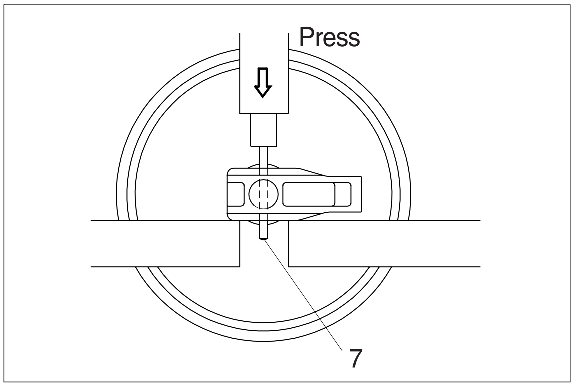


1	Shell	4	O-ring	7	Spring pin
2	Bushing	5	Seal assembly	8	Plug
3	Shaft	6	Bracket		

(2) Disassembly

① Remove plug and drain oil.

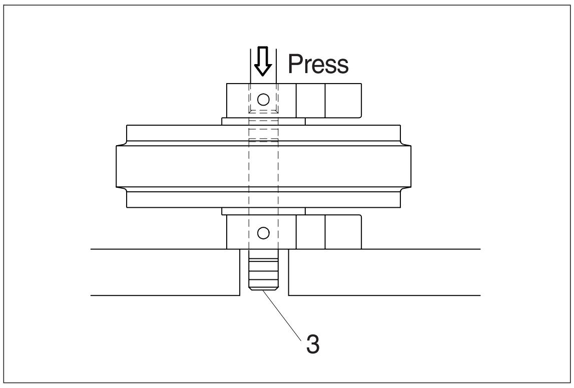
② Draw out the spring pin (7), using a press.



③ Pull out the shaft (2) with a press.

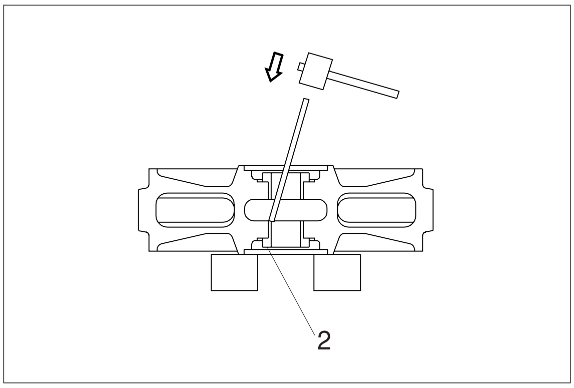
④ Remove seal (5) from shell (1) and bracket (6).

⑤ Remove O-ring (4) from shaft.



⑥ Remove the bushing (2) from idler, using a special tool.

※ Only remove bushing if replacement is necessity.

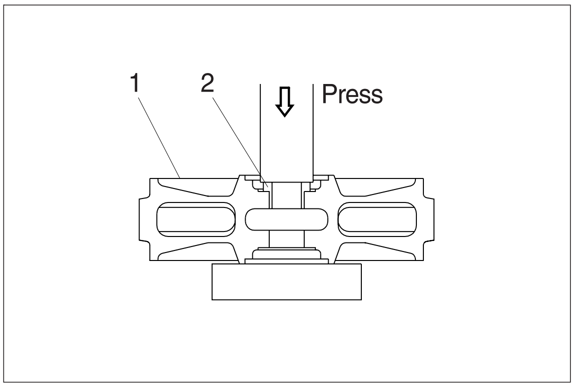


(3) Assembly

※ Before assembly, clean the parts.

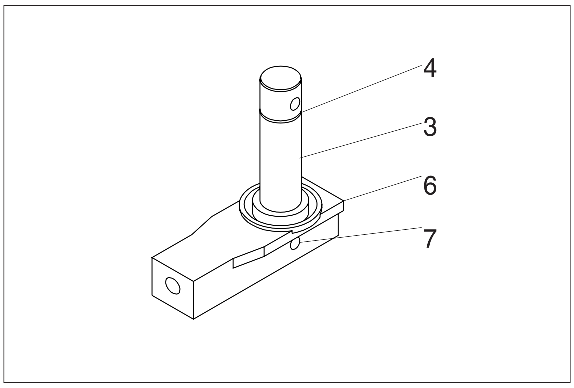
※ Coat the sliding surfaces of all parts with oil.

