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1. STRUCTURE

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

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

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

SECTION 1 GENERAL

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

SECTION 2 STRUCTURE AND FUNCTION

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

SECTION 3 HYDRAULIC SYSTEM

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

SECTION 4 ELECTRICAL SYSTEM

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

SECTION 5 MECHATRONICS SYSTEM

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

SECTION 6 TROUBLESHOOTING

This section explains the troubleshooting charts correlating problems to causes.

SECTION 7 MAINTENANCE STANDARD

This section gives the judgement standards when inspecting disassembled parts.

SECTION 8 DISASSEMBLY AND ASSEMBLY

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

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

2. HOW TO READ THE SERVICE MANUAL

Distribution and updating

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

Filing method

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

Revised edition mark (①②③···)

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

Revisions

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

Symbols

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

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

3. CONVERSION TABLE

Method of using the Conversion Table

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

Example

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

   Convert 55 mm into inches.

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

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

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

2. Convert 550 mm into inches.

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

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

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

Millimeters to inches

1 mm = 0.03937 in

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

Millimeters to inches

1 mm = 0.03937 in

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

Kilogram to Pound

1 kg = 2.2046 lb

	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

1 kgf · m = 7.233 lbf · ft

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

kgf/cm² to lbf/in²

1 kgf / cm² = 14.2233 lbf / in²

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

TEMPERATURE

Fahrenheit-Centigrade Conversion.

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

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

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

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

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

SECTION 1 GENERAL

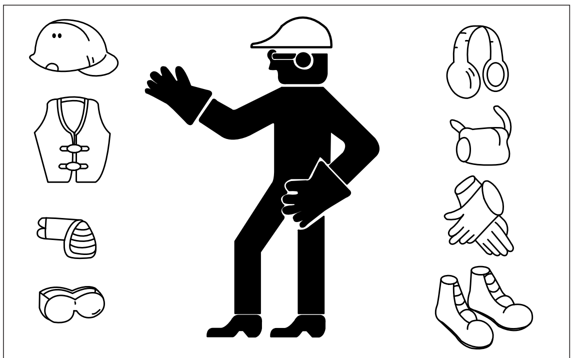
GROUP 1 SAFETY

FOLLOW SAFE PROCEDURE

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

WEAR PROTECTIVE CLOTHING

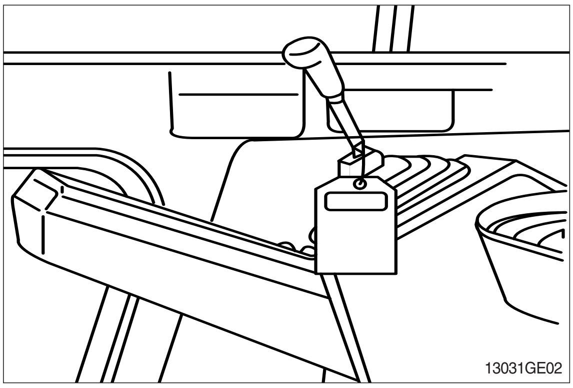
Wear close fitting clothing and safety equipment appropriate to the job.



13031GE01

WARN OTHERS OF SERVICE WORK

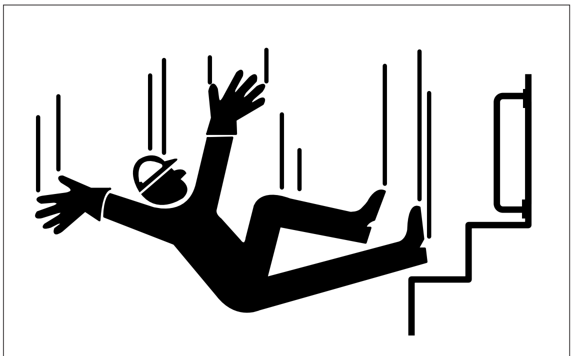
Unexpected machine movement can cause serious injury.
Before performing any work on the excavator, attach a 「Do Not Operate」 tag on the right side control lever.



13031GE02

USE HANDHOLDS AND STEPS

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



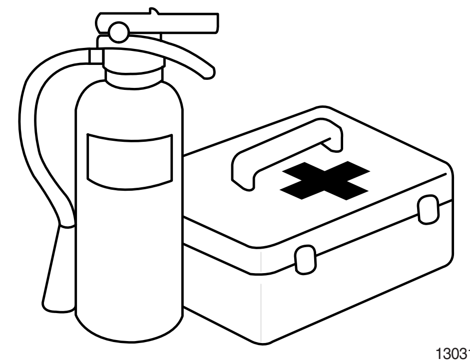
13031GE03

PREPARE FOR EMERGENCIES

Be prepared if a fire starts.

Keep a first aid kit and fire extinguisher handy.

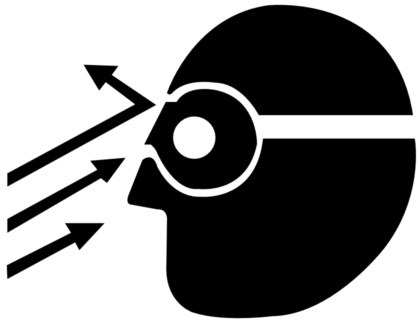
Keep emergency numbers for doctors, ambulance service, hospital, and fire department near your telephone.



13031GE04

PROTECT AGAINST FLYING DEBRIS

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



13031GE05

PROTECT AGAINST NOISE

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

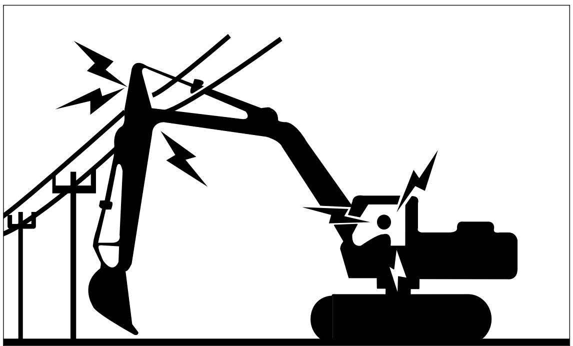
Wear a suitable hearing protective device such as earmuffs or earplugs to protect against objectionable or uncomfortable loud noises.

13031GE06

AVOID POWER LINES

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

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

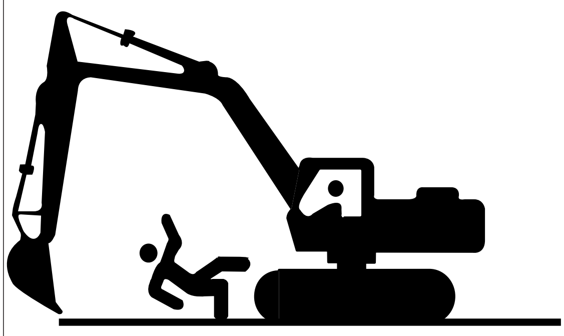


13031GE07

KEEP RIDERS OFF EXCAVATOR

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

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



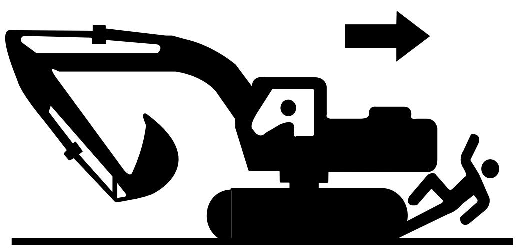
13031GE08

MOVE AND OPERATE MACHINE SAFELY

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

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

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

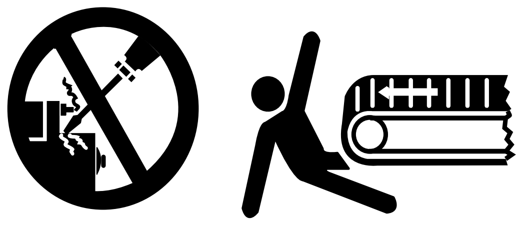


13031GE09

OPERATE ONLY FORM OPERATOR'S SEAT

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

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



13031GE26

PARK MACHINE SAFELY

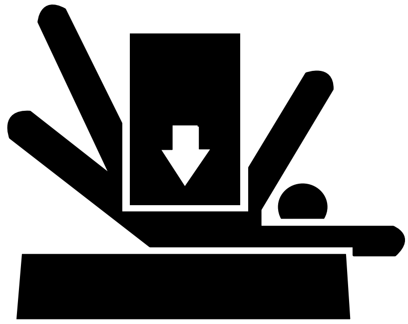
Before working on the machine:

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

SUPPORT MACHINE PROPERLY

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

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

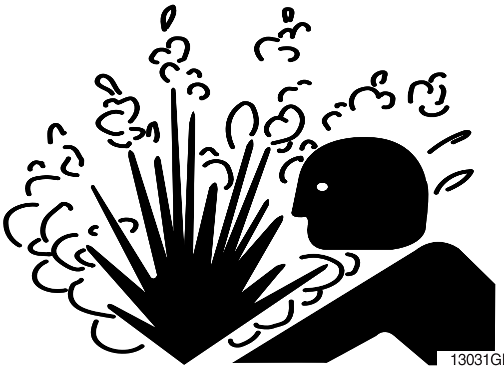


13031GE10

SERVICE COOLING SYSTEM SAFELY

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

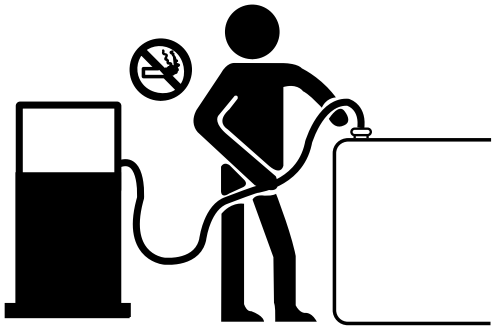
Shut off engine. Only remove filler cap when cool enough to touch with bare hands.



13031GE11

HANDLE FLUIDS SAFELY-AVOID FIRES

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



13031GE12

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

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

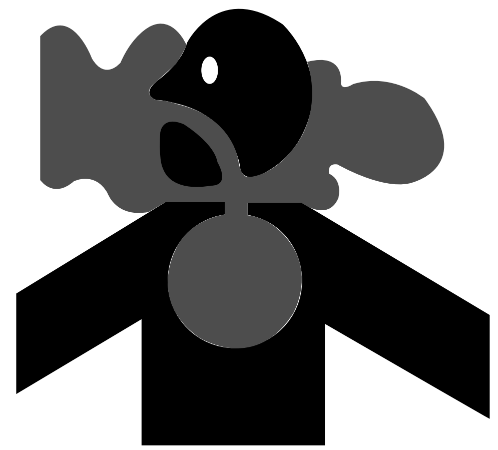
Do not store oily rags; They can ignite and burn spontaneously.

13031GE13

BEWARE OF EXHAUST FUMES

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

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



13031GE14

REMOVE PAINT BEFORE WELDING OR HEATING

Avoid potentially toxic fumes and dust.

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

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

Remove paint before welding or heating:

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

ILLUMINATE WORK AREA SAFELY

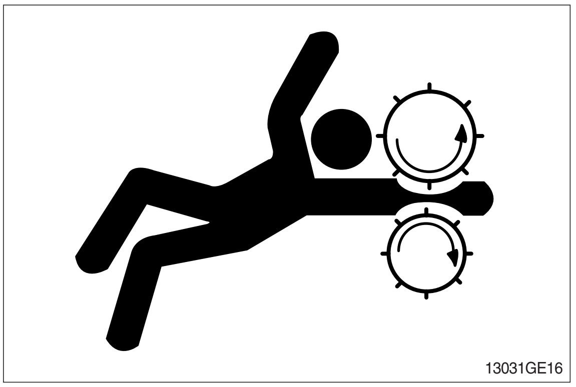
Illuminate your work area adequately but safely. Use a portable safety light for working inside or under the machine. Make sure the bulb is enclosed by a wire cage. The hot filament of an accidentally broken bulb can ignite spilled fuel or oil.

13031GE15

SERVICE MACHINE SAFELY

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

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

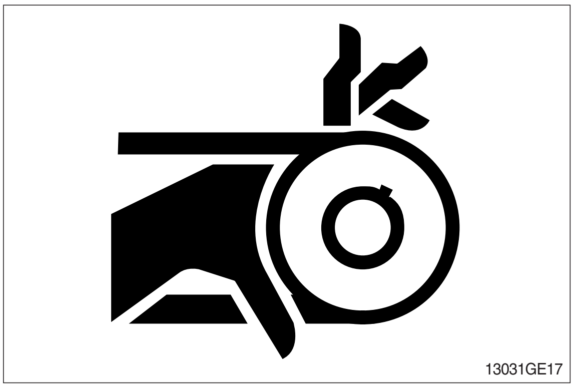


13031GE16

STAY CLEAR OF MOVING PARTS

Entanglements in moving parts can cause serious injury.

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



13031GE17

AVOID HIGH PRESSURE FLUIDS

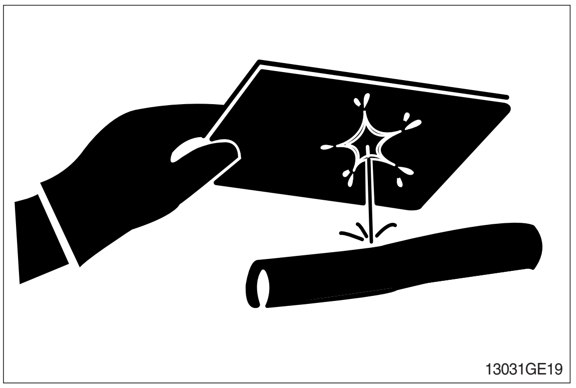
Escaping fluid under pressure can penetrate the skin causing serious injury.

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

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

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

13031GE18



13031GE19

AVOID HEATING NEAR PRESSURIZED FLUID LINES

13031GE20

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

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

PREVENT BATTERY EXPLOSIONS

13031GE21

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

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

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

PREVENT ACID BURNS

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

Avoid the hazard by:

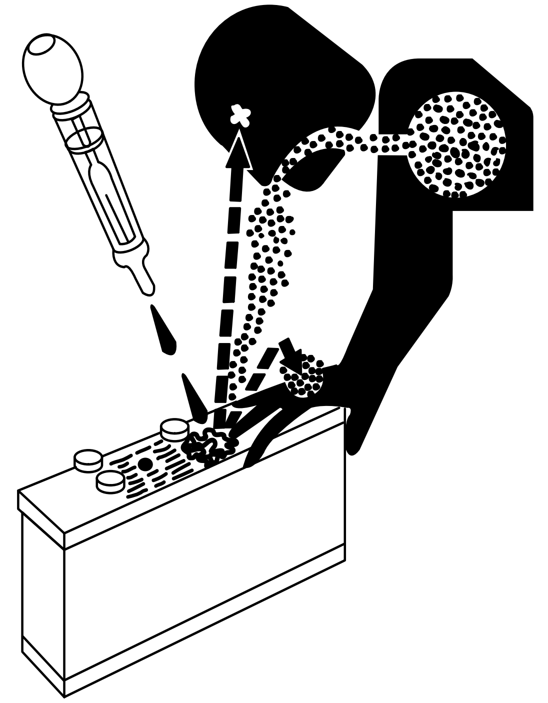
1. Filling batteries in a well-ventilated area.
2. Wearing eye protection and rubber gloves.
3. Avoiding breathing fumes when electrolyte is added.
4. Avoiding spilling of dripping electrolyte.
5. Use proper jump start procedure.

If you spill acid on yourself:

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

If acid is swallowed:

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



13031GE22

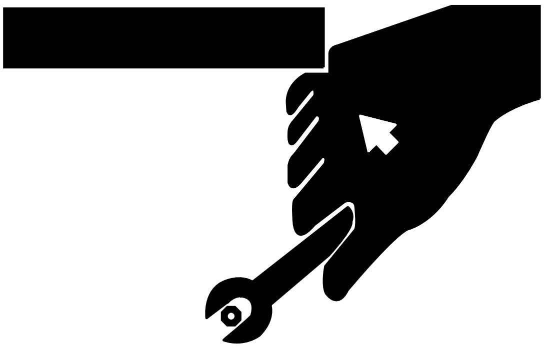
USE TOOLS PROPERLY

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

Use power tools only to loosen threaded tools and fasteners.

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

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



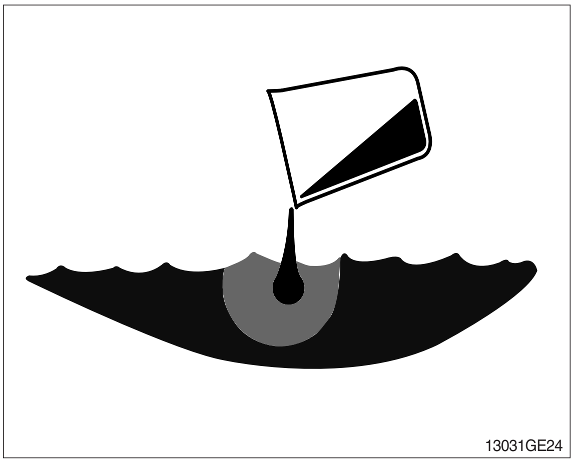
13031GE23

DISPOSE OF FLUIDS PROPERLY

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

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

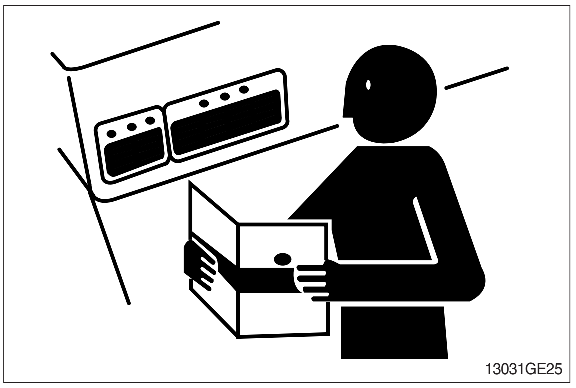
DO NOT pour oil into the ground, down a drain, or into a stream, pond, or lake. Observe relevant environmental protection regulations when disposing of oil, fuel, coolant, brake fluid, filters, batteries, and other harmful waste.



13031GE24

REPLACE SAFETY LABELS

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



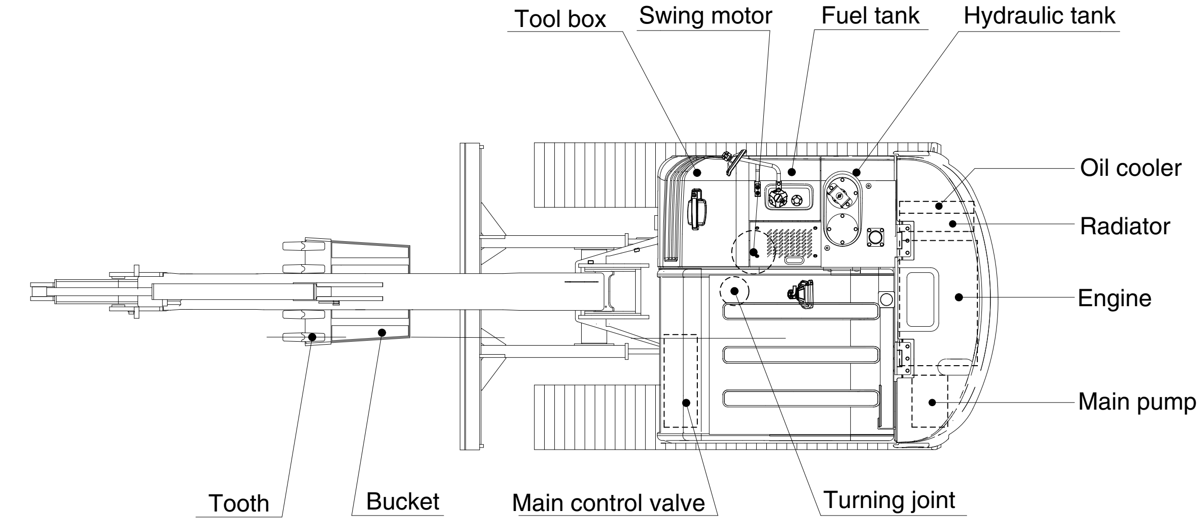
13031GE25

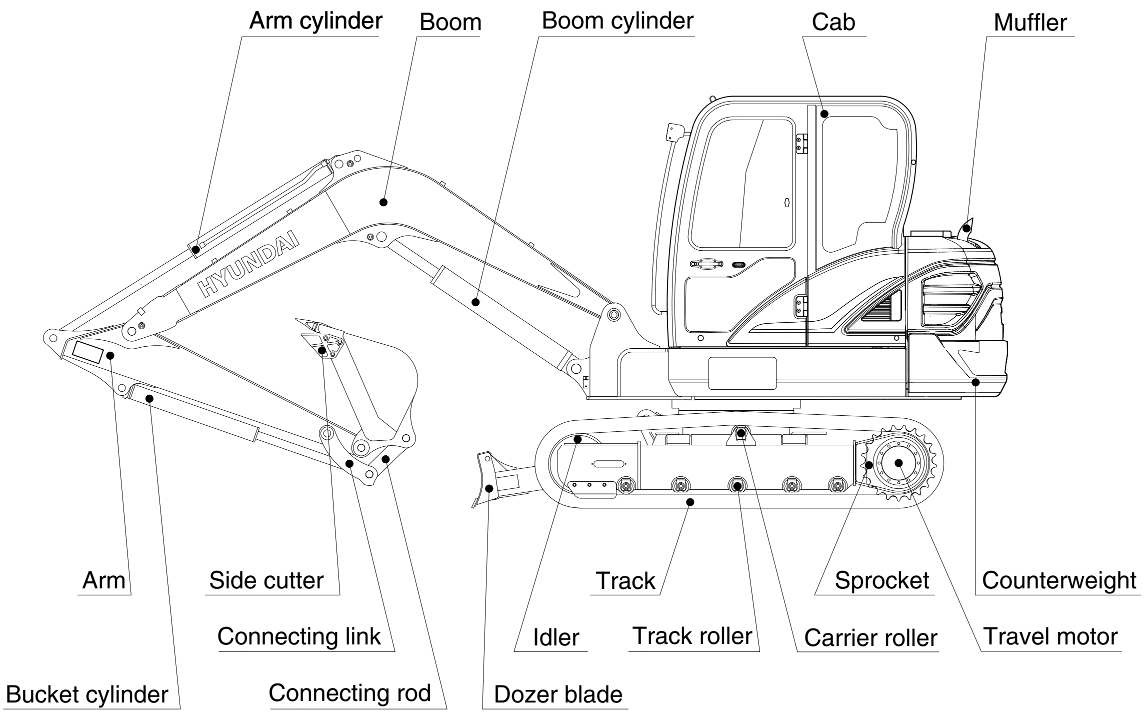
LIVE WITH SAFETY

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

GROUP 2 SPECIFICATIONS

1. MAJOR COMPONENT

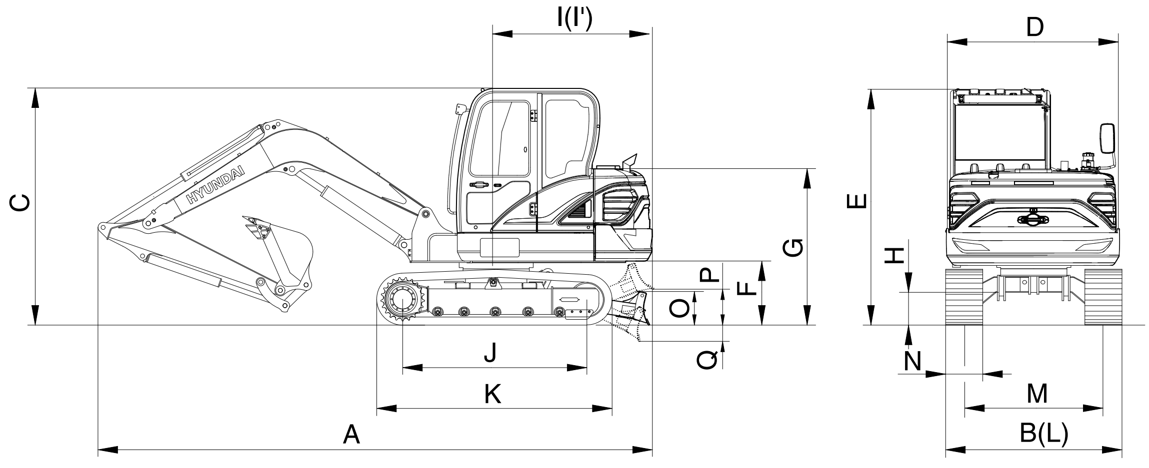




65A2SP01

2. SPECIFICATIONS

1) 3.0 m (9' 10") MONO BOOM, 1.6 m (5' 3") ARM

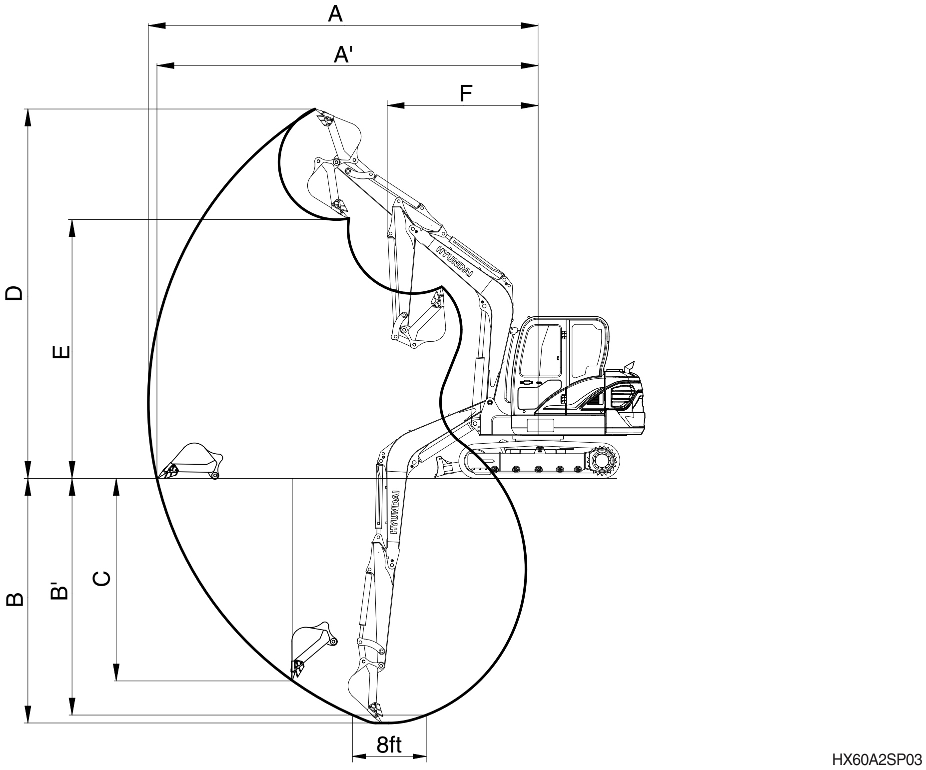


HX60A2SP02

Description		Unit	Specification
Operating weight		kg (lb)	6080 (13430)
Bucket capacity (SAE heaped), standard		m^3 (yd^3)	0.18 (0.24)
Overall length	A	mm (ft-in)	5970 (19' 7")
Overall width, with 400 mm shoe	B		1905 (6' 3")
Overall height	C		2595 (8' 6")
Superstructure width	D		1850 (6' 1")
Overall height of cab	E		2595 (8' 6")
Ground clearance of counterweight	F		687 (2' 3")
Engine cover height	G		1690 (5' 7")
Minimum ground clearance	H		271 (0' 11")
Rear-end distance	I		1650 (5' 5")
Rear-end swing radius	I'		1650 (5' 5")
Distance between tumblers	J		2010 (6' 7")
Undercarriage length (without grouser)	K		2544 (8' 4")
Undercarriage width	L		1900 (6' 3")
Track gauge	M		1500 (4' 11")
Track shoe width, standard	N		400 (1' 4")
Height of blade	O		350 (1' 2")
Ground clearance of blade up	P		400 (1' 4")
Depth of blade down	Q		575 (1' 11")
Travel speed (low/high)		km/hr (mph)	2.2/4.2 (1.4/2.6)
Swing speed		rpm	9.4
Gradeability		Degree (%)	35 (70)
Ground pressure (400 mm shoe)		kgf/cm^2(psi)	0.35 (4.95)
Max traction force		kg (lb)	5221 (11510)

3. WORKING RANGE

1) 3.0 m (9' 10") MONO BOOM



Description		1.6 m (5' 3") Arm
Max digging reach	A	6150 mm (20' 2")
Max digging reach on ground	A'	6020 mm (19' 9")
Max digging depth	B	3770 mm (12' 6")
Max digging depth (8ft level)	B'	3380 mm (11' 1")
Max vertical wall digging depth	C	3230 mm (10' 7")
Max digging height	D	5760 mm (18' 11")
Max dumping height	E	4000 mm (13' 3")
Min swing radius	F	2375 mm (7' 10")
Boom swing radius (left/right)		80˚/50˚
Bucket digging force	SAE	37 kN
		3763 kgf
		8295 lbf
	ISO	42 kN
		4292 kgf
		9461 lbf
Arm digging force	SAE	27 kN
		2779 kgf
		6126 lbf
	ISO	28 kN
		2886 kgf
		6363 lbf

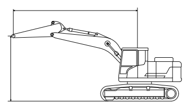
4. WEIGHT

Item	kg	lb
Upperstructure assembly		
· Main frame weld assembly	782	1,724
· Engine assembly (including DFP)	264	582
· Main pump assembly	34	74
· Main control valve assembly	53	118
· Swing motor assembly	76	168
· Hydraulic oil tank WA	95	208
· Fuel tank WA	67	148
· Counterweight (cast type)	285	628
· Counterweight (cast add increased)	435	959
· Cab assembly	350	772
Lower chassis assembly		
· Track frame weld assembly	699	1,541
· Dozer blade assembly	220	485
· Swing bearing	94	207
· Travel motor assembly	152	335
· Turning joint	27	60
· Sprocket	40	88
· Track recoil spring	58	129
· Idler	89	195
· Upper roller	22	49
· Lower roller	112	247
· Track guard	45	99
· Track-chain assembly (380 mm)	648	1,429
· Track-chain assembly (450 mm)	855	1,886
· Track-chain assembly (400 mm, rubber track)	486	1,071
Front attachment assembly		
· Boom assembly (3.0 m)	247	545
· Arm assembly (1.6 m)	130	287
· Arm assembly (1.9 m)	135	298
· Bucket assembly (0.18 $m^{3)}$	162	358
· Bucket assembly (0.07 $m^{3)}$	110	243
· Boom cylinder assembly	78	172
· Arm cylinder assembly	65	143
· Bucket cylinder assembly	37	82
· Dozer cylinder assembly	41	90
· Bucket control linkage total	47	104

5. LIFTING CAPACITIES

Model	Type	Boom	Arm	Counterweight	Wheel	Dozer		Outrigger	
HX65A	MONO BOOM	Length [mm]	Length [mm	weight [kg]	width [mm]	Front	Rear	Front	Rear
		3000	1600	285	-	Down	-	-	-

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



Lift-point height (A)		Lift-point radius (B)								At max. reach		
		2.0 m (6.6 ft)		3.0 m (9.8 ft)		4.0 m (13.1 ft)		5.0 m (16.4 ft)		Capacity		Reach
												m (ft)
4.0 m	kg					*1220	*1220			*1280	1130	4.26
(13.1 ft)	lb					*2690	*2690			*2820	2490	(14.0)
3.0 m	kg					*1270	1240			*1240	900	4.87
(9.8 ft)	lb					*2800	2730			*2730	1980	(16.0)
2.0 m	kg			*1960	1840	*1500	1200	*1320	850	*1250	800	5.18
(6.6 ft)	lb			*4320	4060	*3310	2650	*2910	1870	*2760	1760	(17.0)
1.0 m	kg			*2600	1720	*1760	1140	*1410	830	*1330	770	5.24
(3.3 ft)	lb			*5730	3790	*3880	2510	*3110	1830	*2930	1700	(17.2)
0.0 m	kg			*2850	1660	*1920	1110	*1450	810	*1420	800	5.09
(0.0 ft)	lb			*6280	3660	*4230	2450	*3200	1790	*3130	1760	(16.7)
-1.0 m	kg	*3080	*3080	*2750	1650	*1890	1100			*1480	890	4.67
(-3.3 ft)	lb	*6790	*6790	*6060	3640	*4170	2430			*3260	1960	(15.3)
-2.0 m	kg	*3610	3260	*2290	1670					*1530	1160	3.90
(-6.6 ft)	lb	*7960	7190	*5050	3680					*3370	2560	(12.8)
-3.0 m	kg											
(-9.8 ft)	lb											

※ Note

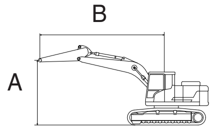
1. Lifting capacity are based on SAE J1097 and ISO 10567.
2. Lifting capacity of the HX series does not exceed 75% of tipping load with the machine on firm, level ground or 87% of full hydraulic capacity.
3. The lift-point is bucket pivot mounting pin on the arm (without bucket mass).
4. *indicates load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

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

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

Model	Type	Boom	Arm	Counterweight	Wheel	Dozer		Outrigger	
HX65A	MONO BOOM	Length [mm]	Length [mm	weight [kg]	width [mm]	Front	Rear	Front	Rear
		3000	1600	285	-	Up	-	-	-

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



Lift-point height (A)		Lift-point radius (B)								At max. reach		
		2.0 m (6.6 ft)		3.0 m (9.8 ft)		4.0 m (13.1 ft)		5.0 m (16.4 ft)		Capacity		Reach
												m (ft)
4.0 m	kg					*1220	1150			*1280	1040	4.26
(13.1 ft)	lb					*2690	2540			*2820	2290	(14.0)
3.0 m	kg					*1270	1140			1020	830	4.87
(9.8 ft)	lb					*2800	2510			2250	1830	(16.0)
2.0 m	kg			*1960	1680	1360	1100	960	780	910	740	5.18
(6.6 ft)	lb			*4320	3700	3000	2430	2120	1720	2010	1630	(17.0)
1.0 m	kg			2000	1560	1310	1040	940	760	880	710	5.24
(3.3 ft)	lb			4410	3440	2890	2290	2070	1680	1940	1570	(17.2)
0.0 m	kg			1940	1500	1270	1010	930	740	900	730	5.09
(0.0 ft)	lb			4280	3310	2800	2230	2050	1630	1980	1610	(16.7)
-1.0 m	kg	*3080	2840	1920	1490	1260	1000			1020	810	4.67
(-3.3 ft)	lb	*6790	6260	4230	3280	2780	2200			2250	1790	(15.3)
-2.0 m	kg	*3610	2900	1950	1520					1330	1060	3.90
(-6.6 ft)	lb	*7960	6390	4300	3350					2930	2340	(12.8)
-3.0 m	kg											
(-9.8 ft)	lb											

※ Note

1. Lifting capacity are based on SAE J1097 and ISO 10567.
2. Lifting capacity of the HX series does not exceed 75% of tipping load with the machine on firm, level ground or 87% of full hydraulic capacity.
3. The lift-point is bucket pivot mounting pin on the arm (without bucket mass).
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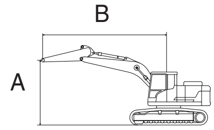
⚠ Failure to comply to the rated load can cause possible personal injury or property damage.
Make adjustments to the rated load as necessary for non-standard configurations.

Model	Type	Boom	Arm	Counterweight	Wheel	Dozer		Outrigger	
HX65A	MONO BOOM	Length [mm]	Length [mm	weight [kg]	width [mm]	Front	Rear	Front	Rear
		3000	1600	335	-	Down	-	-	-

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



Lift-point height (A)		Lift-point radius (B)								At max. reach		
		2.0 m (6.6 ft)		3.0 m (9.8 ft)		4.0 m (13.1 ft)		5.0 m (16.4 ft)		Capacity		Reach
												m (ft)
4.0 m	kg					*1220	*1220			*1280	1150	4.26
(13.1 ft)	lb					*2690	*2690			*2820	2540	(14.0)
3.0 m	kg					*1270	1270			*1240	920	4.87
(9.8 ft)	lb					*2800	2800			*2730	2030	(16.0)
2.0 m	kg			*1960	1880	*1500	1220	*1320	870	*1250	820	5.18
(6.6 ft)	lb			*4320	4140	*3310	2690	*2910	1920	*2760	1810	(17.0)
1.0 m	kg			*2600	1760	*1760	1170	*1410	850	*1330	790	5.24
(3.3 ft)	lb			*5730	3880	*3880	2580	*3110	1870	*2930	1740	(17.2)
0.0 m	kg			*2850	1700	*1920	1130	*1450	840	*1420	820	5.09
(0.0 ft)	lb			*6280	3750	*4230	2490	*3200	1850	*3130	1810	(16.7)
-1.0 m	kg	*3080	*3080	*2750	1690	*1890	1120			*1480	910	4.67
(-3.3 ft)	lb	*6790	*6790	*6060	3730	*4170	2470			*3260	2010	(15.3)
-2.0 m	kg	*3610	3340	*2290	1710					*1530	1190	3.90
(-6.6 ft)	lb	*7960	7360	*5050	3770					*3370	2620	(12.8)
-3.0 m	kg											
(-9.8 ft)	lb											

※ Note

1. Lifting capacity are based on SAE J1097 and ISO 10567.
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3. The lift-point is bucket pivot mounting pin on the arm (without bucket mass).
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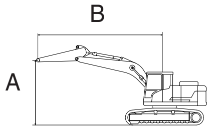
⚠ Failure to comply to the rated load can cause possible personal injury or property damage.
Make adjustments to the rated load as necessary for non-standard configurations.

Model	Type	Boom	Arm	Counterweight	Wheel	Dozer		Outrigger	
HX65A	MONO BOOM	Length [mm]	Length [mm	weight [kg]	width [mm]	Front	Rear	Front	Rear
		3000	1600	335	-	Up	-	-	-

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



Lift-point height (A)		Lift-point radius (B)								At max. reach		
		2.0 m (6.6 ft)		3.0 m (9.8 ft)		4.0 m (13.1 ft)		5.0 m (16.4 ft)		Capacity		Reach
												m (ft)
4.0 m	kg					*1220	1180			*1280	1060	4.26
(13.1 ft)	lb					*2690	2600			*2820	2340	(14.0)
3.0 m	kg					*1270	1170			1040	850	4.87
(9.8 ft)	lb					*2800	2580			2290	1870	(16.0)
2.0 m	kg			*1960	1710	1390	1120	990	800	930	750	5.18
(6.6 ft)	lb			*4320	3770	3060	2470	2180	1760	2050	1650	(17.0)
1.0 m	kg			2040	1600	1340	1070	960	780	900	720	5.24
(3.3 ft)	lb			4500	3530	2950	2360	2120	1720	1980	1590	(17.2)
0.0 m	kg			1980	1540	1300	1030	950	760	930	750	5.09
(0.0 ft)	lb			4370	3400	2870	2270	2090	1680	2050	1650	(16.7)
-1.0 m	kg	*3080	2910	1970	1530	1290	1020			1040	830	4.67
(-3.3 ft)	lb	*6790	6420	4340	3370	2840	2250			2290	1830	(15.3)
-2.0 m	kg	*3610	2970	2000	1550					1360	1080	3.90
(-6.6 ft)	lb	*7960	6550	4410	3420					3000	2380	(12.8)
-3.0 m	kg											
(-9.8 ft)	lb											

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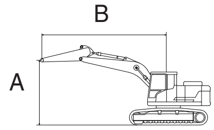
Make adjustments to the rated load as necessary for non-standard configurations.

Model	Type	Boom	Arm	Counterweight	Wheel	Dozer		Outrigger	
HX65A	MONO BOOM	Length [mm]	Length [mm	weight [kg]	width [mm]	Front	Rear	Front	Rear
		3000	1600	435	-	Down	-	-	-

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



Lift-point height (A)		Lift-point radius (B)								At max. reach		
		2.0 m (6.6 ft)		3.0 m (9.8 ft)		4.0 m (13.1 ft)		5.0 m (16.4 ft)		Capacity		Reach
												m (ft)
4.0 m	kg					*1220	*1220			*1280	1210	4.26
(13.1 ft)	lb					*2690	*2690			*2820	2670	(14.0)
3.0 m	kg					*1270	*1270			*1240	970	4.87
(9.8 ft)	lb					*2800	*2800			*2730	2140	(16.0)
2.0 m	kg			*1960	*1960	*1500	1280	*1320	910	*1250	870	5.18
(6.6 ft)	lb			*4320	*4320	*3310	2820	*2910	2010	*2760	1920	(17.0)
1.0 m	kg			*2600	1840	*1760	1230	*1410	890	*1330	830	5.24
(3.3 ft)	lb			*5730	4060	*3880	2710	*3110	1960	*2930	1830	(17.2)
0.0 m	kg			*2850	1780	*1920	1190	*1450	880	*1420	860	5.09
(0.0 ft)	lb			*6280	3920	*4230	2620	*3200	1940	*3130	1900	(16.7)
-1.0 m	kg	*3080	*3080	*2750	1770	*1890	1180			*1480	960	4.67
(-3.3 ft)	lb	*6790	*6790	*6060	3900	*4170	2600			*3260	2120	(15.3)
-2.0 m	kg	*3610	3490	*2290	1800					*1530	1250	3.90
(-6.6 ft)	lb	*7960	7690	*5050	3970					*3370	2760	(12.8)
-3.0 m	kg											
(-9.8 ft)	lb											

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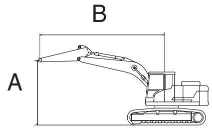
Make adjustments to the rated load as necessary for non-standard configurations.

Model	Type	Boom	Arm	Counterweight	Wheel	Dozer		Outrigger	
HX65A	MONO BOOM	Length [mm]	Length [mm	weight [kg]	width [mm]	Front	Rear	Front	Rear
		3000	1600	435	-	Up	-	-	-



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

Lift-point height (A)		Lift-point radius (B)								At max. reach		
		2.0 m (6.6 ft)		3.0 m (9.8 ft)		4.0 m (13.1 ft)		5.0 m (16.4 ft)		Capacity		Reach
												m (ft)
4.0 m	kg					*1220	*1220			*1280	1110	4.26
(13.1 ft)	lb					*2690	*2690			*2820	2450	(14.0)
3.0 m	kg					*1270	1220			1090	890	4.87
(9.8 ft)	lb					*2800	2690			2400	1960	(16.0)
2.0 m	kg			*1960	1790	1450	1180	1030	840	980	790	5.18
(6.6 ft)	lb			*4320	3950	3200	2600	2270	1850	2160	1740	(17.0)
1.0 m	kg			2140	1670	1400	1120	1010	820	940	760	5.24
(3.3 ft)	lb			4720	3680	3090	2470	2230	1810	2070	1680	(17.2)
0.0 m	kg			2070	1620	1360	1090	1000	800	970	790	5.09
(0.0 ft)	lb			4560	3570	3000	2400	2200	1760	2140	1740	(16.7)
-1.0 m	kg	*3080	3060	2060	1610	1350	1080			1090	880	4.67
(-3.3 ft)	lb	*6790	6750	4540	3550	2980	2380			2400	1940	(15.3)
-2.0 m	kg	*3610	3110	2090	1630					1420	1140	3.90
(-6.6 ft)	lb	*7960	6860	4610	3590					3130	2510	(12.8)
-3.0 m	kg											
(-9.8 ft)	lb											

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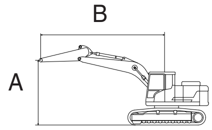
Make adjustments to the rated load as necessary for non-standard configurations.

Model	Type	Boom	Arm	Counterweight	Wheel	Dozer		Outrigger	
		Length [mm]	Length [mm	weight [kg]	width [mm]	Front	Rear	Front	Rear
HX65A	MONO BOOM	3000	1900	285	-	Down	-	-	-

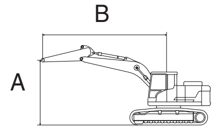
· : Rating over-front · : Rating over-side or 360 degree



Load point height		Load radius										At max. reach		
		1.0 m (3 ft)		2.0 m (7 ft)		3.0 m (10 ft)		4.0 m (13 ft)		5.0 m (16 ft)		Capacity		Reach
		Over-front	Over-side	Over-front	Over-side	Over-front	Over-side	Over-front	Over-side	Over-front	Over-side	Over-front	Over-side	m (ft)
5.0 m	kg											*1200	*1200	3.64
(16.4 ft)	lb											*2650	*2650	(11.9)
4.0 m	kg							*1060	*1060			*1080	1000	4.63
(13.1 ft)	lb							*2340	*2340			*2380	2200	(15.2)
3.0 m	kg							*1140	*1140	*1160	880	*1020	820	5.19
(9.8 ft)	lb							*2510	*2510	*2560	1940	*2250	1810	(17.0)
2.0 m	kg					*1730	*1730	*1380	1210	*1240	860	*1020	740	5.47
(6.6 ft)	lb					*3810	*3810	*3040	2670	*2730	1900	*2250	1630	(18.0)
1.0 m	kg					*2430	1750	*1680	1160	*1360	840	*1080	720	5.54
(3.3 ft)	lb					*5360	3860	*3700	2560	*3000	1850	*2380	1590	(18.2)
0.0 m	kg			*1480	*1480	*2810	1670	*1880	1110	*1440	810	*1210	730	5.39
(0.0 ft)	lb			*3260	*3260	*6190	3680	*4140	2450	*3170	1790	*2670	1610	(17.7)
-1.0 m	kg	*1920	*1920	*2710	*2710	*2820	1640	*1920	1090	*1380	810	*1380	810	5.01
(-3.3 ft)	lb	*4230	*4230	*5970	*5970	*6220	3620	*4230	2400	*3040	1790	*3040	1790	(16.4)
-2.0 m	kg	*3140	*3140	*4070	3230	*2480	1660	*1670	1100			*1440	1000	4.31
(-6.6 ft)	lb	*6920	*6920	*8970	7120	*5470	3660	*3680	2430			*3170	2200	(14.1)
-3.0 m	kg			*2450	*2450	*1430	*1430					*1400	*1400	3.02
(-9.8 ft)	lb			*5400	*5400	*3150	*3150					*3090	*3090	(9.9)

Model	Type	Boom	Arm	Counterweight	Wheel	Dozer		Outrigger	
HX65A	MONO BOOM	Length [mm]	Length [mm	weight [kg]	width [mm]	Front	Rear	Front	Rear
		3000	1900	285	-	Up	-	-	-

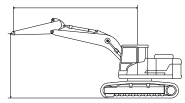
· : Rating over-front · : Rating over-side or 360 degree



Load point height		Load radius										At max. reach		
		1.0 m (3 ft)		2.0 m (7 ft)		3.0 m (10 ft)		4.0 m (13 ft)		5.0 m (16 ft)		Capacity		Reach
														m (ft)
5.0 m	kg											*1200	*1200	3.64
(16.4 ft)	lb											*2650	*2650	(11.9)
4.0 m	kg							*1060	*1060			*1080	920	4.63
(13.1 ft)	lb							*2340	*2340			*2380	2030	(15.2)
3.0 m	kg							*1140	*1140	990	810	930	750	5.19
(9.8 ft)	lb							*2510	*2510	2180	1790	2050	1650	(17.0)
2.0 m	kg					*1730	1710	1380	1110	970	790	840	680	5.47
(6.6 ft)	lb					*3810	3770	3040	2450	2140	1740	1850	1500	(18.0)
1.0 m	kg					2030	1580	1320	1060	950	760	810	650	5.54
(3.3 ft)	lb					4480	3480	2910	2340	2090	1680	1790	1430	(18.2)
0.0 m	kg			*1480	*1480	1950	1510	1270	1010	930	740	830	670	5.39
(0.0 ft)	lb			*3260	*3260	4300	3330	2800	2230	2050	1630	1830	1480	(17.7)
-1.0 m	kg	*1920	*1920	*2710	*2710	1920	1490	1250	990	920	740	920	740	5.01
(-3.3 ft)	lb	*4230	*4230	*5970	*5970	4230	3280	2760	2180	2030	1630	2030	1630	(16.4)
-2.0 m	kg	*3140	*3140	3990	2860	1940	1500	1260	1000			1140	910	4.31
(-6.6 ft)	lb	*6920	*6920	8800	6310	4280	3310	2780	2200			2510	2010	(14.1)
-3.0 m	kg			*2450	*2450	*1430	*1430					*1400	*1400	3.02
(-9.8 ft)	lb			*5400	*5400	*3150	*3150					*3090	*3090	(9.9)

Model	Type	Boom	Arm	Counterweight	Wheel	Dozer		Outrigger	
HX65A	MONO BOOM	Length [mm]	Length [mm	weight [kg]	width [mm]	Front	Rear	Front	Rear
		3000	1900	335	-	Down	-	-	-

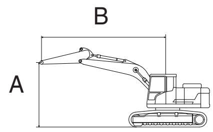
· : Rating over-front · : Rating over-side or 360 degree



Load point height		Load radius										At max. reach		
		1.0 m (3 ft)		2.0 m (7 ft)		3.0 m (10 ft)		4.0 m (13 ft)		5.0 m (16 ft)		Capacity		Reach
														m (ft)
5.0 m	kg											*1200	*1200	3.64
(16.4 ft)	lb											*2650	*2650	(11.9)
4.0 m	kg							*1060	*1060			*1080	1020	4.63
(13.1 ft)	lb							*2340	*2340			*2380	2250	(15.2)
3.0 m	kg							*1140	*1140	*1160	900	*1020	840	5.19
(9.8 ft)	lb							*2510	*2510	*2560	1980	*2250	1850	(17.0)
2.0 m	kg					*1730	*1730	*1380	1240	*1240	880	*1020	760	5.47
(6.6 ft)	lb					*3810	*3810	*3040	2730	*2730	1940	*2250	1680	(18.0)
1.0 m	kg					*2430	1790	*1680	1180	*1360	860	*1080	730	5.54
(3.3 ft)	lb					*5360	3950	*3700	2600	*3000	1900	*2380	1610	(18.2)
0.0 m	kg			*1480	*1480	*2810	1710	*1880	1140	*1440	840	*1210	750	5.39
(0.0 ft)	lb			*3260	*3260	*6190	3770	*4140	2510	*3170	1850	*2670	1650	(17.7)
-1.0 m	kg	*1920	*1920	*2710	*2710	*2820	1680	*1920	1120	*1380	830	*1380	830	5.01
(-3.3 ft)	lb	*4230	*4230	*5970	*5970	*6220	3700	*4230	2470	*3040	1830	*3040	1830	(16.4)
-2.0 m	kg	*3140	*3140	*4070	3310	*2480	1700	*1670	1130			*1440	1030	4.31
(-6.6 ft)	lb	*6920	*6920	*8970	7300	*5470	3750	*3680	2490			*3170	2270	(14.1)
-3.0 m	kg			*2450	*2450	*1430	*1430					*1400	*1400	3.02
(-9.8 ft)	lb			*5400	*5400	*3150	*3150					*3090	*3090	(9.9)

Model	Type	Boom	Arm	Counterweight	Wheel	Dozer		Outrigger	
HX65A	MONO BOOM	Length [mm]	Length [mm	weight [kg]	width [mm]	Front	Rear	Front	Rear
		3000	1900	335	-	Up	-	-	-

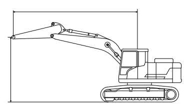
· : Rating over-front · : Rating over-side or 360 degree



Load point height		Load radius										At max. reach		
		1.0 m (3 ft)		2.0 m (7 ft)		3.0 m (10 ft)		4.0 m (13 ft)		5.0 m (16 ft)		Capacity		Reach
														m (ft)
5.0 m	kg													
(16.4 ft)	lb													
4.0 m	kg											*820	820	4.72
(13.1 ft)	lb											*1810	1810	(15.5)
3.0 m	kg							*920	*920	920	730	*790	660	5.27
(9.8 ft)	lb							*2030	*2030	2030	1610	*1740	1460	(17.3)
2.0 m	kg					*1420	*1420	*1160	1040	900	710	740	580	5.55
(6.6 ft)	lb					*3130	*3130	*2560	2290	1980	1570	1630	1280	(18.2)
1.0 m	kg					1970	1510	1240	970	860	680	710	550	5.62
(3.3 ft)	lb					4340	3330	2730	2140	1900	1500	1570	1210	(18.4)
0.0 m	kg			*1830	*1830	1860	1420	1180	920	830	650	720	560	5.47
(0.0 ft)	lb			*4030	*4030	4100	3130	2600	2030	1830	1430	1590	1230	(17.9)
-1.0 m	kg	*1930	*1930	*2780	2700	1820	1380	1160	890	820	640	800	620	5.09
(-3.3 ft)	lb	*4250	*4250	*6130	5950	4010	3040	2560	1960	1810	1410	1760	1370	(16.7)
-2.0 m	kg	*2880	*2880	3870	2740	1830	1390	1160	900			1000	780	4.41
(-6.6 ft)	lb	*6350	*6350	8530	6040	4030	3060	2560	1980			2200	1720	(14.5)
-3.0 m	kg			*2770	*2770	*1640	1450					*1490	1330	3.18
(-9.8 ft)	lb			*6110	*6110	*3620	3200					*3280	2930	(10.4)

Model	Type	Boom	Arm	Counterweight	Wheel	Dozer		Outrigger	
HX65A	MONO BOOM	Length [mm]	Length [mm	weight [kg]	width [mm]	Front	Rear	Front	Rear
		3000	1900	435	-	Down	-	-	-

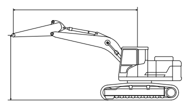
· : Rating over-front · : Rating over-side or 360 degree



Load point height		Load radius										At max. reach		
		1.0 m (3 ft)		2.0 m (7 ft)		3.0 m (10 ft)		4.0 m (13 ft)		5.0 m (16 ft)		Capacity		Reach
														m (ft)
5.0 m	kg											*1200	*1200	3.64
(16.4 ft)	lb											*2650	*2650	(11.9)
4.0 m	kg							*1060	*1060			*1080	1070	4.63
(13.1 ft)	lb							*2340	*2340			*2380	2360	(15.2)
3.0 m	kg							*1140	*1140	*1160	940	*1020	880	5.19
(9.8 ft)	lb							*2510	*2510	*2560	2070	*2250	1940	(17.0)
2.0 m	kg					*1730	*1730	*1380	1300	*1240	920	*1020	800	5.47
(6.6 ft)	lb					*3810	*3810	*3040	2870	*2730	2030	*2250	1760	(18.0)
1.0 m	kg					*2430	1870	*1680	1240	*1360	900	*1080	770	5.54
(3.3 ft)	lb					*5360	4120	*3700	2730	*3000	1980	*2380	1700	(18.2)
0.0 m	kg			*1480	*1480	*2810	1790	*1880	1200	*1440	880	*1210	790	5.39
(0.0 ft)	lb			*3260	*3260	*6190	3950	*4140	2650	*3170	1940	*2670	1740	(17.7)
-1.0 m	kg	*1920	*1920	*2710	*2710	*2820	1770	*1920	1180	*1380	870	*1380	870	5.01
(-3.3 ft)	lb	*4230	*4230	*5970	*5970	*6220	3900	*4230	2600	*3040	1920	*3040	1920	(16.4)
-2.0 m	kg	*3140	*3140	*4070	3460	*2480	1780	*1670	1190			*1440	1080	4.31
(-6.6 ft)	lb	*6920	*6920	*8970	7630	*5470	3920	*3680	2620			*3170	2380	(14.1)
-3.0 m	kg			*2450	*2450	*1430	*1430					*1400	*1400	3.02
(-9.8 ft)	lb			*5400	*5400	*3150	*3150					*3090	*3090	(9.9)

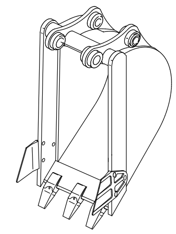
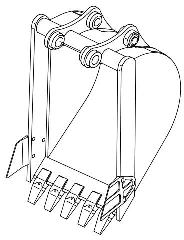
Model	Type	Boom	Arm	Counterweight	Wheel	Dozer		Outrigger	
HX65A	MONO BOOM	Length [mm]	Length [mm	weight [kg]	width [mm]	Front	Rear	Front	Rear
		3000	1900	435	-	Up	-	-	-

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



Load point height		Load radius										At max. reach		
		1.0 m (3 ft)		2.0 m (7 ft)		3.0 m (10 ft)		4.0 m (13 ft)		5.0 m (16 ft)		Capacity		Reach
		Over-front	Over-side	Over-front	Over-side	Over-front	Over-side	Over-front	Over-side	Over-front	Over-side	Over-front	Over-side	m (ft)
5.0 m	kg											*1200	*1200	3.64
(16.4 ft)	lb											*2650	*2650	(11.9)
4.0 m	kg							*1060	*1060			*1080	980	4.63
(13.1 ft)	lb							*2340	*2340			*2380	2160	(15.2)
3.0 m	kg							*1140	*1140	1060	870	1000	810	5.19
(9.8 ft)	lb							*2510	*2510	2340	1920	2200	1790	(17.0)
2.0 m	kg					*1730	*1730	*1380	1190	1040	850	900	730	5.47
(6.6 ft)	lb					*3810	*3810	*3040	2620	2290	1870	1980	1610	(18.0)
1.0 m	kg					2170	1700	1410	1140	1020	820	870	710	5.54
(3.3 ft)	lb					4780	3750	3110	2510	2250	1810	1920	1570	(18.2)
0.0 m	kg			*1480	*1480	2080	1630	1370	1090	1000	800	900	720	5.39
(0.0 ft)	lb			*3260	*3260	4590	3590	3020	2400	2200	1760	1980	1590	(17.7)
-1.0 m	kg	*1920	*1920	*2710	*2710	2060	1600	1350	1070	990	800	990	800	5.01
(-3.3 ft)	lb	*4230	*4230	*5970	*5970	4540	3530	2980	2360	2180	1760	2180	1760	(16.4)
-2.0 m	kg	*3140	*3140	*4070	3080	2070	1620	1360	1080			1230	990	4.31
(-6.6 ft)	lb	*6920	*6920	*8970	6790	4560	3570	3000	2380			2710	2180	(14.1)
-3.0 m	kg			*2450	*2450	*1430	*1430					*1400	*1400	3.02
(-9.8 ft)	lb			*5400	*5400	*3150	*3150					*3090	*3090	(9.9)

6. BUCKET SELECTION GUIDE

	
0.07m^3 SAE heaped bucket	0.18 m^3 SAE heaped bucket

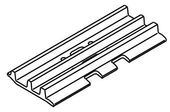
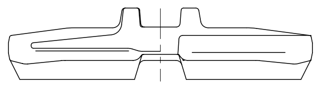
Capacity		Width		Weight	Recommendation
					3.0 m (9' 10") boom
SAE heaped	CECE heaped	Without side cutter	With side cutter		1.6 m (5' 3") arm
0.07 m^3 (0.09 yd^3)	0.06 m^3 (0.08 yd^3)	315 mm (12.4")	360 mm (14.2")	115 kg (255 lb)	Applicable for materials with density of 1600 kgf/m^3 (2700 lb/yd^3) or less
0.18 m^3 (0.24 yd^3)	0.15 m^3 (0.20 yd^3)	670 mm (26.4")	740 mm (29.1")	170 kg (375 lb)	

7. UNDERCARRIAGE

1) TRACKS

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

2) TYPES OF SHOES

Model	Shapes		Triple grouser	Rubber shoe
				
HX65A	Shoe width	mm (in)	380 (15)	400 (16)
	Operating weight	kg (lb)	6250 (13780)	6080 (13400)
	Ground pressure	kgf/cm^2 (psi)	0.38 (5.38)	0.35 (4.95)
	Overall width	mm (ft-in)	1880 (6' 2")	1900 (6' 3")

3) NUMBER OF ROLLERS AND SHOES ON EACH SIDE

Item	Quantity
Carrier rollers	1 EA
Track rollers	5 EA
Track shoes (steel)	40 EA

8. SPECIFICATIONS FOR MAJOR COMPONENTS

1) ENGINE

Item	Specification
Model	Hyundai DM02VB
Type	4-cycle, turbocharged, intercooled, electronic controlled diesel engine
Cooling method	Water cooling
Number of cylinders and arrangement	4 cylinders, in-line
Firing order	1-3-4-2
Combustion chamber type	Direct injection type
Cylinder bore×stroke	90×94 mm (3.5"×3.7")
Piston displacement	2392 cc (146 cu in)
Compression ratio	16.9 : 1
Gross power	65.9 Hp (48.5 kW)
Net power	63.9 Hp (47 kW)
Maximum power	65.9 Hp (48.5 kW)
Pick torque	25 kgf · m (183 lbf · ft)
Engine oil quantity	8.6 L (2.3 U.S. gal)
Dry weight	253 kg (558 lb)
Starting motor	12 V-2.5 kW
Alternator	12 V-90 A

2) MAIN PUMP

Item	Specification
Type	Variable displacement tandem axis piston pumps
Capacity	2×27.5 cc/rev
Maximum pressure	220 kgf/cm^2 (3130 psi)
Rated oil flow	2×55 l/min (14.5 U.S. gpm / 12.1 U.K. gpm)
Rated speed	2000 rpm

3) GEAR PUMP

Item	Specification
Type	Fixed displacement gear pump single stage
Capacity	18.3 cc/rev
Maximum pressure	220 kgf/cm^2 (3130 psi)
Rated oil flow	33.6 l/min (8.9 U.S. gpm / 7.4 U.K. gpm)

4) MAIN CONTROL VALVE

Item	Specification
Type	Sectional, 10 spools
Operating method	Hydraulic pilot system
Main relief valve pressure	220 kgf/cm^2 (3130 psi)
Overload relief valve pressure	240 kgf/cm^2 (3410 psi)

5) SWING MOTOR

Item	Specification
Type	Fixed displacement axial piston motor
Capacity	628.7 cc/rev
Relief pressure	230 kgf/cm^2 (3280 psi)
Braking system	Automatic, spring applied hydraulic released
Braking torque	272.5 kgf · m (1970 lbf · ft)
Brake release pressure	20~40 kgf/cm^2 (284~570 psi)
Reduction gear type	2 - stage planetary

6) TRAVEL MOTOR

Item	Specification
Type	Variable displacement axial piston motor
Relief pressure	350 kgf/cm^2 (4980 psi)
Reduction gear type	2-stage planetary
Braking system	Automatic, spring applied hydraulic released
Brake release pressure	9.6 kgf/cm^2 (137 psi)
Braking torque	17.2 kgf · m (69.4 lbf · ft)

7) CYLINDER

Item		Specification
Boom cylinder	Bore dia×Rod dia×Stroke	Ø110×Ø60×715 mm
	Cushion	Extend only
Arm cylinder	Bore dia×Rod dia×Stroke	Ø90×Ø55×850 mm
	Cushion	Extend and retract
Bucket cylinder	Bore dia×Rod dia×Stroke	Ø80×Ø50×660 mm
	Cushion	Extend only
Dozer blade	Bore dia×Rod dia×Stroke	Ø110×Ø60×224 mm
	Cushion	Extend only

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

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

8) SHOE

Item		Width	Ground pressure	Link quantity	Overall width
HX65A	Steel	380 mm (15")	0.38 kgf/cm^2 (5.38 psi)	40	1880 mm (6' 2")
	Rubber	400 mm (16")	0.35 kgf/cm^2 (4.95 psi)	-	1900 mm (6' 3")

9) BUCKET

Item		Capacity		Tooth quantity	Width	
		SAE heaped	CECE heaped		Without side cutter	With side cutter
HX65A	STD	0.18 m^3 (0.24 yd^3)	0.15 m^3 (0.20 yd^3)	5	670 mm (26.4")	740 mm (29.1")
	OPT	0.07 m^3 (0.09 yd^3)	0.06 m^3 (0.08 yd^3)	3	315 mm (12.4")	360 mm (14.2")

9. RECOMMENDED OILS

HD Hyundai Construction Equipment genuine lubricating oils have been developed to offer the best performance and service life for your equipment. These oils have been tested according to the specifications of HD Hyundai Construction Equipment and, therefore, will meet the highest safety and quality requirements. We recommend that you use only HD Hyundai Construction Equipment genuine lubricating oils and grease officially approved by HD Hyundai Construction Equipment.

Service point	Kind of fluid	Capacity ℓ (U.S. gal)	Ambient temperature °C(°F) -50 (-58), -30 (-22), -20 (-4), -10 (14), 0 (32), 10 (50), 20 (68), 30 (86), 40 (104)
Engine oil pan	Engine oil	8.6 (2.3)	★SAE 5W-40 SAE 30 SAE 10W SAE 10W-30 SAE 15W-40
Swing drive	Grease	0.2 (0.1)	★NLGI NO.1 NLGI NO.2
Swing drive	Gear oil	1.5 (0.4)	★SAE 75W-90 SAE 80W-90
Final drive	Gear oil	1.0×2 (0.3×2)	
Hydraulic tank	Hydraulic oil	Tank; 70 (18.5) System; 120 (31.7)	★ISO VG 15 ISO VG 32 ISO VG 46, HBHO VG 46★3 ISO VG 68
Fuel tank	Diesel fuel★1	125 (33)	★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★2	11 (2.9)	Ethylene glycol base permanent type (50 : 50) ★Ethylene glycol base permanent type (60 : 40)

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

★ : Cold region (Russia, CIS, Mongolia)
★1 : Ultra low sulfur diesel
- sulfur content ≤ 15 ppm

★2 : Soft water : City water or distilled water
★3 : HD Hyundai Construction Equipment Bio Hydraulic Oil

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

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

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

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

SECTION 2 STRUCTURE AND FUNCTION

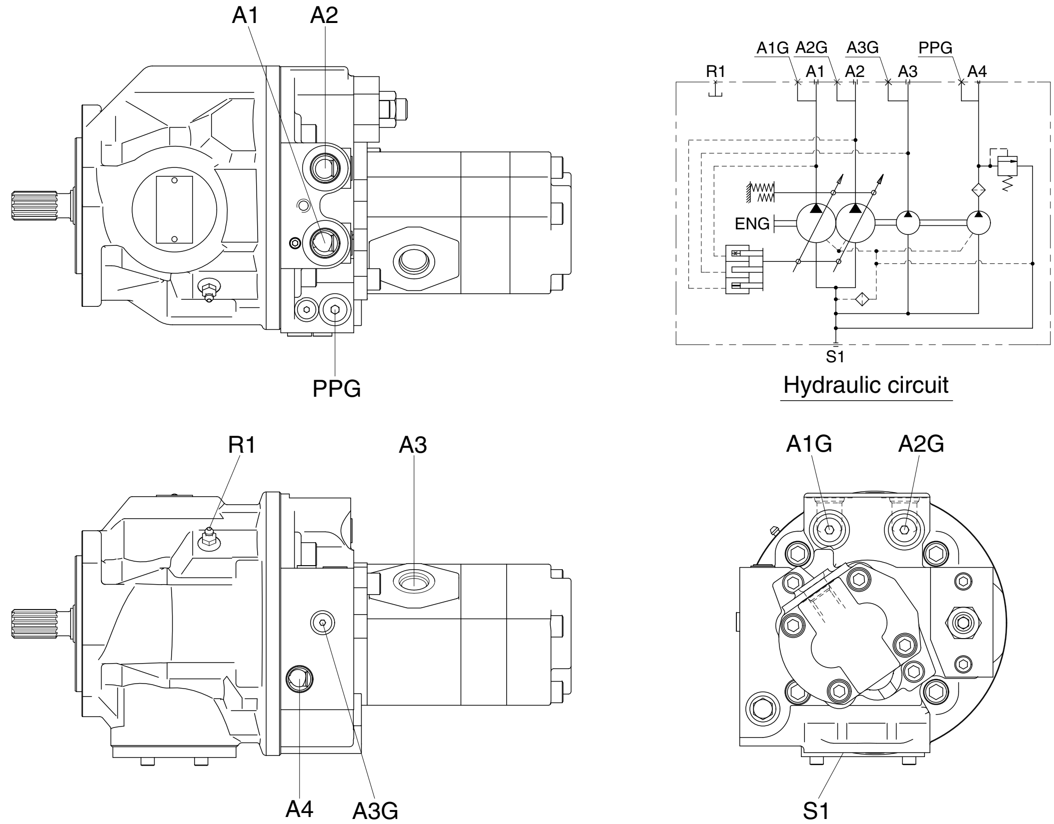
GROUP 1 HYDRAULIC PUMP

1. GENERAL

This is a variable displacement double-piston pump for discharge with equal displacements from one cylinder block. This pump is so compact as to appear a single pump though this is actually a double pump.

Because this pump has one swash plate, the tilting angle is the same for two pumps. Tilting of the pump changes in response to the total pressure of P1 + P2. Namely, the output is controlled to the constant value so that the relationship between the discharge pressure and flow rate Q becomes constant, (P1 + P2)$\times$Q =Constant.

The third pump and pilot pump can be connected to the same shaft via a coupling.



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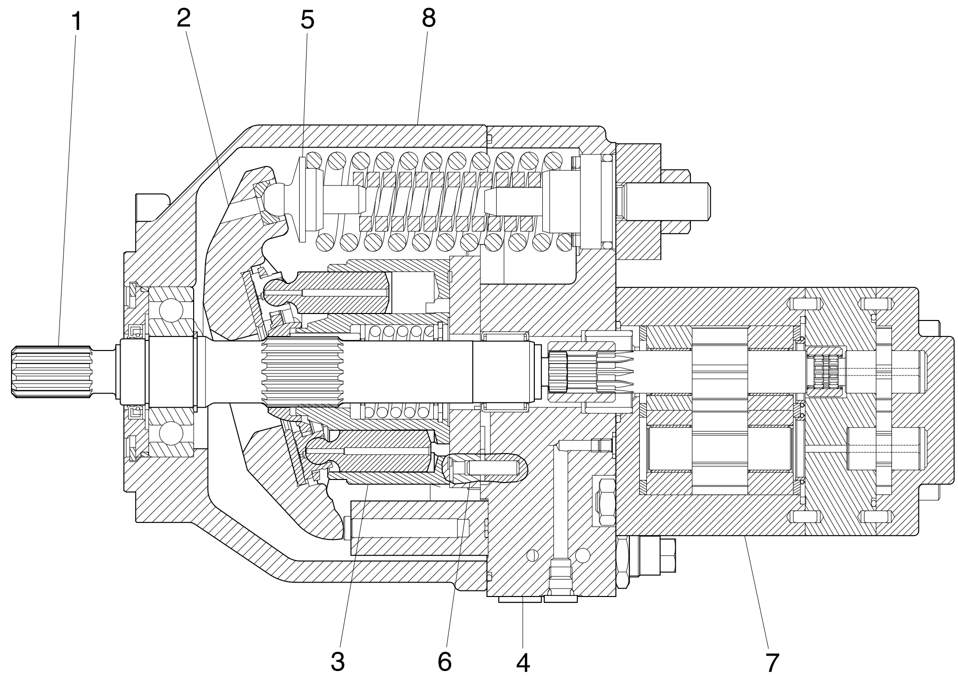
Description of the ports

Port	Name	Bore
S1	Suction port	SAE 1 1/2 (standard)
A1, A2	Discharge port	PF 1/2
A3	Discharge port	PF 1/2
A4	Discharge port	PF 1/4
A1G, A2G	Gauge port	PF 1/4 With quick coupler
A3G	Gauge port	PF 1/8 With quick coupler
A4G	Gauge port	PF 1/4 With quick coupler
R1	Air bleeder port	M10$\times$1.0 (with bleeder valve)

2. PRINCIPAL COMPONENTS AND FUNCTIONS



1	Drive shaft	5	Control spring
2	Hanger	6	Control piston
3	Rotary group	7	Gear pump
4	Cover	8	Housing

SPECIFICATIONS

- Capacity : 2×27.5+18.3+4.5 cc/rev
- Rated oil flow : 2×55+38.4+9.5 ℓ/min
- Rated pressure : 3×220+30 kgf/cm^2

This is a variable displacement double-piston pump for discharge with two equal displacements from one cylinder block. Because this is one rotary group, there is only one suction port.

The oil is divided into two equal flows by the control plate in the cover and directed to two discharge ports provided in the cover.

The discharge pressure directed to the control piston tilts the hanger by overcoming the spring force.

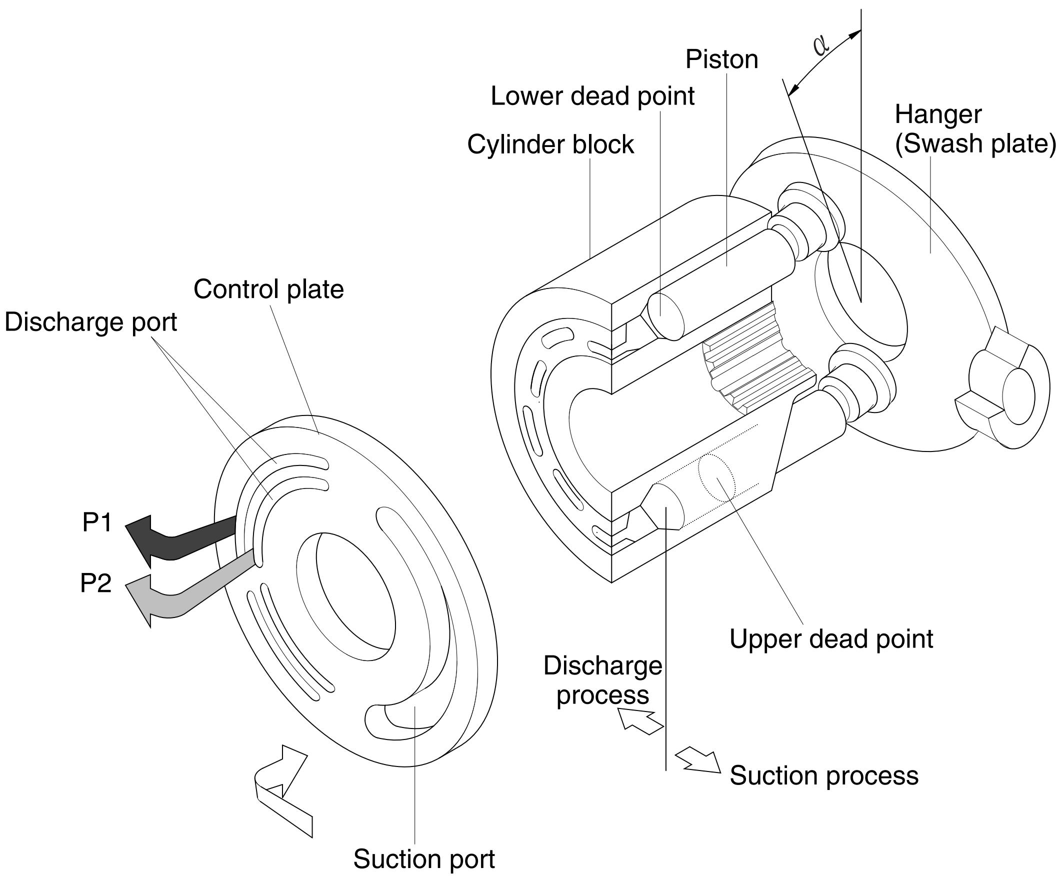
Since the piston stroke changes according to the tilting angle of the hanger, the flow can be changed.

The simultaneous tilting angle constant-output control method is employed.

The third pump and pilot pump can be connected to the same shaft via a coupling.

1) PRINCIPLE OF OPERATION

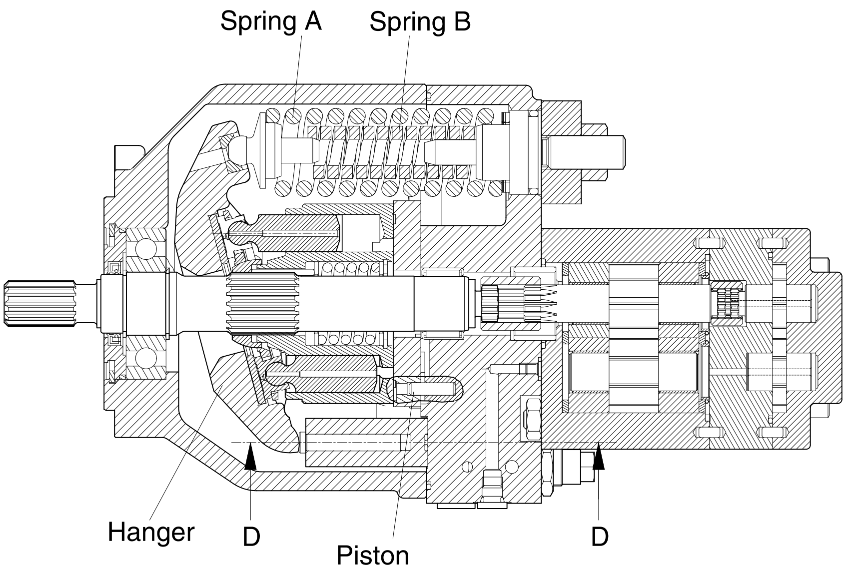
(1) Function of pump

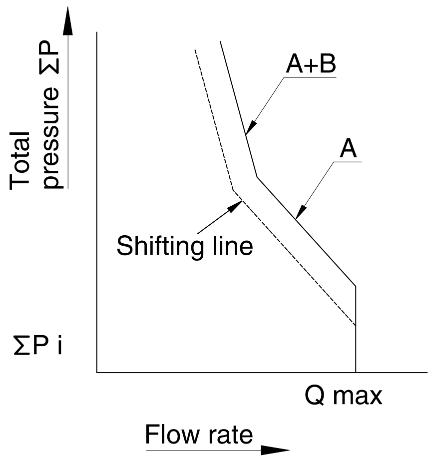


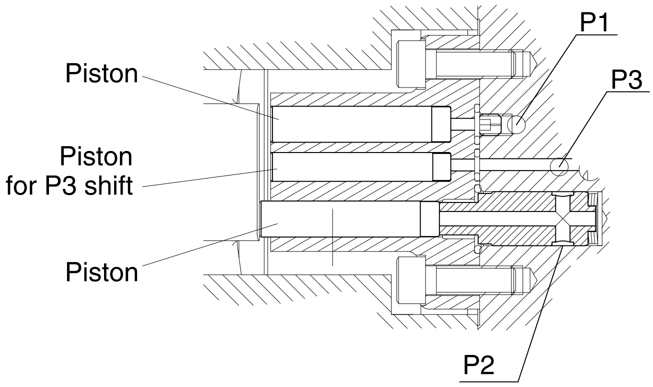
R5572SF03

The cylinder block is connected via spline and can rotate together with the drive shaft.
The piston assembled into the cylinder block performs reciprocal operation while following the swash plate on the hanger.
The piston moves in a direction to increase the displacement during a stroke from the lower to the upper dead points. The oil flows from the suction port via a port plate into the cylinder block (suction process).
During a stroke from the upper to the lower dead points, the piston moves in a direction to decrease the displacement. The oil is discharged to the discharge port (discharge process).
The displacement can be changed by changing the tilting of the hanger (swash plate).
The oil sucked through the port in the cylinder block is discharged from the discharge port in the port plate.
The oil sucked through the port on the outside of the cylinder block is discharged from the discharge port on the outside of the port plate.

2) CONTROL FUNCTIONS







Section D-D

R5572SF04

The discharge pressures P1 and P2 are directed to the pistons of equal area act on the hanger. The spring is provided to act against the discharge pressure. When the oil pressure acting on the piston is less than the installation load of the spring A (outer spring), the hanger is fixed to the maximum tilting position. When the oil, pressure acting on the piston exceeds the installation load of the spring A the hanger is tilted and kept tilted at a position where the oil pressure is balanced with the spring force. (region A in the middle of the figure above)

When the oil pressure acting on the piston rises further to reduce the tilting angle, the spring B which has been inactive up to now becomes active.

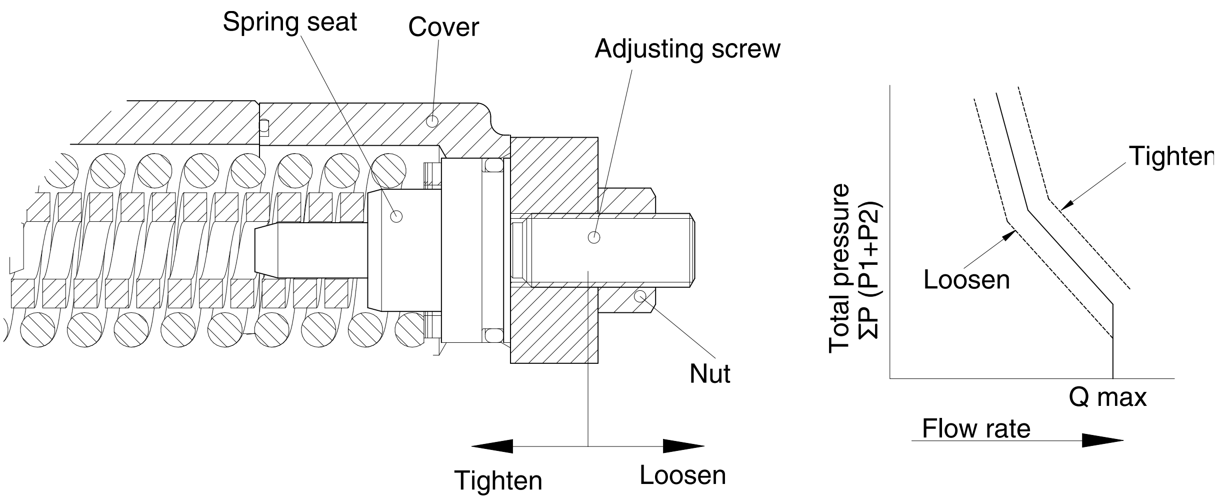
To overcome the spring force of two springs, the oil pressure must be higher and the shifting line becomes more steep. (regions A + B in the middle of the figure above)

When the P3 oil pressure acts on the shift piston, the control shifting line is shifted.

3) CONTROL / ADJUSTMENT PROCEDURE

(1) Loosen the hexagonal nut.

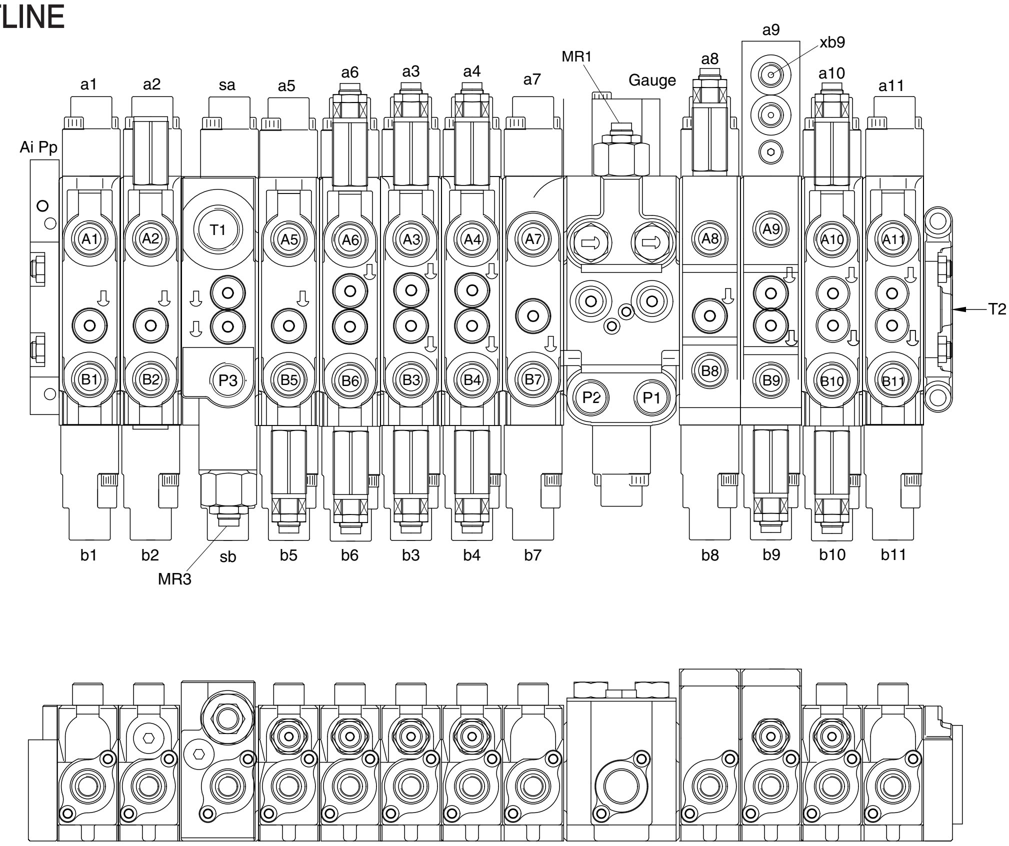
(2) Tighten or loosen the adjusting screw to set the power shifting line.



R5572SF05

GROUP 2 MAIN CONTROL VALVE

1. OUTLINE



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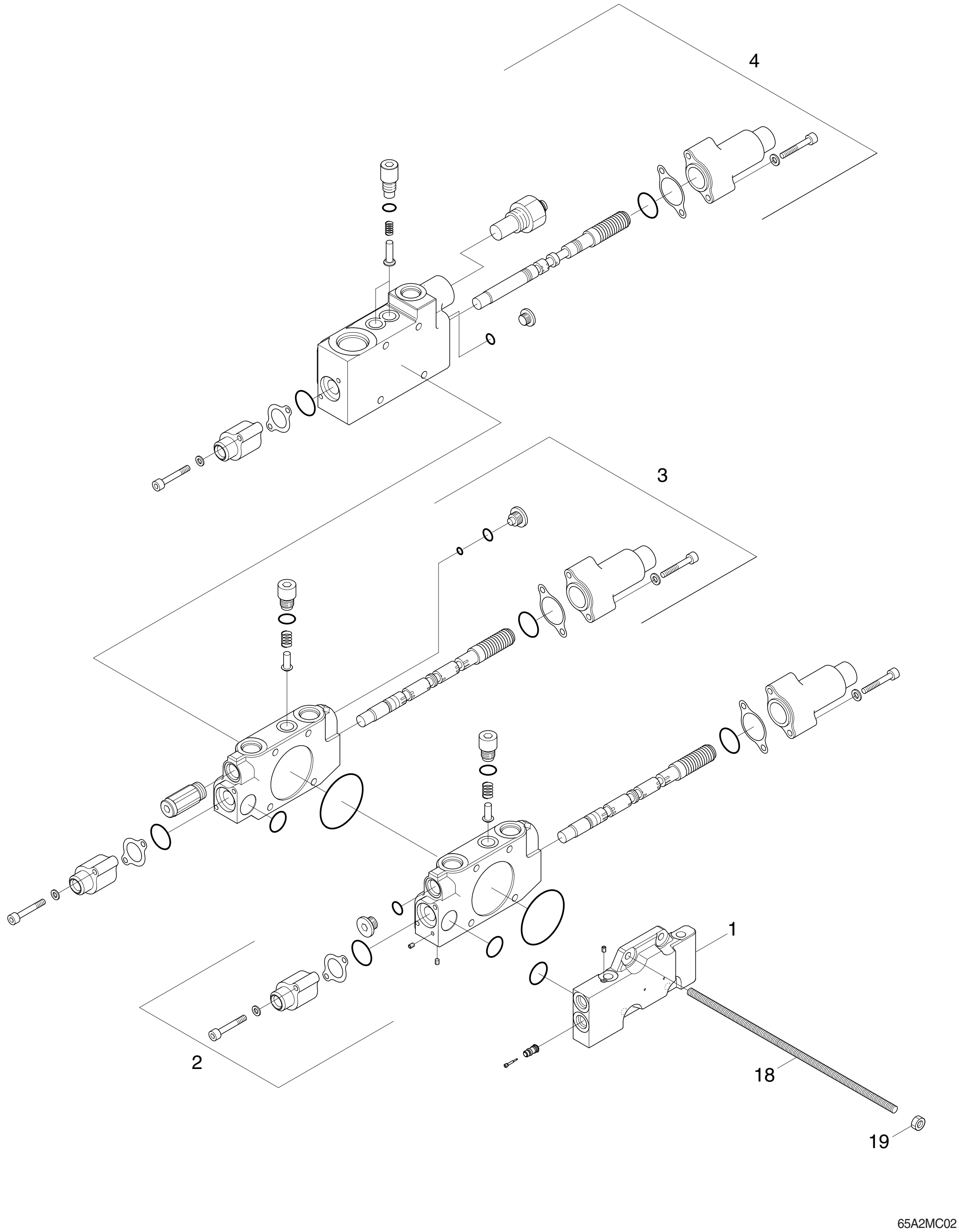
Mark	Port name	Port size	Tightening torque
P1	P1 pump port	PF 1/2	6.0~7.0 kgf · m
P2	P2 pump port		
P3	P3 pump port		
A1	Swing port (LH)		
B1	Swing port (RH)		
A2	Dozer down port		
B2	Dozer up port		
A3	Boom swing port (LH)		
B3	Boom swing port (RH)		
A4	2 Way (opt)		
B4	2 Way (opt)		
A5	Boom 2 port		
B5	Breaker port		
A6	Arm out port		
B6	Arm in port		
A7	Travel port [LH/FW]		
B7	Travel port [LH/RR]		
A8	Travel port [RH/FW]		
B8	Travel port [RH/RR]		
A9	Boom up port		
B9	Boom down port		
A10	Bucket out port		
MR1 MR3	Main relief valve	-	

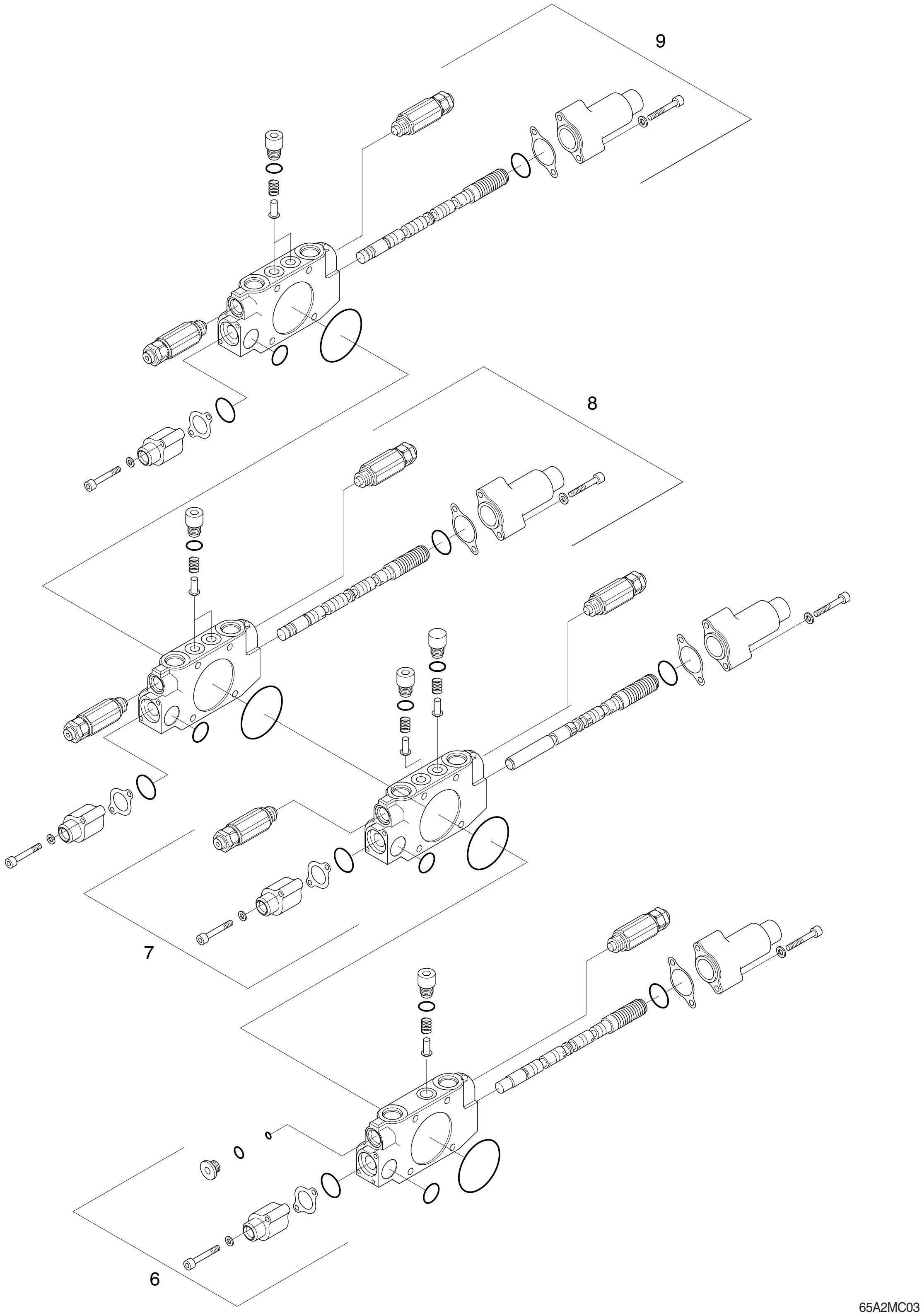
Mark	Port name	Port size	Tightening torque
B10	Bucket in port	PF1/2	6~7 kgf · m
B11	Arm 2 port		
T2	Tank return port	PF3/4	8~9 kgf · m
T1	Tank return port	PF1	10~12 kgf · m
a1	Swing pilot port (LH)	PF1/4	2.5~3.0 kgf · m
b1	Swing pilot port (RH)		
a2	Dozer down pilot port		
b2	Dozer up pilot port		
a3	Boom swing pilot port (LH)		
b3	Boom swing pilot port (RH)		
a4	2 Way pilot port (opt)		
b4	2 Way pilot port (opt)		
a5	Boom 2 pilot port		
b5	Breaker pilot port		
a6	Arm out pilot port		
b6	Arm in pilot port		
a7	Travel pilot port (LH/FW)		
b7	Travel pilot port (LH/RR)		
a8	Travel pilot port (RH/FW)		
b8	Travel pilot port (RH/RR)		
a9	Boom up pilot port		
b9	Boom down pilot port		
a10	Bucket out pilot port		
b10	Bucket in pilot port		
a11	Arm 2 pilot port		
b11	Arm 2 pilot port		
Pp	Pilot supply port	PF1/4	
Ai	Auto idle signal port		

2. STRUCTURE (1/4)



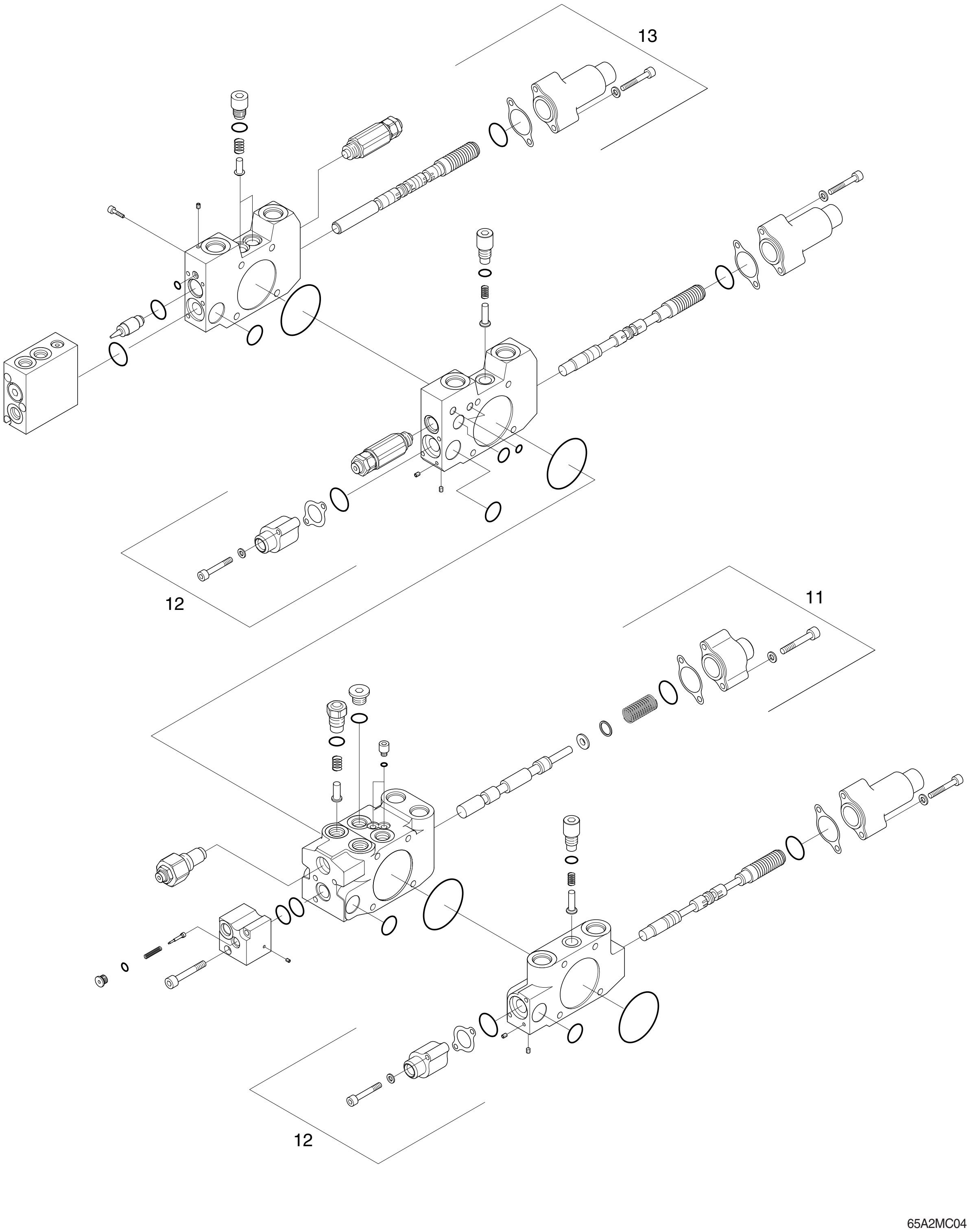
1	Port cover	4	Swing section assy
2	Swing section assy	18	Tie bolt
3	Dozer section assy	19	Nut

STRUCTURE (2/4)



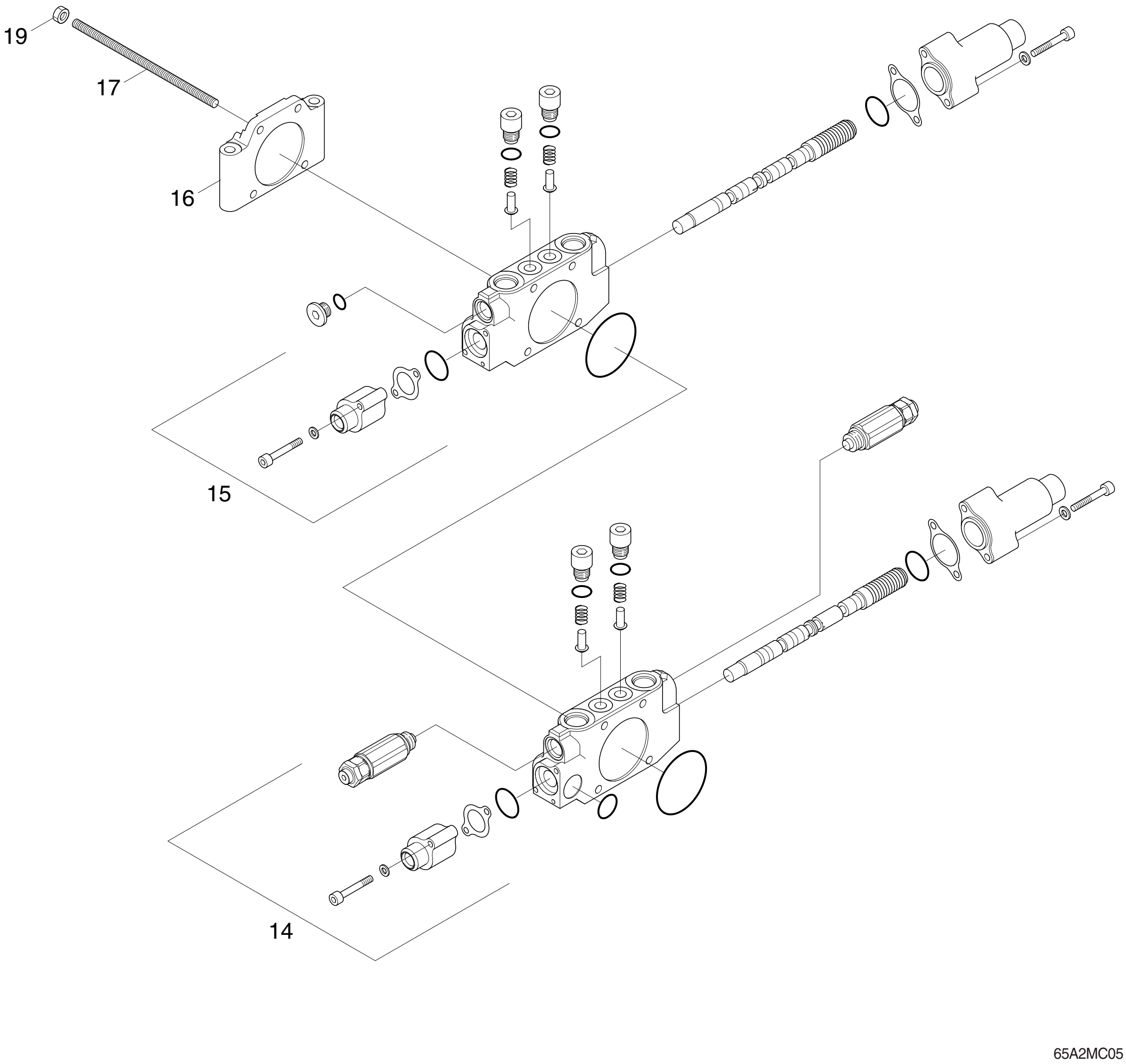
6	Boom 2 section assy	8	Boom swing section assy
7	Arm 1 section assy	9	Option section assy

STRUCTURE (3/4)



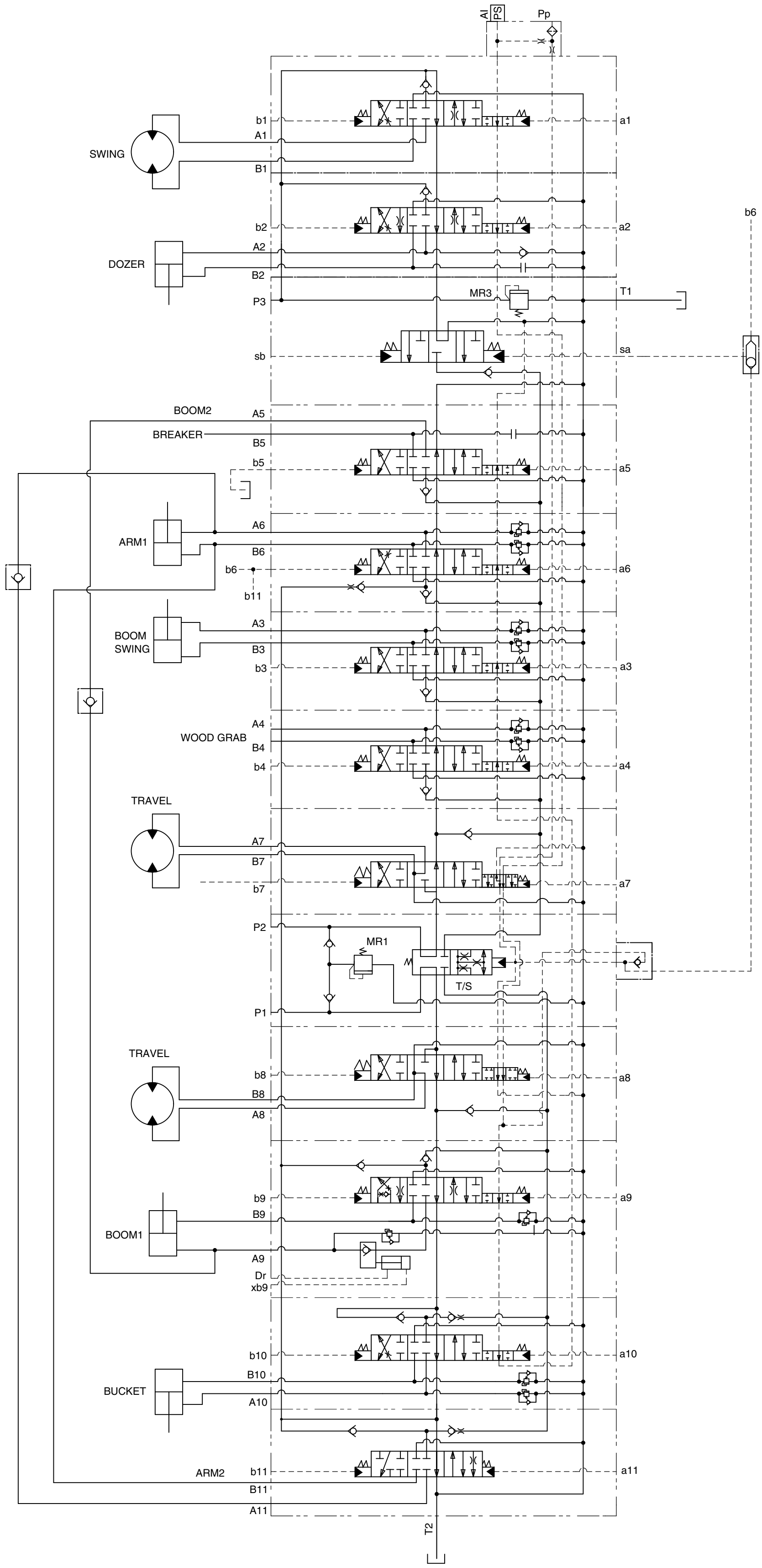
10	Travel LH section assy	12	Travel RH section assy
11	Inlet section assy	13	Boom 1 section assy

STRUCTURE (4/4)



14 Bucket section assy
15 Arm 2 section assy
16 End cover
17 Tie bolt
19 Nut

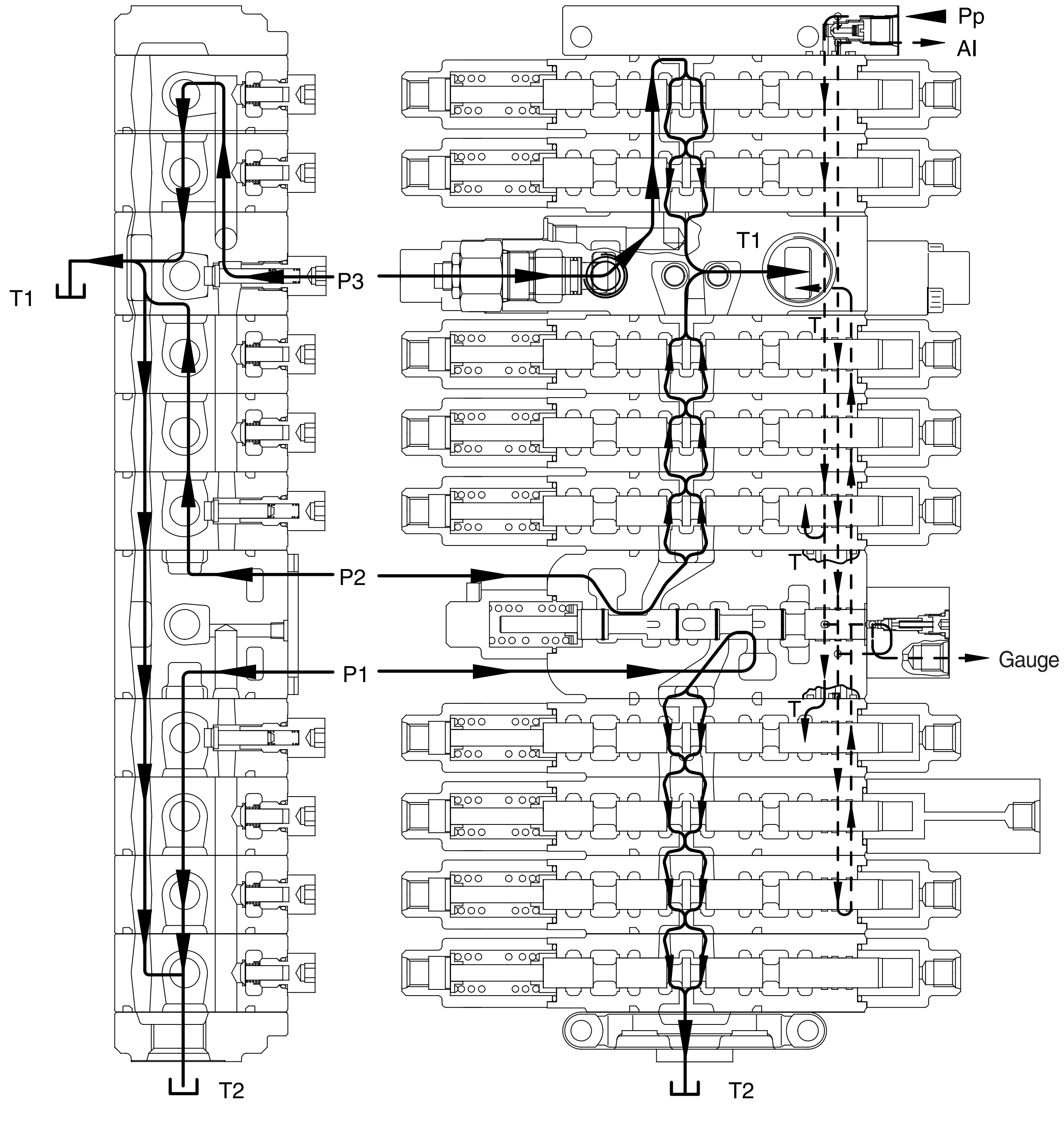
3. HYDRAULIC CIRCUIT



65A2MC06

4. FUNCTION

1) CONTROL IN NEUTRAL FUNCTION



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In neutral, spring sets the spool at the neutral position, the hydraulic oil from pumps flows to the tank through the center bypass.

(1) P1

The oil discharged from the hydraulic pump flows into control valve P1 port, and then flows the right side travel valve through the travel straight valve. In neutral, the oil flows through the center bypass passage in the direction of right travel → boom 1 → bucket → arm 2 spool, and then flows from the center bypass passage to the tank port T1 and T2.

(2) P2

The oil discharged from the hydraulic pump flows into control valve P2 port, and then flows the left side travel valve through the travel straight valve. In neutral, the oil flows through the center bypass passage in the direction of left travel → arm 1 → boom 2/breaker spool, and then flows from the center bypass passage to the tank port T1 and T2.

(3) P3

The oil discharged from the hydraulic pump flows into control valve P3.
In neutral, the oil flows through the center bypass passage in the direction of swing → dozer spool, and then flows from the center bypass passage to the tank port T1 and T2.

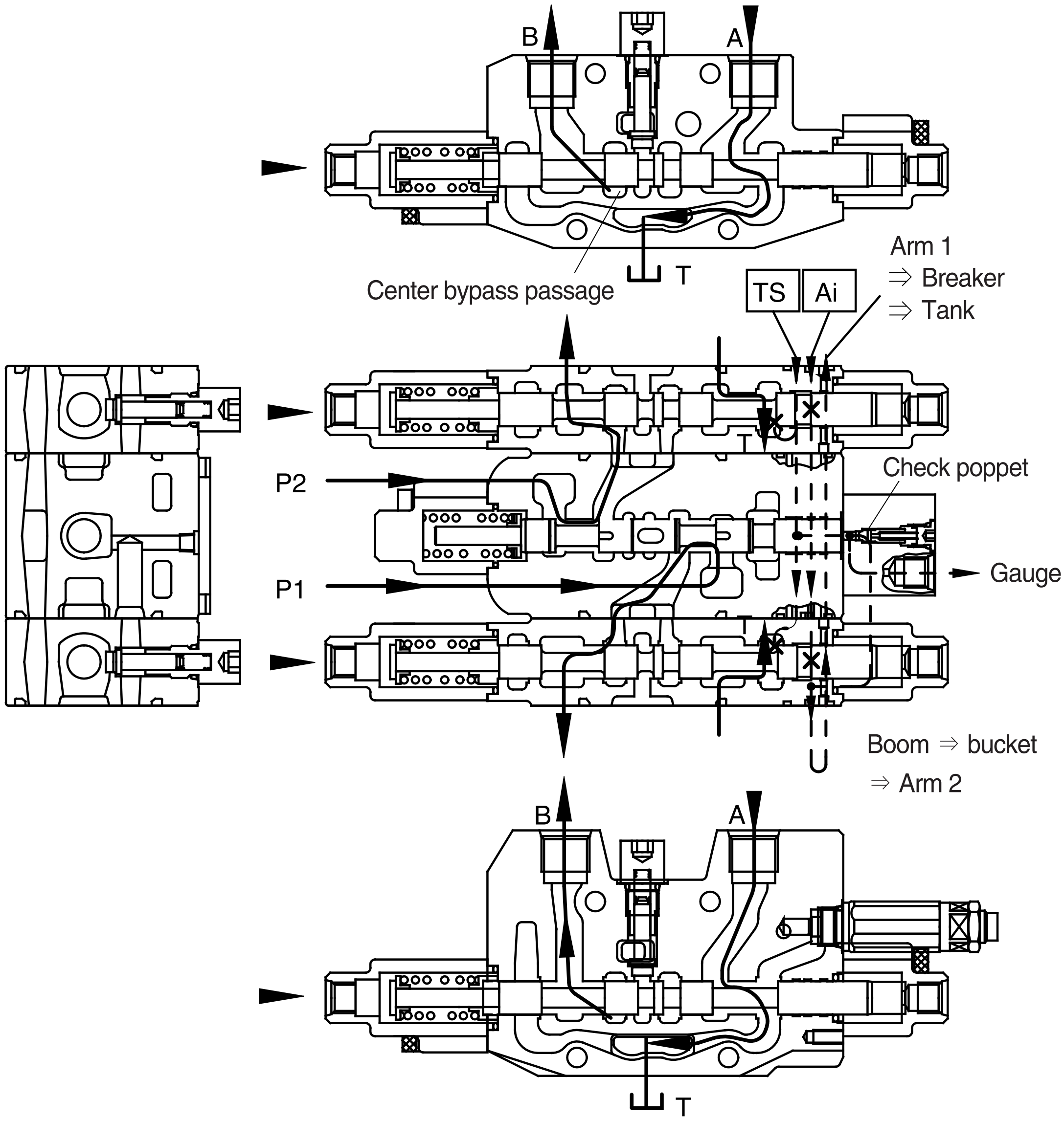
(4) Pp

When Pp port is applied with pilot pressure, the oil flows into the swing block through TS signal passage and Ai signal passage independently via an orifice.

With the spool in neutral, the oil flows into the tank passage through the all section of the control valve(except arm 2 section). As a result, the TS valve is not shifted and the auto idle signal pressure is not raised.

2) EACH SPOOL OPERATION

(1) Travel operation (forward / backward)



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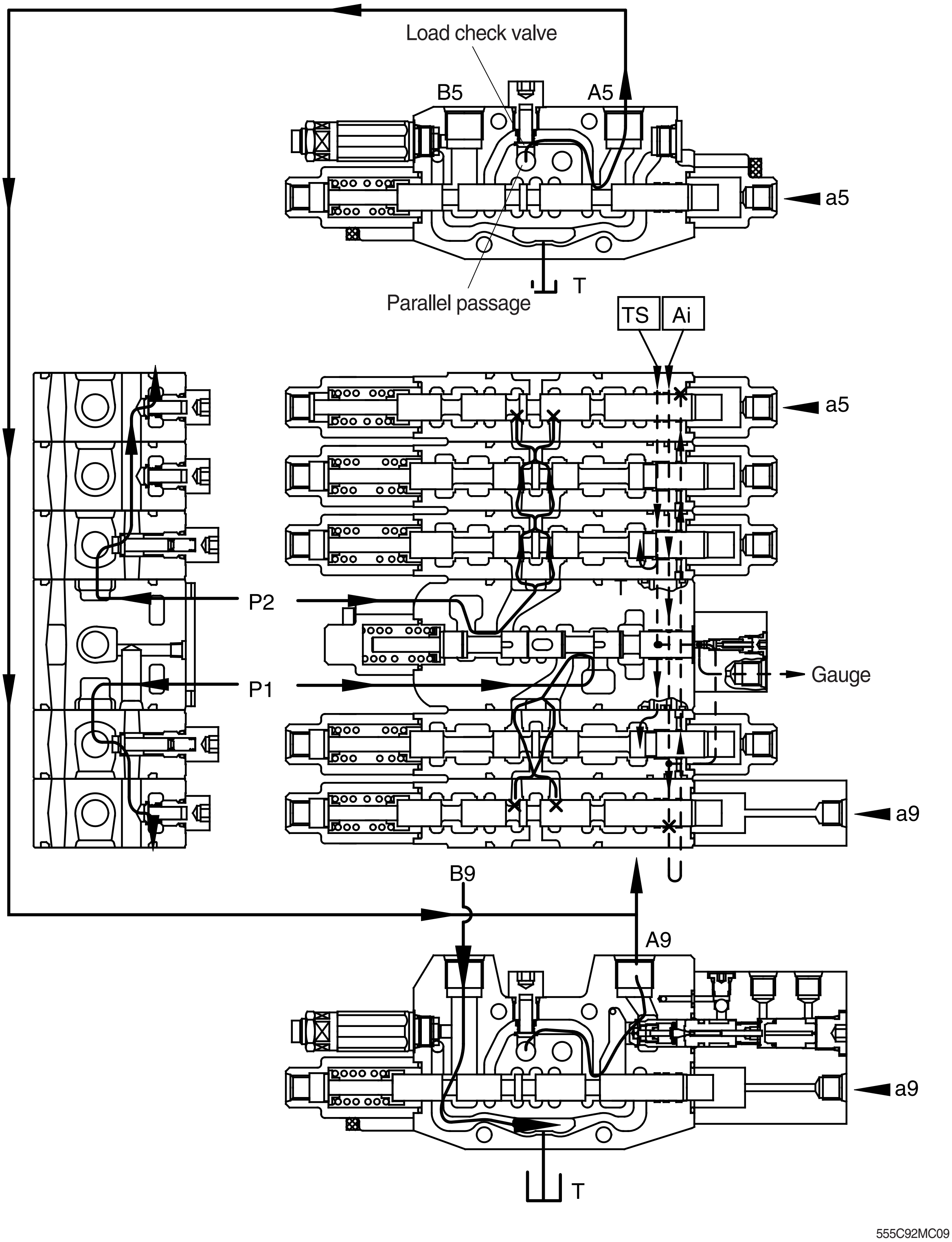
- During travel (forward/backward) operation, the pilot pressure from RCV is supplied into the travel pilot port and shift the travel spool in the right direction.
- The hydraulic oil fluid from pump is entered center bypass passage of inlet block (P1, P2) and then flows into the port of travel motor.
- The oil from the port A of travel motor flows into the main control valve and return to the hydraulic oil tank through the tank passage.
- The TS signal passage is shut off by shifting of the travel spool, but it is connected with Ai signal passage and drain to the hydraulic oil tank. As a result, the travel straight spool is not shifted.
- The Ai signal passage is connected with travel block through swing and dozer block and it is shut off by shifting of the travel spool and then signal pressure of auto idle is raised.

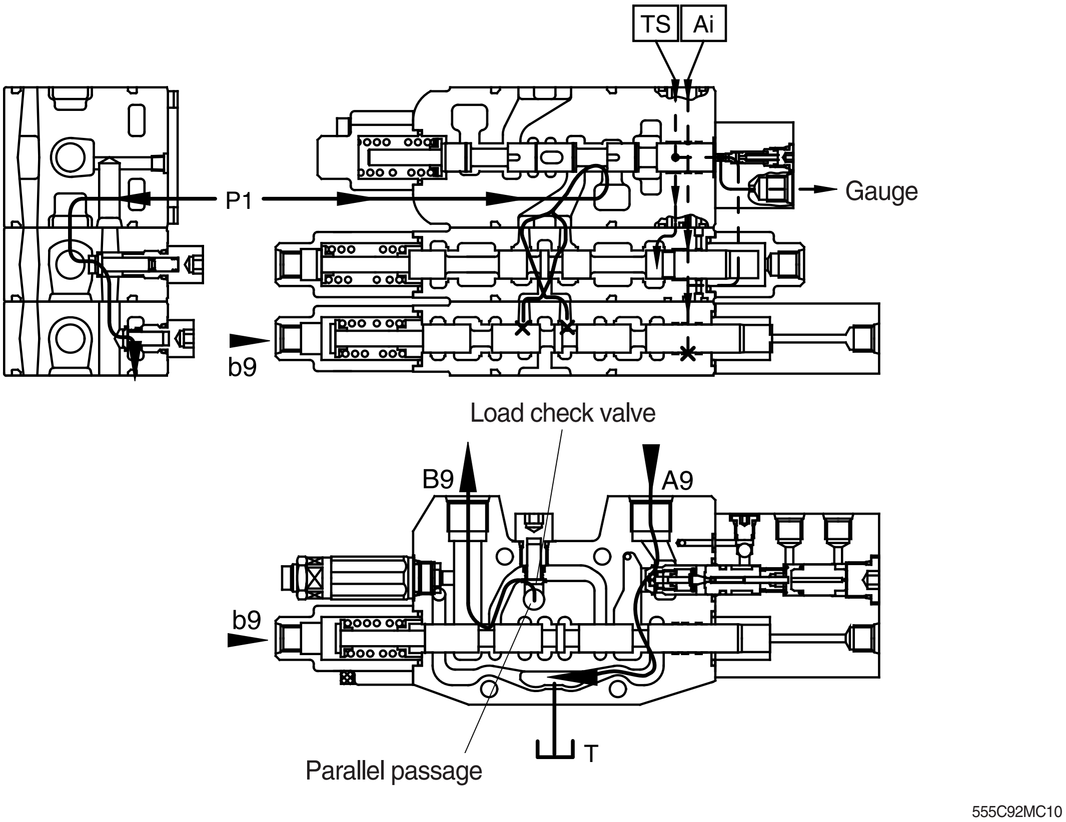
(2) Boom operation

① **Boom up operation** (P1 and P2 summation)



· During boom up operation, the pilot pressure from RCV is supplied into the port a9 and shift the boom 1 spool in the left direction. The hydraulic oil fluid from pump P1 is entered P1 parallel passage and then passes through the load check valve then flows into the port A9.
  Following this, it flows into the head side of the boom cylinder.
  At the same time the pilot pressure through the port a5 shifts the boom 2 spool. The hydraulic oil fluid from pump P2 is entered P2 parallel passage and then passes through the load check valve then flows into the port A5. The flows combine in hydraulic hoses and are directed to the cylinder head side of boom cylinder.
  The flow from rod side of the boom cylinder return to the boom 1 spool through the port B9. There after it is directed to the hydraulic oil tank through the tank passage.
· The TS signal passage oil from the Pp port is drain to the hydraulic oil tank through the left/right travel valve and the signal pressure is not raised.
· The Ai signal passage oil from the Pp port is shut off by shifting of the boom 1 spool and then signal pressure of auto idle is raised.

② Boom down operation

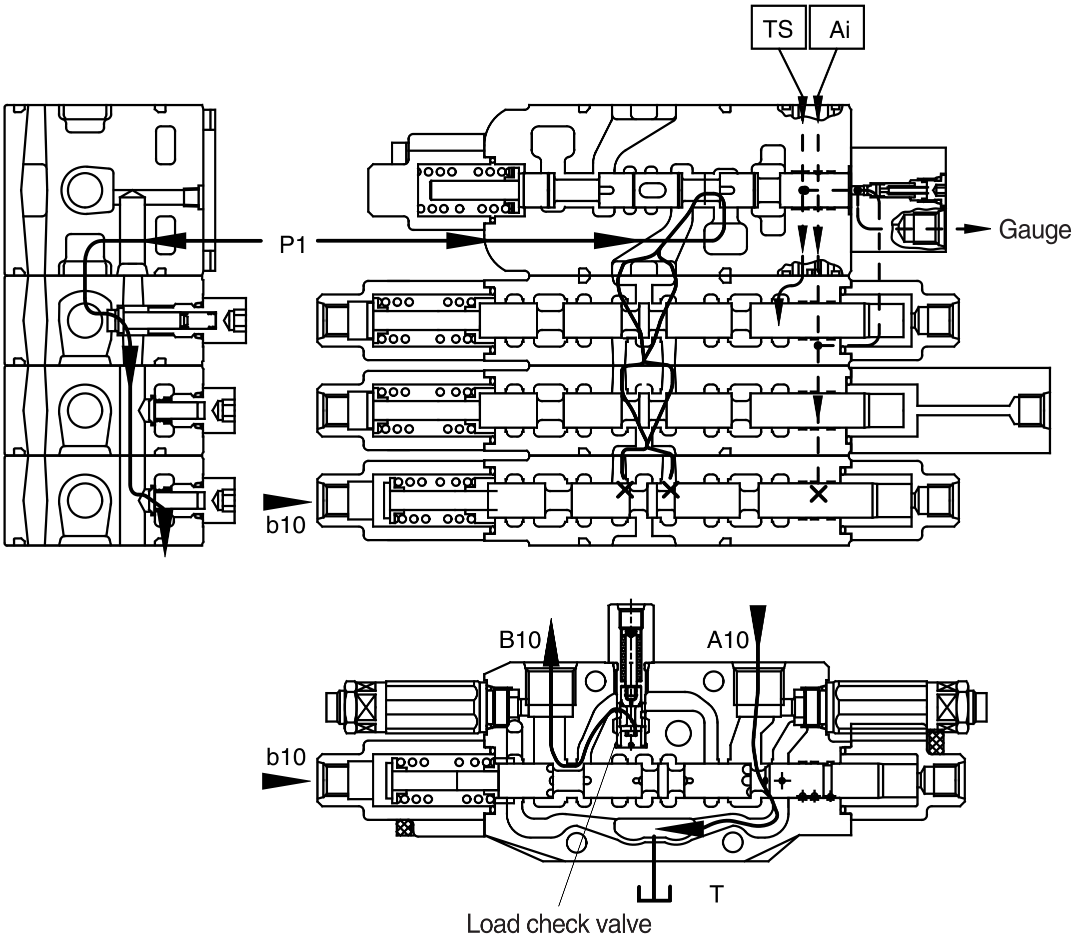


· During the boom lowing operation, the pilot pressure from RCV is supplied to the port b9 and shift the boom 1 spool in the right direction.
The hydraulic fluid from the pump P1 enters the parallel passage and is directed to the port B9 through the load check valve. Following this, it flows into the rod side of the boom cylinder.
The return flow from the head side of the boom cylinder returns to the boom 1 spool through the port A9. Thereafter it is directed to the hydraulic oil tank through tank passage.

· The hydraulic oil flow from the Pp port is same as the boom up operation.

(3) Bucket operation

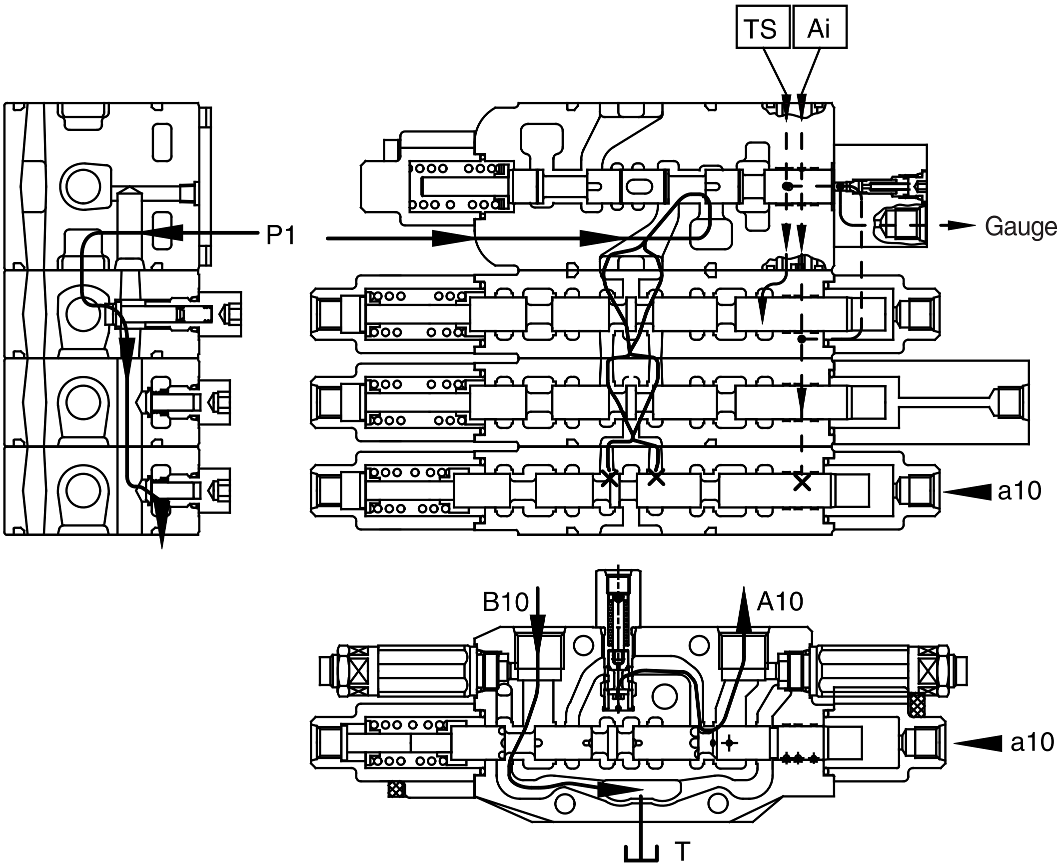
① Bucket roll in operation



555C92MC11

- During the bucket roll in operation, the pilot pressure from RCV is supplied to port b10 and shift the bucket spool in the right direction.
  The hydraulic fluid from pump P1 entered P1 parallel passage and is directed to the port B10 through the load check valve.
  Following this, it flows into the head side of the bucket cylinder.
  The return flow from the rod side of the bucket cylinder returns to the bucket spool through the port A10. Thereafter it is directed to the hydraulic oil tank through the tank passage.
- The TS signal passage oil from the Pp port is drain to the hydraulic oil tank through the left/right travel valve and the signal pressure is not raised.
- The Ai signal passage oil from the Pp port is shut off by shifting of the bucket spool and then signal pressure of auto idle is raised.

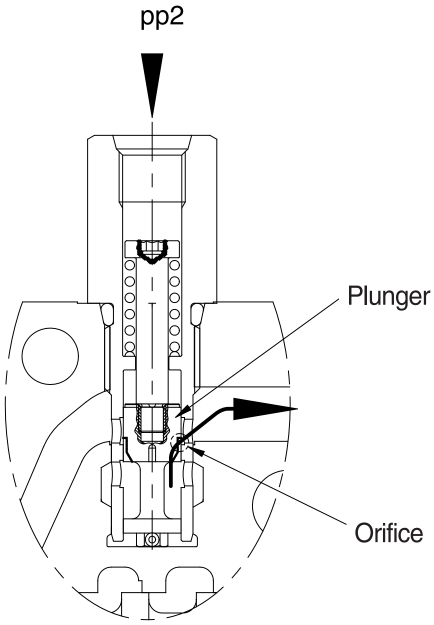
② Bucket roll out operation



555C92MC12

- In case of the bucket roll out operation, the operation is similar.
- The hydraulic oil flow from the Pp port is same as the bucket in operation.

③ Bucket load check valve operation

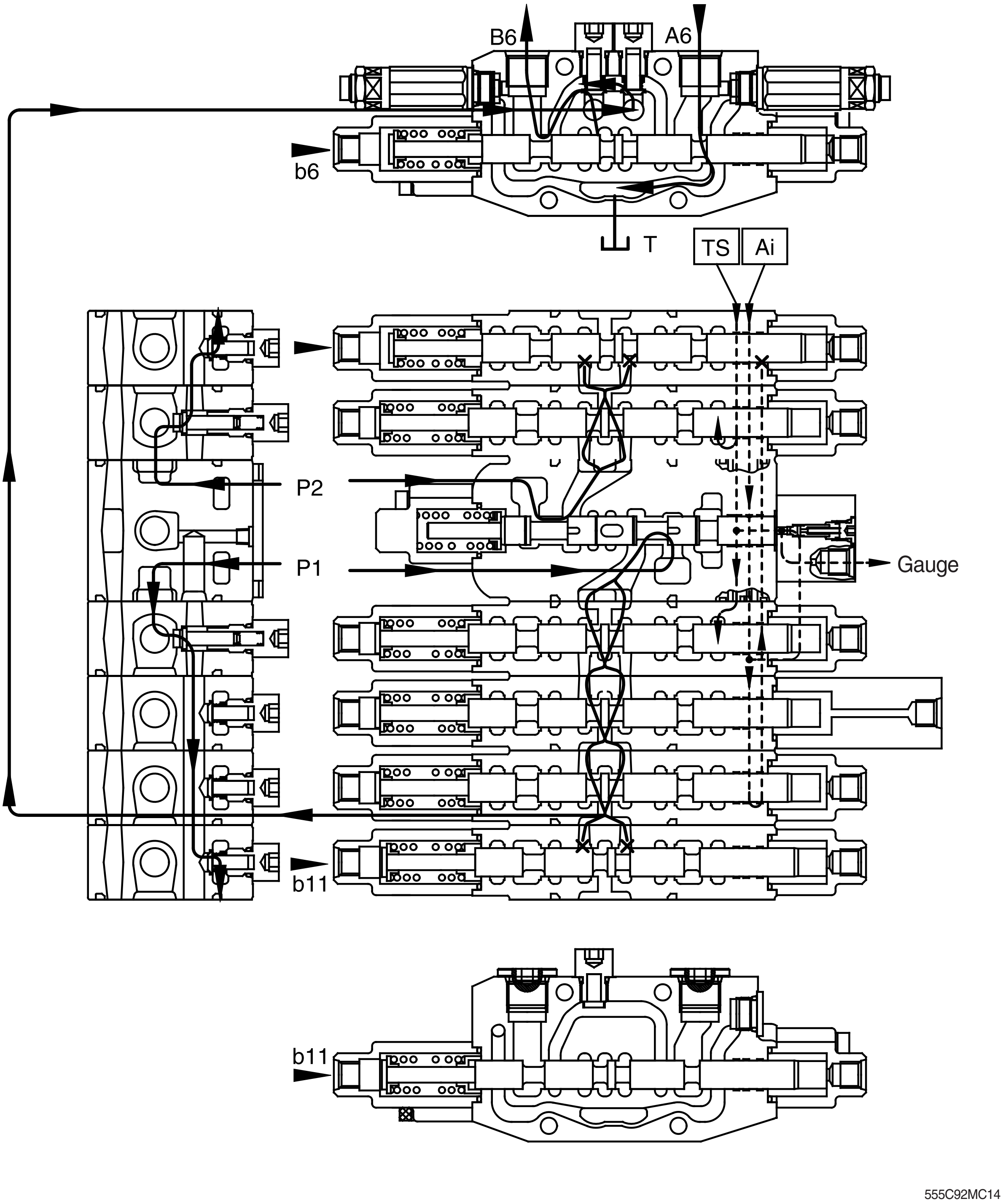


555C92MC13

- This function is used to speed up of the boom or arm by reducing the bucket speed when bucket operation with boom or arm operation simultaneously.
- When the signal pressure flows into port pp2, the plunger is shifted and orifice is made.
- The hydraulic oil from the port P1 flow into bucket cylinder via the orifice and then the speed of bucket cylinder is slow down.
  Accordingly, the much fluid from the port P1 is supplied other cylinder than the bucket cylinder.

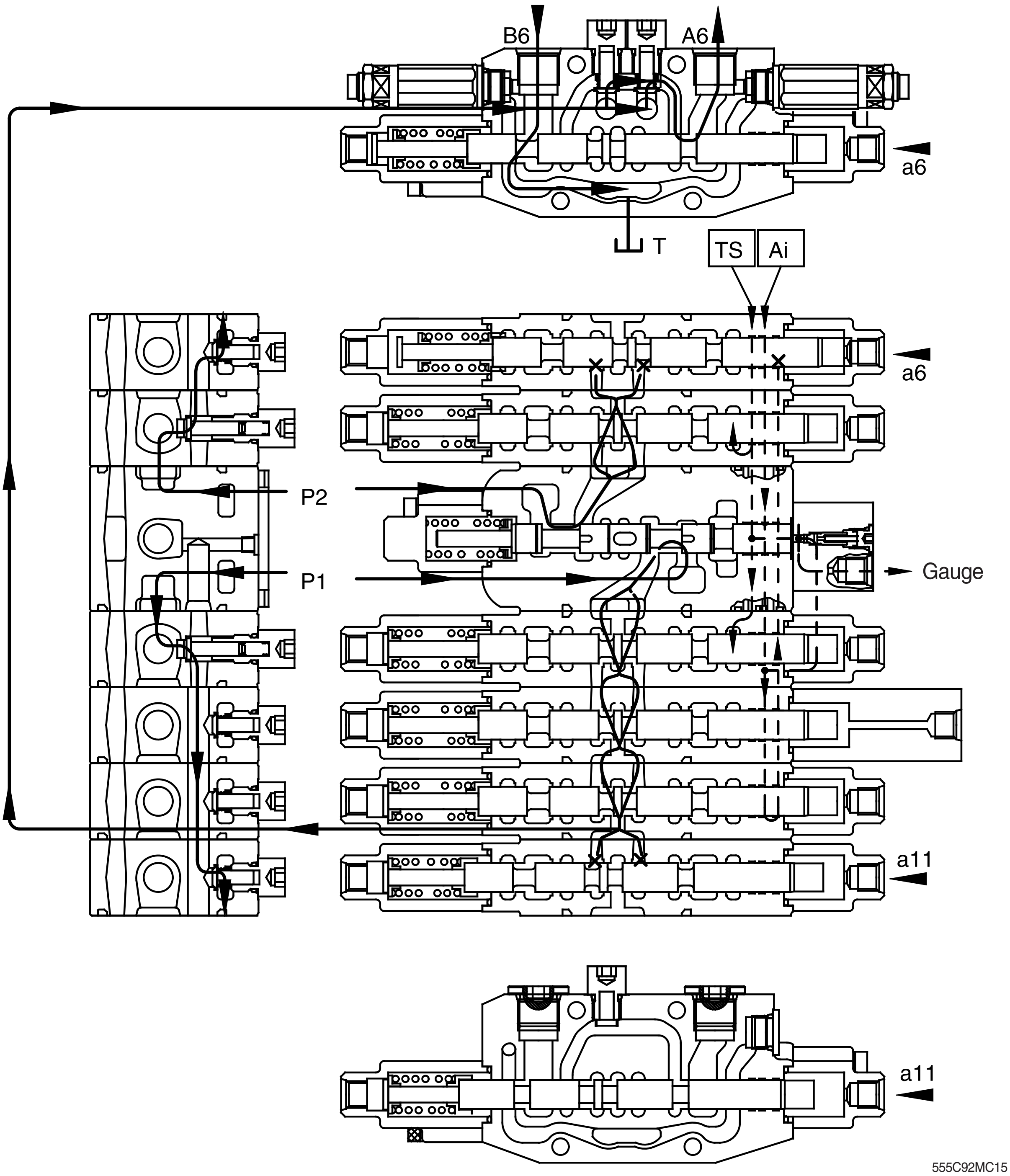
(4) Arm operation

① **Arm roll in operation** (P1 and P2 summation)



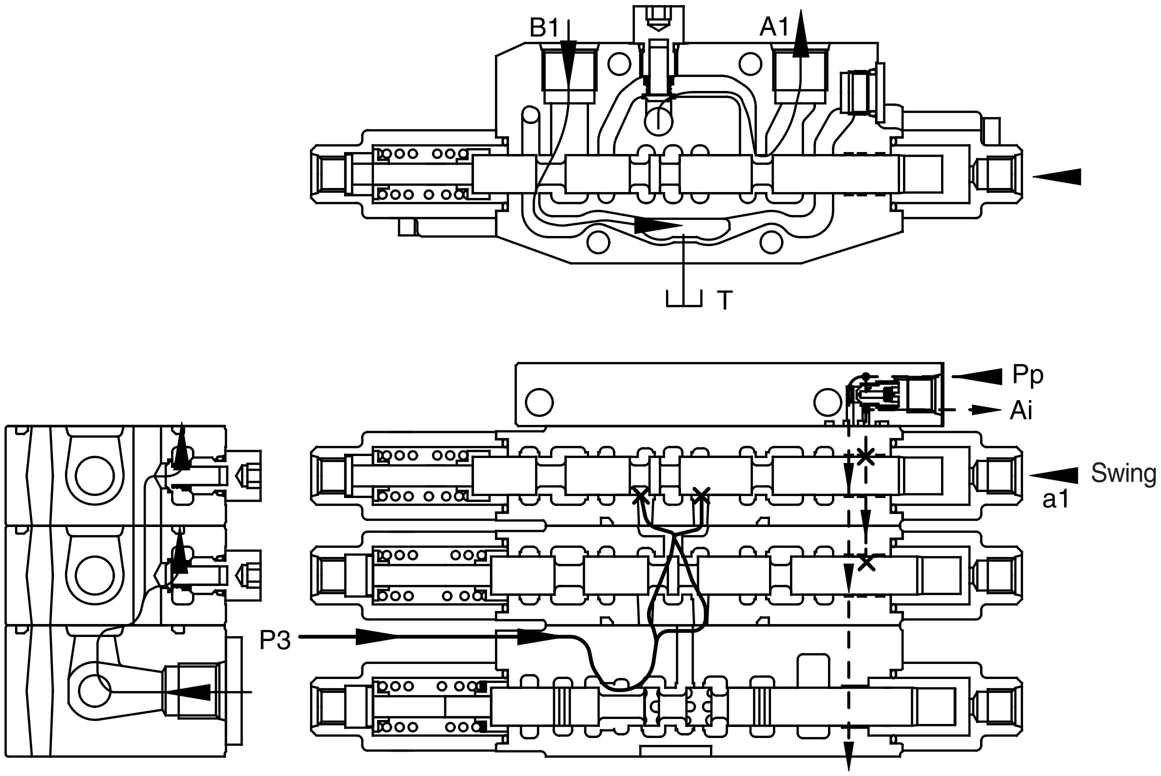
· During arm roll in operation the pilot pressure from the RCV is supplied to the port b6 and b11 and shifts arm 1 spool and arm 2 spool in the direction.
The hydraulic oil from the pump P2 flows into the arm cylinder head side through P2 parallel passage, the load check valve and the port B6.
At same time, the hydraulic fluid from the pump P1 flows into the arm summation passage in arm 1 spool through the arm 2 spool. Then it entered the arm cylinder head side with hydraulic fluid from arm 1 spool.
· The TS signal passage oil from the Pp port is drain to the hydraulic oil tank through the left/right travel valve and the signal pressure is not raised.
· The Ai signal passage oil from the Pp port is shut off by shifting of the arm spool and then signal pressure of auto idle is raised.

② Arm roll out operation



- During arm roll out operation the pilot pressure from RCV is supplied to the port a6 and the a11 and shifts arm 1 spool and arm 2 spool in the left direction.
  The hydraulic fluid from pump P2 flows into arm 1 spool through the parallel passage. Then it enters into the arm cylinder rod side through the load check valve and the port A6.
  At same time, the hydraulic oil from the pump P1 flows into the arm summation passage in arm 1 spool through the arm 2 spool.
  The return flow from the arm cylinder head side returns to the hydraulic tank through the port B6 the arm1 spool and tank passage.
- The hydraulic oil flow from the Pp port is same as the arm roll in operation.

(5) Swing operation



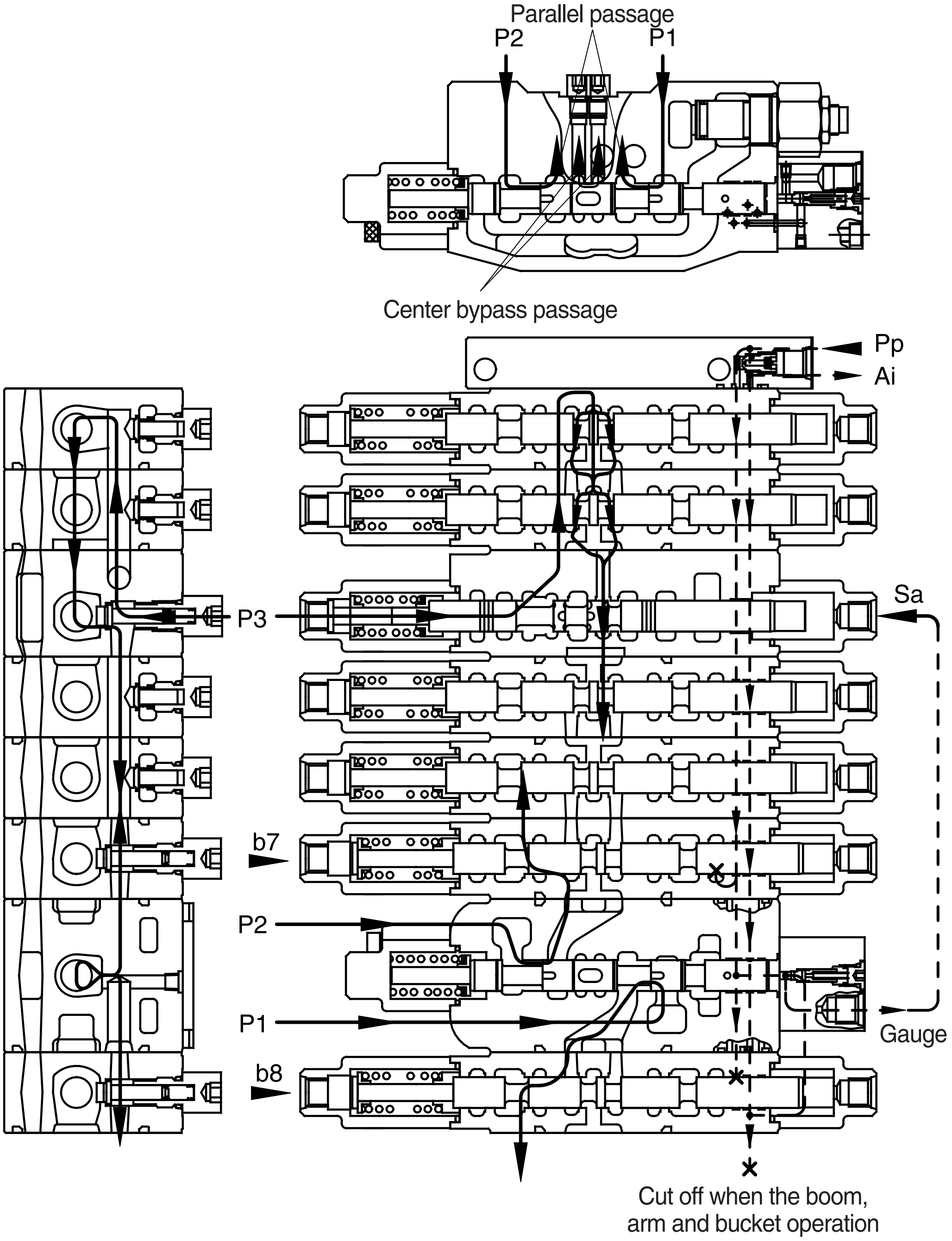
· The pilot pressure from the RCV is supplied to the a1 and shift the swing spool in left direction. The hydraulic fluid from pump P3 flows into swing spool through the parallel passage. Then it is directed to swing motor through the port A1. As a result, swing motor turns and flow from the swing motor returns to the hydraulic oil tank through the port B1, swing spool and the tank passage.

In case of swing left operation, the operation is similar.

· The TS signal passage oil from the Pp port is drain to the hydraulic oil tank through the left/right travel valve and the signal pressure is not raised.

· The Ai signal passage oil from the Pp port is shut off by shifting of the swing spool and then signal pressure of auto idle is raised.

