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1. STRUCTURE

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

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

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

SECTION 1 GENERAL

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

SECTION 2 STRUCTURE AND FUNCTION

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

SECTION 3 HYDRAULIC SYSTEM

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

SECTION 4 ELECTRICAL SYSTEM

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

SECTION 5 MECHATRONICS SYSTEM

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

SECTION 6 TROUBLESHOOTING

This section explains the troubleshooting charts correlating problems to causes.

SECTION 7 MAINTENANCE STANDARD

This section gives the judgement standards when inspecting disassembled parts.

SECTION 8 DISASSEMBLY AND ASSEMBLY

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

SECTION 9 COMPONENT MOUNTING TORQUE

This section shows bolt specifications and standard torque values needed when mounting components to the machine.

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

2. HOW TO READ THE SERVICE MANUAL

Distribution and updating

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

Filing method

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

Revised edition mark (①②③…)

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

Revisions

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

Symbols

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

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

3. CONVERSION TABLE

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

Example

1. **Method of using the Conversion Table to convert from millimeters to inches**
   Convert 55mm into inches.
   (1) Locate the number 50in the vertical column at the left side, take this as ⓐ, then draw a horizontal line from ⓐ.
   (2) Locate the number 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 550mm into inches.
   (1) The number 550 does not appear in the table, so divide by 10(Move the decimal point one place to the left) to convert it to 55 mm.
   (2) Carry out the same procedure as above to convert 55 mm to 2.165 inches.
   (3) The original value (550 mm) was divided by 10, so multiply 2.165 inches by 10 (Move the decimal point one place to the right) to return to the original value.
   This gives 550 mm = 21.65 inches.

Millimeters to inches

ⓑ

1 mm = 0.03937 in

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

Millimeters to inches

1 mm = 0.03937 in

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

Kilogram to Pound

1 kg = 2.2046 lb

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

Liter to U.S. Gallon

1 l = 0.2642 U.S.Gal

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

Liter to U.K. Gallon

1 l = 0.21997 U.K.Gal

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

kgf · m to lbf · ft

1 kgf · m = 7.233 lbf · ft

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

kgf/cm² to lbf/in²

1 kgf / cm² = 14.2233 lbf / in²

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

TEMPERATURE

Fahrenheit-Centigrade Conversion.

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

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

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

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

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

SECTION 1 GENERAL

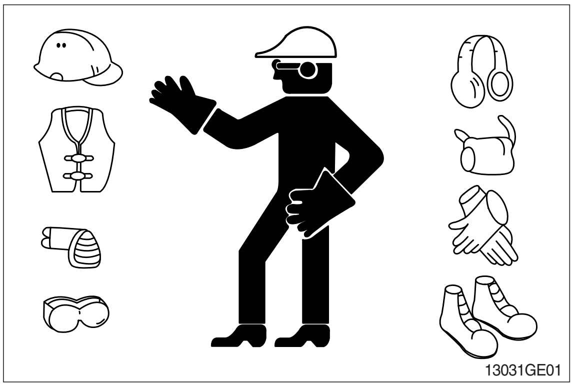
GROUP 1 SAFETY

FOLLOW SAFE PROCEDURE

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

WEAR PROTECTIVE CLOTHING

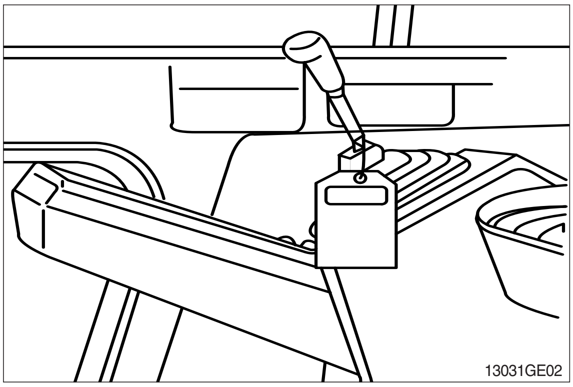
Wear close fitting clothing and safety equipment appropriate to the job.



13031GE01

WARN OTHERS OF SERVICE WORK

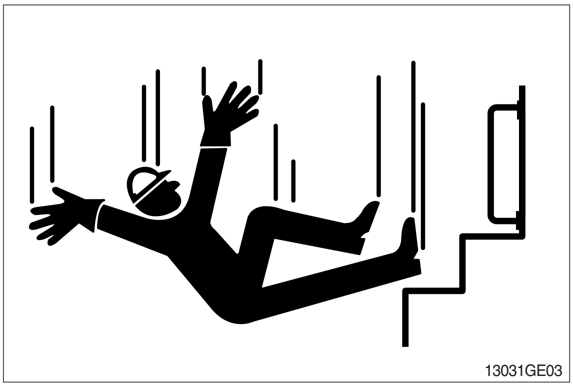
Unexpected machine movement can cause serious injury.
Before performing any work on the excavator, attach a 「Do Not Operate」 tag on the right side control lever.



13031GE02

USE HANDHOLDS AND STEPS

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



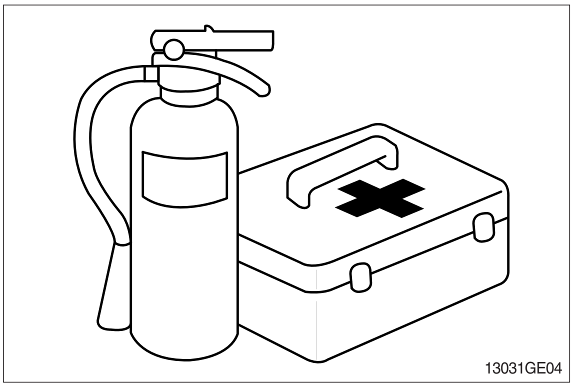
13031GE03

PREPARE FOR EMERGENCIES

Be prepared if a fire starts.

Keep a first aid kit and fire extinguisher handy.

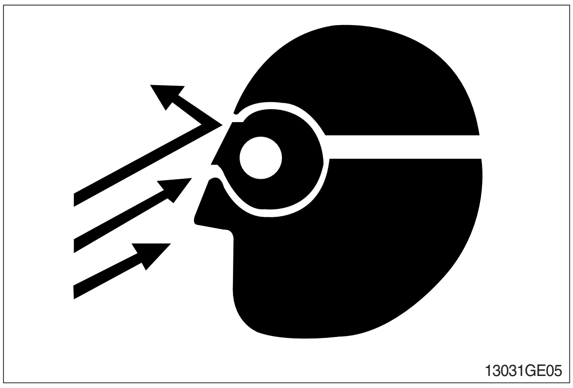
Keep emergency numbers for doctors, ambulance service, hospital, and fire department near your telephone.



13031GE04

PROTECT AGAINST FLYING DEBRIS

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

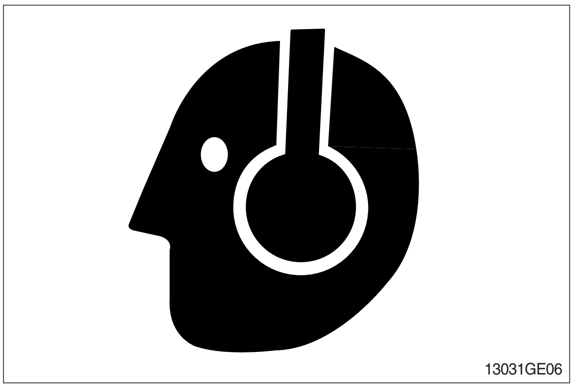


13031GE05

PROTECT AGAINST NOISE

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

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

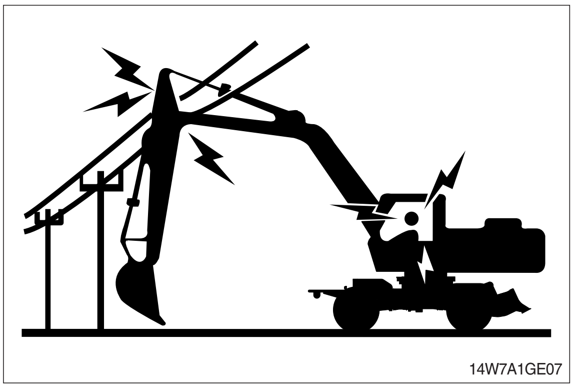


13031GE06

AVOID POWER LINES

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

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

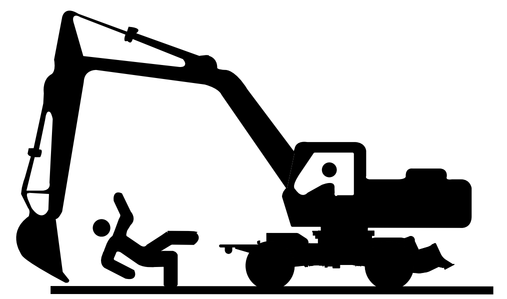


14W7A1GE07

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.



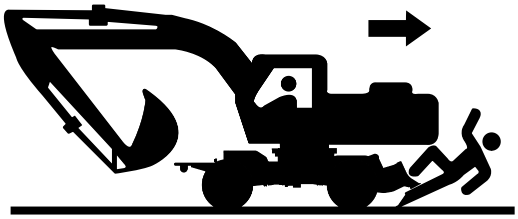
14W7A1GE08

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.

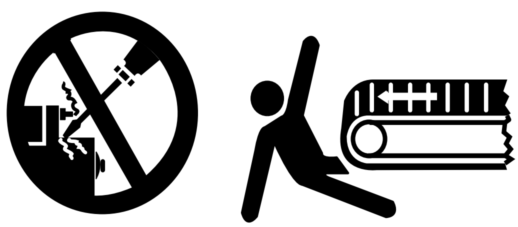


14W7A1GE09

OPERATE ONLY FORM OPERATOR'S SEAT

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

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



13031GE26

PARK MACHINE SAFELY

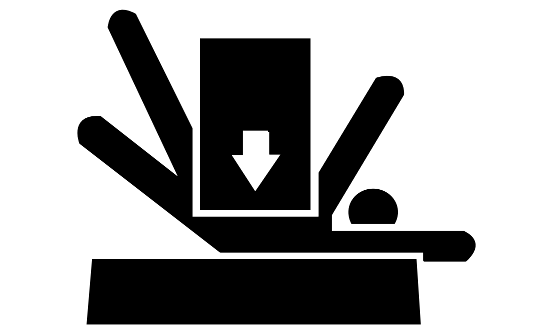
Before working on the machine:

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

SUPPORT MACHINE PROPERLY

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

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

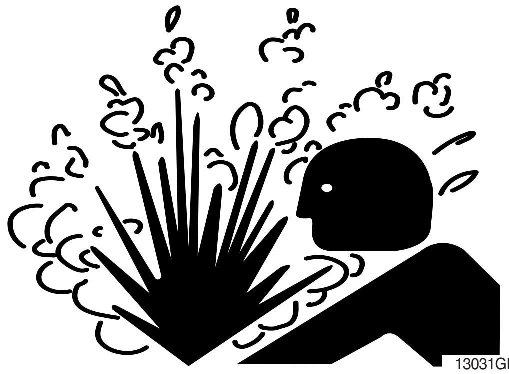


13031GE10

SERVICE COOLING SYSTEM SAFELY

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

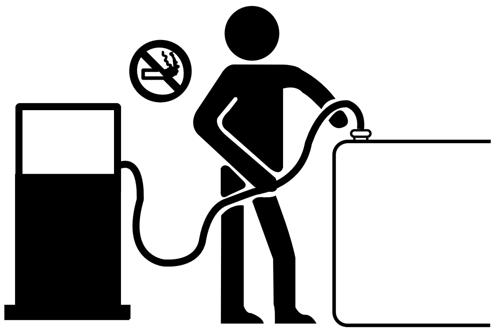
Shut off engine. Only remove filler cap when cool enough to touch with bare hands.



13031GE11

HANDLE FLUIDS SAFELY-AVOID FIRES

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



13031GE12

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

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

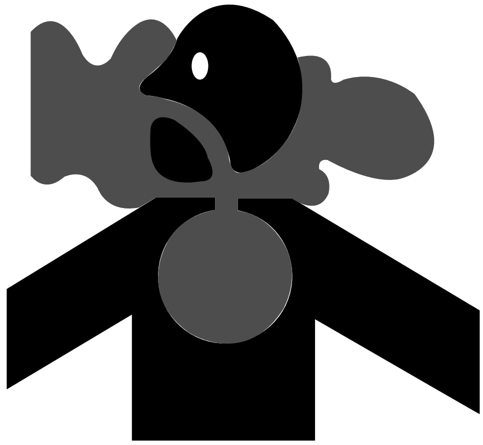
Do not store oily rags ; they can ignite and burn spontaneously.

13031GE13

BEWARE OF EXHAUST FUMES

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

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



13031GE14

REMOVE PAINT BEFORE WELDING OR HEATING

Avoid potentially toxic fumes and dust.

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

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

Remove paint before welding or heating:

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

ILLUMINATE WORK AREA SAFELY

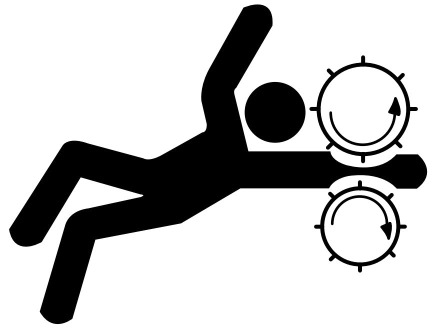
Illuminate your work area adequately but safely. Use a portable safety light for working inside or under the machine. Make sure the bulb is enclosed by a wire cage. The hot filament of an accidentally broken bulb can ignite spilled fuel or oil.

