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1. STRUCTURE

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

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

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

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

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

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

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

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

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

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

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

2. HOW TO READ THE SERVICE MANUAL

Distribution and updating

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

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

Filing method

1. See the page number on the bottom of the page.
   File the pages in correct order.
2. Following examples shows how to read the page number.
   Example 1

   2 - 3
   - 2 : Item number (2. Structure and Function)
   - 3 : Consecutive page number for each item.

3. Additional pages : Additional pages are indicated by a hyphen(-) and number after the page number. File as in the example.

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

Revised edition mark (①②③…)

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

Revisions

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

Symbols

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

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

3. CONVERSION TABLE

Method of using the Conversion Table

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

Example

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

Convert 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

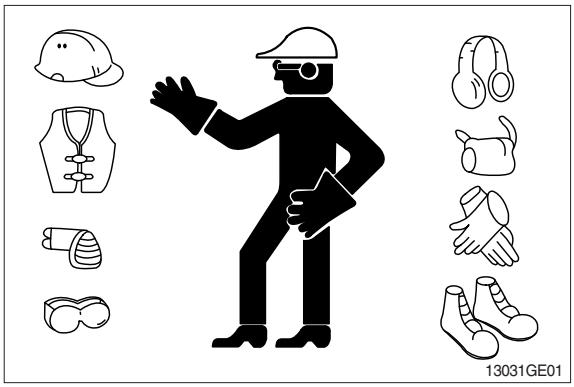
GROUP 1 SAFETY

FOLLOW SAFE PROCEDURE

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

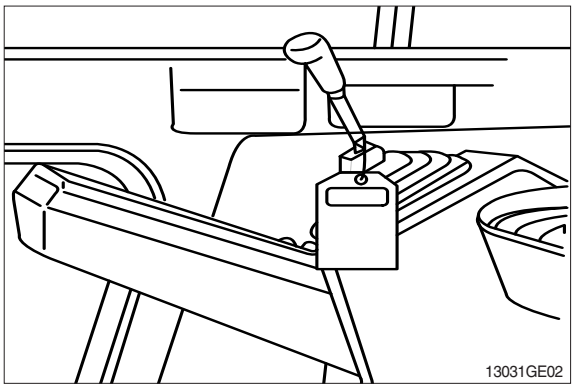
WEAR PROTECTIVE CLOTHING

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



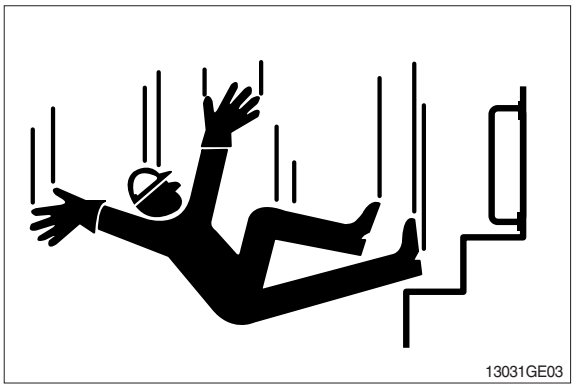
WARN OTHERS OF SERVICE WORK

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.



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.

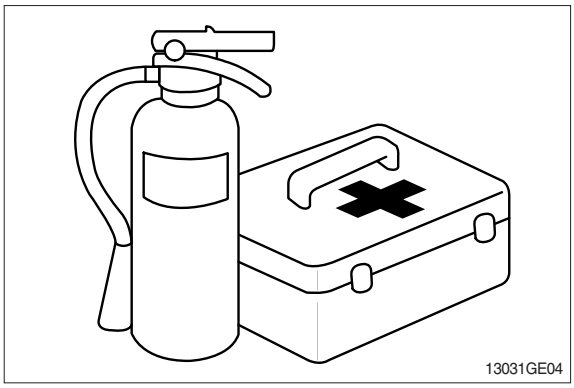


PREPARE FOR EMERGENCIES

Be prepared if a fire starts.

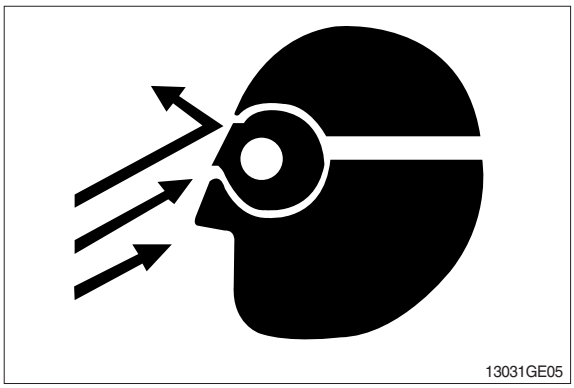
Keep a first aid kit and fire extinguisher handy.

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



PROTECT AGAINST FLYING DEBRIS

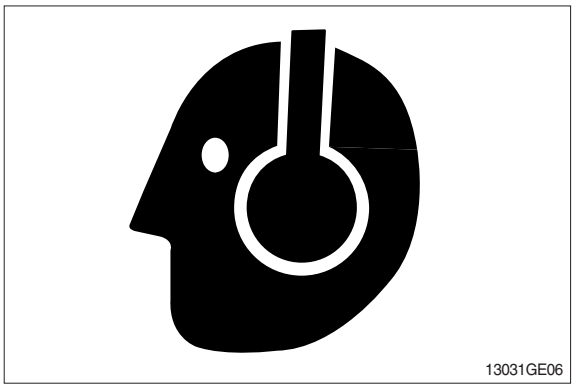
Guard against injury from flying pieces of metal or debris; wear goggles or safety glasses.



PROTECT AGAINST NOISE

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

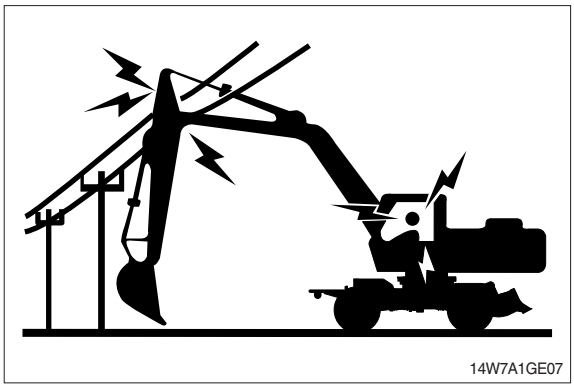
Wear a suitable hearing protective device such as ear-
muffs or earplugs to protect against objectionable or uncomfortable loud noises.



AVOID POWER LINES

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

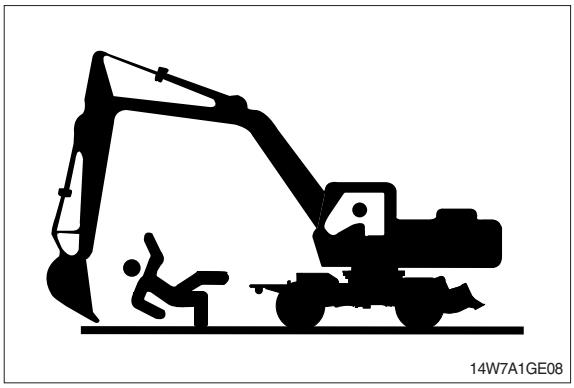
Never move any part of the machine or load closer to electric line than 3m(10ft) plus twice the line insulator length.



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.

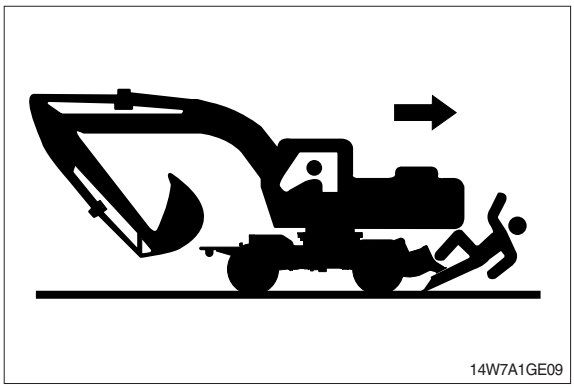


MOVE AND OPERATE MACHINE SAFELY

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.

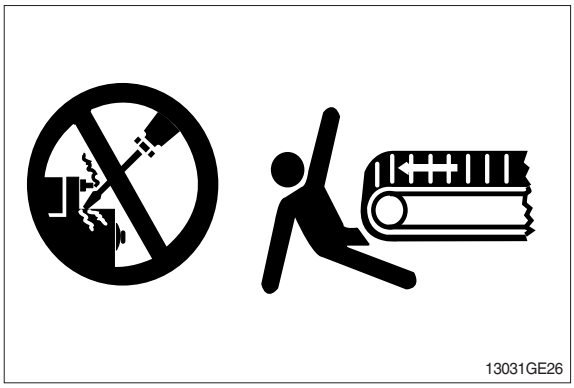
Use a signal person when moving, swinging, or operating the machine in congested areas. Coordinate hand signals before starting the excavator.



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.



PARK MACHINE SAFELY

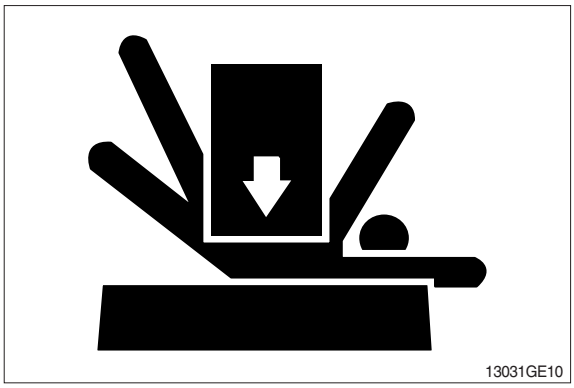
Before working on the machine:

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

SUPPORT MACHINE PROPERLY

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

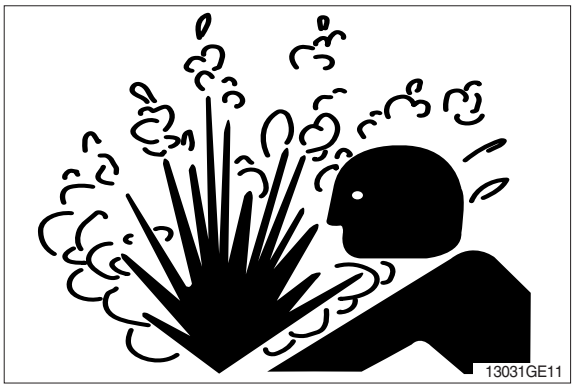
Do not support the machine on cinder blocks, hollow tiles, or props that may crumble under continuous load.
Do not work under a machine that is supported solely by a jack. Follow recommended procedures in this manual.



SERVICE COOLING SYSTEM SAFELY

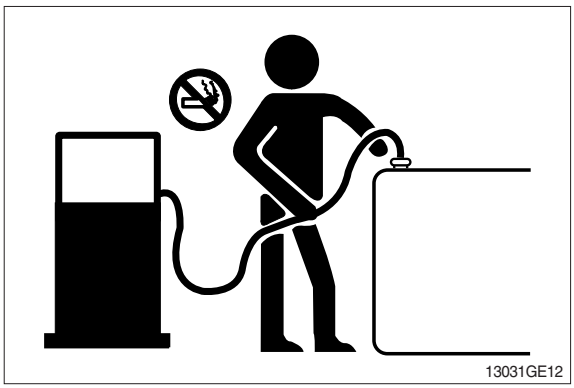
Explosive release of fluids from pressurized cooling system can cause serious burns.

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



HANDLE FLUIDS SAFELY-AVOID FIRES

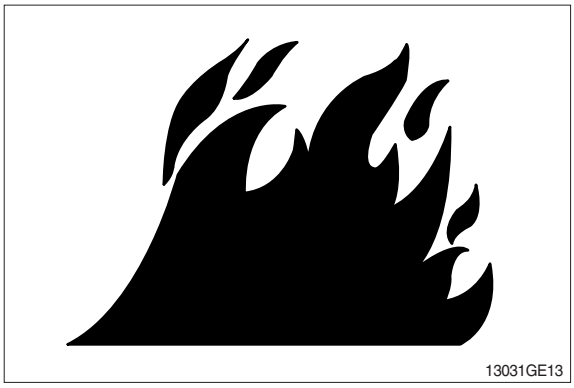
Handle fuel with care; it is highly flammable. Do not refuel the machine while smoking or when near open flame or sparks. Always stop engine before refueling machine.
Fill fuel tank outdoors.



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

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

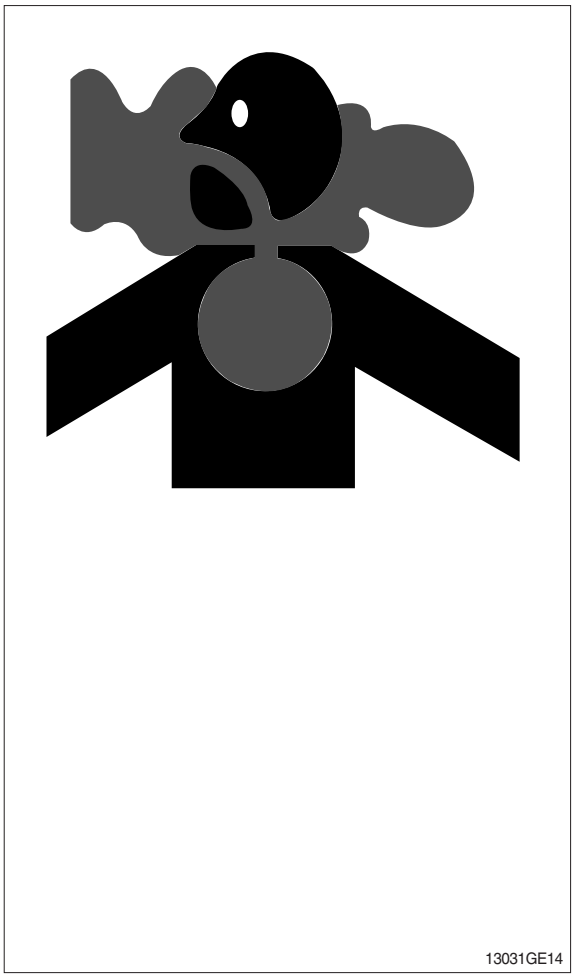
Do not store oily rags ; they can ignite and burn spontaneously.



BEWARE OF EXHAUST FUMES

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

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



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.

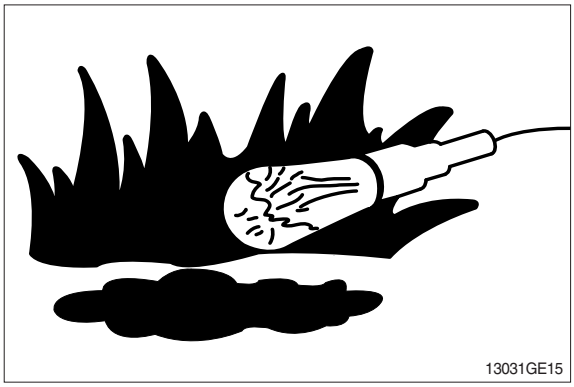
Do all work outside or in a well ventilated area. Dispose of paint and solvent properly.

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

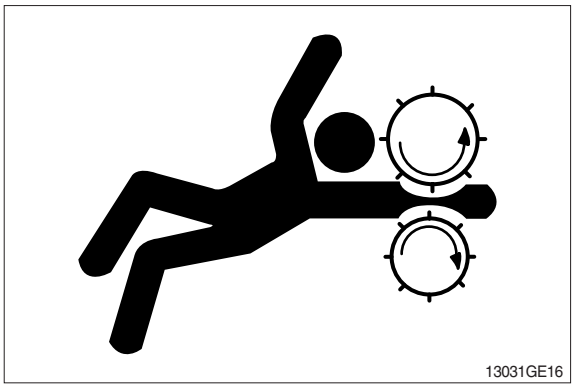
Illuminate your work area adequately but safely. Use a portable safety light for working inside or under the machine. Make sure the bulb is enclosed by a wire cage. The hot filament of an accidentally broken bulb can ignite spilled fuel or oil.



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.

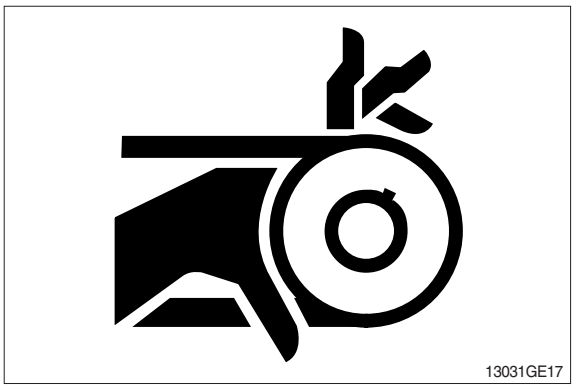
Remove rings and other jewelry to prevent electrical shorts and entanglement in moving parts.



STAY CLEAR OF MOVING PARTS

Entanglements in moving parts can cause serious injury.

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



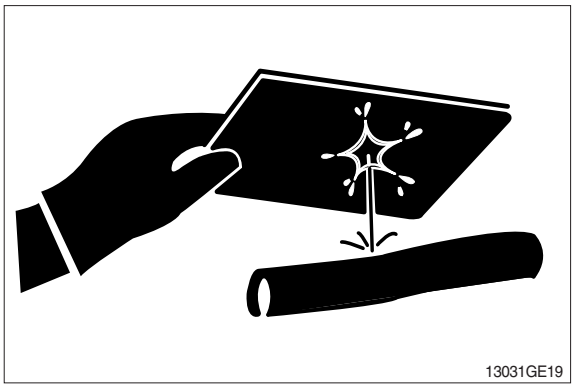
AVOID HIGH PRESSURE FLUIDS

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.



AVOID HEATING NEAR PRESSURIZED FLUID LINES

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

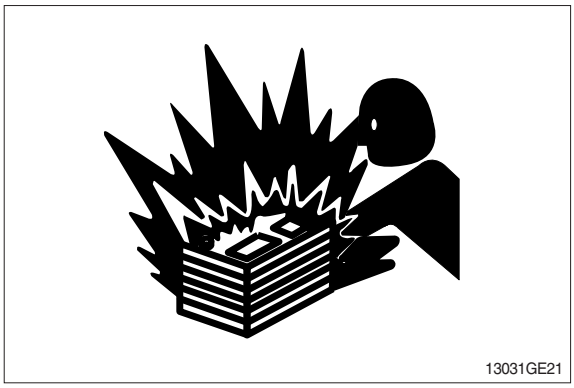
Pressurized lines can be accidentally cut when heat goes beyond the immediate flame area. Install fire resisting guards to protect hoses or other materials.

PREVENT BATTERY EXPLOSIONS

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

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

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



PREVENT ACID BURNS

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

Avoid the hazard by:

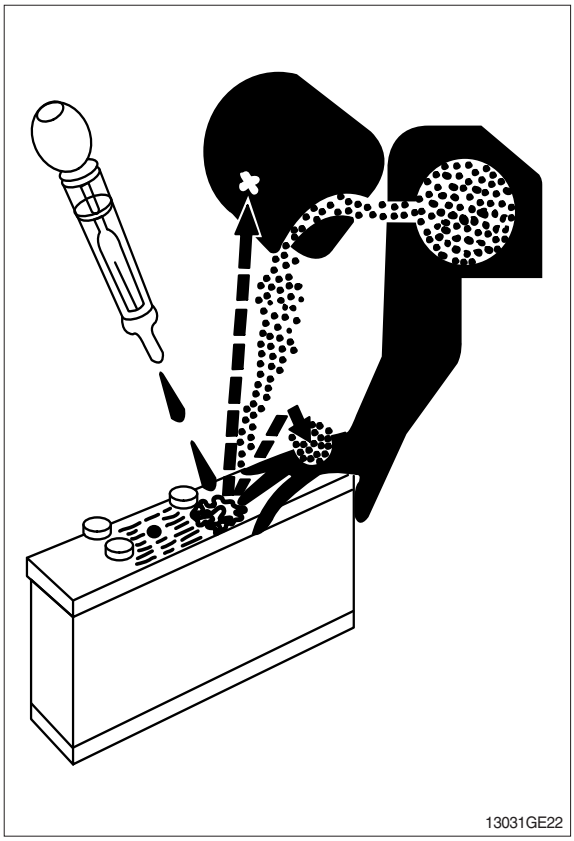
1. Filling batteries in a well-ventilated area.
2. Wearing eye protection and rubber gloves.
3. Avoiding breathing fumes when electrolyte is added.
4. Avoiding spilling of dripping electrolyte.
5. Use proper jump start procedure.

If you spill acid on yourself:

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

If acid is swallowed:

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



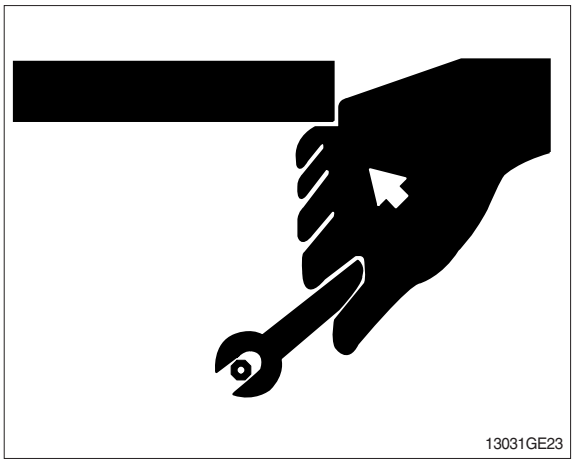
USE TOOLS PROPERLY

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

Use power tools only to loosen threaded tools and fasteners.

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

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

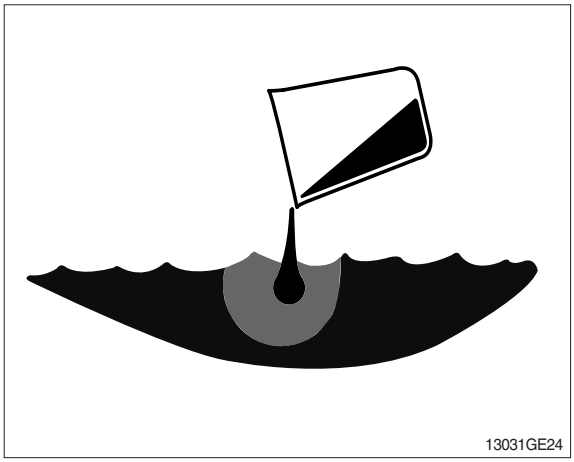


DISPOSE OF FLUIDS PROPERLY

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

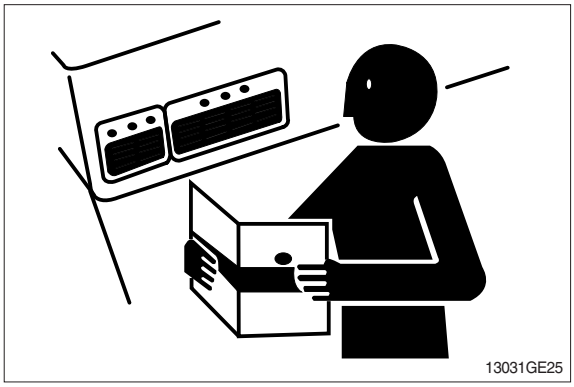
Use proper containers when draining fluids. Do not use food or beverage containers that may mislead someone into drinking from them.

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



REPLACE SAFETY SIGNS

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

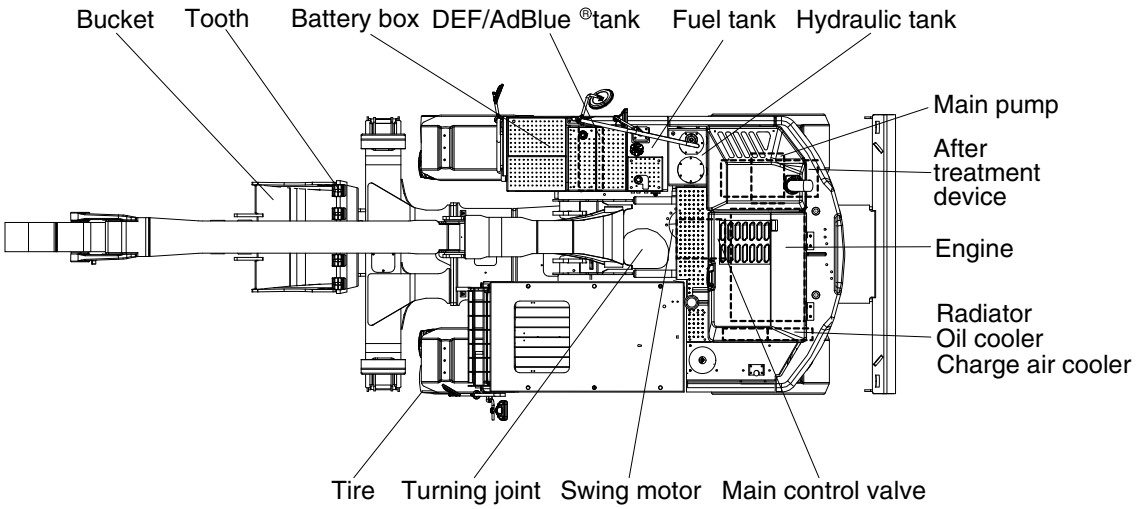


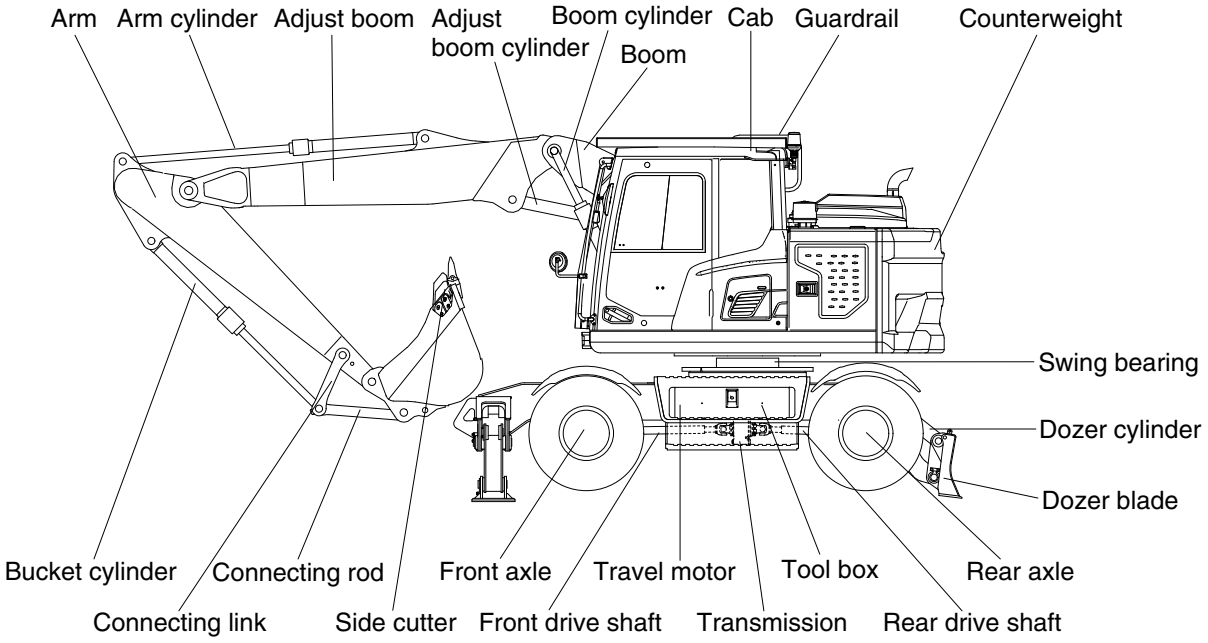
LIVE WITH SAFETY

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

GROUP 2 SPECIFICATIONS

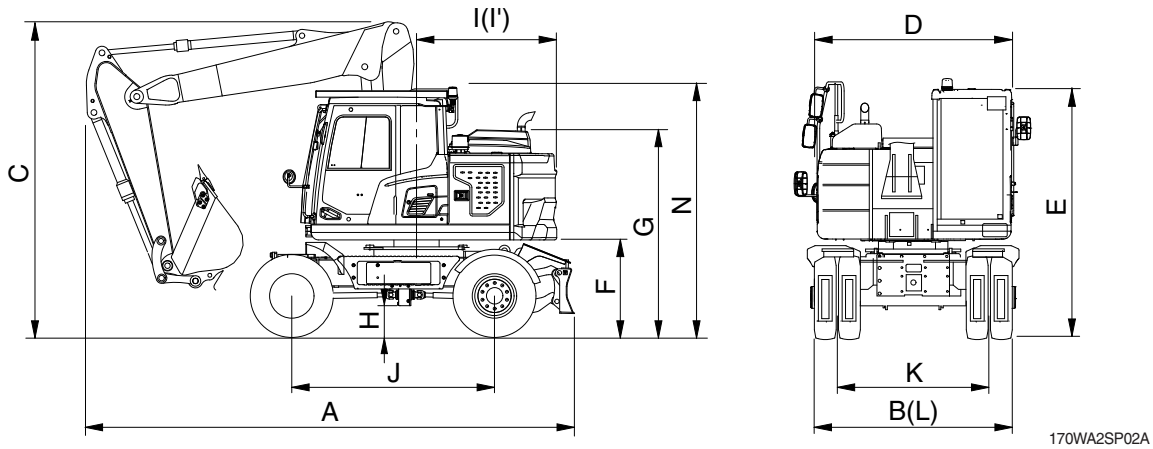
1. MAJOR COMPONENT





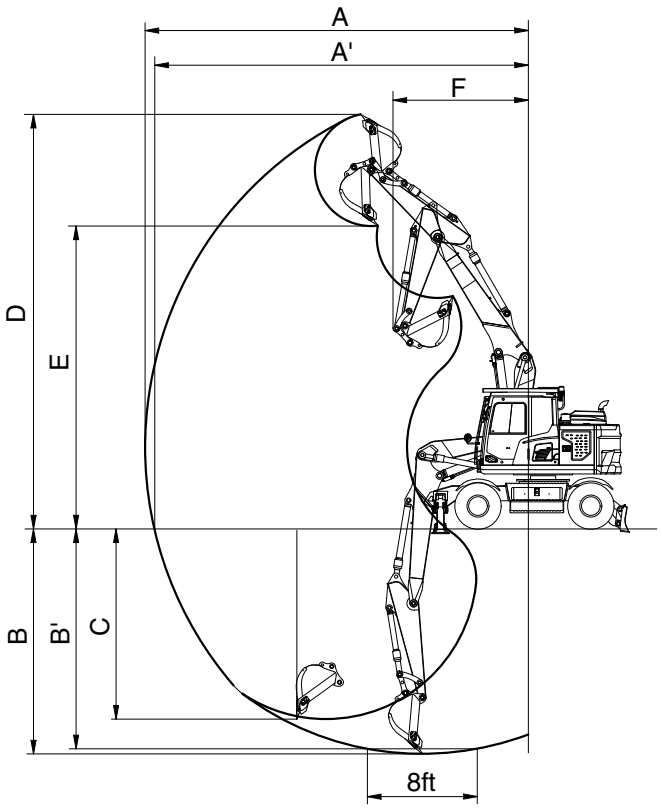
170WA2SP01

2. SPECIFICATIONS



Description			Unit		Specification		
			m (ft-in)	Boom	5.0 (16' 5")		
				Arm	2.45 (8' 0")	2.00 (6' 7")	2.60 (8' 6")
Operating weight			kg (lb)		18820 (41490)	18780 (41400)	18890 (41650)
Bucket capacity (SAE heaped), standard			m^3 (yd^3)		0.70 (0.92)	0.70 (0.92)	0.70 (0.92)
Overall length (traveling)		A	mm (ft-in)		6310 (20' 8")	6340 (20' 10")	6250 (20' 6")
Overall length (shipping)					8290 (27' 2")	8330 (27' 4")	8250 (27' 1")
Overall width		B			2530 (8' 4")	2530 (8' 4")	2530 (8' 4")
Overall height of boom		C			3990 (13' 1")	4000 (13' 1")	4000 (13' 1")
Upperstructure width		D			2500 (8' 2")	2500 (8' 2")	2500 (8' 2")
Cab height		E			3220 (10' 7")	3220 (10' 7")	3220 (10' 7")
Ground clearance of counterweight		F			1265 (4' 2")	1265 (4' 2")	1265 (4' 2")
Engine cover height		G			2730 (8' 11")	2730 (8' 11")	2730 (8' 11")
Minimum ground clearance		H			370 (1' 3")	370 (1' 3")	370 (1' 3")
Rear-end distance		I			1830 (6' 0")	1830 (6' 0")	1830 (6' 0")
Rear-end swing radius		I'			1830 (6' 0")	1830 (6' 0")	1830 (6' 0")
Wheel base		J			2600 (8' 6")	2600 (8' 6")	2600 (8' 6")
Tread	Std axle	K			1944 (6' 5")	1944 (6' 5")	1944 (6' 5")
	Wide axle				2114 (6' 11")	2114 (6' 11")	2114 (6' 11")
Dozer blade width		L			2530 (8' 4")	3275 (10' 9")	2530 (8' 4")
Overall height of guardrail		N			3275 (10' 9")	3275 (10' 9")	3275 (10' 9")
Travel speed		Low	km/hr (mph)		10 (6.2)	10 (6.2)	10 (6.2)
		High			35 (21.7)	35 (21.7)	35 (21.7)
		Creep			3 (1.9)	3 (1.9)	3 (1.9)
Swing speed			rpm		9.50	9.50	9.50
Gradeability			Degree (%)		35 (70)	35 (70)	35 (70)
Max traction force			kg (lb)		10506	10506	10506

3. WORKING RANGE AND DIGGING POWER



170WA2SP05

Description		2.45 m (8' 0") Arm	2.00 m (6' 7") Arm	2.60 m (8' 6") Arm
Max digging reach	A	8950 (29' 4")	8490 (27' 10")	9020 (29' 7")
Max digging reach on ground	A'	8750 (28' 8")	8280 (27' 2")	8820 (28' 11")
Max digging depth	B	5440 (17' 10")	4980 (16' 4")	5565 (18' 3")
Max digging depth (8 ft level)	B'	5340 (17' 6")	4870 (16' 0")	5460 (17' 11")
Max vertical wall digging depth	C	4680 (15' 4")	4150 (13' 7")	4680 (15' 4")
Max digging height	D	9785 (32' 1")	9370 (30' 9")	9680 (31' 9")
Max dumping height	E	7060 (23' 2")	6660 (21' 10")	6980 (22' 11")
Min swing radius	F	3040 (10' 0")	3380 (11' 1")	3500 (11' 6")
Bucket digging force	SAE	98.0 [106.9]	98.2 [107.1]	98.3 [107.3]
		9992 [10900]	10008 [10920]	10026 [10940]
		22030 [24030]	22060 [24070]	22100 [24120]
	ISO	114.8 [125.2]	115.0 [125.4]	115.2 [125.6]
		11706 [12770]	11726 [12790]	11746 [12810]
		25810 [28150]	25850 [28200]	25900 [28240]
Arm digging force	SAE	67.3 [73.4]	84.8 [92.5]	66.7 [72.8]
		6858 [7480]	8648 [9430]	6798 [7420]
		15120 [16490]	19070 [20790]	14990 [16360]
	ISO	70.4 [76.8]	89.4 [97.6]	69.7 [76.0]
		7178 [7830]	9118 [9950]	7106 [7750]
		15830 [17260]	20100 [21940]	15670 [17090]

[ ] : Power boost

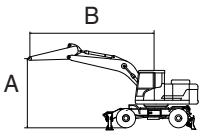
4. WEIGHT

Item	HW170A CR	
	kg	lb
Upperstructure assembly	9260	20410
· Main frame weld assembly	1213	2670
· Engine assembly	378	830
· Aftertreatment assembly	64	140
· Main pump assembly	91	200
· Main control valve assembly	144	320
· Swing motor assembly	148	330
· Hydraulic oil tank WA	135	300
· Fuel tank WA	138	300
· Counterweight	4200	9260
· Cab assembly	495	1090
Lower chassis assembly	5860	12920
· Lower frame weld assembly	1552	3420
· Swing bearing	260	570
· Travel motor assembly (2EA)	80	180
· Turning joint	117	258
· Transmission assembly	135	300
· Front axle assembly	637	1400
· Front axle assembly (wide)	655	1440
· Rear axle assembly	534	1180
· Rear axle assembly (wide)	547	1210
· Dozer blade assembly (front)	810	1786
· Dozer blade assembly (rear)	809	1784
· Front outrigger assembly	1046	2310
· Rear outrigger assembly	1046	2310
Front attachment assembly (5.0 m 2-piece boom, 2.45 m arm, 0.58 m^3 SAE heaped bucket)	3700	8160
· 5.0 m 2-piece boom assembly	1094	2410
· 2.45 m arm assembly	488	1080
· 2.00 m arm assembly	457	1010
· 2.60 m arm assembly	549	1210
· 0.70 m^3 SAE heaped bucket assembly	599	1320
· 0.76 m^3 SAE heaped bucket assembly	620	1370
· 0.89 m^3 SAE heaped bucket assembly	684	1510
· 1.05 m^3 SAE heaped bucket assembly	740	1630
· 0.73 m^3 SAE heaped bucket assembly	617	1360
· 0.85 m^3 SAE heaped bucket assembly	669	1470
· 0.69 m^3 SAE heaped bucket assembly	724	1600
· 0.75 m^3 SAE heaped bucket assembly	536	1180
· Bucket control link assembly	157	350
· Adjustable boom cylinder assembly (2EA)	266	590
· Arm cylinder assembly	169	370
· Bucket cylinder assembly	123	270
· Oscillating cylinder assembly (2EA)	94	207
· Adjustable cylinder assembly	209	460
· Outrigger cylinder assembly (2EA)	182	400
· Blade cylinder assembly (front) (2EA)	86	190
· Blade cylinder assembly (rear) (2EA)	86	190
· Front outrigger assembly	1045	2300
· Rear outrigger assembly	1046	2310

5. LIFTING CAPACITIES

Model	Type	Boom	Arm	Counterweight	Shoe	Wheel	Dozer		Outrigger	
HW170A CR	2-PIECE BOOM	Length [mm]	Length [mm]	weight [kg]	width [mm]	width [mm]	Front	Rear	Front	Rear
		5000	2000	4200	-	500	-	Down	-	-

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



Lift-point height (A)		Lift-point radius (B)						At max. reach		
		3.0 m (9.8 ft)		4.5 m (14.8 ft)		6.0 m (19.7 ft)		Capacity		Reach
										m (ft)
7.5 m (24.6 ft)	kg							*4790	*4790	4.19
	lb							*10560	*10560	(13.8)
6.0 m (19.7 ft)	kg			*4310	*4310			*4390	3240	5.75
	lb			*9500	*9500			*9680	7140	(18.9)
4.5 m (14.8 ft)	kg			*4930	4680	*4350	3000	4000	2550	6.60
	lb			*10870	10320	*9590	6610	8820	5620	(21.7)
3.0 m (9.8 ft)	kg			*6070	4350	4560	2880	3570	2250	7.03
	lb			*13380	9590	10050	6350	7870	4960	(23.1)
1.5 m (4.9 ft)	kg			6770	4070	4430	2750	3450	2160	7.12
	lb			14930	8970	9770	6060	7610	4760	(23.4)
0.0 m (0.0 ft)	kg			6630	3940	4340	2680	3600	2240	6.87
	lb			14620	8690	9570	5910	7940	4940	(22.5)
-1.5 m (-4.9 ft)	kg	*10340	7320	6630	3950	4360	2690	4140	2570	6.24
	lb	*22800	16140	14620	8710	9610	5930	9130	5670	(20.5)

Note 1. Lifting capacity are based on ISO 10567.

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

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

4. *Indicates load limited by hydraulic capacity.

※ Lifting capacities are based upon a standard machine conditions.
Lifting capacities will vary with different work tools, ground conditions and attachments.
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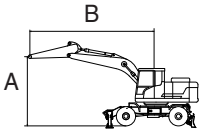
⚠ Failure to comply to the rated load can cause surious injury, death, or property damage. Make adjustments to the rated load as necessory for non-standard configurations.

Model	Type	Boom	Arm	Counterweight	Shoe	Wheel	Dozer		Outrigger	
HW170A CR	2-PIECE BOOM	Length [mm]	Length [mm]	weight [kg]	width [mm]	width [mm]	Front	Rear	Front	Rear
		5000	2000	4200	-	500	-	Up	-	-

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



Lift-point height (A)		Lift-point radius (B)						At max. reach		
		3.0 m (9.8 ft)		4.5 m (14.8 ft)		6.0 m (19.7 ft)		Capacity		Reach
										m (ft)
7.5 m (24.6 ft)	kg							*4790	*4790	4.19
	lb							*10560	*10560	(13.8)
6.0 m (19.7 ft)	kg			*4310	*4310			*4390	2920	5.75
	lb			*9500	*9500			*9680	6440	(18.9)
4.5 m (14.8 ft)	kg			*4930	4220	*4350	2700	4000	2290	6.60
	lb			*10870	9300	*9590	5950	8820	5050	(21.7)
3.0 m (9.8 ft)	kg			*6070	3900	4560	2590	3570	2020	7.03
	lb			*13380	8600	10050	5710	7870	4450	(23.1)
1.5 m (4.9 ft)	kg			6770	3620	4430	2460	3450	1930	7.12
	lb			14930	7980	9770	5420	7610	4250	(23.4)
0.0 m (0.0 ft)	kg			6630	3500	4340	2390	3600	2000	6.87
	lb			14620	7720	9570	5270	7940	4410	(22.5)
-1.5 m (-4.9 ft)	kg	*10340	6400	6630	3510	4360	2400	4140	2290	6.24
	lb	*22800	14110	14620	7740	9610	5290	9130	5050	(20.5)

Note 1. Lifting capacity are based on ISO 10567.

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

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

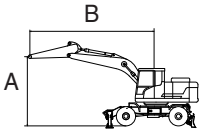
4. *Indicates load limited by hydraulic capacity.

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

⚠ Failure to comply to the rated load can cause surious injury, death, or property damage. Make adjustments to the rated load as necessory for non-standard configurations.

Model	Type	Boom	Arm	Counterweight	Shoe	Wheel	Dozer		Outrigger	
HW170A CR	2-PIECE BOOM	Length [mm]	Length [mm]	weight [kg]	width [mm]	width [mm]	Front	Rear	Front	Rear
		5000	2450	4200	-	500	-	Down	-	-

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



Lift-point height (A)		Lift-point radius (B)								At max. reach		
		3.0 m (9.8 ft)		4.5 m (14.8 ft)		6.0 m (19.7 ft)		7.5 m (24.6 ft)		Capacity		Reach
												m (ft)
7.5 m (24.6 ft)	kg			*4040	*4040					*3280	*3280	4.95
	lb			*8910	*8910					*7230	*7230	(16.2)
6.0 m (19.7 ft)	kg			*3820	*3820	*3900	3070			*2780	*2780	6.31
	lb			*8420	*8420	*8600	6770			*6130	*6130	(20.7)
4.5 m (14.8 ft)	kg			*4470	*4470	*4010	3020			*2600	2260	7.10
	lb			*9850	*9850	*8840	6660			*5730	4980	(23.3)
3.0 m (9.8 ft)	kg			*5630	4410	*4480	2880	*2610	2020	*2590	2020	7.50
	lb			*12410	9720	*9880	6350	*5750	4450	*5710	4450	(24.6)
1.5 m (4.9 ft)	kg			*6770	4080	4420	2740	3180	1980	*2700	1940	7.58
	lb			*14930	8990	9740	6040	7010	4370	*5950	4280	(24.9)
0.0 m (0.0 ft)	kg			6600	3910	4310	2640			*2980	2010	7.35
	lb			14550	8620	9500	5820			*6570	4430	(24.1)
-1.5 m (-4.9 ft)	kg	*9110	7170	6560	3880	4280	2620			*3530	2250	6.77
	lb	*20080	15810	14460	8550	9440	5780			*7780	4960	(22.2)
-3.0 m (-9.8 ft)	kg			*6380	3970							
	lb			*14070	8750							

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Model	Type	Boom	Arm	Counterweight	Shoe	Wheel	Dozer		Outrigger	
HW170A CR	2-PIECE BOOM	Length [mm]	Length [mm]	weight [kg]	width [mm]	width [mm]	Front	Rear	Front	Rear
		5000	2450	4200	-	500	-	Up	-	-

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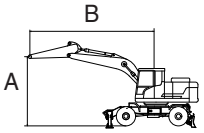

Lift-point height (A)		Lift-point radius (B)								At max. reach		
		3.0 m (9.8 ft)		4.5 m (14.8 ft)		6.0 m (19.7 ft)		7.5 m (24.6 ft)		Capacity		Reach
												m (ft)
7.5 m (24.6 ft)	kg			*4040	*4040					*3280	*3280	4.95
	lb			*8910	*8910					*7230	*7230	(16.2)
6.0 m (19.7 ft)	kg			*3820	*3820	*3900	2770			*2780	2510	6.31
	lb			*8420	*8420	*8600	6110			*6130	5530	(20.7)
4.5 m (14.8 ft)	kg			*4470	4290	*4010	2730			*2600	2030	7.10
	lb			*9850	9460	*8840	6020			*5730	4480	(23.3)
3.0 m (9.8 ft)	kg			*5630	3950	*4480	2590	*2610	1810	*2590	1810	7.50
	lb			*12410	8710	*9880	5710	*5750	3990	*5710	3990	(24.6)
1.5 m (4.9 ft)	kg			*6770	3640	4420	2450	3180	1760	*2700	1730	7.58
	lb			*14930	8020	9740	5400	7010	3880	*5950	3810	(24.9)
0.0 m (0.0 ft)	kg			6600	3470	4310	2350			*2980	1790	7.35
	lb			14550	7650	9500	5180			*6570	3950	(24.1)
-1.5 m (-4.9 ft)	kg	*9110	6260	6560	3430	4280	2330			*3530	2010	6.77
	lb	*20080	13800	14460	7560	9440	5140			*7780	4430	(22.2)
-3.0 m (-9.8 ft)	kg			*6380	3520							
	lb			*14070	7760							

Note 1. Lifting capacity are based on ISO 10567.

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Model	Type	Boom	Arm	Counterweight	Shoe	Wheel	Dozer		Outrigger	
HW170A CR	2-PIECE BOOM	Length [mm]	Length [mm]	weight [kg]	width [mm]	width [mm]	Front	Rear	Front	Rear
		5000	2600	4200	-	500	-	Down	-	-

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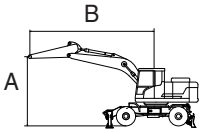

Lift-point height (A)		Lift-point radius (B)								At max. reach		
		3.0 m (9.8 ft)		4.5 m (14.8 ft)		6.0 m (19.7 ft)		7.5 m (24.6 ft)		Capacity		Reach
												m (ft)
7.5 m (24.6 ft)	kg			*3810	*3810					*3480	*3480	5.15
	lb			*8400	*8400					*7670	*7670	(16.9)
6.0 m (19.7 ft)	kg			*3660	*3660	*3740	3090			*2990	2680	6.47
	lb			*8070	*8070	*8250	6810			*6590	5910	(21.2)
4.5 m (14.8 ft)	kg			*4310	*4310	*3900	3030			*2830	2190	7.24
	lb			*9500	*9500	*8600	6680			*6240	4830	(23.7)
3.0 m (9.8 ft)	kg			*5480	4430	*4390	2890	3230	2020	*2820	1960	7.63
	lb			*12080	9770	*9680	6370	7120	4450	*6220	4320	(25.0)
1.5 m (4.9 ft)	kg			*6660	4090	4420	2740	3170	1970	*2950	1890	7.71
	lb			*14680	9020	9740	6040	6990	4340	*6500	4170	(25.3)
0.0 m (0.0 ft)	kg			6590	3900	4300	2630			3150	1940	7.48
	lb			14530	8600	9480	5800			6940	4280	(24.5)
-1.5 m (-4.9 ft)	kg	*8880	7130	6540	3850	4270	2600			3520	2170	6.91
	lb	*19580	15720	14420	8490	9410	5730			7760	4780	(22.7)
-3.0 m (-9.8 ft)	kg			*6510	3930							
	lb			*14350	8660							

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Model	Type	Boom	Arm	Counterweight	Shoe	Wheel	Dozer		Outrigger	
HW170A CR	2-PIECE BOOM	Length [mm]	Length [mm]	weight [kg]	width [mm]	width [mm]	Front	Rear	Front	Rear
		5000	2600	4200	-	500	-	Up	-	-

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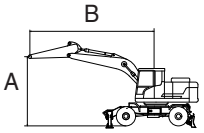

Lift-point height (A)		Lift-point radius (B)								At max. reach		
		3.0 m (9.8 ft)		4.5 m (14.8 ft)		6.0 m (19.7 ft)		7.5 m (24.6 ft)		Capacity		Reach
												m (ft)
7.5 m (24.6 ft)	kg			*3810	*3810					*3480	*3480	5.15
	lb			*8400	*8400					*7670	*7670	(16.9)
6.0 m (19.7 ft)	kg			*3660	*3660	*3740	2790			*2990	2420	6.47
	lb			*8070	*8070	*8250	6150			*6590	5340	(21.2)
4.5 m (14.8 ft)	kg			*4310	*4310	*3900	2740			*2830	1970	7.24
	lb			*9500	*9500	*8600	6040			*6240	4340	(23.7)
3.0 m (9.8 ft)	kg			*5480	3970	*4390	2600	3230	1810	*2820	1750	7.63
	lb			*12080	8750	*9680	5730	7120	3990	*6220	3860	(25.0)
1.5 m (4.9 ft)	kg			*6660	3640	4420	2450	3170	1760	*2950	1680	7.71
	lb			*14680	8020	9740	5400	6990	3880	*6500	3700	(25.3)
0.0 m (0.0 ft)	kg			6590	3460	4300	2340			3150	1730	7.48
	lb			14530	7630	9480	5160			6940	3810	(24.5)
-1.5 m (-4.9 ft)	kg	*8880	6210	6540	3410	4270	2310			3520	1930	6.91
	lb	*19580	13690	14420	7520	9410	5090			7760	4250	(22.7)
-3.0 m (-9.8 ft)	kg			*6510	3490							
	lb			*14350	7690							

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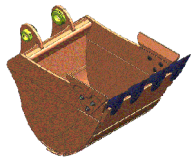
6. BUCKET SELECTION GUIDE

1) DOZER BLADE UP

General bucket

Heavy duty

Ditch cleaning



Hammerless tooth

Type	Capacity		Width		Weight	Tooth	2-PIECE Recommendation mm (ft-in) 5.0 m (16' 5") Boom		
	SAE Heaped	CECE heaped	Without side cutter	With side cutter					
	m^3 (yd^3)	m^3 (yd^3)	mm (in)	mm (in)	kg (lb)	EA	2.0 m (6' 7") Arm	2.45 m (8' 0") Arm	2.6 m (8' 6") Arm
General bucket	0.70 (0.92)	0.60 (0.78)	1020 (40.2")	1100 (43.3")	600 (1320)	5	◐	■	■
	0.76 (0.99)	0.65 (0.85)	1010 (39.8")	1170 (46.1")	620 (1370)	5	■	▲	▲
	0.89 (1.16)	0.77 (1.01)	1170 (46.1")	1325 (52.2")	680 (1500)	6	▲	▲	X
	1.05 (1.37)	0.90 (1.18)	1355 (53.3")	1510 (59.4")	740 (1630)	6	X	X	X
Heavy duty	0.69 (0.90)	0.62 (0.81)	1025 (40.4")	-	720 (1590)	5	◐	■	▲
Ditch cleaning	0.75 (0.98)	0.65 (0.85)	1820 (71.7")	-	540 (1190)	0	◐	■	■
Hammer -less tooth	0.73 (0.95)	0.67 (0.88)	914 (36.0")	946 (37.2")	620 (1370)	5	◐	■	▲
	0.85 (1.11)	0.76 (0.99)	1067 (42.0")	1096 (43.1")	670 (1480)	5	■	▲	▲

● Applicable for materials with density of 2100 kg/m^3 (3500 lb/yd^3) or less

◐ Applicable for materials with density of 1800 kg/m^3 (3000 lb/yd^3) or less

■ Applicable for materials with density of 1500 kg/m^3 (2500 lb/yd^3) or less

▲ Applicable for materials with density of 1200 kg/m^3 (2000 lb/yd^3) or less

X Not recommended

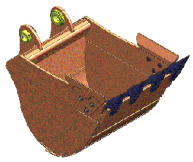
※ These recommendations are for general conditions and average use.
Work tools and ground conditions have effects on machine performance.
Select an optimum combination according to the working conditions and the type of work that is being done.
Consult your HD Hyundai Construction Equipment dealer for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

2) DOZER BLADE DOWN

General bucket

Heavy duty

Ditch cleaning



Hammerless tooth

Type	Capacity		Width		Weight	Tooth	2-PIECE		
							Recommendation mm (ft-in)		
	SAE Heaped	CECE heaped	Without side cutter	With side cutter			5.0 m (16' 5") Boom		
	m^3 (yd^3)	m^3 (yd^3)	mm (in)	mm (in)	kg (lb)	EA	2.0 m (6' 7") Arm	2.45 m (8' 0") Arm	2.6 m (8' 6") Arm
General bucket	0.70 (0.92)	0.60 (0.78)	1020 (40.2")	1100 (43.3")	600 (1320)	5	●	◐	◐
	0.76 (0.99)	0.65 (0.85)	1010 (39.8")	1170 (46.1")	620 (1370)	5	◐	■	■
	0.89 (1.16)	0.77 (1.01)	1170 (46.1")	1325 (52.2")	680 (1500)	6	■	▲	▲
	1.05 (1.37)	0.90 (1.18)	1355 (53.3")	1510 (59.4")	740 (1630)	6	▲	X	X
Heavy duty	0.69 (0.90)	0.62 (0.81)	1025 (40.4")	-	720 (1590)	5	●	◐	■
Ditch cleaning	0.75 (0.98)	0.65 (0.85)	1820 (71.7")	-	540 (1190)	0	●	◐	■
Hammer -less tooth	0.73 (0.95)	0.67 (0.88)	914 (36.0")	946 (37.2")	620 (1370)	5	◐	◐	■
	0.85 (1.11)	0.76 (0.99)	1067 (42.0")	1096 (43.1")	670 (1480)	5	■	■	▲

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

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

7. SPECIFICATIONS FOR MAJOR COMPONENTS

1) ENGINE

Item	Specification
Maker / Model	CUMMINS / B4.5
Type	4-cycle, turbocharged, charge air cooled, electronic controlled diesel engine
Cooling method	Water cooled
Number of cylinders and arrangement	4 cylinders, in-line
Firing order	1-3-2-4
Combustion chamber type	Direct injection type
Cylinder bore × stroke	107 × 124 mm (4.21" × 4.88")
Displacement	4.5 ℓ (275 cu in)
Compression ratio	17.2 : 1
Gross power	173 Hp (129 kW) at 2200 rpm
Net power	170 Hp (127 kW) at 2200 rpm
Max. power	173 Hp (129 kW) at 2200 rpm
Peak Torque	780 N · m (575 lb · ft) at 1500 rpm
Engine oil quantity	11 ℓ (2.9 U.S. gal)
Wet weight or Dry weight	378 kg (830 lb)
Starter motor	24 V-4.8 kW
Alternator	24 V-95 A
Battery	2 × 12 × 100 Ah

2) MAIN PUMP

Item	Specification
Type	Variable displacement piston pump
Capacity	145 cc/rev
Maximum pressure	350 kgf/cm^2 (4980 psi) [380 kgf/cm^2 (5400 psi)]
Rated oil flow	260 ℓ/min (68.7 U.S. gpm / 57.2 U.K. gpm)
Rated speed	1800 rpm

[ ]: Power boost

3) STEERING PUMP

Item	Specification
Type	Fixed displacement gear pump single stage
Capacity	35cc/rev
Maximum pressure	210 kgf/cm^2 (2990 psi)
Rated oil flow	60 ℓ /min (15.9 U.S. gpm/13.2 U.K. gpm)

4) MAIN CONTROL VALVE

Item	Specification
Type	Section block
Operating method	Hydraulic pilot system
Main relief valve pressure	350 kgf/cm^2 (4980 psi)
Main relief valve pressure (power boost)	380 kgf/cm^2 (5400 psi)
Overload relief valve pressure	420 kgf/cm^2 (5970 psi)

5) SWING UNIT

Item	Specification
Type	Radial piston motor
Capacity	1687 cc/rev
Relief pressure	270 kgf/cm^2 (3840 psi)
Braking system	Automatic, spring applied hydraulic released
Brake release pressure	15~40 kgf/cm^2 (213~569 psi)
Reduction gear type	-

6) TRAVEL MOTOR

Item	Specification
Type	Variable displacement bent-axis axial piston motor
Relief pressure	380 kgf/cm^2 (5400 psi)
Counter balance valve	Applied
Capacity (max/min)	140/51.8 cc/rev

7) POWER TRAIN

Item	Description		Specification
Transmission	Type		2 speed power shift transmission
	Gear ratio	1st	4.87
		2nd	1.20
	Clutch pressure		30~32 kgf /cm^2 (427~455 psi)
Parking brake	Type		Multi disc brake integrated in transmission
	Maximum braking torque		3286 kgf · m (23760 lbf · ft)
Axle	Type		4 wheel drive with differential
	Gear ratio		16.0
	Brake		Multi disc brake
	Brake pressure		81.6 kgf /cm^2 (1160 psi)
	Steering pressure		204 kgf /cm^2 (2900 psi)

8) POWER TRAIN GEAR PUMP

Item	Description
Capacity	Steering + brake : 11.9 + 19.3 cc / rev (pump PTO)
Rated flow	Steering + brake : 20 + 33 lpm (1800 rpm) (5.3 + 8.7 U.S. gpm / 4.4 + 7.3 U.K. gpm)

9) CYLINDER

Item		Specification
Arm cylinder	Bore dia × Rod dia × Stroke	Ø120× Ø80×1235 mm
	Cushion	Extend and retract
Bucket cylinder	Bore dia × Rod dia × Stroke	Ø105× Ø75×995 mm
	Cushion	Extend only
Dozer cylinder	Bore dia × Rod dia × Stroke	Ø110× Ø65×235 mm
	Cushion	-
Outrigger cylinder	Bore dia × Rod dia × Stroke	Ø125× Ø75×463 mm
	Cushion	-
Adjust cylinder	Bore dia × Rod dia × Stroke	Ø160× Ø95×624 mm
	Cushion	-
2-piece boom cylinder	Bore dia × Rod dia × Stroke	Ø110× Ø75×992 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. RECOMMENDED OILS

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

Service point	Kind of fluid	Capacity ℓ (U.S. gal)	Ambient temperature ˚C(˚F)
			-50 (-58) -30 (-22) -20 (-4) -10 (14) 0 (32) 10 (50) 20 (68) 30 (86) 40 (104)
Engine oil pan	Engine oil	11 (2.9)	★SAE 0W-40 ★SAE 5W-30 SAE 5W-40
Transmission case		2.5 (0.66)	SAE 15W-40
DEF/ AdBlue® tank	Mixture of urea and deionized water	48 (12.7)	ISO 22241, High-purity urea + deionized water (32.5:67.5)
Front axle	Gear oil	Center : 10.5 (2.77) Hub : 2.5×2 (0.66×2)	SAE 85W-90 LSD or UTTO
Rear axle		Center : 12.5 (3.30) Hub : 2.5×2 (0.66×2)	
Hydraulic tank	Hydraulic oil	Tank: 103 (27.2) System: 204 (53.9)	★ISO VG 15 ISO VG 32 ISO VG 46, HBHO★3 ISO VG 68
Fuel tank	Diesel fuel★1	200 (52.8)	★ASTM D975 NO.1 ASTM D975 NO.2
Fitting (Grease nipple)	Grease	As required	★NLGI NO.1 NLGI NO.2
Radiator (Reservoir tank)	Mixture of antifreeze and soft water★2	19.5 (5.5)	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 Materia
DEF : Diesel Exhaust Fluid, DEF compatible with AdBlue®

★ : Cold region (Russia, CIS, Mongolia)
★1 : Ultra low sulfur diesel
- sulfur content ≤ 10 ppm
★2 : Soft water
City water or distilled water
★3 : HD Hyundai Construction Equipment Bio Hydraulic Oil

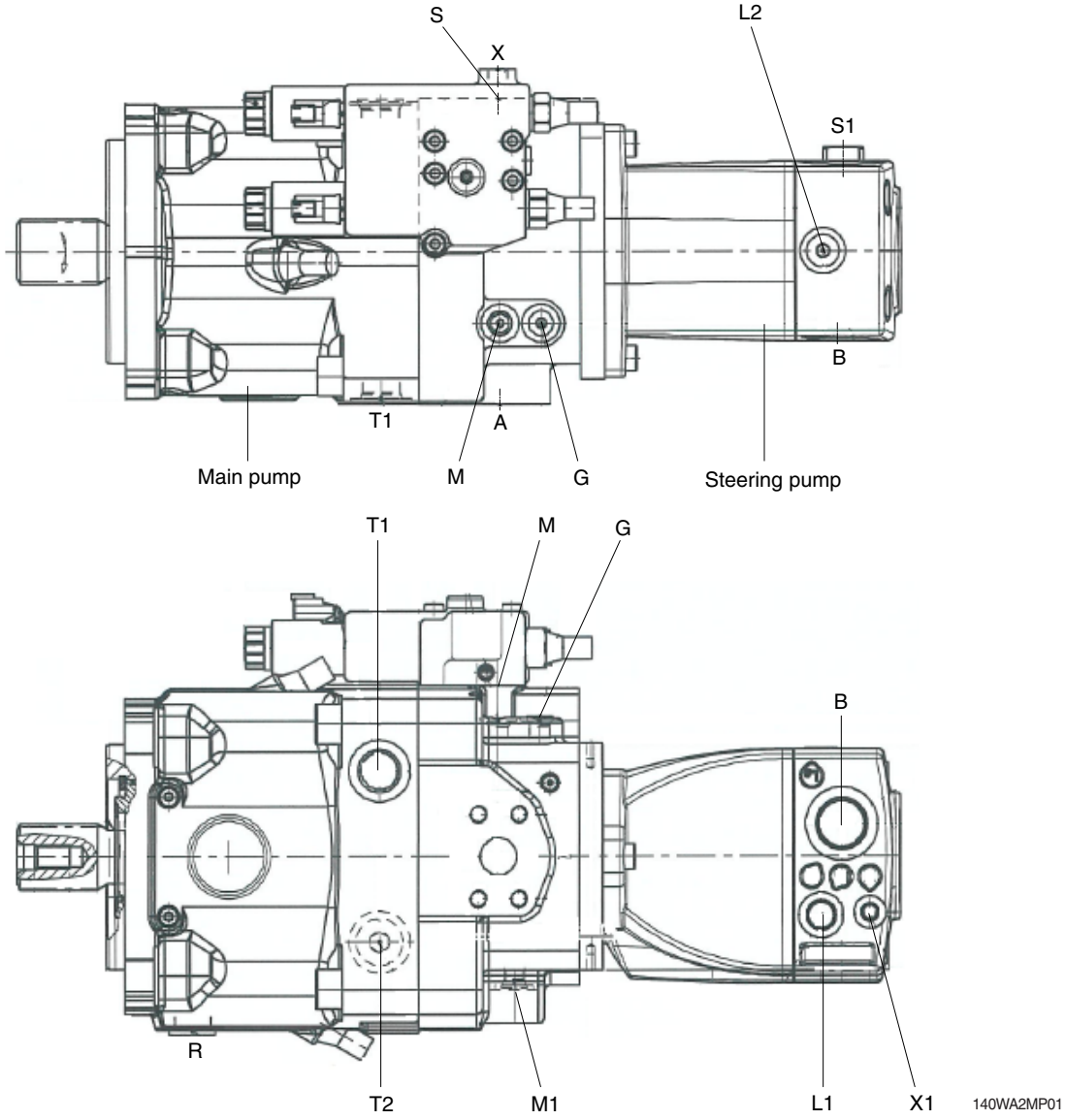
※ Using any lubricating oils other than HD Hyundai Construction Equipment genuine products may lead to a deterioration of performance and cause damage to major components.
※ Do not mix HD Hyundai Construction Equipment genuine oil with any other lubricating oil as it may result in damage to the systems 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 your local HD Hyundai Construction Equipment dealers.

SECTION 2 STRUCTURE AND FUNCTION

GROUP 1 PUMP DEVICE

1. STRUCTURE

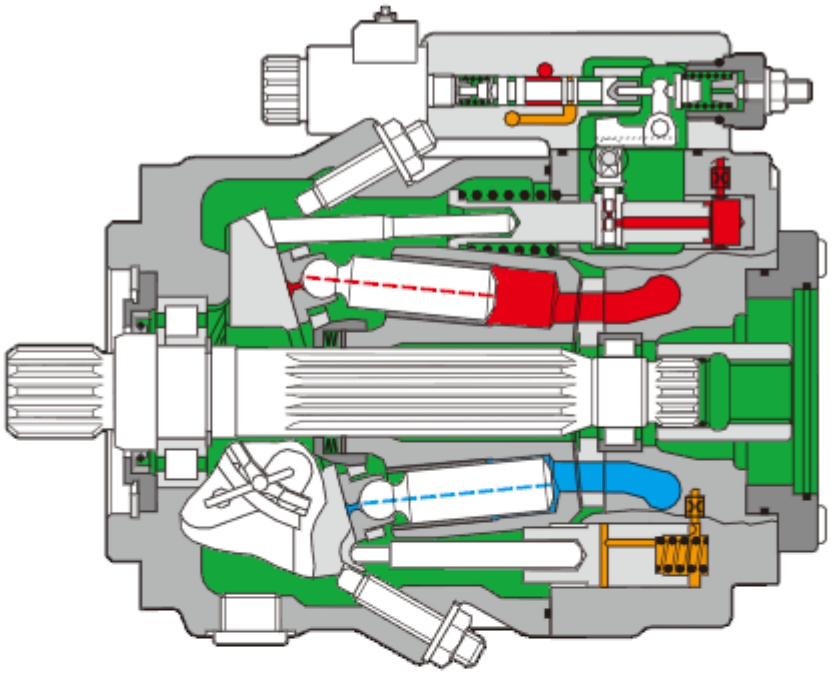
The pump device consists of main pump, and steering pump.

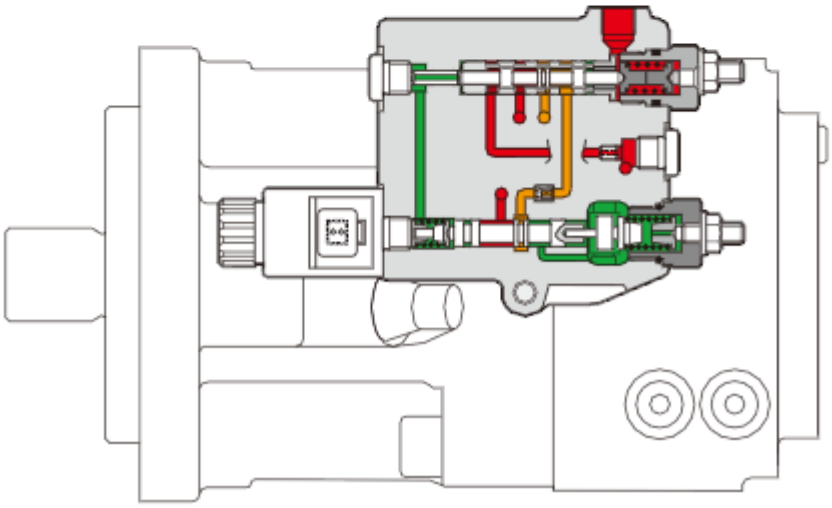


Port	Port name	Port size
A	Service port	1"
S	Suction port	3"
T1	Tank port	1 1/16-12UN
T2	Tank port	1 1/16-12UN
M1	Measuring stroking chamber	9/16-18UNF
M	Measuring service line	9/16-18UNF
R	Air bleed port	-
G	Control pressure port	9/16-18UNF
X	Pilot pressure port	9/16-18UNF
B	Service port	1 5/8-12UN
S1	Suction port	1 9/16-12UN
L1	Case drain port	3/4-16UNF
L2	Case drain port	3/4-16UNF
X1	Load sense port	7/16-20UNF

2. SCHEMATIC

1) MAIN PUMP





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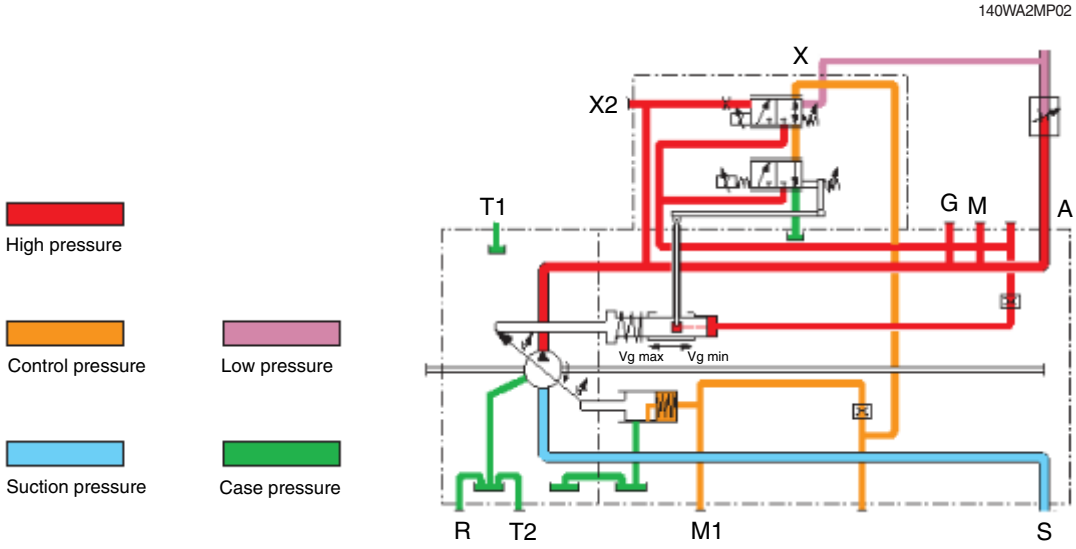
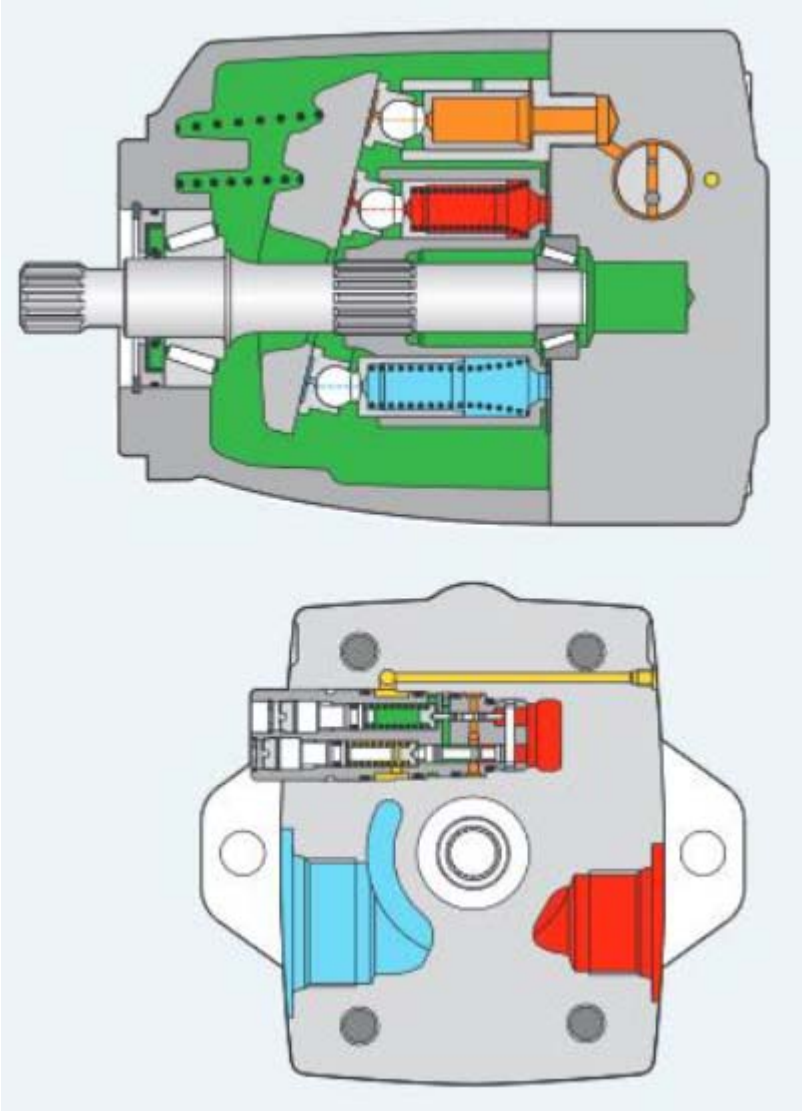
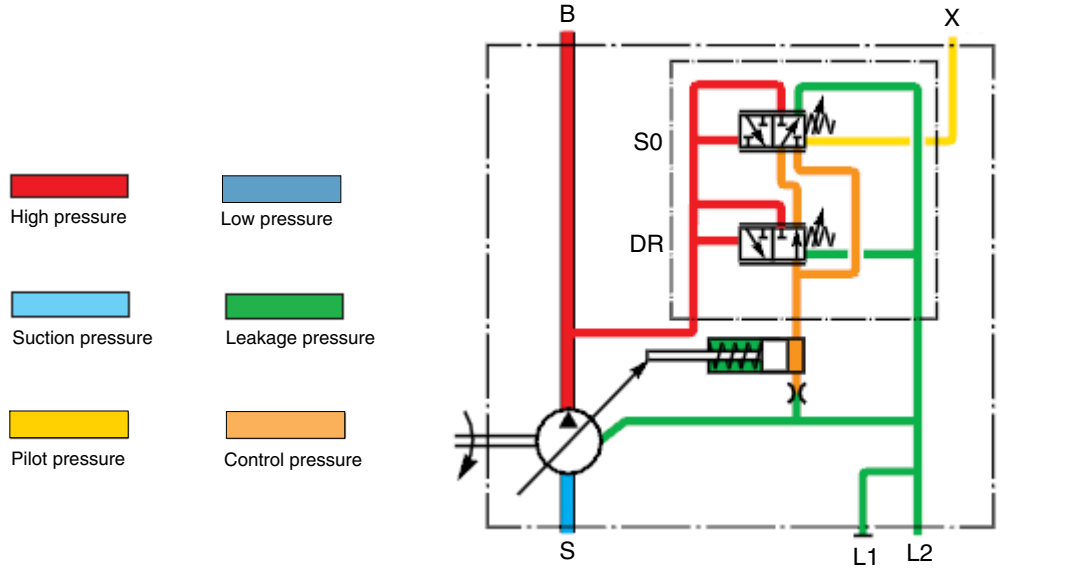


2) STEERING PUMP

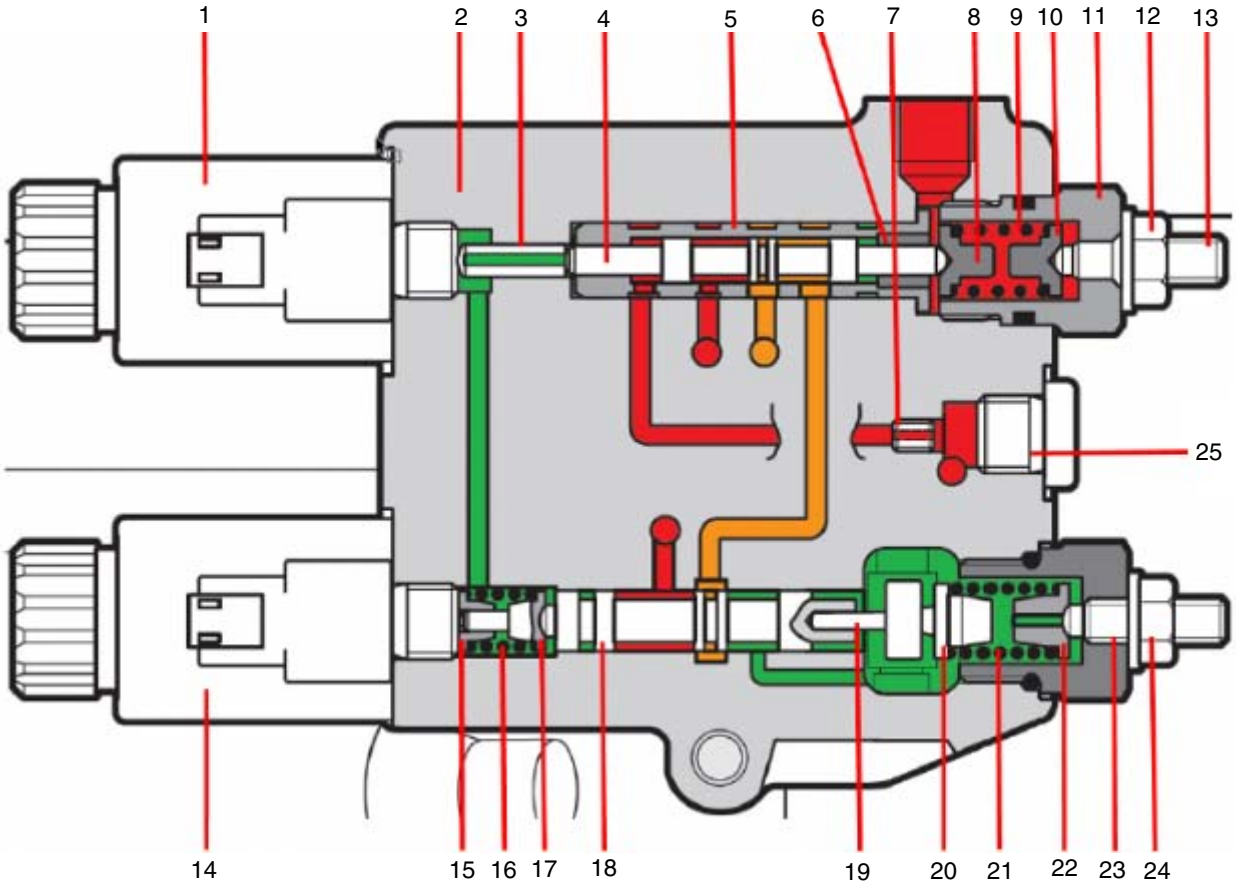




140WA2MP03

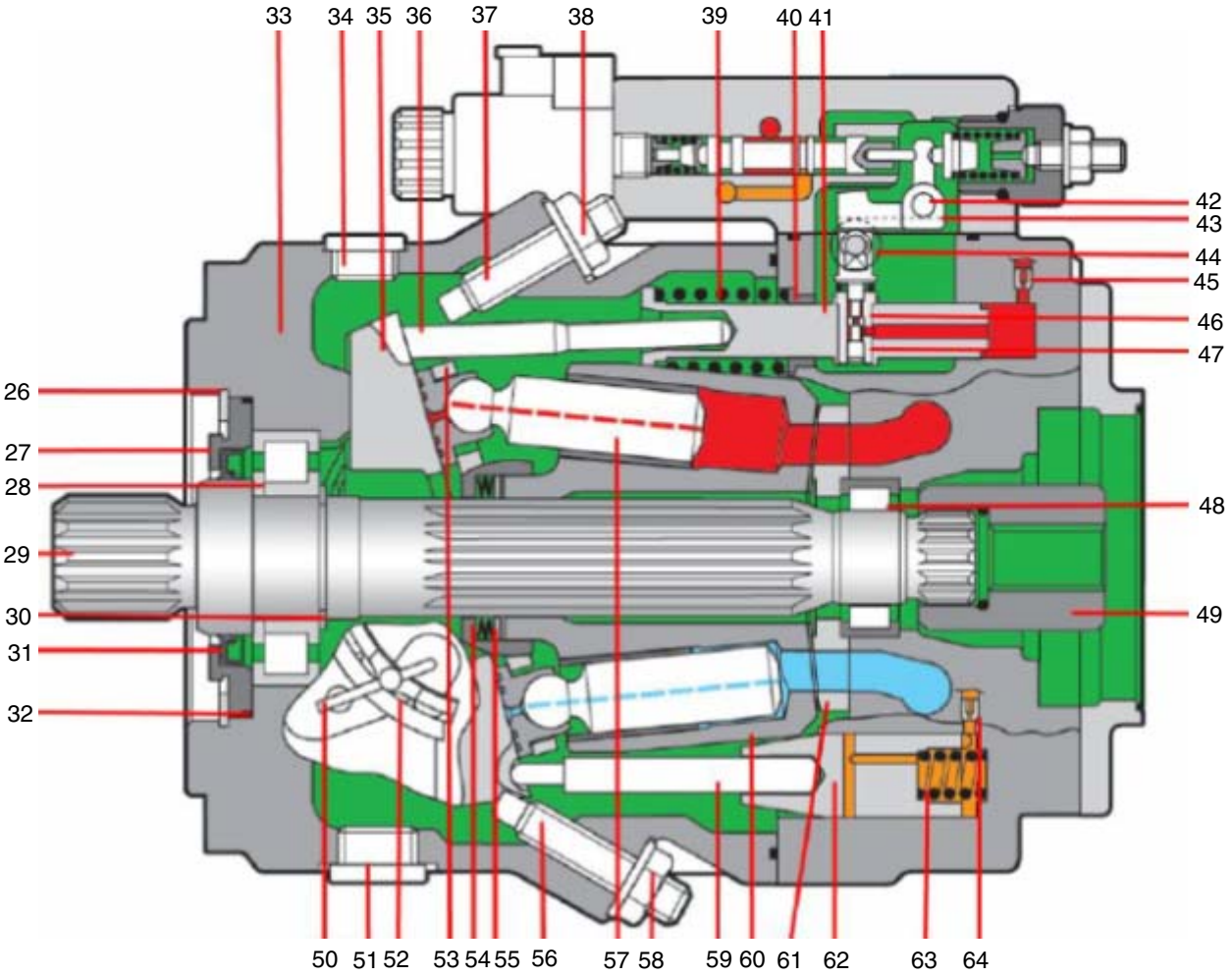
3. PART LIST

1) MAIN PUMP (1/2)



1	Prop. solenoid	10	Spring cup	19	Bolt
2	Control housing	11	Screw plug	20	Spring bolt
3	Pin	12	Sealing nut	21	Spring cup
4	Control piston LS	13	Set screw	22	Set screw
5	Control bushing LS	14	Prop. solenoid	23	Sealing nut
6	Bushing	15	Spring cup	24	Seal screw
7	Orifice	16	Spring	25	Screw plug
8	Spring cup	17	Spring cup		
9	Spring LS	18	Control piston LR		

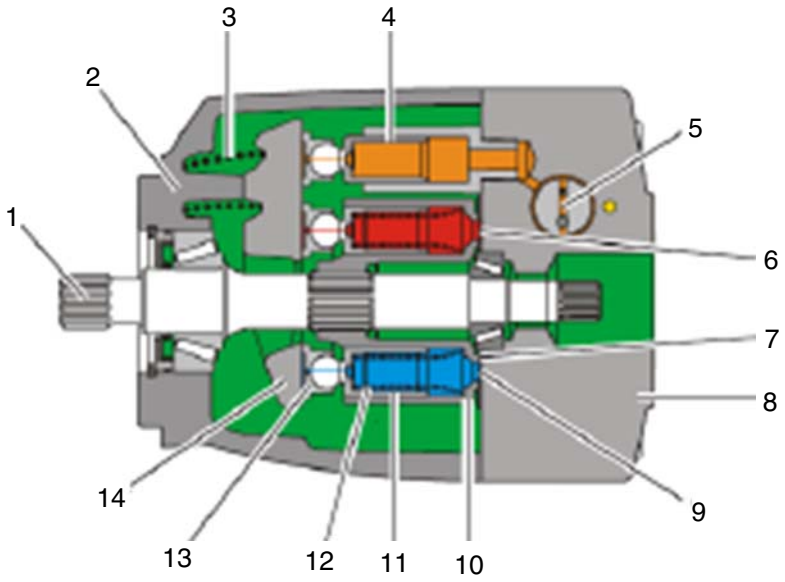
MAIN PUMP (2/2)



140WA2MP05

26	Snap ring	39	Spring	52	Cage pair
27	Locking ring	40	Bushing	53	Retaining plate
28	Cylinderical roller bearing	41	Adjusting bushing small	54	Retaining ball
29	Drive shaft	42	Bolt	55	Cup spring stack
30	Snap ring	43	Angle lever	56	Adjusting screw
31	Shaft seal ring	44	Measuring roll	57	Piston pad
32	O-ring	45	Orifice	58	Sealing nut
33	Housing	46	Measuring bushing	59	Adjusting rod big
34	Screw plug	47	Measuring piston	60	Cylinder
35	Cradle	48	Cylinderical roller bearing	61	Control plate
36	Adjusting rod small	49	Coupling hub	62	Adjusting bushing big
37	Adjusting screw	50	Wire	63	Spring
38	Sealing nut	51	Screw plug	64	Orifice

2) STEERING PUMP



140WA2MP06

1	Drive shaft	6	High pressure side	11	Piston
2	Case	7	Control plate	12	Spring in piston
3	Spring	8	Port plate	13	Slipper pad
4	Stroke piston	9	Suction side	14	Swash plate
5	Control vavle	10	Cylinder		

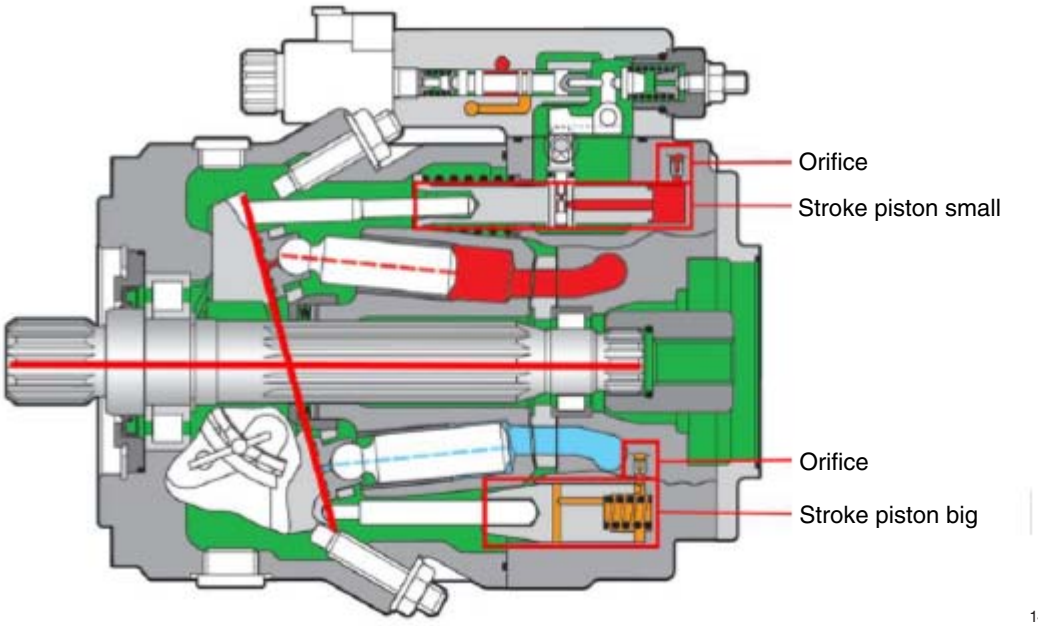
4. MAIN PUMP

1) FUNCTIONAL EXPLANATIONS

There is a priority between the individual controllers. The lowest priority has the LS controller with override function (S2).

The controller with the highest priority is the power control with override (LE2). This protects the diesel engine from overloading when the diesel engine is over-loaded.

(1) Basic function



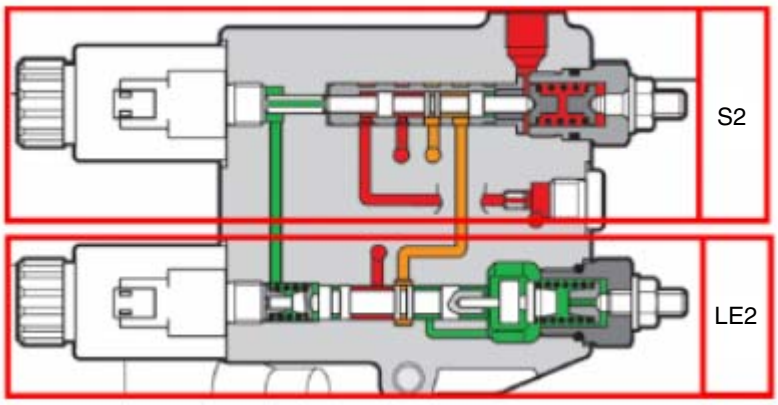
The basic function of the controllers is as follows. The high pressure (red) serves for the rotary group as a signal pressure. This pressure is send to a smaller stroke piston. This causes the rotary group to swivel to Vgmax (large swivel angle). This stroke pressure is send across the port plate to a bigger stroke piston. This is ensured by the larger piston area for the stroke pressure, inside the stroke piston we have area ratio of (2:1). If the forces of the stroke side are bigger than those of the high pressure side, then the unit swivel from Vgmax (large swivel angle) -> Vgmin (small swivel angle). The swivel time can additionally be influenced by two orifice.

You can measure the pressure of the smaller stroke piston at G and the pressure from the bigger stroke piston at M1.

As a special function, we also have a hydraulic Vgmin stop.

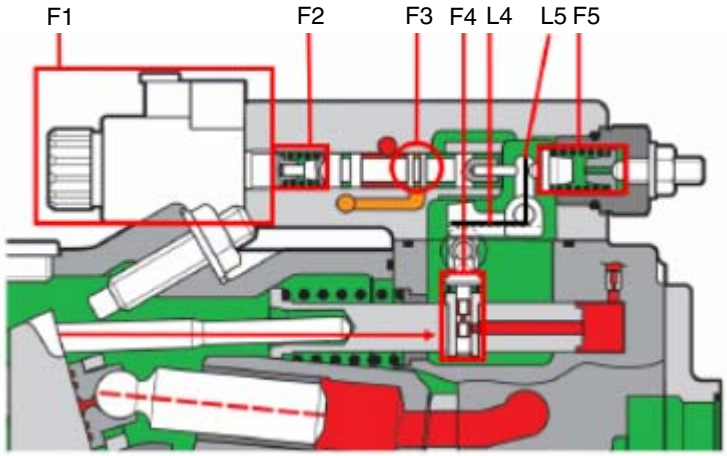
(2) Basic function controllers

The main pump has two controllers. A power controller (L) with electrical over-ride (E2) and a load sensing controller (S) with electrical override (2).



140WA2MP08

① Basic function power controller LE2



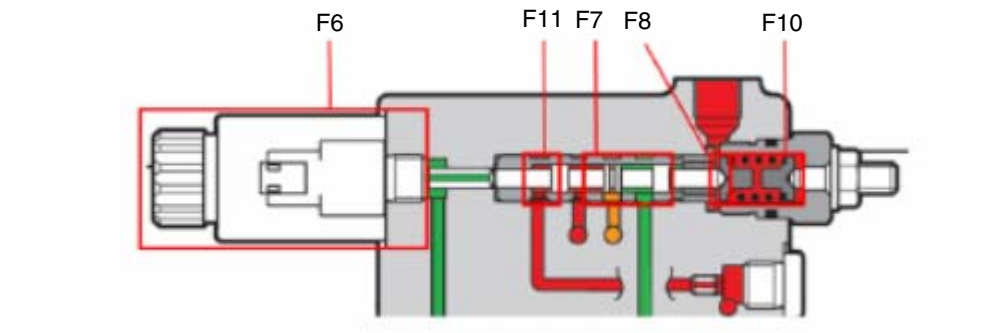
140WA2MP09

We first consider the basic function without the override.
The piston F3 has three functions.
- When the control edge is closed, the unit keeps its swing angle.
- When the control edge connects red and orange. The unit swivel until to Vgmin.
- When the control edge connects orange and green. The unit swivel until to Vgmax.

Two forces or torques act on the control piston. The first torque (D5) is set constantly. It consists of the spring force F5 and the lever arm L5. The second torque (D4) consists of the lever arm L4 and the force that is generated on the piston F4. F4 = (area x high pressure) If the torque of D4 is greater than that of D5. The unit swivel to Vgmin. This reduce the angle lever arm L4 until the torques are balanced again.
F4 X L4 = M = F5 X L5

Power override
The solenoid force F1 enables us to generate a new force that acts directly against the spring force F5 and thus reduces the force F4 required.
We can say: Higher current = lower power setting

② Load sensing controller S2



140WA2MP10

We first consider the basic function without the override.
The piston F7 has three functions.
- When the control edge is closed, the unit keeps its swivel angle.
- When the control edge connects red and orange. The unit swivel until to Vgmin.
- When the control edge connects orange and green. The unit swivel until to Vgmax.

With the load sensing controller, we consider the high pressure of the pump (F11) and the external load pressure (F8). The control ⊿p is set via the spring force (F10).

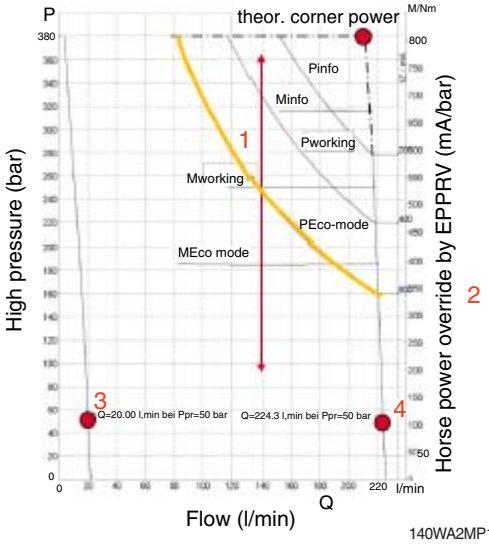
We can say F11 = F8 + F10.

If F11 is greater than F8 + F10, the unit swivel to Vgmin until it balances again. The spring force F8 is fixed. To change the ⊿p during the operation. We have the possi-bility to generate a new force via the solenoid F6.

We can say: higher current = smaller ⊿p setting.

2) ADJUSTMENT

(1) Power controller



140WA2MP11

P-Q diagram

1 Individual power control (hyperbolic regulator)
2 With load limiting control via solenoid
3. Qmin setting
4. Qmax setting

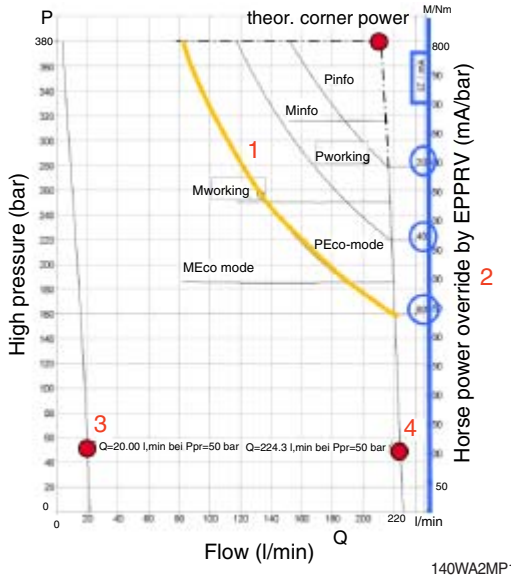
Because the power controller can be overridden with a solenoid. It need the following three points of information for the setting point.
Current, swivel angle of the pump and ⊿p pressure.

First we come to the swivel angle of the pump. Here is important that the unit stand on Vgman. You can check this over the measuring port G and M1. You should see the high pressure on G and no or a lower pressure than 1 (pressure on G) to 3 (pressure at M1). Than check, that you don´t limited the Vg with the stroke limiter screw.

Current: You need the current from the diagram on the solenoid for the override function.
Pressure: You need the high pressure from the p-Q diagram on the measuring port G.

Example for the yellow line: pressure: 160 bar, current 600mA, Vg=145ccm
(q=145ccmX1600 l/min /1000=232 liter)

(2) Power controller override (load limiting control)



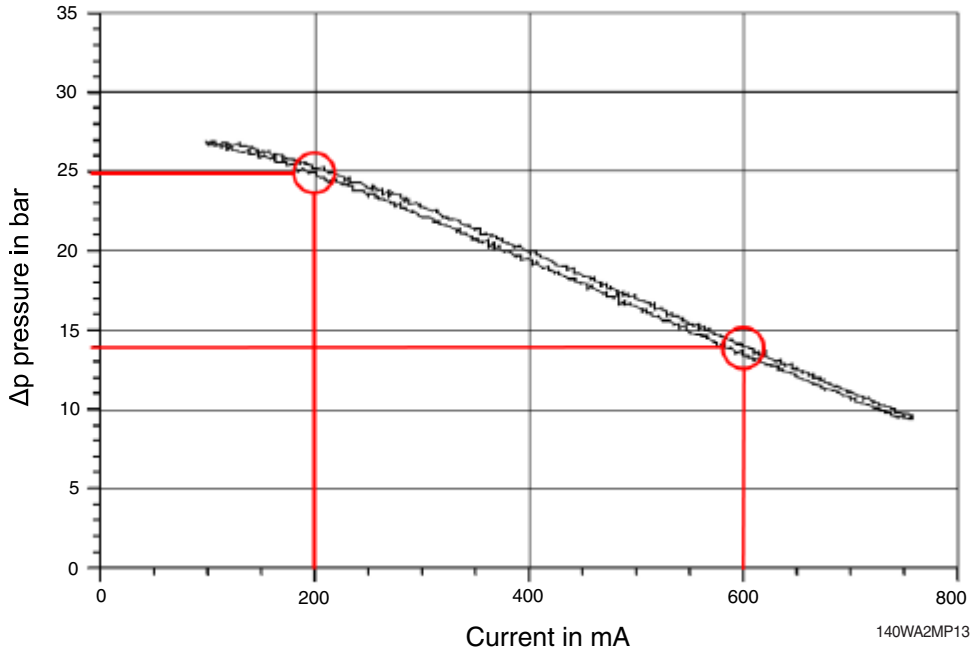
140WA2MP12

P-Q diagram

1 Individual power control (hyperbolic regulator)
2 With load limiting control via solenoid
3. Qmin setting
4. Qmax setting

■ Power override IX3 via ECU (enging control unit)

(3) Load sensing controller



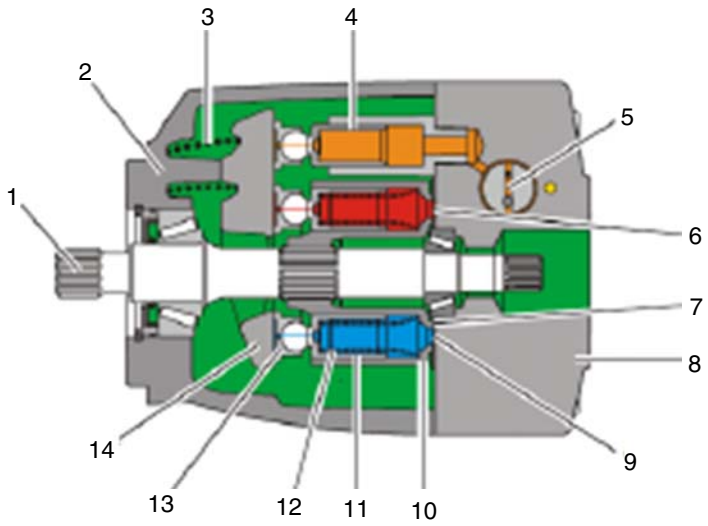
Because the LS controller can be overridden with a solenoid. It need the following two pieces of information for the setting point. Current and ⊿p pressure. You can get this information individually from your HD Hyundai Construction Equipment dealer.

If you have this information, drive the current at the override to the desired value and set the desired ⊿p using the control screw on the LS controller.

In the picture you see two examples.
You can give current to the controller with 200 mA and 25 bar ⊿p or 600 mA and 14 bar ⊿p. The result would be the same.
The controller moves on the characteristic from the diagram.

5. STEERING PUMP

1) FUNCTIONAL DESCRIPTIOM



140WA2MP03

1	Drive shaft	6	High pressure side	11	Piston
2	Case	7	Control plate	12	Spring in piston
3	Spring	8	Port plate	13	Slipper pad
4	Stroke piston	9	Suction side	14	Swash plate
5	Control vavle	10	Cylinder		

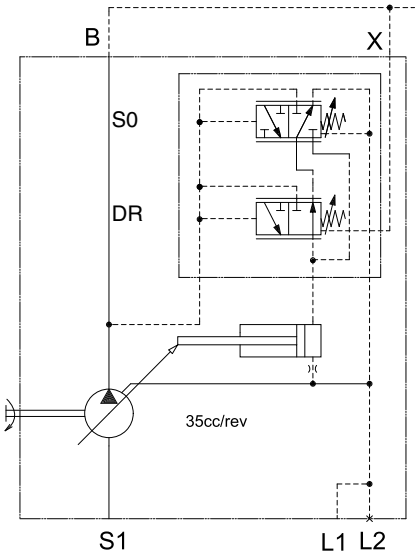
(1) Pump

Torque and rotational speed are applied to the drive shaft (1) by an engine. The drive shaft is connected by splines to the cylinder (10) to set this in motion. With every revolution, the pistons (11) in the cylinder bores execute one stroke whose magnitude depends on the setting of the swash plate (14). The slipper pads (13) are held on and guided along the glide surface of the swash plate by the spring in the piston (12). The swash plate setting during a rotation causes each piston to move over the bottom and top dead centers and back to its initial position. Here, hydraulic fluid is fed in and drained out through the two control slots in the control plate (7) according to the stroke displacement. On the suction side (9) hydraulic fluid flows into the piston chamber as the piston recedes. At the same time, on the high-pressure side (6) the fluid is pushed out of the cylinder chamber into the hydraulic system by the pistons.

(2) Control

The swivel angle of the swash plate (14) is steplessly variable. Controlling the swivel angle of the swash plate changes the piston stroke and therefore the displacement. The swivel angle is changed hydraulically by means of the stroke piston (4). The swash plate is mounted for easy motion in swivel bearings. When pressurized, the swash plate is held in balance by the swiveling forces of the rotary group, which are generated by the eccentrically mounted swash plate and by the control pressure. When depressurized, the spring (3) presses the swash plate to maximum swivel angle. Increasing the swivel angle increases the displacement; reducing the angle results in a corresponding reduction in displacement.

2) CONTROLLER (pressure controller with load sensing)



140WA2MP14

The pressure controller limits the maximum pressure at the pump outlet within the control range of the variable pump. The variable pump only supplies as much hy-draulic fluid as is required by the consumers. If the operating pressure exceeds the pressure setting at the pressure valve, the valve opens the connection from P-chan-nel (high pressure) to A-channel (stroking pressure) and the pump will regulate to a smaller displacement to reduce the control differential.

In addition to the pressure controller function, the load-sensing controller (S0) works as a flow controller to regulate the pump displacement to match the consumer flow requirement.

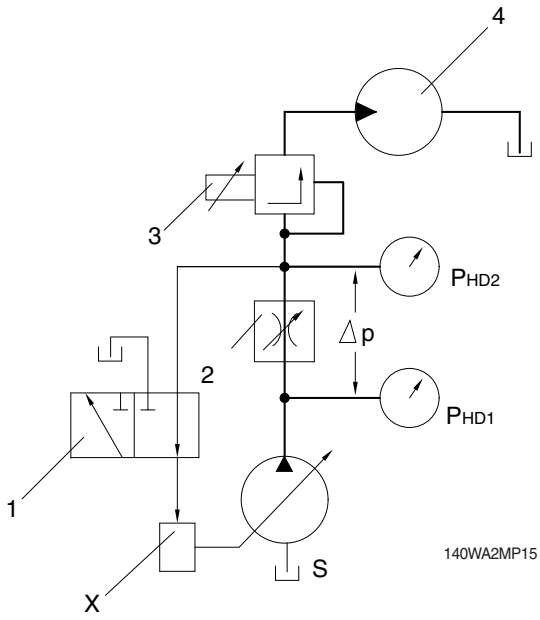
A variable orifice is used to adjust the differential pressure upstream and down-stream of the orifice. The flow controller is working like a pressure compensator to keep a constant delta p by comparing the high pressure against the load-sensing (LS) pressure plus spring preload. If the LS pressure plus spring preload exceeds the high pressure, the controller piston opens the connection from A-channel (stroking pressure) to T-channel (tank/housing) and the pump displacement will increase. If the high pressure exceeds the LS pressure plus spring preload, the controller pis-ton opens the connection from P-channel (high pressure) to A-channel (stroking pressure) and the pump displacement will decrease.

Basic position in depressurized state: Vg max

$$\text{Flow} \quad qv = \frac{Vg \times n \times \eta v}{1000} \; [\ell/\text{min}]$$

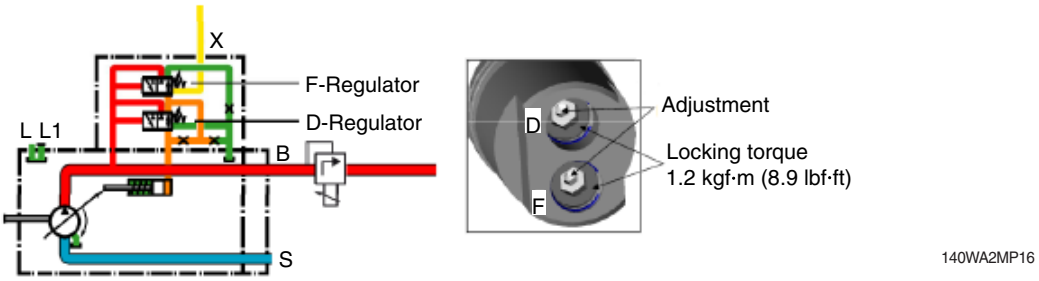
Vg - Displacement per revolution [cm^3]
n - Rotatinal speed (rpm)
ηv - Volumetric efficiency

3) ADJUSTMENT OF PRESSURE CONTROLLER WITH LOAD SENSING

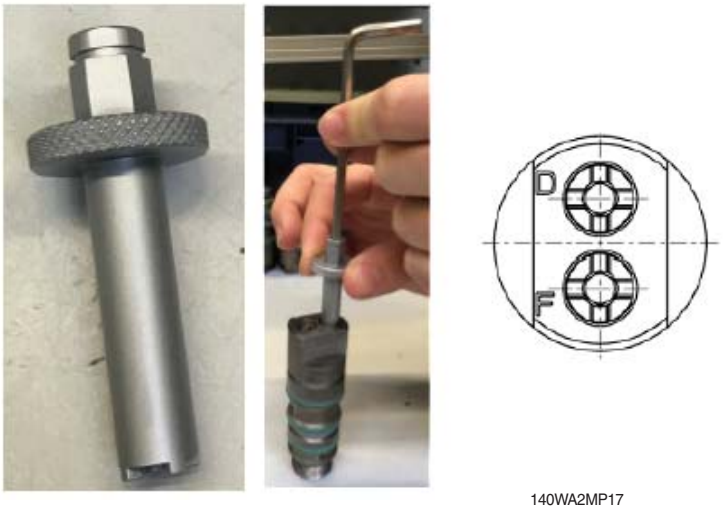


1 2/3 directional valve
2 Metering orifice/shut off valve
3 Load vavle
4 M1easuring motor, flow measuring device

Please note the mounting position of the controller and watch out for the notched letters:
D = Pressure controller
F = Flow controller

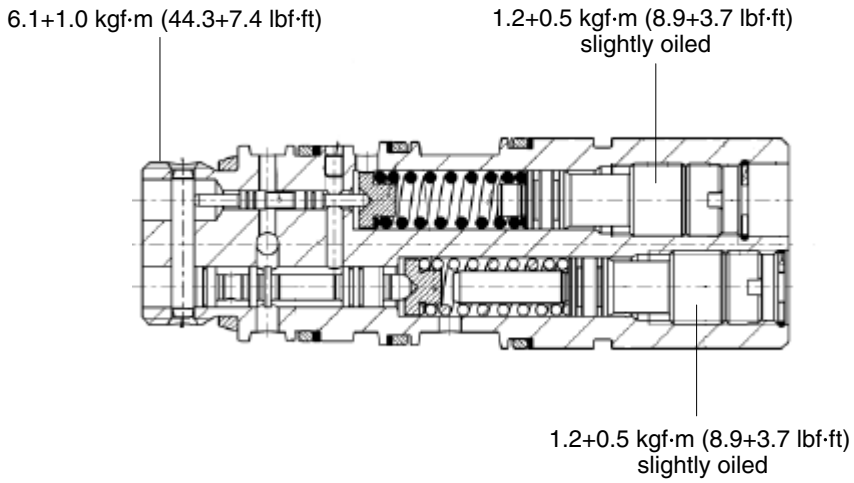


※ Special tool



For setting the controllers, we recommend using a special tool as you can see in the picture below. With this tool deviations of the values are prevented.

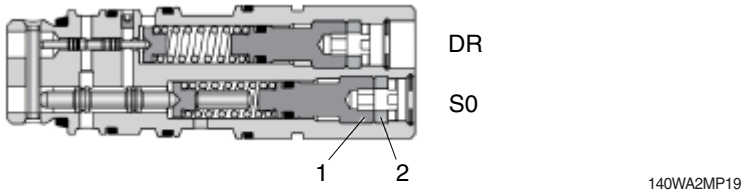
※ Tightening torque



(1) Adjustment of pressure controller (D)

Setting range until 250 bar

1. Turn adjusting screw of F-controller on block
2. Release the adjusting screw of D-controller
3. Close load valve
4. Tighten setting screw (1) of D-controller with lock nut (2) and 1.2+0.5 kgf·m torque until the pressure to be adjusted is reached (one revolution + 59.5 bar).



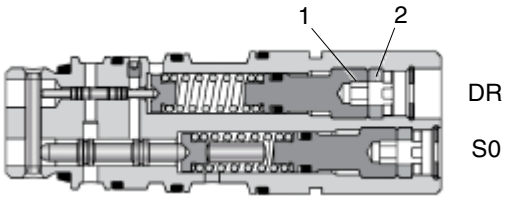
1 Setting screw 2 Lock nut

※ Upon setting without a special tool the following must be kept in mind:
After setting the controller setting screw (AF4) the set value can show an increase of approx. 7 bar due to tightening of the lock nut. The set values of the controller should therefore be correspondingly lower. Since especially new controllers can change their setting values in operation, due to settling of the springs, testing of the settings must be repeated 2-3 times, if needed correct settings. Make sure, that the load valve and the and the pressure control valve are unloaded. Setting of the pressure controller via the load valve according to the performance diagram.

(2) Adjustment of delta p setting (F)

Setting range 14 – 35 bar

1. Release the adjusting screw of F-controller
2. Release X-channel
3. Adjust standby-pressure at setting screw (1) (one revolution = 12.3 bar) and secure the lock nut (2) with a slotted screw driver (width 8.8 mm) with a torque of 1.2+0.5 kgf·m.



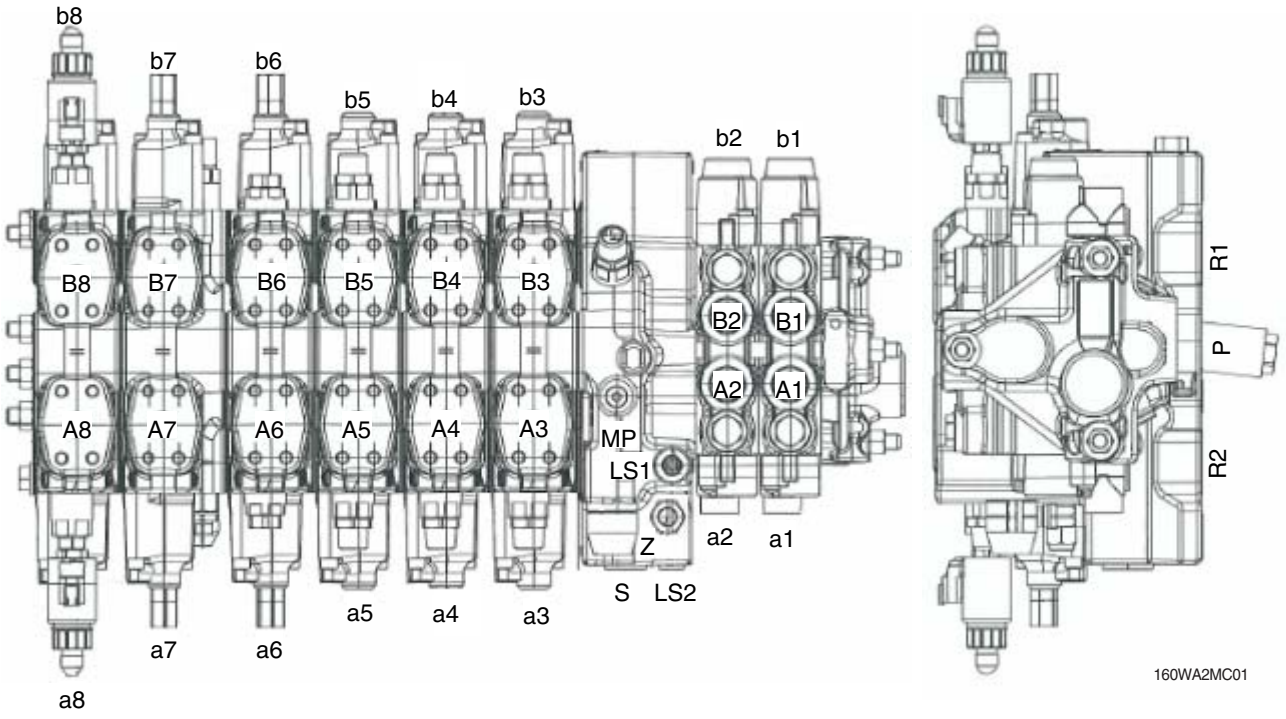
140WA2MP20

1 Setting screw 2 Lock nut

※ When settings are done without special tools, the following must be considered: After setting of the FR setting screw (AF4) the set value can be increased by approx. 1.5 bar through tightening of the lock nut. Therefore the set value of the FR controller should be set a bit lower. Since especially new controllers can change their setting values in operation, due to settling of the springs, testing of the settings must be repeated 2 to 3 times, if needed correct settings.

GROUP 2 MAIN CONTROL VALVE

1. OUTLINE

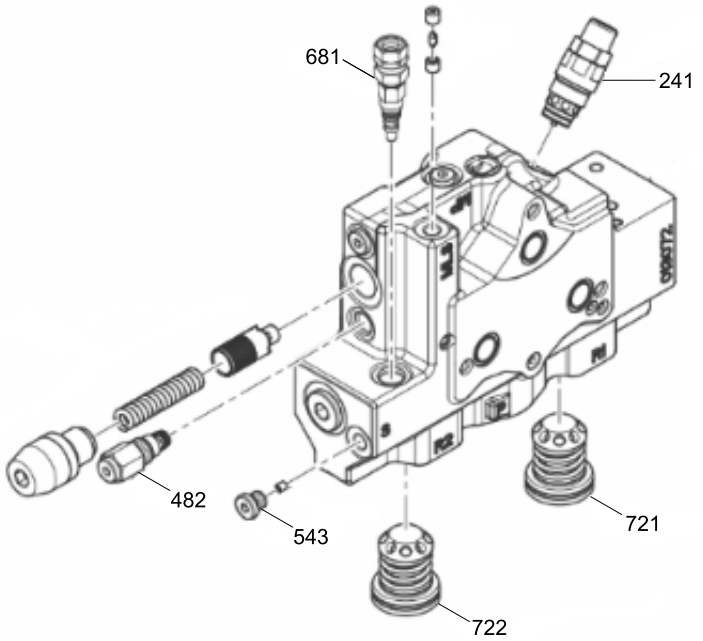


Mark	Port name
P	Pump port
R1	Tank port (cooler)
R2	Tank port
S	Make up port
LS1	Load sensing port
LS2	Pressure switch
MP	Plugged
Z	Power boost port
A1	Dozer down port
B1	Dozer up port
A2	2 pcs boom up port (opt)
B2	2 pcs boom down port (opt)
A3	Boom up port
B3	Boom down port
A4	Arm out port
B4	Arm in port
A5	Bucket in port
B5	Bucket out port
A6	Travel port (FW)
B6	Travel port (RR)

Mark	Port name
A7	Swing port (LH)
B7	Swing port (RH)
A8	Option port
B8	Option port
a1	Dozer down pilot port
b1	Dozer up pilot port
a2	2 pcs boom up pilot port (opt)
b2	2 pcs boom down pilot port (opt)
a3	Boom up pilot port
b3	Boom down pilot port
a4	Arm out pilot port
b4	Arm in pilot port
a5	Bucket in pilot port
b5	Bucket out pilot port
a6	Travel pilot port (FW)
b6	Travel pilot port (RR)
a7	Swing pilot port (LH)
b7	Swing pilot port (RH)
a8	Option pilot port
b8	Option pilot port

2. STRUCTURE

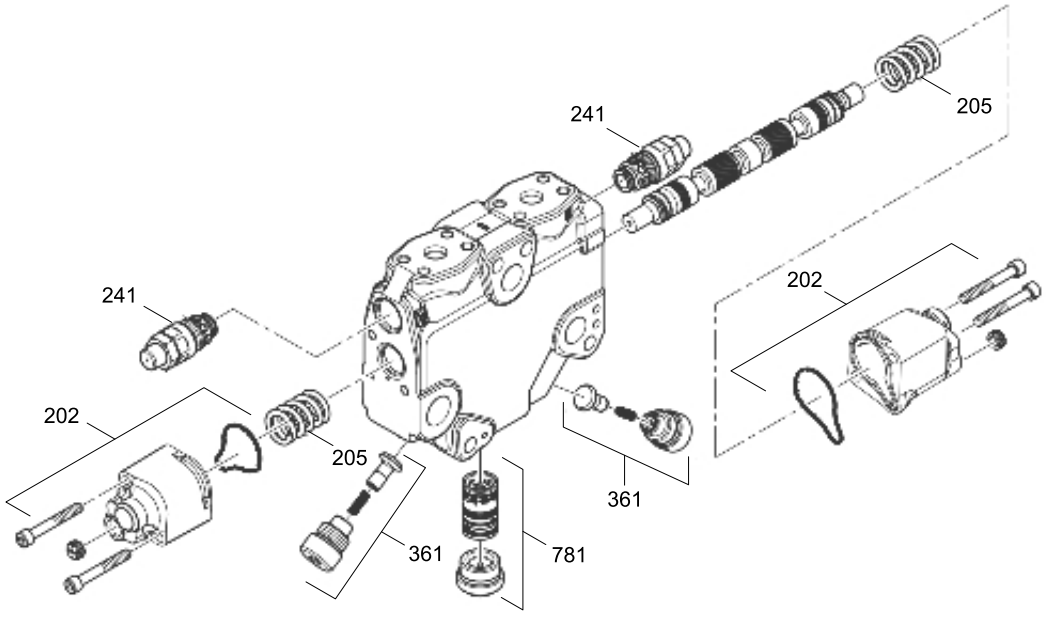
1) INLET SECTION



140WA2MC02

241	Pressure relief valve	543	Screw	721	Check valve
482	Flow valve	681	Pressure relief valve	722	Check valve

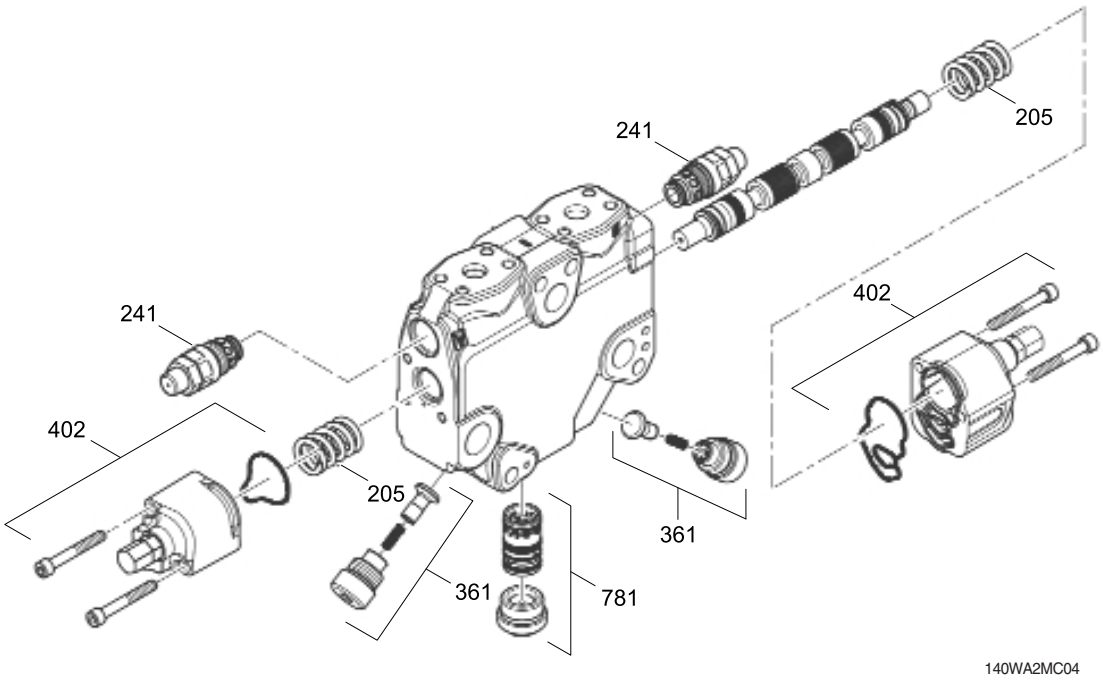
2) BOOM SECTION



140WA2MC03

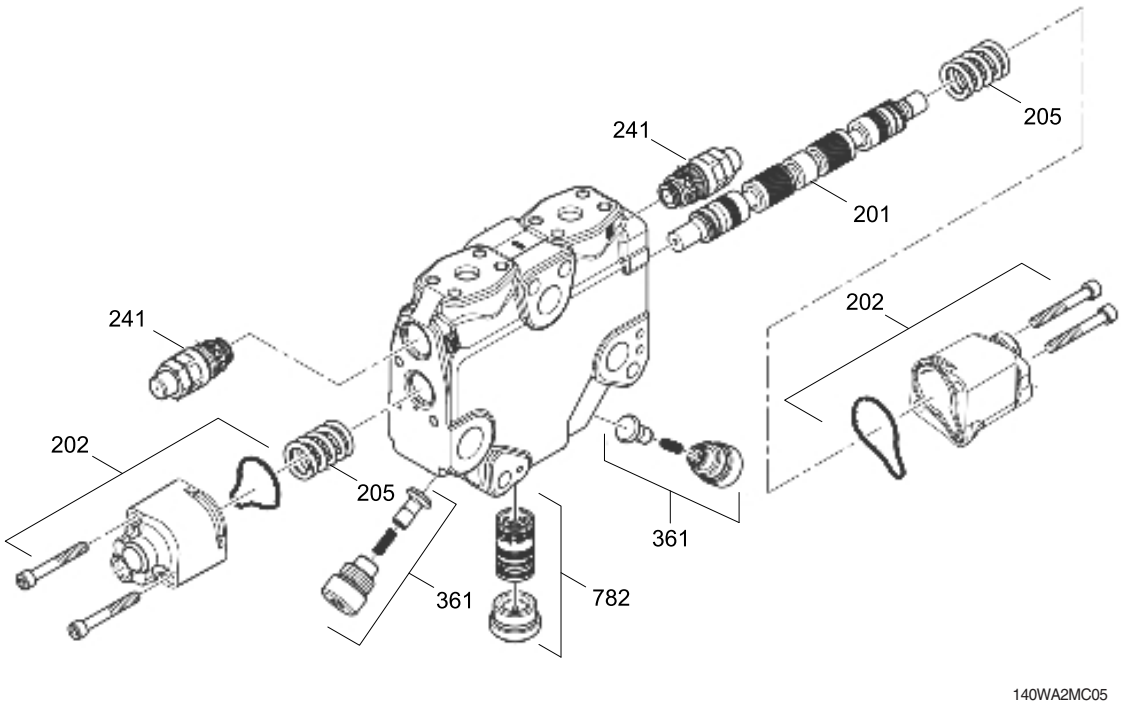
202	Cover assy	241	Pressure relief valve	781	Spool assy
205	Spring	361	Spool assy		

3) ARM SECTION



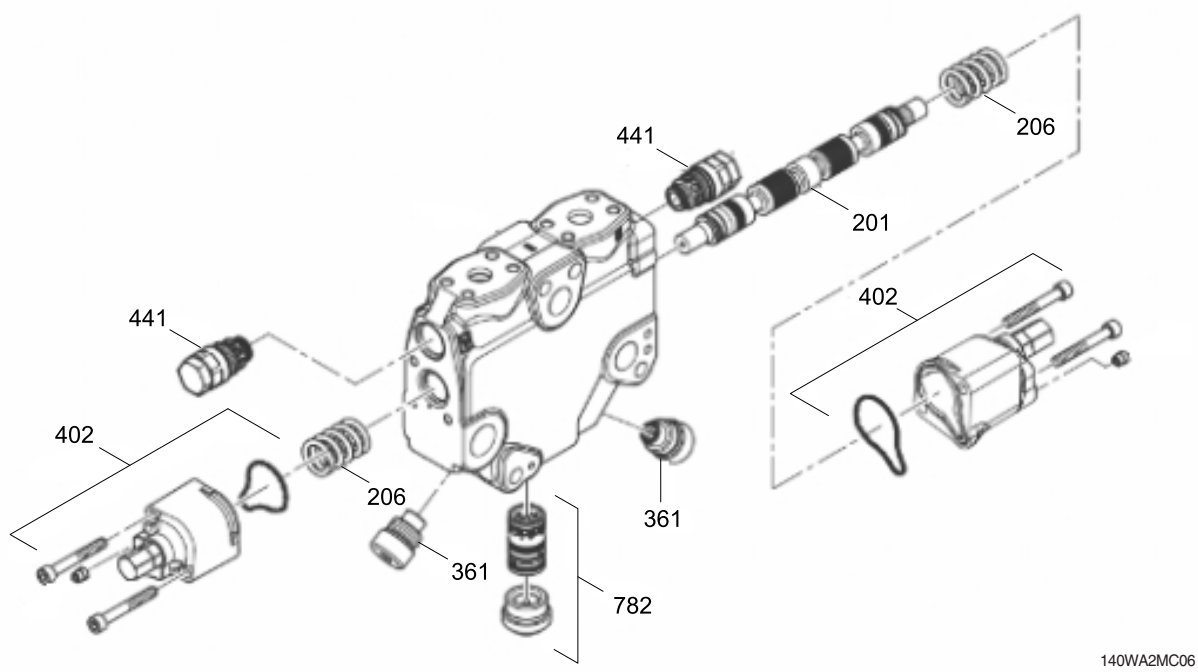
205 Spring
241 Pressure relief valve
361 Spool assy
402 Cover assy
781 Spool assy

4) BUCKET SECTION



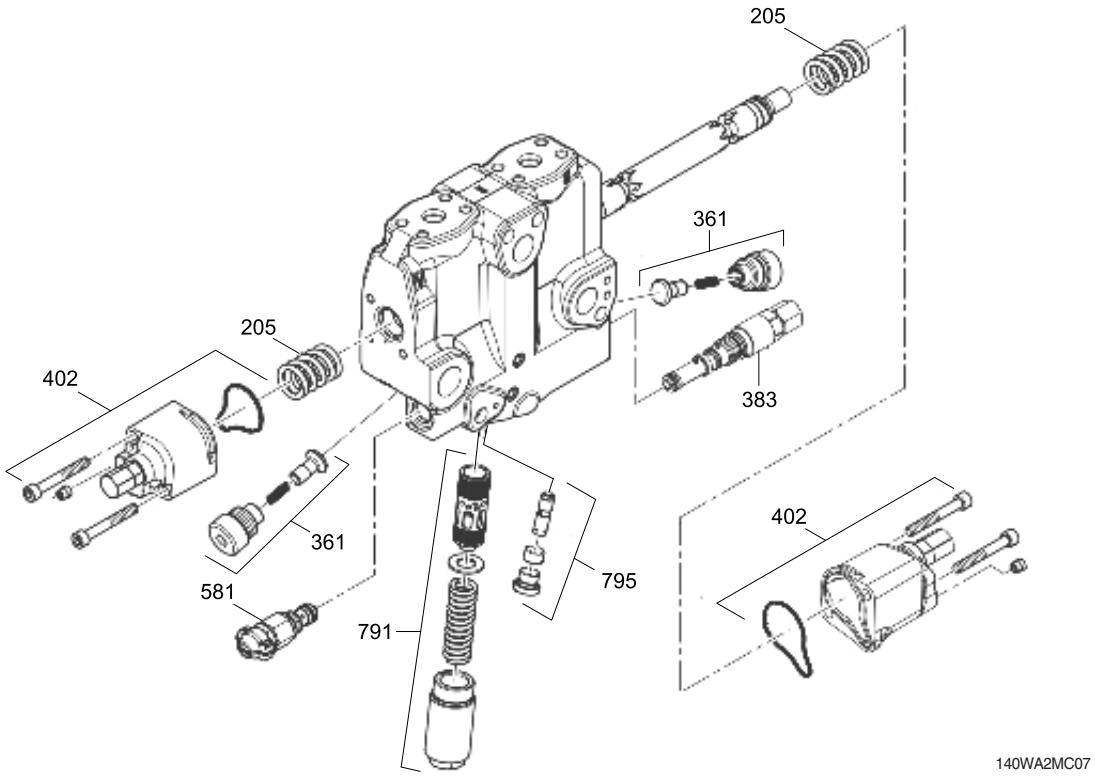
201 Spool assy
202 Cover assy
205 Spring
241 Pressure relief valve
361 Spool assy
782 Spool assy

5) TRAVEL SECTION



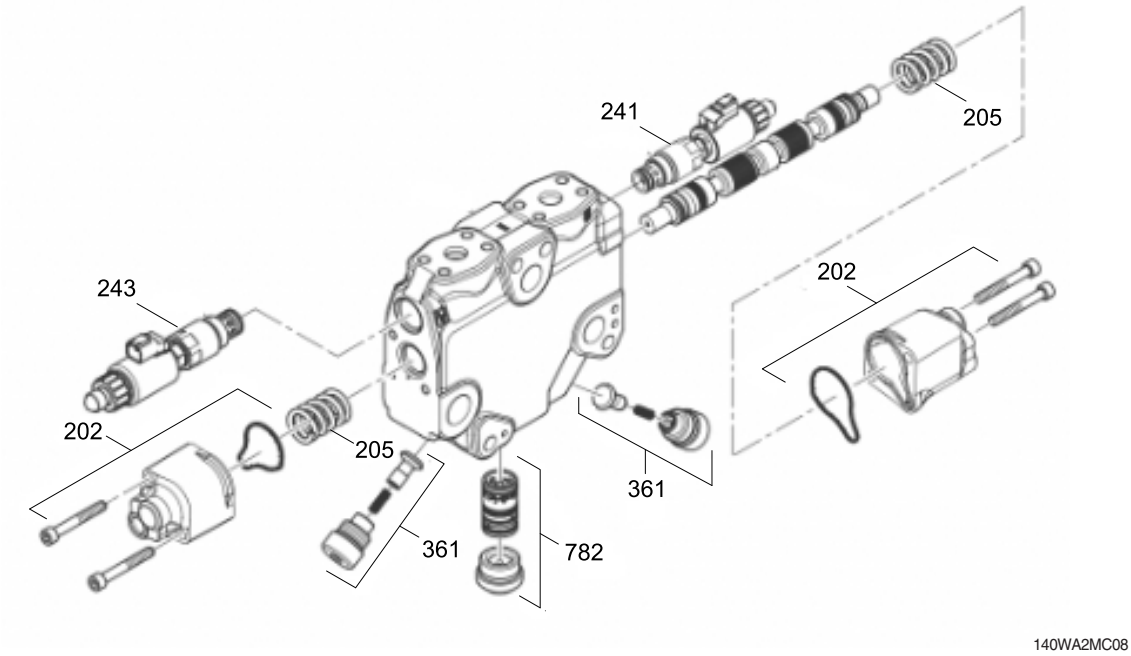
201 Spool assy
206 Spring
361 Spool assy
402 Cover assy
441 Pressure relief valve
782 Spool assy

6) SWING SECTION



205 Spring
361 Spool assy
383 Spool assy
402 Cover assy
581 Relief valve
791 Spool assy
795 Spool assy

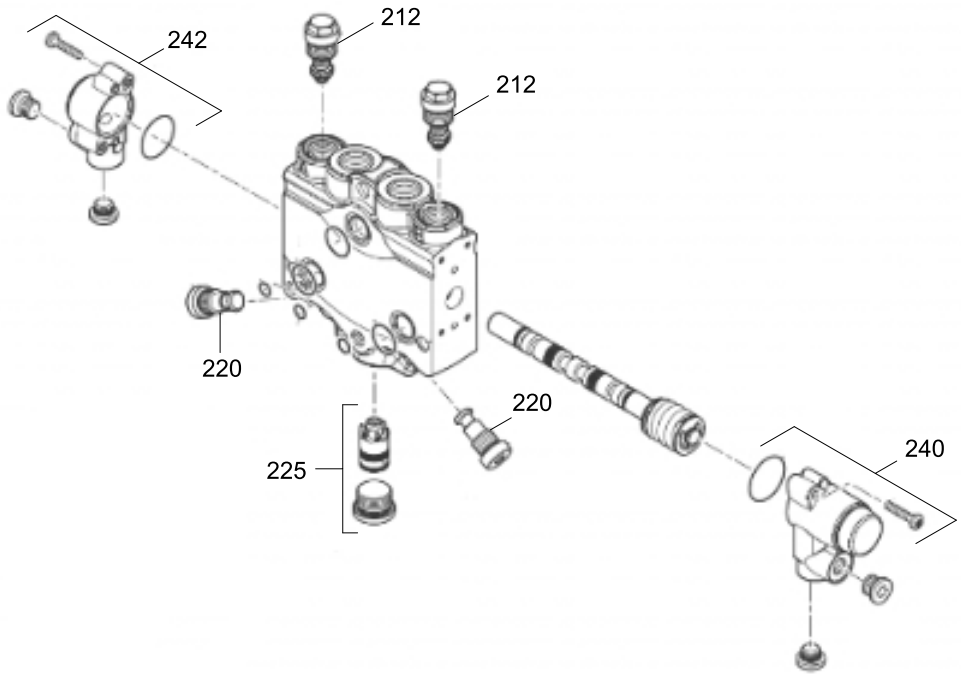
7) OPTION SECTION



140WA2MC08

202	Spool assy	225	Spool assy	361	Spool assy
205	Spring	243	Pressure relief valve	781	Spool assy

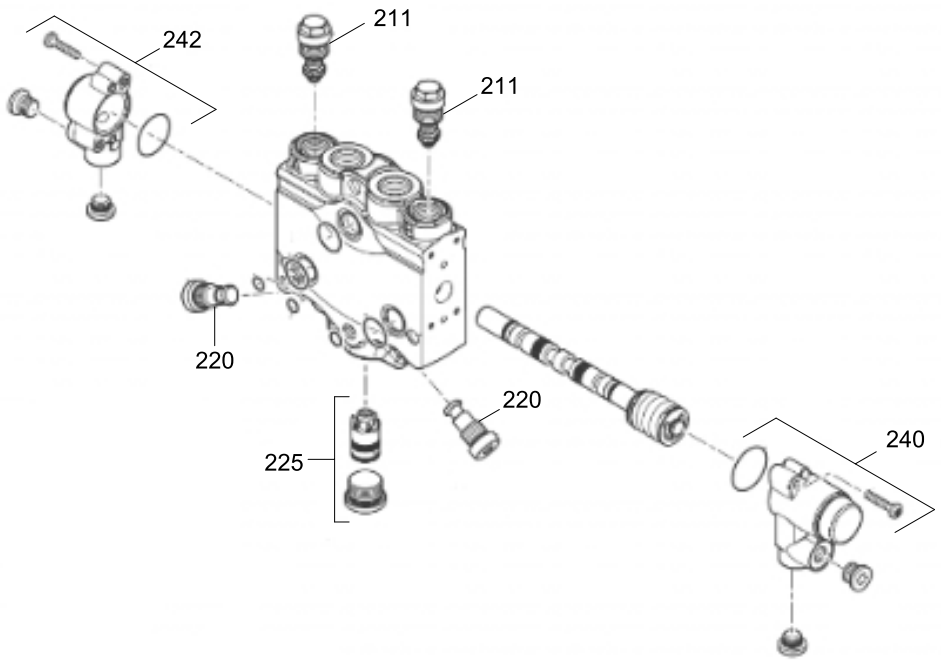
8) 2 PIECE BOOM SECTION



140WA2MC09

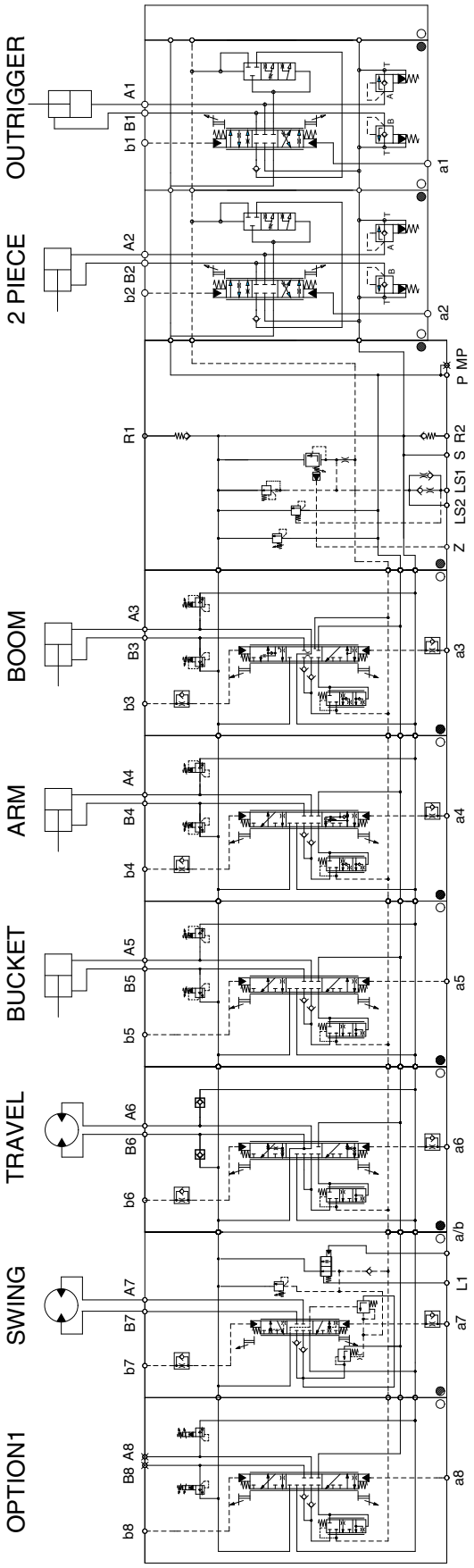
212	Pressure relief valve	225	Spool assy	242	Cover kit
220	Check vavle	240	Cover kit		

9) DOZER (OUTRIGGER) SECTION



211 Pressure relief valve
220 Check valve
225 Spool assy
240 Cover kit
242 Cover kit

3. HYDRAULIC CIRCUIT

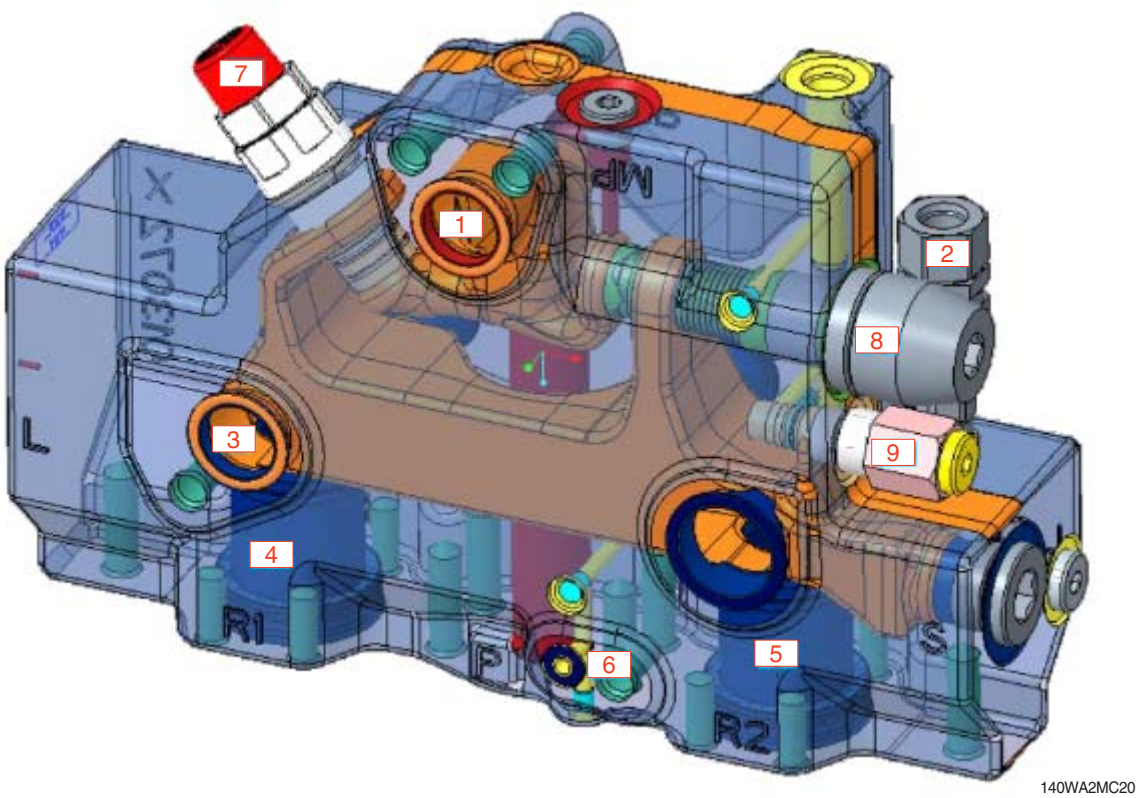


140WA2MC11

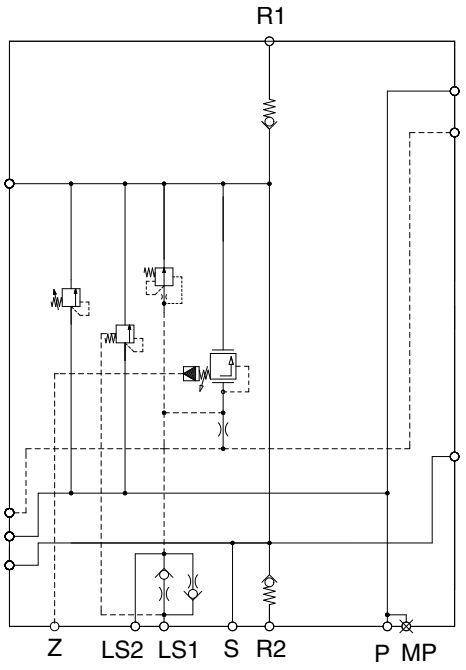
4. FUNCTION

1) INLET SECTION

(1) Structure



140WA2MC20

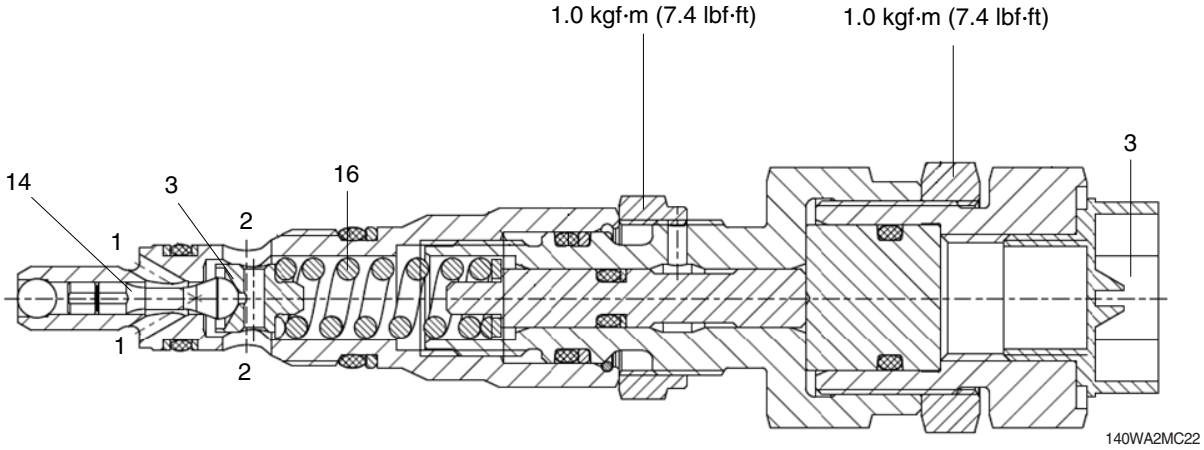


140WA2MC21

1 Pump channel (P)
2 2 stage LS pressure relief valve
3 Tank channel
4 Tank port (R1, cooler)
5 Tank port (R2)
6 LS channel
7 Primary relief valve
8 Unloading valve
9 LS drain valve

(2) 2 stage LS relief valve

The pressure valve type is a direct operated pressure relief valve for the installation in block designs. It is used to limit a system pressure. The system pressure can be set steplessly via the adjustment element.



※ For the case of unintentional adjustment during assembly process, we would recommend to mark the positions by sealing wax.

① Pressure relief function

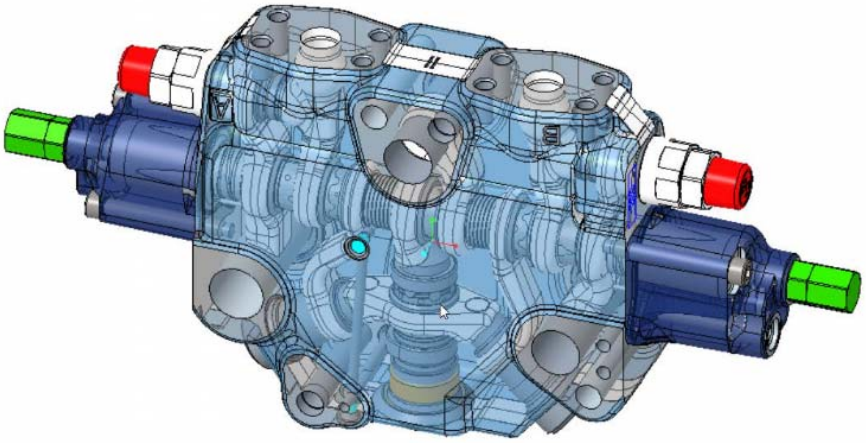
In the initial position the valve is closed. The pressure in the main port 1 acts on the spring plate (4) via pilot line (1) and poppet (14). If the pressure in the main port 1 rises above the value set at the comparisson spring (16), poppet (14) opens and the pressure fluid flows in to the main port 2.

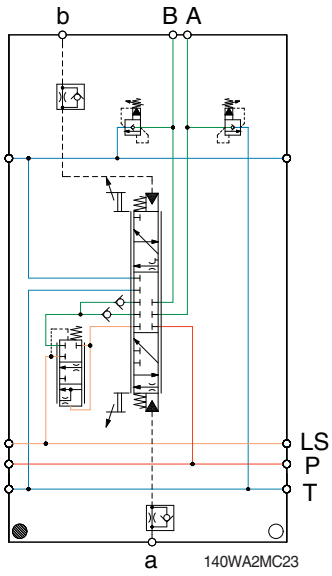
② Pressure connect function

When connecting the external port 3 with pilot pressure, piston (3) will be pressurised. The pretension of the spring and the maximum adjusted system pressure are increasing. A pressureinsation at the external port 3 affects the pressure at the main port 1. Ratio the following pages.

2) COMMON SECTION

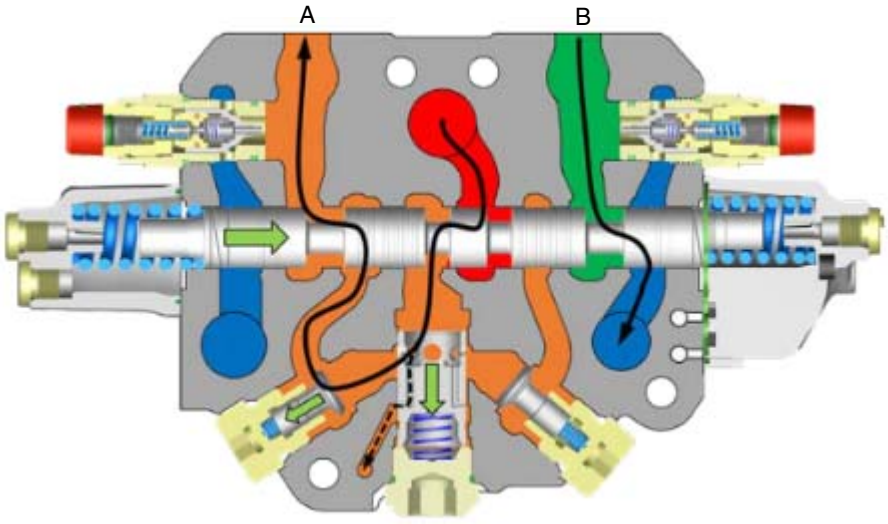
(1) Neutral position

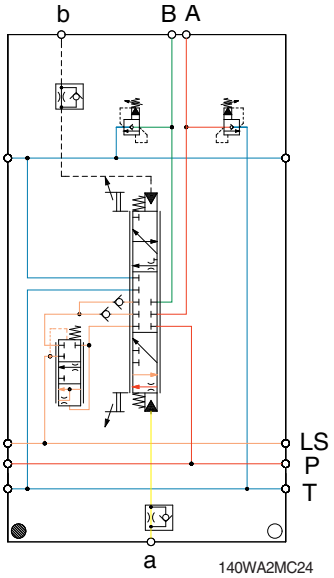




In neutral position, no connection between pump an consumer and also no connection between consumer an tank channel.
Pressure compensator is completely closed, no movements possible.

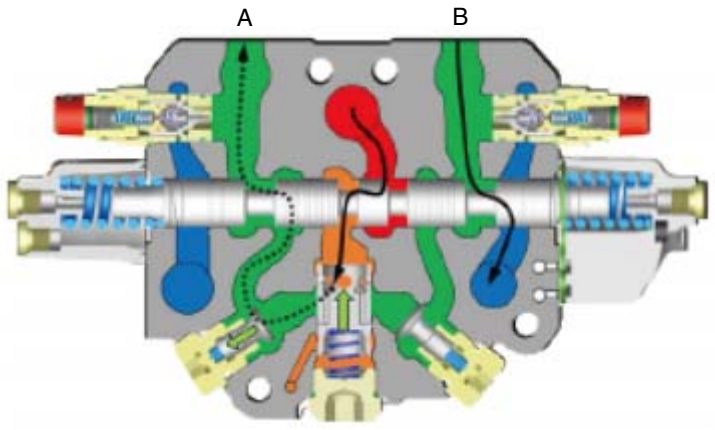
(2) Single mode/highest load

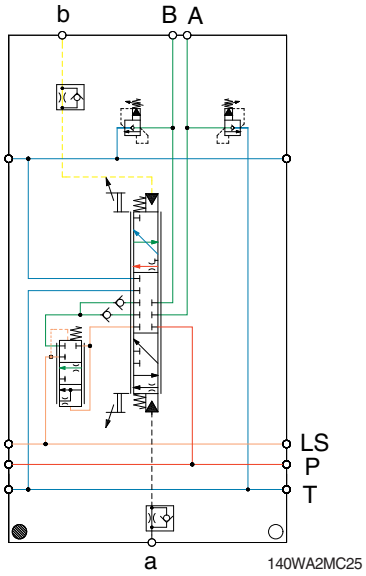




Pilot pressure on A-side opens the spool and connects pump to consumer A.
Compensator is completely open, because of single mode or highest system load of the section.
In parallel the spool opens consumer B to tank, based on defined opening area.

(3) Parallel mode/ lower load

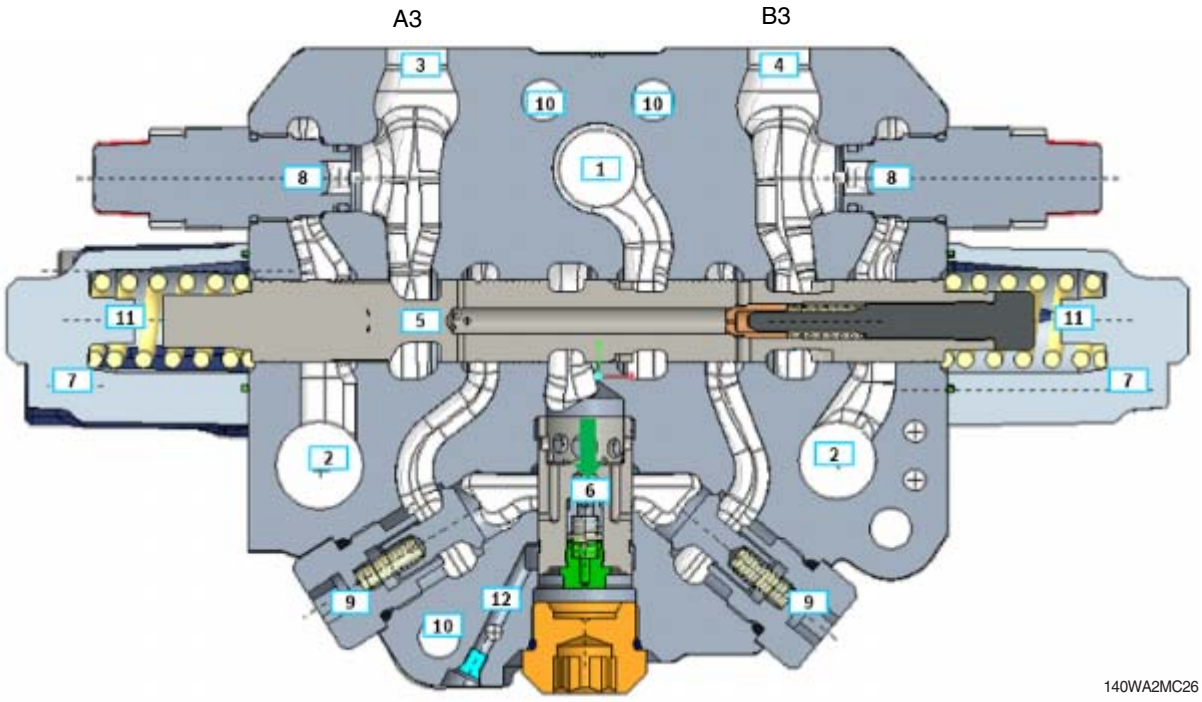




Pilot pressure on A-side opens the spool and connects pump to consumer A.
The compensator gets the signal of highest system load to the spring chamber and throttles automatically the difference between pump pressure and specific consumer load.

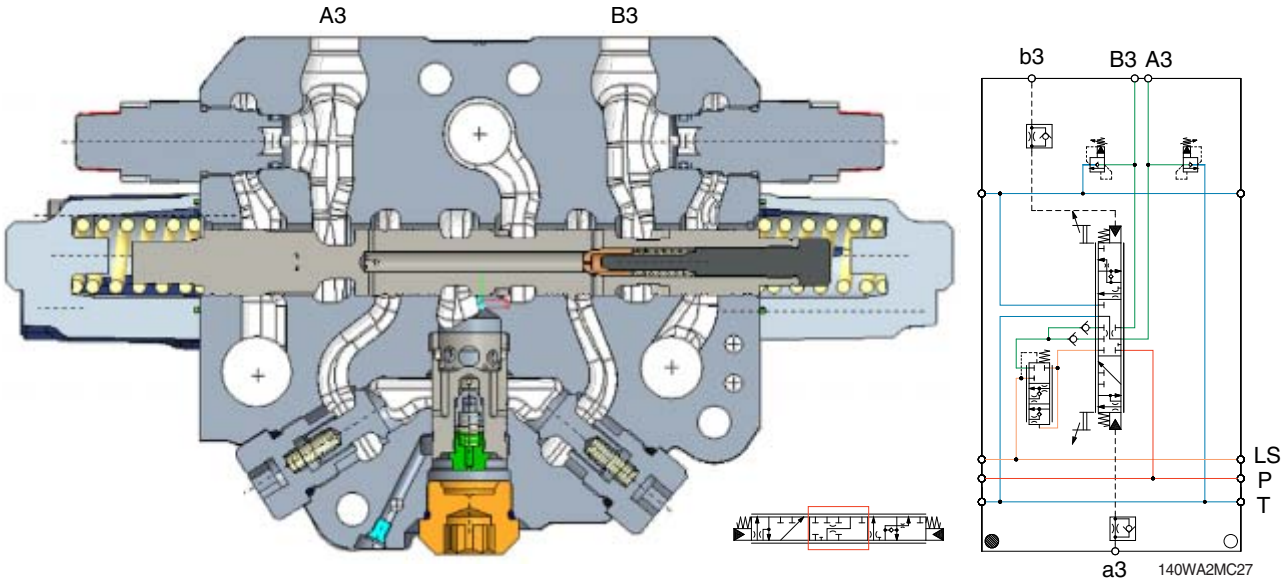
3) BOOM SECTION

(1) Structure



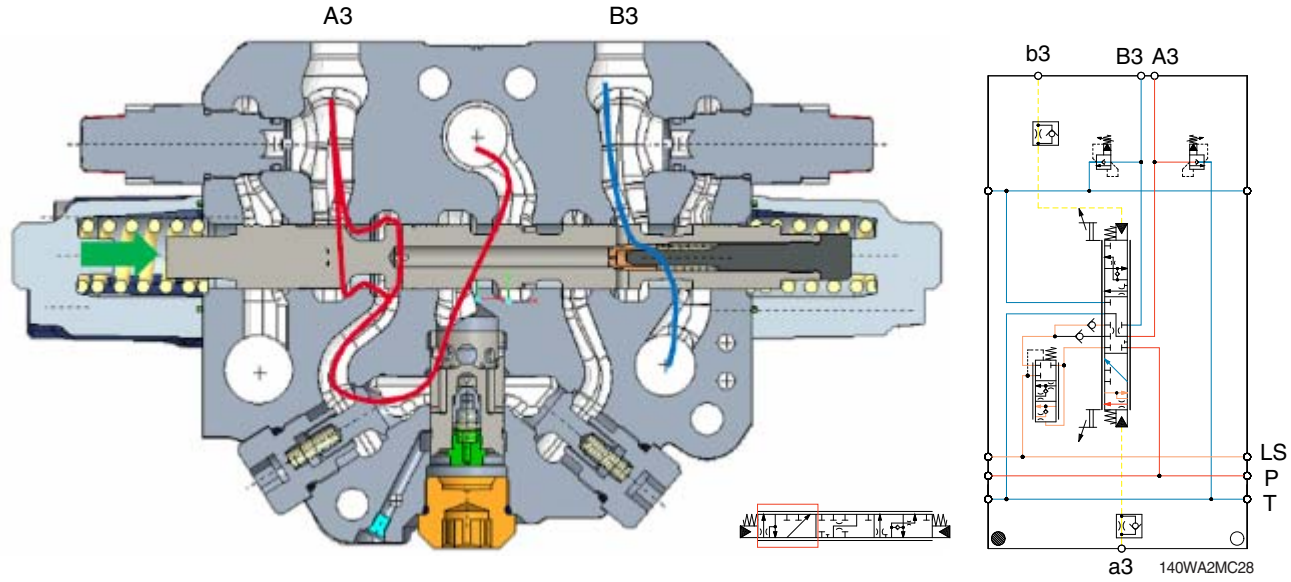
1	Pump channel	6	Pressure compensator	10	Tie rod holes
2	Tank channel	7	Pilot cover	11	Stroke limiter
3	Port A3	8	Secondary relief valves with make-up functionality	12	LS-line
4	Port B3				
5	Main spool with regeneration	9	Load holding valves		

(2) Neutral position



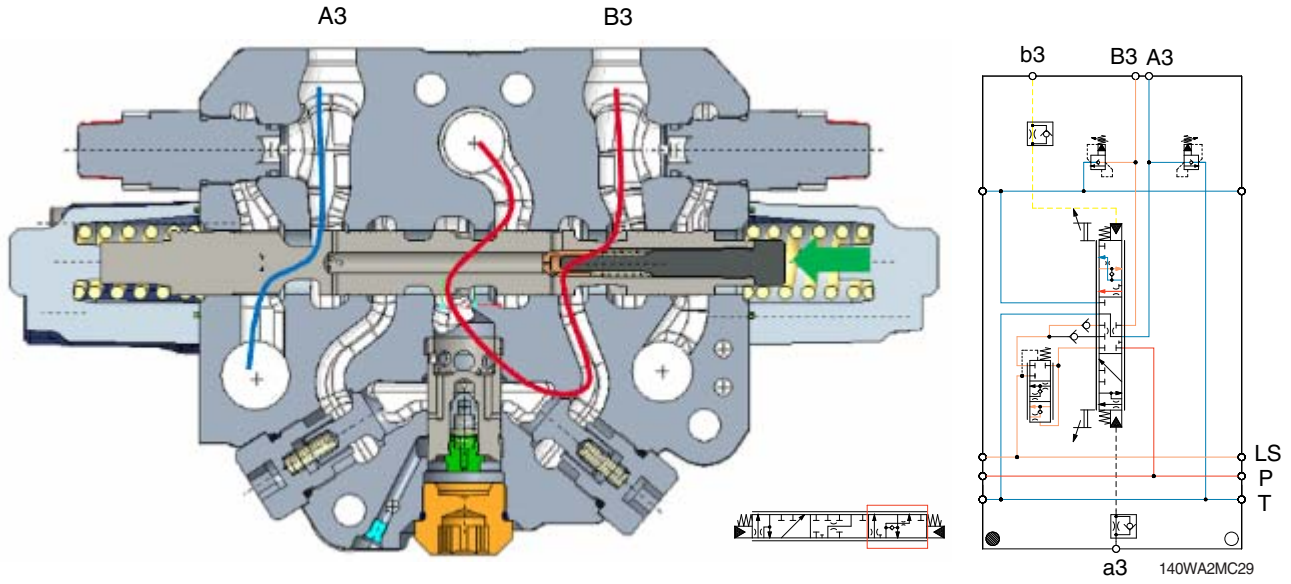
Neutral position of boom spool, port A3 is connected to tank by a small notch. All other connections of the spool are closed.

(3) Boom up position



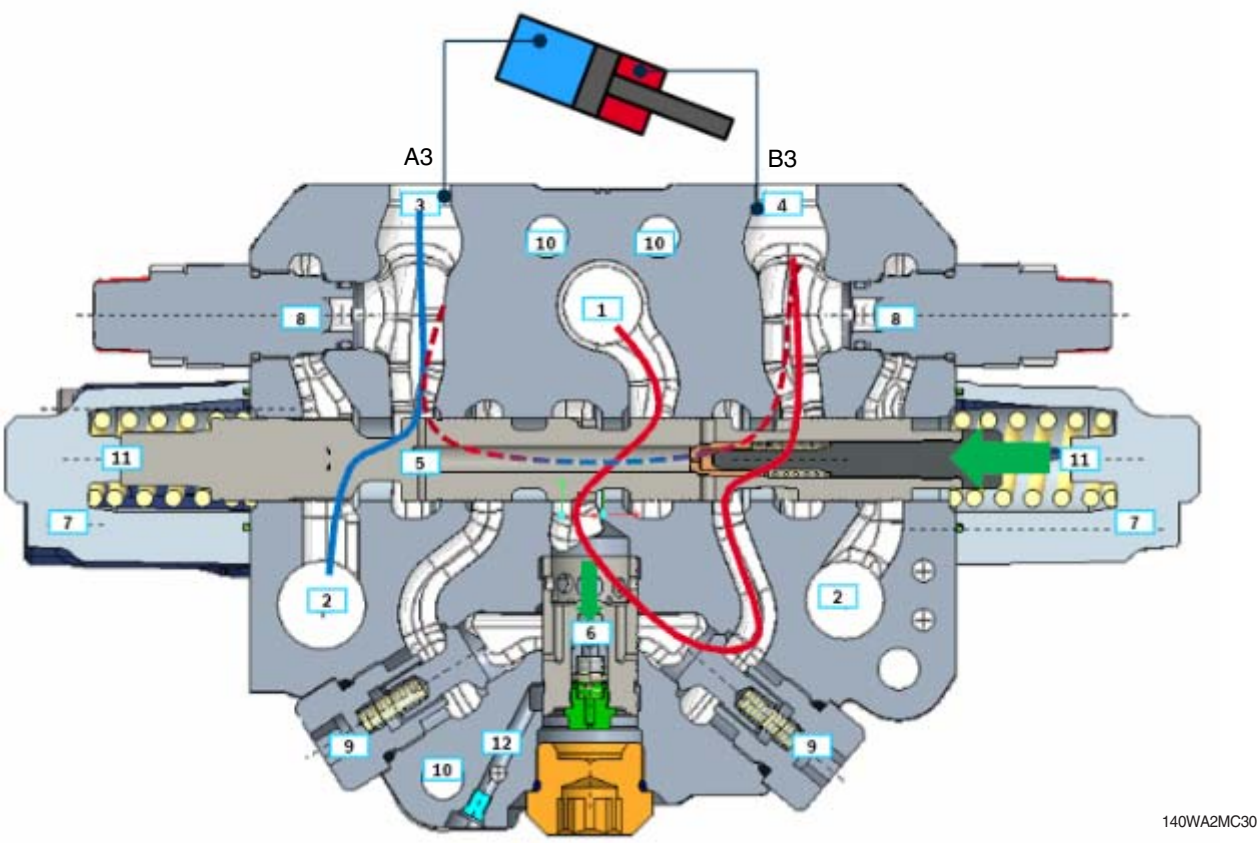
When the pilot pressure is led to the port a3, the oil from the pump flows to the cylinder port A3 and oil from the cylinder flows into the tank through the cylinder port B3.

(4) Boom down position



When the pilot pressure is led to the port b3, the oil from the pump flows to the cylinder port B3 and oil from the cylinder flows into the tank through the cylinder port A3.

(5) Boom regeneration spool

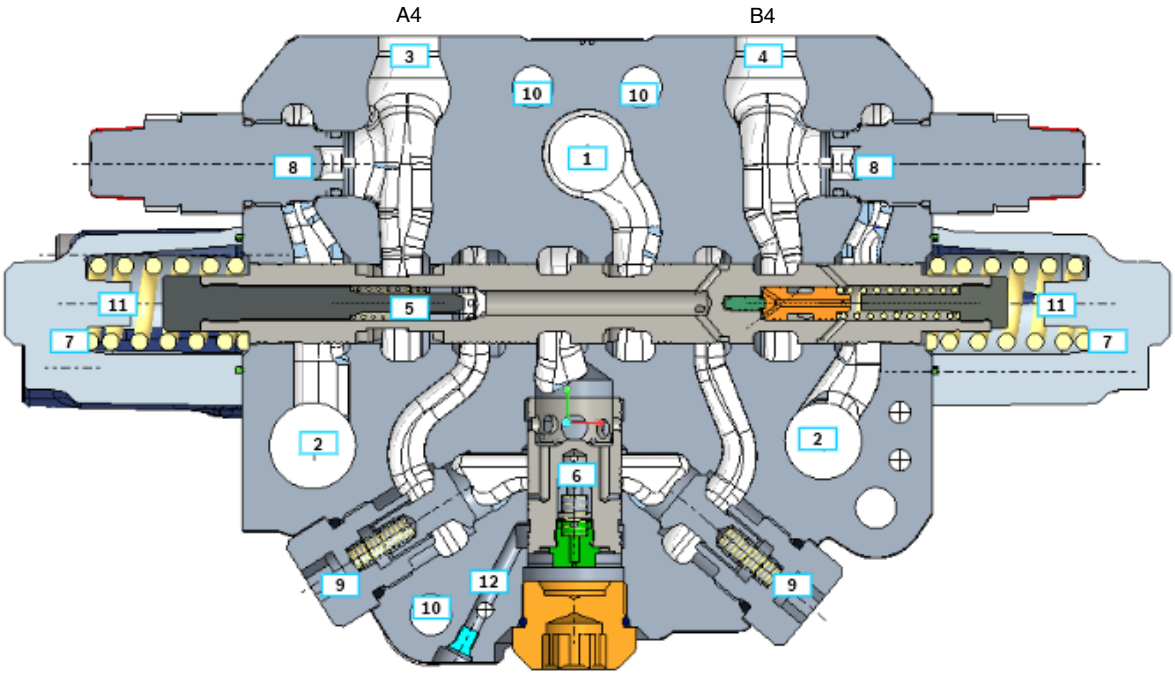


1	Pump channel	6	Pressure compensator	10	Tie rod holes
2	Tank channel	7	Pilot cover	11	Stroke limiter
3	Port A3	8	Secondary relief valves with make-up functionality	12	LS-line
4	Port B3				
5	Main spool with regeneration	9	Load holding valves		

Pump is connected with B3 port. A3 port to tank. Internally connected to the poppet, as well as pump pressure. If pressure on A3 port is higher than on B3 port, the poppet opens and regeneration of flow starts. Flow depends on delta-p between A3 and B3.

4) ARM SECTION

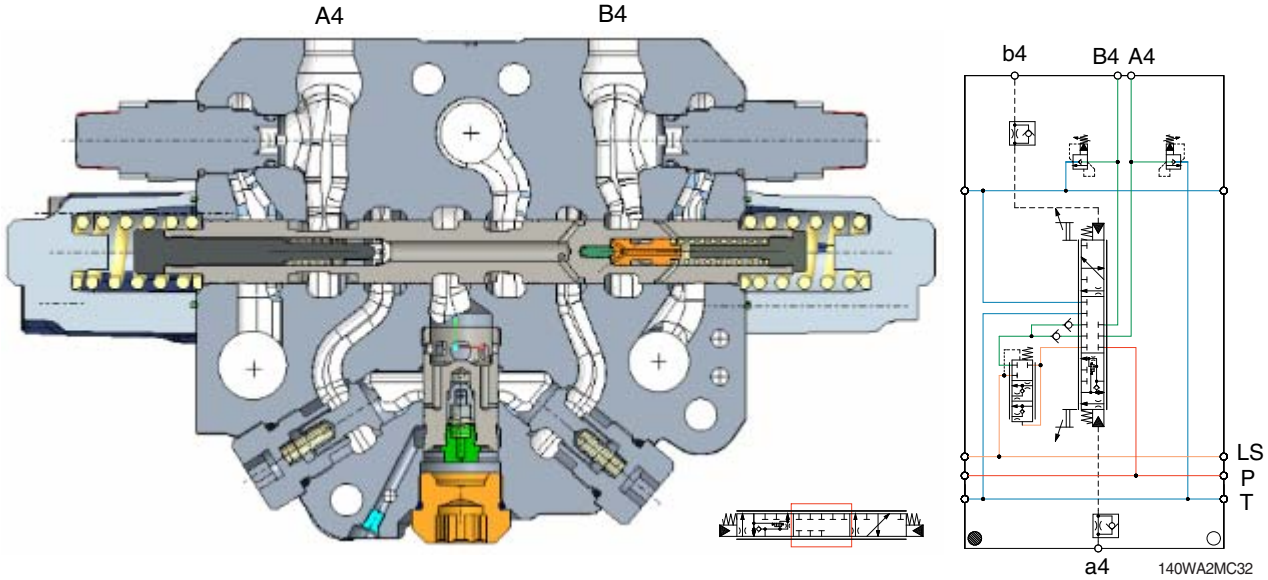
(1) Structure



140WA2MC31

1	Pump channel	6	Pressure compensator	11	Stroke limiter
2	Tank channel	7	Pilot cover	12	LS-line
3	Port A4	8	Secondary relief valves with make-up functionality		
4	Port B4				
5	Main spool with Brake and regeneration functionality	9	Load holding valves		
		10	Tie rod holes		

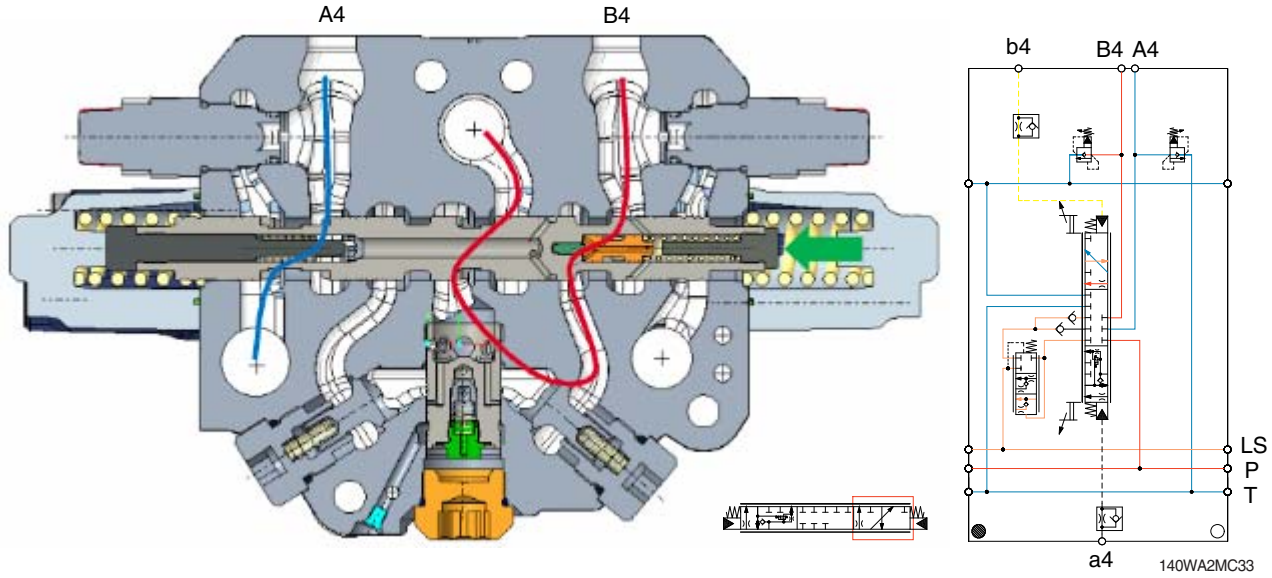
(2) Neutral position



140WA2MC32

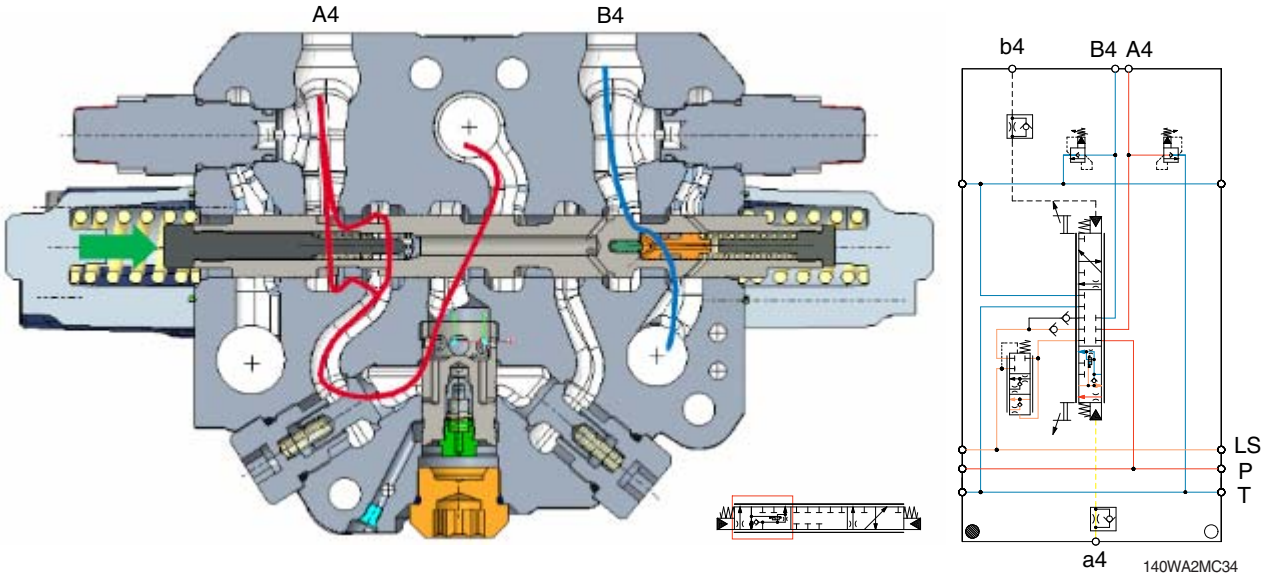
Neutral position of arm spool, all connections of the spool are closed and the A4 and B4 ports are not connected to the pump nor tank.

(3) Arm out position



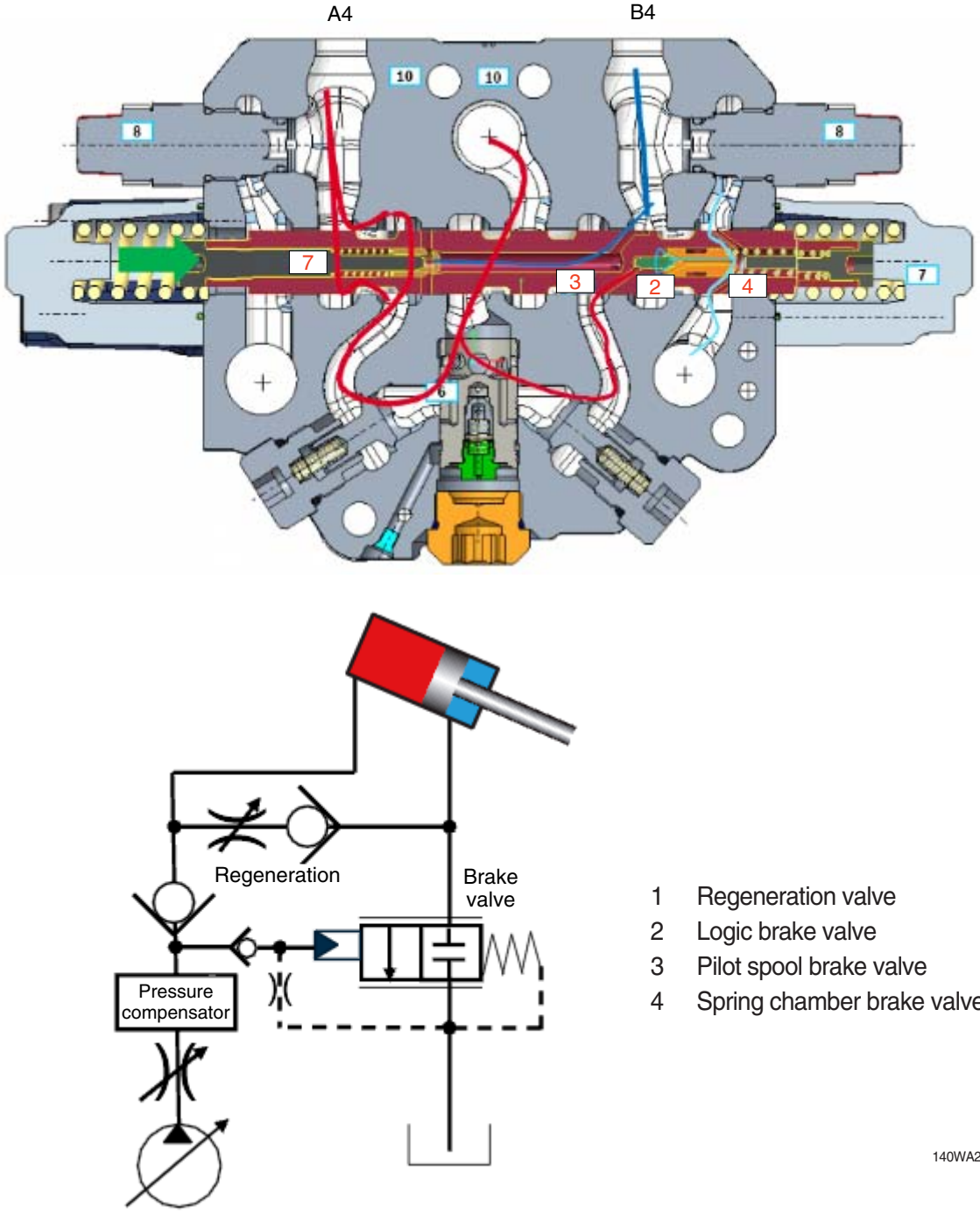
When the pilot pressure is led to the port b4 the oil from the pump flows to the cylinder port B4 and oil from the cylinder flows into the tank through the cylinder port A4.

(4) Arm in position



When the pilot pressure is led to the port a4, the oil from the pump flows to the cylinder port A4 and oil from the cylinder flows into the tank through the cylinder port B4.

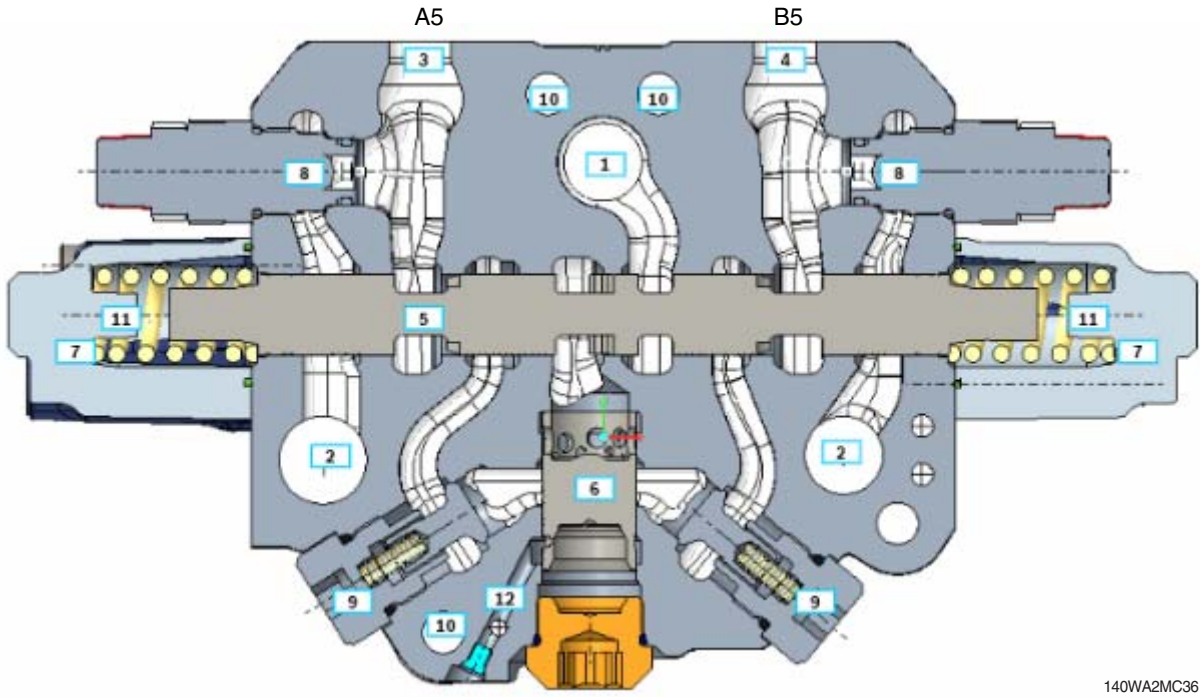
(5) Brake and regeneration spool



Pump flow is connected over compensator and load holding valve to the port A4.
Regeneration valve is closed, because pressure on port A4 is bigger than on port B4.
Port A4 is also connected to pilot spool brake valve.
Spring chamber of logic valve is released to tank pressure. Based on area ratio of the pilot spool and the logic brake valve, the port A4 pressure has to reach a pressure level of 120 bar.
Regeneration function is not active/closed, because pressure on port A4 is bigger than on port B4.

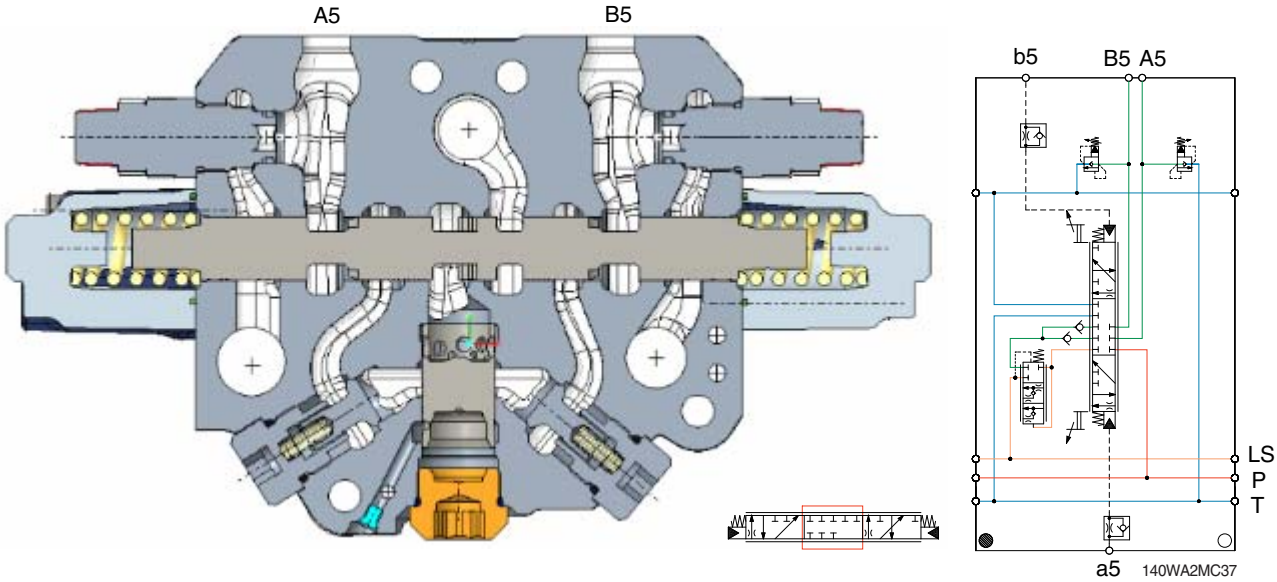
5) BUCKET SECTION

(1) Structure



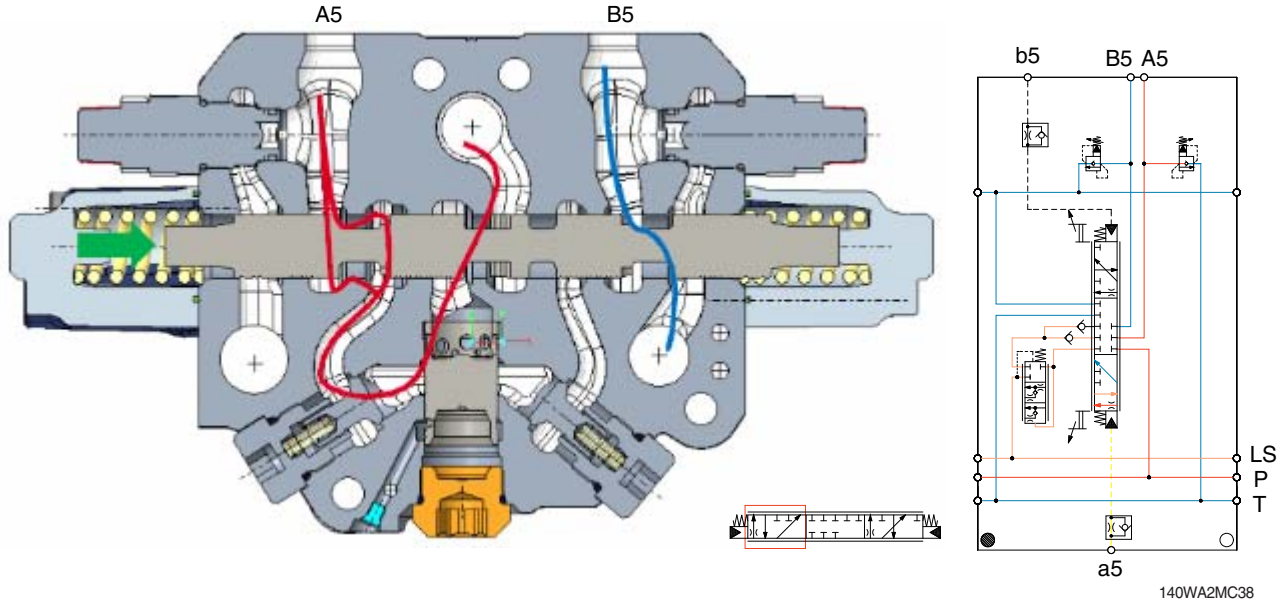
1	Pump channel	6	Pressure compensator	10	Tie rod holes
2	Tank channel	7	Pilot cover	11	Stroke limiter
3	Port A5	8	Secondary relief valves with make-up functionality	12	LS-line
4	Port B5				
5	Main spool	9	Load holding valves		

(2) Neutral position



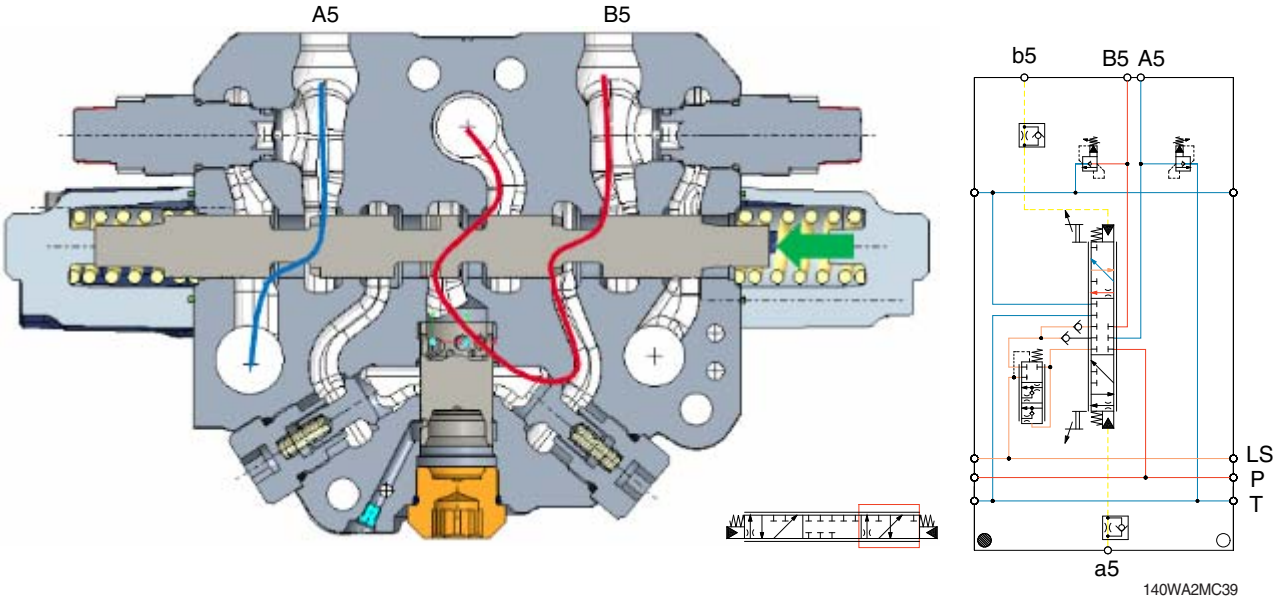
Neutral position of bucket spool, all connections of the spool are closed and the A5 and B5 ports are not connected to the pump nor tank.

(3) Bucket in position



When the pilot pressure is led to the port a5, the oil from the pump flows to the cylinder port A5 and oil from the cylinder flows into the tank through the cylinder port B5.

(4) Bucket out position

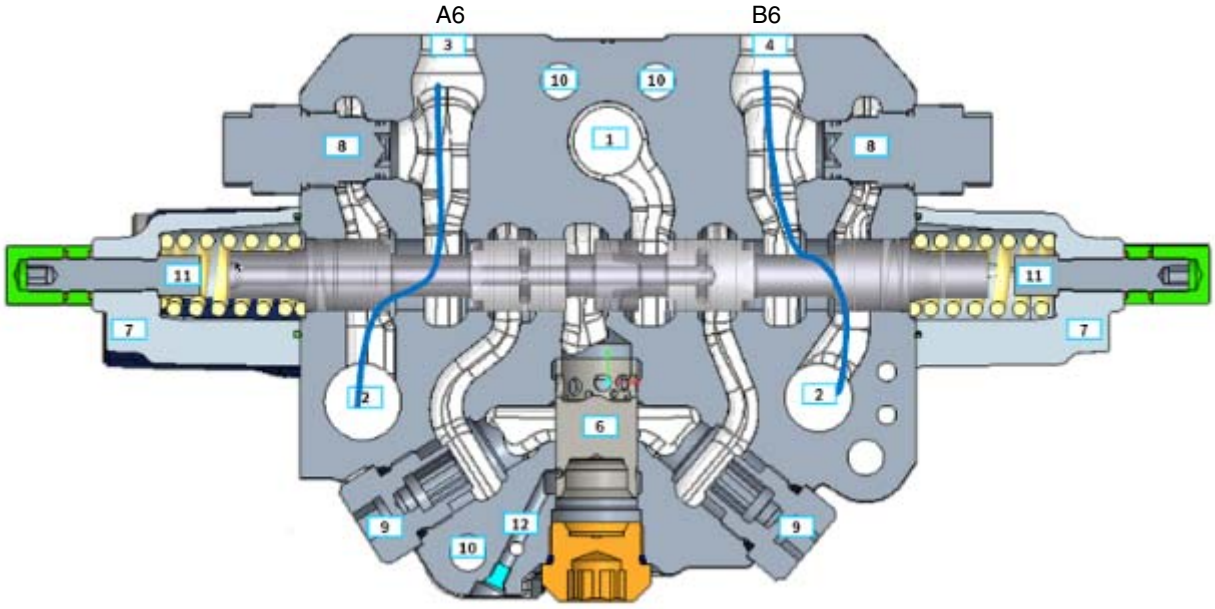


When the pilot pressure is led to the port b5, the oil from the pump flows to the cylinder port B5 and oil from the cylinder flows into the tank through the cylinder port A5.

6) TRAVEL SECTION

(1) Structure

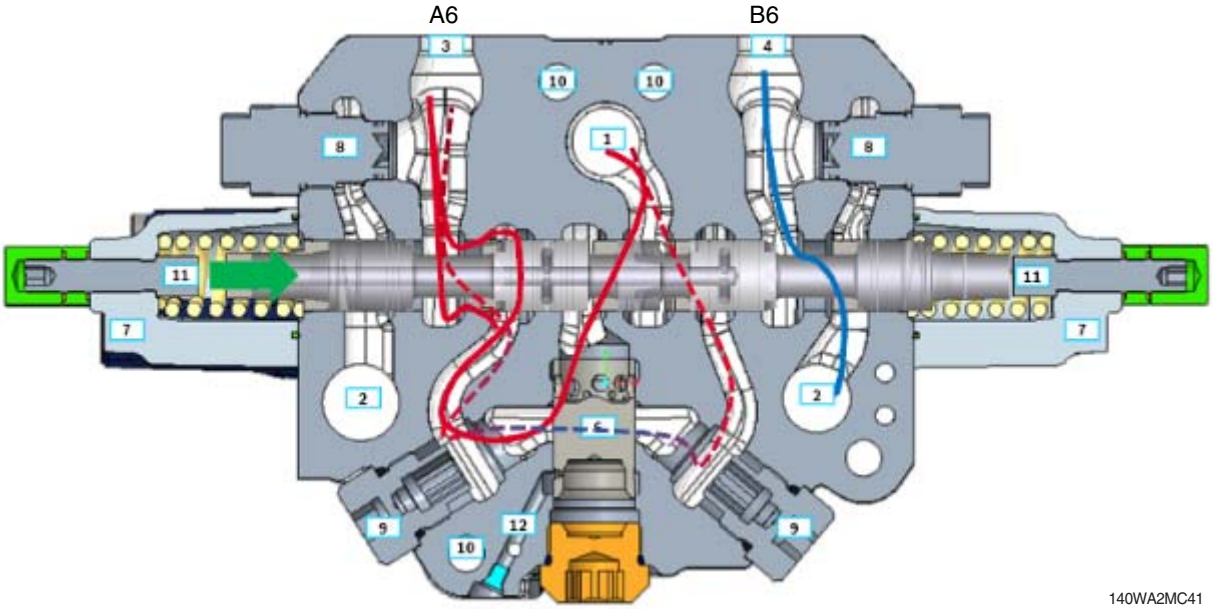
Both sides of the Travel spool B6->T and also A6->T are connected in neutral to tank.



140WA2MC40

1	Pump channel	5	Main spool	9	Load holding valves
2	Tank channel	6	Pressure compensator	10	Tie rod holes
3	Port A6	7	Pilot cover	11	Stroke limiter
4	Port B6	8	Secondary relief valves	12	LS-line

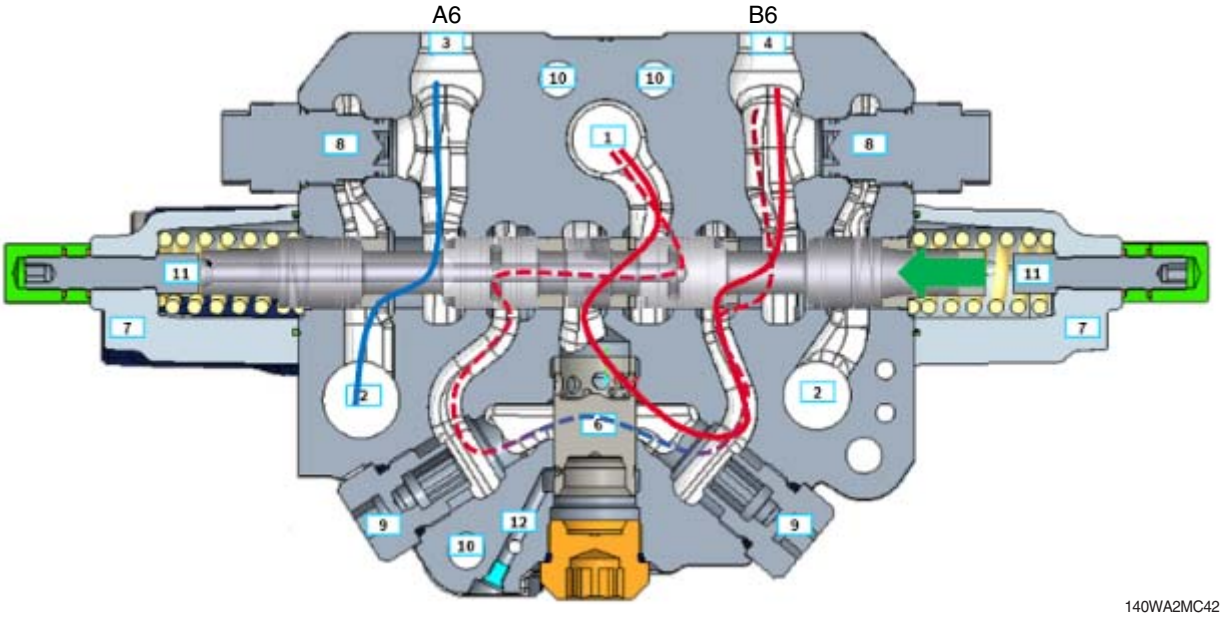
(2) Travel backward position



140WA2MC41

When the pilot pressure is led to the port a6, the oil from the pump flows to the port A6 and oil from the motor flows into the tank through the port B6.

(3) Travel forward position

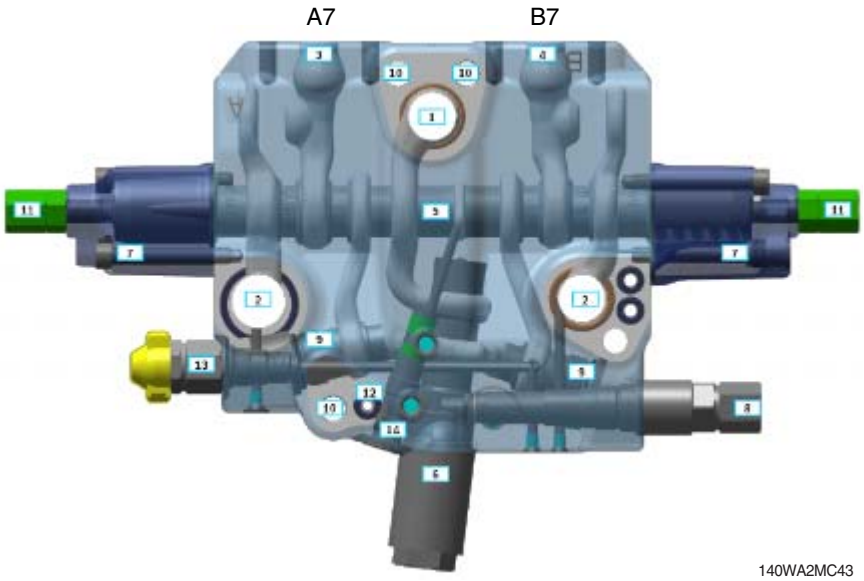


140WA2MC42

When the pilot pressure is led to the port b6, the oil from the pump flows to the port B6 and oil from the motor flows into the tank through the port A6.

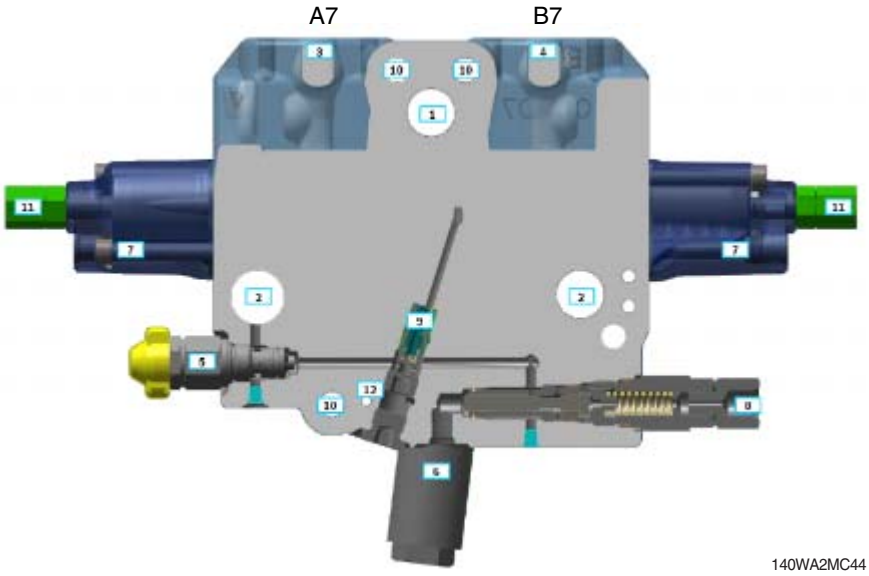
7) SWING SECTION

(1) Structure



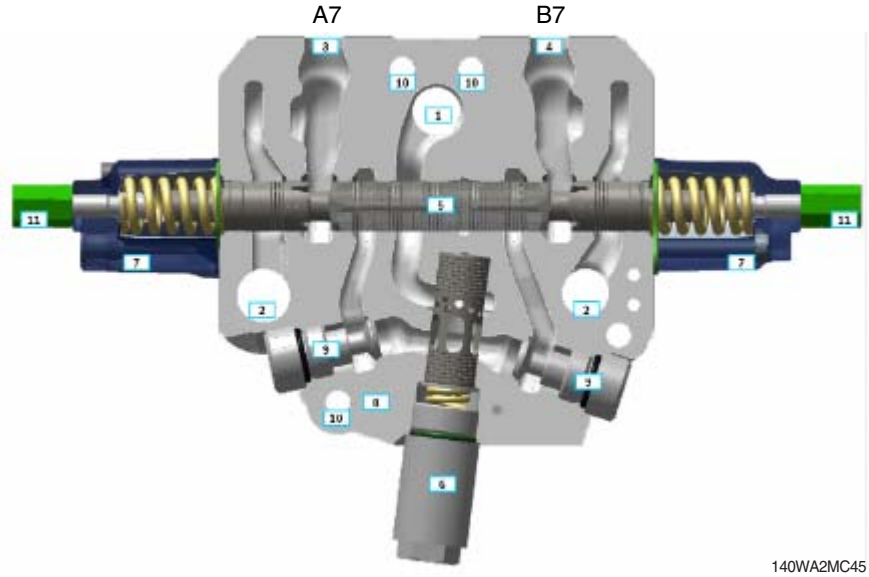
140WA2MC43

1 Pump channel
2 Tank channel
3 Port A7
4 Port B7
5 Main spool
6 Hollow Pressure compensator
7 Pilot cover
8 DTS cartridge
9 Load holding valves
10 Tie rod holes
11 Stroke limiter
12 LS-line
13 LS pressure reducing valve
14 LS copy valve



140WA2MC44

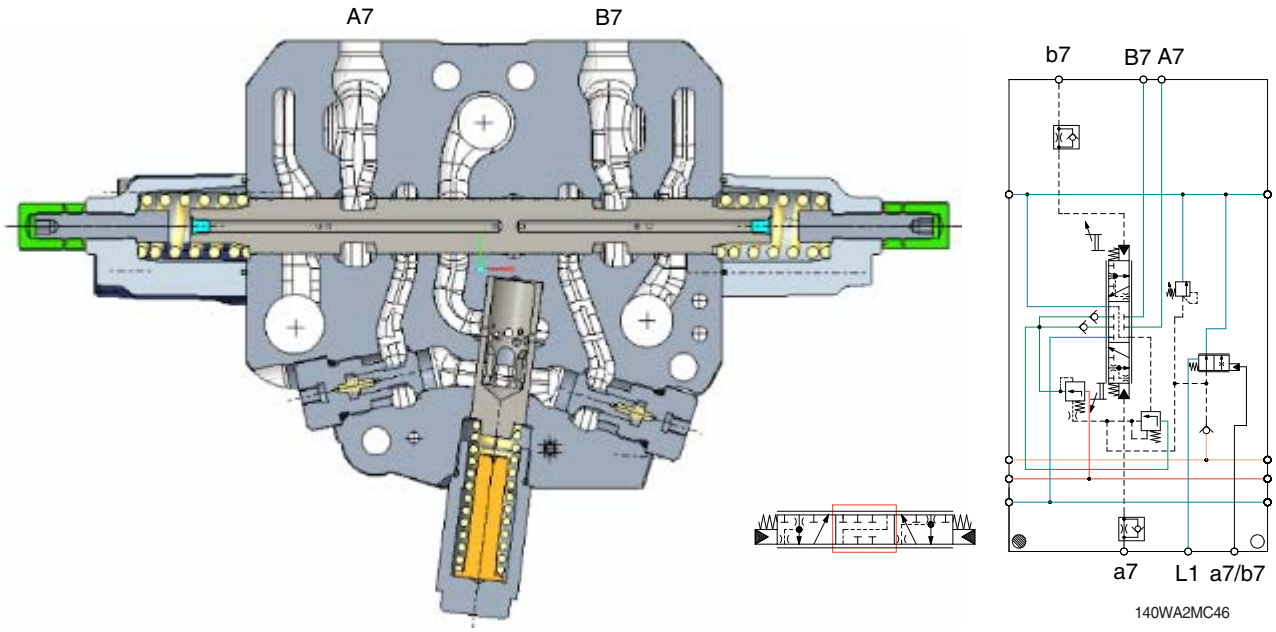
1 Pump channel
2 Tank channel
3 Port A7
4 Port B7
5 LS pressure reducing valve
6 Hollow pressure compensator
7 Pilot cover
8 DTS cartridge
9 LS copy valve
10 Tie rod holes
11 Stroke limiter
12 LS-line



140WA2MC45

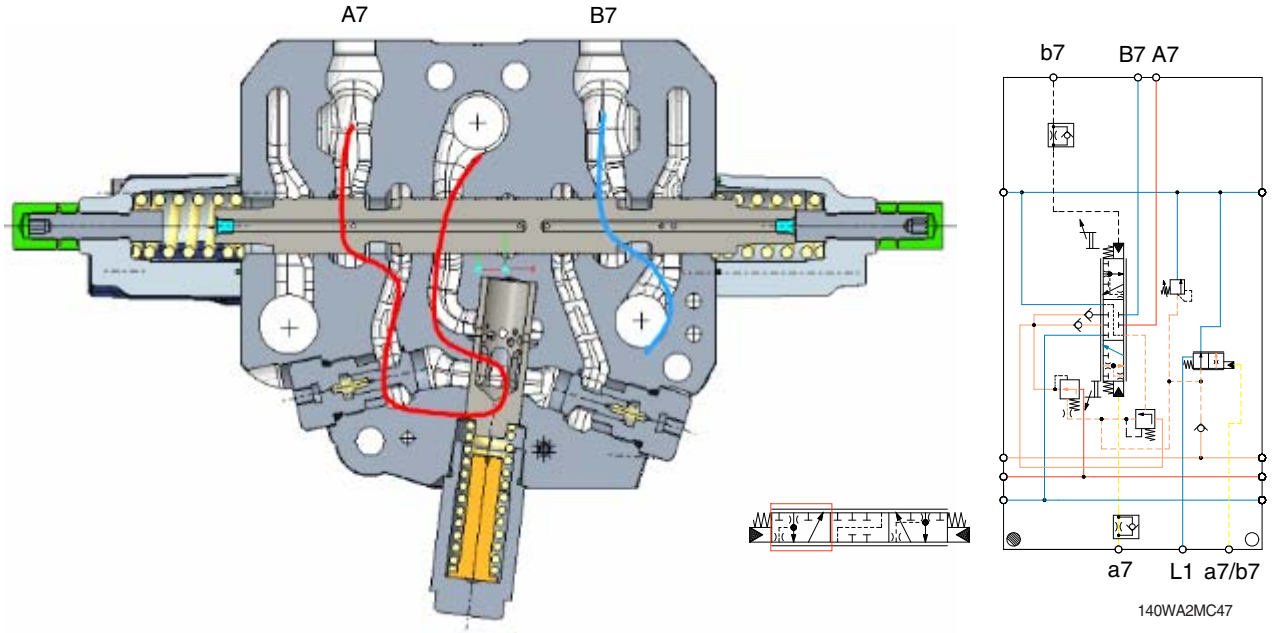
1 Pump channel
2 Tank channel
3 Port A7
4 Port B7
5 Main spool
6 Hollow Pressure compensator
7 Pilot cover
8 LS-line
9 Load holding valves
10 Tie rod holes

(2) Neutral position



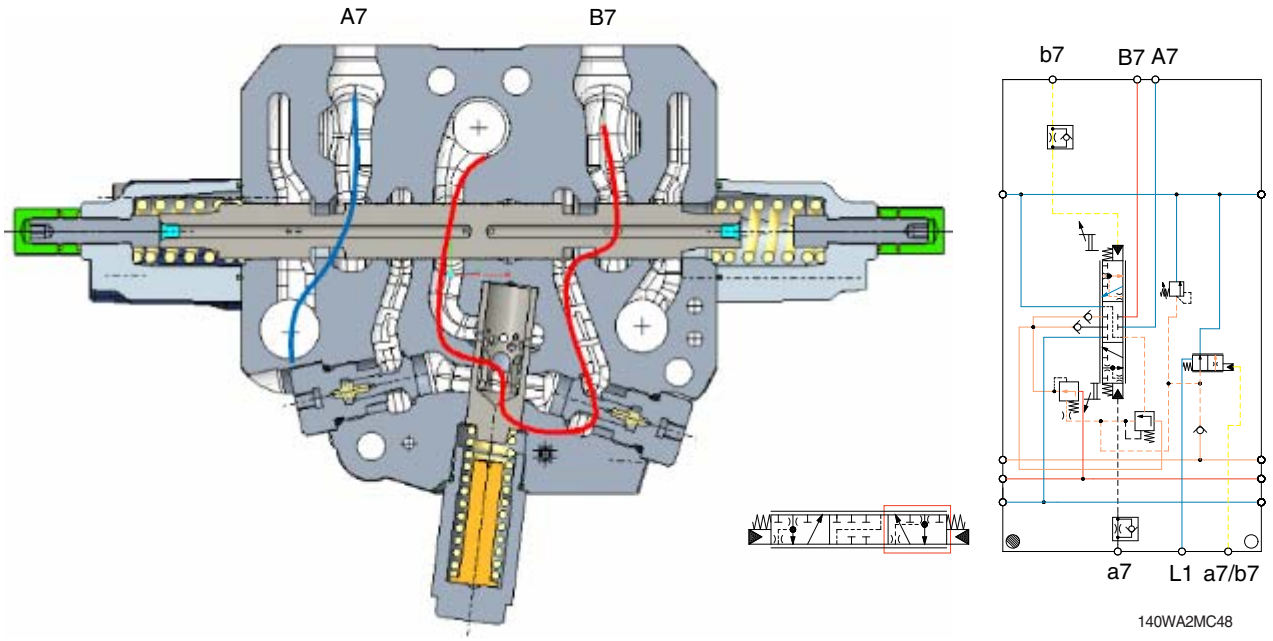
Neutral position of swing spool, all connections of the spool are closed and the A7 and B7 ports are not connected to the pump nor tank.

(3) Swing right position



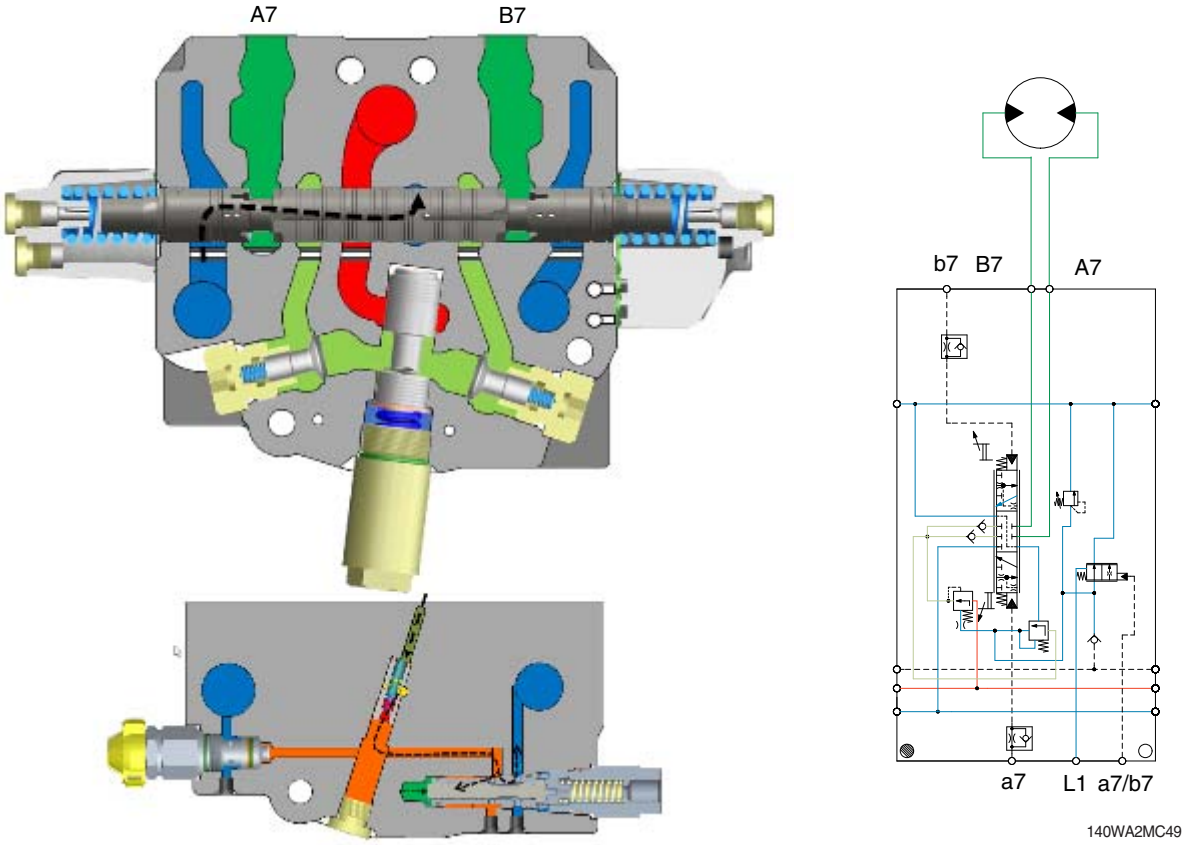
When the pilot pressure is led to the port a7, the oil from the pump flows to the port A7 and oil from the motor flows into the tank through the port B7.

(4) Swing left



When the pilot pressure is led to the port b7, the oil from the pump flows to the port B7 and oil from the motor flows into the tank through the port A7.

(5) LS neutral position

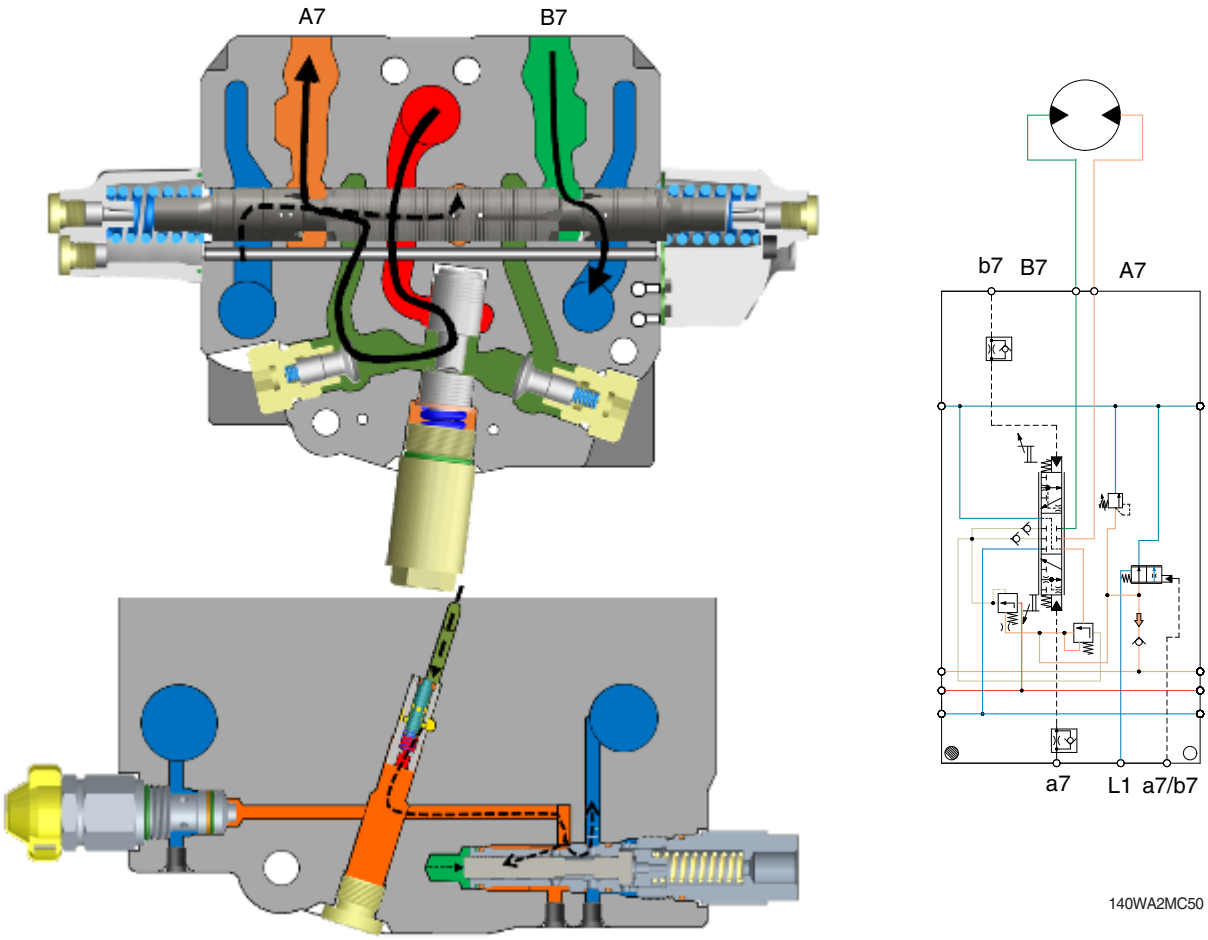


The pump channel is always connected to the compensator. If pump pressure is higher than LS + spring setting of the LS-compensator, the LS compensator will be closed.

The LS channel will be in parallel released to tank and also by the copy valve to the spring chamber of the compensator.

This secures no movement during neutral position of the spool.

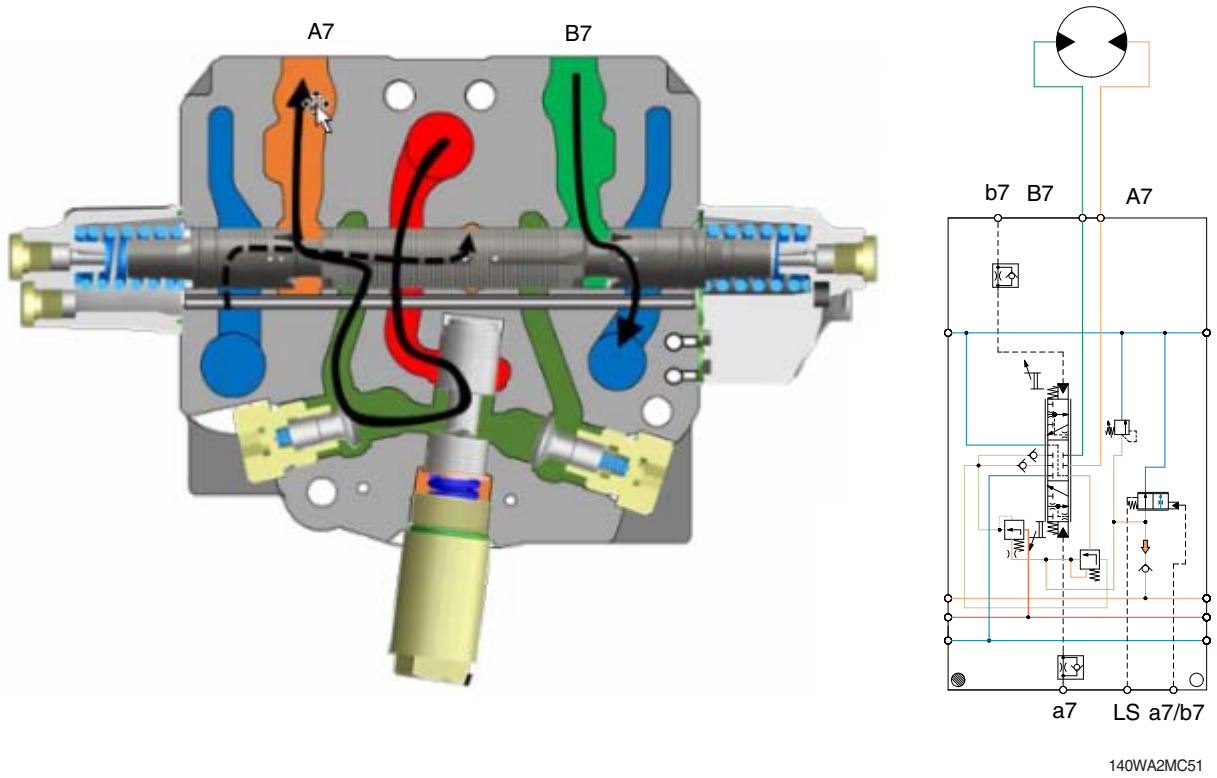
(6) LS highest load



Pilot signal on port A7 opens pump -> port A7 and also port B7 -> tank channel.
LS signal is spool internally connected to spring chamber of the compensator.
LS signal + spring force setting defines the delta p over main spool.
-> This combination leads to precise flow controllability.

The DTS drains the LS signal, in relation to the pilot signal, to the tank channel. The reduced LS pressure is connected to the compensator, which leads to “torque control” of the consumer.

(7) LS lowest consumer load

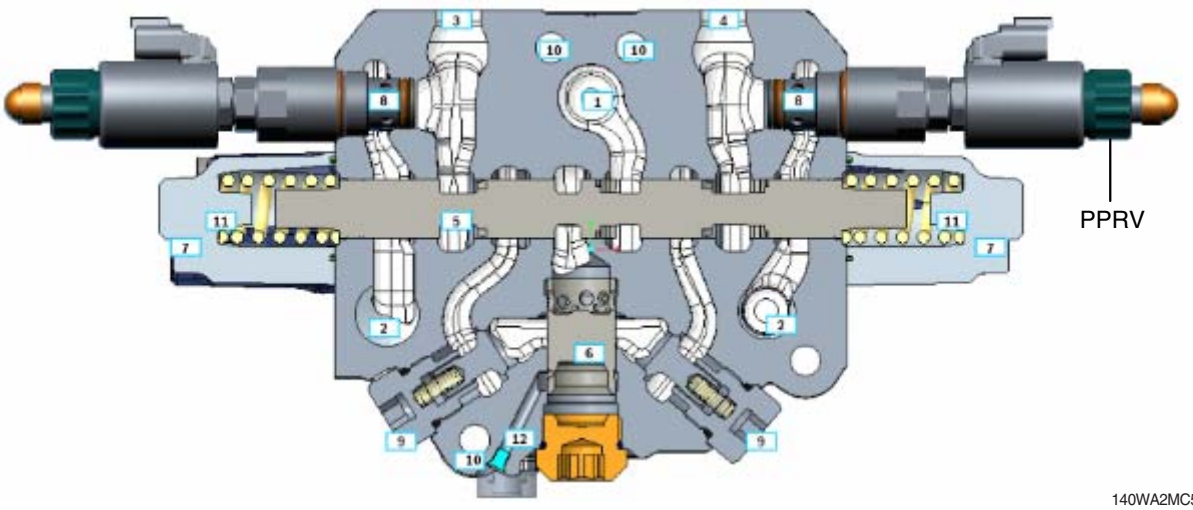


Against LUDV functionality, the LS section is not affected by parallel movements, as long as the system is able to build up the required pump pressure.
We call it “semi-priority” for LS consumers.

8) OPTION SECTION

(1) Structure

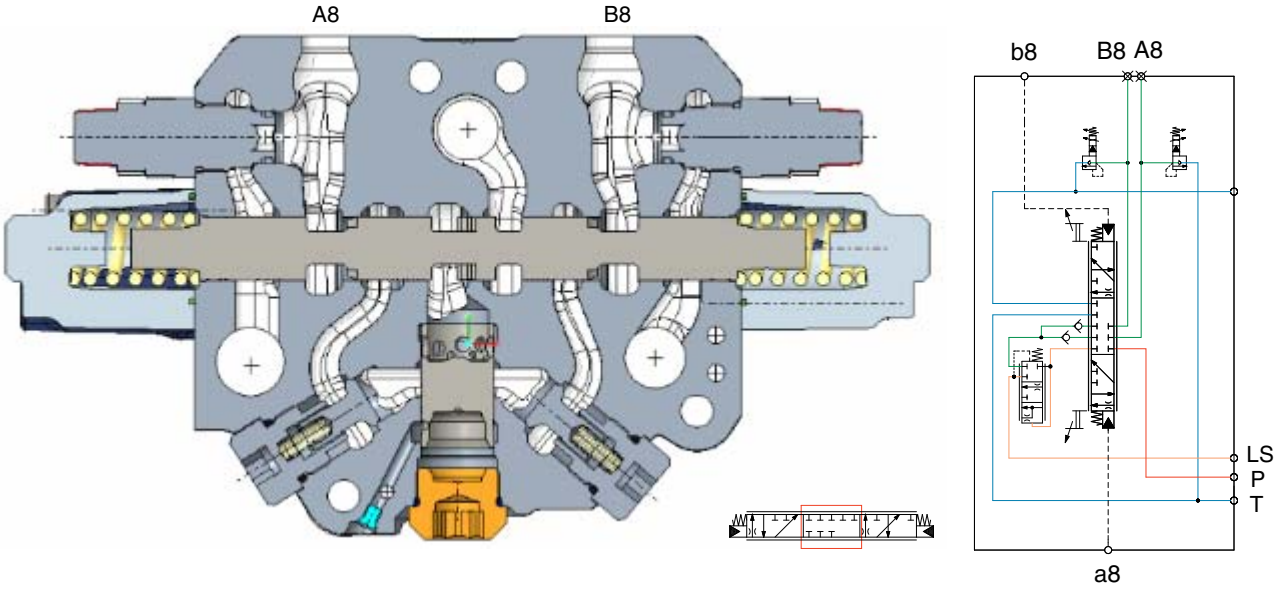
EPPR (position 8) should not be engaged with current, without connected hydraulic oil.
-> This avoids air injection into the PPRV.



140WA2MC52

1	Pump channel	6	Pressure compensator	9	Load holding valves
2	Tank channel	7	Pilot cover	10	Tie rod holes
3	Port A8	8	Electro-proportional secondary relief valves with make-up functionality	11	Stroke limiter
4	Port B8			12	LS-line
5	Main spool				

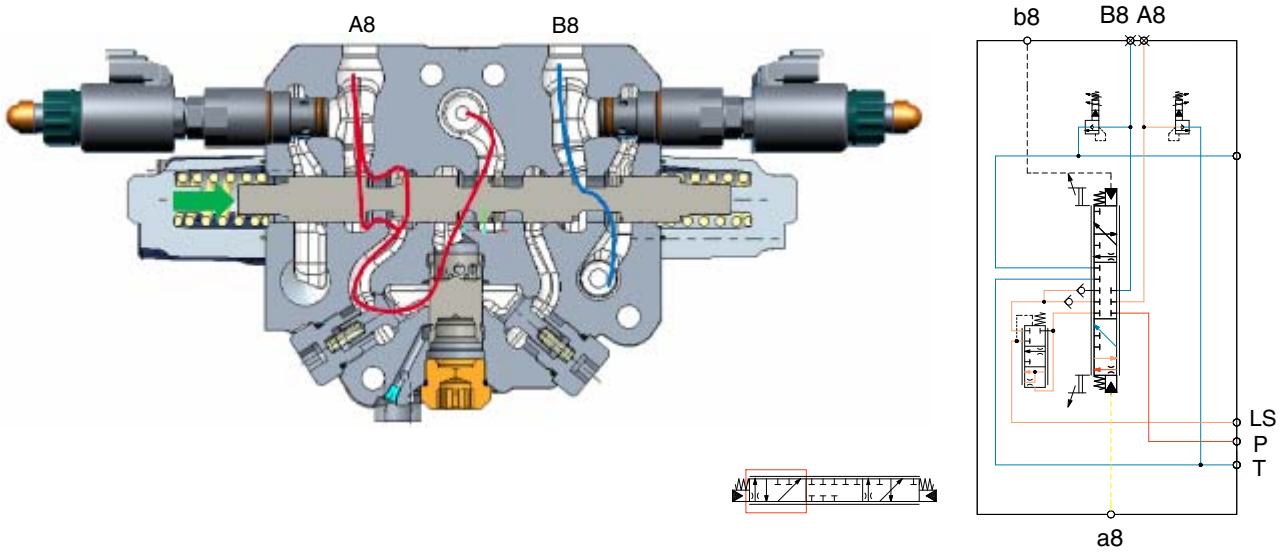
(2) Neutral position



140WA2MC53

Neutral position of option spool, all connections of the spool are closed and the A8 and B8 ports are not connected to the pump nor tank.

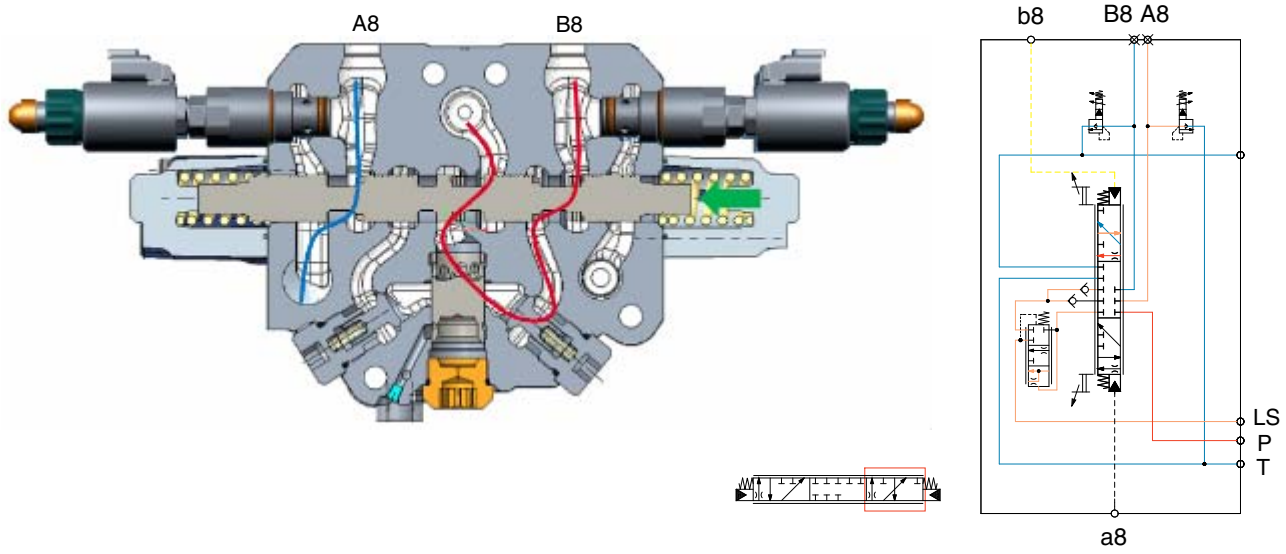
(3) A8 side piloted



140WA2MC54

When the pilot pressure is led to the port a8, the oil from the pump flows to the port A8 and oil from the cylinder flows into the tank through the port B8.

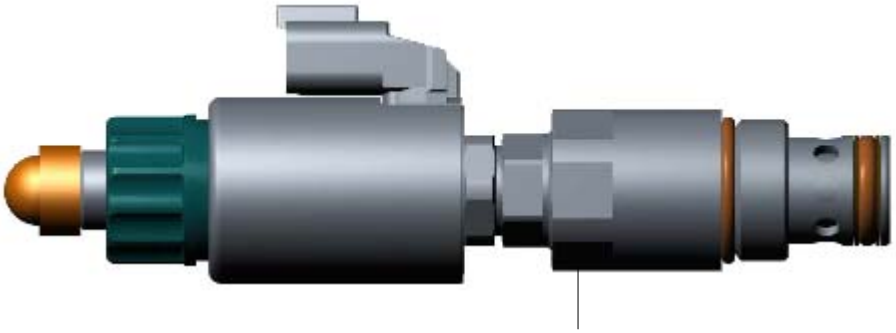
(4) B8 side piloted



140WA2MC55

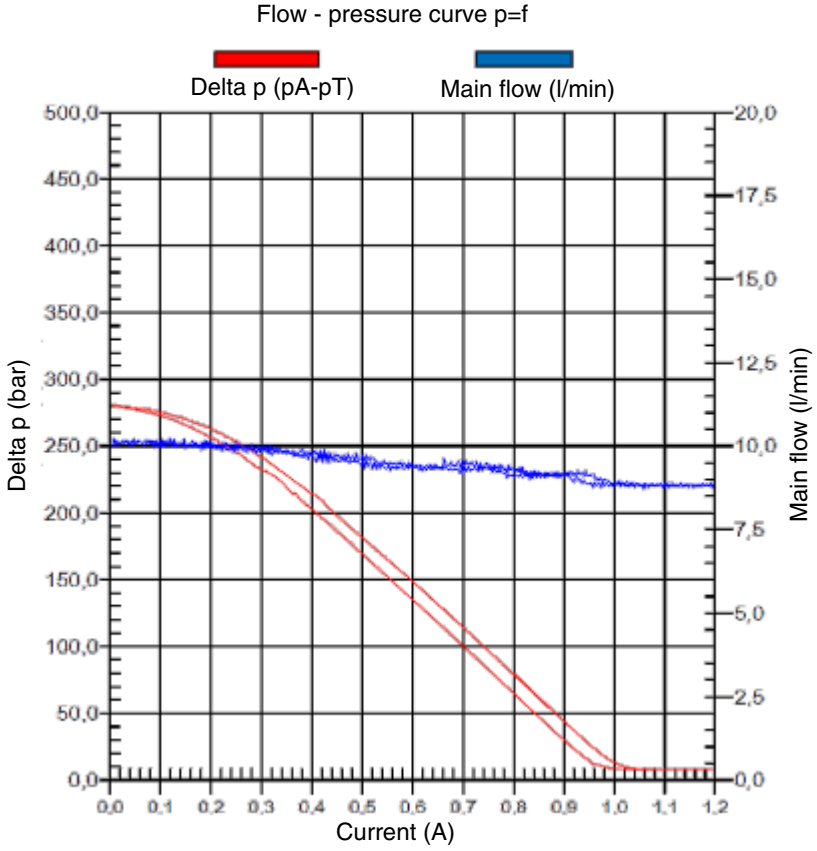
When the pilot pressure is led to the port b8, the oil from the pump flows to the port B8 and oil from the cylinder flows into the tank through the port A8.

(5) PPRV control information



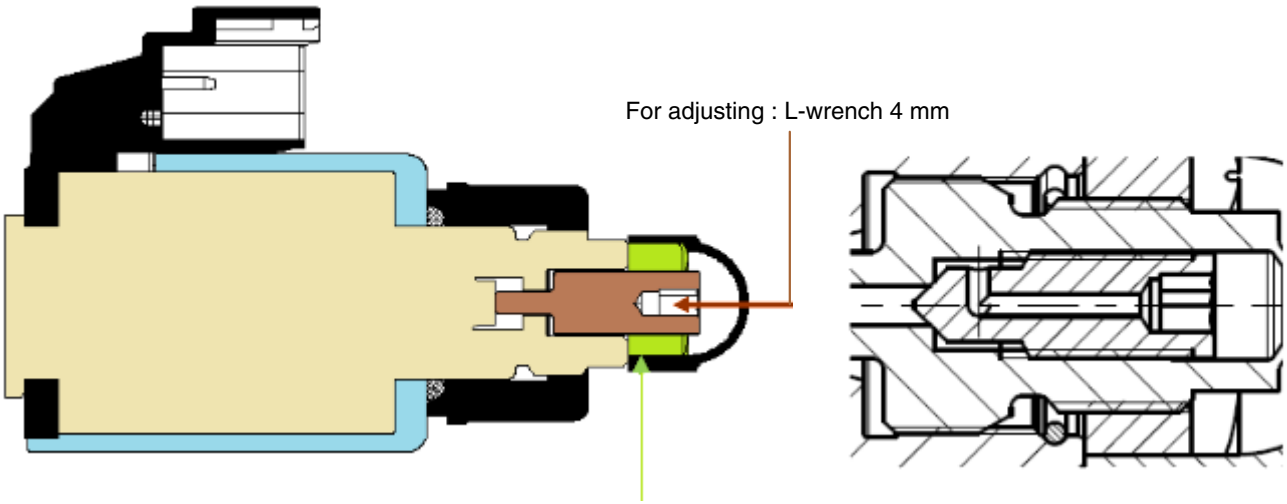
Tool : Spanner 30
Tightening torque : 10.2±1.0 kgf.m (73.8±7.4 lbf.ft)

140WA2MC56



140WA2MC57

· Adjustment

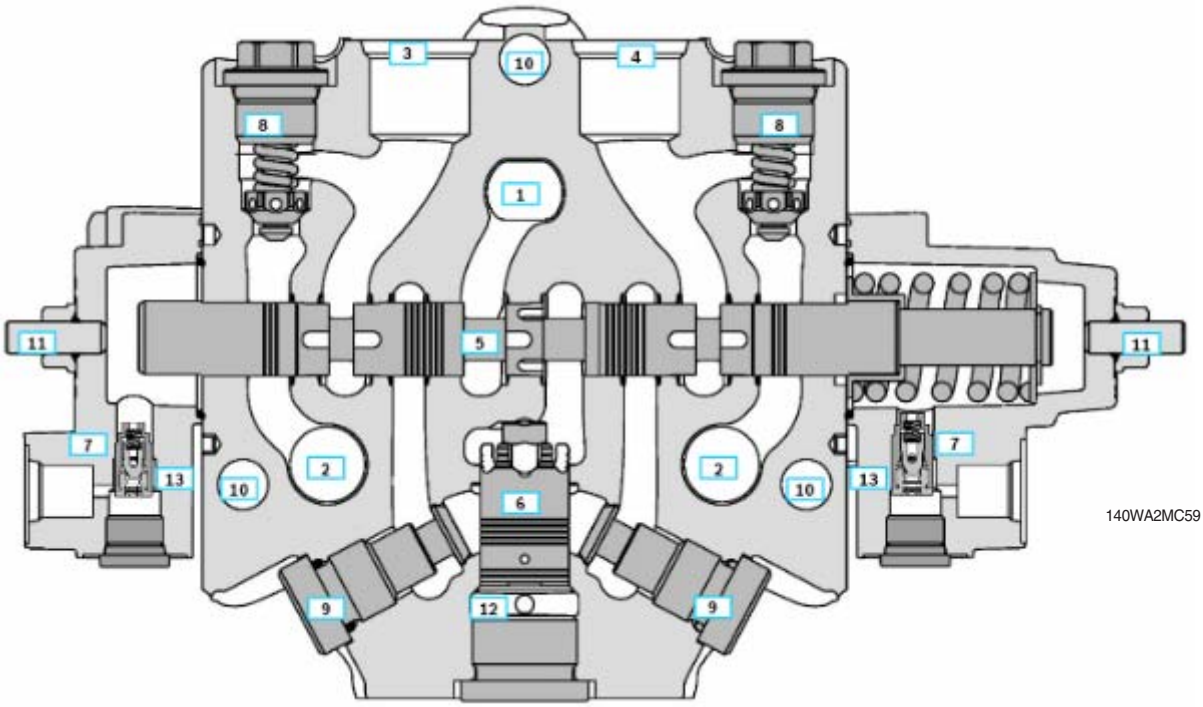


- Release the counter nut (green)
- Turn the positioning screw smoothly (brown)
- Fix the counter nut again (green)

※ **In general the adjustment of the pressure settings will be done in our production line. Afterwards we will seal the adjustment with sealing wax to avoid re-adjustment in the field.**

9) 2-PIECE BOOM

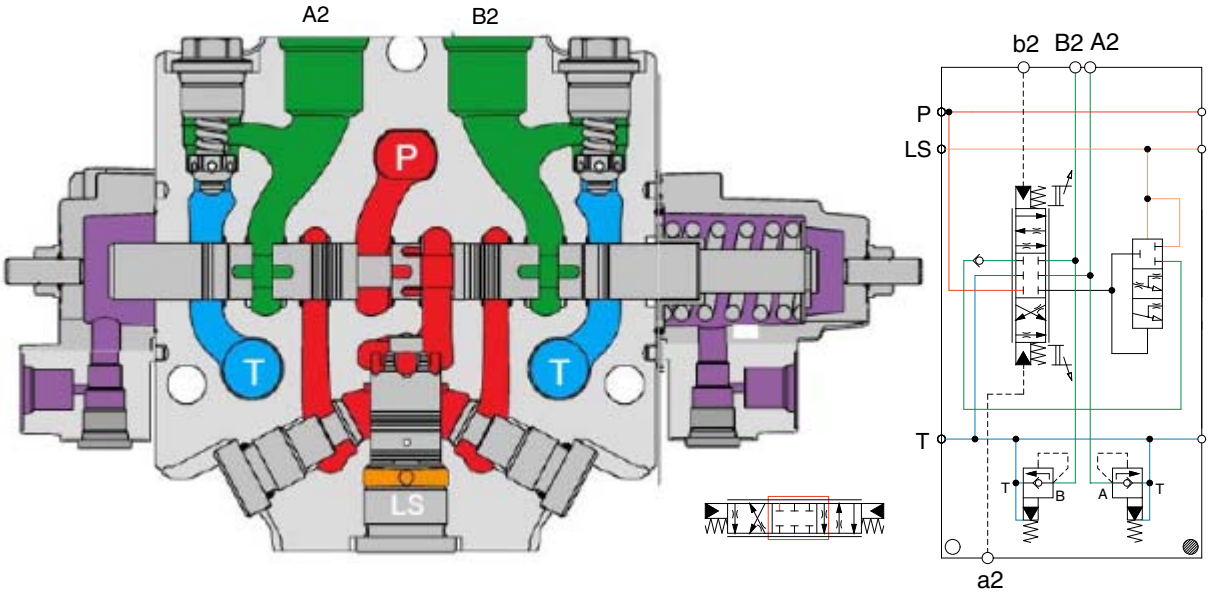
(1) Structure



140WA2MC59

1	Pump channel	6	Pressure compensator	10	Tie rod holes
2	Tank channel	7	Pilot cover	11	Stroke limiter
3	Consumer port A	8	Secondary relief valves	12	LS-line
4	Consumer port B		with make-up functionality	13	Snubber
5	Main spool	9	Load holding valves		

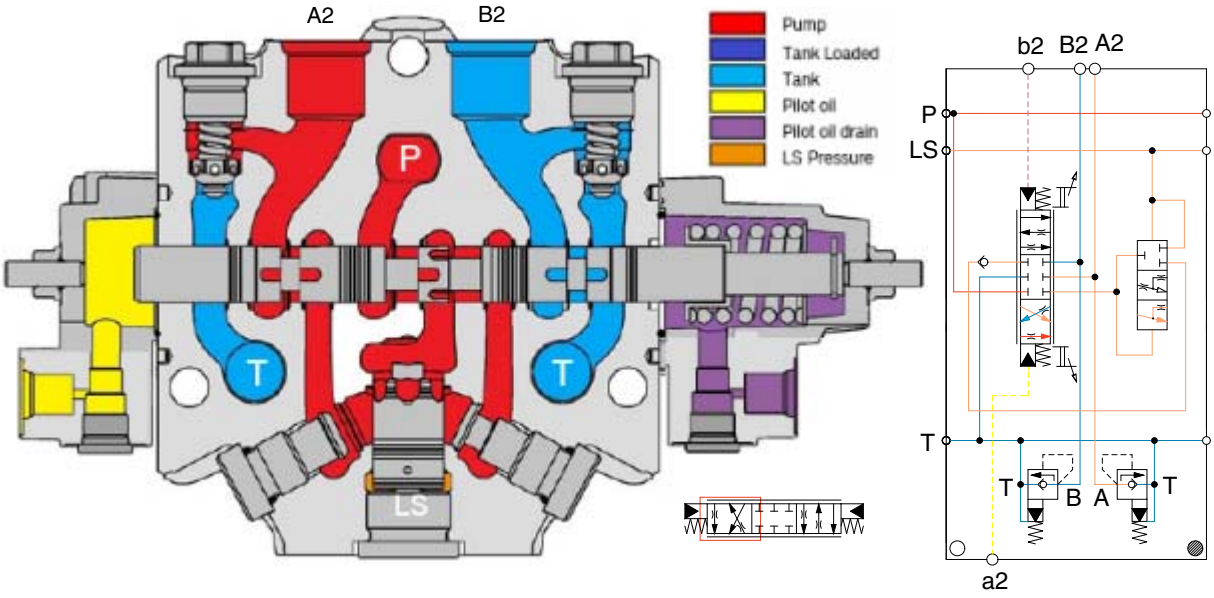
(2) Neutral position



140WA2MC60

The spool is in neutral position, pump is in low pressure stand-by. The A2 and B2 ports are not connected to the pumps nor the tank.

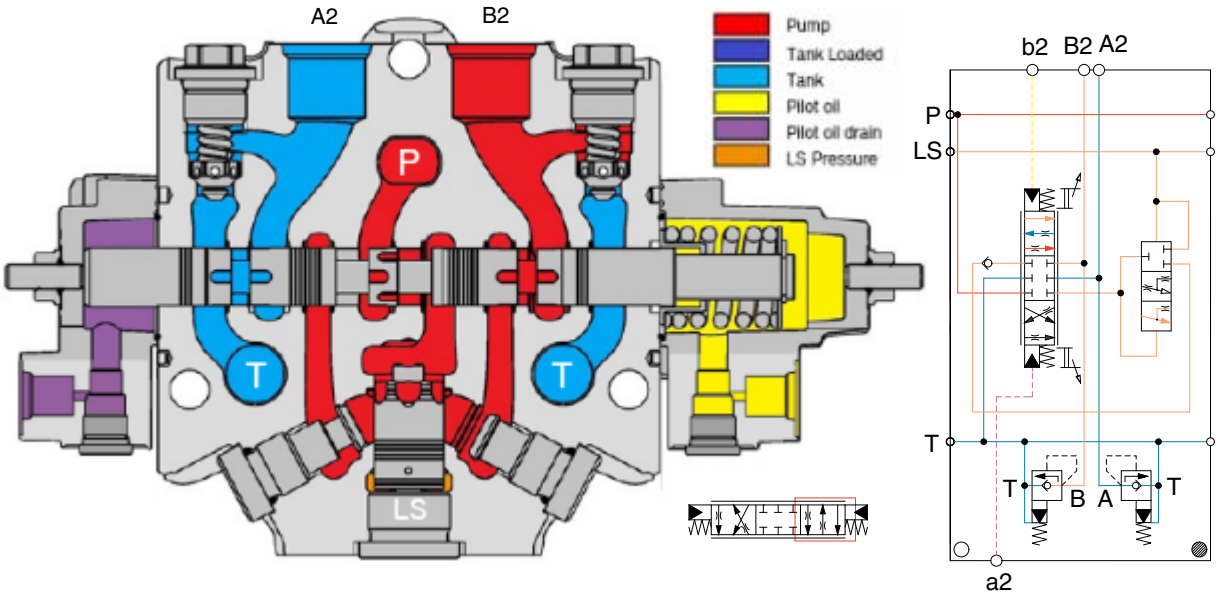
(3) Boom up position



140WA2MC61

When the pilot pressure is led to the port a2, the oil from the pump flows to the cylinder port A2 and oil from the cylinder flows into the tank through cylinder port B2.

(4) Boom down position

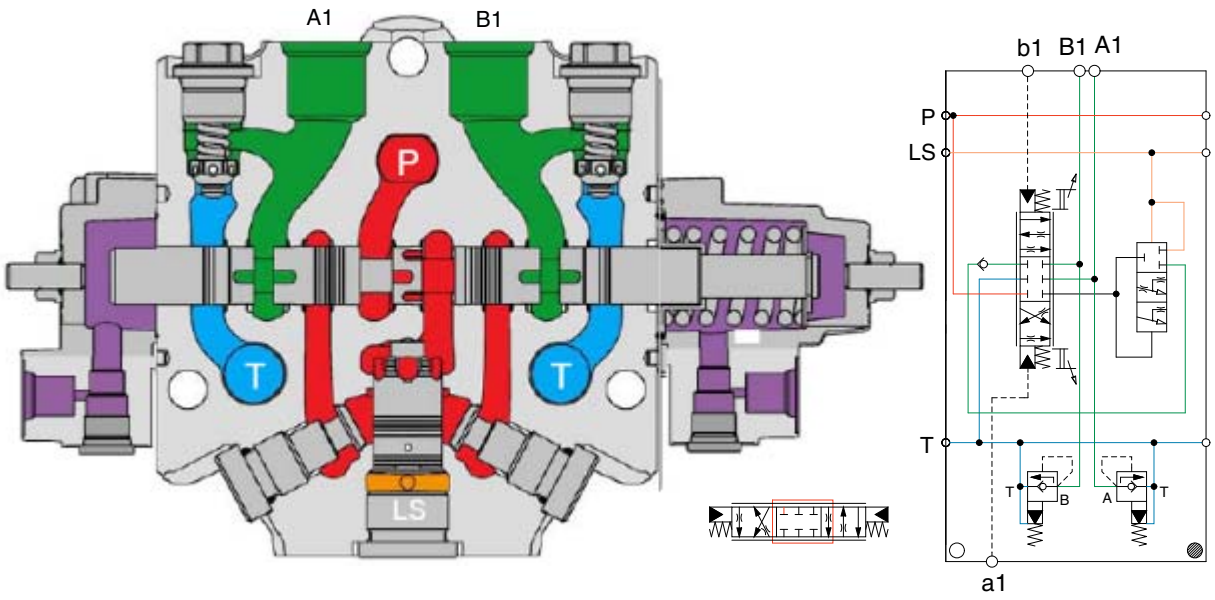


140WA2MC62

When the pilot pressure is led to the port b2, the oil from the pump flows to the cylinder port B2 and oil from the cylinder flows into the tank through the cylinder port A2.

10) OUTRIGGER SECTION

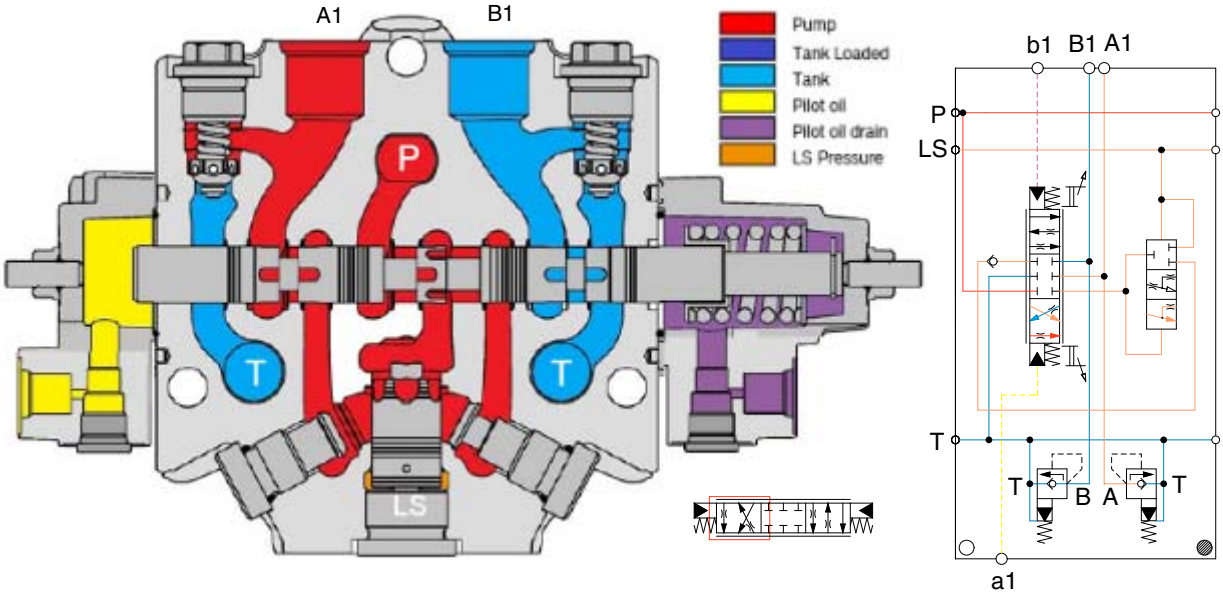
(1) Neutral psition



140WA2MC63

The spool is in neutral position, pump is in low pressure stand-by. The A1 and B1 ports are not connected to the pumps nor the tank.

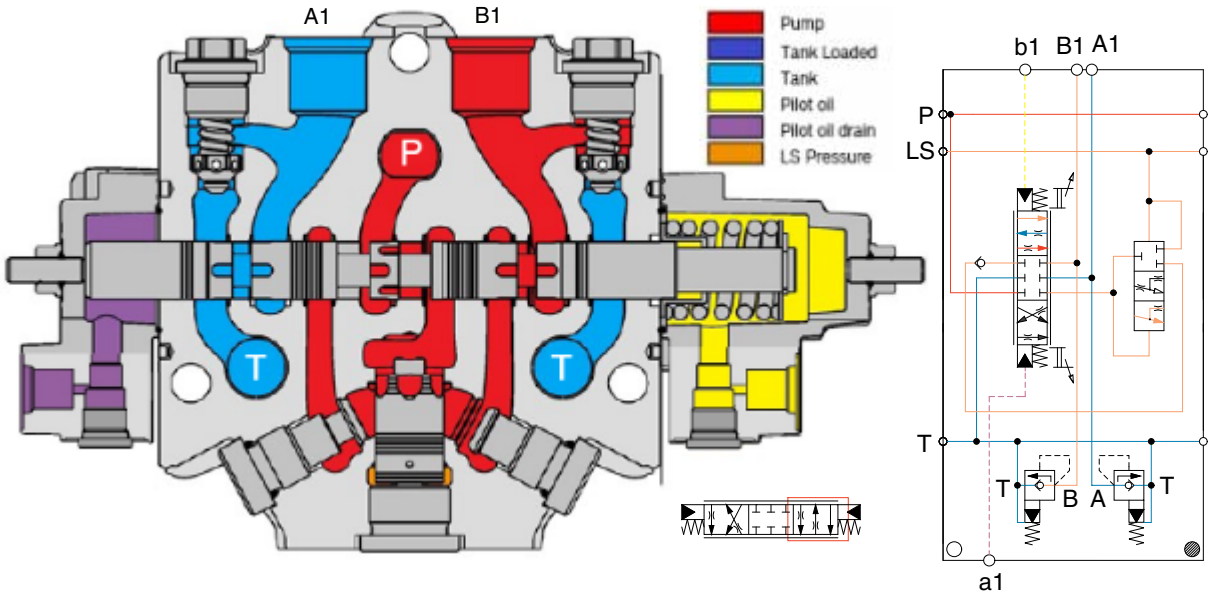
(2) A1 side piloted



140WA2MC64

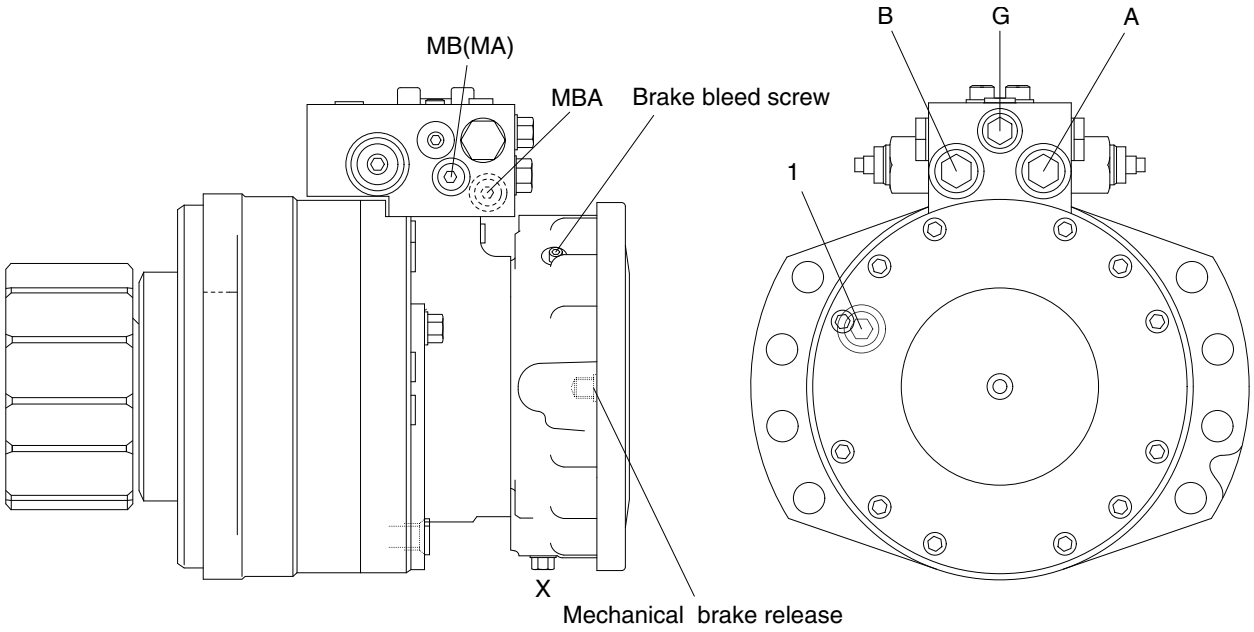
When the pilot pressure is led to the port a1, the oil from the pump flows to the cylinder port A1 and oil from the cylinder flows into the tank through cylinder port B1.

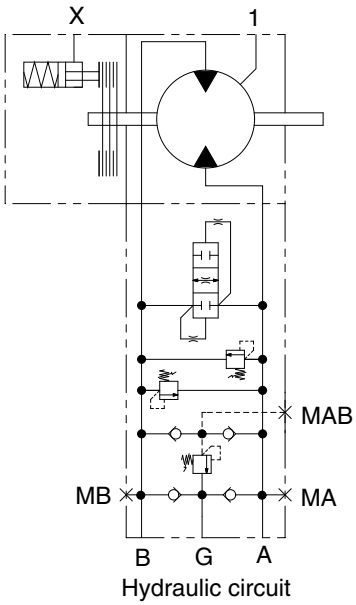
(3) B side piloted



When the pilot pressure is led to B1 side, the oil from the pump flows to the cylinder port B1and oil from the cylinder flows into the tank through the cylinder port A1.

1. STRUCTURE



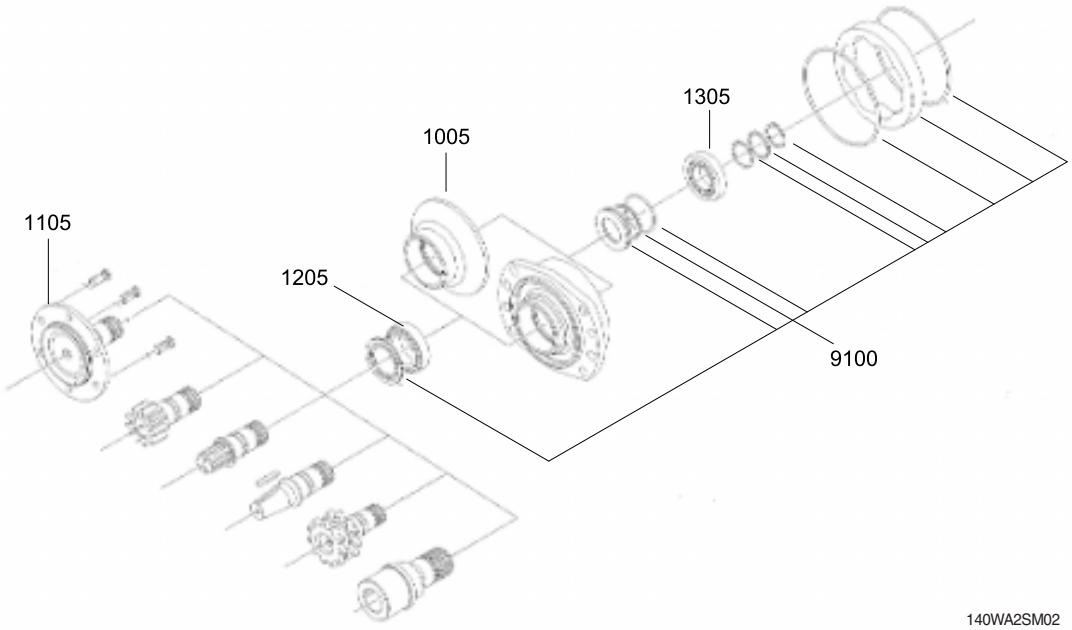


140WA2SM01A

Port	Port name	Port size
A	Main port	1-1/16-12 UNF
B	Main port	1-1/16-12 UNF
G	Make up port	7/8-14 UNF
MA	Gauge port	3/4-16 UNF
MB	Gauge port	3/4-16 UNF
MBA	Gauge port	7/16-20 UNF
X	Brake release port	9/16-18 UNF
1	Drain port	7/8-14 UNF

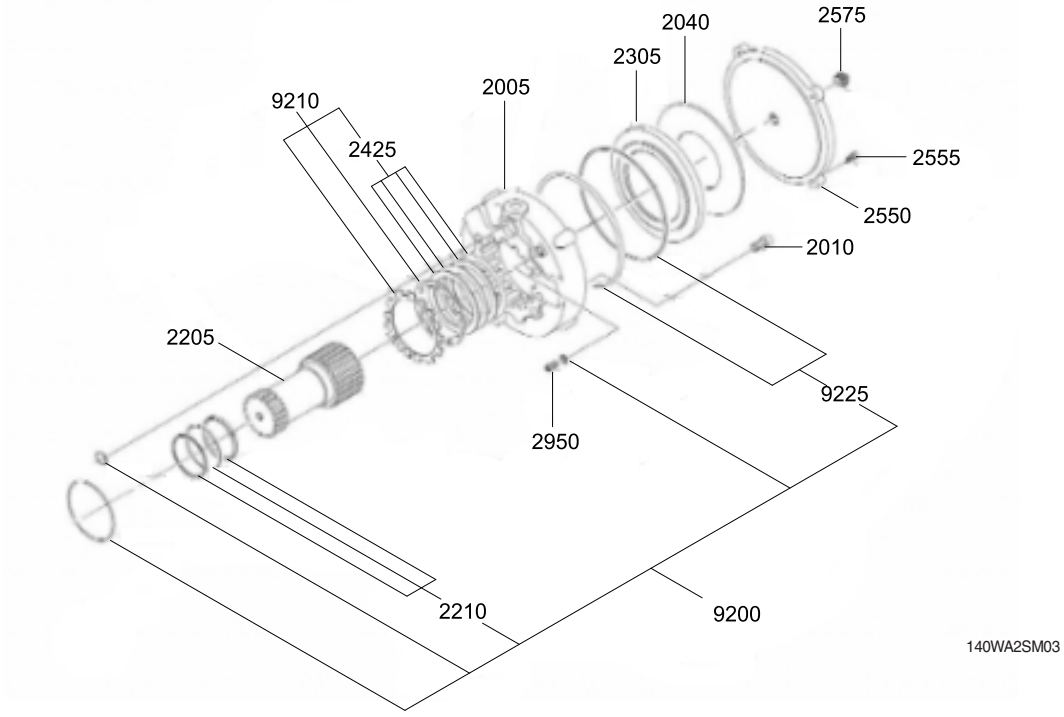
2. PART LIST

1) SUPPORT BEARING ASSY



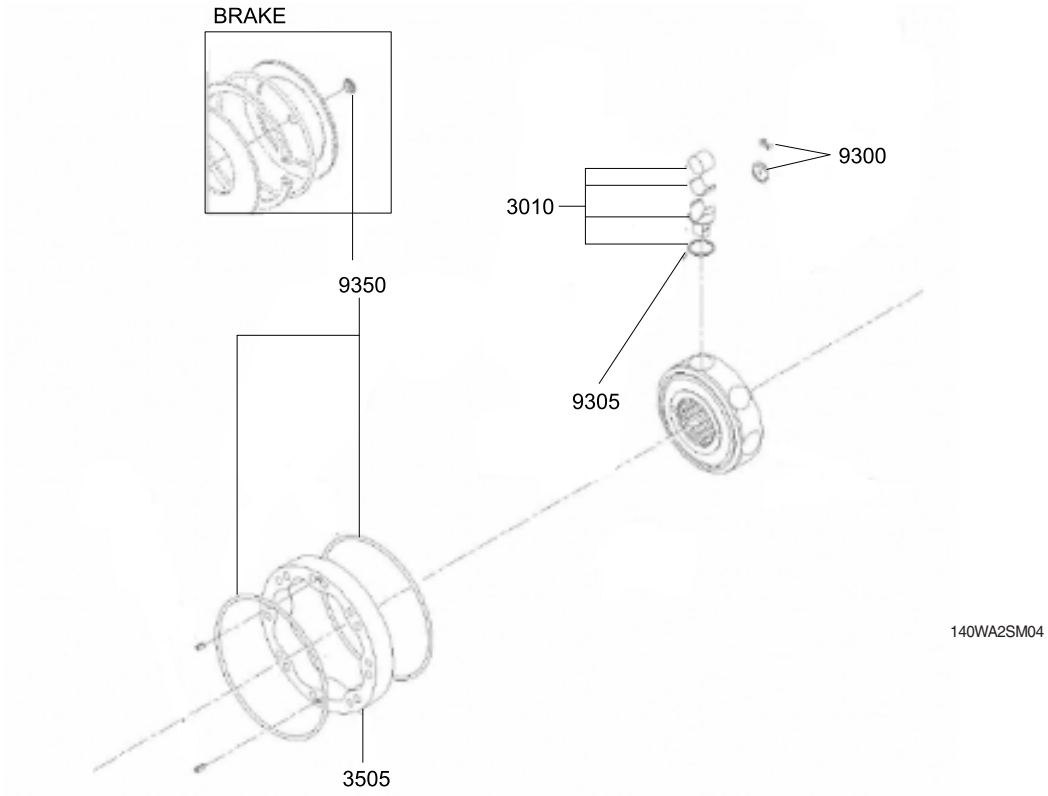
1005 Bearing housing	1205 Taper bearing	9100 Full motor seal kit
1105 Pinion shaft	1305 Taper bearing	

2) BRAKE ASSY



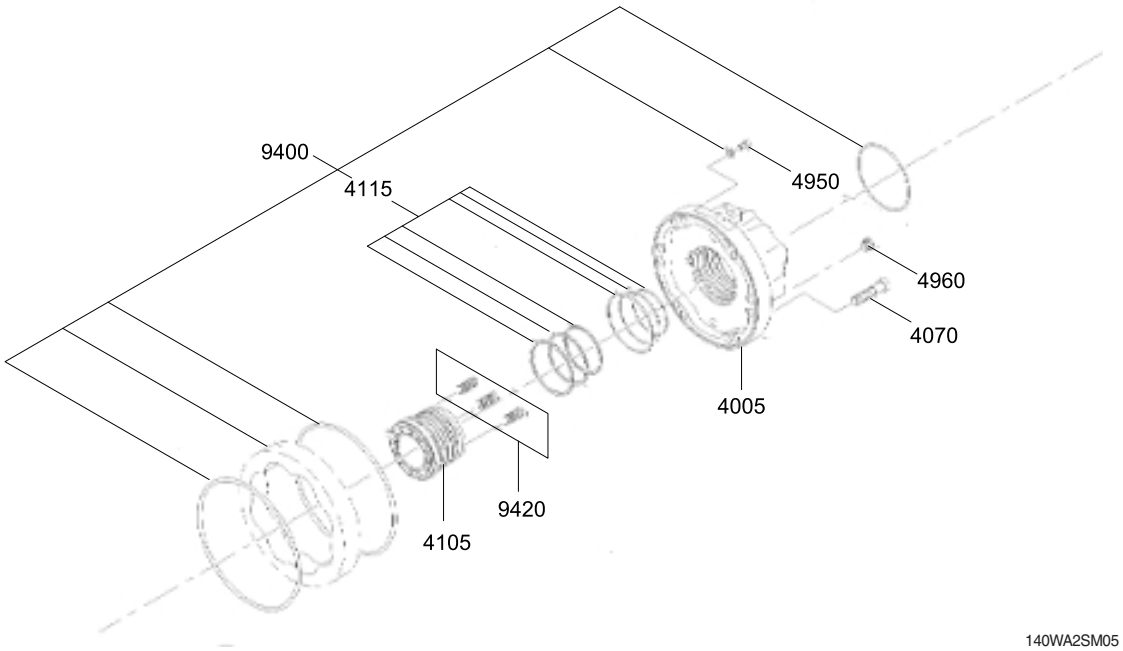
2005 Brake housing	2305 Brake piston	2950 Screw
2010 Screw	2425 Brake disk seal kit	9200 Brake repair kit
2040 Washer spring	2550 Lock plate	9210 Brake disc repair kit
2205 Brake shaft	2555 Screw	9225 Brake cover repair kit
2210 Brake shaft seal kit	2575 Plug	

3) CYLINDER BLOCK ASSY



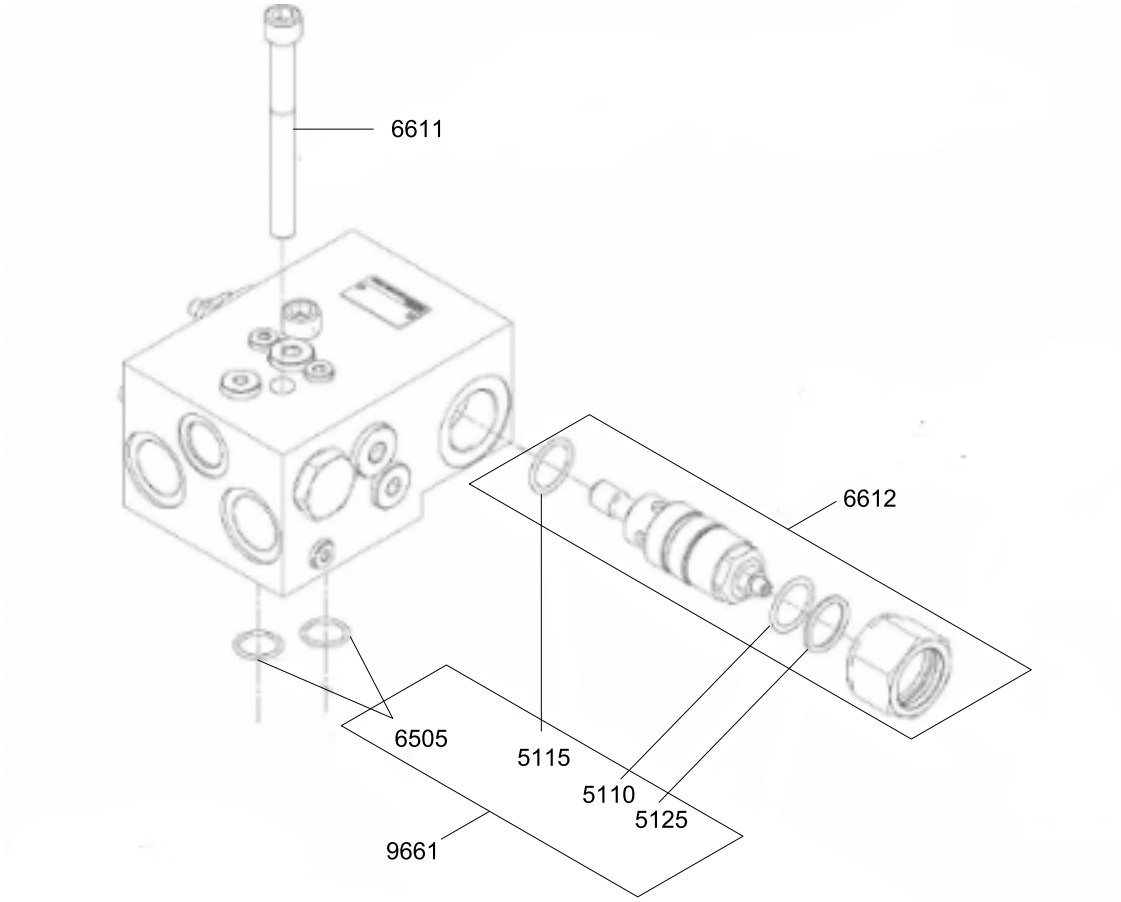
3010	Piston repair kit	9300	Piston insite kit	9350	Open motor repair kit
3505	Cam	9305	Piston ring repair kit		

4) VALVE COVER ASSY



4005	Valve housing	4115	Distribute seal kit	9400	Valve repair kit
4070	Screw	4950	Screw	9420	Compression spring kit
4105	Valve block	4960	Plug		

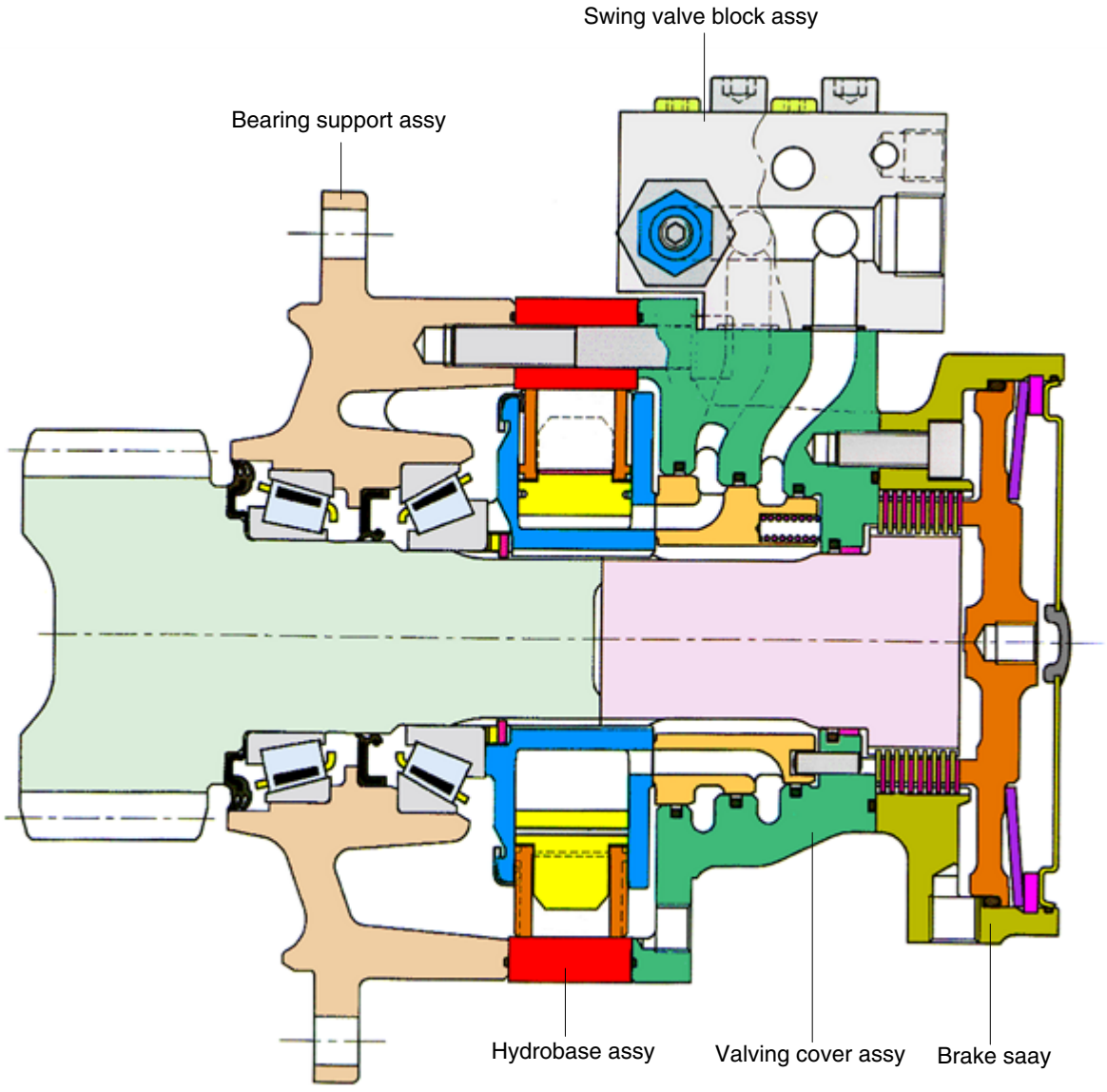
5) VMR VALVE ASSY



5110 O-ring
5115 O-ring
5125 Conte joint
6505 O-ring
6611 Screw
6612 Relief valve
9661 Relief valve seal kit

3. GENERAL DESCRIPTION

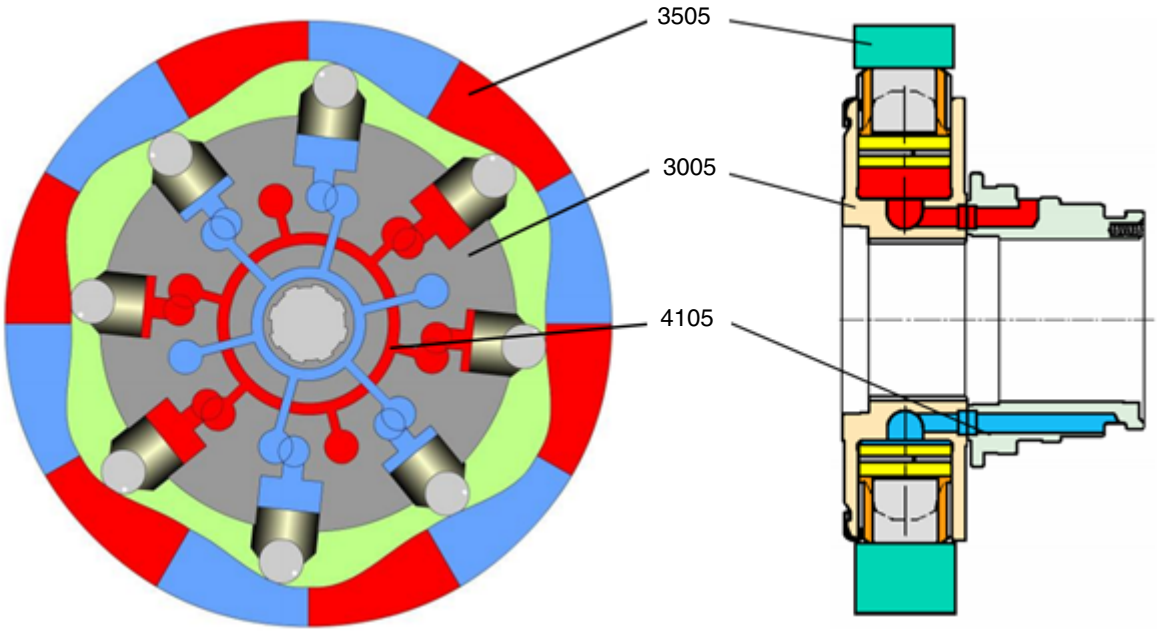
This hydraulic motor is designed to swing the upper structure of the excavator and changes the hydraulic pressure oil supplied from the pump to the rotary motion.
This is the radial piston type for low speed-high torque and section is as blow.