(6) Travel straight function



555C92MC17

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

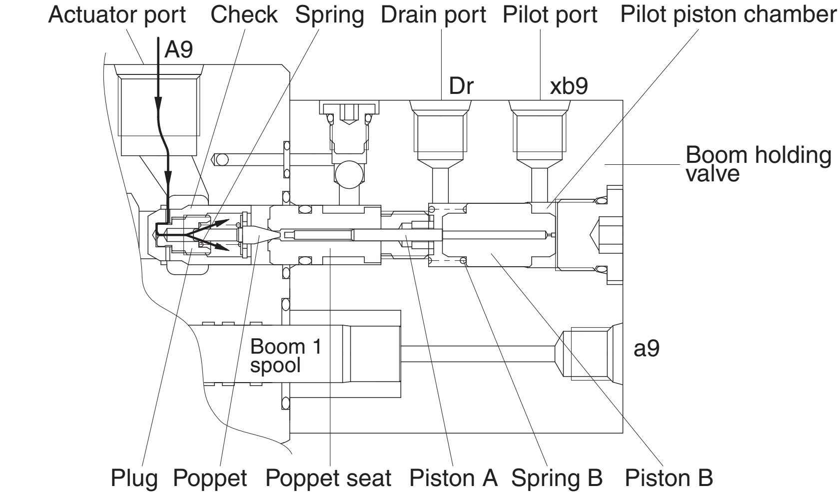
① During travel only :
The hydraulic fluid of the pump P1 is supplied to the travel motor and the pump P2 is supplied to the other motor.
Thus, the machine keep travel straight.

② The other actuator operation during straight travel operation.
When the other actuator spool(s) is selected under straight travel operation, the straight travel spool is moved.
Some of hydraulic fluid from pump P1 and P2 is supplied to the travel motors through parallel passage and the other hydraulic fluid is supplied to the actuator(s) through center bypass passage via orifice passage.
Thus, the machine keeps straight travel.

· The fluid flows into P3 pilot port Sa through the gauge port and the spool is shifted. As a result, the fluid of P3 pump is combined with the boom, arm and bucket and then the actuators speed up.

(7) Holding valve operation

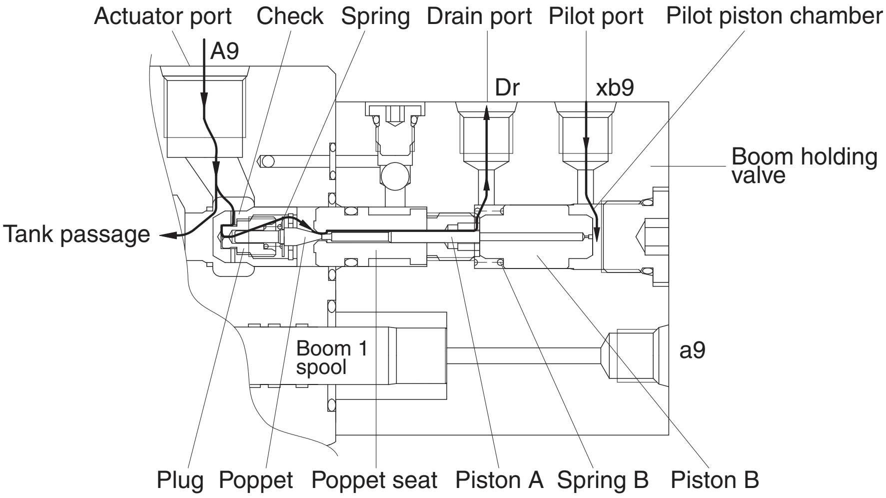
① Holding operation



55W72MC16

At neutral condition, the pilot piston chamber is connected to drain port through the pilot port.
And the piston "B" is supported with spring "B".
Also, the pressured fluid from actuator entered to inside of the holding valve through the periphery hole of check, crevice of the check and the plug and the periphery hole of plug.
Then, this pressured oil pushed the poppet to the poppet seat and the check to the seat of body.
So the hydraulic fluid from actuator is not escaped and the actuator is not moved.

② Release holding operation



55W72MC17

The pilot pressure is supplied to the pilot port for release holding valve and shifts the piston "B" in the left direction against the spring "B", and shifts the poppet in the left direction through piston "B" and piston "A" against spring "B" and shifts the spool in the left side.
At same time, the return fluid from actuator returns to the drain port through the periphery hole of check, crevice of the check and the plug, the periphery hole of the plug, in side of holding valve, crevice of the poppet and the poppet seat, the periphery hole of the poppet seat, crevice of socket and spool and internal passage of spool.
When the poppet is opened, pressure of inside of holding valve is decreased and the return fluid from actuator returns to the tank passage through the notch of spool.

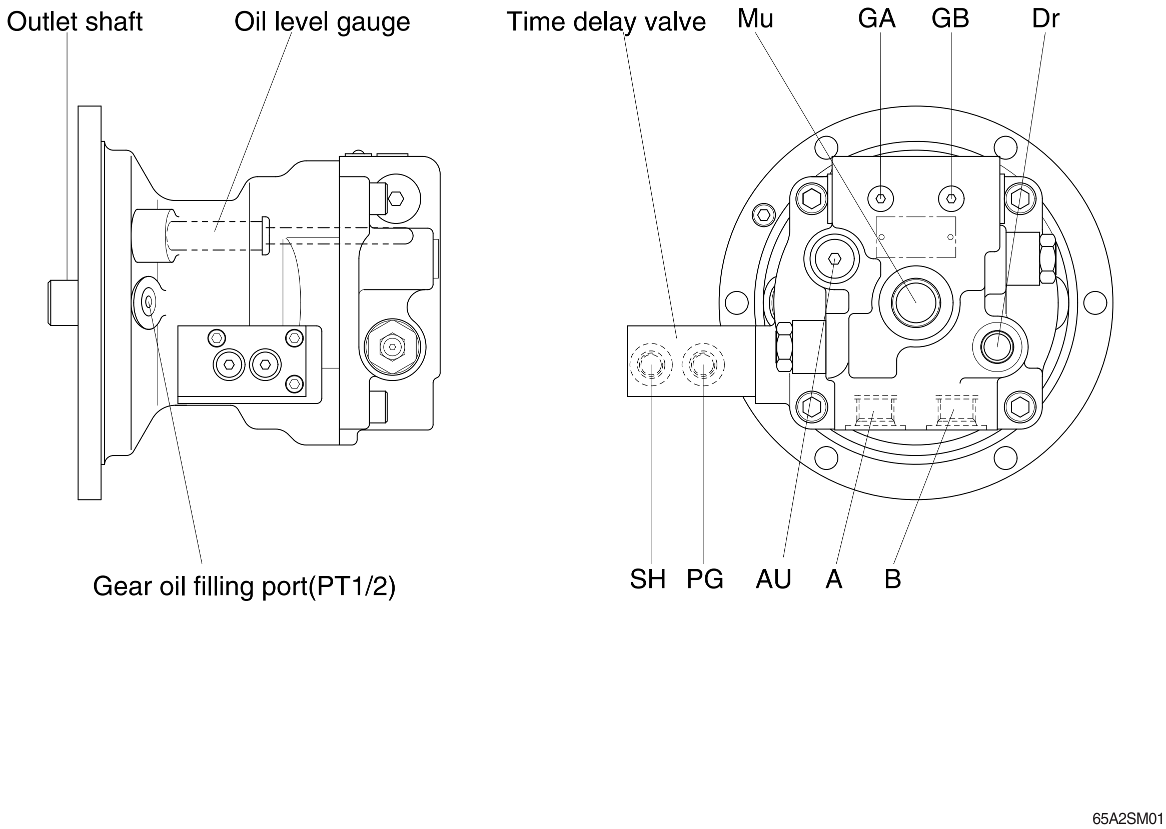
GROUP 3 SWING DEVICE

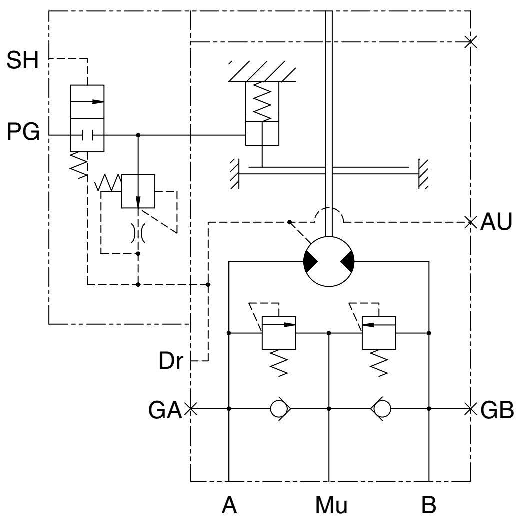
1. STRUCTURE

Swing device consists swing motor, swing reduction gear.

1) SWING MOTOR

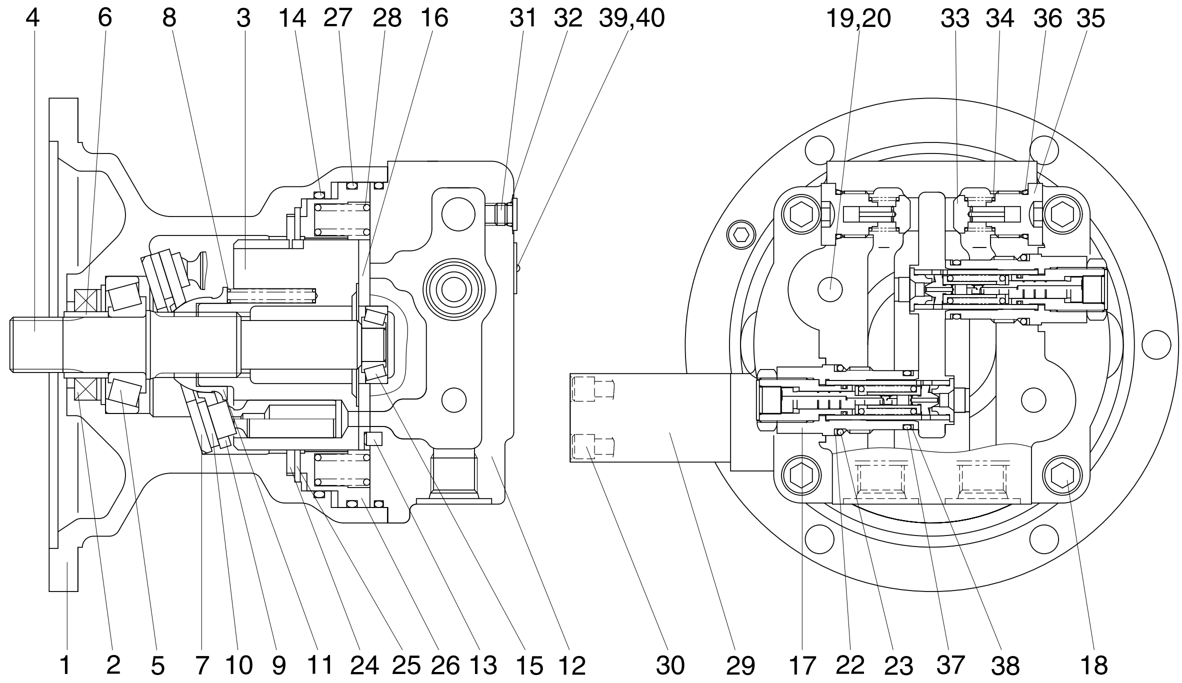
Swing motor include mechanical parking valve, relief valve, make up valve and time delay valve.





Hydraulic circuit

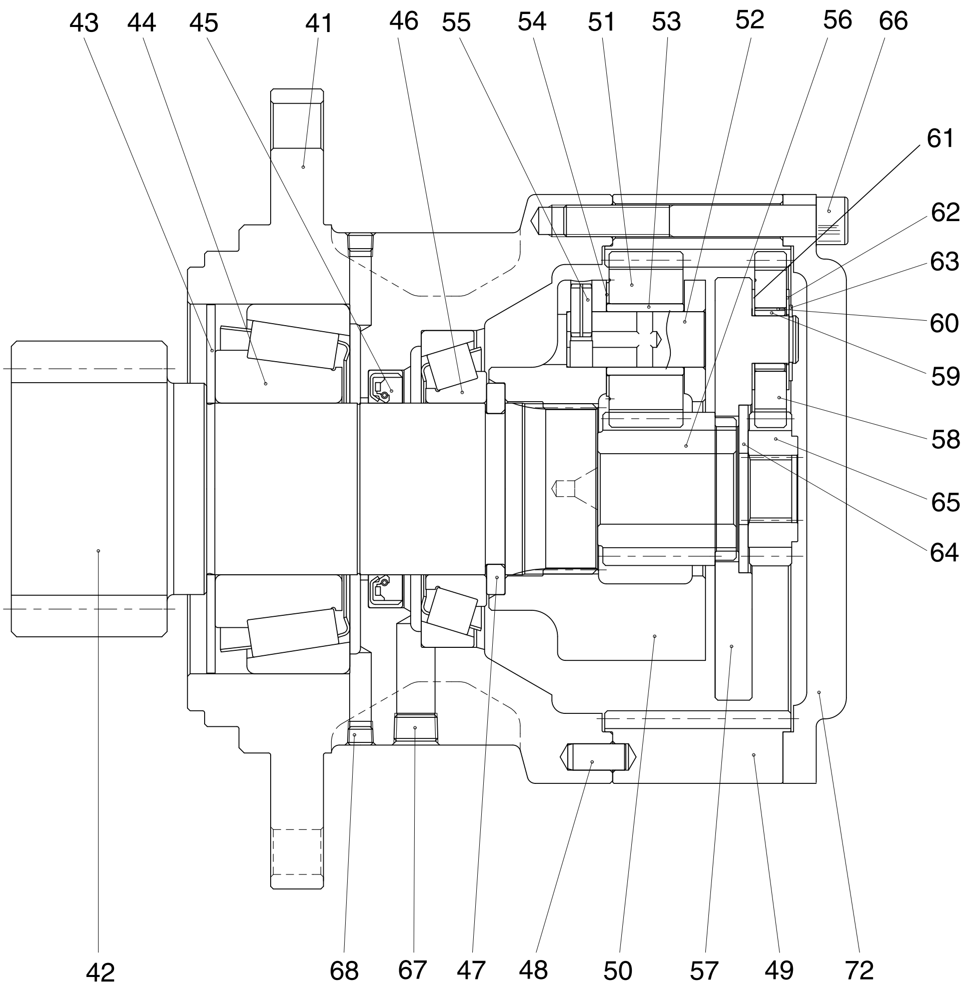
Port	Port name	Port size
A	Main port	PF 1/2
B	Main port	PF 1/2
Dr	Drain port	PF 3/8
Mu	Make up port	PF 3/4
PG	Brake release stand by port	PF 1/4
SH	Brake release pilot port	PF 1/4
GA,GB	Gauge port	PF 1/4
AU	Air vent port	PF 3/8



HX60A2SM03

1	Body	15	Taper bearing	30	Socket bolt
2	Oil seal	16	Valve plate	31	Plug
3	Cylinder block	17	Relief valve assy	32	O-ring
4	Shaft	18	Socket bolt	33	Valve
5	Taper bearing	19	Plug	34	Spring
6	Bushing	20	O-ring	35	Plug
7	Shoe plate	22	Back up ring	36	O-ring
8	Spring	23	O-ring	37	O-ring
9	Set plate	24	Friction plate	38	Back up ring
10	Piston shoe assy	25	Plate	39	Name plate
11	Ball guide	26	Parking piston	40	Rivet
12	Rear cover	27	O-ring		
13	Pin	28	Spring		
14	O-ring	29	Time delay valve		

2) REDUCTION GEAR



HX60A2SM02

41 Case
42 Pinion gear
43 Bearing cover
44 Taper roller bearing
45 Oil seal
46 Taper roller bearing
47 Lock collar
48 Pin
49 Ring gear
50 Carrier assy 2
51 Planet gear 2
52 Pin 2
53 Needle roller bearing
54 Thrust washer 2
55 Spring pin
56 Sun gear 2
57 Carrier assy 1
58 Planet gear 1
59 Needle roller bearing
60 Collar
61 Thrust washer 1
62 Thrust washer 2
63 Snap ring
64 Side plate
65 Sun gear 1
66 Lench bolt
67 Plug
68 Plug
69 Level bar
70 Level pipe
71 Air breather
72 Cover

2. FUNCTION

1) ROTARY PART

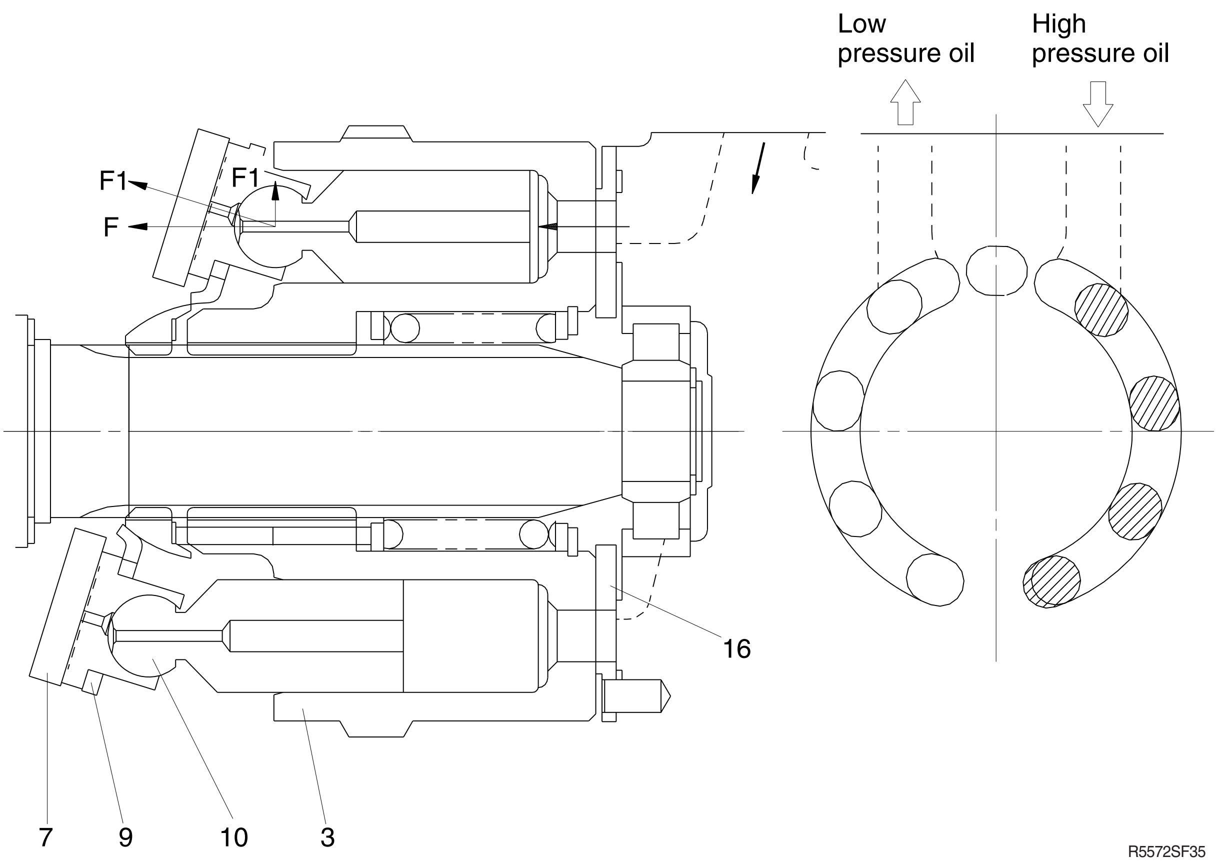
When high pressurized oil enters a cylinder through port(a), which is the inlet of balance plate(16), hydraulic pressure acting on the piston causes axial force F. The pressure force F works via the piston(10) upon the return plate(9) which acts upon the swash plate(7) via an hydrostatic bearing. Force F1 perpendicular to swash plate(7) and force F2 perpendicular to cylinder center.

Being transferred to the cylinder block(3) through piston, force F2 causes rotational moment at surroundings of cylinder.

Since cylinder block has 9 equidistantly arrayed pistons, rotational torque is transmitted to cylinder shaft in order by several pistons connected to the inlet port of high pressurized oil. When the direction of oil flow is reversed, rotational direction of cylinder is also reversed. Output torque is given by the equation.

$$T = \frac{p \times q}{2\pi},\ q = Z \cdot A \cdot PCD \cdot \tan\theta,\ F1 = \frac{F}{\cos\theta},\ F_2 = F\tan\theta,\ S = PCD \times \tan\theta$$

Where p : Effective difference of pressure (kgf/cm^2)
q : Displacement (cc/rev)
T : Output torque (kgf · cm)
Z : Piston number (9EA)
A : Piston area (cm^2)
θ : Tilting angle of swash plate (degree)
S : Piston stroke (cm)



2) MAKE UP VALVE

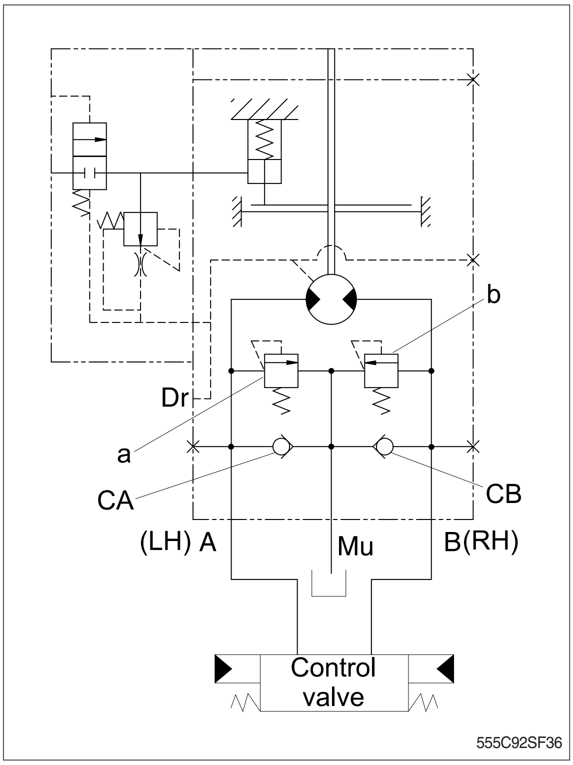
(1) Outline

The safety valve portion consists of a check valve and safety valve.

(2) Function

When the swing is stopped, the output circuit of the motor continues to rotate because of inertia. For this reason, the pressure at the output side of the motor becomes abnormality high, and this will damage the motor. To prevent this, the oil causing the abnormal hydraulic pressure is allowed to escape from the outlet port (high-pressure side) of the motor to port Mu, thereby preventing damage to the motor.

Compared with a counterbalance valve, there is no closed-in pressure generated at the outlet port side when slowing down the swing speed. This means that there is no vibration when slowing down, so the ease of swing control is improved.



(3) Operation

① When starting swing

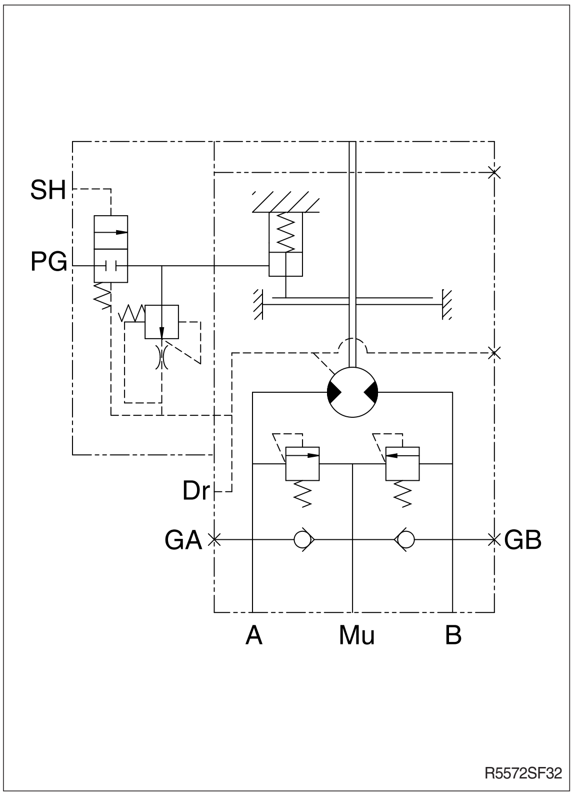
When the swing control lever is operated to left swing, the pressurized oil from the pump passes through the control valves and is supplied to port B. Because of this, the pressure at port B rises, staring torque is generated in the motor, and the motor starts to rotate. The oil from the outlet port of the motor passes from port A through the control valve and returns to the tank.

② When stopping swing

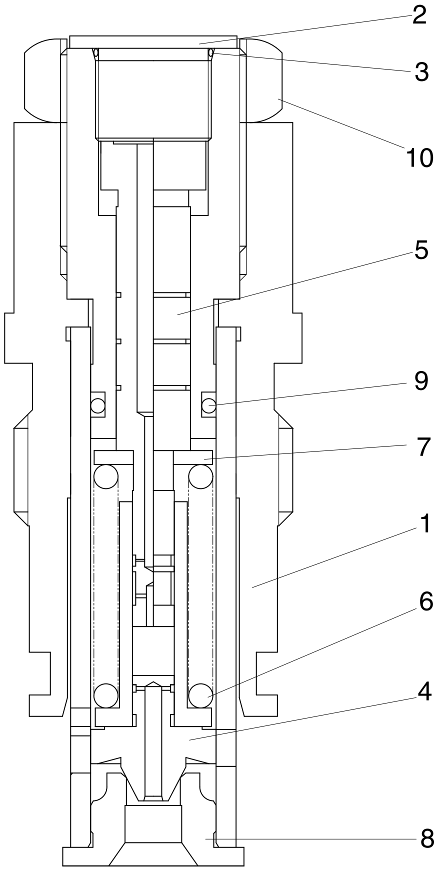
· When the swing control lever is returned to neutral, no pressurized oil is supplied from the pump to port B.
The return circuit to the tank is closed by the control valve. So the oil from the outlet port of the motor increases in pressure at port A. Resistance to the rotation of the motor is created, and the brake starts to act.

· The pressure at port A rises to the set pressure of make up valve a, and in this way, a high brake torque acts on the motor, and the motor stops.

· When make up valve a is being actuated, the relief oil from make up valve a and the oil from port Mu pass through check valve CB and are supplied to port B. This prevents cavitation from forming at port B.



3) RELIEF VALVE



555C92SF37

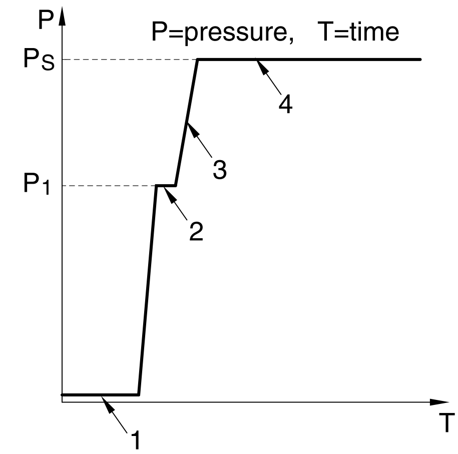
1 Body
2 Plug
3 O-ring
4 Plunger
5 Piston
6 Spring
7 Spring seat
8 Seat
9 O-ring
10 Nut

(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.

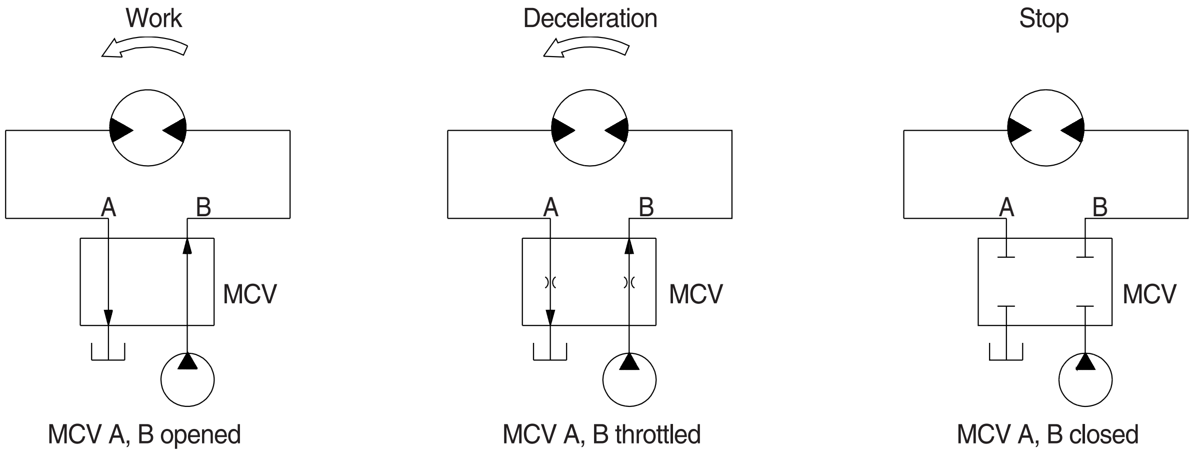


29072SM05

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.



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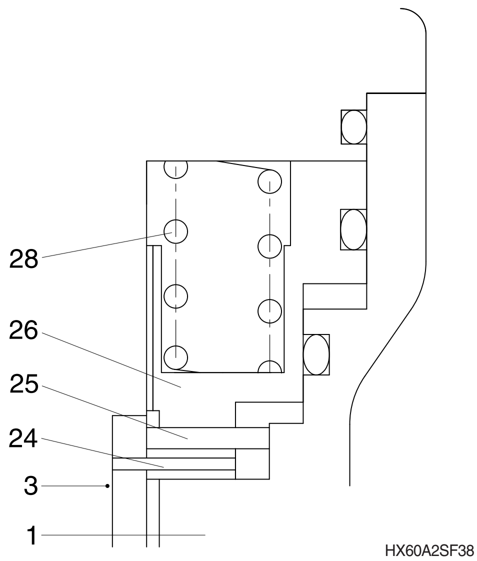
(2) Mechanical swing parking brake system

The mechanical swing parking brake system is installed to prevent the upper structure from swinging downhill because of its own weight when the excavator is parked on a slope since it completely eliminates the hydraulic drift of swing motion while the excavator is on a slop, work can be done more easily and safely.

① Brake assembly

Circumferential rotation of separate plate (25) is constrained by the groove located at body (1). When housing is pressed down by brake spring (28) through friction plate (25), separate plate (25) and brake piston (26), friction force occurs there.

Cylinder block (3) is constrained by this friction force and brake acts, while brake releases when hydraulic force exceeds spring force.



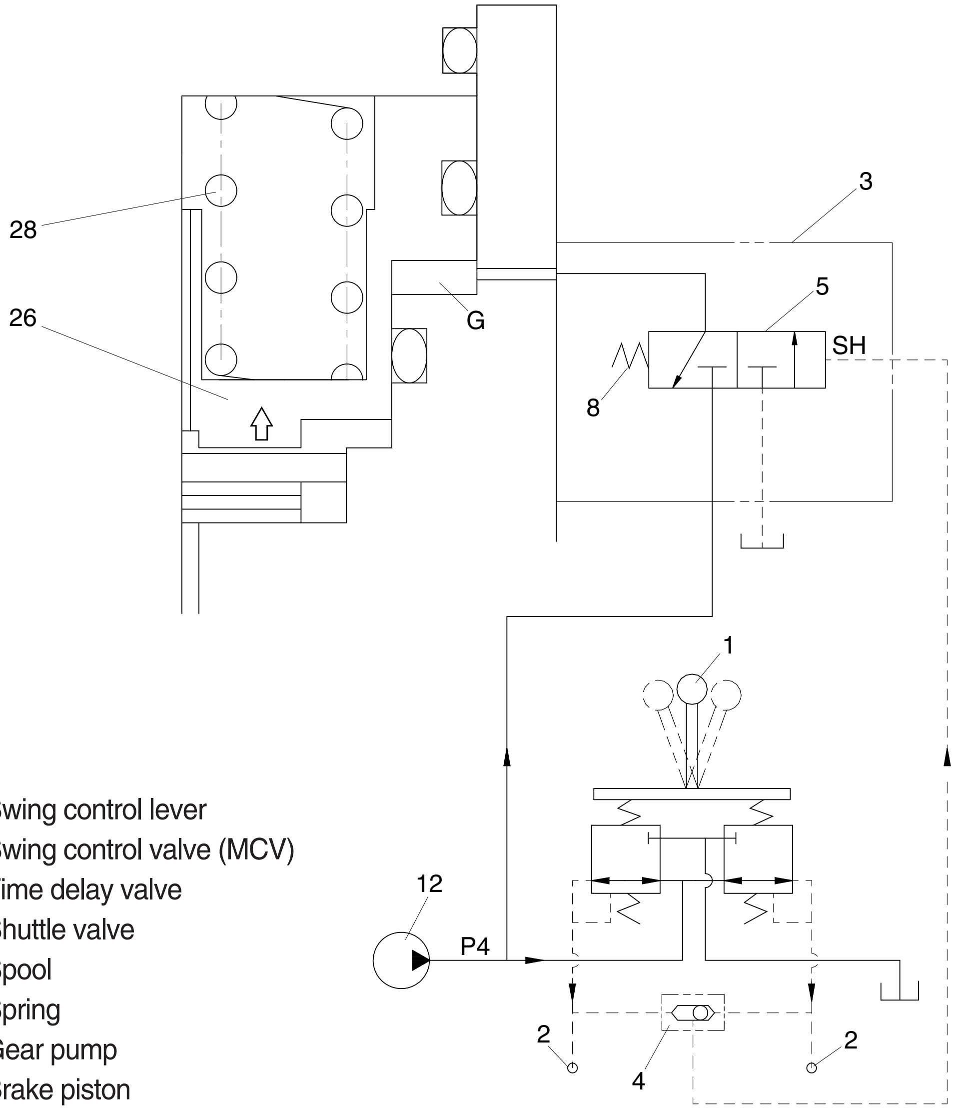
HX60A2SF38

1	Body	25	Separate plate
3	Cylinder block	26	Brake piston
24	Friction plate	28	Brake spring

② Operating principle

a. When the swing control lever is set to the swing position, the pilot oil go to the swing control valve (2) and to SH of the time delay valve (3) via the shuttle valve (4), this pressure move spool (5) to the leftward against the force of the spring (8), so pilot pump charged oil (P4) goes to the chamber G.

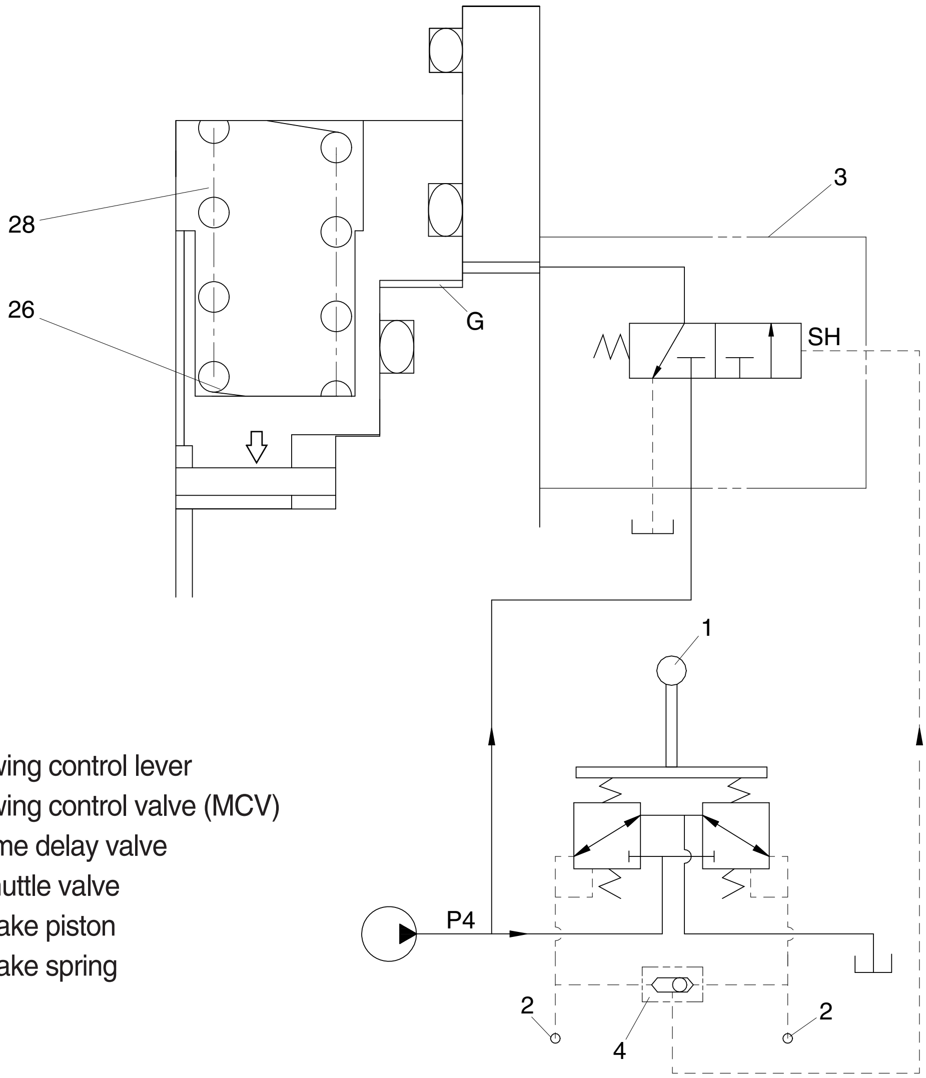
This pressure is applied to move the piston (26) to the upward against the force of the spring (28). Thus, it releases the brake force.



1	Swing control lever
2	Swing control valve (MCV)
3	Time delay valve
4	Shuttle valve
5	Spool
8	Spring
12	Gear pump
26	Brake piston
28	Brake spring

HX60A2SF39

b. When the swing control lever (1) is set the neutral position, the time delay valve (3) shifts the neutral position and the pilot oil blocked chamber G.
Then, the piston (26) is moved lower by spring (28) force and the return oil from the chamber G is drain.



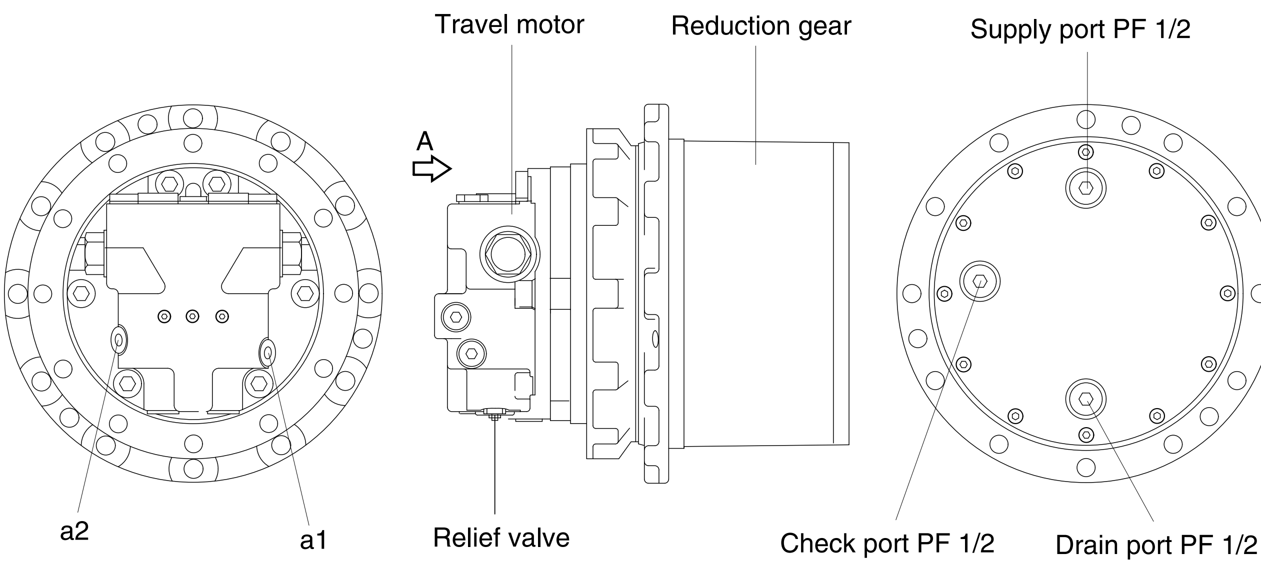
1	Swing control lever
2	Swing control valve (MCV)
3	Time delay valve
4	Shuttle valve
26	Brake piston
28	Brake spring

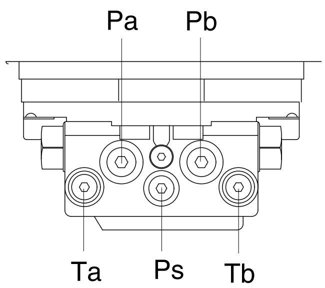
HX60A2SF40

1. CONSTRUCTION

Travel device consists travel motor and gear box.

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

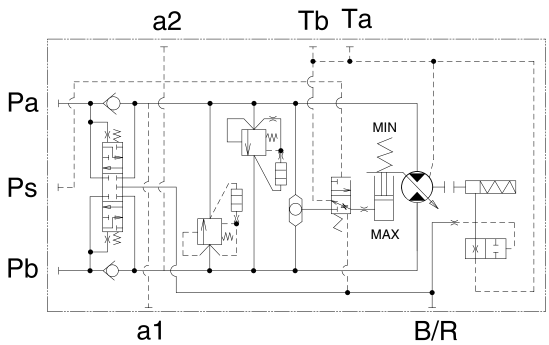




VIEW A

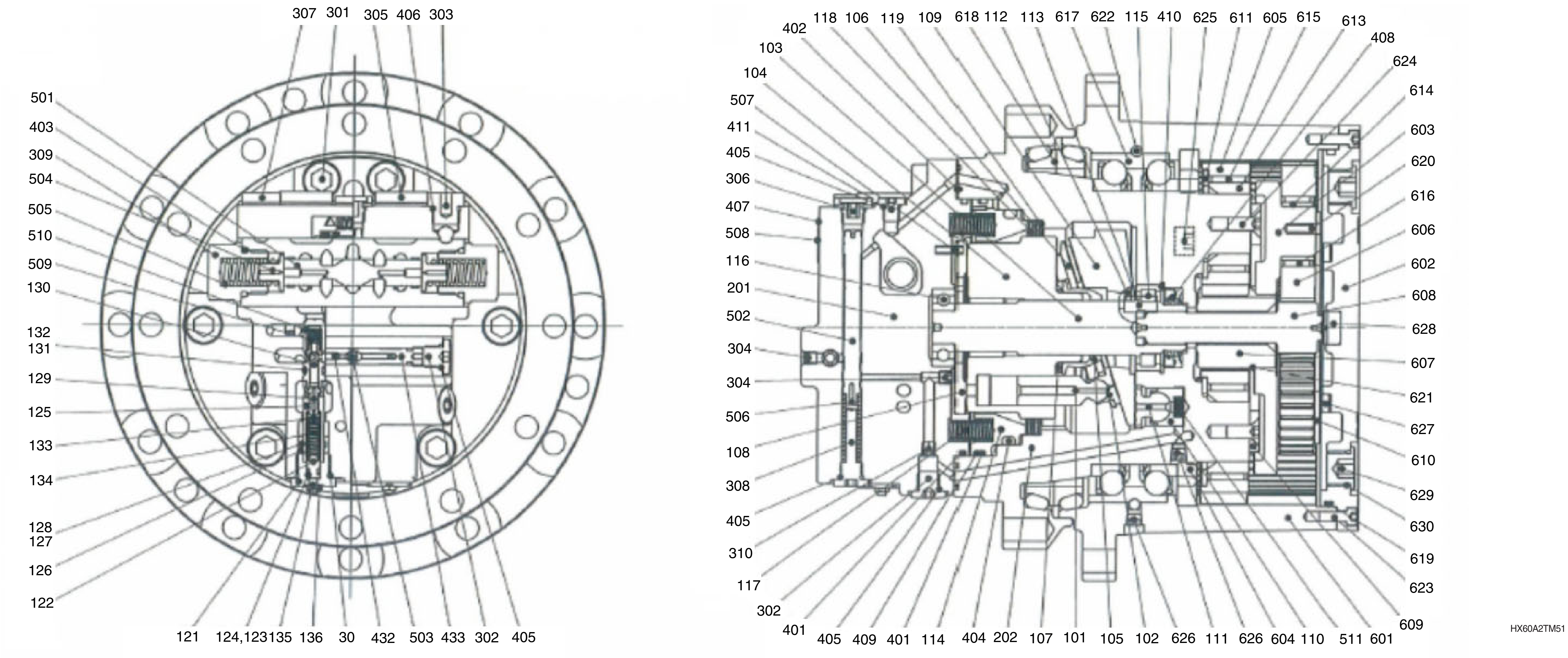
HX60A2TM50E

Port	Port name	Port size
Pa	Main port	PF 1/2
Pb	Main port	PF 1/2
a1,a2	Gauge port	PT 1/4
Ta,Tb	Drain port	PF 3/8
Ps	2 speed control port	PF 1/4



Hydraulic circuit

1) STRUCTURE

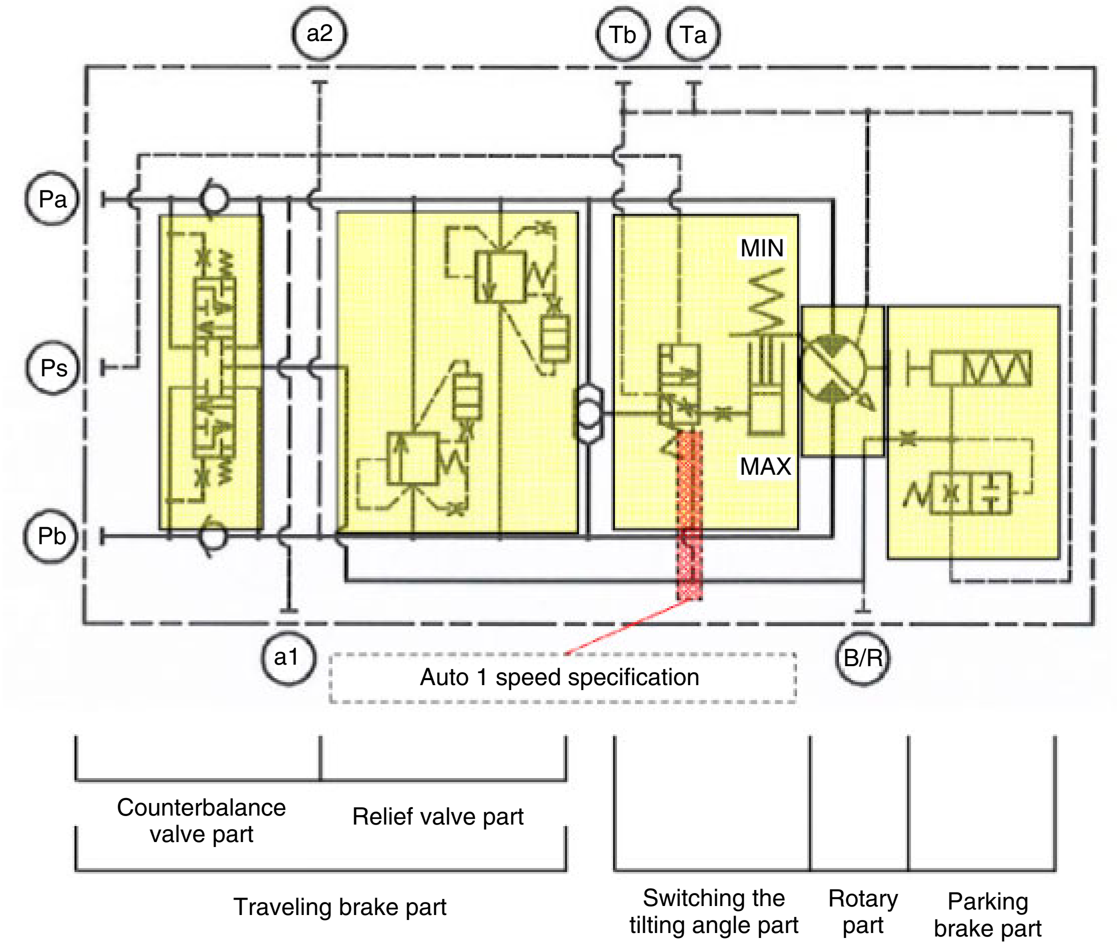


30 Relief valve assy
101 Piston
102 Shoe
103 Drive shaft
104 Cylinder block
105 Spherical bushing
106 Set plate
107 Cylinder spring
108 Valve plate
109 Swash plate
110 Swash piston
111 Swash shoe
112 Pivot
113 Pivot pin
114 Brake piston
115 Roller bearing
116 Ball bearing
117 Brake spring
118 Friction plate
119 Separator plate
121 Plug
122 Guide
123 O-ring
124 Back up ring
125 Sleeve
126 Piston
127 O-ring
128 Back up ring
129 Poppet
130 Poppet seat
131 O-ring
132 Back up ring
133 Spring seat
134 Spring
135 Adjust screw
136 Hex nut
137 O-ring
201 Valve casing
202 Casing
301 Socket bolt
302 Plug
303 Drain plug
304 NPTF plug
305 Dust plug
306 Dust plug
307 Dust plug
308 2 speed plug
309 Set plug
310 Restrictor
311 Plug
401 O-ring
402 O-ring
403 O-ring
404 O-ring
405 O-ring
406 O-ring
407 Name plate
408 Oil seal
409 Back up ring
410 Snap ring
411 O-ring
432 Seat
433 Seat casing
501 Main spool
502 2 speed spool
503 Steel ball
504 Plunger
505 Main spool spring
506 2 speed spool spring
507 Spring pin
508 Pin
509 Spring cap
510 Cap
511 Swash piston spring
601 Housing
602 Cover
603 Holder
604 Ring nut
605 Planetary gear F
606 Planetary gear R
607 Sun gear
608 Ring nut
609 Thrust plate F
610 Thrust plate R
611 Thrust washer
613 Collar
614 Inner race
615 Needle bearing
616 Needle bearing
617 Angular bearing
618 Floating seal kit
619 O-ring
620 Spring pin
621 Snap ring
622 Steel ball
623 Socket bolt
624 Bolt
625 Plug
626 Plug
627 Side plate A
628 Side plate B
629 Plug
630 O-ring

2) MAJOR COMPONENT

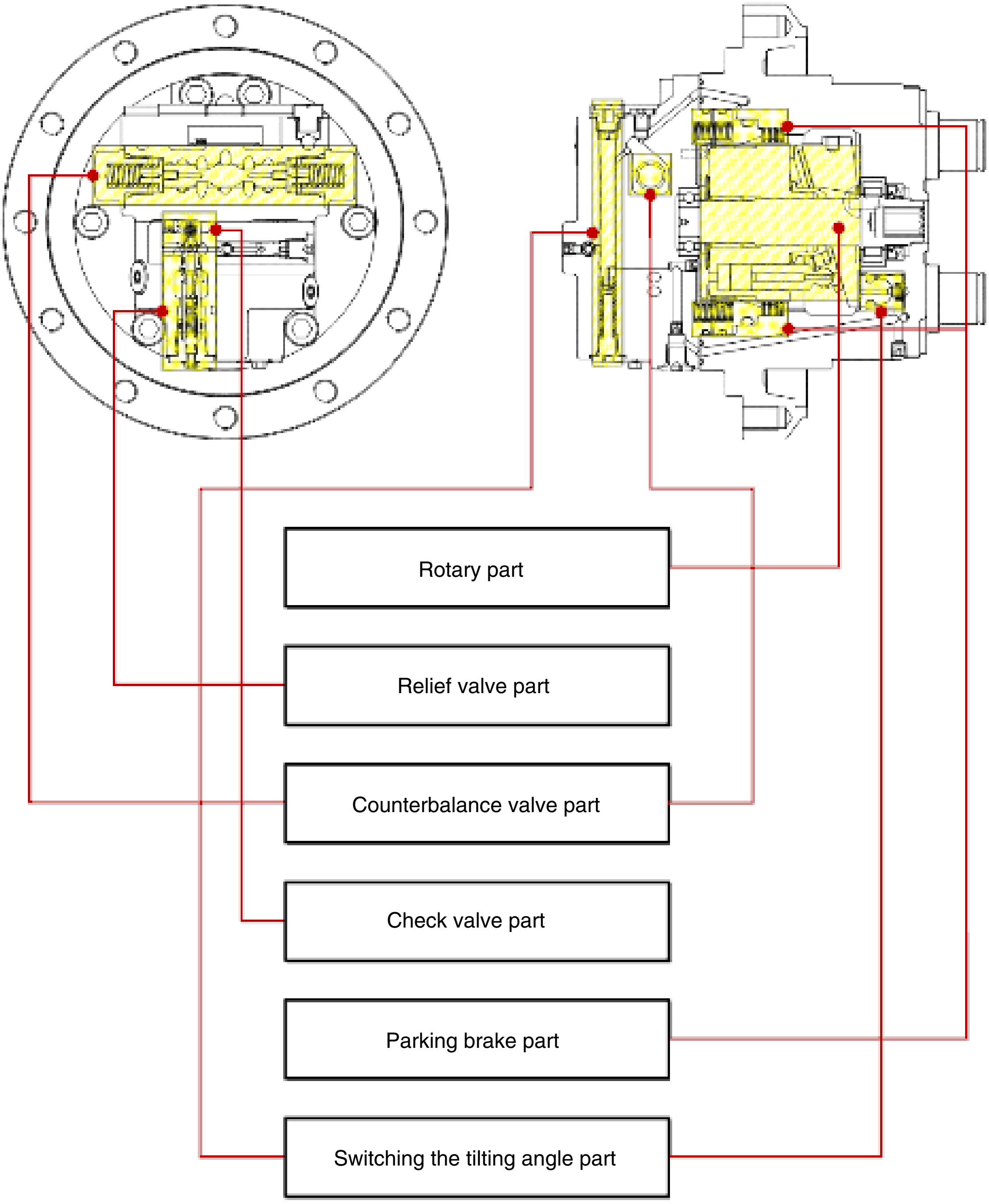
This product is only composed of hydraulic motor. Reduction parts are not composed.
This hydraulic motor is variable swash plate axial piston motor. It is composed of 4 parts.

- Rotary part which makes rotatory power
- Traveling brake valve part
- Parking brake part
- Switching the tilting angle part (auto 1/2 speed control part)



559A2TM52

3) BASIC STRUCTURE



559A2TM53

2. WORKING PRINCIPLE

1) HYDRAULIC MOTOR SECTION

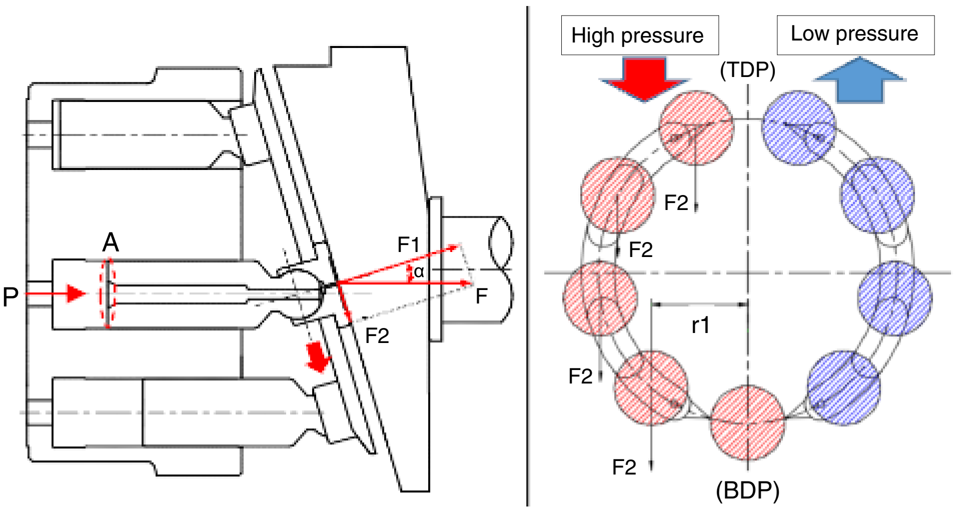
When high pressure oil passes from pump through the inlet port of the valve plate(108) and flows into the cylinder (104) as shown in figure, the oil pressure acts upon the piston (101) to generate the axial force "F". The force "F" acts on the swash (109) plane in the axial direction.

F = P$\times$A (P : Pressure, A : Area)

The swash plate (109) is fixed with an inclination angle of α to the axis of the drive shaft (103). Therefore, this force is divided into two vector forces through the shoe (102) : namely, the force F1 vertical to the swash plate (109) and the force F2 perpendicular to the drive shaft (103).
Because of the force "F2", piston (101) slides along with shoe (102) in the direction of the arrow in Figure. This force "F2" is transmitted to the cylinder block (104) via the piston (101) and generates a couple of forces which turn the output drive shaft (103).
In the cylinder block (104) nine pistons are equispaced and the pistons connected to the high pressure oil inlet ports give their rotating torque to the output shaft sequentially.
When the oil inflow/outflow direction are reversed, the rotating direction of the output shaft is reversed.
The theoretical output torque "T [N/m]" is given by the flowing.

$$T = \frac{P \times q}{2\pi}$$

P : Effective pressure difference (Mpa), q : Displacement per revolution (cm³)



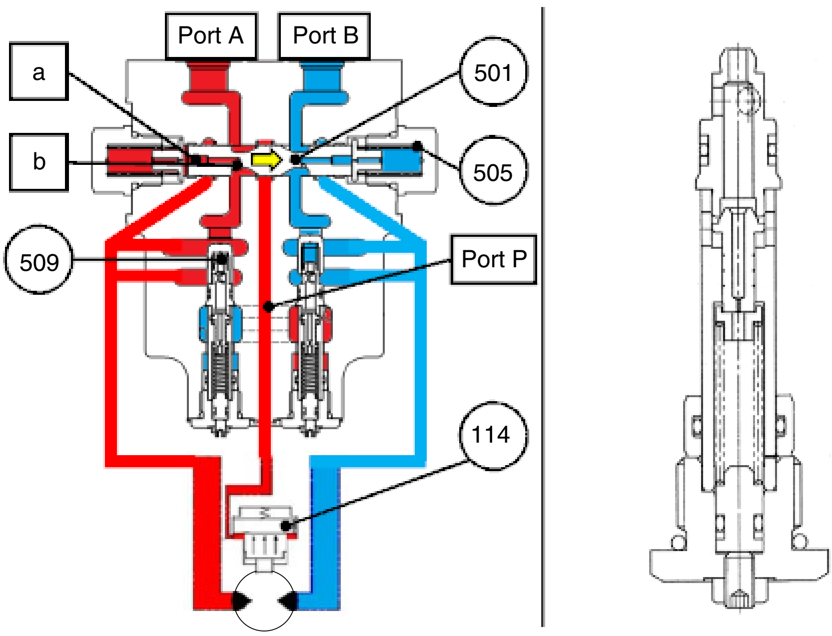
559A2TM54

2) TRAVELING BRAKE VALVE

Traveling brake valve is composed of relief valve, counterbalance valve and check port A is connected with hydraulic pump and port B is connected with tank.

(1) In case of traveling

When the compressed oil, which is supplied along the inlet port, exceeds certain pressure, it pushes cap (509). And, it is supplied to one side of the casing (202).
It is trying to rotate the hydraulic motor.
At the same time, the compressed oil enters the chamber {a} along small hole {b} of main spool (501) and acts on the face of main spool (501). After increasing pressure of oil, when this pressure exceeds the spring elasticity force of main spool spring (505), main spool (501), which is held in neutral by the spring elasticity force, moves to the right.
The inlet side and outlet side that was blocked by main spool (501) during stop connect with each other. So, return oil returns to the oil tank, so the hydraulic motor rotates.
Furthermore as main spool (501) moves, the path of parking brake (port P) is connected.
When compressed pressure, which enter to (port P) , becomes brake release pressure, it operates brake piston (114) and parking brake is released.
If the direction of oil inlet is reversed, main spool (501) and check valve motion is reversed. Output rotation direction is also reversed.



559A2TM55

(2) In case of stop

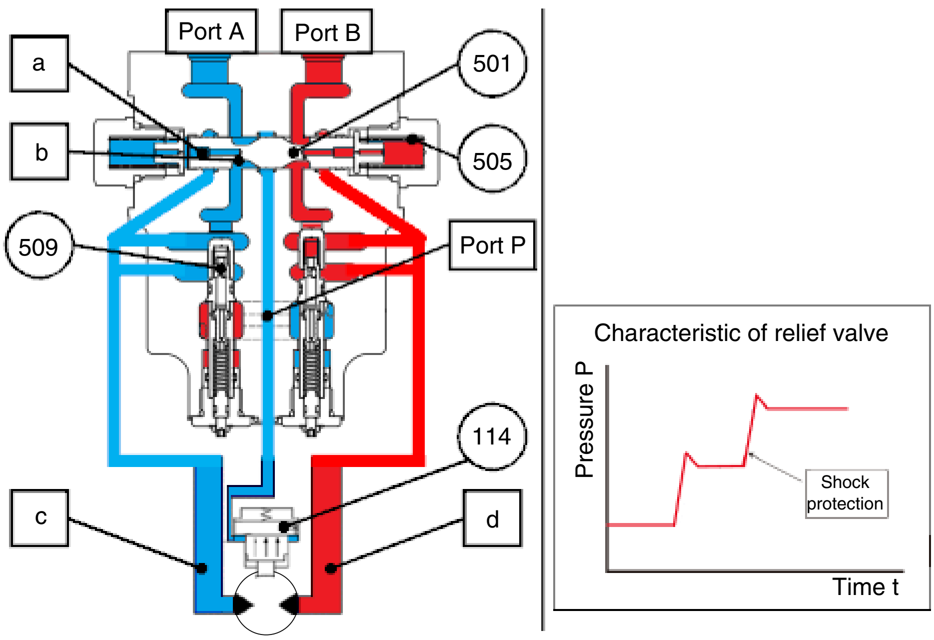
If the pressure supplied along the port to the inlet breaks while traveling, the pressure applied to the section of the main spool (501) is removed. Therefore, the main spool (501), which was pushed to the right, returns to neutral due to the spring elasticity force of the main spool spring (505).

The rotary part continues to rotate under inertia even if pressure is lost from the inlet side. As the main spool (501) returns to neutral, the connected inlet and outlet sides of the flow path are blocked. Since there is no escape location for the returned oil, the pressure of the exit side (D) is raised.

The returned oil with increased pressure enters the relief valve (30). if it exceeds the set pressure of the relief valve (30), operates the relief valve (30). The flow path from the outlet side {D} to the inlet side {C} is connected. And it controls the pressure on the outlet side.

At the same time it prevents cavitation on the inlet side.

It also relieves the shock during stop while controlling pressure on the outlet side with relief valve (30) in two stages, and apply soft braking to the hydraulic motor by applying an orifice and notch on the main spool (501).



559A2TM56

(2) In case of stop

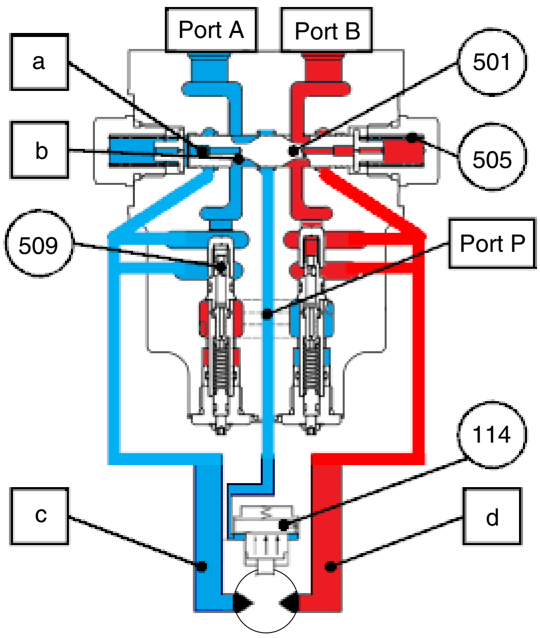
If the pressure supplied along the port to the inlet breaks while traveling, the pressure applied to the section of the main spool (501) is removed. Therefore, the main spool (501), which was pushed to the right, returns to neutral due to the spring elasticity force of the main spool spring (505).

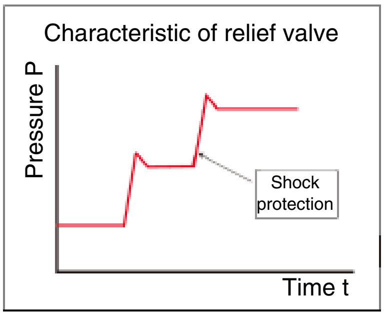
The rotary part continues to rotate under inertia even if pressure is lost from the inlet side. As the main spool (501) returns to neutral, the connected inlet and outlet sides of the flow path are blocked. Since there is no escape location for the returned oil, the pressure of the exit side (D) is raised.

The returned oil with increased pressure enters the relief valve (30). if it exceeds the set pressure of the relief valve (30), operates the relief valve (30). The flow path from the outlet side {D} to the inlet side {C} is connected. And it controls the pressure on the outlet side.

At the same time it prevents cavitation on the inlet side.

It also relieves the shock during stop while controlling pressure on the outlet side with relief valve (30) in two stages, and apply soft braking to the hydraulic motor by applying an orifice and notch on the main spool (501).





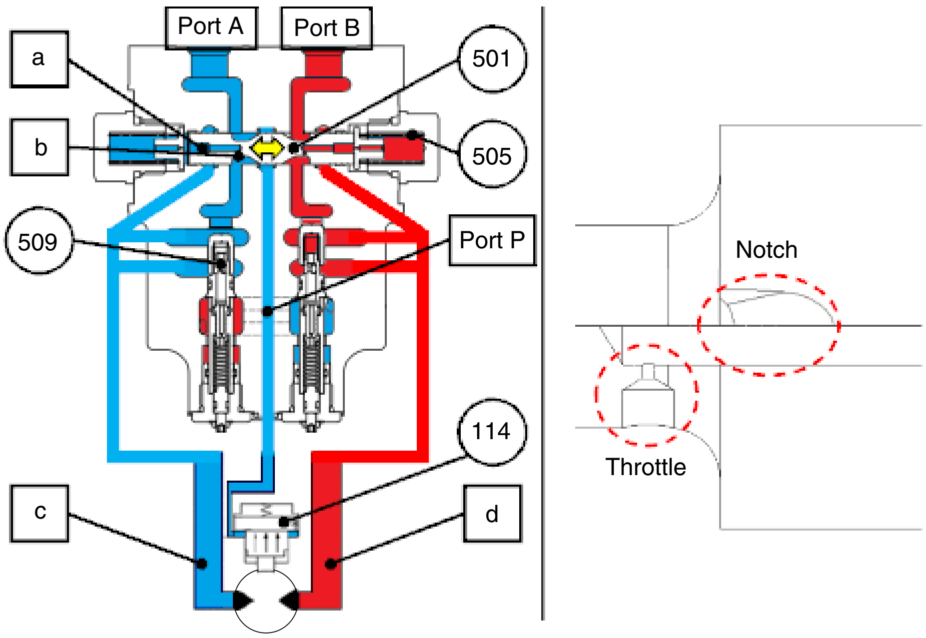
559A2TM56

(3) In case of overrun

Overrun is when the excavator's speed is increased by the it's gravity (inertia), such as when an excavator is going downhill, causing the hydraulic motor to rotate above the supply flow of the hydraulic pump.

In the case of overrun, the compressed oil on the inlet side is entered into the rotary and the pressure on the inlet side is reduced. Therefore, due to the spring elasticity force of the main spool spring (505), main spool (501) returns to neutral, as it stops.

At the same time, back pressure is generated due to the throttle (notch of main spool) between the outlet side (D) and the outlet port (port B) passage. The back pressure controls the return speed of the main spool (501) and hydraulic motor, which is about to be rotated by inertia forces, is decelerated. The operation of main spool (501) is controlled by the notch of main spool (501) and throttle. So motor smoothly moves according to the supply flow rate.



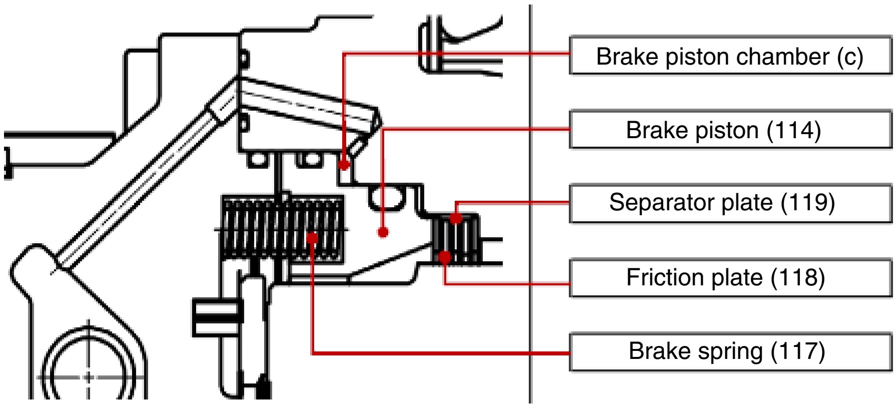
559A2TM57

3) PARKING BRAKE

The parking brake is wet-type multiple disk brakes. It is a negative brake system which is released when the brake release pressure enters the brake piston chamber.

The internal structure of parking brake is shown in figure. Friction plate (118) and separator plate (119) are alternately stacked, and acting on springs to produce brake torque with friction forces.

It prevents not only the braking of excavators but also overrun or slip during traveling and stopping on the slip.



559A2TM58

(1) In case traveling

The cylinder block (104) is connected to the drive shaft (103) with spline. In addition, the separator plate (119) is restrained from circumferentially-rotating by an arc groove cut on the casing (202).

The friction plate (118) which is connected to the arc groove cut on cylinder block (104), can be rotated along the cylinder block (104).

When pressurized oil is supplied from the inlet side during traveling operation, the blocked flow path is opened. so pressurized oil is supplied to the brake piston chamber (c) that is comprised inside brake piston (114) and casing (202).

If the hydraulic force F4 of the brake piston chamber (c) is greater than the spring elasticity force F3 of the brake spring (117), then brake piston (114) move to valve casing. (above brake release pressure)

F3 = k x n , k : Spring constant, x : Spring stroke, n : Number of spring brake

F4 = P × (A1 - A2), P : Main pressure of input, (A1 - A2) : Area difference of brake piston

The force that friction plate (118) and separator plate (119) pressurize the casing (202) disappears and the brake releases.

So, the hydraulic motor can rotate.

(2) In case of stop

If the pressurized oil supplied by the inlet is cut off during stop, the pressurized oil supplied to the brake piston chamber (c) will also be blocked. (below brake release pressure)

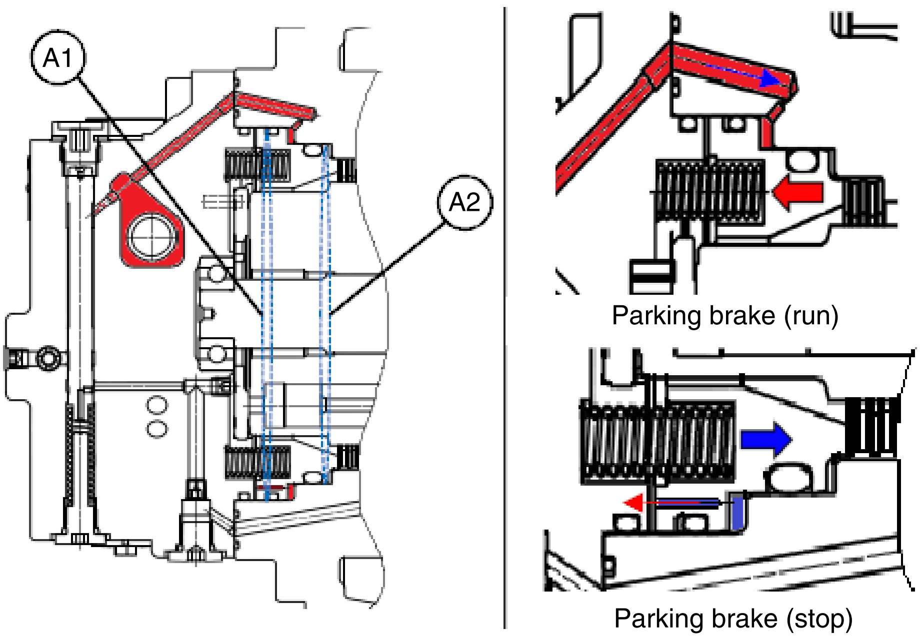
If the spring elasticity force F3 of the brake spring (117) is greater than the hydraulic force F4 of the brake piston chamber (c), then brake piston (114) move to casing by spring elasticity force. The hydraulic oil of the brake piston (114) is drained through the throttle. Therefore brake piston (114) smoothly operates.

F3 < F4

F3 = k x n , k : Spring constant, x : Spring stroke, n : Number of spring brake

F4 = P × (A1 - A2), P : Main pressure of input, (A1 - A2) : Area difference of brake piston

When the brake piston (114) pushes casing (202) by the brake spring (117), the frictional force appears between friction plate (118), casing (202), separator plate (119) and brake piston (114). parking brake appears by friction force and spring elasticity of the brake spring (117), the drive shaft (103) is constrained.



559A2TM59

4) 1/2 SPEED SWITCHING OPERATION (AUTOMATIC 1/2 SPEED CONTROL PART)

(1) Low speed traveling

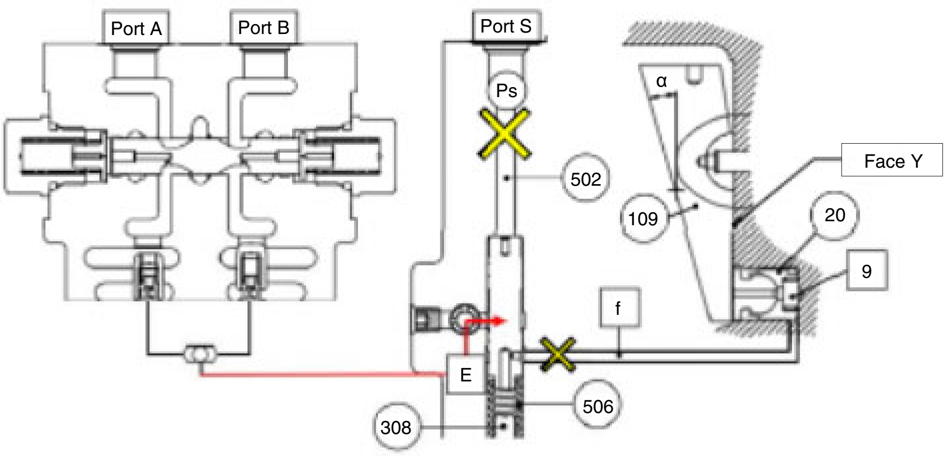
If pilot pressure is not supplied on pilot port (port S), 2 speed spool (502) is pushed in the direction of the port S by spring elasticity of 2 speed spool spring (506).

As a result, the compressed oil from the high pressure selection check valve (E) is not connected to the swash piston chamber (g).

The compressed oil of swash piston chamber{g} is drained through the flow path of 2 speed spool chamber (f).

So, the compressed oil from the high pressure selection check valve (E) is not connected to the swash piston chamber {g}. As a result, the swash plate (109) will be the maximum angle α and the stroke of the piston (101) will be long. So, a large amount of oil will be required for rotating the motor once.

Therefore the displacement of the hydraulic motor is maximized and rotated at low speed.



559A2TM60

(2) High speed traveling

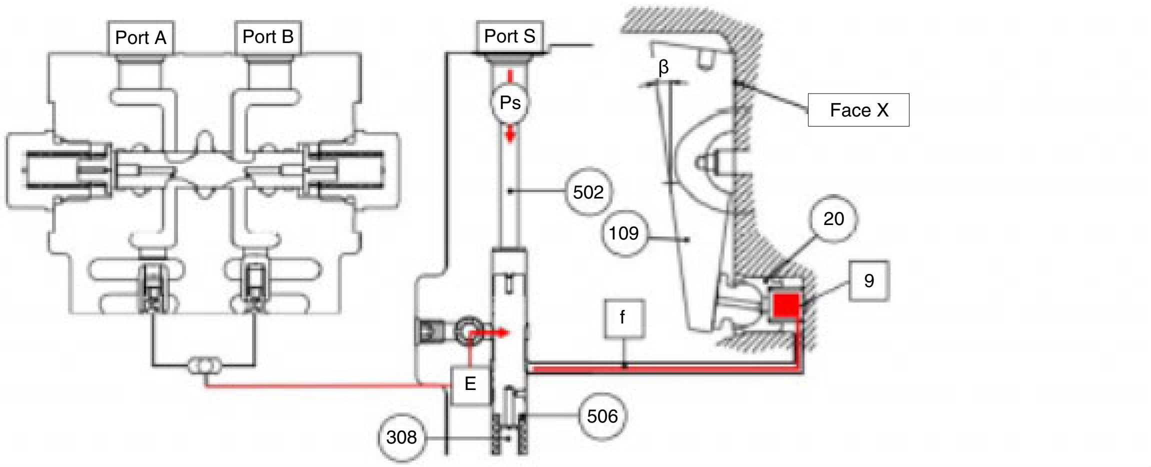
If the pilot pressure (20~50 kgf/cm^2) is supplied to the port (port S), the pilot pressure overcomes the oil pressure in the main port and the spring elasticity force of the 2 speed spool spring (506). and it pushes the 2 speed spool (502) to the 2 speed plug (308) direction.

This is why the pressure from the high pressure selection check valve (E) is connected to the flow path (f).

The pressurized oil flows into the {g} chamber along the flow path {f} and pushes swash piston (20) to contact the face 'X' of swash plate (109) with the wall of the casing (202).

As a result, the swash plate (109) is the minimum angle β. Because stroke of piston (101) is shortened, a small amount of oil is used for one revolution.

Therefore, the displacement of the hydraulic motor is minimized and is rotated at high speed.



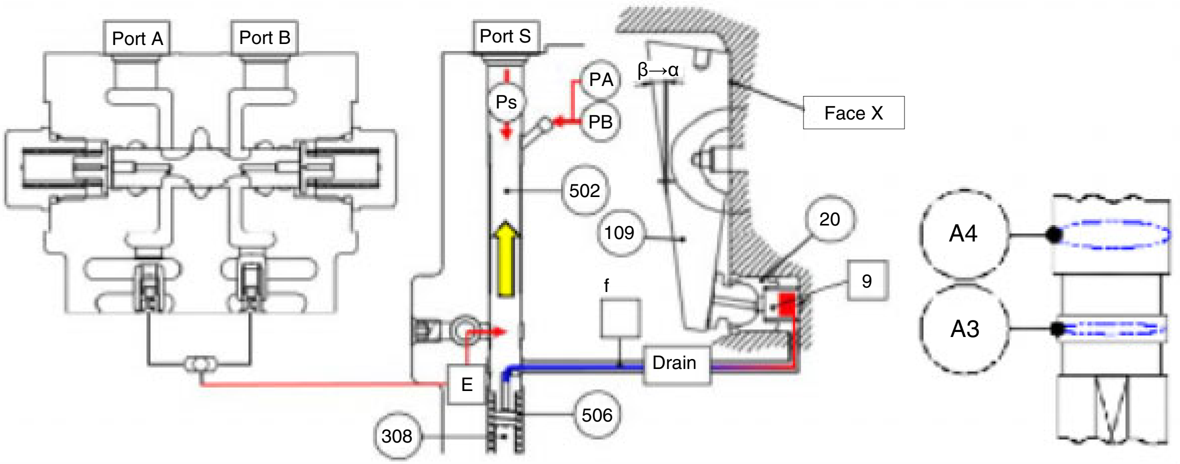
559A2TM61

(3) Automatic 1/2 speed control part

If the load is increased during the 2-speed driving, the hydraulic pressure on the main port is increased. The pressure (△P) of main port and spring elasticity force of 2 speed spool spring (506) will overcome the pressure of pilot, 2 speed spool (502) is pushed in port S direction.

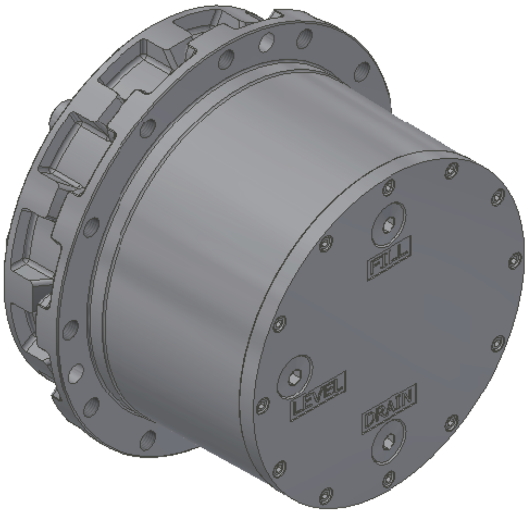
F5 < [{F6 × (A4 - A3)} + (Fspring)]
F5 = PS × A3, PS : Pilot pressure, A3 : 2 speed spool area
F6 = (PA or PB) × (A4 - A3), (PA or PB) : Main pressure difference between inlet side and outlet side
Fspring = K x X ; K : Spring constant of 2 speed spool spring, X : Spring stroke

Therefore, flow path from the high pressure selection check valve (E) to (f) is blocked.
And the pressure of (g) is slowly drained to 2 speed spool chamber (f) through throttle and a notch of 2 speed spool.
The angle of swash plate (109) transfers from β to α, and the motor automatically switches from 2 speed to 1 speed to rotate at low speed.



559A2TM62

5) REDUCTION GEAR



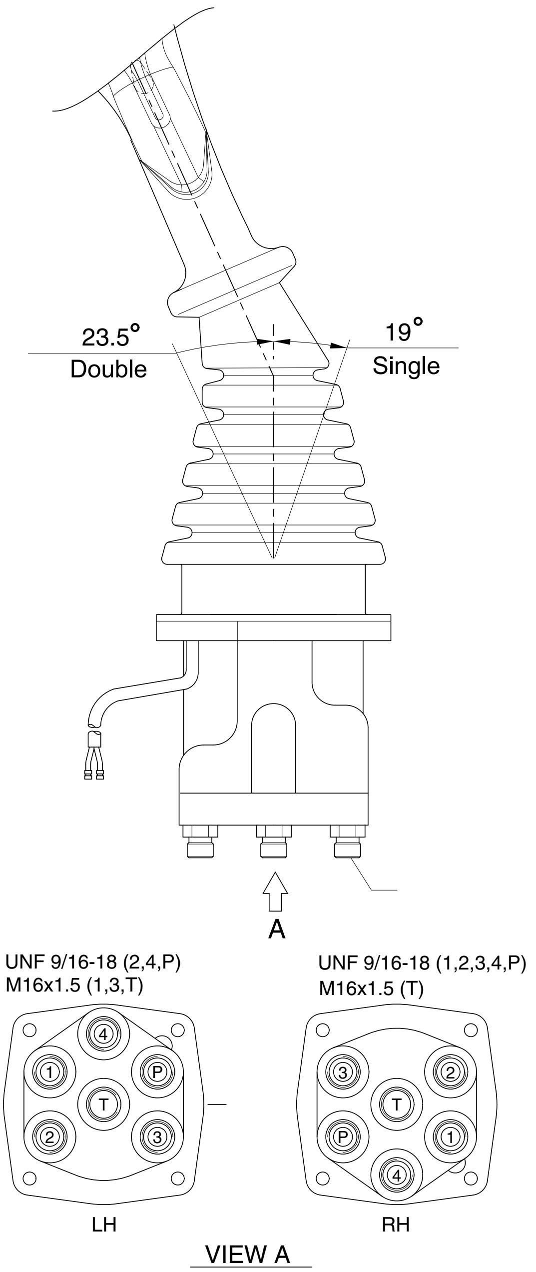
559A2TM63

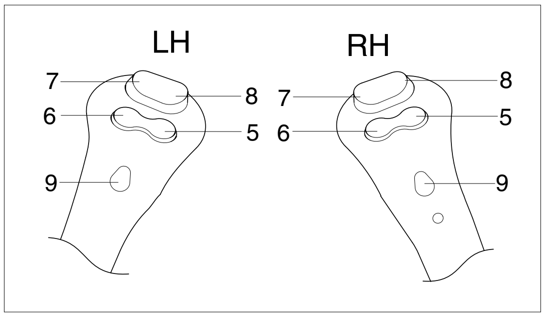
(1) Refer to the section drawing for the basic construction.
(2) The reduction gear consists of two stage planetary gears.
(3) The reduction ratio is determined by the number of teeth of the gear, and the reduction ratio is 42.439.
In other words, the number of revolutions of the hydraulic motor is transmitted to the output shaft at 1 / reduction ratio.
(4) The direction of rotation of the input and output shafts is opposite.

GROUP 5 RCV LEVER

1. STRUCTURE

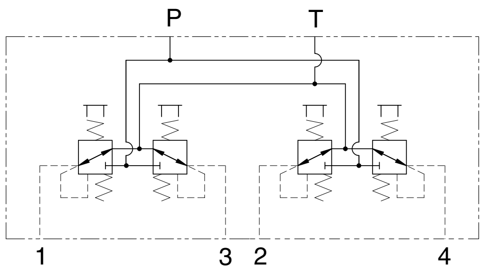
The casing has the oil inlet port P (primary pressure) and the oil outlet port T (tank). In addition the secondary pressure is taken out through ports 1, 2, 3 and 4 provided at the bottom face.





Switches

No.	LH	RH
5	Horn	Breaker
6	Not used	Quick clamp switch
7	Rotating -CCW	2-way clamp
8	Rotating -CW	2-way release
9	Boom swing Rotating switch (opt)	Proportional type ON/OFF switch

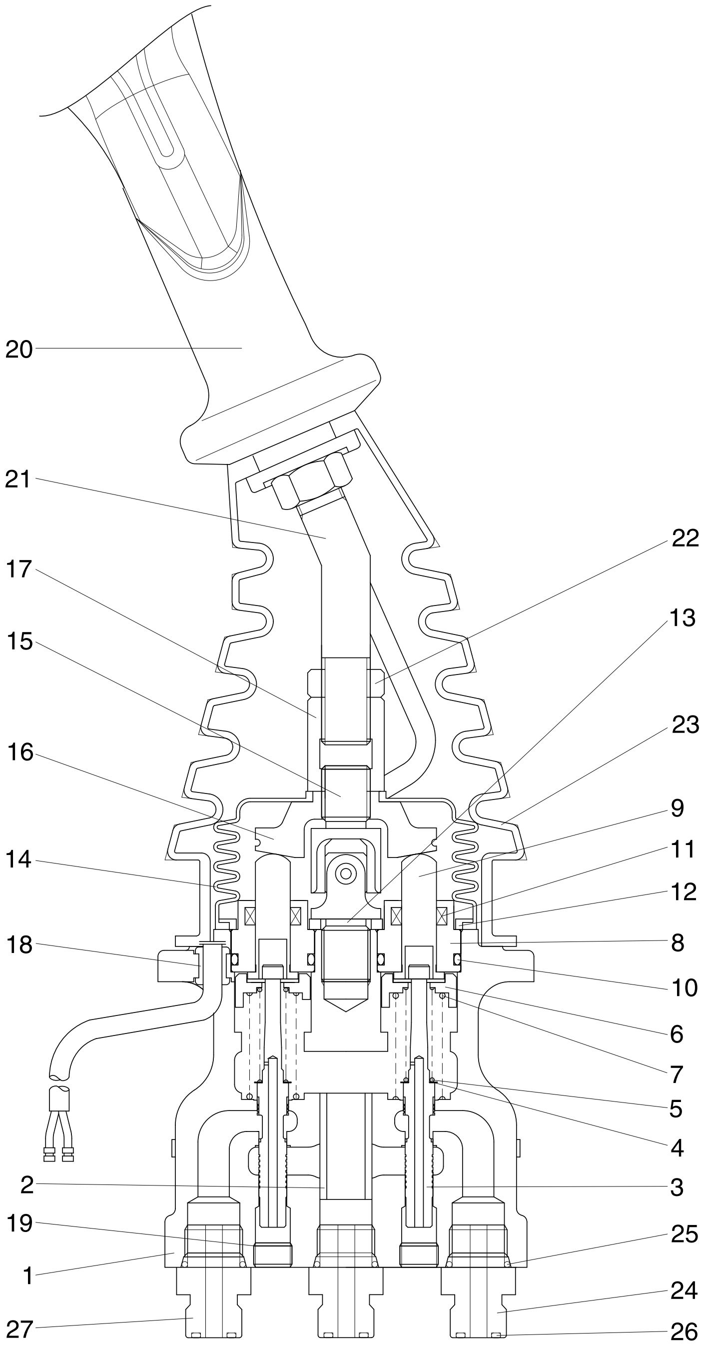


Hydraulic circuit

65A2RL01

Port	LH	RH	Remark
P	Pilot oil inlet port	Pilot oil inlet port	
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



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

300L2RL06K

The construction of the pilot valve is shown in the attached cross section drawing. The casing has vertical holes in which reducing valves are assembled.
The pressure reducing section is composed of the spool (3), spring (5) for setting secondary pressure, return spring (7), spring seat (6) and shim (4). The spring for setting the secondary pressure has been generally so preset that the secondary pressure is 5 to 20.5 kgf/cm^2 (depending on the type). The spool is pushed against the push rod (9) by the return spring.
When the push rod is pushed down by tilting the handle, the spring seat comes down simultaneously and changes setting of the secondary pressure spring.

2. FUNCTIONS

1) FUNDAMENTAL FUNCTIONS

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

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

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

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

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

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

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

2) FUNCTIONS OF MAJOR SECTIONS

Item numbers are based on the type L1.

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

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

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

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

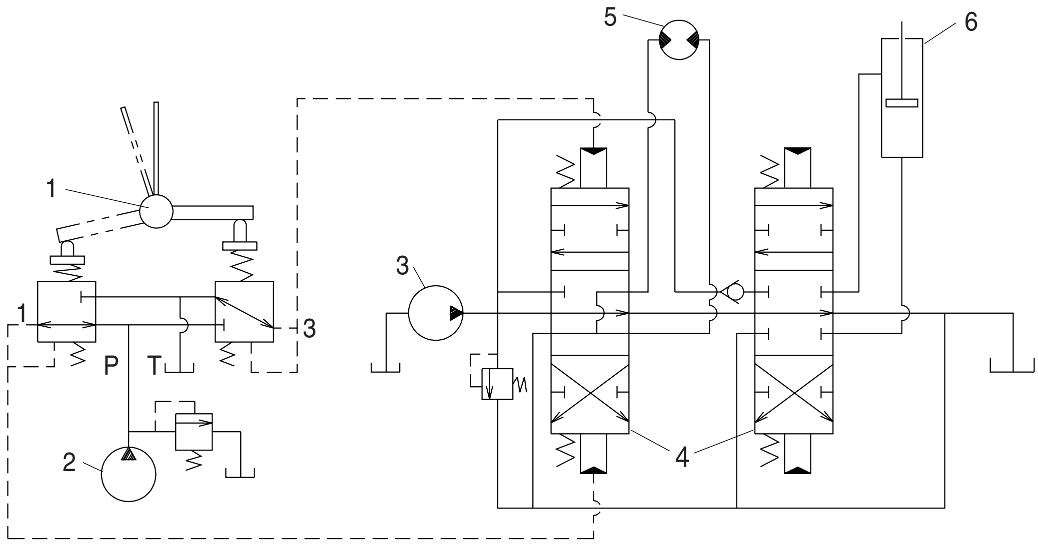
The spring (7) works on the case (1) and spring seat (6) and tries to return the push rod (9) to the zero-displacement position irrespective of the output pressure, securing its resetting to the center position.

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

3) OPERATION

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

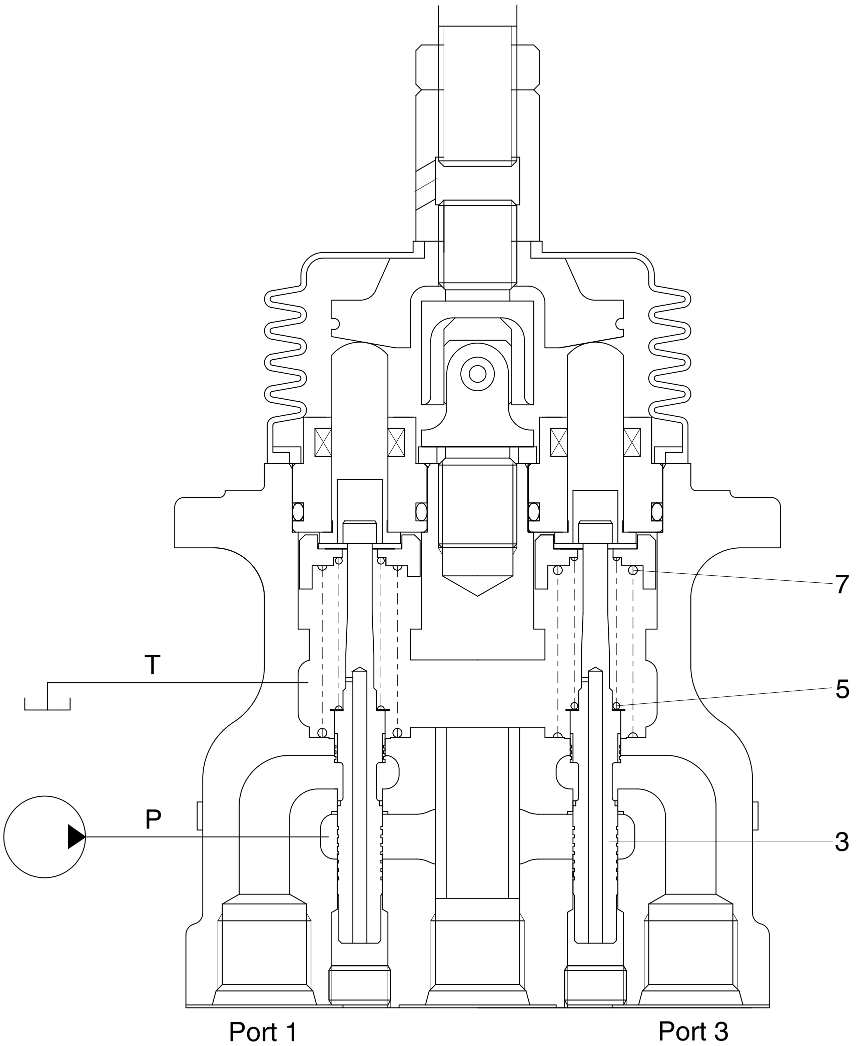
The diagram shown below is the typical application example of the pilot valve.



2-70

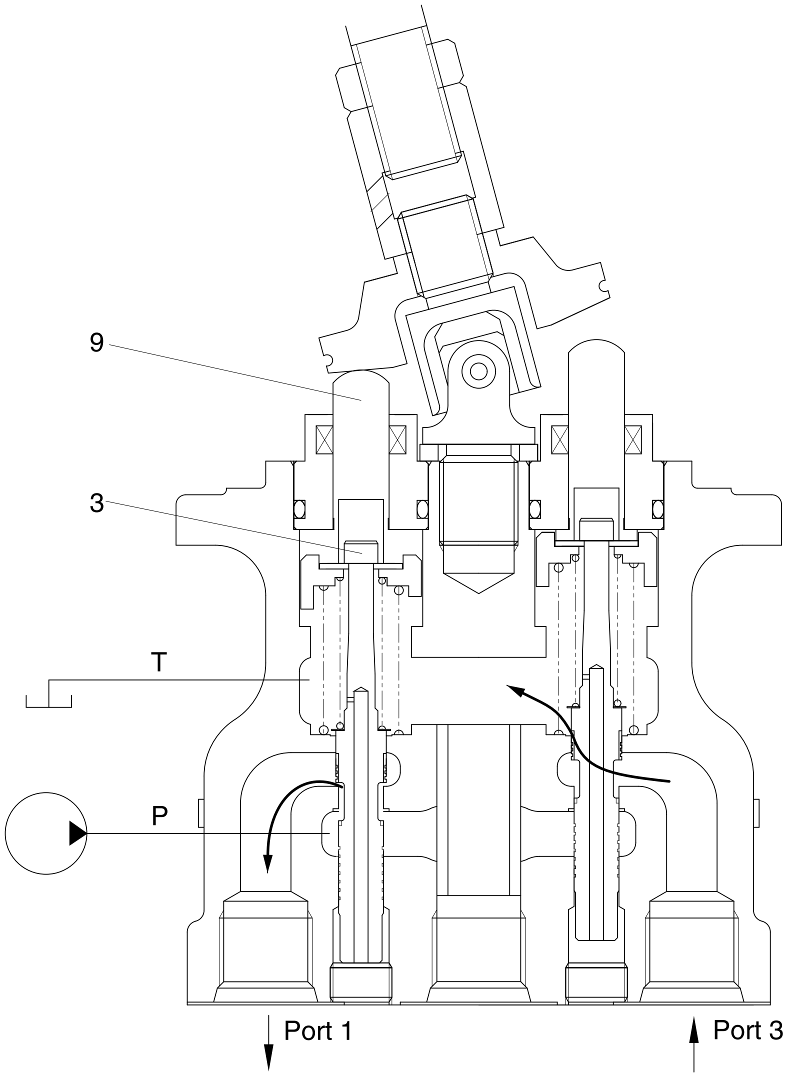
1	Pilot valve	3	Main pump	5	Hydraulic motor
2	Pilot pump	4	Main control valve	6	Hydraulic cylinder

(1) Case where handle is in neutral position



The force of the spring (5) that determines the output pressure of the pilot valve is not applied to the spool (3). Therefore, the spool is pushed up by the spring (7) to the position of port (1, 3) in the operation explanation drawing. Then, since the output port is connected to tank port T only, the output port pressure becomes equal to tank pressure.

(2) Case where handle is tilted



300L2RL04

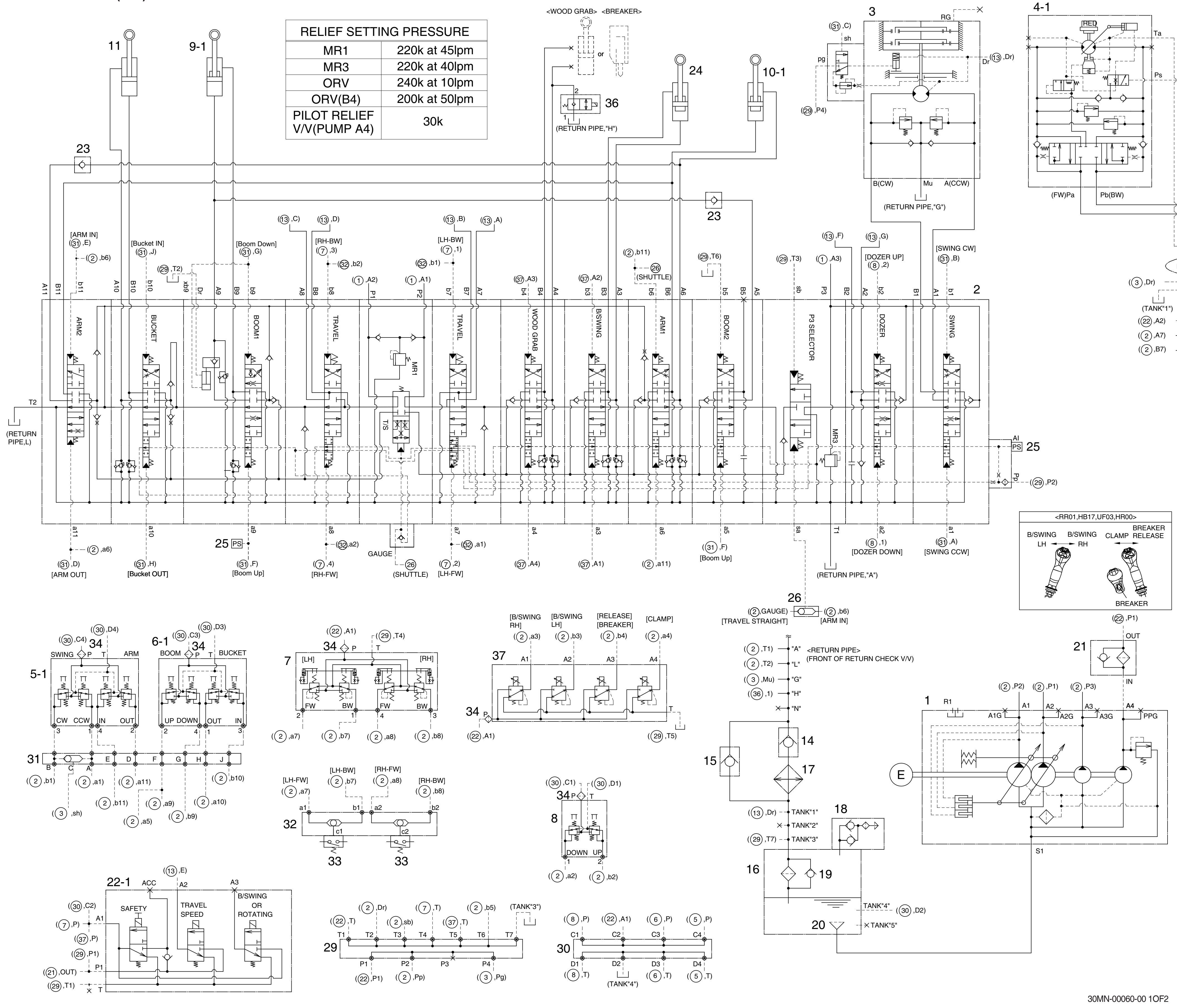
When the push rod (9) is stroked, the spool (3) moves downwards.
Then port P is connected with port (1) and the oil supplied from the pilot pump flows through port (1) to generate the pressure.
When the pressure at port (1) increases to the value corresponding to the spring force set by tilting the handle,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

SECTION 3 HYDRAULIC SYSTEM

GROUP 1 HYDRAULIC CIRCUIT

1. HYDRAULIC CIRCUIT (1/2)

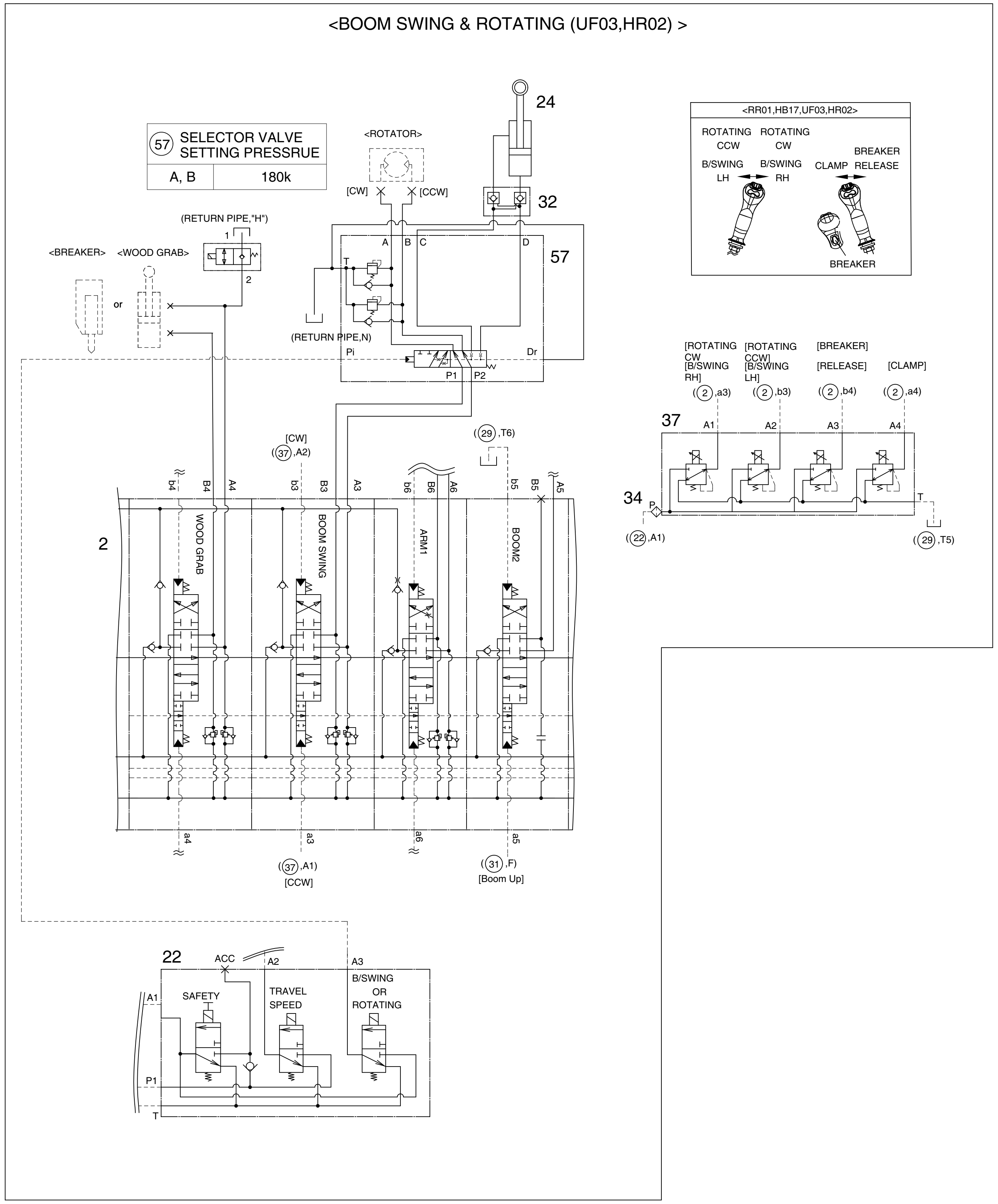
RELIEF SETTING PRESSURE	
MR1	220k at 45lpm
MR3	220k at 40lpm
ORV	240k at 10lpm
ORV(B4)	200k at 50lpm
PILOT RELIEF V/V(PUMP A4)	30k

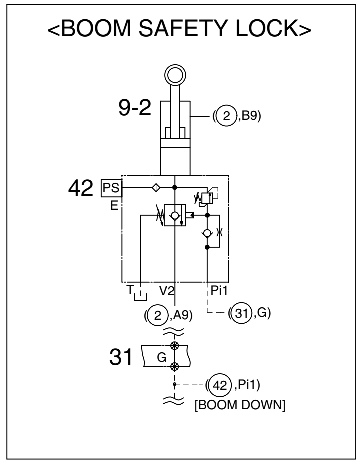


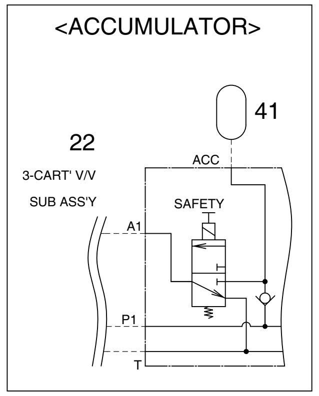
1 Main pump
2 Main control valve
3 Swing motor
4-1 Travel motor (LH)
4-2 Travel motor (RH)
5-1 RCV lever (LH)
6-1 RCV lever (RH)
7 RCV pedal (travel)
8 RCV lever (dozer)
9-1 Boom cylinder
10-1 Arm cylinder
11 Bucket cylinder
12 Dozer cylinder
13 Turning joint
14 Return check valve
15 Return check valve
16 Hydraulic tank
17 Oil cooler
18 Air breather
19 Return filter w/bypass valve
20 Strainer
21 Line filter
22-1 3-cartridge valve
23 Line check valve
24 Boom swing cylinder
25 Pressrue sensor
26 Shuttle tee
29 Block (A)
30 Block (B)
31 Terminal assy
32 Shuttle valve
33 Pressure switch
34 Last guard filter
36 Solenoid valve
37 4-EPPR valve

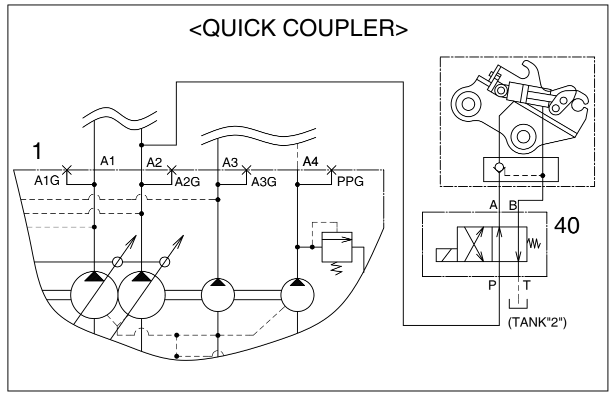
30MN-00060-00 1OF2

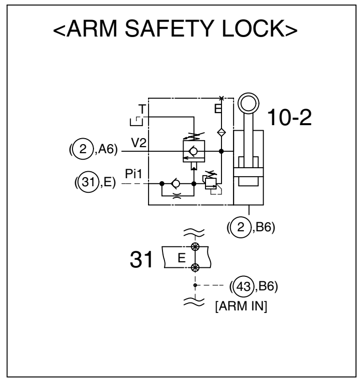
2. HYDRAULIC CIRCUIT (2/2)

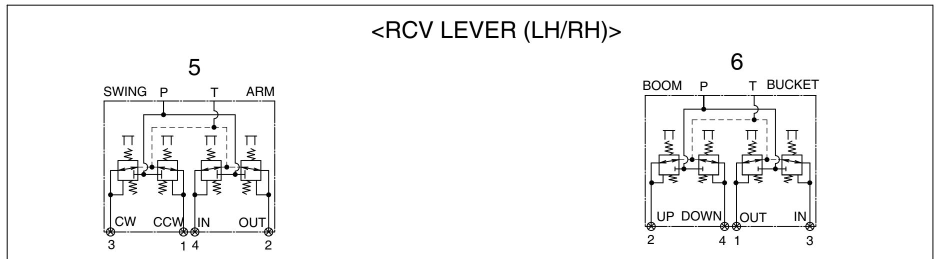












PART NO (5 :LH / 6 : RH)				OPTION CODE	REMARKS	
					PRODUCER	MODULATION
5-1	31K1-21431	6-1	31K1-21441	RR01,JA21	KPM+DAEHYUN	○
5-2	31MN-22030	6-2	31MN-22040	RR01,JA01	DANFOSS+DAEHYUN	○

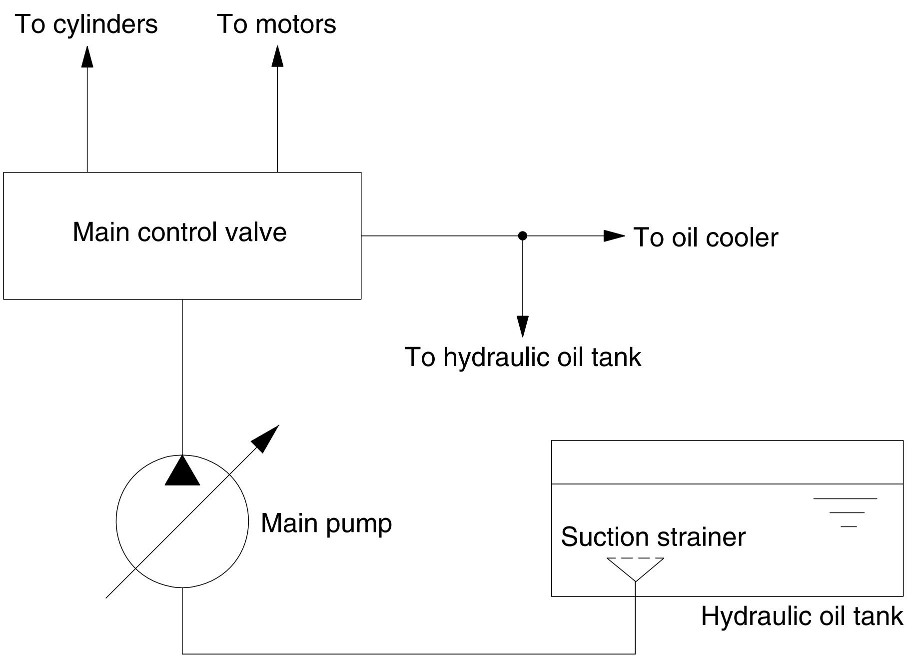
32 DPC valve
5-2 RCV lever (LH, modula)
6-2 RCV lever (RH, modula)
9-2 Boom cylinder with Safety lock valve
10-2 Arm cylinder with Safety lock valve
40 Solenoid valve
41 Accumulator
42 Pressure sensor
57 Selector valve

30MN-00060-00 2OF2

GROUP 2 MAIN CIRCUIT

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

1. SUCTION AND DELIVERY CIRCUIT



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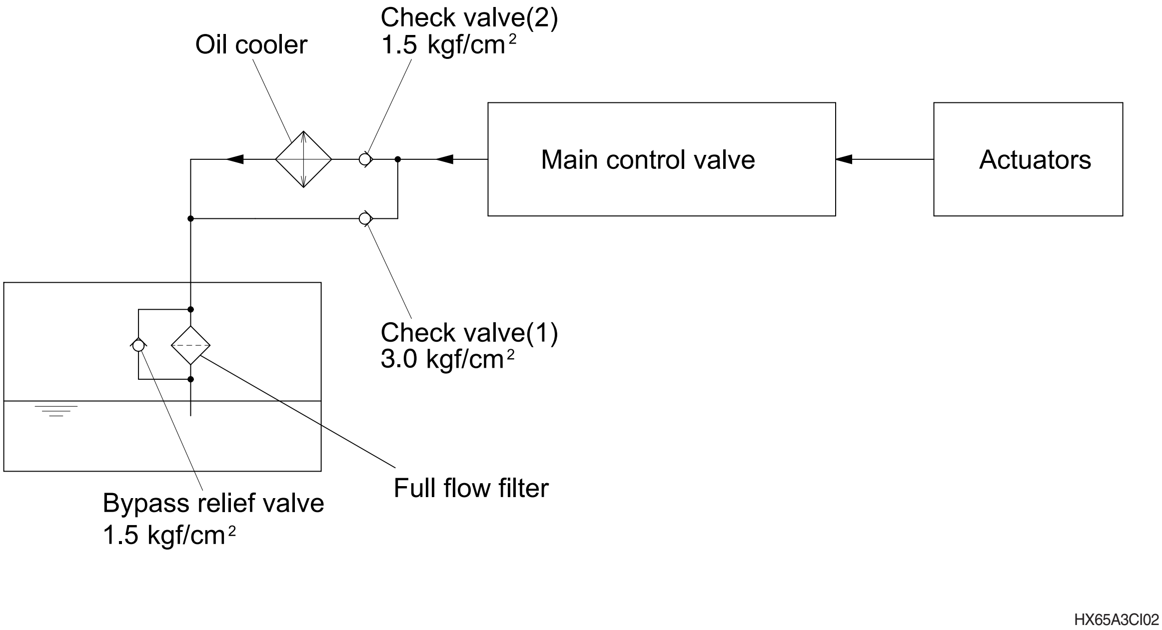
The pumps receive oil from the hydraulic tank through a suction filter. The discharged oil from the pump flows into the control valve and goes out the tank ports.
The oil discharged from the main pump flows to the actuators through the control valve.
The control valve controls the hydraulic functions.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

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

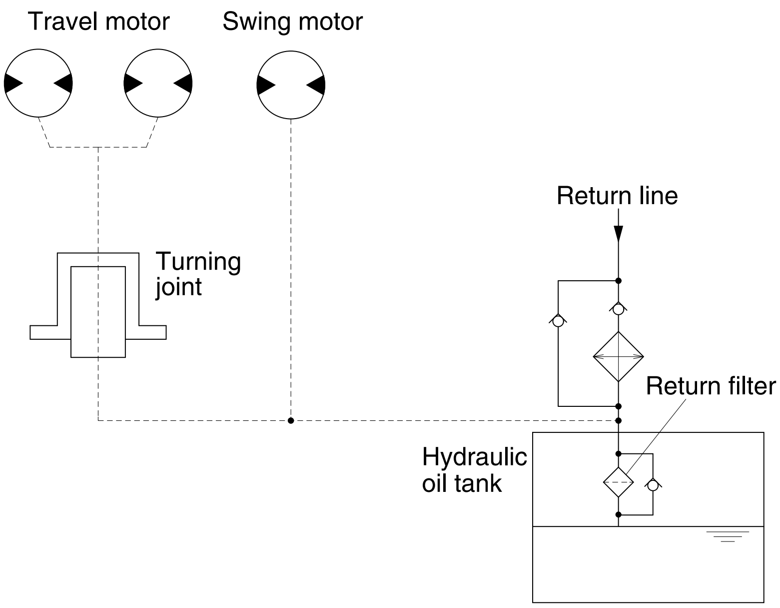
2. RETURN CIRCUIT



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

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

3. DRAIN CIRCUIT



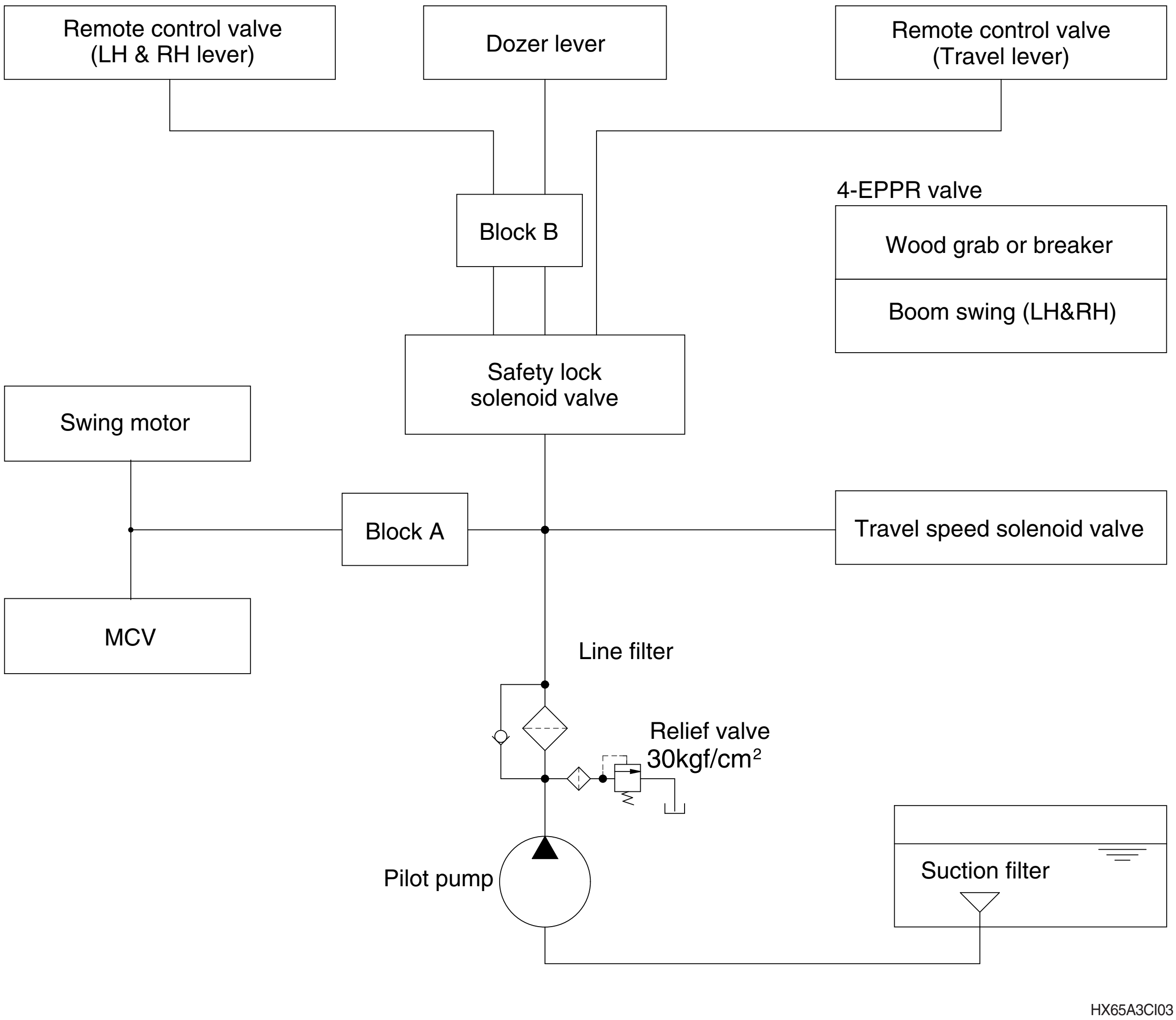
Besides internal leaks from the motors and main pump, the oil for lubrication circulates.

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

2) SWING MOTOR DRAIN CIRCUIT
Oil leaked from the swing motor returns to the hydraulic tank passing through a return filter with oil drained from the travel circuit.

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

GROUP 3 PILOT CIRCUIT



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

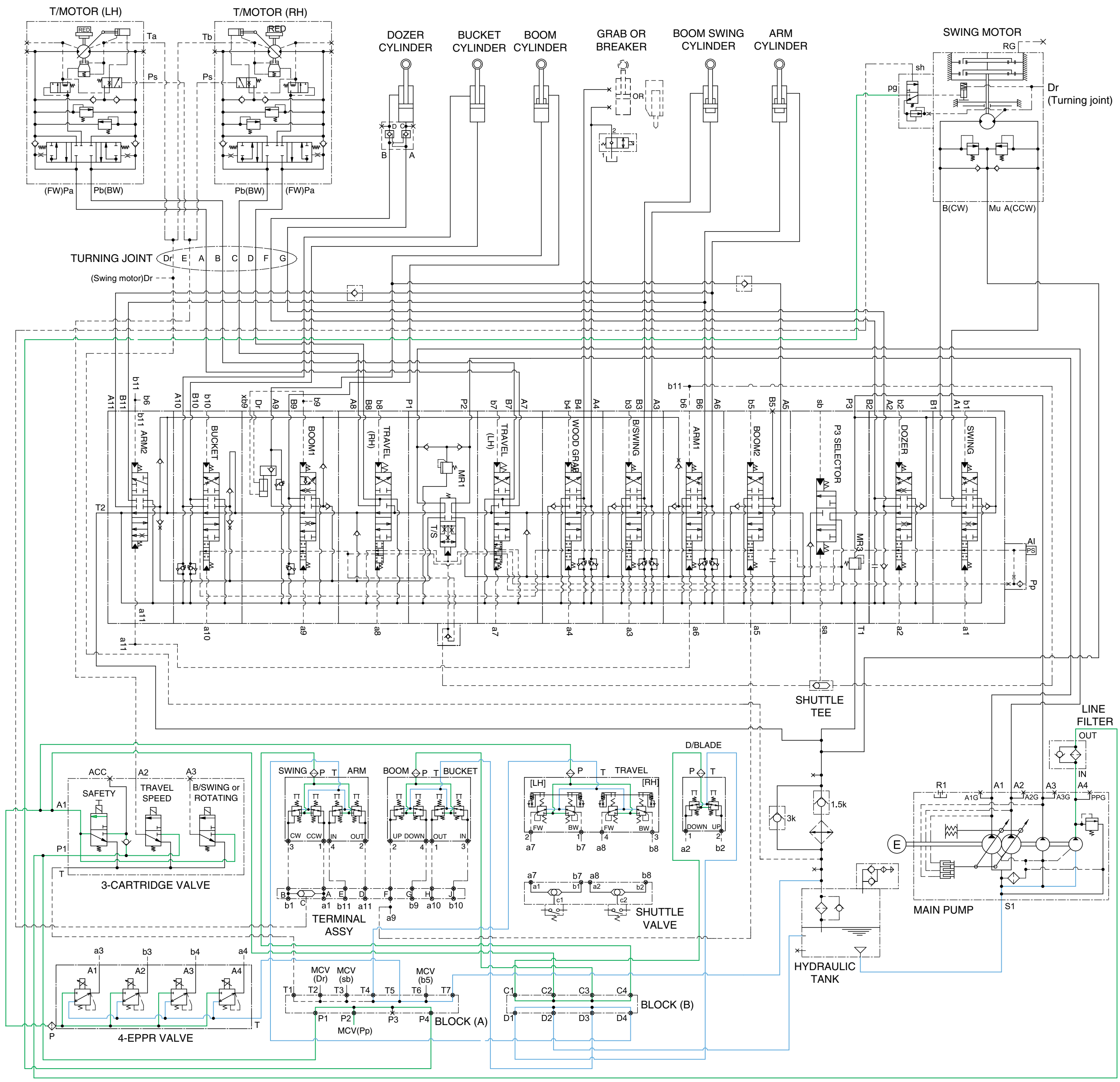
The pilot pump is provided with relief valve, receives the oil from the hydraulic tank through the suction filter.

The discharged oil from the pilot pump flows to the valves and motor through line filter as below.

- RCV lever (LH & RH) and dozer lever through the safety lock solenoid valve and block B.
- RCV lever (travel) through the safety lock solenoid valve.
- 4-EPPR valve (boom swing, wood grab or breaker) through the safety lock solenoid valve.
- Auto idle supply port of MCV and parking brake port of swing motor through the block A.
- Travel speed solenoid valve.

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

1. SUCTION, DELIVERY AND RETURN CIRCUIT



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

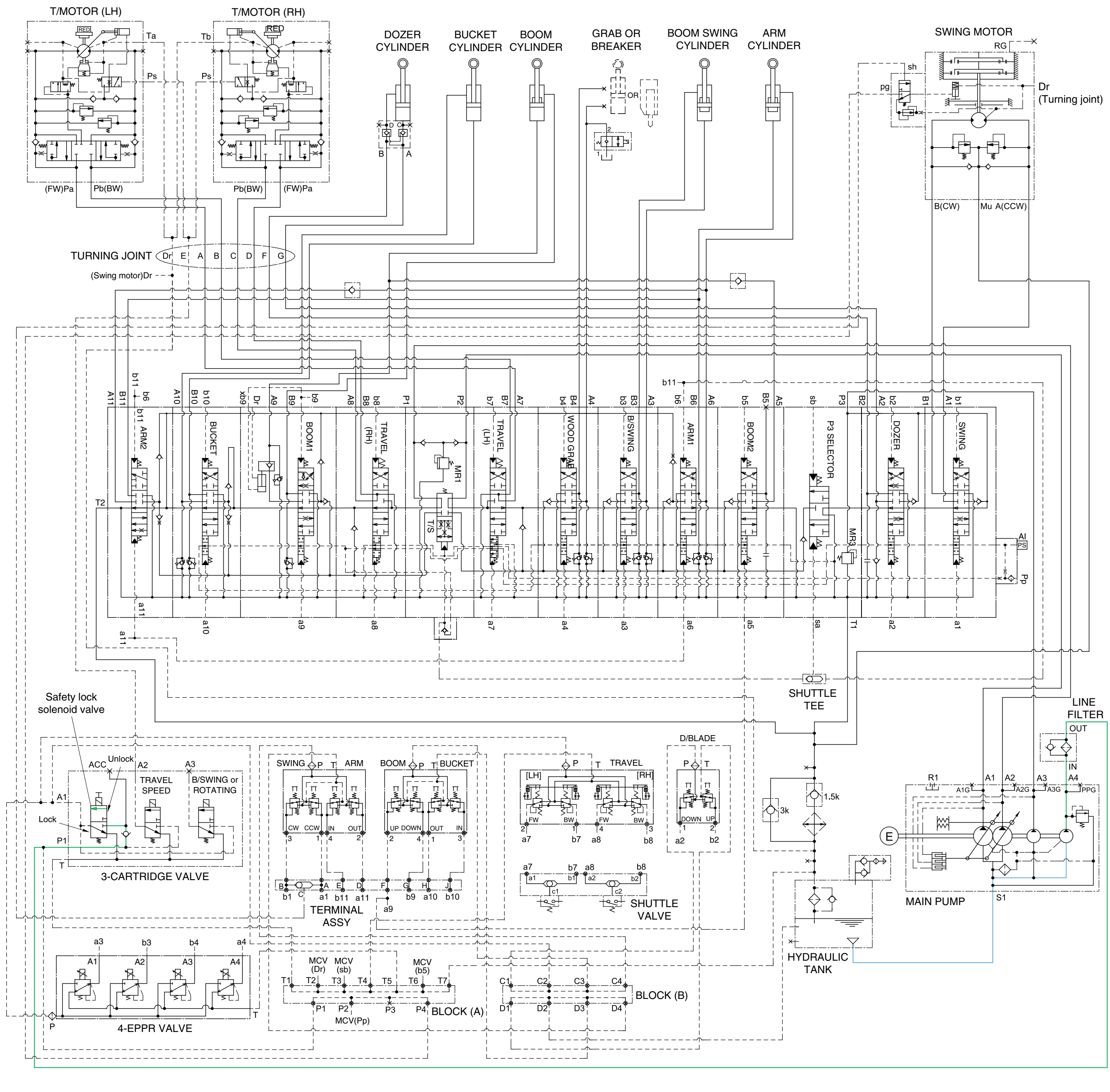
The oil filtered by line filter flows remote control valve through safety solenoid valve.

Also, the oil flows 4-EPPR valve and swing parking brake standby port.

The return oil flow into the hydraulic tank.

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

2. SAFETY VALVE (SAFETY LEVER)

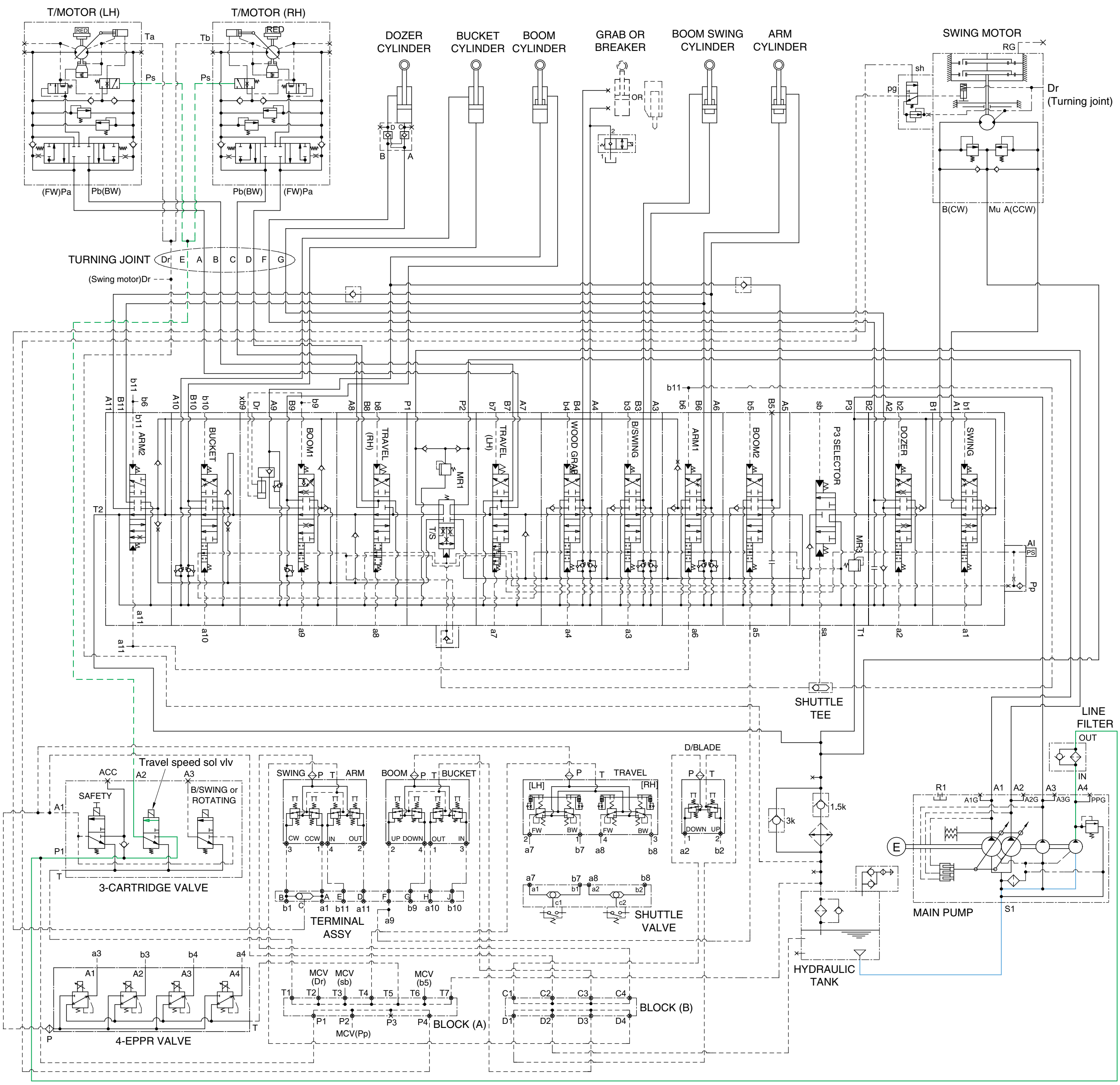


When the lever of the safety solenoid valve is in the unlock position, oil flows into the remote control valve through solenoid valve and line filter.

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

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

3. TRAVEL SPEED CONTROL SYSTEM



HX65A3HC04

When the travel speed switch is pushed, the travel speed solenoid valve is actuated and the discharged oil from the pilot pump flows to the Ps port of pilot valve in the travel motors.

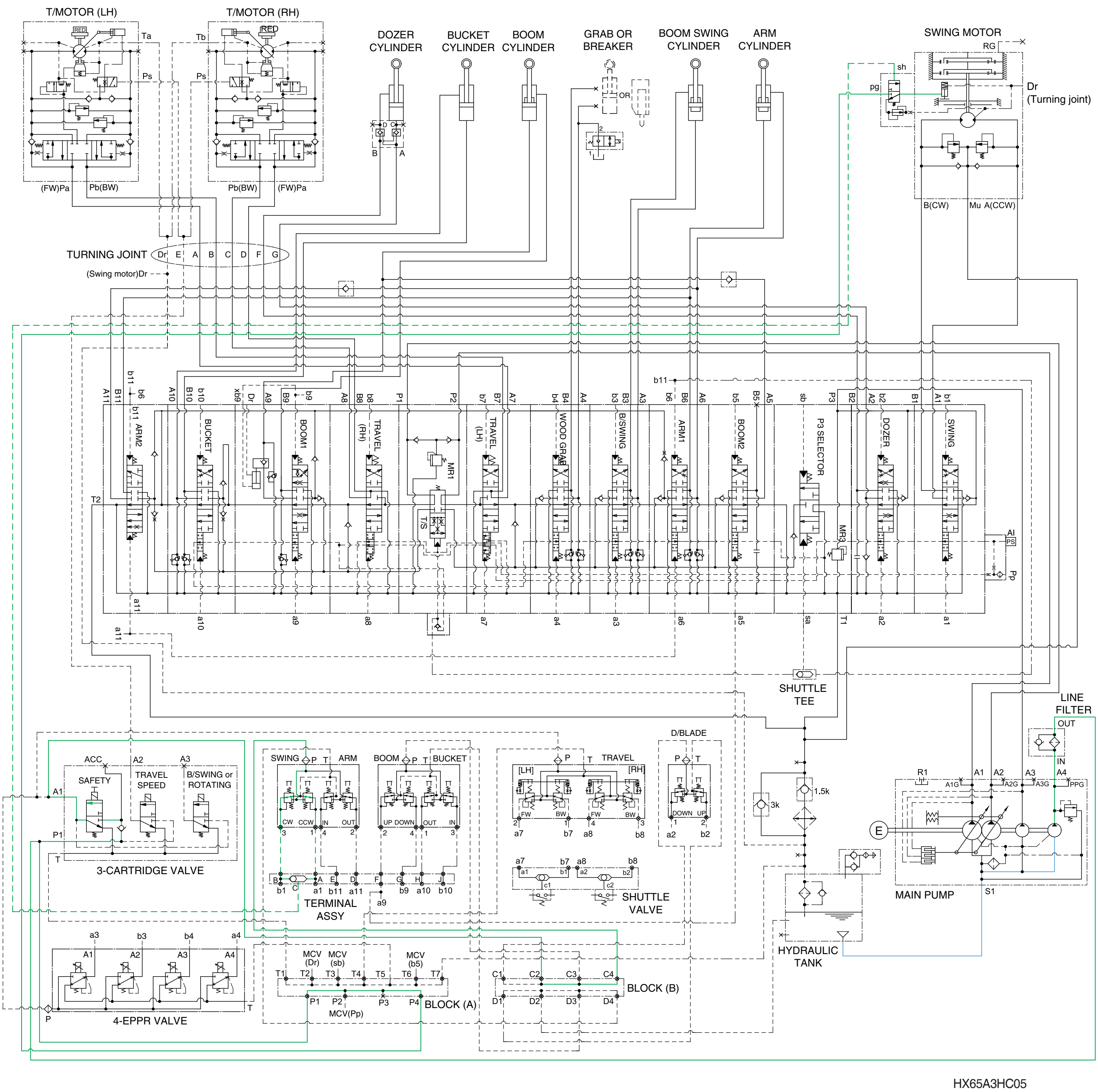
As a result, the control piston is pushed by the main oil flow, thus the displacement is minimized.

When the travel speed switch is pushed once more, the travel speed solenoid valve is return to original position by the force of spring, the hydraulic oil of Ps port returns to the hydraulic tank.

As a result, the control piston is returned by the main oil flow, thus the displacement is maximized.

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

4. SWING PARKING BRAKE RELEASE



When the swing control lever is tilted, the pilot oil flow into **sh** port of shuttle valve, this pressure move spool so, discharged oil from pilot pump flow into **pg** port.

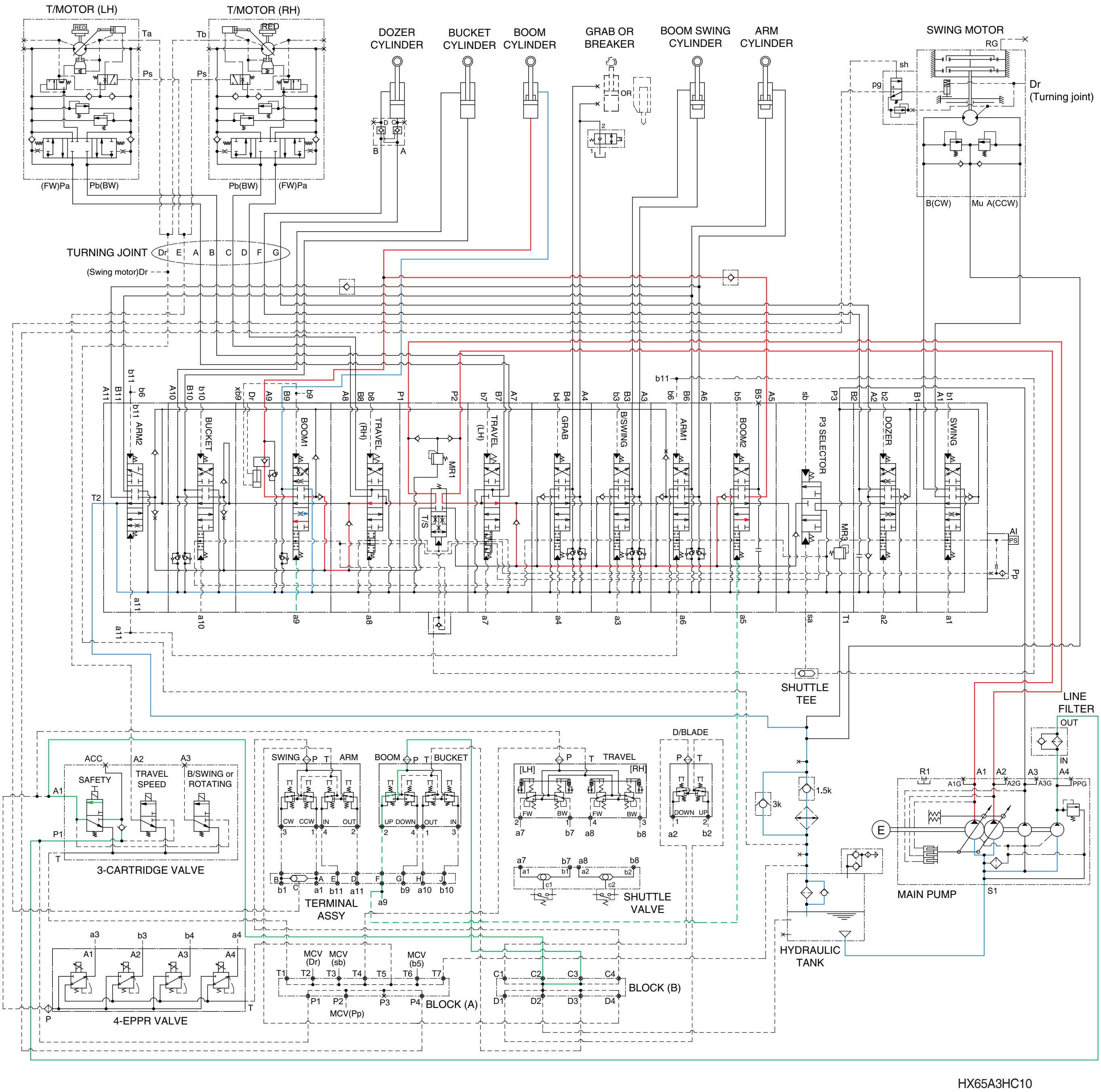
This pressure is applied to swing motor disc, thus the brake is released.

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

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

GROUP 4 SINGLE OPERATION

1. BOOM UP OPERATION

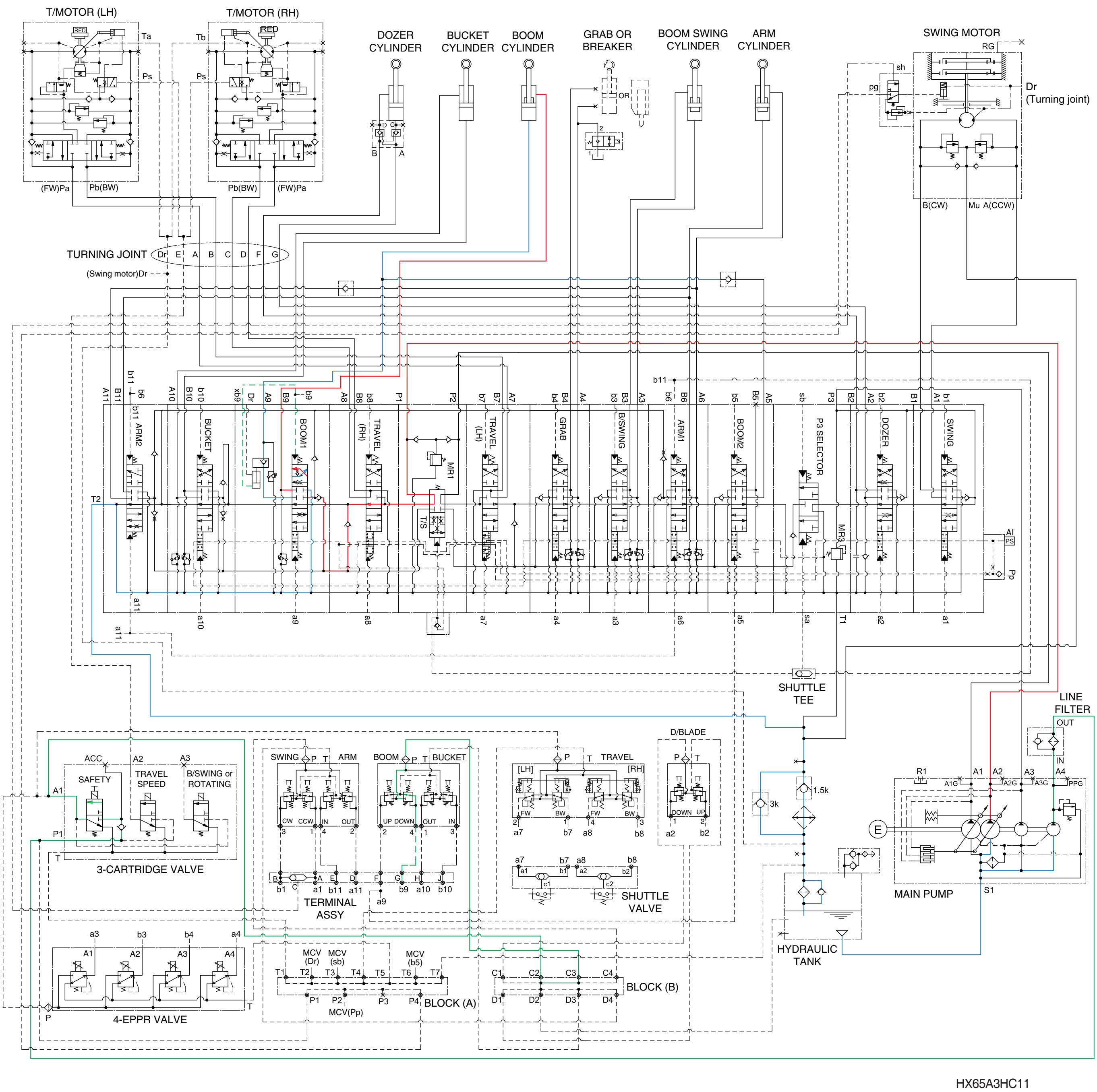


When the right control lever is pulled back, the boom spools in the main control valve are moved to the up position by the pilot oil pressure (a5, a9) from the remote control valve.

The oil from the A1 and A2 pump flows into the main control valve and then goes to the large chamber of boom cylinders. At the same time, the oil from the small chamber of boom cylinders returns to the hydraulic oil tank through the boom spool in the main control valve. When this happens, the boom goes up. The excessive pressure in the boom cylinder bottom end circuit is prevented by relief valve. When the boom is up and the control lever is returned to neutral position, the circuit for the holding pressure at the bottom end of the boom cylinder is closed by the boom holding valve. This prevents the hydraulic drift of boom cylinder.

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

2. BOOM DOWN OPERATION



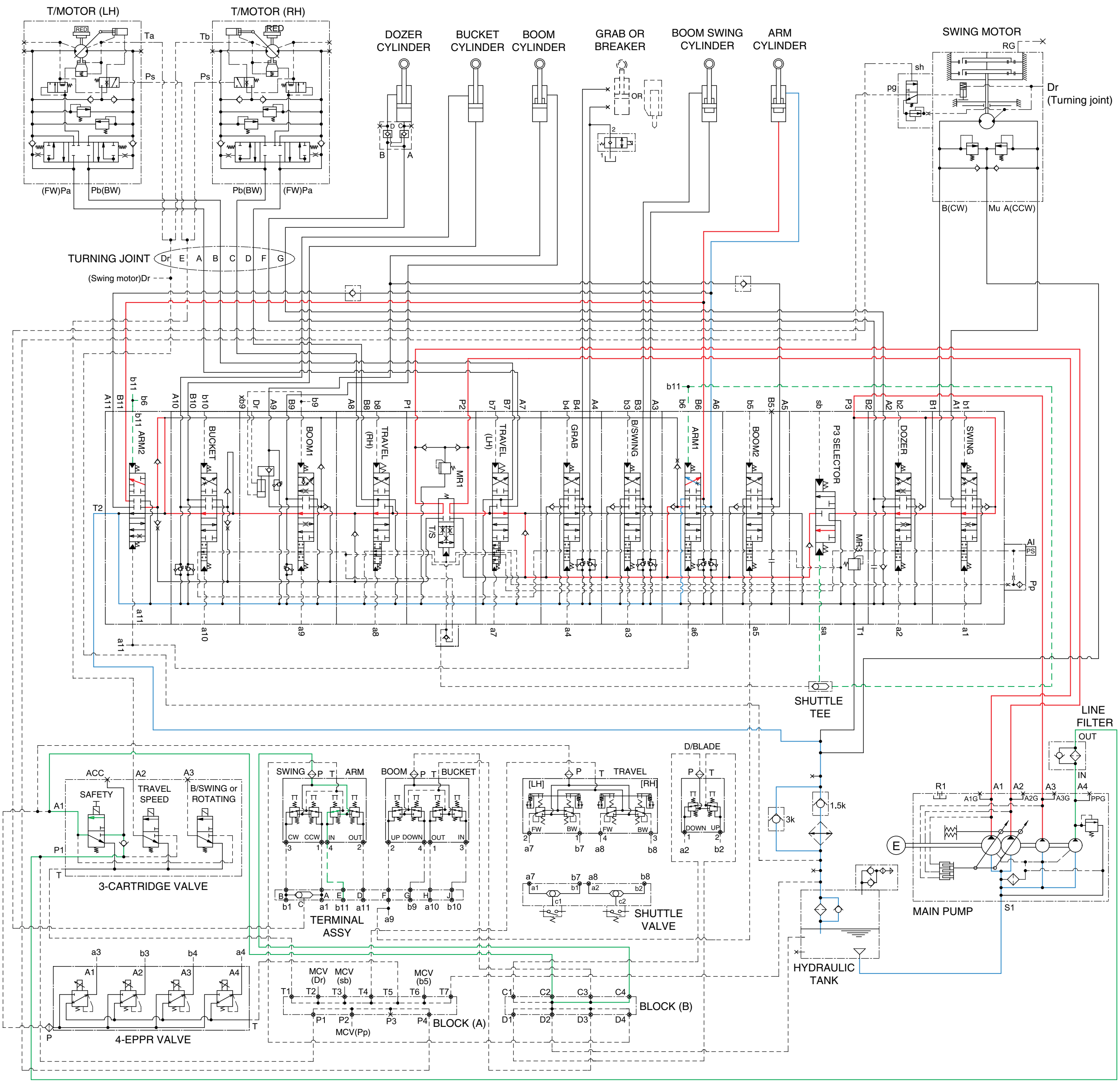
When the right control lever is pushed forward, the boom spool in the main control valve are moved to the down position by the pilot oil pressure (b9) from the remote control valve.