13031GE15

SERVICE MACHINE SAFELY

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

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

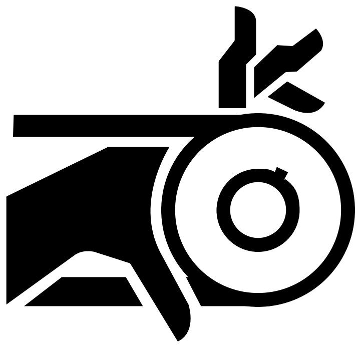


13031GE16

STAY CLEAR OF MOVING PARTS

Entanglements in moving parts can cause serious injury.

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



13031GE17

AVOID HIGH PRESSURE FLUIDS

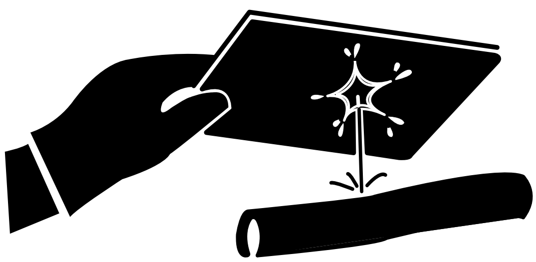
Escaping fluid under pressure can penetrate the skin causing serious injury.

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

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

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

13031GE18



13031GE19

AVOID HEATING NEAR PRESSURIZED FLUID LINES

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

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

13031GE20

PREVENT BATTERY EXPLOSIONS

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

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

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

13031GE21

PREVENT ACID BURNS

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

Avoid the hazard by:

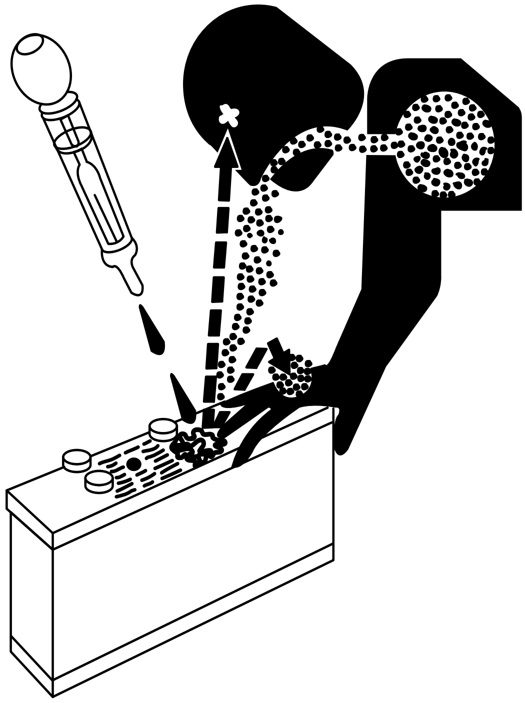
1. Filling batteries in a well-ventilated area.
2. Wearing eye protection and rubber gloves.
3. Avoiding breathing fumes when electrolyte is added.
4. Avoiding spilling of dripping electrolyte.
5. Use proper jump start procedure.

If you spill acid on yourself:

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

If acid is swallowed:

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



13031GE22

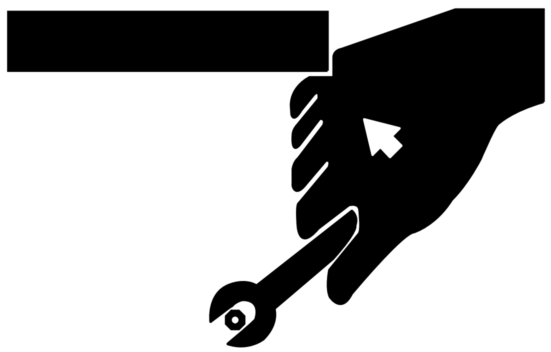
USE TOOLS PROPERLY

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

Use power tools only to loosen threaded tools and fasteners.

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

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



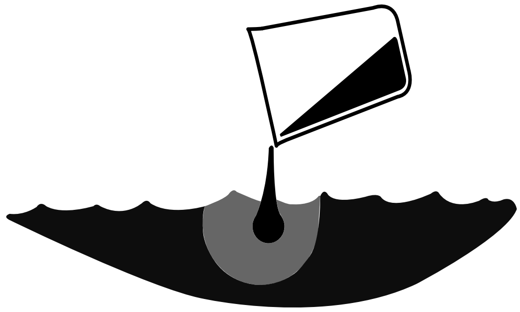
13031GE23

DISPOSE OF FLUIDS PROPERLY

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

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

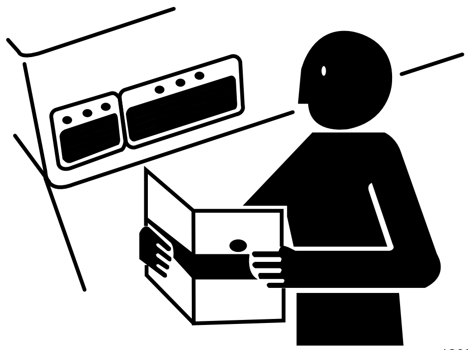
DO NOT pour oil into the ground, down a drain, or into a stream, pond, or lake. Observe relevant environmental protection regulations when disposing of oil, fuel, coolant, brake fluid, filters, batteries, and other harmful waste.



13031GE24

REPLACE SAFETY SIGNS

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



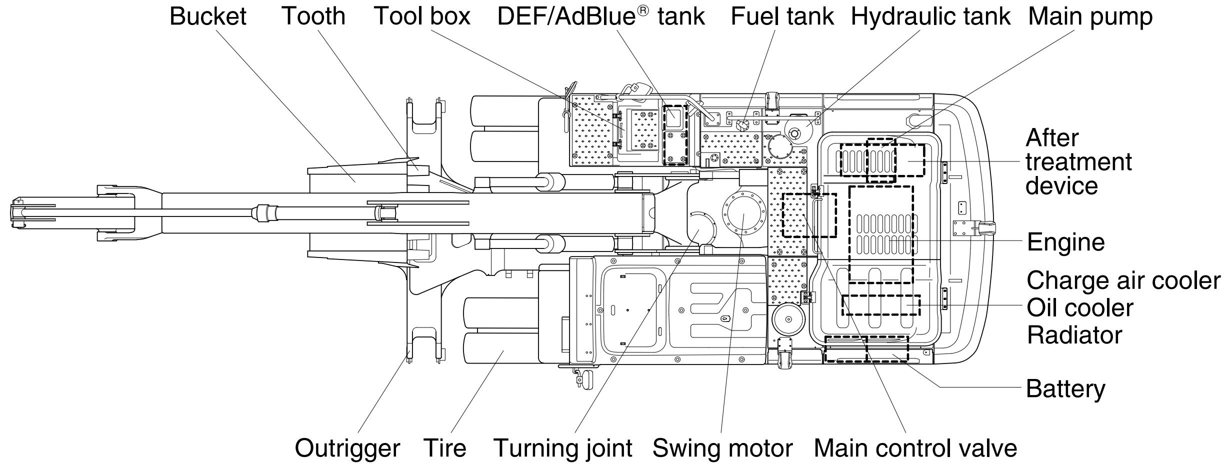
13031GE25

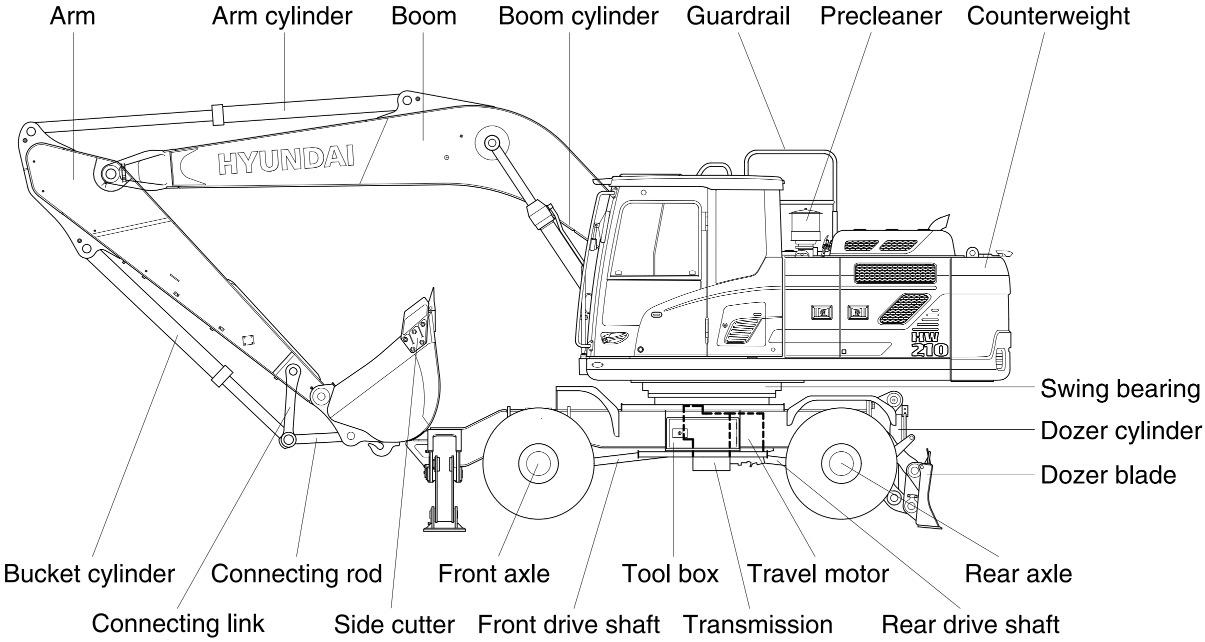
LIVE WITH SAFETY

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

GROUP 2 SPECIFICATIONS

1. MAJOR COMPONENT

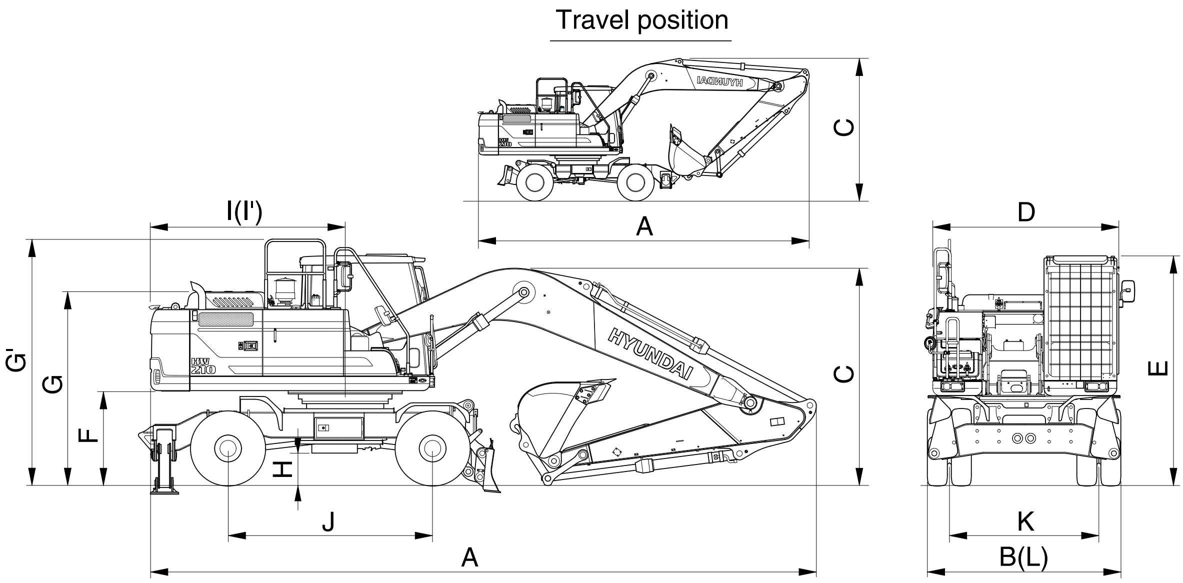




210WF2SP01

2. SPECIFICATIONS

1) 5.65 m (18' 6") MONO BOOM, 2.92 m (9' 7") ARM, FRONT OUTRIGGER AND REAR DOZER BLADE

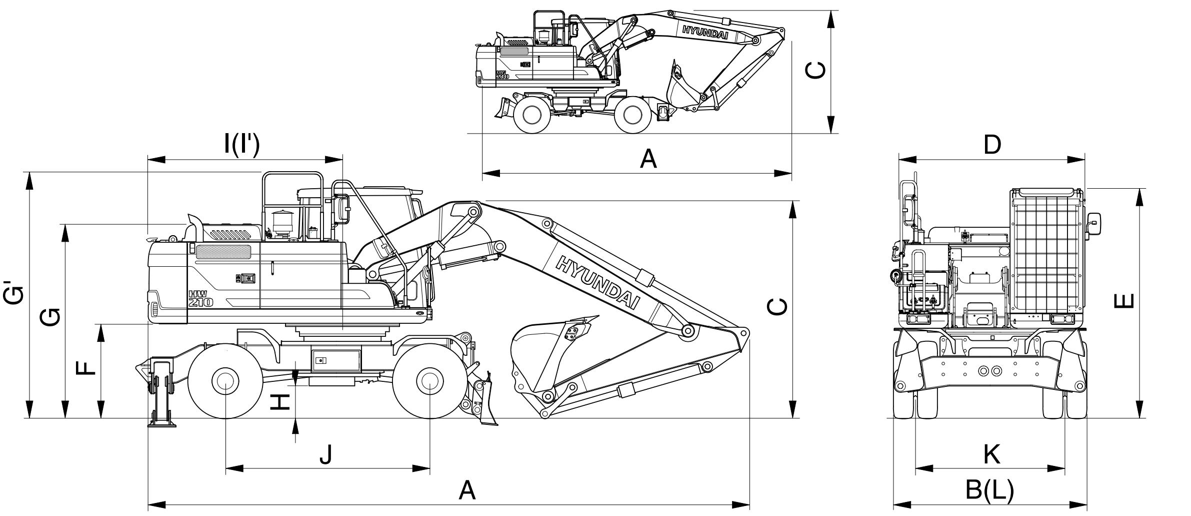


210WF2SP02

Description		Unit	Specification
Operating weight		kg (lb)	21200 (46740)
Bucket capacity (SAE heaped)		m^3 (yd^3)	0.87 (1.14)
Overall length (travel/shipping)	A	mm (ft-in)	9450 (31' 0")/9500 (31' 2")
Overall width (axle / wide axle)	B		2530 (8' 4") / 2730 (8' 11")
Overall height of boom (travel/shipping)	C		3950 (12' 9")/3130 (10' 3")
Upperstructure width	D		2530 (8' 4")
Cab height	E		3245 (10' 8")
Ground clearance of counterweight	F		1300 (4' 3")
Overall height of engine hood	G		2705 (8' 10")
Overall height of guardrail	G'		3134 (10' 3")
Ground to mission cover	H		353 (1' 2")
Rear-end distance	I		2770 (9' 1")
Rear-end swing radius	I'		2850 (9' 4")
Wheel base	J		2800 (9' 2")
Tread (axle / wide axle)	K		1914 (6' 3") / 2114 (6' 9")
Dozer blade width	L		2490 (8' 2")
Travel speed	Low	km/hr (mph)	9.1 (5.7)
	High		35 (21.7)
Swing speed		rpm	9.7
Gradeability		Degree (%)	31.5 (61)
Max traction force		kgf (lbf)	11600 (25570)