① Cool up bushing (2) fully by some dry ice and press it into shell (1).
Do not press it at the normal temperature, or not knock in with a hammer even after the cooling.

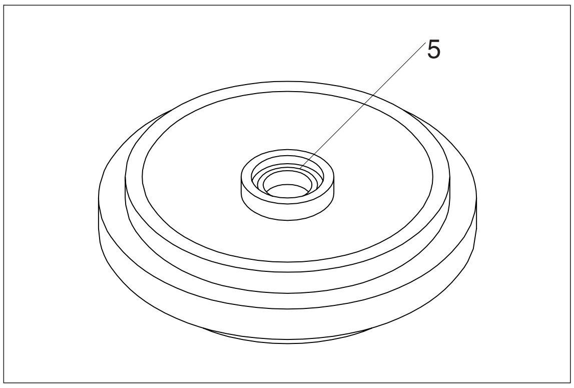


② Coat O-ring (4) with grease thinly, and install it to shaft (3).

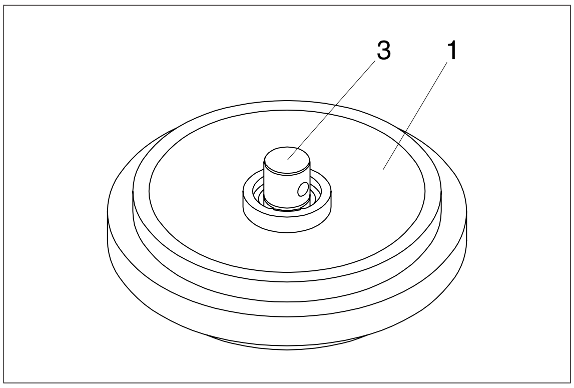
③ Insert shaft (3) into bracket (6) and drive in the spring pin (7).



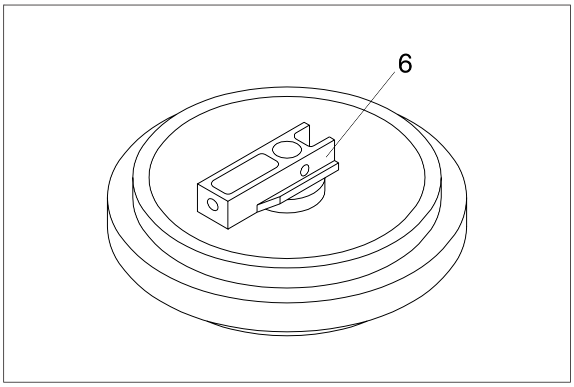
④ Install seal (5) to shell (1) and bracket (6).



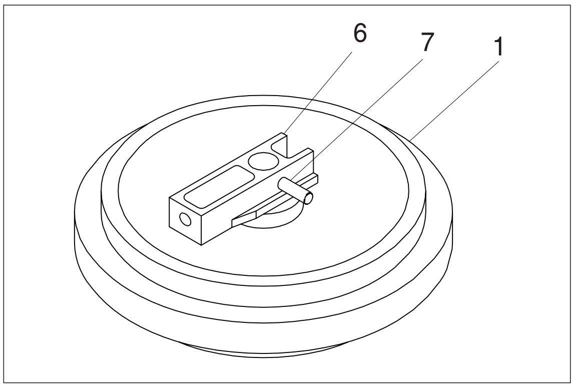
⑤ Install shaft (3) to shell (1).



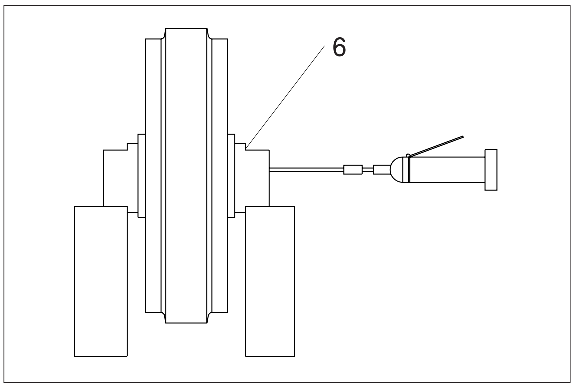
⑥ Install bracket (6) attached with seal (5).