140WA2SM10

This hydraulic motor consists of the five major subassembly such as bearing support assembly, hydrobase assembly, valving cover assembly, brake assembly and swing valve block assembly (VMR valve assembly).

The hydraulic pressure oil flows into hydrobase through the valving cover assembly and the hydraulic energy changes to mechanical energy by the hydrobase. As a result, the upper structure is rotated through the pinion gear of the bearing support.
When the hydraulic oil is supplied to the A port (red) and this pressure oil flows through valving plate (fixed part, not rotating) and cylinder block (3005,rotating part, connect to the the pinion shaft by inside spline) and push red area of the cam (3505) through the piston and cylinder roller. Thus rotating torque is occurred.
(The upper structure starts rotating)



140WA2SM11

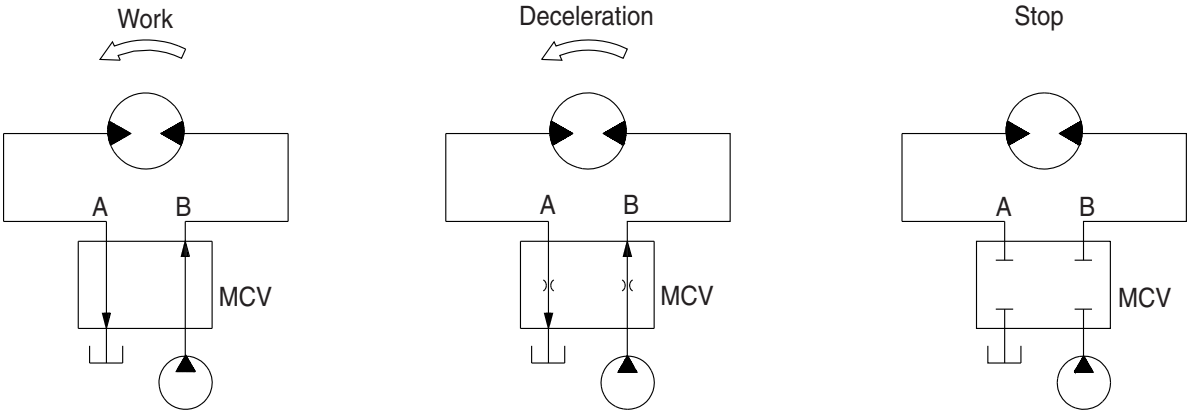
The other way, the blue port oil flows into the piston through the cylinder roller and flows into B port through the cylinder block and valving plate. Incase the upper structure stops from rotating, the resist rotating torque generates due to the throttle effect of the orifice by the slope of the blue area of the cam, then the upper structure stops. (hydrostatic brake function)
The green chamber is filled with oil during the operation, the internal leakage of the motor (leakage of the mechanical contact part of the 3005 and 4105) and leakage of between piston and cylinder block) flows in to green chamber and drains to hydraulic tank without resistance surely. The sealing status of the motor can be checked by measuring this drain oil.
The internal leakage of the motor does not exceed 0.14 lpm at the drain port when the supply oil quantity is 30 lpm.

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.



MCV A, B opened | MCV A, B throttled | MCV A, B closed

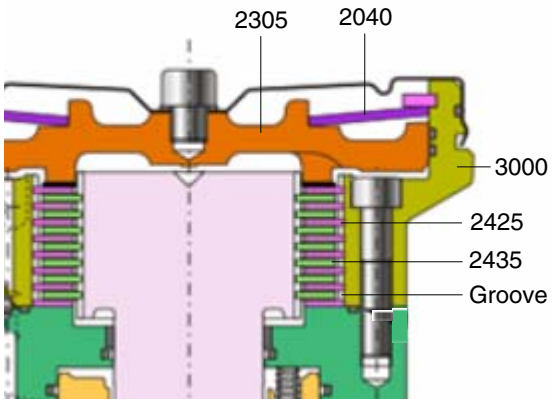
2-48(1)

(2) Mechanical swing parking brake system

This is function as a parking brake only when the swing control lever and arm in control lever are not operated.

① Brake assembly

Circumferential rotation of separate plate (2435) is constrained by the groove located at brake housing (2005). When housing is pressed down by washer spring (2040) through friction plate (2425), separate plate (2435) and brake piston (2305), friction force occurs between friction plate and separate plate. Friction force constrains motion of cylinder block (3000). When hydraulic force exceeds spring force, brake is released.



140WA2SM12

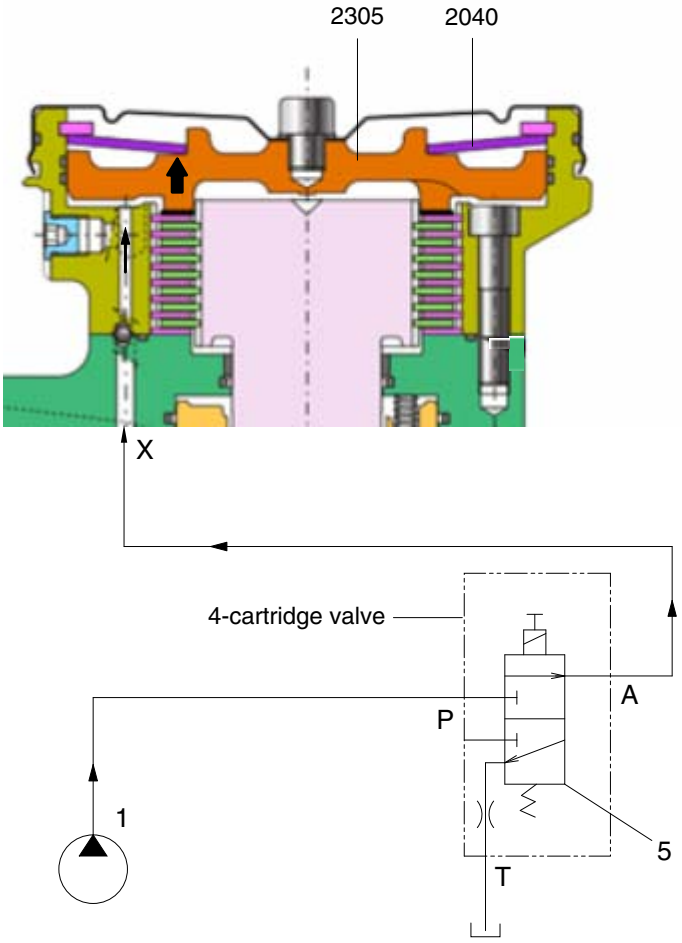
2005	Brake housing	2425	Friction plate
2040	Washer spring	2435	Separate plate
2305	Brake piston	3000	Cylinder block

② Operating principle

a. When any of the swing or arm in function is operated, the swing brake solenoid valve (5) is shifted to the swing position, so brake pump charged oil goes to the chamber G through port X. This pressure is applied to move the parking piston (2305) to the upward against the force of the washer spring (2040). Thus, it releases the brake force.

b. Stop operation and a few second has been elapsed, the swing brake solenoid valve (5) is shifted to the swing parking position and swing brake works.

c. There is time delay for swing parking as below (single operation).
- Swing : 5 sec, arm in : 1 sec, boom up : 2 sec, travel : 3 sec.



140WA2SM13

1	Brake pump	2040	Washer spring
5	Swing brake solenoid valve	2305	Brake piston

③ **Manual override function**

When the swing parking solenoid valve or related electric system is malfunction, the swing parking brake is not released even if the swing or arm in lever is operated.

To release the swing parking brake, the manual override function is needed.

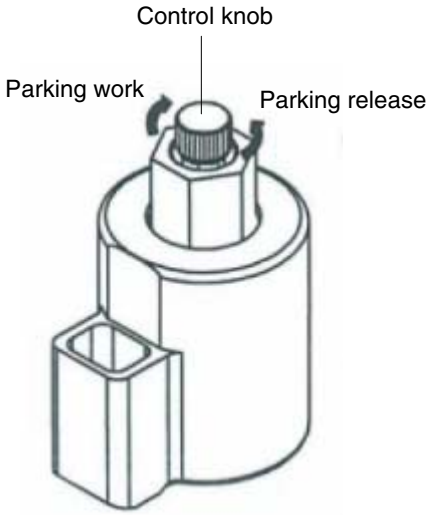
※ **Manual override solenoid valve**

a. Use hand only to turn the control knob (do not use a tool).

b. **Parking brake release**
Turn the control knob to counterclockwise fully (about 2.5 mm)

c. **Parking brake work**
Turn the control knob to clockwise fully.

※ **Be careful not damage the control knob by using a tool or tightening forcibly.**
It can cause malfunction of the solenoid valve.



Swing parking solenoid valve

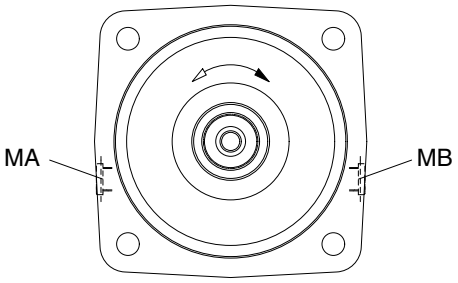
160A2SM11

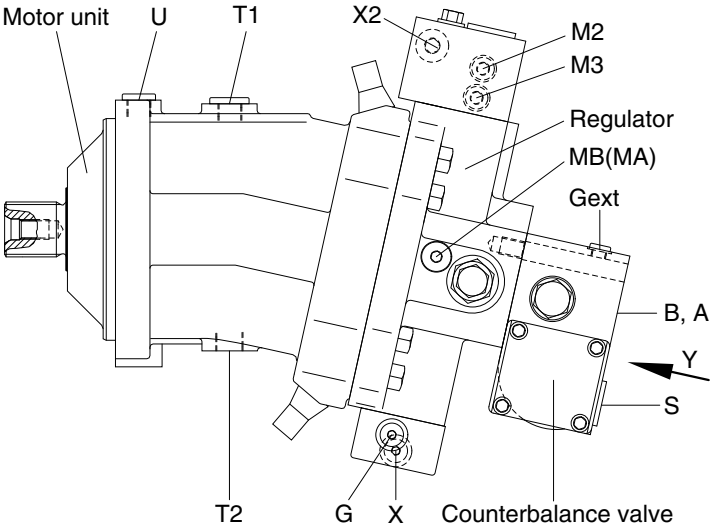
GROUP 4 TRAVEL MOTOR

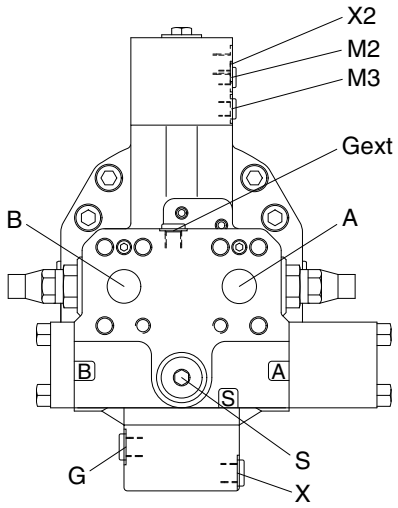
1. CONSTRUCTION

Travel motor consists motor unit, regulator and counterbalance valve.

・High speed (standard)

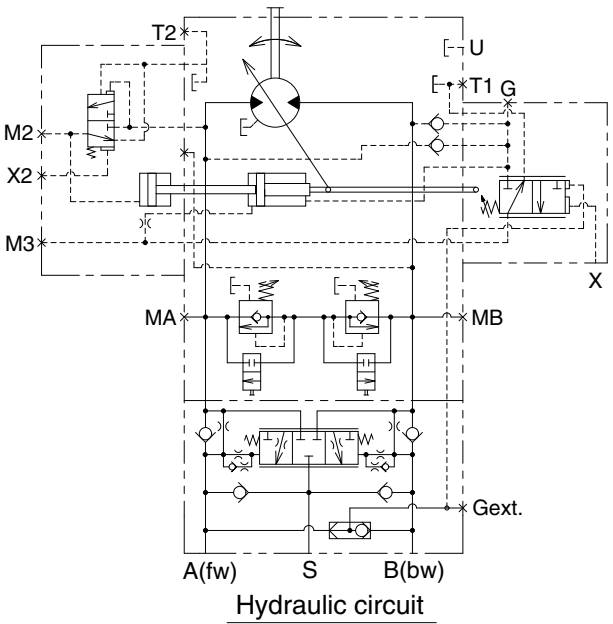






VIEW Y

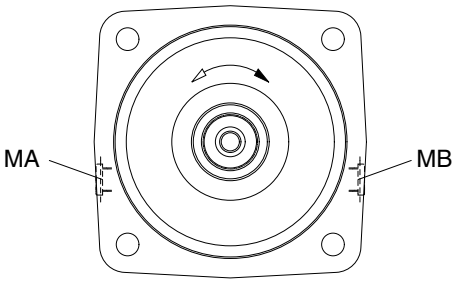
160WA2TR01

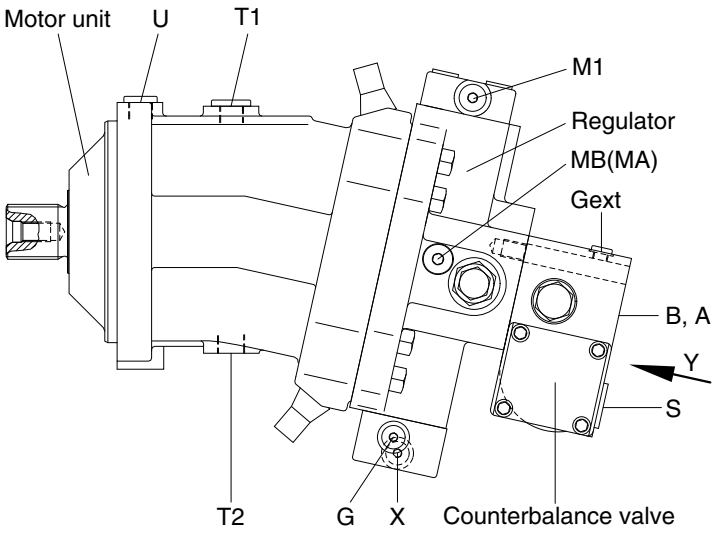


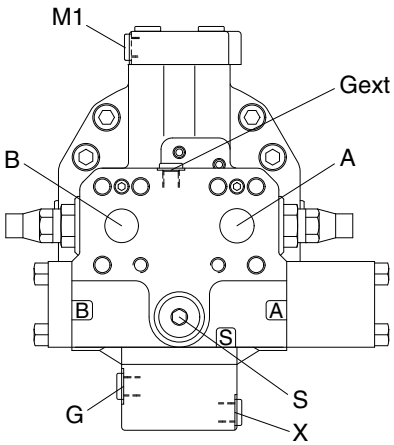
Hydraulic circuit

Port	Port name	Port size
A, B	Main port	SAE 1 1/4"
G	Plugged	M14×1.5 - 12
X	Pilot pressure port	M14×1.5 - 12
X2	Pilot pressure port	M14×1.5 - 12
T1	Drain port	PF 3/4 - 17
T2	Drain port	PF 3/4 - 12
U	Flushing port	PF 1/2 - 16
S	Make up port	M27×2.0 - 16
MA, MB	Gauge port	M18×1.5 - 12
M2, M3	Gauge port	M10×1.0 - 8
Gext	Brake release port	M12×1.5 - 12.5

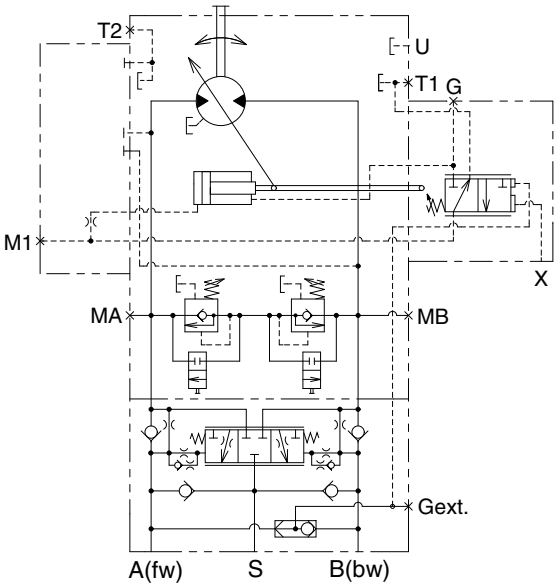
・Low speed (option)







VIEW Y



Hydraulic circuit

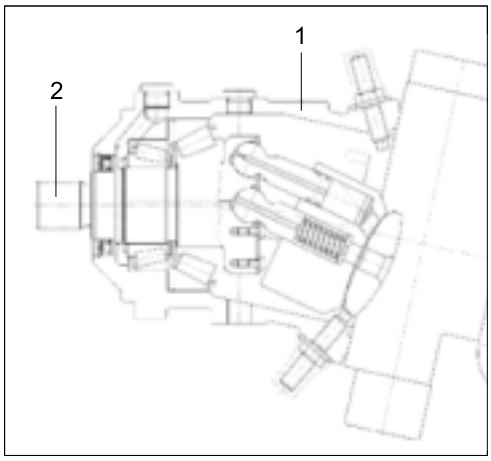
160WA2TR02

Port	Port name	Port size
A, B	Main port	SAE 1 1/4"
G	Plugged	M14×1.5 - 12
M1	Gauge port	M14×1.5 - 12
X	Pilot pressure port	M14×1.5 - 12
T1	Drain port	PF 3/4 - 17
T2	Drain port	PF 3/4 - 12
U	Flushing port	PF 1/2 - 16
S	Make up port	M27×2.0 - 16
MA, MB	Gauge port	M18×1.5 - 12
Gext	Brake release port	M12×1.5 - 12.5

1) PARTS LIST (1/3)

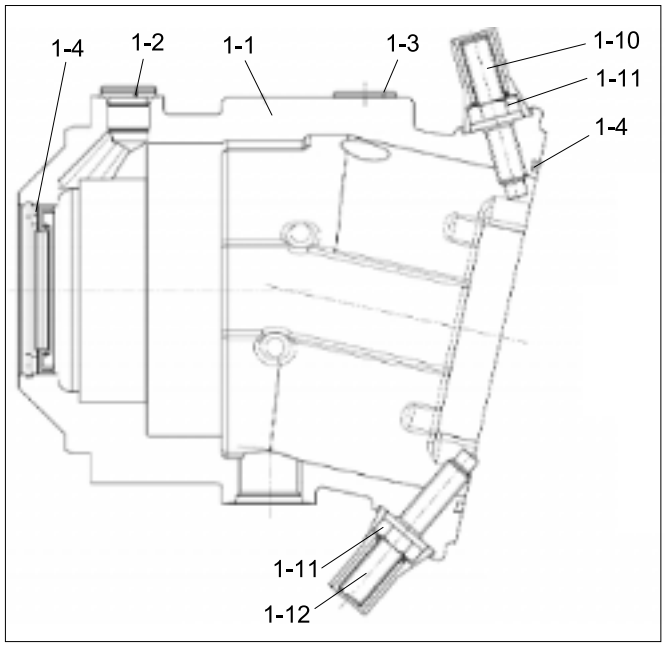
(1) High speed

MOTOR ASSY



1 Motor housing assy
2 Rotary kit

ITEM 1



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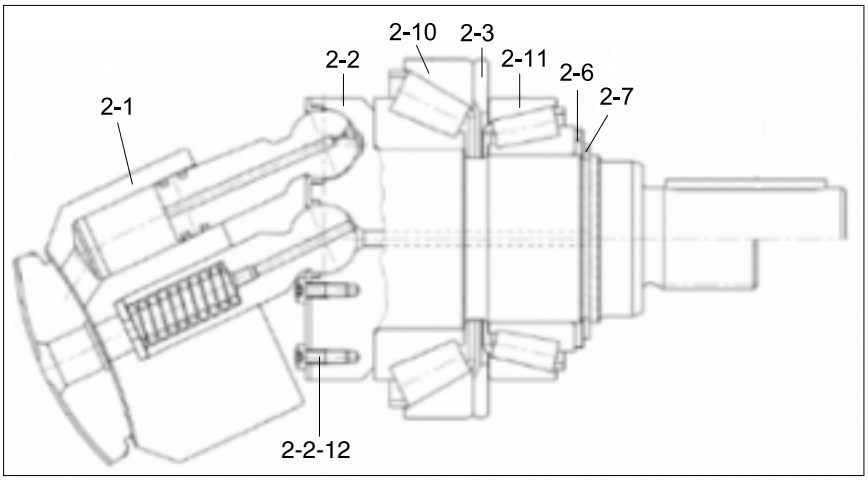
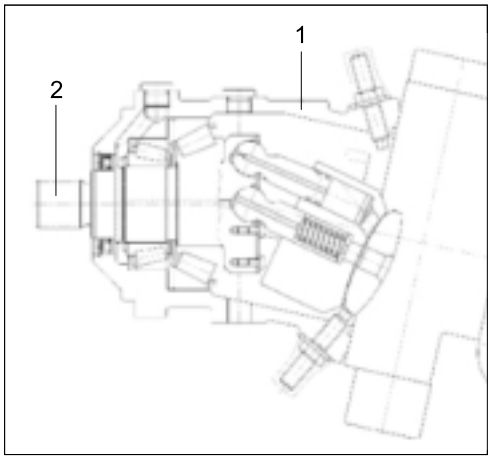


140WA2TR10

1-1	Housing	1-11	Sealing nut	2-3	Shim
1-2	Lock screw	1-12	Threaded pin	2-6	Backup plate
1-3	Lock screw	2-1	Hydraulic rotary section	2-7	Retainer ring
1-4	Motor seal kit	2-2	Drive shaft	2-10	Roller bearing
1-10	Threaded pin	2-2-12	Screw	2-11	Roller bearing

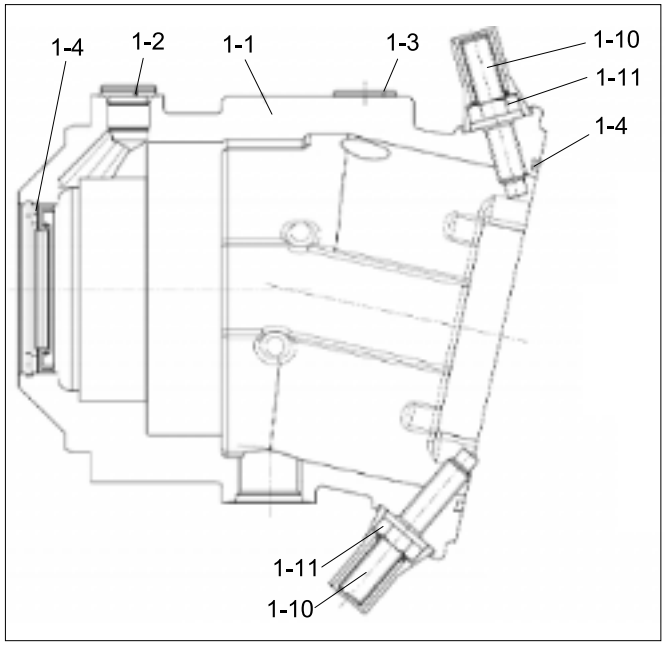
(2) Low speed

MOTOR ASSY



1 Motor housing assy
2 Rotary kit

ITEM 1



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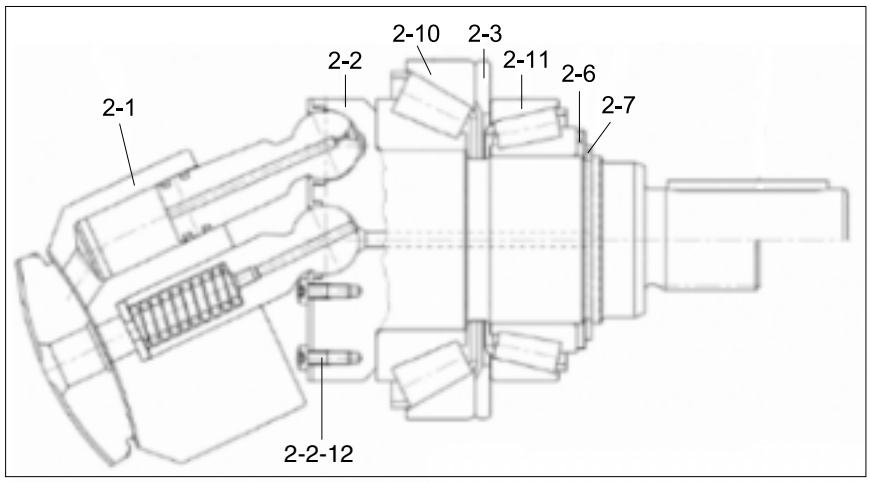


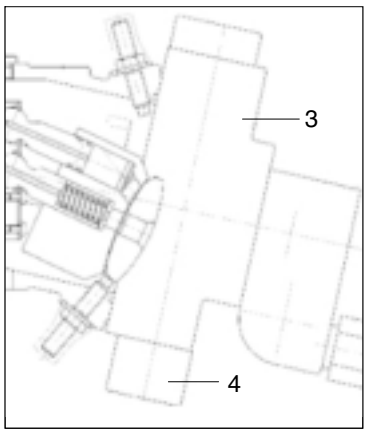
140WA2T11

1-1	Housing	1-11	Sealing nut	2-6	Backup plate
1-2	Lock screw	2-1	Hydraulic rotary section	2-7	Retainer ring
1-3	Lock screw	2-2	Drive shaft	2-10	Roller bearing
1-4	Motor seal kit	2-2-12	Screw	2-11	Roller bearing
1-10	Threaded pin	2-3	Shim		

PARTS LIST (2/3)

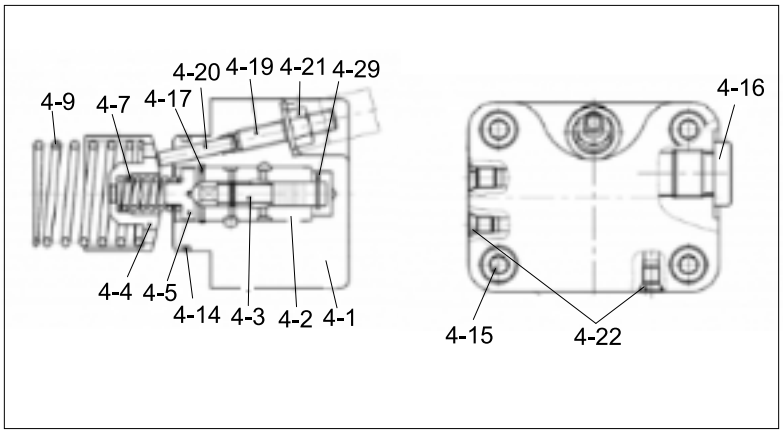
(1) High speed

MOTOR ASSY

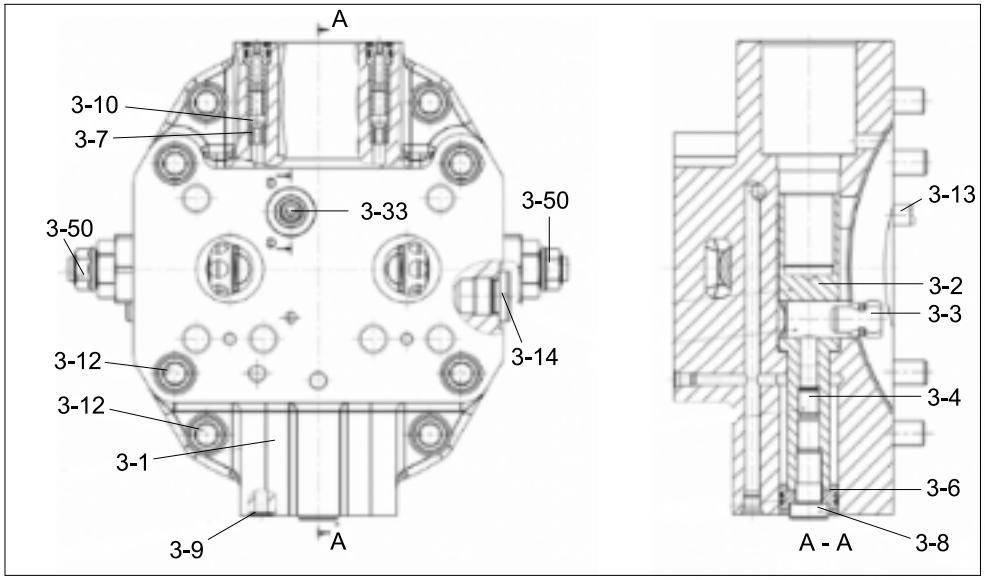


3 Port plate assy
4 Control unit

ITEM 4



ITEM 3

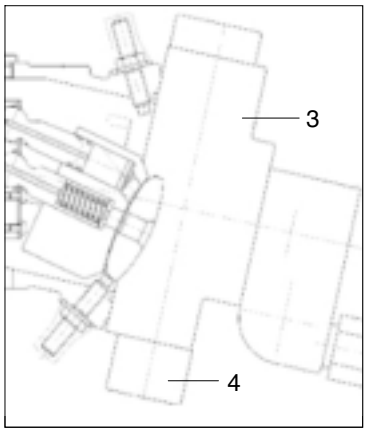


160WA2TR12

3-1	Port plate	3-13	Cylinder pin	4-9	Pressure spring
3-2	Positioning piston	3-14	Locking screw	4-14	O-ring
3-3	Positioning trunnion	3-33	O-ring	4-15	Socket screw
3-4	Threaded pin	3-50	Relief valve	4-16	Locking screw
3-6	Piston ring	4-1	Control housing	4-17	Retainer ring
3-7	Bushing	4-2	Control bushing	4-19	Thread pin
3-8	Socket screw	4-3	Control piston	4-20	Cylinder pin
3-9	O-ring	4-4	Adjust bushing	4-21	Seal lock nut
3-10	Check valve	4-5	Spring collar	4-22	Break pin
3-12	Socket screw	4-7	Pressure spring	4-29	Retainer disc

(2) Low speed

MOTOR ASSY



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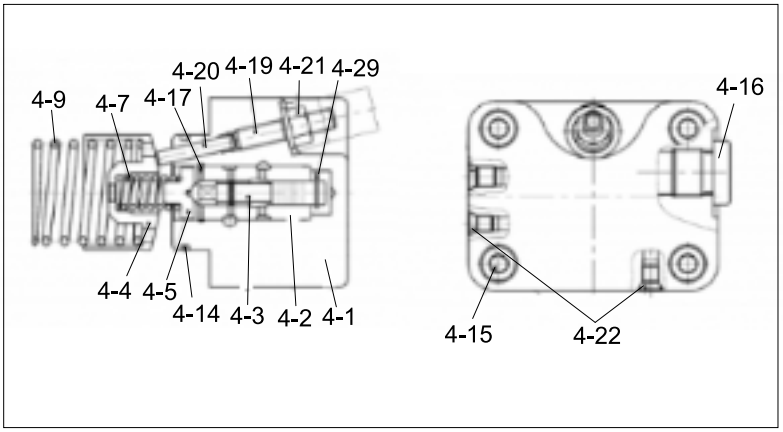
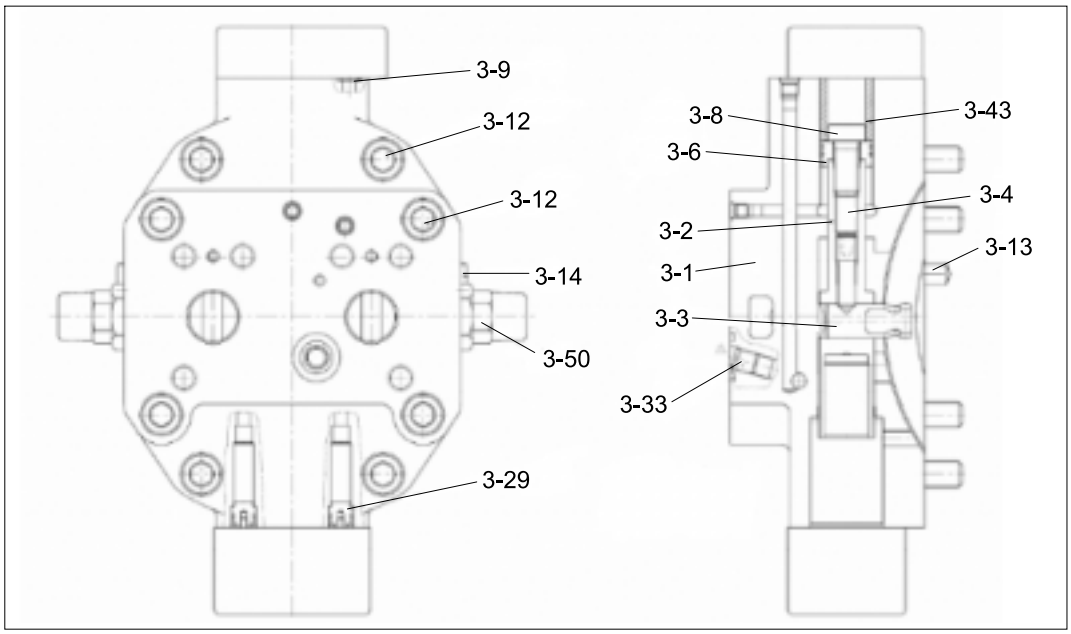


3 Port plate assy
4 Control unit

ITEM 3



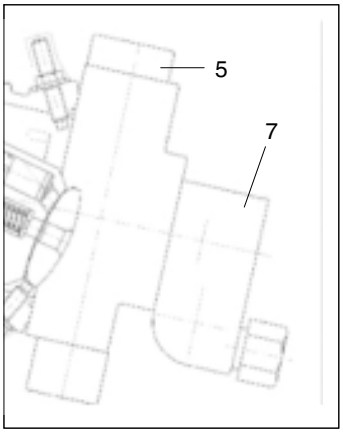
160WA2TR13

3-1	Port plate	3-29	Plug	4-9	Pressure spring
3-2	Positioning piston	3-33	O-ring	4-14	O-ring
3-3	Positioning trunnion	3-43	Stop bushing	4-15	Socket screw
3-4	Threaded pin	3-50	Relief valve	4-16	Locking screw
3-6	Piston ring	4-1	Control housing	4-17	Retainer ring
3-8	Socket screw	4-2	Control bushing	4-19	Thread pin
3-9	O-ring	4-3	Control piston	4-20	Cylinder pin
3-12	Socket screw	4-4	Adjust bushing	4-21	Seal lock nut
3-13	Cylinder pin	4-5	Spring collar	4-22	Break pin
3-14	Locking screw	4-7	Pressure spring	4-29	Retainer disc

PARTS LIST (3/3)

(1) High speed

MOTOR ASSY



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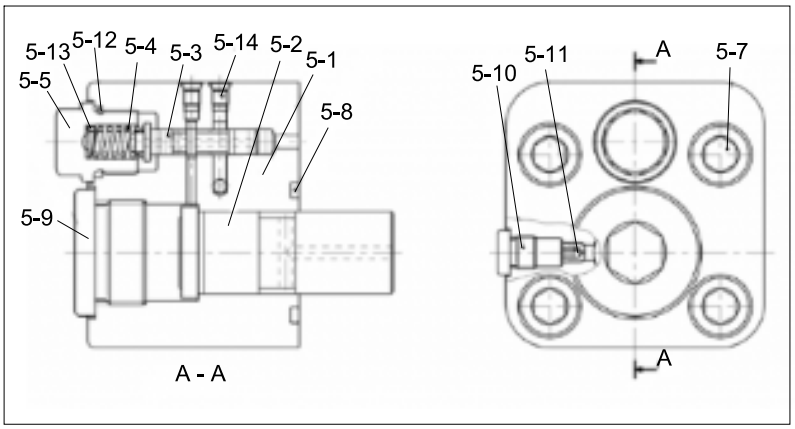
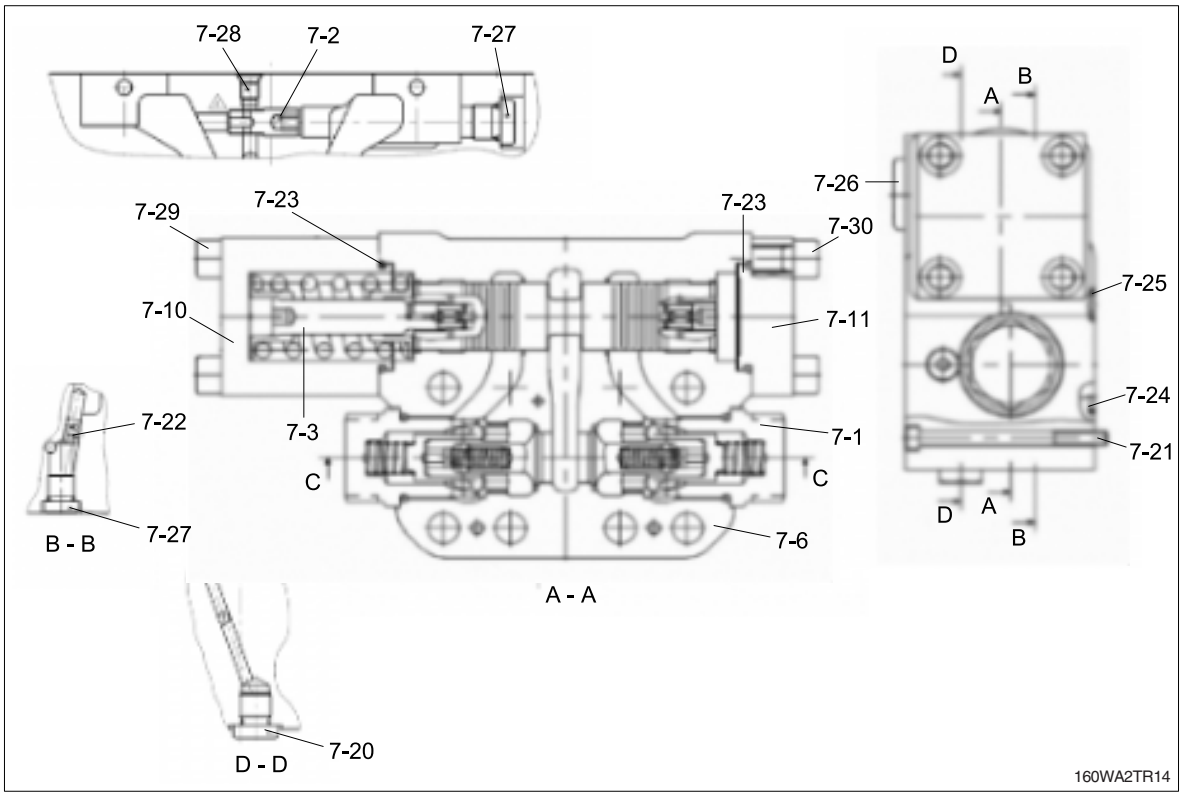


5 Hydraulic stroke limiter
7 Motion control valve assy

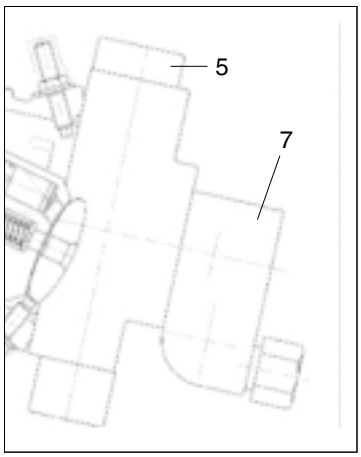
ITEM 7



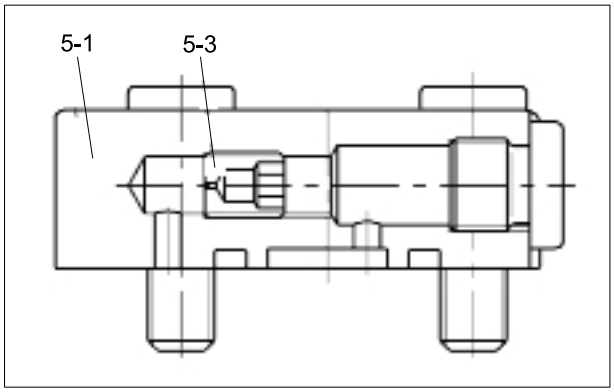
5-1	Limiter housing	5-12	O-ring	7-21	Socket screw
5-2	Piston	5-13	Shim	7-22	Plug
5-3	Control piston	5-14	Break pin	7-23	O-ring
5-4	Pressure spring	7-1	Control valve assy	7-24	O-ring
5-5	Lock screw	7-2	Shuttle valve	7-25	O-ring
5-7	Cap screw	7-3	Brake piston assy	7-26	Locking screw
5-8	O-ring	7-6	Housing	7-27	Locking screw
5-9	Lock screw	7-10	Cover	7-28	Break pin
5-10	Lock screw	7-11	Cover	7-29	Socket screw
5-11	Orifice	7-20	Locking screw	7-30	Socket screw

(2) Low speed

MOTOR ASSY

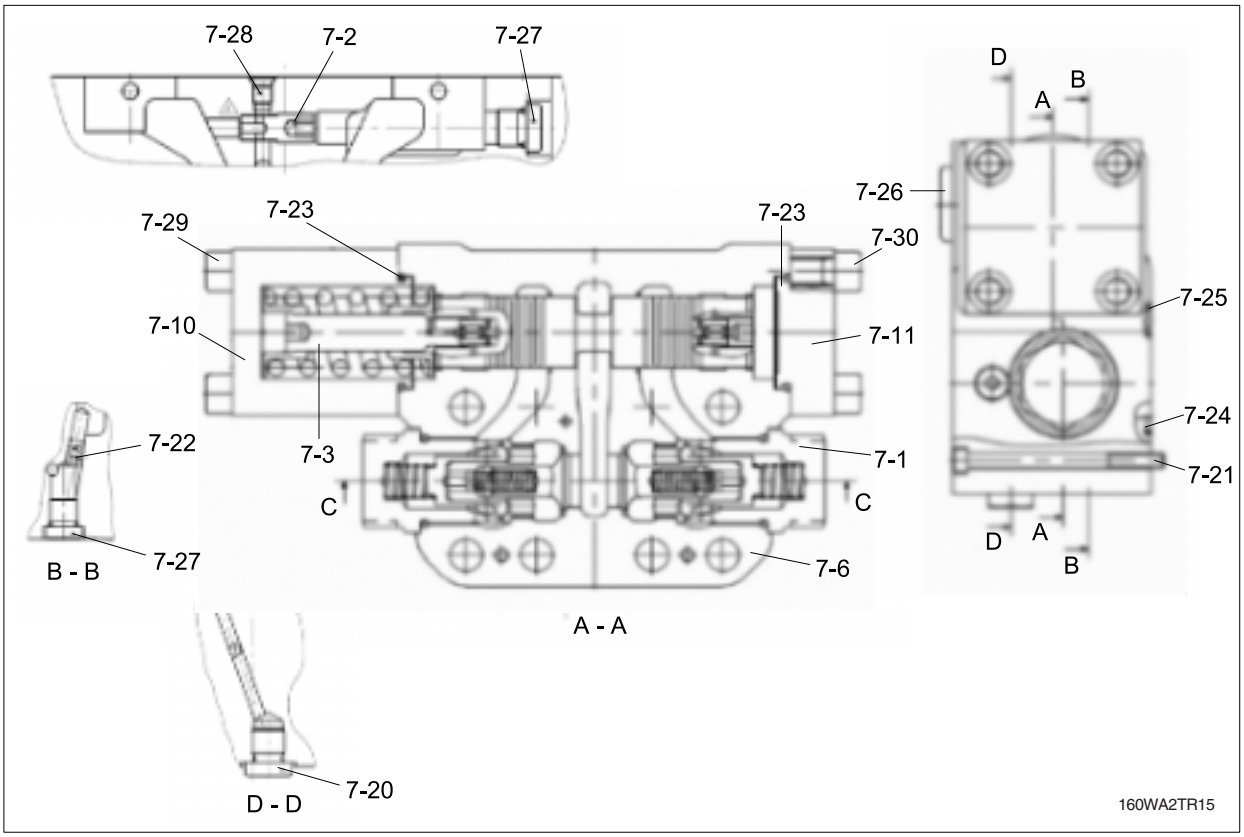


ITEM 5



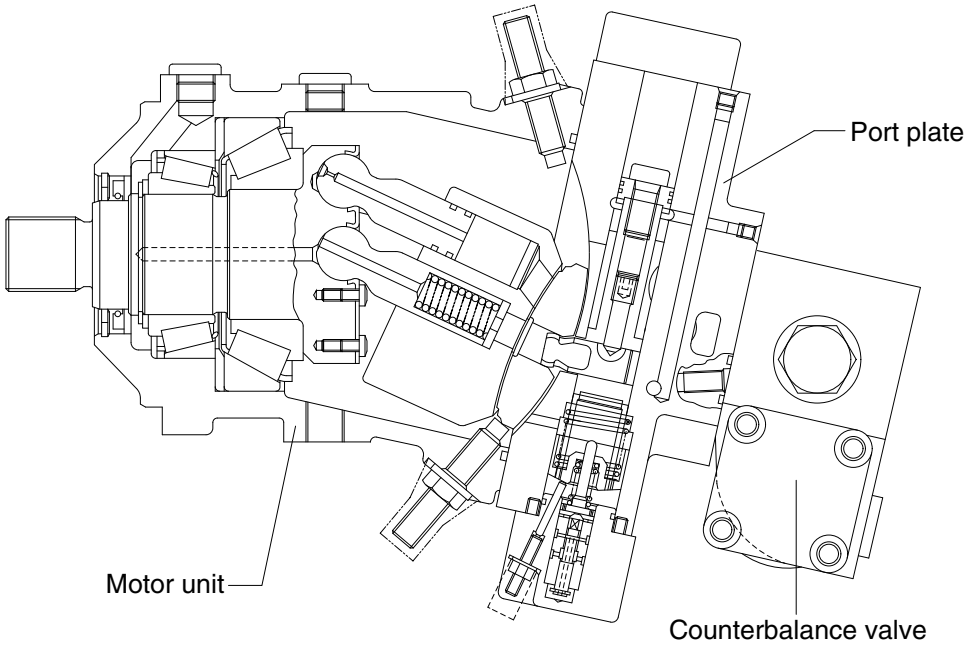
5 Hydraulic stroke limiter
7 Motion control valve assy

ITEM 7



5-1 Cover
5-3 Throttle screw
7-1 Control valve assy
7-2 Shuttle valve
7-3 Brake piston assy
7-6 Housing
7-10 Cover
7-11 Cover
7-20 Locking screw
7-21 Socket screw
7-22 Plug
7-23 O-ring
7-24 O-ring
7-25 O-ring
7-26 Locking screw
7-27 Locking screw
7-28 Break pin
7-29 Socket screw
7-30 Socket screw

2. FUNCTION



160WA2TR05

1) VARIABLE DISPLACEMENT MOTOR (with integrated counterbalance valve)

The variable displacement motor has a rotary group in bent axis design.
The torque is generated directly at the drive shaft.
The cylinder barrel is driven by a tapered piston arrangement.
The change of displacement is generated by the control lens via positioning piston. The control lens slides on a circular shaped surface.

In case of constant pump flow volume and high pressure
- The output speed is increased at smaller swivel angle, the torque is reduced
- The torque rises at swivel angle increase, the output speed is decreased

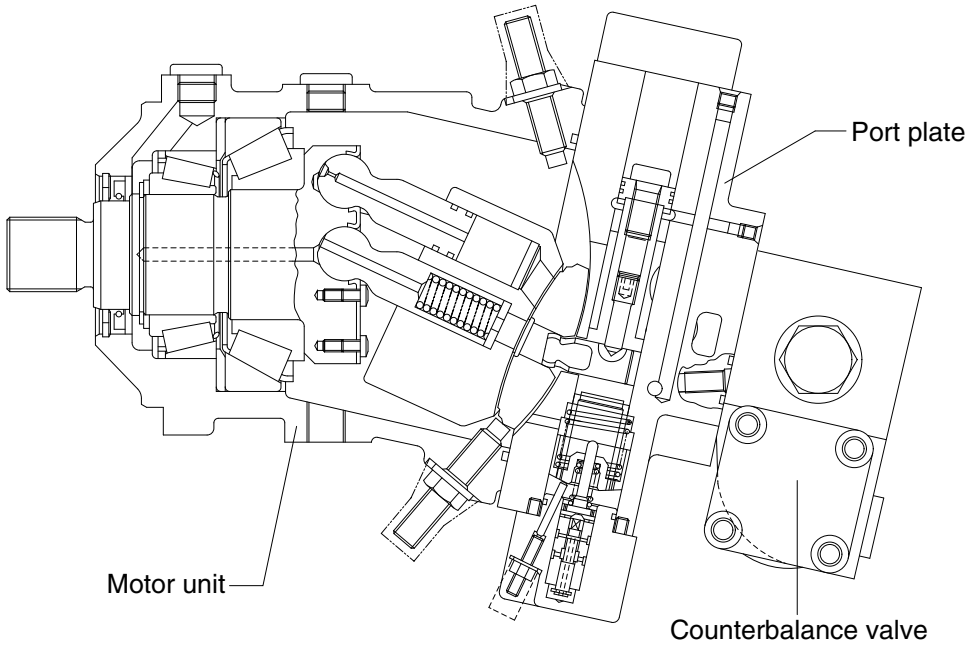
The max swivel angle is 25°, the min swivel angle is 0°.

The variable displacement motor with integrated counterbalance valve is designed to be operated in open loop.

※ Min and max displacement are limited by a stop screw. Stepless adjustment to various higher values is possible.
Reduction to smaller displacement may result in overspeeding the motor.

2) PORT PLATE

With high pressure dependent control HA1, mounted counterbalance valve, integrated secondary pressure relief valves, plugged gauge and boosting ports, service ports to the rear.



160WA2TR05

3) HIGH PRESSURE DEPENDENT CONTROL

The displacement is-dependent on operating pressure - automatically adjusted. Upon reaching the operating pressure set at the control valve - internally measured at A or B - the motor swivels from V_{gmin} to V_{gmax} until output torque = load torque. For values lower than the adjusted one the motor keeps min swivel angle. The necessary positioning energy is taken from the respective high pressure side via shuttle valve.

Swivelling results in a change of the displacement.
Swivel time is controlled by an orifice installed in the cover of the large positioning piston side.

4) COUNTERBALANCE VALVE

Mounted at the rear of the port plate.
Incase of downhill traveling or deceleration of the machine a counterbalance valve avoids overspeeding and cavitation of hydraulic motor.

5) FUNCTION AS TO CIRCUIT DIAGRAM

Check valves in the inlet line A and B for by passing of the counterbalance valve.
At traveling forward the return oil flow is controlled by a counterbalance spool. At drop in inlet pressure the counterbalance spool throttles the return oil flow. The motor is locked. The oil behind the spool is led to the low pressure side via an additional check valve. Same function for traveling forward and backward.

Braking means for the motor that

- At reduced or zero inlet flow the counterbalance spool reaches a modulating position or a neutral position caused by spring force
- The high pressure oil (at outlet side of the motor) is returned to the low pressure side (at inlet side) of the motor via crossover relief valves.

As the control pressure for regulation of the HA control via the integrated shuttle valve is no longer available, the motor with HA control and counterbalance valve will swivel to its minimum displacement during deceleration.
In addition, an external boost flow/pressure can be applied at port S for preventing cavitation.

※ Counterbalance valves do not replace the service and parking brake.

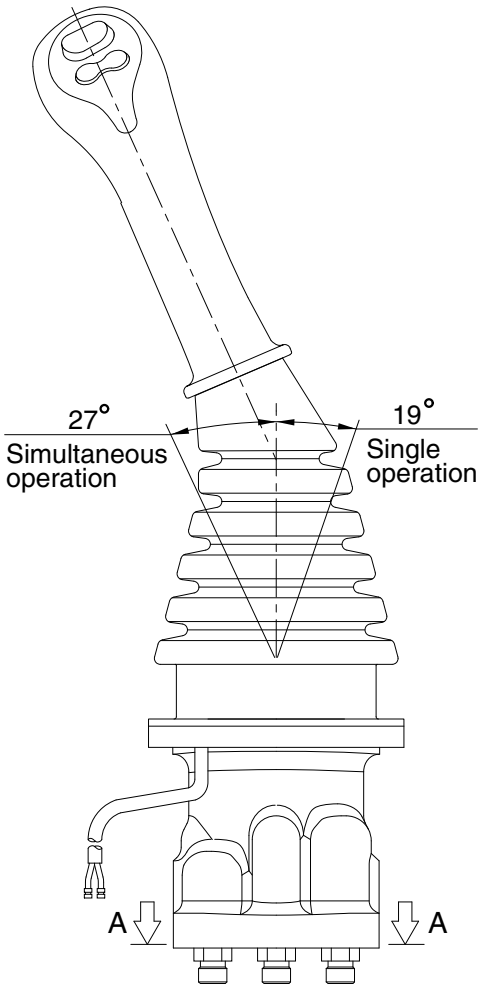
GROUP 5 RCV LEVER

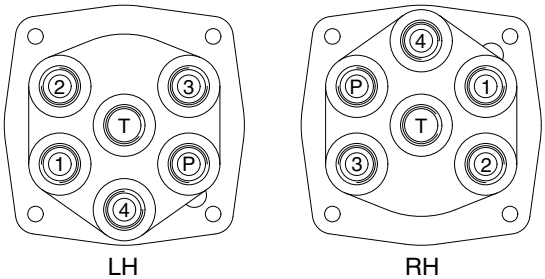
1. STRUCTURE

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

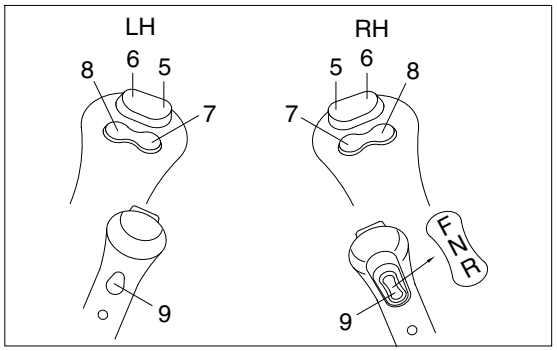
※ **Refer to the parts manual for the types of the RCV lever.**

1) TYPE M25





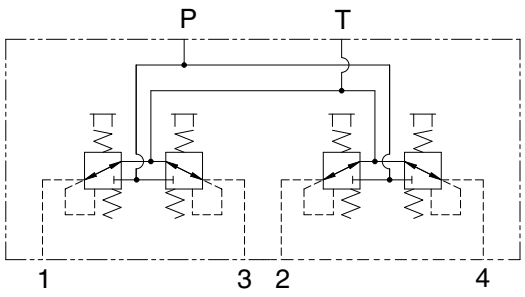
VIEW A-A



TYPE M26

Switches

Type	No.	LH	RH
M25	5	Rotating-CW	2-way clamp
	6	Rotating-CCW	2-way release
	7	One touch decel	Quick coupler
	8	Ram lock	Horn
	9	Power max	FNR switch



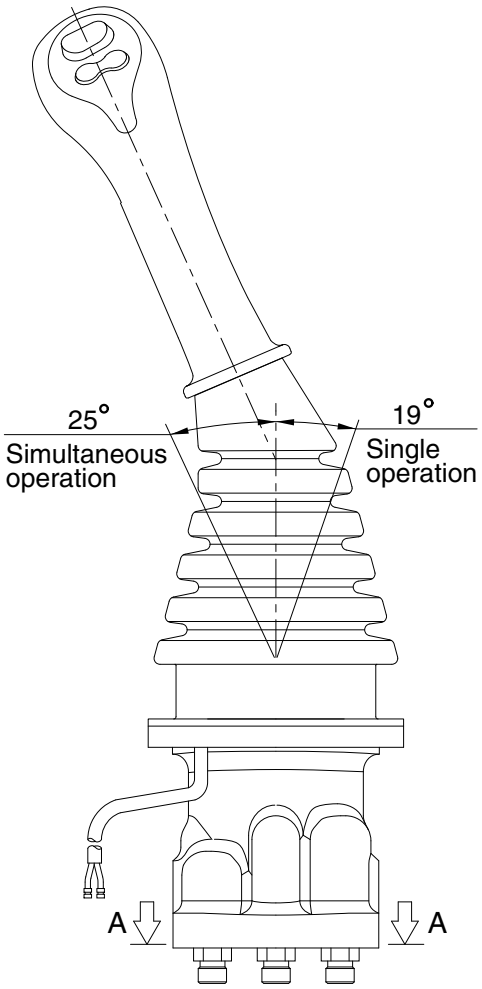
Hydraulic circuit

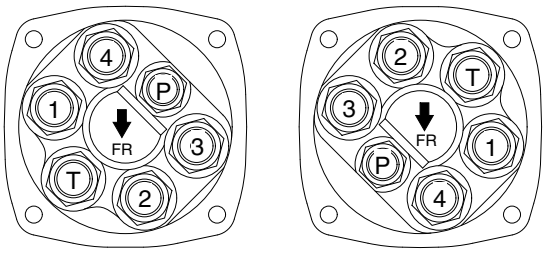
Pilot ports

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

140WA2RL01A

2) TYPE M26 (N.A)





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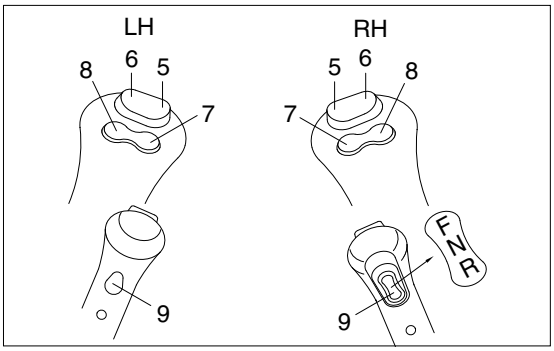
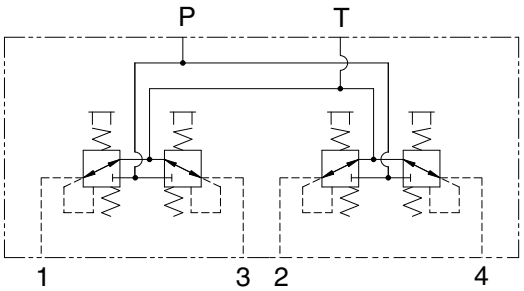


TYPE M26

Switches

Type	No.	LH	RH
M26	5	Rotating-CW	2-way clamp
	6	Rotating-CCW	2-way release
	7	One touch decel	Quick coupler
	8	Ram lock	Horn
	9	Power max	FNR switch



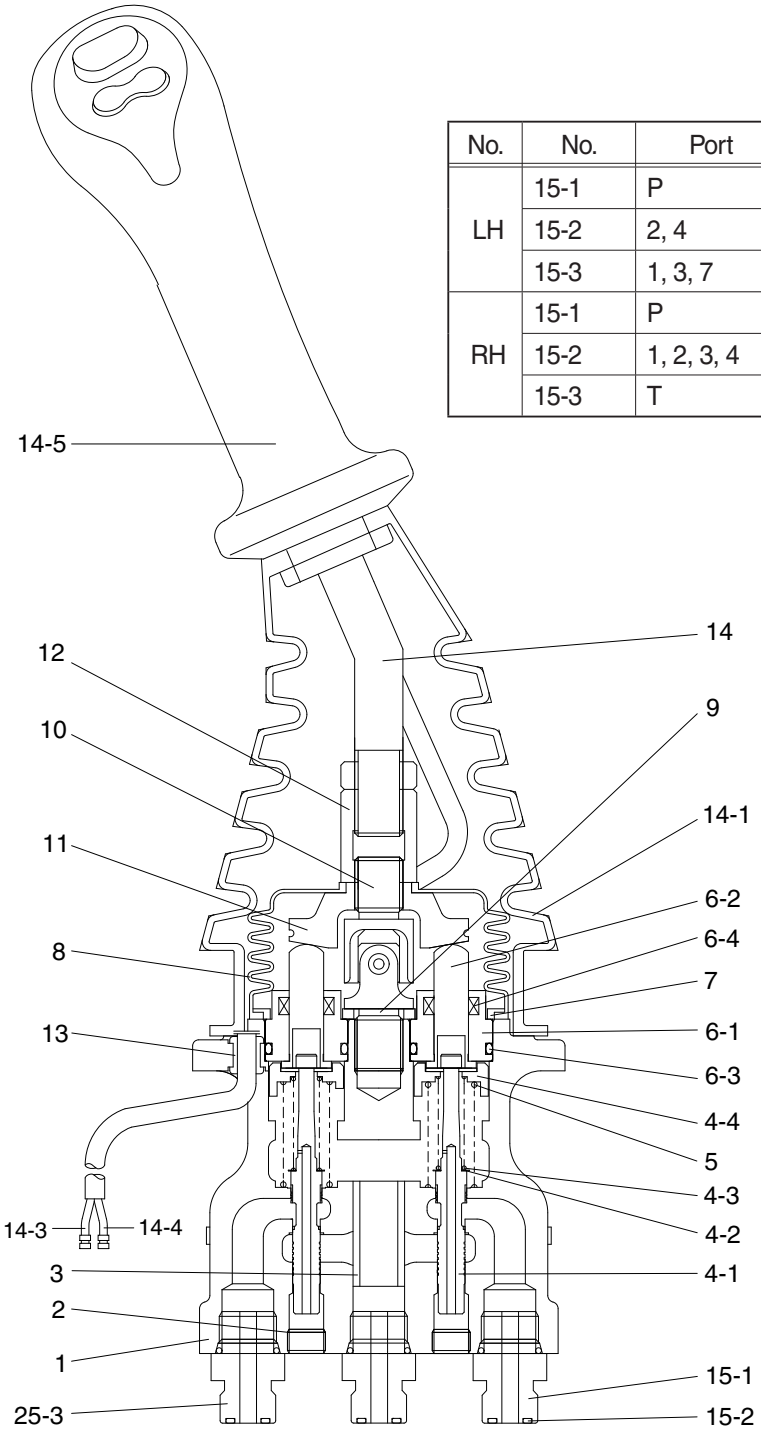
Hydraulic circuit

Pilot ports

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

140WA2RL02A

3) CROSS SECTION



No.	No.	Port
LH	15-1	P
	15-2	2, 4
	15-3	1, 3, 7
RH	15-1	P
	15-2	1, 2, 3, 4
	15-3	T

1 Case
2 Plug
3 Bushing
4-1 Spool
4-2 Shim
4-3 Spring
4-4 Spring seat
5 Spring
6-1 Plug
6-2 Push rod
6-3 O-ring
6-4 Rod seal
7 Spacer
8 Boot
9 Spacer
10 Joint Assy
11 Swash plate
12 Adjusting nut
13 Bushing
14-1 Boot
14-2 Spring pin
14-3 Housing
14-4 Housing
14-5 Handle
15-1 Filter
15-2 Connector
15-3 Connector

140WA2RL06

Item numbers are based on the type M25.

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

The pressure reducing section is composed of the spool (4-1), spring (4-3) for setting secondary pressure, return spring (5), spring seat (4-4) and shim (4-2). 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 (6-2) 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 M25.

The functions of the spool (4-1) 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 (4-3) works on this spool to determine the output pressure.

The change the deflection of this spring, the push rod (6-2) is inserted and can slide in the plug (6-1).

For the purpose of changing the displacement of the push rod through the swash plate (11) and adjusting nut (12) are provided the handle (14-5) that can be tilted in any direction around the fulcrum of the universal joint (10) center.

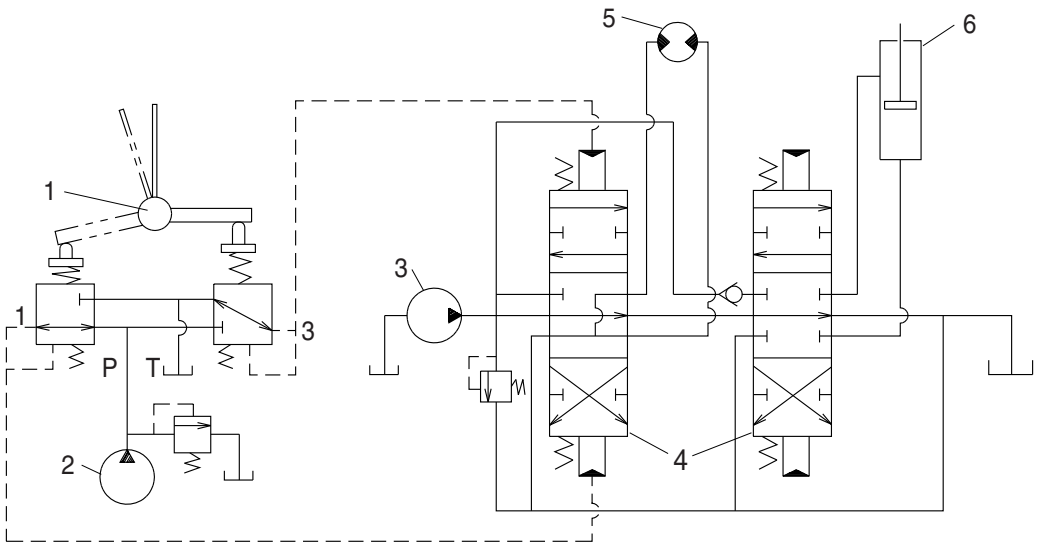
The spring (5) works on the case (1) and spring seat (4-4) and tries to return the push rod (6-2) to the zero-displacement position irrespective of the output pressure, securing its resetting to the center position.

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.

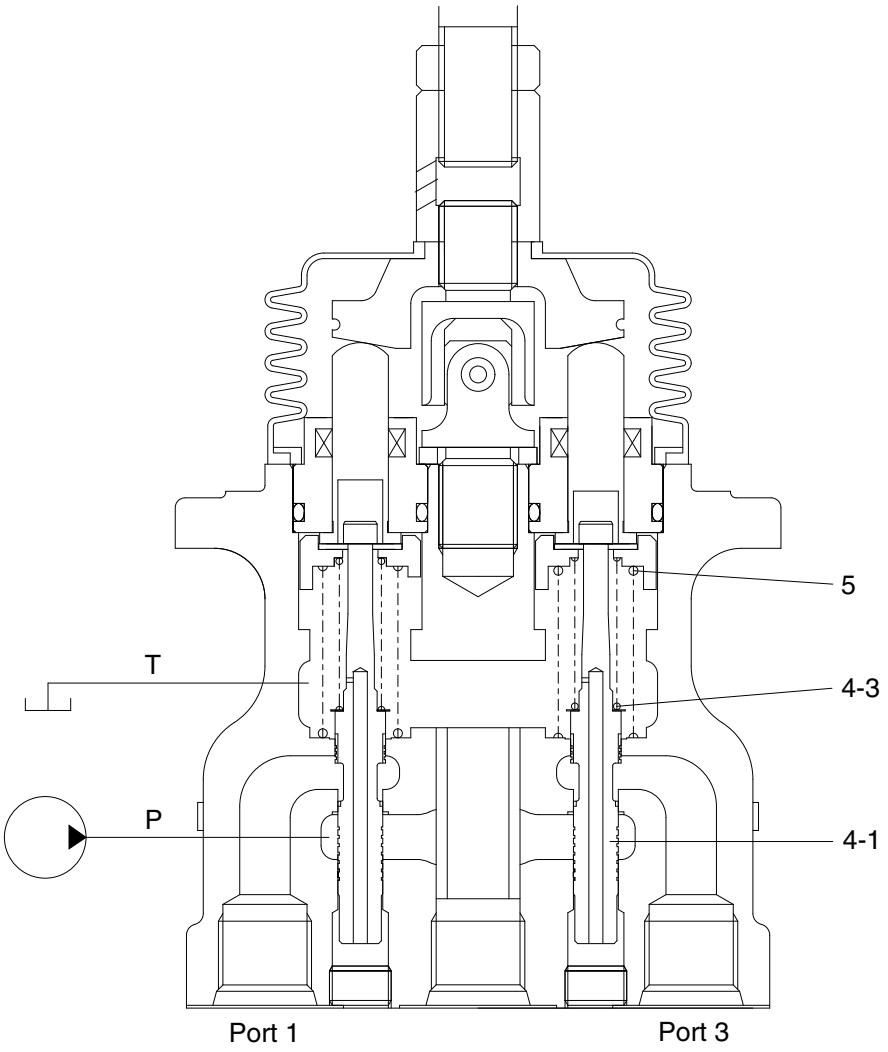
The diagram shown below is the typical application example of the pilot valve.



2-70

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

(1) Case where handle is in neutral position



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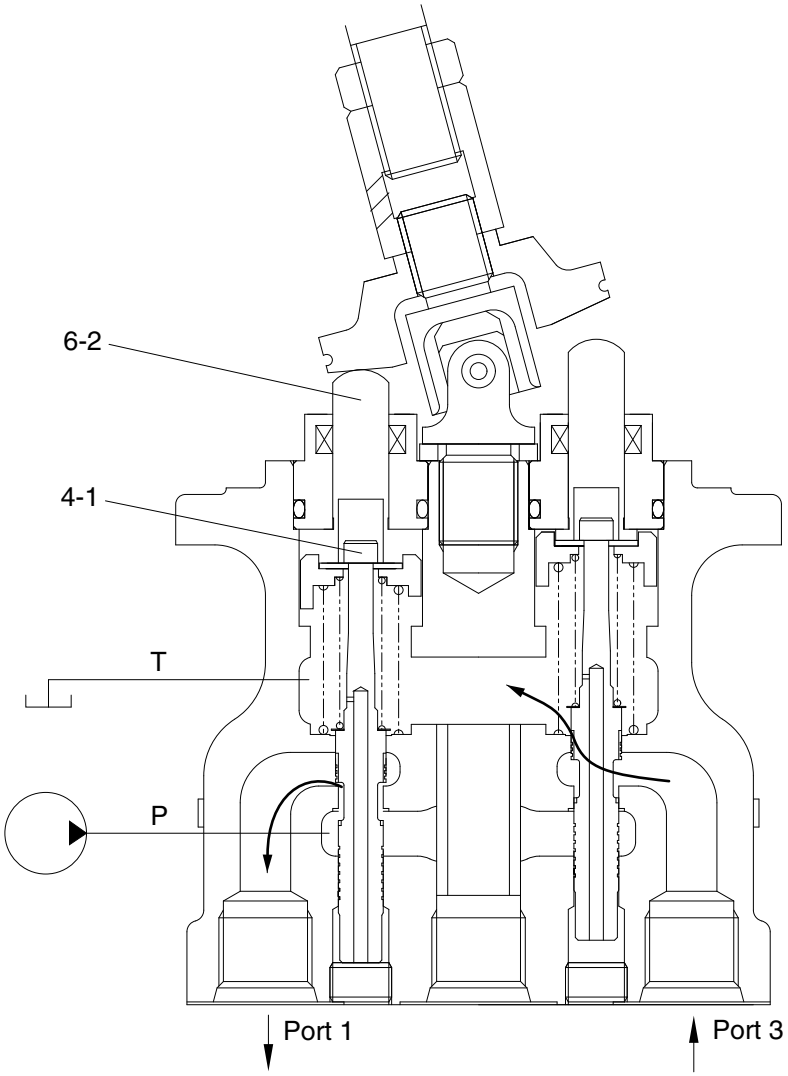
The force of the spring (4-3) that determines the output pressure of the pilot valve is not applied to the spool (4-1). Therefore, the spool is pushed up by the spring (5) to the position of port (1, 3) in the operation explanation drawing. Then, since the output port is connected to tank port T only, the output port pressure becomes equal to tank pressure.

(2) Case where handle is tilted



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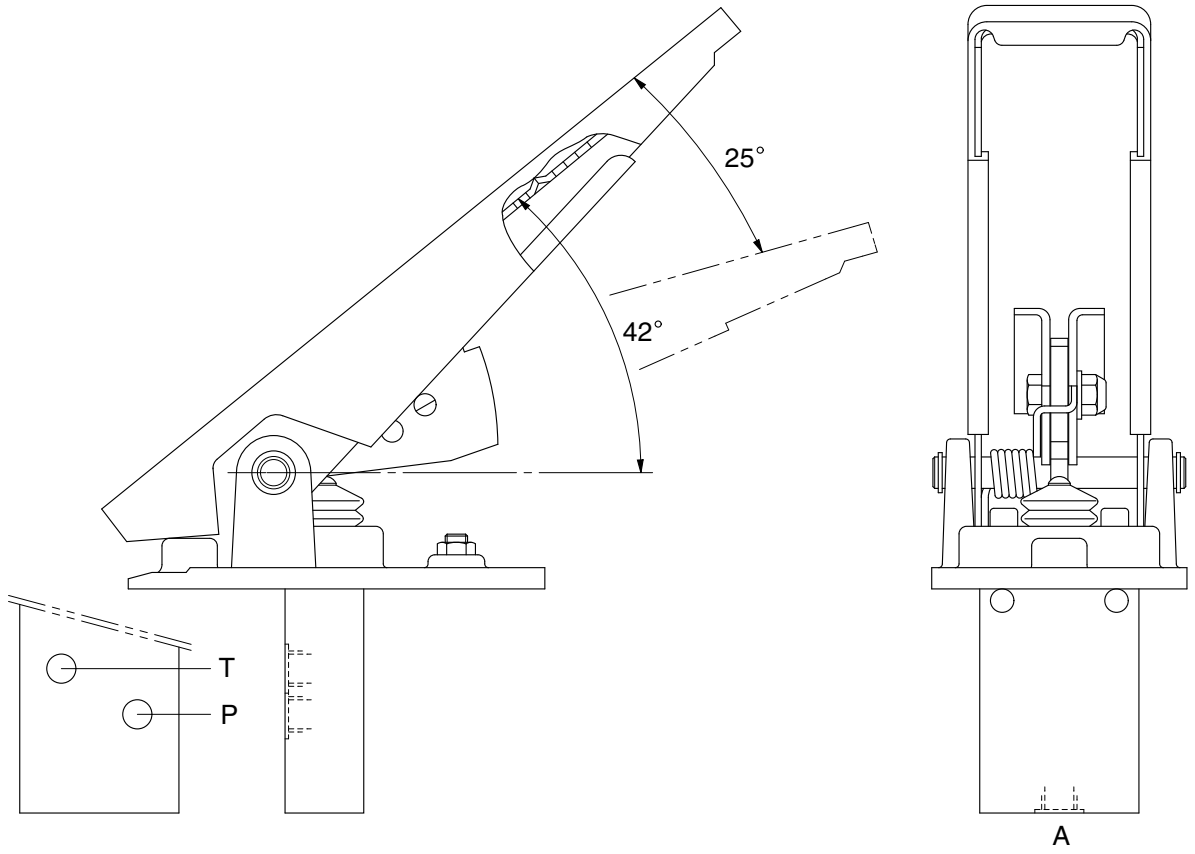
When the push rod (6-2) is stroked, the spool (4-1) moves downwards.
Then port P is connected with port (1) and the oil supplied from the brake pump flows through port (1) to generate the pressure.
When the pressure at port (1) increases to the value corresponding to the spring force set by tilting the handle, the hydraulic pressure force balances with the spring force. If the pressure at port (1) increases higher than the set pressure, port P is disconnected from port (1) and port T is connected with port (1). If it decreases lower than the set pressure, port P is connected with port (1) and port T is disconnected from port 1.
In this manner the secondary pressure is kept at the constant value.
Besides, in some type, when the handle is tilted more than a certain angle, the upper end of the spool contacts with the inside bottom of the push rod and the output pressure is left to be connected with port P.

GROUP 6 ACCELERATOR PEDAL

1. STRUCTURE

The casing has the oil inlet port P (primary pressure), and the oil return port T (tank). In addition the secondary pressure is taken out through port A.



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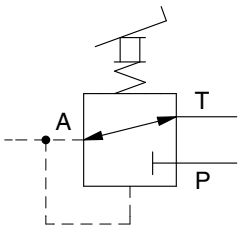


Hydraulic circuit

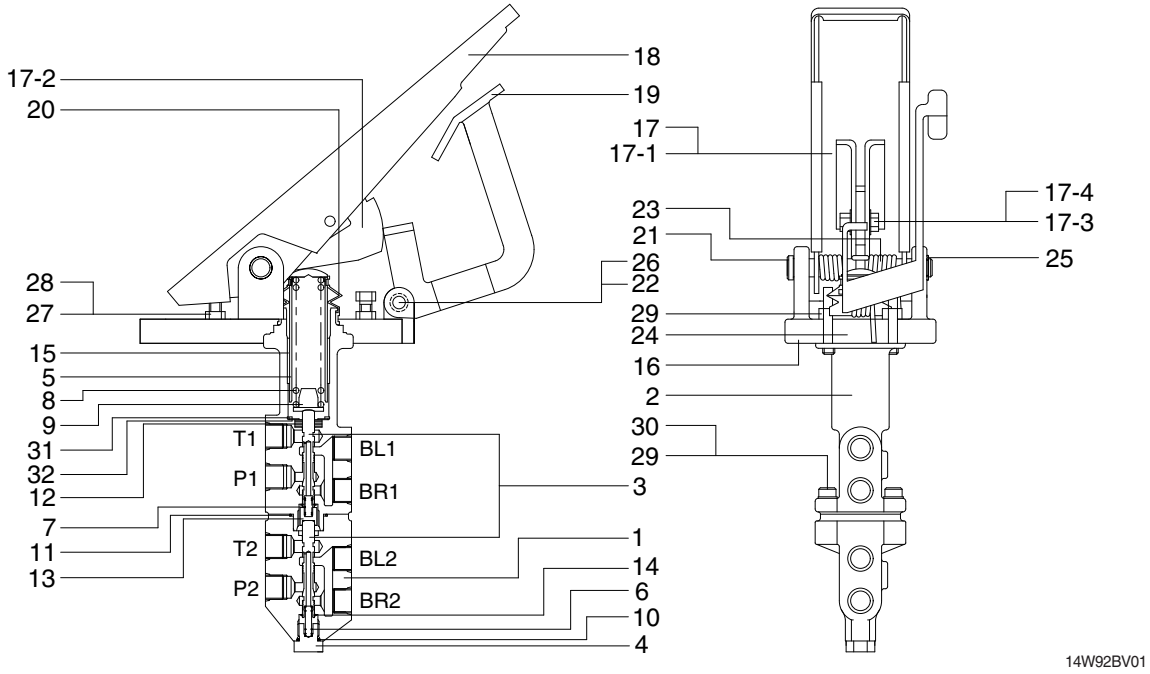
Port	Port name	Port size
P	Pilot oil inlet port	PF 1/4
T	Pilot oil return port	
A	Pilot oil output port	

17032RP01(2)

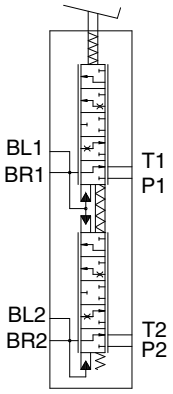
■ BRAKE VALVE

1. STRUCTURE

The body has the oil inlet port P1, P2 (primary pressure), and the oil outlet port T1, T2 (tank). In addition the secondary pressure is taken out through brake cylinder port BR1 (front axle) and BR2 (rear axle).



1	Lower body	13	Spring guide	21	Lock pin 1
2	Upper body	14	Snap ring	22	Lock pin 2
3	Spool	15	DU bushing	23	Torsion spring 1
4	Plug	16	Pedal plate	24	Torsion spring 2
5	Holder	17	Pedal assy	25	Retainer ring
6	Lower spring	17-1	Pedal	26	E-ring
7	Upper spring	17-2	Lock plate	27	Hex bolt
8	Main spring	17-3	Hex bolt	28	Hex nut
9	Spring retainer	17-4	Plain washer	29	Socket head bolt
10	O-ring	18	Pedal cover	30	Spring washer
11	O-ring	19	Latch	31	Plate washer
12	Oil seal	20	Rubber cover	32	Retainer ring



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Port	Port name	Port size
P1	Port	PF 3/8
P2	Port	
BR1	Brake cylinder port	
BR2	Brake cylinder port	
BL1	Pluging	
BL2	Pluging	
T1	Drain port	
T2	Drain port	

2. FUNCTION

1) PURPOSE

The purpose of the brake valve is to sensitively increase and decrease the braking pressure when the brake pedal is actuated.

2) READY POSITION

When the braking system is ready for operation, its accumulator pressure acts directly on port P1/P2 of the brake valve. A connection is established between ports BR1/BR2 and port T1/T2 so that the wheel brakes ports BR1/BR2 are pressureless via the returns ports T1/T2.

3) PARTIAL BRAKING

When the brake valve is actuated, an amount of hydraulic pressure is output as a ratio of the foot force applied.

The main spring (8) beneath pedal plate (16) is designed in such a way that the braking pressure changes depending on the angle. In the lower braking pressure range, the machine can be slowed sensitively.

When the braking process is commenced, the upper spool (3) is mechanically actuated via main spring (8), and the lower spool (3) is actuated hydraulically by spool (3). As spools (3) move downward, they will first close returns T1/T2 via the control edges, thus establishing a connection between accumulator port P1/P2 and ports BR1/BR2 for the wheel brake cylinders. The foot force applied now determines the output braking pressure. The control spools (3) are held in the control position by the force applied (spring assembly) above the spools and the hydraulic pressure below the spool (balance of forces).

After output of the braking pressure, spools (3) are in a partial braking position, causing ports P1/P2 and T1/T2 to close and holding the pressure in ports BR1/BR2.

4) FULL BRAKING POSITION

When pedal (17-1) is fully actuated, an end position of the brakes is reached and a connection established between accumulator ports P1/P2 and brake cylinder ports BR1/BR2. Returns T1/T2 are closed at this point.

When the braking process ended, a connection is once again established between brake cylinder ports BR1/BR2 and return ports T1/T2, closing accumulator ports P1/P2.

The arrangement of spools in the valve ensures that even if one braking circuit fails the other remains fully operational. This is achieved by means of the mechanical actuation of both spools and requires slightly more pedal travel.

5) LIMITING THE BRAKING PRESSURE

Pedal restriction socket bolt (29) on pedal plate (16) below pedal assy (17) is used to limit the braking pressure.

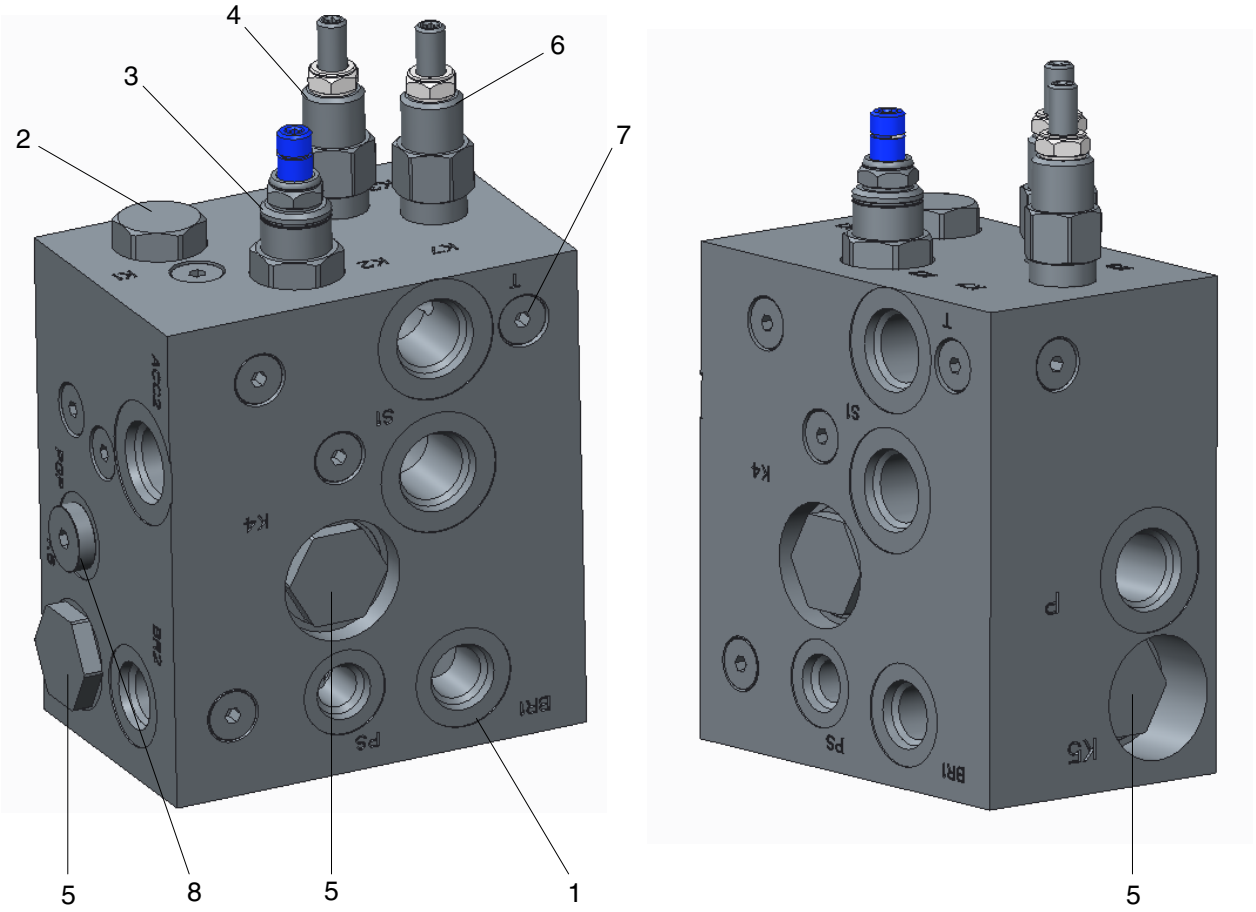
6) FAILURE OF A CIRCUIT

In the event of the lower circuit failing, the upper circuit will remain operational. Main spring (8) will mechanically actuate spool (3). In the event of the upper circuit failing, the lower circuit will remain operational since the lower spool (3) is mechanically actuated by main spring (8) and spool (3).

■ BRAKE SUPPLY VALVE

1. STRUCTURE

The brake supply valve consists of the following parts.



Item	Part name	Size	Qty	Remark
1	Manifold block	-	1	-
2	Logic valve	-	1	K1 port
3	Unloading valve	-	1	K2 port
4	Relief valve	-	1	K3 port
5	Check valve	-	3	K4, 5, 6 ports
6	Relief valve	-	1	K7 port
7	Plug	PF 1/8"	9	-
8	Plug	PF 1/4"	1	PGP port

2. FUNCTION

1) ASSEMBLY

This brake supply valve has the following functions.

(1) Brake pump overload prevention function - energy saving function

(2) Safety device function of brake braking system

(3) Brake braking pressure supply function

2) FUNCTION FOR EACH VALVE

Symbol	Valve name	Description	Remark
K1	Logic valve	This valve is operated by remote control according to the set pressure value of the unloading valve (K2).	
K2	Unloading valve	This valve switches the operation of the pump to a no-load state by bypassing the pressure and flow rate discharged from the pump to the tank when a load occurs in the braking system.	Set pressure - Cut-in set value 112±5 kgf/cm^2 - Cut-out set value 142±5 kgf/cm^2
K3	Relief valve	This valve functions to maintain the pressure of the flow flowing into the “S1” port at the set pressure.	Set pressure 8 l/min @ 32+2 kgf/cm^2
K4	Check valve	This valve prevents reverse flow against the pressure and flow rate formed in the braking system of the brake.	
K5, K6	Check valve	This valve prevents the loss of pressure and flow accumulated in the accumulators installed in the ACC1 and ACC2 ports. In other words, it prevents the back flow of pressure and flow accumulated in the accumulator.	
K7	Relief valve	This valve functions as a safety device to prevent breakage or damage to the system when overload or abnormal pressure occurs within the brake system.	Set pressure 30 l/min @ 173+2 kgf/cm^2

3) DETAIL FUNCTION AND USAGEE

(1) Brake pump overload prevention function - energy saving

① The pressure and flow discharged from the brake pump are supplied to the brake device through the brake supply valve.

② When the engine rotation (rpm) of the machine increases, the rotation of the brake pump increases, increasing the discharge pressure and flow rate.

③ This increased pressure and flow rate causes loss of pump power source and fluid energy. This valve prevents energy loss by reducing power source and fluid energy loss.

④ When the braking system pressure of the brake exceeds the set pressure value of the unloading valve (K2), the pilot spool of the unloading valve is activated and the flow formed in the drain line of the logic valve (K1) is bypassed to the “T” line.

⑤ Therefore, when the flow rate of the drain line of the logic valve is bypassed, the spool of the logic valve is pushed and the pressure and flow rate discharged from the brake pump are bypassed to the tank, thereby converting the pump's operating state to a no-load state.

⑥ Also, when the brake system pressure falls below the set pressure value of the unloading valve, the pilot spool of the unloading valve is closed.

⑦ As the pilot spool of the unloading valve closes, a flow rate is formed in the drain line of the logic valve, and the spool of the logic valve also closes. When the spool of this logic valve is closed, the pressure and flow discharged from the pump are supplied to the brake braking device.

⑧ The discharge pressure and flow rate of the pump are called cut-out when bypassed to the tank, and cut-in when supplied to the brake device.

⑨ When this valve is shipped, the unloading valve setting value is as follows.

Unit : kgf/cm^2

Flow rate	Reference value		Set value	
	Cut-in	Cut-off	Cut-in	Cut-off
30 l/min	112±5	142±5	112±5	142±5

(2) Safety device function of brake braking device

① If an overload occurs within the brake system due to an external force, an abnormal pressure rise may occur, which may cause damage or breakage to various brake systems.

② To prevent such machine problems, a relief valve (K7) is installed.

③ If the system pressure within the brake system exceeds the set pressure value of the relief valve, the relief valve operates to maintain the set pressure value of the relief valve.

④ In other words, the pressure above the set pressure value of the relief valve is returned to the tank to relieve the abnormal rise in pressure caused by overload within the system, thereby preventing damage and breakage of various devices within the system.

⑤ When this valve is shipped, the relief valve setting value is as follows.

Flow rate	Reference value	Set value	Remark
30 l/min	173±2 kgf/cm^2	173±2 kgf/cm^2	-

(3) Brake braking pressure supply function

① When the brake pedal is pressed, the pressure accumulated in the accumulator falls below the cut-in set pressure value of the unloading valve.
At this time, the pilot spool of the unloading valve is closed.

② As the pilot spool of the unloading valve closes, flow is formed in the drain line of the logic valve and the spool of the logic valve also closes.

③ When the spool of this logic valve is closed, the pressure and flow discharged from the pump are supplied to the accumulator and brake device.

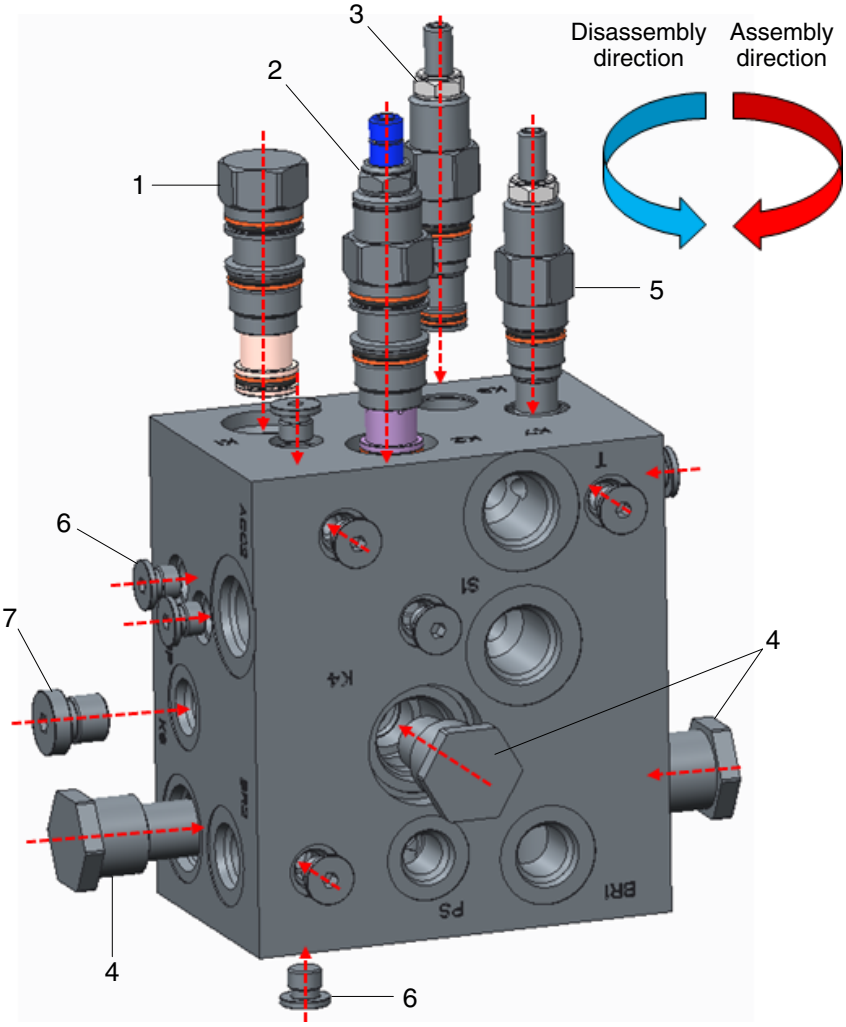
④ Also, when the brake pressure is formed and exceeds the cut-out pressure value of the unloading valve, the logic valve and unloading valve operate to bypass the pressure and flow rate discharged from the pump to the tank, thereby maintaining the no-load start of the pump and prevents rise the pressure within the brake system.

⑤ Check valves (K5, K6) separate each brake circuit (front, rear) so that they do not affect the opposite brake and maintain each brake function.

3. ASSEMBLY DRAWING AND WORK TOOLS

See below for assembly, disassembly, and work tools for the brake supply valve.

※ **The designated tools and tightening torque must be observed.**



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No.	Part name	Screw spec	Torque (kg · cm)	Assembly tool
1	Logic valve	M20×1.5	480	Torque wrench/7/8" hex socket
2	Unloading valve	M20×1.5	480	Torque wrench/7/8" hex socket
3	Relief valve	M16×1.5	350	Torque wrench/3/4" hex socket
4 (3ea)	Check valve	UNF7/8-14"	400	Torque wrench/1" hex socket
5	Relief valve	M16×1.5	350	Torque wrench/3/4" hex socket
6 (9ea)	Plug	PF 1/8	100	Torque wrench/4 mm wrench socket
7	Plug	PF 1/4	300	Torque wrench/6 mm wrench socket

4. PRECAUTION WHEN DISASSEMBLING AND ASSEMBLING

1) Before assembling and disassembling, clean the surrounding area thoroughly to ensure there are no contaminants.

2) When disassembling and assembling parts, be sure to use the assembly torque and tools specified on the previous page.

3) Refer to the picture on the previous page for assembly and disassembly directions.

4) When reassembling after disassembly and inspection, be careful to prevent contaminants from entering the valve.

5) When disassembling and assembling all parts, be sure to wash them and then reassemble them.

5. INSPECTION ITEMS AND DETAILS FOR EACH PART WHEN AN ERROR OCCURS

Problem	Inspection item	Inspection detail and method	Repair
Brake pressure is not supplied	1. Check whether foreign substances and contaminants have entered the logic valve.	1. Disassemble the logic valve and check whether contaminants such as foreign matter or sludge have entered between the spool and body.	Removing foreign substances, cleaning, and assembling
	2. Check whether foreign substances and contaminants enter the relief valve.	2. Disassemble the relief valve and check whether contaminants such as foreign matter or sludge have entered between the poppet and body.	Removing foreign substances, cleaning, and assembling
	3. Check the discharge amount and discharge pressure of the brake pump	3. Install a pressure gauge on the “PGP” port to check the pressure value discharged from the brake pump. - Check at engine low speed - Check with the unloading valve fully closed. - Reference set value; 173±2 kgf/cm^2	Repair or replacement
Brake warning lamp comes ON	1. Check the unloading valve cut-in pressure value	1. Check the cut-in pressure value of the unloading valve (K2) - Install a pressure gauge on the “PGP” port to measure the pressure value at cut-in. - Reference set value; 112±5 kgf/cm^2	Readjust pressure value
	2. Check pressure switch operation	2. If the pressure measurement value in item 1 above is normal but the brake warning lamp continues to come on, check the contact status of the pressure switch.	Repair or replacement
	3. Check the degree of contamination of the brake filter element.	3. Check the element screen in the brake filter for contamination by foreign substances.	Cleaning or replacement
	4. Check whether foreign substances and contaminants are entering the logic valve and relief valve.	4. Refer to paragraphs 1 and 2 of “Brake pressure is not supplied” above.	Removing foreign substances, cleaning, and assembling

Problem	Inspection item	Inspection detail and method	Repair
The cycle of cut-in and cut-out is fast	1. Check whether the O-ring and back-up ring installed on each check valve are damaged.	1. After disassembling each check valve (K4, K5, K6), check whether the O-ring and back-up ring are damaged.	Replace check valve
	2. Check foot brake valve leakage	2. Remove the hydraulic hose installed at the outlet port (BR1, BR2) of the foot brake valve and check the amount of oil leakage. - Check without pressing the brake pedal-Neutral state - Reference set value; Refer to foot brake valve leakage management standards	Replace foot brake valve

6. CHECK BRAKE PRESSURE IN CASE OF ABNORMALITY

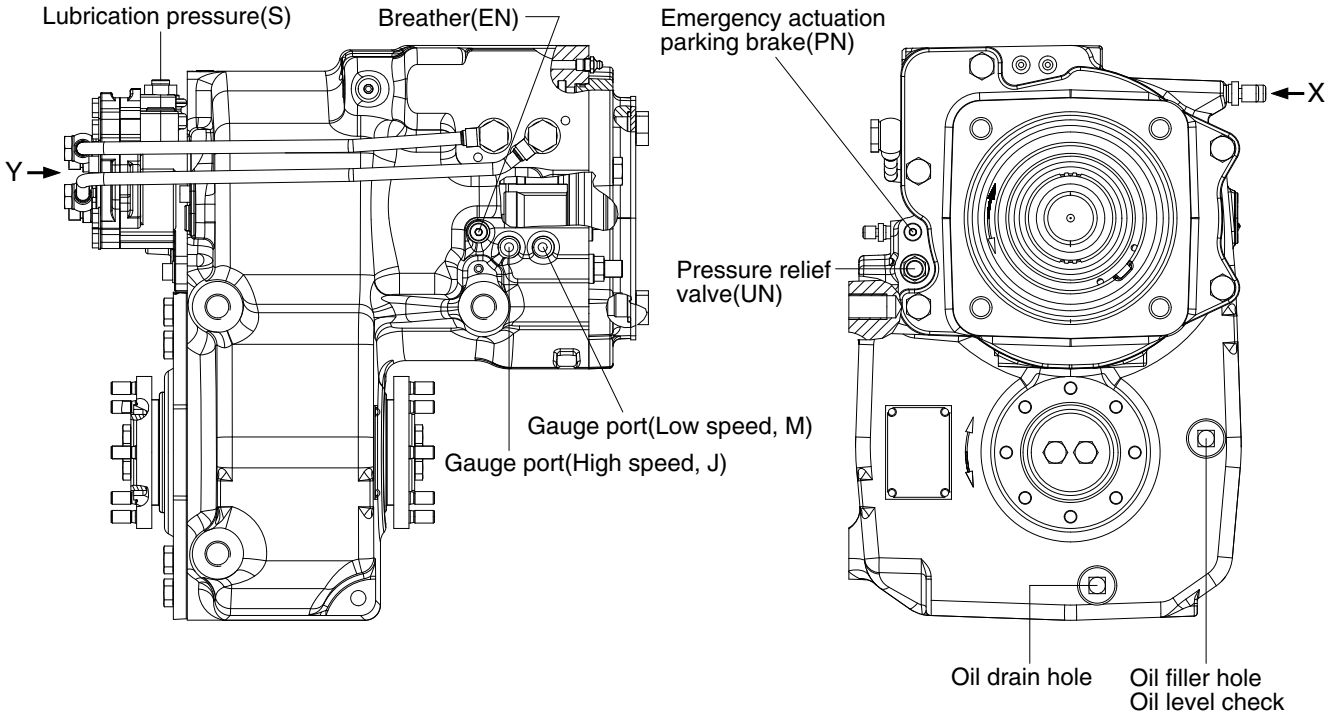
1) INSTALLATION OF PRESSURE GAUAGE

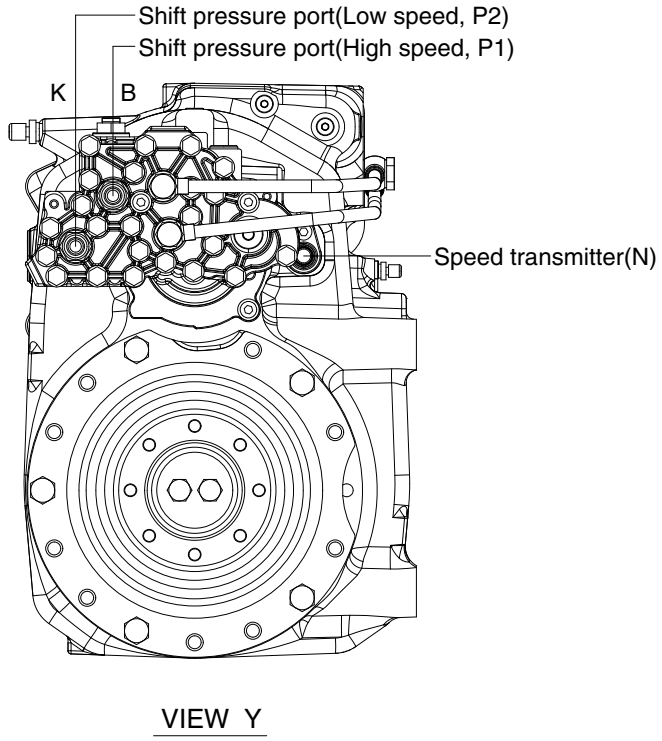
Pressure gauge installation port	Screw	Remark
PGP	PF1/4" O-ring boss	-

2) CHECK PRESSURE VALUE DURING INSPECTION

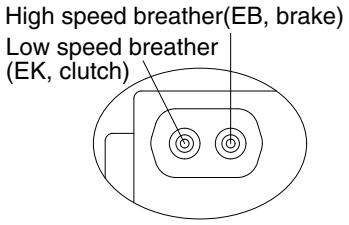
Pressure value confirmation port	Unloading valve operating status	
	Cut-in	Cut-off
PGP	112±5 kgf/cm^2	142±5 kgf/cm^2

1. STRUCTURE





VIEW Y



VIEW X

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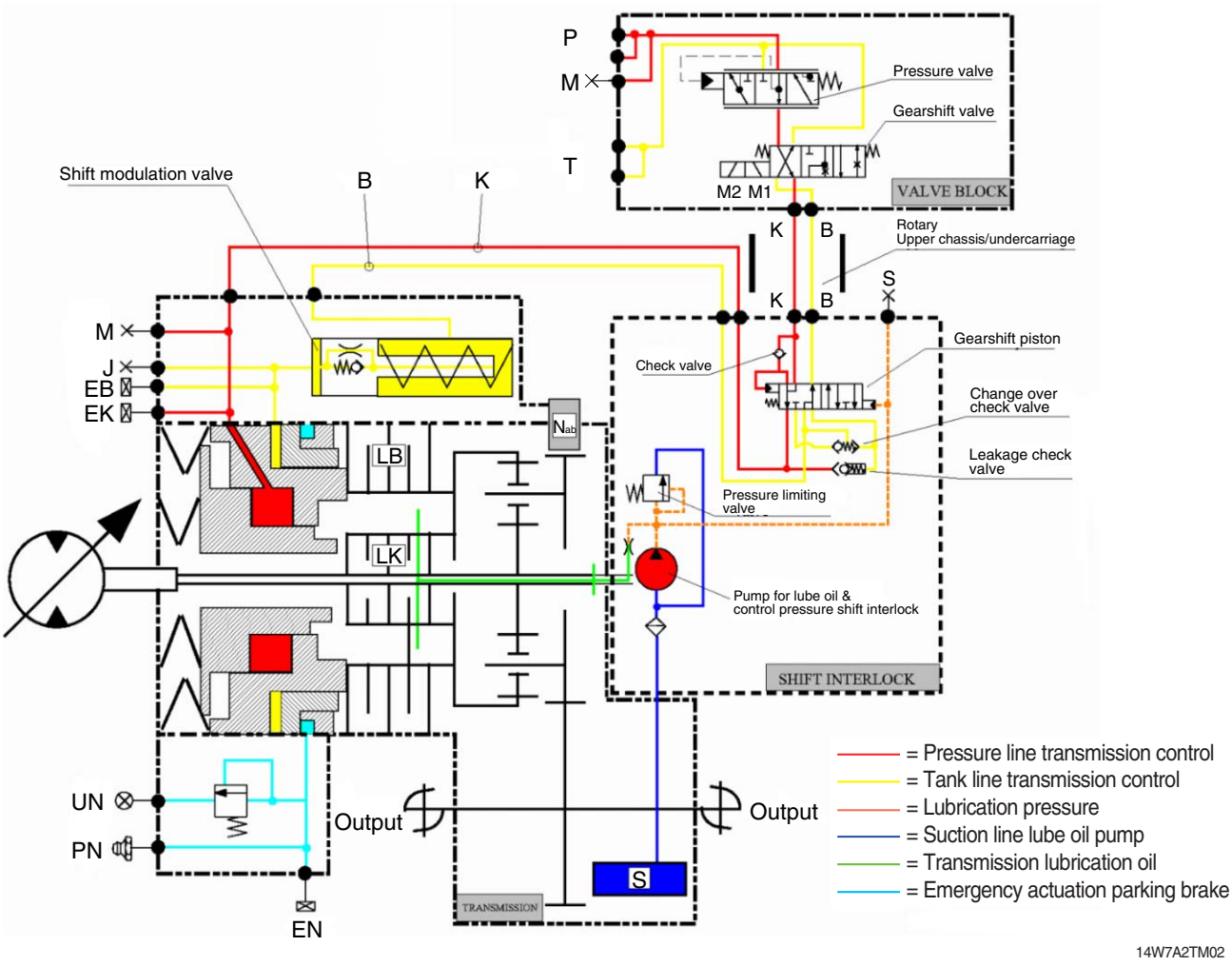
2. TRANSMISSION DIAGRAM



Measuring points-Transmission/Shift interlock :
J : High speed (brake)
M : Low speed (clutch)
S : Lubrication pressure

Connections-Transmission/Shift interlock :
B : Brake
K : Clutch
PN : Emergency actuation parking brake

Measuring points-Valve block :
M : System pressure transmission control

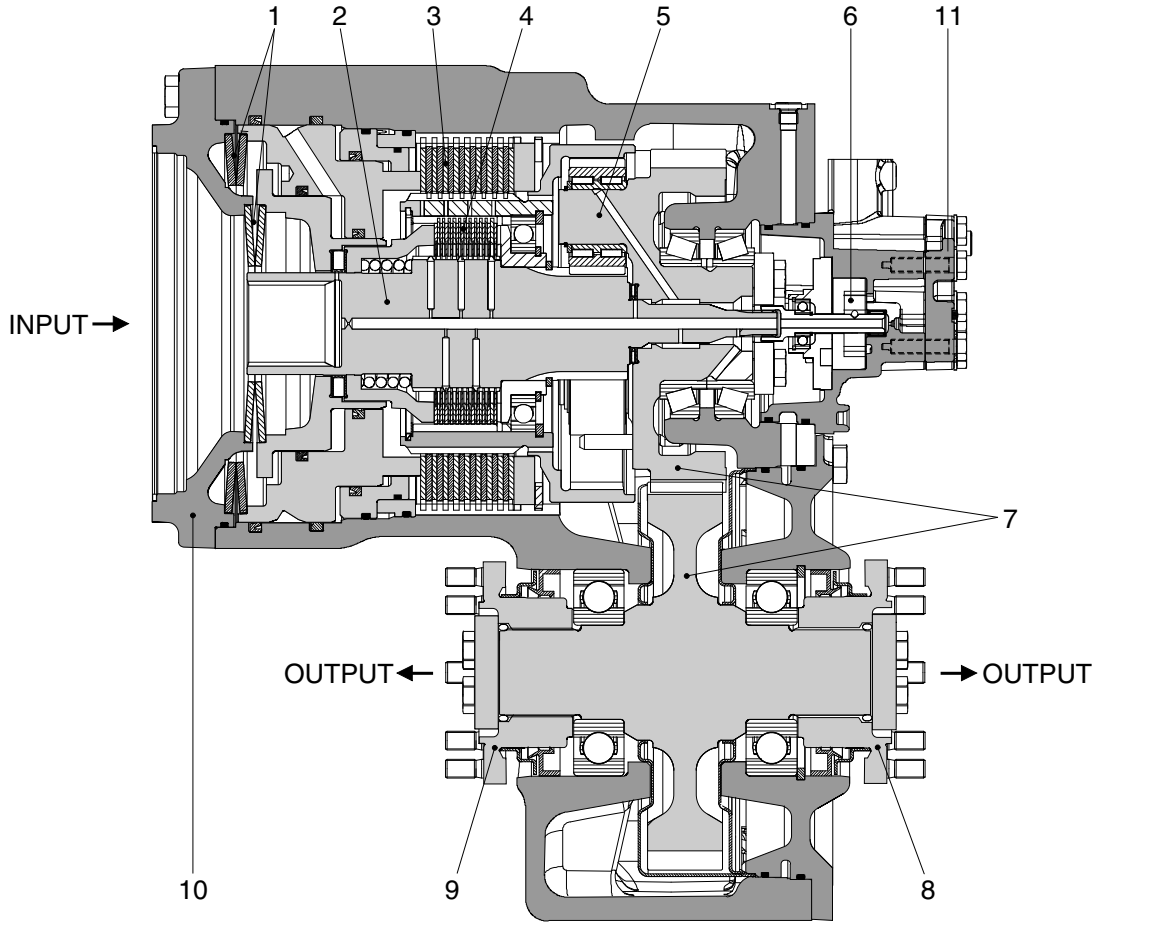
Connections-Valve block :
P : System pressure transmission control
T : Tank
B : Brake
K : Clutch

Solenoid valves-valve block :
M1 : Solenoid valve (low speed)
M2 : Solenoid valve (high speed)

Port	Name	Size	Port	Name	Size
P1 (B)	Shift pressure, High speed	M16×1.5	M	Gauge port, Low speed	M10×1.0
P2 (K)	Shift pressure, Low speed	M16×1.5	S	Lubrication pressure port	M10×1.0
J	Gauge port, High speed	M10×1.0	PN	Parking brake lubricant	Grease nipple

3. OPERATION OF TRANSMISSION

1) DESCRIPTION



1	Cup spring	5	Planetary drive	9	Output flange-front axle
2	Input shaft	6	Lub oil pump	10	Travel motor attachment
3	Disk brake	7	Spur gear drive	11	Shift interlock
4	Disk clutch	8	Output flange-rear axle		

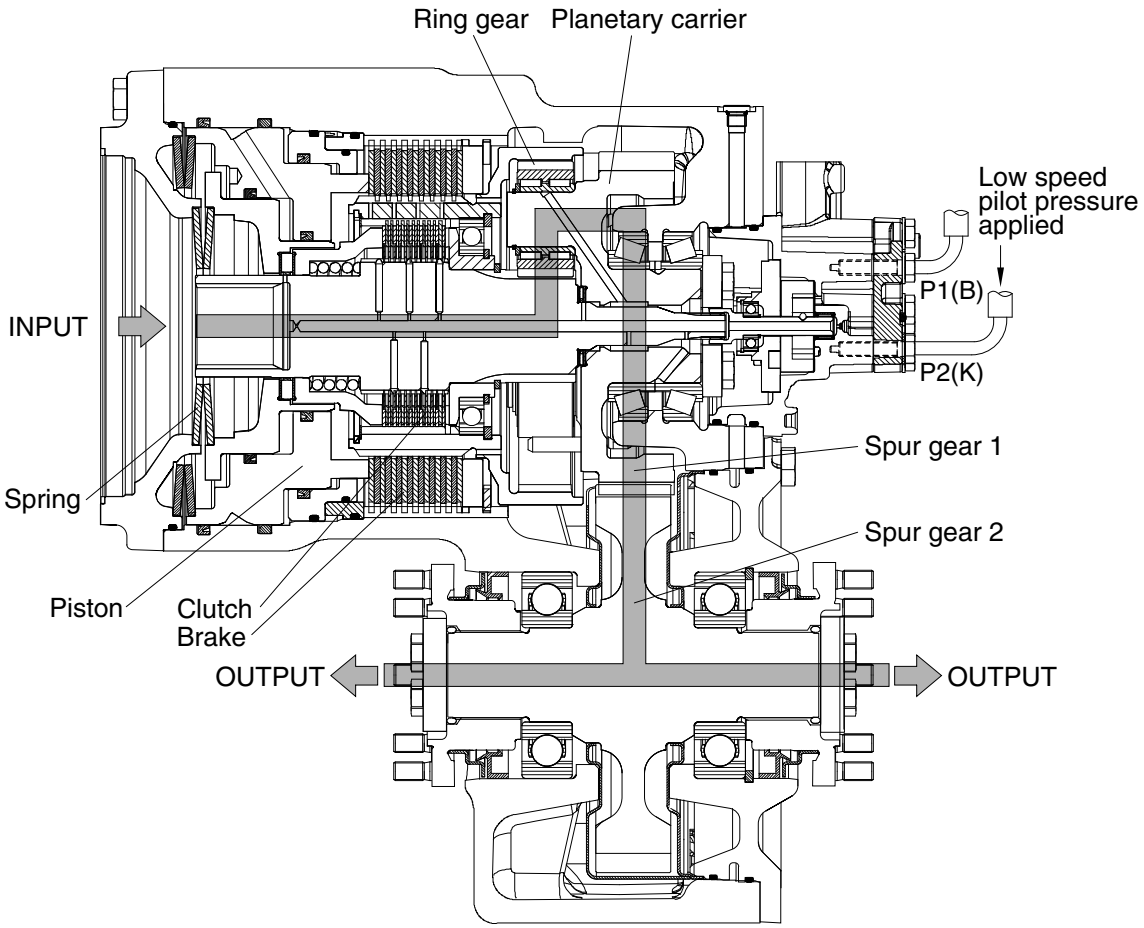
Coaxially-mounted variable displacement travel motor (10) with specific displacement 107 cm^3/rev.

The 2-speed powershift transmission comprises a planetary drive (5), a 2 shaft spur gear drive (7) with output flanges to front and rear axle.

The powershift mechanism for the planet drive comprises a rotating multi-disk clutch (4) underneath a multi-disk brake (3) rigidly connected to the housing. Both are closed by spring pressure (2) and released hydraulically.

The shift interlock (11) prevents downshifts at high machine speeds and thus prevents over-rotation of the travel motor. If the low speed gear is selected while the high speed gear is engaged and input speed is above approx. 1000 rpm, the low speed gear shift is inhibited and only performed if input speed is below this limit. With higher viscosity oil (cold starting), the downshift is performed at a lower input speed. Upshifts are always possible.The speed-dependent interlock is effective in both directions. It does not prevent the possibility of over-rotation when the machine is coasting. For this, a drive brake valve should be fitted to the travel motor.

2) LOW SPEED (forward & reverse)



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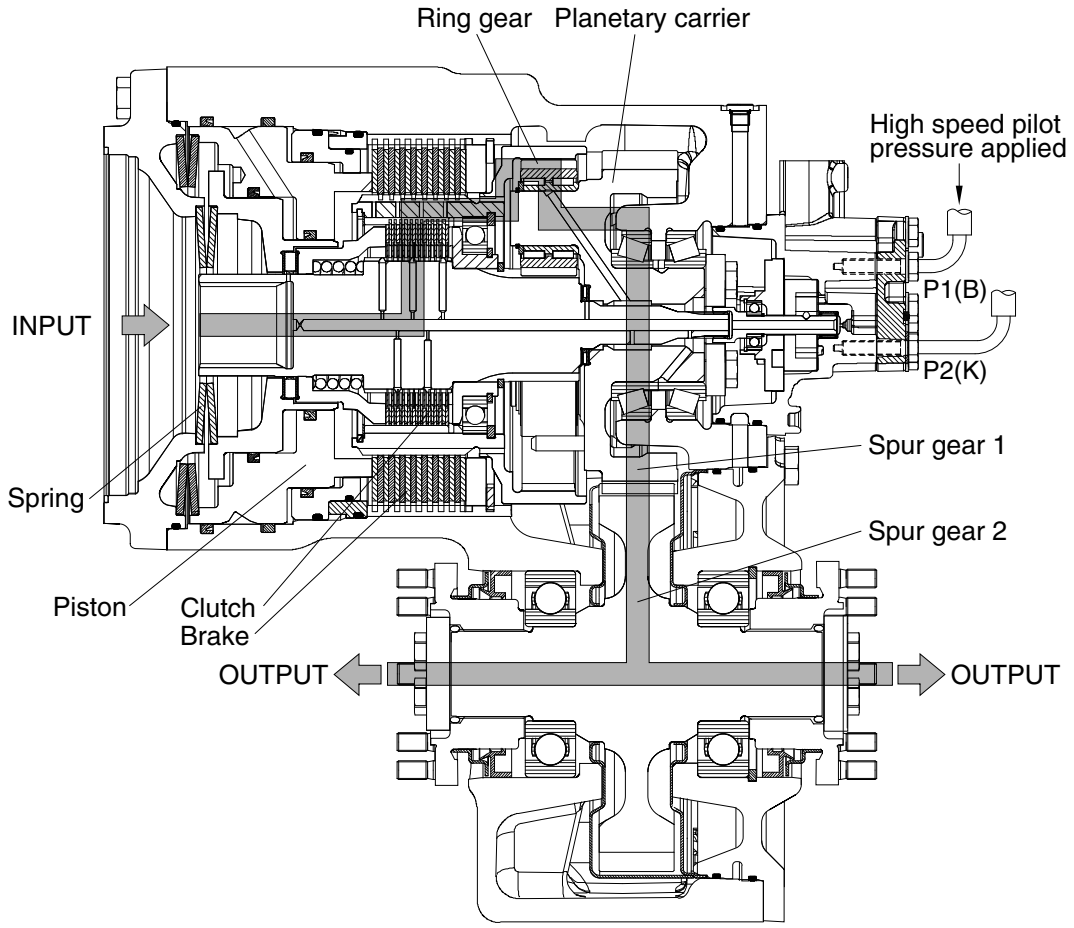
In low speed operation, the internal gear of the planetary drive is backing upon the closed, case-rigid brake. In this speed the piston chamber of the brake is unpressurized, so that the elastic force and additionally the hydraulic pressure of the clutch piston is acting upon the disk pack.
At this time the clutch is open, i.e. the hydraulic released.

3) HIGH SPEED (forward & reverse)



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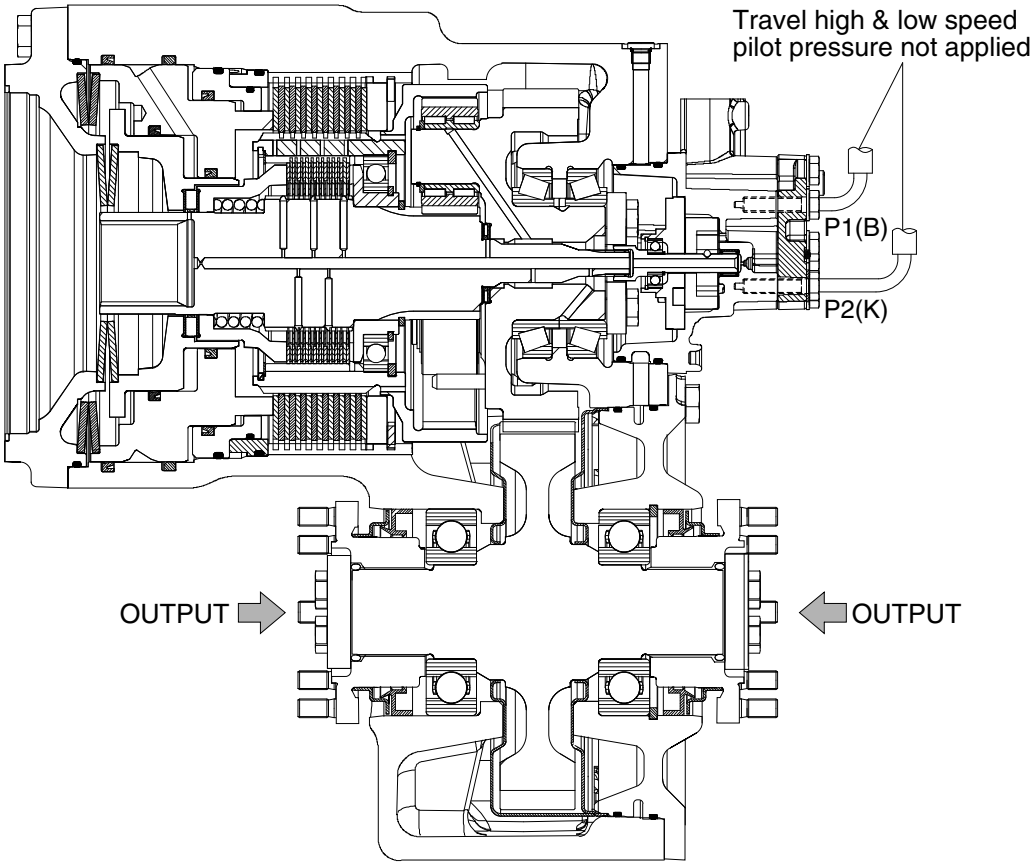
In high speed operation, the clutch is held closed under spring pressure and the brake is hydraulically opened.

When a gear shift occurs-for example from high speed to low speed gear- the oil from the brake piston space is fed back to the tank through a restrictor (change over check valve) due to the spring pressure acting on the brake piston. At the same time the clutch is filled with oil and opened. Required oil flow is necessary for the transmission control to ensure the clutch is open before the brake begins to transmit torque.

A shift modulation valve is also integrated in the transmission. This modulates the pressure sequence at the brake during a upshift in order to achieve good shift quality.

The gear shift equipment also has the function of a parking brake. When the brake is operated-for example with high speed gear engaged-the clutch is closed and is statically loaded.

4) BRAKES



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When the travel high/low speed pilot pressure is not applied in the piston space, the piston compress against the multi disk pack due to the spring force. Thus the parking brake is engaged.

4. TECHNICAL DATA

1) GENERAL DATA

(1) Max input power : 110 kW

(2) Max input torque : 78.5 kgf · m

(3) Max output speed : 3500 rpm

(4) Hydraulic motor : 140 cm^3/rev

(5) Transmission ratio
Gear step : 4.06
· Low speed gear : 4.87
· High speed gear : 1.20

(6) Shift interlock
Downshift possible at operating temperature with input speed 1000 rpm (downshift point lower when oil temperature cold).

(7) Disconnection device
For towing away machine auxiliary release device for parking brake.

(8) Brake
Parking brake. Necessary brake deceleration by controlled locking of planetary drive. Braking torque depends on opening pressure set at brake valve (13 bar).

(9) Output flange
Bolts for propshaft connection : M10 × 1.0 (class 10.9)

(10) Transmission weight : 135 kg (300 lb)

2) TRANSMISSION CONTROL

Following data are valid for oil temperature 30˚C to 40˚C in hydraulic tank, measured at connections at powershift transmission (see structure and diagram).

(1) Control pressure
① At connection P1 and P2 at Low/High engine speed : 33+2 kgf/cm^2
② Definition of lubricants : API CF-4, SAE 10W-30

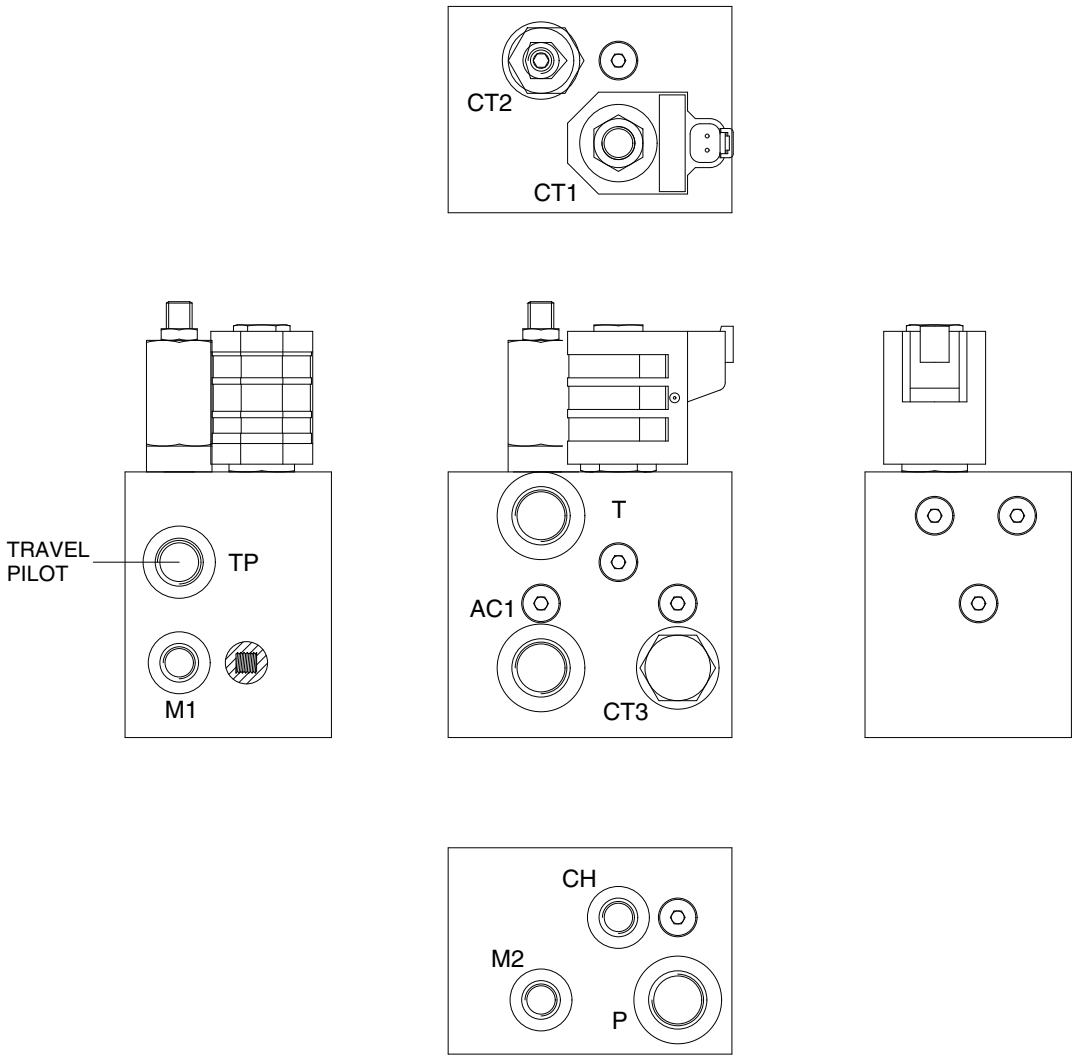
(2) Oil flow
① Min oil flow at 24+1 kgf/cm^2 counter pressure (low engine speed) : 5.5 ℓ /min
② Max oil flow : 25 ℓ /min

(3) Residual pressure
① Max residual pressure in control line to tank connection P1 and P2 : 1.0 kgf/cm^2

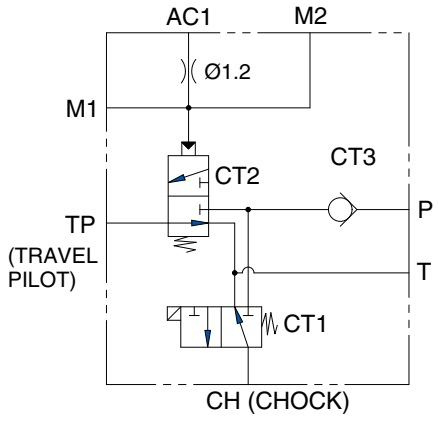
(4) Leakage oil transmission control
① Pressure in input housing connection (E) max : 1.0 kgf/cm^2
② Max oil flow (low speed actuated) : 1 ℓ /min

GROUP 9 TRAVEL CONTROL VALVE

1. STRUCTURE



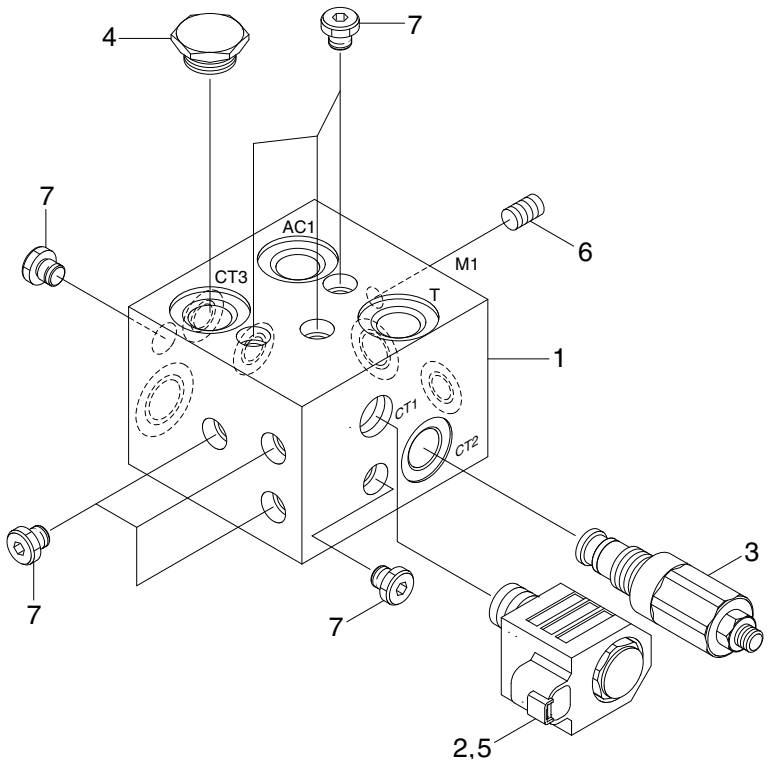
14W7A2TCV02



Hydraulic circuit

Port name	Port size
P, T, AC1	PF 1/2
TP	PF 3/8
M1, M2, CH	PF 1/4

2. COMPONENT



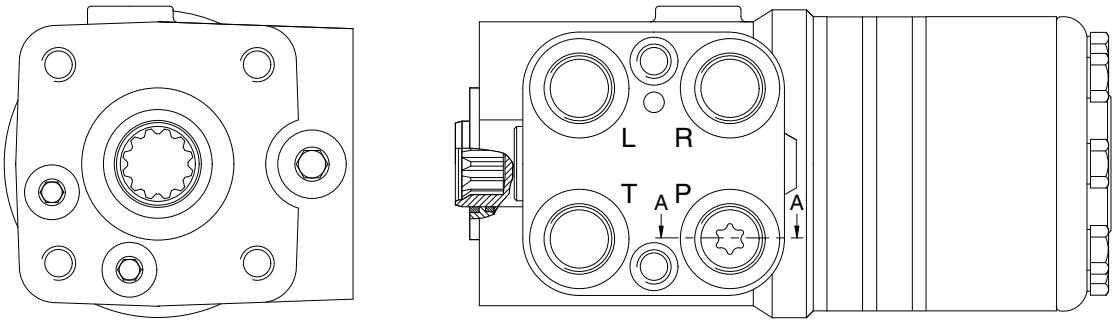
14W7A2TCV01

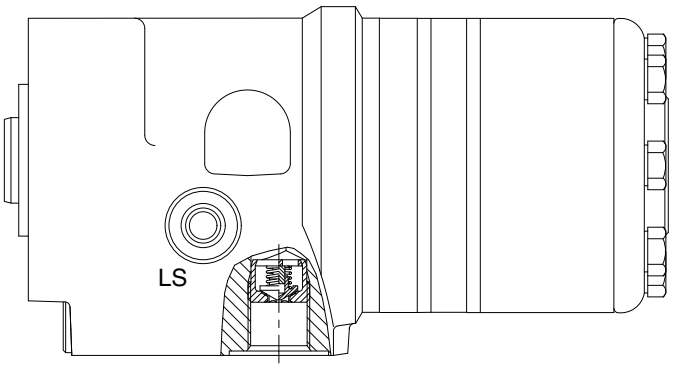
1	Body	5	Coil
2	Solenoid valve	6	Orifice
3	POD valve	7	Plug
4	Check valve		

GROUP 10 STEERING VALVE

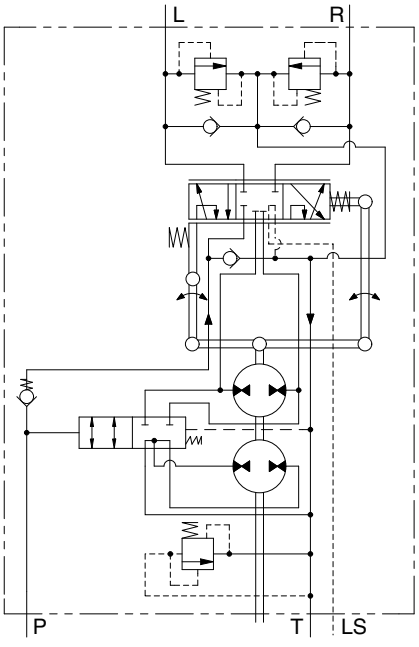
1. STRUCTURE

1) TYPE 1 (without joystick)





SECTION A-A

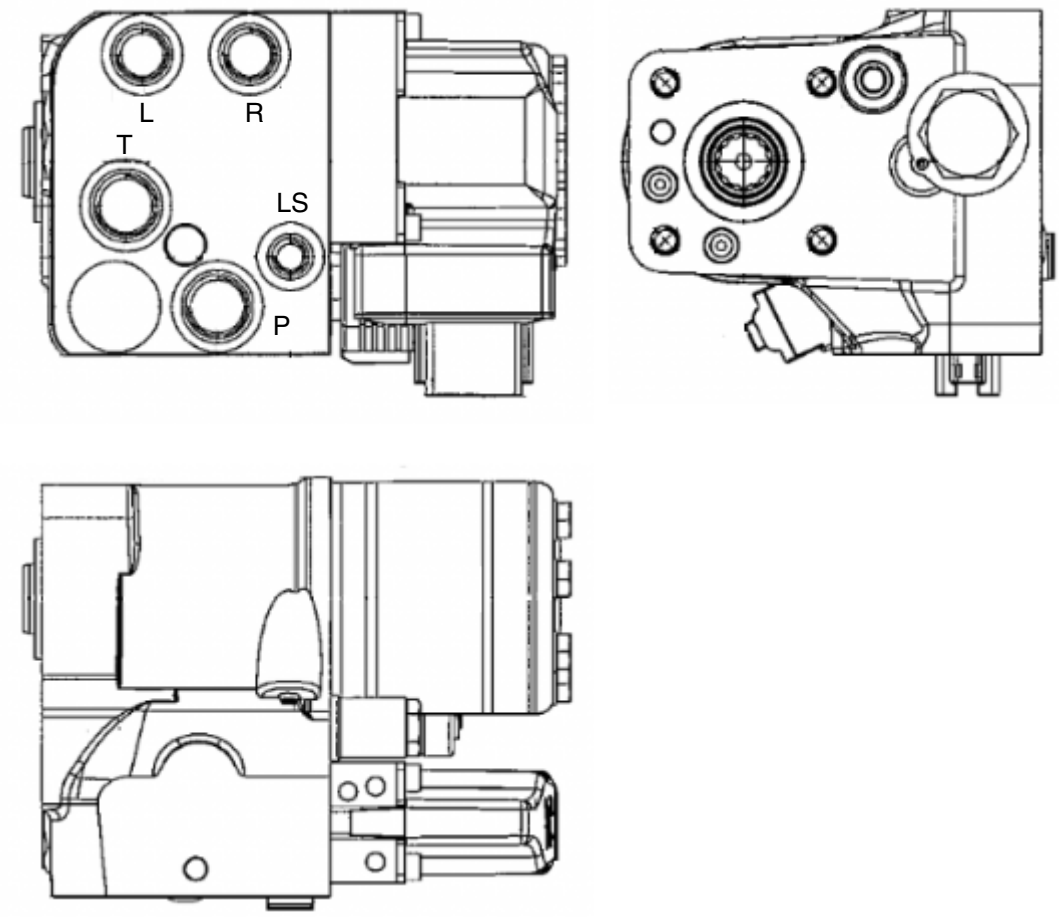


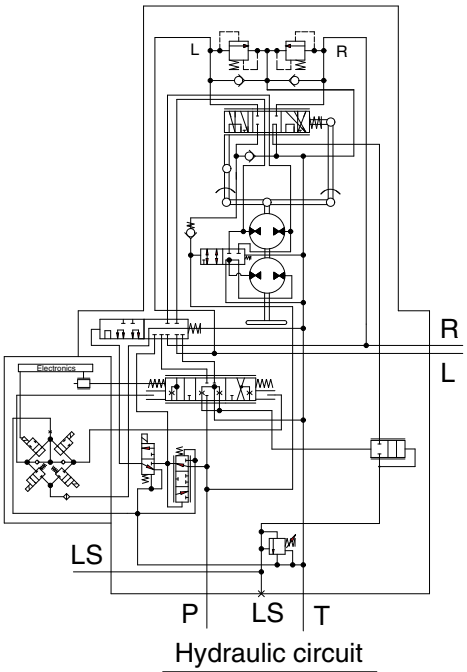
Hydraulic circuit

Port	Port name	Port size
L	Left port	3/4-16UNF
R	Right port	
T	Tank port	
P	Pump port	
LS	Load sensing port	7/16-20UNF

31U6-30020-E

2) TYPE 2 (joystick steering)





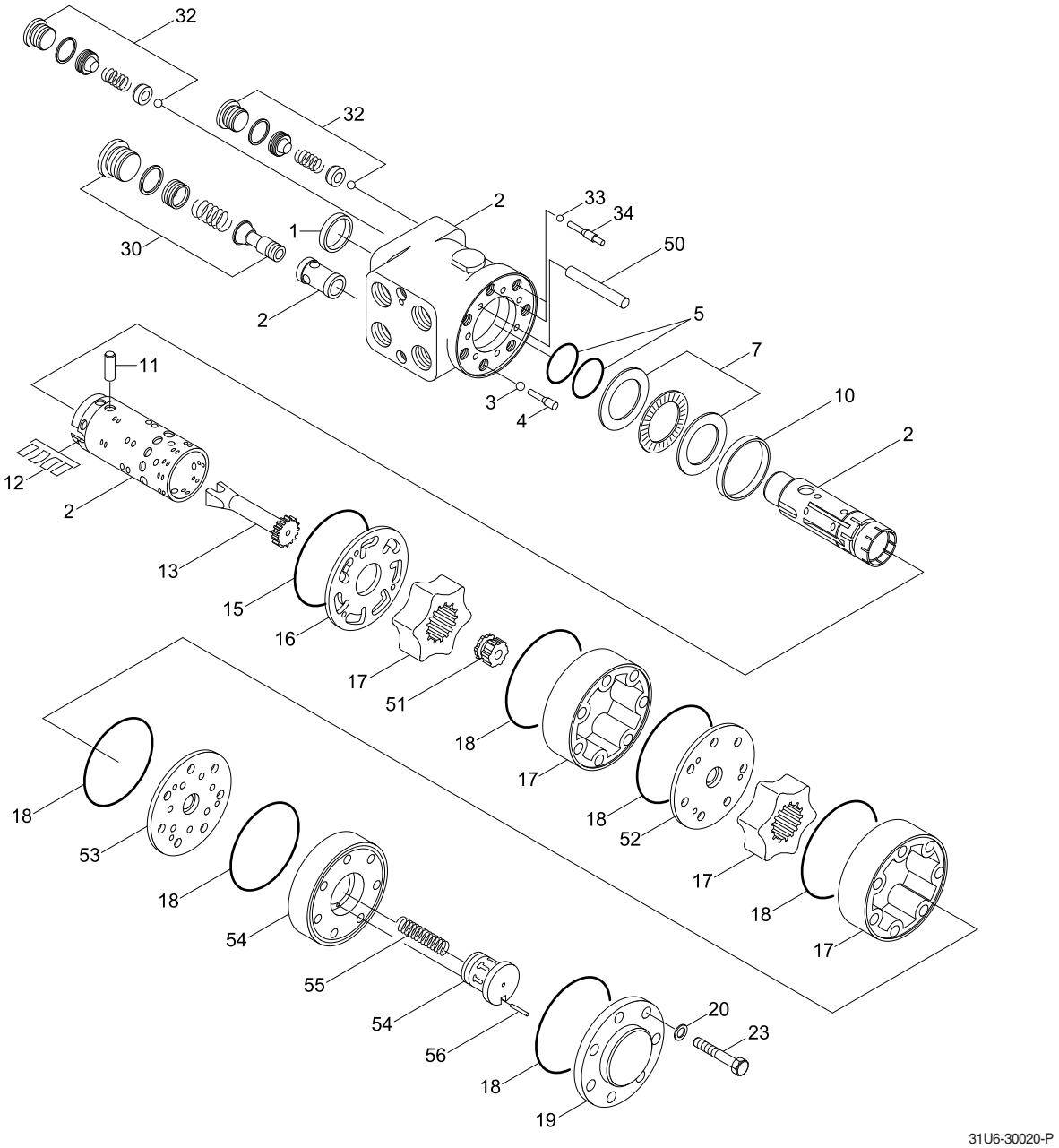
Hydraulic circuit

Port	Port name	Port size
L	Left port	M18x1.5
R	Right port	M18x1.5
T	Tank port	M22x1.5
P	Pump port	M22x1.5
LS	Load sensing port	M12x1.5

81K5-00030-E

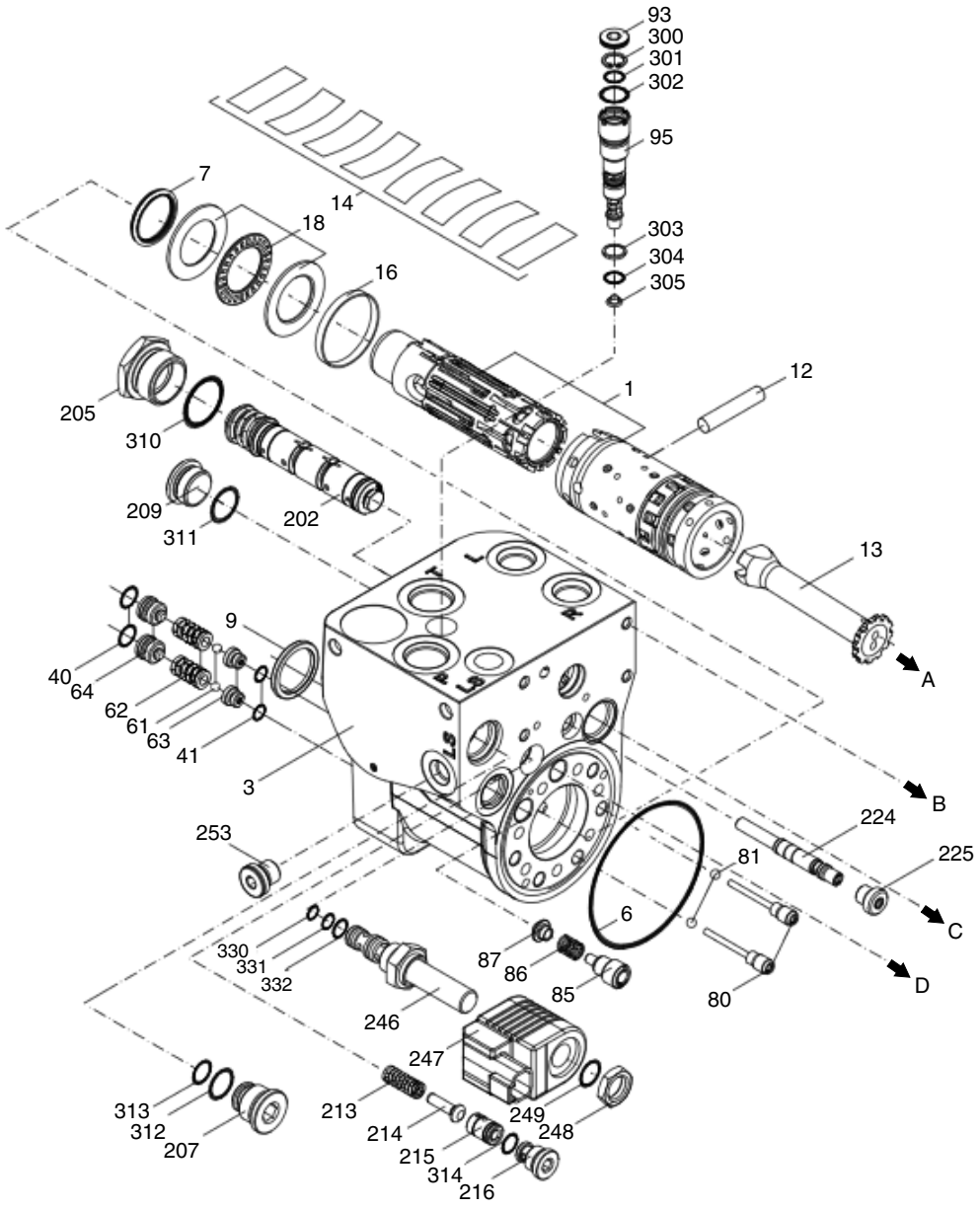
2. COMPONENTS

1) TYPE 1 (without joystick)



1	Dust seal	13	Shaft	31	Relief valve assy
2	Housing, spool, sleeve	16	Distributor plate	32	Shock valve
3	Ball	17	Gear wheel set	33	Ball
4	Ball	18	O-ring	34	Bushing
5	O-ring	19	End cover	50	Mounting pin
7	Bearing assy	20	Washer	51	Cardan shaft
10	Ring	23	Screw	54	Valve and housing
11	Cross pin	24	name plate		
12	Spring set	30	Relief valve assy		

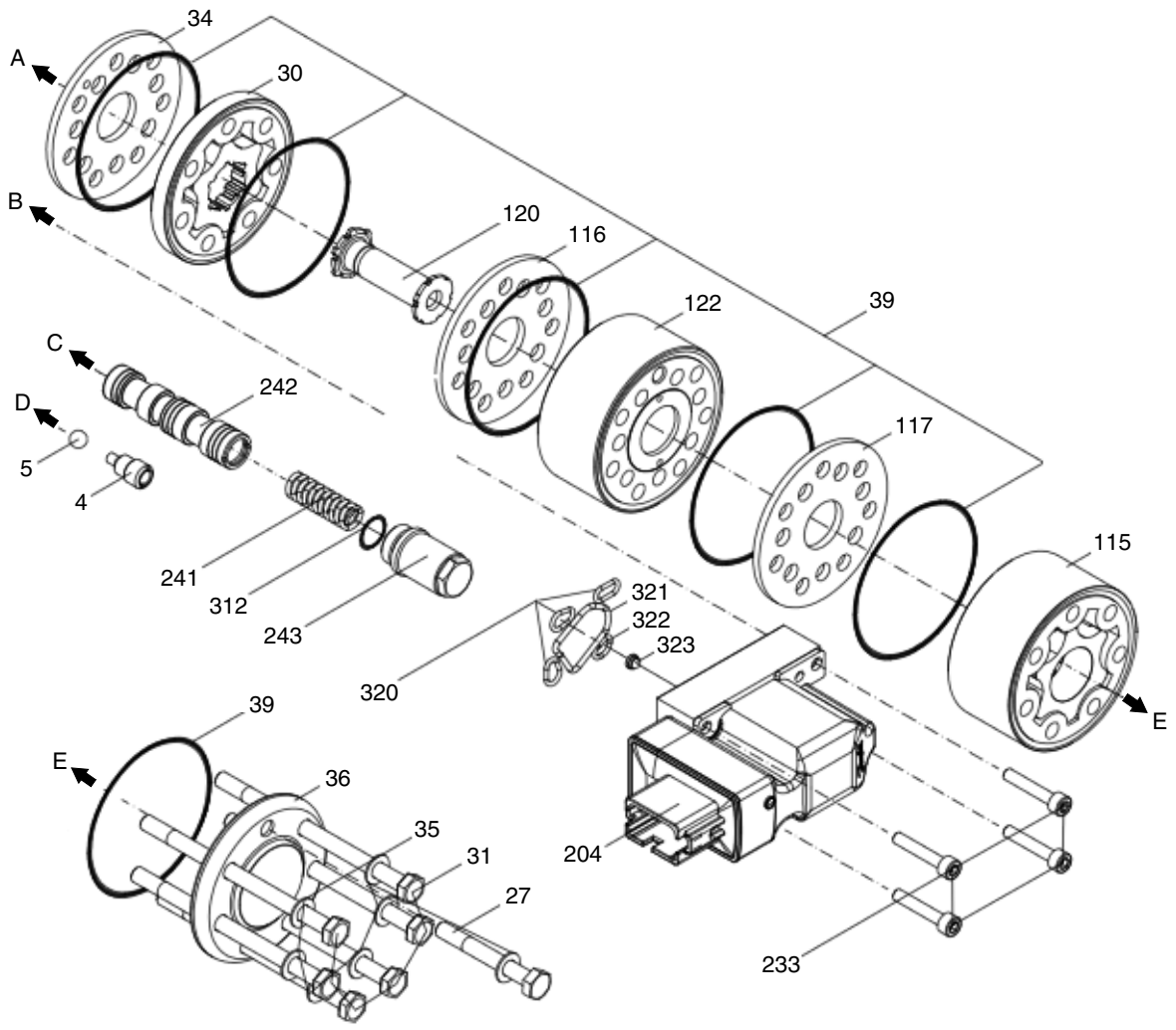
2) TYPE 2 (joystick steering, 1/2)



81K5-00030-P1

1	Spool/sleeve set	81	Ball	247	Coil
3	Housing	85	Screw	248	Nut
6	O-ring	86	Spring	249	O-ring
7	Shaft seal	87	Valve cone	253	Plug
9	Dust seal ring	93	Plug	300	Lock ring
12	Cross pin	95	Port relief valve cartridge	301	O-ring
13	Shaft	202	Spool	302	O-ring
14	Spring set	205	Plug	303	Backup ring
16	Ring	207	Plug	305	Filter
18	Bearing	209	Plug	310	O-ring
40	O-ring	213	Spring	311	O-ring
41	O-ring	214	Cone pilot supply	312	O-ring
61	Ball	215	Spool pilot supply	313	O-ring
62	Spring	216	Plug	314	O-ring
63	Valve seat	224	Spool	330	O-ring
64	Adjust screw	225	Plug	331	O-ring
80	Pin	246	Spool	332	O-ring

TYPE 2 (joystick steering, 2/2)



81K5-00030-P2

4	Screw	39	O-ring	241	Spring
5	Ball	115	Gear set	242	Spool
27	Short screw	116	Valve plate	243	Plug
30	Gear set	117	Valve plate	320	O-ring
31	Screw	120	Shaft	321	O-ring
34	Valve plate	122	Valve housing	322	O-ring
35	Washer	204	PVE	323	O-ring
36	End cover	233	Plug		

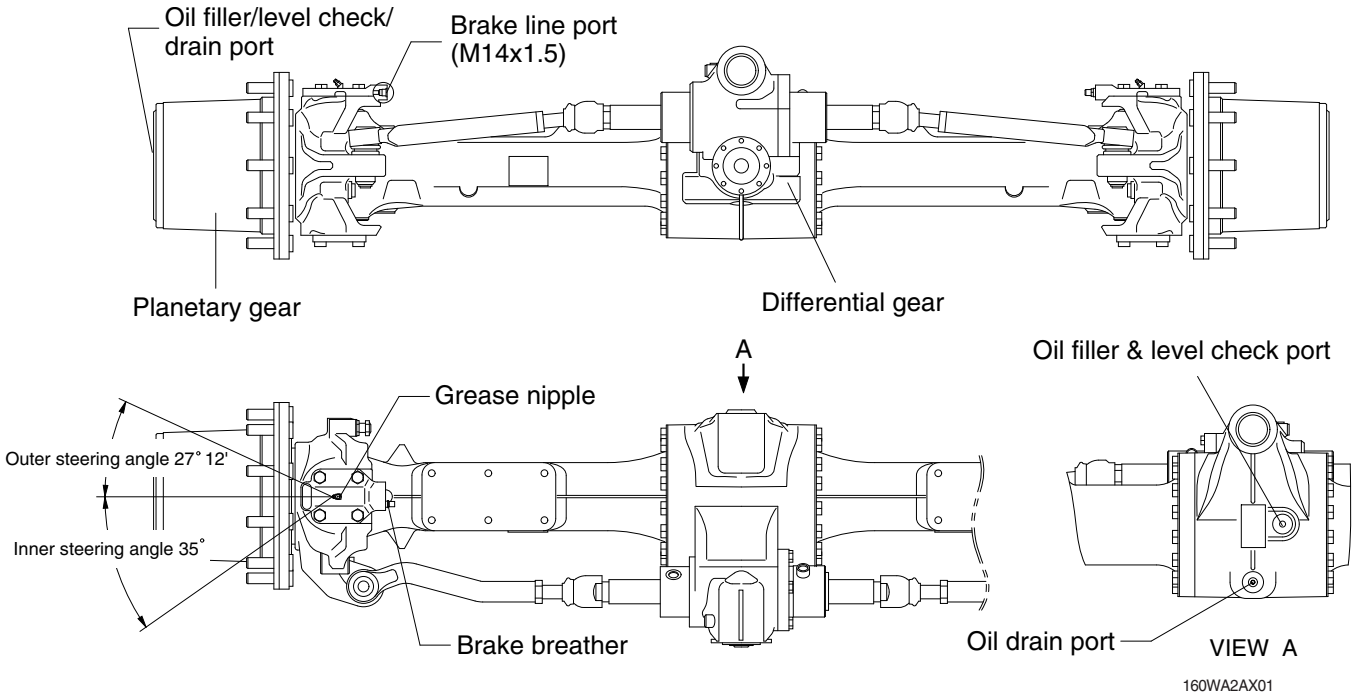
GROUP 11 FRONT AXLE AND REAR AXLE

1. OPERATION

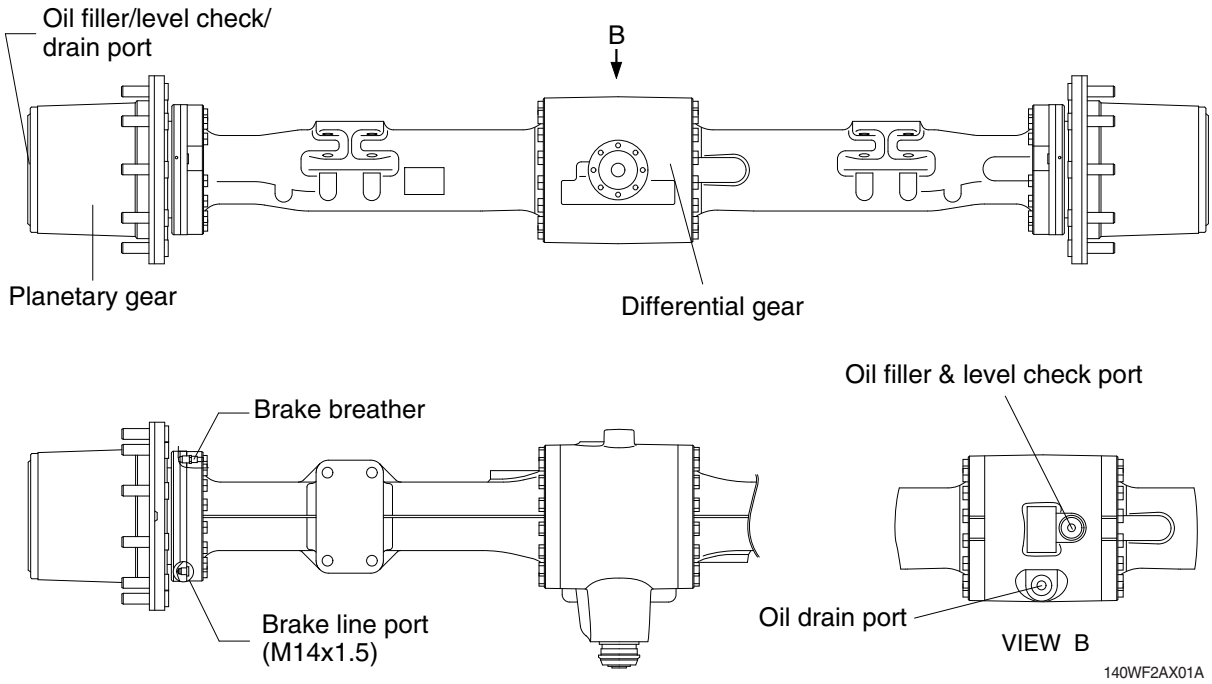
· The power from the engine passes through main pump, travel motor and transmission and drive shafts, and is then sent to the front and rear axles.
Inside the axles, the power passes from the bevel pinion to the bevel gear and is sent at right angles.

· At the same time, the speed is reduced and passes through the both differentials to the axle shafts. The power of the axle shafts is further reduced by planetary-gear-type final drives and is sent to the wheels.

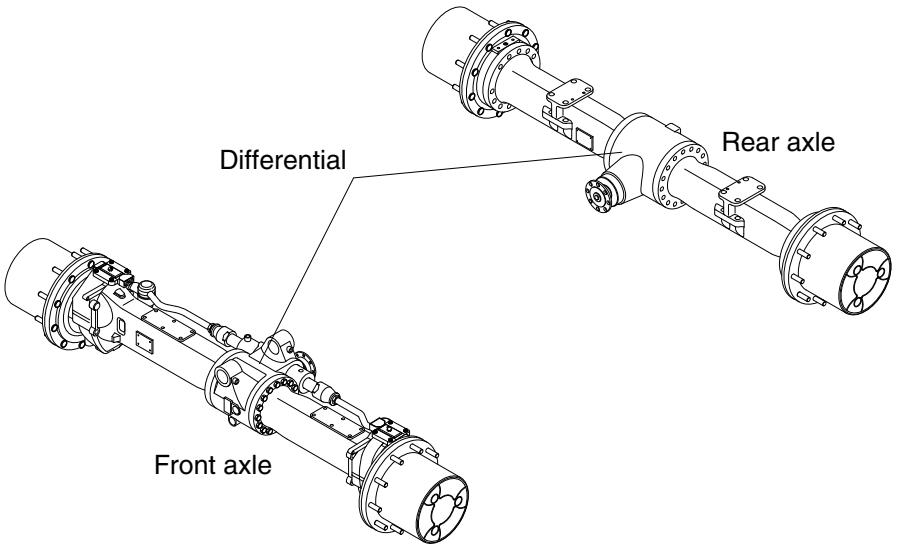
1) FRONT AXLE



2) REAR AXLE



2. DIFFERENTIAL



140WF2AX03

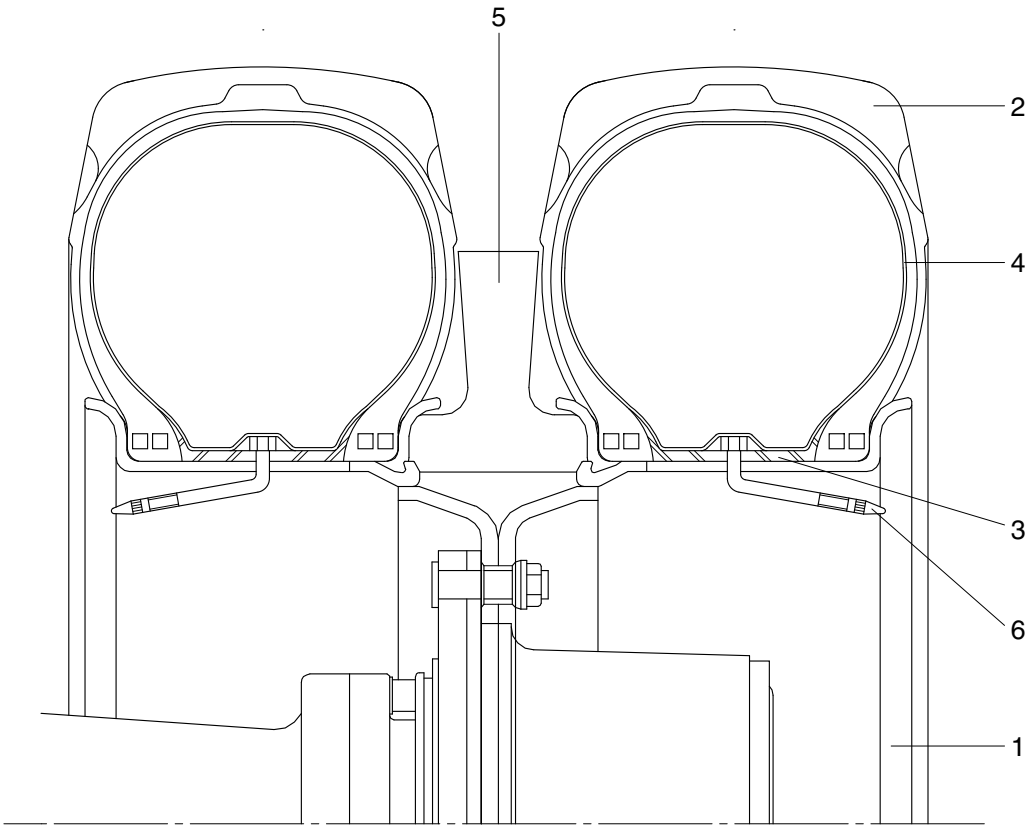
The differential is installed on the front and rear axle to transfer the driving torque from the axle to the wheels. The differential transfers half of the output torque of the transmission via the universal drive shaft to the planetary gear of the wheel hubs and transfers the rpm and torque from the gear via the pinion and the ring.

In addition, the differential also servers as an equalizer when going around curves. If the mechanical connection from the transmission to the universal drive shaft, differential, shaft, and planetary gears to the wheels would be rigid, every steering movement would strain the axle construction and would result in increased tire wear.

The equalizing function comes from the special construction of the differential. The power input from the input flange to the pinion shaft, ring and differential housing to the equalizing axle in the differential housing meshes the four equalizing tapered gears with the axle gears, which are located in the equalizing axles. This changes the relative direction of rotation between the shafts meshed with the side gears. This means that one shaft turns clockwise and the other counterclockwise, and one shaft turns faster than the other.

This balancing movement has the disadvantage that when traveling off road, traction is reduced on uneven ground, on loose ground or on snow or ice only wheel per axle is engaged. This disadvantage can be corrected in part by installing a self locking differential.

3. TIRE AND WHEEL



17032TI01

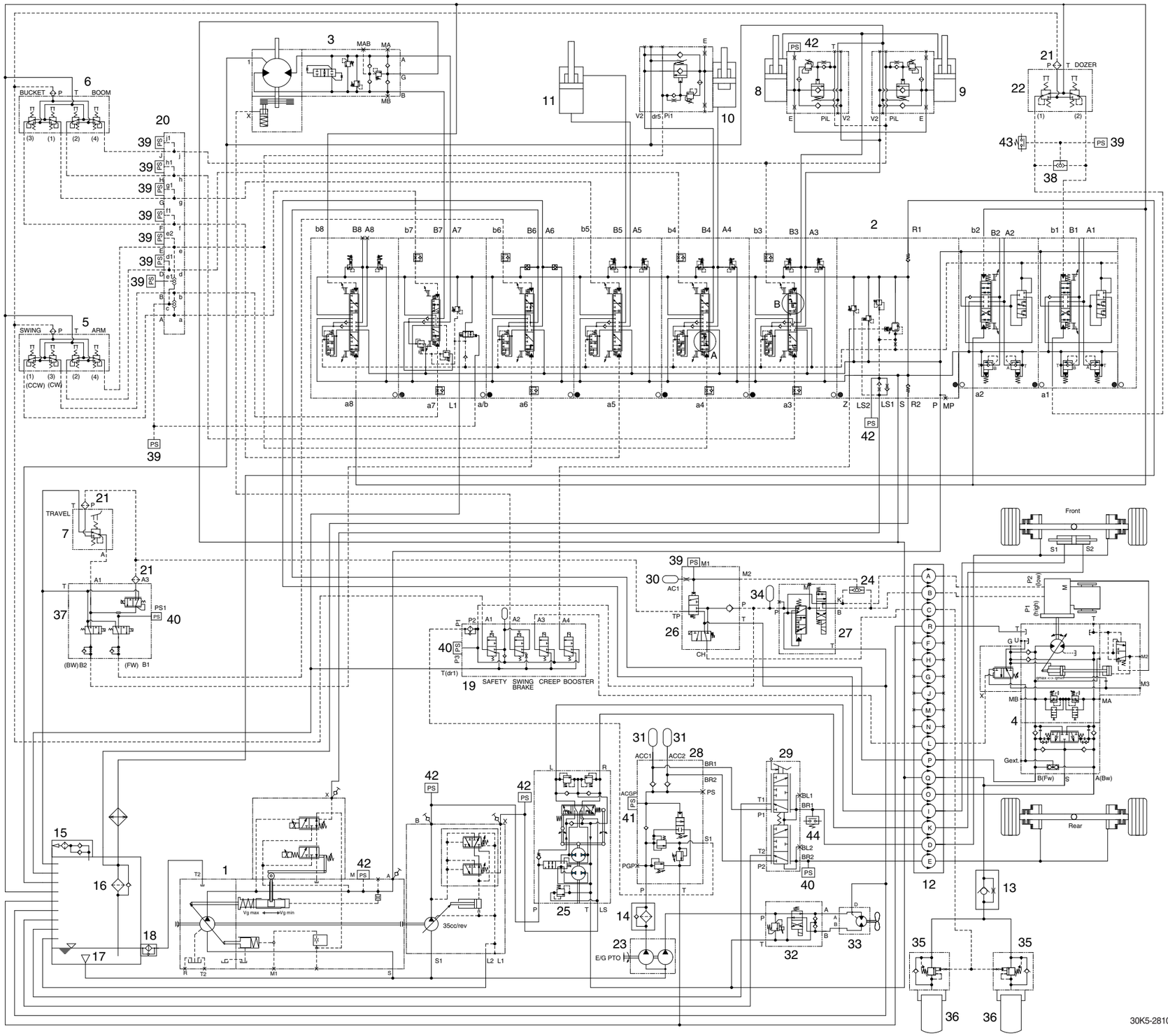
1	Wheel rim	3	Flap	5	Stone resister ring
2	Tire	4	Tube	6	Valve assembly

1) The tire acts to absorb the shock from the ground surface to the machine, and at the same time they must rotate in contact with the ground to gain the power which drives the machine.

2) Various types of tires are available to suit the purpose. Therefore it is very important to select the correct tires for the type of work and bucket capacity.

SECTION 3 HYDRAULIC SYSTEM

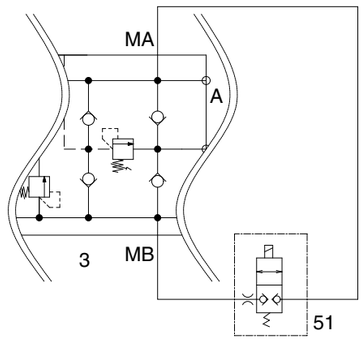
1. HYDRAULIC CIRCUIT (1/4)



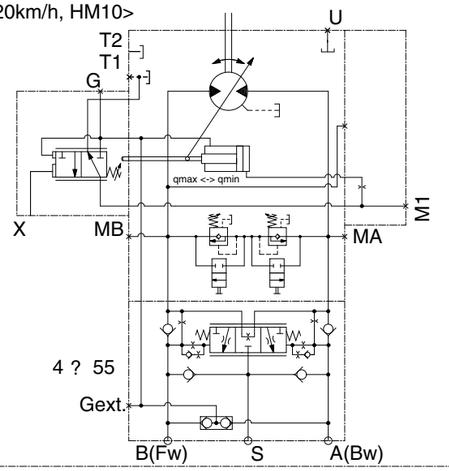
1 Main pump
2 Main control valve
3 Swing motor
4 Travel motor
5 RCV lever (LH)
6 RCV lever (RH)
7 RCV pedal
8 Boom cylinder (LH)
9 Boom cylinder (RH)
10 Arm cylinder
11 Bucket cylinder
12 Turning joint
13 Orifice and check valve
14 Last guard filter
15 Air breather
16 Return filter w/bypass valve
17 Strainer
18 Drain filter
19 4-cartridge valve
20 Terminal block
21 Last guard filter
22 RCV dozer lever
23 Gear pump
24 Shuttle valve
25 Steering unit
26 Travel control valve
27 Transmission control valve
28 Brake supply valve
29 Brake valve
30 Accumulator
31 Accumulator
32 Fan control valve
33 Fan motor-bi
34 Accumulator
35 Locking valve
36 Oscillating cylinder
37 3-cartridge valve
38 Shuttle valve
39 Pressure sensor
40 Pressure sensor
41 Pressure sensor
42 Pressure sensor
43 Pressure switch
44 Pressure switch

2. HYDRAULIC CIRCUIT (2/4)

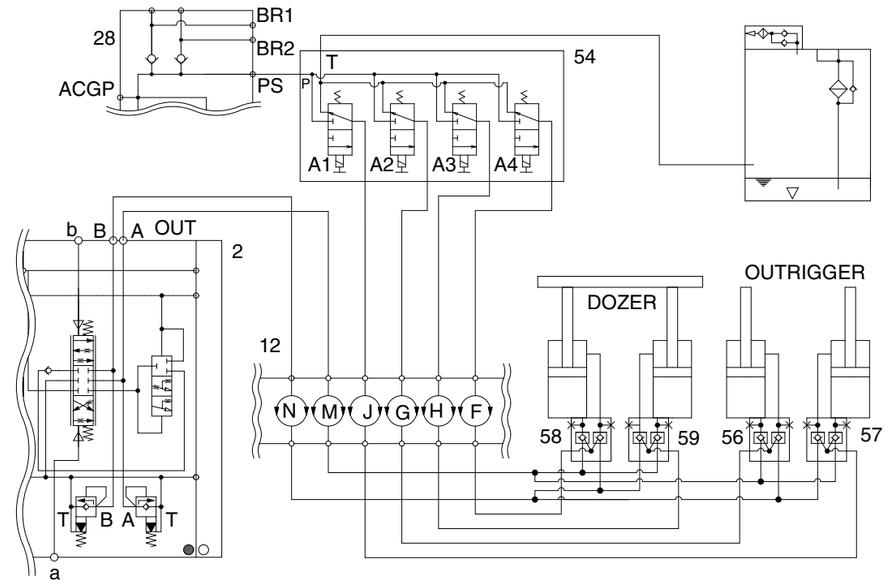
<SWING FINE CONTROL, IS01>



<TRAVEL 20km/h, HM10>



<INDEPENDENT OUTRIGGER, BR01~10+13>



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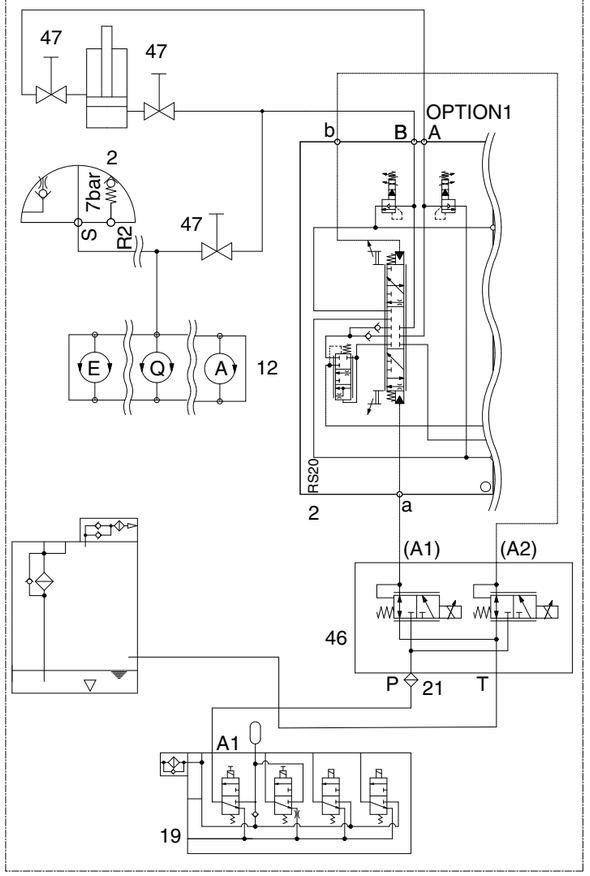

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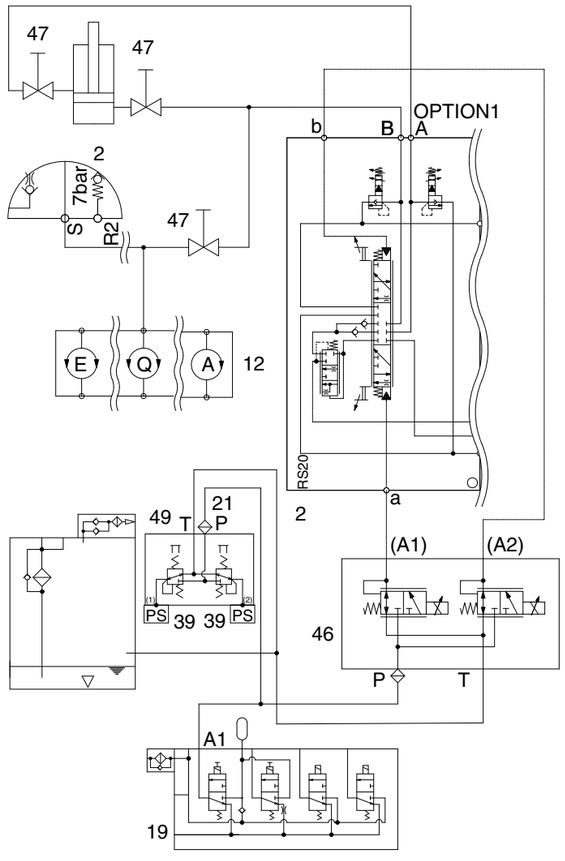
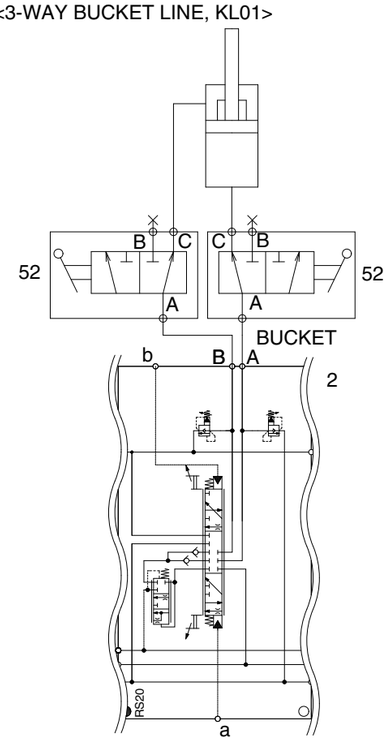
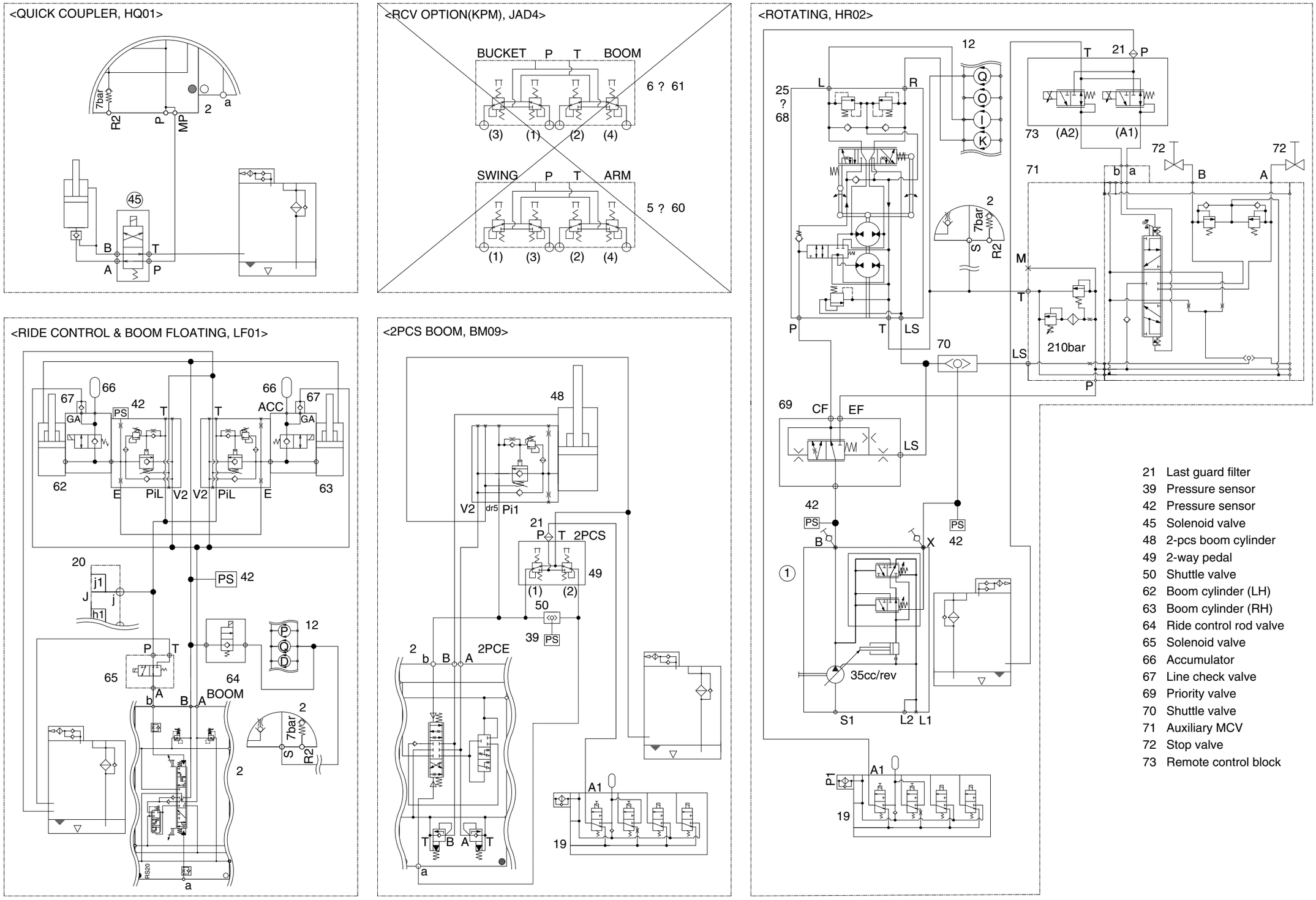


<3-WAY BUCKET LINE, KL01>



21 Last guard filter
39 Pressure sensor
46 Remote control block
47 Stop valve
49 2-way pedal
51 Solenoid valve
52 3-way valve
54 4-cartridge valve
55 Travel motor
56 D.P check valve (LH)
57 D.P check valve (RH)
58 D.P check valve (LH)
59 D.P check valve (RH)

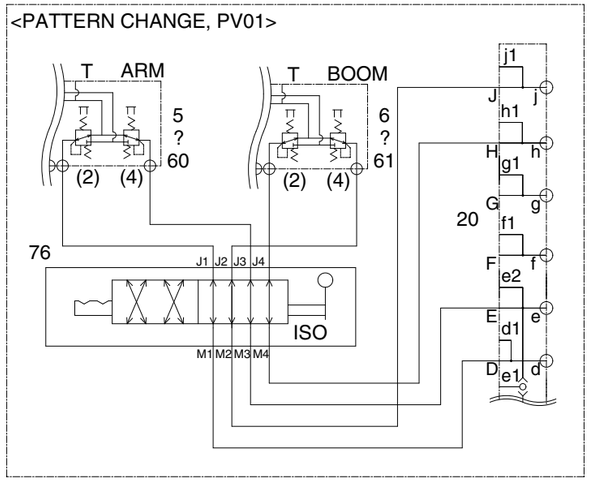
3. HYDRAULIC CIRCUIT (3/4)

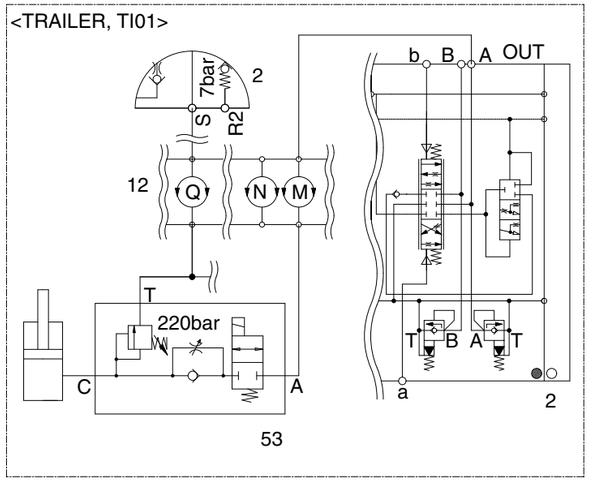


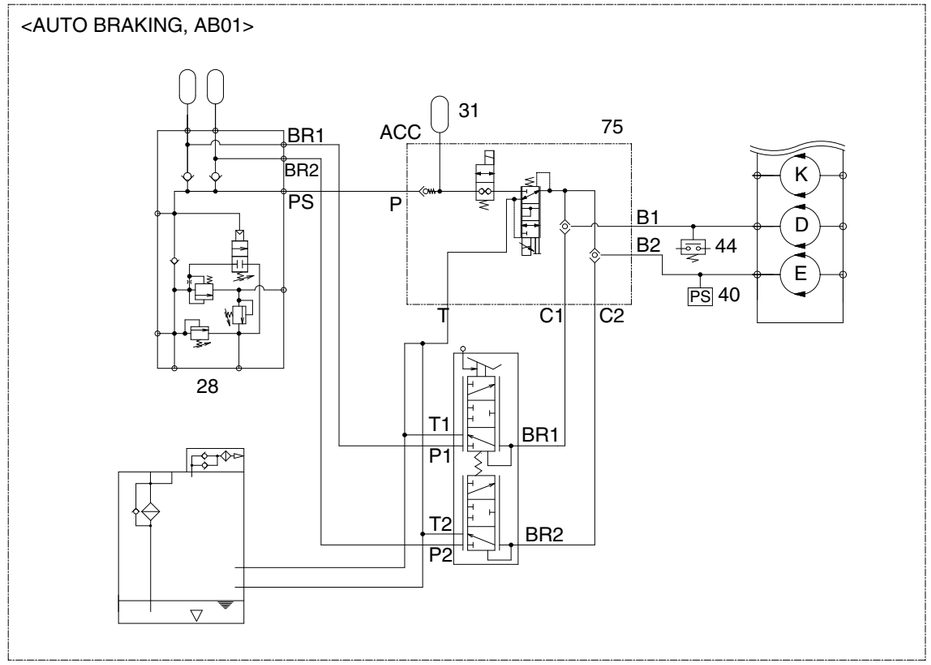
21 Last guard filter
39 Pressure sensor
42 Pressure sensor
45 Solenoid valve
48 2-pcs boom cylinder
49 2-way pedal
50 Shuttle valve
62 Boom cylinder (LH)
63 Boom cylinder (RH)
64 Ride control rod valve
65 Solenoid valve
66 Accumulator
67 Line check valve
69 Priority valve
70 Shuttle valve
71 Auxiliary MCV
72 Stop valve
73 Remote control block

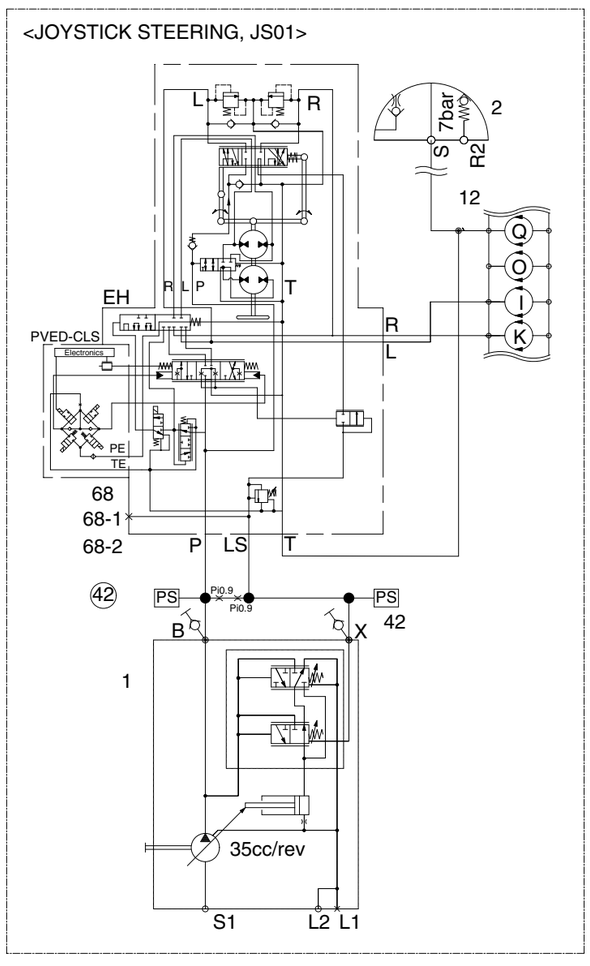
30K5-28100-04 3OF4

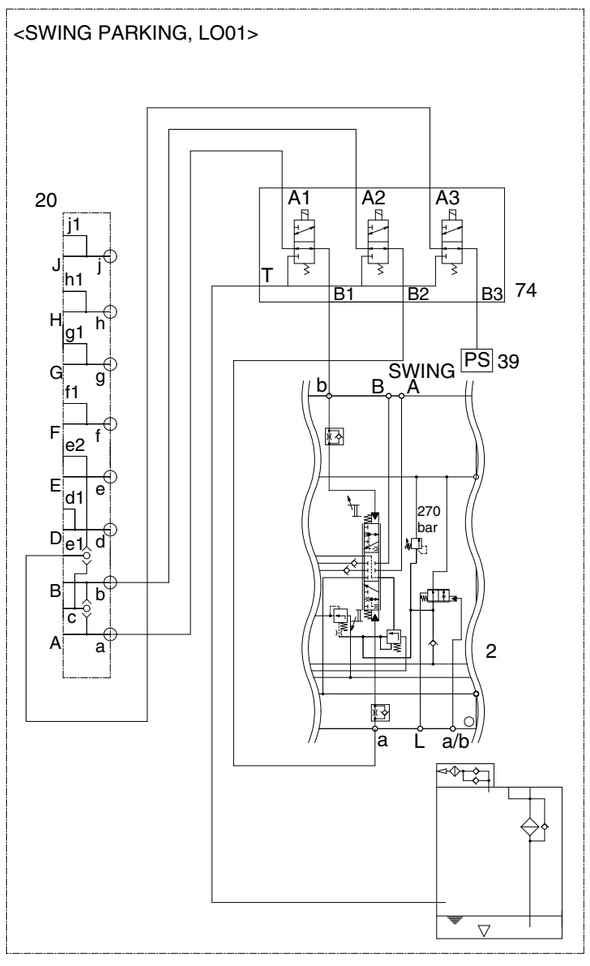
4. HYDRAULIC CIRCUIT (4/4)

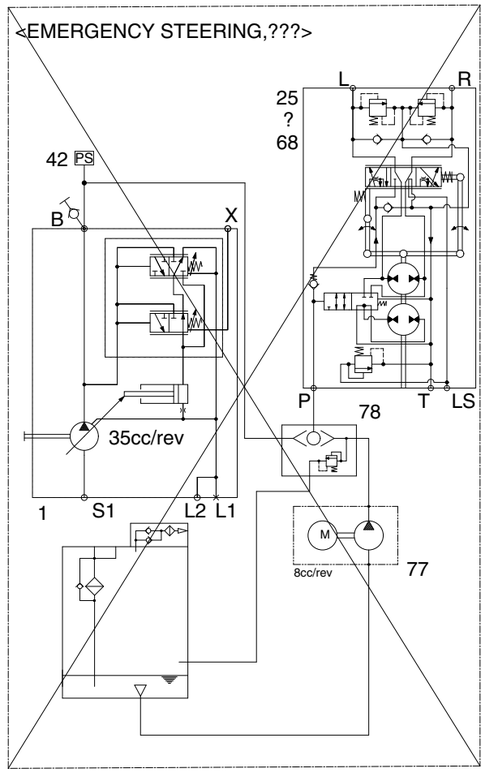












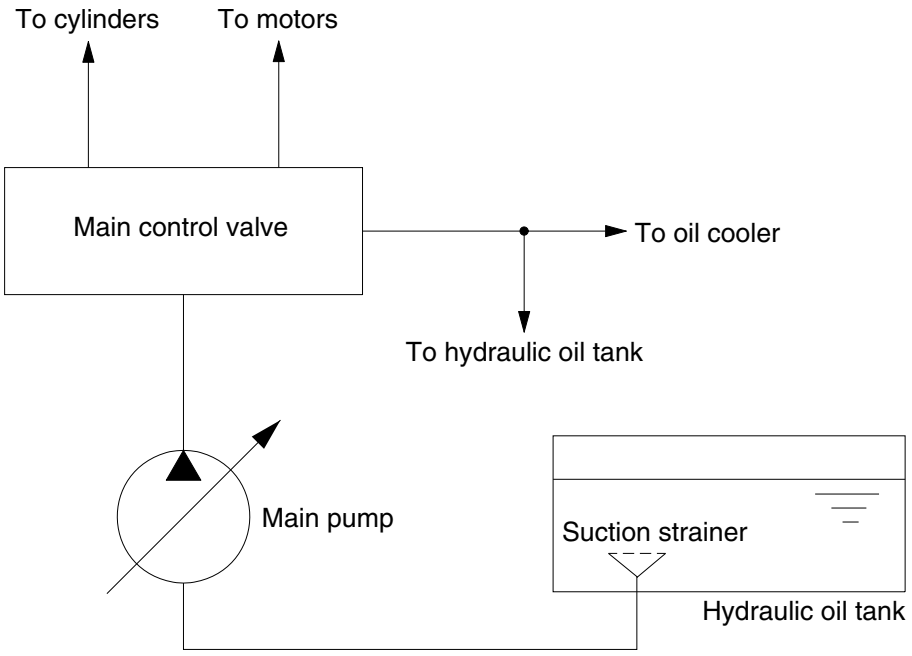
31 Accumulator
53 Trailer valve
68 Steering unit
68-1 Adapter
68-2 Steering sensor
74 Solenoid valve
75 Auto brake valve
76 Pattern change valve

30K5-28100-04 4OF4

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 it is driven by the engine at ratio 1.0 of engine speed.

1. SUCTION AND DELIVERY CIRCUIT

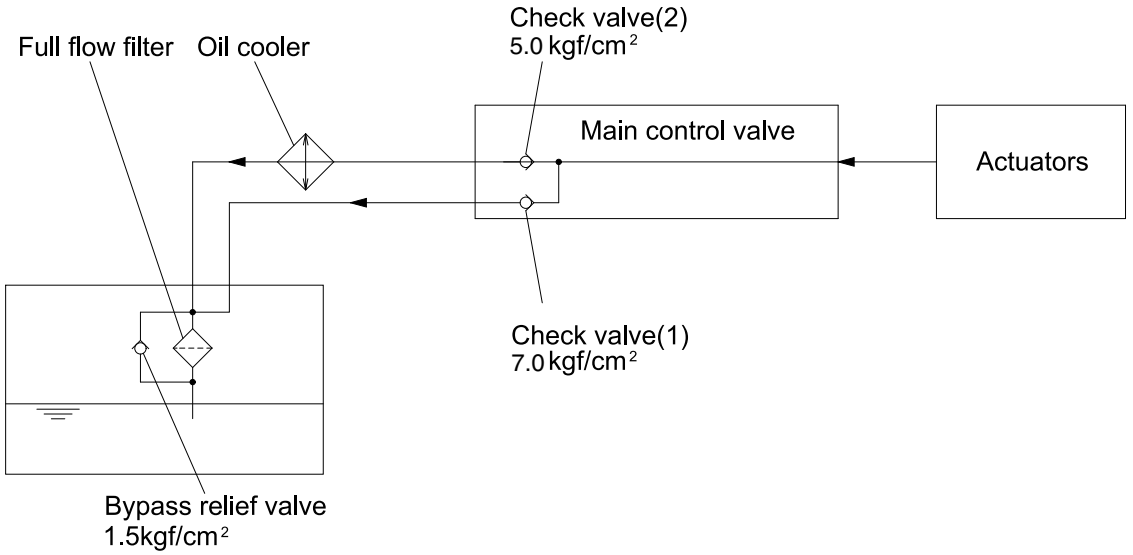


140L3CI01

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



140WA3CI01

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

The bypass check valves are provided in the return circuit.

The setting pressure of bypass check valves are 5.1 kgf/cm^2 (71 psi) and 7.1 kgf/cm^2 (100 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 7.1 kgf/cm^2 (100 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).

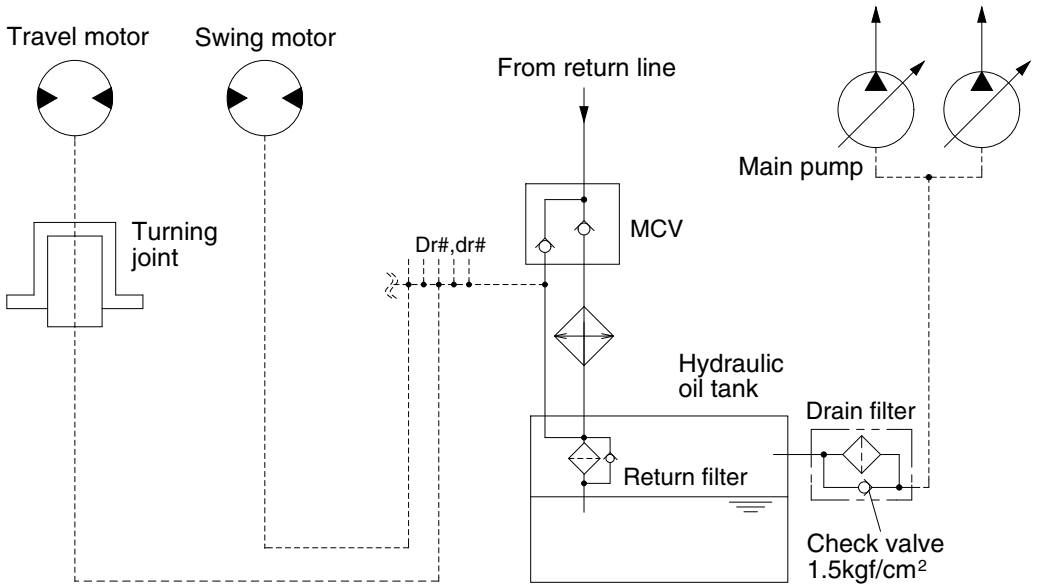
The return filter and bypass relief valve are provided in the hydraulic tank.

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

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

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

3. DRAIN CIRCUIT



140WA3CI02

Besides internal leaks from the motor, transmission, front and rear axle the oil for lubrication circulates. The main pump drain oil have to be fed to the hydraulic tank passing through drain filter. When the drain oil pressure exceed 1.5 kgf/cm² (21 psi), the oil returns to the hydraulic tank directly.

1) TRAVEL MOTOR DRAIN CIRCUIT

Oil leaking from the travel motor comes out of the drain ports provided in the motor casing. This oil passes through turning joint and returns to the hydraulic tank after being filtered by return filter.

2) SWING MOTOR DRAIN CIRCUIT

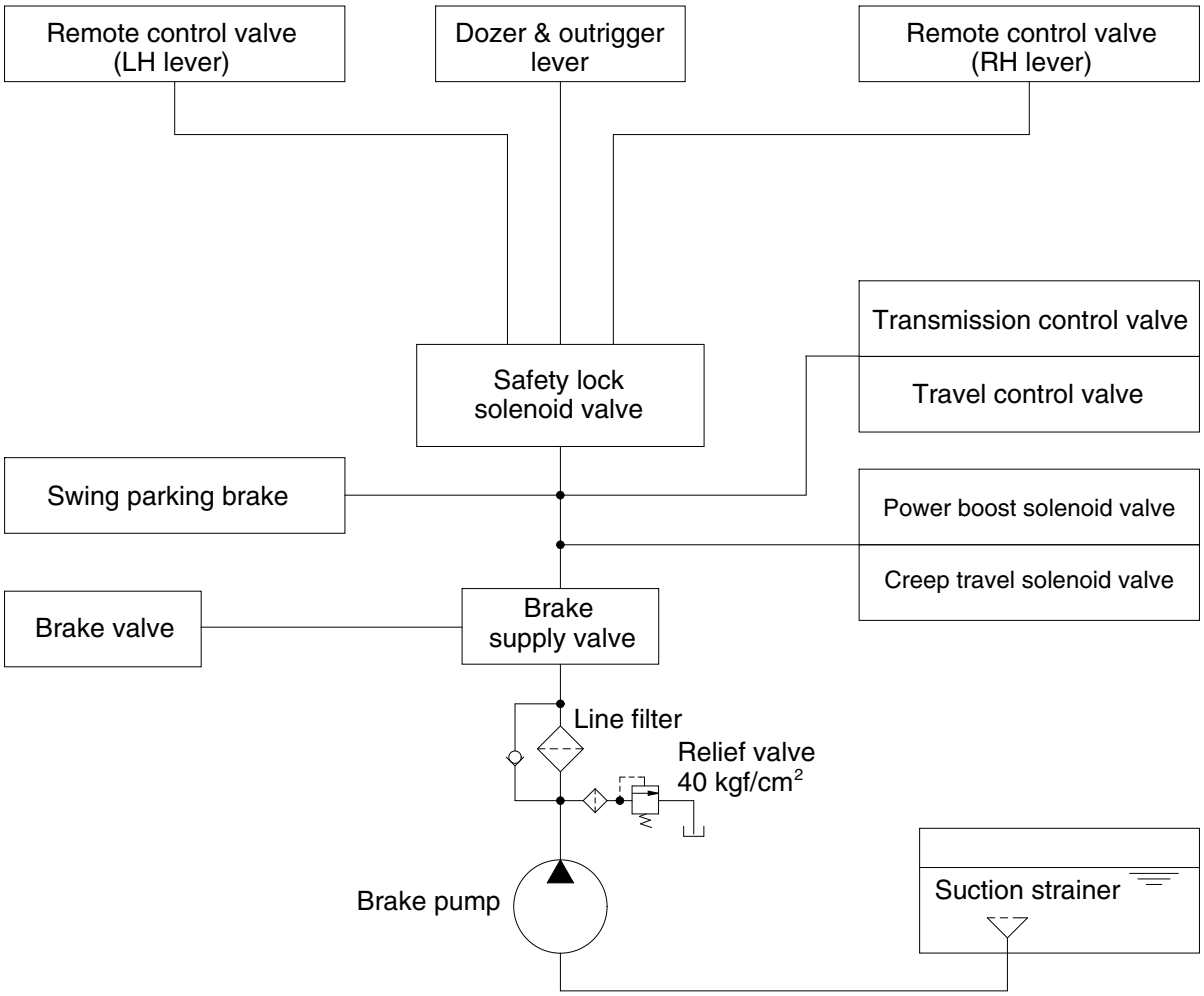
Oil leaking from the swing motor comes out and return to the hydraulic tank.

3) MAIN PUMP DRAIN CIRCUIT

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

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

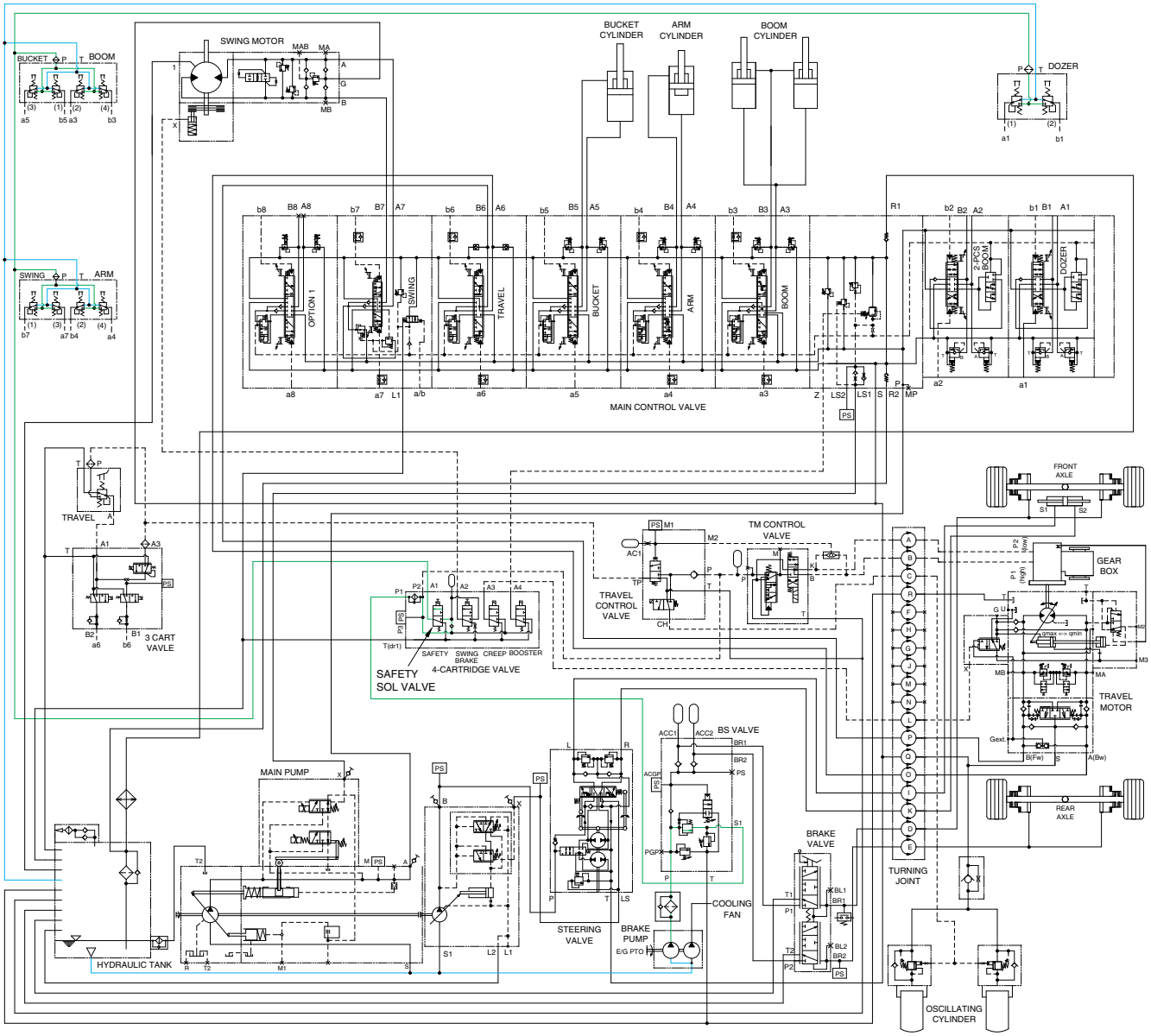
GROUP 3 PILOT CIRCUIT



The pilot circuit consists of suction circuit, delivery circuit and return circuit.
The brake pump receives the oil from the hydraulic tank through the suction strainer.
The discharged oil from the brake pump flows to the remote control valve via safety lock solenoid valve and the swing brake solenoid valve, creep travel solenoid valve, power boost solenoid valve, transmission control valve and travel control valve through the line filter and brake supply valve.

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

1. SUCTION, DELIVERY AND RETURN CIRCUIT

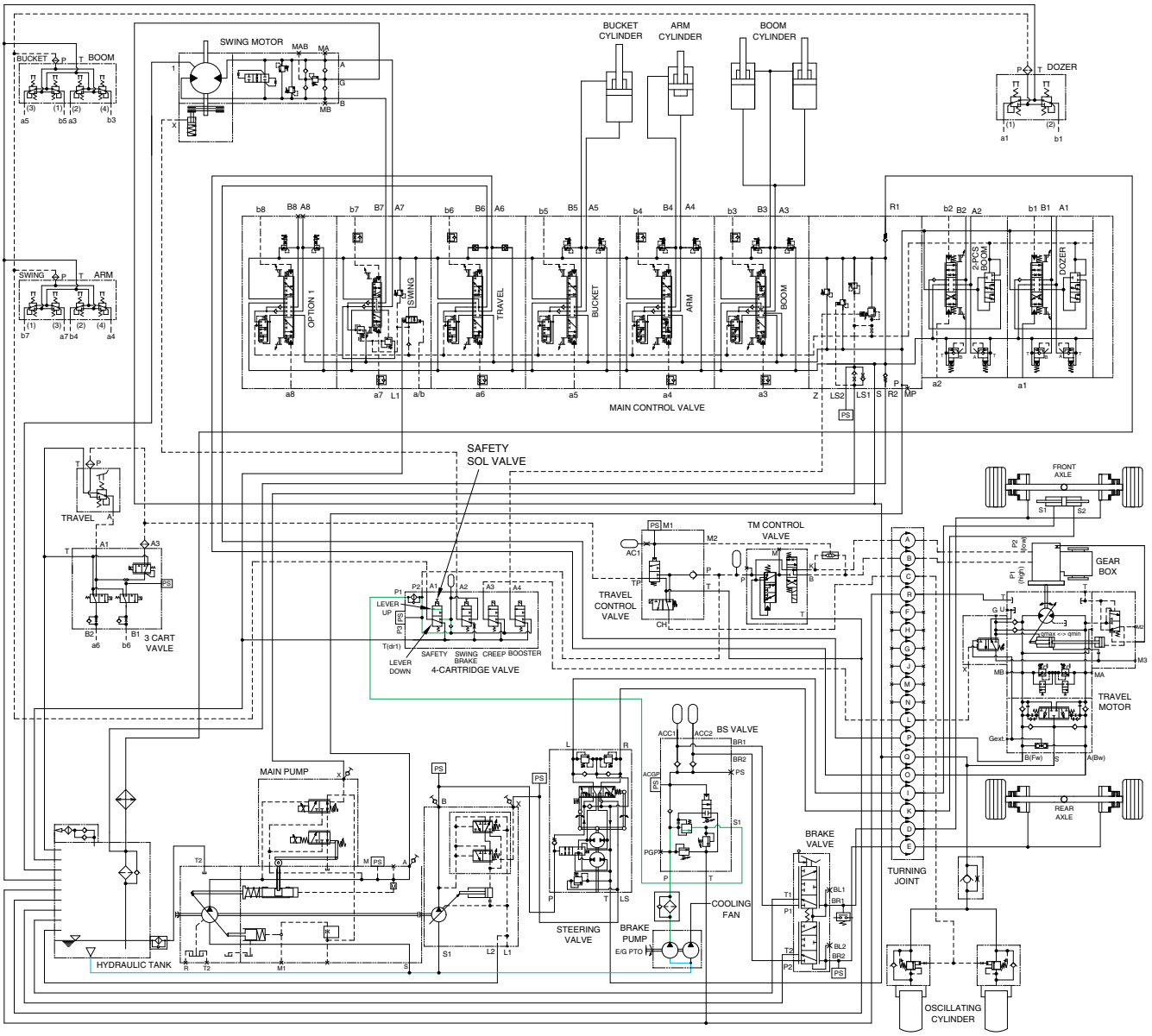


140WA3HC02

The brake pump receives oil from the hydraulic tank. The discharged oil from the brake pump flows to the safety solenoid valve through the line filter and brake supply valve. The oil is filtered by the line filter. The pilot relief valve is provided in the brake supply valve for limiting the pilot circuit pressure.
The oil filtered by line filter flows remote control valve through safety solenoid valve.
The return oil from remote control valve is returned to the hydraulic tank.

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

2. SAFETY SOLENOID VALVE (SAFETY LEVER)



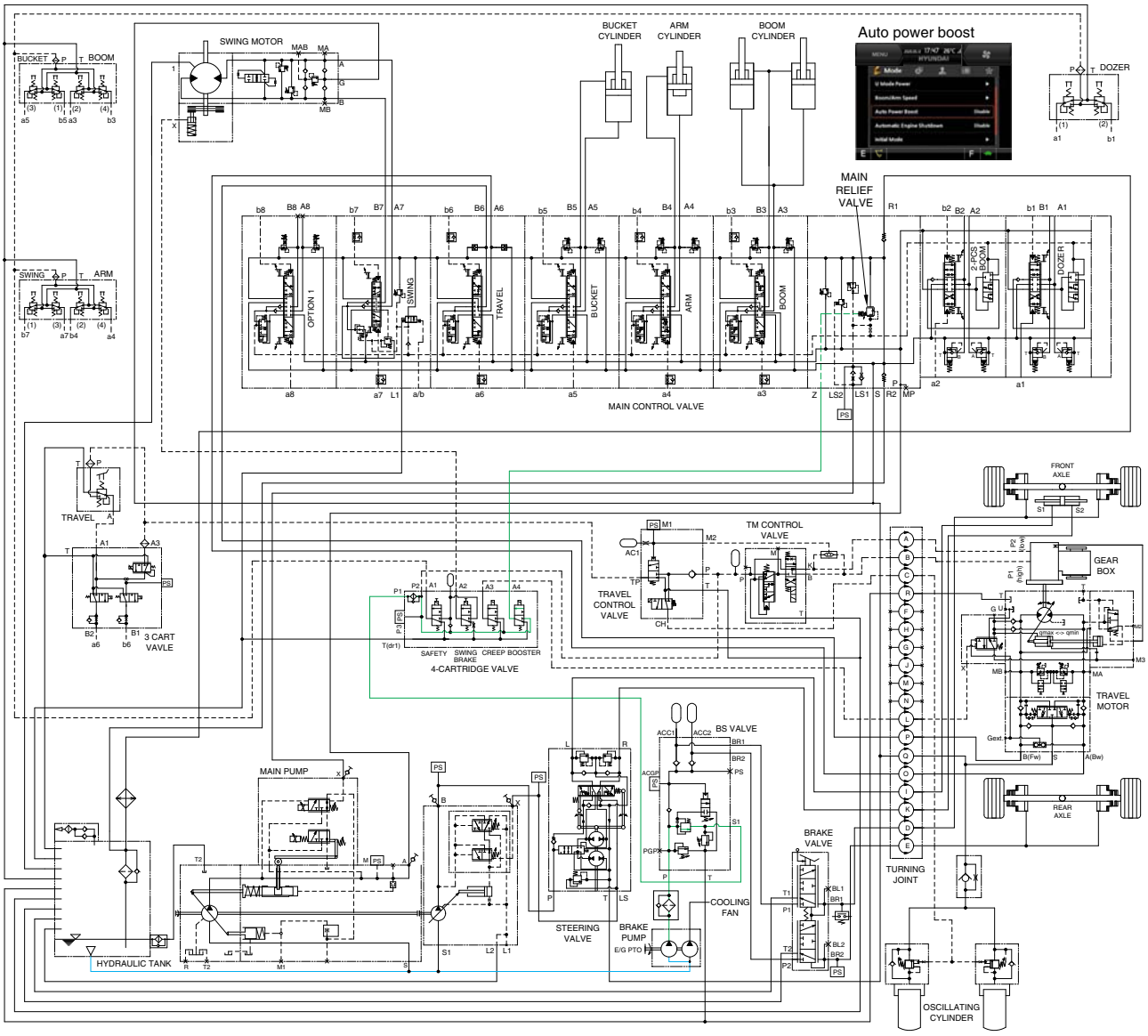
140WA3HC03

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

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

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

3. MAIN RELIEF PRESSURE CHANGE SYSTEM



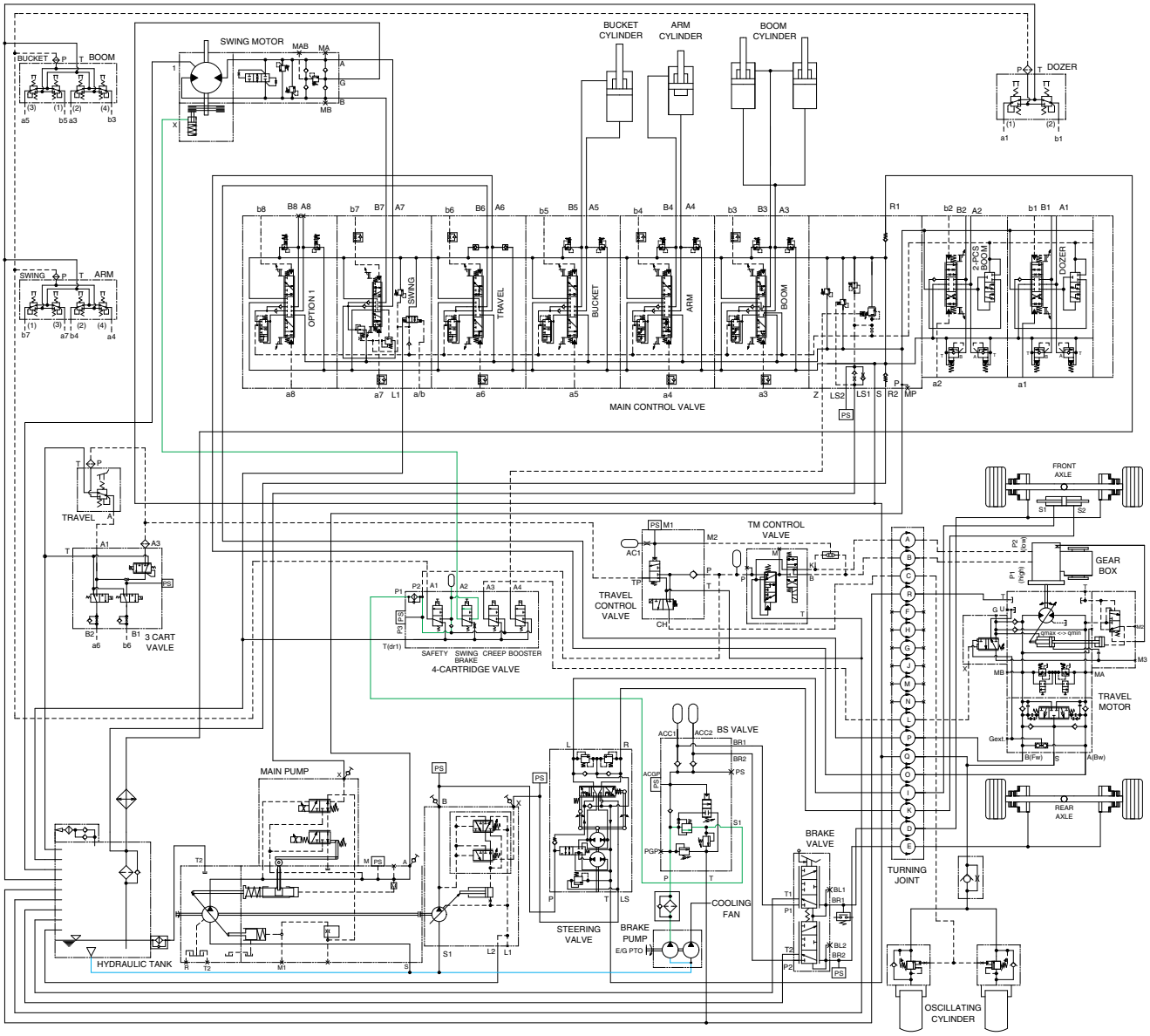
140WA3HC04

When the power boost switch on the left control lever is pushed ON, the power boost solenoid valve is actuated, the discharged oil from the brake pump flows into **Z** port of the main relief valve in main control valve ; then the setting pressure of the main relief valve is raises from 350 kgf/cm^2 to 380 kgf/cm^2 for increasing the digging power. And even when press continuously, it is canceled after 8 seconds.

When the auto power boost function is selected to **Enable** on the cluster, the pressure of the main relief pressure is automatically increased to 380 kgf/cm^2 as working condition by the MCU. It is also operated max 8 seconds. Refer to page 5-83.

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

4. SWING PARKING BRAKE RELEASE



140WA3HC05

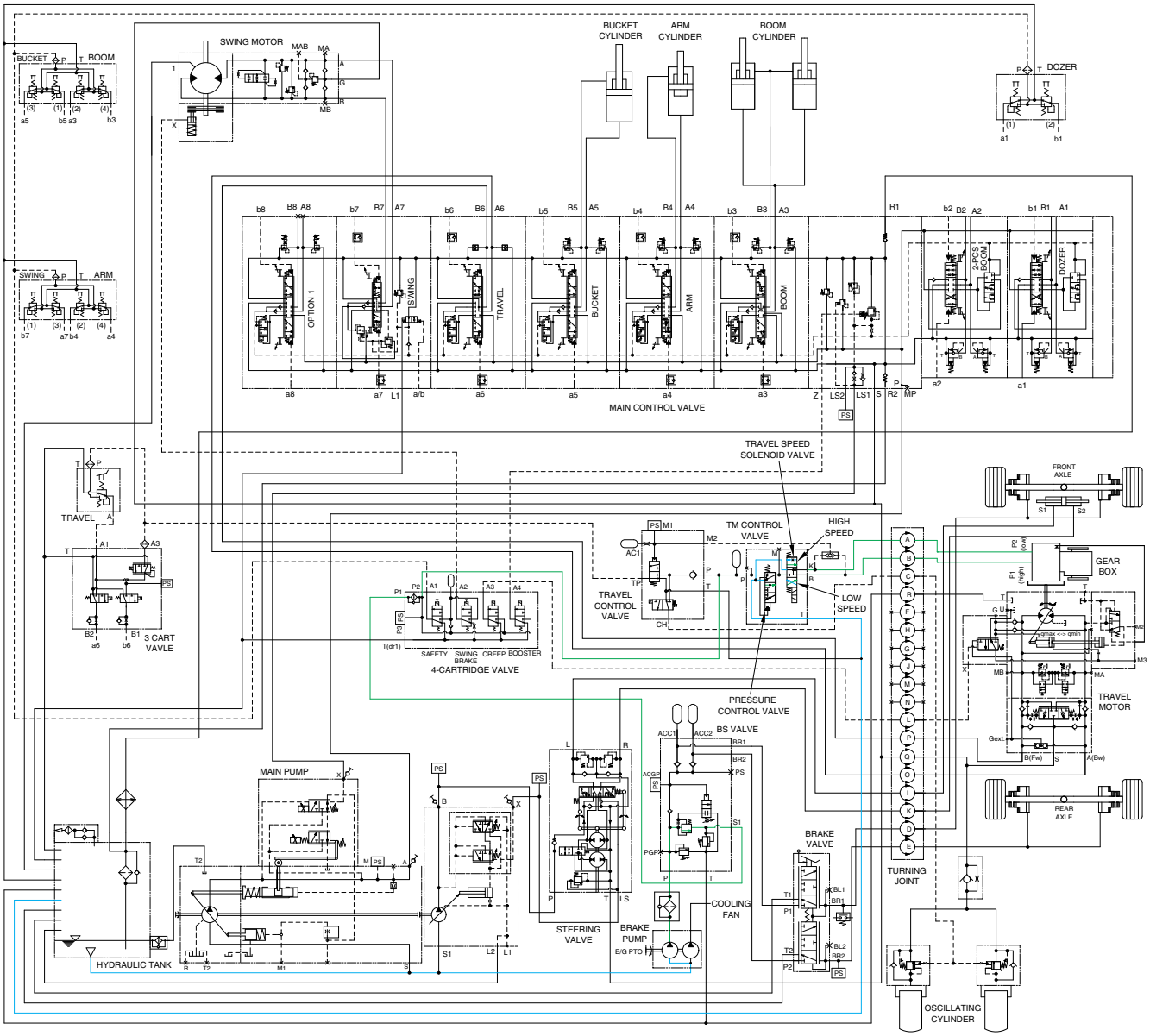
When the swing or arm in control lever is tilted, the swing brake solenoid valve is shifted to the downward by the MCU that senses the pilot pressure of the RCV control lever.

The discharged oil from brake pump flows to swing motor X port through the swing brake solenoid valve. This pressure is applied to swing motor disc, thus the brake is released.

When the swing and arm in control lever are set in the neutral position, the swing brake solenoid valve is shifted to the upward, oil in the swing motor disc cylinder is drained through the the swing brake solenoid valve, thus the brake is applied. For details, refer to page 2-60.

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

5. TRAVEL SPEED SELECTION SYSTEM

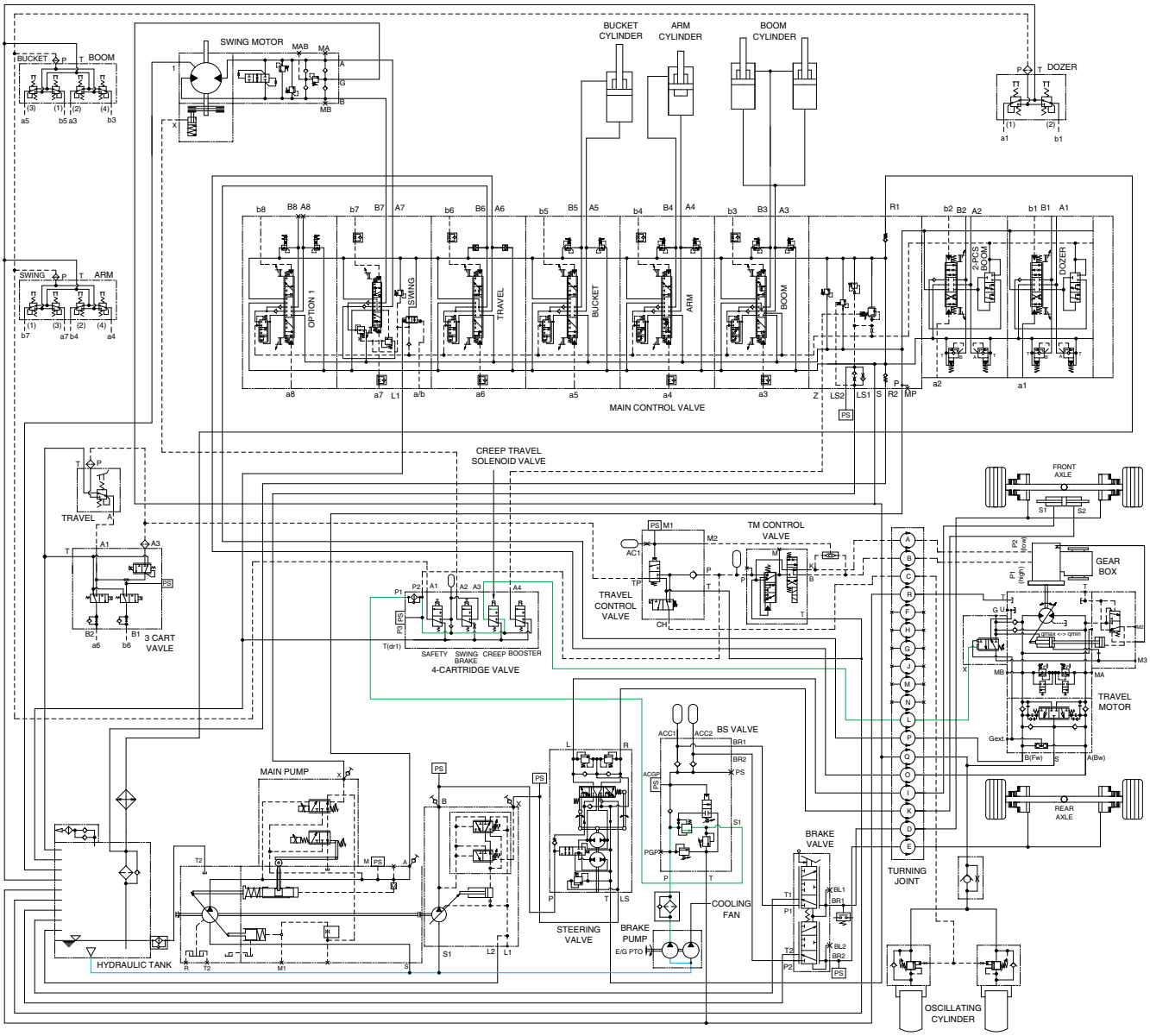


140WA3HC06

When LH multifunction switch was placed in high or low speed position, the pressure oil from brake pump flows to travel speed solenoid valve through pressure control valve, thus the transmission is changed into high (P1) or low (P2) speed condition.

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

6. CREEP TRAVEL SYSTEM



140WA3HC07

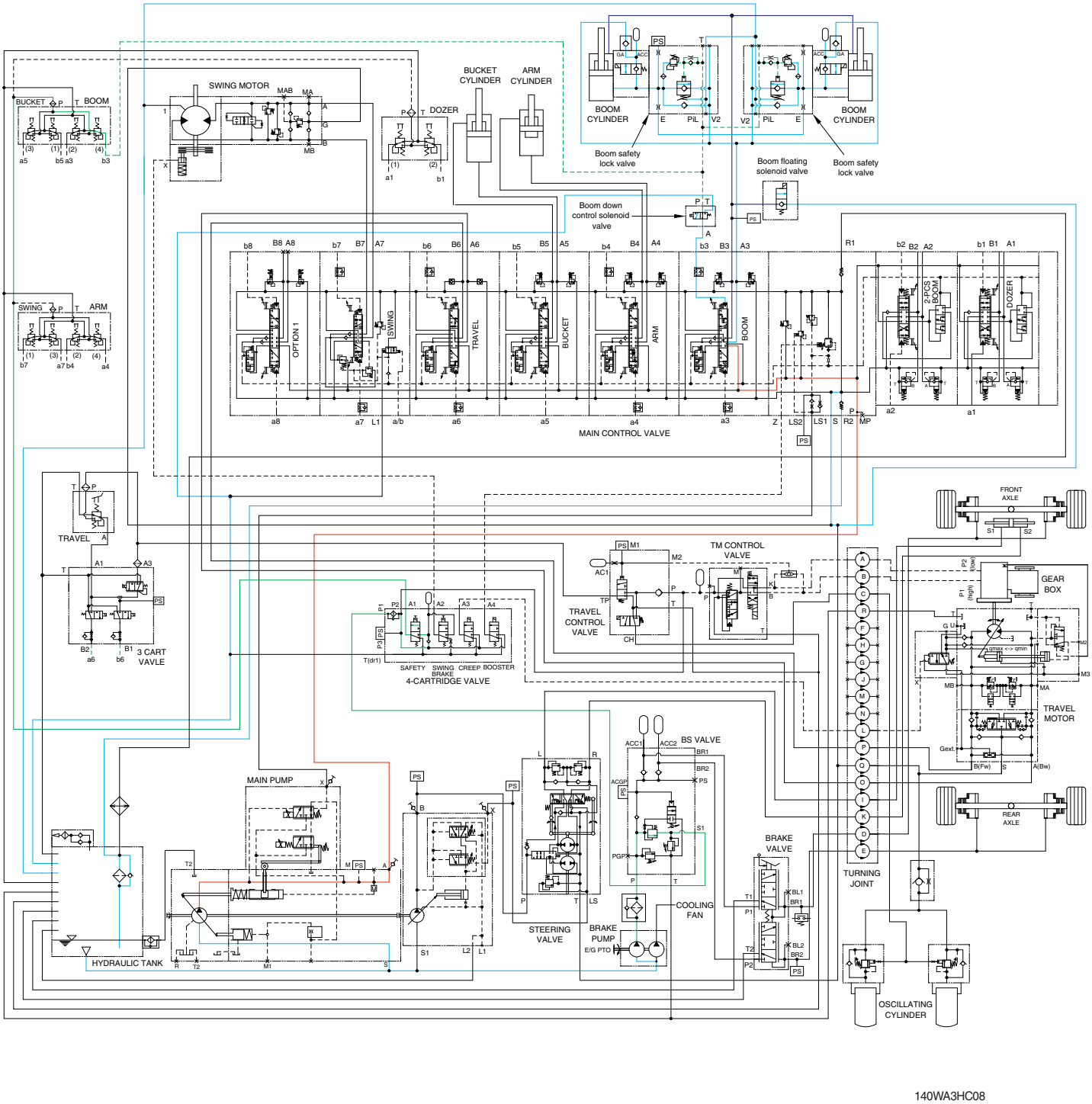
When the creep switch on the dashboard of the steering column is pushed ON, the creep travel solenoid valve is actuated.

The discharged oil from the brake pump flows into X port of travel motor through solenoid valve.

Then, the machine speed is very low travelling more than 1st speed.

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

7. BOOM FLOATING SYSTEM



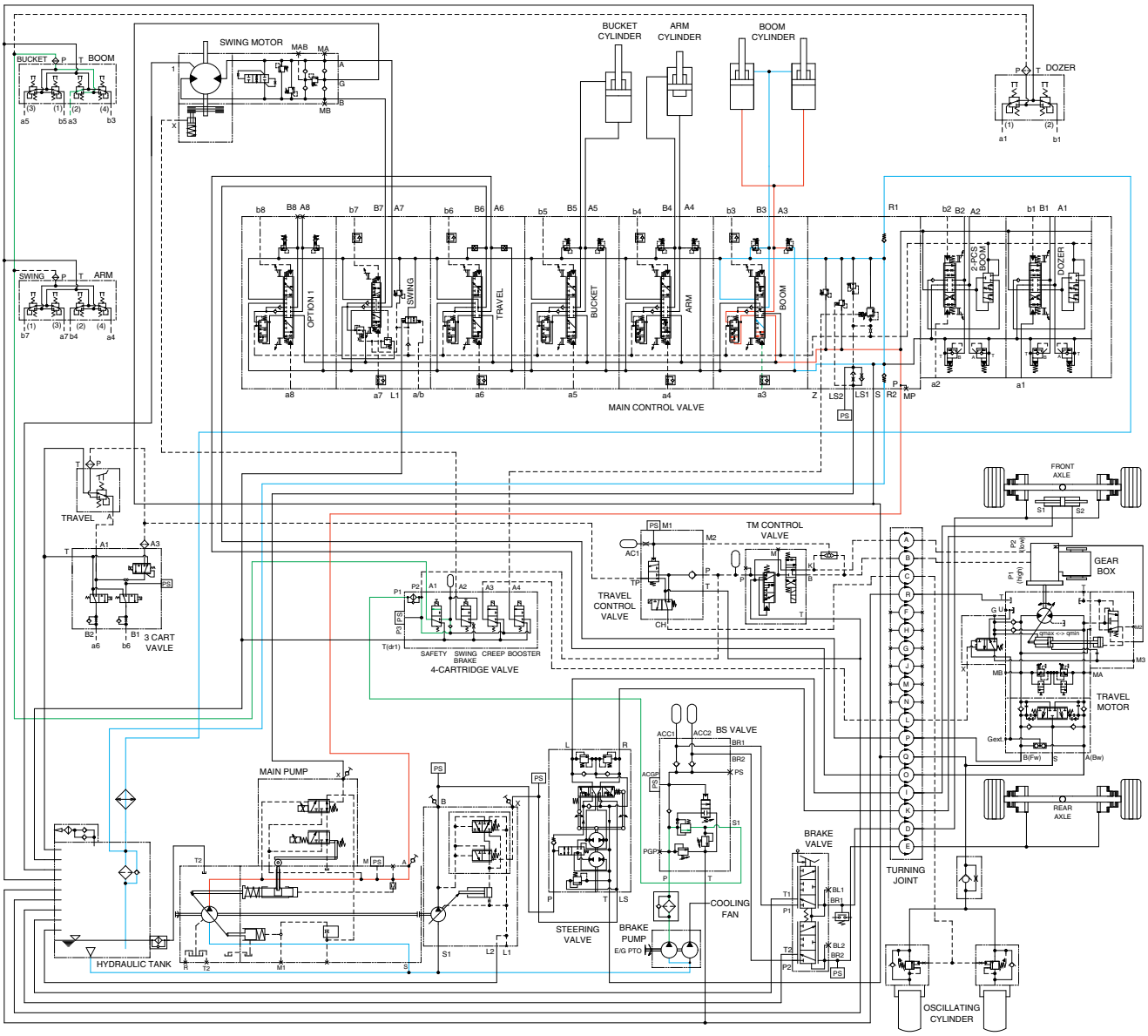
140WA3HC08

Smooth and convenient boom movement is accomplished by only arm control lever operation.
The boom floating solenoid valve are equipped in the rod of boom cylinder that is controlled to act as floating mode.
So the hydraulic oil of rod and head goes to tank, and floating is accomplished. In the mode, boom down control solenoid is active so that boom down pilot pressure is cut.
For more details, refer to page 5-13.

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

GROUP 4 SINGLE OPERATION

1. BOOM UP OPERATION



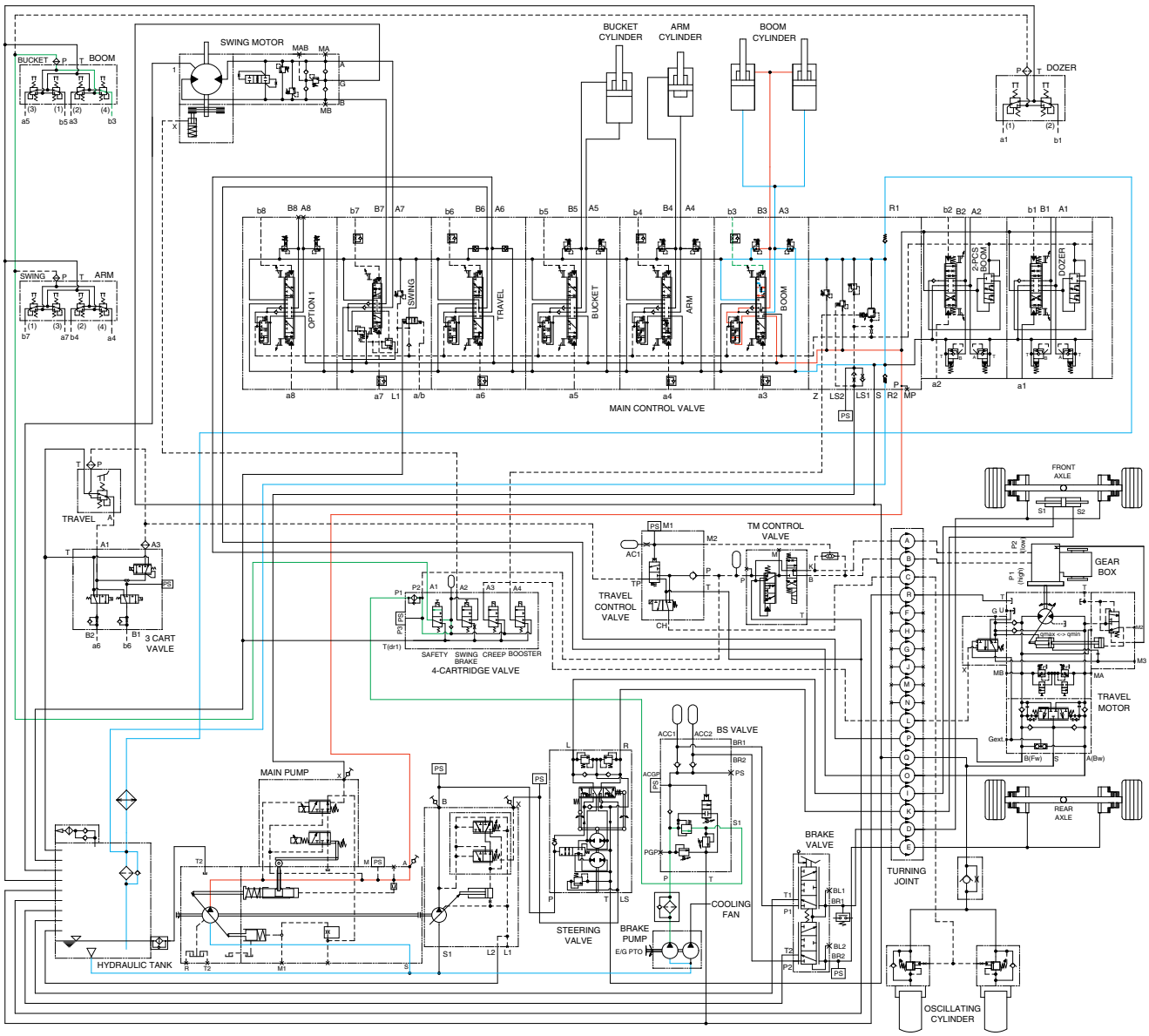
140WA3HC10

When the right control lever is pulled back, the boom spool in the main control valve is moved to the up position by the pilot oil pressure (a3) from the remote control valve.

The oil from the main 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 head side is prevented by relief valve. When the boom is up and the control lever is returned to neutral position, the circuit for the holding pressure at the head side of the boom cylinder is closed by the boom holding valve. This prevents the hydraulic drift of boom cylinders.

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

2. BOOM DOWN OPERATION



140WA3HC11

When the right control lever is pushed forward, the boom spool in the main control valve is moved to the down position by the pilot oil pressure (b3) from the remote control valve.

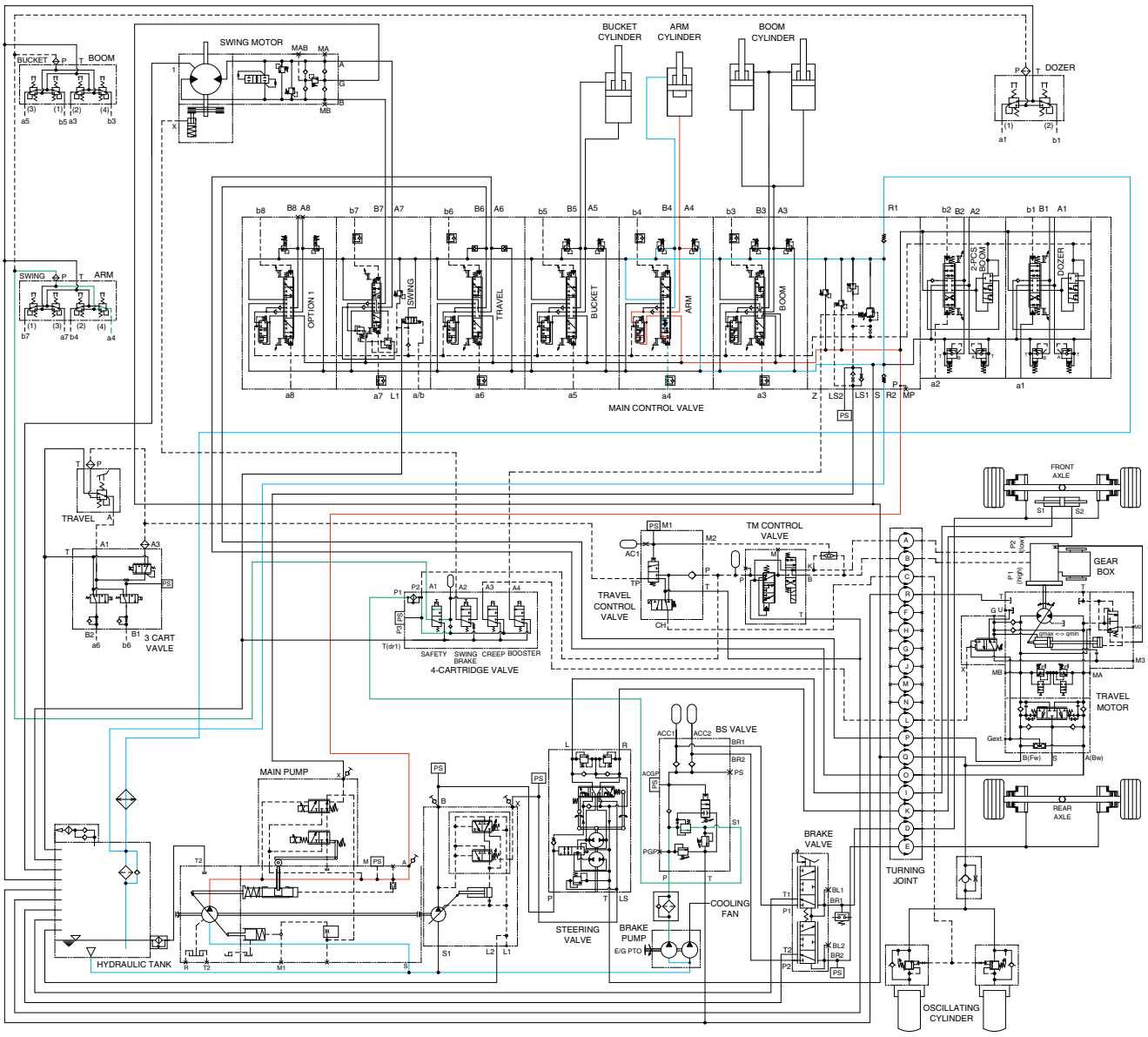
The oil from the main pump flows into the main control valve and then goes to the small chamber of boom cylinders. At the same time, the oil from the large chamber of boom cylinders returns to the hydraulic tank through the boom spool in the main control valve.

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

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

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

3. ARM IN OPERATION



140WA3HC12

When the left control lever is pulled back, the arm spool in the main control valve are moved to the arm in position by the pilot oil pressure (a4) from the remote control valve.

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

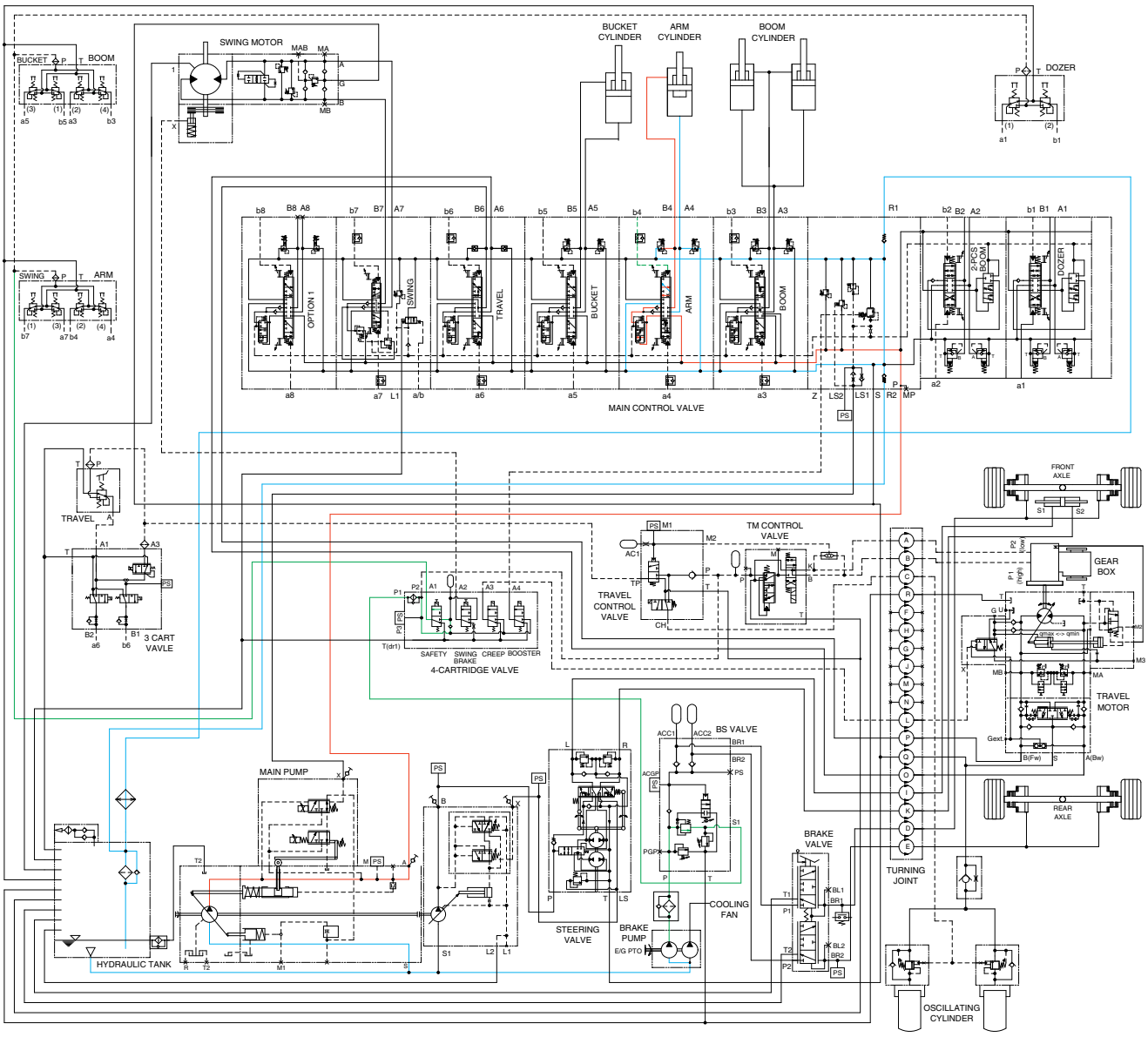
At the same time, the oil from small chamber of arm cylinder returns to the hydraulic oil tank through the arm spool in the main control valve. When this happens, the arm rolls in.

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

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

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

4. ARM OUT OPERATION



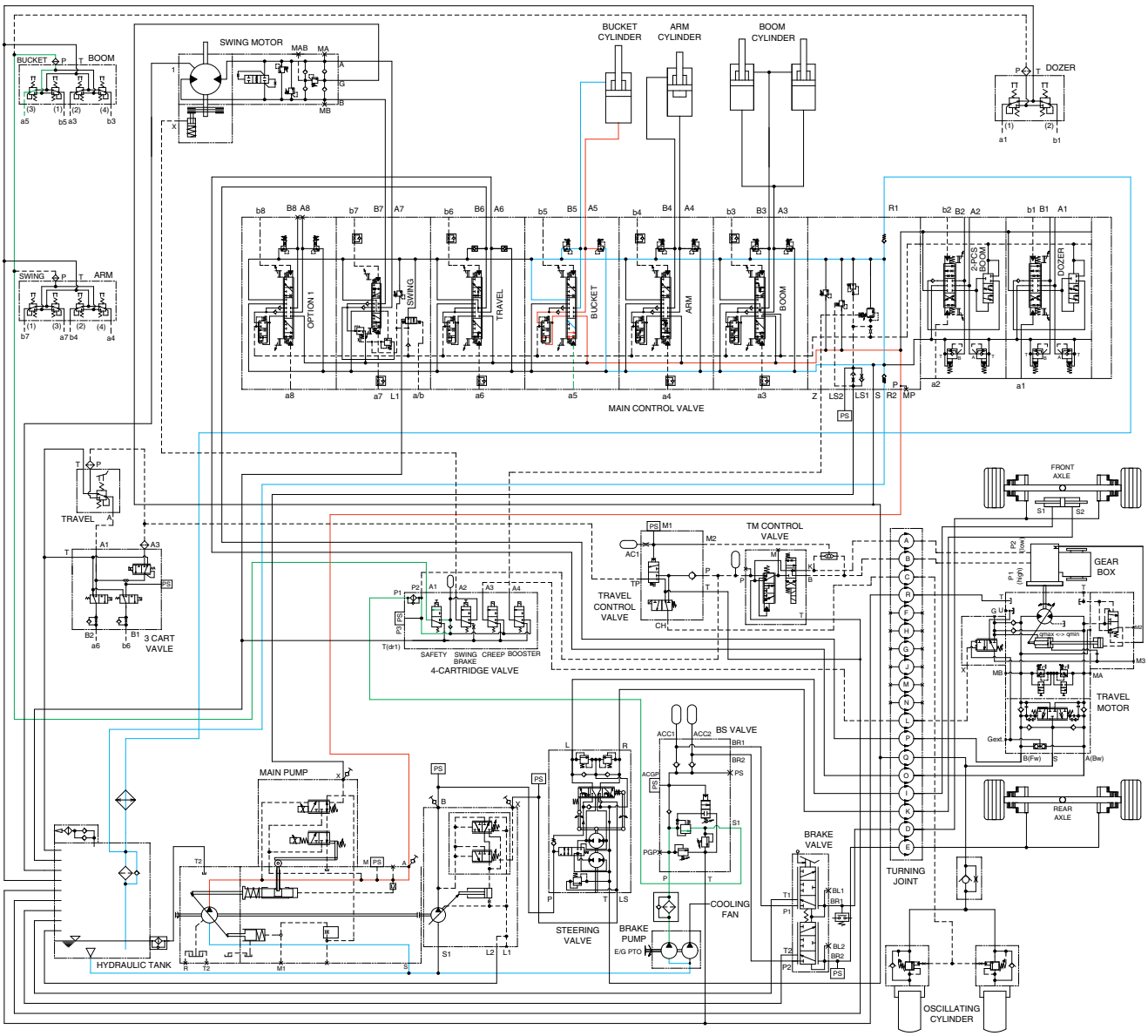
140WA3HC13

When the left control lever is pushed forward, the arm spools in the main control valve are moved to the arm out position by the pilot oil pressure (b4) from the remote control valve.

The oil from the main 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 side of the arm cylinder is also prevented by the make-up valve in the main control valve. When the arm is roll out and the control lever is returned to neutral position, the circuit for the holding pressure at the rod side of the arm cylinder is closed by the arm holding valve. This prevent the hydraulic drift of arm cylinder.

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

5. BUCKET IN OPERATION



140WA3HC14

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 (a5) from the remote control valve.

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

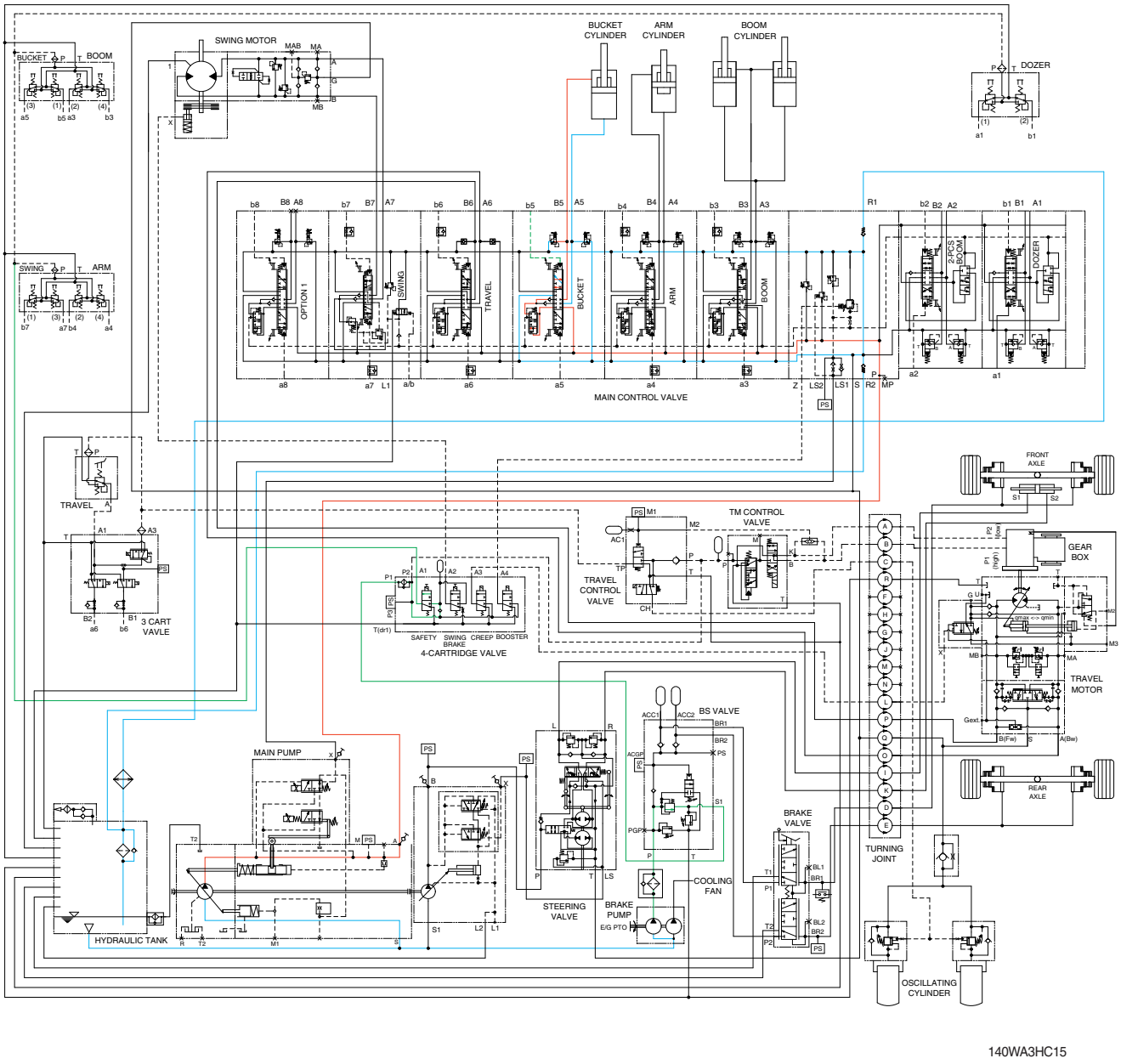
At the same time, the oil from the small chamber of bucket cylinder returns to the hydraulic oil tank through the bucket spool in the main control valve. When this happens, the bucket rolls in.

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

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

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

6. BUCKET OUT OPERATION



When the right control lever is pushed right, the bucket spool in the main control valve is moved to the bucket out position by the pilot oil pressure (b5) from the remote control valve.

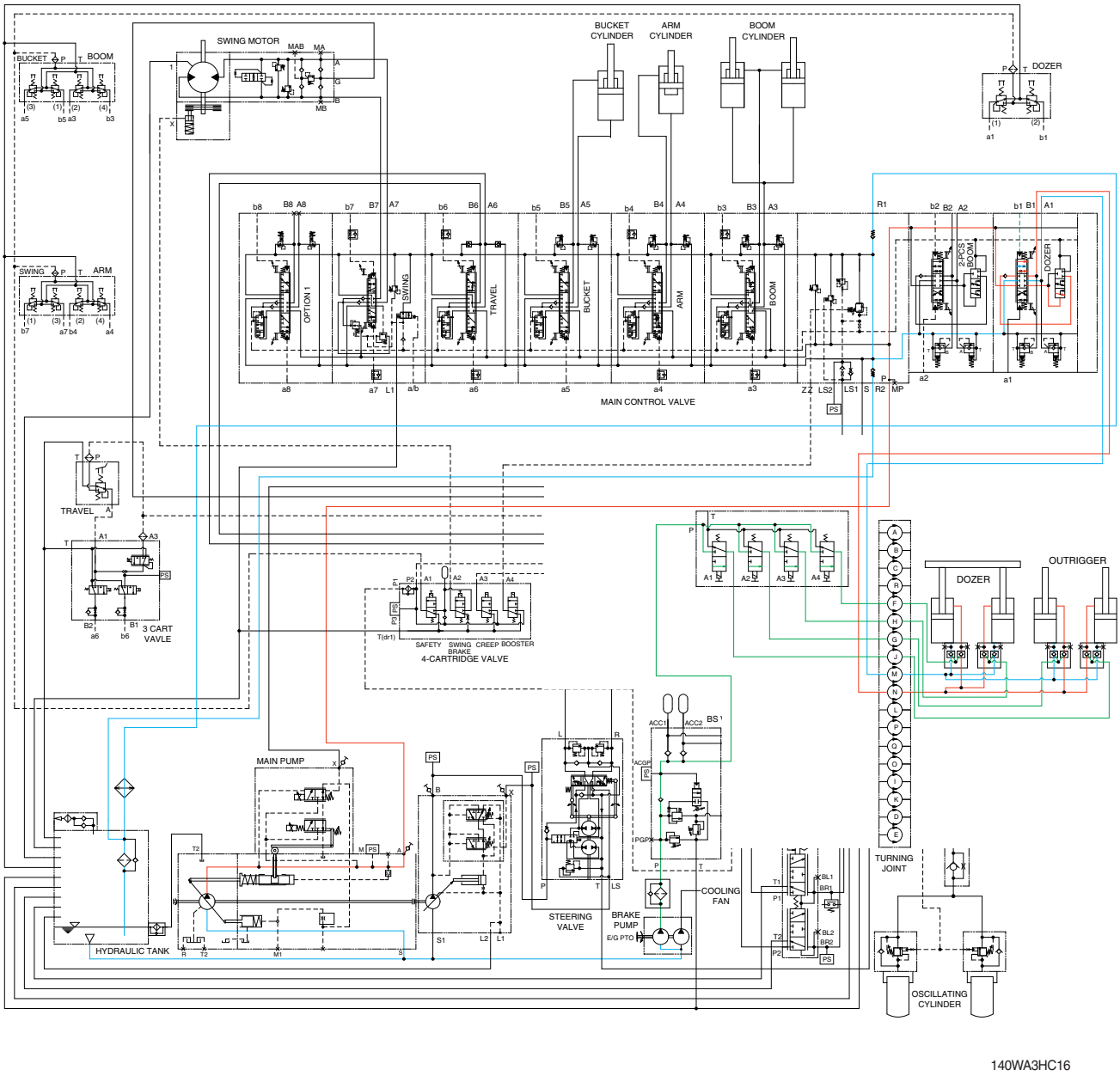
The oil from the main pump flows into the main control valve and then goes to the small chamber of bucket cylinder.

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 side of the bucket cylinder is also prevented by the make-up valve in the main control valve.

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

7. DOZER/OUTRIGGER UP OPERATION

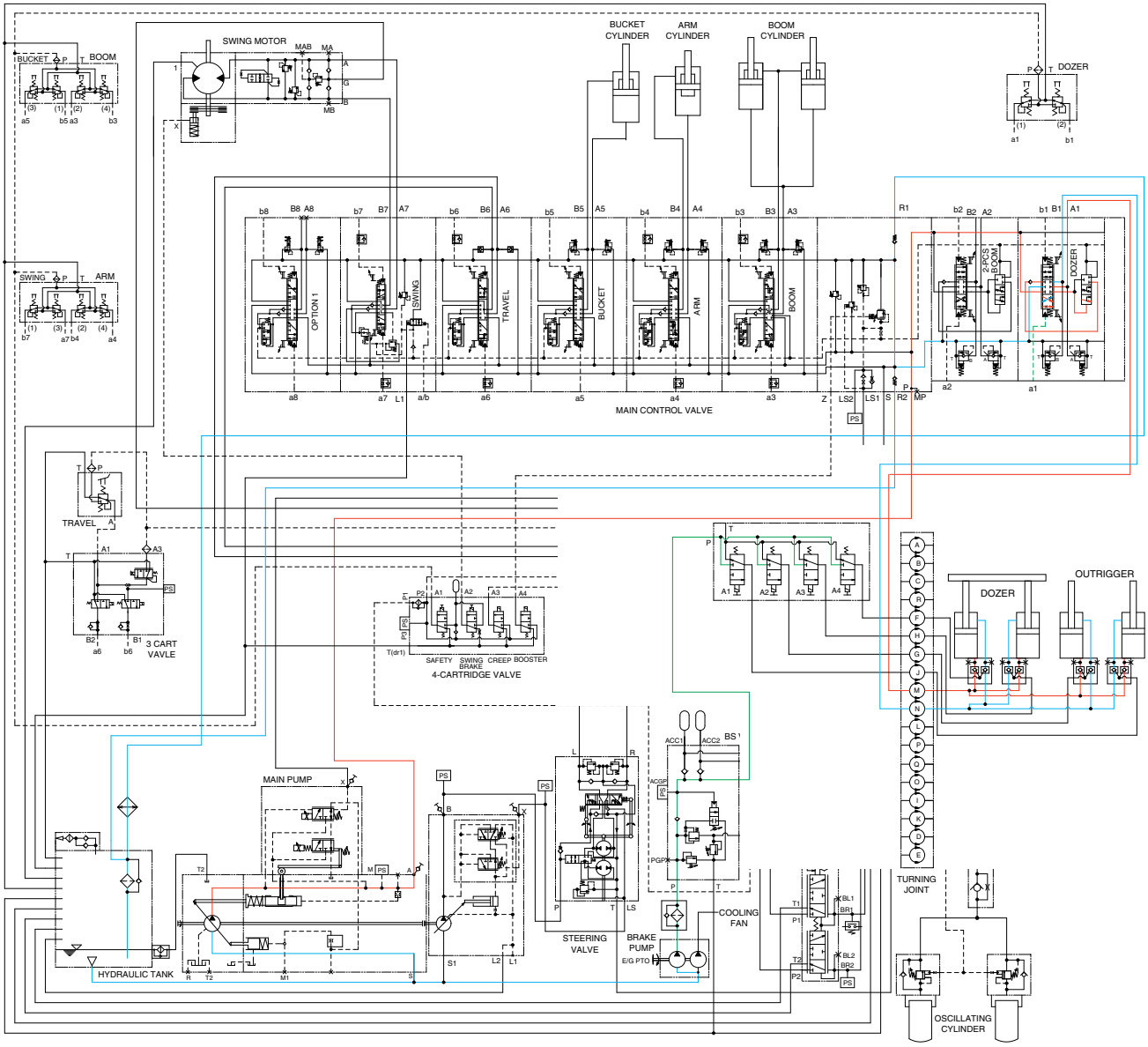


140WA3HC16

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 (b1) from the remote control valve.
The oil from the main pump flows into the main control valve and then goes to the small chamber of rear actuator cylinders (dozer or outrigger).
The other case, the oil flows into the small chamber of front actuator cylinders (dozer or outrigger).
At the same time, the oil from the large chamber of dozer (outrigger) cylinders returns to the hydraulic oil tank through the dozer spool in the main control valve. When this happens, the dozer (outrigger) goes up.

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

8. DOZER/OUTRIGGER DOWN OPERATION

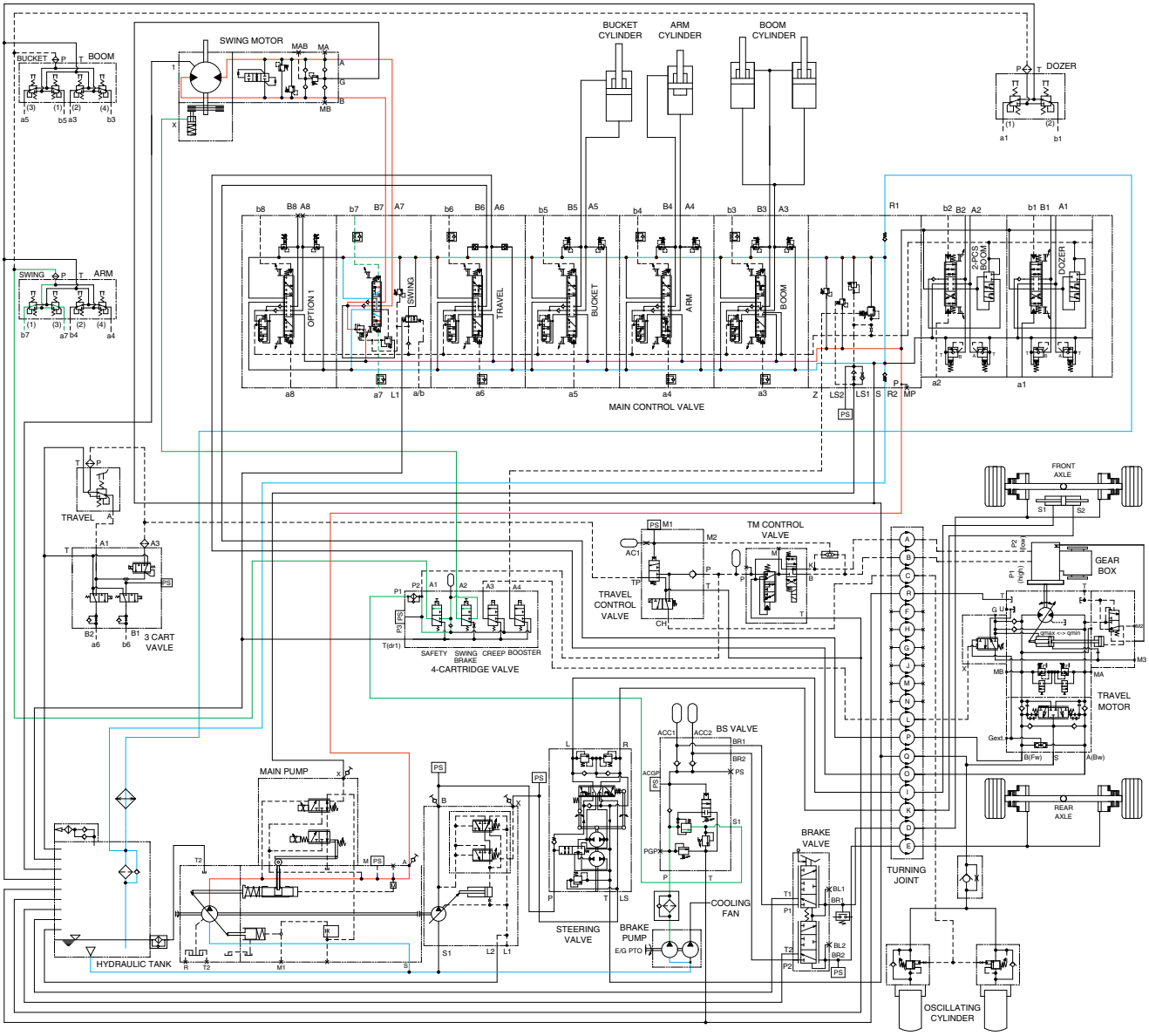


140WA3HC17

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 (a1) from the remote control valve.
The oil from the main pump flows into the main control valve and then goes to the large chamber of rear actuator cylinders (dozer or outrigger).
The other case, the oil flows into the large chamber of front actuator cylinders (dozer or outrigger).
At the same time, the oil from the small chamber of dozer (outrigger) cylinders returns to the hydraulic oil tank through the dozer spool in the main control valve. When this happens, the dozer (outrigger) goes down.

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

9. SWING OPERATION

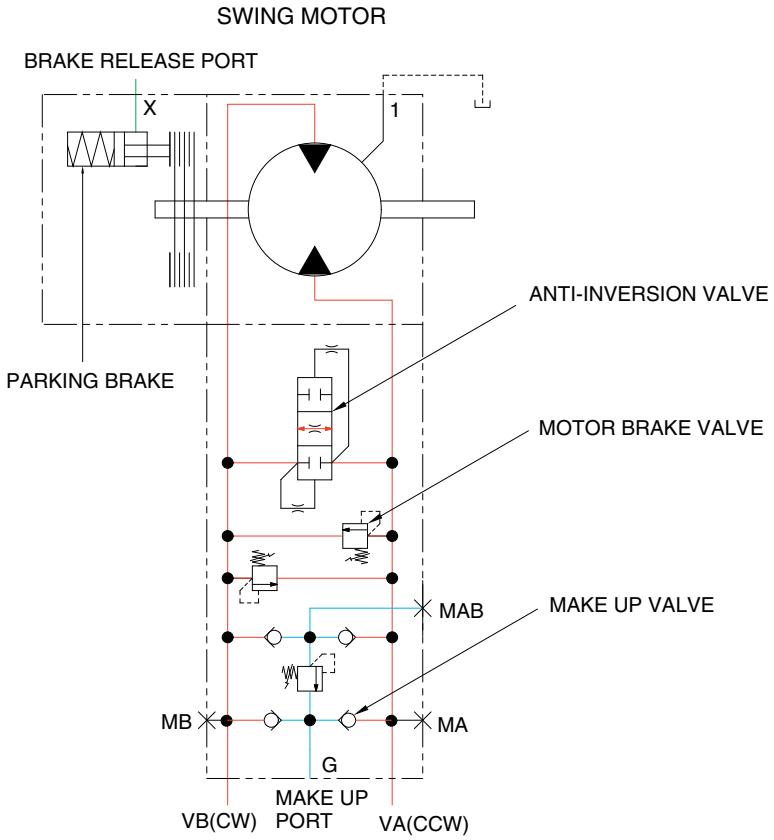


140WA3HC18

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 (a7 or b7) from the remote control valve.
The oil from the main pump flows into the main control valve and then goes to the swing motor.
At the same time, the return oil from the swing motor returns to the hydraulic oil tank through the swing spool in the main control valve.
When this happens, the upper structure swings to the left or right.
The swing parking brake, make up valve and the motor brake valve are provided in the swing motor.
The cavitation which will happen to the swing motor is also prevented by the make up valve in the swing motor itself.

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

SWING CIRCUIT OPERATION



140WA3HC19

1) MOTOR BRAKE VALVE

Motor brake valve for the swing motor limits to cushion the starting and stopping pressure of swing operation and controls the swing motor operating pressure to 270 kgf/cm^2 (3840 psi).

2) MAKE UP VALVE

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

3) PARKING BRAKE

This is function as a parking brake only when the swing control lever and arm in control lever are not operated.

PARKING BRAKE "OFF" OPERATION

When any of the swing or arm in control lever is tilted, the swing brake solenoid valve is energized by the MCU that senses the swing pilot oil pressure.

The discharged oil from brake pump flows to swing motor X port through the swing brake solenoid valve. This pressure is applied to swing parking brake piston, thus the brake is released.

PARKING BRAKE "ON" OPERATION

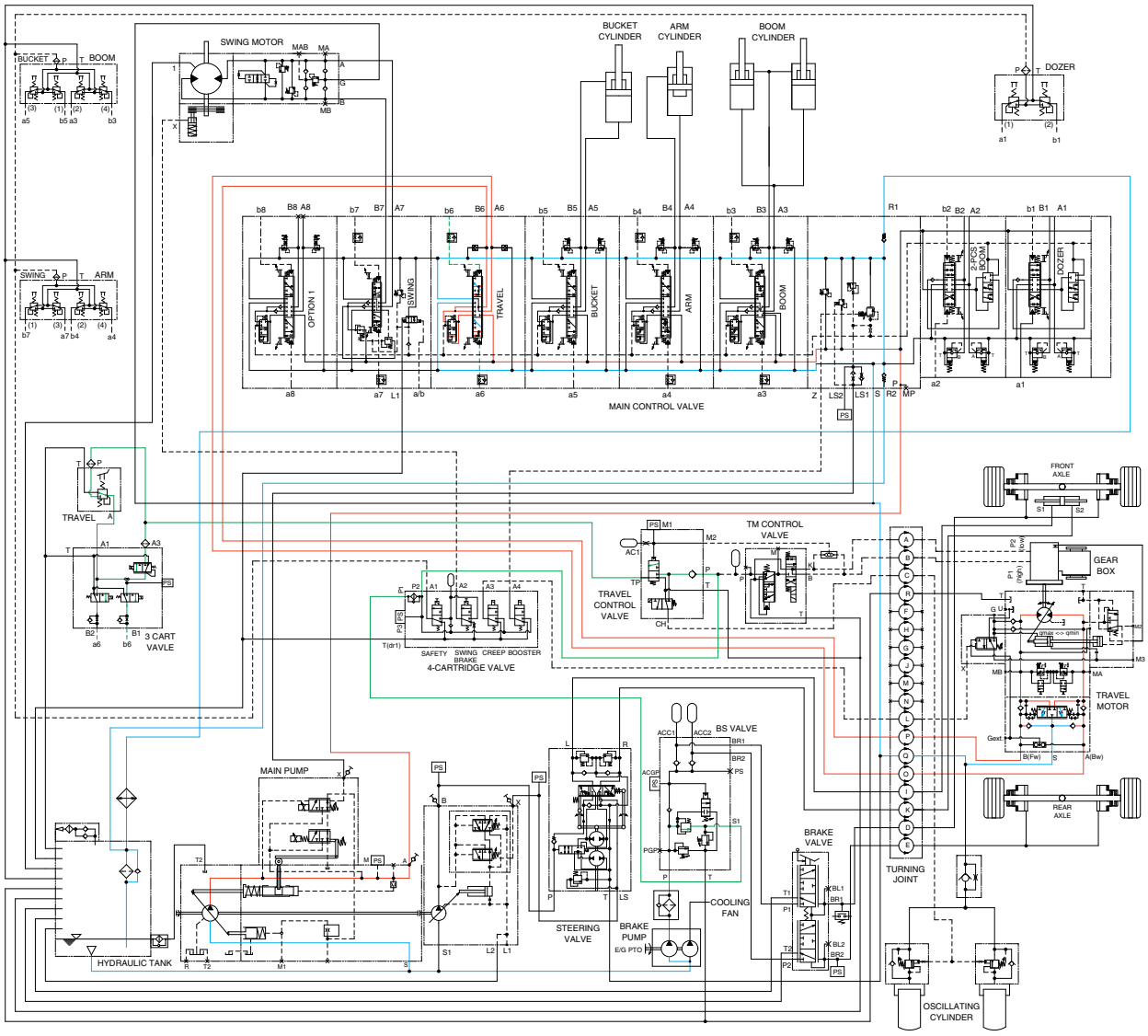
When the swing and arm in control levers are set in the neutral position, the swing brake solenoid valve is de-energized, oil in the swing parking brake chamber is drained through the the swing brake solenoid valve, thus the brake is applied by spring force.

4) ANTI-INVERSION VALVE

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

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

10. TRAVEL FORWARD AND REVERSE OPERATION



140WA3HC20

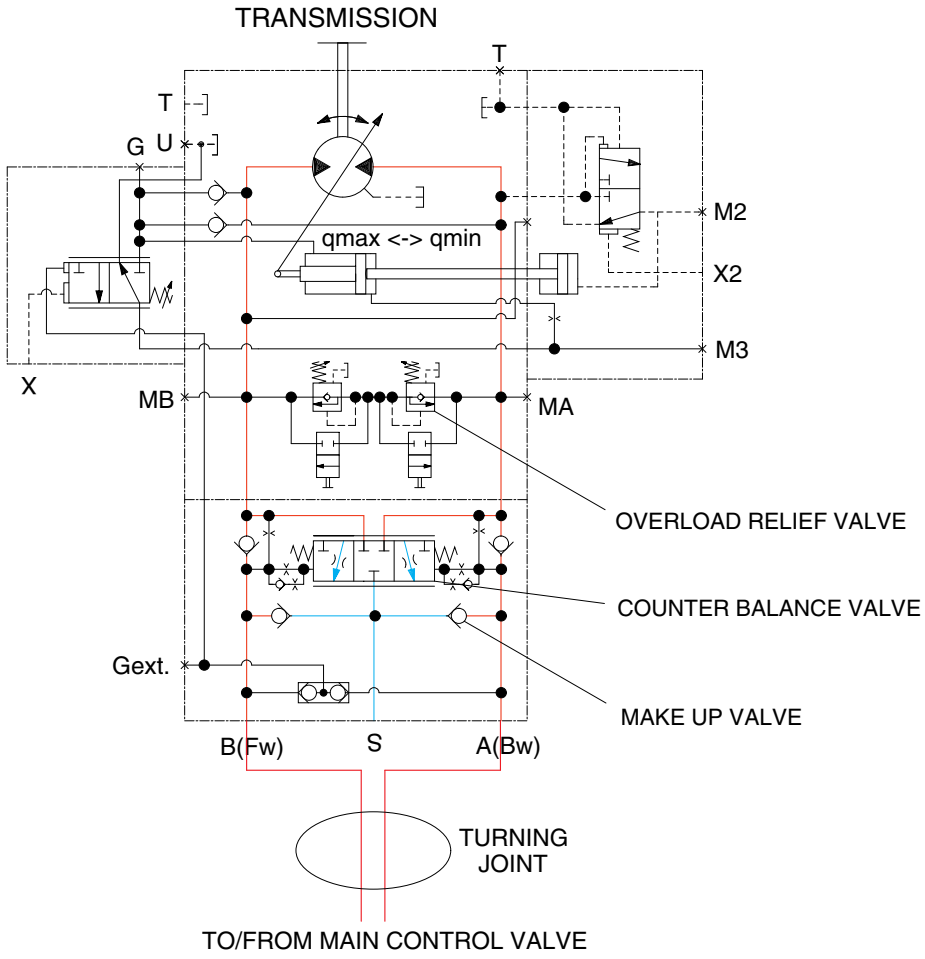
When the FNR switch of the RH RCV lever is placed in forward or reverse position, the travel spool in the main control valve is moved to the forward or reverse position by the pilot oil pressure (a6 or b6) from brake pump through the travel pilot solenoid valve of travel control valve. The oil from the main pump flows into the main control valve and then goes to the travel motor. At the same time, the oil returned from the travel motor returns to the hydraulic oil tank through the turning joint and travel spool in the main control valve.

When this happens, the machine moves forward or reverse.

The cavitation which will happen to the travel motor is prevented by the make-up valves in the main control valve and make up valves in the travel motor itself.

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

TRAVEL CIRCUIT OPERATION



140WA3HC21

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

1) COUNTER BALANCE VALVE

When stopping the motor on a slope descending, this valve prevents the motor from over running.

2) OVERLOAD RELIEF VALVE

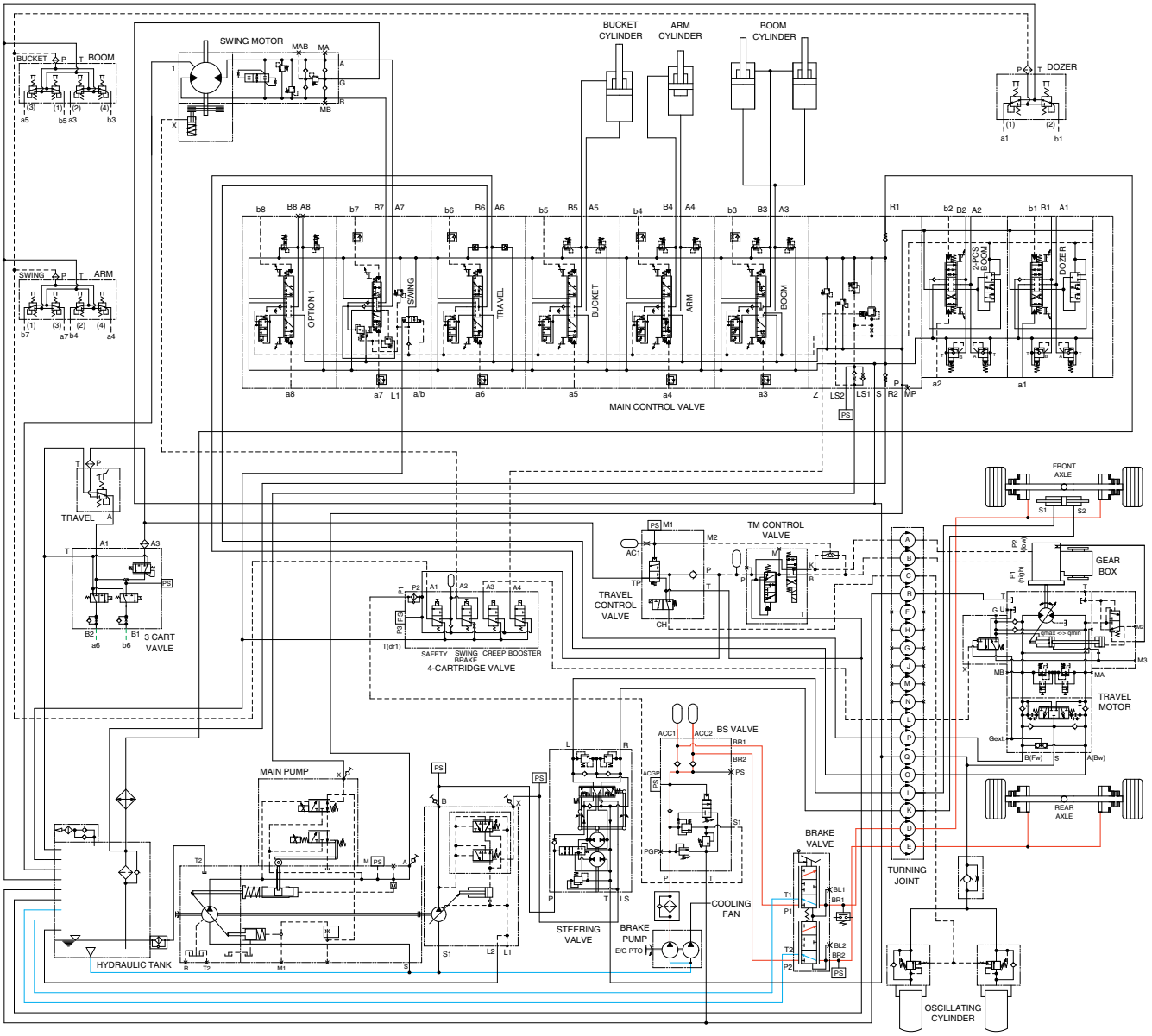
Relief valve limits the circuit pressure below 380 kgf/cm^2 to prevent high pressure from being generated at the time of stopping the machine. When stopping the motor, this valve sucks the oil from lower pressure passage for preventing the negative pressure and the cavitation of the motor.