2) 5.39 m (17' 8") 2-PIECE BOOM, 2.4 m (7' 10") ARM, FRONT OUTRIGGER AND REAR DOZER BLADE

Travel position

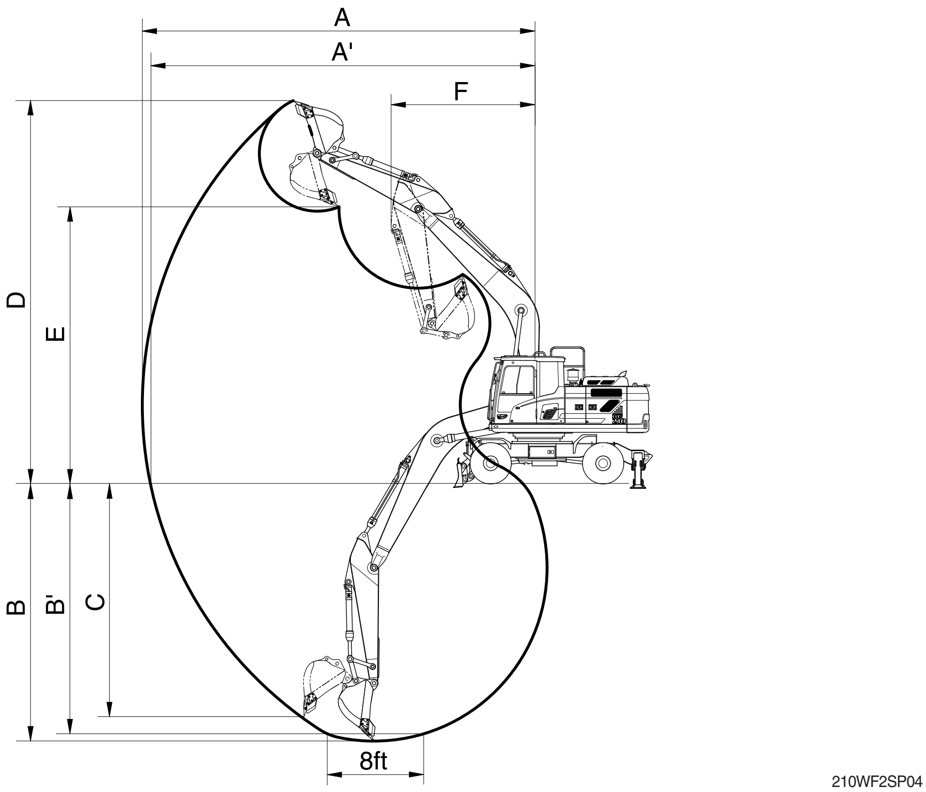


210WF2SP03

Description		Unit	Specification
Operating weight		kg (lb)	21450 (47290)
Bucket capacity (SAE heaped)		m^3 (yd^3)	0.87 (1.14)
Overall length (travel/shipping)	A	mm (ft-in)	7130 (23' 5")/9350 (30' 7")
Overall width (axle / wide axle)	B		2530 (8' 4") / 2700 (8' 9")
Overall height of boom (travel/shipping)	C		4000 (13' 1")/3050 (10' 0")
Upperstructure width	D		2530 (8' 4")
Cab height	E		3245 (10' 8")
Ground clearance of counterweight	F		1300 (4' 3")
Overall height of engine hood	G		2705 (8' 10")
Overall height of guardrail	G'		3134 (10' 3")
Ground to mission cover	H		353 (1' 2")
Rear-end distance	I		2770 (9' 1")
Rear-end swing radius	I'		2850 (9' 4")
Wheel base	J		2800 (9' 2")
Tread (axle / wide axle)	K		1914 (6' 3") / 2114 (6' 9")
Dozer blade width	L		2490 (8' 2")
Travel speed	Low	km/hr (mph)	9.1 (5.7)
	High		35 (21.7)
Swing speed		rpm	9.7
Gradeability		Degree (%)	31.5 (61)
Max traction force		kgf (lbf)	11600 (25570)

3. WORKING RANGE

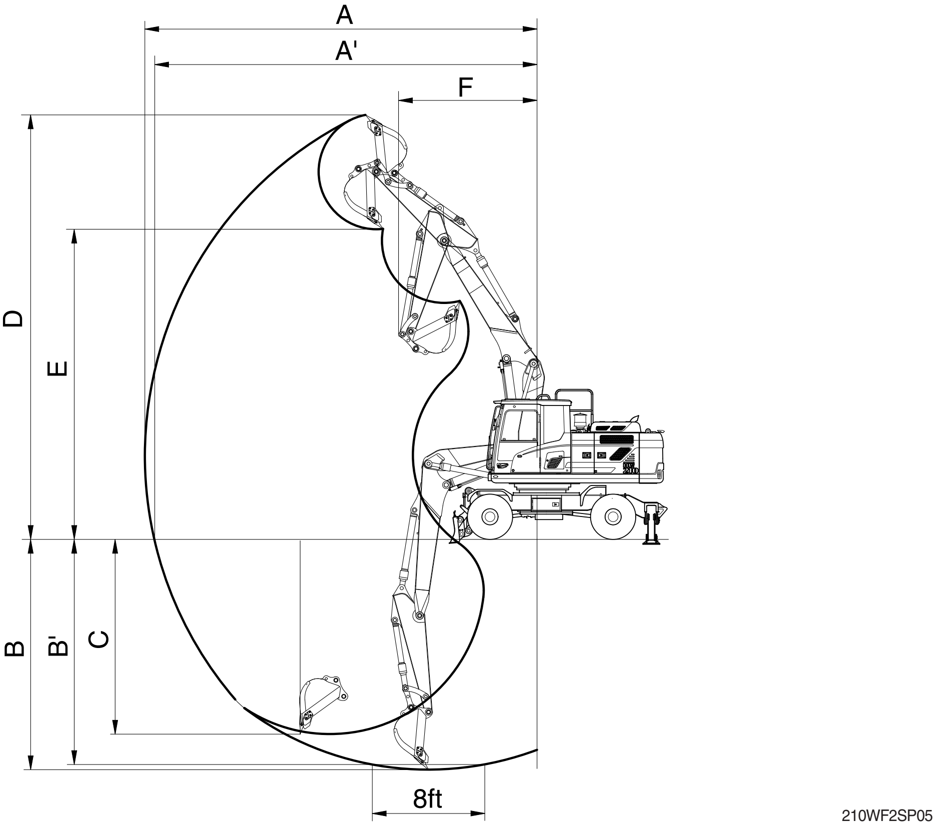
1) 5.65 m (18' 6") MONO BOOM



Description		2.0 m (6' 7") Arm	2.40 m (7' 10") Arm	2.92 m (9' 7") Arm
Max digging reach	A	9110 mm (29'11")	9480 mm (31' 1")	9960 mm (32' 8")
Max digging reach on ground	A'	8870 mm (29' 1")	9260 mm (30' 5")	9750 mm (32' 0")
Max digging depth	B	5480 mm (18' 0")	5880 mm (19' 3")	6380 mm (20'11")
Max digging depth (8ft level)	B'	5240 mm (17' 2")	5670 mm (18' 7")	6210 mm (20' 4")
Max vertical wall digging depth	C	4970 mm (16' 4")	5470 mm (17'11")	5810 mm (19' 1")
Max digging height	D	9500 mm (31' 2")	9730 mm (31'11")	10000 mm (32' 10")
Max dumping height	E	6670 mm (21'11")	6900 mm (22' 8")	7160 mm (23' 6")
Min swing radius	F	3700 mm (12' 2")	3620 mm (11'11")	3580 mm (11' 9")
Bucket digging force	SAE	133.4 [144.8] kN	133.4 [144.8] kN	133.4 [144.8] kN
		13600 [14770] kgf	13600 [14770] kgf	13600 [14770] kgf
		29980 [32550] lbf	29980 [32550] lbf	29980 [32550] lbf
	ISO	152.0 [165.0] kN	152.0 [165.0] kN	152.0 [165.0] kN
		15500 [16830] kgf	15500 [16830] kgf	15500 [16830] kgf
		34170 [37100] lbf	34170 [37100] lbf	34170 [37100] lbf
Arm digging force	SAE	144.2 [156.5] kN	119.6 [129.9] kN	102.0 [110.7] kN
		14700 [15960] kgf	12200 [13250] kgf	10400 [11290] kgf
		32410 [35190] lbf	26900 [29210] lbf	22930 [24900] lbf
	ISO	151.0 [164.0] kN	125.5 [136.3] kN	106.9 [116.1] kN
		15400 [16720] kgf	12800 [13900] kgf	10900 [11830] kgf
		33950 [36860] lbf	28220 [30640] lbf	24030 [26090] lbf

[ ] : Power boost

2) 5.39 m (17' 8") 2-PIECE BOOM



Description		2.0 m (6' 7") Arm	2.40 m (7' 10") Arm	2.92 m (9' 7") Arm
Max digging reach	A	8890 mm (29' 2")	9290 mm (30' 6")	9800 mm (32' 2")
Max digging reach on ground	A'	8670 mm (28' 5")	9080 mm (29' 9")	9600 mm (31' 6")
Max digging depth	B	5250 mm (17' 3")	5630 mm (18' 6")	6150 mm (20' 2")
Max digging depth (8ft level)	B'	5090 mm (16' 8")	5500 mm (18' 1")	6030 mm (19' 9")
Max vertical wall digging depth	C	4330 mm (14' 2")	4800 mm (15' 9")	5330 mm (17' 6")
Max digging height	D	9930 mm (32' 7")	10270 mm (33' 8")	10650 mm (34' 11")
Max dumping height	E	7020 mm (23' 0")	7350 mm (24' 1")	7730 mm (25' 4")
Min swing radius	F	3260 mm (10' 8")	2970 mm (9' 9")	2760 mm (9' 1")
Bucket digging force	SAE	133.4 [144.8] kN	133.4 [144.8] kN	133.4 [144.8] kN
		13600 [14770] kgf	13600 [14770] kgf	13600 [14770] kgf
		29980 [32550] lbf	29980 [32550] lbf	29980 [32550] lbf
	ISO	152.0 [165.0] kN	152.0 [165.0] kN	152.0 [165.0] kN
		15500 [16830] kgf	15500 [16830] kgf	15500 [16830] kgf
		34170 [37100] lbf	34170 [37100] lbf	34170 [37100] lbf
Arm digging force	SAE	144.2 [156.5] kN	119.6 [129.9] kN	102.0 [110.7] kN
		14700 [15960] kgf	12200 [13250] kgf	10400 [11290] kgf
		32410 [35190] lbf	26900 [29210] lbf	22930 [24900] lbf
	ISO	151.0 [164.0] kN	125.5 [136.3] kN	106.9 [116.1] kN
		15400 [16720] kgf	12800 [13900] kgf	10900 [11830] kgf
		33950 [36860] lbf	28220 [30640] lbf	24030 [26090] lbf

[ ] : Power boost

4. WEIGHT

Item	kg	lb
Upperstructure assembly	8950	19730
Main frame weld assembly	1760	3880
Engine assembly	520	1150
Main pump assembly	136	300
Main control valve assembly	220	490
Swing motor assembly	254	560
Hydraulic oil tank weld assembly	165	360
Fuel tank weld assembly	170	375
Counterweight	3400	7500
Cab assembly	500	1100
Lower frame weld assembly	2450	5400
Swing bearing	285	630
Travel motor assembly	80	176
Turning joint	140	305
Transmission assembly	135	300
Front axle assembly	749	1651
Front wide axle assembly	770	1698
Rear axle assembly	592	1305
Rear wide axle assembly	623	1373
Front attachment assembly (5.65 m boom, 2.92 m arm, 0.87 m^3 SAE heaped bucket)	3895	8590
5.65 m boom assembly	1370	3020
2.7 m arm assembly	730	1609
0.87 m^3 SAE heaped bucket assembly	800	1764
Boom cylinder assembly	180/1EA	400/1EA
Arm cylinder assembly	290	640
Bucket cylinder assembly	175	390
Bucket control link assembly	170	370
Oscillating cylinder assembly	40/1EA	90/1EA
Dozer blade assembly	920	2030
Front outrigger assembly	390	860
Rear outrigger assembly	1020	2250
Outrigger cylinder assembly	100/1EA	220/1EA
Blade cylinder assembly	82/1EA	180/1EA

5. LIFTING CAPACITIES

1) MONO BOOM

(1) 5.65 m (18' 6") boom, 2.00 m (6' 7") arm equipped with 0.80 m^3 (SAE heaped) bucket and 4 outrigger down.