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

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

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

3. ARM ROLL IN OPERATION

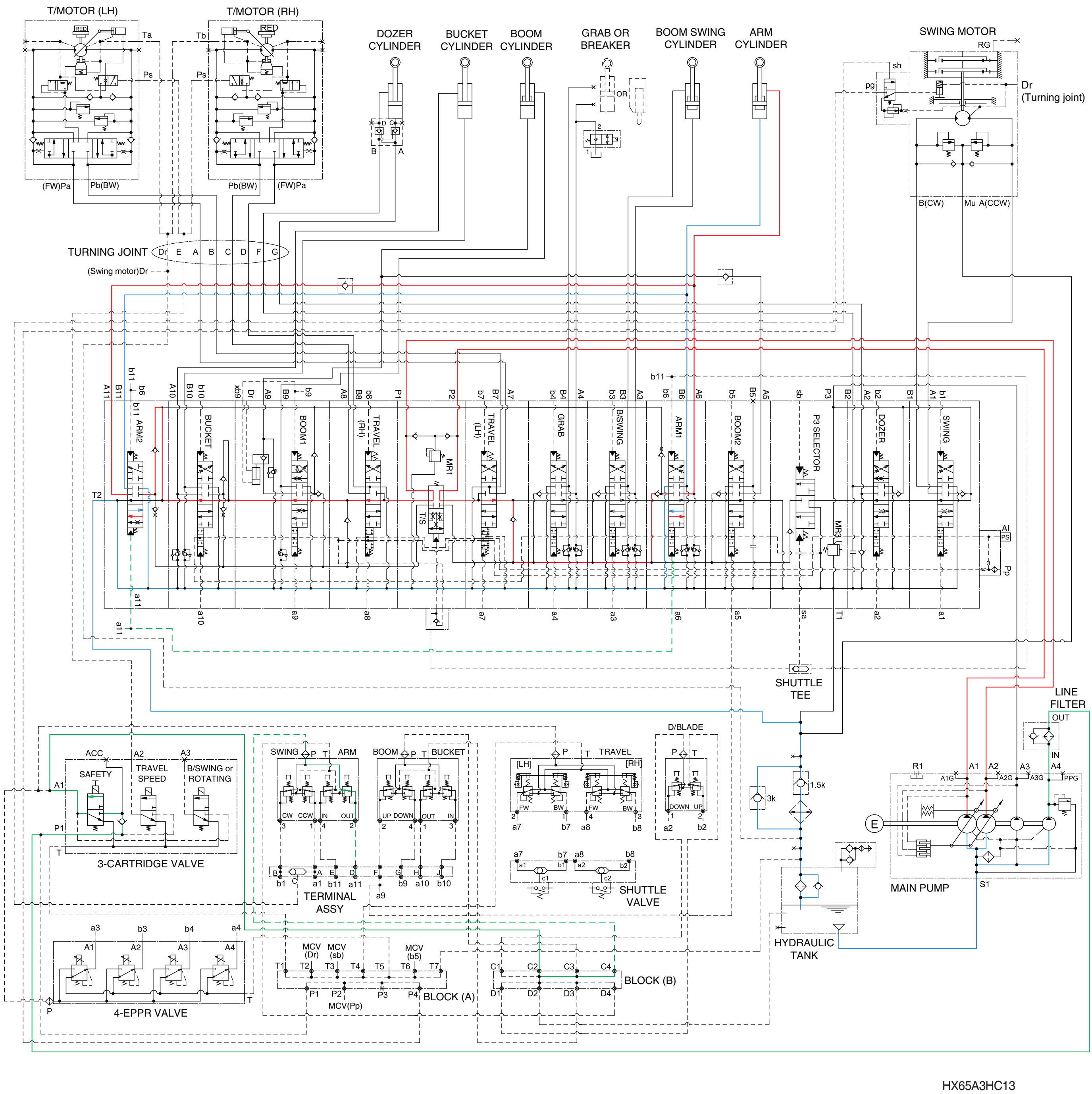


HX65A3HC12

When the left control lever is pulled back, the arm spools in the main control valve are moved the to roll in position by the pilot oil pressure (b6, b11) from the remote control valve.
The oil from the A1, A2 and A3 pump flows into the main control valve and then goes to the large chamber of arm cylinder.
At the same time, the oil from small chamber of arm cylinder returns to the hydraulic oil tank through the arm spool in the main control valve. When this happens, the arm rolls in.
The cavitation which will happen to the bottom of the arm cylinder is also prevented by the make-up valve in the main control valve.

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

4. ARM ROLL OUT OPERATION



When the left control lever is pushed forward, the arm spools in the main control valve are moved to the roll out position by the pilot oil pressure (a6, a11) from the remote control valve.

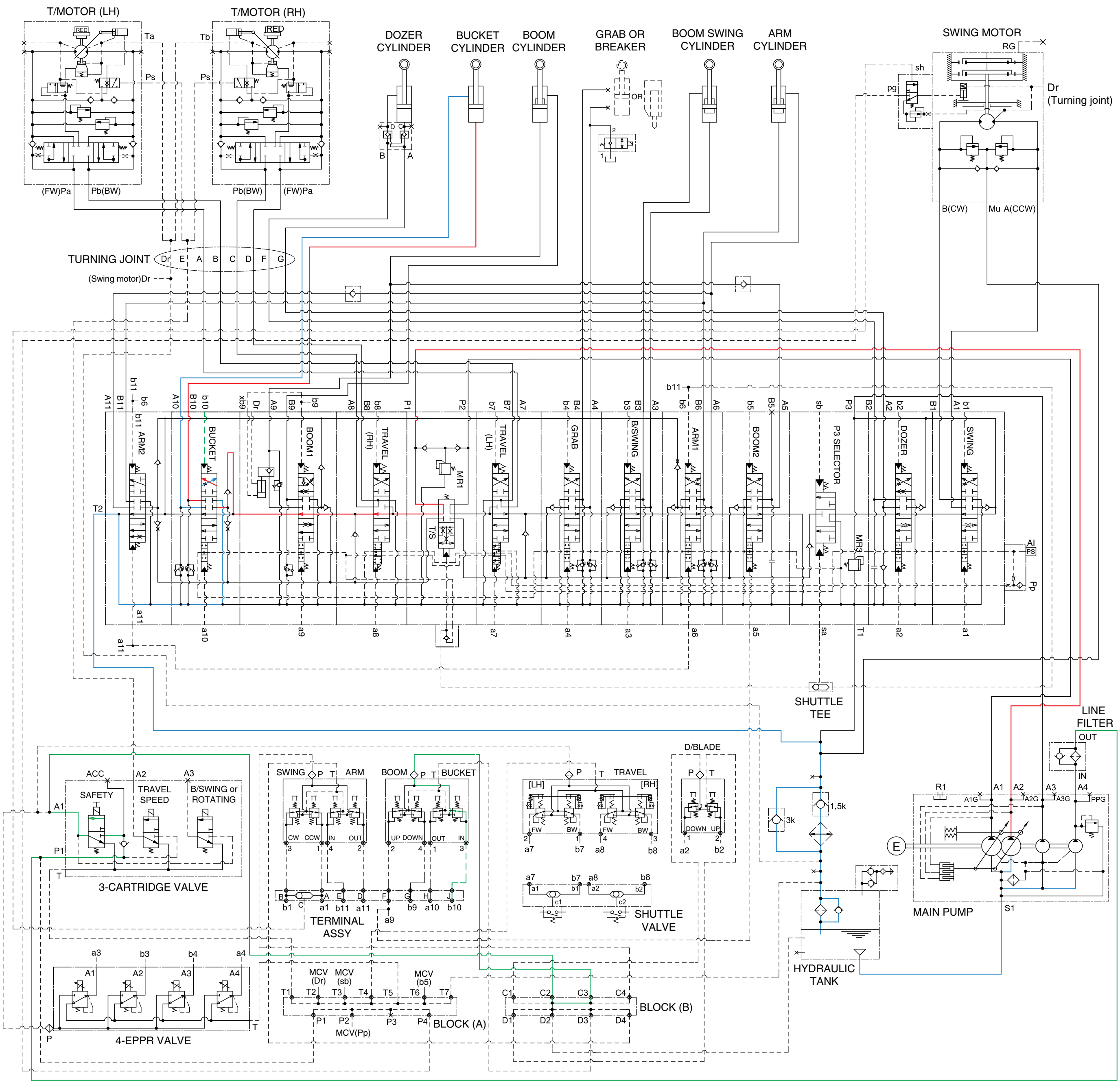
The oil from the A1 and A2 pump flows into the main control valve and then goes to the small chamber of arm cylinder.

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

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

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

5. BUCKET ROLL IN OPERATION



HX65A3HC14

When the right control lever is pulled left, the bucket spool in the main control valve is moved to the roll in position by the pilot oil pressure (b10) from the remote control valve.

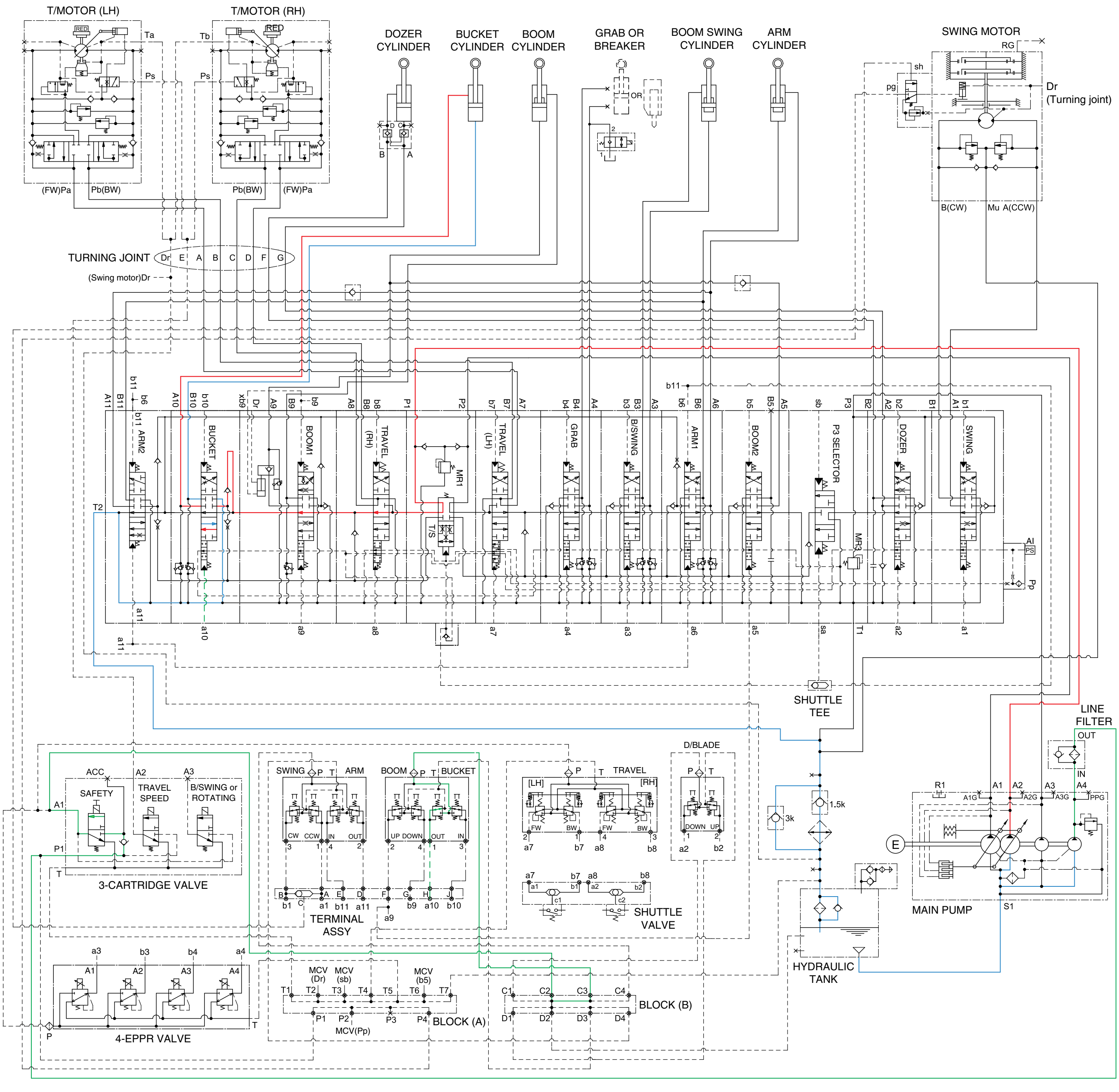
The oil from the A2 pump flows into the main control valve and then goes to the large chamber of bucket cylinder.

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

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

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

6. BUCKET ROLL OUT OPERATION



HX65A3HC15

When the right control lever is pushed right, the bucket spool in the main control valve is moved to the roll out position by the pilot oil pressure (a10) from the remote control valve.

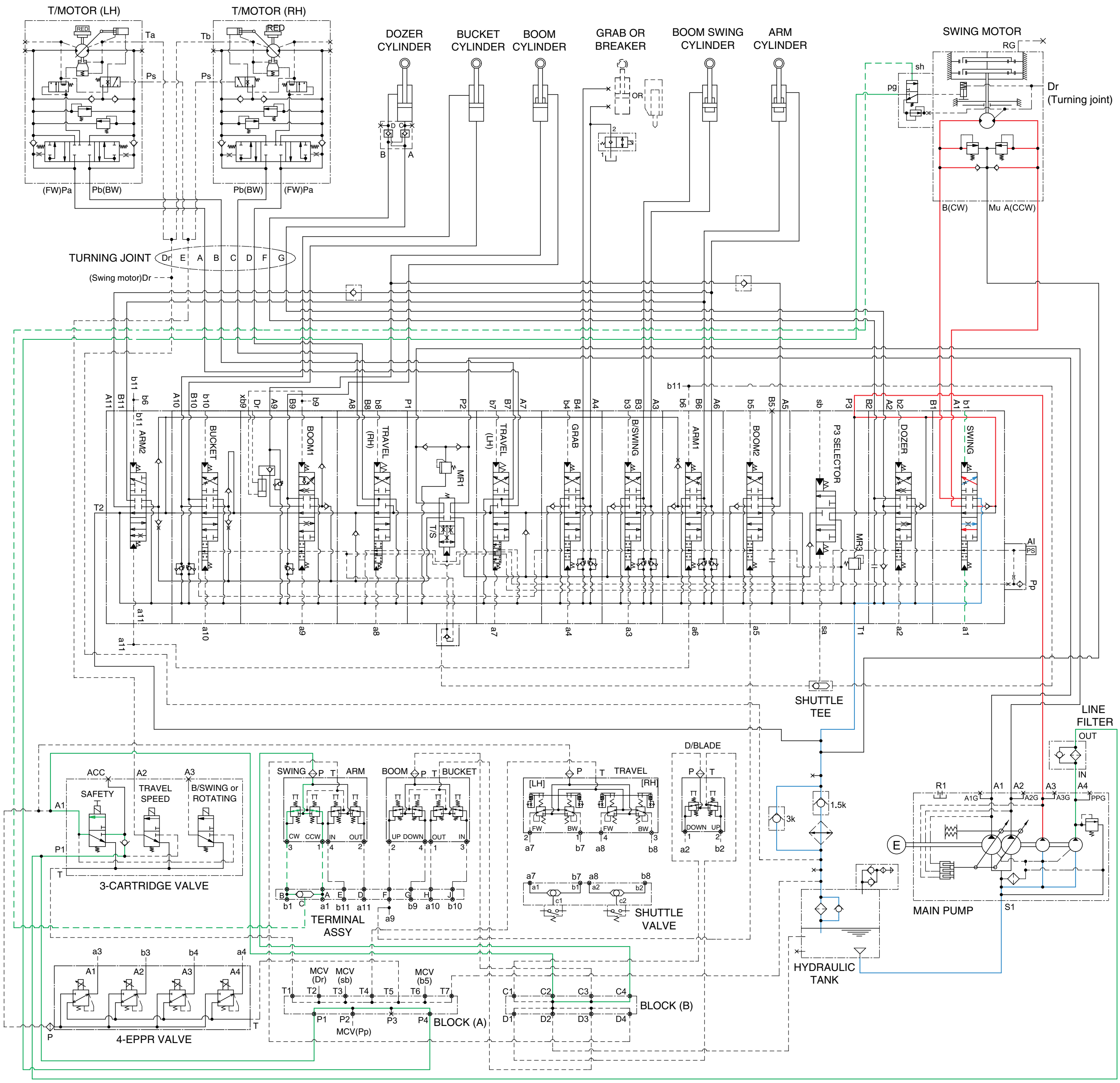
The oil from the A2 pump flows into the main control valve and then goes to the small chamber of bucket cylinder.

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

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

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

7. SWING OPERATION



HX65A3HC16

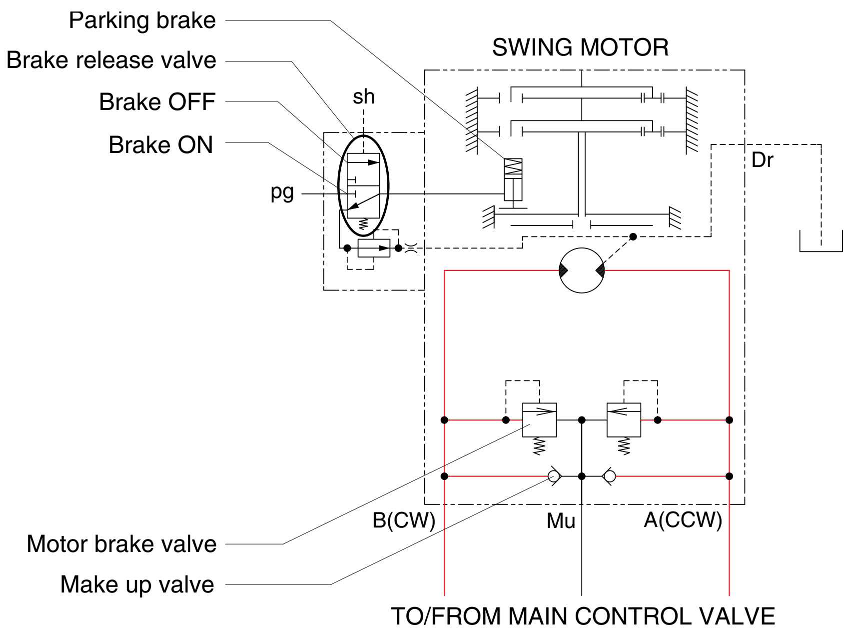
When the left control lever is pushed left or right, the swing spool in the main control valve is moved to the left or right swing position by the pilot oil pressure (a1, b1) from the remote control valve.

The oil from the A3 pump flows into the main control valve and then goes to the swing motor.

At the same time, the return oil from the swing motor returns to the hydraulic oil tank through the swing spool in the main control valve. When this happens, the superstructure swings to the left or right. The swing parking brake, make up valve and the overload relief valve are provided in the swing motors. The cavitation which will happen to the swing motor is also prevented by the make up valve in the swing motor itself.

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

SWING CIRCUIT OPERATION



HX65A3HC17

1) MOTOR BRAKE VALVE

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

2) MAKE UP VALVE

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

3) PARKING BRAKE

In case that the parking, of the machine at slope is required during operation, there is the danger of involuntary swing caused by the self weight of the machine. The brake is connected to prevent this involuntary swing.

PARKING BRAKE "OFF" OPERATION

The parking brake is released by the pilot pressure oil from the pilot pump.

When the left control lever placed in the swing position, the pilot pressure (sh) at the shuttle valve is transferred to the brake release valve and the brake release valve is change over. Then the pilot pressure (pg) lift the brake piston and release the parking brake.

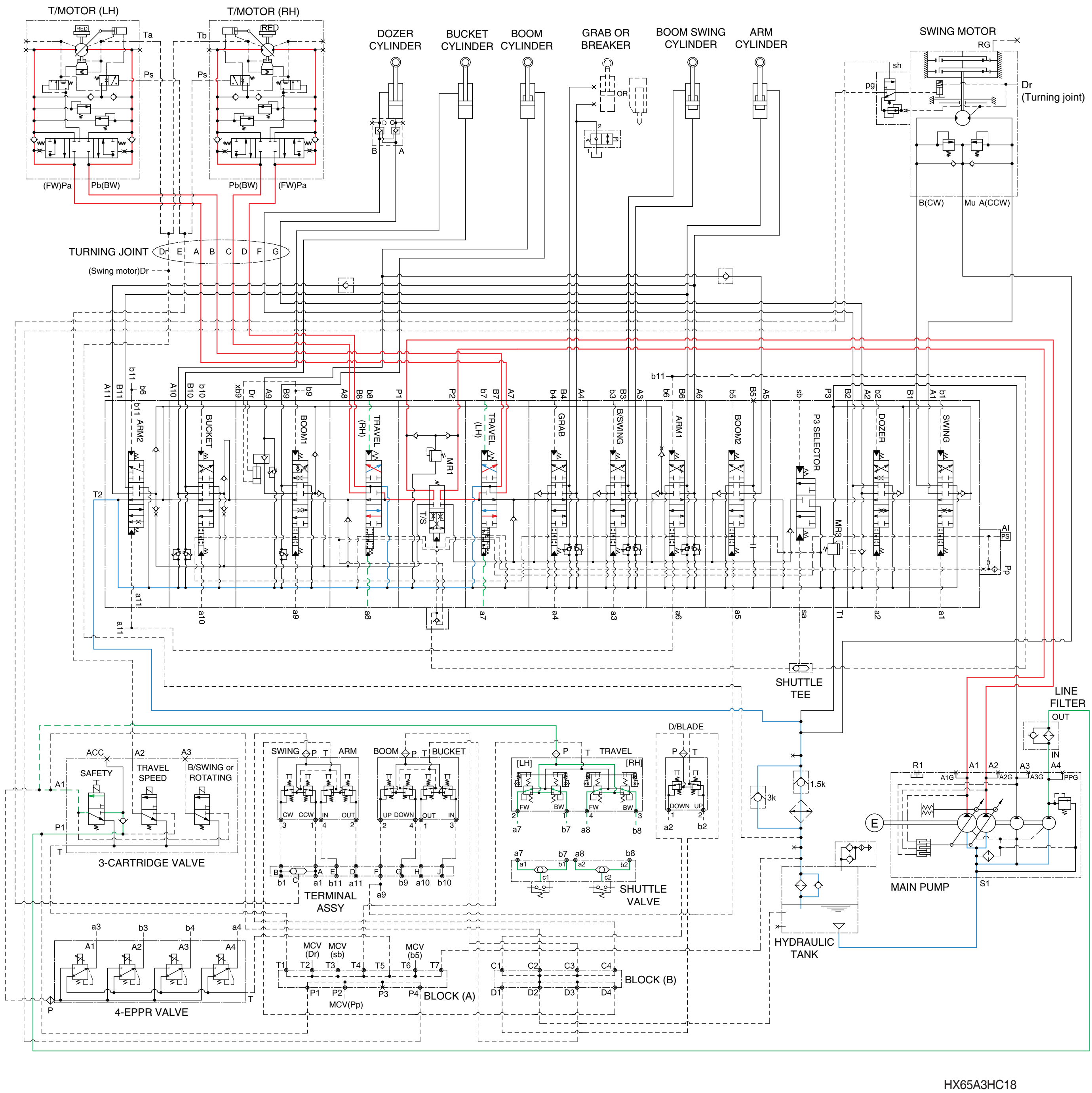
PARKING BRAKE "ON" OPERATION

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

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

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

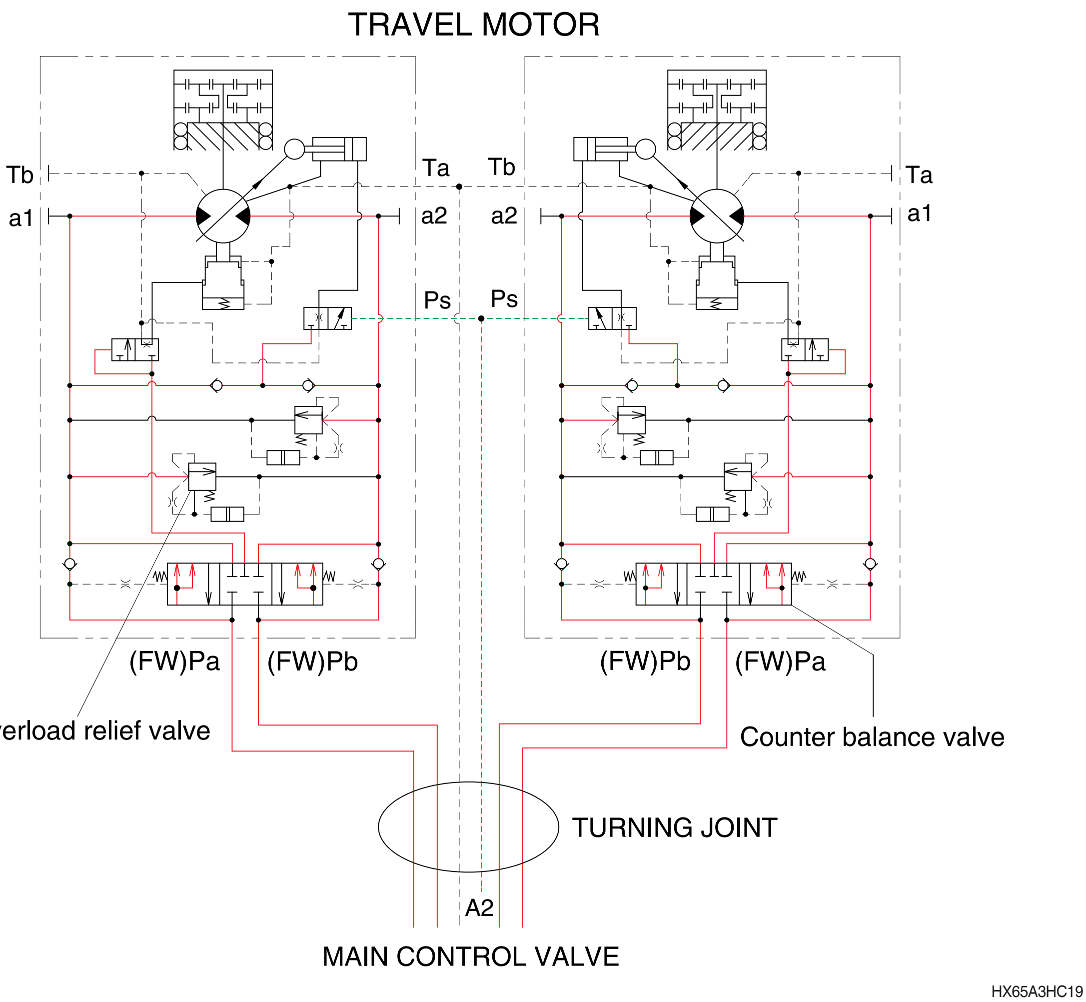
8. TRAVEL FORWARD AND REVERSE OPERATION



When the travel levers are pushed forward or reverse position, the travel spools in the main control valve are moved to the forward or reverse travel position by the pilot oil pressure (a7, a8, b7, b8) from the remote control valve. The oil from the both pumps (A1, A2) flows into the main control valve and then goes to the both travel motors through the turning joint. The return oil from both travel motors returns to the hydraulic oil tank through the turning joint and the travel spools in the main control valve. When this happens, the machine moves to the forward or reverse.

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

TRAVEL CIRCUIT OPERATION



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

1) COUNTER BALANCE VALVE

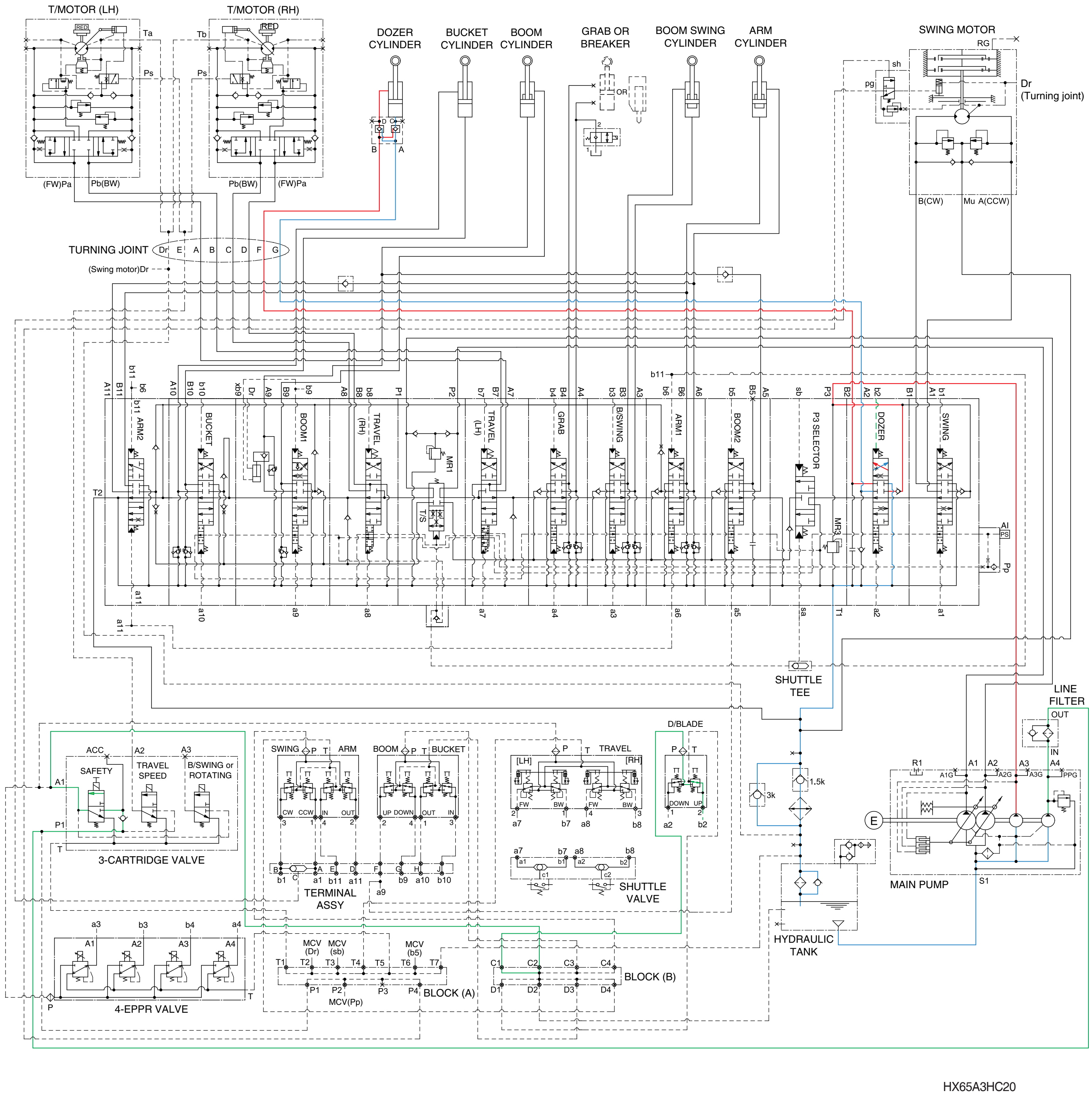
When stopping the motor of slope descending, this valve to prevent the motor over run.

2) OVERLOAD RELIEF VALVE

Relief valve limit the circuit pressure below 240 kgf/cm² (3414 psi) to prevent high pressure generated at at time of stopping the machine. Stopping the motor, this valve sucks the oil from lower pressure passage for preventing the negative pressure and the cavitation of the motor.

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

9. DOZER UP OPERATION



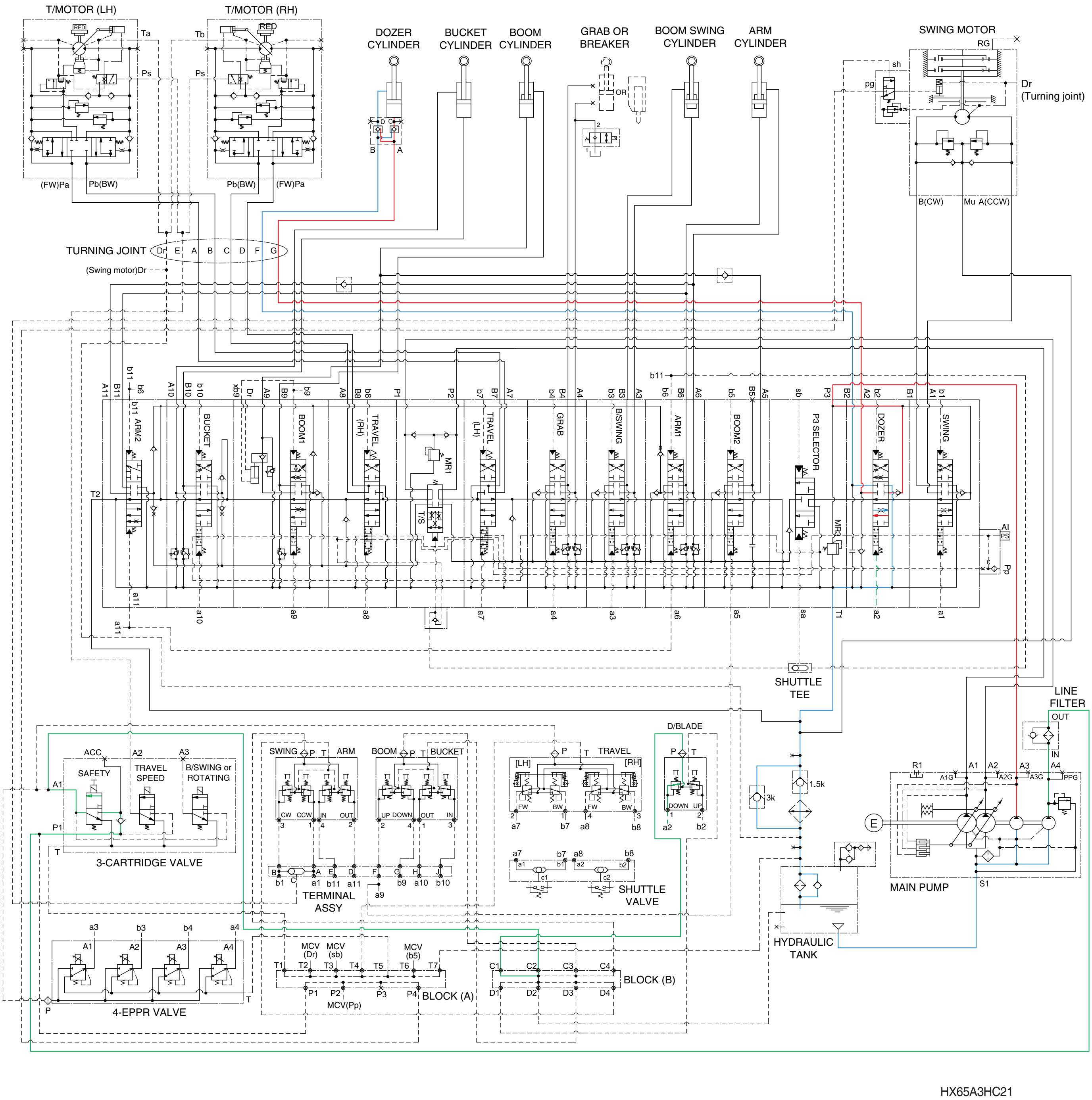
When the dozer control lever is pulled back, the dozer spool in the main control valve is moved to the dozer up position by the pilot oil pressure (b2) from the remote control valve.

The oil from the A3 pump flows into the main control valve and then goes to the small chamber of dozer cylinders.

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

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

10. DOZER DOWN OPERATION



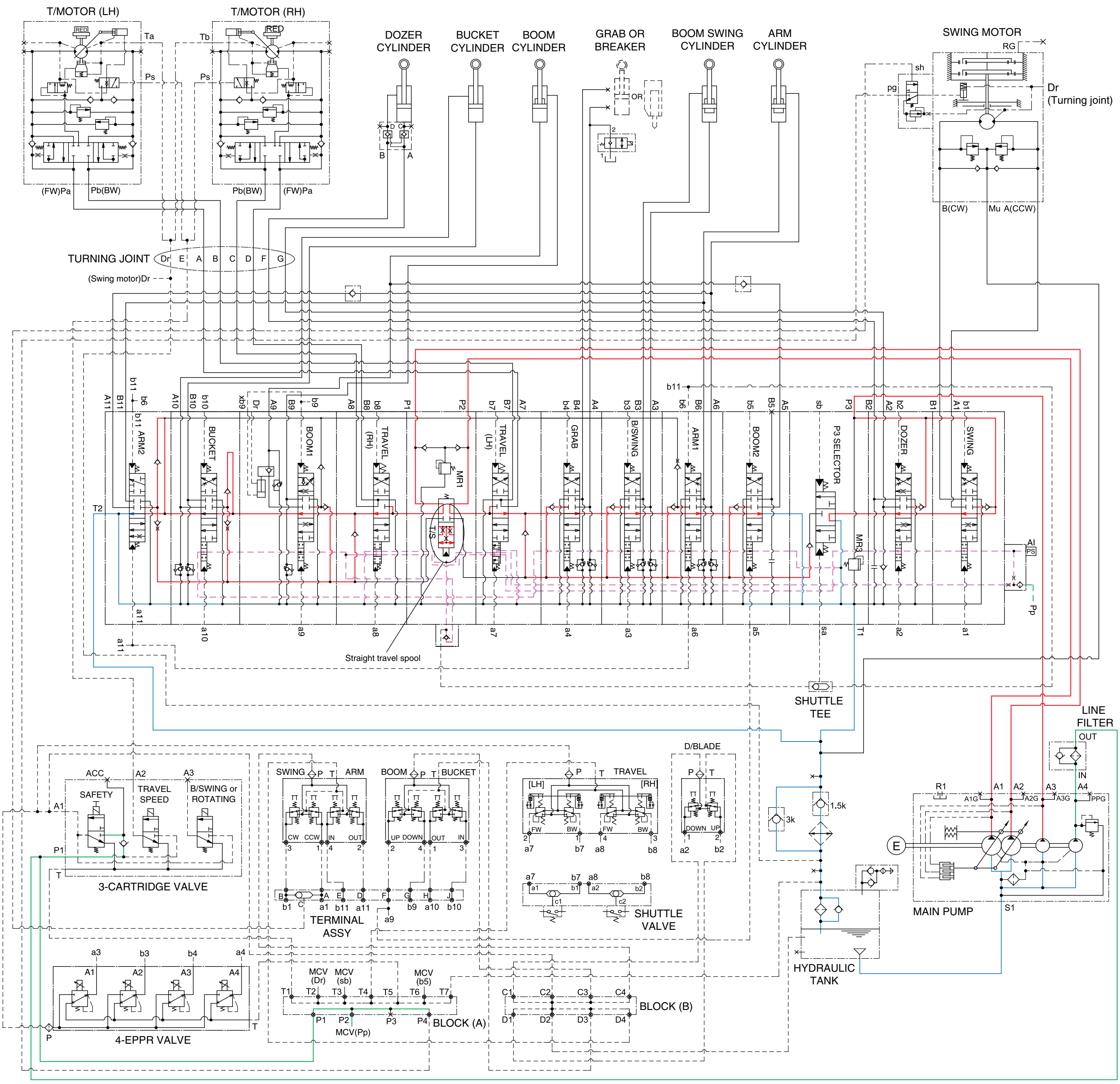
When the dozer control lever is pushed forward, the dozer spool in the main control valve is moved to the dozer down position by the pilot oil pressure (a2) from the remote control valve.

The oil from the A3 pump flows into the main control valve and then goes to the large chamber of dozer cylinders.

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

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

1. OUTLINE



HX65A3HC22

The oil from the A1, A2, A3 pump flows through the neutral oil passage, bypass oil passage and confluence oil passage in the main control valve. Then the oil goes to each actuator and operates them. Check valves and orifices are located on these oil passage in the main control valve. These control the oil from the main pumps so as to correspond to the operation of each actuator and smooth the combined operation.

Straight travel spool

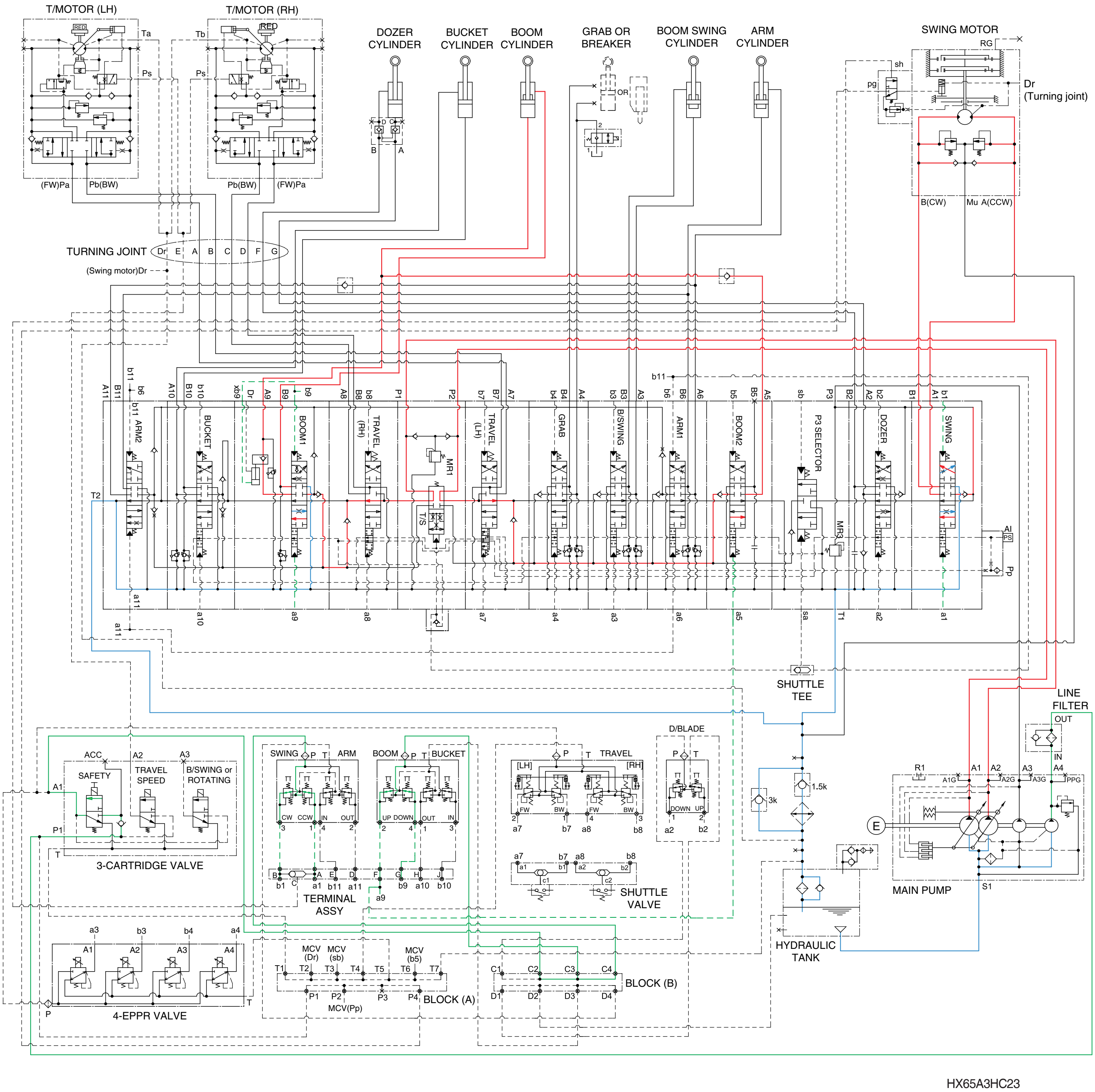
This straight travel spool for straight travel is provided in the main control valve.

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

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

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

2. COMBINED SWING AND BOOM OPERATION



When the swing and boom functions are operated, simultaneously the swing spool and boom spools in the main control valve are moved to the functional position by the pilot oil pressure (a1, b1, a5, a9, b9) from the remote control valve.

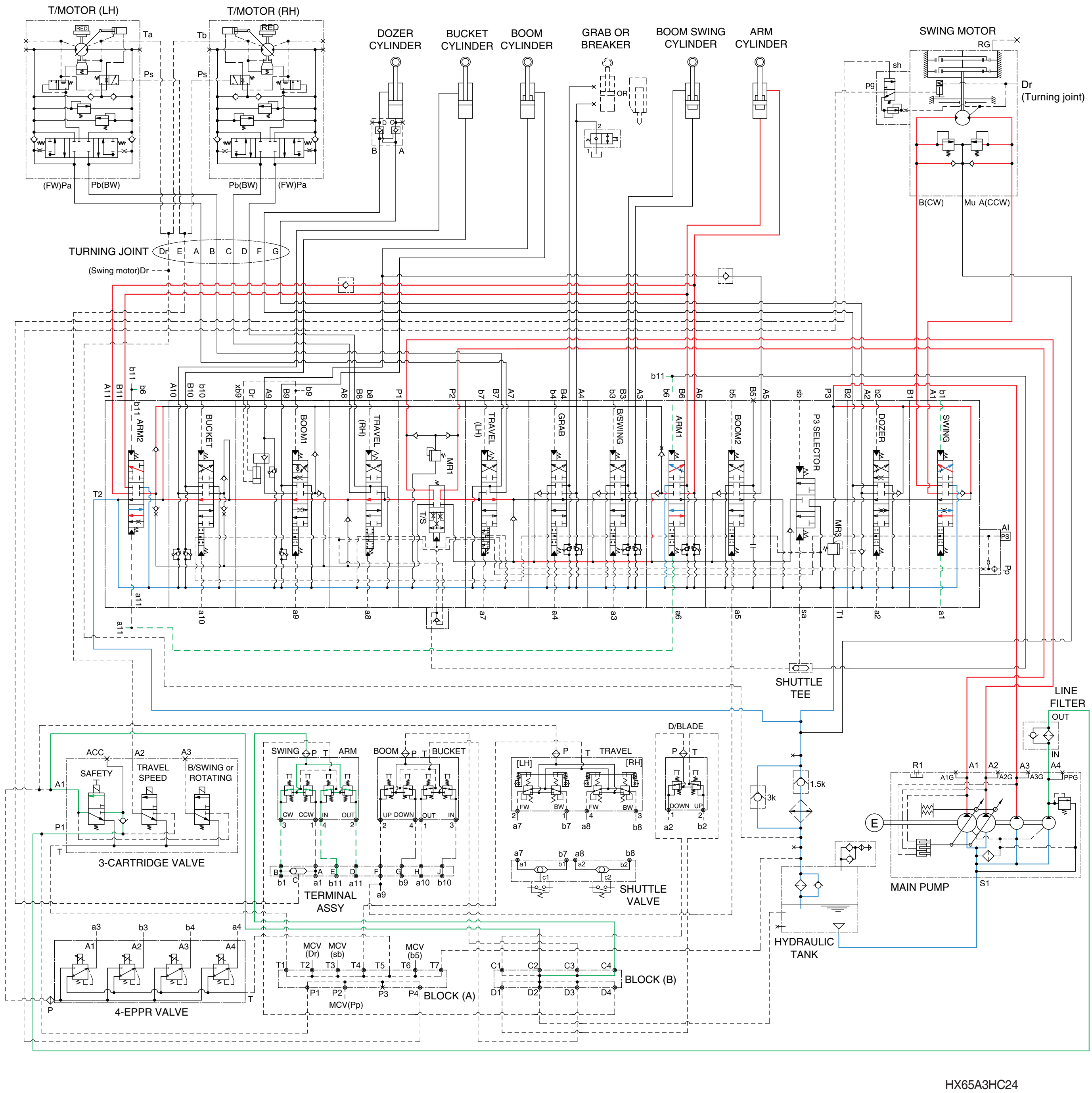
The oil from the A1 and A2 pump flows into the boom cylinder through boom 1 and boom 2 spools.

The oil from the A3 pump flows into the swing motor through the swing spool.

The superstructure swings and the boom is operated.

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

3. COMBINED SWING AND ARM OPERATION



When the swing and arm functions are operated, simultaneously the swing spool and arm spools in the main control valve are moved to the functional position by the pilot oil pressure (a1, b1, a6, a11, b6, b11) from the remote control valve.

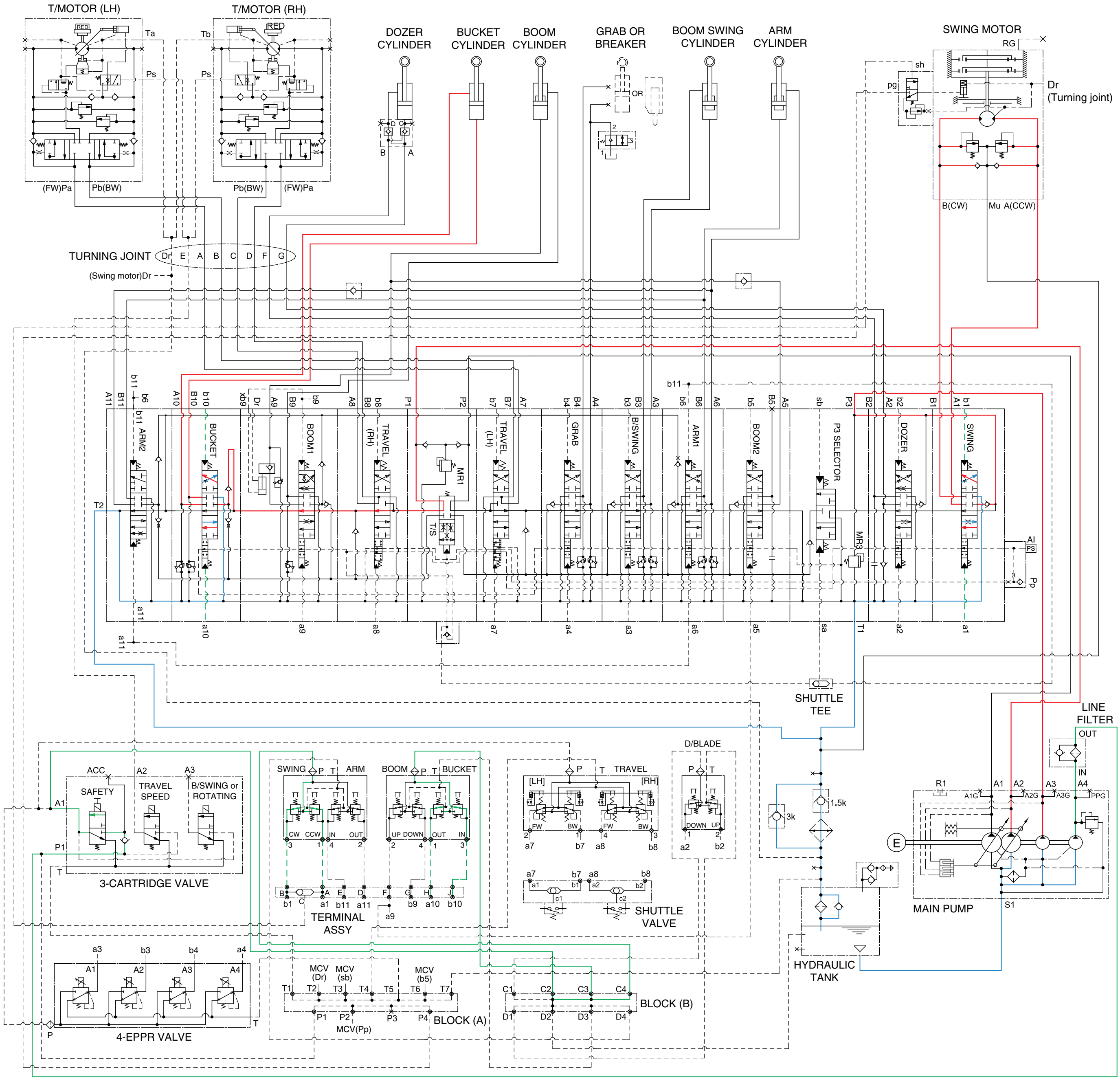
The oil from the A3 pump flows into the swing motor through swing spool.

The oil from the A1 and A2 pump flows into the arm cylinder through the arm 1 and arm 2 spools.

The superstructure swings and the arm is operated.

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

4. COMBINED SWING AND BUCKET OPERATION



HX65A3HC25

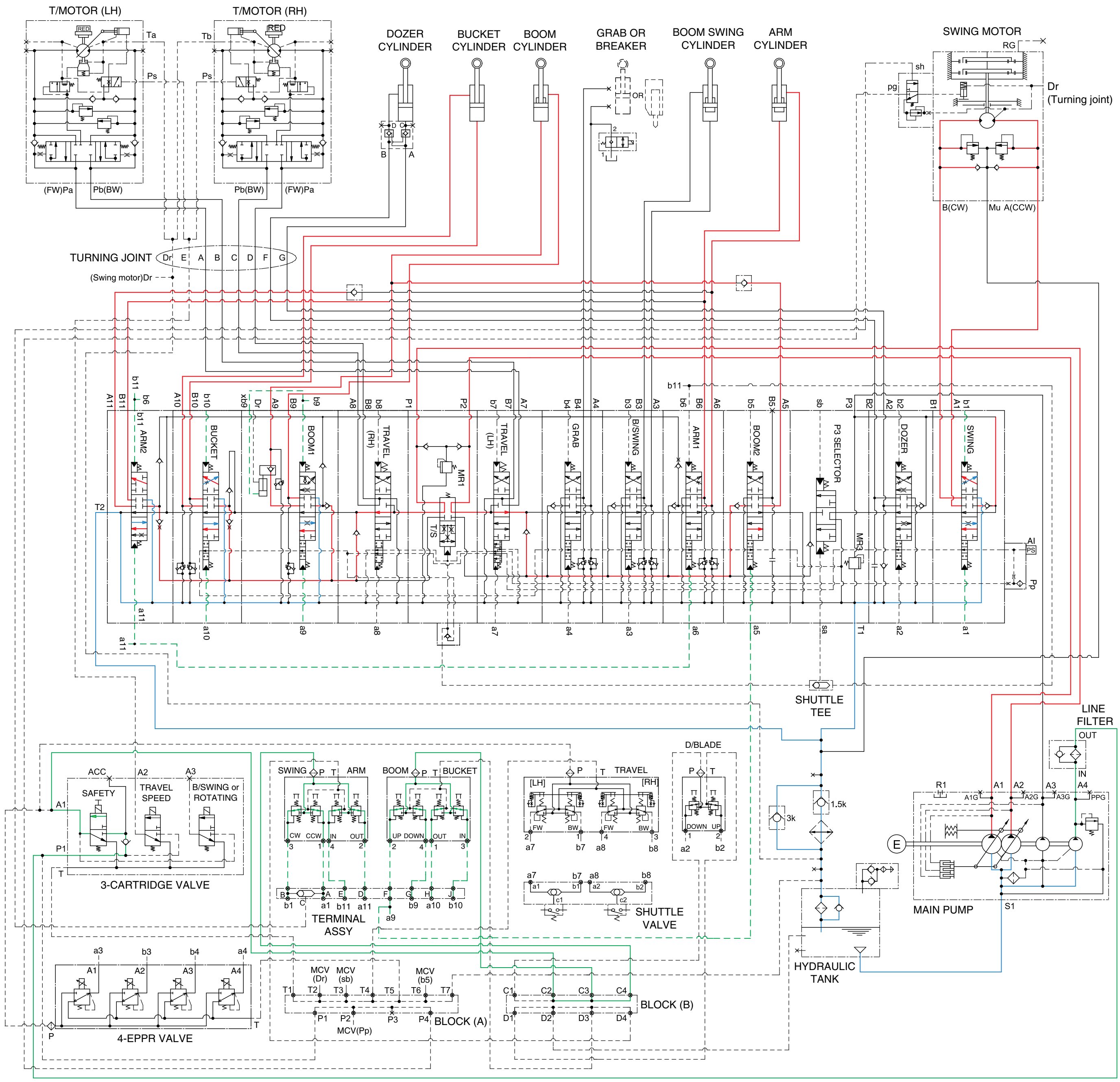
When the swing and bucket functions are operated, simultaneously the swing spool and bucket spool in the main control valve are moved to the functional position by the pilot oil pressure (a1, b1, a10, b10) from the remote control valve.

The oil from the A3 pump flows into the swing motor through the swing spool.

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

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

5. COMBINED SWING, BOOM, ARM AND BUCKET OPERATION



HX65A3HC26

When the swing, boom, arm and bucket functions are operated, simultaneously each spool in the main control valve is moved to the functional position by the pilot oil pressure (a1, b1, a5, a9, b9, a6, a11, b6, b11, a10, b10) from the remote control valve.

The oil from the A1 pump flows into the boom cylinders and arm cylinder through boom 2 spool, arm 1 spool.

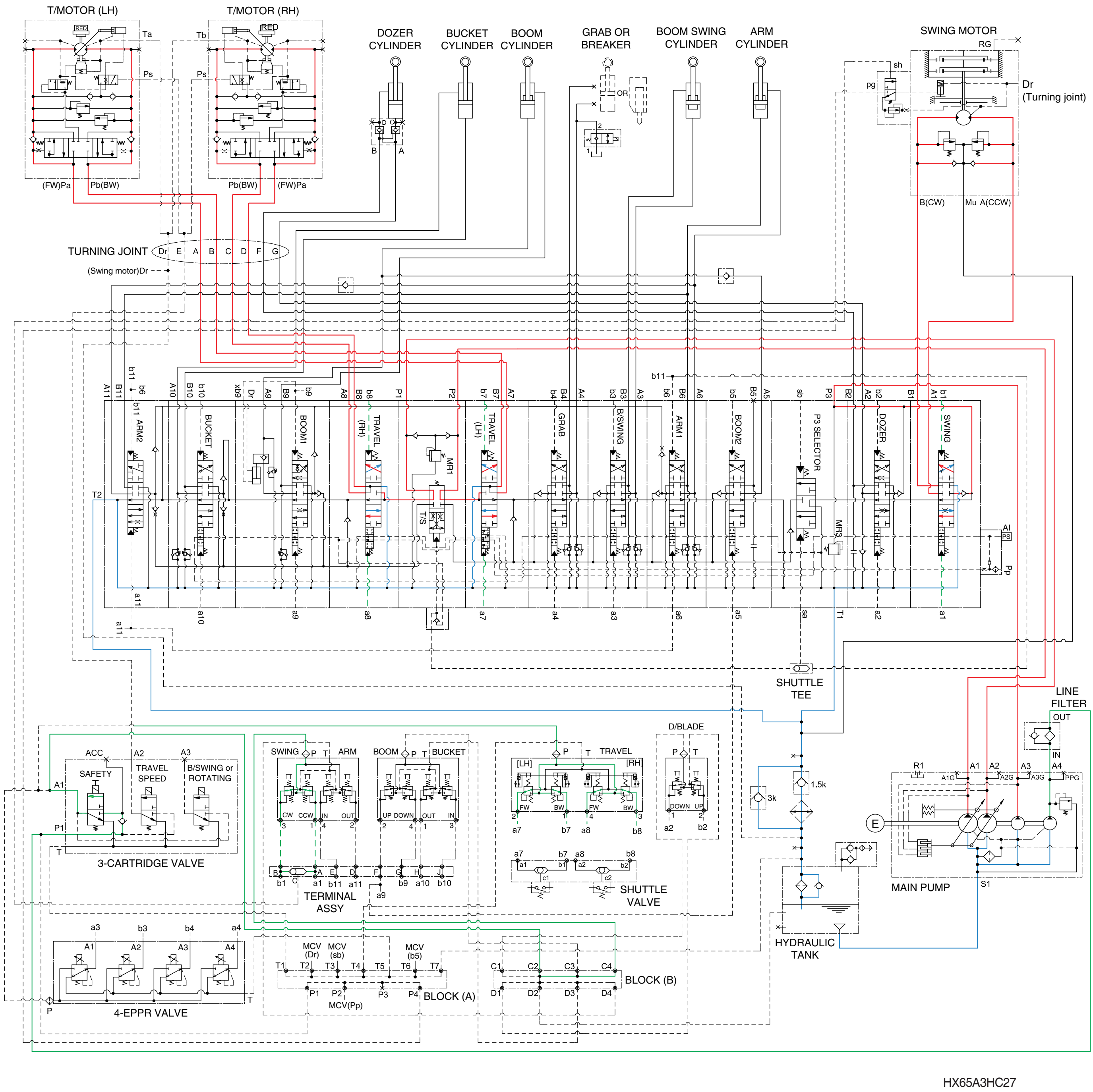
The oil from the A2 pump flows into the boom cylinders, arm cylinder and bucket cylinder through the boom 1 spool, arm 2 spool, bucket spool.

The oil from the A3 pump flows into the swing motor through the swing spool.

The superstructure swings and the boom, arm and bucket are operated.

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

6. COMBINED SWING AND TRAVEL OPERATION



When the swing and travel functions are operated, simultaneously the swing spool and travel spools in the main control valve are moved to the functional position by the pilot oil pressure (a1, b1, a7, a8, b7, b8) from the remote control valve and the travel levers.

The oil from the A3 pump flows into the swing motor through the swing spool.

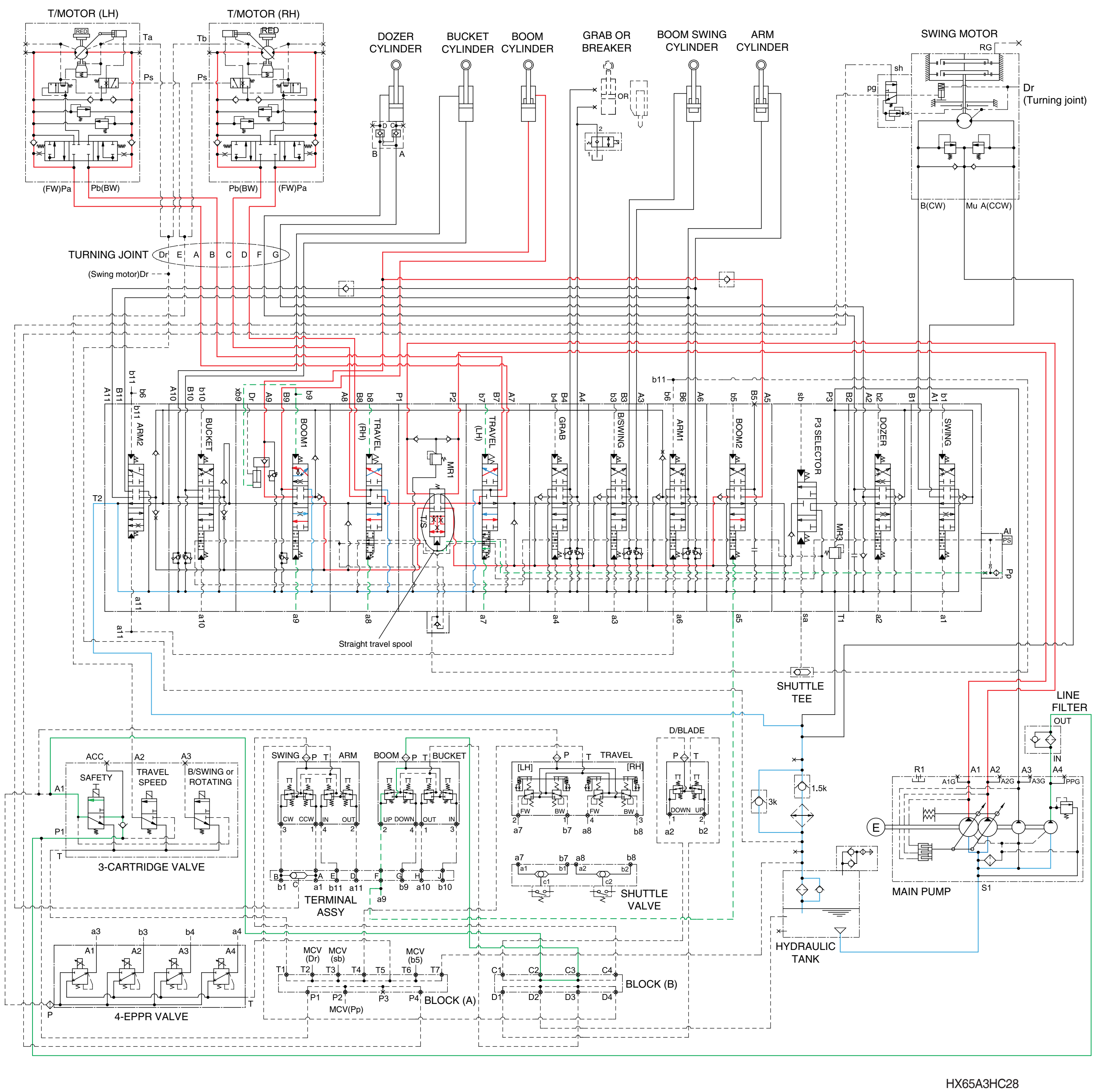
The oil from the A1 pump flows into the travel motor through the LH travel spool.

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

The superstructure swings and the machine travels straight.

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

7. COMBINED BOOM AND TRAVEL OPERATION



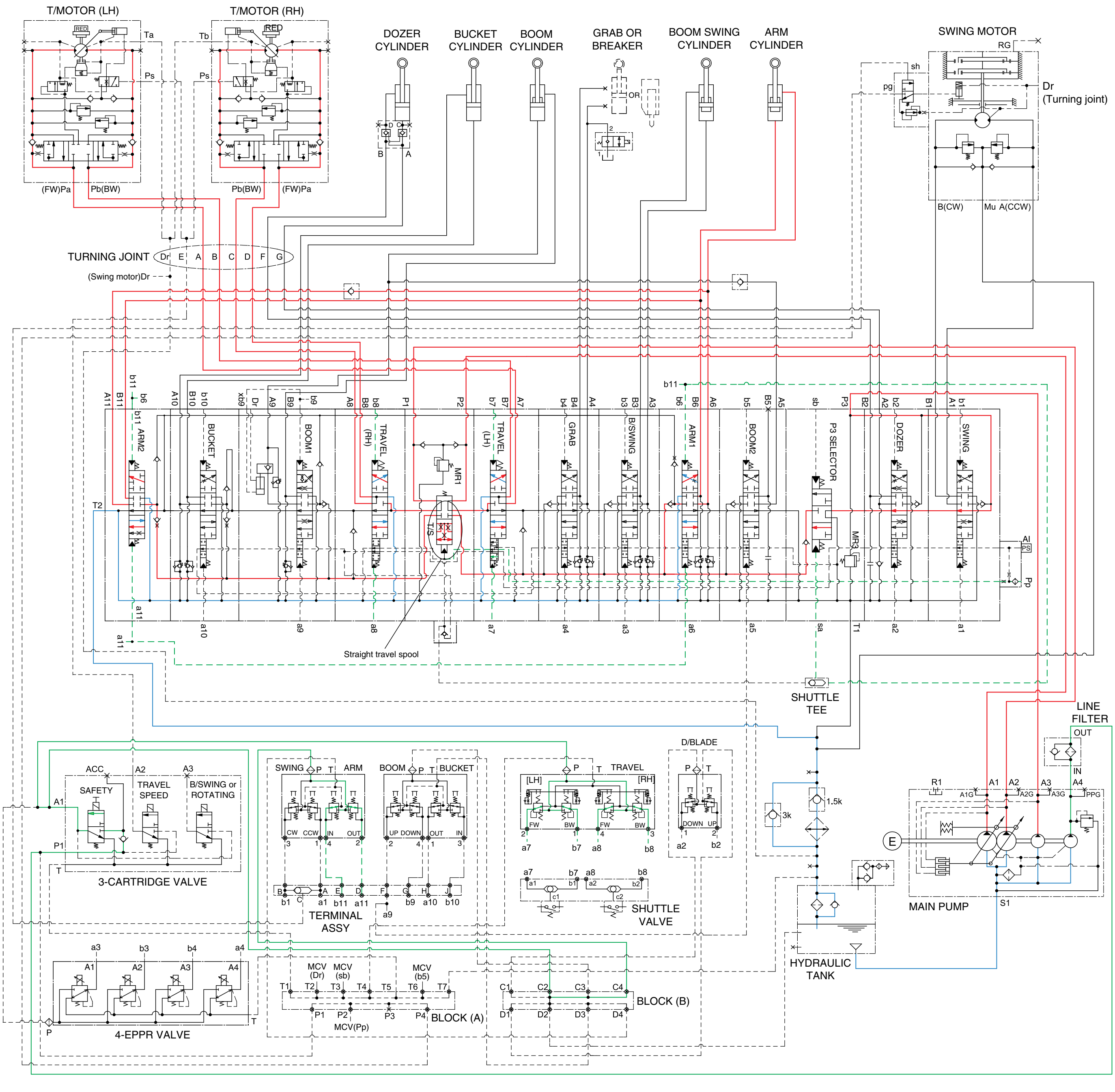
When the boom and travel functions are operated, simultaneously the boom spools and travel spools in the main control valve are moved to the functional position by the pilot oil pressure (a5, a9, b9, a7, a8, b7, b8) from the remote control valve and the straight travel spool is pushed to the up by the oil pressure (Pp) from pilot pump.

The oil from the A1 and A2 pumps flows into the boom cylinders and the travel motors through boom 1, boom 2, travel LH and travel RH spools via the straight travel spool.

The boom is operated and the machine travels straight.

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

8. COMBINED ARM AND TRAVEL OPERATION



HX65A3HC29

When the arm and travel functions are operated, simultaneously the arm spools and travel spools in the main control valve are moved to the functional position by the pilot oil pressure (a6, a11, b6, b11, a7, a8, b7, b8) from the remote control valve and the straight travel spool is pushed to the up by the oil pressure (Pp) from pilot pump.

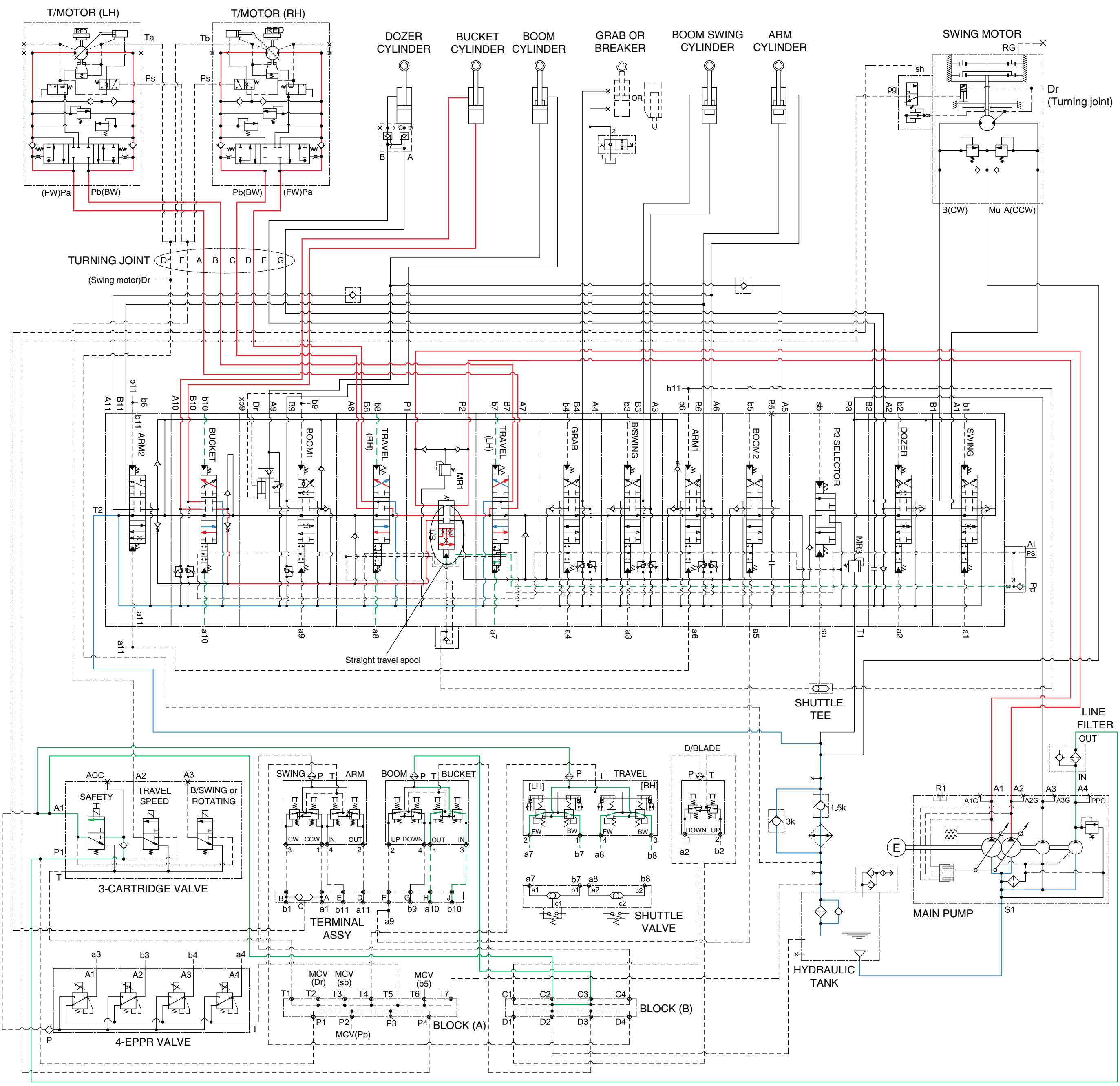
The oil from the A1 and A2 pumps flows into the travel motors and the arm cylinder through travel spools and arm spools via the straight travel spool.

At the same time, the oil from the A3 pump flows into the arm cylinder through the arm 1 spool via the selector valve.

The arm is operated and the machine travels straight.

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

9. COMBINED BUCKET AND TRAVEL OPERATION



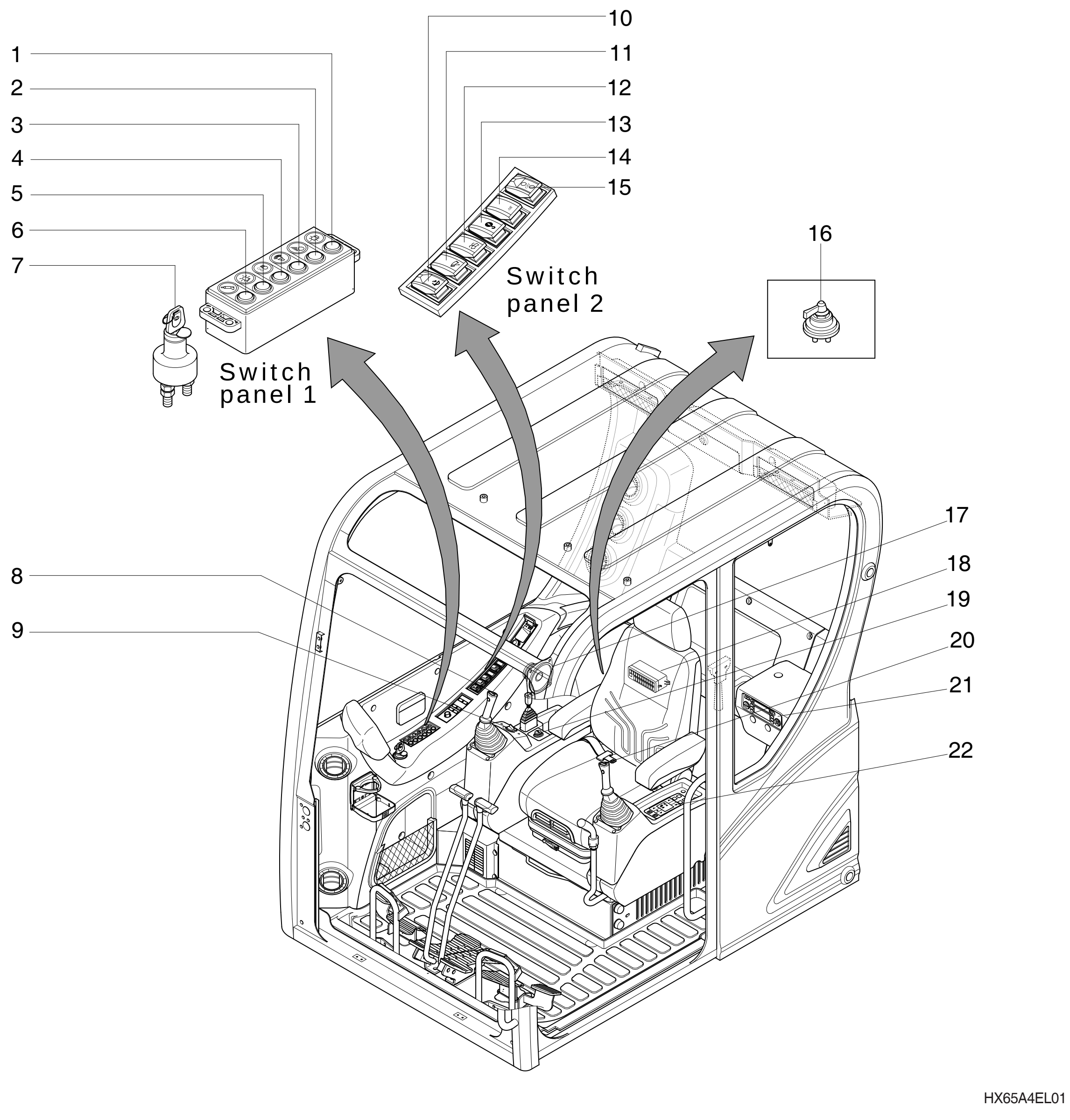
HX65A3HC30

When the bucket and travel functions are operated, simultaneously the bucket spool and travel spools in the main control valve are moved to the functional position by the pilot oil pressure (a10, b10, a7, a8, b7, b8) from the remote control valve, and the straight travel spool is pushed to the up by the oil pressure from pilot pump. The oil from the A1 and A2 pumps flows into the travel motors and the bucket cylinder through the travel spools and the bucket spool via the straight travel spool. The bucket is operated and the machine travels straight.

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

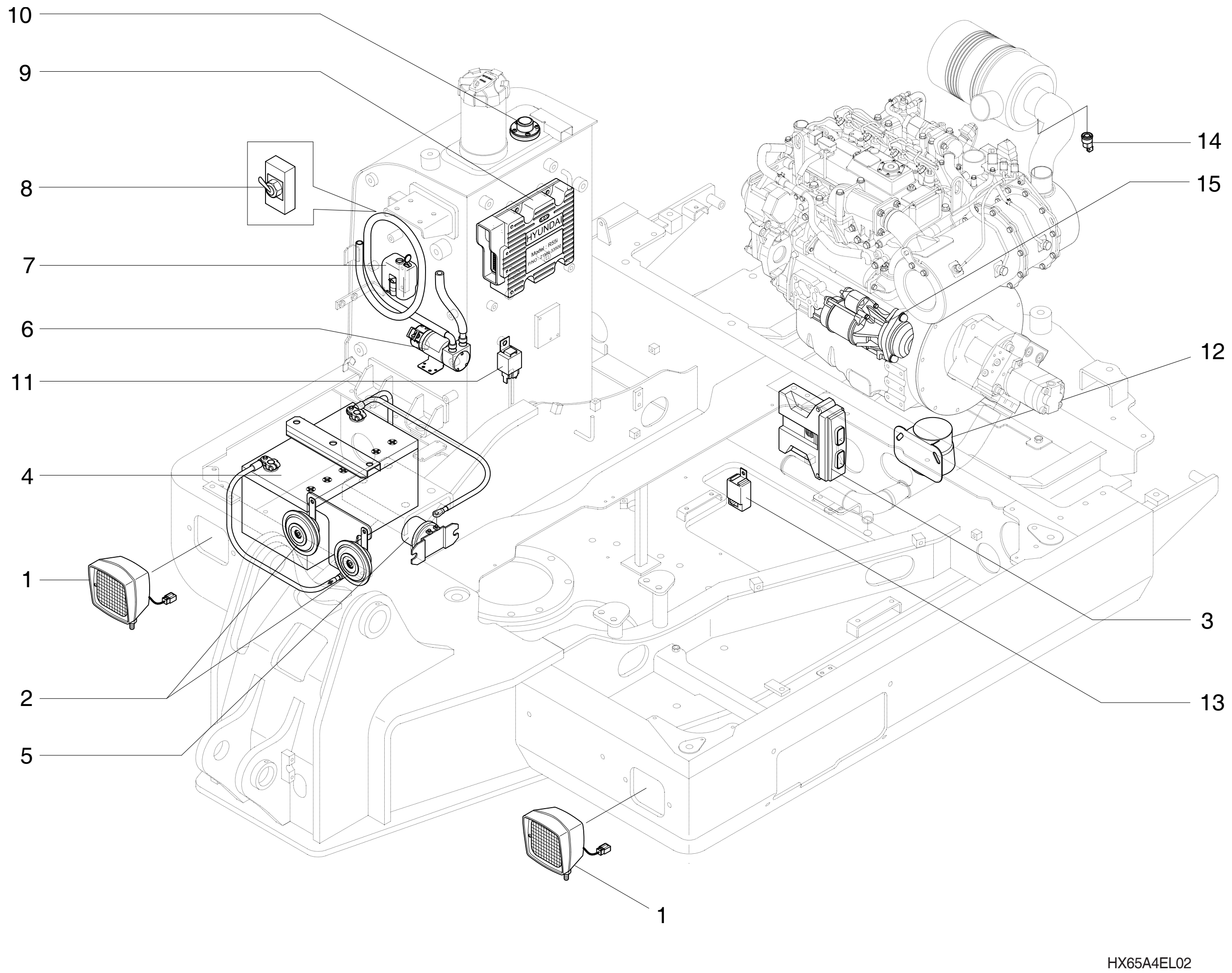
SECTION 4 ELECTRICAL SYSTEM

1. LOCATION 1



1	Head light switch	8	Breaker operation switch (opt)	15	Master switch
2	Work light switch	9	Accel dial switch	16	Travel straight switch
3	Travel alarm switch	10	Quick clamp switch	17	Horn switch
4	Cab light switch	11	DPF switch	18	Aircon & heater controller
5	Beacon switch (opt)	12	Wiper switch	19	Radio & USB player
6	Breaker selection switch (opt)	13	Washer switch	20	Fuse box
7	Start switch	14	Overload switch (opt)	21	Service meter

2. LOCATION 2



1	Work lamp	6	Fuel filler pump	11	Power relay
2	Horn	7	Washer tank assy	12	Travel alarm buzzer
3	PVG controller	8	Filler pump toggle switch	13	Warning buzzer
4	Battery	9	MCU	14	Air cleaner switch
5	Battery relay	10	Fuel sender	15	Alternator

GROUP 2 MONITORING SYSTEM

1) STRUCTURE

The cluster consists of LCD and switches as shown below. The LCD is to warn the operator in case of abnormal machine operation or conditions for the appropriate operation and inspection.

Also, The LCD is to set and display for modes, monitoring and utilities with the switches.

The switches or touch screen are to set the machine operation modes.

※ **The cluster installed on this machine does not entirely guarantee the condition of the machine. Daily inspection should be performed according to chapter 6, Maintenance.**

※ **When the cluster provides a warning immediately check the problem, and perform the required action.**

HX65A4CD01

※ **The warning lamp pops up, lights ON (on the left-top side) and the buzzer sounds when the machine has a problem.**
The warning lamp lights ON until the problem is cleared. Refer to page 4-6 for details.

2) GAUGE

(1) Operation screen

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

HX60A3CD101A

1	Engine coolant temp gauge	3	Fuel level gauge	5	Accel dial
2	Hydraulic oil temp gauge	4	Engine rpm gauge	6	Clinometer

(2) Engine coolant temperature gauge

290F3CD53

① This gauge indicates the temperature of coolant.

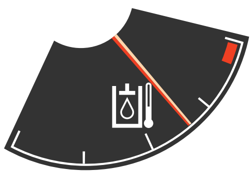
· Black range : General state

· Red range : Engine overheated state

② If the indicator is in the red range or lamp lights ON in red, turn OFF the engine and check the engine cooling system.

※ If the gauge indicates the red range or lamp lights ON even though the machine is in the normal condition range, check the electric device as this can be caused by poor connection of sensor or connector, and poor grounding of the instrument, etc.

(3) Hydraulic oil temperature gauge



290F3CD54

① This gauge indicates the temperature of hydraulic oil.

· Black 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 lights ON in 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 lights ON in red even though the machine is in the normal condition range, check the electric device as this can be caused by poor connection of sensor.

(4) Fuel level gauge

HX60A3CD55A

① This gauge indicates the amount of fuel in the fuel tank.
- Black range : 9% or more
- Red range : below 9%

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

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

(5) Engine rpm gauge and clinometer

HX60A3CD105K

① This displays the engine speed.

② This displays the tilt of machine.

(6) Accel dial gauge

290F3CD59

① This gauge indicates the level of accel dial from 0 to 10 step.

3) COMMUNICATION ERROR AND LOW VOLTAGE WARNING POP-UP

(1) Communication error pop-up

HX60A3CD107A

① Cluster displays this communication error pop-up when it has communication error with MCU.

② Communication error pop-up displays at operation screen only. Just buzzer alarm at the other screen.

③ If communication with MCU become normal state, it will disappear automatically.

(2) Low voltage warning pop-up

HX60A3CD108

① Cluster displays this low voltage warning pop-up when the battery voltage is low.

② Low voltage warning pop-up displays at operation screen only. Just buzzer alarm at the other screen.

③ This pop-up will disappear with using touch screen or buzzer stop switch. While the battery voltage is low, buzzer sounds every minute.

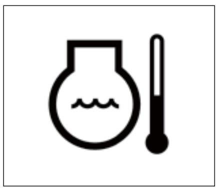
④ When the battery voltage is higher than 11.5 V, the pop-up off.

4) WARNING LAMPS

65A3CD109A

※ Each warning lamp on the left-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 lights up when the buzzer stop switch is pushed or the pop-up is touched. And the buzzer stops. Refer to page 3-17 for the switch.

(1) Engine coolant temperature warning lamp



290F3CD61

① The warning light is turned ON and buzzer is sounded when the engine coolant temperature is overheated.

② The engine speed is also decreased unless the coolant temperature is reduced again. Here, do not turn OFF the engine. When the engine is turned OFF, the coolant temperature is overheated even more to cause engine rattle due to the surge.

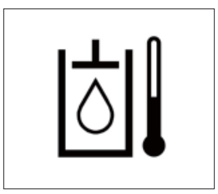
※ Check the temperature gauge of the engine coolant. The coolant is overheated when the gauge in the red range. Here, the coolant temperature warning lamp is turned ON, and the engine speed is decreased automatically.

The engine performs ‘low-speed idle” run until the gauge is returned to the black range. Even when the gauge returns to the black range, do not turn OFF the engine, and perform idle run additionally for 3~5 min. Ignoring this may cause surge from the heat to result in damage to the engine.

The reason for idle run of the engine is to disperse the overheated heat slowly to reduce the temperature.

After proper measures are finished check the coolant level again, and inspect whether the fan belt is loose, and whether there are any foreign substances around the radiator. When the coolant temperature returns to normal temperature, the engine speed is restored to normal speed again.

(2) Hydraulic oil temperature warning lamp



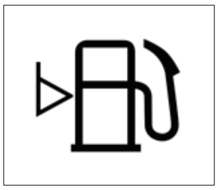
290F3CD62

① This warning lamp pops up on the center of LCD and the buzzer sounds when the hydraulic oil temperature is over 105˚C.

② The pop-up lamp moves to the original position and lights ON when the buzzer stop switch is pushed or pop-up is touched. Also, the buzzer stops and lamp keeps ON.

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

(3) Fuel level warning lamp



290F3CD63

① This warning lamp lights up and the buzzer sounds when the level of fuel is below 9%.
② Fill the fuel immediately when the lamp is ON.

(4) Emergency warning lamp

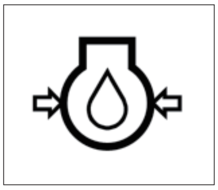
290F3CD64

① This warning lamp pops up and the buzzer sounds when each of the below warnings occurs.
- MCU input voltage abnormal
- Accel dial circuit abnormal or open

※ **The pop-up warning lamp moves to the original position and lights ON when the buzzer stop switch is pushed or pop-up is touched. Also the buzzer will stop.**
This is same as following warning lamps.

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

(5) Engine oil pressure warning lamp



290F3CD65

① This warning lamp lights up when the engine oil pressure is low.
② If the lamp lights up, shut off the engine immediately. Check oil level.

※ **Serious damage can be caused to the engine when the engine is operated continuously while the warning lamp is turned ON.**

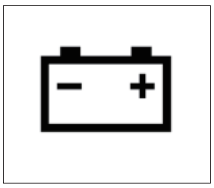
(6) Check engine warning lamp

290F3CD66

① Warning lamp is turned ON when the engine must be checked.

※ **When the warning lamp is turned ON, stop the machine and find the cause for repair.**

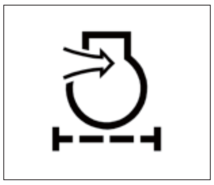
(7) Battery charging warning lamp



290F3CD67

① This warning lamp lights up when the battery charging voltage is low.
② Check the battery charging circuit when this lamp lights up.

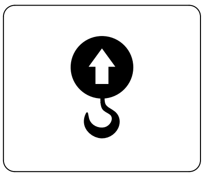
(8) Air cleaner warning lamp



290F3CD68

① This warning lamp lights up when the air cleaner is clogged.
② Check, clean or replace the filter.

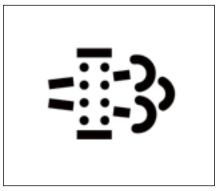
(9) Overload warning lamp (opt)



21093CD36

① When the machine is overloaded, the overload warning lamp lights up when the overload switch is ON. (if equipped)
② Reduce the machine load.
Initiate a manual regeneration

(10) DPF (Diesel Particulate Filter) Warning Lamp



290F3CD70

① This lamp is turned ON or OFF to inform that regeneration is required.
② For details, please refer to the after-treatment system below.

※ After-treatment System

The after-treatment system uses DOG and DPF to satisfy the exhaust regulations.
The oxidation catalyst of DOG reduces the emission of hydrocarbon and carbon monoxide through the catalyst, and the particle materials (PM) discharged from the engine are collected.
DPF regeneration is composed of “forced regeneration” during driving and “manual regeneration” performed by the driver.
When the regeneration is not performed successfully according to the procedure, warning lamp relevant to the each operating condition is turned ON.
When the warning lamp is turned ON, park the machine on a safe place, and perform the regeneration process manually according to the following procedure.
The warning lamp is turned OFF when the regeneration process is performed successfully.

DPF regeneration mode is classified into the following stages according to the soot accumulation level on the DPF.

- Soot level of 80% or less : Normal operating condition
- Soot level of 80~100% : AUTO regeneration during driving
- Soot level of 100~120% : Regeneration initiated by the driver (Manual Regeneration)
- Soot level of 120% or more : Inquiry to the Service Center or agent required (DPF warning lamp turned OFF, check engine warning lamp turned ON, engine power reduced)

⚠ Engine power can be reduced when the regeneration process is not performed manually after the warning lamp is turned ON.

※ DPF Regeneration Procedure

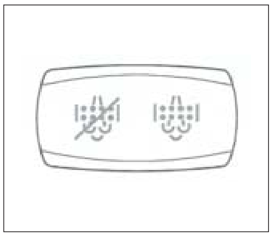
Procedure	Soot Amount	DPF Warning Lamp	Check engine warning lamp	Decrease in Torque	Remark
1	Less than 99%	-	-	-	No action (Manual regeneration according to the equipment)
2	100~105%	-	-	-	Regeneration is started. Performed in high temperature (560~640˚C)
3	106~110%	Blinking slowly	-	-	Forced regeneration induced (Alarm)
4	111~120%	Blinking slowly	Turned ON	Torque reduced weakly	Forced regeneration induced (Decrease in Torque)
5	121% or more	Blinking quickly	Blinking	Torque reduced severely	Regeneration is inactivated. Inquire to the service center or to the agent to start the service regeneration to solve the decrease in torque

– DPF warning lamp is turned ON when the DPF soot exceeds 100%.
– DPF warning lamp is blinked when the DPF soot level exceeds 105%.
– When the DPF soot level exceeds 111%, the DPF warning lamp blinks slowly, and the check engine warning lamp is turned ON to reduce the engine power.
– When the DPF soot level exceeds 121%, the DPF warning lamp blinks slowly, and the check engine warning lamp is turned ON to reduce the engine power.

– DPF regeneration is composed of the active regeneration occurred during driving and forced regeneration activated manually by the driver.
– When the DPF soot level is less than 105%, active regeneration is activated automatically during driving.
  However, the system informs the driver to perform forced regeneration manually when the level is 105% or more.
  The check engine warning lamp is turned ON when the level is 120% or more, and engine power is reduced to 50%. The driver must inquire to the service center or to the agent.

– DPF soot level of 105% or less : Active regeneration
– DPF soot level of 105~120% : Forced regeneration + Engine power reduced
– DPF soot level of 105~120% : Driver is informed that forced regeneration is required.
– DPF soot level of 120% or more : Regeneration not possible, and inquiry required to the service center or to the agent

※ **Manual (Forced) DPF regeneration method**



HW65A3CD24K

DPF regeneration procedure is activated manually by the driver when the driver selects to initiate the regeneration procedure.

Because the operating condition is inappropriate for the hot engine exhaust temperature (Ex.: Work near the inflammable materials), manual regeneration may be required if the driver prohibited the active regeneration procedure for long period.

① Manual regeneration condition
- Coolant (Engine oil) temperature : 40 ˚C or more
- Engine RPM: Low-speed idle run
- Parking brake must be applied (Only relevant to the wheel-type machine)
- When the soot concentration is accumulated to 20% or more

② Manual (Forced) regeneration procedure

Park the machine on a well-ventilated area, and keep away from inflammable materials to set the machine as shown below.
- Operate the machine until the engine coolant and oil temperature becomes 40˚C or more.
- Engine speed is set to low speed.
- Put the gear lever on neutral, and apply the parking brake. (Only relevant to wheel-type machine)
- Safety lever is placed on the locking position.
- When the regeneration mode is in "Prohibit", DPF switch is pressed to the manual regeneration position.

③ Regeneration switch is activated to initiate the regeneration procedure.

※ **DPF warning lamp is lighted on the monitor.**

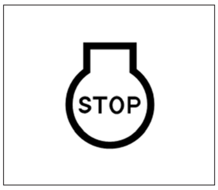
While the engine speed is in low speed, the speed is increased gradually to 2000 RPM, and the regeneration procedure is initiated.

Manual regeneration can be continued for maximum of 30 min. or more according to the soot accumulation amount.

HEST lamp is lighted during the regeneration, and HEST lamp is turned OFF when regeneration is stopped.

※ **The driver can stop the manual regeneration by lifting the safety lever to the "Release Lock" position, or by pressing the DPF switch to the "Prohibit" position.**

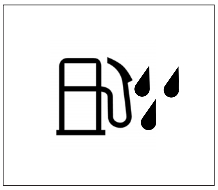
(11) Stop engine warning lamp



290F3CD252

① If this warning lamp lights up, stop the engine immediately and check the engine.
② Check the fault codes on the monitor.
※ **Please contact your HD Hyundai Construction Equipment service center or local dealer.**

(12) Water in fuel warning lamp



HX60A3CD110

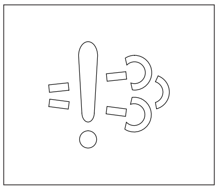
① This warning lamp lights up when the water separator is full of water or malfunctioning.
② When this lamp lights up, stop the machine and drain water from the water separator.

(13) Seat belt reminder warning lamp

300A3CD25

① When operator does not fasten the operator's seat belt, the seat belt reminder warning lamp pops up and the buzzer sounds.
② Fasten the seat belt.

(14) Exhaust System Failure Warning Lamp



HW60A3CD53A

① This warning lamp is turned ON in 3 cases such as when the quantitative distribution is stopped, poor reagent quality and monitoring malfunction, etc.

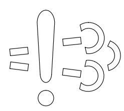
② Please refer to the exhaust gas control system below.

※ Exhaust Gas Control System

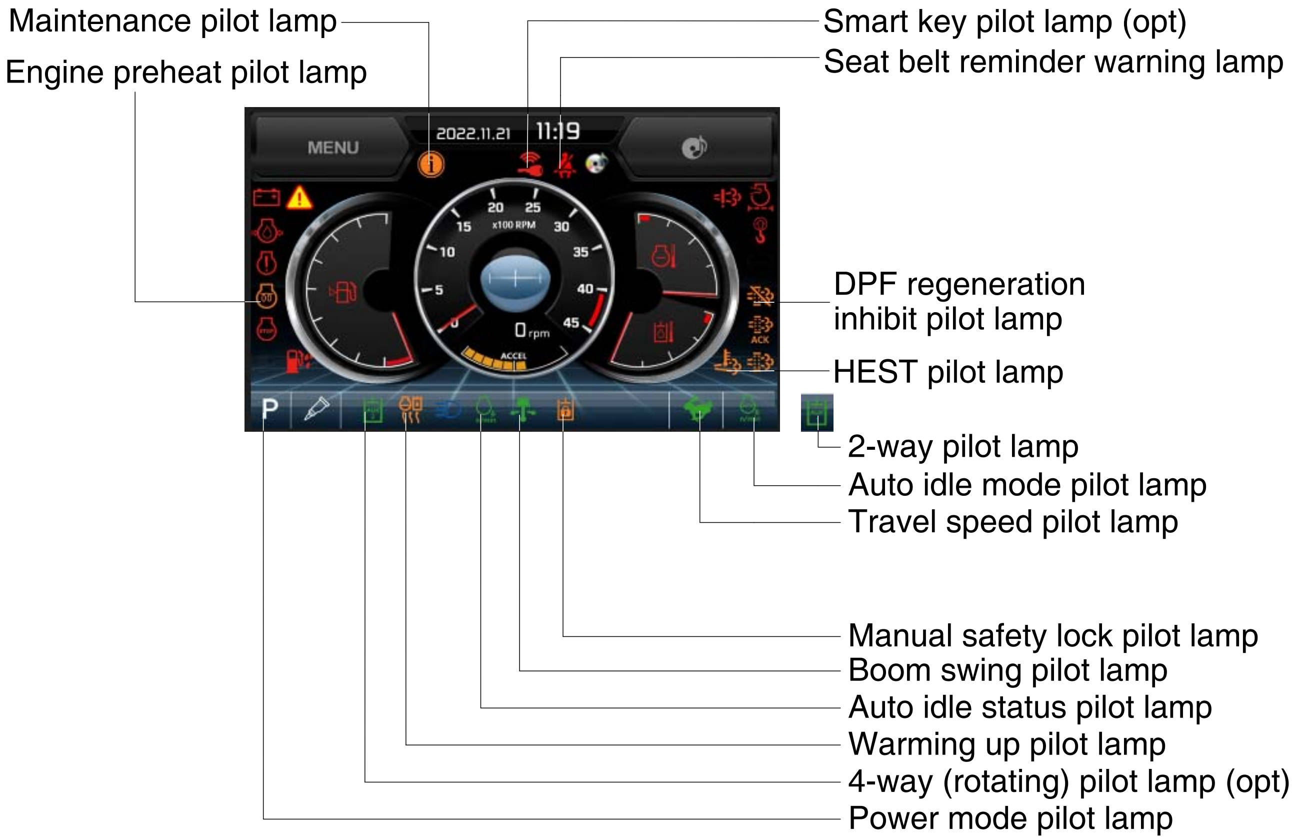
This machine is equipped with the engine exhaust gas emission control system that satisfies the exhaust gas emission regulations. The owner/driver has the responsibility of proper operation and maintenance on the exhaust control system provided in the guaranteed provisions related to emission.

The engine exhaust system is mounted on the DPF. DPF is a emission reduction device that reduces the diesel particulate matter or soot from the exhaust gas of the diesel engine. DPF is stored until the particulate matter is combusted. The process of combustion and elimination of the stored particulate matter is referred to as "Regeneration". After the regeneration process is completed, residue is remaining, and it must be removed from the DPF regularly.

⚠ The temperature of the exhaust gas and components of the exhaust system are in very high temperature during regeneration. There are risks of fire or burn, and it can also result in death, severe injury or property loss. Inflammable materials and explosive gas must be kept far away from the exhaust system during regeneration.

Item	Stage	Reducing Agent Level/Time	Notification Method	Decrease in Torque	Symbol
EGR Valve Problem	Warning	Immediately	Always	-	
	Level 1	+36 hours	Blinking slowly	Torque Limit : ~25%	
	Serious	+64 hours (100 hours)	Blinking quickly + Buzzer	Torque Limit : ~50% Speed Limit : 60%	

5) PILOT LAMPS

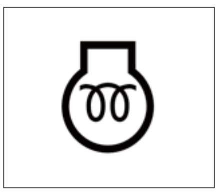


65A3CD112

(1) Mode pilot lamps

No	Mode	Pilot lamp	Selected mode
1	Power mode	P	Heavy duty power work mode
		S	Standard power mode
2	Travel mode		Low speed traveling
			High speed traveling
3	Auto idle mode		Auto idle mode
			Auto idle status

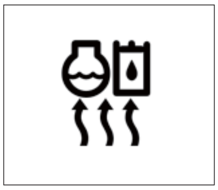
(2) Preheat pilot lamp



290F3CD79

① Turning the start key switch to the ON position starts preheating in cold weather.
② Start the engine after this lamp goes OFF.
※ **Refer to the operator's manual page 4-4.**

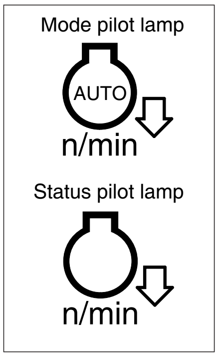
(3) Warming up pilot lamp



290F3CD80

① This lamp is lights up 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 (86˚F), or when 10 minutes have passed since starting the engine.

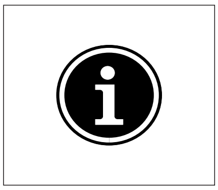
(4) Auto idle status/ mode pilot lamp



85A3CD106

① The auto idle mode pilot lamp will light up when the idle mode is selected.
② The auto idle status pilot lamp will be ON when all levers and pedals are in the neutral position, and the auto idle mode is selected.
③ One of the lever or pedal is operated, the status lamp will go OFF and the engine speed returns to the previous conditions.

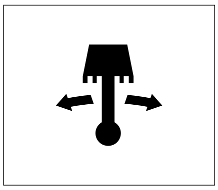
(5) Maintenance pilot lamp



HX60A3CD116

① This lamp lights up when consumable parts are in need of replacement. It means that the change or replacement interval of parts is 30 hours from the required change interval.
② Check the message in maintenance information of main menu. Also, this lamp lights up for 3 minutes when the start switch is switched to the ON position.
※ Refer to page 4-20.

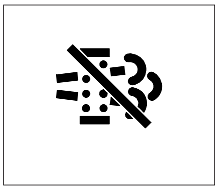
(6) Boom swing pilot lamp



HX603CD82

① This lamp lights up when the boom offset switch is pressed.
※ Refer to the operator's manual page 3-44.

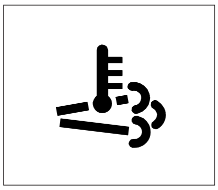
(7) DPF regeneration inhibit warning lamp


85A3CD107

① This warning lamp indicates, the DPF switch is pushed to the inhibit position, therfore automatic and manual regeneration can not occur.

※ Refer to the operator's manual page 3-40 for the DPF switch.

(8) HEST (High exhaust system temperature) warning lamp


85A3CD109

① This warning lamp indicates, when illuminated, that exhaust temperatures are high due to regeneration of the DPF.

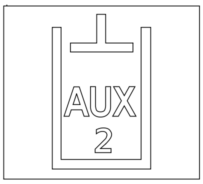
② The lamp will also illuminate during a manual regeneration.

③ When this lamp is illuminated, be sure the exhaust pipe outlet is not directed at any surface or material that can melt, burn, or explode.

⚠ When this lamp is illuminated, the exhaust gas temperature could reach 600˚C [1112˚F], which is hot enough to ignite or melt common materials, and to burn people.

※ The lamp does not signify the need for any kind of equipment or engine service; It merely alerts the equipment operator to high exhaust temperatures. It is common for the lamp to illuminate on and off during normal equipment operation as the engine completes regeneration cycles.

(9) 4-way (rotating) pilot lamp (opt)

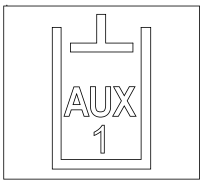


HW60A3CD48A

① This lamp lights up when the boom swing selection switch is set to the rotator (not used boom swing) and the 4-way operation switch on the LH control lever is pressed.

※ Refer to the operator's manual page 3-42.

(10) 2-way pilot lamp



HW65A3CD49

① This lamp lights up when the option flow control function is activated in the cluster.

※ Refer to the page 4-24.

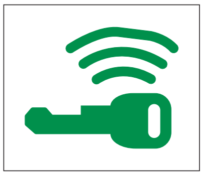
(11) Manual safety lock pilot lamp

140WA3CD37

① This lamp lights up when the safety knob is set to the LOCK position.

※ Refer to the operator's manual page 3-45 for the safety knob.

(12) Smart key pilot lamp (opt)



300A3CD36A

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

② This lamp is red when the a authentication fails, it will be green when it authentication is successful.

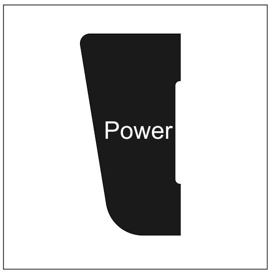
※ Refer to the page 4-28.

6) SWITCHES

65A3CD117A

※ When the switches are selected, the pilot lamps are displayed on the LCD. Refer to the page 4-13 for details.

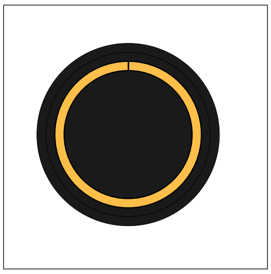
(1) Power mode switch



HX60A3CD118

① This switch is to select the machine power mode and when pressed, the power mode pilot lamp will be displayed on the section of the monitor.
 · P : Heavy duty power work.
 · S : Standard power work.
② The pilot lamp changes S → P → S in this order.

(2) Select switch



HX60A3CD119

① This switch is used to select or change the menu or input value.
② Knob push
 · 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

(3) Auto idle switch

HX60A3CD120

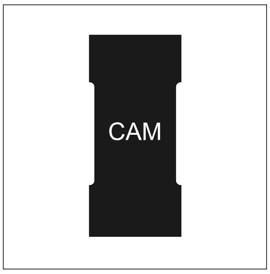
① This switch is used to activate or cancel the auto idle function.
※ Refer to the page 4-13 for details.

(4) Buzzer stop switch

HX60A3CD121

① The buzzer sounds when the machine has a problem.
In this case, push this switch and buzzer stops, but the warning lamp lights up until the problem is cleared.

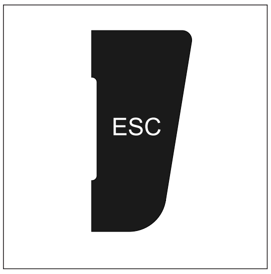
(5) Camera switch



HX60A3CD122

① In the operation screen, pushing this switch will display the view of the camera on the machine (if equipped).
※ Please refer to page 4-35 for the camera.

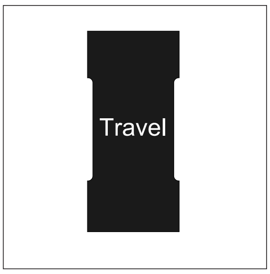
(6) Escape switch



HX60A3CD123

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

(7) Travel speed control switch



HX60A3CD104

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

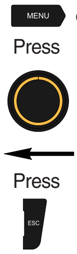
※ Do not change the setting of the travel speed switch while machine is moving. Machine stability may be adversely affected.
⚠ Serious injury or death can result from sudden changes in machine stability.

7) MAIN MENU

Main menu screen

HX60A3CD124A

Tap



or

Press

Press

Sub menu screen

HW60AH3CD125A

※ Please refer to the select switch, page 4-18 for selection and change of menus and input values.
※ In the operation screen, tap MENU or press the select switch to access the sub-menu screen.

(1) Structure

No	Main menu	Sub menu	Description
1	 Monitoring	Active fault - Machine Active fault - Engine Logged fault - Machine/engine Delete logged fault Monitoring - Machine Monitoring - Switch Monitoring - Output	MCU ECU MCU, ECU MCU, ECU Engine rpm, oil temp, voltage and pressure etc. Digital switch status Digital output status
2	 Management	Maintenance information Option flow control ESL mode setting Change password Machine information A/S phone number Cluster update CAN update Service menu	Elapsed time, Change interval, Replacement etc. Opt attch set, Proportional flow control set, Confiffirmation ESL mode setting Password change Cluster, MCU, Engine, Machine A/S phone number, A/S phone number change Application, System Program download, Update Power shift, Operating hour, Gauge type, Rpm, AVCU set, Language update etc
3	 Display	Clock Brightness Unit Language	Current time set Manual, Auto Temperature, Pressure, Flow, Distance, Volumn 22 kinds
4	 Utilities	Entertainment Camera setting Clinometer setting Manual Emergency mode Quick cooling mode	Video/music file playing Setup of number of active cameras, display sequences, and camera numbers Initializing slope sensor Display cluster manual Back-up switch for failed cluster switch and accel dial To maximize engine cooling performance

(2) Monitoring

① Active fault - Machine

HX60A3CD130A

HX60A3CD131A

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

② Active fault - Engine

HX60A3CD130A

HX60A3CD133A

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

③ Logged fault - Machine/ Engine

HX60A3CD134A

HX60A3CD135A

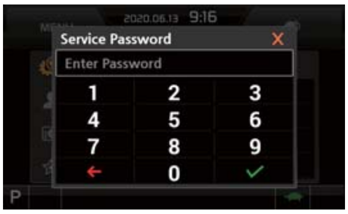
or

HX60A3CD136A

· The logged faults of the machine MCU or engine ECU can be checked by this menu.
· This menu can be used only HCE service man.

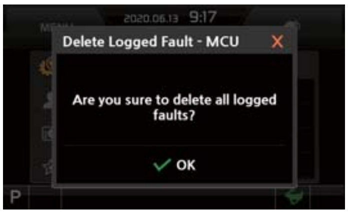
④ Delete logged fault

HX60A3CD143A

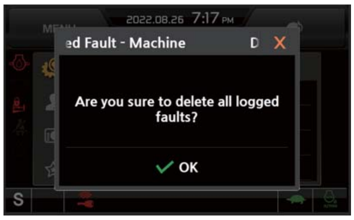


HX60A3CD144A

HW60AH3CD145A



HX60A3CD146A



HW60AH3CD147A

· The logged faults of the MCU, engine ECU can be deleted by this menu.
(It is possible under the engine stop conditions)

⑤ Monitoring (machine status)

HX60A3CD137A

HX60A3CD138A

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

⑥ Monitoring (switch status)

HX60A3CD137A

HX60A3CD140A

· The digital switch status of the machine can be checked by this menu.
· The activated switch will display in blue color.

⑦ Monitoring (output status)

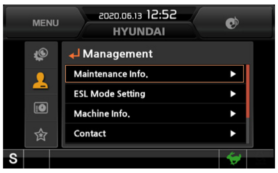
HX60A3CD137A

HX60A3CD142A

· The digital output status of the machine can be checked by this menu.
· The digital output status will display in blue color.

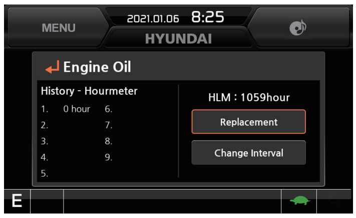
(3) Management

① Maintenance information



HX60A3CD157A

HX60A3CD199K



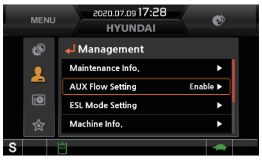
HX60A3CD159A

· Elapsed time : Display the elapsed time after the maintenance.
· Change interval : The change intervals can be changed in hour increments of 50.
· Change history : Display the change history for the maintenance.
· Replacement : The elapsed time will be reset to zero (0).
· Change or replace interval

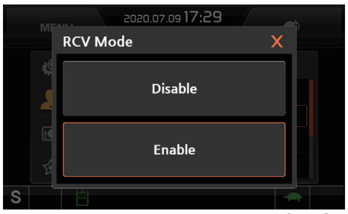
※ Refer to the operator's manual page 6-16.

② Option flow control

a. Option attach selection



HW60A3CD330A



HW60A3CD410A

HW60A3CD420

- Three kinds of option attachment can be selected by this menu.
  ⓐ Rotary grapple (4-way)
  ⓑ Grapple (2-way)
  ⓒ Auger (2-way)

※ There are two user modes (type A or B) in each option attachment.

b. Proportional flow control setting

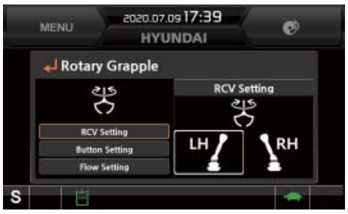
The preferable value of each option attachment can be set by this menu.

a) Rotary setting

HW60A3CD42O

HW60A3CD51OA

· Select rotary
RCV, button and flow can be set by this menu



HW60A3CD52OA

· RCV setting
  – Enable set LH or RH RCV for rotary operation.
  – Select LH for rotary → RH set for grapple automatically

HW60A3CD53OA

· Button setting (CW rotation)
  – Select LH for CW rotation → RH set for CCW rotation automatically

HW60A3CD54OA

· Flux setting
  – Enable set from level 1 to level 5.

b) Grapple setting

HW60A3CD42O

HW60A3CD61OA

· Select grapple
RCV, button and flow can be set by this menu

HW60A3CD62OA

· RCV setting
  – Enable set LH or RH RCV for grapple operation.
  – Select LH for grapple → RH set for rotary automatically

HW60A3CD63OA

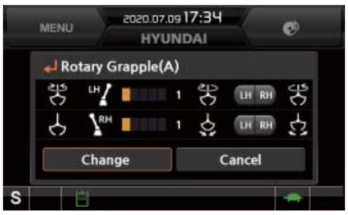
· Button setting (Close)
  – Select RH for Close → LH set for open automatically

HW60A3CD72OA

HW60A3CD64OA

· Flow setting
  – Enable set from level 1 to level 5.

HW60A3CD42O



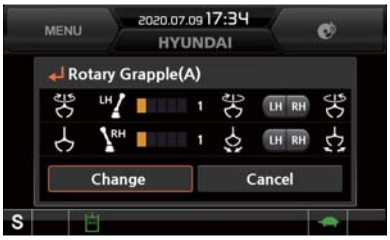
HW60A3CD71OA

· Flow setting value can be saved by pressing change button.

※ Setting value saved once, it memorized in each icon and the last setting value is activated.
※ Saved setting can be used by pressing Icon button only.
※ There are two kinds (A and B) in each option attach setting and six kinds of option attach setting can be saved totally (2 of 4-way, 4 of 2-way).

c) Confiifirmation

HX60A3CD81OA



HW60A3CD71OA

※ Symbol () is activated on the low side of main screen when option attach function is used.

※ Previous setting value can be checked by following procedure.

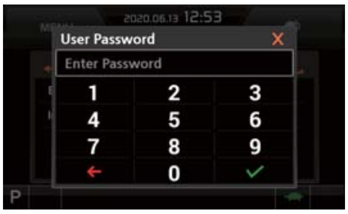
– Menu > Management > option attach

a) Rotary setting
- – Rotary RCV : LH
- – Rotary flow level : 3
- – CW rotation : LH
- – CCW rotation : RH

b) Grapple setting
- – Grapple RCV : RH
- – Grapple flow level : 3
- – Open : LH
- – Close : RH

③ ESL mode setting

HX60A3CD148A



HX60A3CD149A

HW60AH3CD150A

– ESL : Engine Starting Limit

– ESL mode is designed to be a theft deterrent or will prevent the unauthorized operation of the machine.

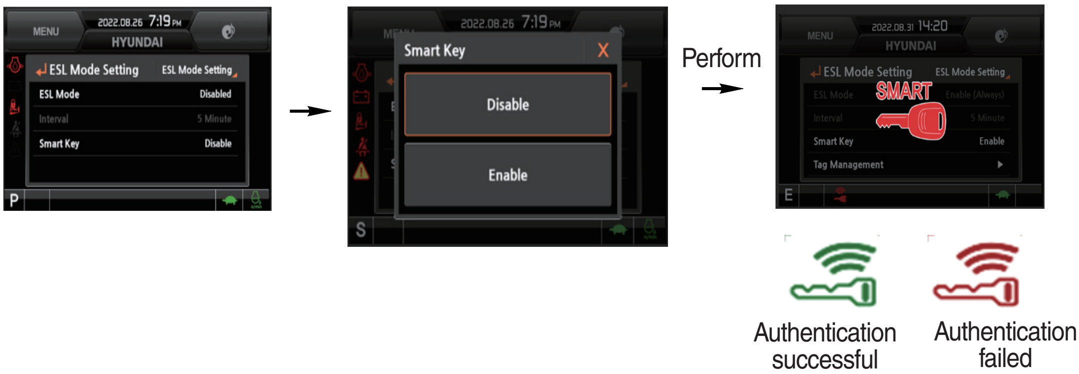
– When you Enable the ESL mode, the password will be required when the starting switch is turned to the on position.

– Disable : ESL function is disabled and password is not required to start engine.
Enable (always) : The password is required whenever the operator starts engine.
Interval : The password is required when the operator starts engine first. But the operator can restart the engine within the interval time without inputting the password.

※ The interval time can be set to a maximum 4 hours.

※ Default password : 00000
Password length : 5~10 digits

Start Limit - Smart Key Setting (When smart key is installed)



- Smart Key Exclusive
  When the Smart key option (optional) is installed, Smart key menu is shown, and performance or non-performance of Smart key authentication can be set through the Smart key menu.
  When the Smart key is not in the cabin, the approval procedure is rejected, and password must be entered.

Start Limit - Tag Management

- The tag management menu is activated only when the Smart key menu is set through performance. Tag can be registered or deleted.
  · When registering the tag : Locate only the tag preferred for registration inside the cabin.
  · When deleting the tag : All registered tags are deleted.

※ Engine Starting Condition

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

④ Password change

– The password is 5~10 digits.

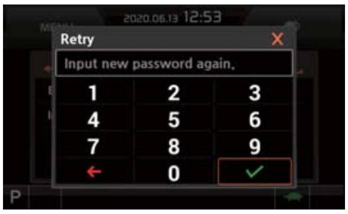
HX60A3CD151A

HX60A3CD149A

Enter the current password

HX60A3CD153A

Select the password change

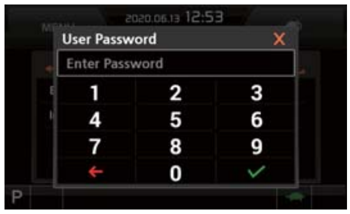


HX60A3CD156A

Saved the new password in the MCU

HX60A3CD155A

Enter the new password again



HX60A3CD149A

Enter the new password

⑤ Machine information

HX60A3CD160A

HX60A3CD161A

HX60A3CD162A

· The information of the cluster, machine MCU and engine and machine checked by this menu.

⑥ A/S phone number

HX60A3CD163A

HX60A3CD164A

HX60A3CD165A

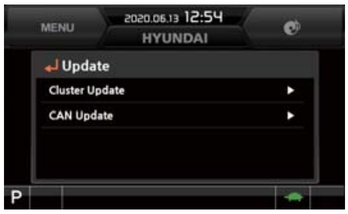
· The A/S phone number can be checked and changed.

⑦ Cluster update

HX60A3CD169A

HX60A3CD149A

Enter the user password



HX60A3CD170A

Select the cluster update

· The cluster and CAN device can be updated by this menu.

※ Do not turn power off while updating.

a. Application update

HX60A3CD172A

Select application item

HX60A3CD173A

Select file to update

HX60A3CD174A

Select OK

HX60A3CD176

Completed

HX60A3CD175A

In process

b. System update

HX60A3CD177A

Select system item

HX60A3CD173A

Select file to update

HX60A3CD174A

Select OK

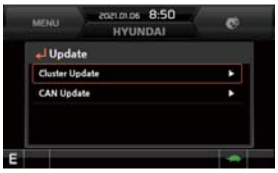
HX60A3CD176

Completed

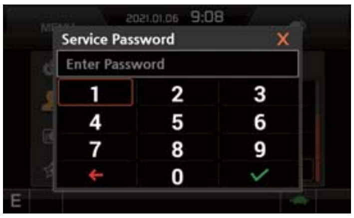
HX60A3CD175A

In process

⑧ CAN update



HX60A3CD169A



HX60A3CD149A

Enter the user password

HX60A3CD179A

Select the CAN update

· The application program can be downloaded and updated by this menu.

※ Do not turn power off while updating.

a. Download

HX60A3CD180A

Select update device

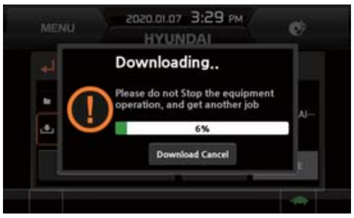
HX60A3CD181A

Select download

HX60A3CD182A

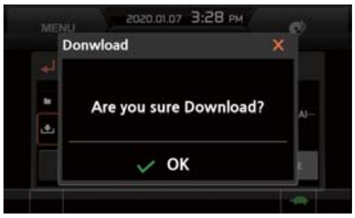
Select download after choose update file

HX60A3CD185A



HX60A3CD184A

Stop download when select the cancel



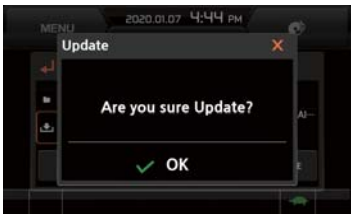
HX60A3CD183A

Confirm download

b. Update

HX60A3CD186A

Select update after the down-load.

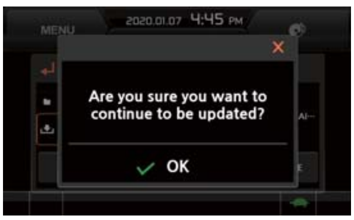


HX60A3CD187A

Confirm the update

HX60A3CD188A

In process update



HX60A3CD190A

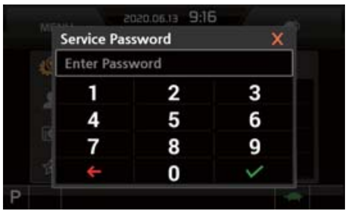
Select the OK to update another application program

HX60A3CD175A

Completed update

⑨ Service menu

HX60A3CD165A



HX60A3CD144A

HX60A3CD168A

Enter the manager password

· Power shift : Power shift mode (default/option can be set by this menu.
· Operating hours : Operating hours in individual modes since the machine line out can be checked by this menu.
· Main gauge type : The engine rpm or fuel level gauge can be display on the main gauge of the main screen by this menu.
· Display RPM : Display the numeric value of engine rpm on the main gauge of the main screen can be set by this menu.
· AVCU setting : Standard, 2-Way or 4-Way dependent upon the machine options can be selected by this menu.
· Adding language : The language displayed on the cluster can be update by this menu when it is required to correct language.

※ **This menu can be used only HCE service man. Do not attempt unauthorized adjustment.**

(4) Display

① Clock adjust

HX60A3CD191A

HX60A3CD192A

- The first row of boxes indicate Year/Month/Day.
- The second row shows the current time. (AM, PM/0:00~12:59)

② Brightness

HX60A3CD193A

HX60A3CD194A

Manual (1st~10th step)

HX60A3CD195A

HX60A3CD197A

Auto (day/night)

HX60A3CD196A

Auto (day time)

- If "Auto" is chosen, brightness for day and night can be set accordingly. Also, users can define which day time interval. (Set day starting time and ending time)

③ Unit set

HX60A3CD198A

HX60A3CD199A

- Metric units : Units change to metric units.
- US units : Units change to U.S. units
- User setting : Units change to user setting units

Item	Metric units	U.S. units	User setting
Temperature	˚C	˚F	˚C, ˚F
Distance	km	mile	km, mile
Pressure	bar	Mpa	bar, Mpa, kgf/cm^2, psi
Flow	lpm	gpm	lpm, gpm
Volume	l	gal	l, gal

④ Language selection

HX60A3CD200A

HX60A3CD201A

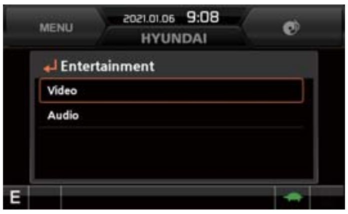
· User can select preferable language (22 languages) and all displays are changed the selected language.

(5) Utilities

① Entertainment

HX60A3CD70A

→



HX60A3CD208A

→

HX60A3CD209A

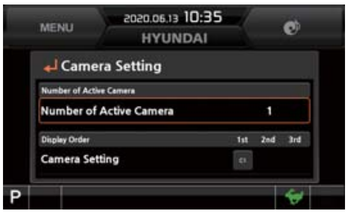
- Play MP4 or codec file of external hard disk through USB port.
- The USB port is located left side of the cluster.
- Over 1100 engine rpm, the screen turns into the operation screen with MP4 or codec file playing for the safety. The video is played again when the engine revolution is 1100 rpm or less.

⚠ **The video play is prohibited for the safety reason when the machine is operated.**

② Camera setting

HX60A3CD202A

→



HX60A3CD203A

- Three cameras can be installed on the machine and display order can be set by this menu.
- If the camera is not equipped, this menu is not useful.
- Turning the select switch in clockwise direction, the next ordered will be shown and in counter-clockwise direction, the previously ordered will be shown. Also, the camera channel can be changed by touching the screen.
- Display change to reduction size or display is not visible by pushing the select switch or touch the screen.
  (display reduction size → hiding → display)

HX60A3CD204

- The camera display is terminated by pressing the ESC switch or touch the X icon on the screen.

■ Rear / RH view camera UI setting (Option)

1) Camera control switch

– Select the CAM switch to activate Rear / RH view camera from the beginning screen.

– While in that mode, select the ESC switch to return to the home screen.

2) Cam image control (CIC) mode

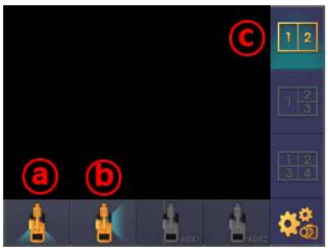
– Touch ⓐ(Rear), ⓑ(RH) button on screen to set single-view camera mode.

– Touch ⓒ(2CH-split-view) button to set split-view camera mode.

ⓐ (Rear)

ⓑ (RH)

ⓒ (2CH Split-view)

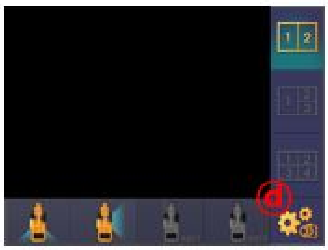


Rear / RH view option

3) Split-view Camera order setting

– Touch ⓓ (camera setting) button to set split-view camera order.

ⓓ(Camera Setting)



Rear / RH view option

– You can change spilt-view camera order on display order menu.

③ Clinometer setting

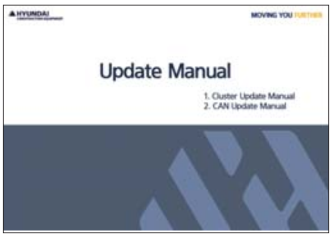
HX60A3CD210A

HX60A3CD211A

· When the machine is on the flatland, if you touch "initialization" on cluster, the values of X, Y will reset to "O".
· You can confirm tilt of machine in cluster's operating screen.

④ Manual

HX60A3CD212A



HX60A3CD213A

· Manual of the cluster can be read on the monitor.

⑤ Emergency mode

HX60A3CD205A

HX60A3CD206A

· When switches of the monitor and the accel dial fails, switches are displayed on LCD, and you are allowed to perform operation by touching the screen.
· Such operation is allowed only on this mode screen.

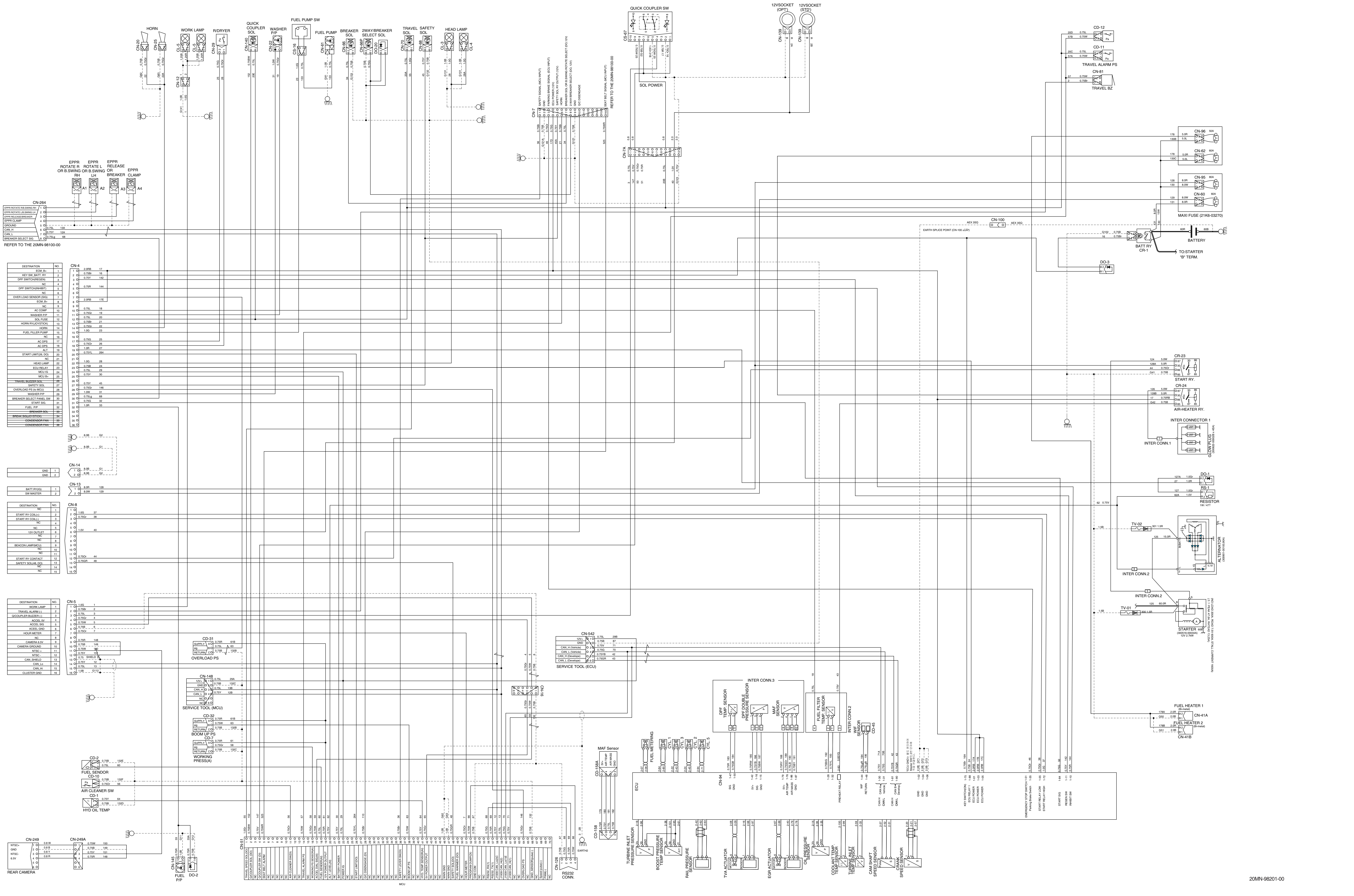
⑥ Quick Cooling Mode

HW60AH3CD205A

HW60AH3CD206A

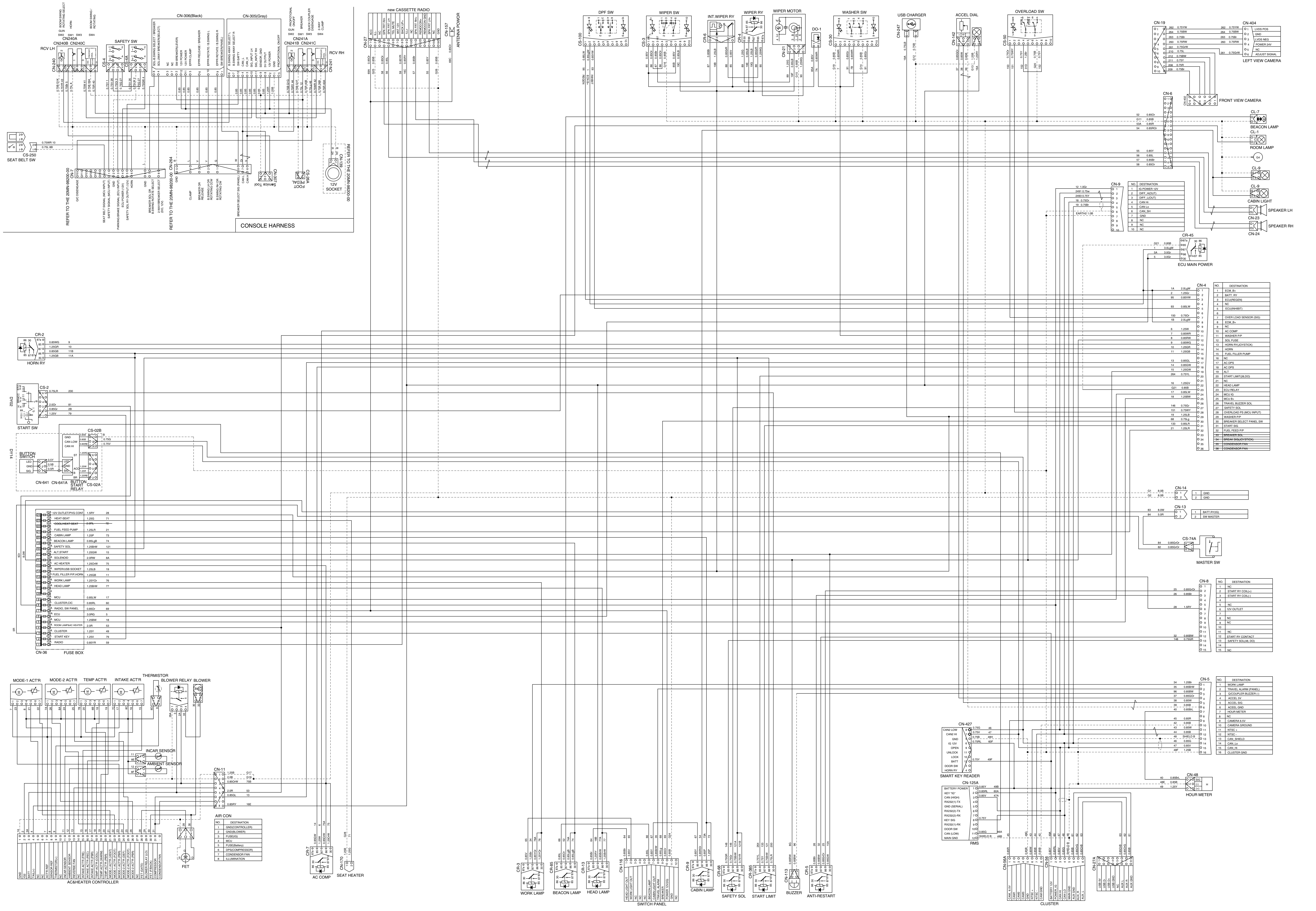
· While the machine is stopped and discontinued with operation, engine can be operated in maximum RPM for maximum rotation of the radiator fan. (Max. for 5 minutes)
- Setting : When the machine is stopped, the safety lever is lowered to set the quick cooling mode in the locked state
- Release : Released when the operating time exceeds 5 minutes, when the safety lever is cleared, and when the quick cooling mode release button is pressed

· ELECTRICAL CIRCUIT (1/2)



20MN-98201-00

· ELECTRICAL CIRCUIT (2/2)



20MN-98100-01

MEMORANDUM

1. POWER CIRCUIT

The negative terminal of battery is grounded to the machine chassis.

When the start switch is in the OFF position, the current flows from the positive battery terminal as shown below.