3) MAKE UP VALVE

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

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

11. FRONT AND REAR AXLE BRAKE SYSTEM (SERVICE BRAKE)

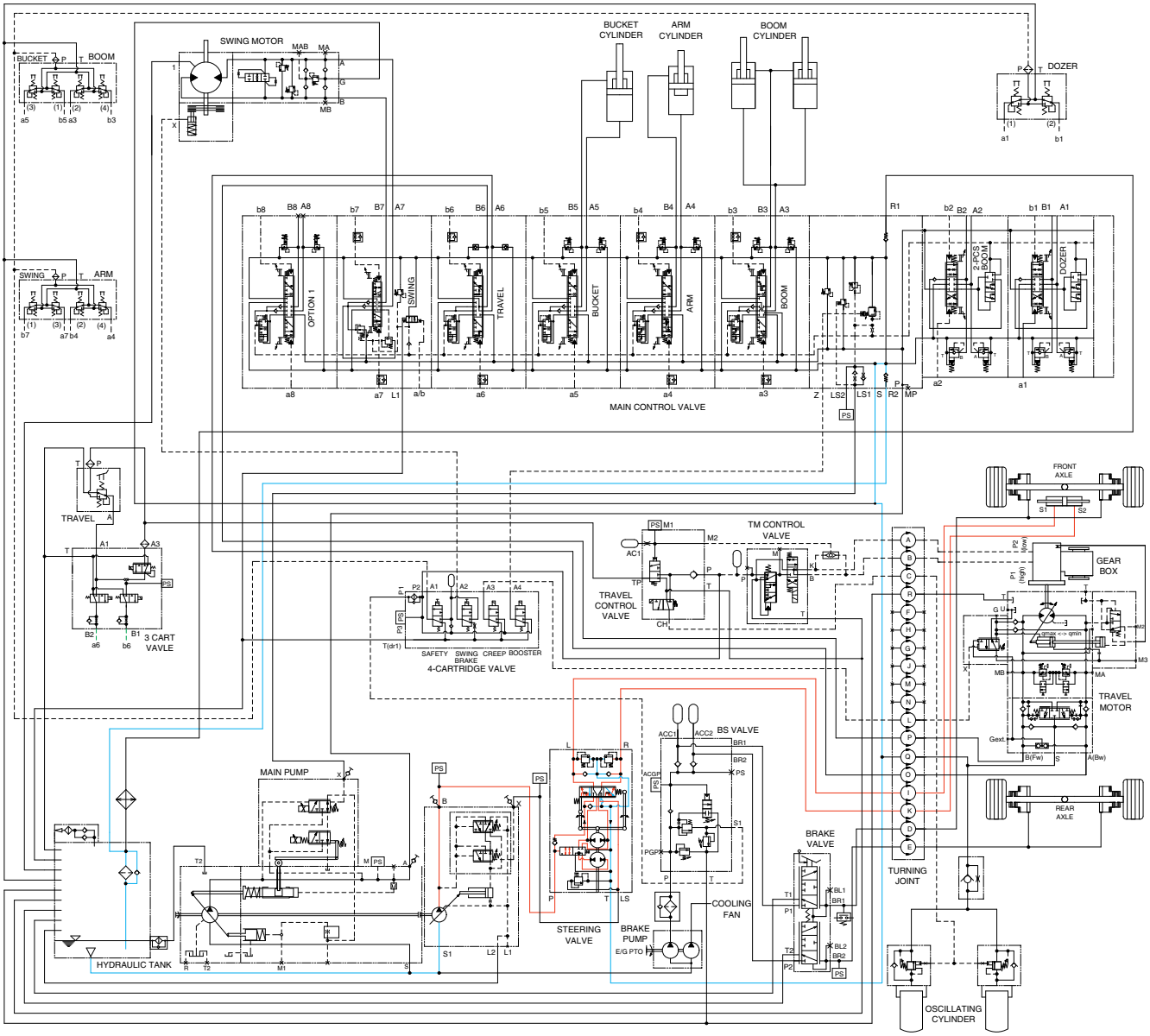


140WA3HC22

When the brake pedal (valve) is pushed, the discharged oil from the brake pump (P2) flows into the front and rear axle brake disc through the brake supply valve.
This pressure is applied to axle brake disc, thus the brake is applied.

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

12. STEERING CIRCUIT OPERATION



140WA3HC23

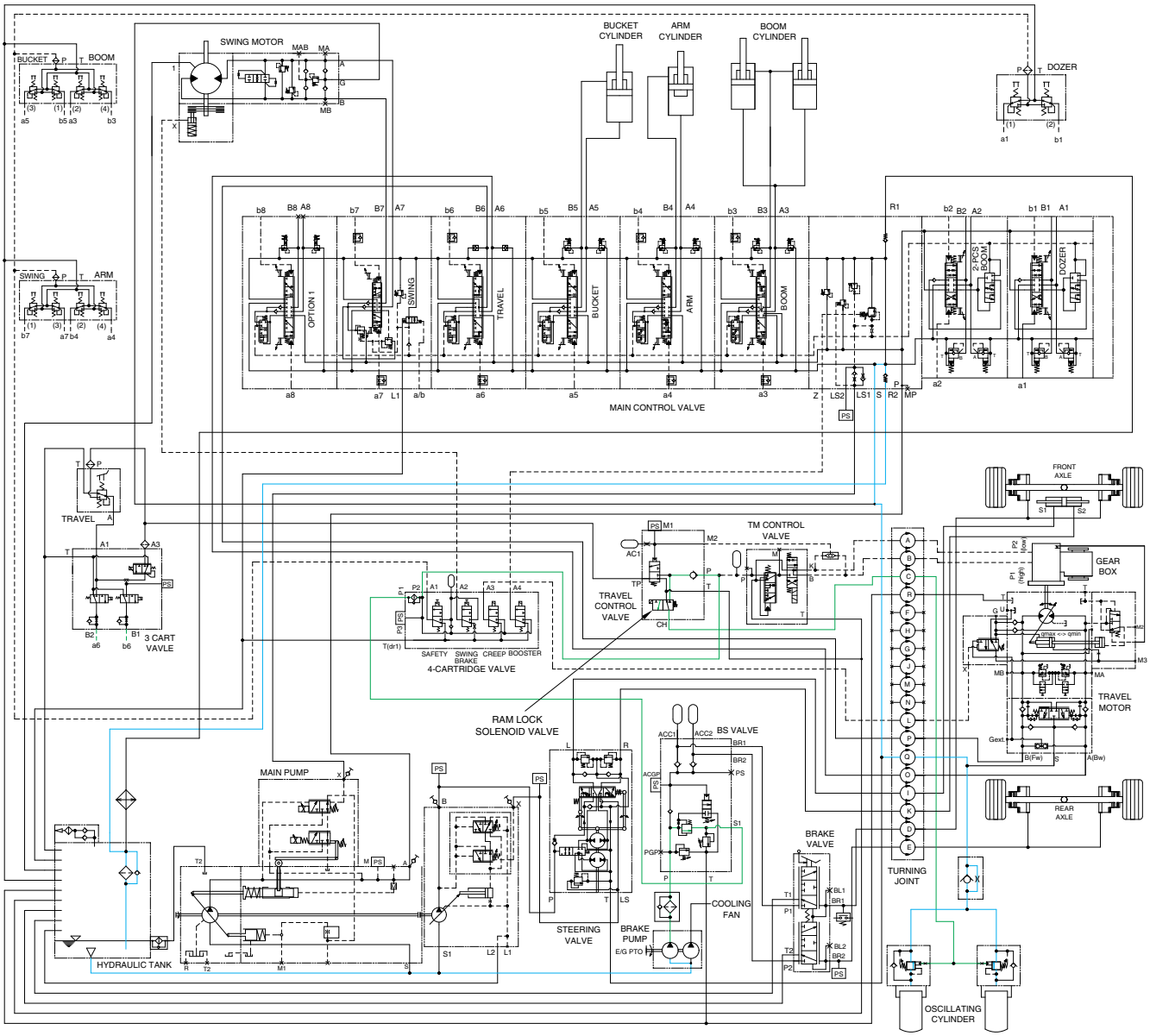
When the steering wheel is turned to the left or right, the spool within the steering valve turns left or right hand direction : Because the spool is connected with steering column.

At this time, the oil discharged from the steering pump flows into steering cylinder through spool and gerotor within the steering valve.

Then the steering direction is applied.

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

13. RAM LOCK CIRCUIT OPERATION



140WA3HC24

When the ram lock rotary switch on the dashboard of the steering column is selected OFF position, the ram lock solenoid valve is changed over.

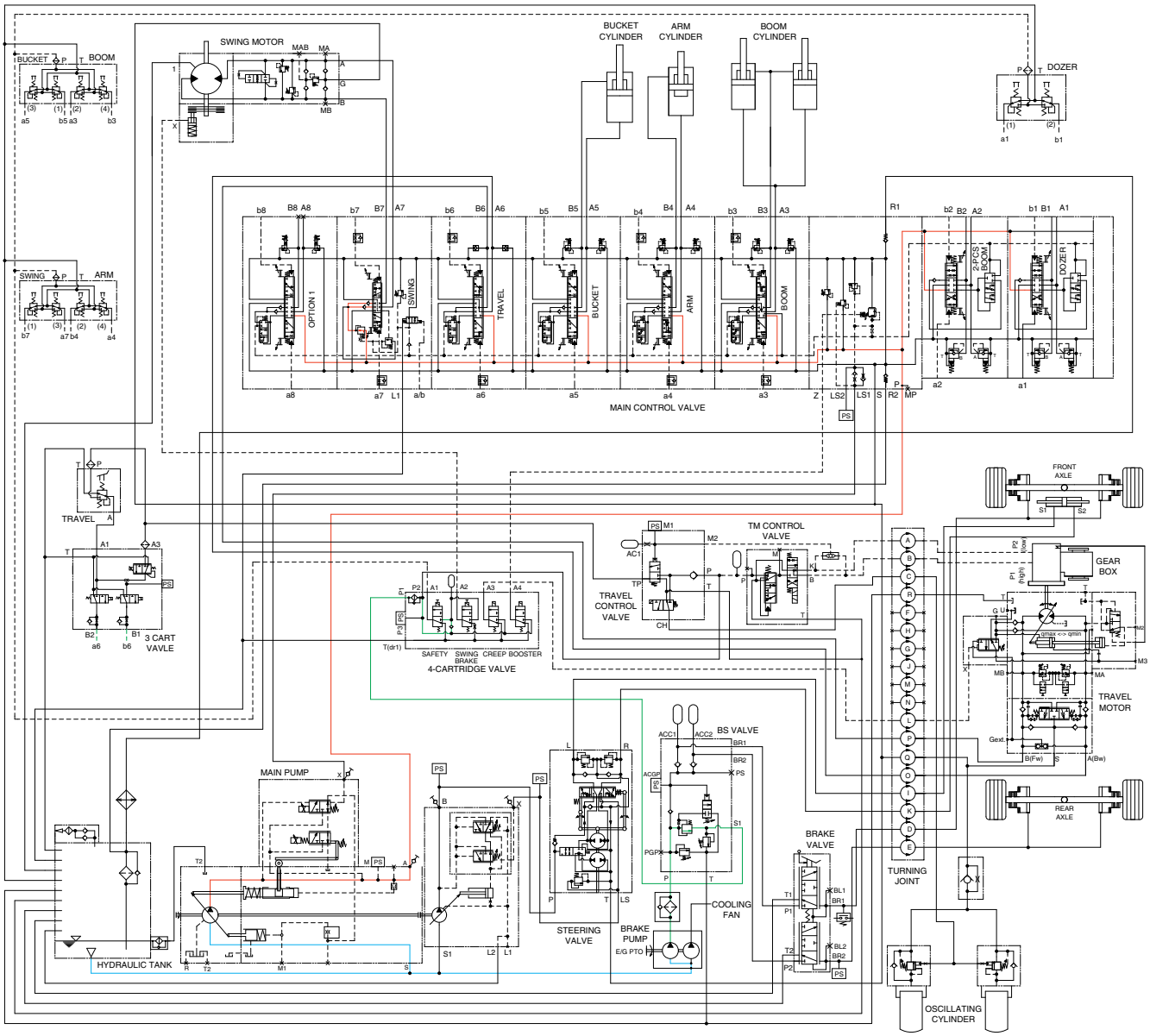
Thus, the oil discharged from the brake pump flows into oscillating cylinder through ram lock solenoid and locking valve.

This pressure is applied to check valve and oscillating cylinder, thus the oscillating function is operated (Ram lock released).

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

GROUP 5 COMBINED OPERATION

1. OUTLINE

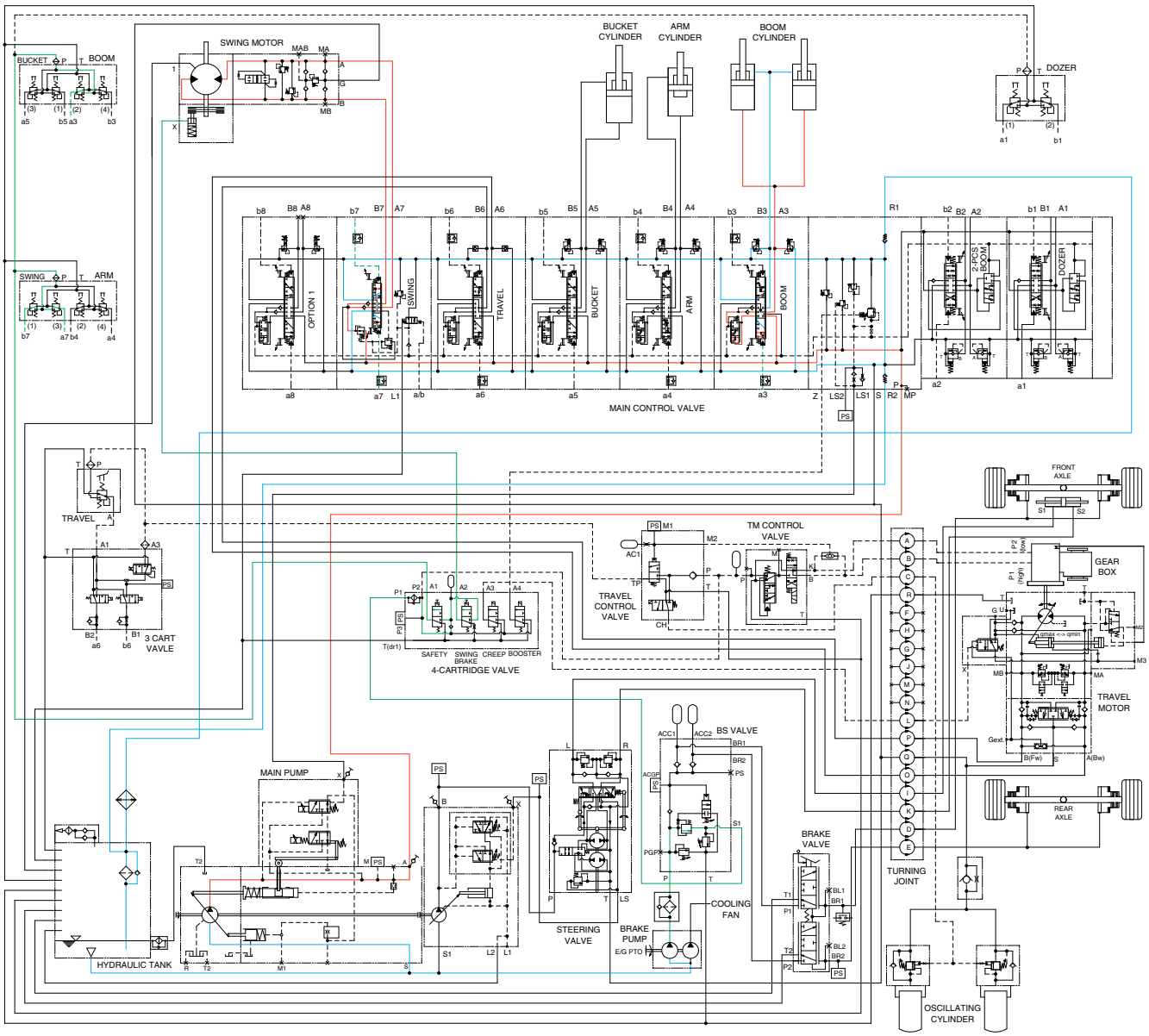


140WA3HC30

The oil from the main pump flows through the parallel 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.

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

2. COMBINED SWING AND BOOM UP OPERATION



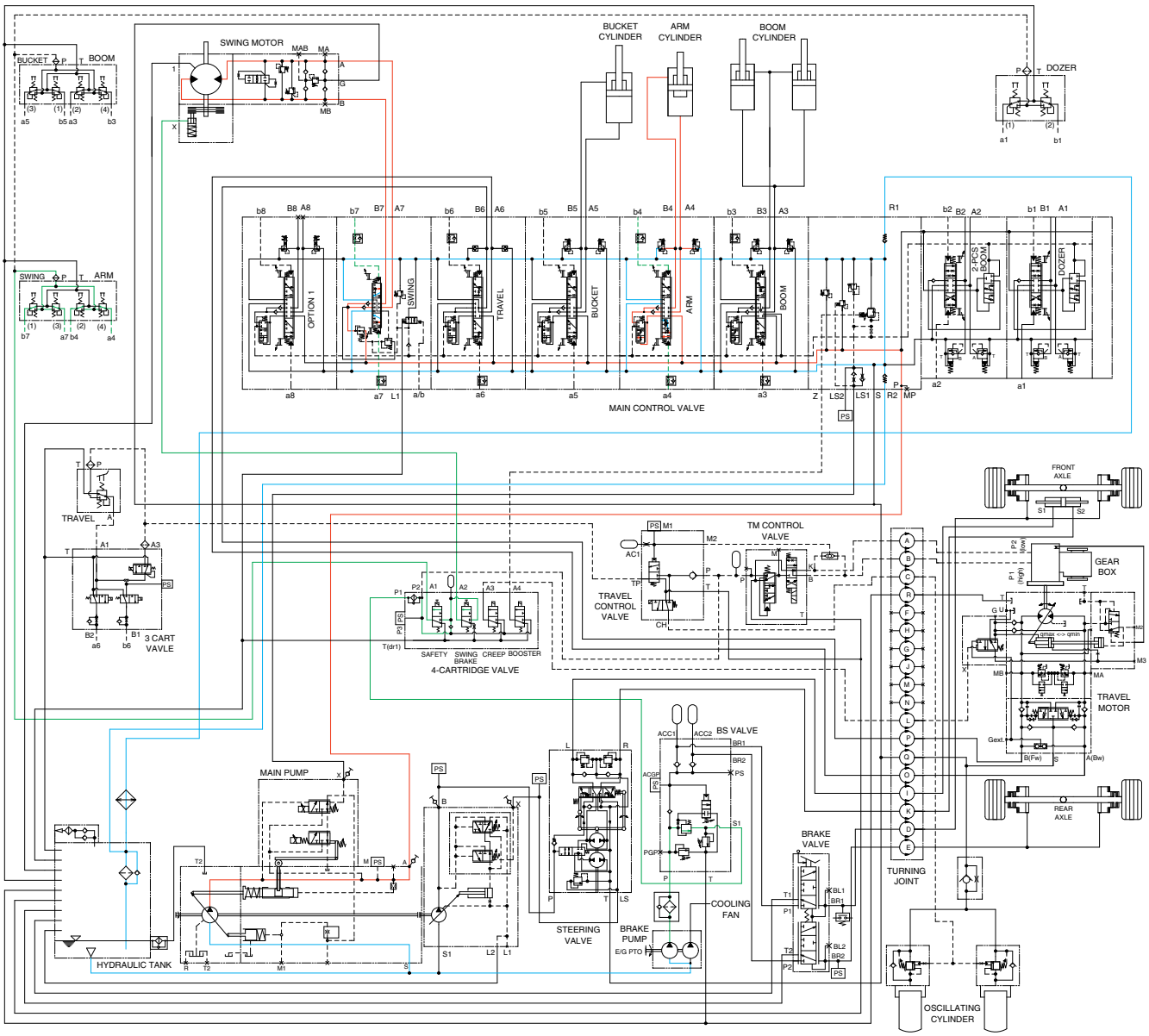
When the swing and boom up functions are operated, simultaneously the swing spool and boom spool in the main control valve are moved to the functional position by the pilot oil pressure (a7, b7, a3) from the remote control valve.

The oil from the main pump flows into the swing motor through swing spool and flows into the boom cylinders through the boom spool via the parallel passage.

The upper structure swings and the boom goes up.

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

3. COMBINED SWING AND ARM OPERATION



140WA3HC32

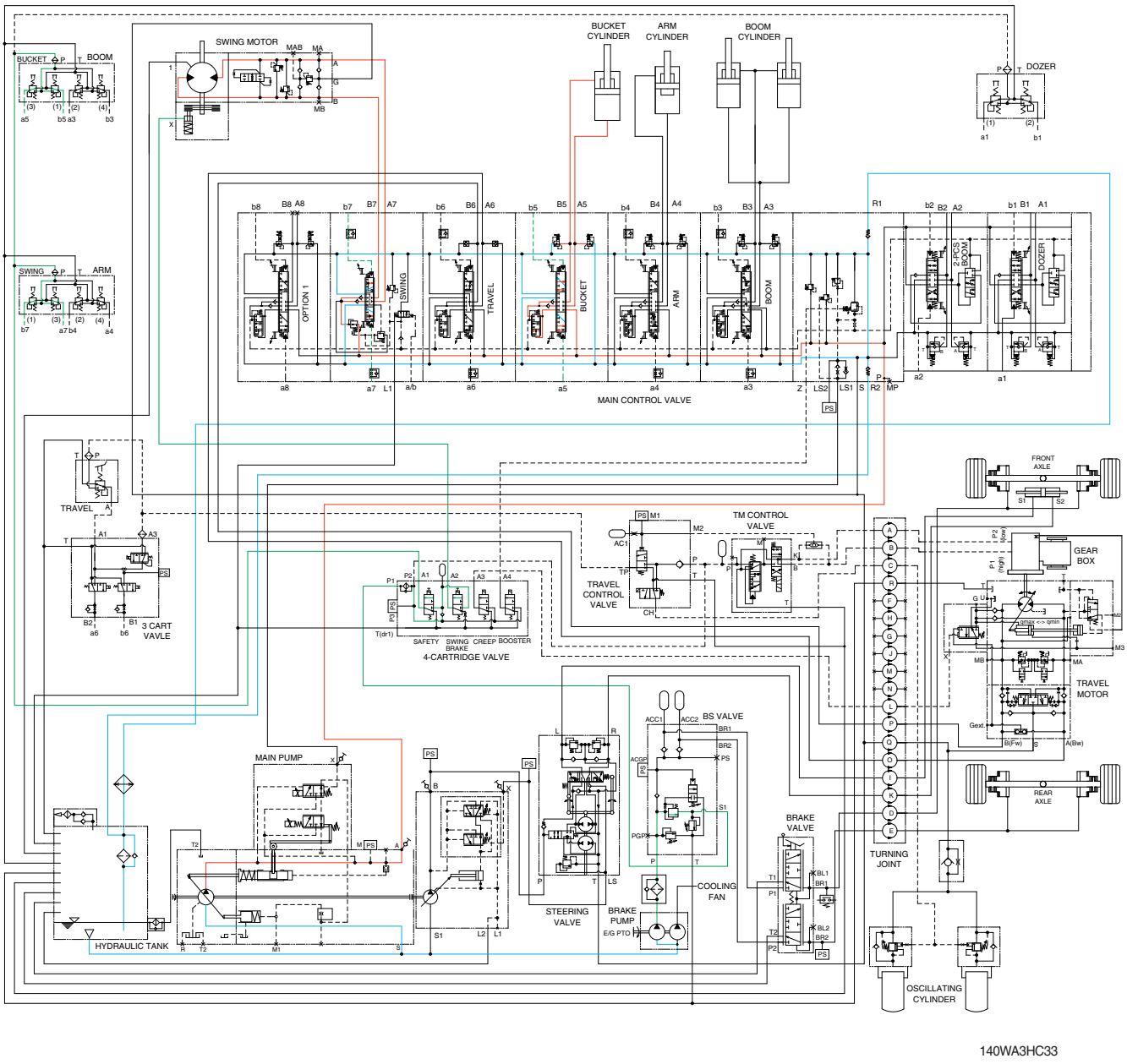
When the swing and arm functions are operated, simultaneously the swing spool and arm spool in the main control valve are moved to the functional position by the pilot oil pressure (a7, b7, a4, b4) from the remote control valve.

The oil from the main pump flows into the swing motor through swing spool and flows into the arm cylinder through the arm spool via the parallel passage.

The upper structure 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



140WA3HC33

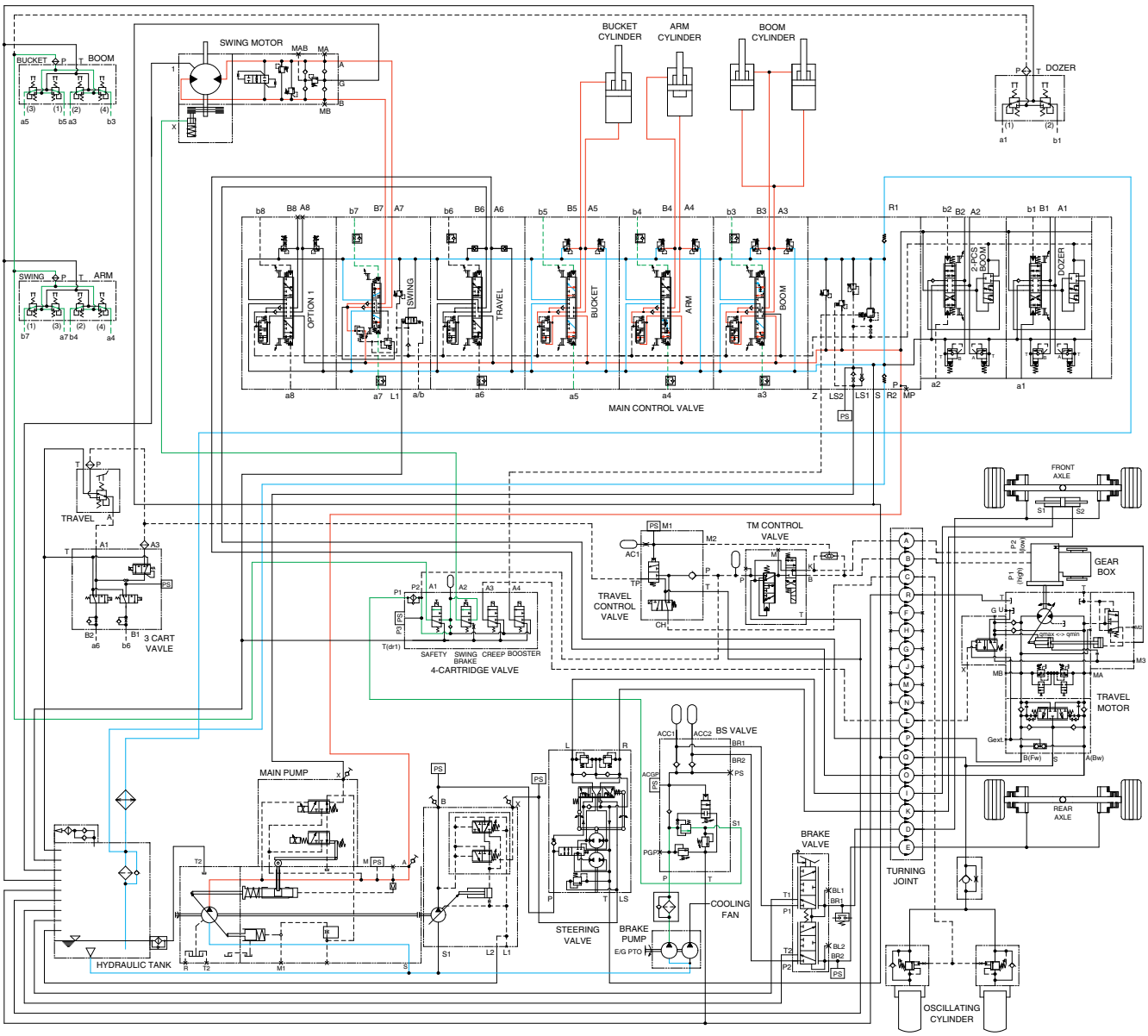
When the swing and bucket functions are operated, simultaneously the swing spool and bucket spool in the main control valve are moved to the functional position by the pilot oil pressure (a7, b7, a5, b5) from the remote control valve.

The oil from the main pump flows into the swing motor through the swing spool and flows into the bucket cylinder through the bucket spool via the parallel passage.

The upper structure swings and the bucket is operated.

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

5. COMBINED SWING, BOOM, ARM AND BUCKET OPERATION



140WA3HC34

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 (a7, b7, a3, b3, a4, b4, a5, b5) from the remote control valve.

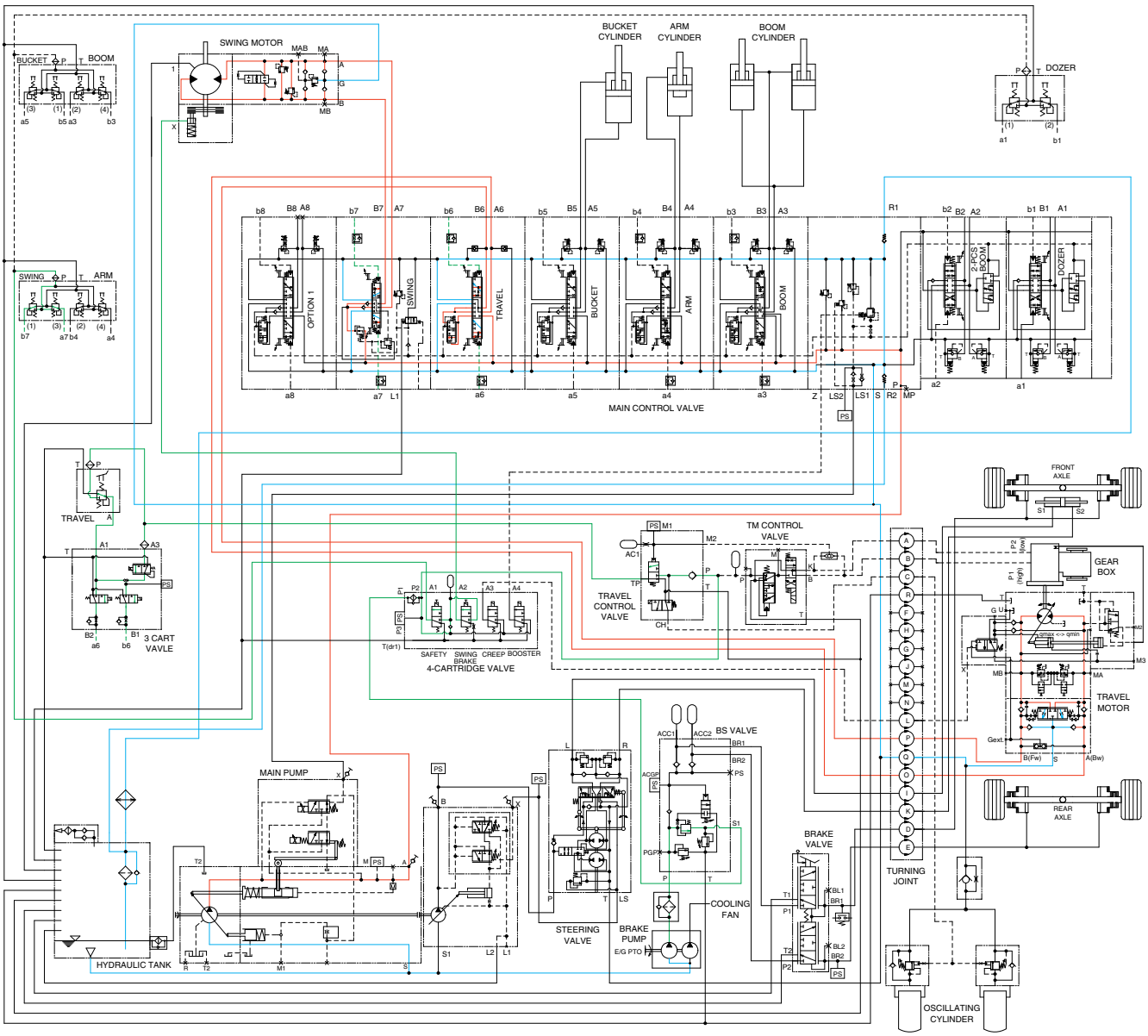
The oil from the main pump flows into the boom cylinder, arm cylinder and bucket cylinder through the boom spool, arm spool, bucket spool via the parallel passage.

Also, the oil flows into the swing motor through the swing spool via the parallel passage.

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



140WA3HC35

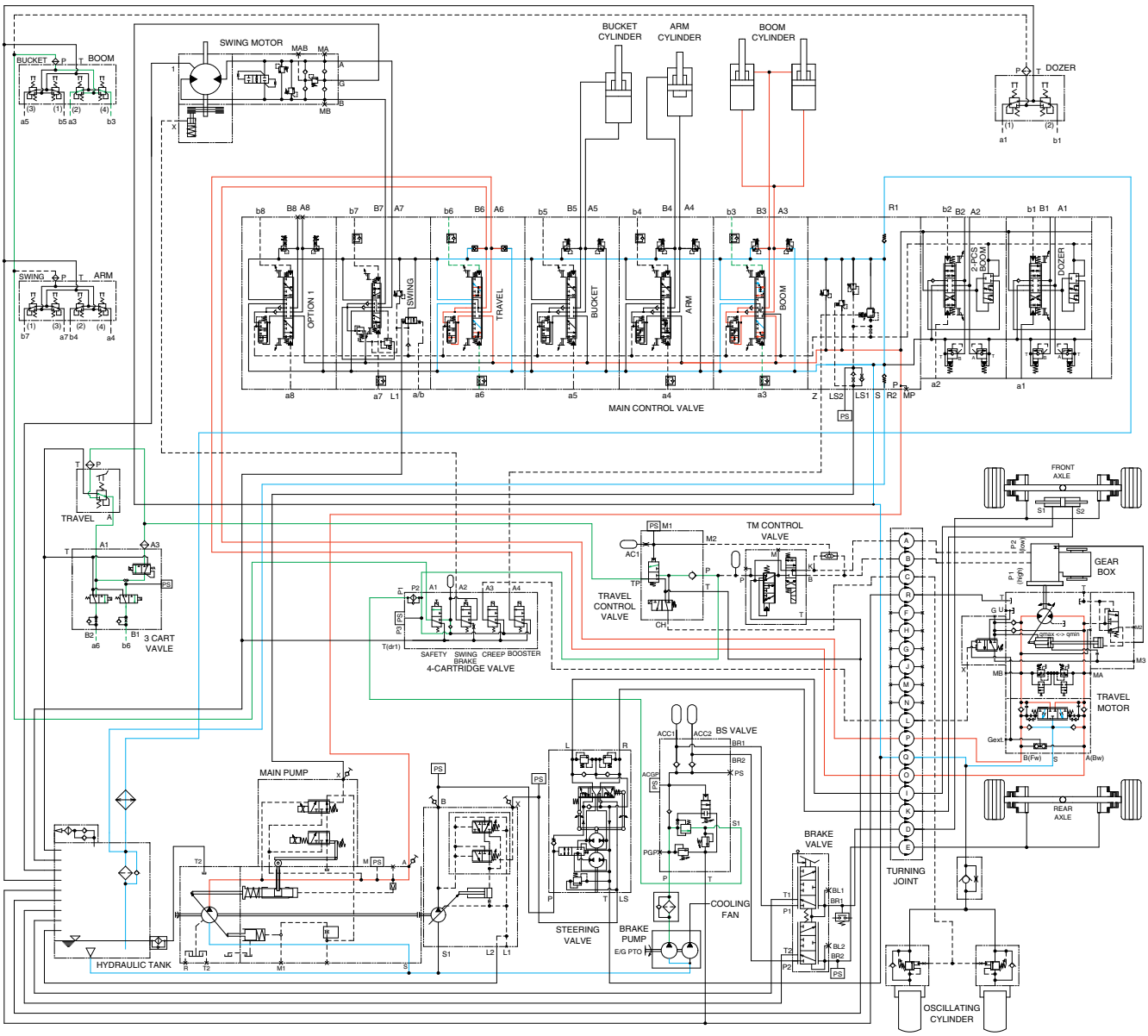
When the swing and travel functions are operated, simultaneously the swing spool and travel spool in the main control valve are moved to the functional position by the pilot oil pressure (a7, b7, a6, b6) from the remote control valve.

The oil from the main pump flows into the swing motor and travel motor through the swing spool and travel spool via the parallel passage.

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



140WA3HC36

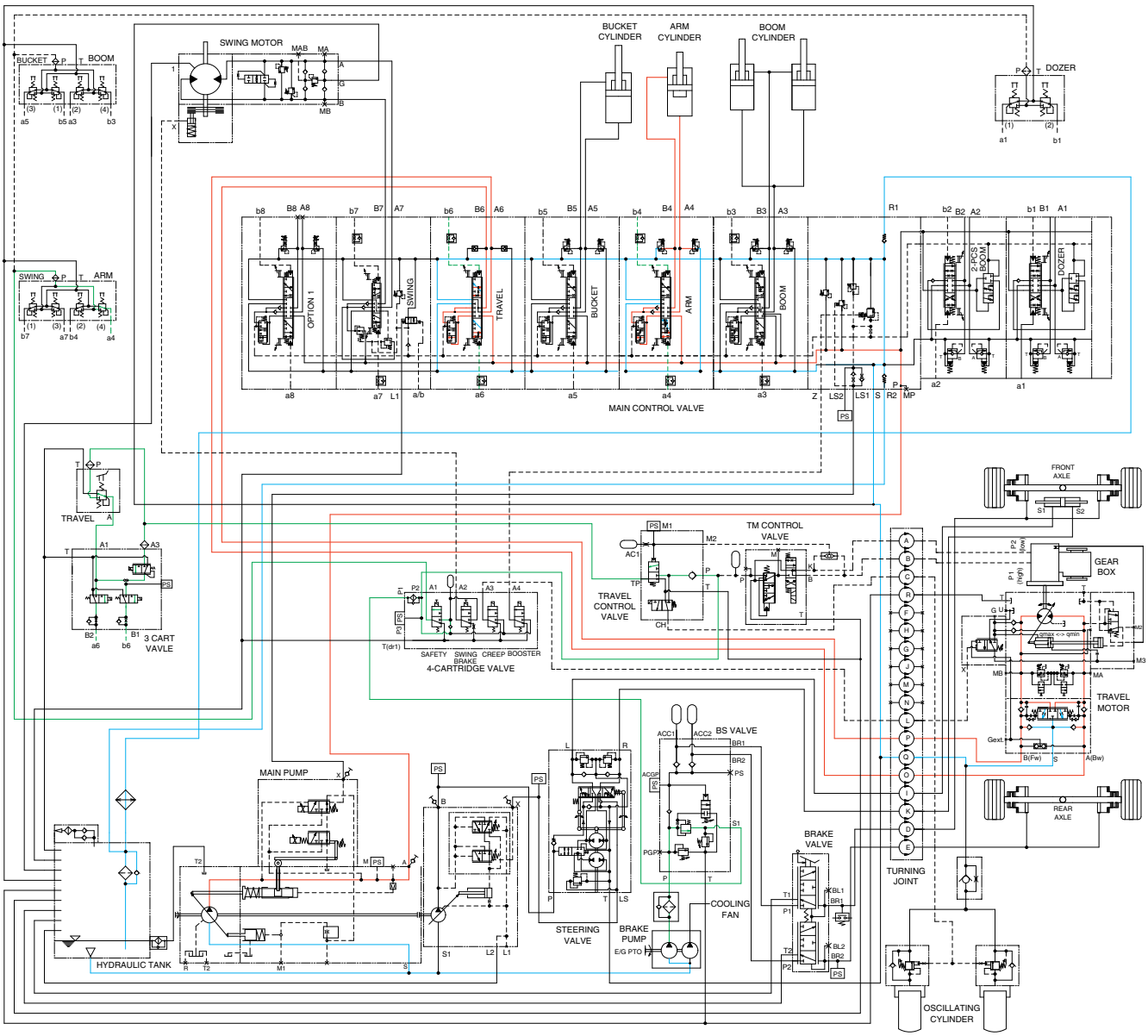
When the boom and travel functions are operated, simultaneously the boom spool and travel spool in the main control valve are moved to the functional position by the pilot oil pressure (a3, b3, a6, b6) from the remote control valve.

The oil from the main pump flows into the boom cylinder and the travel motor through, boom and travel spool via the parallel passage.

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



140WA3HC37

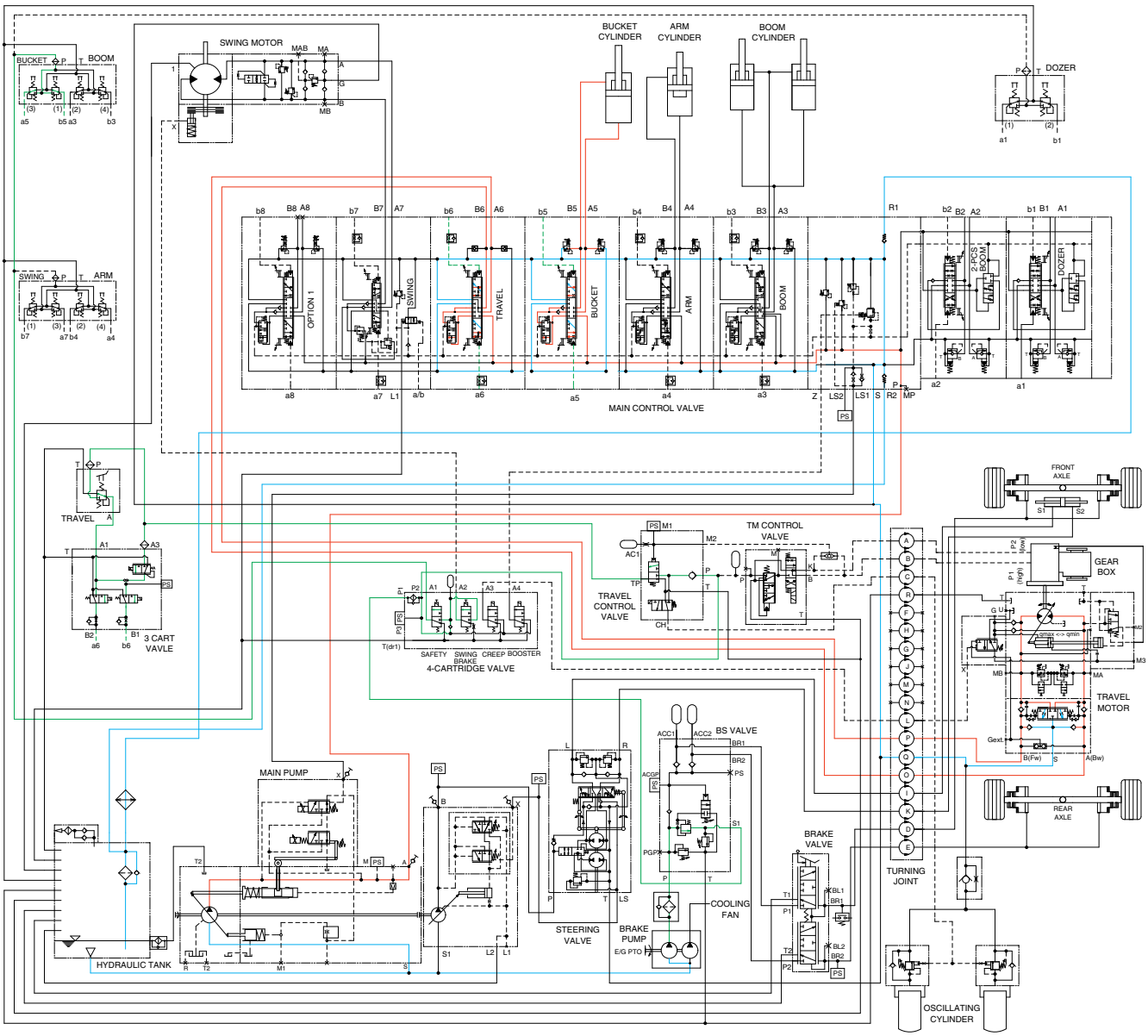
When the arm and travel functions are operated, simultaneously the arm spool and travel spool in the main control valve are moved to the functional position by the pilot oil pressure (a4, b4, a6, b6) from the remote control valve.

The oil from the main pump flows into the travel motor and the arm cylinder through travel spool and arm spool via the parallel passage.

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



140WA3HC38

When the bucket and travel functions are operated, simultaneously the bucket spool and travel spool in the main control valve are moved to the functional position by the pilot oil pressure (a5, b5, a6, b6) from the remote control valve.

The oil from the main pump flows into the travel motor and the bucket cylinder through the travel spool and the bucket spool via the parallel passage.

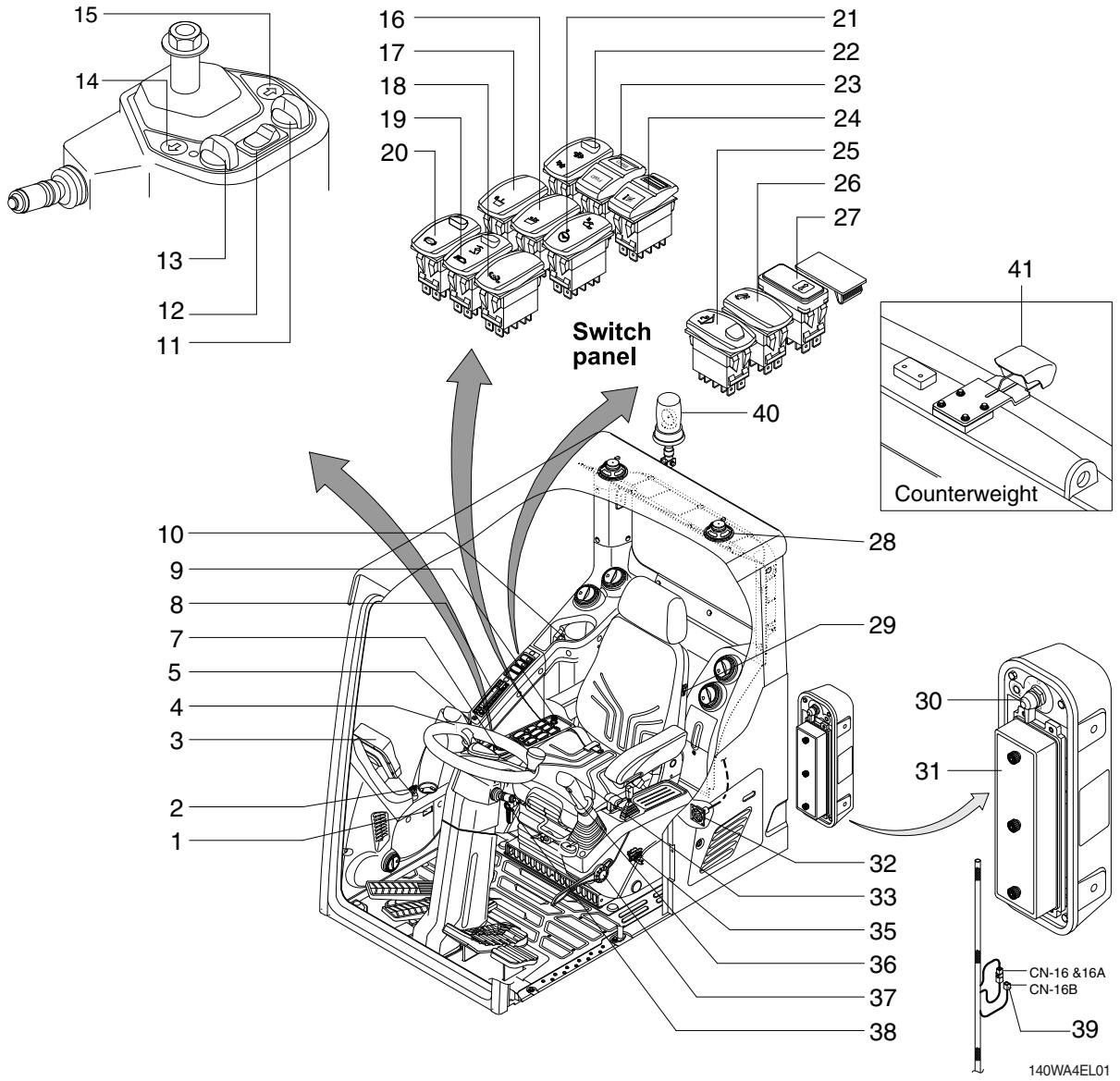
The bucket is operated and the machine travels straight.

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

SECTION 4 ELECTRICAL SYSTEM

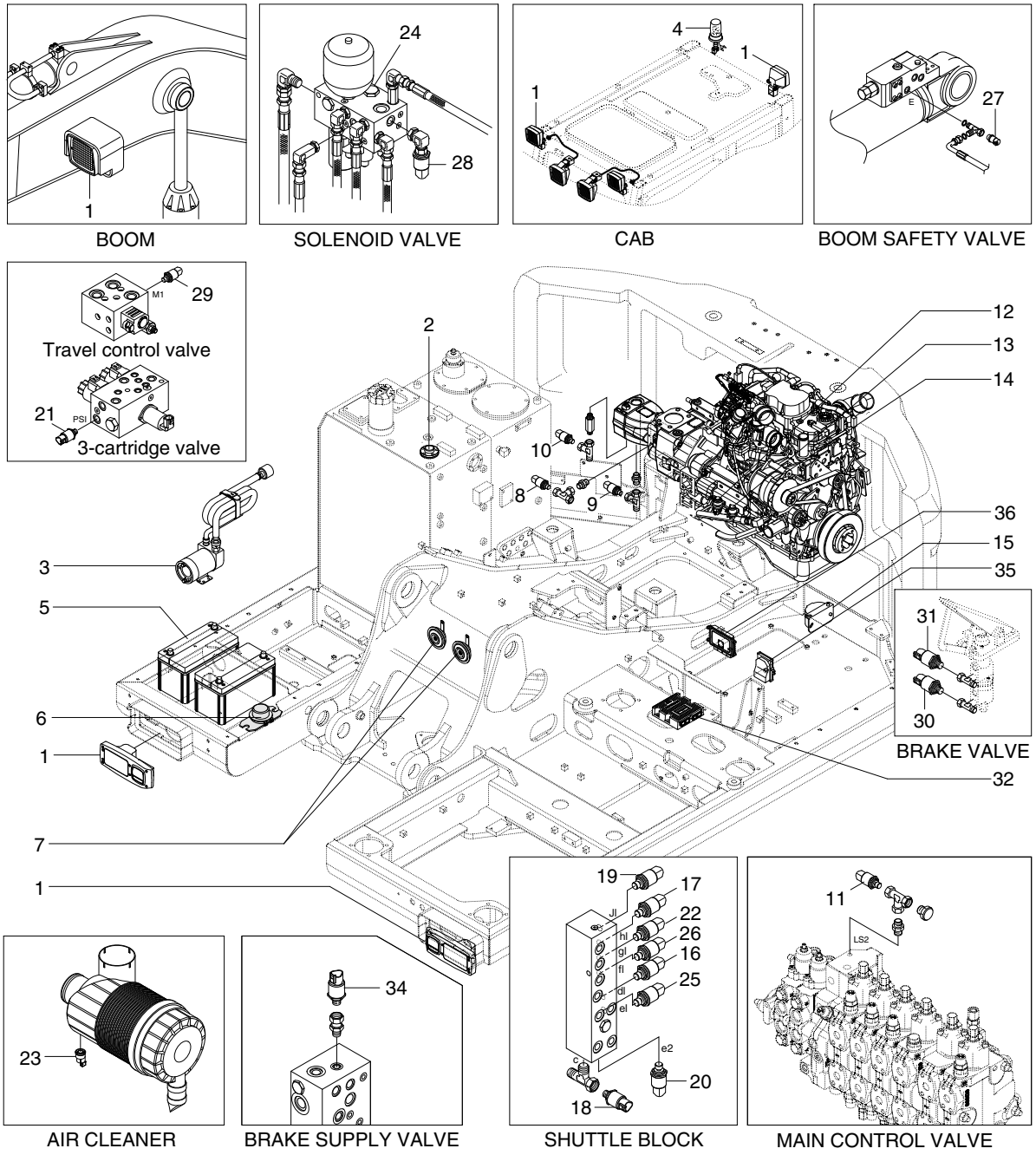
GROUP 1 COMPONENT LOCATION

1. LOCATION 1



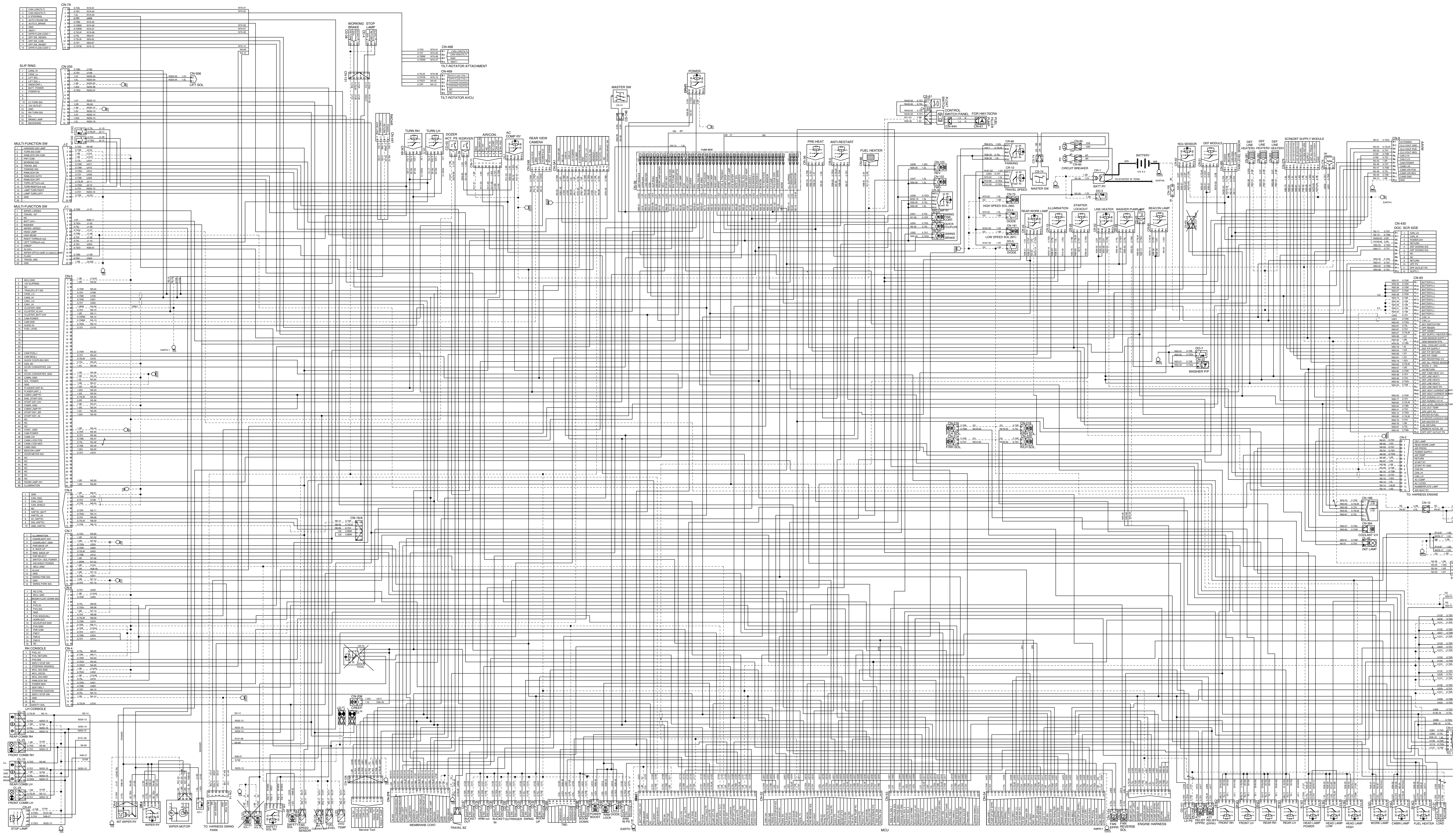
1	Service meter	15	Right turn pilot lamp	29	Seat heater switch
2	Start switch	16	Fine swing switch	30	Master switch
3	Cluster	17	Swing lock switch	31	Fuse & relay box
4	FNR switch	18	Auto cruise switch	32	RS232 & J1939 service socket
5	Horn switch	19	Boom floating & ride control switch	33	One touch decel switch
5	Quick clamp switch			33	Ram lock switch
5	Breaker operation switch	20	Auto brake switch	35	Emergency engine stop switch
7	Jog dial module	21	E/steering & crusher switch	36	Power max switch
8	Radio & USB player	22	Exhaust system cleaning switch	37	Safety knob
9	Cigar lighter	23	FNR switch (emergency)	38	Multi function switch (LH)
10	Socket assy	24	FNR select switch (emergency)	39	Emergency engine speed control connector
11	Ram lock rotary switch	25	Quick clamp switch		
12	Hazard switch	26	Lift trailer Quick clamp switch	40	Beacon lamp
13	Select rotary switch	27	Trailer pilot lamp	41	Rear view camera
14	Left turn pilot lamp	28	Speaker	42	Socket assy

2. LOCATION 2



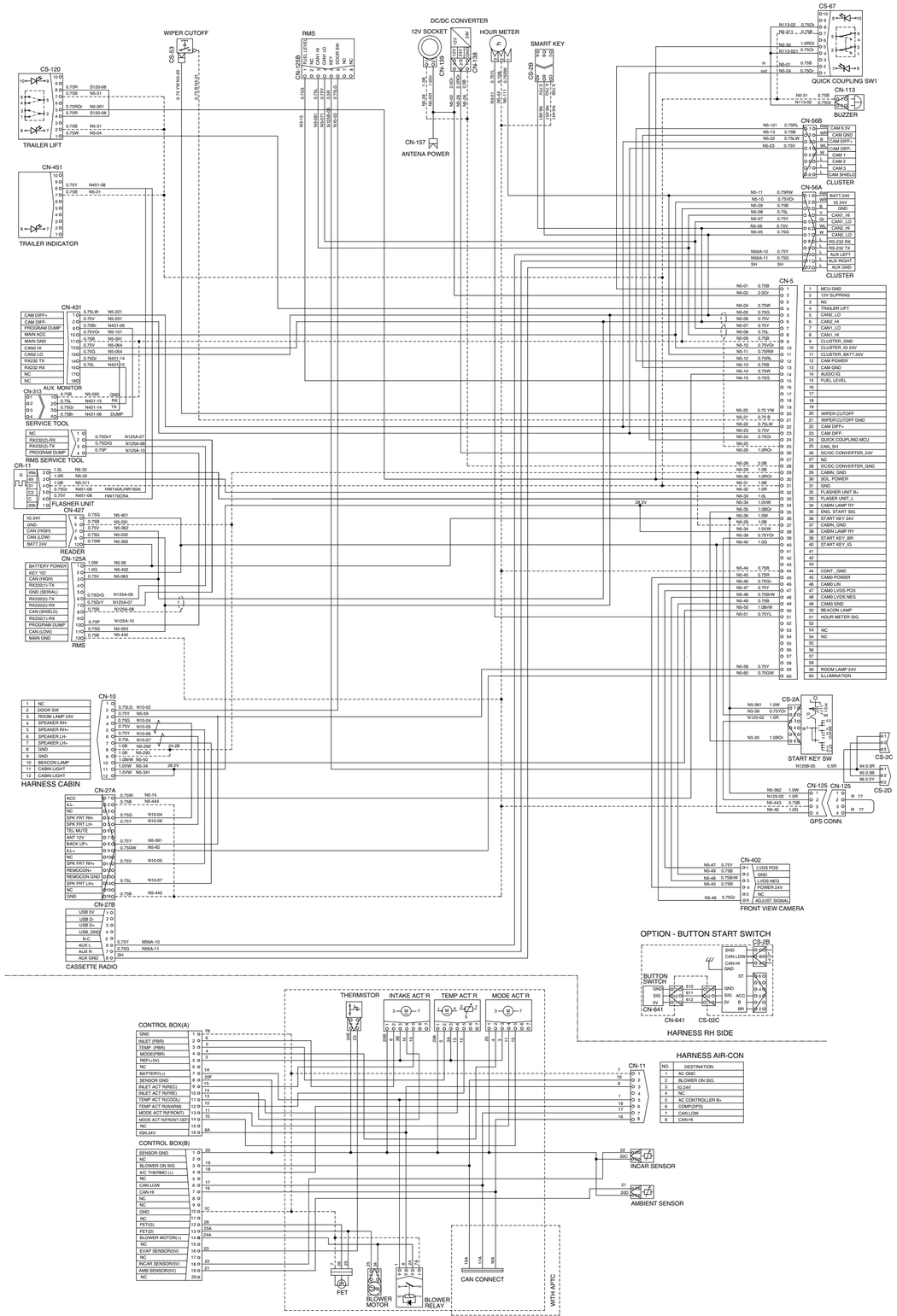
1 Lamp
2 Fuel sender
3 Fuel filler pump
4 Beacon lamp
5 Battery
6 Battery relay
7 Horn
8 Main pump pressure sensor
9 Steering pump pressure sensor
10 Steering load sensing pressure sensor
11 Main pump load sensing pressure sensor
12 Start relay
13 Heater relay
14 Alternator
15 Travel alarm buzzer
16 Arm out pressure sensor
17 Boom up pressure sensor
18 Swing pressure sensor
19 Boom down pressure sensor
20 Arm in pressure sensor
21 Travel pressure sensor
22 Bucket out pressure sensor
23 Air cleaner sensor
24 4 cartridge valve
25 Swing & arm in pressure sensor
26 Bucket in pressure sensor
27 Overload pressure sensor
28 Pilot oil pressure sensor
29 Travel control valve pressure sensor
30 Brake pressure sensor
31 Brake pilot lamp pressure switch
32 MCU
34 Brake supply valve pressure sensor
35 RDU assy
36 View controller

· ELECTRICAL CIRCUIT (1/3)



20K8-98208-01

· ELECTRICAL CIRCUIT (2/3, 1OF2)



NO.	DESTINATION
1	MCU GND
2	12V SUPRING
3	NC
4	TRAILER LIFT
5	CAN2_LO
6	CAN2_HI
7	CAN1_LO
8	CAN1_HI
9	CLUSTER_GND
10	CLUSTER_IG.24V
11	CLUSTER_BATT.24V
12	CAM POWER
13	CAM GND
14	AUDIO IG
15	FUEL LEVEL
16	
17	
18	
19	
20	WIPER CUTOFF
21	WIPER CUTOFF GND
22	CAM DIFF+
23	CAM DIFF-
24	QUICK COUPLING MCU
25	CAN_SH
26	DC/DC CONVERTER_24V
27	NC
28	DC/DC CONVERTER_GND
29	CABIN_GND
30	SOL_POWER
31	GND
32	FLASHER UNIT B+
33	FLASER UNIT_L
34	CABIN LAMP RY
35	ENG. START SIG.
36	START KEY 24V
37	CABIN_GND
38	CABIN LAMP RY
39	START KEY_BR
40	START KEY_IG
41	
42	
43	
44	CONT._GND
45	CAM2 POWER
46	CAM2 LIN
47	CAM2 LVDS POS
48	CAM2 LVDS NEG
49	CAM2 GND
50	BEACON LAMP
51	HOUR METER SIG
52	
53	NC
54	NC
55	
56	
57	
58	
59	ROOM LAMP 24V
60	ILLUMINATION

NO.	DESTINATION
1	NC
2	DOOR SW
3	ROOM LAMP 24V
4	SPEAKER RH+
5	SPEAKER RH-
6	SPEAKER LH-
7	SPEAKER LH+
8	GND
9	GND
10	BEACON LAMP
11	CABIN LIGHT
12	CABIN LIGHT

NO.	DESTINATION
1	NC
2	DOOR SW
3	FUSE
4	CASSETTE_RH-
5	CASSETTE_RH+
6	CASSETTE_LH-
7	CASSETTE_LH+
8	GND
9	GND
10	BEACON SW
11	CABIN LIGHT RY
12	CABIN LIGHT RY

NO.	DESTINATION
1	5V_SV
2	PVG_RETURN
3	PVG_DIAL SIG
4	EMCY STOP SW
5	TILT STEERING SIG(NEG)
6	MCU_SIG.GND
7	MCU_DECEL
8	MCU_SIG.GND
9	RAM LOCK
10	POWER MAX
11	MCU_SEAT BELT
12	TILT STEERING SIG(POS)
13	EMCY STOP SW
14	GND
15	NC
16	SAFETY SOL

NO.	DESTINATION
1	GND
2	CAN_HI
3	CAN_LO
4	CAN_SHIELD
5	NC
6	POWER_BATT
7	POWER_IG
8	5V_ECM
9	SIG_ECM
10	GND_ECM

NO.	DESTINATION
1	ILLUMINATION
2	CIGARLIGHT_IGSIV
3	CIGARLIGHT_GND
4	FWD BACK UP
5	N. BACK UP
6	RWD. BACK UP
7	FNR SELECT
8	SWITCH / SOL POWER
9	AIR SHEAT POWER
10	MCU_GND
11	IG.24V
12	GND
13	FINE SWING SIG
14	GND
15	SWING LOCK SIG.

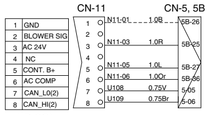
NO.	DESTINATION
1	CAN LOW(TILT)
2	CAN HIGH(TILT)
3	E STEERING
4	AUTO CRUISE
5	AUTO D_BRAKE
6	GND
7	VBAT1
8	EPPR FLOW CONTROL 1
9	DPF SW_RESEN
10	DPF SW_COM
11	DPF SW_INHIBIT
12	EPPR FLOW CONTROL 2

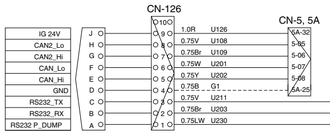
NO.	DESTINATION
1	RD CTRL
2	MCU_GND
3	BOOM FLOAT DOWN SIG
4	NC
5	PVG 5V
6	PVG SIG
7	GND
8	PVG SIG(DUAL)
9	HORN OUT
10	Q/COUPLER SW2
11	PVG GND
12	FNR COM
13	FNR F
14	FNR N
15	FNR R
16	NC

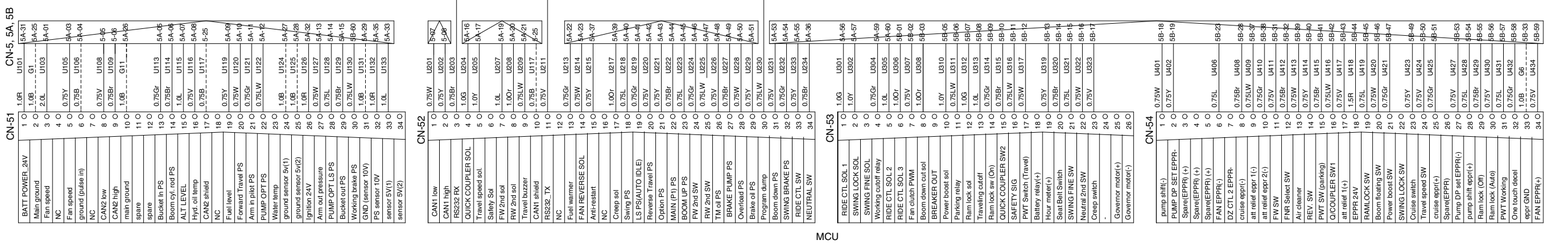
NO.	DESTINATION
1	AC GND
2	BLOWER ON SIG.
3	IG.24V
4	NC
5	AC CONTROLLER B+
6	COMP(OPS)
7	CAN LOW
8	CAN HI

20K8-98106-01 1OF2

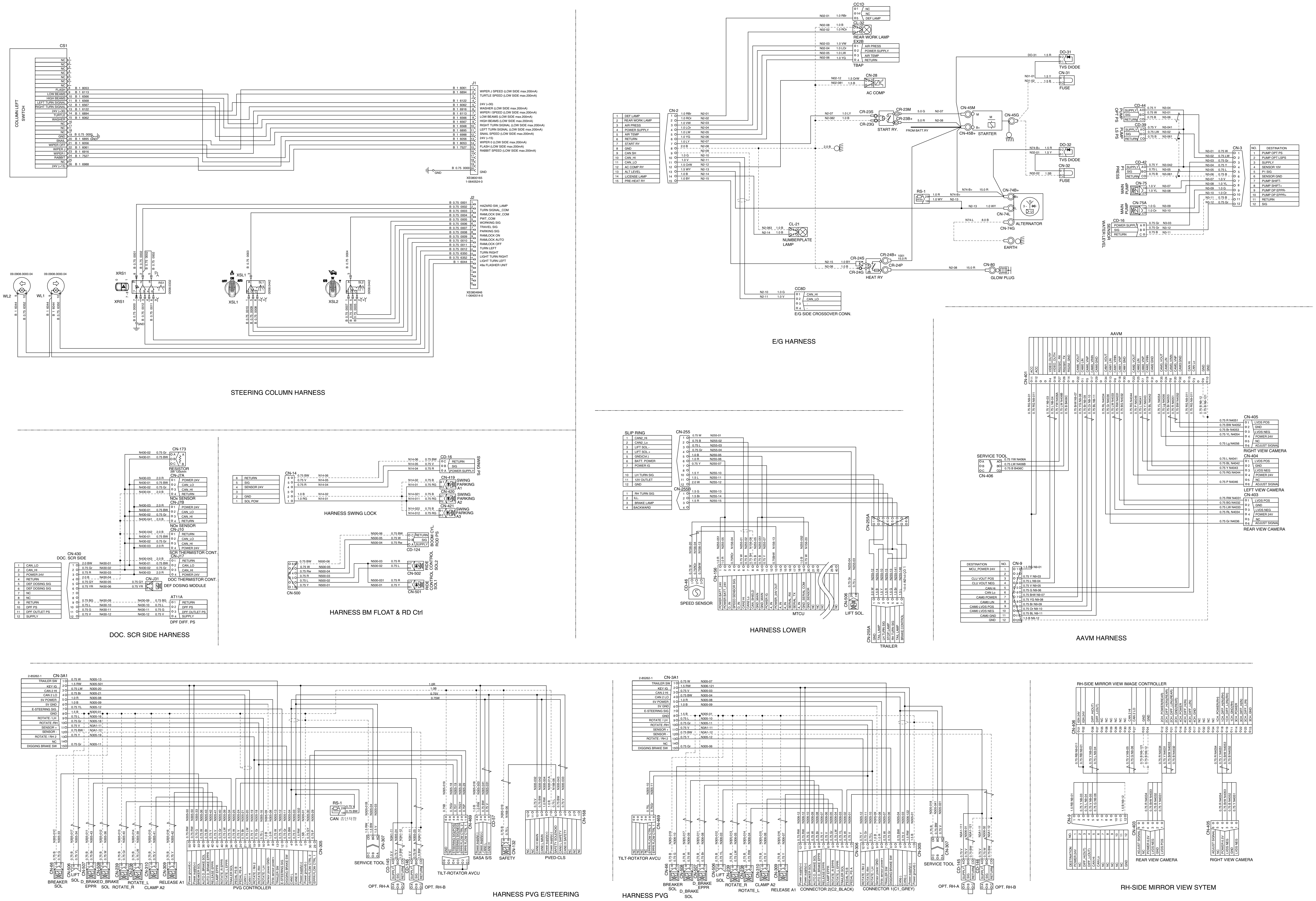
· ELECTRICAL CIRCUIT (2/3, 2OF2)







· ELECTRICAL CIRCUIT (3/3)



20K8-98307-00

MEMORANDUM

MEMORANDUM

1. POWER CIRCUIT

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

1) OPERATING FLOW

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

- → Fuse box [No.1] → DEF/AdBlue® relay [CR-51 (2, 3)]
- → Fuse box [No.2] → MCU [CN-54 (18)]
- → Fuse box [No.3] → Line heater [CR-52 (30, 86)]
- → Fuse box [No.4]
  - → Engine ECM [CN-93 (1, 25, 26, 27, 28)]
  - → DEF/AdBlue® fill up lamp [CL-40 (1)]
- → Fuse box [No.5] → I/conn [CN-255 (6)] → MCU [CN-156 (1, 2)]
- → Fuse box [No.6] → NOx sensor relay [CR-50 (30)]
- → Fuse box [No.7] → I/conn [CN-5 (59)]
  - → I/conn [CN-10 (3)] → Room lamp [CL-1 (2)]
    - → Door switch [CS-1]
  - → Radio & USB player [CN-27A (8)]
- → Fuse box [No.8] → MCU [CN-51 (1)]
- → Fuse box [No.9]
  - → Master switch [CS-74B (2)→(1)] → I/conn [CN-5 (36)]
    - → Start switch [CS-2A (1)]
    - → GPS connection [CN-125 (1)]
    - → RMS [CN-125A (1)]
    - → Reader [CN-427 (12)]
  - → Power relay [CR-35 (30)]
- → Fuse box [No.10] → I/conn [CN-11 (5)]
  - → A/C & heater control box A (7)
  - → A/C & heater blower relay (4)
- → Fuse box [No.11] → Multifuntion SW [J-1 (4)]
- → Fuse box [No.12]
  - → I/conn [CN-5 (11)]
    - → Hour meter [CN-48 (1)]
    - → Cluster [CN-56A (1)]
  - → I/conn [CN-8 (6)] → Jog dial module [CN-363 (2)]
- → Fuse box [No.13]
  - → I/conn [CN-5 (32)] → Flasher unit [CR-11 (3)]
  - → LH turn relay [CR-70 (2)]
  - → RH turn relay [CR-69 (2)]

I/conn : Intermediate connector

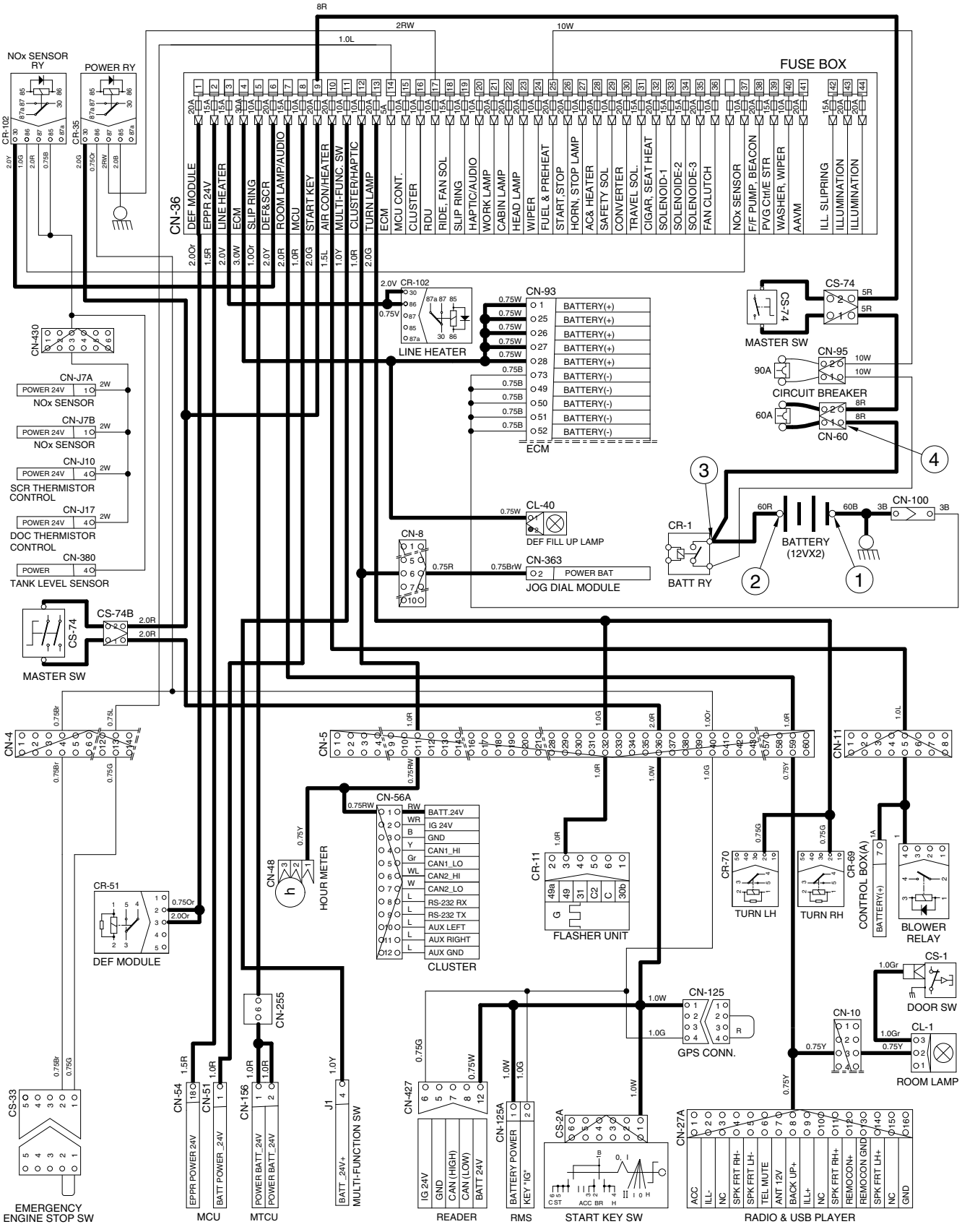
2) CHECK POINT

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

※ GND : Ground

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

POWER CIRCUIT



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

2. STARTING CIRCUIT

1) OPERATING FLOW

Battery (+) terminal → Battery relay [CR-1] → Circuit breaker [CN-60] → Master switch [CS-74]
→ Fuse box [No.9] → Master switch [CS-74B] → I/conn [CN-5 (36)] → Start switch [CS-2A (1)]
→ Power relay [CR-35 (30)]

(1) When start key switch is in ON position

→ Start switch ON [CS-2A (2)] → I/conn [CN-5 (39)] → Battery relay [CR-1]
→ Battery relay operating (all power is supplied with the electric component)
→ Start switch ON [CS-2A (3)] → GPS conn [CN-125 (2)→(4)] → RMS [CN-125A (2)]
→ Reader [CN-427 (6)]
→ I/conn [CN-5 (40)]
→ Power relay [CR-35 (86) → (87)] → Fuse box [No.15]
→ MCU [CN-51 (26)]
→ I/conn [CN-4 (4)] → Emergency engine stop sw [CS-33 (2) → (1)]
→ I/conn [CN-4 (13)] → Fuse box [No. 14] → ECM [CN-93 (5)]

(2) When start key switch is in START position

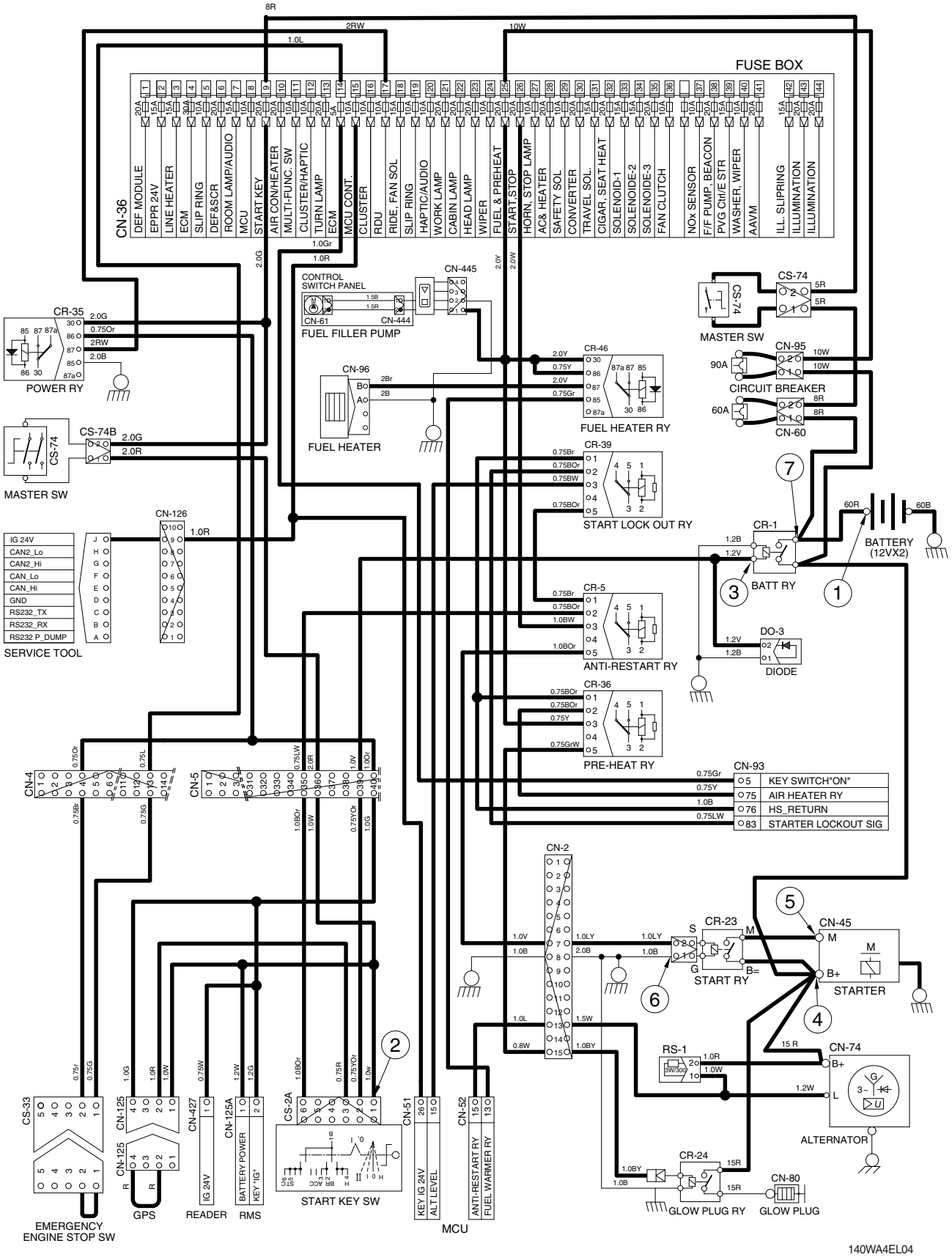
Start switch START [CS-2A (6)] → I/conn [CN-5 (35)] → Anti-restart relay [CR-5 (2) → (5)]
→ I/conn [CN-2 (7)] → Start relay [CR-23 (S)] → Starter motor operating

2) CHECK POINT

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

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

STARTING CIRCUIT



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

3. CHARGING CIRCUIT

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

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

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

1) OPERATING FLOW

(1) Warning flow

Alternator [CN-74 (L)] → I/conn [CN-2 (13)] → MCU alternator level [CN-51 (15)] →
Cluster charging warning lamp (via CAN interface)

(2) Charging flow

Alternator [CN-74 (B^+)] → Starter [CN-45 (B^+) → Battery relay (M8)

- Battery (+) terminal
- Circuit breaker [CN-60] → Master switch [CS-74] → Fuse box [No. 1~13]
- Circuit breaker [CN-95] → Fuse box [No. 20~41]

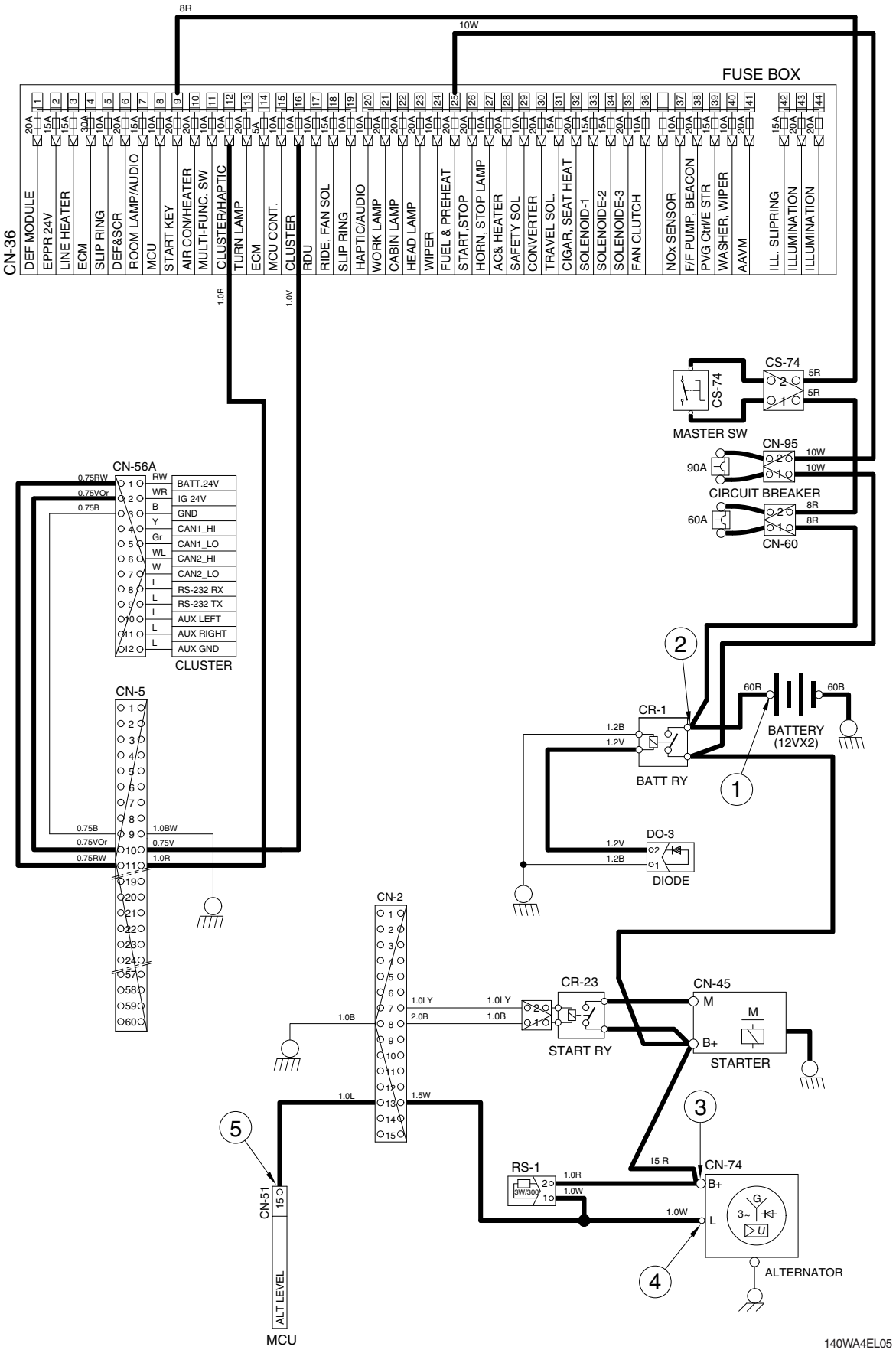
2) CHECK POINT

Engine	Start switch	Check point	Voltage
Run	ON	① - GND (battery voltage) ② - GND (battery relay) ③ - GND (alternator B^+ terminal) ④ - GND (alternator L terminal) ⑤ - GND (MCU)	20~30 V

※ GND : Ground

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

CHARGING CIRCUIT



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

4. HEAD AND WORK LIGHT CIRCUIT

1) OPERATING FLOW

Fuse box (No.23) ┬→ Head light low relay [CR-13 (30, 86)]
├→ Head light high relay [CR-14 (30, 86)]
├→ Head light power relay [CR-78 (86)]
└→ Illumination relay [CR-15 (2, 3)]

Fuse box (No.21) ┬→ Work light relay [CR-3 (30, 86)]
└→ Rear work light relay [CR-44 (30, 86)]

Fuse box (No.17) → Membrane controller [CN-376 (1)]

(1) Head light switch ON

→ Head light switch ON [CN-376 (13)]
→ Head light power relay [CR-78 (85) →(87)]
→ Head light low relay [CR-13 (85)→(87)] → Head light ON [CL-3 (1)], CL-4 (1)]

(2) Work light switch ON

Work light switch ON [CN-376 (4)] → Work light relay [CR-3 (85) → (87)]
→ I/conn [CN-12 (1)] → Work light ON [CL-5 (2), CL-6 (2)]

(3) Rear work light switch ON

Work light switch ON [CN-376 (14)] → Rear work light relay [CR-44 (85) → (87)]
→ I/conn [CN-2 (2)] → Rear work light ON [CL-24 (1)]

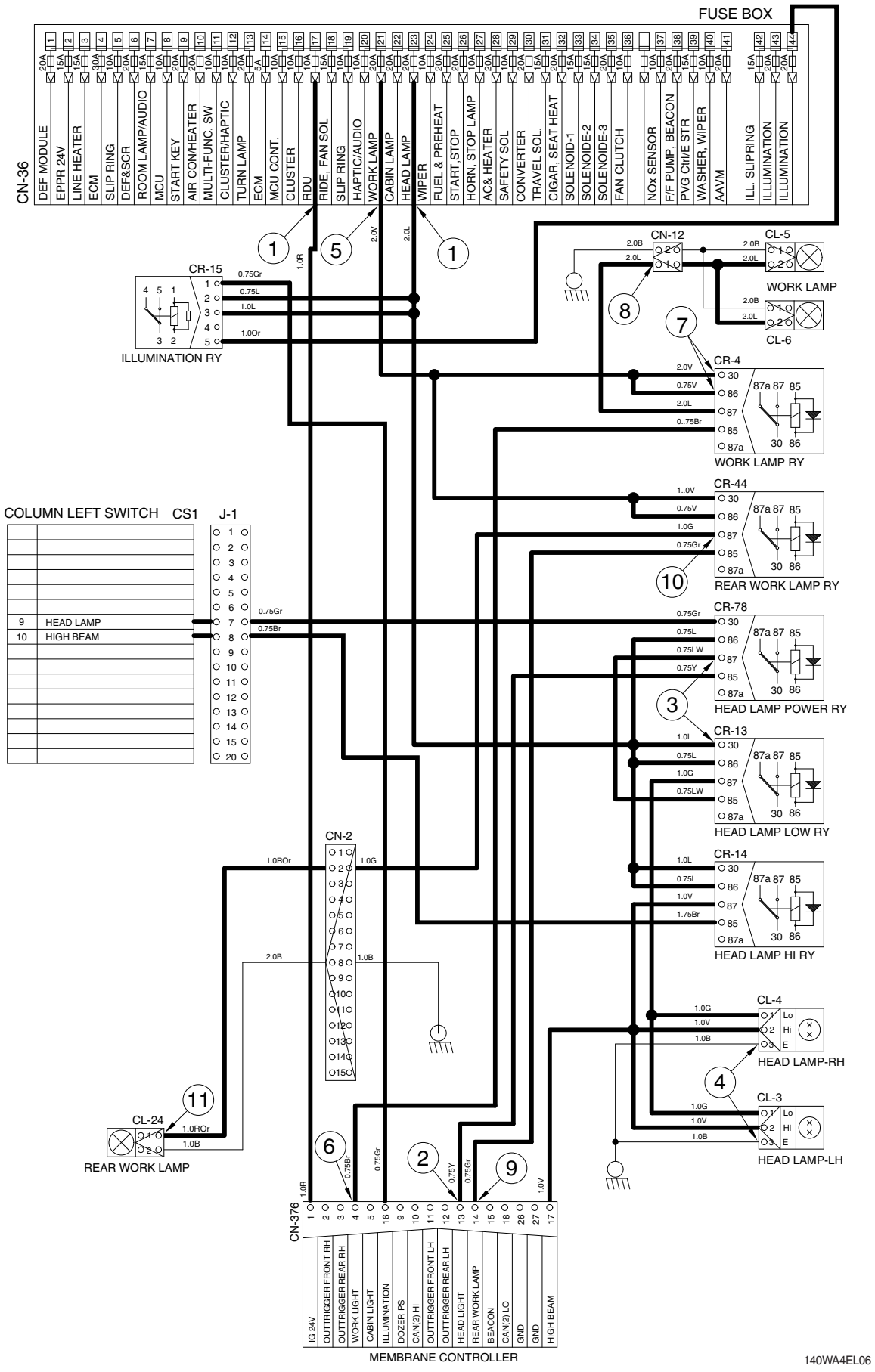
2) CHECK POINT

Engine	Start switch	Check point	Voltage
STOP	ON	① - GND (fuse box) ② - GND (switch power output) ③ - GND (head light relay) ④ - GND (head light) ⑤ - GND (fuse box) ⑥ - GND (switch power output) ⑦ - GND (work light relay) ⑧ - GND (work light) ⑨ - GND (switch power output) ⑩ - GND (rear work light relay) ⑪ - GND (rear work light)	20~30 V

※ GND : Ground

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

HEAD AND WORK LIGHT CIRCUIT



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

5. BEACON LAMP AND CAB LIGHT CIRCUIT

1) OPERATING FLOW

Fuse box (No.38) → Beacon lamp relay [CR-85 (2, 3)]
Fuse box (No.22) → Cab light relay [CR-9 (30, 86)]
Fuse box (No.17) → Membrane controller [CN-376 (1)]

(1) Beacon lamp switch ON

Beacon lamp switch ON [CN-376 (15)] → Beacon light relay [CR-85 (1) → (5)]
→ I/conn [CN-5 (50)] → I/conn [CN-10 (10)] → Beacon lamp ON [CL-7]

(2) Cab light switch ON

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

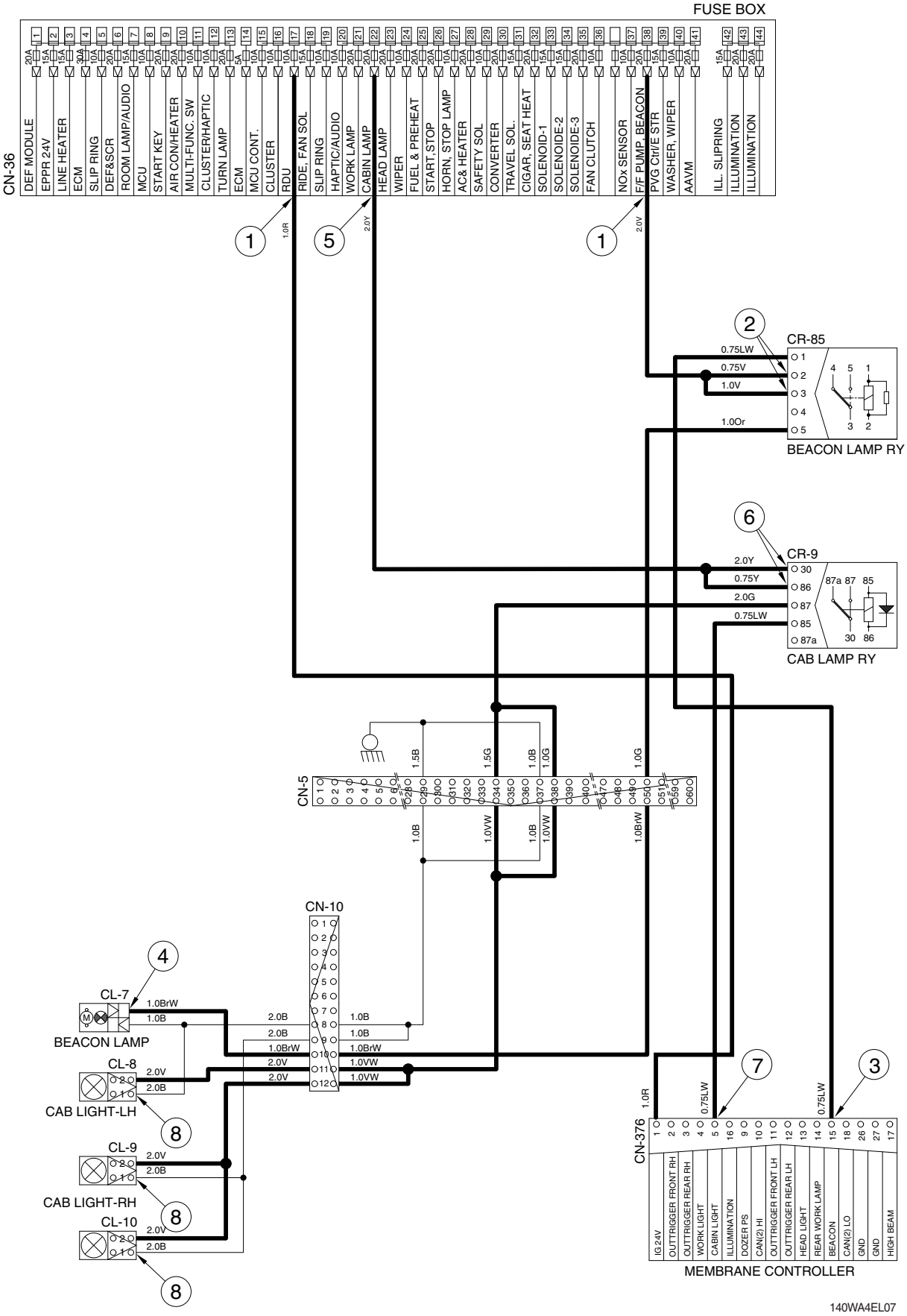
2) CHECK POINT

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

※ GND : Ground

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

BEACON LAMP AND CAB LIGHT CIRCUIT



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

6. WIPER AND WASHER CIRCUIT

1) OPERATING FLOW

(1) Key switch ON

Fuse box (No.11) → I/conn [J-1 (4)] → Column left switch [CS1 (13)]
Fuse box (No.24) → I/conn [J-1 (12)] → Column left switch [CS1 (26)]
Fuse box (No.40) → Wiper motor [CN-21 (1)]
→ Washer pump relay [CR-49 (1, 3)]
→ Int wiper relay [CR-6 (3)]
→ Wiper relay [CR-4 (86, 87)]

(2) Wiper switch ON : 1st step

Wiper switch ON [Column left switch CS1 (23)] → I/conn [J-1 (6)] → Int wiper relay [CR-6 (1)→(2)]
→ Wiper relay [CR-4 (85)→ (87a)] → Wiper motor intermittently operating [CN-21 (3)]

(3) Wiper switch ON : 2nd step

Wiper switch ON [Column left switch CS1 (22)] → I/conn [J-1 (1)] → Int wiper relay [CR-6 (4)→(3)]
→ Wiper relay [CR-4 (87)→(30)] → Wiper motor operating [CN-21 (2)]

(4) Washer switch ON

Washer switch ON [Column left switch CS1 (15)] → I/conn [J-1 (5)]
→ Washer pump relay [CR-49 (2)→(5)] → Washer pump [CN-22 (2)] → Washer operating

(5) Auto parking (when switch OFF)

Switch OFF [Column left switch OFF position] → Wiper motor parking position by control unit.

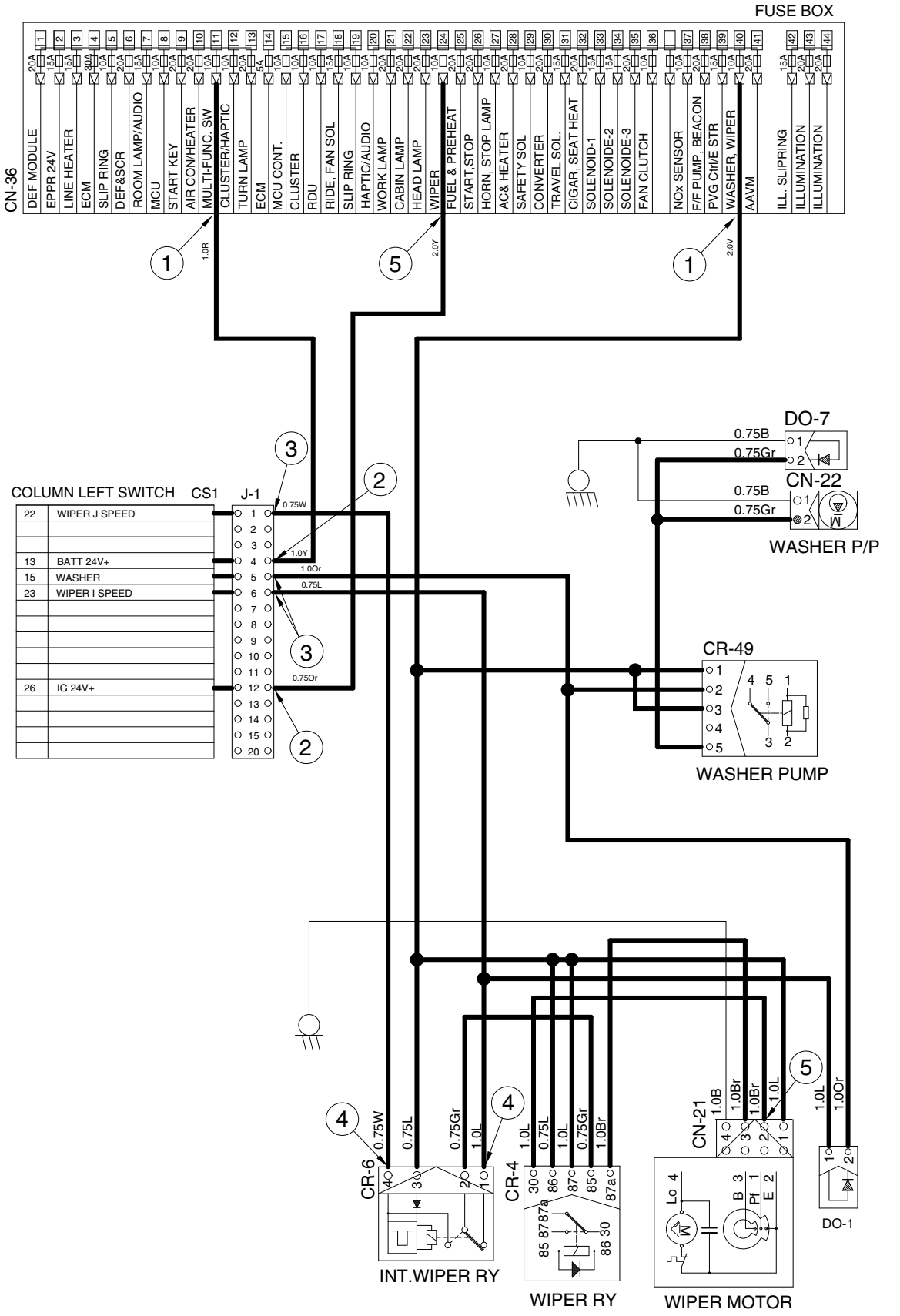
2) CHECK POINT

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

※ GND : Ground

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

WIPER AND WASHER CIRCUIT



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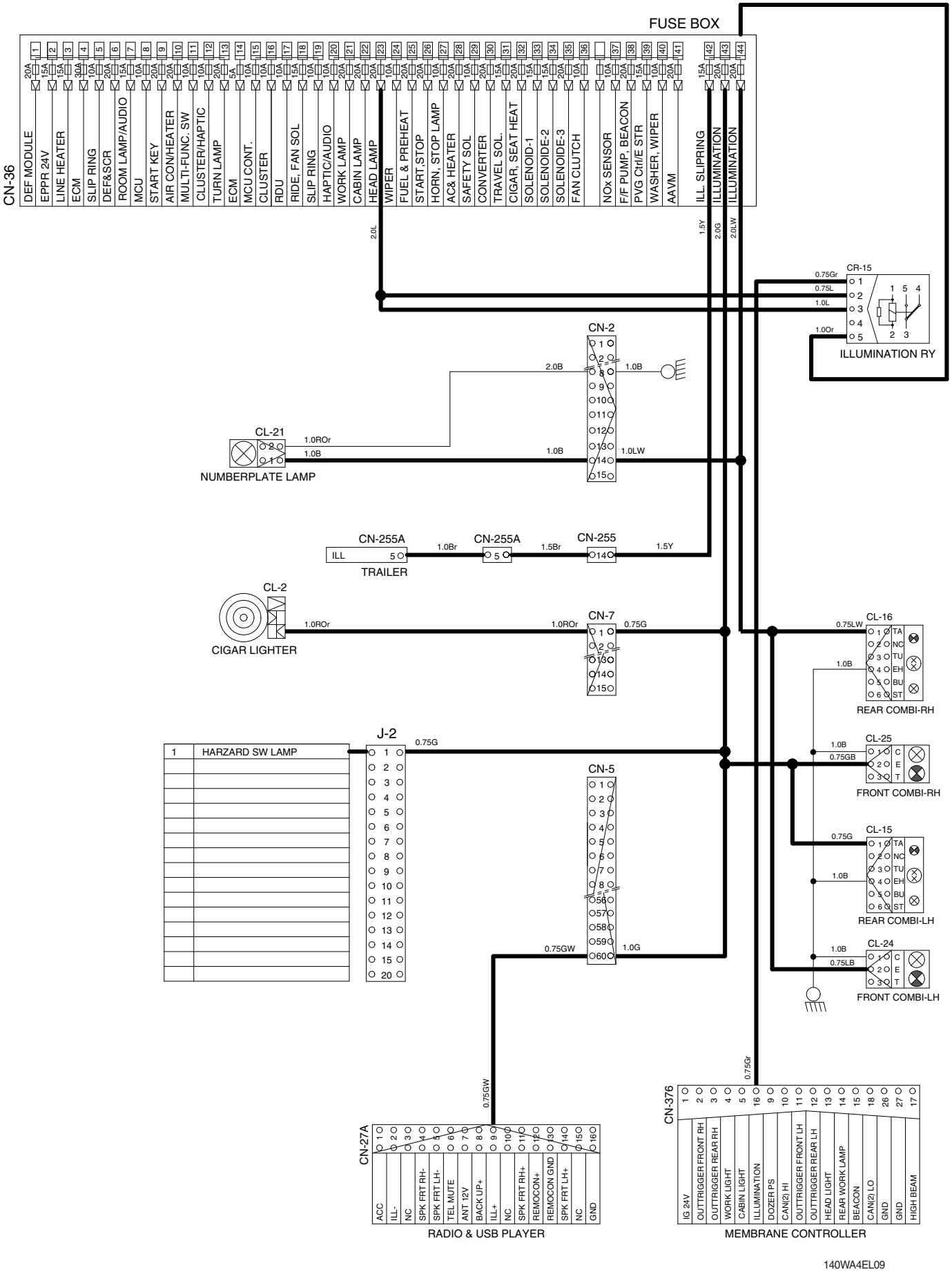
※ The circuit diagram may differ from the equipment, so please check before a repair.

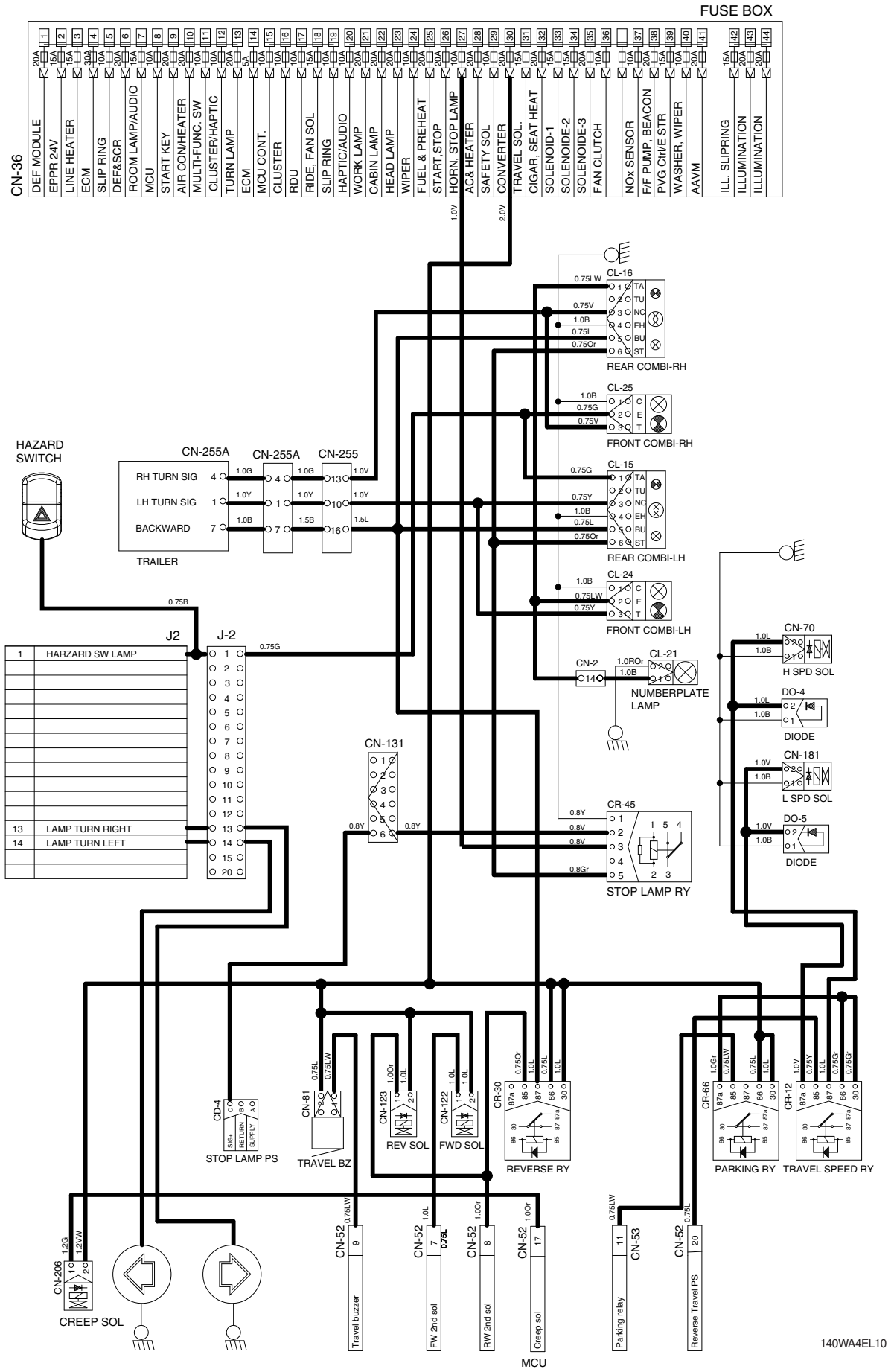
ILLUMINATION CIRCUIT



140WA4EL09

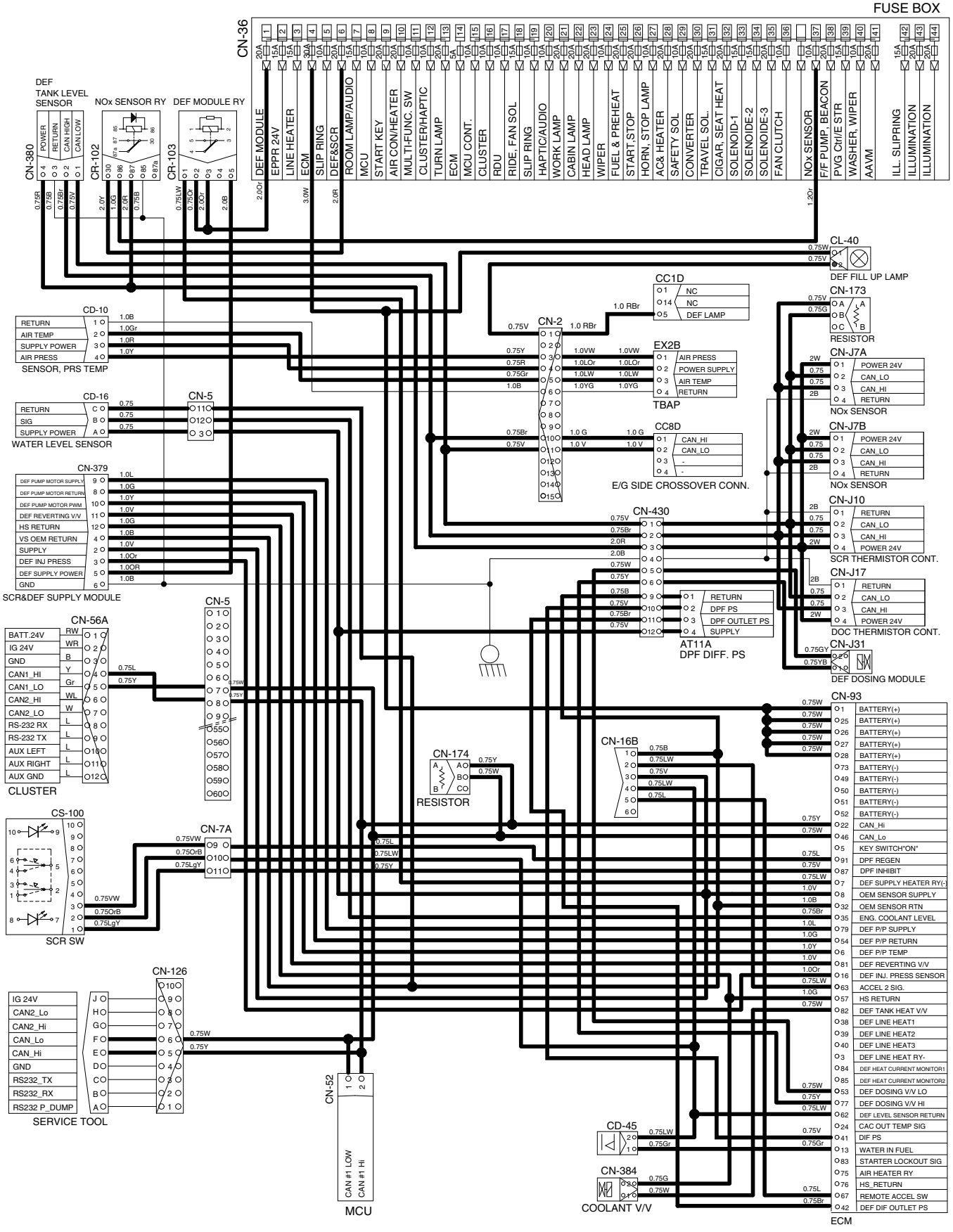
※ The circuit diagram may differ from the equipment, so please check before a repair.

COMBINATION LAMP CIRCUIT



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

CONTROLLER CIRCUIT



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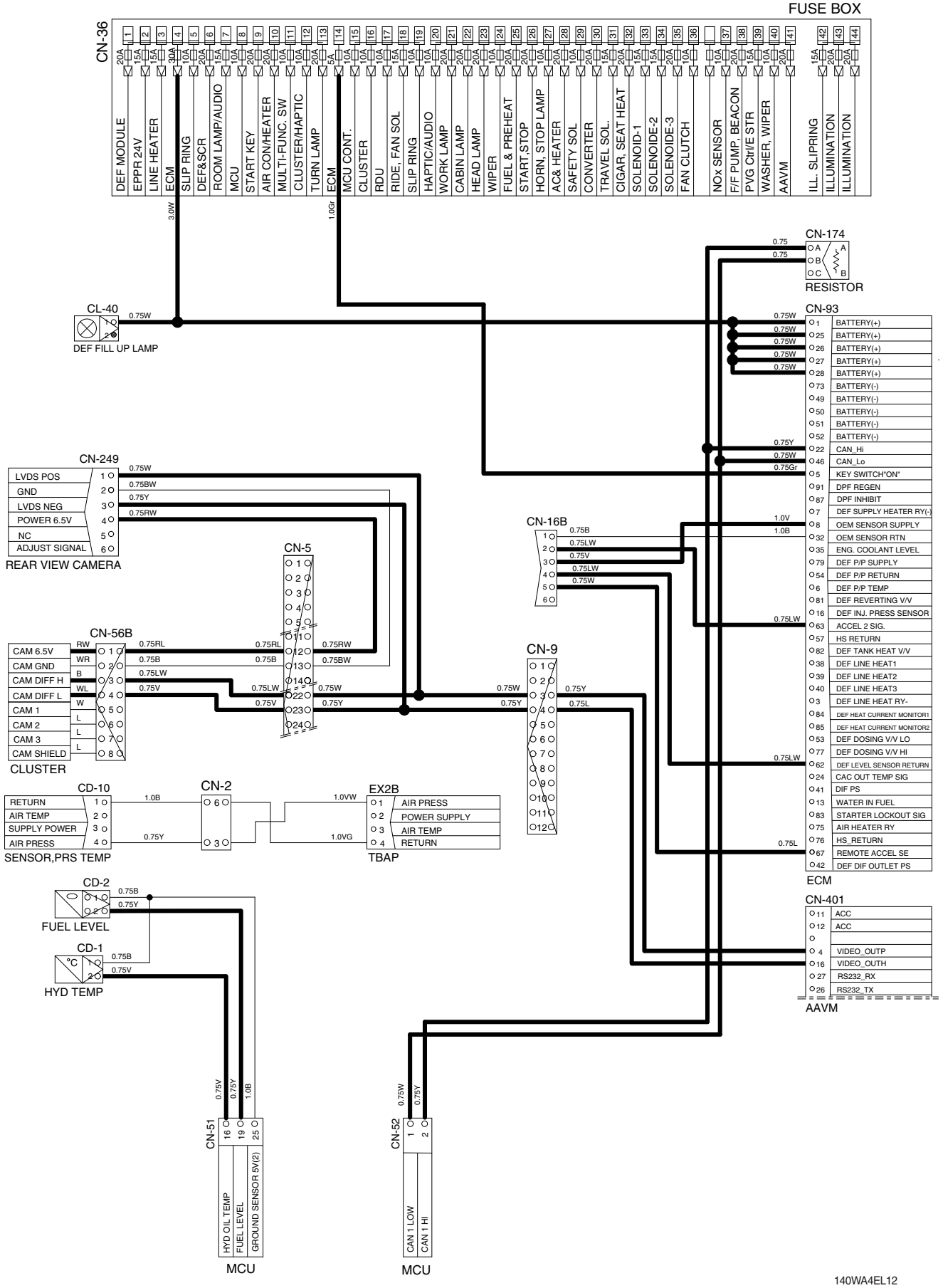
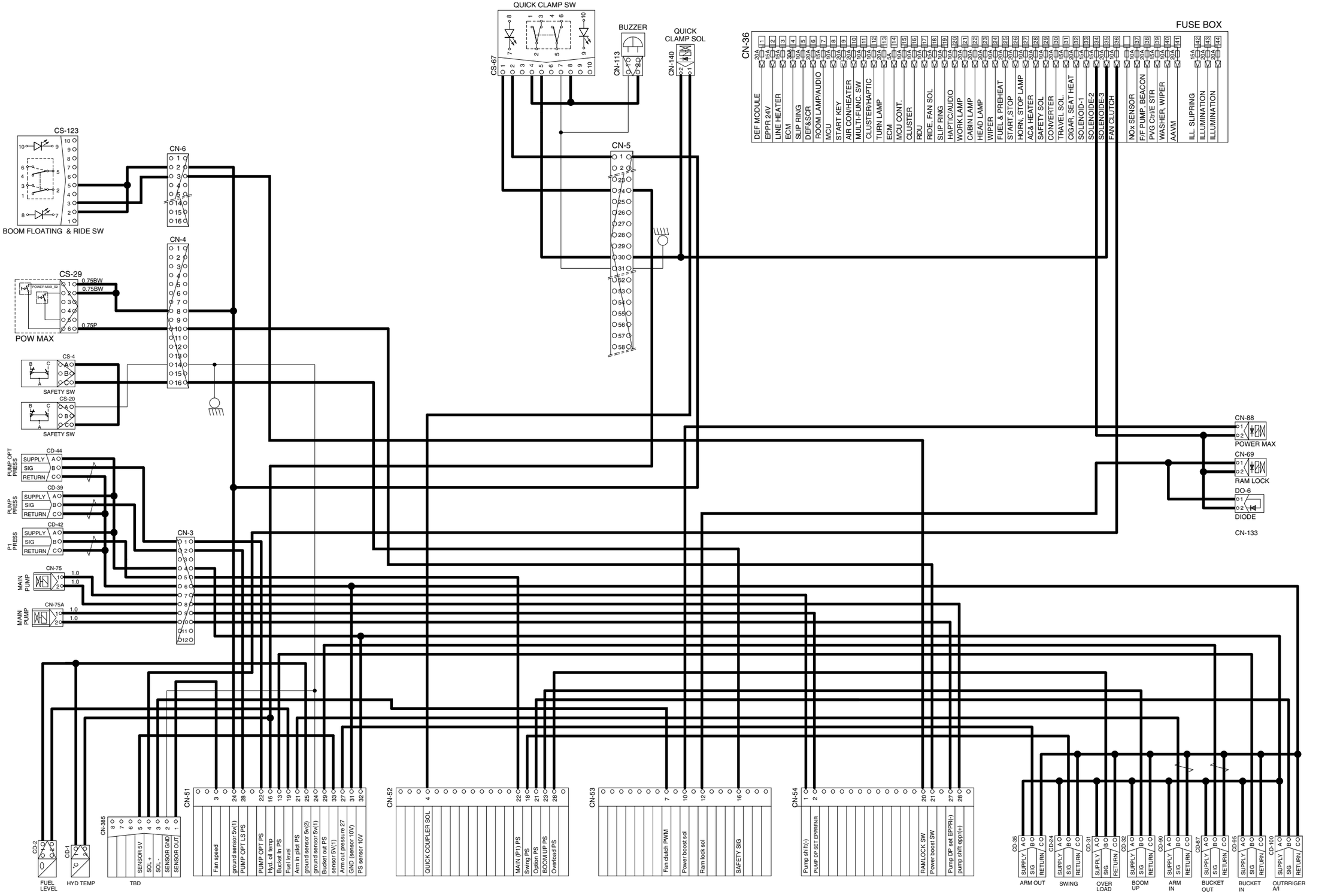
※ The circuit diagram may differ from the equipment, so please check before a repair.

MONITORING CIRCUIT



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

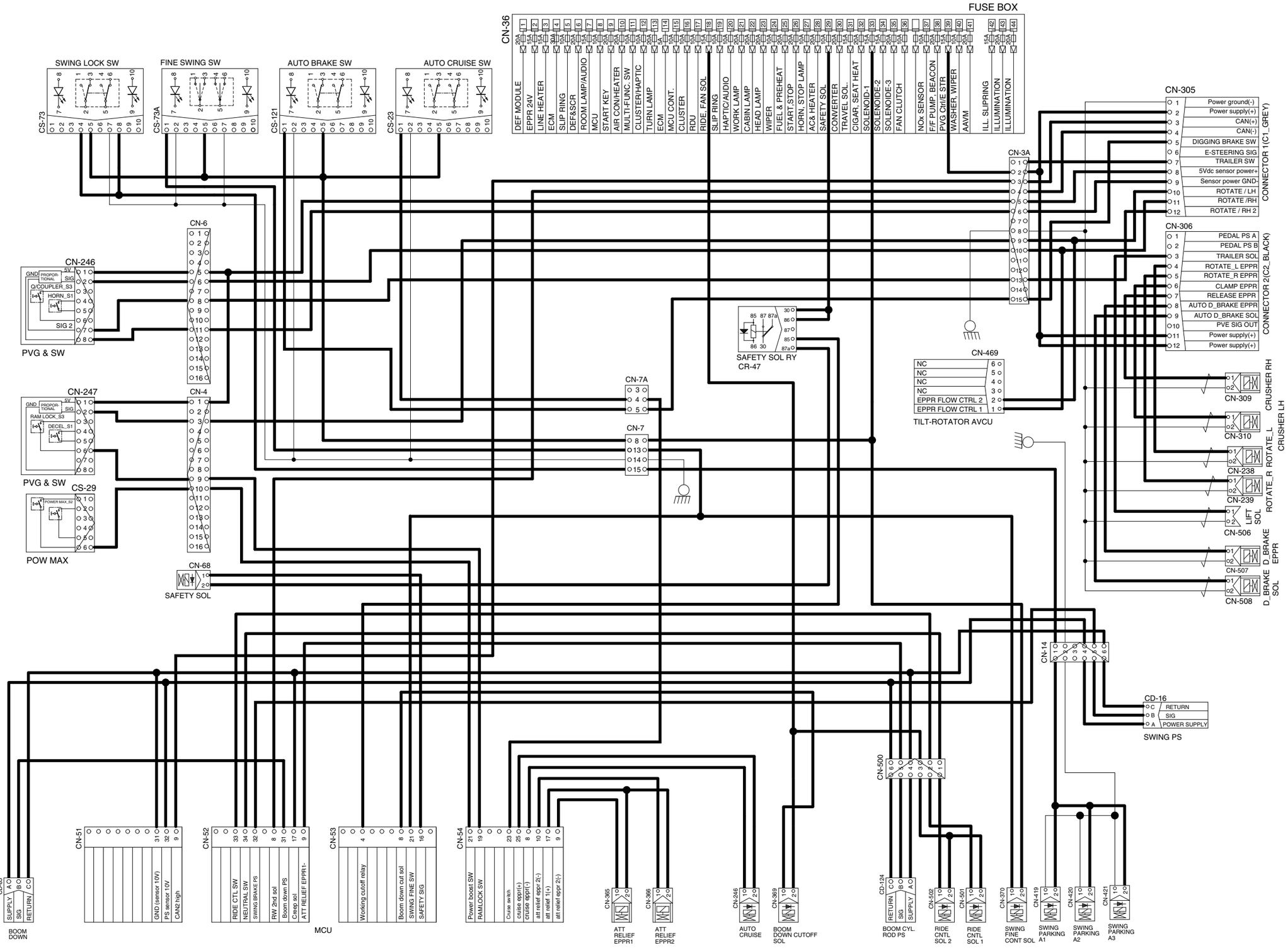
ELECTRIC CIRCUIT FOR HYDRAULIC (1/2)



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

140WA4EL13

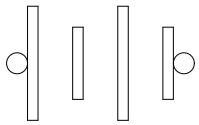
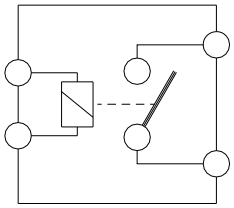
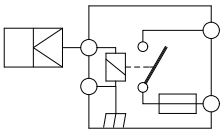
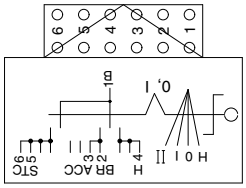
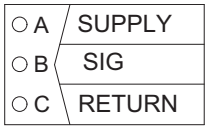
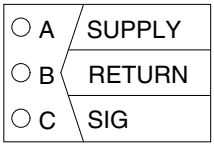
ELECTRIC CIRCUIT FOR HYDRAULIC (2/2)

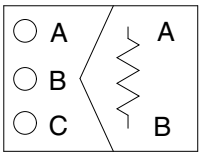
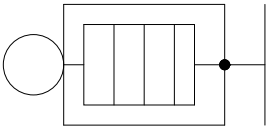
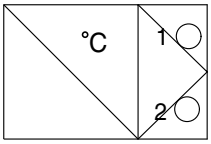
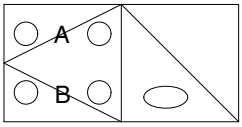
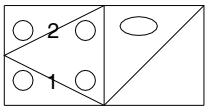
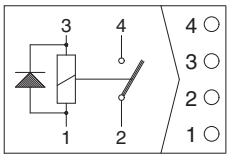


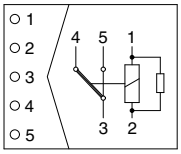
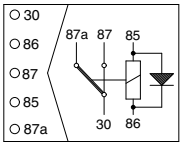
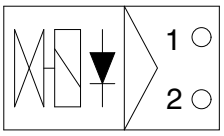
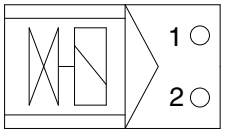
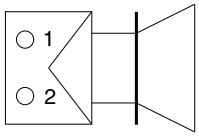
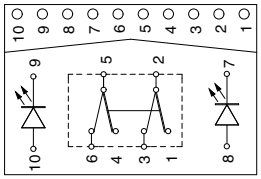
※ The circuit diagram may differ from the equipment, so please check before a repair.

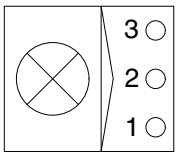
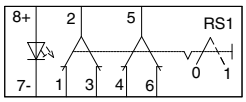
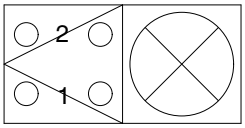
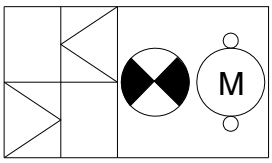
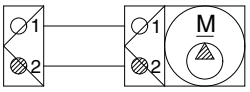
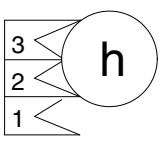
140WA4EL14

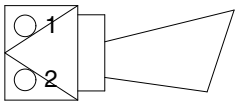
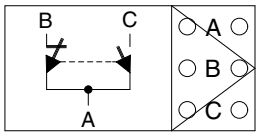
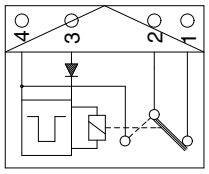
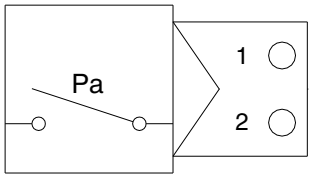
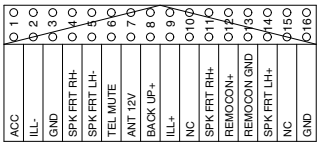
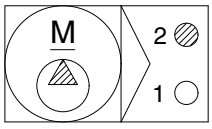
GROUP 3 ELECTRICAL COMPONENT SPECIFICATION

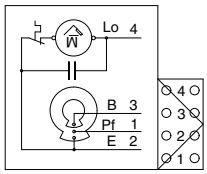
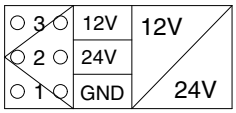
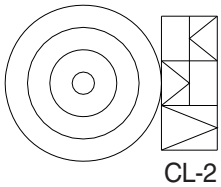
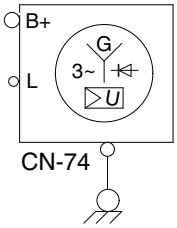
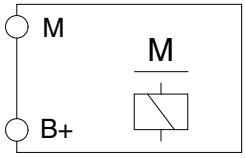
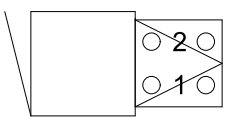
Part name	Symbol	Specifications	Check
Battery		12V × 100Ah (2EA)	※ Check specific gravity 1.280 over : Over charged 1.280 ~ 1.250 : Normal 1.250 below : Recharging
Battery relay	 CR-1	Rated load : 24V 100A (continuity) 1000A (30 seconds)	※ Check coil resistance(M4 to M4) Normal : About 50Ω ※ Check contact Normal : ∞Ω
Glow plug relay	 CR-24	24V 200A	※ Check contact Normal : 0.942Ω (For terminal 1-GND)
Start key	 CS-2A	B-BR : 24V 1A B-ACC : 24V 10A B-ST : 24V 40A	※ Check contact OFF : ∞Ω (for each terminal) ON : 0Ω (for terminal 1-3 and 1-2) START : 0Ω (for terminal 1-6)
Pressure sensor	 CD-3 CD-5 CD-16 CD-24 CD-31 CD-32 CD-35 CD-37 CD-38 CD-39 CD-42 CD-44 CD-71 CD-73 CD-74 CD-85 CD-87 CD-90 CD-95 CD-100 CD-101 CD-102 CD-124 CD-145 CD-146 CD-156	8~30V	※ Check contact Normal : 0.1Ω
Stop lamp pressure sensor	 CD-4	8~30V	※ Check contact Normal : 0.1Ω

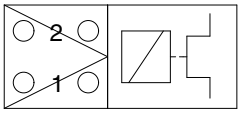
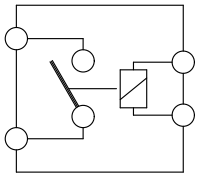
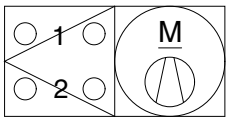
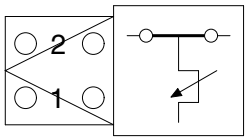
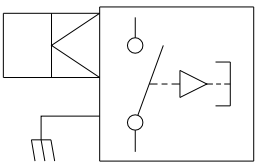
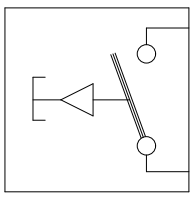
Part name	Symbol	Specifications	Check
Resistor	 CN-173 CN-174	3W	※ Check resistance A-B : 120Ω
Glow plug	 CN-80	24V 200A	※ Check resistance 0.25~0.12Ω
Temperature sensor (hydraulic)	 CD-1	-	※ Check resistance 50˚C : 804Ω 80˚C : 310Ω 100˚C : 180Ω
Fan speed sensor	 CD-52	-	-
Fuel level sender	 CD-2	-	※ Check resistance Full : 50Ω 6/12 : 350Ω 11/12 : 100Ω 5/12 : 400Ω 10/12 : 150Ω 4/12 : 450Ω 9/12 : 200Ω 3/12 : 500Ω 8/12 : 250Ω 2/12 : 550Ω 7/12 : 300Ω 1/12 : 600Ω Empty warning : 700Ω
Relay (air con blower)		24V 16A	※ Check resistance Normal : About 200Ω (for terminal 1-3) 0 Ω (for terminal 2-4)

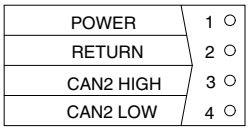
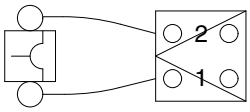
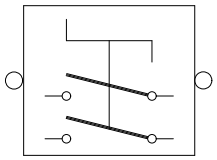
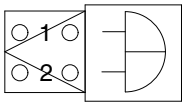
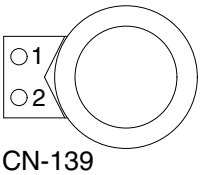
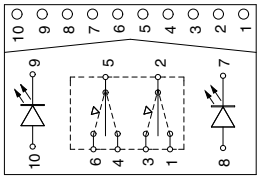
Part name	Symbol	Specifications	Check
Relay	 CR-2 CR-5 CR-15 CR-36 CR-39 CR-45 CR-49 CR-51 CR-69 CR-70 CR-81 CR-82 CR-83 CR-84 CR-85	24V 16A	※ Check resistance Normal : About 160 Ω (for terminal 1-2) 0 Ω (for terminal 3-4) ∞ Ω (for terminal 3-5)
Relay	 CR-3 CR-4 CR-7 CR-9 CR-12 CR-13 CR-14 CR-29 CR-30 CR-35 CR-44 CR-46 CR-47 CR-50 CR-52 CR-66 CR-78	24V 16A	※ Check resistance Normal : About 160 Ω (for terminal 85-86) 0 Ω (for terminal 30-87a) ∞ Ω (for terminal 30-87)
Solenoid valve	 CN-66 CN-68 CN-69 CN-70 CN-88 CN-122 CN-123 CN-140 CN-181 CN-197 CN-206 CN-214 CN-216 CN-218 CN-220 CN-370 CN-419 CN-420 CN-421 CN-501 CN-502 CN-506	24V 1A	※ Check resistance Normal : 15~25 Ω (for terminal 1-2)
EPPR valve	 CN-75 CN-75A CN-154 CN-155 CN-238 CN-239 CN-246 CN-309 CN-310 CN-365 CN-366 CN-369 CN-378 CN-503 CN-507 CN-508	700mA	※ Check resistance Normal : 15~25 Ω (for terminal 1-2)
Speaker	 CN-23(LH) CN-23(RH)	20W	※ Check resistance Normal : A few Ω
Switch (locking type)	 CS-23 CS-67 CS-73 CS-73A CS-121 CS-125	24V 1.5A	※ Check contact Normal ON : 0 Ω (for terminal 2-3, 5-6) ∞ Ω (for terminal 1-2, 4-5) OFF : ∞ Ω (for terminal 2-3, 5-6) 0 Ω (for terminal 1-2, 4-5)

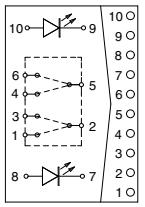
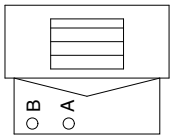
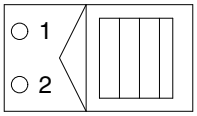
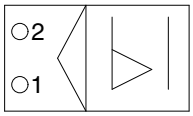
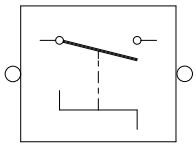
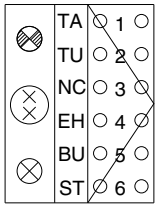
Part name	Symbol	Specifications	Check
Room lamp	 CL-1	24V 10W	※ Check disconnection Normal : 1.0Ω ON : 0Ω(For terminal 1-2) ∞Ω(For terminal 1-3) OFF : ∞Ω(For terminal 1-2) 0Ω(For terminal 1-3)
Hazard switch		24V 1.5A	※ Check contact Normal ON : 0Ω(For terminal 2-3, 5-6) OFF : ∞Ω(For terminal 2-3, 5-6)
Work lamp, Cab lamp, Number plate lamp	 CL-5 CL-6 CL-8 CL-9 CL-10 CL-21 CL-32	24V 65W (H3 Type)	※ Check disconnection Normal : 1.2Ω
Beacon lamp	 CL-7	21V 70W (H1 Type)	※ Check disconnection Normal : A few Ω
Fuel filler pump		24V 10A 35 ℓ /min	※ Check resistance Normal : 1.0Ω
Hour meter	 CN-48	16~32V	※ Check operation Supply power(24V) to terminal No.2 and connect terminal No.1 and ground

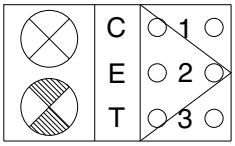
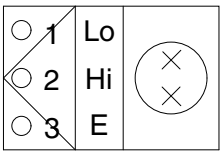
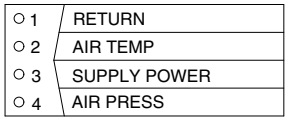
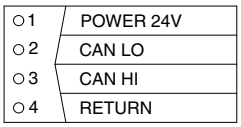
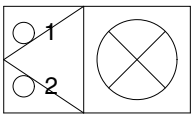
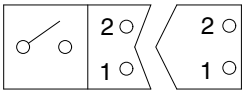
Part name	Symbol	Specifications	Check
Horn	 CN-20 CN-25	DC22~28V 2A	※ Check operation Supply power (24V) to each terminal and connect ground.
Safety switch	 CS-4 CS-20	24V 15A (N.C TYPE)	※ Check contact Normal : 1.0Ω ON : 0Ω(for terminal A-B) ∞Ω(for terminal A-C) OFF : ∞Ω(for terminal A-B) 0Ω(for terminal A-C)
Int wiper relay	 CR-6	-	-
Receiver dryer	 CN-29	24V 2.5A	※ Check contact Normal : ∞Ω
Radio & USB player	 CN-27A	24V 2A	※ Check voltage 20~25V (for terminal 1-3, 3-8)
Washer pump	 CN-22	24V 3.8A	※ Check contact Normal : 10.7Ω(for terminal 1-2)

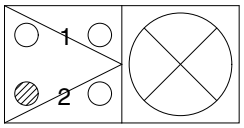
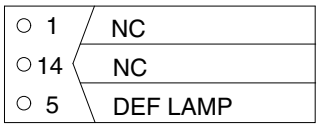
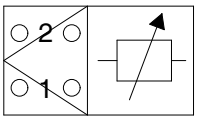
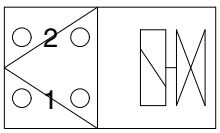
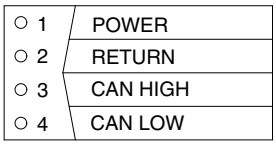
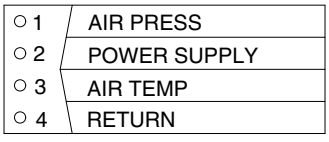
Part name	Symbol	Specifications	Check
Wiper motor	 CN-21	24V 2A	※ Check disconnection Normal : 7Ω (for terminal 2-4)
DC/DC converter	 CN-138	12V 3A	※ Check voltage 24V (for terminal 1-2) 12V (for terminal 1-3)
Cigar lighter	 CL-2	24V 5A 1.4W	※ Check coil resistance Normal : About 1MΩ ※ Check contact Normal : ∞Ω Operating time : 5~15sec
Alternator	 CN-74	24V 95A	※ Check contact Normal : 0Ω (for terminal B^+-L) Normal : 24~27.5V
Starter	 CN-45	24V 4.8kW	※ Check contact Normal : 0.1Ω
Travel alarm	 CN-81	24V 0.5A	※ Check contact Normal : 5.2Ω

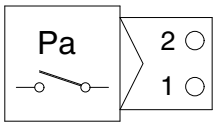
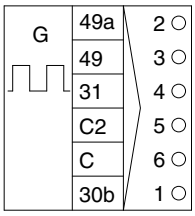
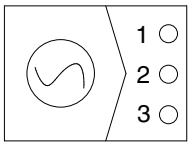
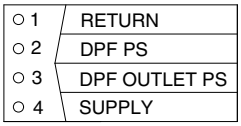
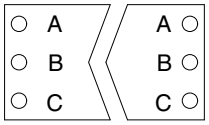
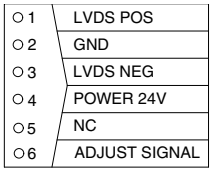
Part name	Symbol	Specifications	Check
Air conditioner compressor	 CN-28	24V 79W	※ Check contact Normal : 13.4Ω
Start relay	 CR-23	24V 300A	※ Check contact Normal : 0.94Ω (for terminal 1-2)
Blower motor		24V 9.5A	※ Check resistance Normal : 2.5Ω (for terminal 1-2)
Duct sensor (switch)		1˚C OFF 4˚C ON	※ Check resistance Normal : 0Ω (for terminal 1-2), the atmosphere temp : Over 4˚C
Door switch	 CS-1	24V 2W	※ Check resistance Normal : About 5MΩ
Switch (power max, one touch decel, horn, breaker)		24V 6A	※ Check resistance Normal : ∞Ω

Part name	Symbol	Specifications	Check
Radar	 CN-441	-	-
Circuit breaker	 CN-60 CN-95	CN-60 : 60A CN-95 : 90A	※ Check disconnection Normal : 0Ω (connect ring terminal and check resist between terminal 1 and 2)
Master switch	 CS-74B	6-36V	※ Check disconnection Normal : 0.1Ω
Quick clamp buzzer	 CN-113	24V 200mA 107±4dB	-
Socket	 CN-139	12V 10A	-
SCR switch	 CS-100	24V 8A	※ Check contact Normal OFF : ∞Ω(for terminal 2-1, 2-3, 4-5, 5-6)

Part name	Symbol	Specifications	Check
Select switch	 CS-120, CS-122, CS-123	24V 8A	※ Check contact Normal 0 or : ∞Ω(for terminal 2-1, 2-3, 4-5, 5-6)
Fuel heater	 CN-96	-	-
DEF/AdBlue® line heater	 CN-381 CN-382 CN-383	-	-
WIF sensor	 CD-45	-	※ Check disconnection Normal : 68.8~4.94Ω
Master switch	 CS-74	6 - 36V	※Check disconnection Normal : 0.1Ω
Rear combination lamp-LH,RH	 CL-15 CL-16	24V 21W×2 LED	※Check resistance Normal : 4.8Ω (For terminal 1-4) Normal : 2.1Ω (For terminal 2-4, 4-5, 4-6)

Part name	Symbol	Specifications	Check
Front combination lamp-LH, RH	 CL-24 CL-25	24V 21W 24V 10W	※Check resistance Normal : 4.8Ω (For terminal 1-2) Normal : 2.1Ω (For terminal 2-3)
Head lamp -LH, RH	 CL-3 CL-4	24V 75/70W	※Check resistance Normal : 1.0Ω (For terminal 1-3, 2-3) Normal : 1.5Ω (For terminal 1-2)
Pressure temperature sensor	 CD-10	5.0V 0.2A	※ Check contact Normal 0Ω(for terminal 1-2, 47.5Ω) ∞Ω(for terminal 3-1, 1kΩ) ∞Ω(for terminal 4-1, 1kΩ)
Sensor (NOx, SCR, DOC)	 CN-J7A CN-J7B CN-J10 CN-J17	-	-
DEF/AdBlue® fill up warning lamp (LED)	 CL-40	-	-
Seat belt switch	 CS-250	-	-

Part name	Symbol	Specifications	Check
DEF/AdBlue® full lamp	 CL-40	-	-
DEF lamp	 CCID	-	-
Air conditioner temperature sensor (incar, ambient)		-	-
EPPR valve	 CN-384 CN-J31	24V 700mA	※Check resistance Normal : 15~25Ω (For terminal 1-2)
DEF/AdBlue® tank level senosr	 CN-380	-	-
TBAP	 EX2B	-	-

Part name	Symbol	Specifications	Check
Dozer act pressure switch	 CD-50	N.O type	※Check resistance Normal : ∞Ω(open)
Flasher unit	 CR-11	24V 85~190 C/M 50dB	-
Speed sensor	 CD-46	-	-
DEF Dif pressure sensor	 AT11A	-	-
Smart button	 CS-2B	-	-
Camera	 CN-249 CN-402 CN-403 CN-404 CN-405	-	-

GROUP 4 CONNECTORS

1. CONNECTOR DESTINATION

Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CN-2	DELPHI	15	I/conn (Frame harness-Engine harness)	2-85262-1	368301-1
CN-3	TYCO	12	I/conn (Frame harness-Engine harness)	174661-2	368537-1
CN-3A	TYCO	15	I/conn (Frame harness-PVG harness)	2-85262-1	368301-1
CN-4	AMP	16	I/conn (Console harness LH-Frame harness)	368047-1	S816-116002
CN-5	DEUTSCH	60	I/conn (Side harness RH-Frame harness)	DRB16-60SAE-L018	DRB12-60PAE-L018
CN-6	AMP	16	I/conn (Console harness RH-Frame harness)	368047-1	S816-116002
CN-7	AMP	15	I/conn (Console harness RH-Frame harness)	2-85262-1	368301-1
CN-7A	AMP	12	I/conn (Console harness RH-Frame harness)	174661-2	368537-1
CN-8	AMP	10	I/conn (Console harness RH-Frame harness)	S816-010002	S816-110002
CN-9	DEUTSCH	12	I/conn (Frame harness-AAVM harness)	DT06-12S	DT04-12PA-P021
CN-10	DEUTSCH	12	I/conn (Cab harness-Side harness RH)	DT06-12S-EP06	DT04-12PA-P021
CN-11	DEUTSCH	8	Air conditioner harness	DT06-8S-EP06	-
CN-12	DEUTSCH	2	I/conn (Frame harness-Boom wire harness)	DT06-2S-EP06	DT04-2P-E005
CN-14	DEUTSCH	6	I/conn (Frame harness-swing parking harness)	DT06-6S-EP06	DT04-6P-EP06
CN-16	AMP	6	Emergency engine start & speed control	S816-006002	S816-106002
CN-16A, B	AMP	6	Emergency engine start & speed control	S816-006002	-
CN-20	DEUTSCH	2	Horn	DT06-2S-EP06	-
CN-21	DEUTSCH	4	Wiper motor	DT06-4S-EP06	-
CN-22	KET	2	Washer pump	MG640605	-
CN-23	KET	2	Speaker-LH	MG610070	-
CN-24	KET	2	Speaker-RH	MG610070	-
CN-25	DEUTSCH	2	Horn	DT06-2S-EP06	-
CN-27A	KUM	16	Radio & USB player	PK145-16017	-
CN-27B	AMP	8	USB player	-	174984-2
CN-28	KET	2	Aircon compressor	MG610320	-
CN-29	KET	2	Receiver dryer	MG640795	-
CN-31	-	2	Fuse 1	-	174352-2
CN-32	-	2	Fuse 1	-	174352-2
CN-36	TYCO	-	Fuse box (micro relay)	-	3-1393292-8
CN-45	RING-TERM	-	Starter motor B^+ /G terminal	S820-410000	-
CN-45	RING-TERM	-	Starter motor M terminal	ST710246-2	-
CN-48	KET	1	Service meter	2-520193-2	-
CN-51	TE	34	MCU	2-1437285-3	-
CN-52	TE	34	MCU	4-1437290-1	-
CN-53	TE	26	MCU	1473416-1	-

Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CN-54	TE	34	MCU	4-1437290-0	-
CN-56A	AMP	12	Cluster	-	174663-2
CN-56B	AMP	8	Cluster	-	174984-2
CN-60	YAZAKI	2	Circuit breaker	-	7222-4220-30
CN-61	DEUTSCH	4	Fuel filler pump	DT06-4S-EP06	DT04-4P-E005
CN-68	DEUTSCH	2	Safety solenoid	DT06-2S-EP06	-
CN-69	DEUTSCH	2	Ram lock solenoid	DT06-2S-EP06	-
CN-70	DEUTSCH	2	Travel high solenoid	DT06-2S-EP06	-
CN-74	RING-TERM	1	Alternator "L" terminal	MG820-105000	-
CN-74	RING-TERM	1	Alternator "B+" terminal	MG820-108000	-
CN-74	RING-TERM	1	Alternator "G" terminal	MG820-306001	-
CN-75	DEUTSCH	2	Main pump shift EPPR valve	DT06-2S-EP06	-
CN-75A	DEUTSCH	2	Main pump DP EPPR valve	DT06-2S-EP06	-
CN-80	RING-TERM	-	Glow plug	S820-406001	-
CN-81	DEUTSCH	2	Travel buzzer solenoid	DT06-2S-EP06	-
CN-88	DEUTSCH	2	Power max solenoid	DT06-2S-EP06	-
CN-93	DELPHI	96	To ECU	13964577	-
CN-95	YAZAKI	2	Circuit breaker	-	722-4220-30
CN-96	-	2	Fuel warmer	1530 0027	-
CN-100	KET	1	Battery earth	MG640994-5	-
CN-113	KET	2	Quick clamp buzzer	MG651205-5	-
CN-122	DEUTSCH	2	Forward solenoid	DT06-2S-EP06	-
CN-123	DEUTSCH	2	Reverse solenoid	DT06-2S-EP06	-
CN-125	Econoseal J	4	GPS connector	S816-004002	S816-104002
CN-125A	DEUTSCH	12	GPS	DT06-12S-P021	DT04-12PA-P021
CN-125B	DEUTSCH	8	RMS	DT06-8S	DT04-8P
CN-126	AMP	10	I/conn (Frame harness-Service tool)	S816-010002	S816-110002
CN-126	DEUTSCH	9	Service tool	-	HD10-9-969
CN-126A	DEUTSCH	4	RMS service tool	DT06-4S	DT04-4P
CN-131	-	6	I/conn (Stop lamp harness-Frame harness)	S816-006002	S816-106002
CN-132	DEUTSCH	2	Safety solenoid	DT06-2S-EP06	-
CN-138	FASTEN	3	DC/DC Converter	S810-003202	-
CN-139	FASTEN	2	12V socket	172434-2	-
CN-140	DEUTSCH	2	Quick clamp solenoid	DT06-2S-EP06	DT04-2P-E005
CN-147	-	2	Fuel heater	1530 00 27	-
CN-154	DEUTSCH	2	Fan EPPR	DT06-2S-EP06	-
CN-155	DEUTSCH	2	Fan reverse solenoid	DT06-2S-EP06	-
CN-156	DEUTSCH	60	MTCU	DRC26-40SA	-
CN-156	AMP	2	Air seat	-	S822-114002

Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CN-157	AMP	1	Antena power	S822-014002	-
CN-168	DEUTSCH	12	PVED-CLS	DT06-12S	-
CN-173	DEUTSCH	3	Resistor	DT06-3S-EP06	DT04-3P-EP10
CN-174	DEUTSCH	3	Resistor	DT06-3S-EP06	-
CN-181	DEUTSCH	2	Travel low speed solenoid	DT06-2S-EP06	-
CN-197	DEUTSCH	2	Swing brake solenoid	DT06-2S-EP06	-
CN-206	DEUTSCH	2	Creep solenoid	DT06-2S-EP06	-
CN-214	DEUTSCH	2	Front outrigger solenoid - RH	DT06-2S-EP06	DT04-2P-E005
CN-216	DEUTSCH	2	Front outrigger solenoid - LH	DT06-2S-EP06	DT04-2P-E005
CN-218	DEUTSCH	2	Rear outrigger solenoid - RH	DT06-2S-EP06	DT04-2P-E005
CN-220	DEUTSCH	2	Rear outrigger solenoid - LH	DT06-2S-EP06	DT04-2P-E005
CN-238	DEUTSCH	2	Rotate-LH	DT06-2S-EP06	-
CN-239	DEUTSCH	2	Rotate-RH	DT06-2S-EP06	-
CN-246	DEUTSCH	2	Cruise solenoid	DT06-2S-EP06	-
CN-246	DEUTSCH	8	PVG switch	DT06-8S	-
CN-247	DEUTSCH	8	PVG signal	DT06-8S	-
CN-249	DEUTSCH	6	Rear view camera	DT06-6S-EP06	DT04-6P
CN-255	-	16	Slipring	368047-1	8-1447231-9
CN-255A	DEUTSCH	8	Trailer hitch	DT06-8S	DT04-8P
CN-255B	-	7	Trailer socket	-	-
CN-305	DEUTSCH	12	PVG connector	DTM06-12SA	-
CN-306	DEUTSCH	12	PVG connector	DTM06-12SB	-
CN-307	DEUTSCH	3	Service tool	DT06-3S-EP06	DT04-3P-E005
CN-309	DEUTSCH	2	2 way release	DT06-2S-EP06	-
CN-310	DEUTSCH	2	2 way clamp	DT06-2S-EP06	-
CN-313	DEUTSCH	4	Service tool	DT06-4S	-
CN-363	-	12	Jog dial module	174045-2	-
CN-365	DEUTSCH	2	Attachment relief EPPR valve 1	DT06-2S-EP06	-
CN-366	DEUTSCH	2	Attachment relief EPPR valve 2	DT06-2S-EP06	-
CN-369	DEUTSCH	2	Boom down cut-off solenoid	DT06-2S-E005	-
CN-370	DEUTSCH	2	Swing fine control solenoid	DT06-2S-EP06	-
CN-376	TYCO	23	RDU	7706087-2	-
CN-379	TYCO	12	SCR supply module	2-1703639-1	-
CN-380	DEUTSCH	4	DEF/AdBlue® tank level sensor	DT06-4S-EP06	-
CN-381	DEUTSCH	2	DEF/AdBlue® line heater 1	DT06-2S-EP06	-
CN-382	DEUTSCH	2	DEF/AdBlue® line heater 2	DT06-2S-EP06	-
CN-383	DEUTSCH	2	DEF/AdBlue® line heater 3	DT06-2S-EP06	-
CN-384	TYCO	2	Coolant valve	1-967325-3	-
CN-401	TE	35	AAVM controller	776164-1	-

Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CN-402	DEUTSCH	6	Front view camera	DT06-6S-P021	DT04-6P-P021
CN-403	DEUTSCH	6	Rear view camera	-	DT04-6P-EP14
CN-404	DEUTSCH	6	Left view camera	-	DT04-6P-EP14
CN-405	DEUTSCH	6	Right view camera	-	DT04-6P-EP14
CN-406	DEUTSCH	3	RS 232	DT06-3S-EP06	DT04-3P-E005
CN-419	DEUTSCH	2	Swing parking A1	DT06-2S-EP06	-
CN-420	DEUTSCH	2	Swing parking A2	DT06-2S-EP06	-
CN-421	DEUTSCH	2	Swing parking A3	DT06-2S-EP06	-
CN-427	MOLEX	12	Reader	5557-12R	5559-12P
CN-430	DEUTSCH	12	I/conn (Side harness RH-Aftertreatment harness)	DT06-12S-EP06	DT06-12P-E005
CN-431	KET	20	Aux monitor	MG653026	-
CN-444	DEUTSCH	2	Fuel filler pump switch 1	DT06-2S-EP06	-
CN-445	DEUTSCH	4	Fuel filler pump switch 2	DT06-4S-EP06	-
CN-451	CARLING	10	Trailer indicator	VC2-01	-
CN-500	DEUTSCH	6	Ride control solenoid connector	DT06-6S-EP06	-
CN-500	DEUTSCH	6	I/conn (Frame harness-Ride control harness)	-	DT04-6P
CN-501	DEUTSCH	2	Ride control solenoid 1	DT06-2S-E005	-
CN-502	DEUTSCH	2	Ride control solenoid 2	DT06-2S-E005	-
CN-503	DEUTSCH	2	Ride control solenoid 3	DT06-2S-E005	-
CN-506	DEUTSCH	2	Lift solenoid	DT06-2S-EP06	DT04-2P
CN-507	DEUTSCH	2	Digging brake EPPR	DT06-2S-EP06	-
CN-508	DEUTSCH	2	Digging brake solenoid	DT06-2S-EP06	-
CN-J7A	TYCO	4	DOC NOx sensor	2-1418390-1	-
CN-J7B	TYCO	4	SCR NOx sensor	1-1418390-1	-
CN-J10	TYCO	4	SCR thermistor controller	5-1418390-1	-
CN-J17	TYCO	4	DOC thermistor controller	4-1418390-1	-
CN-J31	BOSCH	2	DEF/AdBlue® dosing module	1_928_403_874	-
CC1D	FCI	14	DEF lamp connector	13533441	-
CC8D	DEUTSCH	4	Engine side crossover connector	DT06-4S-EP06	-
EX2B	FCI	4	TBAP	54200419	-
J-1	TE	20	Multifunction switch	-	1-0640514-0
J-2	TE	20	Multifunction switch	1-0640524-0	-
· Relay					
CR-1	RING-TERM	1	Battery relay B+/IG terminal	ST710285-2	-
CR-2	-	5	Horn relay	-	-
CR-3	-	5	Working lamp relay	-	-
CR-4	-	5	Wiper relay	-	-
CR-5	-	5	Anti restart relay	-	-
CR-6	TE	4	Wiper relay - int	174202-1	-

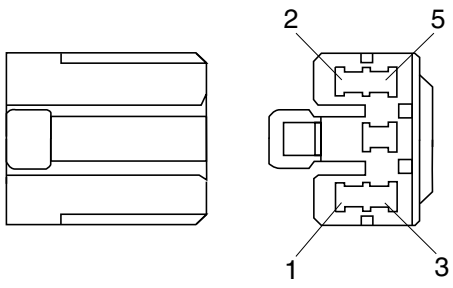
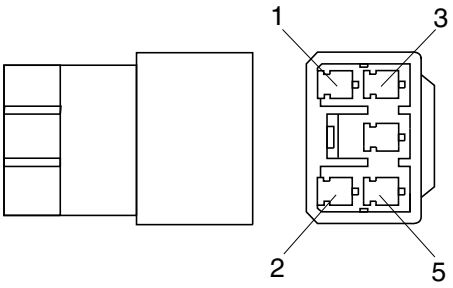
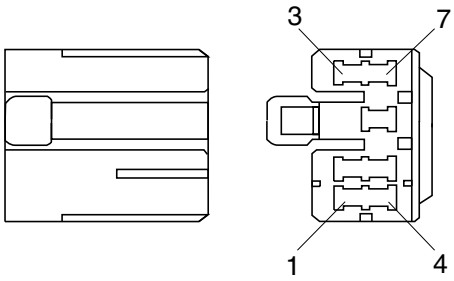
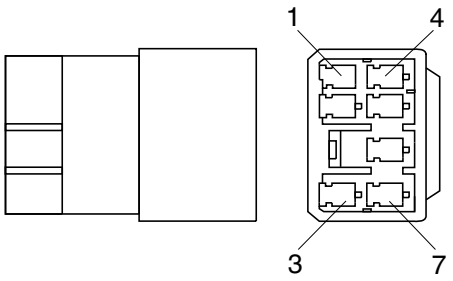
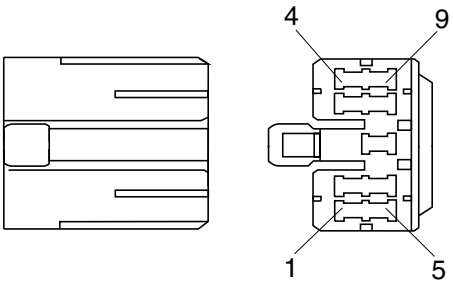
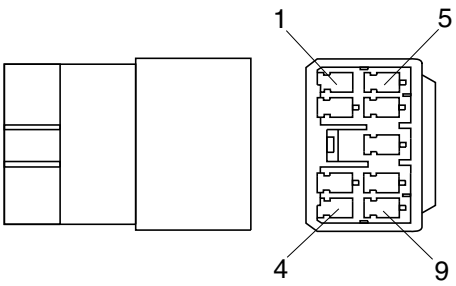
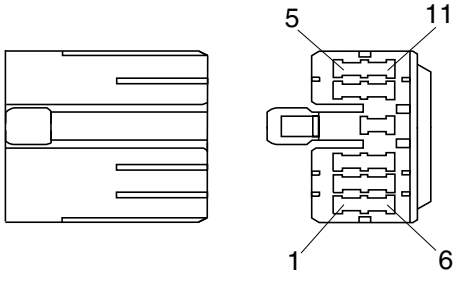
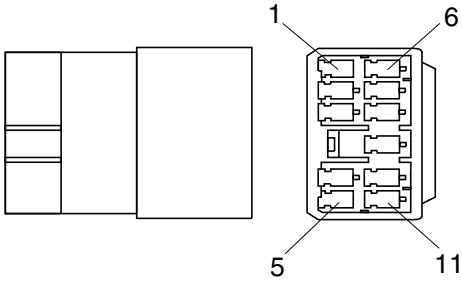
Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CR-7	-	5	Aircon compressor relay	-	-
CR-9	-	5	Cabin lamp relay	-	-
CR-11	HELLA	6	Flasher unit relay	701-230-001	-
CR-12	-	5	Travel speed relay	-	-
CR-13	-	5	Head lamp low relay	-	-
CR-14	-	5	Head lamp high relay	-	-
CR-15	-	5	Illumination relay	-	-
CR-23	RINGTERM	1	Start relay S/G terminal	ST712089-2	-
CR-23	RINGTERM	1	Start relay B+/M terminal	ST710384-2	-
CR-24	RING TERM	1	Preheat relay B+/P terminal	S820-406001	-
CR-24	RING TERM	1	Preheat relay G terminal	S820-108000	-
CR-24	RING TERM	1	Preheat relay S terminal	S820-014000	-
CR-30	-	5	Travel reverse relay	-	-
CR-35	-	5	Power relay	-	-
CR-36	-	5	Preheat relay	-	-
CR-39	-	5	Starter lockout relay	-	-
CR-44	-	5	Rear work lamp relay	-	-
CR-45	-	5	Stop lamp relay	-	-
CR-46	-	5	Fuel warmer relay	-	-
CR-47	-	5	Safety solenoid relay	-	-
CR-49	-	5	Washer pump relay	-	-
CR-50	-	5	NOx sensor relay	-	-
CR-51	-	5	DEF module relay	-	-
CR-52	-	5	Line heater relay	-	-
CR-66	-	5	Parking relay	-	-
CR-69	-	5	Turn relay - RH	-	-
CR-70	-	5	Turn relay - LH	-	-
CR-78	-	5	Head lamp power relay	-	-
CR-81	-	5	Front outrigger relay - RH	-	-
CR-82	-	5	Front outrigger relay - LH	-	-
CR-83	-	5	Rear outrigger relay - RH	-	-
CR-84	-	5	Rear outrigger relay - LH	-	-
CR-85	-	5	Beacon lamp relay	-	-
· Switch					
CS-1	SHUR	1	Door switch	S822-014002	-
CS-2A	WP	6	Start key switch	S814-006100	-
CS-2B	DEUTSCH	3	BKCU	DT06-3S-EP06	DT04-3P-E005
CS-2C	KET	3	BKCU	MG651032	-
CS-2D	KET	3	Button key	-	MG641035

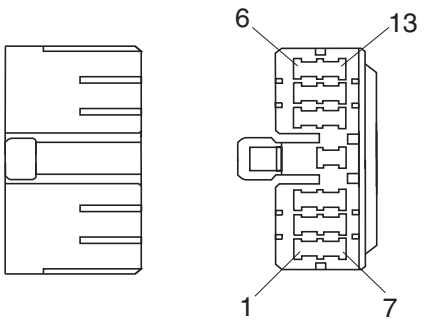
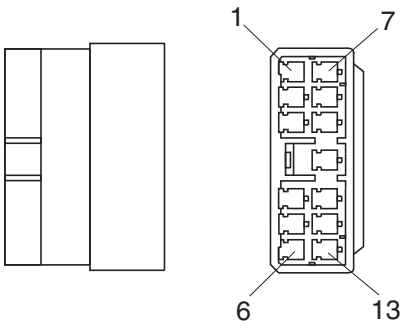
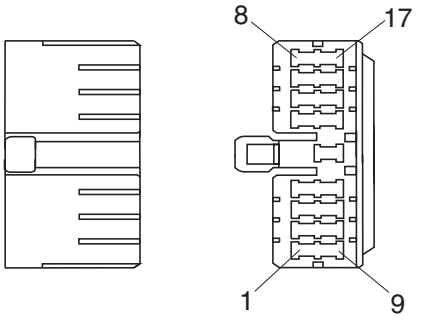
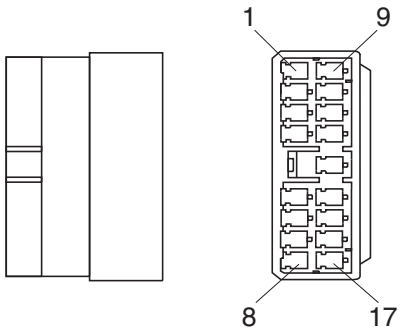
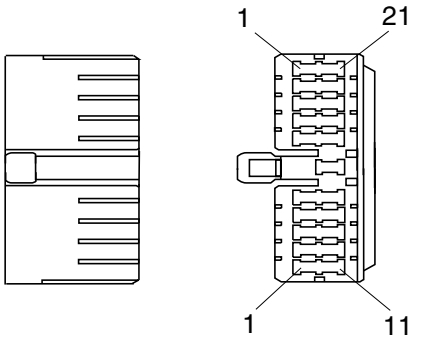
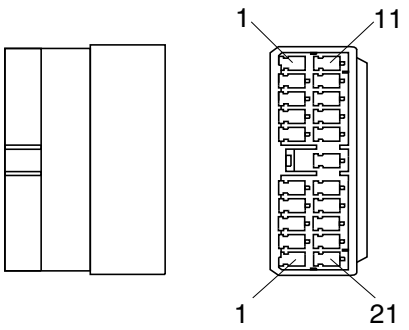
Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CS-4	DEUTSCH	3	Safety switch	DT06-3S	-
CS-10	DEUTSCH	6	FNR switch	DT06-6S	-
CS-20	DEUTSCH	3	Safety switch	-	DT04-3P
CS-23	CARLING	10	Auto cruise switch	VC2-01	-
CS-29	DEUTSCH	6	Power max switch	DT06-6S	-
CS-33	-	6	Emergency engine stop switch	S816-006002	S816-106002
CS-61	-	2	Boom floating switch	174352-2	S816-102002
CS-67	CARLING	10	Quick clamp switch	VC2-01	-
CS-73	CARLING	10	Swing lock switch	VC2-01	-
CS-73A	CARLING	10	Fine swing switch	VC2-01	-
CS-74A	AMP	2	Master switch	S813-030201	-
CS-74B	DEUTSCH	2	Master switch	DT06-2S-EP06	-
CS-100	CARLING	10	SCR switch	VC2-01	-
CS-120	CARLING	10	Trailer lift switch	VC2-01	-
CS-121	CARLING	10	Auto digging brake switch	VC2-01	-
CS-122	CARLING	10	E steeing & crusher switch	VC2-01	-
CS-123	CARLING	10	Boom float & ride control switch	VC2-01	-
CS-124	CARLING	10	FNR emergency switch	VC2-01	-
CS-125	CARLING	10	FNR select switch	VC2-01	-
CS-250	DEUTSCH	2	Seat belt switch	DT06-2S	-
· Light					
CL-1	KET	3	Room lamp	MG651032	-
CL-2	AMP	1	Cigar lighter	S822-014002 -	S822-114002 S810-001202
CL-3	-	3	Head lamp-LH	S810-003702	-
CL-4	-	3	Head lamp-RH	S810-003702	-
CL-5	DEUTSCH	2	Work lamp-LH	DT06-2S-EP06	-
CL-6	DEUTSCH	2	Work lamp-RH	DT06-2S-EP06	-
CL-7	DEUTSCH	2	Beacon lamp	DT06-2S-EP06	DT04-2P
CL-8	DEUTSCH	2	Cab light-LH	DT06-2S-EP06	DT04-2P
CL-9	DEUTSCH	2	Cab light-RH	DT06-2S-EP06	DT04-2P
CL-10	DEUTSCH	2	Cab light-RH	DT06-2S-EP06	DT04-2P
CL-15	AMP	6	Rear combination lamp-LH	S816-006002	-
CL-16	AMP	6	Rear combination lamp-RH	S816-006002	-
CL-21	KET	2	Number plate lamp	S814-002000	-
CL-24	AMP	3	Front combination lamp-LH	S816-003002	-
CL-24	DEUTSCH	2	Rear work lamp	DT06-2S-EP06	DT04-2P-E005
CL-25	AMP	3	Front combination lamp-RH	S816-003002	-
CL-40	DEUTSCH	2	DEF/AdBlue® lamp	DT06-2S-EP06	-

Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
· Sensor, sendor					
CD-1	AMP	2	Hydraulic oil temp sender	85202-1	-
CD-2	DEUTSCH	2	Fuel level sender	DT06-2S-EP06	-
CD-3	DEUTSCH	3	Brake oil pressure sensor	DT06-3S-EP06	-
CD-4	DEUTSCH	3	Stop lamp pressure sensor	DT06-3S-EP06	-
CD-5	DEUTSCH	3	Transmission oil pressure sensor	DT06-3S-EP06	-
CD-10A	SUMITOMO	4	TBAP	6098-0144	-
CD-16	AMP	3	Water level sensor	1211-0293	-
CD-24	DEUTSCH	3	Swing pressure sensor	DT06-3S-EP06	-
CD-31	DEUTSCH	3	Overload pressure sensor	DT06-3S-EP06	DT04-3P-E005
CD-32	DEUTSCH	3	Boom up pressure sensor	DT06-3S-EP06	-
CD-35	DEUTSCH	3	Arm out pressure sensor	DT06-3S-EP06	-
CD-37	DEUTSCH	3	2 piece pressure sensor	DT06-3S-EP06	DT04-3P
CD-38	DEUTSCH	3	Work brake pressure sensor	DT06-3S-EP06	-
CD-39	DEUTSCH	3	Pump load sensing pressure sensor	DT06-3S-EP06	-
CD-42	DEUTSCH	3	P1 pressure sensor	DT06-3S-EP06	-
CD-44	DEUTSCH	3	Pump option pressure sensor	DT06-3S-EP06	-
CD-45	DEUTSCH	2	WIF sensor	DT06-2S-EP06	-
CD-46	AMP	3	Speed sensor	282087	-
CD-50	KET	2	Outrigger action pressure sensor	MG640975	-
CD-52	-	2	Fan speed sensor	174352-2	-
CD-57	DEUTSCH	4	SASA S/S	DT06-4S	-
CD-73	DEUTSCH	3	Travel forward pressure sensor	DT06-3S-EP06	DT04-3P
CD-85	DEUTSCH	3	Boom down pressure sensor	DT06-3S-EP06	-
CD-87	DEUTSCH	3	Bucket out pressure sensor	DT06-3S-EP06	-
CD-90	DEUTSCH	3	Arm in pressure sensor	DT06-3S-EP06	-
CD-95	DEUTSCH	3	Bucket in pressure sensor	DT06-3S-EP06	-
CD-100	DEUTSCH	3	Outrigger pressure sensor	DT06-3S-EP06	-
CD-101	DEUTSCH	3	Load sensing pressure sensor	DT06-3S-EP06	-
CD-102	DEUTSCH	3	Brake pressure sensor	DT06-3S-EP06	-
CD-124	DEUTSCH	3	Boom rod cylinder pressure sensor	DT06-3S-E005	-
CD-145	DEUTSCH	3	Option RH - A	DT06-3S-EP06	DT04-3P-E005
CD-146	DEUTSCH	3	Option RH - B	DT06-3S-EP06	DT04-3P-E005
CD-156	DEUTSCH	3	Swing brake pressure sensor	DT06-3S-EP06	DT04-3P

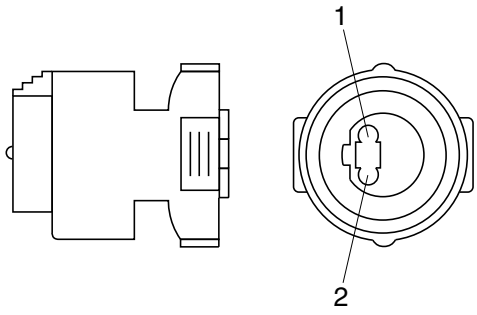
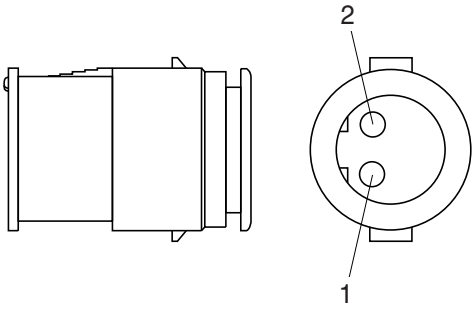
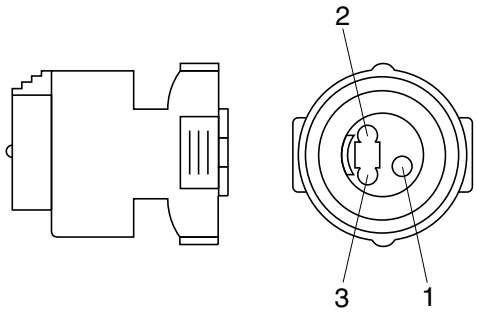
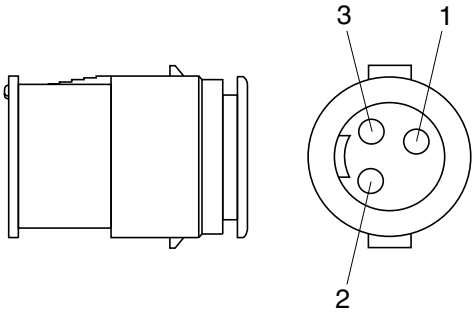
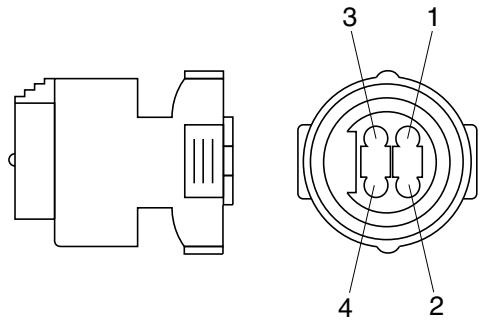
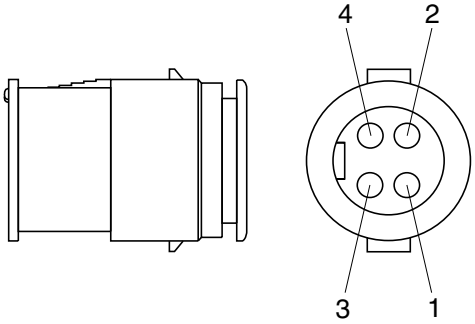
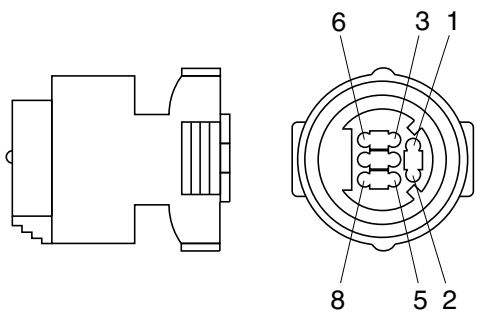
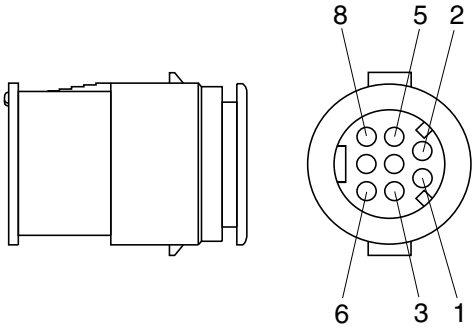
2. CONNECTION TABLE FOR CONNECTORS

1) PA TYPE CONNECTOR

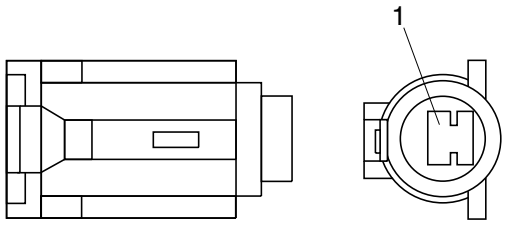
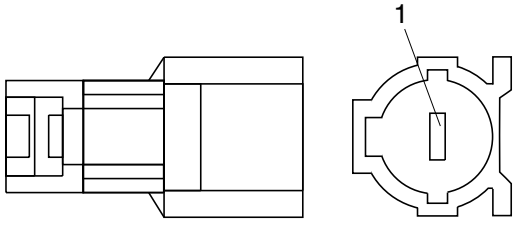
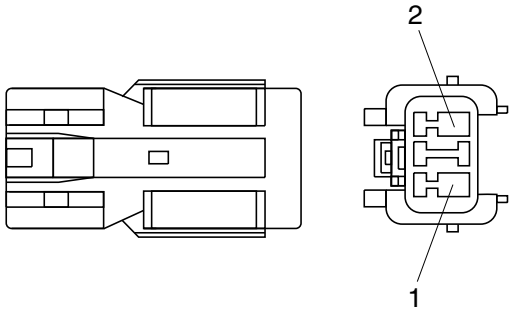
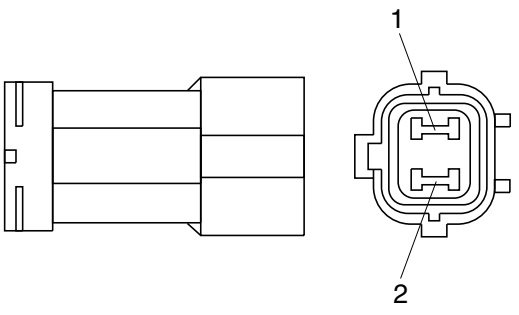
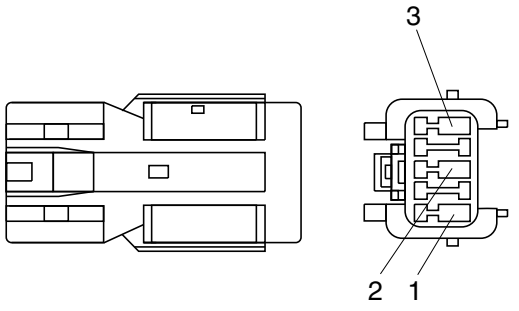
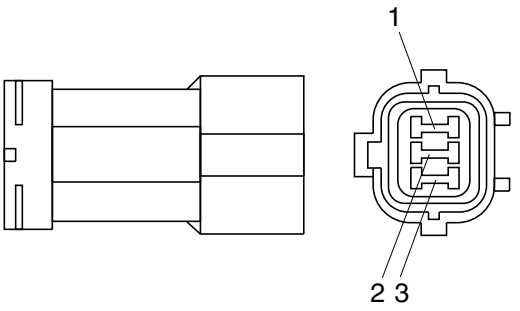
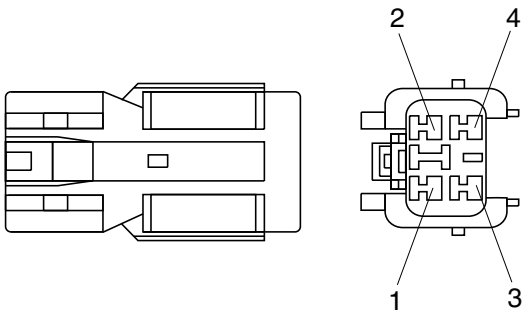
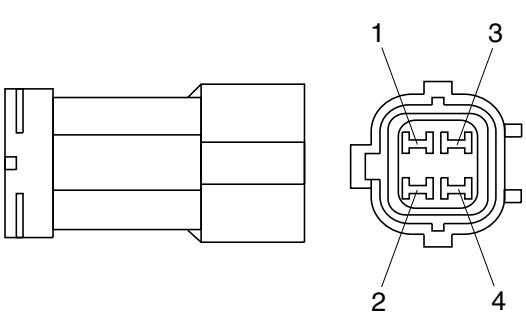
No. of pin	Receptacle connector (female)	Plug connector (male)
5	 S811-005002	 S811-105002
7	 S811-007002	 S811-107002
9	 S811-009002	 3S811-109002
11	 S811-011002	 S811-111002

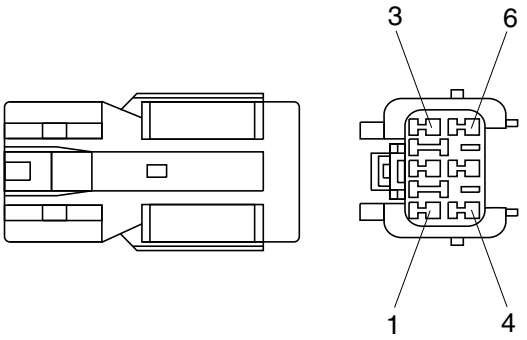
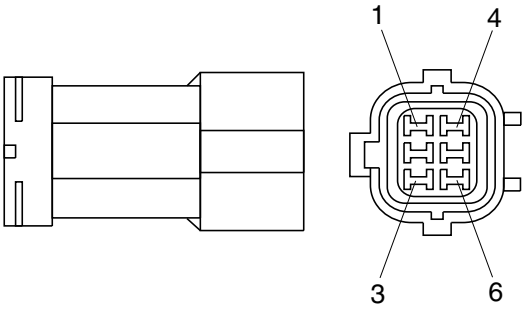
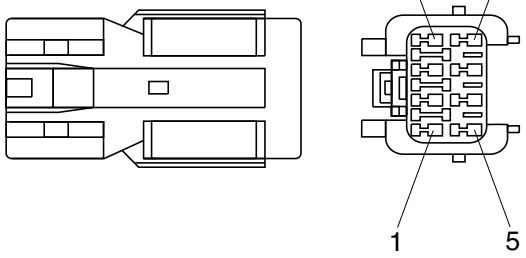
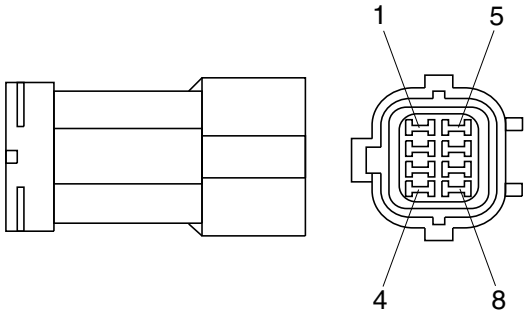
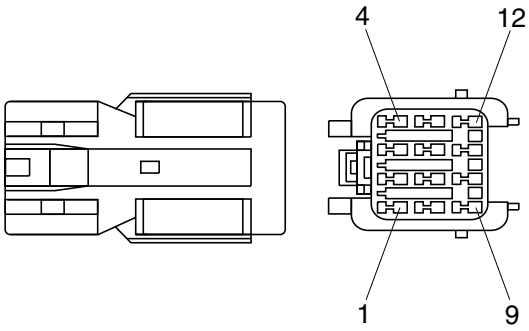
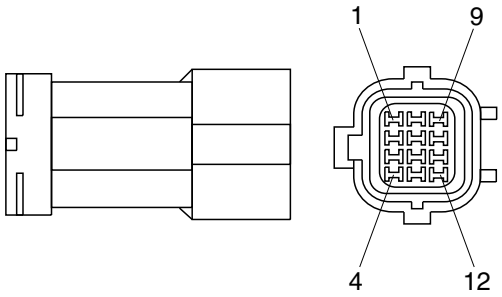
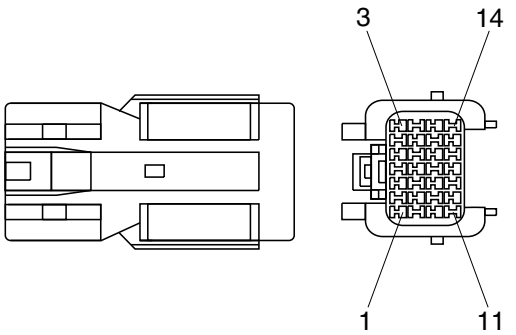
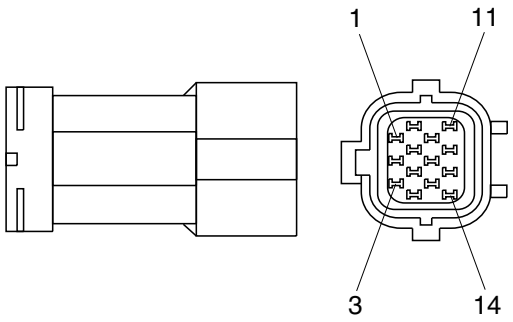
No. of pin	Receptacle connector (female)	Plug connector (male)
13	 S811-013002	 S811-113002
17	 S811-017002	 S811-117002
21	 S811-021002	 S811-121002

2) J TYPE CONNECTOR

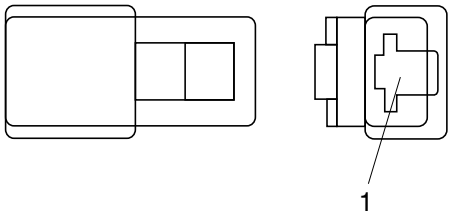
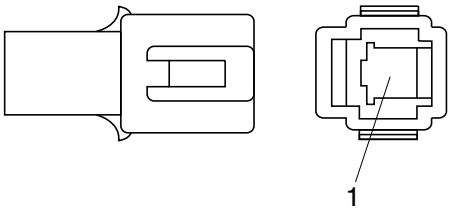
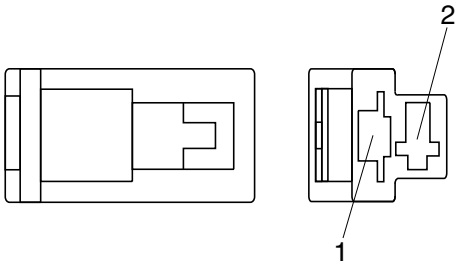
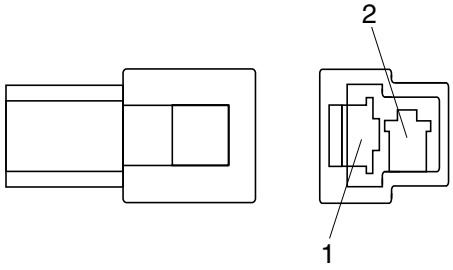
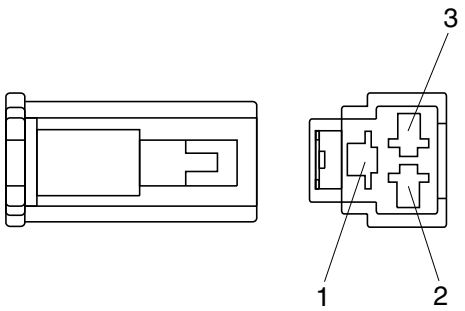
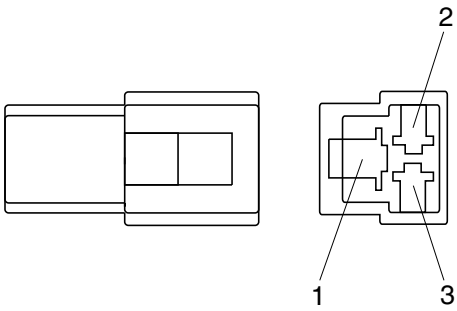
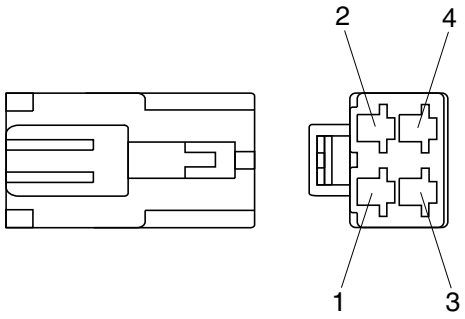
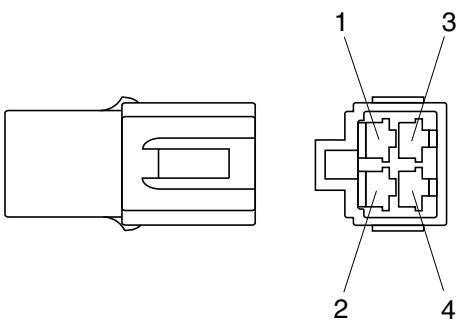
No. of pin	Receptacle connector (female)	Plug connector (male)
2	 S816-002001	 S816-102001
3	 S816-003001	 S816-103001
4	 S816-004001	 S816-104001
8	 S816-008001	 S816-108001

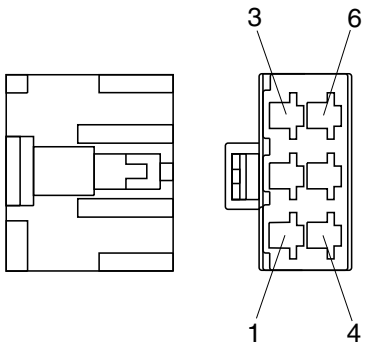
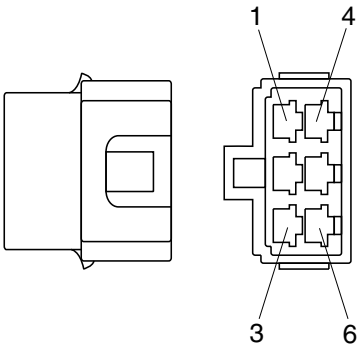
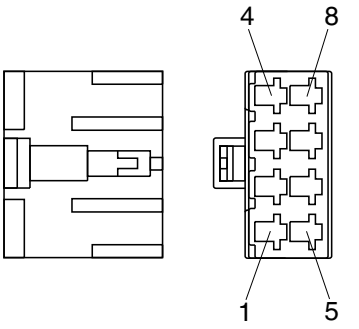
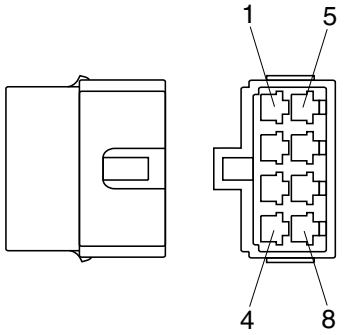
3) SWP TYPE CONNECTOR

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

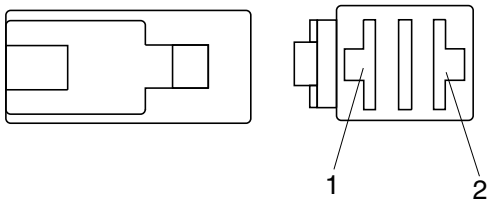
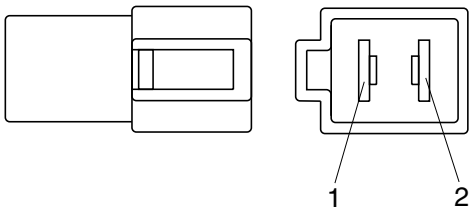
No. of pin	Receptacle connector (female)	Plug connector (male)
6	 S814-006000	 S814-106000
8	 S814-008000	 S814-108000
12	 S814-012000	 S814-112000
14	 S814-014000	 S814-114000

4) CN TYPE CONNECTOR

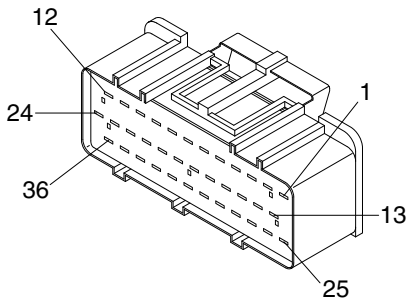
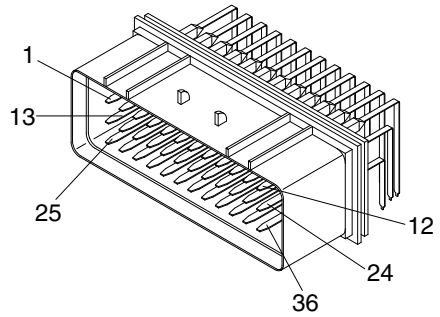
No. of pin	Receptacle connector (female)	Plug connector (male)
1	 S810-001202	 S810-101202
2	 S810-002202	 S810-102202
3	 S810-003202	 S810-103202
4	 S810-004202	 S810-104202

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

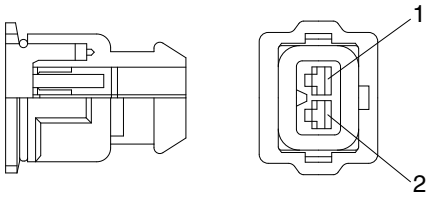
5) 375 FASTEN TYPE CONNECTOR

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

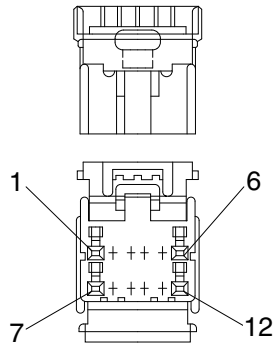
6) AMP ECONOSEAL CONNECTOR

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

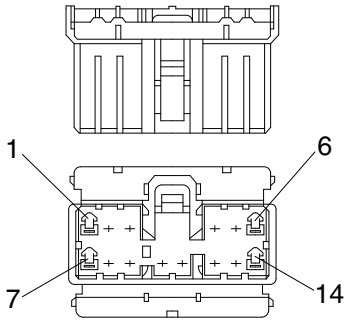
7) AMP TIMER CONNECTOR

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

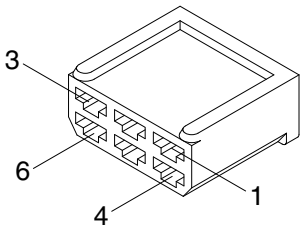
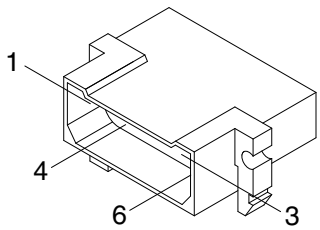
8) AMP 040 MULTILOCK CONNECTOR

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

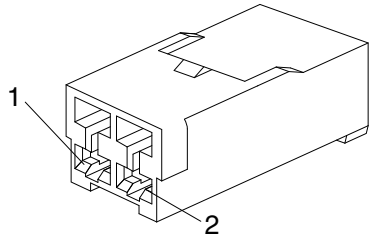
9) AMP 070 MULTILOCK CONNECTOR

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

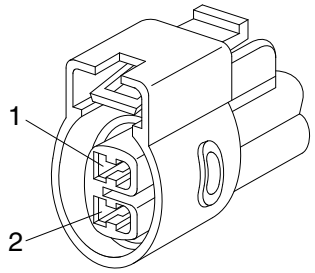
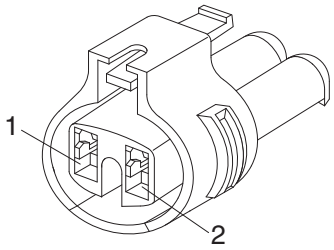
10) AMP FASTIN - FASTON CONNECTOR

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

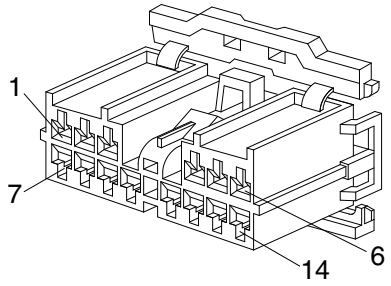
11) KET 090 CONNECTOR

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

12) KET 090 WP CONNECTORS

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

13) KET SDL CONNECTOR

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

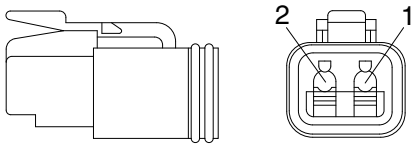
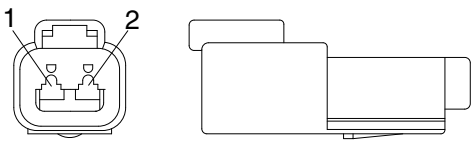
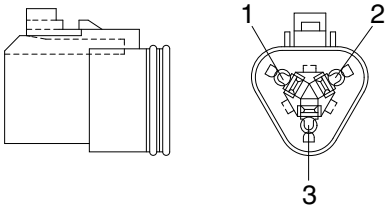
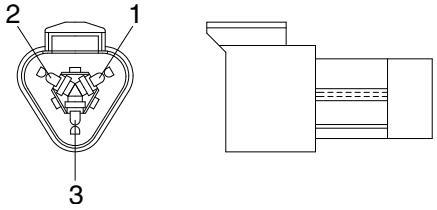
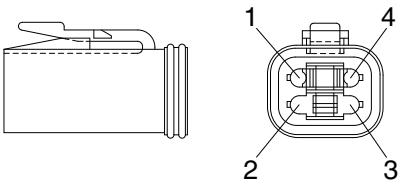
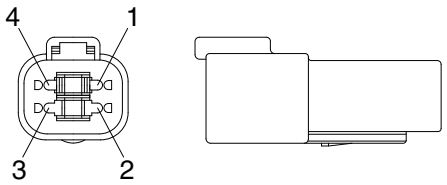
14) DEUTSCH DT CONNECTORS

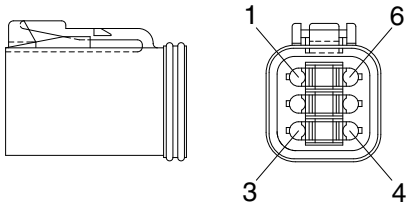
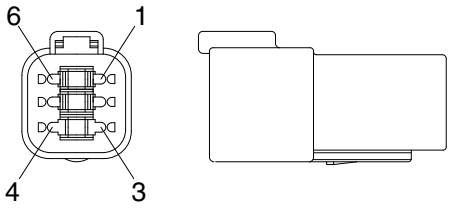
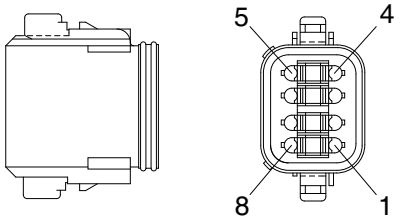
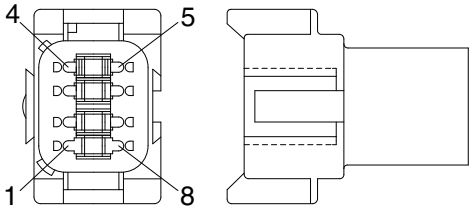
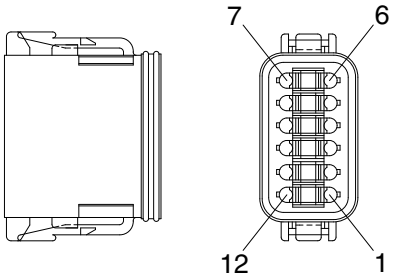
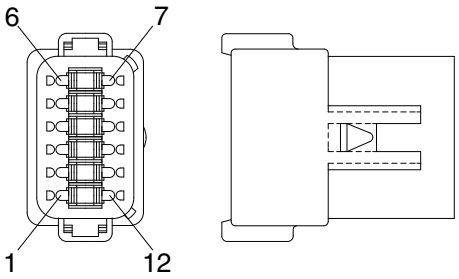
DT 06 - 3S - ★★★★

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

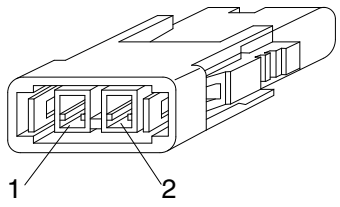
※ Modification

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

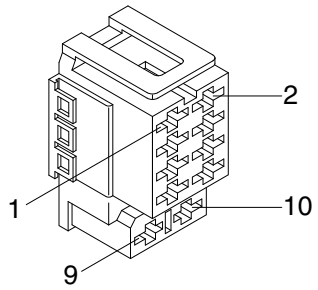
No. of pin	Receptacle connector (female)	Plug connector (male)
2	 DT06-2S	 DT04-2P
3	 DT06-3S	 DT04-3P
4	 DT06-4S	 DT04-4P

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

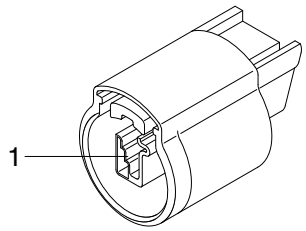
15) MOLEX 2CKTS CONNECTOR

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

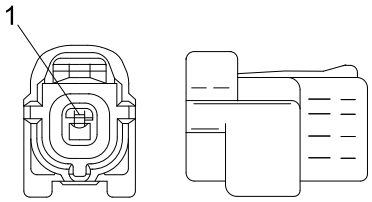
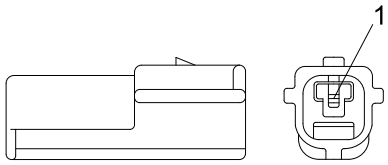
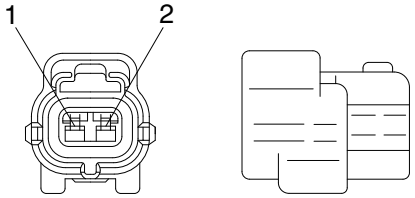
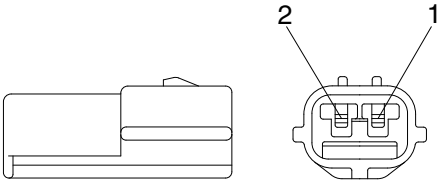
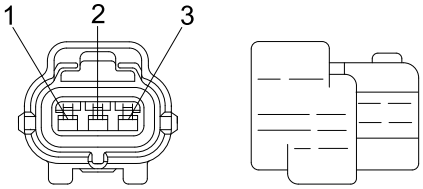
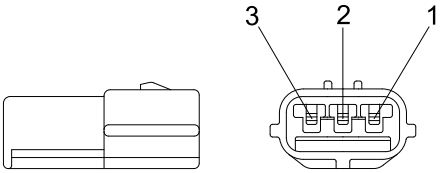
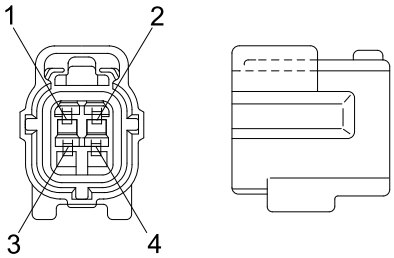
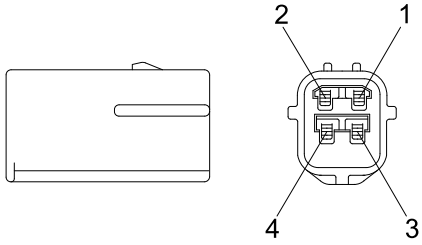
16) ITT SWF CONNECTOR

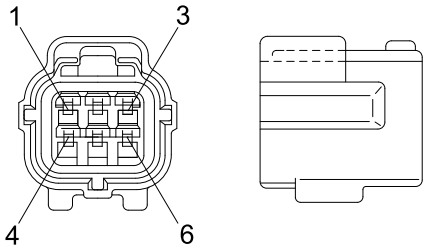
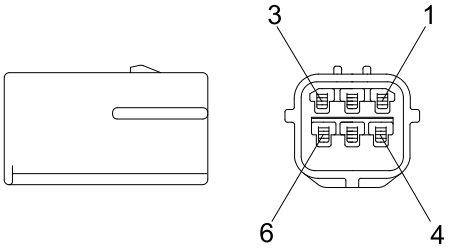
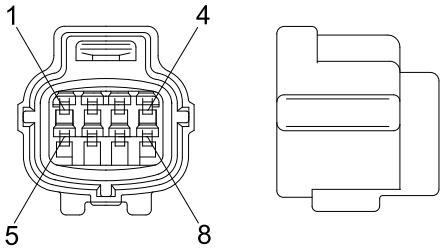
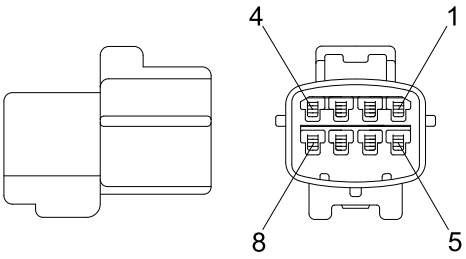
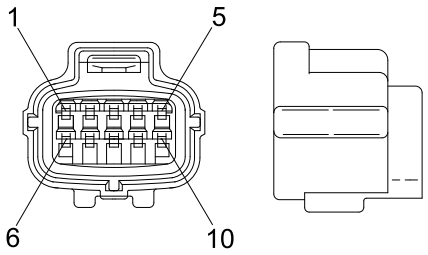
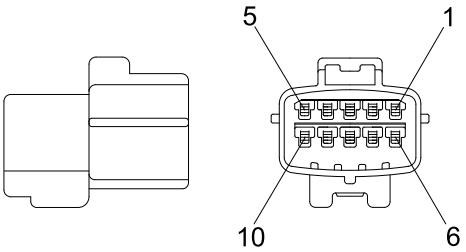
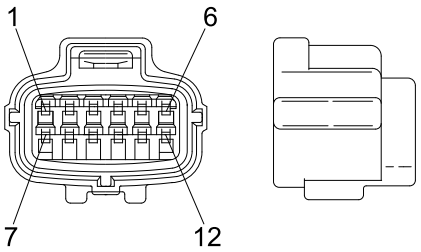
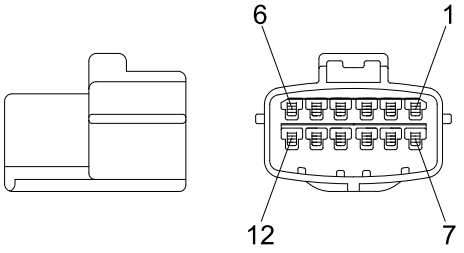
No. of pin	Receptacle connector (female)	Plug connector (male)
10	 SWF593757	

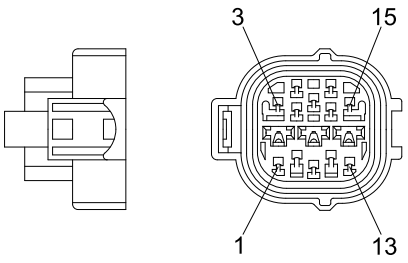
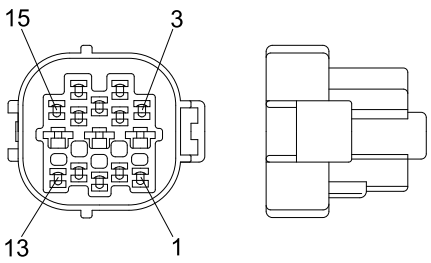
17) MWP NMWP CONNECTOR

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

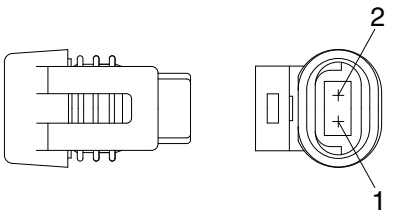
18) ECONOSEAL J TYPE CONNECTORS

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

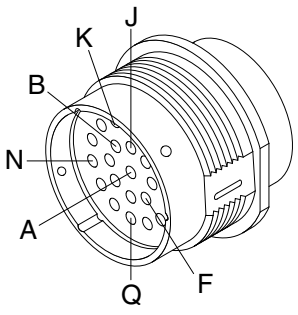
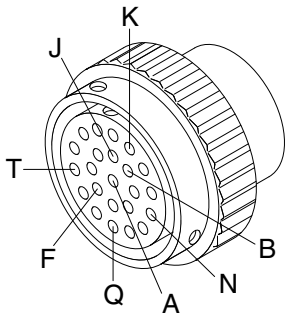
No. of pin	Receptacle connector (female)	Plug connector (male)
6	 S816-006002	 S816-106002
8	 S816-008002	 S816-108002
10	 S816-010002	 S816-110002
12	 S816-012002	 S816-112002

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

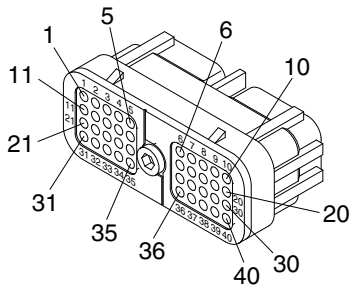
19) METRI-PACK TYPE CONNECTOR

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

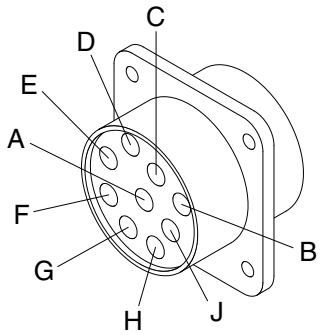
20) DEUTSCH HD30 CONNECTOR

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

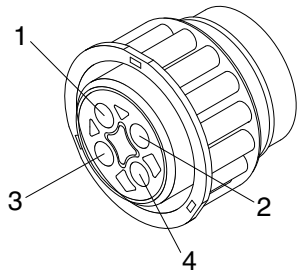
21) DEUTSCH MCU CONNECTOR

No. of pin	Receptacle connector (female)	Plug connector (male)
40	 DRC26-40SA/B	

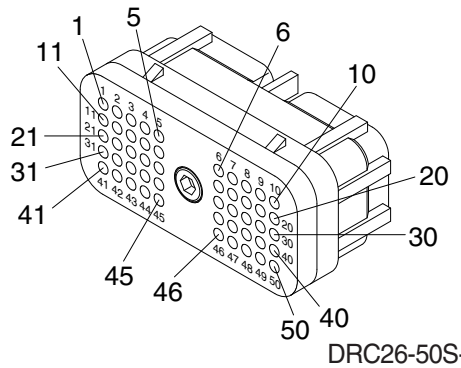
22) DEUTSCH SERVICE TOOL CONNECTOR

No. of pin	Receptacle connector (female)	Plug connector (male)
9	 HD10-9-96P	

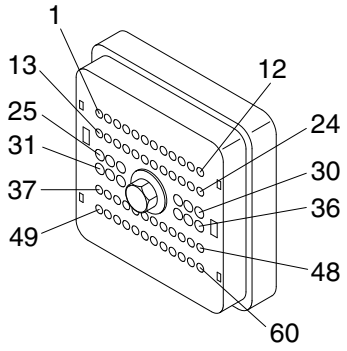
23) AMP FUEL WARMER CONNECTOR

No. of pin	Receptacle connector (female)	Plug connector (male)
4	 2-967325-3	

24) DEUTSCH ENGINE ECM CONNECTOR

No. of pin	Receptacle connector (female)	Plug connector (male)
50	 DRC26-50S-04	

25) DEUTSCH INTERMEDIATE CONNECTOR

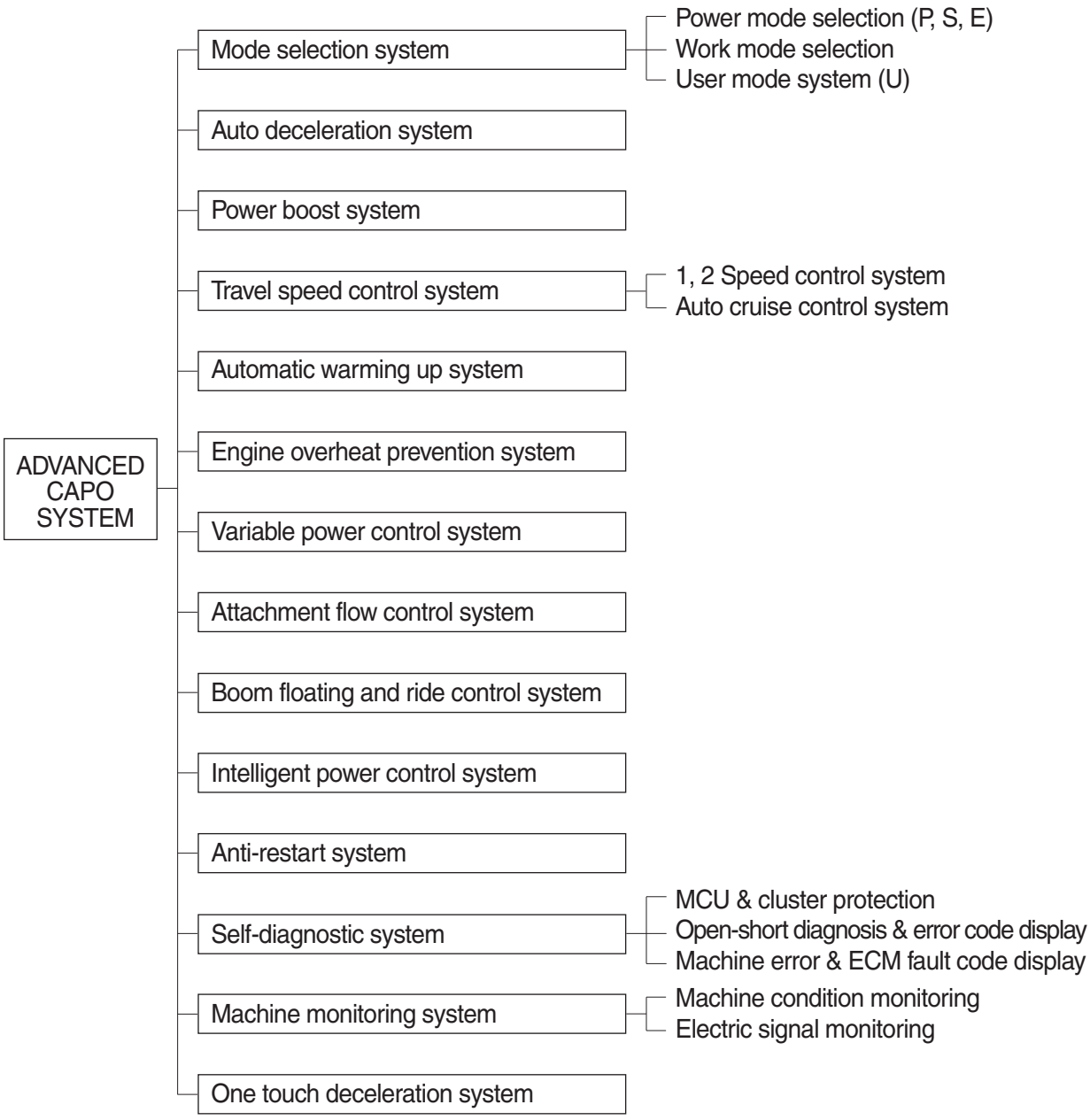
No. of pin	Receptacle connector (female)	Plug connector (male)
60	 DRB16-60SAE-L018	

SECTION 5 MECHATRONICS SYSTEM

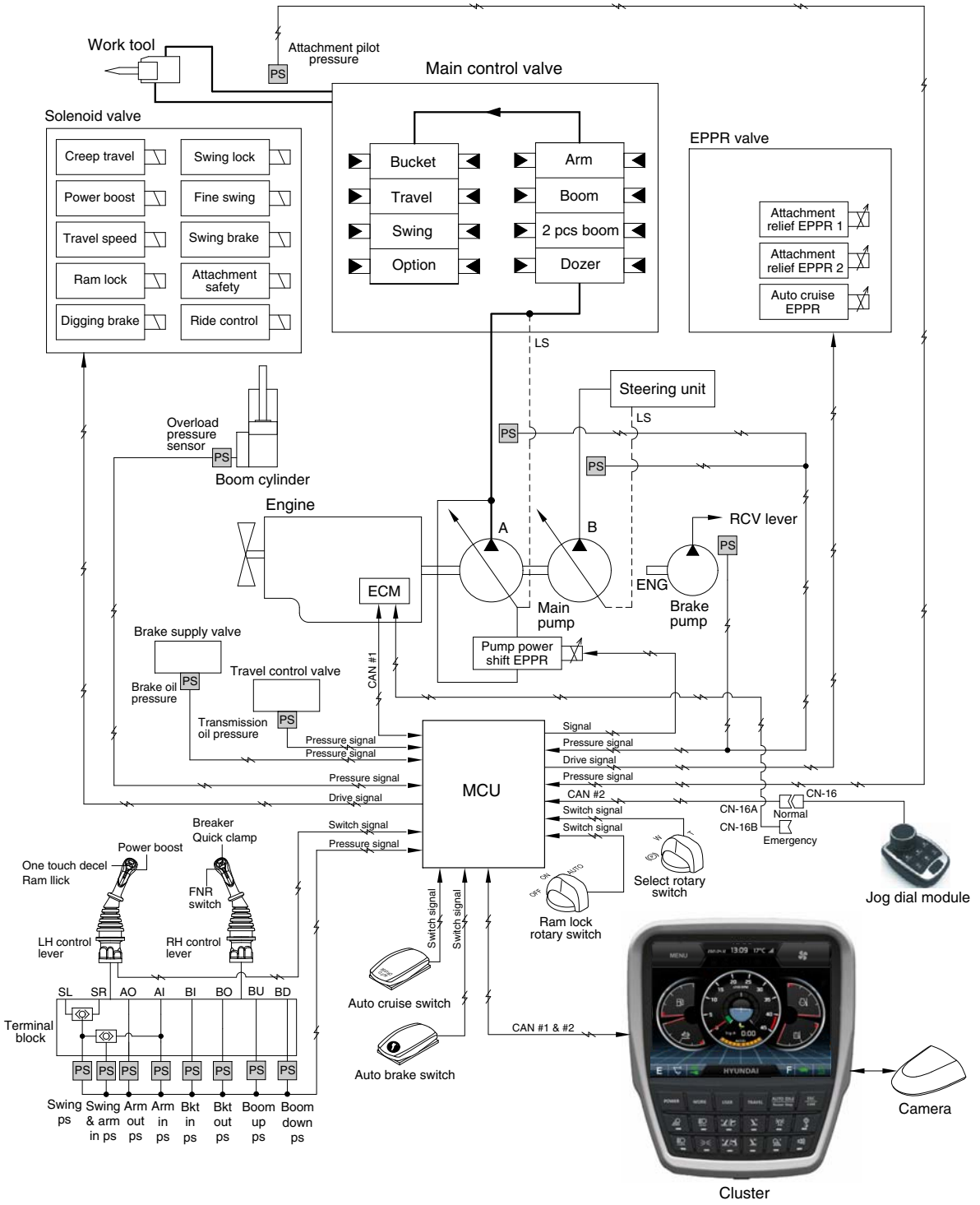
SECTION 5 MECHATRONICS SYSTEM

GROUP 1 OUTLINE

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



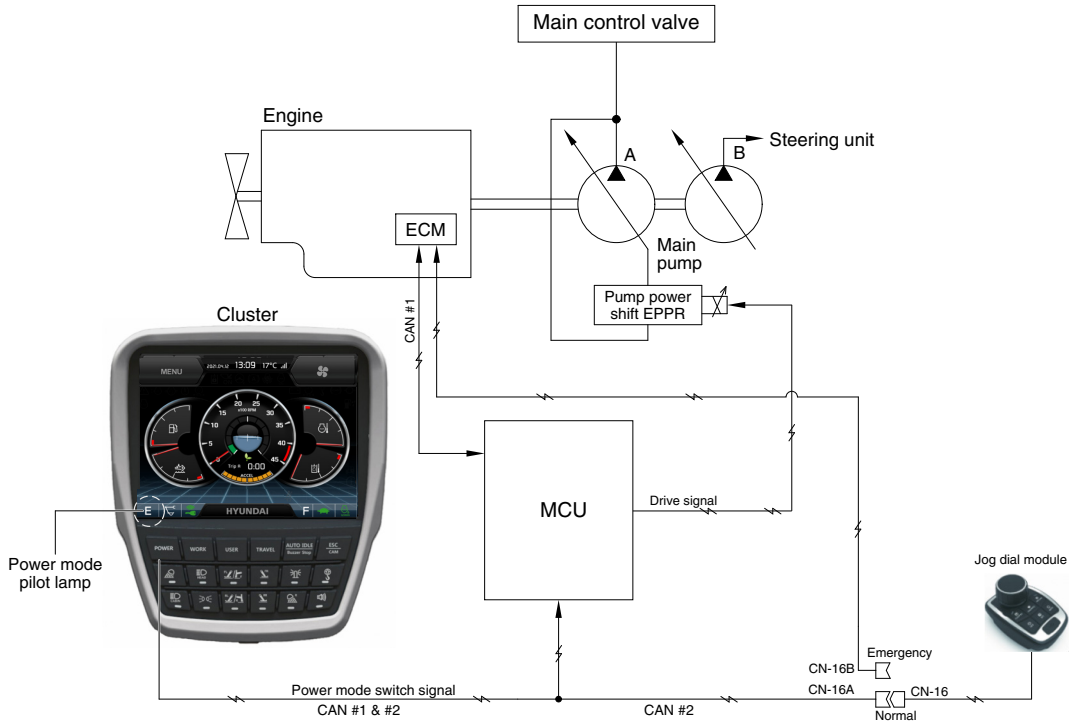
SYSTEM DIAGRAM



140WA5MS01

GROUP 2 MODE SELECTION SYSTEM

1. POWER MODE SELECTION SYSTEM



140WA5MS02

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

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

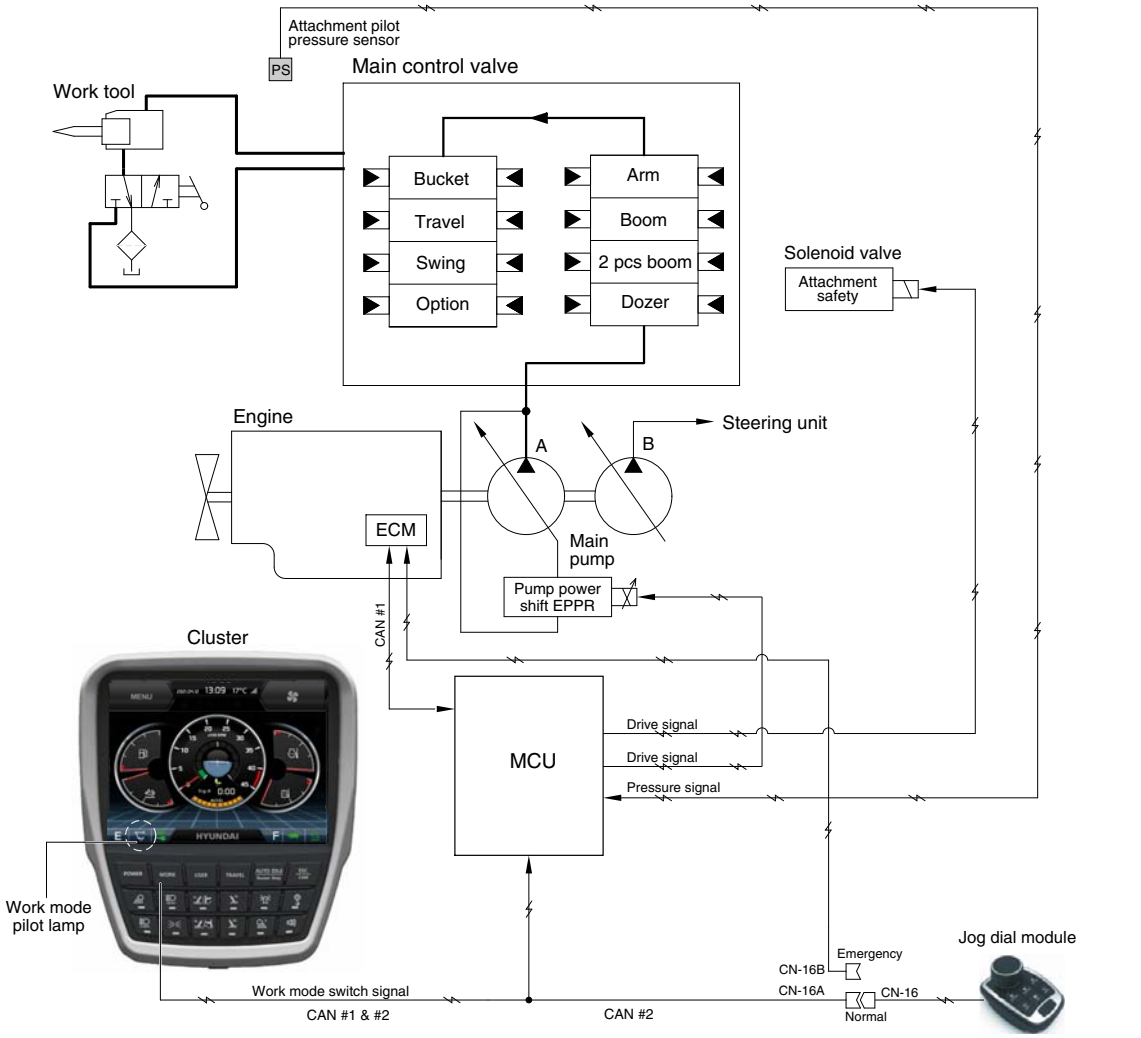
Mode		Engine rpm		PF EPPR		Delta P EPPR	
		No load	Load	Current (mA)		Current (mA)	
				No load	Load	No load	Load
Standard	P	1700	1800	450	380	250	250
	S	1600	1700	550	480	250	250
	E	1500	1600	580	510	250	250
Option	P	1800	1800	380	380	250	250
	S	1700	1700	480	480	250	250
	E	1600	1600	510	510	250	250
AUTO DECEL		1200±50	-	600	-	600	-
One touch decel		1100±50	-	600	-	600	-
KEY START (low idle)		1000±50	-	600	-	600	-

※ In work modes, engine speed stays at 1000 rpm if the safety knob is at "LOCK" position. (Low idle goes to 1100 rpm if "UNLOCK")

※ Auto decel, one touch decel and low idle speed may increase to 1500 rpm while automatic exhaust system cleaning is being performed.

2. WORK MODE SELECTION SYSTEM

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



140WA5MS03

1) GENERAL WORK MODE (bucket)

This mode is used to general digging work.

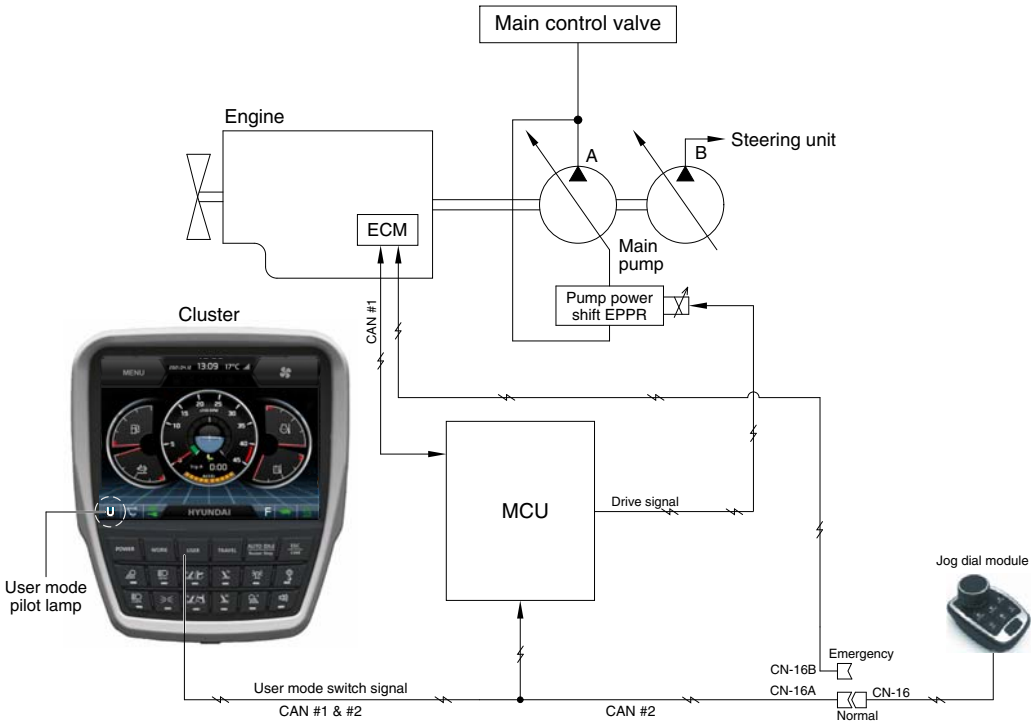
2) ATT WORK MODE (breaker, crusher)

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

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

★ When breaker operating button is pushed.

3. USER MODE SELECTION SYSTEM



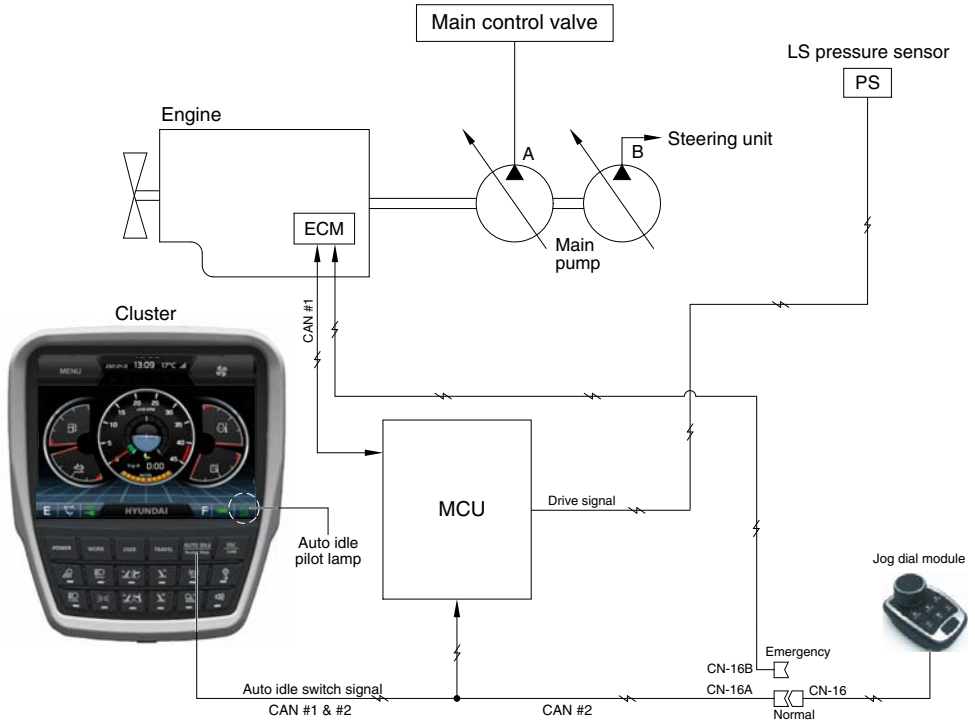
140WA5MS04

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

2) LCD segment vs parameter setting

Step (▮)	Engine speed (rpm)	Idle speed (rpm)	PF EPPR current (mA)
1	1400	800	600
2	1450	850	555
3	1500	900	511
4	1550	950	466
5	1600	1000	422
6	1650	1050	377
7	1700	1100	333
8	1750	1150	288
9	1800	1200 (auto decel)	244
10	1900	1250	200

GROUP 3 AUTOMATIC DECELERATION SYSTEM

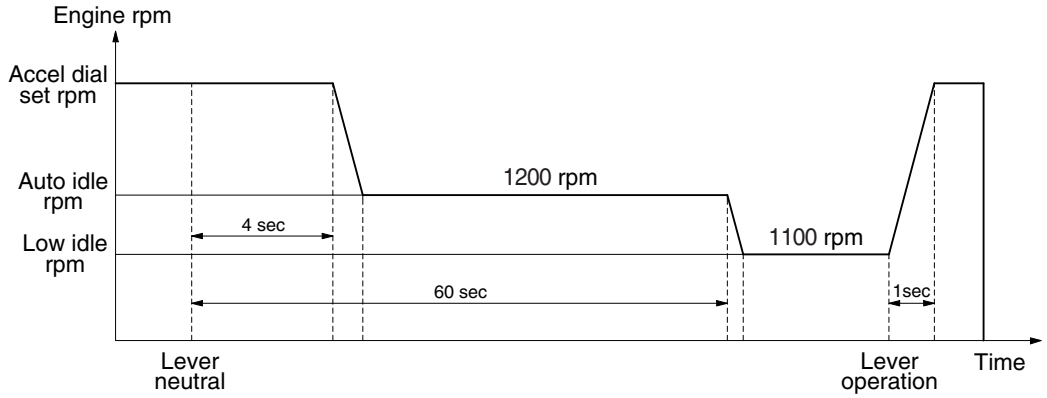


140WA5MS05

1. WHEN AUTO IDLE PILOT LAMP ON

When all of the work equipment control levers including swing and travel levers are at neutral for 4 seconds, MCU sends throttle command to ECM to reduce the engine speed to 1200 rpm. If the control levers are at neutral for 1 minute, MCU reduces the engine speed to 1100 rpm. As the result of reducing the engine speed, fuel consumption and noise are effectively cut down during non-operation of the control levers.

When the Auto idle pilot lamp is turned off by pressing the switch or any control lever is operated, the reduced engine speed rises upto the speed before deceleration in a second.



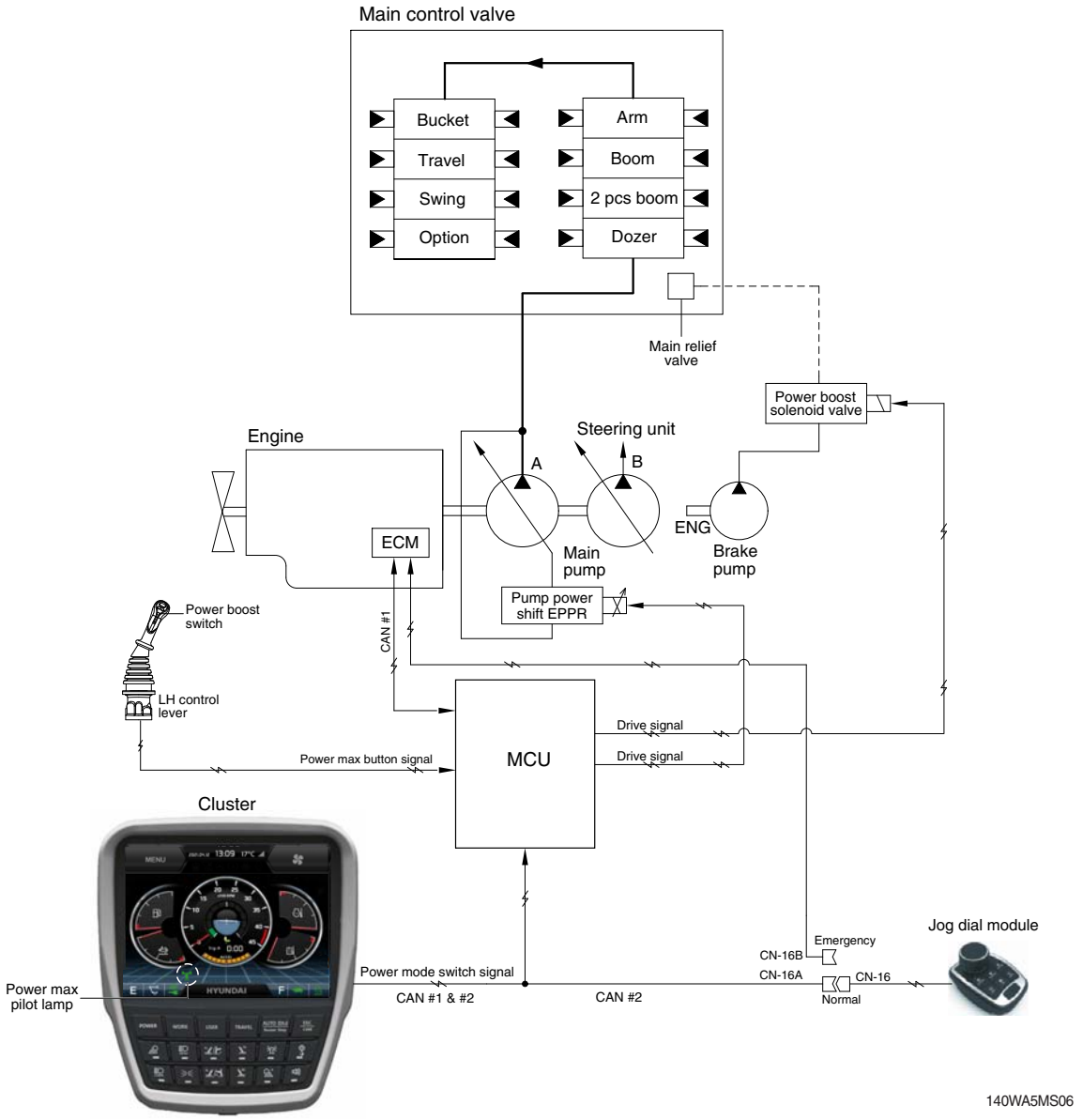
140WA5MS15

2. WHEN AUTO IDLE PILOT LAMP OFF

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

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

GROUP 4 POWER BOOST SYSTEM



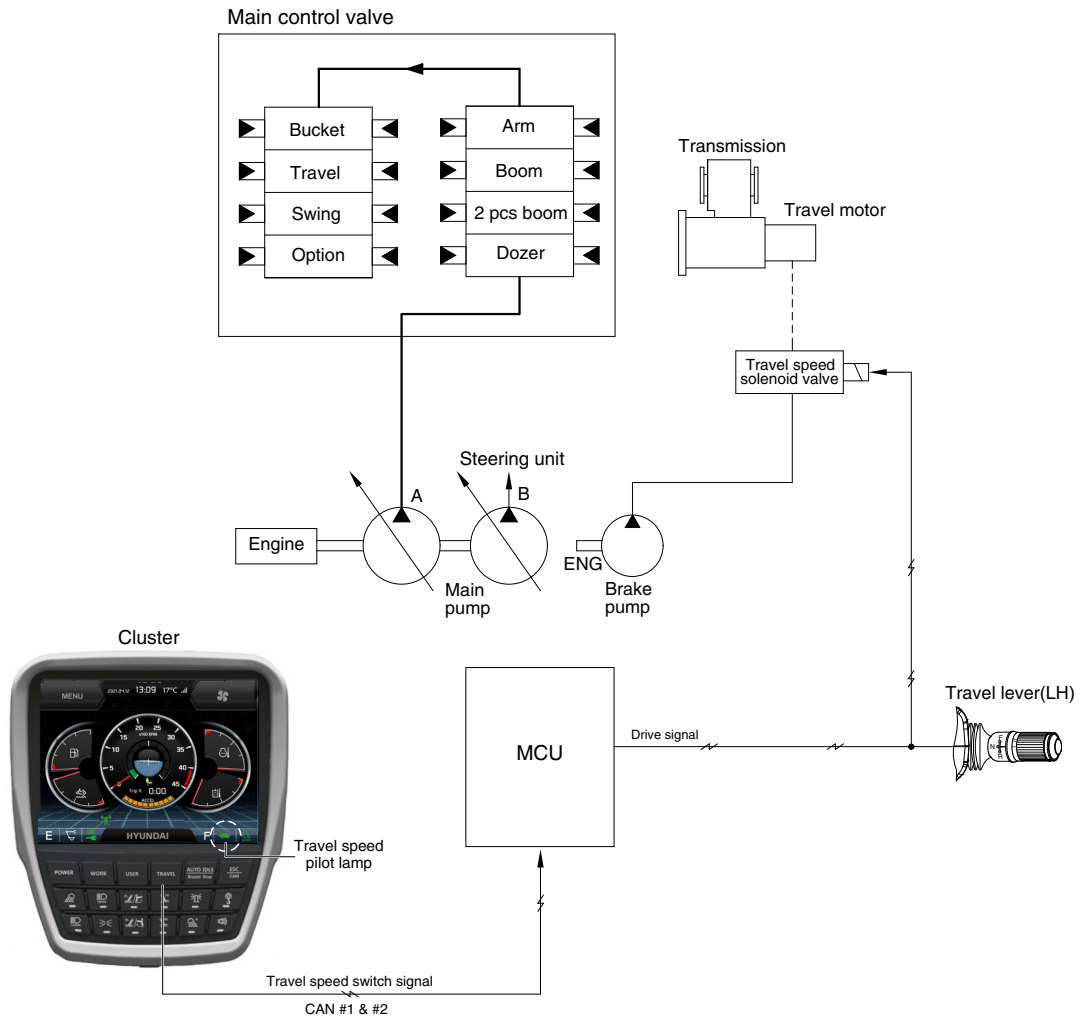
· When the power boost switch on the left control lever pushed ON, the power mode is set P mode and maximum digging power is increased by 10 %.

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

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

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

GROUP 5 TRAVEL SPEED CONTROL SYSTEM



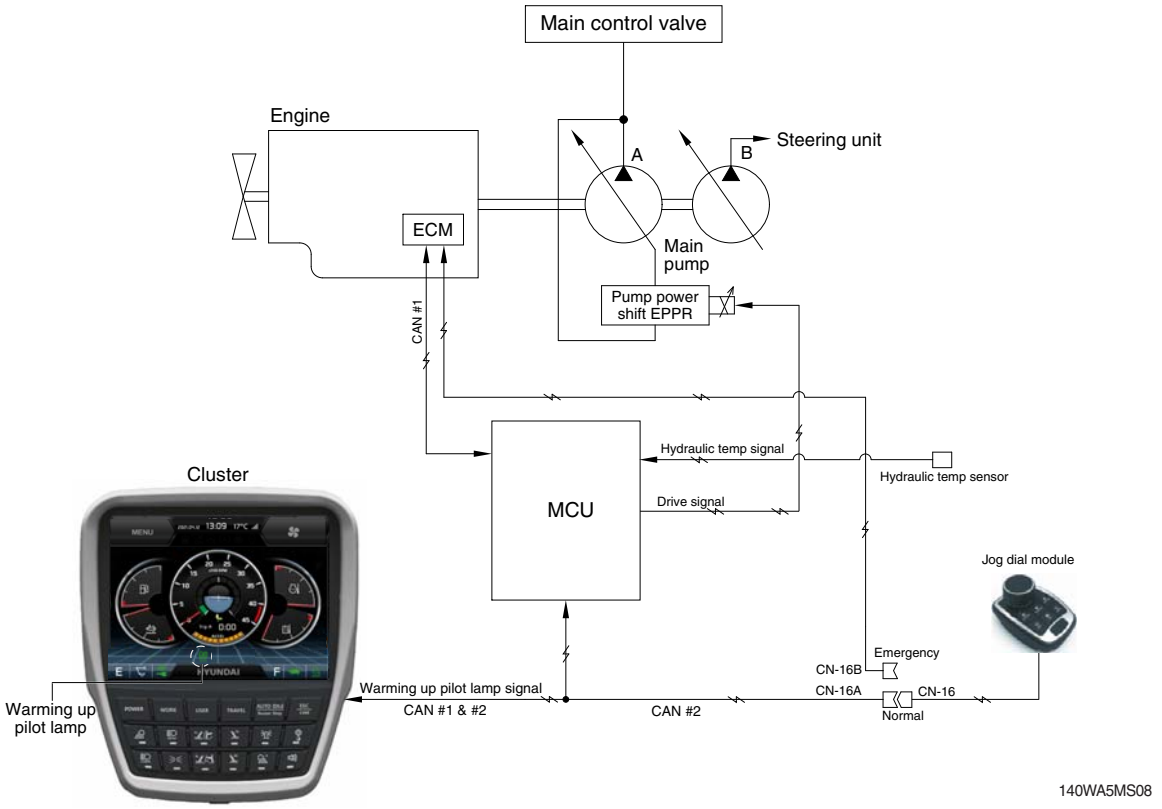
140WA5MS07A

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

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

※ Default : Turtle (Low)

GROUP 6 AUTOMATIC WARMING UP SYSTEM



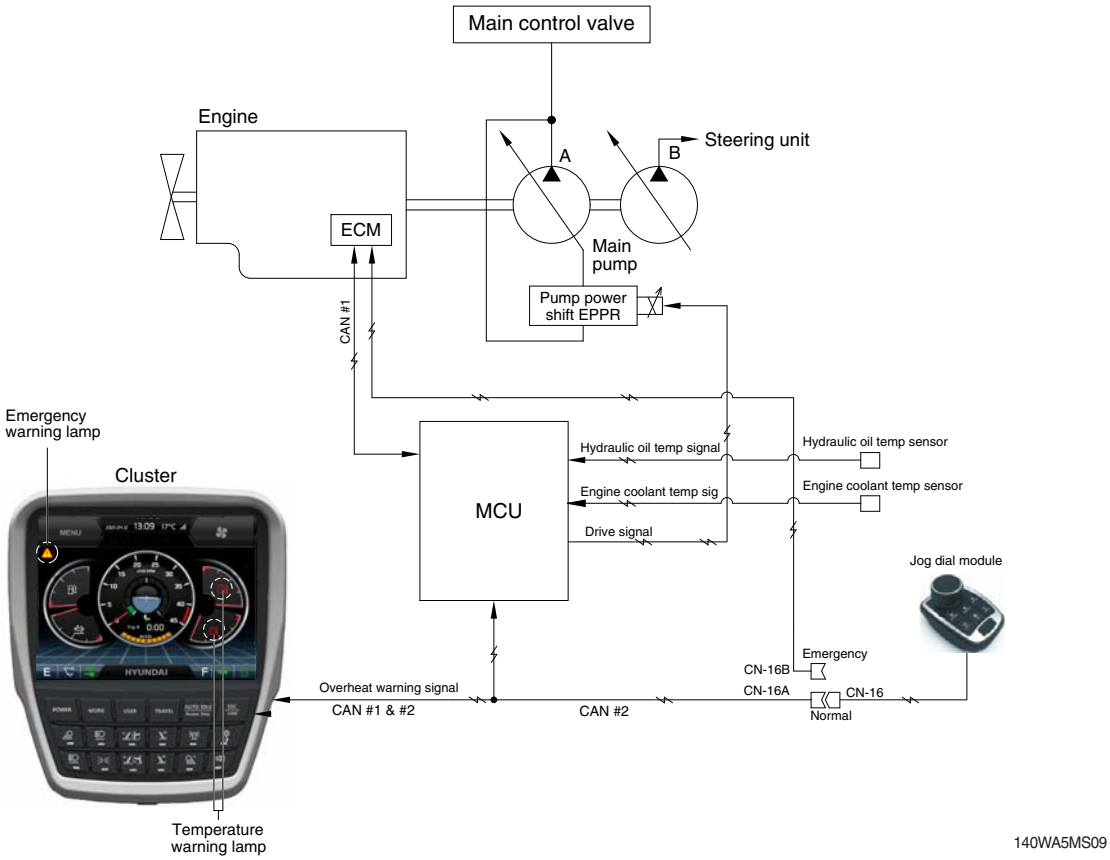
1. The MCU receives the engine coolant temperature from the ECM, and if the coolant temperature is below 30˚C, it increases the engine speed from key start rpm to 1200 rpm. At this time the mode does not change. If the coolant temperature sensor has fault, the hydraulic oil temperature signal is substituted.

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

3. LOGIC TABLE

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

GROUP 7 ENGINE OVERHEAT PREVENTION SYSTEM

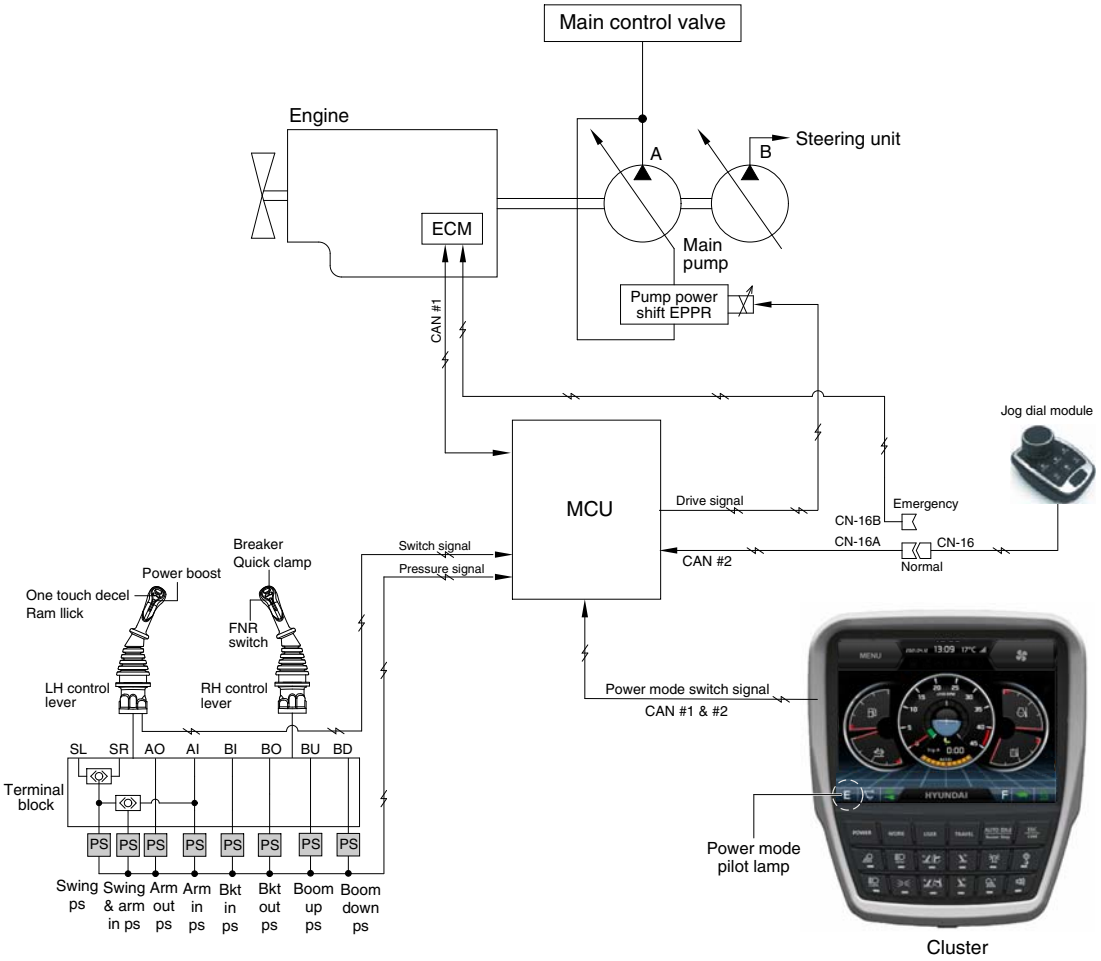


1. If the engine coolant temperature is overheated over 103˚C or the hydraulic oil temperature is overheated over 100˚C, the warning lamp is ON and the pump input torque or the engine speed is reduced as below logic table.

2. LOGIC TABLE

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

GROUP 8 VARIABLE POWER CONTROL SYSTEM



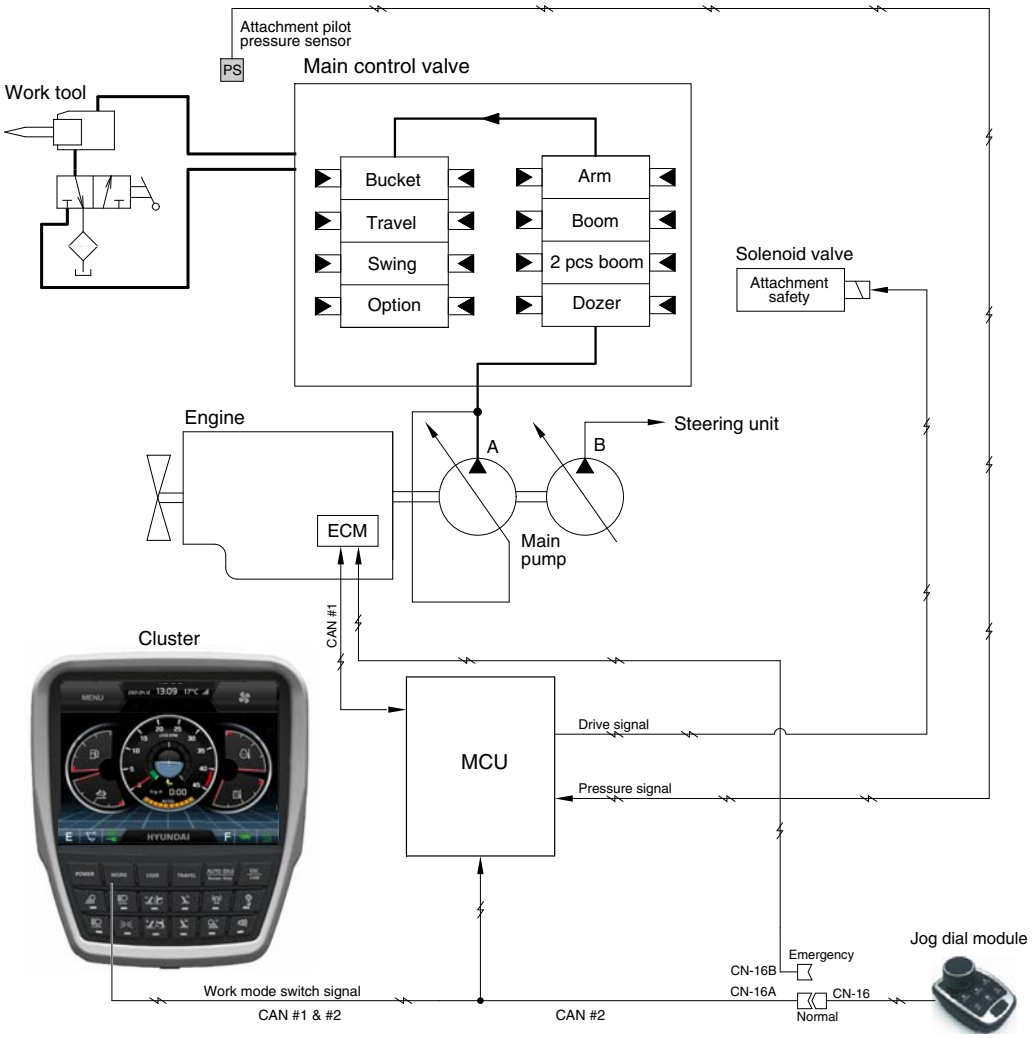
140WA5MS10

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

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

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

GROUP 9 ATTACHMENT FLOW CONTROL SYSTEM



140WA5MS11

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

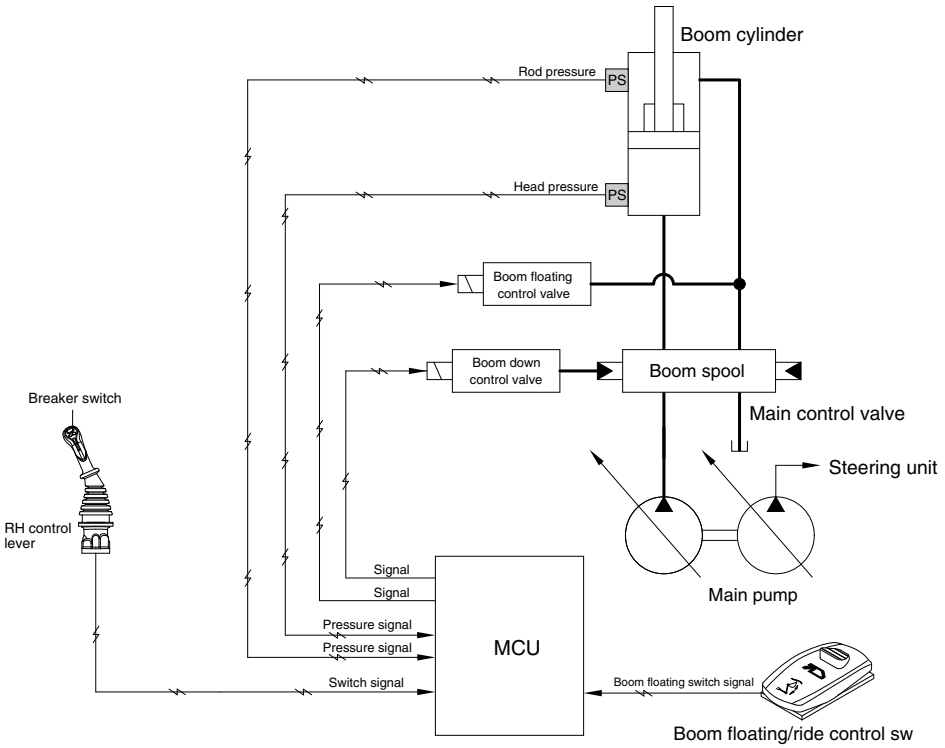
Description	Work tool	
	Breaker	Crusher
Flow level	50~110 lpm	50~260 lpm
Attach safety solenoid	-	ON

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

GROUP 10 BOOM FLOATING AND RIDE CONTROL SYSTEM

1. BOOM FLOATING CONTROL

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



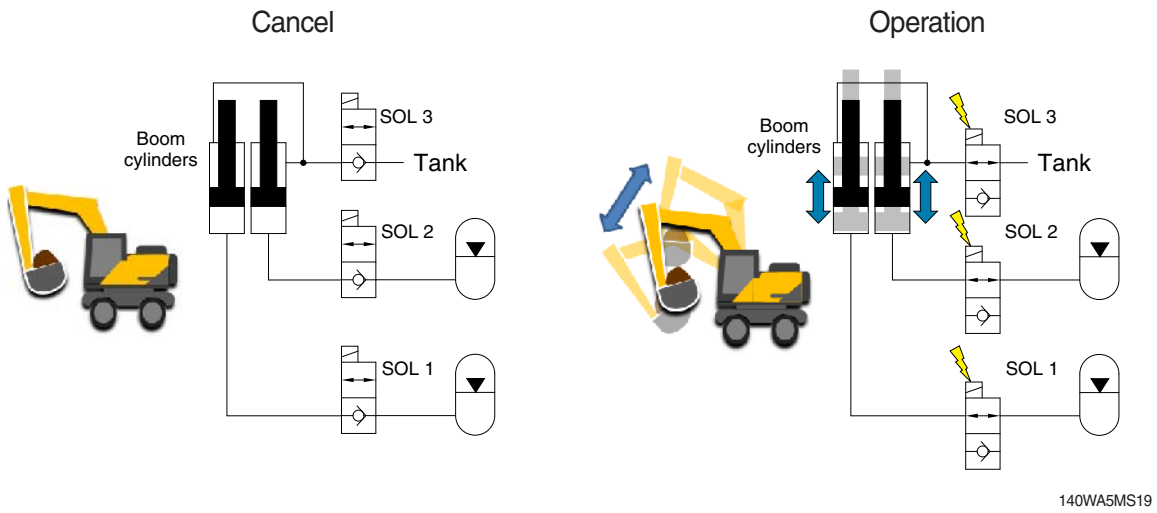
140WA5MS17A

Description Work mode★1	Condition	Function
General mode	Floating mode sw : ON Rod pressure < Head pressure	Boom floating control valve : ON Boom down control valve : OFF
Breaker mode (Special function)	Floating mode sw : ON Breaker switch : Pressed	Boom floating control valve : OFF Boom down control valve : ON
Temporarily canceled	During operation of boom floating Boost sw : Pressed	Boom floating control valve : OFF Boom down control valve : OFF

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

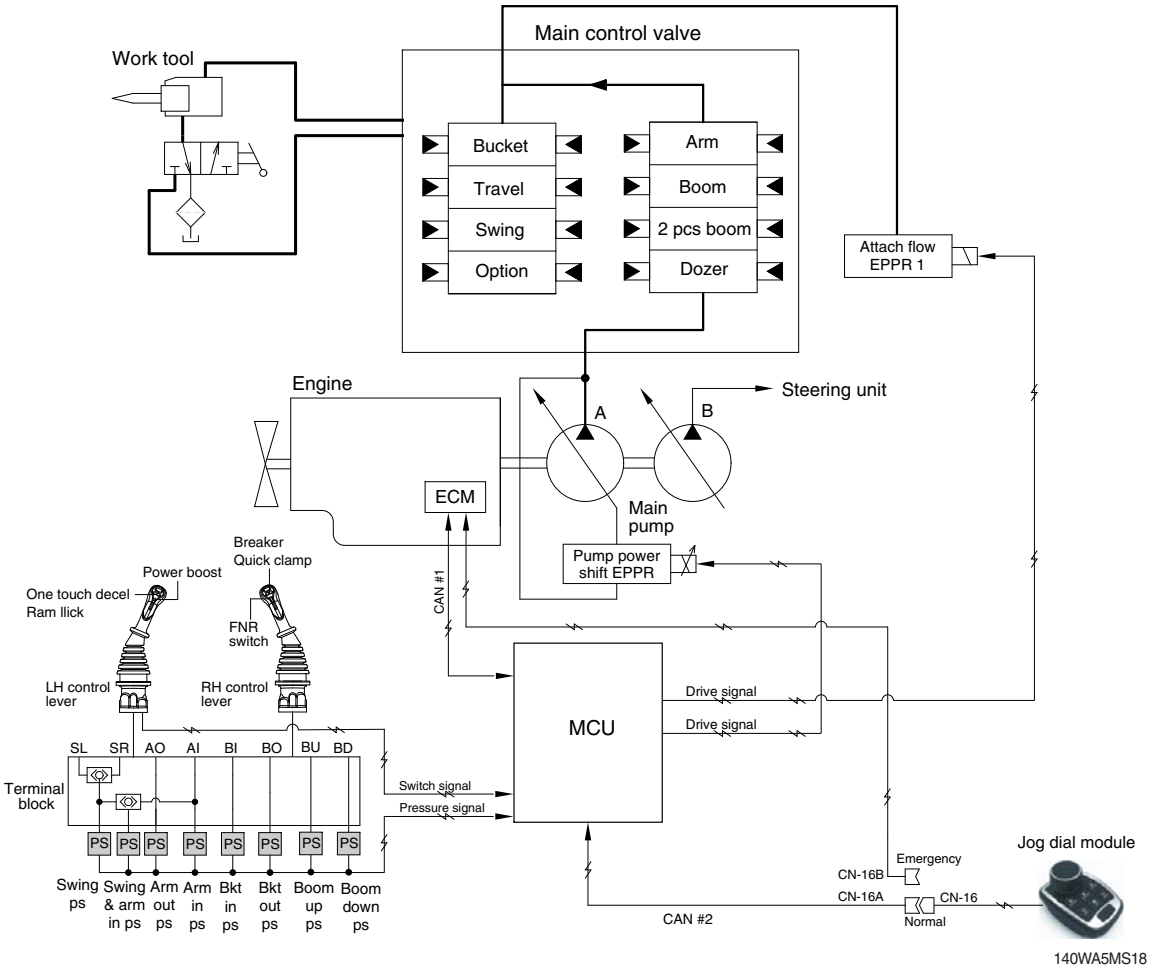
2. BOOM RIDE CONTROL

This removes shocks when driving over a bumpy road.



Description	Condition★1	Function
Operation	- Boom floating/ride switch position : Ride - Select switch position : Working or travel - Machine speed : Below 3 km/h - Pressure : Boom rod < Boom head	- Ride control sol valve 1, 2, 3 : ON
Cancel	- Boom floating/ride switch position : Floating - Select switch position : Parking	- Ride control sol valve 1, 2, 3 : OFF

★1 AND condition



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

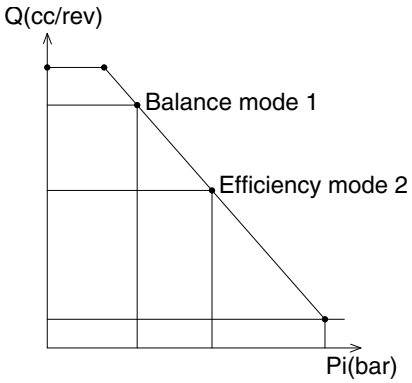
Condition★1	Function
IPC mode : ON★2 Boom up Arm in Not travel motion Not swing motion	Limitation of pump flow rate : Activated
None of upper condition	Limitation of pump flow rate : Canceled

★1 AND condition

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

2. IPC MODE SELECTION

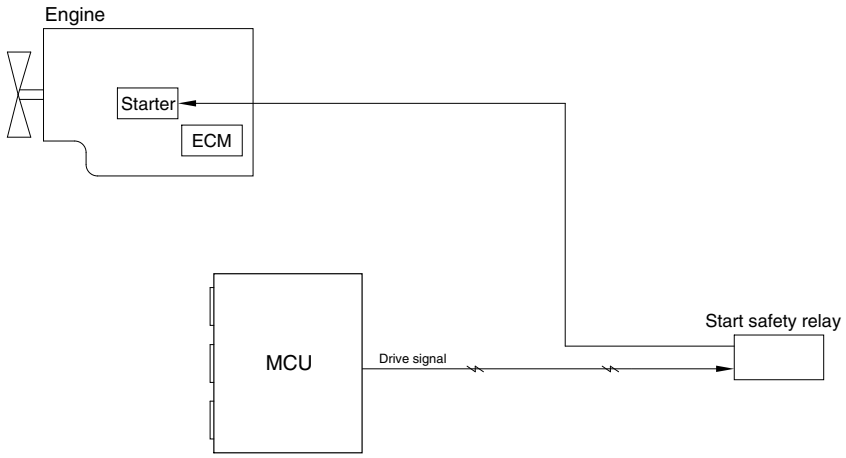
IPC mode ON/OFF and the levels of flow rate limit can be selected at "Monitor > Management"



140WF5MS19A

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

GROUP 12 ANTI-RESTART SYSTEM



300L5MS12

1. ANTI-RESTART FUNCTION

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

GROUP 13 SELF-DIAGNOSTIC SYSTEM

1. OUTLINE

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

2. MONITORING

1) Active fault

140WA3CD80

140WA3CD81

140WA3CD82

· The active faults of the MCU, engine ECM, FATC, AAVM (option) can be checked by this menu.

2) Logged fault

140WA3CD83

140WA3CD84

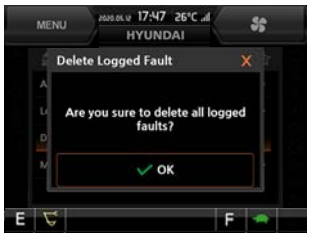
140WA3CD85

· The logged faults of the MCU, engine ECM, FATC, AAVM (option) can be checked by this menu.

3) Delete logged fault

140WA3CD86

140WA3CD87



140WA3CD88

· The logged faults of the MCU, engine ECM, FATC, AAVM (option) can be deleted by this menu.