Load point height		Load radius								At max. reach		
		3.0 m (10 ft)		4.5 m (15 ft)		6.0 m (20 ft)		7.5 m (25 ft)		Capacity		Reach
												m (ft)
7.5 m	kg									*4060	*4060	6.85
(25 ft)	lb									*8950	*8950	(22.5)
6.0 m	kg					*4520	*4520			*4150	4120	7.89
(20 ft)	lb					*9960	*9960			*9150	9080	(25.9)
4.5 m	kg	*8830	*8830	*6030	*6030	*5030	*5030			*4300	3560	8.48
(15 ft)	lb	*19470	*19470	*13290	*13290	*11090	*11090			*9480	7850	(27.8)
3.0 m	kg			*7850	*7850	*5830	*5830	*4980	4260	*4470	3330	8.73
(10 ft)	lb			*17310	*17310	*12850	*12850	*10980	9390	*9850	7340	(28.6)
1.5 m	kg			*9310	*9310	*6610	5920	*5330	4150	*4680	3320	8.67
(5 ft)	lb			*20530	*20530	*14570	13050	*11750	9150	*10320	7320	(28.4)
Ground	kg			*9910	9210	*7090	5770			*4880	3550	8.30
Line	lb			*21850	20300	*15630	12720			*10760	7830	(27.2)
-1.5 m	kg	*14170	*14170	*9750	9210	*7100	5750			*5040	4150	7.57
(-5 ft)	lb	*31240	*31240	*21500	20300	*15650	12680			*11110	9150	(24.8)
-3.0 m	kg	*12470	*12470	*8790	*8790					*4950	*4950	6.30
(-10 ft)	lb	*27490	*27490	*19380	*19380					*10910	*10910	(20.7)

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

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

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

(2) 5.65 m (18' 6") boom, 2.00 m (6' 7") arm equipped with 0.80 m^3 (SAE heaped) bucket and 4 outrigger up.

Load point height		Load radius								At max. reach		
		3.0 m (10 ft)		4.5 m (15 ft)		6.0 m (20 ft)		7.5 m (25 ft)		Capacity		Reach
												m (ft)
7.5 m	kg									*4060	2680	6.85
(25 ft)	lb									*8950	5910	(22.5)
6.0 m	kg					*4520	3300			3880	1980	7.89
(20 ft)	lb					*9960	7280			8550	4370	(25.9)
4.5 m	kg	*8830	*8830	*6030	5030	*5030	3140			3360	1640	8.48
(15 ft)	lb	*19470	*19470	*13290	11090	*11090	6920			7410	3620	(27.8)
3.0 m	kg			*7850	4500	5760	2910	4010	1970	3130	1490	8.73
(10 ft)	lb			*17310	9920	12700	6420	8840	4340	6900	3280	(28.6)
1.5 m	kg			8670	4110	5530	2710	3900	1880	3120	1470	8.67
(5 ft)	lb			19110	9060	12190	5970	8600	4140	6880	3240	(28.4)
Ground	kg			8490	3960	5390	2590			3340	1580	8.30
Line	lb			18720	8730	11880	5710			7360	3480	(27.2)
-1.5 m	kg	*14170	7580	8490	3960	5370	2570			3900	1900	7.57
(-5 ft)	lb	*31240	16710	18720	8730	11840	5670			8600	4190	(24.8)
-3.0 m	kg	*12470	7790	8630	4080					*4950	2680	6.30
(-10 ft)	lb	*27490	17170	19030	8990					*10910	5910	(20.7)

(3) 5.65 m (18' 6") boom, 2.00 m (6' 7") arm equipped with 0.80 m^3 (SAE heaped) bucket, outrigger down and dozer blade down.

Load point height		Load radius								At max. reach		
		3.0 m (10 ft)		4.5 m (15 ft)		6.0 m (20 ft)		7.5 m (25 ft)		Capacity		Reach
												m (ft)
7.5 m	kg									*4090	*4090	6.85
(25 ft)	lb									*9020	*9020	(22.5)
6.0 m	kg					*4550	*4550			*4170	3400	7.89
(20 ft)	lb					*10030	*10030			*9190	7500	(25.9)
4.5 m	kg	*8890	*8890	*6070	*6070	*5060	*5060			*4310	2930	8.48
(15 ft)	lb	*19600	*19600	*13380	*13380	*11160	*11160			*9500	6460	(27.8)
3.0 m	kg			*7880	*7880	*5860	5040	*4990	3490	*4480	2720	8.73
(10 ft)	lb			*17370	*17370	*12920	11110	*11000	7690	*9880	6000	(28.6)
1.5 m	kg			*9330	7490	*6630	4810	*5340	3390	*4680	2710	8.67
(5 ft)	lb			*20570	16510	*14620	10600	*11770	7470	*10320	5970	(28.4)
Ground	kg			*9910	7310	*7100	4680			*4880	2890	8.30
Line	lb			*21850	16120	*15650	10320			*10760	6370	(27.2)
-1.5 m	kg	*14120	*14120	*9740	7310	*7090	4650			*5020	3390	7.57
(-5 ft)	lb	*31130	*31130	*21470	16120	*15630	10250			*11070	7470	(24.8)
-3.0 m	kg	*12390	*12390	*8750	7450					*4910	4650	6.30
(-10 ft)	lb	*27320	*27320	*19290	16420					*10820	10250	(20.7)

(4) 5.65 m (18' 6") boom, 2.00 m (6' 7") arm equipped with 0.80 m³ (SAE heaped) bucket, outrigger up and dozer blade up.

Load point height		Load radius								At max. reach		
		3.0 m (10 ft)		4.5 m (15 ft)		6.0 m (20 ft)		7.5 m (25 ft)		Capacity		Reach
												m (ft)
7.5 m	kg									*4090	2680	6.85
(25 ft)	lb									*9020	5910	(22.5)
6.0 m	kg					*4550	3300			3880	1980	7.89
(20 ft)	lb					*10030	7280			8550	4370	(25.9)
4.5 m	kg	*8890	*8890	*6070	5030	*5060	3140			3360	1640	8.48
(15 ft)	lb	*19600	*19600	*13380	11090	*11160	6920			7410	3620	(27.8)
3.0 m	kg			*7880	4500	5760	2910	4010	1970	3130	1490	8.73
(10 ft)	lb			*17370	9920	12700	6420	8810	4340	6900	3280	(28.6)
1.5 m	kg			8670	4110	5530	2710	3900	1880	3120	1470	8.67
(5 ft)	lb			19110	9060	12190	5970	8600	4140	6880	3240	(28.4)
Ground	kg			8490	3960	5390	2590			3340	1580	8.30
Line	lb			18720	8730	11880	5710			7360	3480	(27.2)
-1.5 m	kg	*14120	7580	8490	3960	5370	2570			3900	1900	7.57
(-5 ft)	lb	*31130	16710	18720	8730	11840	5670			8600	4190	(24.8)
-3.0 m	kg	*12390	7790	8630	4080					*4910	2680	6.30
(-10 ft)	lb	*27320	17170	19030	8990					*10820	5910	(20.7)

(5) 5.65 m (18' 6") boom, 2.40 m (7' 10") arm equipped with 0.80 m³ (SAE heaped) bucket, 4-outrigger down.

Load point height		Load radius										At max. reach		
		1.5 m (5 ft)		3.0 m (10 ft)		4.5 m (15 ft)		6.0 m (20 ft)		7.5 m (25 ft)		Capacity		Reach
														m (ft)
7.5 m	kg											*3760	*3760	7.34
(25 ft)	lb											*8290	*8290	(24.1)
6.0 m	kg							*4100	*4100			*3860	3770	8.31
(20 ft)	lb							*9040	*9040			*8510	8310	(27.3)
4.5 m	kg					*5450	*5450	*4660	*4660	*4350	*4350	*4010	3290	8.87
(15 ft)	lb					*12020	*12020	*10270	*10270	*9590	*9590	*8840	7250	(29.1)
3.0 m	kg					*7280	*7280	*5510	*5510	*4710	4260	*4180	3090	9.10
(10 ft)	lb					*16050	*16050	*12150	*12150	*10380	9390	*9220	6810	(29.9)
1.5 m	kg					*8900	*8900	*6350	5920	*5140	4140	*4380	3070	9.05
(5 ft)	lb					*19620	*19620	*14000	13050	*11330	9130	*9660	6770	(29.7)
Ground	kg			*9890	*9890	*9740	9180	*6940	5740	*5440	4050	*4590	3260	8.70
Line	lb			*21800	*21800	*21470	20240	*15300	12650	*11990	8930	*10120	7190	(28.5)
-1.5 m	kg	*10720	*10720	*14740	*14740	*9810	9130	*7090	5690			*4780	3750	8.00
(-5 ft)	lb	*23630	*23630	*32500	*32500	*21630	20130	*15630	12540			*10540	8270	(26.2)
-3.0 m	kg	*15240	*15240	*13230	*13230	*9100	*9100	*6560	5760			*4830	*4830	6.84
(-10 ft)	lb	*33600	*33600	*29170	*29170	*20060	*20060	*14460	12700			*10650	*10650	(22.4)
-4.5 m	kg			*10230	*10230	*7020	*7020							
(-15 ft)	lb			*22550	*22550	*15480	*15480							

(6) 5.65 m (18' 6") boom, 2.40 m (7' 10") arm equipped with 0.80 m^3 (SAE heaped) bucket, 4-outrigger up.

Load point height		Load radius										At max. reach		
		1.5 m (5 ft)		3.0 m (10 ft)		4.5 m (15 ft)		6.0 m (20 ft)		7.5 m (25 ft)		Capacity		Reach
														m (ft)
7.5 m	kg											*3760	2360	7.34
(25 ft)	lb											*8290	5200	(24.1)
6.0 m	kg							*4100	3350			3550	1780	8.31
(20 ft)	lb							*9040	7390			7830	3920	(27.3)
4.5 m	kg					*5450	5130	*4660	3170	4120	2080	3100	1490	8.87
(15 ft)	lb					*12020	11310	*10270	6990	9080	4590	6830	3280	(29.1)
3.0 m	kg					*7280	4580	*5510	2930	4010	1970	2910	1350	9.10
(10 ft)	lb					*16050	10100	*12150	6460	8840	4340	6420	2980	(29.9)
1.5 m	kg					8710	4140	5530	2710	3890	1860	2890	1330	9.05
(5 ft)	lb					19200	9130	12190	5970	8580	4100	6370	2930	(29.7)
Ground	kg			*9890	7340	8450	3930	5360	2560	3800	1790	3070	1420	8.70
Line	lb			*21800	16180	18630	8660	11820	5640	8380	3950	6770	3130	(28.5)
-1.5 m	kg	*10720	*10720	*14740	7410	8410	3890	5310	2510			3530	1680	8.00
(-5 ft)	lb	*23630	*23630	*32500	16340	18540	8580	11710	5530			7780	3700	(26.2)
-3.0 m	kg	*15240	*15240	*13230	7610	8510	3980	5380	2570			4610	2280	6.84
(-10 ft)	lb	*33600	*33600	*29170	16780	18760	8770	11860	5670			10160	5030	(22.4)
-4.5 m	kg			*10230	7990	*7020	4240							
(-15 ft)	lb			*22550	17610	*15480	9350							

(7) 5.65 m (18' 6") boom, 2.40 m (7' 10") arm equipped with 0.80 m^3 (SAE heaped) bucket, outrigger down and dozer blade down.

Load point height		Load radius										At max. reach		
		1.5 m (5 ft)		3.0 m (10 ft)		4.5 m (15 ft)		6.0 m (20 ft)		7.5 m (25 ft)		Capacity		Reach
														m (ft)
7.5 m	kg											*3760	*3760	7.34
(25 ft)	lb											*8290	*8290	(24.1)
6.0 m	kg							*4100	*4100			*3860	3110	8.31
(20 ft)	lb							*9040	*9040			*8510	6860	(27.3)
4.5 m	kg					*5450	*5450	*4660	*4660	*4350	3610	*4010	2700	8.87
(15 ft)	lb					*12020	*12070	*10270	*10270	*9590	7960	*8840	5950	(29.1)
3.0 m	kg					*7280	*7280	*5510	5060	*4710	3490	*4180	2520	9.10
(10 ft)	lb					*16050	*16050	*12150	11160	*10380	7690	*9220	5560	(29.9)
1.5 m	kg					*8900	7530	*6350	4810	*5140	3370	*4380	2500	9.05
(5 ft)	lb					*19620	16600	*14000	10600	*11330	7430	*9660	5510	(29.7)
Ground	kg			*9890	*9890	*9740	7280	*6940	4650	*5440	3290	*4590	2650	8.70
Line	lb			*21800	*21800	*21470	16050	*15300	10250	*11990	7250	*10120	5840	(28.5)
-1.5 m	kg	*10720	*10720	*14740	*14740	*9810	7230	*7090	4590			*4780	3060	8.00
(-5 ft)	lb	*23630	*23630	*32500	*32500	*21630	15940	*15630	10120			*10540	6750	(26.2)
-3.0 m	kg	*15240	*15240	*13230	*13230	*9100	7340	*6560	4670			*4830	4020	6.84
(-10 ft)	lb	*33600	*33600	*29170	*29170	*20060	16180	*14460	10300			*10650	8860	(22.4)
-4.5 m	kg			*10230	*10230	*7020	*7020							
(-15 ft)	lb			*22550	*22550	*15480	*15480							

(8) 5.65 m (18' 6") boom, 2.40 m (7' 10") arm equipped with 0.80 m^3 (SAE heaped) bucket, outrigger up and dozer blade up.