⑦ Knock in the spring pin (7) with a hammer.

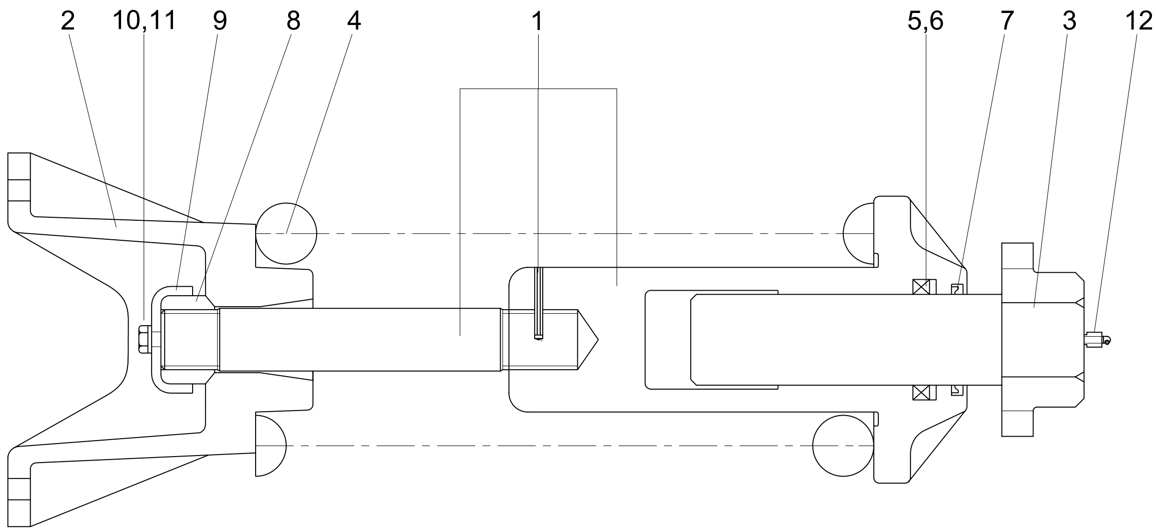


⑧ Lay bracket (6) on its side.
Supply engine oil to the specified level, and tighten plug.



4) DISASSEMBLY AND ASSEMBLY OF RECOIL SPRING

(1) Structure



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 ㎏ (63580 ℔)

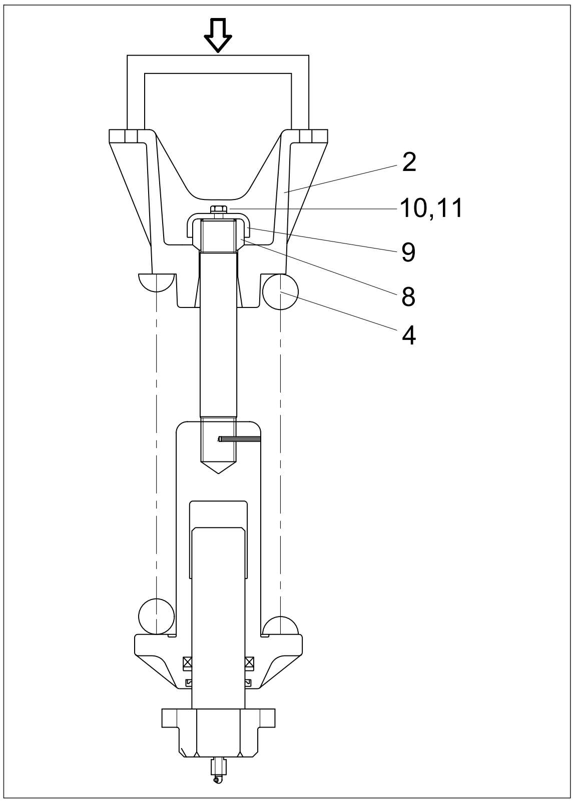
② Remove bolt (10), spring washer (11) and lock plate (9).

③ Remove lock nut (8).