3. MACHINE ERROR CODES TABLE

DTC		Diagnostic Criteria	Application		
HCESPN	FMI		G	C	W
101	3	10 seconds continuous, Hydraulic Oil Temp. Measurement Voltage > 3.8V	●		
	4	10 seconds continuous, Hydraulic Oil Temp. Measurement Voltage < 0.3V	●		
	(Results / Symptoms) 1. Monitor – Hydraulic oil temperature display failure 2. Control Function – Fan revolutions control failure (Checking list) 1. CD-1 (#2), CN-51 (#16) Checking Open/Short 2. CD-1 (#1), CN-51 (#25) Checking Open/Short				
105	0	10 seconds continuous, Load Sensing Press. Sensor Measurement Voltage > 5.2V	●		
	1	10 seconds continuous, 0.3V≤ Load Sensing Press. Sensor Measurement Voltage < 0.8V	●		
	4	10 seconds continuous, Load Sensing Press. Sensor Measurement Voltage < 0.3V	●		
	(Results / Symptoms) 1. Monitor – Load Sensing Press. display failure 2. Control Function – Auto Idle operation failure, Engine variable horse power control operation failure (Checking list) 1. CD-101 (#B) – CN-52 (#19) Checking Open/Short 2. CD-101 (#A) – CN-51 (#32) Checking Open/Short 3. CD-101 (#C) – CN-51 (#31) Checking Open/Short				
108 (N.A)	0	10 seconds continuous, Travel Oil Press. Sensor Measurement Voltage > 5.2V		●	
	1	10 seconds continuous, 0.3V ≤ Travel Oil Press. Sensor Measurement Voltage < 0.8V	●		
	4	10 seconds continuous, Travel Oil Press. Sensor Measurement Voltage < 0.3V	●		
	(Results / Symptoms) 1. Monitor – Travel Oil Press. display failure 2. Control Function – Auto Idle operation failure, Engine variable horse power control operation failure, IPC operation failure, Driving alarm operation failure (Checking list) 1. CD-06 (#B) – CN-52 (#27) Checking Open/Short 2. CD-06 (#A) – CN-51 (#32) Checking Open/Short 3. CD-06 (#C) – CN-51 (#31) Checking Open/Short				

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

DTC		Diagnostic Criteria	Application		
HCESPN	FMI		G	C	W
120	0	10 seconds continuous, Main Pump (A) Press. Sensor Measurement Voltage > 5.2V	●		
	1	10 seconds continuous, 0.3V ≤ Main Pump (A) Press. Sensor Measurement Voltage < 0.8V	●		
	4	10 seconds continuous, Main Pump (A) Press. Sensor Measurement Voltage < 0.3V	●		
	(Results / Symptoms) 1. Monitor – Main Pump (A) Press. display failure 2. Control Function – Automatic voltage increase operation failure, Overload at compensation control failure (Checking list) 1. CD-42 (#B) – CN-52 (#22) Checking Open/Short 2. CD-42 (#A) – CN-51 (#32) Checking Open/Short 3. CD-42 (#C) – CN-51 (#31) Checking Open/Short				
121	0	10 seconds continuous, Main Pump (B) Press. Sensor Measurement Voltage > 5.2V	●		
	1	10 seconds continuous, 0.3V≤ Main Pump (B) Press. Sensor Measurement Voltage < 0.8V	●		
	4	10 seconds continuous, Main Pump (B) Press. Sensor Measurement Voltage < 0.3V	●		
	(Results / Symptoms) 1. Monitor – Main Pump (B) Press. display failure 2. Control Function – Automatic voltage increase operation failure, Overload at compensation control failure (Checking list) 1. CD-44 (#B) – CN-51 (#22) Checking Open/Short 2. CD-44 (#A) – CN-51 (#32) Checking Open/Short 3. CD-44 (#C) – CN-51 (#31) Checking Open/Short				
122	1	(when you had conditions mounting pressure sensor) 10 seconds continuous, 0.3V ≤ Overload Press. Sensor Measurement Voltage < 0.8V	●		
	4	(when you had conditions mounting pressure sensor) 10 seconds continuous, Overload Press. Sensor Measurement Voltage < 0.3V	●		
	(Results / Symptoms) 1. Monitor – Overload Press. display failure 2. Control Function – Overload warning alarm failure (Checking list) 1. CD-31 (#B) – CN-52 (#28) Checking Open/Short 2. CD-31 (#A) – CN-51 (#32) Checking Open/Short 3. CD-31 (#C) – CN-51 (#31) Checking Open/Short				

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

DTC		Diagnostic Criteria	Application		
HCESPN	FMI		G	C	W
123 (N.A)	0	10 seconds continuous, Negative 1 Press. Sensor Measurement Voltage > 5.2V	●		
	1	10 seconds continuous, 0.3V≤ Negative 1 Press. Sensor Measurement Voltage < 0.8V	●		
	4	10 seconds continuous, Negative 1 Press. Sensor Measurement Voltage < 0.3V	●		
	(Results / Symptoms) 1. Monitor – Negative 1 Press. display failure 2. Control Function – IPC operation failure, Option attachment flow control operation failure (Checking list) 1. CD-70 (#B) – CN-51 (#22) Checking Open/Short 2. CD-70 (#A) – CN-51 (#32) Checking Open/Short 3. CD-70 (#C) – CN-51 (#31) Checking Open/Short				
124 (N.A)	0	10 seconds continuous, Negative 2 Press. Sensor Measurement Voltage > 5.2V	●		
	1	10 seconds continuous, 0.3V≤ Negative 2 Press. Sensor Measurement Voltage < 0.8V	●		
	4	10 seconds continuous, Negative 2 Press. Sensor Measurement Voltage < 0.3V	●		
	(Results / Symptoms) 1. Monitor – Negative 2 Press. display failure 2. Control Function – Option attachment flow control operation failure (Checking list) 1. CD-71 (#B) – CN-51 (#28) Checking Open/Short 2. CD-71 (#A) – CN-51 (#32) Checking Open/Short 3. CD-71 (#C) – CN-51 (#31) Checking Open/Short				
127	0	10 seconds continuous, Boom Up Pilot Press. Sensor Measurement Voltage > 5.2V	●		
	1	10 seconds continuous, 0.3V≤ Boom Up Pilot Press. Sensor Measurement Voltage < 0.8V	●		
	4	10 seconds continuous, Boom Up Pilot Press. Sensor Measurement < 0.3V	●		
	(Results / Symptoms) 1. Monitor – Boom Up Pilot Press. display failure 2. Control Function – Engine/Pump variable horse power control operation failure, IPC operation failure, Boom first operation failure (Checking list) 1. CD-32 (#B) – CN-52 (#23) Checking Open/Short 2. CD-32 (#A) – CN-51 (#32) Checking Open/Short 3. CD-32 (#C) – CN-51 (#31) Checking Open/Short				

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

DTC		Diagnostic Criteria	Application		
HCESPN	FMI		G	C	W
128	0	(when you had conditions mounting pressure sensor) 10 seconds continuous, Boom Down Pilot Press. Sensor Measurement Voltage > 5.2V	●		
	1	(when you had conditions mounting pressure sensor) 10 seconds continuous, 0.3V≤ Boom Down Pilot Press. Sensor Measurement Voltage < 0.8V	●		
	4	(when you had conditions mounting pressure sensor) 10 seconds continuous, Boom Down Pilot Press. Sensor Measurement Voltage < 0.3V	●		
	(Results / Symptoms) 1. Monitor – Boom Down Pilot Press. display failure 2. Control Function – Boom floating operation failure (Checking list) 1. CD-85 (#B) – CN-52 (#31) Checking Open/Short 2. CD-85 (#A) – CN-51 (#32) Checking Open/Short 3. CD-85 (#C) – CN-51 (#31) Checking Open/Short				
129	0	10 seconds continuous, Arm In Pilot Press. Sensor Measurement Voltage > 4.8V	●		
	1	10 seconds continuous, 0.3V≤ Arm In Pilot Press. Sensor Measurement Voltage < 0.8V	●		
	4	10 seconds continuous, Arm In Pilot Press. Sensor Measurement Voltage < 0.3V	●		
	(Results / Symptoms) 1. Monitor – Arm In Pilot Press. display failure 2. Control Function – IPC operation failure (Checking list) 1. CD-90 (#B) – CN-51 (#21) Checking Open/Short 2. CD-90 (#A) – CN-51 (#32) Checking Open/Short 3. CD-90 (#C) – CN-51 (#31) Checking Open/Short				
133	0	10 seconds continuous, Arm Out Pilot Press. Sensor Measurement Voltage > 5.2V	●		
	1	10 seconds continuous, 0.3V≤ Arm Out Pilot Press. Sensor Measurement Voltage < 0.8V	●		
	4	10 seconds continuous, Arm Out Pilot Press. Sensor Measurement Voltage < 0.3V	●		
	(Results / Symptoms) 1. Monitor – Arm Out Pilot Press. display failure 2. Control Function – Engine variable horse power control operation failure (Checking list) 1. CD-35 (#B) – CN-51 (#27) Checking Open/Short 2. CD-35 (#A) – CN-51 (#32) Checking Open/Short 3. CD-35 (#C) – CN-51 (#31) Checking Open/Short				

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

DTC		Diagnostic Criteria	Application		
HCESPN	FMI		G	C	W
135	0	10 seconds continuous, Swing Pilot Press. Sensor Measurement Voltage > 5.2V	●		
	1	10 seconds continuous, 0.3V≤ Swing Pilot Press. Sensor Measurement Voltage < 0.8V	●		
	4	10 seconds continuous, Swing Pilot Press. Sensor Measurement Voltage < 0.3V	●		
	(Results / Symptoms) 1. Monitor – Swing Pilot Press. display failure 2. Control Function – IPC operation, Boom first operation failure (Checking list) 1. CD-24 (#B) – CN-52 (#18) Checking Open/Short 2. CD-24 (#A) – CN-51 (#32) Checking Open/Short 3. CD-24 (#C) – CN-51 (#31) Checking Open/Short				
138 (N.A)	0	Monitor – Select Attachment (breaker / crusher) 10 seconds continuous, Attachment Pilot Press. Sensor Measurement Voltage > 5.2V	●		
	1	Monitor – Select Attachment (breaker / crusher) 10 seconds continuous, 0.3V≤ Attachment Pilot Press. Sensor Measurement Voltage < 0.8V	●		
	4	Monitor – Select Attachment (breaker / crusher) 10 seconds continuous, Attachment Pilot Press. Sensor Measurement Voltage < 0.3V	●		
	(Results / Symptoms) 1. Monitor – Attachment Pilot Press. display failure 2. Control Function – Option attachment flow control operation failure (Checking list) 1. CD-69 (#B) – CN-52 (#32) Checking Open/Short 2. CD-69 (#A) – CN-51 (#32) Checking Open/Short 3. CD-69 (#C) – CN-51 (#31) Checking Open/Short				
139 (N.A)	1	10 seconds continuous, 0.3V≤ Option Pilot Press. Sensor Measurement Voltage < 0.8V			●
	4	10 seconds continuous, Option Pilot Press. Sensor Measurement Voltage < 0.3V			●
	(Results / Symptoms) 1. Monitor – Option Pilot Press. display failure 2. Control Function – Auto Idle operation failure (Checking list) 1. CD-37 (#B) – CN-52 (#21) Checking Open/Short 2. CD-37 (#A) – CN-51 (#32) Checking Open/Short 3. CD-37 (#C) – CN-51 (#31) Checking Open/Short				

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

DTC		Diagnostic Criteria	Application		
HCESPN	FMI		G	C	W
140	5	(Detection) (When Pump Shift EPPR Current is more than 10 mA) 10 seconds continuous, Pump Shift EPPR drive current < 0 mA (Cancellation) (When Pump Shift EPPR Current is more than 10 mA) 3 seconds continuous, Pump Shift EPPR drive current ≥10 mA	●		
	6	(Detection) 10 seconds continuous, Pump Shift EPPR drive current > 1.0A (Cancellation) 3 seconds continuous, Pump Shift EPPR drive current ≤ 1.0 A	●		
	(Results / Symptoms) 1. Control Function – Pump horse power setting specification difference (Fuel efficiency/speed specification failure) (Checking list) 1. CN-75 (#2) – CN-54 (#28) Checking Open/Short 2. CN-75 (#1) – CN-54 (#01) Checking Open/Short				
141 (N.A)	5	(Model Parameter) mounting Boom Priority EPPR (Detection) (When Boom Priority EPPR Current is more than 10 mA) 10 seconds continuous, Boom Priority EPPR drive current < 0 mA (Cancellation) (When Boom Priority EPPR Current is more than 10 mA) 3 seconds continuous, Boom Priority EPPR drive current ≥ 10 mA	●		
	6	(Detection) 10 seconds continuous, Boom Priority EPPR drive current > 1.0 A (Cancellation) 3 seconds continuous, Boom Priority EPPR drive current ≤ 1.0 A	●		
	(Results / Symptoms) 1. Control Function – Boom first control operation failure (Checking list) 1. CN-133 (#2) – CN-54 (#34) Checking Open/Short 2. CN-133 (#1) – CN-54 (#04) Checking Open/Short				

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

DTC		Diagnostic Criteria	Application		
HCESPN	FMI		G	C	W
143	5	(Detection) (When Travel EPPR Current is more than 10 mA) 10 seconds continuous, Travel EPPR drive current = 0 mA (Cancellation) (When Travel EPPR Current is more than 100 mA) 3 seconds continuous, Travel EPPR drive current ≥ 10 mA			●
	6	(Detection) 10 seconds continuous, Travel EPPR drive current > 1.0 A (Cancellation) 3 seconds continuous, Travel EPPR drive current ≤ 1.0 A			●
	(Results / Symptoms) 1. Control Function – cruise control operation failure (Checking list) 1. CN-246 (#2) – CN-54 (#25) Checking Open/Short 2. CN-246 (#1) – CN-54 (#08) Checking Open/Short				
145	5	(Model Parameter) mounting Remote Cooling Fan EPPR (Detection) (When Remote Cooling Fan EPPR Current is more than 10 mA) 10 seconds continuous, Remote Cooling Fan EPPR drive current = 0 mA (Cancellation) (When Remote Cooling Fan EPPR Current is more than 10 mA) 3 seconds continuous, Remote Cooling Fan EPPR drive current ≥ 10 mA	●		
	6	(Detection) 10 seconds continuous, Remote Cooling Fan EPPR drive current > 1.0 A (Cancellation) 3 seconds continuous, Remote Cooling Fan EPPR drive current ≤ 1.0 A	●		
	(Results / Symptoms) 1. Control Function – Remote fan control operation failure (Checking list) 1. CN-154 (#1) – CN-54 (#06) Checking Open/Short 2. CN-154 (#2) – CN-54 (#34) Checking Open/Short				

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

DTC		Diagnostic Criteria	Application		
HCESPN	FMI		G	C	W
164	4	(Detection) (When Working Cutoff Relay is Off) 10 seconds continuous, Working Cutoff Relay drive unit Measurement Voltage ≤ 3.0V (Cancellation) (When Working Cutoff Relay is Off) 3 seconds continuous, Working Cutoff Relay drive unit Measurement Voltage > 3.0V			●
	6	(Detection) (When Working Cutoff Relay is On) 10 seconds continuous, Working Cutoff Relay drive current > 6.5 A (Cancellation) (When Working Cutoff Relay is On) 3 seconds continuous, Working Cutoff Relay drive current ≤ 6.5 A			●
	(Results / Symptoms) 1. Control Function – (Wheel Excavator) In driving mode, attachment hydraulic pilot pressure cut off failure (Checking list) 1. CR-47 (#85) – CN-53 (#04) Checking Open/Short 2. CR-47 (#30, #86) – fuse box (#28) Checking Open/Short				
166	4	(Detection) (When Power Max Solenoid is Off) 10 seconds continuous, Power Max Solenoid drive unit Measurement Voltage ≤ 3.0V (Cancellation) (When Power Max Solenoid is Off) 3 seconds continuous, Power Max Solenoid drive unit Measurement Voltage > 3.0V	●		
	6	(Detection) (When Power Max Solenoid is On) 5 seconds continuous, Power Max Solenoid drive current > 4.5 A (Cancellation) (When Power Max Solenoid is On) 3 seconds continuous, Power Max Solenoid drive current ≤ 4.5 A	●		
	(Results / Symptoms) 1. Control Function – Voltage increase operation failure (Checking list) 1. CN-88 (#1) – CN-53 (#10) Checking Open/Short 2. CN-88 (#2) – fuse box (#34) Checking Open/Short				

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

DTC		Diagnostic Criteria	Application		
HCESPN	FMI		G	C	W
167	4	(Detection) (When Travel Speed Solenoid is Off) 10 seconds continuous, Travel Speed Solenoid drive unit Measurement Voltage ≤ 3.0V (Cancellation) (When Travel Speed Solenoid is Off) 3 seconds continuous, Travel Speed Solenoid drive unit Measurement Voltage > 3.0V		●	
		(When Parking mode is not) (Detection) (When Travel Speed Solenoid is Off) 10 seconds continuous, Travel Speed Solenoid drive unit Measurement Voltage ≤ 3.0V (Cancellation) (When Travel Speed Solenoid is Off) 3 seconds continuous, Travel Speed Solenoid drive unit Measurement Voltage > 3.0V			●
	6	(Detection) (When Travel Speed Solenoid is On) 10 seconds continuous, Travel Speed Solenoid drive current > 4.5 A (Cancellation) (When Travel Speed Solenoid is On) 3 seconds continuous, Travel Speed Solenoid drive current ≤ 4.5 A	●		
	(Results / Symptoms) 1. Control Function – driving in 1/2 transmission operation failure (Checking list) 1. CN-70 (#2) – 52 (#05) Checking Open/Short 2. CN-70 (#1) – GND Checking Open/Short				

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

DTC		Diagnostic Criteria	Application		
HCESPN	FMI		G	C	W
169 (N.A)	4	Monitor – Selecting attachment (breaker / crusher) (Detection) (When Attachment Conflux Solenoid is Off) 10 seconds continuous, Attachment Conflux Solenoid drive unit Measurement Voltage ≤ 3.0V (Cancellation) (When Attachment Conflux Solenoid is Off) 3 seconds continuous, Attachment Conflux Solenoid drive unit Measurement Voltage > 3.0V	●		
	6	(Detection) (When Attachment Conflux Solenoid is On) 10 seconds continuous, Attachment Conflux Solenoid drive Current > 6.5 A (Cancellation) (When Attachment Conflux Solenoid is On) 3 seconds continuous, Attachment Conflux Solenoid drive Current ≤ 6.5 A	●		
	(Results / symptoms) 1. Control Function – Option attachment flow control – Joining operation failure (Eco breaker mode, crusher mode) (Checking list) 1. CN-237 (#1) – CN-52 (#16) Checking Open/Short 2. CN-237 (#2) – fuse box (#34) Checking Open/Short				
170 (N.A)	4	(Model Parameter) mounting Arm Regenerating Solenoid (Detection) (When Arm Regeneration Solenoid is Off) 10 seconds continuous, Arm Regeneration Solenoid drive unit Measurement Voltage ≤ 3.0V (Cancellation) (When Arm Regeneration Solenoid is Off) 3 seconds continuous, Arm Regeneration Solenoid drive unit Measurement Voltage > 3.0V	●		
	6	(Detection) (When Arm Regeneration Solenoid is On) 10 seconds continuous, Arm Regeneration Solenoid drive current > 4.5 A (Cancellation) (When Arm Regeneration Solenoid is On) 3 seconds continuous, Arm Regeneration Solenoid drive current ≤ 4.5 A	●		
	(Results / symptoms) 1. Control Function – Arm regeneration operation failure (Eco breaker mode, crusher mode) (Checking list) 1. CN-135 (#1) – CN-52 (#07) Checking Open/Short 2. CN-135 (#2) – fuse box (#33) Checking Open/Short				

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

DTC		Diagnostic Criteria	Application		
HCESPN	FMI		G	C	W
171	4	Monitor – Selecting attachment (crusher) (Detection) (When Attachment Safety Solenoid is Off) 10 seconds continuous, Attachment Safety Solenoid drive unit Measurement Voltage ≤ 3.0V (Cancellation) (When Attachment Safety Solenoid is Off) 3 seconds continuous, Attachment Safety Solenoid drive unit Measurement Voltage > 3.0V	●		
	6	(Detection) (When Attachment Safety Solenoid is On) 10 seconds continuous, Attachment Safety Solenoid drive current > 6.5 A (Cancellation) (When Attachment Safety Solenoid is On) 3 seconds continuous, Attachment Safety Solenoid drive current ≤ 6.5 A	●		
	(Results / Symptoms) 1. Control Function – Option attachment flow control – Option spool pilot pressure cut off failure (crusher mode) (Checking list) 1. CN-68 (#1) – CN-53 (#16) Checking Open/Short 2. CN-68 (#2) – fuse box (#28) Checking Open/Short				
179 (N.A)	4	Monitor – Selecting attachment (breaker / crusher) (Detection) (When Breaker Operating Solenoid is Off) 10 seconds continuous, Attachment Safety Solenoid drive unit Measurement Voltage ≤ 3.0V (Cancellation) (When Breaker Operating Solenoid is Off) 3 seconds continuous, Attachment Safety Solenoid drive unit Measurement Voltage > 3.0V	●		
	6	(Detection) (When Breaker Operating Solenoid is On) 10 seconds continuous, Attachment Safety Solenoid drive current > 6.5 A (Cancellation) (When Breaker Operating Solenoid is On) 3 seconds continuous, Attachment Safety Solenoid drive current ≤ 6.5 A	●		
	(Results / Symptoms) 1. Control Function – Option attachment flow control – Breaker operation failure (breaker mode) (Checking list) 1. CN-66 (#1) – CN-52 (#08) Checking Open/Short 2. CN-66 (#2) – fuse box (#40) Checking Open/Short				

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

DTC		Diagnostic Criteria	Application		
HCESPN	FMI		G	C	W
181	4	(Model Parameter) mounting Reverse Cooling Fan Solenoid (Detection) (When Reverse Cooling Fan Solenoid is Off) 10 seconds continuous, Reverse Cooling Fan Solenoid drive unit Measurement Voltage ≤ 3.0V (Cancellation) (When Reverse Cooling Fan Solenoid is Off) 3 seconds continuous, Reverse Cooling Fan Solenoid drive unit Measurement Voltage > 3.0V	●		
	6	(Detection) (When Reverse Cooling Fan Solenoid is On) 10 seconds continuous, Reverse Cooling Fan Solenoid drive current > 4.5 A (Cancellation) (When Reverse Cooling Fan Solenoid is On) 3 seconds continuous, Reverse Cooling Fan Solenoid drive current ≤ 4.5 A	●		
	(Results / Symptoms) 1. Control Function – Cooling Fan reverse control operation failure (Checking list) 1. CN-155 (#1) – CN-52 (#14) Checking Open/Short 2. CN-155 (#2) – fuse box (#18) Checking Open/Short				
188	5	(Detection) (When Pump (A) EPPR current is equal or more than 300 mA) 10 seconds continuous, Pump (A) EPPR drive current < 100 mA (Cancellation) (When Pump (A) EPPR current is equal or more than 300 mA) 3 seconds continuous, Pump (A) EPPR drive current ≥ 100 mA	●		
	6	(Detection) 10 seconds continuous, Pump (A) EPPR drive current > 1.0 A (Cancellation) 3 seconds continuous, Pump (A) EPPR drive current ≤ 1.0 A	●		
	(Results / Symptoms) 1. Control Function – IPC operation failure, Option attachment flow control operation failure (Checking list) 1. CN-75A (#2) – CN-54 (#27) Checking Open/Short 2. CN-75A (#1) – CN-54 (#02) Checking Open/Short				

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

DTC		Diagnostic Criteria	Application		
HCESPN	FMI		G	C	W
189 (N.A)	5	(Detection) (When Pump P2 regulator EPPR current is equal or more than 300 mA) 10 seconds continuous, Pump P2 regulator EPPR drive current < 100 mA (Cancellation) (When Pump P2 regulator EPPR current is equal or more than 300 mA) 3 seconds continuous, Pump P2 regulator EPPR drive current ≥ 100 mA	●		
	6	(Detection) 10 seconds continuous, Pump P2 regulator EPPR drive current > 1.0 A (Cancellation) 3 seconds continuous, Pump P2 regulator EPPR drive current ≤ 1.0 A	●		
	(Results / Symptoms) 1. Control Function – Option attachment flow control operation failure (Checking list) 1. CN-243 (#2) – CN-54 (#26) Checking Open/Short 2. CN-243 (#1) – CN-54 (#03) Checking Open/Short				
196 (N.A)	0	HW145 10 seconds continuous, Attachment flow control EPPR 1 press. Sensor Measurement Voltage > 5.2V			
	1	HW145 10 seconds continuous, 0.3V≤ Attachment flow control EPPR 1 press. Sensor Measurement Voltage < 0.8V			
	4	HW145 10 seconds continuous, Attachment flow control EPPR 1 press. Sensor Measurement Voltage < 0.3V			
	(Results / Symptoms) 1. Control Function – Driving second pump joining function operation failure (Checking list) 1. CD-33 (#B) – CN-52 (#11) Checking Open/Short 2. CD-33 (#A) – CN-51 (#3) Checking Open/Short 3. CD-33 (#C) – CN-51 (#13) Checking Open/Short				
200	0	10 seconds continuous, Pump EPPR Press. Sensor Measurement Voltage > 5.2V	●		
	1	10 seconds continuous, 0.3V≤ Pump EPPR Press. Sensor Measurement Voltage < 0.8V	●		
	4	10 seconds continuous, Pump EPPR Press. Sensor Measurement Voltage < 0.3V	●		
	(Results / Symptoms) 1. Monitor – Pump EPPR Press. display failure 2. Control Function – Pump input horse power control failure, Overload at compensation control operation failure (Fuel efficiency/speed performance failure) (Checking list) 1. CD-44 (#B) – CN-51 (#22) Checking Open/Short 2. CD-44 (#A) – CN-51 (#32) Checking Open/Short 3. CD-44 (#C) – CN-51 (#31) Checking Open/Short				

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

DTC		Diagnostic Criteria	Application		
HCESPN	FMI		G	C	W
205	0	(Mounting pressure sensor) 10 seconds continuous, Boom Cylinder Rod Press. Sensor Measurement Voltage > 5.2V	●		
	1	(Mounting pressure sensor) 10 seconds continuous, 0.3V≤ Boom Cylinder Rod Press. Sensor Measurement Voltage < 0.8V	●		
	4	(Mounting pressure sensor) 10 seconds continuous, Boom Cylinder Rod Press. Sensor Measurement Voltage < 0.3V	●		
	(Results / Symptoms) 1. Monitor – Boom Cylinder Rod Press. display failure 2. Control Function – Boom floating control operation failure (Checking list) 1. CD-124 (#B) – CN-51 (#13) Checking Open/Short 2. CD-124 (#A) – CN-51 (#32) Checking Open/Short 3. CD-124 (#C) – CN-51 (#31) Checking Open/Short				
218	4	Mounting pressure sensor (HCESPN128 or HCESPN 205) (Detection) (When Boom Up Floating Solenoid is Off) 10 seconds continuous, Boom Up Floating Solenoid drive unit Measurement Voltage ≤ 3.0V (Cancellation) (When Boom Up Floating Solenoid is Off) 3 seconds continuous, Boom Up Floating Solenoid drive unit Measurement Voltage > 3.0V	●		
	6	(Detection) (When Boom Up Floating Solenoid is On) 10 seconds continuous, Boom Up Floating Solenoid drive current > 6.5 A (Cancellation) (When Boom Up Floating Solenoid is On) 3 seconds continuous, Boom Up Floating Solenoid drive current ≤ 6.5 A	●		
	(Results / Symptoms) 1. Control Function – Boom floating control operation failure (Checking list) 1. CD-503 (#1) – CN-53 (#06) Checking Open/Short 2. CD-503 (#2) – fuse (#18) Checking Open/Short				

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

DTC		Diagnostic Criteria	Application		
HCESPN	FMI		G	C	W
220	4	Mounting pressure sensor (HCESPN 128 or 205) (Detection) (When Boom Down Pilot Pressure Cutoff Solenoid is Off) 10 seconds continuous, Boom Down Pilot Pressure Cutoff Solenoid drive unit Measurement Voltage ≤ 3.0V (Cancellation) (When Boom Down Pilot Pressure Cutoff Solenoid is Off) 3 seconds continuous, Boom Down Pilot Pressure Cutoff Solenoid drive unit Measurement Voltage > 3.0V	●		
	6	(Detection) (When Boom Down Pilot Pressure Cutoff Solenoid is On) 10 seconds continuous, Boom Down Pilot Pressure Cutoff Solenoid drive current > 6.5 A (Cancellation) (When Boom Down Pilot Pressure Cutoff Solenoid is On) 3 seconds continuous, Boom Down Pilot Pressure Cutoff Solenoid drive current ≤ 6.5 A	●		
	(Results / Symptoms) 1. Control Function – Boom floating control operation failure (Checking list) 1. CD-369 (#1) – CN-53 (#08) Checking Open/Short 2. CD-369 (#2) – fuse box (#18) Checking Open/Short				
221	5	Monitor – Selecting attachment (breaker / crusher) (Detection) (When ATT Relief Setting EPPR 1 Current is equal or more than 10 mA) 10 seconds continuous, ATT Relief Setting EPPR 1 drive current = 0 mA (Cancellation) ATT Relief Setting EPPR 1 Current is equal or more than 10 mA) 3 seconds continuous, ATT Relief Setting EPPR 1 drive current ≥ 10 mA	●		
	6	(Detection) 10 seconds continuous, ATT Relief Setting EPPR 1 drive current > 1.0 A (Cancellation) 3 seconds continuous, ATT Relief Setting EPPR 1 drive current ≤ 1.0 A	●		
	(Results / Symptoms) 1. Control Function – Option attachment flow control – P1 relief pressure setting failure (Checking list) 1. CN-365 (#2) – CN-54 (#17) Checking Open/Short 2. CN-365 (#1) – CN-54 (#09) Checking Open/Short				

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

DTC		Diagnostic Criteria	Application		
HCESPN	FMI		G	C	W
222	5	Monitor – Selecting attachment (crusher) (Detection) (When ATT Relief Setting EPPR 2 Current is equal or more than 10 mA) 10 seconds continuous, ATT Relief Setting EPPR 2 drive current = 0 mA (Cancellation) (When ATT Relief Setting EPPR 2 Current is equal or more than 10 mA) 3 seconds continuous, ATT Relief Setting EPPR 2 drive current ≥ 10mA	●		
	6	(Detection) 10 seconds continuous, ATT Relief Setting EPPR 2 drive current > 1.0 A (Cancellation) 3 seconds continuous, ATT Relief Setting EPPR 2 drive current ≤ 1.0 A	●		
	(Results / Symptoms) 1. Control Function – Option attachment flow control – P2 relief pressure setting failure (Checking list) 1. CN-366 (#2) – CN-54 (#17) Checking Open/Short 2. CN-366 (#1) – CN-54 (#10) Checking Open/Short				
301	3	10 seconds continuous, Fuel Level Measurement Voltage > 3.8V	●		
	4	10 seconds continuous, Fuel Level Measurement Voltage < 0.3V	●		
	(Results / Symptoms) 1. Monitor – Fuel remaining display failure (Checking list) 1. CD-2 (#2) – CN-51 (#25) Checking Open/Short 2. CD-2 (#1) – CN-51 (#19) Checking Open/Short				
325	4	(Model Parameter) mounting Fuel Warmer Relay (Detection) (When Fuel Warmer Relay is Off) 10 seconds continuous, Fuel Warmer Relay drive unit Measurement Voltage ≤ 3.0V (Cancellation) (When Fuel Warmer Relay is Off) 3 seconds continuous, Fuel Warmer Relay drive unit Measurement Voltage > 3.0V	●		
	6	(Detection) (When Fuel Warmer Relay is On) 10 seconds continuous, Fuel Warmer Relay drive current > 4.5 A (Cancellation) (When Fuel Warmer Relay is On) 3 seconds continuous, Fuel Warmer Relay drive current ≤ 4.5 A	●		
	(Results / Symptoms) 1. Control Function – Fuel warmer operation failure (Checking list) 1. CR-46 (#85) – CN-52 (#13) Checking Open/Short 2. CR-46 (#30, #86) – fuse box (#25) Checking Open/Short				

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

DTC		Diagnostic Criteria	Application		
HCESPN	FMI		G	C	W
501	0	10 seconds continuous, Transmission Oil Press. Sensor Measurement Voltage > 5.2V			●
	1	10 seconds continuous, 0.3V≤ Transmission Oil Press. Sensor Measurement Voltage < 0.8V			●
	4	10 seconds continuous, Transmission Oil Press. Sensor Measurement Voltage < 0.3V			●
	(Results / Symptoms) 1. Monitor – Transmission Oil Press. display failure, Transmission Oil low pressure warning failure (Checking list) 1. CD-05 (#B) – CN-52 (#26) Checking Open/Short 2. CD-05 (#A) – CN-54 (#32) Checking Open/Short 3. CD-05 (#C) – CN-54 (#31) Checking Open/Short				
503	0	10 seconds continuous, Brake Oil Press. Sensor Measurement Voltage > 5.2V			●
	1	10 seconds continuous, 0.3V≤ Brake Oil Press. Sensor Measurement Voltage < 0.8V			●
	4	10 seconds continuous, Brake Oil Press. Sensor Measurement Voltage < 0.3V			●
	(Results / Symptoms) 1. Monitor – Brake Oil Press. display failure, Brake Oil low pressure warning failure (Checking list) 1. CD-03 (#B) – CN-52 (#29) Checking Open/Short 2. CD-03 (#A) – CN-51 (#32) Checking Open/Short 3. CD-03 (#C) – CN-51 (#31) Checking Open/Short				
505	0	10 seconds continuous, Working Brake Press. Sensor Measurement Voltage > 5.2V			●
	1	10 seconds continuous, 0.3V≤ Working Brake Press. Sensor Measurement Voltage < 0.8V			●
	4	10 seconds continuous, Working Brake Press. Sensor Measurement Voltage < 0.3V			●
	(Results / Symptoms) 1. Monitor – Working Brake Oil Press. display failure, Working Brake Oil low pressure warning failure (Checking list) 1. CD-38 (#B) – CN-51 (#30) Checking Open/Short 2. CD-38 (#A) – CN-51 (#32) Checking Open/Short 3. CD-38 (#C) – CN-51 (#31) Checking Open/Short				

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

DTC		Diagnostic Criteria	Application		
HCESPN	FMI		G	C	W
514	4	(Detection) (When Parking Relay is Off) 10 seconds continuous, Parking Relay drive unit Measurement Voltage ≤ 3.0V (Cancellation) (When Parking Relay is Off) 3 seconds continuous, Parking Relay drive unit Measurement Voltage > 3.0V			●
	6	(Detection) (When Parking Relay is On) 10 seconds continuous, Parking Relay drive current > 6.5 A (Cancellation) (When Parking Relay is On) 3 seconds continuous, Parking Relay drive current ≤ 6.5 A			●
	(Results / Symptoms) 1. Control Function – Parking Relay operation failure (Checking list) 1. CR-66 (#85) – CN-53 (#11) Checking Open/Short 2. CR-66 (#30, #86) – fuse box (#30) Checking Open/Short				
517	4	(Detection) (When Traveling Cutoff Relay is Off) 10 seconds continuous, Traveling Cutoff Relay drive unit Measurement Voltage ≤ 3.0V (Cancellation) (When Traveling Cutoff Relay is Off) 3 seconds continuous, Traveling Cutoff Relay drive unit Measurement Voltage > 3.0V			●
	6	(Detection) (When Traveling Cutoff Relay is On) 10 seconds continuous, Traveling Cutoff Relay drive current > 6.5 A (Cancellation) (When Traveling Cutoff Relay is On) 3 seconds continuous, Traveling Cutoff Relay drive current ≤ 6.5 A			●
	(Results / Symptoms) 1. Control Function – Traveling Cutoff Relay operation failure (Checking list) 1. CR-47 (#85) – CN-53 (#04) Checking Open/Short 2. CR-47 (#30, #86) – fuse box (#28) Checking Open/Short				

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

DTC		Diagnostic Criteria	Application		
HCESPN	FMI		G	C	W
525	4	(Detection) (When Ram Lock Solenoid is Off) 10 seconds continuous, Ram Lock Solenoid drive unit Measurement Voltage ≤ 3.0V (Cancellation) (When Ram Lock Solenoid is Off) 3 seconds continuous, Ram Lock Solenoid drive unit Measurement Voltage > 3.0V			●
	6	(Detection) (When Ram Lock Solenoid is On) 10 seconds continuous, Ram Lock Solenoid drive current > 6.5 A (Cancellation) (When Ram Lock Solenoid is On) 3 seconds continuous, Ram Lock Solenoid drive current ≤ 6.5 A			●
	(Results / Symptoms) 1. Control Function – Ram lock control operation failure (Checking list) 1. CN-69 (#1) – CN-53 (#12) Checking Open/Short 2. CN-69 (#2) – fuse box (#34) Checking Open/Short				
527	4	(Detection) (When Creep Solenoid is Off) 10 seconds continuous, Creep Solenoid drive unit Measurement Voltage ≤ 3.0V (Cancellation) (When Creep Solenoid is Off) 3 seconds continuous, Creep Solenoid drive unit Measurement Voltage > 3.0V			●
	6	(Detection) (When Creep Solenoid is On) 10 seconds continuous, Creep Solenoid drive current > 6.5 A (Cancellation) (When Creep Solenoid is On) 3 seconds continuous, Creep Solenoid drive current ≤ 6.5 A			●
	(Results / Symptoms) 1. Control Function – Creep mode operation failure (Checking list) 1. CN-206 (#1) – CN-52 (#17) Checking Open/Short 2. CN-206 (#2) – fuse box (#30) Checking Open/Short				

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

DTC		Diagnostic Criteria	Application		
HCESPN	FMI		G	C	W
530	0	10 seconds continuous, Travel Forward Press. Sensor Measurement Voltage > 5.2V			●
	1	10 seconds continuous, 0.3V≤ Travel Forward Press. Sensor Measurement Voltage < 0.8V			●
	4	10 seconds continuous, Travel Forward Press. Sensor Measurement Voltage < 0.3V			●
	(Results / Symptoms) 1. Monitor – Travel Forward Press. display failure 2. Control Function – Driving interoperability power control operation failure (Checking list) 1. CD-73 (#B) – CN-51 (#20) Checking Open/Short 2. CD-73 (#A) – CN-51 (#32) Checking Open/Short 3. CD-73 (#C) – CN-51 (#31) Checking Open/Short				
531 (N.A)	1	10 seconds continuous, 0.3V≤ Travel Reverse Press. Sensor Measurement Voltage < 0.8V			●
	4	10 seconds continuous, Travel Reverse Press. Sensor Measurement Voltage < 0.3V			●
	(Results / Symptoms) 1. Monitor – Travel Reverse Press. display failure 2. Control Function – Driving interoperability power control operation failure (Checking list) 1. CD-74 (#B) – CN-52 (#20) Checking Open/Short 2. CD-74 (#A) – CN-51 (#32) Checking Open/Short 3. CD-74 (#C) – CN-51 (#31) Checking Open/Short				
705	0	10 seconds continuous, Battery input Voltage > 35V	●		
	1	10 seconds continuous, Battery input Voltage < 18V	●		
	(Results / Symptoms) 1. Control Function – Startup impossibility (Checking list) 1. CS-74B (#1) – CN-51 (#26) Checking Open/Short				
707	1	(When Engine is equal or more than 400 rpm) 10 seconds continuous, Alternator Node L Measurement Voltage < 18V (In case 12v goods, Alternator Node L Measurement Voltage < 9V)	●		
	(Results / Symptoms) 1. Control Function – Battery charging circuit failure (Checking list) 1. CS-74 (#1) – CN-51 (#01) Checking Open/Short				

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

DTC		Diagnostic Criteria	Application		
HCESPN	FMI		G	C	W
714 (N.A)	3	(Model Parameter) Mounting Acc. Dial 10 seconds continuous, Acc. Dial Measurement Voltage > 5.2V	●		
	4	(Model Parameter) Mounting Acc. Dial 10 seconds continuous, Acc. Dial Measurement Voltage < 0.3V	●		
	(Results / Symptoms) 1. Monitor – Acc. Dial Voltage display failure 2. Control Function – Engine rpm control failure (Checking list) 1. CN-7 (#15) – CN-52 (#23) Checking Open/Short				
722	4	(Detection) (When Travel Alarm (Buzzer) Sound is Off) 10 seconds continuous, Travel Alarm (Buzzer) Sound Relay drive unit Measurement Voltage ≤ 3.0V (Cancellation) (When Travel Alarm (Buzzer) Sound Relay is Off) 3 seconds continuous, Travel Alarm (Buzzer) Sound Relay drive unit Measurement Voltage > 3.0V	●		
	6	(Detection) (When Travel Alarm (Buzzer) Sound is On) 10 seconds continuous, Travel Alarm (Buzzer) Sound Relay drive current > 4.5 A (Cancellation) (When Travel Alarm (Buzzer) Sound is On) 3 seconds continuous, Travel Alarm (Buzzer) Sound Relay drive current ≤ 4.5 A	●		
	(Results / Symptoms) 1. Control Function – Driving alarm operation failure (Checking list) 1. CN-81 (#1) – CN-52 (#09) Checking Open/Short 2. CN-81 (#2) – Fuse (#30) Checking Open/Short				
831	2	(When mounting the A/C Controller) 60 seconds continuous, A/C Controller Communication Data Error	●		
	(Results / Symptoms) 1. Control Function – A/C Controller operation failure (Checking list) 1. CN-11 (#8) – CN-51 (#09) Checking Open/Short 2. CN-11 (#7) – CN-51 (#08) Checking Open/Short				
840	2	60 seconds continuous, Cluster Communication Data Error	●		
	(Results / Symptoms) 1. Control Function – Cluster operation failure (Checking list) 1. CN-56A (#5) – CN-52 (#01) Checking Open/Short 2. CN-56A (#4) – CN-52 (#02) Checking Open/Short				

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

DTC		Diagnostic Criteria	Application		
HCESPN	FMI		G	C	W
841	2	10 seconds continuous, ECM Communication Data Error	●		
	(Results / Symptoms) 1. Control Function – ECM operation failure (Checking list) 1. CN-93 (#22) – CN-52 (#02) Checking Open/Short 2. CN-93 (#46) – CN-52 (#01) Checking Open/Short				
848	2	(When mounting the Jog Dial Module) 60 seconds continuous, Jog Dial Module Communication Data Error	●		
	(Results / Symptoms) 1. Control Function – Jog Dial Module operation failure (Checking list) 1. CN-8 (#2) – CN-51 (#09) Checking Open/Short 2. CN-8 (#3) – CN-51 (#08) Checking Open/Short				
850	2	(When mounting the RMCU) 60 seconds continuous, RMCU communication Data Error	●		
	(Resuluts / Symptoms) 1. Control Function – RMCU operation failure (Checking list) 1. CN-125A (#3) – CN-51 (#09) Checking Open/Short 2. CN-125A (#11) – CN-51 (#08) Checking Open/Short				
866	2	(When mounting the AAVM) 60 seconds continuous, AAVM communication Data Error	●		
	(Results / Symptoms) 1. Control Function – AAVM operation failure (Checking list) 1. CN-401 (#15) – CN-51 (#09) Checking Open/Short 2. CN-401 (#3) – CN-51 (#08) Checking Open/Short				
867	2	60 seconds continuous, RDU communication Data Error	●		
	(Results / Symptoms) 1. Control Function – RDU operation failure (Checking list) 1. CN-376 (#10) – CN-51 (#09) Checking Open/Short 2. CN-376 (#18) – CN-51 (#08) Checking Open/Short				

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

DTC		Diagnostic Criteria	Application		
HCESPN	FMI		G	C	W
868	2	60 seconds continuous, Switch Controller communication Data Error	●		
	(Results / Symptoms) 1. Control Function – Switch Controller operation failure (Checking list) 1. CN-56A (#7) – CN-51 (#08) Checking Open/Short 2. CN-56A (#6) – CN-51 (#09) Checking Open/Short				
869	2	(When mounting the BKCU) 60 seconds continuous, BKCU communication Data Error	●		
	(Results / Symptoms) 1. Control Function – BKCU operation failure (Checking list) 1. CS-2B (#A) – CN-51 (#08) Checking Open/Short 2. CS-2B (#B) – CN-51 (#09) Checking Open/Short				

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

4. ENGINE FAULT CODE

Fault code J1939 SPN J1939 FMI	Item	Description
111 629 12	Engine control module critical internal failure	Bad intelligent device or component
122 102 3	Intake manifold 1 pressure sensor circuit	Voltage above normal, or shorted to high source
123 102 4	Intake manifold 1 pressure sensor circuit	Voltage below normal, or shorted to low source
124 102 16	Intake manifold 1 pressure	Data valid but above normal operating range - moderately severe level
125 102 18	Intake manifold 1 pressure	Data valid but below normal operating range - moderately severe level
133 974 3	Remote accelerator pedal or lever position sensor 1 circuit	Voltage above normal, or shorted to high source
134 974 4	Remote accelerator pedal or lever position sensor 1 circuit	Voltage below normal, or shorted to low source
135 100 3	Engine oil rifle pressure 1 sensor circuit	Voltage above normal, or shorted to high source
141 100 4	Engine oil rifle pressure 1 sensor circuit	Voltage below normal, or shorted to low source
143 100 18	Engine oil rifle pressure	Data valid but below normal operating range - moderately severe level
144 110 3	Engine coolant temperature 1 sensor circuit	Voltage above normal, or shorted to high source
145 110 4	Engine coolant temperature 1 sensor circuit	Voltage below normal, or shorted to low source
146 110 16	Engine coolant temperature	Data valid but above normal operating range - moderately severe level
147 91 1	Accelerator pedal or lever position 1 sensor circuit frequency	Data valid but below normal operating range
148 91 0	Accelerator pedal or lever position sensor 1	Data valid but above normal operational range - most severe level
151 110 0	Engine coolant temperature	Data valid but above normal operational range - most severe level

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Item	Description
153 105 3	Intake manifold 1 temperature sensor circuit	Voltage above normal, or shorted to high source
154 105 4	Intake manifold 1 temperature sensor circuit	Voltage below normal, or shorted to low source
187 3510 4	Sensor supply 2 circuit	Voltage below normal, or shorted to low source
197 111 18	Coolant level	Data valid but below normal operating range - moderately severe level
227 3510 3	Sensor supply 2 circuit	Voltage above normal, or shorted to high source
234 190 0	Engine crankshaft speed/position	Data valid but above normal operational range - most severe level
235 111 1	Coolant level	Data valid but below normal operational range - most severe level
237 644 2	External speed command input (Multiple unit synchronization)	Data erratic, intermittent or incorrect
238 3511 4	Sensor supply 3 circuit	Voltage below normal, or shorted to low source
239 3511 3	Sensor supply 3 circuit	Voltage above normal, or shorted to high source
241 84 2	Wheel-based vehicle speed	Data erratic, intermittent or incorrect
242 84 10	Wheel-based vehicle speed sensor circuit tampering has been detected	Abnormal rate of change
271 1347 4	Engine fuel pump pressurizing assembly 1 circuit	Voltage below normal, or shorted to low source
272 1347 3	Engine fuel pump pressurizing assembly 1 circuit	Voltage above normal, or shorted to high source
285 639 9	SAE J1939 multiplexing pgn timeout error	Abnormal update rate
286 639 13	SAE J1939 multiplexing configuration error	Out of calibration

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Item	Description
288 974 19	SAE J1939 multiplexing remote accelerator pedal or lever position sensor system	Received network data in error
293 441 3	Auxiliary temperature sensor input 1 circuit	Voltage above normal, or shorted to high source
294 441 4	Auxiliary temperature sensor input 1 circuit	Voltage below normal, or shorted to low source
297 1388 3	Auxiliary pressure sensor input 2 circuit	Voltage above normal, or shorted to high source
298 1388 4	Auxiliary pressure sensor input 2 circuit	Voltage below normal, or shorted to low source
322 651 5	Injector solenoid driver cylinder 1 circuit	Current below normal or open circuit
324 653 5	Injector solenoid driver cylinder 3 circuit	Current below normal or open circuit
331 652 5	Injector solenoid driver cylinder 2 circuit	Current below normal or open circuit
332 654 5	Injector solenoid driver cylinder 4 circuit	Current below normal or open circuit
334 110 2	Engine coolant temperature	Data erratic, intermittent or incorrect
343 629 12	Engine control module warning internal hardware failure	Bad intelligent device or component
349 191 16	Transmission output shaft speed	Data valid but above normal operating range - moderately severe level
351 3597 12	Injector power supply	Bad intelligent device or component
352 3509 4	Sensor supply 1 circuit	Voltage below normal, or shorted to low source
386 3509 3	Sensor supply 1 circuit	Voltage above normal, or shorted to high source
415 100 1	Engine oil rifle pressure	Data valid but below normal operational range - most severe level

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Item	Description
418 97 15	Water in fuel indicator	Data valid but above normal operating range - least severe level
428 97 3	Water in fuel indicator sensor circuit	Voltage above normal, or shorted to high source
429 97 4	Water in fuel indicator sensor circuit	Voltage below normal, or shorted to low source
431 558 2	Accelerator pedal or lever idle validation switch	Data erratic, intermittent or incorrect
432 558 13	Accelerator pedal or lever idle validation switch circuit	Out of calibration
435 100 2	Engine oil rifle pressure	Data erratic, intermittent or incorrect
451 157 3	Injector metering rail 1 pressure sensor circuit	Voltage above normal, or shorted to high source
452 157 4	Injector metering rail 1 pressure sensor circuit	Voltage below normal, or shorted to low source
488 105 16	Intake manifold 1 temperature	Data valid but above normal operating range - moderately severe level
489 191 18	Transmission output shaft speed	Data valid but below normal operating range - moderately severe level
497 1377 2	Multiple unit synchronization switch	Data erratic, intermittent or incorrect
515 3514 3	Sensor supply 6 circuit	Voltage above normal, or shorted to high source
516 3514 4	Sensor supply 6 circuit	Voltage below normal, or shorted to low source
527 702 3	Auxiliary input/output 2 circuit	Voltage above normal, or shorted to high source
529 703 3	Auxiliary input/output 3 circuit	Voltage above normal, or shorted to high source
553 157 16	Injector metering rail 1 pressure	Data valid but above normal operating range - moderately severe level

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Item	Description
555 101 16	Crankcase pressure	Data valid but above normal operating range - moderately severe level
556 101 0	Crankcase pressure	Data valid but above normal operational range - most severe level
559 157 18	Injector metering rail 1 pressure	Data valid but below normal operating range - moderately severe level
584 677 3	Starter relay driver circuit	Voltage above normal, or shorted to high source
585 677 4	Starter relay driver circuit	Voltage below normal, or shorted to low source
599 640 14	Auxiliary commanded dual output shutdown	Special instructions
611 1383 31	Engine shut down hot	Condition exists
649 1378 31	Engine oil change interval	Condition exists
687 103 18	Turbocharger 1 speed	Data valid but below normal operating range - moderately severe level
689 190 2	Engine crankshaft speed/position	Data erratic, intermittent or incorrect
691 1172 3	Turbocharger 1 compressor intake temperature circuit	Voltage above normal, or shorted to high source
692 1172 4	Turbocharger 1 compressor intake temperature circuit	Voltage below normal, or shorted to low source
693 1172 7	Turbocharger 1 compressor intake temperature	Data erratic, intermittent or incorrect
731 723 7	Engine speed / position camshaft and crankshaft misalignment	Mechanical system not responding or out of adjustment
741 1176 3	Turbocharger 1 compressor intake pressure circuit	Voltage above normal, or shorted to high source
742 1176 4	Turbocharger 1 compressor intake pressure circuit	Voltage below normal, or shorted to low source

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Item	Description
743 1176 2	Turbocharger 1 compressor intake pressure	Data erratic, intermittent or incorrect
769 597 3	Brake switch circuit	Voltage above normal, or shorted to high source
771 597 4	Brake switch circuit	Voltage below normal, or shorted to low source
778 723 2	Engine camshaft speed / position sensor	Data erratic, intermittent or incorrect
1117 3597 2	Power supply lost with ignition on	Data erratic, intermittent or incorrect
1239 2623 3	Accelerator pedal or lever position sensor 2 circuit	Voltage above normal, or shorted to high source
1241 2623 4	Accelerator pedal or lever position sensor 2 circuit	Voltage below normal, or shorted to low source
1242 91 2	Accelerator pedal or lever position sensor 1	Data erratic, intermittent or incorrect
1358 91 3	Accelerator pedal or lever position sensor 1 circuit	Voltage above normal, or shorted to high source
1359 91 4	Accelerator pedal or lever position sensor 1 circuit	Voltage below normal, or shorted to low source
1515 91 19	SAE J1939 multiplexed accelerator pedal or lever sensor system	Received network data in error
1539 1387 3	Auxiliary pressure sensor input 1 circuit	Voltage above normal, or shorted to high source
1621 1387 4	Auxiliary pressure sensor input 1 circuit	Voltage below normal, or shorted to low source
1668 1761 4	Aftertreatment 1 diesel exhaust fluid tank level sensor circuit	Voltage below normal, or shorted to low source
1669 1761 3	Aftertreatment 1 diesel exhaust fluid tank level sensor circuit	Voltage above normal, or shorted to high source
1673 1761 1	Aftertreatment 1 diesel exhaust fluid tank level	Data valid but below normal operational range -most severe level

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Item	Description
1677 3031 4	Aftertreatment 1 diesel exhaust fluid tank temperature sensor	Voltage below normal, or shorted to low source
1678 3031 3	Aftertreatment 1 diesel exhaust fluid tank temperature sensor	Voltage above normal, or shorted to high source
1679 3031 2	Aftertreatment 1 diesel exhaust fluid tank temperature	Data erratic, intermittent or incorrect
1682 3362 31	Aftertreatment 1 diesel exhaust fluid dosing unit input lines	Condition exists
1685 3364 4	Aftertreatment diesel exhaust fluid quality sensor circuit	Voltage below normal, or shorted to low source
1686 3364 3	Aftertreatment diesel exhaust fluid quality sensor circuit	Voltage above normal, or shorted to high source
1695 3513 3	Sensor supply 5	Voltage above normal, or shorted to high source
1696 3513 4	Sensor supply 5	Voltage below normal, or shorted to low source
1713 3363 16	Aftertreatment 1 diesel exhaust fluid tank heater	Data valid but above normal operating range - moderately severe level
1714 3364 13	Aftertreatment diesel exhaust fluid quality	Out of calibration
1715 3364 11	Aftertreatment diesel exhaust fluid quality	Root cause not known
1843 101 3	Crankcase pressure circuit	Voltage above normal, or shorted to high source
1844 101 4	Crankcase pressure circuit	Voltage below normal, or shorted to low source
1852 97 16	Water in fuel indicator	Data valid but above normal operating range - moderately severe level
1879 3251 3	Aftertreatment diesel particulate filter differential pressure sensor circuit	Voltage above normal
1881 3251 4	Aftertreatment diesel particulate filter differential pressure sensor circuit	Voltage below normal

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Item	Description
1883 3251 2	Aftertreatment diesel particulate filter differential pressure sensor	Data erratic, intermittent or incorrect
1885 3216 4	Aftertreatment 1 intake NOx sensor circuit	Voltage below normal, or shorted to low source
1887 3226 4	Aftertreatment 1 outlet NOx sensor circuit	Voltage below normal, or shorted to low source
1921 3251 16	Aftertreatment diesel particulate filter differential pressure	Data valid but above normal operating range
1922 3251 0	Aftertreatment diesel particulate filter differential pressure	Data valid but above normal operating range
1993 4795 31	Aftertreatment 1 diesel particulate filter missing	Condition exists
2185 3512 3	Sensor supply 4 circuit	Voltage above normal, or shorted to high source
2186 3512 4	Sensor supply 4 circuit	Voltage below normal, or shorted to low source
2311 633 31	Electronic fuel injection control valve circuit	Condition exists
2321 190 2	Engine crankshaft speed/position	Data erratic, intermittent or incorrect
2322 723 2	Engine camshaft speed / position sensor	Data erratic, intermittent or incorrect
2373 1209 3	Exhaust gas pressure sensor 1 circuit	Voltage above normal, or shorted to high source
2374 1209 4	Exhaust gas pressure sensor 1 circuit	Voltage below normal, or shorted to low source
2448 111 17	Coolant level	Data valid but below normal operating range - least severe level
2468 190 16	Engine speed	Engine crankshaft speed/position - data valid but above normal operating range - moderately severe level
2554 1209 2	Exhaust gas pressure 1	Data erratic, intermittent or incorrect

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Item	Description
2557 697 3	Auxiliary PWM driver 1 circuit	Voltage above normal, or shorted to high source
2558 697 4	AuxiliaryPWM driver 1 circuit	Voltage below normal, or shorted to low source
2571 2630 3	Engine charge air cooler outlet temperature	Voltage above normal, or shorted to high source
2572 2630 4	Engine charge air cooler outlet temperature	Voltage below normal, or shorted to low source
2639 3251 15	Aftertreatment diesel particulate filter differential pressure	Data valid but above normal operating range
2771 3226 9	Aftertreatment 1 outlet NOx sensor	Abnormal update rate
2778 3481 16	Aftertreatment fuel rate	Data valid but above normal operating range - moderately severe level
2973 102 2	Intake manifold 1 pressure	Data erratic, intermittent or incorrect
2976 3361 2	Aftertreatment 1 diesel exhaust fluid dosing unit temperature	Data erratic, intermittent or incorrect
3133 3610 3	Aftertreatment 1 diesel particulate filter outlet pressure sensor circuit	Voltage above normal, or shorted to high source
3134 3610 4	Aftertreatment 1 diesel particulate filter outlet pressure sensor circuit	Voltage below normal, or shorted to low source
3135 3610 2	Aftertreatment 1 diesel particulate filter outlet pressure	Data erratic, intermittent or incorrect
3139 3667 3	Engine air shutoff circuit	Voltage above normal, or shorted to high source
3141 3667 4	Engine air shutoff circuit	Voltage below normal, or shorted to low source
3142 4360 3	Aftertreatment 1 SCR intake temperature sensor circuit	Voltage above normal, or shorted to high source
3144 4360 2	Aftertreatment 1 SCR intake temperature sensor	Data erratic, intermittent or incorrect

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Item	Description
3146 4363 3	Aftertreatment 1 SCR outlet temperature sensor circuit	Voltage above normal, or shorted to high source
3147 4363 4	Aftertreatment 1 SCR outlet temperature sensor circuit	Voltage below normal, or shorted to low source
3148 4363 2	Aftertreatment 1 SCR outlet temperature sensor	Data erratic, intermittent or incorrect
3151 4974 31	Aftertreatment 1 SCR catalyst system missing	Condition exists
3165 4363 0	Aftertreatment 1 SCR outlet temperature	Data valid but above normal operational range - most severe
3232 3216 9	Aftertreatment 1 intake NOx sensor	Abnormal update rate
3235 4363 16	Aftertreatment 1 SCR outlet temperature	Data valid but above normal operating range - moderately severe level
3251 4765 16	Aftertreatment 1 diesel oxidation catalyst intake temperature	Data valid but above normal operating range
3253 3242 16	Aftertreatment 1 diesel particulate filter intake temperature	Data valid but above normal operating range
3254 3242 16	Aftertreatment 1 diesel particulate filter intake temperature	Data valid but above normal operating range
3255 3246 16	Aftertreatment 1 diesel particulate filter outlet temperature	Data valid but above normal operating range
3311 3242 0	Aftertreatment 1 diesel particulate filter intake temperature	Data valid but above normal operation
3312 3246 0	Aftertreatment 1 diesel particulate filter outlet temperature	Data valid but above normal operation
3313 4765 4	Aftertreatment 1 diesel oxidation catalyst intake temperature sensor circuit	Voltage below normal, or shorted to low source
3314 4765 3	Aftertreatment 1 diesel oxidation catalyst intake temperature sensor circuit	Voltage above normal, or shorted to high source
3315 4765 2	Aftertreatment 1 diesel oxidation catalyst intake temperature	Data erratic, intermittent or incorrect

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Item	Description
3316 3242 4	Aftertreatment 1 diesel particulate filter intake temperature sensor circuit	Voltage below normal, or shorted to low source
3317 3242 3	Aftertreatment 1 diesel particulate filter intake temperature sensor circuit	Voltage above normal, or shorted to high source
3318 3242 2	Aftertreatment 1 diesel particulate filter intake temperature	Data erratic, intermittent or incorrect
3319 3246 3	Aftertreatment 1 diesel particulate filter outlet temperature sensor circuit	Voltage above normal, or shorted to high source
3321 3246 4	Aftertreatment 1 diesel particulate filter outlet temperature sensor circuit	Voltage below normal, or shorted to low source
3322 3246 2	Aftertreatment 1 diesel particulate filter outlet temperature	Data erratic, intermittent or incorrect
3326 91 9	SAE J1939 multiplexed accelerator pedal or lever sensor system	Abnormal update rate
3341 107 16	Engine air filter differential pressure - data valid but above normal operating range	Moderately severe level
3375 5397 31	Aftertreatment diesel particulate filter regeneration too frequent	Condition exists
3376 5319 31	Aftertreatment diesel particulate filter incomplete regeneration	Condition exists
3497 1761 17	Aftertreatment 1 diesel exhaust fluid tank level	Data valid but below normal operating range - least severe level
3498 1761 18	Aftertreatment 1 diesel exhaust fluid tank level	Data valid but below normal operating range - moderately severe level
3527 558 19	Accelerator pedal or lever idle validation switch	Received network data in error
3528 558 9	Accelerator pedal or lever idle validation switch	Abnormal update rate
3545 3226 31	Aftertreatment 1 outlet NOx sensor	Abnormal rate of change
3547 4096 31	Aftertreatment diesel exhaust fluid tank empty	Condition exists

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Item	Description
3558 3361 3	Aftertreatment 1 diesel exhaust fluid dosing unit	Voltage above normal, or shorted to high source
3559 3361 4	Aftertreatment 1 diesel exhaust fluid dosing unit	Voltage below normal, or shorted to low source
3567 5394 5	Aftertreatment diesel exhaust fluid dosing valve	Current below normal or open circuit
3568 5394 7	Aftertreatment diesel exhaust fluid dosing valve	Mechanical system not responding or out of adjustment
3571 4334 3	Aftertreatment 1 diesel exhaust fluid pressure sensor	Voltage above normal, or shorted to high source
3572 4334 4	Aftertreatment 1 diesel exhaust fluid pressure sensor	Voltage below normal, or shorted to low source
3574 4334 18	Aftertreatment 1 diesel exhaust fluid pressure sensor	Data valid but below normal operating range
3575 4334 16	Aftertreatment 1 diesel exhaust fluid pressure sensor	Data valid but above normal operating range
3577 4376 3	Aftertreatment diesel exhaust fluid return valve	Voltage above normal, or shorted to high source
3578 4376 4	Aftertreatment diesel exhaust fluid return valve	Voltage above normal, or shorted to low source
3583 5031 10	Aftertreatment 1 outlet nox sensor heater	Abnormal rate of change
3596 4334 2	Aftertreatment 1 diesel exhaust fluid pressure sensor	Data erratic, intermittent or incorrect
3641 748 9	Transmission output retarder	Abnormal update rate
3649 5024 10	Aftertreatment 1 intake NOx sensor heater	Abnormal rate of change
3681 3228 2	Aftertreatment 1 outlet NOx sensor power supply	Data erratic, intermittent or incorrect
3682 3218 2	Aftertreatment 1 intake NOx sensor power supply	Data erratic, intermittent or incorrect

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Item	Description
3697 630 12	Engine control module calibration memory	Bad intelligent device or component
3712 5246 0	Aftertreatment SCR operator inducement	Data valid but above normal operational range - most severe level
3714 1569 31	Engine protection torque derate	Condition exists
3725 3216 10	Aftertreatment 1 intake NOx sensor	Abnormal rate of change
3727 5571 7	High pressure common rail fuel pressure relief valve	Mechanical system not responding or out of adjustment
3737 1675 31	Engine starter mode overcrank protection	Condition exists
3741 5571 0	High pressure common rail fuel pressure relief valve	Data valid but above normal operational range
3748 3216 20	Aftertreatment 1 intake NOx sensor	Data not rational - drifted high
3765 442 3	Auxiliary temperature sensor input 2 circuit	Voltage above normal, or shorted to high source
3766 442 4	Auxiliary temperature sensor input 2 circuit	Voltage below normal, or shorted to low source
3838 2978 9	Estimated engine parasitic losses - percent torque	Abnormal update rate
3841 596 2	Cruise control enable switch	Data erratic, intermittent or incorrect
3843 5603 9	Cruise control disable command	Abnormal update rate
3845 5603 31	Cruise control disable command	Condition exists
3866 3364 1	Aftertreatment diesel exhaust fluid quality	Data valid but below normal operational range - most severe level
3868 3364 9	Aftertreatment diesel exhaust fluid quality	Abnormal update rate

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Item	Description
3878 3364 2	Aftertreatment diesel exhaust fluid quality	Data erratic, intermittent or incorrect
4151 5742 9	Aftertreatment diesel particulate filter temperature sensor module	Abnormal update rate
4152 5743 9	Aftertreatment selective catalytic reduction temperature sensor module	Abnormal update rate
4156 5746 4	Aftertreatment 1 diesel exhaust fluid dosing unit heater relay	Voltage below normal, or shorted to low source
4158 5742 12	Aftertreatment diesel particulate filter temperature sensor module	Bad intelligent device or component
4159 5743 12	Aftertreatment selective catalytic reduction temperature sensor module	Bad intelligent device or component
4161 5742 3	Aftertreatment diesel particulate filter temperature sensor module	Voltage above normal, or shorted to high source
4162 5742 4	Aftertreatment diesel particulate filter temperature sensor module	Voltage below normal, or shorted to low source
4163 5742 16	Aftertreatment diesel particulate filter temperature sensor module	Data valid but above normal operating range
4164 5743 3	Aftertreatment selective catalytic reduction temperature sensor module	Voltage above normal, or shorted to high source
4165 5743 4	Aftertreatment selective catalytic reduction temperature sensor module	Voltage below normal, or shorted to low source
4166 5743 16	Aftertreatment selective catalytic reduction temperature sensor module	Data valid but above normal
4168 5745 3	Aftertreatment 1 diesel exhaust fluid dosing unit heater	Voltage above normal, or shorted to high source
4169 5745 4	Aftertreatment 1 diesel exhaust fluid dosing unit heater	Voltage below normal, or shorted to low source
4249 4337 10	Aftertreatment 1 diesel exhaust fluid dosing temperature	Abnormal rate of change
4251 5798 10	Aftertreatment 1 diesel exhaust fluid dosing unit heater temperature	Abnormal rate of change

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Item	Description
4259 5742 11	Aftertreatment diesel particulate filter temperature sensor module	Root cause not known
4261 5743 11	Aftertreatment selective catalytic reduction temperature sensor module	Root cause not known
4277 3364 10	Aftertreatment diesel exhaust fluid quality	Abnormal rate of change
4284 5793 9	Desired engine fueling state	Abnormal update rate
4452 3226 7	Aftertreatment 1 outlet NOx sensor closed loop operation	Condition exists
4484 3667 7	Engine air shutoff	Mechanical system not responding or out of Adjustment
4526 521 2	Brake pedal position	Data erratic, intermittent or incorrect
4572 3031 9	Aftertreatment 1 diesel exhaust fluid tank temperature	Abnormal update rate
4584 3936 14	Aftertreatment diesel particulate filter system	Special instructions
4585 4792 14	Aftertreatment 1 SCR catalyst system	Special instructions
4677 1761 9	SAE J1939 multiplexing pgn timeout error	Abnormal update rate
4724 702 5	Auxiliary input/output 2 circuit	Current below normal or open circuit
4725 702 6	Auxiliary input/output 2 circuit	Current above normal or grounded circuit
4731 3031 13	Aftertreatment 1 diesel exhaust fluid tank temperature sensor	Out of calibration
4734 701 14	Auxiliary input/output 1	Special instructions
4737 3031 11	Aftertreatment 1 diesel exhaust fluid tank temperature	Root cause not known

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Item	Description
4739 1761 11	Aftertreatment 1 diesel exhaust fluid tank level sensor	Root cause not known
4747 3217 20	Aftertreatment intake oxygen sensor	Data not rational - drifted high
4748 3217 21	Aftertreatment intake oxygen sensor	Data not rational - drifted low
4749 3227 20	Aftertreatment outlet oxygen	Data not rational - drifted high
4751 3227 21	Aftertreatment outlet oxygen	Data not rational - drifted low
4768 3521 11	Aftertreatment 1 diesel exhaust fluid property	Root cause not known
4769 1761 10	Aftertreatment 1 diesel exhaust fluid tank level sensor	Abnormal rate of change
4842 3364 15	Aftertreatment diesel exhaust fluid quality	Data valid but above normal operating range - Least severe level
4863 5245 31	Aftertreatment diesel exhaust fluid tank low level indicator	-
4953 3353 3	Alternator 1 status	Voltage above normal, or shorted to high source
4954 3353 4	Alternator 1 status	Voltage below normal, or shorted to low source
5248 1623 13	Tachograph output shaft speed	Out of calibration
5272 649 4	Engine exhaust back pressure regulator control circuit	Voltage below normal, or shorted to low source
5273 649 5	Engine exhaust back pressure regulator control circuit	Current below normal or open circuit
5274 5625 2	Engine exhaust back pressure regulator position	Data erratic, intermittent or incorrect
5275 5625 3	Engine exhaust back pressure regulator position sensor circuit	Voltage above normal, or shorted to high source

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Item	Description
5276 5625 4	Engine exhaust back pressure regulator position sensor circuit	Voltage above normal, or shorted to low source
5292 520809 31	Excessive time since last engine air shutoff maintenance test	Condition exists
5383 3720 15	Aftertreatment 1 diesel particulate filter ash load percent	Data valid but above normal operating range - least severe level
5576 107 15	Engine air filter differential pressure	Data valid but above normal operating range - least severe level
5632 6918 31	SCR system cleaning inhibited due to inhibit switch	Condition exists
5652 1209 15	Exhaust pressure 1	Data valid but above normal operating range - least severe level
5653 6881 9	SCR operator inducement override switch	Abnormal update rate
5654 6881 13	SCR operator inducement override switch	Out of calibration
5655 4364 31	Aftertreatment 1 scr conversion efficiency	Condition exists
5689 3226 11	Aftertreatment 1 outlet nox sensor	Root cause not known
5715 3521 10	Aftertreatment 1 diesel particulate filter differential pressure	Abnormal rate of change
5716 3610 10	Aftertreatment 1 diesel particulate filter outlet pressure	Abnormal rate of change
5864 4375 3	Aftertreatment 1 diesel exhaust fluid pump command circuit	Voltage above normal or shorted to high source
5865 4375 4	Aftertreatment 1 diesel exhaust fluid pump command circuit	Voltage below normal or shorted to low source
5868 4339 7	Aftertreatment 1 scr feedback control status	Mechanical system not responding or out of adjustment
5935 4334 7	Aftertreatment 1 diesel exhaust fluid pressure	Mechanical system not responding or out of adjustment

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Item	Description
5936 4334 15	Aftertreatment 1 diesel exhaust fluid pressure	Data valid but above normal operating range - least severe level
5938 3750 14	Aftertreatment 1 diesel particulate filter conditions not met for active regeneration	Special instructions
5939 520968 9	Machine constrained operation	Abnormal update rate. No communication or an Invalid data transfer rate has been detected on the J1939 data link between the ECM and the machine
5941 520968 19	Machine constrained operation	Received network data in error. The received J1939 datalink message was not valid.
6256 168 15	Battery 1 voltage	Data valid but below normal operating range - moderately severe level
6257 168 17	Battery 1 voltage	Data valid but below normal operating range - moderately severe level
6263 647 3	Fan control circuit	Voltage above normal, or shorted to high source
6264 647 4	Fan control circuit	Voltage below normal, or shorted to low source
6456 5484 3	Engine fan clutch 2 control circuit	Voltage above normal, or shorted to high source
6457 5484 4	Engine fan clutch 2 control circuit	Voltage below normal, or shorted to low source
6467 1639 15	Fan speed	Data valid but above normal operational range - most severe level
6468 1639 17	Fan speed	Data valid but below normal operational range - most severe level
6471 6799 3	Fan blade pitch position sensor circuit	Voltage above normal, or shorted to high source
6472 6799 4	Fan blade pitch position sensor circuit	Voltage below normal, or shorted to low source
6475 3363 7	Aftertreatment 1 diesel exhaust fluid tank heater	Mechanical system not responding or out of adjustment
6476 3363 18	Aftertreatment 1 diesel exhaust fluid tank heater	Data valid but below normal operating range - moderately severe level

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Item	Description
6477 5491 3	Aftertreatment diesel exhaust fluid line heater relay	Voltage above normal, or shorted to high source
6478 5491 4	Aftertreatment diesel exhaust fluid line heater relay	Voltage below normal, or shorted to low source
6479 3363 3	Aftertreatment 1 diesel exhaust fluid tank heater	Voltage above normal, or shorted to high source
6481 3363 4	Aftertreatment 1 diesel exhaust fluid tank heater	Voltage below normal, or shorted to low source
6511 6655 3	Maintain ECM power lamp	Voltage above normal, or shorted to high source
6512 6655 4	Maintain ECM power lamp	Voltage below normal, or shorted to low source
6513 5745 17	Aftertreatment 1 diesel exhaust fluid dosing unit heater	Data valid but below normal operating range
6522 111 3	Coolant level sensor 1 circuit	Voltage above normal, or shorted to high source
6523 111 4	Coolant level sensor 1 circuit	Voltage below normal, or shorted to low source
6526 1761 13	Aftertreatment 1 diesel exhaust fluid tank level sensor	Out of calibration
6527 4376 7	Aftertreatment diesel exhaust fluid return valve	Mechanical system not responding or out of adjust
6529 5746 3	Aftertreatment 1 diesel exhaust fluid dosing unit heater relay	Voltage above normal, or shorted to high source
6531 4340 3	Aftertreatment 1 diesel exhaust fluid line heater 1 circuit	Voltage above normal, or shorted to high source
6532 4340 4	Aftertreatment 1 diesel exhaust fluid line heater 1 circuit	Voltage below normal, or shorted to low source
6533 4342 3	Aftertreatment 1 diesel exhaust fluid line heater 2 circuit	Voltage above normal, or shorted to high source
6534 4342 4	Aftertreatment 1 diesel exhaust fluid line heater 2 circuit	Voltage below normal, or shorted to low source

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Item	Description
6535 4344 3	Aftertreatment diesel exhaust fluid line heater 3 circuit	Voltage above normal, or shorted to high source
6536 4344 4	Aftertreatment diesel exhaust fluid line heater 3 circuit	Voltage below normal, or shorted to low source
6556 729 3	Engine intake air heater 1 circuit	Voltage above normal, or shorted to high source
6557 729 4	Engine intake air heater 1 circuit	Voltage below normal, or shorted to low source
6563 976 2	Auxiliary intermediate (PTO) speed switch validation	Data erratic, intermittent or incorrect
6568 3695 2	Aftertreatment regeneration inhibit switch	Data erratic, intermittent or incorrect
6583 441 14	Auxiliary temperature sensor input 1	Special instructions
6584 1388 14	Auxiliary pressure sensor input 2	Special instructions
6595 190 11	Engine speed	Root cause not known
6596 3713 31	Diesel particulate filter active regeneration inhibited due to system timeout	Condition exists
6599 521002 31	Engine cranks slowly	Condition exists
6611 6385 3	Engine starter motor relay control circuit	Voltage above normal or shorted to high source
6612 6385 4	Engine starter motor relay control circuit	Voltage below normal or shorted to low source
6613 5842 14	SCR monitoring system malfunction	Special instructions
6618 70 2	Parking brake switch	Data erratic, intermittent, or incorrect
6619 3515 10	Aftertreatment 1 diesel exhaust fluid temperature 2	Abnormal rate of change

※ Some fault codes are not applied to this machine.

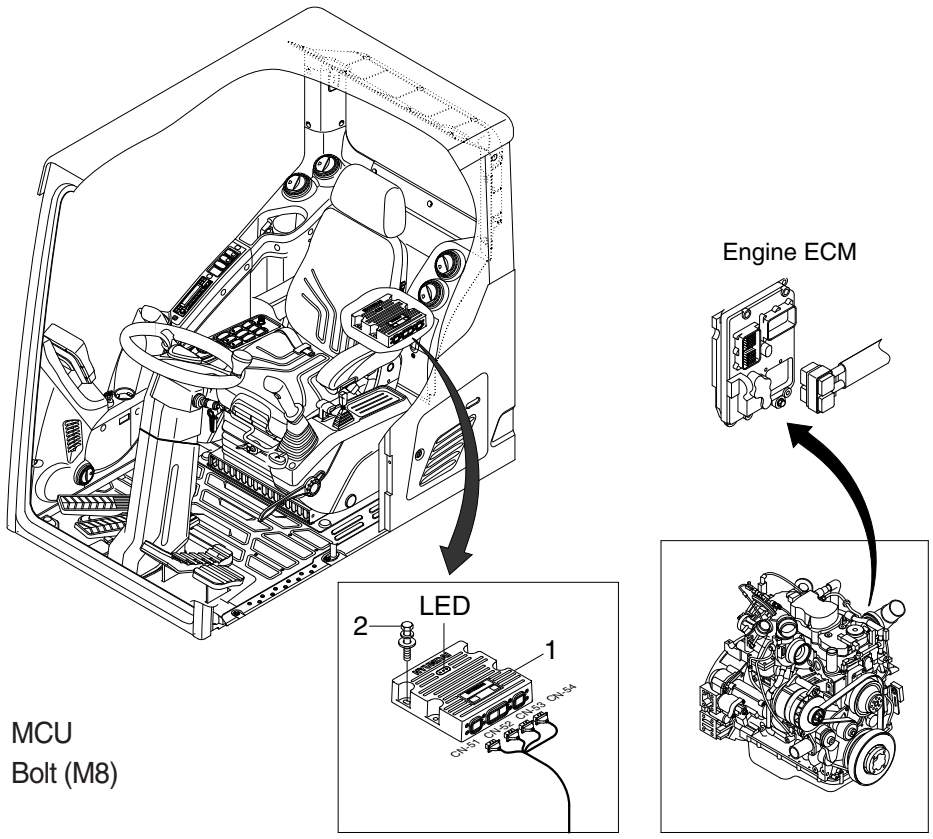
Fault code J1939 SPN J1939 FMI	Item	Description
6654 5626 7	Engine exhaust back pressure regulator	Mechanical system not responding or out of adjustment
6726 4796 31	Aftertreatment 1 diesel oxidation catalyst missing	Condition exists
6752 3364 18	Aftertreatment diesel exhaust fluid quality	Data valid but below normal operating range - moderately severe level
6771 521032 14	Aftertreatment system assembly	Special instructions
6938 5793 9	Desired engine fueling state	Abnormal update rate
6939 7745 9	Engine start request	Abnormal update rate
7133 7745 13	Engine start request	Out of calibration
7134 7746 13	Engine start consent	Out of calibration
7135 103 15	Engine turbocharger speed	Data valid but above normal operating range - least severe level
7745 1569 14	Engine protection torque derate	Special instructions
7393 7745 9	Engine start request	Abnormal update rate
7453 3242 15	Aftertreatment 1 diesel particulate filter intake temperature	Data valid but above normal operating range - least severe level
7454 3246 15	Aftertreatment 1 diesel particulate filter outlet temperature	Data valid but above normal operating range - least severe level

※ Some fault codes are not applied to this machine.

5. AAVM FAULT CODE

Fault Code	Description
A01	AAVM Communication Error -AAVM
A02	AAVM Communication Error -Front Camera
A03	AAVM Communication Error -Rear Camera
A04	AAVM Communication Error -Left Camera
A05	AAVM Communication Error -Right Camera
A06	Manual Setting Fail
A07	No MCU CID
A08	MCU CID Format Error
A09	AAVM Hardware Error -AAVM
A10	AAVM Hardware Error -Front Camera
A11	AAVM Hardware Error -Rear Camera
A12	AAVM Hardware Error -Left Camera
A13	AAVM Hardware Error -Right Camera
A14	MCU CID Model is not registered
A15	MCU CID Model can’t be applied

1. MCU and Engine ECM



1 MCU
2 Bolt (M8)

140WA5MS13

2. MCU ASSEMBLY

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

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

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

G : green, R : red, Y : yellow

GROUP 15 EPPR VALVE

1. PUMP EPPR VALVE

1) COMPOSITION

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

(1) Electro magnet valve

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

(2) Spool valve

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

(3) Electric current value for each mode

Mode		E/G RPM		PF EPPR		Delta P EPPR	
		No Load	Load	Current (mA)		Current (mA)	
				No Load	Load	No Load	Load
Standard	P	1700	1800	450	380	250	250
	S	1600	1700	550	480	250	250
	E	1500	1600	580	510	250	250
Option	P	1800	1800	380	380	250	250
	S	1700	1700	480	480	250	250
	E	1600	1600	510	510	250	250

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

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

- Management
  · Service menu

140WA3CD127

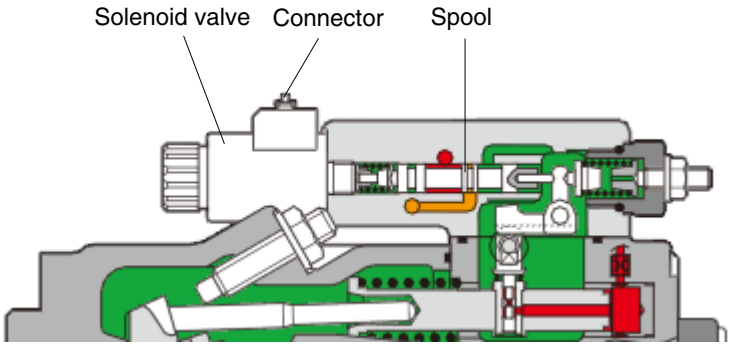
Enter the password 140WA3CD128

140WA3CD129

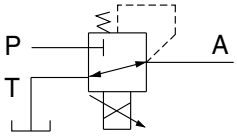
· Power shift (standard/option) : Power shift pressure can be set by option menu.

3) OPERATING PRINCIPLE

(1) Structure



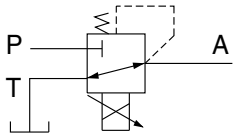
140WA5MS20

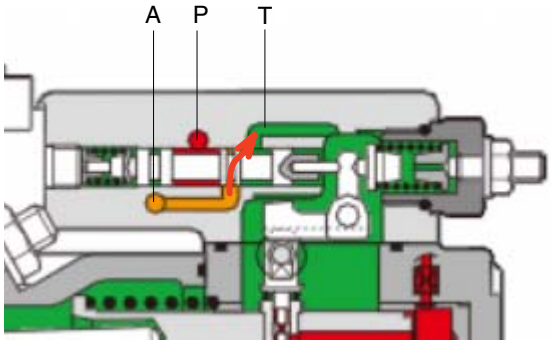


P Pilot oil supply line (pilot pressure)
T Return to tank
A Secondary pressure to flow regulator at main pump

(2) Neutral

Pressure line is blocked and A oil returns to tank.

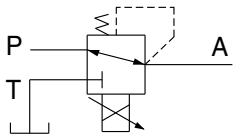


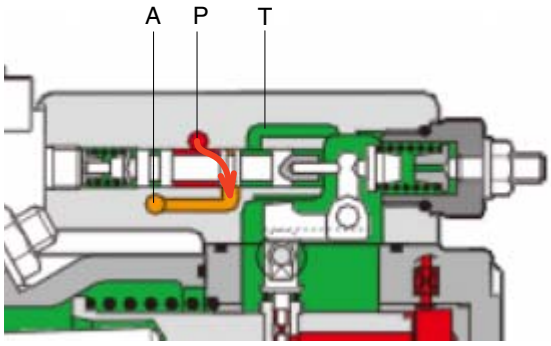


140WA5MS21

(3) Operating

Secondary pressure enters into A.





140WA5MS22

4) EPPR VALVE CHECK PROCEDURE

(1) Check electric current value at EPPR valve

① Disconnect connector CN-75 from EPPR valve.

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

③ Start engine.

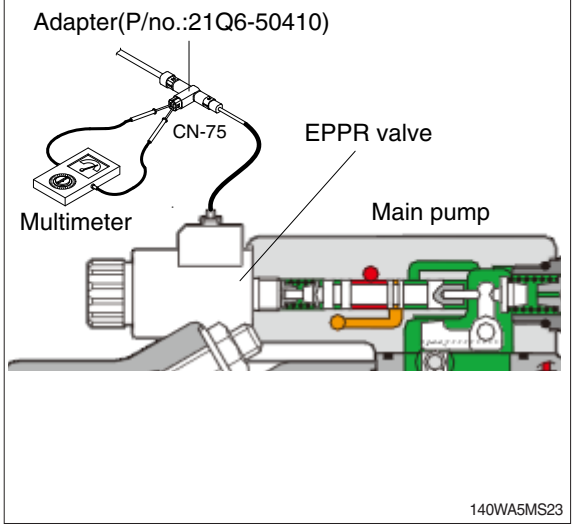
④ Set S-mode and cancel auto decel mode.

⑤ Position the multimodal dial at 10.

⑥ If rpm display show approx 1600±50 rpm check electric current at bucket circuit relief position.

⑦ Check electric current at bucket circuit relief position.

Spec : 200~600 mA



(2) Check pressure at EPPR valve

① Remove plug and connect pressure gauge as figure.
- Gauge capacity : 0 to 50 kgf/cm² (0 to 725 psi)

② Start engine.

③ Set S-mode and cancel auto decel mode.

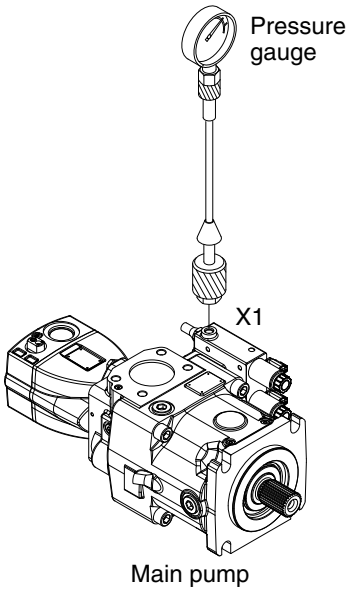
④ Position the multimodal dial at 10.

⑤ If tachometer show approx 1600±50 rpm check pressure at relief position of bucket circuit by operating bucket control lever.

⑥ If pressure is not correct, adjust it.

⑦ After adjust, test the machine.

Spec : 2~25 kgf/cm² (30~350 psi)



GROUP 16 MONITORING SYSTEM

1. OUTLINE

Monitoring system consists of the monitor part and switch part.

The monitor part gives warnings when any abnormality occurs in the machine and informs the condition of the machine. Also, monitor part is to set and display for modes, monitoring and utilities with the switches.

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

2. CLUSTER

1) MONITOR PANEL

140WA5MS25

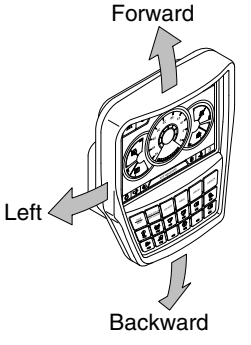
※ The warning lamp pops up and/or blinks and the buzzer sounds when the machine has a problem.

The warning lamp lights up or blinks until the problem is cleared. Refer to page 5-65 for details.

※ This cluster is adjustable.

· Vertical (forward/backward) : each 15°

· Horizontal (left only) : 15°



290F3CD47

2) CLUSTER CHECK PROCEDURE

(1) Start key : ON

① Check monitor

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

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

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

a. Engine rpm display : 0 rpm
b. Engine coolant temperature gauge : White range
c. Hydraulic oil temperature gauge : White range
d. Fuel level gauge : White range
e. DEF/AdBlue® Level gauge : White range

③ Indicating lamp state

a. Power mode pilot lamp : E mode or U mode
b. Work mode pilot lamp : General operation mode (bucket)
c. Travel speed pilot lamp : Low (turtle)

(2) Start of engine

① Check machine condition

a. RPM display indicates at present rpm
b. Gauge and warning lamp : Indicate at present condition.

※ When normal condition : All warning lamp OFF

c. Work mode selection : General work
d. Power mode selection : E mode or U mode
e. Travel speed pilot lamp : Low (turtle)

② When warming up operation

a. Warming up pilot lamp : ON
b. After engine started, engine speed increases to1200 rpm.

※ Others same as above.

③ When abnormal condition

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

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

※ Refer to page 5-88 for details.

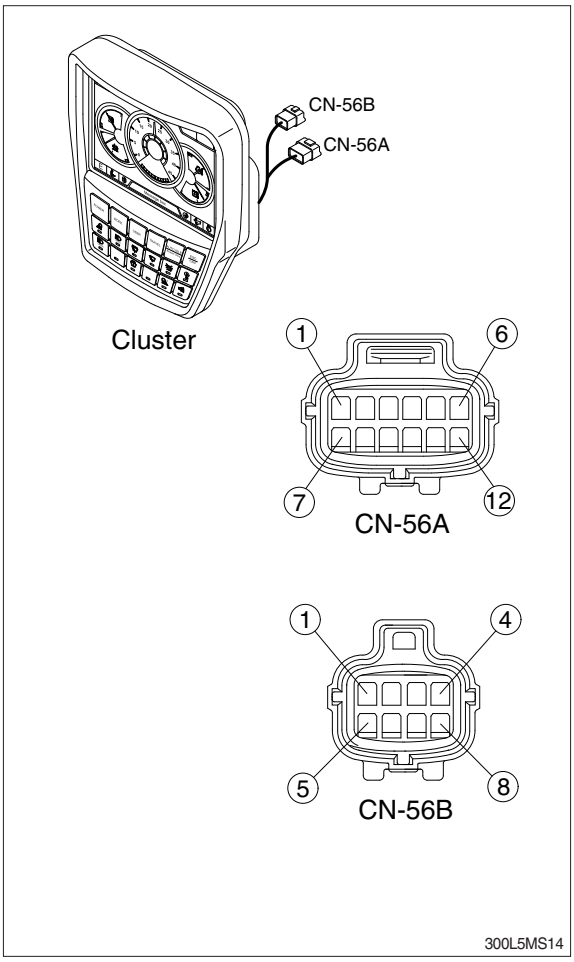
3) CLUSTER CONNECTOR

(1) CN-56A

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

(2) CN-56B

No.	Name	Signal
1	CAM 6.5V	6.3~6.7V
2	CAM GND	-
3	CAM DIFF (H)	0~5V
4	CAM DIFF (L)	0~5V
5	N.C	-
6	N.C	-
7	N.C	-
8	N.C	-



4) GAUGE

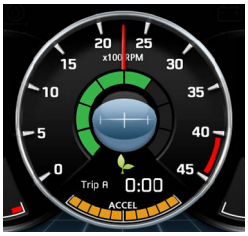
(1) Operation screen

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

140WA3CD11

1	RPM / Speed gauge	5	DEF/AdBlue® level gauge
2	Engine coolant temperature gauge	6	Tripmeter display
3	Hydraulic oil temperature gauge	7	Eco guage
4	Fuel level gauge	8	Accel dial gauge

(2) RPM / Speed gauge



300A3CD22

① This displays the engine speed.

140WA3CD22

② When traveling, the speed gauge is displayed.

(3) Engine coolant temperature gauge

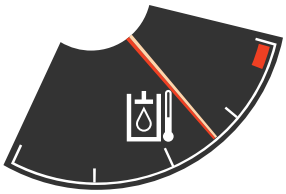
290F3CD53

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

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

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

(4) Hydraulic oil temperature gauge



290F3CD54

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

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

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

(5) Fuel level gauge

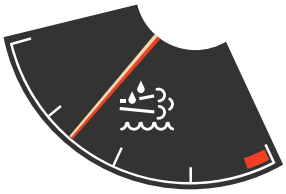
290F3CD55

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

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

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

(6) DEF/AdBlue® Level gauge



290F3CD57

① This gauge indicates the amount of liquid in the DEF/AdBlue® tank.

② Fill the DEF/AdBlue® when in the red range, or lamp pops up and the buzzer sounds.

③ Do not overfull DEF/AdBlue®.

※ **Refer to page 5-78.**

※ **If the gauge indicates the red range or lamp blinks 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 electricity or sensor.**

(7) Tripmeter display

290F3CD56

① This displays the engine the tripmeter.

※ **Refer to page 5-107 for details.**

(8) Eco gauge

290F3CD58

① This gauge indicates the fuel consumption rate and machine load status so that the operators can operate the machine efficient in regards to fuel consumption.

② Fuel consumption rate or machine load is higher if the number of segments are increased.

③ The color of Eco gauge indicates operation status.

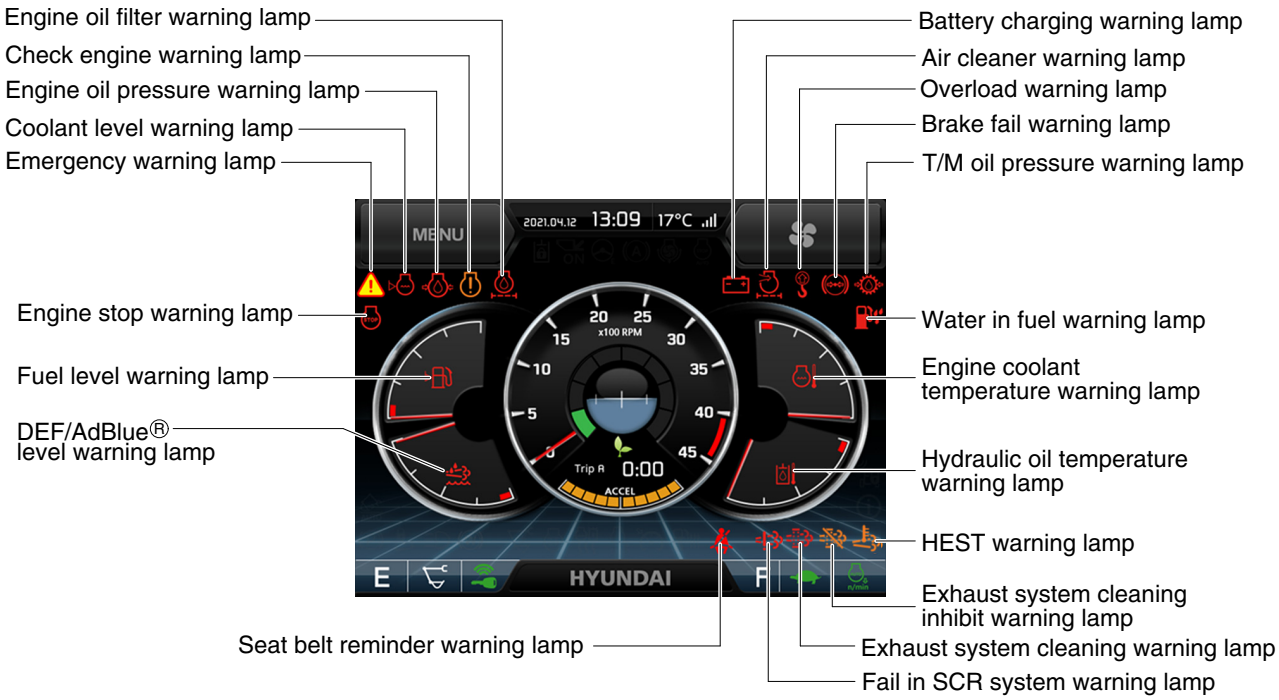
- White : Idle operation
- Green : Economy operation
- Yellow : Non-economy operation at a medium level.
- Red : Non-economy operation at a high level.

(9) Accel dial gauge

290F3CD59

① This gauge indicates the level of accel dial.

5) WARNING LAMPS



140WA3CD20

※ **Warning lamps and buzzer**

Warnings	When error happened	Lamps and buzzer
All warning lamps except below	Warning lamp pops up on the center of the LCD and the buzzer sounds	· The pop-up warning lamp moves to the original position, blinks and the buzzer stops when; - the buzzer stop switch (AUTO IDLE Buzzer Stop) is pushed - the knob of the jog dial module is pushed - the lamp of the LCD is touched
	Warning lamp pops up on the center of the LCD and the buzzer sounds	· The pop-up warning lamp moves to the original position, lights up or blinks and the buzzer stops when; - the buzzer stop switch (AUTO IDLE Buzzer Stop) is pushed - the knob of the jog dial module is pushed - the lamp of the LCD is touched **※ Refer to page 5-78 for details.**
	Warning lamp pops up on the center of the LCD and the buzzer sounds	· The pop-up warning lamp moves to the original position, lights up and the buzzer stops after 2 seconds elapses.
	Warning lamp pops up on the center of the LCD and the buzzer sounds	· The pop-up warning lamp moves to the original position, blinks and the buzzer stops after 2 seconds elapses.
	Warning lamp pops up on the center of the LCD and the buzzer sounds	· Cluster displays this pop-up when it has communication error with MCU. · If communication with MCU become normal state, it will disappear automatically.
	Warning lamp pops up on the center of the LCD and the buzzer sounds	**※ Refer to page 5-74 for details.**
	Warning lamp lights up and the buzzer sounds	**※ Refer to page 5-79 for details.**

※ **Refer to page 5-88 for the buzzer stop switch (AUTO IDLE Buzzer Stop) and the operator's manual page 3-77 for the jog dial module.**

(1) Engine coolant temperature warning lamp

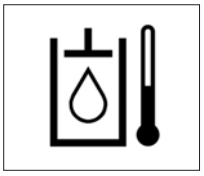
290F3CD61

① Engine coolant temperature warning is indicated in 2 steps.
- 103˚C over : The lamp pops up and the buzzer sounds.
- 107˚C over : The lamp pops up and the buzzer sounds.

② The pop-up , lamps move to the original position and blinks when the buzzer stop switch AUTO IDLE Buzzer Stop is pushed. The buzzer will stop and , lamps will blink.

③ Check the cooling system when the lamps keep blinking.

(2) Hydraulic oil temperature warning lamp



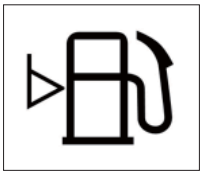
290F3CD62

① Hydraulic oil temperature warning is indicated in 2 steps.
- 100˚C over : The lamp pops up and the buzzer sounds.
- 105˚C over : The lamp pops up and the buzzer sounds.

② The pop-up , lamps move to the original position and blinks when the buzzer stop switch AUTO IDLE Buzzer Stop is pushed. The buzzer will stop and , lamps will blink.

③ Check the hydraulic oil level and hydraulic cooling system.

(3) Fuel level warning lamp



290F3CD63

① This warning lamp pops up and the buzzer sounds when the fuel level is below 35 ℓ (9.2 U.S. gal).

② Fill the fuel immediately after the lamp blinks.

(4) Emergency warning lamp

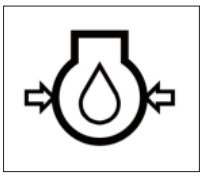
290F3CD64

① This warning lamp pops up and the buzzer sounds when each of the below warnings occurs.
- Engine coolant overheating (over 107˚C)
- Hydraulic oil overheating (over 105˚C)
- MCU input voltage abnormal
- Cluster communication data error
- Engine ECM communication data error

※ The pop-up warning lamp moves to the original position and blinks when the buzzer stop switch AUTO IDLE Buzzer Stop is pushed. The buzzer will stop.

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

(5) Engine oil pressure warning lamp



290F3CD65

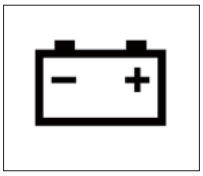
① This warning lamp pops up and the buzzer sounds when the engine oil pressure is low.
② If the lamp lights ON, shut OFF the engine immediately. Check oil level.

(6) Check engine warning lamp

290F3CD66

① This warning lamp pops up and the buzzer sounds when the communication between MCU and engine ECM is abnormal, or if the cluster received specific fault code from the engine ECM.
② Check the communication line between the two.
If the communication line is OK, then check the fault codes on the cluster.

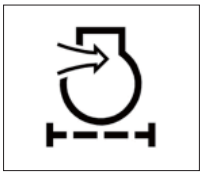
(7) Battery charging warning lamp



290F3CD67

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

(8) Air cleaner warning lamp



290F3CD68

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

(9) Overload warning lamp (opt)

290F3CD69

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

(10) Engine stop warning lamp

290F3CD252

① This warning lamp pops up and the buzzer sounds after 30 minutes of run time elapses, when the DEF/AdBlue® tank has reached it's minimum level. Stop engine immediately and check actual DEF/AdBlue® level.

② Fill the DEF/AdBlue® immediately.

※ Refer to page 5-78.

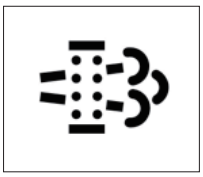
③ This lamp pops up and the buzzer sounds when the maual (stationary) exhuast system cleaning is not performed.

※ Refer to page 5-76.

※ Please contact your HD Hyundai Construction Equipment service center or local dealer.

※ "Engine shutdown" cluster message pops up when the exhaust gas temperature reaches above 800℃.

(11) Exhaust system cleaning warning lamp

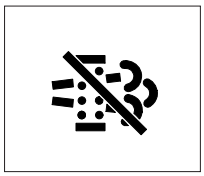


290F3CD70

① This warning lamp lights up or blinks when exhaust system cleaning is needed as seen in the table below.

Warning lamp				Description
Exhaust 	HEST 	Check engine 	Stop engine 	
Off	Off	Off	Off	· Normal operating mode
On (Amber)	Off	Off	Off	· Manual (stationary) exhaust system cleaning is recommended. ※ Refer to page 5-77.
On (Amber)	Off	On (Red)	Off	· Manual exhaust system cleaning must be conducted immediately. · Engine power will be reduced automatically if action is not taken. ※ Refer to page 5-77.
On (Amber)	Off	On (Red)	On (Red)	· These lamps will be ON if manual exhaust system cleaning is not conducted for a certain period of time. Stop the engine immediately. · Please contact HD Hyundai Construction Equipment service center or local dealer.
Blink (Red)	Off	Off	Off	· The exhaust system cleaning lamp will blink without HEST lamp while automatic exhaust system cleaning is being performed. · Low idle speed will increase to 1500 rpm. · The machine can be operated as normal operating mode. · Fuel consumption may slightly increase.
Blink (Red)	On (Amber)	Off	Off	· The exhaust system cleaning lamp will blink with HEST lamp while manual exhaust system cleaning is being performed. · The machine must remain stationary at low idle. ※ Refer to page 5-77.

(12) Exhaust system cleaning inhibit warning lamp

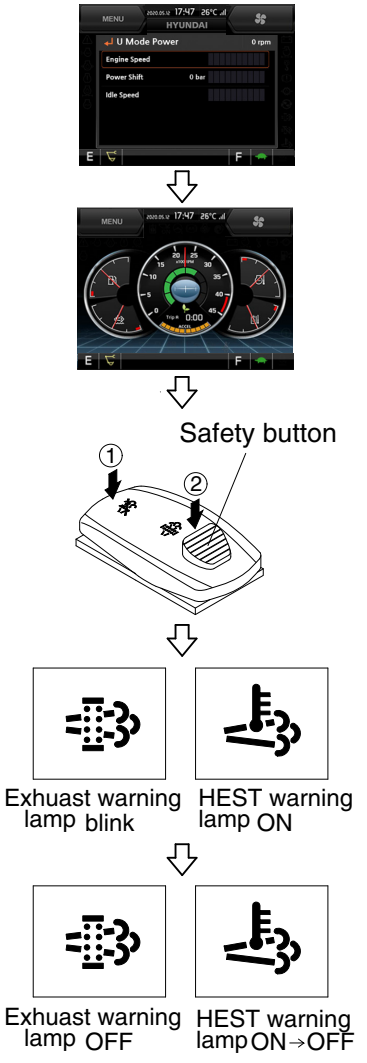


2609A3CD201

① This warning lamp indicates the exhaust system cleaning switch is pushed to the inhibit position, therefore automatic and manual exhaust system cleaning can not occur.

※ Refer to the operator's manual page 3-46 for the exhaust system cleaning switch.

※ Manual exhaust system cleaning



140WA3CD202

※ Manual exhaust system cleaning must be operated in a fireproof area.

※ To stop a manual exhaust system cleaning before it has completed, set to the exhaust system cleaning switch to the inhibit position or turn OFF the engine.

① Stop and park the machine.

② Pull the safety button and push the switch to position ② to initiate the manual exhaust system cleaning.

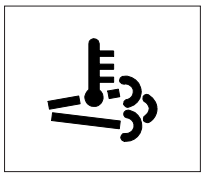
※ Refer to the operator's manual page 3-47 for the exhaust system cleaning switch operation.

※ The engine speed may increase to 1500 rpm and exhaust system cleaning begins and it will take approximately 20~30 minutes.

③ The exhaust system cleaning warning lamp will blink and HEST warning lamp will light up during the exhaust system cleaning operation.

④ The exhaust system cleaning and/or HEST warning lamp light will go off when the exhaust system cleaning is completed.

(13) HEST (High exhaust system temperature) **warning lamp**



2609A3CD211A

① This warning lamp indicates, when illuminated, that exhaust temperatures are high due to exhaust system cleaning.
② The lamp will also illuminate during a manual exhaust system cleaning.
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 800˚C [1500˚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 exhaust system cleaning cycles.

(14) DEF/AdBlue® level warning lamp

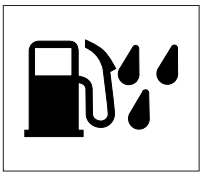
290F3CD257A

① This warning lamp when ON or blinking, indicates that the DEF/AdBlue® level is low as per the table below.

※ It is recommended that the DEF/AdBlue® tank be filled completely full of the DEF/AdBlue® in order to correct any fault conditions.

Warning lamp				Description
Fail in SCR system	DEF/AdBlue® level	Check engine	Stop engine	
On	On	Off	Off	· The DEF/AdBlue® level has fallen below the initial warning level (10%).
On	On	On	Off	· The DEF/AdBlue® level has fallen below the initial derate level (2.5%). · The engine power will be limited automatically.
On	Blink	On	On	· This happens when 30 minutes has elapsed with empty conditions (0%) of the DEF/AdBlue® tank. · The engine will enter the final derate level which may include low idle lock or engine shutdown with restart limitations. · In order to remove the final derate, the DEF/AdBlue® tank must be filled to above 10% gauge reading.

(15) Water in fuel warning lamp



300A3CD24A

① This warning lamp lights up and the buzzer sounds when the water separator is full of water or malfunctioning.

※ **When this lamp lights up, stop the machine and drain water from the separator.**

(16) Seat belt reminder warning lamp

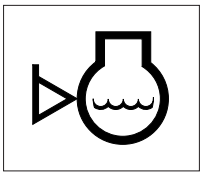
300A3CD25

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

② sounds.

Fasten the seat belt.

(17) Coolant level warning lamp

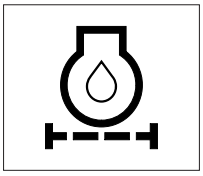


760F3CD58

① This warning lamp indicates lack of coolant.

② Check and refill coolant.

(18) Eninge oil filter warning lamp



300A3CD306

① This warning lamp pops up and the buzzer sounds when the filter of eninge oil is clogged.

② Check, clean or replace filter.

(19) Brake fail warning lamp

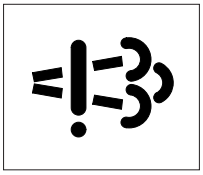
140WA3CD95

① This lamp blinks when the oil pressure of service brake drops below the normal range.

② Stop the engine and check for its cause.

※ **Do not operate until any problems are corrected.**

(20) Fail in SCR system warning lamp



300A3CD15

① This warning lamp indicates there are faults related to SCR system.

② The lamp lights up when each of the below warnings is happening.

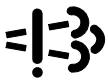
a. Low DEF/AdBlue® level

b. Poor quality of DEF/AdBlue®

c. Tempering or malfunction in the aftertreatment system

③ Once the lamp lights up, the engine will derate soon.

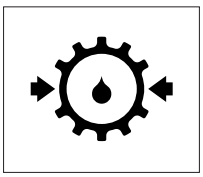
※ Please contact your HD Hyundai Construction Equipment service center or local dealer.

Warning lamp		Torque reduction
	Time	
On	Fault detected	-
On	After 2 h 30 min	· Torque is reduced to 75% of the highest torque.
Blink	After 3 h 45 min	· Torque is reduced to 50% of the highest torque.
Blink rapidly	After 4 hours	· Torque is reduced to 0% (low idling) of the hightest torque within 2~10 min.

※ If a new fault ocuurs within 40 hours of operation since the first fault, the warning lamp will light up. After 3 hours of operation, the warning lamp will blink rapidly and torque will be reduced to 0% (low idling) within 2~10 minutes.

※ Once the fault has been remedied and the engine control unit has received an indication that it is working, torque returns to the normal level.

(21) T/M oil pressure warning lamp

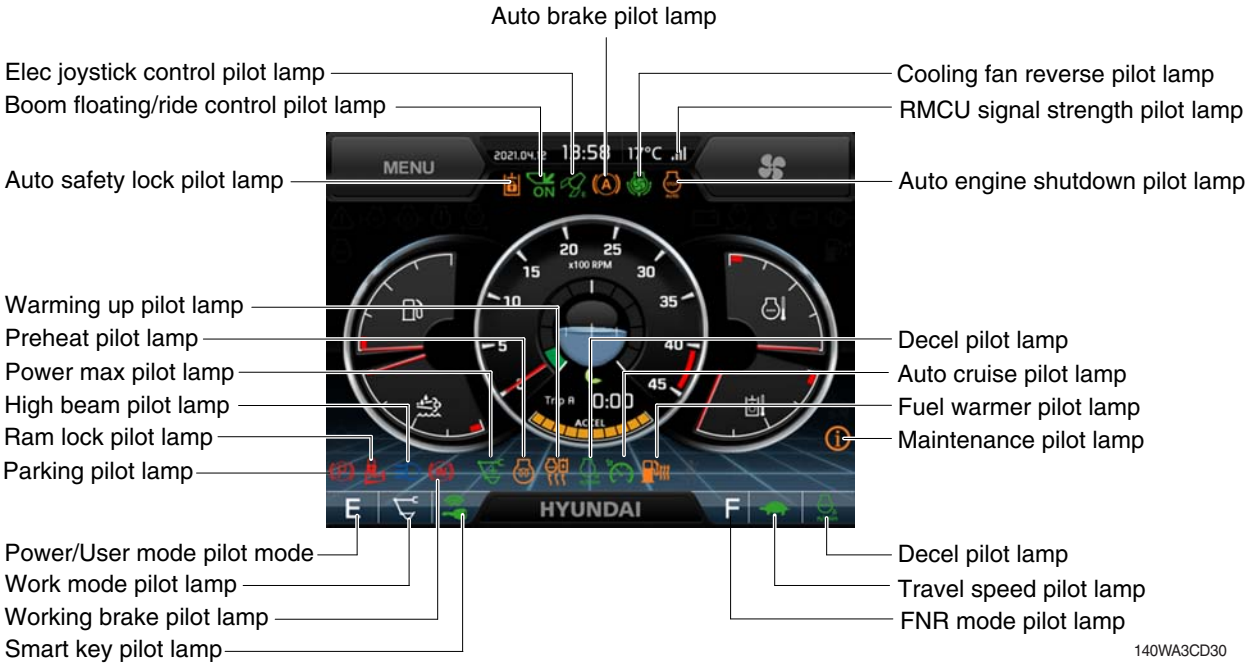


140WA3CD96

① This lamp blinks when the oil pressure of the transmission drops.

② Stop the engine and check the transmission system.

6) PILOT LAMPS



(1) Mode pilot lamps

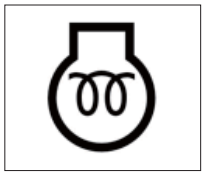
No	Mode	Pilot lamp	Selected mode
1	Power mode	P	Heavy duty power work mode
		S	Standard power mode
		E	Economy power mode
2	User mode	U	User preferable power mode
3	Work tool mode		General operation - IPC speed mode
			General operation - IPC balance mode
			General operation - IPC efficiency mode
	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

(2) Power max pilot lamp

300A3CD32

① The lamp will be ON when pushing power max switch on the LH RCV lever.
② The power max function operates for a max period of 8 seconds.
※ **Refer to the operator's manual page 3-53 for power max function.**

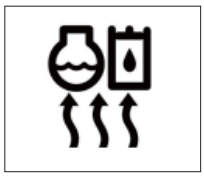
(3) Preheat pilot lamp



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.

(4) Warming up pilot lamp



290F3CD80

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

(5) Decel pilot lamp

300A3CD33

① Operating one touch decel switch on the RCV lever makes the lamp light up.
② Also, the lamp will light up and engine speed will be reduced automatically to save fuel when all levers and pedals are in the neutral position, and the auto idle function is selected.
③ If it follows the case below, decel goes off in the idle state.
- Auto idle button off
- Working/Travel
- One touch decel button off
- Safety lever unlock

※ **Refer to the operator's manual page 3-53.**

(6) Fuel warmer pilot lamp

300A3CD34

① This lamp lights up when the coolant temperature is below 10℃ (50°F) or the hydraulic oil temperature is 20℃ (68°F).
② The automatic fuel warming is cancelled when the engine coolant temperature is above 60℃ (140°F), and the hydraulic oil temperature is above 45℃ (113°F) since the start switch was ON position.

(7) Maintenance pilot lamp

300A3CD35

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 5-100.**

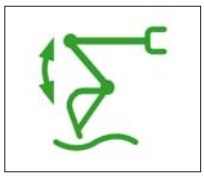
(8) RMCU signal strength pilot lamp (mobile only)

220A3CD200

① This lamp indicates RMCU signal strength as below.

- : Searching
- : Bad
- : Normal
- : Good
- : Excellent

(9) Boom floating mode pilot lamp



140WA3CD639

① This lamp lights ON when the boom floating is activated.

※ **Refer to the operator's manual page 3-48.**

(10) Ride control pilot lamp (option)

140WA3CD638

① Manual ride control

This lamp lights ON when the manual ride control function is activated (**ON, Always** setting).

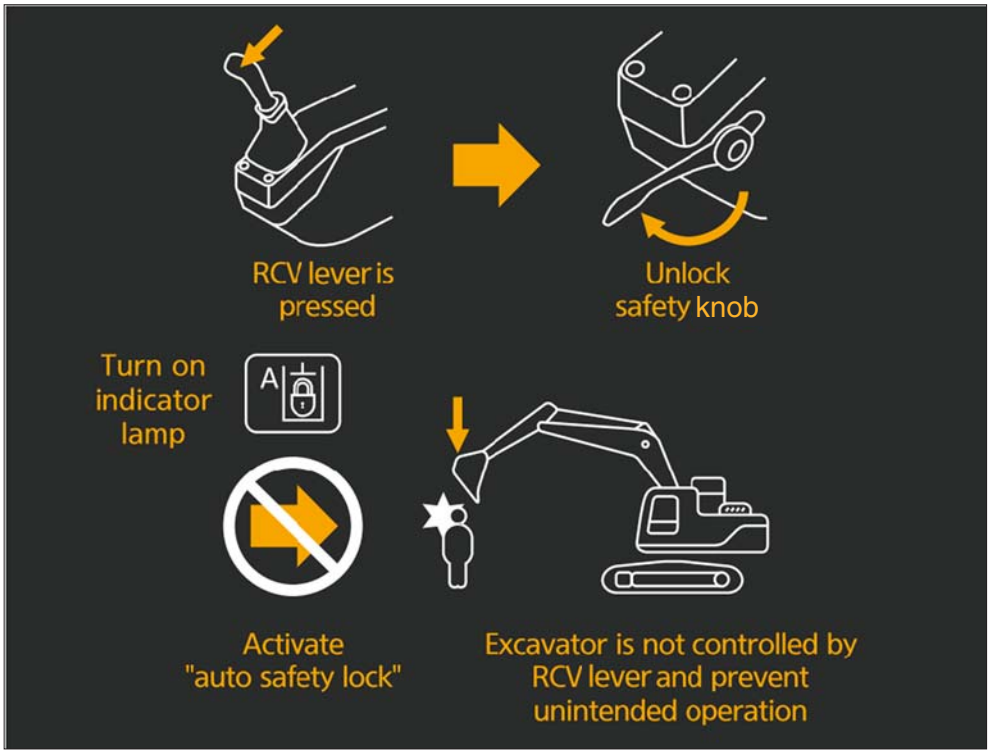
※ **Refer to the operator's manual page 3-48.**

(11) Auto safety lock pilot lamp

300A3CD37A

① Auto safety lock system prevents unintended operation of the machine in order to improve safety.
② Engine will only start if safety knob is locked.
③ If operator unlocks safety knob when RCV lever is pressed, machine is not controlled by RCV lever.

⚠ If operator unlocks safety knob while any control/function is being operated, the machine will move violently. This could cause serious injury, death or damage to property.



300A3CD38A

(12) 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 3-56 for the safety knob.**

(13) Auto engine shutdown pilot lamp

220A3CD202A

① This lamp lights up when the auto engine shutdown is activated.

※ **Refer to page 5-95.**

(14) Smart key pilot lamp (opt)

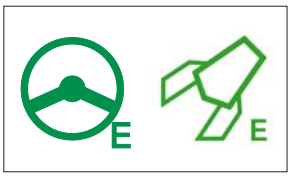
300A3CD36A

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 5-101.**

(15) Elec joystick control pilot lamp



140WA3CD649 140WA3CD637

① This lamp lights up when the joystick steering is ready to operate.

※ **Refer to the operator's manual page 3-59.**

(16) Auto brake pilot lamp

140WA3CD33

① This lamp lights up in amber when the auto digging brake is ready to operate.

② This lamp lights up in green when the auto digging brake is operating.

※ **Refer to the operator's manual page 3-49.**

(17) Cooling fan reverse pilot lamp

140WA3CD647

① This lamp lights up when the cooling fan reverse function is activated.

※ **Refer to page 5-96.**

(18) FNR mode pilot lamp

140WA3CD631

① This lamp indicates the selection of the FNR switch on the RH RCV lever.

- F : Machine moves forward
- N : Neutral position
- R : Machine moves backward

(19) FNR mode pilot lamp (emergency)

140WA3CD634

① This lamp indicates the selection of the FNR switch on the switch board when when the FNR switch on the RH RCV lever is failed.

- F : Machine moves forward
- N : Neutral position
- R : Machine moves backward

(20) Ram lock pilot lamp

210WF3CD04

① This lamp lights up when the ram lock switch is set to the LOCK position.

※ **Refer to the operator's manual page 3-52.**

(21) Parking pilot lamp

210WF3CD05

① This lamp lights up when the the parking switch is set to the parking position.

※ **Refer to the operator's manual page 3-52.**

(22) High beam pilot lamp

210WF3CD06

① The lamp lights up when the head lamp switch is set to the high beam position.

② When passing other machines ahead, this lamp must be used for a few seconds to give other machines warning for a few seconds.

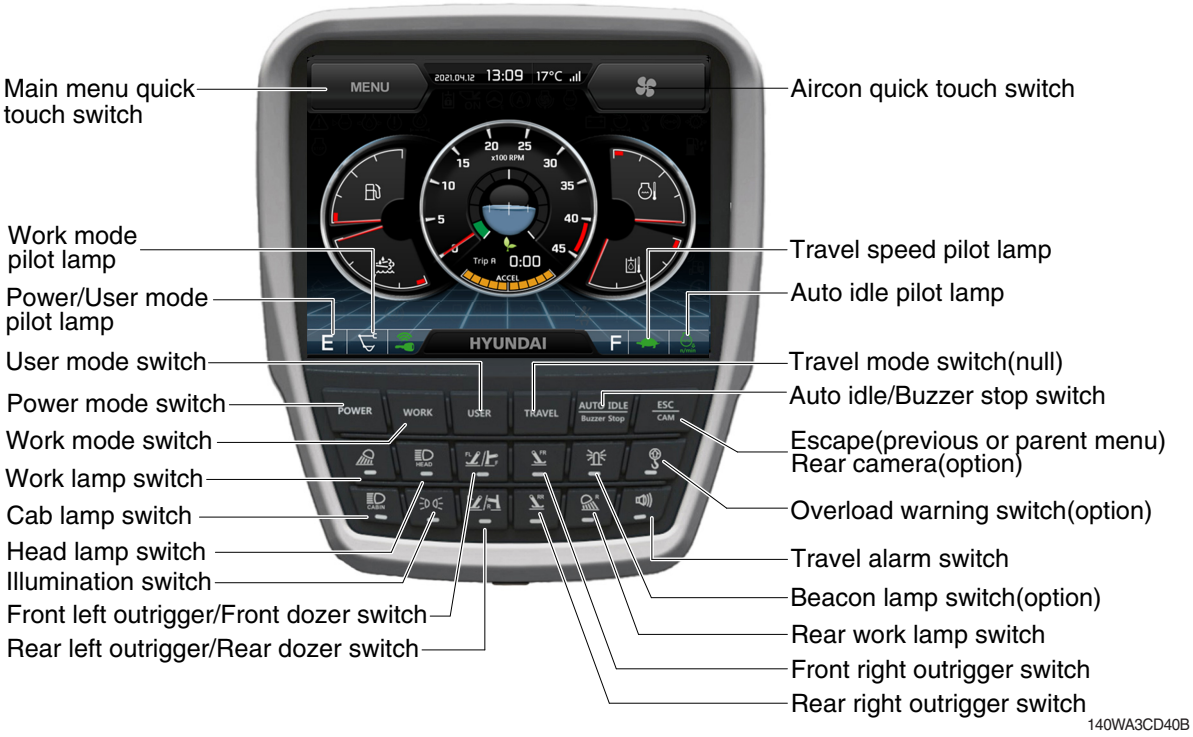
(23) Working brake pilot lamp

210WF3CD07

① This lamp lights up when the working brake switch is set to working position.

※ **Refer to the operator's manual page 3-52.**

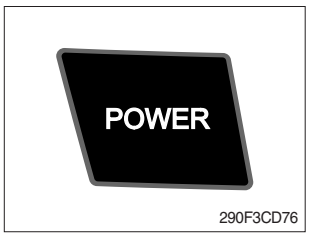
7) SWITCHES



140WA3CD40B

※ **When some of the switches are selected, the pilot lamps are displayed on the LCD. Refer to page 5-81 for details.**

(1) Power mode switch

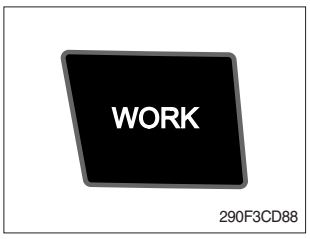


290F3CD76

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.
- E : Economy power work.

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

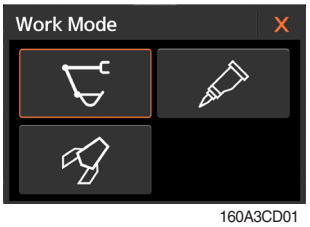
(2) Work mode switch



290F3CD88

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

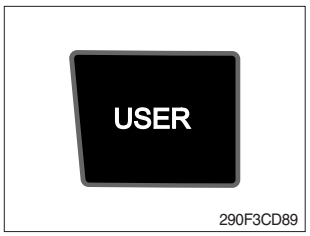
※ **Refer to the operator's manual page 2-7 for details.**



160A3CD01

② If you press this switch for a time (1 second), quick pop-up will appear. When you select an attachment from the popup, the operation mode will immediately switch to selected attachment.

(3) User mode switch



① This switch is used to select the user mode.
② Refer to page 5-93 for another set of the user mode.

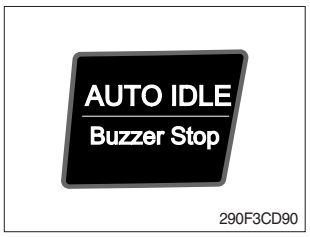
(4) Travel speed switch (null)

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.

(5) Auto idle/ buzzer stop switch



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

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

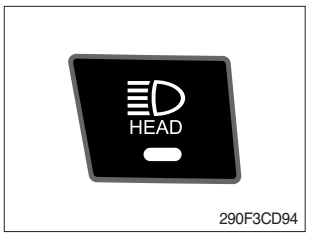
(6) Escape/Camera switch

① This switch is used to return to the previous menu or parent menu.
② In the operation screen, pushing this switch will display the view of the camera on the machine (if equipped).
Please refer to page 5-107 for the camera.
③ If the camera is not installed, this switch is used only ESC function.

(7) Work light switch

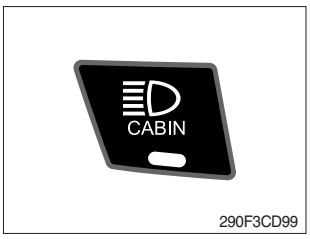
① This switch is used to operate the work light.
② The pilot lamp lights up when this switch is pressed.

(8) Head light switch



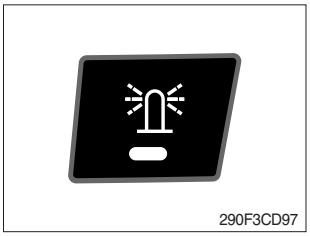
① This switch is used to operate the head light.
② The pilot lamp lights up when this switch is pressed.

(9) Cab light switch



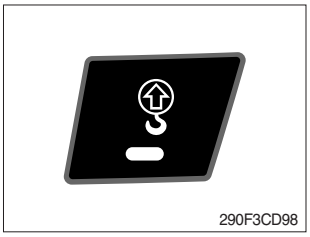
① This switch turns on the cab light.
② The pilot lamp lights up when this switch is pressed.

(10) Beacon switch (opt)



① This switch activates the rotary light on the cab.
② The pilot lamp lights up when this switch is pressed.

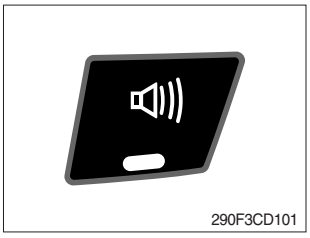
(11) Overload switch (opt)



① When this switch is activated, buzzer makes sound and overload warning lamp lights up in the event that the machine is or becomes in an overloaded situation.
② When the switch is inactivated, buzzer stops and warning lamp goes off.

⚠ Overloading the machine could impact the machines stability which could result in tipover hazard. A tipover hazard could result in serious injury or death. Always activate the overload warning device before you handle or lift objects.

(12) Travel alarm switch (null)



① This switch is to activate travel alarm function surrounding when the machine travels forward and backward.
② After activating this switch, the alarm operates only when the machine is traveling.
③ The pilot lamp lights up when this switch is pressed.

(13) Air conditioner quick touch switch


290F3CD216A

① This switch used to select air conditioner control mode.

※ **Refer to page 5-109.**

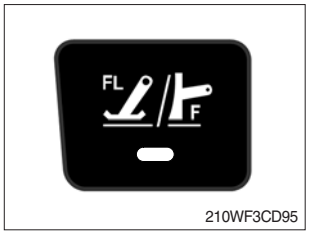
(14) Main menu quick touch switch

290F3CD217A

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

※ **Refer to page 5-92.**

(15) Front left outrigger/Front dozer switch



210WF3CD95

① This switch is used to select the front left outrigger or front dozer blade operation.

② The pilot lamp lights up when this switch is pressed.

※ **Please check the installed equipment (outrigger or dozer) on your machine before selecting the switch.**

※ **Refer to the operator's manual page 3-56 for the dozer and outrigger lever.**

(16) Front right outrigger switch

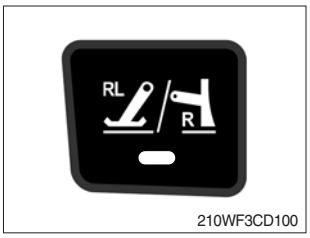
210WF3CD96

① This switch is used to select the front right outrigger operation if equipped.

② The pilot lamp lights up when this switch is pressed.

※ **Refer to the operator's manual page 3-56 for the dozer and outrigger lever.**

(17) Rear left outrigger/Rear dozer switch



210WF3CD100

① This switch is used to select the rear left outrigger or rear dozer blade operation.

② The pilot lamp lights up when this switch is pressed.

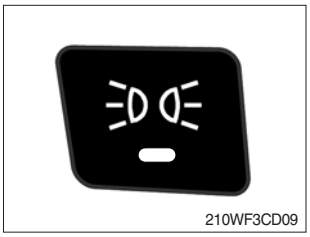
※ **Please check the installed equipment (outrigger or dozer) on your machine before selecting the switch.**

※ **Refer to the operator's manual page 3-56 for the dozer and outrigger lever.**

(18) Rear right outrigger switch

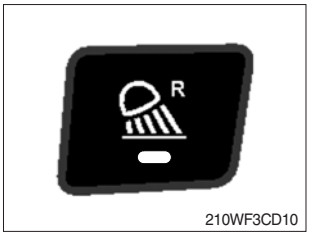
① This switch is used to select the rear right outrigger operation if equipped.
② The pilot lamp lights up when this switch is pressed.
※ **Refer to operator's manual page 3-56 for the dozer and outrigger lever.**

(19) Illumination switch



① This switch is used to operate on the clearance lamp and all panel lamps.
② The pilot lamp lights up when this switch is pressed.

(20) Rear work lamp switch



① This switch is used to operate the rear work lamp.
② The pilot lamp lights up when this switch is pressed.

8) MAIN MENU

※ You can select or set the menu by the jog dial module or touch screen.
On the operation screen, tap MENU to access the main menu screen.
On the sub menu screen, you can tap the menu bar to access functions or applications.

· Operation screen

140WA3CD50

※ Please refer to the jog dial module, the operator's manual page 3-77 for selection and change of menu and input value.

(1) Structure

No	Main menu	Sub menu	Description
1	 Mode 290F3CD103	Work mode U mode power Boom/Arm speed (null) Auto power boost IPC mode (null) Auto engine shutdown Initial mode Emergency mode	Breaker, Crusher, Not installed User mode only Boom speed, Arm speed Enable, Disable Speed mode, Balance mode, Efficiency mode One time, Always, Disable Key on initial mode / initial work mode, Accel initial mode / step Switch function
2	 Monitoring 290F3CD104	Active fault Logged fault Delete logged fault Monitoring	MCU, Engine ECM, FATC, AAVM (option) MCU, Engine ECM, FATC, AAVM (option) All logged fault delete, Initialization canceled Machine information, Switch status, Output status
3	 Management 290F3CD105	Fuel rate information Maintenance information Machine security Machine information Contact Clinometer Update	General record, Hourly, Daily, Mode record Replacement, Change interval oils and filters ESL mode setting, Password change Model, MCU, Monitor, jog dial module, switch controller, RMCU, Relay drive unit, FATC, AAVM (option) A/S phone number, A/S phone number change Clinometer setting Cluster, ETC device
4	 Display 290F3CD106	Display item Clock Brightness Unit setup Language selection Screen type	Engine speed, Tripmeter A, Tripmeter B, Tripmeter C Clock Manual, Auto Temperature, Pressure, Flow, Distance, Date format Korean, English, Chinese, ETC A type, B type
5	 Utilities 290F3CD107	Tripmeter Camera Exterior aural warning Auto idle time setting	3 kinds (A, B, C) Camera setting, Auto mode (travel) Enable, disable 3~30 sec

(2) Mode setup

① Work mode

140WA3CD51

A

140WA3CD52

B

140WA3CD53A

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

140WA3CD651

140WA3CD652A

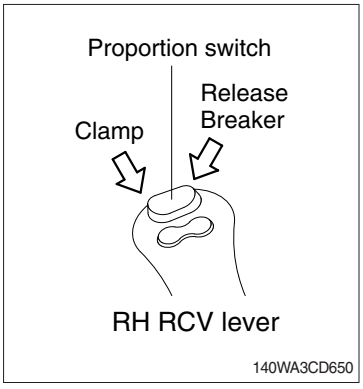
140WA3CD653A

140WA3CD654A

■ Operation type

Operation type is used to set the operation of the proportion switch on the RCV lever if equipped proportional function.

- Push : Switch actuation will be deactivated when the proportion switch is released.
- Detent : Switch actuation will remain even if the proportion switch is released.
  To deactivate, move the switch in the same direction again or to the opposite direction.
- Proportion : Switch actuation is proportional to the movement of the proportion switch.



140WA3CD650

② U mode power

140WA3CD54 140WA3CD55

- Engine speed, idle speed, power shift (pump power) and pump flow can be modulated and memorized separately in U-mode.
- U-mode can be activated by user mode switch.

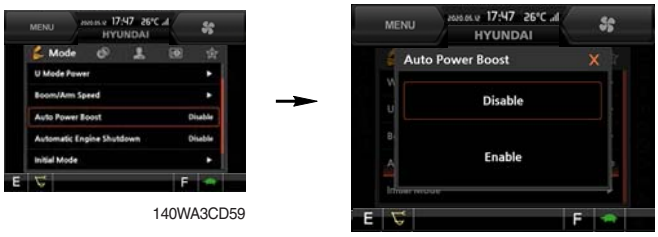
User mode level position (▮)	Unit	1	2	3	4	5	6	7	8	9	10
Engine speed	rpm	1400	1450	1500	1550	1600	1650	1700	1750	1800	1900
Idle speed	rpm	750	800	850	900	950	1000	1050	1100	1150	1200
Power shift (pf EPPR)	mA	600	555	511	466	422	377	333	288	244	200
Pump flow (delta EPPR)	mA	600	555	511	466	422	377	333	288	244	200

③ Boom/Arm speed (null)

140WA3CD56 140WA3CD57 140WA3CD58

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

④ Auto power boost



140WA3CD59

140WA3CD60

· The power boost function can be activated or cancelled.
Enable - The digging power is automatically increased as working conditions by the MCU.
It is operated max 8 seconds, then goes off for a period or 1 second and then activates again for 8 seconds and continues this cycle.
Disable - Not operated.

⑤ IPC mode (null)

140WA3CD61 140WA3CD62 140WA3CD63

140WA3CD64 140WA3CD65

140WA3CD66 140WA3CD67

· The IPC mode can be selected by this menu.
- Speed mode
- Balance mode (default)
- Efficiency mode

※ Please update the cluster programs if this mode is not displayed in the mode setup menu. Refer to the page 3-36.

⑥ Automatic engine shutdown

140WA3CD68

140WA3CD69

140WA3CD70

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

⑦ Initial mode

140WA3CD71

140WA3CD72

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

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

· **Accel initial mode**
  - Last setting value
  - User setting value

· **Accel initial step**
  - 0~9 step

⑧ Emergency mode

140WA3CD73

140WA3CD74

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

⑨ Cooling fan reverse mode

140WA3CD75

140WA3CD76

140WA3CD77

· Manual : Rotate the fan with reverse direction while pressing the button "Excute".
· Automatic : Rotate the fan with reverse direction by preset cycle.
  - Interval : 30 minutes ~ 5 hours
  - Time : 30 seconds ~ 5 minutes

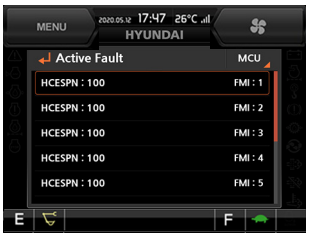
※ **Default : interval (60 minutes), time (120 seconds)**

(3) Monitoring

① Active fault

140WA3CD80

140WA3CD81

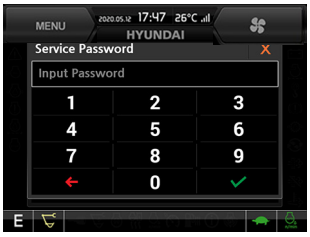


140WA3CD82

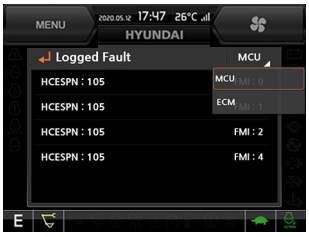
· The active faults of the MCU, ECM, FATC, AAVM (option) can be checked by this menu.

② Logged fault

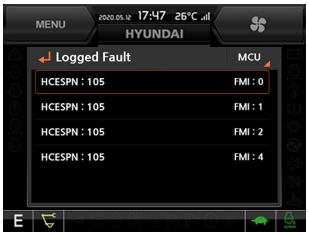
300A3CD68A



300A3CD72A



300A3CD69A

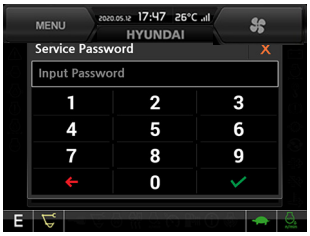


300A3CD70A

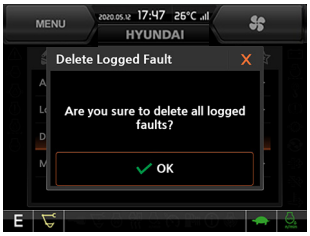
· The logged faults of the MCU, ECM, FATC, AAVM (option) can be checked by this menu.

③ Delete logged fault

300A3CD71A



300A3CD72A

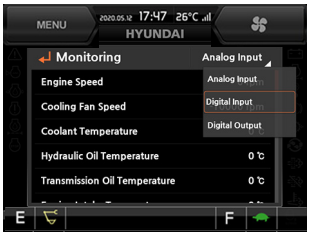


300A3CD73A

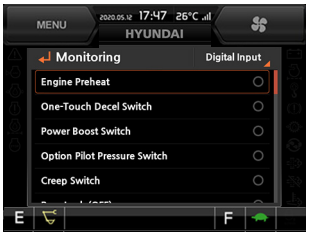
· The logged faults of the MCU, ECM, FATC, AAVM (option) can be deleted by this menu.

④ Monitoring

140WA3CD89



140WA3CD90



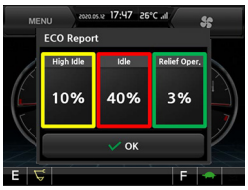
140WA3CD91

- The machine status such as the engine rpm, oil temperature, voltage and pressure etc. can be checked by this menu (Analog input).
- The switch status or output status can be confirmed by this menu (Digital input & Digital output).
- The activated switch or output pilot lamps ● will light up.

(4) Management

① ECO report

This reports the machine's inefficient operation status in order to improve operator's improper working habit.



140WA3CD100

High idle

140WA3CD101

- Shows a breakdown of high idle, idle and relief operation when monitor is on.
- Gives a daily usage breakdown record for a 7 day period and an overall accumulated record from the first operation.

Idle

140WA3CD102

Relief operation

140WA3CD103

② Fuel rate information

140WA3CD104

140WA3CD105

A

· **General record (A)**
  - Average fuel rate (left) (from "Reset" to now)
    Fuel consumption divided by engine run time (service meter time).
  - A days fuel used (right)
    Fuel consumption from 24:00 (or "Reset" time) to now (MCU real time).

140WA3CD106

B

· **Hourly record (B)**
  - Hourly fuel rates for past 12 hours (service meter time).
  - No record during key-off time.
  - One step shift to the right for every one hour.
  - Automatic deletion of data from 12 hours and earlier.
  - "Reset" deletes all hourly records.

140WA3CD107

C

· **Daily record (C)**
  - Daily fuel consumption for past seven days (MCU real time).
  - No record during key-off time.
  - One step shift to the right at 24:00 for every day.
  - Automatically deletes data from 7 days and earlier.
  - All daily records deletion by "Reset".

140WA3CD108

D

· **Mode record (D)**
  - Average fuel rate for each power mode/accel dial (at least 7) from "Reset" till present.
  - No record during idle.
  - All records can be deleted by "Reset".

140WA3CD109

③ Maintenance information

140WA3CD110

140WA3CD111

140WA3CD112

- Alarm lamp (●) is ON when oil or filter needs to be changed or replaced.
- Replacement : The elapsed time will be reset to zero (0).
- Change interval : The change intervals can be changed in hour increments of 50.

※ **Refer to section, Maintenance chart for further information of maintenance interval.**

④ Machine security

300A3CD90A

300A3CD91A

300A3CD92A

· **ESL mode setting**

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

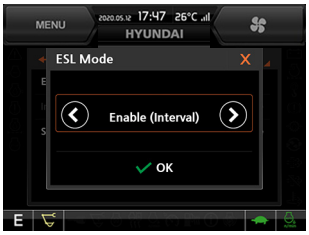
  Disable : ESL function is disabled and password is not required to start engine.

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

※**Default password : 00000 +** ✔

※**Password length : (5~10 digits) +** ✔

- **Smart key** (option) : Refer to next page.



300A3CD93A

300A3CD94A

· **Password change**

- The password is 5~10 digits.

300A3CD95A

300A3CD96A

300A3CD91A

Enter the current password

300A3CD99A

Enter the new password

300A3CD98A

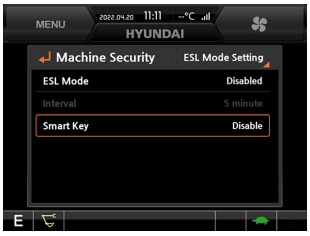
Enter the new password again

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

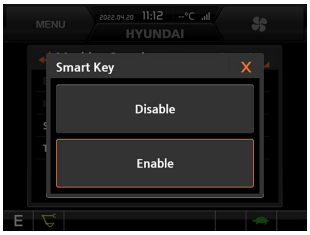
- Smart key

300A3CD90A

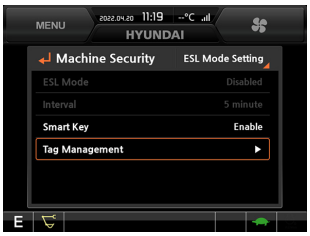
300A3CD91A



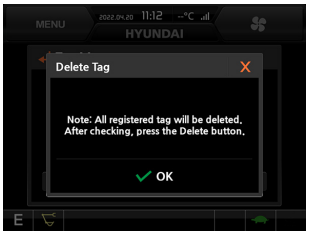
300A3CD001



300A3CD002

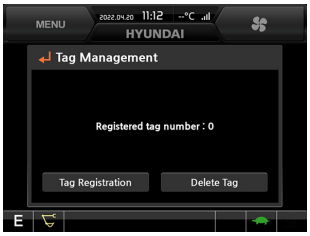


300A3CD003



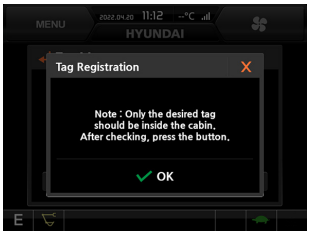
300A3CD006

Deleting



300A3CD004

Registering



300A3CD005

· Smart key is registered when equipped with optional smart key. If smart key is not inside of the cabin, authentication process fails and the password is needed.

· Tag management menu is activated when the Smart key menu is Enabled.
You can register and delete the tags.

- Tag management

· When registering a tag : Only the tag you want to register must be in the cabin.

· When deleting a tag : All registered tags are deleted.

· 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.

⑤ Machine Information

140WA3CD122

140WA3CD123

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

⑥ Contact (A/S phone number)

140WA3CD124

140WA3CD125

140WA3CD126

Enter the new A/S phone number

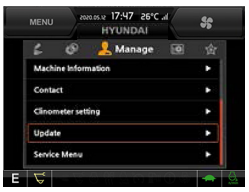
⑦ Clinometer

140WA3CD130

140WA3CD131

· 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.

⑧ Update (cluster & ETC devices)

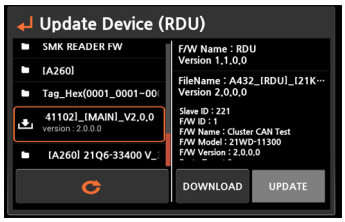


300A3CD110A

300A3CD111A

300A3CD112A

300A3CD114A



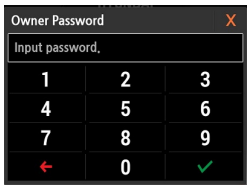
380F3CD06

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

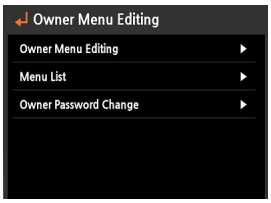
⑨ OME (owner menu editing)

The owner of machine can restrict operator access to set functions.

300A3CD115A



300A3CD115B



300A3CD115C

- **Owner can set the status of the function.**
  - Enable
  - Disable
- **In the menu, owner can set the list of functions in which they would like to lock or leave unlocked.**
- **Owner password (default password : 11111)**
  - Owner can manage and change the password.
  - Necessary to input the password to access function menu.

300A3CD116A

300A3CD117A

300A3CD118A

(5) Display

① Display item

140WA3CD150

140WA3CD151

140WA3CD152

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

② Clock

140WA3CD153

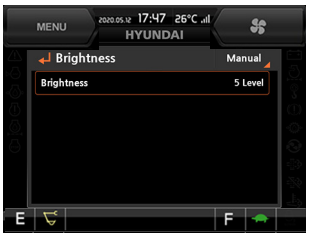
140WA3CD154

- The first row of boxes indicate Year/Month/Day.
- The second row shows the current time. (0:00~23:59)

③ Brightness

140WA3CD155

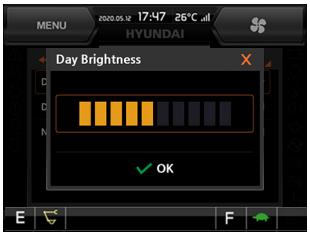
140WA3CD156



140WA3CD157

140WA3CD158

140WA3CD159

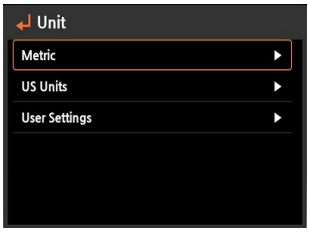


140WA3CD160

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

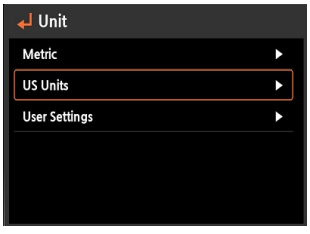
④ Unit

300A3CD130A

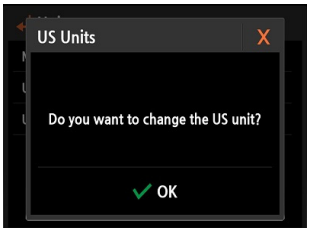


300A3CD130B

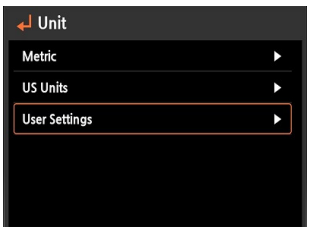
300A3CD130C



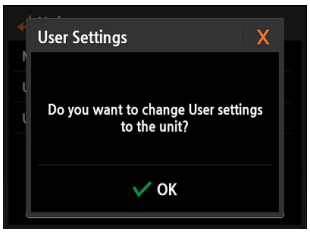
300A3CD130D



300A3CD130E

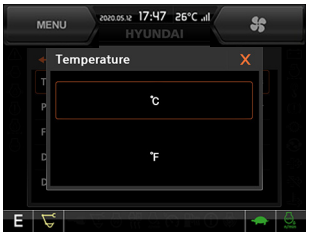


300A3CD130F



300A3CD130G

300A3CD131A



300A3CD132A

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

⑤ Language

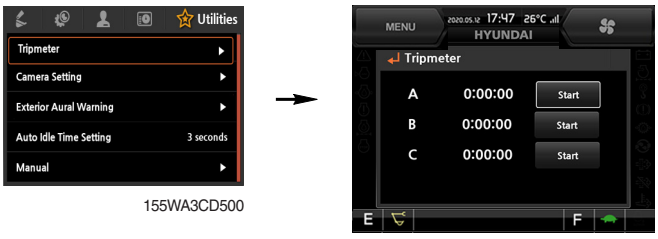
140WA3CD164

140WA3CD165

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

(6) Utilities

① Tripmeter



155WA3CD500

140WA3CD171

- A maximum of 3 types of tripmeters can be used at the same time.
- Each tripmeter can be turned on by choosing "Start". It can be turned off by choosing "Stop".
- If the tripmeter icon is activated in the operation screen, it can be controlled directly in this screen.

② Camera setting

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

155WA3CD501

140WA3CD173

140WA3CD174

- Auto mode (travel) : Enable
  The cluster will automatically show camera view while machine is traveling.
- In the operation screen, rear camera screen shows up when ESC/CAM switch is pushed.

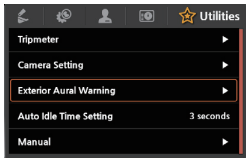
140WA3CD175

290F3CD221

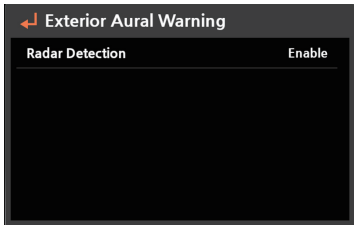
※ The monitor's screen can be set by the camera monitor in case the camera option is rear camera only/mirror view/AAVM etc.

※ The monitor's screen can't be set by the camera monitor in case the camera option is CIC etc. Set the monitor's detail screen by the main cluster.

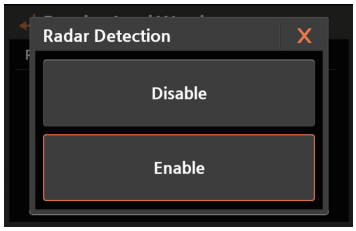
③ Exterior aural warning (option)



155WA3CD502



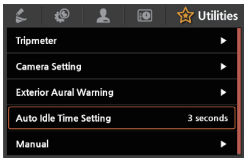
155WA3CD503



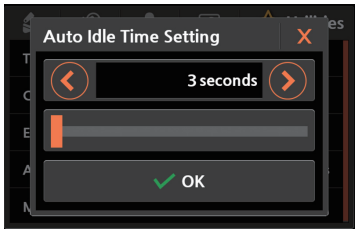
155WA3CD504

· This menu is activated when the radar/siren amplifier is equipped optionally.
· The siren amplifier will sounds aural warning when the radar detection menu is set to the Enable.

④ Auto idle time setting



155WA3CD505



155WA3CD506

· The auto idle time is can be set by this menu.
· Time : 3~30 seconds

⑤ **AAVM** (Advanced Around View Monitoring, option)

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

140WA3CD176

- **Escape switch**

· Activates AAVM mode from the beginning if AAVM is installed.

· While in the AAVM mode, select the ESC switch to return to the home screen.

140WA3CD175

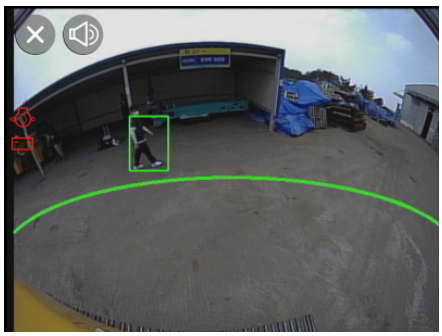
Home screen

AAVM mode 235SA3CD222A

- **Buzzer stop switch**

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

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



220A3CD246

· When a worker/pedestrian reaches the green line, which is an external danger area equipped on the cluster, warning buzzer sounds and it displays a green rectangular box recognizing the worker/pedestrian.
Stop work immediately. Stop the buzzer by pressing the buzzer stop switch. Then resume work after you confirm that the area is safe and clear of workers/objects.

220A3CD247

· When a worker/pedestrian reaches the red line, which is an internal danger area equipped on the cluster, warning buzzer sounds and it displays a red rectangular box recognizing the worker/pedestrian.
Stop work immediately. Stop the buzzer by pressing the buzzer stop switch. Then resume work after you confirm that the area is safe and clear of workers/objects.

⚠ **Failure to comply may result in serious injury or death.**

※ **In AAVM mode, a touch screen of the LCD is available only. The multimodal dial of the jog dial module is not available.**

⑥ Mirror / RH view camera UI setting (opt)

· The mirror / RH view camera mode can be set by the main cluster.

Escape switch

140WA3CD174K

- **Escape switch**

· Activate mirror / RH mode from the beginning if the option is installed.

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

140WA3CD175

Home screen

140WA3CD176K

Cam image control (CIC) mode

- **Cam image control (CIC) mode**

※ Type A / Type B are divided by equipment camera option.

- Type A. RH view option.

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

· Touch ⓓ (2CH split-view) button to set split-view camera mode.

- Type B. mirror view option.

· Touch ⓐ (rear), ⓒ (mirror) button on screen to set single-view camera mode.

· Touch ⓓ (2CH split-view) button to set split-view camera mode.

※ ⓐ (rear), ⓒ (mirror) camera image is inverted for a mirror effect.

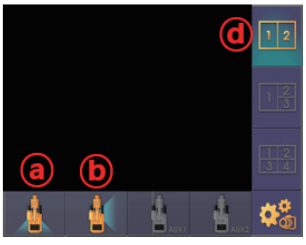
ⓐ (Rear)

ⓑ (RH)

ⓒ (Mirror)

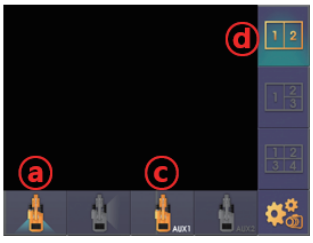
ⓓ (2CH split-view)

140WA3CD177K



140WA3CD178K

Type A. RH view opt



140WA3CD179K

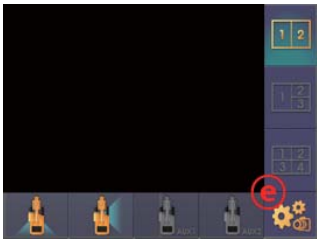
Type B. mirror view opt

- **Split-view camera order setting**

· Touch ⓔ (camera setting) button to set split-view camera order.

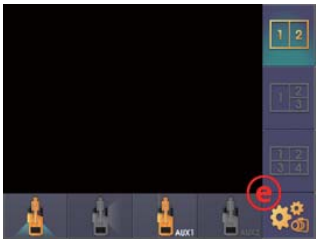
140WA3CD180K

Camera setting



140WA3CD181K

Type A. RH view option



140WA3CD182K

Type B. mirror view option

· You can change split-view camera order on display order menu.

140WA3CD183K

Type A (RH view) default setting

1st rear / 2nd right

140WA3CD184K

Type B (mirror view) default setting

1st rear / 2nd Aux1

- **With 2nd camera monitor option.**

※ You can set camera view on maun cluster.

140WA3CD185K

Set camera view on main cluster

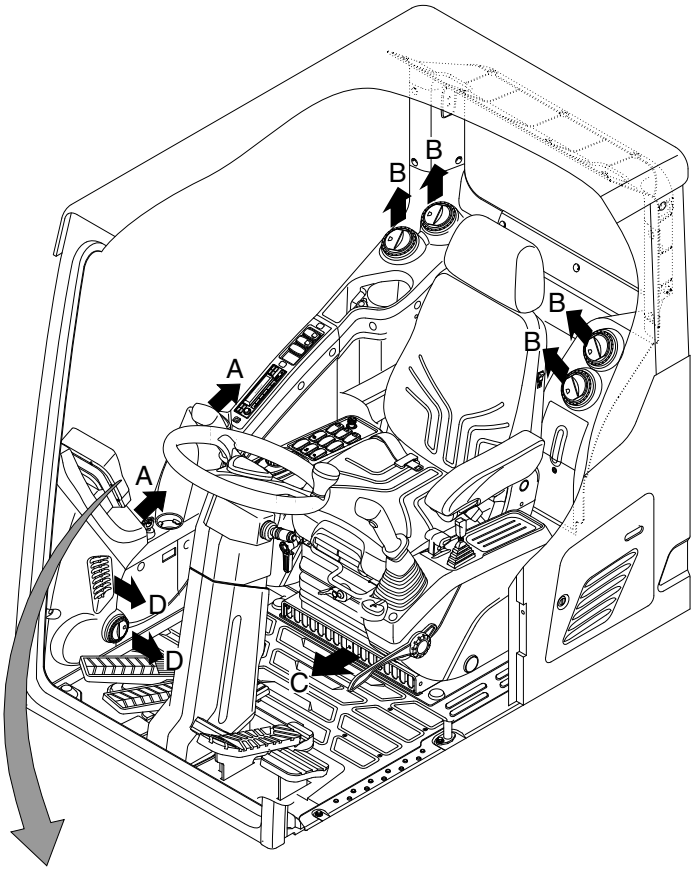
→

140WA3CD186K

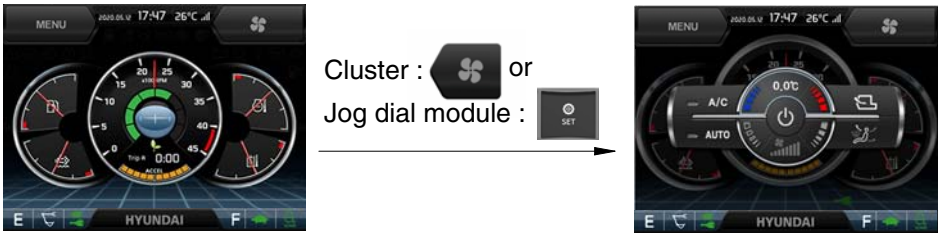
9) AIR CONDITIONER AND HEATER

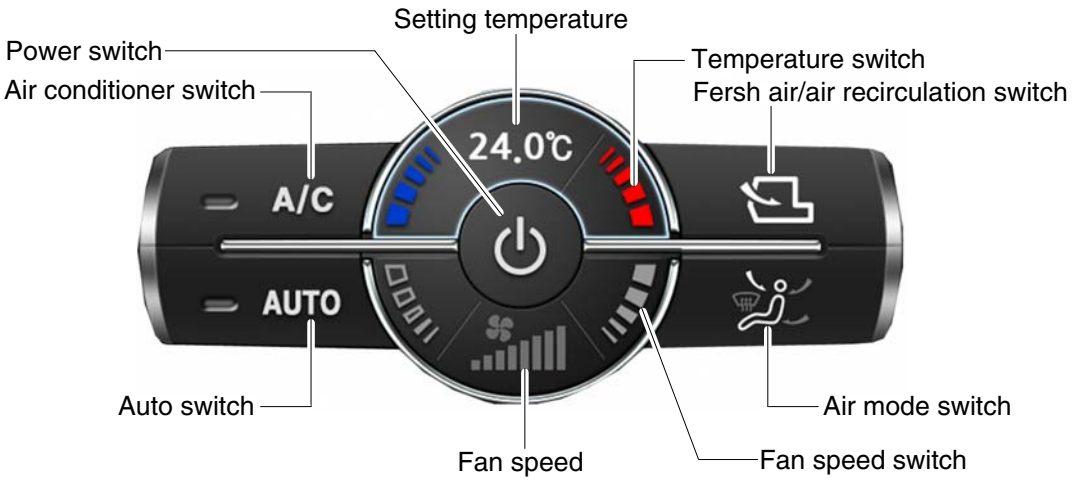
Full auto air conditioner and heater system automatically keeps the optimum condition in accordance with operator's temperature configuration, sensing ambient and cabin inside temperature.

· **Location of air flow ducts**



Cluster LCD





140WA3CD201

※ **Jog dial module : Refer to the operator's manual page 3-77.**

(1) Power switch

① This switch turns the system ON and OFF.
Just before powering OFF, set values are stored.
② Default setting values

Function	Air conditioner	In/outlet	LCD	Temperature	Mode
Value	OFF	Inlet	OFF	Previous sw OFF	Previous sw OFF

(2) Air conditioner switch

① This switch turns the compressor ON/OFF.
※ Air conditioner operates to remove vapor and drains water through a drain hose. Water can be sprayed into the cab in case that the drain cock at the ending point of drain hose has a problem.
In this case, exchange the drain cock.

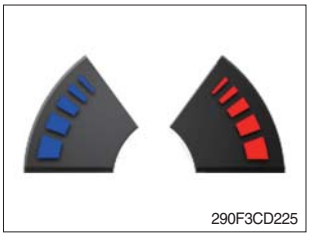
(3) Auto switch

① Auto air conditioner and heater system automatically keeps the optimum condition in accordance with operator's temperature configuration sensing ambient and cabin inside temperature.

(4) Setting temperature

① Displays the temperature setting.

(5) Temperature switch

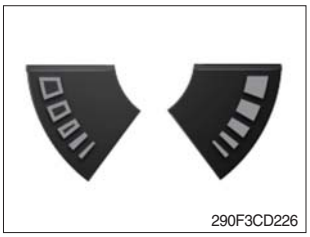


① Setting temperature indication
· Lo (17˚C), 17.5~31.5˚C, Hi (32˚C)
② Max cool and max warm beeps 5 times.
③ The max cool or the max warm position operates per the following table.

Temperature	Compressor	Fan speed	In/outlet	Mode
Max cool	ON	Hi (8 step)	Recirculation	Face
Max warm	OFF	Hi (7 step)	Fresh	Def/Foot

④ Temperature unit can be changed between celsius (˚C) and fahrenheit (˚F)
a. Default status (˚C)
b. The temperature unit can be changed (℃ ↔ ℉) by pressing temperature switchs (Up/Down) simultaneously for more than 5 seconds.

(6) Fan speed switch



① Fan speed is controlled automatically by set temperature.
② This switch controls fan speed manually.
- There are 8 up/down steps to control fan speed.
- The maximum step or the minimum step beeps 5 times.

(7) Fan speed

① Steps 1 through 8 to display the amount of air being circulated.

(8) Fresh air/air recirculation switch

① It is possible to change the air-inlet method.
a. **Fresh air ( )**
Inhaling air from the outside.
b. **Air recirculation ( )**
It recycles the heated or cooled air to increase the energy efficiency.
※ **Change air occasionally when using recirculation for a long periods of time.**
※ **Check condition of fresh air filter and recirculation filter periodically to maintain good efficiency of the system.**

(9) Air mode switch

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

Mode switch		Face	Face/Rear	Face/Rear/Foot	Foot	Def/Foot
Outlet	A	●	●	●		
	B		●	●		
	C			●	●	●
	D					●

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

(10) Self Diagnosis Function

① Diagnostic methods : Diagnostic information window, select

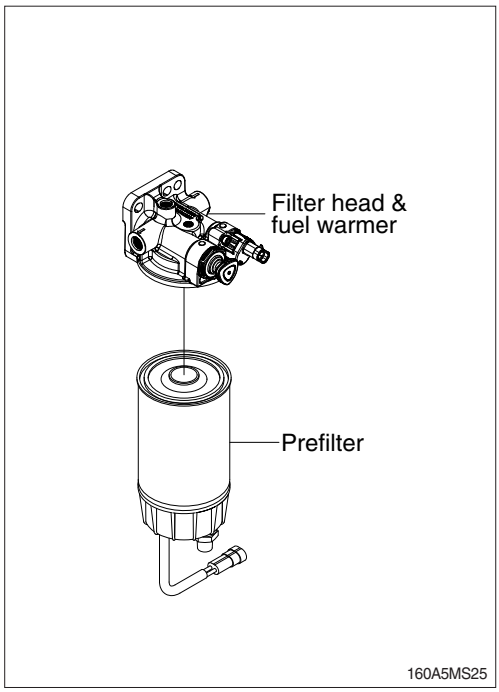
② Diagnostic indication (Displays fault)

Fault code	Description	Fail safe function
F01	Ambient temperature sensor open	20˚C alternate value control
F02	Ambient temperature sensor short	
F03	Cab inside temperature sensor open	25˚C alternate value control
F04	Cab inside temperature sensor short	
F05	Evaporate temperature sensor open	0˚C alternate value control
F06	Evaporate temperature sensor short	
F07	Null	-
F08	Null	-
F09	Mode 1 actuator open/short	The alternate value is face
F10	Mode 1 actuator drive circuit malfunction	If not, the alternate value is Def/Foot
F11	Intake actuator open/short	The alternate value is air recirculation
F12	Intake actuator drive circuit malfunction	The alternate fresh air
F13	Temperature actuator open/short	If opening amount is 0 %, the alternate value is 0 %
F14	Temperature actuator drive circuit malfunction	If not, the alternate value is 100 %
F15	Null	-
F16	Null	-

GROUP 17 FUEL WARMER SYSTEM

1. SPECIFICATION

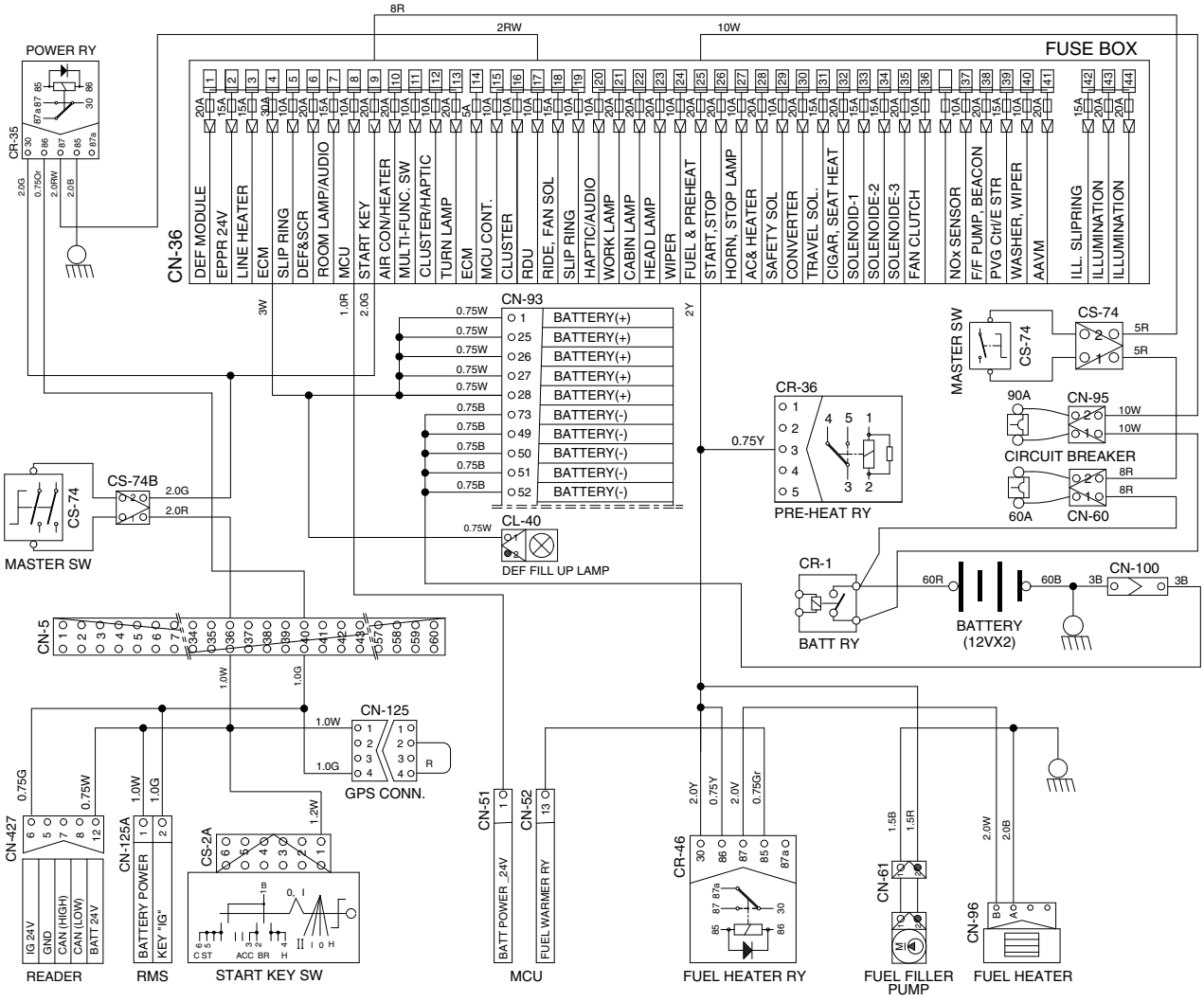
1) Operating voltage : 24±4 V
2) Power : 350±50 W
3) Current : 15 A



2. OPERATION

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

3. ELECTRIC CIRCUIT



140WA5MS26

GROUP 18 1 or 2-WAY OPTIONAL PIPING PRESSURE REMOVAL SYSTEM

■ Machine serial no. : #0109~

1. OUTLINE

This system can be removed the residual pressure of the optional attachment hydraulic piping when the quick coupler is operated by the switch of the RCV lever and then the oil quick function of the optional attachment is performed.

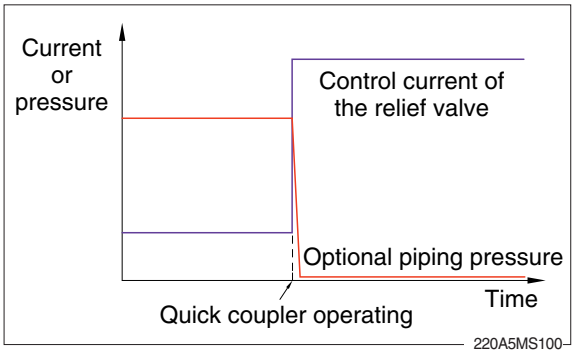
※ Oil quick function

In a convention work, the optional attachments such as breaker or grab are installed on the machine and needed to connect hydraulic piping additionally.

But currently, the hydraulic piping connection is not needed by the work man. The attachment is installed on the machine and the hydraulic pipings are connected by a coupler that is built in the quick coupler automatically and the attachment can be ready to operate immediately. This is called the oil quick function.

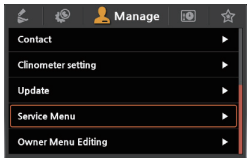
2. OPERATING PRINCIPLE

This is operated by controlling the setting pressure of the electric type relief valve when you operate the quick coupler with the switch of the RCV lever.

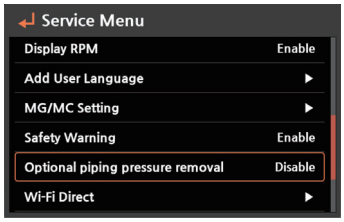


220A5MS100

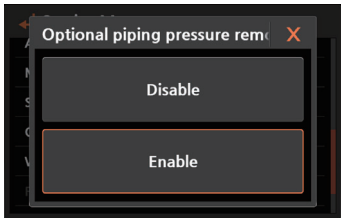
3. SETTING METHOD



220A5MS101



220A5MS102



220A5MS103

1) Optional piping pressure removal is set to Disable in the factory.
2) Optional piping pressure removal is set to Enable then the oil quick function is operated. Also, the caution letter is display on the lower side of the cluster.
3) The setting condition is saved even if shut the engine off.

220A5MS104

4. CAUTION

1) When the oil quick function is used, the hydraulic drift and etc can be occurred as the modified equipment specification.
2) The status of the cluster must be changed by a manager that is well-acquainted with the function and the operator must be well-informed of the oil quick function and safety work.

SECTION 6 TROUBLESHOOTING

SECTION 6 TROUBLESHOOTING

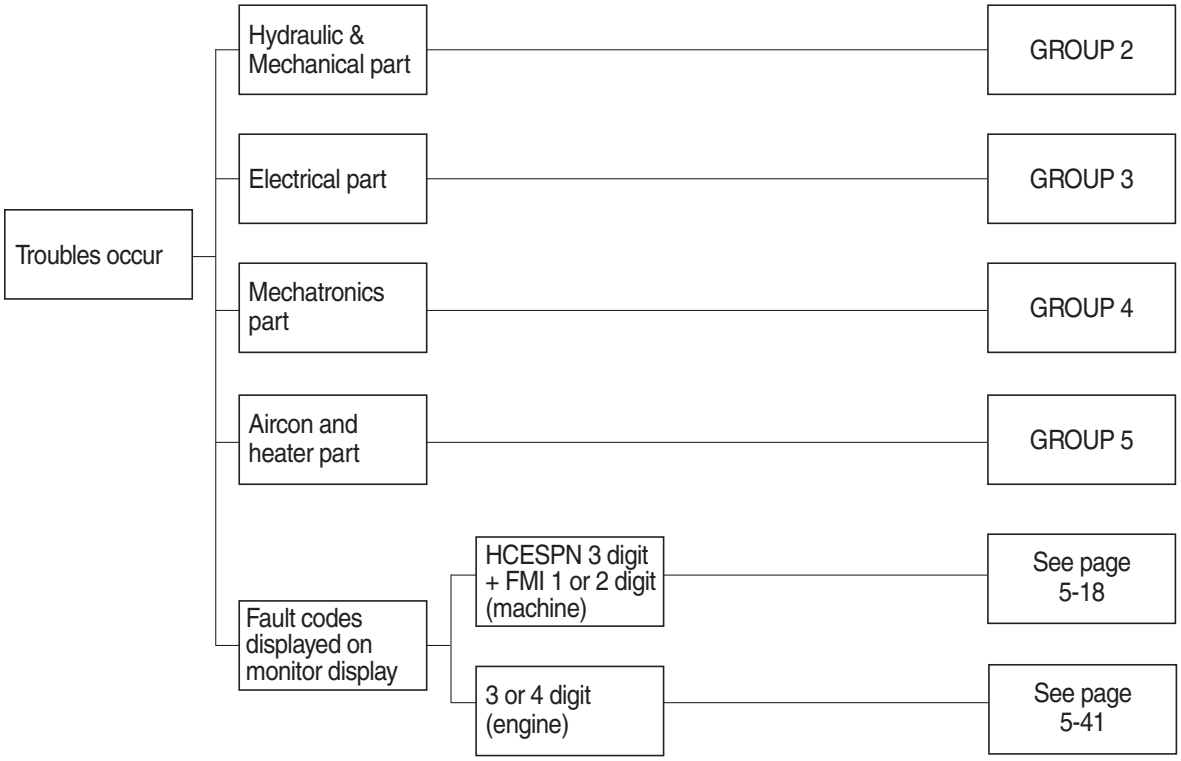
GROUP 1 BEFORE TROUBLESHOOTING

1. INTRODUCTION

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

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

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

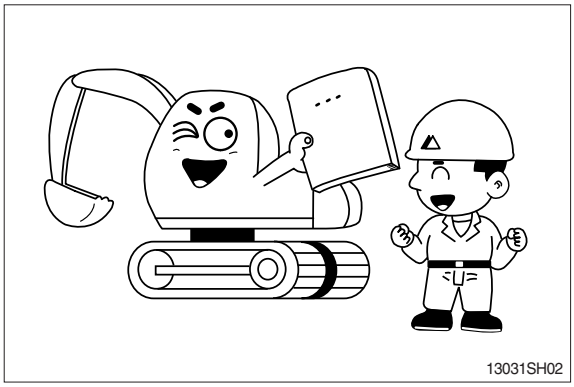


2. DIAGNOSING PROCEDURE

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

STEP 1. Study the machine system

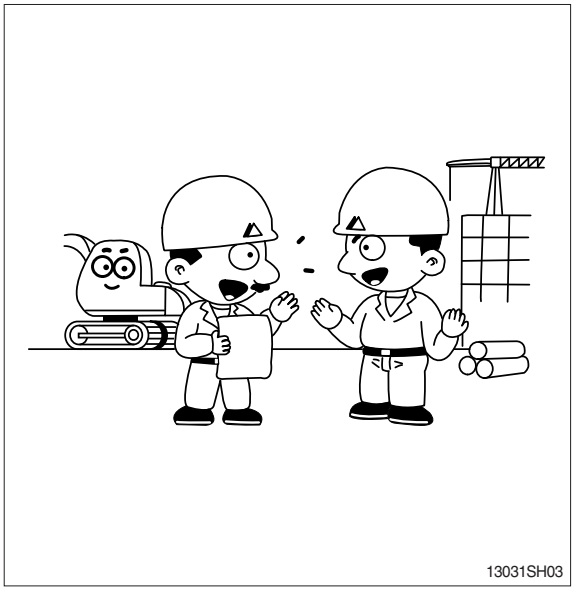
Study and know how the machine is operating, how the system is composing, what kinds of function are installed in the machine and what are specifications of the system components by the machine service manual.
Especially, deepen the knowledge for the related parts of the trouble.


13031SH02

STEP 2. Ask the operator

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

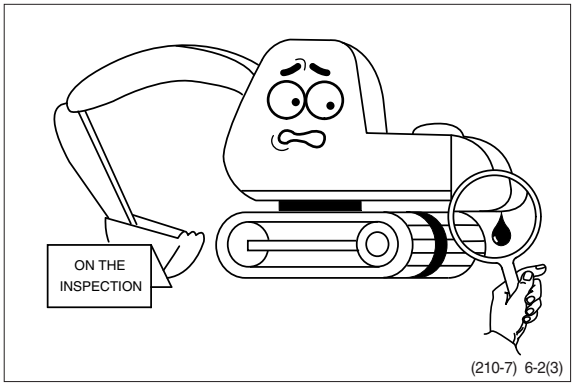
1) How the machine is used and when it is serviced?
2) When the trouble was noticed and what work the machine was doing at that time?
3) What is the phenomenon of the trouble? Was the trouble getting worse, or did it come out suddenly for the first time?
4) Did the machine have any troubles previously?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


13031SH03

STEP 3. Inspect the machine

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

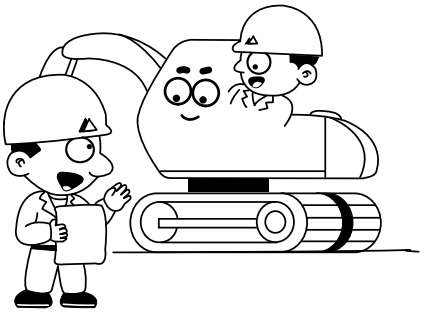
And also check the electrical system including batteries, as the troubles in the electrical system such as low battery voltage, loose connections and blown out fuses will result in malfunction of the controllers causing total operational failures of the machine.



(210-7) 6-2(3)

STEP 4. Inspect the trouble actually on the machine

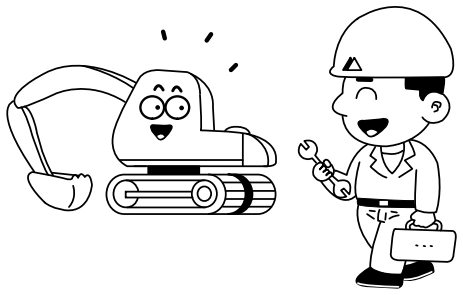
In case that some trouble cannot be confirmed, obtain the details of the malfunction from the operator.
Also, check if there are any in complete connections of the wire harnesses are or not.



(210-7) 6-3(1)

STEP 5. Perform troubleshooting

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

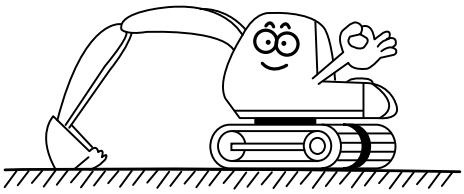


13031SH05

STEP 6. Trace a cause

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

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



(210-7) 6-3(3)

GROUP 2 HYDRAULIC AND MECHANICAL SYSTEM

1. INTRODUCTION

1) MACHINE IN GENERAL

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

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

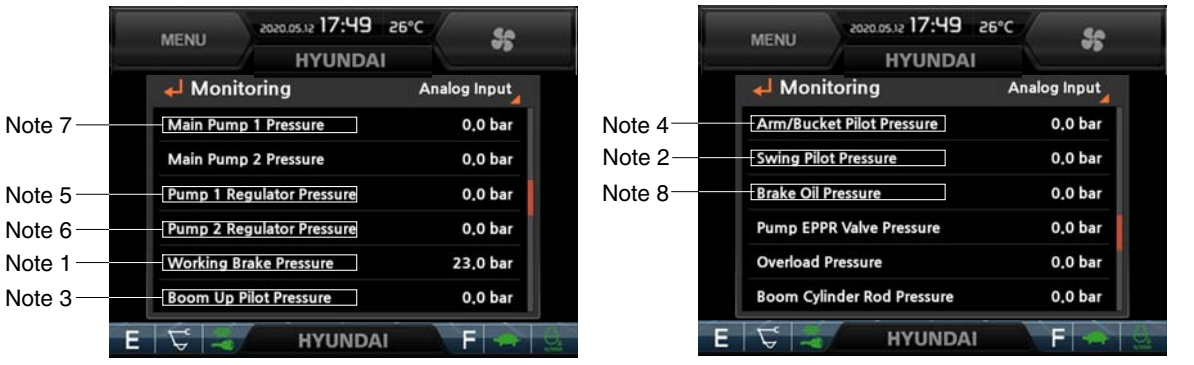
(3) When carrying out troubleshooting, do not hurry to disassemble the components.
It will become impossible to find the cause of the problem.

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

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

2) MACHINE STATUS MONITORING ON THE CLUSTER

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



Analog 1 Analog 2

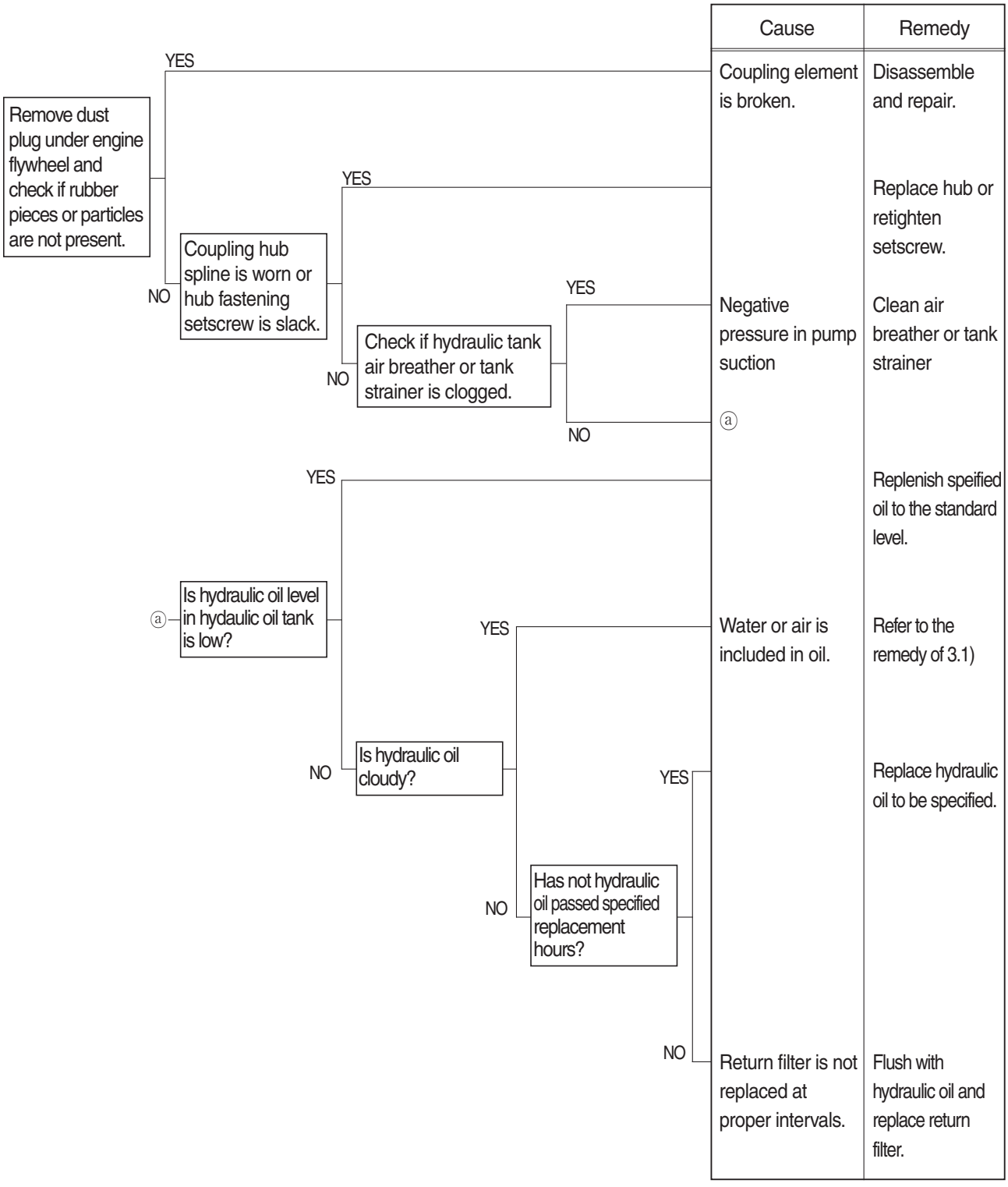
140WA6HS01

(2) Specification

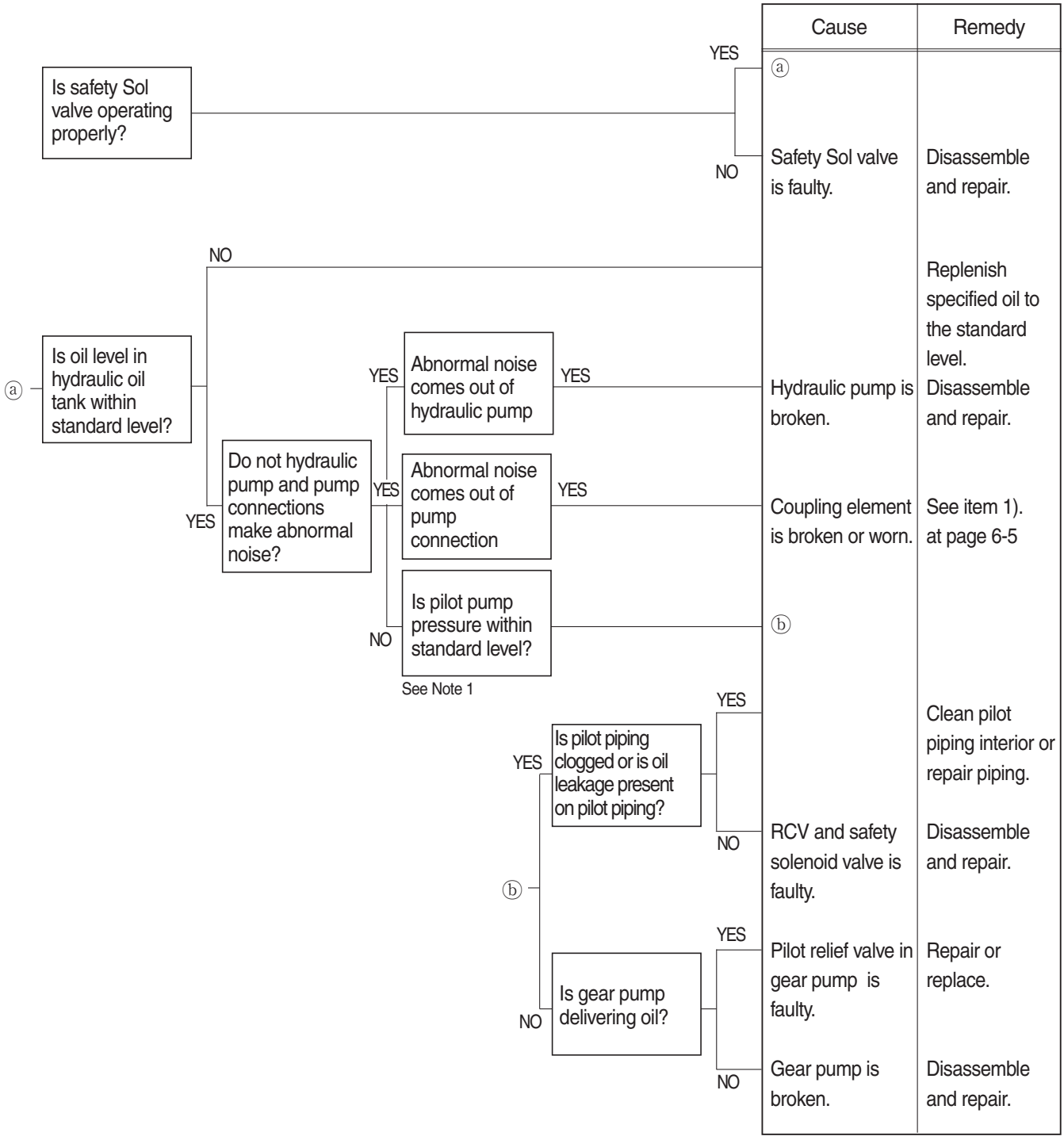
No.	Description	Specification
Note 1	Work pilot pressure	40^{+2}_{0} bar
Note 2	Swing pilot pressure	0~40 bar
Note 3	Boom up pilot pressure	0~40 bar
Note 4	Arm/bucket pilot pressure	0~40 bar
Note 5	Pump 1 regulator pressure	0~50 bar
Note 6	Pump 2 regulator pressure	0~50 bar
Note 7	Pump 1 pressure	350 bar
Note 8	Brake oil pressure	60±3 bar

2. DRIVE SYSTEM

1) UNUSUAL NOISE COMES OUT OF PUMP CONNECTION



2) ENGINE STARTS BUT MACHINE DOES NOT OPERATE AT ALL

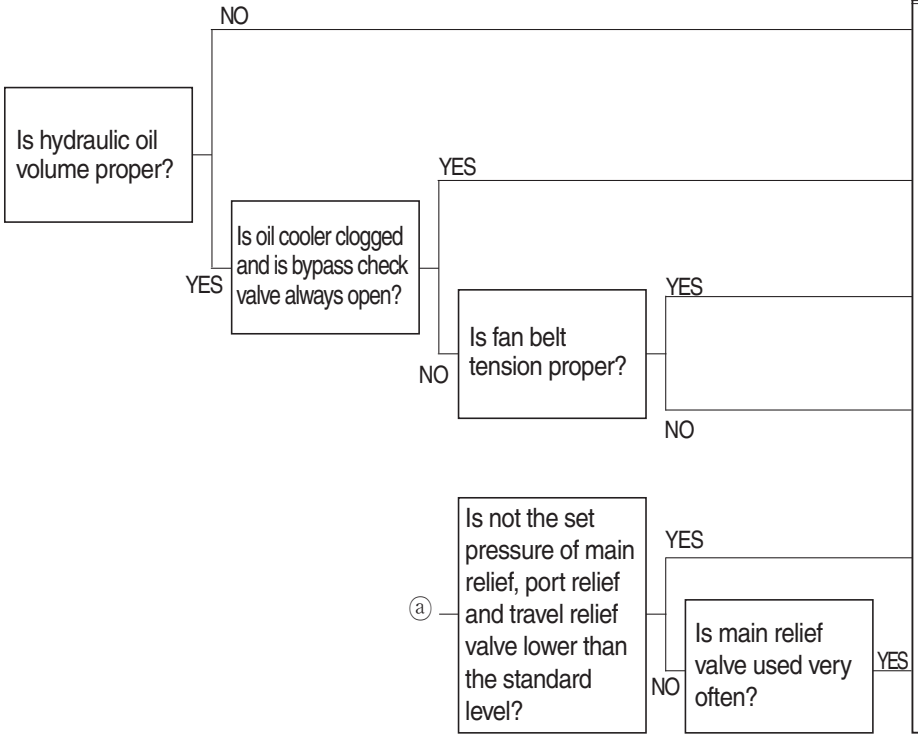


3. HYDRAULIC SYSTEM

1) HYDRAULIC OIL IS CLOUDY

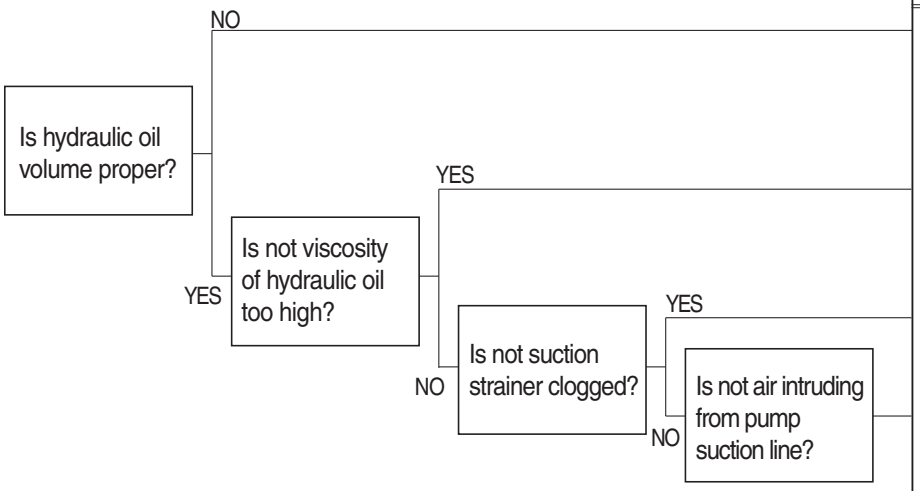
Cause	Remedy
Water is mixed.	Put hydraulic oil still, separate water and dispose it or replace hydraulic oil.
Air is intruded.	Check suction line and return line and eliminate the air intruding source.

2) HYDRAULIC OIL TEMPERATURE HAS RISEN ABNORMALLY



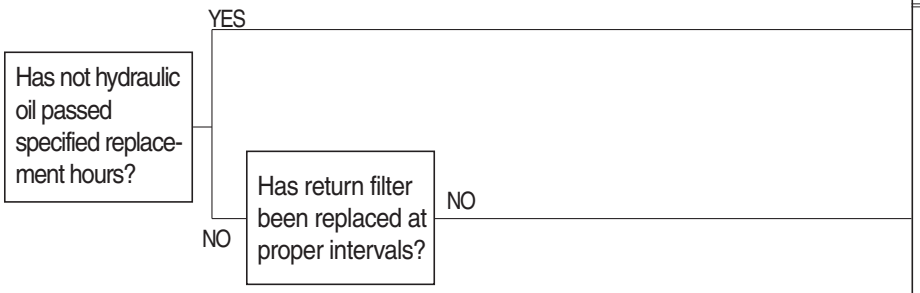
Cause	Remedy
Oil cooler clogged. Bypass check valve is defective. ⓐ	Replenish specified oil to the standard level. Clean oil cooler. Replace
	Adjust belt tension or replace belt.
	Readjust set pressure.
	Reduce load.

3) CAVITATION OCCURS WITH PUMP



Cause	Remedy
	Replenish specified oil to the standard level. Replace oil with one of proper viscosity. Clean suction strainer. Check for air intrusion in suction line and retighten or replace parts.

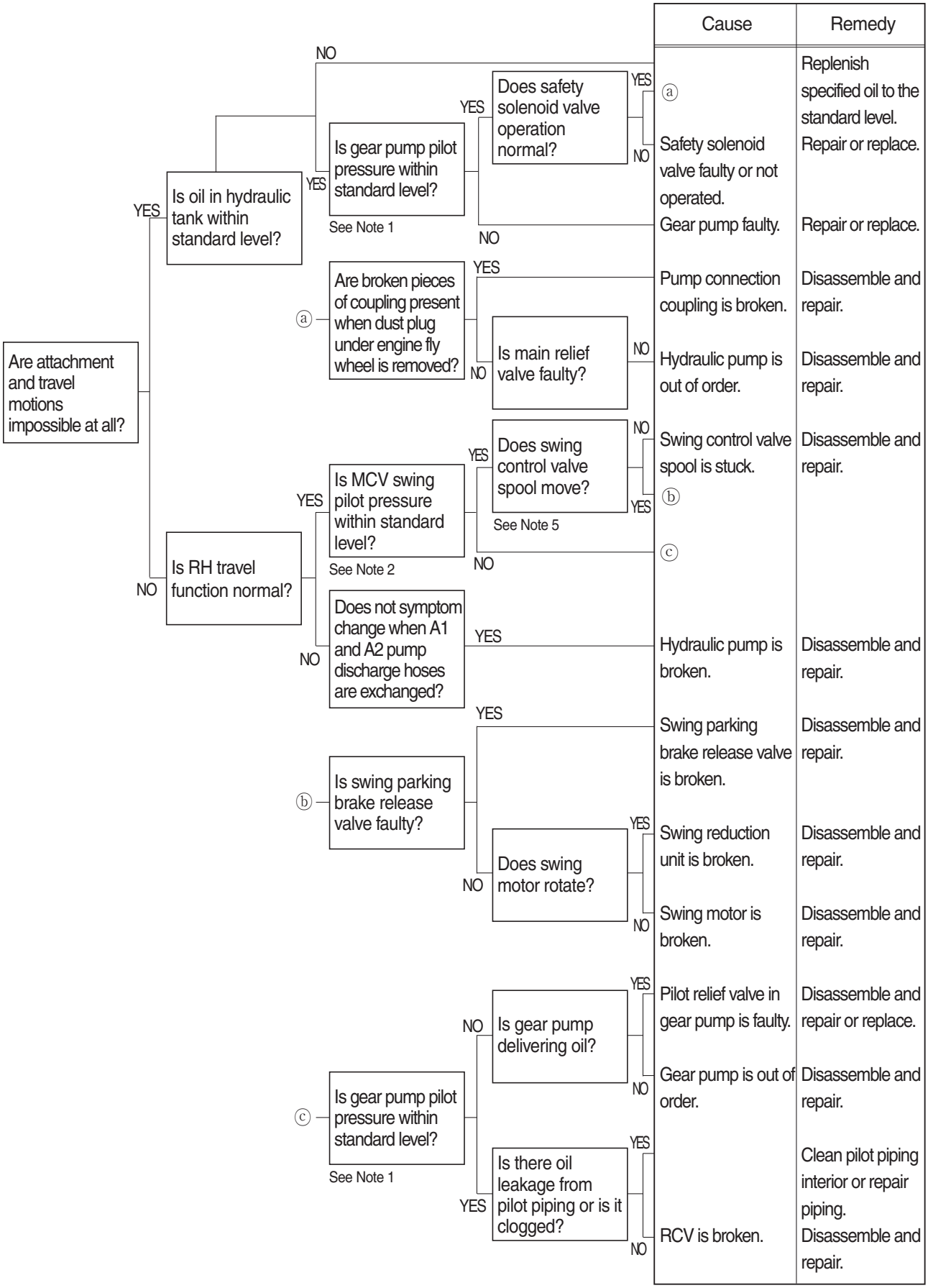
4) HYDRAULIC OIL IS CONTAMINATED



Cause	Remedy
	Replace hydraulic oil to be specified. Flush with hydraulic oil and replace return filter.

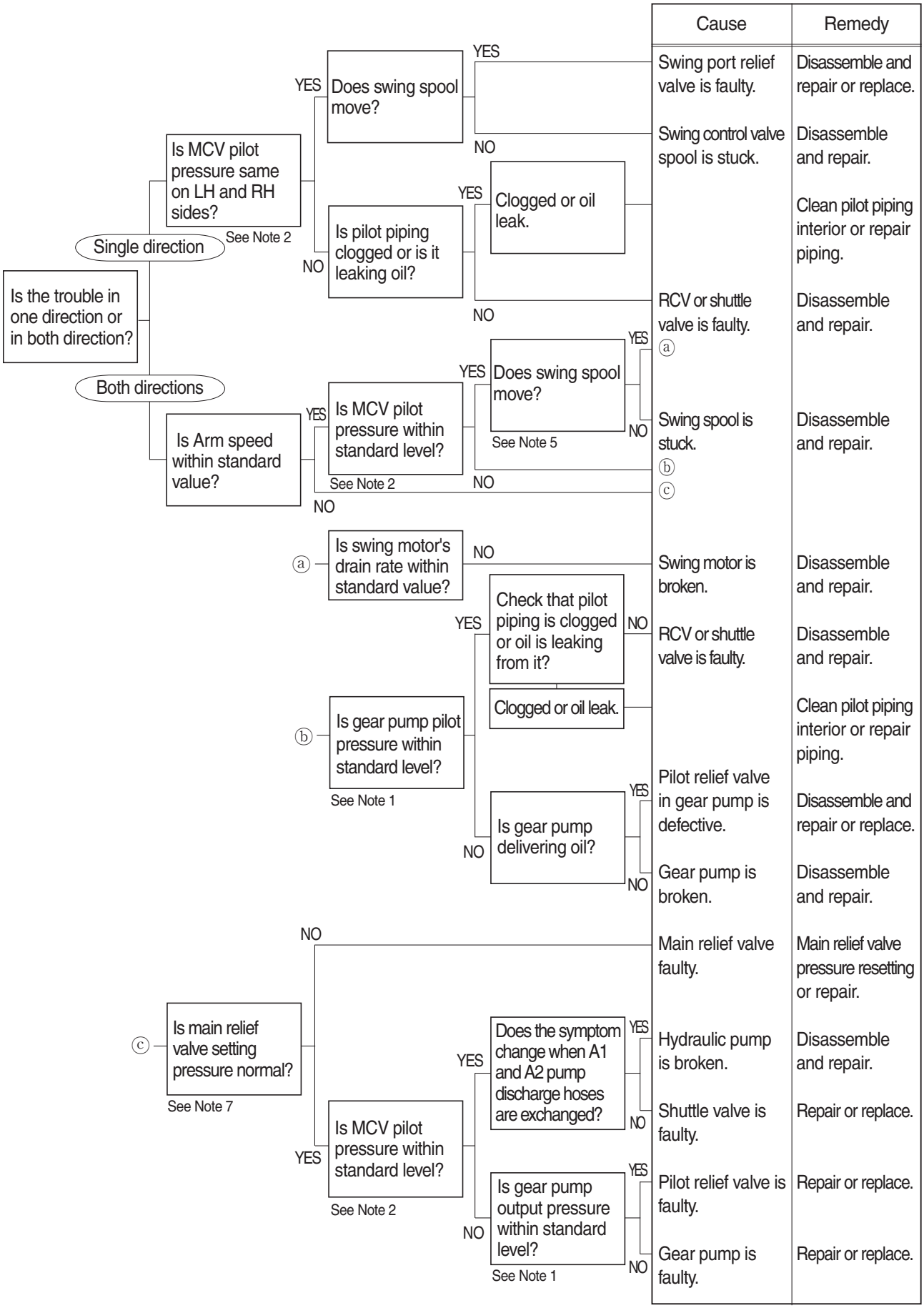
4. SWING SYSTEM

1) BOTH LH AND RH SWING ACTIONS ARE IMPOSSIBLE

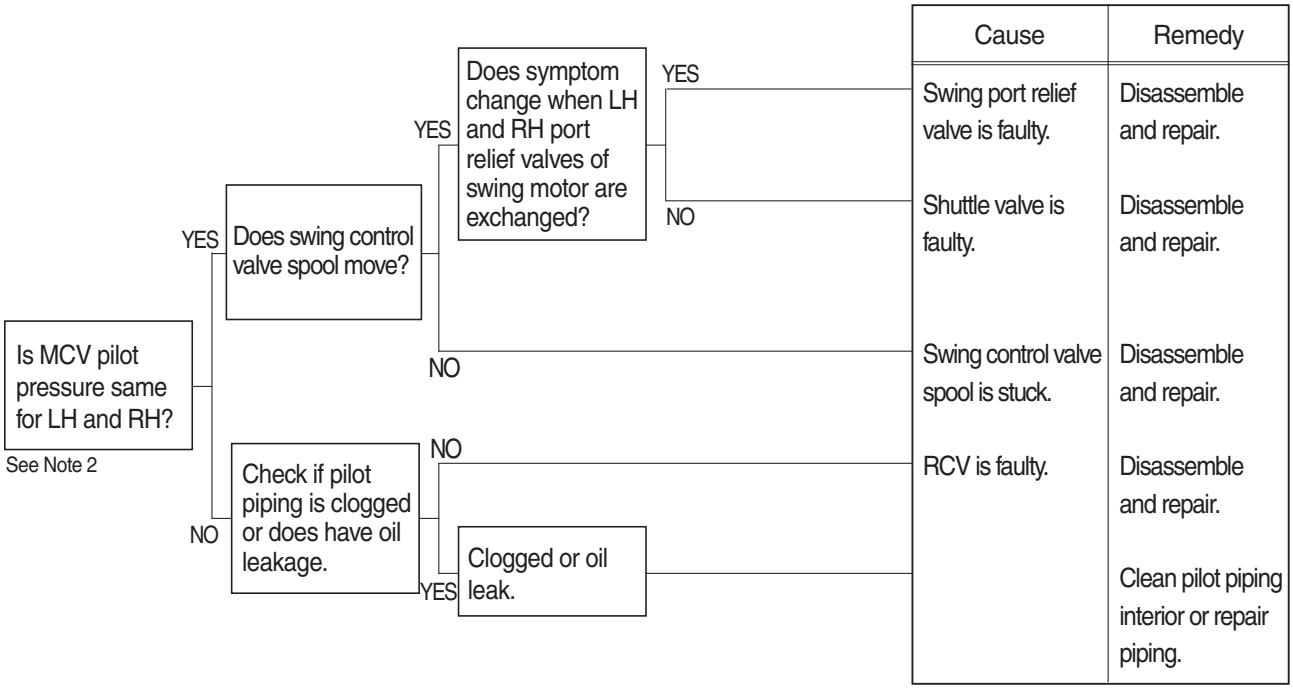


Cause	Remedy
ⓐ	Replenish specified oil to the standard level.
Safety solenoid valve faulty or not operated.	Repair or replace.
Gear pump faulty.	Repair or replace.
Pump connection coupling is broken.	Disassemble and repair.
Hydraulic pump is out of order.	Disassemble and repair.
Swing control valve spool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

2) SWING SPEED IS LOW

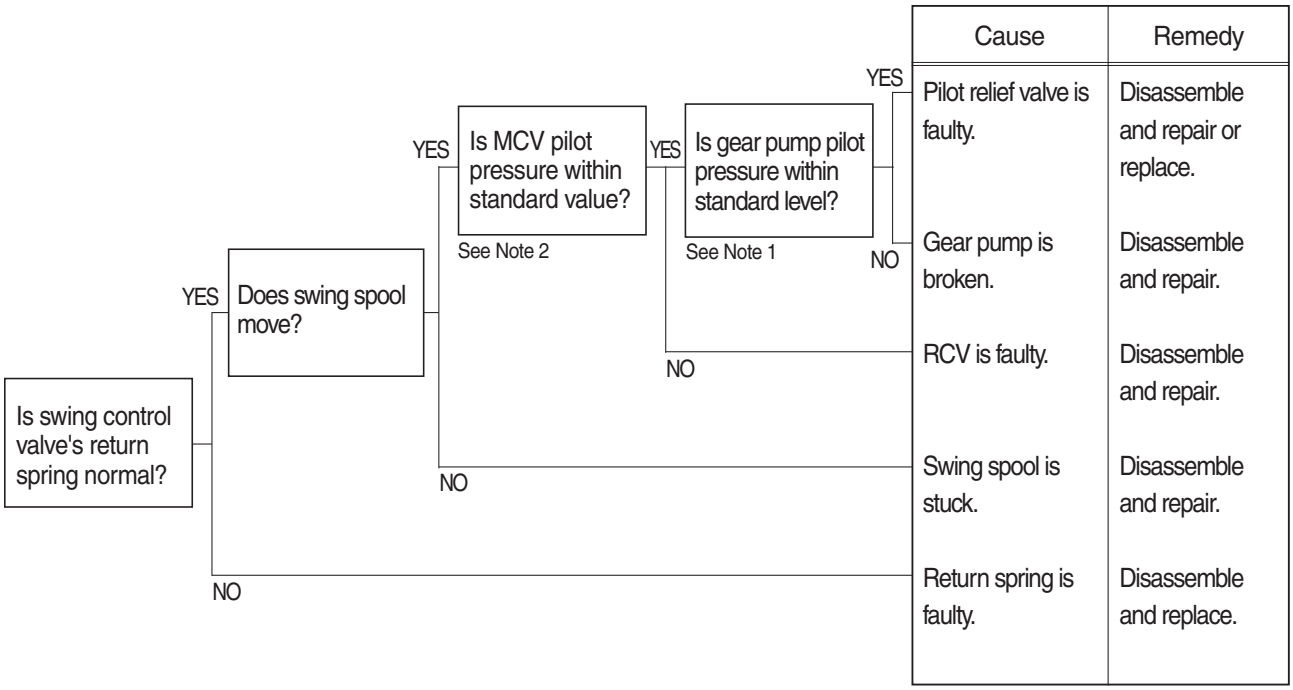


3) SWING MOTION IS IMPOSSIBLE IN ONE DIRECTION



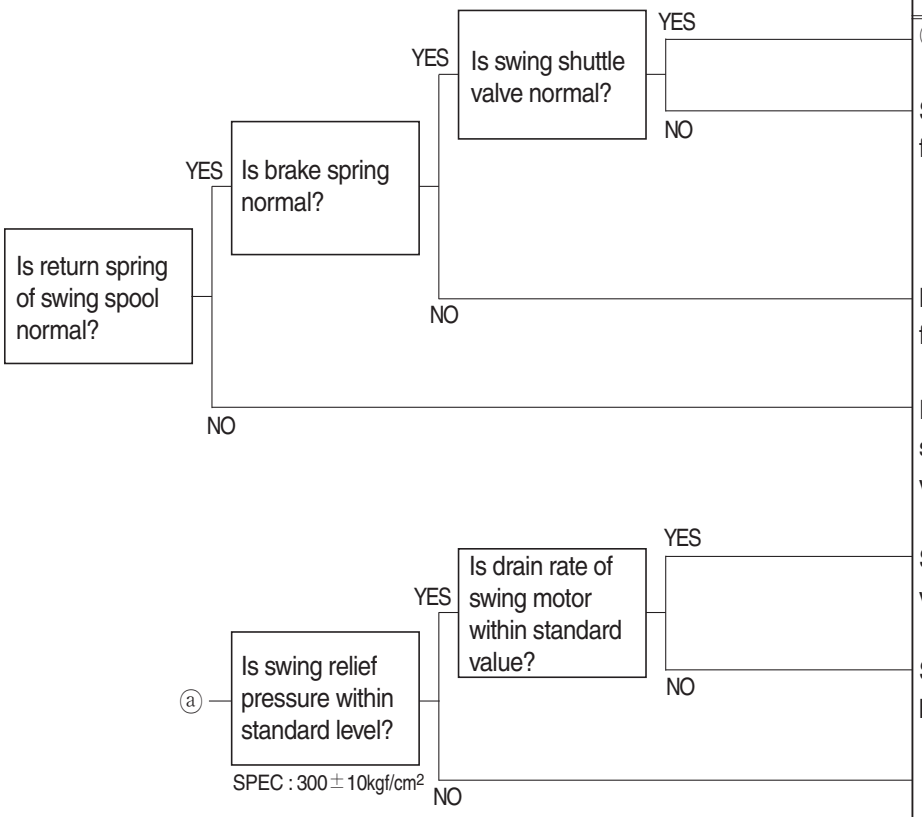
Cause	Remedy
Swing port relief valve is faulty.	Disassemble and repair.
Shuttle valve is faulty.	Disassemble and repair.
Swing control valve spool is stuck.	Disassemble and repair.
RCV is faulty.	Disassemble and repair.
	Clean pilot piping interior or repair piping.

4) MACHINE SWINGS BUT DOES NOT STOP



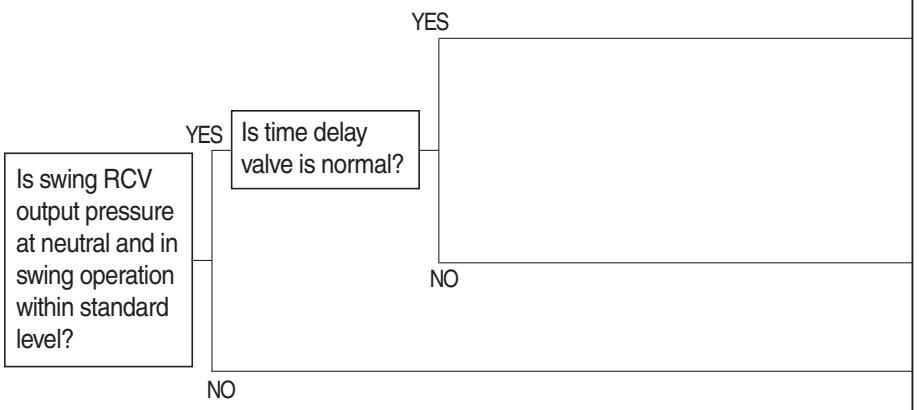
Cause	Remedy
Pilot relief valve is faulty.	Disassemble and repair or replace.
Gear pump is broken.	Disassemble and repair.
RCV is faulty.	Disassemble and repair.
Swing spool is stuck.	Disassemble and repair.
Return spring is faulty.	Disassemble and replace.

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



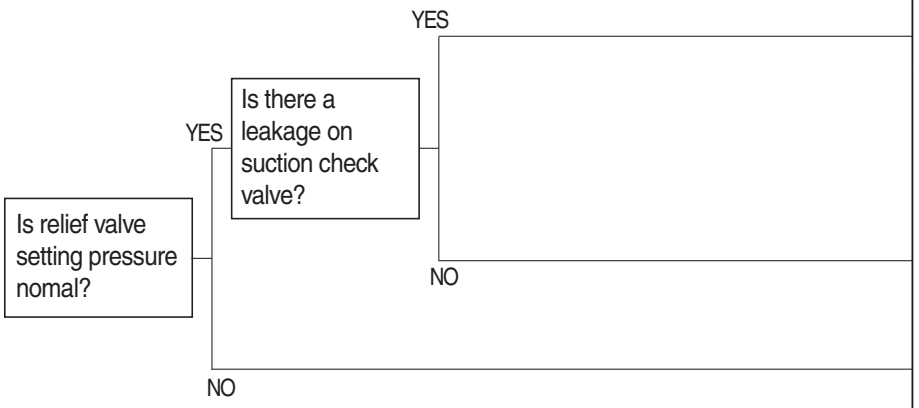
Cause	Remedy
ⓐ	
Shuttle valve is faulty.	Disassemble and replace.
Brake spring is faulty.	Disassemble and replace.
Return spring of swing control valve is faulty.	Disassemble and replace.
Swing port relief valve is faulty.	Disassemble and repair or replace.
Swing motor is broken.	Disassemble and repair.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

6) LARGE SHOCK OCCURS WHEN STOP SWINGING



Cause	Remedy
Swing motor is broken.	Disassemble and repair.
Time delay valve is faulty.	Disassemble and repair or replace.
Malfunction of swing RCV	Disassemble and repair.

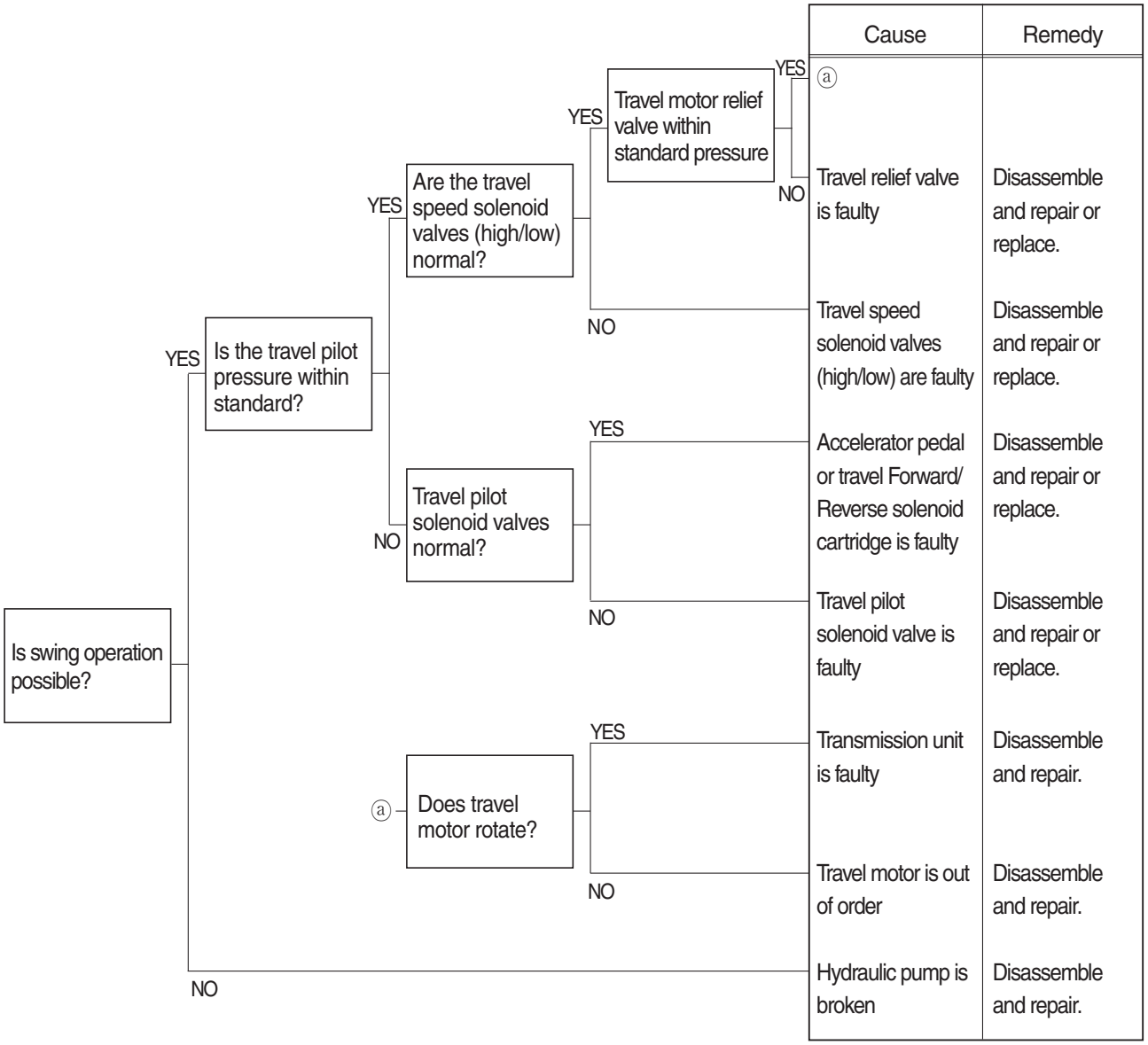
7) LARGE SOUND OCCURS WHEN STOP SWINGING



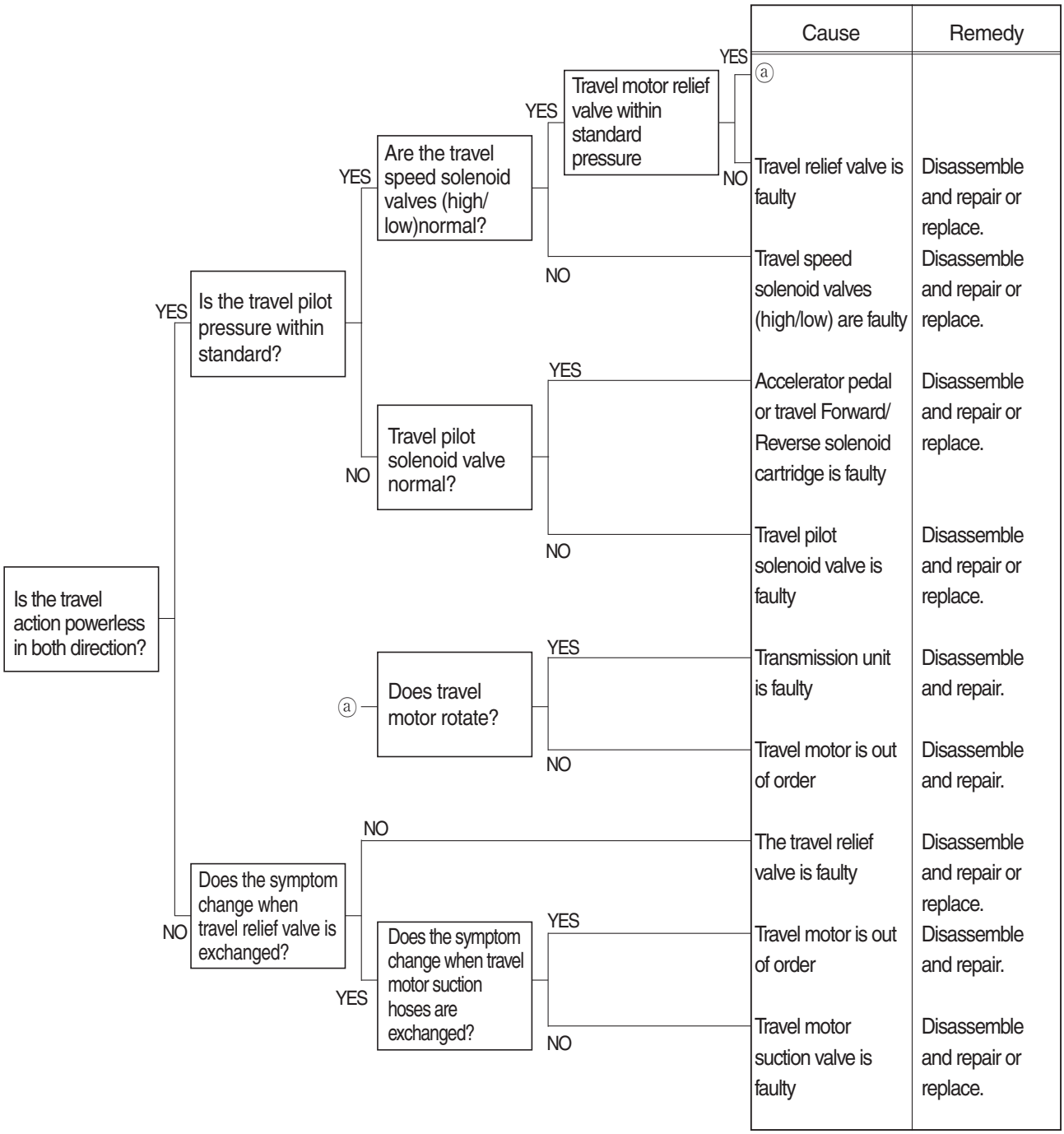
Cause	Remedy
Seal of suction valve is faulty.	Disassemble and repair.
Internal defect of swing motor.	Disassemble and repair.
Malfunction of relief valve.	Adjust swing relief valve pressure or replace swing relief valve.

5. TRAVEL SYSTEM

1) TRAVEL DOES NOT FUNCTION



2) TRAVEL ACTION IS POWERLESS (travel only)



3) THE HYDRAULIC MOTOR DOSE NOT GET STARTED

The hydraulic motor does not get started

Cause	Remedy
The spool does work properly. (The spool keeps fully open)	Screw the fitting bolts one more time with correct tightening torque. If the spool turns out to be damaged, it should be repaired or the new one should be used
The anti-avitation check valve does not work properly. (The check valve is kept open.)	Ditto

4) IT TAKES TIME TO ACCELERATE THE MOTOR

It takes time to accelerate the motor

Cause	Remedy
The spool does not work properly.	Screw the fitting bolts one more time with correct tightening torque. If the spool turns out to be damaged, it should be repaired, or the new one should be used.
The orifice for closing the counterbalance is clogged.	Remove the foreign matter by disassembling and cleaning.
Wrong setting of pressure of the relief valve.	Adjust at the correct value. If the relief valve turns out to be out of order, the new one should be used.

5) IT IS NOT POSSIBLE TO REDUCE THE MOTOR SMOOTHLY

It is not possible to reduce the motor smoothly

Cause	Remedy
The orifice for closing the counterbalance is clogged. The opening of the neutral position of the spool is clogged.	Remove the foreign matter by disassembling and cleaning.
Wrong setting of pressure of the relief valve.	Adjust at the correct value. If the relief valve turns out to be out of order, the new one should be used.

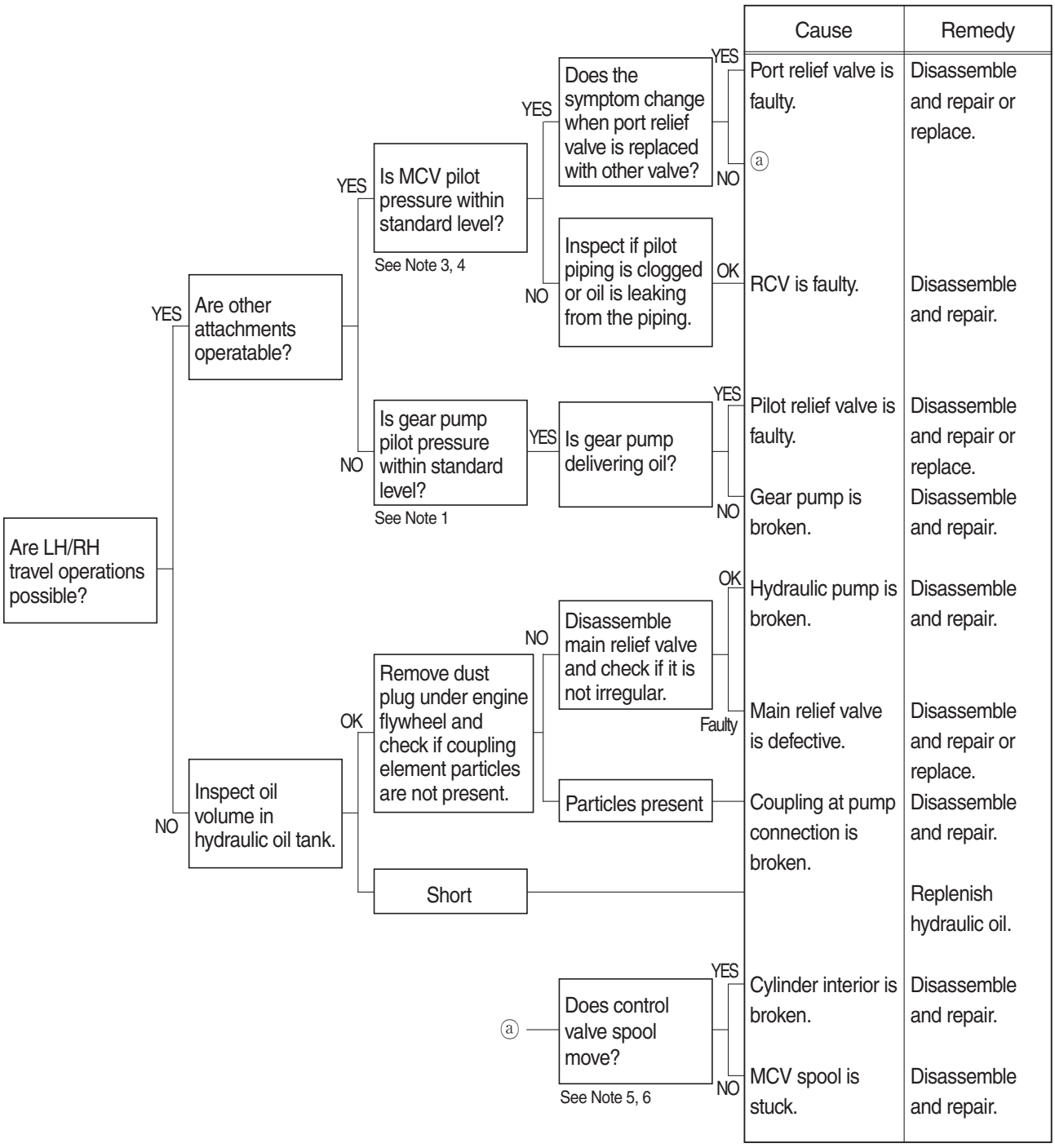
6) EXTRAORDINARY NOISE IS HEARD WHEN SUDDENLY REDUCING THE SPEED FROM THE HIGH-SPEED MODE

It takes time to accelerate the motor

Cause	Remedy
The anti-cavitation valve does not not work properly.	Screw the fitting bolts one more time with correct tightening torque. If the valve turns out to be damaged, is should be repaired.

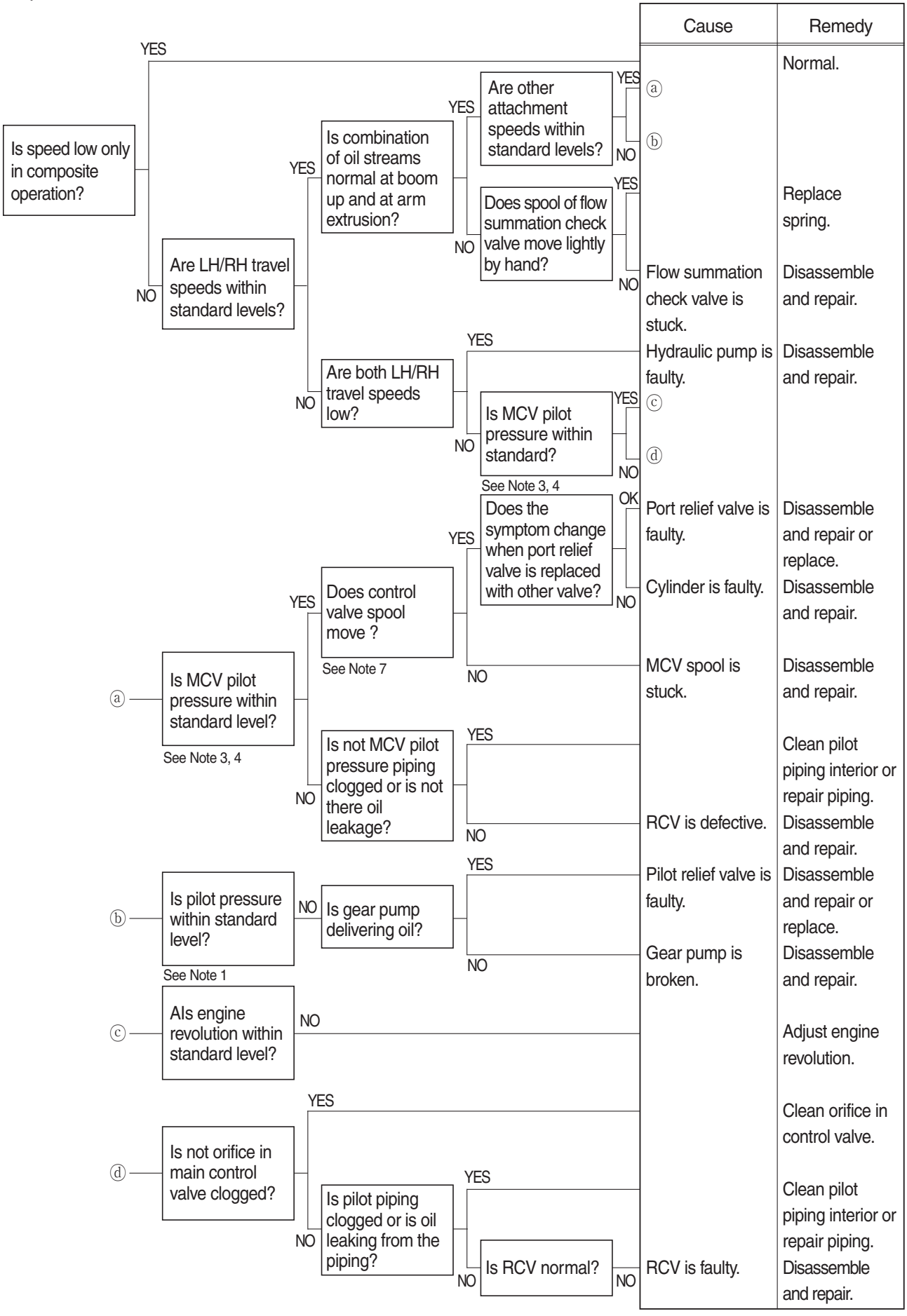
6. ATTACHMENT SYSTEM

1) BOOM OR ARM ACTION IS IMPOSSIBLE AT ALL



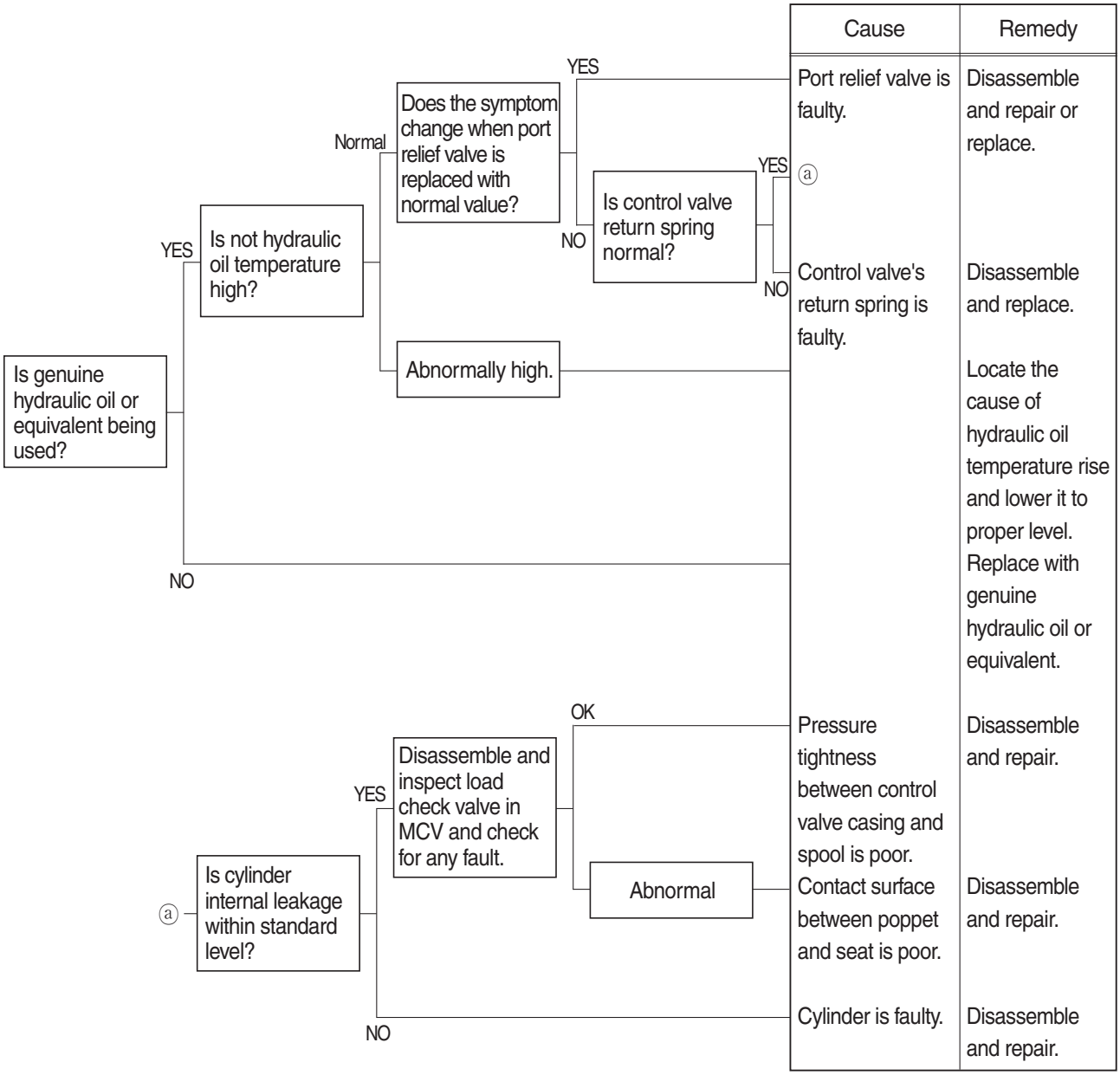
Cause	Remedy
Port relief valve is faulty.	Disassemble and repair or replace.
RCV is faulty.	Disassemble and repair.
Pilot relief valve is faulty.	Disassemble and repair or replace.
Gear pump is broken.	Disassemble and repair.
Hydraulic pump is broken.	Disassemble and repair.
Main relief valve is defective.	Disassemble and repair or replace.
Coupling at pump connection is broken.	Disassemble and repair.
	Replenish hydraulic oil.
Cylinder interior is broken.	Disassemble and repair.
MCV spool is stuck.	Disassemble and repair.

2) BOOM, ARM OR BUCKET SPEED IS LOW



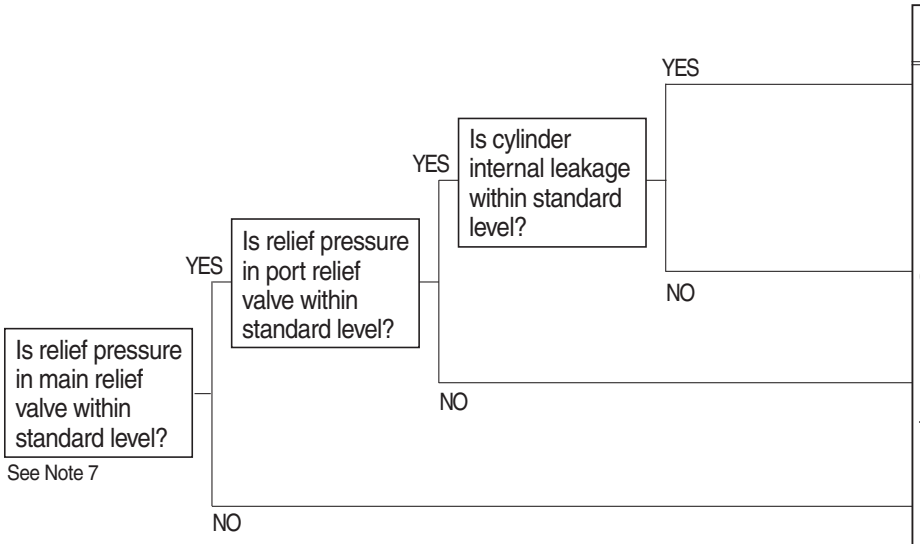
Cause	Remedy
	Normal.
	Replace spring.
Flow summation check valve is stuck.	Disassemble and repair.
Hydraulic pump is faulty.	Disassemble and repair.
Port relief valve is faulty.	Disassemble and repair or replace.
Cylinder is faulty.	Disassemble and repair.
MCV spool is stuck.	Disassemble and repair.
	Clean pilot piping interior or repair piping.
RCV is defective.	Disassemble and repair.
Pilot relief valve is faulty.	Disassemble and repair or replace.
Gear pump is broken.	Disassemble and repair.
	Adjust engine revolution.
	Clean orifice in control valve.
	Clean pilot piping interior or repair piping.
RCV is faulty.	Disassemble and repair.

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



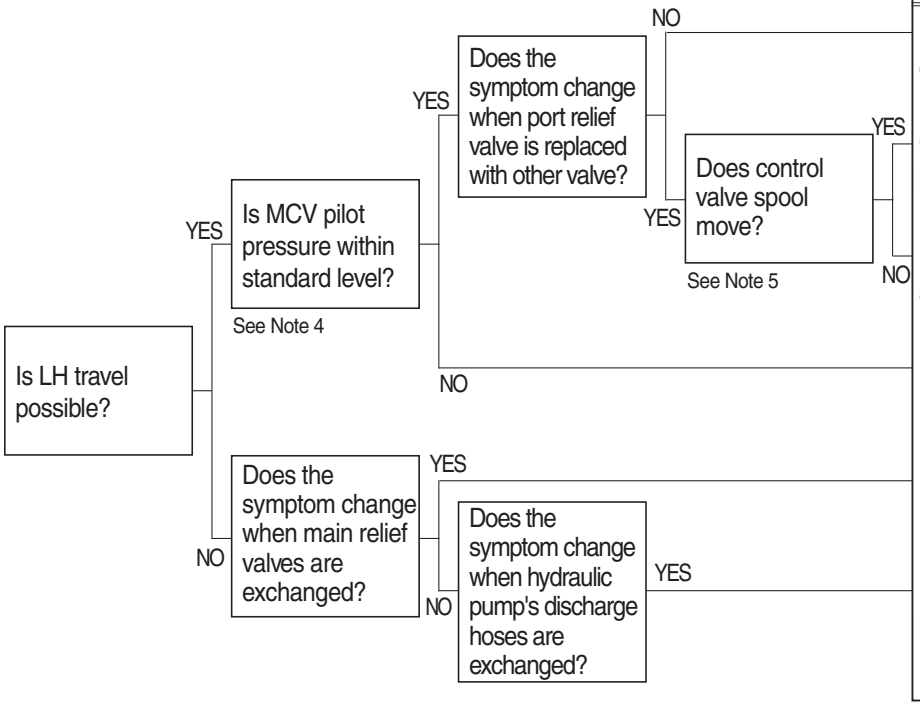
Cause	Remedy
Port relief valve is faulty.	Disassemble and repair or replace.
Control valve's return spring is faulty.	Disassemble and replace.
	Locate the cause of hydraulic oil temperature rise and lower it to proper level. Replace with genuine hydraulic oil or equivalent.
Pressure tightness between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



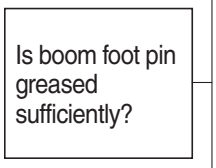
Cause	Remedy
Cylinder is faulty.	Check according to the procedure in Item "Speed is low". Disassemble and repair.
Port relief valve is faulty.	Adjust pressure, repair or replace.
Main relief valve is defective.	Adjust pressure, repair or replace.

5) ONLY BUCKET OPERATION IS TOTALLY IMPOSSIBLE



Cause	Remedy
Port relief valve is defective.	Disassemble and repair or replace.
Cylinder interior is broken.	Disassemble and repair.
MCV spool is stuck.	Disassemble and repair.
RCV is faulty.	Disassemble and repair.
Main relief valve is faulty.	Adjust pressure, repair or replace.
Hydraulic pump is broken.	Disassemble and repair.

6) BOOM MAKES A SQUEAKING NOISE WHEN BOOM IS OPERATED

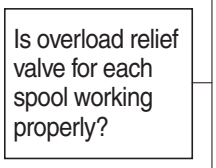


YES

NO

Cause	Remedy
	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.
Boom foot pin has run out of grease.	Supply grease to it. ※ If seizure is in an initial stage, supply sufficient grease. If seizure is in a grown state, correct it by paper lapping or with an oil stone.

7) TIME LAG OF MACHINE WORKING IS LARGE.



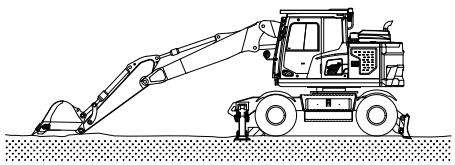
YES

NO

Cause	Remedy
	Refer to 2)
Overload relief valve is faulty.	Disassemble and repair.

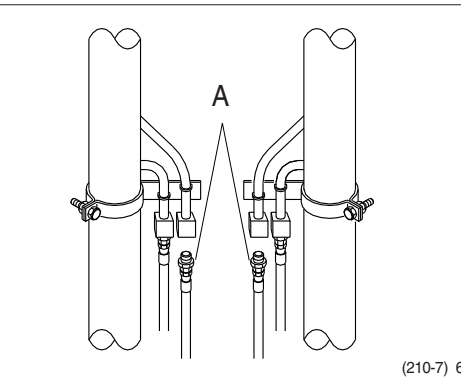
※ HOW TO CHECK INTERNAL BOOM CYLINDER LEAKAGE

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



170WA6TS01

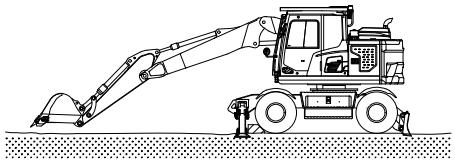
2. Disconnect hose (A) from rod side of boom cylinder and drain oil from cylinders and hose. (put cups on piping and hose ends)



(210-7) 6-20(2)

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

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



170WA6TS02

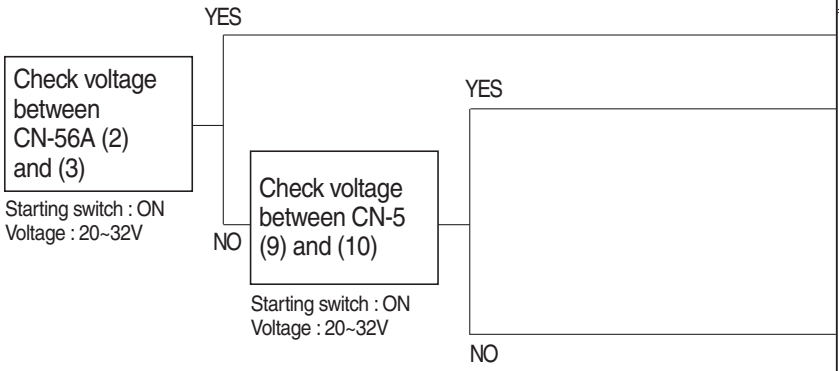
7. FRONT AXLE AND REAR AXLE

Problem	Cause	Correction
Insufficient braking	1. Incorrect adjustment	Inspect disc thickness and if discs are usable readjust brakes to the specifications in the manual.
	2. Brake discs worn out	Inspect disc thickness and replace if necessary.
	3. Incorrect brake fluid	Replace all seals in axle and master cylinder that have made contact with the incorrect fluid and all brake hoses. If incorrect fluid leaked into axle oil, seals and O-rings in axle must be replaced.
	4. Loss of brake fluid	Inspect for and repair any leaks in outside circuit or master cylinder. If caused by incorrect brake fluid see correction No.3. If leak is to the outside replace the O-rings between the center and intermediate housings. If leak is to the inside replace above O-rings and brake piston O-rings.
	5. Overheated axle causing brake fluid to vaporize. (Brake return when axle cools)	See “overheating” problem.
Soft brake pedal	6. Air in brake circuit	Bleed air in brake circuit.
Ineffective safety brake	7. Incorrect adjustment	See correction No.1.
	8. Brake disc worn out	See correction No.2.
Overheating	9. Oil level wrong	Drain, flush and refill oil to proper level.
	10. Too small of a brake gap	Readjust brakes to the specifications.
	11. Park brake dragging	Unlock the brake and adjust the correct gap.
	12. Incorrect brake fluid in system	See correction No.3.
	13. No free-pedal at master cylinder	Readjust brake pedal.
	14. Restriction in brake lines	Inspect for and replace damage lines.
	15. Restriction in return line of brake servo system	Inspect for and replace damaged return line. Inspect for and remove any filter, tee’d in line or any other source of back pressure from the return line.
	16. Incorrect lubricant	Change the retaining rings of the brake circuit and brake pump.
Diff-lock inoperative	17. If manual control, loose or misadjusted linkage	Inspect and correct linkage and readjust.
	18. If hydraulic control, problems in the hydraulic or electrical circuits of the machine.	Refer to the hydraulic or electrical section in this manual.
	19. If hydraulic control problems in actuating cylinder(noteable through loss of hydraulic oil or increase of the oil level in axle)	Rebuilt cylinder.
	20. If with limit slip differential, worn discs	Replace discs.

Problem	Cause	Correction
Oil coming out of breather	21. Leak in internal brake system	See correction No.2 and No.3.
	22. Leak in diff-lock actuating cylinder	See correction No.19.
Nospin indexing noise when driving straight ※With nospin, fatigue damage can occur on the side with the larger tire.	23. Unequal tire pressure left and right	Inflate tires to the recommended pressure in this manual, or until the rolling radius is equal.
	24. Different style, size or brand of tires between left and right hand side	Change tires to make the rolling radius equal. Vary the tire pressure within the specifications until the rolling radius is equal.
Noise during coast and under power the same	25. Wheel bearings damaged	Replace and adjust
Noise under power greater than during coast	26. Low oil level	Refill oil to proper level
	27. Incorrect lubricant	See correction No.16.
	28. Ring and pinion worn	Inspect through top cover. Replace and adjust.
	29. Worn ring and pinion bearings	Replace and adjust
	30. Worn planetary gears or bearings	Replace.
Noise during coast greater than under power	31. Loose pinion nut	Inspect ring, pinion and pinion bearings. If undamaged, retighten nut.
	32. Only pinion bearing damaged	See correction No.29.
Noise during turn (Without nospin)	33. Worn spider and/or side gears	Replace.
A stick slip noise when going from forward to reverse	34. Worn or damaged cardan shaft	Inspect and replace.
	35. Loose wheel	Inspect for wheel and wheel stud damage. Replace if needed and retorque lugnuts.
	36. Articulation box joint and achsel shaft damaged	Inspect and replace.
	37. Spider pins loose in diff-carrier	Inspect through top cover. Replace.
	38. Damaged or missing spider and/or side gear washers	See correction No.33.

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

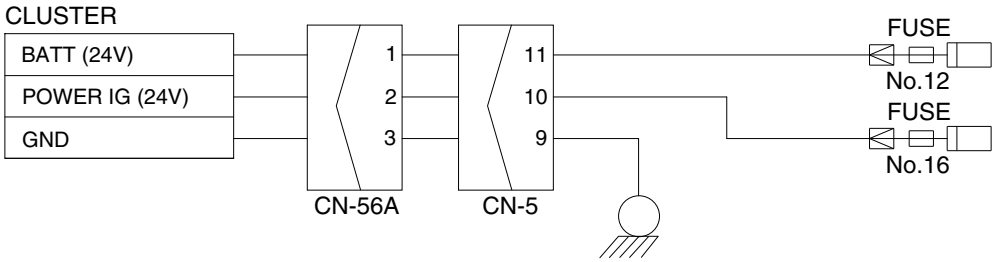
· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted and short of fuse No. 12, 16.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.



Cause	Remedy
Defective cluster	Replace
Disconnection in wiring harness or poor contact between CN-5-CN-56A	Repair or replace (after clean)
Disconnection in wiring harness or poor contact between CN-5 (9) -GND or fuse No. 12, 16	Repair or replace (after clean)

Check voltage

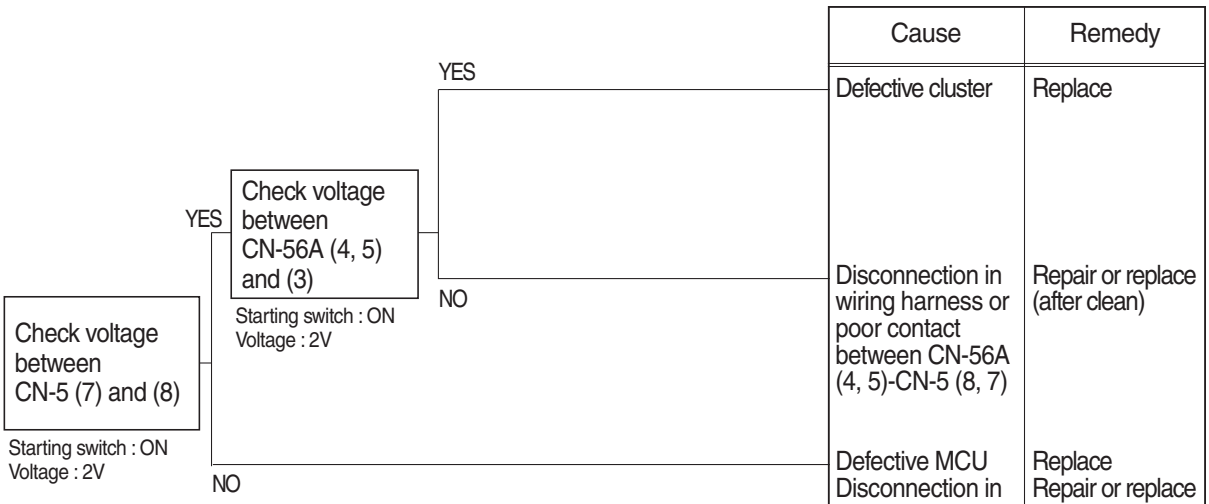
YES	20~32V
NO	0V



140WA6ES01

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

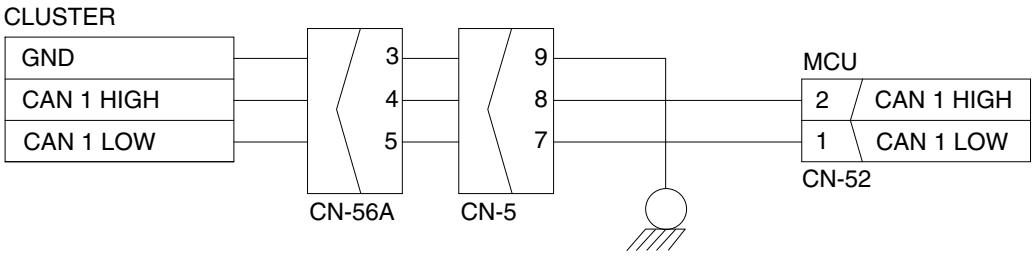
· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.



Cause	Remedy
Defective cluster	Replace
Disconnection in wiring harness or poor contact between CN-56A (4, 5)-CN-5 (8, 7)	Repair or replace (after clean)
Defective MCU Disconnection in wiring harness or poor contact between CN-5 (8, 7)- CN-52 (2, 1)	Replace Repair or replace (after clean)

Check voltage

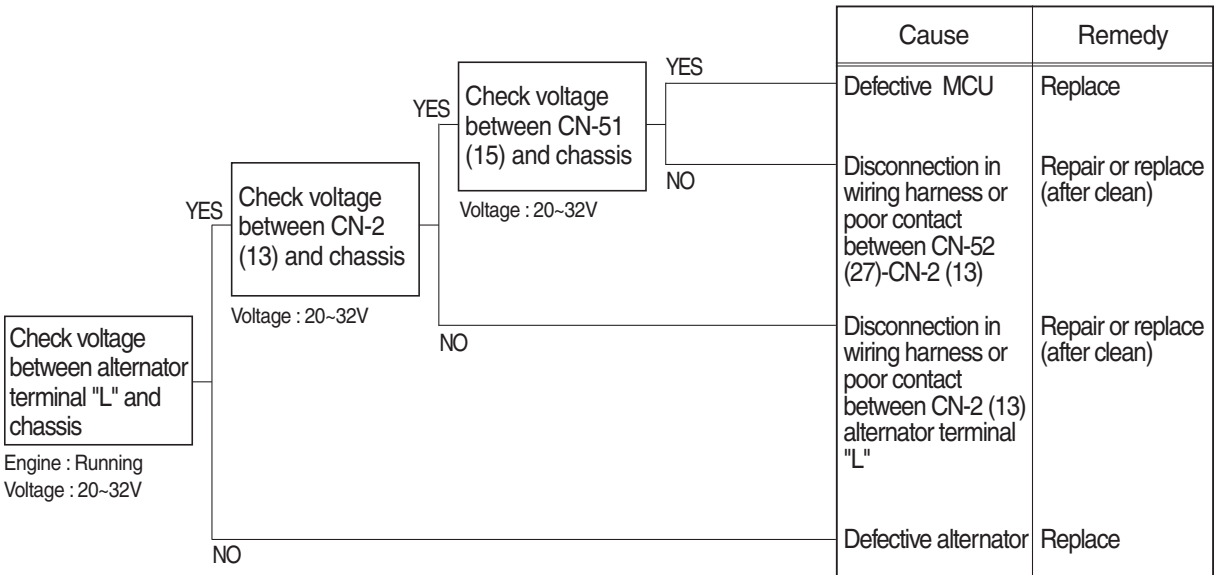
YES	2V
NO	0V



140WA6ES02

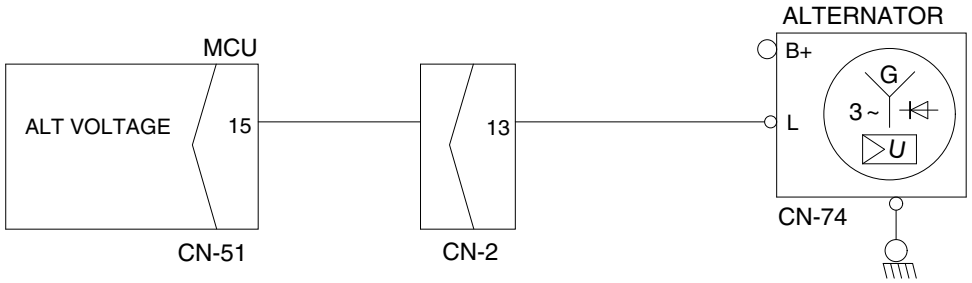
3. BATTERY CHARGING WARNING LAMP LIGHTS UP (Starting switch : ON)

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



Check voltage

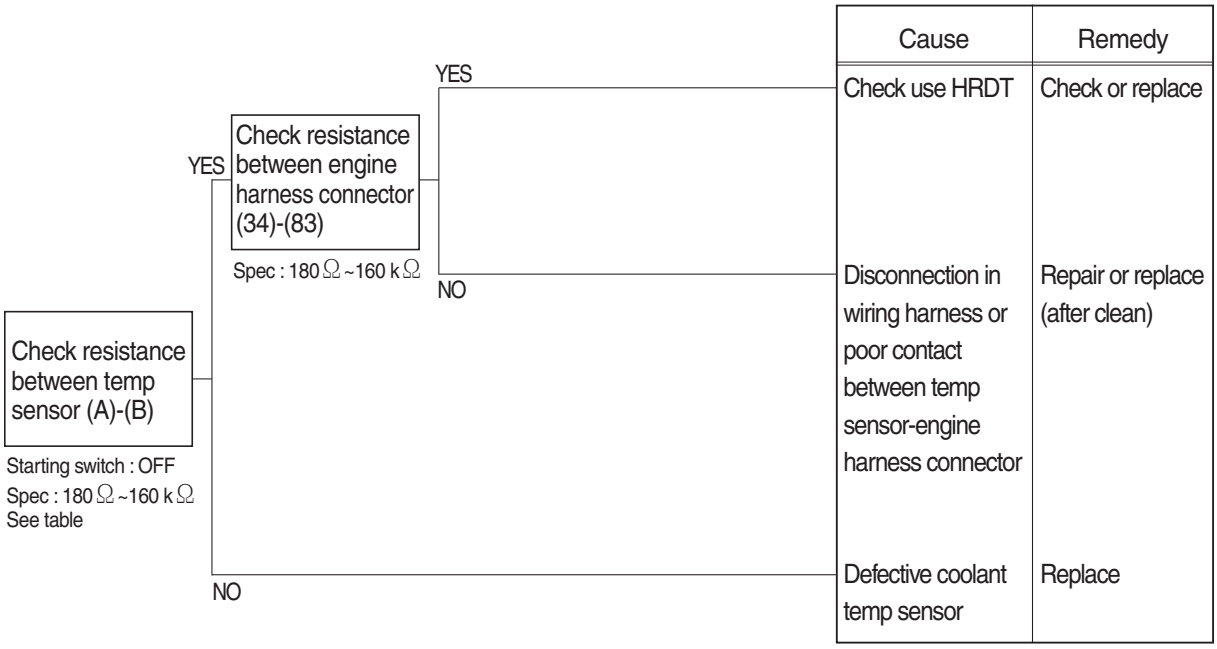
YES	20~32V
NO	0V



140WA6ES03

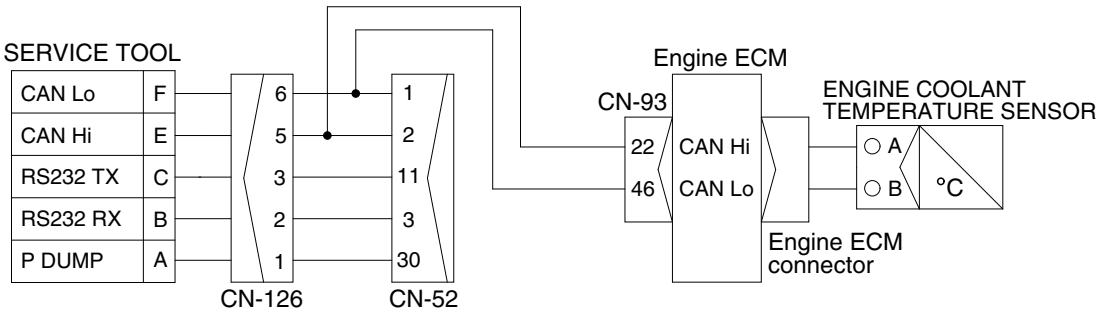
4. WHEN COOLANT OVERHEAT WARNING LAMP LIGHTS UP (engine is started)

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



Check Table

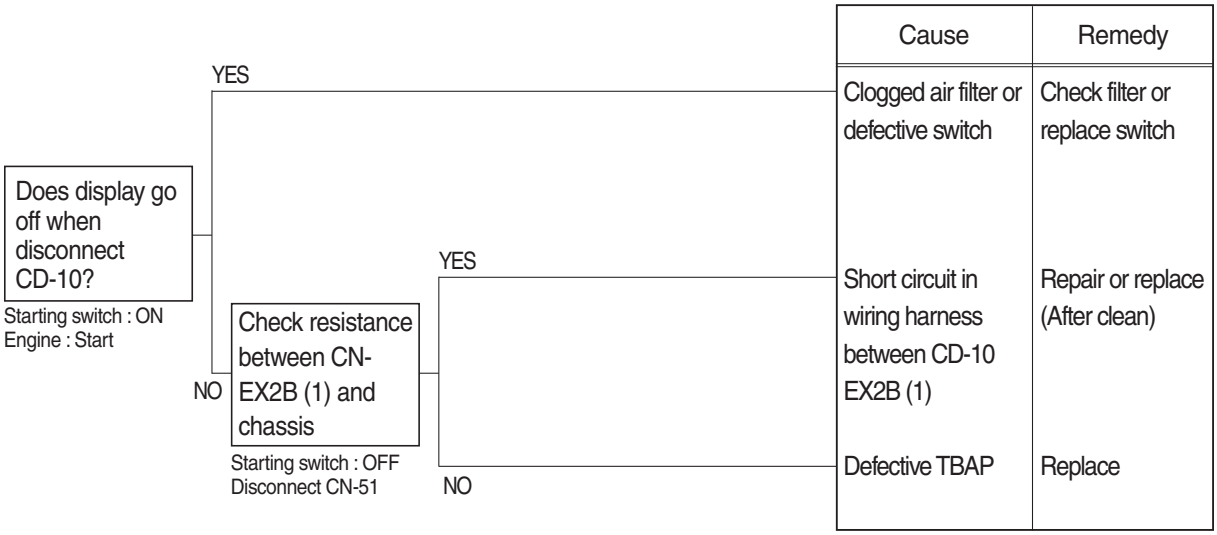
Temperature (˚C)	0	25	50	80	95
Resistance (kΩ)	30~37	9.3~10.7	3.2~3.8	1.0~1.3	0.7~0.8



140WA6ES04

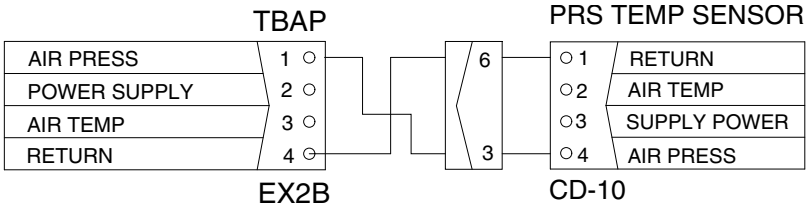
5. WHEN AIR CLEANER WARNING LAMP LIGHTS UP (engine is started)

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



Check resistance

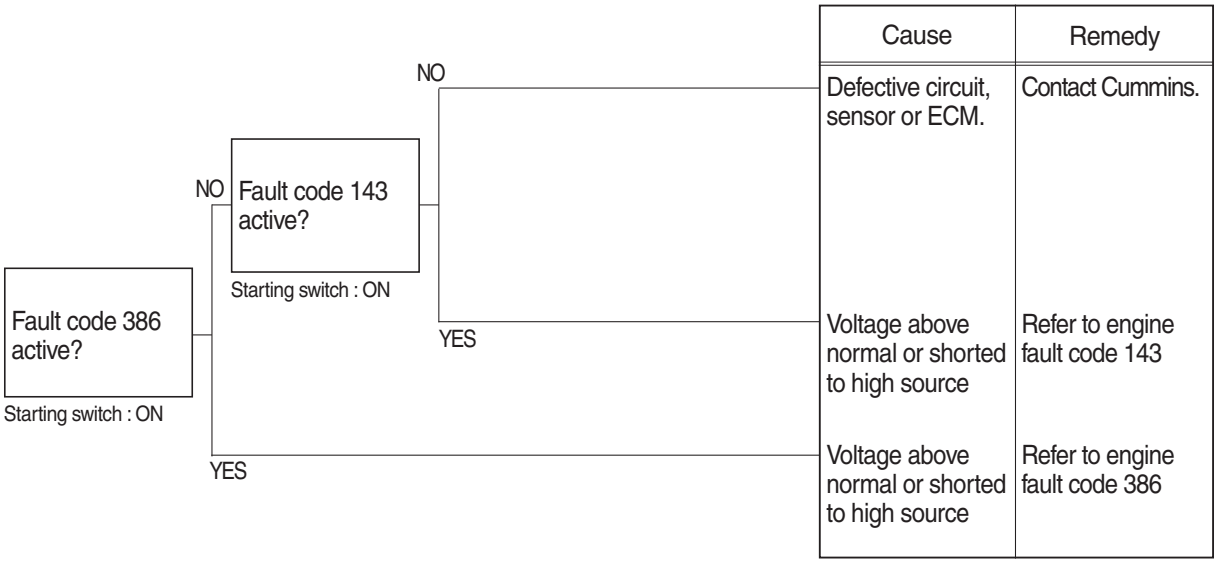
YES	MAX 1Ω
NO	MIN 1MΩ

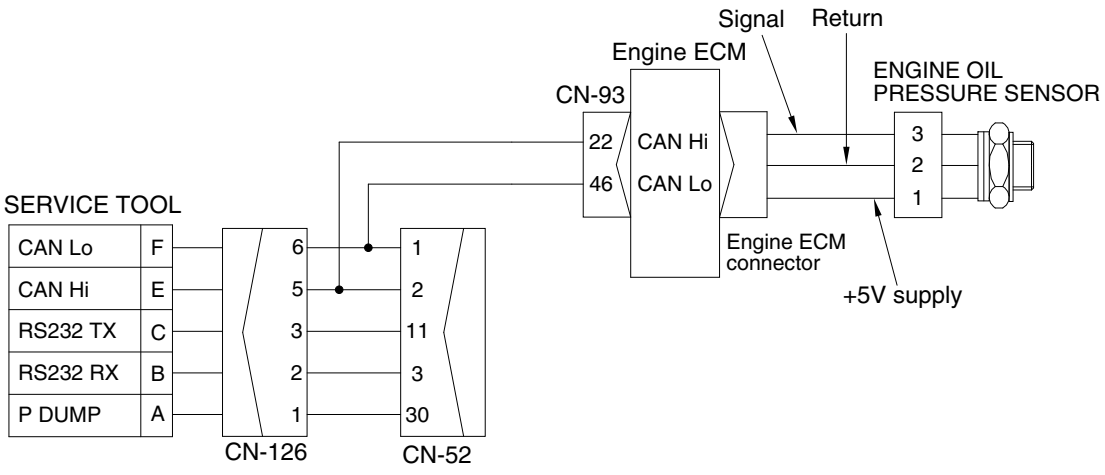


140WA6ES06

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

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

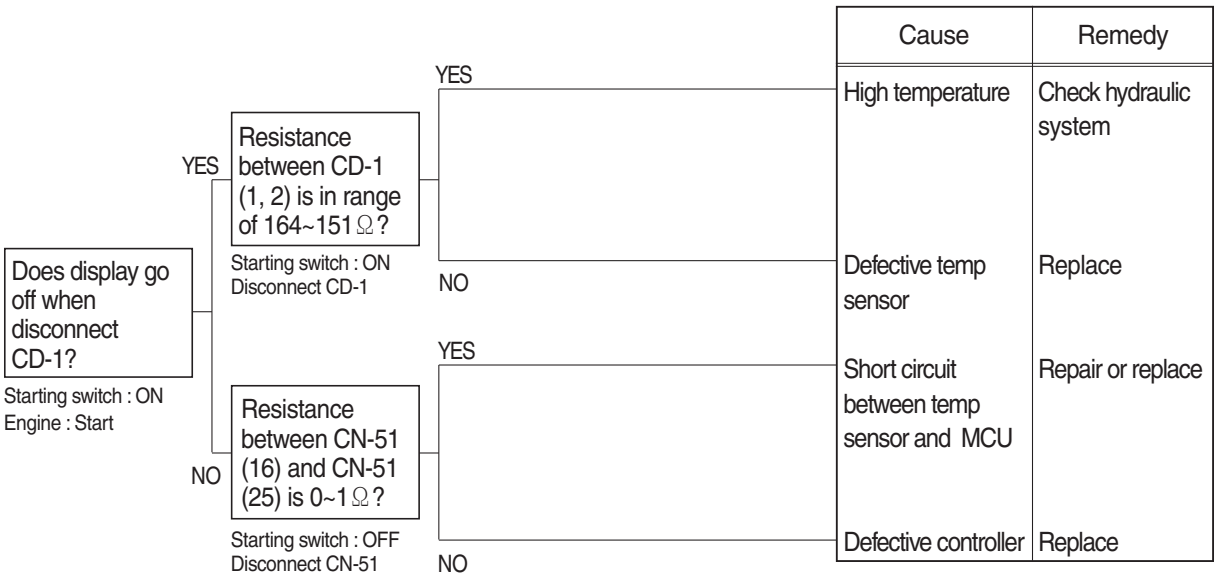


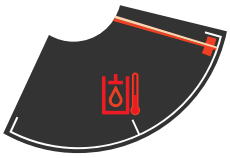


140WA6ES07

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

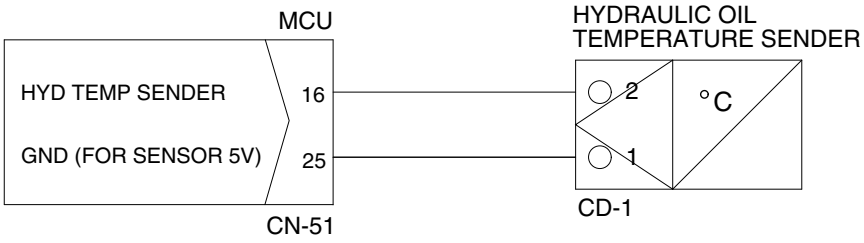
· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.





Check Table

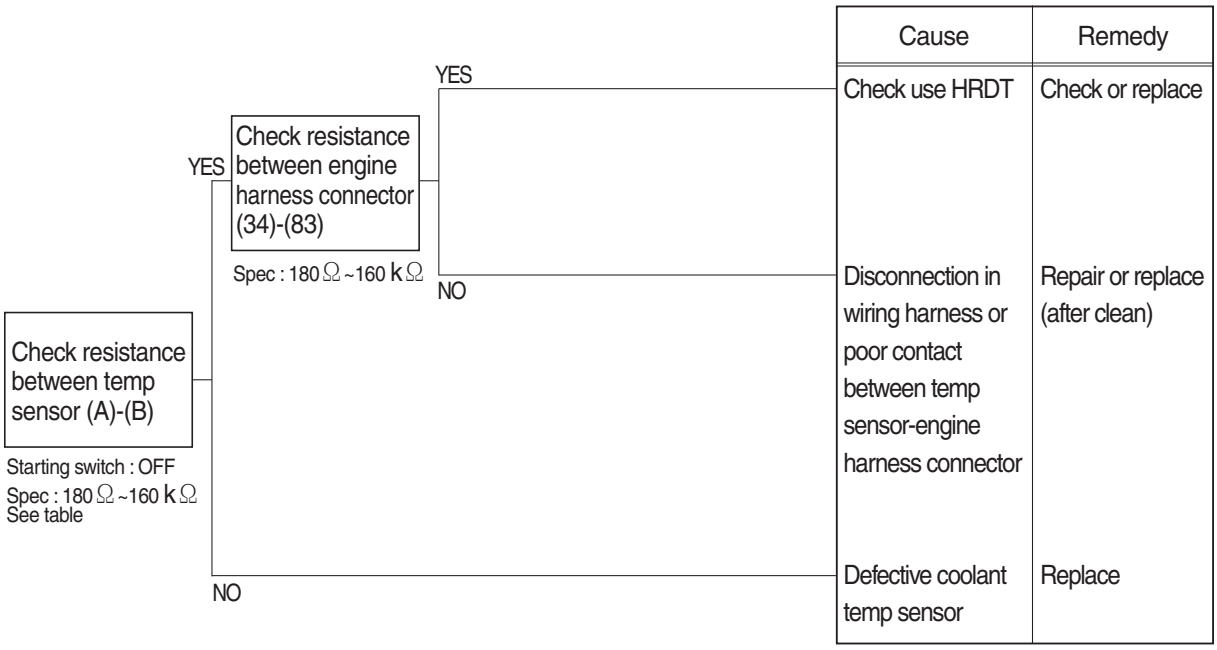
Temperature (˚C)	~ -30	~ -10	~ 0	~ 40	~ 70	~ 80	~ 90	~ 100	105~
Resistance (kΩ)	22.22 ~31.78	8.16 ~10.74	5.18 ~ 6.6	1.06 ~1.28	0.39 ~0.476	0.322 ~0.298	0.243 ~0.219	0.185 ~0.167	0.164 0.151



140WA6ES08

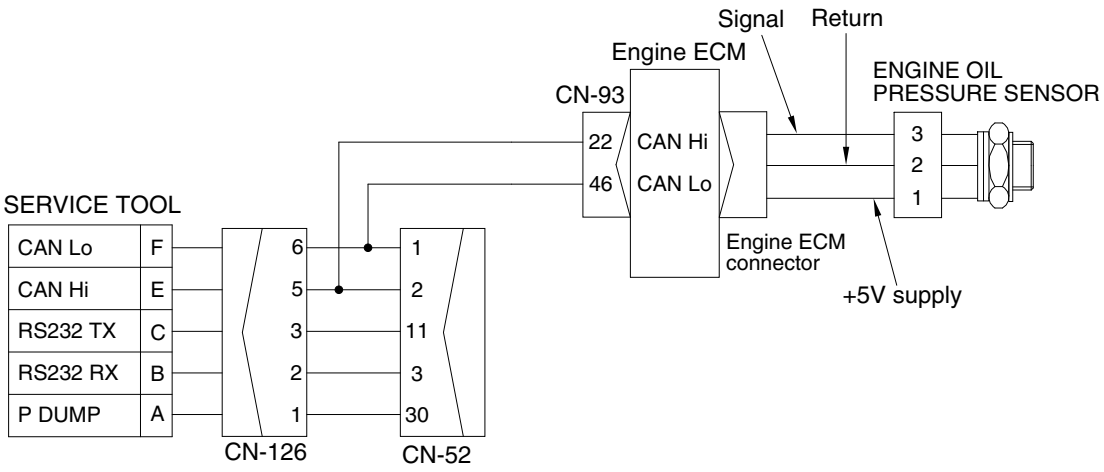
8. WHEN COOLANT TEMPERATURE GAUGE DOES NOT OPERATE (HCESPN 304, FMI 3 or 4)

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



Check Table

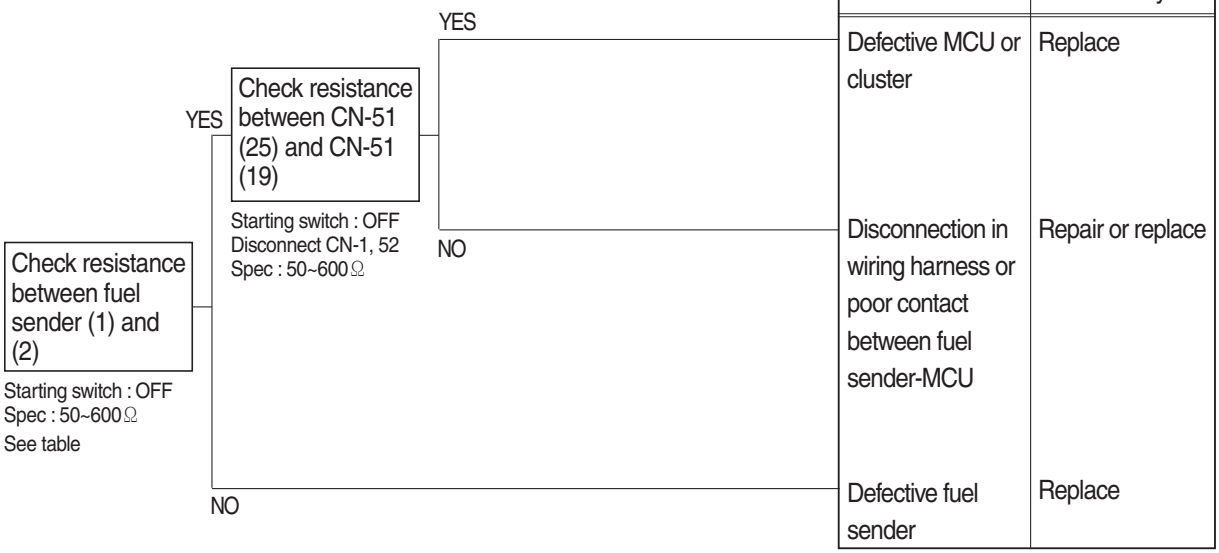
Temperature (˚C)	0	25	50	80	95
Resistance (kΩ)	30~37	9.3~10.7	3.2~3.8	1.0~1.3	0.7~0.8

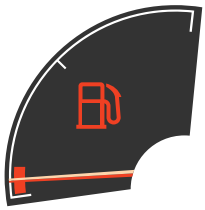


140WA6ES07

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

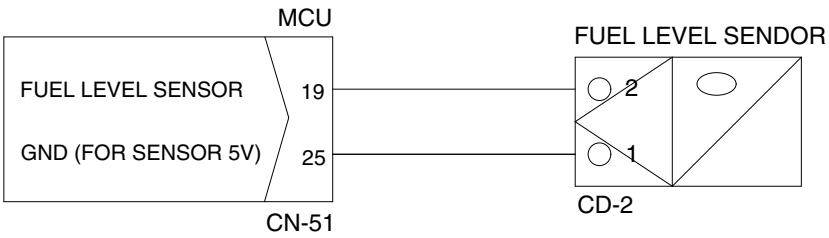
· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.





Check Table

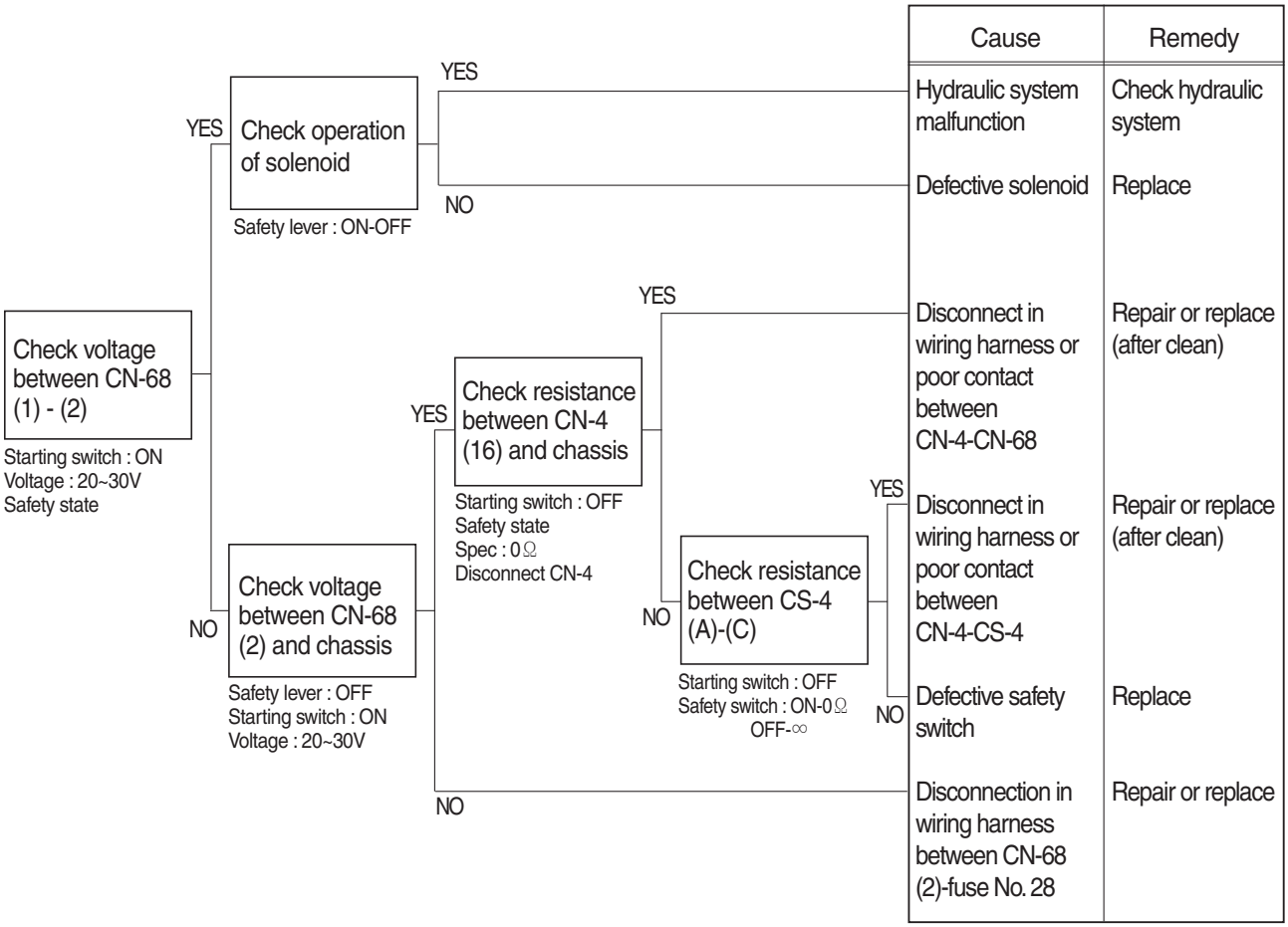
Range	Resistance (Ω)	Range	Resistance (Ω)
Full	50	5/12	400
11/12	100	4/12	450
10/12	150	3/12	500
9/12	200	2/12	550
8/12	250	1/12	600
7/12	300	Empty warning	700
6/12	350	-	-

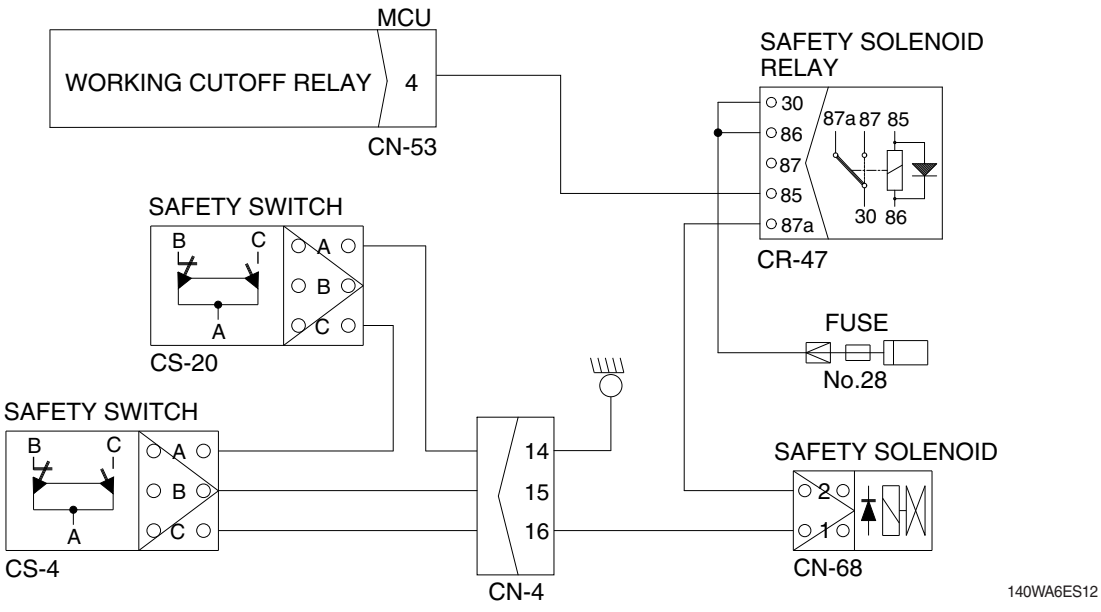


140WA6ES10

10. WHEN SAFETY SOLENOID DOES NOT OPERATE

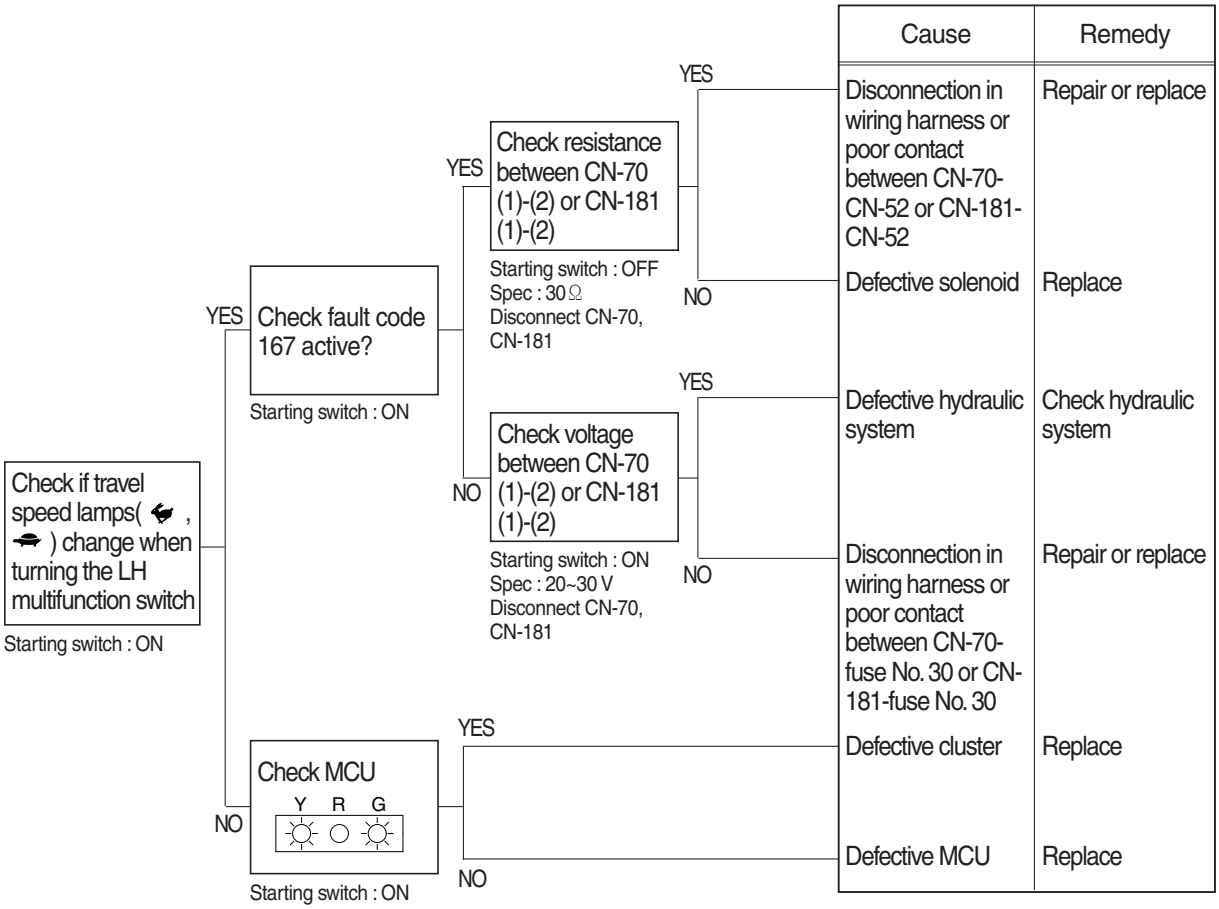
· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted and short of fuse No. 28.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.

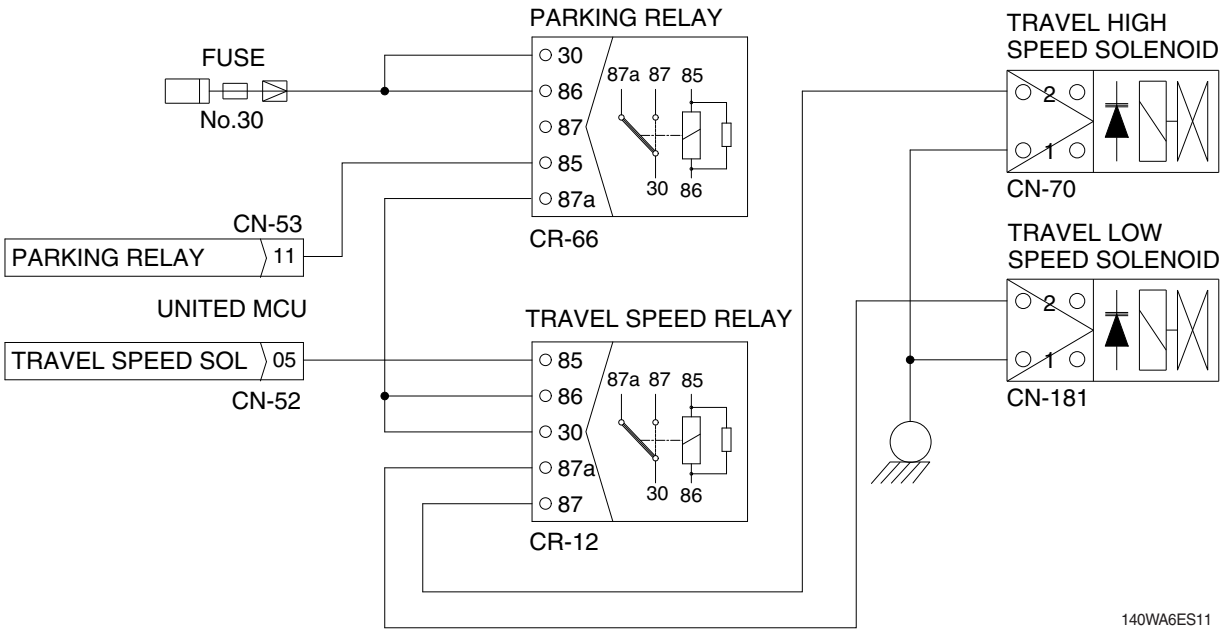




11. WHEN TRAVEL SPEED 1, 2 DOES NOT OPERATE (HCESPN 167, FMI 4 or 6)

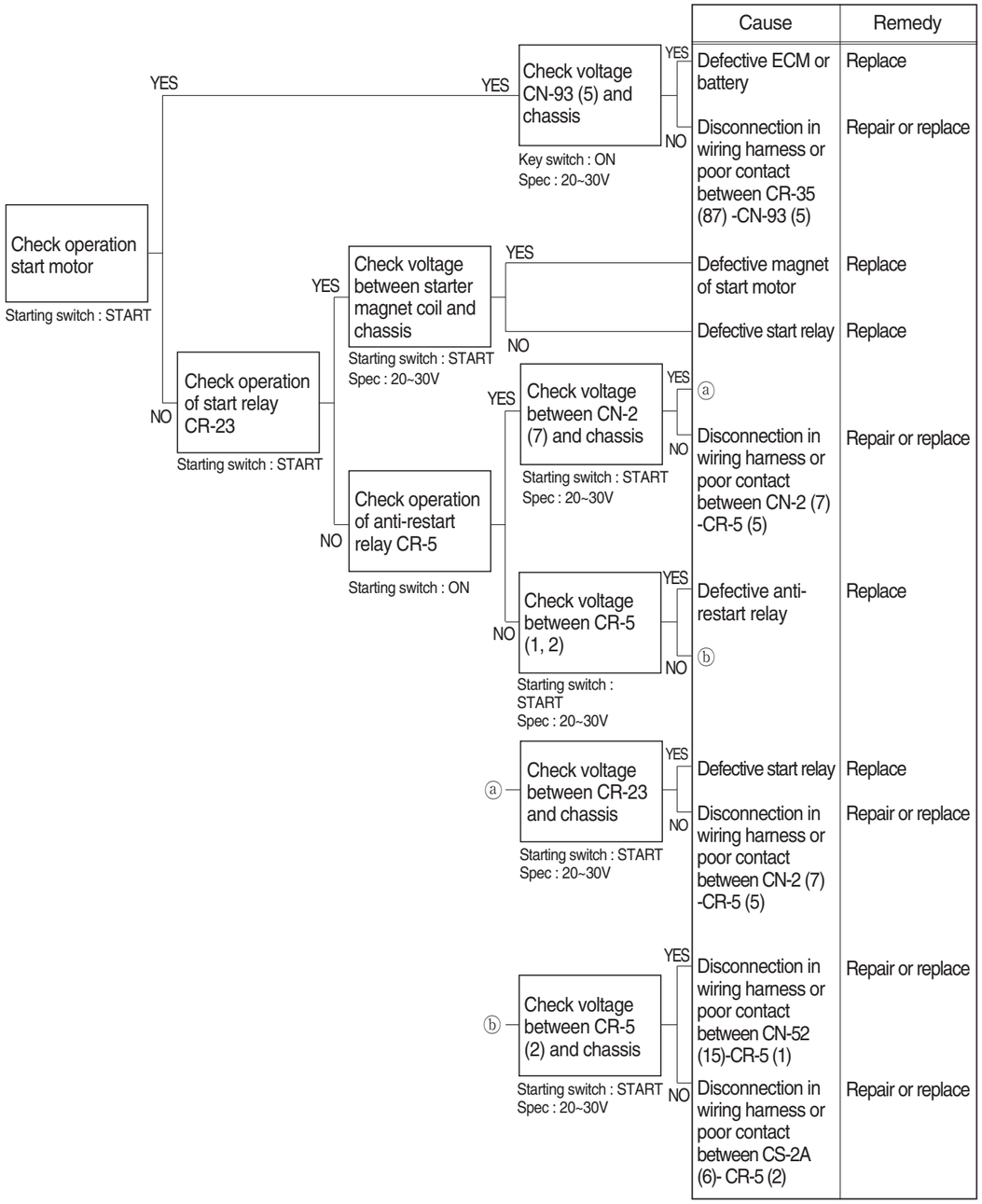
· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted and short of fuse No. 30.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.