Load point height		Load radius										At max. reach		
		1.5 m (5 ft)		3.0 m (10 ft)		4.5 m (15 ft)		6.0 m (20 ft)		7.5 m (25 ft)		Capacity		Reach
														m (ft)
7.5 m	kg											*3760	2360	7.34
(25 ft)	lb											*8290	5200	(24.1)
6.0 m	kg							*4100	3350			3550	1780	8.31
(20 ft)	lb							*9040	7390			7830	3920	(27.3)
4.5 m	kg					*5450	5130	*4660	3170	4120	2080	3100	1490	8.87
(15 ft)	lb					*12020	11310	*10270	6990	9080	4590	6830	3280	(29.1)
3.0 m	kg					*7280	4580	*5510	2930	4010	1970	2910	1350	9.10
(10 ft)	lb					*16050	10100	*12150	6460	8840	4340	6420	2980	(29.9)
1.5 m	kg					8710	4140	5530	2710	3890	1860	2890	1330	9.05
(5 ft)	lb					19200	9130	12190	5970	8580	4100	6370	2930	(29.7)
Ground	kg			*9890	7340	8450	3930	5360	2560	3800	1790	3070	1420	8.70
Line	lb			*21800	16180	18630	8660	11820	5640	8380	3950	6770	3130	(28.5)
-1.5 m	kg	*10720	*10720	*14740	7410	8410	3890	5310	2510			3530	1680	8.00
(-5 ft)	lb	*23630	*23630	*32500	16340	18540	8580	11710	5530			7780	3700	(26.2)
-3.0 m	kg	*15240	*15240	*13230	7610	8510	3980	5380	2570			4610	2280	6.84
(-10 ft)	lb	*33600	*33600	*29170	16780	18760	8770	11860	5670			10160	5030	(22.4)
-4.5 m	kg			*10230	7990	*7020	4240							
(-15 ft)	lb			*22550	17610	*15480	9350							

(9) 5.65 m (18' 6") boom, 2.92 m (9' 7") arm equipped with 0.80 m^3 (SAE heaped) bucket, 4-outrigger down.

Load point height		Load radius										At max. reach		
		1.5 m (5 ft)		3.0 m (10 ft)		4.5 m (15 ft)		6.0 m (20 ft)		7.5 m (25 ft)		Capacity		Reach
														m (ft)
9.0m	kg											*3350	*3350	6.52
(30 ft)	lb											*7390	*7390	(21.4)
7.5 m	kg											*3400	*3400	7.96
(25 ft)	lb											*7500	*7500	(26.1)
6.0 m	kg									*2360	*2360	*3510	3370	8.85
(20 ft)	lb									*5800	*5800	*7740	7430	(29.0)
4.5 m	kg							*4140	*4140	*3920	*3920	*3650	2970	9.37
(15 ft)	lb							*9130	*9130	*8640	*8640	*8050	6550	(30.7)
3.0 m	kg			*10640	*10640	*6480	*6480	*5020	*5020	*4350	4260	*3820	2790	9.59
(10 ft)	lb			*23460	*23460	*14290	*14290	*11070	*11070	*9590	9390	*8420	6150	(31.5)
1.5 m	kg			*8960	*8960	*8280	*8280	*5950	5910	*4840	4110	*4010	2770	9.54
(5 ft)	lb			*19750	*19750	*18250	*18250	*13120	13030	*10670	9060	*8840	6110	(31.3)
Ground	kg			*10270	*10270	*9290	9130	*6660	5690	*5240	3990	*4220	2920	9.21
Line	lb			*22640	*22640	*20700	20130	*14680	12540	*11550	8800	*9300	6440	(30.2)
-1.5 m	kg	*9530	*9530	*13530	*13530	*9740	9000	*6990	5590	*5370	3950	*4430	3300	8.56
(-5 ft)	lb	*21010	*21010	*29830	*29830	*21470	19840	*15410	12320	*11840	8710	*9770	7280	(28.1)
-3.0 m	kg	*12990	*12990	*13990	*13990	*9350	9050	*6760	5620			*4570	4140	7.50
(-10 ft)	lb	*28640	*28640	*30840	*30840	*20610	19950	*14900	12390			*10080	9130	(24.6)
-4.5 m	kg			*11590	*11590	*7910	*7910							
(-15 ft)	lb			*25550	*25550	*17440	*17440							

(10) 5.65 m (18' 6") boom, 2.92 m (9' 7") arm equipped with 0.80 m^3 (SAE heaped) bucket, 4-outrigger up.

Load point height		Load radius										At max. reach		
		1.5 m (5 ft)		3.0 m (10 ft)		4.5 m (15 ft)		6.0 m (20 ft)		7.5 m (25 ft)		Capacity		Reach
														m (ft)
9.0m	kg											*3350	3040	6.52
(30 ft)	lb											*7390	6700	(21.4)
7.5 m	kg											*3400	2010	7.96
(25 ft)	lb											*7500	4430	(26.1)
6.0 m	kg									*2630	2160	3170	1540	8.85
(20 ft)	lb									*5800	4760	6990	3400	(29.0)
4.5 m	kg							*4140	3210	*3920	2090	2800	1300	9.37
(15 ft)	lb							*9130	7080	*8640	4610	6170	2870	(30.7)
3.0 m	kg			*10640	8580	*6480	4680	*5020	2950	4010	1960	2630	1180	9.59
(10 ft)	lb			*23460	18920	*14290	10320	*11070	6500	8840	4320	5800	2600	(31.5)
1.5 m	kg			*8960	7420	*8280	4170	5520	2690	3860	1830	2610	1150	9.54
(5 ft)	lb			*19750	16360	*18250	9190	12170	5930	8510	4030	5750	2540	(31.3)
Ground	kg			*10270	7170	8400	3870	5310	2500	3740	1730	2740	1220	9.21
Line	lb			*22640	15810	18520	8530	11710	5510	8250	3810	6040	2690	(30.2)
-1.5 m	kg	*9530	*9530	*13530	7180	8280	3770	5210	2420	3700	1680	3100	1410	8.56
(-5 ft)	lb	*21010	*21010	*29830	15830	18250	8310	11490	5340	8160	3700	6830	3110	(28.1)
-3.0 m	kg	*12990	*12990	*13990	7340	8340	3820	5240	2440			3890	1860	7.50
(-10 ft)	lb	*28640	*28640	*30840	16180	18390	8420	11550	5380			8580	4100	(24.6)
-4.5 m	kg			*11590	7660	*7910	4000							
(-15 ft)	lb			*25550	16890	*17440	8820							

(11) 5.65 m (18' 6") boom, 2.92 m (9' 7") arm equipped with 0.80 m^3 (SAE heaped) bucket, outrigger down and dozer blade down.

Load point height		Load radius										At max. reach		
		1.5 m (5 ft)		3.0 m (10 ft)		4.5 m (15 ft)		6.0 m (20 ft)		7.5 m (25 ft)		Capacity		Reach
														m (ft)
9.0m	kg											*3350	*3350	6.52
(30 ft)	lb											*7390	*7390	(21.4)
7.5 m	kg											*3400	*3400	7.96
(25 ft)	lb											*7500	*7500	(26.1)
6.0 m	kg									*2630	*2630	*3510	2760	8.85
(20 ft)	lb									*5800	*5800	*7740	6080	(29.0)
4.5 m	kg							*4140	*4140	*3920	3630	*3650	2420	9.37
(15 ft)	lb							*9130	*9130	*8640	8000	*8050	5340	(30.7)
3.0 m	kg			*10640	*10640	*6480	*6480	*5020	*5020	*4350	3490	*3820	2260	9.59
(10 ft)	lb			*23460	*23460	*14290	*14290	*11070	*11070	*9590	7690	*8420	4980	(31.5)
1.5 m	kg			*8960	*8960	*8280	7570	*5950	4800	*4840	3340	*4010	2240	9.54
(5 ft)	lb			*19750	*19750	*18250	16690	*13120	10580	*10670	7360	*8840	4940	(31.3)
Ground	kg			*10270	*10270	*9390	7230	*6660	4600	*5240	3230	*4220	2360	9.21
Line	lb			*22640	*22640	*20700	15940	*14680	10140	*11550	7120	*9300	5200	(30.2)
-1.5 m	kg	*9530	*9530	*13530	*13530	*9740	7110	*6990	4500	*5370	3190	*4430	2670	8.56
(-5 ft)	lb	*21010	*21010	*29830	*29830	*21470	15670	*15410	9920	*14840	7030	*9770	5890	(28.1)
-3.0 m	kg	*12990	*12990	*13990	*13990	*9350	7160	*6760	4520			*4570	3380	7.50
(-10 ft)	lb	*28640	*28640	*30840	*30840	*20610	15790	*14900	9960			*10080	7450	(24.6)
-4.5 m	kg			*11590	*11590	*7910	7380							
(-15 ft)	lb			*25550	*25550	*17440	16270							

(12) 5.65 m (18' 6") boom, 2.92 m (9' 7") arm equipped with 0.80 m^3 (SAE heaped) bucket, outrigger up and dozer blade up.

Load point height		Load radius										At max. reach		
		1.5 m (5 ft)		3.0 m (10 ft)		4.5 m (15 ft)		6.0 m (20 ft)		7.5 m (25 ft)		Capacity		Reach
														m (ft)
9.0m	kg											*3350	3040	6.52
(30 ft)	lb											*7390	6700	(21.4)
7.5 m	kg											*3400	2010	7.96
(25 ft)	lb											*7500	4430	(26.1)
6.0 m	kg									*2630	2160	3170	1540	8.85
(20 ft)	lb									*5800	4760	6990	3400	(29.0)
4.5 m	kg							*4140	3210	*3920	2090	2800	1300	9.37
(15 ft)	lb							*9130	7080	*8640	4610	6170	2870	(30.7)
3.0 m	kg			*10640	8580	*6480	4680	*5020	2950	4010	1960	2630	1180	9.59
(10 ft)	lb			*23460	18920	*14290	10320	*11070	6500	8840	4320	5800	2600	(31.5)
1.5 m	kg			*8960	7420	*8280	4170	5520	2690	3860	1830	2610	1150	9.54
(5 ft)	lb			*19750	16360	*18250	9190	12170	5930	8510	4030	5750	2540	(31.3)
Ground	kg			*10270	7170	8400	3870	5310	2500	3740	1730	2740	1220	9.21
Line	lb			*22640	15810	18520	8530	11710	5510	8250	3810	6040	2690	(30.2)
-1.5 m	kg	*9530	*9530	*13530	7180	8280	3770	5210	2420	3700	1680	3100	1410	8.56
(-5 ft)	lb	*21010	*21010	*29830	15830	18250	8310	11490	5340	8160	3700	6830	3110	(28.1)
-3.0 m	kg	*12990	*12990	*13990	7340	8340	3820	5240	2440			3890	1860	7.50
(-10 ft)	lb	*28640	*28640	*30840	16180	18390	8420	11550	5380			8580	4100	(24.6)
-4.5 m	kg			*11590	7660	*7910	4000							
(-15 ft)	lb			*25550	16890	*17440	8820							

2) ADJUST BOOM

(1) 5.39 m (17' 8") boom, 2.00 m (6' 7") arm equipped with 0.80 m^3 (SAE heaped) bucket, 4-outrigger down.

Load point height		Load radius								At max. reach		
		3.0 m (10 ft)		4.5 m (15 ft)		6.0 m (20 ft)		7.5 m (25 ft)		Capacity		Reach
												m (ft)
9.0m	kg									*3890	*3890	4.39
(30 ft)	lb									*8580	*8580	(14.4)
7.5 m	kg			*3980	*3980					*3660	*3660	6.49
(25 ft)	lb			*8770	*8770					*8070	*8070	(21.3)
6.0 m	kg			*4080	*4080	*4000	*4000			*3690	*3690	7.61
(20 ft)	lb			*8990	*8990	*8820	*8820			*8140	*8140	(25.0)
4.5 m	kg	*6860	*6860	*5020	*5020	*4320	*4320			*3800	3800	8.25
(15 ft)	lb	*15120	*15120	*11070	*11070	*9520	*9520			*8380	8380	(27.1)
3.0 m	kg			*6510	*6510	*4960	*4960	*4340	4330	*3960	3520	8.53
(10 ft)	lb			*14350	*14350	*10930	*10930	*9570	9550	*8730	7760	(28.0)
1.5 m	kg			*7880	*7880	*5650	*5650	*4640	4240	*4160	3510	8.49
(5 ft)	lb			*17370	*17370	*12460	*12460	*10230	9350	*9170	7740	(27.9)
Ground	kg			*8620	*8620	*6150	5910			*4370	3740	8.13
Line	lb			*19000	*19000	*13560	13030			*9630	8250	(26.7)
-1.5 m	kg	*12970	*12970	*8660	*8660	*6230	5880					
(-5 ft)	lb	*28590	*28590	*19090	*19090	*13730	12960					

(2) 5.39 m (17' 8") boom, 2.00 m (6' 7") arm equipped with 0.80 m^3 (SAE heaped) bucket, 4-outrigger up.