Take enough notice so that the press

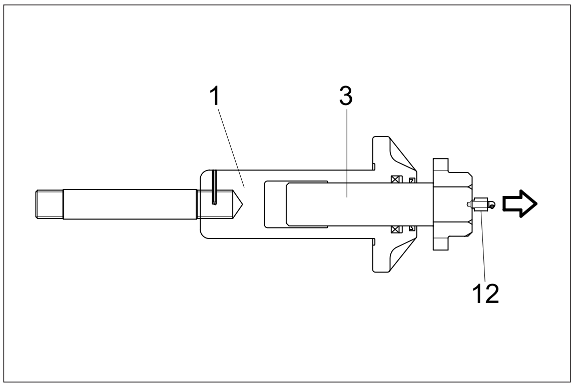
④ which pushes down the spring, should not be slipped out in its operation.

Lighten the press load slowly and remove bracket (2) and spring (4).

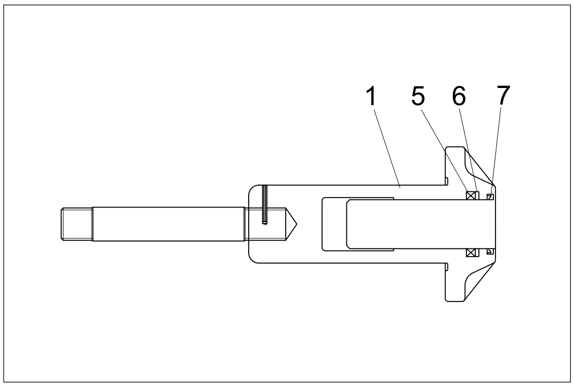


⑤ Remove rod (3) from body (1).

⑥ Remove grease valve (12) from rod (3).



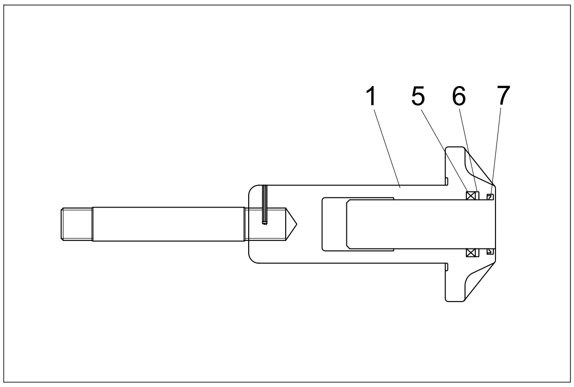
⑦ Remove rod seal (5), back up ring (6) and dust seal (11).



(3) Assembly

① Install dust seal (7), back up ring (6) and rod seal (5) to body (1).

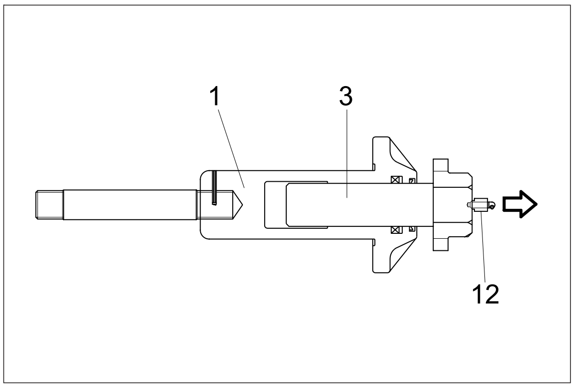
※ When installing dust seal (7) and rod seal (5), take full care so as not to damage the lip.



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)