1) OPERATING FLOW

Battery (B^+) → Battery relay (CR-1) → Maxi fuse (CN-60) → I/conn [CN-13 (2)] → Master switch [CS-74A]

- → Fuse box [No.1] → New cassette radio [CN-27 (8)]
- → Fuse box [No.2] → Start switch [CS-2 (1)]
- → Fuse box [No.3]
  - → Cluster [CN-56 (1)]
  - → Hour meter [CN-48 (1)]
  - → RMS [CN-125A (1)]
  - → Smart key reader [CN-427 (12)]
- → Fuse box [No.4]
  - → I/conn [CN-11 (5)]
    - → AC & Heater controller [3]
    - → Blower relay [2]
  - → I/conn [CN-6 (7)] → Room lamp [CL-1 (2)]
- → Fuse box [No.5] → I/conn [CN-4 (25)] → MCU [CN-51 (22)]
- → Fuse box [No.6] → ECU main power relay [CR-45 (30, 86)]

※ I/conn : Intermediate connector

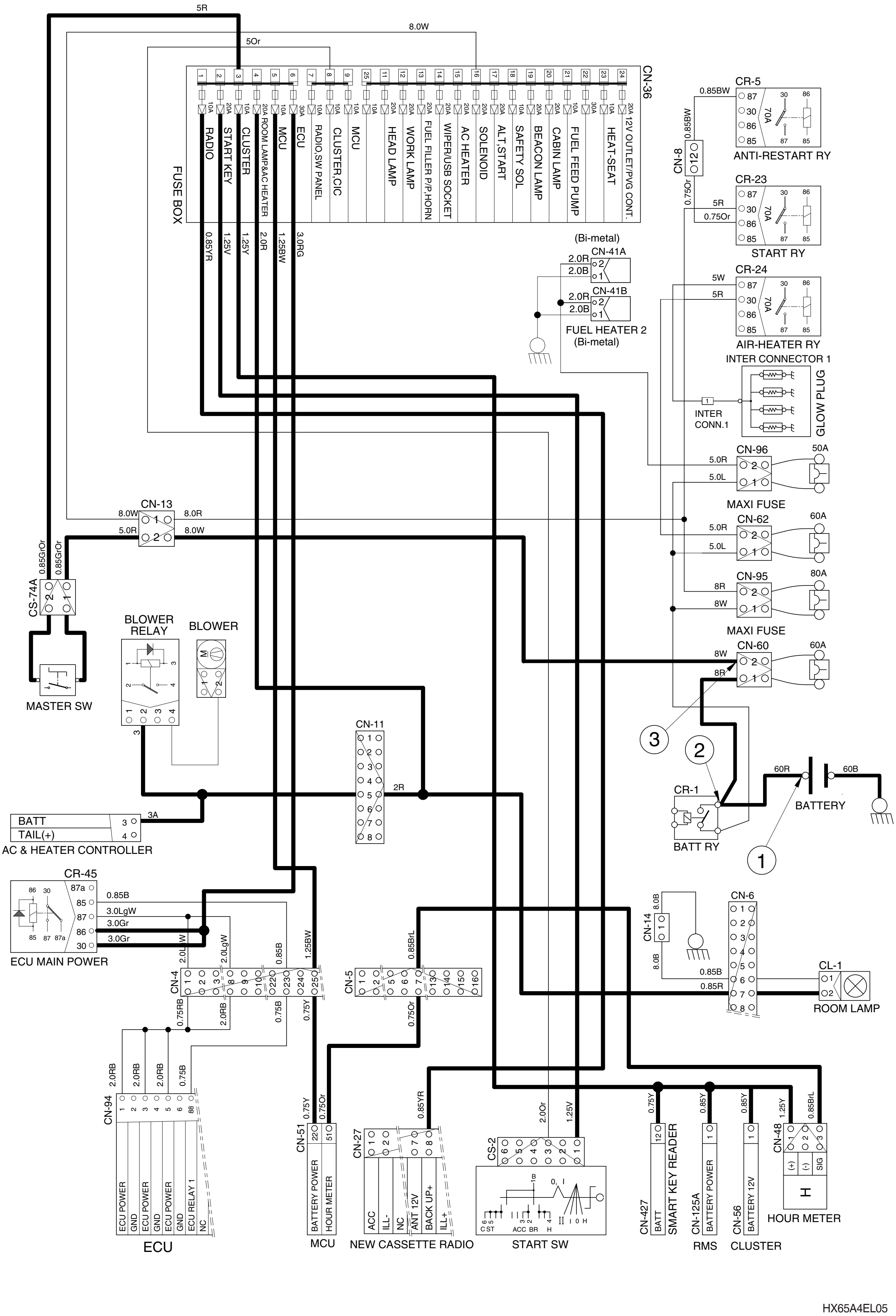
2) CHECK POINT

Engine	Start switch	Check point	Voltage
STOP	OFF	① - GND (battery B^+) ② - GND (battery relay) ③ - GND (fusible link)	10~12.5V

※ GND : Ground

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

POWER CIRCUIT



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

2. STARTING CIRCUIT

1) OPERATING FLOW

Battery (+) terminal → Battery relay [CR-1] → Maxi fuse [CN-60]
→ I/conn [CN-13 (2)] → Master switch [CS-74A] → Fuse box No.2 → Start key [CS-2 (1)]

※ Start switch : ON

→ Start switch ON [CS-2 (2)] → I/conn [CN-4 (2)] → ECU [CN-94 (1-75)]
→ Battery relay [CR-1]

Battery relay [CR-1] : Battery relay operating (all power is supplied with the electric component)

→ Start switch ON [CS-2 (3)] → Fuse box (No. 7, 8, 9)] → I/conn [CN-4 (24)] →
MCU [CN-51 (23)]

※ Start switch : START

Start switch START [CS-2 (6)] → Start limit relay [CR-385 (30) → (87)] → I/conn [CN-4 (31)]
→ ECU [CN-94A (1-84) → (1-72)]
→ I/conn [CN-8 (3) → Anti-restart relay [CR-5 (85) → (87)] → I/conn [CN-8 (12)]
→ Start relay [CR-23 (86) → (87)] → Starter operating

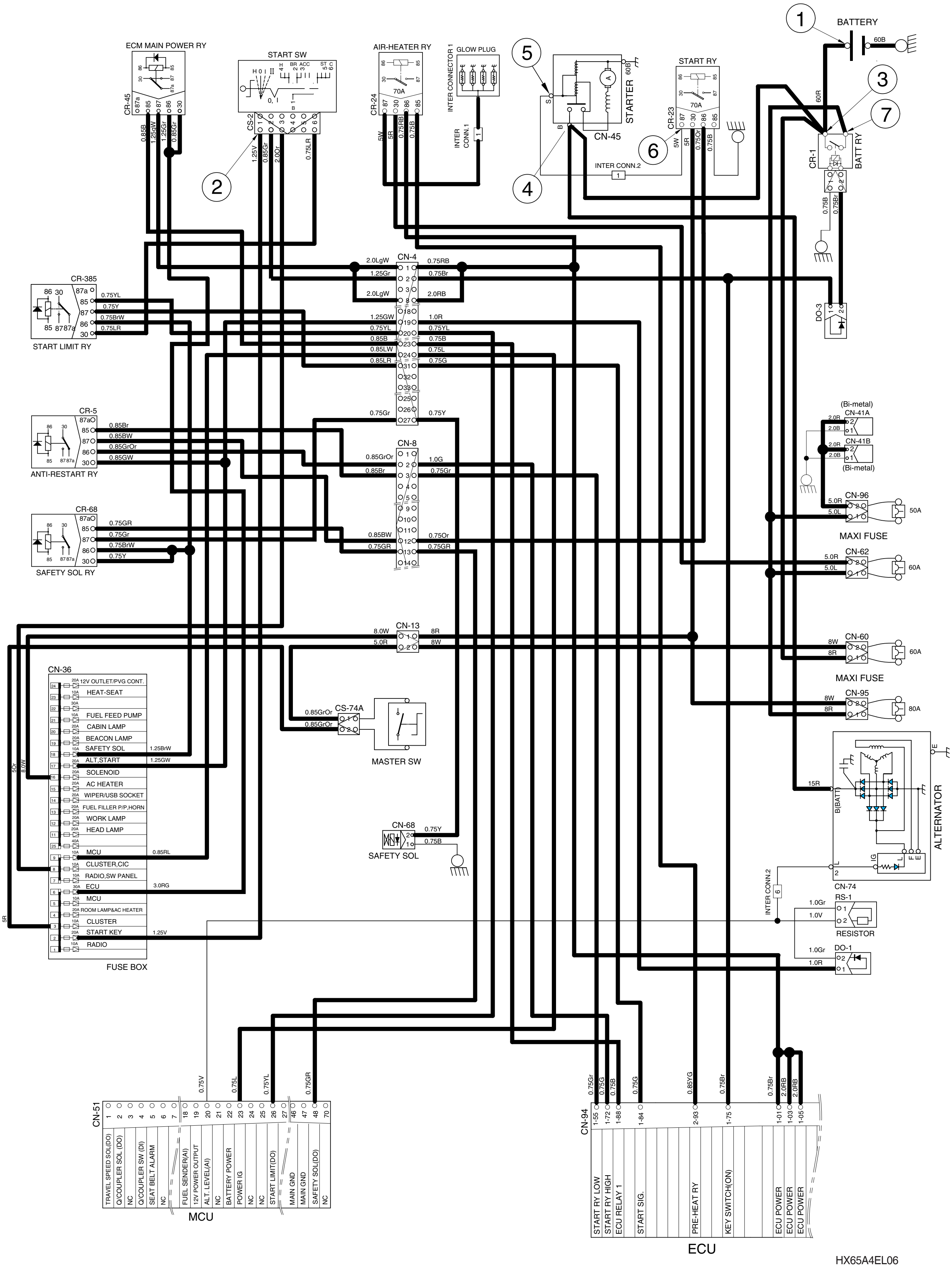
2) CHECK POINT

Engine	Start switch	Check point	Voltage
Operating	START	① - GND (battery B^+) ② - GND (start key) ③ - GND (battery relay M4) ④ - GND (starter B) ⑤ - GND (starter S) ⑥ - GND (start relay) ⑦ - GND (battery relay M8)	10~12.5V

※ GND : Ground

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

STARTING CIRCUIT



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

3. CHARGING CIRCUIT

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

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

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

1) OPERATING FLOW

(1) Warning flow

Alternator [CN-74 (L)] → I/conn 2 [6] → MCU [CN-51 (20)] → Cluster warning lamp

(2) Charging flow

Alternator [CN-74 (B)] → Starter [CN-45 (B)] → Battery relay [CR-1]

→ Battery (+) terminal
→ Maxi fuse [CN-60] → I/conn [CN-13 (2)] → Master switch [CN-74A]
→ Fuse box [CN-36 No.1~6]
→ Maxi fuse [CN-95] → I/conn [CN-13 (1)] → Fuse box [CN-36 No.11~25]

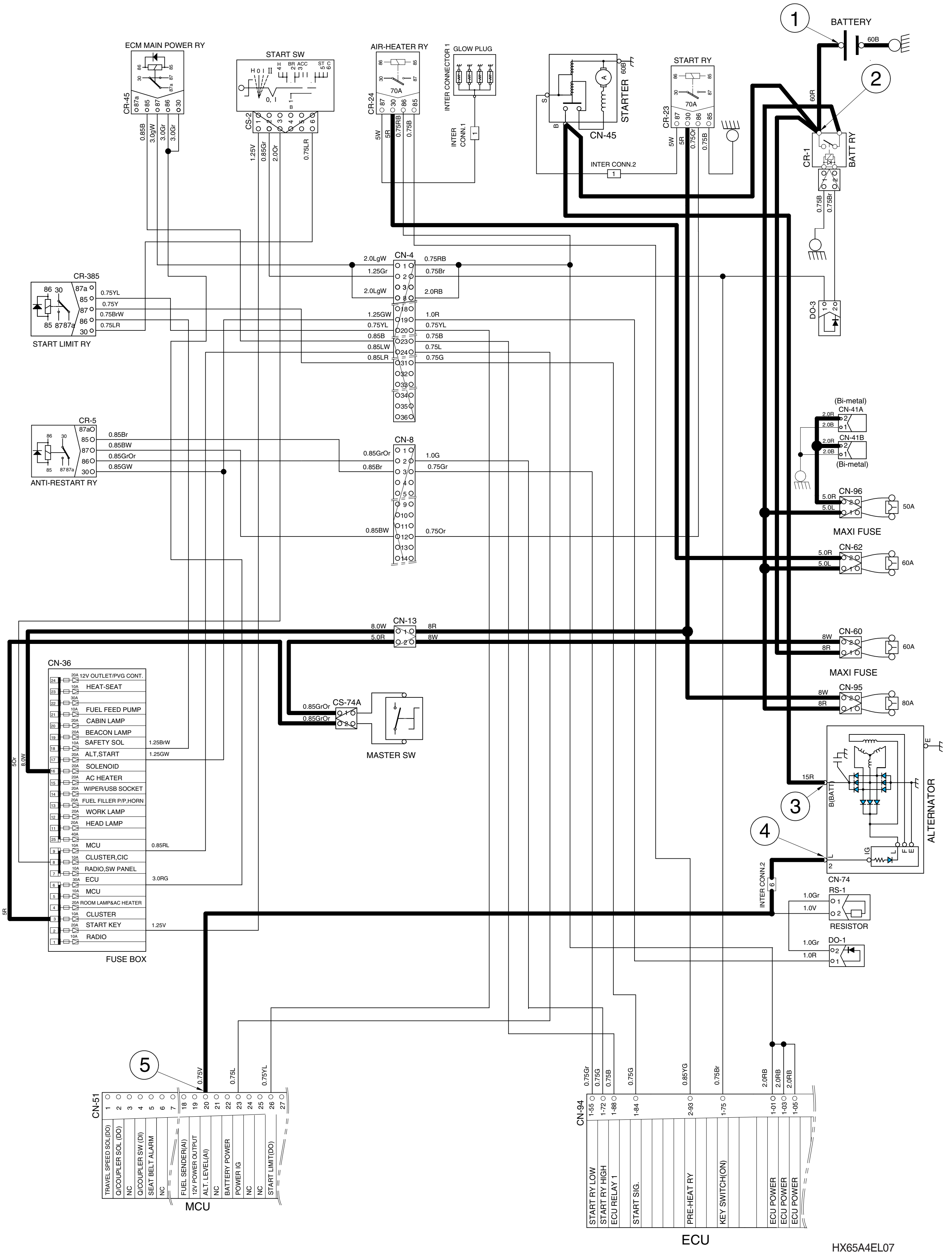
2) CHECK POINT

Engine	Start switch	Check point	Voltage
Operating	ON	① － GND (battery B^+) ② － GND (battery relay) ③ － GND (alternator B terminal) ④ － GND (alternator L terminal) ⑤ － GND (MCU)	10~12.5V

※ GND : Ground

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

CHARGING CIRCUIT



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

4. HEAD AND WORK LAMP CIRCUIT

1) OPERATING FLOW

Fuse box (No.11) → Head lamp relay [CR-13 (30, 86)]
Fuse box (No.12) → Work lamp relay [CR-3 (30, 86)]
Fuse box (No.7) → Switch panel [CR-116 (10)]

(1) Head lamp switch ON

Head lamp switch ON [CN-116 (1)] → Head lamp relay [CR-13 (85) → (87)]
→ I/conn [CN-4 (22)] → Head lamp ON [CL-3, 4 (2)]
→ New cassette radio illumination ON [CN-27 (9)]
→ Accel dial illumination ON [CN-142 (2)
→ I/conn [CN-11 (8)] → AC/Heater controller illumination ON

(2) Work lamp switch ON

Work light switch ON [CN-116 (2)] → Work lamp [CR-3 (85) → (87)] → I/conn [CN-5 (1)]
I/conn [CN-12 (2)] → Work lamp ON [CL-5 (2)]

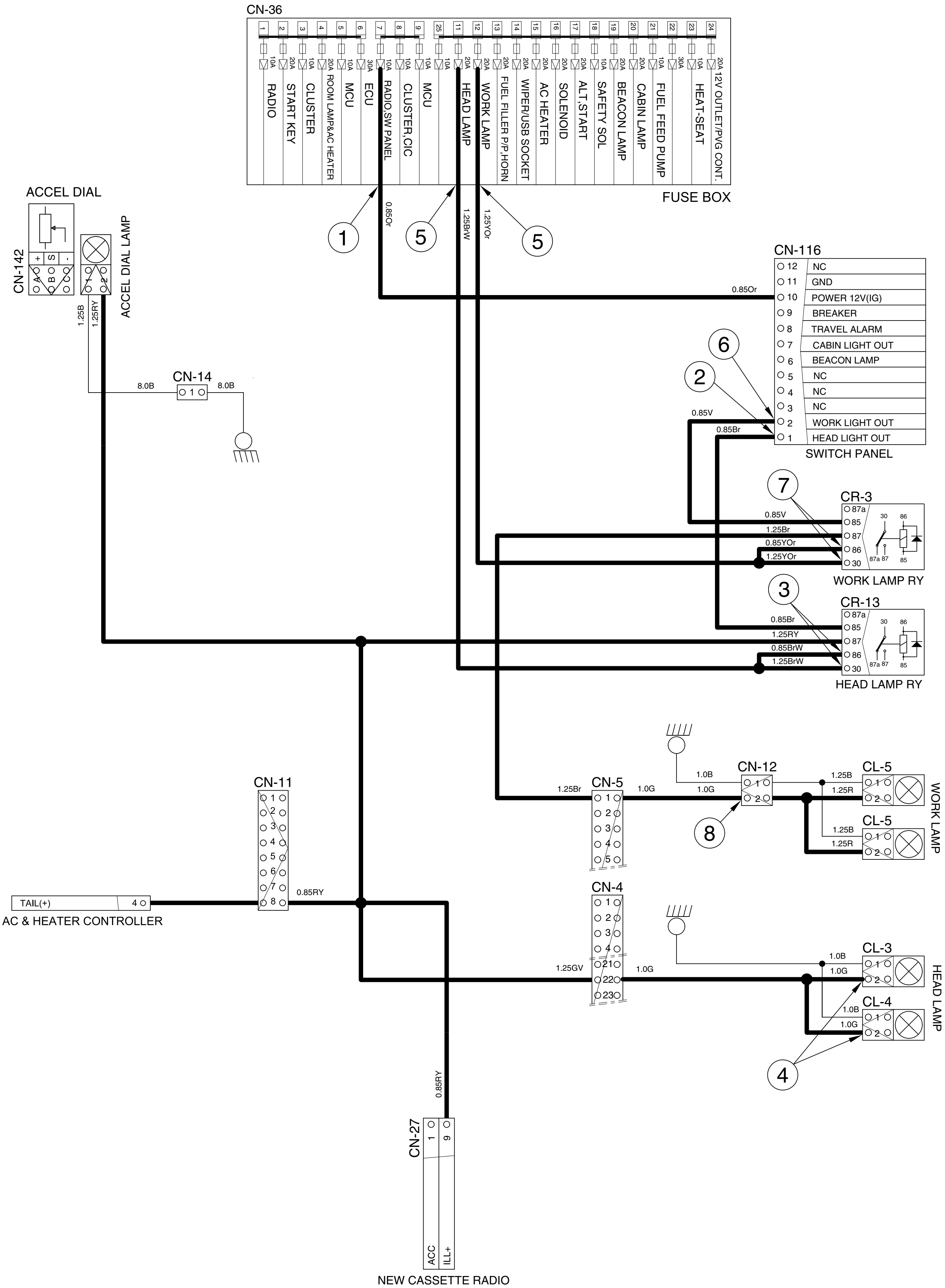
2) CHECK POINT

Engine	Start switch	Check point	Voltage
STOP	ON	① - GND (fuse box) ② - GND (switch power output) ③ - GND (switch relay input) ④ - GND (head light) ⑤ - GND (fuse box) ⑥ - GND (switch power output) ⑦ - GND (switch relay input) ⑧ - GND (work light)	10~12.5V

※ GND : Ground

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

HEAD AND WORK LAMP CIRCUIT



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

5. BEACON LAMP AND CAB LAMP CIRCUIT

1) OPERATING FLOW

Fuse box (No.18) → Beacon lamp relay [CR-85 (30, 86)]
Fuse box (No.20) → Cab lamp relay [CR-9 (30, 86)]
Fuse box (No.7) → Switch panel [CN-116 (10)]

(1) Beacon lamp switch ON

Beacon lamp switch ON [CN-116 (6)] → Beacon lamp relay [CR-85 (85) → (87)]
→ I/conn [CN-6 (5)] → Beacon lamp ON [CL-7 (2)]

(2) Cab lamp switch ON

Cab lamp switch ON [CN-116 (7)] → Cab lamp relay [CR-9 (85) → (87)] → I/conn [CN-6 (8)]
→ Cab lamp ON [CL-9 (2)]

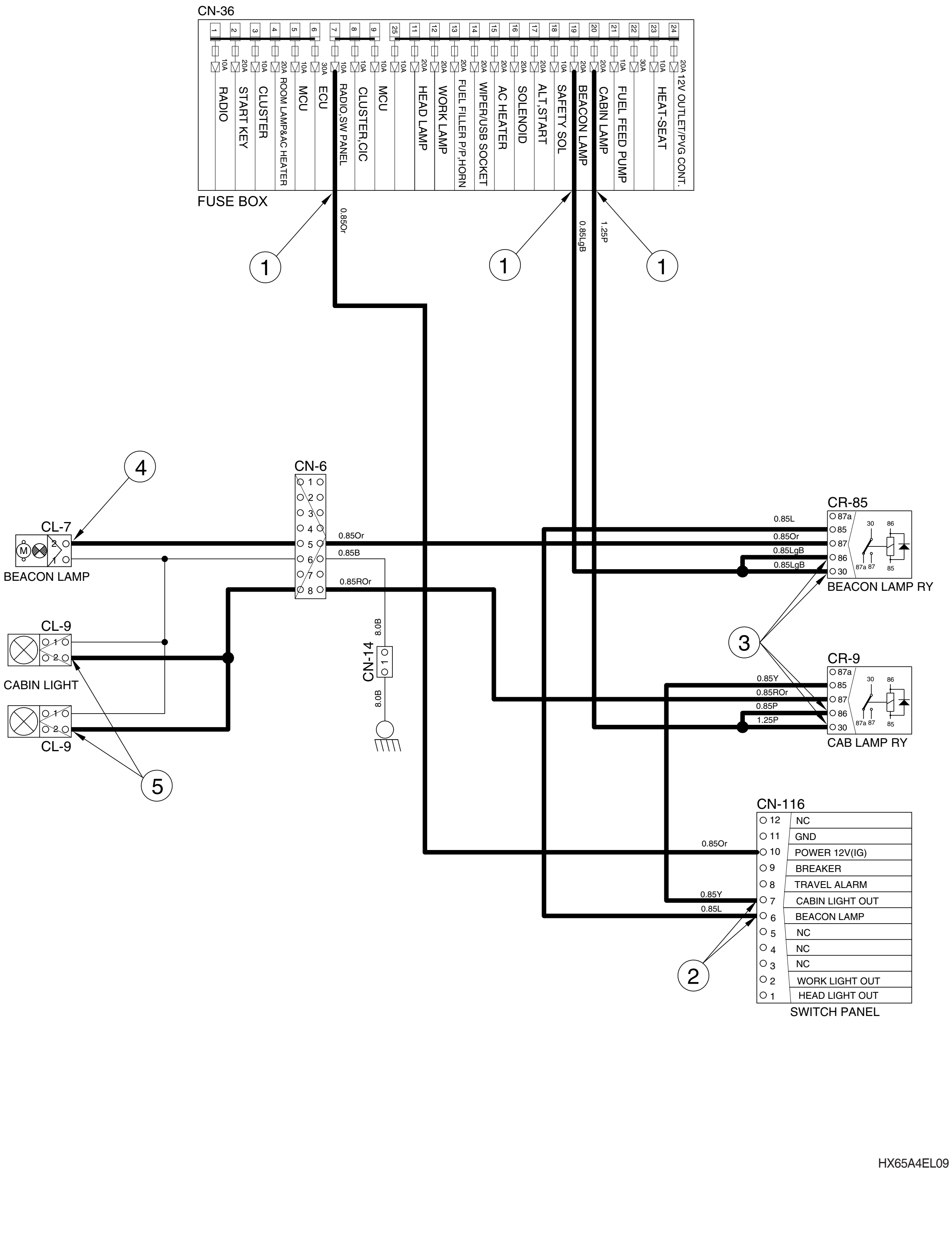
2) CHECK POINT

Engine	Start switch	Check point	Voltage
STOP	ON	① - GND (fuse box) ② - GND (switch power output) ③ - GND (relay power input) ④ - GND (beacon lamp) ⑤ - GND (cab lamp)	10~12.5V

※ GND : Ground

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

BEACON AND CAB LAMP CIRCUIT



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

6. WIPER AND WASHER CIRCUIT

1) OPERATING FLOW

(1) Key switch ON

Fuse box (No.14)
- → Wiper relay [CR-4 (86, 87)]
- → Int wiper relay [CR-6 (3)]
- → Wiper switch [CS-3 (8)]
- → Wiper motor [CN-21 (3)]
- → I/conn [CN-4 (29)] → Washer pump [CN-22 (2)]

(2) Wipe switch ON : 1st step (intermittent speed)

Wiper switch ON [CS-3 (8)→(3)] → Int wiper relay [CR-6 (4)→(2)] → Wiper relay [CR-4 (85)→(30)] → Washer motor operating [CN-21 (4)]

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

Wiper switch ON [CS-3 (8)→(1)] → Int wiper relay [CR-6 (1)→(2)] → Wiper relay [CR-4 (85)→(30)] → Wiper motor operating [CN-21 (4)]

(4) Washer switch ON

Washer switch ON [CS-30 (2,5)]
- → I/conn [CN-4 (11)] → Washer pump operating [CN-22 (1)]
- → Int wiper relay [CR-6 (1)→(2)] → Wiper relay [CR-4 (85)→(30)] → Wiper motor operating [CN-21 (4)]

(5) Auto parking (when switch OFF)

Switch OFF
- → Wiper relay OFF
- → Int wiper relay OFF → Wiper motor [CN-21 (3)→(1)]

→ Wiper relay [CR-4 (87a)→(30)] → Wiper motor [CN-21 (4)]
→ Wiper motor parking position by wiper motor controller

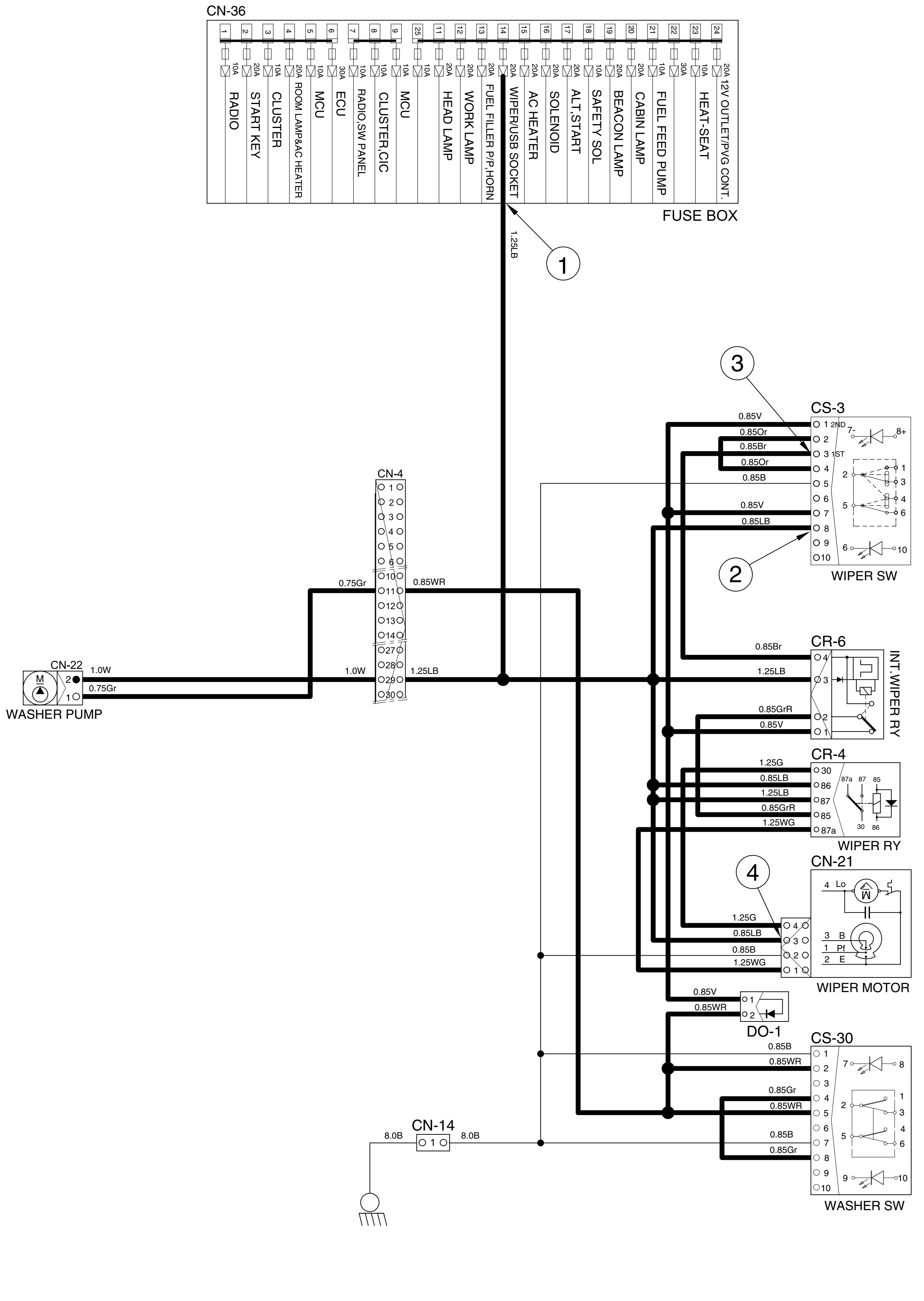
2) CHECK POINT

Engine	Start switch	Check point	Voltage
STOP	ON	① - GND (fuse box) ② - GND (switch power input) ③ - GND (switch power output) ④ - GND (wiper motor)	10~12.5V

※ GND : Ground

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

WIPER AND WASHER CIRCUIT



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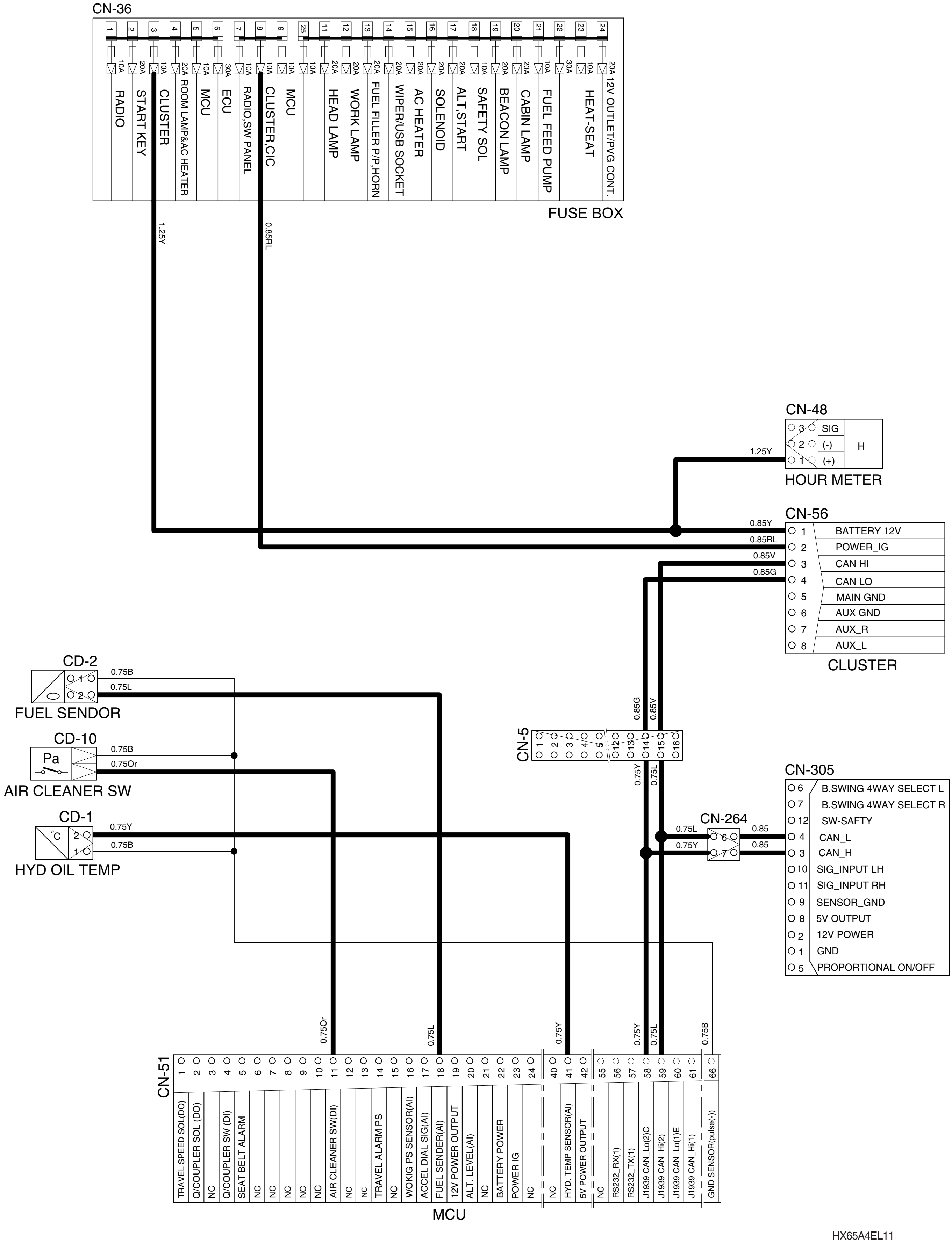
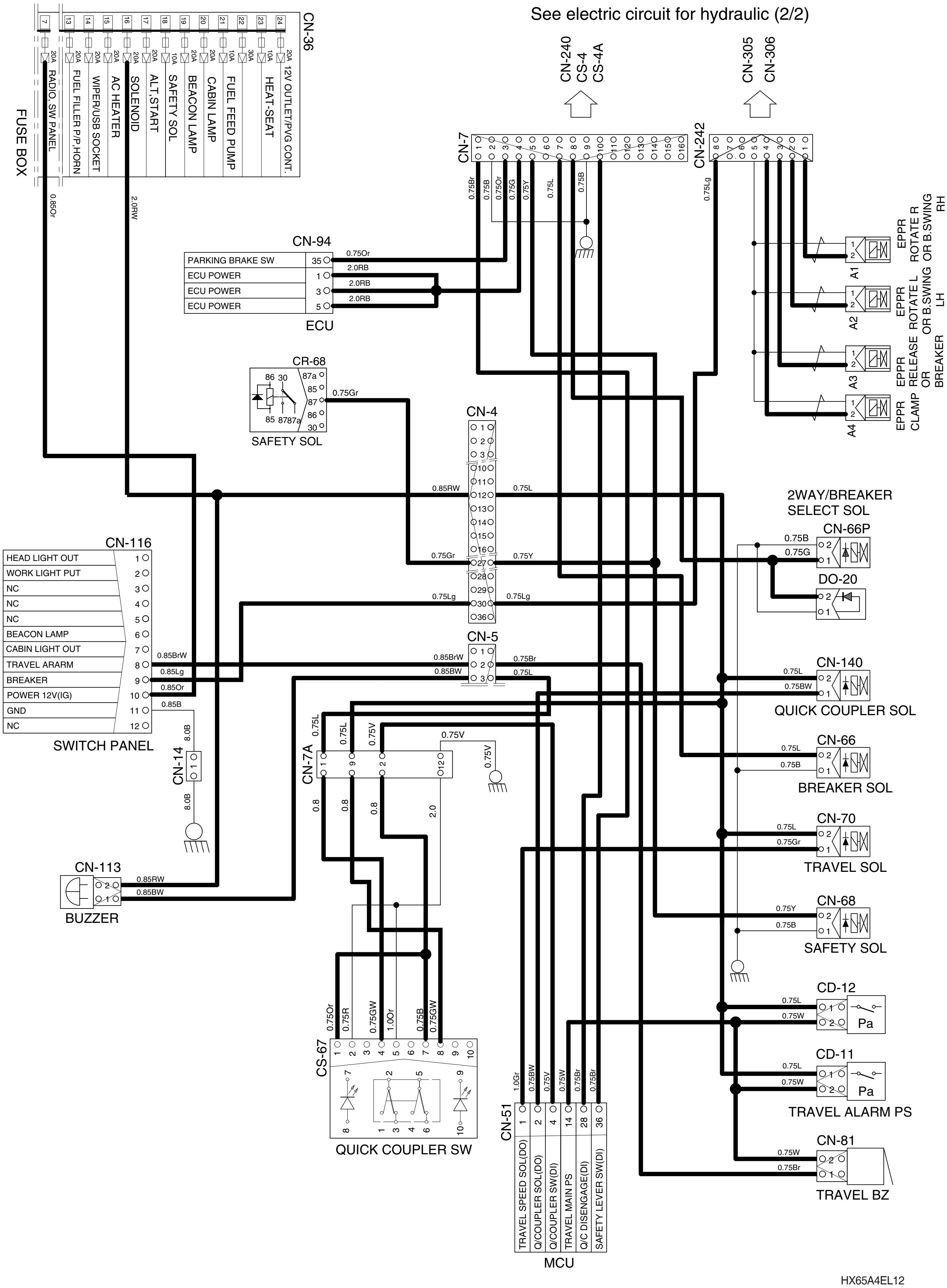
※ The circuit diagram may differ from the equipment, so please check before a repair.

MONITORING CIRCUIT



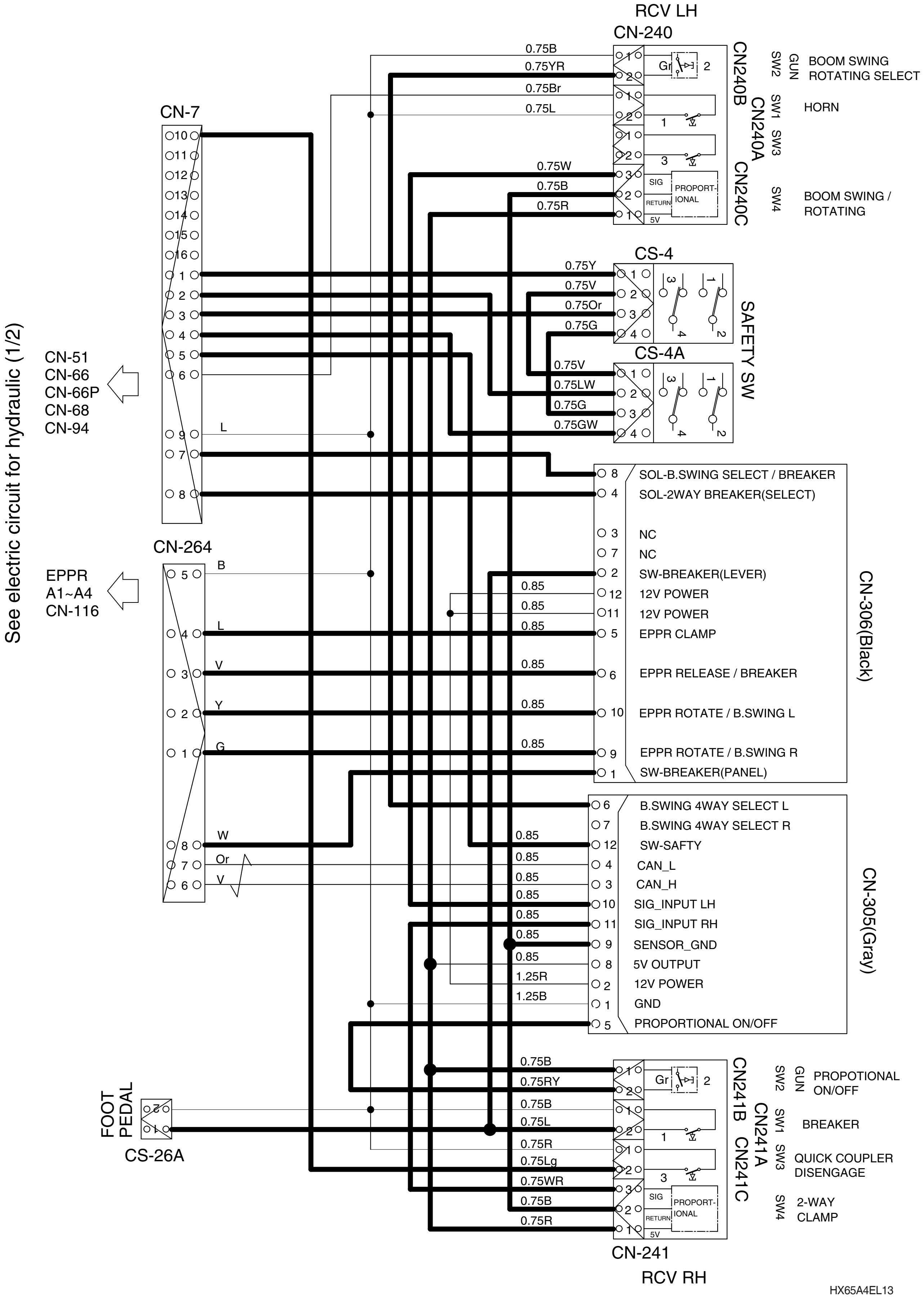
※ The circuit diagram may differ from the equipment, so please check before a repair.

ELECTRIC CIRCUIT FOR HYDRAULIC (1/2)



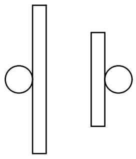
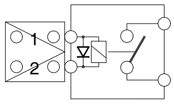
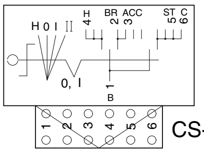
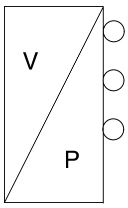
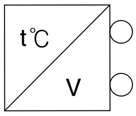
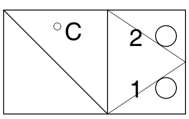
※ The circuit diagram may differ from the equipment, so please check before a repair.

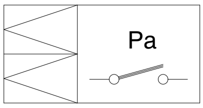
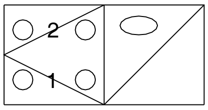
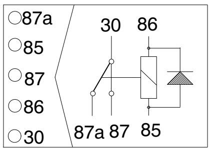
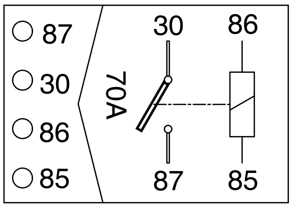
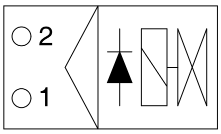
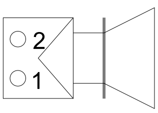
ELECTRIC CIRCUIT FOR HYDRAULIC (2/2)

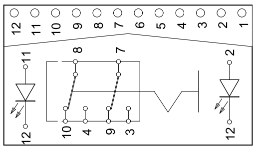
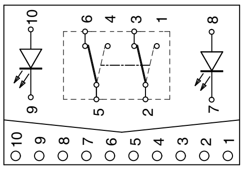
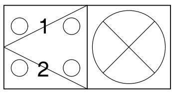
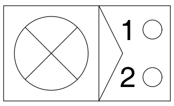
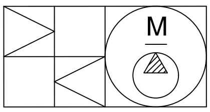
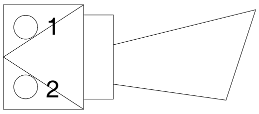


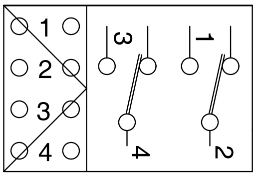
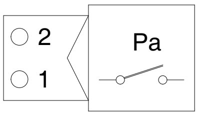
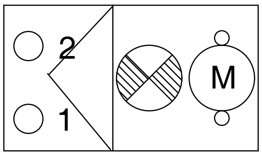
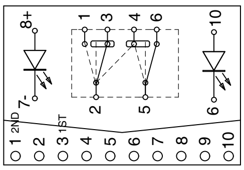
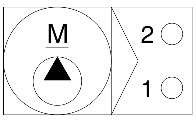
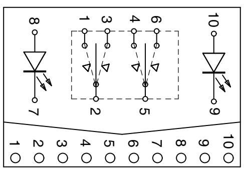
※ The circuit diagram may differ from the equipment, so please check before a repair.

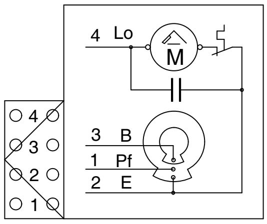
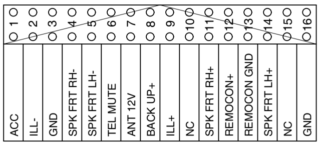
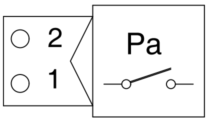
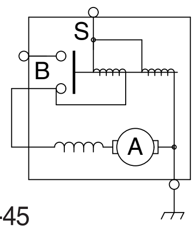
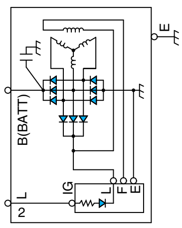
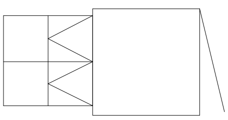
GROUP 4 ELECTRICAL COMPONENT SPECIFICATION

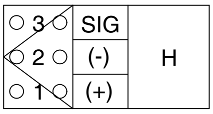
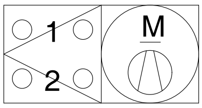
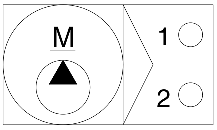
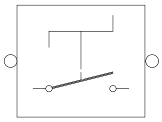
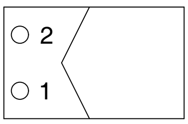
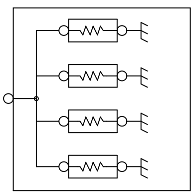
Part name	Symbol	Specification	Check
Battery		12V × 100Ah	※ Check specific gravity 1.280 over : over charged 1.280 ~ 1.250 : normal 1.250 below : recharging
Battery relay	 CR-1	Rated load : 12V 100A (continuity) 1000A (30 second)	※ Check coil resistance Normal : about 12Ω ※ Check contact Normal : ∞Ω
Start switch	 CS-2	12V	※Check contact OFF : ∞Ω (for each terminal) ON : 0Ω (for terminal 1-3 and 1-2) START : 0Ω (for terminal 1-6)
Pressure switch (for engine oil)		-	※ Check resistance Normal : 0Ω (CLOSE)
Coolant temperature sensor		-	※ Check resistance 50˚C : 804Ω 80˚C : 310Ω 100˚C : 180Ω
Hydraulic temperature sensor		-	※ Check resistance 50˚C : 804Ω 80˚C : 310Ω 100˚C : 180Ω

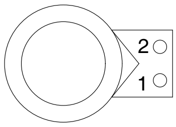
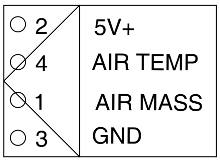
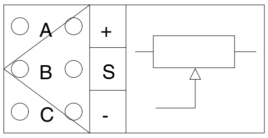
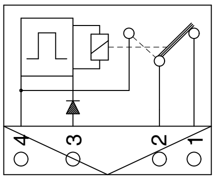
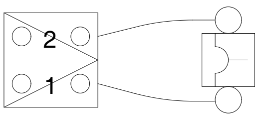
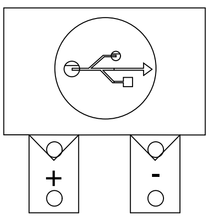
Part name	Symbol	Specification	Check
Air cleaner pressure switch	 CD-10	Pressure: 635mmH_2O (N.O TYPE)	※ Check contact Normal : ∞Ω
Fuel sender	 CD-2	-	※ Check resistance Full : 100Ω Low : 500Ω Empty warning : 700Ω
Relay	 CR-2 CR-3 CR-4 CR-5 CR-7 CR-9 CR-13 CR-45 CR-68 CR-85 CR-385	12V 20A	※ Check resistance Normal : about 200Ω (for terminal 85-86) : 0Ω (for terminal 30-87a) : ∞Ω (for terminal 30-87)
Relay (Start, Air heater)		12V 70A	※ Rated coil current 1.2±0.3A
Solenoid valve	 CN-66 CN-66P CN-68 CN-70 CN-140	12V 1A	※ Check resistance Normal : 15~25Ω (for terminal 1-2)
Speaker	 CN-23(LH) CN-24(RH)	4Ω 20W	※Check resistance Normal : 4Ω

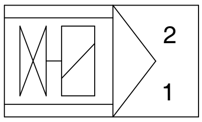
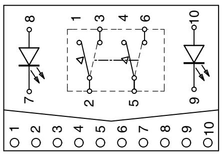
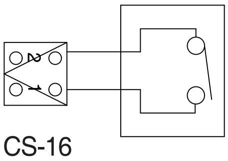
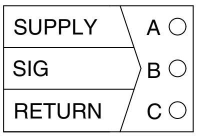
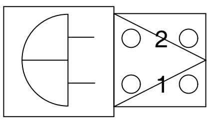
Part name	Symbol	Specification	Check
Overload switch	 CS-50	12V 16A	※ Check contact Normal OFF - ∞Ω (for terminal 1-5,2-6) - 0Ω (for terminal 5-7,6-8)
Quick clamp switch	 CS-67	12V 16A	※ Check contact Normal OFF - ∞Ω (for terminal 1-5,2-6) - 0Ω (for terminal 5-7,6-8)
Lamp	 CL-3 CL-4 CL-5 CL-9	12V 55W (H3 TYPE)	※ Check disconnection Normal : 1.2Ω
Room lamp	 CL-1	12V 10W	※ Check disconnection Normal : a few Ω
Fuel filler pump	 CN-61	12V 35 ℓ/min	※Check operation Supply power (for terminal 1) : 12V
Horn	 CN-20 CN-25	12V	100±5dB

Part name	Symbol	Specification	Check
Safety switch	 CS-4 CS-4A	–	–
Pressure switch	 CD-11 CD-12	10bar (N.C type)	※ Check contact Normal : 0.1Ω
Beacon lamp	 CL-7	12V (Strobe type)	※ Check disconnection Normal : a fewΩ
Wiper switch		12V 16A	※Check contact Normal : ∞Ω
Washer pump	 CN-22	12V 3.8A	※Check contact Normal : 3Ω(for terminal 1-2)
DPF switch	 CS-100	12V 16A	※ Check contact Normal : ∞Ω(for terminal 1-2, 4-5)

Part name	Symbol	Specification	Check
Wiper motor	 CN-21	12V 3A	–
New cassette radio	 CN-27	24V 2A	※ Check voltage 20 ~ 25V (for terminal 1-3, 3-8)
Receiver dryer	 CN-29	12V (N.O type)	※ Check contact Normal : ∞Ω(for terminal 1-2)
Starter	 CN-45	12V 2.5kW	※ Check contact Normal : 0.1Ω
Alternator	 CN-74	12V 90A	※ Check contact Normal : 0Ω(for terminal B-L)
Travel buzzer	 CN-81	12V	-

Part name	Symbol	Specification	Check
Hour meter	 CN-48	12V	-
Air con blower		12V 8.5A	-
Fuel feed pump	 CN-145	12V	-
Master switch	 CS-74A	12V 1000A	-
Fuel heater	 CN-41A CN-41B	12V 38W	-
Glow plug		-	-

Part name	Symbol	Specification	Check
12V socket	 CN-139	12V 120W	-
MAF sensor	 CD-158A	5V	-
Accel dial	 CN-142	-	※ Check resistance Normal : about 5kΩ (for terminal A-C) ※ Check voltage Normal : about 5V (for terminal A-C) : 2~4.5V (for terminal C-B)
Int wiper relay	 CR-6	12V 12A	-
Maxi fuse	 CN-60 CN-62 CN-95 CN-96	12V, 50A (CN-96) 12V, 60A (CN-60, 62) 12V, 80A (CN-95)	-
USB charger	 CN-247	-	-

Part name	Symbol	Specification	Check
EPPR valve	 A1, A2, A3, A4	-	-
Washer switch	 CS-30	12V 16A	※ Check resistance Normal OFF -∞Ω (for terminal 2-3, 5-6)
Fuel pump switch	 CS-16	-	-
Pressure sensor	 CD-7 CD-31 CD-32	8~30A	※ Check contact Normal -0.1Ω
Buzzer	 CN-113	12V	-

GROUP 5 CONNECTORS

1. CONNECTOR DESTINATION

Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CN-4	AMP	36	Cabin room harness - Main harness	1743059-2	1743062-3
CN-5	AMP	16	Cabin room harness - Main harness	368047-1	368050-1
CN-6	AMP	16	Cabin harness - Cabin room lamp harness	368047-1	368050
CN-7	AMP	16	Main harness-console harness	368047-1	368050-1
CN-7A	AMP	12	Main harness-console harness	174661-2	368537-1
CN-8	-	15	Cabin room harness-Main harness	2-85262-1	368301-1
CN-9	AMP	10	AAVM harness	174655-2	174657-2
CN-11	DEUTSCH	8	Air-con harness	DT06-8S-EP06	-
CN-12	AMP	2	Main harness - Boom lamp harness	S816-002002	S816-102002
CN-13	KET	2	Earth	MG620557-5	MG620558-5
CN-14	-	2	Earth	S813-030201	-
CN-16	AMP	6	Power connector	174264-2	-
CN-16A	AMP	6	Power connector	-	174262-2
CN-19	AMP	10	AAVM-RH camera harness	174655-2	174657-2
CN-20	DEUTSCH	2	Horn	DT06-2S-EP06	-
CN-21	AMP	4	Wiper harness	180900-0	-
CN-22	KET	2	Washer tank	MG640605	-
CN-23	KET	2	Speaker LH	MG610070	-
CN-24	KET	2	Speaker RH	MG610070	-
CN-25	DEUTSCH	2	Horn	DT06-2S-EP06	-
CN-27	KUM	16	Cassette & radio	PK145-16017	-
CN-27A	-	8	Cassette & radio	-	S816-108002
CN-29	KET	2	Receiver dryer	MG640795	-
CN-36	-	-	Fuse box	21MN-55100	-
CN-41A	DELPHI	2	Fuel heater 1	15300027	-
CN-41B	DELPHI	2	Fuel heater 2	15300027	-
CN-45	TERM	-	Starter	-	-
CN-48	TERM	4	Hour meter	2-520193-2	-
CN-51	AMP	70	MCU	1-968879-1	-
CN-56	AMP	8	Cluster	-	S816-106002
CN-56A	AMP	8	Cluster	174982	-
CN-60	AMP	8	Maxi fuse	21K6-03270	03.01060
CN-61	DEUTSCH	2	Fuel filler pump	DT06-2S-EP06	DT04-2P-E005
CN-62	-	-	Maxi fuse	21K6-03270	03.01060

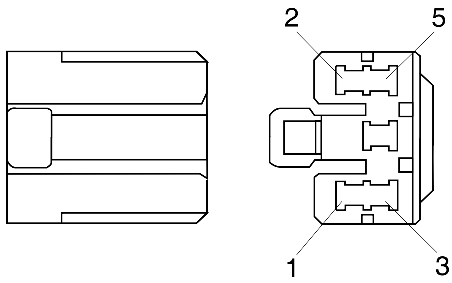
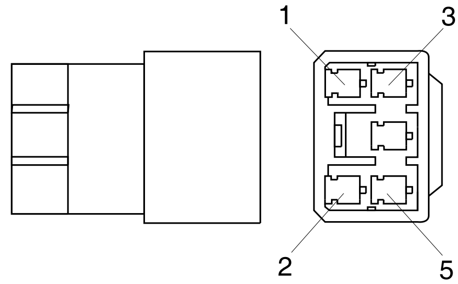
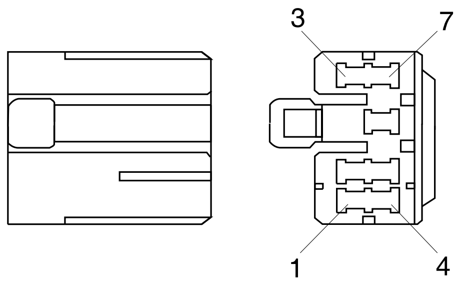
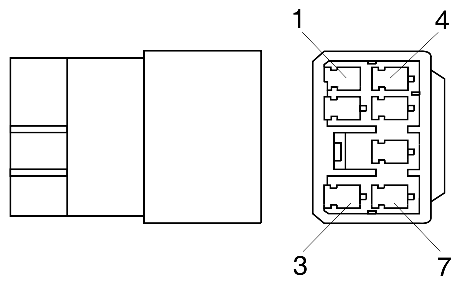
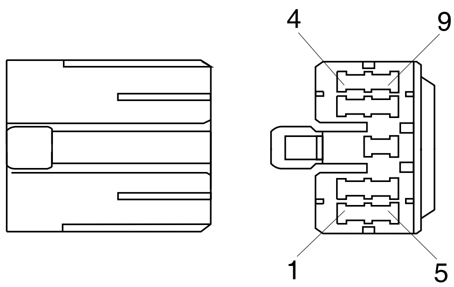
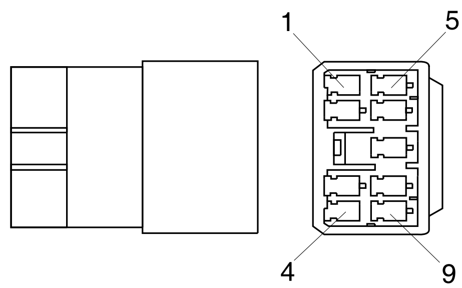
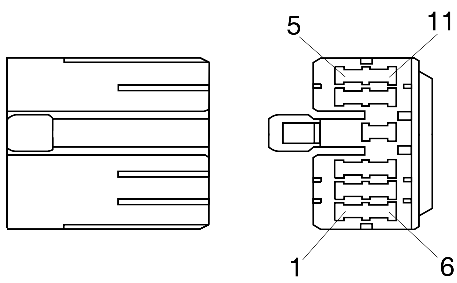
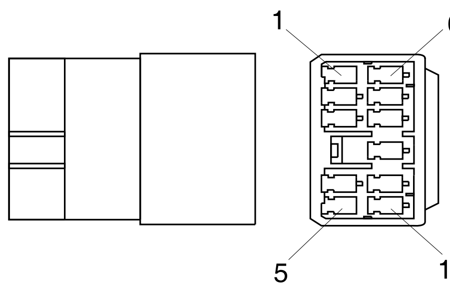
Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CN-66	DEUTSCH	2	Breaker solenoid	DT06-2S-EP06	-
CN-66P	DEUTSCH	2	2way / breaker select sol	DT06-2S-EP06	DT04-2P-E005
CN-68	DEUTSCH	2	Safety solenoid	DT06-2S-EP06	-
CN-70	DEUTSCH	2	Travel HI-LO solenoid	DT06-2S-EP06	-
CN-74	DONGA	1	Alternator	S820-408000	-
CN-81	DEUTSCH	2	Travel buzzer	DT06-2S-EP06	DT04-2P-E005
CN-94	BOSCH	91	ECU	1 928 405 452	-
CN-95	-	-	Maxi fuse	21K6-03270	03.01080
CN-96	-	-	Maxi fuse	21K6-03270	03.01050
CN-100	KET	1	ECU ground	MG640944-5	-
CN-113	AMP	2	Buzzer	S810-002202	-
CN-116	AMP	12	Switch panel	368542-1	-
CN-125A	DEUTSCH	12	RMS	DT06-126-P021	DT04-12PA-P021
CN-126	DEUTSCH	4	RS232	DT06-4S-EP06	DT04-4P-E005
CN-139	AMP	2	12V socket (opt)	172434-2	-
CN-139	AMP	2	12V socket (std)	174198-1	-
CN-140	DEUTSCH	2	Quick coupler	DT06-2S-EP06	DT04-2P-E005
CN-142	DEUTSCH	3	Accel dial	DT06-3S-EP06	-
CN-142	AMP	2	Accel dial lamp	174352-2	-
CN-145	DEUTSCH	2	Fuel feed pump	DT06-2S-EP06	-
CN-148	DEUTSCH	6	Service tool	DT06-6S-EP06	DT04-6P-E005
CN-157	-	1	Antena power	S822-014000	-
CN-170	AMP	2	Seat heat switch	12162017	-
CN-170	-	2	Seat belt switch	12052641	-
CN-240	DEUTSCH	3	Boom swing/rotating	DT06-3S-EP06	-
CN-240A	DEUTSCH	2	Horn	-	DT04-2P-E005
CN-240B	DEUTSCH	3	Boom swing/rotating sel	DT06-2S-EP06	-
CN-240C	-	1	-	-	S822-114000
CN-241	DEUTSCH	3	2 way clamp	DT06-3S-EP06	-
CN-241A	DEUTSCH	2	Breaker	-	DT04-2P-E005
CN-241B	DEUTSCH	3	Proportional ON/OFF	DT06-2S-EP06	-
CN-241C	-	1	Q/C disengage	-	S822-114000
CN-247	AMP	1	USB socket	171809	-
CN-249A	DEUTSCH	6	Rear camera	DT06-6S-EP06	DT04-6P-E005
CN-264	DEUTSCH	8	PVG EPPR	DT06-8S	DT04-8P
CN-264	DEUTSCH	8	Console harness-Main harness	DT06-8S	-
CN-305	DEUTSCH	12	AVCU	DTM06-06-12SA	-
CN-306	DEUTSCH	12	AVCU	DTM06-06-12SB	-

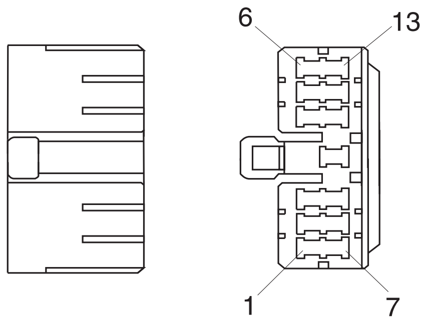
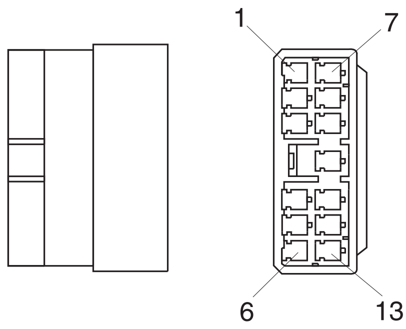
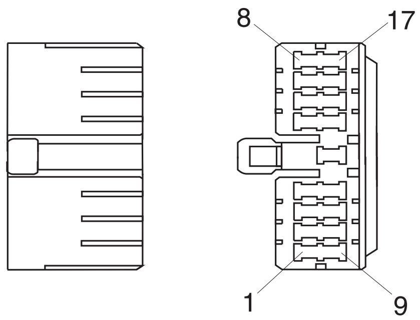
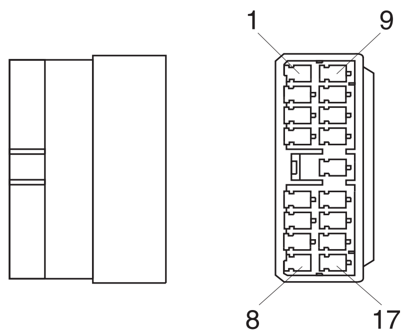
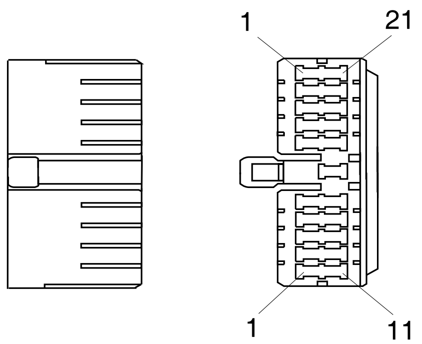
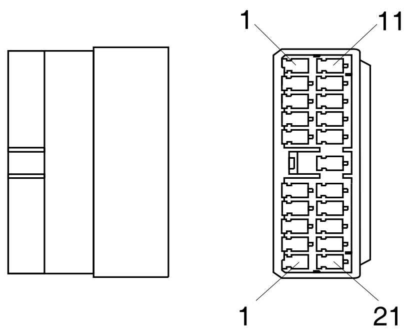
Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CN-307	DEUTSCH	3	Service tool	DT06-3S-EP06	DT04-3P-E005
CN-402	DEUTSCH	6	Front view camera	DT06-6S-EP06	DT04-6P-E005
CN-404	DEUTSCH	6	LH view camera	DT06-6S-EP06	DT04-6P-E005
CN-427	-	12	Smart key reader	5557-12R	5559-12P
CN-542	DEUTSCH	6	Service tool (ECU)	DT06-6S-EP06	DT04-6P-E005
CN-641	KET	3	Button key (opt)	MG641035	-
CN-641A	KET	3	BKCU	MG651032	-
CN-A1	DEUTSCH	2	EPPR- Rotate or boom swing RH	DT06-2S-EP06	-
CN-A2	DEUTSCH	2	EPPR- Rotate or boom swing LH	DT06-2S-EP06	-
CN-A3	DEUTSCH	2	EPPR- Release or breaker	DT06-2S-EP06	-
CN-A4	DEUTSCH	2	EPPR- Clamp	DT06-2S-EP06	-
CN-INTER 1	KET	1	Inter connection 1	-	MG643800
CN-INTER 2	KET	6	Inter connection 2	-	MG610513
CN-INTER 3	DEUTSCH	12	Inter connection 3	-	DT04-12P-E005
· LAMP					
CL-1	KET	2	Room lamp	MG610392	-
CL-3	DEUTSCH	2	Head lamp	DT06-2S-EP06	DT04-2P-E005
CL-4	DEUTSCH	2	Head lamp	DT06-2S-EP06	DT04-2P-E005
CL-5	DEUTSCH	2	Work lamp	DT06-2S-EP06	DT04-2P-E005
CL-7	DEUTSCH	2	Beacon lamp	DT06-2S-EP06	DT04-2P-E005
CL-9	DEUTSCH	2	Cabin lamp	DT06-2S-EP06	DT04-2P-E005
CL-10	DEUTSCH	2	Cabin lamp	DT06-2S-EP06	DT04-2P-E005
· RELAY					
CR-1	AMP	2/-	Battery relay	S816-002002	S816-100002
CR-1	DONGA	-	Battery relay contact (IG)	S820-408000	-
CR-1	DONGA	-	Battery relay contact (B^+)	S820-408000	-
CR-2	-	5	Horn relay	SJA003526-001	-
CR-3	-	5	Work lamp relay	SJA003526-001	-
CR-4	-	5	Wiper relay	SJA003526-001	-
CR-5	-	5	Anti-restart relay	SJA003526-001	-
CR-6	KET	4	Int wiper relay	MG652999	-
CR-7	-	5	AC comp relay	SJA003526-001	-
CR-9	-	5	Cabin lamp relay	SJA003526-001	-
CR-13	-	5	Head lamp relay	SJA003526-001	-
CR-23	KET	4	Start relay	MG612017-5	-
CR-24	KET	4	Air heater relay	MG612017-5	-
CR-45	-	5	ECU power relay	SJA003526-001	-
CR-68	-	5	Safety solenoid relay	SJA003526-001	-

Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CR-85	-	5	Beacon lamp relay	SJA003526-001	-
CR-385	-	5	Start limit relay	SJA003526-001	-
· SENDER					
CD-1	AMP	2	Hydraulic temp sender	85202-1	-
CD-2	AMP	2	Fuel sender	-	S816-102002
CD-7	DEUTSCH	3	Auto idle pressure switch	DT06-3S-EP06	-
CD-10	AMP	2	Air cleaner switch	85202-1	-
CD-11	KET	2	Travel pressure switch	MG640795	-
CD-12	KET	2	Travel pressure switch	MG640795	-
CD-31	DEUTSCH	3	Overload pressure	DT06-3S-EP06	DT04-3P-E005
CD-32	DEUTSCH	3	Boom up pressure	DT06-3S-EP06	-
CD-45	DEUTSCH	2	WIF sensor	DT06-2S-EP06	-
CD-158	AMP	4	MAF connector	-	1-1564559-1
CD-158A	AMP	4	MAF sensor	1-178645-1	-
DO-1	AMP	2	Diode	174352-2	21EA-50570
DO-2	AMP	2	Diode	174352-2	21EA-50550
DO-3	-	2	Diode	S816-002002	21EA-50550
DO-20	AMP	2	Diode	S816-002002	21EA-50550
· SWITCH					
CS-2	KET	6	Start key switch	S814-006000	-
CS-2A	-	6	Start key	S814-006000	-
CS-2B	DEUTSCH	3	BKCU	DT06-3S-EP06	DT04-3P-E005
CS-3	CARLING	10	Wiper switch	VC2-01	-
CS-4	AMP	3	Safety switch	174257-2	-
CS-4A	AMP	4	Safety switch	-	174259-2
CS-16	AMP	2	Fuel filler pump switch	174352-2	174354-2
CS-26	DEUTSCH	2	Fool pedal	DT06-2S-EP06	-
CS-26A	AMP	2	Foot pedal	174352-2	174359-2
CS-30	CARLING	10	Wiper/washer switch	VC2-01	-
CS-50	CARLING	10	Overload switch	VC2-01	-
CS-67	CARLING	10	Quick coupler switch	VC2-01	-
CS-74A	YAZAKI	2	Master switch	S813-030201	S813-130201
CS-100	CARLING	10	DPF switch	VC2-01	-
CS-250	DEUTSCH	2	Seat belt alarm	DT06-2S-EP06	DT04-2P-E005

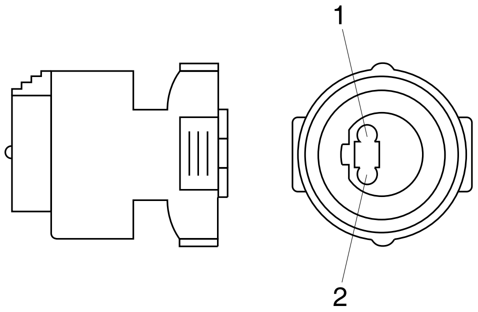
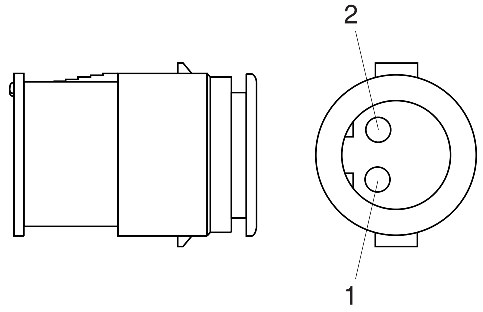
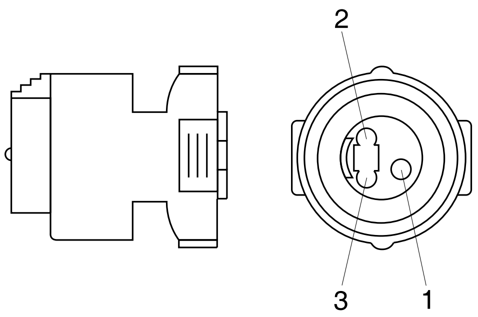
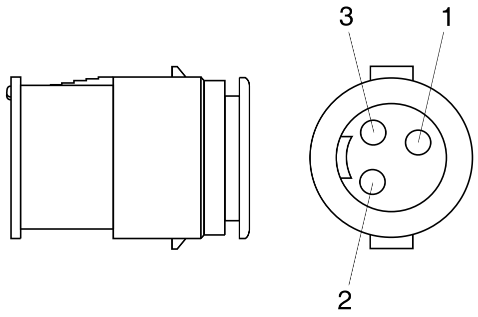
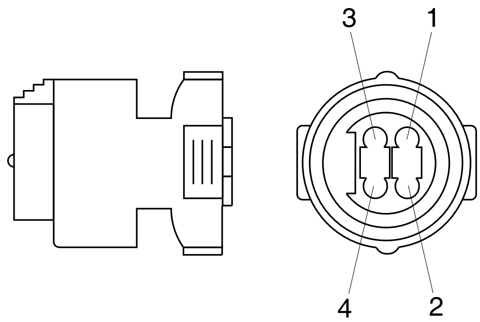
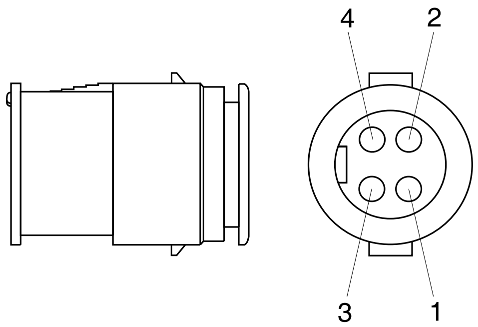
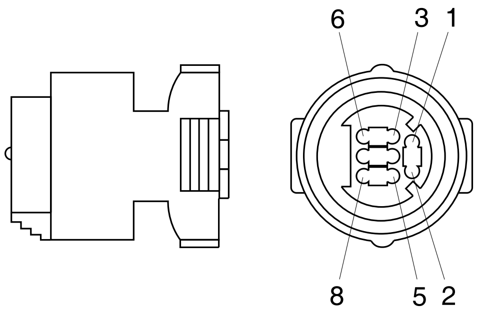
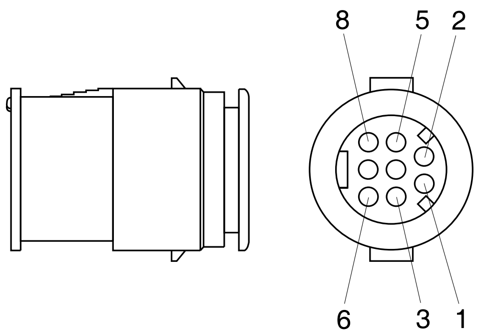
2. CONNECTION TABLE FOR CONNECTORS

1) PA TYPE CONNECTOR

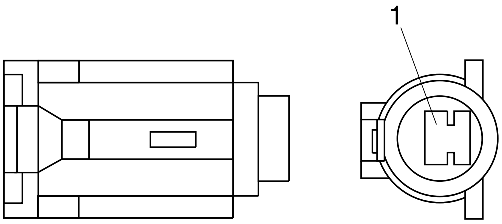
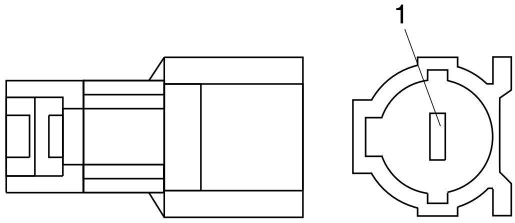
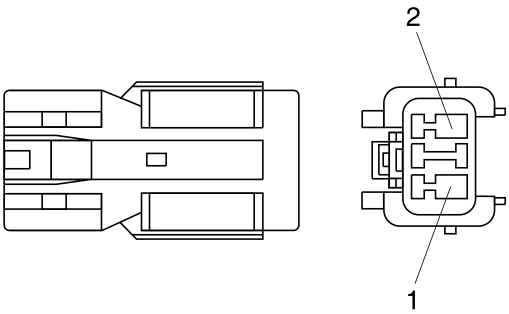
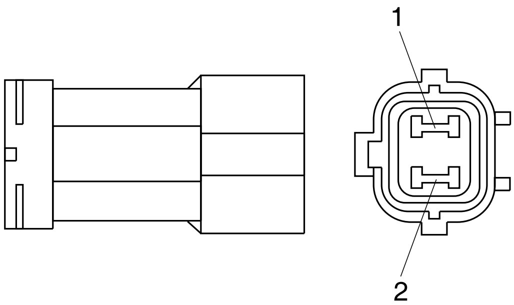
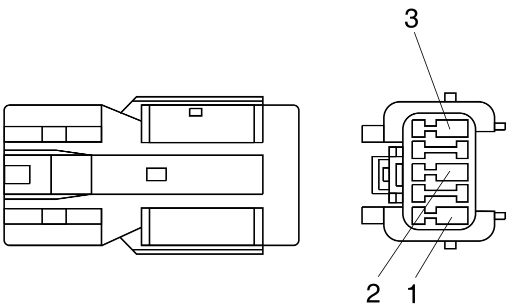
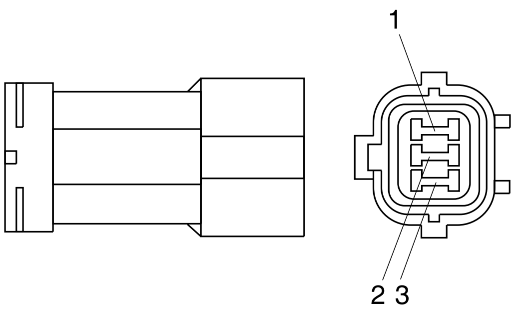
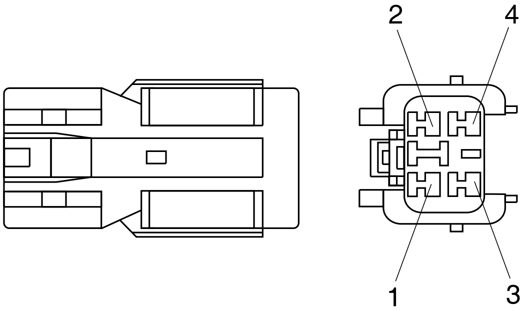
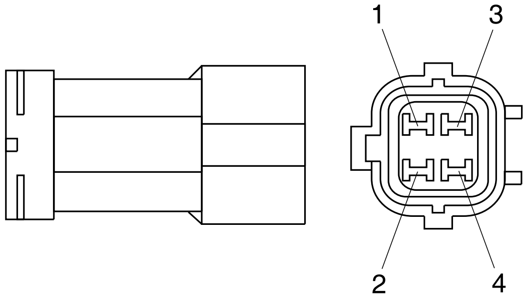
No. of pin	Receptacle connector (female)	Plug connector (male)
5	 S811-005002	 S811-105002
7	 S811-007002	 S811-107002
9	 S811-009002	 S811-109002
11	 S811-011002	 S811-111002

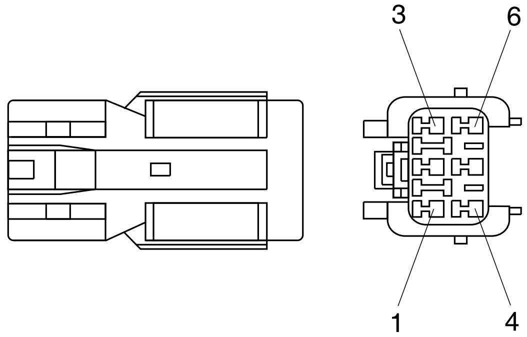
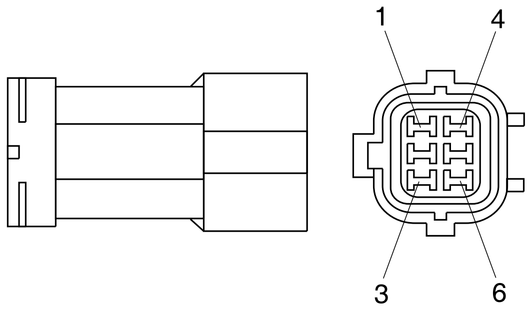
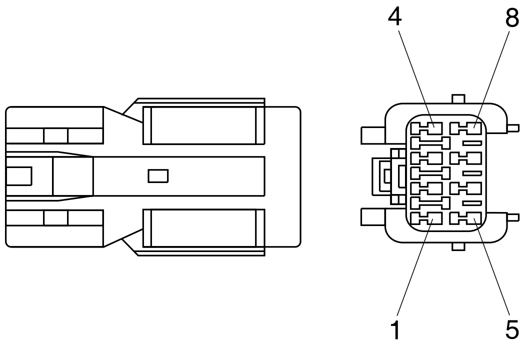
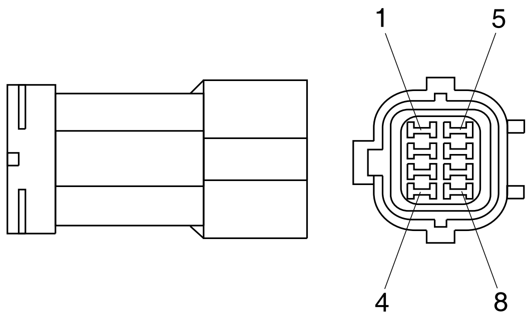
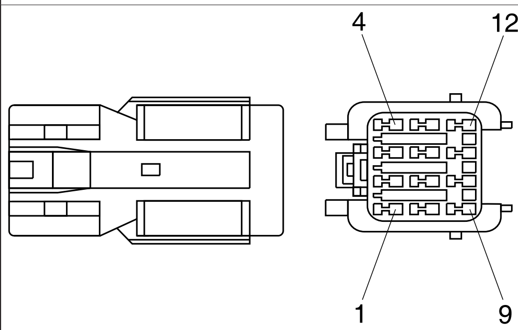
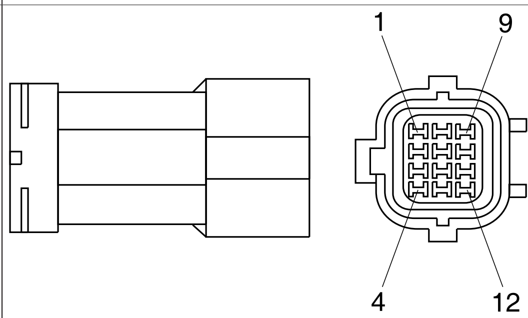
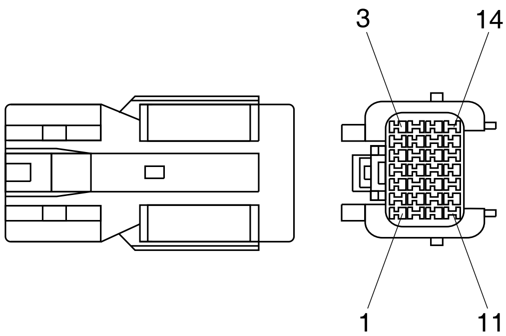
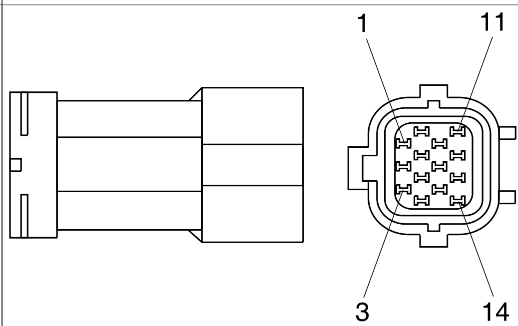
No. of pin	Receptacle connector (female)	Plug connector (male)
13	 S811-013002	 S811-113002
17	 S811-017002	 S811-117002
21	 S811-021002	 S811-121002

2) J TYPE CONNECTOR

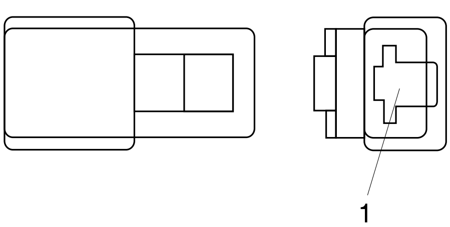
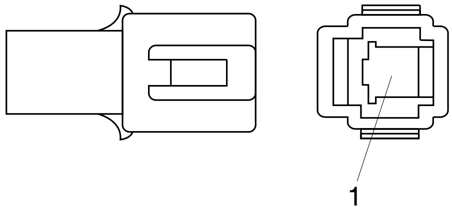
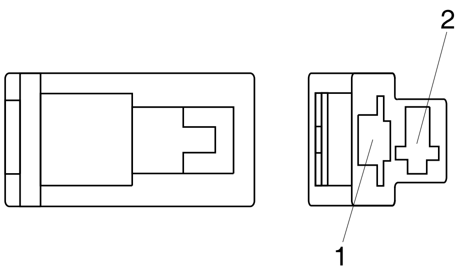
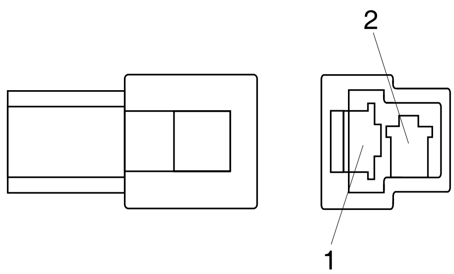
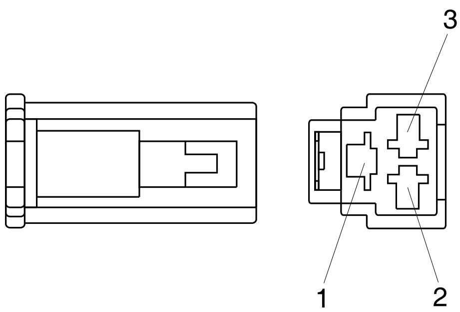
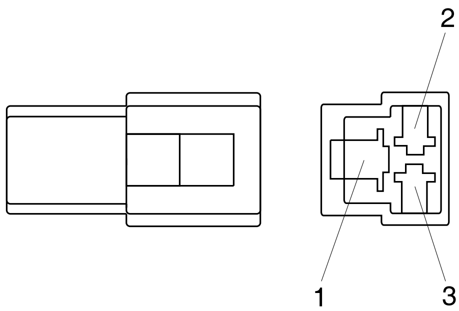
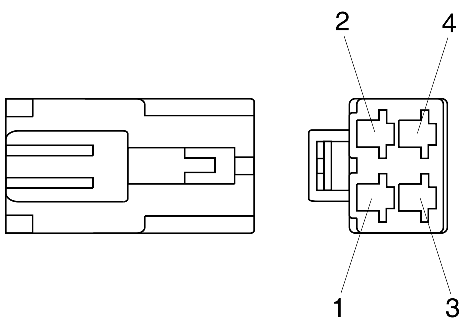
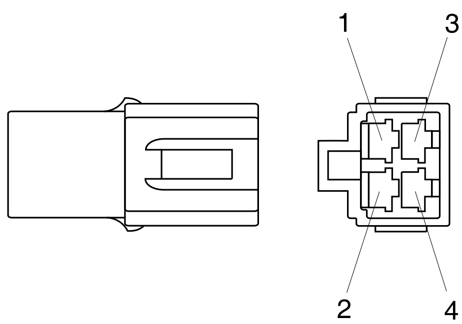
No. of pin	Receptacle connector (female)	Plug connector (male)
2	 S816-002001	 S816-102001
3	 S816-003001	 S816-103001
4	 S816-004001	 S816-104001
8	 S816-008001	 S816-108001

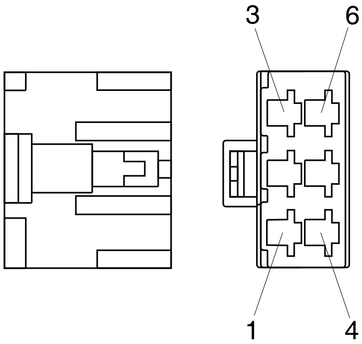
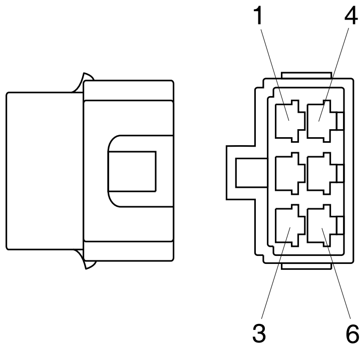
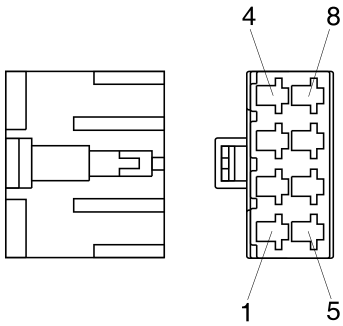
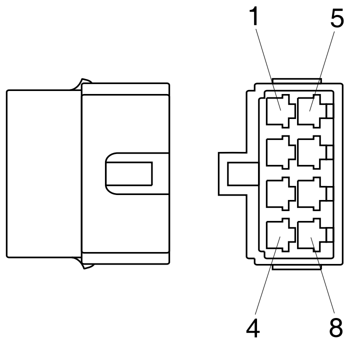
3) SWP TYPE CONNECTOR

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

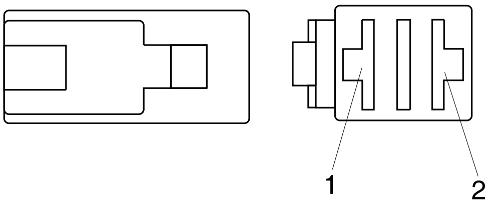
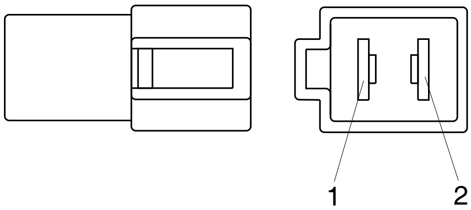
No. of pin	Receptacle connector (female)	Plug connector (male)
6	 S814-006000	 S814-106000
8	 S814-008000	 S814-108000
12	 S814-012000	 S814-112000
14	 S814-014000	 S814-114000

4) CN TYPE CONNECTOR

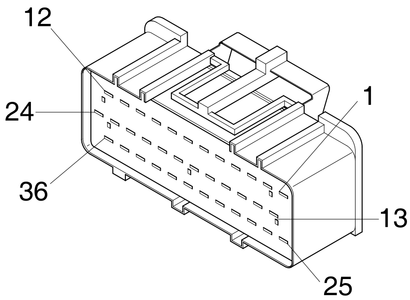
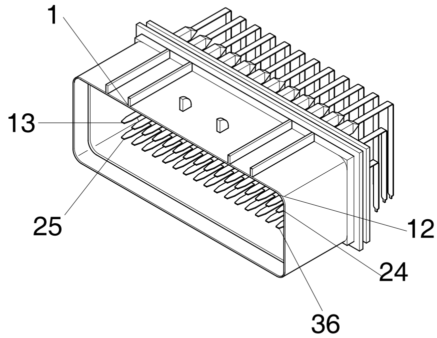
No. of pin	Receptacle connector (female)	Plug connector (male)
1	 S810-001202	 S810-101202
2	 S810-002202	 S810-102202
3	 S810-003202	 S810-103202
4	 S810-004202	 S810-104202

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

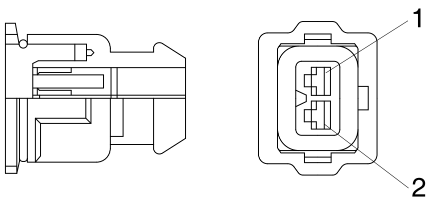
5) 375 FASTEN TYPE CONNECTOR

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

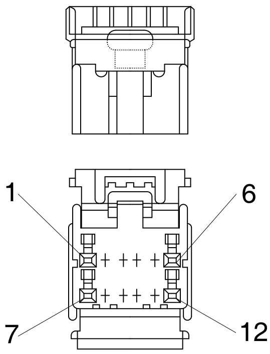
6) AMP ECONOSEAL CONNECTOR

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

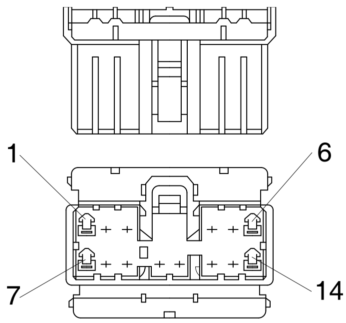
7) AMP TIMER CONNECTOR

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

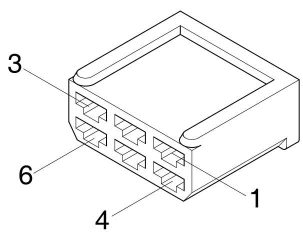
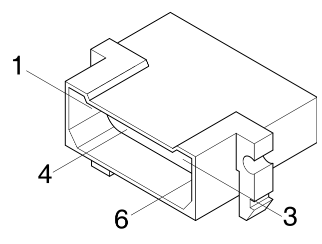
8) AMP 040 MULTILOCK CONNECTOR

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

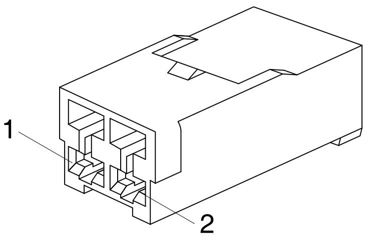
9) AMP 070 MULTILOCK CONNECTOR

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

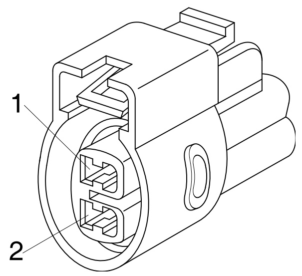
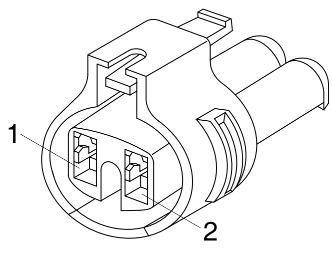
10) AMP FASTIN - FASTON CONNECTOR

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

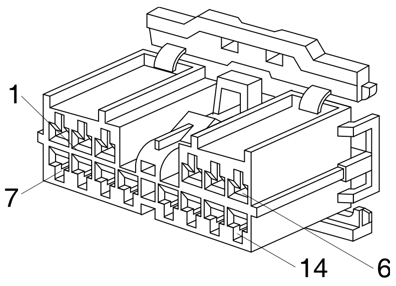
11) KET 090 CONNECTOR

No. of pin	Receptacle connector (female)	Plug connector (male)
6	 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	

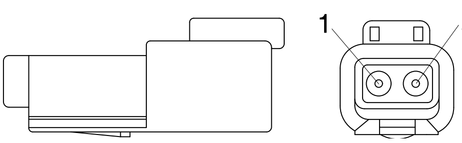
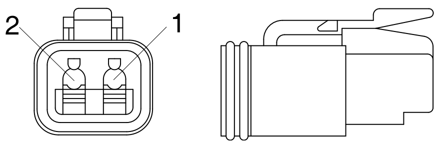
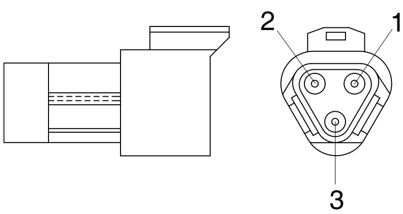
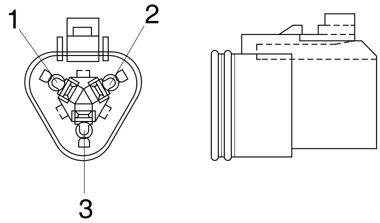
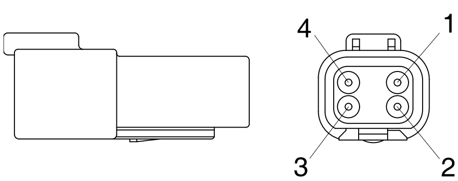
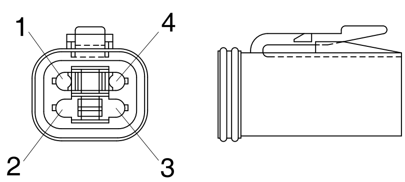
14) DEUTSCH DT CONNECTORS

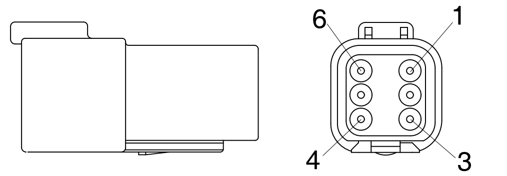
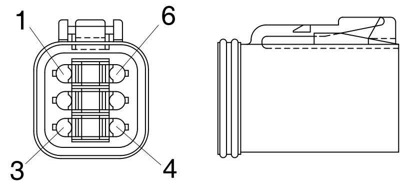
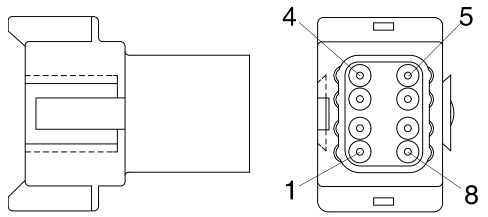
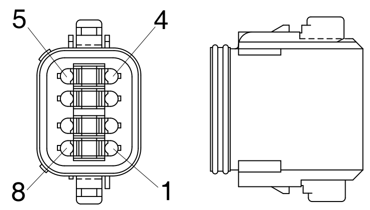
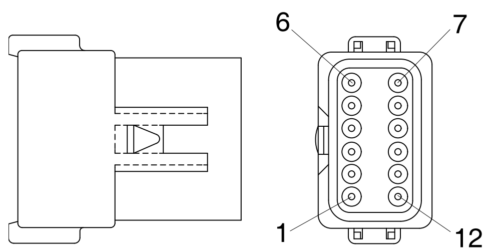
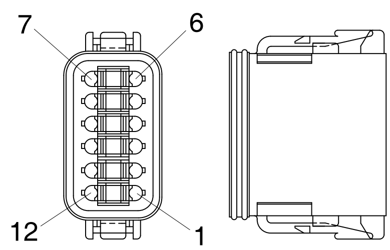
DT 06 - 3S - ★★★★

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

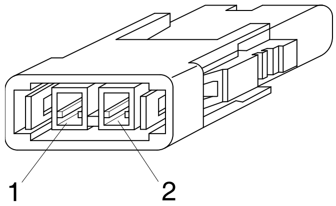
※ Modification

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

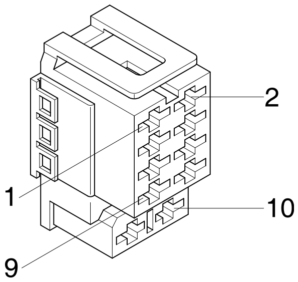
No. of pin	Receptacle connector (female)	Plug connector (male)
2	 DT06-2S	 DT06-2P
3	 DT06-3S	 DT06-3P
4	 DT06-4S	 DT06-4P

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

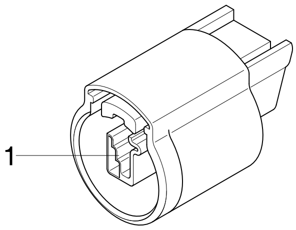
15) MOLEX 2CKTS CONNECTOR

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	

GROUP 6 FAULT CODES

1. MACHINE FAULT CODE

Fault code		Description
HCESPN	FMI	
101	3	Hydraulic oil temperature sensor circuit - voltage above normal or shorted to high source (or open circuit)
	4	Hydraulic oil temperature sensor circuit - voltage below normal or shorted to low source
105	0	Working pressure sensor data above normal range (or open circuit)
	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 (or open circuit)
	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
122	0	Overload pressure sensor data above normal range (or open circuit)
	1	Overload pressure sensor data below normal range
	2	Overload pressure sensor data error
	3	Overload pressure sensor circuit - voltage below normal or shorted to low source
301	3	Fuel level sensor circuit - voltage above normal or shorted to high source (or open circuit)
	4	Fuel level sensor circuit - voltage below normal or shorted to low source
503	0	Brake pressure sensor data above normal range (or open circuit)
	1	Brake pressure sensor data below normal range
	2	Brake pressure sensor data error
	4	Brake pressure sensor data - voltage below normal or shorted to low source
505	0	Working brake pressure sensor data above normal range (or open circuit)
	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
530	0	Travel fwd pilot pressure sensor data above normal range (or open circuit)
	1	Travel fwd pilot pressure sensor data below normal range
	2	Travel fwd pilot pressure sensor data error
	4	Travel fwd pilot pressure sensor circuit - voltage below normal, or shorted to low source
	14	Travel fwd pilot pressure sensor circuit - special instructions
	16	Travel fwd pilot pressure sensor circuit - voltage valid but above normal operational range
701	4	Hour meter 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 (or open circuit)
714	3	Acc. dial circuit - voltage above normal, or shorted to high source (or open circuit)
	4	Acc. dial circuit - voltage below normal, or shorted to low source

Fault code		Description
HCESPN	FMI	
840	2	Cluster communication data error
841	2	ECM communication data error
ISDP	2	Water in fuel warning
Lo bat	2	Low battery warning

2. ENGINE FAULT CODE

Fault code		Description
SPN	FMI	
0	19	Timeout Error of CAN-Receive-Frame TSC1VE (Engine speed & Torque demand)
27	0	EGR Position Open jammed fault
27	1	EGR Position Closed jammed fault
27	3	EGR Position Sensor High Fault
27	4	EGR Position Sensor Low Fault
27	20	EGR Close Position Learning Range Over Fault
27	22	EGR Close Position Learning Drift Fault for long time
27	23	EGR Close Position Learning Drift Fault for short time
29	3	Accel pedal position track2 sensor High fault
29	4	Accel pedal position track2 sensor Low fault
29	15	Hand pedal position track2 sensor High fault
29	17	Hand pedal position track2 sensor Low fault
51	0	Throttle valve Position Open jammed fault
51	1	Throttle valve Position Closed jammed fault
51	3	Throttle valve Position Sensor High Fault
51	4	Throttle valve Position Sensor Low Fault
51	22	Throttle valve Close Position Learning Drift Fault for long time
51	23	Throttle valve Close Position Learning Drift Fault for short time
51	30	Throttle valve Close Position Learning Range Over Fault
91	3	Accel pedal position track1 sensor High fault
91	4	Accel pedal position track1 sensor Low fault
91	11	Accel pedal position sensor plausibility fault (Not synchronism between track1 and track2)
91	12	Hand pedal position sensor plausibility fault (Not synchronism between track1 and track2)
91	15	Hand pedal position track1 sensor High fault
91	17	Hand pedal position track1 sensor Low fault
91	19	Timeout Error of CAN-Receive-Frame EEC2 (Pedal)
97	3	Water In Fuel Sensor signal range high fault
97	4	Water In Fuel Sensor signal range low fault
97	14	Water in fuel detected – Warning step
97	23	Water in fuel detected – Torque de-rate step (After 20min)
98	3	Oil combination (Level and temperature) signal output short circuit to battery error
98	4	Oil combination (Level and temperature) signal output short circuit to ground error
98	5	Oil combination (Level and temperature) sensor itself open or short circuit error
98	18	Engine oil level is too low (Low step3)
98	22	Oil combination (Level and temperature) sensor timeout fault
98	23	Oil combination (Level and temperature) sensor itself Voltage out of range error
98	24	Engine oil level is low (Low step2)

Fault code		Description
SPN	FMI	
100	1	Engine Oil Pressure Too Low Fault
100	3	Engine Oil Pressure Sensor High Fault
100	4	Engine Oil Pressure Sensor Low Fault
102	3	Intake Manifold Pressure Sensor High Fault
102	4	Intake Manifold Pressure Sensor Low Fault
105	3	Intake manifold temperature sensor High fault
105	4	Intake manifold temperature sensor Low fault
105	16	Intake manifold temperature High fault
108	3	Atmospheric Pressure Sensor High Fault
108	4	Atmospheric Pressure Sensor Low Fault
110	0	Coolant high temperature Fault
110	3	Coolant Temperature Sensor High Fault
110	4	Coolant Temperature Sensor Low Fault
110	10	Coolant Temperature Plausibility Fault
132	1	Intake manifold pressure low plausibility fault (Compressor out pressure too low)
132	3	Signal range check high error for Air mass flow sensor
132	4	Signal range check low error for Air mass flow sensor
132	5	Battery voltage error of Air mass flow sensor
132	19	Signal error of Air mass flow sensor
132	21	Sensitivity drift error low for Air mass flow sensor
157	10	Fuel Leakage is detected based on fuel quantity balance
157	11	Maximum positive deviation of rail pressure exceeded
157	26	Rail pressure too low fault
157	27	Maximum rail pressure exceeded
157	28	Pressure relief valve(PRV) failure
171	0	Environment Temperature Too High
171	3	Environment Temperature Sensor Signal High
171	4	Environment Temperature Sensor Signal Low
172	0	Inlet air temperature High fault
172	3	Inlet air temperature sensor High fault
172	4	Inlet air temperature sensor Low fault
173	1	DOC Exothermal Efficiency Fault
174	0	Fuel temperature high fault
174	3	Fuel Temperature Sensor High Fault
174	4	Fuel Temperature Sensor Low Fault
175	11	Oil combination (Level and temperature) sensor itself Oil temperature out of range error
177	15	Transmission oil temperature high fault (CAN)
177	16	Transmission oil temperature high fault (H/W Switch)
190	0	Engine over speed detection fault

Fault code		Description
SPN	FMI	
444	0	Battery Voltage High fault (Warning)
444	1	Battery Voltage Low fault (Warning)
444	2	Powerstage diagnosis could be disabled due to low Battery voltage
444	3	Battery Voltage Signal Range Max fault
444	4	Battery Voltage Signal Range Min fault
444	12	Powerstage diagnosis disabled due to high Battery voltage
626	12	Starter switch stuck fault (Cranking request is too long.)
636	2	Crank Signal disturbed fault
636	8	Cranks No signal error
637	2	Cam Signal disturbed fault
637	8	Cam Signal Lost fault
637	30	Cam Signal Drift Fault
639	2	CAN communication error
639	19	CAN bus off error
651	2	Injector Code(IQA) Program Missing Fault (Cylinder#1)
651	4	Injector Short circuit Fault (Cylinder #1)
651	5	Injector Open circuit Fault (Cylinder #1)
651	22	Injector High Low side Short circuit Fault (Cylinder #1)
652	2	Injector Code(IQA) Program Missing Fault (Cylinder#2)
652	4	Injector Short circuit Fault (Cylinder #2)
652	5	Injector Open circuit Fault (Cylinder #2)
652	22	Injector High Low side Short circuit Fault (Cylinder #2)
653	2	Injector Code(IQA) Program Missing Fault (Cylinder#3)
653	4	Injector Short circuit Fault (Cylinder #3)
653	5	Injector Open circuit Fault (Cylinder #3)
653	22	Injector High Low side Short circuit Fault (Cylinder #3)
654	2	Injector Code(IQA) Program Missing Fault (Cylinder#4)
654	4	Injector Short circuit Fault (Cylinder #4)
654	5	Injector Open circuit Fault (Cylinder #4)
654	22	Injector High Low side Short circuit Fault (Cylinder #4)
676	3	Glow plug Relay driver Short circuit to Battery Fault
676	4	Glow plug Relay driver Short circuit to Ground Fault
676	5	Glow plug Relay driver Open circuit Fault
970	12	Engine shut off request through CAN (EBC1)
970	22	Engine shut off request through hardwire
975	3	PWM FAN Output short to battery circuit fault
975	4	PWM FAN Output short to ground circuit fault
975	5	PWM FAN Output open circuit fault
987	3	CE(Check engine) Lamp Short to Battery

Fault code		Description
SPN	FMI	
987	4	CE(Check engine) Lamp Short to Ground
987	5	CE(Check engine) Lamp Open circuit
1076	3	Fuel Metering unit plausibility error in overrun mode
1076	4	Fuel Metering unit plausibility error in idle mode
1076	16	Maximum negative rail pressure deviation with metering unit on lower limit is exceeded
1076	20	Rail pressure too low for injection
1081	3	Glow plug Lamp Short to Battery
1081	4	Glow plug Lamp Short to Ground
1081	5	Glow plug Lamp Open circuit
1207	0	ECU temperature High fault
1207	3	ECU temperature sensor High fault (Short circuit to battery)
1207	4	ECU temperature sensor Low fault (Short circuit to ground)
1382	0	Fuel filter pressure high fault
1382	1	Fuel filter pressure low fault
1382	3	Fuel filter pressure sensor signal high fault
1382	4	Fuel filter pressure sensor signal low fault
1382	7	Fuel Filter Pressure low detection 1 - Warning
1382	13	Fuel Filter Pressure low detection 2 - Torque reduction
1485	7	ECU Main relay Stuck fault
1485	11	ECU Main relay Early opening fault
1568	3	Multi-torque switch signal too high fault
1568	4	Multi-torque switch signal too low fault
1612	3	Injector bank 1st Short circuit fault
1612	12	Injector bank 2nd Short circuit fault
1639	3	Fan speed too high fault
1639	4	Fan speed too low fault
1639	11	Fan speed signal long period fault path
1761	19	DEF Tank Level Signal error
1867	1	ECU over temperature for SCR Monitoring
1867	3	"ABE active" report due to overvoltage detection
1867	4	"ABE active" report due to undervoltage detection
1867	11	"WDA/ABE active" report due to unknown reason
1867	19	"WDA active" report due to errors in query-response communication
1867	22	ECU Software Reset 0 fault
2789	0	Turbine inlet temperature High fault
2789	3	Turbine inlet temperature sensor High fault
2789	4	Turbine inlet temperature sensor Low fault
2789	11	Turbine inlet temperature Plausibility Fault
2791	3	EGR H-Bridge Driver Short circuit to battery

Fault code		Description
SPN	FMI	
2791	4	EGR H-Bridge Driver Short circuit to ground
2791	5	EGR H-Bridge Driver Open Circuit Fault
3031	14	DEF Tank temperature overheated
3031	16	DEF Tank Temperature sensor High plausibility fault
3031	18	DEF Tank Temperature sensor Low plausibility fault
3216	4	NOx sensor signal low fault (Upstream NOx sensor)
3216	18	NOx sensor 1 (Upstream) concentration Low plausibility fault
3219	7	NOx sensor heating error (Upstream NOx sensor)
3224	5	NOx sensor Open circuit fault (Upstream NOx sensor)
3224	6	NOx sensor Short circuit fault (Upstream NOx sensor)
3226	4	NOx sensor signal low fault (Downstream NOx sensor)
3229	7	NOx sensor heating error (Downstream NOx sensor)
3234	5	NOx sensor Open circuit fault (Downstream NOx sensor)
3234	6	NOx sensor Short circuit fault (Downstream NOx sensor)
3236	0	EGR rate slow response positive error
3236	16	Maximum EGR rate governor deviation
3242	0	DPF(SCRF) inlet temperature High fault
3242	3	DPF(SCRF) inlet temperature sensor High fault
3242	4	DPF(SCRF) inlet temperature sensor Low fault
3242	11	DPF(SCRF) inlet temperature Plausibility Fault
3242	20	DPF(SCRF) inlet temperature Drift fault
3251	3	DPF differential pressure sensor High fault
3251	4	DPF differential pressure sensor Low fault
3251	13	DPF differential pressure drift fault
3251	18	DPF differential pressure too low fault
3360	14	DEF pressure line heater error (Perform afterrun)
3361	3	DEF dosing valve actuator Short circuit to battery Fault
3361	4	DEF dosing valve actuator Short circuit to ground Fault
3361	5	DEF dosing valve actuator Open Circuit Fault
3361	13	DEF dosing valve actuator Over temperature Fault
3361	14	Urea dosing valve plausibility fault
3361	22	DEF dosing valve actuator HS(High side) Short circuit to battery Fault
3361	23	DEF dosing valve actuator HS(High side) Short circuit to ground Fault
3361	27	DEF Dosing valve is blocked
3363	3	DEF Tank heating coolant valve output Short circuit to battery Fault
3363	4	DEF Tank heating coolant valve output Short circuit to ground Fault
3363	5	DEF Tank heating coolant valve output Open circuit Fault
3363	7	DEF Tank heating coolant valve output Over temperature Fault
3509	3	ECU Sensor supply1 Over voltage fault

Fault code		Description
SPN	FMI	
3509	4	ECU Sensor supply1 Under voltage fault
3509	5	ECU Sensor supply1 voltage fault
3509	6	ECU Sensor supply1 Short circuit to ground
3509	11	ECU Sensor supply Overvoltage monitoring error
3510	3	ECU Sensor supply2 Over voltage fault
3510	4	ECU Sensor supply2 Under voltage fault
3510	5	ECU Sensor supply2 voltage fault
3510	6	ECU Sensor supply2 Short circuit to ground
3510	11	ECU Sensor supply Undervoltage monitoring error
3511	3	ECU Sensor supply3 Over voltage fault
3511	4	ECU Sensor supply3 Under voltage fault
3511	5	ECU Sensor supply3 voltage fault
3511	6	ECU Sensor supply3 Short circuit to ground
3516	0	DEF Quality Too High fault
3516	1	DEF Quality Too Low fault
3517	18	DEF Tank level is empty
3520	3	DEF Quality Sensor Open circuit
3520	4	DEF Quality Sensor Short circuit
3532	3	DEF Level Sensor Open circuit
3532	4	DEF Level Sensor Short circuit
3695	3	DPF regeneration inhibit switch Stuck (Short to Battery) fault (Hardwire)
3696	3	DPF regeneration enable switch Stuck (Short to Battery) fault (Hardwire)
3696	11	DPF regeneration inhibit & enable switch plausibility fault (Hardwire)
3697	3	DPF lamp 1 (DPF regeneration switch enable lamp) Short to Battery
3697	4	DPF lamp 1 (DPF regeneration switch enable lamp) Short to Ground
3697	5	DPF lamp 1 (DPF regeneration switch enable lamp) Open circuit
3715	14	DPF regeneration failure (DPF regeneration is not performed well during machine operation mode)
3720	16	DPF Ash loading High fault (Ash cleaning is needed)
4082	3	Fuel metering unit Short circuit to Battery fault
4082	4	Fuel metering unit Short circuit to Ground fault
4082	5	Fuel metering unit Open circuit fault
4082	7	Fuel metering unit Over temperature fault
4335	0	DEF Overpressure error at METERINGCONTROL (DEF pump pressure is too high)
4335	1	DEF Underpressure error at METERINGCONTROL (DEF pump pressure is too low)
4335	2	DEF pressure build up error at PRESSUREBUILDUP (DEF pump pressure is too low)
4335	7	DEF Leakage detection at METERINGCONTROL
4335	12	DEF Overpressure error regardless of the state (DEF pump pressure is too high)

Fault code		Description
SPN	FMI	
4335	15	DEF Pressure reduction error at PRESSUREREDUCTION (Detected an insufficient pressure drop)
4335	16	DEF underpressure error at AFTERRUN_PRESSURECOMPENSATION
4344	2	DEF backflow Line plausibility error at DETECTIONMODE (Does not detect a pressure drop)
4354	5	DEF Pressure line heater circuit Open circuit Fault
4354	6	DEF Pressure line heater circuit Open circuit or Short circuit to ground Fault
4355	5	DEF Backflow line heater circuit Open circuit Fault
4355	6	DEF Backflow line heater circuit Open circuit or Short circuit to ground Fault
4356	5	DEF Suction line heater circuit Open circuit Fault
4356	6	DEF Suction line heater circuit Open circuit or Short circuit to ground Fault
4364	14	SCR Efficiency Too low fault
4365	3	DEF Temperature Sensor Open circuit
4365	4	DEF Temperature Sensor Short circuit
4365	14	DEF Tank temperature plausibility fault (Insufficient temperature increment)
4374	3	DEF Supply Pump Motor Signal output Short circuit to battery Fault
4374	4	DEF Supply Pump Motor Signal output Short circuit to ground Fault
4374	5	DEF Supply Pump Motor Signal output Open circuit Fault
4374	7	DEF Supply Pump Motor Signal output Over temperature Fault
4374	8	DEF Supply Pump Motor Speed Deviation Fault
4374	9	DEF Supply Pump Motor Speed Deviation Permanent Fault
4374	12	DEF Supply Pump Motor No activation Fault
4781	15	DPF Soot mass too high status (> 120%)
4781	16	DPF Soot mass high status (> 110%)
5067	3	PTO (Idle up) Lamp Short to Battery
5067	4	PTO (Idle up) Lamp Short to Ground
5067	5	PTO (Idle up) Lamp Open circuit
5099	3	Oil Pressure Warning Lamp Short to Battery
5099	4	Short circuit to ground error of oil pressure lamp
5099	5	Oil Pressure Warning Lamp Open circuit
5313	3	Rail pressure sensor High fault
5313	4	Rail pressure sensor Low fault
5419	3	Throttle valve H-Bridge Driver Short circuit to battery
5419	4	Throttle valve H-Bridge Driver Short circuit to ground
5419	5	Throttle valve H-Bridge Driver Open Circuit Fault
5435	10	DEF pressure stabilization error at DETECTIONMODE (DEF pump pressure is not stable)
5435	12	DEF pressure check error at DETECTIONMODE (Detected an insufficient pressure drop)
5436	3	DEF Reverting valve output Short circuit to battery Fault
5436	4	DEF Reverting valve output Short circuit to ground Fault

Fault code		Description
SPN	FMI	
5436	5	DEF Reverting valve output Open circuit Fault
5436	7	DEF Reverting valve output Over temperature Fault
5436	11	DEF Reverting valve Pressure drop plausibility fault
5436	14	DEF Reverting valve is blocked (Detected an insufficient pressure drop)
5491	3	DEF Pressure line heater relay output Short circuit to battery Fault
5491	4	DEF Pressure line heater relay output Short circuit to ground Fault
5491	5	DEF Pressure line heater relay output Open circuit Fault
5491	7	DEF Pressure line heater relay output Over temperature Fault
5491	12	DEF Pressure line heater feedback plausibility Fault
5571	22	Common rail pressure relief valve reached maximum allowed opening count
5571	23	Common rail pressure relief valve Forced to open status (Pressure increase)
5571	24	Common rail pressure relief valve Forced to open status (Pressure shock)
5571	25	Common rail pressure relief valve is open
5571	27	Averaged rail pressure is outside the expected tolerance range
5571	28	Common rail pressure relief valve reached maximum allowed open time
5629	14	DPF differential pressure too high fault
5629	15	DPF differential pressure high fault (Warning)
5706	5	DEF Supply module heater circuit Open circuit Fault
5706	6	DEF Supply module heater circuit Open circuit or Short circuit to ground Fault
5706	12	DEF Supply module heater temperature plausibility fault (Insufficient temperature increment)
5706	14	DEF Supply module heater temperature plausibility fault at cold start (Insufficient temperature increment)
5706	22	DEF Supply module heater plausibility fault (Insufficient temperature increment)
5746	3	DEF Main heater relay output Short circuit to battery Fault
5746	4	DEF Main heater relay output Short circuit to ground Fault
5746	5	DEF Main heater relay output Open circuit Fault
5746	6	DEF heater line circuit Short circuit to battery Fault
5746	7	DEF Main heater relay output Over temperature Fault
5965	3	SCR system Main relay short circuit to battery
5965	4	SCR system Main relay short circuit to ground
5965	5	SCR system Main relay open circuit
6323	3	Electric fuel feed pump Output short to battery circuit fault
6323	4	Electric fuel feed pump Output short to ground circuit fault
6323	5	Electric fuel feed pump Output open circuit fault
6323	13	Electric fuel feed pump performance fault
6385	19	Timeout Error of CAN-Receive-Frame EOI (Engine Starter Motor Relay Control)
6875	3	DEF Supply Pump pressure sensor High fault
6875	4	DEF Supply Pump pressure sensor Low fault

Fault code		Description
SPN	FMI	
6875	16	DEF Supply Pump pressure sensor High plausibility fault
6875	18	DEF Supply Pump pressure sensor Low plausibility fault
6915	3	DPF lamp 2 (DPF Regeneration Active Lamp) Short to Battery
6915	4	DPF lamp 2 (DPF Regeneration Active Lamp) Short to Ground
6915	5	DPF lamp 2 (DPF Regeneration Active Lamp) Open circuit
6916	3	DPF lamp 3 (DPF regeneration switch inhibit lamp) Short to Battery
6916	4	DPF lamp 3 (DPF regeneration switch inhibit lamp) Short to Ground
6916	5	DPF lamp 3 (DPF regeneration switch inhibit lamp) Open circuit
7069	3	DEF Backflow line heater relay output Short circuit to battery Fault
7069	4	DEF Backflow line heater relay output Short circuit to ground Fault
7069	5	DEF Backflow line heater relay output Open circuit Fault
7069	7	DEF Backflow line heater relay output Over temperature Fault
7069	12	DEF Backflow line heater feedback plausibility Fault
7107	12	DEF Supply module temperature plausibility fault (Insufficient temperature increment)
7107	14	DEF Supply module temperature plausibility fault at cold start (Insufficient temperature increment)
7416	3	DEF Supply module heater relay output Short circuit to battery Fault
7416	4	DEF Supply module heater relay output Short circuit to ground Fault
7416	5	DEF Supply module heater relay output Open circuit Fault
7416	7	DEF Supply module heater relay output Over temperature Fault
7416	12	DEF Supply module heater feedback plausibility Fault
7538	12	DEF Supply module temperature duty cycle in failure range
7538	13	Diagnostic Fault Check for Urea supply module duty cycle in the invalid range
7538	22	DEF Supply module heater temperature duty cycle in failure range
7538	23	DEF Supply module heater temperature duty cycle in invalid range
7538	24	DEF Supply module temperature measurement non-availability fault
7538	25	DEF Supply module time period outside specified range
7538	26	DEF Supply module PWM signal fault
7540	3	DEF Suction line heater relay output Short circuit to battery Fault
7540	4	DEF Suction line heater relay output Short circuit to ground Fault
7540	5	DEF Suction line heater relay output Open circuit Fault
7540	7	DEF Suction line heater relay output Over temperature Fault
7540	12	DEF Suction line heater feedback plausibility Fault
7748	3	Starter relay power stage output short circuit to battery
7748	4	Starter relay HS power stage output short circuit to ground
7748	5	Starter relay power stage output open circuit
8614	12	Injection cut off demand (ICO) for shut off coordinator
55296	12	ECU EEPROM Read Error
55552	12	ECU EEPROM Write Error

Fault code SPN	FMI	Description
57344	19	Timeout Error of CAN-Receive-Frame CM1 (Status of regeneration initiate and inhibit switches)
61441	19	Timeout Error of CAN-Receive-Frame EBC1 (Engine shut off request)
61454	19	Timeout Error of CAN-Receive-Frame AT1IG1 (NOx Upstream Concentration)
61455	19	Timeout Error of CAN-Receive-Frame AT1O1 (NOx Downstream Concentration)
64923	19	Timeout Error of CAN-Receive-Frame A1DEFI (DEF Tank)
65110	19	Timeout Error of CAN-Receive-Frame AT1T1I (Urea Level, Temperature over CAN)
65164	19	Timeout Error of CAN-Receive-Frame AAI (Hydraulic Oil Temperature)
65241	19	Timeout Error of CAN-Receive-Frame AUXIO1 (status of vehicle cut off [Safety bar])
65265	19	Timeout Error of CAN-Receive-Frame RxCCVS (PTO / Idle up)
65272	19	Timeout Error of CAN-Receive-Frame TRF1 (Transmission oil temperature)
65320	19	Timeout Error of CAN-Receive-Frame FanCtl (FAN Control)
65400	19	Timeout Error of CAN-Receive-Frame RxSMVCU (Pedal & Engine speed demand from VCU)
65400	22	Message Check Sum Error of CAN Receive Frame SMVCU (Pedal & Engine speed demand from VCU)
65400	23	Message Counter Error of CAN Receive Frame SMVCU (Pedal & Engine speed demand from VCU)
65401	19	Timeout Error of CAN-Receive-Frame DPM1 (Air Conditioning Switch Status / Oil life reset)
65402	19	Timeout Error of CAN-Receive-Frame DPM9 (Multiple torque Map select switch)
104332	9	NOx sensor Mounting Error (Upstream NOx sensor)
104385	9	NOx sensor Mounting Error (Downstream NOx sensor)
520601	12	CY327(Power control chipset) SPI Communication Error
520618	12	ECU ADC(Analog to Digital Convertor) NTP(Null Load Test Pulse) Monitoring fault
520641	12	ECU ROM Memory multiple error
520642	12	ECU MM(Monitoring Module) Synchronization Loss fault during Shut-off path test
520643	12	MoF(Monitoring of Function) Over Run error
520696	12	ECU ADC(Analog to Digital Convertor) Test error
520697	12	ECU ADC(Analog to Digital Convertor) Voltage ratio error
520698	12	ECU query response-communication error
520699	12	ECU SPI-communication error
520700	12	ECU Shut–off path test error
520701	12	ECU Wrong set response time error during shut off path test
520702	12	ECU Too many SPI errors during shut off path test
520703	12	ECU WDA working error during Shut-off path test
520704	12	ECU OS Timeout error during Shut-off path test
520705	12	ECU Positive test failure error during Shut-off path test
520706	12	ECU Shut-off path test timeout fault
520707	3	ECU Overvoltage error during Shut-off path test
520707	4	ECU Undervoltage error during Shut-off path test

Fault code		Description
SPN	FMI	
520723	12	NCD Inducement Fault Level1 (Group1 - EGR Block)
520724	12	NCD Inducement Fault Level2 (Group1 - EGR Block)
520725	12	NCD Inducement Fault Level3 Final inducement (Group1 - EGR Block)
520726	12	NCD Inducement Fault Warning (Group1 - EGR Block)
520727	12	NCD Inducement Fault Level1 (Group2 – Dosing Interrupt)
520728	12	NCD Inducement Fault Level2 (Group2 – Dosing Interrupt)
520729	12	NCD Inducement Fault Level3 Final inducement (Group2 – Dosing Interrupt)
520730	12	NCD Inducement Fault Warning (Group2 – Dosing Interrupt)
520736	12	NCD inducement Fault Level1 (Group4 – DEF Quality)
520737	12	NCD inducement Fault Level2 (Group4 – DEF Quality)
520738	12	NCD inducement Fault Level3 Final inducement (Group4 – DEF Quality)
520739	12	NCD inducement Fault Warning (Group4 – DEF Quality)
520740	12	NCD inducement Fault Level1 (Group5 – Tampering)
520741	12	NCD inducement Fault Level2 (Group5 – Tampering)
520742	12	NCD inducement Fault Level3 Final inducement (Group5 – Tampering)
520743	12	NCD inducement Fault Warning (Group5 – Tampering)
520790	12	NCD inducement Repeat offense Level1
520791	12	NCD inducement Repeat offense Level2
520792	12	NCD inducement Repeat offense Level3 Final inducement
520797	12	MoF(Monitoring of Function) Engine speed error

SECTION 5 TROUBLESHOOTING

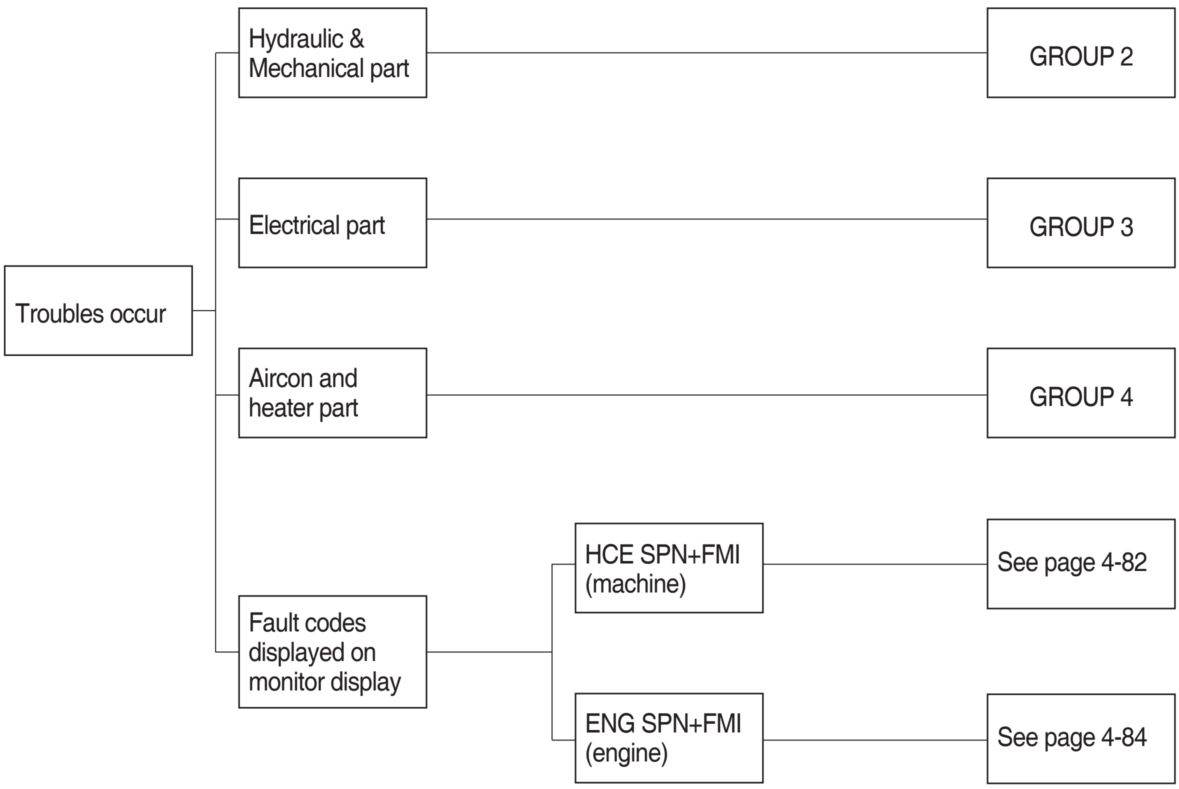
GROUP 1 BEFORE TROUBLESHOOTING

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, and Air conditioner and heater system.

At each system part, an operator can check the machine according to the troubleshooting process diagram.

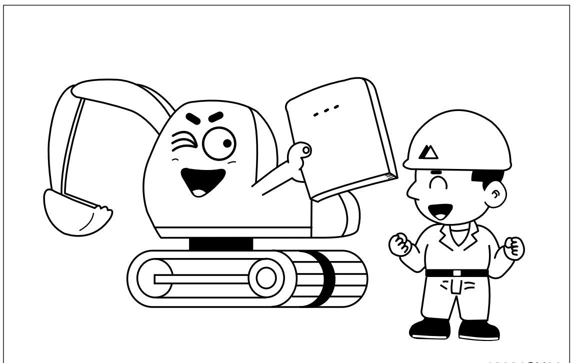


2. DIAGNOSING PROCEDURE

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.



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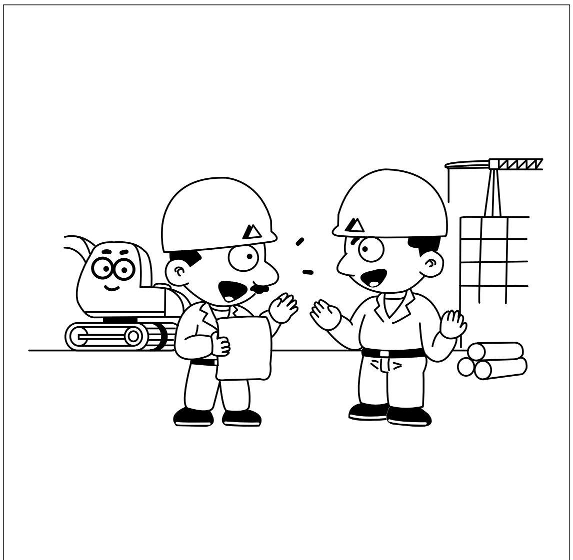
STEP 2. Ask the operator

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

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

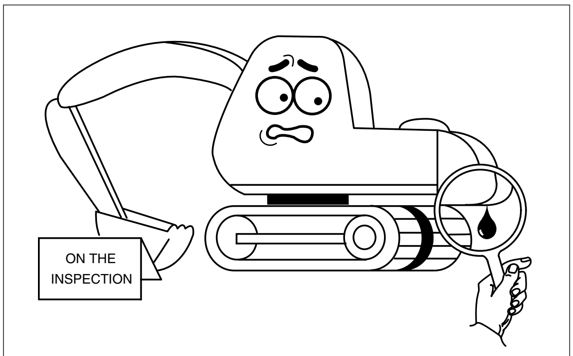


13031SH03

STEP 3. Inspect the machine

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

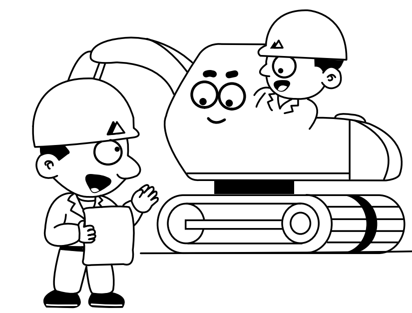
And also check the electrical system including batteries, as the troubles in the electrical system such as low battery voltage, loose connections and blown out fuses will result in malfunction of the controllers causing total operational failures of the machine.



6-2(3) 140-7

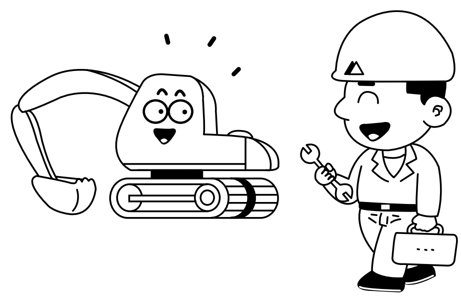
STEP 4. Inspect the trouble actually on the machine

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.


6-3(1) 140-7

STEP 5. Perform troubleshooting

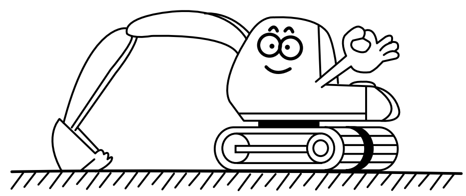
According to where the trouble parts are located, hydraulic & mechanical system part or electrical system part or mechatronics system part, perform troubleshooting the machine refer to the each system part's troubleshooting process diagram.


13031SH05

STEP 6. Trace a cause

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

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


6-3(3) 140-7

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.

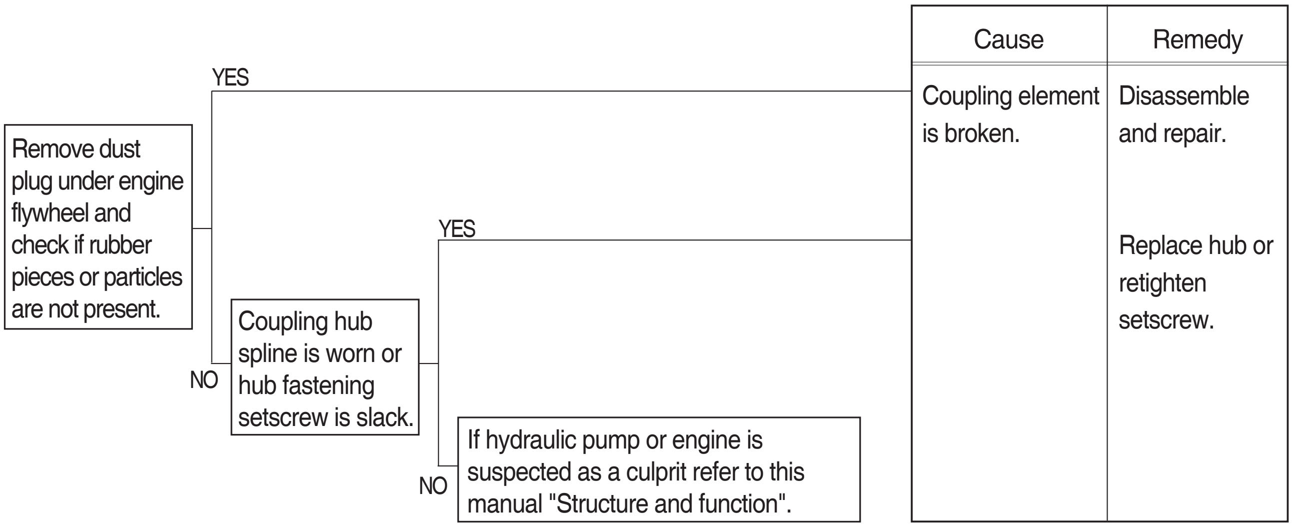
(3) When carrying out troubleshooting, do not hurry to disassemble the components.
It will become impossible to find the cause of the problem.

(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?

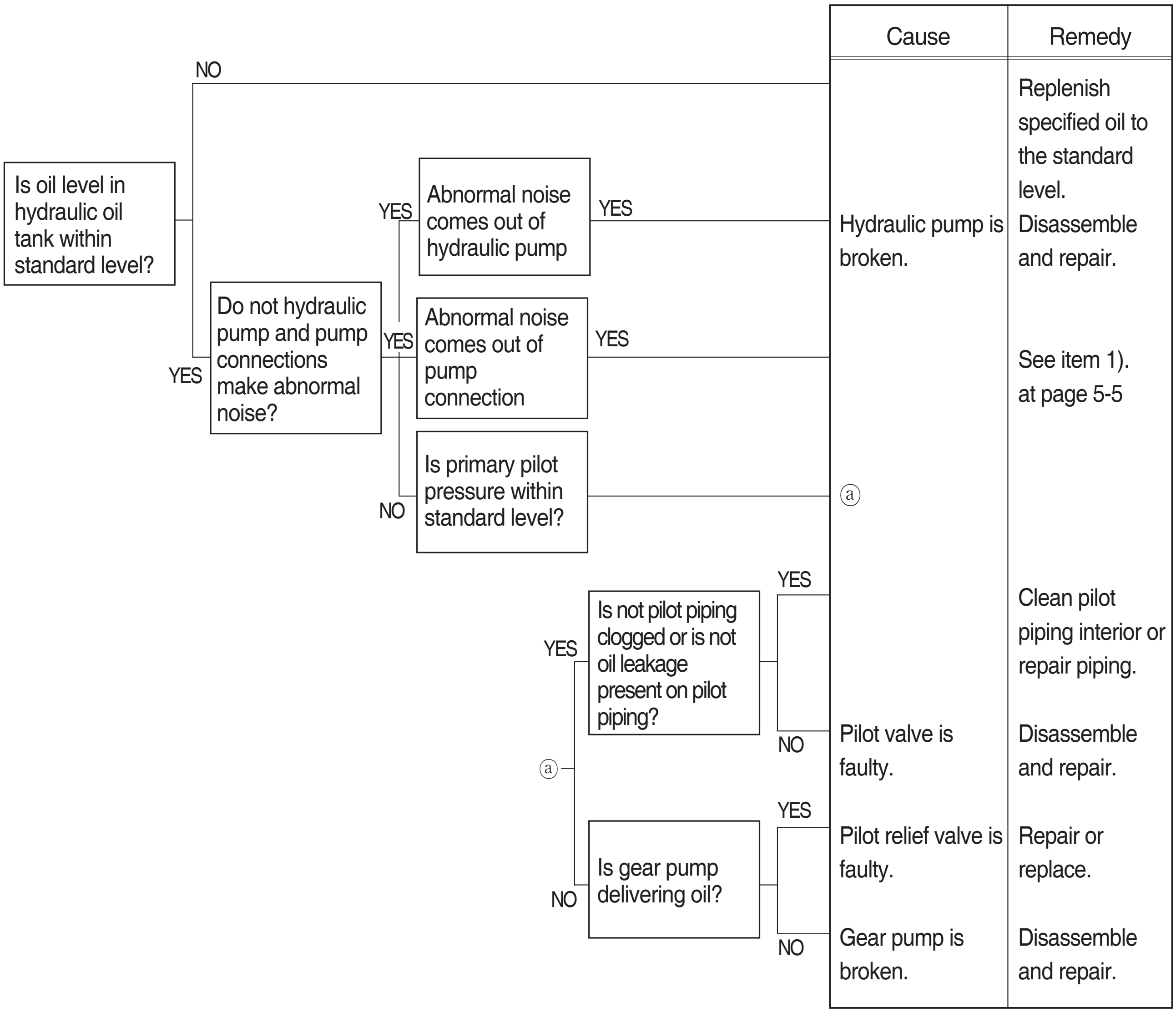
(5) Check before troubleshooting.
① Check oil and fuel level.
② Check for any external leakage of oil from components.
③ Check for loose or damage of wiring and connections.