Load point height		Load radius								At max. reach		
		3.0 m (10 ft)		4.5 m (15 ft)		6.0 m (20 ft)		7.5 m (25 ft)		Capacity		Reach
												m (ft)
9.0m	kg									*3890	*3890	4.39
(30 ft)	lb									*8580	*8580	(14.4)
7.5 m	kg			*3980	*3980					*3660	2990	6.49
(25 ft)	lb			*8770	*8770					*8070	6590	(21.3)
6.0 m	kg			*4080	*4080	*4000	3330			*3690	2150	7.61
(20 ft)	lb			*8990	*8990	*8820	7340			*8140	4740	(25.0)
4.5 m	kg	*6860	*6860	*5020	*5020	*4320	3210			3580	1770	8.25
(15 ft)	lb	*15120	*15120	*11070	*11070	*9520	7080			7890	3900	(27.1)
3.0 m	kg			*6510	4680	*4960	3000	4070	2010	3320	1600	8.53
(10 ft)	lb			*14350	10320	*10930	6610	8970	4430	7320	3530	(28.0)
1.5 m	kg			*7880	4270	*5650	2800	3980	1930	3300	1570	8.49
(5 ft)	lb			*17370	9410	*12460	6170	8770	4250	7280	3460	(27.9)
Ground	kg			*8620	4080	5520	2670			3520	1690	8.13
Line	lb			*19000	8990	12170	5890			7760	3730	(26.7)
-1.5 m	kg	*12970	7700	8650	4060	5490	2640					
(-5 ft)	lb	*28590	16980	19070	8950	12100	5820					

(3) 5.39 m (17' 8") boom, 2.00 m (6' 7") arm equipped with 0.80 m^3 (SAE heaped) bucket, outrigger down and dozer blade down.

Load point height		Load radius								At max. reach		
		3.0 m (10 ft)		4.5 m (15 ft)		6.0 m (20 ft)		7.5 m (25 ft)		Capacity		Reach
												m (ft)
9.0m	kg									*3900	*3900	4.40
(30 ft)	lb									*8600	*8600	(14.4)
7.5 m	kg			*3980	*3980					*3660	*3660	6.49
(25 ft)	lb			*8770	*8770					*8070	*8070	(21.3)
6.0 m	kg			*4070	*4070	*4000	*4000			*3690	3670	7.62
(20 ft)	lb			*8970	*8970	*8820	*8820			*8140	8090	(25.0)
4.5 m	kg	*6850	*6850	*5020	*5020	*4320	*4320			*3800	3120	8.25
(15 ft)	lb	*15100	*15100	*11070	*11070	*9520	*9520			*8380	6880	(27.1)
3.0 m	kg			*6510	*6510	*4960	*4960	*4340	3550	*3960	2880	8.53
(10 ft)	lb			*14350	*14350	*10930	*10930	*9570	7830	*8730	6350	(28.0)
1.5 m	kg			*7880	7710	*5650	4940	*4640	3470	*4160	2860	8.50
(5 ft)	lb			*17370	17000	*12460	10890	*10230	7650	*9170	6310	(27.9)
Ground	kg			*8620	7490	*6150	4790			*4360	3060	8.14
Line	lb			*19000	16510	*13560	10560			*9610	6750	(26.7)
-1.5 m	kg	*12970	*12970	*8660	7470	*6240	4760					
(-5 ft)	lb	*28590	*28590	*19000	16470	*13760	10490					

(4) 5.39 m (17' 8") boom, 2.00 m (6' 7") arm equipped with 0.80 m^3 (SAE heaped) bucket, outrigger up and dozer blade up.

Load point height		Load radius								At max. reach		
		3.0 m (10 ft)		4.5 m (15 ft)		6.0 m (20 ft)		7.5 m (25 ft)		Capacity		Reach
												m (ft)
9.0m	kg									*3890	*3890	4.39
(30 ft)	lb									*8580	*8580	(14.4)
7.5 m	kg			*3980	*3980					*3660	2990	6.49
(25 ft)	lb			*8770	*8770					*8070	6590	(21.3)
6.0 m	kg			*4080	*4080	*4000	3330			*3690	2150	7.61
(20 ft)	lb			*8990	*8990	*8820	7340			*8140	4740	(25.0)
4.5 m	kg	*6860	*6860	*5020	*5020	*4320	3210			3580	1770	8.25
(15 ft)	lb	*15120	*15120	*11070	*11070	*9520	7080			7890	3900	(27.1)
3.0 m	kg			*6510	4680	*4960	3000	4070	2010	3320	1600	8.53
(10 ft)	lb			*14350	10320	*10930	6610	8970	4430	7320	3530	(28.0)
1.5 m	kg			*7880	4270	*5650	2800	3980	1930	3300	1570	8.49
(5 ft)	lb			*17370	9410	*12460	6170	8770	4250	7280	3460	(27.9)
Ground	kg			*8620	4080	5520	2670			3520	1690	8.13
Line	lb			*19000	8990	12170	5890			7760	3730	(26.7)
-1.5 m	kg	*12970	7700	8650	4060	5490	2640					
(-5 ft)	lb	*28590	16980	19070	8950	12100	5820					

(5) 5.39 m (17' 8") boom, 2.40 m (7' 10") arm equipped with 0.80 m^3 (SAE heaped) bucket, 4-outrigger down.

Load point height		Load radius								At max. reach		
		3.0 m (10 ft)		4.5 m (15 ft)		6.0 m (20 ft)		7.5 m (25 ft)		Capacity		Reach
												m (ft)
9.0m	kg									*3480	*3480	5.19
(30 ft)	lb									*7670	*7670	(17.0)
7.5 m	kg									*3370	*3370	7.00
(25 ft)	lb									*7430	*7430	(23.0)
6.0 m	kg					*3600	*3600			*3420	*3420	8.04
(20 ft)	lb					*7940	*7940			*7540	*7540	(26.4)
4.5 m	kg			*4520	*4520	*3980	*3980	*3700	*3700	*3530	3500	8.64
(15 ft)	lb			*9960	*9960	*8770	*8770	*8160	*8160	*7780	7720	(28.3)
3.0 m	kg	*10000	*10000	*6010	*6010	*4660	*4660	*4070	*4070	*3690	3260	8.91
(10 ft)	lb	*22050	*22050	*13250	*13250	*10270	*10270	*8970	*8970	*8140	7190	(29.2)
1.5 m	kg			*7490	*7490	*5400	*5400	*4430	4230	*3880	3240	8.87
(5 ft)	lb			*16510	*16510	*11900	*11900	*9770	9330	*8550	7140	(29.1)
Ground	kg	*10060	*10060	*8410	*8410	*5980	5880	*4720	4140	*4090	3440	8.54
Line	lb	*22180	*22180	*18540	*18540	*13180	12960	*10410	9130	*9020	7580	(28.0)
-1.5 m	kg	*13330	*13330	*8650	*8650	*6200	5820			*4270	3960	7.85
(-5 ft)	lb	*29390	*29390	*19070	*19070	*13670	12830			*9410	8730	(25.8)
-3.0 m	kg			*8130	*8130	*5760	*5760					
(-10 ft)	lb			*17920	*17920	*12700	*12700					

(6) 5.39 m (17' 8") boom, 2.40 m (7' 10") arm equipped with 0.80 m^3 (SAE heaped) bucket, 4-outrigger up.

Load point height		Load radius								At max. reach		
		3.0 m (10 ft)		4.5 m (15 ft)		6.0 m (20 ft)		7.5 m (25 ft)		Capacity		Reach
												m (ft)
9.0m	kg									*3480	*3480	5.19
(30 ft)	lb									*7670	*7670	(17.0)
7.5 m	kg									*3370	2600	7.00
(25 ft)	lb									*7430	5730	(23.0)
6.0 m	kg					*3600	3390			*3420	1930	8.04
(20 ft)	lb					*7940	7470			*7540	4250	(26.4)
4.5 m	kg			*4520	*4520	*3980	3240	*3700	2100	3300	1600	8.64
(15 ft)	lb			*9960	*9960	*8770	7140	*8160	4630	7280	3530	(28.3)
3.0 m	kg	*10000	8610	*6010	4760	*4660	3020	*4070	2020	3070	1450	8.91
(10 ft)	lb	*22050	18980	*13250	10490	*10270	6660	*8970	4450	6770	3200	(29.2)
1.5 m	kg			*7490	4300	*5400	2800	3970	1920	3050	1420	8.87
(5 ft)	lb			*16510	9480	*11900	6170	8750	4230	6720	3130	(29.1)
Ground	kg	*10060	7490	*8410	4050	5490	2640	3890	1840	3230	1520	8.54
Line	lb	*22180	16510	*18540	8930	12100	5820	8580	4060	7120	3350	(28.0)
-1.5 m	kg	*13330	7550	8580	3990	5430	2580			3720	1790	7.85
(-5 ft)	lb	*29390	16640	18920	8800	11970	5690			8200	3950	(25.8)
-3.0 m	kg			*8130	4070	5510	2560					
(-10 ft)	lb			*17920	8970	12150	5860					

(7) 5.39 m (17' 8") boom, 2.40 m (7' 10") arm equipped with 0.80 m^3 (SAE heaped) bucket, outrigger down and dozer blade down.

Load point height		Load radius								At max. reach		
		3.0 m (10 ft)		4.5 m (15 ft)		6.0 m (20 ft)		7.5 m (25 ft)		Capacity		Reach
												m (ft)
9.0m	kg									*3480	*3480	5.19
(30 ft)	lb									*7670	*7670	(17.0)
7.5 m	kg									*3370	*3370	7.00
(25 ft)	lb									*7430	*7430	(23.0)
6.0 m	kg					*3600	*3600			*3420	3340	8.04
(20 ft)	lb					*7940	*7940			*7540	7360	(26.4)
4.5 m	kg			*4520	*4520	*3980	*3980	*3700	3650	*3530	2870	8.64
(15 ft)	lb			*9960	*9960	*8770	*8770	*8160	8050	*7780	6330	(28.3)
3.0 m	kg	*10000	*10000	*6010	*6010	*4660	*4660	*4070	3560	*3690	2660	8.91
(10 ft)	lb	*22050	*22050	*13250	*13250	*10270	*10270	*8970	7850	*8140	5860	(29.2)
1.5 m	kg			*7490	*7490	*5400	4940	*4430	3450	*3880	2640	8.87
(5 ft)	lb			*16510	*16510	*11900	10890	*9770	7610	*8550	5820	(29.1)
Ground	kg	*10060	*10060	*8410	7470	*5980	4770	*4720	3370	*4090	2800	8.54
Line	lb	*22180	*22180	*18540	16470	*13180	10520	*10410	7430	*9020	6170	(28.0)
-1.5 m	kg	*13330	*13330	*8650	7390	*6200	4700			*4270	3230	7.85
(-5 ft)	lb	*29390	*29390	*19070	16290	*13670	10360			*9410	7120	(25.8)
-3.0 m	kg			*8130	7490	*5760	4780					
(-10 ft)	lb			*17920	16510	*12700	10540					

(8) 5.39 m (17' 8") boom, 2.40 m (7' 10") arm equipped with 0.80 m^3 (SAE heaped) bucket, outrigger up and dozer blade up.

Load point height		Load radius								At max. reach		
		3.0 m (10 ft)		4.5 m (15 ft)		6.0 m (20 ft)		7.5 m (25 ft)		Capacity		Reach
												m (ft)
9.0m	kg									*3480	*3480	5.19
(30 ft)	lb									*7670	*7670	(17.0)
7.5 m	kg									*3370	2600	7.00
(25 ft)	lb									*7430	5730	(23.0)
6.0 m	kg					*3600	3390			*3420	1930	8.04
(20 ft)	lb					*7940	7470			*7540	4250	(26.4)
4.5 m	kg			*4520	*4520	*3980	3240	*3700	2100	3300	1600	8.64
(15 ft)	lb			*9960	*9960	*8770	7140	*8160	4360	7280	3530	(28.3)
3.0 m	kg	*10000	8610	*6010	4760	*4660	3020	*4070	2020	3070	1450	8.91
(10 ft)	lb	*22050	18980	*13250	10490	*10270	6660	*8970	4450	6770	3200	(29.2)
1.5 m	kg			*7490	4300	*5400	2800	3970	1920	3050	1420	8.87
(5 ft)	lb			*16510	9480	*11900	6170	8750	4230	6720	3130	(29.1)
Ground	kg	*10060	7490	*8410	4050	5490	2640	*3890	1840	3230	1520	8.54
Line	lb	*22180	16510	*18540	8930	12100	5820	*8580	4060	7120	3350	(28.0)
-1.5 m	kg	*13330	7550	8580	3990	5430	2580			3720	1790	7.85
(-5 ft)	lb	*29390	16640	18920	8800	11970	5690			8200	3950	(25.8)
-3.0 m	kg			*8130	4070	5510	2660					
(-10 ft)	lb			*17920	8970	12150	5860					

(9) 5.39 m (17' 8") boom, 2.92 m (9' 7") arm equipped with 0.80 m^3 (SAE heaped) bucket, 4-outrigger down.

Load point height		Load radius								At max. reach		
		3.0 m (10 ft)		4.5 m (15 ft)		6.0 m (20 ft)		7.5 m (25 ft)		Capacity		Reach
												m (ft)
9.0m	kg									*3060	*3060	6.09
(30 ft)	lb									*6750	*6750	(20.0)
7.5 m	kg					*3150	*3150			*3030	*3030	7.65
(25 ft)	lb					*6940	*6940			*6680	*6680	(25.1)
6.0 m	kg					*3090	*3090			*3090	*3090	8.60
(20 ft)	lb					*6810	*6810			*6810	*6810	(28.2)
4.5 m	kg			*3820	*3820	*3500	*3500	*3390	*3390	*3200	3150	9.15
(15 ft)	lb			*8420	*8420	*7720	*7720	*7470	*7470	*7050	6940	(30.0)
3.0 m	kg	*8220	*8220	*5300	*5300	*4210	*4210	*3710	*3710	*3350	2950	9.40
(10 ft)	lb	*18120	*18120	*11680	*11680	*9280	*9280	*8180	*8180	*7390	6500	(30.8)
1.5 m	kg	*10330	*10330	*6890	*6890	*5020	*5020	*4140	*4140	*3530	2920	9.37
(5 ft)	lb	*22770	*22770	*15190	*15190	*11070	*11070	*9130	*9130	*7780	6440	(30.7)
Ground	kg	*10560	*10560	*8020	*8020	*5700	*5700	*4510	4090	*3730	3070	9.06
Line	lb	*23280	*23280	*17680	*17680	*12570	*12570	*9940	9020	*8220	6770	(29.7)
-1.5 m	kg	*13510	*13510	*8510	*8510	*6070	5780	*4670	4050	*3930	3470	8.42
(-5 ft)	lb	*29780	*29780	*18760	*18760	*13380	12630	*10300	8930	*8660	7650	(27.6)
-3.0 m	kg	*12660	*12660	*8310	*8310	*5940	5750					
(-10 ft)	lb	*27910	*27910	*18320	*18320	*13100	12680					

(10) 5.39 m (17' 8") boom, 2.92 m (9' 7") arm equipped with 0.80 m^3 (SAE heaped) bucket, 4-outrigger up.