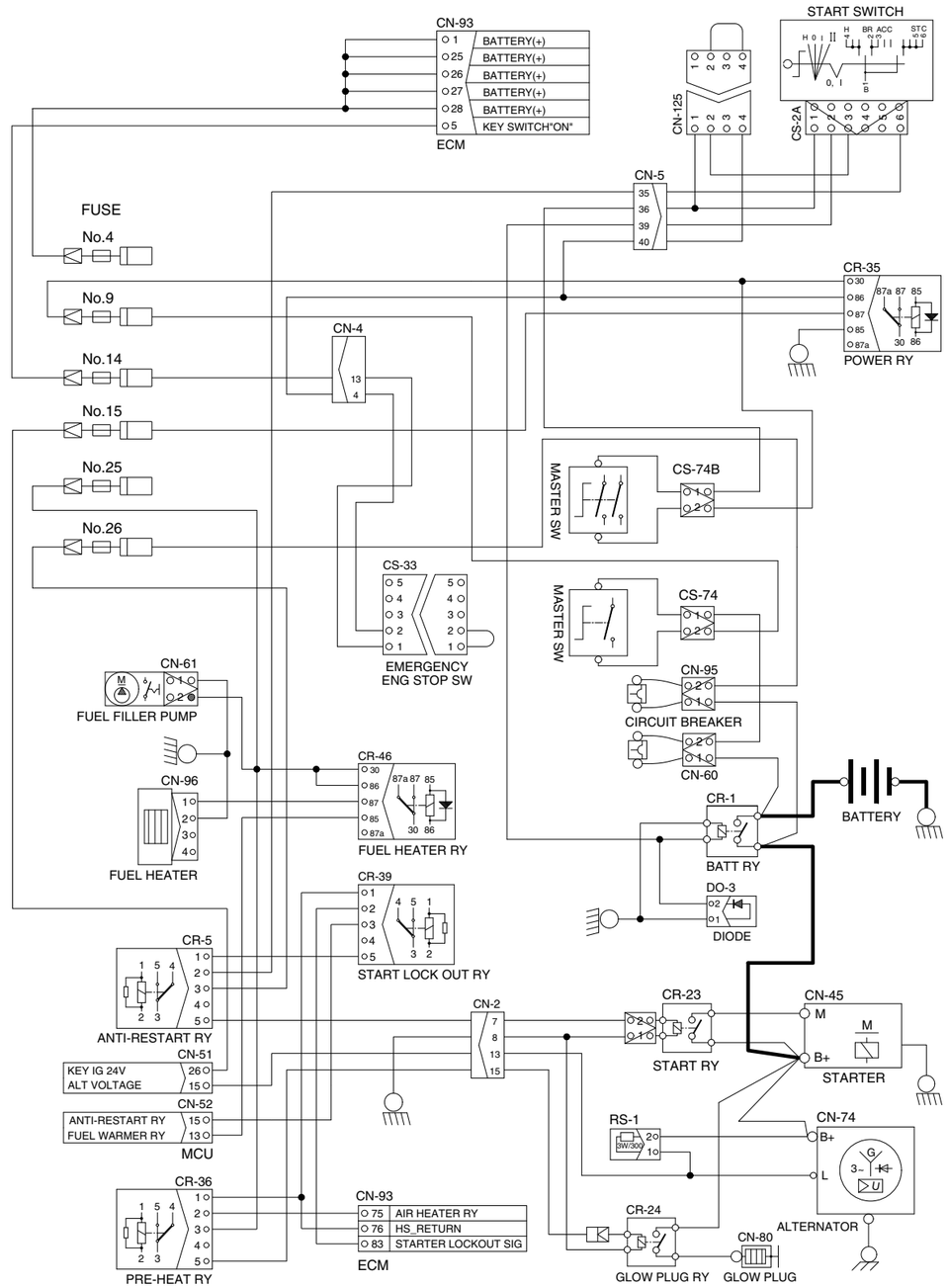


12. WHEN ENGINE DOES NOT START (lights up condition)

· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted and short of fuse No. 4, 9, 14, 15, 25, 26.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.



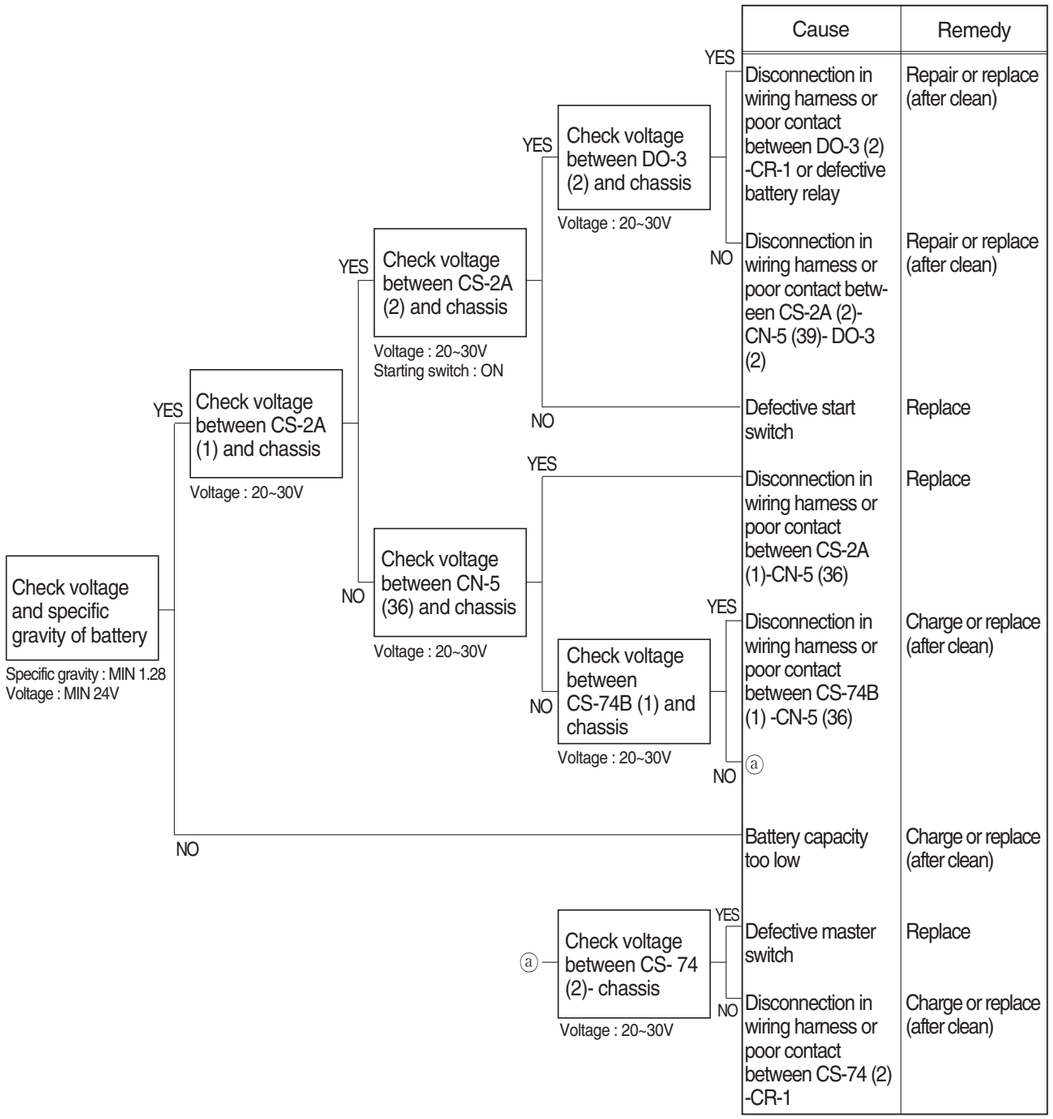
Cause	Remedy
Defective ECM or battery	Replace
Disconnection in wiring harness or poor contact between CR-35 (87) -CN-93 (5)	Repair or replace
Defective magnet of start motor	Replace
Defective start relay	Replace
Disconnection in wiring harness or poor contact between CN-2 (7) -CR-5 (5)	Repair or replace
Defective anti-restart relay	Replace
Defective start relay	Replace
Disconnection in wiring harness or poor contact between CN-2 (7) -CR-5 (5)	Repair or replace
Disconnection in wiring harness or poor contact between CN-52 (15)-CR-5 (1)	Repair or replace
Disconnection in wiring harness or poor contact between CS-2A (6)- CR-5 (2)	Repair or replace

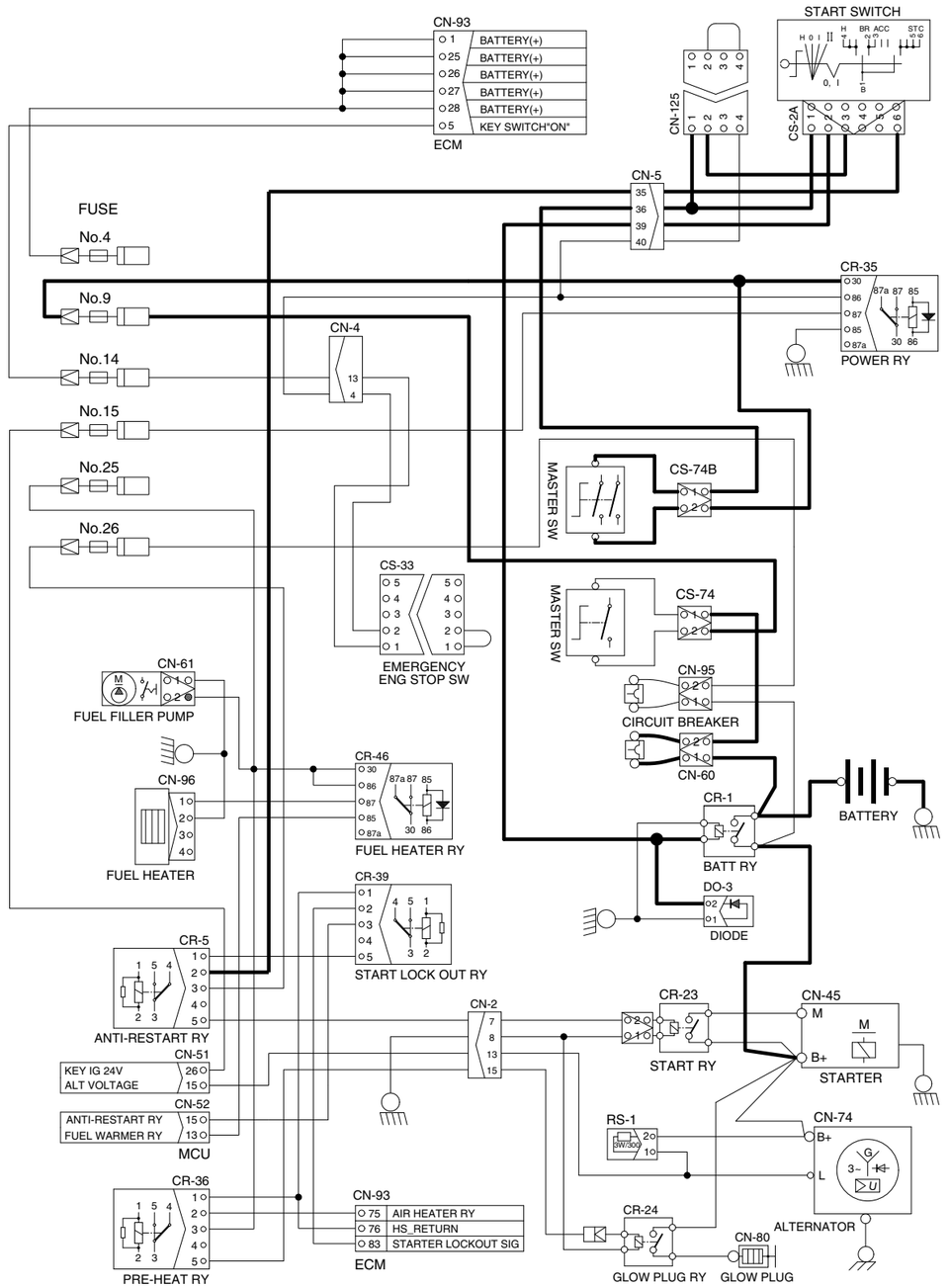


140WA6ES14

13. WHEN STARTING SWITCH ON DOES NOT OPERATE

· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted, master switch ON and check open circuit of circuit breaker (CN-60, CN-95).
· After checking, insert the disconnected connectors again immediately unless otherwise specified.

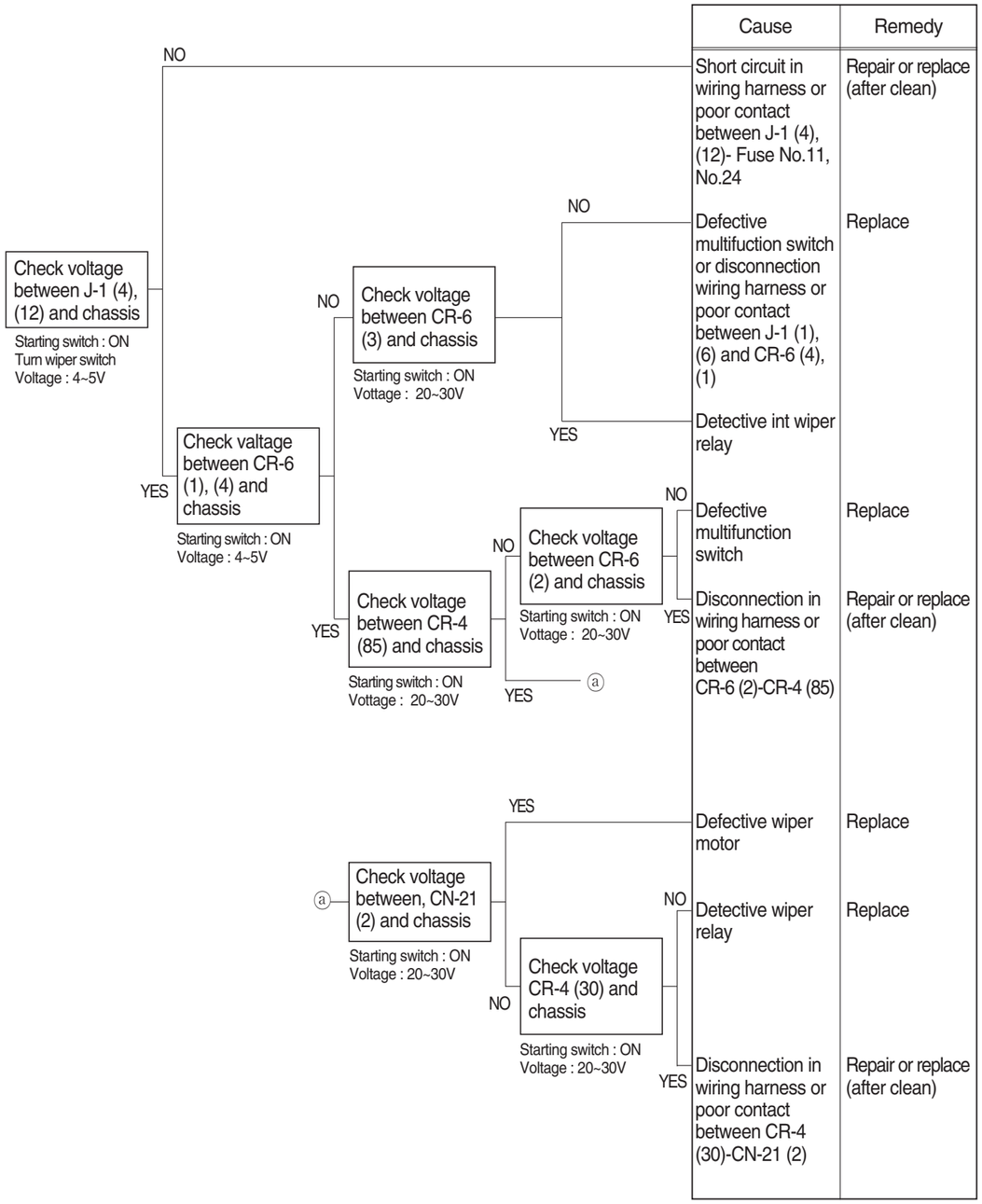




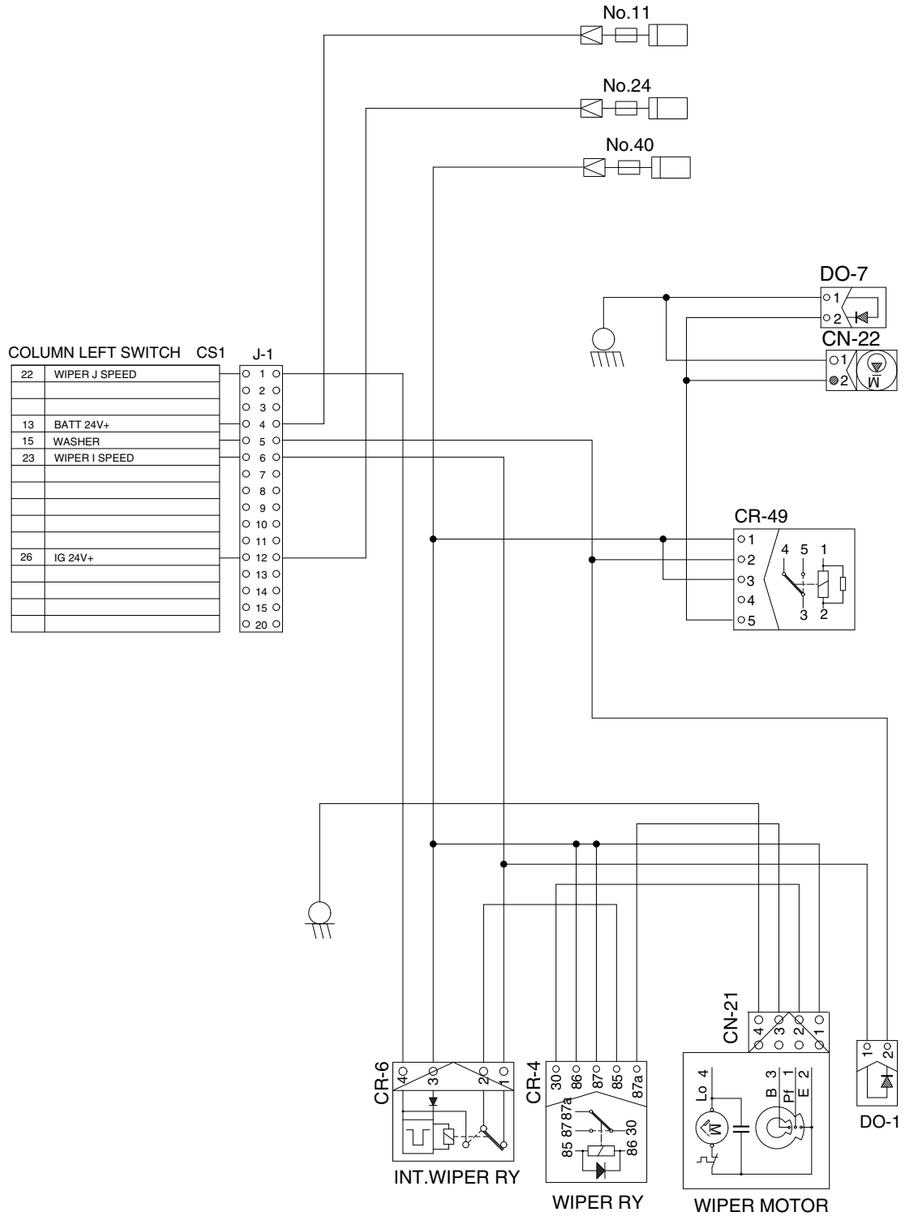
140WA6ES15

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

- Before disconnecting the connector, always turn the starting switch OFF.
- Before carrying out below procedure, check all the related connectors are properly inserted and the fuse No. 11, 24 and 40 is not blown out.
- After checking, insert the disconnected connectors again immediately unless otherwise specified.



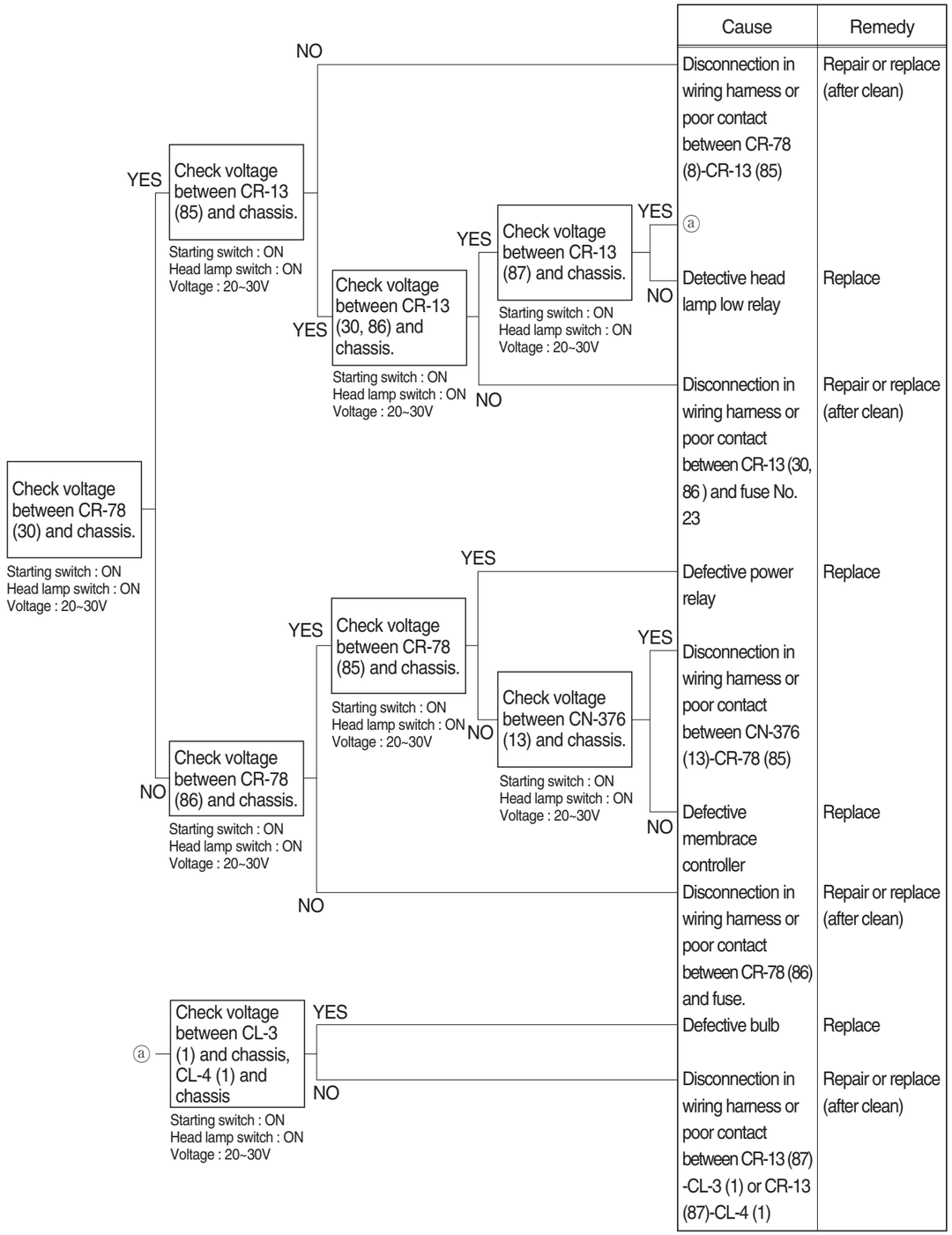
Cause	Remedy
Short circuit in wiring harness or poor contact between J-1 (4), (12)- Fuse No.11, No.24	Repair or replace (after clean)
Defective multifuction switch or disconnection wiring harness or poor contact between J-1 (1), (6) and CR-6 (4), (1)	Replace
Detective int wiper relay	
Defective multifunction switch	Replace
Disconnection in wiring harness or poor contact between CR-6 (2)-CR-4 (85)	Repair or replace (after clean)
Defective wiper motor	Replace
Detective wiper relay	Replace
Disconnection in wiring harness or poor contact between CR-4 (30)-CN-21 (2)	Repair or replace (after clean)



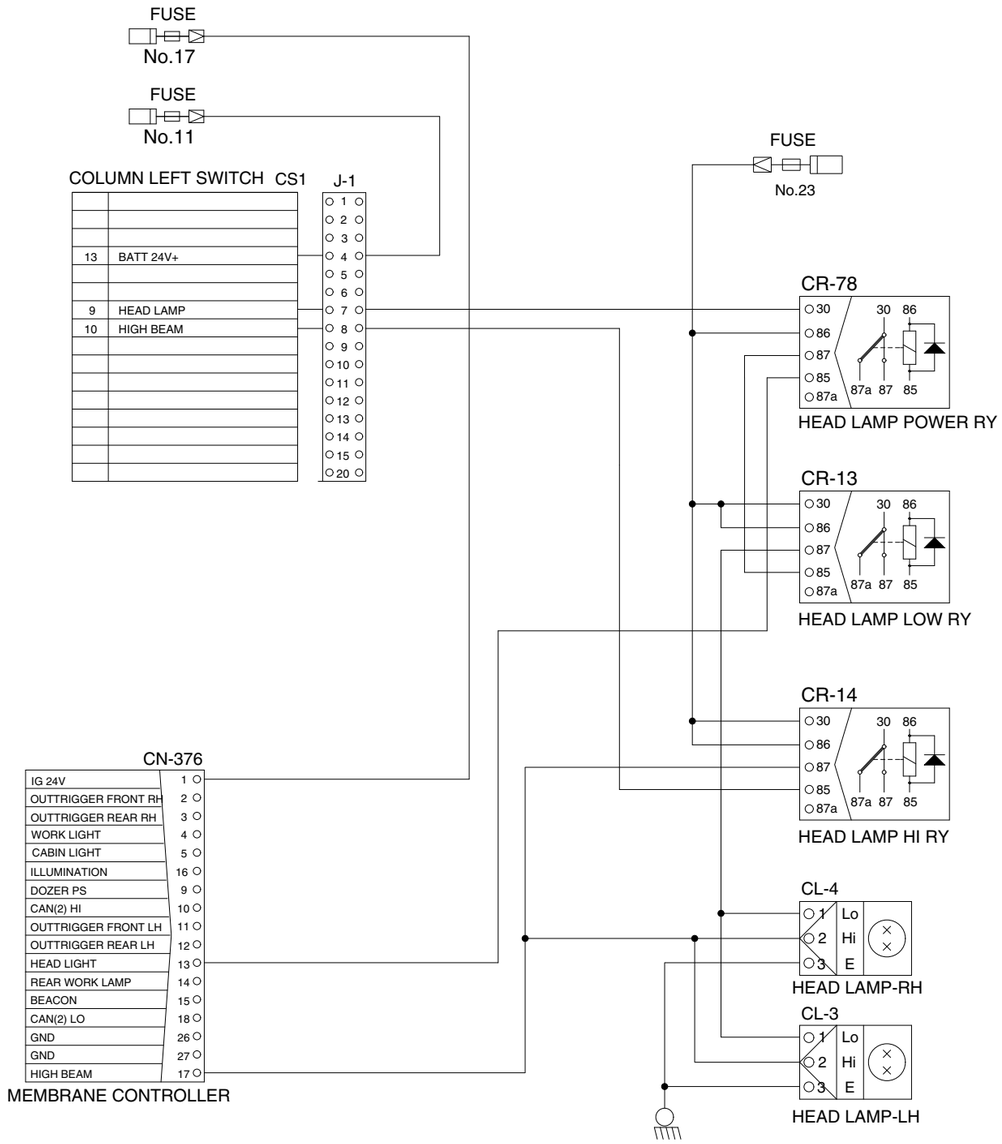
140WA6ES16

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

· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted and short of fuse No. 11, 17, 23.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.



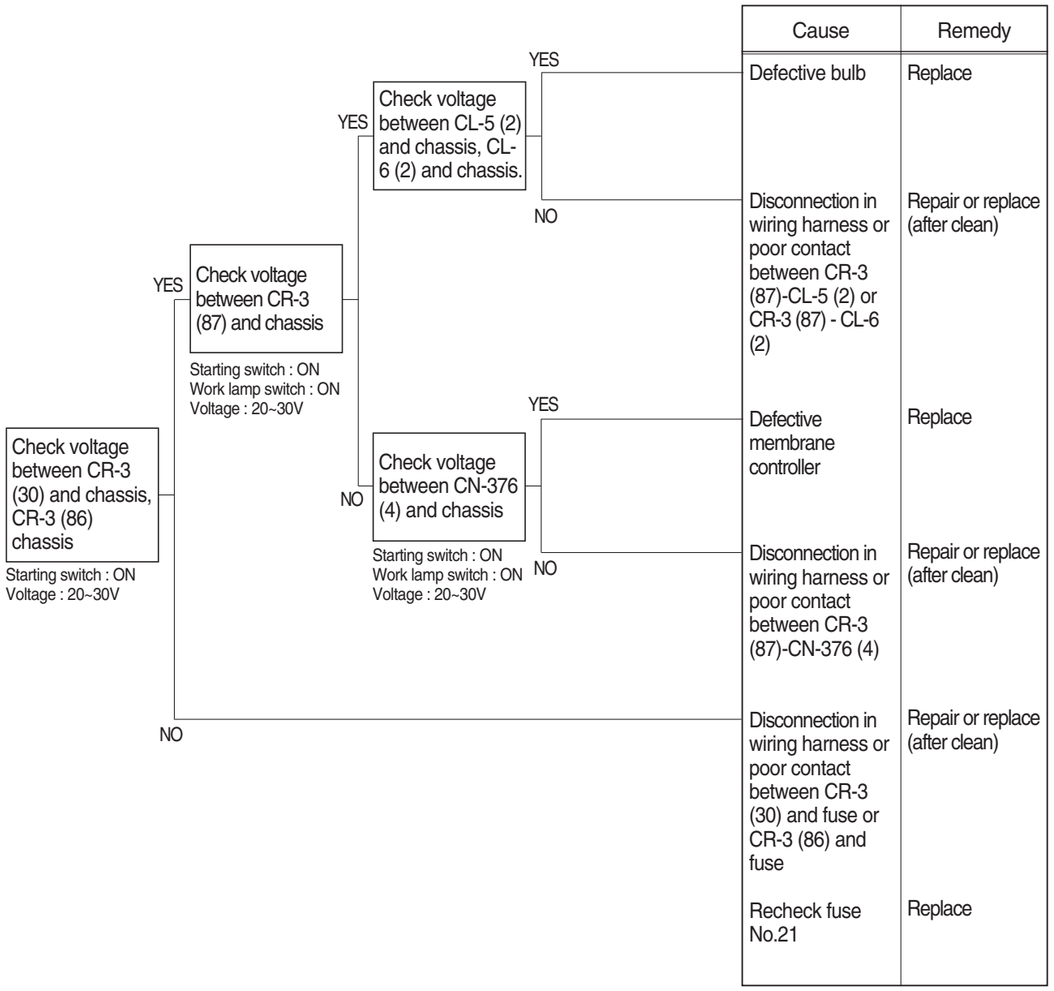
Cause	Remedy
Disconnection in wiring harness or poor contact between CR-78 (8)-CR-13 (85)	Repair or replace (after clean)
ⓐ	
Detective head lamp low relay	Replace
Disconnection in wiring harness or poor contact between CR-13 (30, 86) and fuse No. 23	Repair or replace (after clean)
Defective power relay	Replace
Disconnection in wiring harness or poor contact between CN-376 (13)-CR-78 (85)	
Defective membrace controller	Replace
Disconnection in wiring harness or poor contact between CR-78 (86) and fuse.	Repair or replace (after clean)
Defective bulb	Replace
Disconnection in wiring harness or poor contact between CR-13 (87) -CL-3 (1) or CR-13 (87)-CL-4 (1)	Repair or replace (after clean)

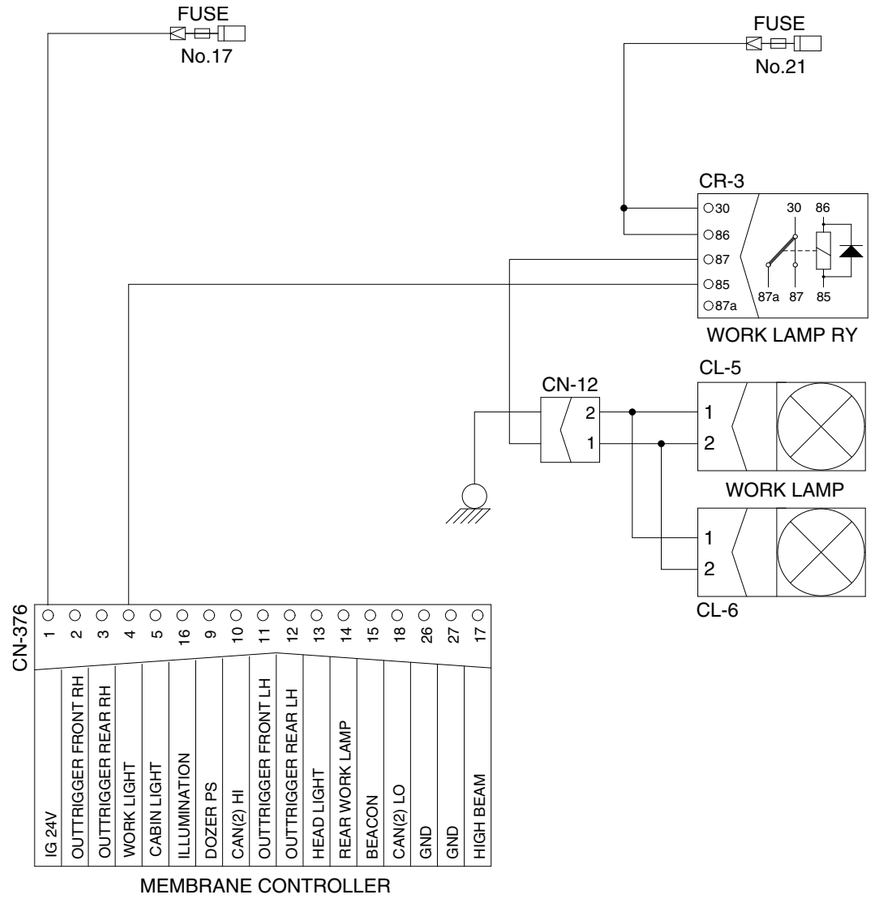


140WA6ES17

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

· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted and short of fuse No. 17, 21.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.



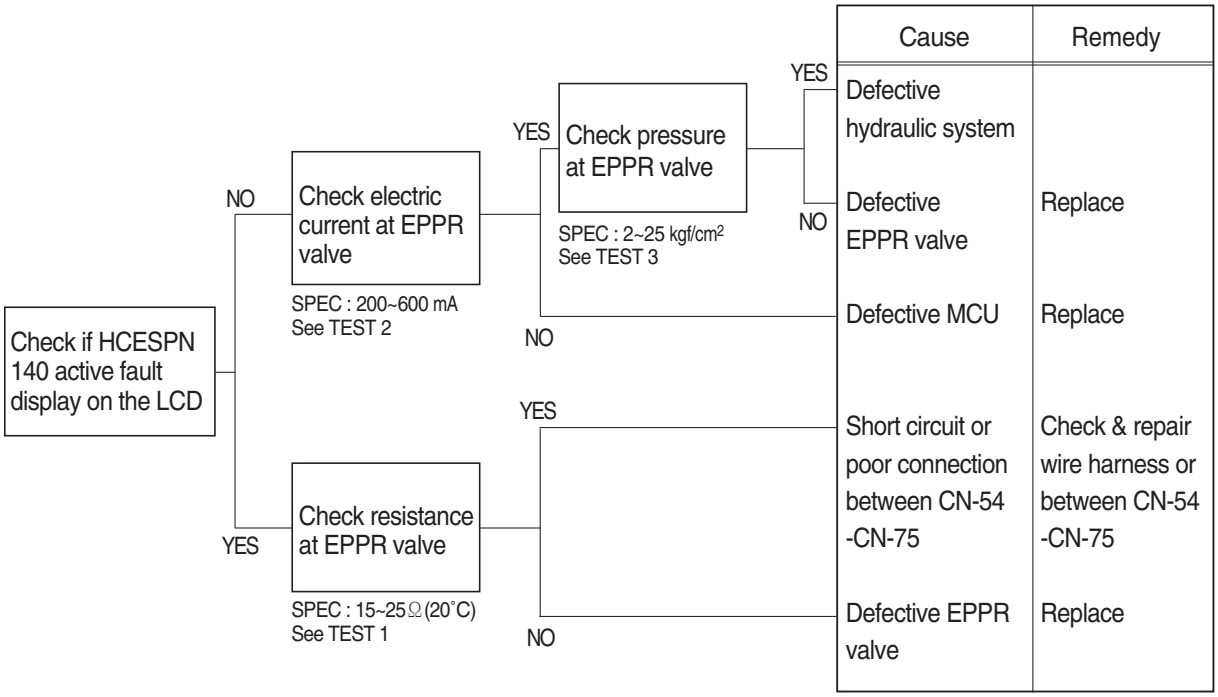


140WA6ES18

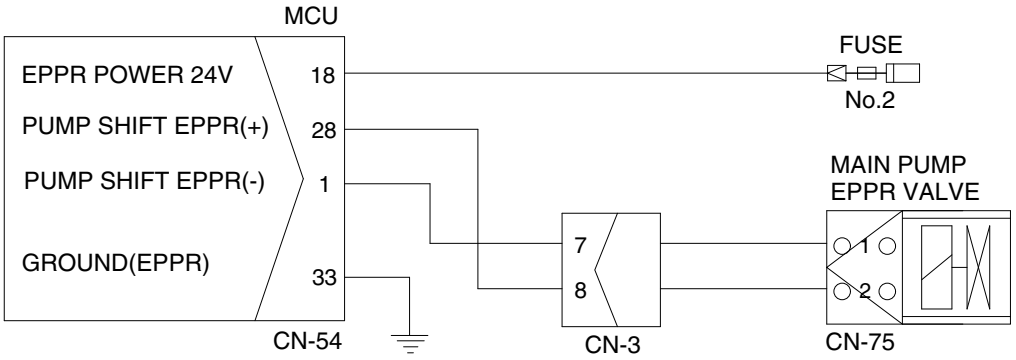
1. ALL ACTUATORS SPEED ARE SLOW

※ Boom, Arm, Bucket, Swing and travel speed are slow, but engine speed is good.
※ Spec : P-mode 1700 ± 50 rpm S -mode 1600 ± 50 rpm E-mode 1500 ± 50 rpm
※ Before carrying out below procedure, check all the related connectors are properly inserted and fault code on the cluster.

1) INSPECTION PROCEDURE



Wiring diagram



140WA6MS01

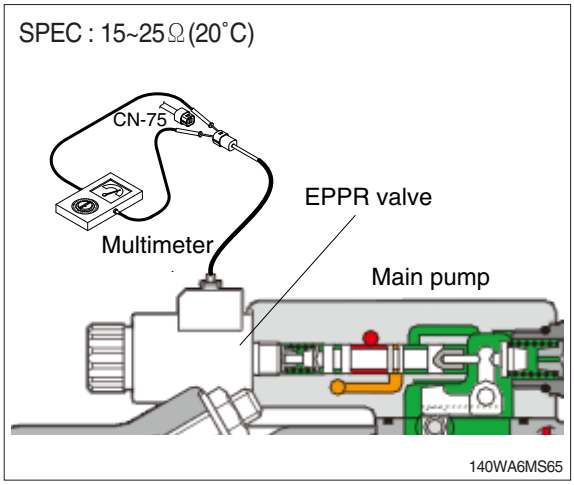
2) TEST PROCEDURE

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

① Starting switch OFF.

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

③ Check resistance between 2 lines as figure.



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

① Disconnect connector CN-75 from EPPR valve.

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

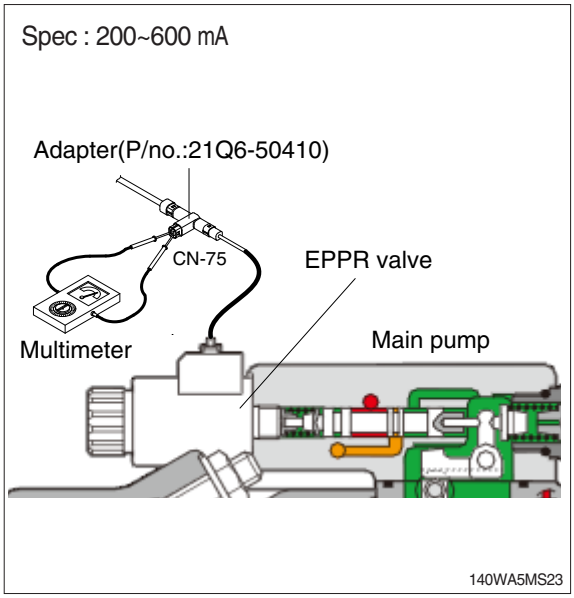
③ Start engine.

④ Set S-mode and cancel auto decel mode.

⑤ Position the multimodal dial at 10.

⑥ If tachometer show approx 1600±50 rpm disconnect one wire harness from EPPR valve.

⑦ Check electric current at bucket circuit relief position.



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

① Remove plug and connect pressure gauge as figure.

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

② Start engine.

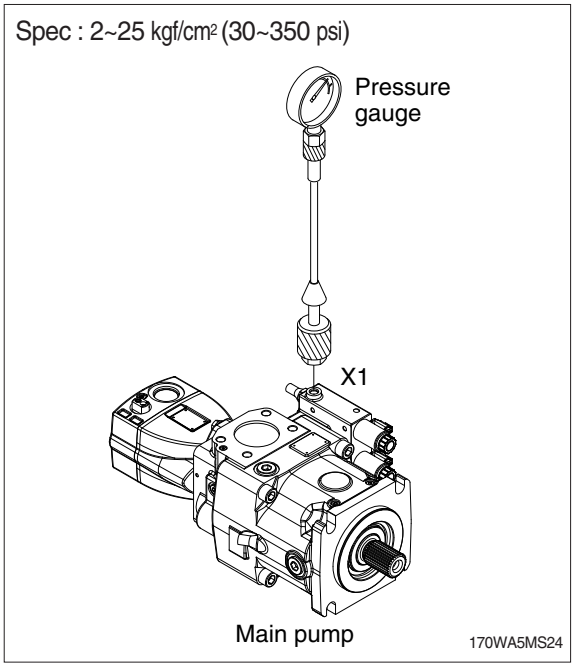
③ Set S-mode and cancel auto decel mode.

④ Position the multimodal dial at 10.

⑤ If tachometer show approx 1600±50 rpm check pressure at relief position of bucket circuit by operating bucket control lever.

⑥ If pressure is not correct, adjust it.

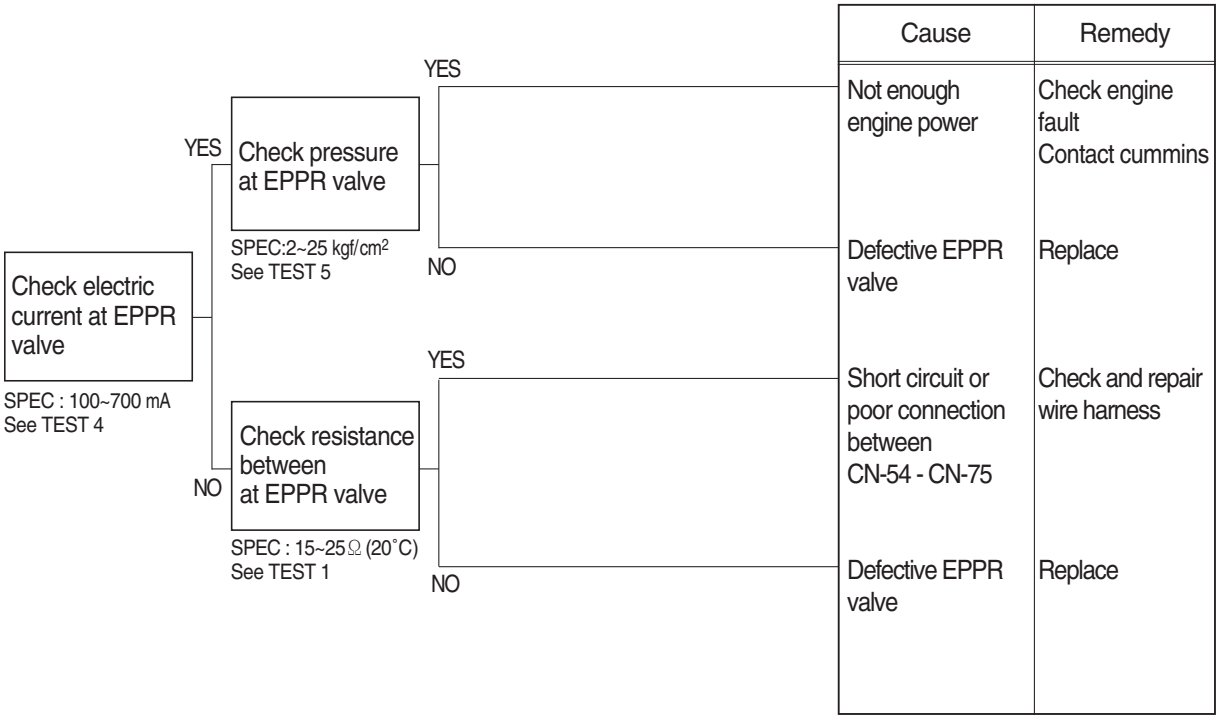
⑦ After adjust, test the machine.



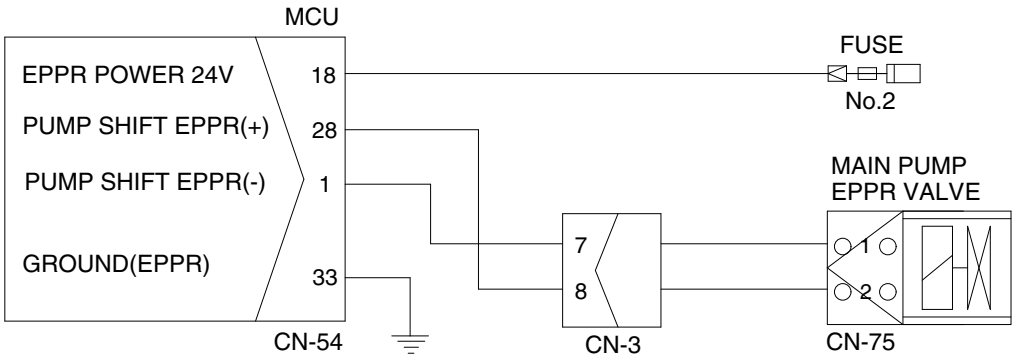
2. ENGINE STALL

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

1) INSPECTION PROCEDURE



Wiring diagram

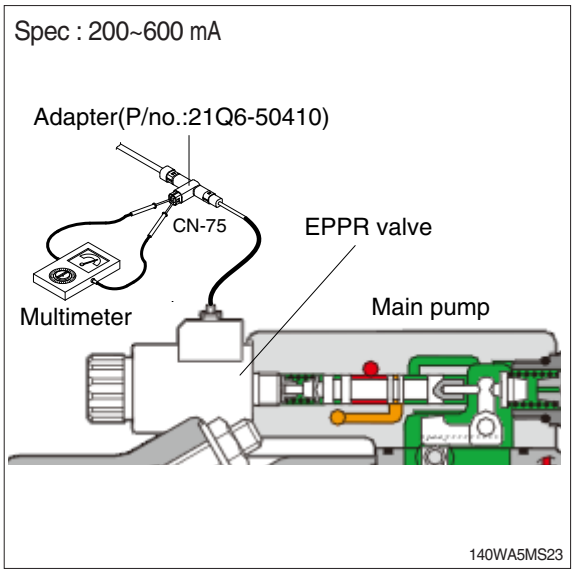


140WA6MS01

2) TEST PROCEDURE

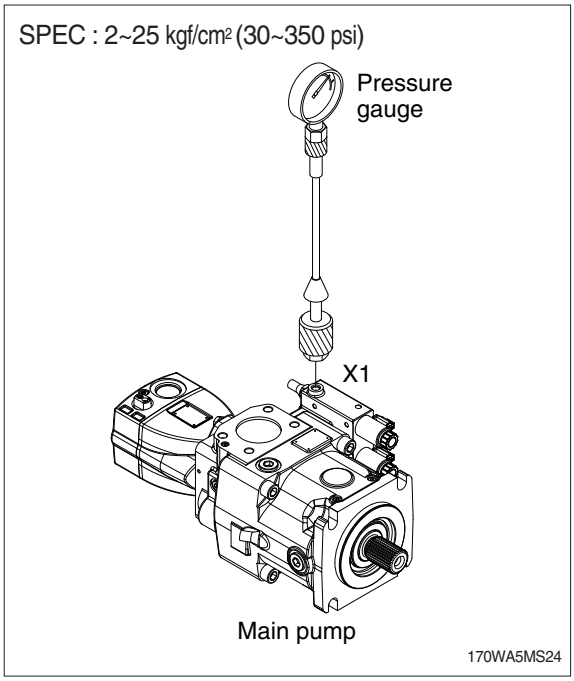
(1) Test 4 : Check electric current at EPPR valve.

① Disconnect connector CN-75 from EPPR valve.
② Insert the adapter to CN-75 and install multimeter as figure.
③ Start engine.
④ Set S-mode and cancel auto decel mode.
⑤ Position the multimodal dial at 10.
⑥ If rpm show approx 1600±50 rpm disconnect one wire harness from EPPR valve.
⑦ Check electric current at bucket circuit relief position.



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

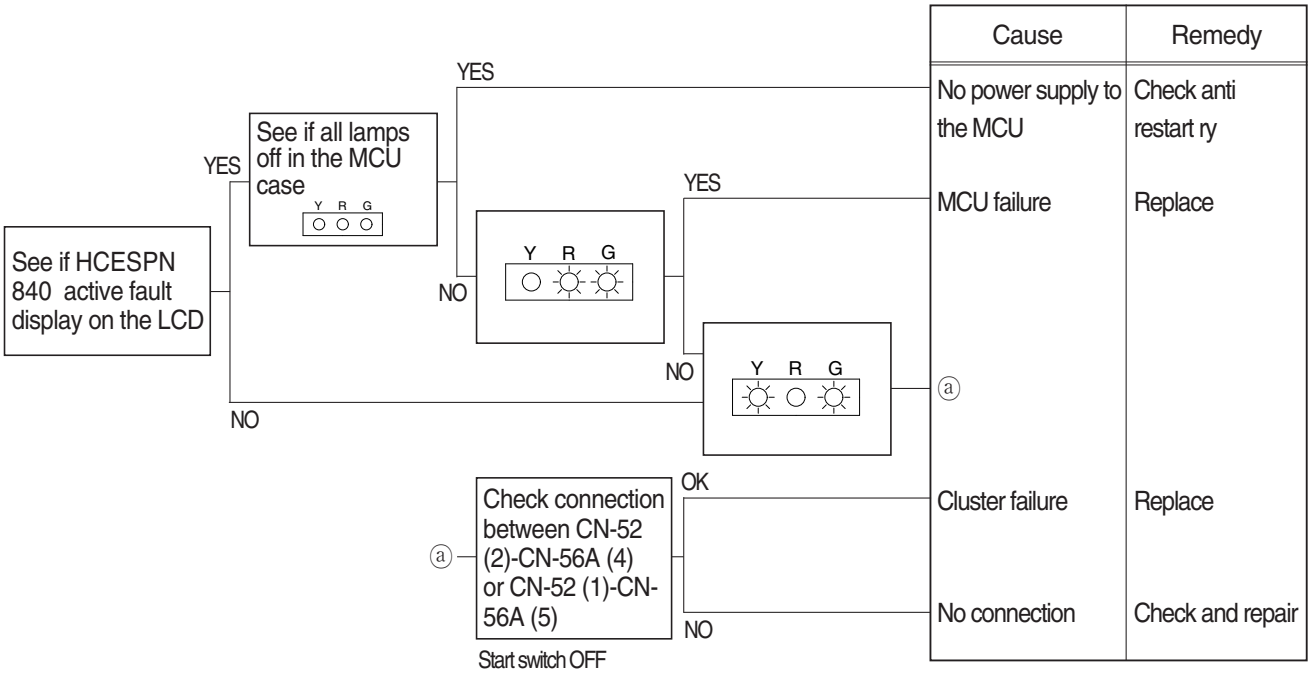
① Remove plug and connect pressure gauge as figure.
· Gauge capacity : 0 to 50 kgf/cm² (0 to 725 psi)
② Start engine.
③ Set S-mode and cancel auto decel mode.
④ Position the multimodal dial at 10.
⑤ If rpm show approx 1600±50 rpm check pressure at relief position of bucket circuit by operating bucket control lever.
⑥ If pressure is not correct, adjust it.
⑦ After adjust, test the machine.



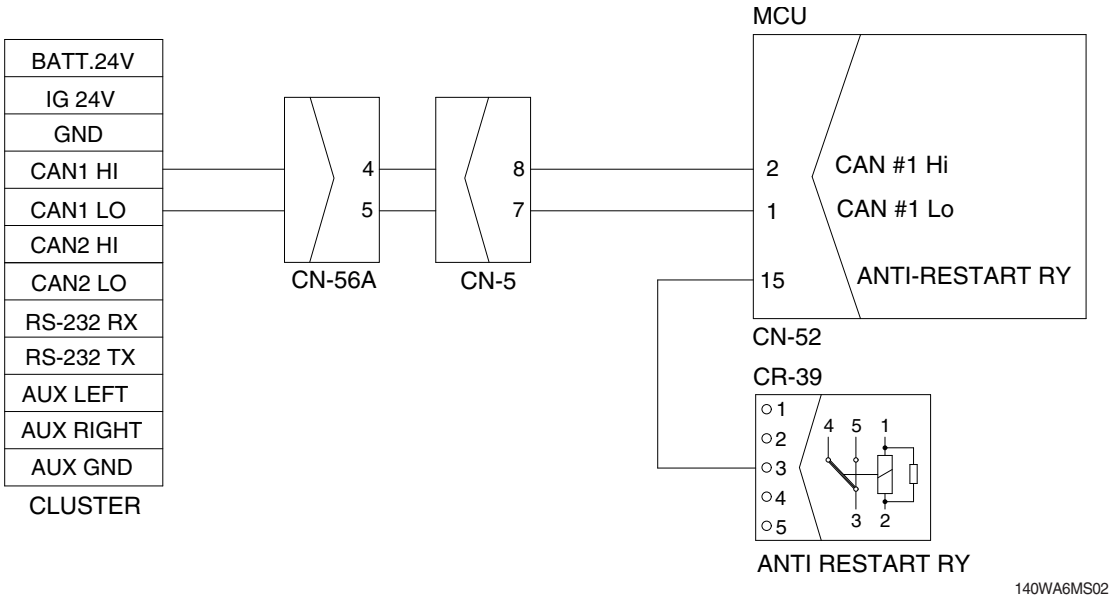
3. MALFUNCTION OF CLUSTER OR MODE SELECTION SYSTEM

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

1) INSPECTION PROCEDURE



Wiring diagram



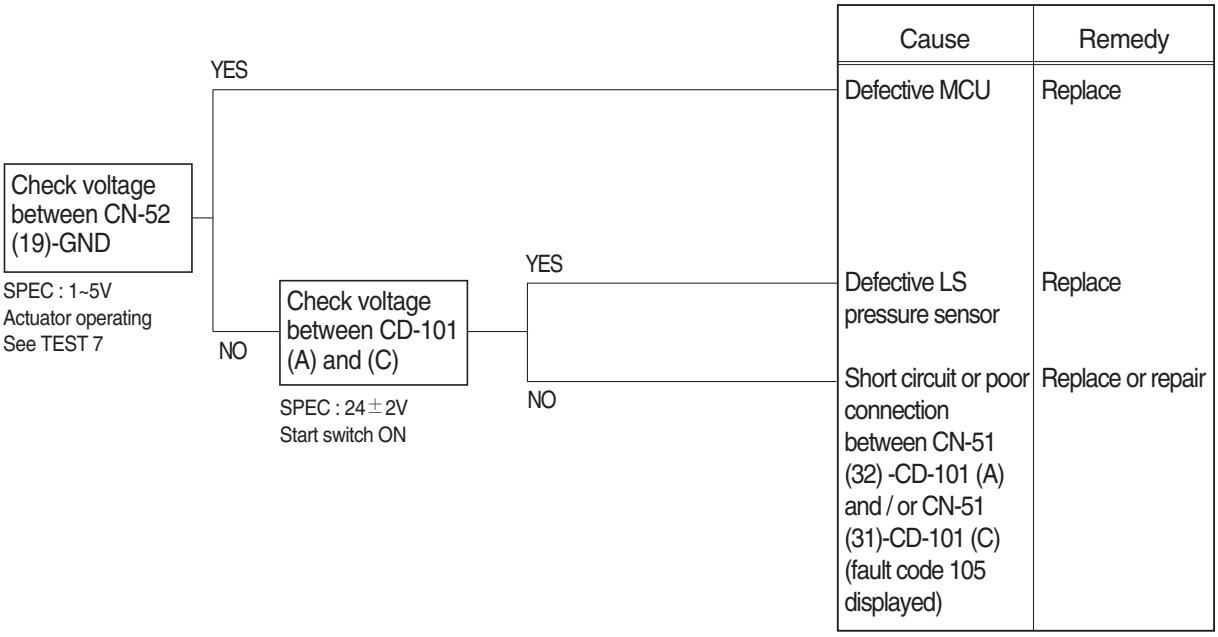
140WA6MS02

4. AUTO DECEL SYSTEM DOES NOT WORK

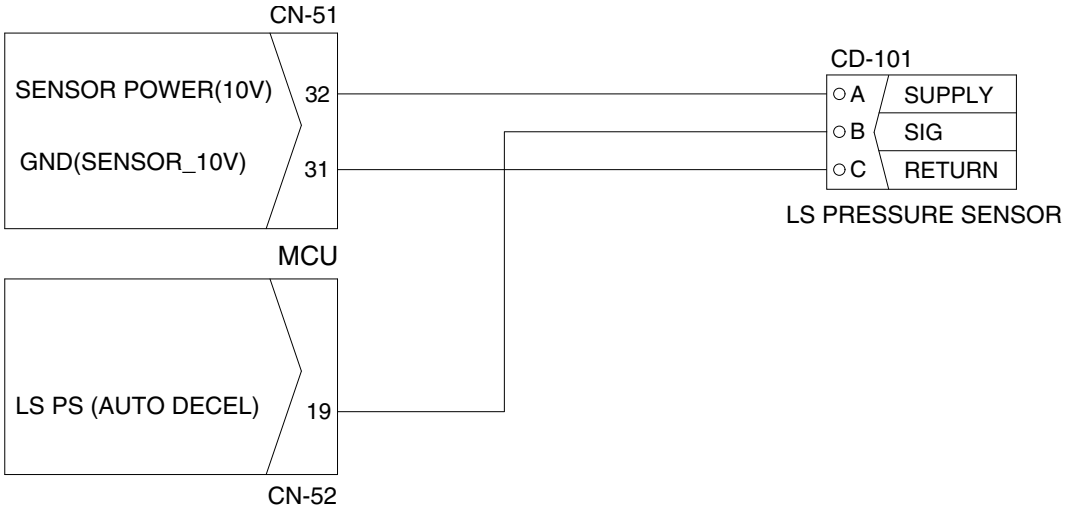
· Fault code : HCESPN 105, FMI 0~4 (work pressure sensor)
HCESPN 108, FMI 0~4 (travel oil pressure sensor)

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

1) INSPECTION PROCEDURE



Wiring diagram



140WA6MS03

2) TEST PROCEDURE

(1) Test 7 : Check voltage at CN-52 (19) and ground.

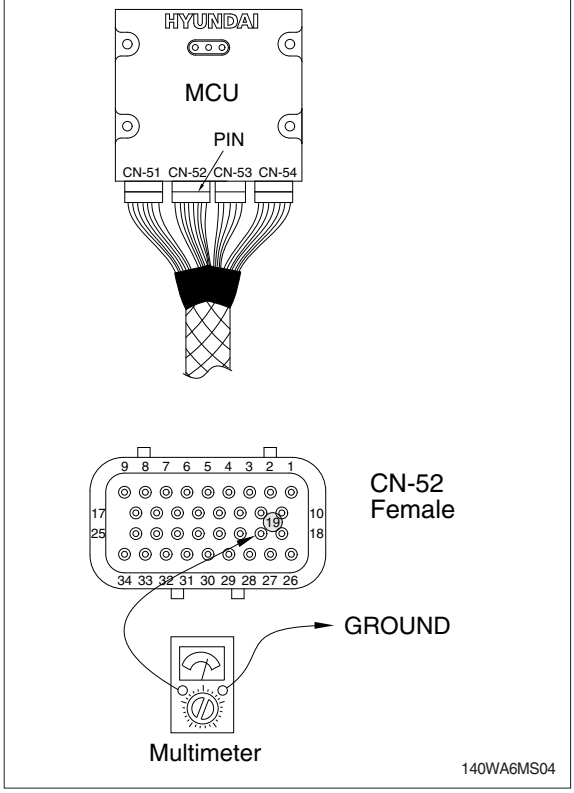
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (19) of CN-52.

③ Starting switch ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V

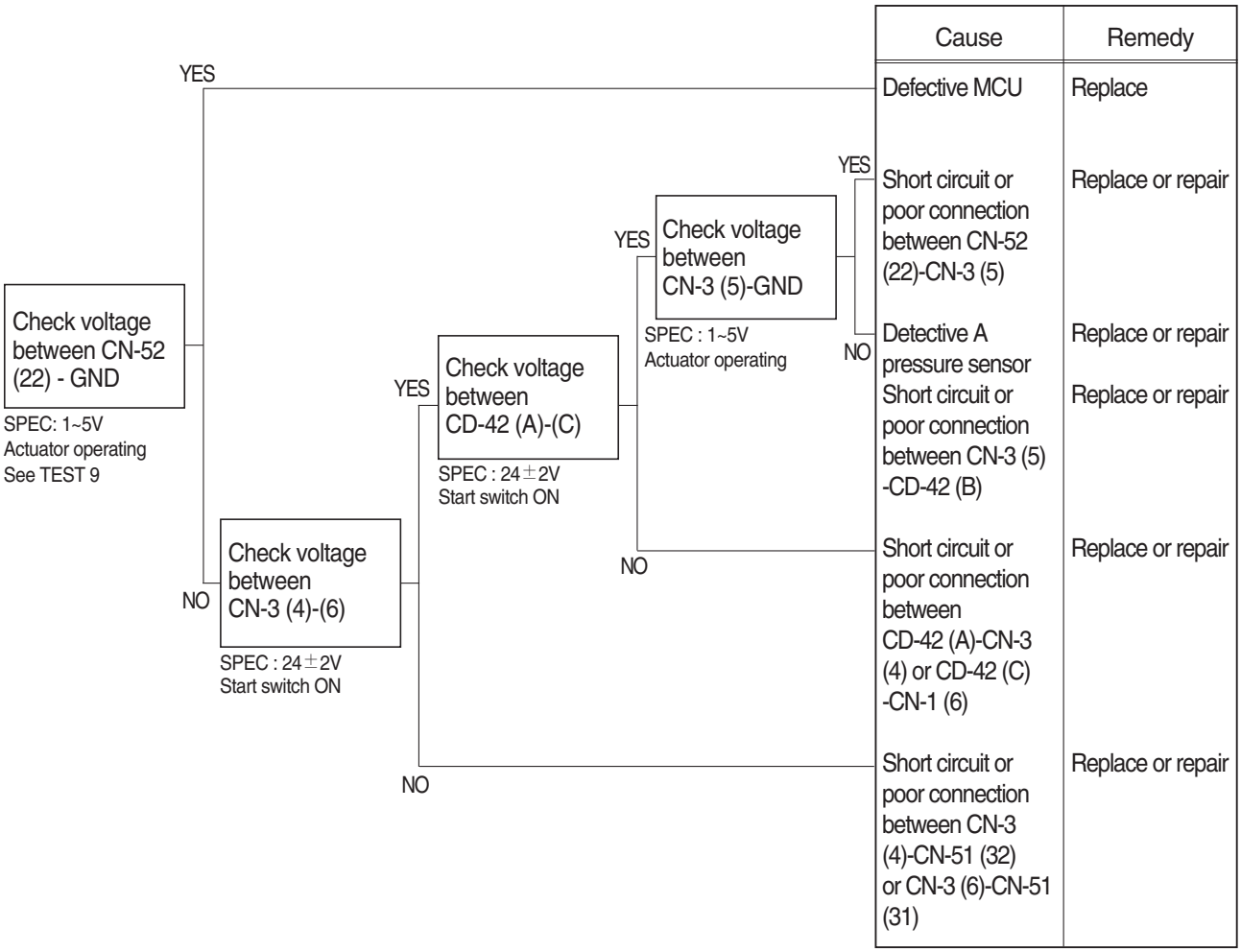


5. MALFUNCTION OF PUMP (A) PRESSURE SENSOR

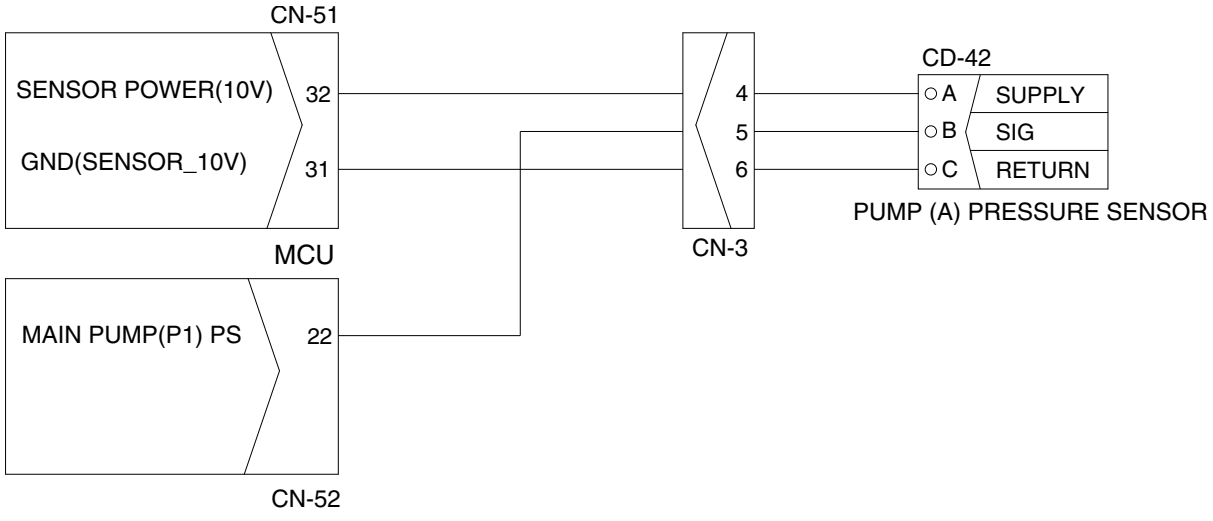
· Fault code : HCESPN 120, FMI 0~4

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

1) INSPECTION PROCEDURE



Wiring diagram



140WA6MS05

2) TEST PROCEDURE

(1) Test 9 : Check voltage at CN-52 (22) and ground.

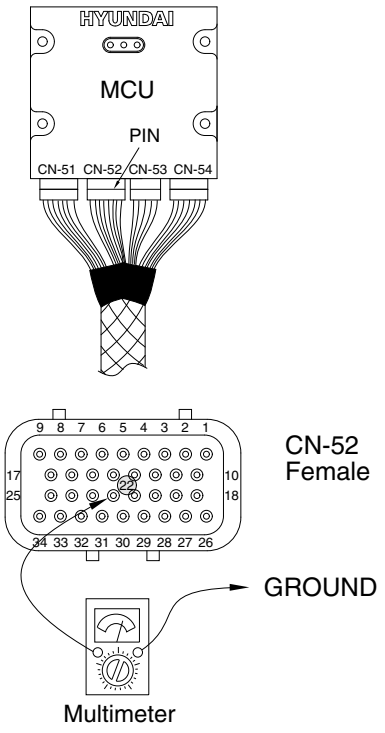
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (22) of CN-52.

③ Starting switch ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V



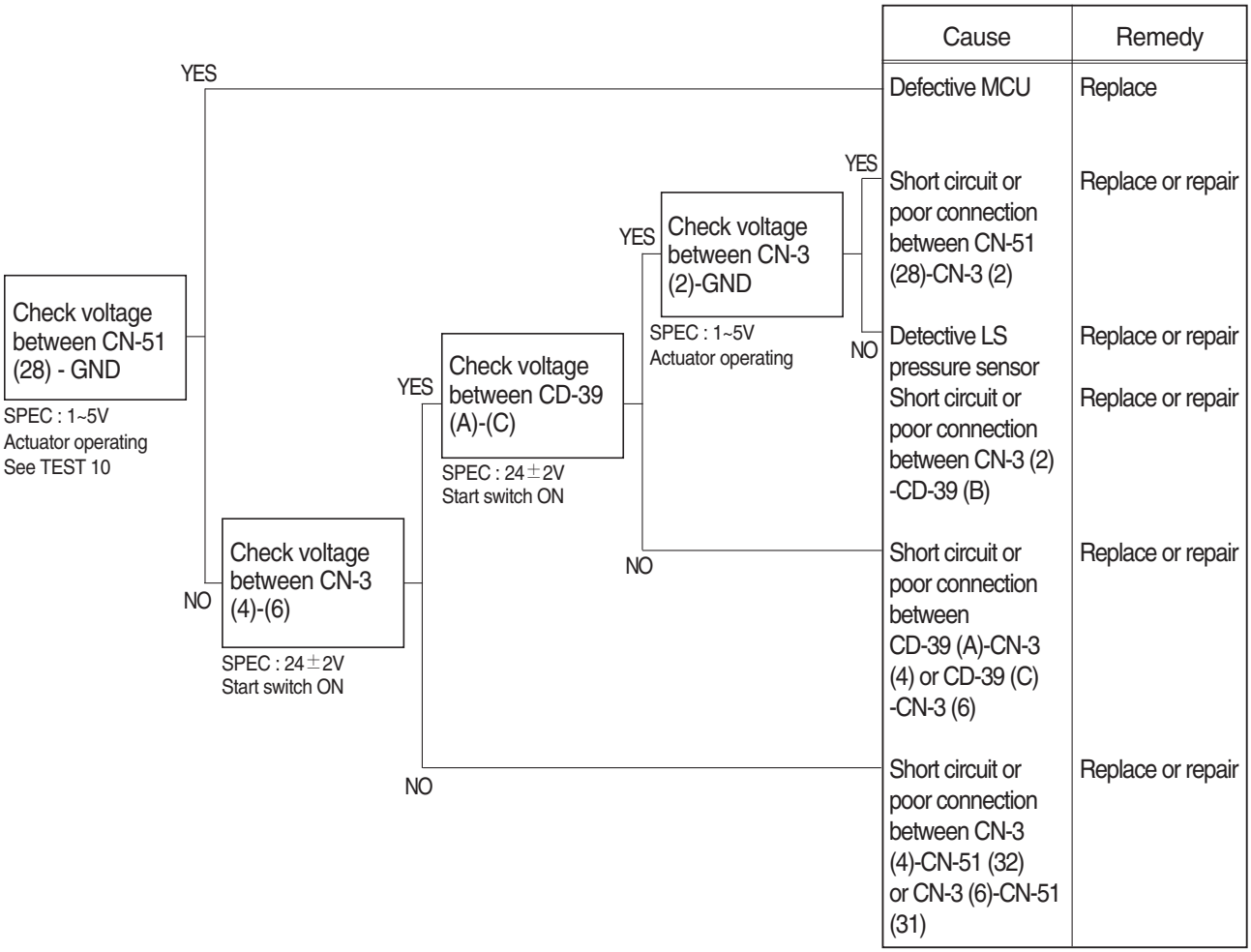
140WF6MS106

6. MALFUNCTION OF PUMP (B) PRESSURE SENSOR

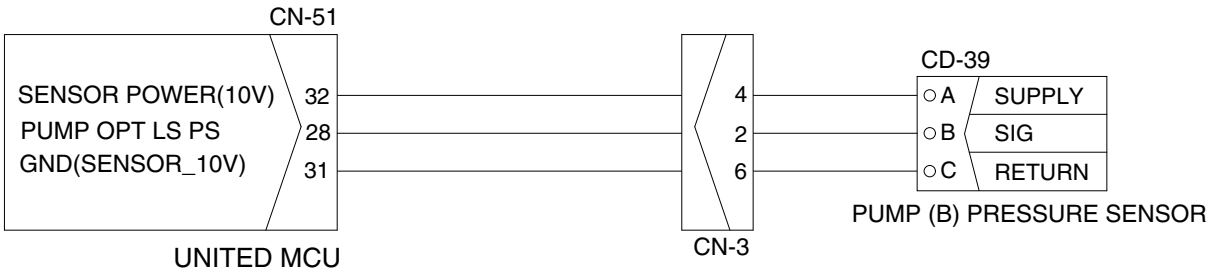
· Fault code : HCESPN 121, FMI 0~4

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

1) INSPECTION PROCEDURE



Wiring diagram



140WA6MS07

2) TEST PROCEDURE

(1) Test 10 : Check voltage at CN-51 (28) and ground.

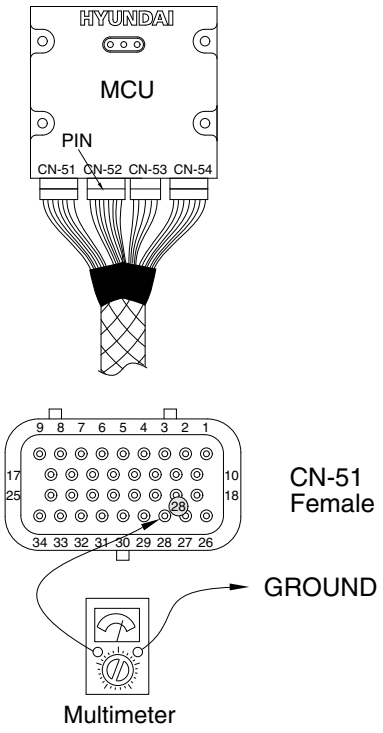
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (28) of CN-51.

③ Starting switch ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V



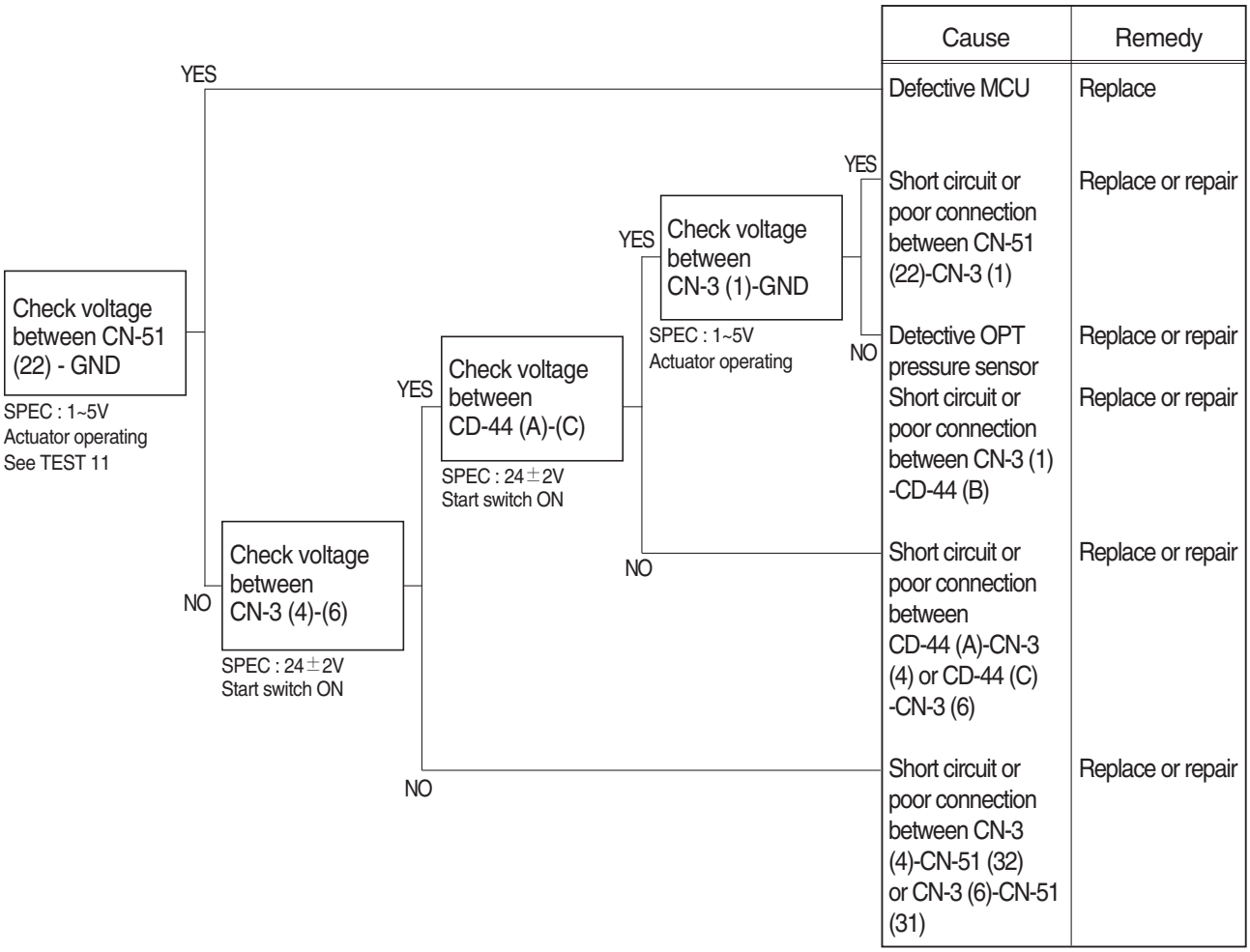
140WA6MS56

7. MALFUNCTION OF PUMP OPT PRESSURE SENSOR

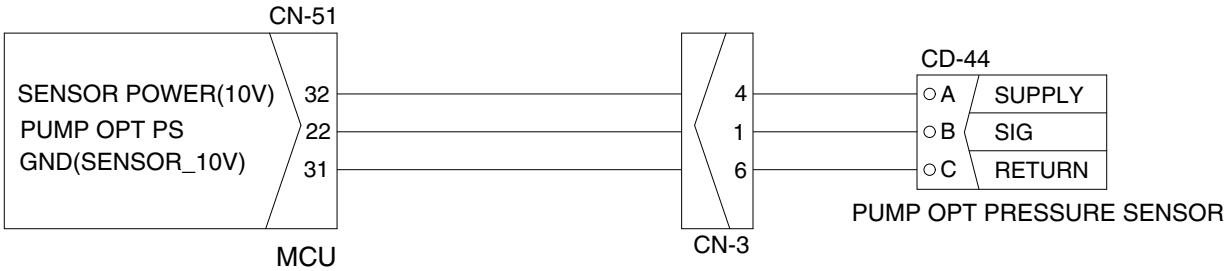
· Fault code : HCESPN 125, FMI 0~4

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

1) INSPECTION PROCEDURE



Wiring diagram



140WA6MS09

2) TEST PROCEDURE

(1) Test 11 : Check voltage at CN-51 (22) and ground.

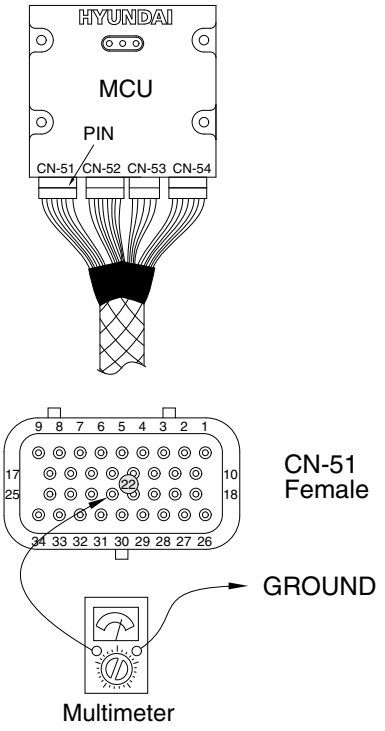
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (22) of CN-51.

③ Starting switch ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V



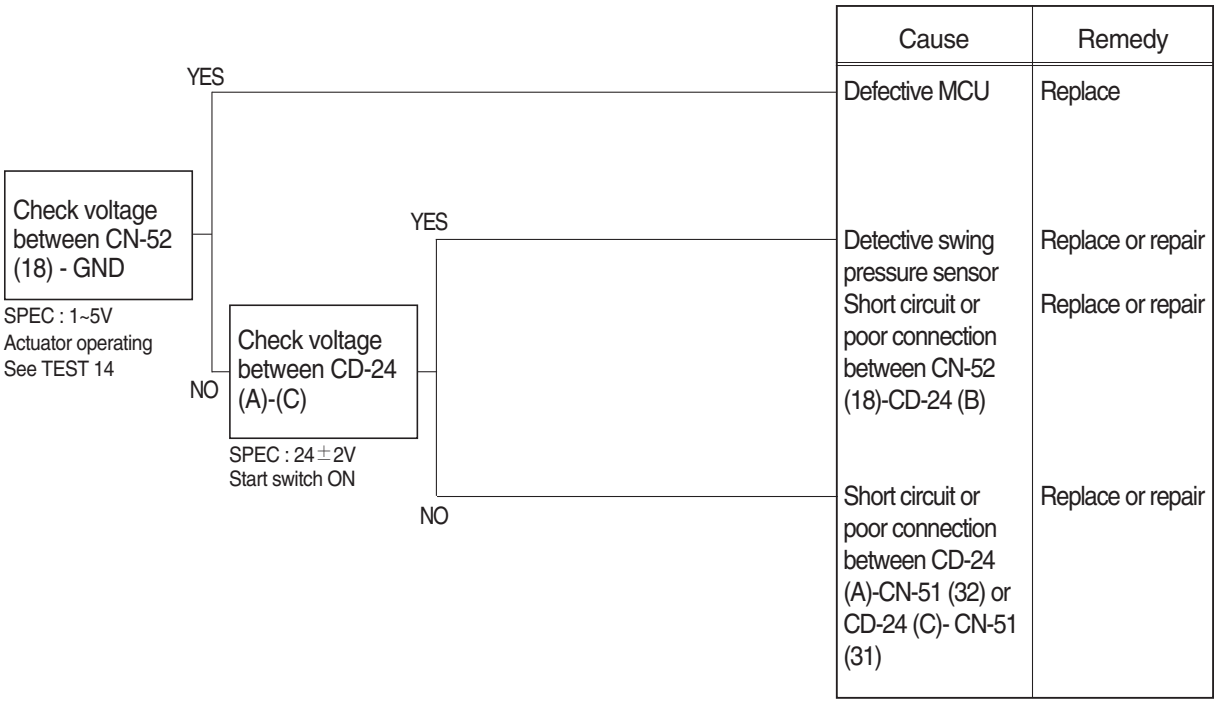
140WA6MS10

8. MALFUNCTION OF SWING PRESSURE SENSOR

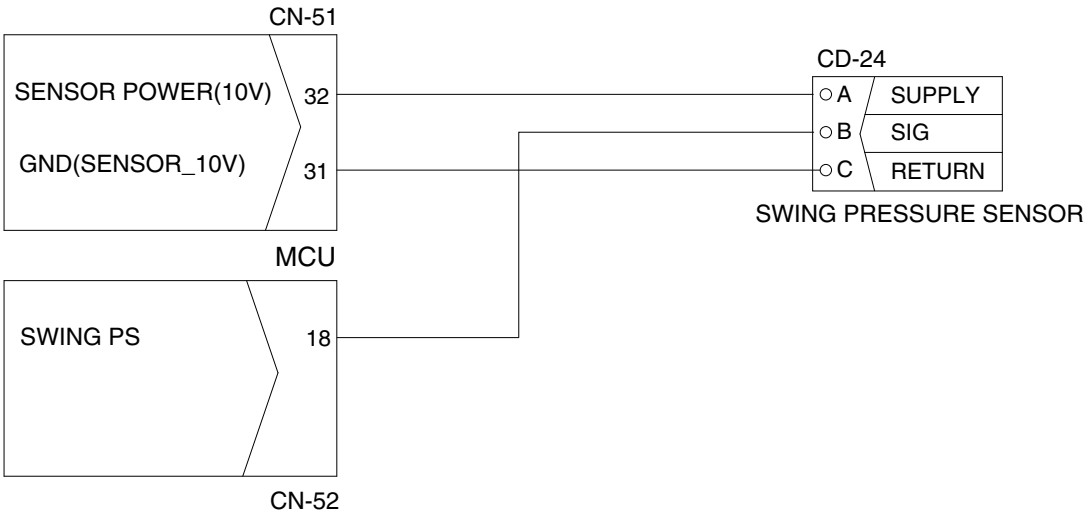
· Fault code : HCESPN 135, FMI 0~4

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

1) INSPECTION PROCEDURE



Wiring diagram



140WA6MS15

2) TEST PROCEDURE

(1) Test 14 : Check voltage at CN-52 (18) and ground.

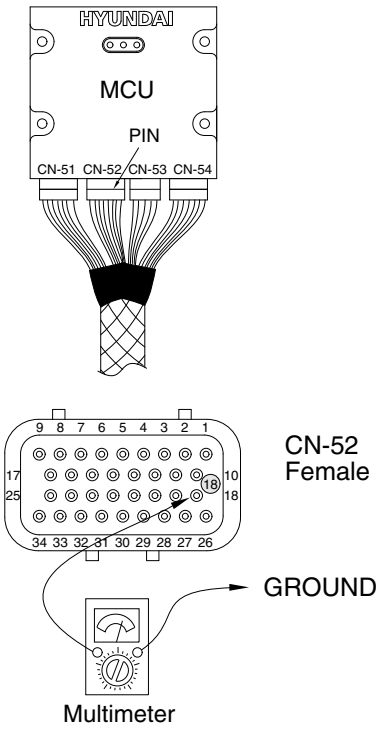
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (18) of CN-52.

③ Starting switch ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V



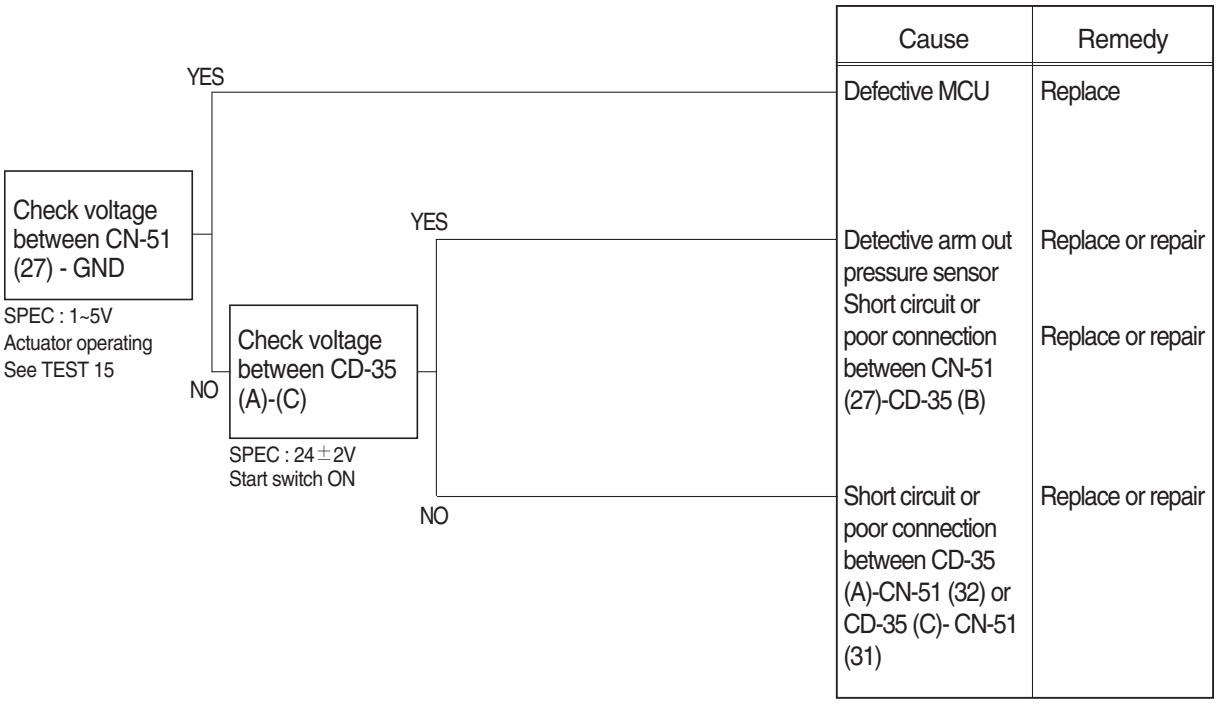
140WF6MS116

9. MALFUNCTION OF ARM OUT PRESSURE SENSOR

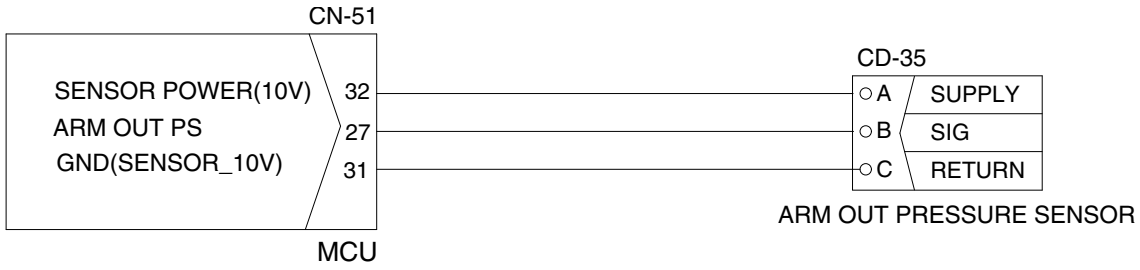
· Fault code : HCESPN 133, FMI 0~4

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

1) INSPECTION PROCEDURE



Wiring diagram



140WA6MS17

2) TEST PROCEDURE

(1) Test 15 : Check voltage at CN-51 (27) and ground.

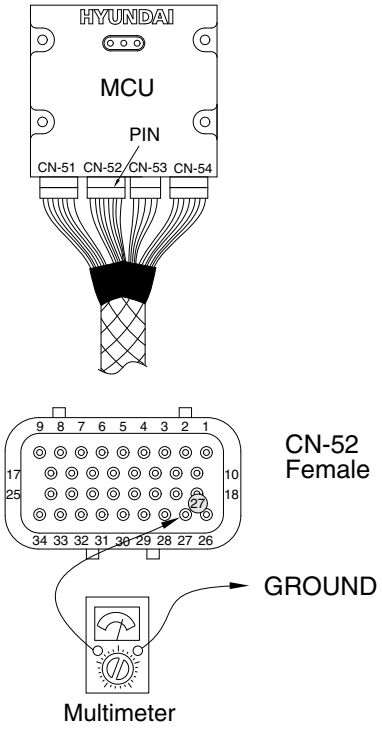
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (27) of CN-51.

③ Starting switch ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V



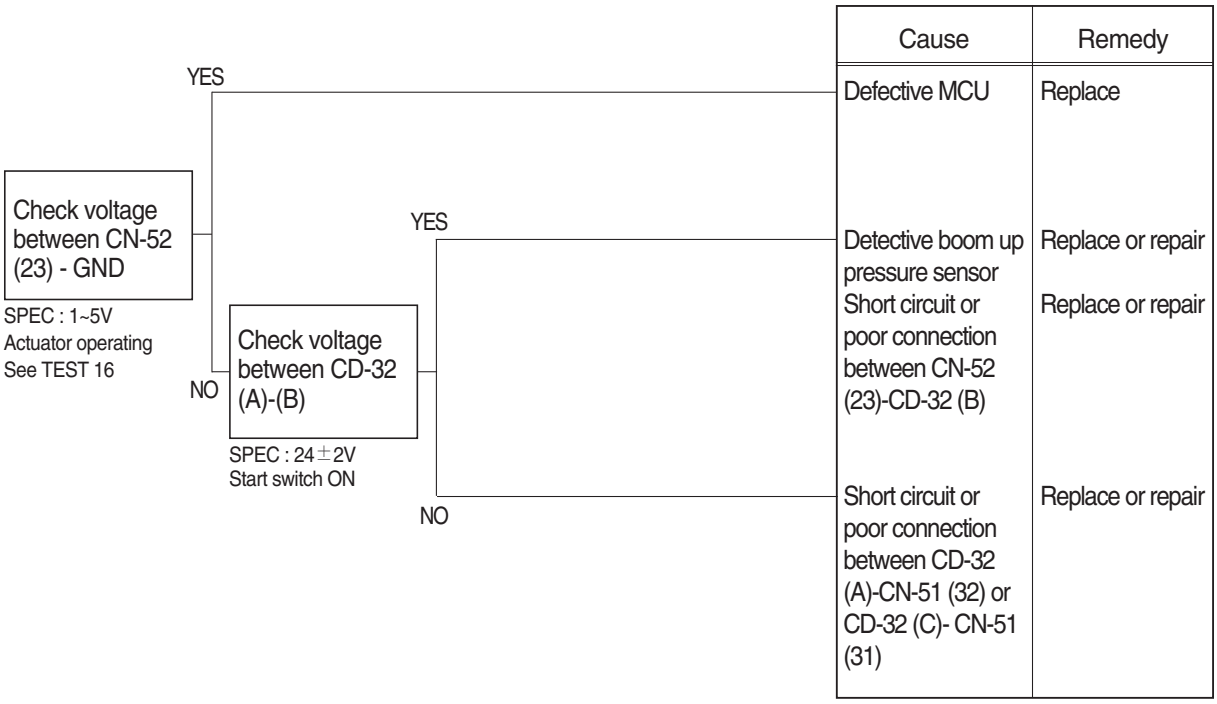
140WA6MS18

10. MALFUNCTION OF BOOM UP PRESSURE SENSOR

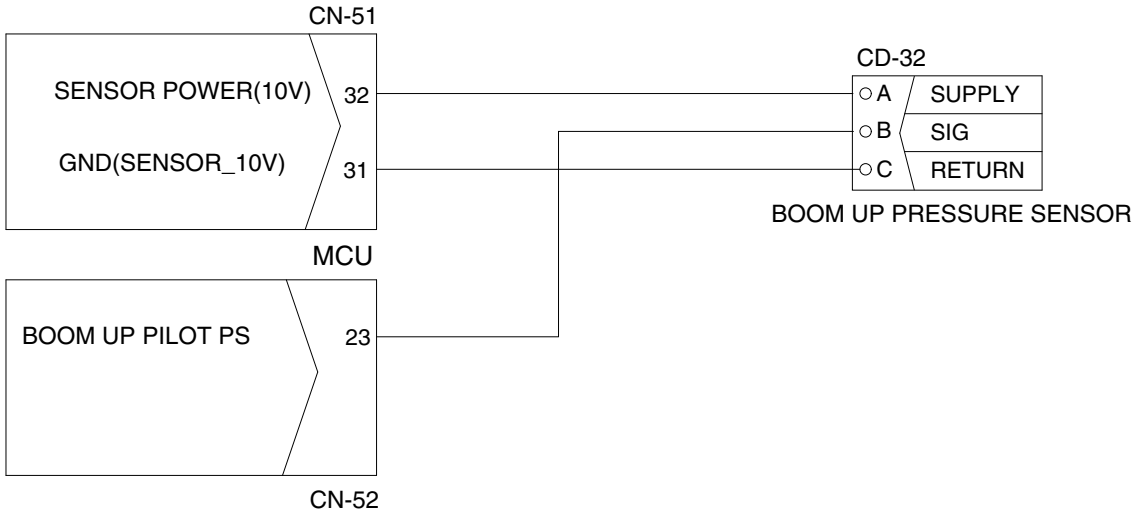
· Fault code : HCESPN 127, FMI 0~4

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

1) INSPECTION PROCEDURE



Wiring diagram



140WA6MS19

2) TEST PROCEDURE

(1) Test 16 : Check voltage at CN-52 (23) and ground.

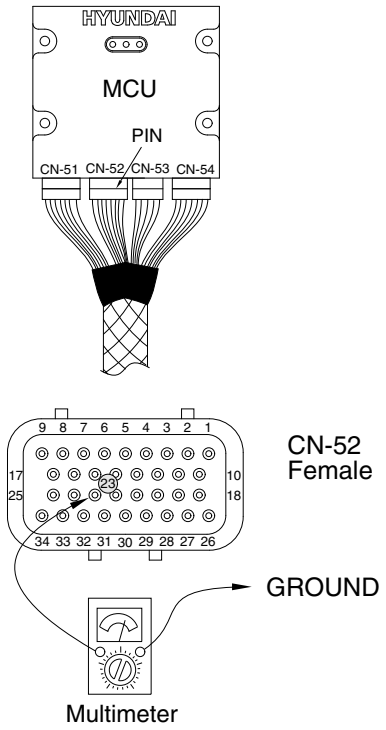
① Prepare 1 piece of thin sharp pin, steel or copper.

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

③ Starting switch ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V



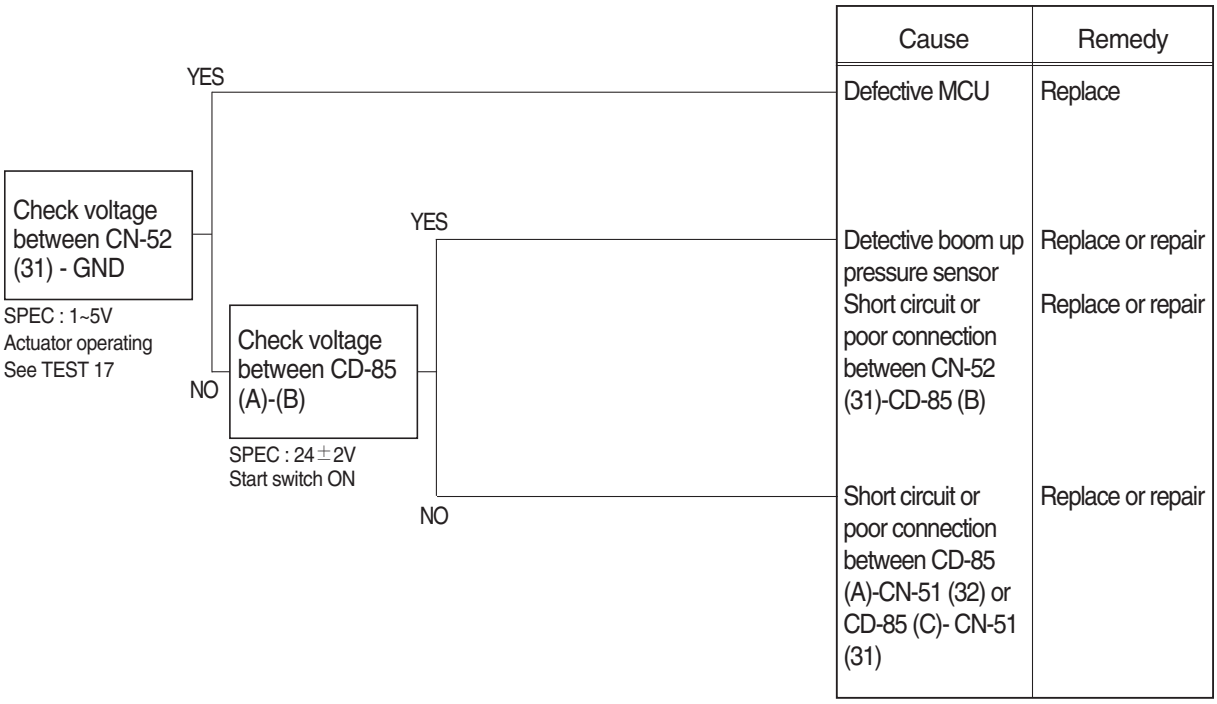
140WF6MS120

11. MALFUNCTION OF BOOM DOWN PRESSURE SENSOR

· Fault code : HCESPN 128, FMI 0~4

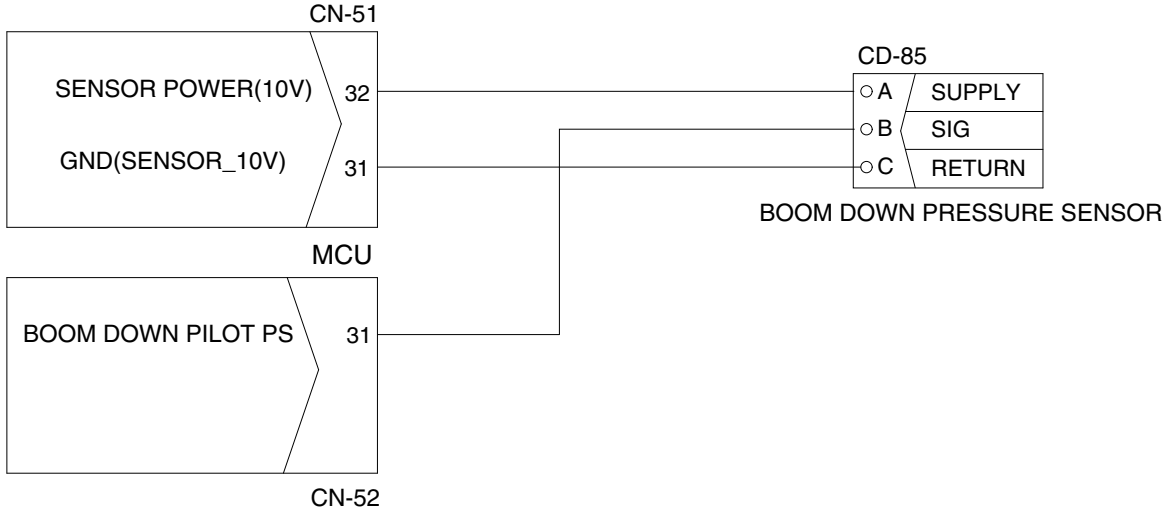
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective MCU	Replace
Detective boom up pressure sensor	Replace or repair
Short circuit or poor connection between CN-52 (31)-CD-85 (B)	Replace or repair
Short circuit or poor connection between CD-85 (A)-CN-51 (32) or CD-85 (C)- CN-51 (31)	Replace or repair

Wiring diagram



140WA6MS25

2) TEST PROCEDURE

(1) Test 17 : Check voltage at CN-52 (31) and ground.

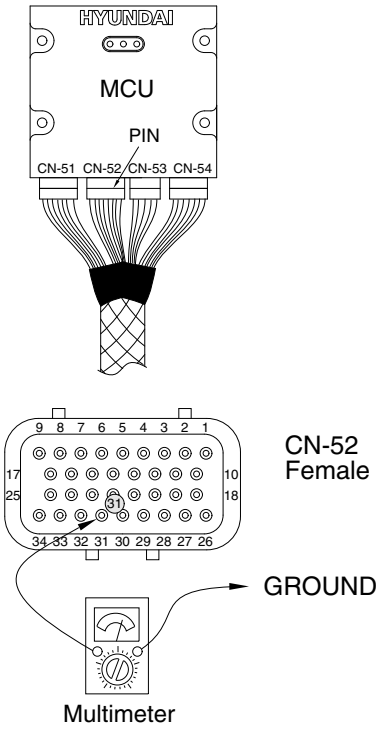
① Prepare 1 piece of thin sharp pin, steel or copper.

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

③ Starting switch ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V



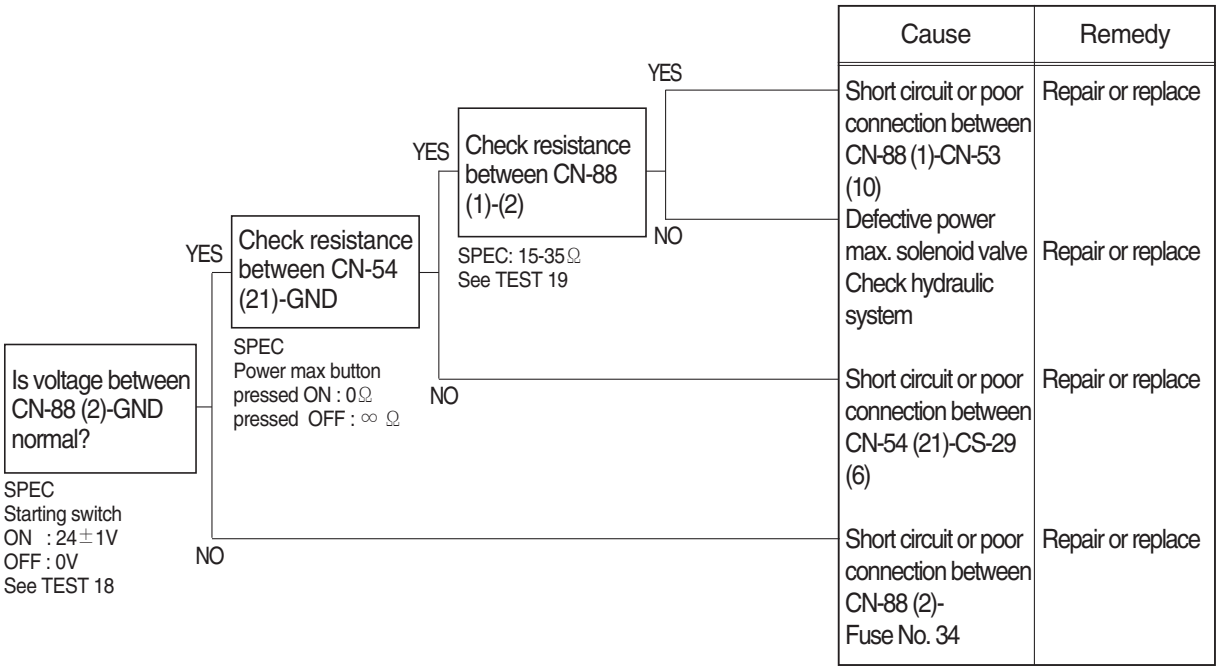
140WF6MS126

12. MALFUNCTION OF POWER MAX

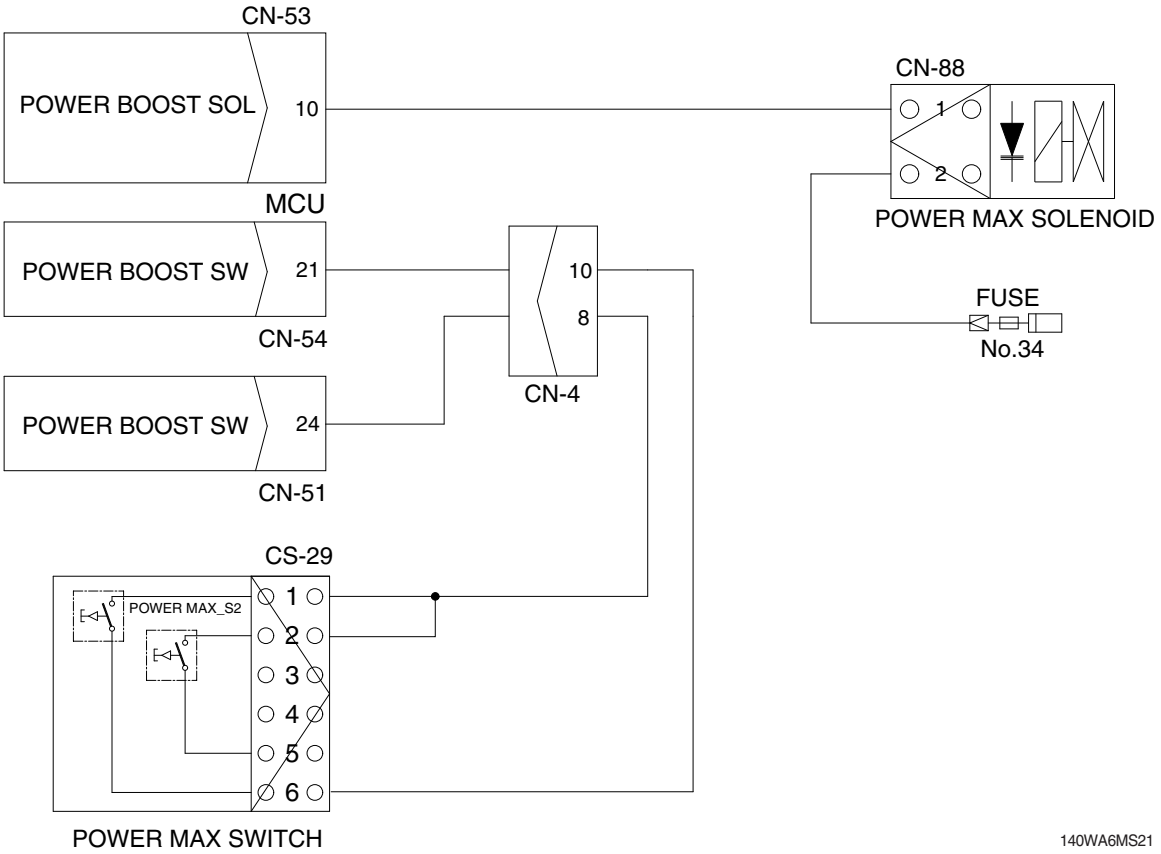
· Fault code : HCESPN 166, FMI 4 or 6

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

1) INSPECTION PROCEDURE



Wiring diagram



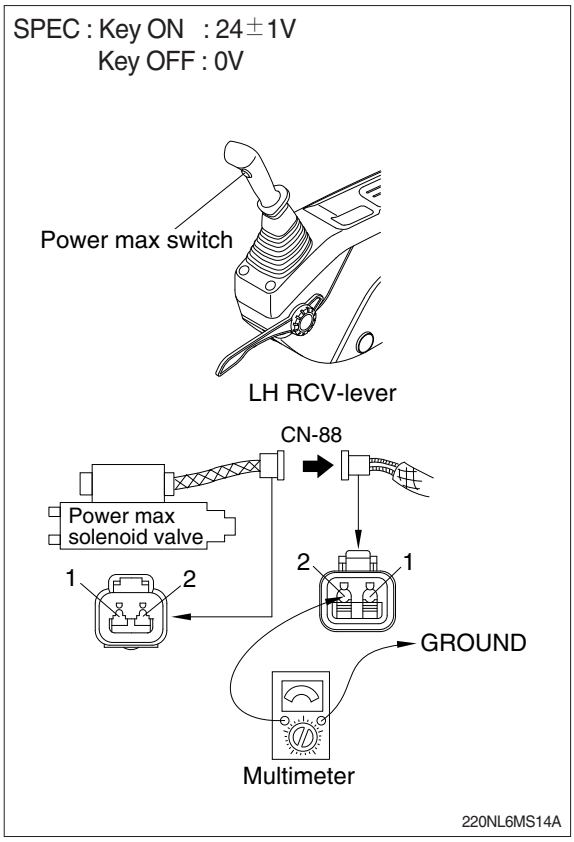
2) TEST PROCEDURE

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

① Disconnect connector CN-88 from power max solenoid valve.

② Start switch ON.

③ Check voltage as figure.

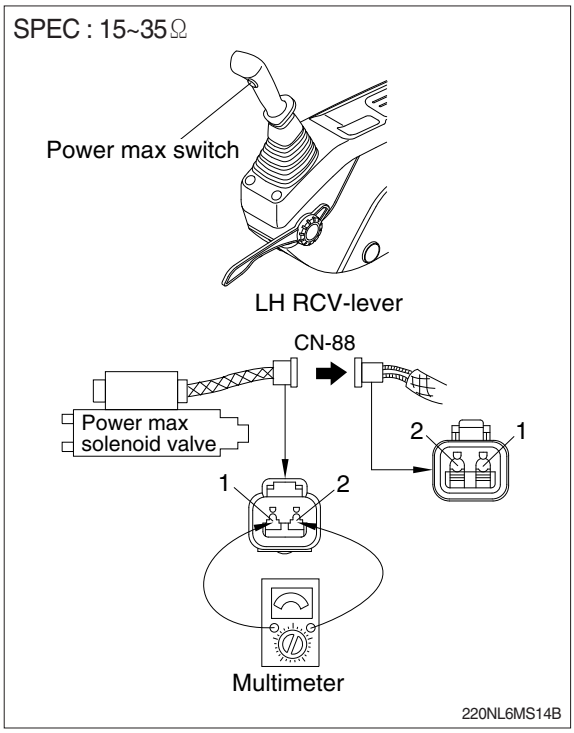


(2) Test 19: Check resistance of the solenoid valve between CN-88 (1)-(2).

① Starting key OFF.

② Disconnect connector CN-88 from power max solenoid valve.

③ Check resistance as figure.

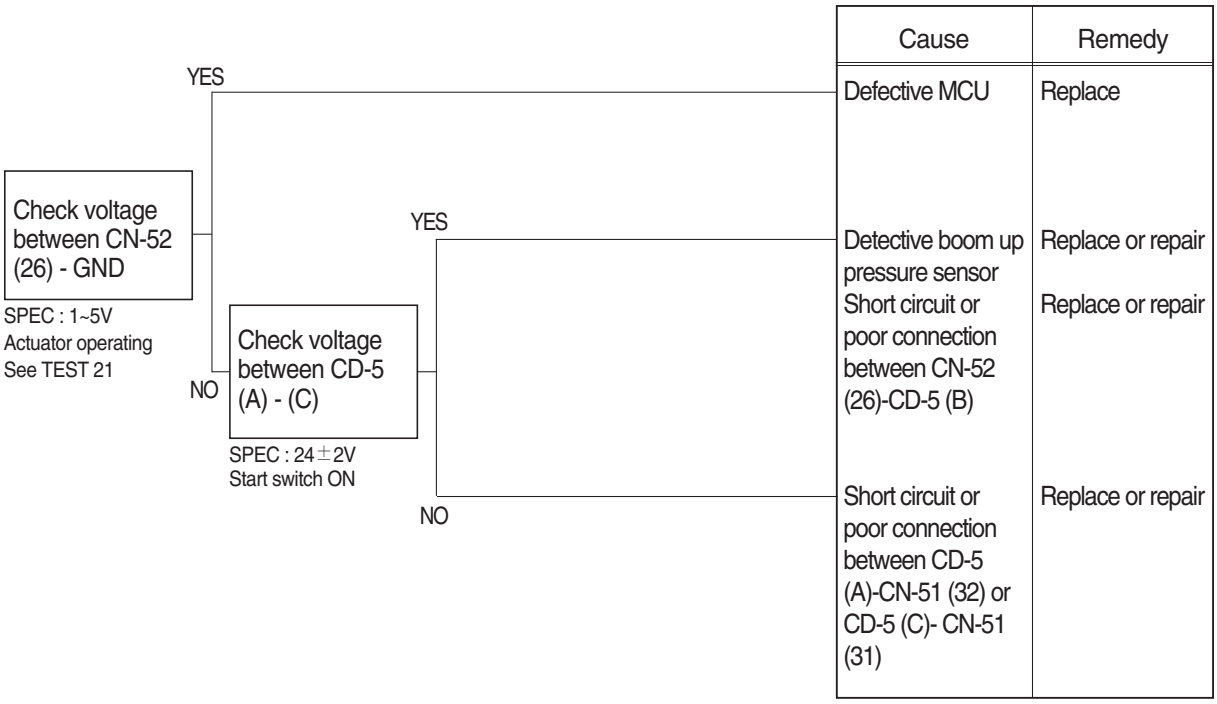


13. MALFUNCTION OF TRANSMISSION OIL PRESSURE SENSOR

· Fault code : HCESPN 501, FMI 0~4

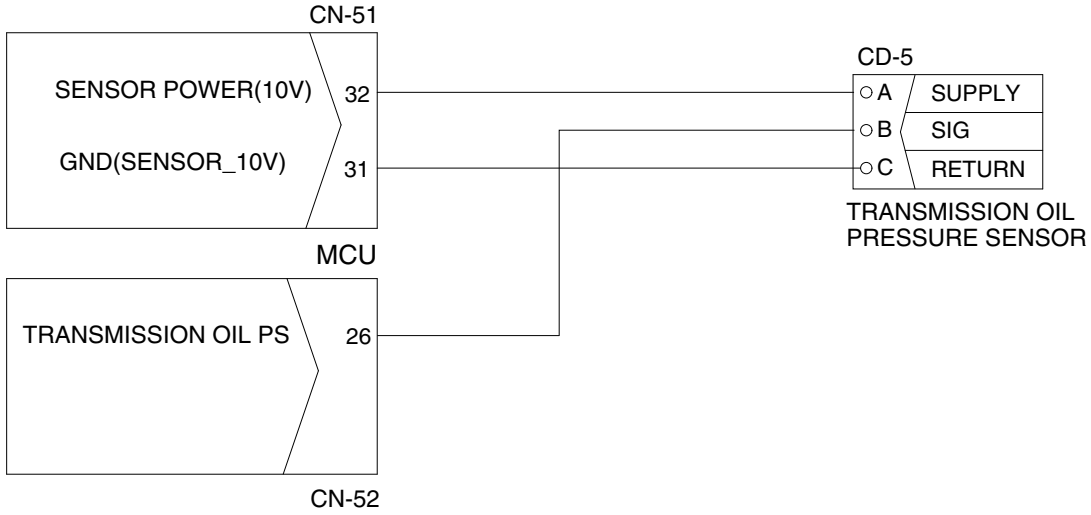
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective MCU	Replace
Detective boom up pressure sensor	Replace or repair
Short circuit or poor connection between CN-52 (26)-CD-5 (B)	Replace or repair
Short circuit or poor connection between CD-5 (A)-CN-51 (32) or CD-5 (C)- CN-51 (31)	Replace or repair

Wiring diagram



140WA6MS60

2) TEST PROCEDURE

(1) Test 21 : Check voltage at CN-52 (26) and ground.

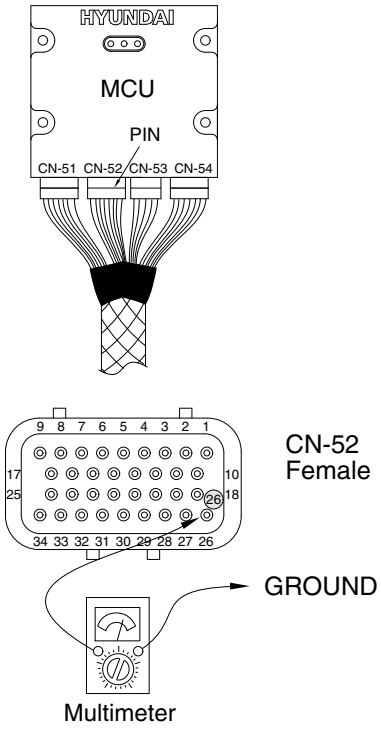
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (26) of CN-52.

③ Starting switch ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V



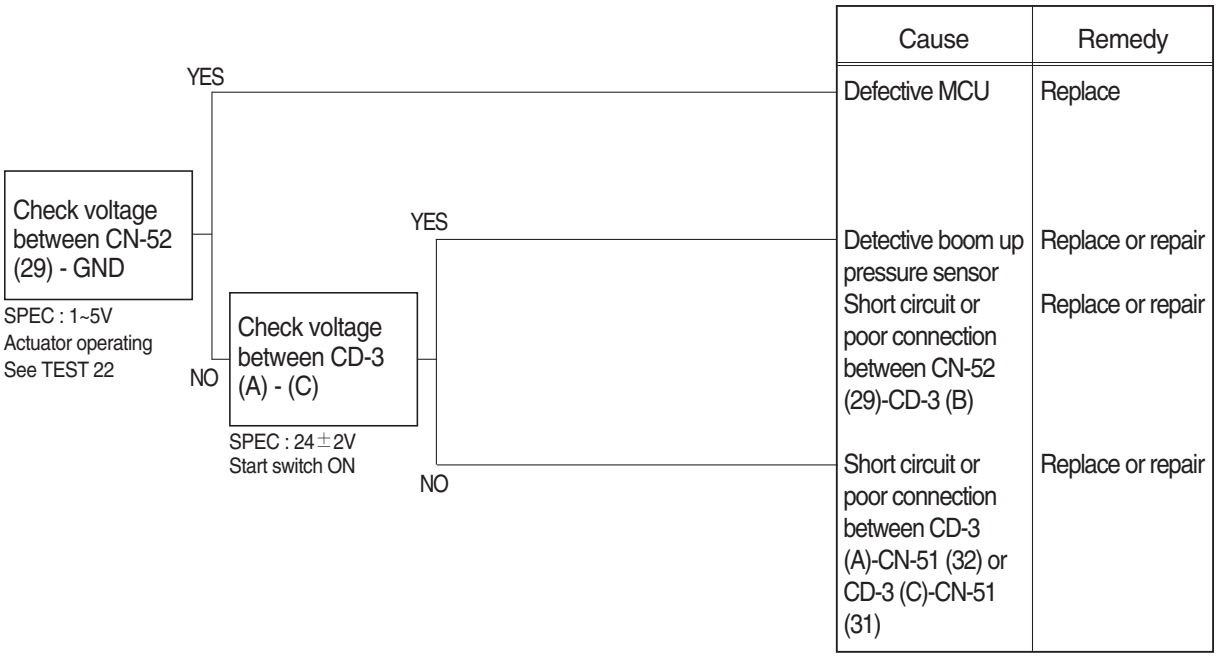
140WF6MS161

14. MALFUNCTION OF BRAKE OIL PRESSURE SENSOR

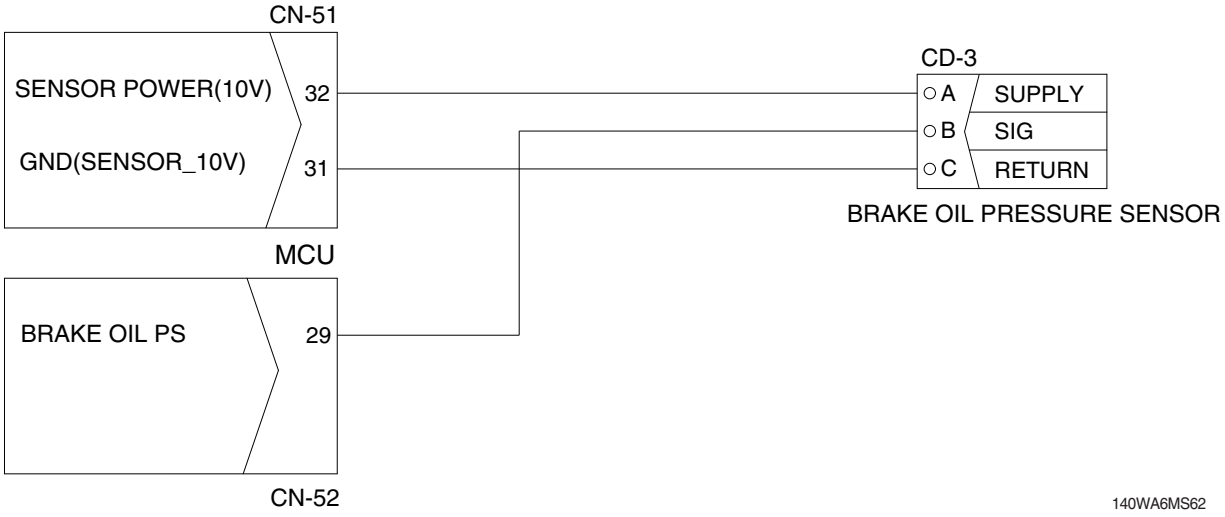
· Fault code : HCESPN 503, FMI 0~4

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

1) INSPECTION PROCEDURE



Wiring diagram



2) TEST PROCEDURE

(1) Test 22 : Check voltage at CN-52 (29) and ground.

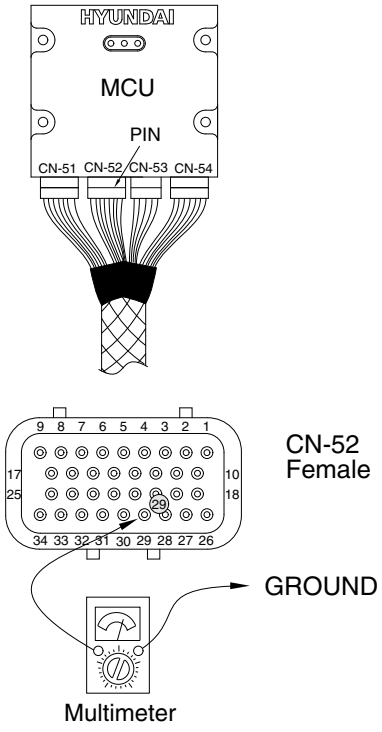
① Prepare 1 piece of thin sharp pin, steel or copper.

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

③ Starting switch ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V



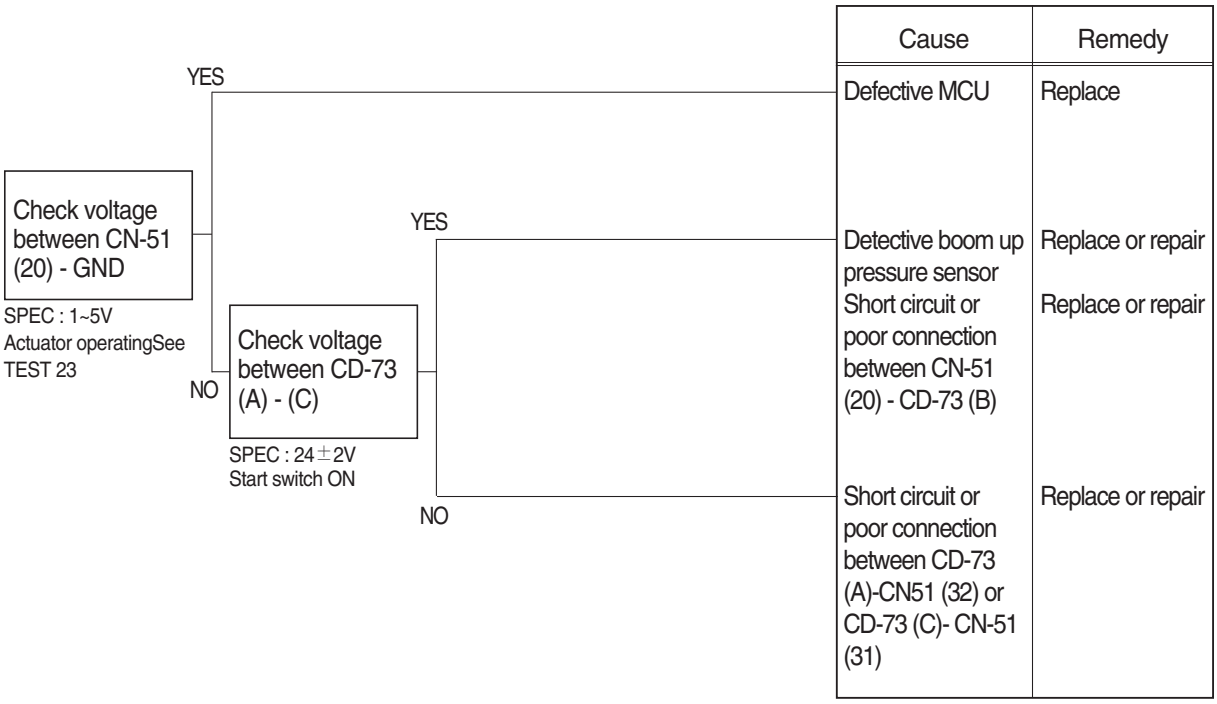
140WF6MS163

15. MALFUNCTION OF TRAVEL FORWARD PRESSURE SENSOR

· Fault code : HCESPN 530, FMI 0~4

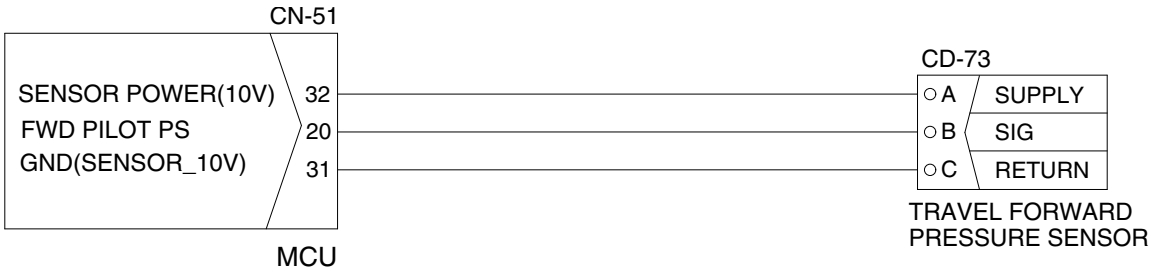
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective MCU	Replace
Detective boom up pressure sensor	Replace or repair
Short circuit or poor connection between CN-51 (20) - CD-73 (B)	Replace or repair
Short circuit or poor connection between CD-73 (A)-CN51 (32) or CD-73 (C)- CN-51 (31)	Replace or repair

Wiring diagram



140WA6MS64

2) TEST PROCEDURE

(1) Test 23 : Check voltage at CN-51 (20) and ground.

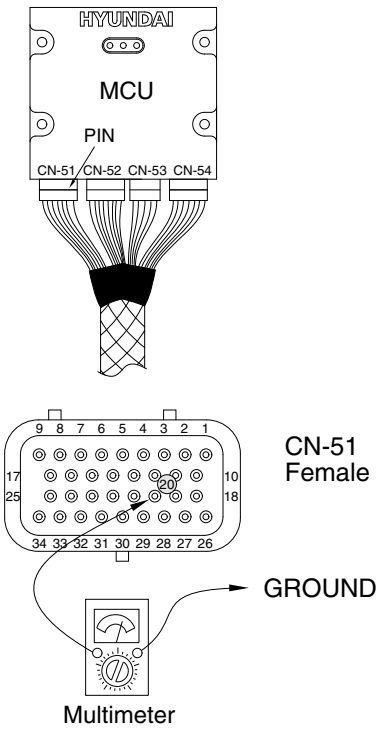
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (20) of CN-51.

③ Starting switch ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V



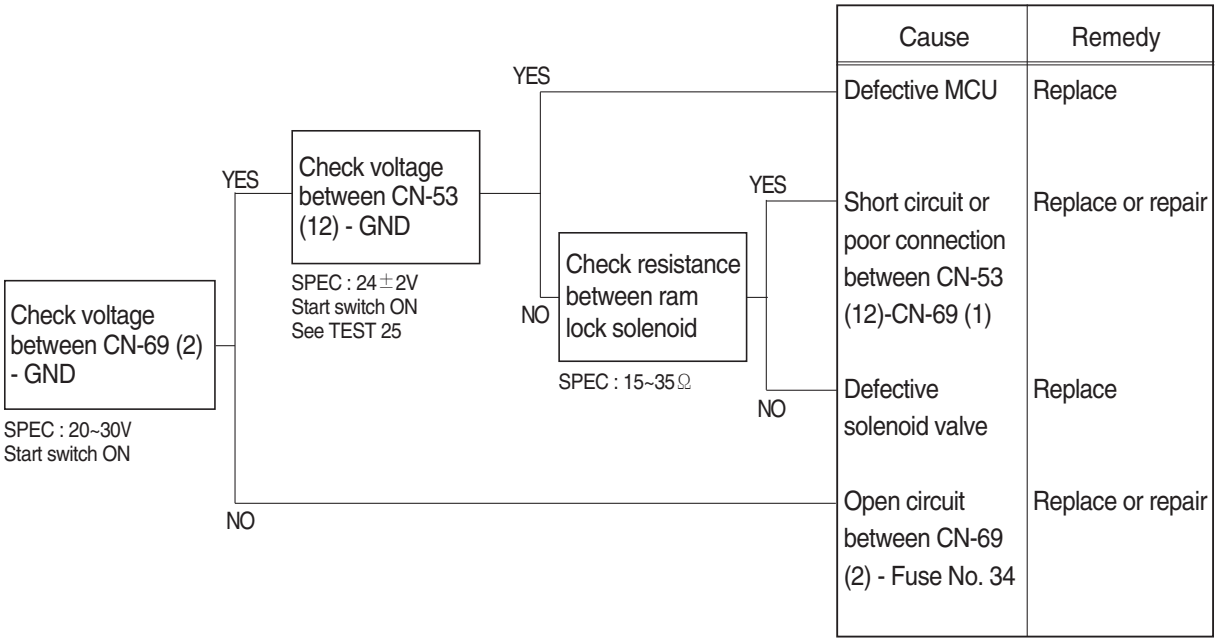
140WF6MS165

16. MALFUNCTION OF RAM LOCK SOLENOID

· Fault code : HCESPN 525, FMI 4 or 6

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

1) INSPECTION PROCEDURE



Wiring diagram

140WA6MS68

2) TEST PROCEDURE

(1) Test 25 : Check voltage at 53 (12) and ground.

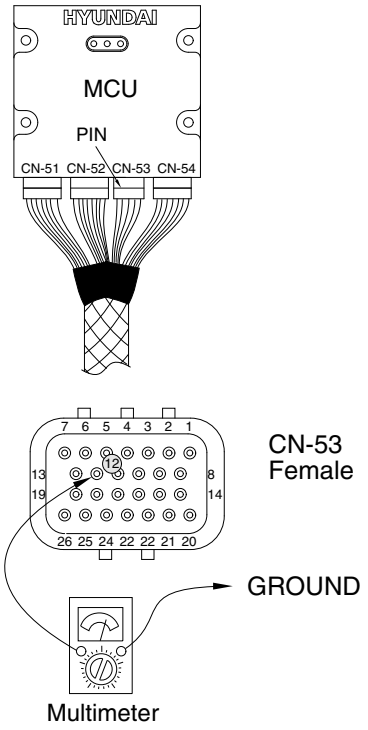
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (12) of CN-53.

③ Starting switch ON.

④ Check voltage as figure.

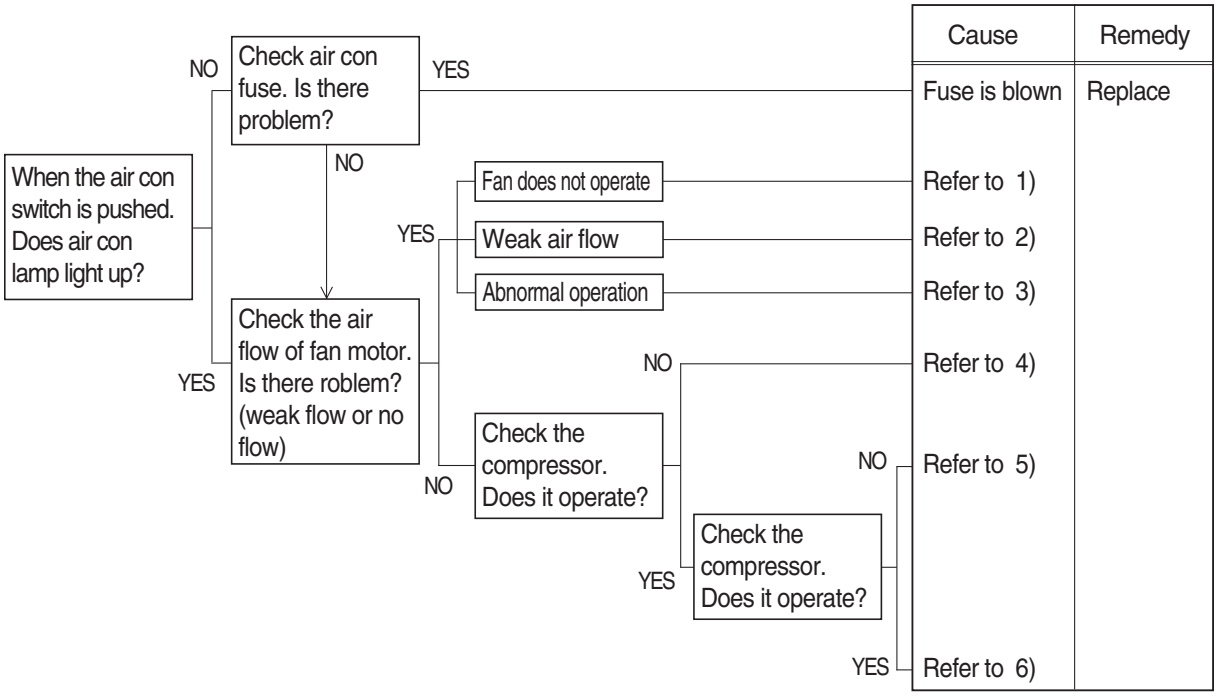
SPEC : Key ON : 24±2 V



140WF6MS169

GROUP 5 AIR CONDITIONER & HEATER SYSTEM

1. AIR CONDITIONER DOES NOT OPERATE



1) FAN DOES NOT OPERATE

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

2) WEAK AIR FLOW FROM FAN MOTOR

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

3) ABNORMAL OPERATION OF FAN MOTOR

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

4) COMPRESSOR DOES NOT ROTATE OR HARDLY ROTATE

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

5) COMPRESSOR OPERATE NORMALLY AND AIR FLOW IS NORMAL

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

6) COMPRESSOR OPERATE NORMALLY AND AIR FLOW IS NORMAL

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

SECTION 7 MAINTENANCE STANDARD

SECTION 7 MAINTENANCE STANDARD

GROUP 1 OPERATIONAL PERFORMANCE TEST

1. PURPOSE

Performance tests are used to check:

1) OPERATIONAL PERFORMANCE OF A NEW MACHINE

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

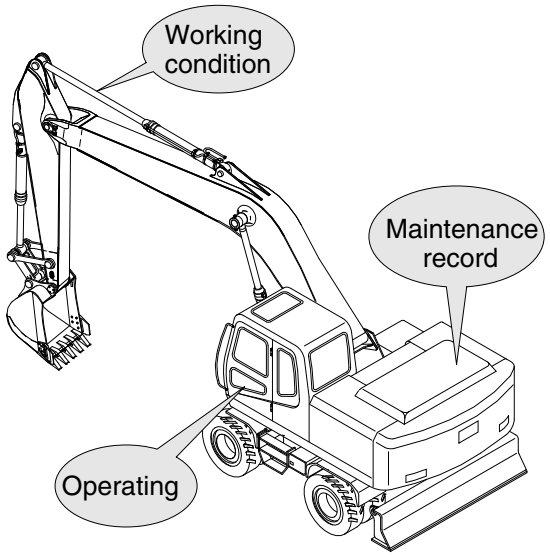
2) OPERATIONAL PERFORMANCE OF A WORKING MACHINE

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

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

3) OPERATIONAL PERFORMANCE OF A REPAIRED MACHINE

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

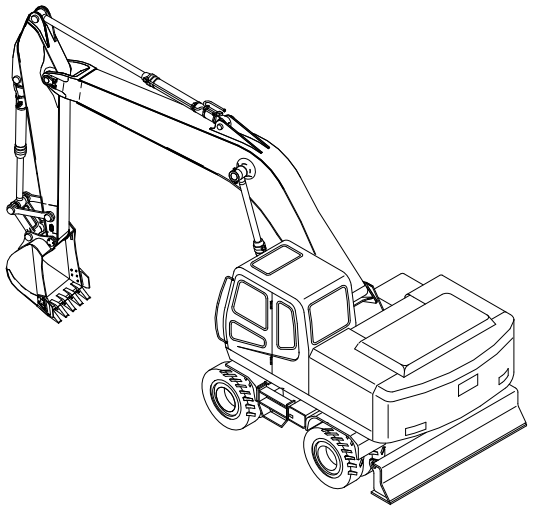


14W77MS01

2. TERMINOLOGY

1) STANDARD

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

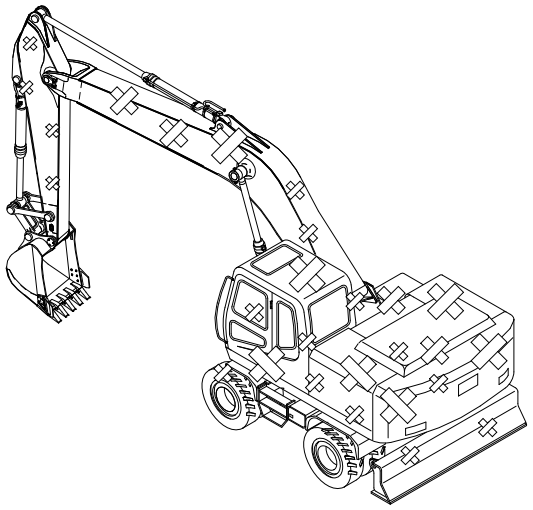


140W77MS02

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.



140W77MS03

3. OPERATION FOR PERFORMANCE TESTS

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

(1) The machine

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

(2) Test area

① Select a hard, flat surface.

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

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

(3) Precautions

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

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

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

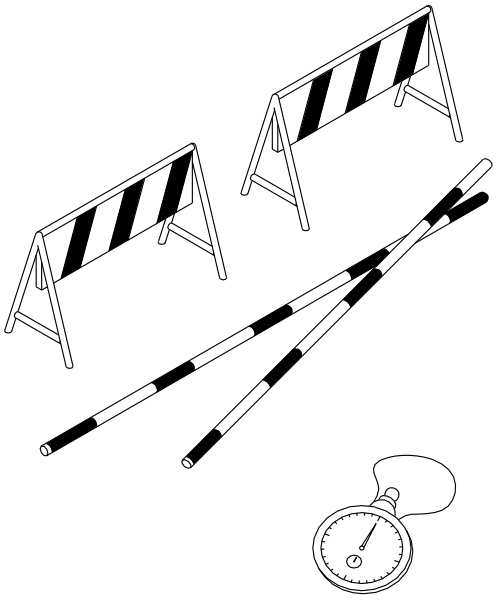
④ Avoid polluting the machine and the ground with leaking oil. Use oil pans to catch escaping oil. Pay special attention to this when removing hydraulic pipings.

(4) Make precise measurements

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

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

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



(290-7TIER) 7-3

2) ENGINE SPEED

(1) Measure the engine speed at each power mode

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

(2) Preparation

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

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

③ Measure the engine RPM.

(3) Measurement

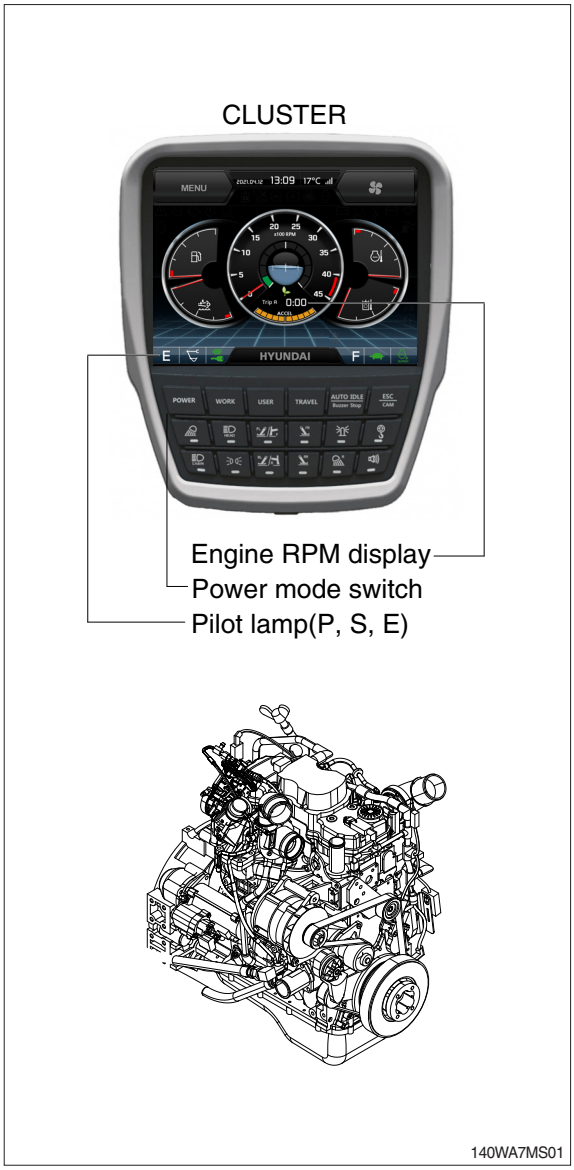
① Start the engine. The engine will run at start idle speed. Measure engine speed with a engine rpm display.

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

③ Select the P-mode.

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

⑤ Measure and record the auto deceleration speed.



(4) Evaluation

The measured speeds should meet the following specifications.

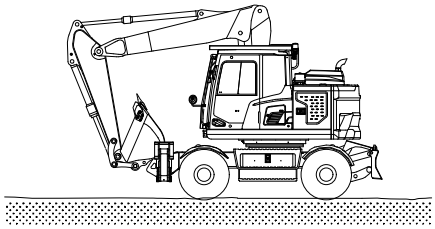
Unit : rpm

Model	Engine speed	Standard	Remarks
HW170A CR	Start idle	1000±50	Safety knob : Lock position
		1100±50	Safety knob : Unlock position
	P mode	1700±50	
	S mode	1600±50	
	E mode	1500±50	
	Auto decel	1200±50	
	One touch decel	1100±50	

※ Auto decel, one touch decel and low idle speed may increase to 1500 rpm while automatic exhaust system cleaning is being performed.

3) TRAVEL SPEED

(1) Measure the time require for the excavator to travel a 50m at high speed and a 20m at low speed test run.



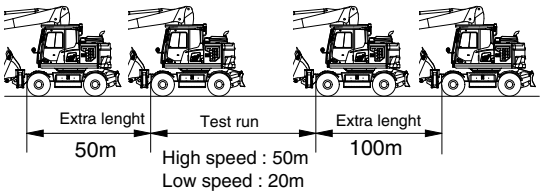
170WA7MS04

(2) Preparation

① Prepare a flat and solid test track 50m in length, with extra length of 150m for machine acceleration.
② Set the traveling position as figure.
③ Keep the hydraulic oil temperature at 50±5˚C.

(3) Measurement

① Measure both the low and high speeds of the machine.
② Before starting either the low or high speed tests, adjust the RH multifunction switch to the speed to be tested, then select the following switch position.
· Power mode switch : P mode
③ Start traveling the machine in the extra length with the two speed switch at high or low speed.
④ Measure the time required to travel 50 m at high speed or 20 m at low speed.
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.



170WA7MS05

(4) Evaluation

The average measured time should meet the following specifications.

Unit : km/h

Model	Travel speed	Standard	Maximum allowable	Remarks
HW170A CR	Low speed	10	12	Max 200 m
	High speed	30	40	Max 200 m

4) SWING SPEED

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

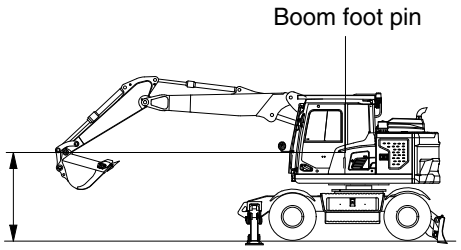
(2) Preparation

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.



170WA7MS06

(3) Measurement

① Select the following switch positions.

· Power mode switch : P mode

② Operate swing control lever fully.

③ Swing 1 turn and measure time taken to swing next 3 revolutions.

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

(4) Evaluation

The time required for 3 swings should meet the following specifications.

Unit : Seconds / 3 revolutions

Model	Power mode switch	Standard	Remarks
HW170A CR	P mode	18.2±1.8	

5) SWING FUNCTION DRIFT CHECK

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

(2) Preparation

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

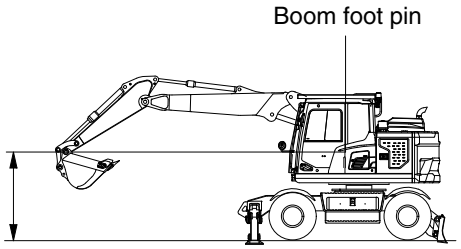
② Place the machine on flat, solid ground with ample space for swinging. Do not conduct this test on slopes.

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

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

⑤ Swing the upperstructure 360˚.

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



170WA7MS06

(3) Measurement

① Conduct this test in the M mode.

② Select the following switch positions.

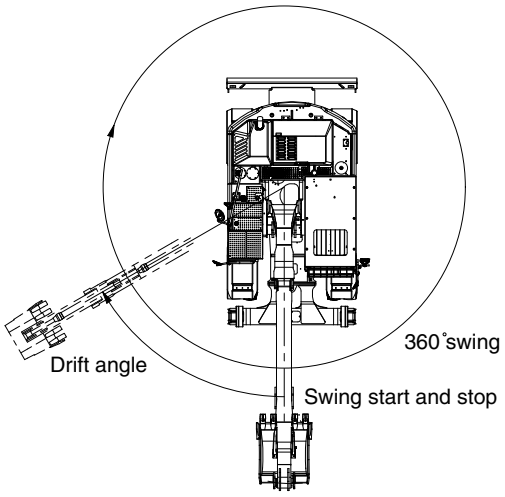
· Power mode switch : P mode

③ Operate the swing control lever fully and return it to the neutral position when the mark on the upperstructure aligns with that on track frame after swinging 360˚.

④ Measure the distance between the two marks.

⑤ Align the marks again, swing 360˚, then test the opposite direction.

⑥ Repeat steps ④ and ⑤ three times each and calculate the average values.



170WA7MS07

(4) Evaluation

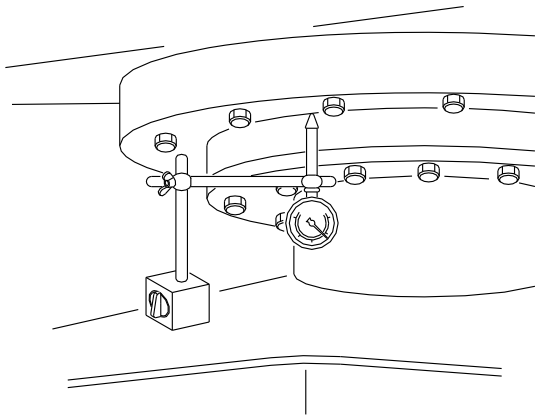
The measured drift angle should be within the following specifications.

Unit : Degree

Model	Power mode switch	Standard	Maximum allowable	Remarks
HW170A CR	P mode	90 below	157.5	

6) 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

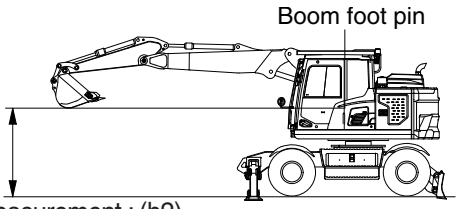
(2) Preparation

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.

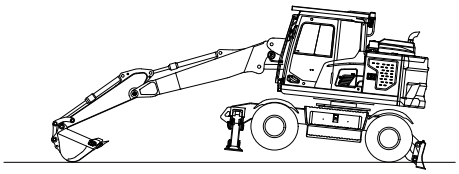
(3) Measurement

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)



Measurement : (h2)



170WA7MS08

(4) Evaluation

The measured drift should be within the following specifications.

Unit : mm

Model	Standard	Maximum allowable	Remarks
HW170A CR	0.5 ~ 1.5	3.0	

7) HYDRAULIC CYLINDER CYCLE TIME

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

(2) Preparation

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

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

③ To measure the cycle time of the bucket cylinder.
The empty bucket should be positioned at midstroke between roll-in and roll-out, so that the sideplate edges are vertical to the ground.

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

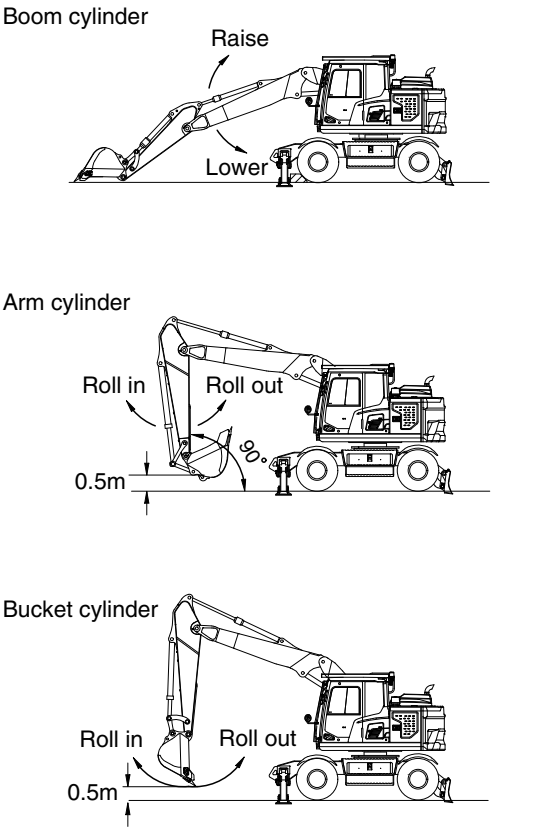
(3) Measurement

① Select the following switch positions.

· Power mode switch : P mode

② To measure cylinder cycle times.

- Boom cylinders.
Measure the time it takes to raise the boom, and the time it takes to lower the boom. To do so, position the boom at one stroke end then move the control lever to the other stroke end as quickly as possible.
Arm cylinder.
- Measure the time it takes to roll in the arm, and the time it takes to roll out the arm. To do so, position the bucket at one stroke end, then move the control lever to the other stroke end as quickly as possible.



170WA7MS09

- Bucket cylinder.
  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
HW170A CR	Boom raise	4.0±0.4	Below 5.0	
	Boom lower	3.2±0.4	Over 2.3	
	Arm in	2.8±0.4	3.4	
	Arm out	2.6±0.4	3.6	
	Bucket load	2.6±0.4	4.6	
	Bucket dump	2.0±0.4	2.9	

8) DIG FUNCTION DRIFT CHECK

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

(2) Preparation

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

· $W=M^3 \times 1.5$

Where :

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

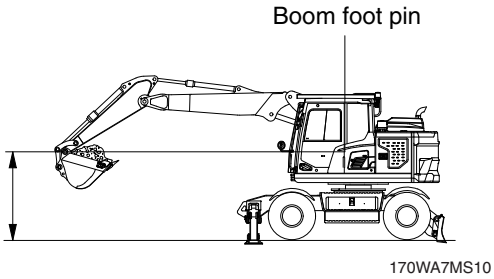
1.5 = Soil specific gravity

② Position the arm cylinder with the rod 20 to 30㎜ extended from the fully retracted position.

③ Position the bucket cylinder with the rod 20 to 30㎜ 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.



170WA7MS10

(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 : ㎜ / 5 min

Model	Drift to be measured	Standard	Maximum allowable	Remarks
HW170A CR	Boom cylinder	10 below	20	
	Arm cylinder	10 below	20	
	Bucket cylinder	40 below	60	

9) CONTROL LEVER OPERATING FORCE

(1) Use a spring scale to measure the maximum resistance of each control lever at the middle of the grip.

(2) Preparation

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

(3) Measurement

① Start the engine.
② Select the following switch positions.
· Power mode switch: P mode
③ Operate each boom, arm, bucket and swing lever at full stroke and measure the maximum operating force for each.
④ Lower the bucket to the ground to raise one track off the ground. Operate the travel lever at full stroke and measure the maximum operating force required. When finished, lower the track and then jack-up the other track.
⑤ Repeat steps ③ and ④ three times and calculate the average values.

(4) Evaluation

The measured operating force should be within the following specifications.

Unit : kgf

Model	Kind of lever	Standard	Maximum allowable	Remarks
HW170A CR	Boom lever	1.3 or below	1.7	
	Arm lever	1.3 or below	1.7	
	Bucket lever	1.3 or below	1.7	
	Swing lever	1.3 or below	1.7	

10) 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
HW170A CR	Boom lever	115±10	140	
	Arm lever	115±10	140	
	Bucket lever	90±10	115	
	Swing lever	90±10	115	

11) PILOT PRIMARY PRESSURE

(1) Preparation

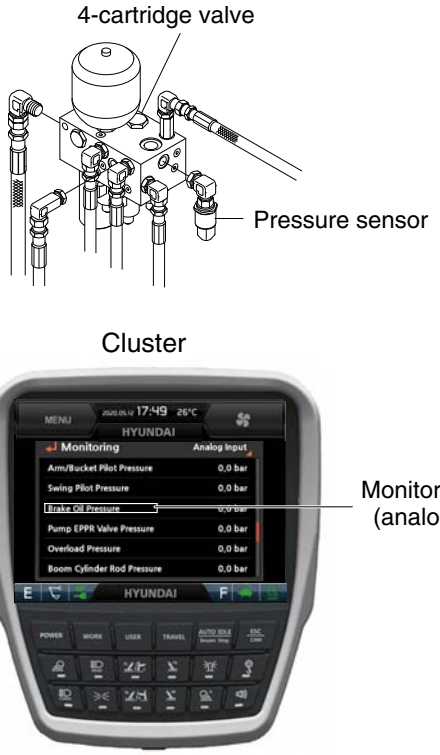
① Keep the hydraulic oil temperature at 50±5˚C.

(2) Measurement

① Select the following switch positions.

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

② Slowly operate the boom control lever of boom up functions at full stroke over relief and measure the primary pilot pressure by the monitoring menu of the cluster.



170WA7MS12

(3) Evaluation

The average measured pressure should meet the following specifications:

Unit : kgf / cm²

Model	Kind of lever	Standard	Maximum allowable	Remarks
HW170A CR	M mode	Over 32	50	

12) FOR TRAVEL SPEED SELECTING PRESSURE

(1) Preparation

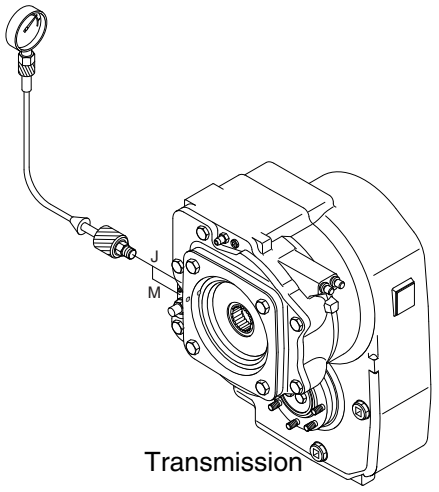
① Stop the engine.

② Loosen the cap and relieve the pressure in the hydraulic tank by pushing the top of the air breather.

③ To measure the speed selecting pressure : Install a connector and pressure gauge assembly to transmission J, M port as shown the figure.

④ Start the engine and check for on leakage from the adapter.

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



14W97MS13

(2) Measurement

① Lower the bucket and dozer blade to the ground to raise the tires off the ground.

② Select the following switch position.

· Parking switch : OFF

· Power mode switch : P mode

③ Operate the travel speed switch turns to the high or lower position and measure the port J or M pressure.

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

(3) Evaluation

The average measured pressure should be within the following specifications.

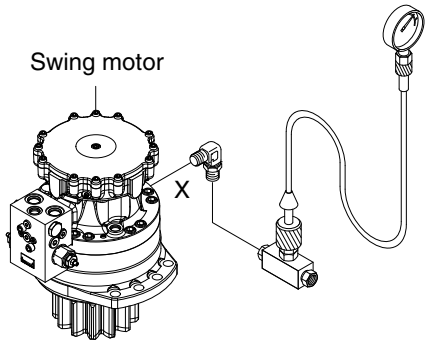
Unit : kgf / cm^2

Model	Travel speed mode	Standard		Allowable limits		Remarks
		J port	M port	J port	M port	
HW170A CR	Low Speed	-	33+2	-	30~35	
	High Speed	33+2	-	30~35	-	

13) SWING PARKING BRAKE RELEASING PRESSURE

(1) Preparation

① Stop the engine.
② Loosen the cap and relieve the pressure in the hydraulic tank by pushing the top of the air breather.
③ The pressure release L wrench to bleed air.
④ Install a connector and pressure gauge assembly to swing motor X port, as shown.
⑤ Start the engine and check for oil leakage from the adapter.
⑥ Keep the hydraulic oil temperature at 50±5˚C.



140WA7MS14

(2) Measurement

① Select the following switch positions.
· Power mode switch : P mode
② Operate the swing function or arm roll in function and measure the swing brake control pressure with the brake disengaged. Release the control lever to return to neutral and measure the control pressure when the brake is applied.
③ Repeat step ② three times and calculate the average values.

(3) Evaluation

The average measured pressure should be within the following specifications.

Unit : kgf / cm²

Model	Description	Standard	Allowable limits	Remarks
HW170A CR	Brake disengaged	40	Over 15	
	Brake applied	Below 3	-	

14) MAIN PUMP DELIVERY PRESSURE

(1) Preparation

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

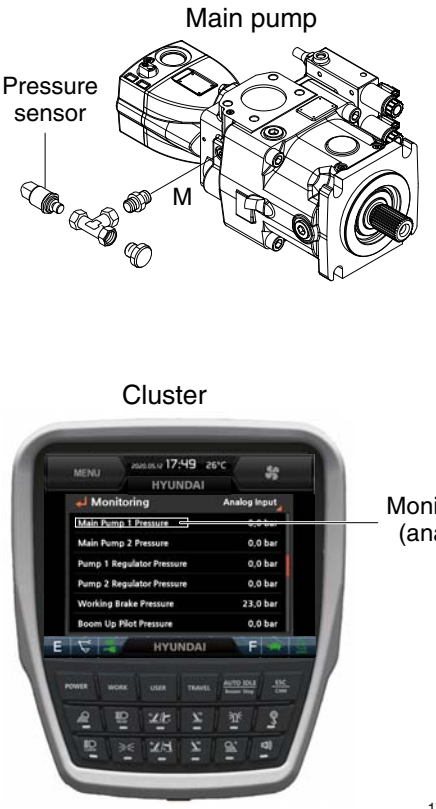
(2) Measurement

① Select the following switch positions.

· Power mode switch : P mode

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

※ Do not operate any of the RCV lever and pedal.



170WA7MS15

(3) Evaluation

The average measured pressure should meet the following specifications.

Unit : kgf / cm^2

Model	Engine speed	Standard	Allowable limits	Remarks
HW170A CR	High idle	34~40	-	

15) SYSTEM PRESSURE REGULATOR RELIEF SETTING

(1) Preparation

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

(2) Measurement

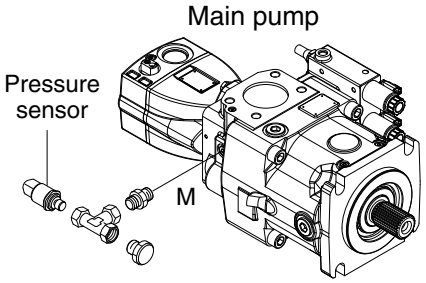
① Select the following switch positions.

· Power mode switch : P mode

② Slowly operate each control lever of boom, arm and bucket functions at full stroke over relief and measure the pressure.

③ In the swing function, place bucket against an immovable object and measure the relief pressure.

④ In the travel function, lock lower structure with an immovable object and measure the relief pressure.



170WA7MS16

(3) Evaluation

The average measured pressure should be within the following specifications.

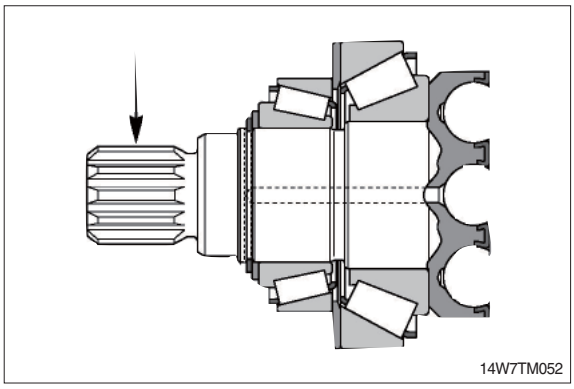
Unit : kgf / cm²

Model	Function to be tested	Standard	Port relief setting at 20 lpm
HW170A CR	Boom, Arm, Bucket	350 (380)±10	400±10
	Travel	380±10	-
	Swing	270±10	-

( ) : Power boost

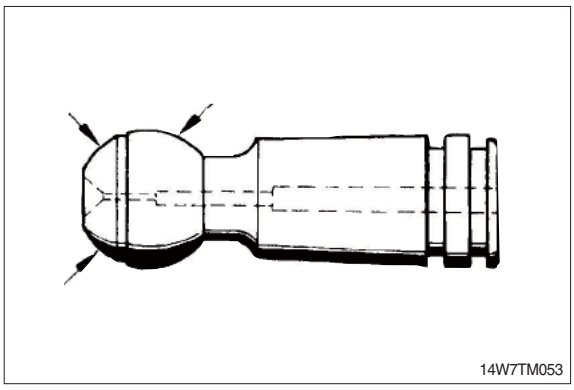
1. TRAVEL MOTOR

1) Free of corrosion, erosion or fretting; no damage to splines or keyways.



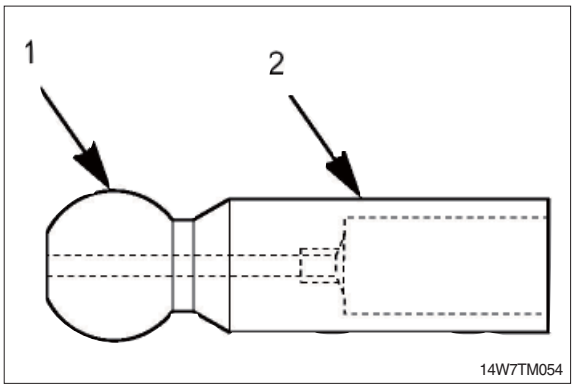
2) Pistons

No scoring and no pittings.



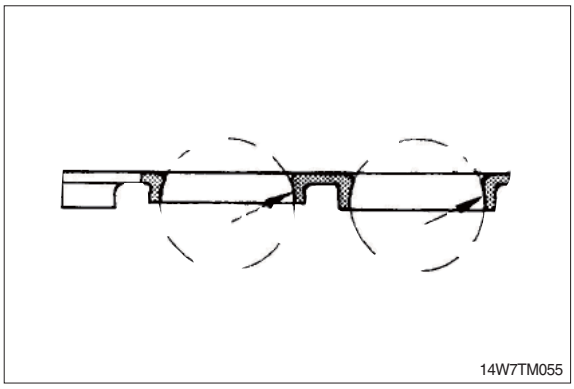
3) Center pin

No scoring and no pittings.



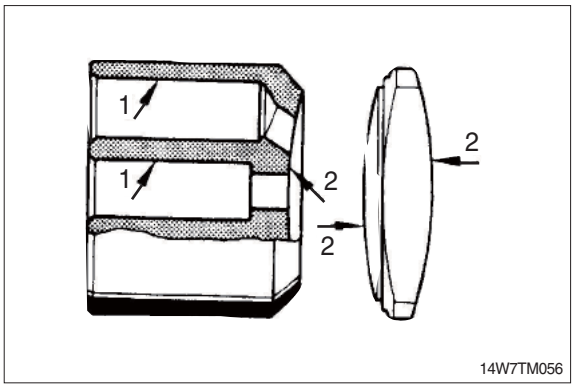
4) Retaining plate

No scoring and no evidence of wear.



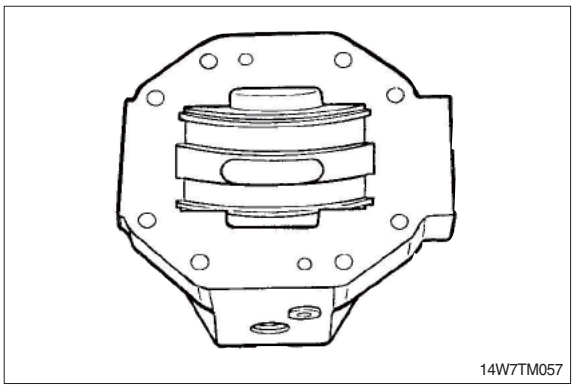
5) Cylinder block/control lens

① Bores free of scoring, no evidence of wear.
② Faces smooth and even, free of cracks and scoring.



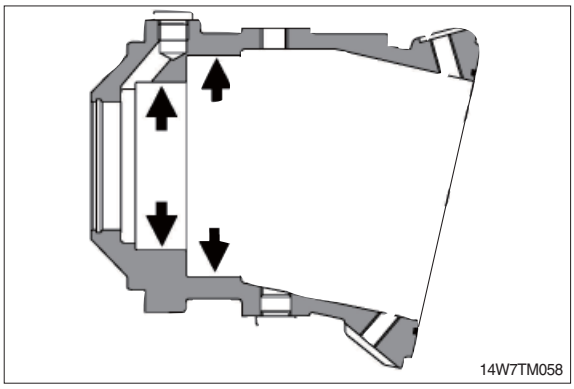
6) Control housing

Sliding surface and side guides free of scoring and no wear.

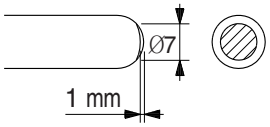


7) Visual check

Bearing areas free of scoring and no evidence of wear.

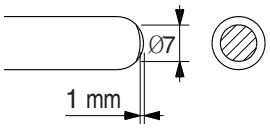


2. RCV LEVER

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

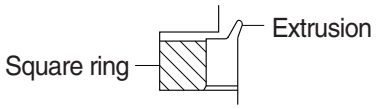
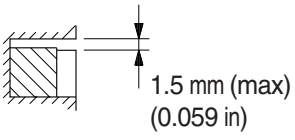
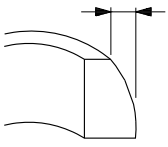
Notes 1. It is desirable to replace seal materials, such as O-rings, every disassembling. However, they may be reused, after being confirmed to be free of damage.

3. ACCELERATOR PEDAL

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

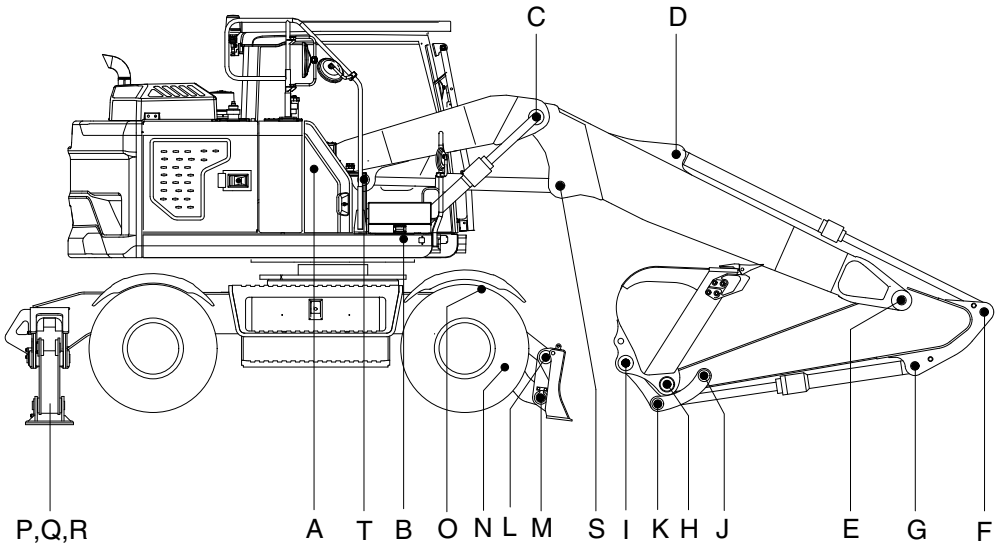
Notes 1. It is desirable to replace seal materials, such as O-rings, every disassembling. However, they may be reused, after being confirmed to be free of damage.

4. 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)	
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

5. CYLINDER

Part name	Inspecting section	Inspection item	Remedy
Piston rod	· Neck of rod pin	· Presence of crack	· Replace
	· Weld on rod hub	· Presence of crack	· Replace
	· Stepped part to which piston is attached	· Presence of crack	· Replace
	· Threads	· Presence of crack	· Recondition or replace
	· Plated surface	· Plating is not worn off to base metal	· Replace or replate
		Rust is not present on plating	· Replace or replate
		Scratches are not present	· Recondition, replate or replace
	· Rod	· Wear of O.D.	· Recondition, replate or replace
Cylinder tube	· Bushing at mounting part	· Wear of I.D.	· Replace
	· 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



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Unit : mm

Mark	Measuring point (pin and bushing)	Normal value	Pin		Bushing		Remedy & Remark
			Recomm. service limit	Limit of use	Recomm. service limit	Limit of use	
A	Boom rear	80	79	78.5	80.5	81	Replace
B	Boom cylinder head	70	69	68.5	70.5	71	〃
C	Boom cylinder rod	75	74	73.5	75.5	76	〃
D	Arm cylinder head	70	69	68.5	70.5	71	〃
E	Boom front	75	74	73.5	75.5	76	〃
F	Arm cylinder rod	70	69	68.5	70.5	71	〃
G	Bucket cylinder head	70	69	68.5	70.5	71	〃
H	Arm link	70	69	68.5	70.5	71	〃
I	Bucket and arm link	70	69	68.5	70.5	71	〃
J	Bucket cylinder rod	70	69	68.5	70.5	71	〃
K	Bucket link	70	69	68.5	70.5	71	〃
L	Dozer link (B)	60	59	58.5	60.5	61	〃
M	Dozer link (A)	60	59	58.5	60.5	61	〃
N	Dozer cylinder rod	70	69	68.5	70.5	71	〃
O	Dozer cylinder head	70	69	68.5	70.5	71	〃
P	Outrigger leg joint	70	69	68.5	70.5	71	〃
Q	Outrigger foot joint	70	69	68.5	70.5	71	〃
R	Outrigger cylinder pin	75	74	73.5	75.5	76	〃
S	Adjust cylinder head	95	94	93.5	95.5	96	〃
T	Adjust cylinder rod	95	94	93.5	95.5	96	〃

SECTION 8 DISASSEMBLY AND ASSEMBLY

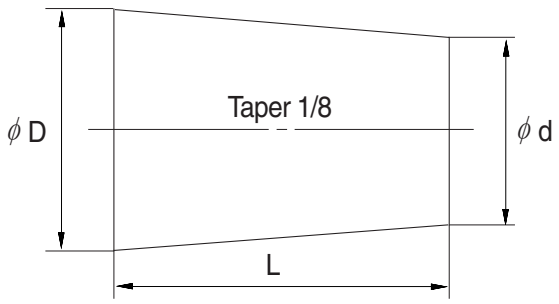
SECTION 8 DISASSEMBLY AND ASSEMBLY

GROUP 1 PRECAUTIONS

1. REMOVAL WORK

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

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



2. INSTALL WORK

1) Tighten all bolts and nuts (sleeve nuts) to the specified torque.
2) Install the hoses without twisting or interference.
3) Replace all gaskets, O-rings, cotter pins, and lock plates with new parts.
4) Bend the cotter pin or lock plate securely.
5) When coating with adhesive, clean the part and remove all oil and grease, then coat the threaded portion with 2-3 drops of adhesive.
6) When coating with gasket sealant, clean the surface and remove all oil and grease, check that there is no dirt or damage, then coat uniformly with gasket sealant.
7) Clean all parts, and correct any damage, dents, burrs, or rust.
8) Coat rotating parts and sliding parts with engine oil.
9) When press fitting parts, coat the surface with antifriction compound (LM-P).
10) After installing snap rings, check that the snap ring is fitted securely in the ring groove (check that the snap ring moves in the direction of rotation).
11) When connecting wiring connectors, clean the connector to remove all oil, dirt, or water, then connect securely.
12) When using eyebolts, check that there is no deformation or deterioration, and screw them in fully.
13) When tightening split flanges, tighten uniformly in turn to prevent excessive tightening on one side.
14) When operating the hydraulic cylinders for the first time after repairing and reassembling the hydraulic cylinders, pumps, or other hydraulic equipment or piping, always bleed the air from the hydraulic cylinders as follows:
    (1) Start the engine and run at low idling.
    (2) Operate the control lever and actuate the hydraulic cylinder 4-5 times, stopping 100㎜ 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 (bracket-frame, FR)	M16 × 2.0	29.7±3.0	215±32.5
2		Engine mounting bolt (bracket-frame, RR)	M16 × 2.0	29.7±3.0	215±32.5
3		Engine mounting bolt (engine-bracket)	M12 × 1.75	11.5±1.0	83.2±7.2
4		Radiator mounting bolt, nut	M16 × 2.0	29.7±4.5	215±32.5
5		Fuel tank mounting bolt	M20 × 2.5	57.9±5.8	419±42.0
6		Coupling mounting socket bolt	M16 × 2.0	22.0±1.0	159±7.2
7	Hydraulic system	Main pump housing mounting bolt	M10 × 1.5	6.5±0.7	47.0±5.1
8		Main pump mounting socket bolt	M20 × 2.5	57.9±8.7	419±62.9
9		Main control valve mounting bolt	M12 × 1.75	12.2±1.3	88.2±9.4
10		Travel motor mounting socket bolt	M16 × 2.0	29.6±3.2	214±23.1
11		Hydraulic oil tank mounting bolt	M20 × 2.5	57.9±5.8	419±42.0
12		Turning joint mounting bolt, nut	M12 × 1.75	12.8±3.0	92.6±21.7
13	Power train system	Swing motor mounting bolt	M20 × 2.5	57.9±5.8	419±42.0
14		Swing bearing upper mounting bolt	M20 × 2.5	57.9±6.0	419±43.4
15		Swing bearing lower mounting bolt	M20 × 2.5	57.9±6.0	419±43.4
16		Real axle mounting bolt, nut	M20 × 2.5	58.0±6.3	420±45.6
17		Transmission bracket mounting bolt	M20 × 2.5	58.0±6.3	420±45.6
18		Transmission mounting bolt	M20 × 2.5	39.0±4.2	282±30.4
19		Oscillating cylinder mounting bolt	M22 × 1.5	83.2±9.2	602±66.5
20		Oscillating cylinder support mounting bolt	M16 × 2.0	29.7±4.5	215±32.5
21		Wheel nut	M22 × 1.5	60±5.0	434±36.2
22		Front drive shaft mounting bolt, nut	M10 × 1.0	5.9±0.6	42.7±4.3
23		Rear drive shaft mounting bolt, nut	M10 × 1.0	5.9±0.6	42.7±4.3
24		Fan & brake pump mounting bolt	M10 × 1.5	6.9±1.4	49.9±10.1
25	Others	Counterweight mounting bolt	M36 × 3.0	308±46	2228±333
26		Cab mounting bolt, nut	M12 × 1.75	12.8±3.0	92.6±21.7
27		Operator's seat mounting bolt	M 8 × 1.25	4.05±0.8	29.3±5.8
28		Under cover mounting bolt	M12 × 1.75	12.8±3.0	92.6±21.7

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

2. TORQUE CHART

The torques given are standard figures. Any figures specifically described in this manual has priority.

1) BOLT AND NUT

(1) Coarse thread

Bolt size	8T		10T	
	kg · m	lb · ft	kg · m	lb · ft
M 6 × 1.0	0.9 ~ 1.3	6.5 ~ 9.4	1.1 ~ 1.7	8.0 ~ 12.3
M 8 × 1.25	2.0 ~ 3.0	14.5 ~ 21.7	2.7 ~ 4.1	19.5 ~ 29.7
M10 × 1.5	4.0 ~ 6.0	28.9 ~ 43.4	5.5 ~ 8.3	39.8 ~ 60.0
M12 × 1.75	7.4 ~ 11.2	53.5 ~ 81.0	9.8 ~ 15.8	70.9 ~ 114
M14 × 2.0	12.2 ~ 16.6	88.2 ~ 120	16.7 ~ 22.5	121 ~ 163
M16 × 2.0	18.6 ~ 25.2	135 ~ 182	25.2 ~ 34.2	182 ~ 247
M18 × 2.5	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	130.2
1"	41	21	151.9
1-1/4"	50	35	253.2

3) PIPE AND HOSE (ORFS type)

Thread size (UNF)	Width across flat (mm)	kgf · m	lbf · ft
9/16-18	19	4	28.9
11/16-16	22	5	36.2
13/16-16	27	9.5	68.7
1-3/16-12	36	18	130.2
1-7/16-12	41	21	151.9
1-11/16-12	50	35	253.2

4) FITTING

Thread size	Width across flat (mm)	kgf · m	lbf · ft
1/4"	19	4	28.9
3/8"	22	5	36.2
1/2"	27	9.5	68.7
3/4"	36	18	130.2
1"	41	21	151.9
1-1/4"	50	35	253.2

1. REMOVAL AND INSTALL

1) REMOVAL

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

(2) Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping

(3) Loosen the breather slowly to release the pressure inside the hydraulic tank.

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

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

· Hydraulic tank quantity : 103 ℓ
(27.2 U.S. gal)

(5) Remove socket bolts (13) and disconnect hoses (1, 2).

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

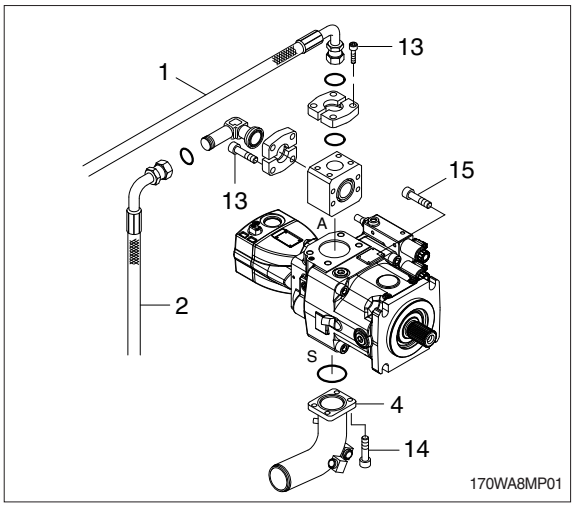
(7) Remove socket bolts (14) and disconnect pump suction pipe (4).

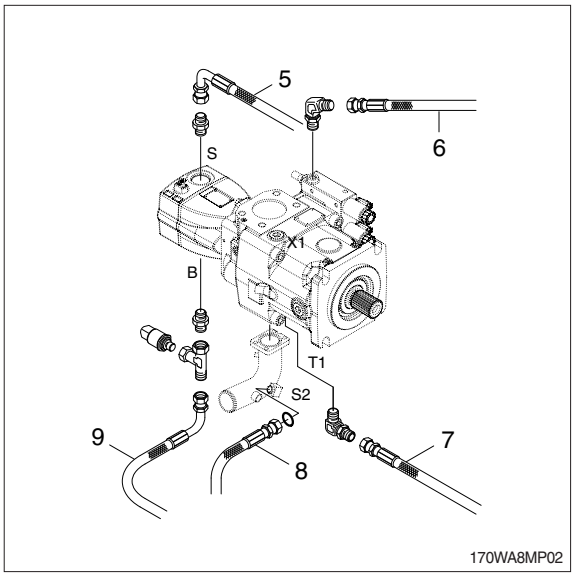
※ When pump suction tube is disconnected, the oil inside the piping will flow out, so catch it in oil pan.

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

· Weight : 91 kg (200 lb)
· Tightening torque : 57.9 ± 8.7 kgf·m
(419 ± 62.9 lbf·ft)

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





2) INSTALL

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

(2) Remove the suction strainer and clean it.

(3) Replace return filter with new one.

(4) Remove breather and clean it.

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

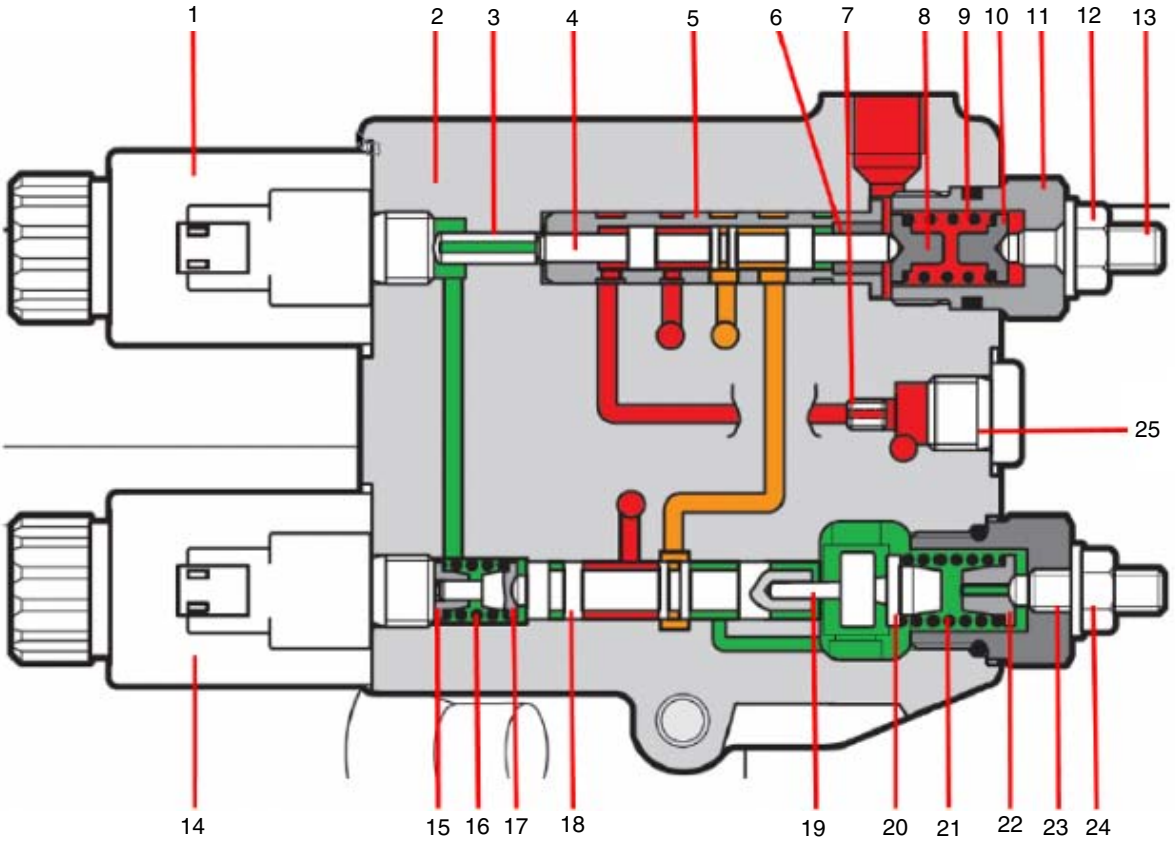
(6) Bleed the air from the hydraulic pump.
① Remove the air vent plug (2EA).
② Tighten plug lightly.
③ Start the engine, run at low idling, and check oil come out from plug.
④ Tighten plug.

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

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

2. MAIN PUMP

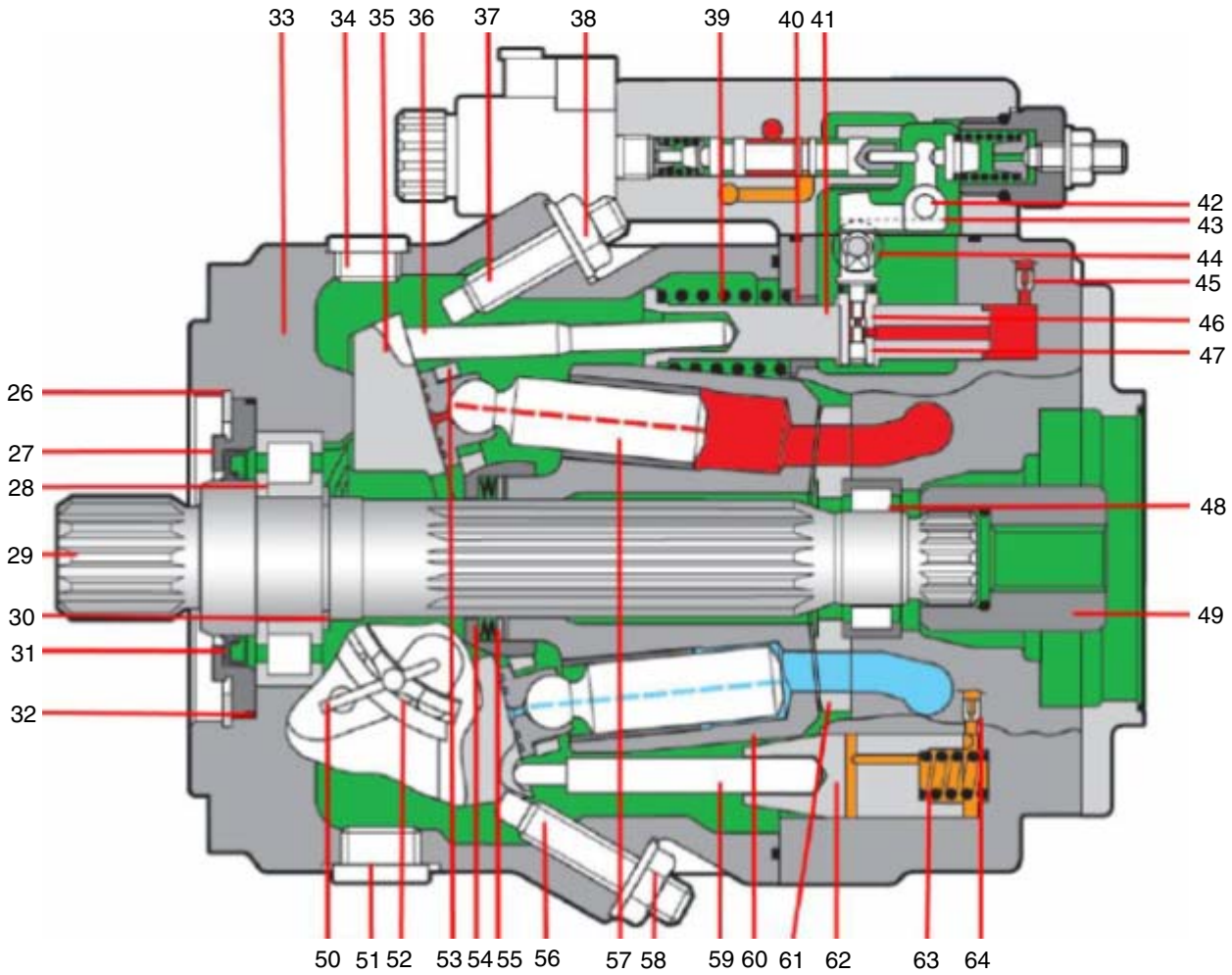
1) STRUCTURE (1/2)



140WA2MP04

1	Prop. solenoid	10	Spring cup	19	Bolt
2	Control housing	11	Screw plug	20	Spring bolt
3	Pin	12	Sealing nut	21	Spring cup
4	Control piston LS	13	Set screw	22	Set screw
5	Control bushing LS	14	Prop. solenoid	23	Sealing nut
6	Bushing	15	Spring cup	24	Seal screw
7	Orifice	16	Spring	25	Screw plug
8	Spring cup	17	Spring cup		
9	Spring LS	18	Control piston LR		

STRUCTURE (2/2)



140WA2MP05

26	Snap ring	39	Spring	52	Cage pair
27	Locking ring	40	Bushing	53	Retaining plate
28	Cylinderical roller bearing	41	Adjusting bushing small	54	Retaining ball
29	Drive shaft	42	Bolt	55	Cup spring stack
30	Snap ring	43	Angle lever	56	Adjusting screw
31	Shaft seal ring	44	Measuring roll	57	Piston pad
32	O-ring	45	Orifice	58	Sealing nut
33	Housing	46	Measuring bushing	59	Adjusting rod big
34	Screw plug	47	Measuring piston	60	Cylinder
35	Cradle	48	Cylinderical roller bearing	61	Control plate
36	Adjusting rod small	49	Coupling hub	62	Adjusting bushing big
37	Adjusting screw	50	Wire	63	Spring
38	Sealing nut	51	Screw plug	64	Orifice

2) GENERAL PRECAUTIONS

(1) Disassembly

① Before disassembling the main pump, check the items to be inspected and, for remedy against trouble, closely examine the nature of the trouble, so that the motor can be disassembled effectively.

② To disassemble the main pump, use the disassembling procedures described in section 2) and select a clean place.

③ Place a rubber or vinyl sheet or other such protective materials on your working bench to protect the surface of the main pump to be serviced.

④ During disassembly, give a match mark to the mating surfaces of each part.

⑤ Arrange removed parts in order so that they will not become damaged or missing during disassembly.

⑥ Once seals have been disassembled, they should be replaced even if damage is not observed. Have replacement seals ready on hand before starting your disassembling job.

(2) Assembly

① Reassemble in a work area that is clean and free from dust and grit.

② Handle parts with bare hands to keep them free of linty contaminants.

③ Repair or replace the damaged parts.
Each parts must be free of burrs its corners.

④ Do not reuse O-ring and seal ring that were removed in disassembly.
Provide the new parts.

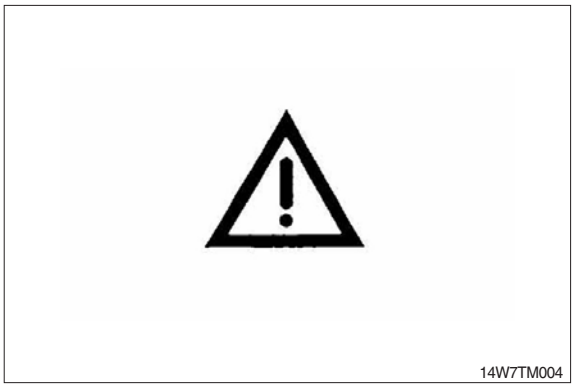
⑤ Wash all parts thoroughly in a suitable solvent.
Dry thoroughly with compressed air.
Do not use the cloths.

⑥ When reassembling oil motor components of main pump, be sure to coat the sliding parts of the main pump and valve with fresh hydraulic oil. (NAS class 9 or above)

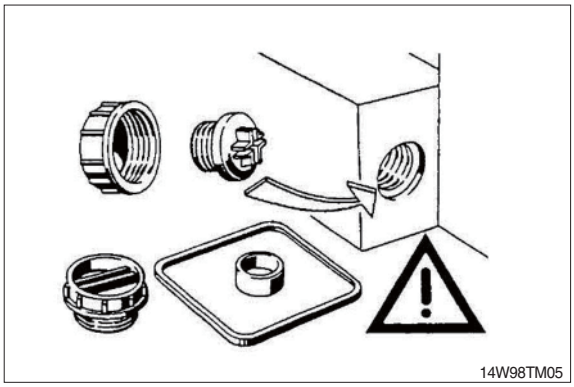
⑦ Use a torque wrench to tighten bolts and plugs, to the torque specified.

3) GENERAL REPAIR INSTRUCTIONS

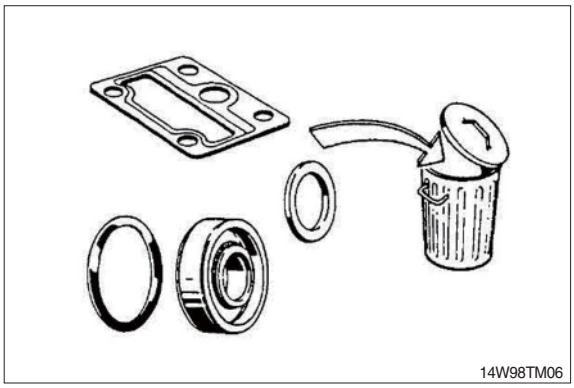
Observe the following notices when carrying out repair work at hydraulic aggregates.



(1) Close all ports of the hydraulic aggregates.

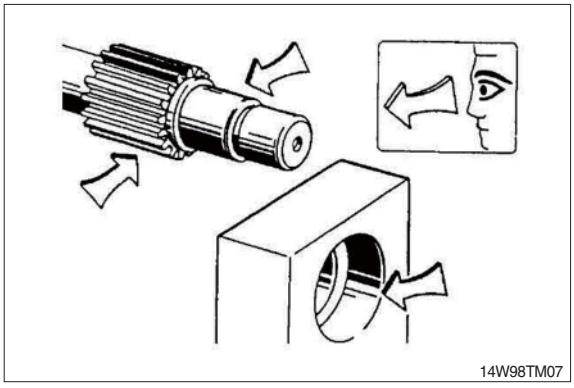


(2) Replace all seals.
Use only Hyundai original spare parts.

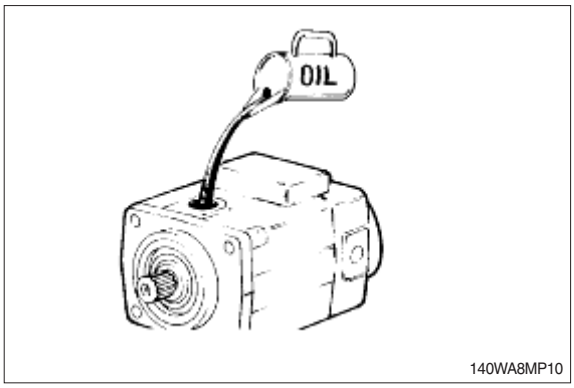


(3) Check all seal and sliding surfaces for wear.

※ Rework of sealing area f.ex. with abrasive paper can damage surface.

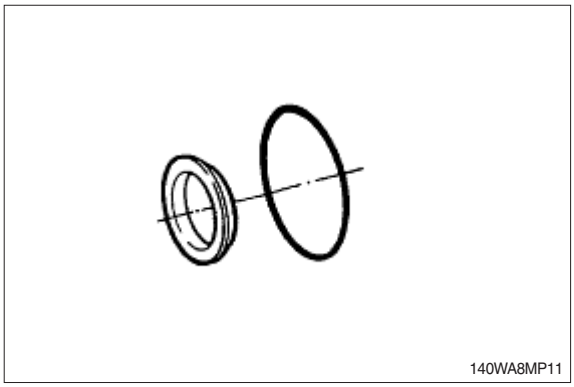


(4) Fill up hydraulic aggregates with hydraulic oil respectively deaerate before start up.

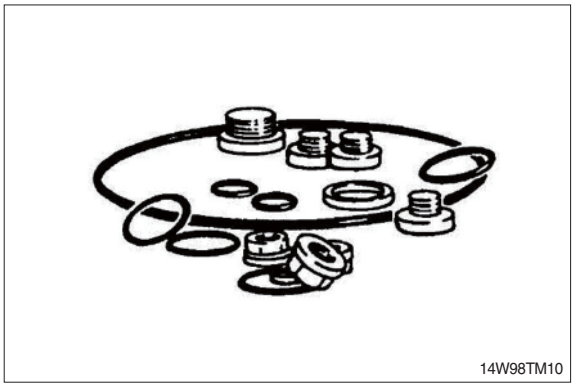


140WA8MP10

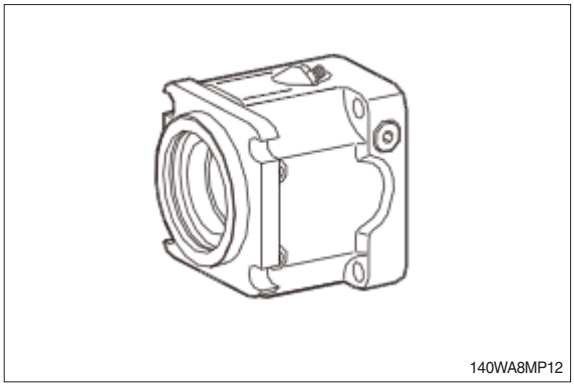
(5) Seal kit for drive shaft


140WA8MP11

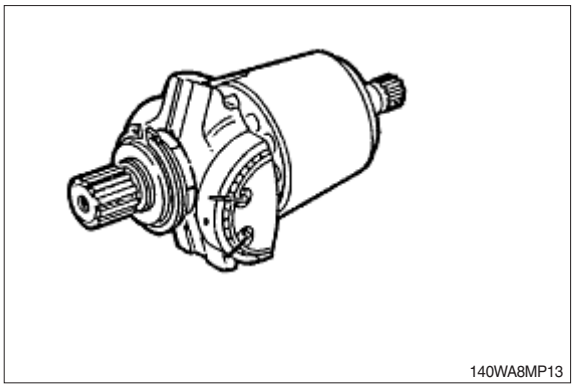
(6) External seal kit.


14W98TM10

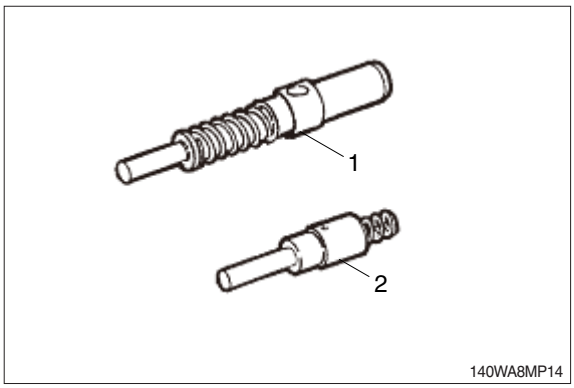
(7) Housing.


140WA8MP12

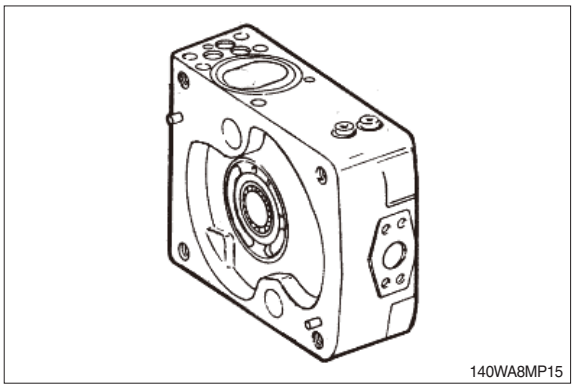
(8) Complete rotary group.



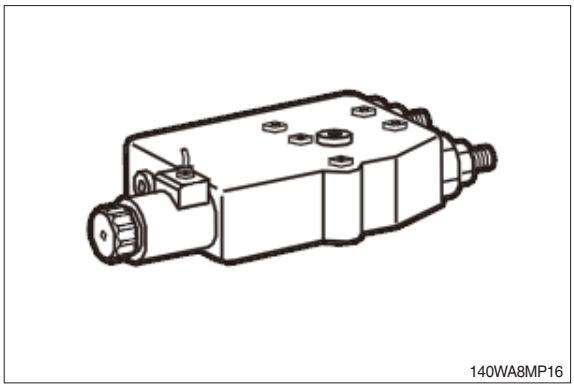
(9) Hydraulic control
1 Small size
2 Big size



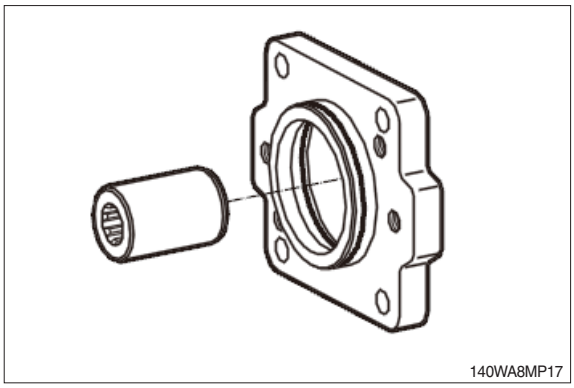
(10) Port plate



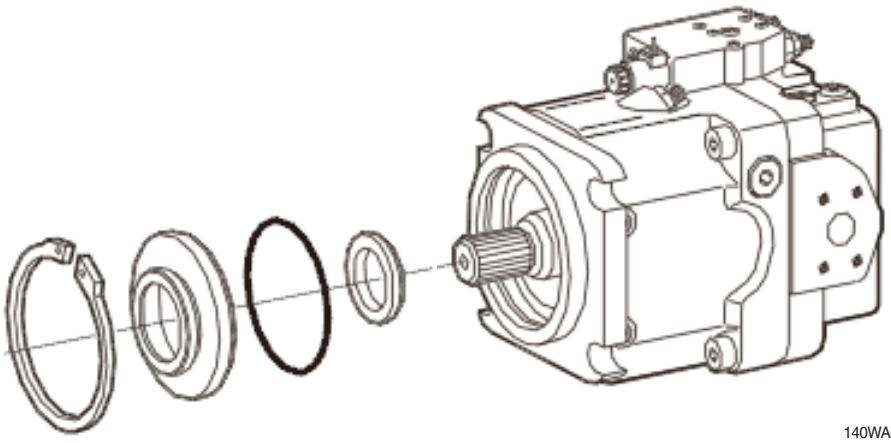
(11) Complete regulator



(12) Pump support plate

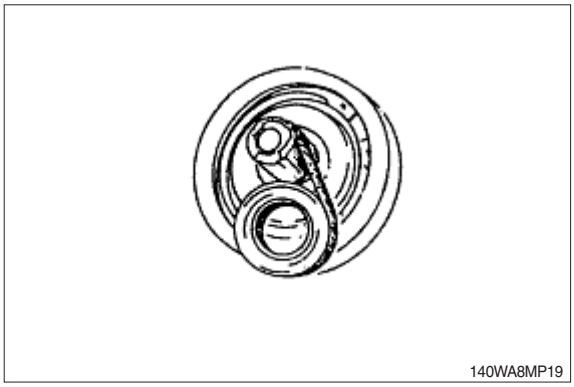


4) SEALING OF THE DRIVE SHAFT



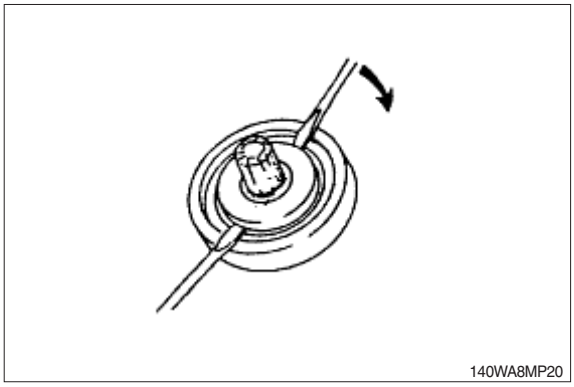
140WA8MP18

(1) Protect the drive shaft.



140WA8MP19

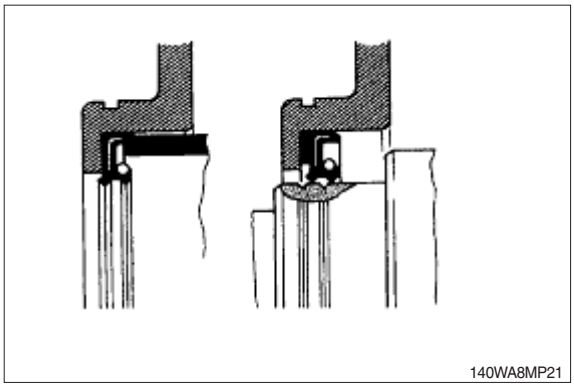
(2) Loosen retaining ring and remove it, press away front cover.



140WA8MP20

(3) Press in the shaft seal ring to the correct position with a suitable sleeve.

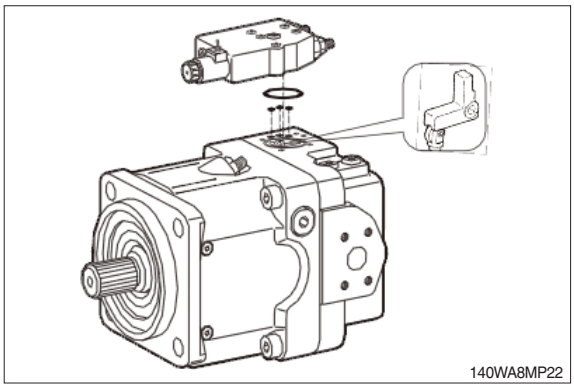
※ If the shaft is deeply grooved, insert shim behind seal.

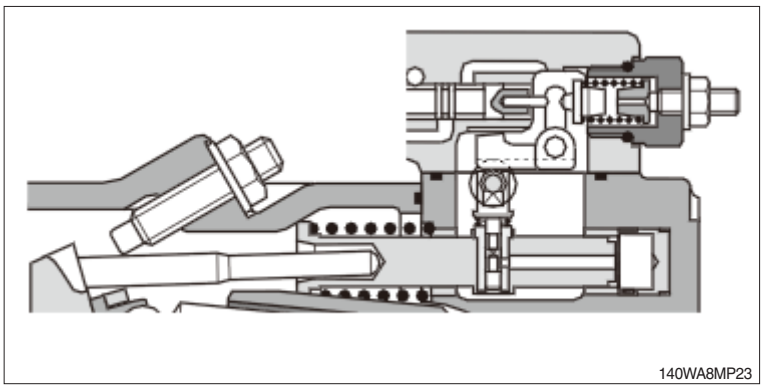


140WA8MP21

5) SEALING OF THE REGULATOR HOUSING

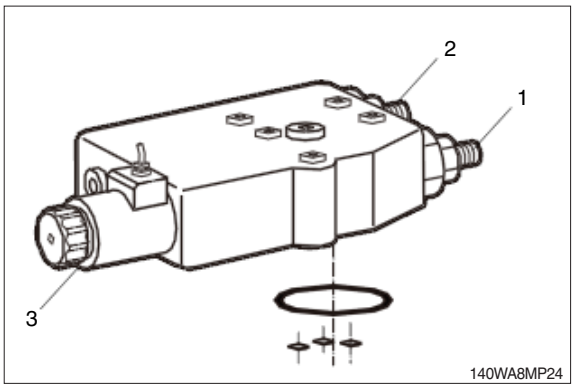
(1) Remove screws and press off regulator, thereby make sure that sealing surface is not damaged.



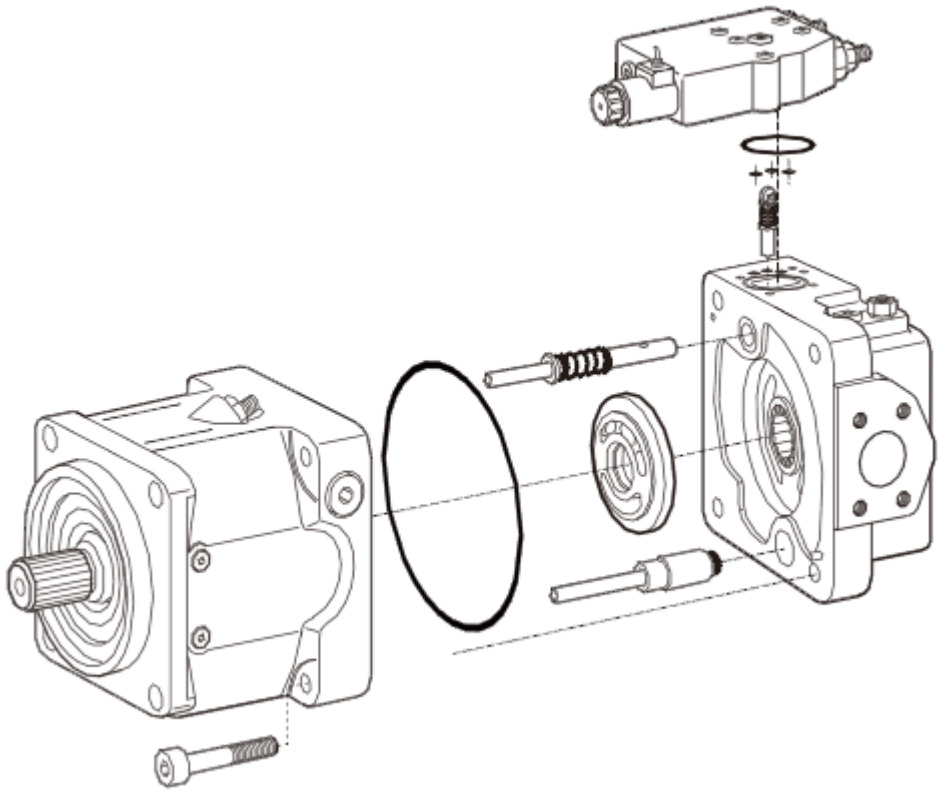


1 Power control
2 Load sensing control
3 Solenoid for power override

※ Do not change position of adjustment screws.
Remove complete set of threaded bush with adjustment screws.

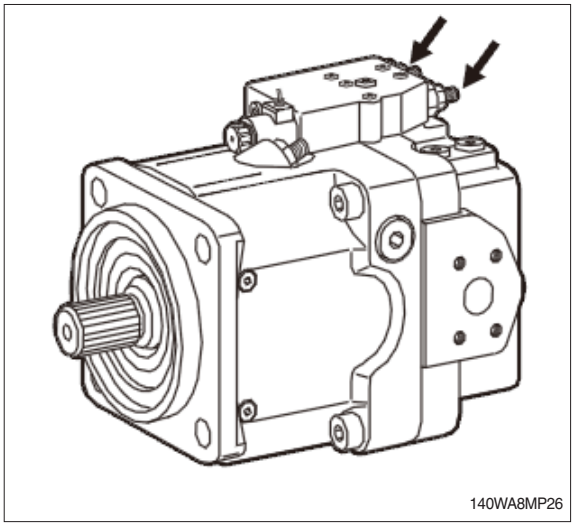


6) REMOVE PORT PLATE, REGULATOR

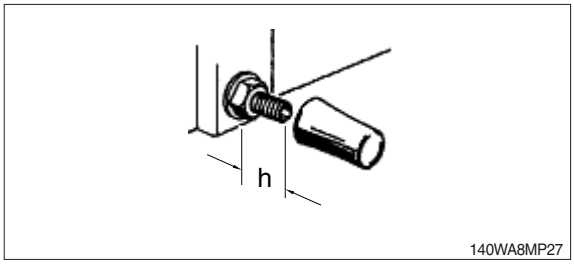


140WA8MP25

(1) Remove protection cover.
Measure and note adjustment heigth "h".

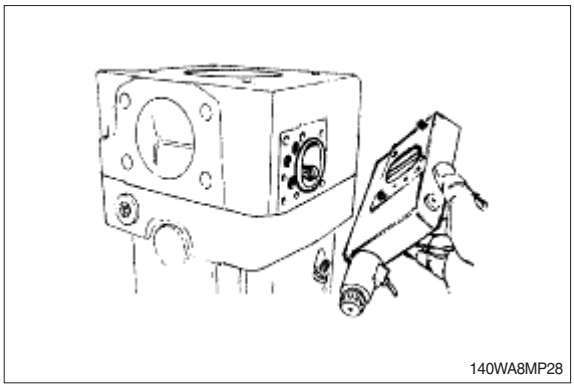


140WA8MP26

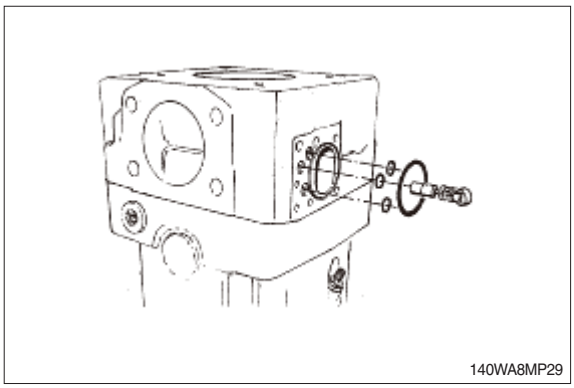


140WA8MP27

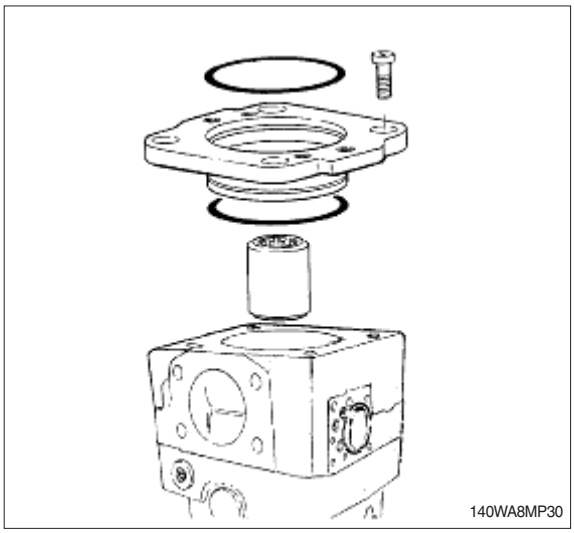
(2) Remove regulator housing.



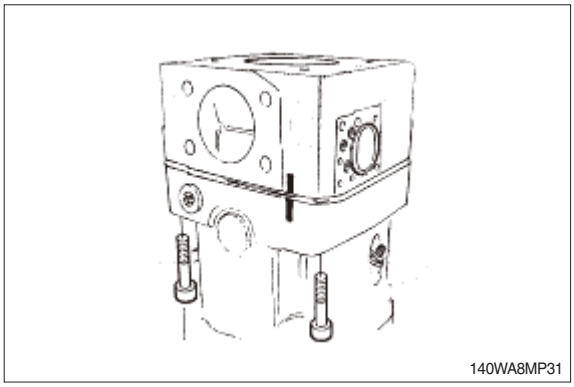
(3) Remove O-ring, measuring piston with bushing and spring.



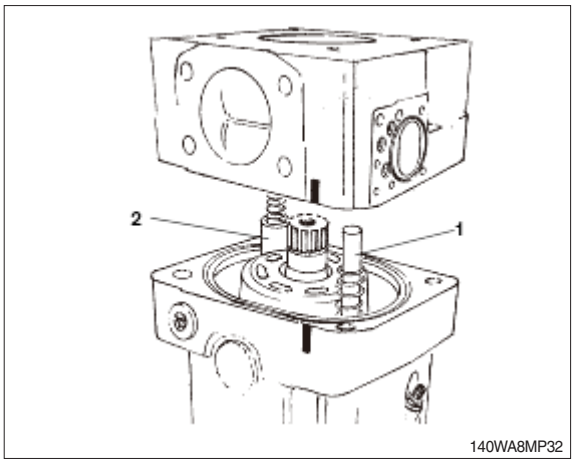
(4) Remove pump support plate.



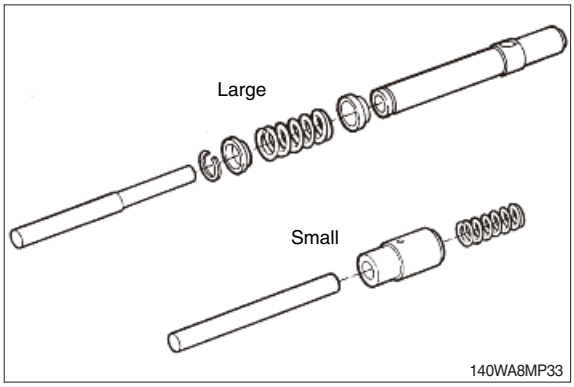
(5) Mark position of the connection plate. Loosen connection plate fixation.



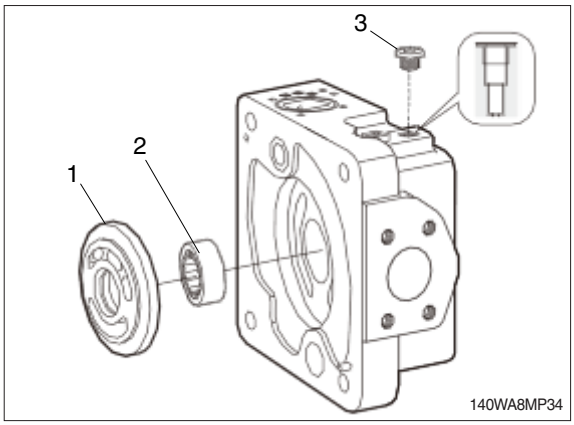
(6) Remove port plate with control plate.
Disassemble regulator.



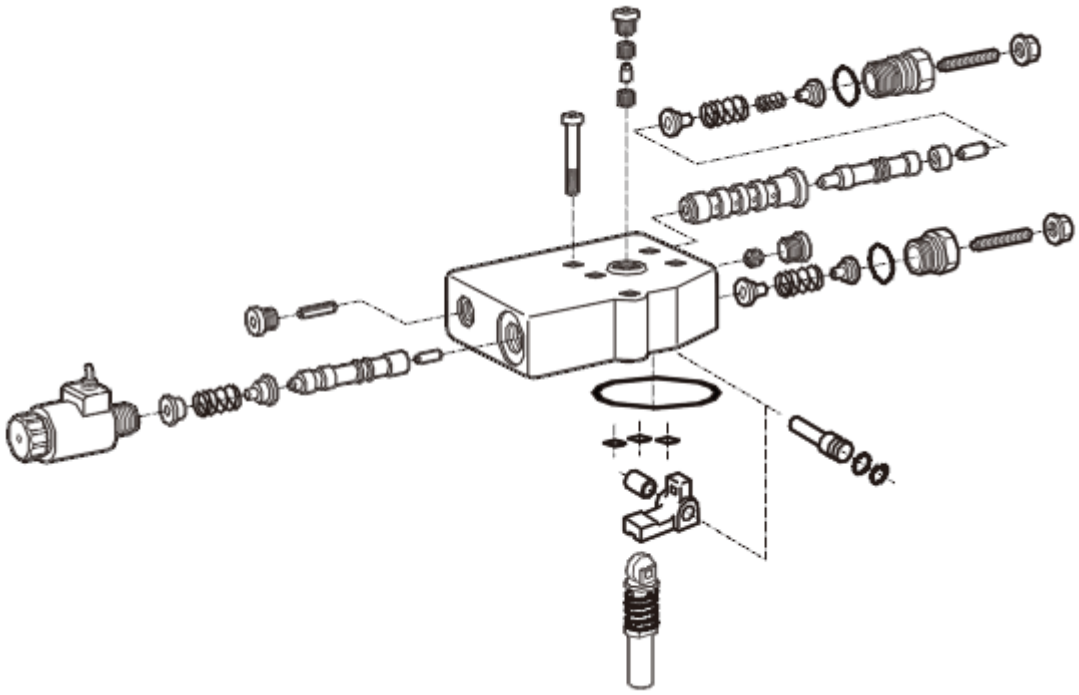
1 Hydraulic control - small
2 Hydraulic control - large



1 Control plate
2 Cylinder roller bearing
3 Port "G"

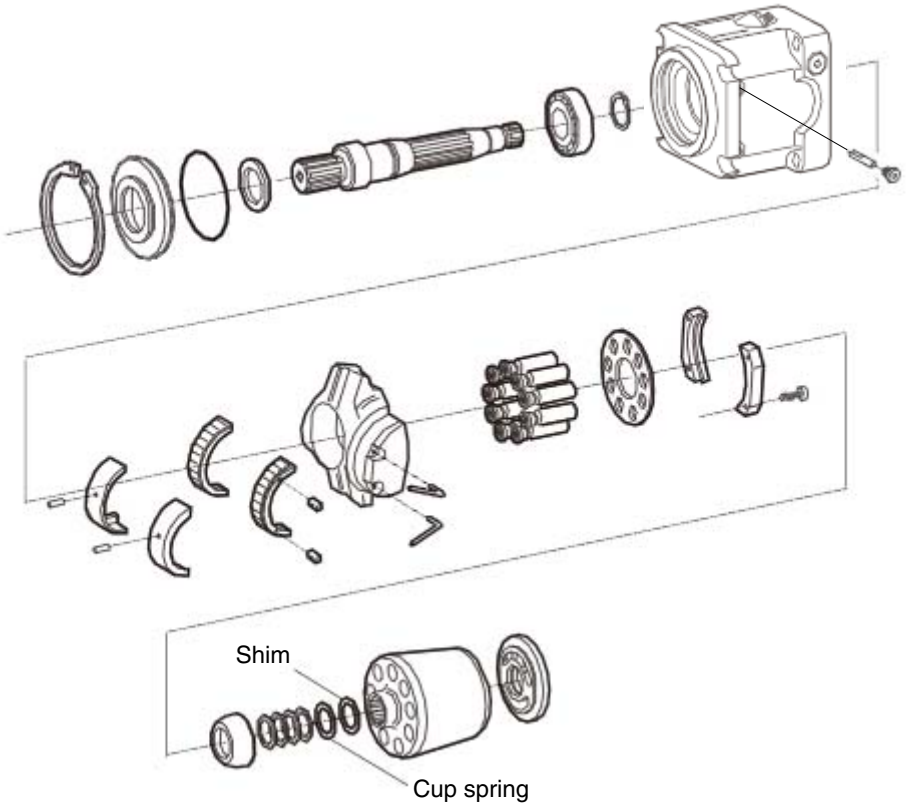


7) REMOVE REGULATOR



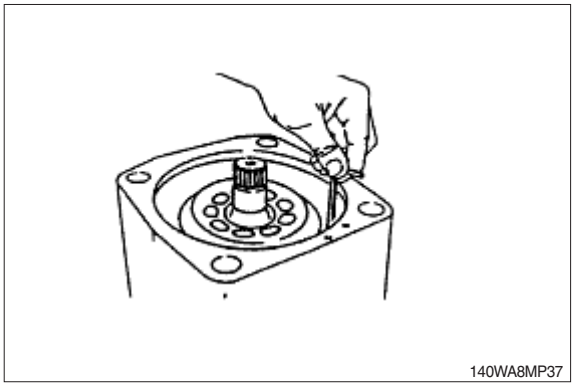
140WA8MP35

8) REMOVE ROTARY GROUP



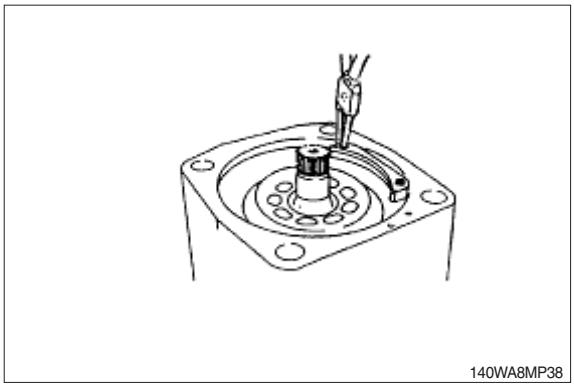
140WA8MP36

(1) Loosen fixing of the retaining segments.



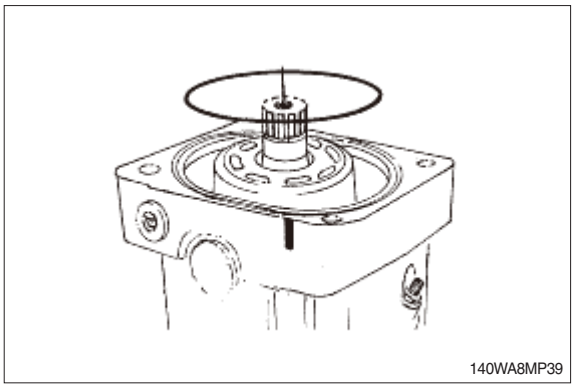
140WA8MP37

(2) Remove retaining segments with screws.

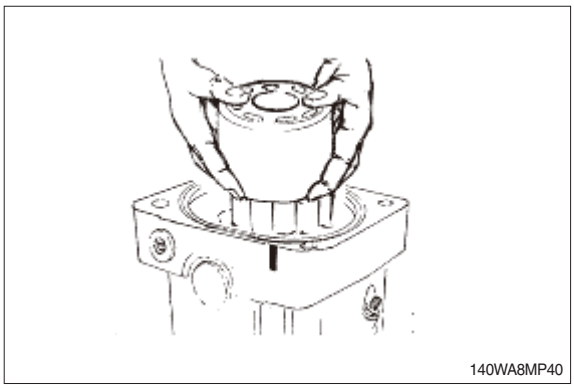


140WA8MP38

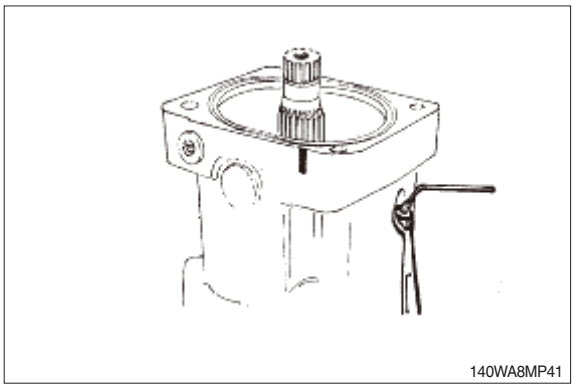
(3) Remove O-ring.



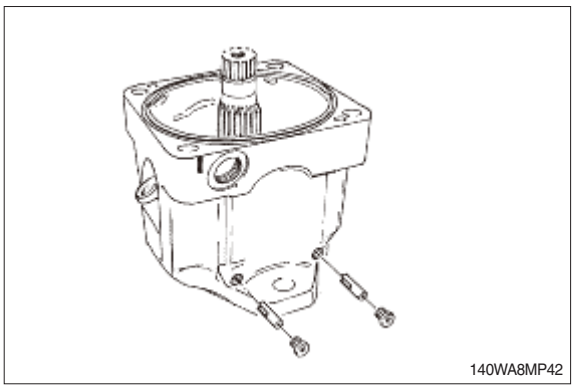
(4) Remove cylinder with pistons.



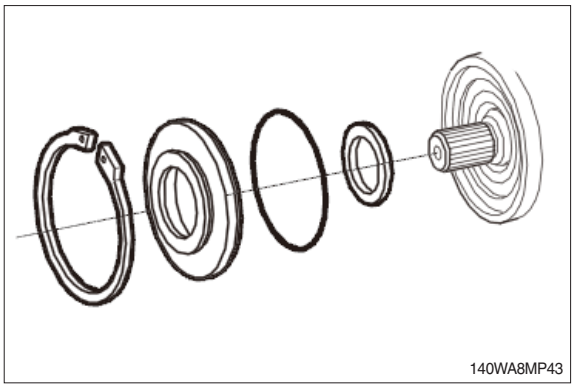
(5) Remove Q-min and Q-max screws after noting down adjustment dimension.



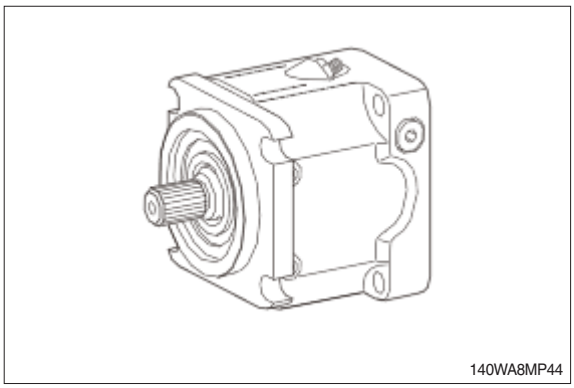
(6) Remove joint pin for swivel cradle.



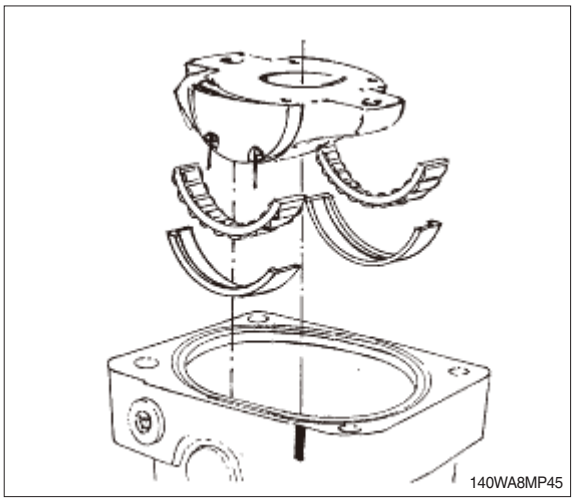
(7) Remove completely cover ring.



(8) Press out drive shaft.

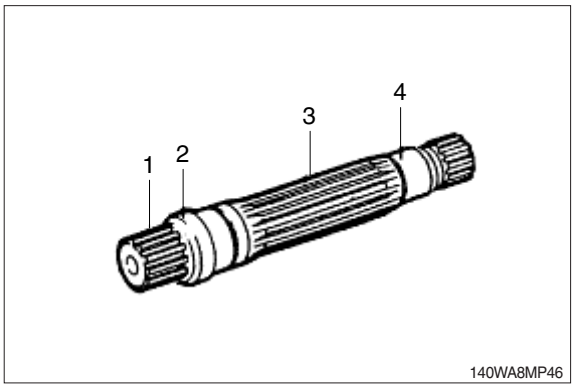


(9) Remove swivel cradle with bearing as well as bearing case.

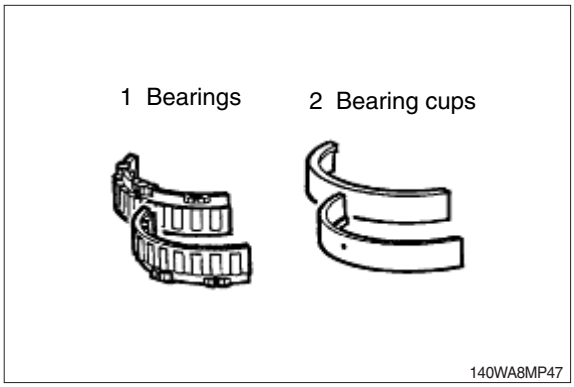


9) GENERAL REPAIR INSTRUCTIONS

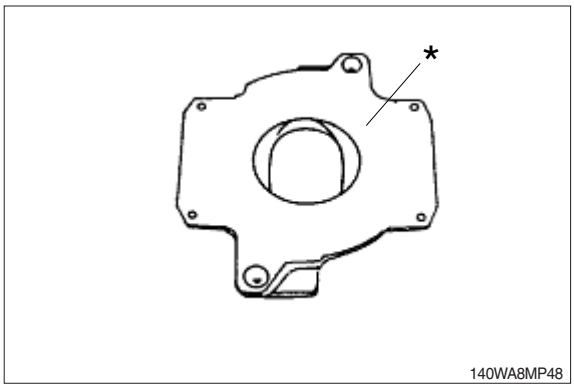
(1) Check
① Gears (1); Contact area shaft seal (2); Gears (3); Bearing seat (4).
② Sliding surface (1) free of scoring.



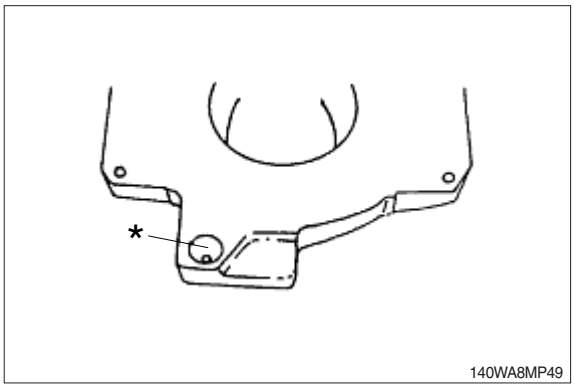
(2) Check
① Bearings (1).
② Bearing cups (2).



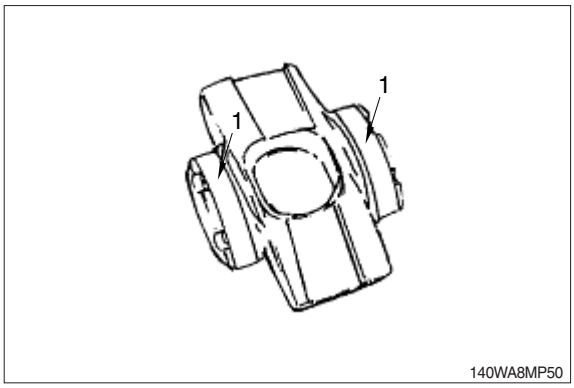
(3) Check
① Contact area (*).



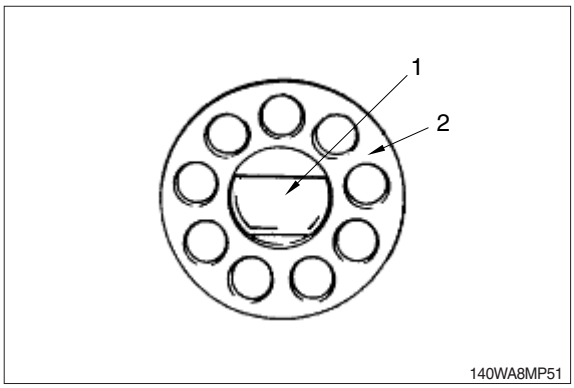
(4) Check
① Socket for regulator (*).



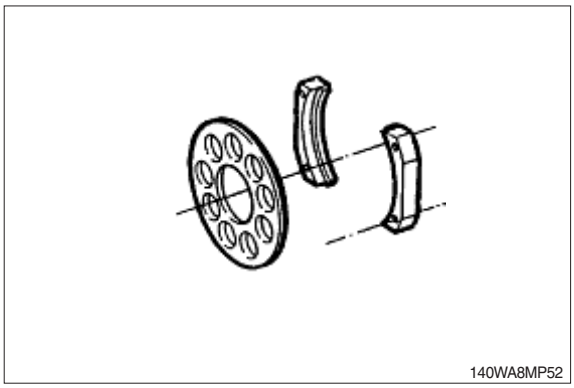
(5) Check
① Contact area of bearing (1).



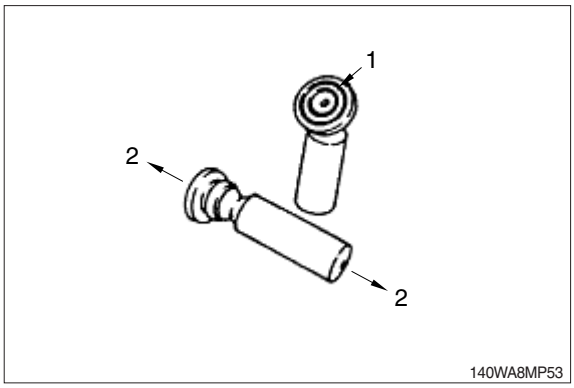
(6) Inspection
① Retaining ball (1)
② Retaining plate (2).



(7) Inspection
① Fixing segments



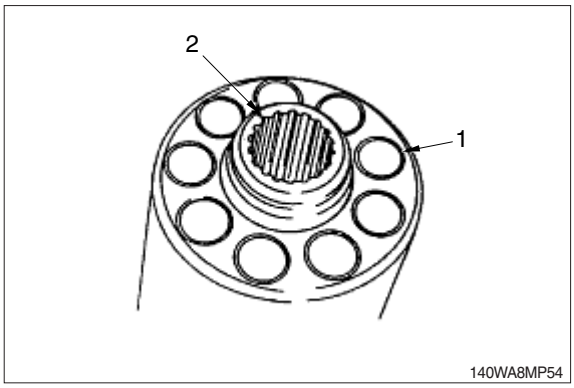
(8) Inspection
① Slipperpads (1),
② Axial backslash (2).



(9) Inspection

① Cylinder boring (1),

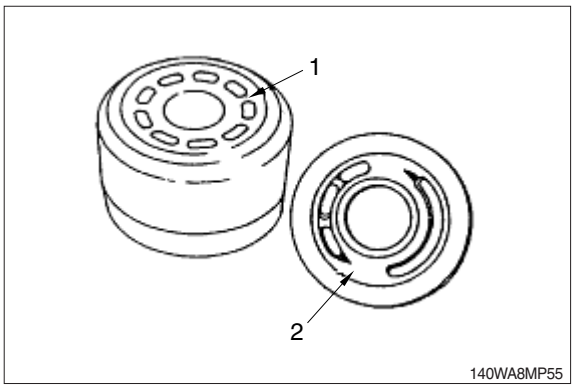
② Gears (2).



(10) Inspection

① Cylinder contact area (1).

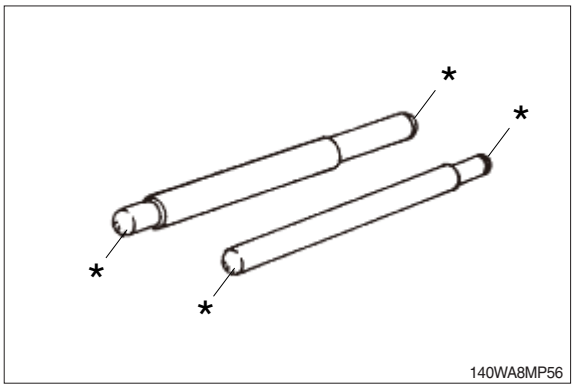
② Contact area control plate (2).



(11) Inspection

① Fixing segments

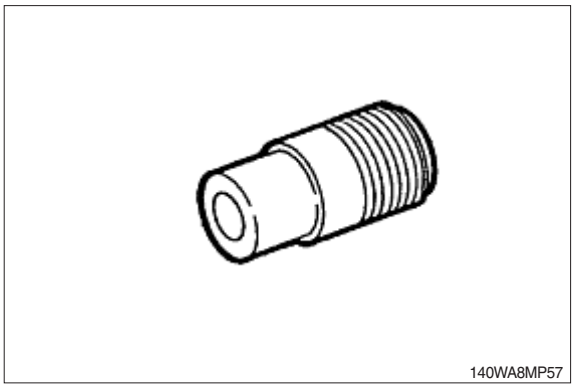
⚠ Assemble the grinded side to the cradle!



(12) Inspection

① Piston (*)

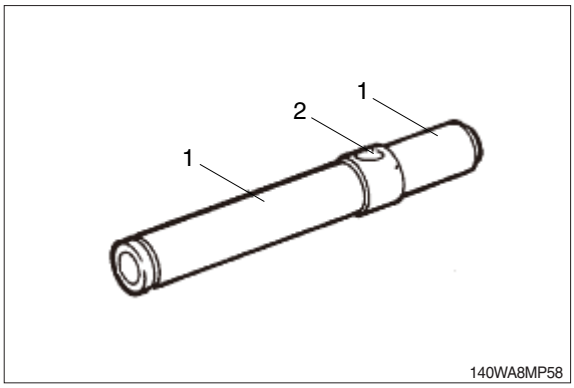
Adjustment



(13) Inspection

① Positioning piston (1),

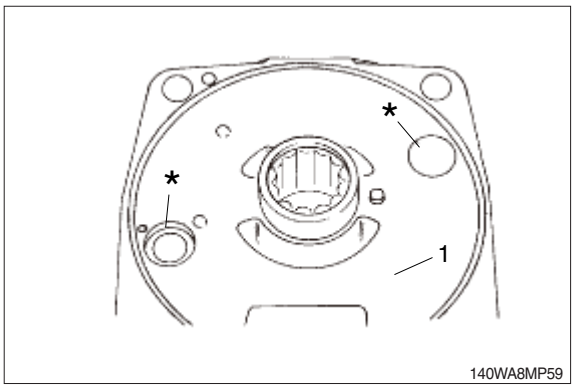
② Boring - control bush (2).



(14) Inspection

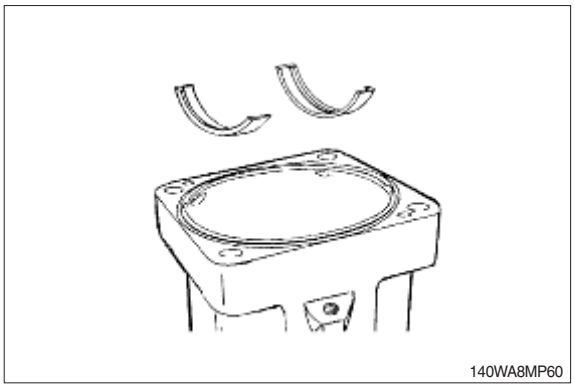
① Boring (*),

② Contact area control plate (1).

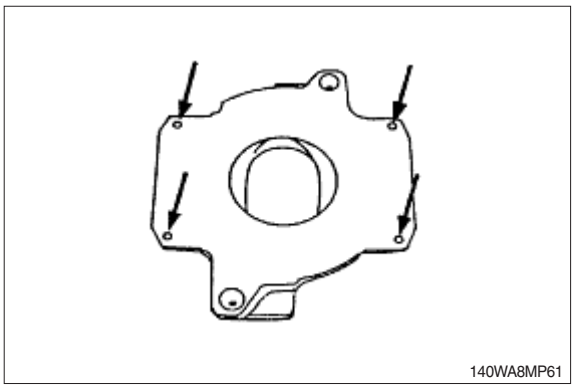


10) PUMP ASSEMBLY

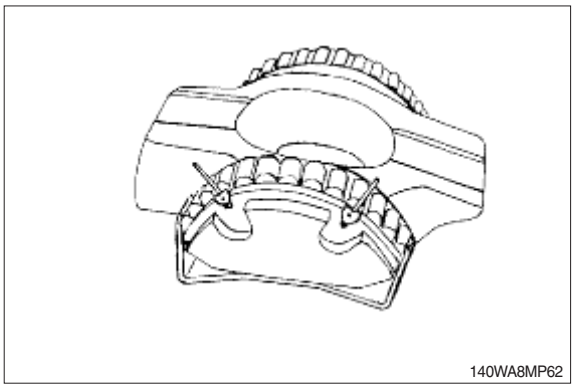
(1) Insert bearing bell.



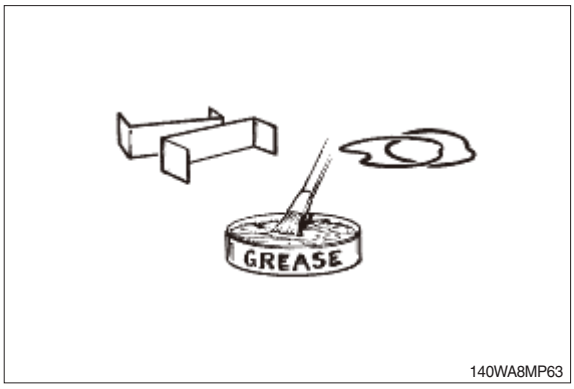
(2) Clean threaded borings.



(3) Install bearings with wire guide on swivel cradle.
Fixing with auxiliary device.

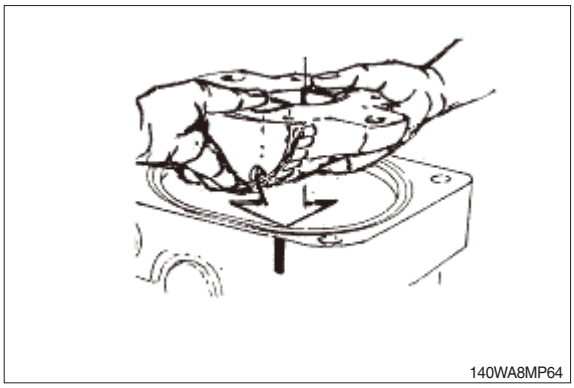


(4) Auxiliary devices e. g.
① Clamp
② Rubber rings
② Grease



(5) Place swivel cradle with bearing into bearing shell.

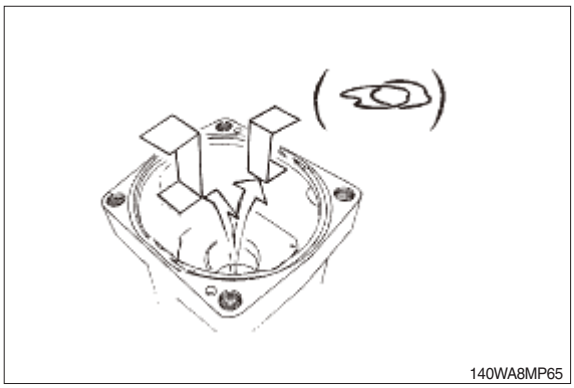
※ Installation position.



140WA8MP64

(6) Remove auxiliary devices.

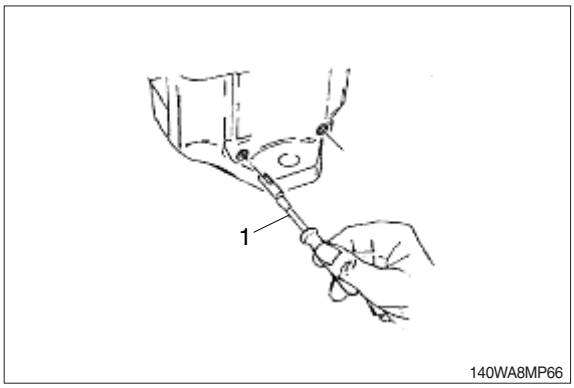
⚠ Check bearing seats.



140WA8MP65

(7) Adjust guide wire. Install joint pins. Install locking screws.

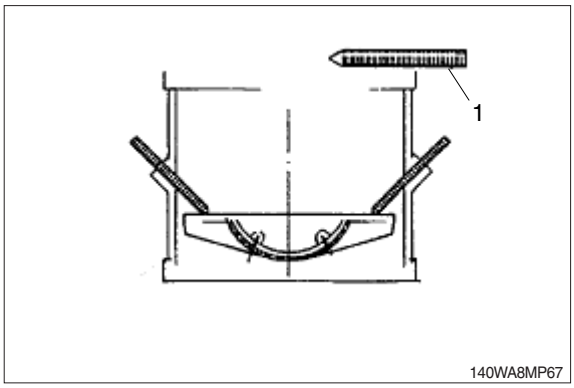
1 Auxiliary device screw driver



140WA8MP66

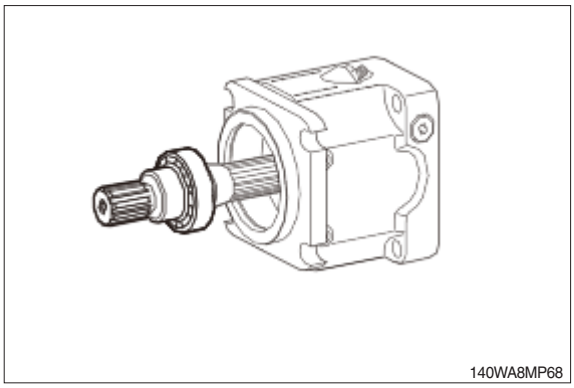
(8) Fit swivel cradle with threaded pin in zero position.

1 Auxiliary device (threaded pins 2x).

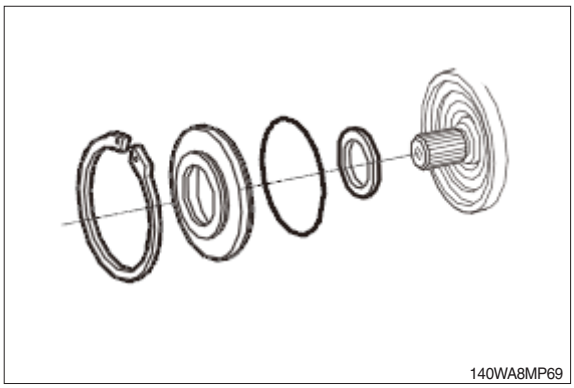


140WA8MP67

(9) Install drive shaft.

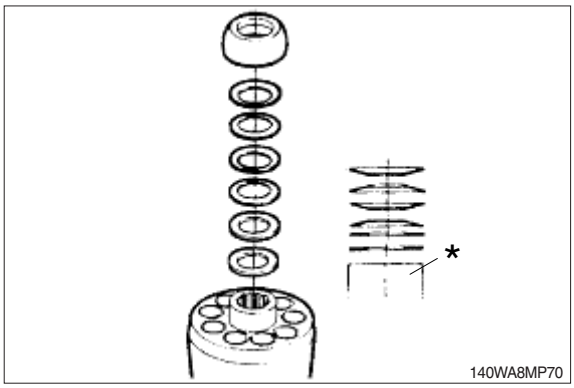


(10) Mount cover ring.



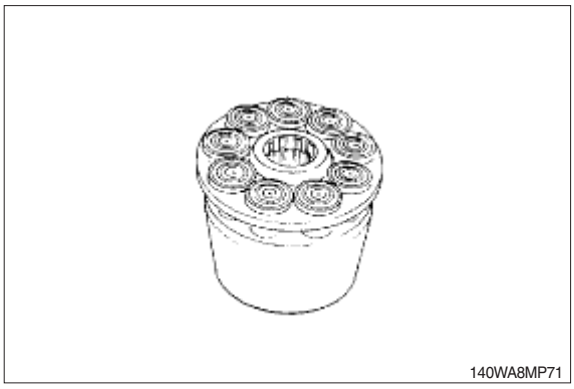
(11) Mount shims, springs and retaining ball.

⚠ Observe correct mounting position*.



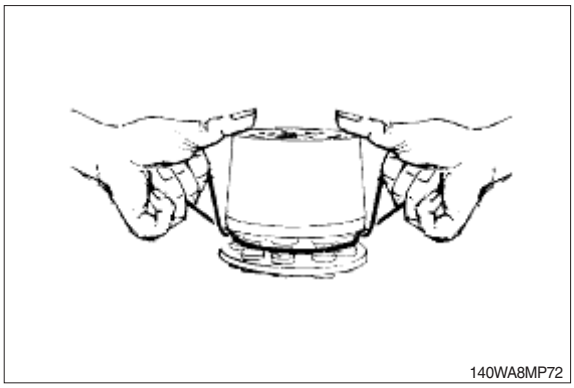
(12) Place retaining plate with piston into cylinder.

⚠ Align gearing of retaining ball / cylinder.



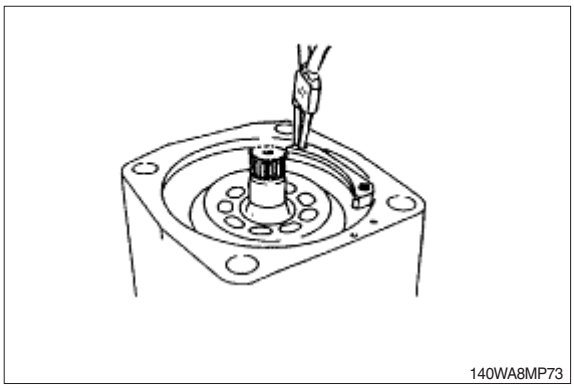
(13) Assembly hint

Fix with O-ring via piston retaining assembly.



140WA8MP72

(14) Insert fixing segments.

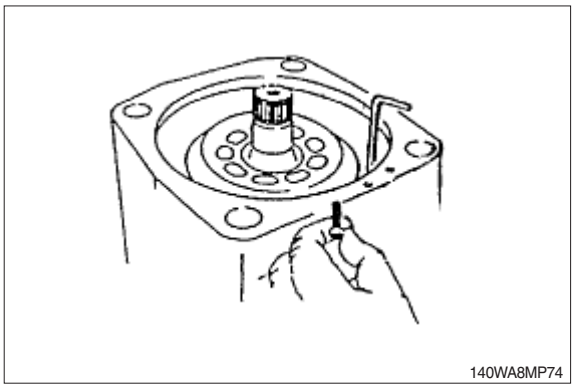


140WA8MP73

(15) Install screws with Precote.

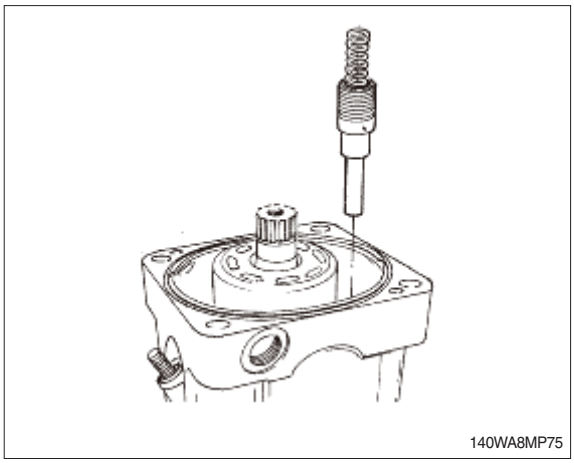
⚠ Pay attention with hardening time.

Tight screws with torque value.



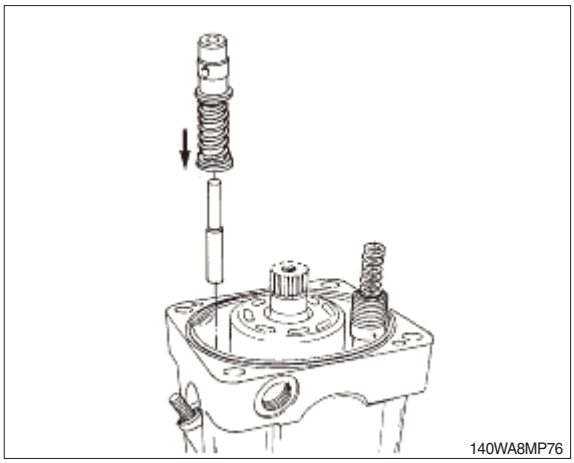
140WA8MP74

(16) Hydraulic control rod - big size



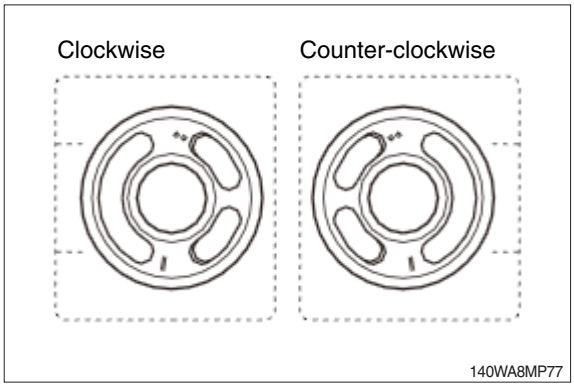
140WA8MP75

(17) Hydraulic control rod - small size.

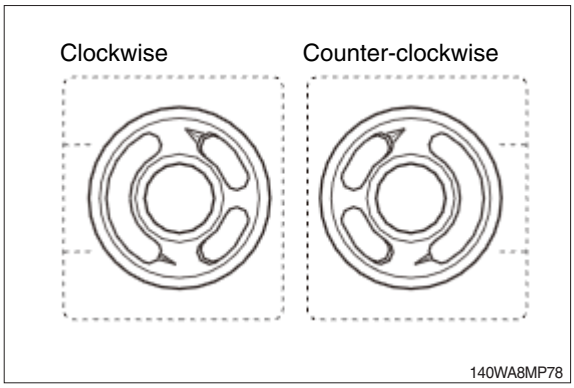


(18) Direction of rotation

① Standard type

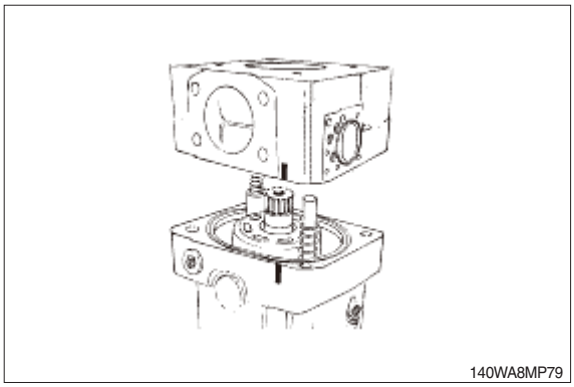


② Special type



(19) Install control plate.

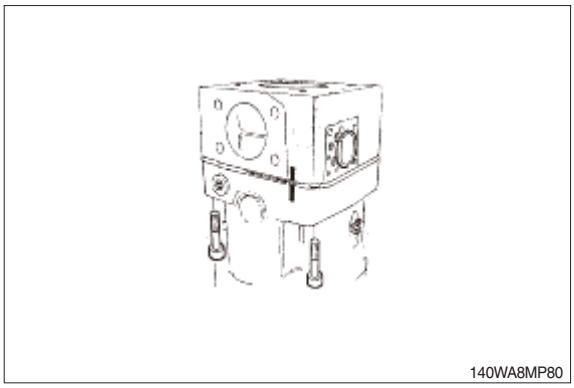
※ Installation position (direction of rotation).



(20) Fix port plate, assembly with screws.

※ Tightening torque

· Tightening torque : 40.8 kgf·m (295 lbf·ft)

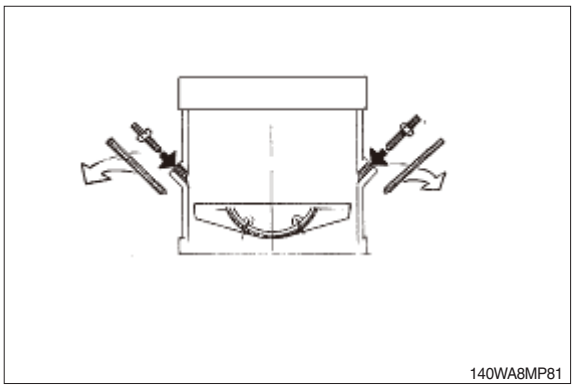


140WA8MP80

(21) Remove threaded pins.

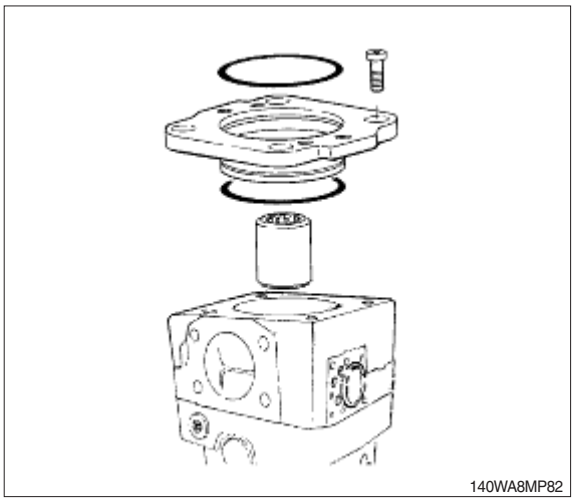
① Install Q-min, Q-max- screws.

② Adjustment measure



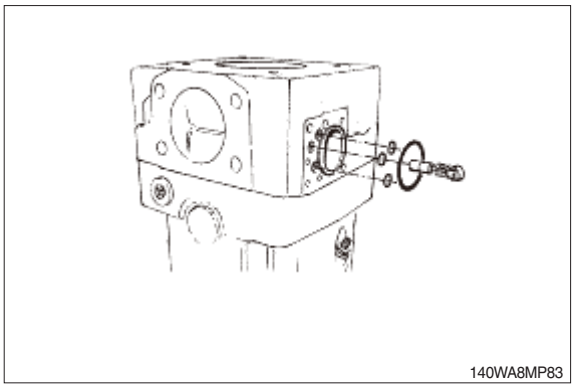
140WA8MP81

⚠ Assemble pump support plate.



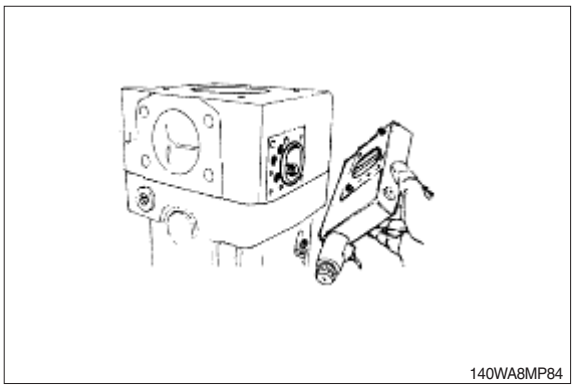
140WA8MP82

(22) Install measuring piston with O-rings.



140WA8MP83

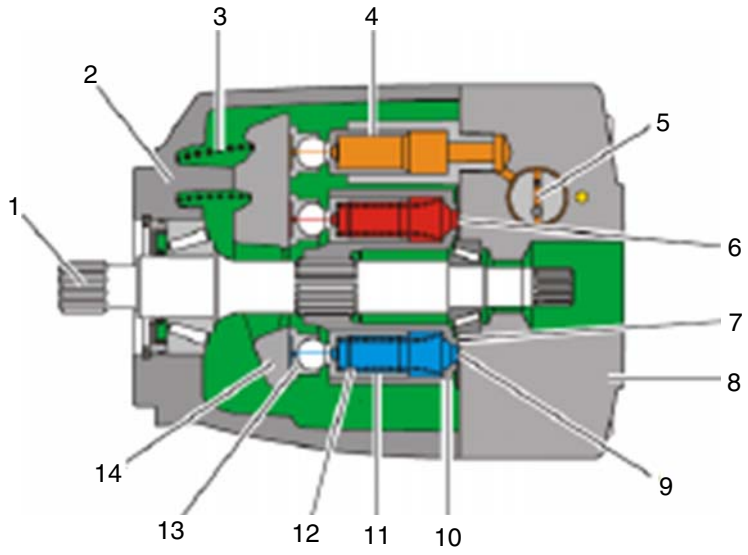
(23) Place regulator.



140WA8MP84

3. STEERING PUMP

1) STRUCTURE

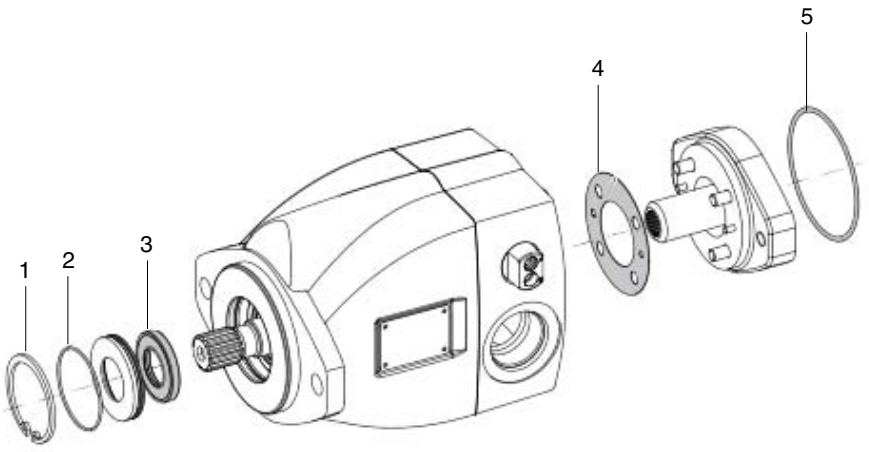


140WA2MP06

1	Drive shaft	6	High pressure side	11	Piston
2	Case	7	Control plate	12	Spring in piston
3	Spring	8	Port plate	13	Slipper pad
4	Stroke piston	9	Suction side	14	Swash plate
5	Control vavle	10	Cylinder		

2) SEALING OF ASSEMBLY GROUPS

Seal kit for control valves and basic unit



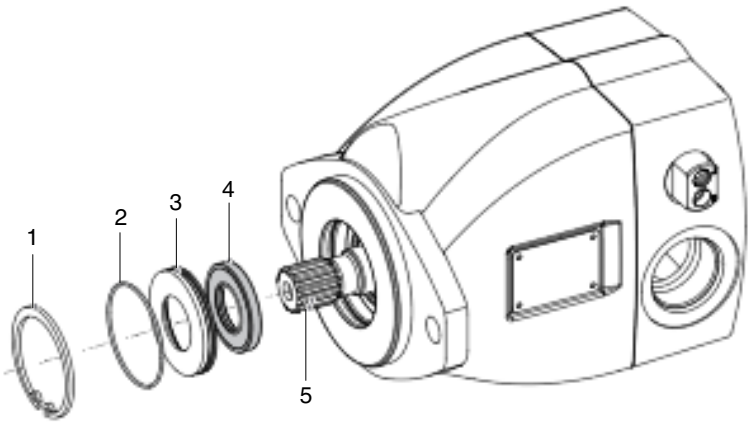
140WA8MP100

1	Snap ring	3	Shaft seal	5	O-ring
2	O-ring	4	Flat gasket		

3) REPLACING SHAFT SEAL

※ Special tools are needed

(1) Removing shaft seal

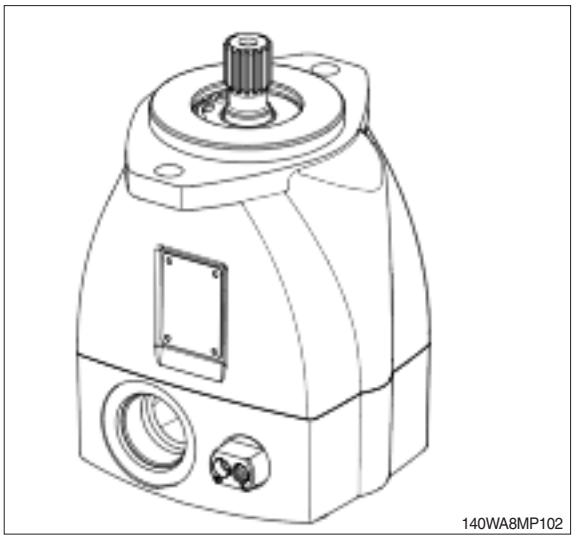


140WA8MP101

1	Snap ring	3	Bearing cover	5	Drive shaft
2	O-ring	4	Shaft seal		

(2) Removal and installation position

In order to replace the shaft seal bring the axial piston unit in an upright position i.e. drive shaft upwards

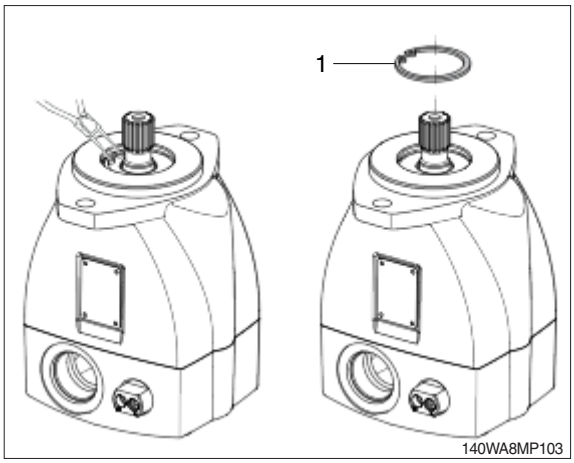


140WA8MP102

(3) Remove the snap ring or shim ring (1).

※ When removing, the snap ring may release in a project-like manner and spring into your face.

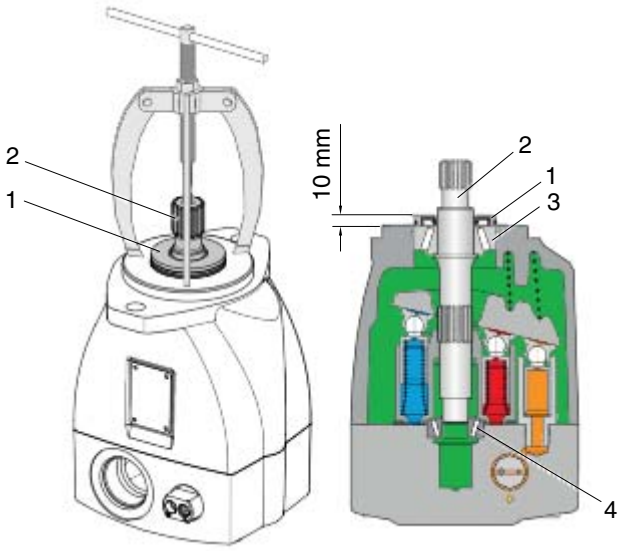
※ Wear safety glasses.



(4) Pull-off tool for removal of bearing cover.
Use a suitable tool when removing the bearing cover.
The relevant thread size in the drive shaft can be found in the installation drawing.

(5) Removal of shaft seal

1 Bearing cover
2 Drive shaft
3 Tapered roller bearing
4 Tapered roller bearing



140WA8MP105

① Pull the drive shaft (2) out far enough to be able to remove the bearing cover (1) without a problem. CAUTION however not more than 10 mm. When removing the bearing cover, pay attention, that the drive shaft is not pulled out any further.

※ Pulling the drive shaft too far out, can cause considerable problems during re-installation or when inserting the drive shaft into the bearing(4) and can lead to rotary group damage.

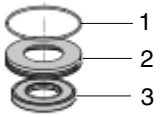
② Remove the pull-off tool without lifting the drive shaft out any further.

③ After removal of the bearing cover (1) bring the drive shaft (2) with the tapered roller bearing and the outer ring (3) back into the initial position i.e. push back as far as possible into the bearing (4) or tapered roller bearing with outer ring (3) to stop collar drive shaft. Leave the axial piston unit in the upright position.

(6) Replacement of O-ring and shaft seal

A special tool is needed to replace the shaft seal

1 O-ring
2 Bearing cover
3 Shaft seal



140WA8MP106

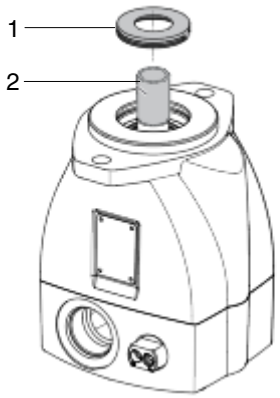
① Press the shaft seal (3) with a suitable special tool out of the bearing cover (2).
② Remove the O-ring (1).
③ Press the new shaft seal (3) with a suitable special tool in.
④ Use and install now the new O-ring (1) from the seal kit as the old O-ring is being destroyed with the removal.

4) INSTALLATION OF BEARING COVER (with new shaft seal and O-ring)

(1) Bearing cover

1 Bearing cover with shaft seal and O-ring
2 Mounting sleeve

① Bring the mounting sleeve (2) over the drive shaft.
② Lightly grease the new shaft seal between the sealing lip and dust lip to prevent dry running.
③ Push the bearing cover (1) correctly positioned over the mounting sleeve (2) without canting and without using force to the stop into the housing.



140WA8MP107

(2) Snap ring/shim ring

1 Snap ring

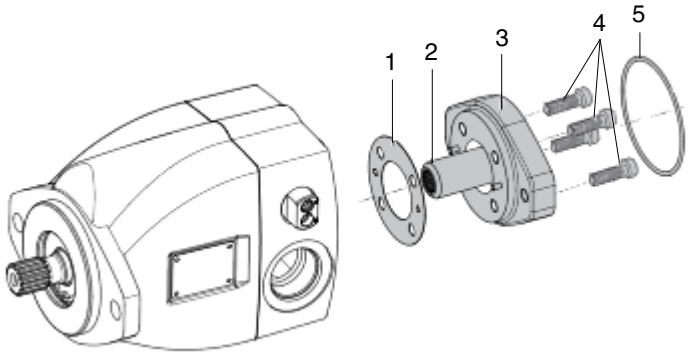
① Install the snap ring (1) correctly positioned in the housing.
② Make sure, that the snap ring snaps completely into the groove.

※ If the snap ring must be replaced, it is necessary that the new, rough snap ring from the seal kit is ground the exactly the same height (shim measurement) as the old snap ring.

140WA8MP108

5) SEALING OF THE UNIVERSAL THROUGH DRIVE

1 Flat gasket
2 Splined hub
3 Adapter flange
4 Mounting bolts
5 O-ring



140WA8MP109

(1) Removal

① Remove the O-ring (5).
② Loosen and remove the mounting bolts (4).
③ Remove the adapter flange (3).
④ Remove the splined hub (2).
⑤ Remove the flat gasket (1).
⑥ Check the sealing surface for damage.

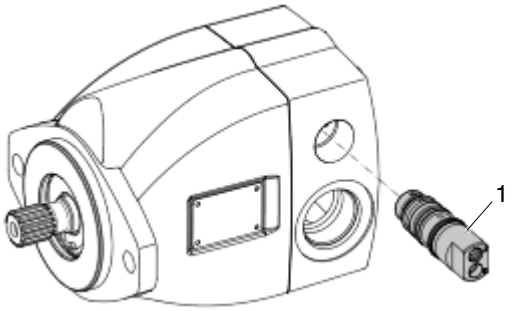
(2) Installation

① Put the flat gasket (1) correctly positioned onto the adapter flange, cylinder pins are used as guide.
※ Pins are not pressed in and can fall out.
② Install the adapter flange (3) with flat gasket (1) onto the port plate.
③ Screw the mounting bolts (4) in by hand and tighten these with the correct tightening torque.
④ Put the O-ring (5) into the appropriate groove.
⑤ Put the splined hub (2) correctly positioned onto the drive shaft.

6) SEALING OF CONTROL VALVE

In case of leakage, the complete control valve must be replaced.

1 Control valve



140WA8MP110

(1) Replace the control valve

① Loosen and unscrew the control valve (1) out of the port plate.

② Screw the new control valve (1) in by hand, tighten with a torque of 6.1±1.0 kgf·m (44.3±7.4 lbf·ft).

1. REMOVAL AND INSTALL OF MOTOR

1) REMOVAL

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

(2) Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

(3) Loosen the breather slowly to release the pressure inside the hydraulic tank.

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

※ When pipes and hoses are disconnected, the oil inside the piping will flow out, so catch it in oil pan.

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

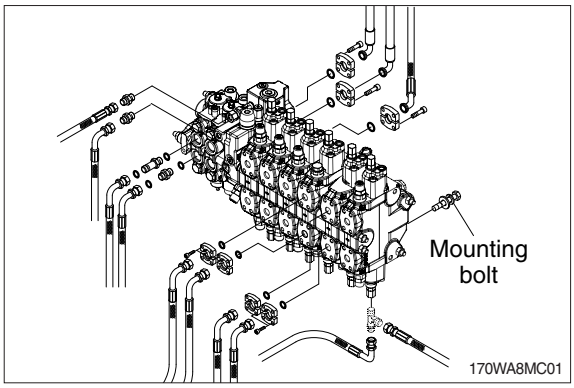
(5) Remove bolts and disconnect pipe.

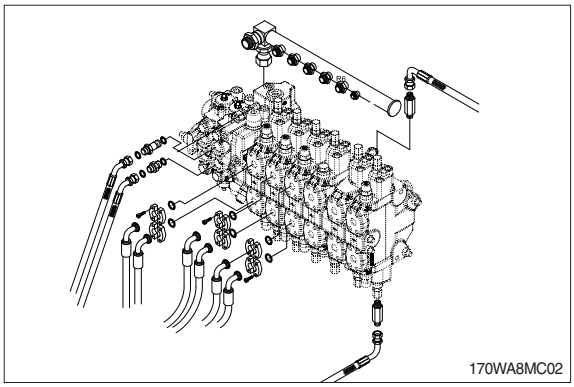
(6) Disconnect pilot line hoses.

(7) Disconnect pilot piping.

(8) Sling the control valve assembly and remove the control valve mounting bolt and bracket.
- Weight : 144 kg (317 lb)
- Tightening torque : 12.2 ± 1.3 kgf·m (88.2 ± 9.4 lbf·ft)

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



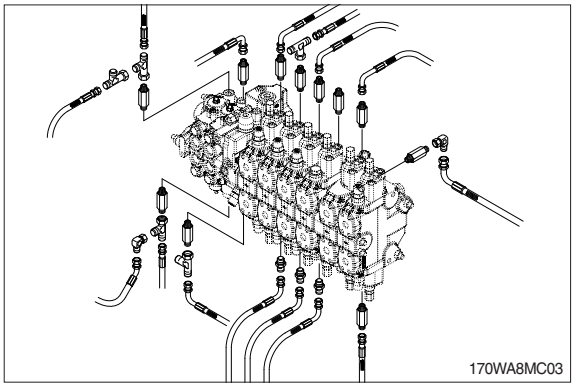


2) INSTALL

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

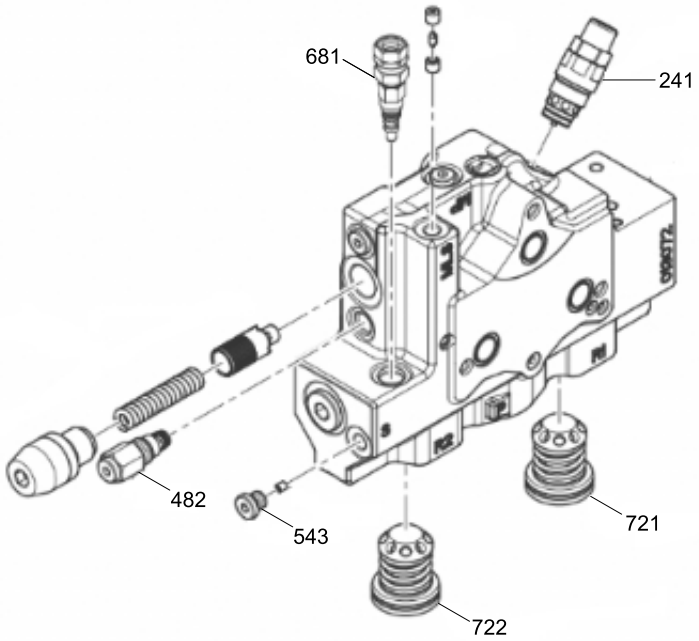
(2) Bleed the air from below items.
① Cylinder (Boom, arm, bucket)
② Swing motor
③ Travel motor
※ See each item removal and install.