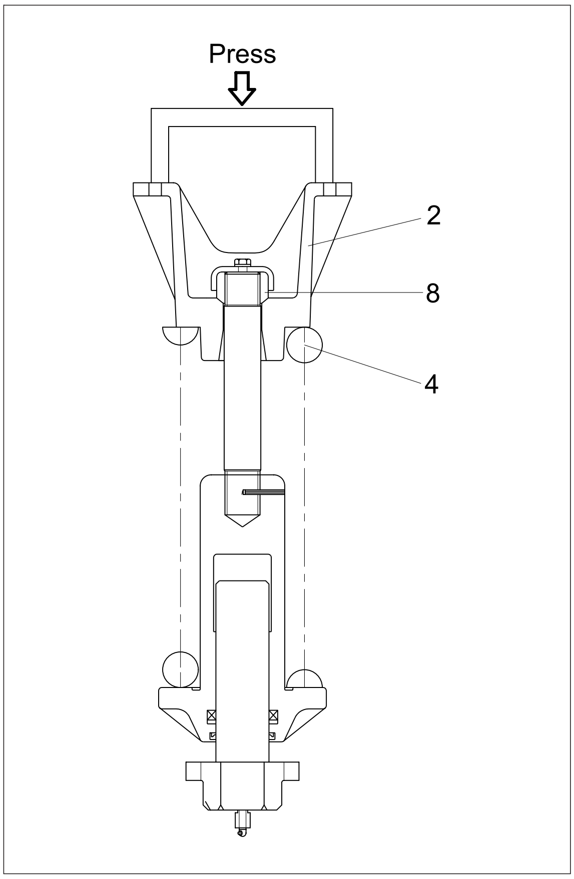


④ Install spring (4) and bracket (2) to body (1).

⑤ Apply pressure to spring (4) with a press and tighten lock nut (8).

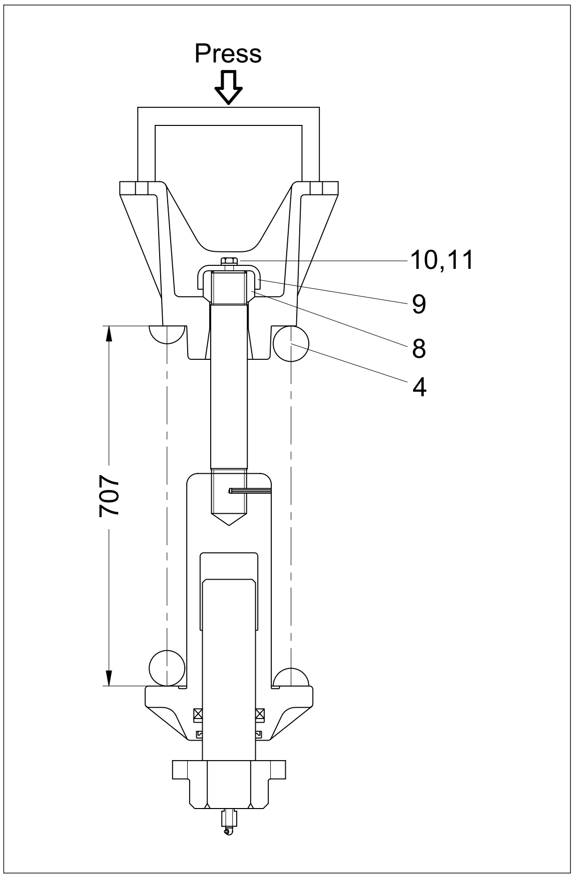
※ Apply sealant before assembling.

※ During the operation, pay attention specially to prevent the press from slipping out.