Load point height		Load radius								At max. reach		
		3.0 m (10 ft)		4.5 m (15 ft)		6.0 m (20 ft)		7.5 m (25 ft)		Capacity		Reach
												m (ft)
9.0m	kg									*3060	*3060	6.09
(30 ft)	lb									*6750	*6750	(20.0)
7.5 m	kg					*3150	*3150			*3030	2200	7.65
(25 ft)	lb					*6940	*6940			*6680	4850	(25.1)
6.0 m	kg					*3090	*3090			*3090	1670	8.60
(20 ft)	lb					*6810	*6810			*6810	3680	(28.2)
4.5 m	kg			*3820	*3820	*3500	3290	*3390	2130	2960	1390	9.15
(15 ft)	lb			*8420	*8420	*7720	7250	*7470	4700	6530	3060	(30.0)
3.0 m	kg	*8220	*8220	*5300	4860	*4210	3040	*3710	2010	2770	1260	9.40
(10 ft)	lb	*18120	*18120	*11680	10710	*9280	6700	*8180	4430	6110	2780	(30.8)
1.5 m	kg	*10330	7790	*6890	4340	*5020	2780	3940	1890	2740	1230	9.37
(5 ft)	lb	*22770	17170	*15190	9570	*11070	6130	8690	4170	6040	2710	(30.7)
Ground	kg	*10560	7370	*8020	4010	5440	2590	3830	1780	2880	1300	9.06
Line	lb	*23280	16250	*17680	8840	11990	5710	8440	3920	6350	2870	(29.7)
-1.5 m	kg	*13510	7340	8470	3880	5340	2500	3790	1750	3260	1510	8.42
(-5 ft)	lb	*29780	16180	18670	8550	11770	5510	8360	3860	7190	3330	(27.6)
-3.0 m	kg	*12660	7480	*8310	3910	5360	2520					
(-10 ft)	lb	*27910	16490	*18320	8620	11820	5560					

(11) 5.39 m (17' 8") boom, 2.92 m (9' 7") arm equipped with 0.80 m³ (SAE heaped) bucket, outrigger down and dozer blade down.

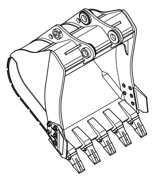
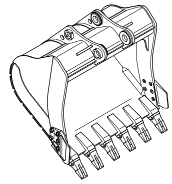
Load point height		Load radius								At max. reach		
		3.0 m (10 ft)		4.5 m (15 ft)		6.0 m (20 ft)		7.5 m (25 ft)		Capacity		Reach
												m (ft)
9.0m	kg									*3060	*3060	6.09
(30 ft)	lb									*6750	*6750	(20.0)
7.5 m	kg					*3150	*3150			*3030	*3030	7.65
(25 ft)	lb					*6940	*6940			*6680	*6680	(25.1)
6.0 m	kg					*3090	*3090			*3090	2950	8.60
(20 ft)	lb					*6810	*6810			*6810	6500	(28.2)
4.5 m	kg			*3820	*3820	*3500	*3500	*3390	*3390	*3200	2570	9.15
(15 ft)	lb			*8420	*8420	*7720	*7720	*7470	*7470	*7050	5670	(30.0)
3.0 m	kg	*8220	*8220	*5300	*5300	*4210	*4210	*3710	3570	*3350	2390	9.40
(10 ft)	lb	*18120	*18120	*11680	*11680	*9280	*9280	*8180	7870	*7390	5270	(30.8)
1.5 m	kg	*10330	*10330	*6890	*6890	*5020	4930	*4140	3430	*3530	2360	9.37
(5 ft)	lb	*22770	*22770	*15190	*15190	*11070	10870	*9130	7560	*7780	5200	(30.7)
Ground	kg	*10560	*10560	*8020	7430	*5700	4720	*4510	3320	*3730	2490	9.06
Line	lb	*23280	*23280	*17680	16380	*12570	10410	*9940	7320	*8220	5490	(29.7)
-1.5 m	kg	*13510	*13510	*8510	7280	*6070	4610	*4670	3270	*3930	2820	8.42
(-5 ft)	lb	*29780	*29780	*18760	16050	*13380	10160	*10300	7210	*8660	6220	(27.6)
-3.0 m	kg	*12660	*12660	*8310	7320	*5940	4640					
(-10 ft)	lb	*27910	*27910	*18320	16140	*13100	10230					

(12) 5.39 m (17' 8") boom, 2.92 m (9' 7") arm equipped with 0.80 m³ (SAE heaped) bucket, outrigger up and dozer blade up.

Load point height		Load radius								At max. reach		
		3.0 m (10 ft)		4.5 m (15 ft)		6.0 m (20 ft)		7.5 m (25 ft)		Capacity		Reach
												m (ft)
9.0m	kg									*3060	*3060	6.09
(30 ft)	lb									*6750	*6750	(20.0)
7.5 m	kg					*3150	*3150			*3030	2200	7.65
(25 ft)	lb					*6940	*6940			*6680	4850	(25.1)
6.0 m	kg					*3090	*3090			*3090	1670	8.60
(20 ft)	lb					*6810	*6810			*6810	3680	(28.2)
4.5 m	kg			*3820	*3820	*3500	3290	*3390	2130	2960	1390	9.15
(15 ft)	lb			*8420	*8420	*7720	7250	*7470	4700	6530	3060	(30.0)
3.0 m	kg	*8220	*8220	*5300	4860	*4210	3040	*3710	2010	2770	1260	9.40
(10 ft)	lb	*18120	*18120	*11680	10710	*9280	6700	*8180	4430	6110	2780	(30.8)
1.5 m	kg	*10330	7790	*6890	4340	*5020	2780	3940	1890	2740	1230	9.37
(5 ft)	lb	*22770	17170	*15190	9570	*11070	6130	8690	4170	6040	2710	(30.7)
Ground	kg	*10560	7370	*8020	4010	5440	2590	3830	1780	2880	1300	9.06
Line	lb	*23280	16250	*17680	8840	11990	5710	8440	3920	6350	2870	(29.7)
-1.5 m	kg	*13510	7340	8470	3880	5340	2500	3790	1750	3260	1510	8.42
(-5 ft)	lb	*29780	16180	18670	8550	11770	5510	8360	3860	7190	3330	(27.6)
-3.0 m	kg	*12660	7480	*8310	3910	5360	2520					
(-10 ft)	lb	*27910	16490	*18320	8620	11820	5560					

6. BUCKET SELECTION GUIDE

1) GENERAL BUCKET

	
0.80, 0.87, 0.92, 1.10, 1.20 m³ SAE heaped bucket	1.34 m³ SAE heaped bucket

Capacity		Width		Weight	Recommendation					
					5.65 m (18' 6") Mono boom			5.39 m (17' 8") adjust boom		
SAE heaped	CECE heaped	Without side cutter	With side cutter		2.0 m arm (6' 7")	2.4 m arm (7' 10")	2.92 m arm (9' 7")	2.0 m arm (6' 7")	2.4 m arm (7' 10")	2.92 m arm (9' 7")
0.80 m^3 (1.05 yd^3)	0.70 m^3 (0.92 yd^3)	1070 mm (42.1")	1160 mm (45.7")	770 kg (1700 lb)	○	○	○	○	○	○
0.87 m^3 (1.14 yd^3)	0.76 m^3 (0.99 yd^3)	1140 mm (44.9")	1230 mm (48.4")	800 kg (1760 lb)	○	○	○	○	○	⊙
0.92 m^3 (1.20 yd^3)	0.80 m^3 (1.05 yd^3)	1190 mm (46.9")	1280 mm (50.4")	820 kg (1810 lb)	○	○	⊙	○	○	⊙
1.10 m^3 (1.44 yd^3)	0.96 m^3 (1.26 yd^3)	1375 mm (54.1")	1465 mm (57.7")	890 kg (1960 lb)	○	⊙	●	⊙	⊙	●
1.20 m^3 (1.57 yd^3)	1.05 m^3 (1.37 yd^3)	1390 mm (54.7")	1480 mm (58.3")	920 kg (2030 lb)	○	⊙		⊙	●	
1.34 m^3 (1.75 yd^3)	1.17 m^3 (1.53 yd^3)	1525 mm (60.0")	1615 mm (63.6")	990 kg (2180 lb)	⊙	●		●		

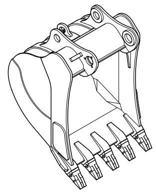
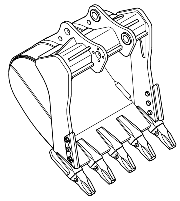
○ Applicable for materials with density of 2000 kgf/m^3 (3370 lbf/yd^3) or less

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

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

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

2) HEAVY DUTY AND ROCK-HEAVY DUTY BUCKET

	
◈ 0.90, 1.05 m³ SAE heaped bucket	◆ 0.87 m³ SAE heaped bucket

Capacity		Width		Weight	Recommendation					
					5.65 m (18' 6") boom			5.39 m (17' 8") adjust boom		
SAE heaped	SAE heaped	Without side cutter	With side cutter		2.0 m arm (6' 7")	2.4 m arm (7' 10")	2.92 m rm (9' 7")	2.0 m arm (6' 7")	2.4 m arm (7' 10")	2.92 m arm (9' 7")
◈ 0.90 m³ (1.18 yd³)	0.79 m³ (1.03 yd³)	1210 mm (47.6")	-	880 kg (1940 lb)	○	○	⊙	○	○	⊙
◈ 1.05 m³ (1.37 yd³)	0.92 m³ (1.20 yd³)	1355 mm (53.3")	-	940 kg (2070 lb)	○	⊙	●	⊙	⊙	●
◆ 0.87 m³ (1.14 yd³)	0.77 m³ (1.01 yd³)	1195 mm (47.0")	-	940 kg (2070 lb)	○	○	⊙	○	○	⊙

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

○ Applicable for materials with density of 2000 kgf/m³ (3370 lbf/yd³) or less

⊙ Applicable for materials with density of 1600 kgf/m³ (2700 lbf/yd³) or less

● Applicable for materials with density of 1100 kgf/m³ (1850 lbf/yd³) or less

7. SPECIFICATIONS FOR MAJOR COMPONENTS

1) ENGINE

Item	Specification
Model	Cummins QSB6.7
Type	4-cycle turbocharged charger air cooled diesel engine
Cooling method	Water cooling
Number of cylinders and arrangement	6 cylinders, in-line
Firing order	1-5-3-6-2-4
Combustion chamber type	Direct injection type
Cylinder bore×stroke	107×124 mm (4.2"×4.9")
Piston displacement	6700 cc (409 cu in)
Compression ratio	17.3 : 1
Rated net horse power (SAE J1349)	174 Hp at 2000 rpm (130 kW at 2000 rpm)
Rated gross horse power (SAE J1995)	183 Hp at 2000 rpm (136 kW at 2000 rpm)
Maximum torque	85.7 kgf·m (620 lbf·ft at 1500 rpm)
Engine oil quantity	23.7 ℓ (6.2 U.S. gal)
Wet weight	520 kg (1150 lb)
High idling speed	2200±50 rpm
Low idling speed	700±100 rpm
Rated fuel consumption	158 g/Hp·hr at 2000 rpm
Starting motor	Denso (24 V-4.8 kW)
Alternator	Denso (24 V-95 A)
Battery	2×12 V×100 Ah

2) MAIN PUMP

Item	Specification
Type	Variable displacement parallel axis piston pumps
Capacity	2×117 cc/rev
Maximum pressure	350 kgf/cm^2 (4980 psi) [380 kgf/cm^2 (5400 psi)]
Rated oil flow	2×234 ℓ/min (61.8 U.S. gpm / 51.5 U.K. gpm)
Rated speed	1700 rpm

[ ] : Power boost

3) GEAR PUMP

Item	Specification
Type	Fixed displacement gear pump single stage
Capacity	15cc/rev
Maximum pressure	40 kgf/cm^2 (570 psi)
Rated oil flow	25.5 ℓ/min (6.7 U.S. gpm/5.6 U.K. gpm)

4) MAIN CONTROL VALVE

Item	Specification
Type	9 spools
Operating method	Hydraulic pilot system
Main relief valve pressure	350 kgf/cm^2 (4980 psi) [380 kgf/cm^2 (5400 psi)]
Overload relief valve pressure	400 kgf/cm^2 (5690 psi)

[ ] : Power boost

5) SWING MOTOR

Item	Specification
Type	Fixed displacement axial piston motor
Capacity	142.8 cc/rev
Relief pressure	265 kgf/cm^2 (3770 psi)
Braking system	Automatic, spring applied hydraulic released
Braking torque	63.3 kgf · m (458 lbf · ft)
Brake release pressure	20.9~35.5 kgf/cm^2 (297~505 psi)
Reduction gear type	2 - stage planetary