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



2. STRUCTURE

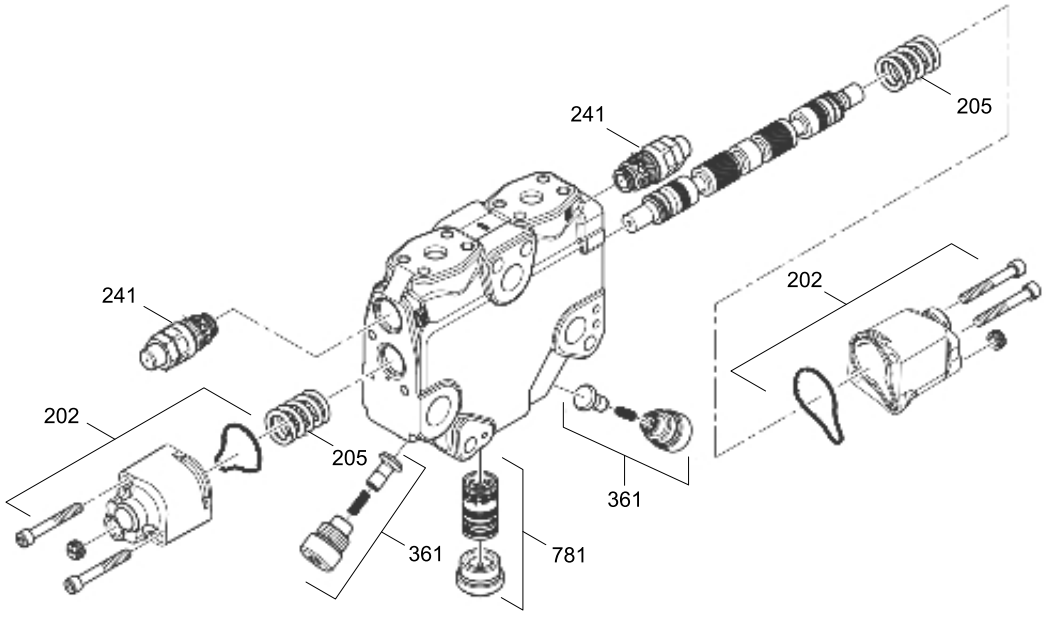
1) INLET SECTION



140WA2MC02

241	Pressure relief valve	543	Screw	721	Check valve
482	Flow valve	681	Pressure relief valve	722	Check valve

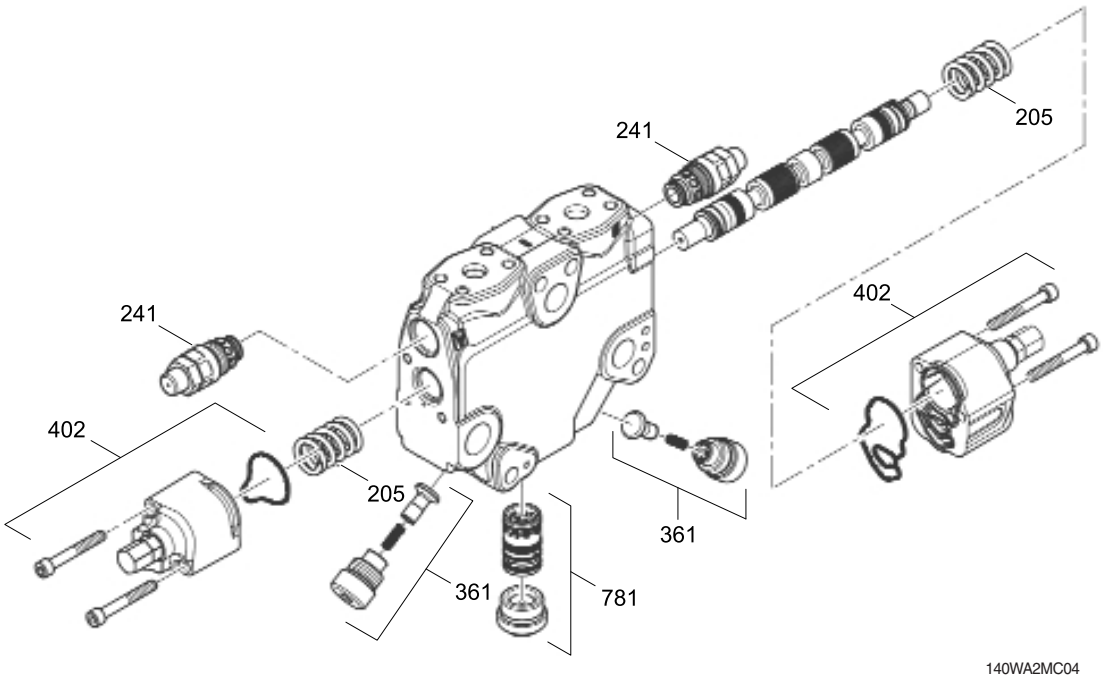
2) BOOM SECTION



140WA2MC03

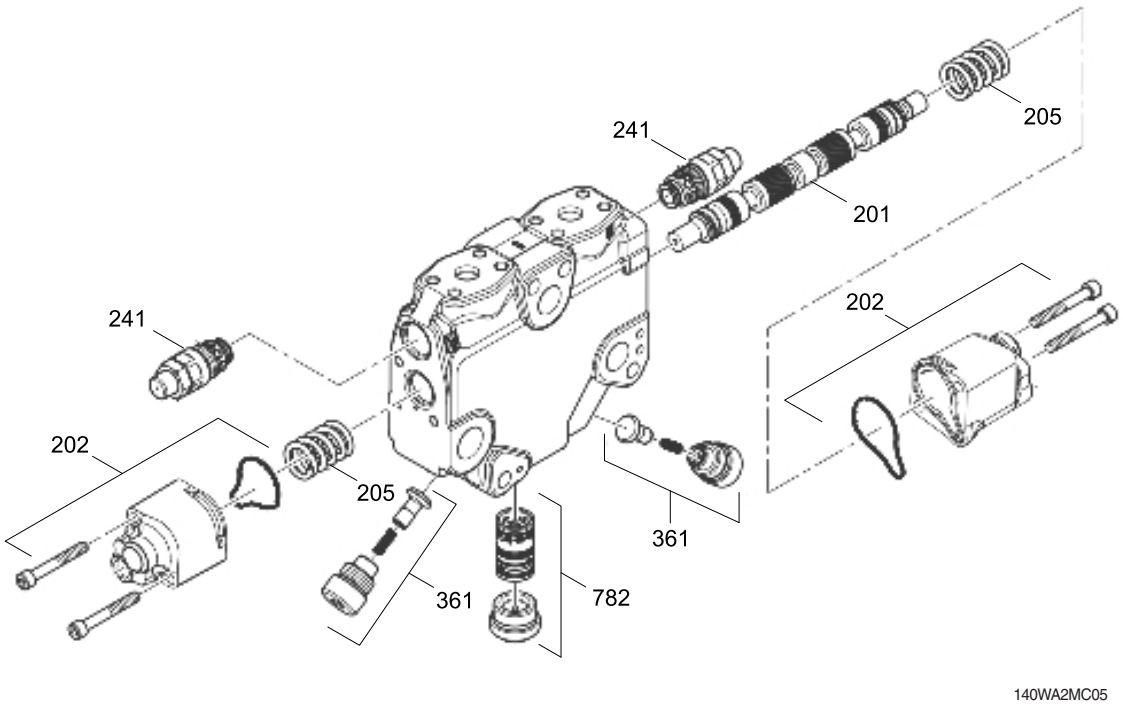
202	Cover assy	241	Pressure relief valve	781	Spool assy
205	Spring	361	Spool assy		

3) ARM SECTION



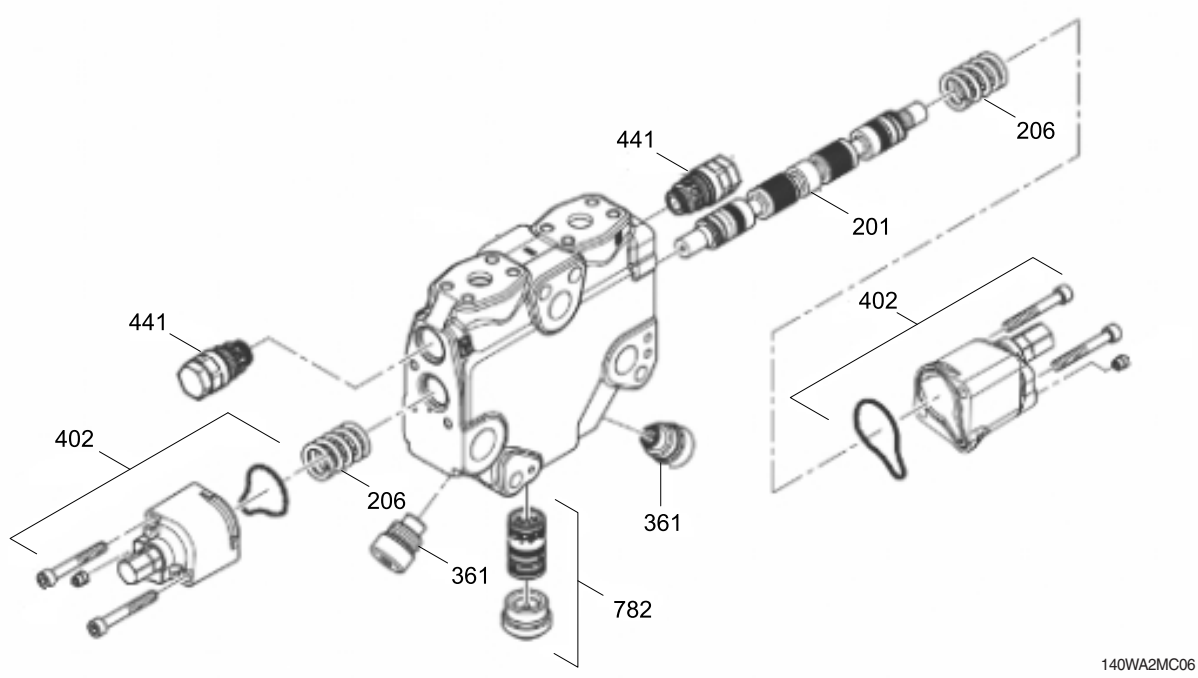
205 Spring
241 Pressure relief valve
361 Spool assy
402 Cover assy
781 Spool assy

4) BUCKET SECTION



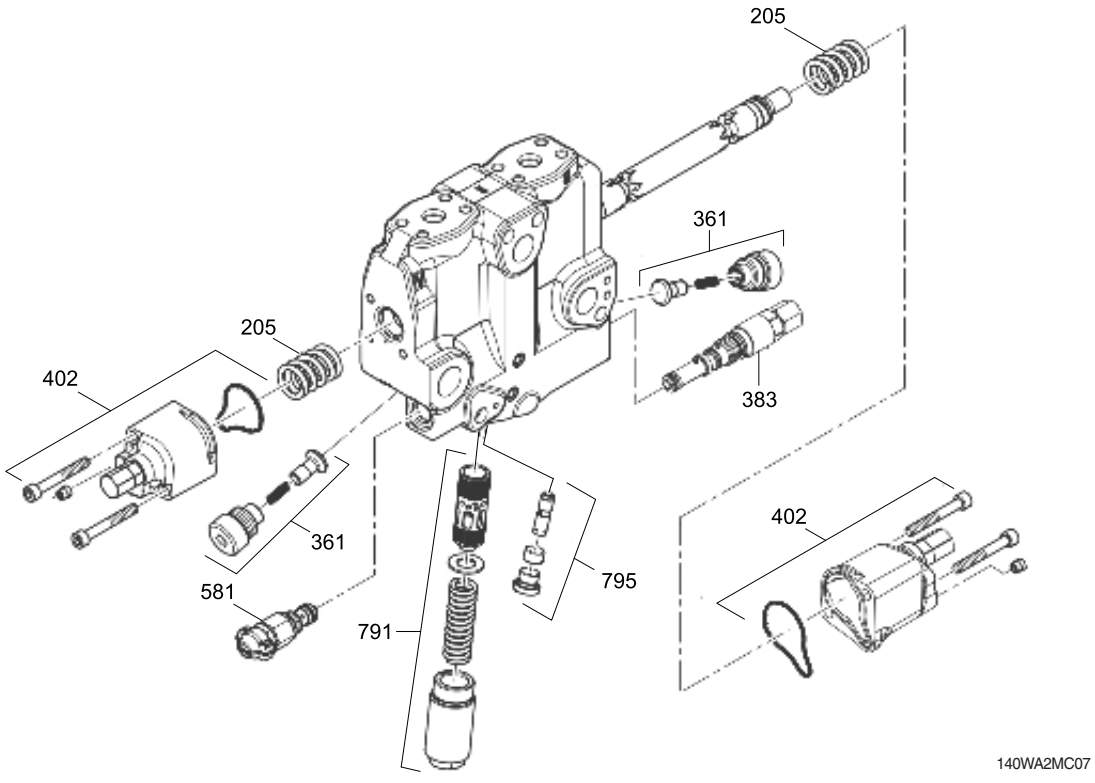
201 Spool assy
202 Cover assy
205 Spring
241 Pressure relief valve
361 Spool assy
782 Spool assy

5) TRAVEL SECTION



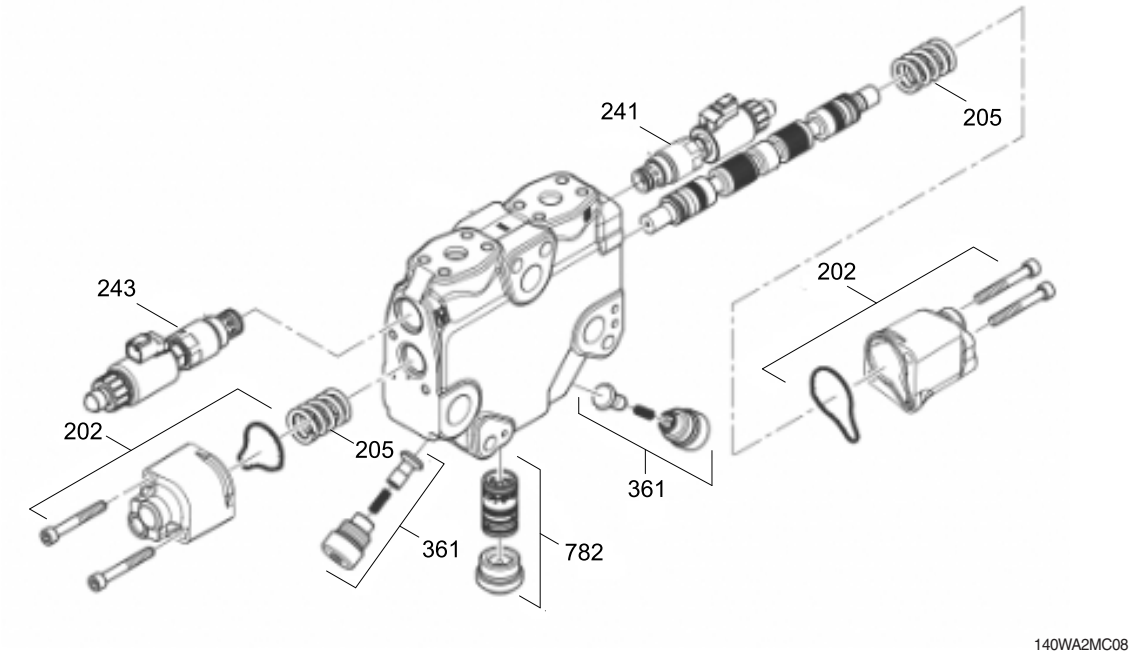
201 Spool assy
206 Spring
361 Spool assy
402 Cover assy
441 Pressure relief valve
782 Spool assy

6) SWING SECTION



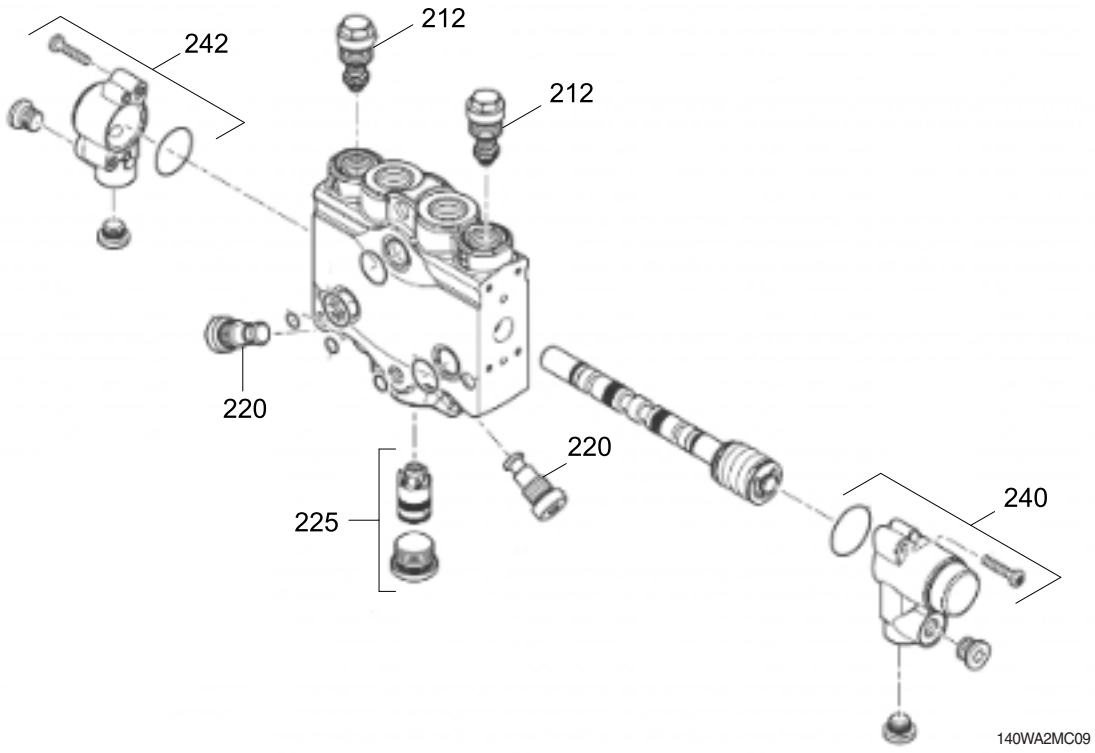
205 Spring
361 Spool assy
383 Spool assy
402 Cover assy
581 Relief valve
791 Spool assy
795 Spool assy

7) OPTION SECTION



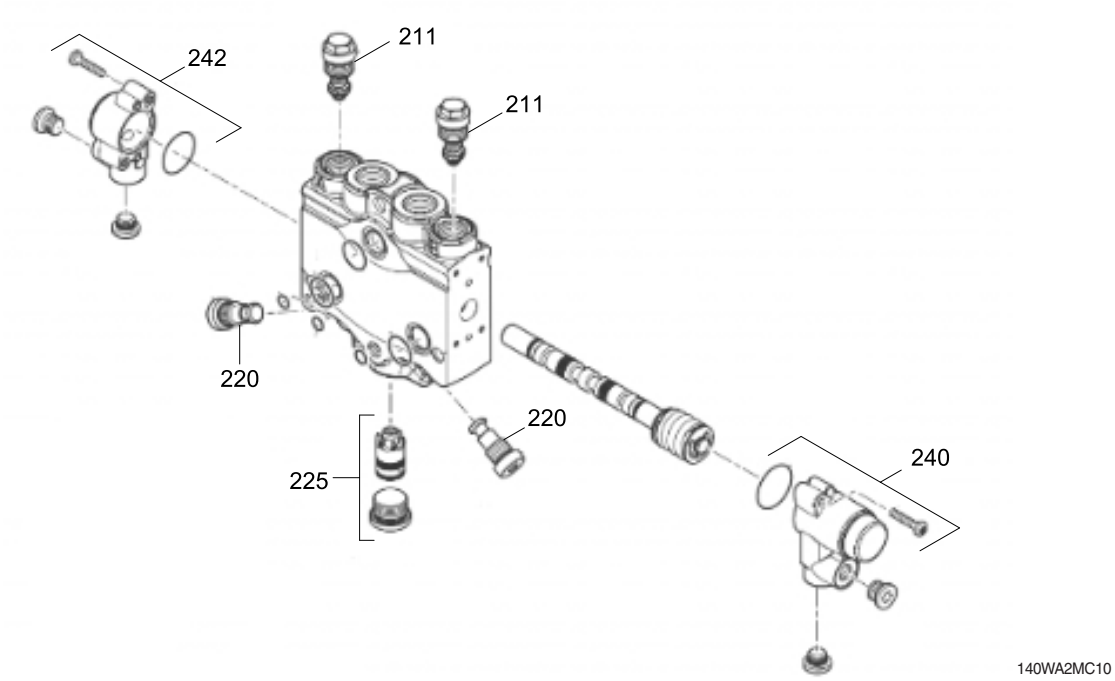
202	Spool assy	225	Spool assy	361	Spool assy
205	Spring	243	Pressure relief valve	781	Spool assy

8) 2 PIECE BOOM SECTION



212	Pressure relief valve	225	Spool assy	242	Cover kit
220	Check vavle	240	Cover kit		

9) DOZER (OUTRIGGER) SECTION



211 Pressure relief valve
220 Check valve
225 Spool assy
240 Cover kit
242 Cover kit

1. REMOVAL AND INSTALL OF MOTOR

1) REMOVAL

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

(2) Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

(3) Loosen the breather slowly to release the pressure inside the hydraulic tank.

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

※ When pipes and hoses are disconnected, the oil inside the piping will flow out, so catch it in oil pan.

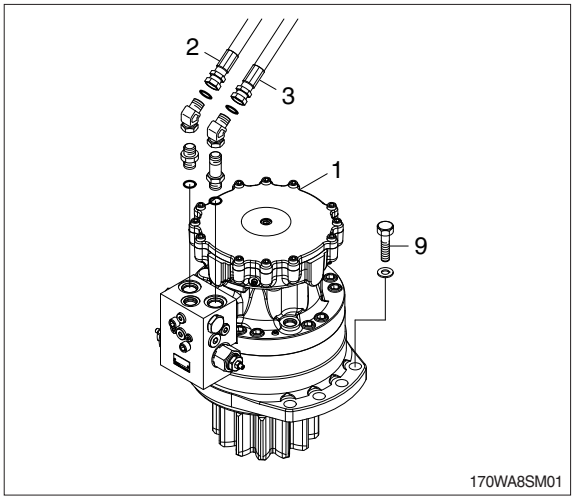
(4) Disconnect hose assembly (2).

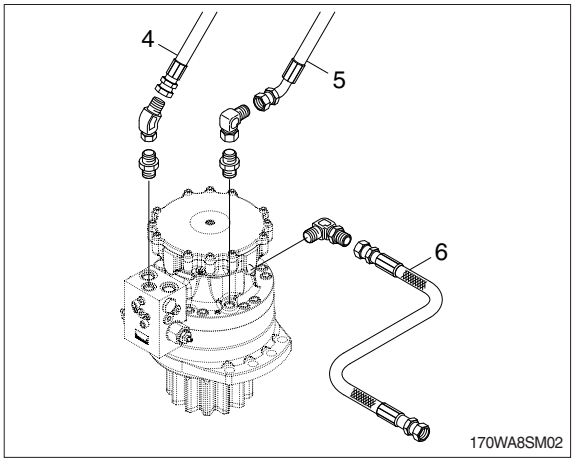
(5) Disconnect pilot line hoses (3, 4, 5, 6).

(6) Sling the swing motor assembly (1) and remove the swing motor mounting socket bolts (9).
- Motor device weight : 148 kg (326 lb)
- Tightening torque : 57.9 ± 6.4 kgf·m (419 ± 46.3 lbf·ft)

(7) Remove the swing motor assembly.

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





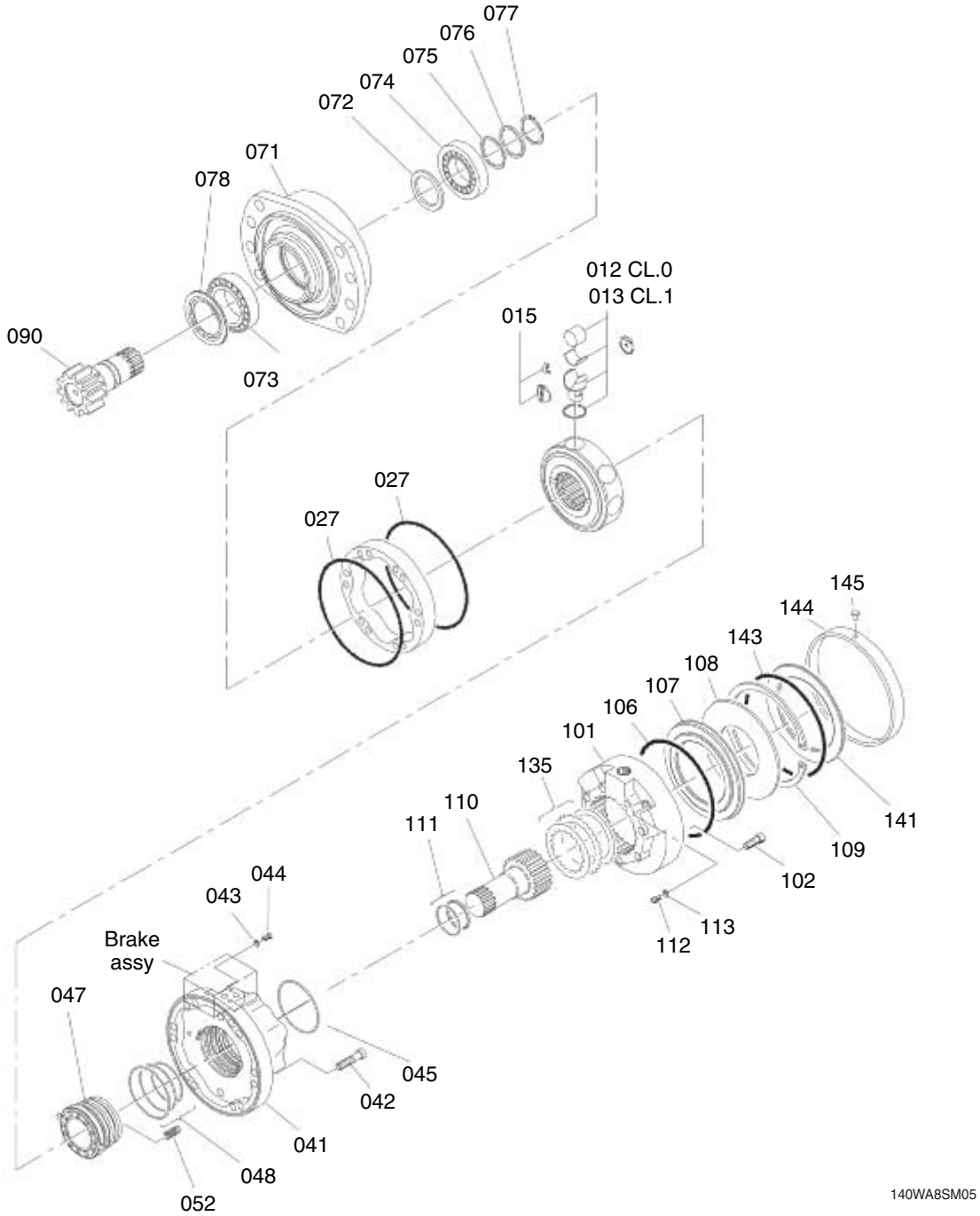
2) INSTALL

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

(2) Bleed the air from the swing motor.
① Remove the air vent plug.
② Pour in hydraulic oil until it overflows from the port.
③ Tighten plug lightly.
④ Start the engine, run at low idling and check oil come out from plug.
⑤ Tighten plug fully.

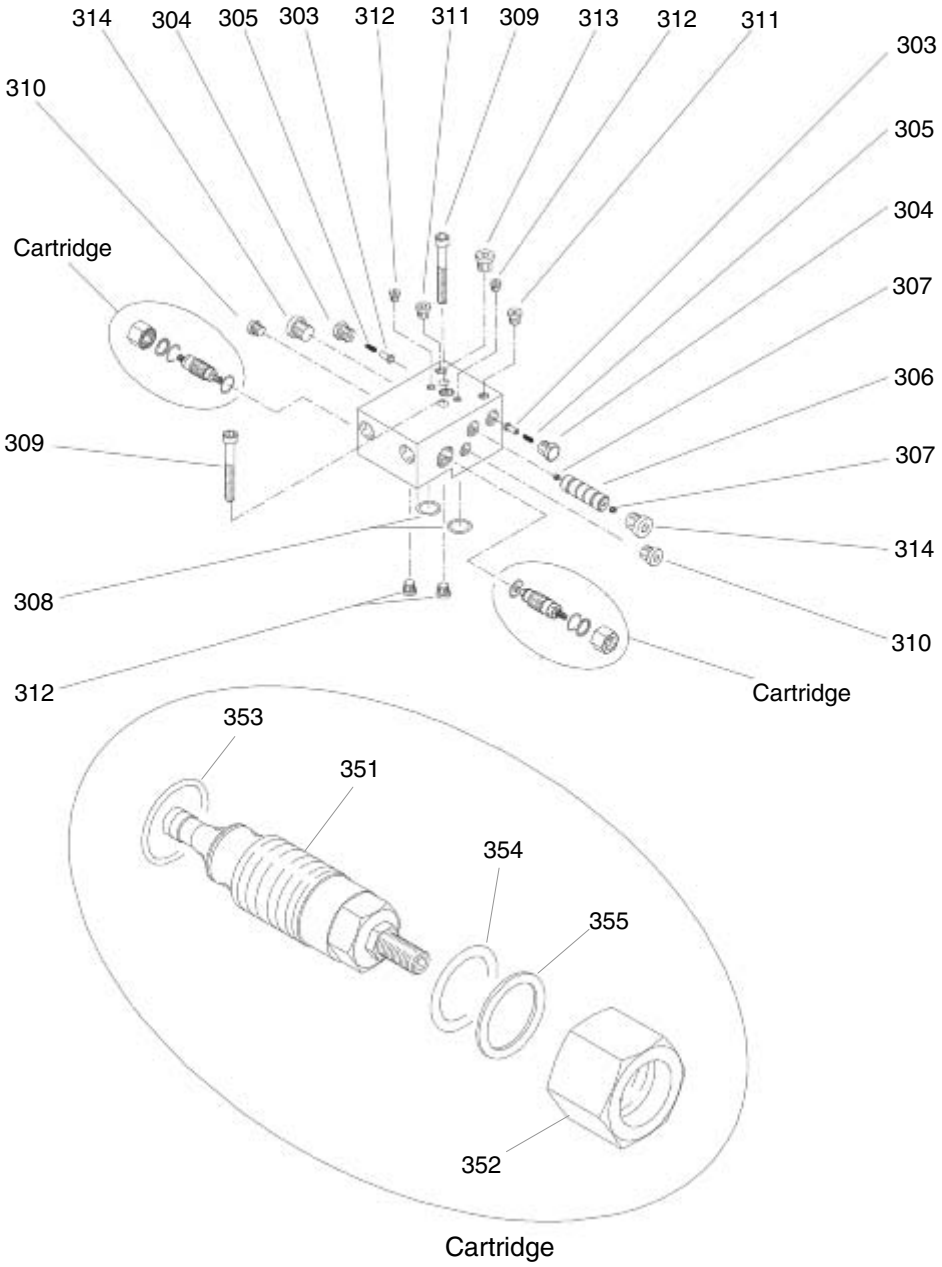
(3) Confirm the hydraulic oil level and check the hydraulic oil leak or not.

2. SPARE PARTS (1/2)



012	Piston sub-assy Cl.0	071	Bearing support part	107	Brake piston
013	Piston sub-assy Cl.1	072	Radial lip seal	108	Spring washer
015	Repair kit	073	Roller bearing	109	Snap ring
027	Joint seal	074	Roller bearing	110	Brake shaft
041	Valve cover part	075	Set of shims	111	Seal
042	Screw	076	Thrust ring	112	Screw
043	Seal washer	077	Snap ring	113	Sealing ring
044	Screw	078	Lip seal	135	Brake kit
045	O-ring	090	Shaft	141	Protector
047	Valve	101	Brake body	143	O-ring
048	Seal kit	102	Screw	144	Protection plate
052	Spring	106	O-ring	145	Dowel

SPARE PARTS (2/2)

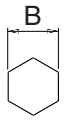
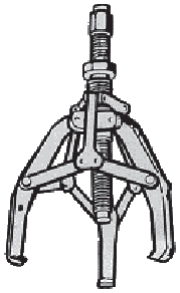
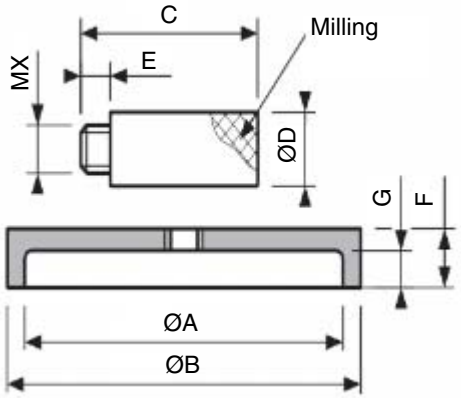


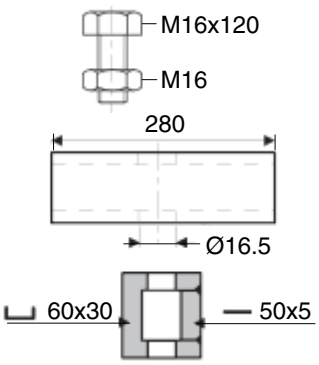
140WA8SM06

302	Cartridge	308	O-ring	314	Plug
303	Valve	309	Screw	353	O-ring
304	Plug	310	Plug	354	O-ring
305	Spring	311	Plug	355	Back-up
306	Valve spool	312	Plug		
307	Nozzle	313	Plug		

3. DISASSEMBLY AND ASSEMBLY

1) TOOLS

<table>
<tr><th>Tool name</th><th colspan="2">Remark</th></tr>
<tr><td>Allen wrench (5, 6, 8, 10, 12, 14)</td><td>6</td><td rowspan="3"> 
</td></tr>
<tr><td rowspan="2">Hexagon wrench (13, 17, 19, 22, 24, 27, 41)</td><td>22</td></tr>
<tr><td>27</td></tr>
<tr><td>Torque wrench</td><td colspan="2">Capable of tightening with the specified torques</td></tr>
<tr><td>Internal snap ring pliers</td><td colspan="2">For snap ring with 65 mm (2.56") to 120 mm (4.72") in diameter.</td></tr>
<tr><td>3-leg puller</td><td colspan="2">- Spread : 12 mm (0.98") to 260 mm (10.23") dia.
- Max. pulling force : 7138 kgf (15736 lbf).
 
140WA8SM08</td></tr>
<tr><td>Mandrels for the brake
1) For reassembling the brake cover.
2) To compress the spring washer.
<table>
<tr><th rowspan="2">Item</th><th colspan="2">Mandrel 1</th><th colspan="2">Mandrel 2</th></tr>
<tr><th>mm</th><th>Inch</th><th>mm</th><th>Inch</th></tr>
<tr><td>ØA</td><td>180</td><td>7.09</td><td>180</td><td>7.09</td></tr>
<tr><td>ØB</td><td>190</td><td>7.48</td><td>190</td><td>7.48</td></tr>
<tr><td>C</td><td>100</td><td>3.93</td><td>100</td><td>3.93</td></tr>
<tr><td>ØD</td><td>35</td><td>1.37</td><td>35</td><td>1.37</td></tr>
<tr><td>E</td><td>10</td><td>0.39</td><td>10</td><td>0.39</td></tr>
<tr><td>F</td><td>10</td><td>0.39</td><td>10</td><td>0.39</td></tr>
<tr><td>G</td><td>20</td><td>0.78</td><td>20</td><td>0.78</td></tr>
</table></td><td colspan="2"> 

140WA8SM09</td></tr>
<tr><td>Tool for mechanical brake release</td><td colspan="2"> 

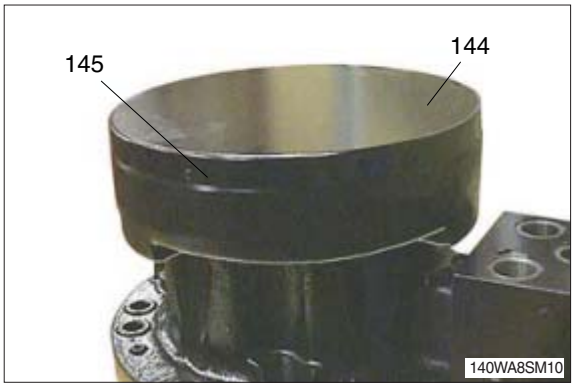
140WA8SM07</td></tr>
</table>

2) MECHANICAL BRAKE RELEASE

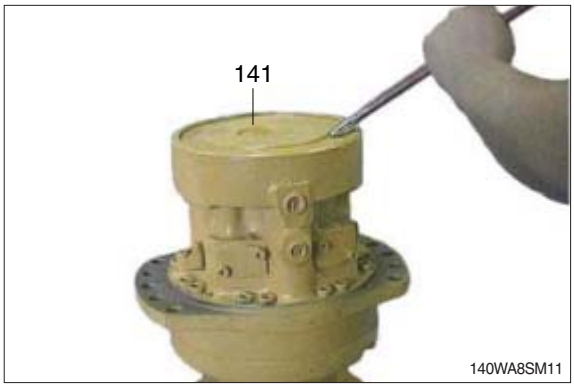
In certain service situations, it may be necessary to release the motor brake.

※ Plan to supply dowels (145), the brake cover (141) and the O-ring (143).

(1) Extract the dowels (145).
(2) Remove the protective plate (144).



(3) Remove and discard the brake cover (141).



(4) Tighten the screw in the piston and tighten the nut until the motor shaft turns freely.

3) REPLACEMENT OF THE O-RING OF THE BRAKE PISTON

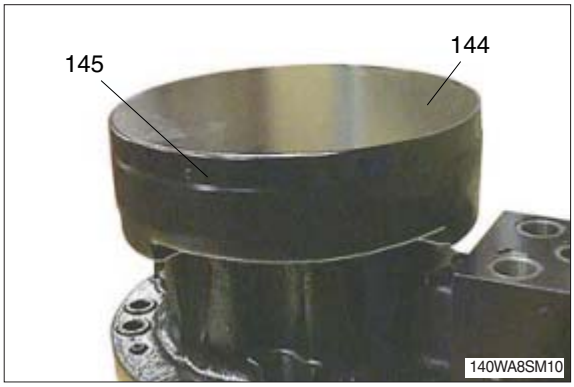
(1) Disassembly

① Place the motor on the bearing support.

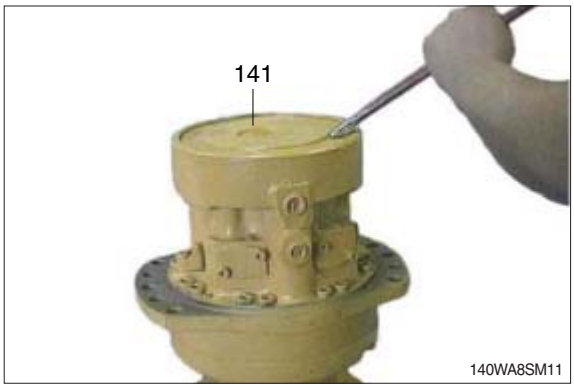
※ Plan to supply dowels (145), the brake cover (141) and the O-ring (143).

② Extract the dowels (145).

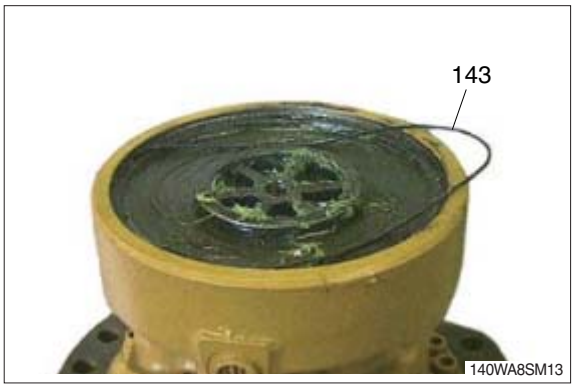
③ Remove the protective plate (144).



④ Remove and discard the brake cover (141).



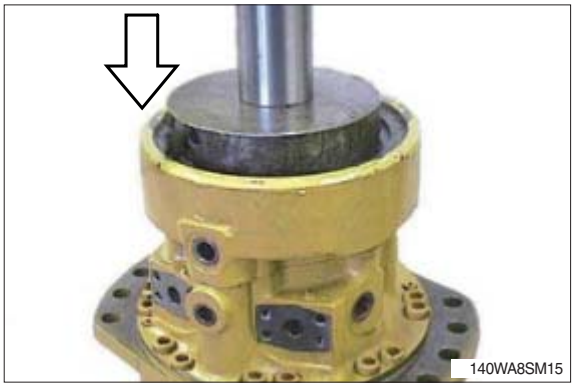
⑤ Extract and discard the O-ring (143).



⑥ Compress the washer (108)

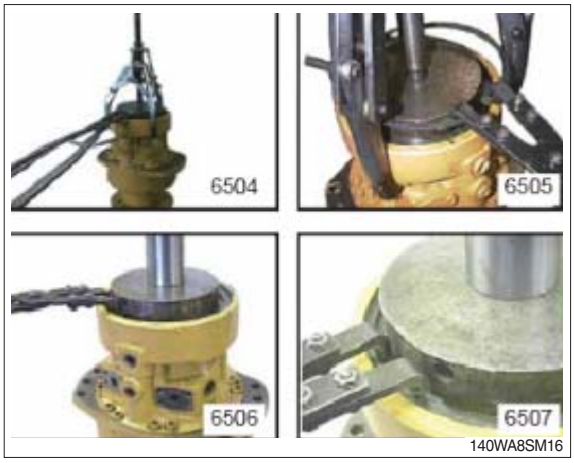
- Using a mandrel and an extractor
- Using a mandrel and a press

※ Mark the mounting direction of the snap ring.

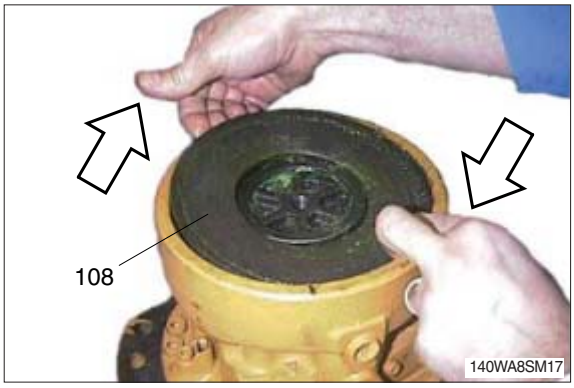


⑦ Remove the snap ring (109) with an internal snap ring pliers.

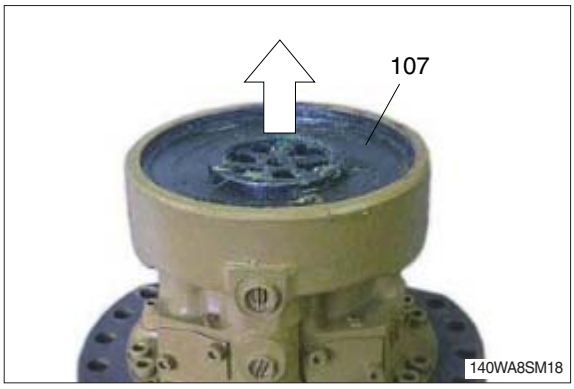
- Extractor and pliers : figure 6504 and 6505.
- Press and pliers : figure 6505 and 6507.



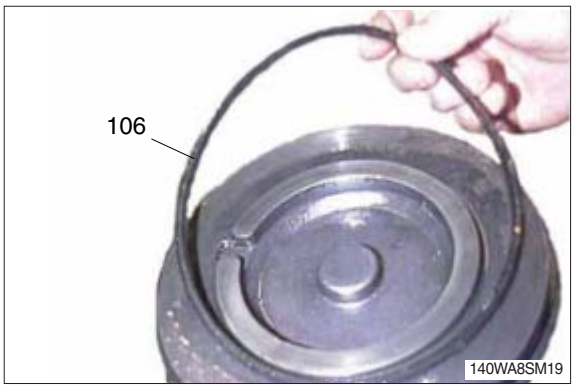
⑧ Extract the washer (108).



⑨ Extract the brake piston (107).



⑩ Remove and discard the O-ring (106).



(2) **Ressembly**

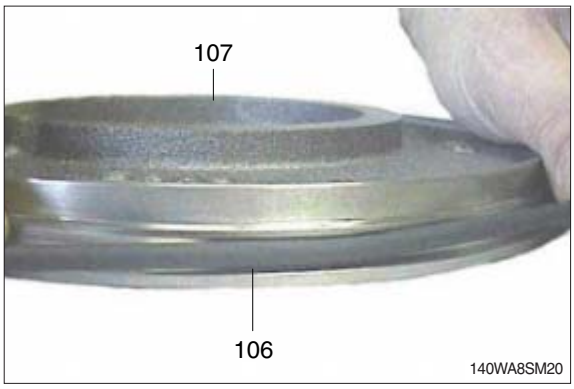
※ Before assembling, it is necessary to make sure that all parts, sealing surfaces and grooves are clean.

※ All traces of rust, mud, water must be removed.

① Coat with anti-oxidizing grease the grooves, the top of the brake piston, the spring washer, the snap ring and the piston seal contact surface in the brake body.

② Install a new O-ring (106) in the piston (107).

※ The ring should be tight on the piston and not twisted.



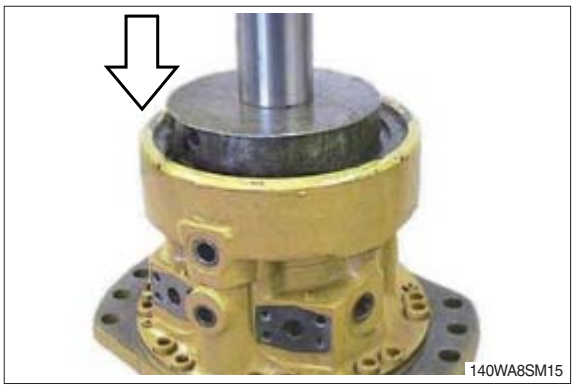
③ Install the brake piston (107).

※ Take care when passing the seal over the snap ring groove.

④ Install the spring washer (108).

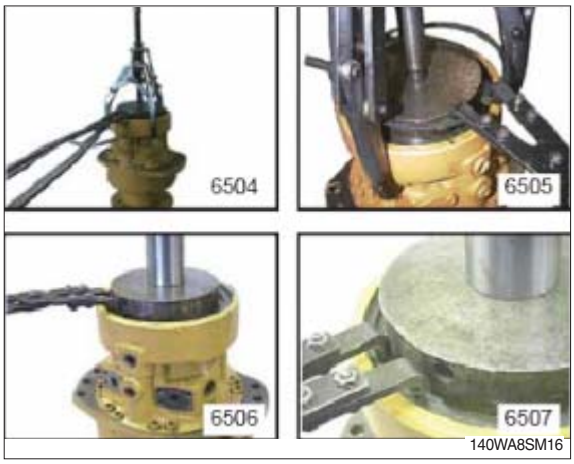
⑤ Compress the washer (108) :

- Using a mandrel and an extractor
- Using a mandrel and a press.

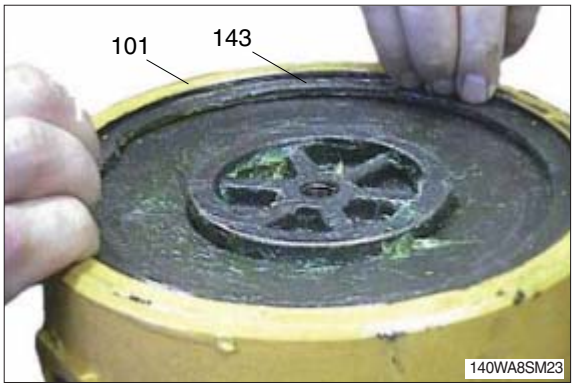


⑥ Install the snap ring (109) with an internal snap ring pliers in line with the mark made during disassembly.

- Extractor and pliers: fig. 6504 and 6505.
- Press and pliers : fig. 6505 and 6507.



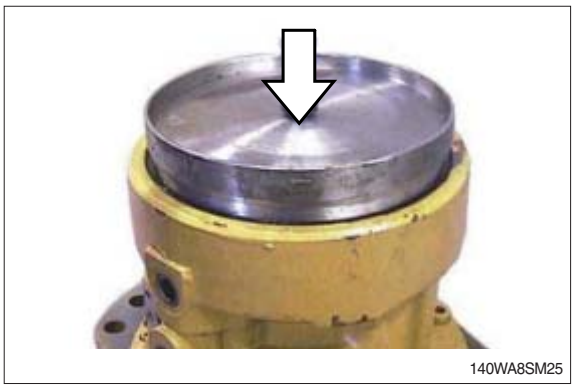
⑦ Install a new O-ring (143) coated with anti-oxidizing grease in the groove of brake body (101).



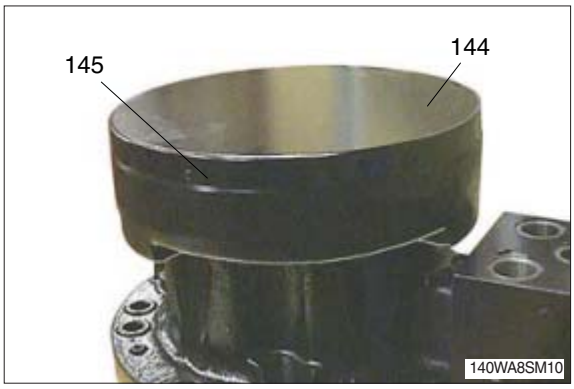
⑧ Place the new cover (141) on the entry chamfer.

⑨ Click the cover into place using the right mandrel.

※ Make sure that the outer edge of the cover is engaged in the groove.



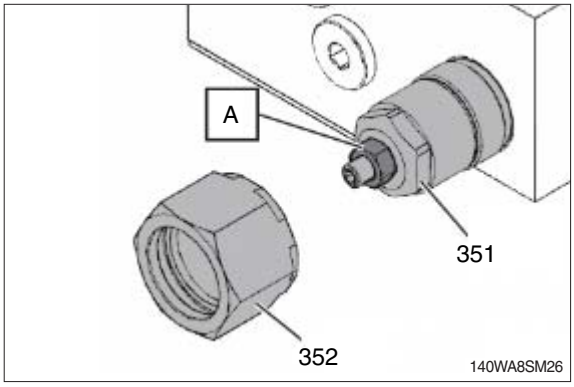
⑩ Install the protective plate (144).
⑪ Drive the dowels (145).



⑫ Install the motor.

4) REPLACEMENT OF A CARTRIDGE (302) OR RING (353, 354 AND 355) OF THE BLOCK ASSEMBLY

※ Never loosen the locknut [A] that set the cartridge pressure during the disassembly and reassembly of nut (352) and cartridge (351).

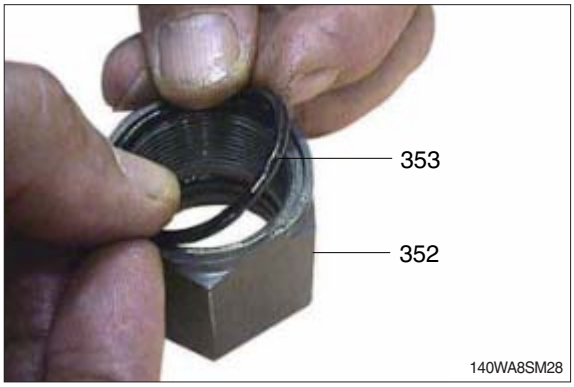


(1) Disassembly

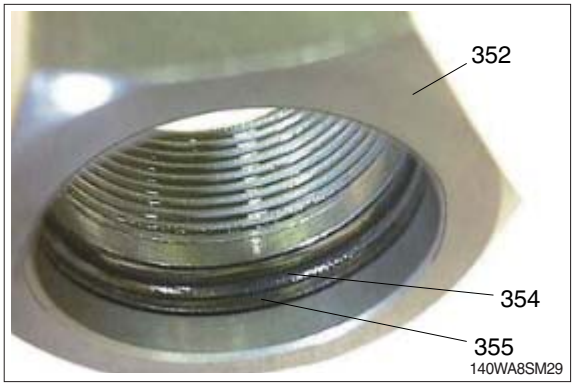
① Release the pressure in the supply circuit.

② Remove the nut (352) then the cartridge body (351).

③ Discard the O-ring (353).



④ Discard the O-ring (354) and the back-up ring (355).



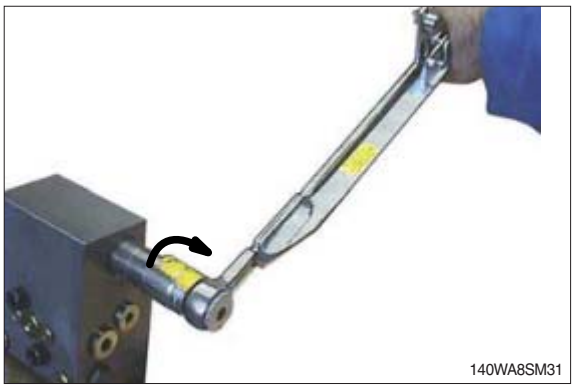
(2) **Reassembly**

※ Make sure that the contact surfaces between the cartridge and the block are clean.

① Install the cartridge (351) without nut (352).

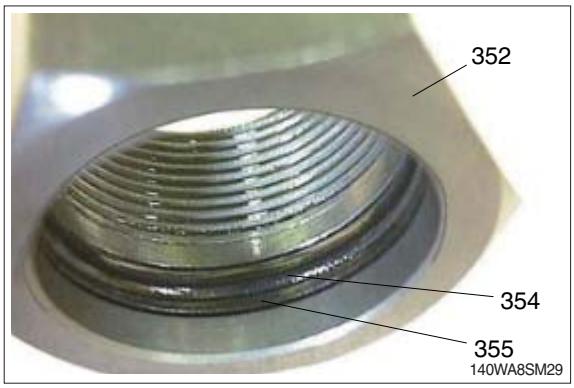
② Tighten the cartridge to the required torque.

· Tightening torque : 20.3± 2.1 kgf·m
(147± 15 lbf·ft)



③ Grease and install the back-up (355) and the O-ring (354) in the nut groove (352).

※ The O-ring (354) must be installed towards the thread.



④ Grease and install the O-ring (353) in the nut spot facing (352).

⑤ Install and tighten the nut (352) to the required torque.

· Tightening torque : 6.1 ± 0.6 kgf · m
(44.2 ± 4.4 lbf · ft)

5) REPLACEMENT OF THE BLOCK ASSEMBLY

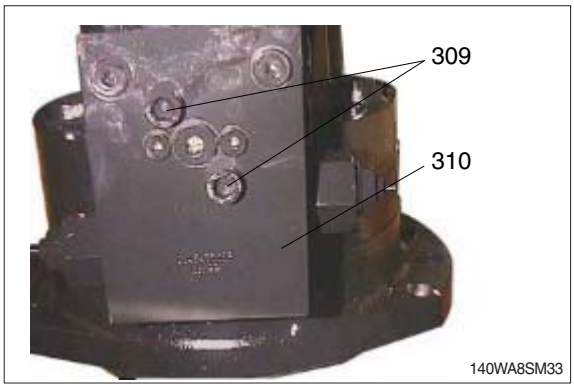
(1) Removal

① Release the pressure in the supply circuit.

② Disconnect the drain line at the tank level to avoid its siphoning.

③ Disconnect and plug the pipes or hoses which are connected to the block.

④ Remove the mounting screws (309).



⑤ Remove the block (300) and discard the O-rings (308). (See spare parts).

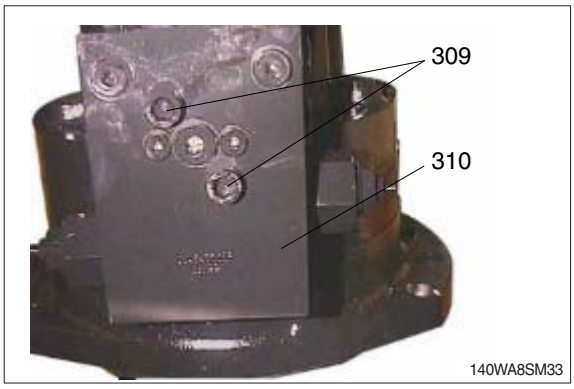
(2) Installation

※ Make sure that the mounting face is clean.

① Grease and install new O-rings (308).

② Install the block, the mounting face allows one mounting position only.

③ Install and tighten the mounting screws (309) to the required torque.



GROUP 6 TRAVEL MOTOR

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) and remove the pipes (2).

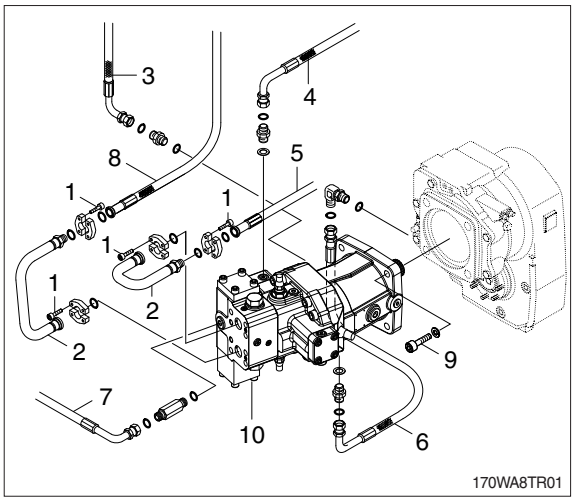
(5) Disconnect hoses (3, 4, 5, 6, 7, 8).

(6) Loosen the socket bolt (9) and remove travel motor (10).

· Weight : 80 kg (180 lb)

· Tightening torque : 29.6 ± 3.2 kgf·m (214 ± 23.1 lbf·ft)

※ When removing the travel motor assembly, check that all the hoses have been disconnected.



2) INSTALL

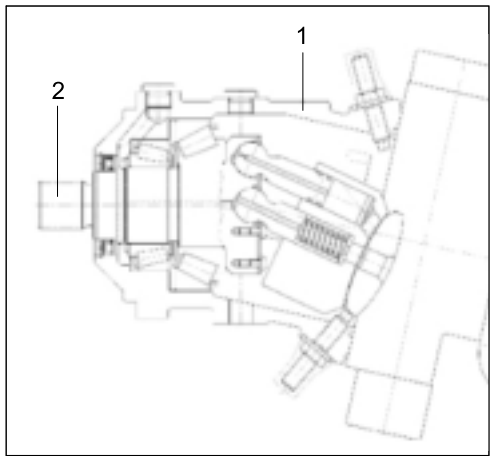
(1) Carry out installation in the reverse order to removal.

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

2. STRUCTURE (1/3)

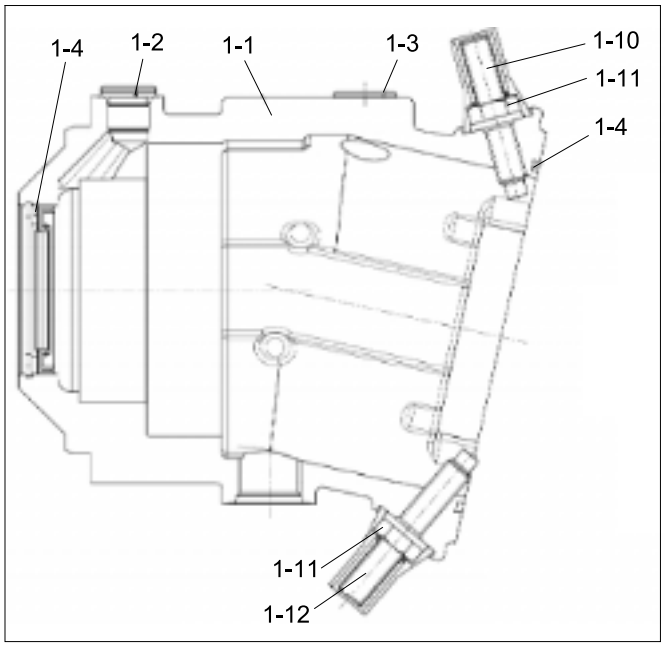
1) HIGH SPEED

MOTOR ASSY

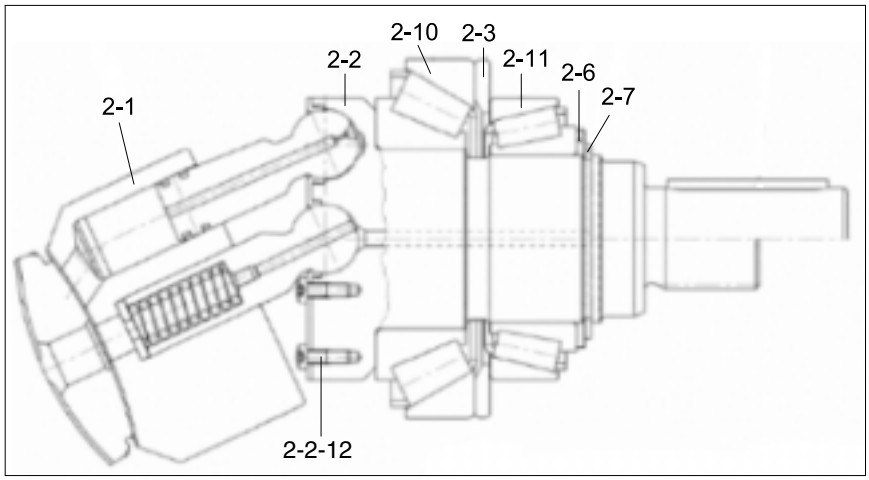


1 Motor housing assy
2 Rotary kit

ITEM 1



ITEM 2

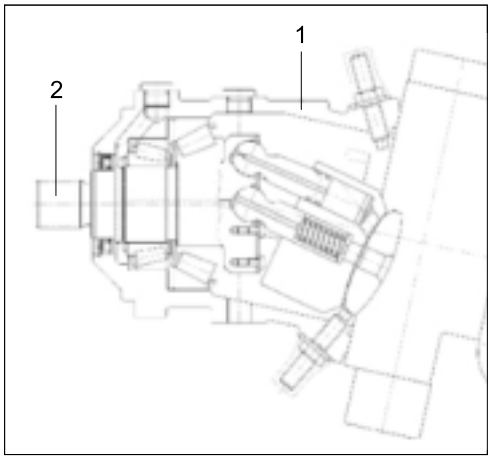


140WA2TR10

1-1	Housing	1-11	Sealing nut	2-3	Shim
1-2	Lock screw	1-12	Threaded pin	2-6	Backup plate
1-3	Lock screw	2-1	Hydraulic rotary section	2-7	Retainer ring
1-4	Motor seal kit	2-2	Drive shaft	2-10	Roller bearing
1-10	Threaded pin	2-2-12	Screw	2-11	Roller bearing

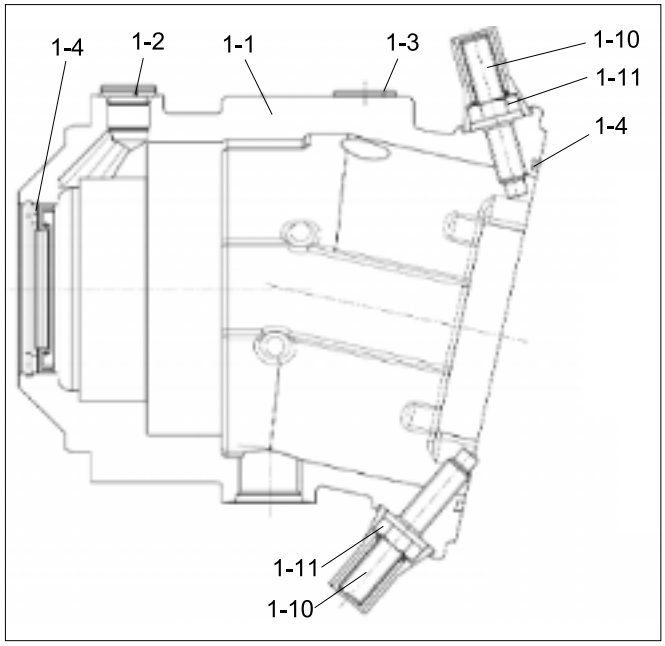
2) LOW SPEED

MOTOR ASSY

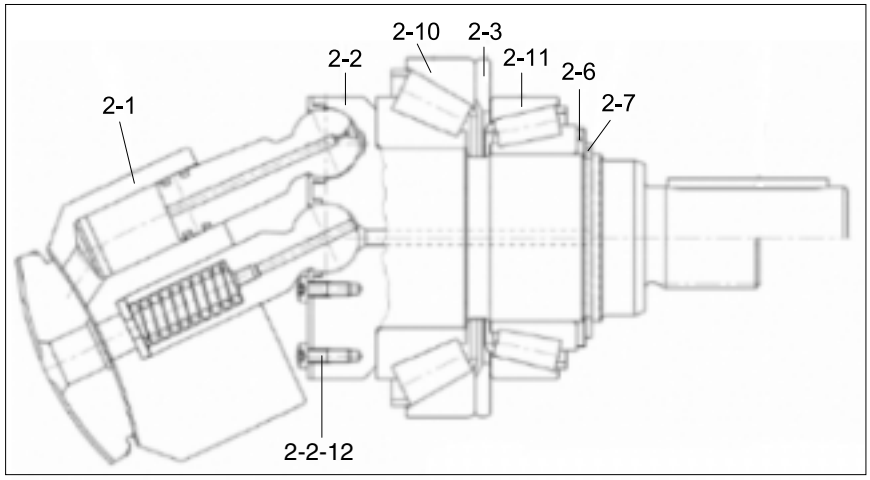


1 Motor housing assy
2 Rotary kit

ITEM 1



ITEM 2



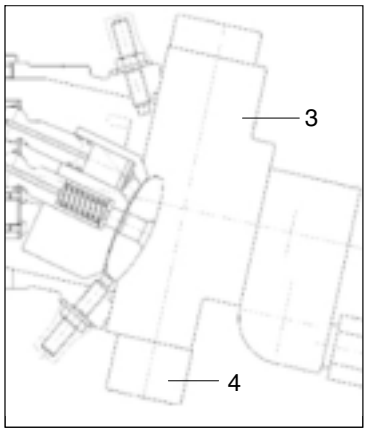
140WA2TR11

1-1	Housing	1-11	Sealing nut	2-6	Backup plate
1-2	Lock screw	2-1	Hydraulic rotary section	2-7	Retainer ring
1-3	Lock screw	2-2	Drive shaft	2-10	Roller bearing
1-4	Motor seal kit	2-2-12	Screw	2-11	Roller bearing
1-10	Threaded pin	2-3	Shim		

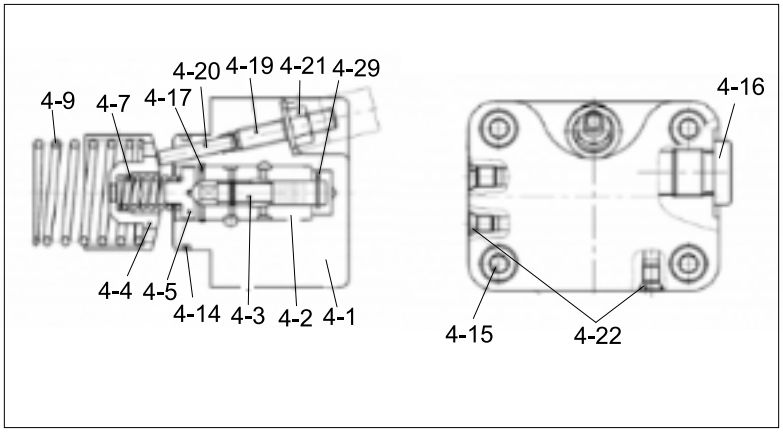
STRUCTURE (2/3)

1) HIGH SPEED

MOTOR ASSY

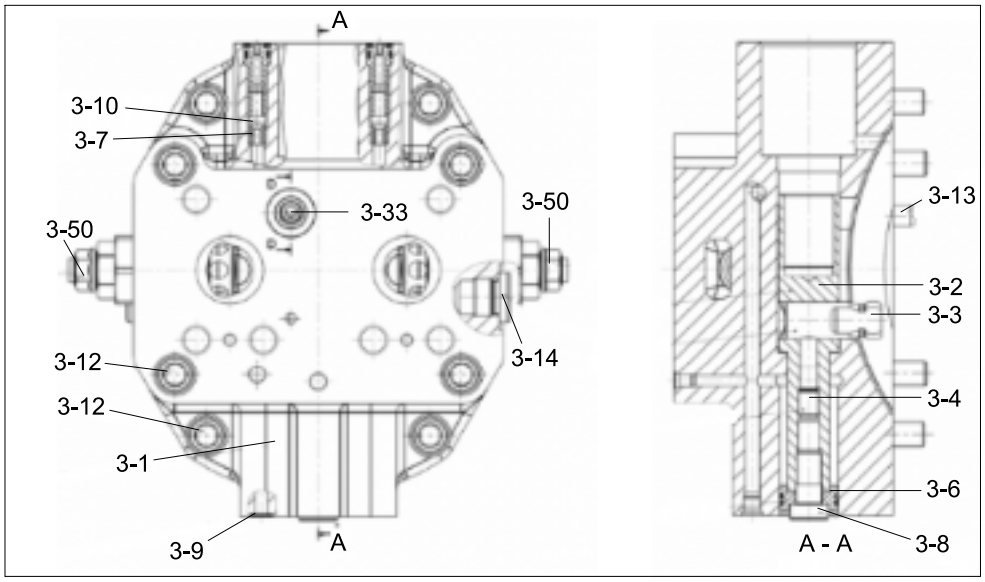


ITEM 4



3 Port plate assy
4 Control unit

ITEM 3

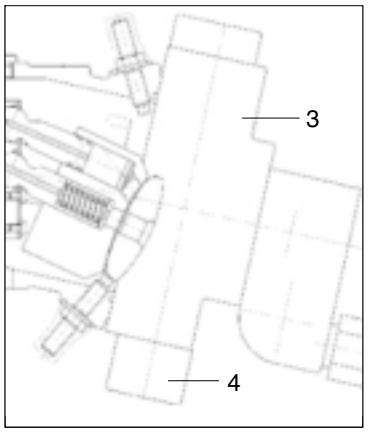


160WA2TR12

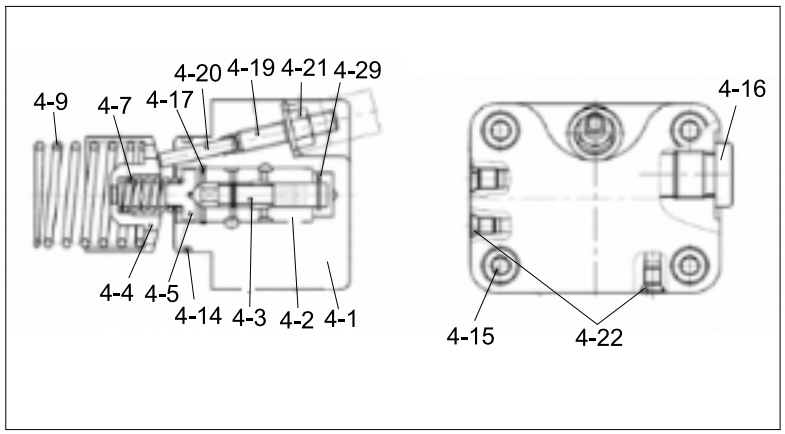
3-1	Port plate	3-13	Cylinder pin	4-9	Pressure spring
3-2	Positioning piston	3-14	Locking screw	4-14	O-ring
3-3	Positioning trunnion	3-33	O-ring	4-15	Socket screw
3-4	Threaded pin	3-50	Relief valve	4-16	Locking screw
3-6	Piston ring	4-1	Control housing	4-17	Retainer ring
3-7	Bushing	4-2	Control bushing	4-19	Thread pin
3-8	Socket screw	4-3	Control piston	4-20	Cylinder pin
3-9	O-ring	4-4	Adjust bushing	4-21	Seal lock nut
3-10	Check valve	4-5	Spring collar	4-22	Break pin
3-12	Socket screw	4-7	Pressure spring	4-29	Retainer disc

2) LOW SPEED

MOTOR ASSY

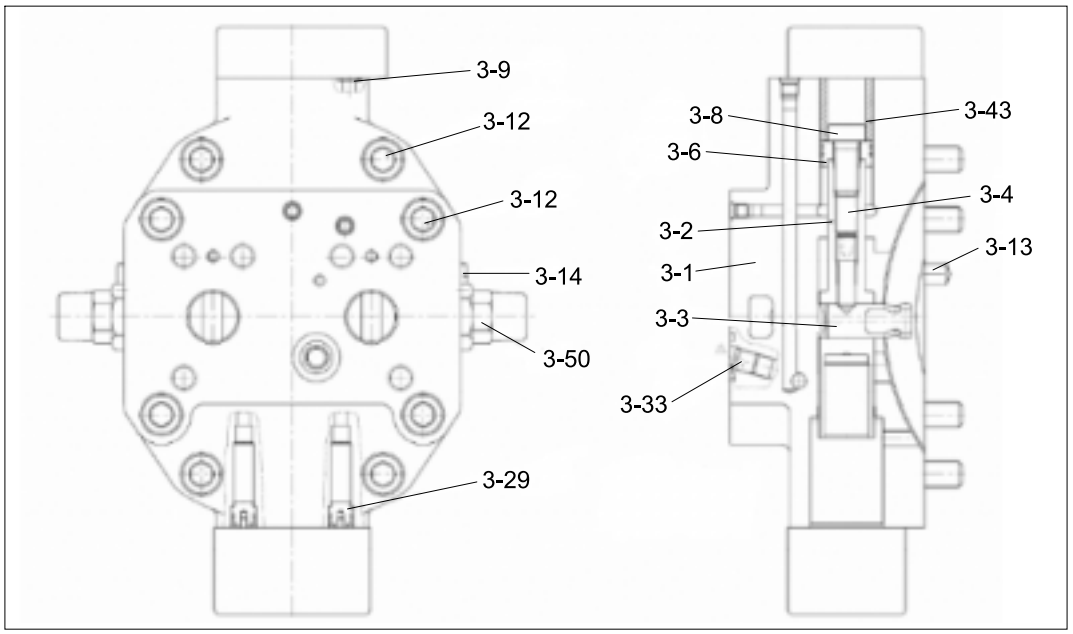


ITEM 4



3 Port plate assy
4 Control unit

ITEM 3



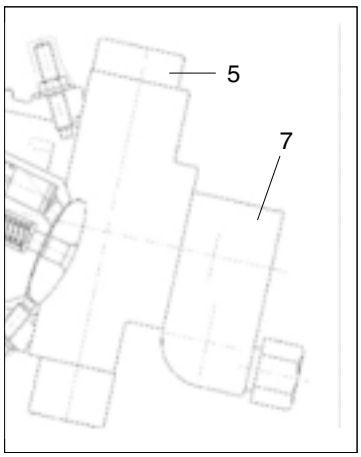
160WA2TR13

3-1	Port plate	3-29	Plug	4-9	Pressure spring
3-2	Positioning piston	3-33	O-ring	4-14	O-ring
3-3	Positioning trunnion	3-43	Stop bushing	4-15	Socket screw
3-4	Threaded pin	3-50	Relief valve	4-16	Locking screw
3-6	Piston ring	4-1	Control housing	4-17	Retainer ring
3-8	Socket screw	4-2	Control bushing	4-19	Thread pin
3-9	O-ring	4-3	Control piston	4-20	Cylinder pin
3-12	Socket screw	4-4	Adjust bushing	4-21	Seal lock nut
3-13	Cylinder pin	4-5	Spring collar	4-22	Break pin
3-14	Locking screw	4-7	Pressure spring	4-29	Retainer disc

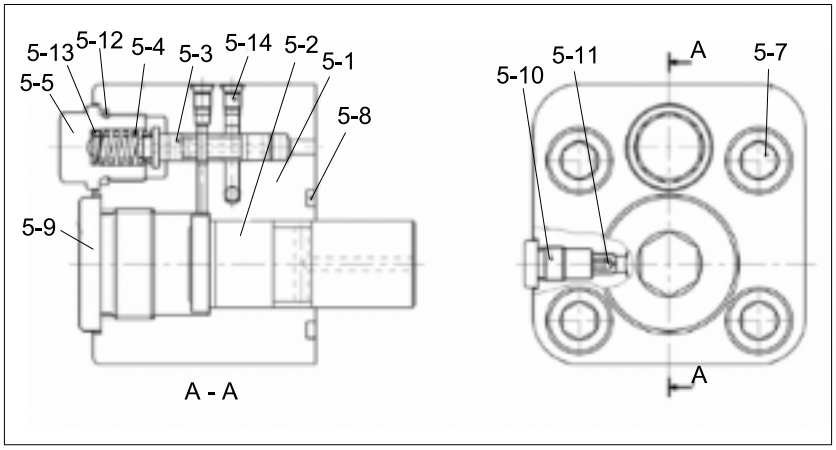
STRUCTURE (3/3)

1) HIGH SPEED

MOTOR ASSY

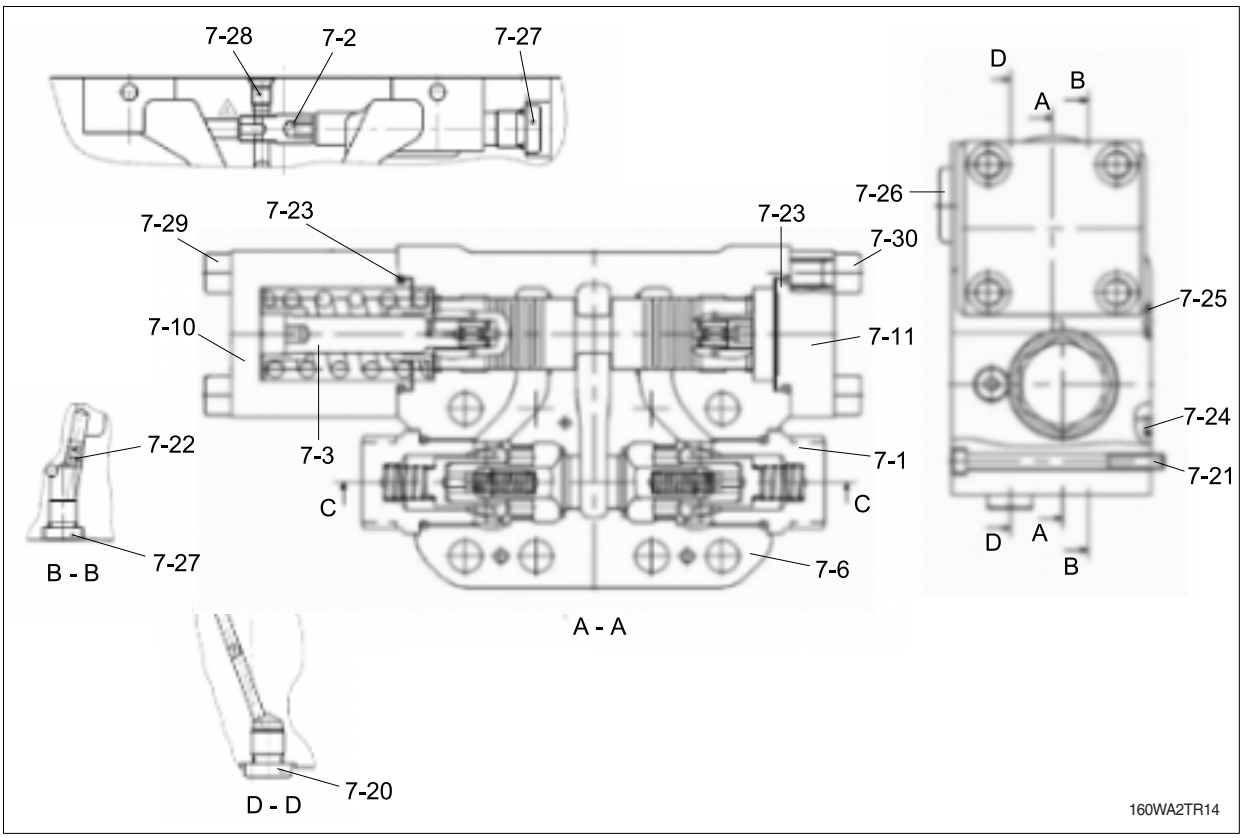


ITEM 5



5 Hydraulic stroke limiter
7 Motion control valve assy

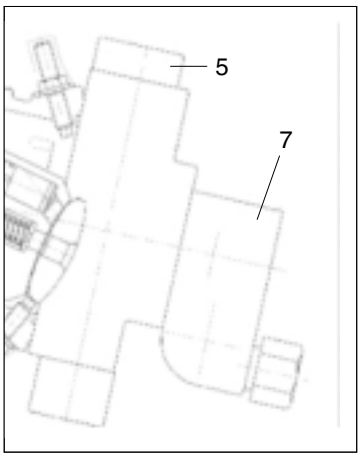
ITEM 7



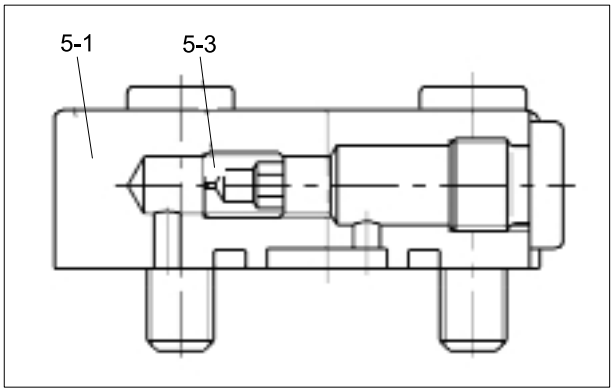
5-1	Limiter housing	5-12	O-ring	7-21	Socket screw
5-2	Piston	5-13	Shim	7-22	Plug
5-3	Control piston	5-14	Break pin	7-23	O-ring
5-4	Pressure spring	7-1	Control valve assy	7-24	O-ring
5-5	Lock screw	7-2	Shuttle valve	7-25	O-ring
5-7	Cap screw	7-3	Brake piston assy	7-26	Locking screw
5-8	O-ring	7-6	Housing	7-27	Locking screw
5-9	Lock screw	7-10	Cover	7-28	Break pin
5-10	Lock screw	7-11	Cover	7-29	Socket screw
5-11	Orifice	7-20	Locking screw	7-30	Socket screw

2) LOW SPEED

MOTOR ASSY

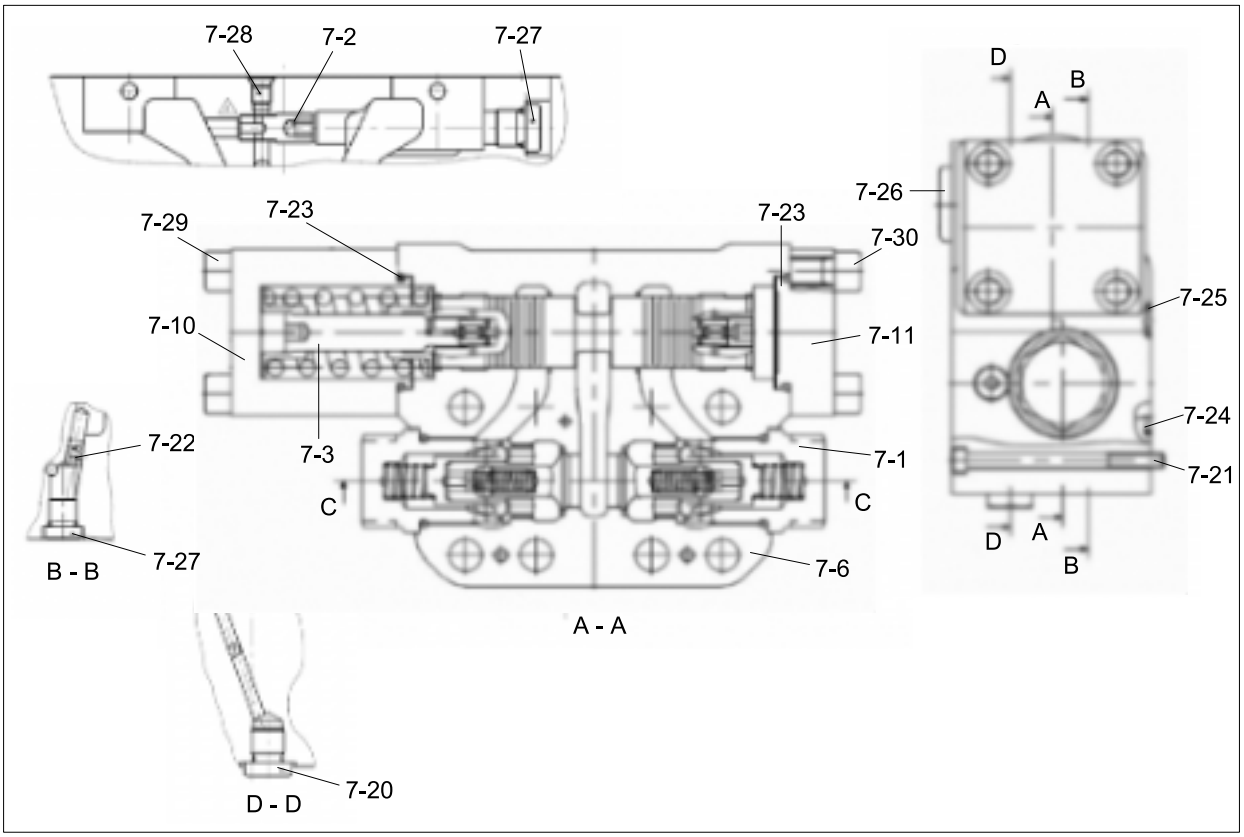


ITEM 5



5 Hydraulic stroke limiter
7 Motion control valve assy

ITEM 7



160WA2TR15

5-1	Cover	7-11	Cover	7-26	Locking screw
5-3	Throttle screw	7-20	Locking screw	7-27	Locking screw
7-1	Control valve assy	7-21	Socket screw	7-28	Break pin
7-2	Shuttle valve	7-22	Plug	7-29	Socket screw
7-3	Brake piston assy	7-23	O-ring	7-30	Socket screw
7-6	Housing	7-24	O-ring		
7-10	Cover	7-25	O-ring		

3. TIGHTENING TORQUE

The torques given are standard figures. Any figures specifically described in the procedure has priority.

Page	Item	Size	kgf · m	lbf · ft
8-54, 55	1-2	M22 × 1.5	6.1	44
	1-3	M26 × 1.5	7.1	51
	1-11	M12	7.0	50.9
	2-2-12	M 6 × 20	1.4	10.3
8-58	5-5	-	32.6	236
	5-7	M10 × 1.0	5.2	37.6

4. DISASSEMBLY AND ASSEMBLY

1) GENERAL PRECAUTIONS

(1) Disassembly

① Before disassembling the motor, check the items to be inspected and, for remedy against trouble, closely examine the nature of the trouble, so that the motor can be disassembled effectively.

② To disassemble the motor, use the disassembling procedures described in section 2) and select a clean place.

③ Place a rubber or vinyl sheet or other such protective materials on your working bench to protect the surface of the motor to be serviced.

④ During disassembly, give a match mark to the mating surfaces of each part.

⑤ Arrange removed parts in order so that they will not become damaged or missing during disassembly.

⑥ Once seals have been disassembled, they should be replaced even if damage is not observed. Have replacement seals ready on hand before starting your disassembling job.

(2) Assembly

① Reassemble in a work area that is clean and free from dust and grit.

② Handle parts with bare hands to keep them free of linty contaminants.

③ Repair or replace the damaged parts.
Each parts must be free of burrs its corners.

④ Do not reuse O-ring oil seal and floating seal that were removed in disassembly.
Provide the new parts.

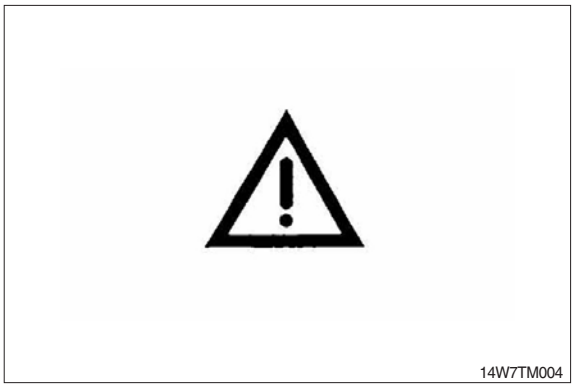
⑤ Wash all parts thoroughly in a suitable solvent.
Dry thoroughly with compressed air.
Do not use the cloths.

⑥ When reassembling oil motor components of motor, be sure to coat the sliding parts of the motor and valve with fresh hydraulic oil. (NAS class 9 or above)

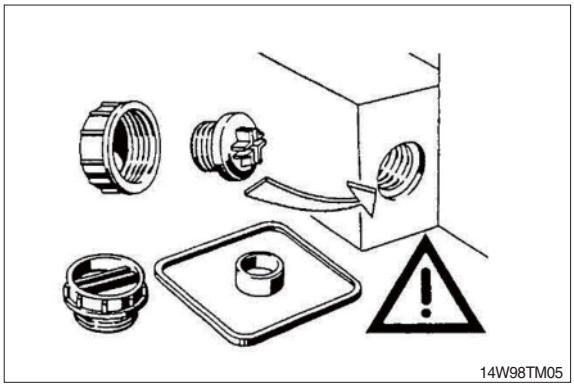
⑦ Use a torque wrench to tighten bolts and plugs, to the torque specified as follows.

2) SEAL KITS AND COMPONENT GROUPS

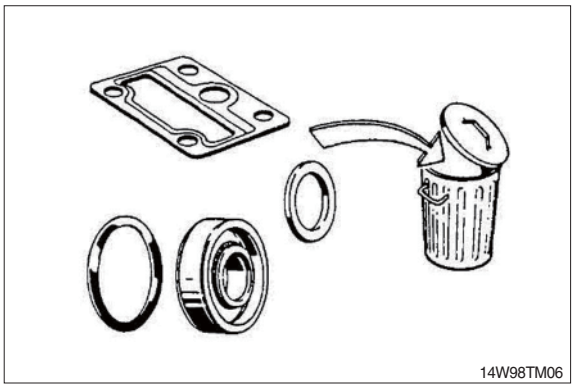
Observe the following notices when carrying out repair work at hydraulic aggregates.



(1) Close all ports of the hydraulic aggregates.

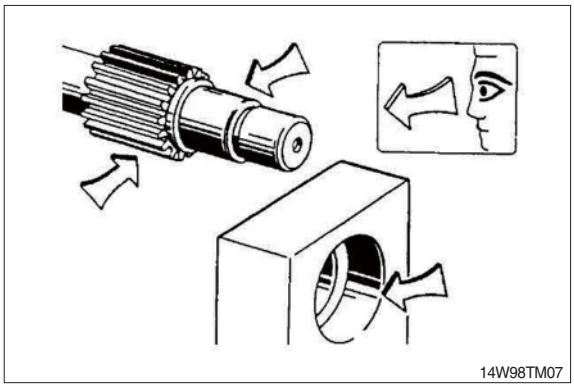


(2) Replace all seals.
Use only original spare parts.



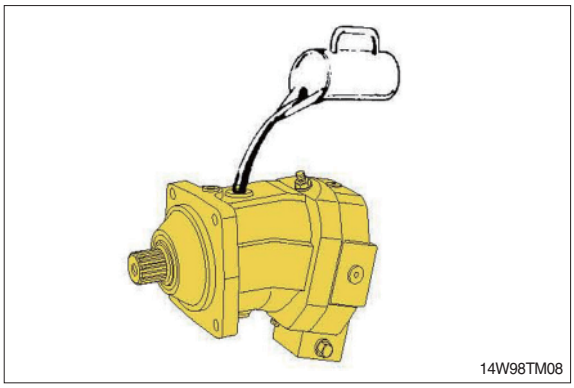
(3) Check all seal and sliding surfaces for wear.

※ Rework of sealing area f.ex. with abrasive paper can damage surface.



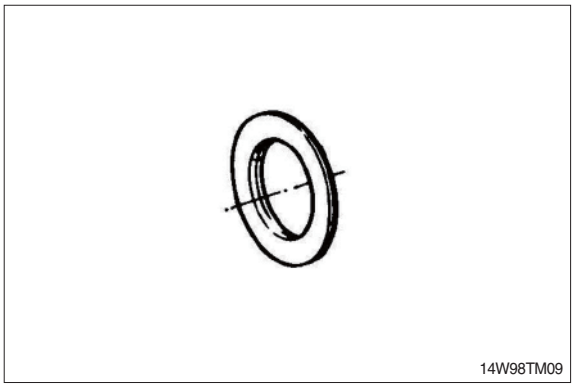
(4) Fill up hydraulic aggregates with hydraulic oil before start up.

※ Without fill up bearing damage happens!



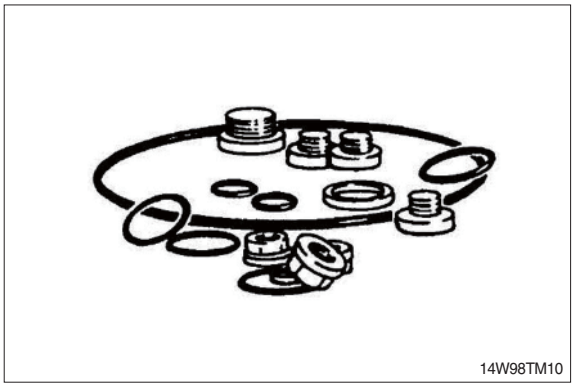
14W98TM08

(5) Seal kit for drive shaft



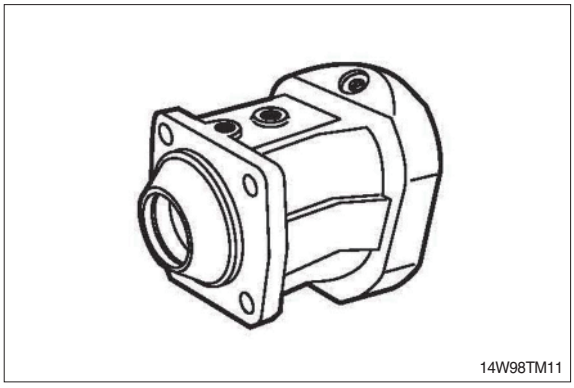
14W98TM09

(6) External seal kit.



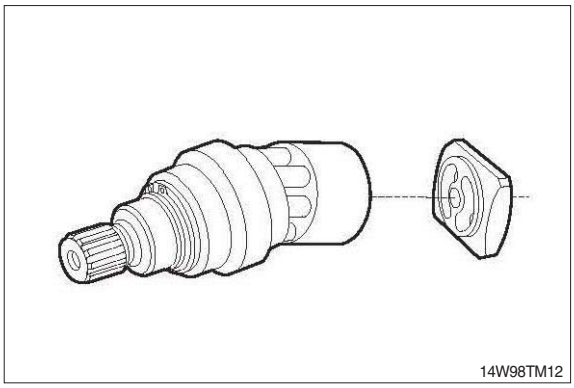
14W98TM10

(7) Housing.

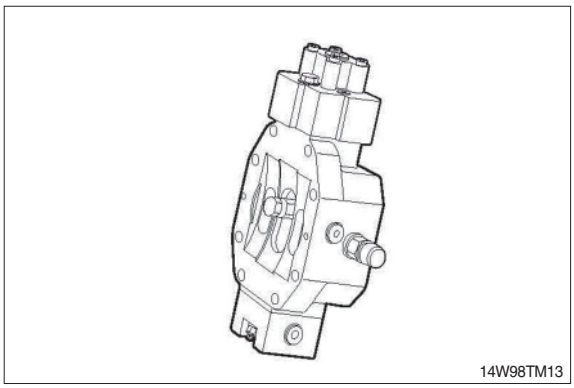


14W98TM11

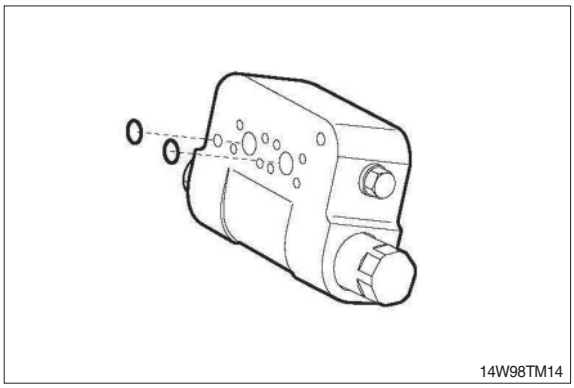
(8) Complete rotary group.



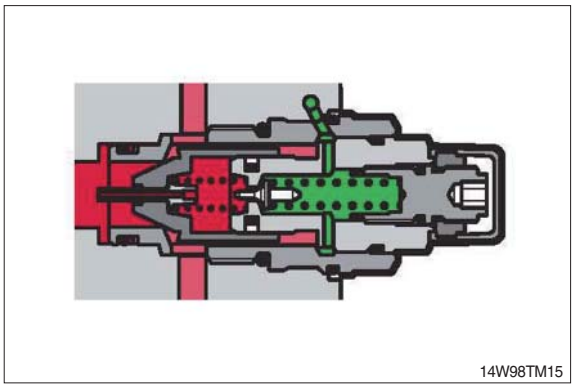
(9) Port plate with control piston.



(10) Counter balance valve.

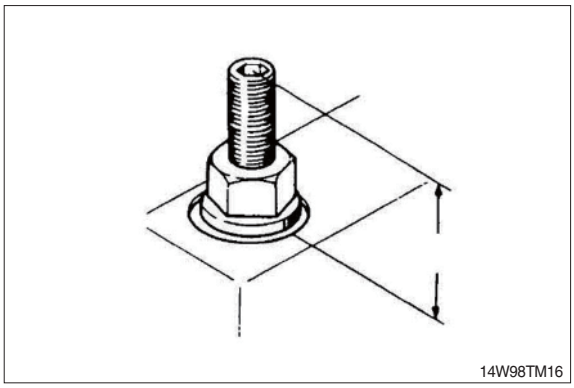


(11) Relief valve.

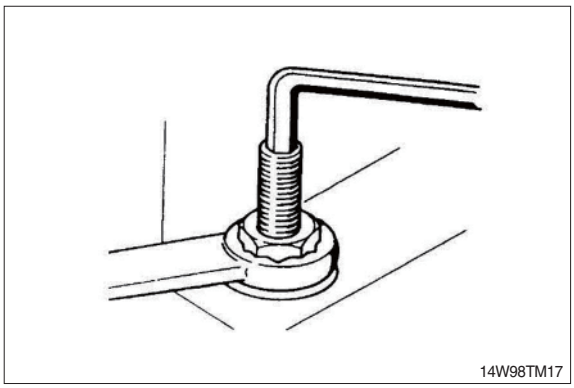


3) SEAL NUT

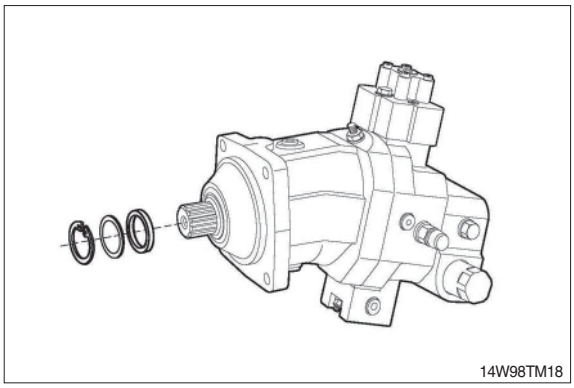
(1) Replace seal nut.
First measure and record setting height.



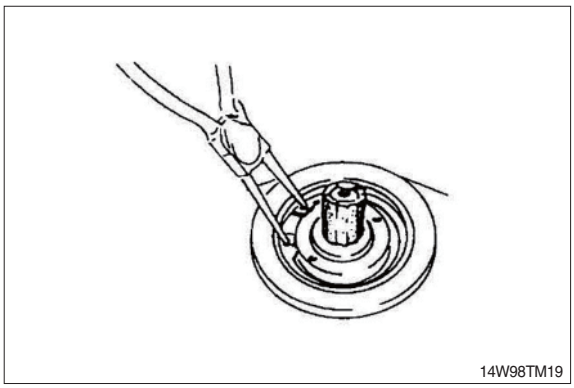
(2) When tightening, counterhold setting screw, then check setting height.



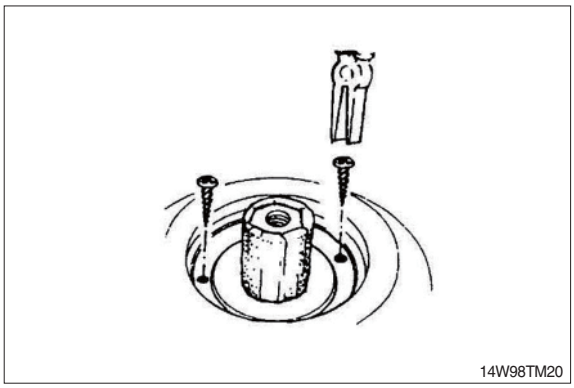
4) SEALING THE DRIVE SHAFT



(1) Protecting the drive shaft.
Remove retaining ring and shim.



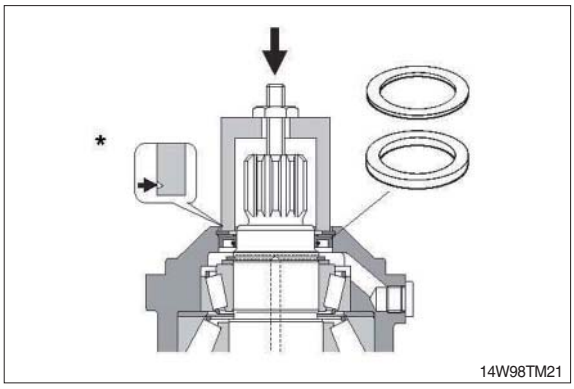
(2) Screw in sheet metal screw into the holes fitted with rubber.
Pull out seal with pliers.



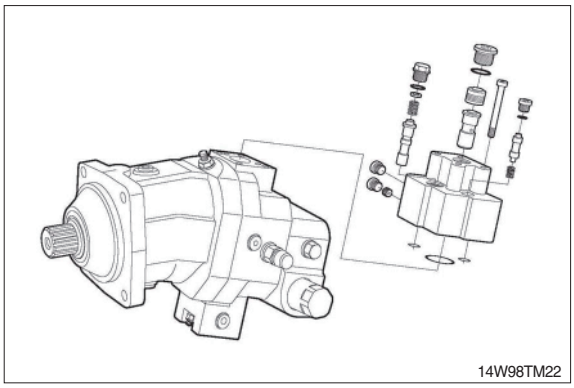
(3) Press in shaft seal and shim with bush to stop.

⚠ **Pay attention to pressing depth.**

* Mark for pressing depth.
Assemble retaining ring.

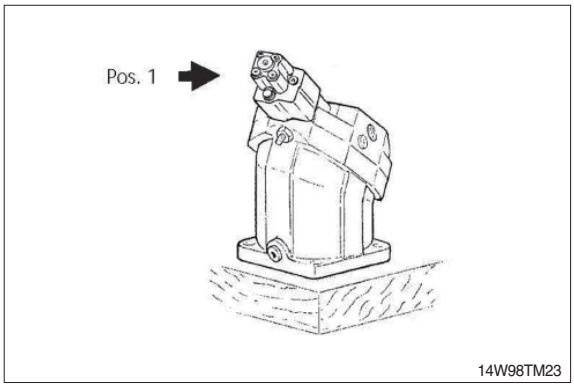


5) SEALING OF THE CONTROL PARTS



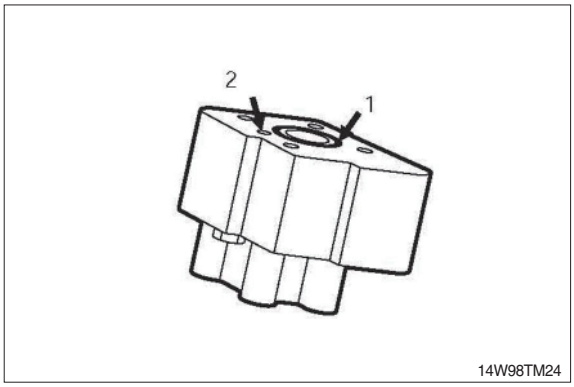
(1) Disassembly position

Remove cover pos.1.

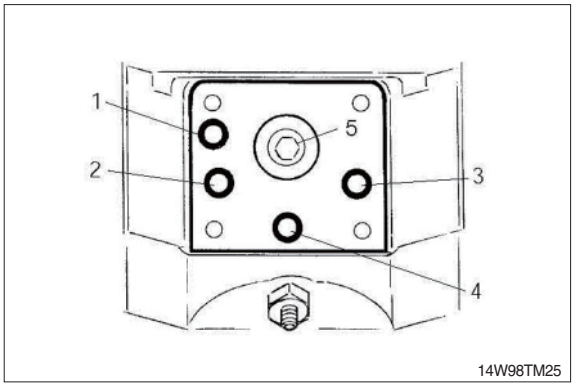


1 O-ring
2 Input flow of oil control

※ Installation position differs according to the control components.

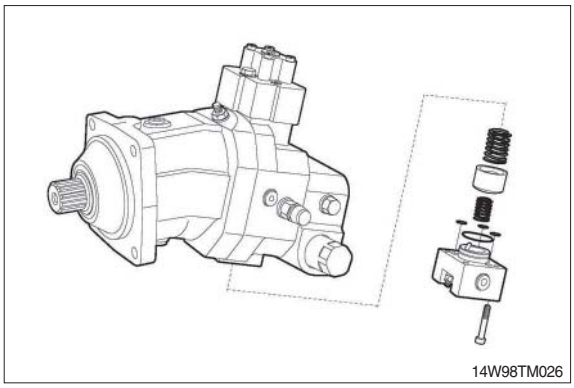


1 Input flow of oil control
2 High pressure / Low pressure
3 High pressure / Low pressure
4 Leakage oil
5 Control piston

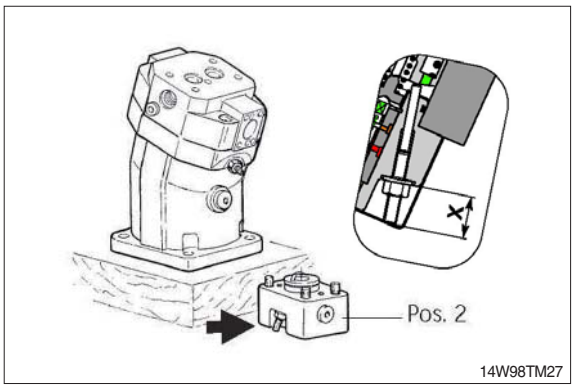


(2) Disassembly position : Remove cover 2.

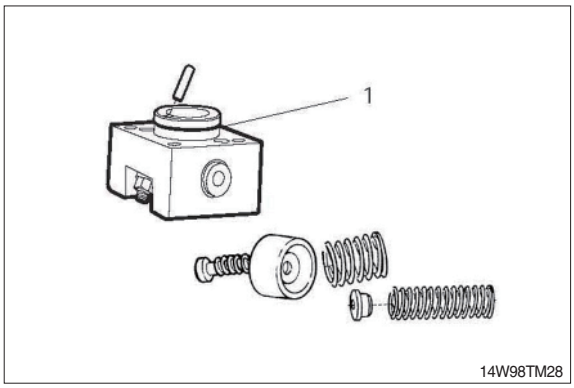
※ Attention spring load.



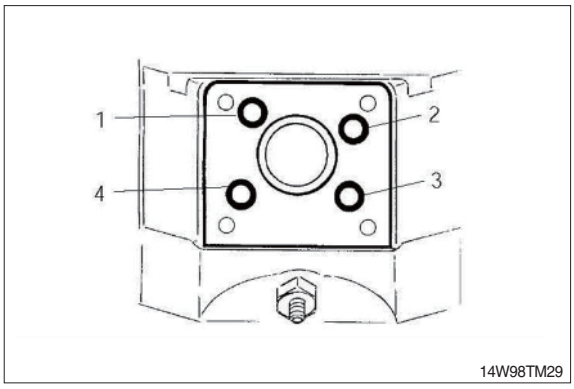
※ Dimension X : Note dimension (begin of regulation)



1 Check of O-ring

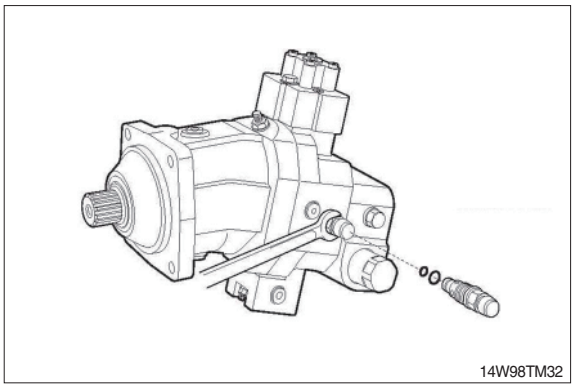


1 O-ring / High pressure-small control position side
2 O-ring / Control pressure
3 O-ring / High pressure-check valve
4 O-ring / High pressure-check valve

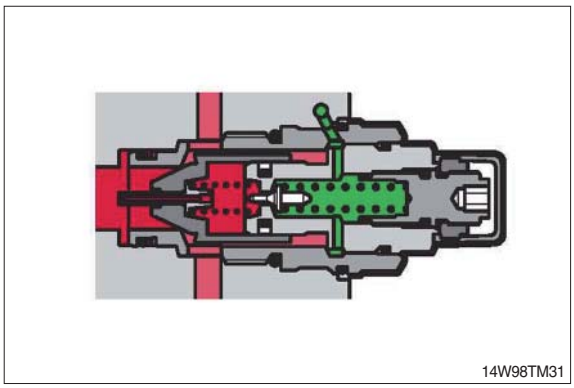


6) SEALING OF THE RELIEF VALVE / COUNTER BALANCE VALVE

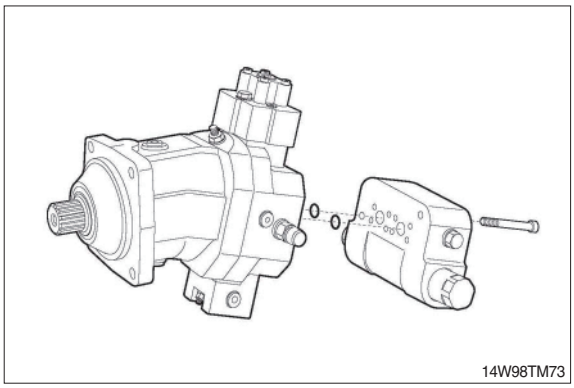
(1) Remove relief valve.



(2) Inspect
O-ring



(3) Remove counter-balance valve.
Inspect
O-ring



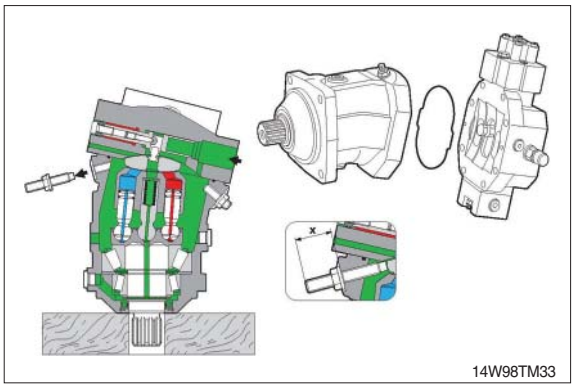
7) DISASSEMBLY OF THE PORT PLATE

· Note dimension X

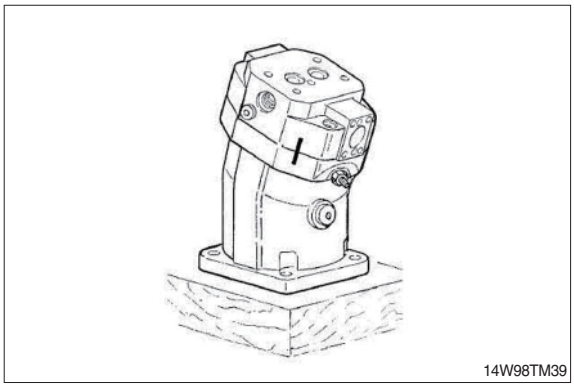
· Remove Q_{min} screw

· Swivel rotary group to zero P

※ For disassembly of the port plate, swivel always rotary group to zero position. Piston rings to hang out of the cylinder boring.

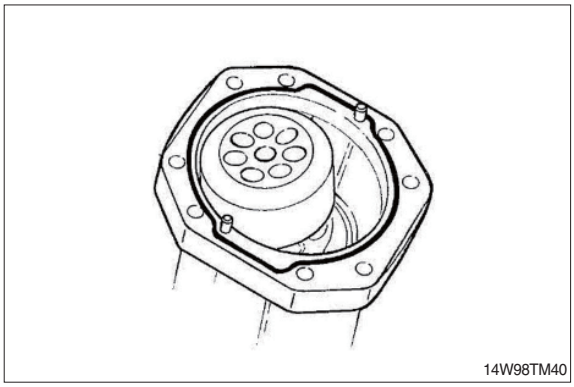


(1) Port plate.
Mark position. Loosen screws.
Removal.

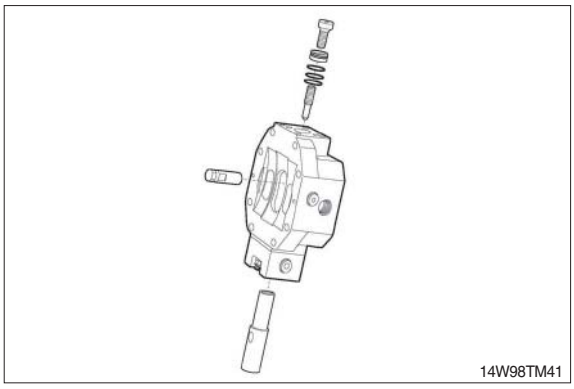


(2) Check O-ring.

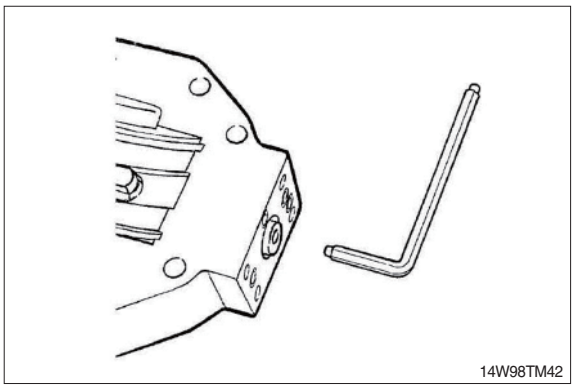
※ Stick new O-ring with some grease.
Do not swivel rotary group.
Piston rings to hang out from the cylinder boring.



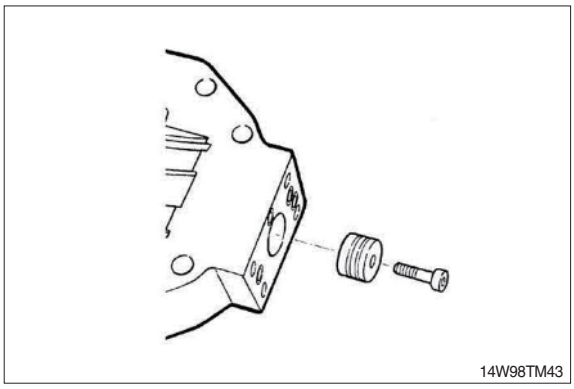
8) REMOVE OF THE POSITIONING PISTON



(1) Loosen fixing screw.
Use only socket wrench.

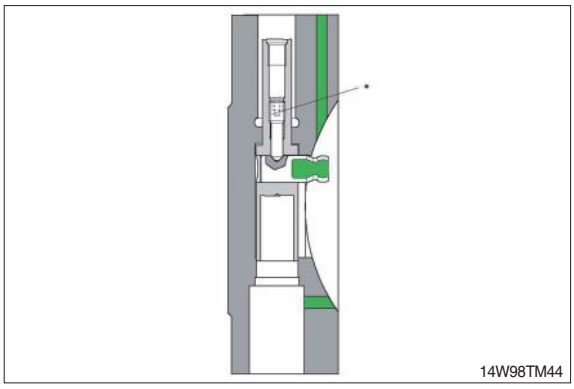


(2) Remove piston with piston ring.

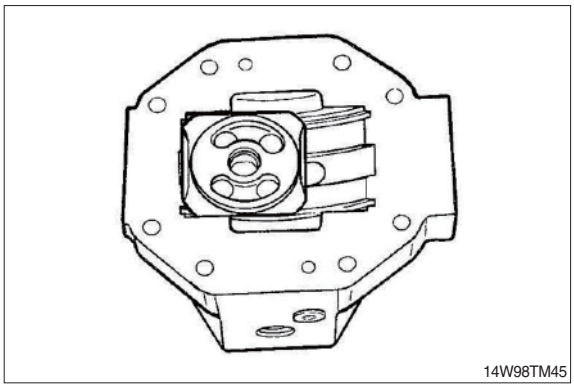


(3) Warm up fixation screw * for positioning plug via boring (screw glued-to turn out).

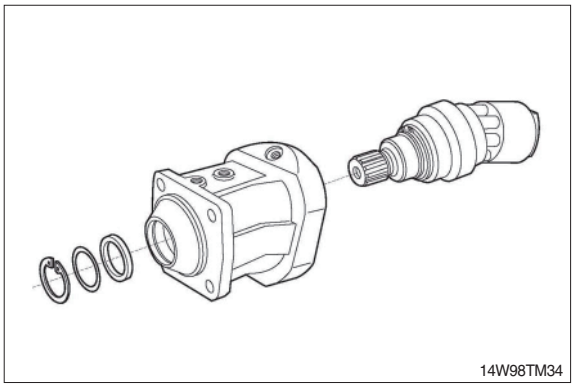
※ Use new screw.
Precote coating.
Note tightening torque.



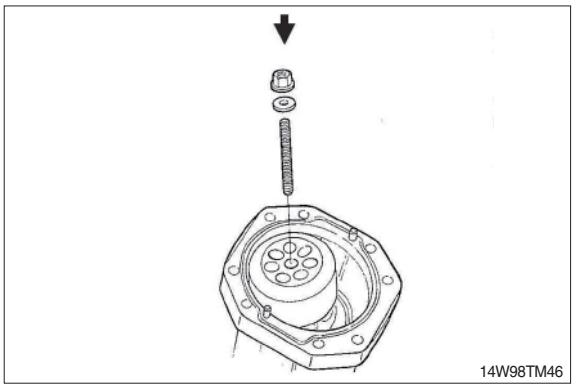
※ Stick control lens in sliding surface with grease. Assembly in reversal order. Mount port plate.
※ Rotary group vertical.


14W98TM45

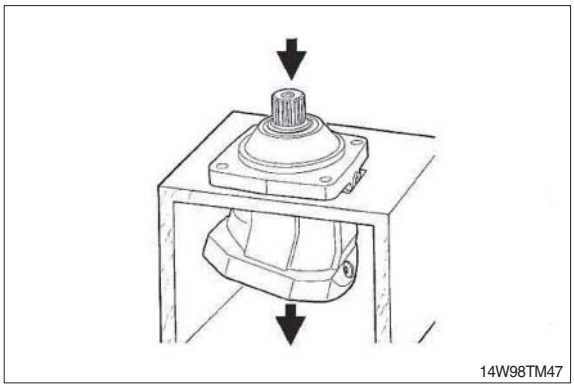
9) REMOVE ROTARY GROUP


14W98TM34

(1) Screw in threaded pin into center pin. Fix the cylinder with disc and locknut. M8×105 ℓ

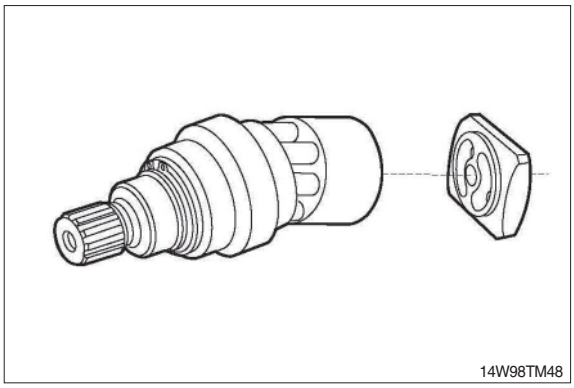

14W98TM46

(2) Press out rotary group.
※ If the bearings are used again do not hit on the drive shaft.

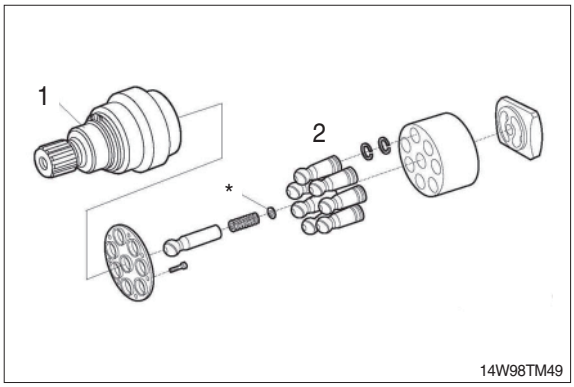

14W98TM47

10) EXCHANGING OF THE ROTARY GROUP

※ Complete rotary group
Setting of hydraulic part necessary.

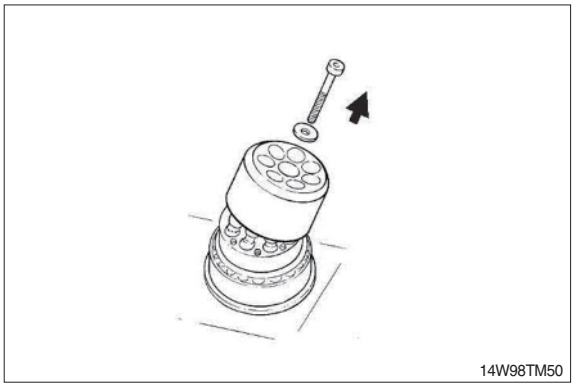

14W98TM48

Rotary group
1 Mechanical part : Adjust drive shaft with bearing
2 Hydraulic part : Adjustment necessary

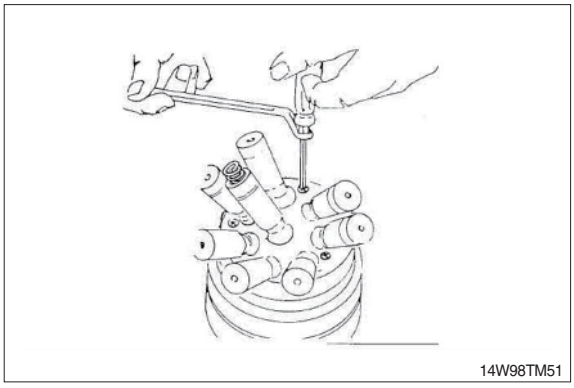


14W98TM49

(1) Remove fixing screw (cylinder).
Remove cylinder.

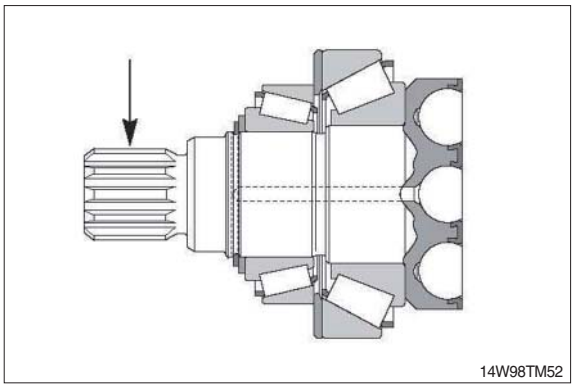

14W98TM50

(2) Disassemble retaining plate.
※ Screws are glued.
Use Torx tools.


14W98TM51

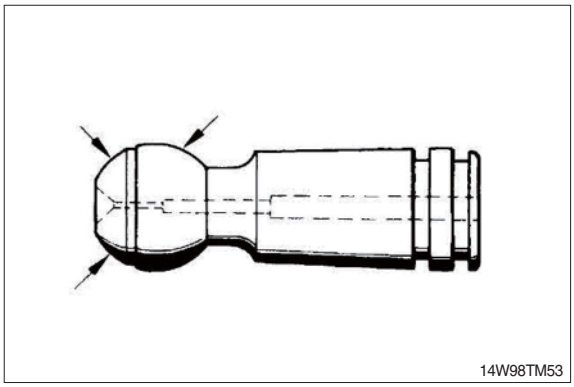
11) INSPECTION INSTRUCTIONS

(1) Free of corrosion, erosion or fretting; No damage to splines or keyways.



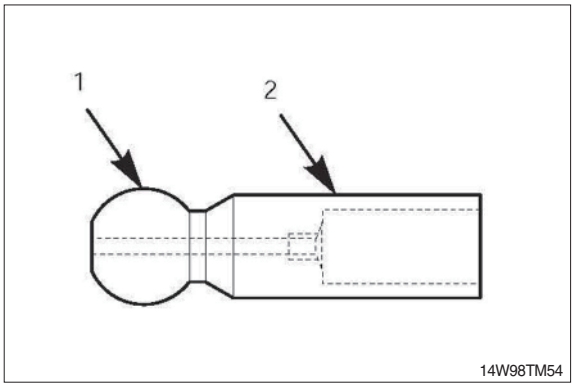
(2) Pistons

No scoring and no pittings.



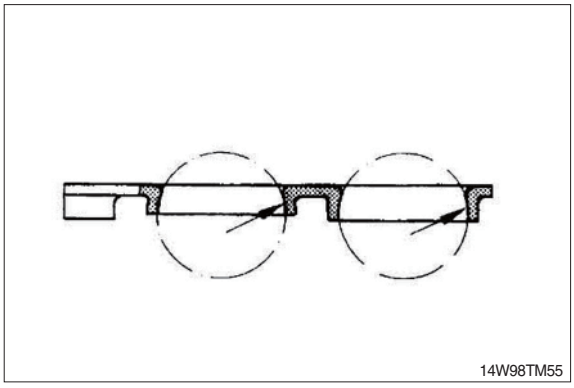
(3) Center pin

No scoring and no pittings.



(4) Retaining plate

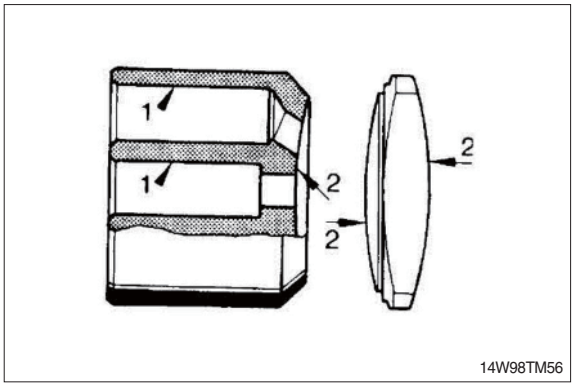
No scoring and no evidence of wear.



(5) Cylinder block / Control lens

1 Bores free of scoring, no evidence of wear

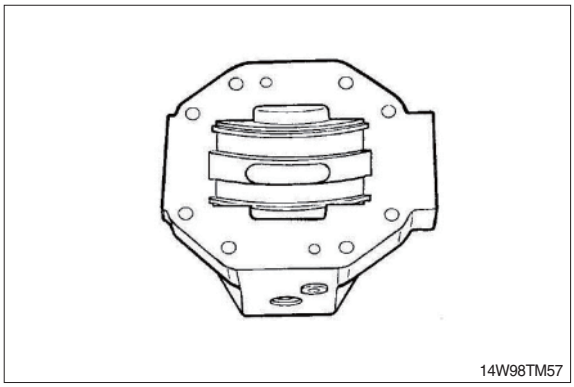
2 Faces smooth and even, free of cracks and scoring



14W98TM56

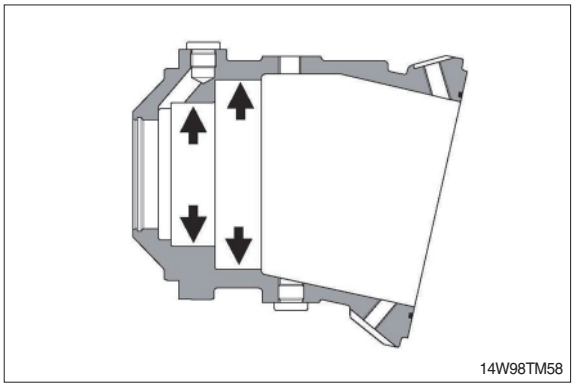
(6) Control housing

Sliding surface and side guides free of scoring and no wear.


14W98TM57

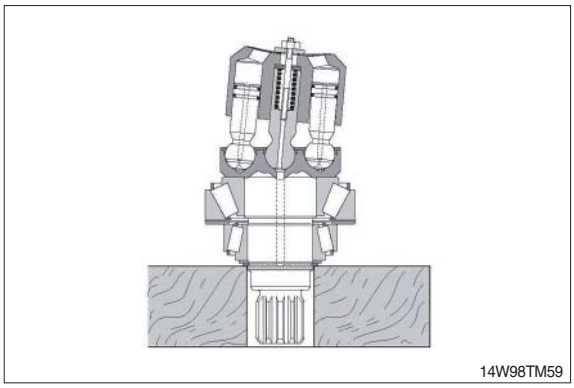
(7) Visual check

Bearing areas free of scoring and no evidence of wear.

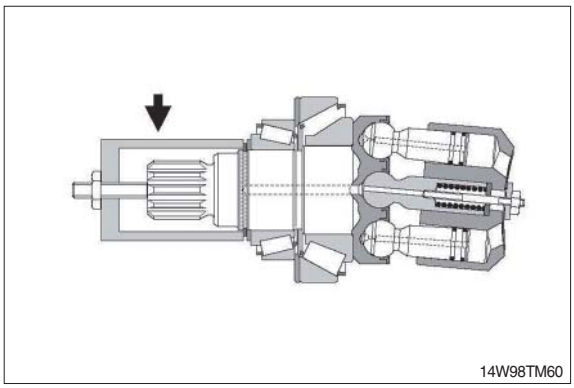

14W98TM58

12) ROTARY GROUP ASSEMBLY

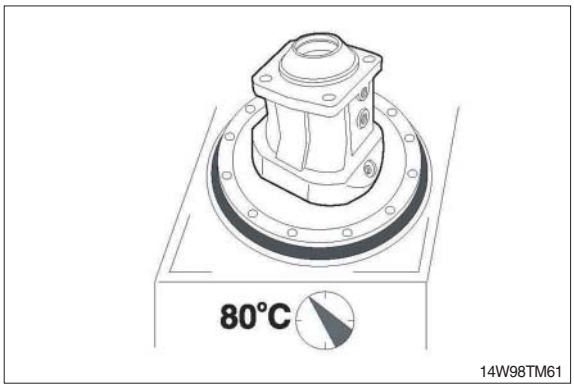
(1) Rotary group completely assembled ready for assembly.


14W98TM59

(2) Place assembly sleeve.

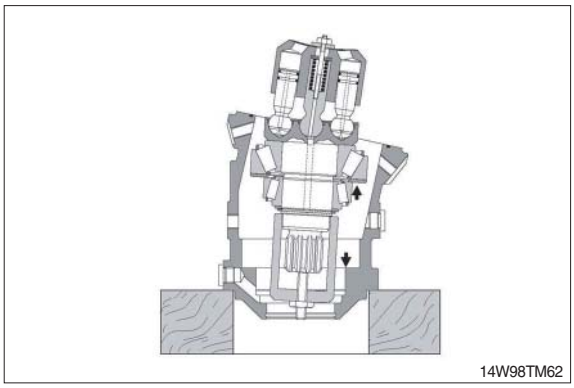

14W98TM60

(3) Warm up housing to 80˚C.

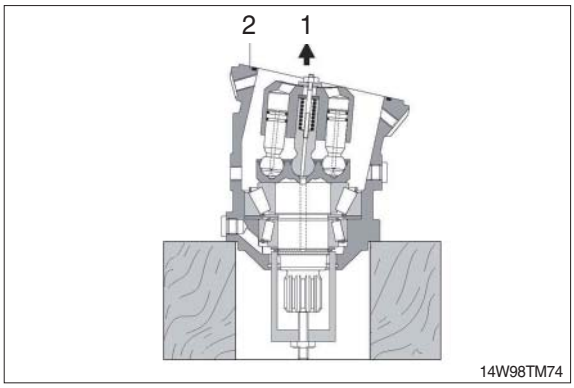


14W98TM61

(4) Insert rotary group into housing to seat position.

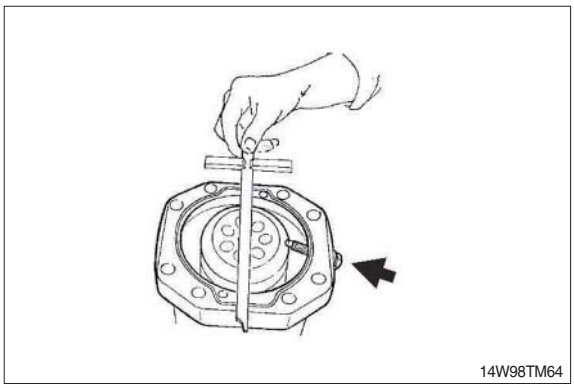

14W98TM62

(5) Fix zero position of cylinder with Q_{max} screw.
1 Disassemble cylinder fixing screw
2 Insert O-ring

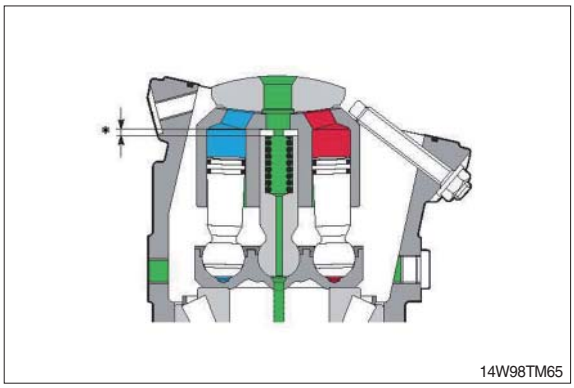


13) ROTARY GROUP ADJUSTMENT

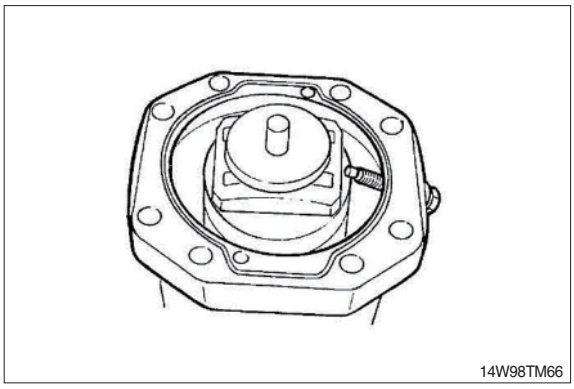
(1) Determine cylinder swivel range to max angle with screw.



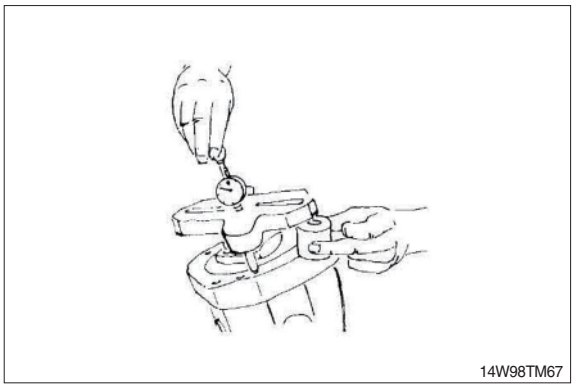
(2) * Disc



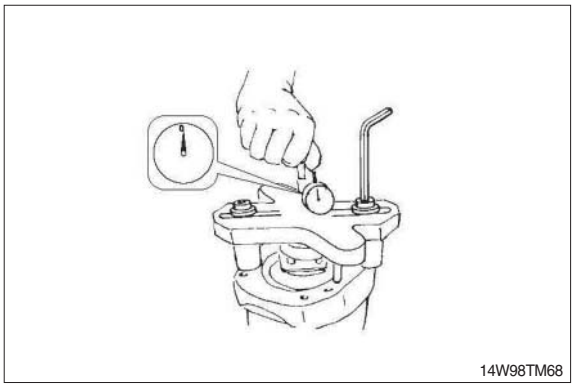
(3) Place centering disc.



(4) Mount measuring device.



(5) Check dimension X.



14) ASSEMBLY OF THE PORT PLATE

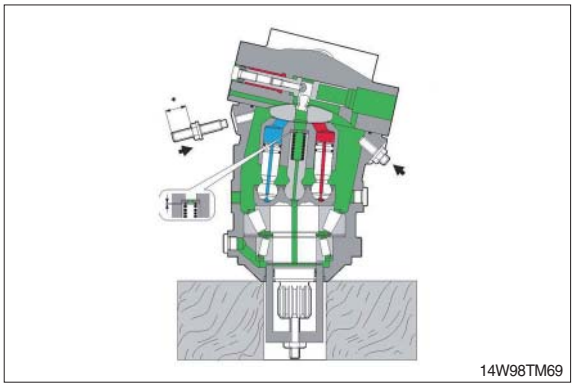
(1) Assemble port plate.

※ Take care of assembly design.
Tighten fixing screws with torque.

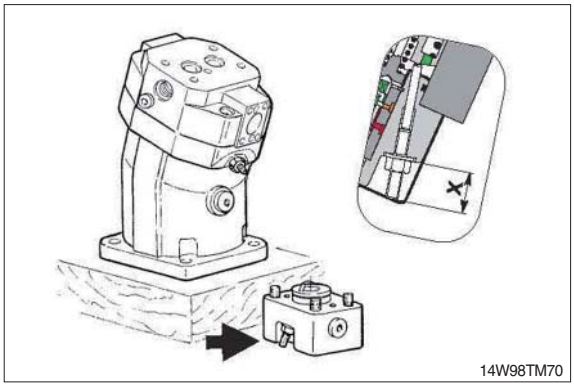
(2) Set Q_{min} screw to dimension(*).

(3) Assemble plug.

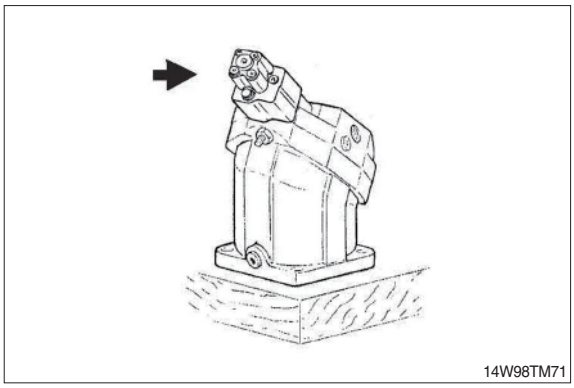
(4) Remove assembly sleeve.



(5) Assemble control components.

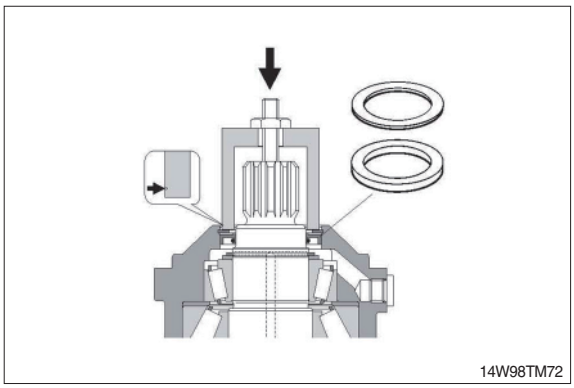


(6) Assemble cover.

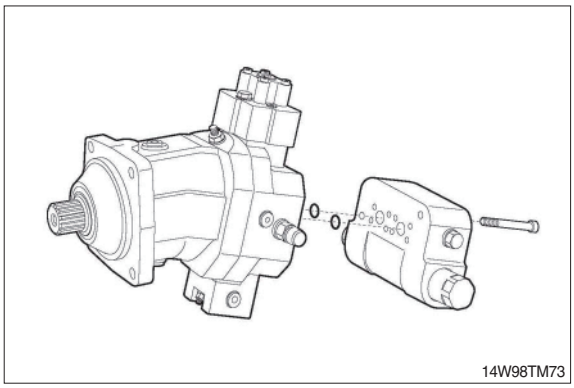


(7) Assemble shaft seal, disc and safety ring.
Press in with assembly sleeve.

※ Take care of press in depth.



(8) Assemble counter balance valve.



1. REMOVAL AND INSTALL

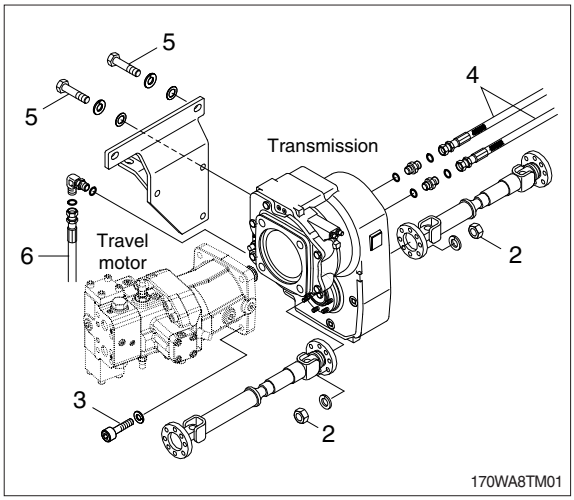
1) REMOVAL

(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 transmission guard plate if equipped.
(5) Remove the propeller shaft mounting nuts (2).
· Tightening torque : 5.9±0.6 kgf · m (42.7±4.3 lbf · ft)
(6) Remove the travel motor mounting bolt (3).
· Tightening torque : 29.6±3.2 kgf · m (214±23.1 lbf · ft)
(7) Remove the hoses (4, 6).
Fit blind plugs to the disconnected hoses.
(8) Remove the mounting bolts (5), then remove the transmission device assembly.
· Weight : 135 kg (298 lb)
· Tightening torque : 39.0±4.2 kgf · m (282±30.4 lbf · ft)



2) INSTALL

(1) Carry out installation in the reverse order to removal.
(2) Bleed the air from the transmission.
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. GENERAL INSTRUCTIONS

1) GENERAL WORKING INSTRUCTIONS

(1) This manual has been developed for the skilled serviceman, trained by manufacturer.

(2) During all operations, pay attention to cleanliness and skilled working.
Therefore,transmission removed from the machine must be cleaned prior to open them.

(3) We assume that the special tools, specified by manufacturer, will be used.
The special tools are available from manufacturer.

(4) After the disassembly, all components must be cleaned, especially corners, cavities and recesses of housing and covers.

(5) The old sealing compound must be carefully removed.

(6) Check lubricating holes, grooves and pipes for free passage. They must be free of residues, foreign material or protective compounds.

(7) The latter refers especially to new parts.

(8) Parts which have been inevitably damaged in a disassembly operation, must be generally replaced by new ones, e.g. rotary seal rings, O-rings, U-section rings, cap boots, protective caps etc..

(9) Components such as roller bearings, thrust washers, synchronizing parts etc. which are subject to normal wear in automotive operation, must be checked by the skilled Serviceman.
He will decide if the parts can be reused.

(10) For the heating of bearings etc., hot plates, rod heaters or heating furnaces must be used.

(11) Never heat parts directly with the flame. An auxiliary solution would be to immerse the bearing in a vessel filled with oil, which is then heated with the flame.
In this way, damage to the bearings could be avoided.

(12) Ball bearings, covers, flanges and parts like that must be heated to about 90 to 100˚C.

(13) Hot-mounted parts must be reset after cooling in order to assure a proper contact.

(14) Before pressing shafts, bearings etc. in position, both parts must be lubricated.

(15) During to reassembly, all specified adjustment values, testing specifications and tightening torque must be respected.

(16) After the repair, units are filled up with oil.

(17) After the oil filling, the oil level plugs and oil drain plugs must be tightened to the specified tightening torque.

2) IMPORTANT INSTRUCTIONS CONCERNING THE LABOUR SAFETY

(1) In principle, repairers are themselves responsible for the labour safety.

(2) The observance of all valid safety regulations and legal rules is a precondition to prevent damage to individuals and products during the maintenance and repair operations.

(3) Before starting the work, the repairers have to make themselves familiar with these regulations.

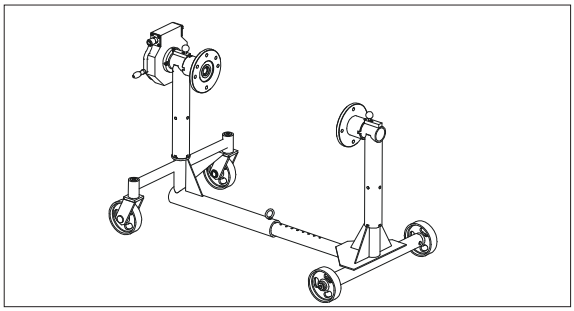
(4) The proper repair of these products requires especially trained personnel.

(5) The repairer himself is obliged to provide for the training.

3. SPECIAL TOOLS FOR DISASSEMBLY AND REASSEMBLY

1) Assembly truck assy with tilting device

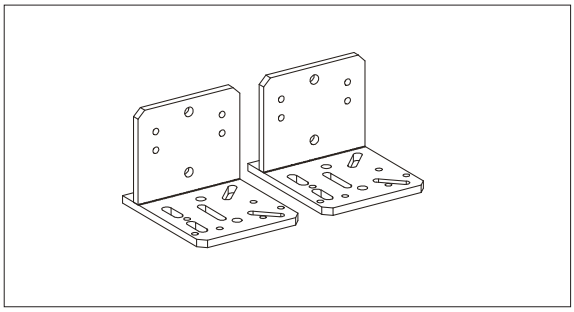
5870 350 000



14WF8TM01

2) Supporting bracket

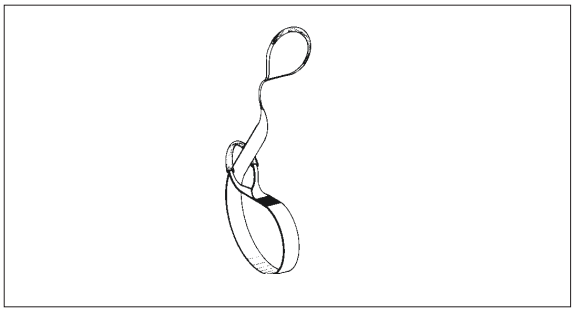
5870 350 106



14WF8TM02

3) Lifting strap

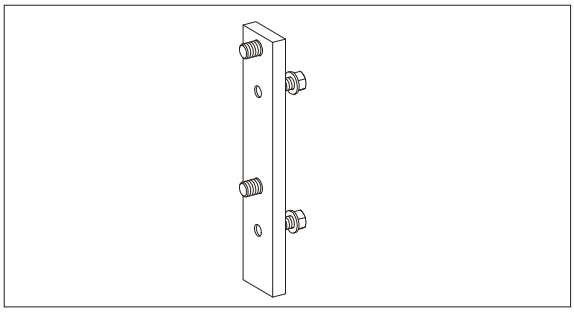
5870 281 026



14WF8TM03

4) Fixture

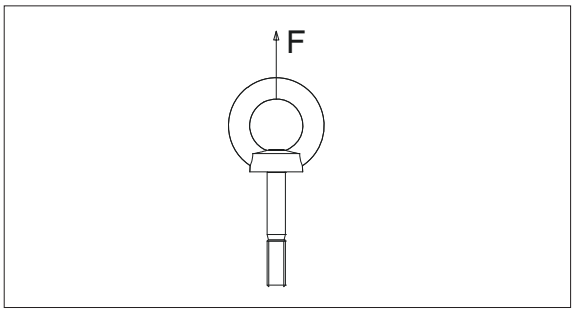
5870 350 079



14WF8TM04

5) Eye bolt assortment

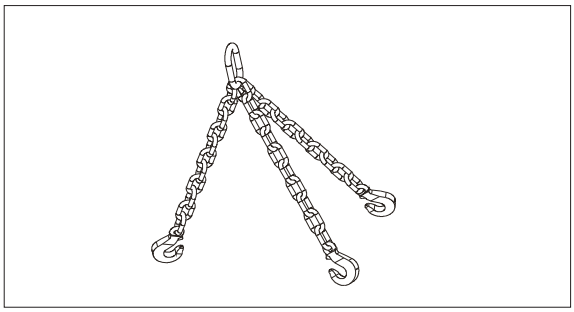
5870 204 002



14WF8TM05

6) Lifting chain

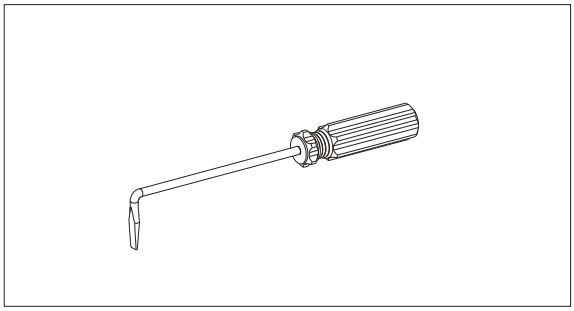
5870 221 047



14WF8TM06

7) Resetting device

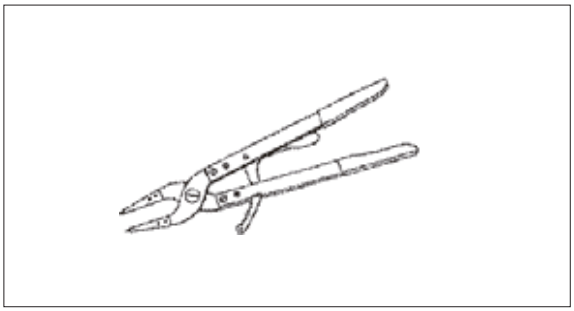
5870 400 001



14WF8TM07

8) Clamping pliers

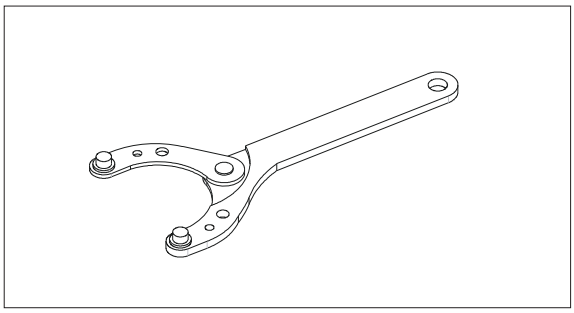
5870 900 021



14WF8TM08

9) Clamping fork

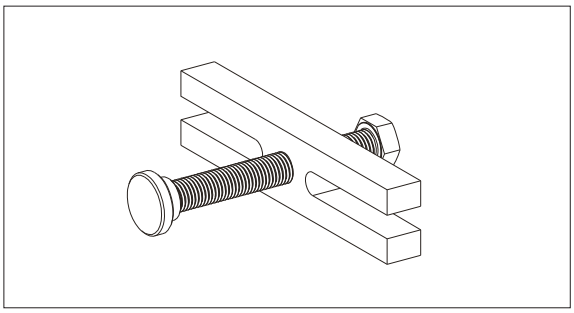
5870 240 025



14WF8TM09

10) Extractor

5870 000 017



14WF8TM10

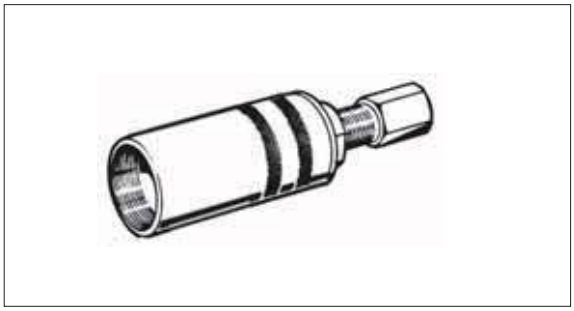
11) Rapid grip

5873 012 021

14WF8TM11

12) Basic tool

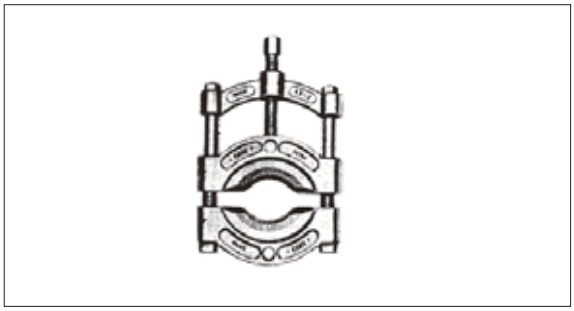
5873 002 001



14WF8TM12

13) Cut-off device

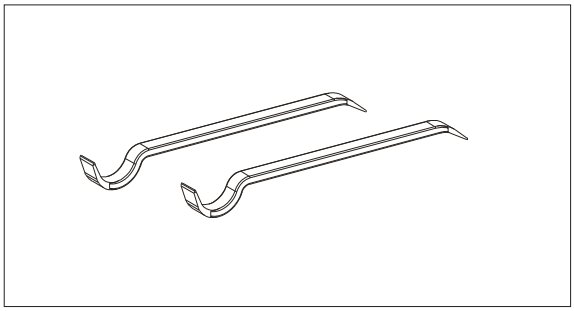
5870 300 028



14WF8TM13

14) Assembly lever

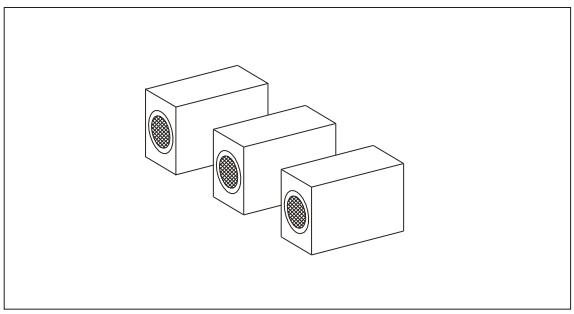
5870 345 036



14WF8TM14

15) Solenoid block

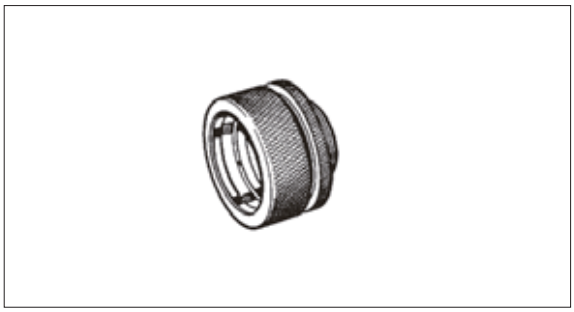
5870 450 003



14WF8TM15

16) Grab sleeve

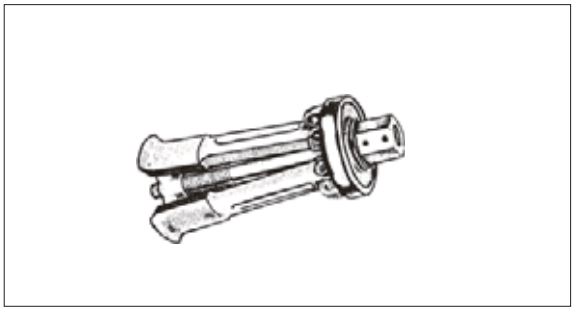
5873 001 037



14WF8TM16

17) Inner extractor

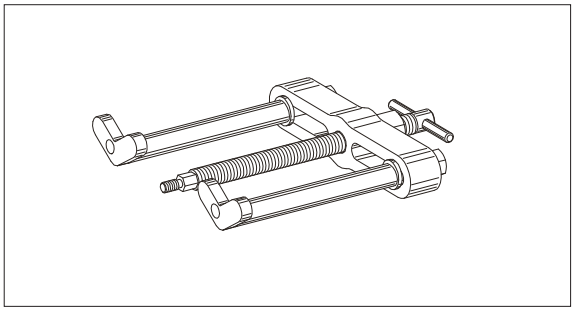
5870 300 019



14WF8TM17

18) Counter support

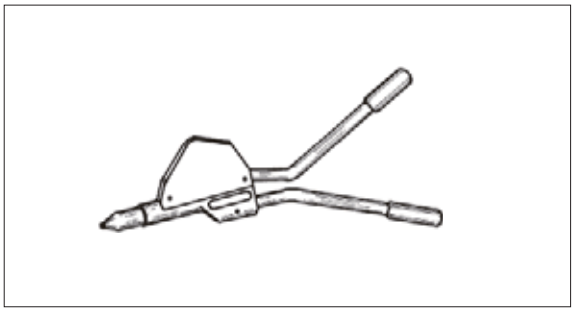
5870 300 020



14WF8TM18

19) Lever riveting tongs

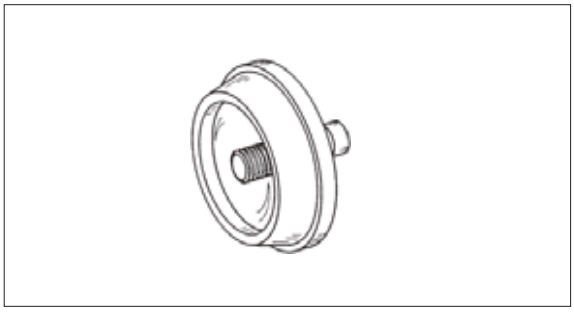
5870 320 016



14WF8TM19

20) Driver tool

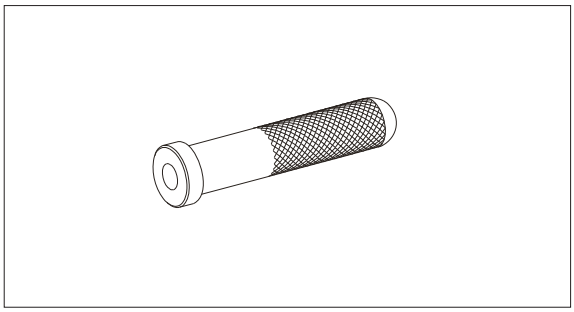
5870 058 073



14WF8TM20

21) Handle

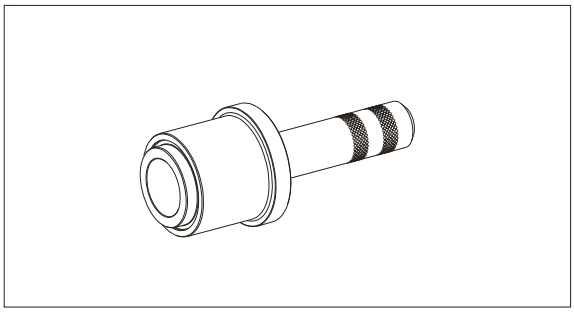
5870 260 002



14WF8TM21

22) Driver tool

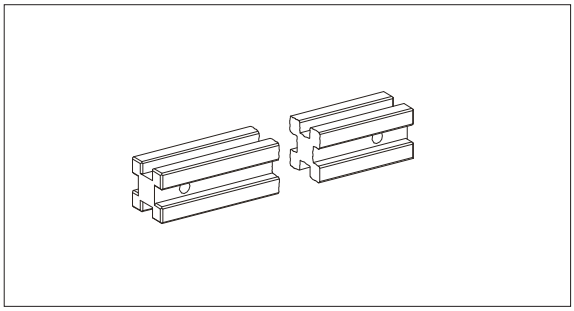
5870 048 281



14WF8TM22

23) Straightedge

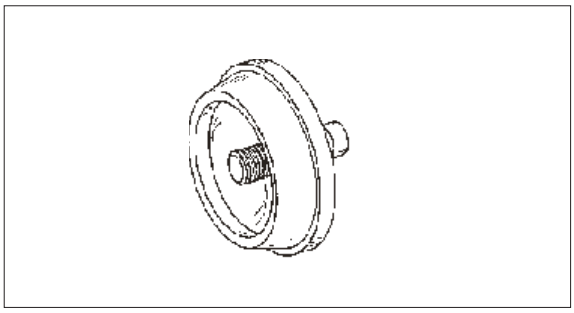
5870 200 108



14WF8TM23

24) Driver tool

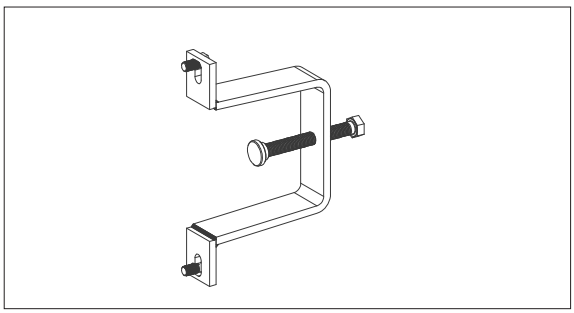
5870 058 078



14WF8TM24

25) Clamping bar

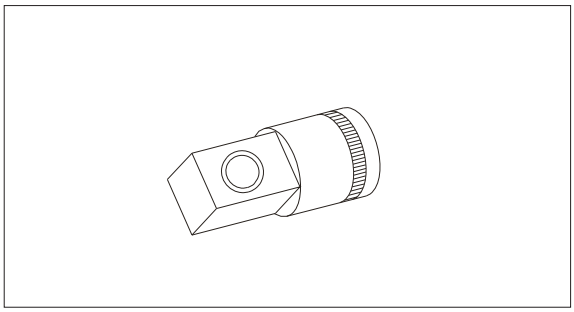
5870 654 049



14WF8TM25

26) Reduction

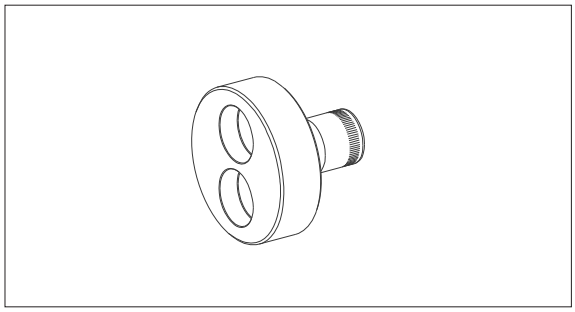
5870 656 056



14WF8TM26

27) Plug insert

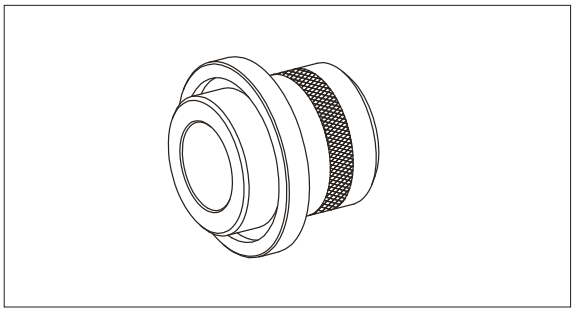
AA00 392 461



14WF8TM27

28) Driver tool

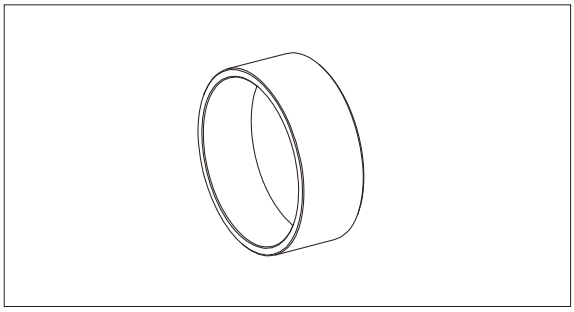
5870 048 279



14WF8TM28

29) Pressure piece

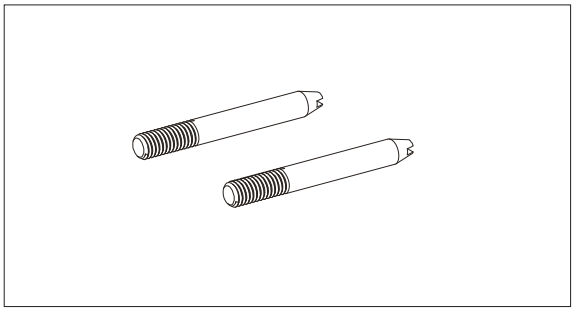
5870 506 150



14WF8TM29

30) Adjusting screws (M12)

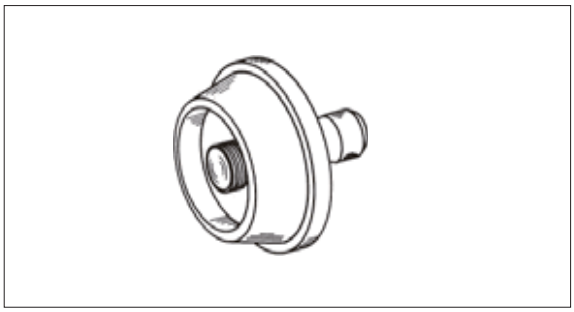
5870 204 021



14WF8TM30

31) Driver tool

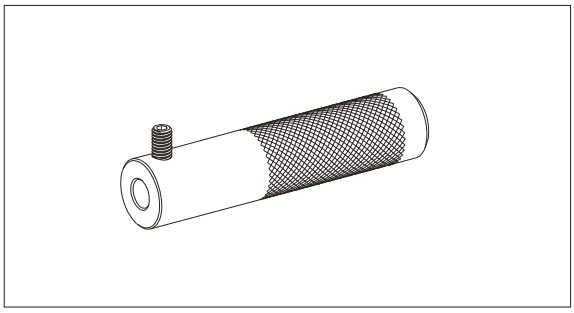
5870 058 051



14WF8TM31

32) Press-fit mandrel

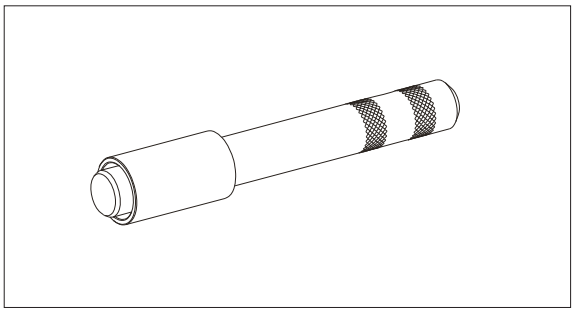
AA00 392 151



14WF8TM32

33) Driver tool

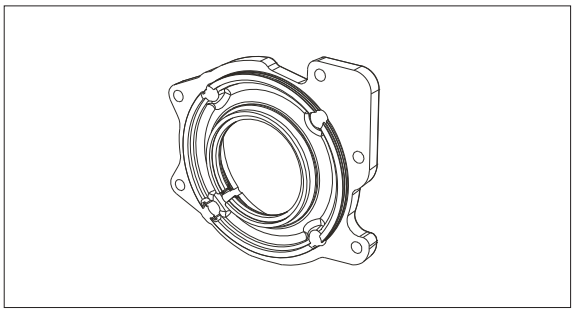
5870 048 283



14WF8TM33

34) Measuring device

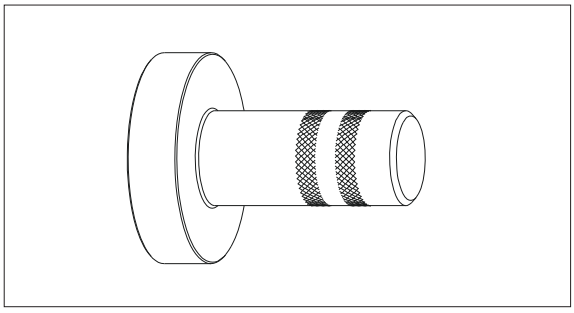
5870 200 131



14WF8TM34

35) Driver tool

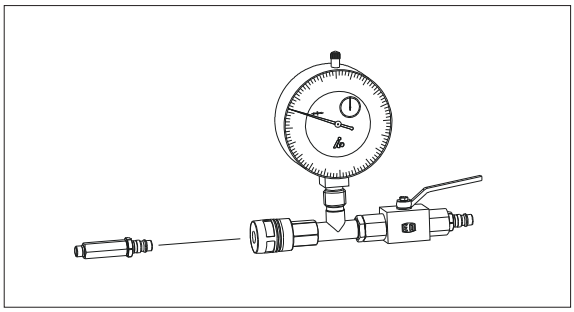
5870 506 161



14WF8TM35

36) Air connection

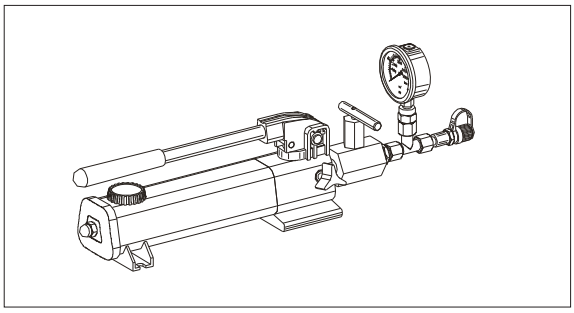
5870 505 012



14WF8TM36

37) HP pump

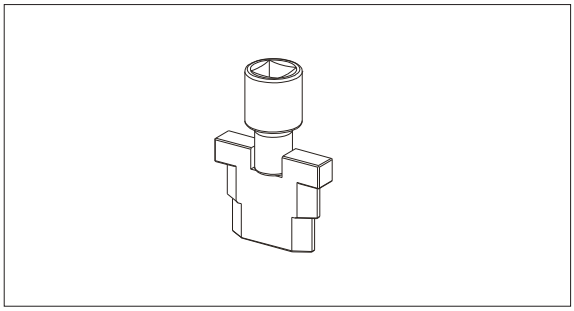
5870 287 007



14WF8TM37

38) Spline mandrel

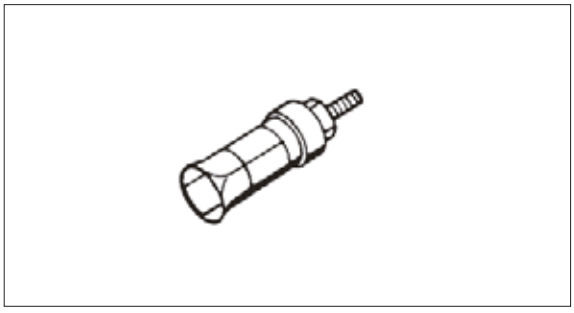
5870 510 039



14WF8TM38

39) Inner extractor

5870 300 012



14WF8TM39

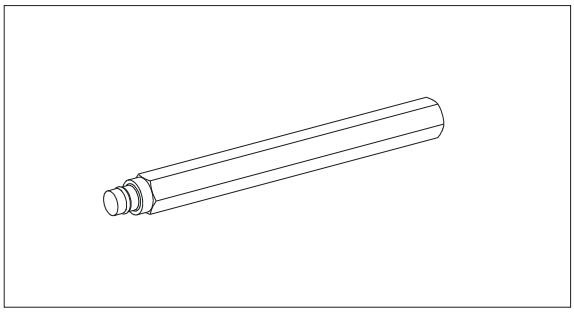
40) Counter support

5870 300 011

14WF8TM40

41) Driver tool

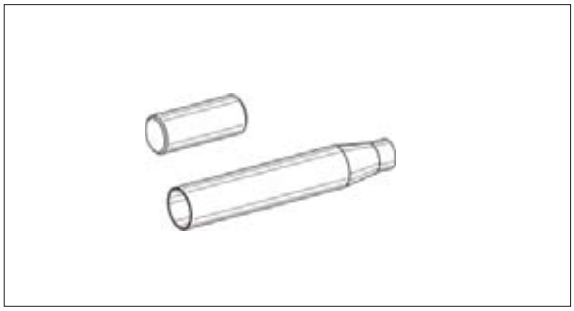
5870 705 003



14WF8TM41

42) Inner installer

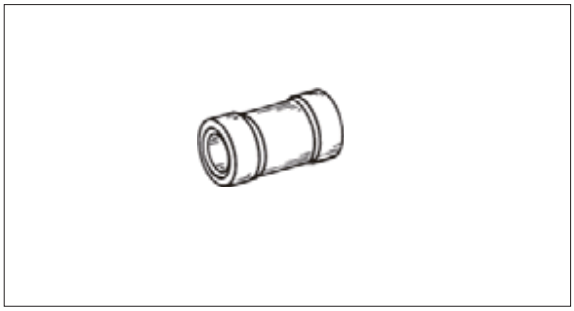
5870 651 055



14WF8TM42

43) Calibrating mandrel

5870 651 056



14WF8TM43

4. COMMERCIAL TOOLS FOR DISASSEMBLY AND REASSEMBLY

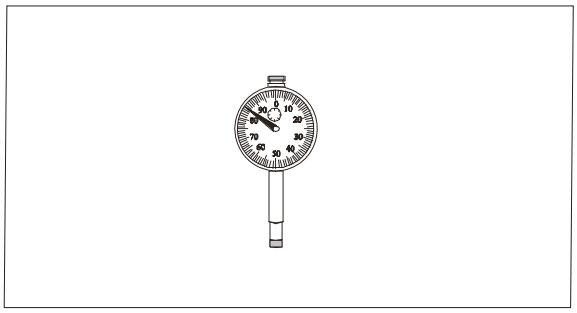
1) Magnetic stand

5870 200 055

14WF8TM44

2) Dial indicator

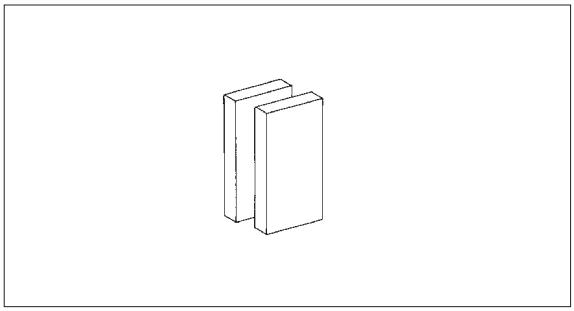
5870 200 057



14WF8TM45

3) Gauge blocks

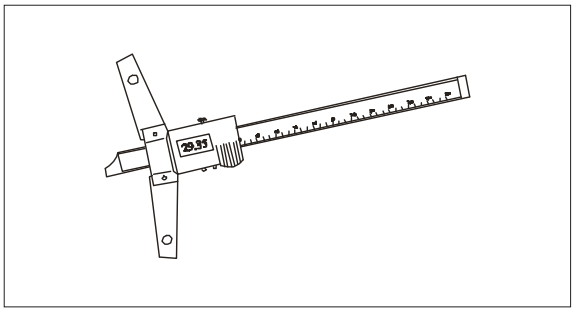
5870 200 066	70 mm
5870 200 067	100 mm



14WF8TM46

4) Digital depth gauge

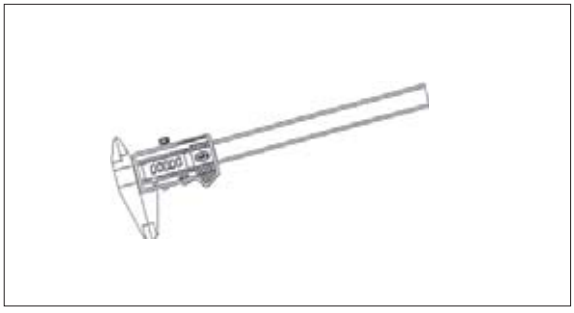
5870 200 072	200 mm
5870 200 114	300 mm



14WF8TM47

5) Digital caliper gauge

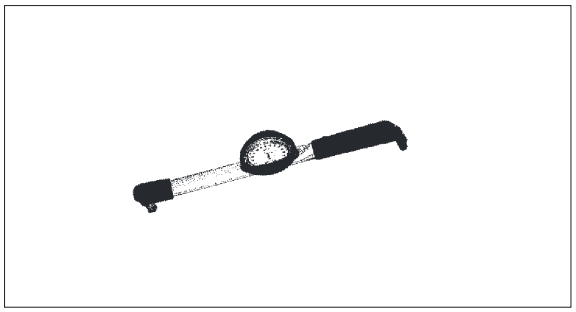
5870 200 109	150 mm



14WF8TM48

6) Torque wrench

5870 203 030	0.6 -6.0 Nm
5870 203 031	1.0 – 12 Nm
5870 203 032	3.0 – 23 Nm
5870 203 033	5.0 – 45 Nm
5870 203 034	10 – 90 Nm
5870 203 039	80 – 400 Nm
5870 203 016	140 – 750 Nm
5870 203 011	750 - 2000 Nm

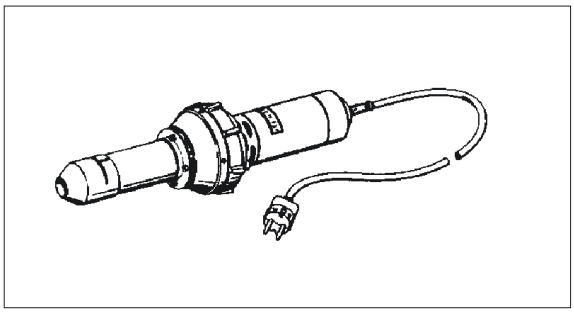


14WF8TM49

14WF8TM50

7) Hot air blower

5870 221 500	230 V
5870 221 501	115 V



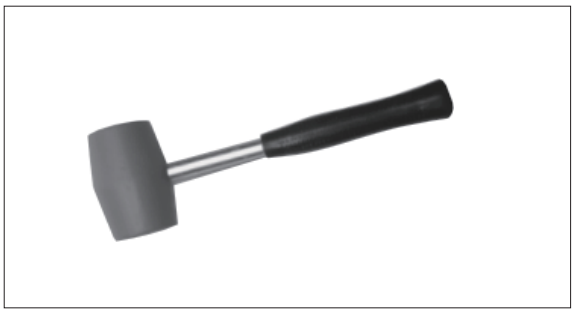
14WF8TM51

8) Plastic hammer

5870 280 004	Ø 60 mm

Substitute nylon insert

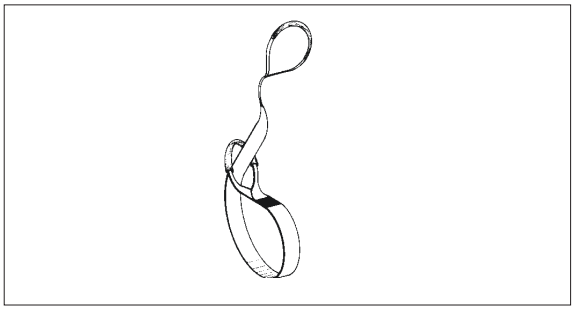
5870 280 006



14WF8TM52

9) Lifting strap

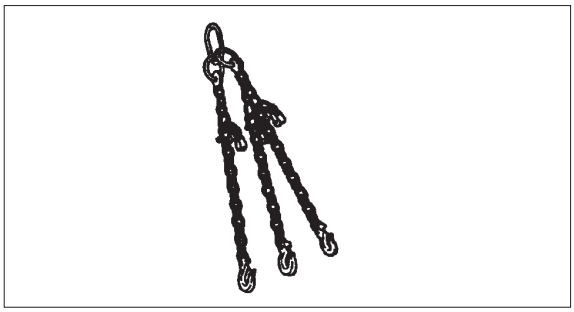
5870 281 026



14WF8TM53

10) Lifting chain

5870 281 047



14WF8TM54

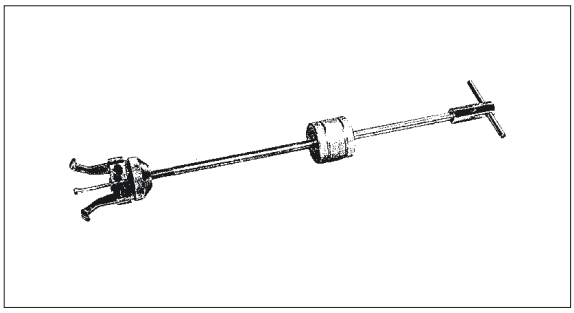
11) Pry bar

5870 345 071

14WF8TM55

12) Striker

5870 650 004



14WF8TM56

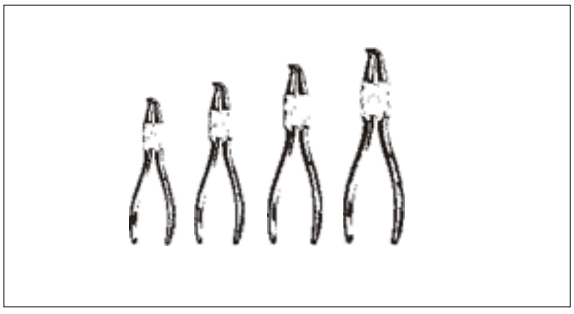
13) Set of internal pliers
I1-I2-I3-I4

5870 900 013

14WF8TM57

14) Set of internal pliers
I11-I21-I31-I41 90˚

5870 900 014



14WF8TM58

15) Set of external pliers
A1-A2-A3-A4

5870 900 015

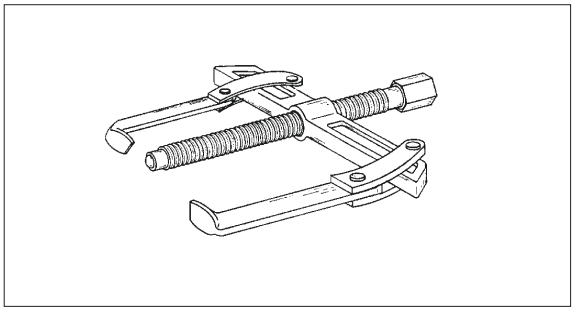
14WF8TM59

16) Set of external pliers
A01-A02-A03-A04 90˚

5870 900 016

14WF8TM60

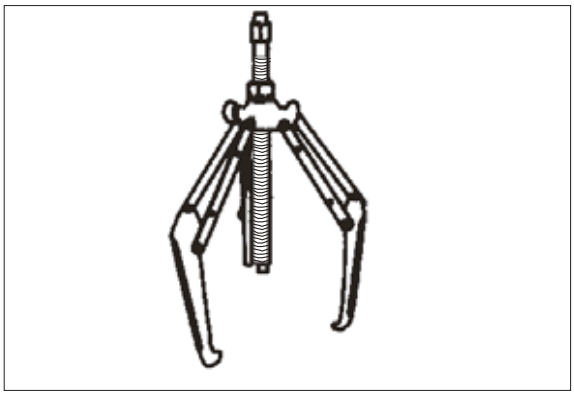
17) Two-armed puller



14WF8TM61

5870 970 001	
Jaw width	80 mm
Throat depth	100 mm
5870 970 002	
Jaw width	120 mm
Throat depth	125 mm
5870 970 003	
Jaw width	170 mm
Throat depth	125 mm
5870 970 004	
Jaw width	200 mm
Throat depth	175 mm
5870 970 006	
Jaw width	350 mm
Throat depth	250 mm
5870 970 007	
Jaw width	520 mm
Throat depth	300 - 500 mm
5870 970 026	
Jaw width	250 mm
Throat depth	200 mm
5870 970 028	
Jaw width	380 mm
Throat depth	200 mm

18) Three armed puller



14WF8TM62

5870 971 001	
Jaw width	85 mm
Throat depth	65 mm
5870 971 002	
Jaw width	130 mm
Throat depth	105 mm
5870 971 003	
Jaw width	230 mm
Throat depth	150 mm
5870 971 004	
Jaw width	295 mm
Throat depth	235 mm
5870 971 005	
Jaw width	390 mm
Throat depth	230 mm
5870 971 006	
Jaw width	640 mm
Throat depth	290 mm

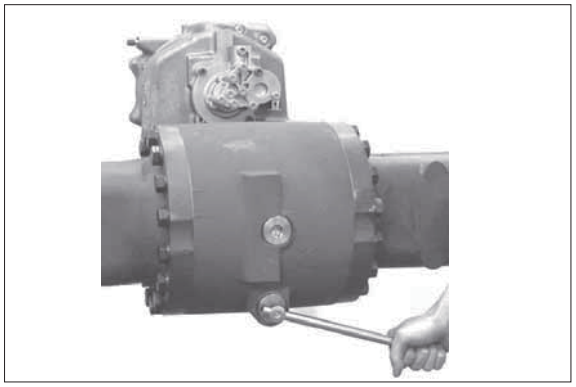
5. SEPARATE TRANSMISSION FROM AXLE HOUSING

(only for version Axle attachment)

1) Drain oil from axle housing – use a suitable oil reservoir.

(S) Assembly truck 5870 350 000
(S) Clamping fork 5870 350 106

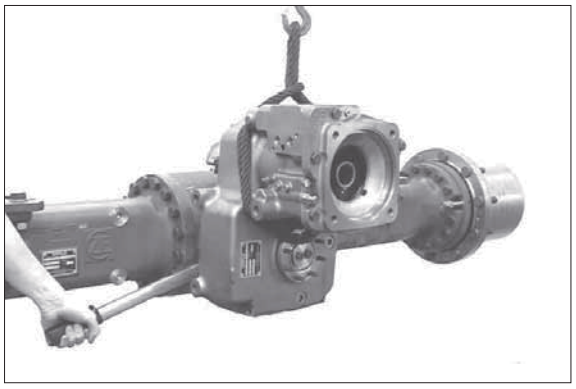
⚠ **Waste oil to be disposed of ecologically.**



14WF8TM63

2) Pick-up Transmission by means of lifting tackle, loosen threaded joint and separate complete Transmission from axle housing.

(S) Lifting strap 5870 281 026

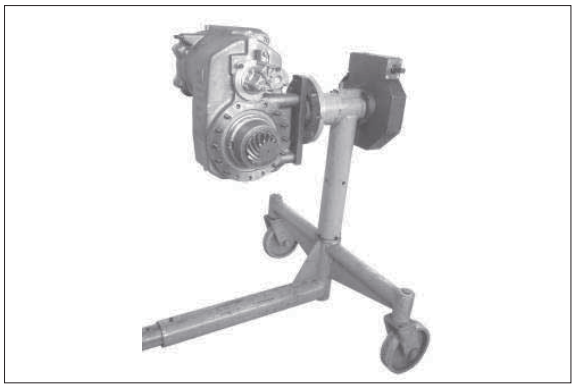


14WF8TM64

6. DISASSEMBLY – BRAKE / CLUTCH / PLANETARY CARRIER

1) Mount transmission to assembly truck.

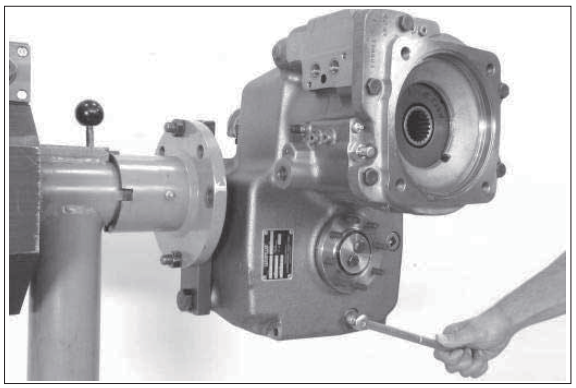
(S) Assembly truck assy. 5870 350 000
(S) Fixture 5870 350 079



14WF8TM65

2) Loosen screw plug and drain oil – use a suitable oil reservoir.

⚠ **Waste oil to be disposed of ecologically.**

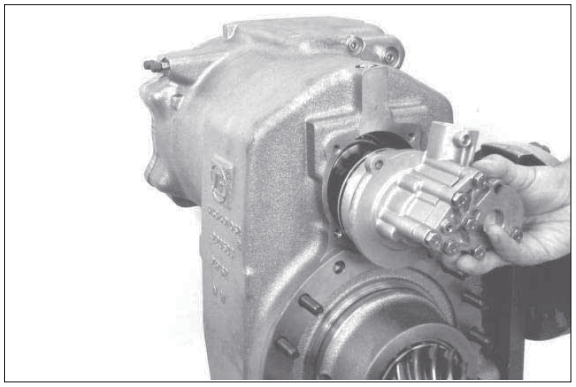


14WF8TM66

Lubrication pump

3) Remove lubrication pump or shift interlock (depending on version, Illustration shows version with Lubrication pump).

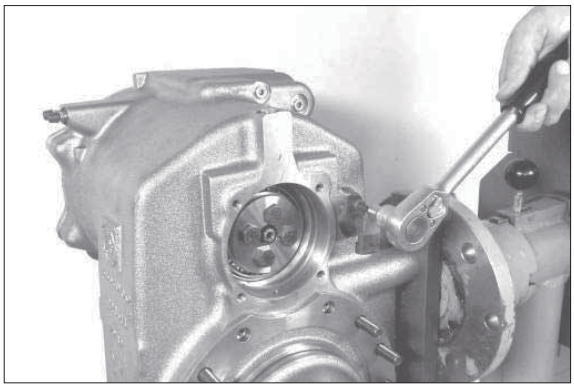
※ Complete disassembly of lubrication pump / shift interlock – see page 8-264.



14WF8TM67

Speed sensor

4) Loosen screw and pull off speed sensor.

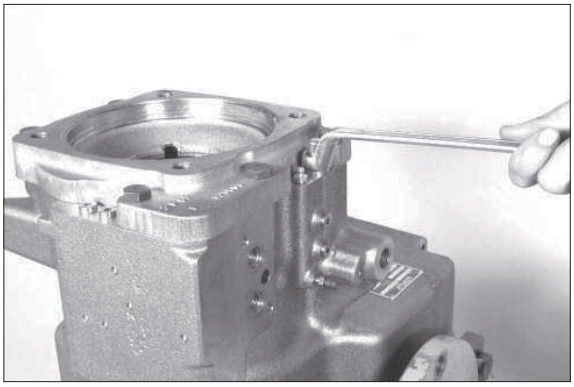


14WF8TM68

Emergency release (Parking brake)

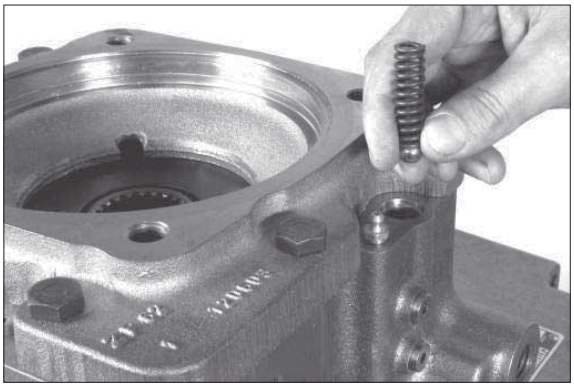
5) Remove breather.
(Illustration 14WF8TM69~14WF8TM72 shows version transmission installation position "Vertical")

※ Position of single connections or breather valves /lubrication nipples etc. as to version transmission installation position Horizontal - see 14WF8TM265.



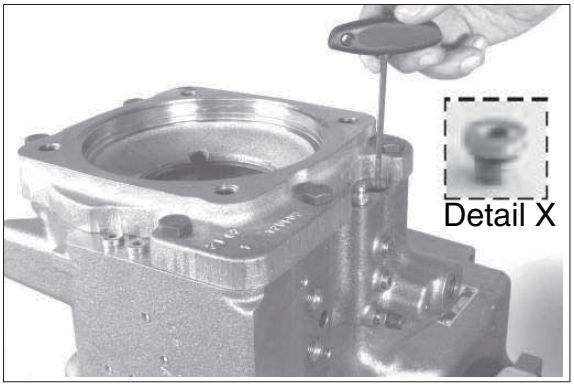
14WF8TM69

6) Remove compression spring and ball.



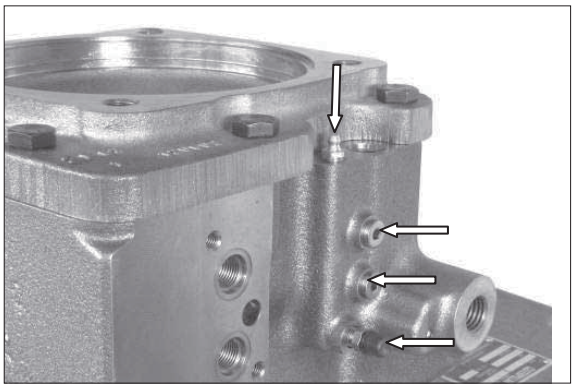
14WF8TM70

7) Remove threaded element (see Detail X) with O-ring from hole.



14WF8TM71

8) Remove lubrication nipple, both screw plugs and breather valve – see arrow.

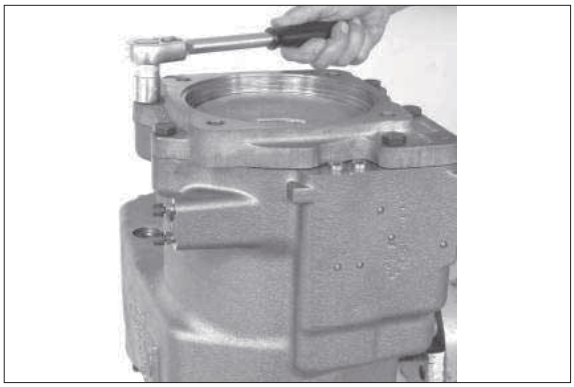


14WF8TM72

Input housing and modulation valve

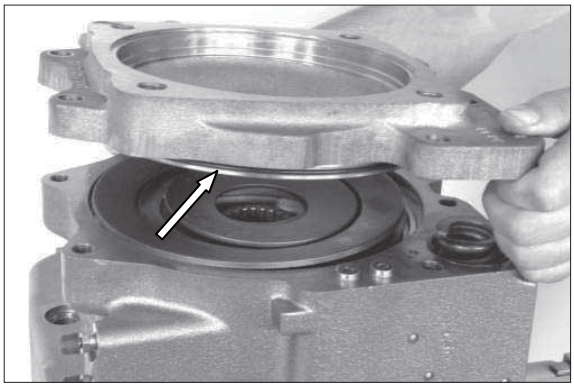
9) Loosen threaded joint of input housing evenly.

※ Input housing is subject to cup spring and compression spring preload.



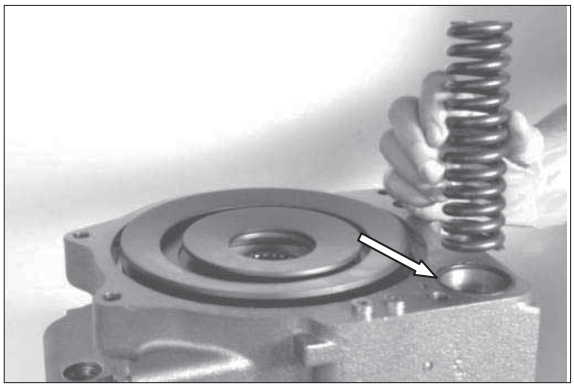
14WF8TM73

10) Take off input housing and remove O-ring (arrow).



14WF8TM74

11) Remove compression spring and O-ring (arrow).



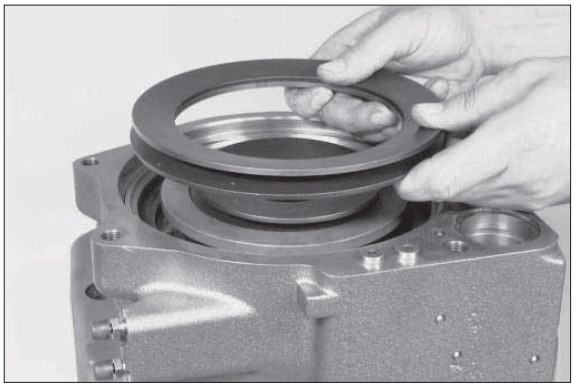
14WF8TM75

12) Pull complete piston out of hole.

14WF8TM76

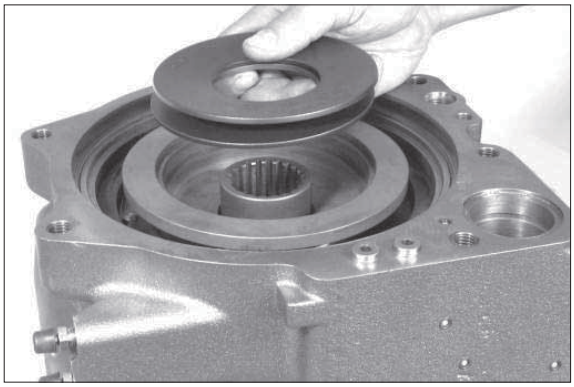
Brake and clutch

13) Remove cup springs from brake.



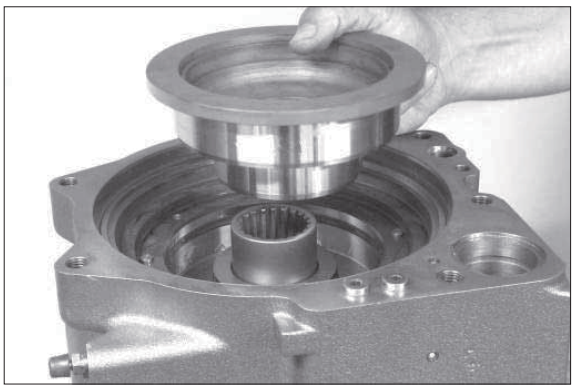
14WF8TM77

14) Remove cup springs from clutch.



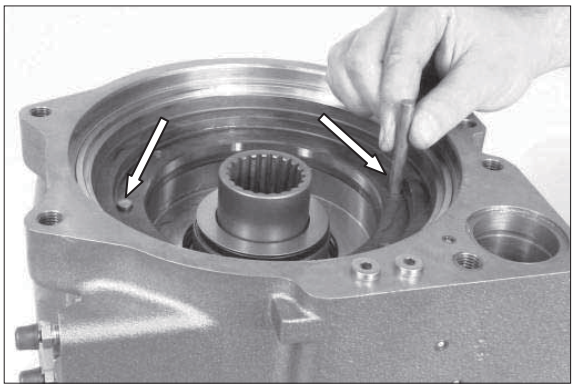
14WF8TM78

15) Remove piston.



14WF8TM79

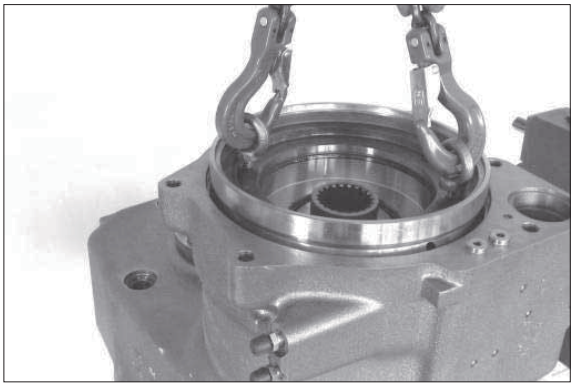
16) Pull off both cyl. pins (arrows).



14WF8TM80

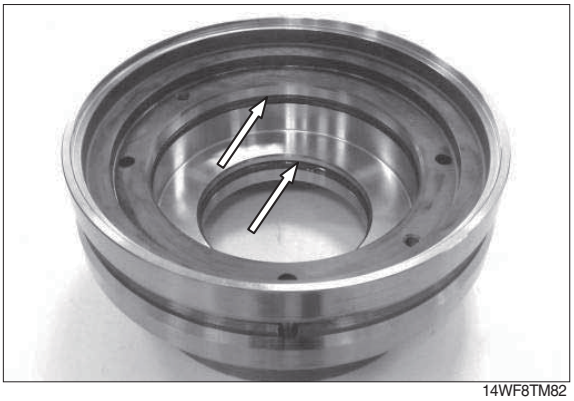
17) Attach 2 (two) eyebolts and pull piston cautiously out of housing – risk of damage.

(S) Eyebolt assortment 5870 204 002
(S) Lifting chain 5870 281 047



14WF8TM81

18) Remove both seals (arrows) from piston.

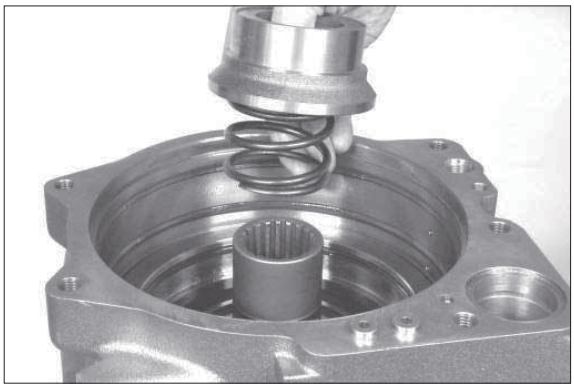


14WF8TM82

19) Remove axial roller cage with both thrust washers.

14WF8TM83

20) Remove pressure piece and compression spring.

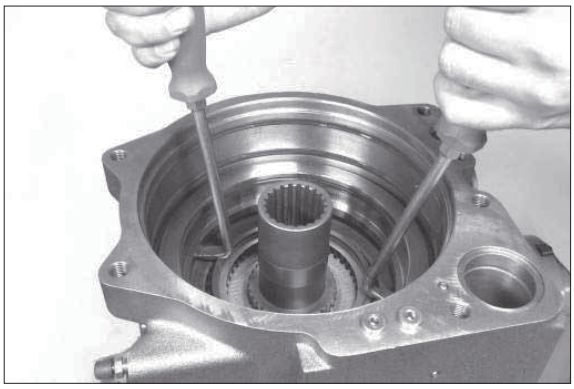


14WF8TM84

21) Remove pressure ring with ring – also see 14WF8TM86 – cautiously with lever – risk of damaging sealing surfaces.

(S) Resetting device 5870 400 001

※ Ring may also remain in housing during disassembly – disassemble ring separately.



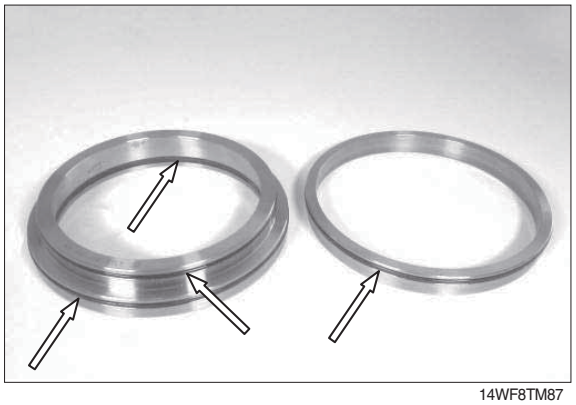
14WF8TM85

22) Remove pressure ring from ring cautiously with lever – risk of damaging sealing surfaces .

(S) Resetting device 5870 400 001

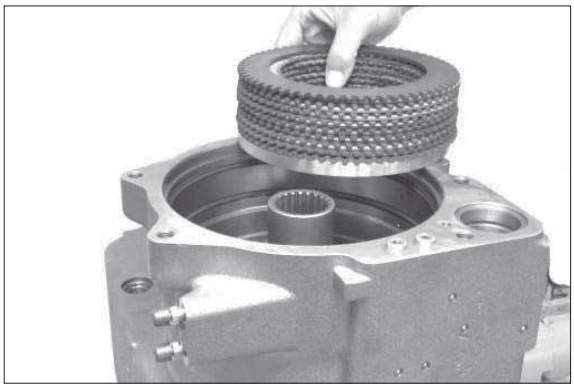
14WF8TM86

23) Remove seal and O-rings (see arrows) from pressure ring and ring.



14WF8TM87

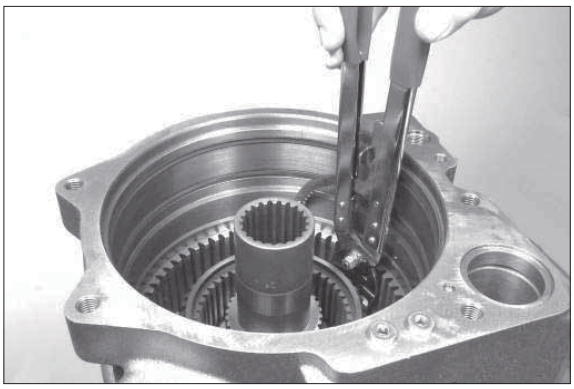
24) Take disk package of brake with end plate(s) out of housing.



14WF8TM88

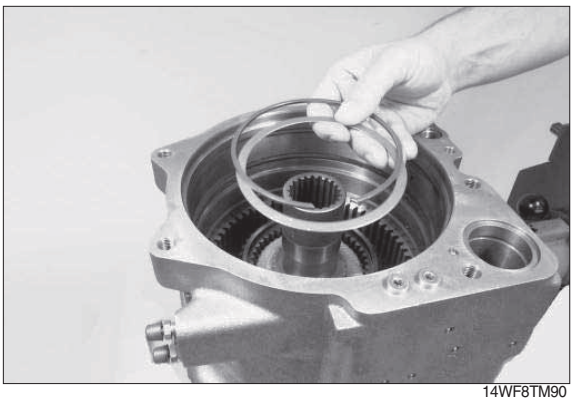
25) Disengage retaining ring.

(S) Clamping pliers 5870 900 021



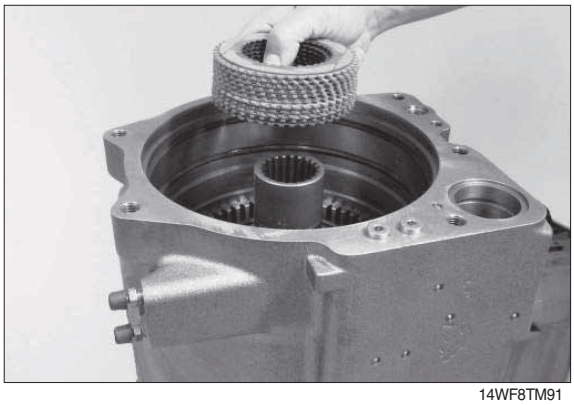
14WF8TM89

26) Remove snap ring and shim.



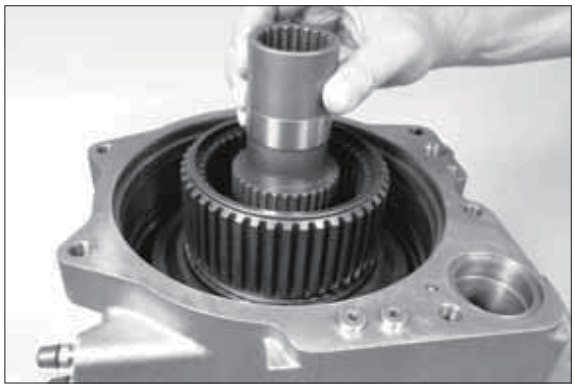
14WF8TM90

27) Take disk package of clutch with end plate(s) out of ring gear.



14WF8TM91

28) Remove cpl. input shaft with ring gear from housing.

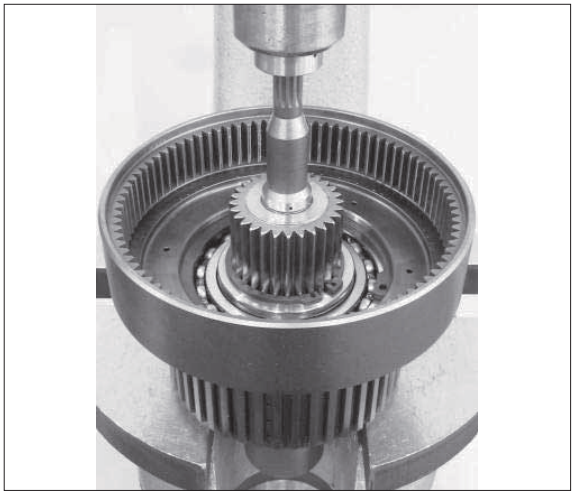


14WF8TM92

29) Unsnap retaining ring.

14WF8TM93

30) Press input shaft out of ball bearing/ring gear.



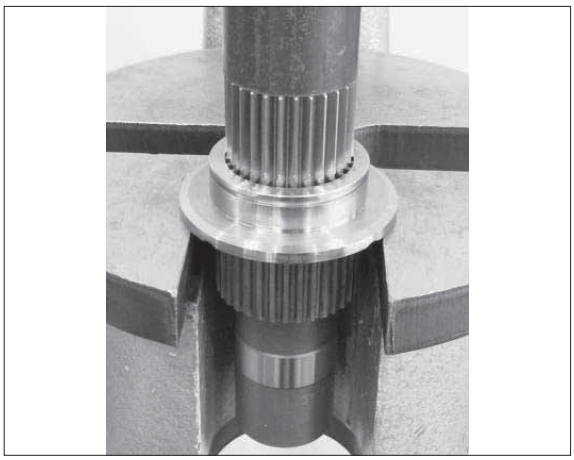
14WF8TM94

31) Unsnap retaining ring.

14WF8TM95

32) Press centering disk from input shaft.

※ In case of extreme press fit – heat centering disk.



14WF8TM96

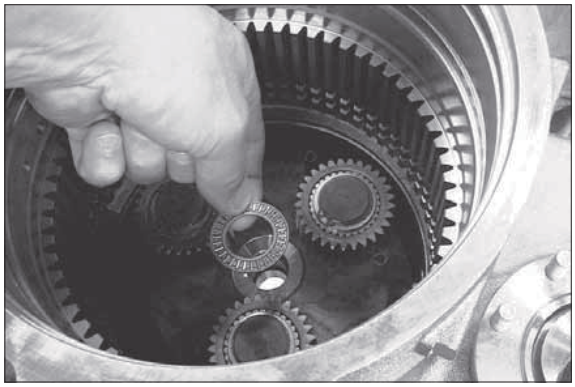
33) Unsnap retaining ring and remove ball bearing.

(S) Clamping pliers 5870 900 021

14WF8TM97

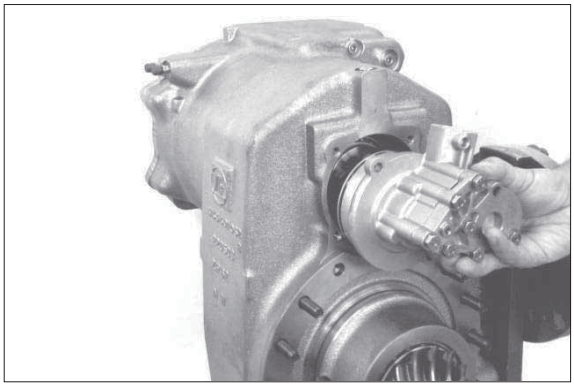
Planetary carrier

34) Remove axial needle cage.



14WF8TM98

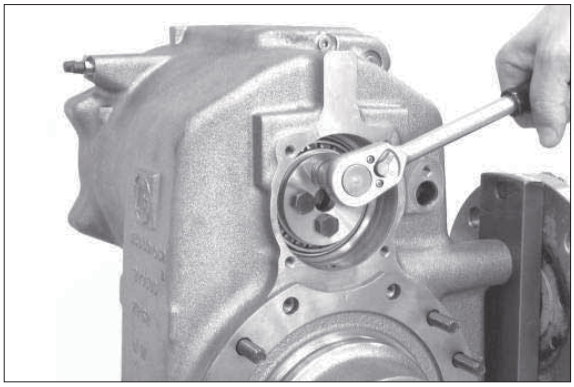
35) If not yet disassembled previously – remove lubrication pump or shift interlock (depending on version).
(Illustration shows version - Lubrication pump).



14WF8TM99

36) Loosen threaded joint and remove disk – fasten output flange by means of clamping fork.

(S) Clamping fork 5870 240 025

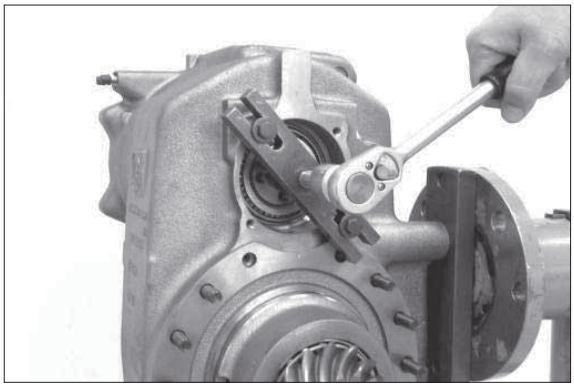


14WF8TM100

37) Press cpl. planetary carrier out of roller bearing.

(S) Extractor 5870 000 017

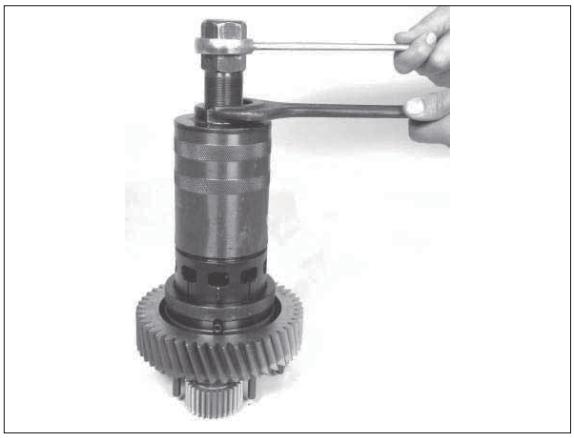
※ Pay attention to releasing planetary carrier and bearing inner ring.



14WF8TM101

38) Pull second bearing inner ring from planetary carrier.

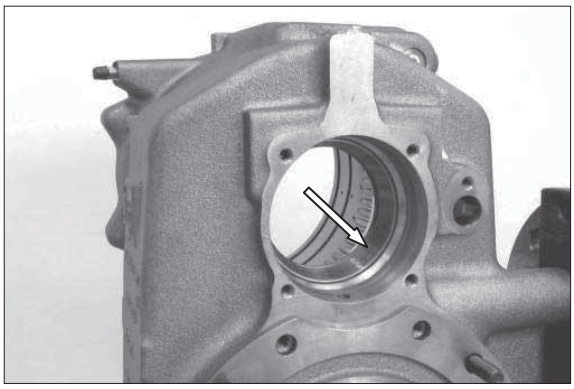
(S) Rapid grip 5873 012 021
(S) Basic tool 5873 002 001



14WF8TM102

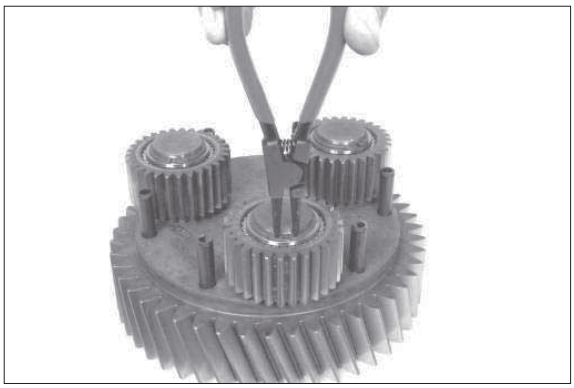
39) If required – force both bearing outer rings (arrow) out of bearing hole.

※ When reusing tapered roller bearings – pay attention to bearing allocation, i.e. respective bearing inner ring to bearing outer ring.



14WF8TM103

40) Unsnap retaining ring.

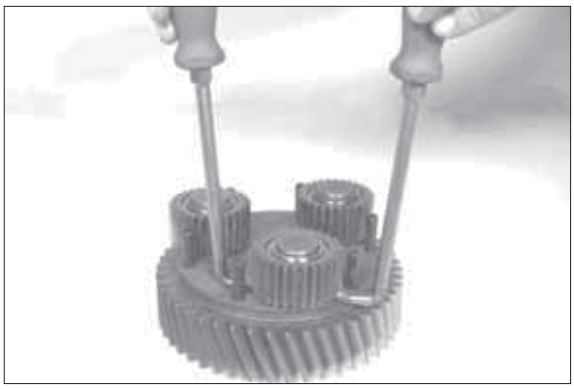


14WF8TM104

41) Lift planetary gear with resetting device – then disassemble with two armed puller .

(S) Resetting device 5870 400 001

※ If necessary, force out slotted pins (6x).

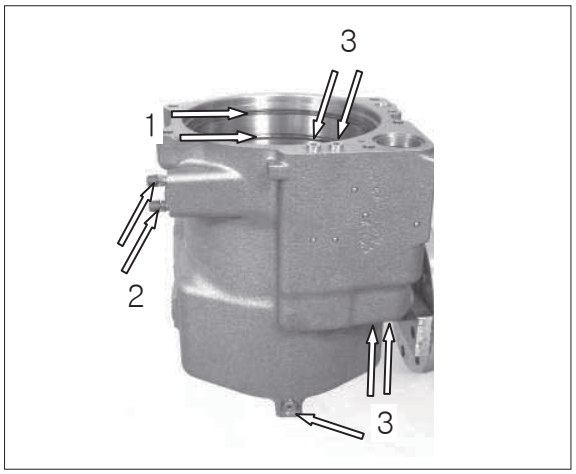


14WF8TM105

42) Remove both seals (1).

Remove breather valves (2) and all screw plugs (3) with seal and O-ring.

※ Illustration shows positions for transmission version Installation position "Vertical".

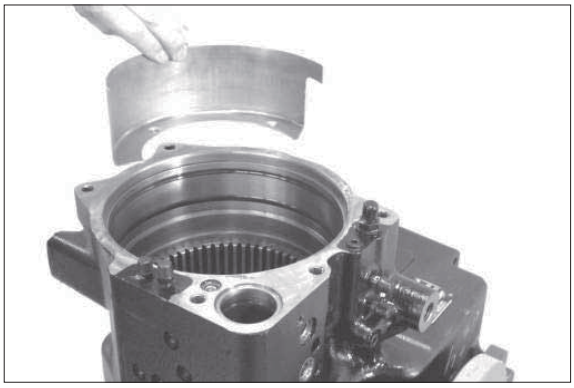


14WF8TM106

43) Only for version
Transmission installation position "Horizontal" :

Loosen countersunk screws and remove screen sheet.

※ Countersunk screws are installed with locking compound (loctite). If necessary, heat for disassembly .



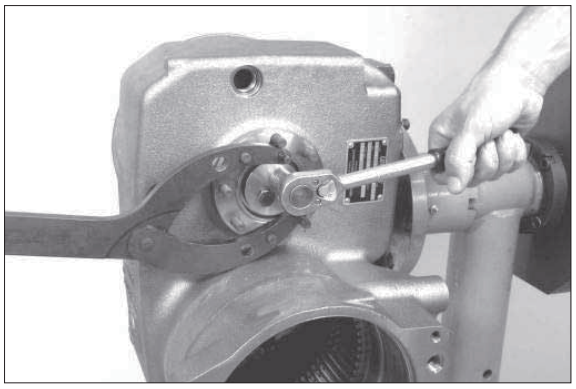
14WF8TM107

7. DISASSEMBLY - OUTPUT

Version "Axle attachment"

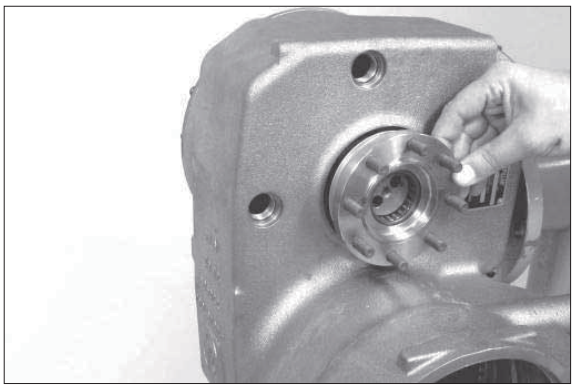
1) Loosen threaded joint, remove cover and O-ring.

※ (S) Clamping fork 5870 240 025



14WF8TM108

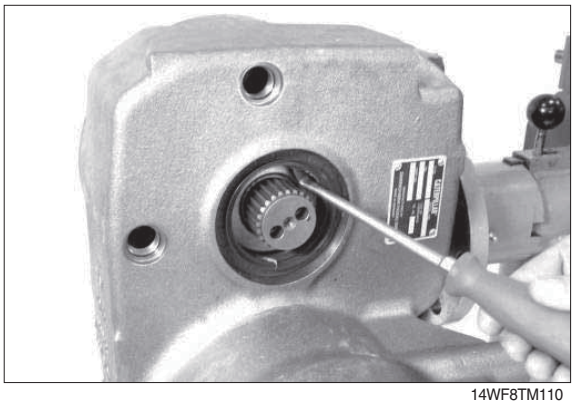
2) Pull off flange.



14WF8TM109

3) Remove shaft seal with a lever.

※ (S) Resetting device 5870 400 001

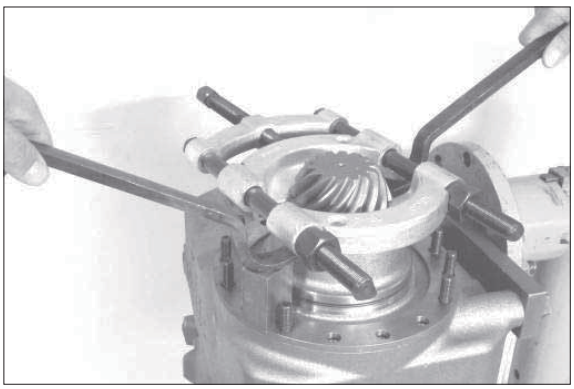


14WF8TM110

4) Fix pinion with fixture and press off.

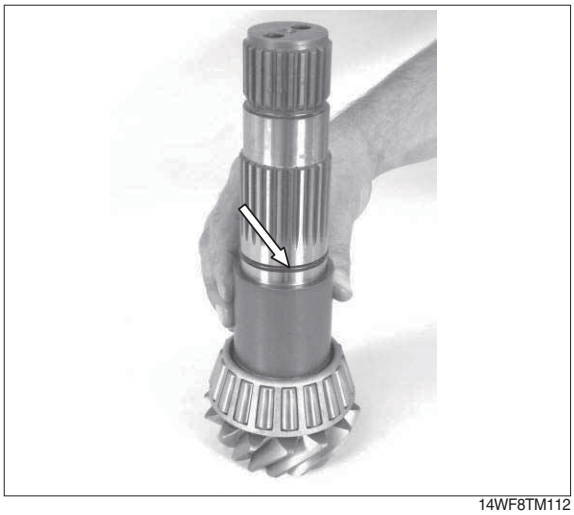
(S) Cut-off device 5870 300 028
(S) Assembly lever 5870 345 036
(S) Solenoid block 5870 450 003

※ Pay attention to releasing bearing inner ring and adjusting ring (rolling torque/pinion bearing) behind.



14WF8TM111

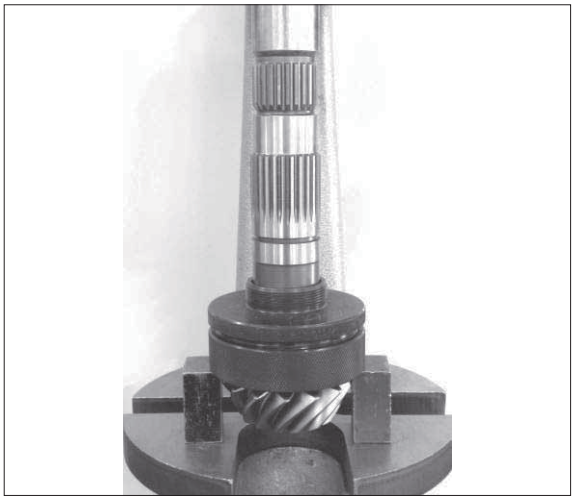
5) Remove O-ring (see arrow) and bush from pinion.



14WF8TM112

6) Press-off bearing inner ring from pinion shaft.

(S) Grab sleeve	5873 001 037
(S) Solenoid block	5870 450 003

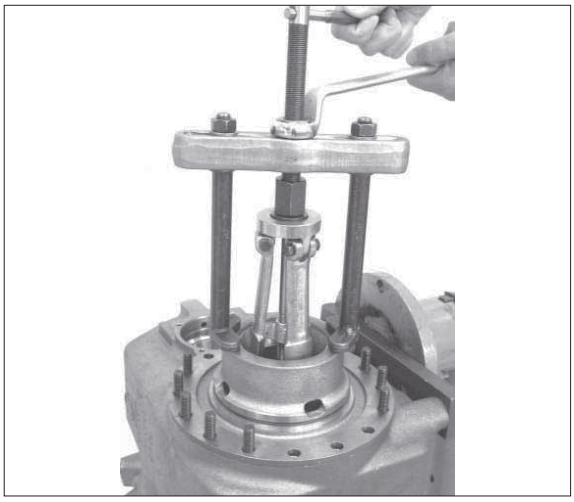


14WF8TM113

7) Pull bearing outer ring out of bearing cover.

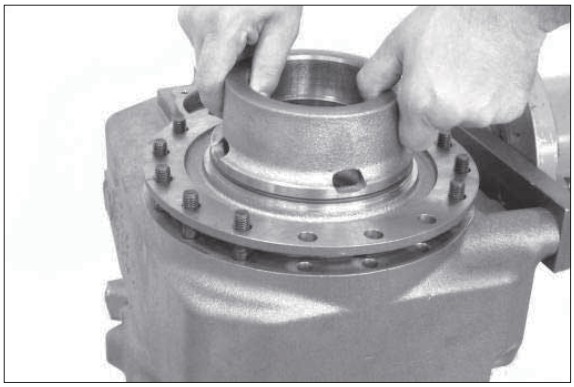
(S) Inner extractor	5870 300 019
(S) Counter support	5870 300 020

※ Pay attention to shim behind (pinion gap setting).



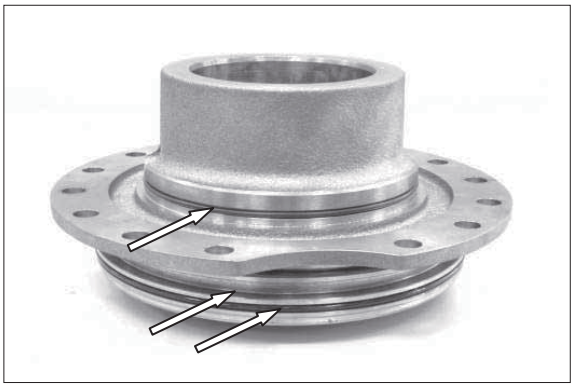
14WF8TM114

8) Pull off bearing cover.



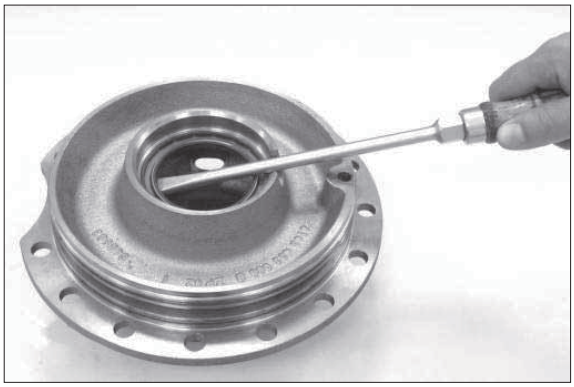
14WF8TM115

9) Remove O-rings (arrows).



14WF8TM116

10) Remove shaft seal.

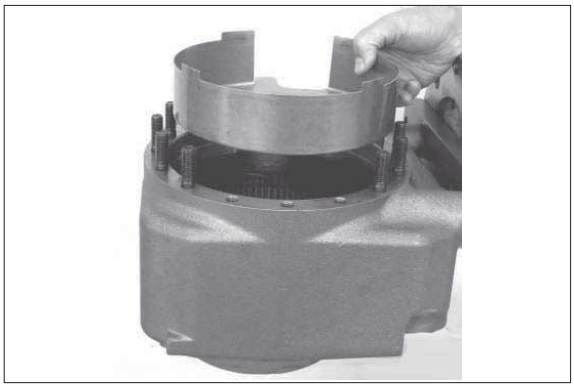


14WF8TM117

11) Lift output gear with oil screen sheet out of housing. Remove oil screen sheet from output gear.

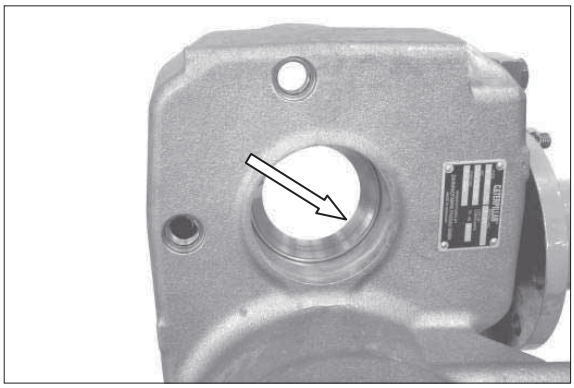
14WF8TM118

12) Remove screen sheet.



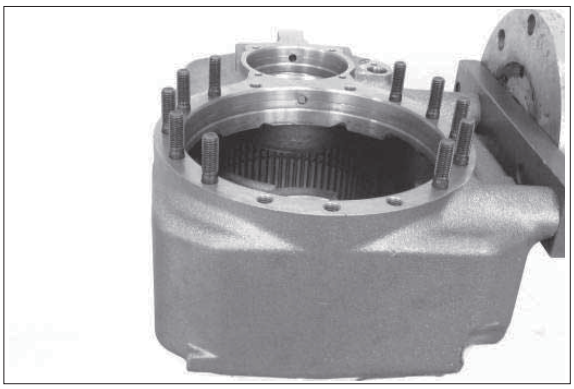
14WF8TM119

13) Disassemble bearing outer ring from housing hole (see arrow).



14WF8TM120

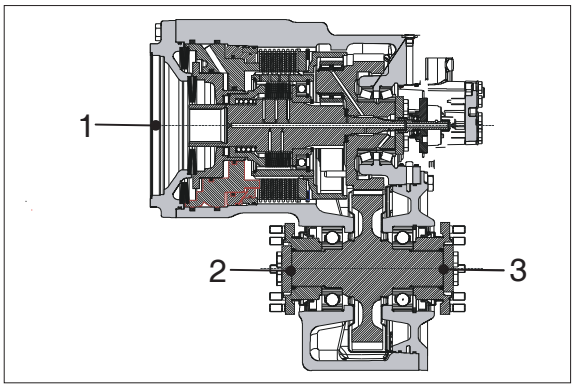
14) If necessary, remove stud bolts.



14WF8TM121

Version "Separate installation"

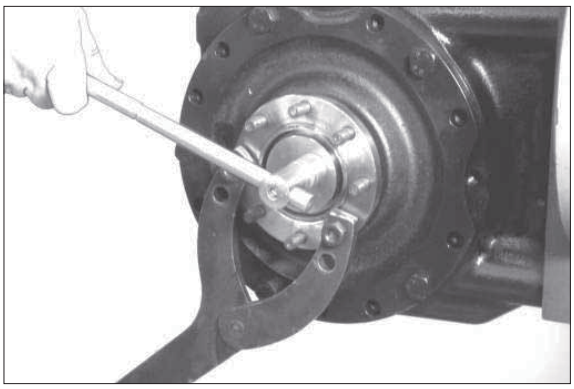
15) 1 = Input
2 = Output – front axle
3 = Output – rear axle



14WF8TM122

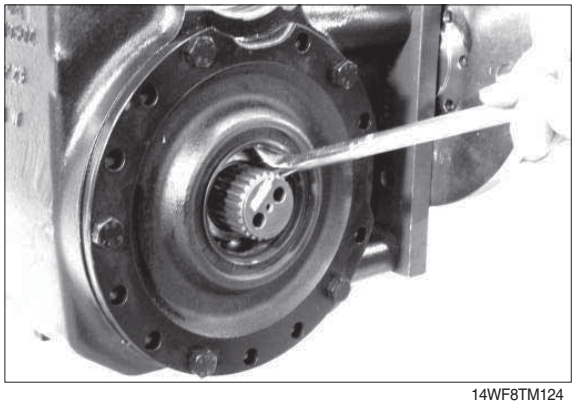
16) Use clamping fork to fix output flange. Loosen threaded joint, pull off disk, O-ring and flange.

(S) Clamping fork 5870 240 025

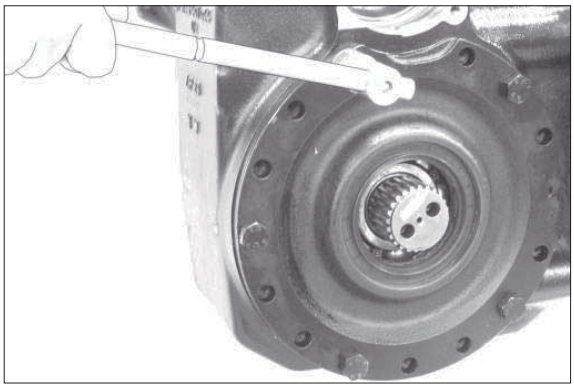

14WF8TM123

17) Remove shaft seal with a lever.

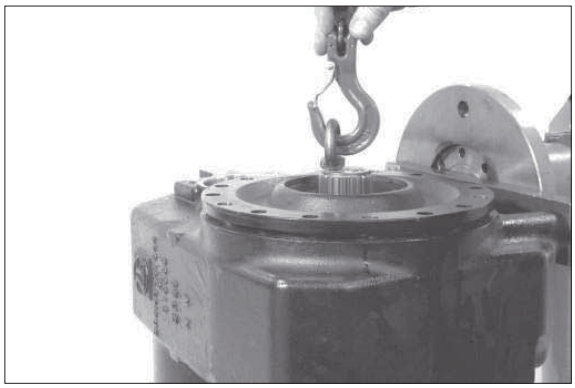
※ Disassemble second output flange and shaft seal analogously.


14WF8TM124

18) Loosen threaded joint.

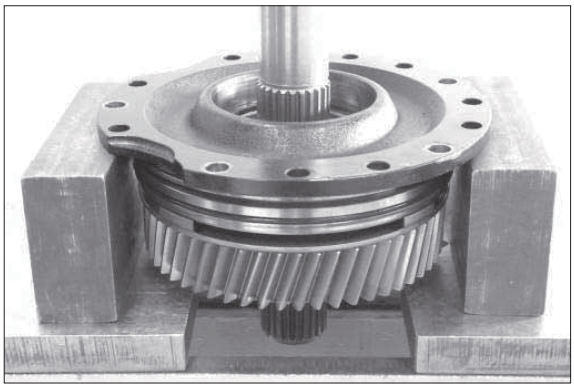

14WF8TM125

19) Use lifting tackle to separate output gear with cover from transmission housing.



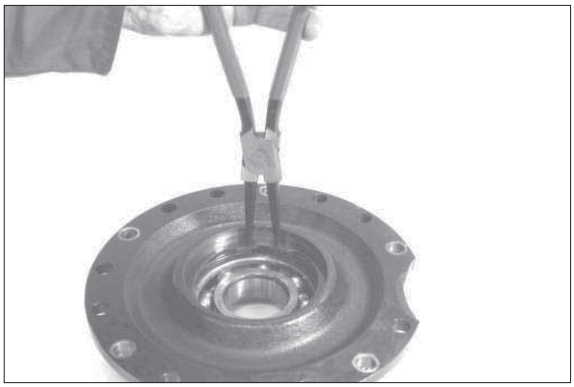
14WF8TM126

20) Press output gear out of ball bearing/cover – remove releasing oil screen sheet.



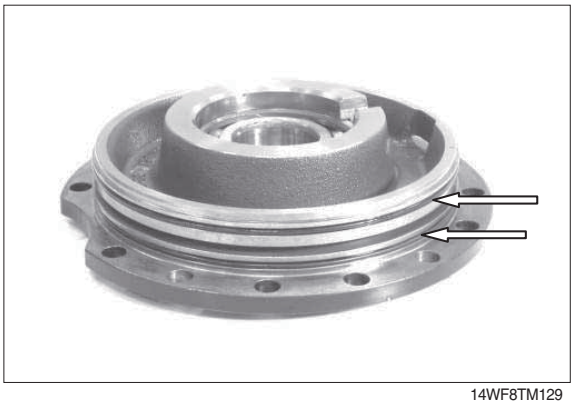
14WF8TM127

21) Unsnap retaining ring and disassemble ball bearing from cover.



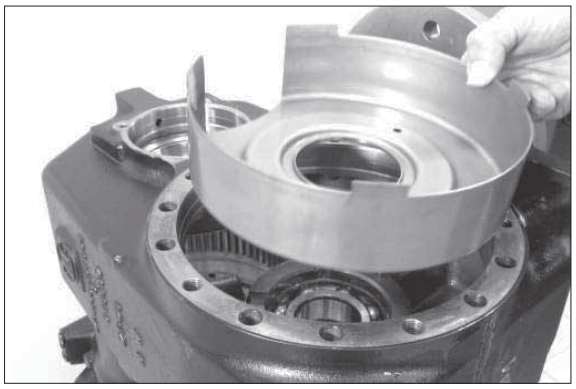
14WF8TM128

22) Remove O-rings (see arrows) from cover.



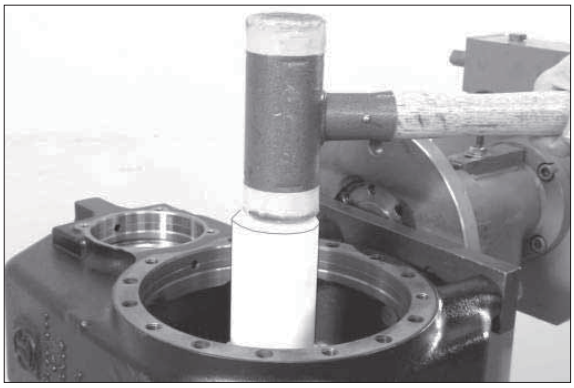
14WF8TM129

23) Remove screen sheet from transmission housing.



14WF8TM130

24) Disassemble ball bearing from housing hole.

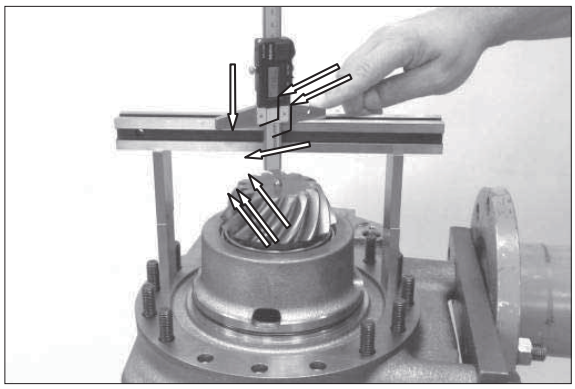


14WF8TM131

8. REASSEMBLY - OUTPUT

1) Seal finished holes (8x) of oil supply holes with screw plugs.

   (S) Lever riveting tongs 5870 320 016



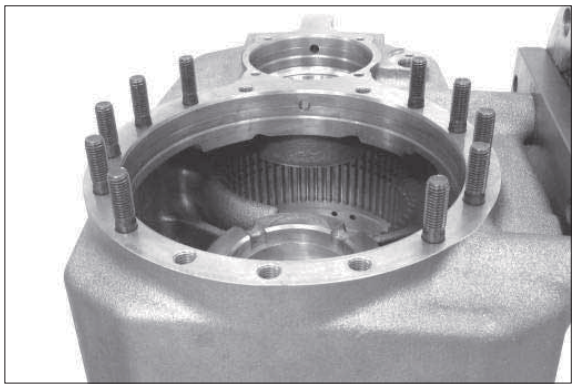
14WF8TM132

Version "Axle attachment"

2) Install stud bolts.

   Tightening torque M_A = 27 Nm

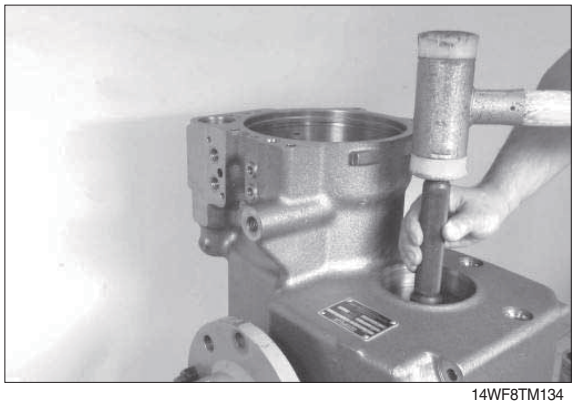
※ Pay attention to installation position.



14WF8TM133

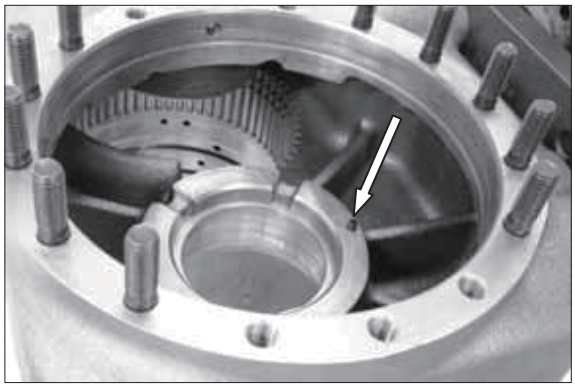
3) Install bearing outer ring until contact.

   (S) Driver tool 5870 058 073
   (S) Handle 5870 260 002



14WF8TM134

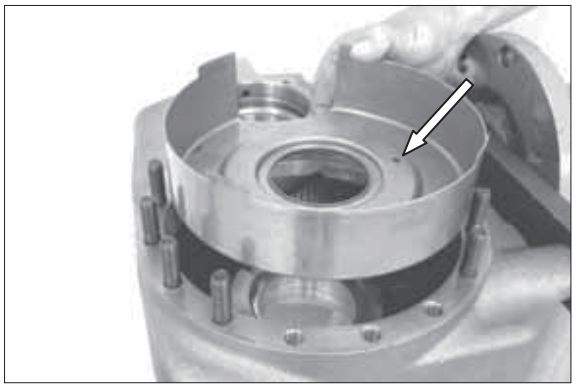
4) Insert slotted pin (see arrow) to the bottom.



14WF8TM135

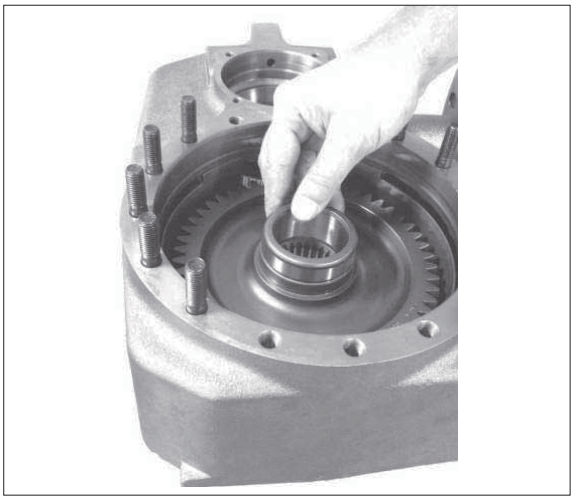
5) Position screen sheet – with slotted pin (see 14WF8TM135) into fixing hole (arrow).

※ Pay attention to installation position, slotted pin = radial fixing of screen sheet.



14WF8TM136

6) Insert output gear with the short collar showing downwards.



14WF8TM137

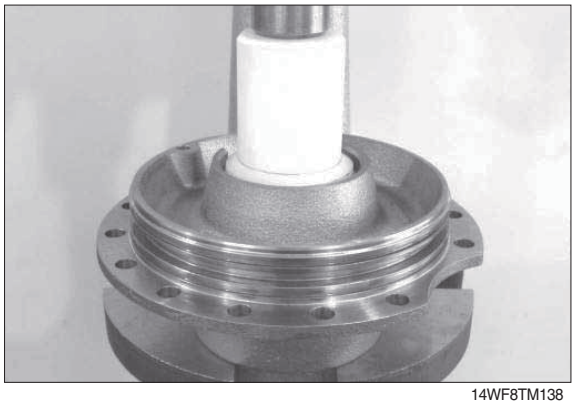
7) Press shaft seal into bearing cover.

(S) Driver tool 5870 048 281

※ For installation wet shaft seal on outer diameter with spirit.

※ Installation position of shaft seal, pay attention that seal lip is showing to oil sump (see 14WF8TM139).

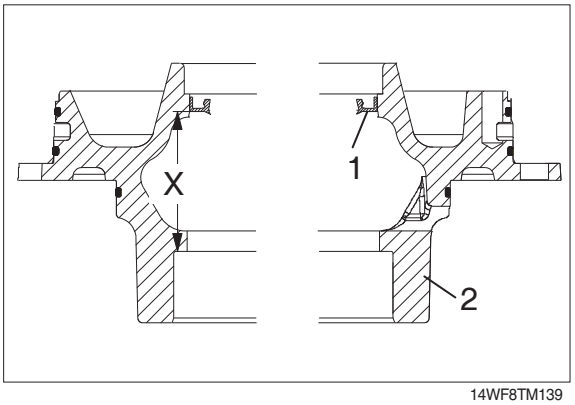
※ Use of specified driver ensures exact installation position of shaft seal.



14WF8TM138

8) 1 = Shaft seal
2 = Bearing cover

X = Installation dimension



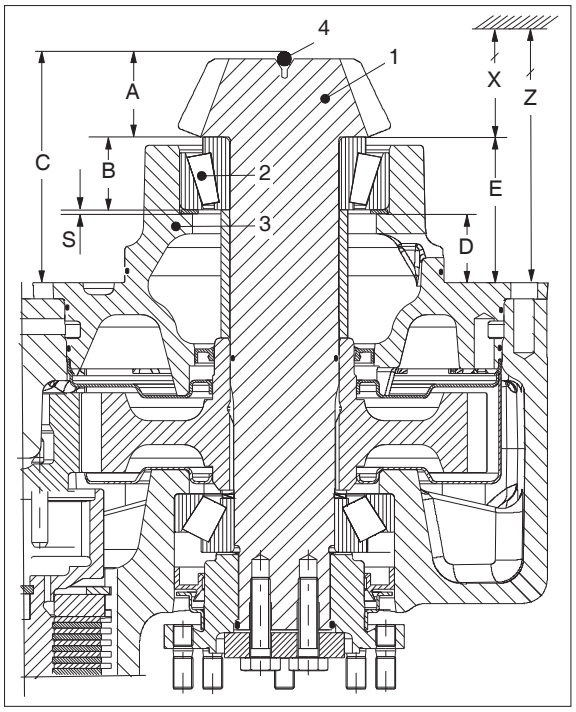
14WF8TM139

Determine shim for pinion gap

9) 1 = Pinion
2 = Roller bearing
3 = Bearing cover
4 = Ball (Ø = 7 mm)

A = Auxiliary dimension
B = Bearing width
C = Reference dimension
D = Contact surface/bearing cover to contact/bearing hole
E = 73.0 mm (constant value)
X = Pinion dimension (stamped into pinion)
Z = 189.0 mm
(contact surface/bearing cover to center/axle housing)

※ For correct installation and positioning of pinion, following steps must be carried out as precisely as possible .



14WF8TM140

10) Determine auxiliary dimension A.

Position ball (Ø = 7 mm) into centering hole of pinion and determine dim. A, from contact surface/pinion shoulder to ball.

Auxiliary dimension A = e.g. 42.56 mm

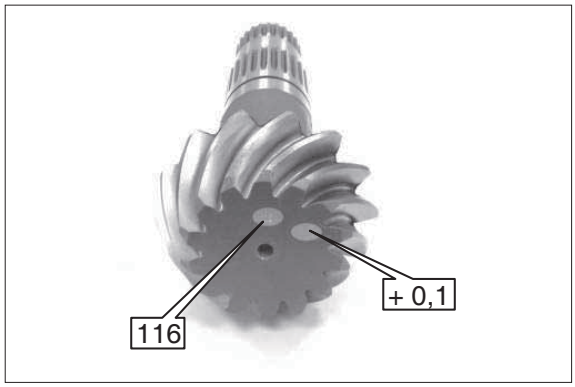
※ Auxiliary dimension A is obligatory to determine reference dimension C – on installed pinion (Fig. 14WF8TM168).

(S) Straightedge 5870 200 108


14WF8TM141

11) Read pinion dim. X on pinion (see arrow) or measure it in case of manufacturing-specific + or – deviation from pinion dim. (relating value is marked by hand on pinion e.g. + 0.1).

Pinion dim. X (without + or – deviation) = 116.0 mm
Pinion dim. X with an indicated deviation + 0.1 = 116.1 mm
Pinion dim. X with an indicated deviation - 0.1 = 115.9 mm

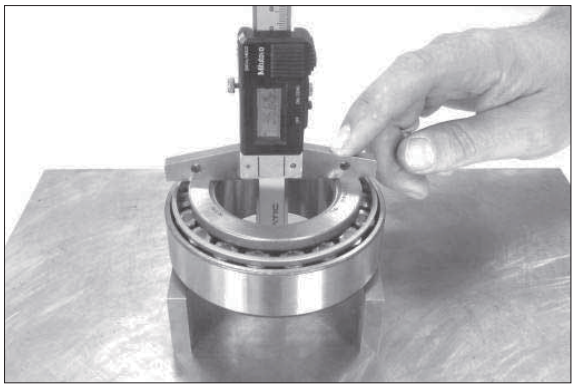


14WF8TM142

12) Determine dim. B bearing width, paying attention that rollers are seated without clearance (roller setting – rotate bearing inner ring in both directions several times).

※ Since installed roller bearing is subject to preload in installation position, deduction of empirical value of – 0.1 mm must be considered.

Dim. B = e.g. 36.65 mm - 0.1 mm → 36.55 mm

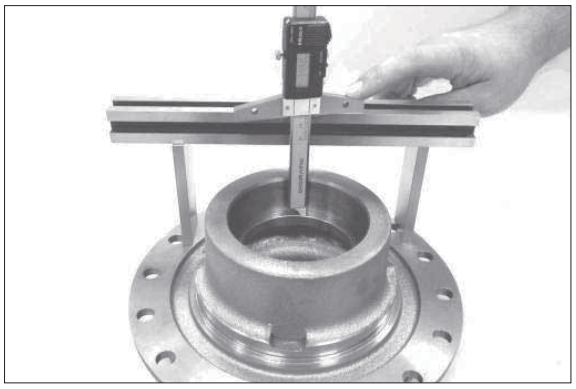


14WF8TM143

13) Determine dim. D (contact surface/bearing cover to contact/bearing hole).

Dim. D = e.g. 35.10 mm

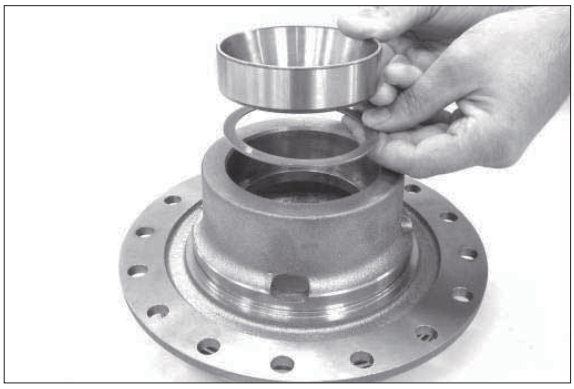
(S) Straightedge (2 sets) 5870 200 066



14WF8TM144

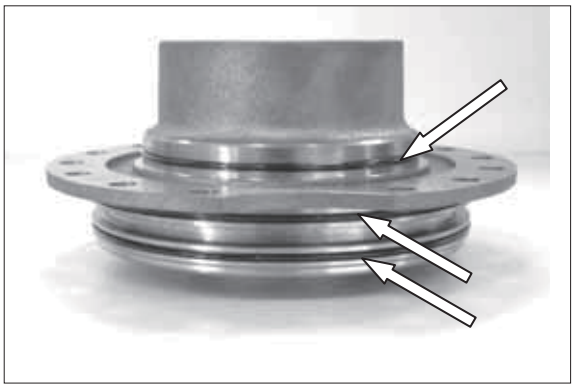
14) Insert determined shim(s) S = e.g. 1.35 mm and install bearing outer ring until contact.

(S) Driver tool 5870 058 078
(S) Handle 5870 260 002



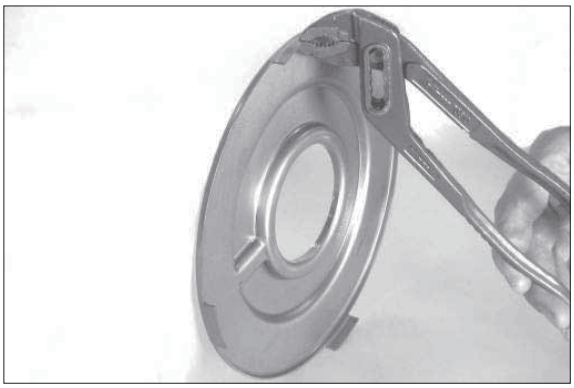
14WF8TM145

15) Oil O-rings (arrows) and insert them into annular grooves of bearing cover.



14WF8TM146

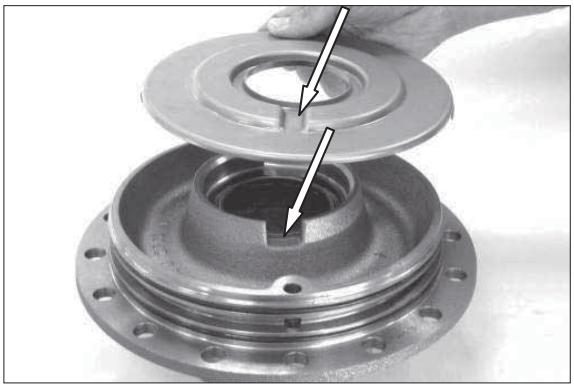
16) Bend edges of fixing straps of oil screen sheet slightly – assembly aid (sheet is fixed to bearing cover – see 14WF8TM148).



14WF8TM147

17) Mount oil screen sheet on bearing cover.

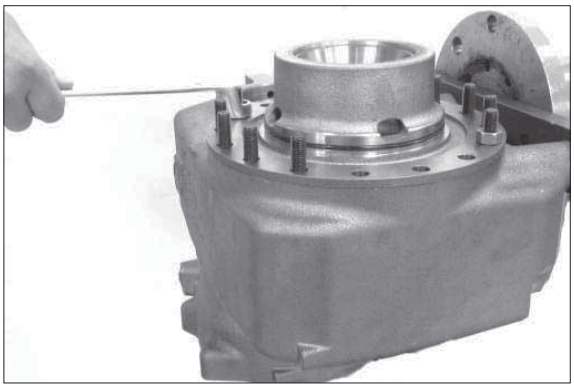
※ Pay attention to installation position – place locating tab of oil screen sheet into recess of bearing cover (see arrow).



14WF8TM148

18) Mount preassembled bearing cover and locate equally with hexagon nuts until contact. Then remove hexagon nuts again.

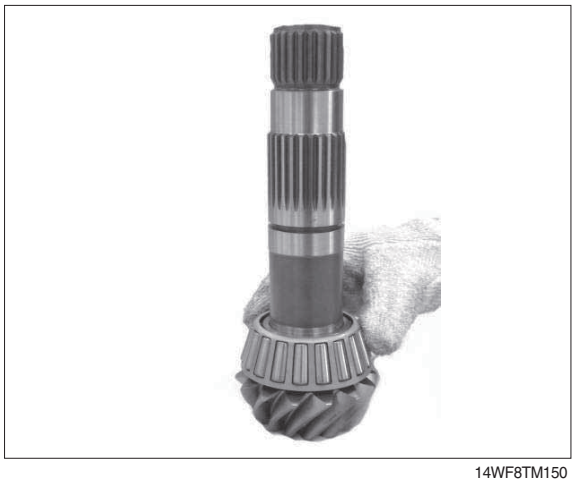
※ Oil contact face/oil screen sheet/housing (assembly aid).



14WF8TM149

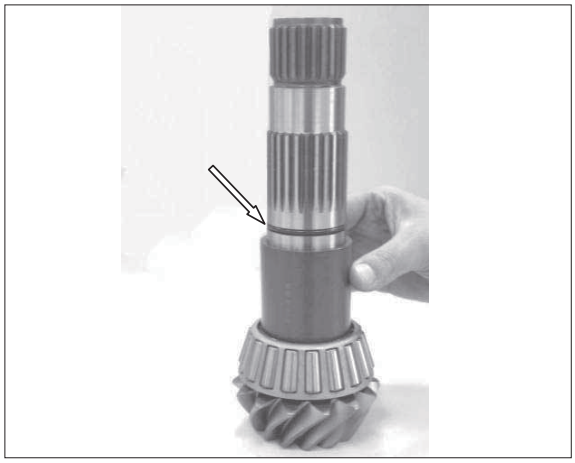
19) Install heated bearing inner ring until contact.

※ Adjust bearing inner ring after cooing down.



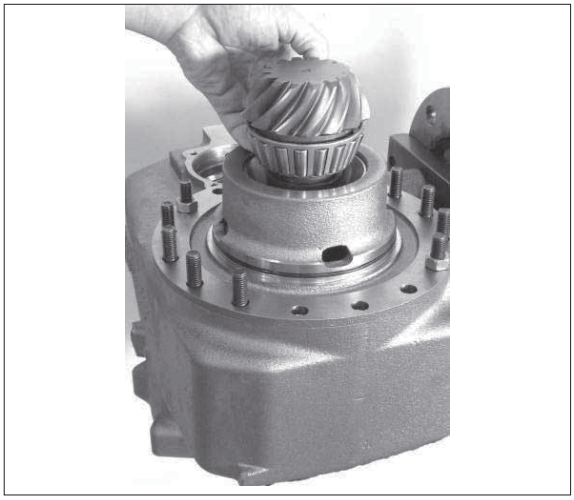
14WF8TM150

20) Mount bush, oil O-ring (arrow) and put it into annular groove.



14WF8TM151

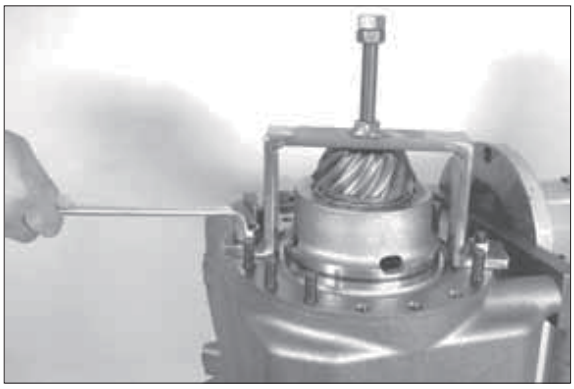
21) Mount preassembled pinion.



14WF8TM152

22) Fix pinion with clamping bar.

(S) Clamping bar 5870 654 049



14WF8TM153

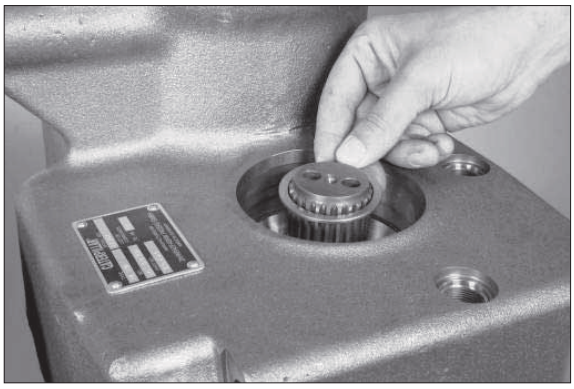
Determine adjusting ring for rolling torque/pinion bearing :

23) Rotate transmission by 180˚.

Mount adjusting ring (s = optional).

※ It is recommended to reinstall the adjusting ring (e.g. s = 1.35 mm) removed during disassembly, if however the required rolling torque of 1.5~4.0 Nm (without shaft seal) is not obtained – see bearing rolling torque check Fig. 14WF8TM159 – bearing rolling torque is to be corrected with an adequate adjusting ring.

※ When shaft seal is installed, try to achieve upper rolling torque value.



14WF8TM154

24) Insert heated bearing inner ring until contact.

※ Adjust bearing inner ring after cooling down.

14WF8TM155

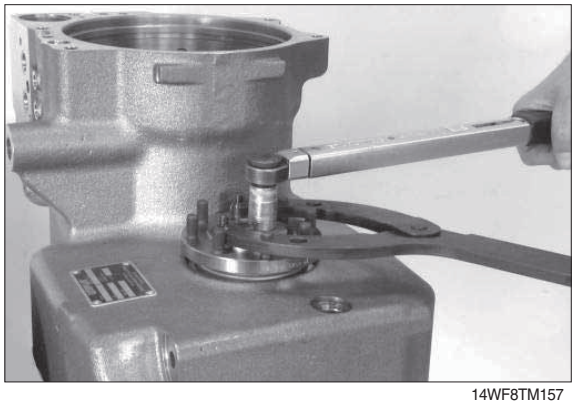
25) Mount flange.

14WF8TM156

26) Place shim and fix flange with hexagon screws.

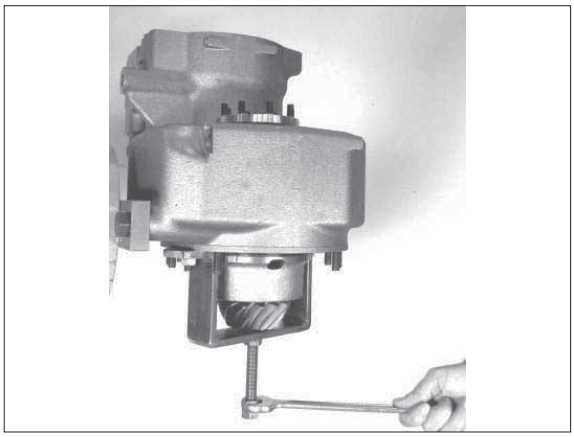
Tightening torque (M 10/10.9) M_A = 68 Nm
(S) Clamping fork 5870 240 025

※ Rotate pinion – when tightening – in both directions (roller setting) several times .



14WF8TM157

27) Turn back pinion fastening / remove clamping bar.



14WF8TM158

Check rolling torque of pinion bearing

28) Bearing rolling torque (without shaft seal) 1.5~4.0 Nm

※ When using new roller bearings /for mounted shaft seal, try to achieve the upper value.

※ If the required rolling torque deviates, it must be corrected with an adequate adjusting ring (see 14WF8TM154).

(S) Reduction ½ -¼	5870 656 056
(S) Plug insert	AA00 392 461

14WF8TM159

29) Disassemble flange again.

14WF8TM160

Shaft seal output flange

30) Install new shaft seal.

(S) Driver tool 5870 048 279

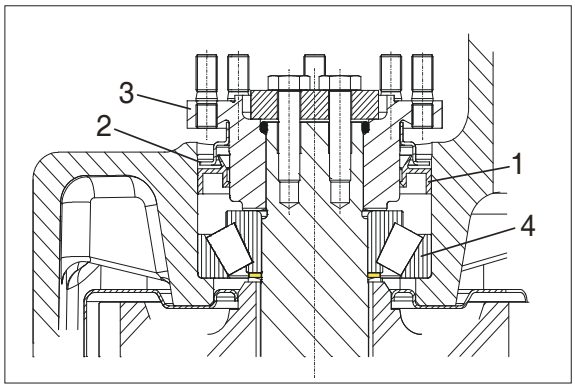
※ For reassembly wet shaft seal on outer diameter with spirit.

※ Pay attention to installation position of shaft seal, seal lip showing to oil sump (see 14WF8TM162).

※ Use of specified driver tool ensures exact installation position of shaft seal.

14WF8TM161

31) 1 = Shaft seal
2 = Metal sheet
3 = Output flange
4 = Roller bearing

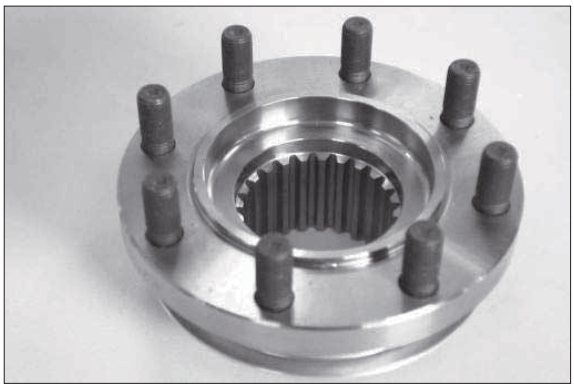


14WF8TM162

32) Install stud bolts.

Tightening torque (M10 × 1) M_A = 20 Nm

※ Pay attention to installation position.
Install stud bolts with short thread length into flange.

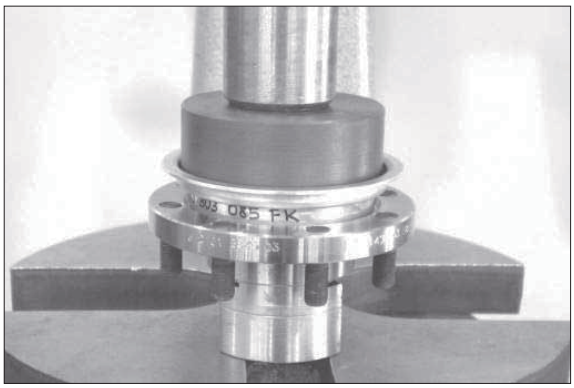


14WF8TM163

33) Install screen sheet (see 14WF8TM162).

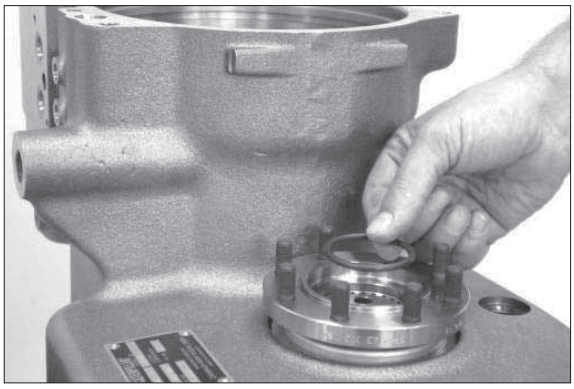
(S) Pressure piece 5870 506 150

※ Use of specified driver tool ensures exact installation position of screen sheet.



14WF8TM164

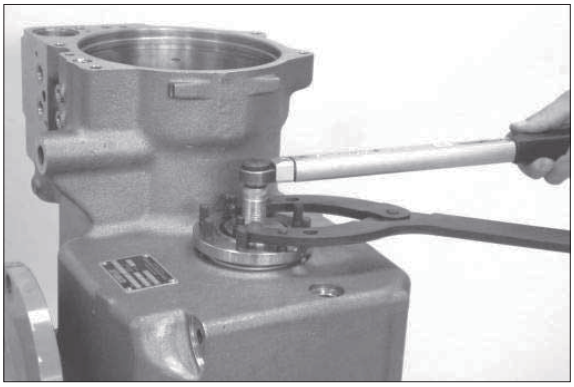
34) Mount preassembled flange and put O-ring into recess.



14WF8TM165

35) Place disk and fix it with hexagon screws.

Tightening torque (M 10/10.9)	M_A = 68 Nm
(S) Clamping fork	5870 240 025

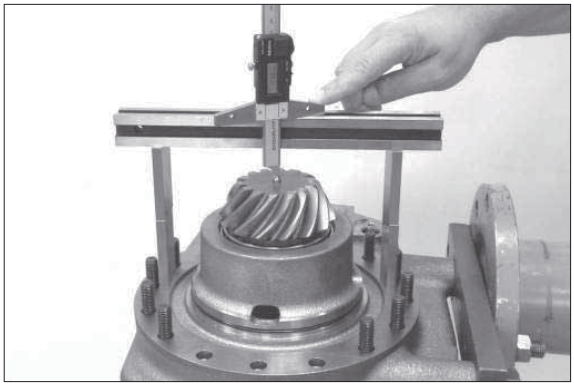


14WF8TM166

Check pinion gap

36) Position ball [use Ø = 7 mm → ball Ø like for determination of auxiliary dimension A into centering hole of the pinion and determine dim. C (see 14WF8TM140), from contact surface/bearing cover to ball.

(S) Straightedge	5870 200 108



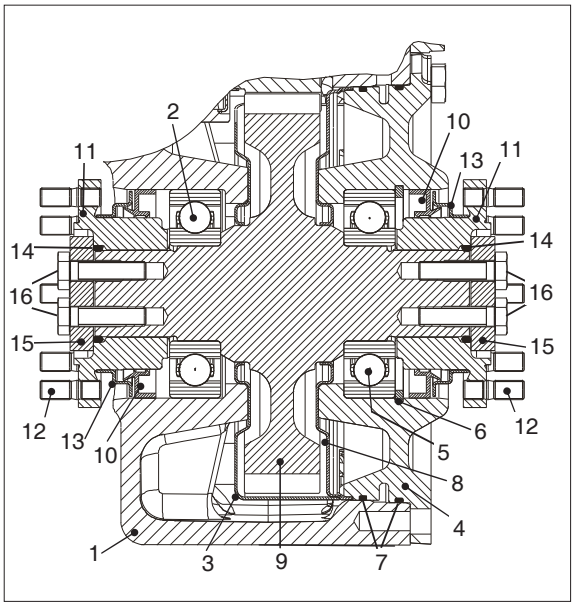
14WF8TM167

⚠ If the constant value of dimensionE = 73.00±0.05 mm

If the constant value of Dim. E = 73.00 ±0.05 mm is not achieved, correct with an adequate shim/pinion gap (see 14WF8TM145).

For a correction of the shim/pinion gap, a counter correction of adjusting ring of rolling moment/ pinion gap – Fig. 14WF8TM154 must also be considered.

37) 1 = Transmission housing
2 = Ball bearing
3 = Screen sheet
4 = Bearing cover
5 = Ball bearing
6 = Retaining ring
7 = O-ring
8 = Oil screen sheet
9 = Output gear
10 = Shaft seal
11 = Output flange
12 = Stud bolt
13 = Metal sheet
14 = O-ring
15 = Disk
16 = Hexagon screw

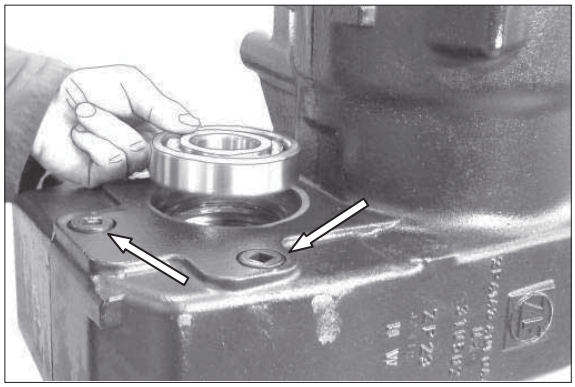


14WF8TM168

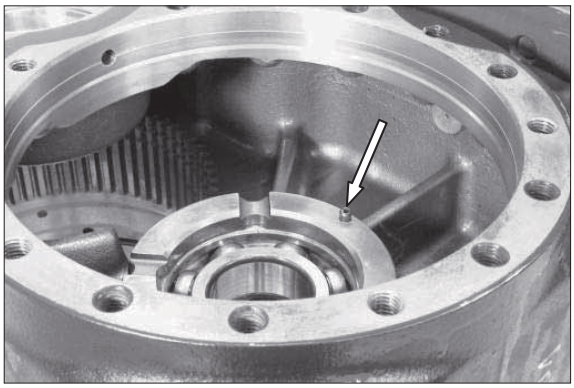
38) Provide screw plugs (see arrows) with new O-ring and install it.

Tightening torque M_A = 80 Nm

※ Then insert ball bearing (2) until contact.

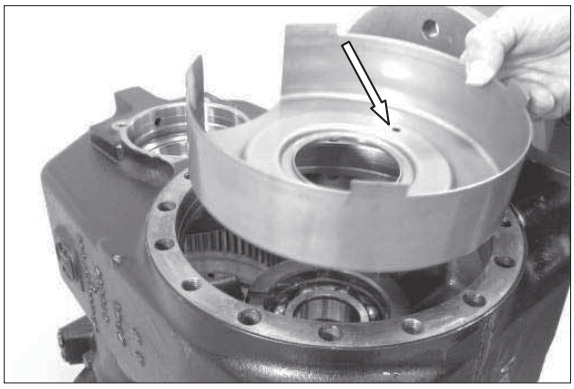

14WF8TM169

39) Rotate transmission by 180˚.
Insert slotted pin (see arrow) to the bottom.


14WF8TM170

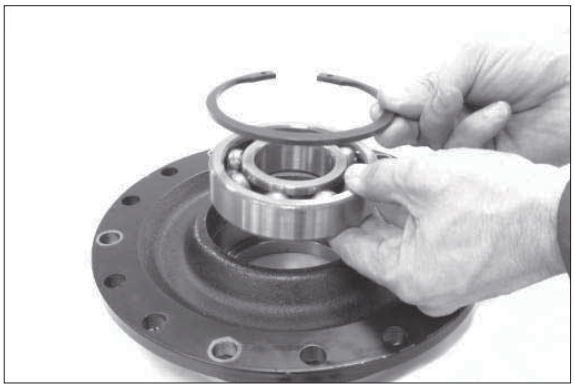
40) Position screen sheet – with slotted pin into fixing hole (arrow).

※ Observe installation position –slotted pin = radial fixing of screen sheet.



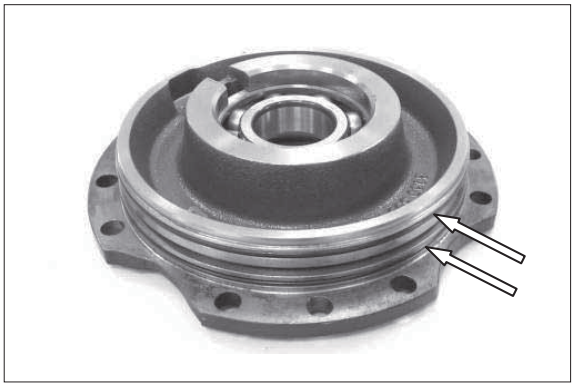
14WF8TM171

41) Insert ball bearing into cover and fix with retaining ring.



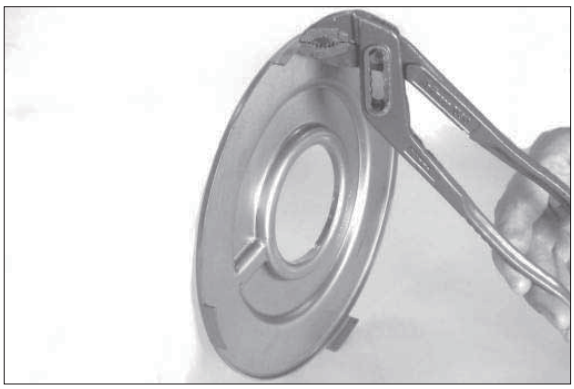
14WF8TM172

42) Oil both O-rings (arrows) and insert them into annular grooves of planetary carrier.



14WF8TM173

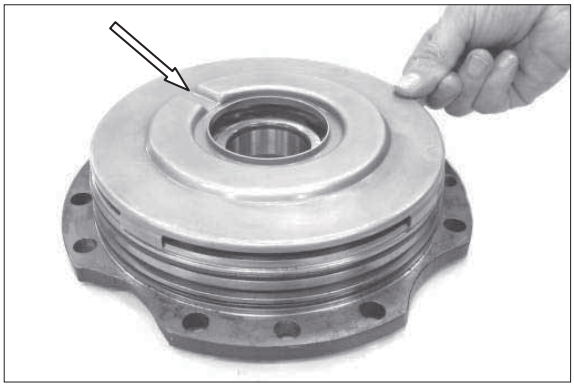
43) Bend edges of fixing straps of oil screen sheet slightly. Assembly aid screen sheet is fixed to bearing cover – see 14WF8TM176).



14WF8TM174

44) Insert oil screen sheet onto bearing cover

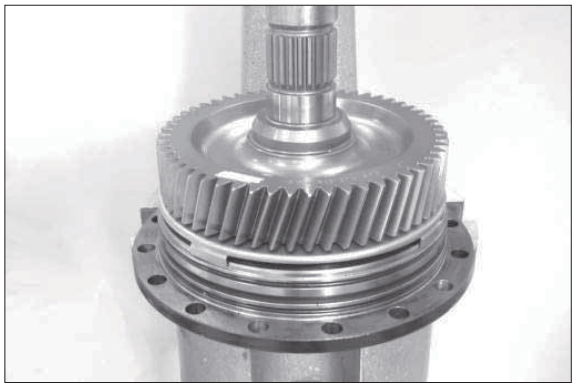
※ Observe installation position - place locating tab (see arrow) into recess of bearing cover (radial fixing).



14WF8TM175

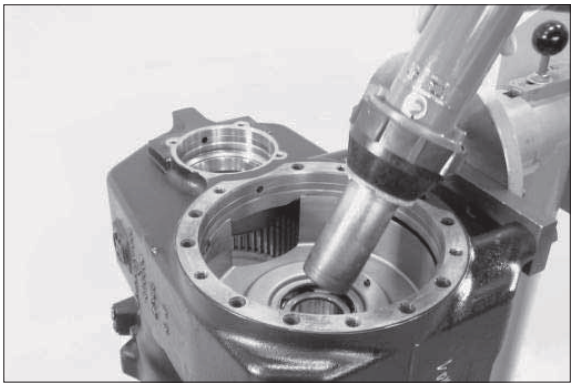
45) Press output gear into ball bearing/bearing cover.

※ Support ball bearing onto bearing inner ring.



14WF8TM176

46) Heat bearing inner ring of ball bearing.

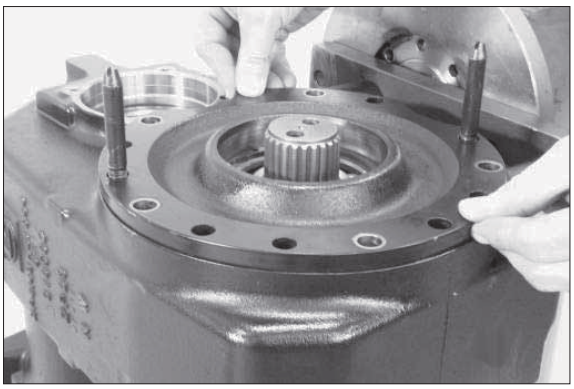


14WF8TM177

47) Attach two adjusting screws and mount preassembled bearing cover/output gear until contact.

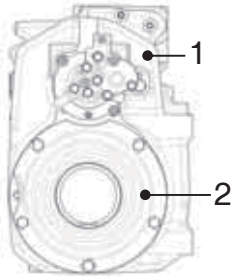
(S) Adjusting screws (M12) 5870 204 021

※ Observe installation position of bearing cover (2) in transmission (1) – transmission installation VERTICAL or HORIZONTAL - see detailed sketches below:

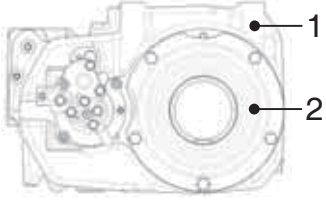


14WF8TM178

<VERTICAL>

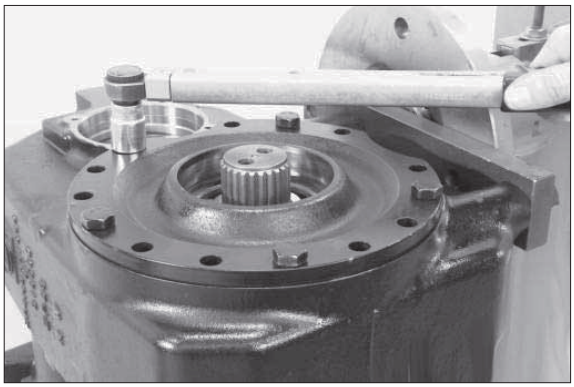


<HORIZONTAL>



48) Fix bearing cover by means of hexagon screws.

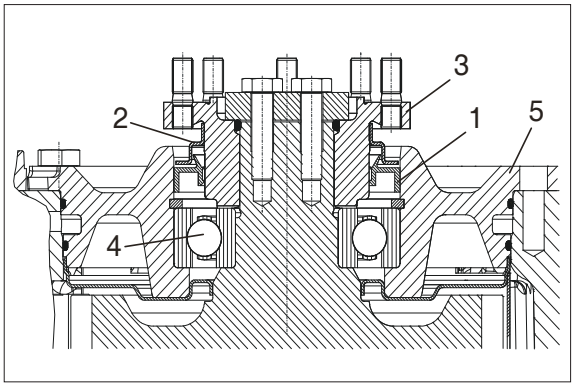
Tightening torque (M 12/8.8) M_A = 80 Nm



14WF8TM181

Shaft seal output flange

49) 1 = Shaft seal
2 = Metal sheet
3 = Output flange
4 = Ball bearing
5 = Bearing cover

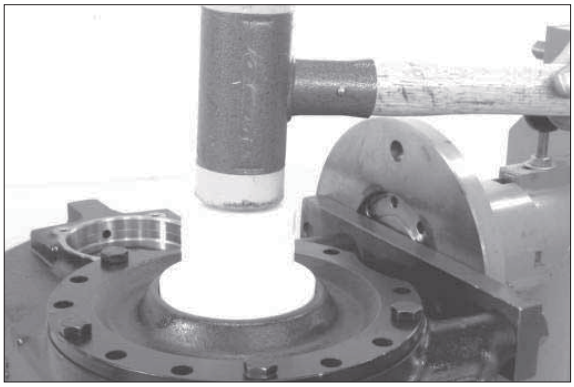


14WF8TM182

50) Install new shaft seal.

(S) Driver tool 5870 048 279

※ For reassembly wet shaft seal on outer diameter with spirit.
※ Pay attention to installation position of shaft seal, seal lip showing to oil sump.
※ Use of specified driver tool ensures exact installation position of shaft seal.

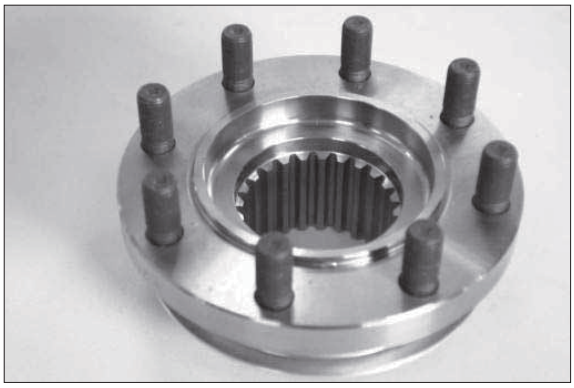


14WF8TM183

51) Install stud bolts.

Tightening torque (M10 × 1) M_A = 20 Nm

※ Pay attention to installation position.
Install stud bolts with short thread length into flange.

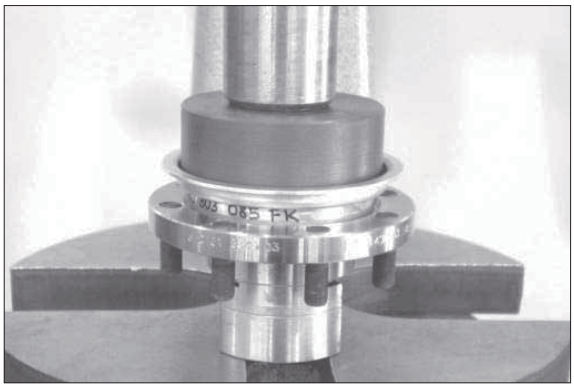


14WF8TM184

52) Install screen sheet (see 14WF8TM183).

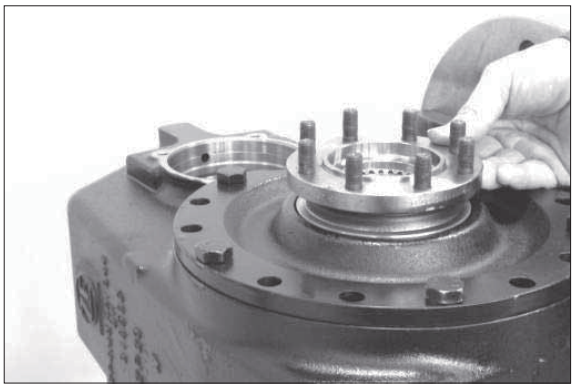
(S) Pressure piece 5870 506 150

※ Use of specified driver tool ensures exact installation position of screen sheet.