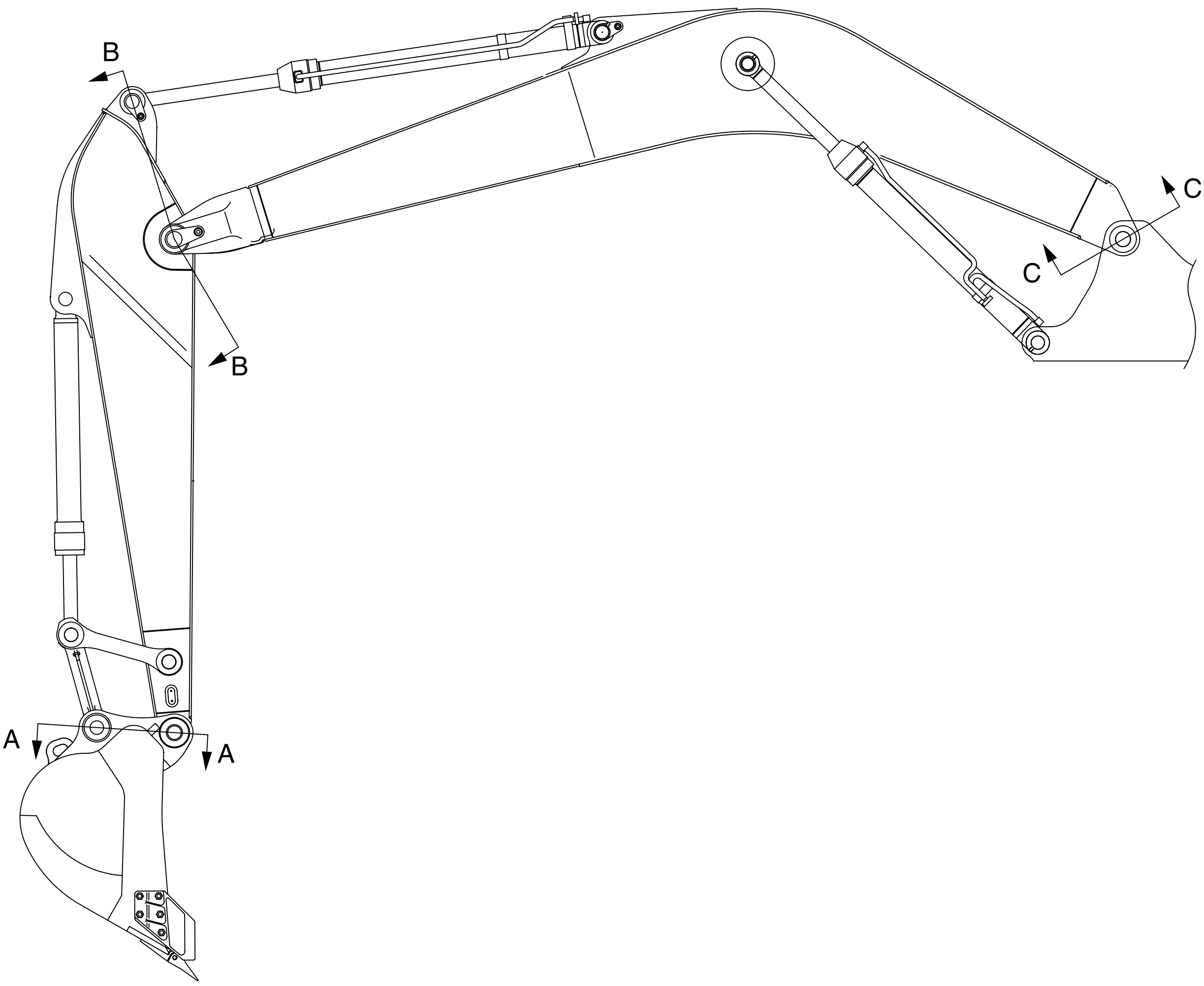
⑥ Lighten the press load and confirm the set length of spring (4).

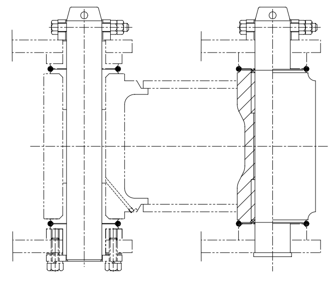
⑦ After the setting of spring (4), install lock plate (9), spring washer (11) and bolt (10).