2. DRIVE SYSTEM

1) UNUSUAL NOISE COMES OUT OF PUMP CONNECTION

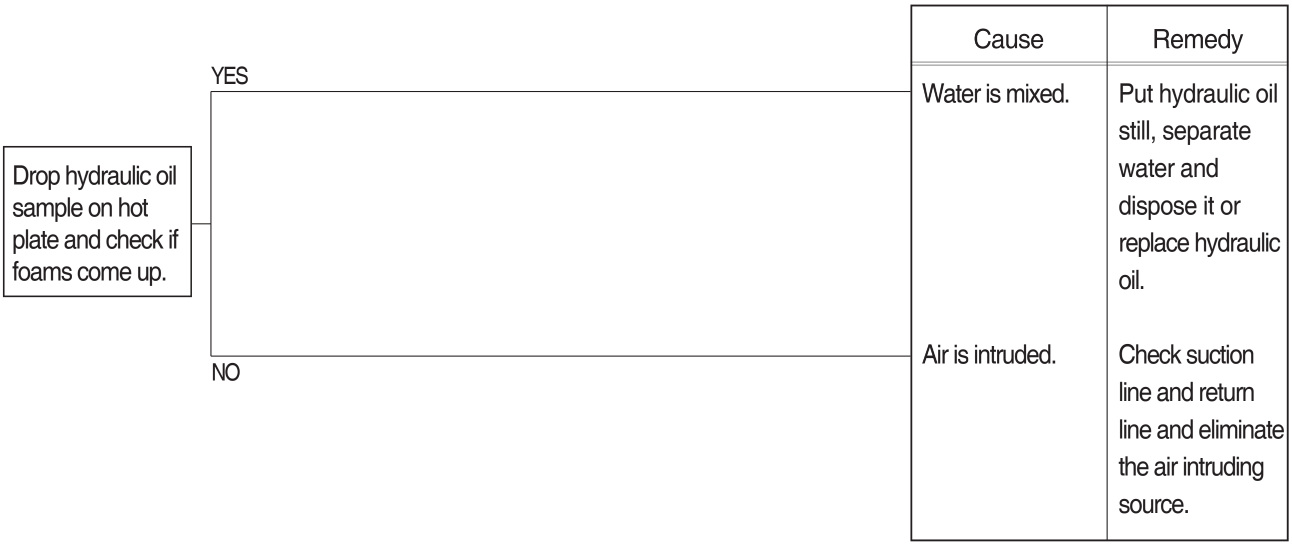


2) ENGINE STARTS BUT MACHINE DOES NOT OPERATE AT ALL

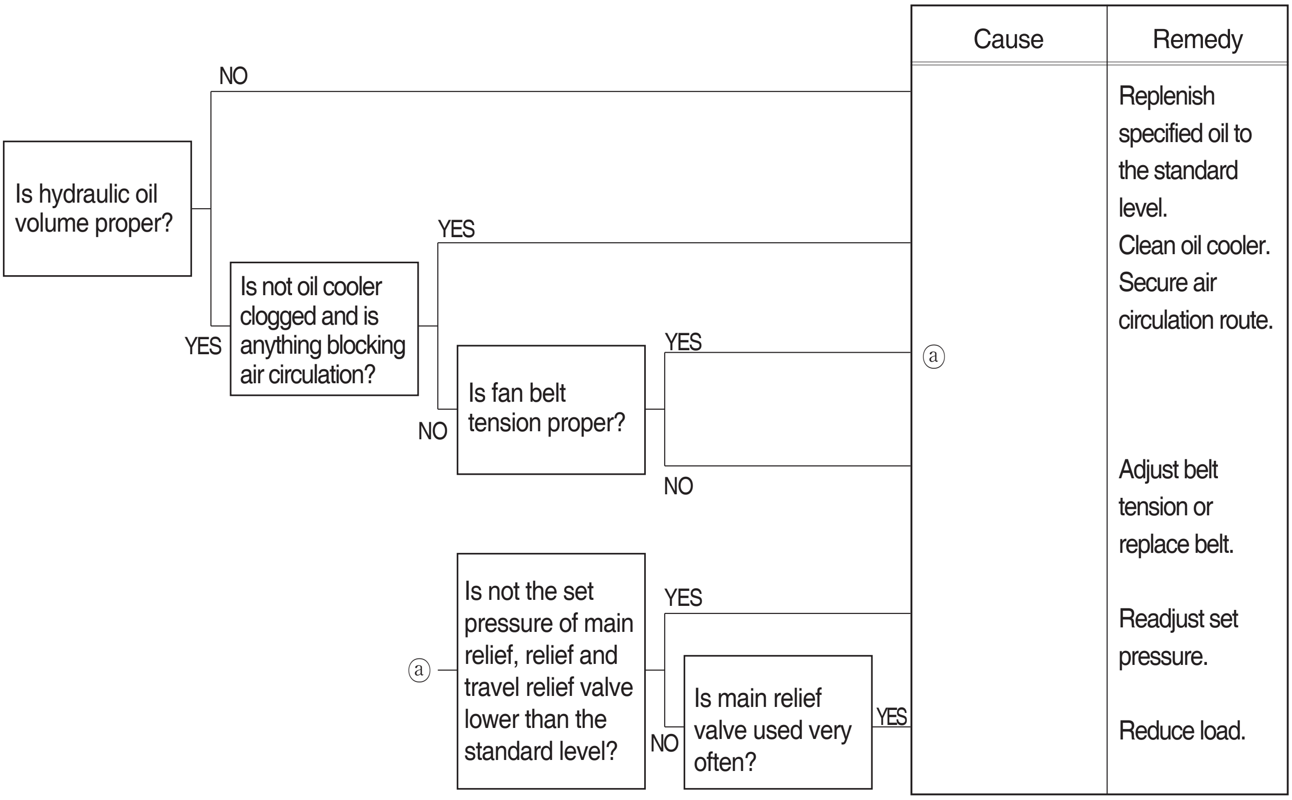


3. HYDRAULIC SYSTEM

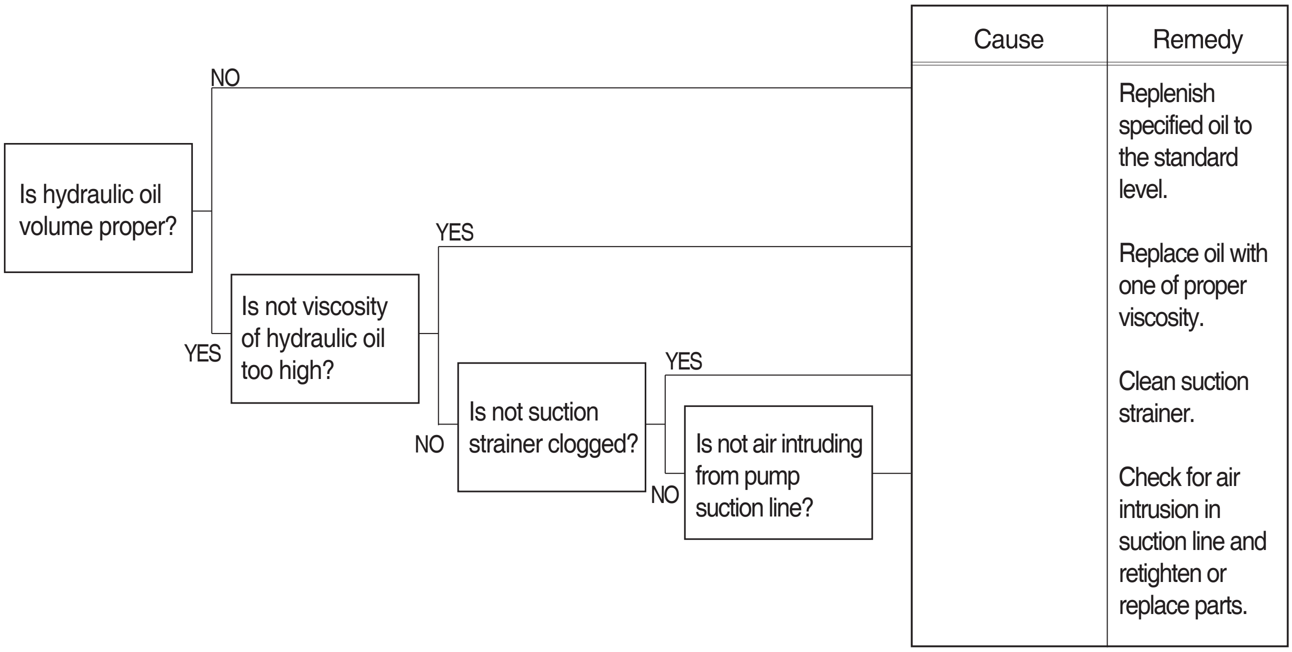
1) HYDRAULIC OIL IS CLOUDY



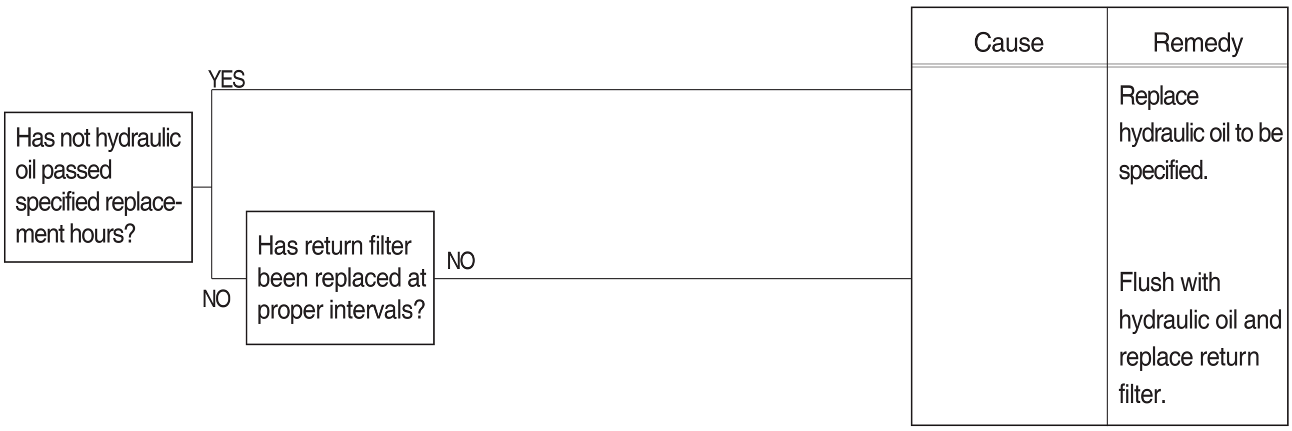
2) HYDRAULIC OIL TEMPERATURE HAS RISEN ABNORMALLY



3) CAVITATION OCCURS WITH PUMP

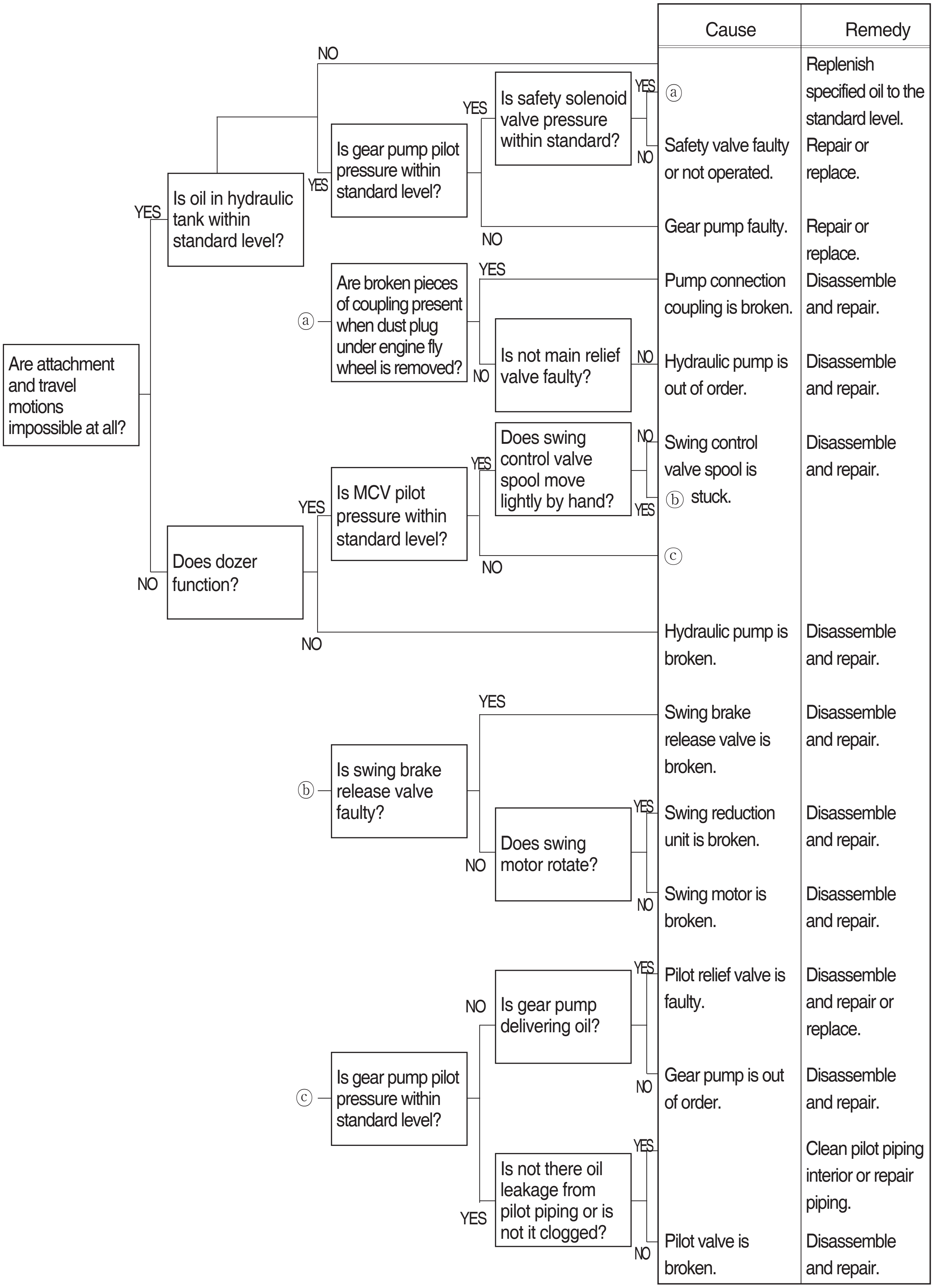


4) HYDRAULIC OIL IS CONTAMINATED

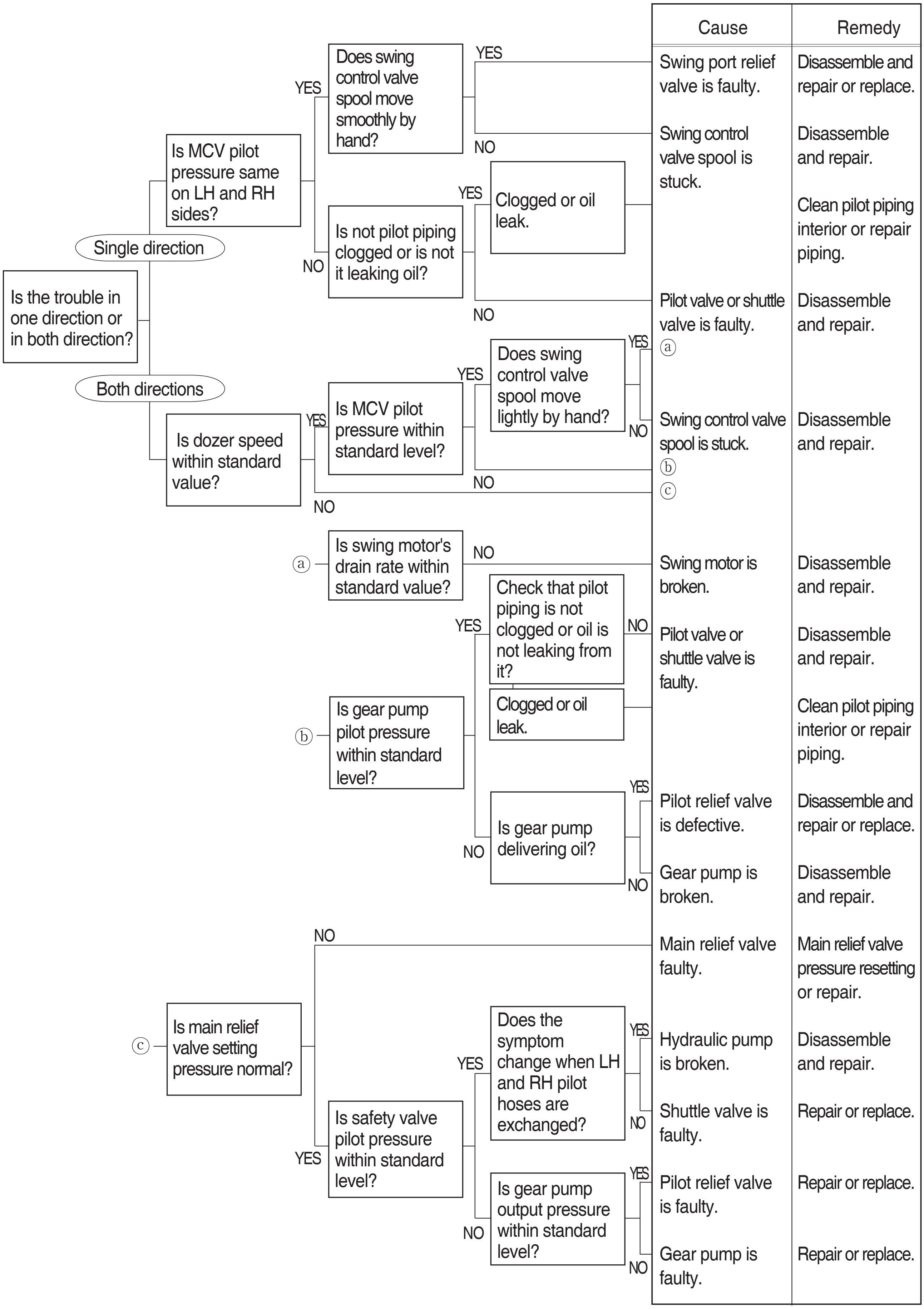


4. SWING SYSTEM

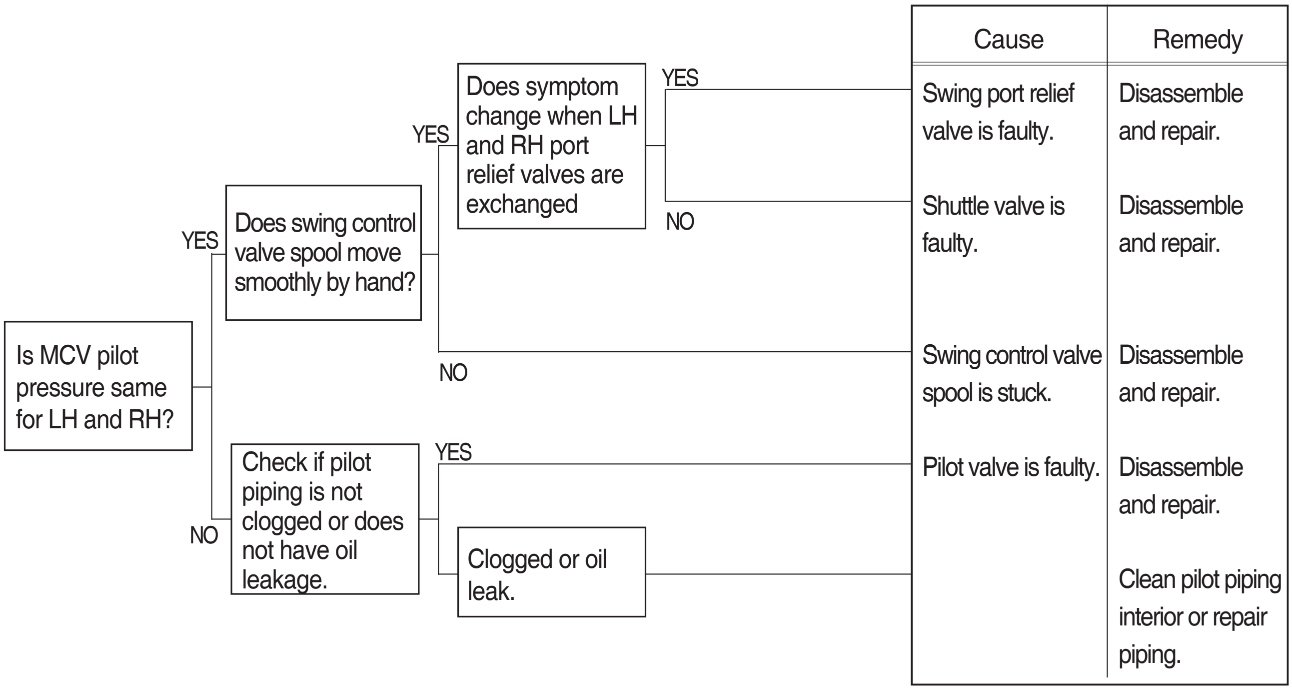
1) BOTH LH AND RH SWING ACTIONS ARE IMPOSSIBLE



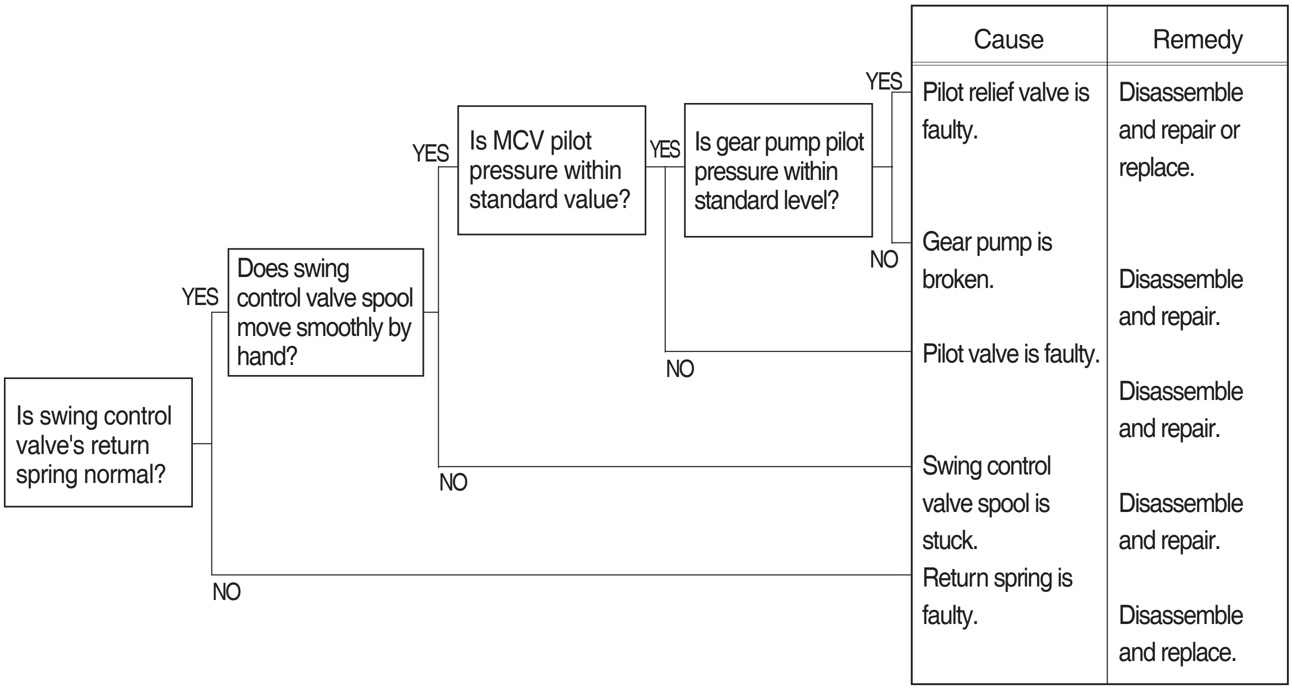
2) SWING SPEED IS LOW



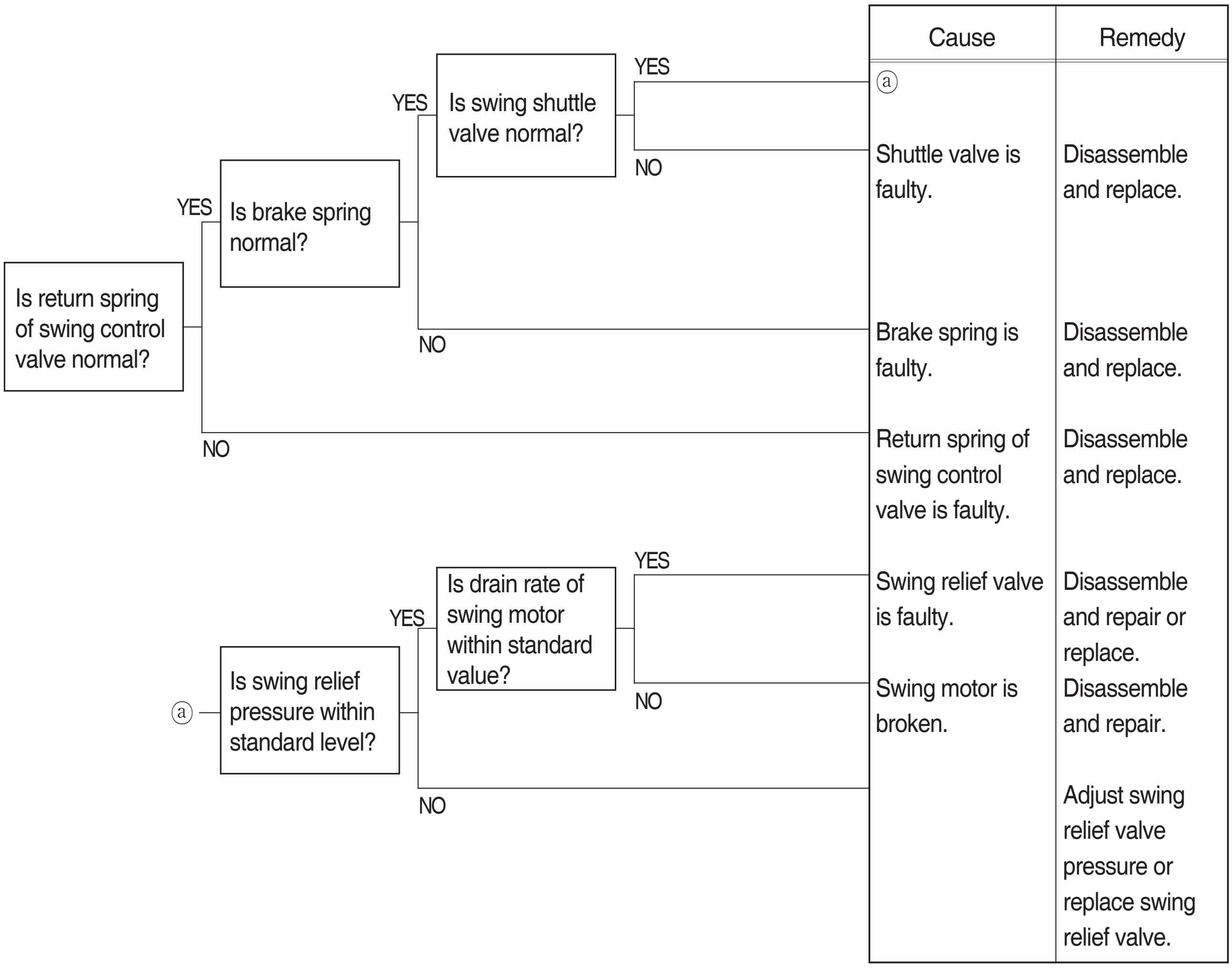
3) SWING MOTION IS IMPOSSIBLE IN ONE DIRECTION



4) MACHINE SWINGS BUT DOES NOT STOP

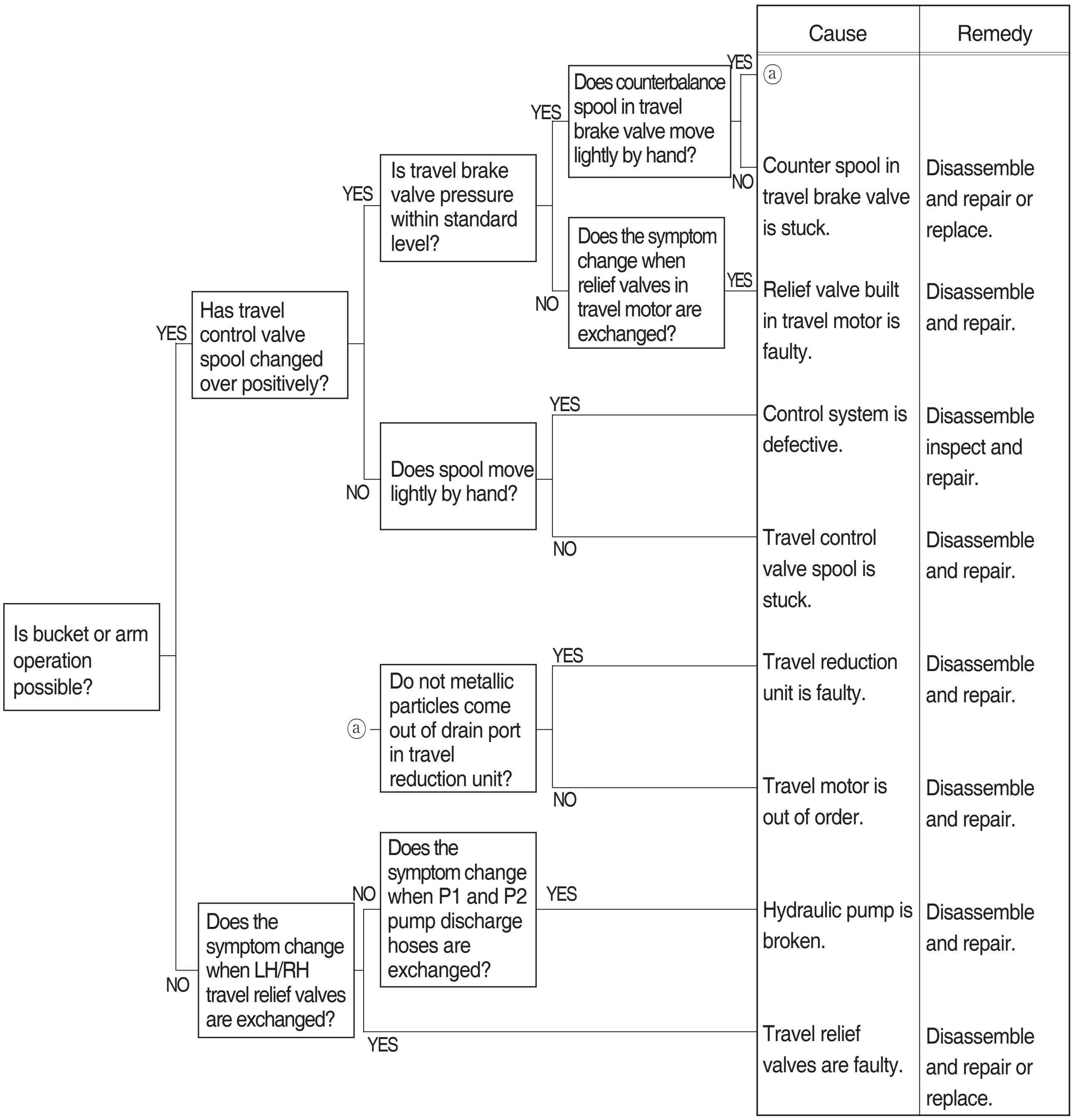


5) THE SWING UNIT DRIFTS WHEN THE MACHINE IS AT REST ON A SLOPE

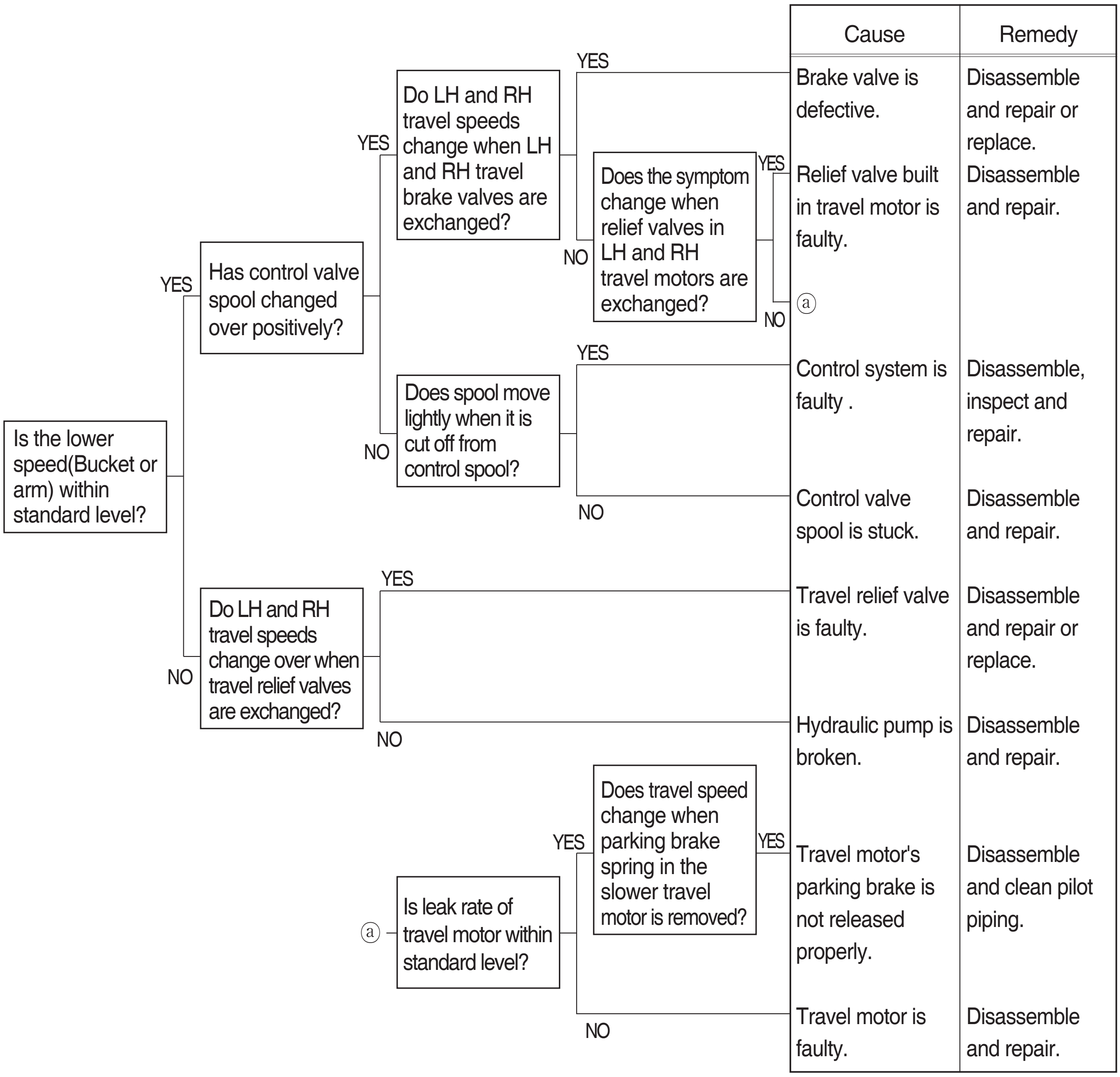


5. TRAVEL SYSTEM

1) TRAVEL DOES NOT FUNCTION AT ALL ON ONE SIDE

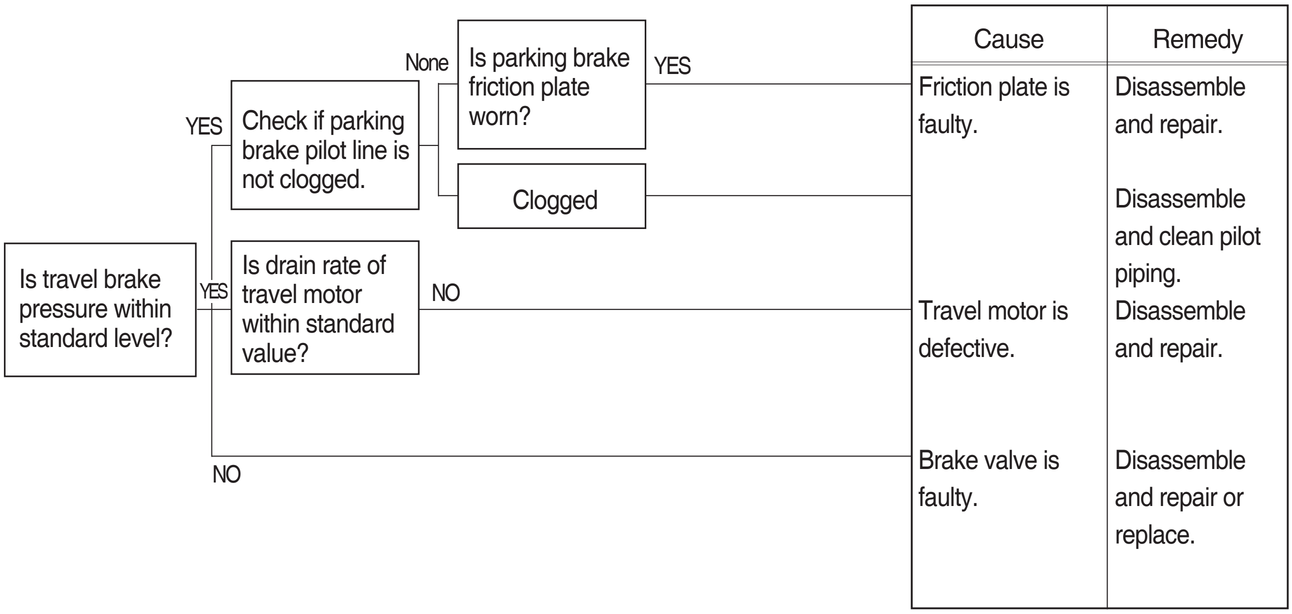


2) SPEED ON ONE SIDE FALLS AND THE MACHINE CURVES

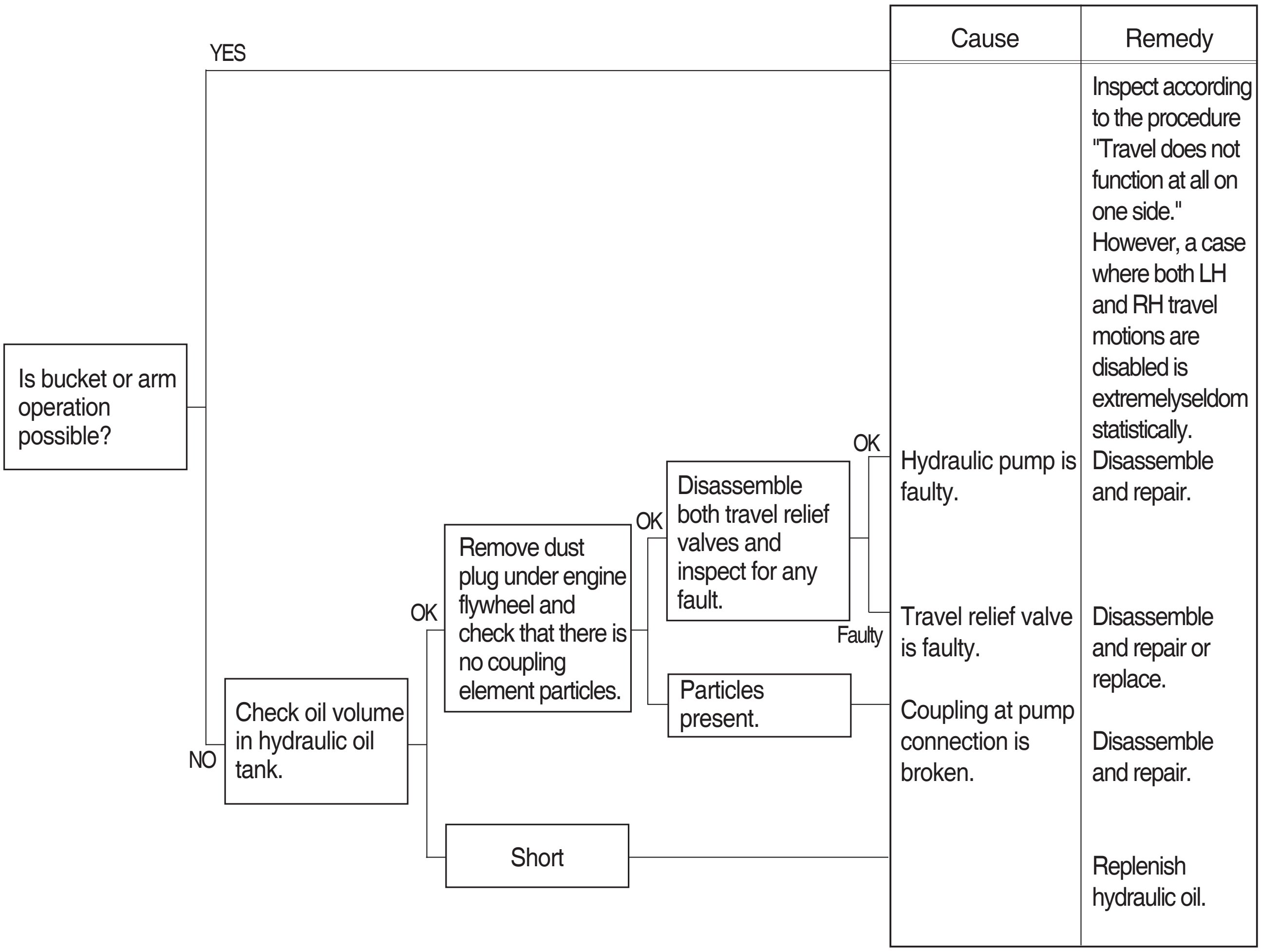


3) MACHINE DOES NOT STOP ON A SLOPE

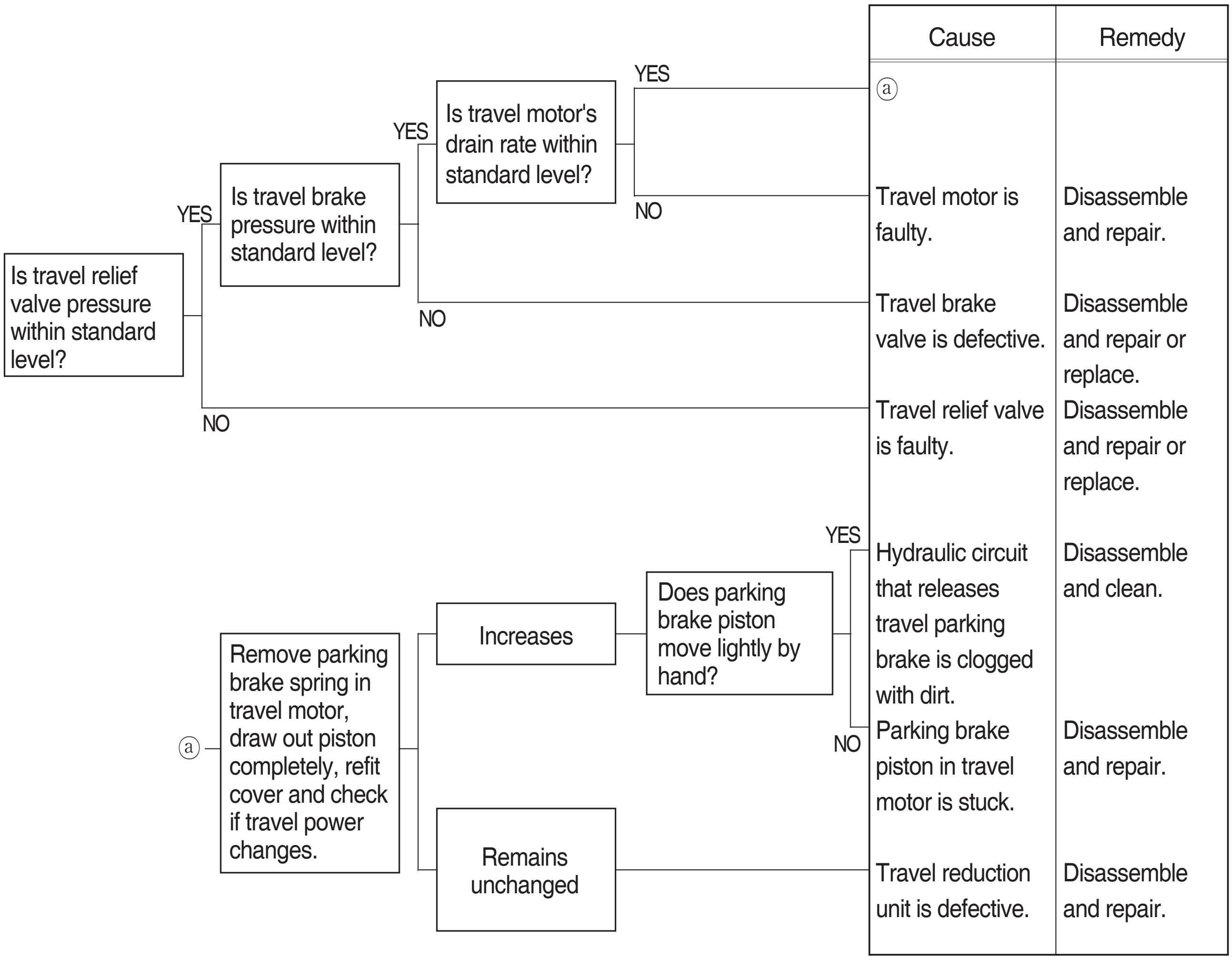
Machine is pulled forward as sprocket rotates during digging operation.



4) LH AND RH TRAVEL MOTIONS ARE IMPOSSIBLE

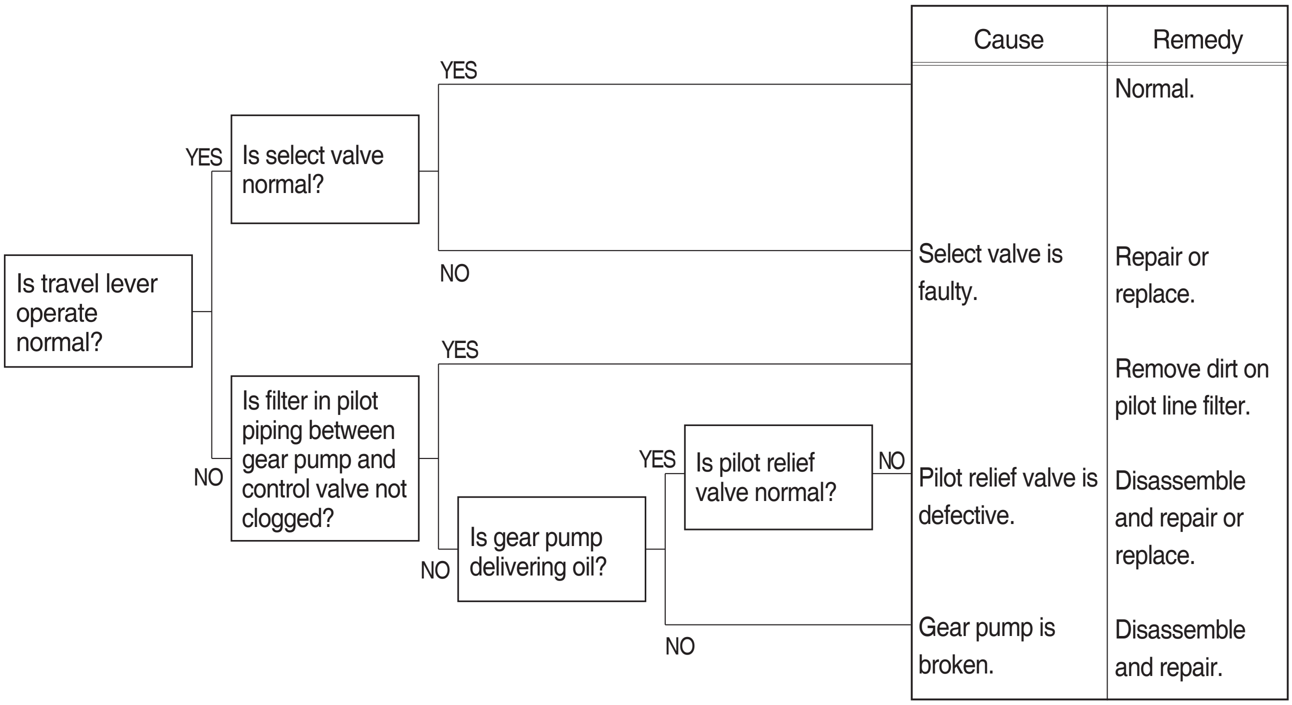


5) TRAVEL ACTION IS POWERLESS (travel only)



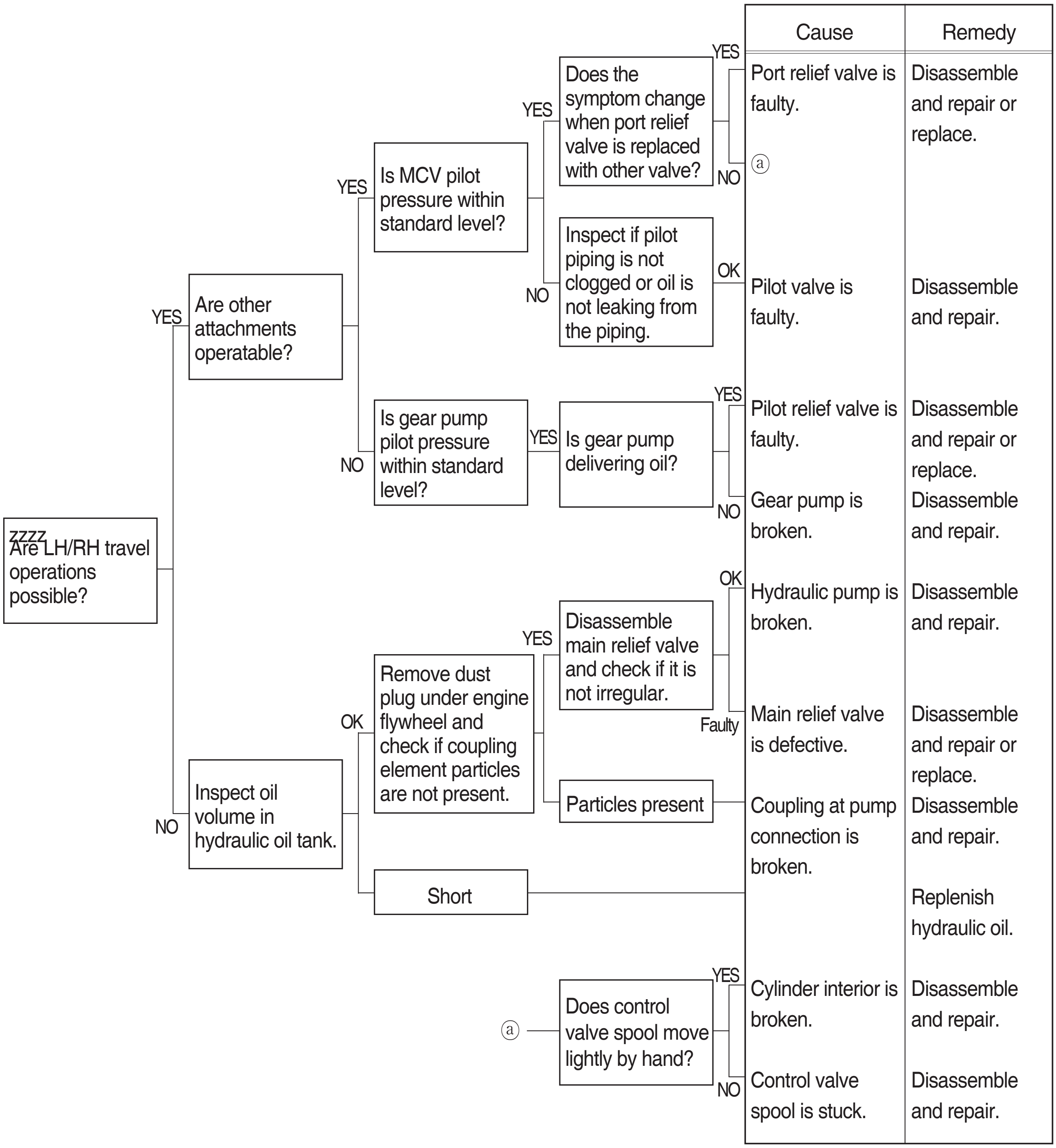
6) MACHINE RUNS RECKLESSLY ON A SLOPE

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

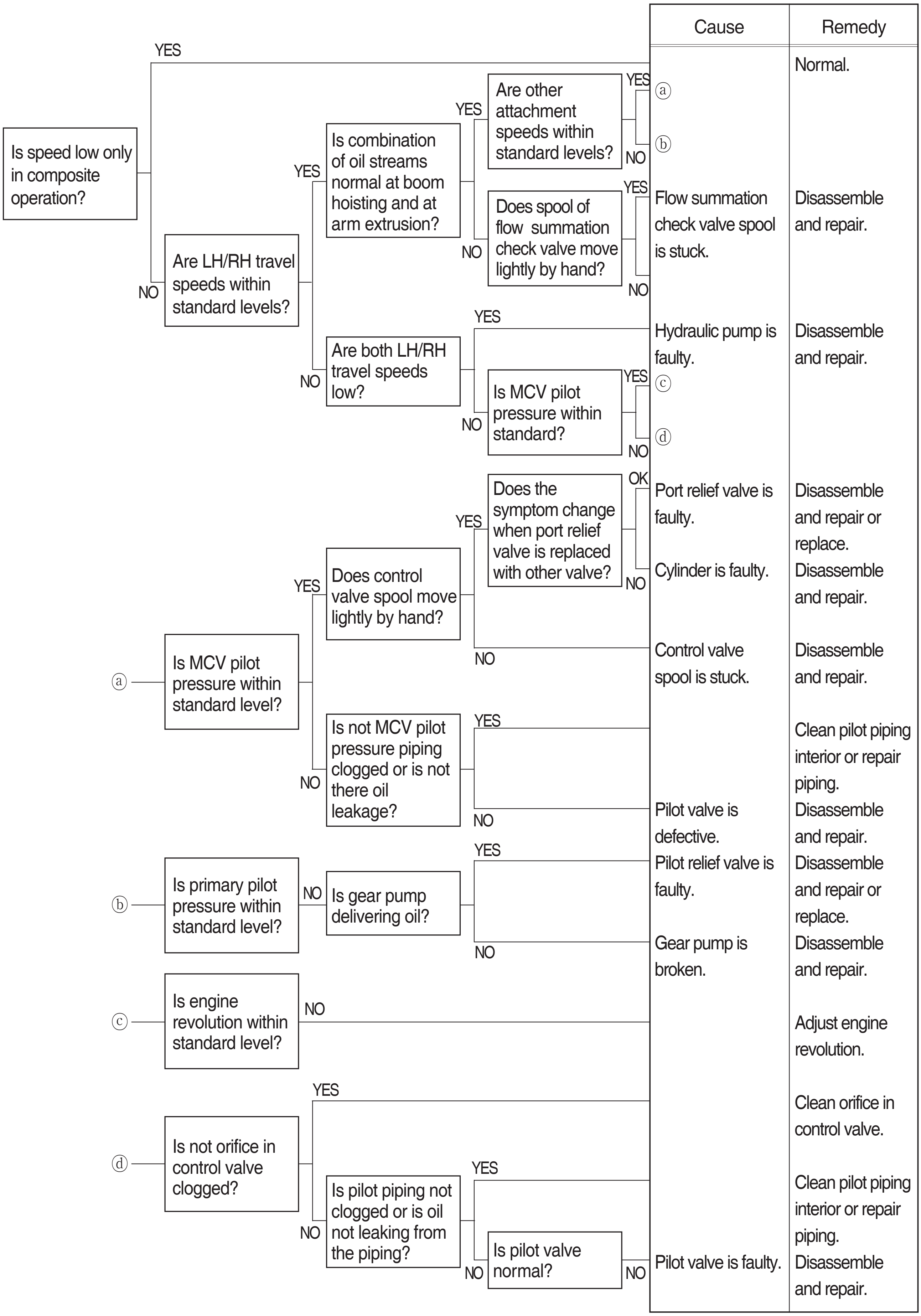


6. ATTACHMENT SYSTEM

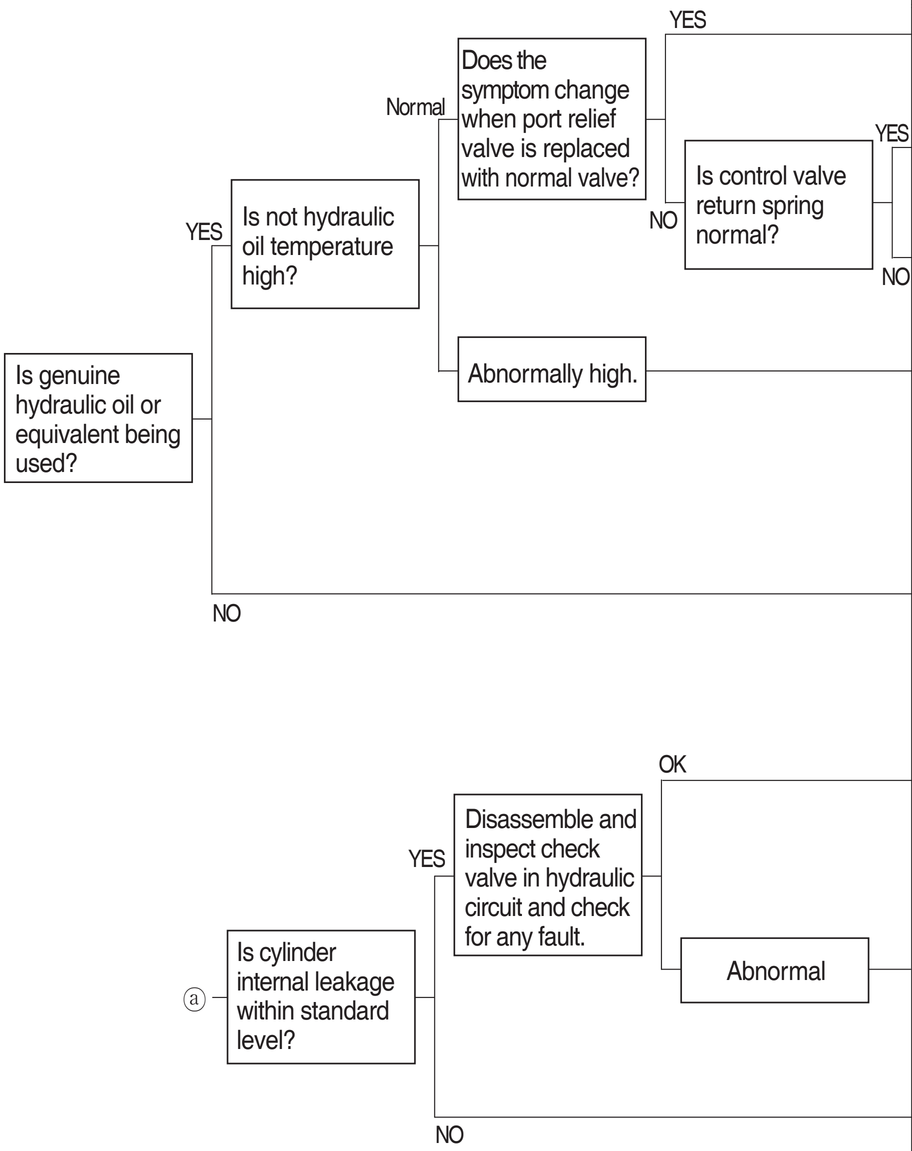
1) BOOM OR ARM ACTION IS IMPOSSIBLE AT ALL



2) BOOM, ARM OR BUCKET SPEED IS LOW

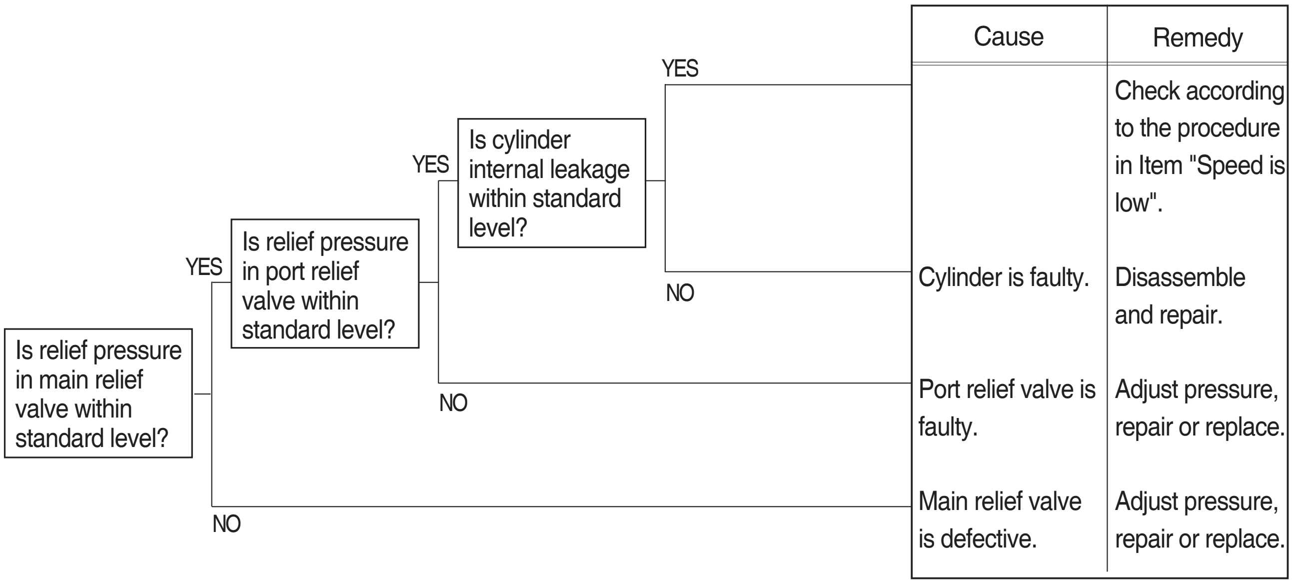


3) BOOM, ARM OR BUCKET CYLINDER EXTENDS OR CONTRACTS ITSELF AND ATTACHMENT FALLS

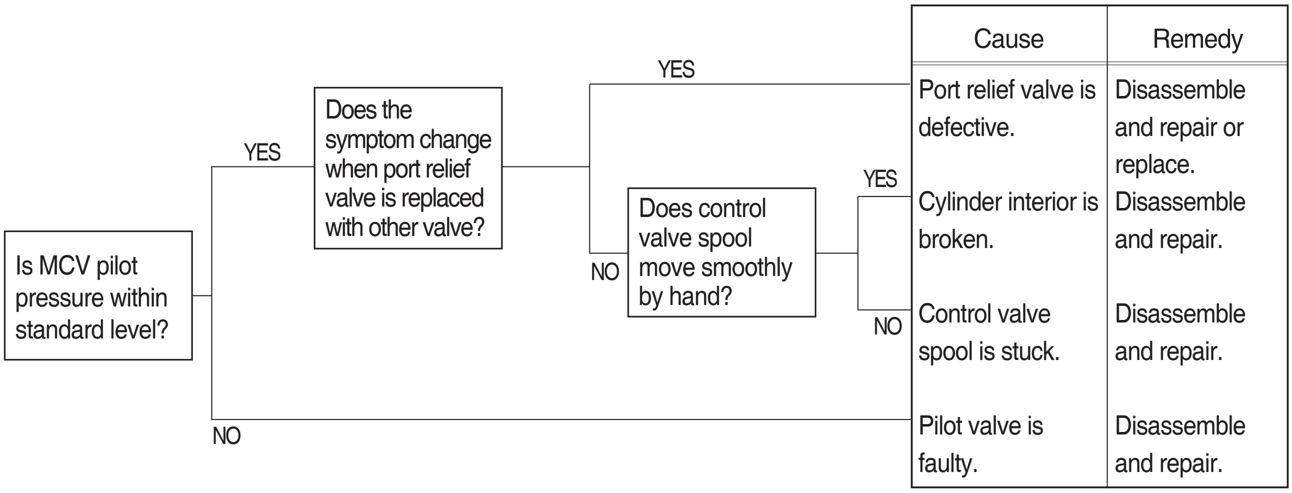


Cause	Remedy
Port relief valve is faulty.	Disassemble and repair or replace.
ⓐ	
Control valve's return spring is faulty.	Disassemble and replace.
	Locate the cause of hydraulic oil temperature rise and lower it to proper level.
	Replace with genuine hydraulic oil or equivalent.
Pressure tightness between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

4) BOOM, ARM OR BUCKET POWER IS WEAK



5) ONLY BUCKET OPERATION IS TOTALLY IMPOSSIBLE

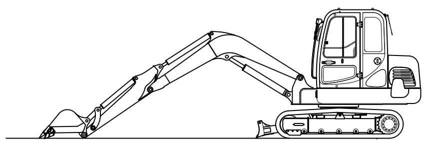


6) BOOM MAKES A SQUEAKING NOISE WHEN BOOM IS OPERATED

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

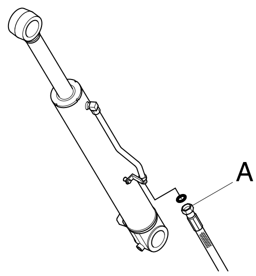
※ HOW TO CHECK INTERNAL BOOM CYLINDER LEAKAGE

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



R5575BY01

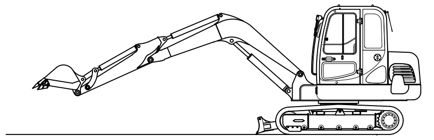
2. Disconnect hose(A) from rod side of boom cylinder and drain oil from cylinders and hose.(Put cups on piping and hose ends)



R5575BY02

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.

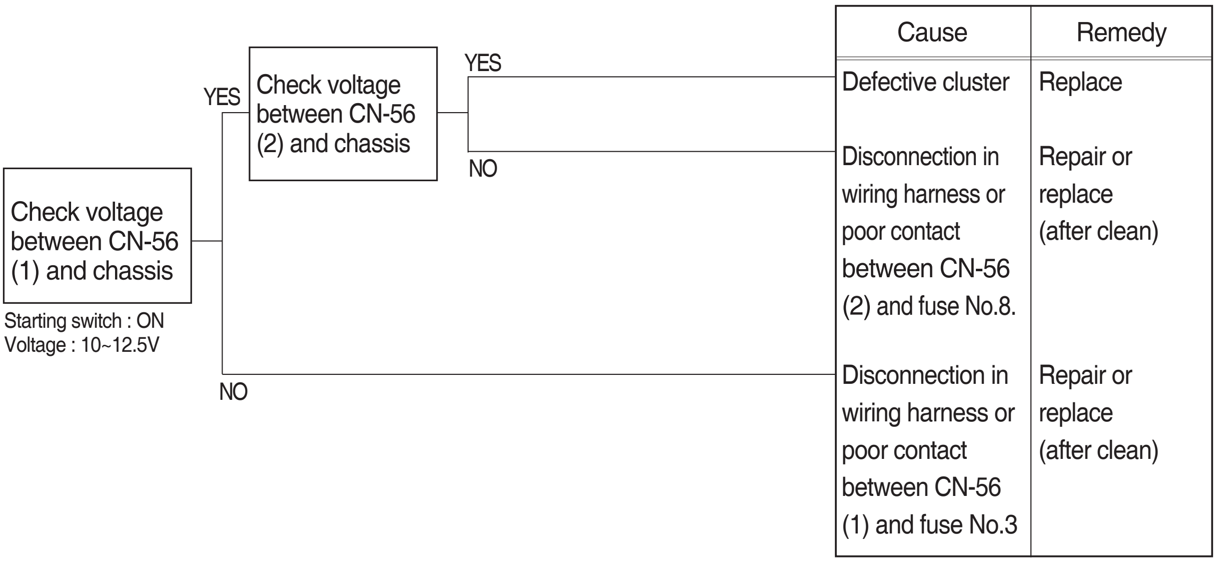


R5575BY03

GROUP 3 ELECTRICAL SYSTEM

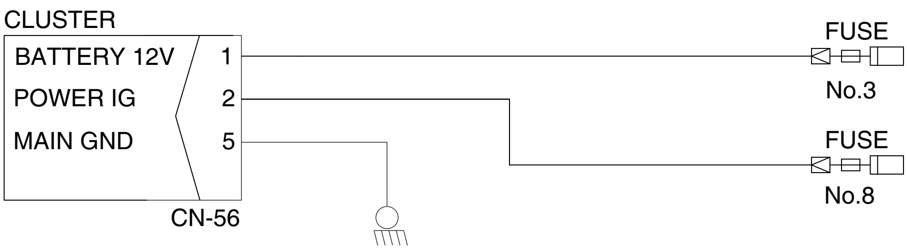
1. WHEN STARTING SWITCH IS TURNED ON, MONITOR PANEL DISPLAY DOES NOT APPEAR

· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted and short of fuse No.3 and No.8.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.



Check voltage

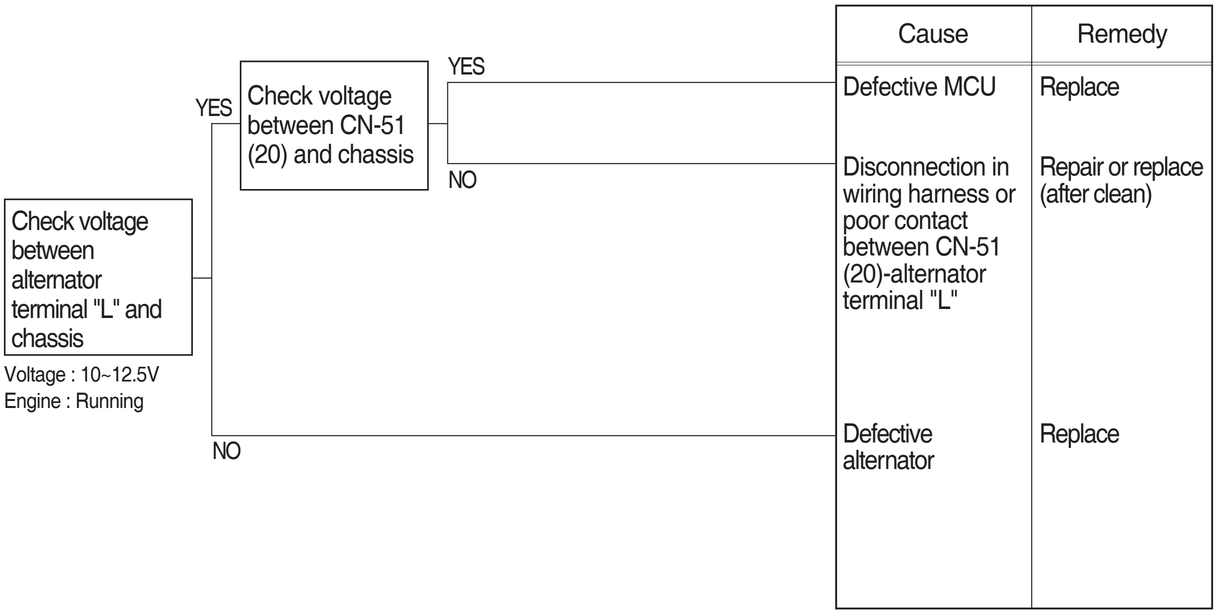
YES	10 ~ 12.5V
NO	0V



65A5TS10

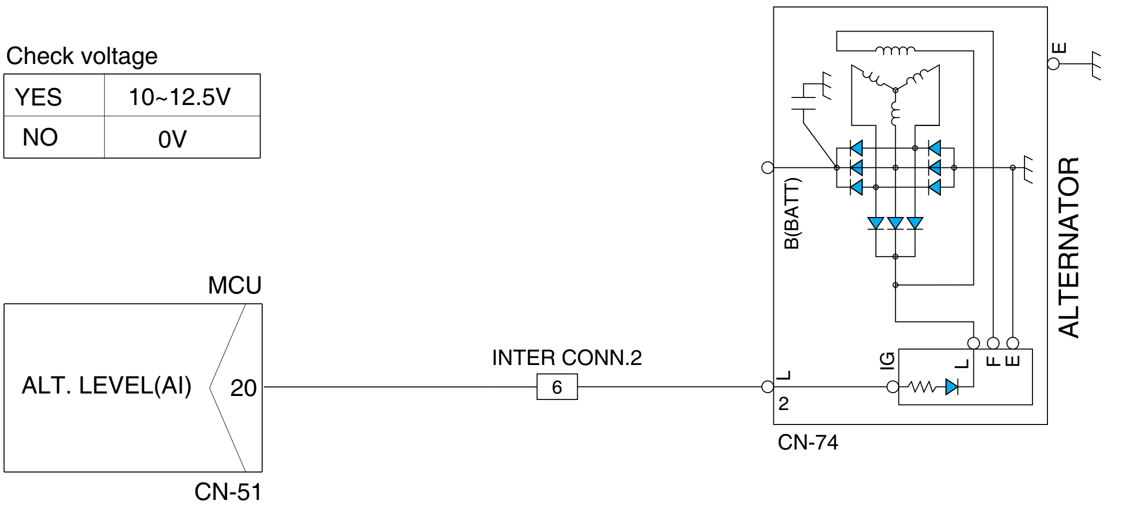
2. BATTERY CHARGING WARNING LAMP LIGHTS UP (starting switch : ON)

· 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

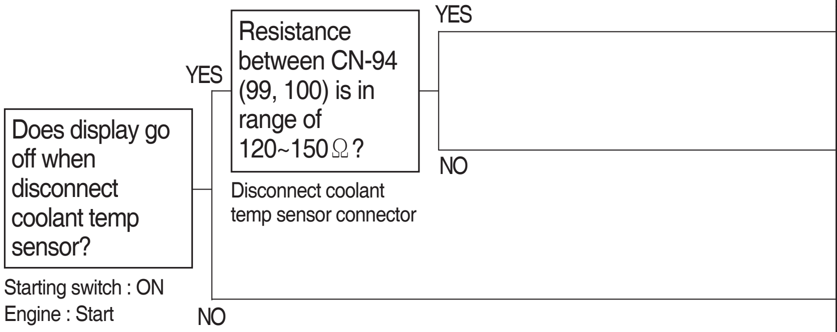
YES	10~12.5V
NO	0V



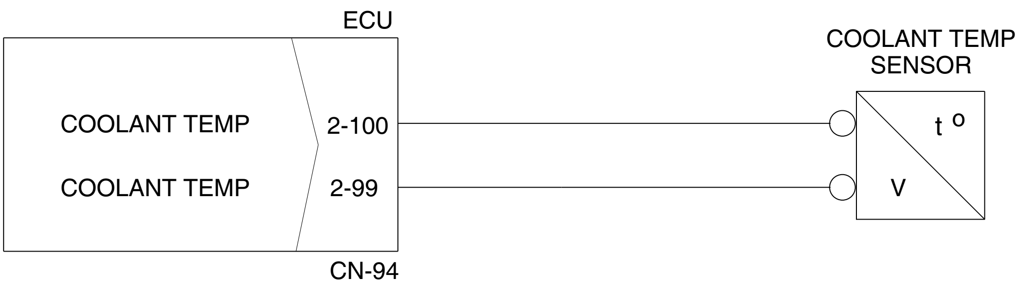
65A5TS11

3. 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.



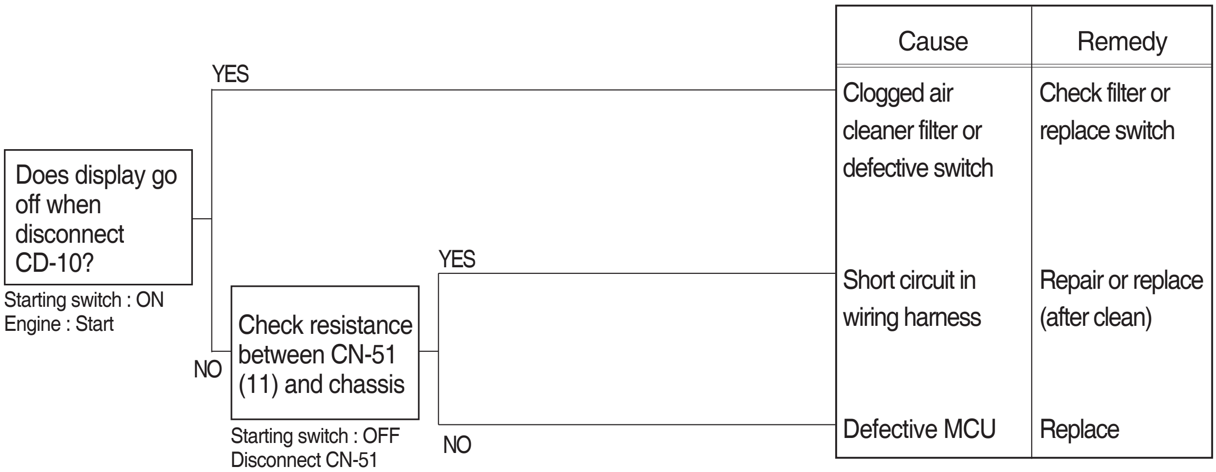
Cause	Remedy
Coolant overheat (115˚C ±2˚C)	Check engine cooling system
Defective temp sensor	Replace
Defective ECU	Replace



65A5TS12

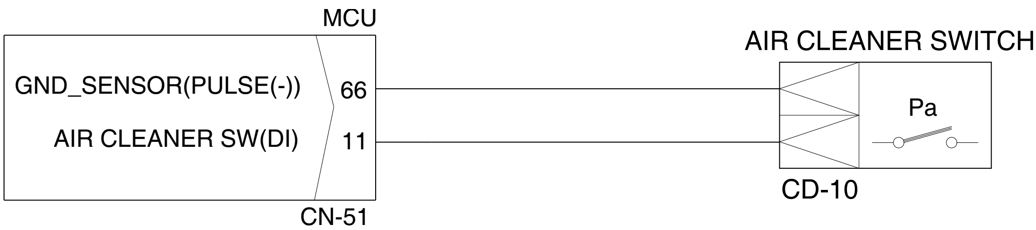
4. WHEN AIR CLEANER WARNING LAMP LIGHTS UP (engine is started)

· 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

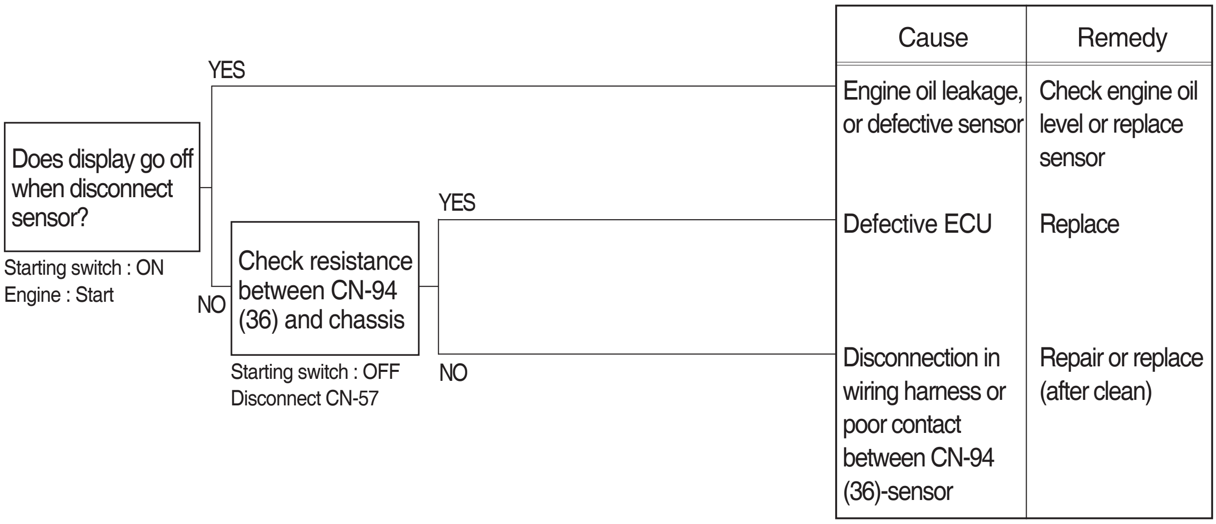
YES	MAX 1Ω
NO	MIN 1MΩ



65A5TS13

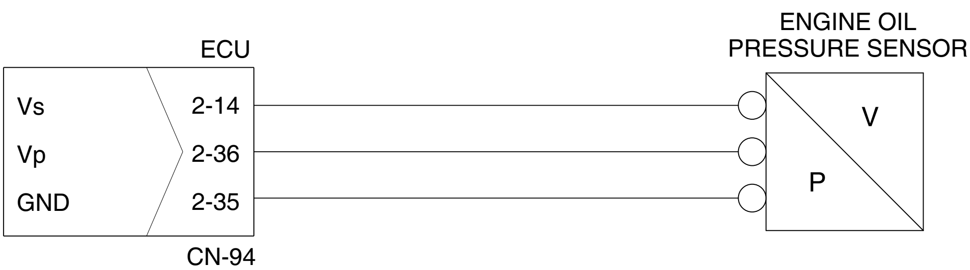
5. WHEN ENGINE OIL PRESSURE WARNING LAMP LIGHTS UP (engine is started)

· 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.



Check resistance

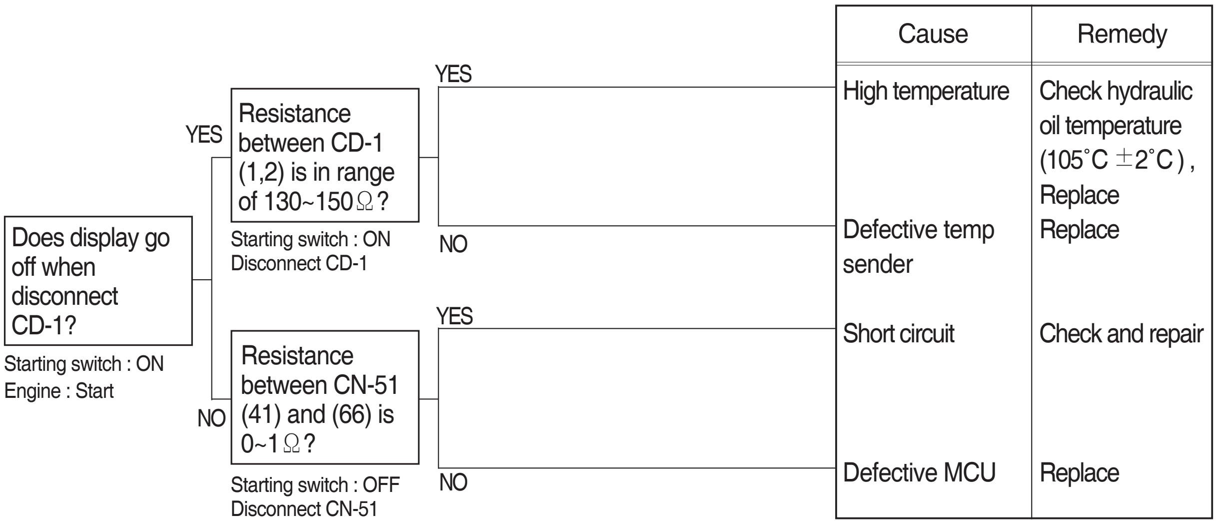
YES	MAX 1Ω
NO	MIN 1MΩ



65A5TS14

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

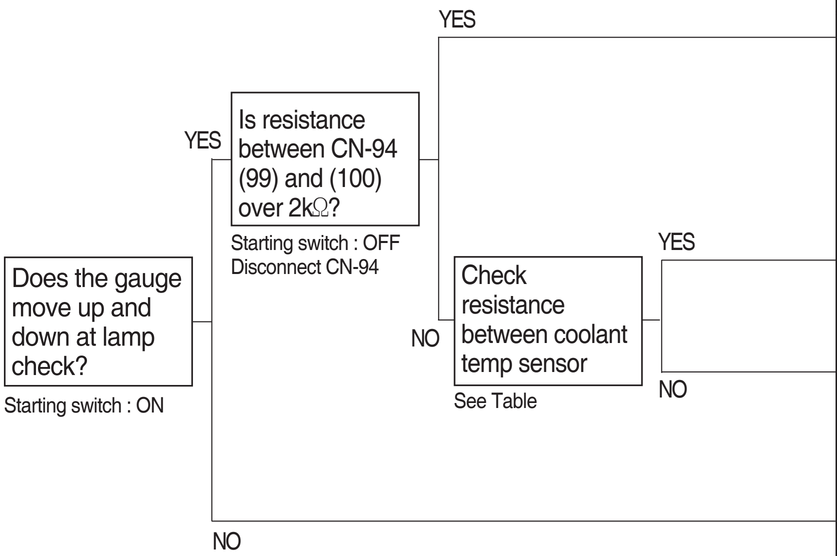
· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.



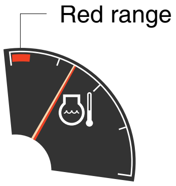
65A5TS15

7. WHEN COOLANT TEMPERATURE GAUGE DOES NOT OPERATE

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

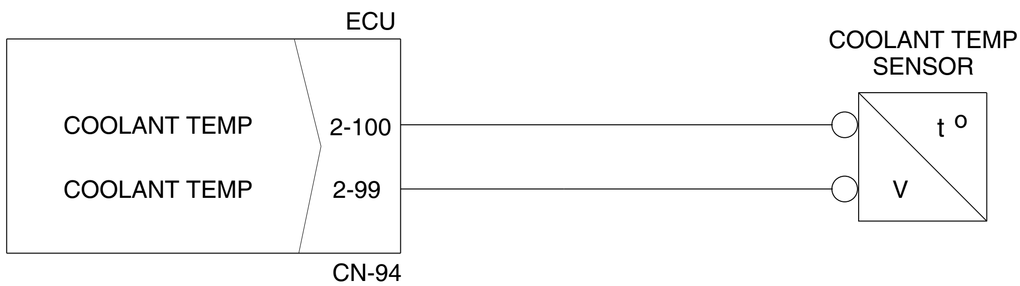


Cause	Remedy
Disconnection in wiring harness or poor contact between CN-94 and sensor	Repair or replace (after clean)
Defective ECU	Replace
Defective temp sensor	Replace
Defective cluster	Replace



Check Table

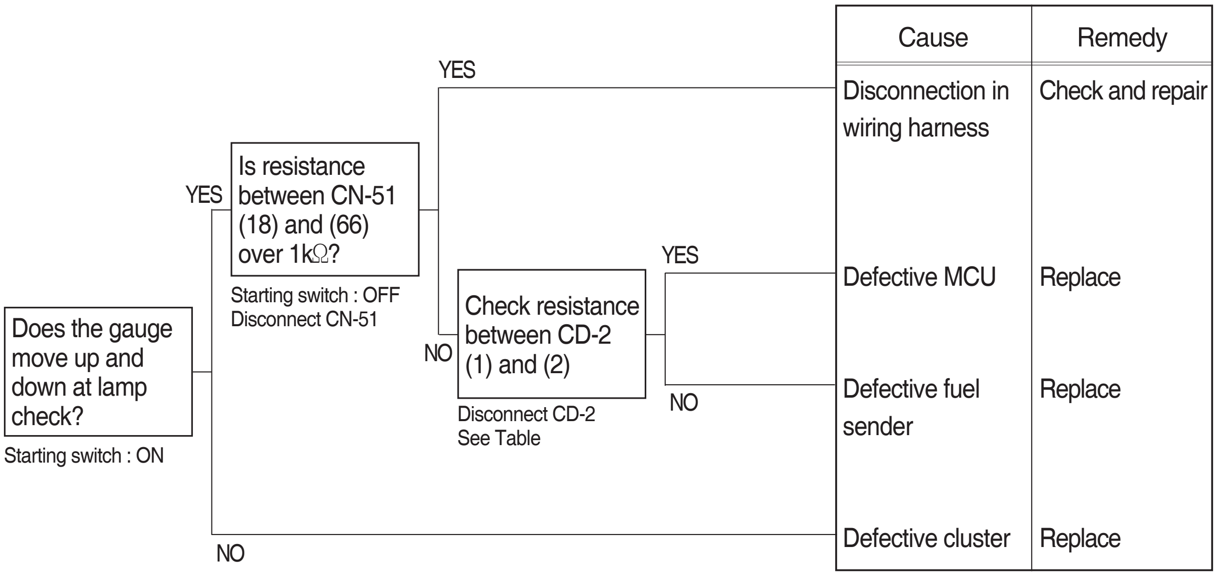
Item \ Temperature	40˚C	85~110˚C	115˚C (red range)
Unit Resistance(Ω)	1170~	270~130	~124
Tolerance(%)	±5	−8~0	±5



65A5TS12

8. WHEN FUEL GAUGE DOES NOT OPERATE (check warning lamp ON/OFF)

· 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

Item \ Level	Empty	1/2	Full
Unit Resistance (Ω)	700	300	~100
Tolerance (%)	±5	±8	±5

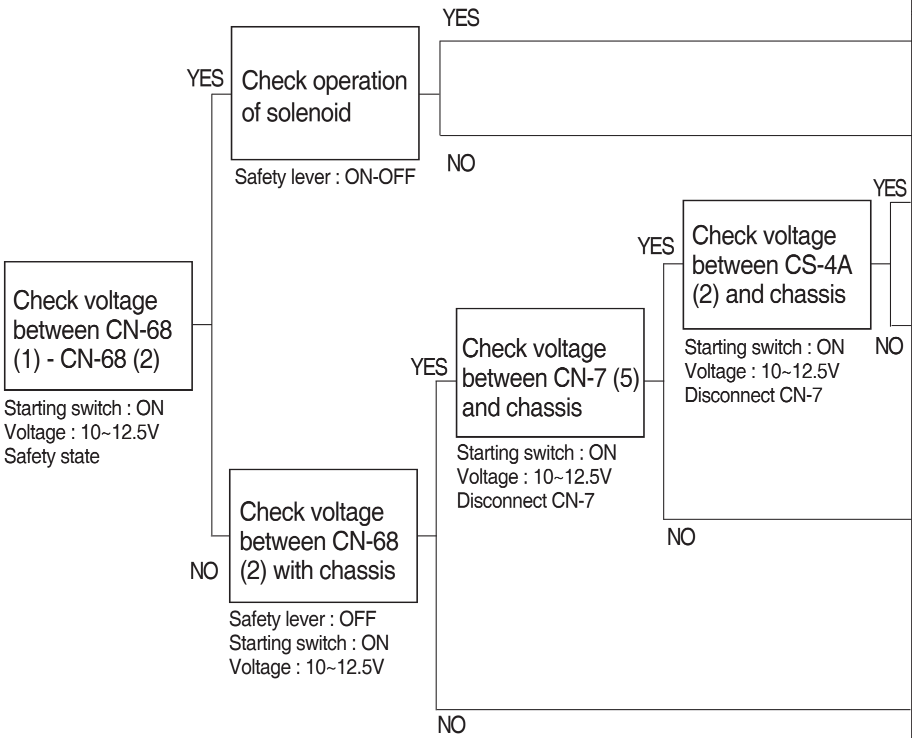
65A5TS17

9. WHEN SAFETY SOLENOID DOES NOT OPERATE

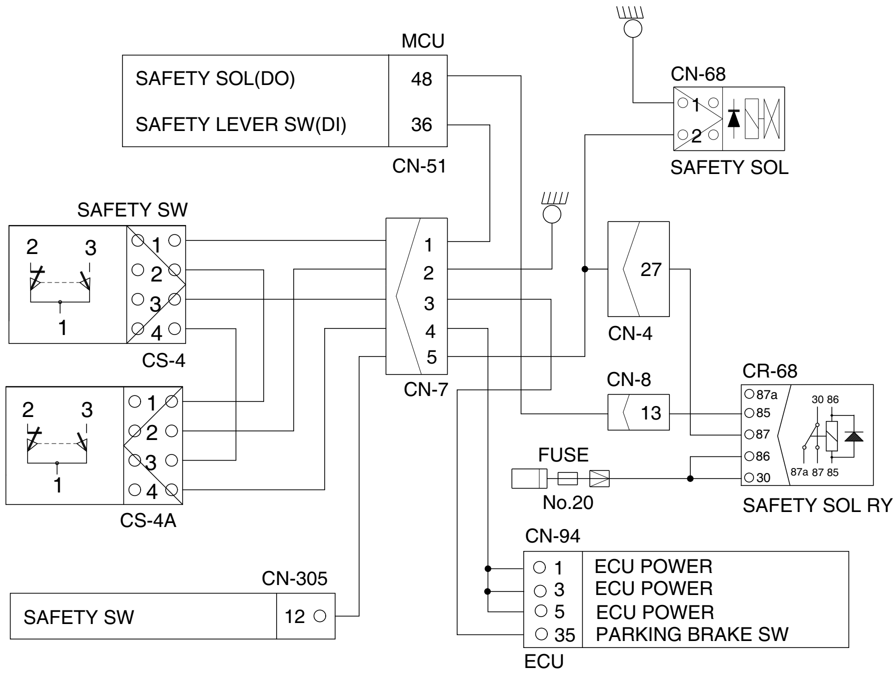
· Before disconnecting the connector, always turn the starting switch OFF.

· Before carrying out below procedure, check all the related connectors are properly inserted and short of fuse No.20.

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



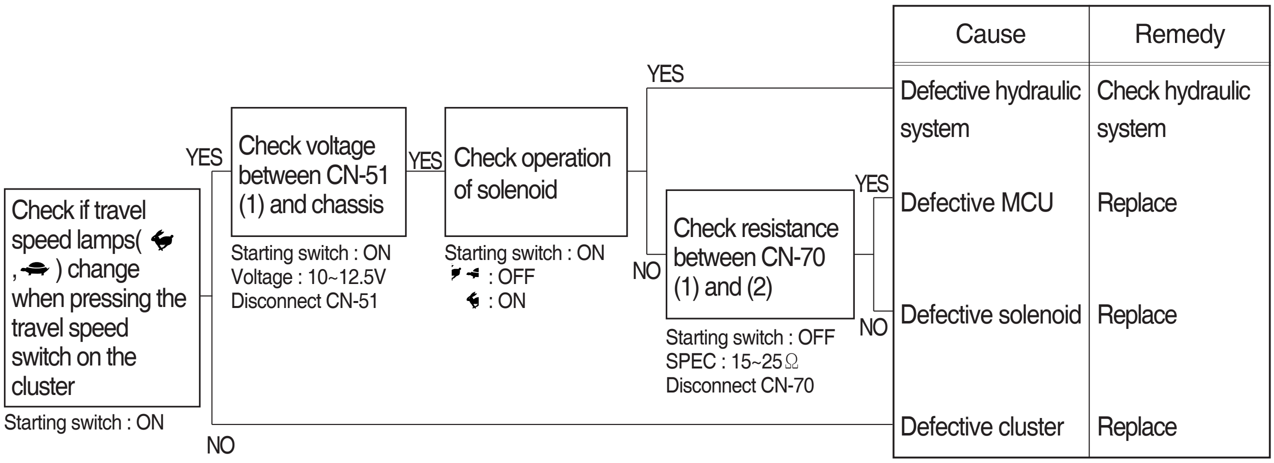
Cause	Remedy
Hydraulic malfunction	Check hydraulic system
Defective solenoid	Replace
Defective switch (CS-4)	Repair or replace
Disconnect in wiring harness or poor contact between CN-7 (1)-CS-4A (2)	Repair or replace (after clean)
Disconnect in wiring harness or poor contact between CN-7 (2)-CN-68 (2)	Repair or replace (after clean)
Disconnection in fuse or poor contact between CN-68 (2)-CR-68 (87)	Replace

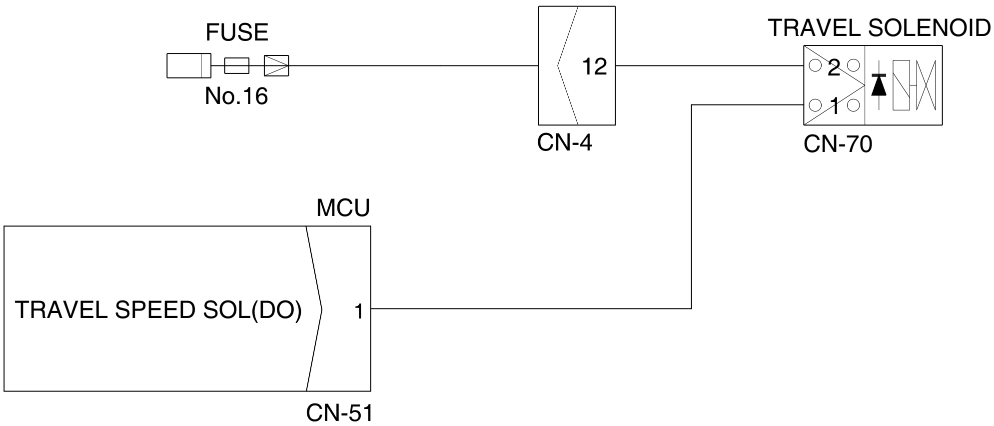


65A5TS19

10. WHEN TRAVEL SPEED 1, 2 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.16.
- After checking, insert the disconnected connectors again immediately unless otherwise specified.

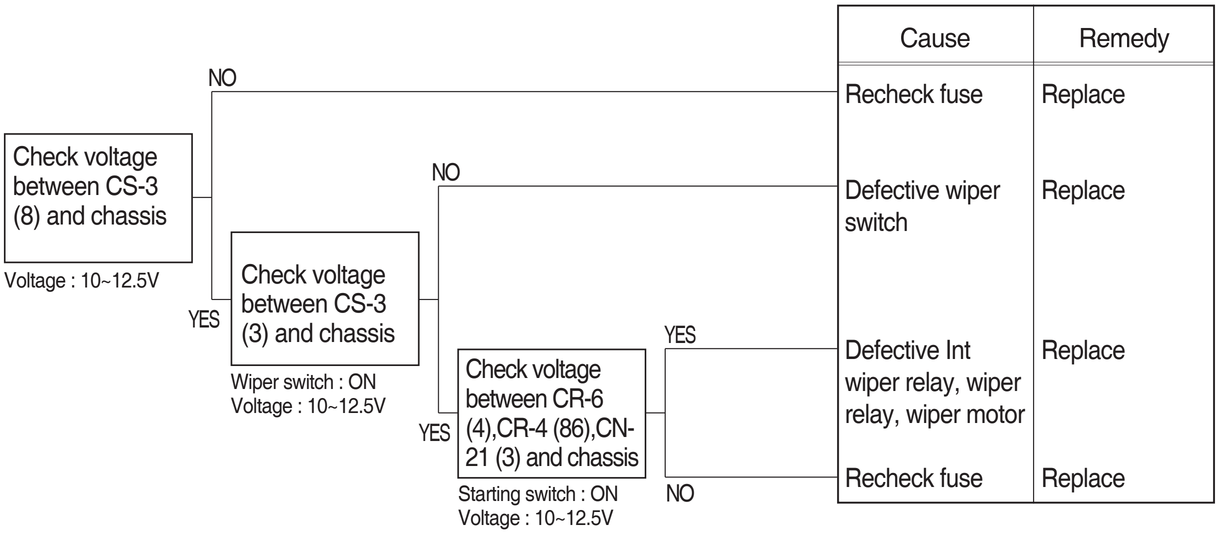


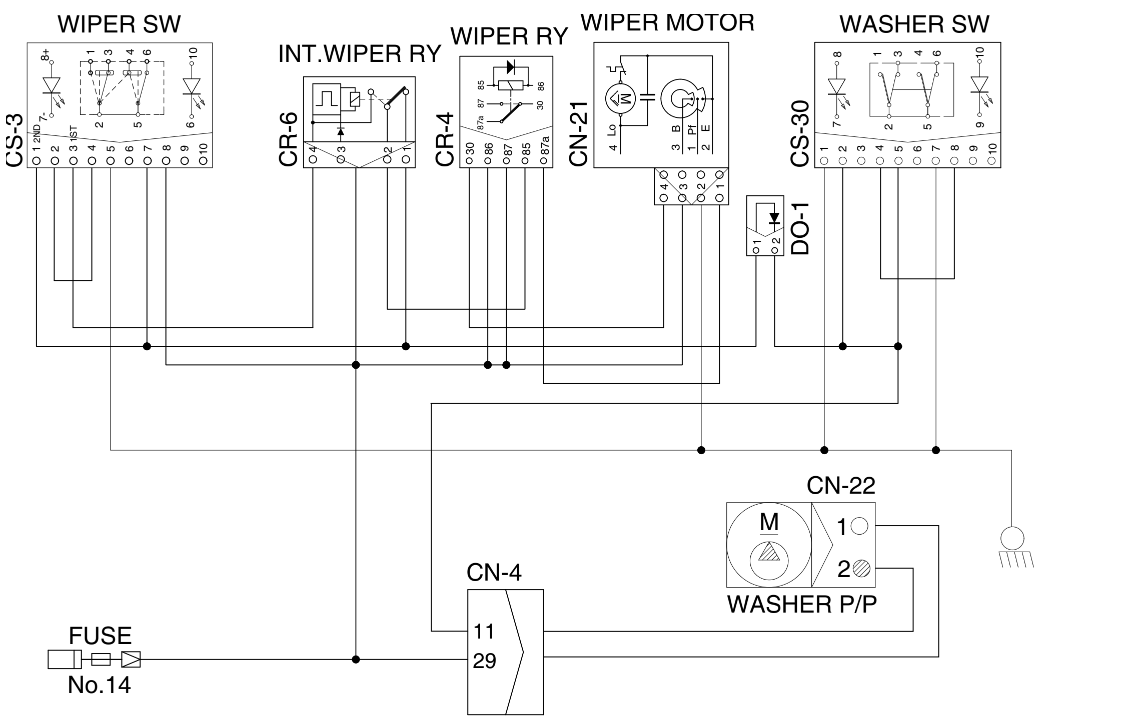


65A5TS20

11. 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.14 is not blown out.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.

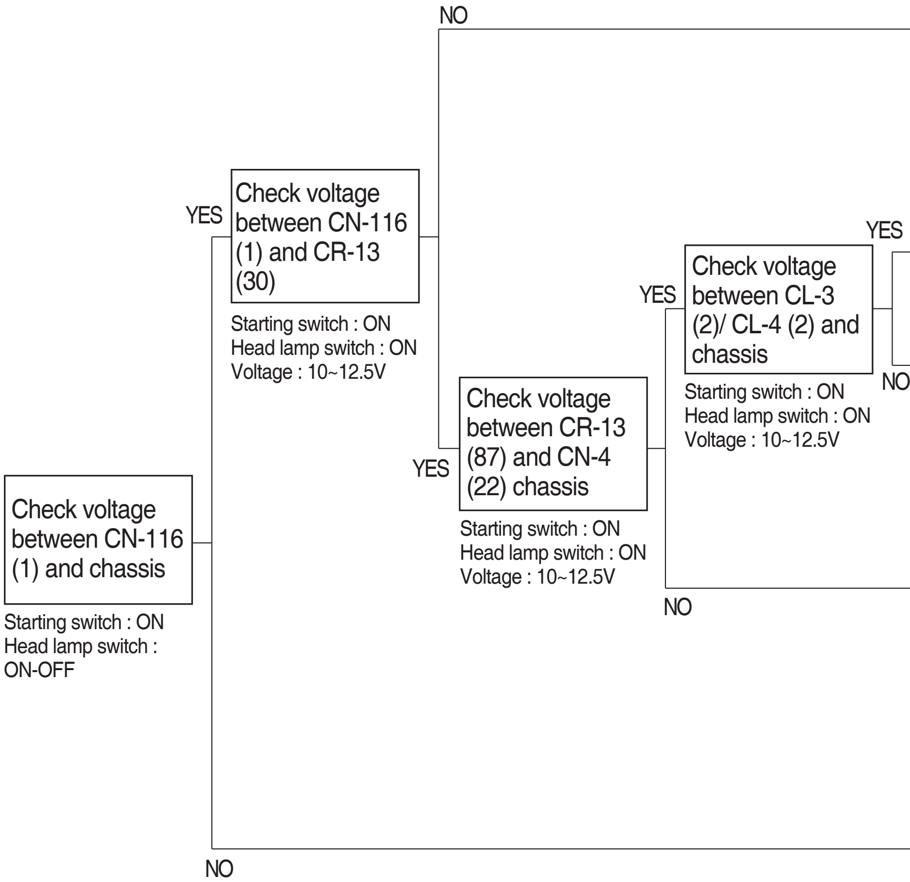




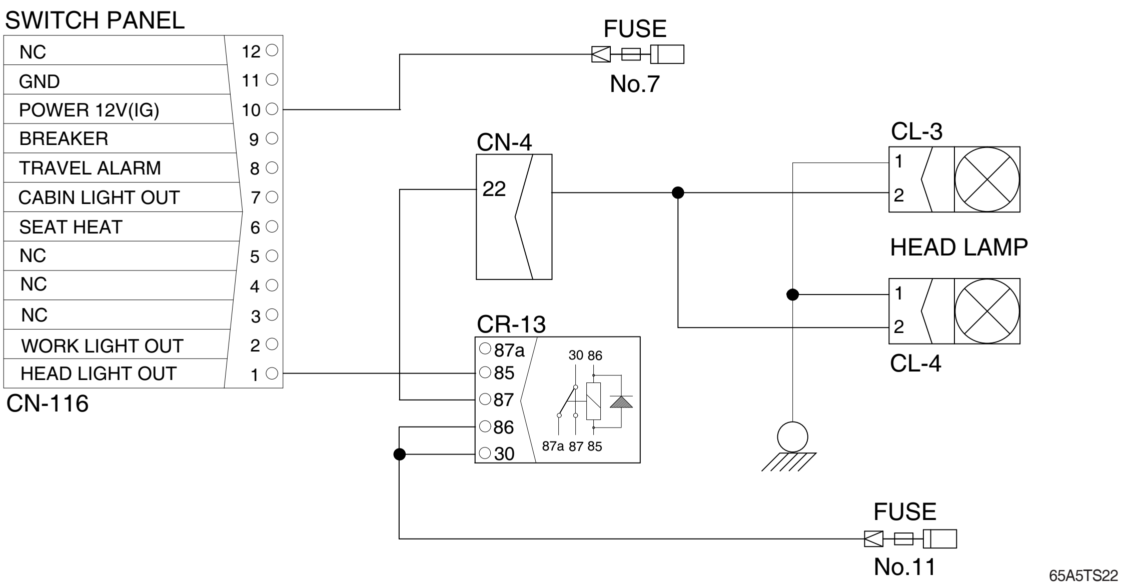
65A5TS21

12. 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.7, 11.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.

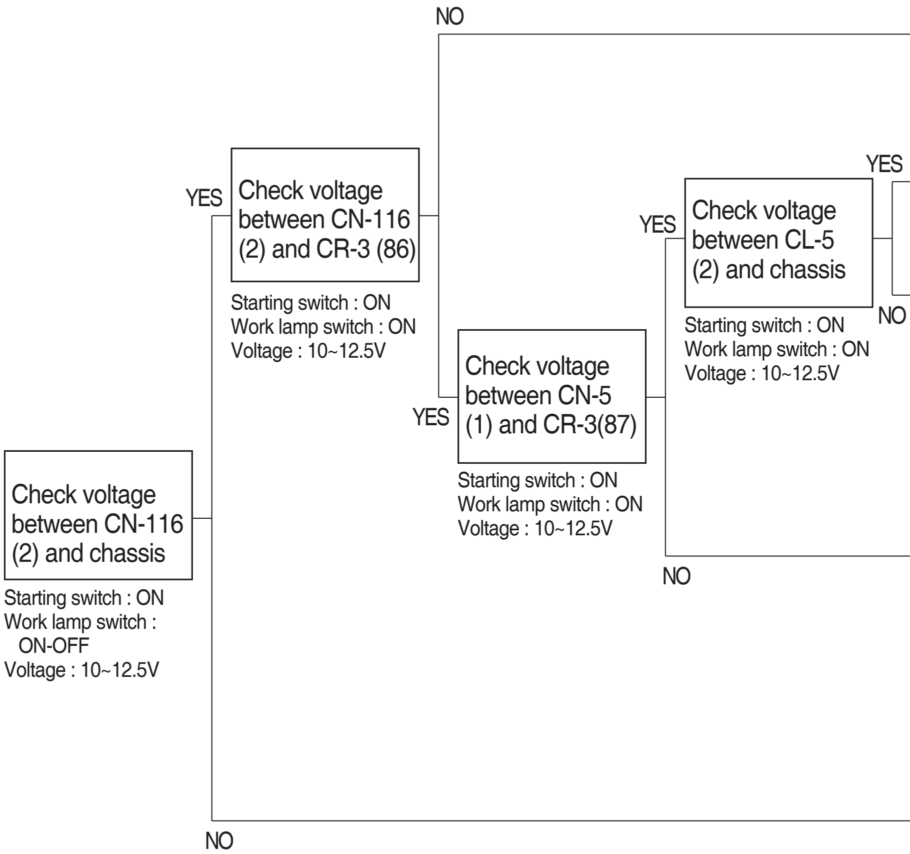


Cause	Remedy
Defective light switch	Replace switch
Defective bulb	Replace
Disconnection in wiring harness or poor contact between CN-4 (22) -CL-3 (2)/CL-4 (2)	Repair or replace (after clean)
Disconnection in wiring harness or poor contact between CR-13 (87)-CN-4 (22)	Repair or replace (after clean)
Disconnection in wiring harness or poor contact between CN-116 (1) and fuse No.7	Repair or replace (after clean)

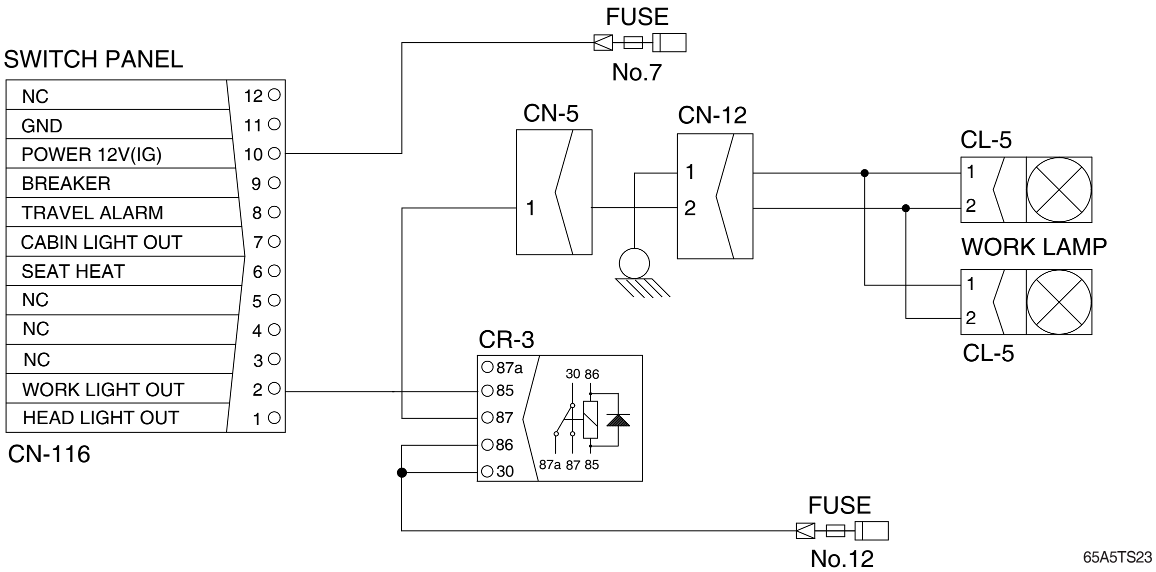


13. WHEN STARTING SWITCH IS TURNED ON, WORK LAMP DOES NOT LIGHTS UP

· 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. 7, 12.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.

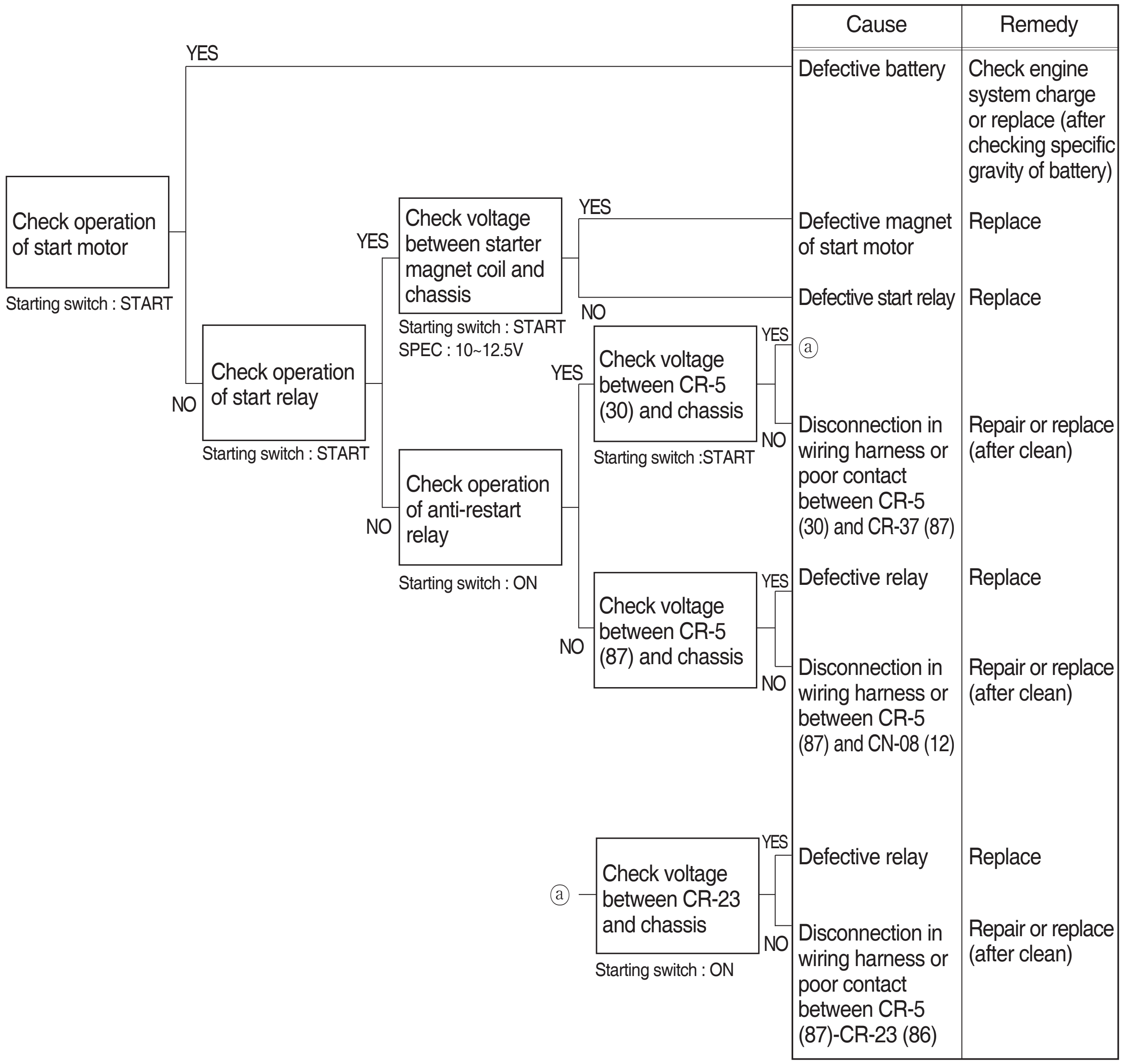


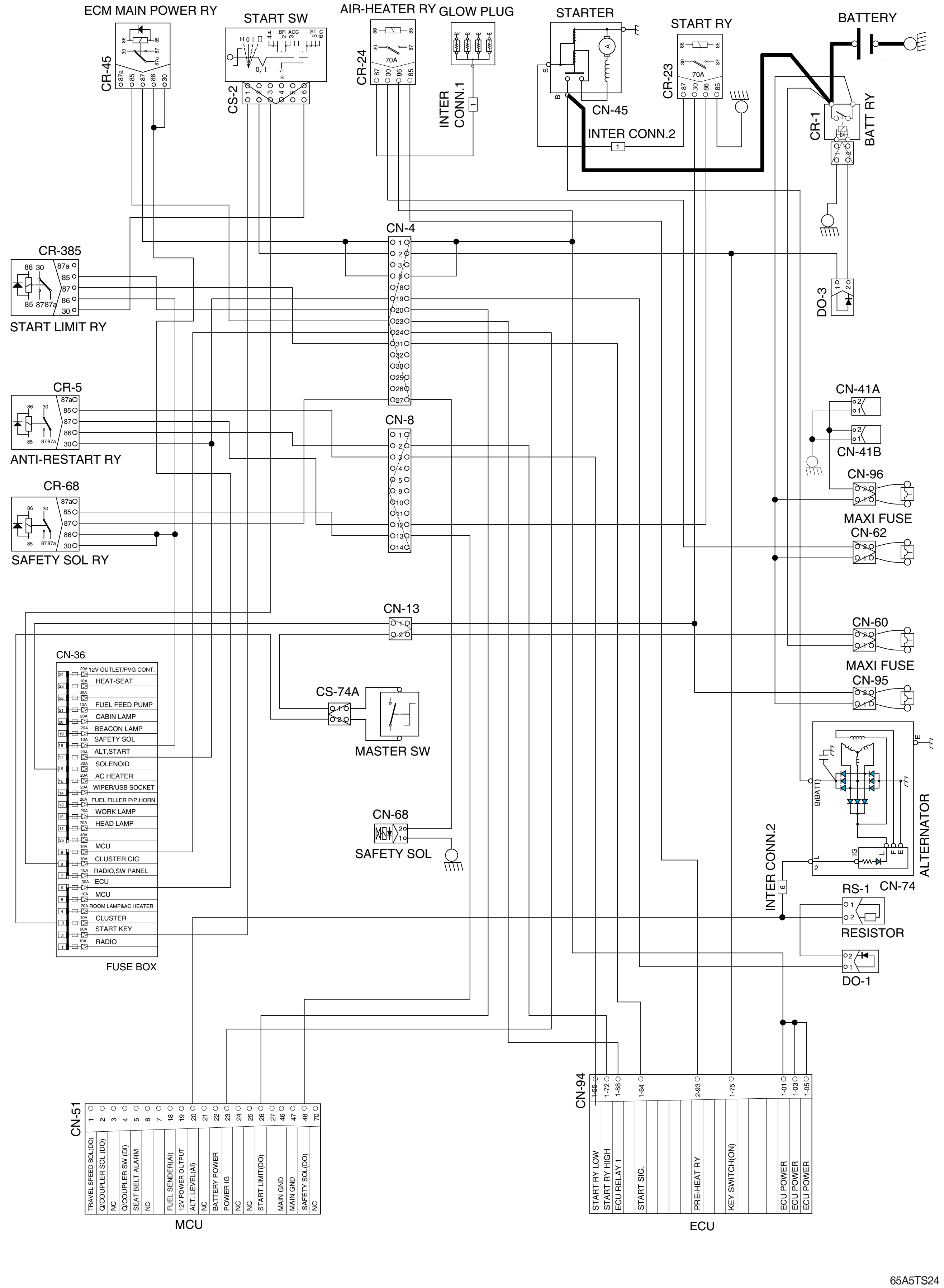
Cause	Remedy
Defective light switch	Replace switch
Defective bulb	Replace
Disconnection in wiring harness or poor contact between CN-5 (1) and CL-5 (2)	Repair or replace (after clean)
Disconnection in wiring harness or poor contact between CN-116 (2)-CN-5 (1)	Repair or replace (after clean)
Disconnection in wiring harness or poor contact between CN-116 (2) and fuse No.7	Repair or replace (after clean)



14. WHEN ENGINE DOES NOT START

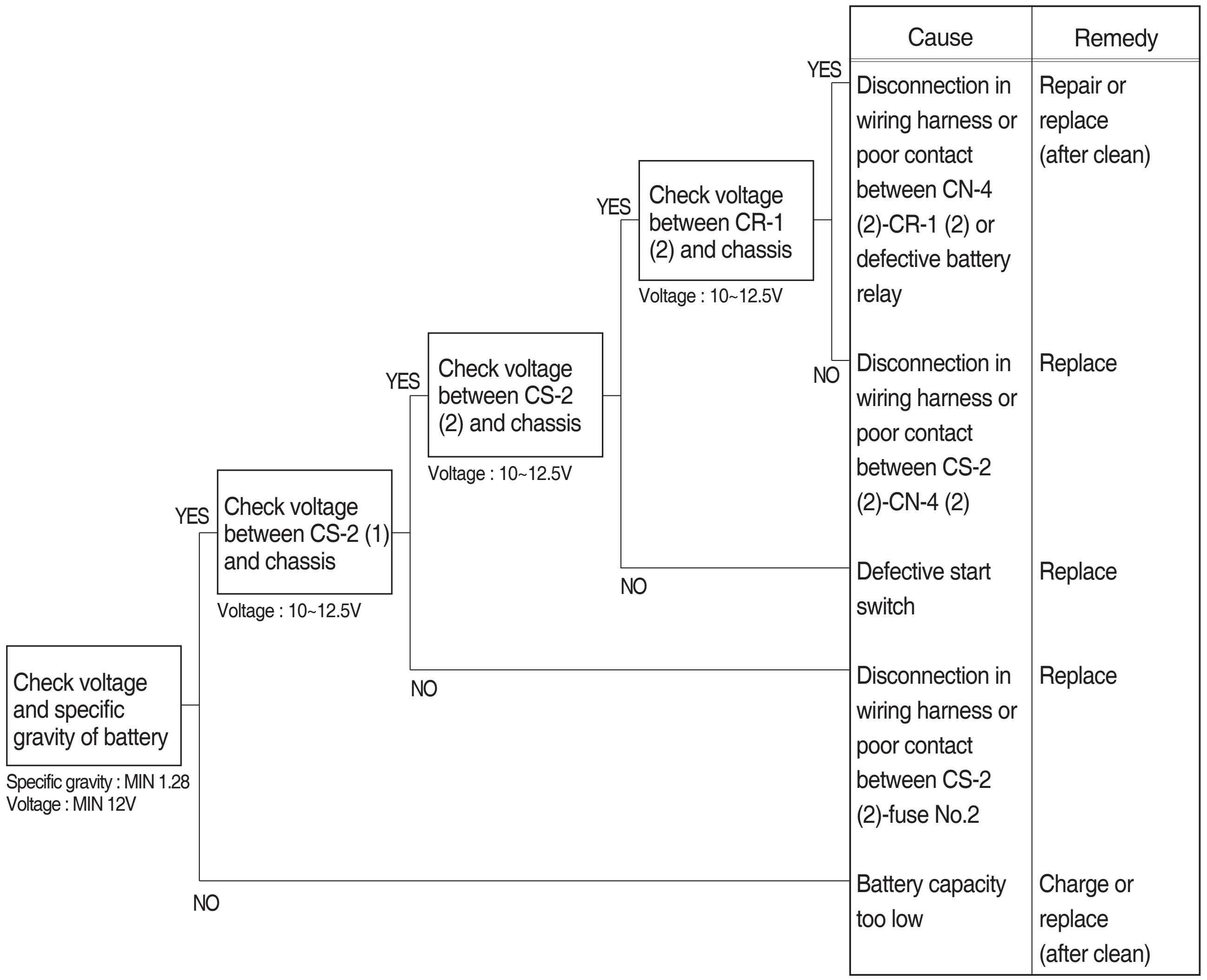
· Check supply of the power at engine stop solenoid while starting switch is ON.
· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.

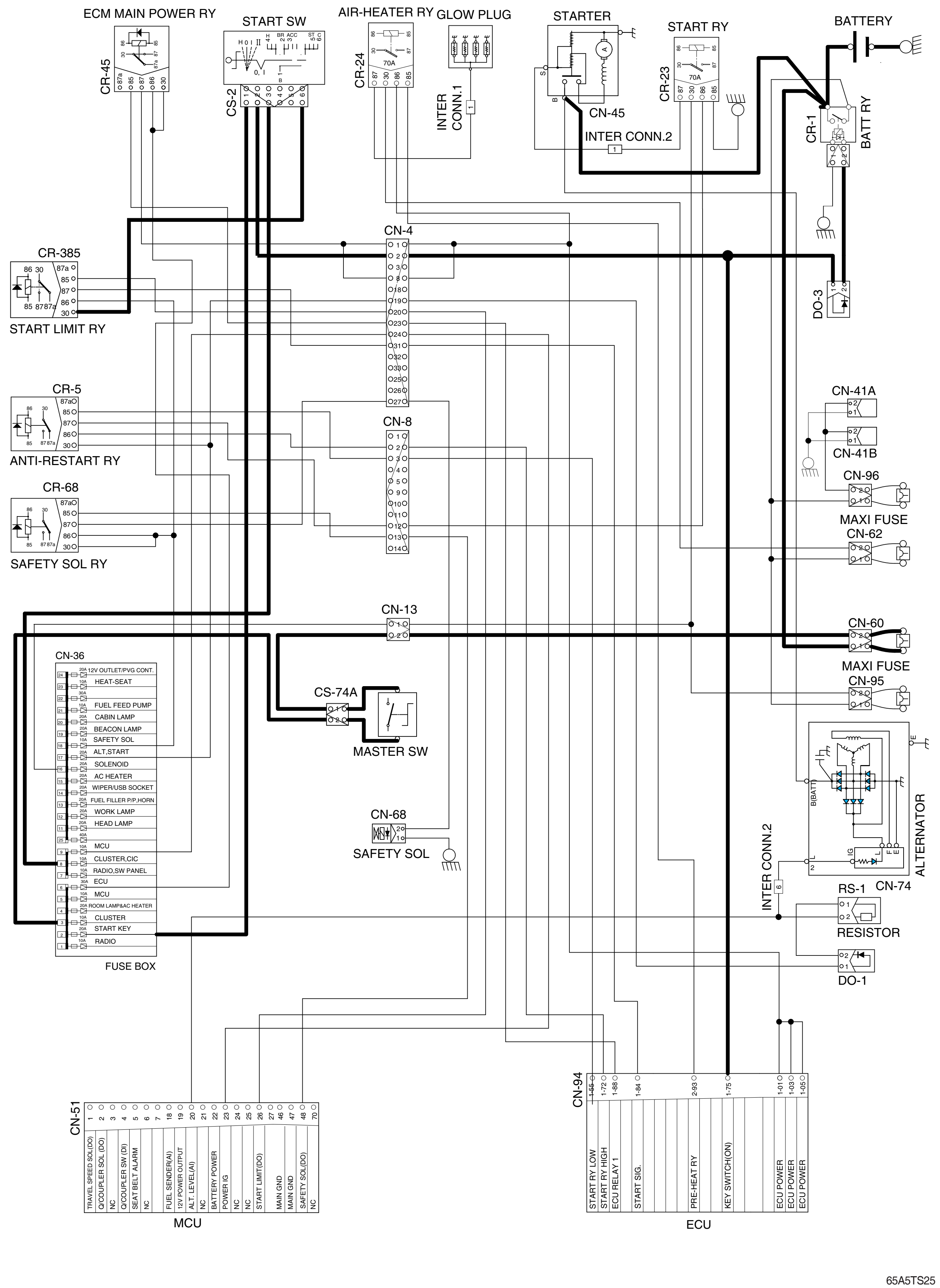




15. WHEN STARTING SWITCH ON DOES NOT OPERATE

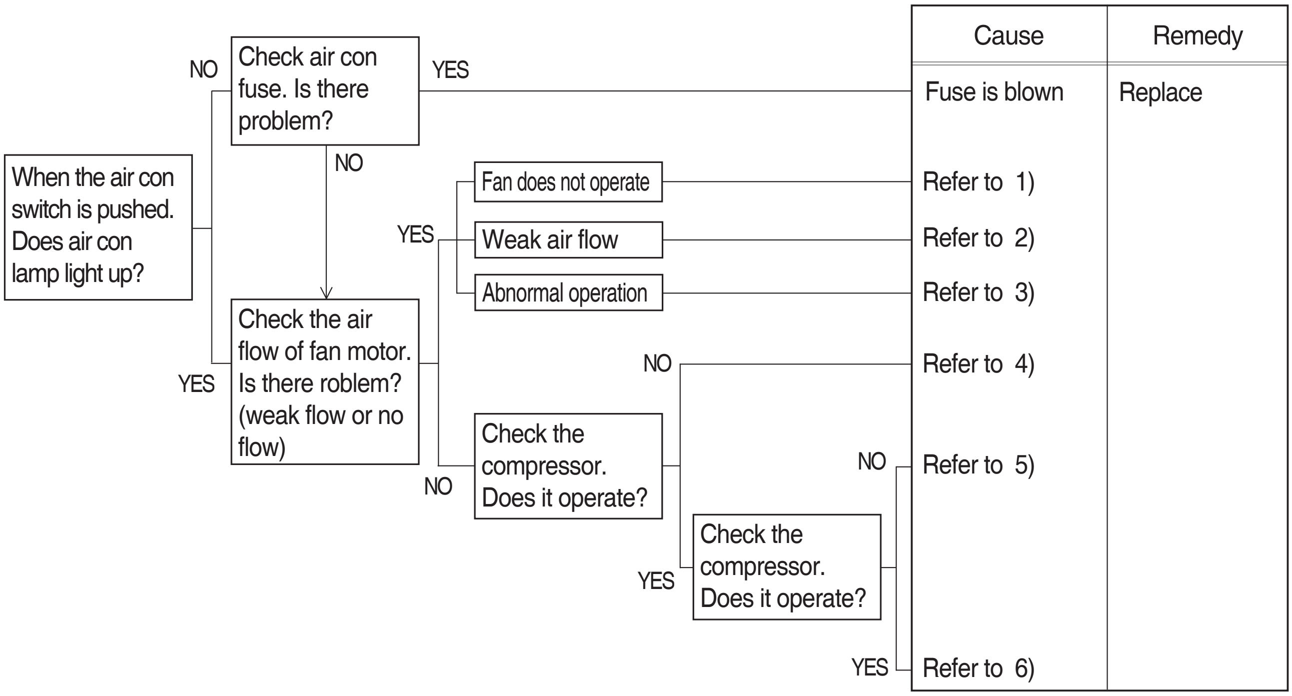
- Before disconnecting the connector, always turn the starting switch OFF.
- Before carrying out below procedure, check all the related connectors are properly inserted and master switch ON.
- After checking, insert the disconnected connectors again immediately unless otherwise specified.





GROUP 4 AIR CONDITIONER AND HEATER SYSTEM

1. AIR CONDITIONER DOES NOT OPERATE



1) FAN DOES NOT OPERATE

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

2) WEAK AIR FLOW FROM FAN MOTOR

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

3) ABNORMAL OPERATION OF FAN MOTOR

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

4) COMPRESSOR DOES NOT ROTATE OR HARDLY ROTATE

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

5) COMPRESSOR OPERATE NORMALLY AND AIR FLOW IS NORMAL

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

6) COMPRESSOR OPERATE NORMALLY AND AIR FLOW IS NORMAL

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

SECTION 6 MAINTENANCE STANDARD

GROUP 1 OPERATIONAL PERFORMANCE TEST

1. PURPOSE

Performance tests are used to check:

1) OPERATIONAL PERFORMANCE OF A NEW MACHINE

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

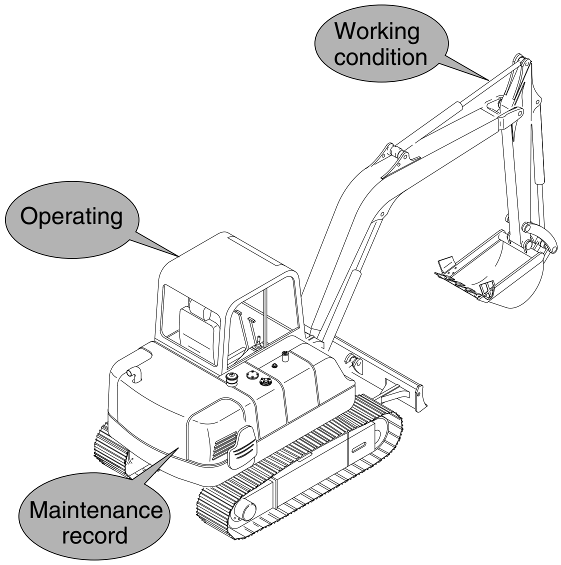
2) OPERATIONAL PERFORMANCE OF A WORKING MACHINE

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

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

3) OPERATIONAL PERFORMANCE OF A REPAIRED MACHINE

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

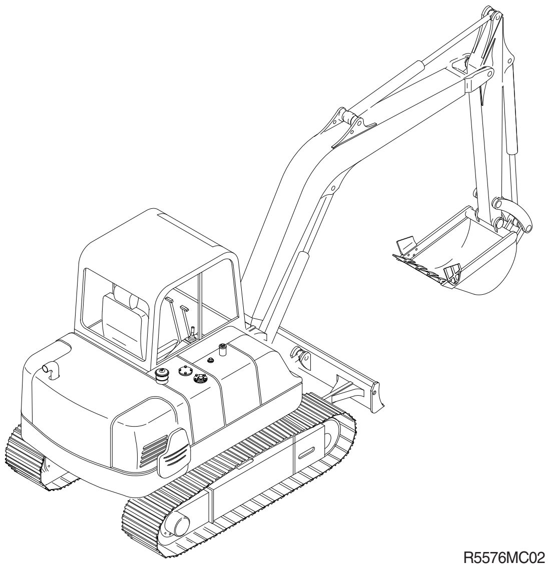


R5576MC01

2. TERMINOLOGY

1) STANDARD

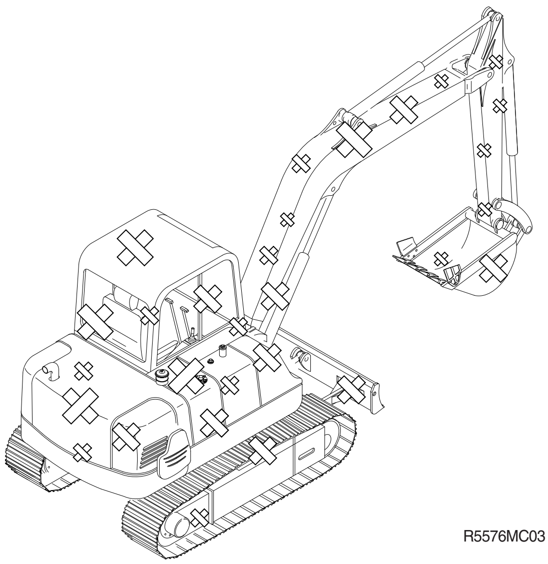
Specifications applied to the brand-new machine, components and parts.



R5576MC02

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.



R5576MC03

3. OPERATION FOR PERFORMANCE TESTS

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

(1) The machine

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

(2) Test area

① Select a hard, flat surface.

② Secure enough space to allow the machine to run straight more than 20m, and to make a full swing with the front attachment extended.

③ If required, rope off the test area and provide signboards to keep unauthorized personnel away.

(3) Precautions

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

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

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

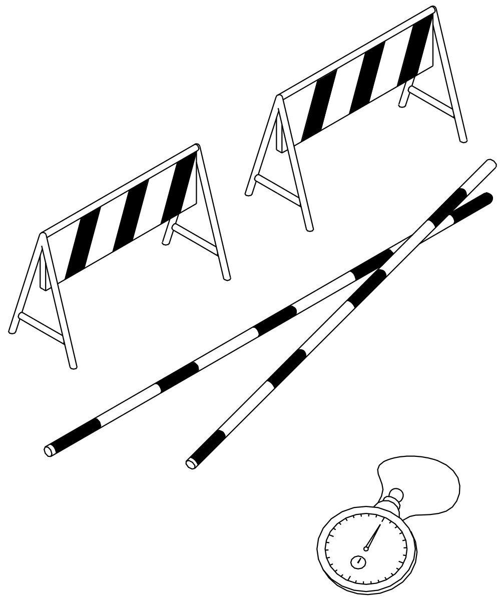
④ Avoid polluting the machine and the ground with leaking oil. Use oil pans to catch escaping oil. Pay special attention to this when removing hydraulic pipings.

(4) Make precise measurements

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

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

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



7-3 (140-7)

2) ENGINE SPEED

(1) Measure the engine speed at each power mode

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

(2) Preparation

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

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

③ Measure the engine RPM.

(3) Measurement

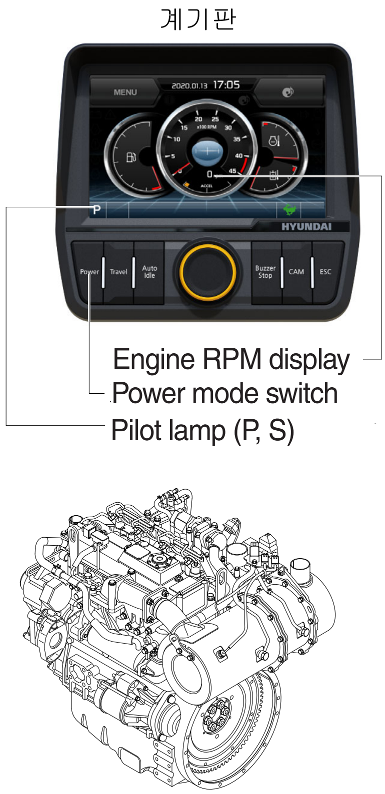
① Start the engine. The engine will run at start idle speed. Measure engine speed with a engine rpm display.

② Measure and record the engine speed at each mode (P, S).

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.



HX60A6MS01

(4) Evaluation

The measured speeds should meet the following specifications.

Unit : rpm

Model	Engine speed	Standard	Remark
HX65A	Start idle	1000±50	
	P mode	1900±50	
	S mode	1850±50	
	Auto decel	1100±50	

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

3) TRAVEL SPEED

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

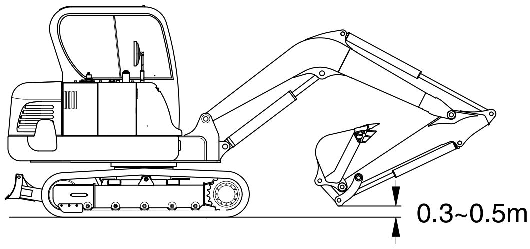
(2) Preparation

① Adjust the tension of both tracks to be equal.

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

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

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



555C96MC04

(3) Measurement

① Measure both the low and high speeds of the machine.

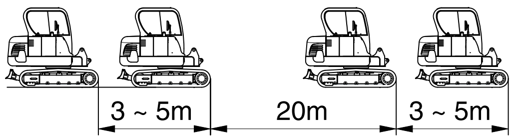
② Before starting either the low or high speed tests, adjust the travel mode switch to the speed to be tested.

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

④ Measure the time required to travel 20m.

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.



555C96MC05

(4) Evaluation

The average measured time should meet the following specifications.

Unit : Seconds / 20m

Model	Travel speed	Standard	Maximum allowable	Remarks
HX65A	1 Speed	32.7±2.0	41	
	2 Speed	17.1±1.0	22	

4) TRACK REVOLUTION SPEED

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

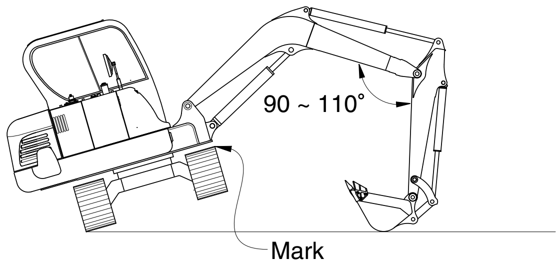
(2) Preparation

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.



555C96MC06

(3) Measurement

① Select the following switch positions.

· Travel mode switch : 1 or 2 speed

② Operate the travel control lever of the raised track in full forward and reverse.

③ Rotate 1 turn, then measure time taken for next 3 revolutions.

④ Raise the other side of machine and repeat the procedure.

⑤ Repeat steps ③ and ④ three times and calculate the average values.

(4) Evaluation

The revolution cycle time of each track should meet the following specifications.

Unit : Seconds / 3 revolutions

Model	Travel speed	Standard	Maximum allowable
HX65A	1 Speed	26.5±2.0	33.1
	2 Speed	13.9±2.0	17.6

5) TRAVEL DEVIATION

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

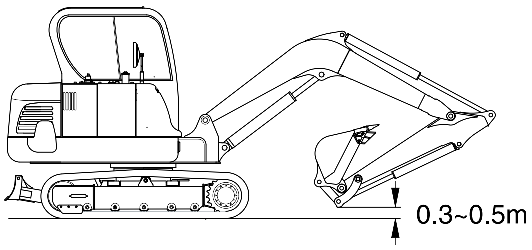
(2) Preparation

① Adjust the tension of both tracks to be equal.

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

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

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



555C96MC04

(3) Measurement

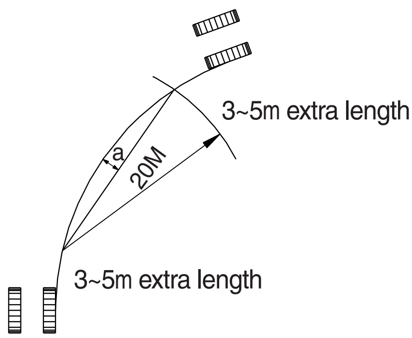
① Measure the amount of mistracking at high and low travel speeds.

② Start traveling the machine in the acceleration zone with the travel levers at full stroke.

③ Measure the distance between a straight 20m line and the track made by the machine. (dimension a)

④ After measuring the tracking in forward travel, turn the upperstructure 180˚ and measure that in reverse travel.

⑤ Repeat steps ③ and ④ three times and calculate the average values.



7-7(2) 140-7

(4) Evaluation

Mistrack should be within the following specifications.

Unit : mm / 20m

Model	Standard	Maximum allowable	Remarks
HX65A	200 below	240	

6) SWING SPEED

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

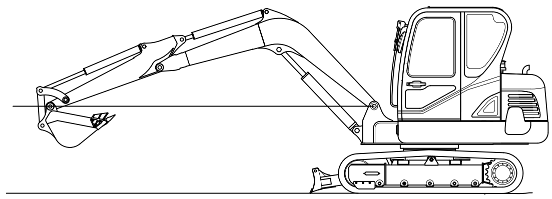
(2) Preparation

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

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

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

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



555C96MC07

(3) Measurement

① Operate swing control lever fully.

② Swing 1 turn and measure time taken to swing next 2 revolutions.

③ Repeat steps ① and ② three time and calculate the average values.

(4) Evaluation

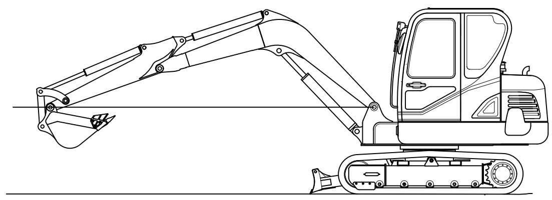
The time required for 2 swings should meet the following specifications.

Unit : Seconds / 2 revolutions

Model	Standard	Maximum allowable	Remarks
HX65A	12.8±1.0	16	

7) SWING FUNCTION DRIFT CHECK

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



555C96MC07

(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.

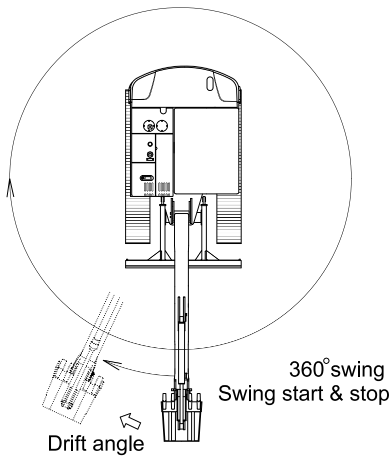
(3) Measurement

① 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˚.

② Measure the distance between the two marks.

③ Align the marks again, swing 360˚, then test the opposite direction.

④ Repeat steps ② and ③ three times each and calculate the average values.



R5576MC08

(4) Evaluation

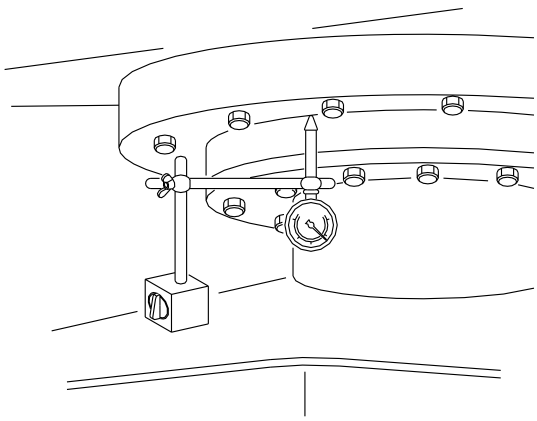
The measured drift angle should be within the following specifications.

Unit : Degree

Model	Standard	Maximum allowable	Remarks
HX65A	40 below	70	

8) SWING BEARING PLAY

(1) Measure the swing bearing play using a dial gauge to check the wear of bearing races and balls.



7-10(1) 140-7

(2) Preparation

① Check swing bearing mounting cap screws for loosening.

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

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

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

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

⑥ Bucket should be empty.

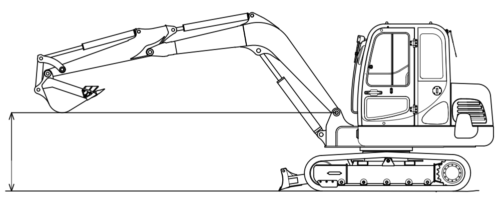
(3) Measurement

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

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

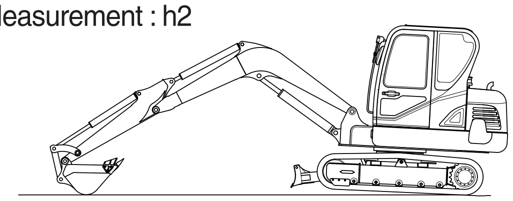
③ Calculate bearing play (H) from this data (h1 and h2) as follows. H=h2-h1

Measurement : h1



R5576MC09

Measurement : h2



555C96MC10

(4) Evaluation

The measured drift should be within the following specifications.

Unit : mm

Model	Standard	Maximum allowable	Remarks
HX65A	0.5 ~ 1.2	2.4	

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 0.5m 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.

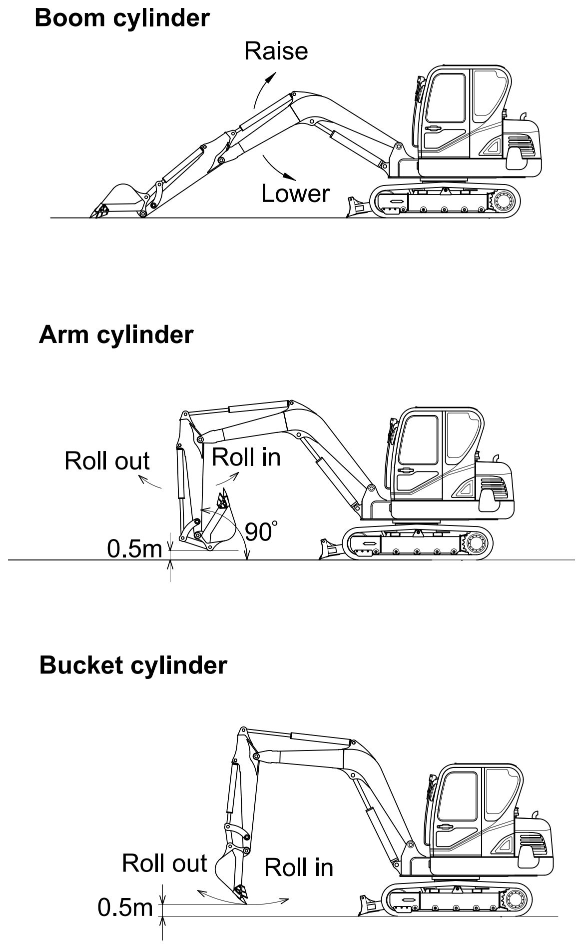
④ Keep the hydraulic oil temperature at 50±5˚C.

(3) Measurement

① 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.



555C96MC11

- Bucket cylinders
  Measure the time it takes to roll in the bucket, and the time it takes to roll out the bucket. To do so, position the bucket at one stroke end, then move the control lever to the other stroke end as quickly as possible.
- Repeat each measurement 3 times and calculate the average values.

(4) Evaluation

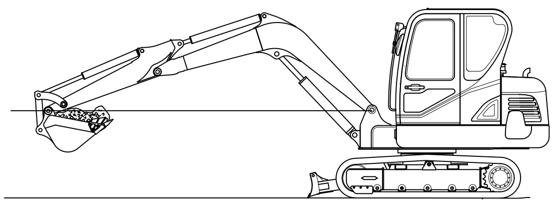
The average measured time should meet the following specifications.

Unit : Seconds

Model	Function	Standard	Maximum allowable	Remarks
HX65A	Boom raise	2.2±0.4	2.8	
	Boom lower	2.2±0.4	2.8	
	Arm in	2.4±0.4	3.0	
	Arm out	2.4±0.4	3.0	
	Bucket load	3.3±0.4	4.1	
	Bucket dump	2.2±0.4	2.8	
	Boom swing (LH)	6.3±0.4	8.2	
	Boom swing (RH)	5.1±0.4	6.8	
	Dozer up (raise)	3.3±0.3	4.1	
	Dozer down (lower)	3.4±0.3	4.3	

10) DIG FUNCTION DRIFT CHECK

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



555C96MC12

(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 30mm extended from the fully retracted position.

③ Position the bucket cylinder with the rod 20 to 30mm 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	Maximum allowable	Remarks
HX65A	Boom cylinder	10 below	20	
	Arm cylinder	20 below	30	
	Bucket cylinder	20 below	30	

11) CONTROL LEVER OPERATING FORCE

(1) Use a spring scale to measure the maximum resistance of each control lever at the middle of the grip.

(2) Preparation
① Keep the hydraulic oil temperature at 50±5˚C.

(3) Measurement
① Start the engine.
② Operate each boom, arm, bucket and swing lever at full stroke and measure the maximum operating force for each.
③ Lower the bucket to the ground to raise one track off the ground. Operate the travel lever at full stroke and measure the maximum operating force required. When finished, lower the track and then jack-up the other track.
④ Repeat steps ② and ③ three times and calculate the average values.

(4) Evaluation
The measured operating force should be within the following specifications.

Unit : kgf

Model	Kind of lever	Standard	Maximum allowable	Remarks
HX65A	Boom lever	1.4 or below	1.9	
	Arm lever	1.4 or below	1.9	
	Bucket lever	1.4 or below	1.9	
	Swing lever	1.4 or below	1.9	
	Travel lever	2.0 or below	2.5	

12) CONTROL LEVER STROKE

(1) Measure each lever stroke at the lever top using a ruler.

※ When the lever has play, take a half of this value and add it to the measured stroke.

(2) Preparation

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

(3) Measurement

① Stop the engine.

② Measure each lever stroke at the lever top from neutral to the stroke end using a ruler.

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

(4) Evaluation

The measured drift should be within the following specifications.

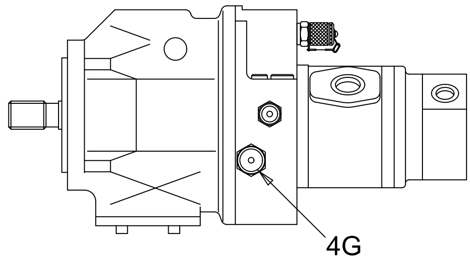
Unit : mm

Model	Kind of lever	Standard	Maximum allowable	Remarks
HX65A	Boom lever	82±10	103	
	Arm lever	82±10	103	
	Bucket lever	82±10	103	
	Swing lever	82±10	103	
	Travel lever	148±20	185	

13) PILOT PRIMARY PRESSURE

(1) Preparation

① Stop the engine.
② Push the pressure release button to bleed air.
③ Loosen and remove plug on the pilot pump delivery port (4G) and connect pressure gauge.
④ Start the engine and check for oil leakage from the port.
⑤ Keep the hydraulic oil temperature at 50±5˚C.



R55NN7MA14

(2) Measurement

① Measure the primary pilot pressure in the M mode.

(3) Evaluation

The average measured pressure should meet the following specifications:

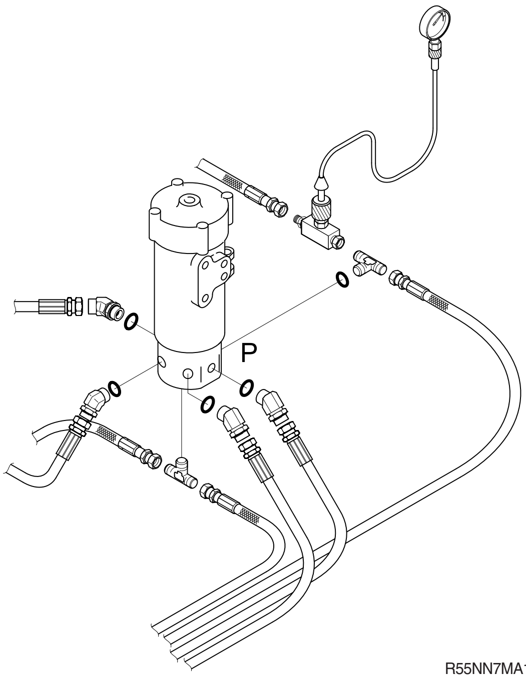
Unit : kgf / cm^2

Model	Standard	Remarks
HX65A	30±5	

14) FOR TRAVEL SPEED SELECTING PRESSURE:

(1) Preparation

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



R55NN7MA15

(2) Measurement

① Select the following switch positions.
Travel mode switch : 1 speed
2 speed
② Measure the travel speed selecting pressure in the Hi or Lo mode.
③ Lower the bucket to the ground to raise the track off the ground. Operate the travel lever at full stroke and measure the fast speed pressure.
④ Repeat steps ② and ③ three times and calculate the average values.

(3) Evaluation

The average measured pressure should be within the following specifications.

Unit : kgf / cm^2

Model	Travel speed mode	Standard	Maximum allowable	Remarks
HX65A	1 Speed	0	-	
	2 Speed	30±5	-	

15) SWING PARKING BRAKE RELEASING PRESSURE

(1) Preparation

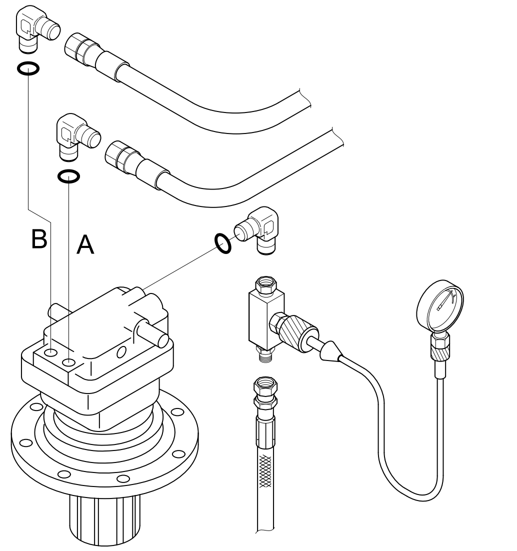
① Stop the engine.

② Push the pressure release button to bleed air.

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.



R55NN7MA16

(2) Measurement

① 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.

② Repeat three times and calculate the average values.

(3) Evaluation

The average measured pressure should be within the following specifications.

Unit : kgf / cm²

Model	Description	Standard	Remarks
HX65A	Brake disengaged	30±5	
	Brake applied	0	

16) MAIN PUMP DELIVERY PRESSURE

(1) Preparation

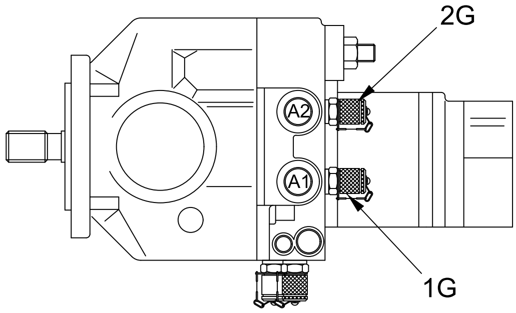
① Stop the engine.

② Push the pressure release button to bleed air.

③ To measure the main pump pressure. Install a connector and pressure gauge assembly main pump gauge port (1G, 2G) as shown.

④ Start the engine and check for oil leakage from the port.

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



R55NN7MA17

(2) Measurement

① Measure the main pump delivery pressure at high idle.

(3) Evaluation

The average measured pressure should meet the following specifications.

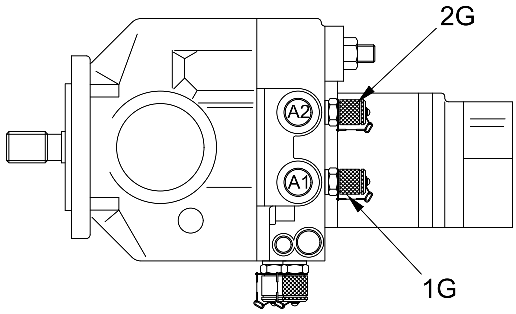
Unit : kgf / cm^2

Model	Engine speed	Standard	Allowable limits	Remarks
HX65A	High idle	20±5	-	

17) SYSTEM PRESSURE REGULATOR RELIEF SETTING

(1) Preparation

① Stop the engine.
② Push the pressure release button to bleed air.
③ To measure the system relief pressure. Install a connector and pressure gauge assembly main pump gauge port, as shown.
④ Start the engine and check for oil leakage from the port.
⑤ Keep the hydraulic oil temperature at 50±5˚C.



R55NN7MA17

(2) Measurement

① Slowly operate each control lever of boom, arm and bucket functions at full stroke over relief and measure the pressure.
② In the swing function, place bucket against an immovable object and measure the relief pressure.
③ 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
HX65A	Boom, Arm, Bucket	220±10
	Travel	220±10
	Swing	220±10

GROUP 2 MAJOR COMPONENT

1. MAIN PUMP

Before inspection, wash the parts well and dry them completely.

Inspect the principal parts with care and replace them with new parts when any abnormal wear exceeding the allowable limit or damage considered harmful is found.

Replace the seal also when any remarkable deformation and damage are found.

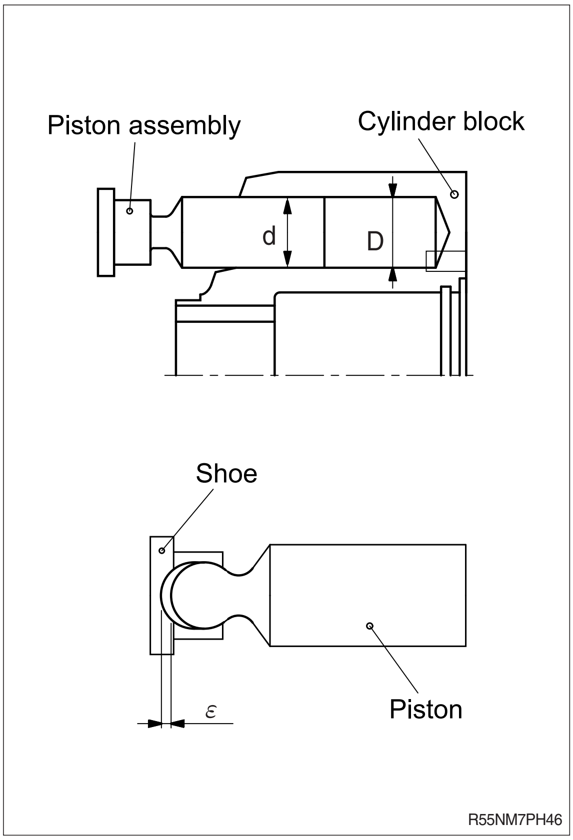
1) PISTON ASSEMBLY AND CYLINDER BLOCK

(1) Check the appearance visually.
No damage, scouring, abnormal wear (particularly, in the slide portion) should be found.

(2) Check the clearance between the piston outside dia and cylinder block inside dia.
D-d ≤ 0.050 mm

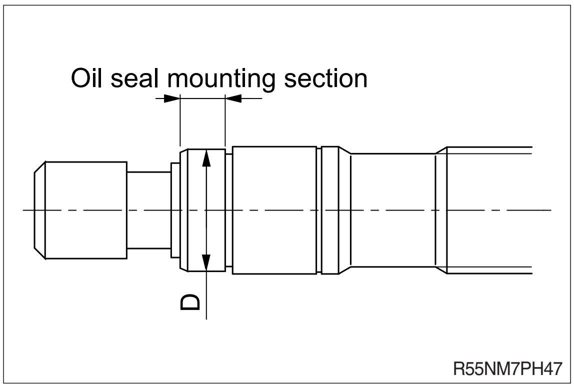
2) PISTON SHOE AND PISTON

(1) Check the axial play of the piston and piston shoe.
ε ≤ 0.2 mm



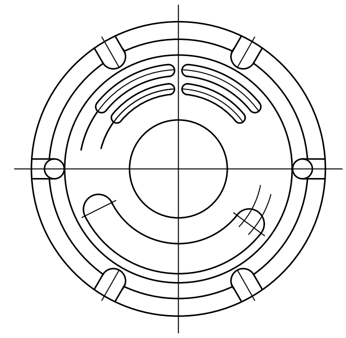
3) SHAFT

(1) Check the wear amount of the oil seal mounting section.
Wear mount ≤ 0.025 mm



4) CONTROL PLATE

(1) Check the slide surface for any damage. When the damage is large, replace the plate with new one.

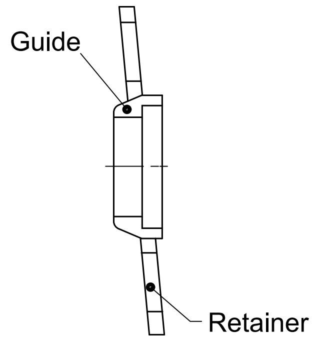


R55NM7PH48

5) GUIDE AND RETAINER

(1) Check for scouring or stepped wear. If this can not be corrected, replace the guide and retainer with new full-set.

(2) Fine scouring or damage can be corrected with lapping. Carry out thorough washing after lapping.



R55NM7PH49

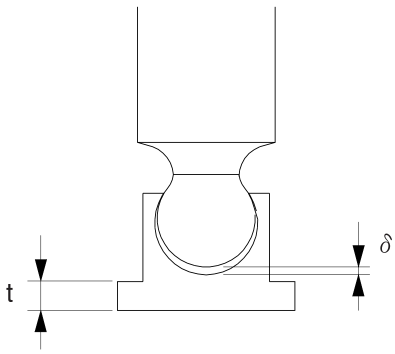
2. MAIN CONTROL VALVE

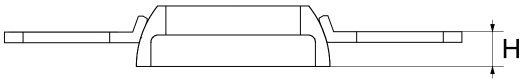
Part name	Inspection item	Criteria & measure
Block	· Existence of scratch, rusting or corrosion.	· In case of damage in following section, replace part. - Sliding sections of casing fore and spool, especially land sections applied with holded pressure. - Seal pocket section where spool is inserted. - Seal section of port where O-ring contacts. - Seal section of each relief valve for main, travel, and port. - Other damages that may damage normal functions.
Spool	· Existence of scratch, gnawing, rusting or corrosion. · O-ring seal sections at both ends. · Insert spool in casing hole, rotate and reciprocate it.	· Replacement when its outside sliding section has scratch (especially on seals-contacting section). · Replacement when its sliding section has scratch. · Correction or replacement when O-ring is damaged or when spool does not move smoothly.
Poppet	· Damage of poppet or spring · Insert poppet into casing and function it.	· Correction or replacement when sealing is incomplete. · Normal when it can function lightly without being caught.
Around spring	· Rusting, corrosion, deformation or breaking of spring, spring seat, plug or cover.	· Replacement for significant damage.
Around seal for spool	· External oil leakage. · Rusting, corrosion or deformation of seal plate.	· Correction or replacement. · Correction or replacement.
Main relief valve & port relief valve	· External rusting or damage. · Contacting face of valve seat. · Contacting face of poppet. · Abnormal spring. · O-rings, back up rings and seals.	· Replacement. · Replacement when damaged. · Replacement when damaged. · Replacement. · 100% replacement in general.

3. SWING DEVICE

1) WEARING PARTS

Inspection item	Standard dimension	Recommended replacement value	Counter measures
Clearance between piston and cylinder block bore	0.020	0.045	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)	4	3.8	Replace assembly of piston and shoe
Combined height of set plate and guide (H)	17.4	17	Replace set of set plate and guide
Thickness of friction plate	3.6	3.2	Replace





2) SLIDING PARTS

Part name	Standard roughness	Remark
Shoe	0.8S	
Shoe plate	0.8S	
Cylinder block	6.3S	
Valve plate	0.8S	

4. TRAVEL DEVICE

Disassembling and inspection of the motor must be done in strict accordance with the servicing standards described here. During servicing, handle each part very carefully not to damage them, especially for their movable or sliding sections.

1) PARTS INSPECTION TIPS AND REPLACEMENT STANDARDS

(1) **Sun gear, drive gear, planetary gear, housing.**
Pitting and breaking appear on the tooth surface.

※ **When the size of the groove or cavity in one pitting is Φ 1mm or more or the area ratio is 5% or more for the entire area.**

(2) **Oil seal**
Replace when the surface of the lip is damaged or worn.
When disassembling the oil seal from the motor for inspection.

(3) **Planetary gear F of needle bearing part**
As the planetary gear F is assembled, check the boss and circumference direction clearance of the motor casing.
If it is 0.5 mm or more, replace it.

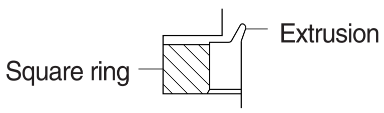
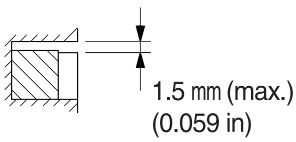
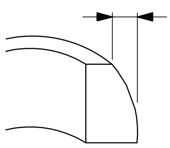
(4) **Do not disassemble in housing and check with the following tips.**

① Check the raceway surface, rollers or balls in the visible range, and make sure there are no pittings or cracks.
② Check for local corrosion and wear on the ball.
③ Please check again with the following tips.
a) Check the gear oil for excessive wear powder.
b) Make sure that there is excessive wear powder between the ball and cage.
c) When turning lightly by hand, check that it rotates smoothly.
After performing the above inspection, replace any problem.
Do not use angular bearing separated from housing again.

(5) **Side plate**
If the drive gear and sliding surfaces are markedly damaged, they must be replaced.

(6) Fitting on rotating surfaces of needle bearing and inner racefor planetary gear R, should be replaced when broken.