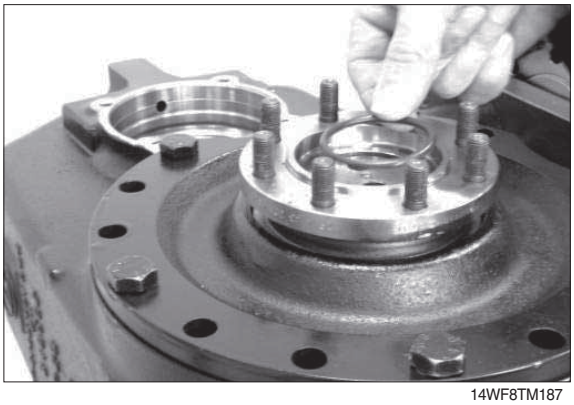
14WF8TM185

53) Install preassembled output flange.



14WF8TM186

54) Insert O-ring.

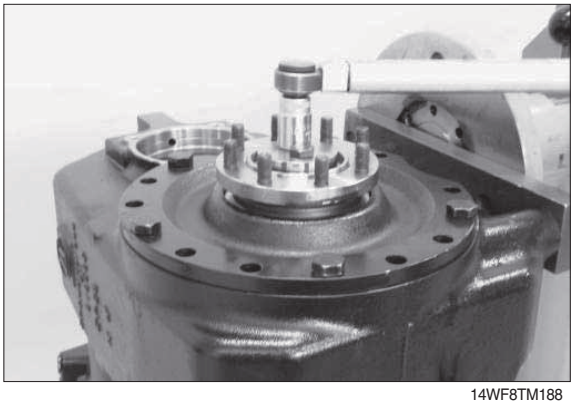


14WF8TM187

55) Position disk and fix output flange by means of hexagon screws.

Tightening torque (M10/10.9) M_A = 68 Nm

※ Install second shaft seal/output flange (front axle output) analogously.



14WF8TM188

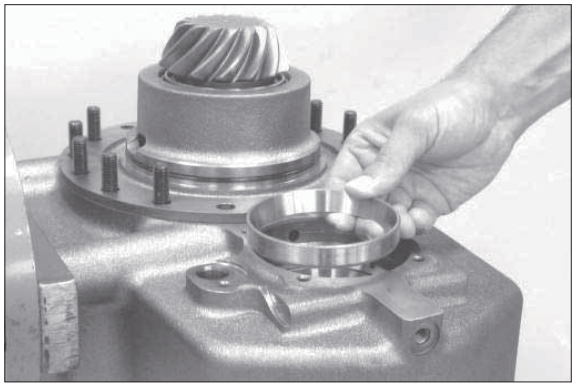
9.REASSEMBLY - BRAKE / CLUTCH / PLANETARY CARRIER

Planetary carrier

1) Install bearing outer ring until contact.

(S) Driver tool	5870 058 051
(S) Handle	5870 260 002

※ Observe bearing allocation – bearing inner ring to bearing outer ring – also see instructions for disassembly, 14WF8TM103.

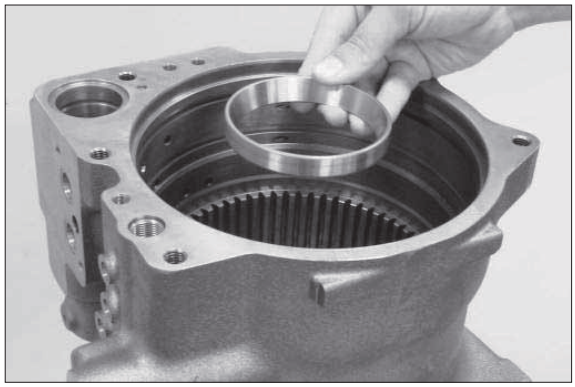


14WF8TM189

2) Rotate transmission by 180˚.
Install second bearing outer ring until contact.

(S) Driver tool	5870 058 051
(S) Handle	5870 260 002

※ Observe bearing allocation – bearing inner ring to bearing outer ring – also see instructions for disassembly 14WF8TM103.



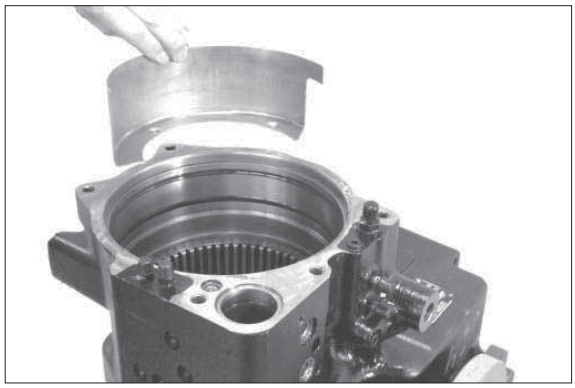
14WF8TM190

3) **Only for version transmission installation position**

※ Insert screen sheet and fasten with countersunk screws.

Tightening torque (M 6/8.8) M_A = 7.4 Nm

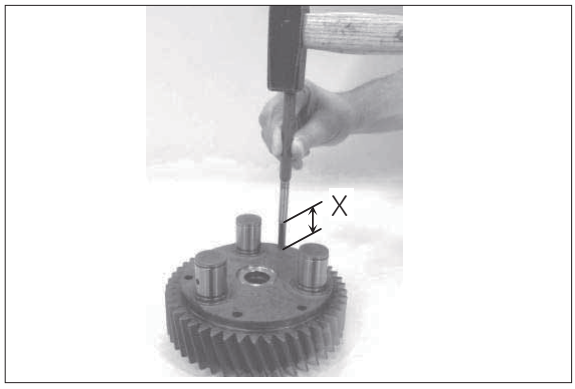
Wet countersunk screws with Loctite type no.243.



14WF8TM191

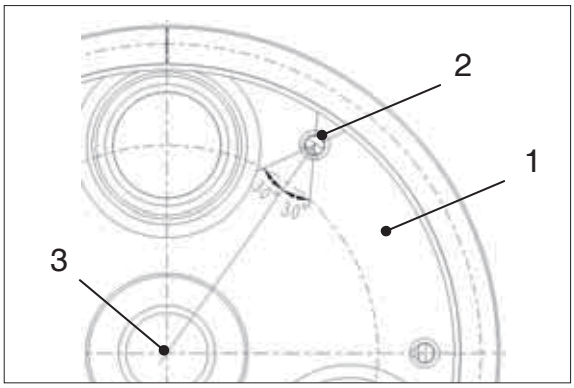
4) Install slotted pins (2) considering installation dimension X and installation position, see 14WF8TM193 (groove showing to center).

(S) Press-fit mandrel	AA00 392 151



14WF8TM192

5) 1 = Planetary carrier
2 = Slotted pin (6x)
3 = Center (planetary carrier)

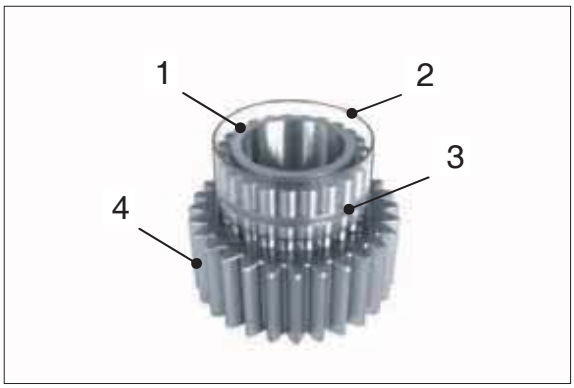


14WF8TM193

6) Insert cylindrical roller bearing into planetary gear. Press cylindrical roller bearing through packaging sleeve until snap ring engages into annular groove of planetary gear.

※ Use packaging sleeve to facilitate assembly.

1 = Cylindrical roller bearing
2 = Packaging sleeve
3 = Snap ring
4 = Planetary gear

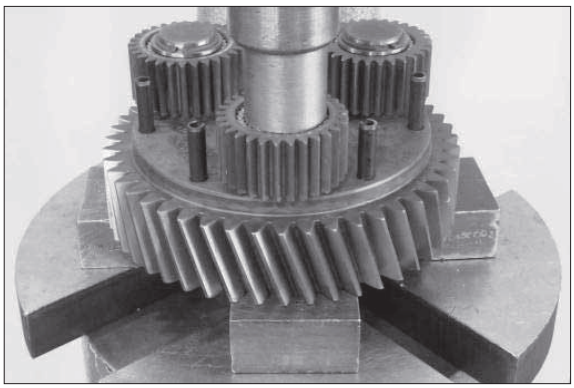


14WF8TM194

7) Press on planetary gear over bearing inner ring until contact.

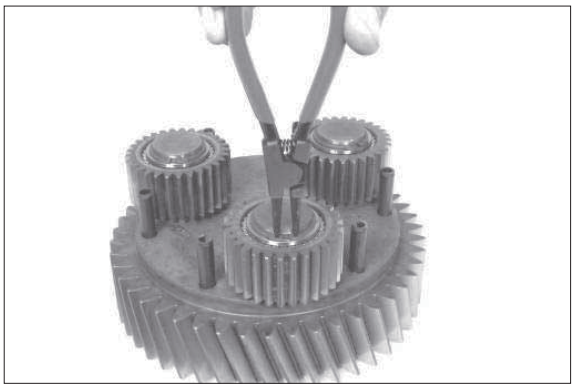
(S) Driver tool 5870 048 283

※ Install planetary gears with large radius on cylindrical roller bearing (downwards) towards planetary carrier.

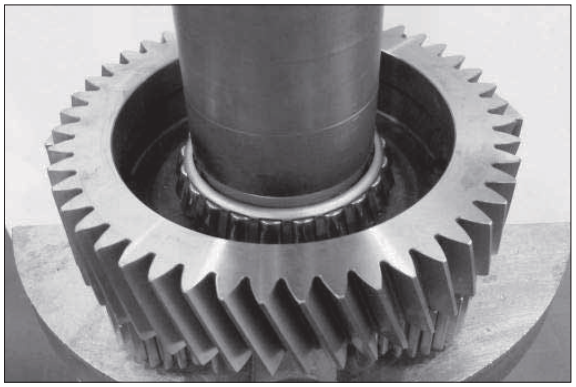

14WF8TM195

8) Engage retaining ring.

※ Adjust retaining ring until contact with groove base.


14WF8TM196

9) Press bearing inner ring onto planetary carrier until contact.



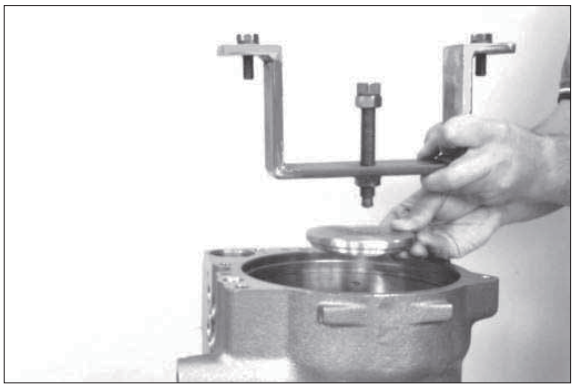
14WF8TM197

10) Insert preassembled planetary carrier.

14WF8TM198

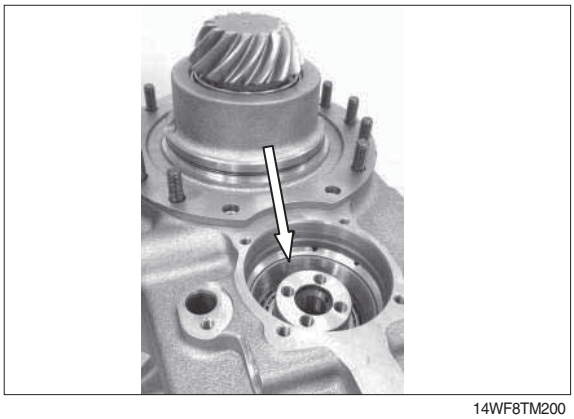
11) Fix planetary carrier with pressure plate and clamping bar.

(S) Clamping bar 5870 654 049



14WF8TM199

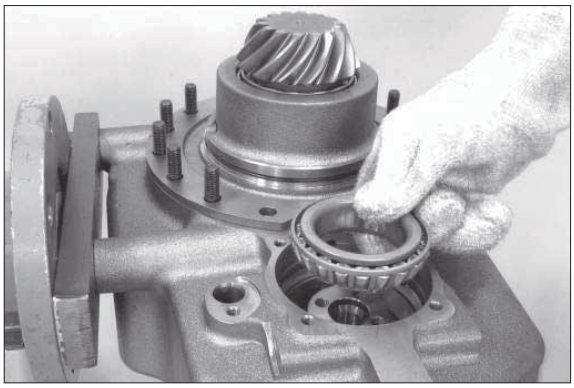
12) Rotate transmission by 180˚.
Check contact of bearing outer ring (see arrow). Reassembly of bearing outer ring, see 14WF8TM189.



14WF8TM200

13) Install heated bearing inner ring until contact.

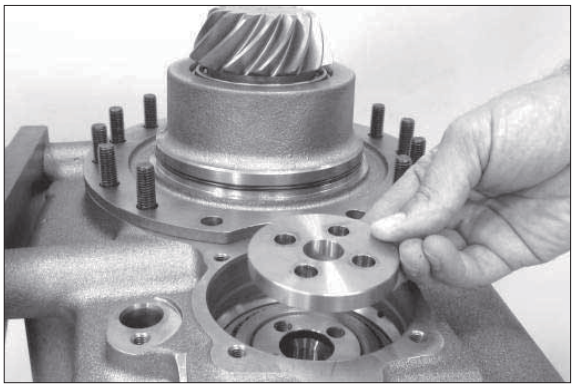
※ Adjust bearing inner ring after cooling down.



14WF8TM201

14) Position disk and manually turn in hexagon screws (fix planetary carrier).

Then remove clamping bar, see 14WF8TM199.

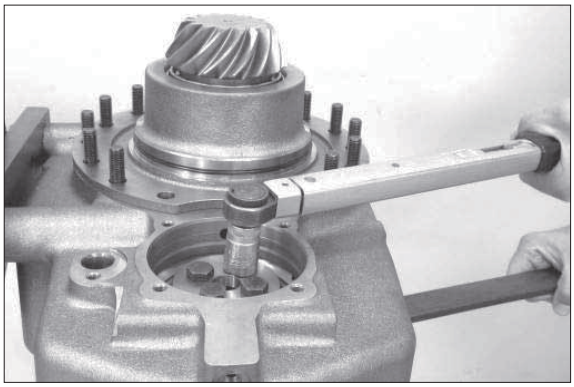


14WF8TM202

15) Fix clamping fork to output flange.
Tighten hexagon screws evenly – risk of strain.

Tightening torque (M 10/10.9)	M_A = 46 Nm
(S) Clamping fork	5870 240 025

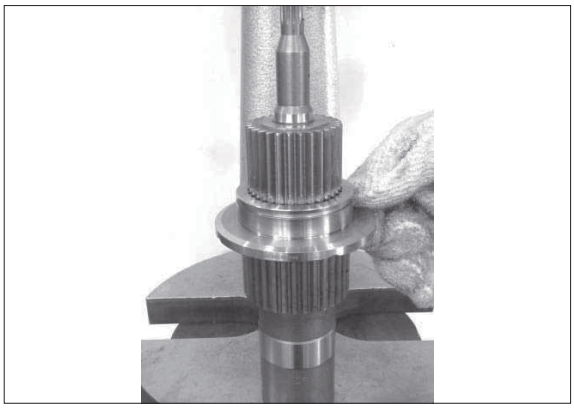
※ While tightening hexagon screws, rotate planetary carrier several times in both directions (roller setting).



14WF8TM203

Brake and clutch

16) Mount heated centering disk and press it until contact.



14WF8TM204

17) Fix centering disk by engaging retaining ring into annular groove of input shaft.

14WF8TM205

18) Insert ball bearing into ring gear and fasten it by engaging retaining ring into annular groove of ring gear.

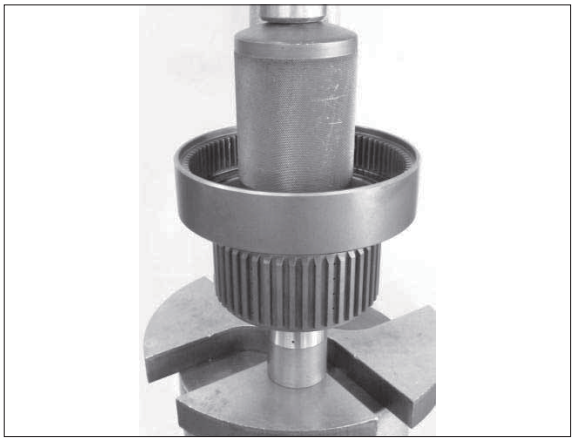
(S) Clamping pliers 5870 900 021

14WF8TM206

19) Heat bearing inner ring of ball bearing.

14WF8TM207

20) Mount preassembled ring gear to input shaft until contact.



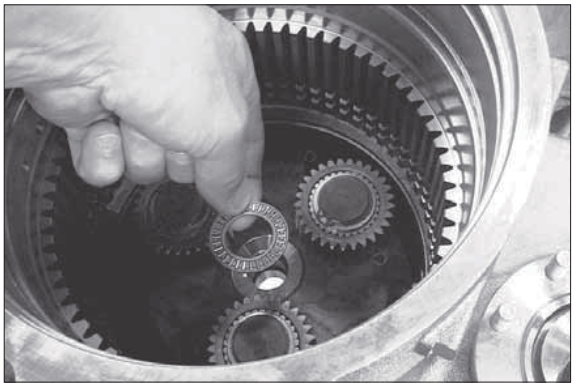
14WF8TM208

21) Engage retaining ring into annular groove of input shaft.

14WF8TM209

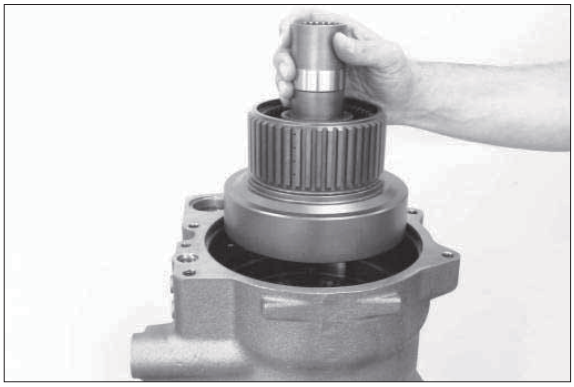
22) Rotate transmission by 180˚.
Insert axial needle cage into recess of planetary carrier.

※ Oil axial needle cage for reassembly.



14WF8TM210

23) Insert preassembled input shaft (with ring gear).

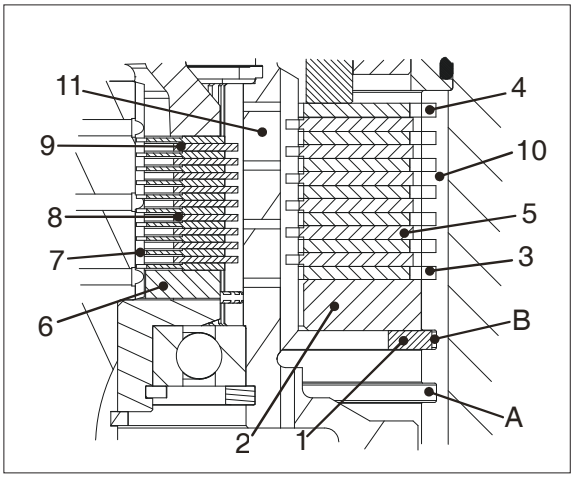


14WF8TM211

Disk components brake and clutch

24) A = Lower annular groove (Item retaining ring-1)
B = Upper annular groove (Item retaining ring-1)

1 = Retaining ring
2 = End plate/Brake (1 pc)
3 = Outer disk/Brake (6 pcs.)
4 = Outer disk/Brake optional (1 pc)
5 = Inner disk/Brake (6 pcs.)
6 = End plate/Clutch (1 pc)
7 = Lining disk/Clutch (10 pcs.)
8 = Outer disk/Clutch (8 pcs.)
9 = Outer disk/Clutch optional (1 pc)
10 = Transmission housing
11 = Disk carrier / Ring gear



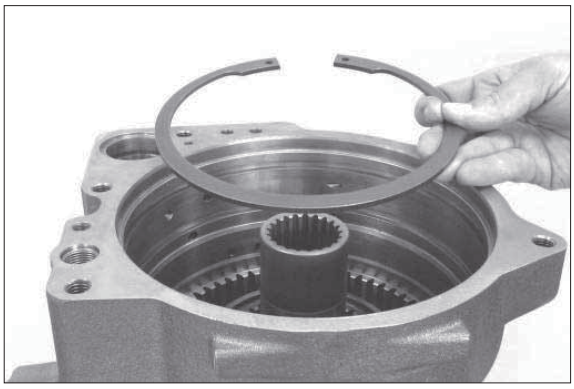
14WF8TM213

Reassembly brake :

25) Engage retaining ring (1) into annular groove (A).

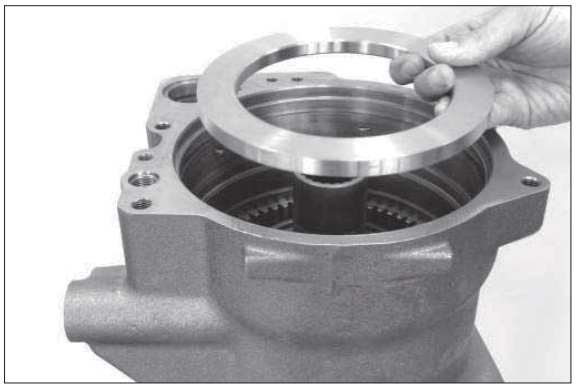
(S) Clamping pliers 5870 900 021

※ Observe installation position of retaining ring (1).



14WF8TM215

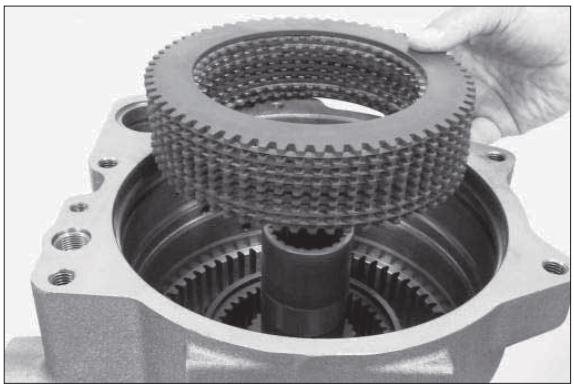
26) Insert end plate (2).



14WF8TM216

27) Insert disk package alternately, beginning with an outer disk.

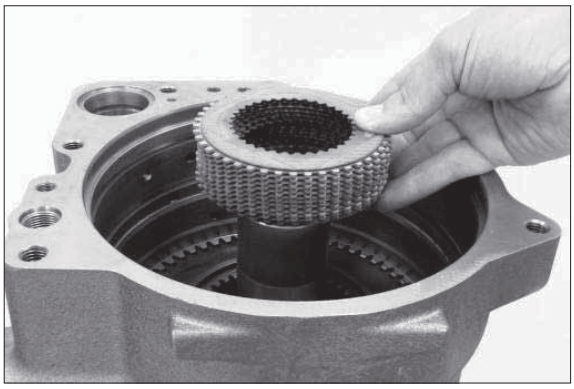
※ Position outer disk (1 pc) s = variable 2.8 ~ 3.7 mm to top of disk package (piston side). With outer disk s = variable, disk clearance/ piston stroke is adjusted - see 14WF8TM229.



14WF8TM217

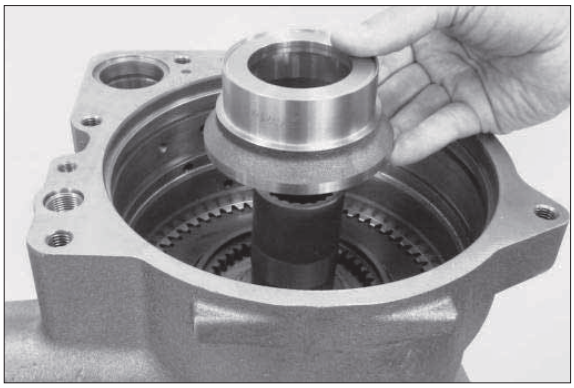
28) Insert disk package alternately, beginning with a lining disk.

※ Position outer disk (1 pc) s = variable 1.2 ~1.6 mm to top of disk package (pressure piece side).
With outer disk s = variable, disk clearance / piston stroke is adjusted – see 14WF8TM228.



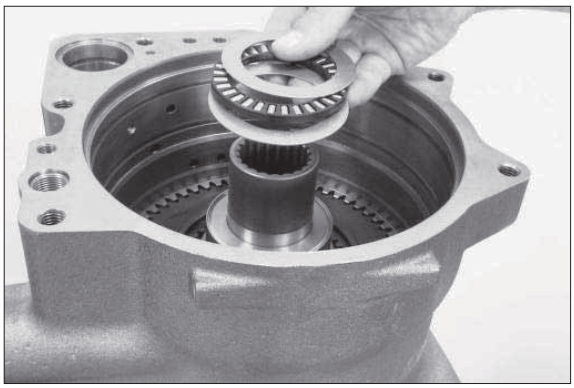
14WF8TM218

29) Mount pressure piece (without compression spring).



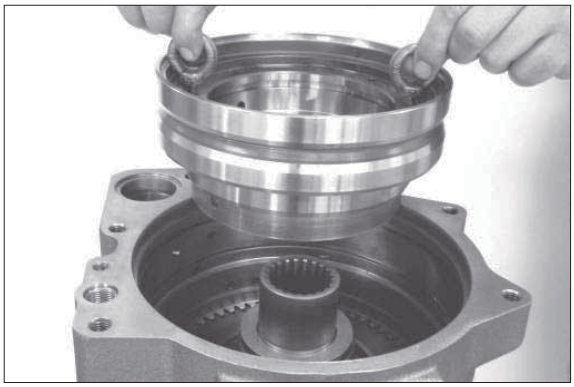
14WF8TM219

30) Oil axial roller cage and mount it with both axial washers (1x each, positioned underneath and onto axial needle cage).



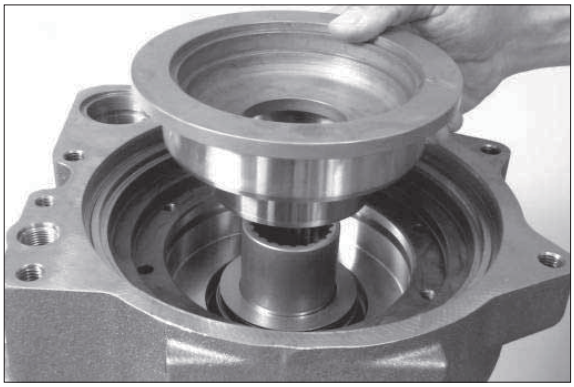
14WF8TM220

31) Insert piston (brake) – without mounted sealing elements.



14WF8TM221

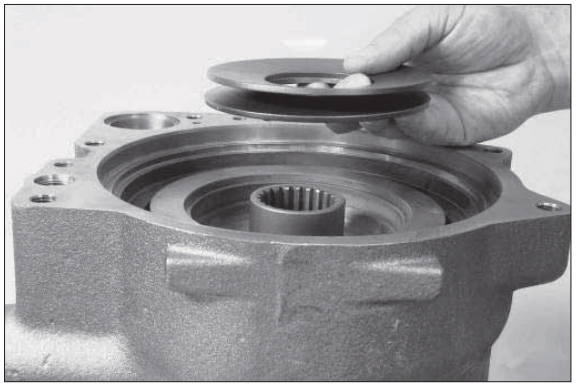
32) Insert piston (clutch) – without mounted sealing elements.



14WF8TM222

33) Insert both cup springs/clutch.

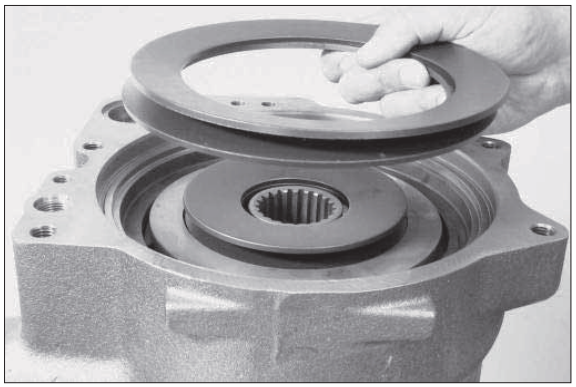
※ Fix cup springs with grease and position them centrically.
※ Observe installation position, see 14WF8TM225.



14WF8TM223

34) Insert both cup springs/brake.

※ Fix cup springs with grease and position them centrically.
※ Observe installation position, see 14WF8TM225.



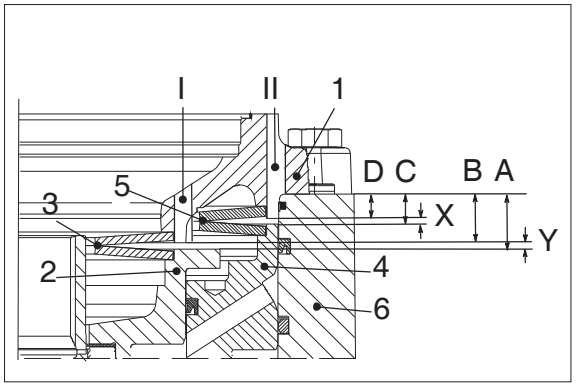
14WF8TM224

35) 1 = Measuring device
2 = Piston/clutch
3 = Cup springs/Clutch
4 = Piston/Brake
5 = Cup springs/Brake
6 = Transmission housing

I = Measuring hole (disk clearance / clutch)
II = Measuring hole (disk clearance / brake)

A = Mounting face/Housing – Front face/Piston
B = Mounting face/Housing – Piston contact/Housing
C = Mounting face/Housing – Front face/Piston
D = Mounting face/Housing – Piston contact/Housing

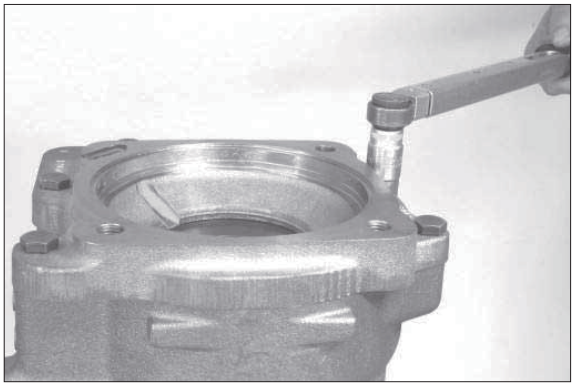
Y = Disk clearance/Clutch → 2.4 +0.3 mm (piston stroke)
X = Disk clearance/Brake → 1.8 + 0.3 mm (piston stroke)



14WF8TM225

36) Locate measuring device evenly with hexagon screws (risk of breakage) until contact.

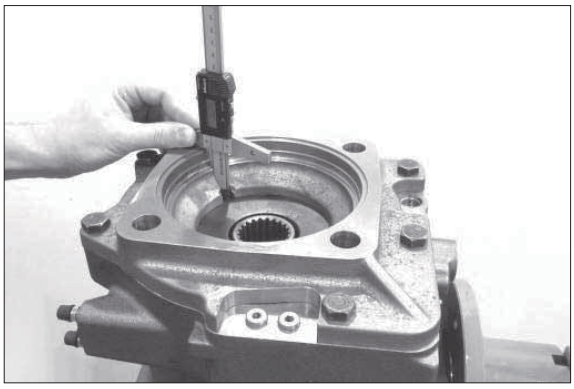
Tightening torque (M 12/8.8) M_A = 80 Nm
(S) Measuring device 5870 200 131



14WF8TM226

37) Determine dim. A (Measuring hole I) from mounting face/housing to front face/piston (clutch).

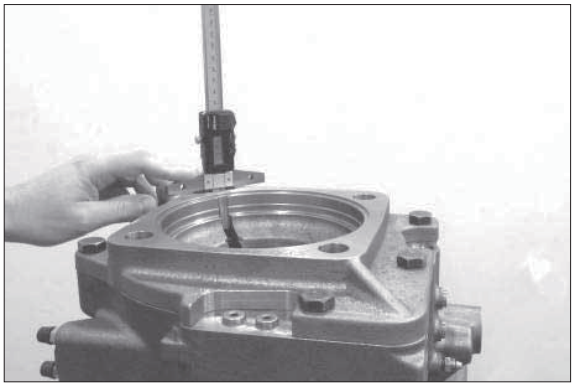
Dim. A e.g. = 22.45 mm
(S) Straightedge 5870 200 108



14WF8TM227

38) Determine Dim. C (Measuring hole II) from mounting face/housing to front face/piston (brake).

Dim. C e.g. = 11.85 mm



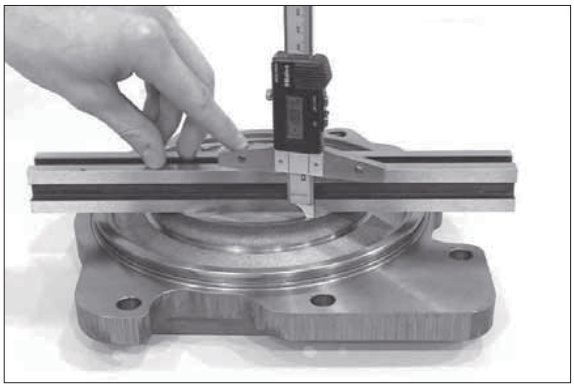
14WF8TM228

39) Determine Dim. B from mounting face/housing to clutch piston contact/housing.

Dim. B e.g. = 19.95 mm
A-B = 2.50 mm (disk clearance)

Clutch disk clearance (piston stroke) = $2.4^{+0.3}$ mm

⚠ **If the required disk clearance (piston stroke) is not obtained, correct with a suitable outer disk – see 14WF8TM218.**



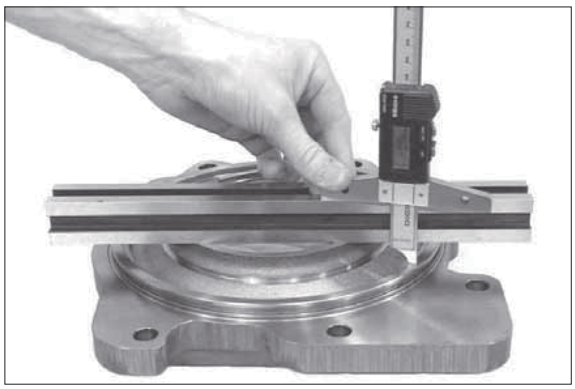
14WF8TM229

40) Determine Dim. D from mounting face/housing to brake piston contact/housing.

Dim. D e.g. = 9.95 mm
C-D = 1.90 mm (disk clearance)

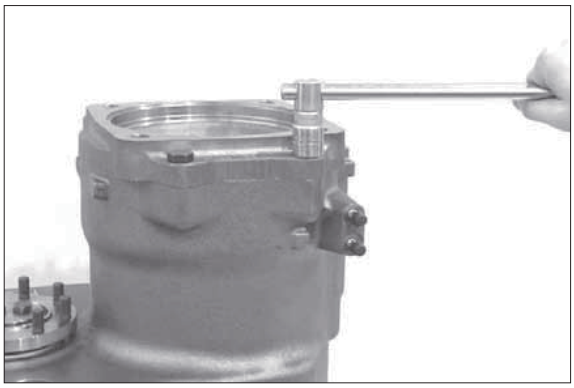
Disk clearance (piston stroke) Brake = $1.8^{+0.3}$ mm

⚠ **If the required disk clearance (piston stroke) is not obtained, correct with a suitable outer disk – see 14WF8TM217.**



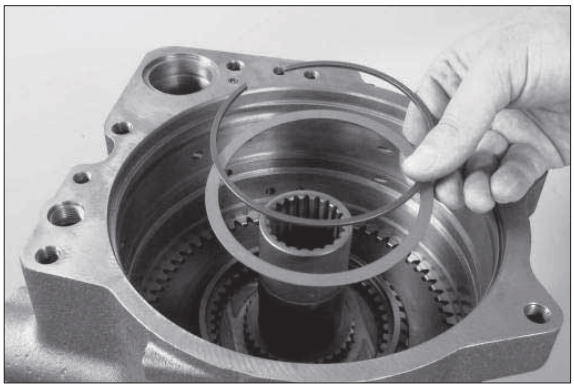
14WF8TM230

41) Remove measuring device again – loosen screws evenly.
Remove all cup springs, both pistons, axial roller cage with axial washers and pressure piece.



14WF8TM231

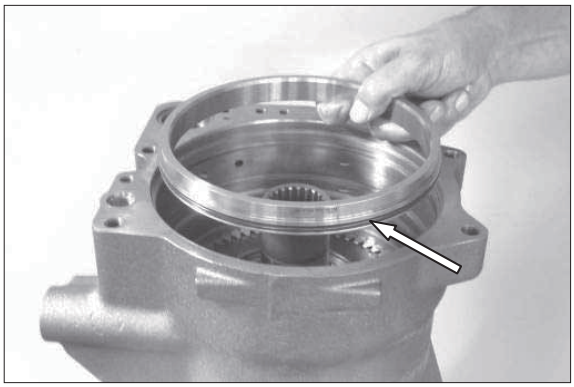
42) Insert shim into ring gear and fix by engaging snap ring into annular groove of ring gear.



14WF8TM232

43) Place O-ring (see arrow) into groove and insert ring.

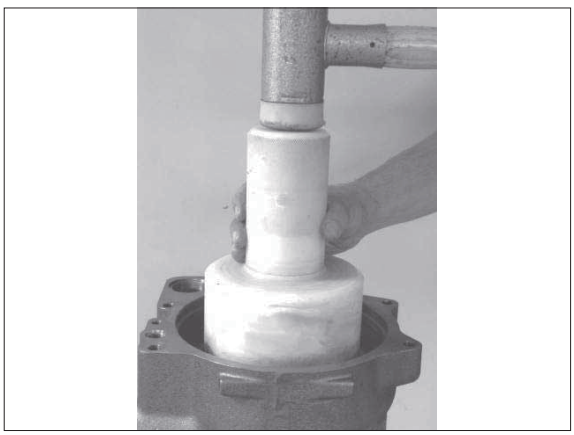
※ Oil sealing surfaces in housing and O-ring for reassembly.
※ Observe installation position



14WF8TM233

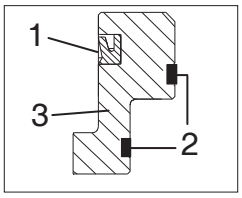
44) Mount ring with driver tool until contact.

(S) Driver tool 5870 506 161

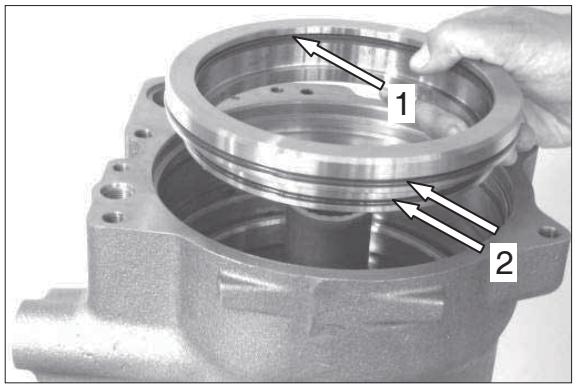


14WF8TM234

45) Oil sealing surfaces in housing and sealing elements. Insert seal (1) with sealing lip showing to oil sump – also see detail sketch.



Put both O-rings (2) into annular grooves of pressure ring (3) and insert preassembled pressure ring into housing.



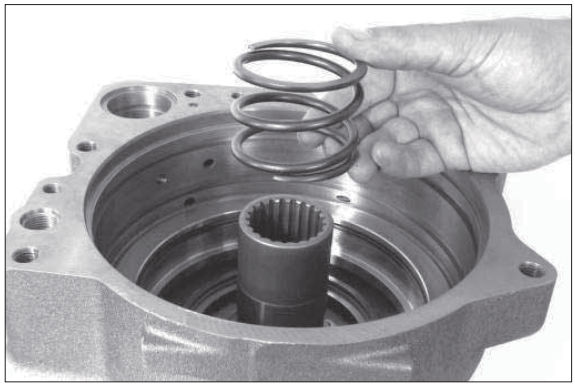
14WF8TM235

46) Bring pressure ring with driver tool into contact position.

(S) Driver tool 5870 506 161

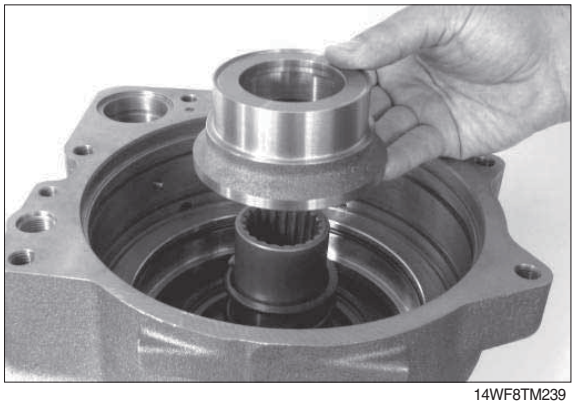
14WF8TM237

47) Insert compression spring until contact.



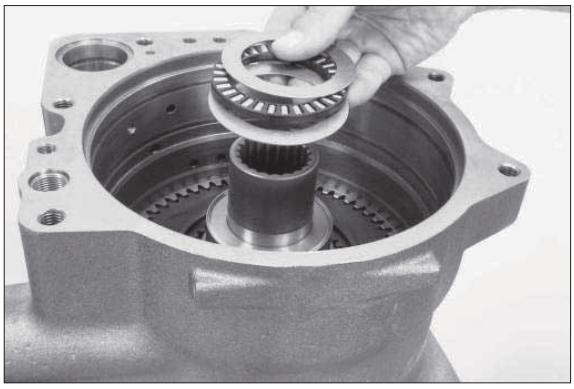
14WF8TM238

48) Insert pressure piece over compression spring until contact.



14WF8TM239

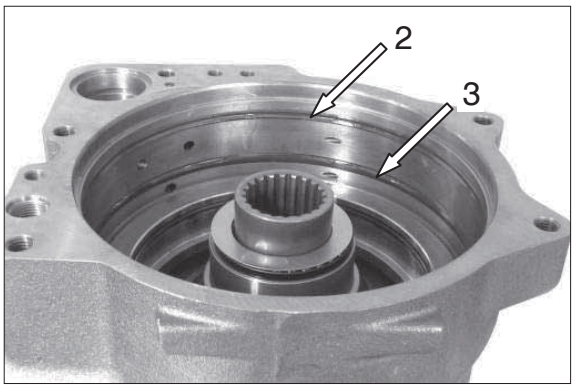
49) Oil axial roller cage and mount it with both axial washers (1x each to be positioned underneath and onto axial needle cage).



14WF8TM240

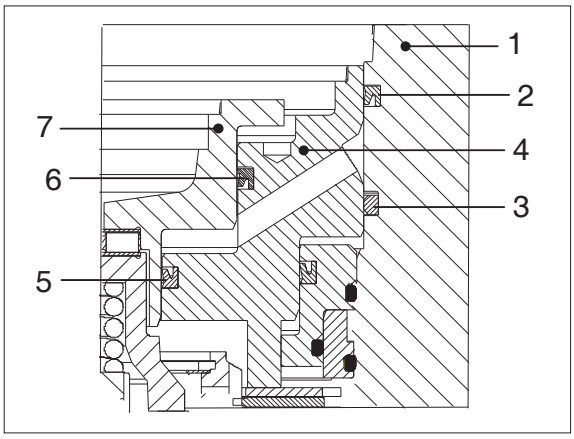
50) Insert seal (2, with sealing lip showing to oil sump) and seal (3) – see 14WF8TM242 into housing (1).

※ Oil sealing elements and sealing surfaces on piston for reassembly.



14WF8TM241

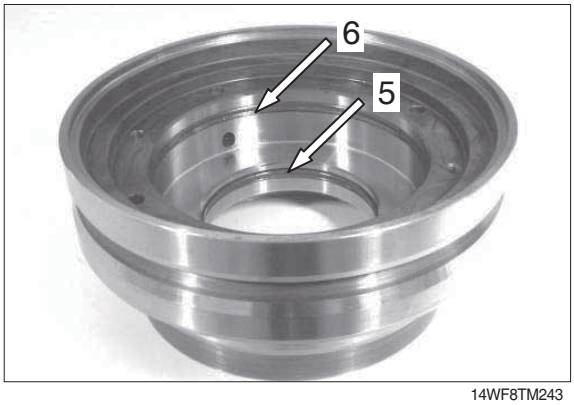
51) 1 = Housing
2 = Seal (with sealing lip)
3 = Seal
4 = Piston / Brake
5 = Seal (with sealing lip)
6 = Seal (with sealing lip)
7 = Piston / Clutch



14WF8TM242

52) Insert seals (5 and 6, see 14WF8TM247), with sealing lips showing to oil sump into piston / brake (4).

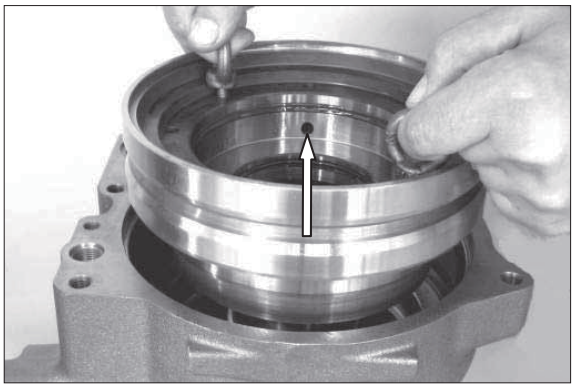
※ Oil sealing surfaces on piston and sealing elements for reassembly.



14WF8TM243

53) Insert preassembled piston/brake until contact.

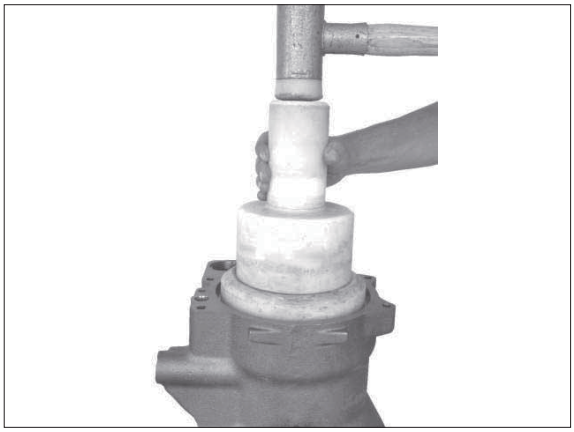
※ Position piston in such a way that oil supply hole (see arrow) is at 12.00 o'clock position. Observe version as to transmission installation position HORIZONTAL – VERTICAL.



14WF8TM244

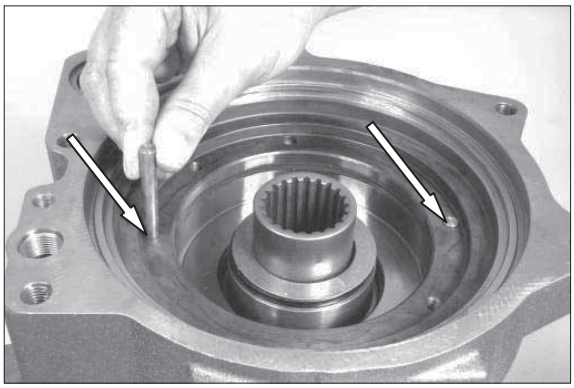
54) Use driver tool to bring piston into contact position.

(S) Driver tool 5870 506 161



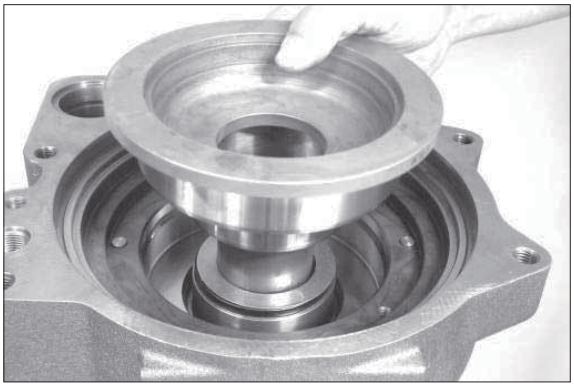
14WF8TM245

55) Insert both cyl. pins (arrow).



14WF8TM246

56) Insert piston/clutch until contact.

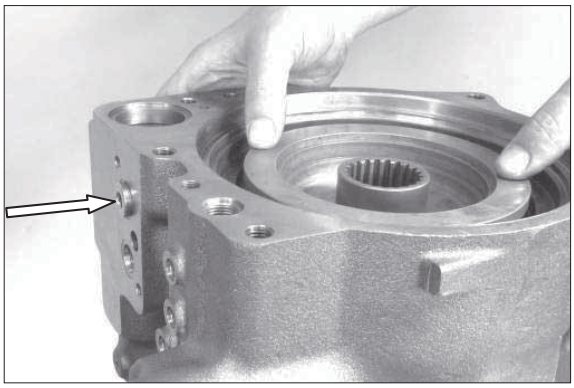


14WF8TM247

57) Press piston axially, against compression spring preload.
Provide screw plug with new O-ring and seal pressure oil supply hole (see arrow).

Tightening torque M_A = 40 Nm

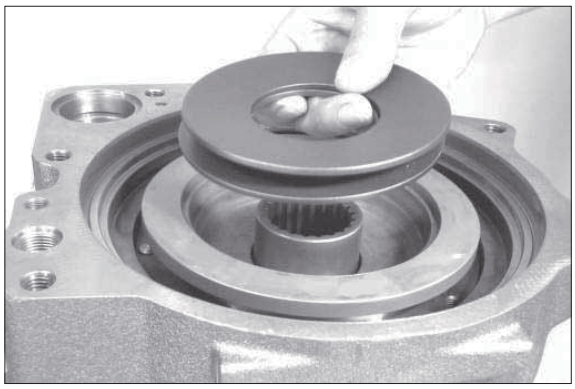
※ Axial position of piston is maintained (Facilitate assembly for installation of input housing, see 14WF8TM254~ 14WF8TM255).



14WF8TM248

58) Insert both cup springs/clutch.

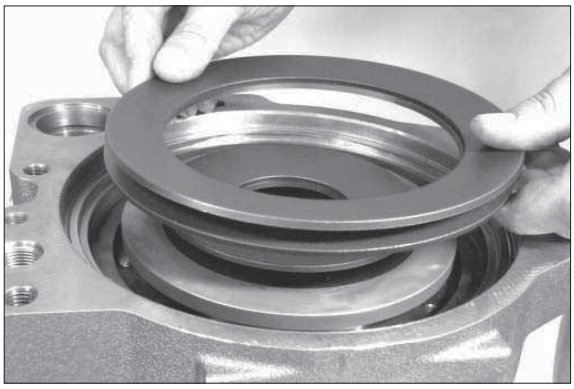
※ Observe installation position, see also 14WF8TM225.



14WF8TM249

59) Insert both cup springs/brake.

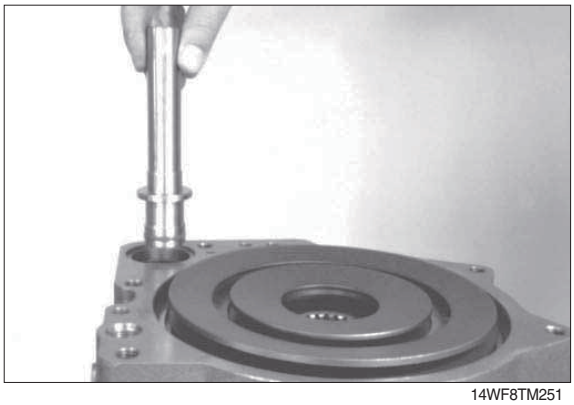
※ Observe installation position – see also 14WF8TM225.



14WF8TM250

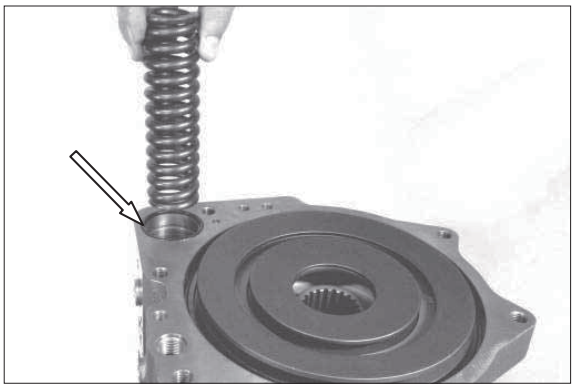
Install modulation valve and input housing

60) Insert piston (modulation valve cpl. – can only be replaced as unit).



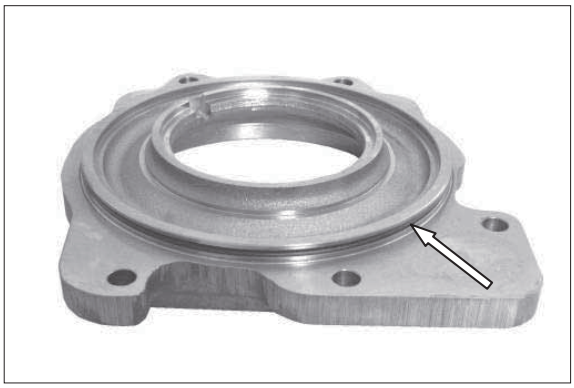
14WF8TM251

61) Place O-ring (see arrow) into annular groove of housing and insert compression spring.



14WF8TM252

62) Oil O-ring and insert it into annular groove of input housing.

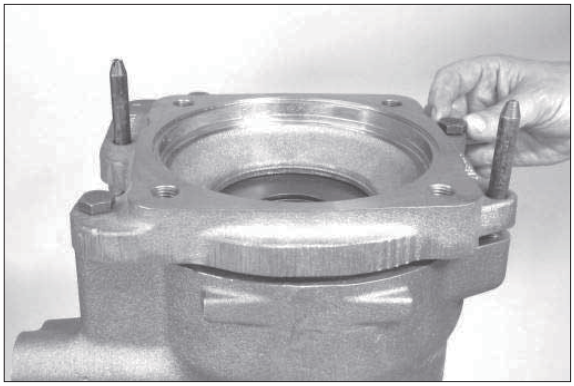


14WF8TM253

63) Insert two adjusting screws (M 12), mount input housing and fix it with hexagon screws.

(S) Adjusting screws (M12) 5870 204 021

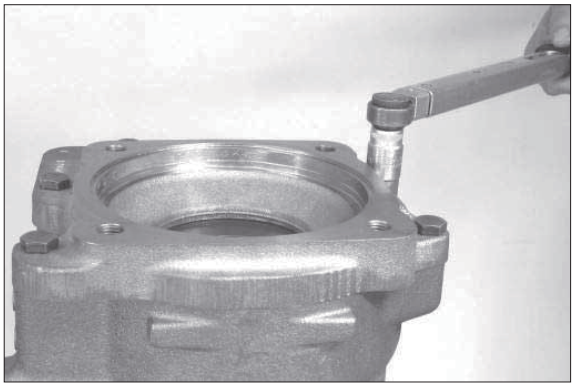
※ For installation of input housing align cup springs centrically.



14WF8TM254

64) Locate input housing evenly with hexagon screws (risk of breakage) until contact.

Tightening torque (M 12/8.8) M_A = 80 Nm



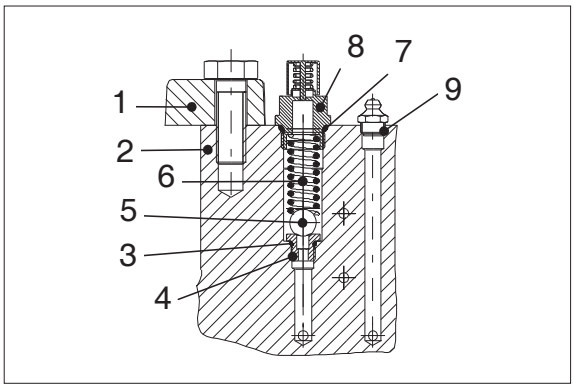
14WF8TM255

Emergency release (parking brake)

65) 1 = Input housing
2 = Housing
3 = O-ring
4 = Threaded element (orifice)
5 = Ball
6 = Compression spring
7 = O-ring
8 = Breather
9 = Position of lubrication nipple for version Transmission installation position Vertical

※ Position of lubrication nipple for version transmission installation position Horizontal, see 14WF8TM261.

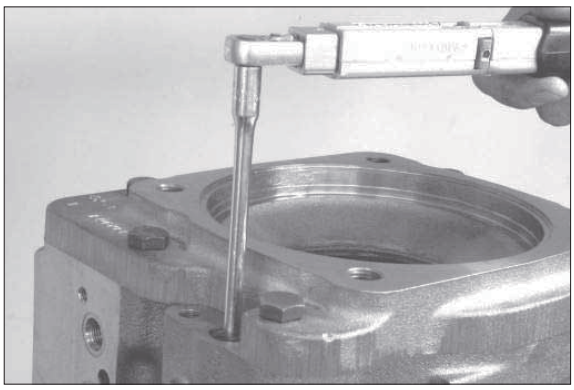
※ Remove protective cap of lubrication nipple only if emergency release is required.



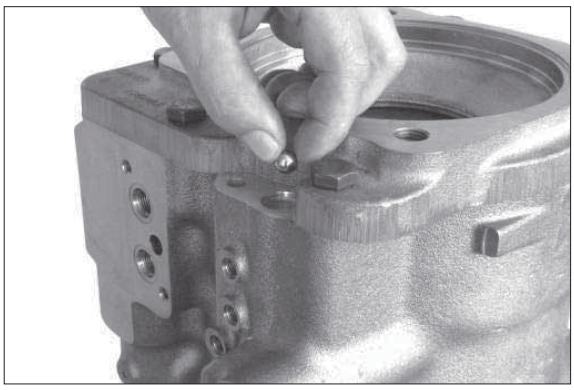
14WF8TM256

66) Install threaded element (4) with new O-ring (3).

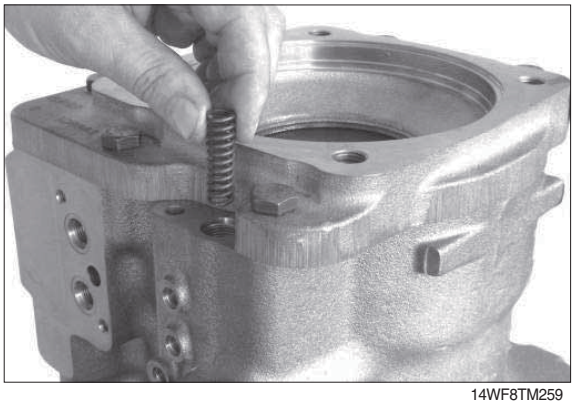
Tightening torque (M 10×1) M_A = 15 Nm


14WF8TM257

67) Insert ball (5).


14WF8TM258

68) Insert compression spring (6).


14WF8TM259

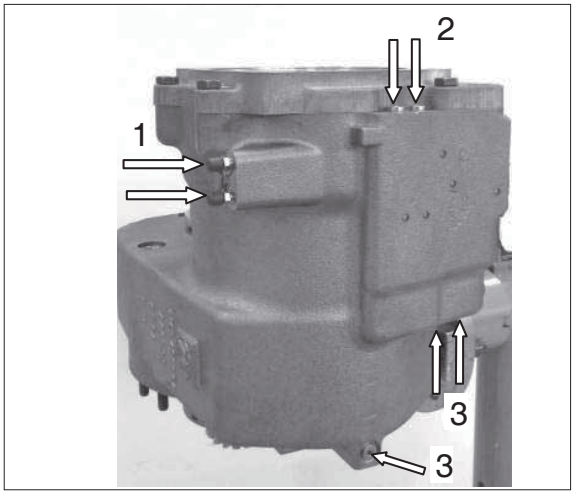
Check emergency release for leak tightness

69) Illustration shows version transmission installation position Vertical.

※ For version transmission installation position Horizontal connections and positions of breather valves/lubrication nipple etc. must be considered as shown on illustration of 14WF8TM261.

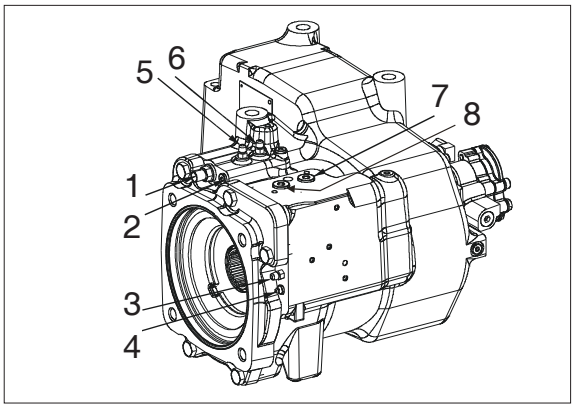
Install both breather valves (1), screw plugs (2) with new seal rings and screw plugs (3) with new O-rings.

Breather valve (M 10×1) M_A = 15 Nm
Screw plug (M 10×1 with seal ring) M_A = 20 Nm
Screw plug (M 10×1 with O-ring) M_A = 20 Nm



14WF8TM260

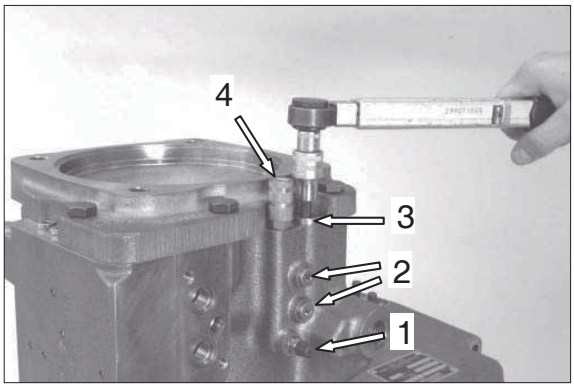
70) 1 = Breather/Pressure relief-valve
(emergency release –parking brake)
2 = Screw plug
3 = Breather valve
(emergency release – parking brake)
4 = Lubrication nipple
(emergency release – parking brake)
5 = Breather valve (multi-disk clutch)
6 = Breather valve (mulit-disk brake)
7 = Pressure oil connection – multi-disk brake
8 = Pressure oil connection – multi-disk clutch



14WF8TM261

71) Install breather valve (1), screw plugs (2), screw plug (3) with new O-ring and compressed air connection piece (4).

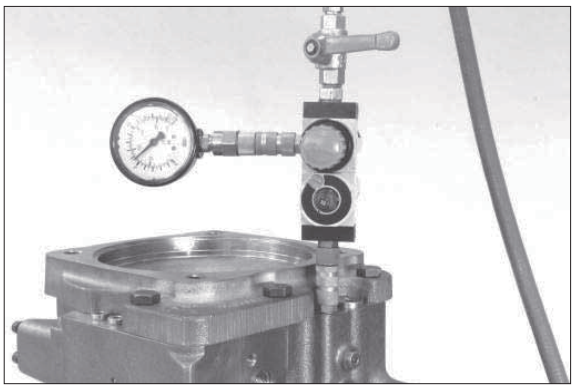
Breather valve (M 10×1) M_A = 15 Nm
Screw plug (M 10×1 with O-ring) M_A = 20 Nm
Screw plug (M 18×1.5 with O-ring) M_A = 35 Nm
Compressed air connect. piece (M 10×1) with seal ring M_A = 20 Nm



14WF8TM262

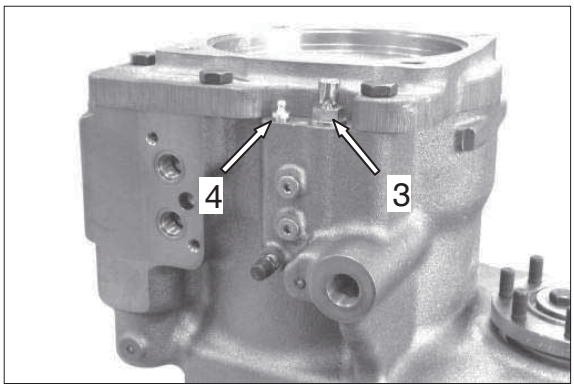
72) Pressurize emergency release with compressed air p = 5 + 1bar and close shut-off valve. During a test duration of 3 minutes no pressure drop is allowed.

(S) Air connection 5870 505 012


14WF8TM263

73) Remove screw plug and compressed air connection piece (see 14WF8TM262).
Install breather (3) with new O-ring and lubrication nipple (4).

Lubrication nipple (M 10×1) M_A = 15 Nm
Breather (M 18×1.5) M_A = 22 Nm



14WF8TM264

Check multi-disk brake and clutch for leak tightness as wells as closing pressure

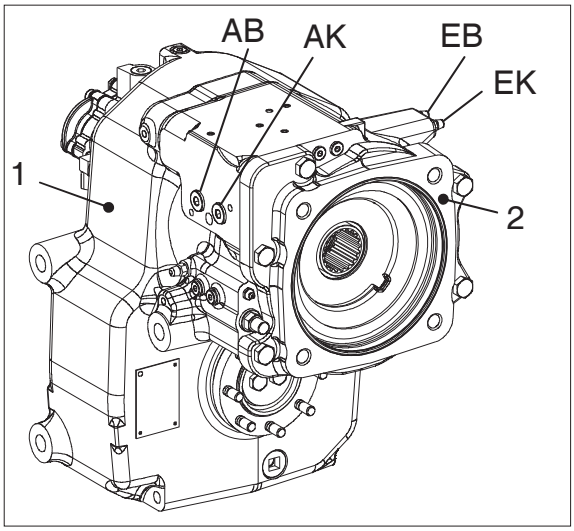
74) 1 = Transmission housing
2 = Input housing

AB = Pressure oil connection – multi-disk brake
AK = Pressure oil connection – multi-disk clutch

EB = Breather valve – multi-disk brake
EK = Breather valve – multi-disk clutch

※ Illustration shows version transmission installation position Vertical.

※ For version Transmission installation position Horizontal, connections and positions of breather valves/lubrication nipple etc. according to illustration in 14WF8TM261 must be considered.

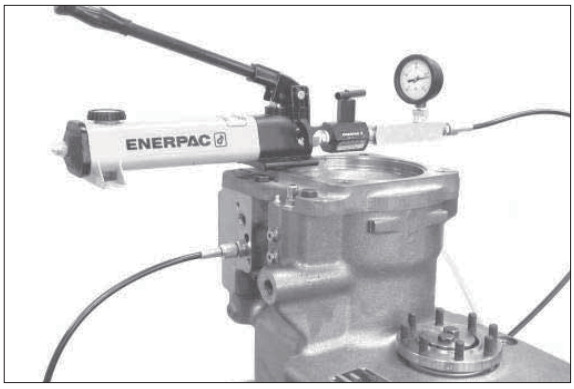


14WF8TM265

Multi-disk brake

75) Connect HP pump (AB – see 14WF8TM265 and 14WF8TM261) and build up pressure of p = 30 (max. 35 bar).
- Bleed pressure chamber several times. Close shut-off valve.
During a test duration of 3 minutes no measurable pressure drop is allowed.

(S) HP pump 5870 287 007



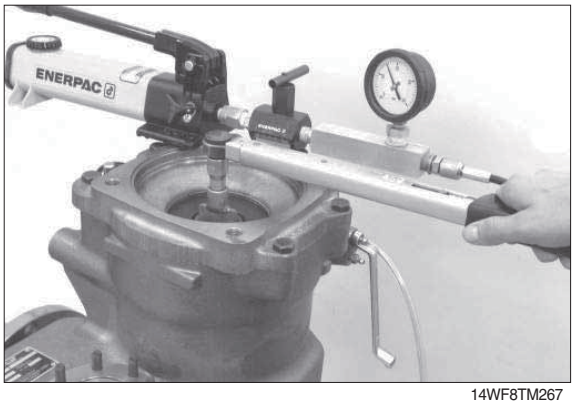
14WF8TM266

Closing pressure test (Cup spring preloading force)

76) When measuring closing pressure, valve block may not be attached to transmission due to by-pass function between brake and clutch.
Connection AK (see 14WF8TM265 and 14WF8TM261) open (not closed and tank connection).

Reduce pressure slowly, when pressure range 12~9 bar (closing pressure) is reached, input shaft must be locked at a tightening torque of 35 Nm.

(S) Spline mandrel 5870 510 039

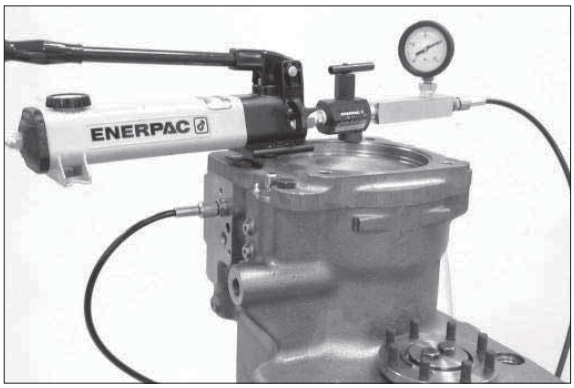


14WF8TM267

Multi-disk clutch

77) Connect HP-pump (AK see 14WF8TM265 and 14WF8TM261), build up pressure of p = 30~max. 35 bar.
- Relieve pressure chamber several times. Close shut-off valve.
During a test duration of 3 minutes no measurable pressure drop is allowed.

(S) HP-pump 5870 287 007

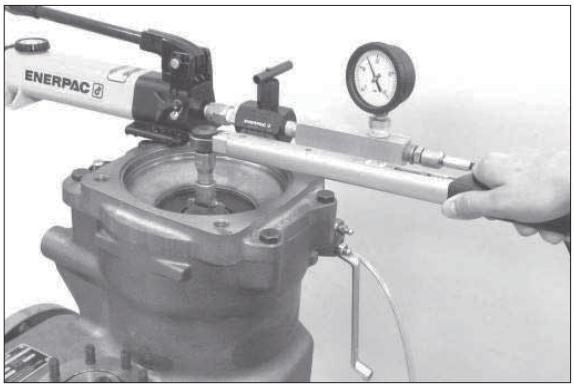


14WF8TM268

Closing pressure test (Cup spring preloading force)

78) When measuring closing pressure, valve block (only for version with mounted valve block) may not be attached to transmission due to by-pass function between brake and clutch.
Connection AB (see 14WF8TM265 and 14WF8TM261) open (not closed and tank connection).
Reduce pressure slowly, when pressure range 17~13 bar (closing pressure) is reached, input shaft must be locked at a tightening torque of 35 Nm.

(S) Spline mandrel 5870 510 039

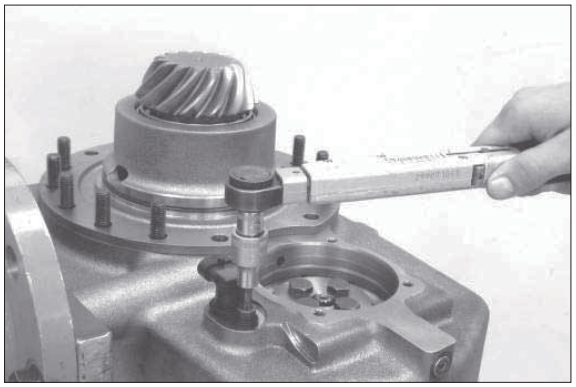


14WF8TM269

Speed sensor

79) Install speed sensor with new O-ring.

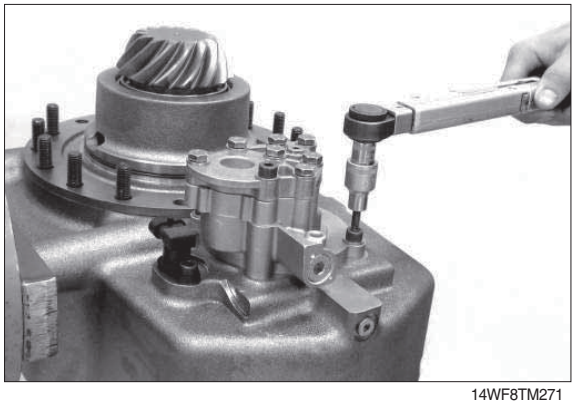
Tightening torque (M 8/8.8) M_A = 23 Nm


14WF8TM270

Lubrication pump/shift interlock

80) Install lubrication pump (with O-rings) or shift interlock – depending on version – (Illustration shows – Lubrication Pump).

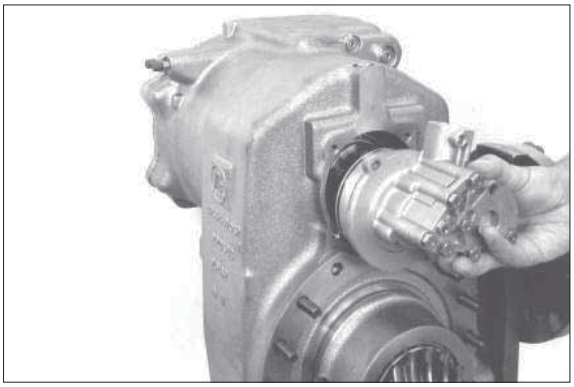
Tightening torque (M 8/10.9) M_A = 23 Nm


14WF8TM271

10.DISASSEMBLY - LUBRICATION PUMP/ SHIFT INTERLOCK and VALVE BLOCK

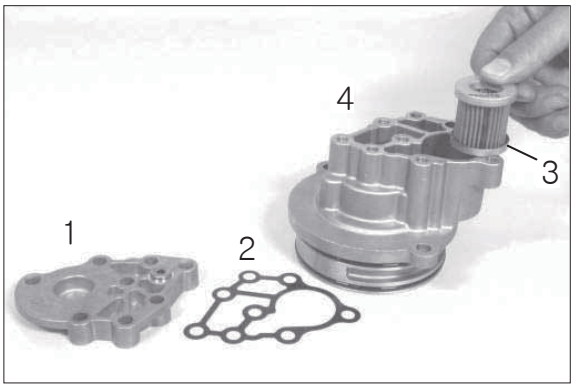
Lubrication pump version

1) Loosen threaded joint and pull off cpl. lubrication pump.



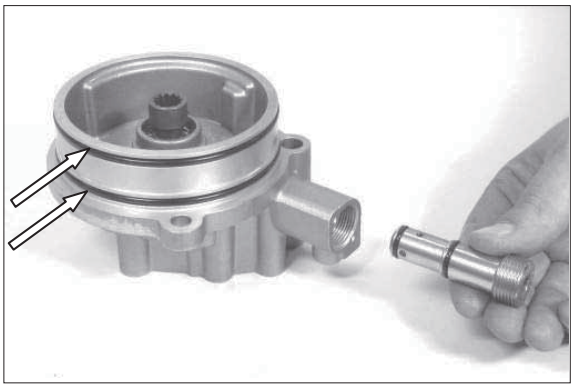
14WF8TM272

2) Loosen cover screws, remove cover (1) with seal (2) and filter (3) from housing (4).



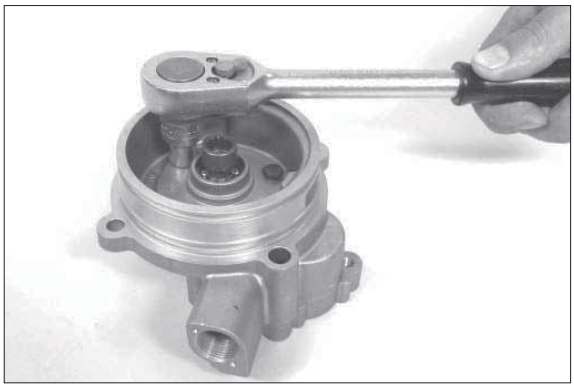
14WF8TM273

3) Remove cpl. pressure limiting valve and both O-rings (arrows).



14WF8TM274

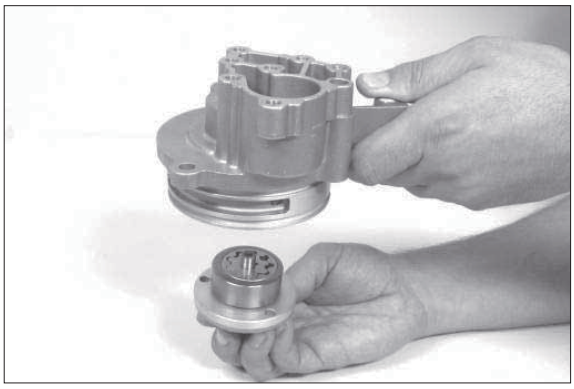
4) Keep housing in vertical position, while loosening pump cover screws.



14WF8TM275

※ Maintain contact position of pump and rotate by 180˚- disassembly aid.

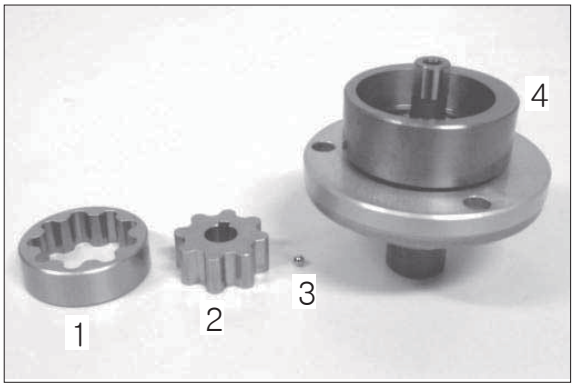
5) Then pull pump in vertical position out of housing – pay attention to possibly releasing balls and compression springs.



14WF8TM276

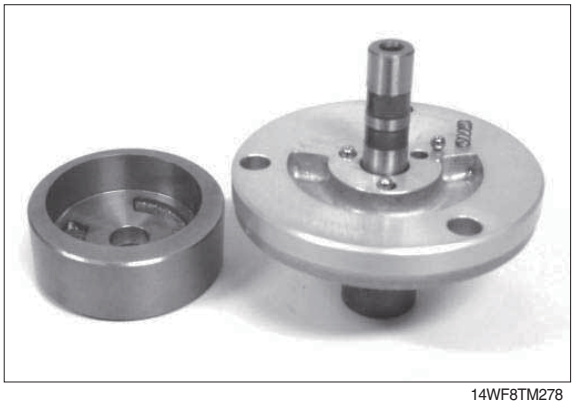
6) Remove outer (1) and inner rotor (2) and take releasing ball [(3) driver] out of control housing (4).

※ Outer, inner rotor and control housing = rotor set



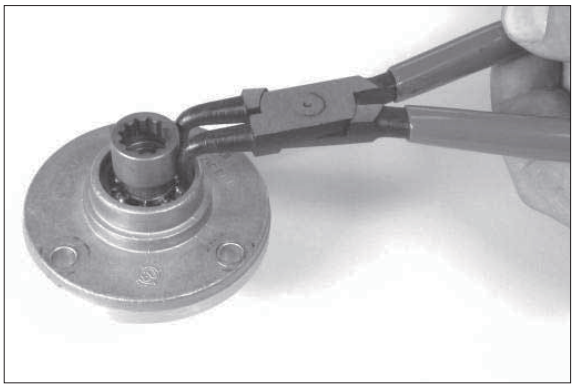
14WF8TM277

7) Remove control housing and releasing balls and compression springs (3 pcs. each).



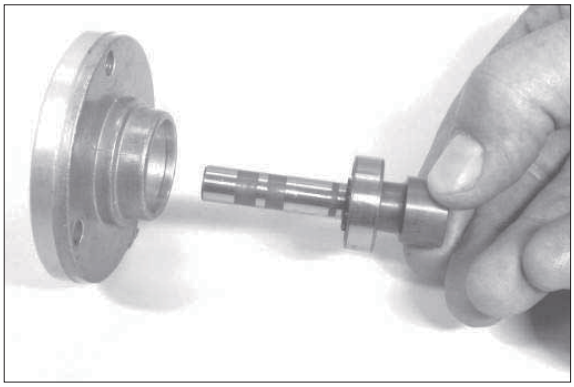
14WF8TM278

8) Unsnap retaining ring.



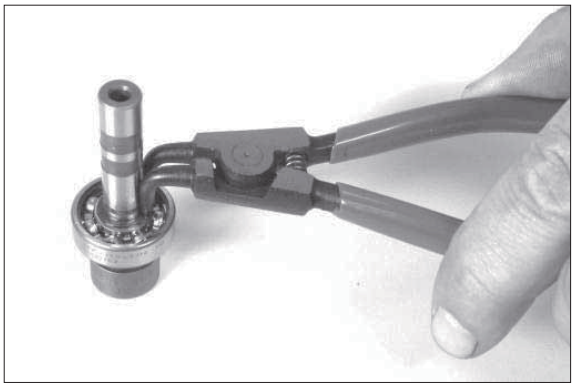
14WF8TM279

9) Pull cpl. pump shaft out of pump cover.



14WF8TM280

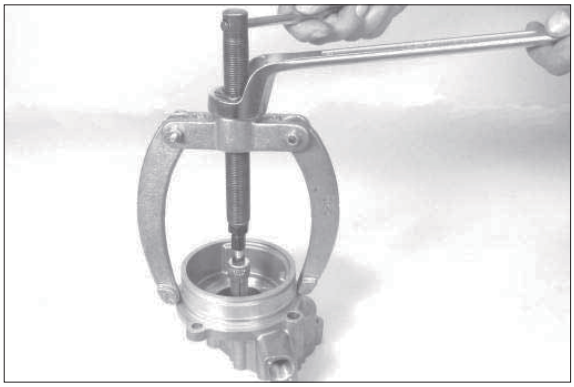
10) Unsnap retaining ring and press ball bearing from shaft.



14WF8TM281

11) Pull needle sleeve out of housing hole.

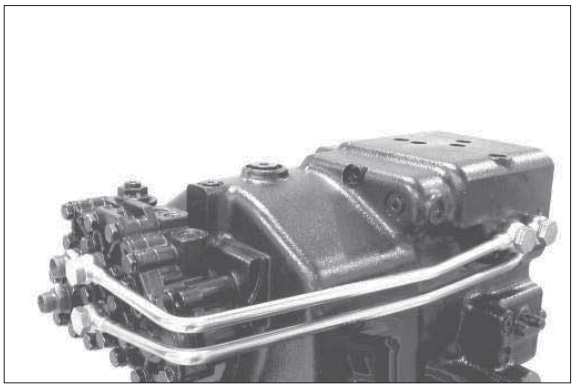
(S) Inner extractor	5870 300 012
(S) Counter support	5870 300 011



14WF8TM282

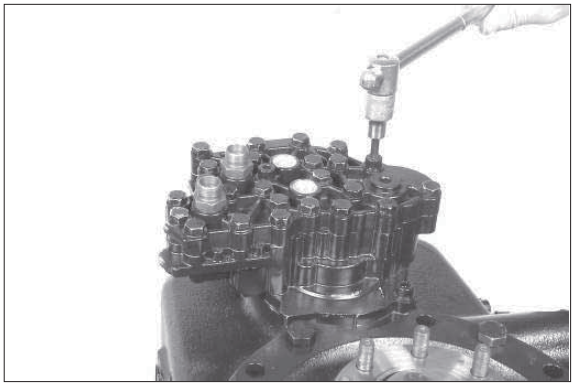
Shift interlock version

12) Disassemble both oil tubes.



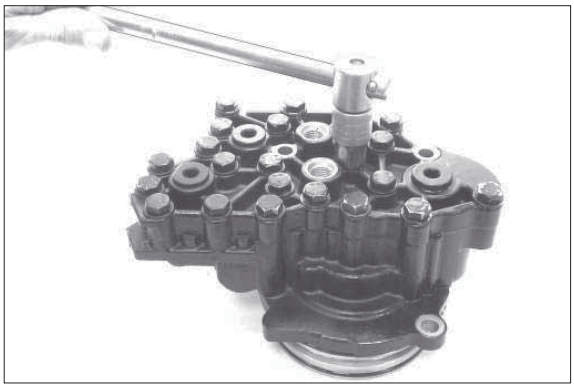
14WF8TM283

13) Loosen threaded joint of shift interlock (3 x cylindrical screws) and remove cpl. shift interlock.



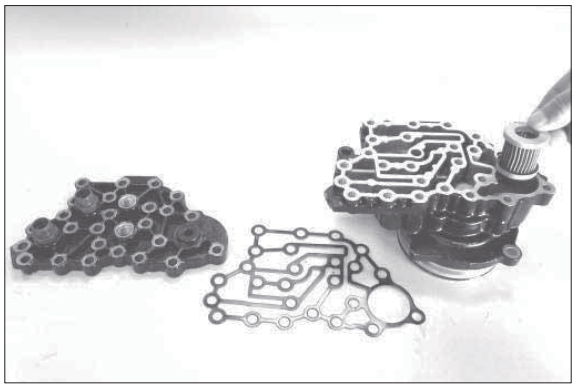
14WF8TM284

14) Loosen cover screws, remove cover and gasket (see also 14WF8TM286).



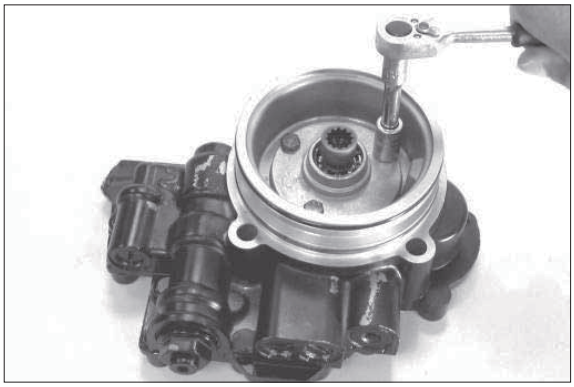
14WF8TM285

15) Take filter out of housing.



14WF8TM286

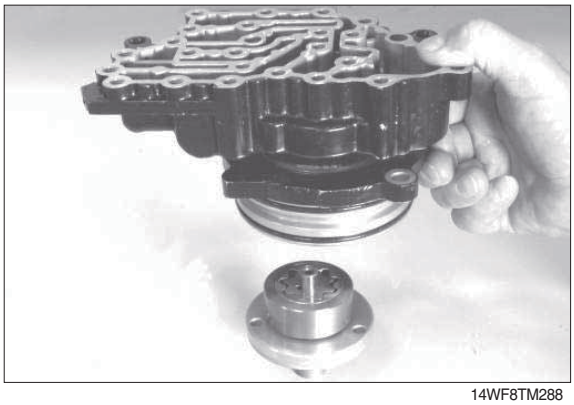
16) Loosen cover screws of pump.



14WF8TM287

※ Maintain contact position of pump and rotate it by 180˚ – disassembly aid.

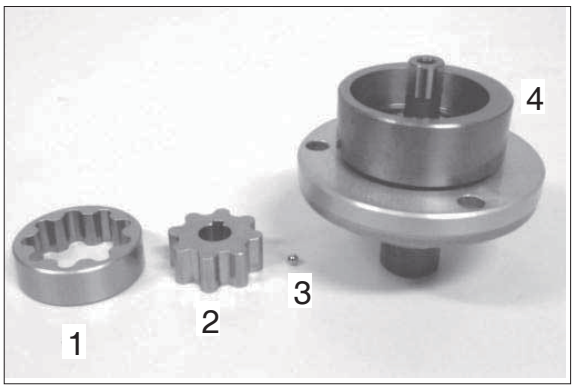
17) Then pull pump in vertical position out of housing – pay attention to possibly releasing balls and compression springs (see 14WF8TM289 and 14WF8TM290).



14WF8TM288

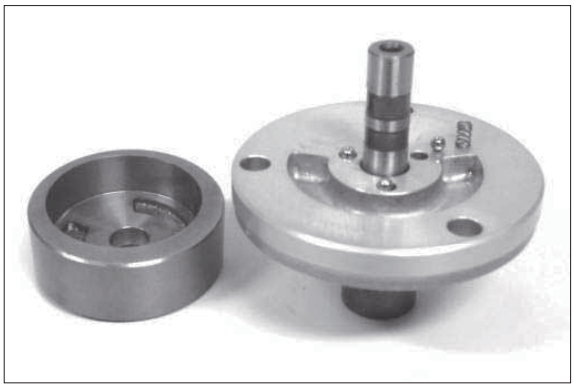
18) Remove outer (1) and inner rotor (2) and take releasing ball [(3) driver] out of control housing (4).

※ Outer, inner rotor and control housing = rotor set



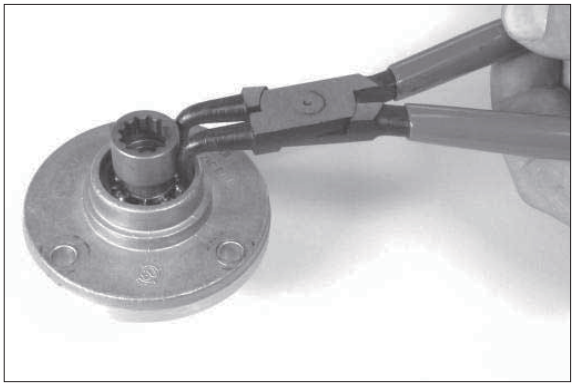
14WF8TM289

19) Remove control housing and releasing balls and compression springs (3 pcs. each).



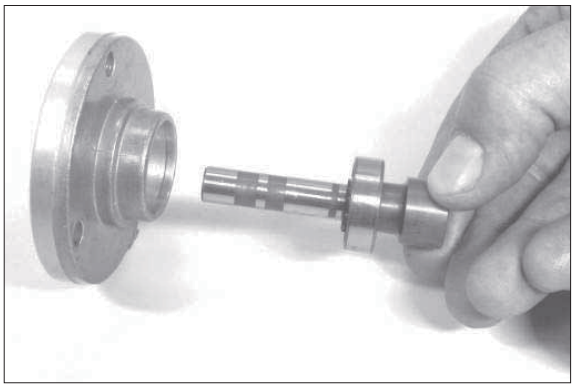
14WF8TM290

20) Unsnap retaining ring.



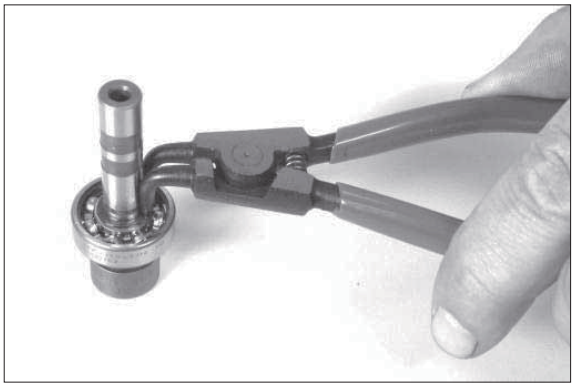
14WF8TM291

21) Pull cpl. pump shaft out of pump cover.



14WF8TM292

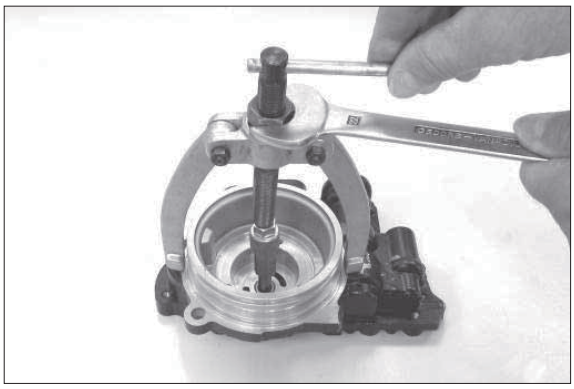
22) Unsnap retaining ring and press ball bearing from shaft.



14WF8TM293

23) Pull needle sleeve out of housing hole.

(S) Inner extractor 5870 300 012
(S) Counter support 5870 300 011

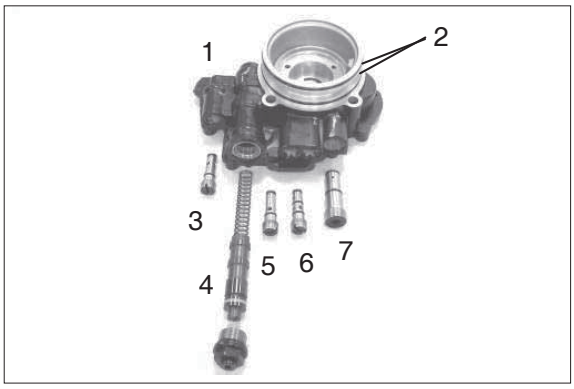


14WF8TM294

24) Remove O-rings and all single parts, remove valves.

1 = Housing
2 = O-rings
3 = Check valve (010)
4 = Shift piston
5 = Check valve (009)
6 = Check valve (008)
7 = Pressure relief valve

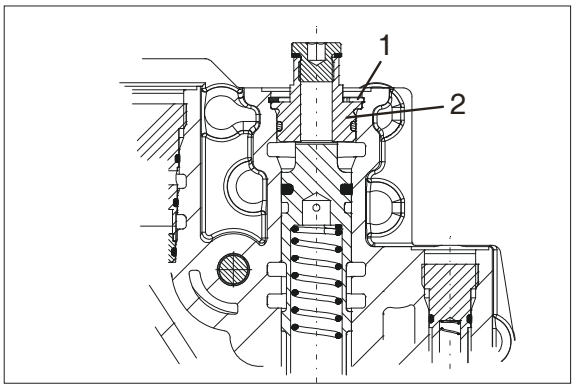
Position 4 (shift piston) shows version with screw plug.



14WF8TM295

25) In sketch 14WF8TM296 version II is shown with plug (2) and retaining ring (1).

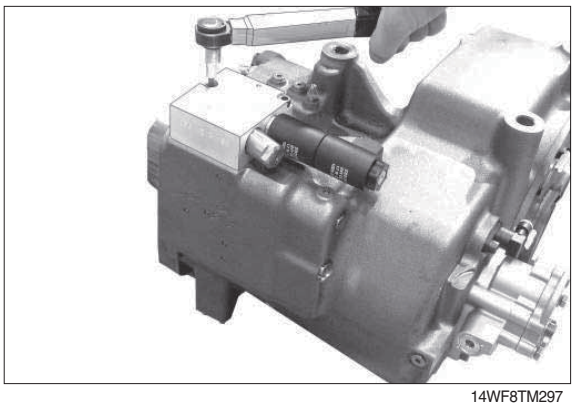
⚠ **When disengaging retaining ring – Pay attention to spring preload. Protect against movement.**



14WF8TM296

Disassemble valve block

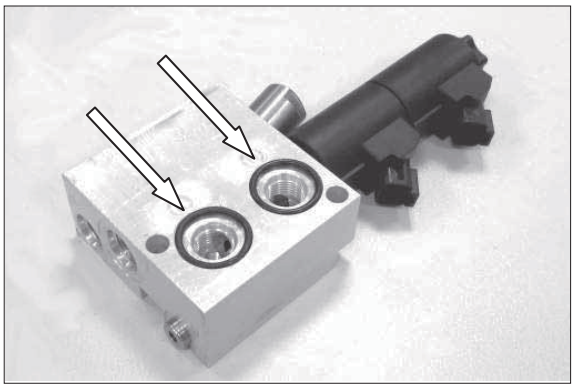
26) Loosen fixing screws and remove cpl. valve block.



14WF8TM297

27) Remove both O-rings (see arrows).

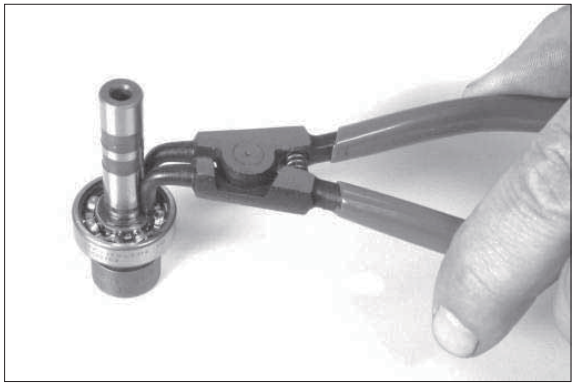
※ Do not further disassemble. Valve block may only be replaced as component.



14WF8TM298

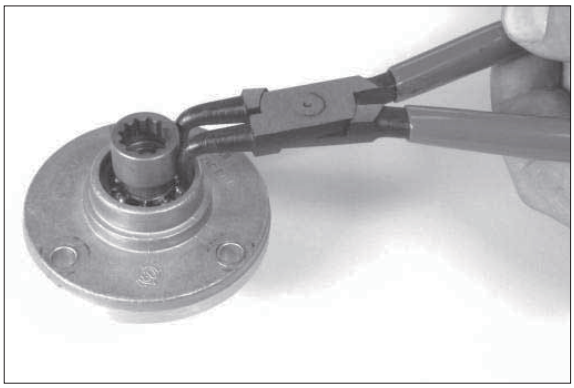
11. REASSEMBLY LUBRICATION PUMP

1) Mount ball bearing onto pump shaft and fix it by engaging retaining ring into annular groove of pump shaft.



14WF8TM299

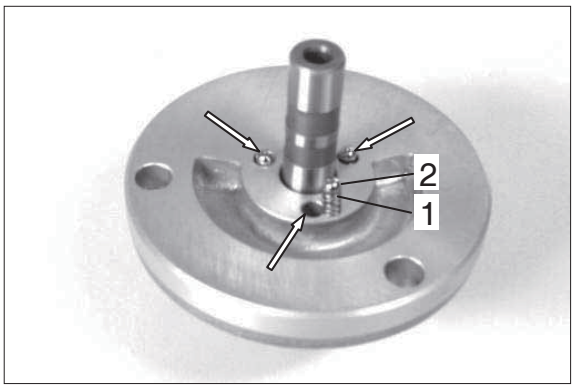
2) Press preassembled pump shaft into pump cover and fix it by engaging retaining ring into annular groove of pump cover.



14WF8TM300

3) Insert compression springs (1) and ball (2) into holes (see arrows - 3x).

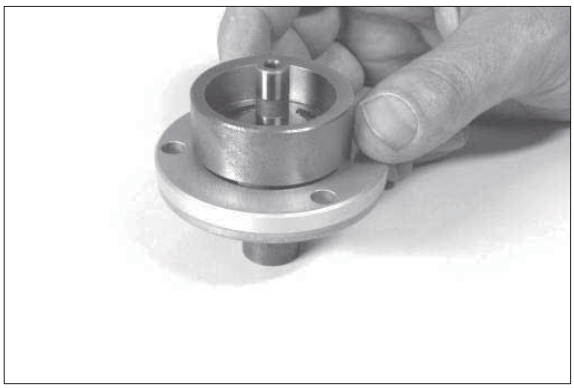
※ Keep preassembled single parts in vertical position–pay attention to position of inserted balls and compression springs (see work steps 14WF8TM301~14WF8TM307).



14WF8TM301

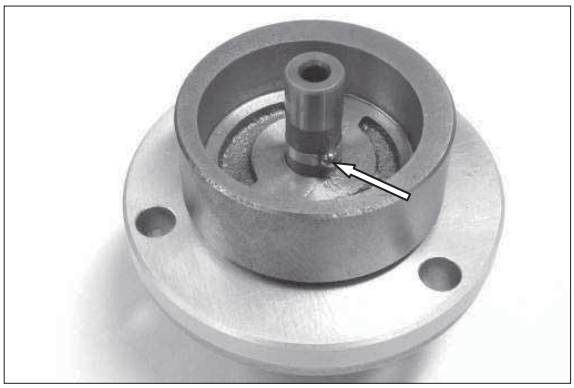
4) Mount control housing.

※ Control housing, inner and outer rotor = rotor set



14WF8TM302

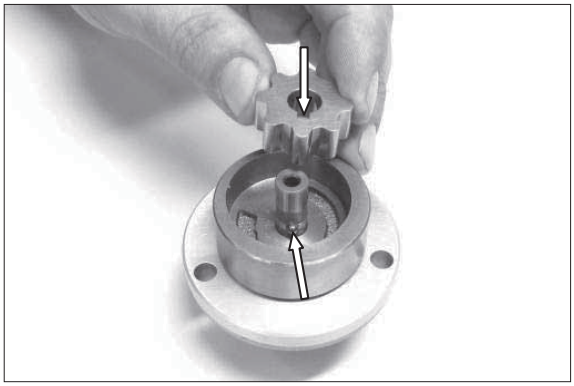
5) Position ball – (see arrow, engagement for inner rotor) with grease into countersink of pump shaft.



14WF8TM303

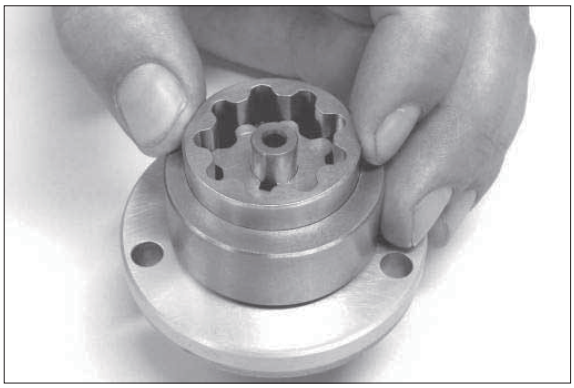
6) Mount inner rotor.

※ Place groove of inner rotor over ball (see arrows).



14WF8TM304

7) Mount outer rotor



14WF8TM305

8) Insert needle sleeve to installation dimension X into housing.

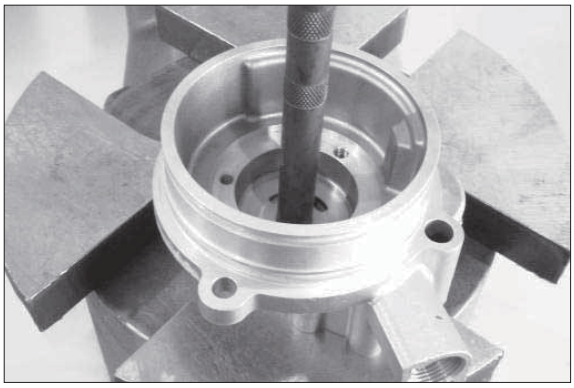
X = 0.2~0.7 mm below plane face / housing

(S) Driver tool 5870 705 003

※ Use of specified driver tool ensures exact installation position.

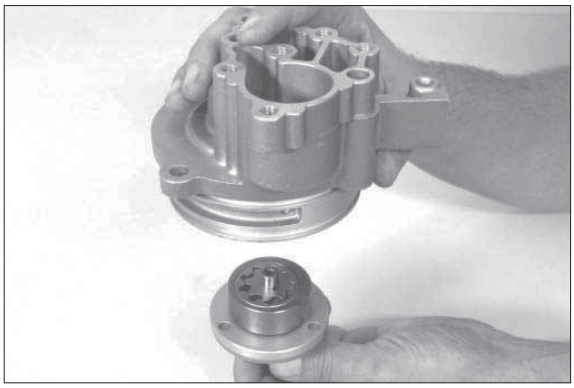
※ Insert needle sleeve with marked front face showing upwards.

※ Check opening of orifice / oil hole in housing bottom.



14WF8TM306

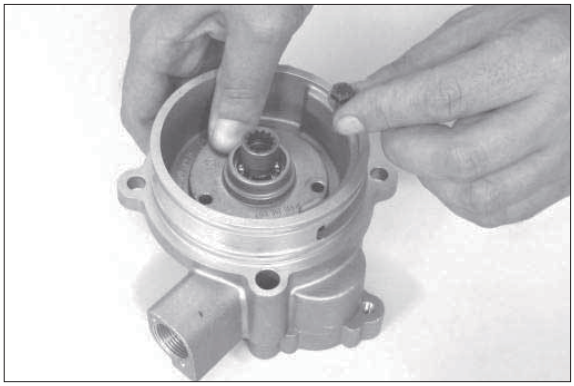
9) Maintain pump in vertical position while inserting housing with mounted needle sleeve onto preassembled pump.



14WF8TM307

10) Rotate housing by 180˚ and fix pump with hexagon screws.

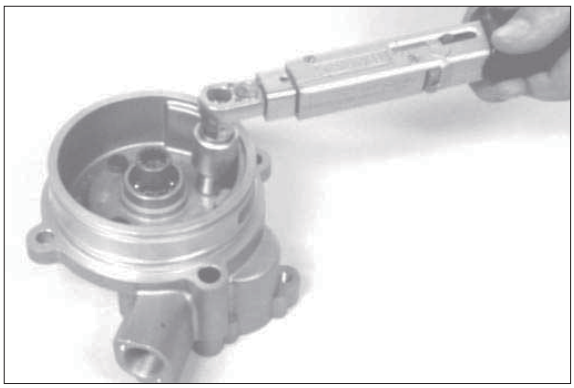
※ Maintain contact position of inserted pump.



14WF8TM308

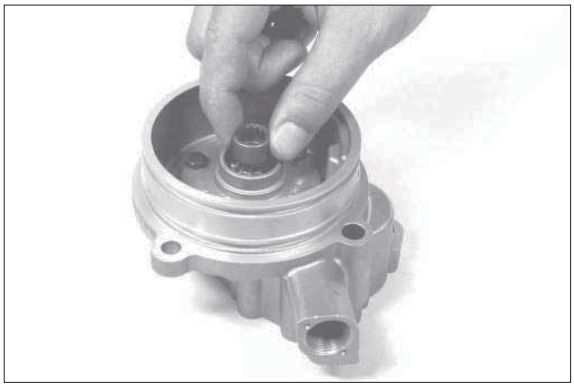
11) Fix pump.

Tightening torque (M6/8.8) M_A = 9.5 Nm



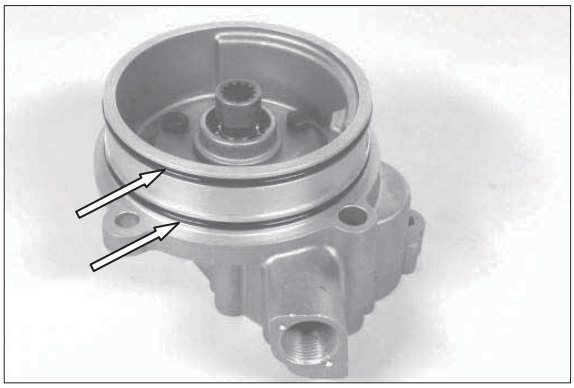
14WF8TM309

12) With counter-turning motions on pump shaft, swiveling of control housing (stop LH/RH in pump cover) is audible.



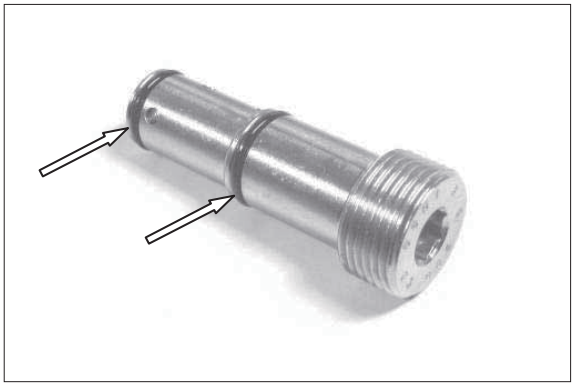
14WF8TM310

13) Oil both O-rings (arrows) and put them into annular groove of housing.



14WF8TM311

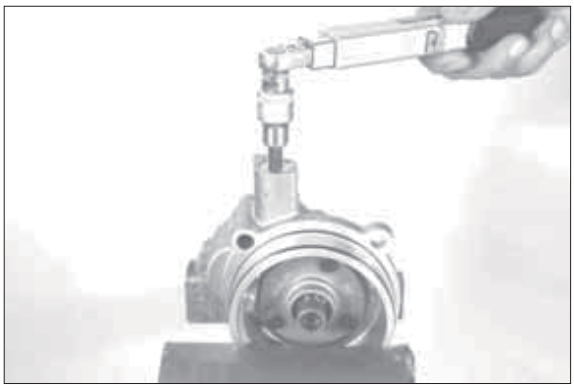
14) Insert O-rings (see arrows) into annular grooves of pressure relief valve.



14WF8TM312

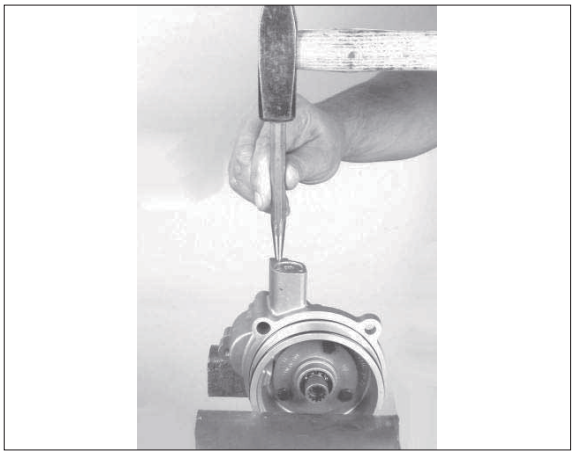
15) Mount pressure relief valve.

Tightening torque M_A = 10 Nm



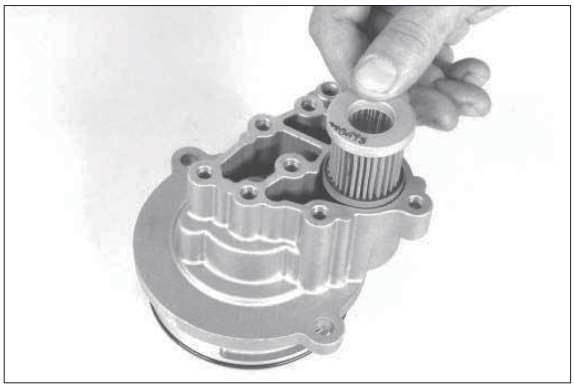
14WF8TM313

16) Secure pressure relief valve by center punch marks (2x).



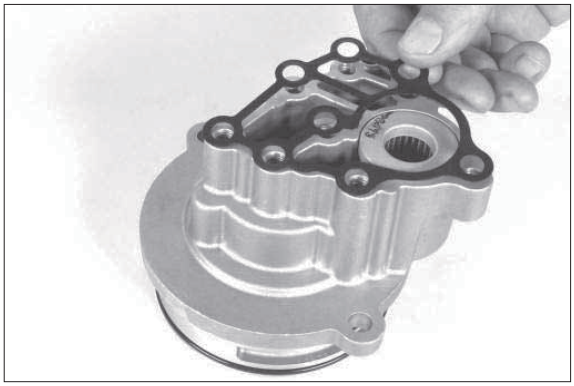
14WF8TM314

17) Insert filter.



14WF8TM315

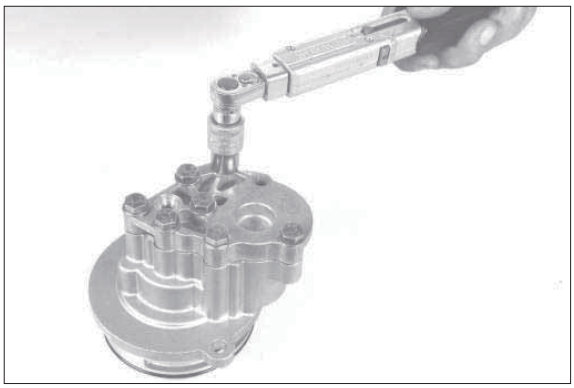
18) Place gasket.



14WF8TM316

19) Place cover and fix it with hexagon screws and disks.

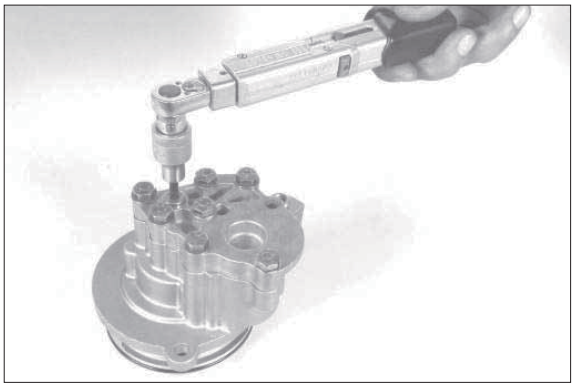
Tightening torque (M8/8.8) M_A = 23 Nm



14WF8TM317

20) Insert screw plug with new O-ring.

Tightening torque (M10 × 1) M_A = 15 Nm

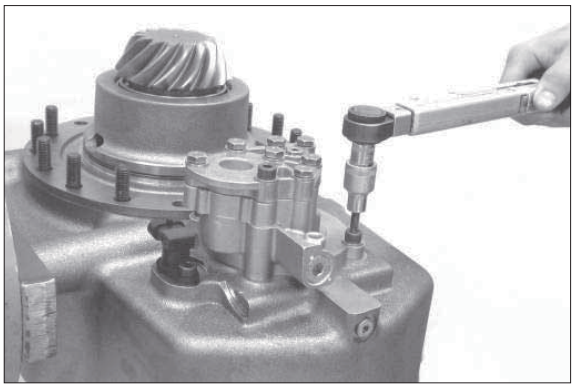


14WF8TM318

21) Mount cpl. lubrication pump and fasten it with cylindrical screws and disks.

Tightening torque (M8/10.9) M_A = 23 Nm

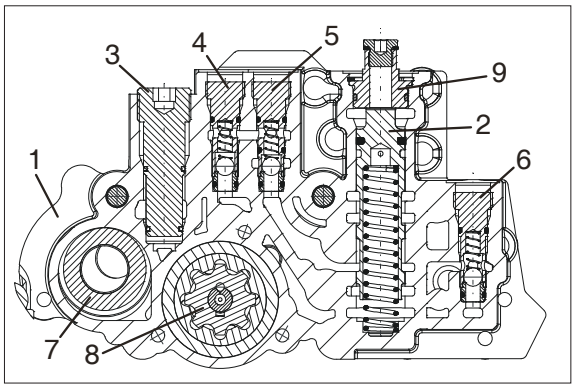
※ Prior to putting the unit into operation, observe the specifications and regulations.



14WF8TM319

12. REASSEMBLY SHIFT INTERLOCK

1) 1 = Housing
   2 = Shift piston
   3 = Pressure relief valve
   4 = Check valve (008)
   5 = Check valve (009)
   6 = Check valve (010)
   7 = Filter
   8 = Lubrication pump
   9 = Plug

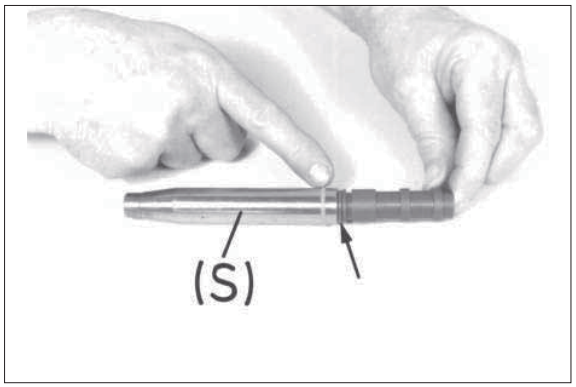


14WF8TM320

2) Put O-ring (see arrow) into annular groove of piston.
   Lead plastic ring by means of inner installer (S) over piston and position it at O-ring.

   (S) Inner installer 5870 651 055

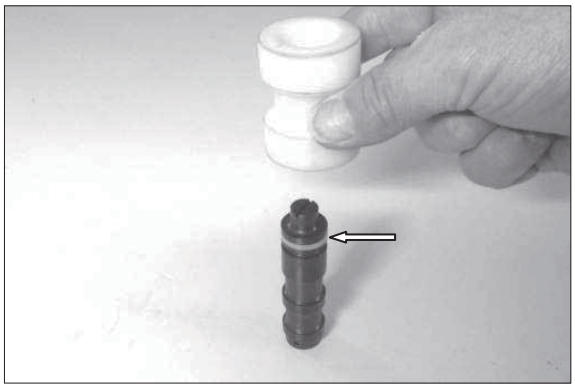
※ Seal consists of plastic ring and O-ring (see 14WF8TM321~14WF8TM322).



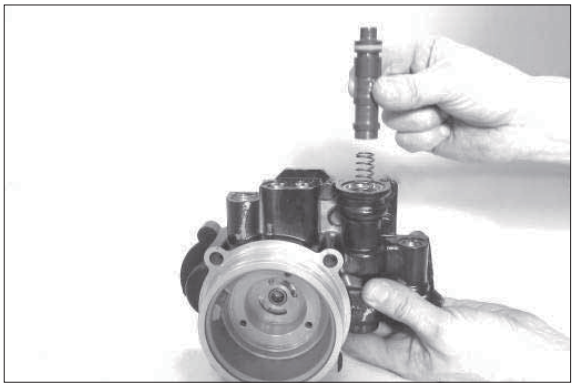
14WF8TM321

3) Center plastic ring (see arrow) with calibrating mandrel.

   (S) Calibrating mandrel 5870 651 056


14WF8TM322

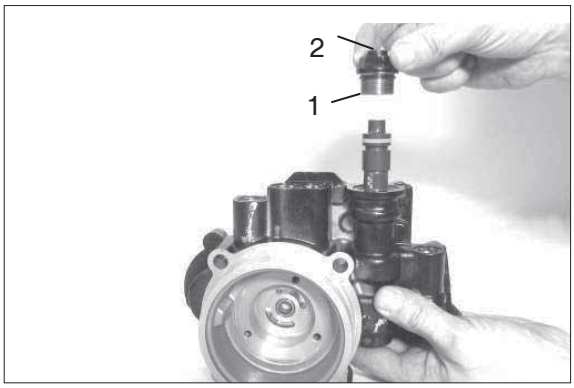
4) Insert compression spring, oil preassembled piston and install.


14WF8TM323

Version I :

5) Fix piston with screw plug (1- with O-ring). Install screw plug (2 – with seal ring).

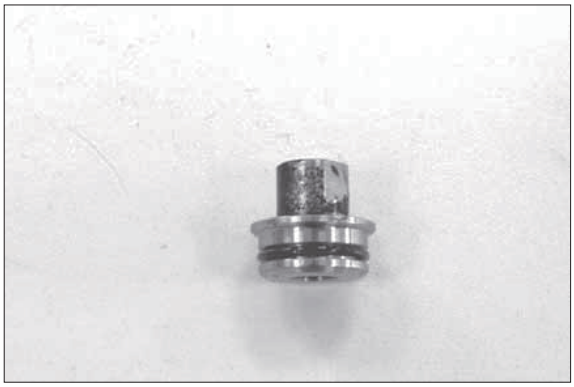
Screw plug (M24 × 1.5) M_A = 50 Nm
Screw plug (M10 × 1) M_A = 15 Nm



14WF8TM324

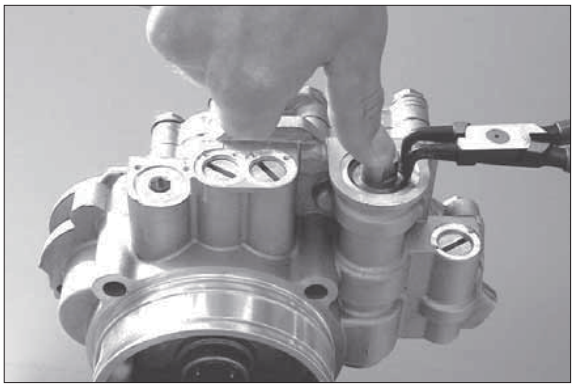
Version II (14WF8TM325 ~ 14WF8TM327) :

6) Oil O-ring and insert it into annular groove of plug.


14WF8TM325

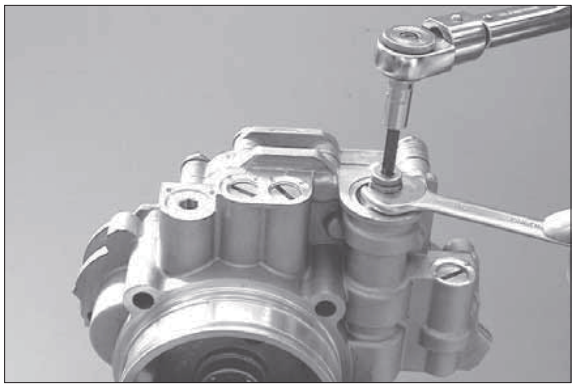
7) Fix plug by engaging retaining ring into annular groove of housing.

※ Pay attention to spring preload – protect against movement.


14WF8TM326

8) Mount screw plug with seal.

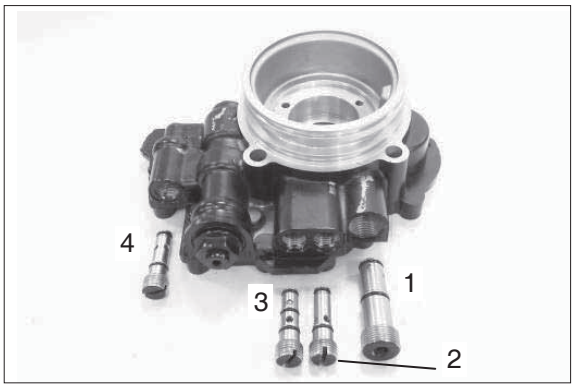
Tightening torque (M10 × 1) M_A = 15 Nm


14WF8TM327

9) Install single parts according to adjacent illustration.

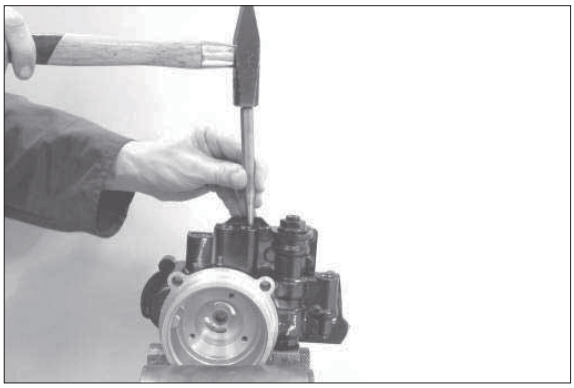
1 = Pressure relief valve cpl. M_A = 10 Nm
2 = Check valve cpl. M_A = 10 Nm
3 = Check valve cpl. M_A = 10 Nm
4 = Check valve cpl. M_A = 10 Nm

※ Observe installation position of the different check valves (see also 14WF8TM320).



14WF8TM328

10) Secure check valves and pressure relief valves with two center punch marks each.

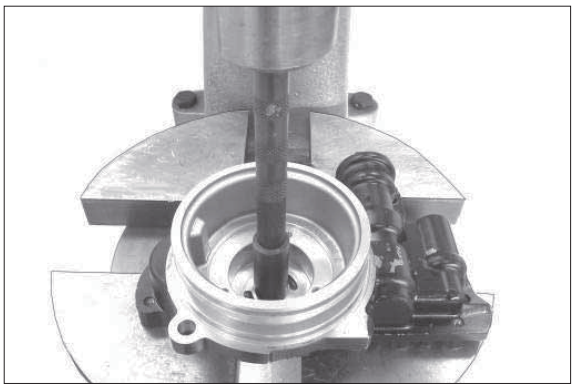

14WF8TM329

11) Insert needle sleeve to installation dimension X into housing.

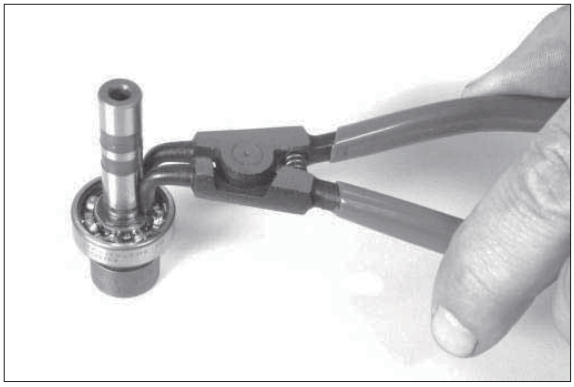
X = 0.2~0.7 mm below plane face/housing

(S) Driver tool 5870 705 003

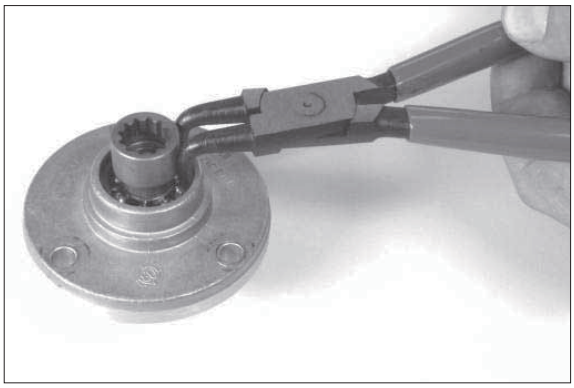
※ Use of specified driver ensures exact installation position.
※ Insert needle sleeve with marked front face showing upwards.
※ Check opening of orifice / oil hole in housing bottom.


14WF8TM330

12) Insert ball bearing onto pump shaft and fix it by engaging retaining ring into annular groove of pump shaft.


14WF8TM331

13) Press preassembled pump shaft into pump cover and fix it by engaging retaining ring into annular groove of pump cover.

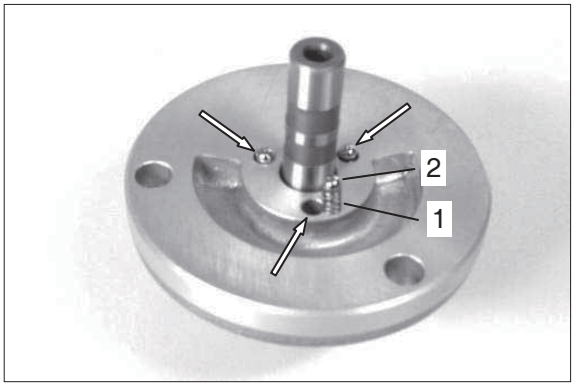


14WF8TM332

14) Insert compression springs (1) and ball (2) into holes (see arrows - 3x).

⚠ **Prior to installation, oil single parts of pump/ rotor set (control housing, inner and outer rotor) – use oil (lubrication)**

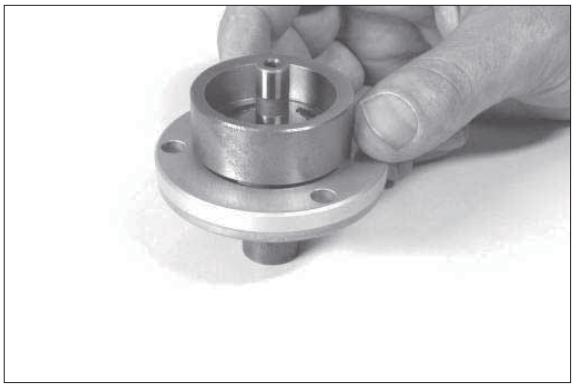
※ Keep preassembled single parts in vertical position – pay attention to position of inserted balls and compression springs (see work steps 14WF8TM333 ~14WF8TM338).



14WF8TM333

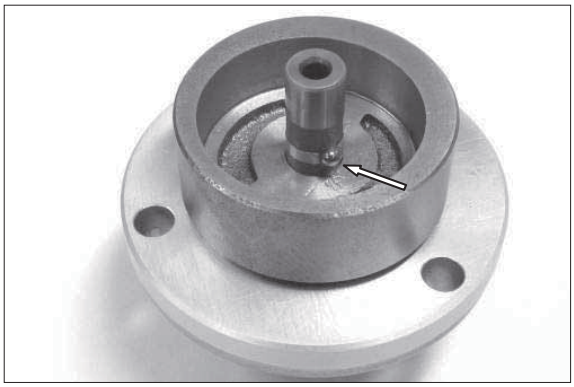
15) Mount control housing.

※ Control housing, inner and outer rotor = rotor set



14WF8TM334

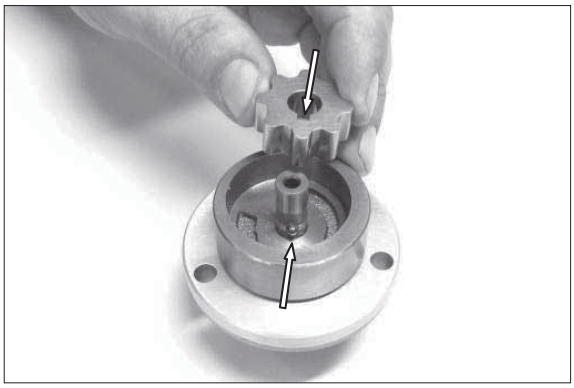
16) Position ball – (see arrow –engagement for inner rotor) with grease into countersink of pump shaft



14WF8TM335

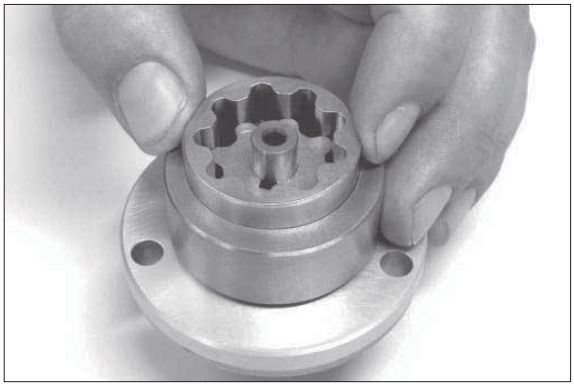
17) Mount inner rotor.

※ Place groove of inner rotor over ball (see arrows).



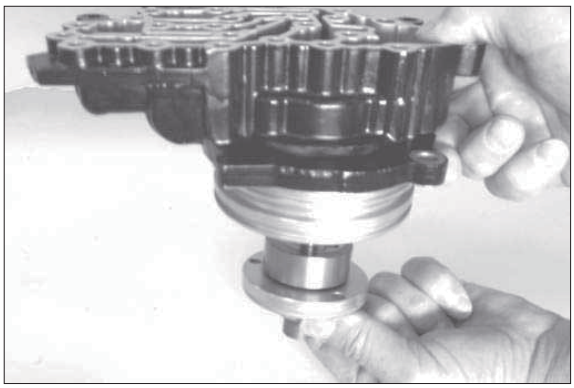
14WF8TM336

18) Mount outer rotor.



14WF8TM337

19) Maintain pump in vertical position while inserting housing with mounted needle sleeve onto preassembled pump.

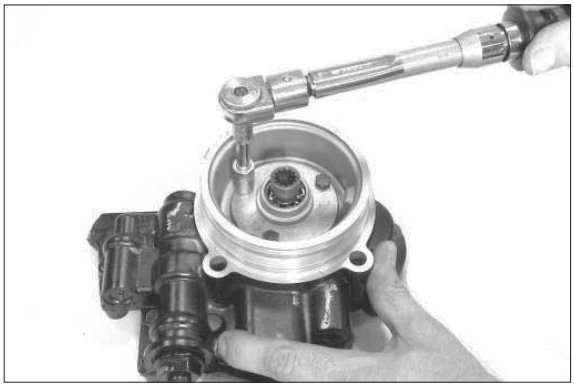


14WF8TM338

20) Rotate housing by 180˚ and fix pump with hexagon screws.

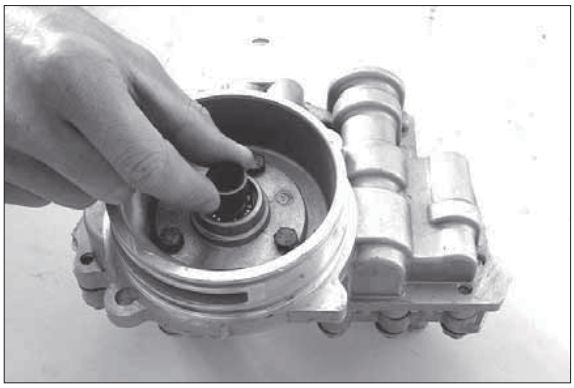
Tightening torque (M6/8.8) M_A = 9.5 Nm

※ Maintain contact position of inserted pump.



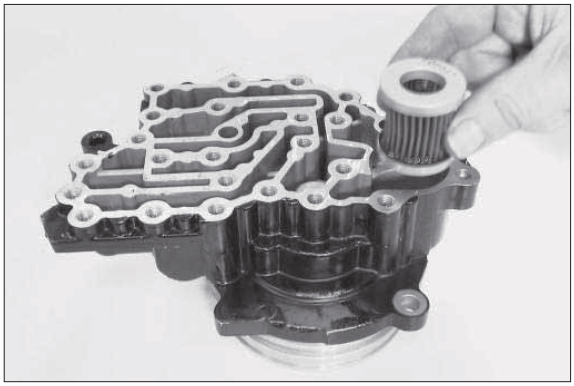
14WF8TM339

21) With counter-turning motions on pump shaft, swiveling of control housing (stop LH/ RH in pump cover) is audible.



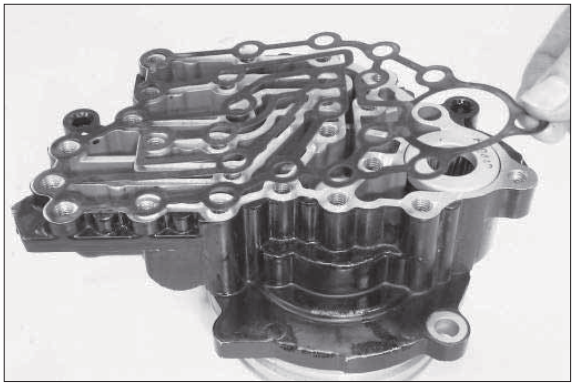
14WF8TM340

22) Insert screen filter.



14WF8TM341

23) Place gasket.

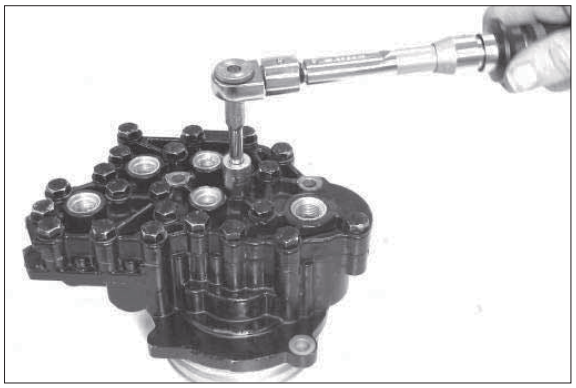


14WF8TM342

24) Place cover and fix with hexagon screws and disks.

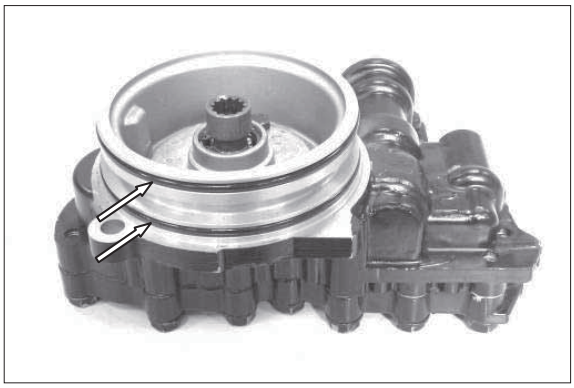
Tightening torque (M8/8.8) M_A = 23 Nm

※ Pay attention to different screw length.



14WF8TM343

25) Oil both O-rings (arrows) and put them into annular groove of housing.

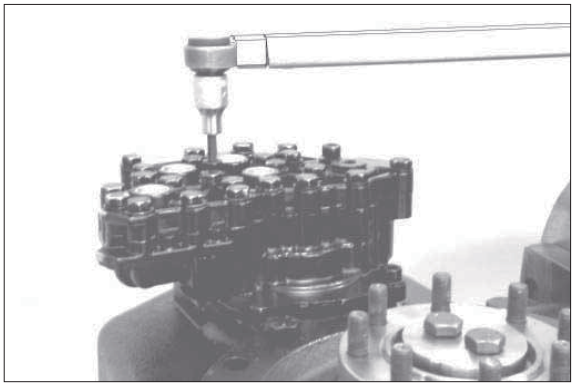


14WF8TM344

26) Insert cpl. shift interlock and fix with cylindrical screws with disks.

Tightening torque (M8/10.9) M_A = 23 Nm

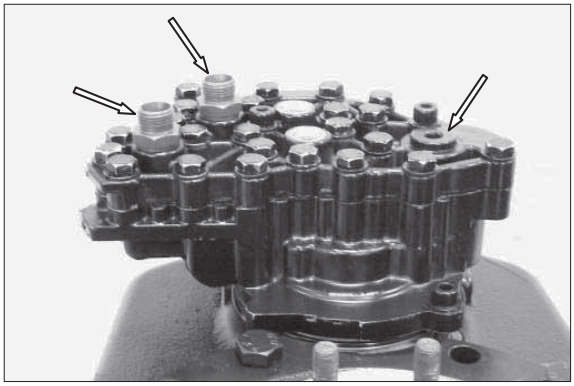
※ Pay attention to different screw length.



14WF8TM345

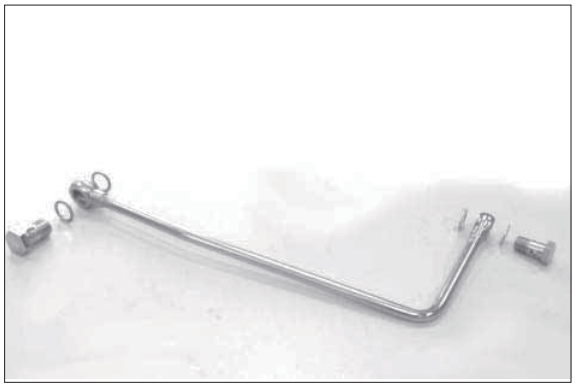
27) Install both screw-in sleeves and screw plug (see arrow) with O-rings.

Screw-in sleeve (M 16×1.5) M_A = 30 Nm
Screw plug (M 18×1.5) M_A = 35 Nm



14WF8TM346

28) 1 = Oil tube
2 = Hollow screw (M16×1.5)
3 = Seal ring
4 = Hollow screw (M14×1.5)
5 = Seal ring

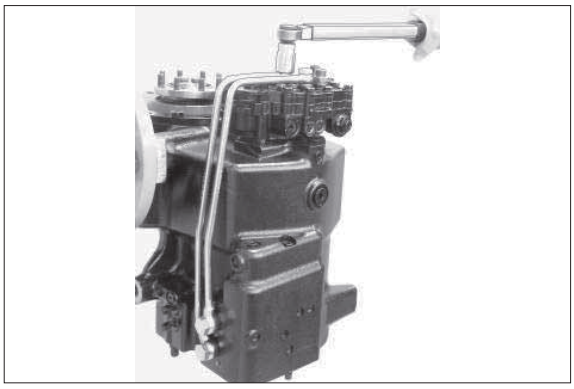


14WF8TM347

29) Mount oil tubes.

Hollow screw (M14×1.5) M_A = 40 Nm
Hollow screw (M16×1.5) M_A = 40 Nm

※ Prior to putting the unit into operation, observe the specifications and regulations.

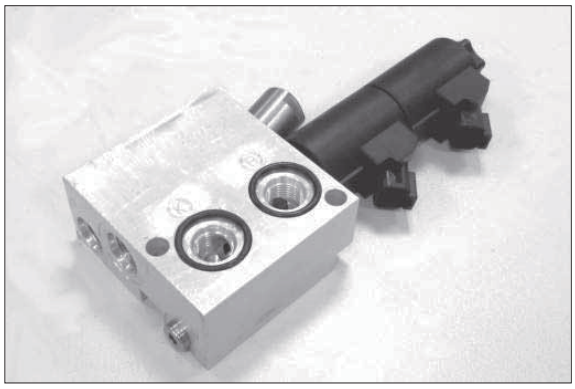


14WF8TM3428

13. VALVE BLOCK (shifting low gear – high gear)

1) Insert O-rings (see arrows) into countersinks of valve block.

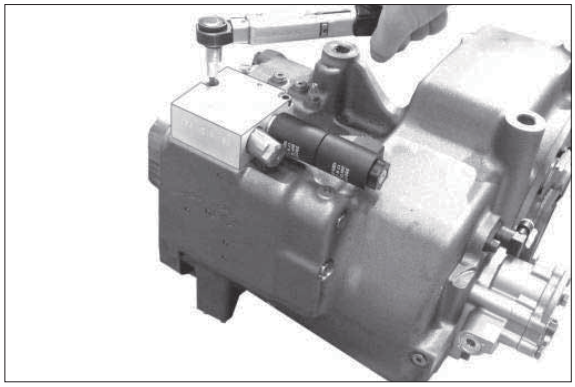
※ Use grease as assembly aid.



14WF8TM349

2) Fix cpl. valve block with cylindrical screws.

Tightening torque (M8/10.9) M_A = 23 Nm

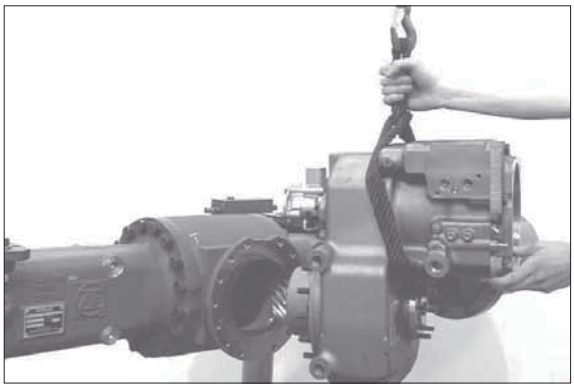


14WF8TM350

14. Mount TRANSMISSION to AXLE (only for version axle attachment)

1) Position complete transmission to axle.

(S) Lifting strap 5870 281 026

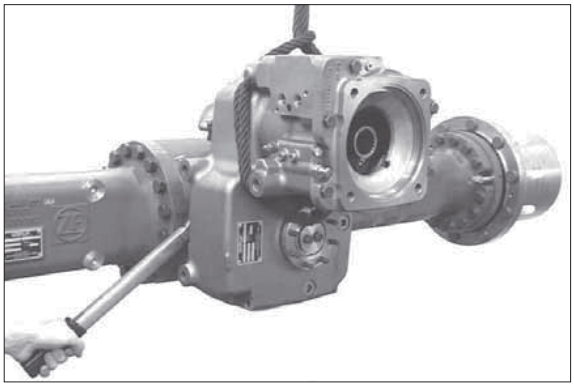


14WF8TM351

2) Fix transmission to axle with hexagon screws and nuts.

Tightening torque (M12/8.8) M_A = 79 Nm

※ Prior to putting the unit into operation, observe the specifications and regulations.



14WF8TM352

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.

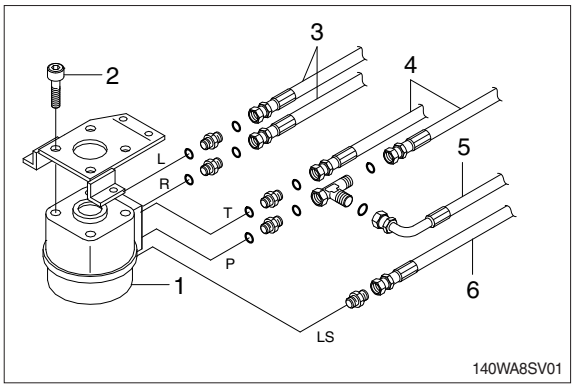
(3) Loosen the breather slowly to release the pressure inside the hydraulic tank.

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

(4) Disconnect steering line hoses (3, 4, 5, 6).

(5) Loosen the socket bolt (2) and remove the steering valve assembly (1).

· Tightening torque : 8.3± 1.7 kgf · m
(60.0± 12.3 lbf · ft)



2) INSTALL

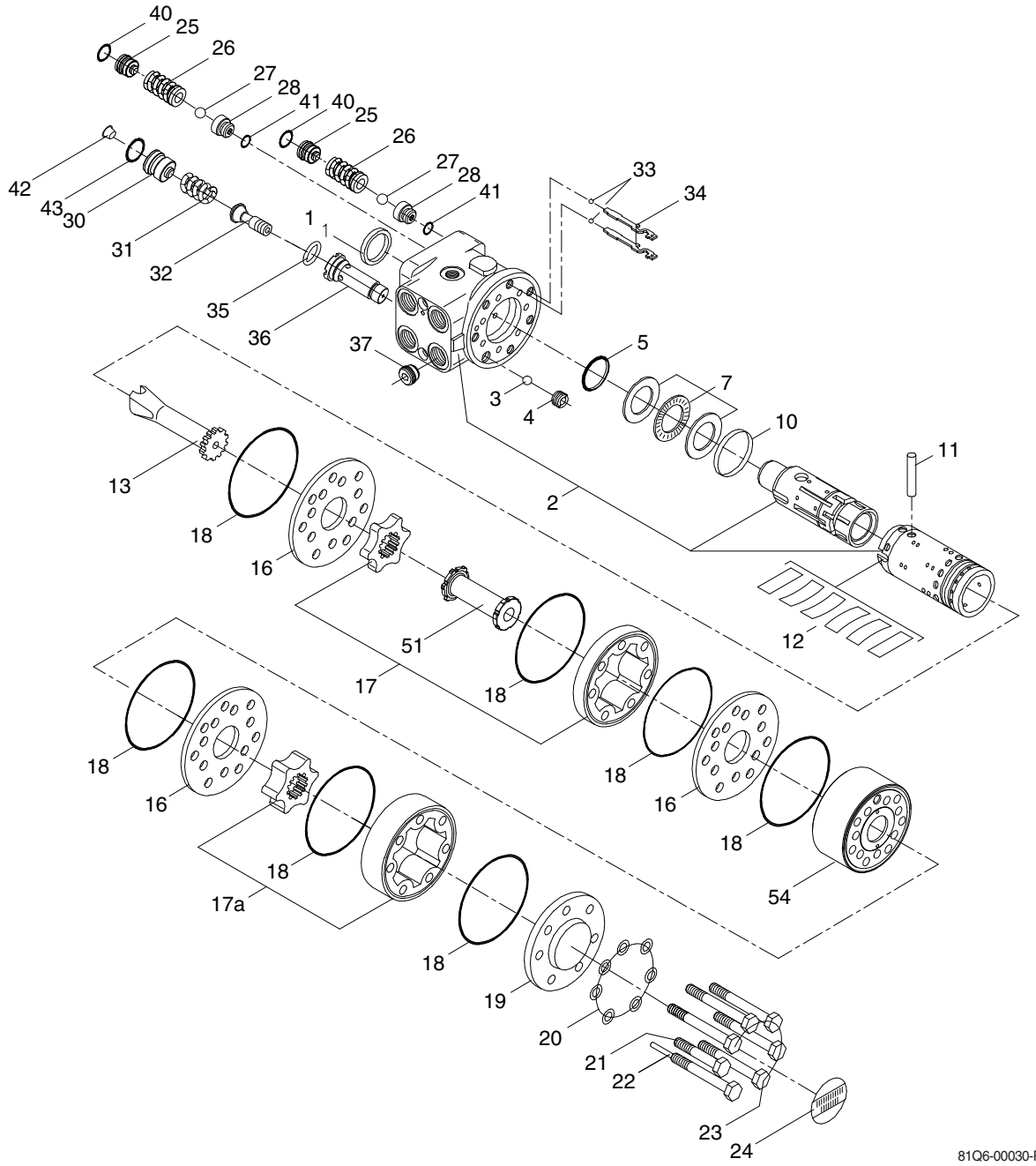
(1) Carry out installation in the reverse order to removal.

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

※ When removing the steering valve assembly, check that all the hoses have been disconnected.

2. STEERING VALVE

1) STRUCTURE

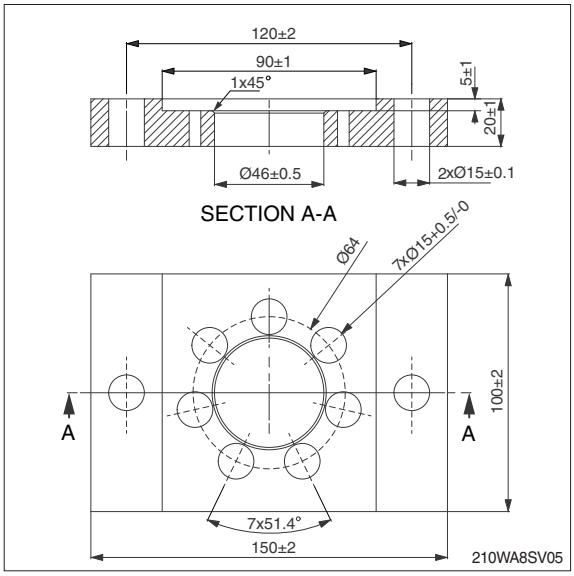


1	Dust seal ring	18	O-ring	33	Ball
2	Housing, spool, sleeve	19	End cover	34	Bushing
3	Ball	20	Washer	35	Ball stop
4	Threaded bushing	22	Pin bushing	36	Ball
5	Shaft seal	23	Screw	37	Check valve
7	Bearing assy	24	Model/code label	40	O-ring
10	Ring	25	Adjusting screw	41	O-ring
11	Cross pin	26	Spring	42	Plug
12	Spring set	27	Ball	43	O-ring
13	Cardan shaft	28	Seat	51	Cardan shaft
16	Distributor plate	30	Adjusting screw	54	Valve and housing
17	Gear wheel set	31	Spring	56	Spacer
17a	Gear wheel set	32	piston		

2) TOOLS

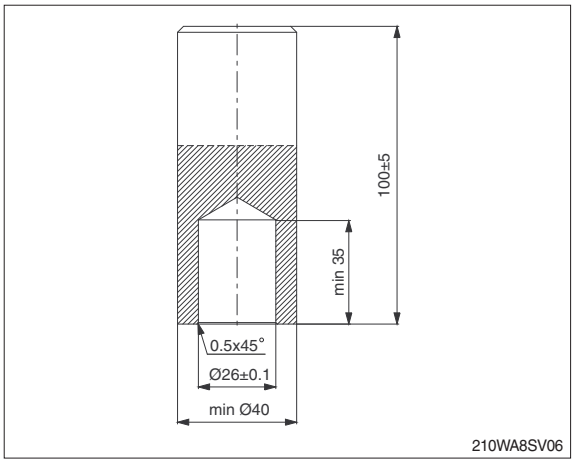
(1) Holding tool for the entire steering unit.

※ Appropriate metal or hard plastic.

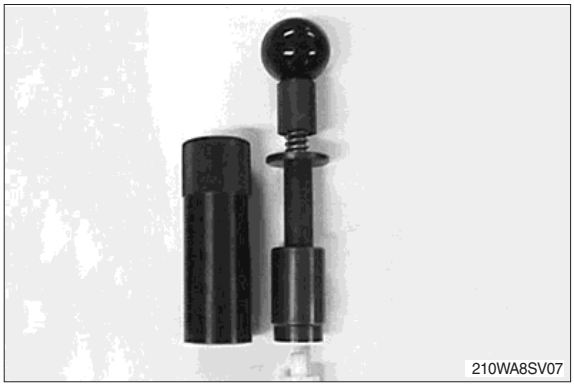


(2) Assembly tool for dust seal.

※ Material : Free cutting steel.



(3) Assembly tool for shaft seal, O-ring.



(4) Common tool

Torque wrench : 0~7.1 kgf · m
(0~54.4 lbf · ft)

13 mm socket spanner.

2.75, 5 and 6 mm hex sockets.

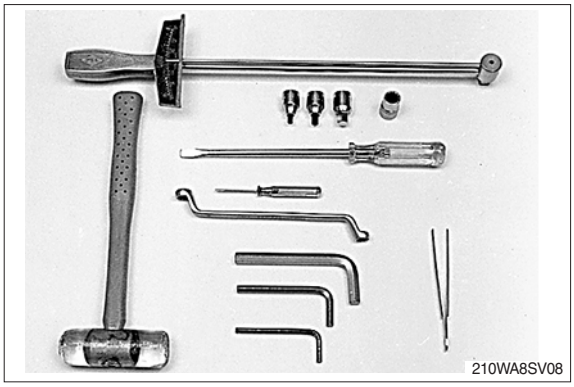
12 mm screwdriver.

2 mm screwdriver.

13 mm ring spanner.

Plastic hammer.

Tweezers.

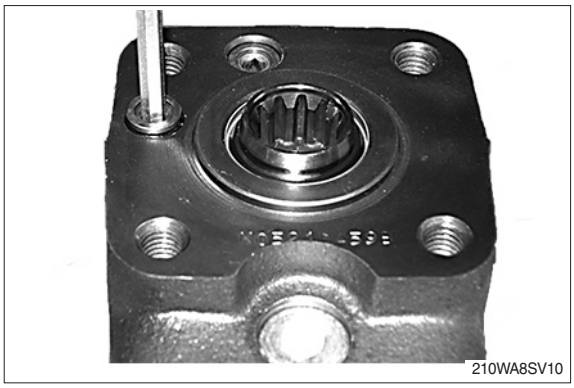


3) TIGHTENING TORQUE

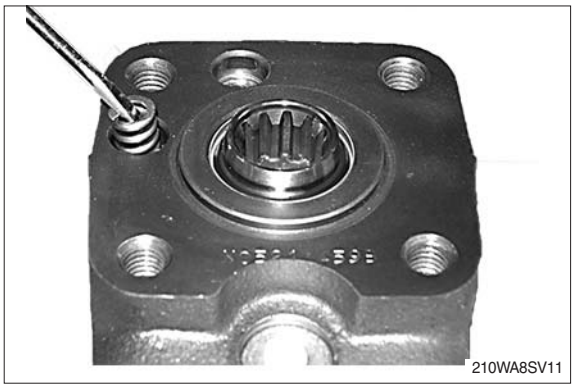
Screwed connection	Max. tightening torque kgf · m (lbf · ft)			
	With cutting edge	With copper washer	With aluminum washer	O-ring
PF 1/4	3.6 (25.8)	3.6 (25.8)	3.6 (25.8)	-
PF 3/8	7.1 (51.6)	4.6 (33.2)	5.1 (36.9)	-
PF 1/2	10.2 (73.6)	5.6 (40.6)	8.2 (59.0)	-
PF 3/4	18.4 (133)	9.2 (66.4)	13.3 (95.9)	-
7/16-20 UNF	-	-	-	2.0 (14.8)
3/4-16 UNF	-	-	-	6.1 (44.3)
7/8-14 UNF	-	-	-	9.2 (66.4)
11/16-12 UNF	-	-	-	12.2 (88.5)
M12×1.5	3.1 (22.1)	2.0 (14.8)	3.1 (22.1)	2.5 (18.4)
M18×1.5	8.2 (59.0)	5.6 (40.6)	7.1 (51.6)	5.1 (36.9)
M22×1.5	10.2 (73.6)	6.6 (47.9)	8.2 (59.0)	6.1 (44.3)
9/16-18 UNF, ORFS	-	-	-	2.5 (18.4)
11/16-16 UN, ORFS	-	-	-	2.8 (19.9)

4) DISASSEMBLY

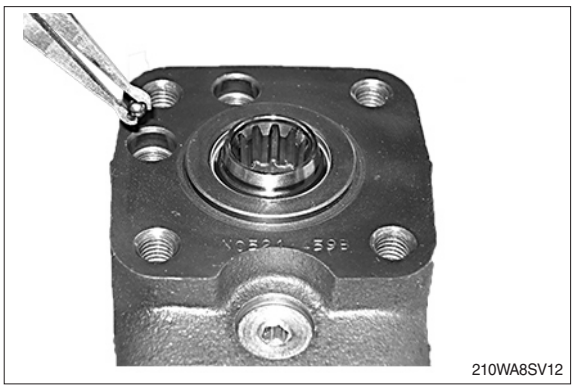
(1) Place the unit in the holding tool on gear set end.
Screw out the adjusting screws for shock valves (25).
O-ring (40) is fitted on adjusting screw (25).


210WA8SV10

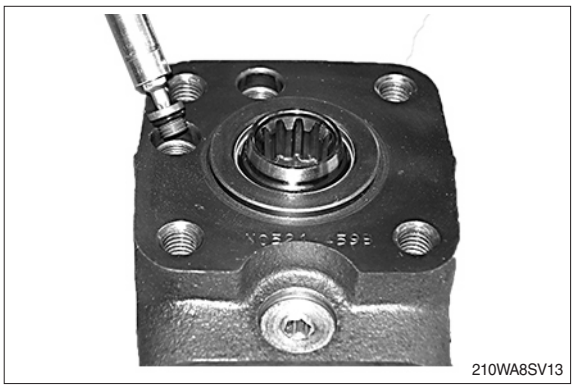
(2) Remove the springs with trust pads for shock valves (26).


210WA8SV11

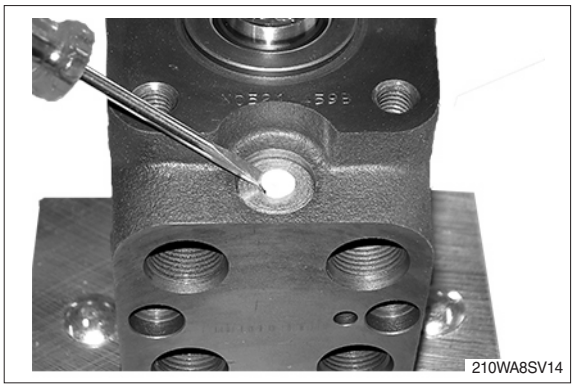
(3) Remove the balls for shock valves (27).


210WA8SV12

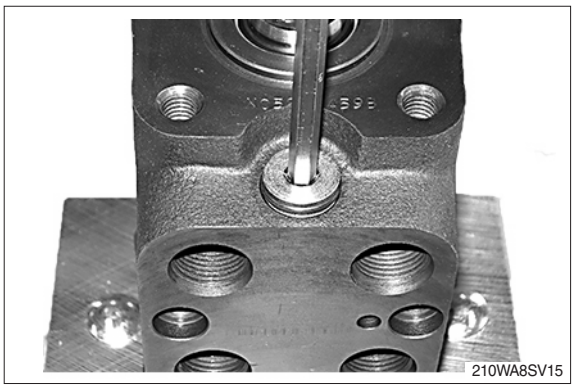
(4) Screw out the seats for shock valves (28).
O-ring (41) is fitted on seat (28).


210WA8SV13

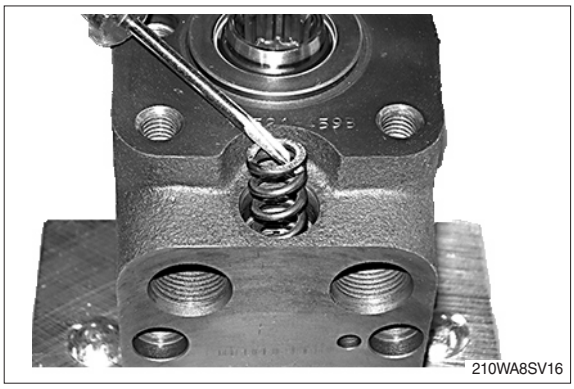
(5) Remove the plastic plug (42).



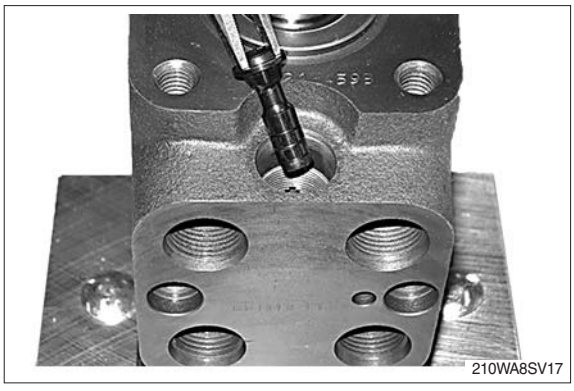
(6) Screw out the adjusting screw for relief valve (30).
O-ring (43) is fitted on adjusting screw (30).



(7) Remove the spring for relief valve (31).



(8) Remove the piston for relief valve (32).



(9) Replace the unit in the holding tool on steering column end.

① Remove the screws (21, 22 and 23) with washers (20).

② Some versions have pin bolt screw (22), threaded bushing (4) and 5 pieces standard screws (23) as shown page 8-178. Other versions (like this taken apart) has threaded bushing with ball stop (4) and 6 pieces standard screws (23).

③ All versions have one piece short standard screw (21).

④ Screw (21) is threaded in valve housing (54).


210WA8SV18

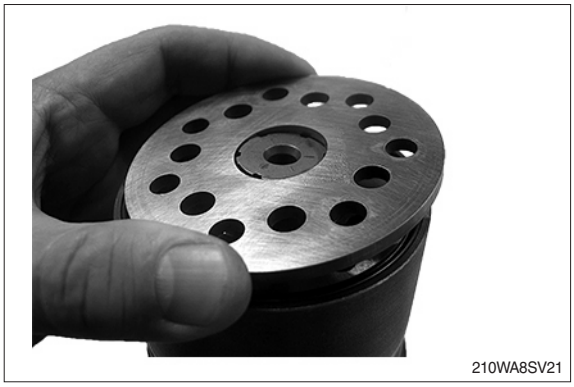
(10) Remove the end cover (19), sideways.


210WA8SV19

(11) Lift the gearwheel set (17a) off the unit. Remove the two O-rings (18).


210WA8SV20

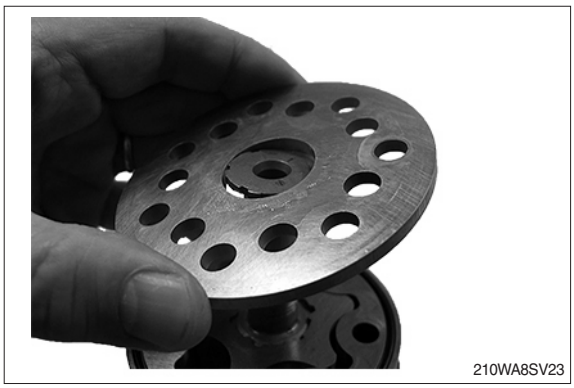
(12) Remove the rear distributor plate (16).


210WA8SV21

(13) Remove valve housing assembly (54).
Remove the two O-rings (18).
※ Do not disassemble the entire valve (54)


210WA8SV22

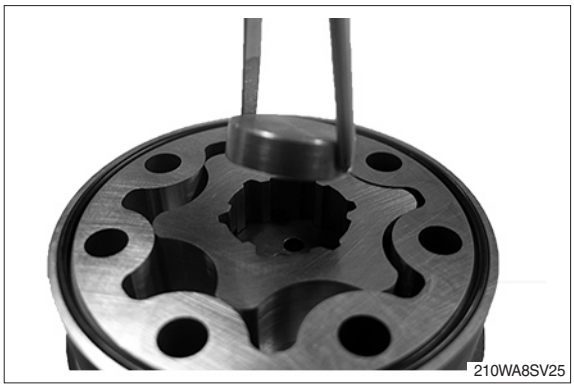
(14) Remove the middle distributor plate (16).


210WA8SV23

(15) Remove the cardan shaft (51).

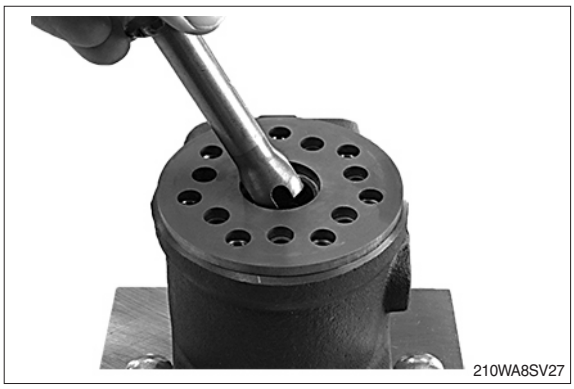

210WA8SV24

(16) Remove spacer (56) if present.
※ Spacer is only present in OSPD with GSW1 (17) equal to 100 cm^3/rev or larger/ height 13.0 mm or larger.

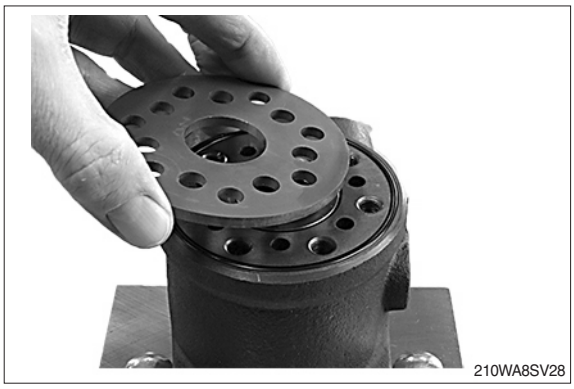

210WA8SV25

(17) Lift the gearwheel set (17) off the unit. Remove the two O-rings (18).

(18) Remove the cardan shaft (13).



(19) Remove the distributor plate (16) from the housing.



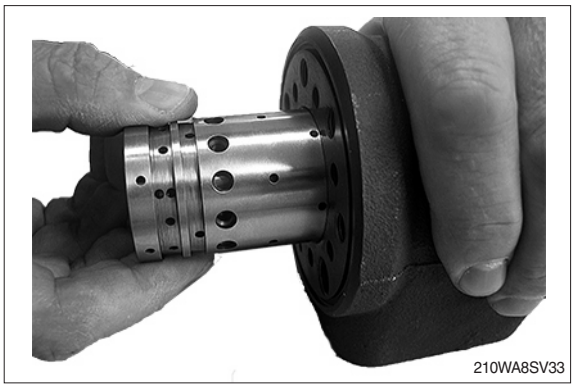
(20) Remove the threaded bushing/ball stop (4) from housing.

(21) Remove the ball stop (35) from housing.
Ball stop (35), and belonging ball (36) is only present in
OSPD LS with check valve in LS line.

(22) Remove the O-ring (18) from housing.

(23) Shake out the check valve ball (3), suction valve pins (34), balls (33) and ball (36).

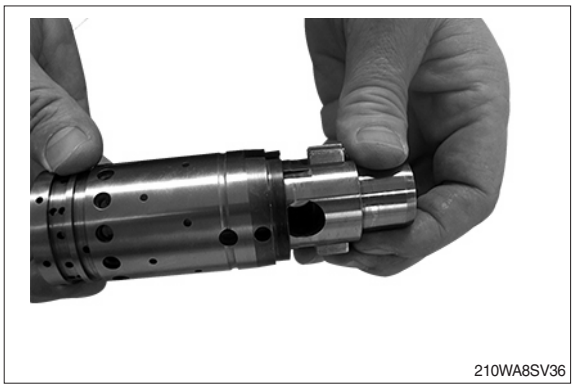
(24) Place the housing with the ports facing down on the work bench. Ensure that the cross pin (11) in the spool and sleeve set (2) is in the horizontal position.
The pin (11) can be observed through the open end of the spool.
Press the spool (2) inwards (from the housing mounting face end) and the sleeve (2), ring (7) and bearing assembly (6) will be pushed out of the housing together.



(25) Take the ring (10), bearing races and needle bearing (7) from the spool and sleeve set (2).
The outer bearing (7) race can sometimes “stick” in the housing, therefore check that it has come out.

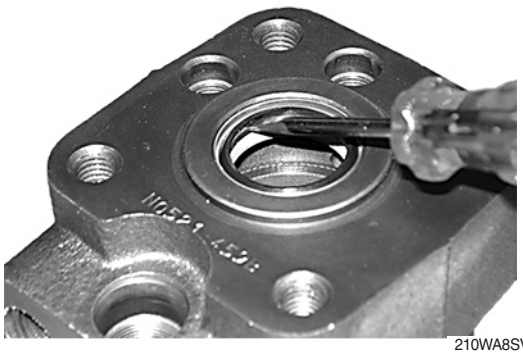
(26) Press out the cross pin (11).

(27) Carefully press the spool out of the sleeve.

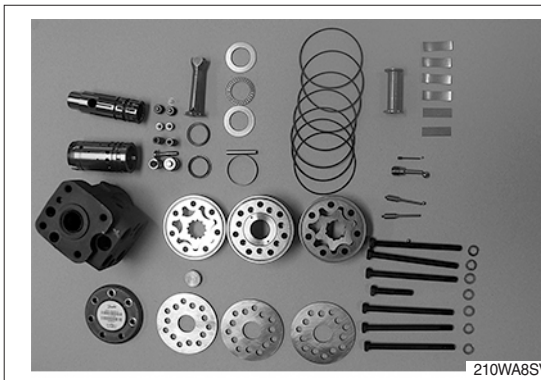


(28) Press the neutral position springs (12) out of the slot of the spool.

(29) Remove dust seal (1) and shaft seal (Roto Glyd) (5) carefully with a screw driver or similar tool.


210WA8SV38

(30) The steering unit OSPD is now completely dismantled


210WA8SV39

※ **Cleaning**

Clean all parts carefully in Shellsol K or similar cleaner fluid.

※ **Inspection and Replacement**

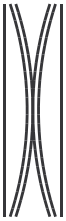
Replace all seals and washers. Check all parts carefully and make any replacements as is necessary.

5) ASSEMBLY

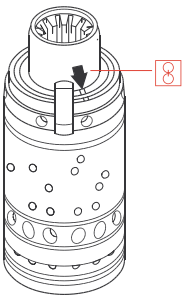
(1) Place the two flat neutral position springs in the slot.
Place the curved springs between the flat ones and press them into place.


210WA8SV40

(2) Configuration of spring set (12).
There can be different numbers of curved springs depending on configuration of spring set. There can be 2, 4 or 6 curved springs.


210WA8SV41

(3) Spool and sleeve must be positioned correctly relatively to each other. Small marks are present on both spool and sleeve close to one of the slots for the spring set.



210WA8SV42

(4) Guide the spool into the sleeve (2).
If the spool and sleeve has marks as shown above, these must be placed on same side. Make sure the centering springs (12) are placed into the slot.


210WA8SV43

(5) Line up the spring set (12).

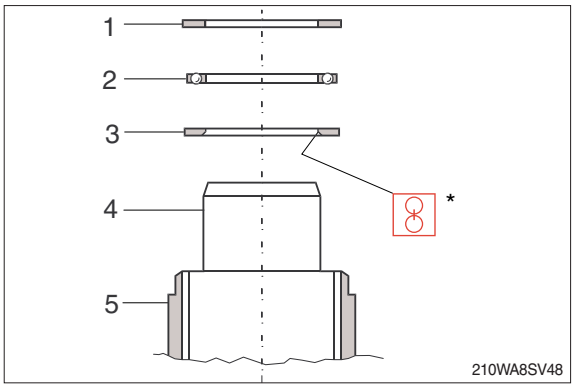
(6) Guide the ring (10) down over the sleeve. The ring should be able to move free of the springs.

(7) Fit the cross pin (11) into the spool/sleeve.

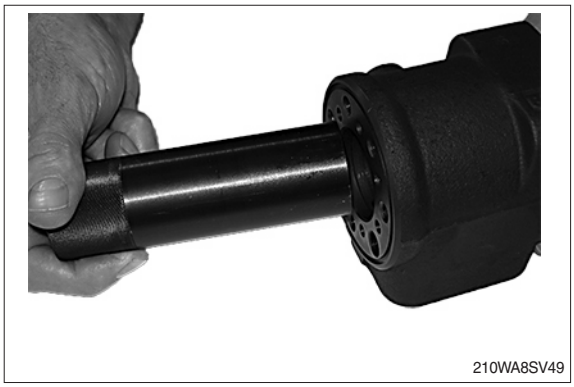
(8) Fit bearing races and needle bearing (7) as shown on the next drawing.

(9) Assembly pattern for standard bearing
1 Outer bearing race
2 Needle bearing
3 Inner bearing race
4 Spool
5 Sleeve

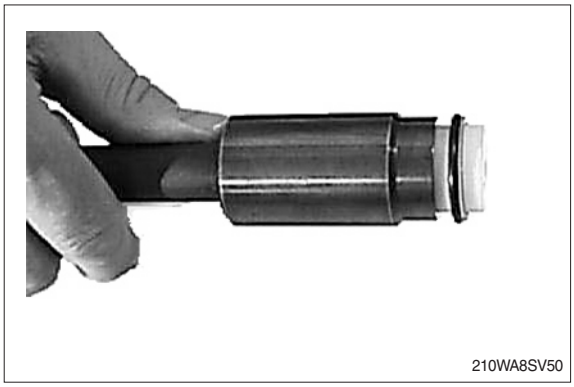
※ * The inside chamfer on the inner bearing race must face the chest of the inner spool.



(10) Place the steering unit housing with the port face down on the work bench. Guide the outer part of the assembly tool into the bore for the spool/sleeve set (2).

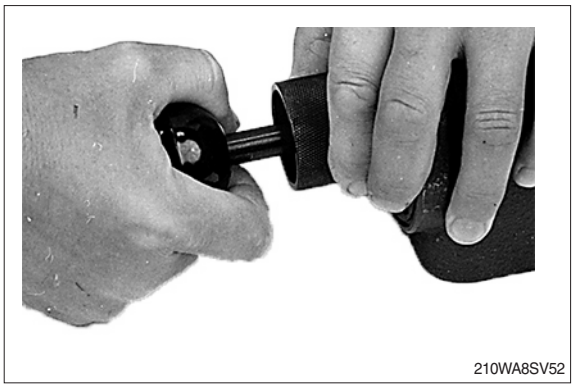


(11) Grease the shaft seal (Roto Glyd, 5) with hydraulic oil and place them on the tool. Ensure that the Roto Glyd seal is placed on the insertion tool as per the photograph.

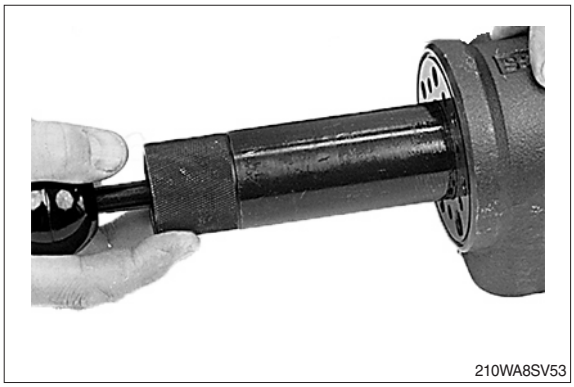


(12) Hold the outer part of the assembly tool in the bottom of the steering unit housing and guide the inner part of the tool right to the bottom.

(13) Press and turn the shaft seal (5) into position in the housing.

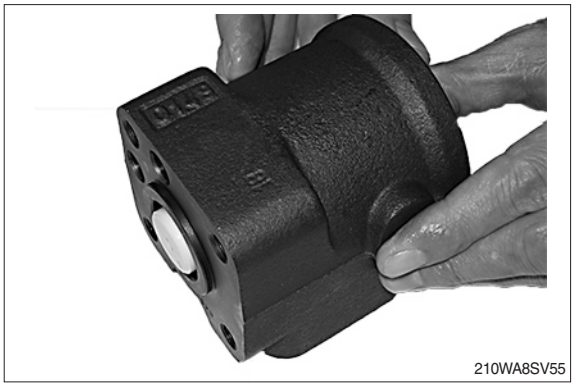


(14) Draw the inner and outer parts of the assembly tool out of the steering unit bore, leaving the guide from the inner part in the bore.

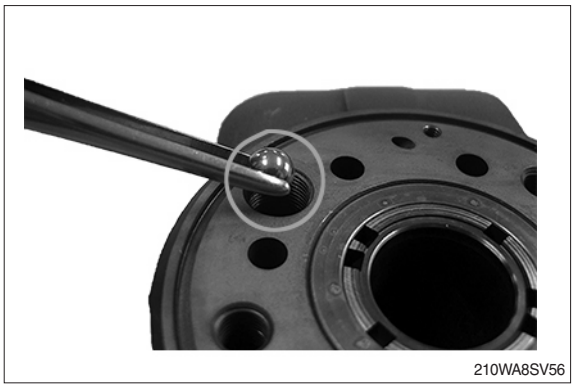


(15) With a light turning movement, guide the spool and sleeve into the bore.
Fit the spool set holding the cross pin (11) horizontal.

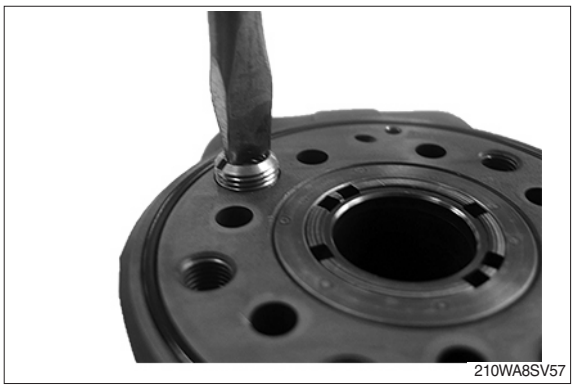
(16) The spool set will push out the assembly tool guide. The shaft seal (5) is now installed.



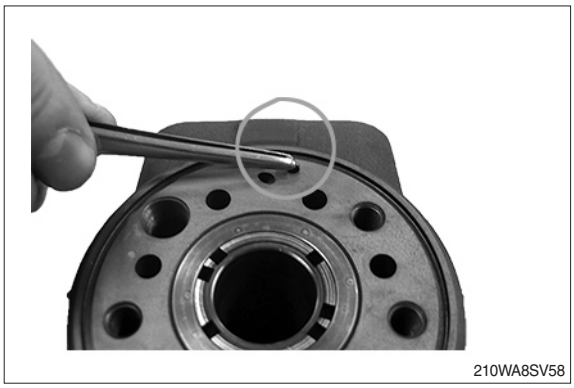
(17) Place the steering unit housing on the holding tool on the steering column end. Put the check valve ball (3) into the hole indicated by the circle.


210WA8SV56

(18) Screw the threaded bushing/ball stop (4) lightly into the check valve bore. The top of the bush must lie just below the surface of the housing.


210WA8SV57

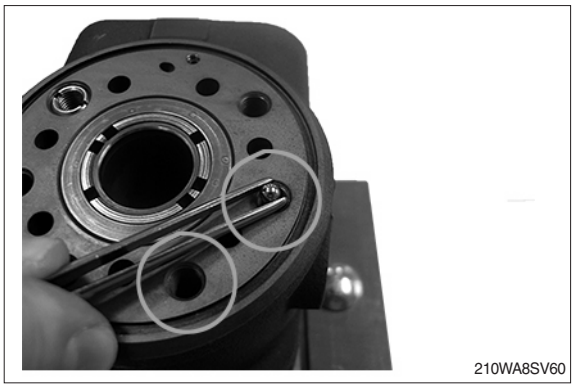
(19) Put the check valve ball (36) into the hole indicated by the circle.
Ball (36) is only present in OSPD LS with check valve in LS line.


210WA8SV58

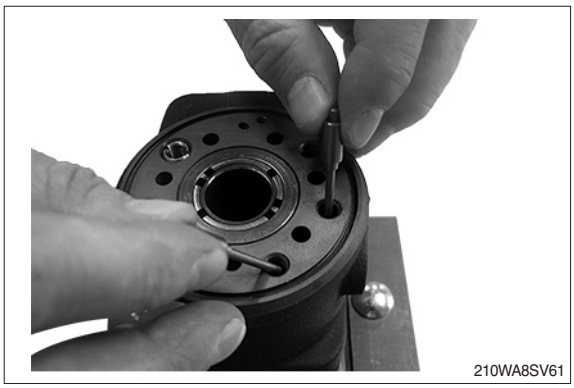
(20) Screw the ball stop (35) into the LS check valve bore.
1 ± 0.1 N·m [8.85 ± 0.885 lbf·in].


210WA8SV59

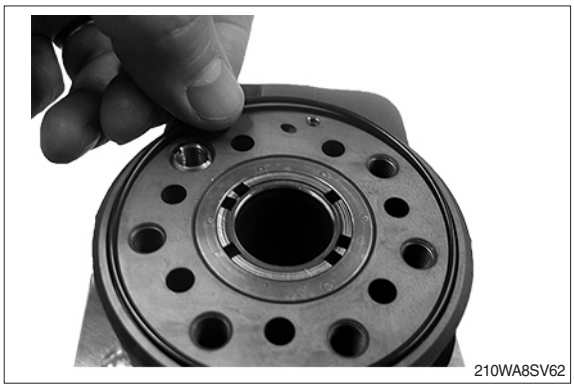
(21) Place a ball (33) in the two bolt holes indicated by the circles.



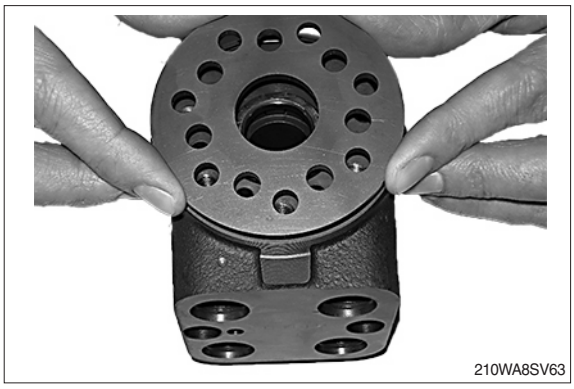
(22) Place the pins (34) in the same two bolt holes.



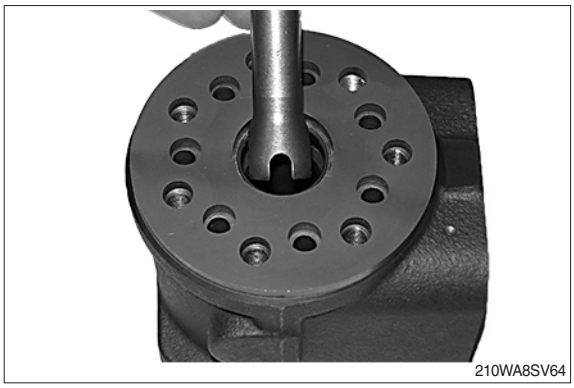
(23) Insert the O-ring (18) in the grove on the housing.



(24) Place the distributor plate (16) so that the channel holes match the holes in the housing.



(25) Guide the cardan shaft (13) down into the bore so that the slot is parallel with the connection flange ports and lines up with the cross pin (11).



(26) Place the 2 O-rings (18) in the two groves in the gear rim.
Fit the gearwheel and rim (17) on the cardan shaft (13).

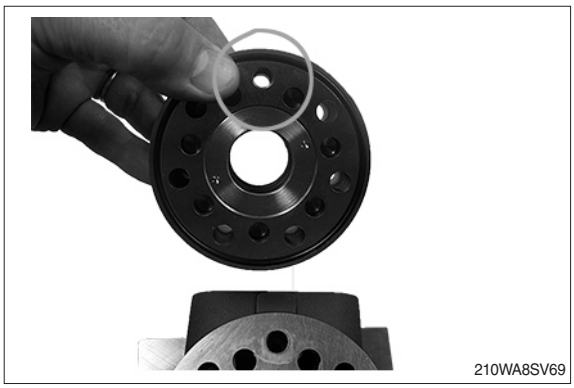
※ Place the gear wheel side with all the deeper splines facing downwards. Only this side will fit on the cardan shaft due to all gear sets used in OSPD V2 has timing securing: splines of gear wheel and cardan shaft can only be assembled with correct timing.

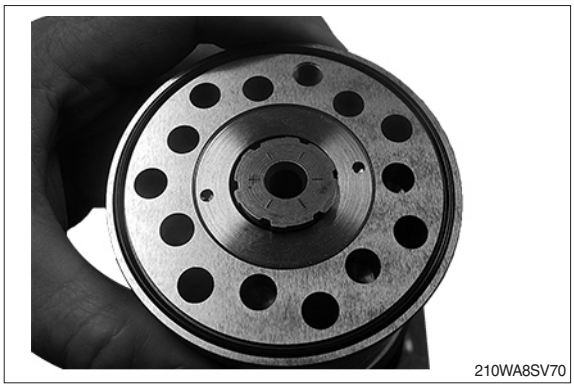
(27) Place the spacer (56) if present.
Spacer is only present in OSPD with GSW1 (17) equal to or larger than 100 cm3.

(28) Place and rotate the cardan shaft (51) with the big diameter end until it moves in gear with gear wheel of gear set (17).

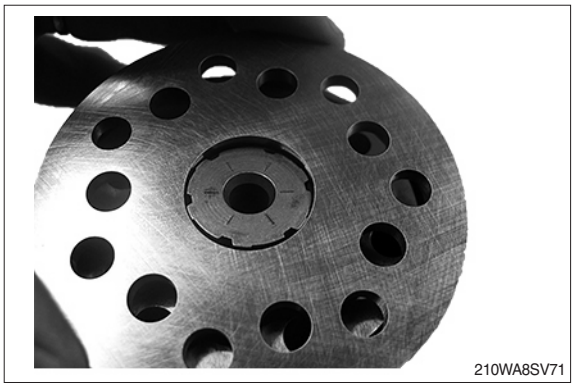
(29) Place the middle distributor plate (16) so that the channel holes match the holes in the gear set.

(30) Place the 2 O-rings (18) in the two groves in the valve housing assembly (54).
Place the valve housing assembly so that the one and only M8 thread whole points upwards and direction port face.
Make sure that channel holes match the holes in the distributor plate (16).





(31) Place the rear distributor plate (16) so that the channel holes match the holes in valve housing assembly (54).



(32) Place the 2 O-rings (18) in the two groves in the gear rim.
Fit the gearwheel and rim (17a) on the cardan shaft (51).
Place the gear wheel side with all the deeper splines facing downwards. Only this side will fit on the cardan shaft due to all gear sets used in OSPD V2 has timing securing: splines of gear wheel and cardan shaft can only be assembled with correct timing.


210WA8SV72

(33) Place the end cover (19) in position. Ensure that the bar codes and writing are parallel with port face.

210WA8SV73

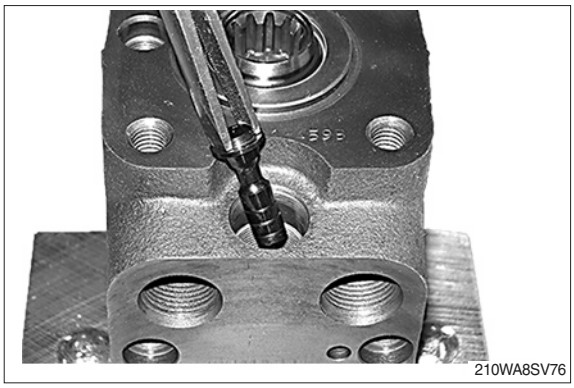
(34) Fit the short screw (22) with new washer (20) and place it in the hole shown.


210WA8SV74

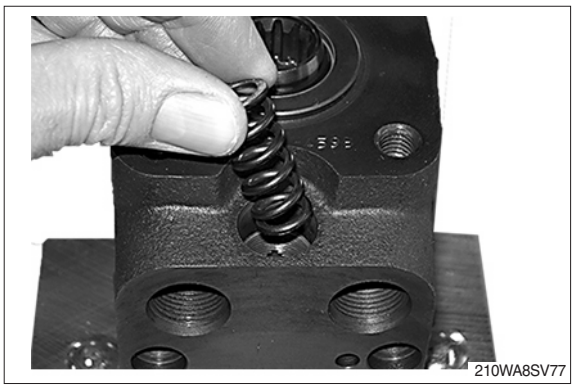
(35) Fit the six screws (23) with new washers (20) and insert them. In case the unit has pin bolt screw, this must be inserted where the circle is marked: Cross-tighten all the screws (22 and 23) with a torque of 30±6 N·m [265.5±53 lbf·in].
Replace the unit in the holding tool on gear set end.
The OSPD V2 can now be function tested manually: it must be possible to rotate input shaft with torque < 3.5 N·m [31.0 lbf·in].

210WA8SV75

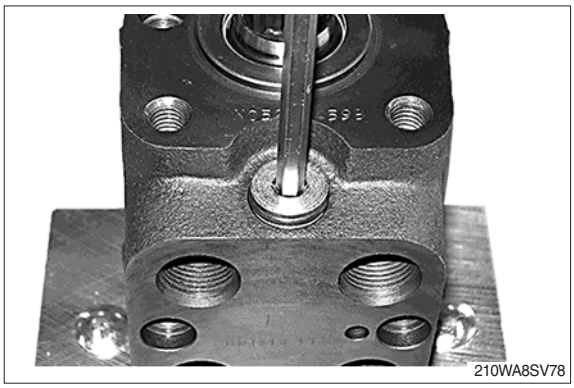
(36) Install the piston (32) to housing.



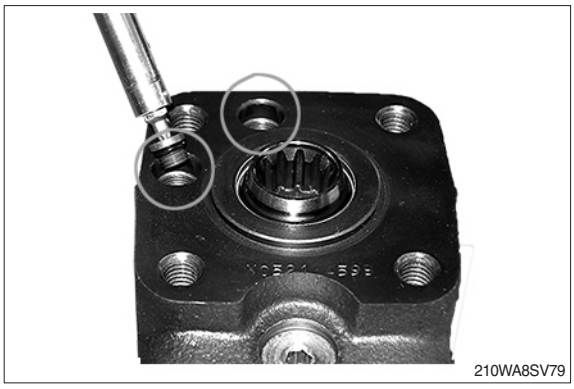
(37) Install the spring (31) on top of the piston (32).



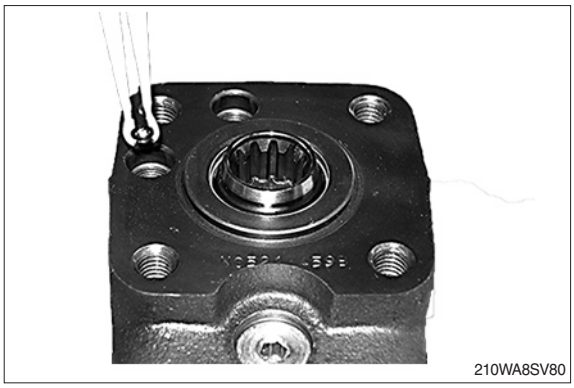
(38) Place O-ring (43) on adjusting screw (30). Screw in the adjustment screw (30) with a 6 mm Allan key. Make the pressure setting on a test panel according to valve setting specification.
Insert plastic protection plug (42) to the adjustment screw (30).



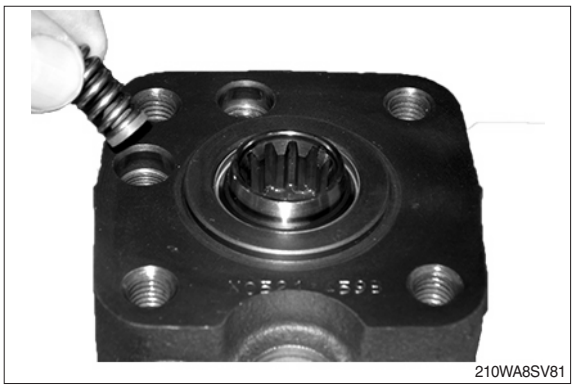
(39) Place O-ring (41) on the shock valve seats (28). Screw in the seats (28) with a 2.75 mm allan key into the cavities indicated by the circles.
Torque 6±N·m [53.1±8.85 lbf·in].



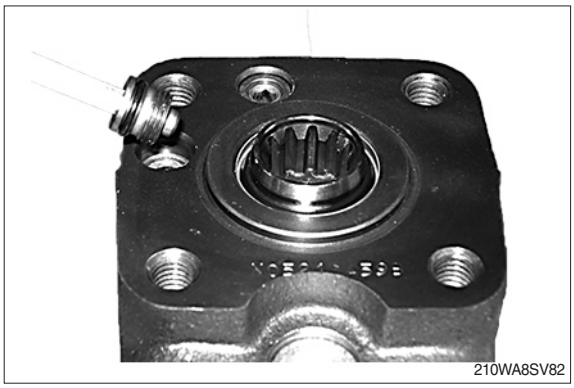
(40) Place one ball (27) in each of the shock valve cavities.


210WA8SV80

(41) Place springs with trust pads (26) over the two balls.


210WA8SV81

(42) Place O-rings (40) on adjusting screws (25).
Screw in the two adjusting screws (25) using a 5 mm allan key.
Make the pressure setting on a test panel according to valve setting specification.


210WA8SV82

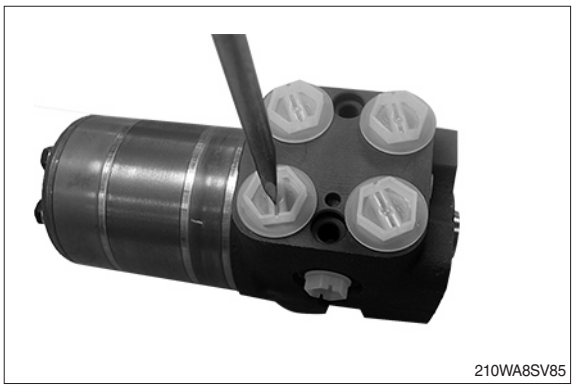
※ Plug all ports, established 35 bar, hydraulic pressure on T and check the unit is completely leak free.

(43) Place the dust seal ring (1) in the housing.


210WA8SV83

(44) Fit the dust seal ring in the housing using special tool for dust seal assembly and a plastic hammer.

(45) Screw in the plastic plugs into the connection ports to keep the ports clean during storage and transportation.



GROUP 9 FRONT AXLE

1. REMOVAL FRONT AXLE

1) Propeller shaft mounting nut (1, M10)
   · Tightening torque : 5.9±0.6 kgf · m
   (42.7±4.3 lbf · ft)

2) Wheel nut (2, M22)
   · Tightening torque : 60±5.0 kgf · m
   (433±36.2 lbf · ft)

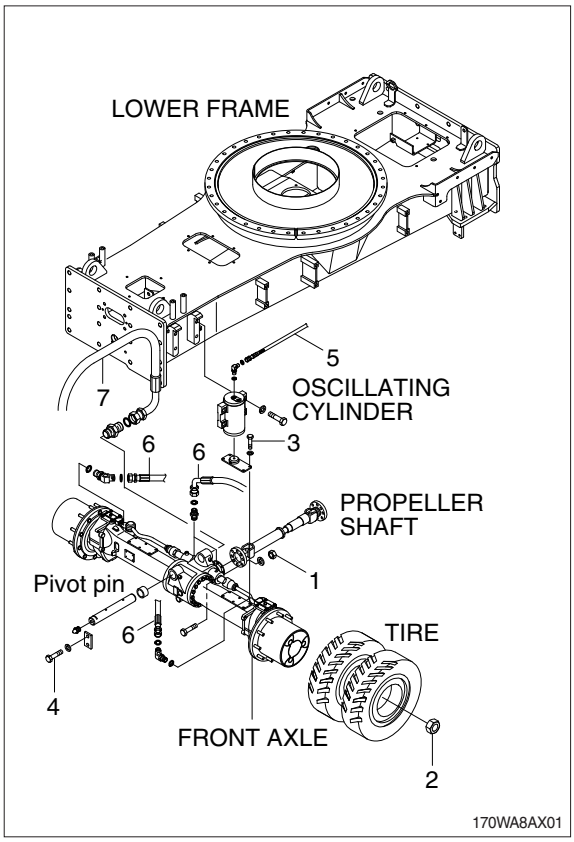
3) Oscillating cylinder supporting mounting bolt (3, M16)
   · Tightening torque : 29.7±4.5 kgf · m
   (215±32.5 lbf · ft)

4) Pivot pin lock plate mounting bolt (4, M12)
   · Tightening torque : 12.8±3.0 kgf · m
   (92.6±25.7 lbf · ft)

5) Pipe assy (5)

6) Hose assy (6, 7)

7) Front axle weight : 637 kg (1400 lb)



2. GENERAL INSTRUCTIONS

1) GENERAL WORKING INSTRUCTIONS

(1) This manual has been developed for the skilled serviceman, trained by the ZF-Passau.

(2) During all operations, pay attention to cleanliness and skilled working.
Therefore, axle removed from the machine, must be cleaned prior to open them.

(3) We assume that the special tools, specified by ZF, will be used.
The special tools are available from ZF-Passau.

(4) After the disassembly, all components must be cleansed, especially corners, cavities and recesses of housing and covers.

(5) The old sealing compound must be carefully removed.

(6) Check lubricating holes, grooves and pipes for free passage. They must be free of residues, foreign material or protective compounds.

(7) The latter refers especially to new parts.

(8) Parts which have been inevitably damaged in a disassembly operation, must be generally replaced by new ones, e.g. rotary seal rings, O-rings, U-section rings, cap boots, protective caps etc..

(9) Components such as roller bearings, thrust washers, synchronizing parts etc. which are subject to normal wear in automotive operation, must be checked by the skilled Serviceman.
He will decide if the parts can be reused.

(10) For the heating of bearings etc., hot plates, rod heaters or heating furnaces must be used.

(11) Never heat parts directly with the flame. An auxiliary solution would be to immerse the bearing in a vessel filled with oil, which is then heated with the flame.
In this way, damage to the bearings could be avoided.

(12) Ball bearings, covers, flanges and parts like that must be heated to about 90 to 100˚C.

(13) Hot-mounted parts must be reset after cooling in order to assure a proper contact.

(14) Before pressing shafts, bearings etc. in position, both parts must be lubricated.

(15) During to reassembly, all specified adjustment values, testing specifications and tightening torque must be respected.

(16) After the repair, units are filled up with oil.

(17) After the oil filling, the oil level plugs and oil drain plugs must be tightened to the specified tightening torque.

2) IMPORTANT INSTRUCTIONS CONCERNING THE LABOUR SAFETY

(1) In principle, repairers are themselves responsible for the labour safety.

(2) The observance of all valid safety regulations and legal rules is a precondition to prevent damage to individuals and products during the maintenance and repair operations.

(3) Before starting the work, the repairers have to make themselves familiar with these regulations.

(4) The proper repair of these products requires especially trained personnel.

(5) The repairer himself is obliged to provide for the training.

3) LUBRICANT SPECIFICATIONS

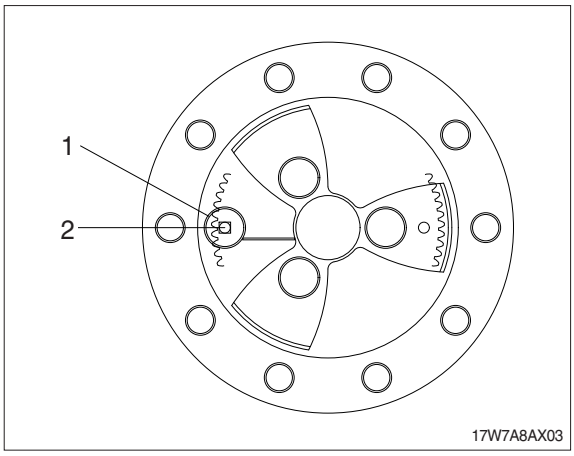
(1) Gear oils with limited - slip additives.

(2) API GL-5

(3) MIL-L-2105D (SAE 85W-90 LSD or UTTO)

4) BRAKE LINING WEARING TEST

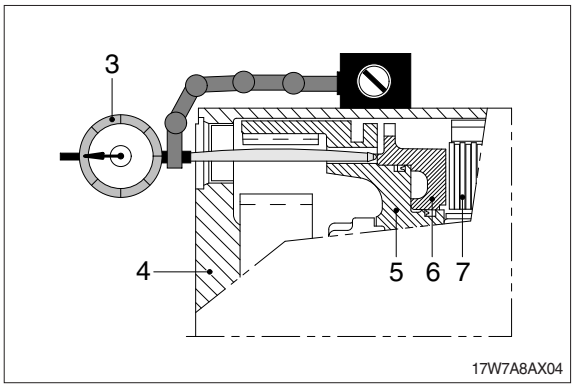
(1) The measurement of wear on the multi-disc brake only gives limited information on the total state of the plate pack without disassembling the output.
Make measurement of lining wear at least once per year, in particular, however, in case of a different braking behaviour, like :
- Braking noises
- Reduced braking power
- Different deceleration
- Different brake oil level
- Different braking pressure

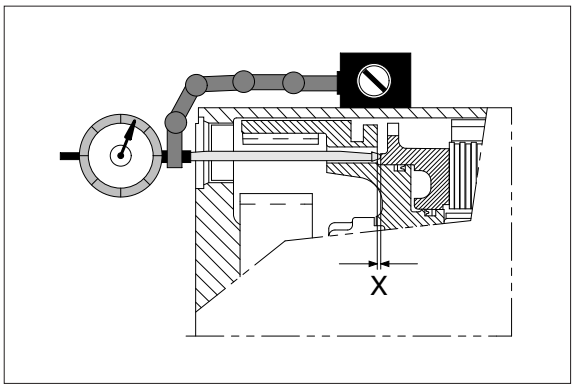


※ To avoid injury when opening the oil drain/ oil filler plug (1), due to a possible pressure build-up in the planetary carrier bring drain hole to topmost position (12 o'clock) and carefully unscrew oil drain and filler plug (1).

(2) Then turn output until oil filler / oil drain hole (2) is on 9 o'clock position.

1 = Oil filler-/oil drain hole
2 = Gauge hole (∅=10 ㎜) in ring gear
9 o'clock position
3 = Dial indicator with solenoid support
4 = Planetary carrier
5 = Ring gear
6 = Piston
7 = Plate pack
X = Piston stroke



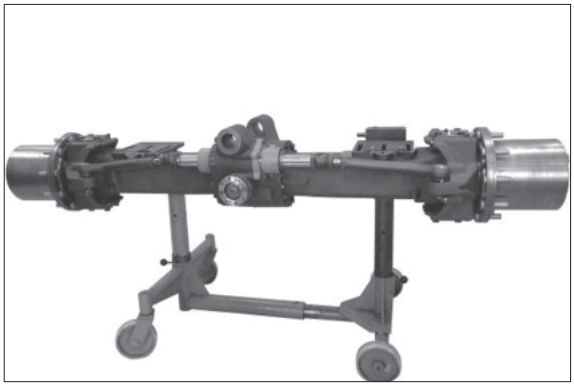


3. DISASSEMBLY

1) STEERING

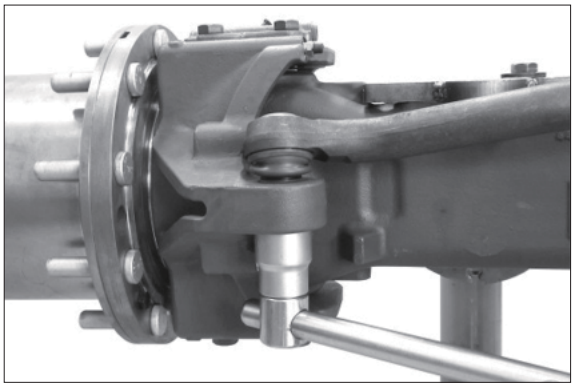
(1) Fix the axle to the assembly truck.

(S) Assembly truck 5870 350 000
(S) Support 5870 350 106



17W98FA001

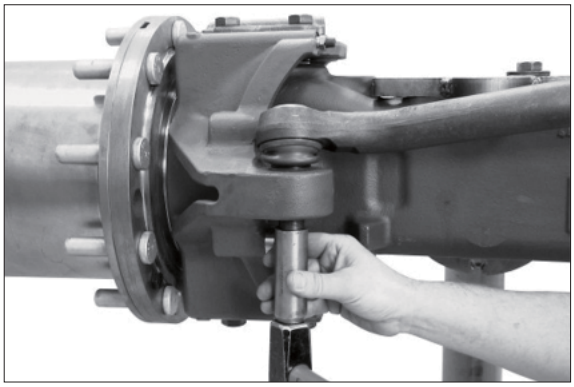
(2) Loosen locknut.



17W98FA002

(3) Force out tie rod from bevel seat.

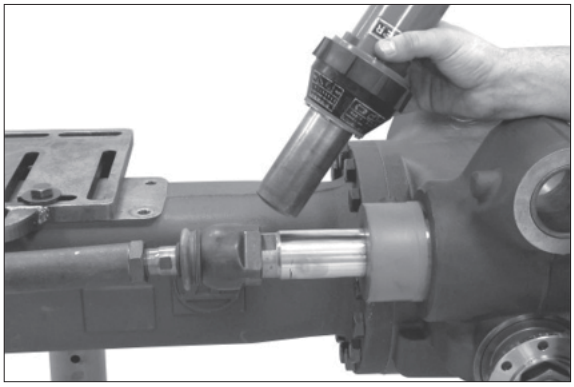
※ Use suitable mandrel (brass or aluminum).



17W98FA003

(4) Warm up piston rod by means of hot air blower.

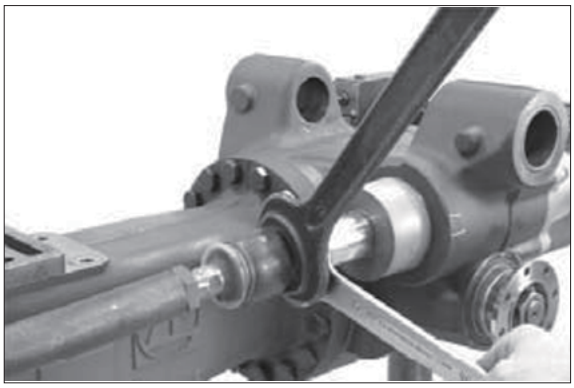
※ Axial joint is installed with Loctite no. 243.



17W98FA004

(5) Separate both tie rods from piston rod.

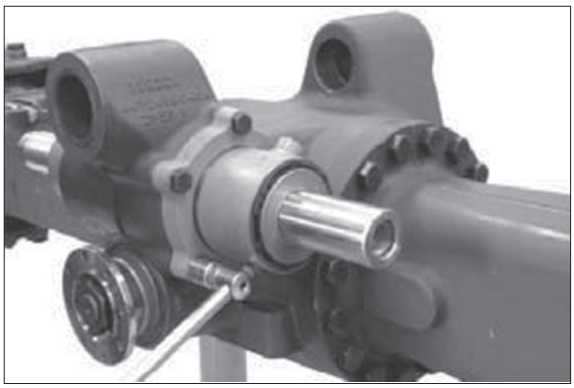
※ If work is just to be done on piston rod, guide or sealing elements, no disassembly of the steering cylinder assy is required.



17W98FA005

(6) Loosen hexagon screws.

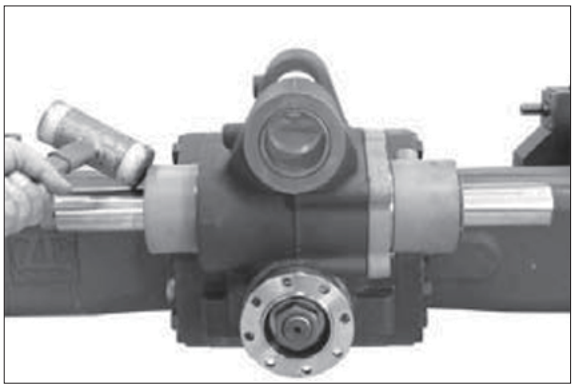
※ Mark radial installation position of steering cylinder to axle housing – assembly aid.



17W98FA006

(7) Drive out steering cylinder assy from axle housing hole.

※ Use a plastic hammer.



17W98FA007

(8) Unsnap the retaining ring and remove the releasing flange.

17W98FA008

(9) Unsnap retaining ring.

17W98FA009

(10) Push/force the brake head into the cylinder tube, until the retaining ring (see figure FA011) can be removed.

17W98FA010

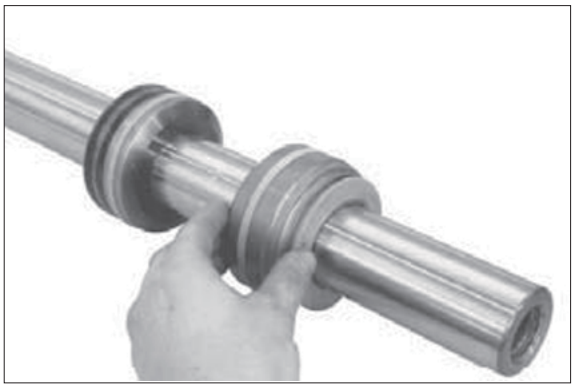
(11) Unsnap retaining ring.

Then drive out piston rod together with brake head from cylinder tube.

17W98FA011

(12) Pull off brake head from the piston rod.

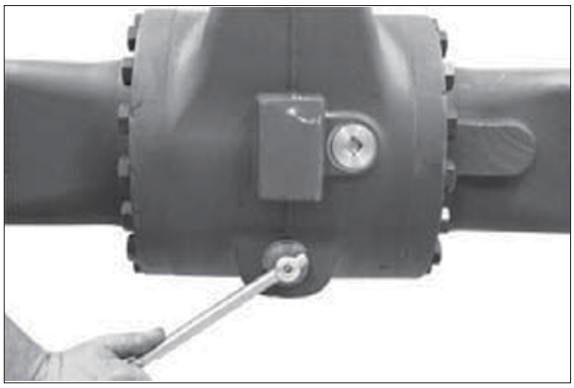
Then remove all sealing elements from piston rod, brake head and cylinder tube.



17W98FA012

2) OUTPUT

(1) Loosen screw plug and drain oil from the axle.

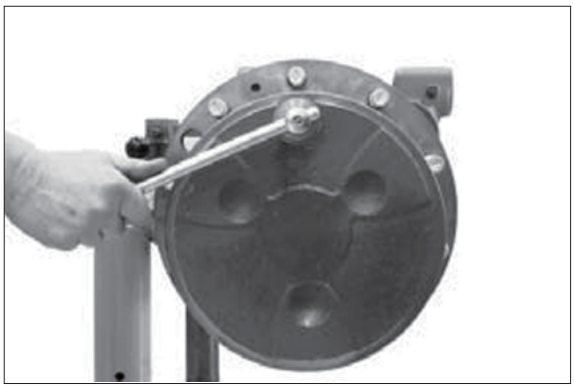


17W98FA013

(2) Loosen screw plug and drain oil from the planetary carrier.

※ To avoid injury due to a possible pressure build-up in the oil system of the planetary carrier, bring oil filler and control plug to 12 o'clock position and carefully unscrew. Then bring drain hole to 6 o'clock position and drain oil.

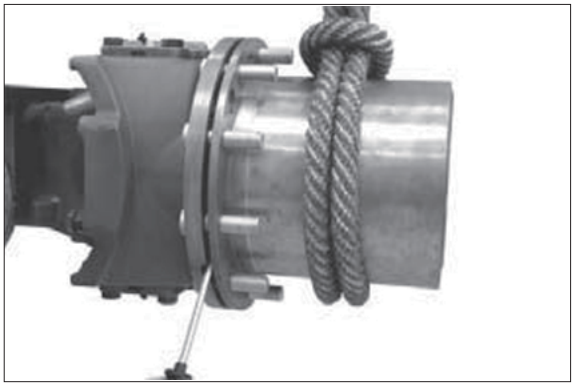
※ Use suitable collecting basin environmental protection.



17W98FA014

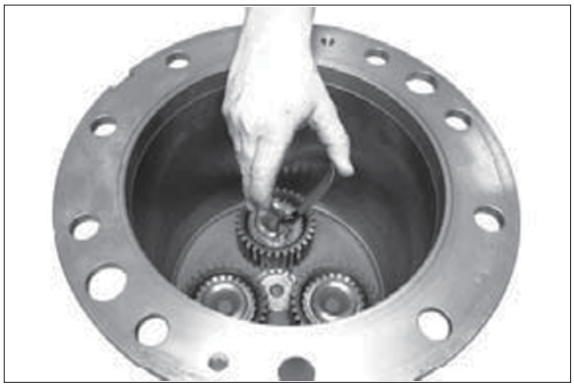
(3) Planetary carrier

Loosen both hexagon screws and separate planetary carrier from hub.



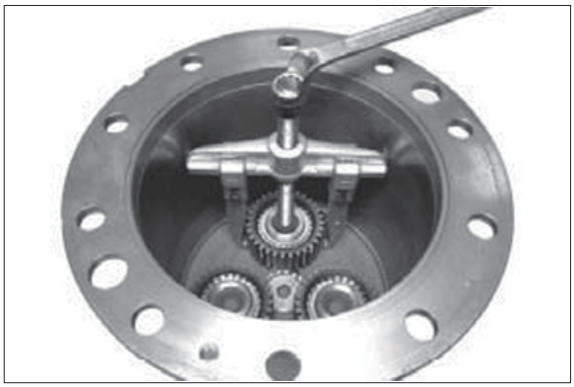
17W98FA015

(4) Unsnap retaining ring.



17W98FA016

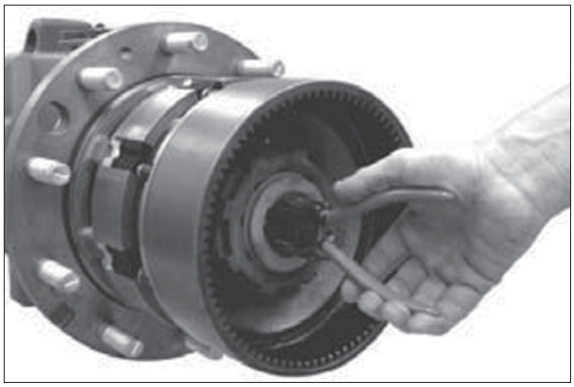
(5) Pull off planetary gear together with cylindrical roller bearing.



17W98FA017

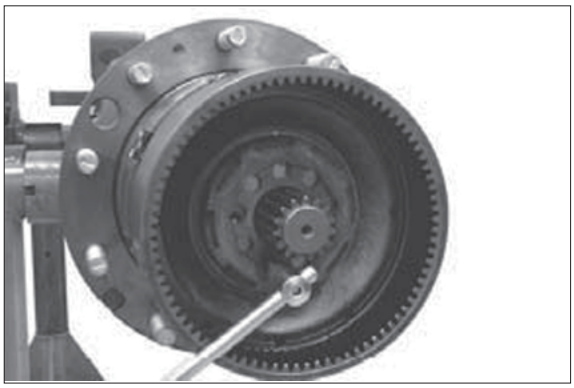
(6) Brake

Unsnap retaining ring and remove both thrust washers.



17W98FA018

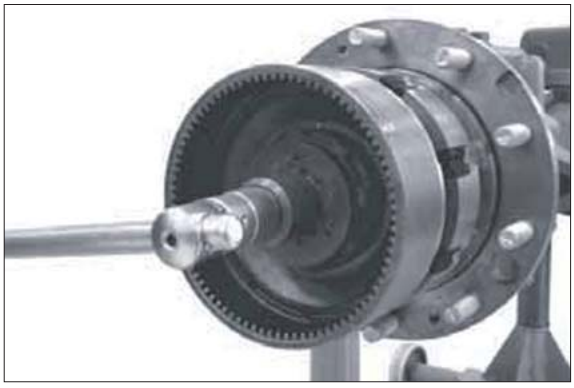
(7) Loosen cylindrical screw (slotted nut fixing).



17W98FA019

(8) Loosen slotted nut.

(S) Socket wrench 5870 656 097

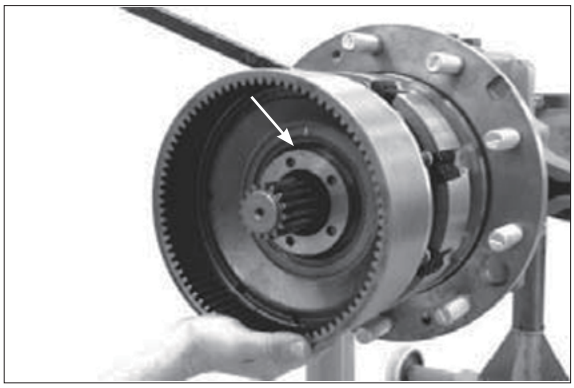


17W98FA020

(9) Press off ring gear together with piston from joint housing.

(S) Assembly lever 5870 345 036

※ Pay attention to releasing O-ring (arrow).



17W98FA021

(10) Loosen hexagon screws and remove releasing spring sleeves and compression springs.

17W98FA022

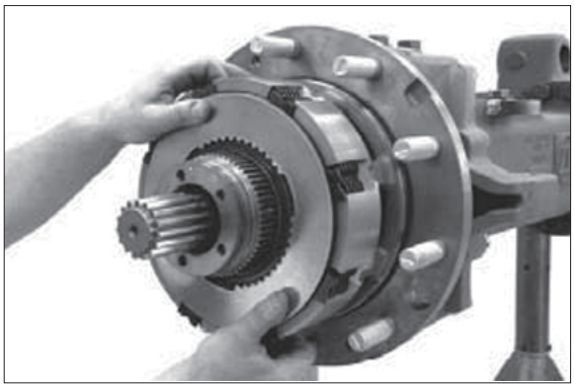
(11) Press off piston from ring gear.

17W98FA023

(12) Remove sealing elements from the annular grooves (see arrows) of the ring gear.

17W98FA024

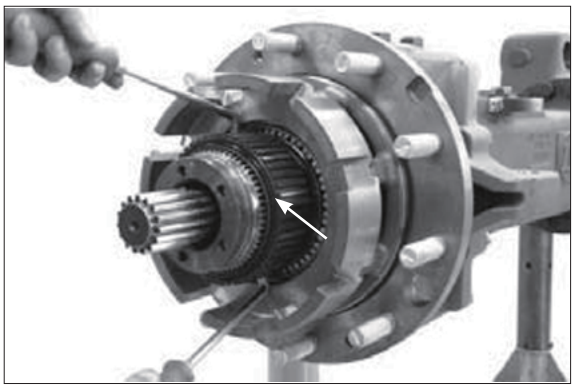
(13) Remove disk package.



17W98FA025

(14) Remove O-ring (see arrow) and lift off disk carrier from the joint housing.

(S) Adjusting device 5870 400 001



17W98FA026

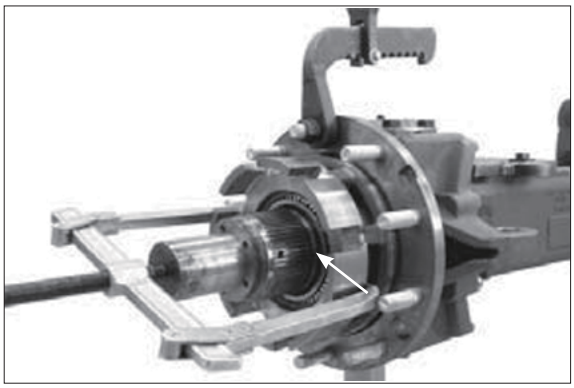
(15) Hub

Remove O-ring (see arrow).

Secure hub with lifting bracket (S) and pull from joint housing by means of a two armed puller.

(S) Lifting bracket 5870 281 043
(S) Pressure piece 5870 100 067

※ Pay attention to releasing bearing inner ring.

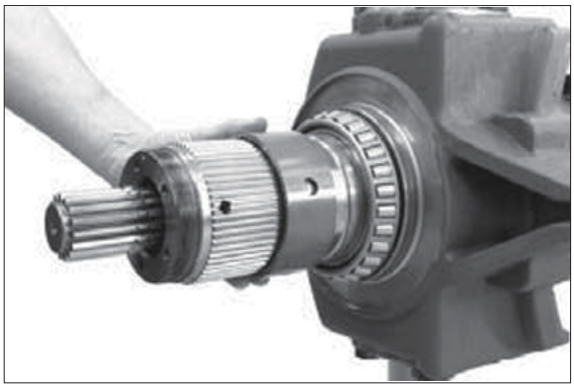


17W98FA027

(16) Use a lever to lift-off shaft seal ring (see arrow) from hub hole and force both bearing outer rings out of the hub.

17W98FA028

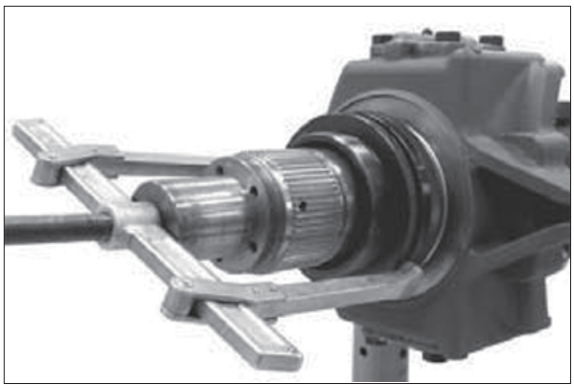
(17) Remove spacer bushing.



17W98FA029

(18) Pull tapered roller bearing from joint housing.

(S) Grab sleeve 5873 003 022
(S) Pressure piece 5870 100 067



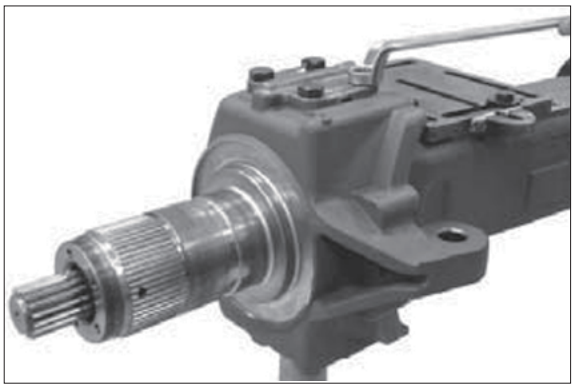
17W98FA030

(19) Knuckle housing

Loosen threaded joint and remove upper bearing pin.

※ Pay attention to releasing O-ring.

※ Remove lower bearing pin only after securing the knuckle housing (see figure FA032).



17W98FA031

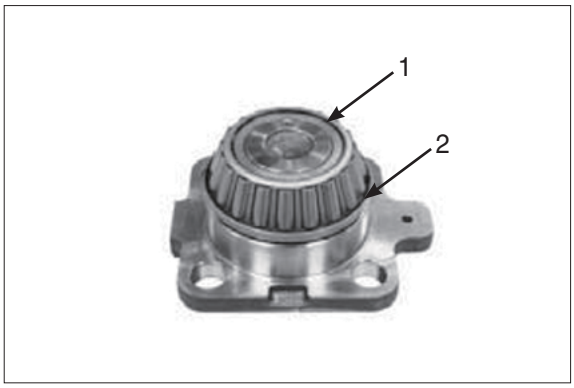
(20) Secure knuckle housing by means of lifting tackle.

Then loosen threaded joint and remove lower bearing pin.

(S) Eyebolts (M 16) 5870 804 001

17W98FA032

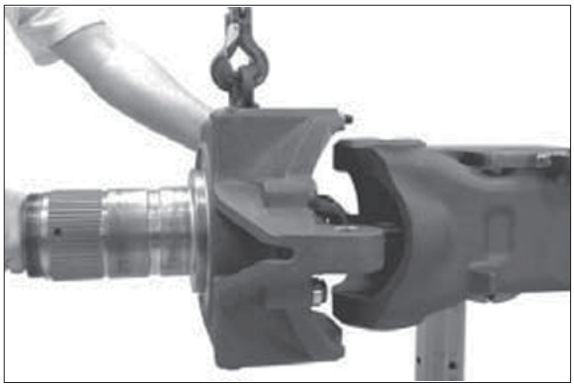
(21) Use lever to remove tapered roller bearing (1) from bearing pin, remove releasing sealing cap (2) and the O-ring lying behind.



17W98FA033

(22) Separate knuckle housing with double u-joint shaft from the axle housing.

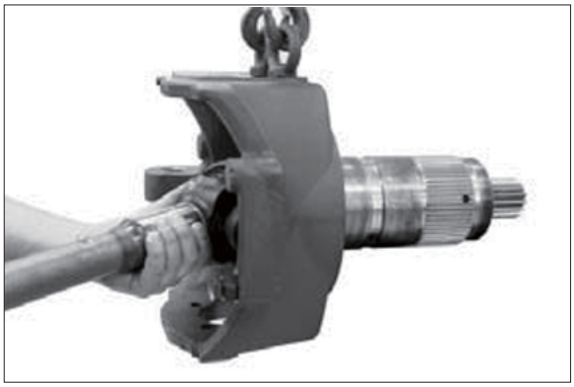
※ Pay attention to shaft seal ring in the axle housing risk of damage.



17W98FA034

(23) Pull out double u-joint shaft from knuckle housing.

※ Pay attention to shaft seal ring in the knuckle housing risk of damage.



17W98FA035

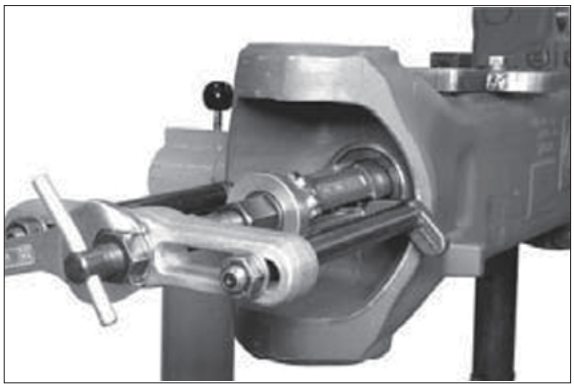
(24) Pull out shaft seal ring and afterwards the bushing behind from the axle housing.

(S) Internal extractor	5870 300 007
(S) Counter support	5870 300 020

17W98FA036

(25) Pull out shaft seal ring and afterwards the bushing behind from the axle housing.

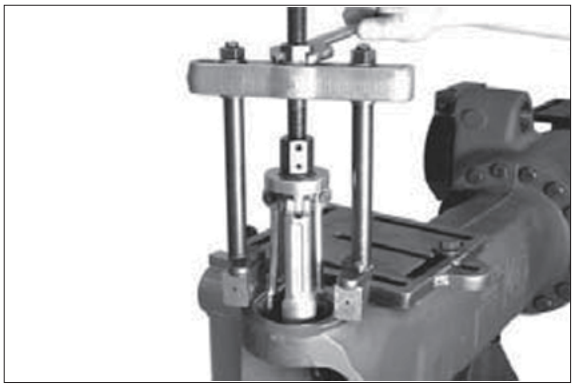
(S) Internal extractor 5870 300 017
(S) Counter support 5870 300 020



17W98FA037

(26) Pull out both bearing outer rings from the pivot bearing holes.

(S) Internal extractor 5870 300 019
(S) Counter support 5870 300 020



17W98FA038

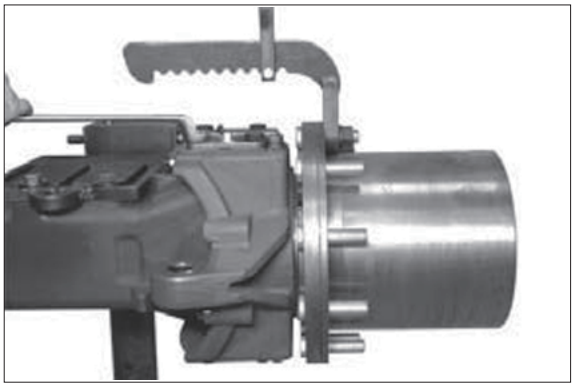
(27) Output assy

※ If work is required on the differential or pinion, you may disassembly the output as complete unit (operation FA039 and FA040).

Secure output assy by means of lifting tackle (S).

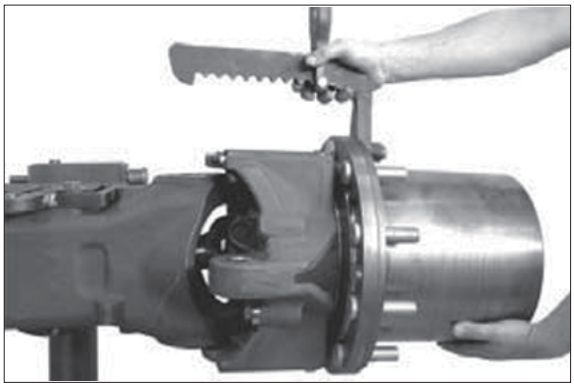
(S) Lifting bracket 5870 281 043

Then loosen threaded joints of both bearing pins.



17W98FA039

(28) Remove both bearing pins and separate the output assy from the axle housing.

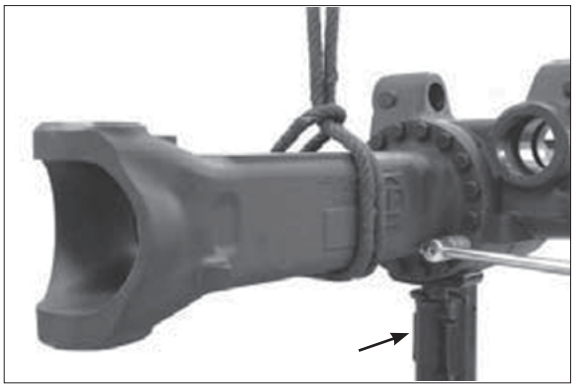


17W98FA040

3) INPUT

(1) Support axle to axle drive housing (see arrow).
Then secure axle housing (crown wheel side) by means of lifting tackle and loosen threaded joint.
Then separate axle housing from axle drive housing.

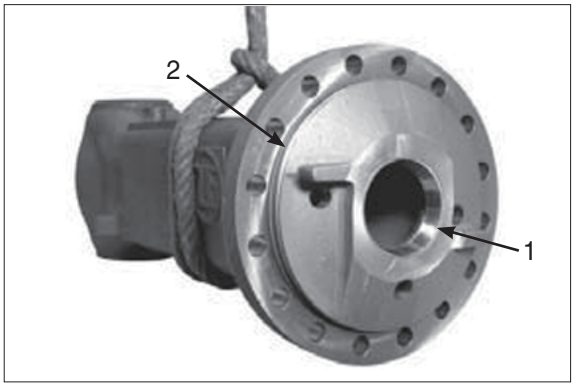
※ Pay attention to possibly releasing differential.



17W98FA041

(2) Pull bearing outer ring (arrow 1) from the bearing hole and remove releasing shim.
Then remove O-ring (arrow 2).

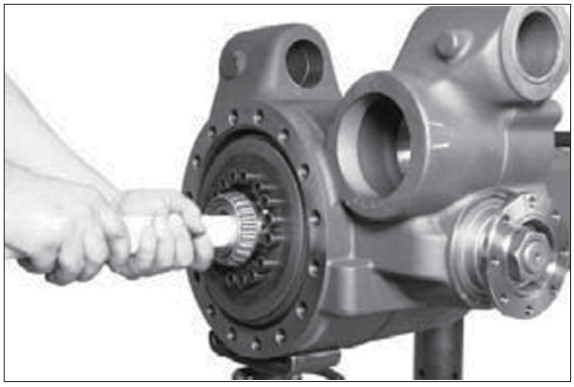
(S) Striker 5870 650 004



17W98FA042

(3) Lift differential out of the axle drive housing.

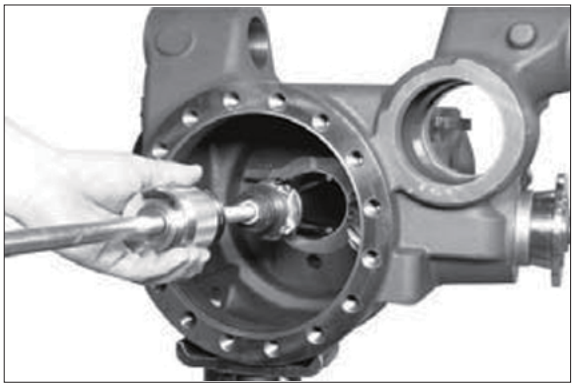
※ Disassembly of the differential is described as of page 8-230.



17W98FA043

(4) Use striker (S) to pull bearing outer ring out of the bearing hole (axle housing) and remove releasing shim.

(S) Striker 5870 650 004

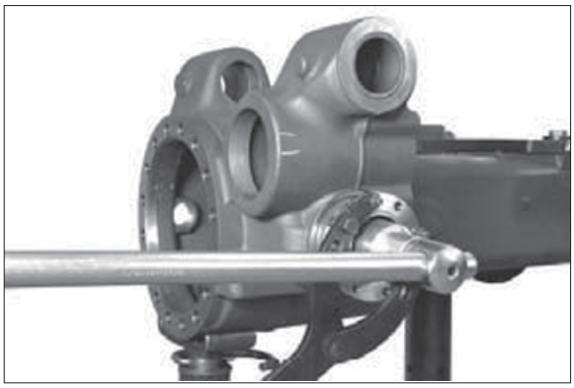


17W98FA044

(5) Warm up hexagon nut by means of hot air blower.
Then loosen hexagon nut and remove the releasing shim.

(S) Clamping fork 5870 240 025

※ Hexagon nut is installed with Loctite no. 262.



17W98FA045

(6) Pull input flange from pinion.
If necessary, remove screen sheet from flange.

17W98FA046

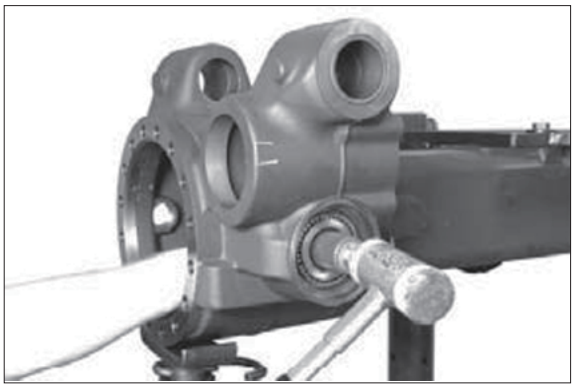
(7) Use a lever to remove the shaft seal ring from the housing hole.

17W98FA047

(8) Force out input pinion and remove releasing roller bearing.

※ Use plastic hammer.

※ If tapered roller bearings should not be replaced, pay attention that the outer bearing inner ring with all its rolls is in contact with bearing outer ring when forcing out the input pinion.



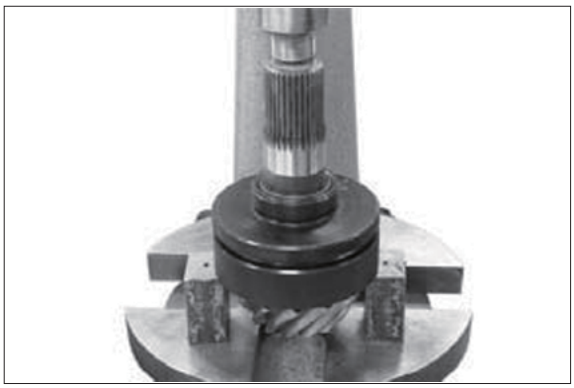
17W98FA048

(9) Remove spacer ring.

17W98FA049

(10) Press roller bearing from input pinion.

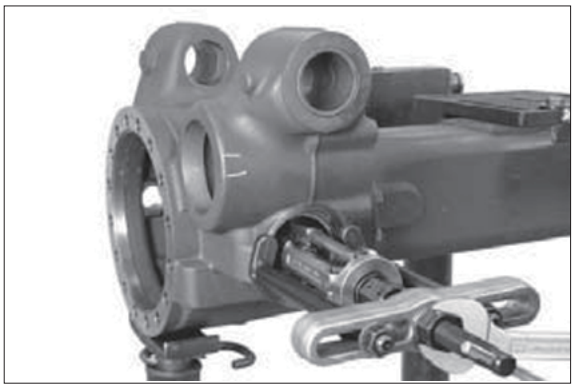
(S) Grab sleeve 5873 001 037



17W98FA050

(11) Pull off outer bearing outer ring from bearing hole.

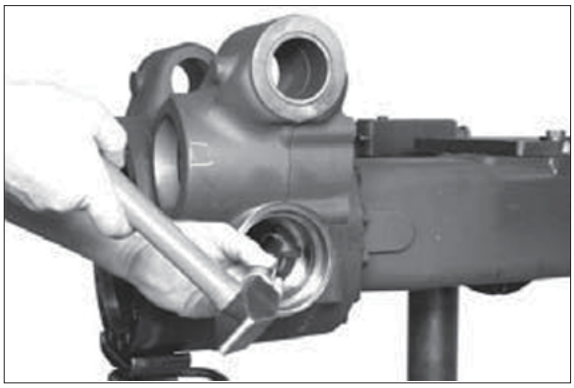
(S) Internal extractor 5870 300 019
(S) Counter support 5870 300 020



17W98FA051

(12) Force out bearing outer ring from the inner bearing hole pay attention to the shim behind.

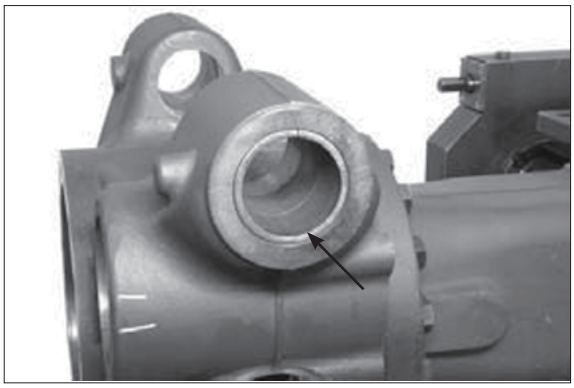
※ Mark shim (with regard to position/bearing allocation) assembly aid.



17W98FA052

(13) If necessary, provide bushings with a separating slot (see arrow) and remove from holes.

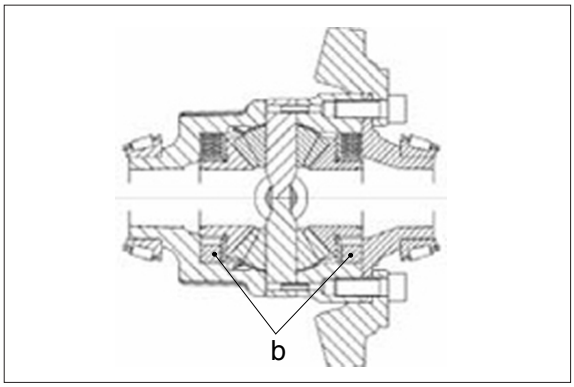
※ Bushings are destroyed by this.



17W98FA053

4) DIFFERENTIAL

(1) Differential - versions:
b = Constant spacers



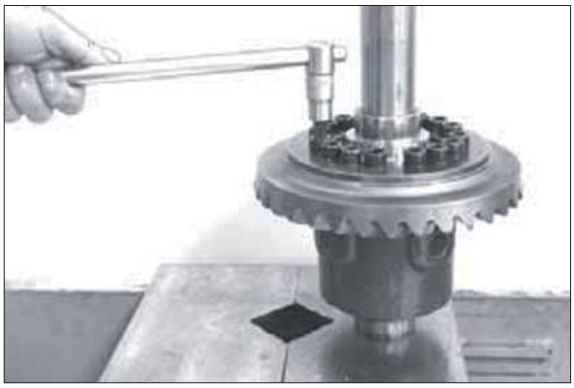
17W98FA054

(2) Pull both tapered roller bearings from differential carrier.

(S) Grab sleeve	5873 011 019
(S) Basic tool	5873 001 000
(S) Pressure piece	5870 100 009

17W98FA055

(3) Use press to fix differential and loosen threaded joint crown wheel / differential carrier.



17W98FA056

(4) Press crown wheel from differential.

17W98FA057

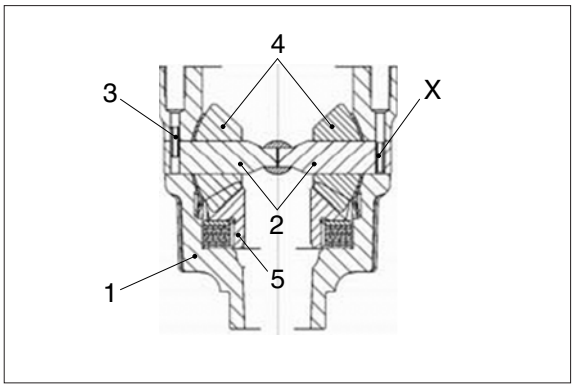
(5) Remove single parts.
Remove axle bevel gear together with thrust washer and constant spacer from the differential carrier.

17W98FA058

(6) Force slotted pins (considering position "X", see subsequent sketch FA060) into the spider shafts.

17W98FA059

(7) Comment on sketch:
1 = Differential carrier
2 = Spider shafts (short)
3 = Slotted pins
4 = Differential bevel gears
5 = Axle bevel gear
X = Position of the slotted pin to force out the spider shafts



17W98FA060

(8) Force out both spider shafts (short).

17W98FA061

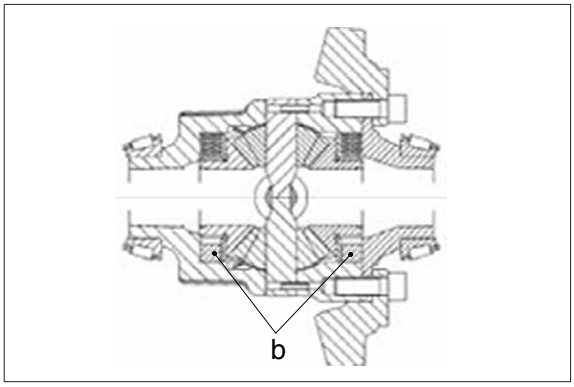
(9) Remove all single parts.

17W98FA062

4. REASSEMBLY

1) DIFFERENTIAL

(1) b = Constant spacers

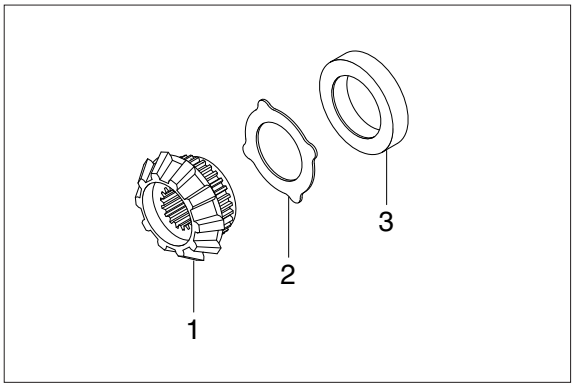


17W98FA054

(2) All outer and inner disks are replaced by a constant spacer (see figure FA066).

1 = Axle bevel gear
2 = Pressure disk
3 = Constant ring

※ No measuring / setting of the axial play of the two axle bevel gears is required, therefore single parts can be immediately oiled.



17W98FA065

(3) Insert premounted axle bevel gear into the differential carrier.

17W98FA066

(4) Insert differential bevel gears (1) with thrust washers (2) and fix with spider shafts (3 and 4).

※ Pay attention to radial installation position of the thrust washers.

17W98FA067

(5) Check axial play of the axle bevel gear 0.0 ~ 0.15 mm.

※ If the axial play is not within the specified tolerance, correct with the corresponding outer disks.

After the setting procedure separate the single parts again.

Then oil and reassemble all single parts again.

※ Make sure that thickness and arrangement of the second disk package are identical (figure FA071).

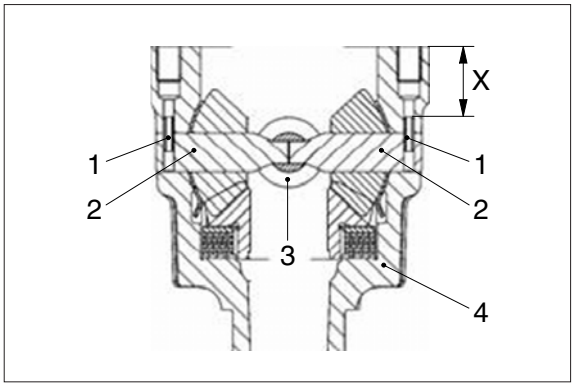
17W98FA068

(6) Fix both spider shafts (short) by means of slotted pins (considering installation dimension, see sketch FA070).

17W98FA069

(7) Comment on sketch:

1 = Slotted pin
2 = Spider shaft (short)
3 = Spider shaft
4 = Differential carrier
X = Installation dimension 34±0.5 mm



17W98FA070

(8) Mount second axle bevel gear with thrust washer and constant spacer (see also figure FA065).

※ Mount the pressure disk with the coated surface showing to the outer disk.

※ Thickness and arrangement of the disk package must be identical on both sides of the differential gear.

17W98FA071

(9) Check axial play of the second axle bevel gear 0.0~0.15 ㎜.

※ If the axial play is not within the specified tolerance, correct with the corresponding outer disks.

After the resetting procedure remove the second axle bevel gear together with the disk package from the differential carrier.

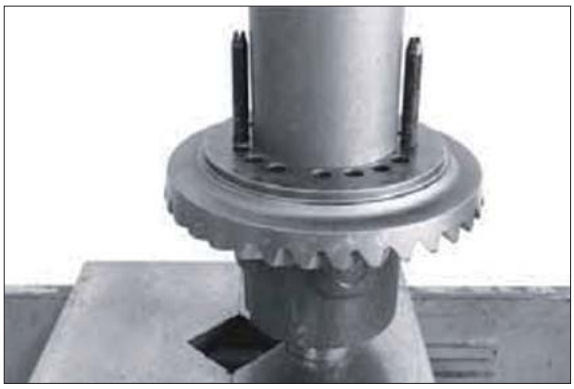
Then oil and reassemble all single parts.

17W98FA072

(10) Mount two adjusting screws (S) and insert cover.
(S) Adjusting screws (M12×1.5)
5870 204 027

17W98FA073

(11) Press crown wheel onto the cover / differential carrier until contact position is obtained.



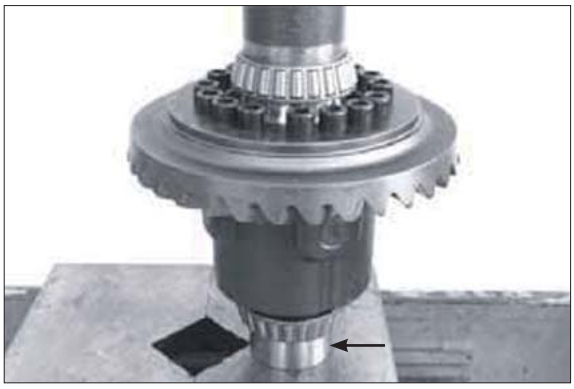
17W98FA074

(12) Fix differential with press and tighten crown wheel with cylindrical screws.
Tightening torque (M12×1,5/12.9) . . . . . MA = 145 Nm

17W98FA075

(13) Press on both bearing inner rings until contact is obtained.

※ Use an appropriate support (arrow) differential may not be supported on the bearing cage.



17W98FA076

2) INPUT

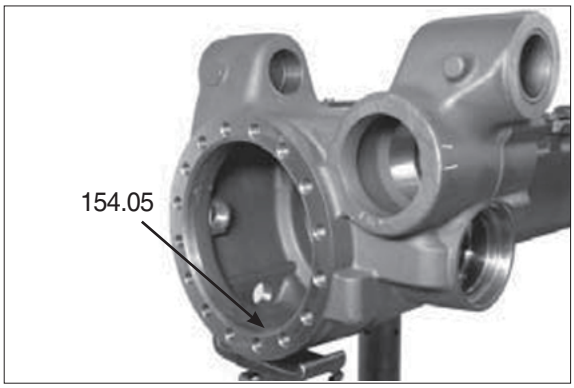
(1) Input pinion

※ The following measuring procedures must be carried out with utmost accuracy. Inaccurate measurements lead to an incorrect contact pattern and another disassembly and reassembly of the input pinion is required.

(2) Determine thickness of the shim to obtain a correct contact pattern

Read dimension I from the axle drive housing.

Dimension I e.g . . . . . 154.05 mm



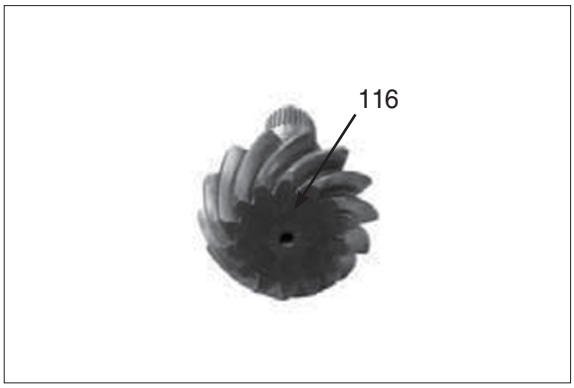
17W98FA077

(3) Read dimension II (pinion dimension).

Dimension II e.g. . . . . 116.00 mm

In case of a + or – deviation of the pinion dimension for production reasons the relevant value is marked by hand on the pinion.

Pinion dimension (without + or – deviation) = 116.0 mm
Pinion dimension with an indicated + 0.1 deviation = 116.1 mm
Pinion dimension with an indicated – 0.1 deviation = 115.9 mm



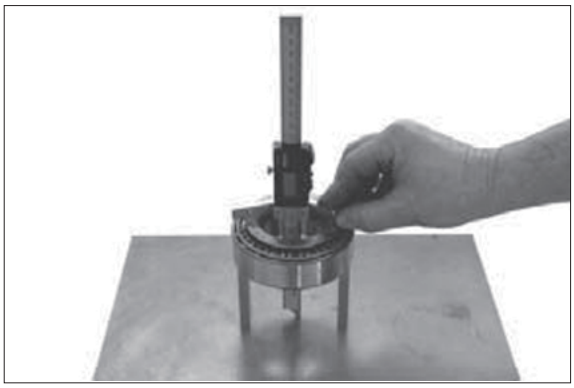
17W98FA078

(4) Determine dimension III (bearing width).

※ Make sure that the rollers are located without any play (rotate bearing g inner ring several times in both directions roller setting).

Since the installed roller bearing is subject to a pre-load in installation position, consider an experience deduction of 0.1 mm.

Dimension III, e.g. 36.60 mm – 0.1 mm . . . . . = 36.50 mm

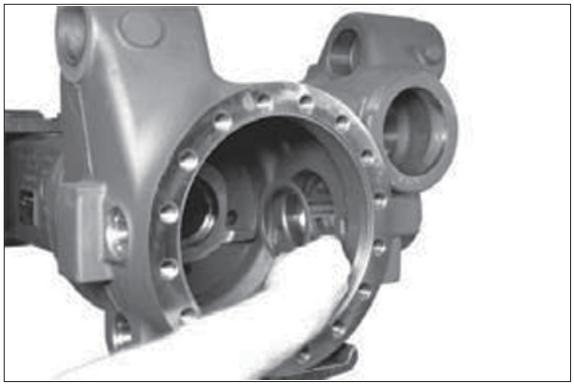


17W98FA079

(5) Calculation example "B" :

Dimension I . . . . . 154.05 mm
Dimension X . . . . . - 152.50 mm
Difference = shim s = 1.55 mm

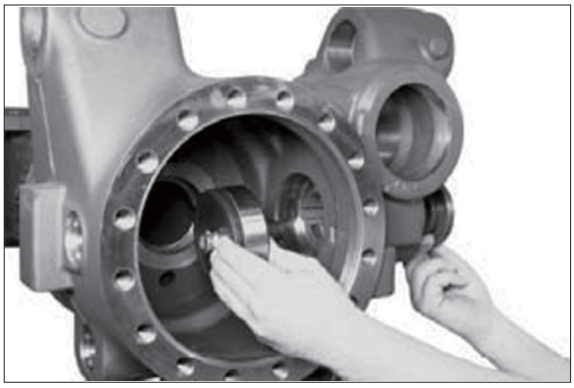
Insert the determined shim (e.g. s = 1.55 mm) into the inner bearing hole.



17W98FA080

(6) Undercool bearing outer ring (see arrow) and bring into contact position in the bearing hole by using the assembly fixture (S).

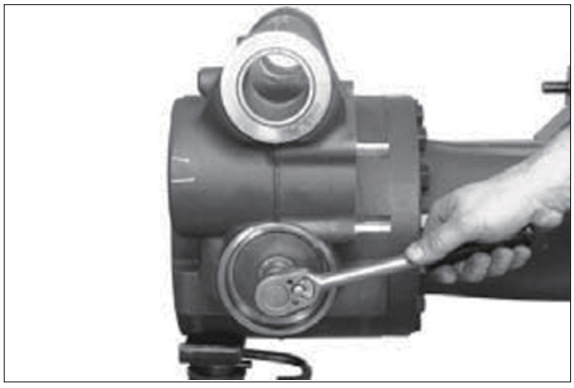
(S) Assembly fixture 5870 345 049
(S) Pressure ring 5870 345 056



17W98FA081

(7) Undercool outer bearing outer ring and insert into bearing hole until contact is obtained.

(S) Assembly fixture 5870 345 049
(S) Pressure ring 5870 345 056

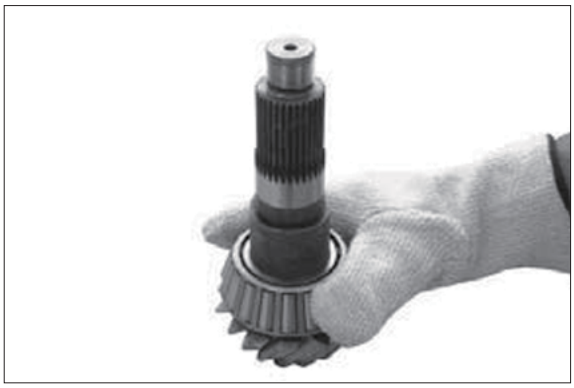


17W98FA082

(8) Setting of rolling torque of the input pinion bearing 1.0 ... 3.0 Nm (without shaft seal ring)

Warm up roller bearing and insert until contact is obtained.

※ Adjust bearing after cooling down.



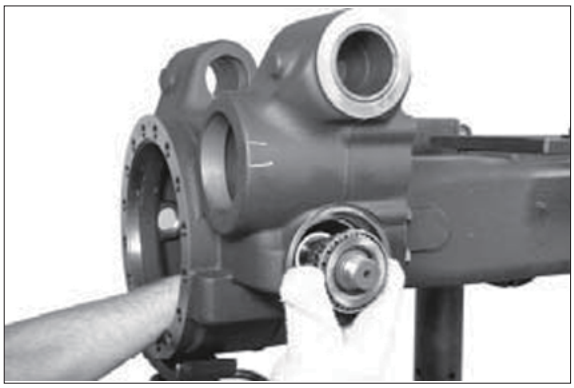
17W98FA083

(9) Insert spacer ring (e.g. s = 16.96 mm).

※ According to our experience, the necessary rolling torque is obtained when reusing the spacer ring which has been removed during disassembly (e.g. s = 16.96 mm).
A later check of the rolling torque, however, is absolutely necessary.

17W98FA084

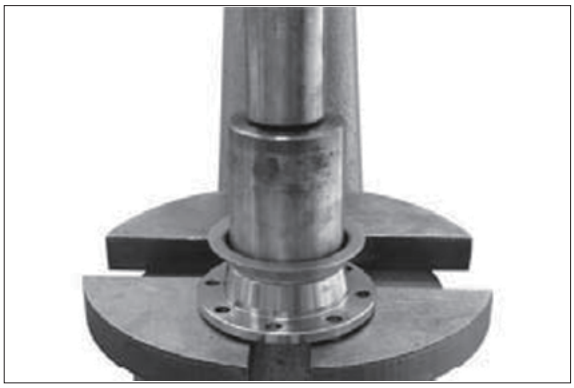
(10) Insert the preassembled input pinion into the axle housing and mount the heated roller bearing until contact is obtained.



17W98FA085

(11) Press screen sheet (see arrow) onto the input flange until contact is obtained.

※ The shaft seal ring is mounted only after contact pattern check.



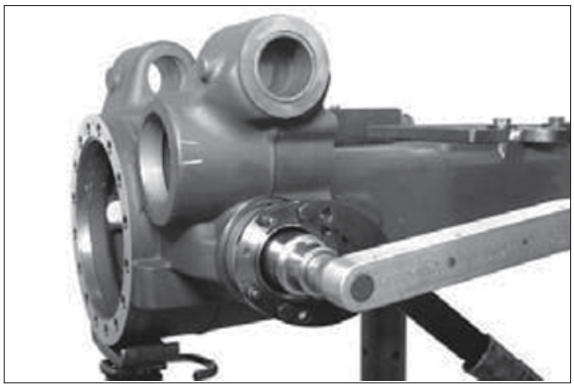
17W98FA086

(12) Mount input flange, fix with disk and hexagon nut.

Tightening torque (M30 x 1,5) . . . . . MA = 600 Nm

(S) Clamping fork 5870 240 025

※ During the tightening process rotate the input pinion several times in both directions.



17W98FA087

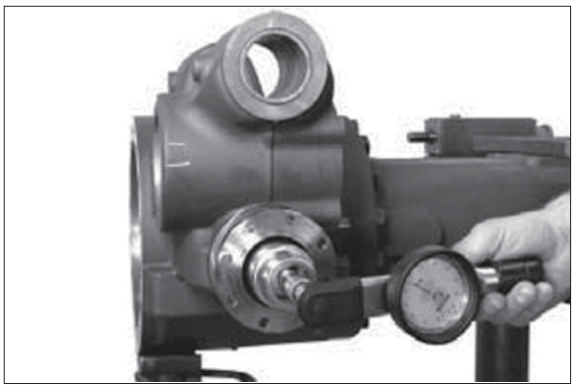
(13) Check rolling torque (1.0 ... 3.0 Nm without shaft seal ring).

※ When installing new bearings try to achieve the upper value of the rolling torque.

※ In case of deviations from the necessary rolling torque correct with a corresponding spacer ring (figure FA084) as specified below.

Insufficient rolling torque
install thinner spacer ring

Excessive rolling torque
install thicker spacer ring.

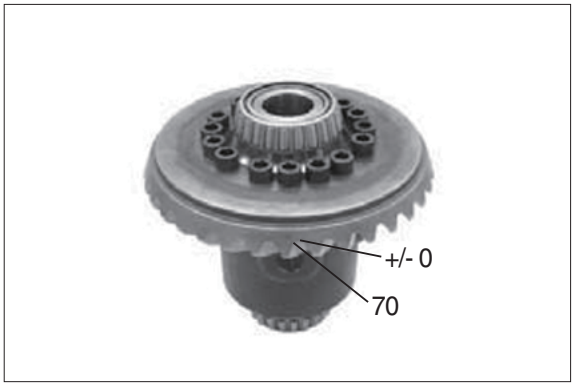


17W98FA088

(14) Determine shim for setting the bearing rolling torque (differential bearing) and backlash (bevel gear set).

※ The required shims must be determined on the basis of the read value (test dimension / crown wheel) and the corresponding specifications of the table next page : (KRS – SET – RIGHT) :
Read test dimension from crown wheel rear.

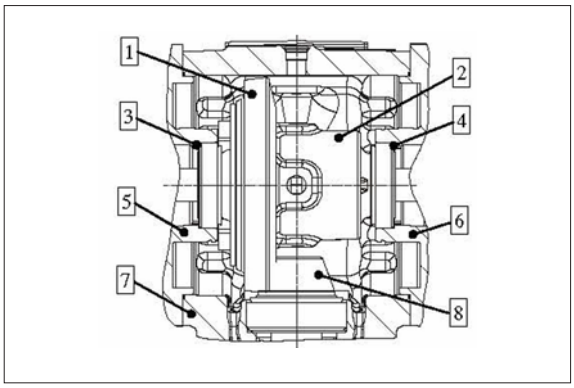
※ Test dimension "70" is stamped into the crown wheel rear. Without + or deviation specification, this corresponds to test dimension / Actual value "70" in the table below.
According to this value the necessary shims are allocated in the table next page.



17W98FA089

※ In case of + or – deviation of the test dimension for production reasons, it is additionally signed on the crown wheel rear (e.g. - 20 or - 10 . 10 or 20) .

※ In accordance with this deviation the necessary shims are allocated in the below table.



17W98FA090

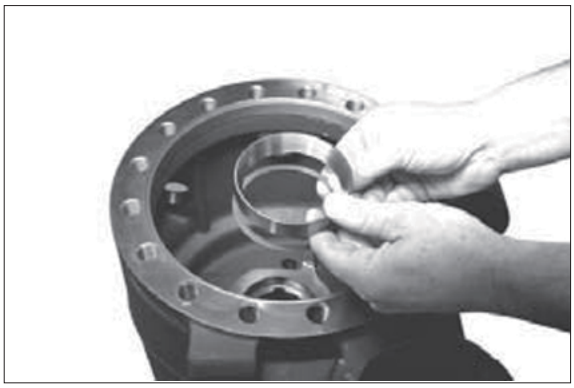
(15) Comment on sketch:

1 = Crown wheel 2 = Differential carrier
3 = Shim (crown wheel side) 4 = Shim (diff. carrier side)
5 = Axle housing 6 = Axle housing
7 = Axle drive housing 8 = Input pinion

Setting disks for differential					
Test dimension/Marking of crown wheel 70 and deviation	-20	-10	0	10	20
Result → Test dimension / Act. value	69.80	69.90	70.0	70.10	70.20
Shim/Diff. carrier side Required disk thickness	0.95	1.05	1.15	1.25	1.35
Shim no.	ZGAQ-00545	ZGAQ-00547	ZGAQ-00549	ZGAQ-00552	ZGAQ-00554
Shim/Crown wheel side Required disk thickness	1.35	1.25	1.15	1.05	0.95
Shim no.	ZGAQ-00554	ZGAQ-00552	ZGAQ-00549	ZGAQ-00547	ZGAQ-00545

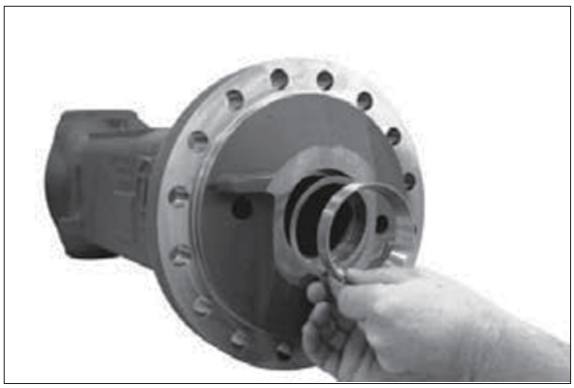
(16) Insert the determined shim (e.g. s = 1.15 mm) and the bearing outer ring into the hole of the axle housing on the differential carrier side.

※ Pivot axle housing 90˚.



17W98FA091

(17) Insert the determined shim (e.g. s = 1.15 mm) and the bearing outer ring into the hole of the axle housing on the crown wheel side.



17W98FA092

(18) Check the contact pattern of the bevel gear set

Wet some drive and coast flanks of the crown wheel with marking ink.

17W98FA093

(19) Insert the preassembled differential into the axle drive housing.

(S) Internal extractor 5870 300 005

17W98FA094

(20) Use lifting tackle to mount the axle housing (crown wheel side) and preliminarily fix with hexagon screws.

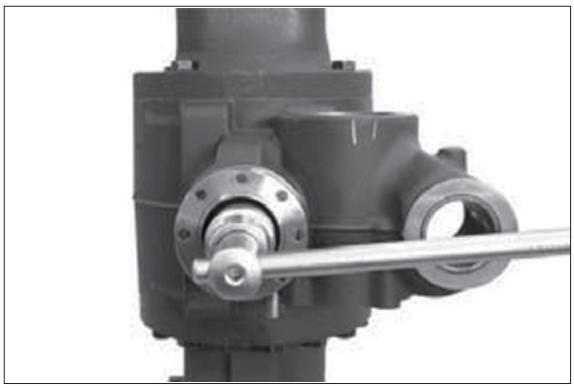
Tightening torque (M18/10.9) . . . . . .
. . . . . .MA = 390 Nm

※ Preliminarily fix axle housing without O-ring.

17W98FA095

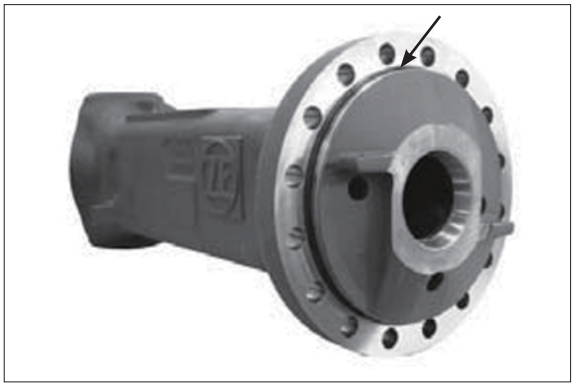
(21) Roll the crown wheel by rotation on the input flange several times in both directions over the input pinion.
Then remove axle housing again and lift differential out of the axle drive housing.
Compare the obtained contact pattern with contact pattern example page 0/4 and 0/5.

※ In case of a contact pattern deviation a measuring mistake was made when determining the shim (figure FA080), which must be absolutely corrected.



17W98FA096

(22) Grease O-ring (see arrow) and mount to axle housing.



17W98FA097

(23) Use lifting tackle to mount the axle housing (part II), finally tighten with hexagon screws.

Tightening torque (M18/10.9) . . . . . .
. . . . . MA = 390 Nm

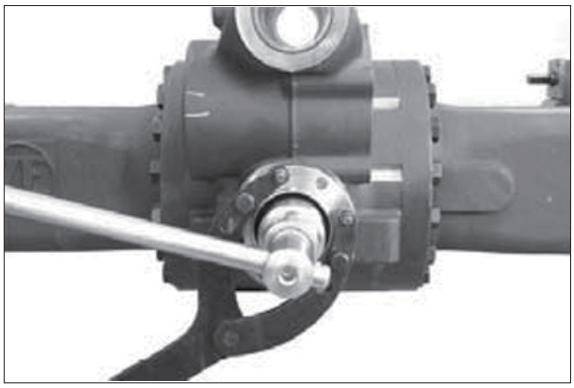
Then bring axle into horizontal position and reassemble the second clamping angle (S) (see also figure FA001).

17W98FA098

(24) Mount shaft seal ring (input flange)

Loosen hexagon nut and pull the input flange from the input pinion.

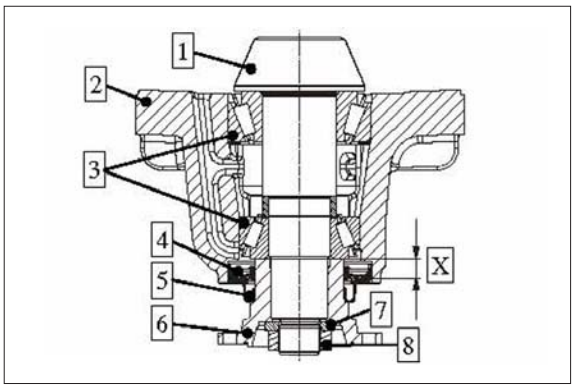
(S) Clamping fork 5870 240 025



17W98FA099

(25) Comment on sketch:

1 = Input pinion
2 = Axle drive housing
3 = Tapered roller bearing
4 = Shaft seal ring
5 = Screen sheet
6 = Input flange
7 = Disk
8 = Hexagon nut
X = Installation dimension → 13.5 +0, 2 mm



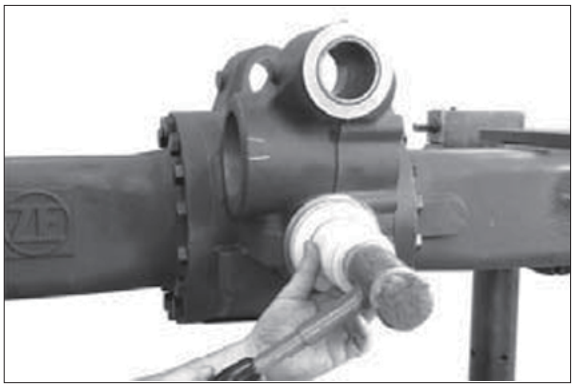
17W98FA100

(26) Mount shaft seal ring with the seal lip showing to the oil chamber.

(S) Driver tool 5870 048 286

※ Use of the specified driver tool (S) ensures the exact installation position of the shaft seal ring.

※ Just before fitting, wet contact face shaft seal ring/axle drive housing with lubricant. Apply grease on seal and dust lip of the shaft seal ring.



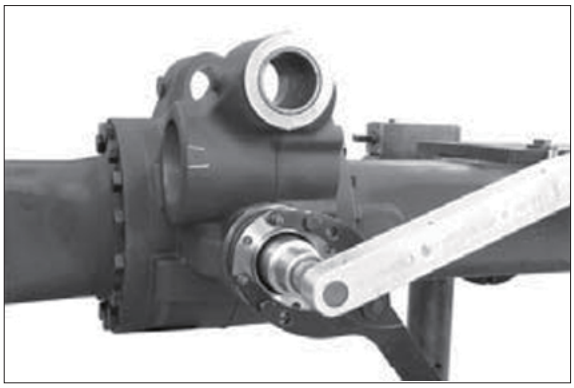
17W98FA101

(27) Mount input flange, finally tighten with disk and hexagon nut.

Tightening torque (M30x1.5) . . . . . MA = 600 Nm

(S) Clamping fork 5870 240 025

※ Wet thread of the hexagon nut with Loctite no. 262.



17W98FA102

3) OUTPUT

(1) Preassembly axle housing

Insert bushing into hole of axle housing considering installation dimension “B” and installation position "Y" (see also sketch FA104 and FA106).

(S) Driver tool	5870 055 081
(S) Handle	5870 260 002

17W98FA103

(2) Comment on sketch:

1 = Axle housing

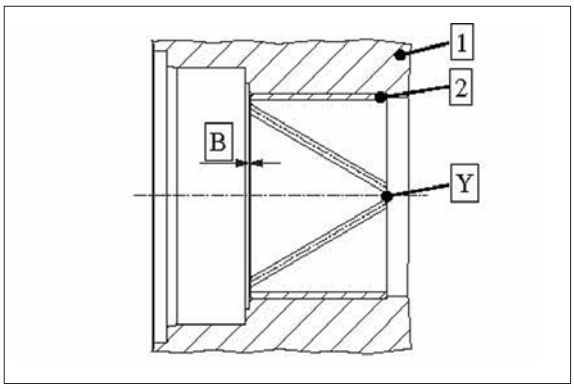
2 = Bushing

B = Installation dimension 1.0±0.3 mm

Y = Installation position / lubrication groove outlet of bushing (top view)

※ Lubrication groove outlet (V-point) must be mounted in 6 o’clock position (bottom) and showing to the oil chamber side.

※ Use of the specified driver tool (S) ensures the exact installation depth of the bushing.

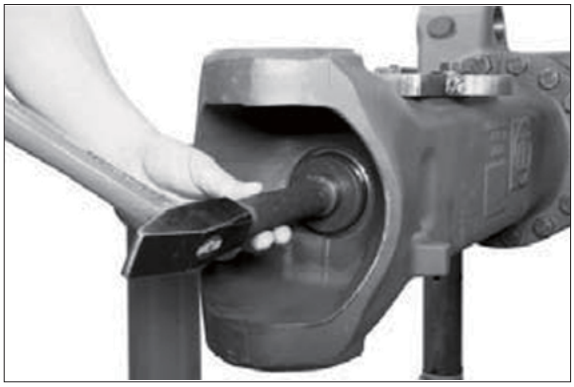


17W98FA104

(3) Flush-mount seal ring with the seal lip showing to the oil chamber (see sketch FA106) into the axle housing hole.

(S) Driver tool	5870 055 081
(S) Handle	5870 260 002

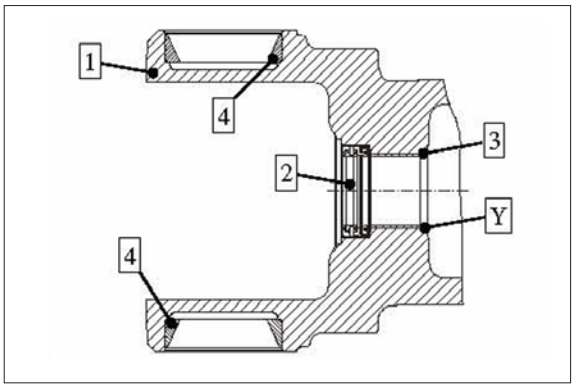
※ Use of the specified driver tool (S) ensures the exact installation position of the shaft seal ring.



17W98FA105

※ Just before fitting wet the contact face shaft seal ring/axle drive housing with lubricant.
Apply grease on seal and dust lip of the shaft seal ring.

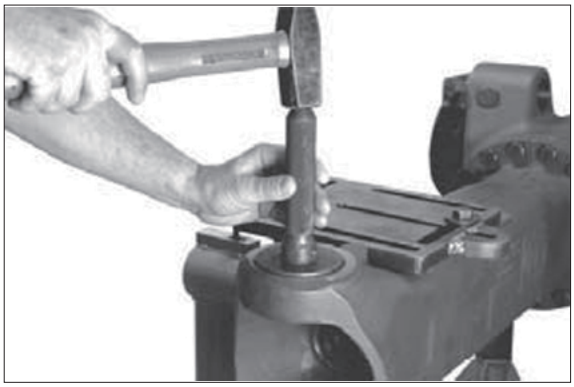
(4) Comment on sketch:
1 = Axle housing
2 = Shaft seal ring
3 = Bushing
4 = Bearing outer rings (pivot bearing)
Y = Lubrication groove outlet (V-point – in 6 o'clock position and on oil chamber side)



17W98FA106

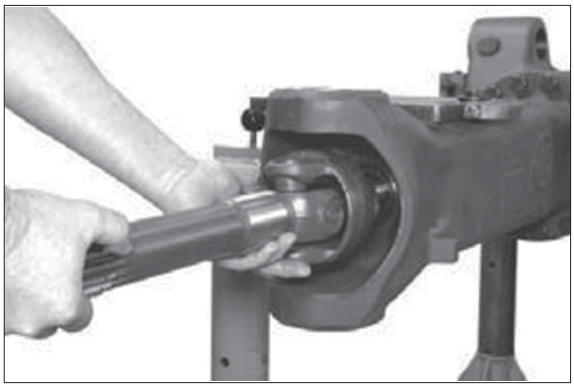
(5) Insert both bearing outer rings into the pivot bearing holes of the axle housing.

(S) Driver tool	5870 058 058
(S) Handle	5870 260 002


17W98FA107

(6) Install the u-joint shaft by inserting the u-joint shaft into the axle bevel gear teeth.

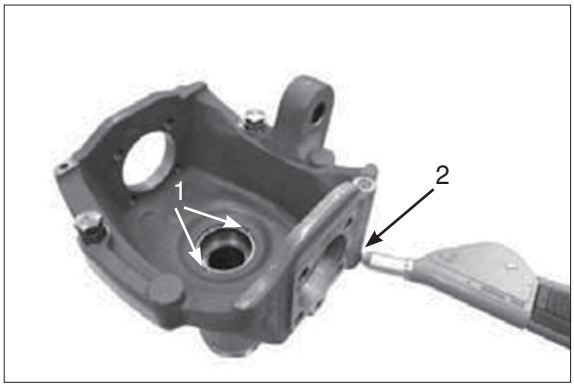
※ Pay attention to shaft seal ring in the axle housing risk of damage.


17W98FA108

(7) Knuckle housing (pivot bearing-SET-RIGHT)
Seal machining openings of oil supply holes – position 1 and 2 with plugs.

(S) Lever riveting tongs	5870 320 016

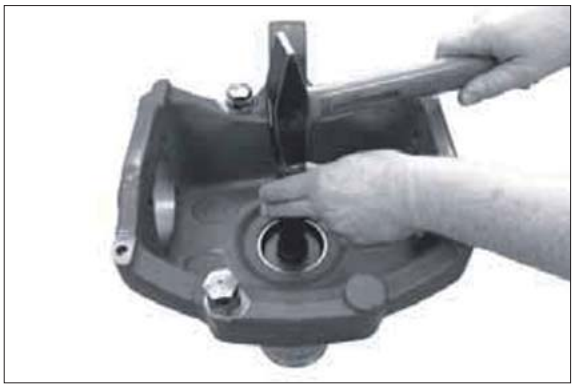
※ Operation is only required when using a new knuckle housing.



17W98FA109

(8) Insert bushing into the hole of the knuckle housing considering the installation dimension "B" and installation position "Y" (see also sketch FA111 and FA113).

(S) Driver tool 5870 055 090
(S) Handle 5870 260 002



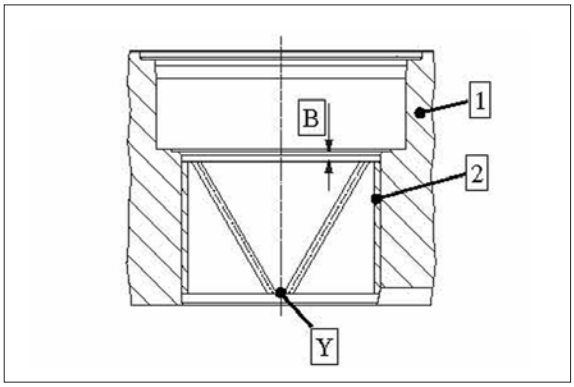
17W98FA110

(9) Comment on sketch:

1 = Knuckle housing
2 = Bushing
B = Installation dimension. . . 2.0±0.2 mm
Y = Installation position / lubrication groove outlet of the bushing

※ Lubrication groove outlet (V-point) must be mounted in 6 o'clock position (bottom) and showing to the oil chamber side (referred to the axle fitted into the vehicle).

※ Use of the specified driver tool (S) ensures the exact installation depth of the bushing.



17W98FA111

(10) Insert shaft seal ring into the hole of the knuckle housing with the seal lip showing to the oil chamber – considering the installation dimension "W" (see also sketch below).

(S) Driver tool 5870 055 081
(S) Handle 5870 260 002

※ Use of the specified driver tool (S) ensures the exact installation position of the shaft seal ring.

17W98FA112

(11) Comment on sketch:

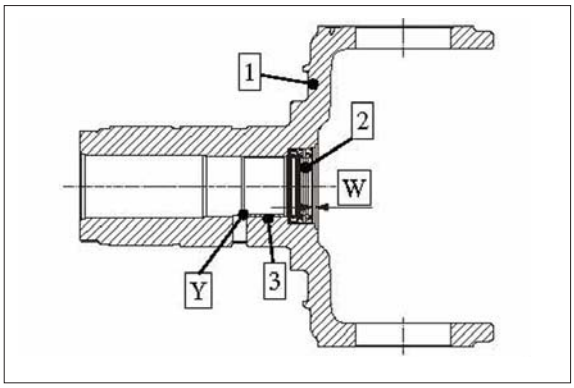
1 = Knuckle housing

2 = Shaft seal ring

3 = Bushing

W = Installation dimension – shaft seal ring . . . . . 2.0±0.2 mm

Y = Lubrication groove outlet (V-point) must be mounted in 6 o'clock position and showing to the oil chamber side (referred to the axle fitted into the vehicle)



17W98FA113

※ Just before fitting wet contact face shaft seal ring / knuckle housing with sealing agent.

Apply grease on seal and dust lip of the seal ring.

(12) Grease O-ring (see arrow) and insert it into the groove of the bearing pin.

17W98FA114

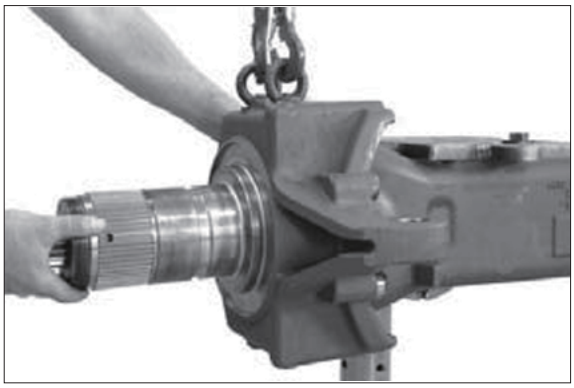
(13) Place sealing cap (see arrow) and mount the tapered roller bearing until contact position is obtained.

17W98FA115

(14) Locate pre-assembled knuckle housing on axle housing and carefully mount u-joint shaft.

(S) Eyebolts (M 16) 0636 804 001

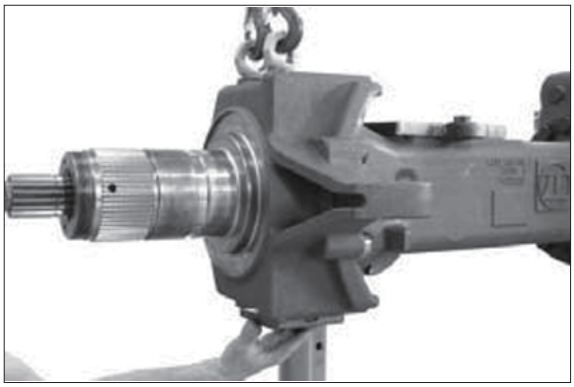
※ Pay attention to shaft seal ring in the knuckle housing risk of danger.



17W98FA116

(15) Insert the pre-assembled lower bearing pin and preliminarily fix with hexagon screws.

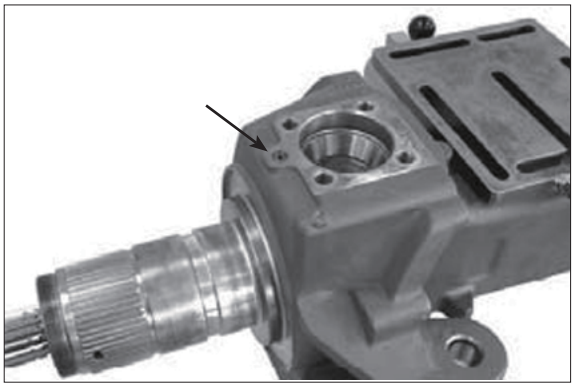
※ Pay attention to installation position mount bearing pin with lubrication nipple showing to axle centre.



17W98FA117

(16) Insert O-ring (see arrow) or O-rings into countersink of the knuckle housing.

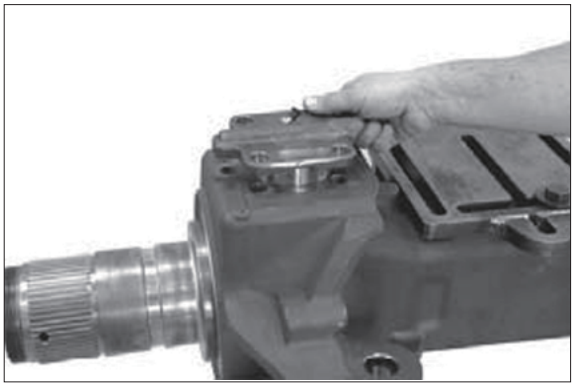
1 ps for version with breather valve in the knuckle housing
2 pcs for version with breather valve in the bearing pin



17W98FA118

(17) Insert pre-assembled upper bearing pin.

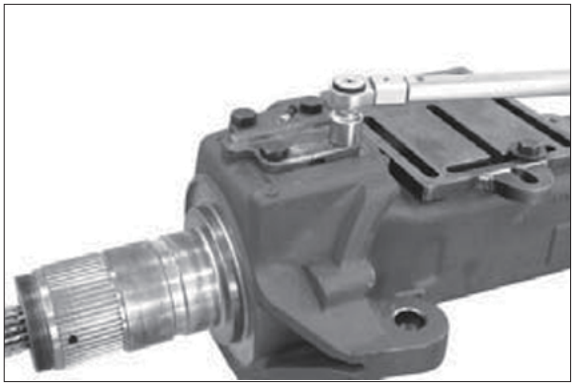
※ Observe installation position mount bearing pin with oil supply holes showing to axle centre.