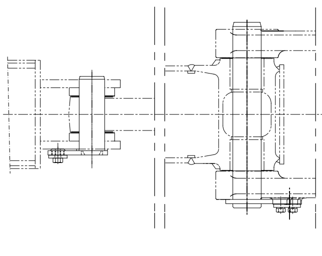
GROUP 11 WORK EQUIPMENT

1. STRUCTURE

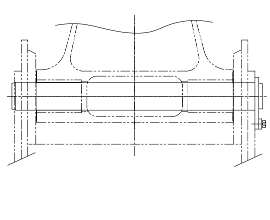




SECTION A



SECTION B



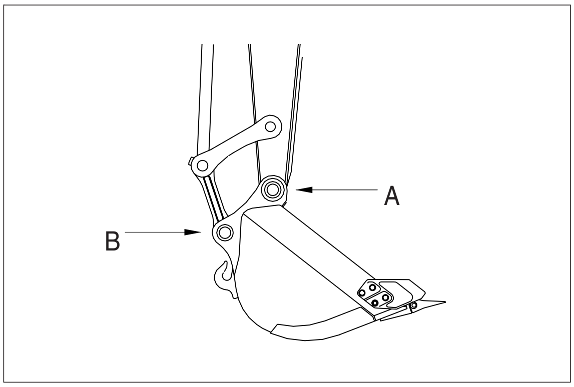
SECTION C

2. REMOVAL AND INSTALL

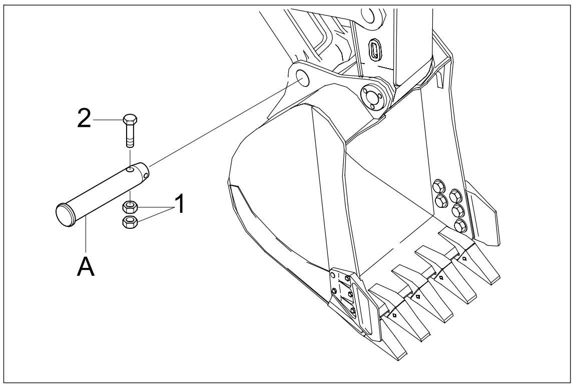
1) BUCKET ASSEMBLY

(1) Removal

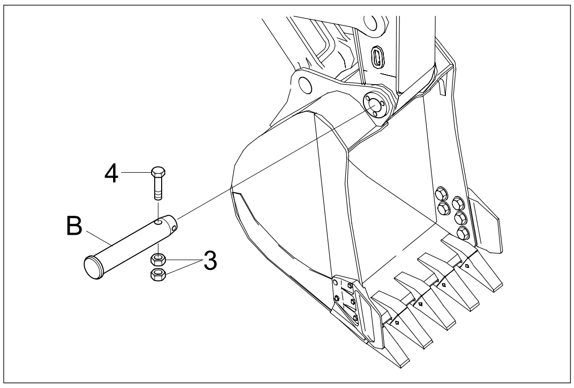
① Lower the work equipment completely to ground with back of bucket facing down.



② Remove nut (1), bolt (2) and draw out the pin (A).



③ Remove nut (3), bolt (4) and draw out the pin (B).

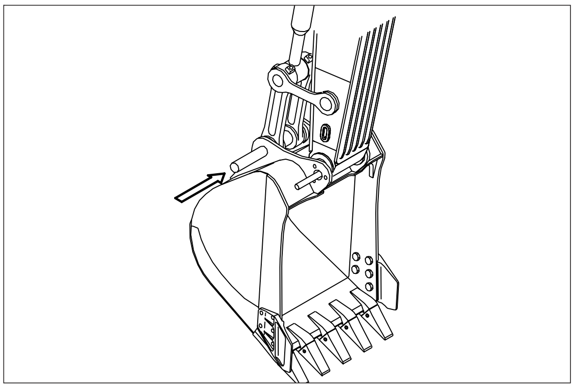


(2) Install

① Carry out installation in the reverse order to removal.

⚠ **When aligning the mounting position of the pin, do not insert your fingers in the pin hole.**

※ Adjust the bucket clearance.
For detail, see **operation manual**.

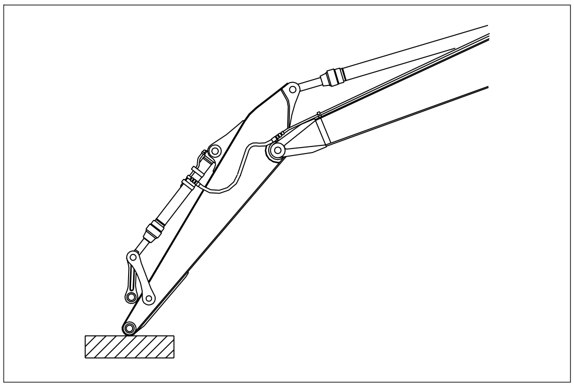


2) ARM ASSEMBLY

(1) Removal

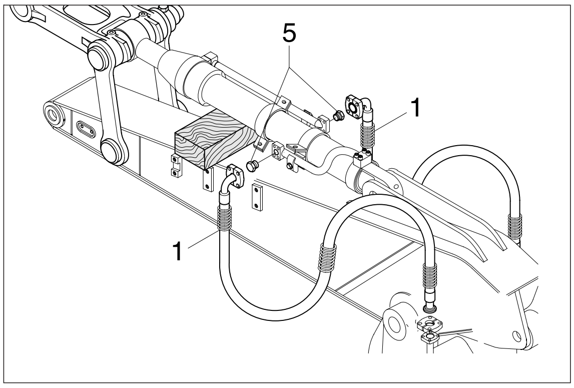
※ Loosen the breather slowly to release the pressure inside the hydraulic tank.

⚠ **Escaping fluid under pressure can penetrated the skin causing serious injury.**



① Remove bucket assembly.
For details, see removal of bucket assembly.