5. 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

6. 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

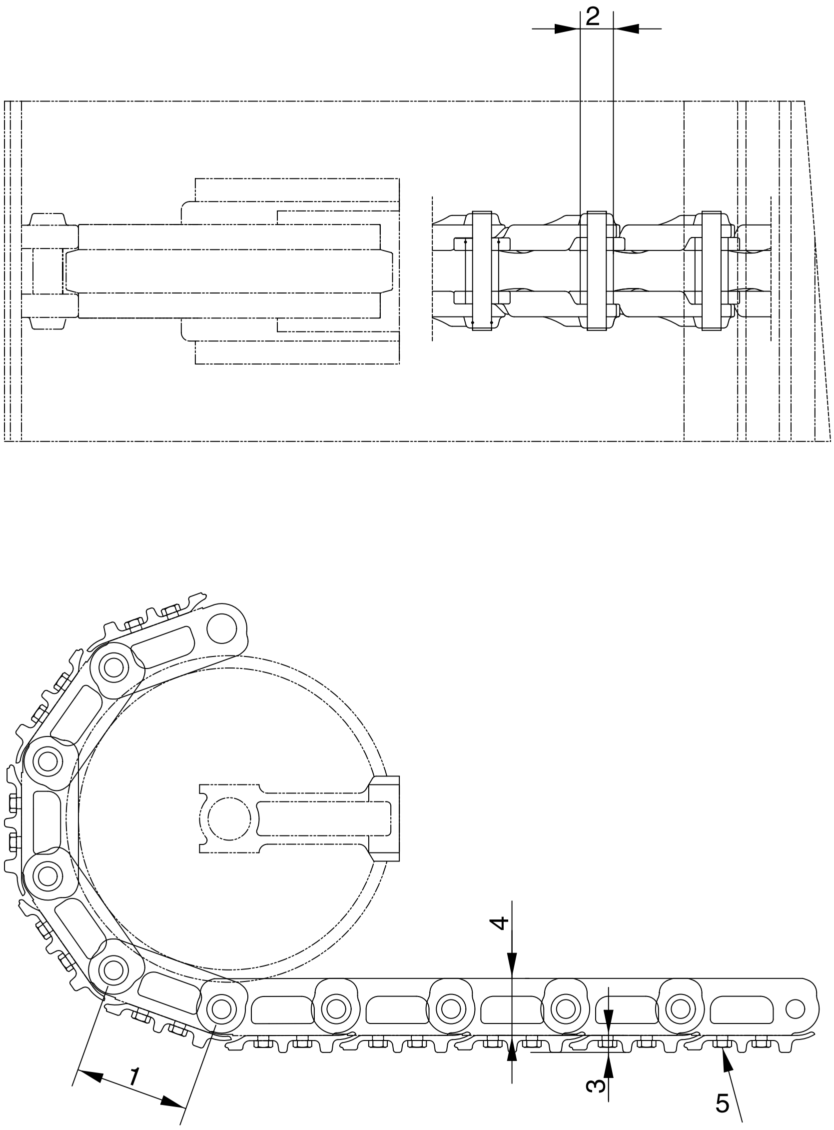
MEMORANDUM

MEMORANDUM

GROUP 3 TRACK AND WORK EQUIPMENT

1. TRACK SHOE

1) STEEL SHOE SPEC

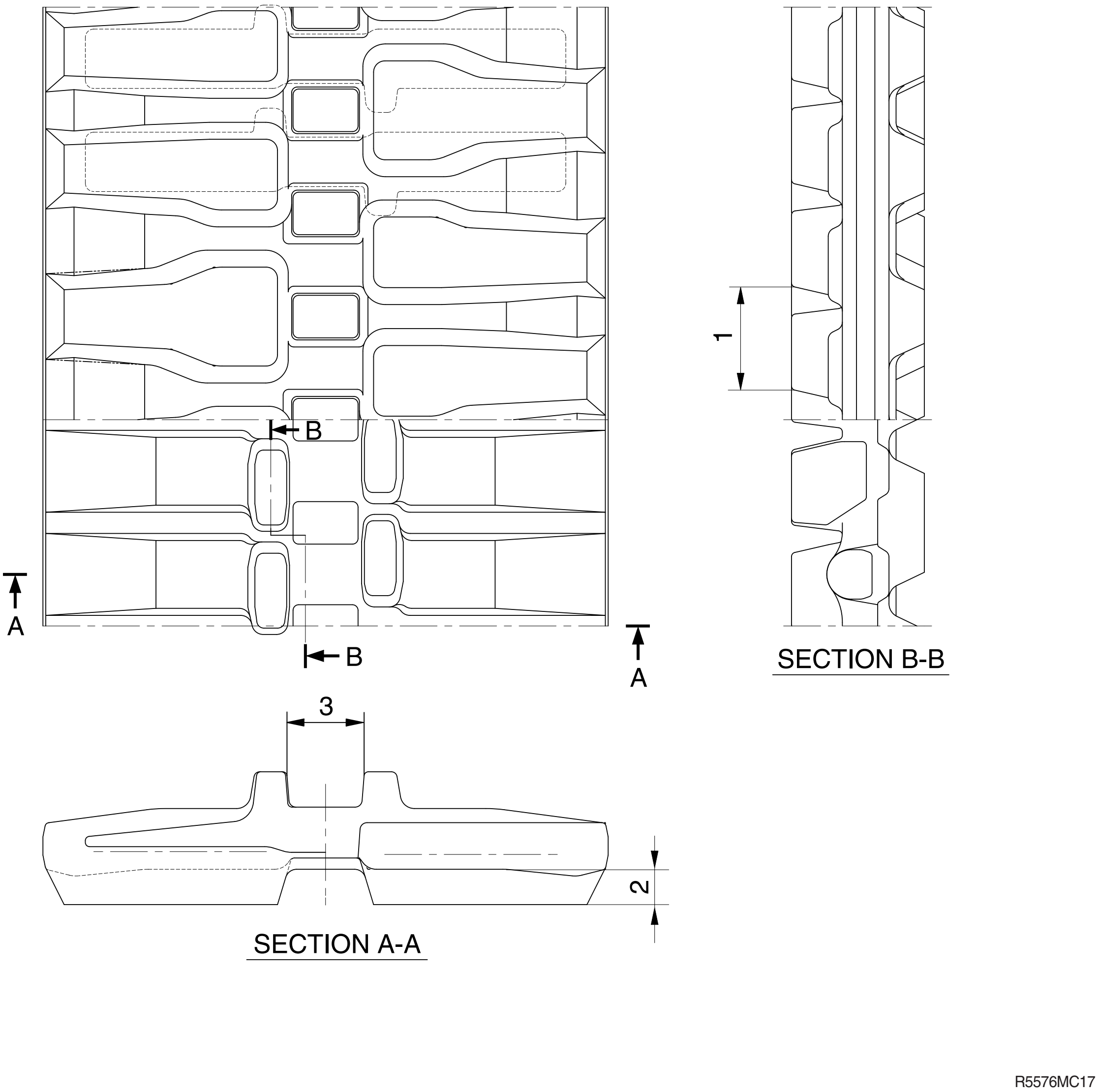


R5576MC16

Unit : mm

No	Check item	Criteria		Remedy
		Standard size	Repair limit	
1	Link pitch	135	138.6	Replace bushing and pin and link assembly
2	Outside diameter of bushing	39	35.4	
3	Height of grouser	20	17	Lug welding, rebuild or replace
4	Height of link	70	64.5	
5	Tightening torque	Initial tightening torque : 19.5±2.0kgf · m		Retighten

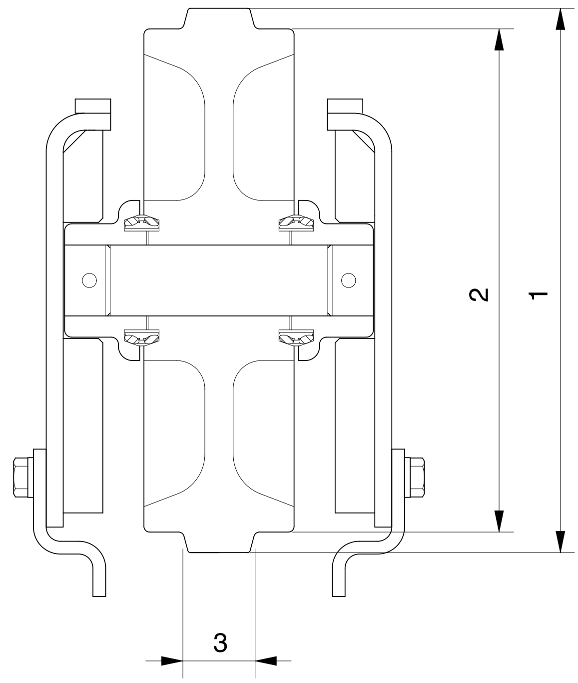
2) RUBBER SHOE SPEC



Unit : mm

No	Check item	Criteria			Remedy
		Standard size	Tolerance	Repair limit	
1	Link pitch	73	±1.0	76	Replace
2	Height of grouser	25	-	5	
3	Width of link	54	-	70	

2. IDLER

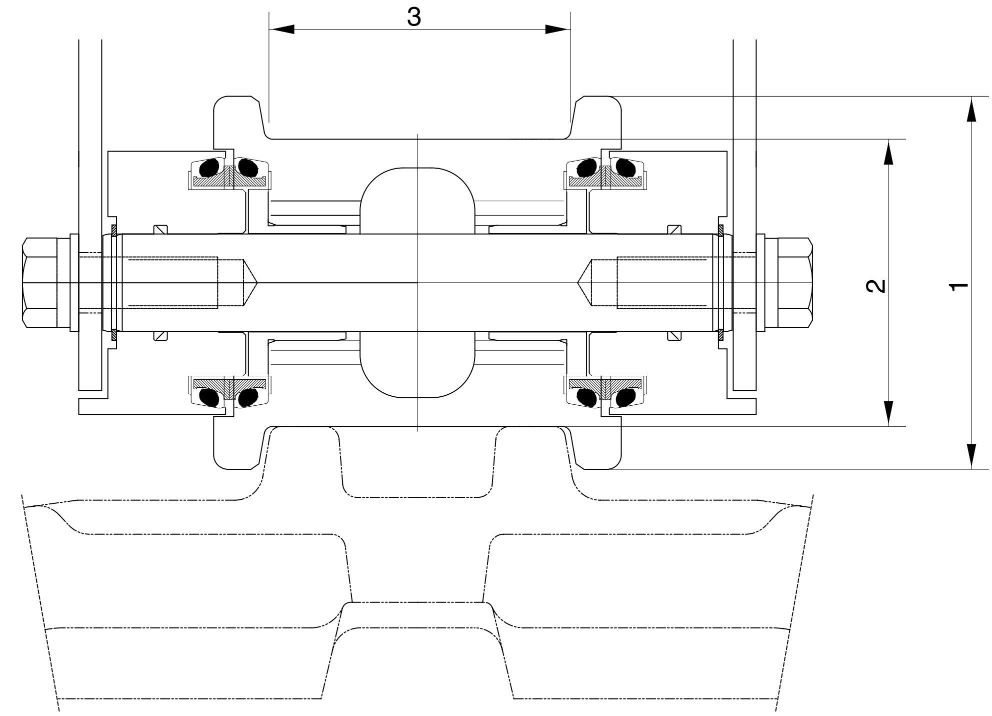


R5576MC18

Unit : mm

No	Check item		Criteria		Remedy
			Standard size	Repair limit	
1	Outside diameter of flange	Steel	384	-	Rebuild or replace
		Rubber	411	-	
2	Outside diameter of thread	Steel	355	345	
		Rubber	368	-	
3	Width of flange	Steel	41.9	-	
		Rubber	51	-	

3. TRACK/CARRIER ROLLER



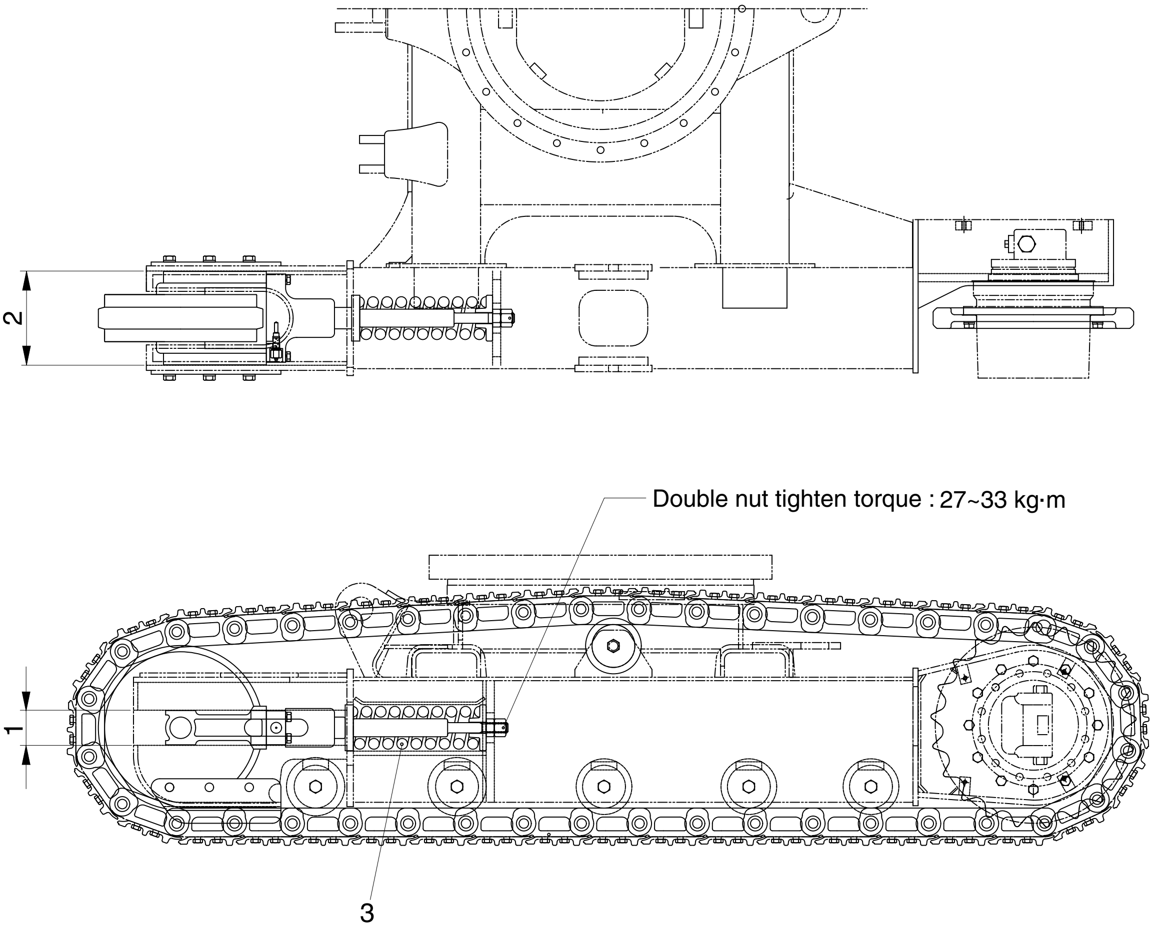
R5576MC15

Unit : mm

No	Check item	Criteria		Remedy
		Standard size	Repair limit	
1	Outside diameter of flange	130	-	Rebuild or replace
2	Outside diameter of thread	105	95	
3	Width of flange	108	114	

4. TENSION CYLINDER

1) STEEL SHOE SPEC

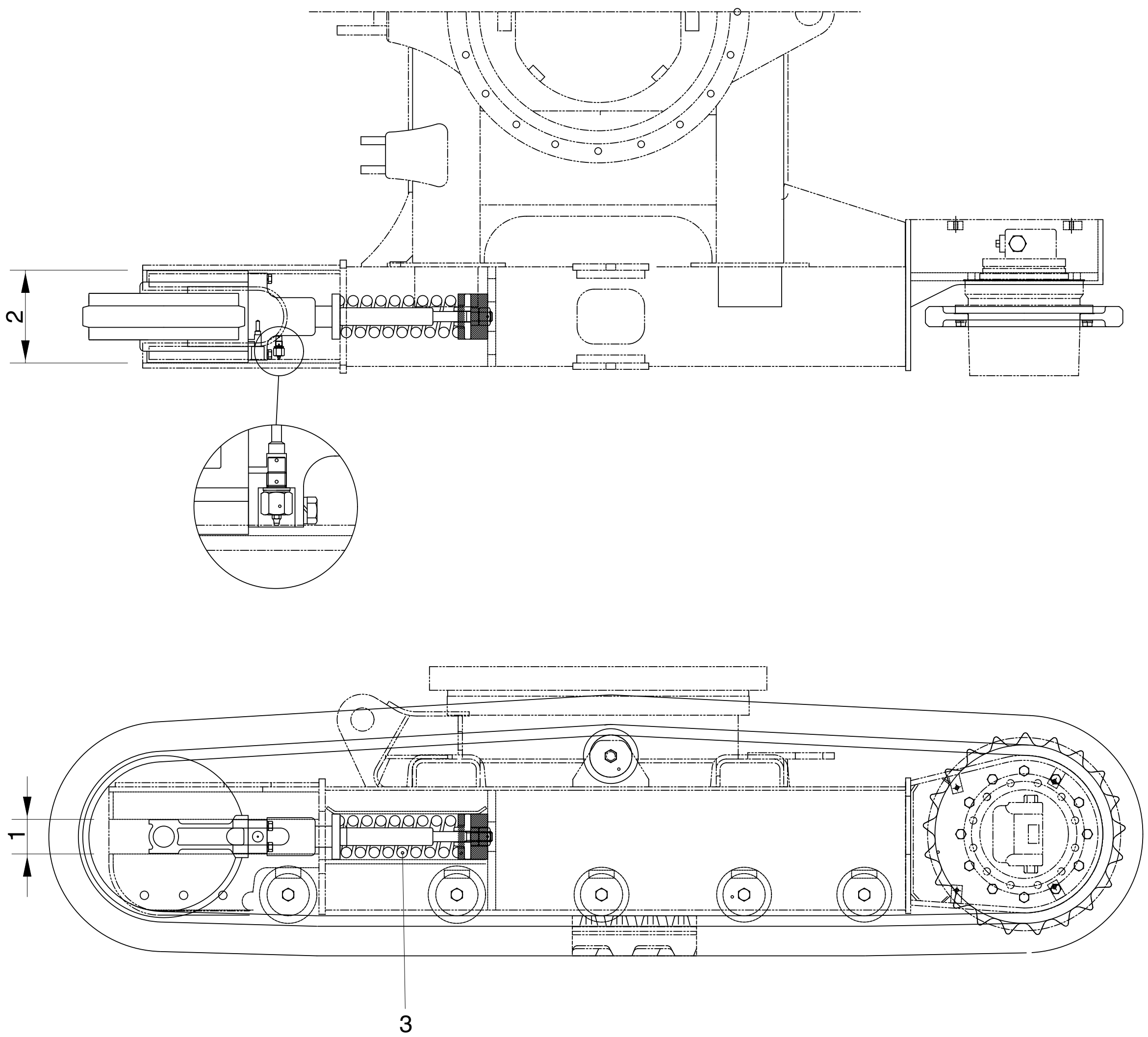


Unit : mm

<table>
<tr><th rowspan="2">No</th><th rowspan="2">Check item</th><th colspan="3">Criteria</th><th rowspan="2">Remedy</th></tr>
<tr><th></th><th>Standard size</th><th>Repair limit</th></tr>
<tr><td rowspan="2">1</td><td rowspan="2">Outside diameter of flange</td><td>Track frame</td><td>82</td><td>86</td><td>Rebuild</td></tr>
<tr><td>Idler support</td><td>80</td><td>78</td><td>Rebuild or replace</td></tr>
<tr><td rowspan="2">2</td><td rowspan="2">Outside diameter of thread</td><td>Track frame</td><td>220</td><td>222</td><td>Rebuild</td></tr>
<tr><td>Idler guide</td><td>218</td><td>214</td><td>Rebuild or replace</td></tr>
</table>

<table>
<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>Installed length</td><td>Installed load</td><td>Free length</td><td>Installed load</td></tr>
<tr><td>Ø100×330</td><td>292</td><td>3,900 kg</td><td>-</td><td>3,120 kg</td></tr>
</table>

2) RUBBER SHOE SPEC



R5576MC20

Unit : mm

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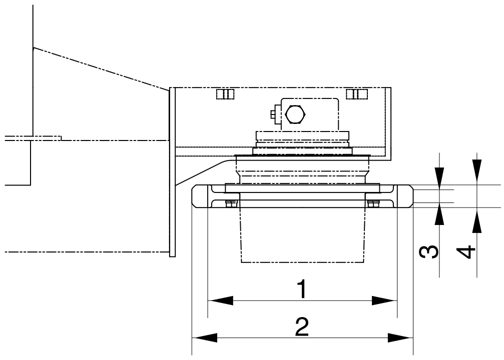
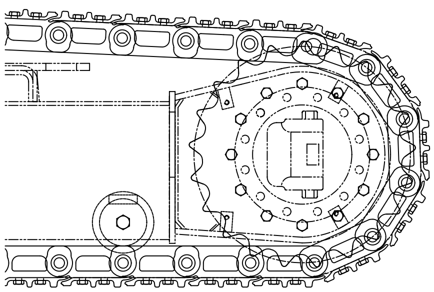
<tr><td colspan="2"></td><td colspan="2">Standard size</td><td>Repair limit</td></tr>
<tr><td rowspan="2">1</td><td rowspan="2">Vertical width of idler guide</td><td colspan="2">Track frame</td><td colspan="2">82</td><td>86</td><td rowspan="2">Rebuild or replace</td></tr>
<tr><td colspan="2">Idler support</td><td colspan="2">80</td><td>76</td></tr>
<tr><td rowspan="2">2</td><td rowspan="2">Horizontal width of idler guide</td><td colspan="2">Track frame</td><td colspan="2">220</td><td>222</td><td rowspan="2">Rebuild or replace</td></tr>
<tr><td colspan="2">Idler guide</td><td colspan="2">218</td><td>214</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>Installed length</td><td>Installed load</td><td>Free length</td><td>Installed load</td></tr>
<tr><td>330</td><td>280</td><td>5,140 kg</td><td>-</td><td>4,110 kg</td></tr>
</table>

5. SPROCKET



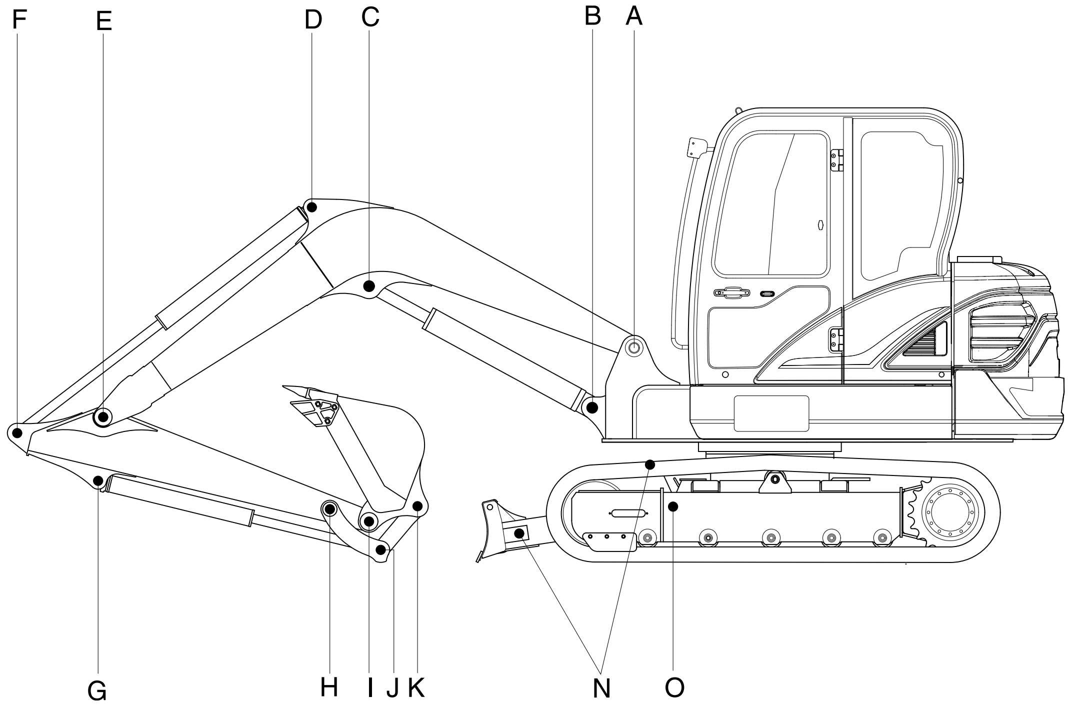


R5576MC21

Unit : mm

No	Check item	Criteria		Remedy
		Standard size	Repair limit	
1	Wear out of sprocket tooth lower side diameter	418.6	412	Repair or Replace
2	Wear out of sprocket tooth upper side diameter	476	-	
3	Wear out of sprocket tooth upper side width	33.5	-	
4	Wear out of sprocket tooth lower side width	42.5	36.5	

6. WORK EQUIPMENT



Unit : ㎜

Mark	Measuring point (pin and bushing)	Normal value	Pin		Bushing		Remedy & Remark
			Recomm. service limit	Limit of use	Recomm. service limit	Limit of use	
A	Boom Rear	50	49	48.5	50.5	51	Replace
B	Boom Cylinder Head	60	59	58.5	60.5	61	〃
C	Boom Cylinder Rod	60	59	58.5	60.5	61	〃
D	Arm Cylinder Head	50	49	48.5	50.5	51	〃
E	Boom Front	50	49	48.5	50.5	51	〃
F	Arm Cylinder Rod	50	49	48.5	50.5	51	〃
G	Bucket Cylinder Head	45	44	43.5	45.5	46	〃
H	Arm Link	45	44	43.5	45.5	46	〃
I	Bucket and Arm Link	45	44	43.5	45.5	46	〃
J	Bucket Cylinder Rod	45	44	43.5	45.5	46	〃
K	Bucket Link	45	44	43.5	45.5	46	〃
N	Blade cylinder	55	54	53.5	55.5	56	〃
O	Blade and frame link	35	34	33.5	35.5	36	〃

SECTION 7 DISASSEMBLY AND ASSEMBLY

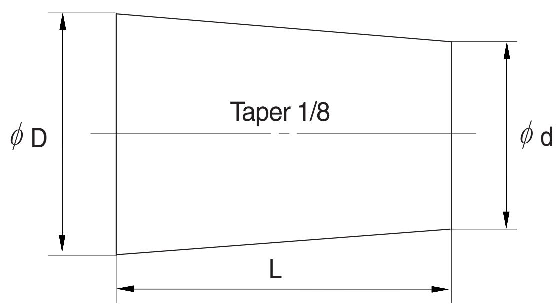
SECTION 7 DISASSEMBLY AND ASSEMBLY

GROUP 1 PRECAUTIONS

1. REMOVAL WORK

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

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



2. INSTALL WORK

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

2) Install the hoses without twisting or interference.

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

4) Bend the cotter pin or lock plate securely.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

3. COMPLETING WORK

1) If the coolant has been drained, tighten the drain valve, and add water to the specified level. Run the engine to circulate the water through the system. Then check the water level again.
2) If the hydraulic equipment has been removed and installed again, add engine oil to the specified level. Run the engine to circulate the oil through the system. Then check the oil level again.
3) If the piping or hydraulic equipment, such as hydraulic cylinders, pumps, or motors, have been removed for repair, always bleed the air from the system after reassembling the parts.
4) Add the specified amount of grease(Molybdenum disulphied grease) to the work equipment related parts.

GROUP 2 TIGHTENING TORQUE

1. MAJOR COMPONENTS

No.	Descriptions		Bolt size	Torque	
				kgf · m	lbf · ft
1	Engine	Engine mounting bolt (engine-bracket)	M12 × 1.75	11±1.0	79.6±7.2
2		Engine mounting bolt (rubber, 4EA)	M14 × 2.0	18.3±2.0	132±14.5
3		Radiator mounting bolt, nut	M12 × 1.75	12.8±3.0	92.5±21.7
4		Coupling mounting socket bolt	M14 × 2.0	14±1.0	101±7.2
		Coupling mounting clamp bolt	M16 × 2.0	11±1.0	79.6±7.2
5	Hydraulic system	Main pump mounting bolt Main pump housing mounting bolt	M12 × 1.75 M10 × 1.5	12.3±3.0 6.5±0.7	89±21.7 47±5.1
6		Main control valve mounting bolt	M 8 × 1.25	2.5±0.5	18.1±3.6
7		Fuel tank mounting bolt	M16 × 2.0	29.7±4.5	215±32.5
8		Hydraulic oil tank mounting bolt	M16 × 2.0	29.7±4.5	215±32.5
9		Turning joint mounting bolt, nut	M12 × 1.75	12.8±3.0	92.5±21.7
10	Power train system	Swing motor mounting bolt	M16 × 2.0	29.7±4.5	215±32.5
11		Swing bearing upper mounting bolt	M16 × 2.0	29.7±3.0	215±21.7
12		Swing bearing lower mounting bolt	M16 × 2.0	29.7±3.0	215±21.7
13		Travel motor mounting bolt	M14 × 2.0	20±2.0	145±14.5
14	Under carriage	Sprocket mounting bolt	M14 × 2.0	19.6±2.0	142±14.5
15		Carrier roller mounting bolt, nut	M18 × 2.0	41.3±4.0	299±28.9
16		Track roller mounting bolt	M18 × 2.0	41.3±4.0	299±28.9
17		Track tension cylinder mounting bolt	M12 × 1.75	12.8±3.0	92.5±21.7
18		Track shoe mounting bolt, nut	1/2-20UNF	19.6±2.0	142±14.5
19		Track guard mounting bolt	M16 × 2.0	29.7±3.0	215±21.7
20	Others	Counter weight mounting bolt	M20 × 2.5	57.8±6.4	418±46.3
21		Cab mounting bolt, nut	M12 × 1.75	12.8±3.0	92.5±21.7
22		Operator's seat mounting bolt	M 8 × 1.25	1.17±0.1	8.5±0.7

※ 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	2.7 ~ 4.1	19.5 ~ 29.7
M10 × 1.5	4.0 ~ 6.0	28.9 ~ 43.4	5.5 ~ 8.3	39.8 ~ 60
M12 × 1.75	7.4 ~ 11.2	53.5 ~ 81.0	9.8 ~ 15.8	70.9 ~ 114
M14 × 2.0	12.2 ~ 16.6	88.2 ~ 120	16.7 ~ 22.5	121 ~ 163
M16 × 2.0	18.6 ~ 25.2	135 ~ 182	25.2 ~ 34.2	182 ~ 247
M18 × 2.5	25.8 ~ 35.0	187 ~ 253	35.1 ~ 47.5	254 ~ 344
M20 × 2.5	36.2 ~ 49.0	262 ~ 354	49.2 ~ 66.6	356 ~ 482
M22 × 2.5	48.3 ~ 63.3	349 ~ 458	65.8 ~ 98.0	476 ~ 709
M24 × 3.0	62.5 ~ 84.5	452 ~ 611	85.0 ~ 115	615 ~ 832
M30 × 3.0	124 ~ 168	898 ~ 1214	169 ~ 229	1223 ~ 1656
M36 × 4.0	174 ~ 236	1261 ~ 1704	250 ~ 310	1808 ~ 2242

(2) Fine thread

Bolt size	8T		10T	
	kg · m	lb · ft	kg · m	lb · ft
M 8 × 1.0	2.2 ~ 3.4	15.9 ~ 24.6	3.0 ~ 4.4	21.7 ~ 31.8
M10 × 1.2	4.5 ~ 6.7	32.5 ~ 48.5	5.9 ~ 8.9	42.7 ~ 64.4
M12 × 1.25	7.8 ~ 11.6	56.4 ~ 83.9	10.6 ~ 16.0	76.7 ~ 116
M14 × 1.5	13.3 ~ 18.1	96.2 ~ 131	17.9 ~ 24.1	130 ~ 174
M16 × 1.5	19.9 ~ 26.9	144 ~ 195	26.6 ~ 36.0	192 ~ 260
M18 × 1.5	28.6 ~ 43.6	207 ~ 315	38.4 ~ 52.0	278 ~ 376
M20 × 1.5	40.0 ~ 54.0	289 ~ 391	53.4 ~ 72.2	386 ~ 522
M22 × 1.5	52.7 ~ 71.3	381 ~ 516	70.7 ~ 95.7	511 ~ 692
M24 × 2.0	67.9 ~ 91.9	491 ~ 665	90.9 ~ 123	658 ~ 890
M30 × 2.0	137 ~ 185	990 ~ 1339	182 ~ 248	1314 ~ 1796
M36 × 3.0	192 ~ 260	1390 ~ 1880	262 ~ 354	1894 ~ 2562

2) PIPE AND HOSE (FLARE type)

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

3) PIPE AND HOSE (ORFS type)

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

4) FITTING

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

GROUP 3 PUMP DEVICE

1. REMOVAL AND INSTALL

1) REMOVAL

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

(2) Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping

(3) Loosen the breather slowly to release the pressure inside the hydraulic tank.

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

13031GE18

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

· Hydraulic tank quantity : 70 ℓ (18.5 U.S.gal)

(5) Disconnect hydraulic hoses (1, 2, 3, 4).

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

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

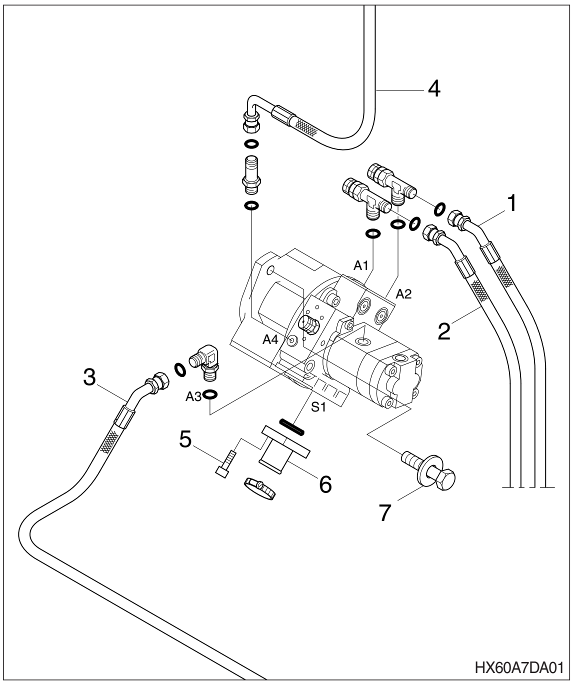
(7) Sling the pump assembly and remove the pump mounting bolts.

· Weight : 30 kg (70 lb)

· Tightening torque :

12.3 ± 3.0 kgf · m (89 ± 21.7 lbf · ft)

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



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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.

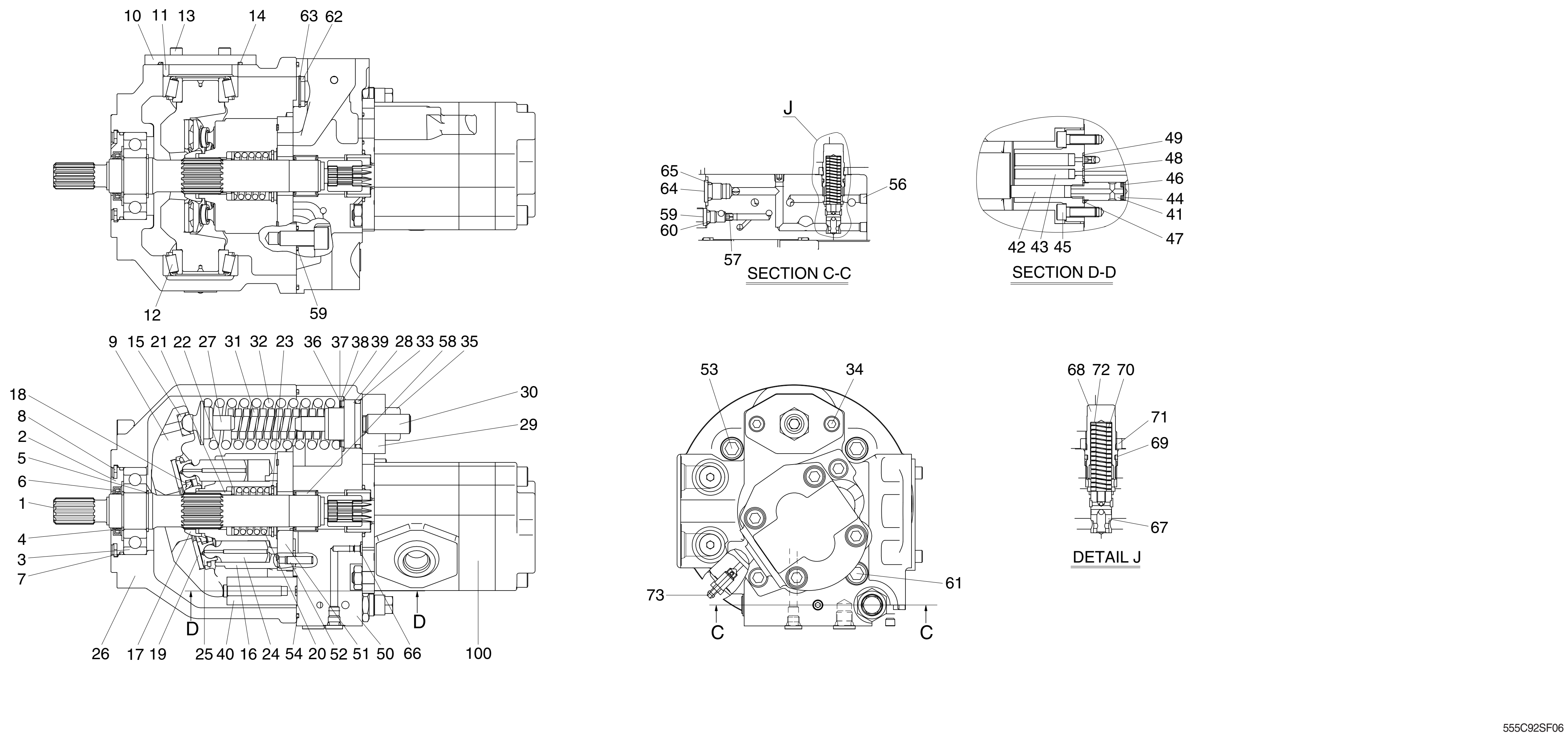
(6) Bleed the air from the hydraulic pump.
① Loosen the air vent plug.
② Start the engine, run at low idling, and check oil come out from plug.
③ Tighten plug.

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

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

2. MAIN PUMP

1) STRUCTURE



1	Drive shaft	14	O-ring	27	Spring seat(1)	39	Shim	51	Valve plate	63	Snap ring
2	Seal cover	15	Pivot	28	Spring seat(2)	40	Control cylinder	52	Parallel pin	64	RO plug
3	Ball bearing	16	Cylinder block	29	Spring cover	41	Control piston	53	Socket bolt	65	O-ring
4	Snap ring	17	Bushing	30	Adjusting screw	42	Control push-rod(1)	54	O-ring	66	O-ring
5	Snap ring	18	Push plate	31	Spring	43	Control push-rod(2)	55	O-ring	67	Spool
6	Oil seal	19	Shoe plate	32	Spring	44	Spring seat(1)	56	Plug	68	Adjusting screw
7	O-ring	20	Spring	33	O-ring	45	Socket bolt	57	Orifice	69	O-ring
8	Snap ring	21	Parallel pin	34	Socket bolt	46	Conical spring washer	58	Needle bearing	70	Spring
9	Swash plate	22	Spring seat	35	Hex nut	47	O-ring	59	RP plug	71	Hex nut
10	Plate	23	Snap ring	36	Shim	48	O-ring	60	O-ring	72	Shim
11	Bearing spacer	24	Piston	37	Shim	49	O-ring	61	Socket bolt	73	Air breather
12	Roller bearing	25	Shoe	38	Shim	50	Valve block	62	Filter	100	Gear pump assy
13	Socket bolt	26	Pump casing								

2) TOOLS AND TIGHTENING TORQUE

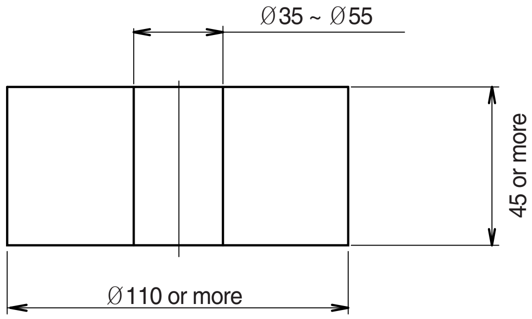
(1) Tools

The tools necessary to disassemble/reassemble the pump are shown in the follow list.

Name	Quantity	Size (nominal)
Hexagonal bar spanner	One each	5, 6, 8, 10
Spanner	1	17, 24
Plastic hammer	1	Medium size
Snap ring pilers	1	For hole (stop ring for 72)
Snap ring pilers	1	For shaft (stop rings for 28 and 30)
Standard screw-driver	2	Medium size
Torque wrench	-	Wrench which can tighten at the specified torque
Grease	Small	-
Adhesives	Small	LOCTITE #270

(2) Jigs

① Disassembling table



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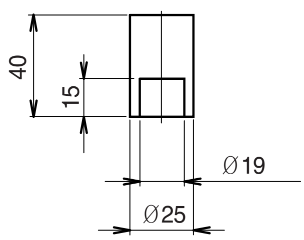
This is plate to stand the pump facing downward.
A square block may be used instead if the shaft end does not contact.

② Bearing assembling jig



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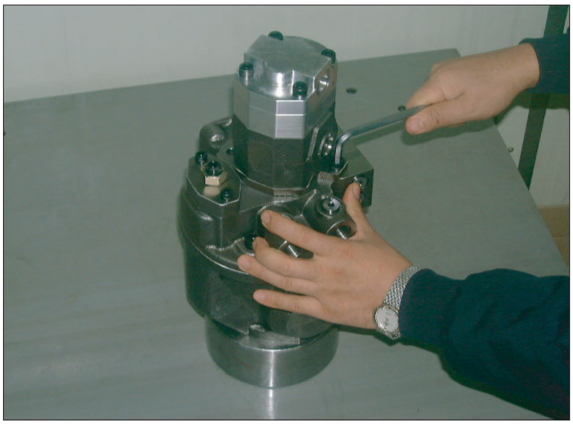
(3) Tightening torque

Part name	Bolt size	Torque		Wrench size	
		kgf · m	lbf · ft	in	mm
Hexagon socket head bolt	M 6	1.2	8.7	0.20	5
	M 8	3.0	21.7	0.24	6
	M12	10.0	72.3	0.39	10
	M16	24.0	174	0.55	14
	M18	34.0	246	0.55	14
PT Plug	PT 1/16	0.9	6.5	0.16	4
PF Plug	PF 1/8	1.5	10.8	0.20	5
	PF 1/4	3.0	21.7	0.24	6

3. DISASSEMBLY PROCEDURE

1) DISASSEMBLING THE GEARED PUMP

① Remove the hexagonal socket headed bolts (M10 × 25, 2 pieces).
Hexagonal bar spanner
(Hex. side distance : 8)
※ Be careful because the O-ring and filter are provided to the match surface of the geared pump.



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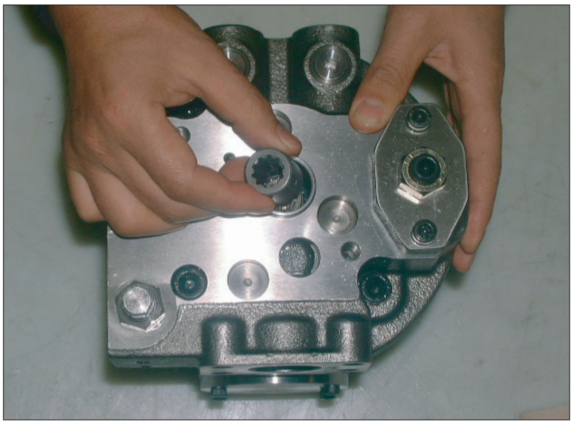
② Remove the coupling.



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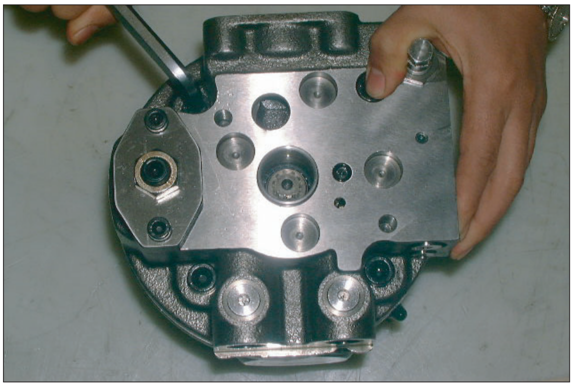
2) DISASSEMBLING THE MAIN PUMP

① Remove the cover.
Remove the hexagonal socket headed bolts. (M12 × 30, 3pieces) and (M12× 55, 1piece).
Hexagonal bar spanner
(Hex. side distance : 10)



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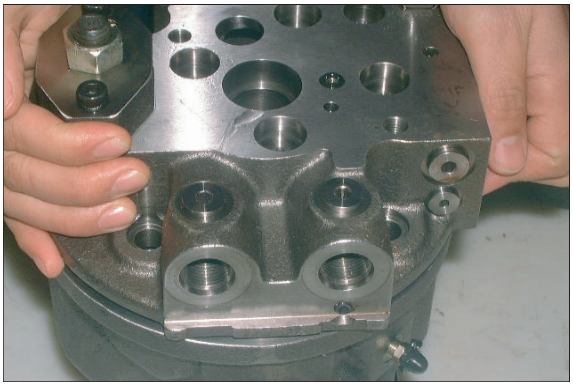
② Remove the cover in a horizontal condition.
Connect motor to work table.
※ Be careful because the control plate is provided to the backside.
When the cover is difficult to remove, knock lightly with a plastic hammer.



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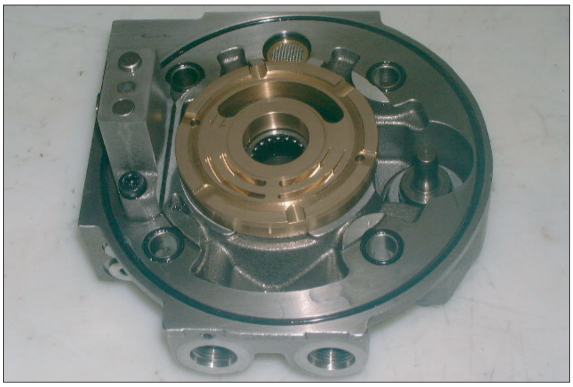
③ This photo shows the state with the cover removed.



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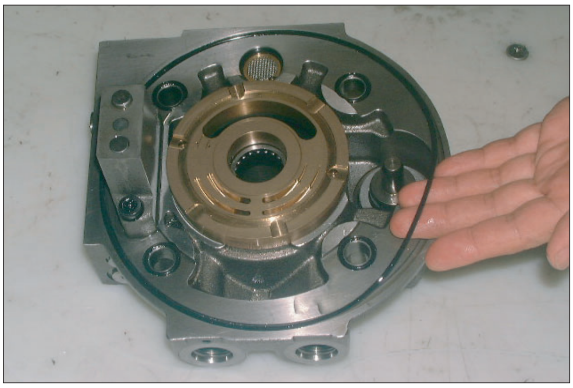
④ Remove the O-ring from the cover.



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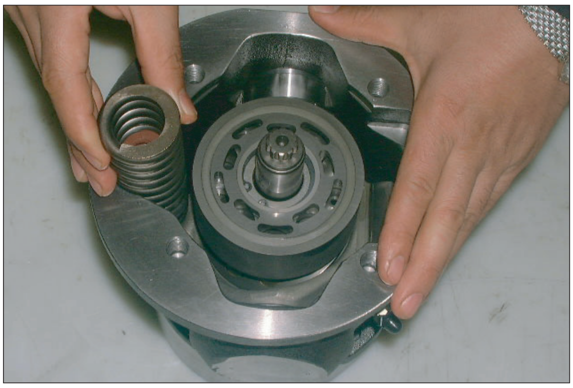
(1) The removal of the control spring

① Remove 2 springs (inner and outer).



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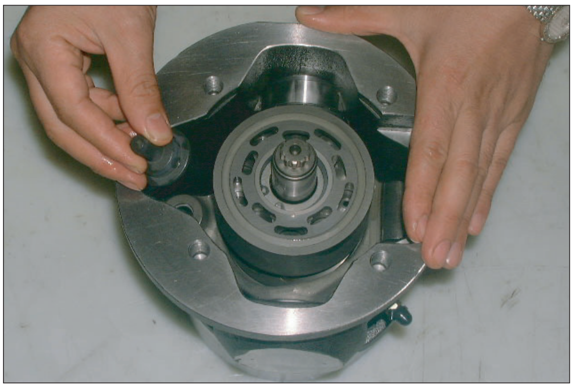
② Remove the spring seat.



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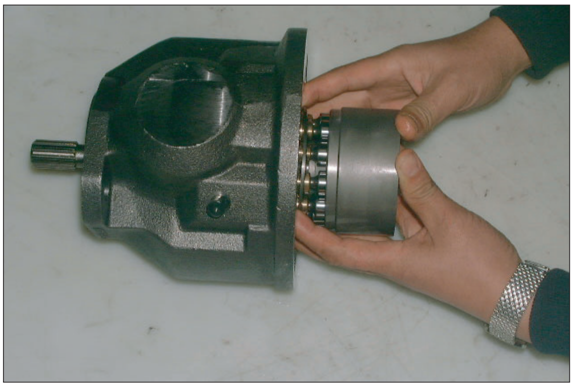
(2) The removal of rotary group

① Lay the pump on the side and take out the rotary group from the shaft.



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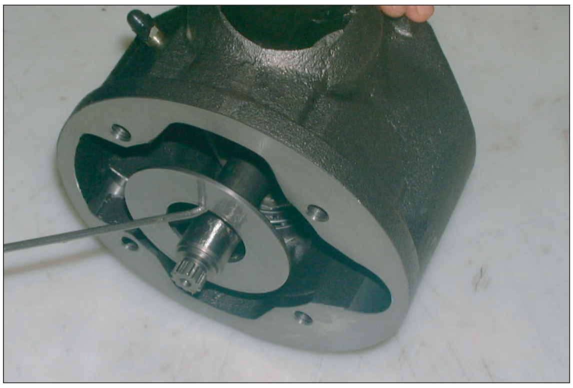
② Remove the plate.



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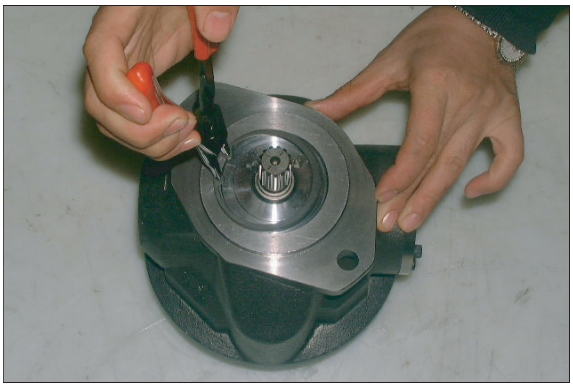
(3) The removal of the shaft

① Remove the C-type stop ring.
(snap ring pliers for hole)



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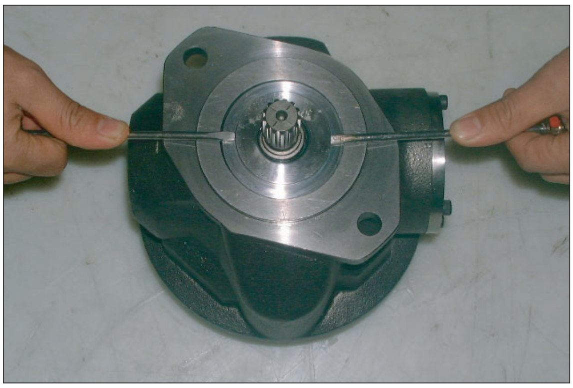
② Use two standard screw-drivers to remove the oil seal case.



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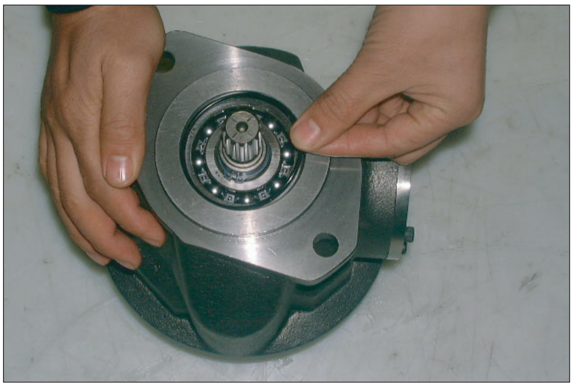
③ Remove the O-ring.



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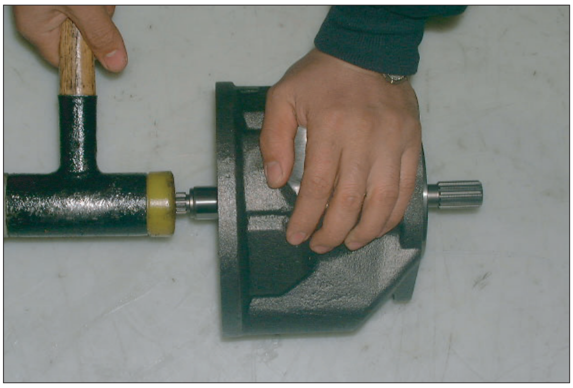
④ Remove it while knocking the shaft rear and lightly with a plastic hammer.



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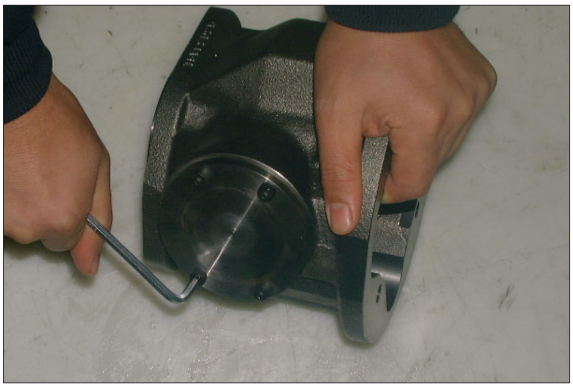
(4) The removal of the hanger

① Remove the hexagonal socket headed bolts (M6 × 16, 4pieces) and plate.
Hexagonal bar spanner
(Hex. side distance : 5)



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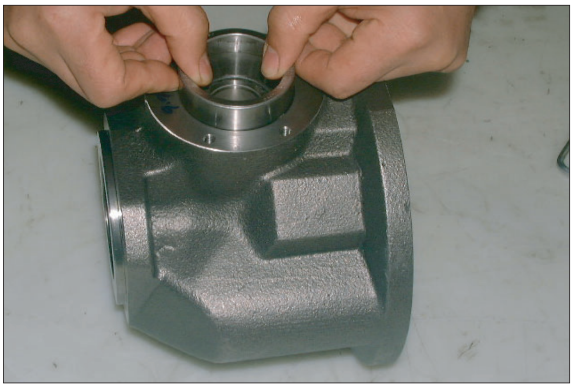
② Remove the distance piece.



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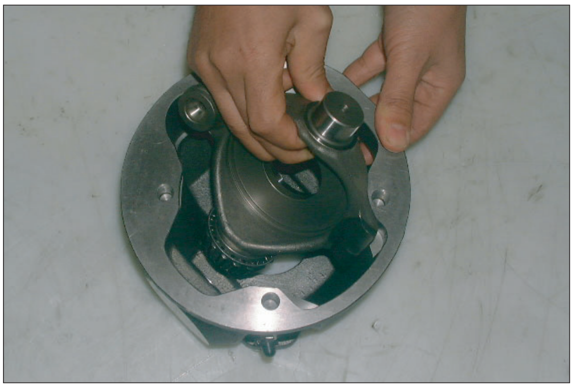
③ Remove the bearing.

R55NM7HP19

④ Remove the hanger.



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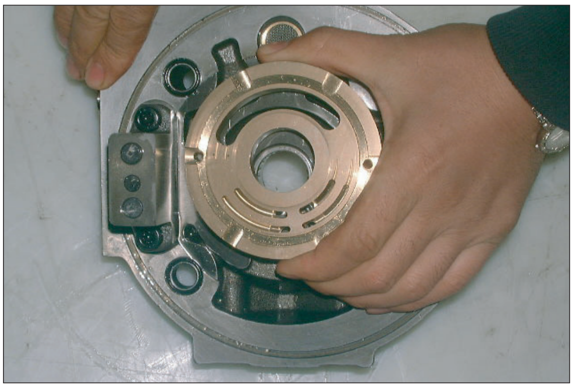
(5) The removal of the cover

① Remove the control plate.



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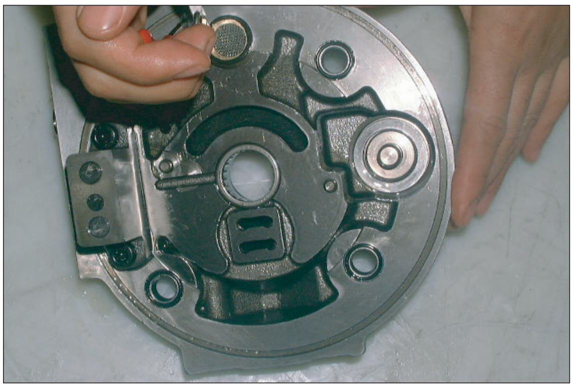
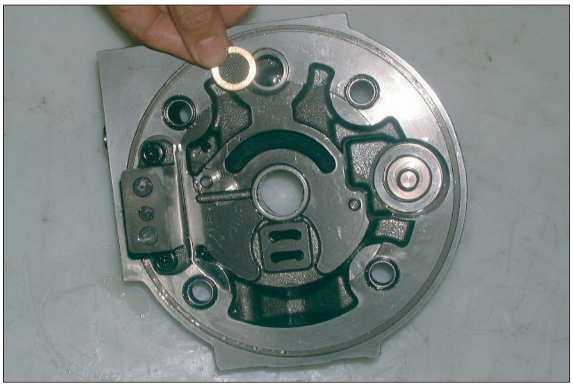
② Remove the C-type stop ring.



R55NM7HP22

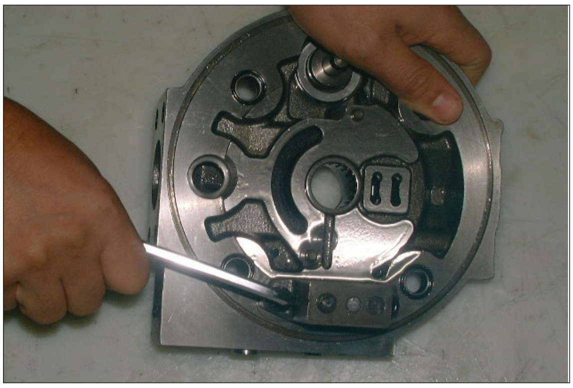
③ Remove the filter.



R55NM7HP23

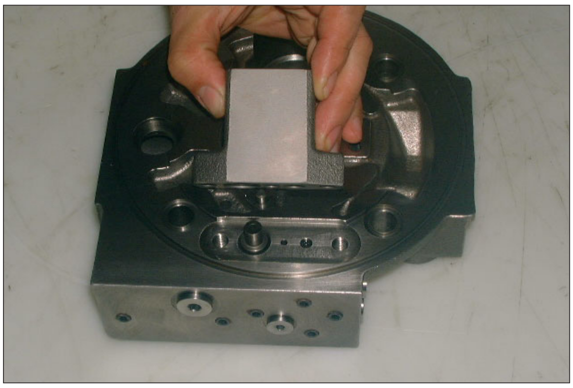
(6) The removal of the control piston

① Remove the hexagonal socket headed bolts. (M8 × 25, 2pieces)
Hexagonal bar spanner
(Hex. side distance : 6)
The threaded portion of the bolt is coated with LOCTITE #270.
This disassembly must therefore be made only when necessary.



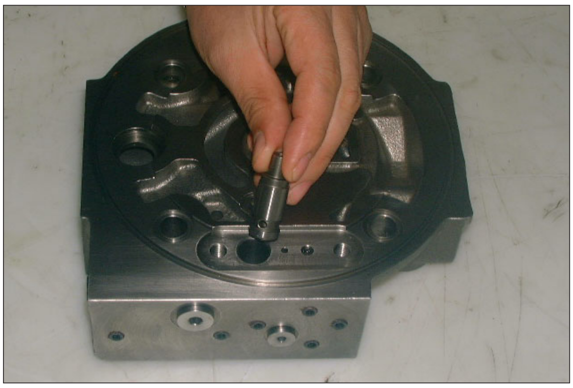
R55NM7HP24

② Remove the cylinder and parallel pin.
※ Be careful because 3 O-rings are provided to the cylinder.



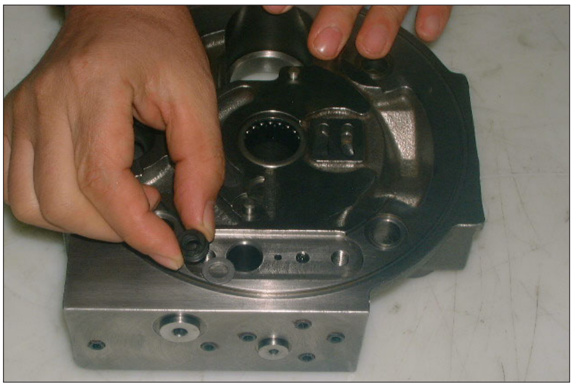
R55NM7HP25

③ Take out the piston.



R55NM7HP26

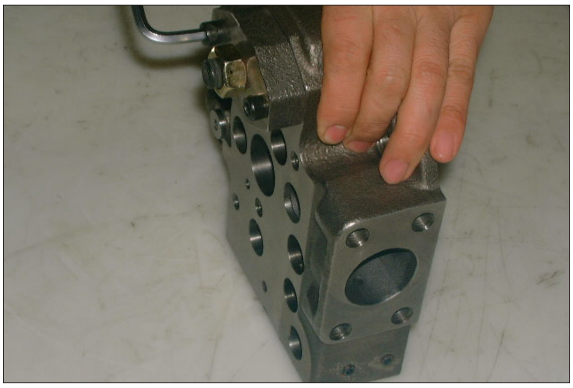
④ Take out three caned disk springs and spring seats.



R55NM7HP27

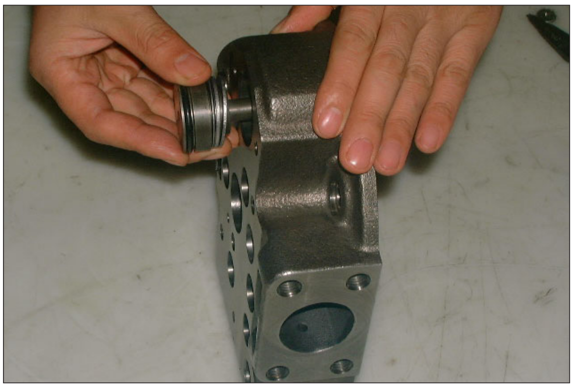
(7) The removal of the control spring

① Remove the hexagonal socket headed bolts (M8×30, 2pieces) and remove the cover.
Hexagonal bar spanner
(Hex. side distance : 6).



R55NM7HP28

② Remove the spring seat.

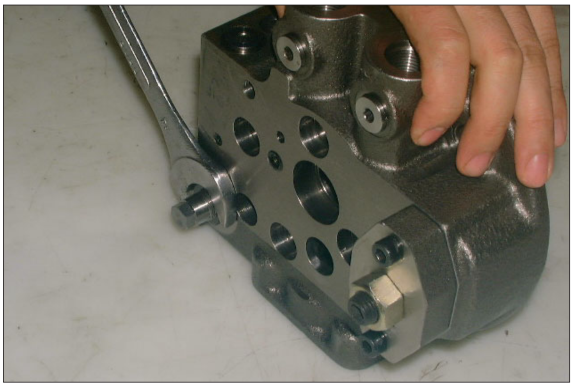


R55NM7HP29

(8) The removal of the relief valve

① Remove the hexagonal nuts.

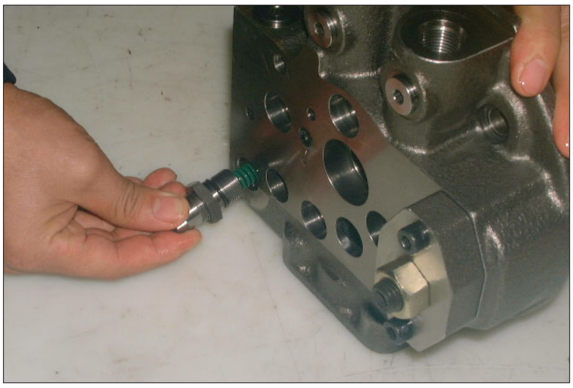
※ Since the pressure has been set, this assembly must be made only when necessary.
Spanner (Hex. side distance : 24).



R55NM7HP30

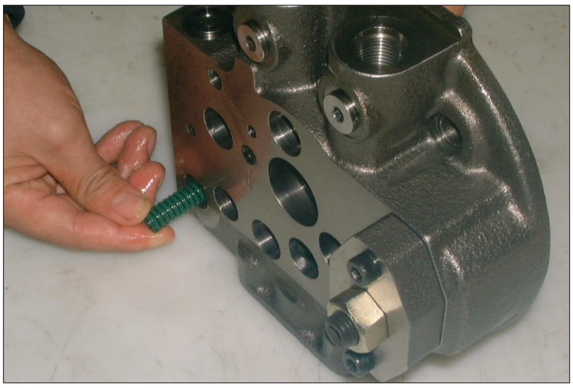
② Remove the adjusting screw.

※ Be careful because the shim is inserted.



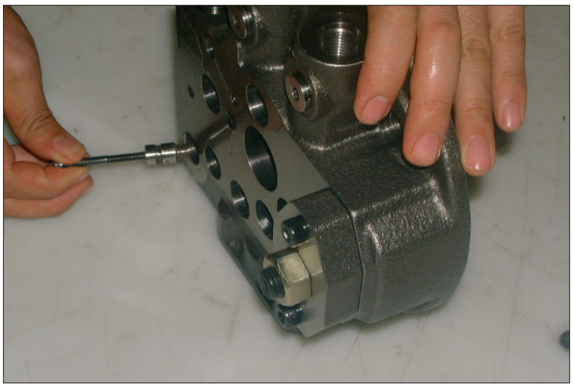
R55NM7HP31

③ Remove the spring.



R55NM7HP32

④ Remove the spool.



R55NM7HP33

(9) Disassembly of the shaft

① Remove the bearing.
Remove the C-type stop ring.
Snap ring pliers for shaft.

R55NM7HP34

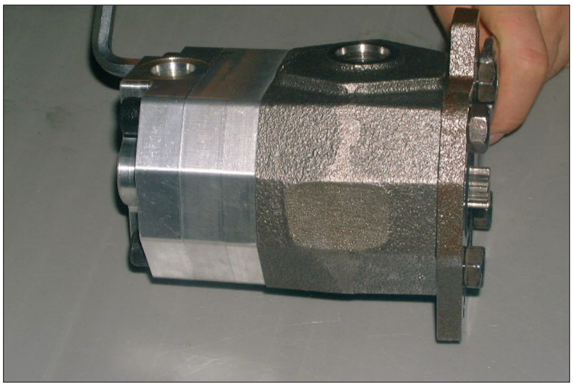
② Remove it while knocking the rear end of shaft lightly with a plastic hammer.

R55NM7HP35

3) DISASSEMBLING THE GEARED PUMP

(1) Disassembling the P3 and P4 pump

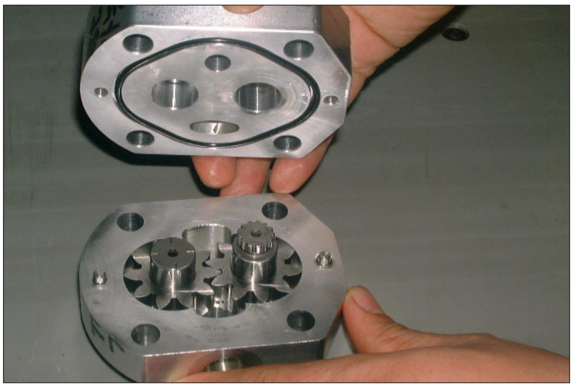
① Removed hexagonal socket head bolt and nut.
Hexagonal socket wrench (8 mm).
Hexagonal bar spanner (17 mm).



R55NM7HP209

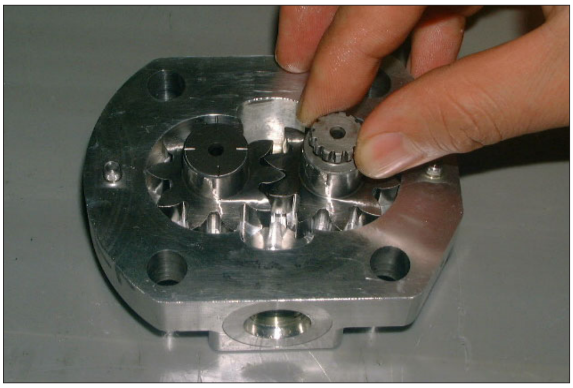
(2) Disassembling the geared pump (P4)

① Remove the geared pump (P4) from the center frame.



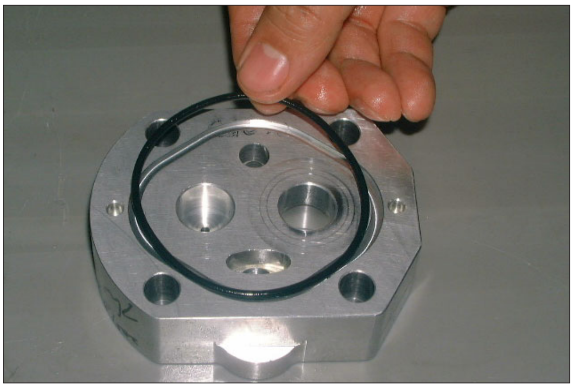
R55NM7HP208

② Pulling out the drive gear and the idle gear.



R55NM7HP207

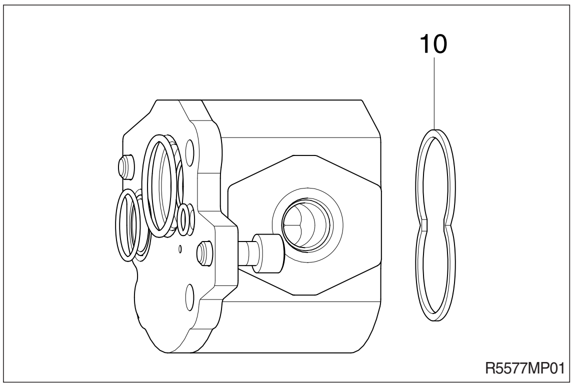
③ Remove the O-ring from the center frame.



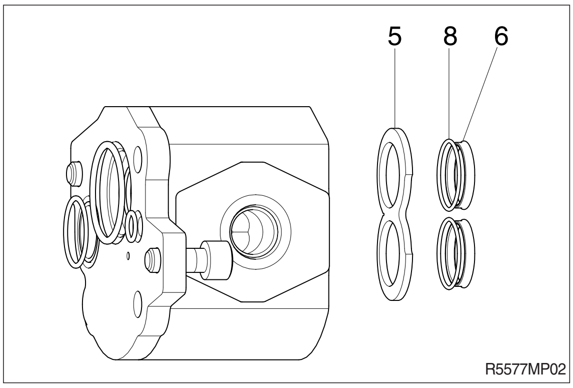
R55NM7HP206

(3) Disassembling the geared pump (P3)

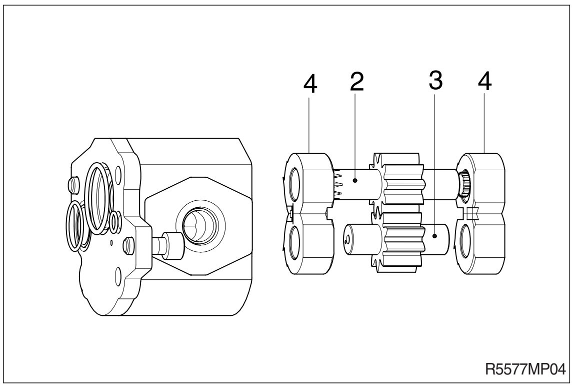
① Remove the square ring (10).



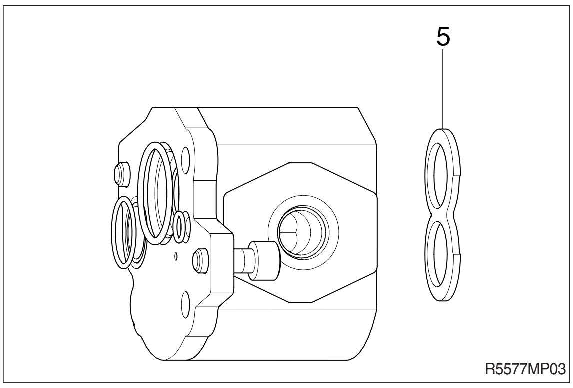
② Remove the plate (5) and the guide ring (pieces). With O-ring (6, 8).
Remove the O-ring (8) from guide ring (6).



③ Remove the drive and idle gear (2, 3) and the side plate (4) assembly.



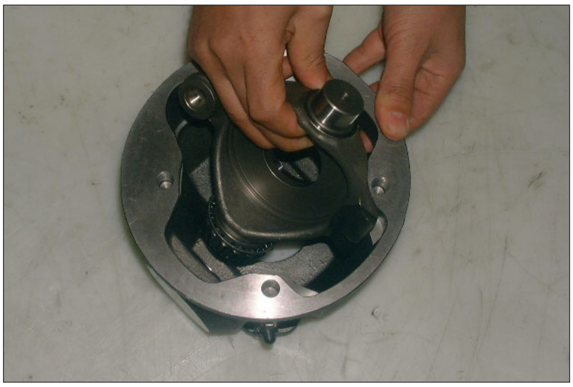
④ Remove the plate



4. ASSEMBLING PROCEDURE

1) ASSEMBLING THE MAIN PUMP

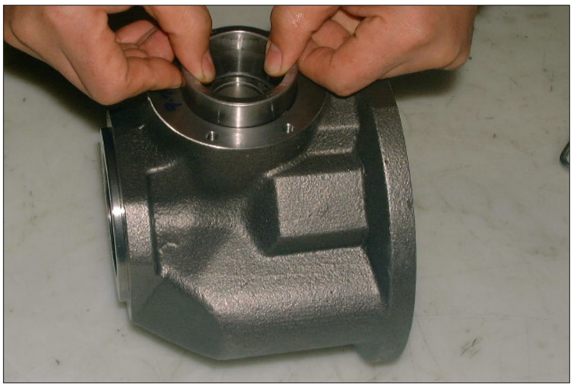
(1) Assembling the hanger.


R55NM7HP50

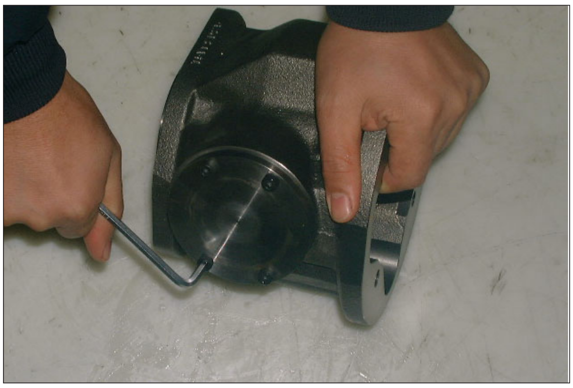
(2) Install the bearing.


R55NM7HP50A

(3) Install the distance piece.
Confirm that pre-load is 0.1 ± 0.2.


R55NM7HP51

(4) Fix the plate with the hexagonal socket headed bolts (M6 × 16, 4pieces).
Hexagonal bar spanner
(Hex. side distance : 5)
Tightening torque : 1.2 ~ 1.5 kgf · m
(8.7 ~ 10.8 lbf · ft)

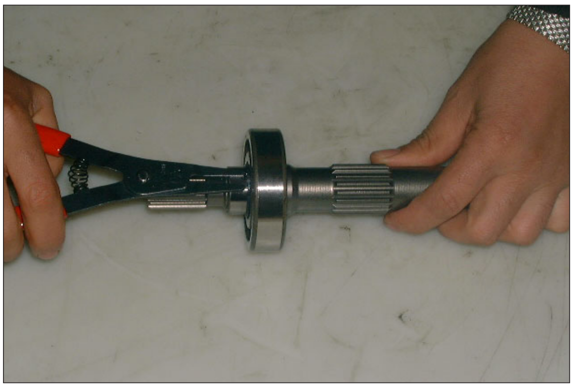

R55NM7HP52

(5) Assembling the shaft

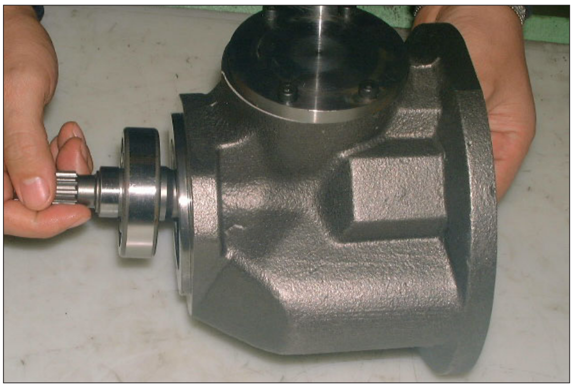
① Fit the shaft into the bearing (with the bearing in the bottom) by using the press machine and jig. If the press is not available, use the jig in the similar manner and drive the shaft into the bearing by knocking with a plastic hammer.


R55NM7HP53

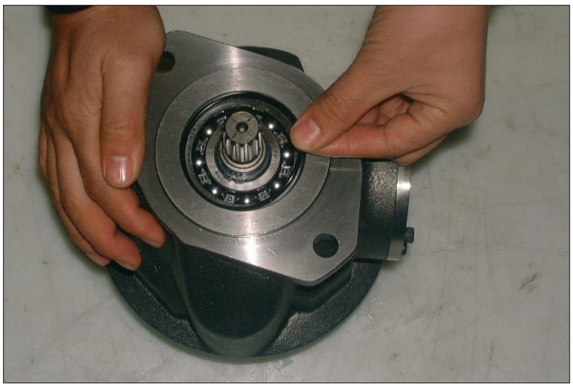
② Install the C-type stop ring to fix the bearing.


R55NM7HP54

③ Assembling the shaft.
Assemble the shaft into the housing.
Knock the spline end lightly with a plastic hammer and fix the bearing outer ring firmly into the housing hole.


R55NM7HP55

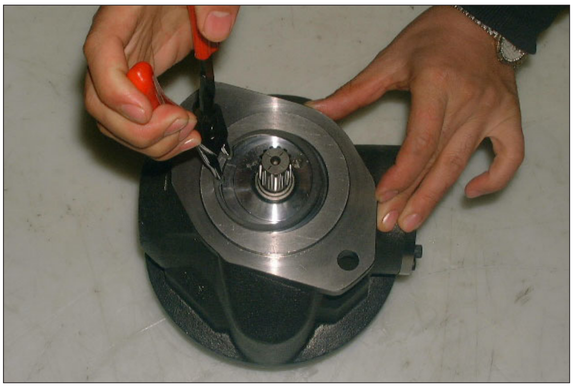
(6) Apply grease to the O-ring for assembling.


R55NM7HP56

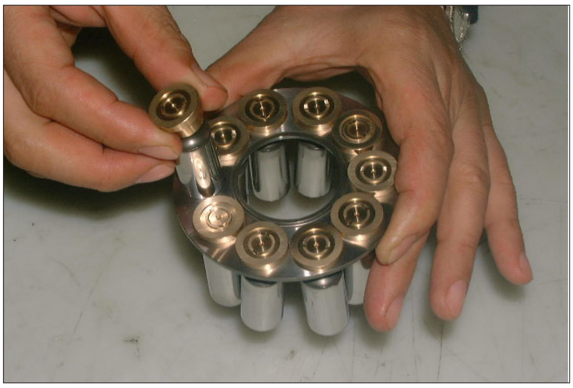
(7) Install the case with oil seal vertically without tilting.
※ Apply grease to the oil seal lip beforehand.


R55NM7HP57

(8) Install the C-type stop ring to fix the shaft.


R55NM7HP58

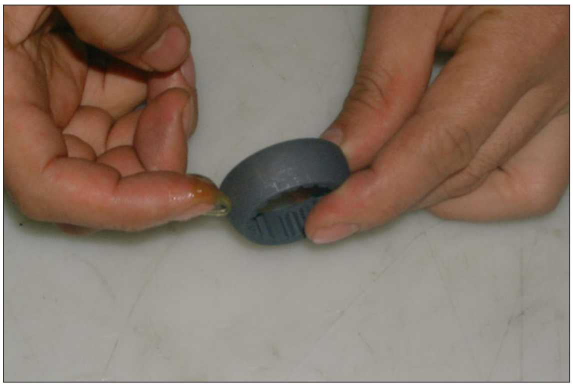
(9) Assembling the rotary group.
Install 10 (ten) pistons into the retainer.


R55NM7HP59

(10) Apply grease to 3 parallel pins and assemble them to the cylinder block.

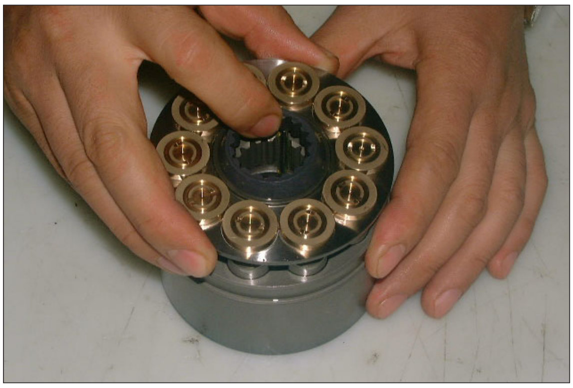

R55NM7HP60

(11) Apply grease to the spherical portion of the guide.



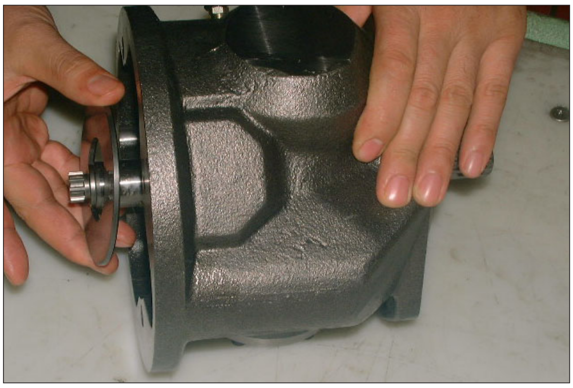
R55NM7HP61

(12) Insert the guide between the retainer and cylinder block and assemble the piston into the hole of cylinder block.



R55NM7HP62

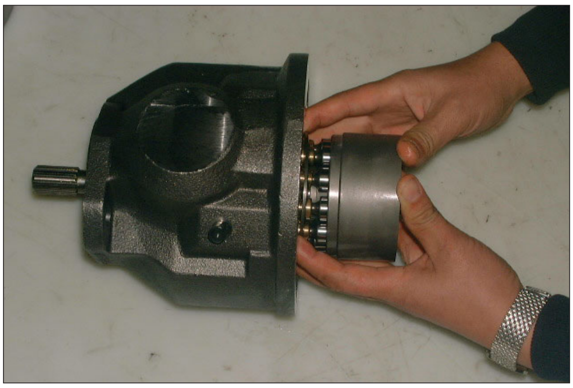
(13) Assembling the rotary group.
To prevent dislodgement, apply grease to the back side of the plate and assemble it to the hanger.



R55NM7HP63

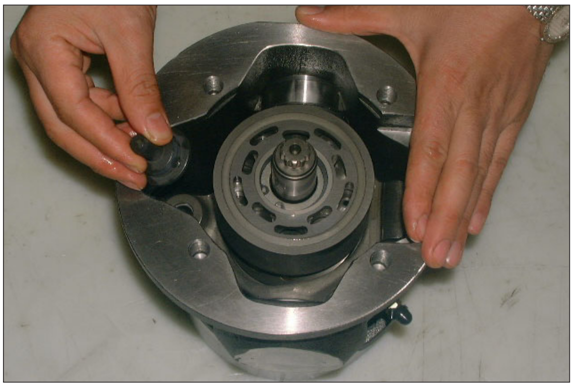
(14) Assemble the rotary group along the shaft spline.

※ During assembly, apply grease to the slide surface of piston shoe and to the slide surface of the cylinder block relative to the control plate.

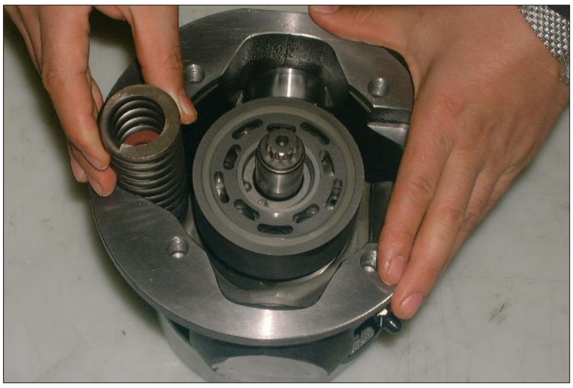


R55NM7HP64

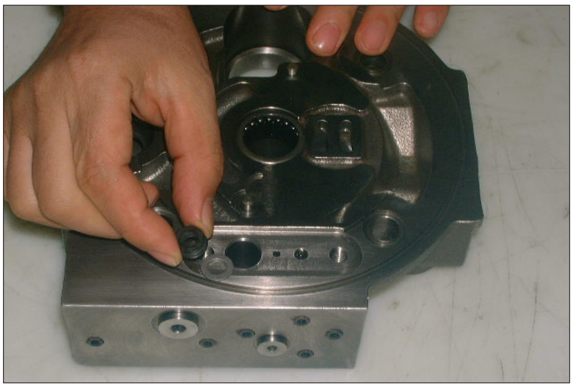
(15) Assembling the control spring.
Apply grease to the spherical portion of the spring seat before assembling.


R55NM7HP65

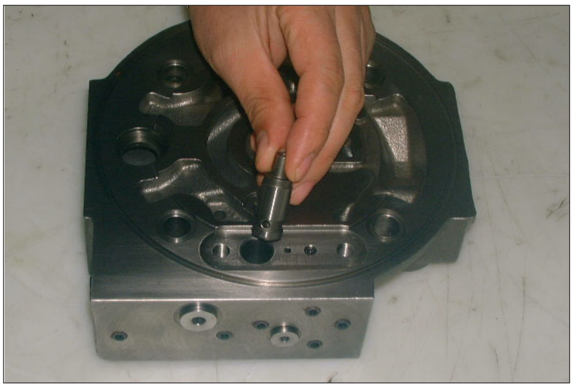
(16) Assemble 2 springs (inner and outer).


R55NM7HP66

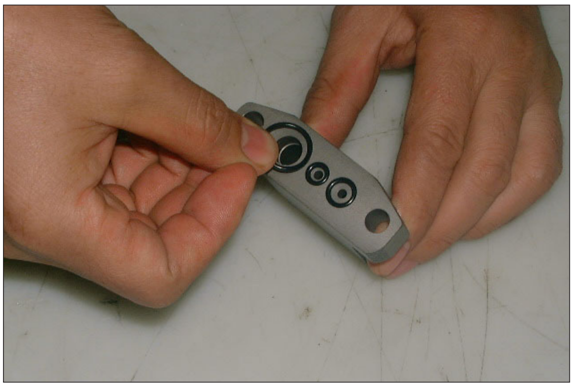
(17) Assembling the cover.
Assemble the spring seats and coned disk springs (3 pieces).


R55NM7HP67

(18) Assembling the control piston.

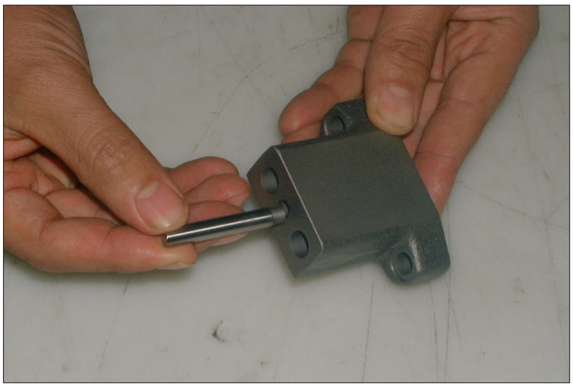

R55NM7HP68

(19) Apply grease to the O-rings (5.28×1.78, 1piece), (7.65×1.78, 1piece) and (15.6×1.78, 1piece) and assemble them to the cylinder.



R55NM7HP69

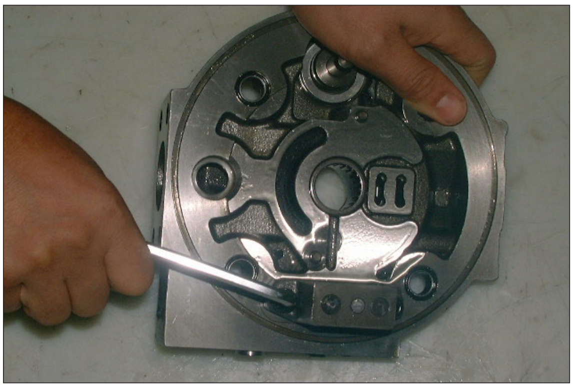
(20) Apply grease to 3 parallel pins and assemble 3 pins into the cylinder.



R55NM7HP70

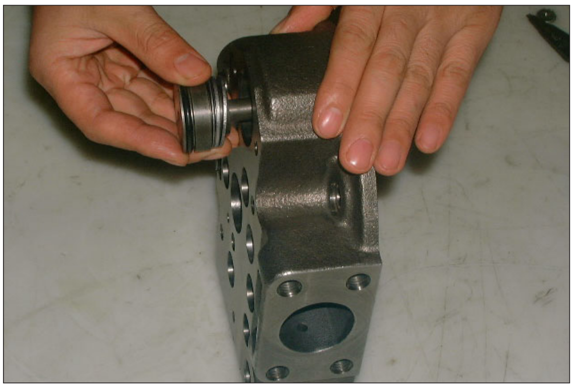
(21) Fix the cylinder with the hexagonal socket headed bolts (M8×25, 2pieces).

※ Apply LOCTITE #270 to the threaded portion of bolt.
Hexagonal bar spanner
(Hex. side distance : 6)
Tightening torque : 2.9 ~ 3.5 kgf · m
(21 ~ 25.3 lbf · ft)



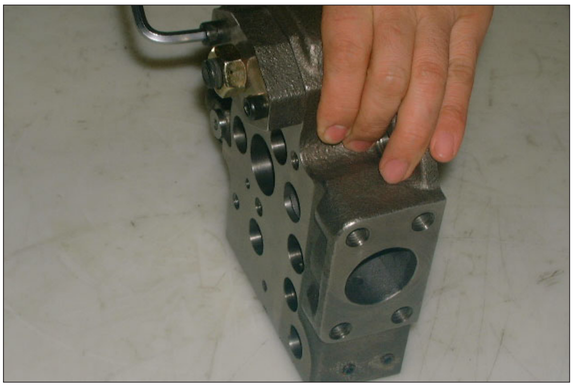
R55NM7HP71

(22) Assembling the control spring.
Install the spring seat.



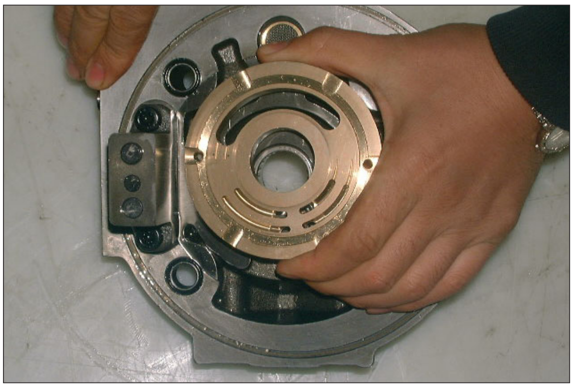
R55NM7HP72

(23) Fix the cover with the hexagonal socket headed bolts (M8×30, 2pieces)
Hexagonal bar spanner
(Hex. side distance : 6)
Tightening torque : 2.9 ~ 3.5 kgf · m
(21 ~ 25.3 lbf · ft)



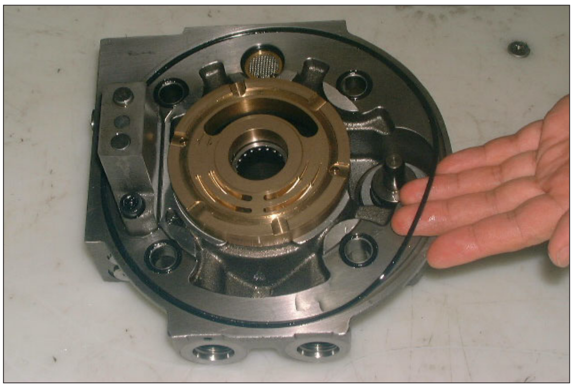
R55NM7HP73

(24) Apply grease to the back side of the control plate and assemble it to the cover while matching knock holes.



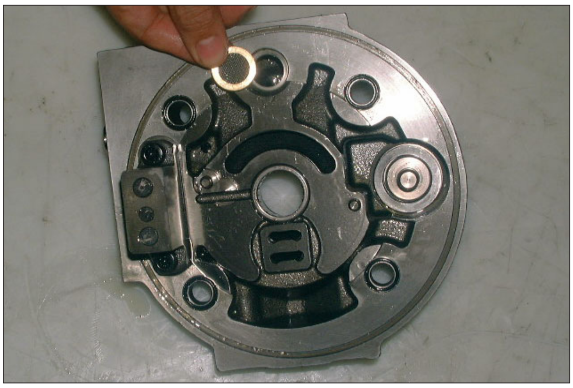
R55NM7HP74

(25) Install the O-ring.
Assemble the spring seats and coned disk springs (3pieces).



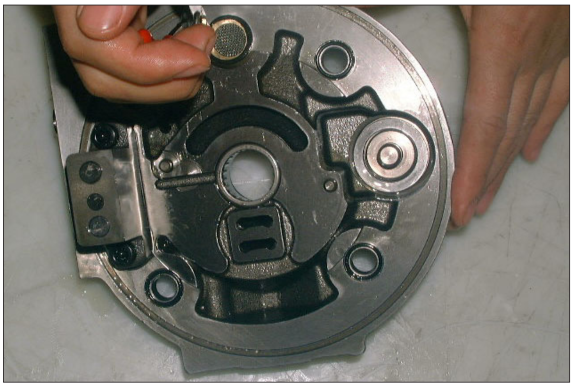
R55NM7HP75

(26) Install the filter into the cover.



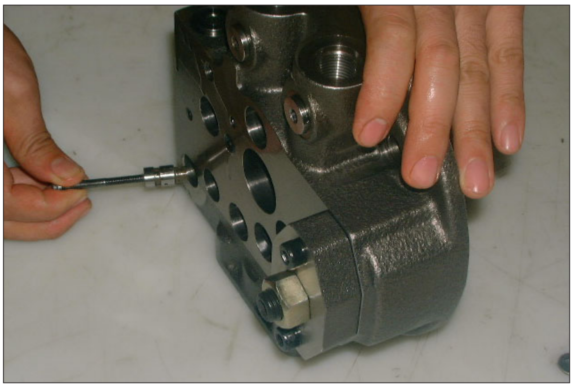
R55NM7HP76

(27) Fix the filter with the C-type stop ring.



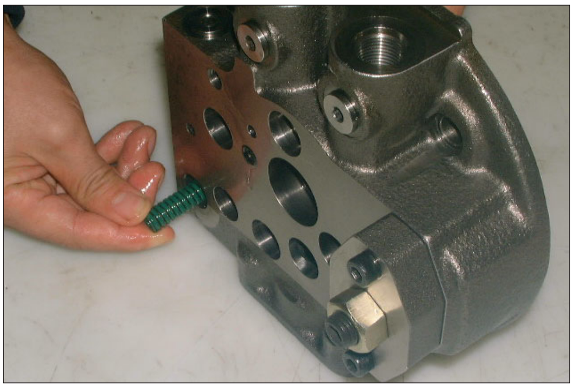
R55NM7HP77

(28) Assembling the relief valve.
Assemble the spool.



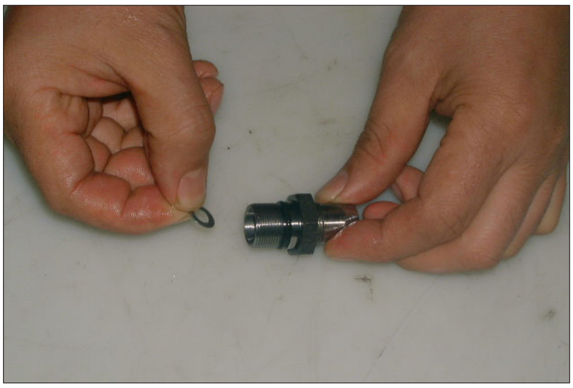
R55NM7HP78

(29) Assemble the spring.



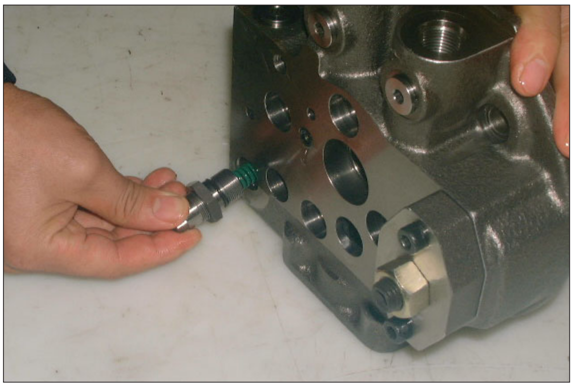
R55NM7HP79

(30) Insert the shim into the adjusting screw.

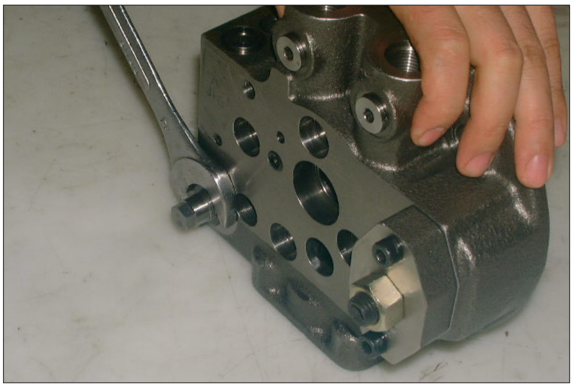


R55NM7HP80

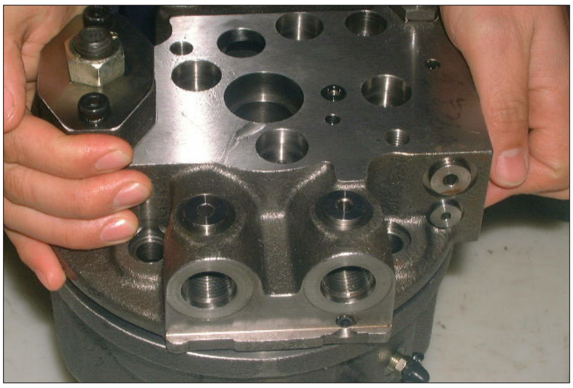
(31) Assemble the adjusting screw.


R55NM7HP81

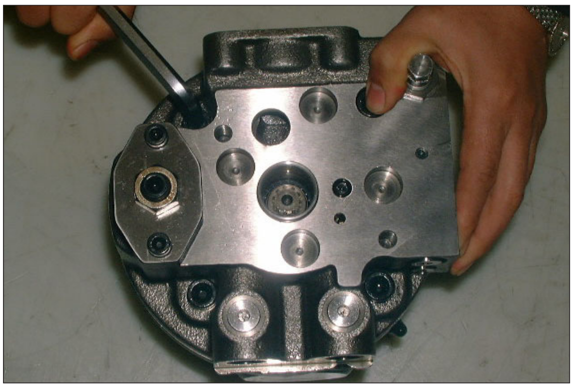
(32) Tighten the hexagonal nuts.
After assembling, set the pressure and tighten the nuts.
1 kgf · m (7.2 lbf · ft)
Spanner (Hex. side distance : 24)


R55NM7HP82

(33) Install the cover in a parallel direction to the housing mounting surface.


R55NM7HP83

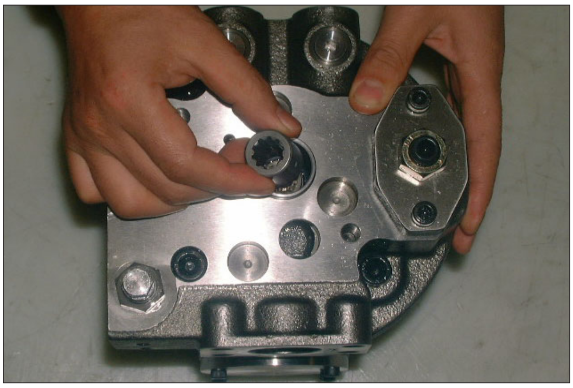
(34) Fix the cover with the hexagonal socket headed bolts (M12×30, 3pieces) and (M12×55, 1piece)
Hexagonal bar spanner
(Hex. side distance :10)
Tightening torque : 10 ~ 12.5 kgf · m
(72.3 ~ 90.4 lbf · ft)


R55NM7HP84

(35) Install the O-ring into the cover.

R55NM7HP85

(36) Install the coupling to the shaft end of the main pump.

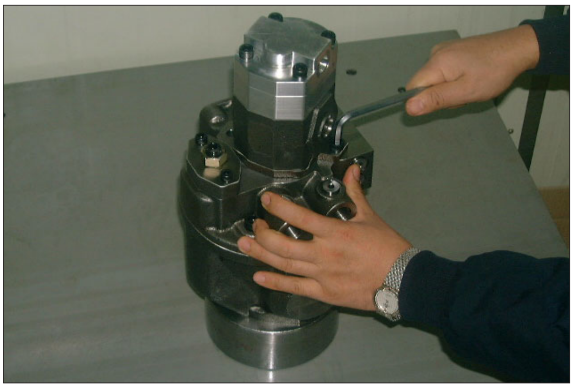


R55NM7HP86

(37) Connect the main and geared pump.

R55NM7HP87

(38) Fix the geared pump with the hexagonal socket headed bolts (M10×25, 2pieces).
Hexagonal bar spanner
(Hex. side distance : 8)
Tightening torque : 5.6 ~ 7.0 kgf · m
(40.5 ~ 50.6 lbf · ft)

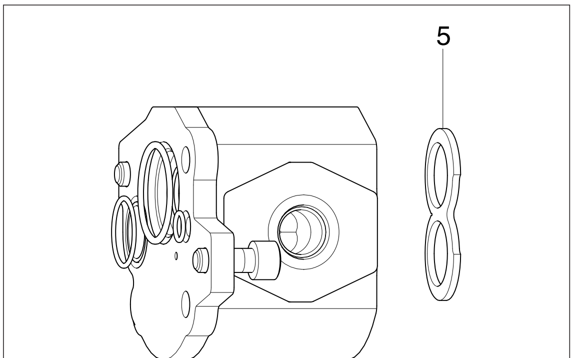


R55NM7HP88

2) REASSEMBLING THE GEARED PUMP

(1) Reassembling the geared pump (P3)

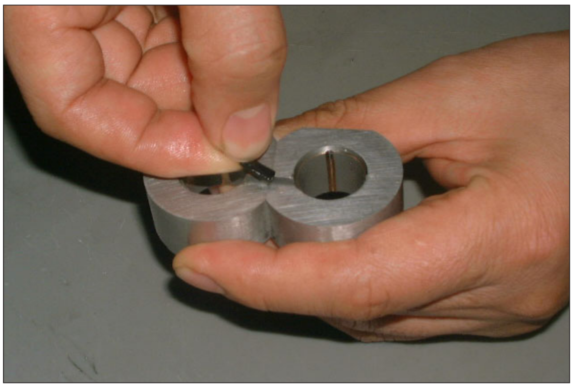
① Insert the plate (5) to the pump housing.



R5577MP03

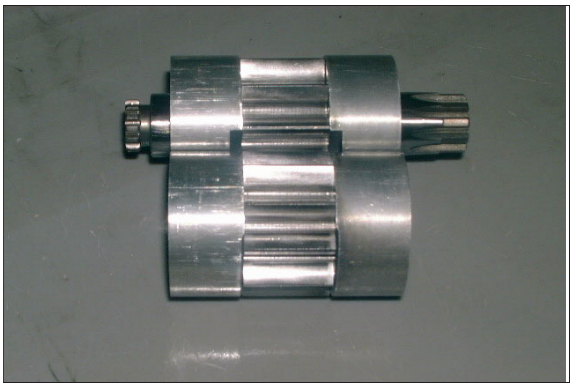
② Insert the square ring into the side plate.

※ Be careful to suction and discharge side.



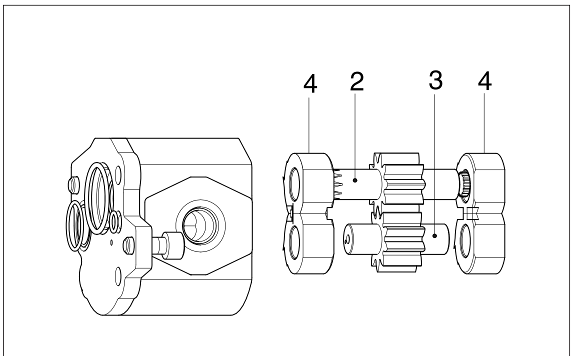
R55NM7HP210

③ Assemble the side plate to the drive and idle gear.



R55NM7HP211

④ Assemble the gear assembly into the gear casing.

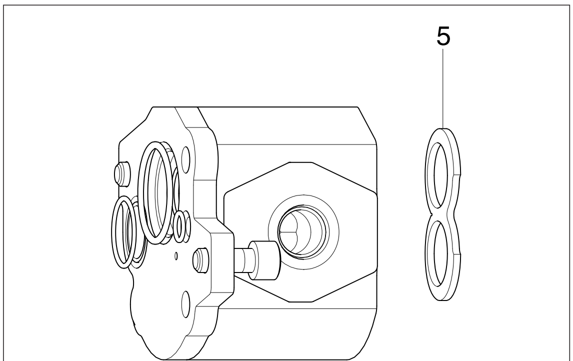


R5577MP04

⑤ Assemble the O-ring to the guide ring and assemble them to the plate.

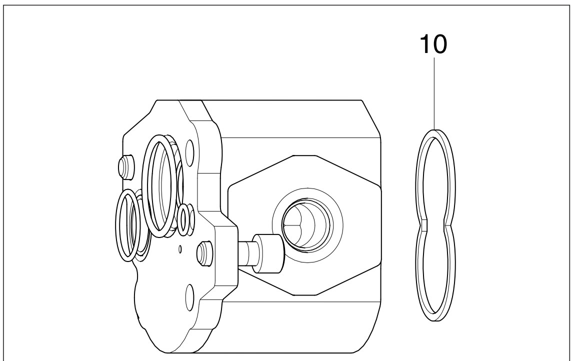
R55NM7HP213

⑥ Assemble the guide ring assembly (6, 8) and plate (5) to the gear casing.



R5577MP03

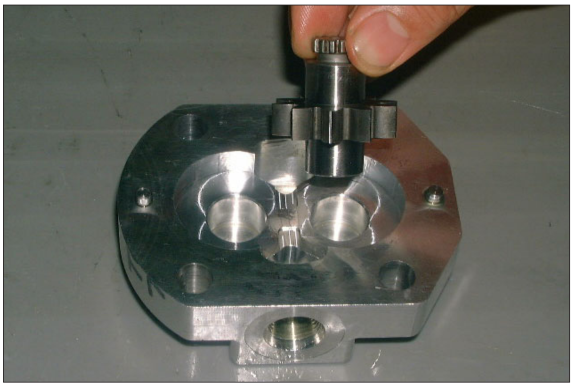
⑦ Assemble the square ring (10) to the gear casing.



R5577MP01

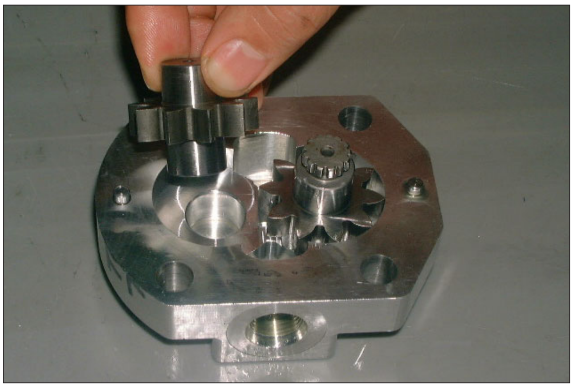
(2) Reassembling the geared pump (P4)

① Insert the drive gear into the gear casing.



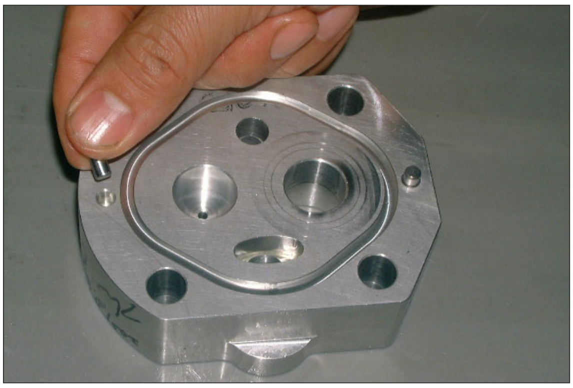
R55NM7HP219

② Insert the idle gear to into the gear casing.



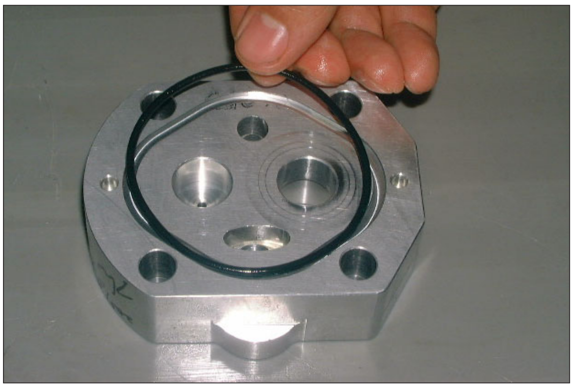
R55NM7HP220

③ Insert the pins (2-pieces) to the center frame.



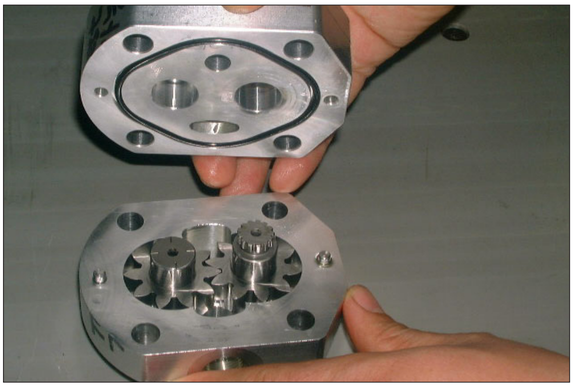
R55NM7HP221

④ Assemble the O-ring to the center frame.



R55NM7HP222

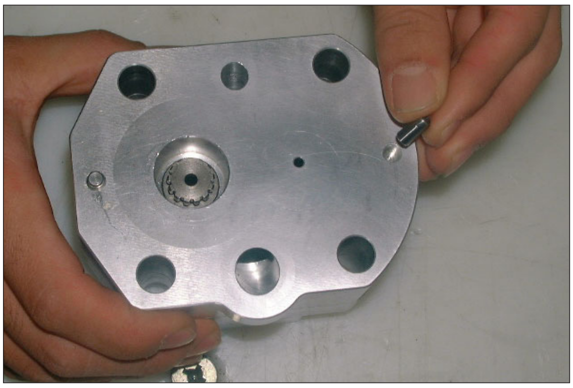
⑤ Assemble the center frame sub-assemble to the gear casing sub-assembly.



R55NM7HP223

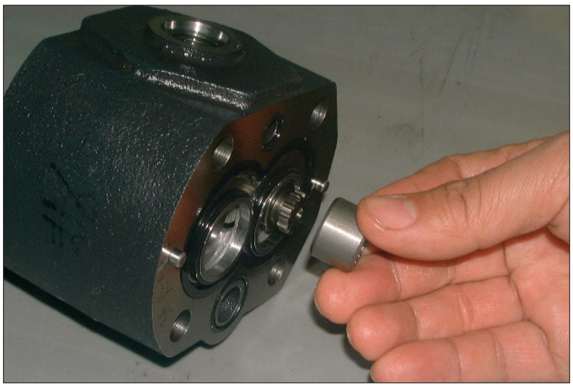
(3) Reassembling the P3 and P4 pumps

① Insert the pins (2-pieces) into the center frame.



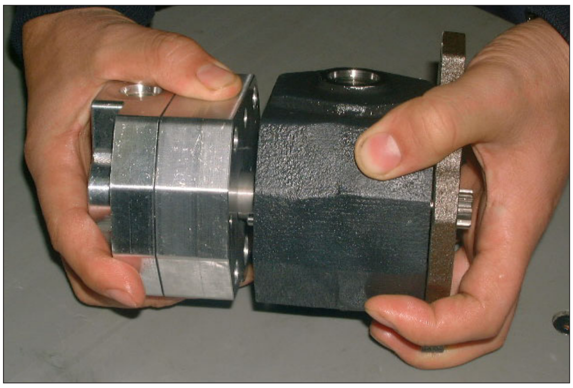
R55NM7HP224

② Insert coupling to the P3 geared pump.



R55NM7HP225

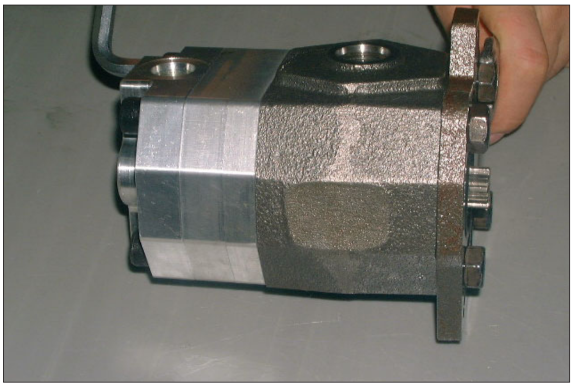
③ Assemble the P3 and P4 geared pumps.



R55NM7HP226

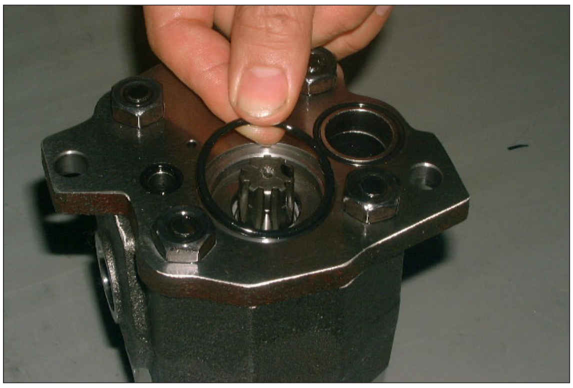
④ Assemble the hexagonal socket bolts and nuts.

· Size : M10×65L, 4pieces
· Allen wrench : 8 ㎜
· Spanner : 17 ㎜
· Tightening torque : 580 kgf · cm (56.9 N · m)



R55NM7HP227

⑤ Assemble the O-ring to the pump housing.



R55NM7HP228

GROUP 4 MAIN CONTROL VALVE

1. REMOVAL AND INSTALL OF MOTOR

1) REMOVAL

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

(2) Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

(3) Loosen the breather slowly to release the pressure inside the hydraulic tank.

13031GE18

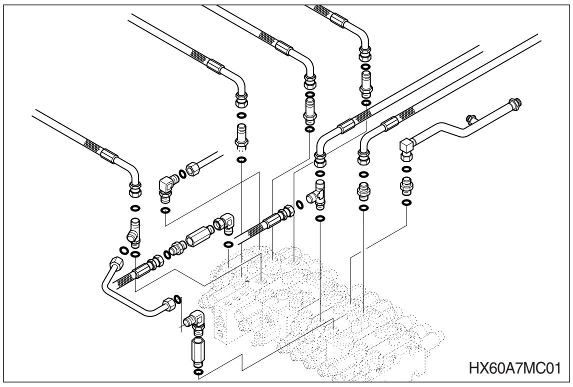
⚠ **Escaping fluid under pressure can penetrate the skin causing serious injury.**

※ When pipes and hoses are disconnected, the oil inside the piping will flow out, so catch it in oil pan.

(4) Disconnect hydraulic pipe.

(5) Disconnect pilot line hoses.

(6) Remove links.

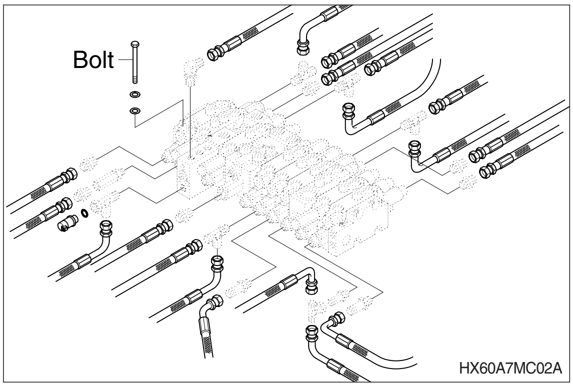


HX60A7MC01

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

· Weight : 40 ㎏ (90 ℔)

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



HX60A7MC02A

2) INSTALL

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

(2) Bleed the air from below items.

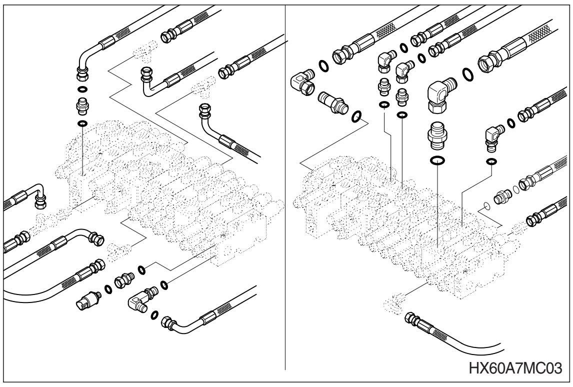
① Cylinder (boom, arm, bucket)

② Swing motor

③ Travel motor

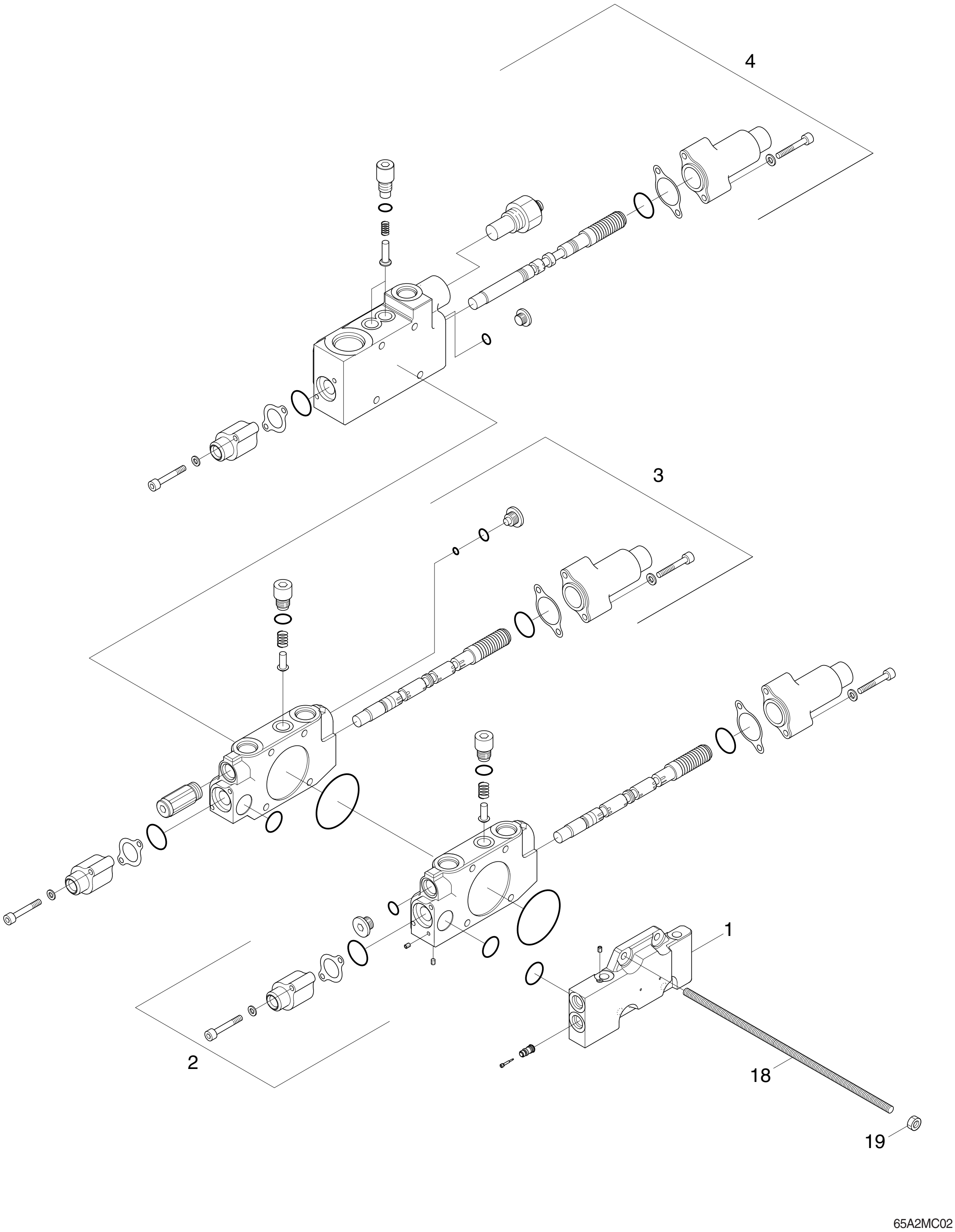
※ See each item removal and install.

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



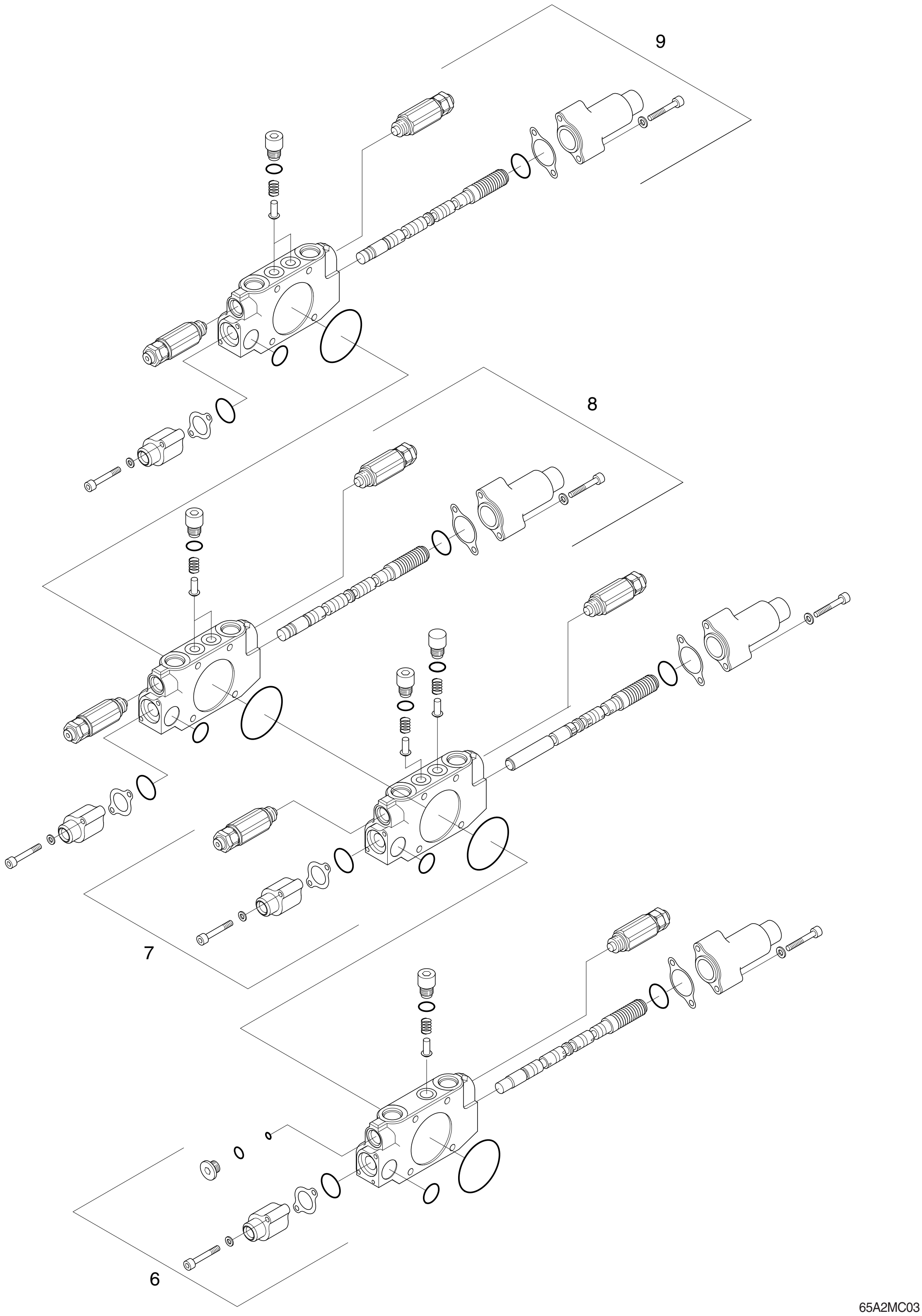
HX60A7MC03

2. STRUCTURE (1/4)



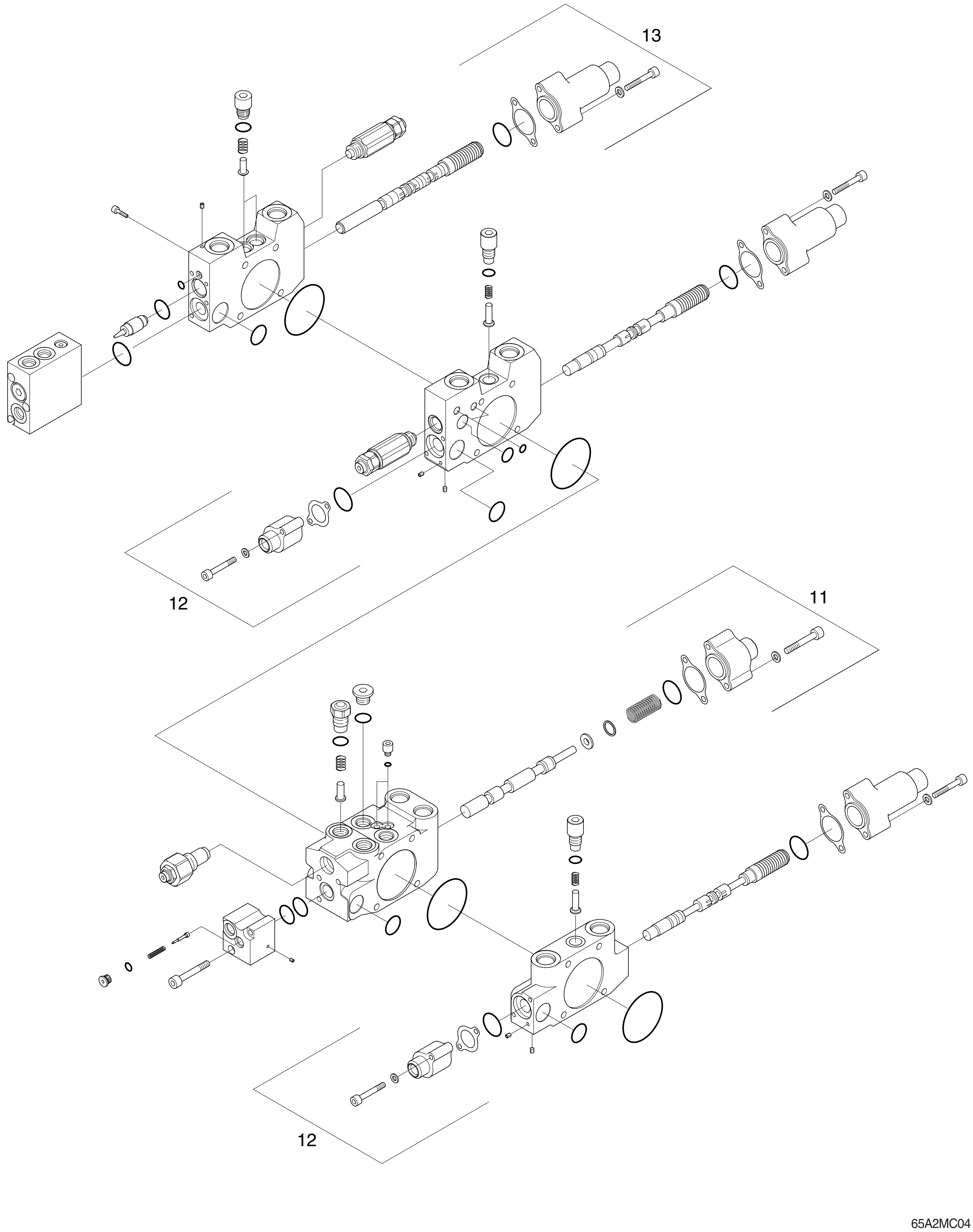
1	Port cover	4	Swing section assy
2	Swing section assy	18	Tie bolt
3	Dozer section assy	19	Nut

STRUCTURE (2/4)



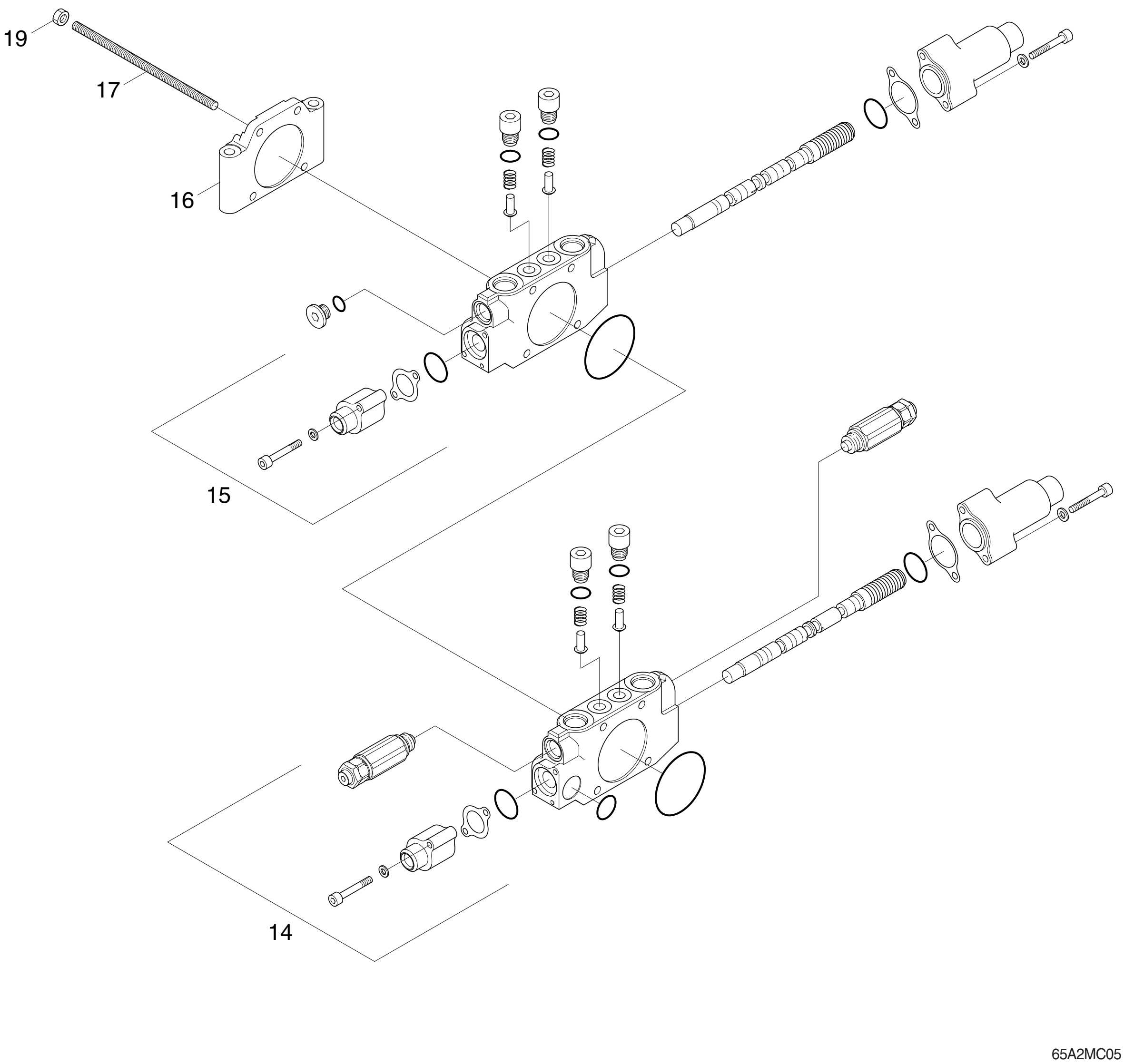
6	Boom 2 section assy	8	Boom swing section assy
7	Arm 1 section assy	9	Option section assy

STRUCTURE (3/4)



10 Travel LH section assy
11 Inlet section assy
12 Travel RH section assy
13 Boom 1 section assy

STRUCTURE (4/4)



14	Bucket section assy	17	Tie bolt
15	Arm 2 section assy	19	Nut
16	End cover		

3. DISASSEMBLY AND ASSEMBLY

1) GENERAL PRECAUTIONS

(1) All hydraulic components are manufactured to a high precision. Consequently, before disassembling and assembling them, it is essential to select an especially clean place.

(2) In handling a control valve, pay full attention to prevent dust, sand, etc. from entering into it.

(3) When a control valve is to be remove from the machine, apply caps and masking seals to all ports. Before disassembling the valve, recheck that these caps and masking seals are fitted completely, and then clean the outside of the assembly. Use a proper bench for working. Spread paper or a rubber mat on the bench, and disassemble the valve on it.

(4) Support the body section carefully when carrying or transferring the control valve. Do not lift by the exposed spool, end cover section etc.

(5) After disassembling and assembling of the component it is desired to carry out various tests (for the relief characteristics, leakage, flow resistance, etc.), but hydraulic test equipment is necessary for these tests. Therefore, even when its disassembling can be carried out technically, do not disassemble such components that cannot be tested, adjusted, and so on. Additionally one should always prepare clean cleaning oil, hydraulic oil, grease, etc. beforehand.

2) TOOLS

Before disassembling the control valve, prepare the following tools beforehand.

Name of tool	Quantity	Size (mm)
Vice mounted on bench (soft jaws)	1 unit	
Hexagon wrench	Each 1 piece	5, 6, 10, 12 and 14
Socket wrench	Each 1 piece	5 and 6
Spanner	Each 1 piece	13, 21 and 30
Rod	1 piece	Less than 10×250

3) DISASSEMBLY

(1) Disassembly of spools (pilot type)

① Loosen hexagon socket head bolts (5) with washer (6).
(Hexagon wrench : 5 mm)

② Remove the pilot cover (3).

※ Pay attention not to lose the O-ring (7) under the pilot cover.

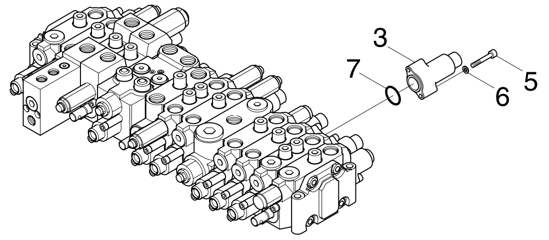
③ Remove the spool assembly (2) from the body by hand slightly.

※ When extracting each spool from its body, pay attention not to damage the body.

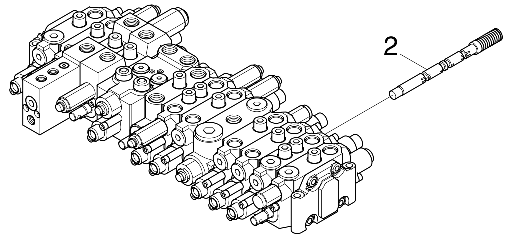
※ When extracting each spool assembly, it must be extracted from spring side only.

※ When any abnormal parts are found, replace it with completely new spool assembly.

※ When disassembled, tag the components for identification so that they can be reassembled correctly.



R5577MCV04



R5577MCV05

(2) Disassembly of holding valve (boom 1)

① Loosen hexagon socket head bolts (7).
(Hexagon wrench : 5 mm)

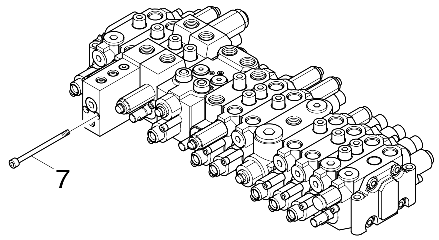
② Remove the holding valve.

※ Pay attention not to lose the O-ring and the poppet under the pilot cover.

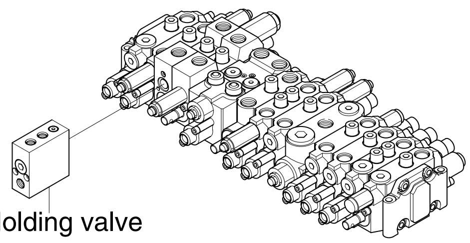
※ Pay attention not to damage the "piston A" under pilot cover.

※ When any abnormal parts are found, replace it with completely new holding valve assembly.

※ When disassembled, tag the components for identification so that they can be reassembled correctly.



R5577MCV13



R5577MCV14

(3) Disassembly of the load check valve and the negative relief valve

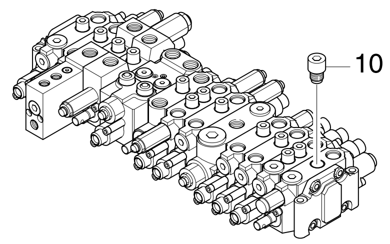
① The load check valve

a. Fix the body to suitable work bench.

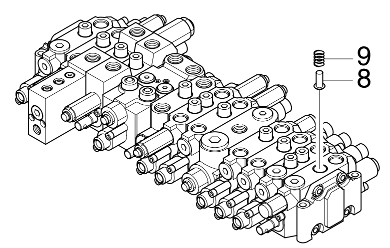
※ Pay attention not to damage the body.

b. Loosen the plug (10)
(Hexagon wrench : 10 mm).

c. Remove the spring (9) and the load check valve (8) with pincers or magnet.



R5577MCV11



R5577MCV12

(4) Disassembly of the main and overload relief valve

① Fix the body to suitable work bench.

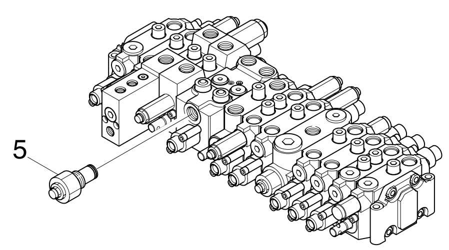
② Remove the main relief valve (5).
(Spanner : 30 mm)

③ Remove the overload relief valve (12).
(Spanner : 22 mm)

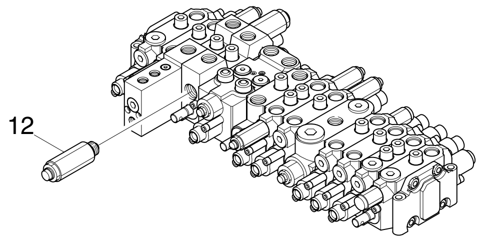
※ When disassembled, tag the relief valve for identification so that they can be reassembled correctly.

※ Pay attention not to damage seat face.

※ When any abnormal parts are found, replace it with completely new relief valve assembly.



R5577MCV09



R5577MCV10

(5) Disassembly of the block assembly

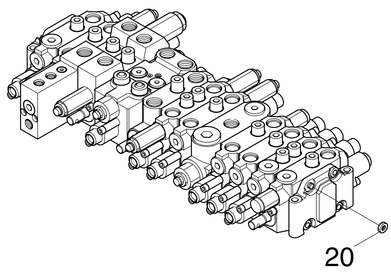
① Fix the body to suitable work bench.

② Remove the nut (20).
(Spanner : 13 mm)

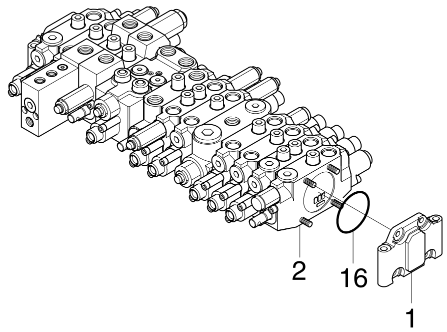
※ The work block is assembled by two sets of tie-bolts.

③ Remove the end cover (1) and the work blocks.

※ Do not removed the tie bolt.
※ Pay attention not to lose the O-ring (16).



R5577MCV15



R5577MCV16

(6) Inspection after disassembly

Clean all disassembled parts with clean mineral oil fully, and dry them with compressed air. Then, place them on clean papers or cloths for inspection.

① Control valve

a. Check whole surfaces of all parts for burrs, scratches, notches and other defects.
b. Confirm that seal groove faces of body and block are smooth and free of dust, dent, rust etc.
c. Correct dents and damages and check seat faces within the body, if any, by lapping.
※ Pay careful attention not to leave any lapping agent within the body.
d. Confirm that all sliding and fitting parts can be moved manually and that all grooves and path's are free foreign matter.
e. If any spring is broken or deformed, replace it with new one.
f. When a relief valve does not function properly, repair it, following it's the prescribed disassembly and assembly procedures.
g. Replace all seals and O-rings with new ones.

② Relief valve

a. Confirm that all seat faces at ends of all poppets and seats are free of defects and show uniform and consistent contact faces.
b. Confirm manually that main poppet and seat can slide lightly and smoothly.
c. Confirm that outside face of main poppet and inside face of seat are free from scratches and so on.
d. Confirm that springs are free from breakage, deformation, and wear.
e. Confirm that orifices of main poppet and seat section are not clogged with foreign matter.
f. Replace all O-rings with new ones.
g. When any light damage is found in above inspections, correct it by lapping.
h. When any abnormal part is found, replace it with a completely new relief valve assembly.

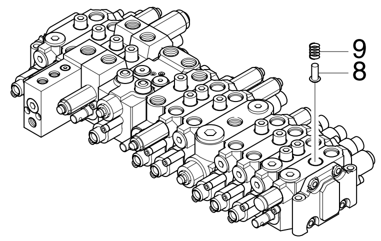
4) ASSEMBLY

(1) General precaution

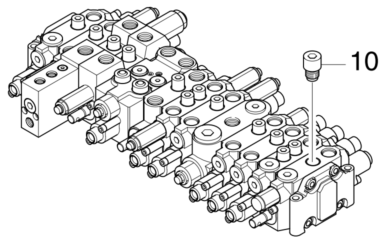
① In this assembly section, explanation only is shown.
For further understanding, please refer to the figures shown in the previous structure & disassembly section.
② Pay close attention to keeping all seals free from handling damage and inspect carefully for damage before using them.
③ Apply clean grease or hydraulic oil to the seal so as to ensure it is fully lubricated before assembly.
④ Do not stretch seals so much as to deform them permanently.
⑤ 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.
⑥ Tighten fitting bolts for all sections with a torque wrench adjusted to the respective tightening torque.
⑦ Do not reuse removed O-rings and seals.

(2) Load check valve

① Assemble the load check valve (8) and spring (9).
② Put O-rings on to plug (10).
③ Tighten plug to the specified torque.
· Hexagon wrench : 8 ㎜
· Tightening torque : 3.7 kgf · m
(26.7 lbf · ft)



R5577MCV12

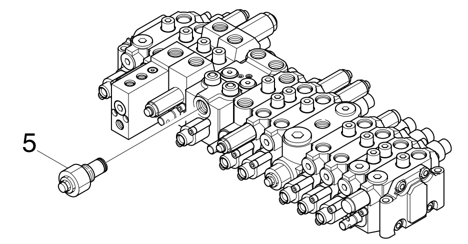


R5577MCV11

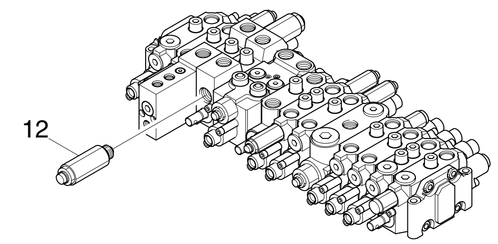
(3) Main relief, port relief valves

① Install the main relief valve (5).
  · Spanner : 30 mm
  · Tightening torque : 6 kgf · m (43.4 lbf · ft)

② Install the over load relief valve (12).
  · Spanner : 22 mm
  · Tightening torque : 4 kgf · m (28.9 lbf · ft)



R5577MCV09

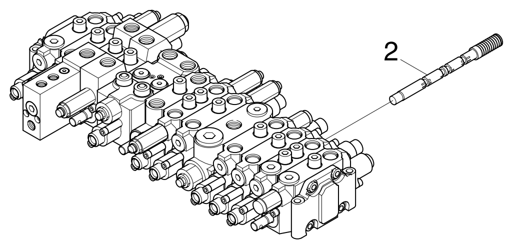


R5577MCV10

(4) Main spools

① Carefully insert the previously assembled spool assemblies into their respective bores within of body.

※ Fit spool assemblies into body carefully and slowly. Do not under any circumstances push them forcibly in.

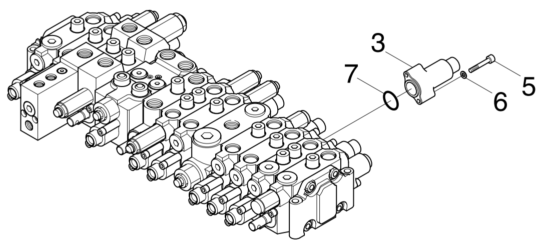


R5577MCV05

(5) Covers of pilot type

① Fit spool covers (3) tighten the hexagonal socket head bolts (5) to the specified torque.
  · Hexagon wrench : 5 mm
  · Tightening torque : 1~1.1 kgf · m
    (7.2~7.9 lbf · ft)

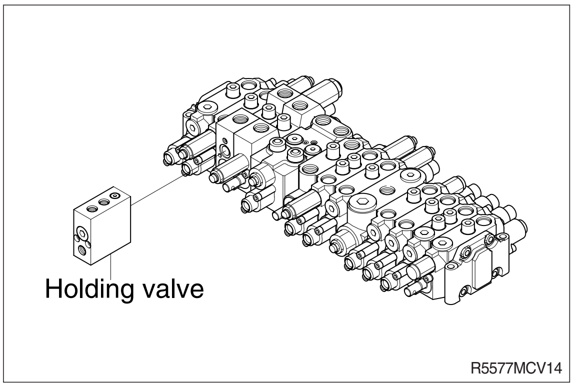
※ Confirm that O-rings (7) have been fitted.

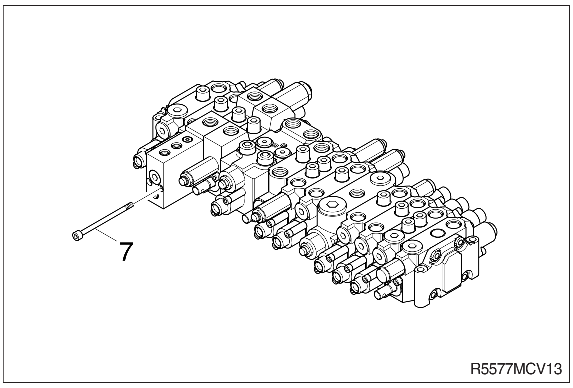


R5577MCV04

(6) Holding valve

① Fit the holding valve to the body and tighten hexagon socket head bolt (7) to specified torque.
  · Hexagon wrench : 5 ㎜
  · Tightening torque : 1.1 kgf · m(7.9 lbf · ft)





GROUP 5 SWING DEVICE

1. REMOVAL AND INSTALL OF MOTOR

1) REMOVAL

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

(2) Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

(3) Loosen the breather slowly to release the pressure inside the hydraulic tank.

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

※ When pipes and hoses are disconnected, the oil inside the piping will flow out, so catch it in oil pan.

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

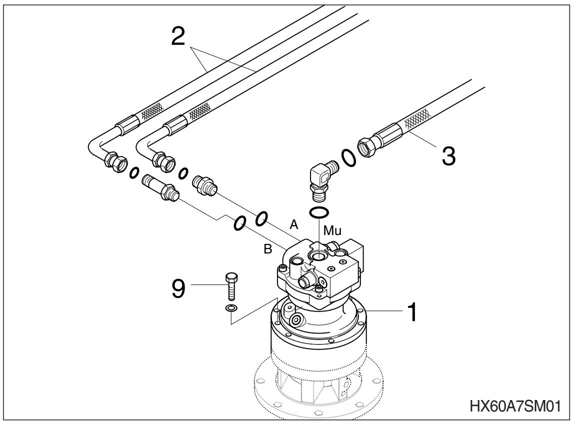
(5) Disconnect pilot line hoses (4, 5, 6, 7, 8).

(6) Sling the swing motor assembly (1) and remove the swing motor mounting bolts (9).

· Motor device weight : 23 kg (51 lb)

· Tightening torque :

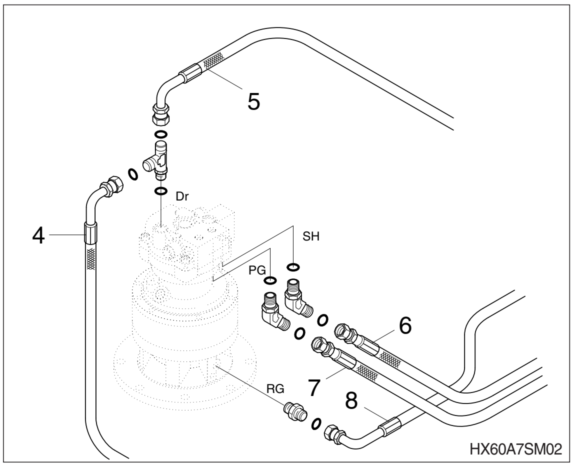
11 ± 0.5 kgf · m (29.6 ± 3.6 lbf · ft)



HX60A7SM01

(7) Remove the swing motor assembly.

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



HX60A7SM02

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.