17W98FA119

(18) Fix both bearing pins definitely.

※ Tightening torque (M 16/10.9) . . . . . MA = 280 Nm



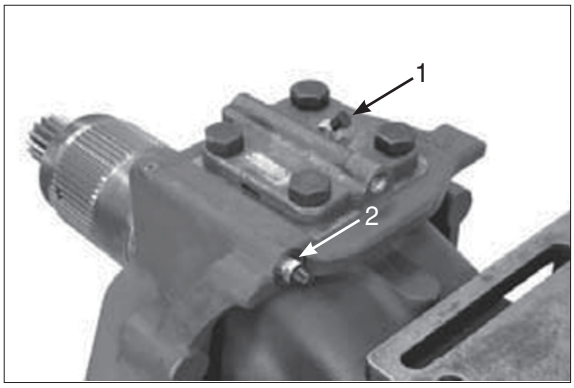
17W98FA120

(19) Mount lubrication nipple in both bearing pins (arrow 1 showing to the axle centre) and apply grease to the pivot bearing.

Tightening torque (M 10×1) . . . . . MA = 3 Nm

Mount breather valve (arrow 2, position depending on version : integrated in the knuckle housing or in the bearing lid) and provide with dust cap.

Tightening torque (M 14×1,5) . . . . . MA = 20 Nm



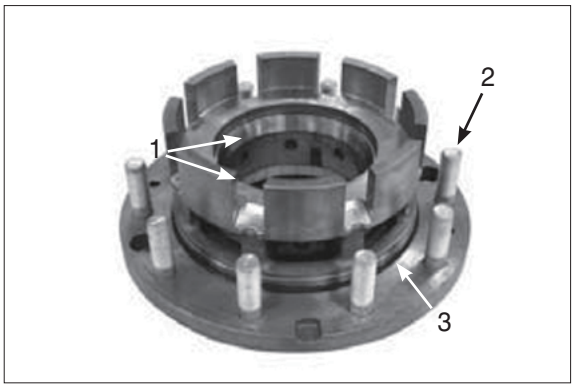
17W98FA121

4) HUB (Hub bearing-SET-RIGHT)

(1) Insert both bearing outer rings (1) of the hub bearing until contact position is obtained.

Press wheel bolts (2) into the hub until contact position is obtained.

Oil O-ring (3) and locate in annular groove of hub.



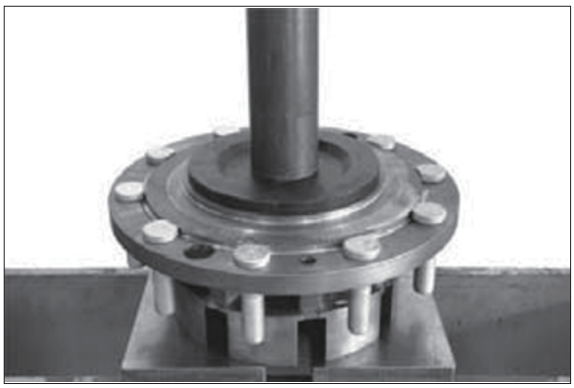
17W98FA122

(2) Press shaft seal ring with the marking "OUT SIDE" showing outside (upwards) into the hub.

(S) Driver tool 5870 051 035

※ Use of the specified driver tool (S) ensures the exact installation position of the shaft seal ring.

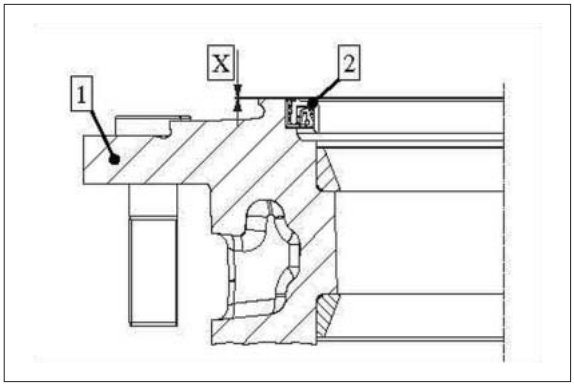
※ Wet the outer diameter of the shaft seal ring with Loctite no. 574.



17W98FA123

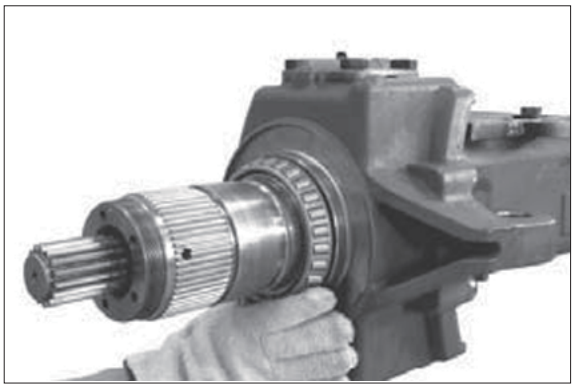
(3) Comment on sketch:

1 = Hub
2 = Shaft seal ring
X = Installation dimension – Shaft seal ring
..... 0.0~0.3 mm



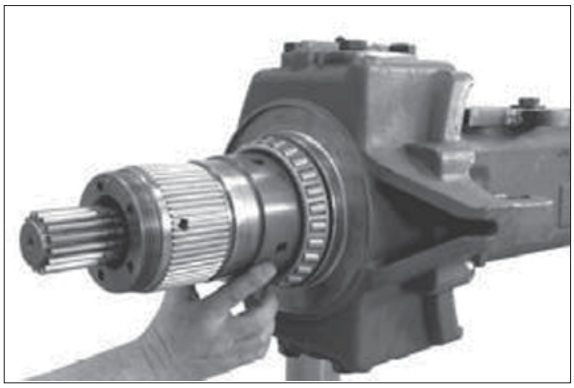
17W98FA124

(4) Heat the tapered roller bearing and mount until contact position with the knuckle housing is obtained.



17W98FA125

(5) Insert spacer bushing.



17W98FA126

(6) Install preassembled hub until contact is obtained and fix with heated tapered roller bearing.

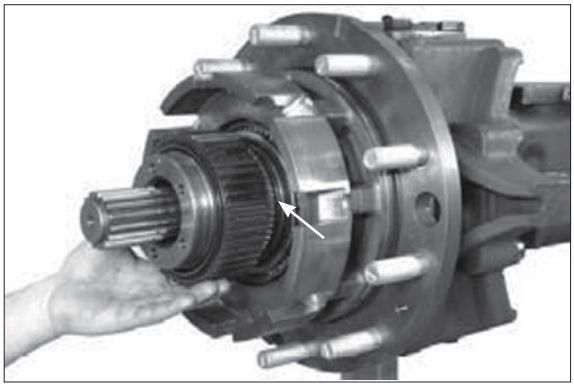
(S) Lifting bracket 5870 281 043

※ Just before fitting wet the seal lips of the shaft seal ring with lubricant.

17W98FA127

(7) Oil O-ring and insert it into the annular groove (see arrow) of the knuckle housing.

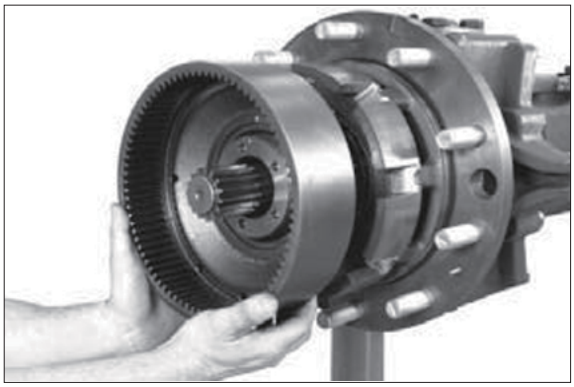
Then install disk carrier.



17W98FA128

(8) Bring disk carrier and hub bearing into contact position (figure FA129 and FA130)

Install ring gear (without sealing elements).



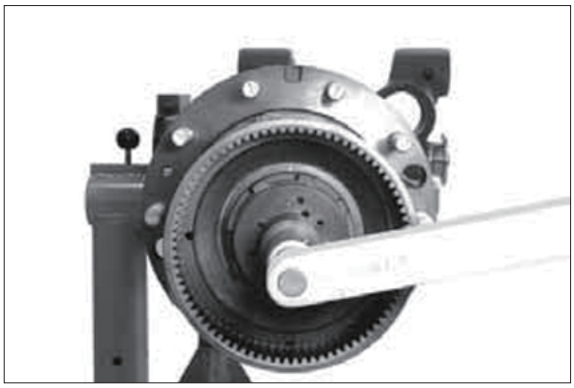
17W98FA129

(9) Bring hub bearing into contact position for this purpose tighten slotted nut with a tightening torque of max. 1400 Nm.

(S) Socket wrench 5870 656 097

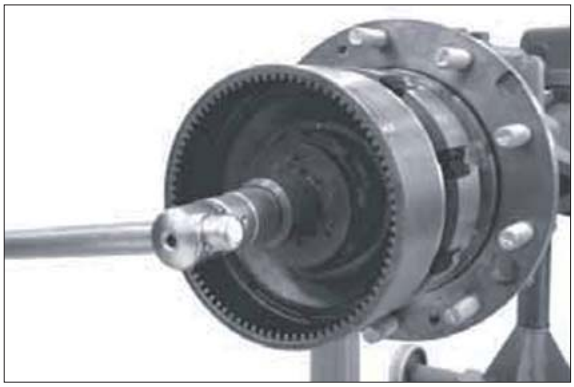
※ While tightening the slotted nut rotate hub in both directions several times roller setting.

※ Apply lubricant to thread knuckle housing / slotted nut.



17W98FA130

(10) Loosen slotted nut again and remove ring gear.



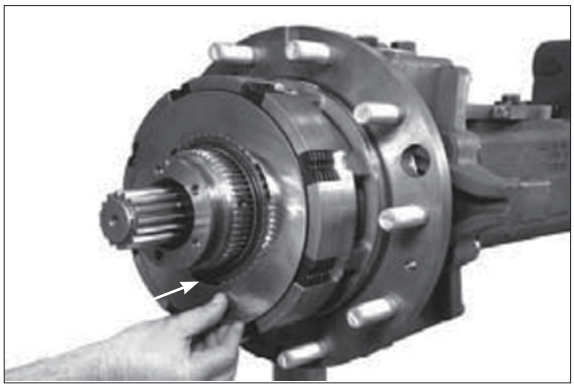
17W98FA131

5) DISK BRAKE

(1) Install disk package alternately starting with an outer disk.

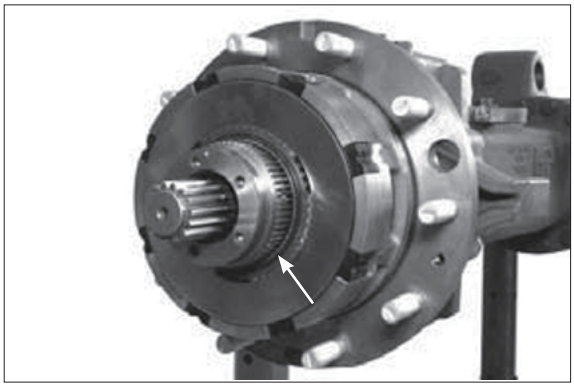
※ Take the actually required disk fitting / arrangement from the corresponding spare parts list.

※ Bring inner clutch disks in a position where one of the tooth recesses (see arrow) is in 6 o'clock position with axle being installed in the vehicle.



17W98FA132

(2) Oil O-ring and locate in annular groove of disk carrier.



17W98FA133

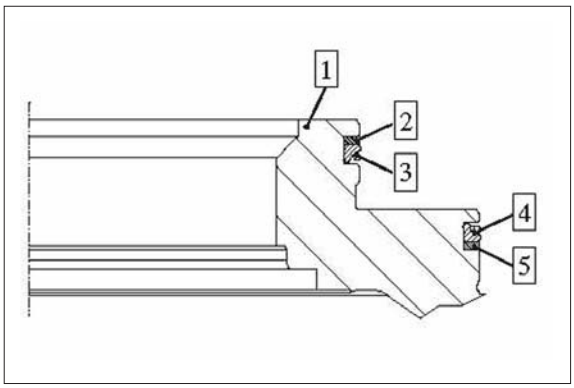
(3) Oil U- and support rings and insert them into the annular grooves of the ring gear.

※ Observe installation position, see sketch below.

17W98FA134

(4) Comment on sketch:

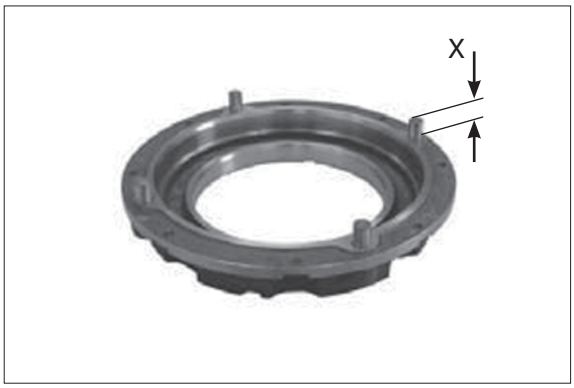
1 = Ring gear
2 = Support ring
3 = U-ring
4 = U-ring
5 = Support ring



17W98FA135

(5) Mount cylindrical pins into piston, considering installation dimension "X".

X = Installation dimension . . . . . 18.00 mm



17W98FA136

(6) Install piston on ring gear.

17W98FA137

(7) Fix piston with "new" hexagon screws (1), spring sleeves (2) and compression springs (3 and 4).

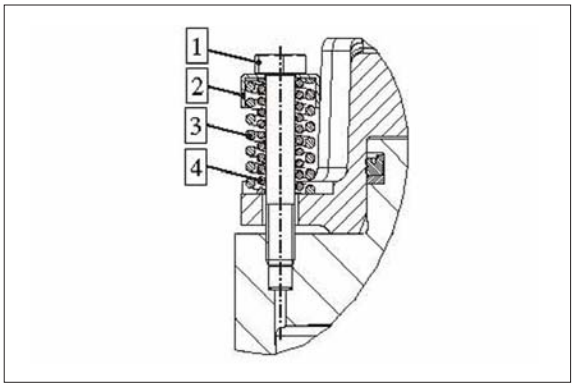
Tightening torque (M 6/8.8) . . . . . MA = 8 Nm

※ Use hexagon screws just once.

17W98FA138

(8) Comment on sketch:

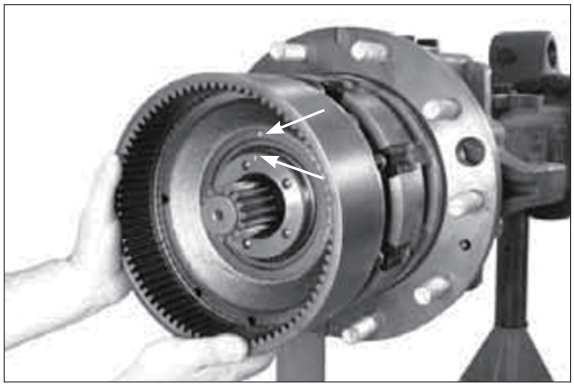
1 = Hexagon screw (special version)
2 = Spring sleeve
3 = Compression spring
4 = Compression spring



17W98FA139

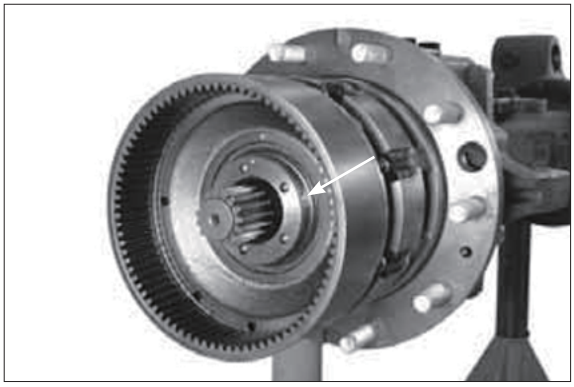
(9) Mount preassembled ring gear considering the installation position (markings O in 12 o'clock position - see arrows).

※ Ensure exact toothing position of oil supply holes knuckle housing / ring gear (pressure oil supply to brake piston).



17W98FA140

(10) Oil O-ring and insert in recess (see arrow).



17W98FA141

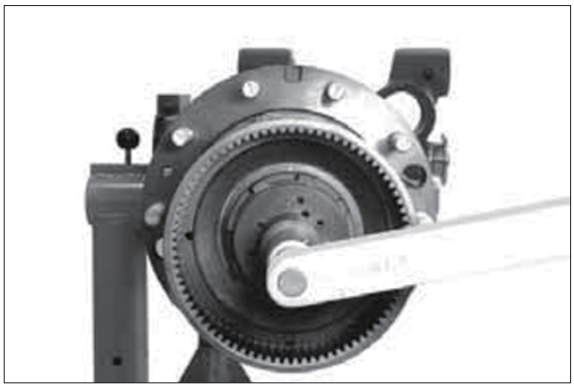
(11) Fix ring gear with slotted nut.

Tightening torque:
(M 110 x 1.5) . . . . . MA = 1400 $^{+200}$ Nm

(S) Socket wrench 5870 656 097

※ First tighten slotted nut with 1400 Nm, then retighten slotted nut until a fixing hole overlaps a threaded hole in the knuckle housing.
While tightening the slotted nut rotate hub in both directions several times roller setting.

※ Wet thread knuckle housing / slotted nut with lubricant.



17W98FA142

(12) Make leakage test of multi-disk brake

Mount threaded coupling (S) and connect HP pump.

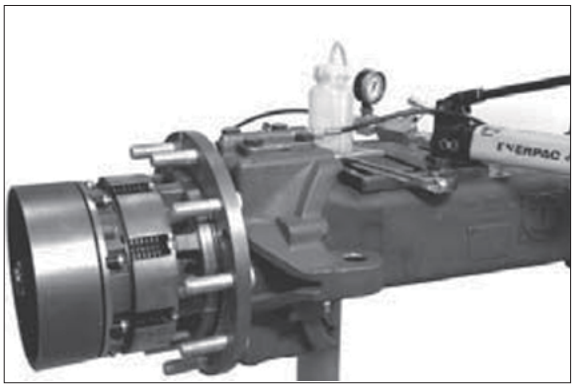
(S) HP pump 5870 287 007
(S) Threaded coupling (M14x1.5) 5870 950 102
(S) Breather bottle 5870 286 072

※ Breathe brake completely before starting the test.

Test media :
Motor oils SAE-10W

High-pressure test:
Build up test pressure p = 100 bar and close locking valve of HP pump.
A pressure drop by max. 3 bar is permissible during a 5-minute test duration.

Low pressure test:
Reduce test pressure p = 5 bar and close locking valve.
No pressure drop is allowed during a 5-minute testing duration.



17W98FA143

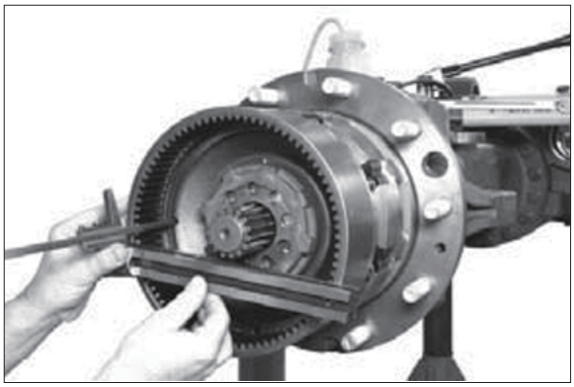
(13) **Adjust and check piston stroke**

Piston stroke / disk clearance = 0.7 ..... 1.3 mm
Build up braking pressure (100 bar) and close locking valve of the HP pump.

Determine dimension "A", from face of the ring gear (1) through measuring hole (see also sketch FA145) to the face of the piston (3).

Dimension "A" e.g. . . . . 83.10 mm

※ Breathe brake completely before starting the measuring operation.

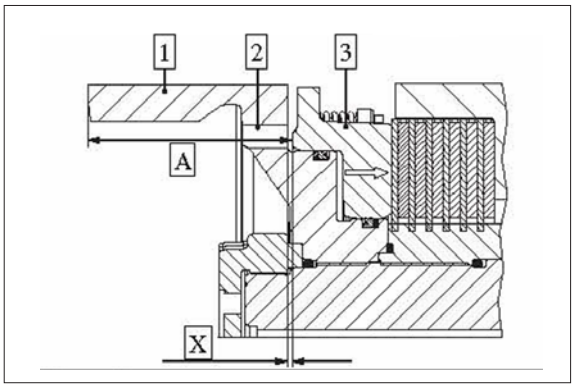


17W98FA144

(14) Then open locking valve of the HP pump and release pressure from brake (reset piston through compression springs).

Determine dimension "B", from the face of the ring gear (1) through the measuring hole (see also sketch FA146) to the face of the piston (3).

Dimension "B" e.g. . . . . 82.10 mm



17W98FA145

(15) CALCULATION EXAMPLE:

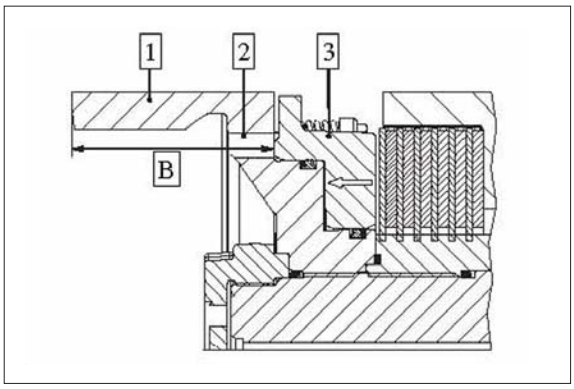
Dimension "A" e.g. . . . . 83.10 mm
Dimension "B" e.g. . . .. - 82.10 mm
Difference = Piston stroke = 1.00 mm

※ If the required piston stroke (0.7 ... 1.3 mm) is not achieved, correct it with the corresponding inner clutch disk (s) – refer to corresponding spare parts list.

Then remove HP pump (S), breather bottle (S) and threaded coupling (S).

Comment on sketch 43 and 44:
1 = Ring gear
2 = Measuring hole
3 = Piston
X = Piston stroke / disk clearance

(S) Straightedge 5870 200 022



17W98FA146

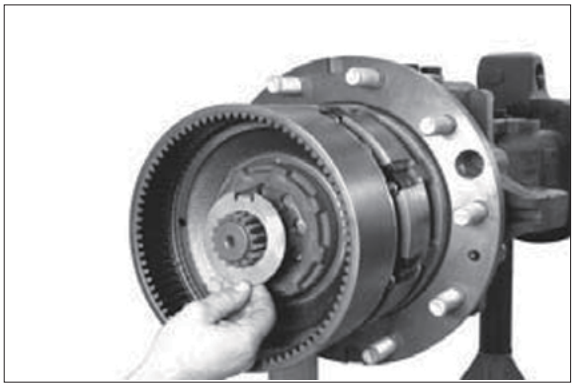
(16) Secure slotted nut with cylindrical screw (please also refer to figure FA142)

Tightening torque (M 10/8.8) . . . . . MA = 32 Nm

17W98FA147

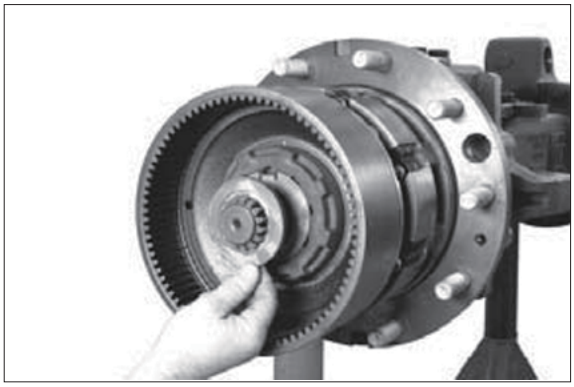
(17) Insert thrust washer.

※ Observe installation position ensure that both lugs of the thrust washer are engaged each in a spare fixing hole of the slotted nut.



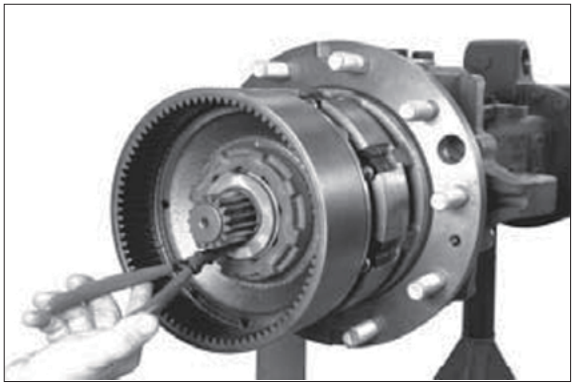
17W98FA148

(18) Mount thrust washer with shoulder showing to the retaining ring (outwards).



17W98FA149

(19) Fix thrust washers by using a retaining ring.



17W98FA150

6) PLANETARY CARRIER

(1) Press thrust washer into the planetary carrier until contact position is obtained.

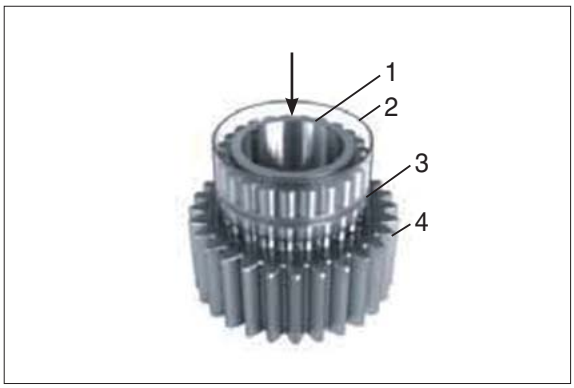
(S) Driver tool 5870 048 245

17W98FA151

(2) Insert the cylindrical roller bearing into the planetary gear for this purpose press the cylindrical roller bearing through the packaging sleeve until the snap ring engages into the annular groove of the planetary gear.

※ Use packaging sleeve to facilitate assembly.

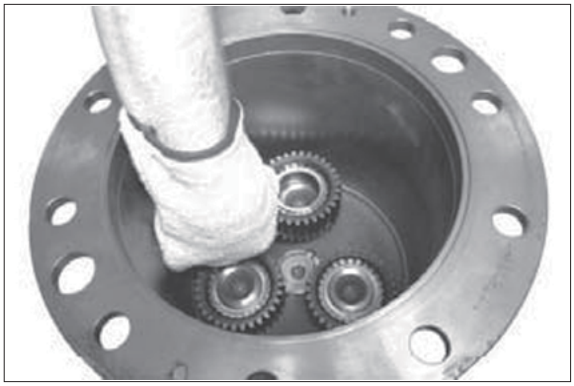
1 = Cylindrical roller bearing
2 = Packaging sleeve
3 = Snap ring
4 = Planetary gear



17W98FA152

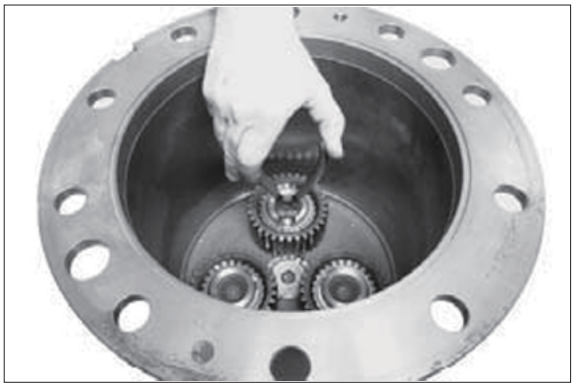
(3) Warm up bearing inner ring and install pre-assembled planetary gear until contact is obtained.

※ Mount bearing inner ring with large radius, showing to the planetary carrier (downwards).



17W98FA153

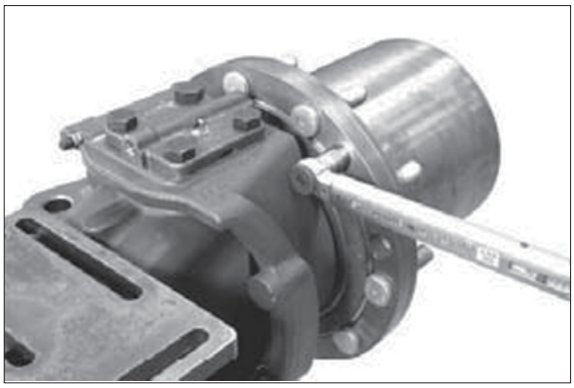
(4) Fix planetary gear by means of retaining ring.



17W98FA154

(5) Install preassembled planetary carrier and fix with hexagon screws.

Tightening torque (M12/8.8) . . . . . MA = 55 Nm



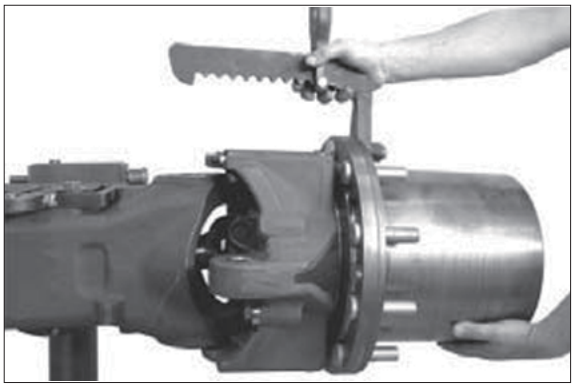
17W98FA155

(6) Output assy

Locate output assy on the axle by means of the lifting bracket (S) by installing the u-joint shaft in the axle bevel gear toothing.

(S) Lifting bracket 5870 281 043

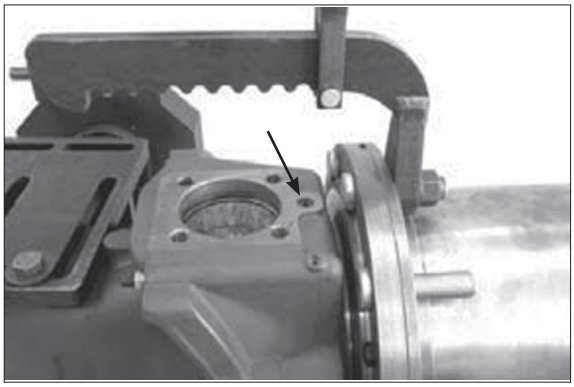
※ Pay attention to shaft seal ring in the axle housing risk of damage.



17W98FA156

(7) Insert O-ring (see arrow) or O-rings into the countersink (s) of the knuckle housing.

1 pc for version with breather valve in knuckle housing.
2 pcs. for version with breather valve in bearing pin.

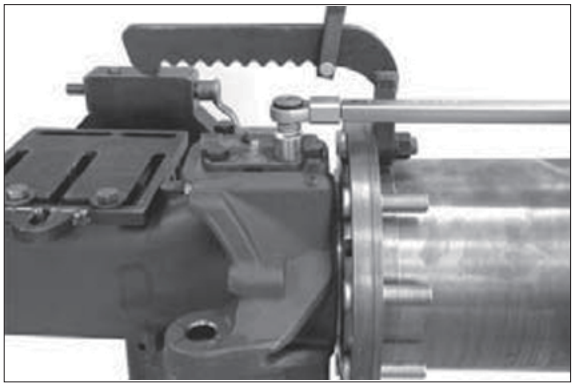


17W98FA157

(8) Mount both bearing pins and fix with hexagon screws or locking screws.

Tightening torque (M 16/10.9) . . . . . MA = 280 Nm

※ Observe installation position, mount upper bearing pin with oil supply holes showing to axle centre.



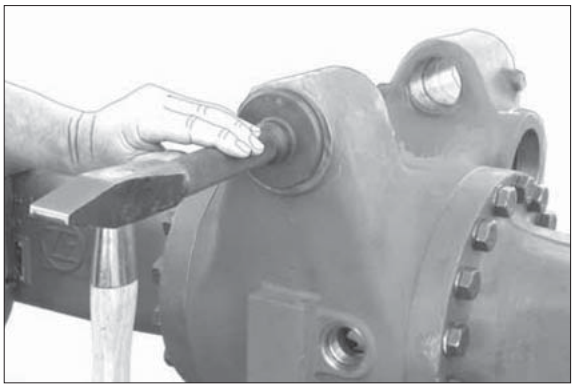
17W98FA158

(9) Pivot bearing

Super-cool bushings and insert into the heated pivot bearing hole until contact is obtained.

※ Observe installation position for bushing version with slot, insert bushings with slot in 12 o'clock position.

※ Prior to putting the axle into operation, fill in oil.

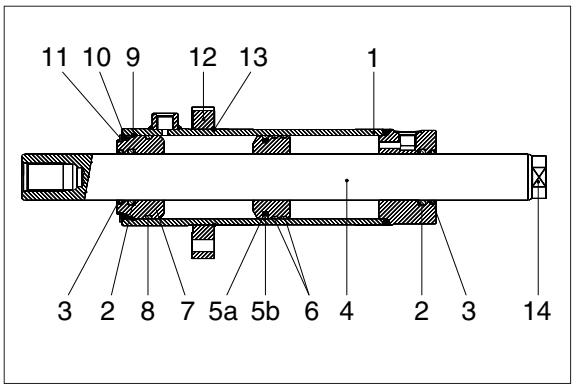


17W98FA159

7) STEERING

(1) Comment on sketch:

1 = Steering cylinder
2 = Grooved ring
3 = Scraper
4 = Piston rod
5a = O-ring
5b = Form seal ring 〉Piston sealing
6 = Guide ring
7 = Brake head
8 = Dual ring
9 = Retaining ring
10 = O-Ring (only for version "with" O-ring)
11 = Retaining ring
12 = Flange
13 = Retaining ring
14 = Wrench point of attack (piston rod)



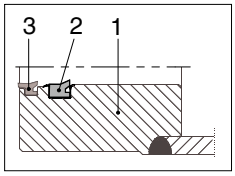
17W98FA160

(2) Preassemble steering

Mount U-ring (2) and scraper (3) in the steering cylinder (1).

※ Observe installation position – see detailed sketch.

Detailed sketch:

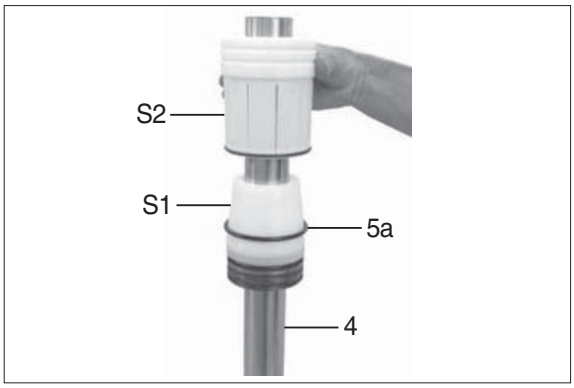


17W98FA161

(3) Position inner installer (S1) on piston rod (4).

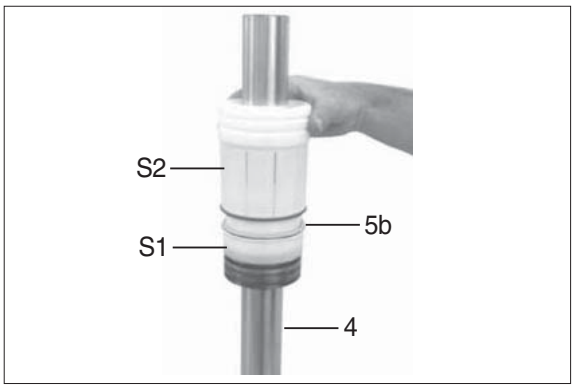
Mount O-ring (5a) and press with inner installer (S2) into annular groove (arrow) of the piston (4).

(S) Inner installer (S1) 5870 651 086
(S) Inner installer (S2) 5870 651 087



17W98FA162

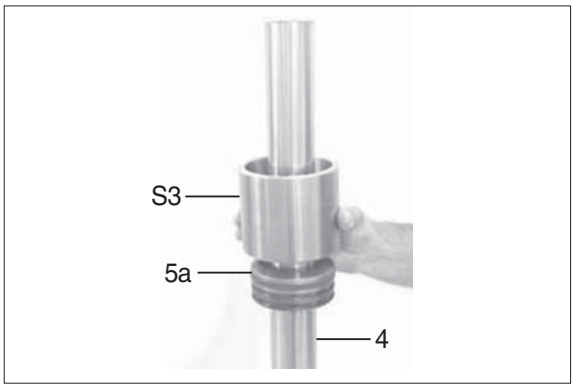
(4) Install form seal ring (5b) and press with inner installer (S2) into the annular groove of the piston (4).



17W98FA163

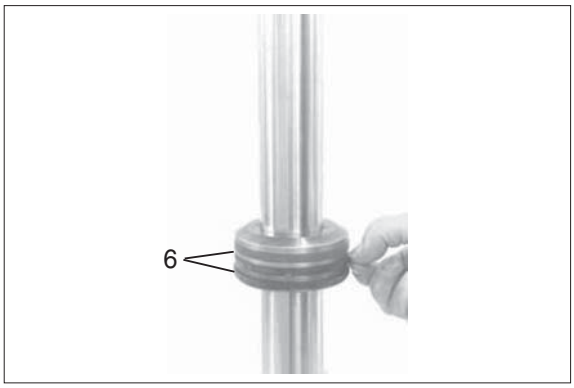
(5) Calibrate form seal ring (5b) with calibration bushing (S3).

(S) Calibration bushing (S3) 5870 651 090



17W98FA164

(6) Place both guide rings (6) into the annular grooves of the piston rod.

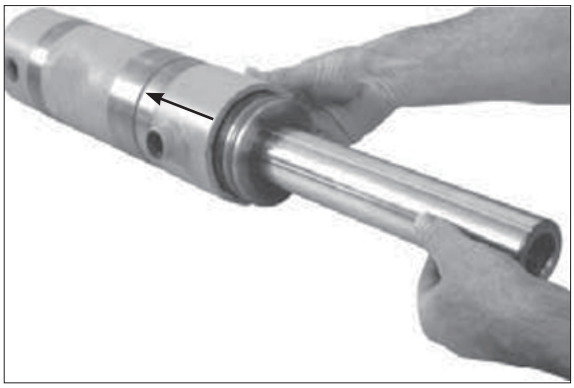


17W98FA165

(7) Insert preassembled piston rod into the steering cylinder.

※ Slightly oil all sealing elements before installing the piston rod.

※ Observe installation position, insert piston rod with wrench point of attack (14, see also sketch FA160) showing in direction of arrow.

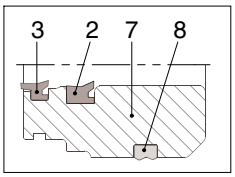


17W98FA166

(8) Insert U-ring (2), scraper (3) and dual ring (8) into the grooves of the brake head (7).

※ Observe installation position in this connection refer to detailed sketch.

Detailed sketch:



17W98FA167

(9) Push preassembled brake head into the steering cylinder so that the retaining ring (see figure FA169) can be mounted.

※ Slightly oil all sealing elements before inserting the brake head.

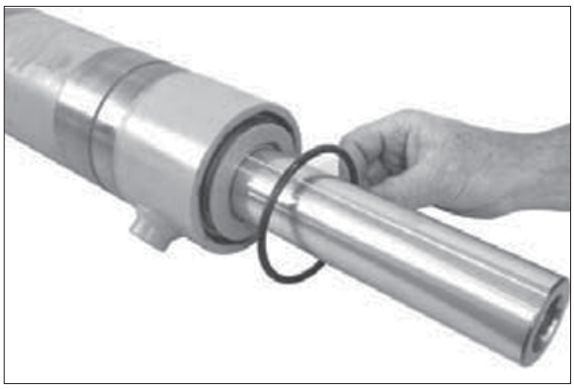
17W98FA168

(10) Engage retaining ring (9) into the groove of the cylinder tube.

17W98FA169

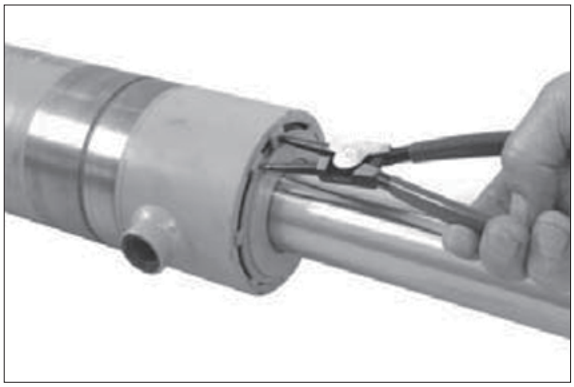
(11) Position the inserted brake head (7) on the snap ring (9) until contact is obtained (arrow).

Only for version with O-ring (see corresponding spare parts list) : Oil O-ring (10) and place into the recess.



17W98FA170

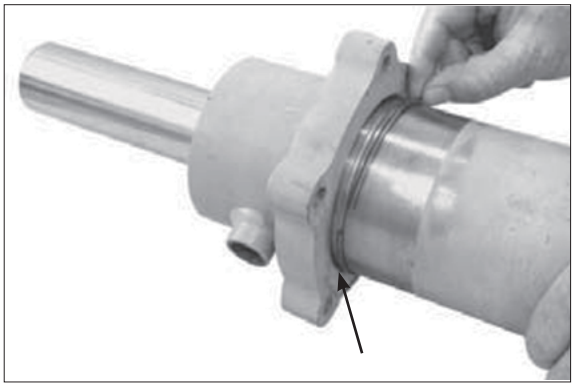
(12) Fix brake head (7) with retaining ring (11).



17W98FA171

(13) Install flange (12) and engage retaining ring (13).

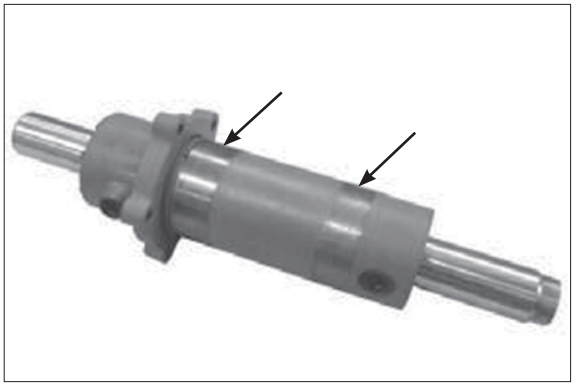
※ Observe installation position of flange mount flange with chamfer (see arrow) showing to the snap ring.



17W98FA172

(14) Mount steering

Apply anti-corrosive agent (Weicon Anti-Seize) on contact faces (cylinder tube / axle housing, see arrow).



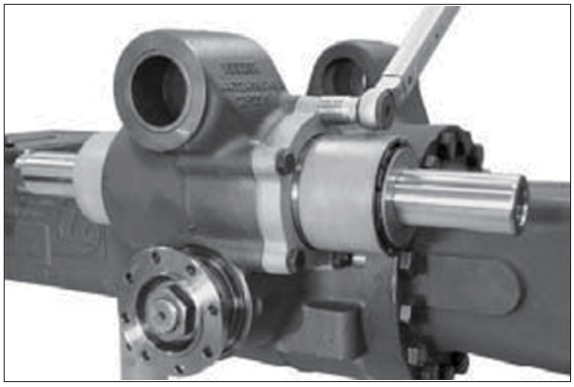
17W98FA173

(15) Insert preassembled steering cylinder into axle housing and fix with hexagon screws.

Tightening torque (M 12/8.8) . . . . . MA = 79 Nm

※ The radial installation position of the steering cylinder (position of the hydr. connections) is customer specific see also disassembly instructions figure FA018.

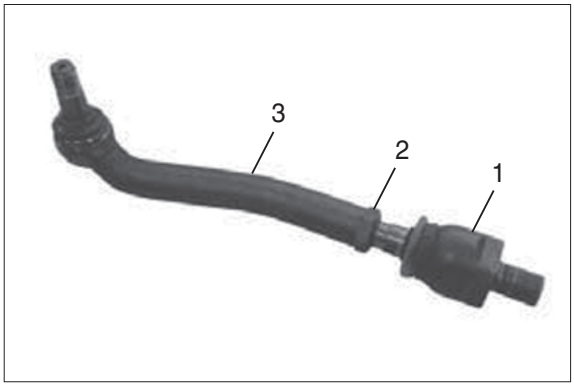
※ Wet the thread of the hexagon screws with Loctite no. 243.



17W98FA174

(16) Bolt hexagon nut (2) and ball joint (3) to axial joint (1).

※ Do not tighten hexagon nut before setting the track.



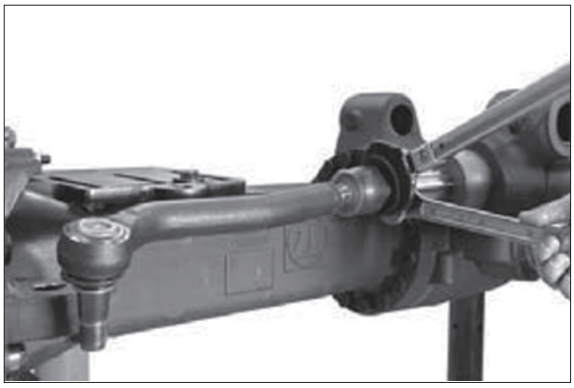
17W98FA175

(17) Fix both tie rods to piston rod (with offset showing to the axle housing).

Tightening torque (M30 × 1.5) . . . . . MA = 450 Nm

※ (S) Socket wrench (SW 55) 5870 656 100

Wet thread of the axial joint with Loctite no. 243.

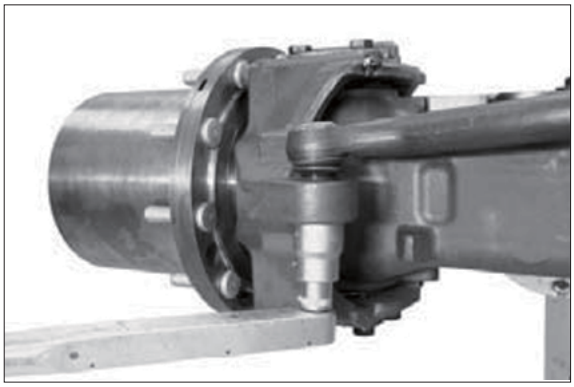


17W98FA176

(18) Install tie rod into knuckle housing and fix with "new" locking nut.

Tightening torque (M 27 × 1.5) . . . . . MA = 600 Nm

※ Use locking screws just once.



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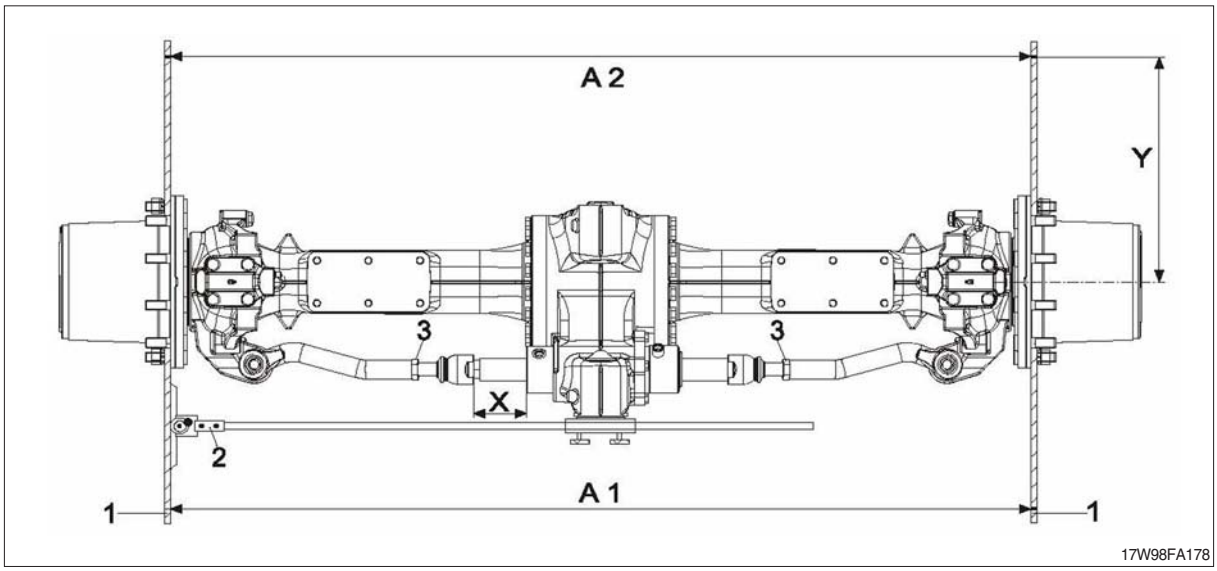
(19) Steering setting and checking



1 = (S) Straightedge 5870 200 029
2 = (S) Measuring device 5870 200 033
3 = Hexagon nut
X = Installation dimension (central position – piston rod)
Y = Distance – wheel center to rim flange

(20) Basic track setting

Bring piston rod in central position.
Dimension X = 119 mm (measured from front face/steering cylinder to contact face/axial joint).

※ Do not change axial position of piston rod any more during track setting.

Mount straightedge (1) in horizontal and central axis position.
Fix measuring device (2) to yoke.
Loosen hexagon nut (3) and set length of tie rod (axial joint) until the measuring device (2) indicates 0° (corresponds to a track setting of zero mm).

※ For a toe-in and toe-out setting, which might be required, stick to the vehicle manufacturer's specification.

※ Make setting on both output sides.

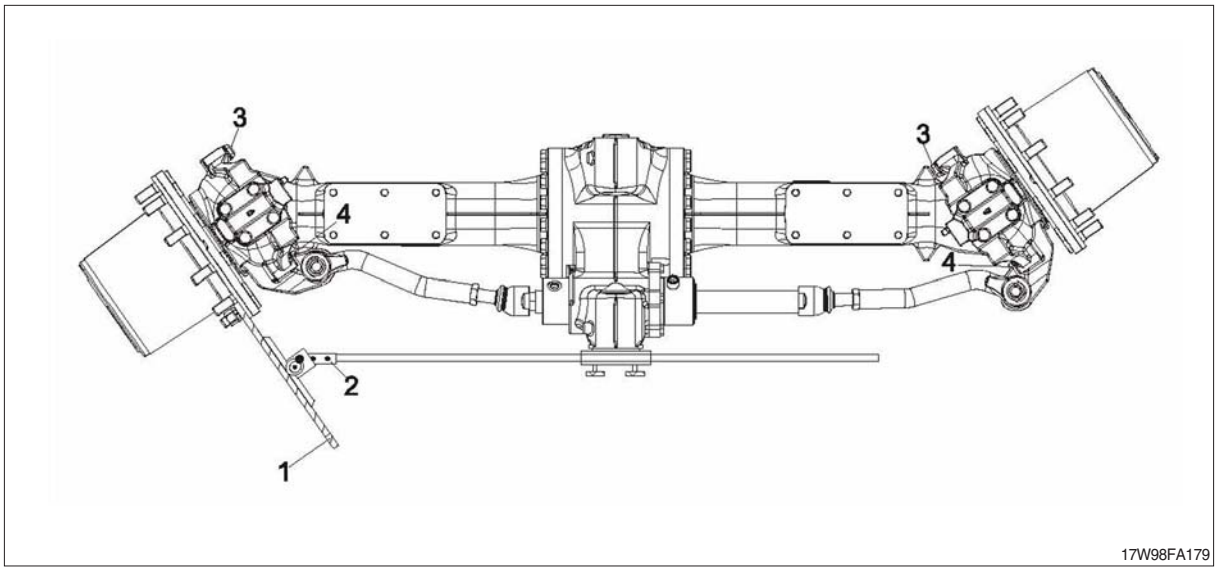
Check track setting (0°):
Determine dimension A1.
Rotate both outputs by 180° – dimension A2 must equal dimension A1.
Dimension "Y" = distance between rim center and rim flange.

Then fix both tie rods (axial joint) by means of hexagon nut (3).

Tightening torque . . . . . MA = 400 - 450 Nm

(21) Steering angle setting

※ When track setting is required, steering angle setting may only be carried out after track setting has been completed.



1 = (S) Straightedge 5870 200 029
2 = (S) Measuring device 5870 200 033
3 = Stop screw with stop washer (optional)
4 = Stop screw with hexagon nut

Mount straightedge (1) in horizontal and central axis position.
Fix measuring device (2) to yoke.
Pivot output until the required steering angle (e.g. 35˚) is indicated on the measuring device (2).

※ Take the value of the steering angle to be set from the vehicle manufacturer's specifications.

Bring the stop screw (4) on the axle housing in contact position and lock with hexagon nut.
Tightening torque (M18/10.9) . . . . . MA = 300 Nm

Then set inner stop by means of stop screw (3) and stop washer (s = optional).
Tightening torque (M18/10) . . . . . MA = 390 Nm

※ Make setting on both output sides.

(22) Check leakage of steering

Make leakage test of steering in both steering directions by means of HP pump.

Test pressure: 200 bar
Test medium: Engine oils SAE 10W

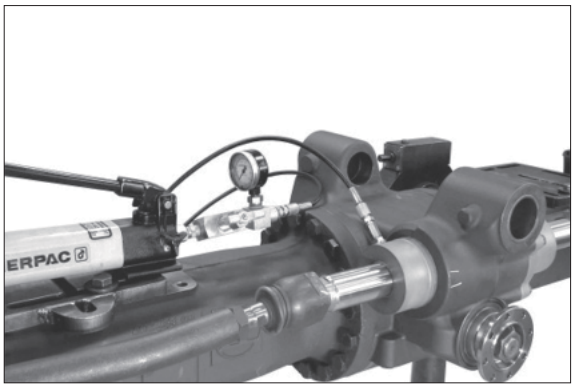
Test pressure p = Build up 200 bar (bleed pressure chamber).

Then close connection to HP pump by means of locking valve.

A 5 bar pressure drop is permissible during a test duration of 20 sec.

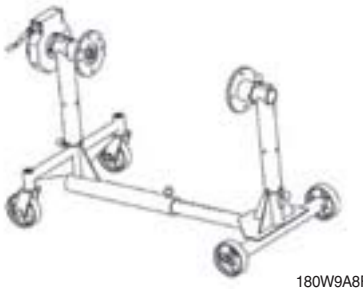
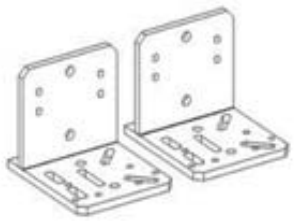
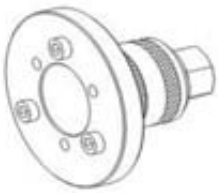
(S) HP pump	5870 287 007
(S) Reduction	5870 950 161
(S) Clutch	0501 207 939

※ Prior to putting the axle into operation fill it with oil.

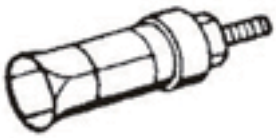
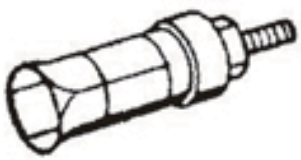


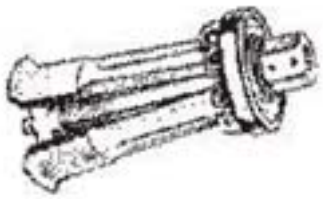
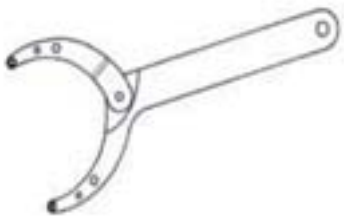
17W98FA180

5. SPECIAL TOOLS FOR DISASSEMBLY AND REASSEMBLY

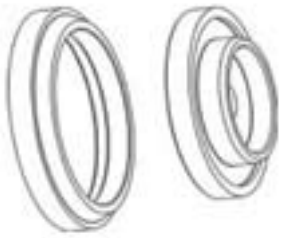
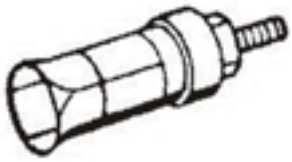
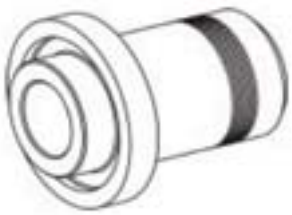
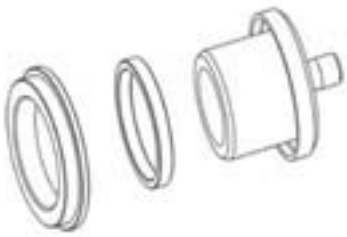
No.	Figure	Designation order no.	Qty	Page
1	 180W9A8FA501	Assembly truck assy with tilting device 5870 350 000	1	8-217 8-290
2	 180W9A8FA502	Supporting bracket 5870 350 106	1	8-217 8-290
3	 180W9A8FA503	Socket wrench 5870 656 097	1	8-221 8-290
4	 180W9A8FA504	Assembly lever 5870 345 036	1	8-222 8-291
5	 180W9A8FA505	Adjusting device 5870 400 001	2	8-223 8-292

No.	Figure	Designation order no.	Qty	Page
6	 180W9A8FA506	Lifting bracket 5870 281 043	1	8-223, 226, 251, 259 8-292, 294, 318, 326
7	 180W9A8FA507	Pressure piece 5870 100 067 (FR axle) 5870 100 063 (RR axle)	1 1	8-223, 224 8-292, 293
8	FR axle  180W9A8FA508-1 RR axle  180W9A8FA508-2	Grab sleeve 5873 003 022 (FR axle) 5873 013 015 (RR axle)	1	8-214 8-293
9	 180W9A8FA509	Grab sleeve HW180 / HW210 5873 004 026	1	-
10	 180W9A8FA510	Grab sleeve HW210 5873 004 022	1	-

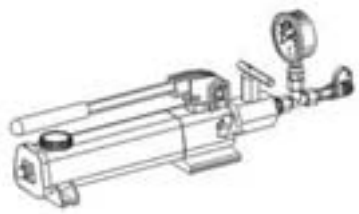
No.	Figure	Designation order no.	Qty	Page
11	 180W9A8FA511	Eyebolts (FR axle) 0636 804 001 (M16)	2	8-248
12	 180W9A8FA512	Eyebolts (FR axle) 5870 204 085 (M18)	2	-
13	 180W9A8FA513	Eyebolts (FR axle) HW210 0636 804 003 (M20)	2	-
14	 180W9A8FA514	Inner installer (FR axle) 5870 300 007 (Ø 46 ~ 56 mm)	1	8-225
15	 180W9A8FA515	Inner installer (FR axle) 5870 300 017 (Ø 56 ~ 70 mm)	1	8-226

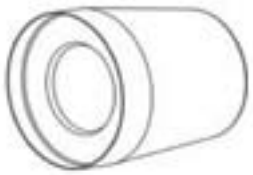
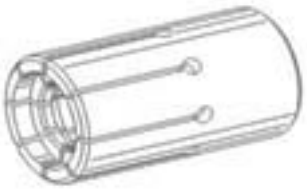
No.	Figure	Designation order no.	Qty	Page
16	 180W9A8FA516	Counter support 5870 300 020	1	8-226, 229 8-298
17	 180W9A8FA517	Inner installer 5870 300 019 (Ø 56 - 110 mm)	1	8-226, 229 8-298
18	 180W9A8FA518	Striker 5870 650 004	1	8-227 8-293, 296, 297
19	 180W9A8FA519	Clamping fork 5870 240 025	1	8-228, 239, 243 8-303, 312, 316
20	 180W9A8FA520	Grab sleeve 5873 001 037	1	8-229 8-298

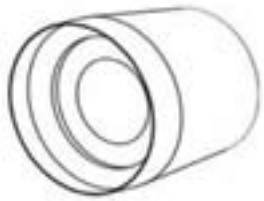
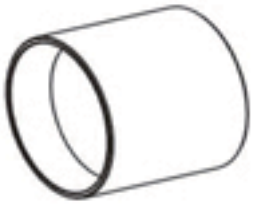
No.	Figure	Designation order no.	Qty	Page
21	 180W9A8FA521	Grab sleeve 5873 011 019	1	8-230 8-299
22	 180W9A8FA522	Basic tool 5873 001 000	1	8-230 8-299
23	 180W9A8FA523	Pressure piece 5870 100 009	1	8-230 8-299
24	 180W9A8FA524	Adjusting screws 5870 204 027 (M12×1.5)	1	8-235 8-304
25	 180W9A8FA525	Assembly fixture 5870 345 049	1	8-237 8-311

No.	Figure	Designation order no.	Qty	Page
26	 180W9A8FA526	Pressure ring 5870 345 056	1	8-237 8-311
27	 180W9A8FA527	Internal extractor 5870 300 005 (Ø 36 ~ 46 mm)	1	8-247 8-307
28	 180W9A8FA528	Driver tool (FR axle) 5870 048 286	1	8-243
29	 180W9A8FA529	Driver tool (FR axle) 5870 055 081	1	8-246
30	 180W9A8FA530	Driver tool (FR axle) 5870 055 090	1	8-246

No.	Figure	Designation order no.	Qty	Page
31	 180W9A8FA531	Handle (FR axle) 5870 260 002	1	8-244, 245, 246
32	 180W9A8FA532	Driver tool 5870 058 058	1	8-245
33	 180W9A8FA533	Driver tool 5870 058 022	1	8-245
34	 180W9A8FA534	Driver tool (FR axle) HW210 5870 058 078	1	-
35	 180W9A8FA535	Lever riveting tongs (RR axle) 5870 320 016	1	8-245, 317

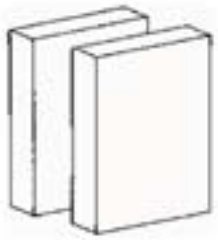
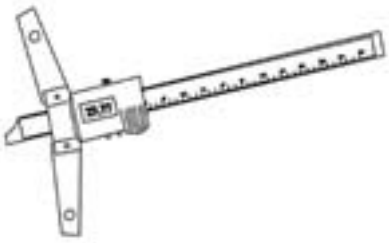
No.	Figure	Designation order no.	Qty	Page
36	 180W9A8FA536	Driver tool 5870 051 035	1	8-250 8-318
37	 180W9A8FA537	Driver tool HW210 5870 051 068	1	-
38	 180W9A8FA538	HP pump 5870 287 007	1	8-255, 267 8-323
39	 180W9A8FA539	Threaded coupling 5870 950 102 (M14×1.5)	1	8-257 8-323
40	 180W9A8FA540	Breather bottle 5870 286 072	1	8-257 8-323

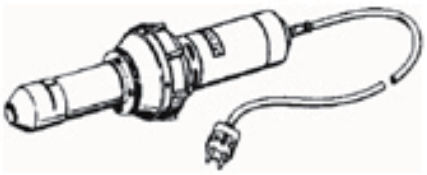
No.	Figure	Designation order no.	Qty	Page
41	 180W9A8FA541	Straightedge 5870 200 022	1	8-256 8-324
42	 180W9A8FA542	Driver tool 5870 048 245	1	8-258
43	 180W9A8FA543	Driver tool HW180 / HW210 5870 048 263	1	-
44	 180W9A8FA544	Inner installer (FR axle) 5870 651 086	1	8-241
45	 180W9A8FA545	Inner installer (FR axle) 5870 651 087	1	8-261

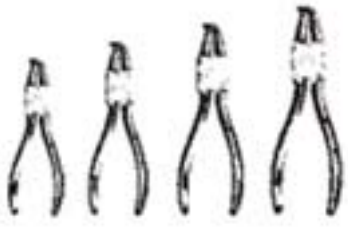
No.	Figure	Designation order no.	Qty	Page
46	 180W9A8FA546	Inner installer (FR axle) 5870 651 088	1	-
47	 180W9A8FA547	Inner installer 5870 651 089	1	-
48	 180W9A8FA548	Calibration bushing 5870 651 090	1	8-261
49	 180W9A8FA549	Calibration bushing 5870 651 091	1	-
50	 180W9A8FA550	Socket wrench 5870 656 100 (SW 55) 5870 656 097	1	8-221, 252, 255, 264 8-280, 319, 323

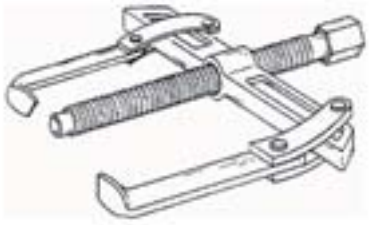
No.	Figure	Designation order no.	Qty	Page
51	 180W9A8FA551	Socket wrench (FR axle) HW210 5870 656 099 (SW 75)	1	-
52	 180W9A8FA552	Straightedges (FR axle) 5870 200 029	1	8-265, 266
53	 180W9A8FA553	Measuring device (FR axle) 5870 200 033	1	8-265, 266
54	 180W9A8FA554	Reduction (FR axle) 5870 950 161	1	8-267
55	 180W9A8FA555	Clutch (FR axle) 0501 207 939	1	8-267

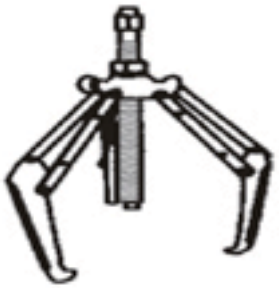
6. COMMERCIAL TOOLS FOR DISASSEMBLY AND REASSEMBLY

No.	Figure	Designation order no.	Qty	Remark
1	 180W9A8FA556	Magnetic stand 5870 200 055	1	Universal
2	 180W9A8FA557	Dial indicator 5870 200 057	1	Universal
3	 180W9A8FA558	Gauge blocks 5870 200 066 (70 mm) 5870 200 067 (100 mm)	1	Universal 8-295
4	 180W9A8FA559	Digital depth gauge 5870 200 072 (200 mm) 5870 200 114 (300 mm)	1	Universal
5	 180W9A8FA560	Digital caliper gauge 5870 200 109 (150 mm)	1	Universal

No.	Figure	Designation order no.	Qty	Remark
6	 180W9A8FA561	Torque wrench 5870 203 030 0.6 ~ 6.0 Nm 5870 203 031 1.0 ~ 12 Nm 5870 203 032 3.0 ~ 23 Nm 5870 203 033 5.0 ~ 45 Nm 5870 203 034 10 ~ 90 Nm 5870 203 039 80 ~ 400 Nm 5870 203 016 140 ~ 750 Nm 5870 203 011 750 ~ 2000 Nm	1	Universal
7	 180W9A8FA562	Hot air blower 5870 221 500 230 V 5870 221 501 115 V	1	Universal
8	 180W9A8FA563	Plastic hammer 5870 280 004 Ø 60 mm Substitute nylon insert 5870 280 006	1	Universal
9	 180W9A8FA564	Lifting strap 5870 281 026	1	Universal

No.	Figure	Designation order no.	Qty	Remark
10	 180W9A8FA565	Lifting chain 5870 281 047	1	Universal
11	 180W9A8FA566	Pry bar 5870 345 071	1	Universal
12	 180W9A8FA567	Striker 5870 650 004	1	Universal
13	 180W9A8FA568	Set of internal pliers I1-I2-I3-I4 5870 900 013	1	Universal
14	 180W9A8FA569	Set of internal pliers I11-I21-I31-I41 90° 5870 900 014	1	Universal

No.	Figure	Designation order no.	Qty	Remark
15	 180W9A8FA570	Set of external pliers A1-A2-A3-A4 5870 900 015	1	Universal
16	 180W9A8FA571	Set of external pliers A01-A02-A03-A04 90° 5870 900 016	1	Universal
17	 180W9A8FA572	Two-armed puller 5870 970 001 Jaw width 80 mm Throat depth 100 mm 5870 970 002 Jaw width 120 mm Throat depth 125 mm 5870 970 003 Jaw width 170 mm Throat depth 125 mm 5870 970 004 Jaw width 200 mm Throat depth 175 mm 5870 970 006 Jaw width 350 mm Throat depth 250 mm 5870 970 007 Jaw width 520 mm Throat depth 300 ~ 500 mm 5870 970 026 Jaw width 250 mm Throat depth 200 mm 5870 970 028 Jaw width 380 mm Throat depth 200 mm	1	Universal

No.	Figure	Designation order no.	Qty	Remark
18	 180W9A8FA573	Two-armed puller 5870 971 001 Jaw width 85 mm Throat depth 65 mm 5870 971 002 Jaw width 130 mm Throat depth 105 mm 5870 971 003 Jaw width 230 mm Throat depth 150 mm 5870 971 004 Jaw width 295 mm Throat depth 235 mm 5870 971 005 Jaw width 390 mm Throat depth 270 mm 5870 971 006 Jaw width 640 mm Throat depth 300 mm	1	Universal

1. REMOVAL FRONT AXLE

1) Rear axle mounting nut (1, M20)
   · Tightening torque : 58.0±6.3 kgf · m
   (420±45.6 lbf · ft)

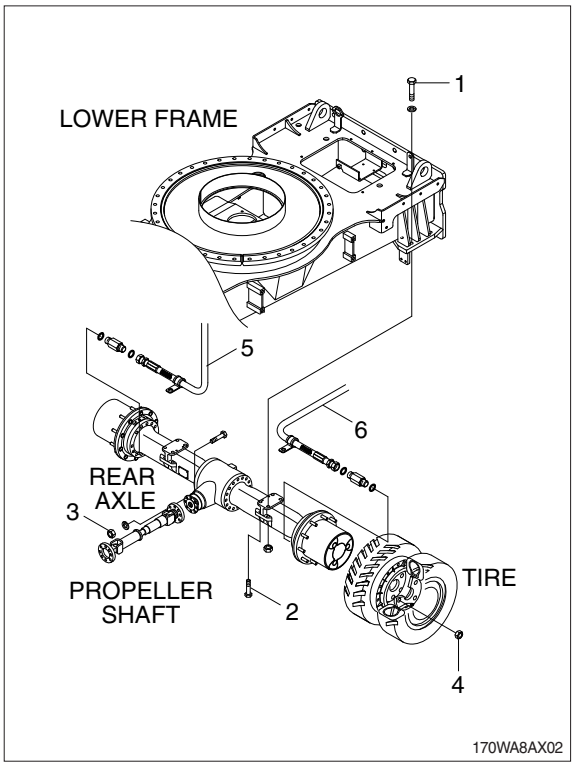
   Rear axle mounting nut (2, M20)
   · Tightening torque : 62.8±9.4 kgf · m
   (454±68 lbf · ft)

2) Propeller shaft mounting bolt (3, M10)
   · Tightening torque : 5.9±0.6 kgf · m
   (42.7±4.3 lbf · ft)

3) Wheel nut (4, M22)
   · Tightening torque : 60±5.0 kgf · m
   (433±36.2 lbf · ft)

4) Hose assy (5, 6)

5) Axle weight : 534 kg (1180 lb)



2. GENERAL INSTRUCTIONS

1) GENERAL WORKING INSTRUCTIONS

(1) This manual has been developed for the skilled serviceman, trained by the ZF-Passau.

(2) During all operations, pay attention to cleanliness and skilled working.
Therefore, axle removed from the machine, must be cleaned prior to open them.

(3) We assume that the special tools, specified by ZF, will be used.
The special tools are available from ZF-Passau.

(4) After the disassembly, all components must be cleansed, especially corners, cavities and recesses of housing and covers.

(5) The old sealing compound must be carefully removed.

(6) Check lubricating holes, grooves and pipes for free passage. They must be free of residues, foreign material or protective compounds.

(7) The latter refers especially to new parts.

(8) Parts which have been inevitably damaged in a disassembly operation, must be generally replaced by new ones, e.g. rotary seal rings, O-rings, U-section rings, cap boots, protective caps etc..

(9) Components such as roller bearings, thrust washers, synchronizing parts etc. which are subject to normal wear in automotive operation, must be checked by the skilled Serviceman.
He will decide if the parts can be reused.

(10) For the heating of bearings etc., hot plates, rod heaters or heating furnaces must be used.

(11) Never heat parts directly with the flame. An auxiliary solution would be to immerse the bearing in a vessel filled with oil, which is then heated with the flame.
In this way, damage to the bearings could be avoided.

(12) Ball bearings, covers, flanges and parts like that must be heated to about 90 to 100˚C.

(13) Hot-mounted parts must be reset after cooling in order to assure a proper contact.

(14) Before pressing shafts, bearings etc. in position, both parts must be lubricated.

(15) During to reassembly, all specified adjustment values, testing specifications and tightening torque must be respected.

(16) After the repair, units are filled up with oil.

(17) After the oil filling, the oil level plugs and oil drain plugs must be tightened to the specified tightening torque.

2) IMPORTANT INSTRUCTIONS CONCERNING THE LABOUR SAFETY

(1) In principle, repairers are themselves responsible for the labour safety.

(2) The observance of all valid safety regulations and legal rules is a precondition to prevent damage to individuals and products during the maintenance and repair operations.

(3) Before starting the work, the repairers have to make themselves familiar with these regulations.

(4) The proper repair of these products requires especially trained personnel.

(5) The repairer himself is obliged to provide for the training.

3) LUBRICANT SPECIFICATIONS

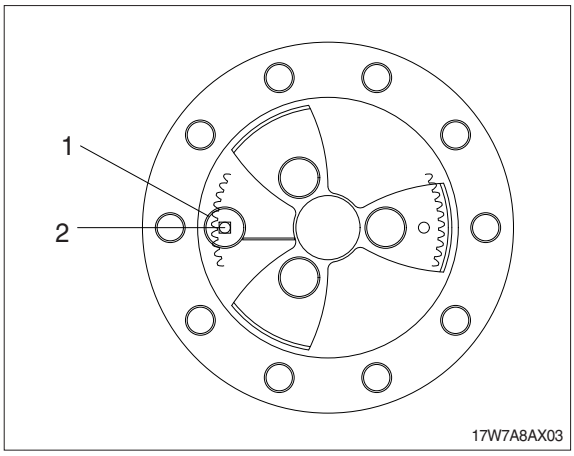
(1) Gear oils with limited - slip additives.

(2) API GL-5

(3) MIL-L-2105D (SAE 85W-90 LSD or UTTO)

4) BRAKE LINING WEARING TEST

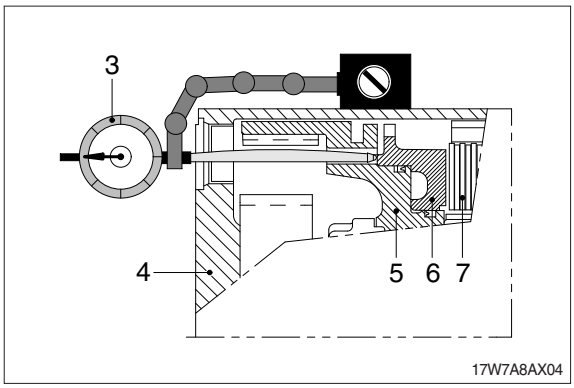
(1) The measurement of wear on the multi-disc brake only gives limited information on the total state of the plate pack without disassembling the output.
Make measurement of lining wear at least once per year, in particular, however, in case of a different braking behaviour, like :
- Braking noises
- Reduced braking power
- Different deceleration
- Different brake oil level
- Different braking pressure

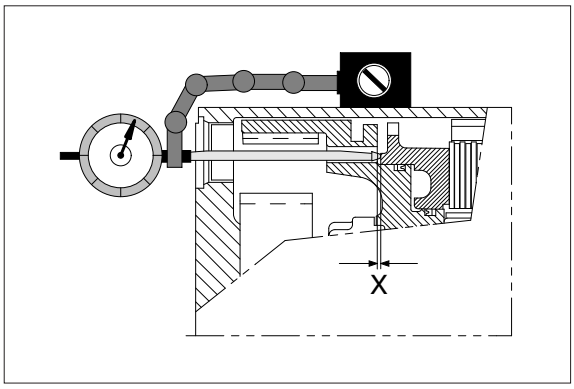


※ To avoid injury when opening the oil drain/ oil filler plug (1), due to a possible pressure build-up in the planetary carrier bring drain hole to topmost position (12 o'clock) and carefully unscrew oil drain and filler plug (1).

(2) Then turn output until oil filler / oil drain hole (2) is on 9 o'clock position.

1 = Oil filler-/oil drain hole
2 = Gauge hole (Ø=10 ㎜) in ring gear
9 o'clock position
3 = Dial indicator with solenoid support
4 = Planetary carrier
5 = Ring gear
6 = Piston
7 = Plate pack
X = Piston stroke



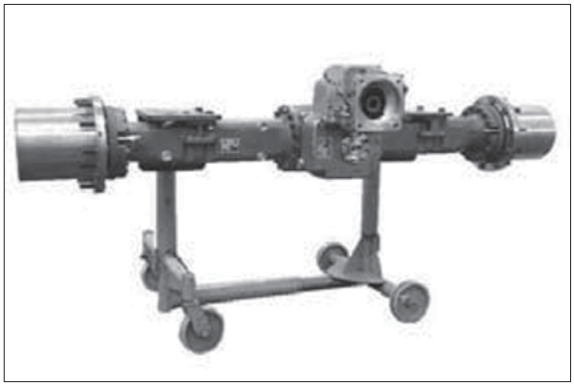


3. DISASSEMBLY

1) OUTPUT

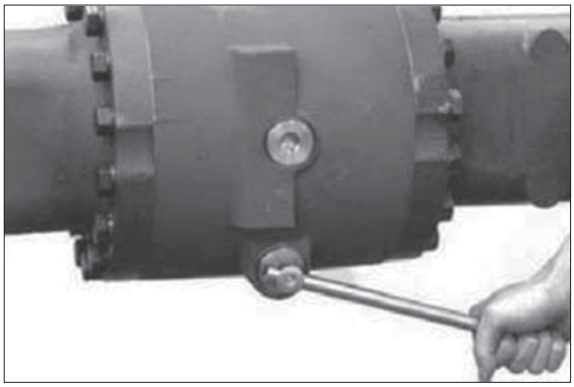
(1) Attach axle to the assembly truck.

(S) Assembly truck 5870 350 000
(S) Supporting bracket 5870 350 106



17W98RA001

(2) Loosen screw plug and drain oil from the axle.

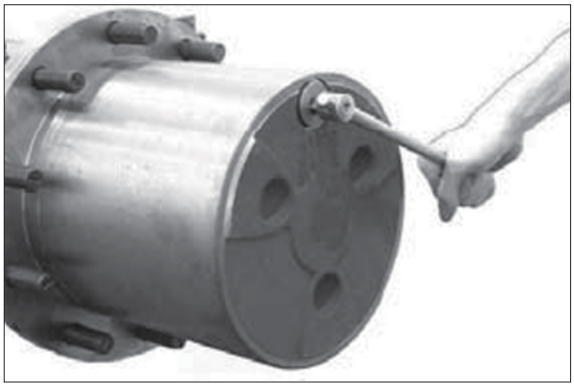


17W98RA002

(3) Loosen screw plug and drain oil from the planetary carrier.

※ To avoid any risk of injury due to a possible pressure buildup in the oil system of the planetary carrier, bring oil filler / level check plug to the uppermost position (12 o'clock) and turn it out carefully.
Then bring drain hole to 6 o'clock position and drain oil.

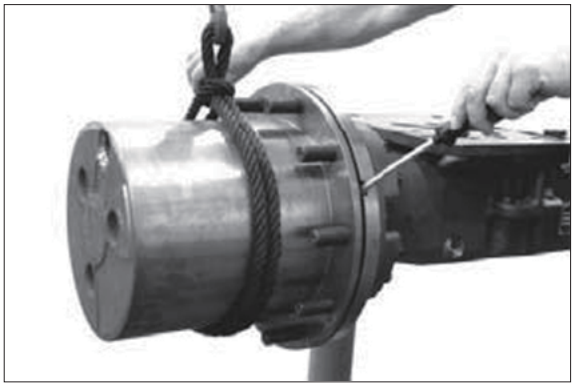
※ Use suitable oil reservoir environmental protection.



17W98RA003

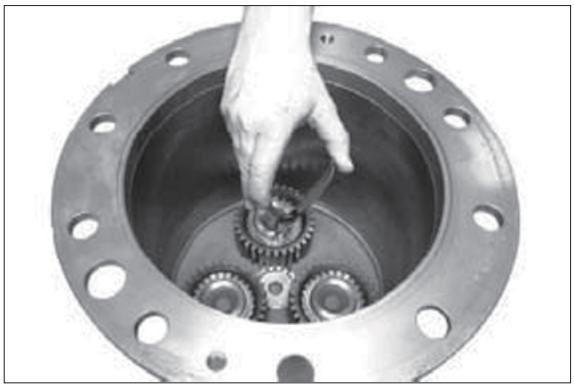
(4) Planetary carrier

Loosen both hexagon screws and separate planetary carrier from the hub.



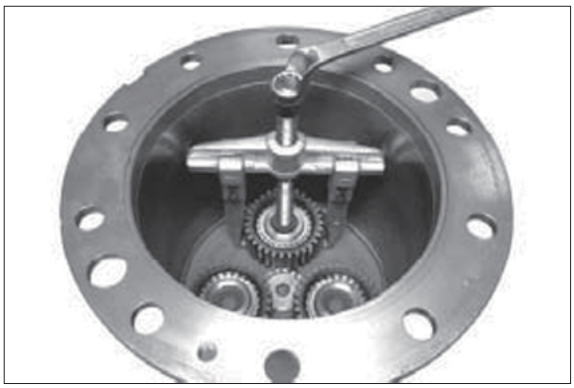
17W98RA004

(5) Snap out retaining ring.



17W98RA005

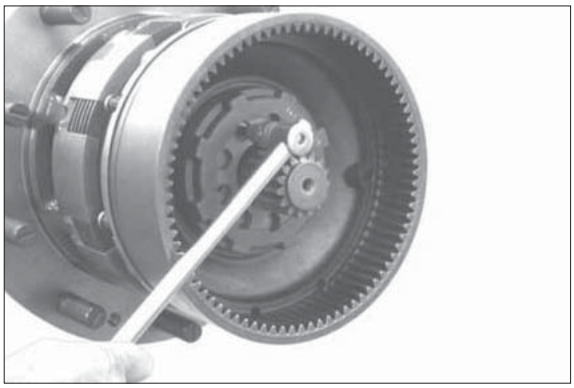
(6) Pull off planetary gear together with cylindrical roller bearing.



17W98RA006

(7) Brake

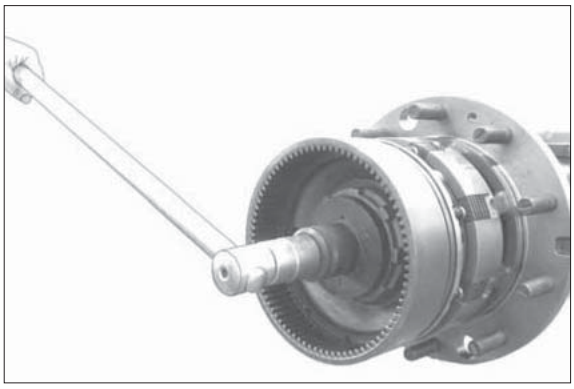
Loosen cylindrical screw (slotted nut fixing).



17W98RA007

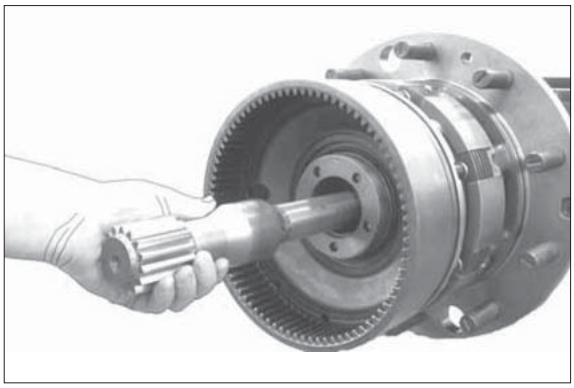
(8) Loosen slotted nut.

(S) Socket wrench 5870 656 097



17W98RA008

(9) Pull sun gear together with stub shaft out of the axle housing.

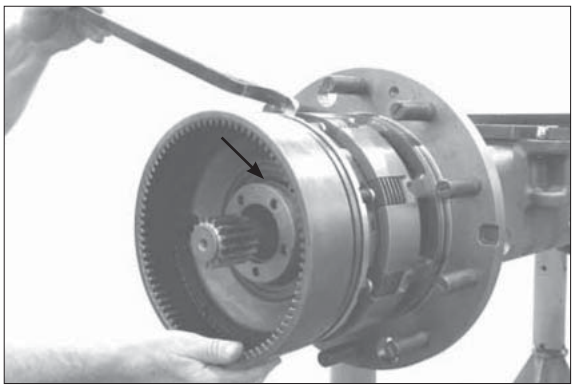


17W98RA009

(10) Press ring gear together with piston off the hub carrier.

(S) Assembly lever 5870 345 036

※ Pay attention so that the O-ring (arrow) does not drop.



17W98RA010

(11) Loosen hexagon screws and remove releasing spring sleeves and compression springs.

17W98RA011

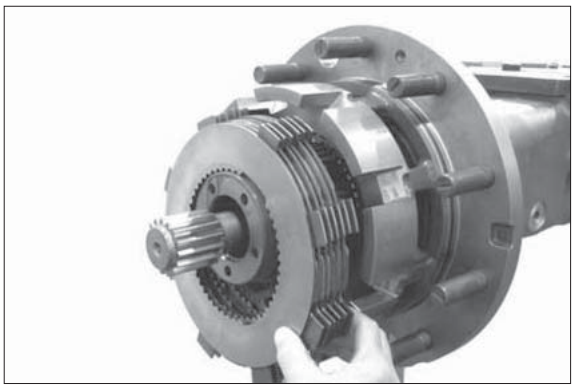
(12) Press piston off the ring gear.

17W98RA012

(13) Remove sealing elements from the annular grooves (see arrows) of the ring gear.

17W98RA013

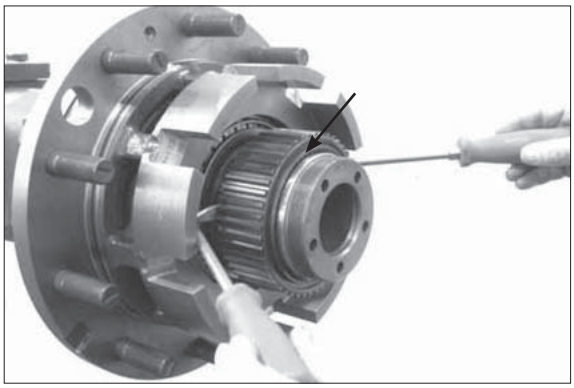
(14) Remove disk package.



17W98RA014

(15) Remove O-ring (seee arrow) and use a lever to remove disk carrier from hub carrier.

(S) Resetting device 5870 400 001



17W98RA015

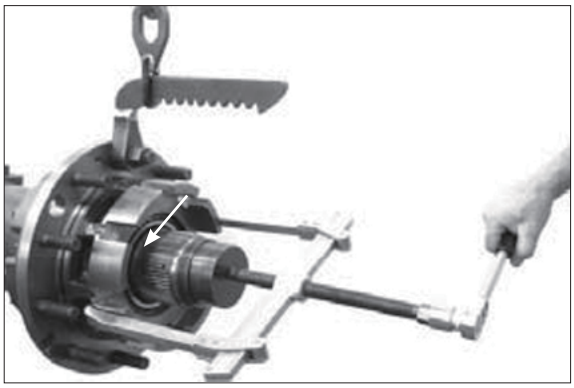
(16) Hub

Remove O-ring (see arrow).

Secure hub with lifting bracket (S) and pull it off the hub carrier by means of a two armed puller.

(S) Lifting bracket 5870 281 043
(S) Pressure piece 5870 100 063

※ Pay attention that the releasing bearing inner ring does not drop.

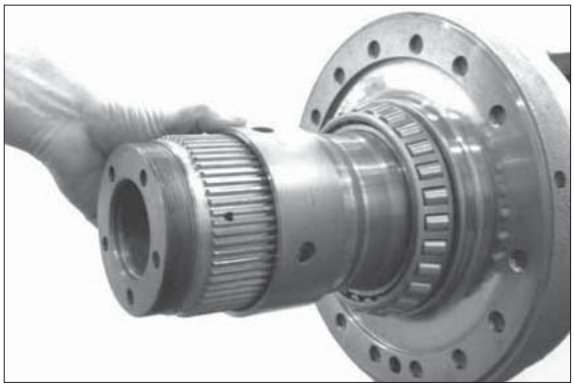


17W98RA016

(17) Use a lever to remove the shaft seal ring (see arrow) from the hub hole and force both bearing outer rings out of the hub.

17W98RA017

(18) Remove spacer bushing.



17W98RA018

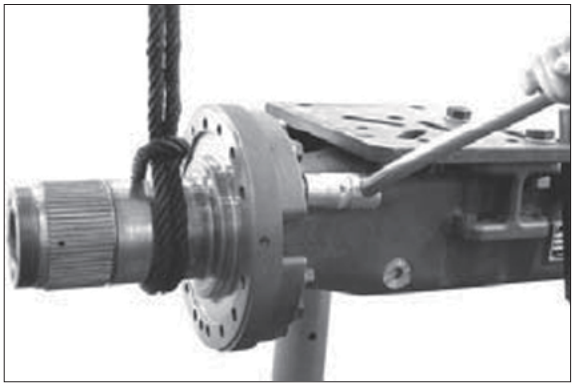
(19) Pull tapered roller bearing off the hub.

(S) Grab sleeve	5873 013 015
(S) Pressure piece	5870 100 063

17W98RA019

(20) Secure hub carrier with lifting tackle, loosen threaded joint and separate hub carrier from the axle housing.

Then remove single parts such as screw neck, breather valve and O-ring from the hub carrier.



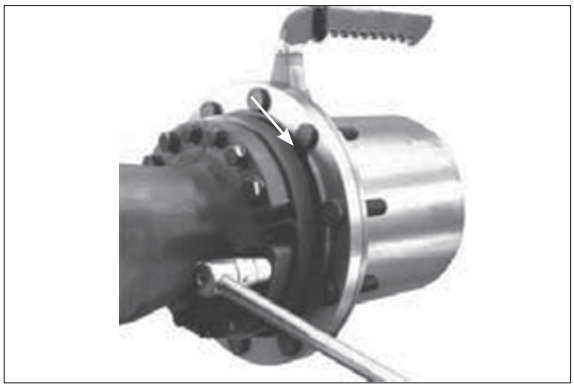
17W98RA020

(21) Output assy

※ If work is to be done on the differential or pinion, you may remove the output as a complete unit (operations figure RA021 and RA022).

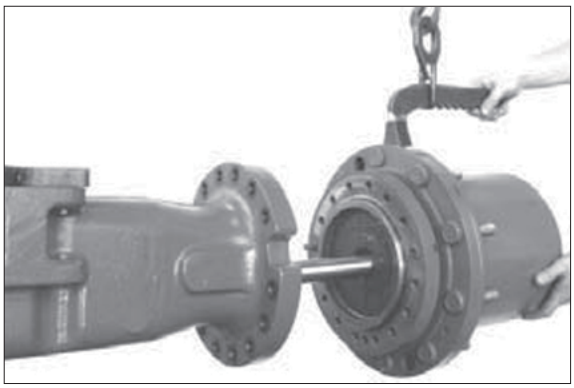
Secure output by means of lifting tackle (S) and loosen threaded joint.

(S) Lifting bracket 5870 281 043



17W98RA021

(22) Separate output assy from the axle housing and pull out stub shaft.



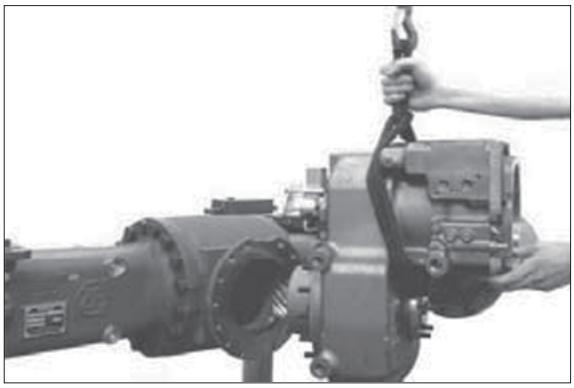
17W98RA022

2) INTPUT

(1) Secure transmission with lifting tackle and loosen threaded joint (transmission/axle drive housing).

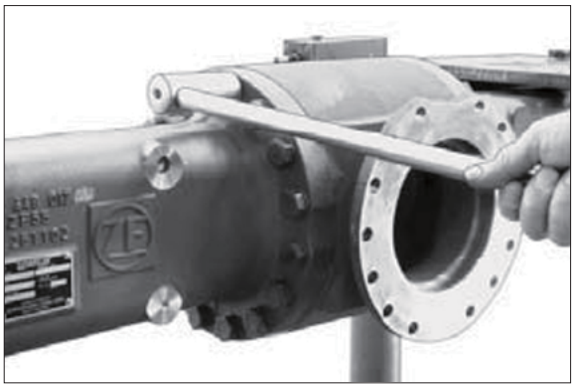
17W98RA023

(2) Separate transmission from the axle.



17W98RA024

(3) Secure axle housing (on crown wheel side) by means of lifting tackle and loosen threaded joint.

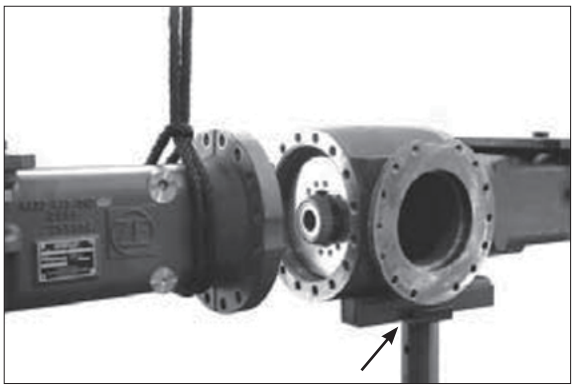


17W98RA025

(4) Support axle at the axle drive housing (see arrow).

Then separate axle housing from the axle drive housing.

※ Pay attention that the differential does not drop.

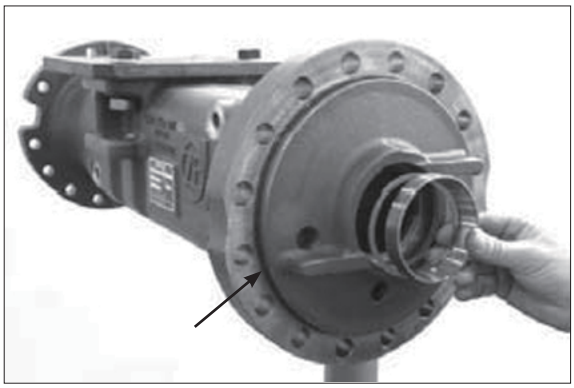


17W98RA026

(5) Pull bearing outer ring out of the bearing hole and remove the releasing shim.

Then remove O-ring (see arrow).

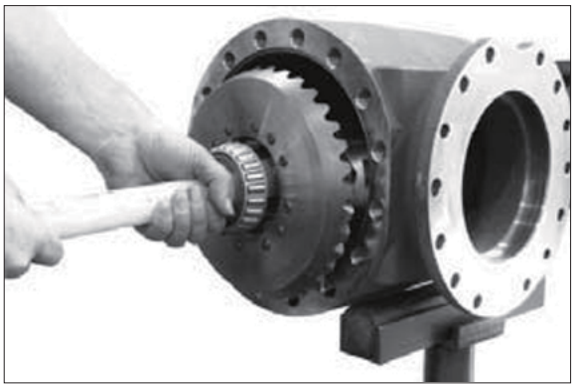
(S) Striker 5870 650 004



17W98RA027

(6) Lift differential out of the axle drive housing.

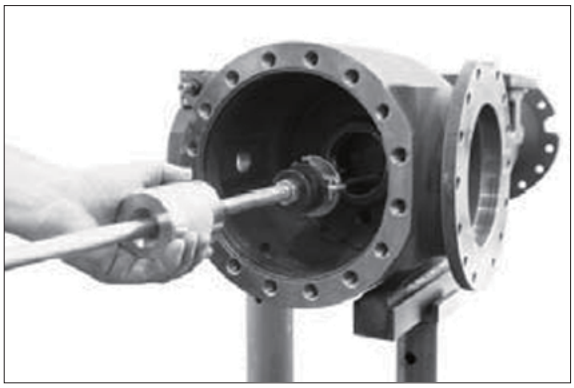
※ Disassembly of the differential see description on page 8-299 and following.



17W98RA028

(7) Use striker (S) to pull bearing outer ring out of the bearing hole (axle housing) and remove the releasing shim.

(S) Striker 5870 650 004

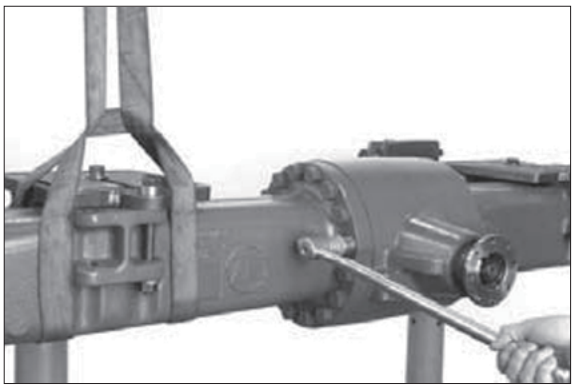


17W98RA029

(8) Secure axle housing (on crown wheel side, part II) by means of lifting tackle and loosen threaded joint.

Then separate axle housing (part II) from the axle drive housing.

※ Pay attention that the differential does not drop.

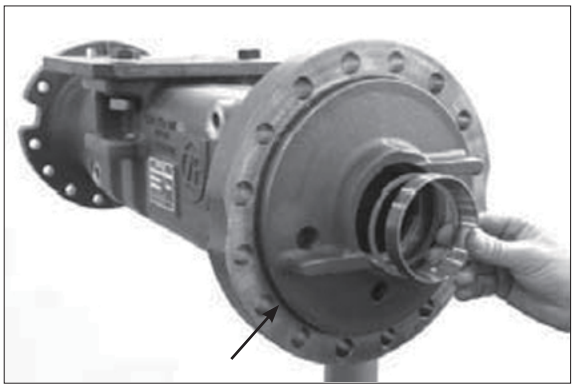


17W98RA030

(9) Pull bearing outer ring out of the bearing hole and remove the releasing shim.

Then remove O-ring (see arrow).

(S) Striker 5870 650 004

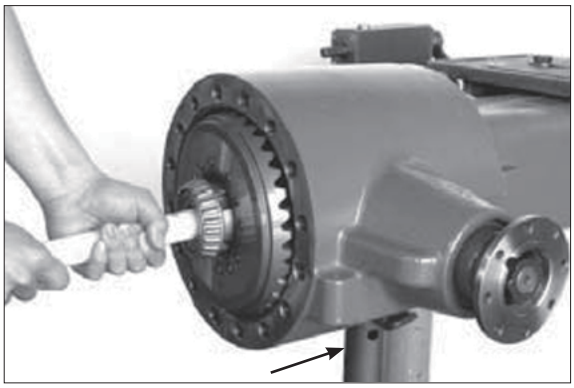


17W98RA031

(10) Support axle at the axle drive housing (see arrow).

Then lift differential out of the axle drive housing.

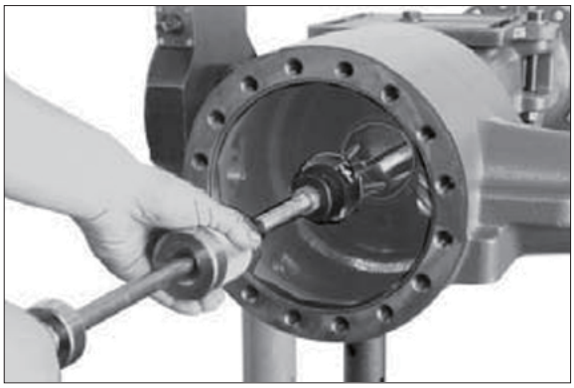
※ Disassembly of the differential see description on page 8-299 and following.



17W98RA032

(11) Use striker (S) to pull bearing outer ring out of the bearing hole (axle housing) and remove the releasing shim.

(S) Striker 5870 650 004



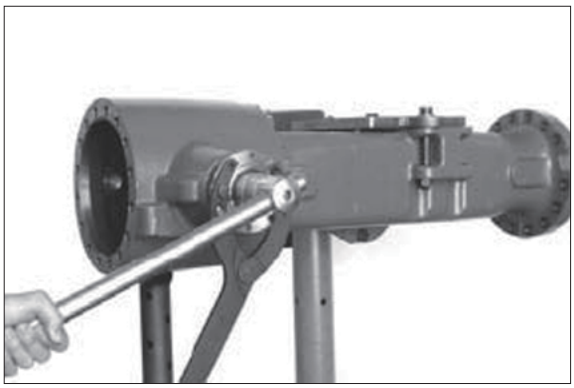
17W98RA033

(12) Heat up hexagon nut with hot-air blower.

Then loosen hexagon nut and remove the releasing washer.

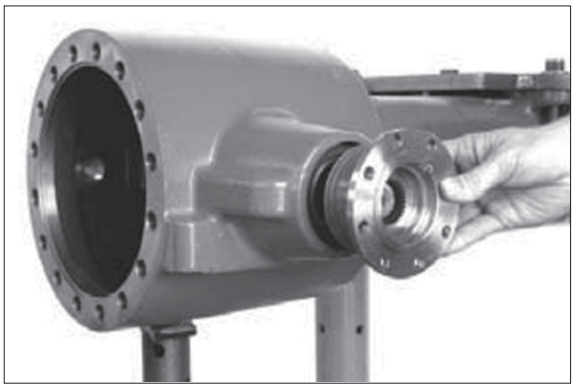
(S) Clamping fork 5870 240 025

※ Hexagon nut is secured with Loctite no. 262.



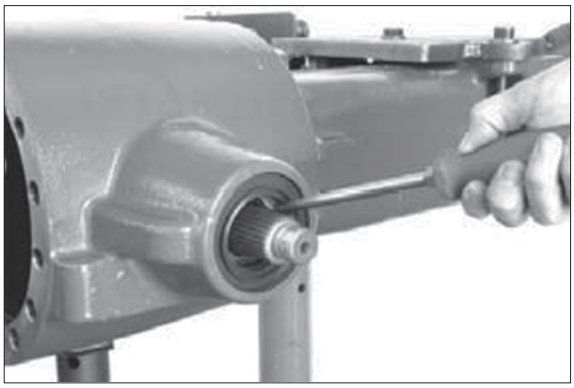
17W98RA034

(13) Pull input flange off the pinion.
If required, remove screen sheet from the flange.



17W98RA035

(14) Use a lever to remove the shaft seal ring out of the housing hole.

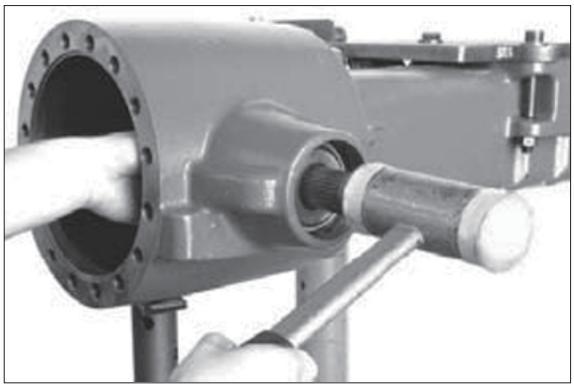


17W98RA036

(15) Force out input pinon and remove the releasing roller bearing.

※ Use a plastic hammer.

※ If the tapered roller bearings are not replaced, pay attention that all the rollers of the outer bearing inner ring are always in contact with the bearing outer ring when forcing out the input pinion.



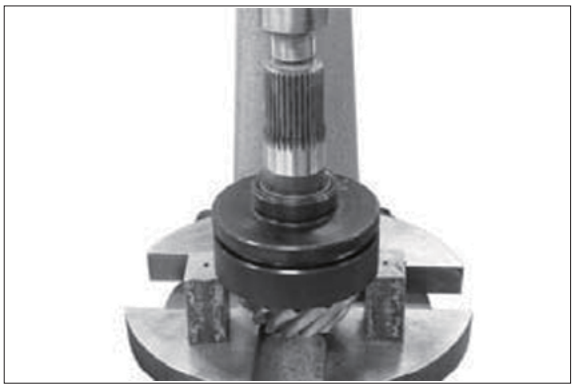
17W98RA037

(16) Remove spacer ring.

17W98RA038

(17) Press roller bearing off the input pinion.

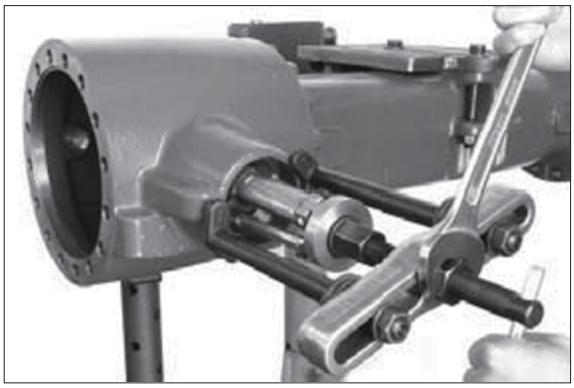
(S) Grab sleeve 5873 001 037



17W98RA039

(18) Pull external bearing outer ring out of the bearing hole.

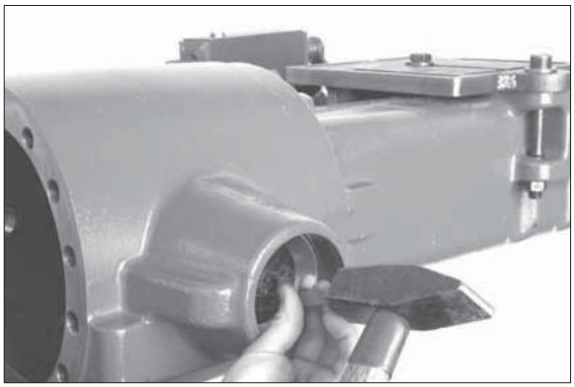
(S) Internal extractor 5870 300 019
(S) Counter support 5870 300 020



17W98RA040

(19) Force bearing outer ring off the inner bearing hole pay attention to the shim behind.

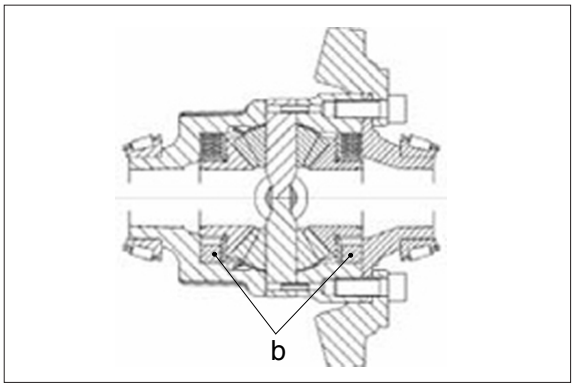
※ Mark shim regarding position/bearing allocation reassembly aid.



17W98RA041

3) DIFFERENTIAL

(1) b = Constant spacers



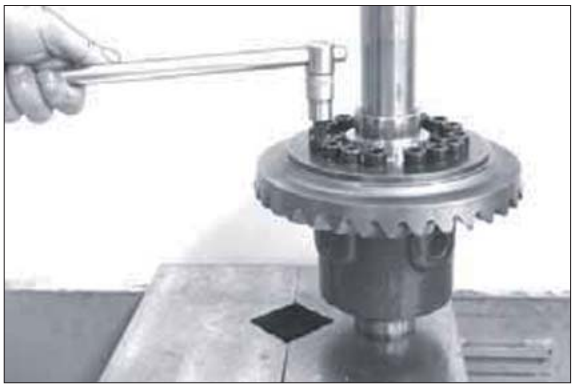
17W98RA042

(2) Pull both tapered roller bearings from differential carrier.

(S) Grab sleeve	5873 011 019
(S) Basic tool	5873 001 000
(S) Pressure piece	5870 100 009

17W98RA043

(3) Use press to fix differential and loosen threaded joint crown wheel / differential carrier.



17W98RA044

(4) Press crown wheel from differential.

17W98RA045

(5) Remove single parts.

Remove axle bevel gear together with thrust washer and constant spacer from the differential carrier.

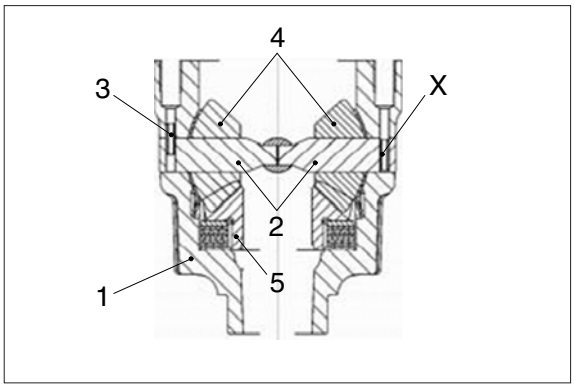
17W98RA046

(6) Force slotted pins (considering position "X", see subsequent sketch) into the spider shafts.

17W98RA047

(7) Comment on sketch:

1 = Differential carrier
2 = Spider shafts (short)
3 = Slotted pins
4 = Differential bevel gears
5 = Axle bevel gear
X = Position of the slotted pin to force out the spider shafts



17W98RA048

(8) Force out both spider shafts (short).

17W98RA049

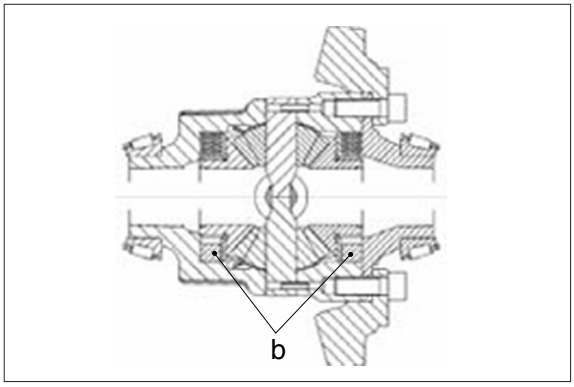
(9) Remove all single parts.

17W98RA050

4. REASSEMBLY

1) DIFFERENTIAL

(1) b = Constant spacers

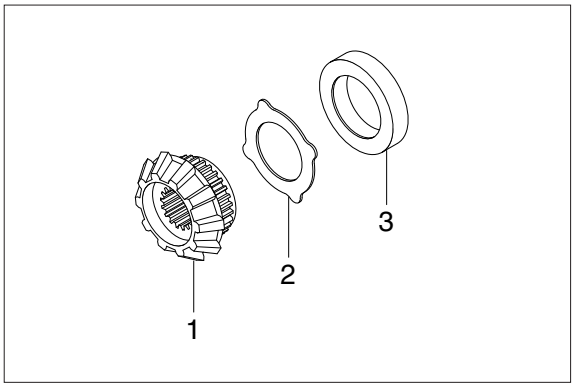


17W98RA042

(2) All outer and inner disks are replaced by a constant spacer (see figure RA054).

1 = Axle bevel gear
2 = Pressure disk
3 = Constant ring

※ No measuring / setting of the axial play of the two axle bevel gears is required, therefore single parts can be immediately oiled.



17W98RA053

(3) Insert premounted axle bevel gear into the differential carrier.

17W98RA054

(4) Insert differential bevel gears (1) with thrust washers (2) and fix with spider shafts (3 and 4).

※ Pay attention to radial installation position of the thrust washers.

17W98RA055

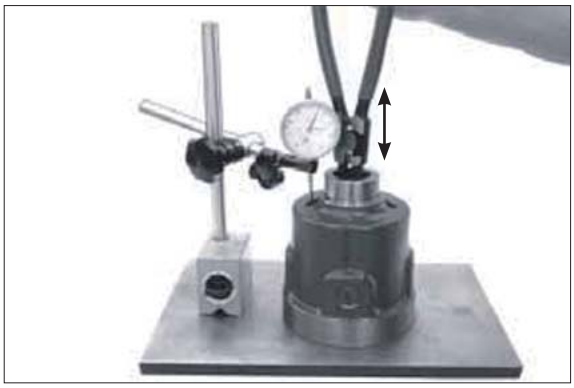
(5) Check axial play of the axle bevel gear 0.0 … 0.15 mm.

※ If the axial play is not within the specified tolerance, correct with the corresponding outer disks.

After the setting procedure separate the single parts again.

Then oil and reassemble all single parts again.

※ Make sure that thickness and arrangement of the second disk package are identical (figure RA059).



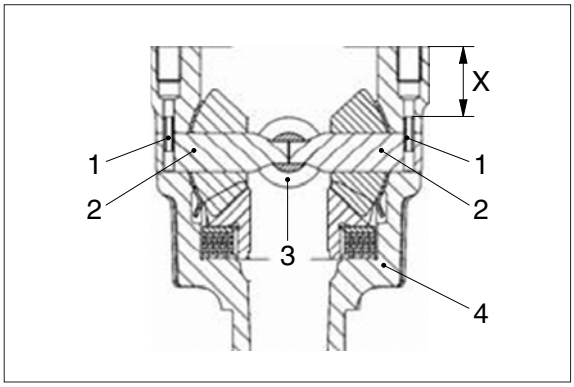
17W98RA056

(6) Fix both spider shafts (short) by means of slotted pins (considering installation dimension, see sketch RA058).

17W98RA057

(7) Comment on sketch:

1 = Slotted pin
2 = Spider shaft (short)
3 = Spider shaft
4 = Differential carrier
X = Installation dimension 34 ± 0.5 mm



17W98RA058

(8) Mount second axle bevel gear with thrust washer and constant spacer (see also figure RA053).

※ Mount the pressure disk with the coated surface showing to the outer disk.

※ Thickness and arrangement of the disk package must be identical on both sides of the differential gear.

17W98RA059

(9) Check axial play of the second axle bevel gear 0.0 … 0.15 mm.

※ If the axial play is not within the specified tolerance, correct with the corresponding outer disks.

After the resetting procedure remove the second axle bevel gear together with the disk package from the differential carrier.

Then oil and reassemble all single parts.

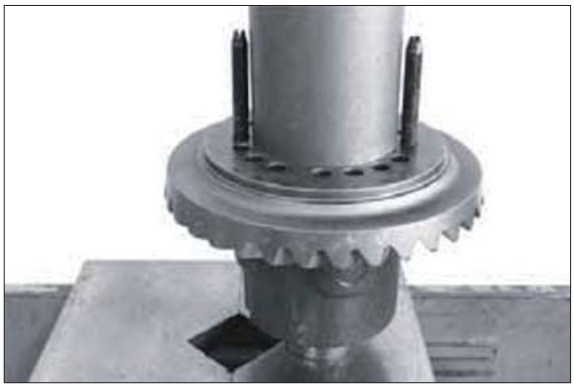
17W98RA060

(10) Mount two adjusting screws (S) and insert cover.

(S) Adjusting screws (M12 × 1.5)
5870 204 027

17W98RA061

(11) Press crown wheel onto the cover / differential carrier until contact position is obtained.



17W98RA062

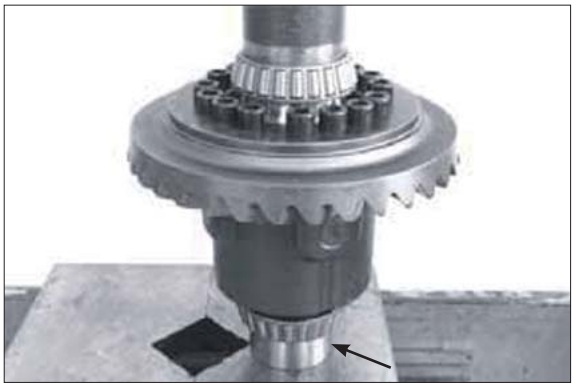
(12) Fix differential with press and tighten crown wheel with cylindrical screws.

Tightening torque (M12×1.5/12.9) . . . . . MA = 145 Nm

17W98RA063

(13) Press on both bearing inner rings until contact is obtained.

※ Use an appropriate support (arrow) differential may not be supported on the bearing cage.

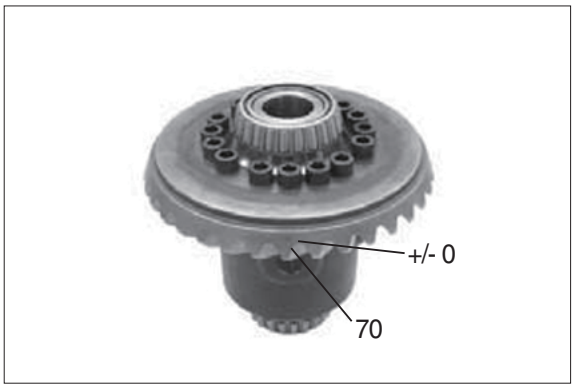


17W98RA064

2) INPUT

(1) Determination of shims for setting the bearing rolling torque (differential bearing) and the backlash (bevel gear set).

※ Determine the required shims on basis of the read value (test dimension/ crown wheel) and the corresponding specifications of the table next page : (KRS – SET – RIGHT) (KRS = bevel gear set)

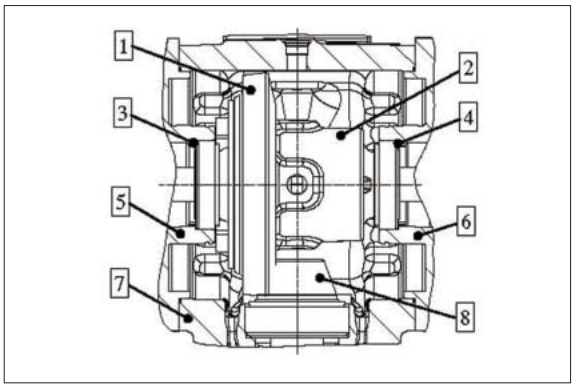


17W98RA065

(2) Test dimension see crown wheel rear side.

※ The test dimension "70" is stamped into the crown wheel rear side. If no + or deviation is indicated, this value corresponds with the test dimension/ actual value "70" in the table below. According to this value, the required shims are allocated in the table below.

Any + or - deviation of the test dimension caused by production is also marked on the crown wheel rear side (e.g. 20 or – 10 / 10 or 20) . In accordance with this deviation, the required shims are allocated in the table below.



17W98RA066

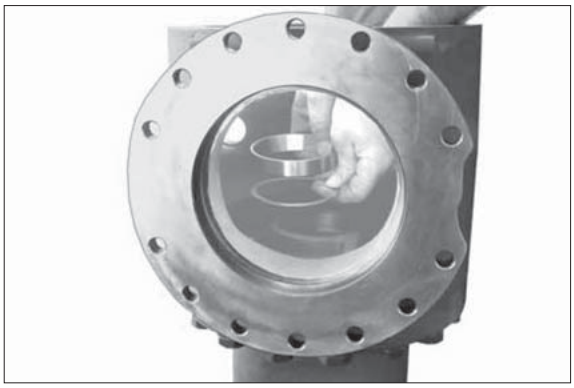
· Legend to sketch:

1 = Crown wheel
2 = Differential carrier
3 = Shim (crown wheel side)
4 = Shim (diff. carrier side)
5 = Axle housing
6 = Axle housing
7 = Axle drive housing
8 = Input pinion

Setting disks for differential					
Test dimension/crown wheel marking 70 and deviation	-20	-10	0	10	20
results in → test dim. / actual value	69.80	69.90	70.0	70.10	70.20
Shim/ diff. carrier side Required shim thickness	0.95	1.05	1.15	1.25	1.35
Shim No.	ZGAQ-00545	ZGAQ-00547	ZGAQ-00549	ZGAQ-00552	ZGAQ-00554
Shim/crown wheel side Required shim thickness	1.35	1.25	1.15	1.05	0.95
Shim No.	ZGAQ-00554	ZGAQ-00552	ZGAQ-00549	ZGAQ-00547	ZGAQ-00545

(3) Place determined shim (e.g. thickness = 1.15 mm) and bearing outer ring into the hole of the axle housing on differential carrier side.

※ Rotate axle housing by 90˚.



17W98RA067

(4) Place determined shim (e.g. thickness = 1.15 mm) and bearing outer ring into the hole of the axle housing on crown wheel side.

17W98RA068

(5) Contact pattern check of bevel gear set

Cover some drive and coast flanks of the crown wheel with marking ink.

17W98RA069

(6) Place preassembled differential into the axle drive housing.

(S) Internal extractor 5870 300 005

17W98RA070

(7) Use lifting tackle to mount the axle housing (crown wheel side) and preliminarily fix it with hexagon screws.

Tightening torque (M18/10.9) . . . . . MA = 390 Nm

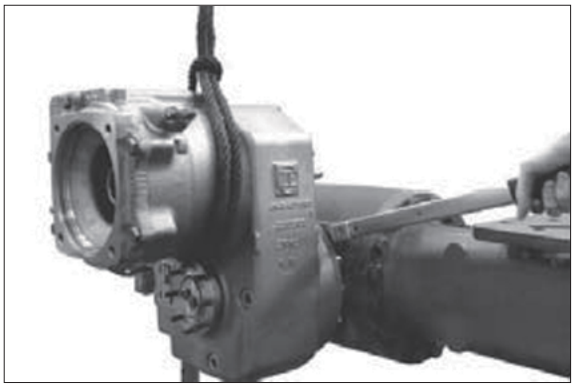
※ Preliminarily fix axle housing without O-ring.

17W98RA071

(8) Rotate axle by 90˚ and support it.

Use lifting tackle to bring HL transmission into contact position with the axle housing and fix it.

Tightening torque . . . . . MA = 79 Nm



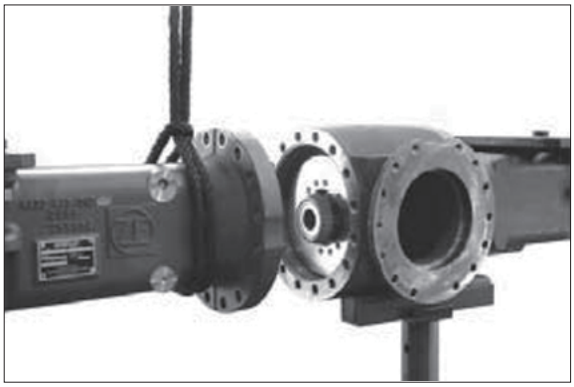
17W98RA072

(9) By rotating the input flange, roll crown wheel over the input pinion in both directions several times.

Then remove transmission and axle housing and lift differential out of the axle drive housing.

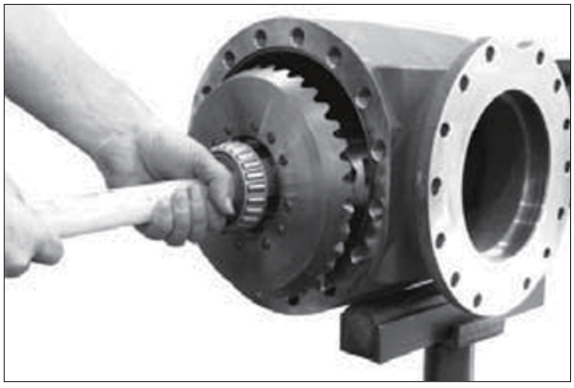
Compare the obtained contact pattern.

※ In case of a contact pattern deviation, check the pinion shimming of the transmission.



17W98RA073

(10) After contact pattern check, place differential into the axle drive housing.



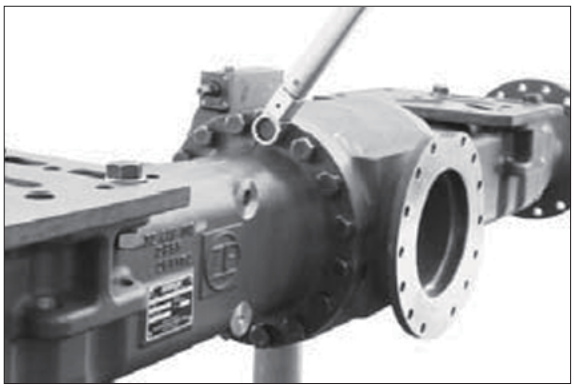
17W98RA074

(11) Grease O-ring (see arrow) and mount it to axle housing.

17W98RA075

(12) Use lifting tackle to mount the axle housing and finally tighten it with hexagon screws.

Tightening torque (M18/10.9) . . . . . MA = 390 Nm



17W98RA076

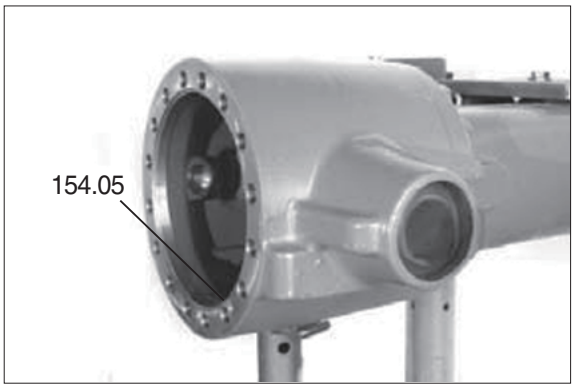
3) INPUT PINION

The following measuring operations must be carried out with utmost accuracy.
Inaccurate measurements lead to an incorrect contact pattern and require an additional disassembly and reassembly of the input pinion.

(1) Determination of shim thickness to obtain a correct contact pattern

Read dimension l from the axle drive housing.

Dim. l e.g. . . . . 154.05 mm



17W98RA077

(2) Read dimension II (pinion dimension).

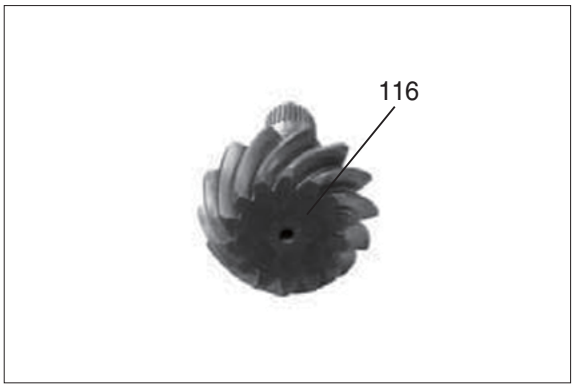
Dim. II e.g. . . . . 116.00 mm

In case of a + or - deviation of the pinion dimension for production reasons, the respective value is marked by hand on the pinion.

Pinion dim. (without + or – deviation) = 116.0 mm

Pinion dim. with + 0.1 deviation value = 116.1 mm

Pinion dim. with - 0.1 deviation value = 115.9 mm



17W98RA078

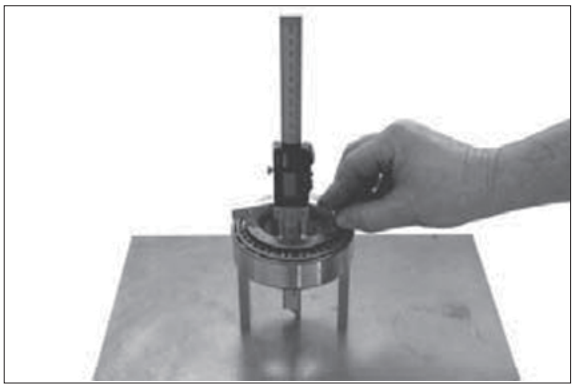
(3) Determine dimension III (bearing width).

※ Make sure that the rollers are located without any play (rotate bearing inner ring several times in both directions roller setting).

Since the installed roller bearing is subject to a preload in installation position, deduct an experience value of 0.1 mm.

Dimension III, e.g. 36.60 mm - 0.1 mm = 36.50 mm

(S) Gage blocks 5870 200 066

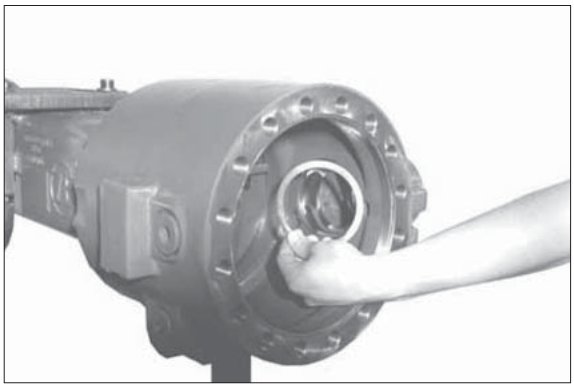


17W98RA079

(4) Calculation example :

Dimension I . . . . . 154.05 mm
Dimension X . . . . . - 152.50 mm
Difference = shim s = 1.55 mm

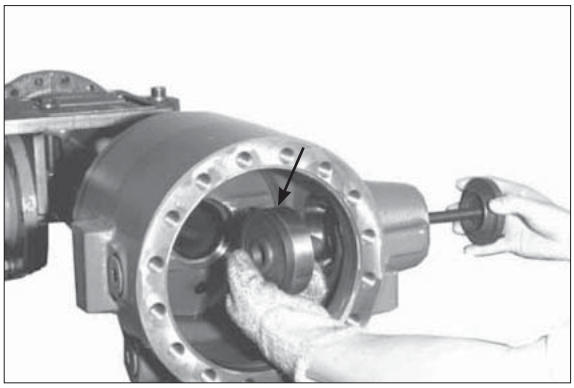
Place the determined shim (e.g. thickness = 1.55 mm) into the inner bearing hole.



17W98RA080

(5) Undercool bearing outer ring (see arrow) and bring it into contact position in the bearing hole by using the assembly fixture (S).

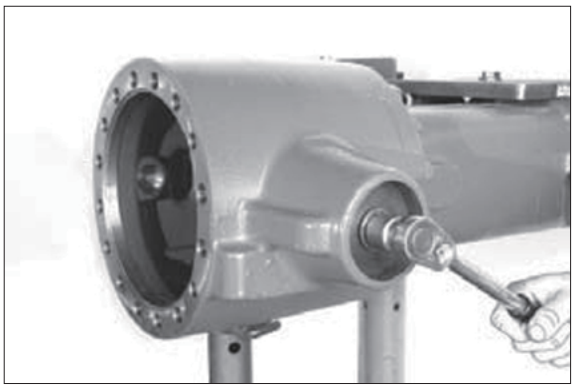
(S) Assembly fixture 5870 345 049
(S) Pressure ring 5870 345 056



17W98RA081

(6) Undercool external bearing outer ring and insert it into the bearing hole until contact is obtained.

(S) Assembly fixture 5870 345 049
(S) Pressure ring 5870 345 056

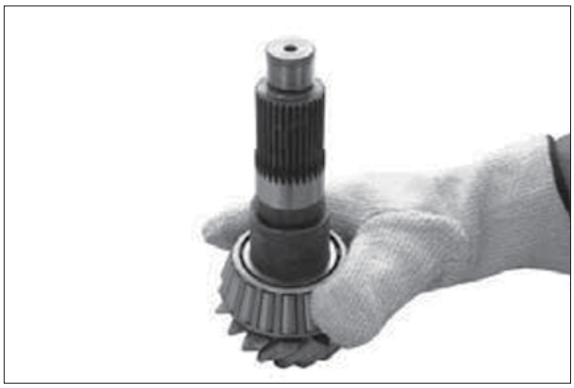


17W98RA082

(7) Adjustment of the rolling torque of input pinion bearing 1.0 ... 3.0 Nm (without shaft seal ring)

Heat up roller bearing and install it until contact is obtained.

※ Adjust bearing after cooling-down.



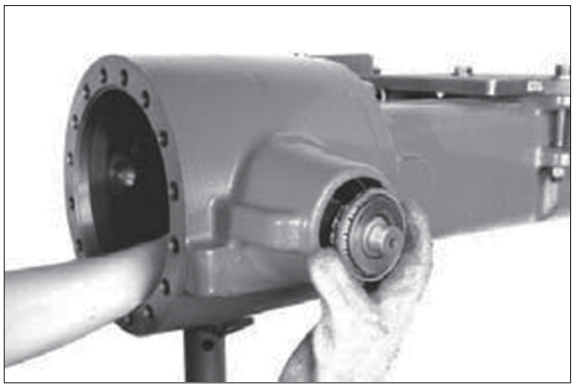
17W98RA083

(8) Mount spacer ring (e.g. thickness = 16.96 mm).

※ According to our experience, the necessary rolling torque is obtained when reusing the spacer ring which has been removed during disassembly (e.g. thickness = 16.96 mm).
A later check of the rolling torque, however, is absolutely necessary.

17W98RA084

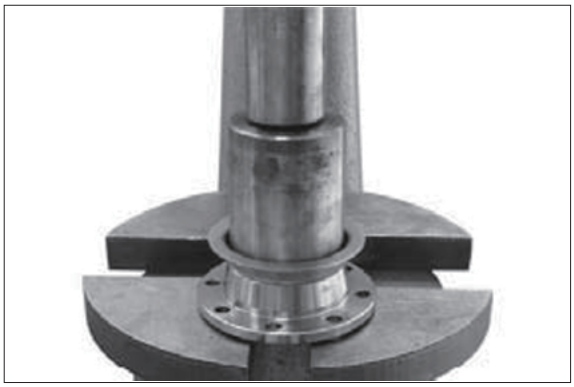
(9) Place the preassembled input pinion into the axle housing and mount the heated roller baring until contact is obtained.



17W98RA085

(10) Press screen sheet (see arrow) onto the input flange until contact is obtained.

※ Do not fit the shaft seal ring until the contact pattern has been checked.



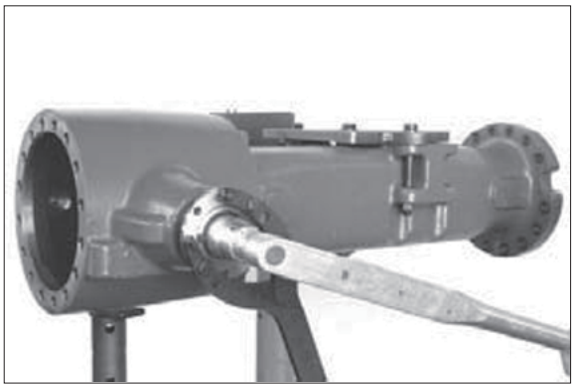
17W98RA086

(11) Mount input flange and fix it with washer and hexagon nut.

Tightening torque (M30 x 1.5) . . . . . MA = 600 Nm

(S) Clamping fork 5870 240 025

※ While tightening, rotate the input pinion in both directions several times.



17W98RA087

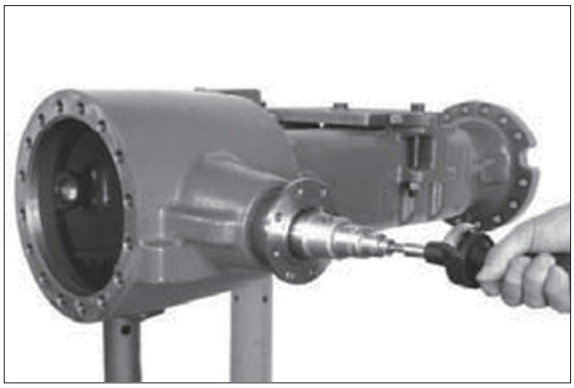
(12) Check rolling torque (1.0 ... 3.0 Nm without shaft seal ring).

※ When installing new bearings, try to achieve the upper value of the rolling torque.

※ Any deviation from the required rolling torque must be corrected with an appropriate spacer ring (figure RA110) as specified below.

Insufficient rolling torque - install thinner spacer ring.

Excessive rolling torque - install thicker spacer ring.



17W98RA088

(13) Determination of shims for setting the bearing rolling torque (differential bearing) and the backlash (bevel gear set)

※ Determine the required shims on basis of the read value (test dimension/crown wheel) and the corresponding specifications of the table below:
(KRS – SET – RIGHT) (KRS = bevel gear set) : Test dimension see crown wheel rear side.

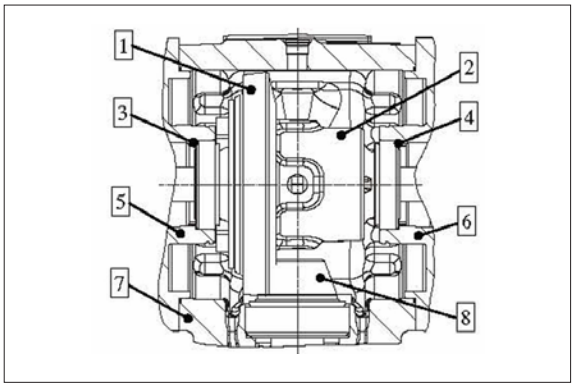
※ The test dimension "70" is stamped into the crown wheel rear side. If no + or deviation is indicated, this value corresponds with the test dimension/ actual value "70" in the table below. According to this value, the required shims are allocated in the table below.

※ Any + or – deviation of the test dimension caused by production is also marked on the crown wheel rear side (e.g. – 20 or – 10 / 10 or 20) . In accordance with this deviation, the required shims are allocated in the table below.

17W98RA089

(14) Legend to sketch:

1 = Crown wheel
2 = Differential carrier
3 = Shim (crown wheel side)
4 = Shim (diff. carrier side)
5 = Axle housing
6 = Axle housing
7 = Axle drive housing
8 = Input pinion

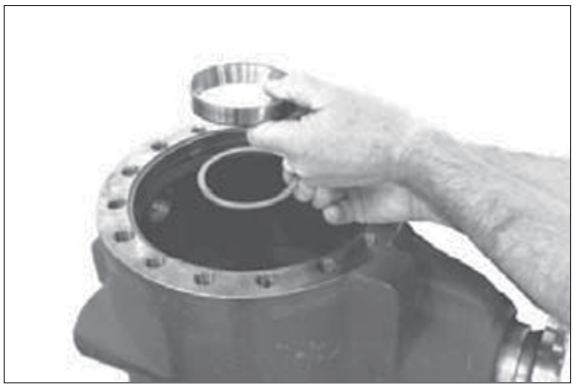


17W98RA090

Shims for differential					
Test dimension/crown wheel marking 70 and deviation	-20	-10	0	10	20
results in → test dim. / actual value	69.80	69.90	70.0	70.10	70.20
Shim/ diff. carrier side Required shim thickness	0.95	1.05	1.15	1.25	1.35
Shim No.	ZGAQ-00545	ZGAQ-00547	ZGAQ-00549	ZGAQ-00552	ZGAQ-00554
Shim/crown wheel side Required shim thickness	1.35	1.25	1.15	1.05	0.95
Shim No.	ZGAQ-00554	ZGAQ-00552	ZGAQ-00549	ZGAQ-00547	ZGAQ-00545

(15) Place determined shim (e.g. thickness = 1.15 ㎜) and bearing outer ring into the hole of the axle housing on differential carrier side (part I).

※ Rotate axle housing by 90˚.



17W98RA091

(16) Place determined shim (e.g. thickness = 1.15 ㎜) and bearing outer ring into the hole of the axle housing on crown wheel side (part II).

17W98RA092

(17) Contact pattern check of bevel gear set

Cover some drive and coast flanks of the crown wheel with marking ink.

17W98RA093

(18) Place preassembled differential into the axle drive housing.

17W98RA094

(19) Use lifting tackle to mount the axle housing (crown wheel side, part II) and preliminarily fix it with hexagon screws.

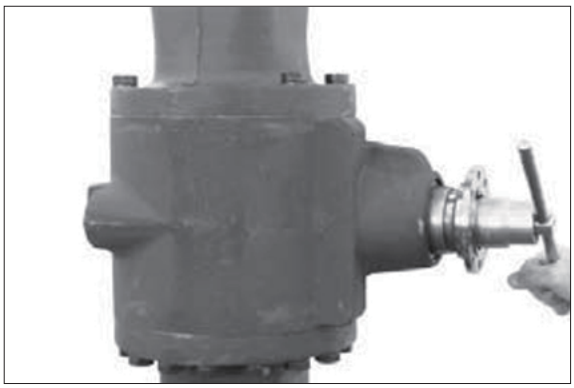
Tightening torque (M18/10.9) . . . . . MA = 390 Nm

※ Preliminarily fix axle housing without O-ring.

17W98RA095

(20) By rotating the input flange, roll crown wheel over the input pinion in both directions several times.
Then remove axle housing and lift differential out of the axle drive housing.
Compare the obtained contact pattern with contact pattern.

※ In case of a contact pattern deviation it is imperative to correct the measuring error which was made when determining the shim (figure RA080).



17W98RA096

(21) After contact pattern check, place differential into the axle drive housing.

Grease O-ring (see arrow) and mount it to the axle housing.

17W98RA097

(22) Use lifting tackle to mount the axle housing and finally fix it with hexagon screws.

Tightening torque (M18/10.9) . . . . . MA = 390 Nm

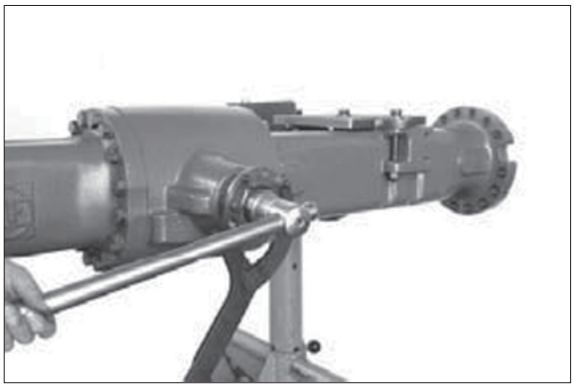
Then bring axle into horizontal position and reassemble the second supporting bracket (S) (see also figure RA001).

17W98RA098

(23) Fitting of shaft seal ring (input flange)

Loosen hexagon nut and pull input flange off the input pinion.

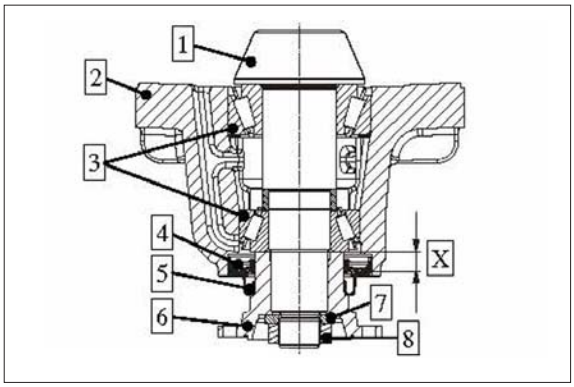
(S) Clamping fork 5870 240 025



17W98RA099

(24) Legend to sketch:

1 = Input pinion
2 = Axle drive housing
3 = Tapered roller bearing
4 = Shaft seal ring
5 = Screen sheet
6 = Input flange
7 = Washer
8 = Hexagon nut
X = Installation dimension → 13.5 +0. 2 mm



17W98RA100

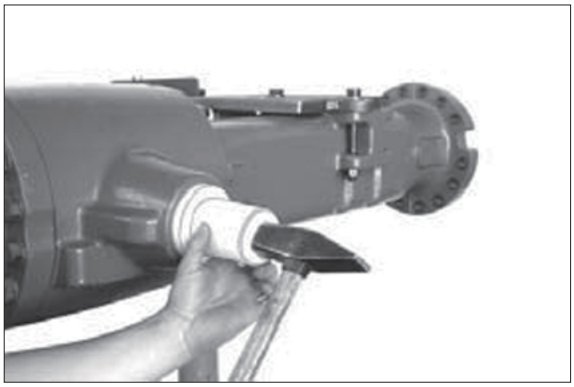
(25) Mount shaft seal ring with the sealing lip facing the oil chamber.

(S) Driver tool 5870 048 286

※ Use of the specified driver tool (S) ensures the exact installation position of the shaft seal ring.

※ Just before fitting, apply lubricant to the contact face of shaft seal ring/axle drive housing.

Apply grease to seal and dust lip of the shaft seal ring.



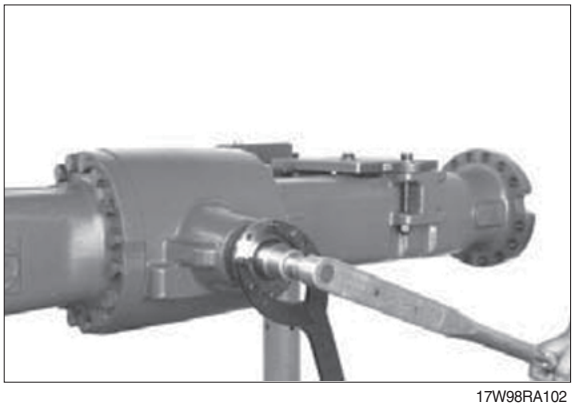
17W98RA101

(26) Mount input flange and finally fix it with washer and hexagon nut.

Tightening torque (M30 x 1.5) . . . . . MA = 600 Nm

(S) Clamping fork 5870 240 025

※ Wet thread of hexagon nut with Loctite no. 262.



17W98RA102

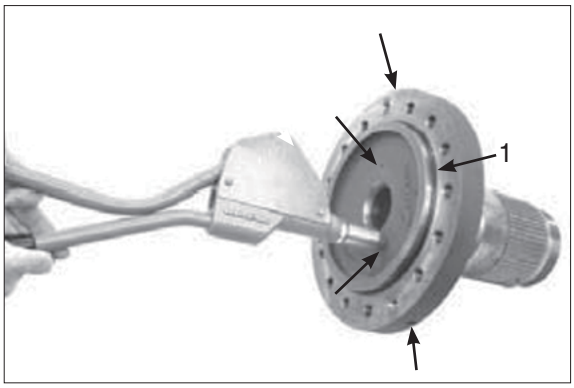
4) OUTTPUT

(1) Hub carrier

Grease O-ring (1) and mount it to hub carrier.

The following operation is only required when fitting a new hub carrier :
Seal machining openings (arrows) of oil supply holes with plugs.

(S) Lever riveting tongs 5870 320 016

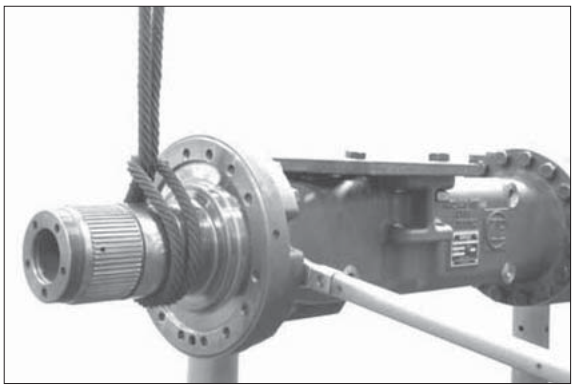


17W98RA103

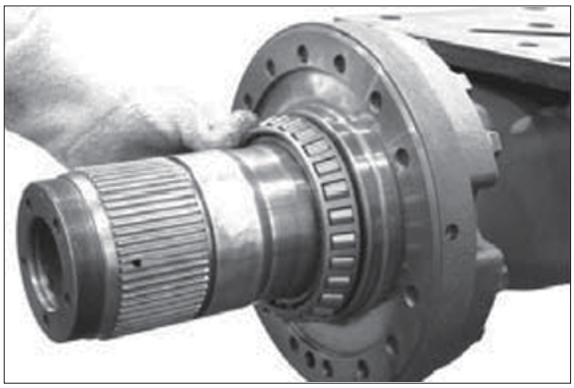
(2) Mount preassembled hub carrier to the axle housing, considering the installation position, and fix it with hexagon screws.

Tightening torque (M 16/10.9) . . . . . MA = 280 Nm

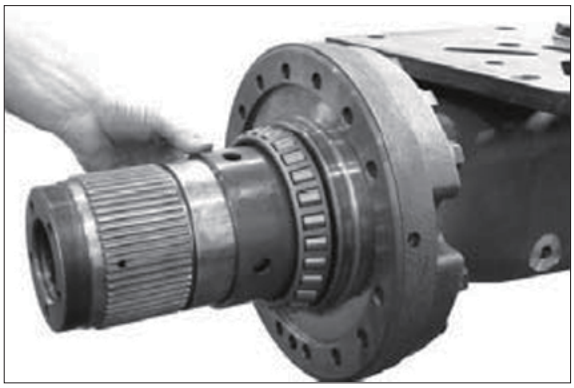
※ Ensure radial installation position. Stamped circle (see arrow) must be in uppermost (12 o'clock) position.


17W98RA104

(3) Hub (Hub bearing SET-RIGHT)
Heat up tapered roller bearing and mount it to hub carrier until contact is obtained.


17W98RA105

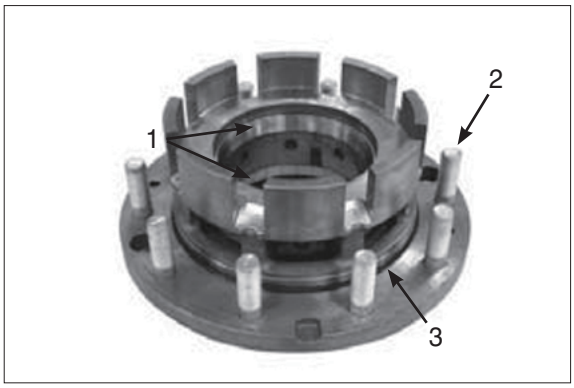
(4) Mount spacer bushing.


17W98RA106

(5) Insert both bearing outer rings (1) of the hub bearing until contact position is obtained.

Press wheel bolts (2) into the hub until contact position is obtained.

Grease O-ring (3) and place it into the annular groove of the hub.



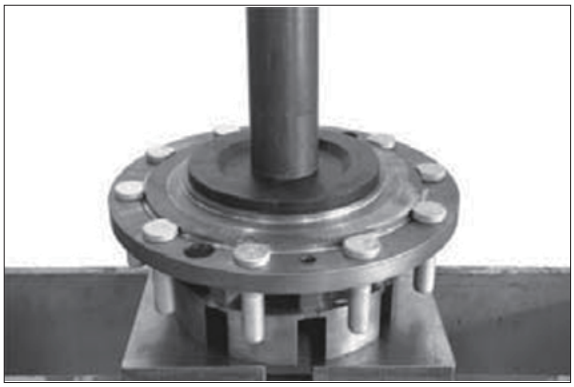
17W98RA107

(6) Press shaft seal ring into the hub, with the marking "OUT SIDE" showing outwards (facing up):

(S) Driver tool 5870 051 035

※ Use of the specified driver tool (S) ensures the exact installation position of the shaft seal ring.

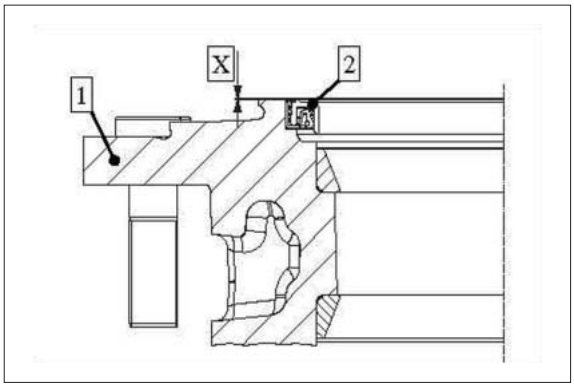
※ Wet outer diameter of the shaft seal ring with Loctite no. 574.



17W98RA108

(7) Legend to sketch:

1 = Hub
2 = Shaft seal ring
X = Installation dimension – shaft seal ring
..... 0.0~0.3 mm

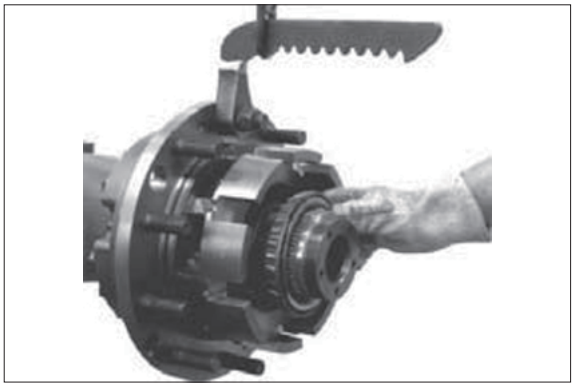


17W98RA109

(8) Mount preassembled hub until contact is obtained and fix it with heated tapered roller bearing.

(S) Lifting bracket 5870 281 043

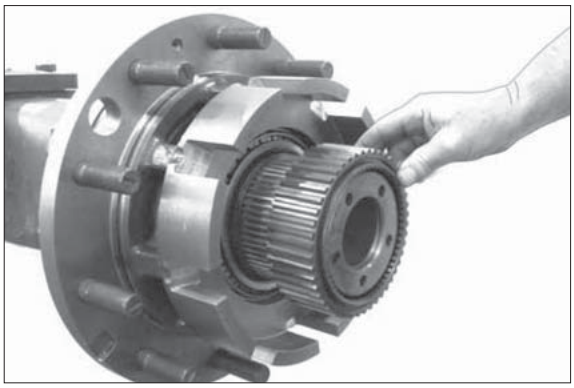
※ Just before fitting, wet sealing lips of shaft seal ring with lubricant.



17W98RA110

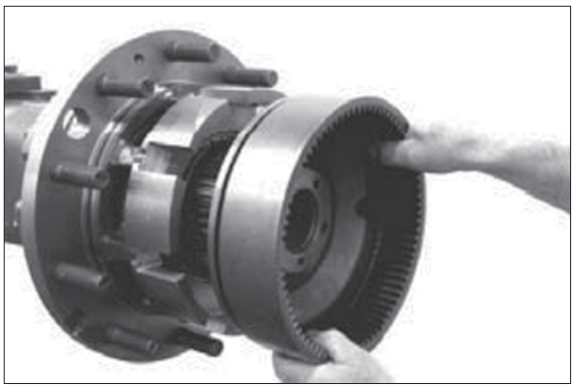
(9) Oil O-ring and insert it into the annular groove (see arrow) of the hub carrier.

Then mount disk carrier.



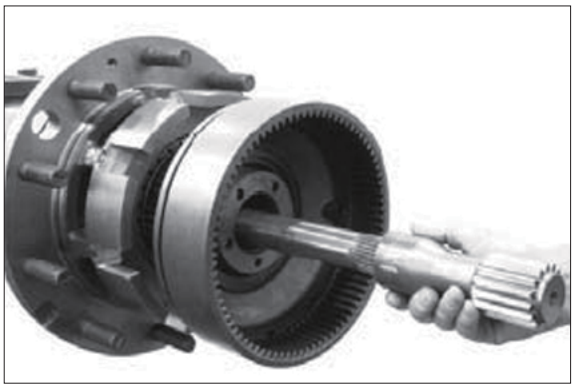
17W98RA111

(10) Bring disk carrier and hub bearing into contact position (figure no. RA112 ... RA115) :
Mount ring gear (without sealing elements).



17W98RA112

(11) Insert stub shaft and sun gear shaft for supporting the socket wrench (see following figure).



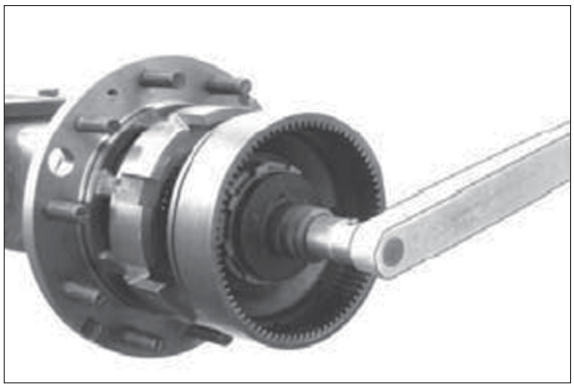
17W98RA113

(12) Bring hub bearing into contact position for this purpose tighten slotted nut with a tightening torque of 1400 Nm max.

(S) Socket wrench 5870 656 097

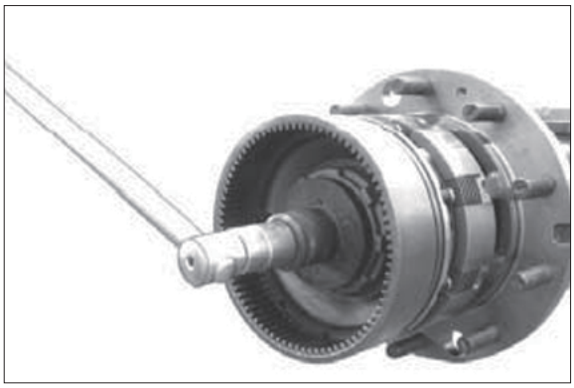
※ While tightening the slotted nut rotate hub in both directions several times roller setting.

※ Apply lubricant to thread of knuckle housing/slotted nut.



17W98RA114

(13) Loosen slotted nut and remove ring gear.

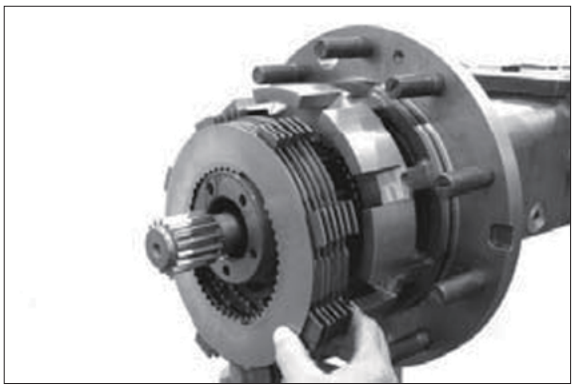


17W98RA115

(14) Multi-disk brake

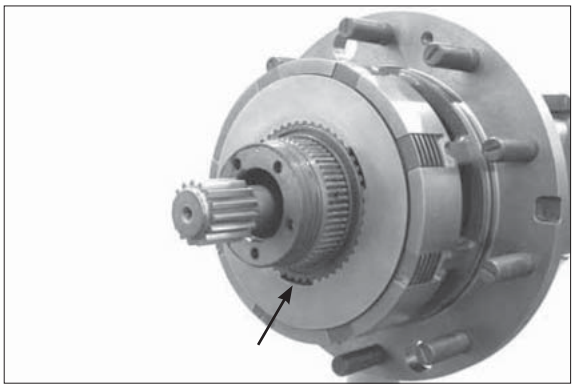
Mount outer and inner disks of the disk package alternately, starting with an outer disk.

※ For the actually required disk fitting/ arrangement please refer to the corresponding spare parts list.



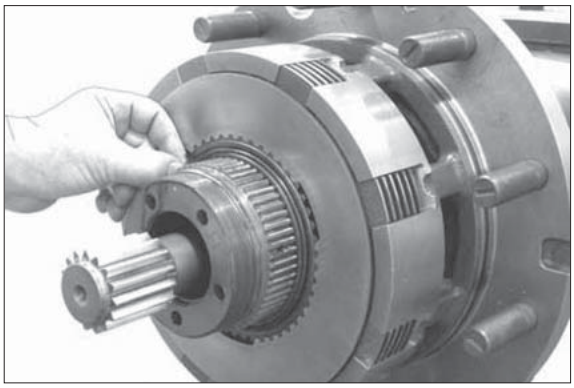
17W98RA116

(15) Bring inner clutch disks into a position where one of the tooth recesses is in 6 o'clock position after installation of the axle into the vehicle.



17W98RA117

(16) Oil O-ring and place it into the annular groove of the disk carrier.



17W98RA118

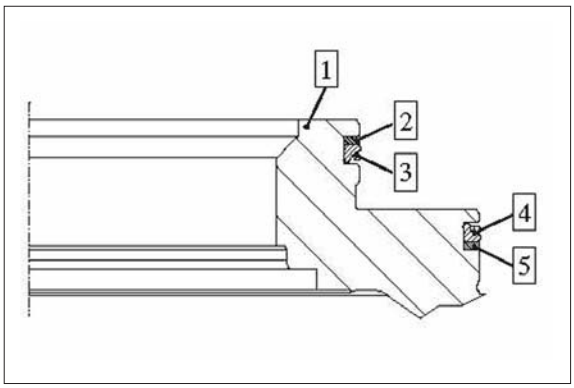
(17) Oil grooved and back-up rings and insert them into the annular grooves of the ring gear.

※ Observe installation position, see sketch below.

17W98RA119

(18) Legend to sketch:

1 = Ring gear
2 = Back-up ring
3 = Grooved ring
4 = Grooved ring
5 = Back-up ring



17W98RA120

(19) Fit cylindrical pins into the piston, considering the installation dimension "X".

X = Installation dimension . . . . .18.00 mm

17W98RA121

(20) Mount piston onto ring gear.

17W98RA122

(21) Fix piston with "new" hexagon screws (1), spring sleeves (2) and compression springs (3 and 4).

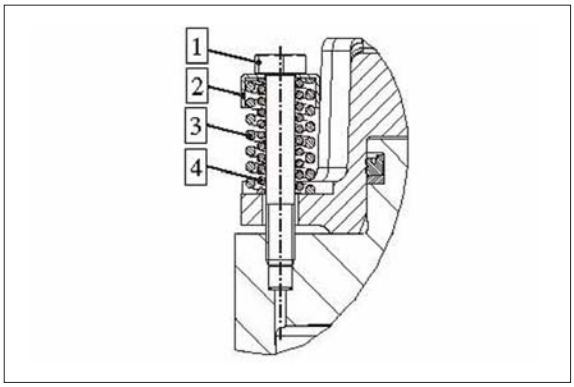
Tightening torque (M 6/8.8) . . . . . MA = 8 Nm

※ Use hexagon screws just once.

17W98RA123

(22) Legend to sketch:

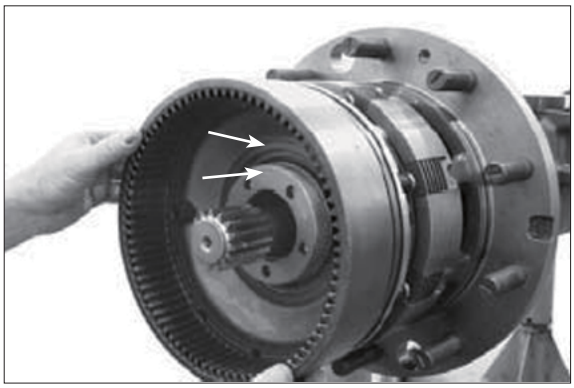
1 = Hexagon screw (special version)
2 = Spring sleeve
3 = Compression spring
4 = Compression spring



17W98RA124

(23) Mount preassembled ring gear, considering the installation position (markings O in 12 o'clock position – see arrows).

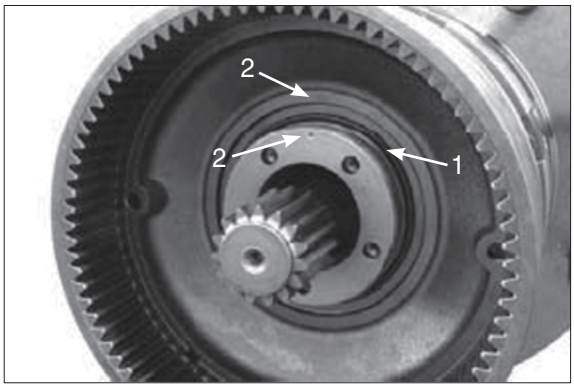
※ Ensure exact toothing position of oil supply holes – hub carrier/ring gear (pressure oil supply to brake piston).



17W98RA125

(24) Oil O-ring and insert it into the recess (see arrow 1).

※ Arrows (2) show once more the markings O and the installation position of hub carrier and ring gear.



17W98RA126

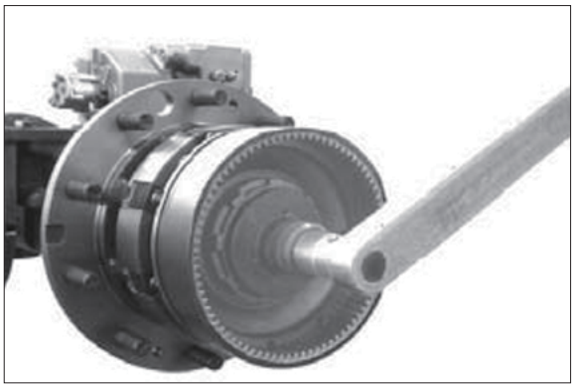
(25) Fix ring gear with slotted nut.

Tightening torque (M85 × 1.5) . . . . . MA = 1400 + 200 Nm

(S) Socket wrench 5870 656 097

※ Pretighten slotted nut with 1400 Nm, then continue tightening the slotted nut until a fixing hole overlaps a threaded hole in the knuckle housing.
While tightening the slotted nut rotate hub in both directions several times – roller setting.

※ Apply lubricant to thread of knuckle housing/slotted nut.



17W98RA127

(26) Leakage test of multi-disk brake

Fit breather (arrow) and threaded coupling (S), then connect HP pump.

(S) HP pump 5870 287 007
(S) Threaded coupling (M14 × 1.5) 5870 950 102
※ (S) Breather bottle 5870 286 072

Breathe brake completely before starting the test.

Test media :
Motor oils SAE-10W

High-pressure test:
Build up test pressure p = 100 bar and close shut-off valve of HP pump.
A maximum pressure drop of 3 bar is permissible during a 5-minute test.

Low-pressure test:
Reduce test pressure to p = 5 bar and close shut-off valve.
No pressure drop is allowed during a 5-minute test.

17W98RA128

(27) Adjustment and check of piston stroke

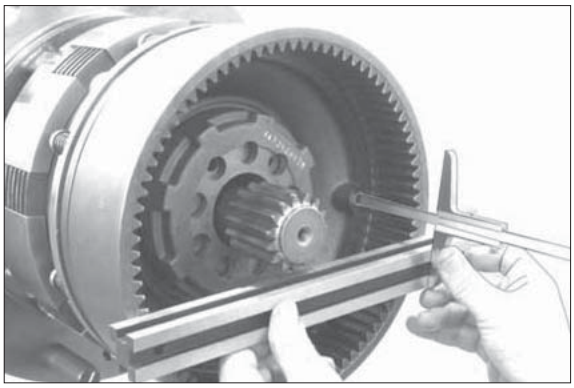
Piston stroke / disk clearance =
0.7 ... 1.3 mm

Build up brake pressure (100 bar) and close shut-off valve of HP pump.

Determine dimension "A", from face of the ring gear (1) through the measuring hole (see also sketch 43) to the face of the piston (3).

Dim. "A" e.g. . . . . 83.10 mm

※ Breathe brake completely before starting the measuring operation.

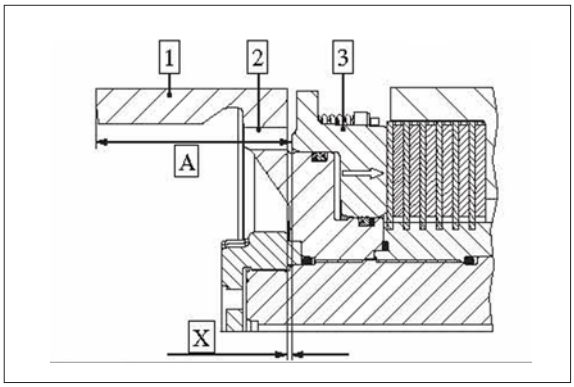


17W98RA129

(28) Then open shut-off valve of HP pump and release pressure from brake (piston return via compression springs).

Determine dimension "B", from the face of the ring gear (1) through the measuring hole (see also sketch RA131) to the face of the piston (3).

Dimension "B" e.g . . . . . 82.10 mm



17W98RA130

(29) Calculation example :

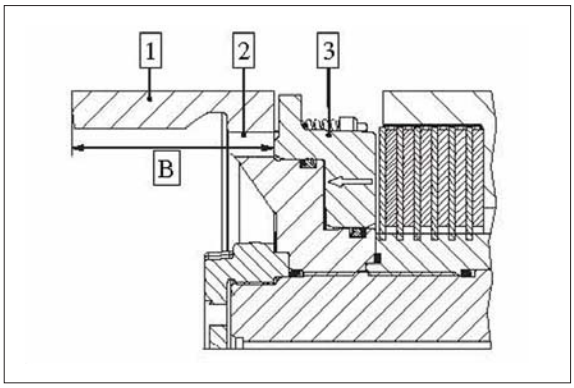
Dimension „A“ e.g. . . . . 83.10 mm
Dimension „B“ e.g. . . . . - 82.10 mm
Difference = piston stroke = 1.00 mm

※ If the required piston stroke (0.7 ... 1.3 mm) is not achieved, correct it with (a) corresponding inner clutch disk(s) – see respective spare parts list.

Then remove HP pump (S), breather bottle (S) and threaded coupling (S).

Legend to sketches RA130 and RA131:
1 = Ring gear
2 = Measuring hole
3 = Piston
X = Piston stroke/disk clearance

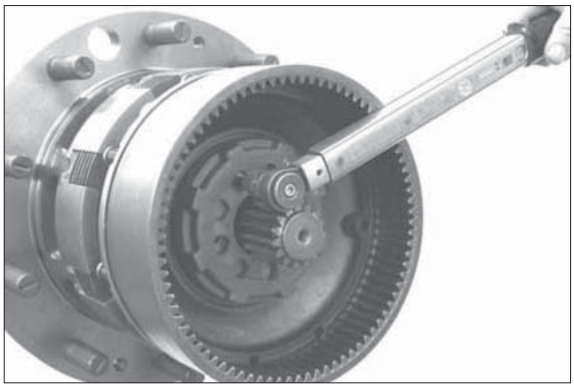
(S) Straightedge 5870 200 022



17W98RA131

(30) Secure slotted nut with cylindrical screw (see also figure RA127).

Tightening torque (M 10/8.8) . . . . . MA = 32 Nm



17W98RA132

(31) Planetary carrier

Press thrust washer into the planetary carrier until contact is obtained.

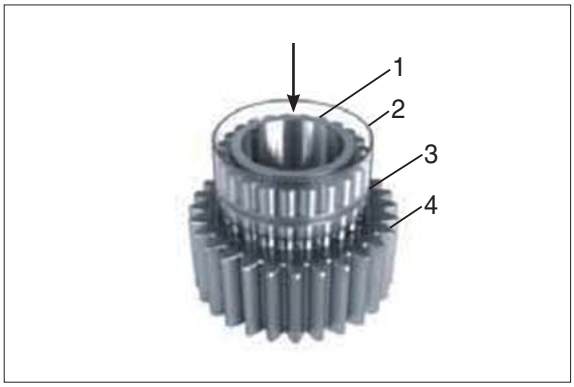
(S) Driver tool 5870 048 245

17W98RA133

(32) Insert the cylindrical roller bearing into the planetary gear – for this purpose press the cylindrical roller bearing through the packaging sleeve until the snap ring engages into the annular groove of the planetary gear.

※ Use packaging sleeve to facilitate assembly.

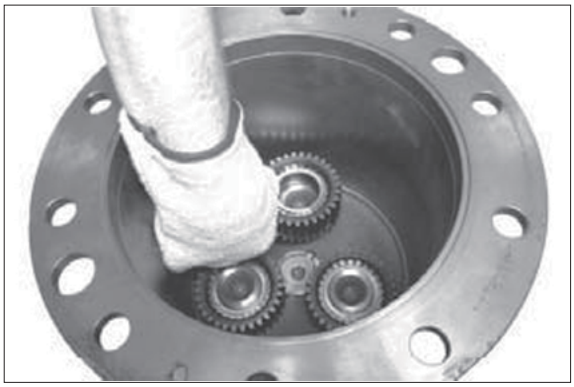
1 = Cylindrical roller bearing
2 = Packaging sleeve
3 = Snap ring
4 = Planetary gear



17W98RA134

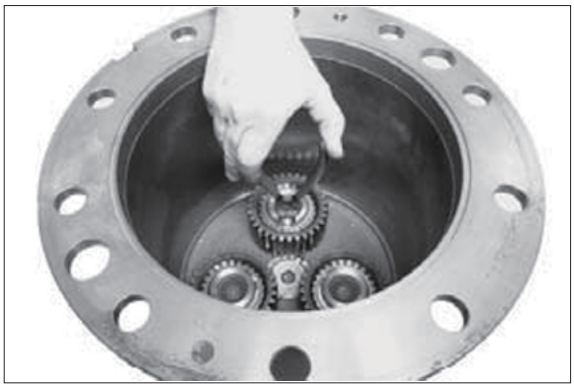
(33) Heat up bearing inner ring and mount preassembled planetary gear until contact is obtained.

※ Mount bearing inner ring with the large radius facing the planetary carrier (downwards).



17W98RA135

(34) Fix planetary gear by means of retaining ring.



17W98RA136

(35) Mount preassembled planetary carrier and fix it with hexagon screws.

Tightening torque (M12/8.8) . . . . . MA = 55 Nm

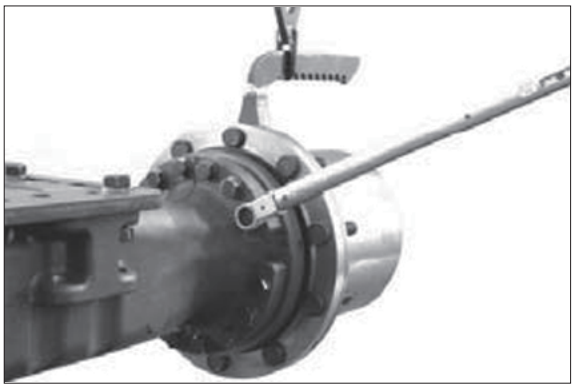
17W98RA137

(36) Output assy

Use lifting tackle (S) to locate the output assy at the axle, mount stub shaft into the teeth of the axle bevel gear and fix output assy with hexagon screws.

Tightening torque (M16/10.9) . . . . . MA = 280 Nm

(S) Lifting bracket 5870 281 043



17W98RA138

※ Prior to putting the axle into operation, fill in oil.

Observe the vehicle manufacturer's instructions and specifications for the installation and commissioning of the unit.

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.

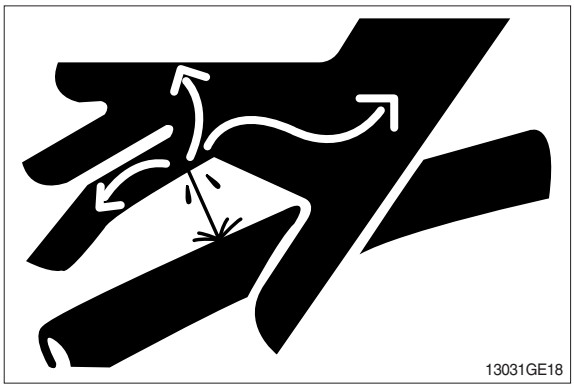
(4) Loosen the socket bolt (1).
Tightening torque : 1.05 ± 0.2 kgf · m
(7.6 ± 1.45 lbf · ft)

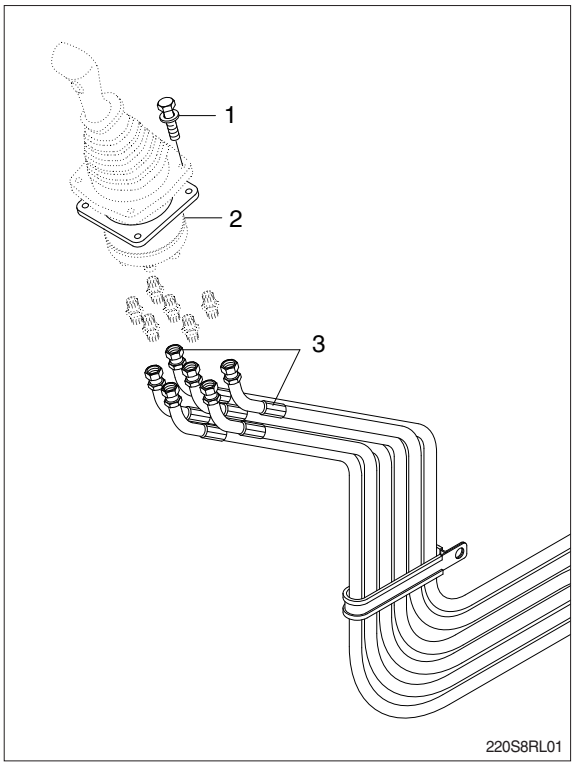
(5) Remove the cover of the console box.

(6) Disconnect pilot line hoses (3).

(7) Remove the pilot valve assembly (2).

※ When removing the pilot valve assembly, check that all the hoses have been disconnected.





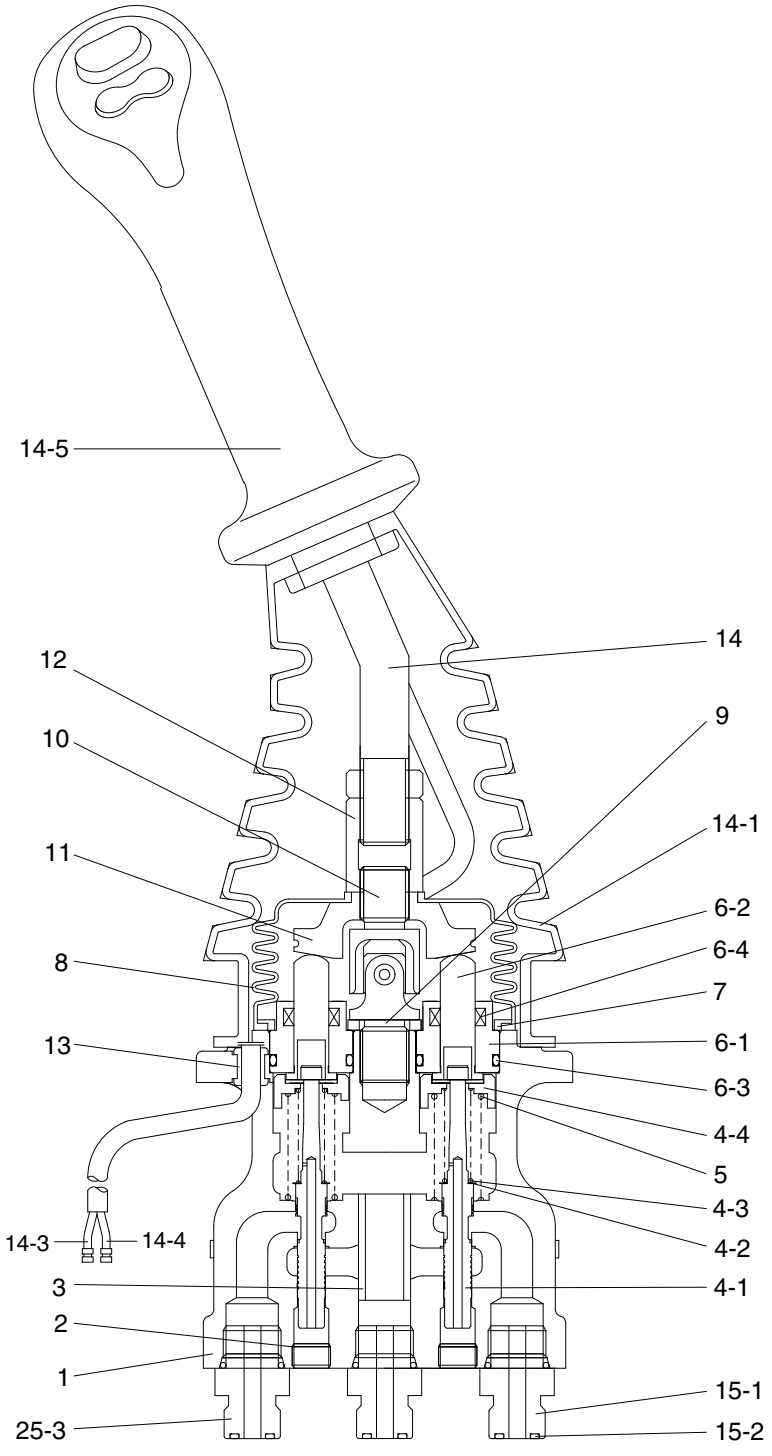
2) INSTALL

(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

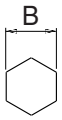


140WA2RL06

1	Case	5	Spring	9	Spacer	14-3	Housing
2	Plug	6-1	Plug	10	Joint Assy	14-4	Housing
3	Bushing	6-2	Push rod	11	Swash plate	14-5	Handle
4-1	Spool	6-3	O-ring	12	Adjusting nut	14-6	Lock nut
4-2	Shim	6-4	Rod seal	13	Bushing	15-1	Filter
4-3	Spring	7	Spacer	14-1	Boot	15-2	Connector
4-4	Spring seat	8	Boot	14-2	Spring pin	15-3	Connector

2) TOOLS AND TIGHTENING TORQUE

(1) Tools

Tool name	Remark	
Allen wrench	6	
Spanne	22	
	27	
(+) Driver	Length 150	
(-) Driver	Width 4~5	
Torque wrench	Capable of tightening with the specified torques	

(2) Tightening torque

Part name	Item	Size	Torque	
			kgf · m	lbf · ft
Joint	10	M14	3.5	25.3
Swash plate	11	M14	5.0±0.35	36.2±2.5
Adjusting nut	12	M14	5.0±0.35	36.2±2.5
Lock nut	14-6	M14	5.0±0.35	36.2±2.5

3) DISASSEMBLY

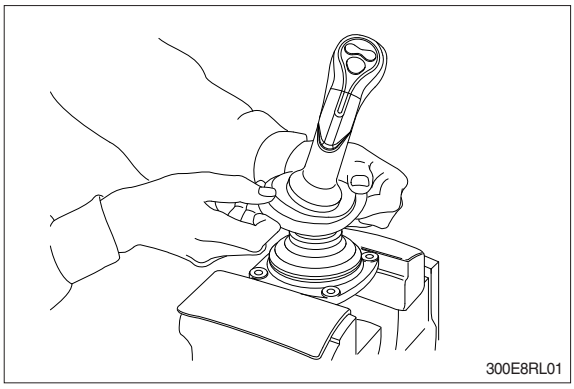
※ Procedures are based on the type M25.

(1) Clean pilot valve with kerosene.

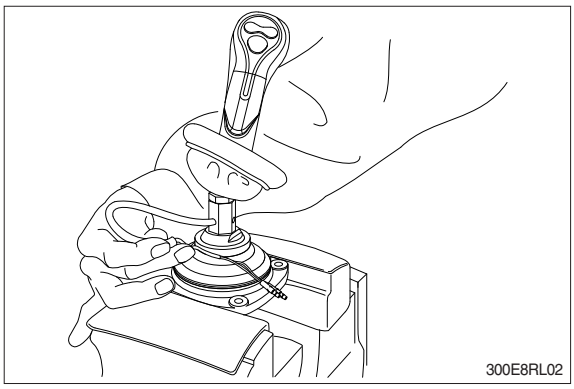
※ Put blind plugs into all ports

(2) Fix pilot valve in a vise with copper (or lead) sheets.

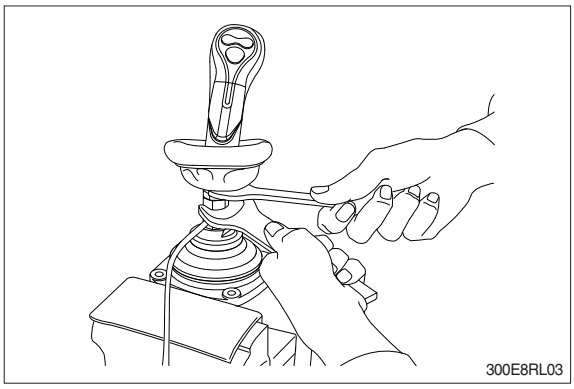
(3) Remove end of boot (14-1) from case (1) and take it out upwards.



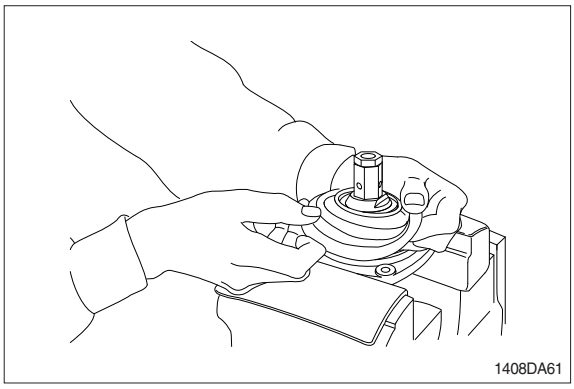
※ For valve with switch, remove cord also through hole of casing.



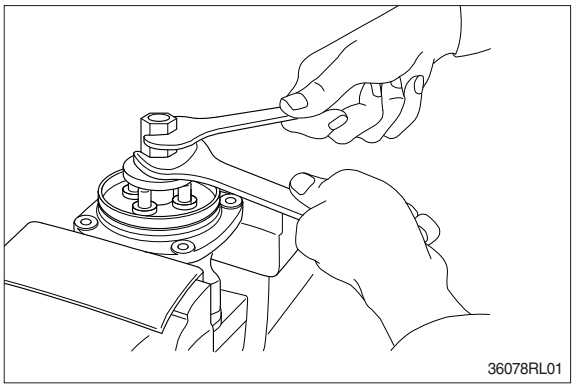
(4) Loosen lock nut (14-6) and adjusting nut (12) with spanners on them respectively, and take out handle section as one body.

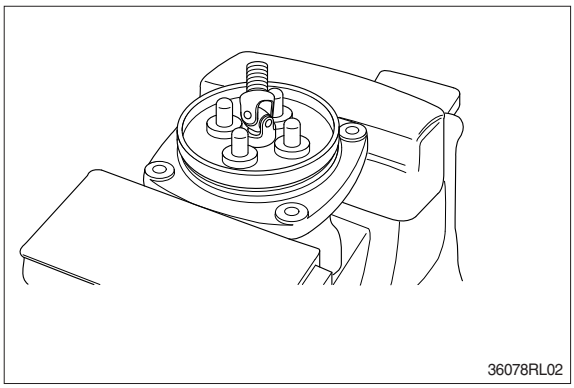


(5) Remove the boot (8).



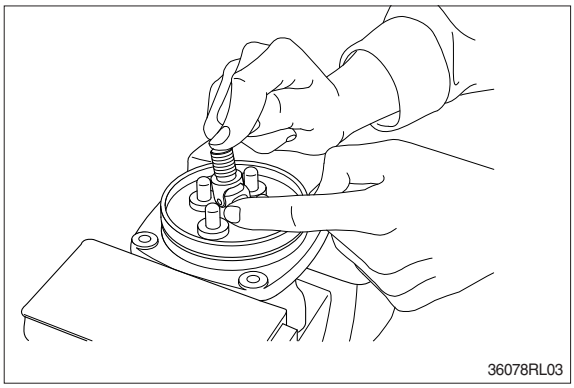
(6) Loosen adjusting nut (12) and swash plate (11) with spanners on them respectively, and remove them.

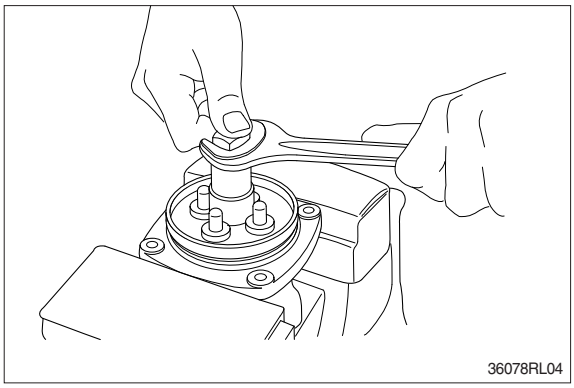




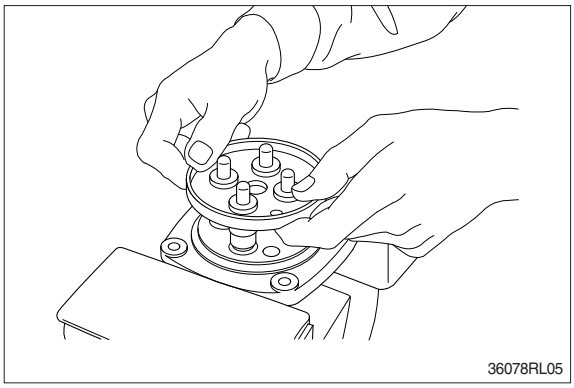
(7) Turn joint anticlockwise to loosen it, utilizing jig (Special tool).

※ When return spring (5) is strong in force, plate (7), plug (6-1) and push rod (6-2) will come up on loosening joint.
Pay attention to this.





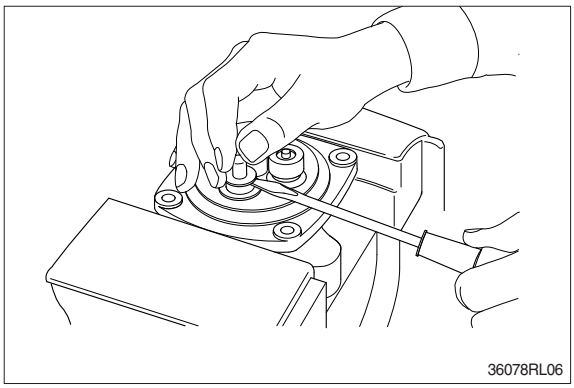
(8) Remove plate (7-1).



(9) When return spring (5) is weak in force, plug (6-1) stays in casing because of sliding resistance of O-ring.

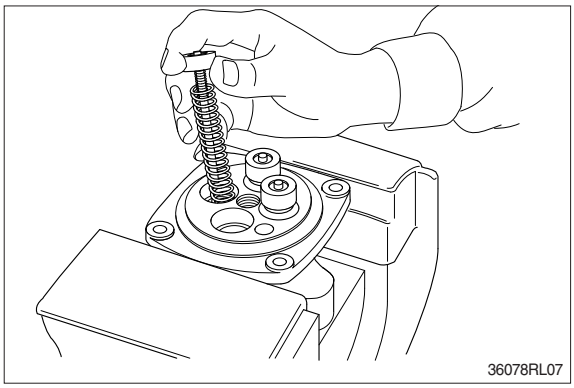
※ Take it out with minus screwdriver.
Take it out, utilizing external periphery groove of plug and paying attention not to damage it by partial loading.

※ During taking out, plug may jump up due to return spring (5) force.
Pay attention to this.



(10) Remove reducing valve subassembly and return spring (5) out of casing.

※ Record relative position of reducing valve subassembly and return springs.

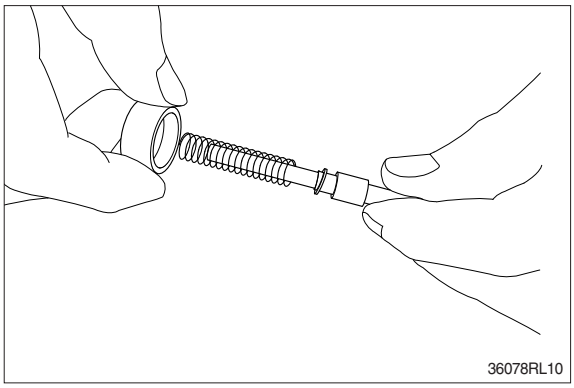


(11) Separate spool (4-1), spring seat (4-4), spring (4-3) and shim (4-2) individually.

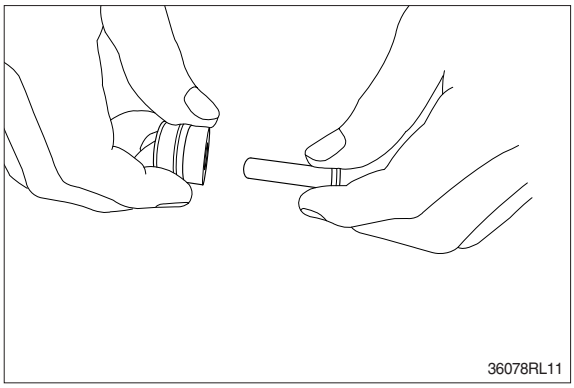
※ Pay attention not to damage spool surface.

※ Record original position of spring seat (4-4).

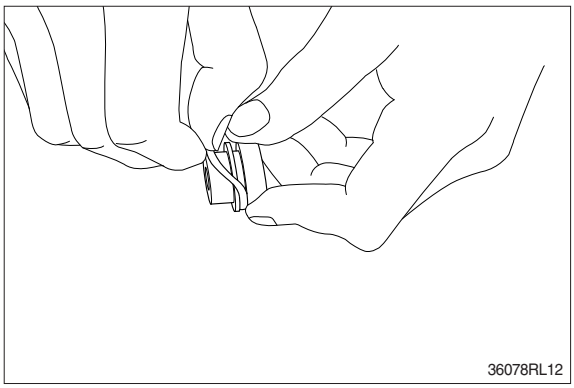
※ Until being assembled, they should be handled as one subassembly group.

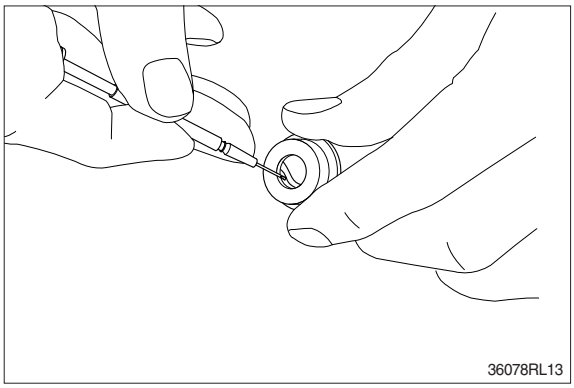


(12) Take push rod (6-2) out of plug (6-1).

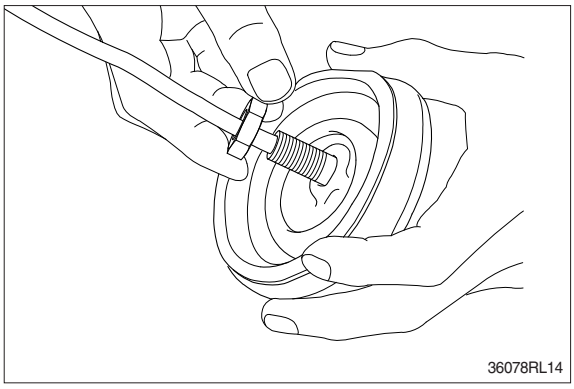


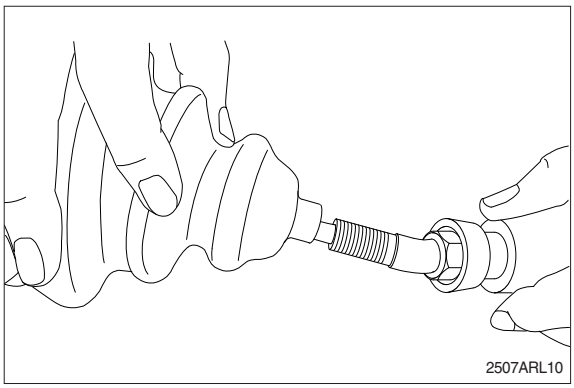
(13) Remove O-ring (8-3) and seal (6-4) from plug (6-1).
Use small minus screwdriver or so on to remove this seal.





(14) Remove lock nut (14-6) and then boot (14-1).





(15) Cleaning of parts

① Put all parts in rough cleaning vessel filled with kerosene and clean them (rough cleaning).

※ If dirty part is cleaned with kerosene just after putting it in vessel, it may be damaged. Leave it in kerosene for a while to loosen dust and dirty oil.

※ If this kerosene is polluted, parts will be damaged and functions of reassembled valve will be degraded.
Therefore, control cleanliness of kerosene fully.

② Put parts in final cleaning vessel filled with kerosene, turning it slowly to clean them even to their insides (finish cleaning).

※ Do not dry parts with compressed air, since they will be damaged and/or rusted by dust and moisture in air.

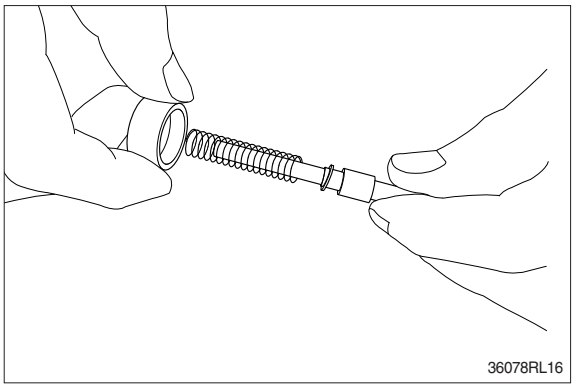
(16) Rust prevention of parts

Apply rust-preventives to all parts.

※ If left as they after being cleaned, they will be rusted and will not display their functions fully after being reassembled.

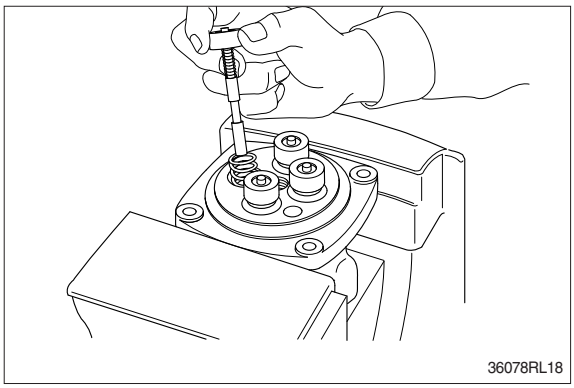
4) ASSEMBLY

(1) Put shim (4-2), springs (4-3) and spring seat (4-4) onto spool (3) in this order.

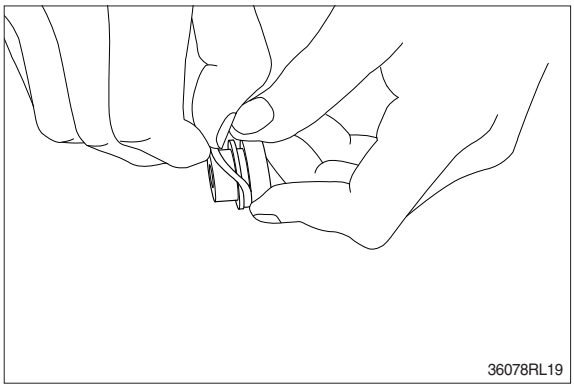


(2) Assemble spring (5) into casing (1). Assemble reducing valve subassembly into casing.

※ Assemble them to their original positions.

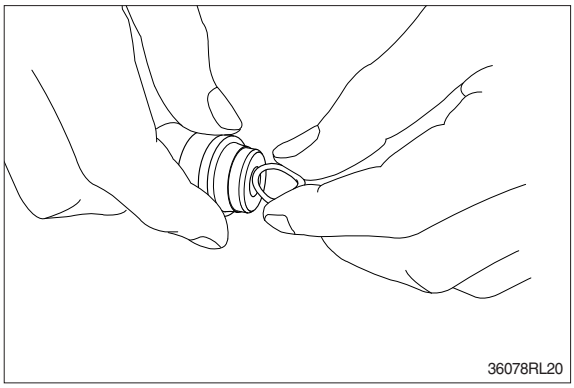


(3) Assemble O-ring (8-3) onto plug (6-1).

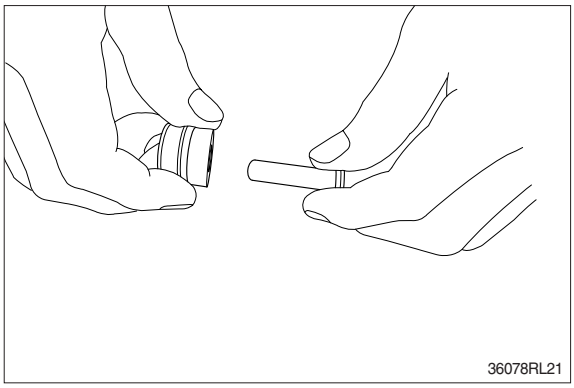


(4) Assemble seal (6-4) to plug (6-1).

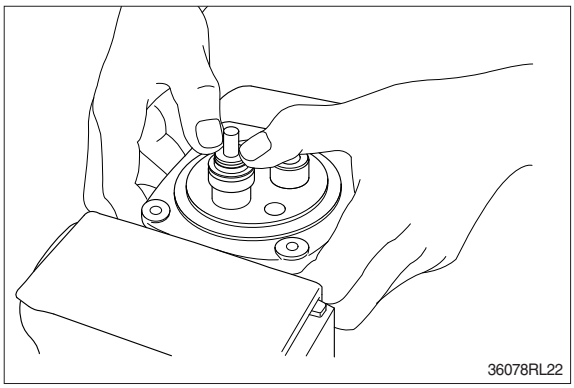
※ Assemble seal in such lip direction as shown below.



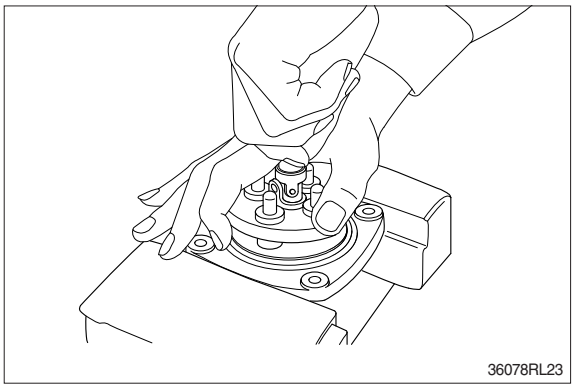
(5) Assemble push rod (6-2) to plug (6-1).
※ Apply working oil on push-rod surface.



(6) Assemble plug subassembly to casing.
※ When return spring is weak in force, subassembly stops due to resistance of O-ring.

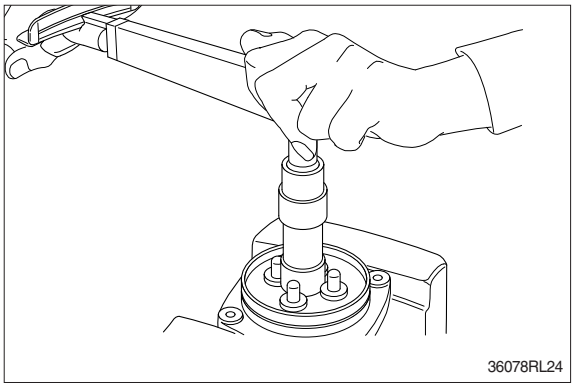


(7) When return spring is strong in force, assemble 4 sets at the same time, utilizing plate (7), and tighten joint (10) temporarily.



(8) Fit plate (7).

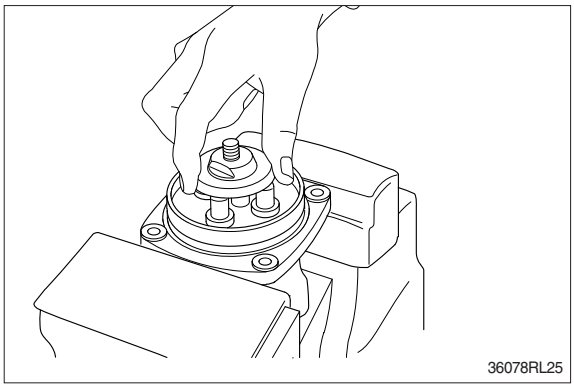
(9) Tighten joint (10) with the specified torque to casing, utilizing jig.



(10) Assemble swash plate (11) to joint (10).

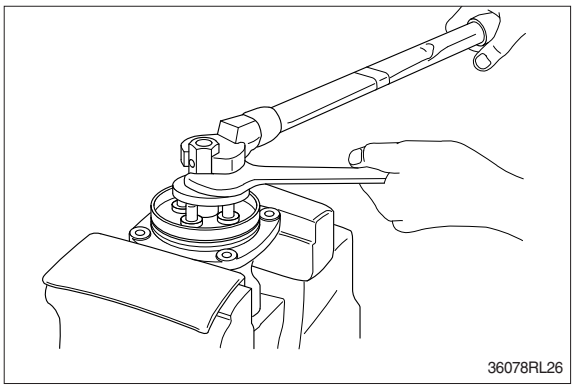
※ Screw it to position that it contacts with 4 push rods evenly.

※ Do not screw it over.

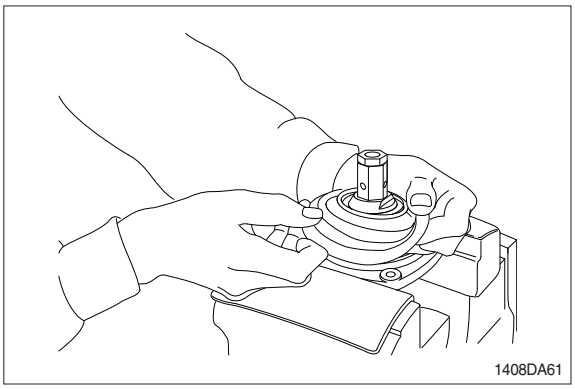


(11) Assemble adjusting nut (12), apply spanner to width across flat of plate (11) to fix it, and tighten adjusting nut to the specified torque.

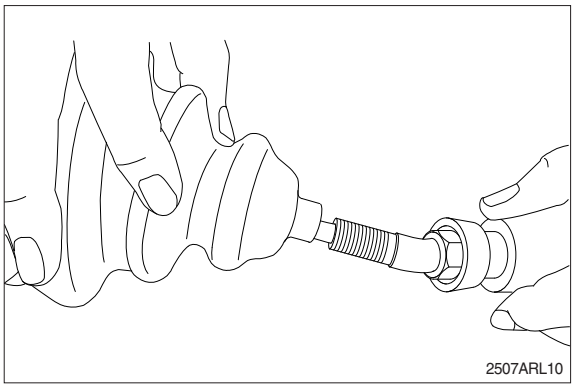
※ During tightening, do not change position of disk.

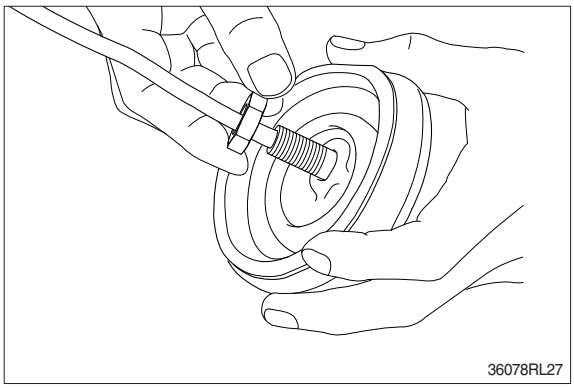


(12) Fit boot (8) to plate.

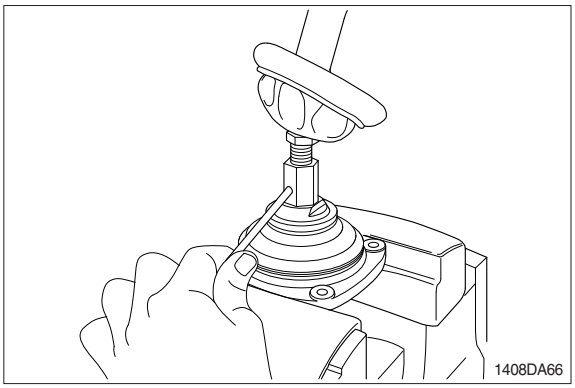


(13) Fit boot (14-1) and lock nut (14-6), and handle subassembly is assembled completely.



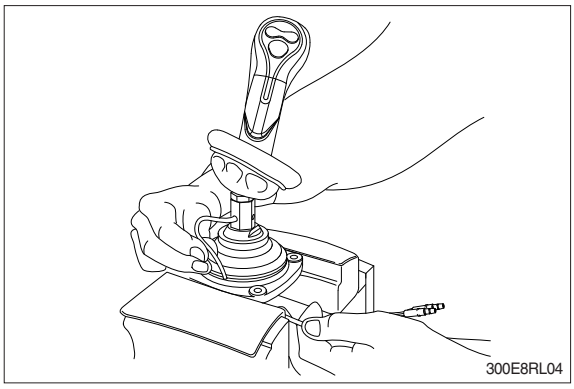


(14) Pull out cord and tube through adjusting nut hole provided in direction 60 ° to 120 ° from casing hole.

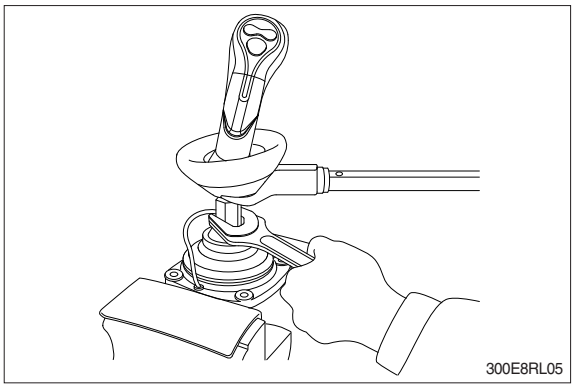


(15) Assemble bushing (13) to plate and pass cord and tube through it.

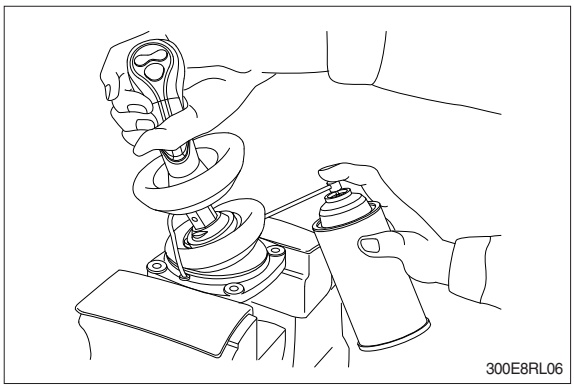
※ Provide margin necessary to operation.



(16) Determine handle direction, tighten lock nut (14-6) to specified torque to fix handle.

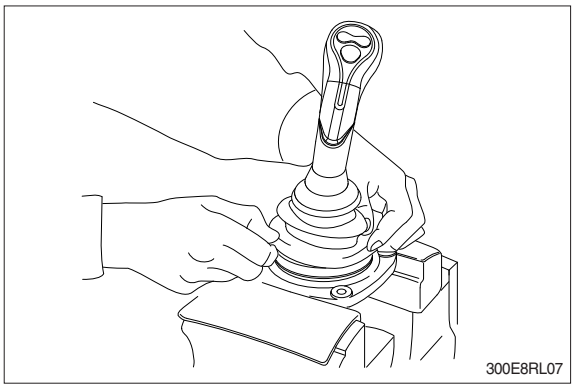


(17) Apply grease to rotating section of joint and contacting faces of disk and push rod.



(18) Assemble lower end of bellows to casing.

(19) Inject volatile rust-preventives through all ports and then put blind plugs in ports.



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.

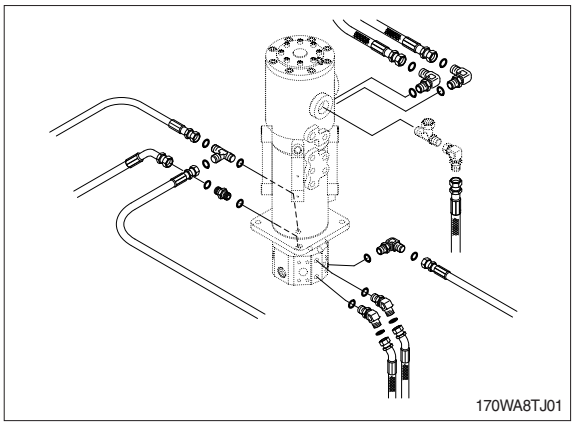
※ When pipes and hoses are discon-nected, the oil inside the piping will flow out, so catch it in oil pan.

(4) Disconnect all hoses.

(5) Sling the turning joint assembly (1) and remove the mounting bolt (2).
- Weight : 117 kg (260 lb)
- Tightening torque : 12.8 ± 3.0 kgf · m (92.6 ± 21.7 lbf · ft)

(6) Remove the turning joint (1) assembly.

※ When removing the turning joint, check that all the hoses have been disconn-ected.



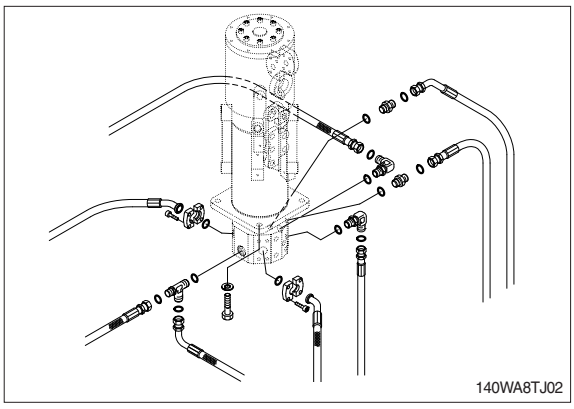
2) INSTALL

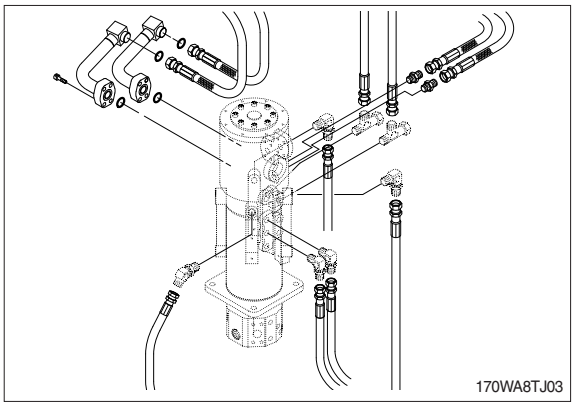
(1) Carry out installation in the reverse order to removal.

※ Take care of turning joint direction.

※ Assemble hoses to their original positions.

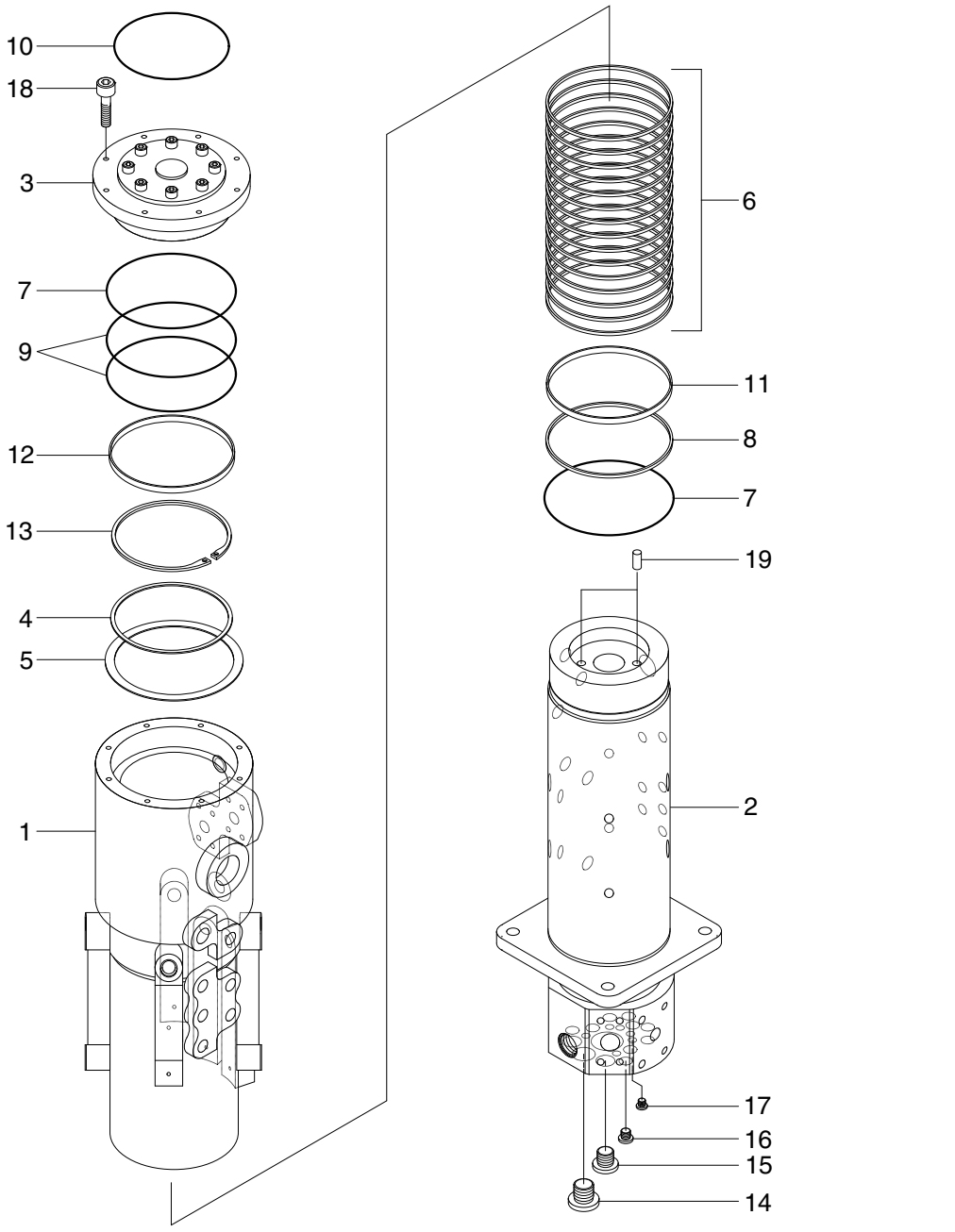
※ Confirm the hydraulic oil level and check the hydraulic oil leak or not.





2. DISASSEMBLY AND ASSEMBLY

1) STRUCTURE



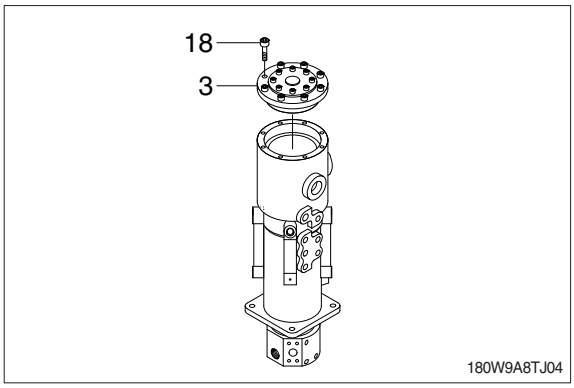
180W9A8TJ03

1	Hub	8	O-ring	15	Plug
2	Shaft	9	O-ring	16	Plug
3	Cover	10	O-ring	17	Plug
4	Spacer	11	Wear ring	18	Socket bolt
5	Shim	12	Wear ring	19	Spring pin
6	Slipper seal	13	Retainer ring		
7	O-ring	14	Plug		

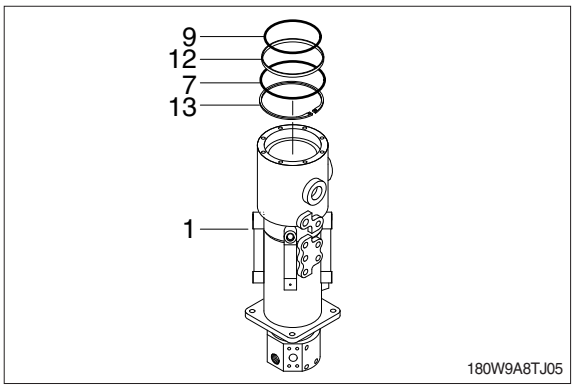
2) DISASSEMBLY

※ Before the disassembly, clean the turning joint.

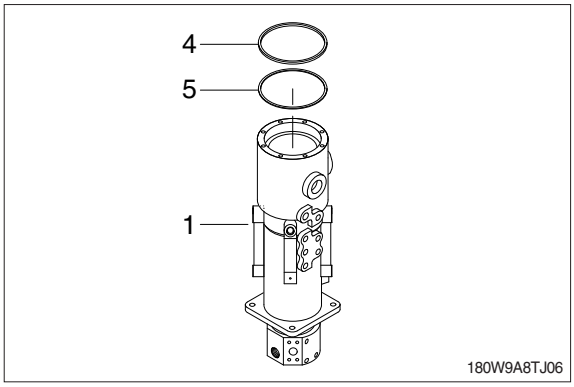
(1) Loosen the socket bolt (18) and remove cover (3).



(2) Remove O-ring (9), wear ring (12), O-ring (7) and retainer ring (13) from hub (1).



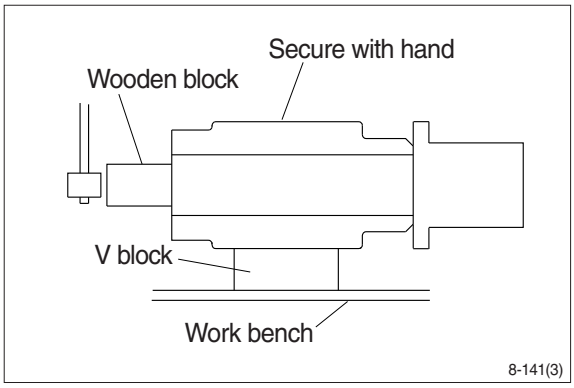
(3) Remove spacer (4) and shim (5) from hub (1).



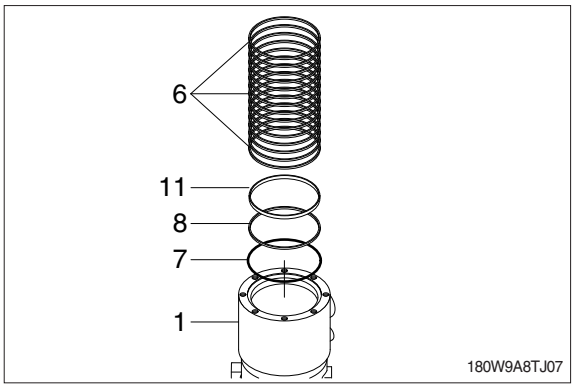
(4) Place hub (1) on a V-block and by using a wood buffer at the shaft end, hit out shaft (2) to about 1/2 from the hub with a hammer.

※ 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 seventeen slipper seal (6), O-ring (7, 8) and wear ring (11) from hub (1).

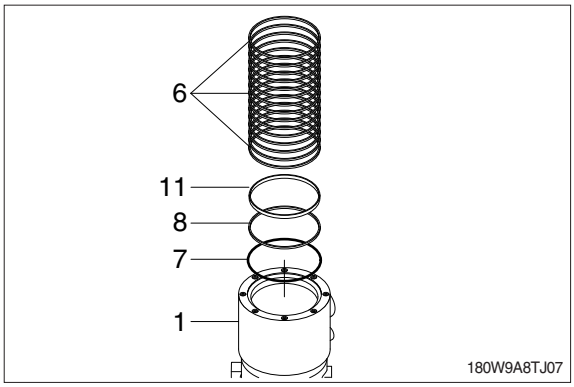


3) ASSEMBLY

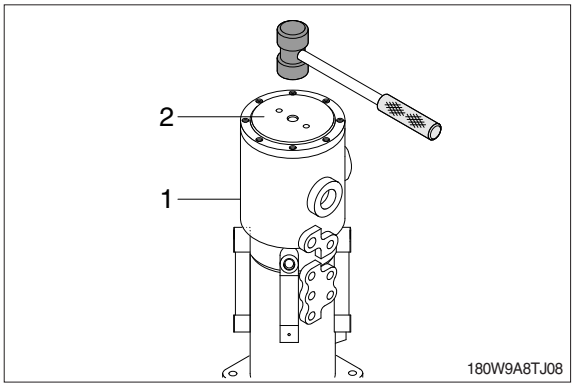
※ Clean all parts.
※ As a general rule, replace oil seals and O-ring.
※ Coat the sliding surfaces of all parts with engine oil or grease before installing.

(1) Fit O-ring (8), seventeen slipper seal (6), and wear ring (11).

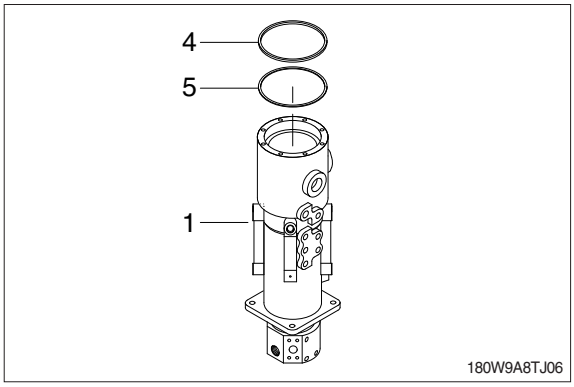
(2) Fit O-ring (7) to shaft (2).



(3) Set shaft (2) on block, tap hub (1) with a plastic hammer to install.

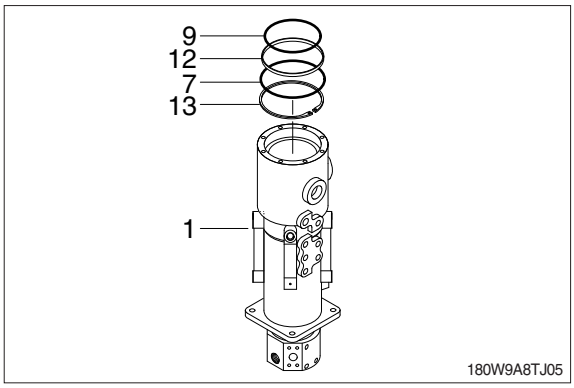


(4) Fit shim (5), and spacer (4) to hub (1) of turning joint upside.



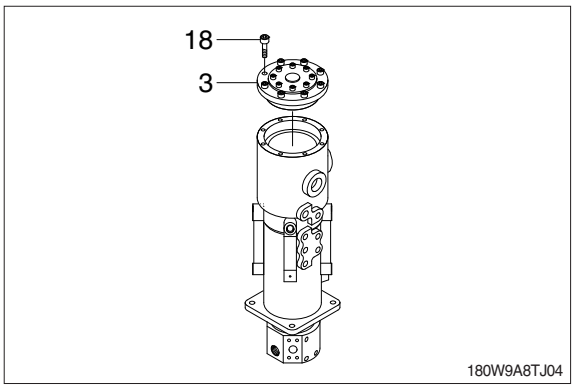
(5) Fit retainer ring (13), O-ring (7) and wear ring (12) to shaft (2).

(6) Fit O-ring (9) to hub (1).



(7) Install cover (3) to hub and tighten bolts (18).

· Torque : 2.35±0.35 kgf · m
(17.0±2.5 lbf · ft)



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.

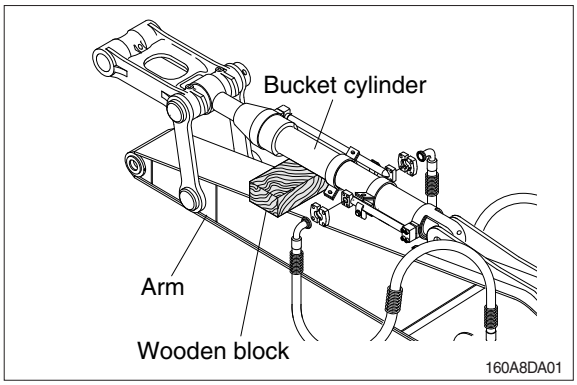
※ Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

※ 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.

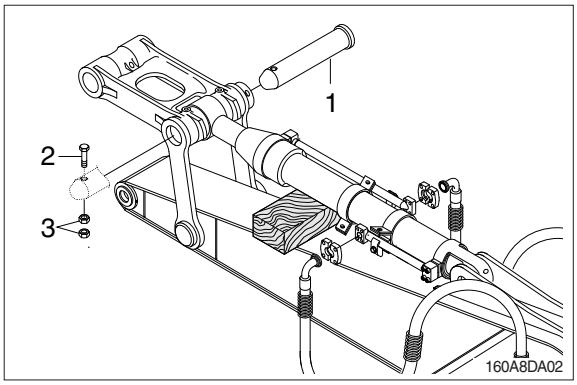
① Set block between bucket cylinder and arm.



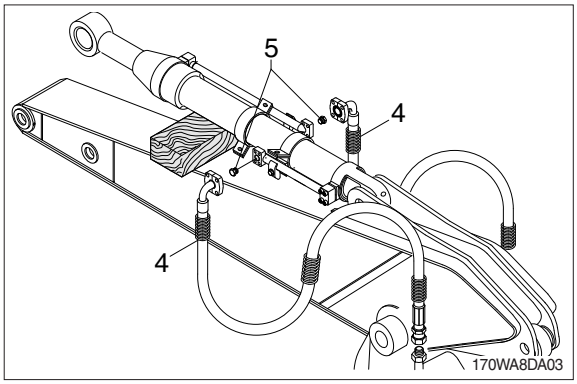
② Remove bolt (2), nut (3) and pull out pin (1).

※ Tie the rod with wire to prevent it from coming out.

· Tightening torque (2) : 29.7± 4.5 kgf · m (215± 32.5 lbf · ft)



③ Disconnect bucket cylinder hoses (4), and put plugs (5) on cylinder pipe.

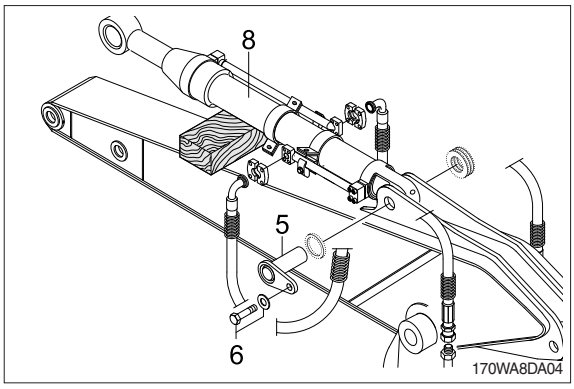


④ Sling bucket cylinder assembly (8) and remove bolt (6) then pull out pin (5).

⑤ Remove bucket cylinder assembly (8).

· Weight : 123 kg (270 lb)

· Tightening torque (6) : 29.7 ± 4.5 kgf · m (215 ± 32.5 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.

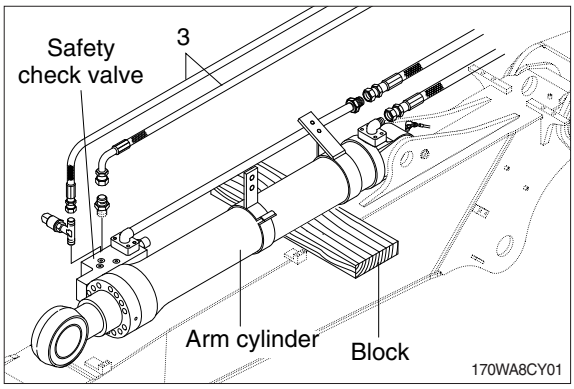
※ Loosen the breather slowly to release the pressure inside the hydraulic tank.

⚠ 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.

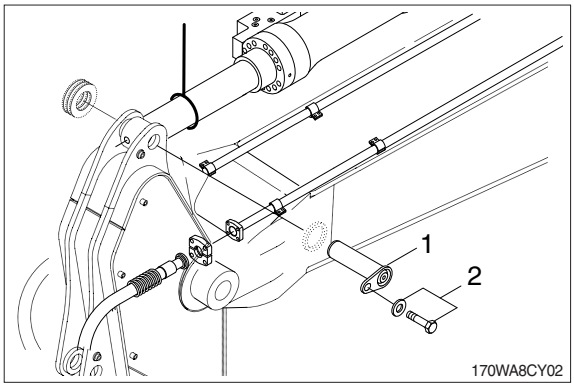
② Disconnect arm cylinder hoses (3) and put plugs on safety check valve.



③ Remove bolt (2) and pull out pin (1).

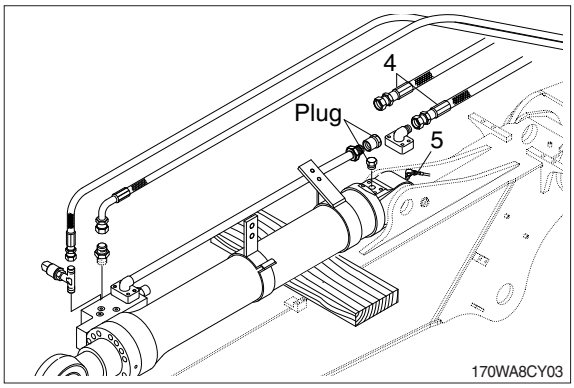
※ Tie the rod with wire to prevent it from coming out.

· Tightening torque (2) : 29.7± 4.5 kgf · m (215± 32.5 lbf · ft)



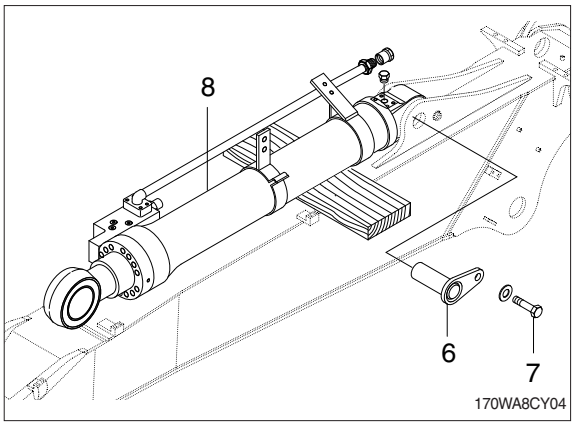
④ Disconnect arm cylinder hoses (4) and put plugs on cylinder pipe.

⑤ Disconnect greasing pipings (5).



⑥ Sling arm cylinder assembly(8) and remove bolt (7) then pull out pin (6).
· Tightening torque (7) : 29.7± 4.5 kgf · m (215± 32.5 lbf · ft)

⑦ Remove arm cylinder assembly (8).
· Weight : 169 kg (370 lb)



(2) Install

① Carry out installation in the reverse order to removal.

⚠ When aligning the mounting position of the pin, do not insert your fingers in the pin hole.

※ Bleed the air from the arm cylinder.

※ Confirm the hydraulic oil level and check the hydraulic oil leak or not.

3) DOZER CYLINDER

(1) Removal

※ Expand the arm and bucket fully, lower the work equipment to the ground and stop the engine.

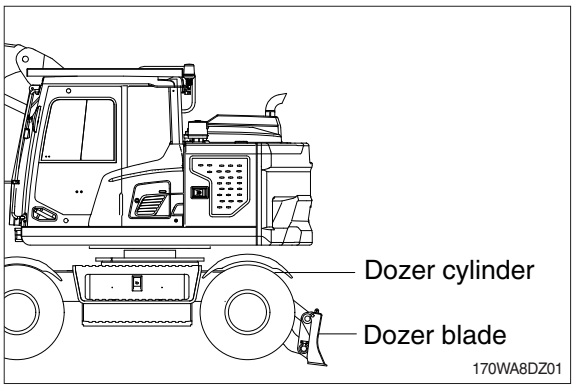
※ Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

※ Loosen the breather slowly to release the pressure inside the hydraulic tank.

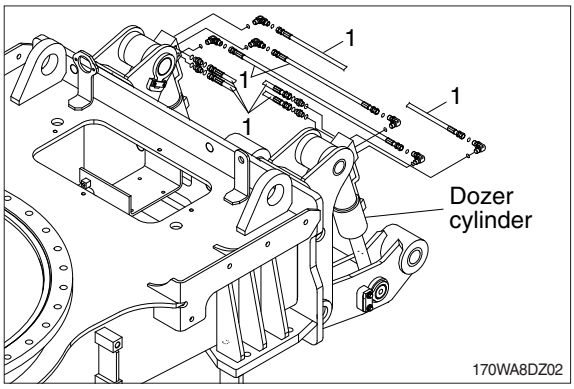
⚠ Escaping fluid under pressure can penetrate the skin causing serious injury.

※ Fit blind plugs in the hoses after disconnecting them, to prevent dirt or dust from entering.

① Lower the dozer blade to the ground.



② Disconnect dozer cylinder hoses (1), and put plugs on cylinder pipe.

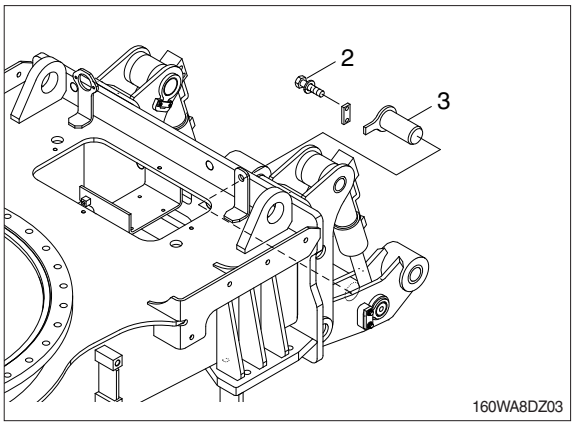


③ Sling dozer cylinder assembly.

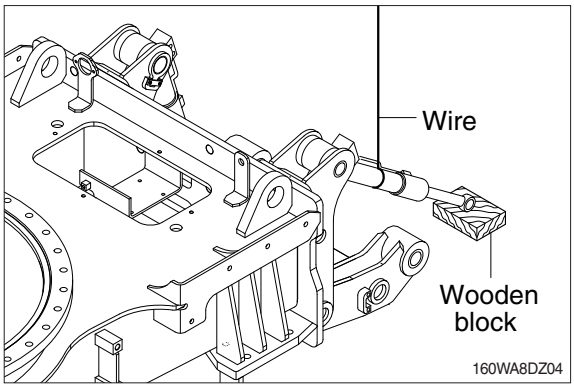
④ Remove bolt (2) and pull out pin (3).

· Tightening torque (2) : 12.8± 3.0 kgf · m (92.6± 21.7 lbf · ft)

※ Tie the rod with wire to prevent it from coming out.

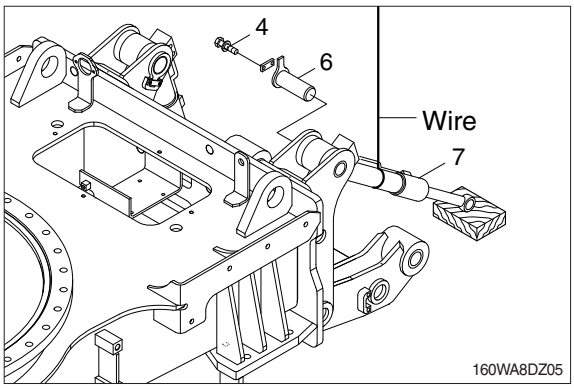


⑤ Lower the dozer cylinder rod side on a wooden block.



⑥ Loosen the bolt (4) and nut (5), and pull out pin (6).
· Tightening torque (4) : 12.8± 3.0 kgf · m (92.6± 21.7 lbf · ft)

⑦ Remove the dozer cylinder assy (7).
· Weight : 43 kg (95 lb)



(2) Install

① Carry out installation in the reverse order to removal.

⚠ **When aligning the mounting position of the pin, do not insert your fingers in the pin hole.**

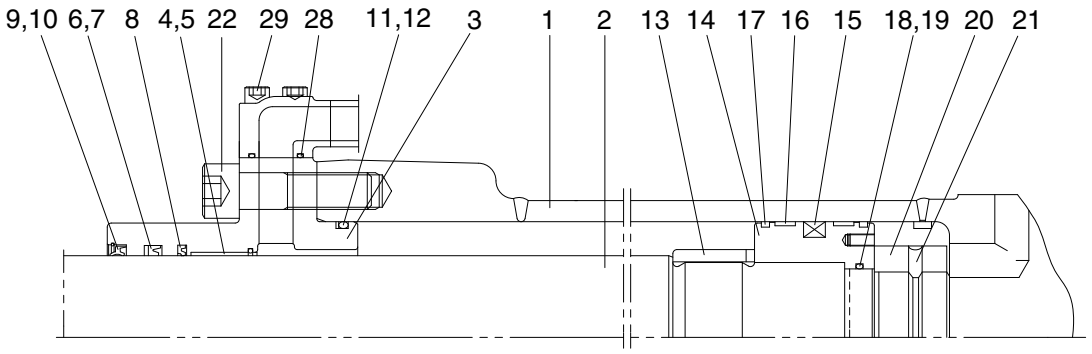
※ Bleed the air from the dozer cylinder.

※ Confirm the hydraulic oil level and check the hydraulic oil leak or not.

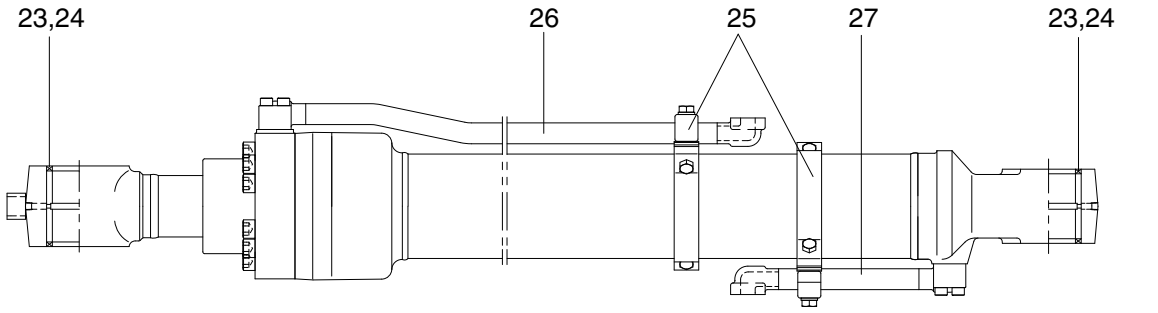
2. DISASSEMBLY AND ASSEMBLY

1) STRUCTURE

(1) Bucket cylinder



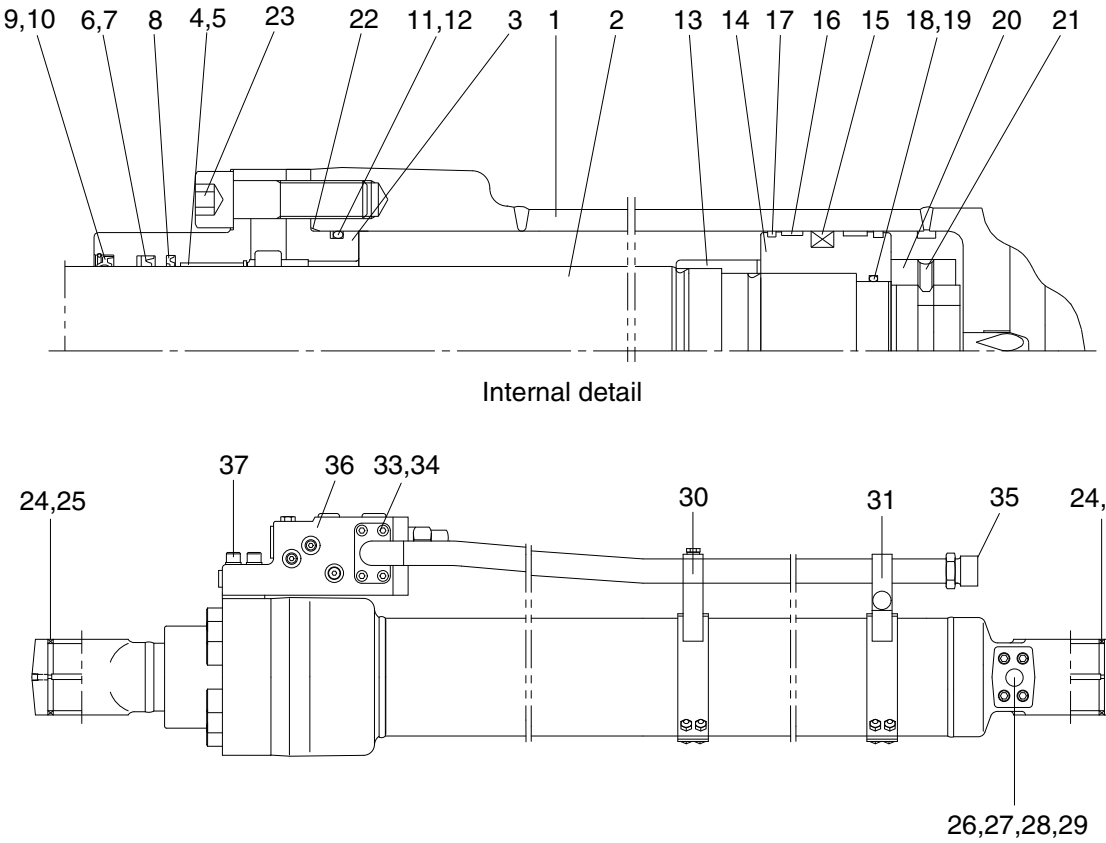
Internal detail



32Q5-60110CGG

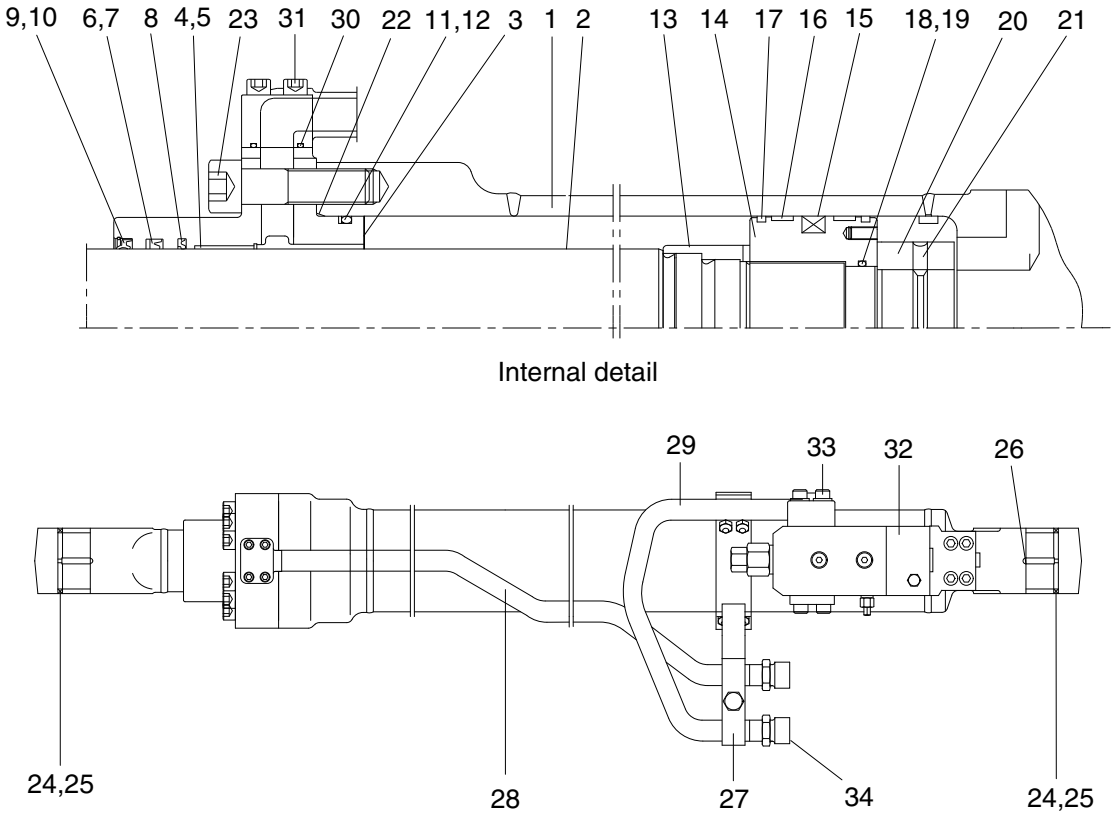
1	Tube assembly	11	O-ring	21	Hex socket headless set screw
2	Rod assembly	12	Back up ring	22	Hexagon socket head bolt
3	Gland	13	Cushion ring	23	Dimple bushing
4	DD2 bushing	14	Piston	24	Dust seal
5	Snap ring	15	Piston seal	25	Band assembly
6	Rod seal	16	Wear ring	26	Pipe assembly-R
7	Back up ring	17	Dust ring	27	Pipe assembly-B
8	Buffer ring	18	O-ring	28	O-ring
9	Dust wiper	19	Back up ring	29	Hexagon socket head bolt
10	Snap ring	20	Lock nut		

(2) Arm cylinder



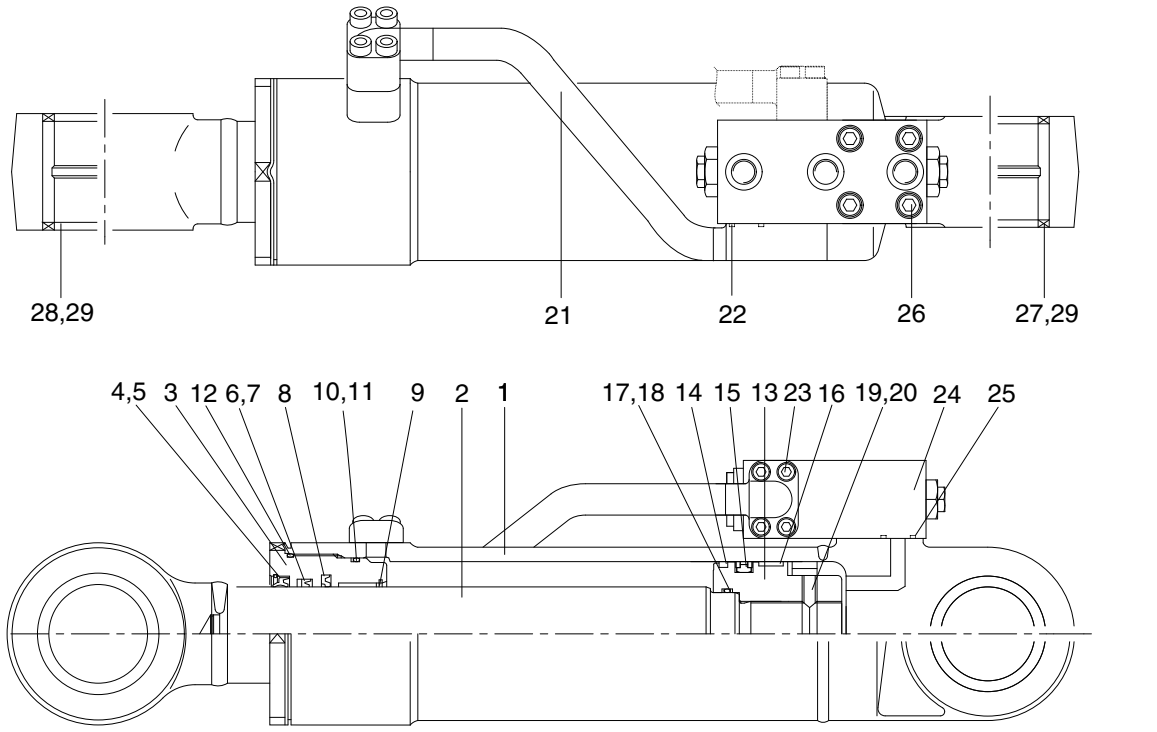
1	Tube assembly	14	Piston	27	Coil spring
2	Rod assembly	15	Piston seal	28	O-ring
3	Gland	16	Wear ring	29	Check valve
4	DU bushing	17	Dust ring	30	Band assembly-R
5	Snap ring	18	O-ring	31	Band assembly-B
6	Rod seal	19	Back up ring	32	Pipe assembly-R
7	Back up ring	20	Lock nut	33	O-ring
8	Buffer ring	21	Hex socket headless set screw	34	Hexagon socket head bolt
9	Dust wiper	22	O-ring	35	O-ring
10	Snap ring	23	Hexagon socket head bolt	36	Safety lock valve
11	O-ring	24	Dimple bushing	37	Hexagon socket head bolt
12	Back up ring	25	Dust seal		
13	Cushion ring	26	Plug		

(3) Boom cylinder (2 piece)



1	Tube assembly	13	Cushion ring	25	Dust seal
2	Rod assembly	14	Piston	26	Plug
3	Gland	15	Piston seal	27	Band assembly
4	DU bushing	16	Wear ring	28	Pipe assembly-R
5	Snap ring	17	Dust ring	29	Pipe assembly-B
6	Rod seal	18	O-ring	30	O-ring
7	Back up ring	19	Back up ring	31	Hexagon socket head bolt
8	Buffer ring	20	Lock nut	32	Safety lock valve
9	Dust wiper	21	Hex socket headless set screw	33	Hexagon socket head bolt
10	Snap ring	22	O-ring	34	O-ring
11	O-ring	23	Hexagon socket head bolt		
12	Back up ring	24	Dimple bushing		

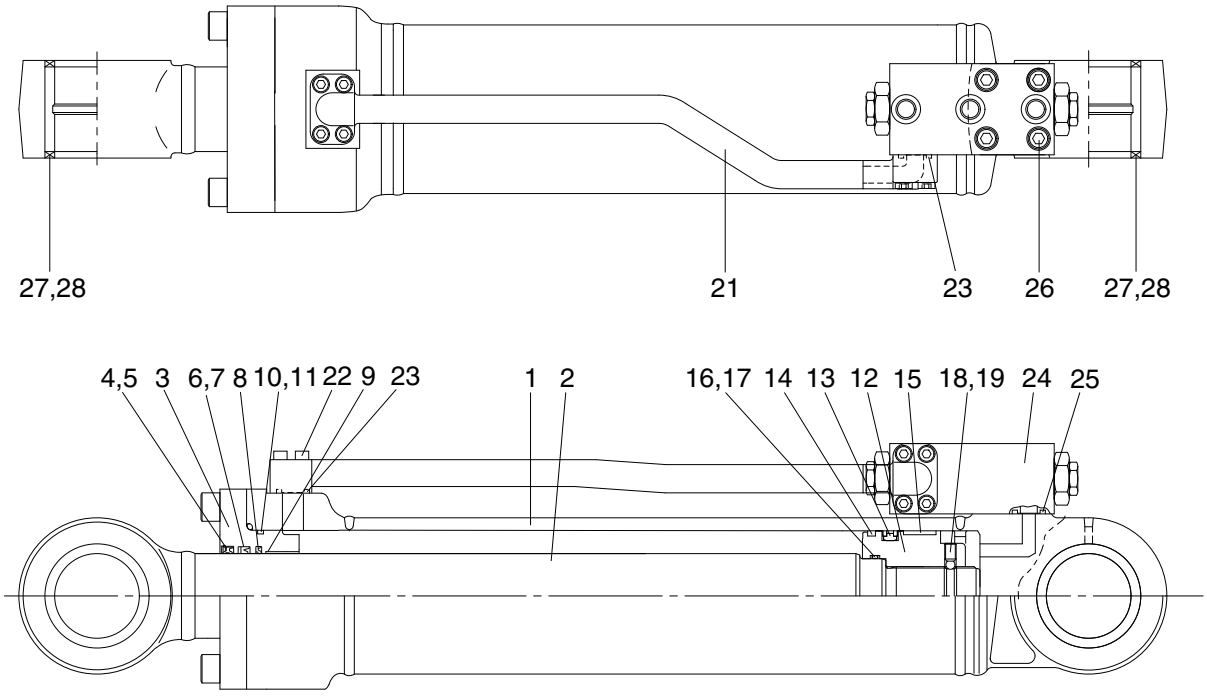
(4) Dozer cylinder



31K5-70110

1	Tube assembly	11	Retaining ring	21	Pipe assy
2	Rod assembly	12	O-ring	22	O-ring
3	Gland	13	Piston	23	Hexagon socket head bolt
4	Dust wiper	14	Piston seal	24	Pilot check valve
5	Retaining ring	15	Dust ring	25	O-ring
6	Rod seal	16	Wear ring	26	Hexagon socket head bolt
7	Back up ring	17	O-ring	27	Pin bushing
8	Buffer ring	18	Backup ring	28	Pin bushing
9	Dry bearing	19	Steel ball	29	Dust seal
10	O-ring	20	Set screw		

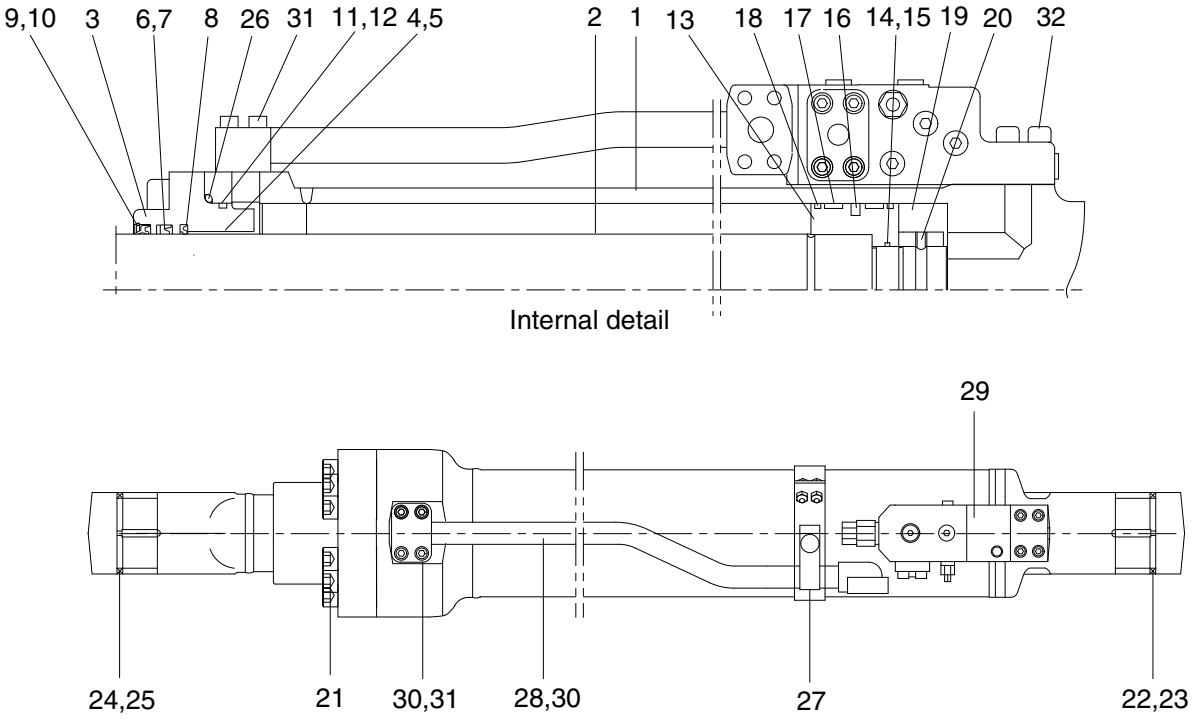
(5) Outrigger cylinder



31Q5-70211

1	Tube assembly	10	O-ring	19	Set screw
2	Rod assembly	11	Back up ring	20	Hexagon socket head bolt
3	Gland	12	Piston	21	Pipe assembly
4	Dust wiper	13	Piston seal	23	O-ring
5	Retainer ring	14	Dust ring	24	Check valve assembly
6	Rod seal	15	Wear ring	25	O-ring
7	Back up ring	16	O-ring	26	Hexagon socket head bolt
8	Buffer ring	17	Back up ring	27	Pin bushing
9	Dry bushing	18	Steel ball	28	Dust seal

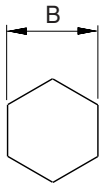
(6) Adjust cylinder



1	Tube assembly	12	Retaining ring	23	Dust seal
2	Rod assembly	13	Piston	24	Dimple bushing
3	Gland	14	O-ring	25	Dust seal
4	DU bushing	15	Back up ring	26	O-ring
5	Snap ring	16	Piston seal	27	Band assy
6	Rod seal	17	Wear ring	28	Pipe assy
7	Back up ring	18	Dust ring	29	Safety lock valve
8	Buffer ring	19	Lock nut	30	O-ring
9	Dust wiper	20	Hex socket headless set screw	31	Hexagon socket head bolt
10	Snap ring	21	Hexagon socket head bolt	32	Hexagon socket head bolt
11	O-ring	22	Dimple bushing		

2) TOOLS AND TIGHTENING TORQUE

(1) Tools

Tool name	Remark	
Allen wrench	6	
	8	
	14	
	17	
Spanner	7	
	8	
(-) Driver	Small and large sizes	
Torque wrench	Capable of tightening with the specified torques	

(2) Tightening torque

Part name		Item	Size	Torque	
				kgf · m	lbf · ft
Socket head bolt	Bucket cylinder	22★1★3	M14	15.0±2.0	108±14.5
		29★3	M10	5.4±0.5	39.1±3.6
	Boom cylinder	23★1★3★5	M14	15.0±2.0	108±14.5
		31★3★5	M10	5.4±0.5	39.1±3.6
		33★3★5	M10	5.4±0.5	39.1±3.6
	Arm cylinder	23★1★3	M16	23±2.0	166±14.5
		34★3	M10	5.4±0.5	39.1±3.6
		37★3	M10	5.4±0.5	39.1±3.6
	Adjustment cylinder	21★1★3	M22	63.0±6.0	456±43.4
		31★3	M10	5.4±0.5	39.1±3.6
		32★3	M10	5.4±0.5	39.1±3.6
	Dozer cylinder	23★3	M8	3.3±0.3	23.9±2.2
	Outrigger cylinder	20★7	M16	23±2.3	166±16.6
		22★7	M8	2.7±0.3	19.5±2.2
		26★7	M10	5.4±0.5	39.1±3.6
Lock nut	Bucket cylinder	20★3	-	100±10.0	723±72.3
	Boom cylinder	31★3★5	M52	100±10.0	723±72.3
	Arm cylinder	20★3	M56	100±10.0	723±72.3
	Adjustment cylinder	19★3	M76	100±10.0	723±72.3

★1 : Apply loctite #243 on the thread of bolt.
★3 : CHANGZHOU
★5 : 2-piece boom
★7 : SH PAC

Part name		Item	Size	Torque	
				kgf · m	lbf · ft
Piston	Bucket cylinder	14★3★5	-	125±12.0	904±86.8
	Boom cylinder	14★3★5	M65	125±12.0	904±86.8
	Arm cylinder	14★3	M70	150±15.0	1085±108
	Adjustment cylinder	13★3	M90	150±15.0	1085±108
	Dozer cylinder	13★3	M45	112±11.2	810±81.0
	Outrigger cylinder	12★7	M56	140±14	1013±101
Set screw	Bucket cylinder	21★3	M8	2.7±0.3	19.5±2.2
	Boom cylinder	21★3★5	M8	2.7±0.3	19.5±2.2
	Arm cylinder	21★3	M8	2.7±0.3	19.5±2.2
	Dozer cylinder	20★3	M8	1.7±0.2	12.3±1.4
	Adjustment cylinder	20★3	M10	5.4±0.5	39.1±3.6
	Outrigger cylinder	19★7	M8	2.7±0.3	19.5±2.2
Gland	Dozer cylinder	3★3	M115	92±9.2	665±66.5

★1 : Apply loctite #243 on the thread of bolt.
★3 : CHANGZHOU
★5 : 2-piece boom
★7 : SH PAC

3) DISASSEMBLY

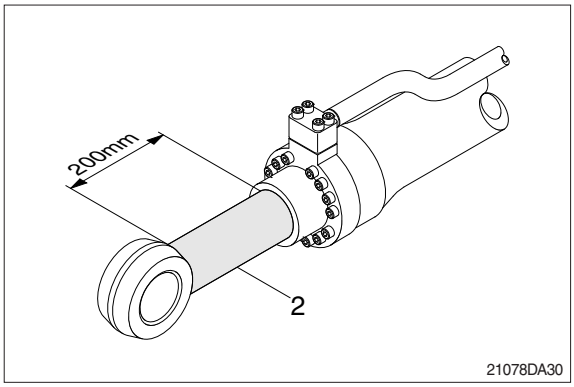
(1) Remove cylinder head and piston rod

※ Procedures are based on the bucket cylinder. (CHANGZHOU type)

① Hold the clevis section of the tube in a vise.

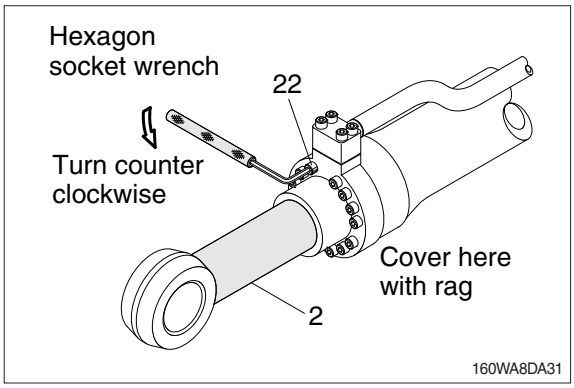
※ Use mouth pieces so as not to damage the machined surface of the cylinder tube. Do not make use of the outside piping as a locking means.

② Pull out rod assembly (2) about 200 ㎜ (7.1 in). Because the rod assembly is rather heavy, finish extending it with air pressure after the oil draining operation.



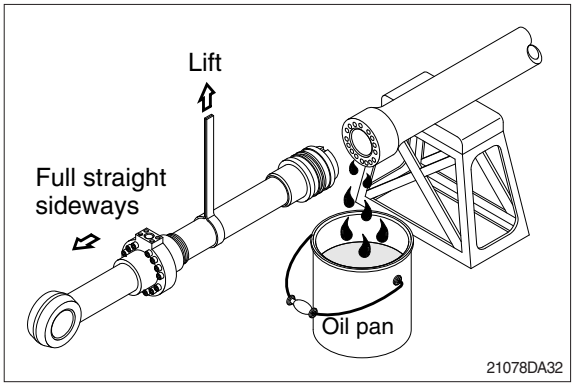
③ Loosen and remove socket bolts (22) of the gland in sequence.

※ Cover the extracted rod assembly (2) with rag to prevent it from being accidentally damaged during operation.



④ Draw out cylinder head and rod assembly together from tube assembly (1).

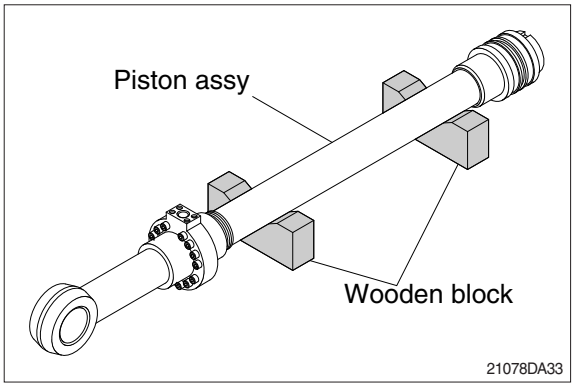
※ Since the rod assembly is heavy in this case, lift the tip of the rod assembly (2) with a crane or some means and draw it out. However, when rod assembly (2) has been drawn out to approximately two thirds of its length, lift it in its center to draw it completely.



Note that the plated surface of rod assembly (2) is to be lifted. For this reason, do not use a wire sling and others that may damage it, but use a strong cloth belt or a rope.

⑤ Place the removed rod assembly on a wooden V-block that is set level.

※ Cover a V-block with soft rag.



(2) Remove piston and cylinder head

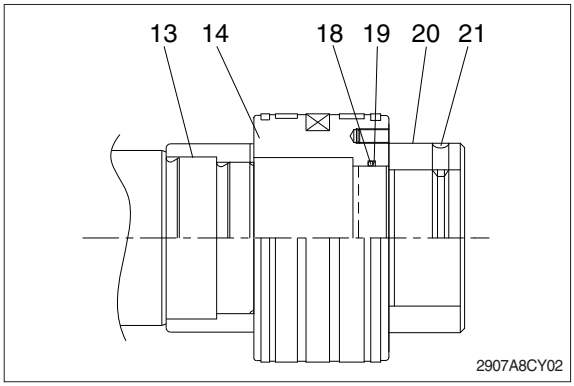
① Remove set screw (21).

② Remove lock nut (20).

※ Since piston (14) and lock nut (20) are tightened to a high torque, use a hydraulic and power wrench that utilizers a hydraulic cylinder, to remove the piston (14) and lock nut (20).

③ Remove piston assembly (14), back up ring (19), and O-ring (18).

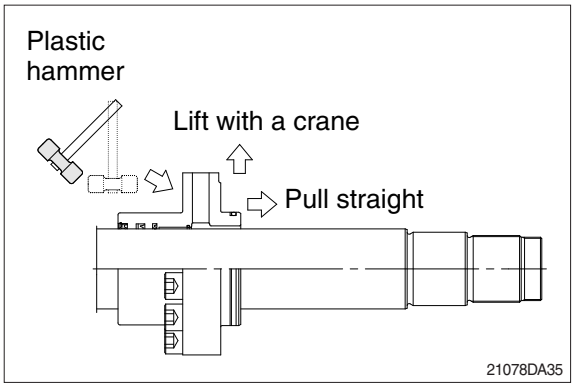
④ Remove cushion ring (13).



⑤ Remove the cylinder head assembly from rod assembly (2).

※ If it is too heavy to move, move it by striking the flanged part of cylinder head with a plastic hammer.

※ Pull it straight with cylinder head assembly lifted with a crane.
Exercise care so as not to damage the lip of rod bushing (4) and packing (5,6,7,8,9,10) by the threads of rod assembly (2).

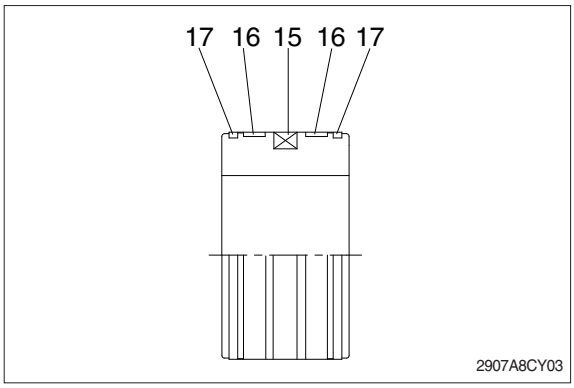


(3) Disassemble the piston assembly

① Remove wear ring (16).

② Remove dust ring (17) and piston seal (15).

※ Exercise care in this operation not to damage the grooves.



(4) Disassemble cylinder head assembly

① Remove back up ring (12), and O-ring (11).

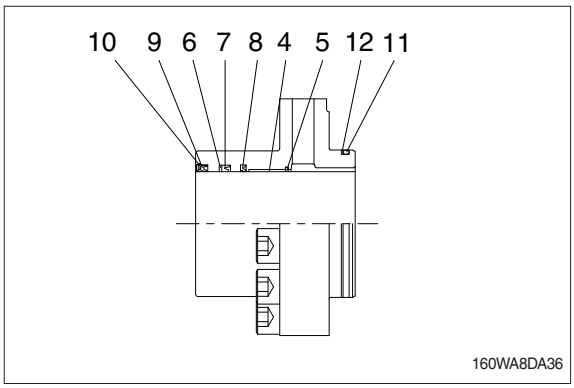
② Remove snap ring (10), dust wiper (9).

③ Remove back up ring (7), rod seal (6) and buffer ring (8).

※ Exercise care in this operation not to damage the grooves.

※ Do not remove seal and ring, if does not damaged.

※ Do not remove bushing (4).

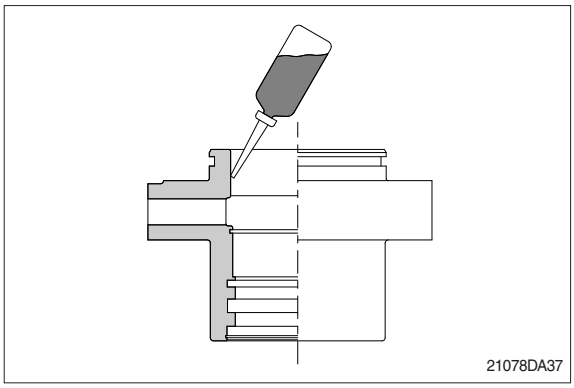


4) ASSEMBLY

(1) Assemble cylinder head assembly

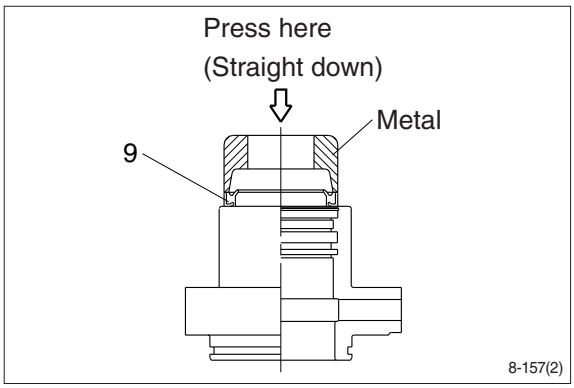
※ Check for scratches or rough surfaces if found smooth with an oil stone.

① Coat the inner face of gland (3) with hydraulic oil.



② Coat dust wiper (9) with grease and fit dust wiper (9) to the bottom of the hole of dust seal.
At this time, press a pad metal to the metal ring of dust seal.

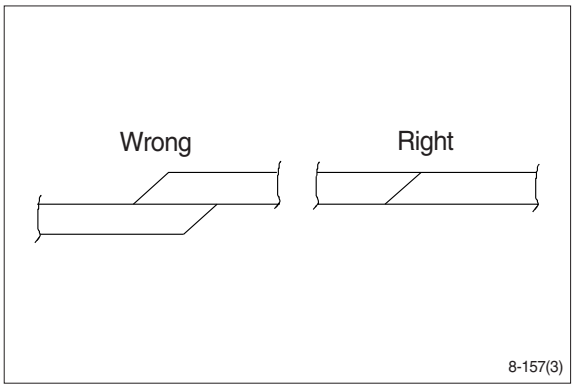
③ Fit snap ring (10) to the stop face.



④ Fit back up ring (7), rod seal (6) and buffer ring (8) to corresponding grooves, in that order.

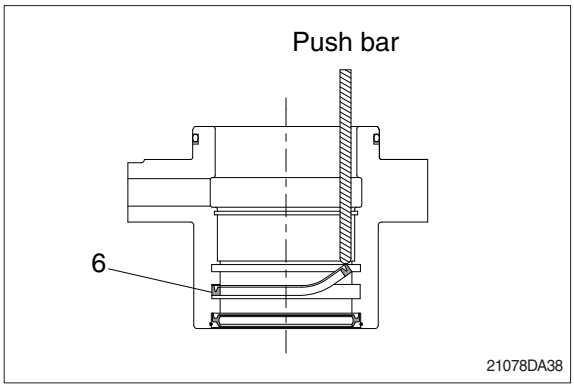
※ Coat each packing with hydraulic oil before fitting it.

※ Insert the backup ring until one side of it is inserted into groove.



※ Rod seal (6) has its own fitting direction. Therefore, confirm it before fitting them.

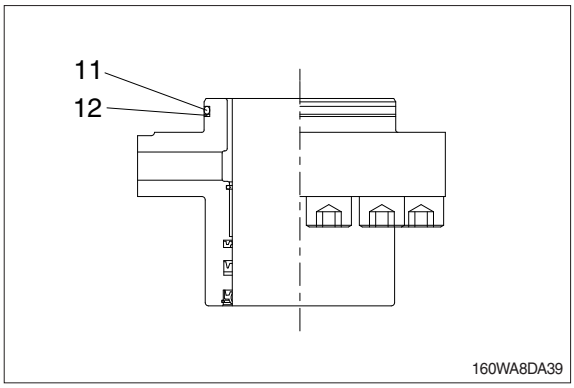
※ Fitting rod seal (6) upside down may damage its lip. Therefore check the correct direction that is shown in fig.



⑤ Fit back up ring (12) to gland (3).

※ Put the backup ring in the warm water of 30~50˚C.

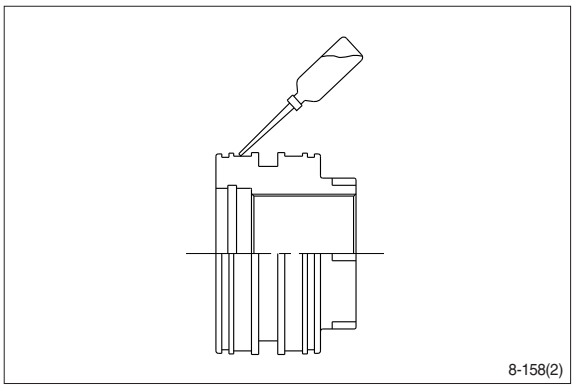
⑥ Fit O-ring (11) to gland (3).



(2) Assemble piston assembly

※ Check for scratches or rough surfaces. If found smooth with an oil stone.

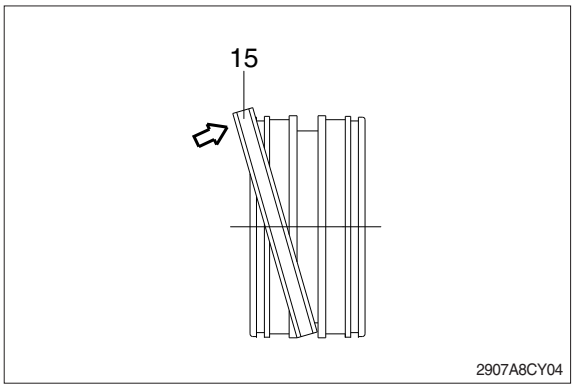
① Coat the outer face of piston (14) with hydraulic oil.



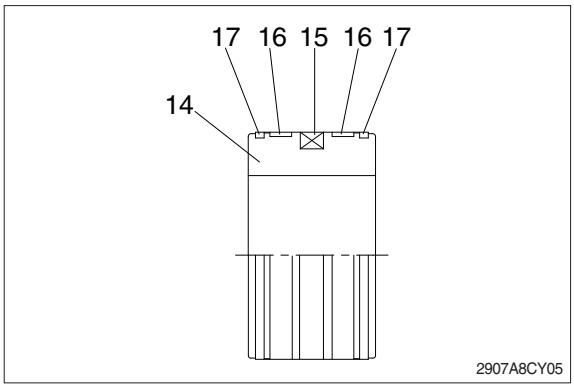
② Fit piston seal (15) to piston.

※ Put the piston seal in the warm water of 60~100˚C for more than 5 minutes.

※ After assembling the piston seal, press its outer diameter to fit in.



③ Fit wear ring (16) and dust ring (17) to piston (14).

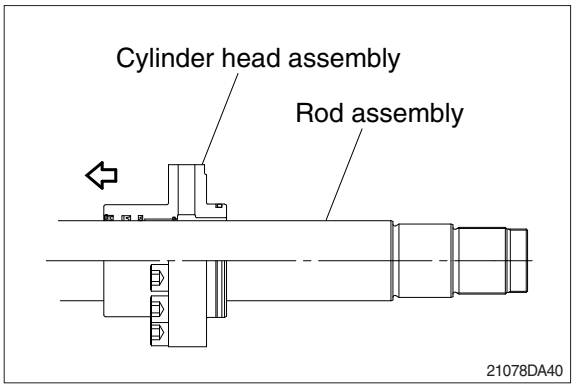


(3) Install piston and cylinder head

① Fix the rod assembly to the work bench.

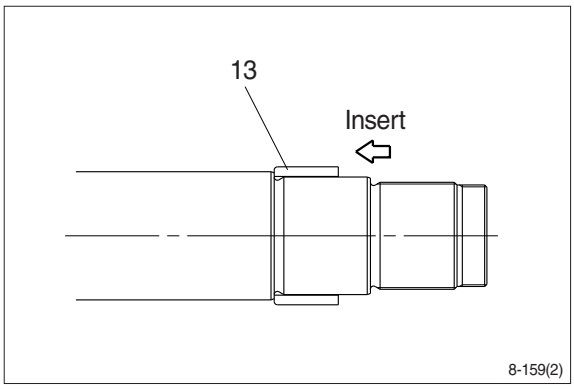
② Apply hydraulic oil to the outer surface of rod assembly (2), the inner surface of piston and cylinder head.

③ Insert cylinder head assembly to rod assembly.



④ Insert cushion ring (13) to rod assembly.

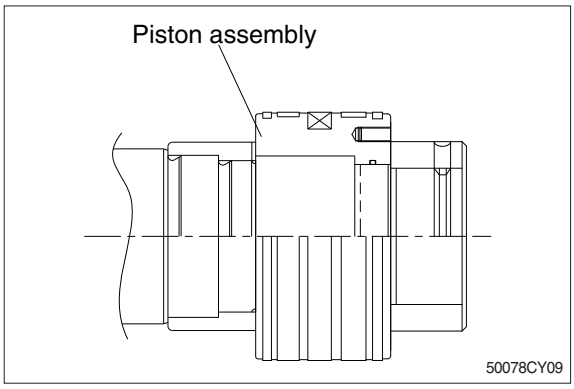
※ Note that cushion ring (13) has a direction in which it should be fitted.



⑤ Fit piston assembly to rod assembly.

· Tightening torque : 125±12.0 kgf · m (904±86.8 lbf · ft)

※ Refer to page 8-349.



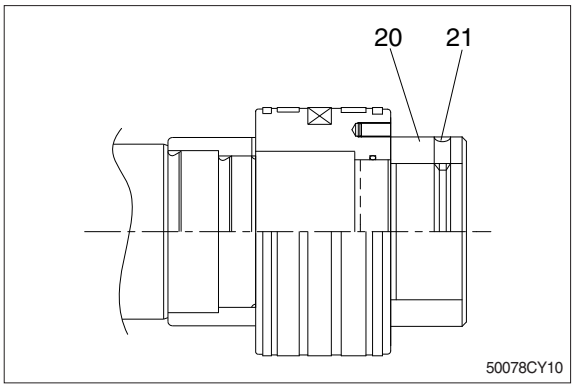
⑥ Fit lock nut (20) and tighten the screw (21).

· Tightening torque :

Item 20 : 100±10.0 kgf·m (723±72.3 lbf·ft)

Item 21 : 2.7±0.3 kgf·m (19.5±2.2 lbf·ft)

※ Refer to page 8-349.



(4) Overall assemble

① Place a V-block on a rigid work bench. Mount the tube assembly (1) on it and fix the assembly by passing a bar through the clevis pin hole to lock the assembly.

② Insert the rod assembly in to the tube assembly, while lifting and moving the rod assembly with a crane.

※ Be careful not to damage piston seal by thread of tube assembly.

③ Match the bolt holes in the cylinder head flange to the tapped holes in the tube assembly and tighten socket bolts to a specified torque.

※ Refer to the table of tightening torque.