② Disconnect bucket cylinder hose (1).



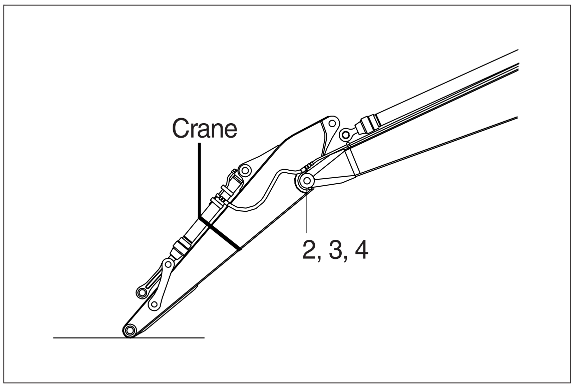
⚠ **Fit blind plugs in the piping at the chassis end securely to prevent oil from spurting out when the engine is started.**

③ Sling arm cylinder assembly, remove spring, pin stopper and pull out pin.

※ Tie the rod with wire to prevent it from coming out.

④ For details, see removal of arm cylinder assembly.
Place a wooden block under the cylinder and bring the cylinder down to it.

⑤ Remove bolt (2), plate (3) and pull out the pin (4) then remove the arm assembly.
· Weight : 1450 ㎏ (3200 ㏈)



※ When lifting the arm assembly, always lift the center of gravity.

(2) Install

① Carry out installation in the reverse order to removal.

⚠ **When lifting the arm assembly, always lift the center of gravity.**

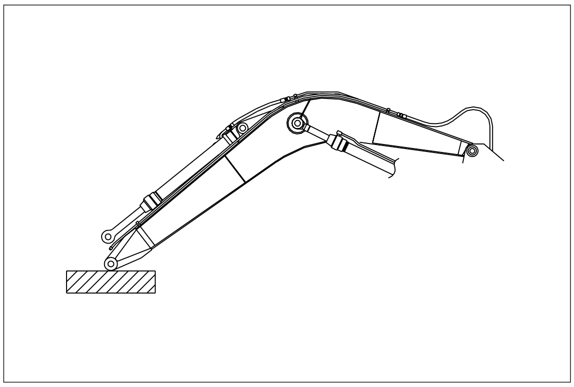
※ Bleed the air from the cylinder.

3) BOOM 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.

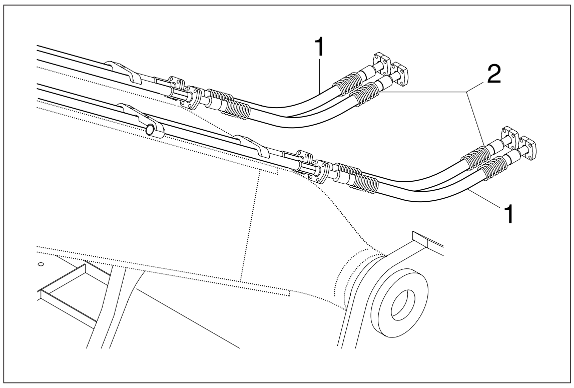


③ Disconnect head lamp wiring.

④ Disconnect bucket cylinder hose (2) and arm cylinder hose (1).

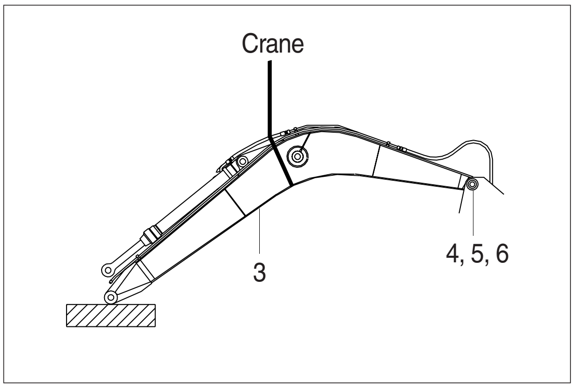
※ When the hose are disconnected, oil may spurt out.

⑤ Sling boom assembly (3).



⑥ Remove bolt (4), plate (5) and pull out the pin (6) then remove boom assembly.
· Weight : 3300 ㎏ (7360 ㏈)

※ When lifting the boom assembly always lift the center of gravity.



(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.