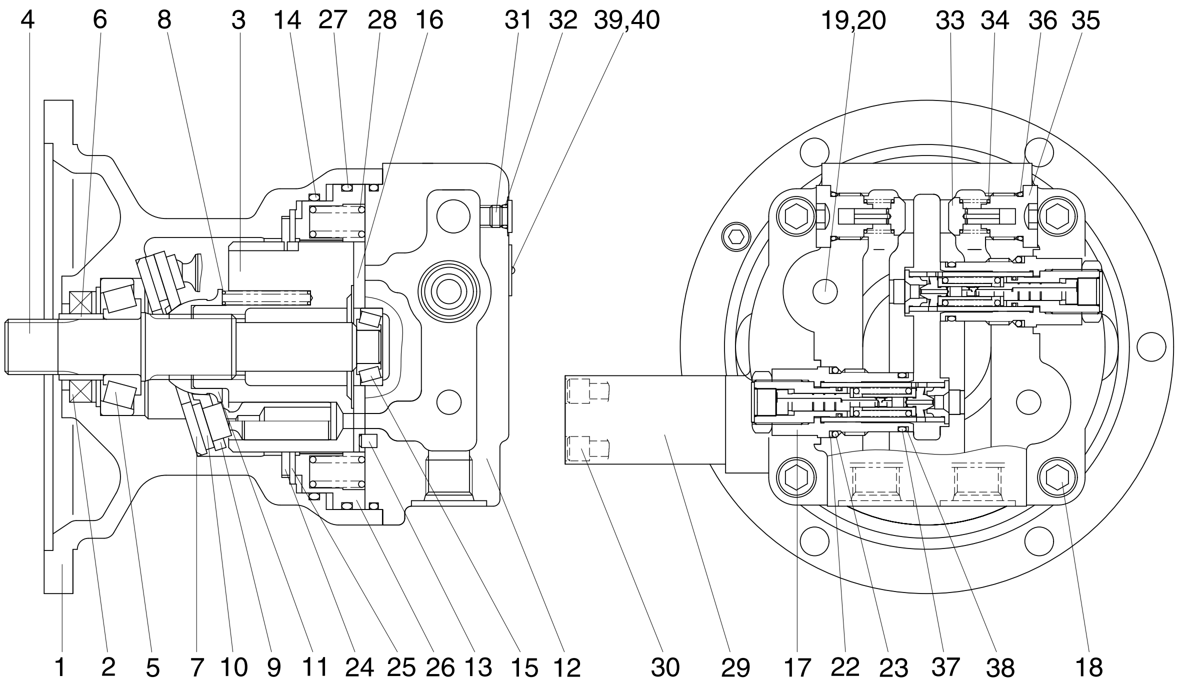
④ Start the engine, run at low idling and check oil come out from plug.

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

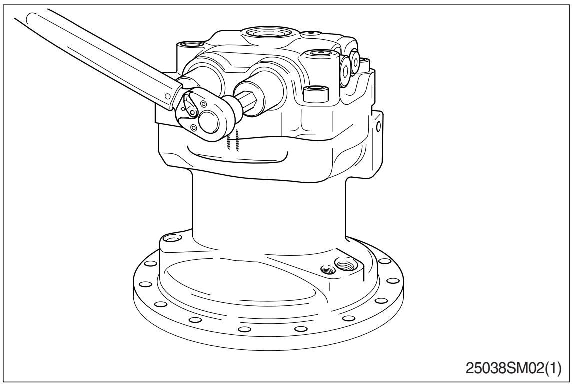


HX60A2SM03

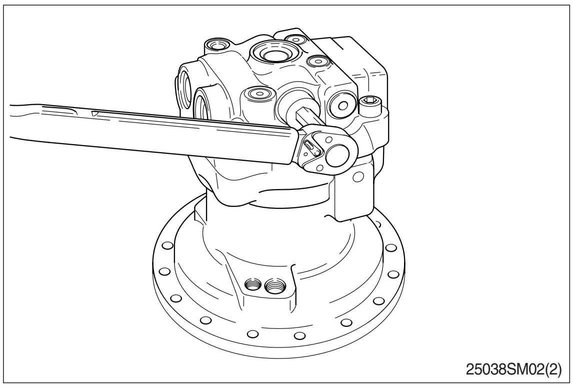
1	Body	15	Taper bearing	30	Socket bolt
2	Oil seal	16	Valve plate	31	Plug
3	Cylinder block	17	Relief valve assy	32	O-ring
4	Shaft	18	Socket bolt	33	Valve
5	Taper bearing	19	Plug	34	Spring
6	Bushing	20	O-ring	35	Plug
7	Shoe plate	22	Back up ring	36	O-ring
8	Spring	23	O-ring	37	O-ring
9	Set plate	24	Friction plate	38	Back up ring
10	Piston shoe assy	25	Plate	39	Name plate
11	Ball guide	26	Parking piston	40	Rivet
12	Rear cover	27	O-ring		
13	Pin	28	Spring		
14	O-ring	29	Time delay valve		

2) DISASSEMBLY

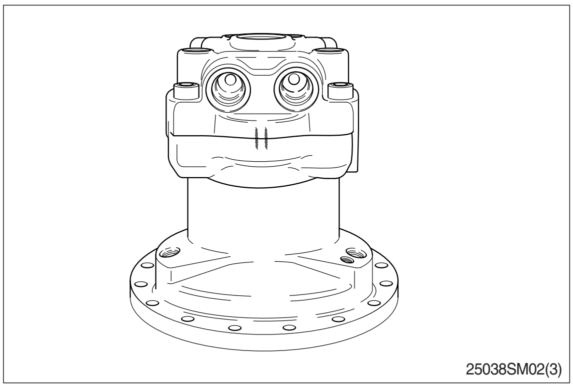
(1) Removal of relief valve assembly
Remove cap of relief valve assembly (17) with 14 mm hexagonal wrench.
※ Assemble removed relief valve assembly (17) to original state when reassembling.


25038SM02(1)

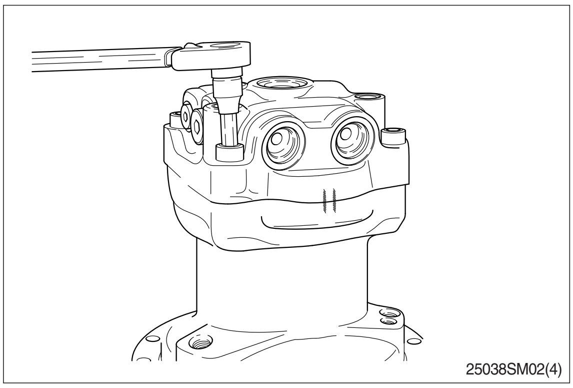
(2) Removal of make up valve and bypass valve assembly
Loosen plug (37) with 14 mm hexagonal wrench, and remove check valve (35) and spring (36).


25038SM02(2)

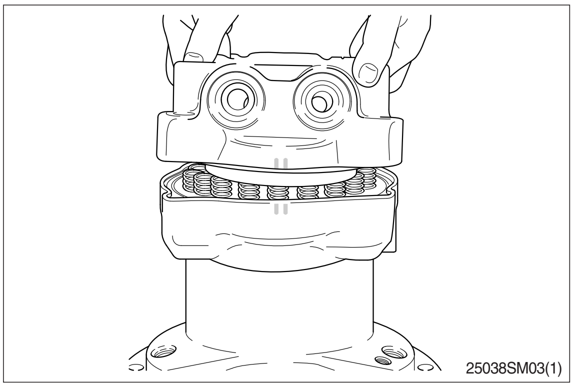
(3) Marking at swing motor
Before disassembling motor, make a matching mark between cover (12) and housing (1) for easy reassembling.


25038SM02(3)

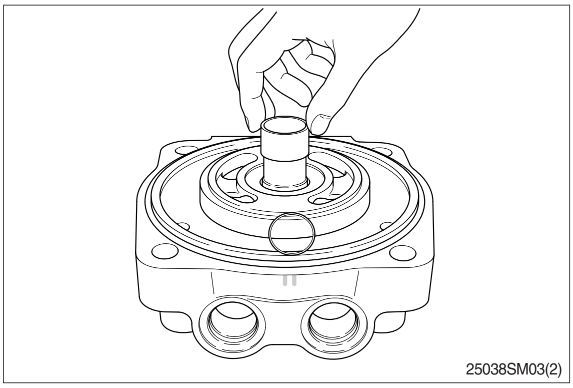
(4) Remove mounting bolts of cover
Loosen hexagon socket bolt (18) with 12 mm hexagonal wrench.


25038SM02(4)

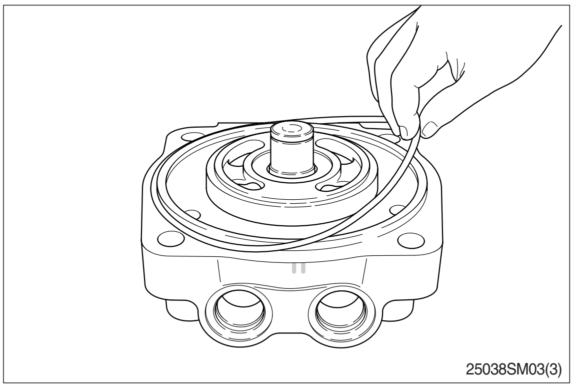
(5) Removal of cover assembly
Place shaft of motor assembly to downward and take cover (12) out.


25038SM03(1)

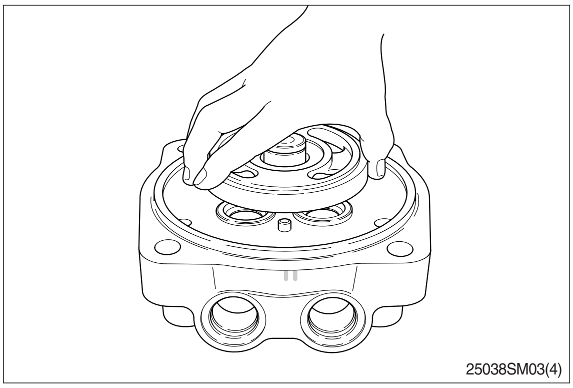
(6) Remove shim (22) remove inner race of needle bearing (15) by bearing puller.


25038SM03(2)

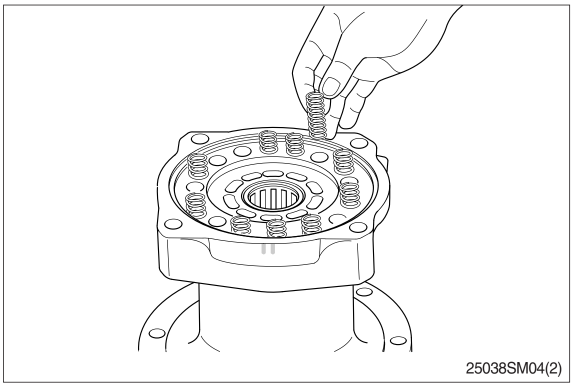
(7) Remove O-ring (29) from cover.


25038SM03(3)

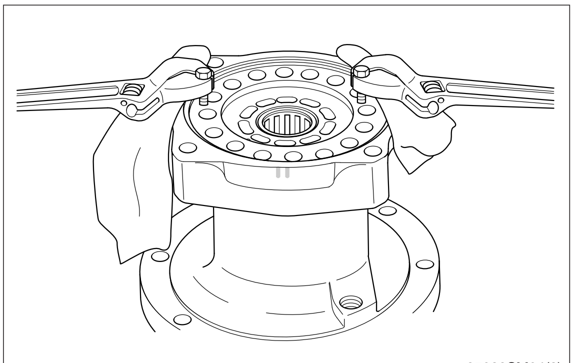
(8) Remove balance plate
Valve plate (16) is adhered on end surface of cylinder (3) by oil viscosity. Take off balance plate (16) with hands.
Assembling method of balance plate (16) depends on cover (12).
(Band groove and round groove of high · low pressure transmission area)
Before removing, check and record location of balance plate (16) to prevent misassembling.


25038SM03(4)

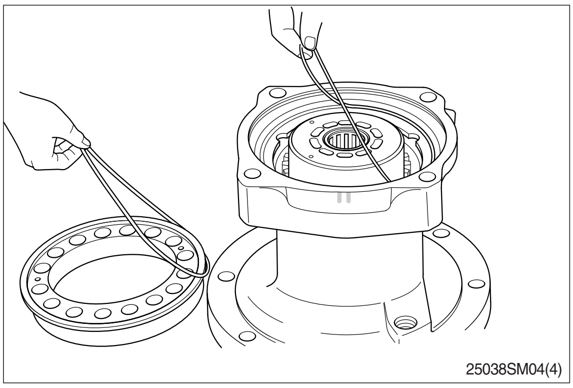
(9) Removal of spring (30, brake area)
Remove spring (30) from piston (28).
Check and record original position of each spring (30) for correct assembling.


25038SM04(2)

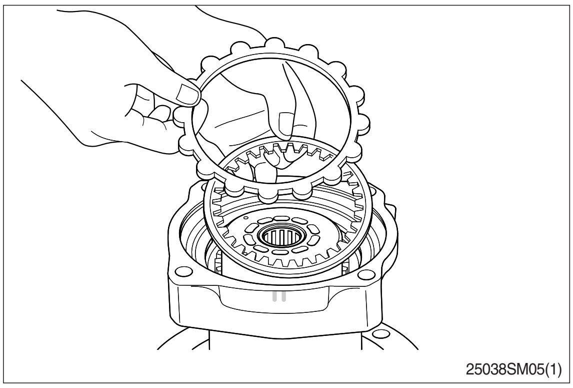
(10) Removal of brake piston
When removing piston (28) from housing (1), there is a sliding resistance against tightening of O-rings (14,29). Use tap hole on piston (28) as shown in the picture.


25038SM04(3)

(11) Remove O-rings (14, 29) from piston (28) and housing (1).


25038SM04(4)

(12) Remove friction plate (26) and lining plate (27) from housing (1).


25038SM05(1)

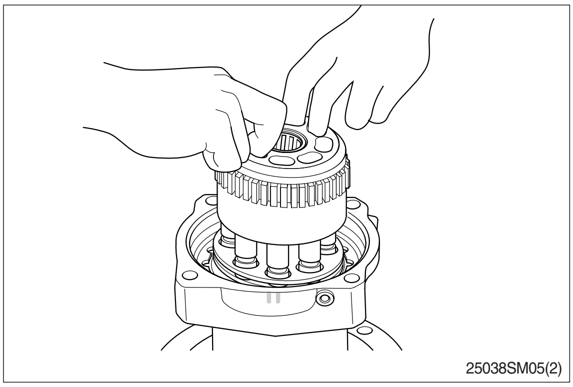
(13) Removal of cylinder assembly

Holding end of cylinder assembly (3) with hand, draw out cylinder assembly from housing.

※ Oil seal (2) and outer race of taper roller bearing (15) are left inside of housing.

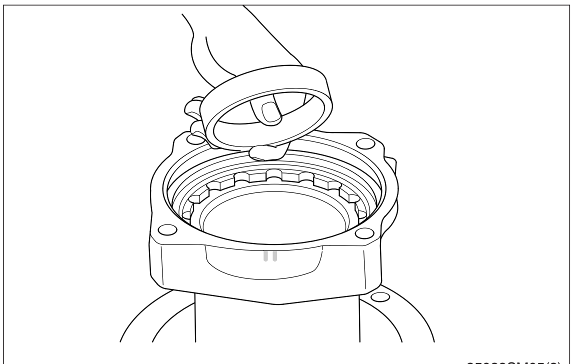
※ End surface of cylinder (3) is sliding face . So, protect the surface with a scrap of cloth against damage.

※ Make a matching mark on piston hole of cylinder (3) and piston assembly (10) to fit piston into the same hole when reassembling.



25038SM05(2)

(14) Separate outer race of taper roller bearing (5) from housing.

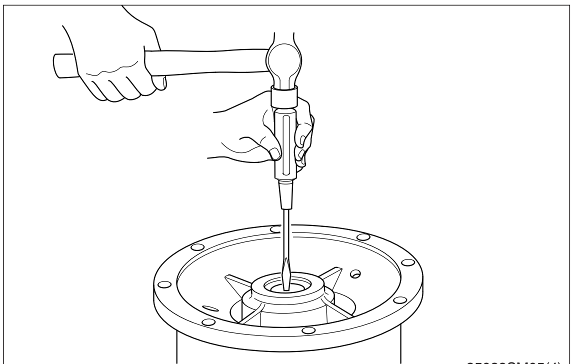


25038SM05(3)

(15) Removal of oil seal

Remove oil seal (2) from housing (1) with driver and hammer.

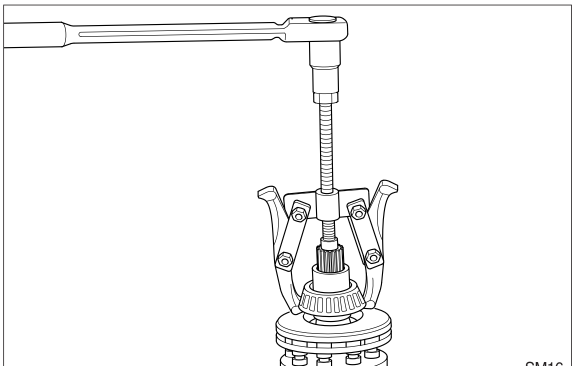
※ Do not reuse oil seal after removal.



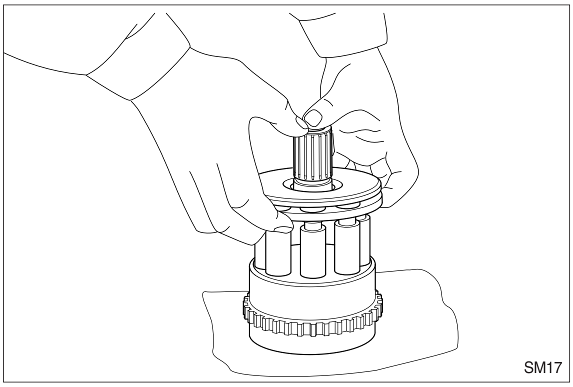
25038SM05(4)

(16) Disassembly of cylinder assembly

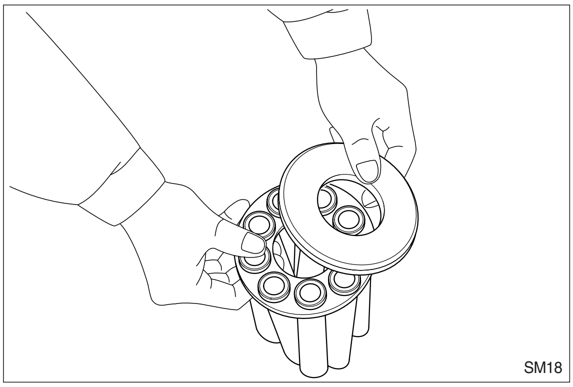
① Removal of inner race of taper roller bearing (5).
Lift out cylinder block (3) with 2 inner race of roller bearing (5) by applying gear puller at the end of spline in the cylinder.


SM16

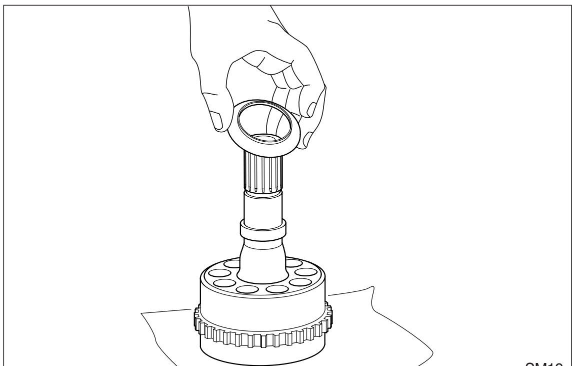
② Separate shoe plate (7), piston assembly (10), set plate (9) from cylinder block (3).


SM17

③ Get shoe plate (7) slide on sliding face of piston assembly (10) and remove it.
※ Be cautious not to damage on sliding face of cam plate.


SM18

④ Remove ball guide (11) from cylinder block (3).


SM19

This completes disassembly.

3) ASSEMBLY

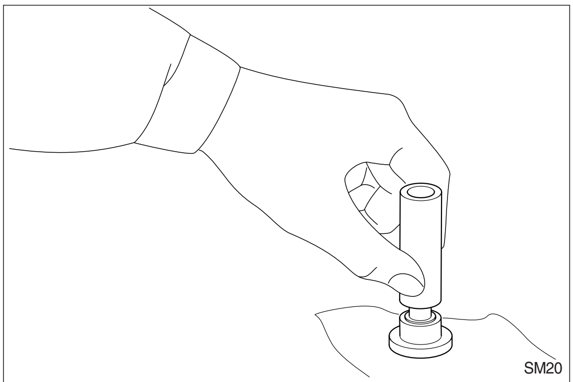
(1) Preparation

Before reassembling, perform below procedure.

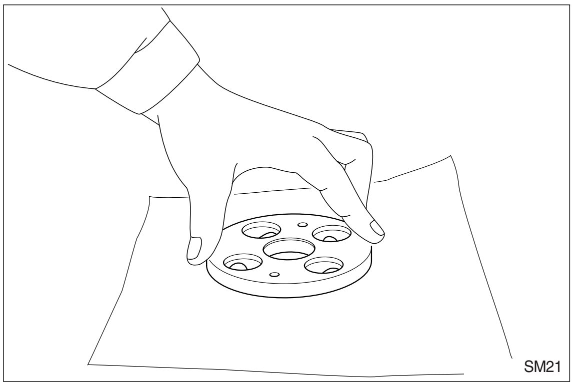
① Check each part for damage caused by using or disassembling. If damaged, eliminate damage by grinding with proper sandpaper, wash them with cleaning oil and dry with compressed air.

② Replace seal with new one.

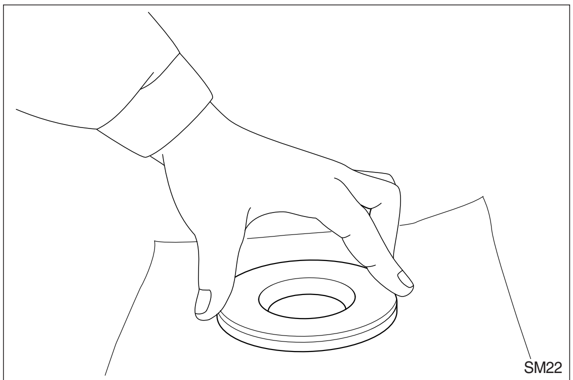
③ Grind sliding face of piston assembly (10), balance plate (16) and shoe plate (7) with sandpaper #2000.



SM20



SM21



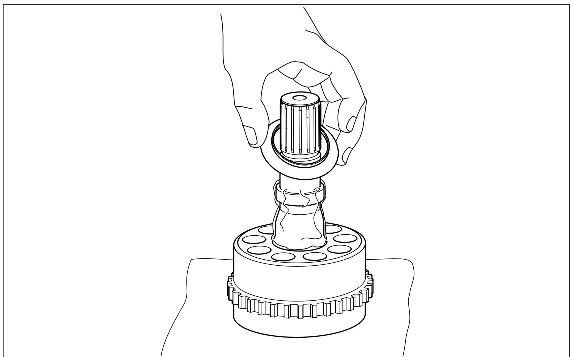
SM22

④ When assembling, lubricate with specified clean hydraulic oil.

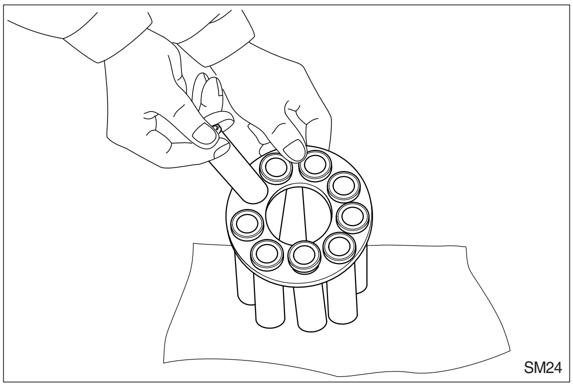
⑤ When assembling piston assembly (10) to piston hole of cylinder block (3), check matching mark between them.

(2) Cylinder assembly

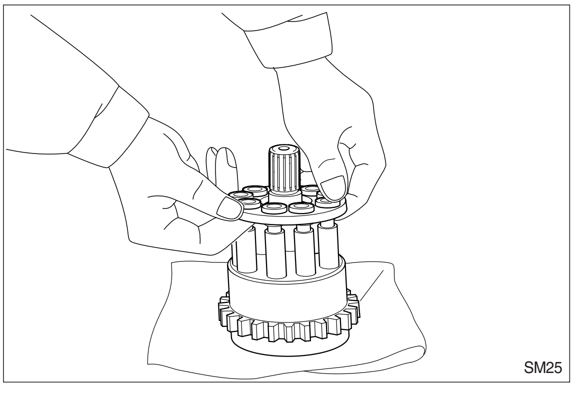
① Lubricate grease on round area (Contacting area withball guide (11)) of cylinder block (3) and assemble spring (4).


SM23

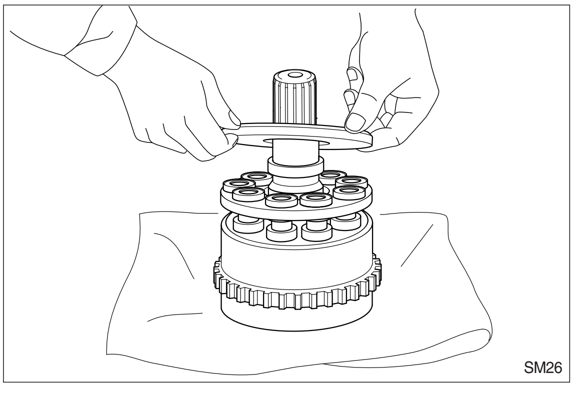
② Insert piston assembly (10) in hole of set plate (9).


SM24

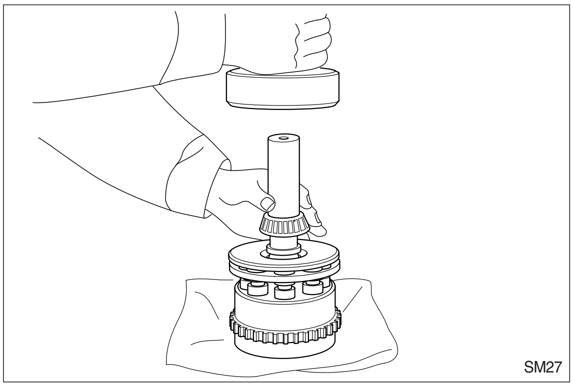
③ Assemble piston assembly (10) and set plate (9) to cylinder block (3). When assembling, check matching mark between them. Before assembling, lubricate specified hydraulic oil in piston hole of cylinder block (3).


SM25

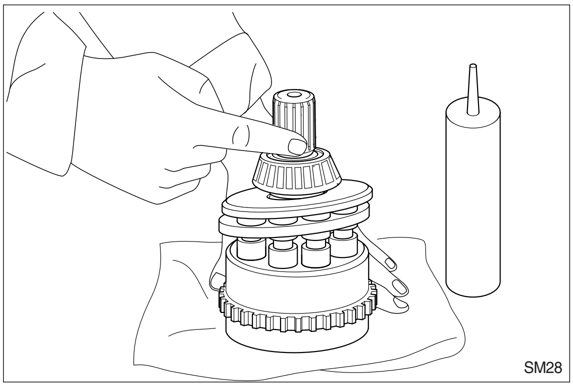
④ Lubricate specified hydraulic oil on shoe sliding face of piston assembly (10) and assemble shoe plate (7).


SM26

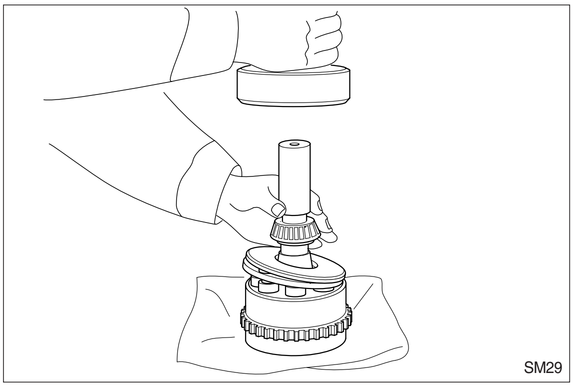
⑤ Assemble inner race of taper roller bearing (5) to cylinder block (3).


SM27

⑥ Apply loctite to bearing mounting area of inner race of cylinder block (3) lightly.


SM28

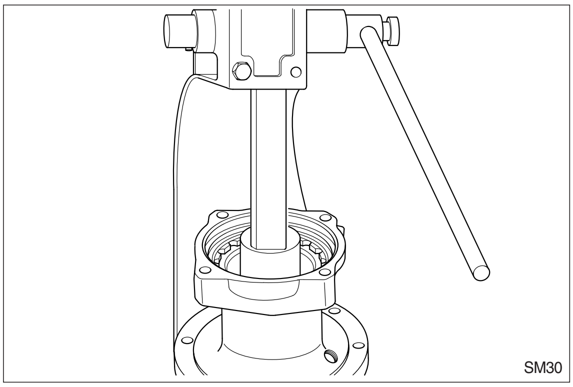
⑦ Assemble bushing (6) to cylinder block (3).


SM29

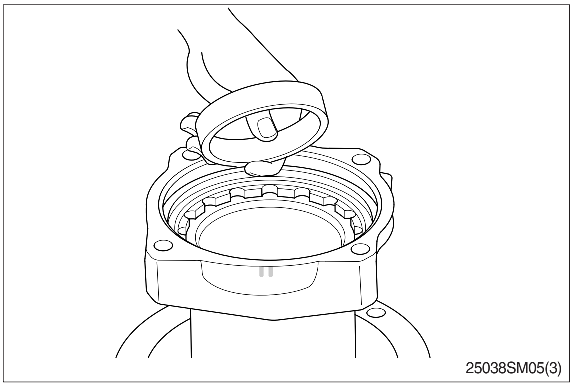
(3) Oil seal

Apply three bond of white color on outer surface of oil seal (2) and assemble and insert it.

※ Before assembling, lubricate lip of oil seal with grease.

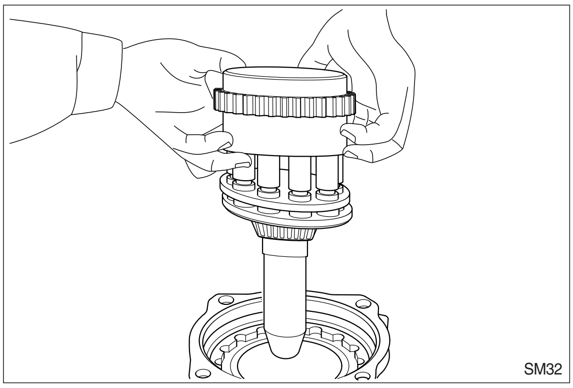

SM30

(4) Assemble outer race of taper roller bearing (5) to motor housing (1).



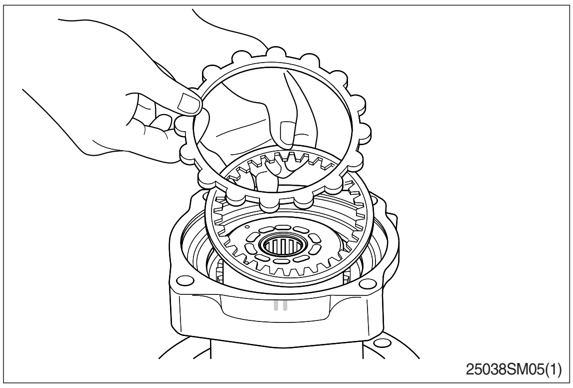
(5) Cylinder assembly
Hold end of cylinder assembly(3) with hands and assemble cylinder assembly to housing(1). Be careful to prevent damage of seal by spline of shaft.

※ When assemble cylinder assembly, spline shaft of cylinder is protruded from end of housing, therefore put pads with length 30~50mm under bottom of housing.



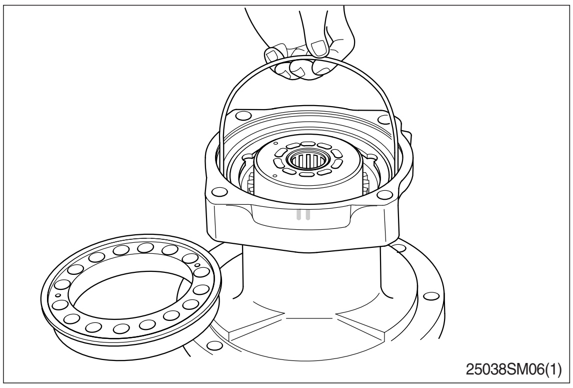
(6) Assemble friction plate (26) and lining plate (27).

※ Lubricate specified hydraulic oil on each side.



(7) Insert O-rings (14,29) into housing (1) and piston (28).

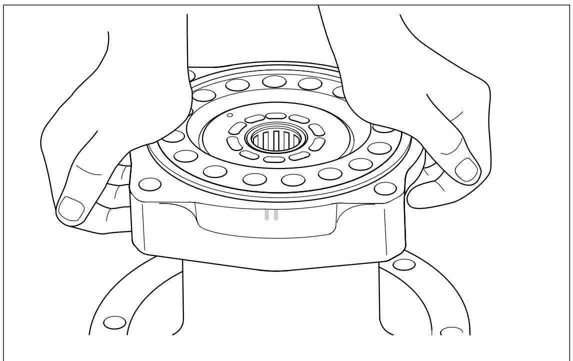
※ Lubricate O-ring with grease.



(8) Brake piston

Lubricate specified hydraulic oil on outer sliding face of piston (28) and assemble brake piston to housing (1).

※ It is too tight to assemble piston (10) because O-rings (14,29) are fitted, therefore it is recommended to push piston (28) horizontally by hands at once.

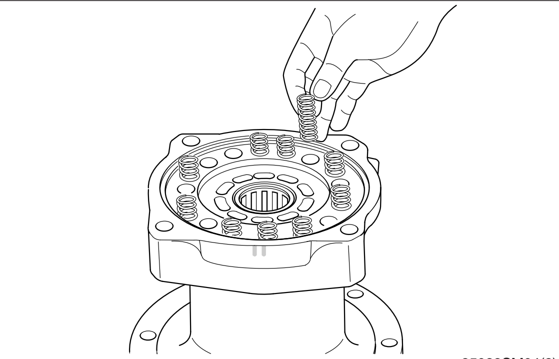


25038SM06(2)

(9) Spring (30, brake unit)

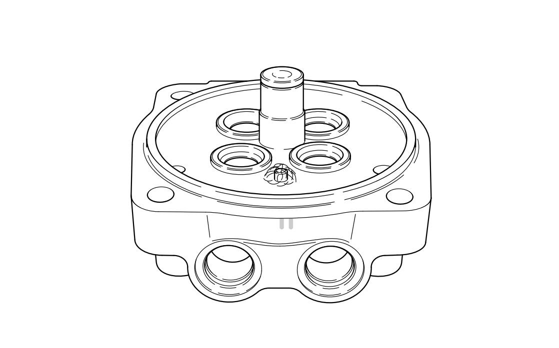
Assemble spring (30) to piston (28) of brake unit.

※ Insert spring (30) into original position.



25038SM04(2)

(10) Lubricate locating pin for antirotation of valve plate (16) of cover (12) with grease sufficiently and install locating pin to housing.

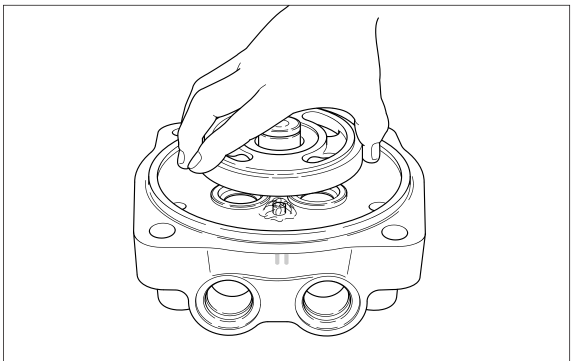


25038SM07(1)

(11) Balance plate

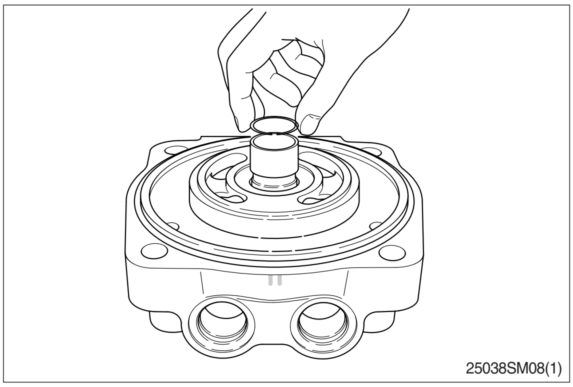
Assemble valve plate (16) to cover (12).

※ Be cautious of assembling direction.



25038SM07(2)

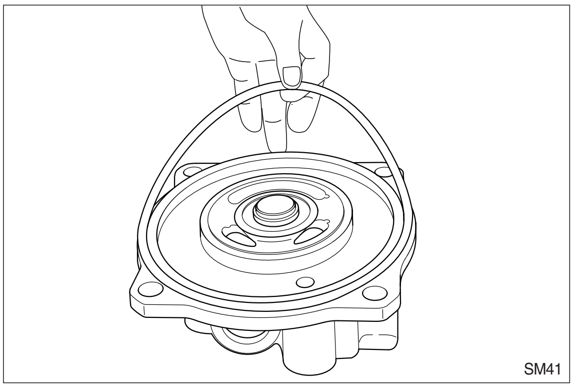
(12) Assemble inner race of needle bearing (15) and shim (22) to cover (12).



25038SM08(1)

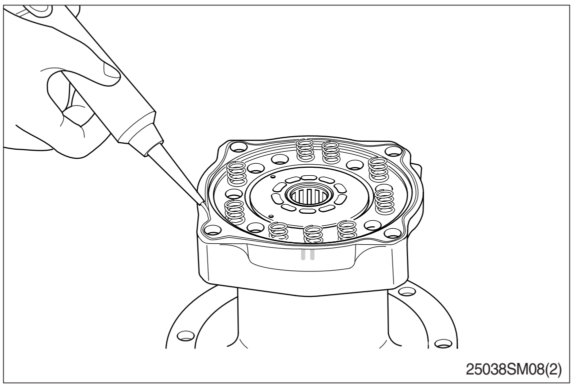
(13) Assemble O-ring (29) to cover (12).

※ Lubricate O-ring with grease.



SM41

(14) Apply three bond of white color to distinguish oil leakage from remaining oil in bolt hole of cover (12).



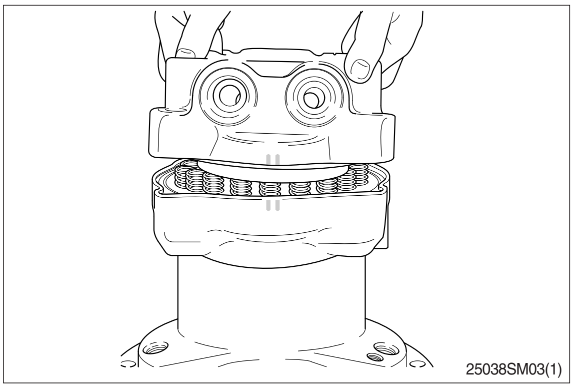
25038SM08(2)

(15) Cover

Assemble cover (12) and valve plate (16) to housing (1) lightly, holding them up with hands.

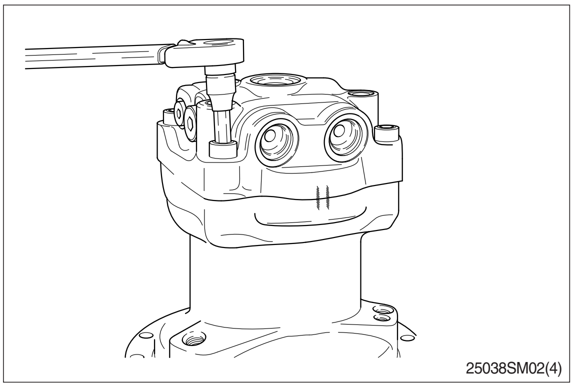
※ When assembling, be careful not to detach valve plate (16) and bushing (6) from cover (12).

※ Fit matching marks on housing (1) and cover (12) made before disassembling.

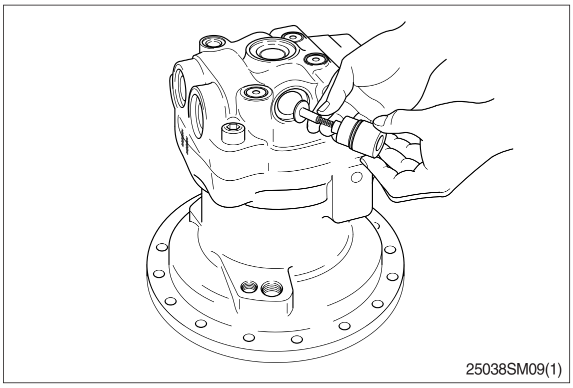


25038SM03(1)

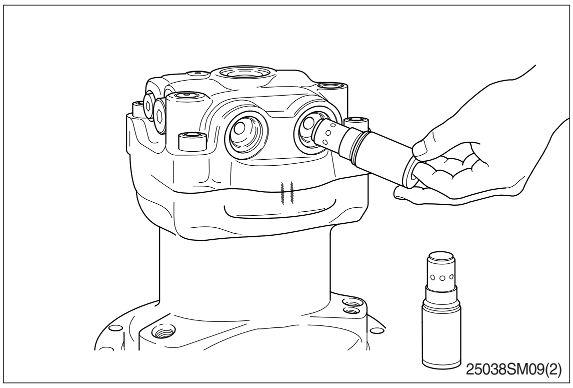
(16) Tighten cover (12) and housing (1) with 12 mm hexagonal socket bolt (18).
· Tightening torque : 16 kgf · m (116 lbf · ft)



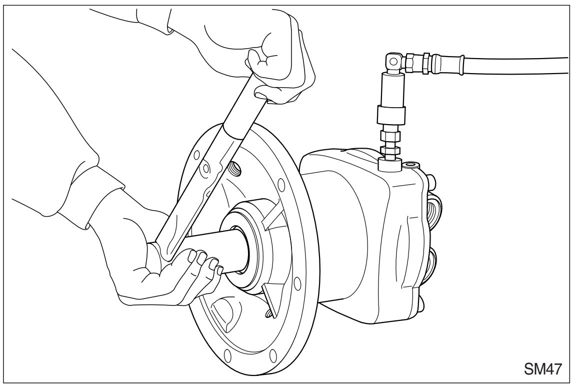
(17) Make up valve
Assemble check(35) and spring(36) to cover(12) and tighten plug(37) with 14 mm hexagonal socket bolt.
· Tightening torque : 14 kgf · m (101 lbf · ft)



(18) Relief assembly
Assemble relief valve assembly(17) to cover(12) with 14mm hexagonal socket bolt.
· Tightening torque : 8 kgf · m (58 lbf · ft)
※ Be cautious of assembling method.



(19) Check of assembly
Load pilot pressure of 20 kgf/cm^2 to brake release port after opening inlet and outlet port.
Check if output shaft is rotated smoothly around torque of 0.5~1 kgf · m.
If not rotated, disassemble and check.



This completes assembly.

3. REMOVAL AND INSTALL OF REDUCTION GEAR

1) REMOVAL

(1) Remove the swing motor assembly.
For details, see removal of swing motor assembly.

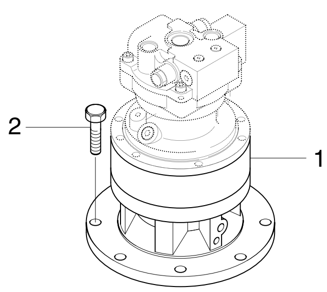
(2) Sling reduction gear assembly (1) and remove mounting bolts (2).

(3) Remove the reduction gear assembly.
· Reduction gear device weight : 45 kg (99 lb)

13031GE18

2) INSTALL

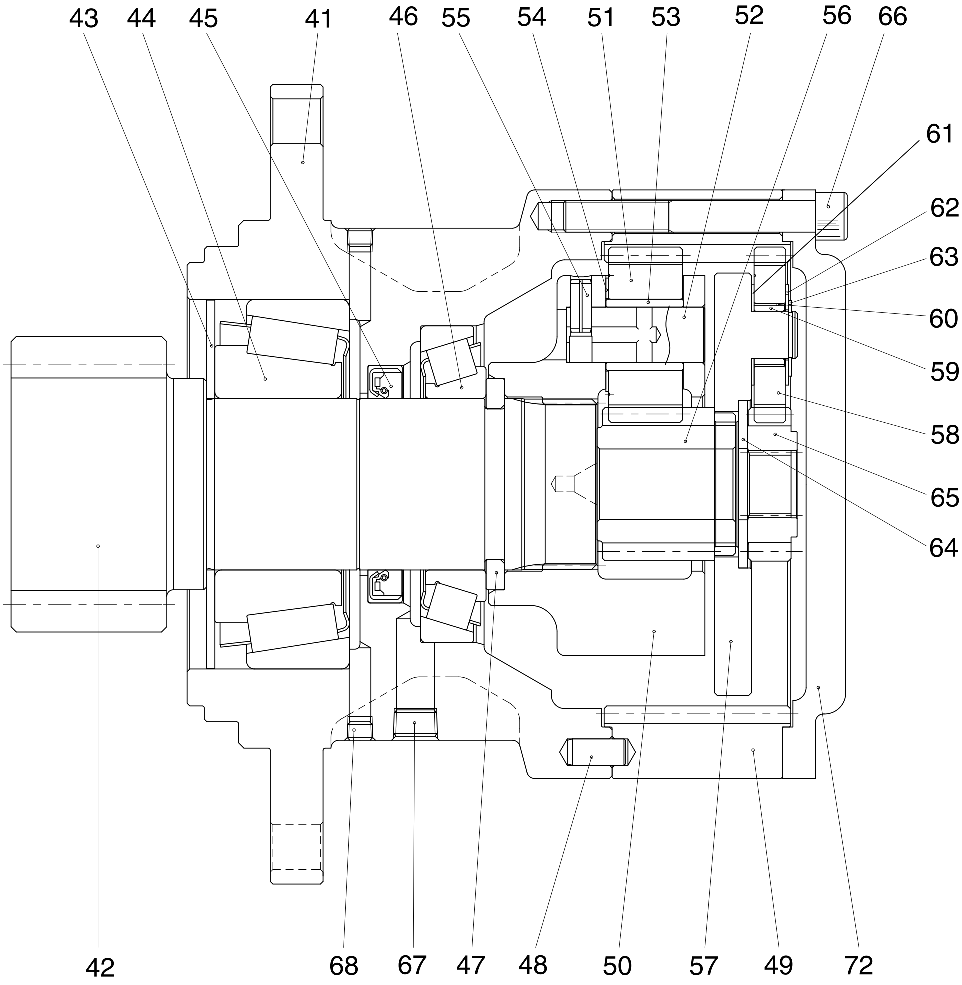
(1) Carry out installation in the reverse order to removal.
· Tightening torque :
29.7 ± 4.5 kgf · m (215 ± 32.5 lbf · ft)



HX60A7SM03

4. DISASSEMBLY AND ASSEMBLY OF REDUCTION GEAR

1) STRUCTURE

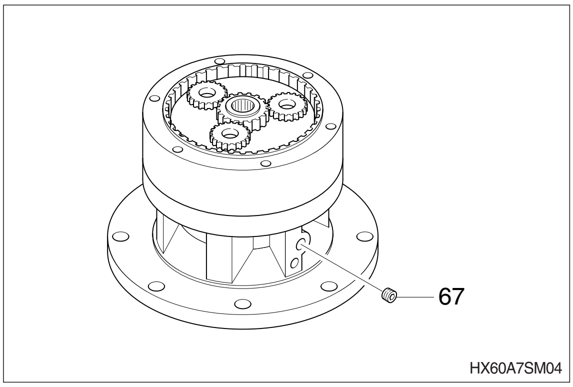


HX60A2SM02

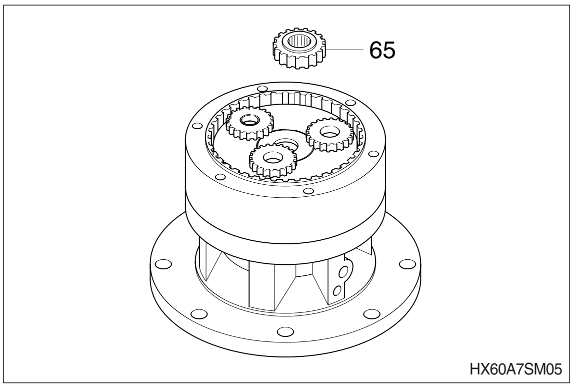
41	Case	52	Pin 2	63	Snap ring
42	Pinion gear	53	Needle roller bearing	64	Side plate
43	Bearing cover	54	Thrust washer 2	65	Sun gear 1
44	Taper roller bearing	55	Spring pin	66	Lench bolt
45	Oil seal	56	Sun gear 2	67	Plug
46	Taper roller bearing	57	Carrier assy 1	68	Plug
47	Lock collar	58	Planet gear 1	69	Level bar
48	Pin	59	Needle roller bearing	70	Level pipe
49	Ring gear	60	Collar	71	Air breather
50	Carrier assy 2	61	Thrust washer 1	72	Cover
51	Planet gear 2	62	Thrust washer 2		

2) DISASSEMBLY

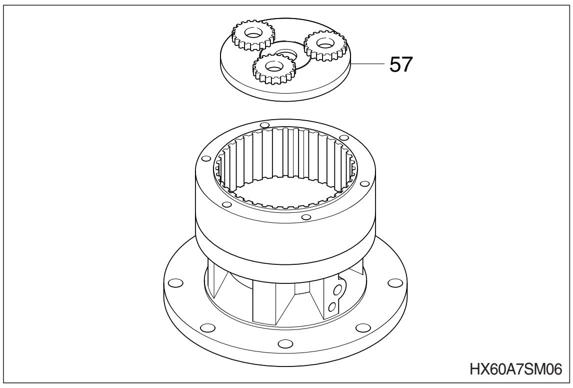
(1) Remove the plug (67) and drain out gear oil.



(2) Remove the No.1 sun gear (65).

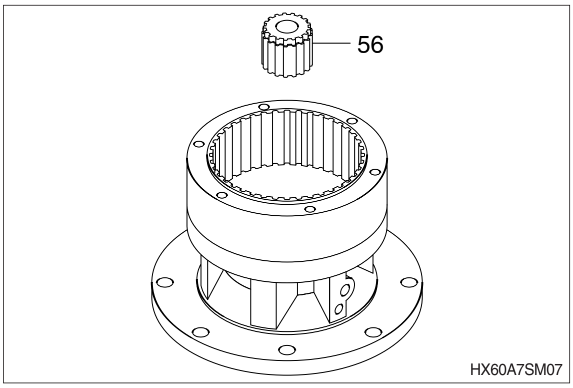


(3) Remove the No.1 carrier sub-assembly (57) using the jig.

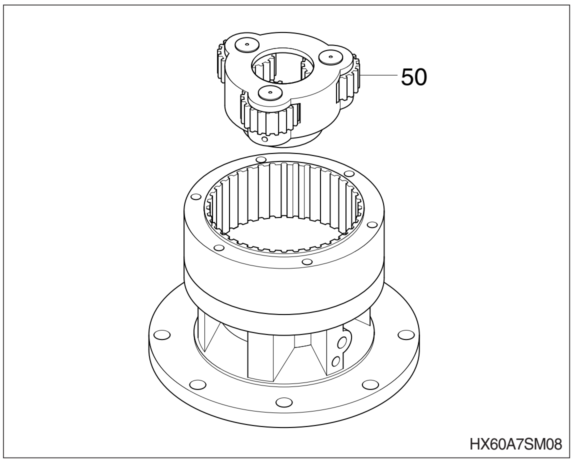


(4) Remove the No.2 sun gear (56).

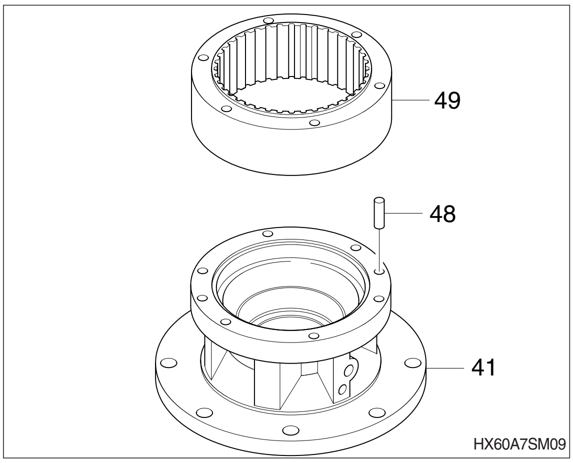
※ Pay attention to ensure the gear is not damaged during disassembling.



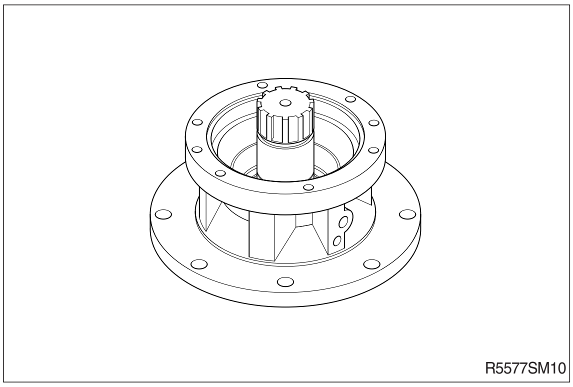
(5) Remove the No.2 carrier sub assembly (50).



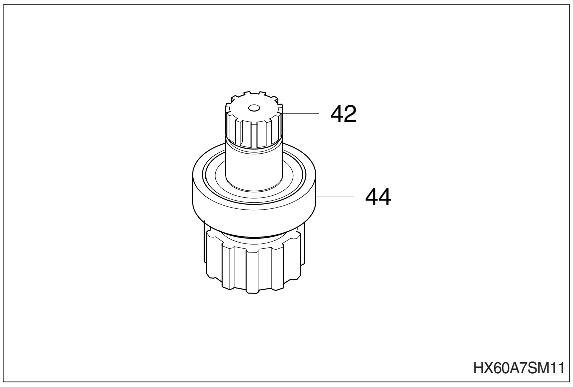
(6) Remove the ring gear by the removal groove between the ring gear (49) and casing (41) by using jig.
Full out the knock pin (48).
Do not need to remove the knock pin (48) if it is not worn or damaged.



(7) Put it on the working table with the drive shaft up.

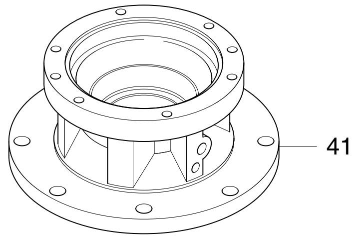


(8) Disassemble the drive shaft (42) with bearing (44) by using jig.



3) ASSEMBLING SWING REDUCTION GEAR

(1) Place the case (41) on the reversing machine having the flange side of the case up.

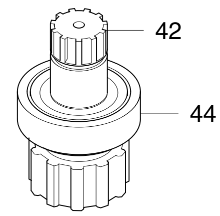


HX60A7SM12

(2) Install shaft assembly (42) into case (41).

※ Be sure to clean the case before install, using washing machine with the temperature of 80°C

※ Do not install shaft assembly by force.

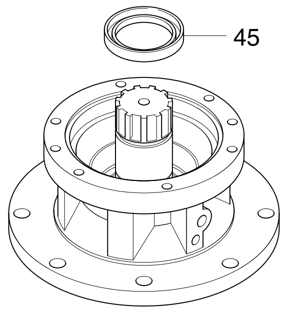


HX60A7SM11

(3) Reverse case and press to insert oil seal (45) by using pressing jig after spreading grease oil around the outside ring of the seal and bearing.

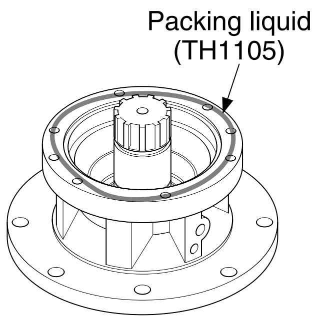
Coat grease oil slightly on the lip surface to prevent any scratch when installing.

※ Be sure to check by eye that the oil seal is seated completely after being installed.



HX60A7SM13

(4) Clean the assembling surface of case and spread packing liquid (TH1105) as shown in figure.

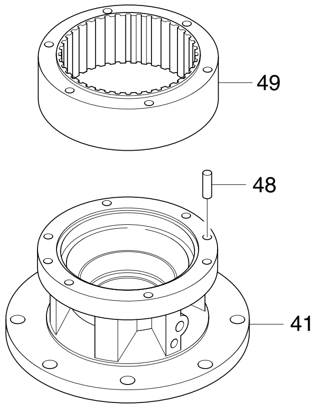


R5577SM14

(5) Place ring gear (49) on the case by matching it with knock pin (48) hole.

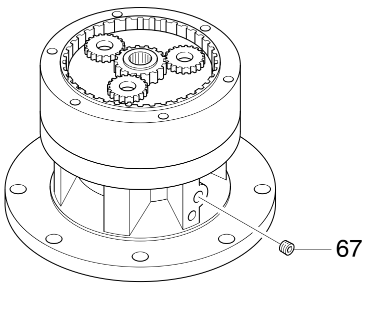
(6) Insert 2 knock pins (48) by using jig.

※ Be sure to check the hole location of oil gage before inserting.



HX60A7SM09

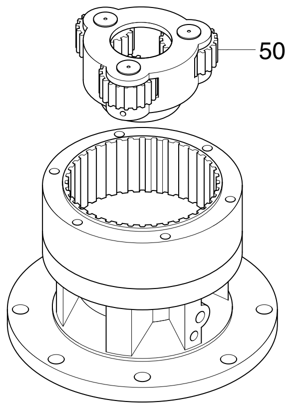
(7) Screw drain plug into drain plug (67) after winding sealing tape.



HX60A7SM04

(8) Mount No.2 carrier assembly (50) in the case sub assembly and install bolts into 2 TAP holes (M6) as shown in figure.

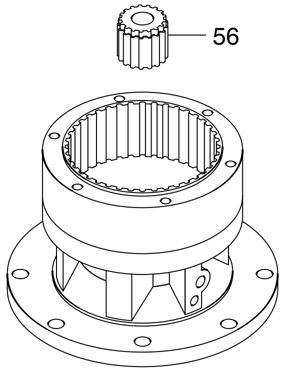
※ Turn the carrier slowly by hand to adjust the matching holes when assembling.



HX60A7SM08

(9) Install No.2 sun gear (56).

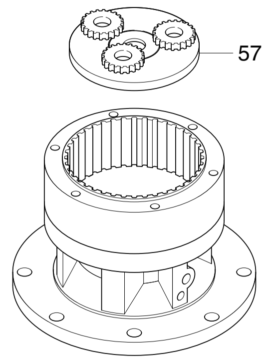
※ Be sure to check the direction of sun gear (56) when assembling.



HX60A7SM07

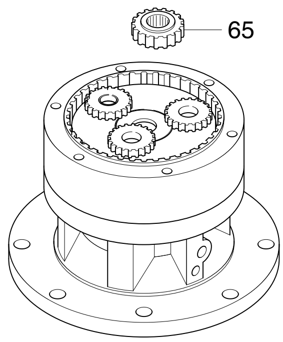
(10) Mount No.1 carrier assembly (57) in the case sub assembly and install bolts into 2 TAP holes (M6) as shown in figure.

※ Turn the carrier slowly by hand to adjust the matching holes when assembling.



HX60A7SM06

(11) Assemble No.1 sun gear (65).



HX60A7SM05

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.

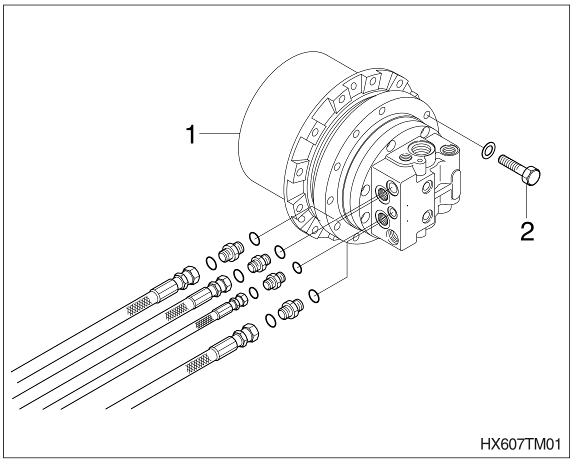
※ When pipes and hoses are disconnected, the oil inside the piping will flow out, so catch it in oil pan.

(4) Remove the track shoe assembly.
For details, see removal of track shoe assembly.

(5) Remove the cover.

(6) Remove the hose.

※ Fit blind plugs to the disconnected hoses.



(7) Remove the bolts and the sprocket.

(8) Sling travel device assembly(1).

(9) Remove the mounting bolts(2), then remove the travel device assembly.

· Weight : 80 kg (180 lb)
· Tightening torque : 20±2.0 kgf·m (145±14.5 lbf·ft)

2) INSTALL

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

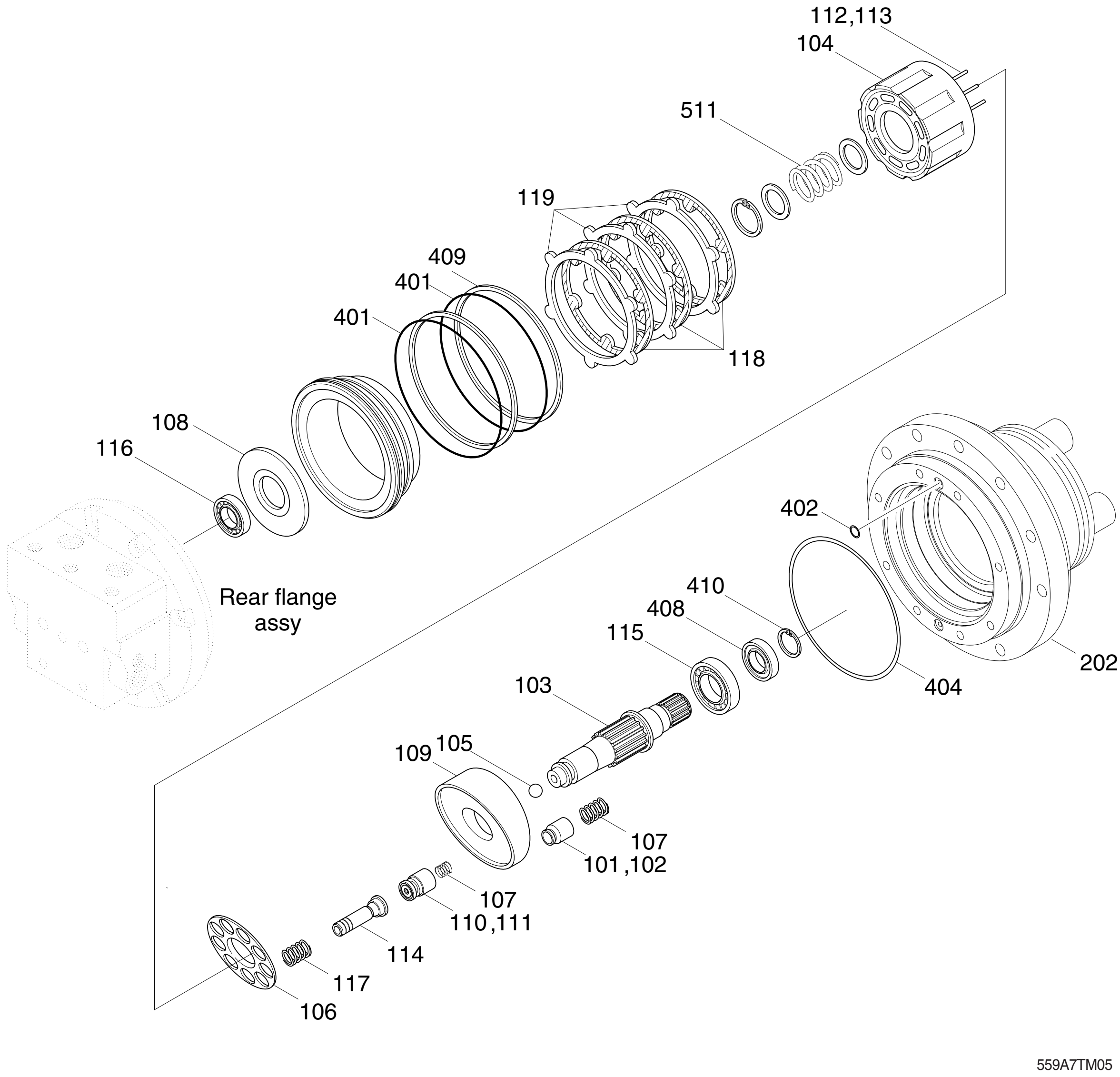
(2) Bleed the air from the travel motor.

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.

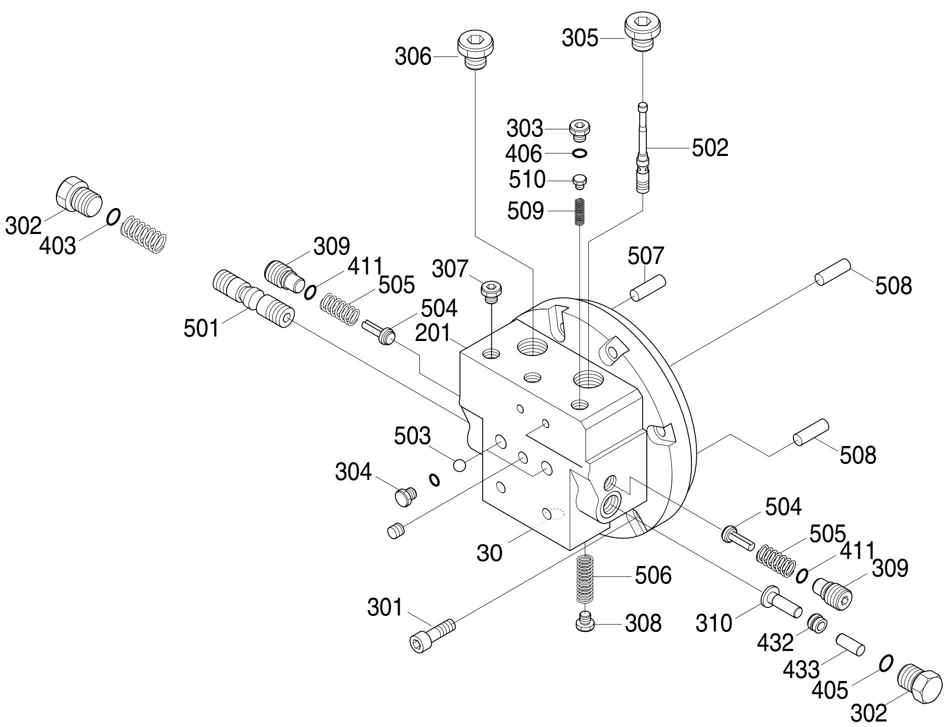
2. DISASSEMBLY AND ASSEMBLY OF MOTOR UNIT

1) PARTS LIST (1/2)



101	Piston	110	Swash piston	119	Separator plate
102	Shoe	111	Swash shoe	202	Reducer casing
103	Drive shaft	112	Pivot	401	O-ring
104	Cylinder block	113	Pivot pin	402	O-ring
105	Spherical bushing	114	Brake piston	404	O-ring
106	Set plate	115	Roller bearing	408	Oil seal
107	Cylinder spring	116	Ball bearing	409	Back up ring
108	Valve plate	117	Brake spring	410	Snap ring
109	Swash plate	118	Friction plate	511	Swash piston spring

PARTS LIST (2/2)



559A7TM06

30	Relief valve assy	309	Set plug	503	Steel ball
201	Valve casing	310	Restrictor	504	Plunger
301	Socket bolt	403	O-ring	505	Main spool spring
302	Plug	405	O-ring	506	2 speed spool spring
303	Drain plug	406	O-ring	507	Spring pin
304	NPTF plug	411	O-ring	508	Pin
305	Dust plug	432	Seat	509	Spring cap
306	Dust plug	433	Seat casing	510	Cap
307	Dust plug	501	Main spool		
308	2 speed plug	502	2 speed spool		

2) TOOLS AND TIGHTENING TORQUE

(1) Tightening torque

This table shows the typical screw sizes and tightening torques used in the motor

Item	Part name	Size	Tightening torque	
			kgf · m	lbf · ft
30	Relief valve assy	G 1/2	11.2	81.0
301	Socket bolt	M14	16.3	118
302	ROH plug	G 1/4	3.6	26.0
303	Drain plug	G 3/8	7.5	54.2
304	NPTF plug	NPTF 1/16	1.1	8.0
308	2 speed plug	G 1/4	3.6	26.0
309	Set plug	G 3/4	17.3	125
310	Restrictor	NPTF 1/16	1.1	8.0
626	Pipe plug	RC 1/8	1.2	8.7
632	ROH plug	G 1/8	1.5	10.8

(2) Tools

① Hexagon and socket wrench

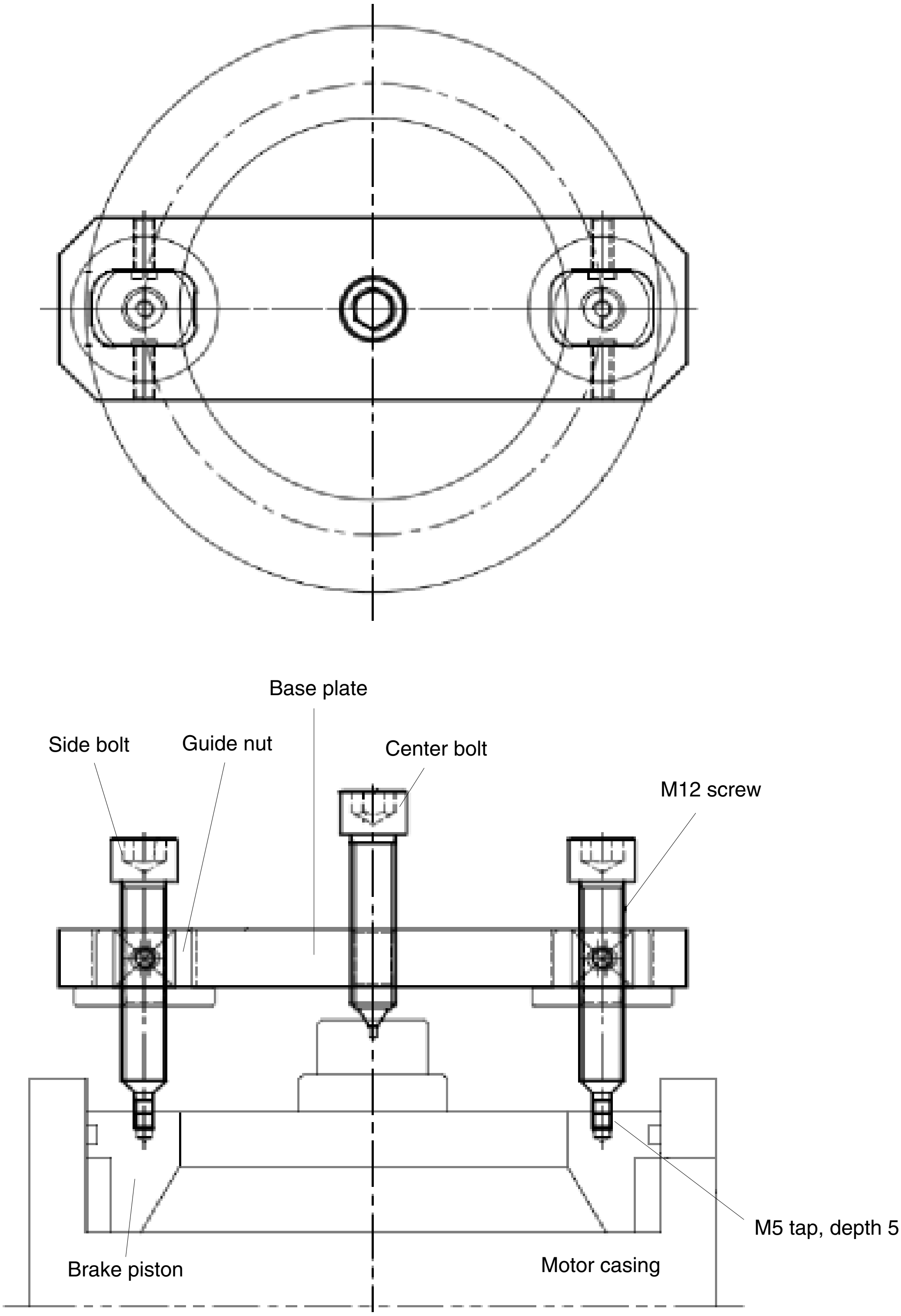
Tools	Item	Part name	B size	Screw size
Hexagon wrench	304, 310	NPTF plug, Restrictor	4	R 1/16
	626, 632	Pipe plug, ROH plug	5	R 1/8
	302, 308	ROH plug, 2 speed plug	6	G 1/4
	301	Socket bolt	12	M14
Socket wrench	303	Drain plug	22	G 3/8
	30	Relief valve assy	27	G 1/2
	309	Set plug	30	G 3/4
	30	Relief valve assy	8	M5

② Others

Tools	Specification
Driver	Screw driver (small, medium)
Hammer	Rubber or plastic hammer, iron hammer
	Round bar : about Ø45 mm x 150 mm
Bearing press jig	Round bar : about Ø60 mm x 150 mm
Torque wrench	Torque adjustment range
	- For 4~20 Nm
	- For 20~100 Nm
	- For 40~200 Nm
Slide hammer bearing puller	-
Brake piston disassembly jig	-
Brake piston press jig	-
Snap ring plier	Inner diameter

(3) Special tools

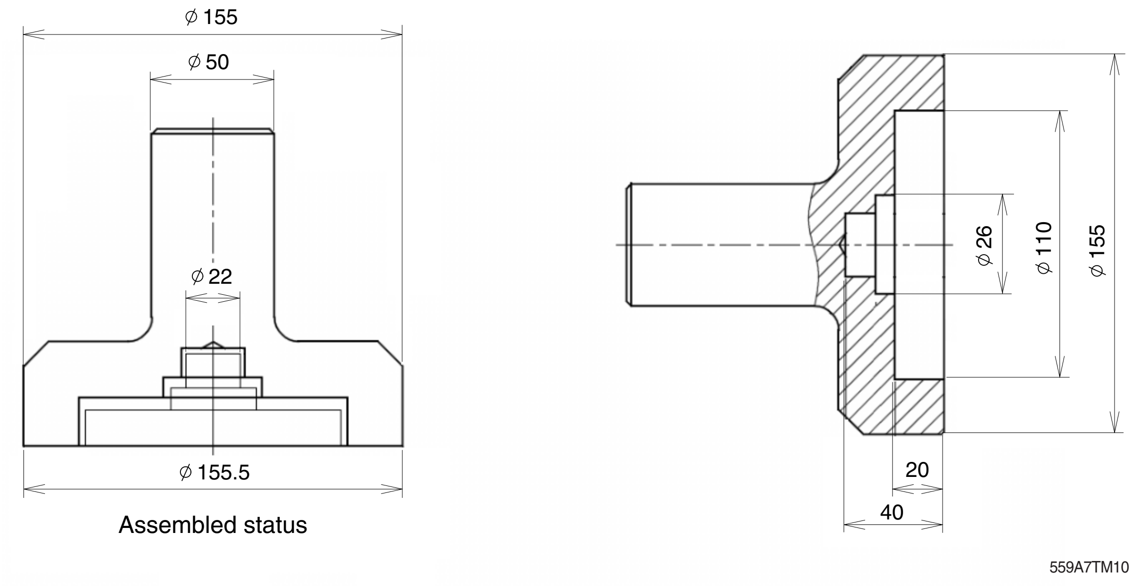
① Brake piston disassembly jig



559A7TM05

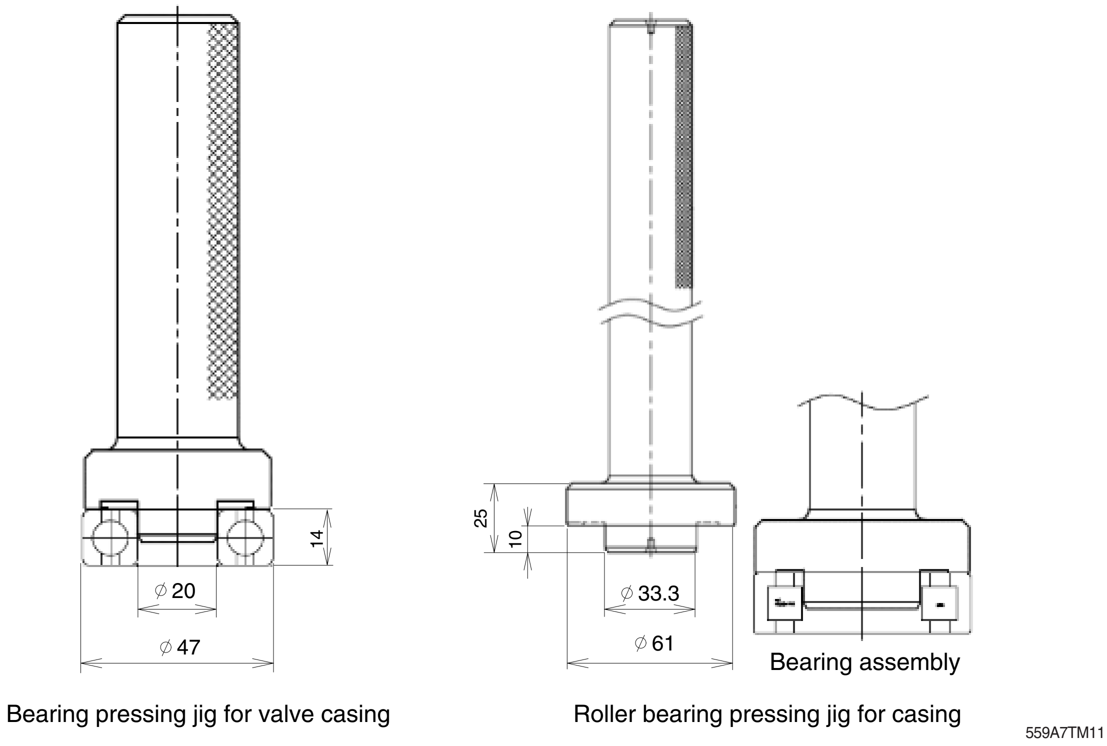
② Brake piston press jig

The below dimensions are the reference dimensions.



③ Bearing press jig

The below dimensions are the reference dimensions.



3) DISASSEMBLY

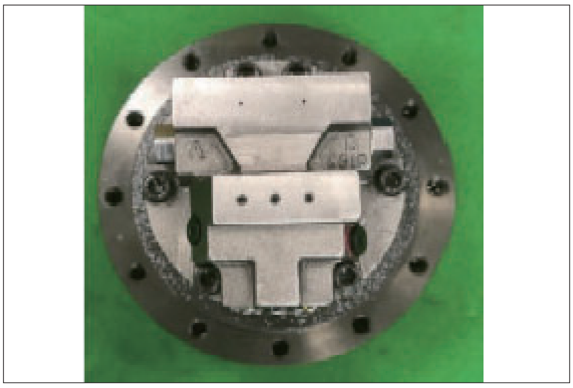
When disassembling the motor, disassemble in the order shown below. The number in brackets after part name means item number of section drawing.

(1) Wrap a wire rope around the outer periphery of the motor, lift it with a crane, and wash it with white kerosene. After washing, dry with compressed air.

※ The motor can be disassembled into an mounted state on the excavator. In this case, disassemble not to be got foreign materials: dust, mud, etc.

(2) Remove the oil in the casing (202) from the drain plug.

※ In the case of automatic 1-speed specification, 2 speed spool (502) may drop out during operation. Block pilot port with dust plug (306).



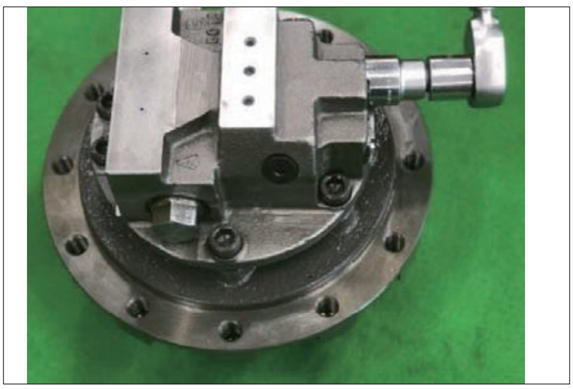
559A7TM12

(3) Disassembly is easily fixed to the workstation.
Place the shaft end of the drive shaft (103) facing down.
Mark the joint mark at the junction point of casing (202) and valve casing (201).

※ Choose a clean place.
Spread a rubber plate or cloth on the workbench to prevent friction and damage of the parts.

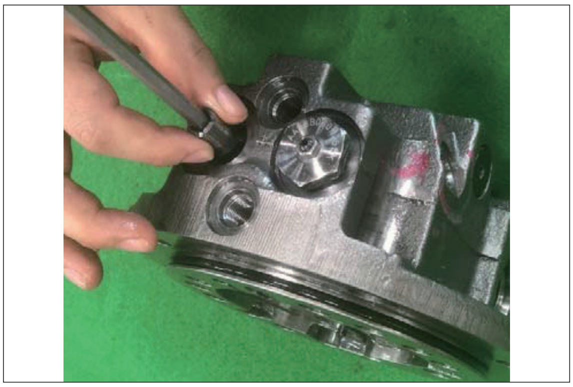
■ Disassembly of valve casing kit

(4) Loosen the relief valve assy (30) and remove it from the valve casing (201).



559A7TM13

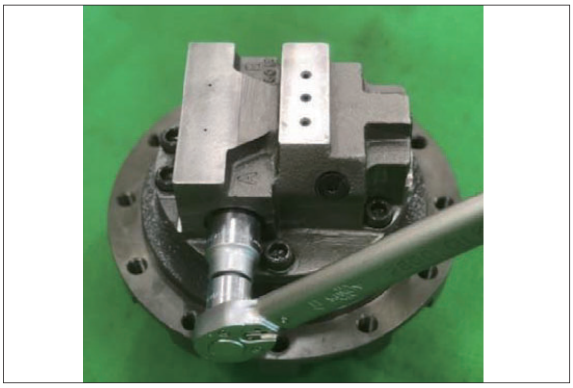
(5) Disassemble the spring cap (510) → cap (509).



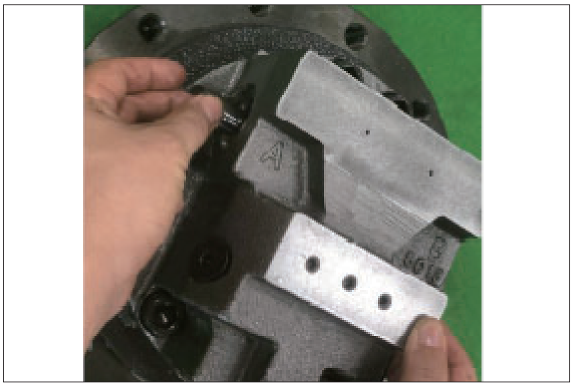
559A7TM14

(6) Loosen the set plug (309), remove the plunger (504) and the main spool spring (505).
Then take out the main spool (501).

※ Main spool is disassembled in the horizontal direction with the hole. Be careful not to scratch the sliding surface of the main spool.

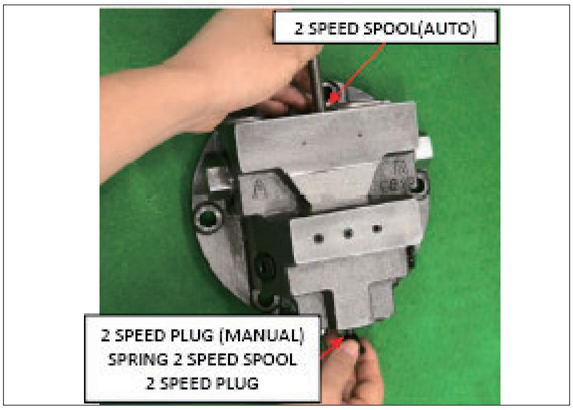


559A7TM15



559A7TM16

(7) Loosen the 2 speed plug (308), take out the 2 speed plug spring (506) and the 2 speed spool (502).

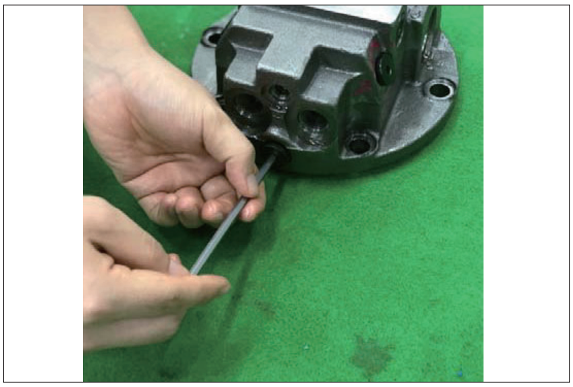


559A7TM17

(8) The following operations should be carried out if necessary.

① Loosen the ROH plug (302) and remove the restrictor (310).

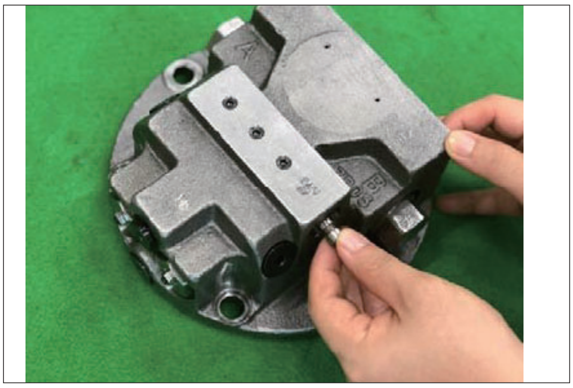
※ If there is no problem with the 1st / 2nd speed switching, no special disassembly is required.



559A7TM18

② Release ROH plug (302) and disassemble in the following order: Seat casing (433) → steel ball (503) → seat (432).

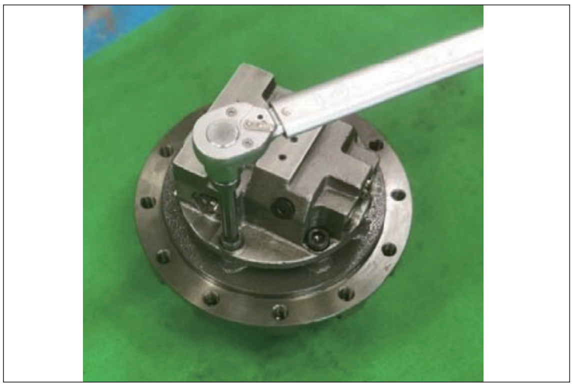
※ If there is no problem with the 1st / 2nd speed switching, no special disassembly is required. Please be careful about the loss of the steel ball. Please be careful not to damage the inner diameter of the seat casing and seat.



559A7TM19

(9) Loosen socket bolt (301) and remove valve casing (201) from casing (202).

※ (Due to the force of the brake spring E (117), when the socket bolt (301) is unscrewed, the valve casing (201) is raised from the casing (202). Further, remove the valve plate (108) from the valve casing (201).

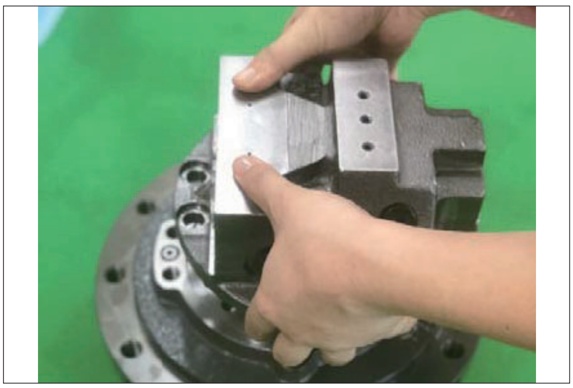


559A7TM20

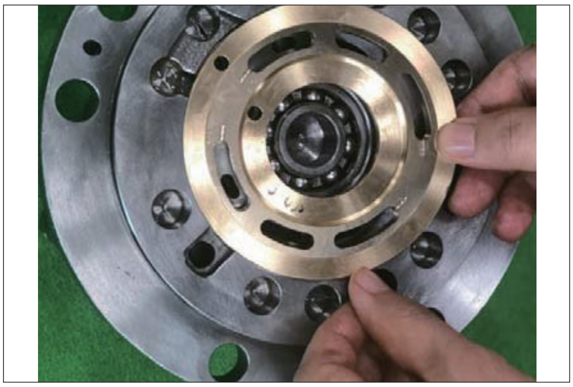
Carefully work so that the valve plate does not fall off the valve casing.

※ In some cases, the valve plate is attached to the cylinder block.

Be careful not to scratch the sliding surface and mating surface when you disassemble the mating surface with a screwdriver or the like.



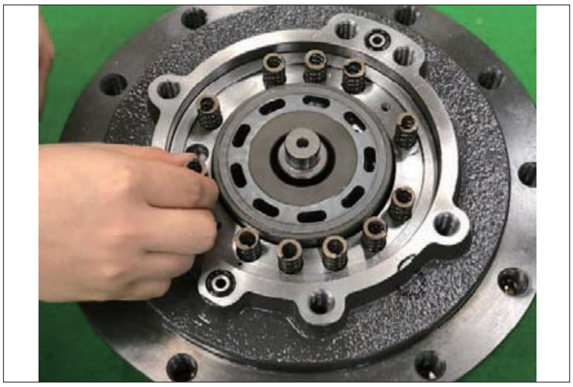
559A7TM21



559A7TM22

■ DISASSEMBLY OF MOTOR BODY

(10) Remove the brake spring (117) from the brake piston (114).



559A7TM25

(11) Using the jig, remove the brake piston (114) from the casing (202). No.16

※ If you need to disassemble without jig, Fill the brake flow path hole with compressed air.

If you blow compressed air suddenly brake piston can jump out of casing.

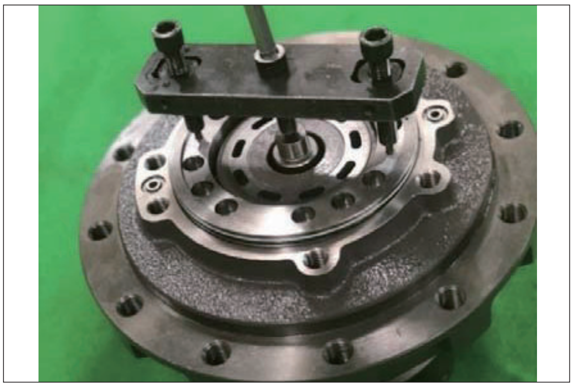
There is a risk of damage or injury to the part;

Please follow the directions below.

① Cover the casing with a clean cloth.

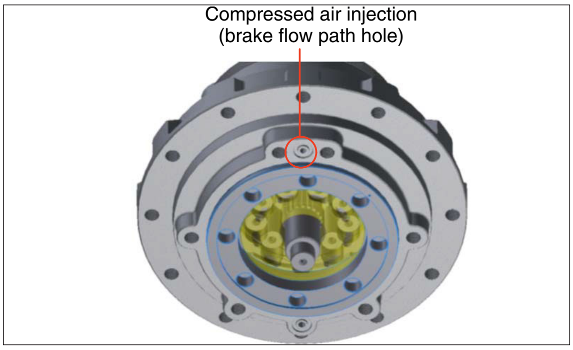
② Press the cloth lightly with your hand to prevent the brake piston from jumping out.

③ Fill the brake flow path hole with compressed air.



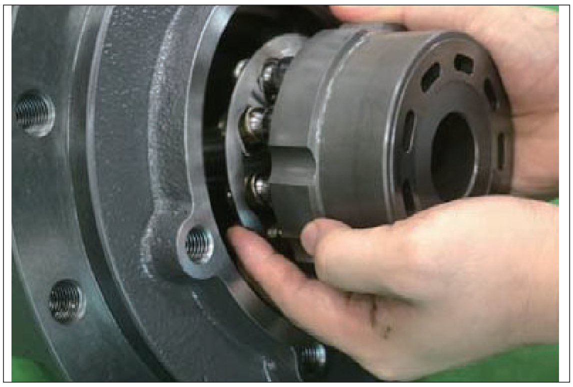
559A7TM26

※ Both ends of the jig are hooked to the groove of the brake piston. The center of the jig is hooked to the center of the drive shaft and makes the jig and brake piston parallel.



559A7TM40

(12) Put the motor horizontally.
Disassemble cylinder block (104) from drive shaft (103).
Also, disassemble piston assy (10), set plate (106), spherical bush (105), cylinder spring (107).



559A7TM31

※ Mark each cylinder block bore, piston assy, and set plate bore in the assembled position so that the assembled position does not change.
Be careful not to scratch the sliding surface of cylinder block, piston, shoe, etc.

559A7TM32

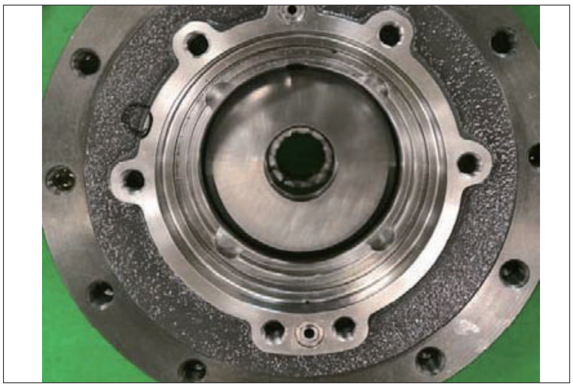
559A7TM33

559A7TM34

(13) Disassemble friction plate (118) and separator plate (119) in casing (202).

559A7TM35

(14) Disassemble the drive shaft (103) and swash plate (109).



559A7TM37

(15) Disassemble swash piston assy (20), swash piston spring (511), pivot (112), pivot pin (113).

559A7TM38

(16) Do not disassemble any further unless there is a specific problem. At this state, check bearing according to the following inspection instructions.

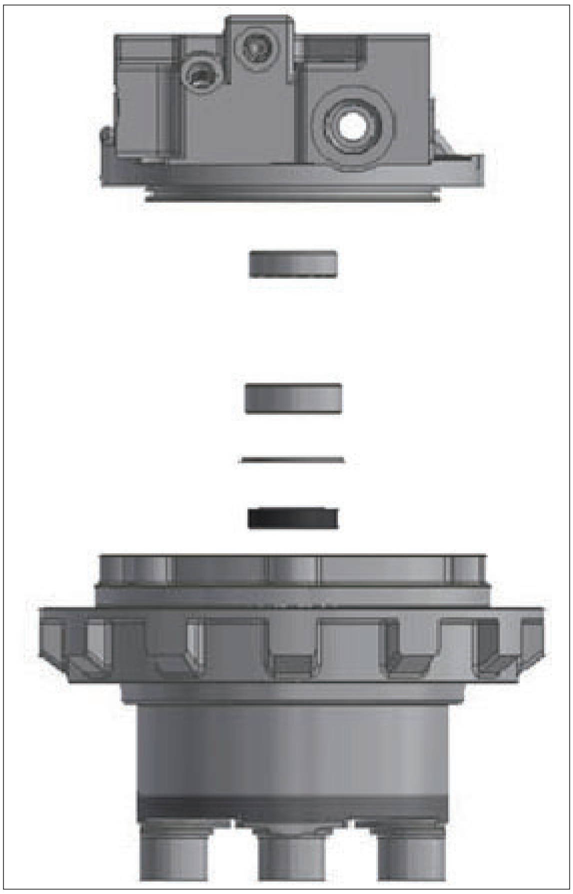
① Check the raceway surface, rollers or balls in the visible range, and make sure there are no pittings or cracks.

② Check for local corrosion and wear on the ball or roller.

③ Make sure that there is excessive wear powder between the ball or roller and cage.

④ When turning lightly by hand, check that it rotates smoothly.

If there is no problem after checking in this step, the following disassembly is not necessary.



559A7TM41

(17) The following operations should be carried out if necessary.
From the casing (202), the outer ring of the cylindrical roller bearing (115) is tapped lightly from the housing part side of the oil seal (408) via the steel bar and is pulled out.

※ Do not reuse the removed roller bearing.

(18) Disassemble the snap ring (410) using a snap ring plier (inner diameter) in casing (202).

(19) From the casing (202), the gently tap out the housing side of the oil sea (408) is tapped lightly from the rear of the casing (202) via the steel bar and is pulled out.

※ Do not reuse the removed oil seal.

(20) Remove the cylindrical ball bearing (116) from the valve casing (201) using the slide hammer bearing puller.

※ Do not reuse the removed ball bearing.

※ The disassembly operation is finished. Please check that there is no problem in each part.

4) ASSEMBLY

(1) The assembly way is the reverse of the disassembly way, but be careful of the following items.

① Be sure to repair damaged parts during disassembly. Please prepare replacement parts in advance.

② Wash each part thoroughly with wash liquid and dry with compressed air.

③ Be sure to coating clean hydraulic oil to sliding parts, bearings, etc. and assemble them.

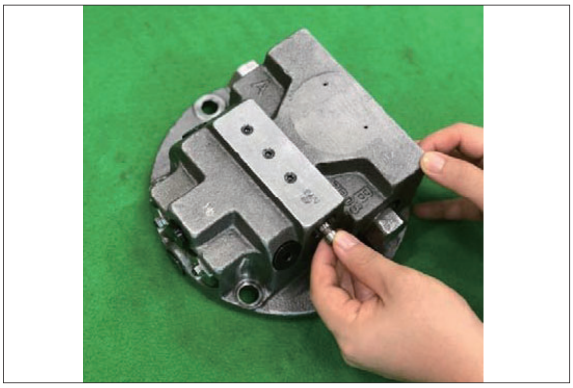
④ In principle, should replace seal parts such as O ring and oil seal.

⑤ Use the torque wrench to tighten the mounting bolts and plugs of each part, and tighten with the torque shown in page 7-99-4.

■ ASSEMBLY OF VALVE CASING KIT

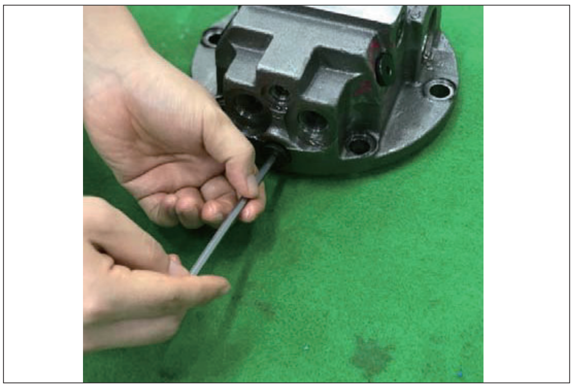
(2) This operation is necessary only when the seat assy is removed.
Assemble seat (432) → steel ball (503) → seat casing (433) → ROH plug (302) in this order.

※ Please pay attention to the assembly sequence.
Refer to section drawing.



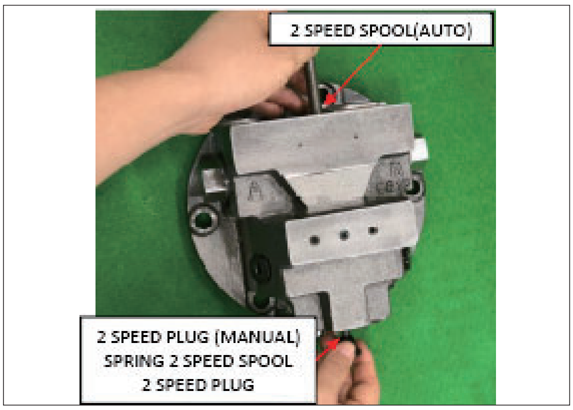
559A7TM19

(3) This operation is necessary only when the restrictor is removed.
Apply loctite on the restrictor (310) and assemble to casing (21). And tighten ROH plug (302) with specified torque.



559A7TM18

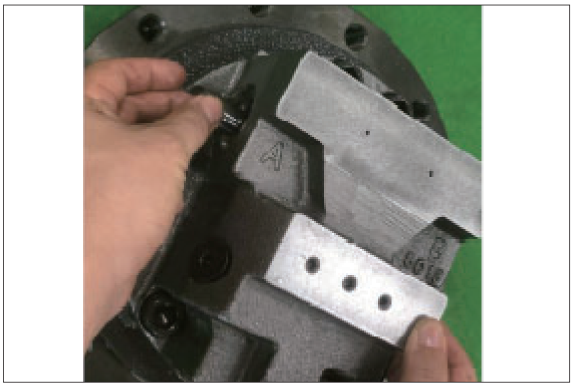
(4) Assemble the 2 speed spool (502), the 2 speed spool spring (506), the 2 speed plug (308).



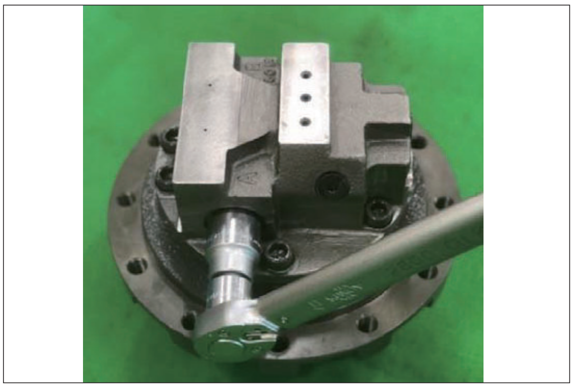
559A7TM17

(5) Assemble main spool (501), Plunger (504) → main spool spring (505) → O-ring (411) → Assemble set plug (309) in order.

※ Make sure the main spool moves smoothly.

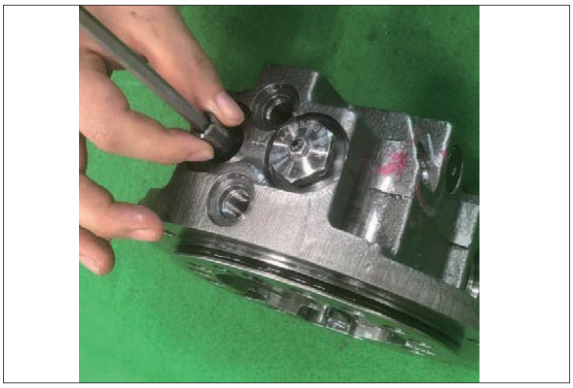


559A7TM16



559A7TM15

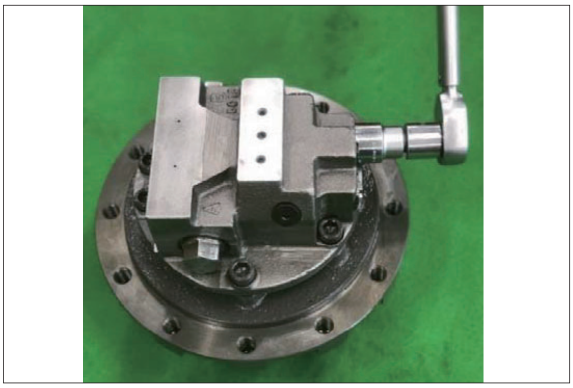
(6) Assemble the cap (509).



559A7TM14

(7) Assemble the spring cap (510) to the relief valve assy (30). Attach the relief valve to the valve casing (201).

※ It is advisable to apply grease thinly on the mating surface of spring cap to prevent falling off.



559A7TM13

■ ASSEMBLY OF MOTOR BODY

(8) Place the casing (202) on the work surface with the valve casing (201) assembly surface facing up.

(9) Insert the oil seal (408) into the casing (202) using a jig.

※ Pay attention to the direction of the oil seal. (refer to cross-section drawing)
Apply grease thinly to the lip portion of the oil seal.
Hit it uniformly and be careful not to scratch the outer circumference.

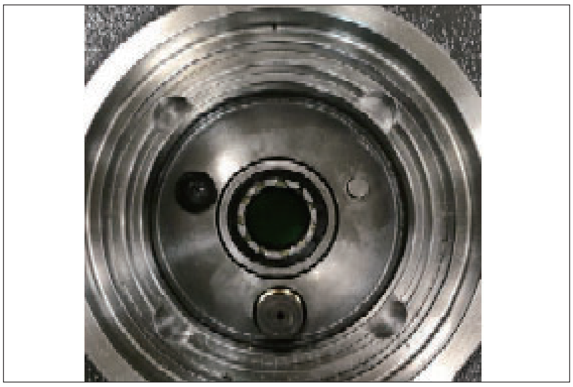
(10) Assemble the snap ring (410) using the snap pliers (internal diameter) on the casing (202).

※ The snap ring "R" faces the oil seal.

(11) The outer ring of the cylindrical roller bearing (115) is tapped lightly on the casing (202) via the bearing press jig and incorporated.

559A7TM39

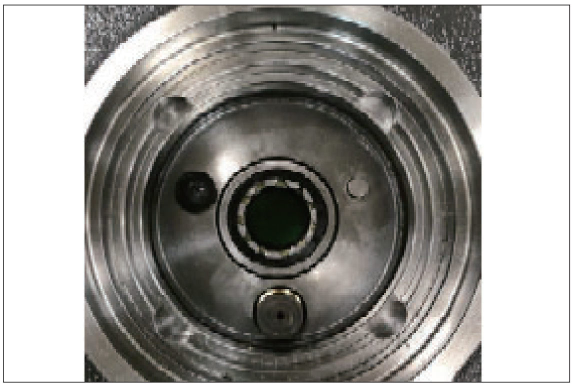
(12) Assemble pivot pin (113), pivot (112) to casing (202).



559A7TM38

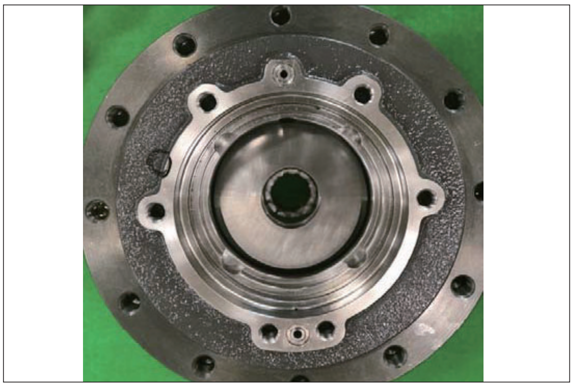
(13) Assemble swash piston spring (511) and swash piston assy (20) to casing (202).

※ It is advisable to apply grease thinly on the mating surface of swash piston spring to prevent falling off.
When assembled normally, the pushed swash piston assy goes deeper than the casing stage.
Make sure the swash piston assy moves smoothly.


559A7TM38

(14) Place casing (202) horizontally and insert swash plate (109).

※ Make sure the swash plate moves smoothly.


559A7TM37

(15) The drive shaft (103) is attached to the casing (202).

※ Carefully insert so that the lip of the oil seal will not be scratched.
Assemble by applying oil to the oil seal assembly of drive shaft.
When assembled normally, the pushed swash piston assy goes deeper than the casing stage.
Make sure the swash piston assy moves smoothly.


559A7TM36

(16) Set the cylinder spring (107) and the spherical bush (105) into the cylinder block (107). and insert the piston assy. (10) to the bore of set plate (106).

※ Assemble the Larger outer diameter face of set plate and the sliding movement face of shoe in the same direction. (Refer to section drawing)

559A7TM34

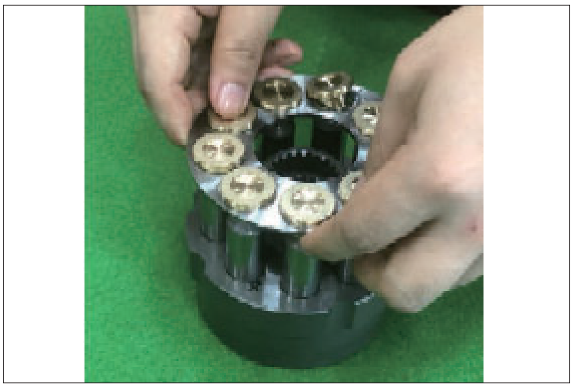
559A7TM33

(17) The piston assy (101) set on the set plate (106) is assembled in the cylinder block (104). And the cylinder block sub assembled is inserted in accordance with the spline of the drive shaft (103) to casing (202).

※ Before assembly, apply oil to the surface of cylinder bore or piston.

※ It is easy to insert into drive shaft by matching spline of cylinder block and the spherical bush.

※ After assembly, try rotating the cylinder block lightly in the forward and reverse directions by hand.



559A7TM32

(18) Place casing (202) with the valve casing (201) assembly surface of casing (202) facing up.
Separator plate (119) and friction plate (118) are alternately assembled to casing (202).

※ Put the separator plate in arc groove of casing.
※ Please refer to the assembly drawing for the number of assembly of the separator plate and friction plate.

559A7TM30

559A7TM29

(19) Install the O-ring (118, 401) and the back up ring (409) on the brake piston (114).

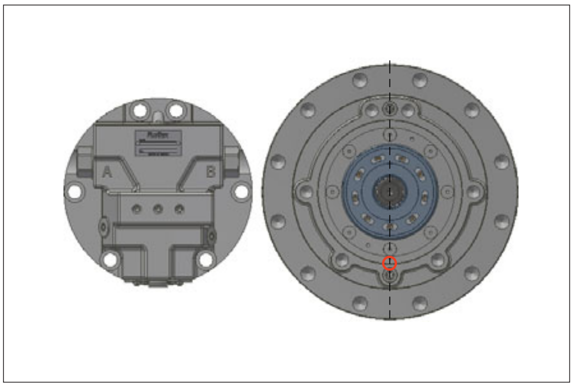
※ Back up ring is installed to the valve casing direction.
※ If the grease is lightly applied to the O-ring, it will not be cut when the brake piston is inserted.

559A7TM28

(20) The brake piston (114) is tapped lightly via the brake piston press jig and pressed into casing (202).

559A7TM27

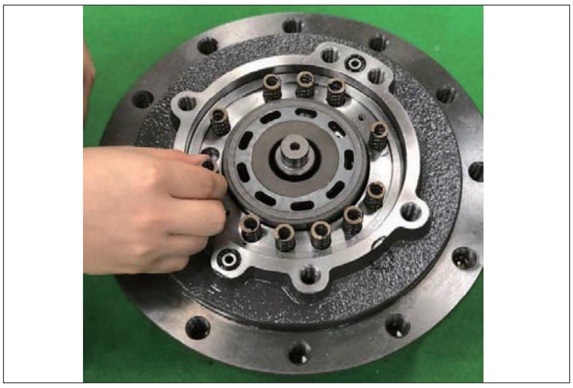
※ Pay attention to the assembly direction of the brake piston. The orifice of the brake piston is located downward on the same vertical line as the flow hole in casing.



559A7TM42

(21) Attach the brake spring (117) to the brake piston (114).

(22) Attach the O-ring (402) to the casing (202).



559A7TM25

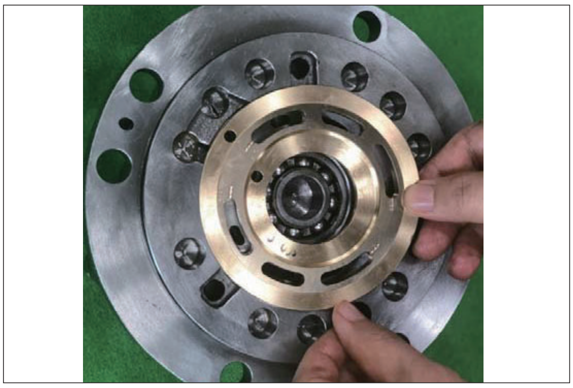
(23) This term is necessary only when the cylindrical ball bearing (116) is removed.
The outer ring of the cylindrical ball bearing (116) is tapped lightly on the valve casing (201) via the bearing press JIG and incorporated.

559A7TM24

(24) The valve plate (108) is installed in the valve casing (202) and the O-ring (401) is mounted.

※ Apply grease thinly to the joint surface of the valve plate. (prevention of dropout)

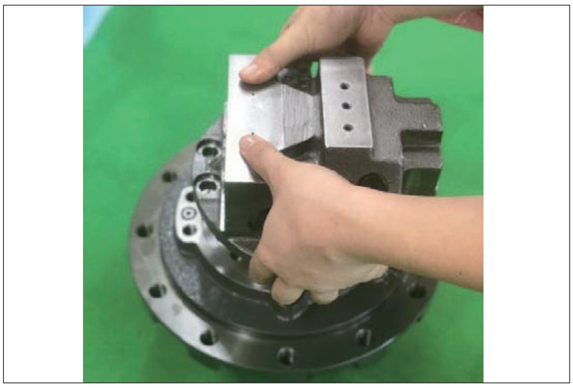
559A7TM23



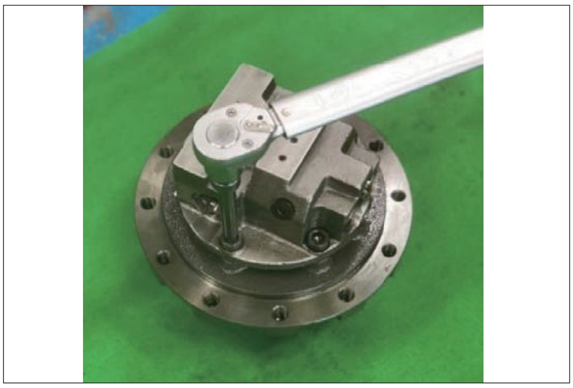
559A7TM22

(25) Attach the valve casing (201) to the casing (202) and fasten it with a socket bolt (301).

※ Be careful not to remove the valve plate.
Be careful not to tilt the brake spring.
Tighten the socket bolt evenly until specified torque.



559A7TM21

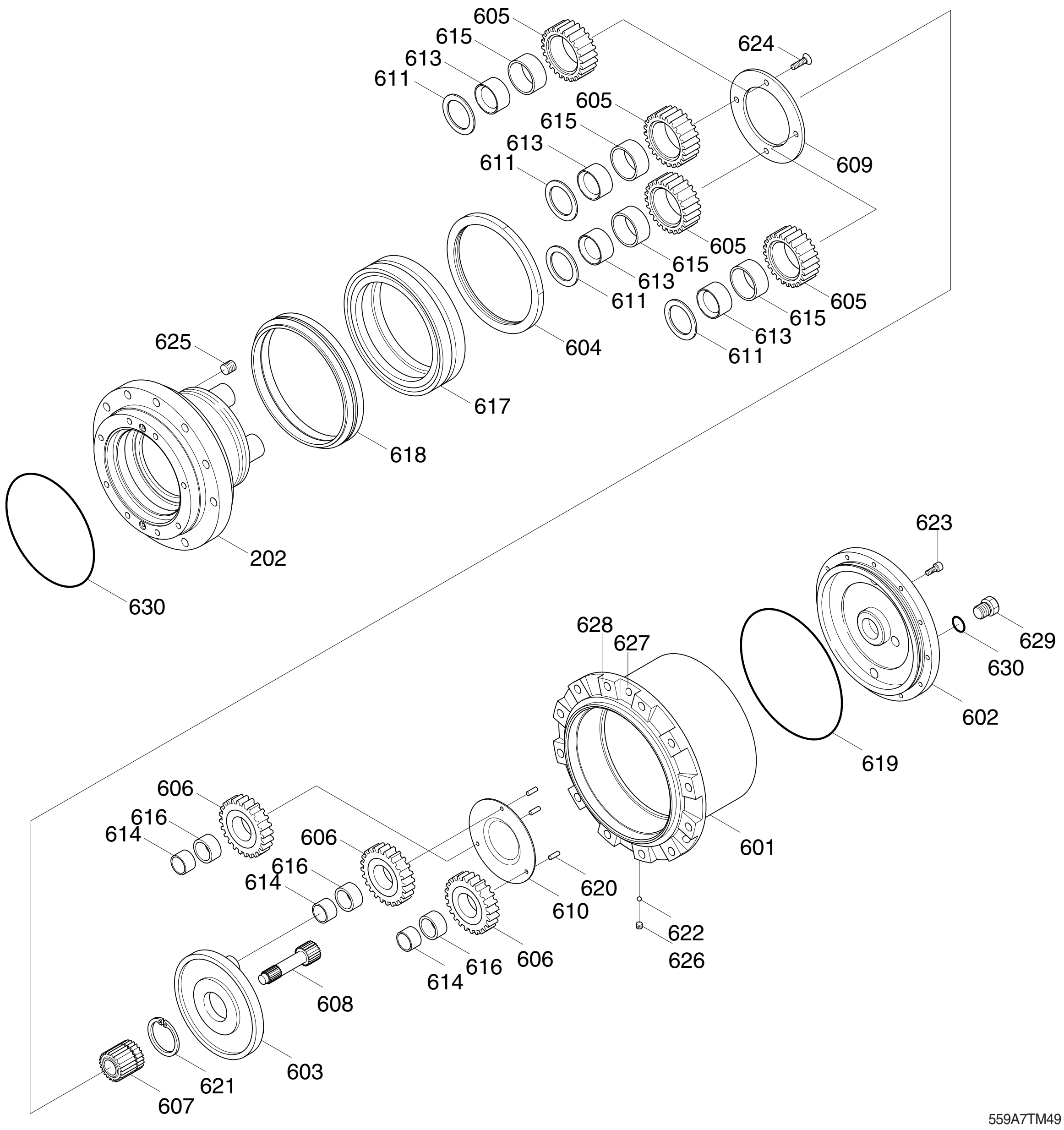


559A7TM20

※ Assembly is completed with the above.

3. DISASSEMBLY AND ASSEMBLY OF REDUCTION GEAR

1) PARTS LIST



202	Reducer casing	610	Thrust plate R	621	Snap ring
601	Housing	611	Thrust washer	622	Steel ball
602	Cover	613	Collar	623	Socket bolt
603	Holder	614	Inner race	624	Bolt
604	Ring nut	615	Needle bearing	625	Plug
605	Planetary gear F	616	Needle bearing	626	Plug
606	Planetary gear R	617	Angular bearing	627	Side plate A
607	Sun gear	618	Floating seal kit	628	Side plate B
608	Ring nut	619	O-ring	629	Plug
609	Thrust plate F	620	Spring pin	630	O-ring

2) GENERAL PRECAUTIONS

This reduction gear is designed to reduce the number of parts and balance the life of the parts. Therefore, all parts can be supplied separately, but when replacing, it is often necessary to replace them both structurally and functionally.

			Parts to be replaced at the same time													
	Part number		617	618	611	613	615	605	612	609	624	603	620	614	616	606
	Name of part		Angular bearing	Floating seal	Thrust washer	Collar	Needle bearing	Planetary gear F	Thrust washer	Thrust plate F	Ext. flush bolt	Holder	Spring pin	Inner race	Needle bearing	Planetary gear R
Replace-ment parts	617	Angular bearing	—	○												
	618	Floating seal	△	—												
	611	Thrust washer			—	△	△	△	△	○	○					
	613	Collar			△	—	○	○	△	○	○					
	615	Needle bearing			△	○	—	○	△	○	○					
	605	Planetary gear F			△	△	△	—	△	○	○					
	612	Thrust washer			△	△	△	△	—	○	○					
	609	Thrust plate F			△	△	△	△	△	—	○					
	624	Ext. flush bolt			△	△	△	△	△	○	—					
	603	Holder														
	620	Spring pin											No disassembly			
	614	Inner race										Please replace the entire No.1 holder assy.				
	616	Needle bearing														
	606	Planetary gear R														

○ Indicates parts that must be replaced at the same time.

▲ Indicates parts that is desirable to be replaced at the same time.

※ Be sure to replace the bearing inner and outer rings at the same time.

3) TOOLS AND TIGHTENING TORQUE

(1) Tightening torque

This table shows the typical screw sizes and tightening torques used in the reduction gear.

Item	Part name	Size	Tightening torque	
			kgf · m	lbf · ft
604	Ring nut	M165	18	130
623	Socket bolt	M6	1.2	8.7
624	Ext flush bolt	M8	3	21.7
625	Pipe plug	RC 3/8	10	72.3
626	Pipe plug	RC 1/8	1.2	8.7
629	RO plug	G 1/2	8.4	60.8
632	ROH plug	G 1/8	1.5	10.8

(2) Tools

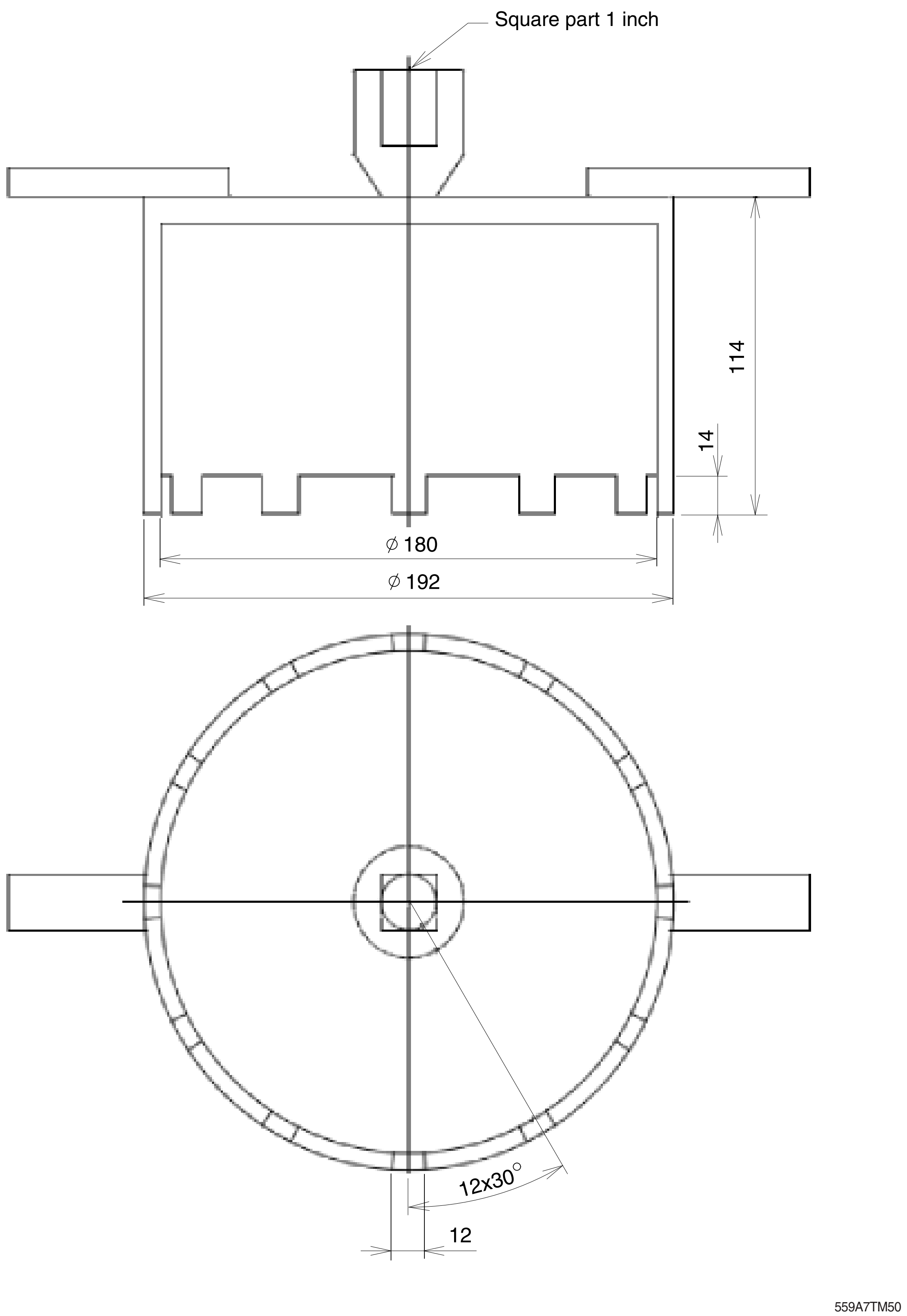
① Hexagon wrench and exclusive jig

Tools	Item	Part name	B size	Screw size
Hexagon wrench	626	Pipe plug	5	R 1/8
	625	Pipe plug	8	R 3/8
	629	RO plug	10	G 1/2
	623	Socket bolt	5	M6
	624	Ext flush bolt	6	M8
Exclusive jig	604	Nut ring	-	M165

② Others

Tools	Specification
Driver	Screw driver (small, medium)
Hammer	Rubber or plastic hammer, iron hammer
Torque wrench	Torque adjustment range
	- For 4~20 Nm
	- For 20~100 Nm
	- For 40~200 Nm
Snap ring plier	Outer diameter
Nut ring disassembly and assembly jig	-

(3) Special tools



4) ASSEMBLY

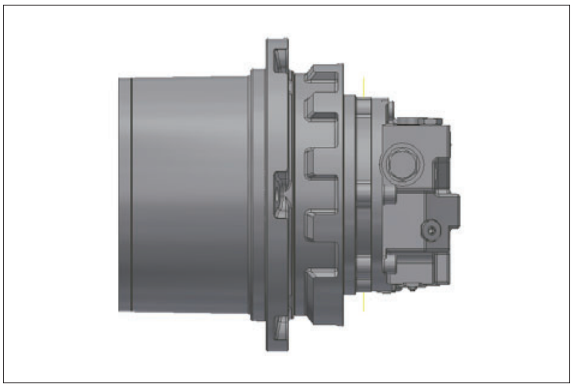
(1) Disassembly and assembly tips

① When disassembling, be careful not to damage the parts.

② Wash each part with washing oil and dry it with compressed air.

③ The numbers in parentheses after the part name represent the symbols of the cross-sectional drawing.

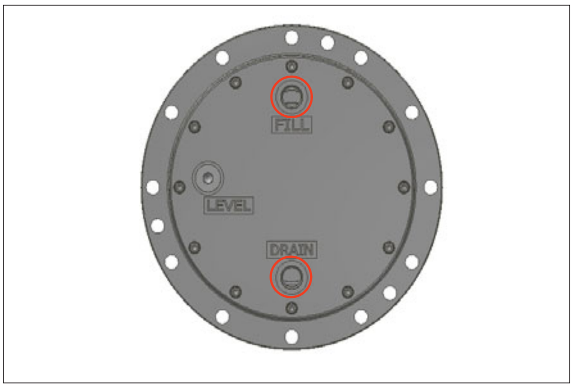
(2) Wrap a wire rope around the outside of the traveling device to lift it with a crane. Then wash with white kerosene. After washing, dry with compressed air.



559A7TM51

(3) Make sure that the fill plug (629) and drain plug (629) shown in the dimensional installation drawing are perpendicular to the horizontal plane.
Unplug both ports and remove the gear oil.
Place it on a suitable base.

※ Receive the gear oil in a clean container and inspect the presence and presence of wear powder.



559A7TM52

(4) Loosen the socket bolt (623) and disassemble the cover (602).

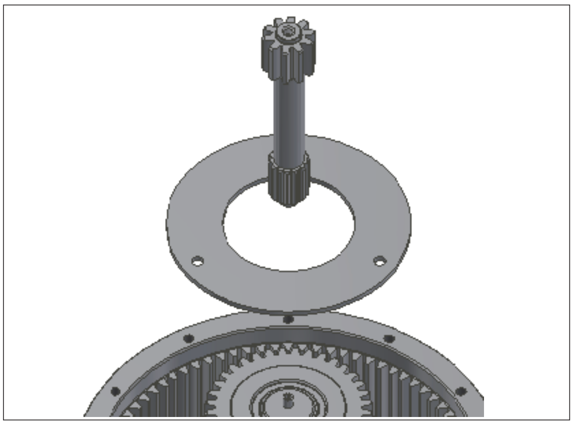
559A7TM53

※ Be careful not to damage the O-ring (619) of the cover during disassembly.

559A7TM54

(5) Disassemble thrust plate R (610), drive gear (608).

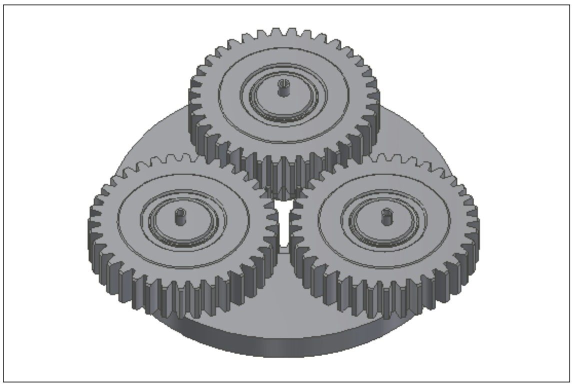
559A7TM55



559A7TM56

(6) Disassemble the No.1 holder assembly with the planetary gear R (606) attached.

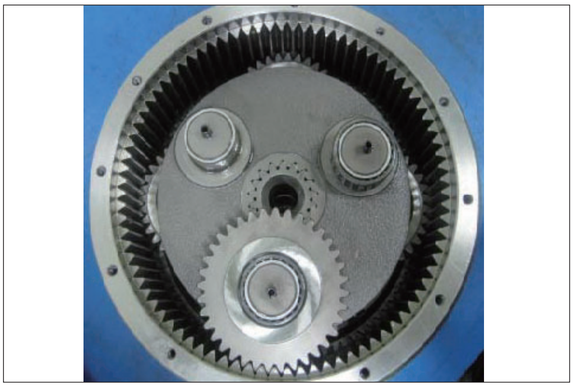
※ No. 1 holder assy components are as follows.
- Holder (603)
- Spring pin (620)
- Planetary gear R (606)
- Needle bearing (616)
- Inner race (614)



559A7TM57

(7) Disassembly of No.1 holder assy

Do not disassemble the No.1 holder assy further.
In this state, check the parts according to the inspection instructions shown in section 6.
As mentioned above, it is recommended to exchange No.1 holder assy as a set as much as possible.
Please follow the instructions below when you are forced to exchange parts.



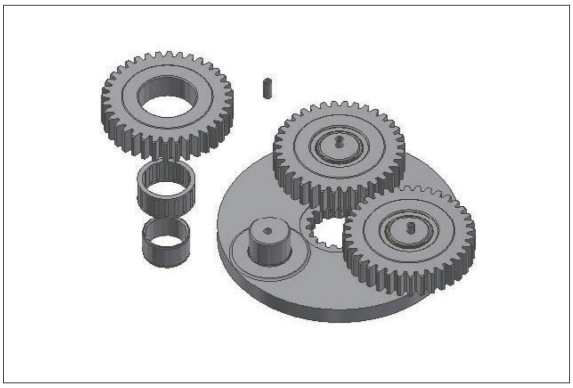
559A7TM58

① Disassemble in the order of planetary gear R (606) → Needle bearing (616) → Inner race (614).

② Unplug the spring pin.

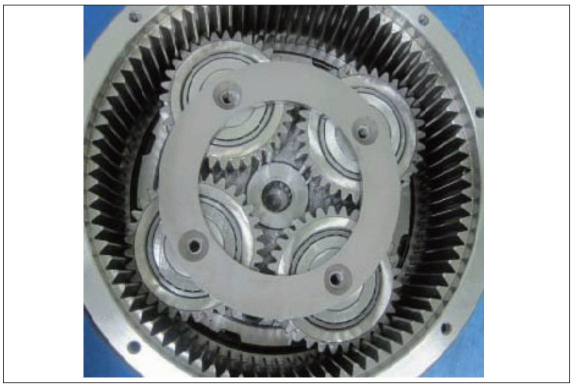
※ Mark each planetary gear, needle bearing, and inner race in the assembled position so that each combination and assembly position does not change.

※ When disassembling the spring pin, do not reuse it.

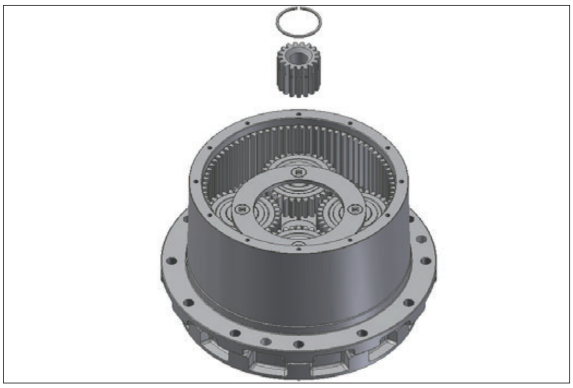


559A7TM59

(8) Disassemble the sun gear (607).
Then, the snap ring (621) is separated from the sun gear (607) using a snap ring pliers.



559A7TM60



559A7TM61

(9) Disassemble the No.2 holder assy.

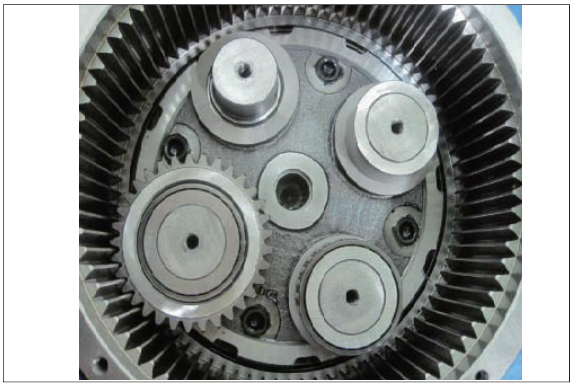
(10) Disassembly of No.2 holder assy

Do not disassemble any more No.2 holder assy unless otherwise specified.

In this state, check the parts according to the inspection instructions shown in section 6.

As mentioned above, it is recommended to exchange No.2 holder assy as a set as much as possible.

Please follow the instructions below when you are forced to exchange parts.

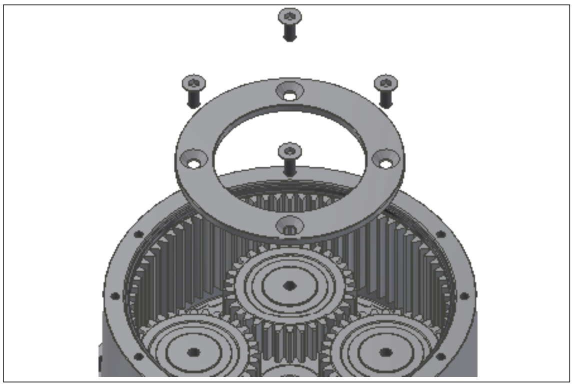


559A7TM62

① Apply enough heat to ext flush bolt(624)

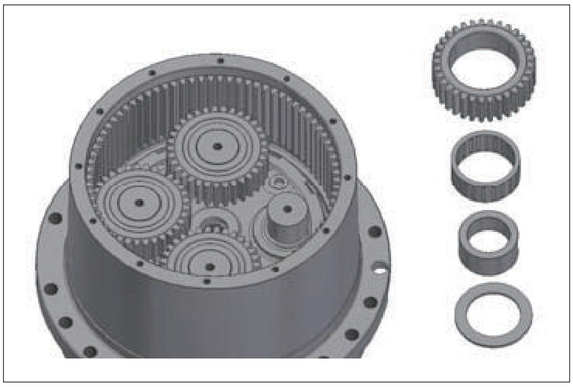
② Disassemble thrust plate F (609).

③ Disassemble in the order of thrust plate F (609) → Planetary gear F (605) → Needle bearing (615) → Collar (613) → Thrust washer (611)



559A7TM63

※ Mark each planetary gear, needle bearing, and inner race in the assembled position so that each combination and assembly position does not change.



559A7TM64

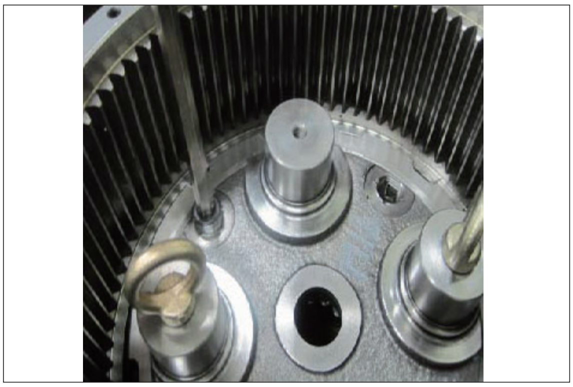
(11) Do not disassemble any further unless there is a specific problem.

In this condition, check the parts according to the inspection instructions shown in Section 1-2.

※ If there is no problem after checking in this step, the following disassembly is not necessary.

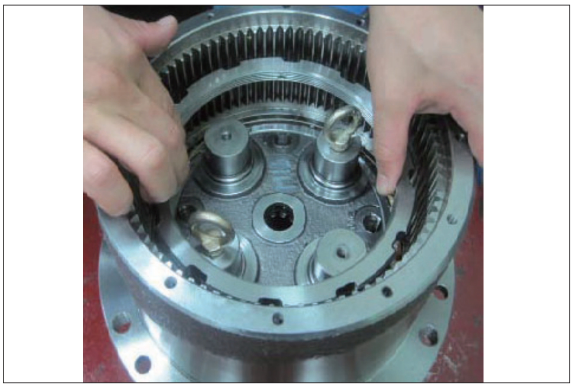
(12) Disassemble pipe plug (625).

※ When disassembling the pipe plug (625), Do not reuse.



559A7TM65

(13) Disassemble the nut ring (604).

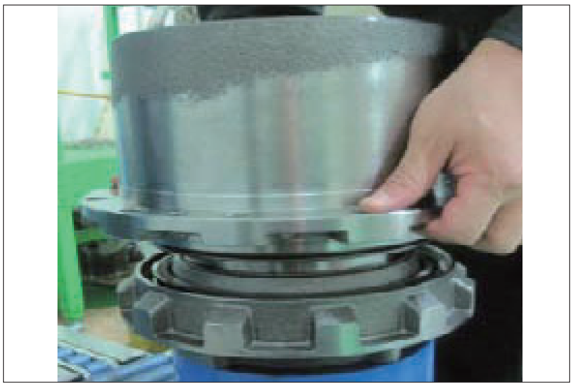


559A7TM66

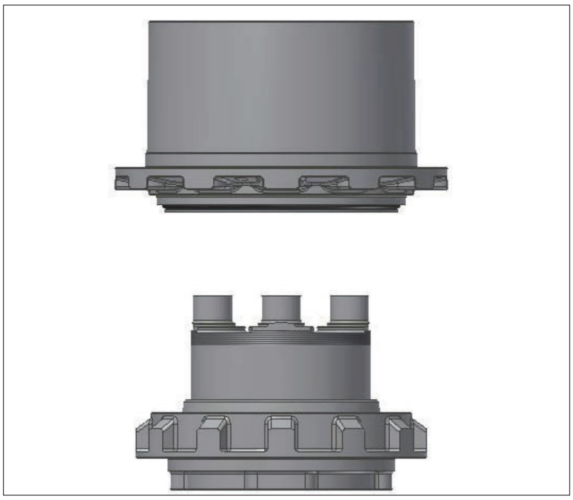
※ Please disassemble the nut ring using the dedicated jig referring to the attachment.

559A7TM67

(14) Disassemble casing (202) from housing (601).



559A7TM68



559A7TM69

(15) After disassembling the pipe plug (626), remove the steel ball (622).

※ The number of steel ball is 105.
When disassembling, be sure to check the number of balls.

559A7TM70

(16) Disassemble the floating seal kit (618).

559A7TM71

(17) Disassemble angular bearing (617).

559A7TM72

※ Use a press for disassembly.

559A7TM73

※ The disassembly process is finished.

5) ASSEMBLY

(1) After placing angular bearing (617) on housing (601), press the angular bearing (617) using a press.

559A7TM72

※ Assemble the protrusion of the inner ring face down.

559A7TM73

(2) Insert 105ea steel ball (622) into housing (601) and tighten the pipe plug (626).

※ Pipe plug is assembled by wrapping Teflon tape.
After assembling the pipe plug, check if the cloud condition of the angular bearing is smooth.

(3) Assemble the floating seal kit (618) using dedicated jig for casing (202) and housing (601).

559A7TM74

※ Before assembling, check the metal surface of the floating seal for cracks, dents, and O-ring damage.
Do not apply oil to the floating seal rubber part.
After assembling the floating seal, check if there are any deviations.

559A7TM75

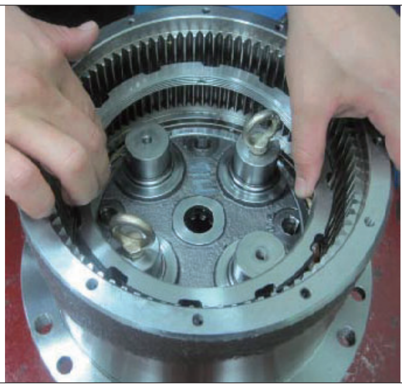
(4) Using a press, assemble the housing sub on the casing (202).

※ Floating seal are located on the same circumference.
Rotate so that the floating seal is in place.

559A7TM68

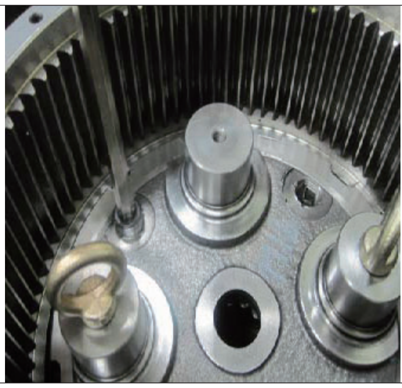
(5) Use the nut ring disassembly jig to assemble the nut ring (604).

※ After tightening, check the gap between casing and housing (0.5 ~1.5 mm) with a gauge.



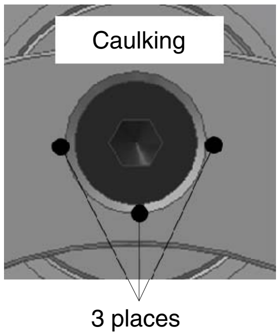
559A7TM66

(6) Tighten pipe plug (625).



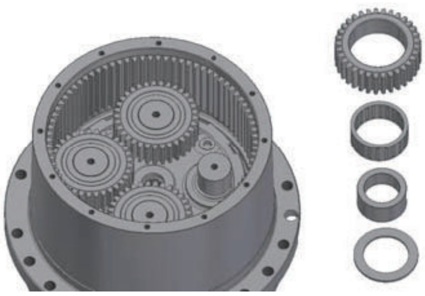
559A7TM65

※ Caulking is performed to prevent loosening around the assembly.



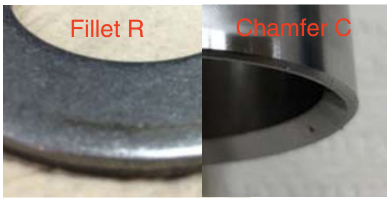
559A7TM76

(7) Assemble the No. 2 holder assy
Assemble in the order of thrust washer (611) → Collar (613) → Needle bearing (615) → Planetary gear F (605)



559A7TM64

※ The thrust washer R part is assembled in the bearing direction and the chamfered part of the collar is assembled in the casing direction.



559A7TM77

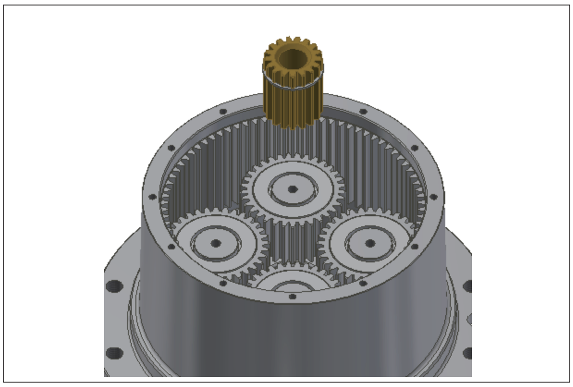
(8) Assemble the thrust plate F (609), ext flush bolt (624).

※ Assemble ext flush bolt by applying loctite in the axial direction.

559A7TM60

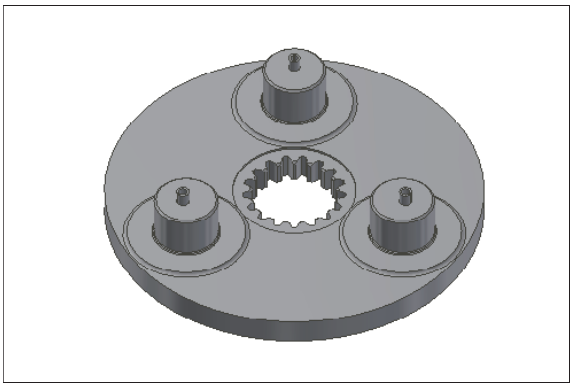
(9) Fasten snap ring (621) to sun gear (607) using snap ring pliers. And assemble in the center of planetary gear F.

※ Assemble R part of snap ring toward cover.
Sun gear is assembled with the long end facing toward casing.



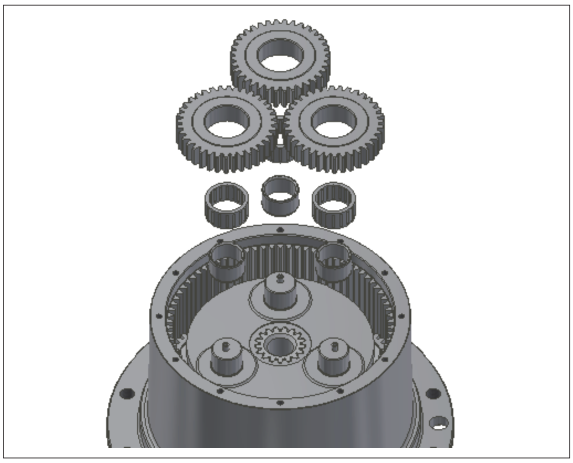
559A7TM78

(10) Assemble the No.1 holder assy.
Assemble spring pin (620) to holder (603).



559A7TM79

(11) Assemble the holder sub to the sun gear (607).
Then, assemble inner race (614) → Needle bearing (616) → planetary gear R.



559A7TM80

※ When assembling planetary gear R, assemble the convex part in the direction of thrust plate R.

※ Check the rotation status.

559A7TM81

(12) Assemble drive gear (608) and thrust plate R (610).

559A7TM55

(13) Assemble the O-ring (619), side plate A (627) and side plate B (628) on the cover (602).

※ After assembling the side plate B, remove any debris from the side.

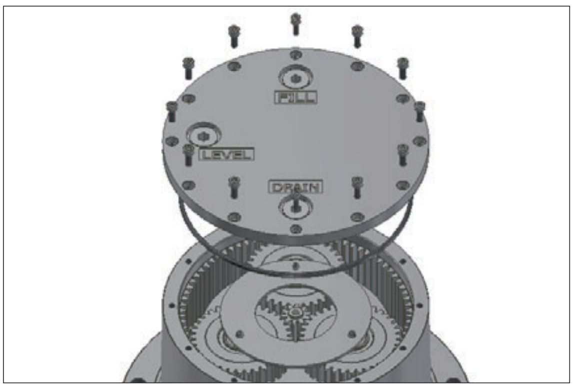
559A7TM82

(14) Assemble cover sub to housing.

559A7TM53

(15) Assemble the socket bolt (623).

※ Assemble by applying loctite in the direction of the socket bolt axis.



559A7TM54

※ The assembly process is finished.

GROUP 7 RCV LEVER

1. REMOVAL AND INSTALL

1) REMOVAL

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

(2) Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

(3) Loosen the breather slowly to release the pressure inside the hydraulic tank.

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

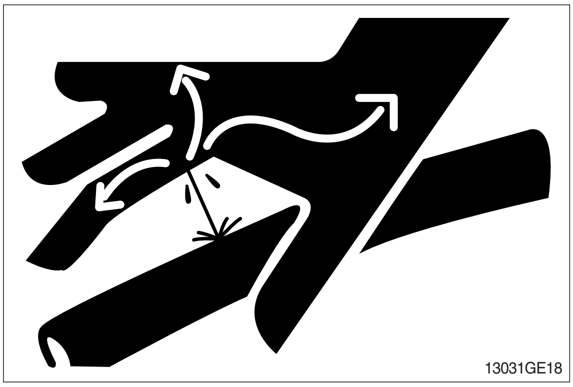
(4) Loosen the socket bolt (1).

(5) Remove the cover of the console box.

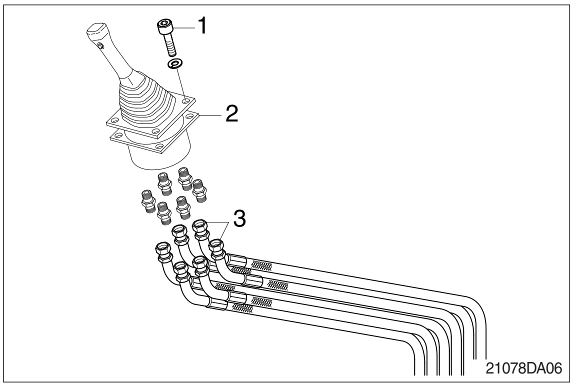
(6) Disconnect pilot line hoses (3).

(7) Remove the pilot valve assembly (2).

※ When removing the pilot valve assembly, check that all the hoses have been disconnected.



13031GE18



21078DA06

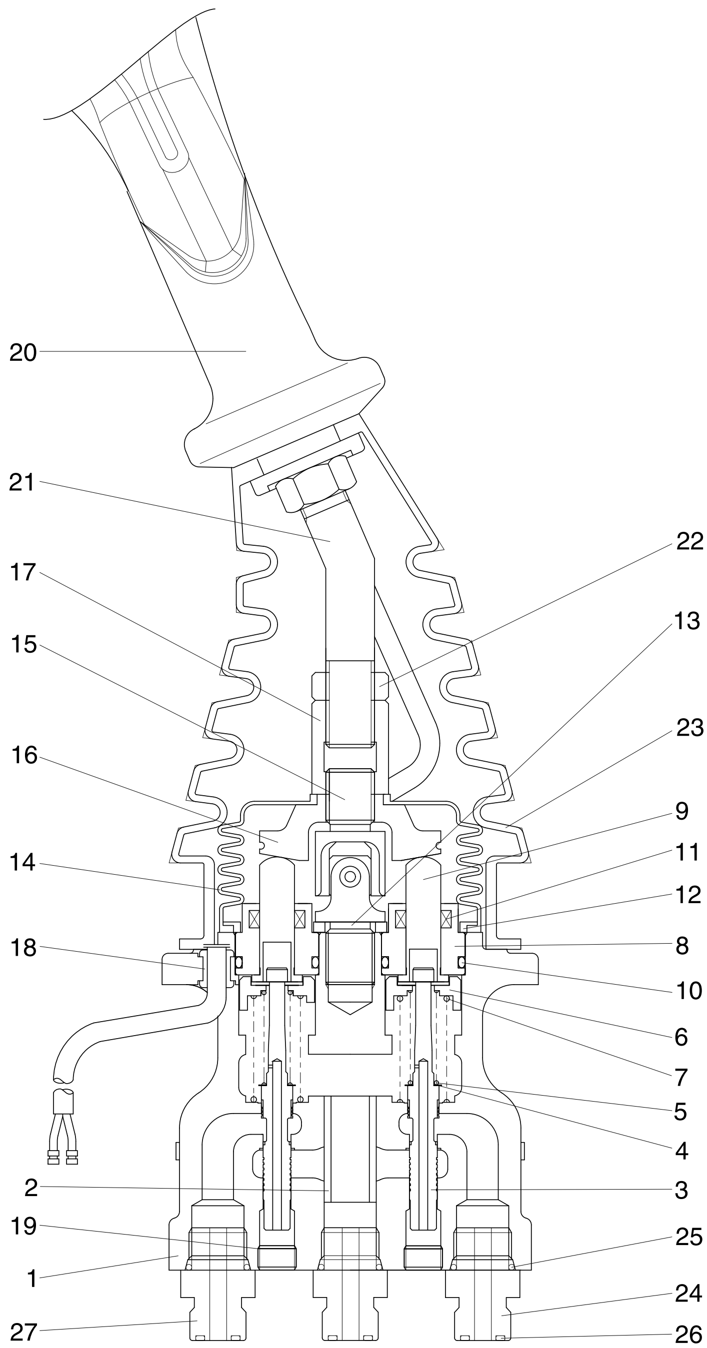
2) INSTALL

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

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

2. DISASSEMBLY AND ASSEMBLY

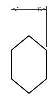
1) STRUCTURE



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

2) TOOLS

(1) Tools

Tool name	Remark	
Allen wrench	6	B 
Spanner	22	
	27	
(+) Driver	Length 150	
(-) Driver	Width 4~5	
Torque wrench	Capable of tightening with the specified torques	

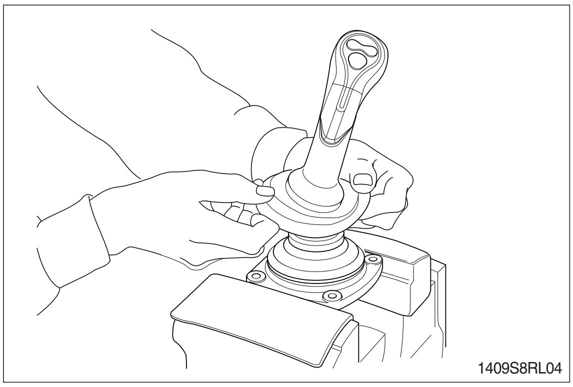
3) DISASSEMBLY

(1) Clean pilot valve with kerosene.

※ Put blind plugs into all ports

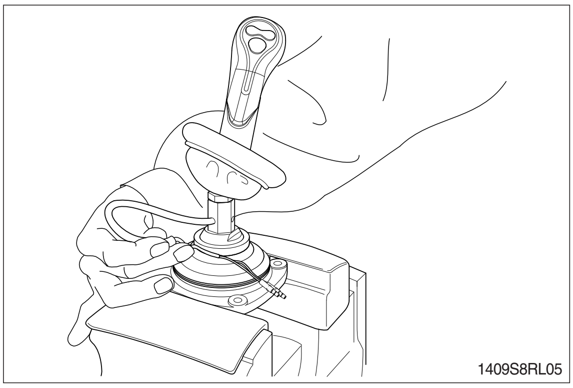
(2) Fix pilot valve in a vise with copper (or lead) sheets.

(3) Remove end of boot (23) from case (1) and take it out upwards.



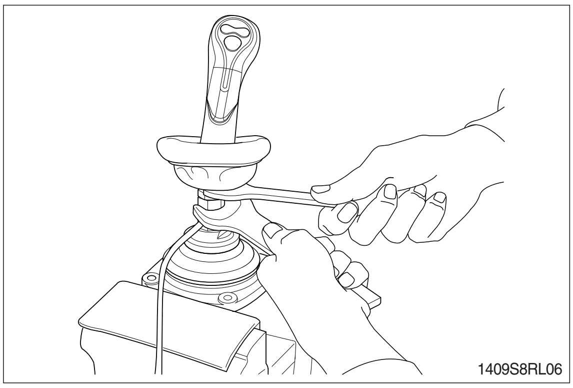
1409S8RL04

※ For valve with switch, remove cord also through hole of casing.



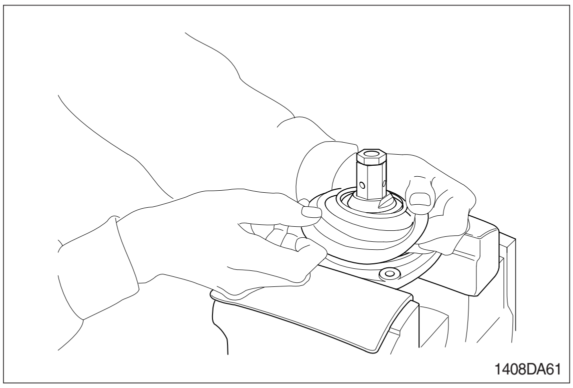
1409S8RL05

(4) Loosen lock nut (22) and adjusting nut (17) with spanners on them respectively, and take out handle section as one body.



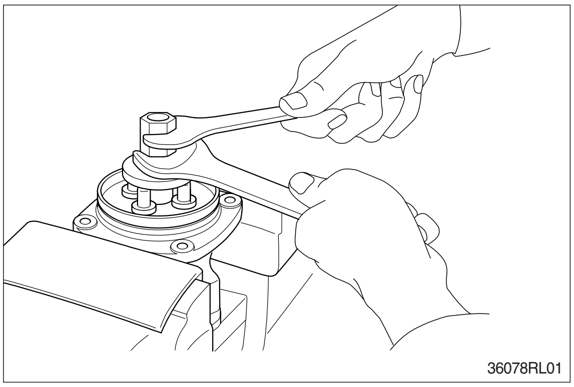
1409S8RL06

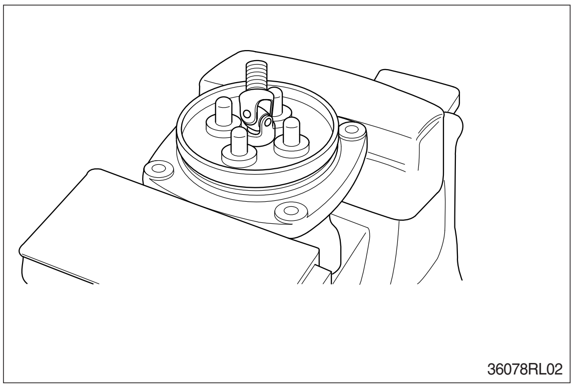
(5) Remove the boot (17).



1408DA61

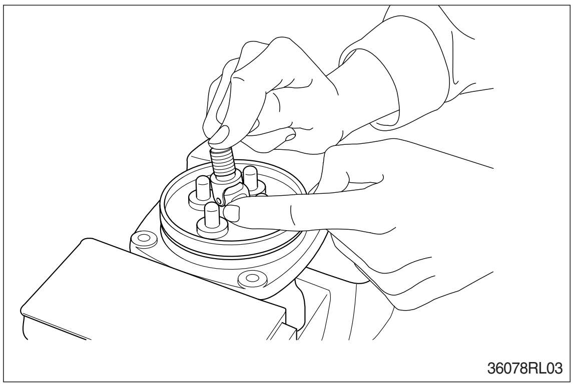
(6) Loosen adjusting nut (17) and swash plate (16) with spanners on them respectively, and remove them.

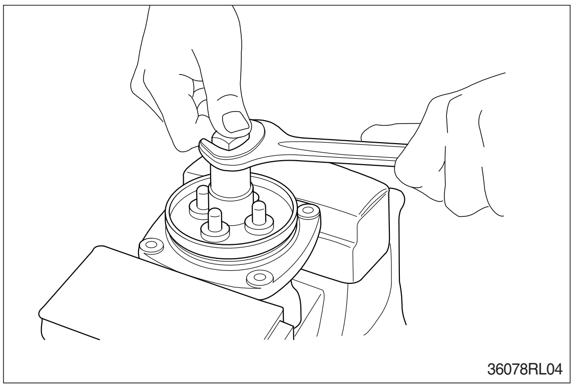




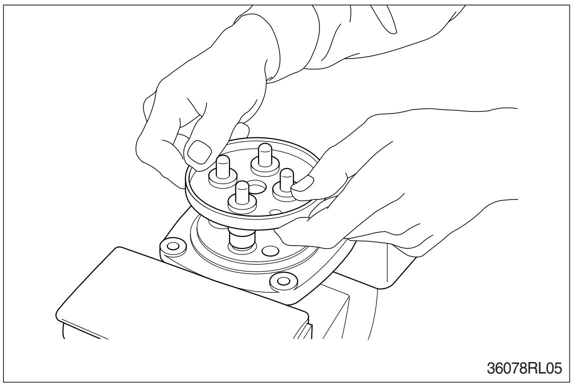
(7) Turn joint anticlockwise to loosen it, utilizing jig (Special tool).

※ When return spring (7) is strong in force, plate (12), plug (8) and push rod (9) will come up on loosening joint.
Pay attention to this.





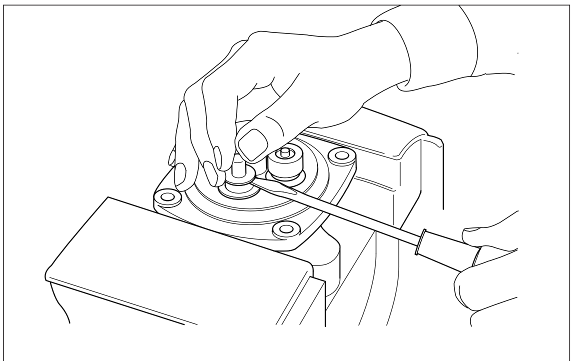
(8) Remove plate (12).


36078RL05

(9) When return spring (7) is weak in force, plug (12) stays in casing because of sliding resistance of O-ring.

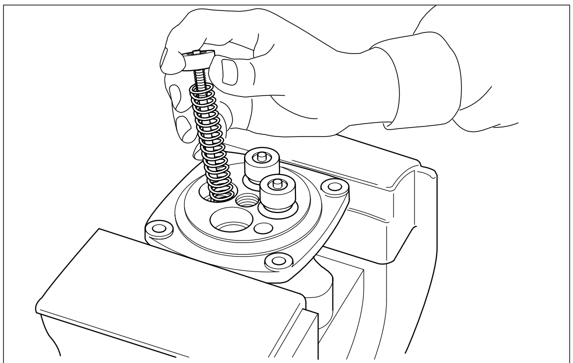
※ Take it out with minus screwdriver. Take it out, utilizing external periphery groove of plug and paying attention not to damage it by partial loading.

※ During taking out, plug may jump up due 7to return spring (9) force. Pay attention to this.


36078RL06

(10) Remove reducing valve subassembly and return spring (7) out of casing.

※ Record relative position of reducing valve subassembly and return springs.

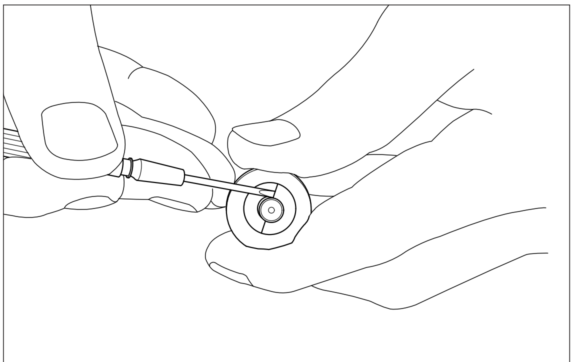

36078RL07

(11) For disassembling reducing valve section, stand it vertically with spool (3) bottom placed on flat workbench. Push down spring seat (6) and remove two pieces of semicircular stopper with tip of small minus screwdriver.

※ Pay attention not to damage spool surface.

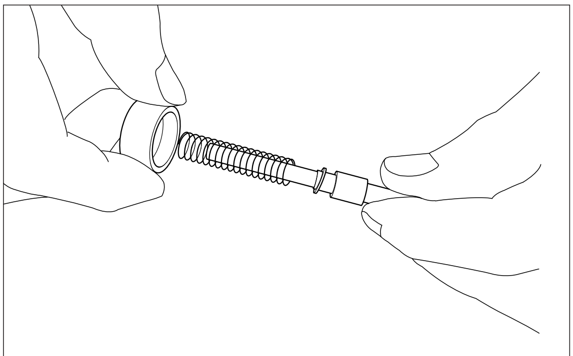
※ Record original position of spring seat (6).

※ Do not push down spring seat more than 6 mm.


36078RL09

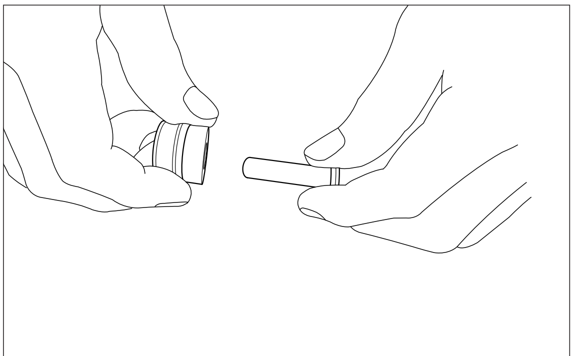
(12) Separate spool (3), spring seat (6), spring (5) and shim (4) individually.

※ Until being assembled, they should be handled as one subassembly group.



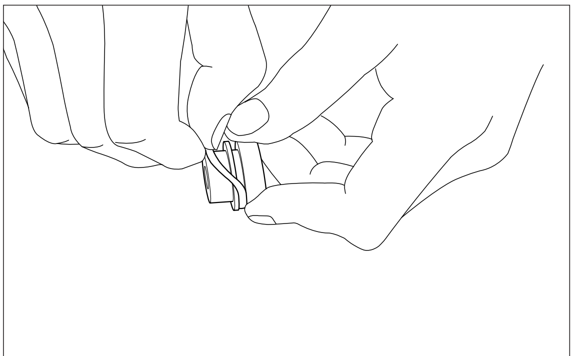
36078RL10

(13) Take push rod (9) out of plug (8).

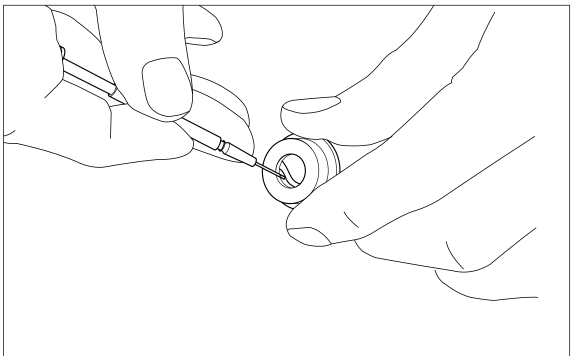


36078RL11

(14) Remove O-ring (10) and seal (11) from plug (8).
Use small minus screwdriver or so on to remove this seal.

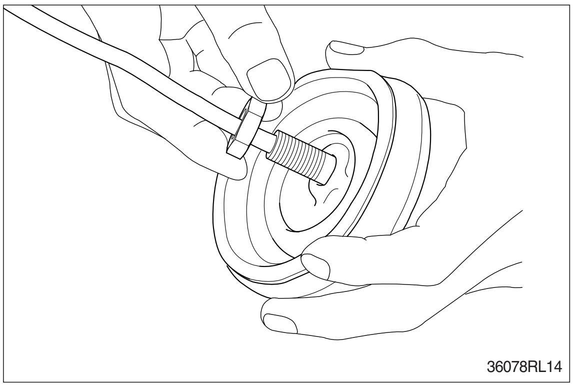


36078RL12

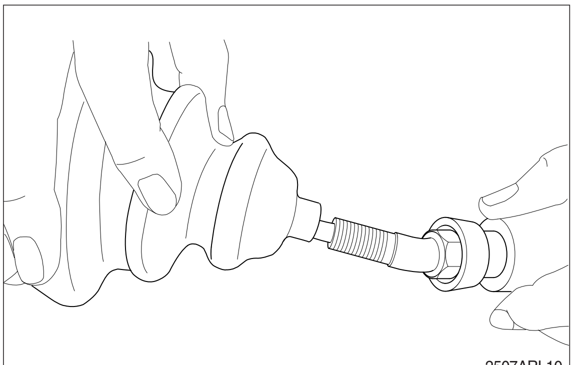


36078RL13

(15) Remove lock nut (22) and then boot (14).



36078RL14



2507ARL10

(16) Cleaning of parts

① Put all parts in rough cleaning vessel filled with kerosene and clean them (rough cleaning).

※ If dirty part is cleaned with kerosene just after putting it in vessel, it may be damaged. Leave it in kerosene for a while to loosen dust and dirty oil.

※ If this kerosene is polluted, parts will be damaged and functions of reassembled valve will be degraded.
Therefore, control cleanliness of kerosene fully.

② Put parts in final cleaning vessel filled with kerosene, turning it slowly to clean them even to their insides (finish cleaning).

※ Do not dry parts with compressed air, since they will be damaged and/or rusted by dust and moisture in air.

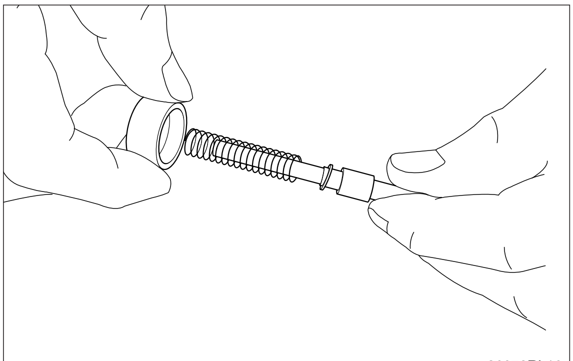
(17) Rust prevention of parts.

Apply rust-preventives to all parts.

※ If left as they after being cleaned, they will be rusted and will not display their functions fully after being reassembled.

4) ASSEMBLY

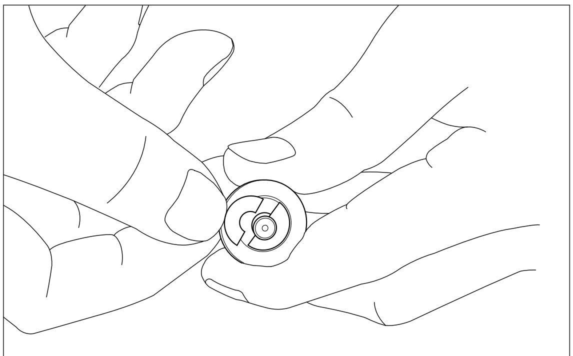
(1) Put shim (4), springs (5) and spring seat (6) onto spool (3) in this order.



36078RL16

(2) Stand spool vertically with its bottom placed on flat workbench, and with spring seat pushed down, put two pieces of semicircular stopper on spring seat without piling them on.

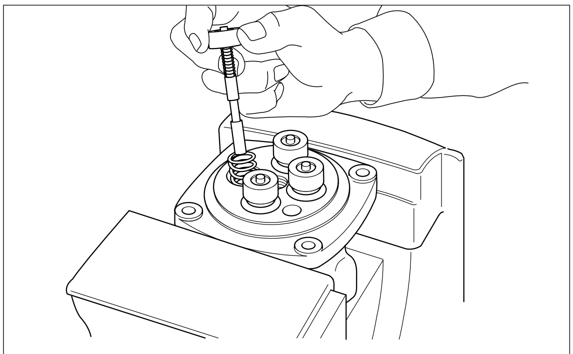
※ Assemble stopper so that its sharp edge side will be caught by head of spool.
Do not push down spring seat more than 6 mm.



36078RL17

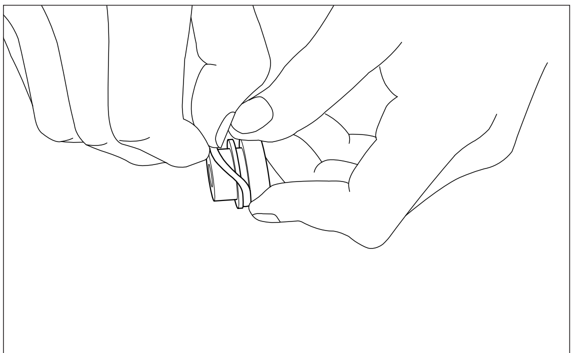
(3) Assemble spring (7) into casing (1).
Assemble reducing valve subassembly into casing.

※ Assemble them to their original positions.



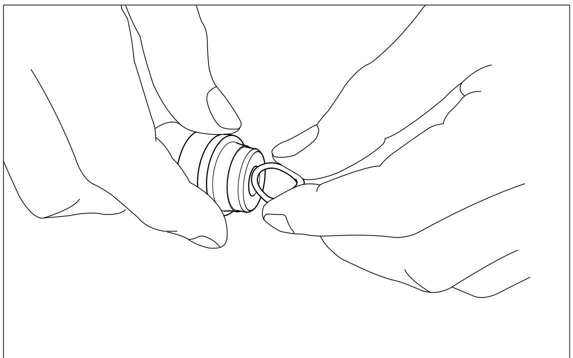
36078RL18

(4) Assemble O-ring (10) onto plug (8).



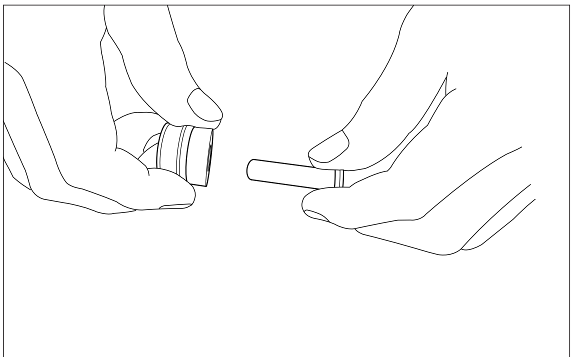
36078RL19

(5) Assemble seal (11) to plug (8).
※ Assemble seal in such lip direction as shown below.



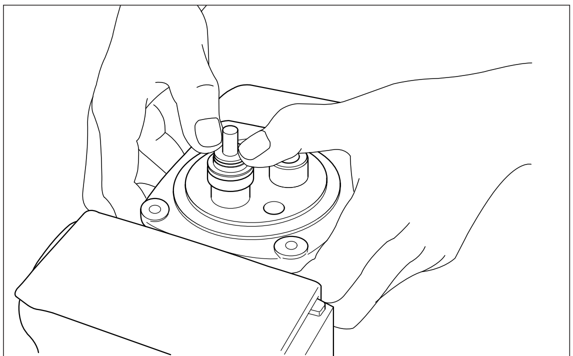
36078RL20

(6) Assemble push rod (9) to plug (8).
※ Apply working oil on push-rod surface.



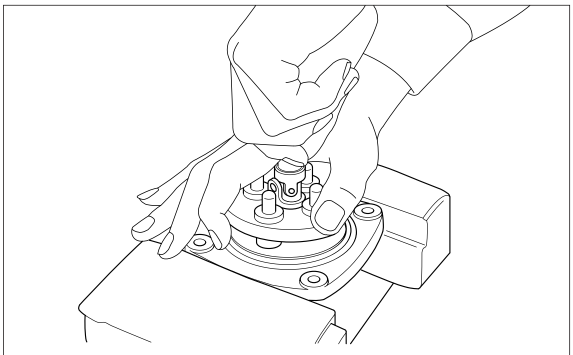
36078RL21

(7) Assemble plug subassembly to casing.
※ When return spring is weak in force, subassembly stops due to resistance of O-ring.



36078RL22

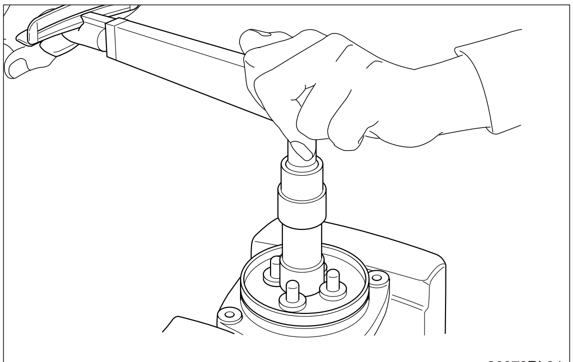
(8) When return spring is strong in force, assemble 4 sets at the same time, utilizing plate (12), and tighten joint (15) temporarily.



36078RL23

(9) Fit plate (12).

(10) Tighten joint (15) with the specified torque to casing, utilizing jig.

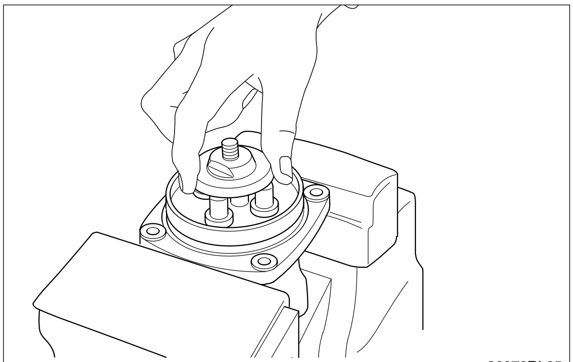


36078RL24

(11) Assemble swash plate (16) to joint (15).

※ Screw it to position that it contacts with 4 push rods evenly.

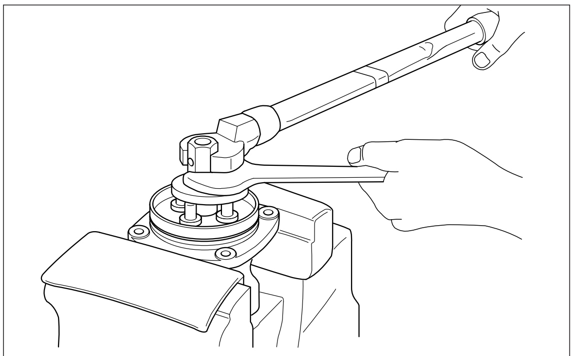
※ Do not screw it over.



36078RL25

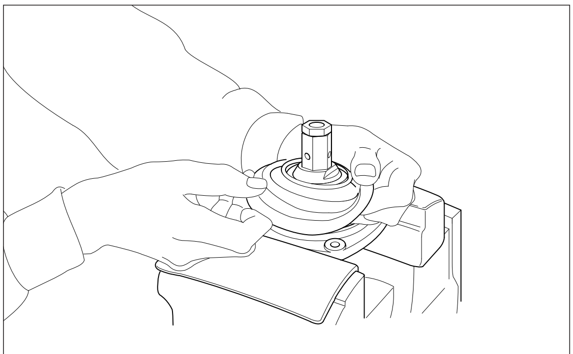
(12) Assemble adjusting nut (22), apply spanner to width across flat of plate (16) to fix it, and tighten adjusting nut to the specified torque.

※ During tightening, do not change position of disk.



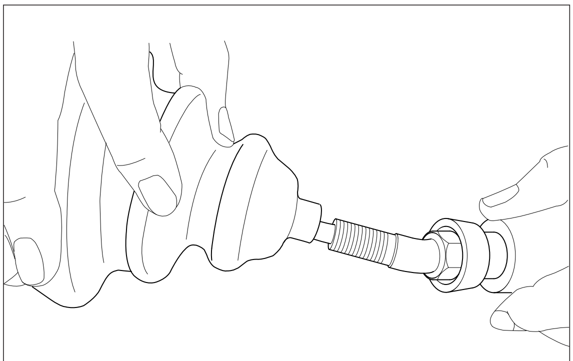
36078RL26

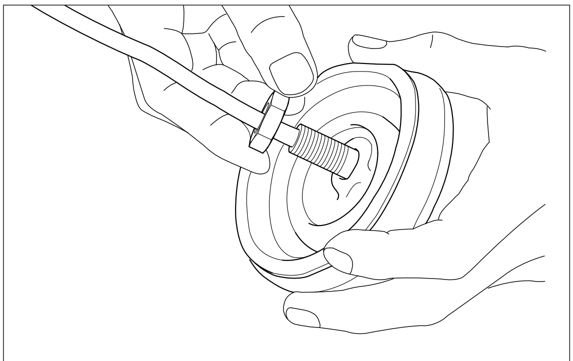
(13) Fit boot (23) to plate.



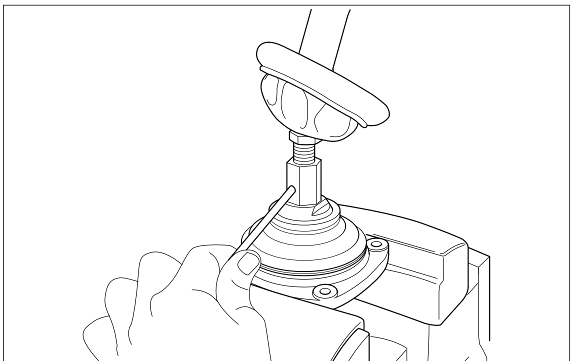
1408DA61

(14) Fit boot (23) and lock nut (22), and handle subassembly is assembled completely.


2507ARL10

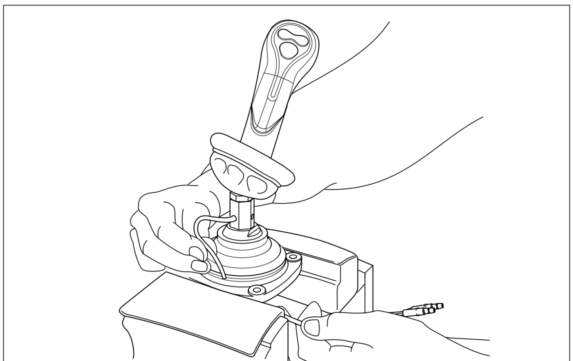

36078RL27

(15) Pull out cord and tube through adjusting nut hole provided in direction 60˚ to 120˚ from casing hole.

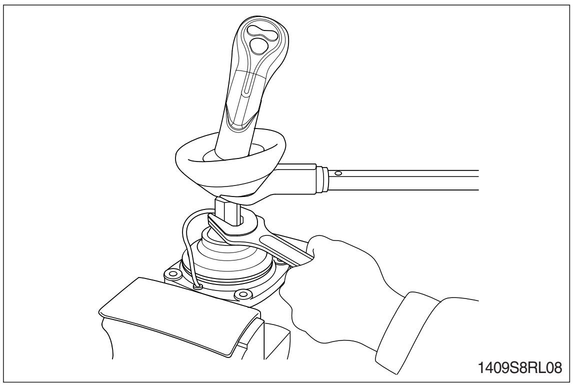

1408DA66

(16) Assemble bushing (18) to plate and pass cord and tube through it.

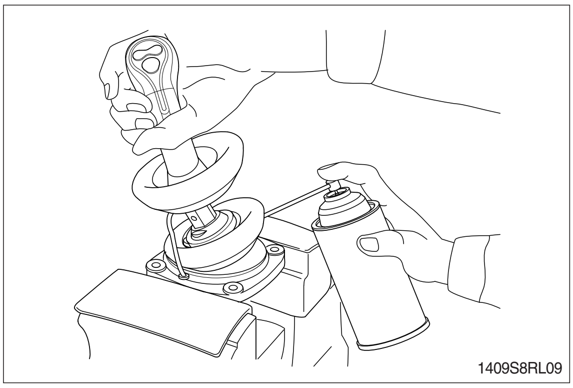
※ Provide margin necessary to operation.


1409S8RL07

(17) Determine handle direction, tighten lock nut (22) to specified torque to fix handle.

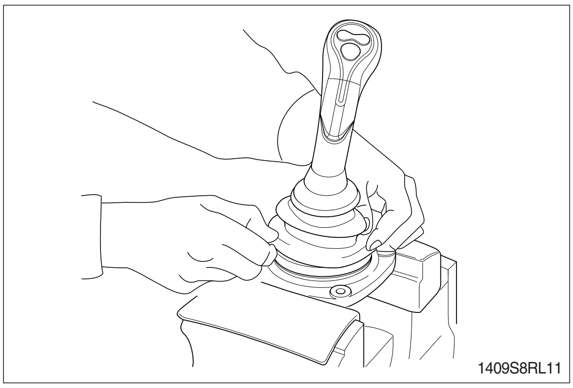

1409S8RL08

(18) Apply grease to rotating section of joint and contacting faces of disk and push rod.


1409S8RL09

(19) Assemble lower end of bellows to casing.

(20) Inject volatile rust-preventives through all ports and then put blind plugs in ports.


1409S8RL11

GROUP 8 TURNING JOINT

1. REMOVAL AND INSTALL

1) REMOVAL

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

(2) Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

(3) Loosen the breather slowly to release the pressure inside the hydraulic tank.

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

※ When pipes and hoses are disconnected, the oil inside the piping will flow out, so catch it in oil pan.

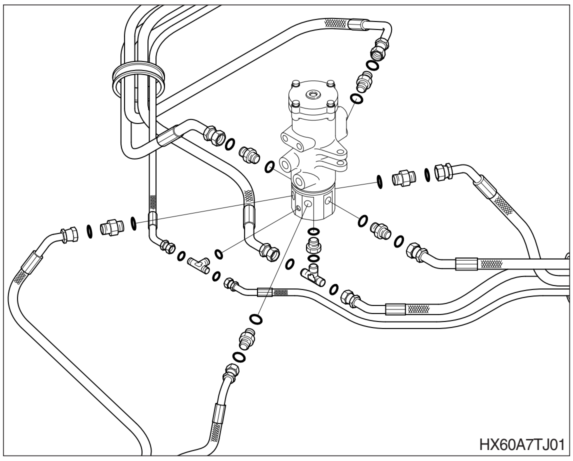

13031GE18

(4) Disconnect all hoses.

(5) Sling the turning joint assembly (1) and remove the mounting bolt (2).

· Weight : 30 kg (70 lb)

· Tightening torque : 12.8±3.0 kgf · m (92.6±21 lbf · ft)


HX60A7TJ01

(6) Remove the turning joint assembly.

※ When removing the turning joint, check that all the hoses have been disconnected.

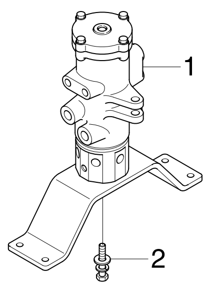
2) INSTALL

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

※ Take care of turning joint direction.

※ Assemble hoses to their original positions.

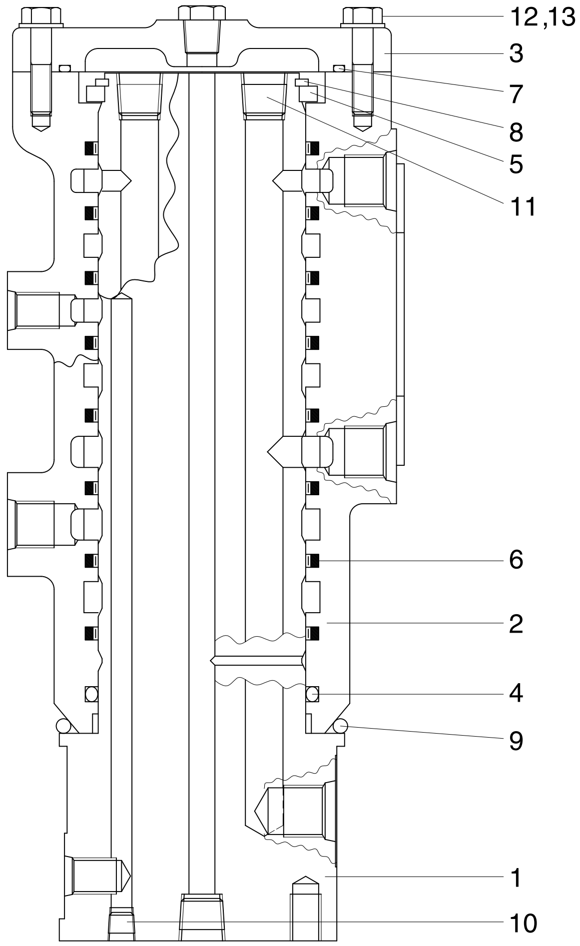
※ Confirm the hydraulic oil level and check the hydraulic oil leak or not.



R5577TJ02

2. DISASSEMBLY AND ASSEMBLY

1) STRUCTURE



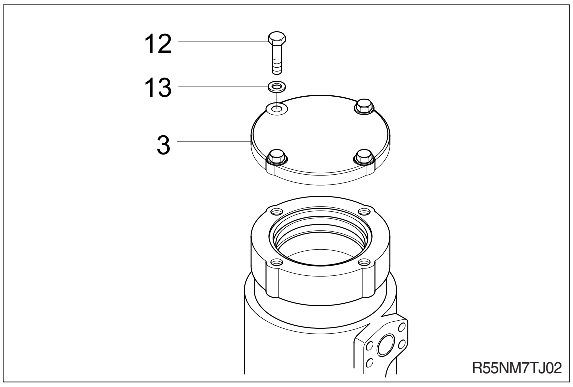
HX60A7TJ03

1	Shaft	6	Slipper seal	11	Plug
2	Rotor	7	O-ring	12	Hexagon bolt
3	Cover	8	Retainer ring	13	Spring washer
4	O-ring	9	O-ring		
5	Ring	10	Plug		

2) DISASSEMBLY

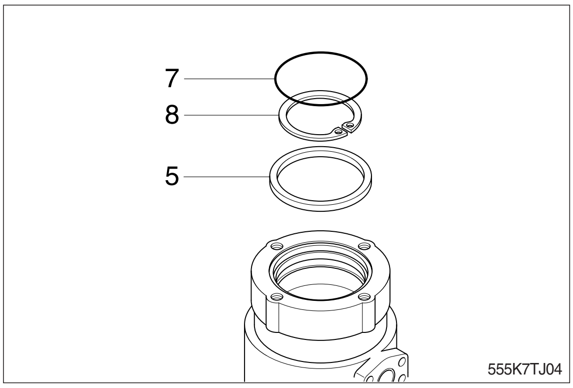
※ Before the disassembly, clean the turning joint.

(1) Remove bolts (12), washer (13) and cover (3).



(2) Remove O-ring (7).

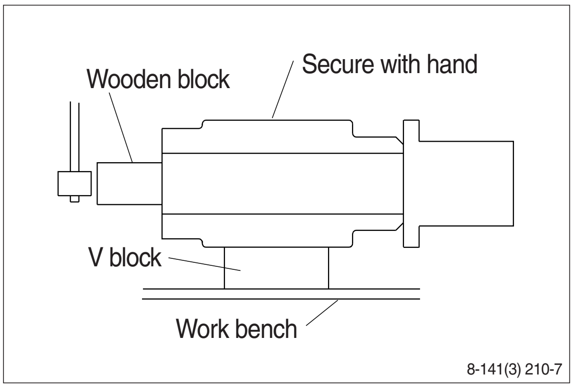
(3) Remove retainer ring (8) and ring (5).



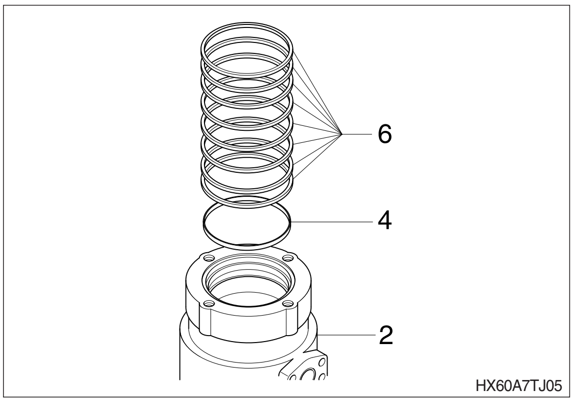
(4) Place hub (1) on a V-block and by using a wood buffer at the shaft end, hit out shaft (2) to about 1/2 from the body with a hammer.

※ Take care not to damage the shaft (2) when remove hub (1) or rest it sideway.

※ Put a fitting mark on hub (1) and shaft (2).



(5) Remove eight slipper seals (6) and O-ring (4) from rotor (2).



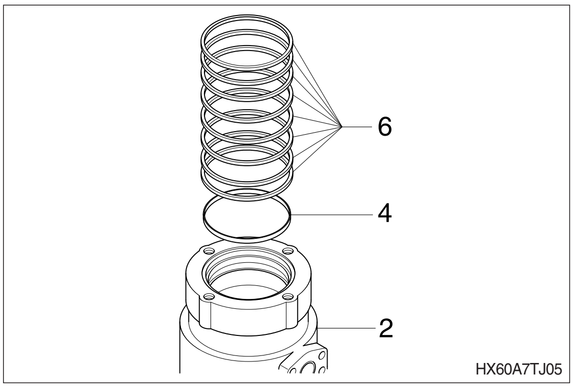
3) ASSEMBLY

※ Clean all parts.

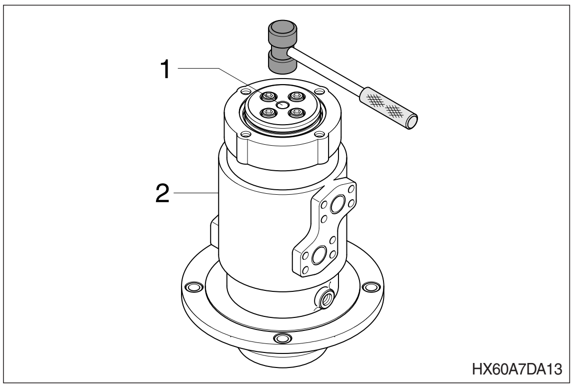
※ As a general rule, replace oil seals and O-ring.

※ Coat the sliding surfaces of all parts with engine oil or grease before installing.

(1) Fix eight slipper seal (6) and O-ring (4) to rotor (2).

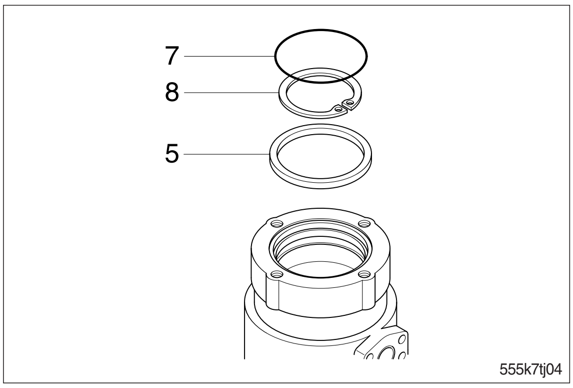


(2) Set shaft (1) on block, tap rotor (2) with a plastic hammer to install.



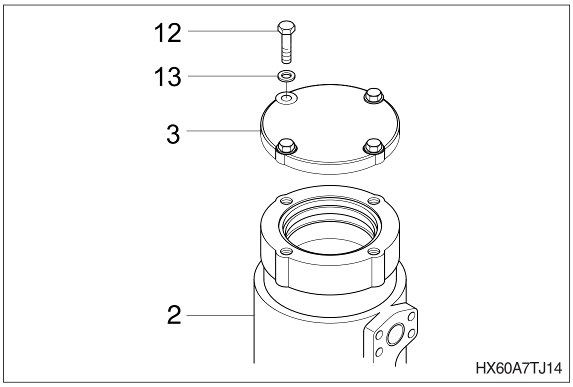
(3) Ring (5) and retainer ring (8) to shaft (1).

(4) Fit O-ring (7) to rotor (2).



(5) Install cover (3) to rotor (2) and tighten bolts (12) with washer (13).

· Tightening torque : 3.4 ± 0.7 kgf · m
(24.6 ± 5.1 lbf · ft)



GROUP 9 BOOM, ARM AND BUCKET CYLINDERS

1. REMOVAL AND INSTALL

1) BUCKET CYLINDER

(1) Removal

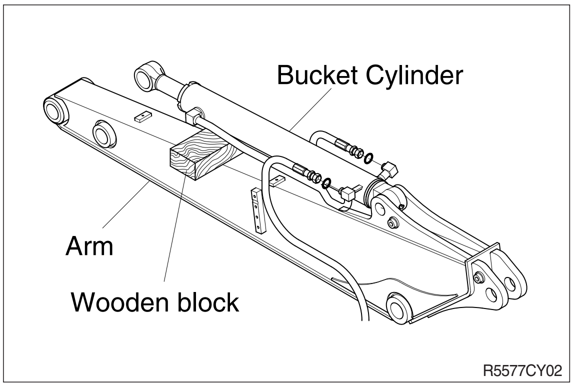
※ Expand the arm and bucket fully, lower the work equipment to the ground and stop the engine.

※ Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

⚠ Loosen the breather slowly to release the pressure inside the hydraulic tank. Escaping fluid under pressure can penetrate the skin causing serious injury.

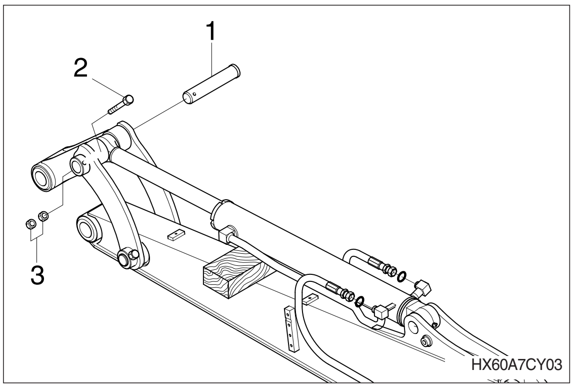
※ Fit blind plugs in the hoses after disconnecting them, to prevent dirt or dust from entering.

① Set block between bucket cylinder and arm.

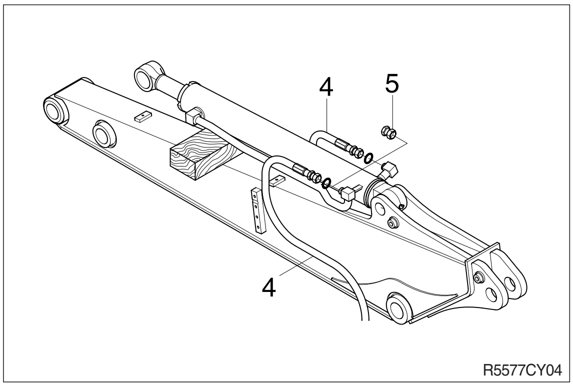


② Remove bolt (2), nut (3) and pull out pin (1).

※ Tie the rod with wire to prevent it from coming out.



③ Disconnect bucket cylinder hoses (4) and put plugs (5) on cylinder pipe.

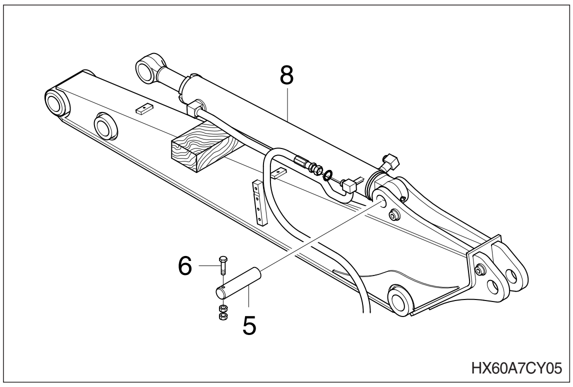


④ Sling bucket cylinder assembly (8) and remove bolt (6) then pull out pin (5).

⑤ Remove bucket cylinder assembly (8).

· Weight : 34 ㎏ (75 ℔)

· Tightening torque : 12.8±3.0 kgf · m (92.6±21.7 lbf · ft)



(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

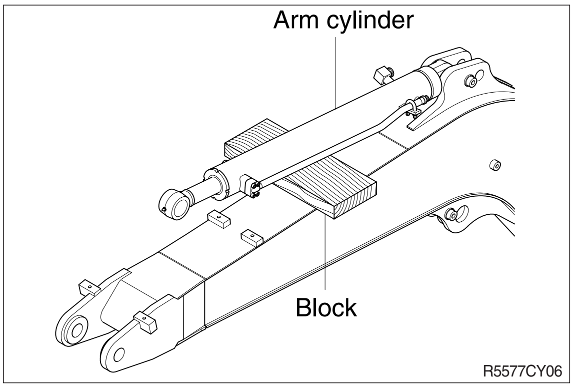
※ Expand the arm and bucket fully, lower the work equipment to the ground and stop the engine.
※ Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

⚠ 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.

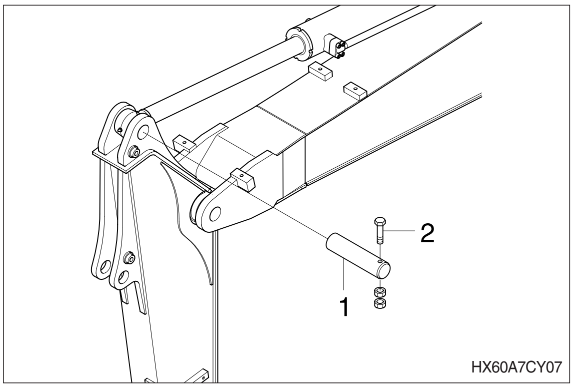
① Set block between arm cylinder and boom.



② Remove bolt (2) and pull out pin (1).

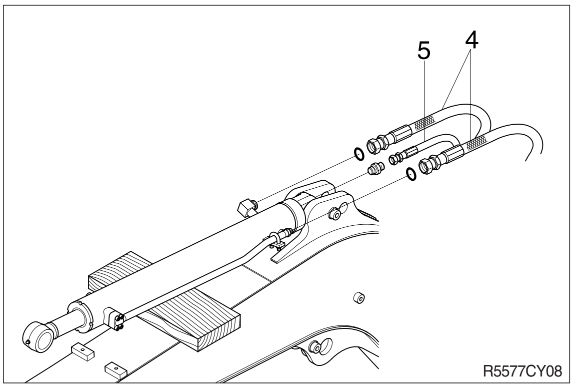
※ Tie the rod with wire to prevent it from coming out.

· Tightening torque : 12.8±3.0 kgf · m
(92.6±21.7 lbf · ft)



③ Disconnect arm cylinder hoses (4) and put plugs on cylinder pipe.

④ Disconnect greasing pipings (5).

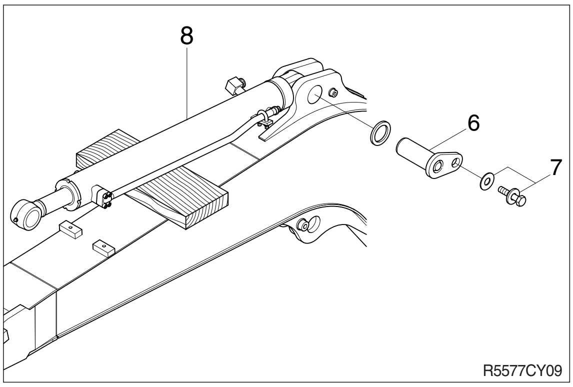


⑤ Sling arm assembly (8) and remove bolt (7) then pull out pin (6).

⑥ Remove arm cylinder assembly (8).

· Weight : 56 kg (123 lb)

· Tightening torque : 12.8 ± 3.0 kgf · m (92.6 ± 21.7 lbf · ft)



(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.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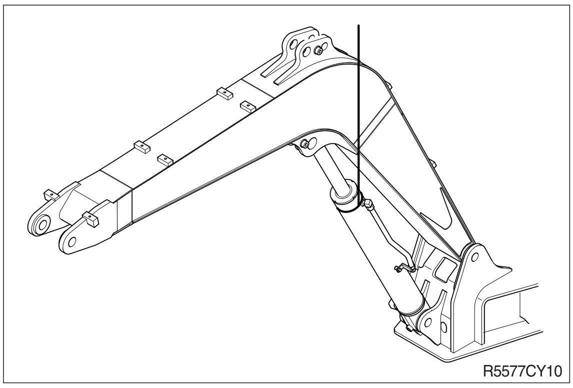
⚠ **Loosen the breather slowly to release the pressure inside the hydraulic tank.**

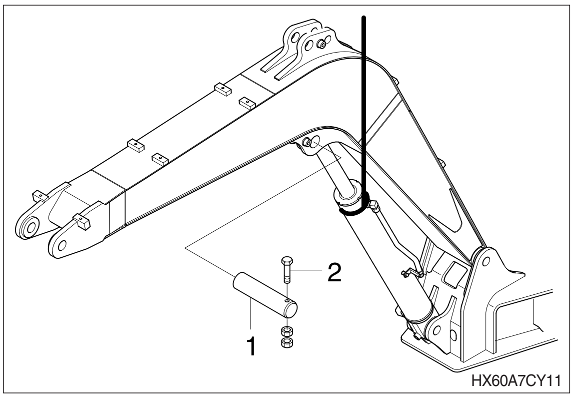
⚠ **Escaping fluid under pressure can penetrate the skin causing serious injury.**

※ 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.

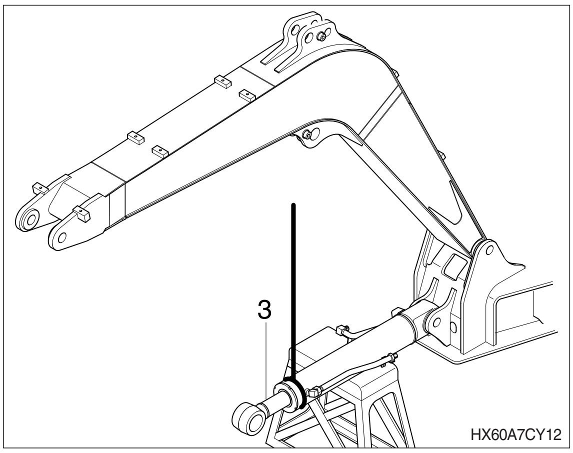

R5577CY10

③ Remove bolt (2) and pull out pin (1).
※ Tie the rod with wire to prevent it from coming out.
· Tightening torque : 12.8±3.0 kgf · m (92.6±21.7 lbf · ft)



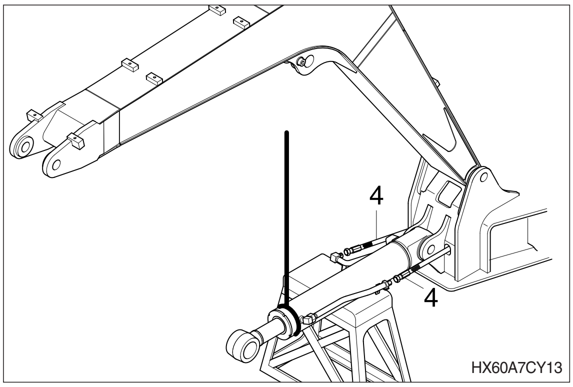
HX60A7CY11

④ Lower the boom cylinder assembly (3) on a stand.



HX60A7CY12

⑤ Disconnect boom cylinder hoses (4) and put plugs on cylinder pipe.

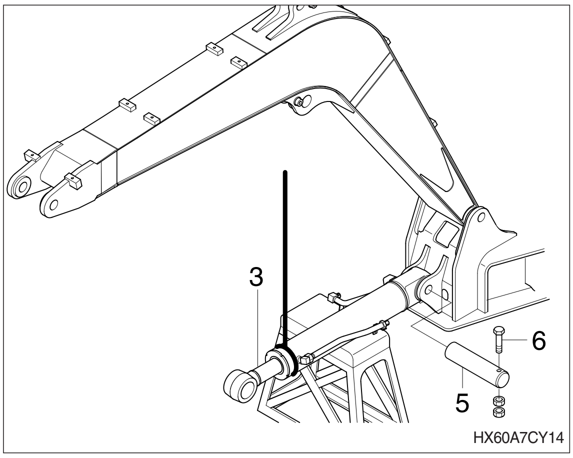


⑥ Remove bolt (6) and pull out pin (5).

⑦ Remove boom cylinder assembly (3).

· Weight : 64 kg (141 lb)

· Tightening torque : 12.8 ± 3.0 kgf · m (92.6 ± 21.7 lbf · ft)



(2) Install

① Carry out installation in the reverse order to removal.

▲ **When aligning the mounting position of the pin, do not insert your fingers in the pin hole.**

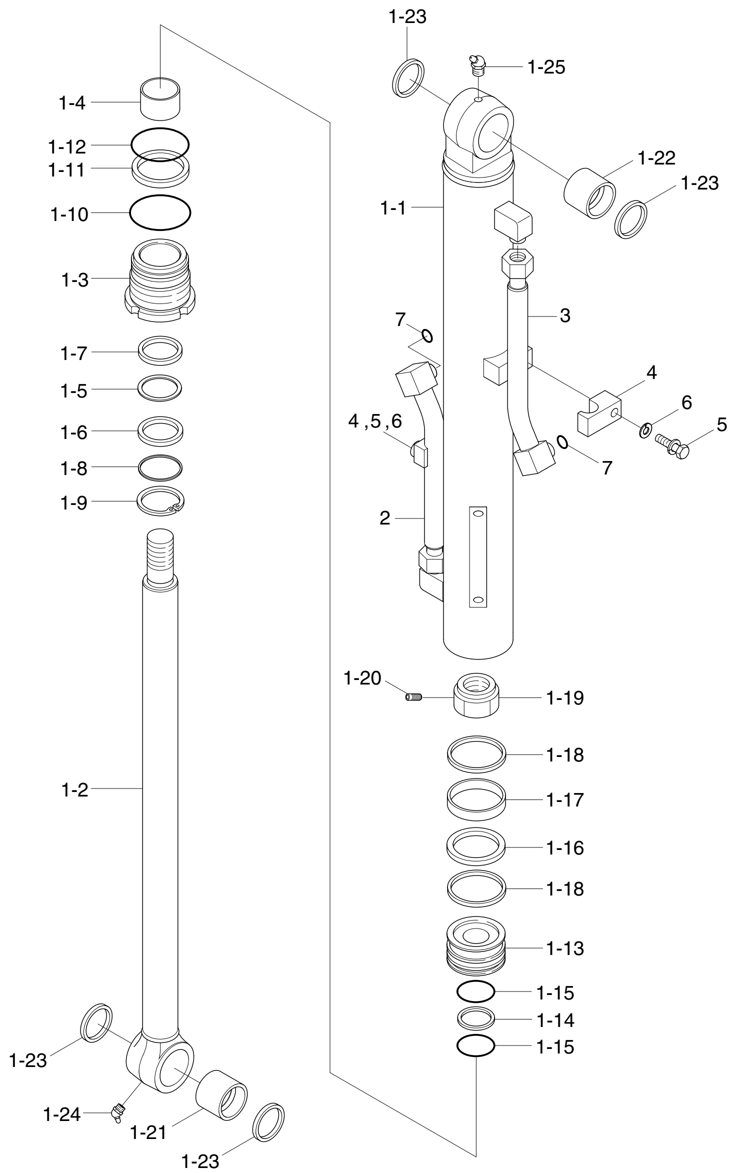
※ Bleed the air from the boom cylinder.

※ Conformed the hydraulic oil level and check the hydraulic oil leak or not.

2. DISASSEMBLY AND ASSEMBLY

1) STRUCTURE

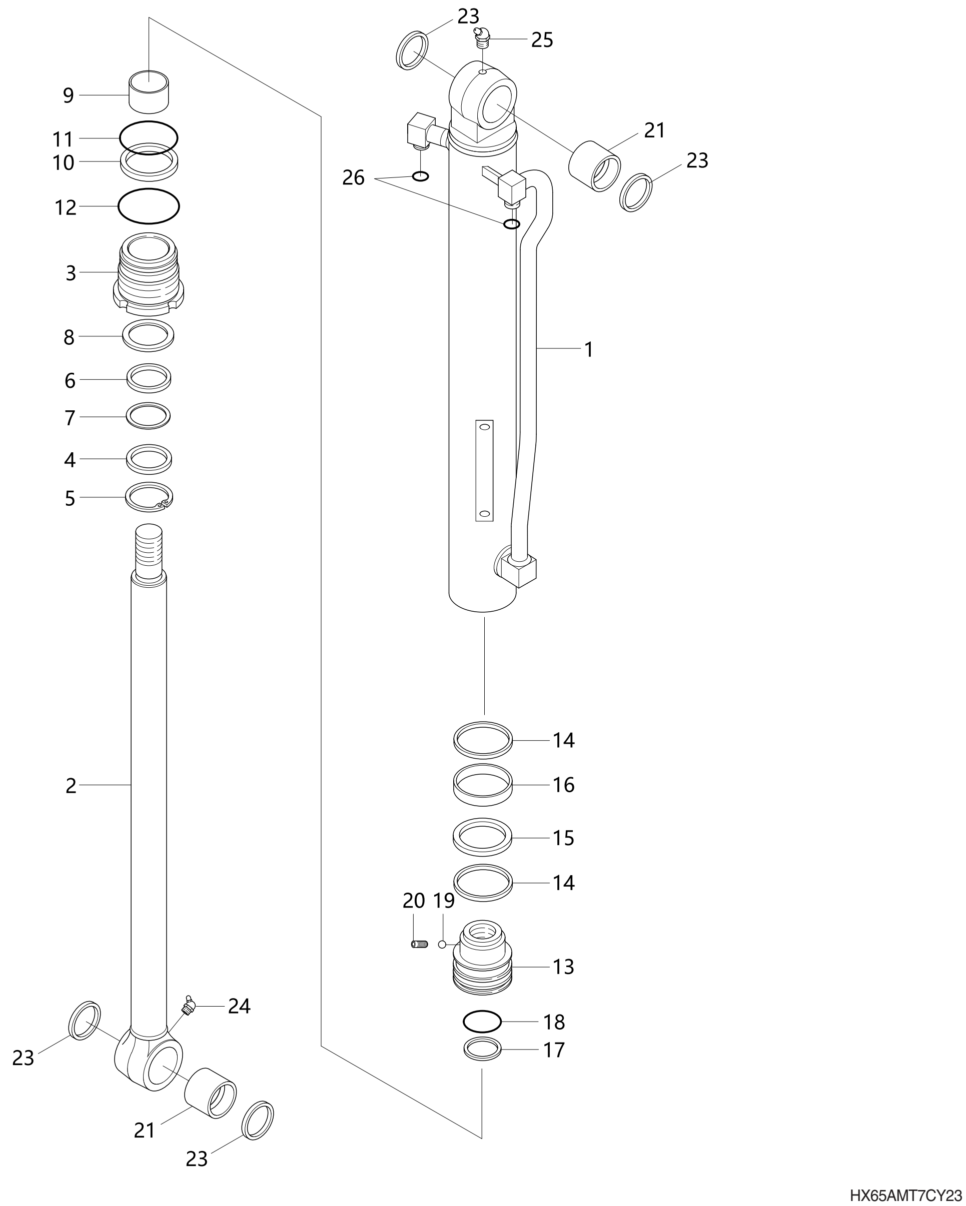
(1) Bucket cylinder (CHANGZHOU)



HX65AMT7CY22

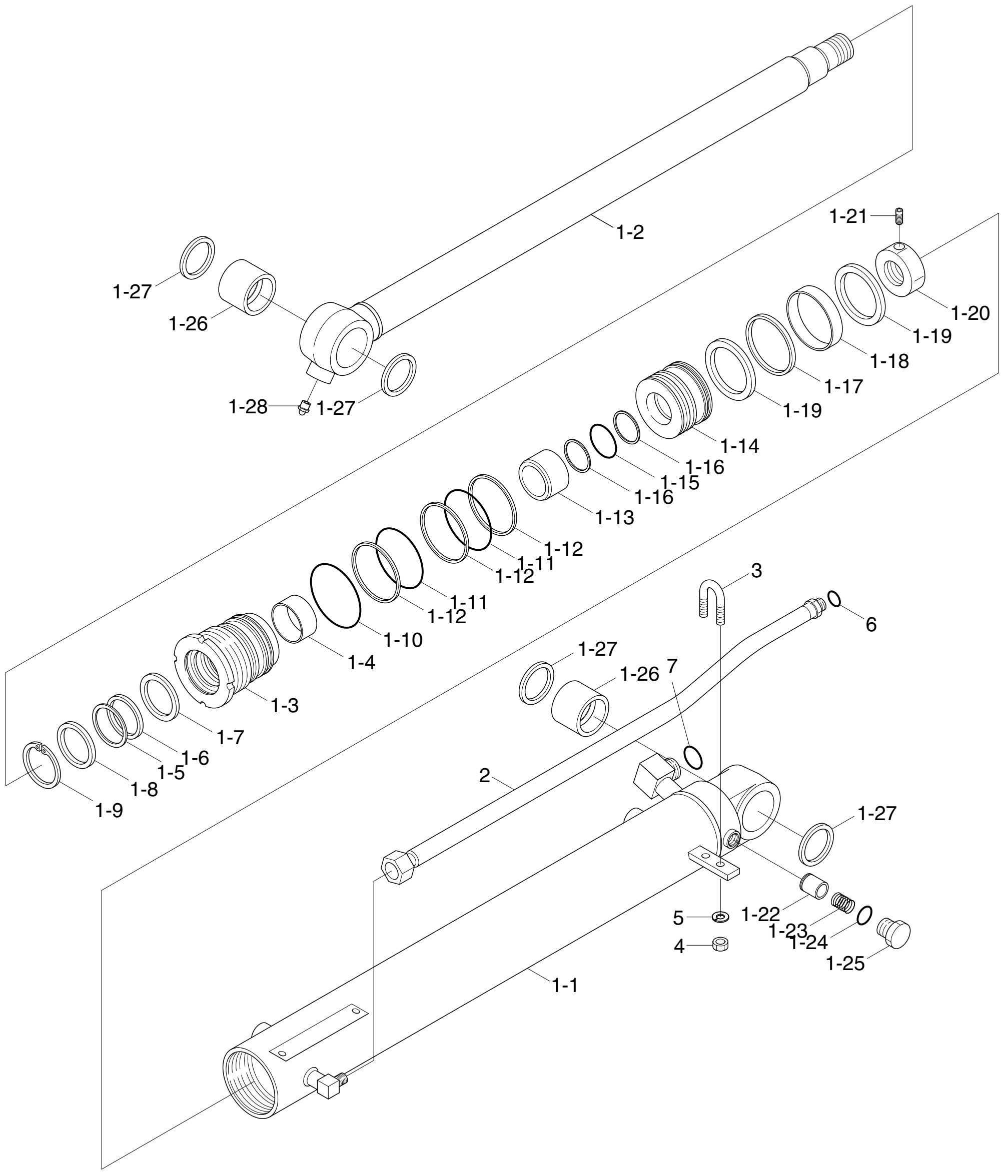
1	Tube assembly	12	Dust seal	23	Dust seal
2	Rod	13	Piston	24	Pipe (B)
3	Grand	14	O-ring	25	Pipe (R)
4	Du bushing	15	Back-up ring	26	Clamp
5	Rod seal	16	Piston seal	27	Bolt
6	Rod bushing	17	Wear ring	28	Spring washer
7	Back-up ring	18	Dust ring	29	Grease nipple
8	Dust wiper	19	Lock nut	30	Grease nipple
9	Snap ring	20	Set screw	31	O-ring seal
10	O-ring	21	Bushing		
11	O-ring	22	Bushing		

Bucket cylinder (SH PAC)



1	Tube assembly	10	O-ring	19	Ball
2	Rod	11	Ring	20	Bolt
3	Grand	12	O-ring	21	Bushing
4	Dust seal	13	Piston	23	Dust seal
5	Retaining ring	14	Dust ring	24	Grease nipple
6	Rod seal	15	Piston seal	25	Grease nipple
7	Ring	16	Ring	26	O-ring
8	Buffer ring	17	O-ring		
9	Bushing	18	O-ring		

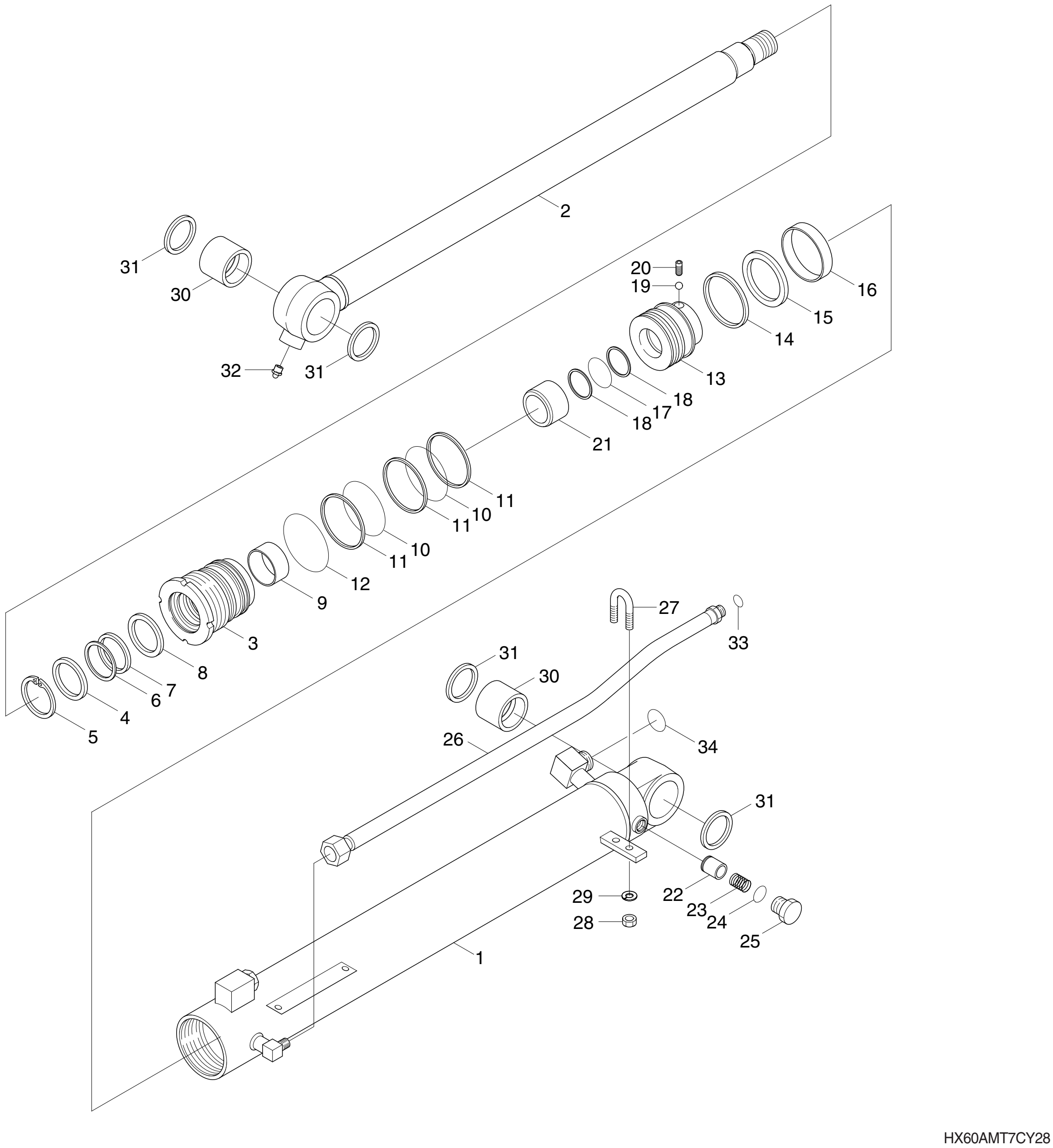
(2) Arm cylinder (CHANGZHOU)



HX65AMT7CY27

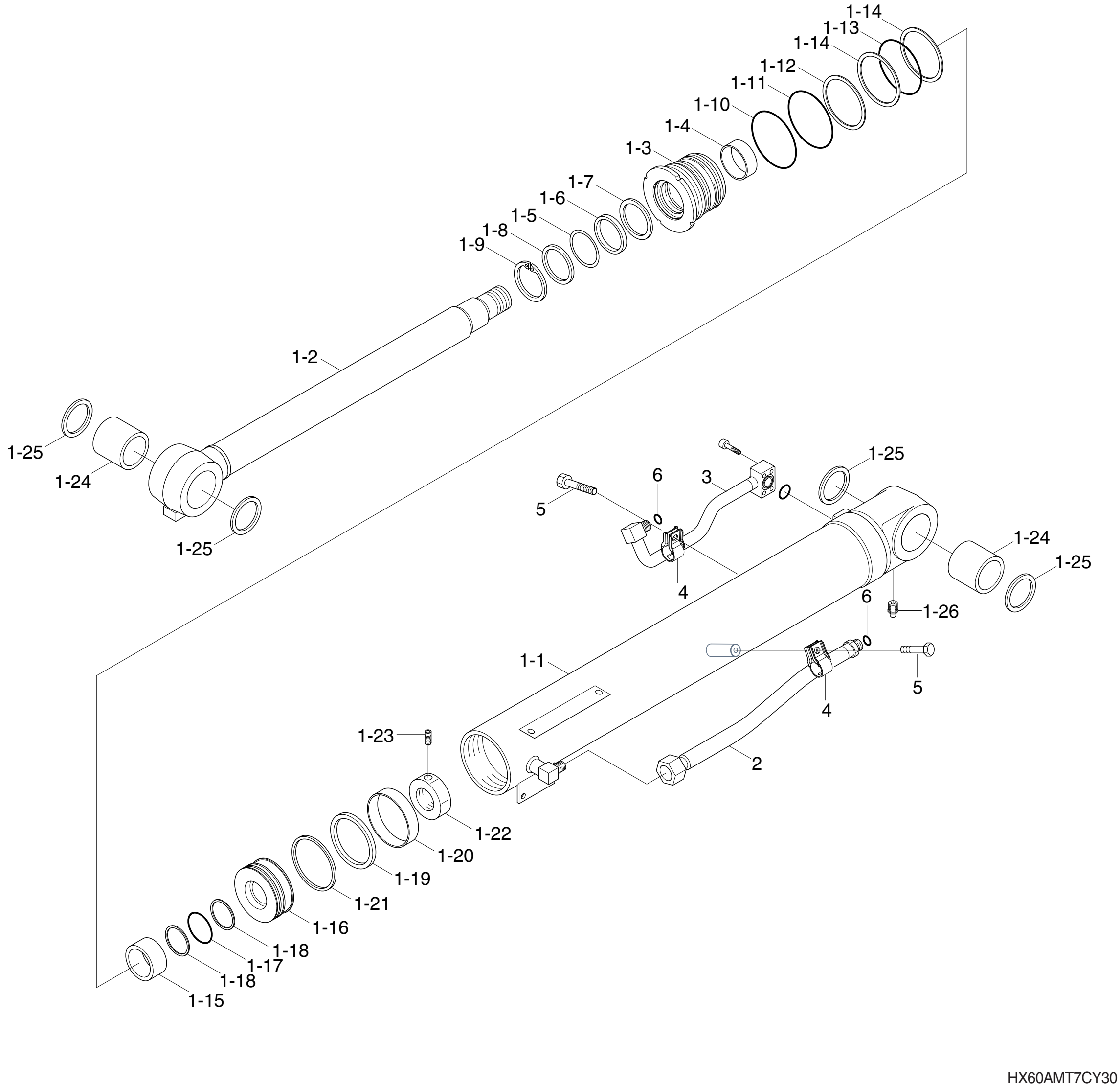
1	Tube assembly	12	Back-up ring	23	Coil spring
2	Rod	13	Cushion ring	24	O-ring
3	Grand	14	Piston	25	Plug
4	Du bushing	15	O-ring	26	Bushing
5	Rod seal	16	Back-up ring	27	Dust seal
6	Back-up ring	17	Piston seal	28	Pipe (R)
7	Buffer ring	18	Wear ring	29	U-bolt
8	Dust wiper	19	Dust ring	30	Nut
9	Snap ring	20	Lock nut	31	Spring washer
10	O-ring	21	Set screw	32	Grease nipple
11	O-ring	22	Check valve	33	O-ring seal
				34	O-ring seal

Arm cylinder (SH PAC)



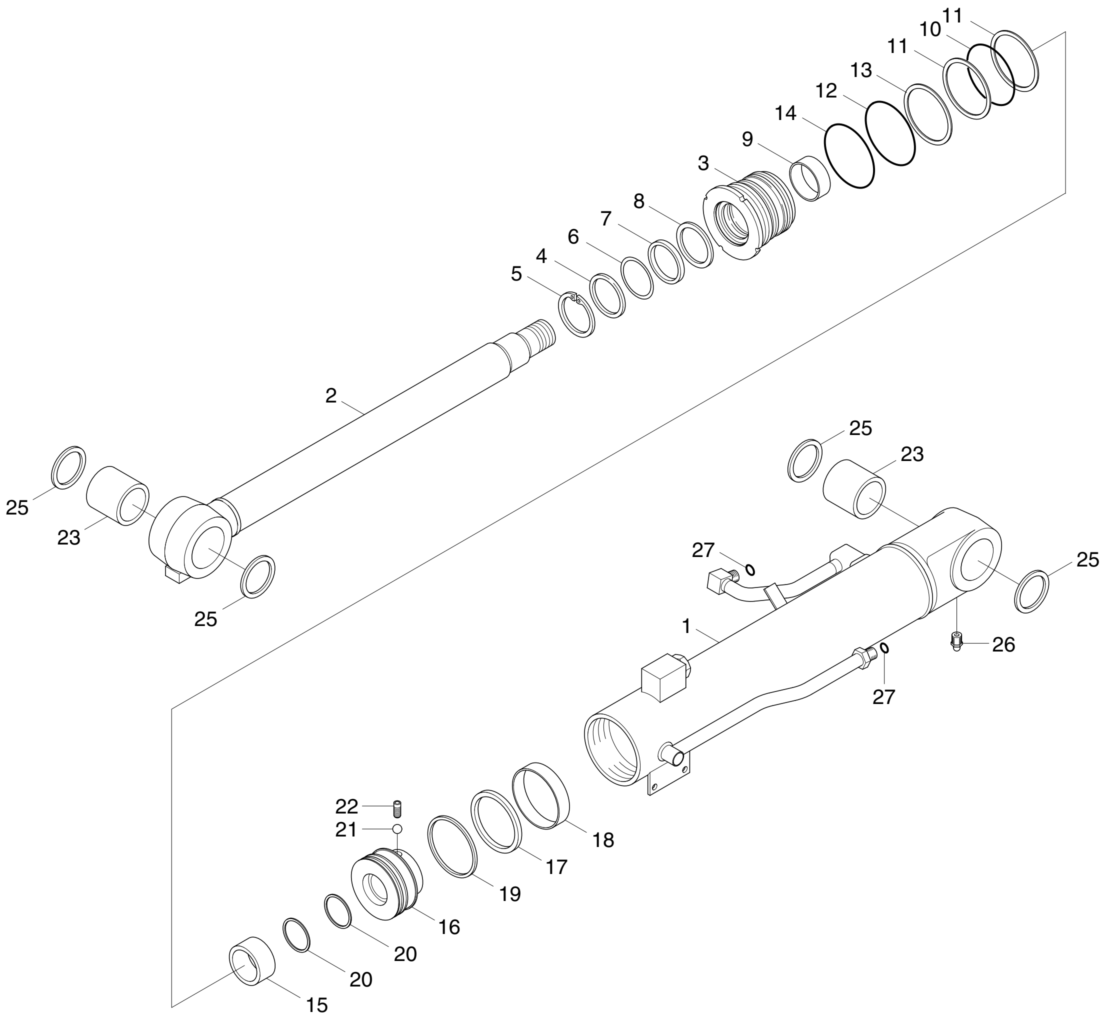
1	Tube assembly	13	Piston	25	Plug
2	Rod	14	Dust ring	26	Pipe
3	Grand	15	Piston seal	27	Bolt
4	Dust seal	16	Ring	28	Nut
5	Retainer	17	O-ring	29	Spring washer
6	Rod seal	18	Ring	30	Bushing
7	Ring	19	Ball	31	Dust seal
8	Buffer ring	20	Bolt	32	Grease nipple
9	Bushing	21	Cushion ring	33	O-ring
10	O-ring	22	Valve	34	O-ring
11	Ring	23	Coil spring		
12	O-ring	24	O-ring		

(3) Boom cylinder (CHANGZHOU)



1	Tube assembly	13	O-ring	26	Dust seal
2	Rod	14	Back up ring	27	Pipe (R)
3	Grand	15	Cushion ring	28	Pipe (B)
4	DU bushing	16	Piston	29	U-bolt
5	Rod seal	17	O-ring	30	Spring washer
6	Back up ring	18	Back up ring	31	Hex nut
7	Buffer ring	19	Piston seal	34	Clamp
8	Dust wiper	20	Wear ring	35	Bolt
9	Snap ring	21	Dust ring	36	Spring washer
10	O-ring	22	Lock nut	37	Grease nipple
11	O-ring	23	Set screw	38	O-ring
12	Back up ring	24	Ring		

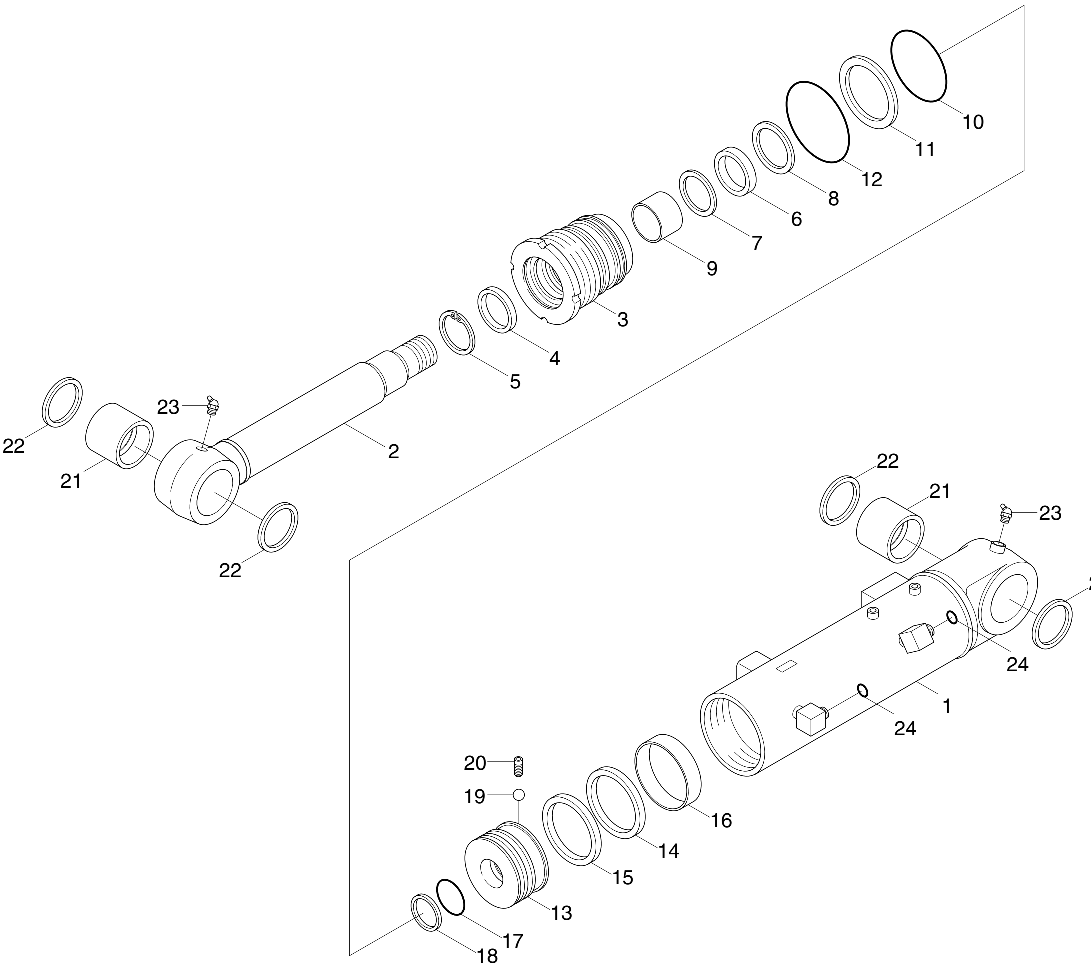
Boom cylinder (SH PAC)



HX60AMT7CY31

1	Tube assembly	11	Back-up ring	21	Steel ball
2	Rod assembly	12	O-ring	22	Hex bolt
3	Gland	13	Wear ring	23	Pin bushing
4	Dust wiper	14	O-ring	24	Pin bushing
5	Retaining ring	15	Piston	25	Dust seal
6	Rod seal	16	Dust ring	26	Grease nipple
7	Back-up ring	17	Piston seal	27	O-ring
8	Buffer ring	18	Back-up ring	28	Cushion ring
9	Bushing	19	O-ring		
10	O-ring	20	Back-up ring		

(4) Dozer cylinder

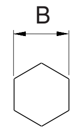


HX60AMT7CY24

1	Tube assembly	9	DU bushing	17	O-ring
2	Rod assembly	10	O-ring	18	Back-up ring
3	Gland	11	Back-up ring	19	Steel ball
4	Dust seal	12	O-ring	20	Set screw
5	Retaining ring	13	Piston	21	Bushing
6	Rod seal	14	Piston seal	22	Dust seal
7	Back-up ring	15	Dust ring	23	Grease nipple
8	Buffer ring	16	Wear ring	24	O-ring

2) TOOLS AND TIGHTENING TORQUE

(1) Tools

Name	Specification	
Allen wrench	8	
	10	
Spanner	M22	
Hook spanner	Suitable size	
(-) 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
Rod cover	Boom cylinder(CHANGZHOU) Boom cylinder(SHPAC)	3	M115	95±9.5 70±7.0	687±69 510±51
	Arm cylinder(CHANGZHOU) Arm cylinder(SHPAC)	3	M95	76±7.6 70±7.0	550±55 510±51
	Bucket cylinder(CHANGZHOU) Bucket cylinder(SHPAC)	3	M85	70±7.0	510±51
	Dozer cylinder	3	M115	95±9.5	690±69
Piston nut	Boom cylinder(CHANGZHOU)	22	-	75±7.5	540±54
	Arm cylinder(CHANGZHOU)	20	-	75±7.5	540±54
	Bucket cylinder(CHANGZHOU)	19	M36	75±7.5	540±54
Piston	Boom cylinder(CHANGZHOU) Boom cylinder(SHPAC)	15 16	M45 -	113±11.3 50±5.0	817±82 362±36
	Arm cylinder(CHANGZHOU) Arm cylinder(SHPAC)	13 14	M39 -	97.5±9.8 50±5.0	705±70 362±36
	Bucket cylinder(CHANGZHOU) Bucket cylinder(SHPAC)	13	M36 M48	90±9.0 50±5.0	550±55 362±36
	Dozer cylinder	13	M45	113±11.3	817±82

3) DISASSEMBLY

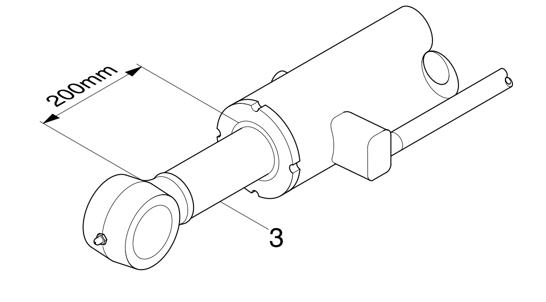
(1) Remove cylinder head and piston rod

※ Procedure 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 (3) about 200 mm (7.1 in). Because the rod assembly is rather heavy, finish extending it with air pressure after the oil draining operation.



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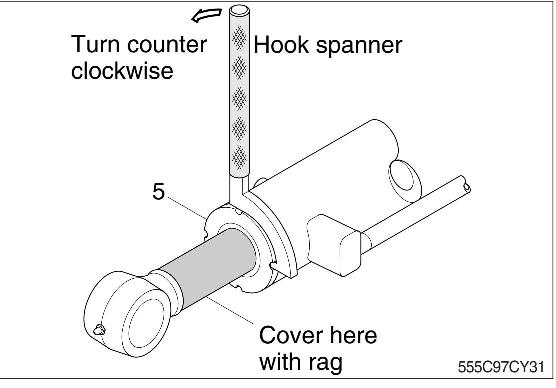
③ Remove rod cover (5) by hook spanner.

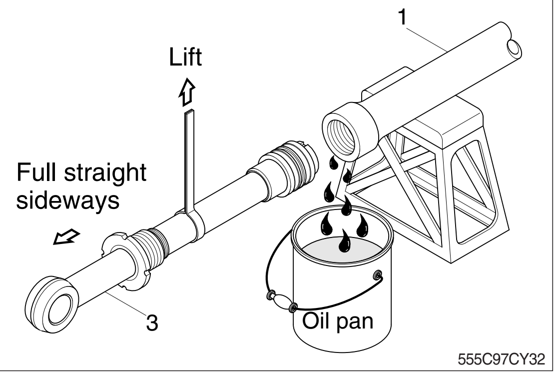
※ Cover the extracted rod assembly (3) with rag to prevent it from being accidentally damaged during operation.



555C97CY31

④ Draw out cylinder head and rod assembly (3) together from tube assembly (1).

※ Since the rod assembly is heavy in this case, lift the tip of the rod assembly (3) with a crane or some means and draw it out. However, when rod assembly (3) has been drawn out to approximately two thirds of its length, lift it in its center to draw it completely.

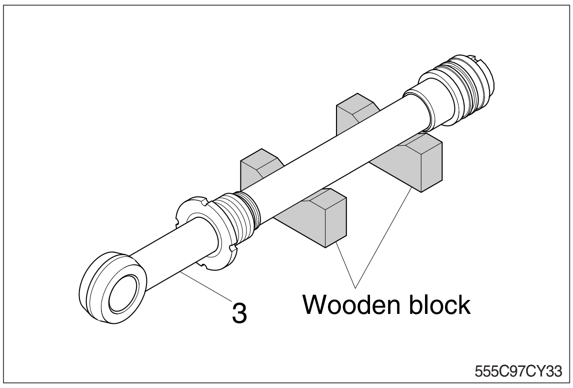


555C97CY32

Note that the plated surface of rod assembly (3) is to be lifted. For this reason, do not use a wire sling and others that may damage it, but use a strong cloth belt or a rope.

⑤ Place the removed rod assembly on a wooden V-block that is set level.

※ Cover a V-block with soft rag.

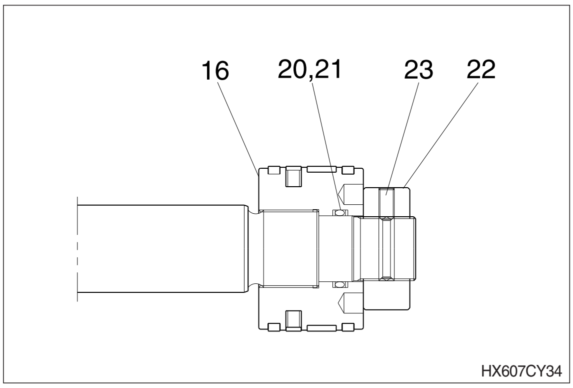


(2) Remove piston and rod cover

① Loosen set screw (23) and remove piston nut (22).

※ Since piston nut (22) is tightened to a high torque, use a hydraulic and power wrench that utilizers a hydraulic cylinder, to remove the piston nut (22).

② Remove piston assembly (16), back up ring (21), and O-ring (20).

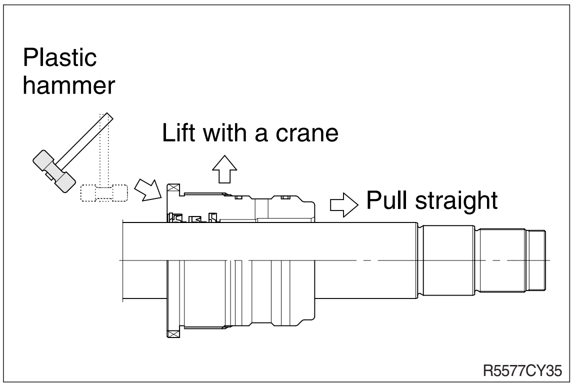


③ Remove the rod cover from rod assembly (3).

※ If it is too heavy to move, move it by striking the flanged part of gland 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 Du bushing (6) and packing (8, 9, 10, 11, 12, 13, 14) by the threads of rod assembly (3).

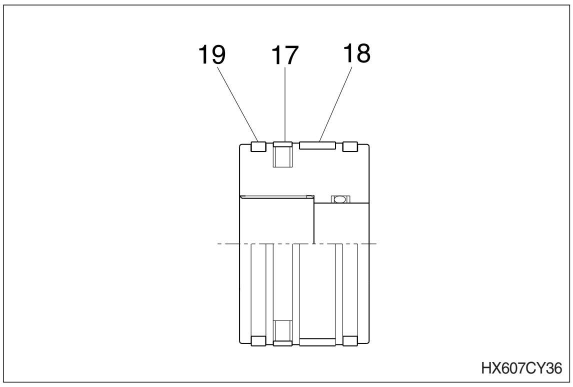


(3) Disassemble the piston assembly

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 gland assembly

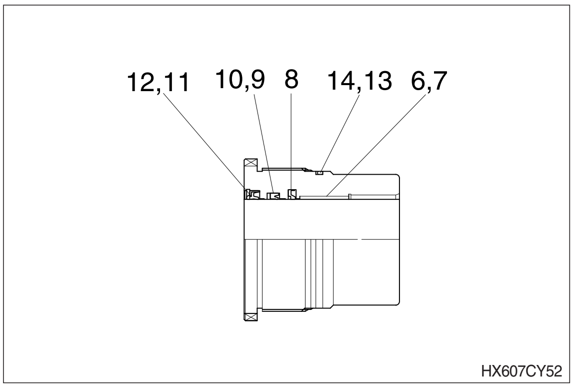
① Remove back up ring (14) and O-ring (13).

② Remove snap ring (12), dust seal (11).

③ Remove U-packing (9) and buffer seal (8).

※ Exercise care in this operation not to damage the grooves.

※ Do not remove seal and ring, if does not damaged.

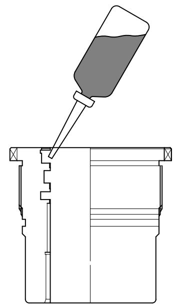


4) ASSEMBLY

(1) Assemble cylinder head assembly

※ Check for scratches or rough surfaces if found smooth with an oil stone.

① Coat the inner face of rod cover (5) with hydraulic oil.



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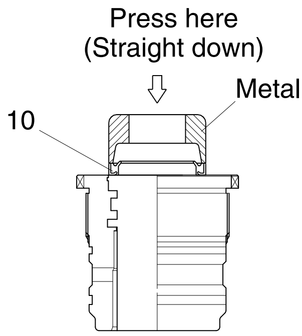
② Coat dust seal (10) with grease and fit dust seal (10) to the bottom of the hole of dust seal.
At this time, press a pad metal to the metal ring of dust seal.

③ Fit retaining ring (12) to the stop face.

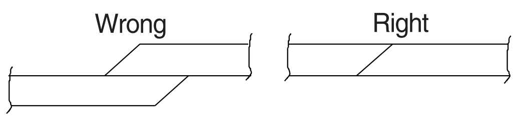


555C97CY39

④ Fit U-packing (9) and buffer seal (8) to corresponding grooves, in that order.

※ Coat each packing with hydraulic oil before fitting it.

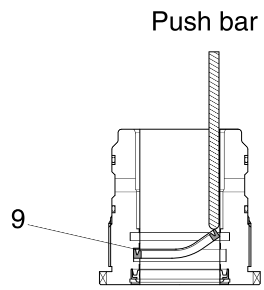
※ Insert the backup ring until one side of it is inserted into groove.



8-157(3) 210-7

※ U-packing (9) has its own fitting direction. Therefore, confirm it before fitting them.

※ Fitting U-packing (9) upside down may damage its lip. Therefore check the correct direction that is shown in fig.

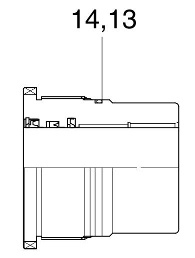


555C97CY40

⑤ Fit back up ring (14) to rod cover (5).

※ Put the backup ring in the warm water of 30~50˚C .

⑥ Fit O-ring (13) to rod cover (5).

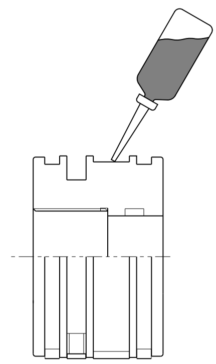


HX607CY41

(2) Assemble piston assembly

※ Check for scratches or rough surfaces. If found smooth with an oil stone.

① Coat the outer face of piston (16) with hydraulic oil.

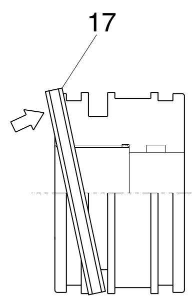


555C97CY42

② Fit piston seal (17) to piston.

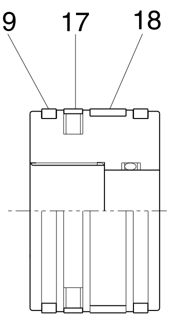
※ Put the piston seal in the warm water of 60~100˚C for more than 5 minutes.

※ After assembling the piston seal, press its outer diameter to fit in.



HX607CY43

③ Fit wear ring (18) and dust ring (19) to piston (16).



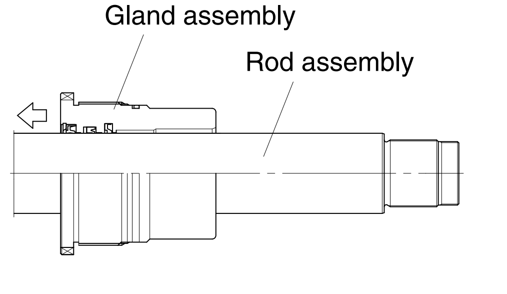
HX607CY44

(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, the inner surface of piston and cylinder head.

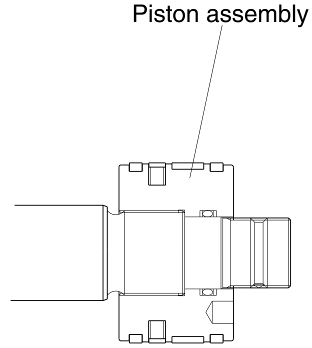
③ Insert gland assembly to rod assembly.



555C97CY45

⑤ Fit piston assembly to rod assembly.

· Tightening torque : 50 ± 5.0 kgf · m
(362 ± 36.2 lbf · ft)



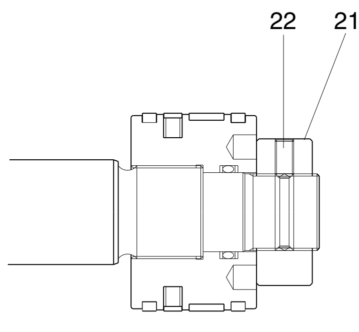
555C97CY47

⑥ Fit piston nut and tighten the set screw (22).

· Tightening torque :

Piston nut (21) : 75 ± 7.5 kgf · m
(540 ± 54 lbf · ft)

Set screw (22) : 1.75 kgf · m (12.7 lbf · ft)



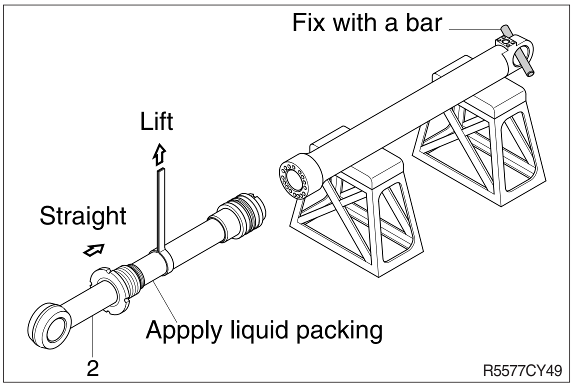
HX607CY48

(4) Overall assemble

① Place a V-block on a rigid work bench. Mount the tube assembly (2) on it and fix the assembly by passing a bar through the clevis pin hole to lock the assembly.

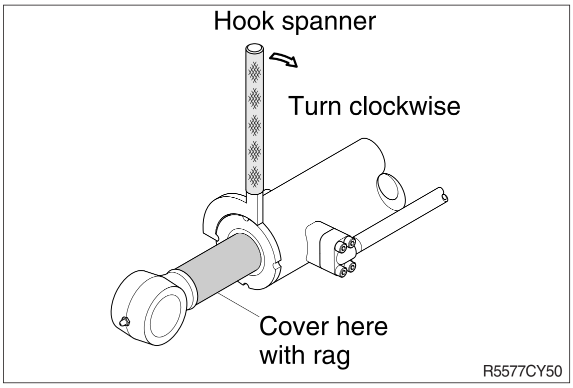
② Insert the rod assembly in to the tube assembly, while lifting and moving the rod assembly with a crane.

※ 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.

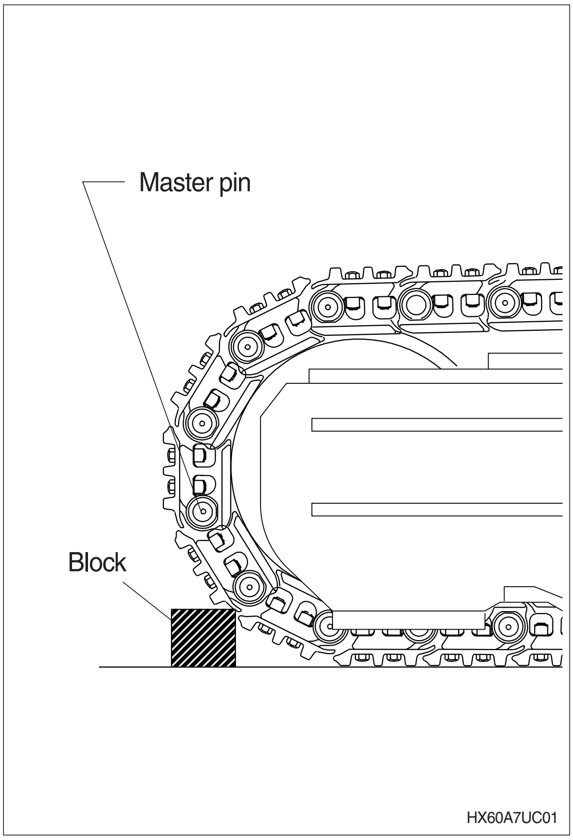


GROUP 10 UNDERCARRIAGE

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.

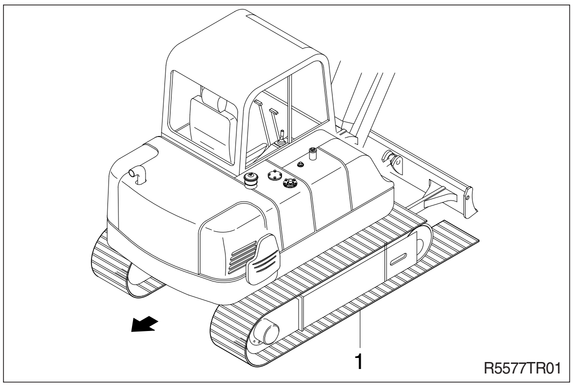
※ If track tension is not relieved when the grease valve is loosened, move the machine backwards and forwards.

(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.

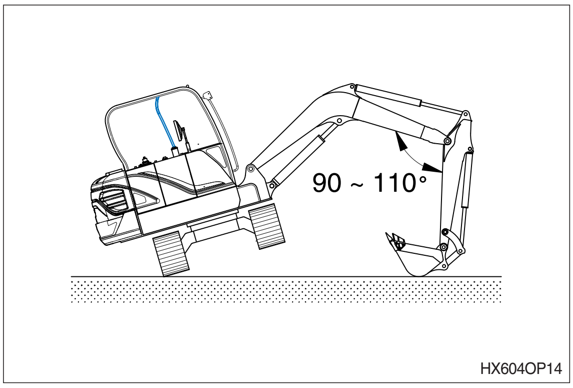
※ Don't get close to the sprocket side as the track shoe plate may fall down on your feet.



2) INSTALL

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

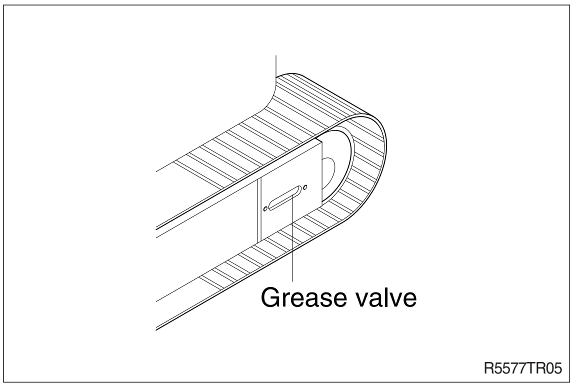
※ Adjust the tension of the track link.



2. CARRIER ROLLER

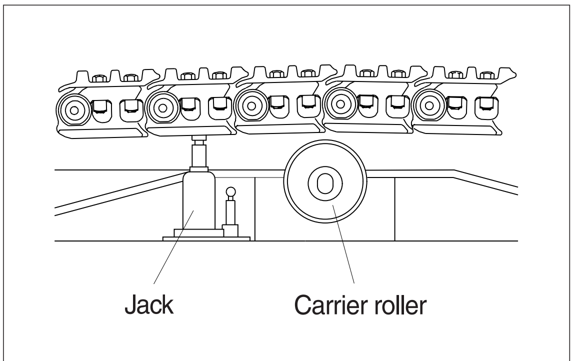
1) REMOVAL

(1) Loosen tension of the track link.



R5577TR05

(2) Jack up the track link height enough to permit carrier roller removal.

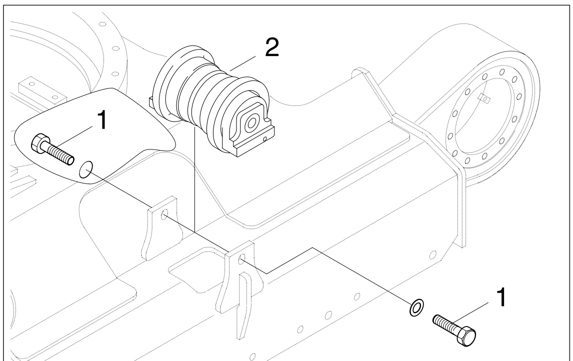


HX60A7TR04

(3) Remove bolt (1) at both side.

(4) Remove carrier roller (2).

- · Weight : 10 kg (22 lb)
- · Tightening torque : 41.3 ± 4.0 kgf · m (299 ± 28.9 lbf · ft)



HX60A7TR03

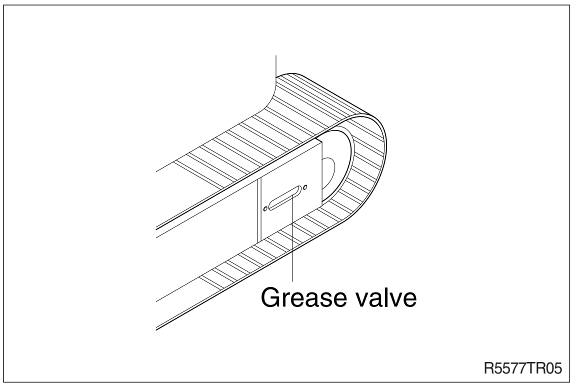
2) INSTALL

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

3. TRACK ROLLER

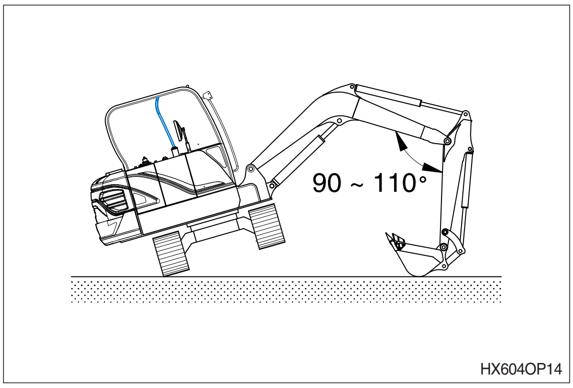
1) REMOVAL

(1) Loosen tension of the track link.



(2) Using the work equipment, push up track frame on side which is to be removed.

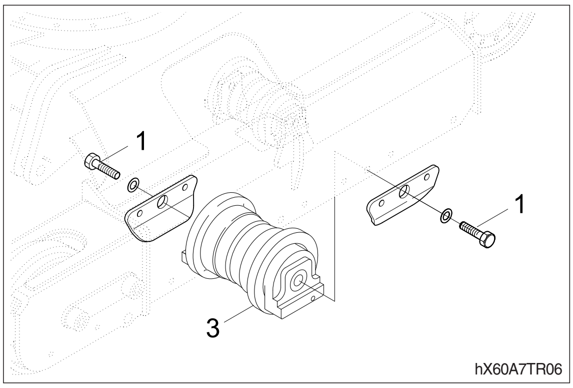
※ After jack up the machine, set a block under the unit.



(3) Remove the mounting bolt (1) and draw out the track roller (3).

· Weight : 11 ㎏ (46 ㏐)

· Tightening torque : 41.3 ± 4.0 kgf · m (299 ± 28.9 lbf · ft)



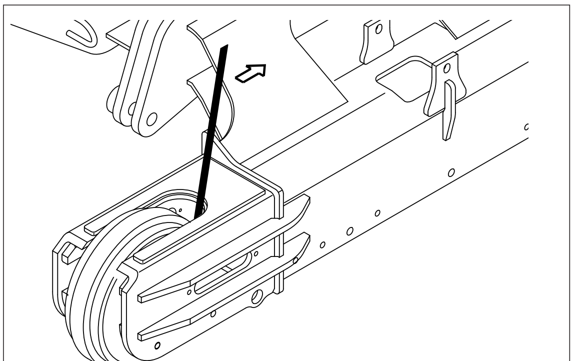
2) INSTALL

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

4. IDLER AND RECOIL SPRING

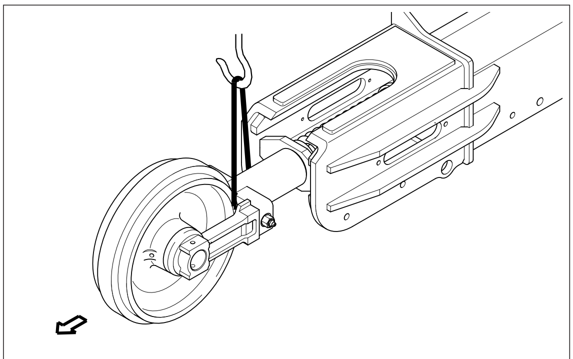
1) REMOVAL

(1) Remove the track link.
For detail, see removal of track link.



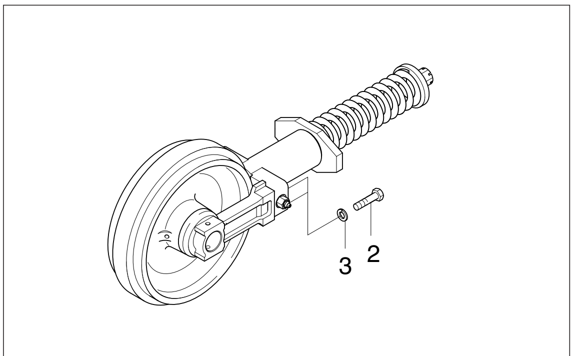
HX60A7TR10

(2) Sling the recoil spring (1) and pull out idler and recoil spring assembly from track frame, using a pry.
· Weight : 100 kg (220 lb)



HX60A7TR11

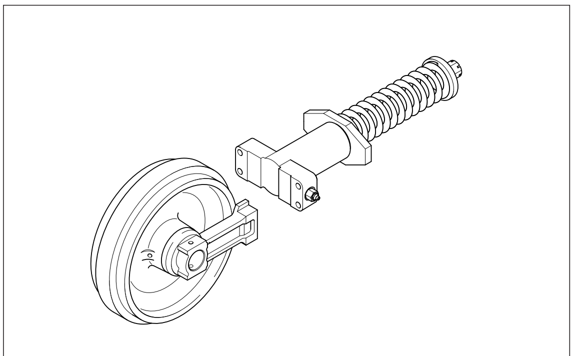
(3) Remove the bolts (2), washers (3) and separate idler from recoil spring.
· Tightening torque : 12.8 ± 3.0 kgf · m
(92.6 ± 21.7 lbf · ft)



HX60A7TR12

2) INSTALL

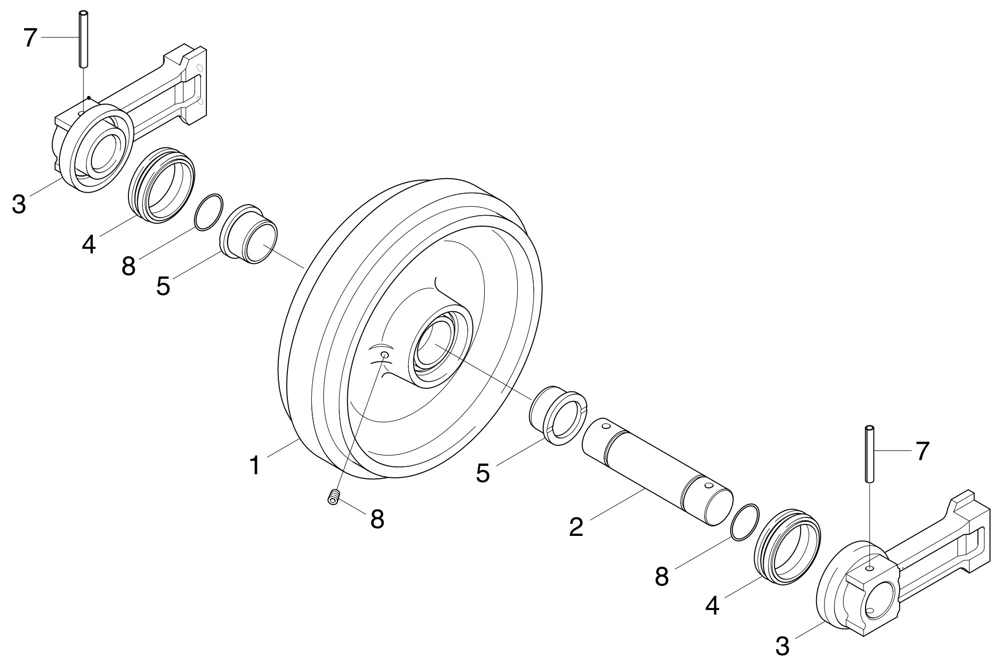
(1) Carry out installation in the reverse order to removal.
※ Make sure that the boss on the end face of the recoil cylinder rod is in the hole of the track frame.



HX60A7TR13

3) DISASSEMBLY AND ASSEMBLY OF IDLER

(1) Structure



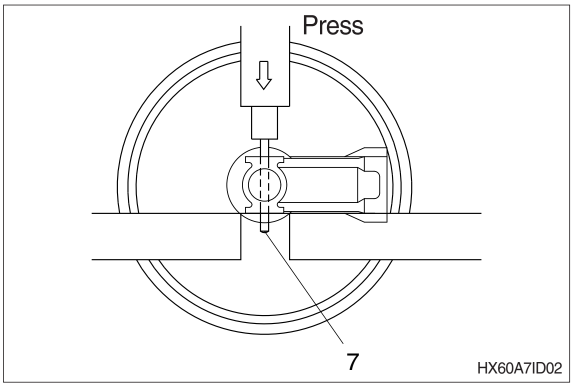
HX60A7ID01

1	Shell	4	Seal	7	Spring pin
2	Shaft	5	Bushing	8	O-ring
3	Bracket	6	Piug		

(2) Disassembly

① Remove plug and drain oil.

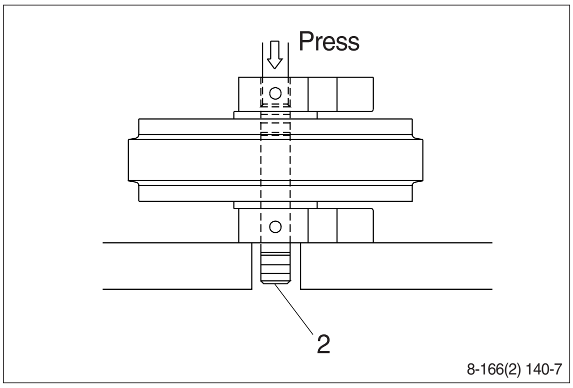
② Draw out the spring pin (7), using a press.



③ Pull out the shaft (2) with a press.

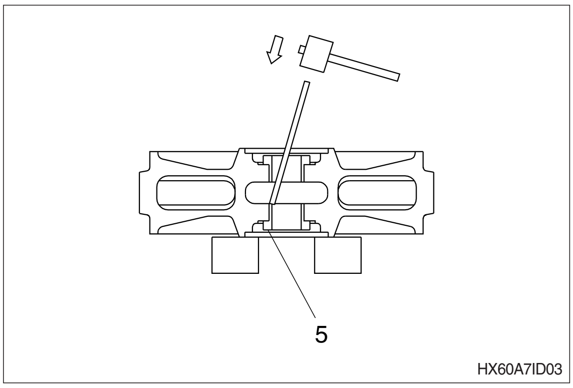
④ Remove seal (4) from idler (1) and bracket (3).

⑤ Remove O-ring (8) from shaft.



⑥ Remove the bushing (5) from idler, using a special tool.

※ Only remove bushing if replacement is necessity.

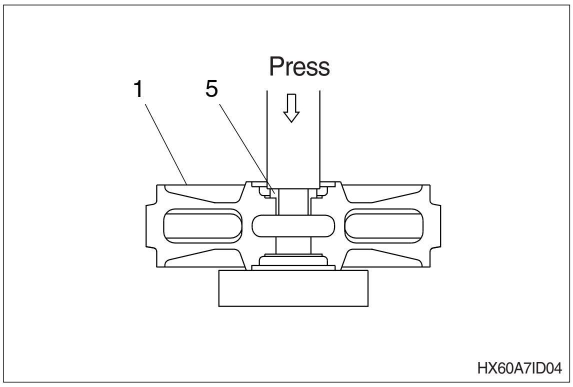


(3) Assembly

※ Before assembly, clean the parts.

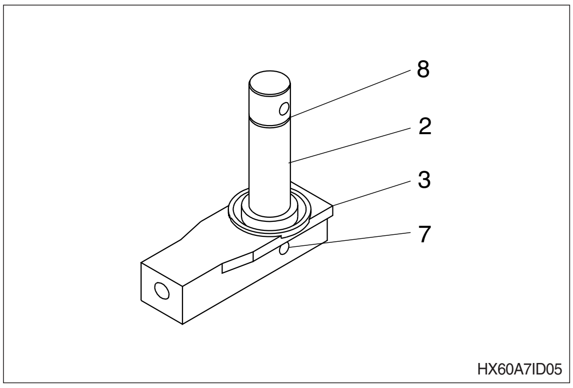
※ Coat the sliding surfaces of all parts with oil.

① Cool up bushing (5) 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.

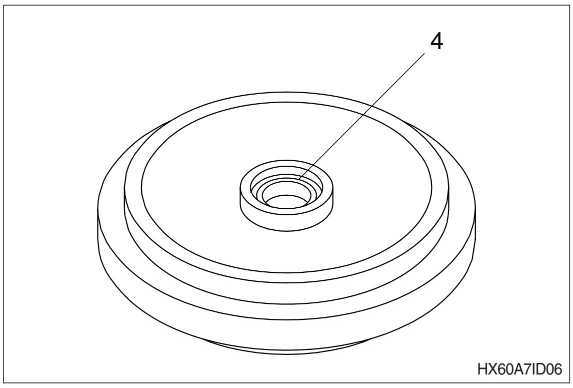


② Coat O-ring (8) with grease thinly, and install it to shaft (2).

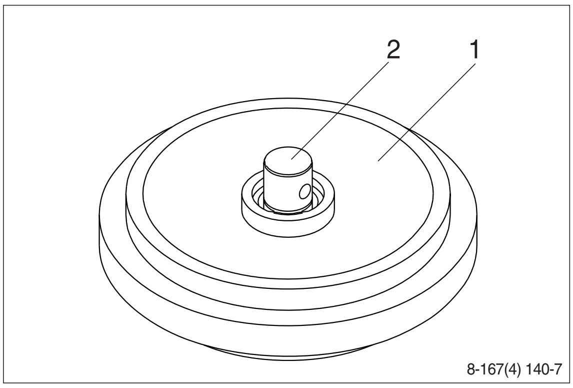
③ Insert shaft (2) into bracket (3) and drive in the spring pin (7).



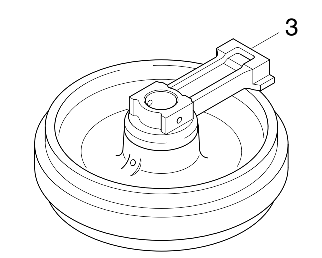
④ Install seal (4) to shell (1) and bracket (3).



⑤ Install shaft (2) to shell (1).

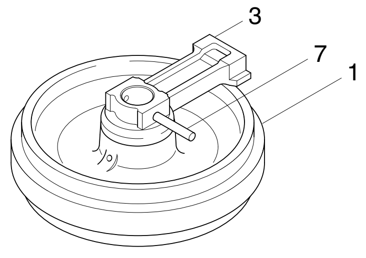


⑥ Install bracket (3) attached with seal (4).



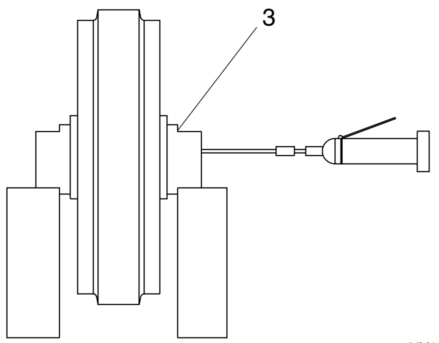
HX60A7ID07

⑦ Knock in the spring pin (7) with a hammer.



HX60A7ID08

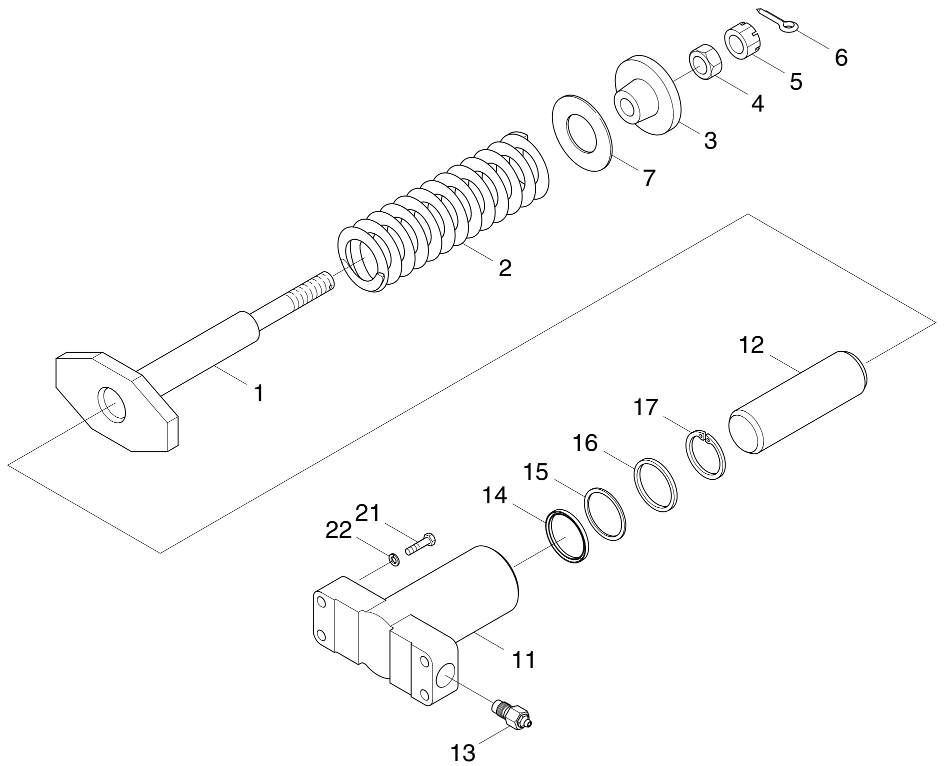
⑧ Lay bracket (3) on its side.
Supply engine oil to the specified level, and tighten plug.



HX60A7ID09

4) DISASSEMBLY AND ASSEMBLY OF RECOIL SPRING

(1) Structure



1	Rod	7	Spacer	16	Dust seal
2	Spring	11	Bracket	17	Retaining ring
3	Lock washer	12	Piston	21	Bolt
4	Hex-nut	13	Grease valve	22	Washer
5	Slotted hex-nut	14	O-ring		
6	Split pin	15	Back up ring		

(2) Disassembly

① Apply pressure on spring (3) with a press. The spring is under a large installed load.

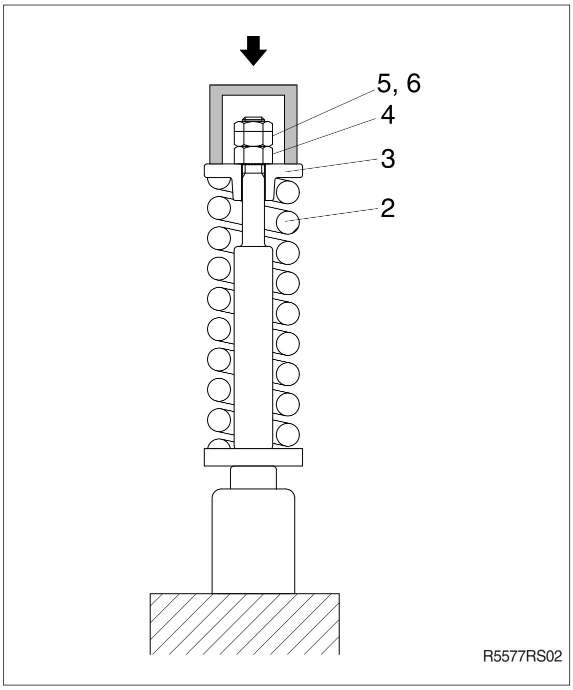
※ This is dangerous, so be sure to set properly.

· Spring set load : 3900 ㎏ (8600 ℔)

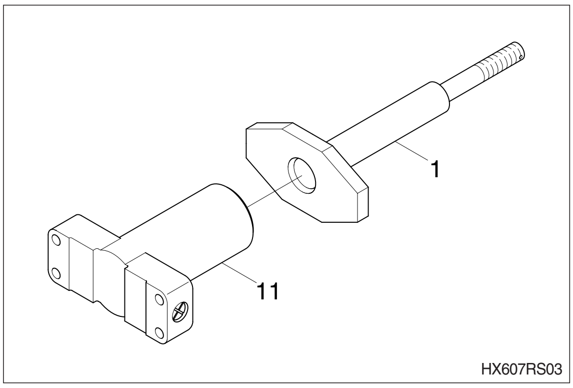
② Remove split pin (6) and nut (5).

③ Remove lock nut (4). Take enough notice so that the press which pushes down the spring, should not be slipped out in its operation.

④ Lighten the press load slowly and remove lock washer (3) and spring (2).

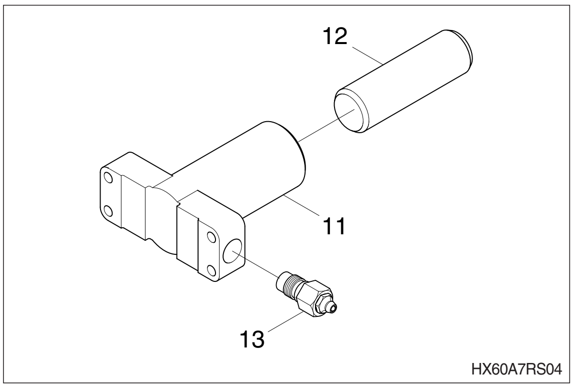


⑤ Remove rod (1) from bracket (11).

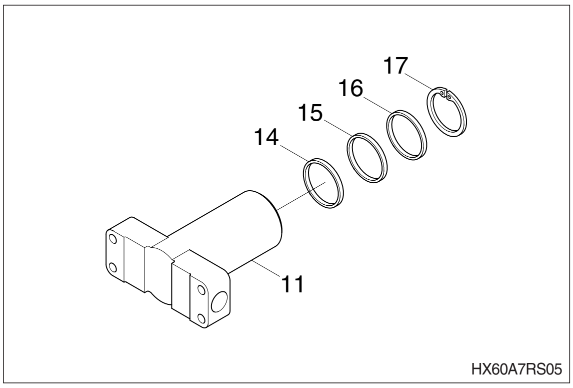


⑥ Remove grease valve (13) from bracket (11).

⑦ Remove piston (12) from bracket (11).



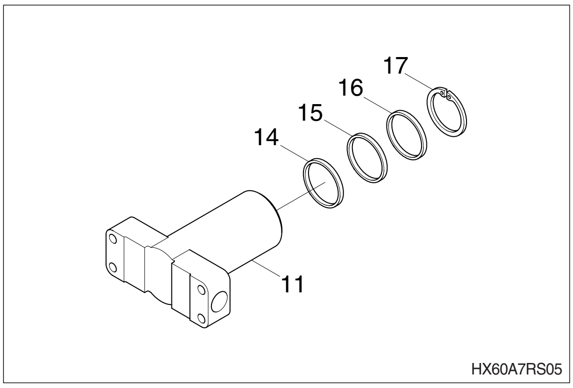
⑧ Remove retaining ring (17), dust seal (16), back up ring (15) and dust seal (14).



(3) Assembly

① Install dust seal (14), back up ring (15), dust seal (16), and retaining ring (17) to bracket (11).

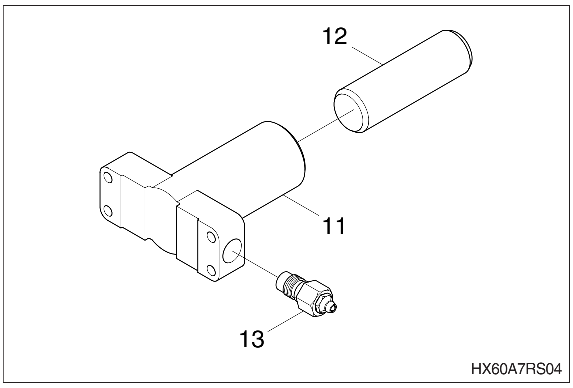
※ When installing dust seal (14,16) take full care so as not to damage the lip.



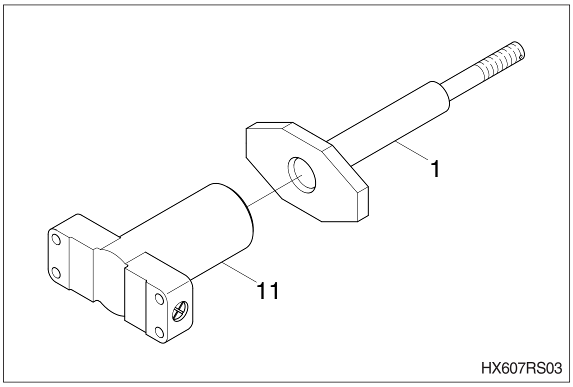
② Pour grease into bracket (11), then push in piston (12) by hand.
After take grease out of grease valve mounting hole, let air out.

※ If air letting is not sufficient, it may be difficult to adjust the tension of crawler.

③ Fit grease valve (13) to bracket (11).
- Tightening torque : 8±1.0 kg · m (57.9±7.2 lb · ft)



④ Install rod (1) to bracket (11).



⑤ Install spring (2) and lock washer (3) .

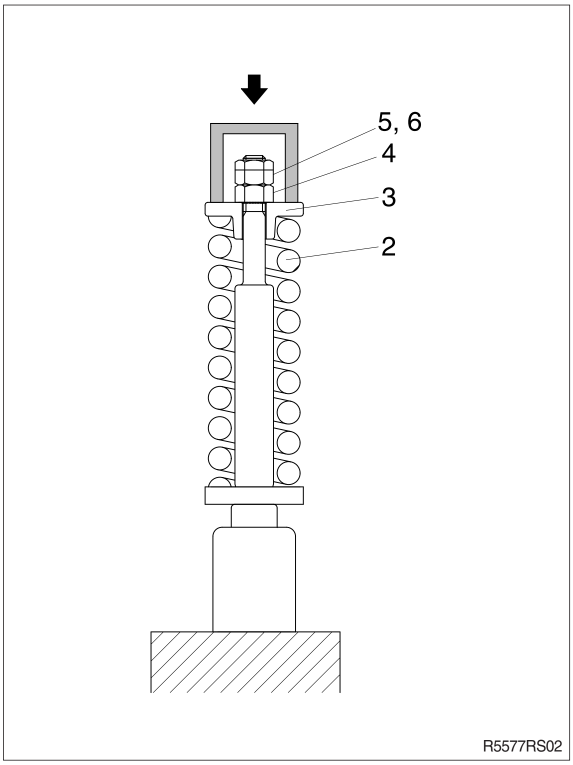
⑥ Apply pressure to spring (2) with a press and tighten nut (4).

※ Apply sealant before assembling.

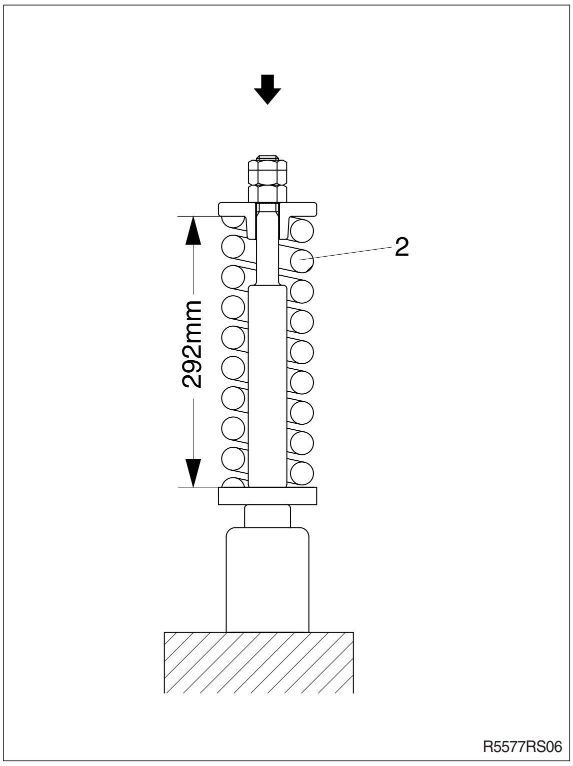
※ During the operation, pay attention specially to prevent the press from slipping out.

· Tightening torque : 30±3 kgf · m (217±21 lbf · ft)

⑦ Tighten nut (5) and insert split pin (6).

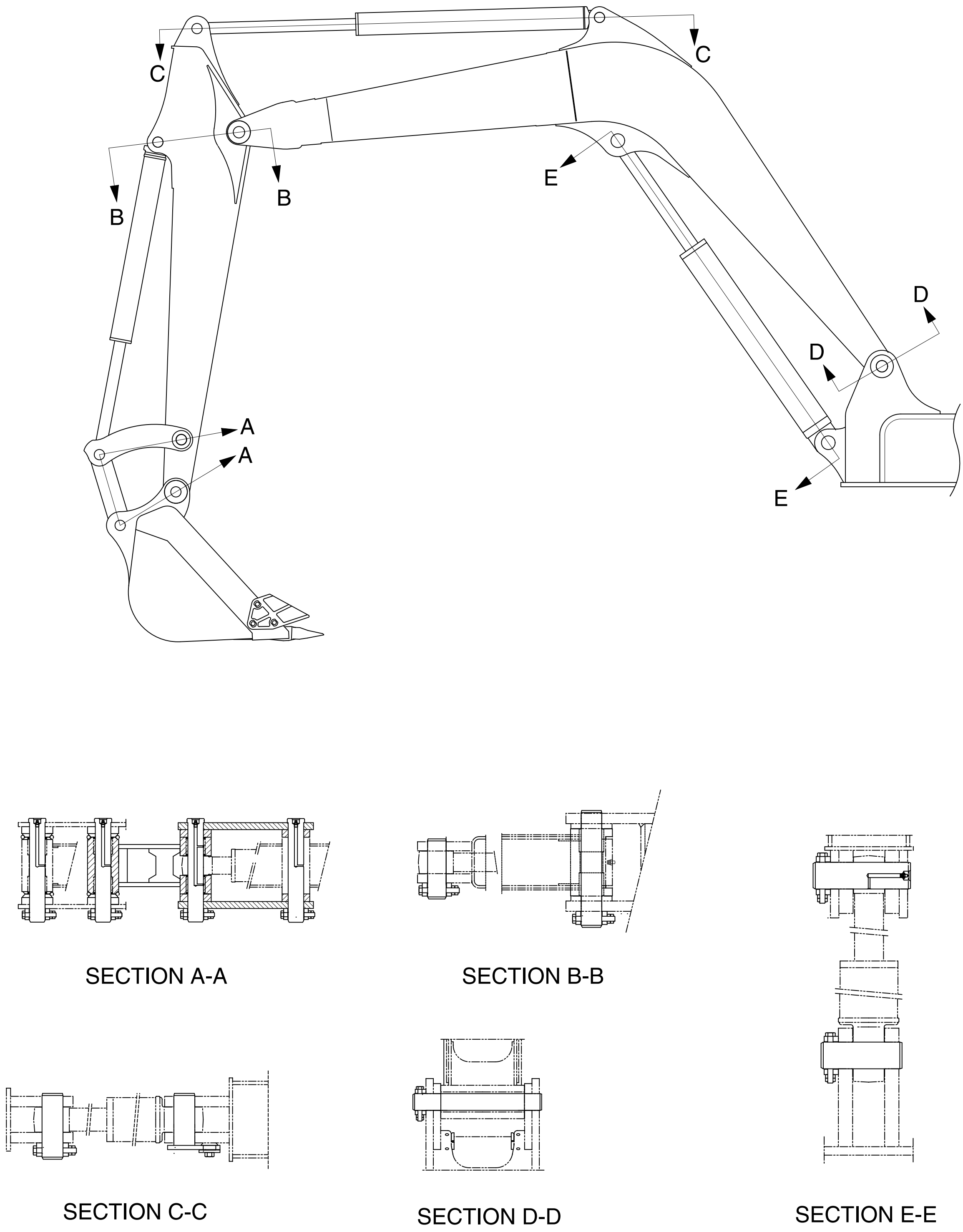


⑧ Lighten the press load and confirm the set length of spring (2).



GROUP 11 WORK EQUIPMENT

1. STRUCTURE



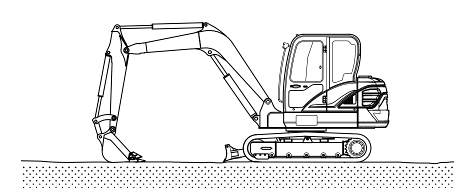
R5577AT01

2. REMOVAL AND INSTALL

1) BUCKET ASSEMBLY

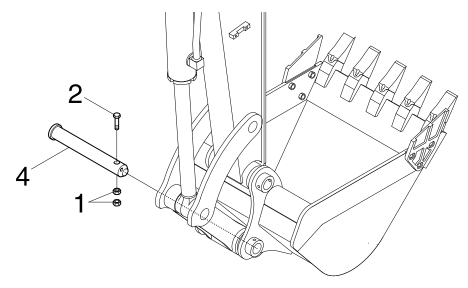
(1) Removal

① Lower the work equipment completely to ground with back of bucket facing down.



HX607AT02

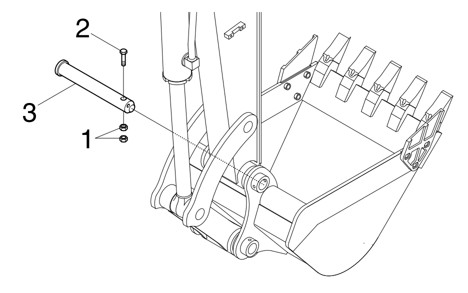
② Remove nut (1), bolt (2) and draw out the pin (4).



R5577AT13

③ Remove nut (1), bolt (2) and draw out the pin (3) then remove the bucket assembly.

· Weight (0.18 ㎥) : 170 ㎏ (370 ℔)



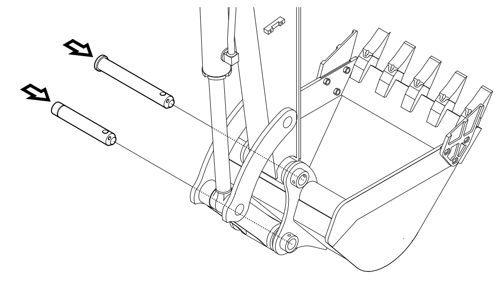
R5577AT04

(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.



R5577AT03

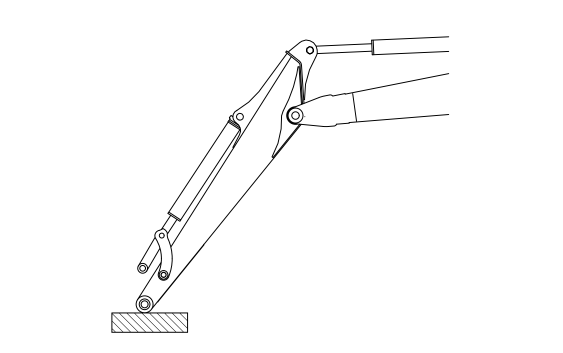
2) ARM ASSEMBLY

(1) Removal

※ Loosen the breather slowly to release the pressure inside the hydraulic tank.

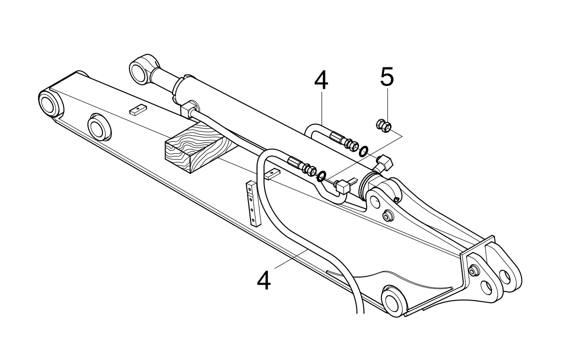
⚠ **Escaping fluid under pressure can penetrated the skin causing serious injury.**

① Remove bucket assembly.
For details, see removal of bucket assembly.


R5577AT06

② Disconnect bucket cylinder hose (4).

⚠ **Fit blind plugs (5) in the piping at the chassis end securely to prevent oil from spurting out when the engine is started.**



R5577CY04

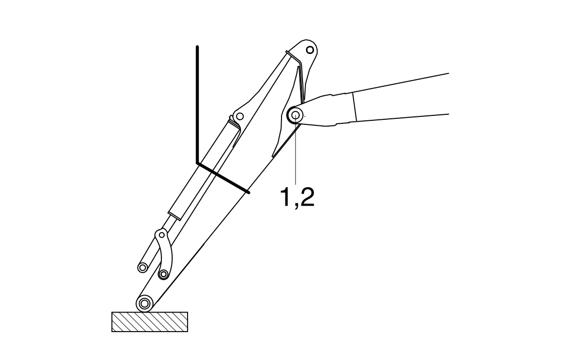
③ Sling arm cylinder assembly, remove spring, pin stopper and pull out pin.

※ 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 (1) and pull out the pin (2) then remove the arm assembly.
· Weight (1.6 m) : 205 kg (451 lb)

※ When lifting the arm assembly, always lift the center of gravity.



R5577AT07

(2) Install

① Carry out installation in the reverse order to removal.

⚠ **When lifting the arm assembly, always lift the center of gravity.**

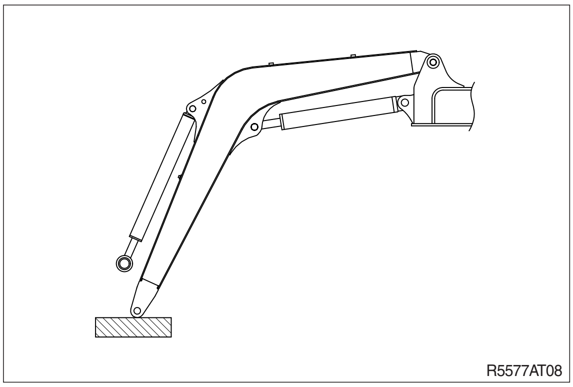
※ Bleed the air from the cylinder.

3) BOOM CYLINDER

(1) Removal

① Remove arm and bucket assembly.

② For details, see removal of arm and bucket assembly.
Remove boom cylinder assembly from boom.
For details, see removal of arm cylinder assembly.

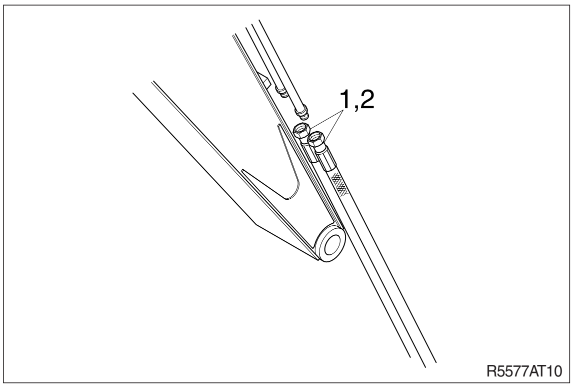

R5577AT08

③ Disconnect head lamp wiring.

④ Disconnect bucket cylinder hose (2) and arm cylinder hos e(1).

※ When the hose are disconnected, oil may spurt out.

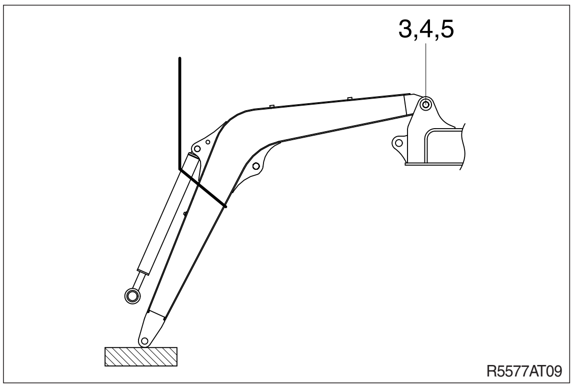
⑤ Sling boom assembly (3).



R5577AT10

⑥ Remove bolt (3), nut (4) and pull out the pin (5) then remove boom assembly.
· Weight (3.0 ㎜) : 315 ㎏ (694 ℔)

※ When lifting the boom assembly always lift the center of gravity.



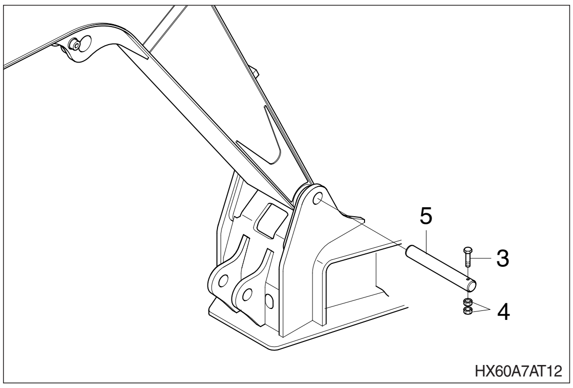
R5577AT09

(2) Install

① Carry out installation in the reverse order to removal.

⚠ **When lifting the arm assembly, always lift the center of gravity.**

※ Bleed the air from the cylinder.



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