6) TRAVEL MOTOR

Item	Specification
Type	Variable displacement bent-axis axial piston motor
Rated pressure	380 kgf/cm^2 (5400 psi)
Counter balance valve	Applied
Capacity	160/61 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/cm² (427~455 psi)
Parking brake	Type		Multi disc brake integrated in transmission
	Maximum braking torque		2937 kgf · m (21240 lbf · ft)
Axle / Wide axle	Type		4 wheel drive with differential
	Gear ratio		16.0
	Brake		Multi disc brake
	Brake pressure		81.6 kgf/cm² (1160 psi)
	Steering pressure		204 kgf/cm² (2900 psi)

8) POWER TRAIN GEAR PUMP

Item	Description
Type	Fixed displacement gear pump (tanedm)
Capacity	19.4 / 8.2 cc / rev [22.4 / 8.2 cc / rev] (engine PTO)
Rated flow	36.2 / 15.3 l / min (9.6 / 4.0 U.S.gpm / 8.0 / 3.4 U.K.gpm) [41.8 / 15.3 l / min (9.6 / 4.0 U.S.gpm / 8.0 / 3.4 U.K.gpm)]

※ [ ] Rotating option

9) REMOTE CONTROL VALVE

Item	Description	Specification
Type		Pressure reducing
Operating pressure	Minimum	6.5 kgf/ cm² (92 psi)
	Maximum	25 kgf/ cm² (360 psi)
Single operation stroke	Lever (1, 3 port)	90 mm (3.5 in)
	Lever (2, 4 port)	130 mm (4.4 in)

10) CYLINDER

Item		Specification
Boom cylinder	Bore dia × Rod dia × Stroke	Ø120 × Ø85 × 1290 mm
	Cushion	Extend only
Arm cylinder	Bore dia × Rod dia × Stroke	Ø140 × Ø100 × 1510 mm
	Cushion	Extend and retract
Bucket cylinder	Bore dia × Rod dia × Stroke	Ø125 × Ø85 × 1055 mm
	Cushion	Extend only
Dozer cylinder	Bore dia × Rod dia × Stroke	Ø125 × Ø75 × 222 mm
	Cushion	Extend only
Outrigger cylinder	Bore dia × Rod dia × Stroke	Ø130 × Ø80 × 427 mm
	Cushion	-
Adjust boom cylinder	Bore dia × Rod dia × Stroke	Ø120 × Ø85 × 1010 mm
	Cushion	Extend only
Adjust cylinder	Bore dia × Rod dia × Stroke	Ø170 × Ø105 × 754 mm
	Cushion	-

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

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

11) BUCKET

Item	Capacity		Tooth quantity	Width	
	SAE heaped	CECE heaped		Without side cutter	With side cutter
Standard	0.80 m^3 (1.05 yd^3)	0.70 m^3 (0.92 yd^3)	5	1070 mm (42.1")	1160 mm (45.7")
Option	0.87 m^3 (1.14 yd^3)	0.76 m^3 (0.99 yd^3)	5	1140 mm (44.9")	1230 mm (48.4")
	0.92 m^3 (1.20 yd^3)	0.80 m^3 (1.05 yd^3)	5	1190 mm (46.9")	1280 mm (50.4")
	1.10 m^3 (1.44 yd^3)	0.96 m^3 (1.26 yd^3)	5	1375 mm (54.1")	1465 mm (57.7")
	1.20 m^3 (1.57 yd^3)	1.05 m^3 (1.37 yd^3)	5	1390 mm (54.7")	1480 mm (58.3")
	1.34 m^3 (1.75 yd^3)	1.17 m^3 (1.53 yd^3)	6	1525 mm (60.0")	1615 mm (63.6")
	◈0.90 m^3 (1.18 yd^3)	0.79 m^3 (1.03 yd^3)	5	1210 mm (47.6")	-
	◈1.05 m^3 (1.37 yd^3)	0.92 m^3 (1.20 yd^3)	5	1355 mm (53.3")	-
	◆0.87 m^3 (1.14 yd^3)	0.77 m^3 (1.01 yd^3)	5	1195 mm (47.0")	-

◈ : Heavy duty bucket

◆ : Rock-Heavy duty bucket

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	23.7 (6.26)	★SAE 5W-40 SAE 30 SAE 10W SAE 10W-30 SAE 15W-40
Transmission case	Engine oil	2.5 (0.66)	
DEF/ AdBlue® tank	Mixture of urea and deionized water	27.0 (7.1)	ISO 22241, High-purity urea + deionized water (32.5:67.5)
Swing drive	Gear oil	6.2 (1.6)	★SAE 75W-90 SAE 80W-90
Front axle	Gear oil	Center : 9.6 (2.5) Hub : 2.5×2 (0.7×2)	SAE 85W-90 LSD or UTTO
Rear axle	Gear oil	Center : 13.5 (3.6) Hub : 2.5×2 (0.7×2)	
Front wide axle	Gear oil	Center : 11.0 (2.9) Hub : 2.5×2 (0.7×2)	SAE 85W-90 LSD or UTTO
Rear wid axle	Gear oil	Center : 15.0 (4.0) Hub : 2.5×2 (0.7×2)	
Hydraulic tank	Hydraulic oil	Tank: 165 (43.6) System: 340 (89.8)	★ISO VG 15 ISO VG 32 ISO VG 46, HBHO VG 46★3 ISO VG 68
Fuel tank	Diesel fuel★1	310 (81.9)	★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	40 (10.6)	Ethylene glycol base permanent type (50 : 50) ★Ethylene glycol base permanent type (60 : 40)

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

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

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

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

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

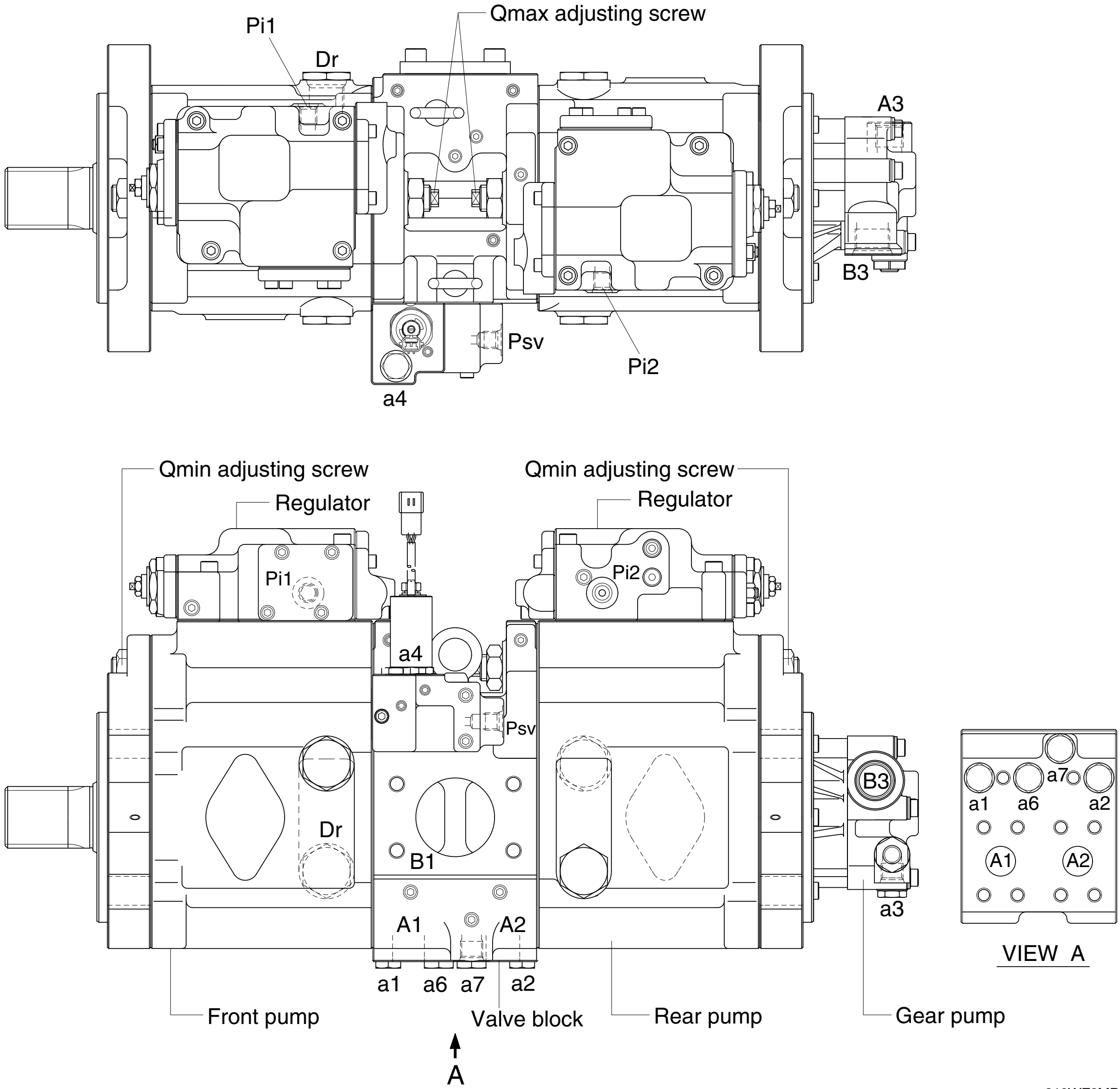
※ For HD Hyundai Construction Equipment genuine lubricating oils and grease for use in regions with extremely low temperatures, please contact HD Hyundai Construction Equipment dealers.

SECTION 2 STRUCTURE AND FUNCTION

GROUP 1 PUMP DEVICE

1. STRUCTURE

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



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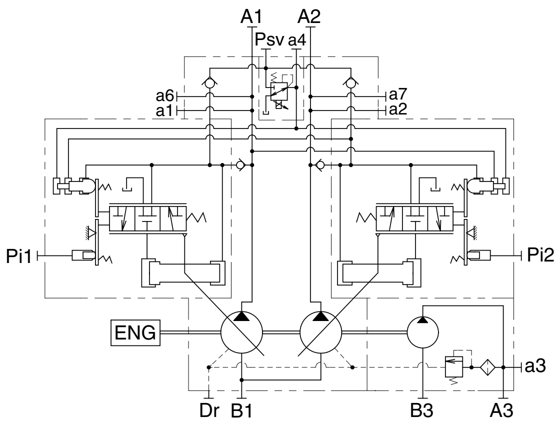
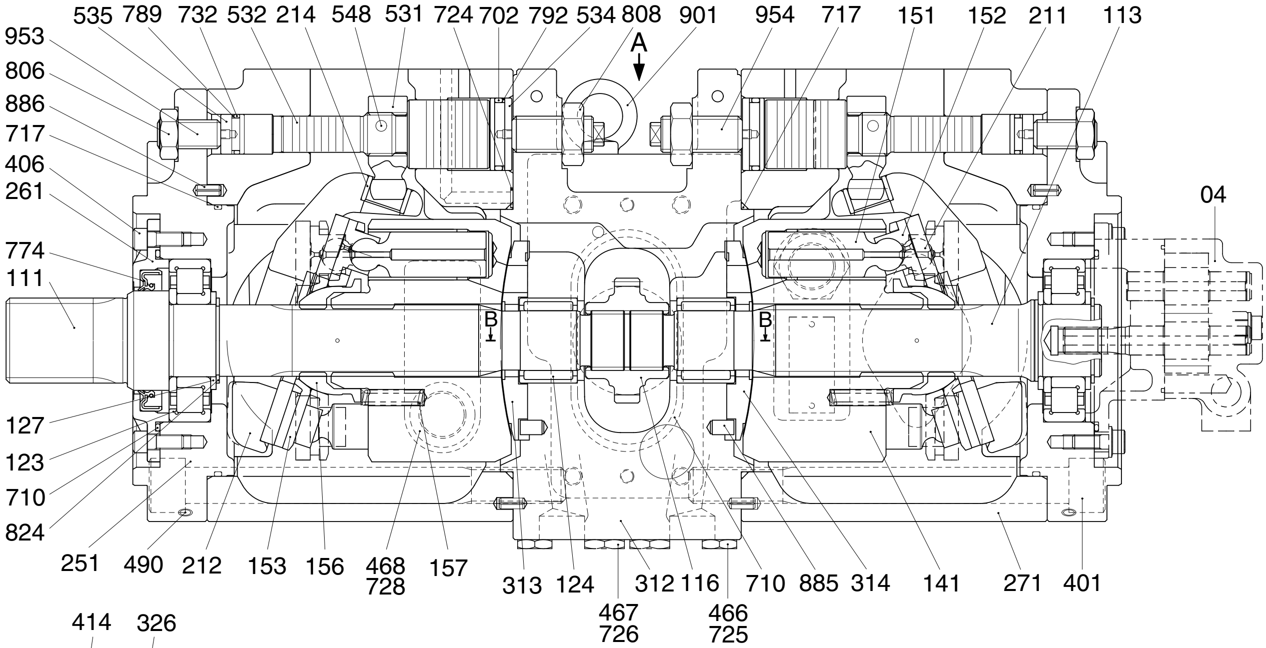


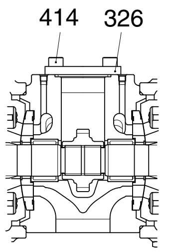
Hydraulic circuit

Port	Port name	Port size
A1,2	Delivery port	SAE6000psi 1"
B1	Suction port	SAE2500psi 2 1/2"
Dr	Drain port	PF 3/4 - 20
Pi1,i2	Pilot port	PF 1/4 - 15
Psv	Servo assist port	PF 1/4 - 15
a1,2,4	Gauge port	PF 1/4 - 15
a6, 7	Gauge port	PF 3/8 - 17
a3	Gauge port	PF 1/4 - 14
A3	Gear pump delivery port	PF 1/2 - 19
B3	Gear pump suction port	PF 3/4 - 20.5

1) **MAIN PUMP** (1/2)

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



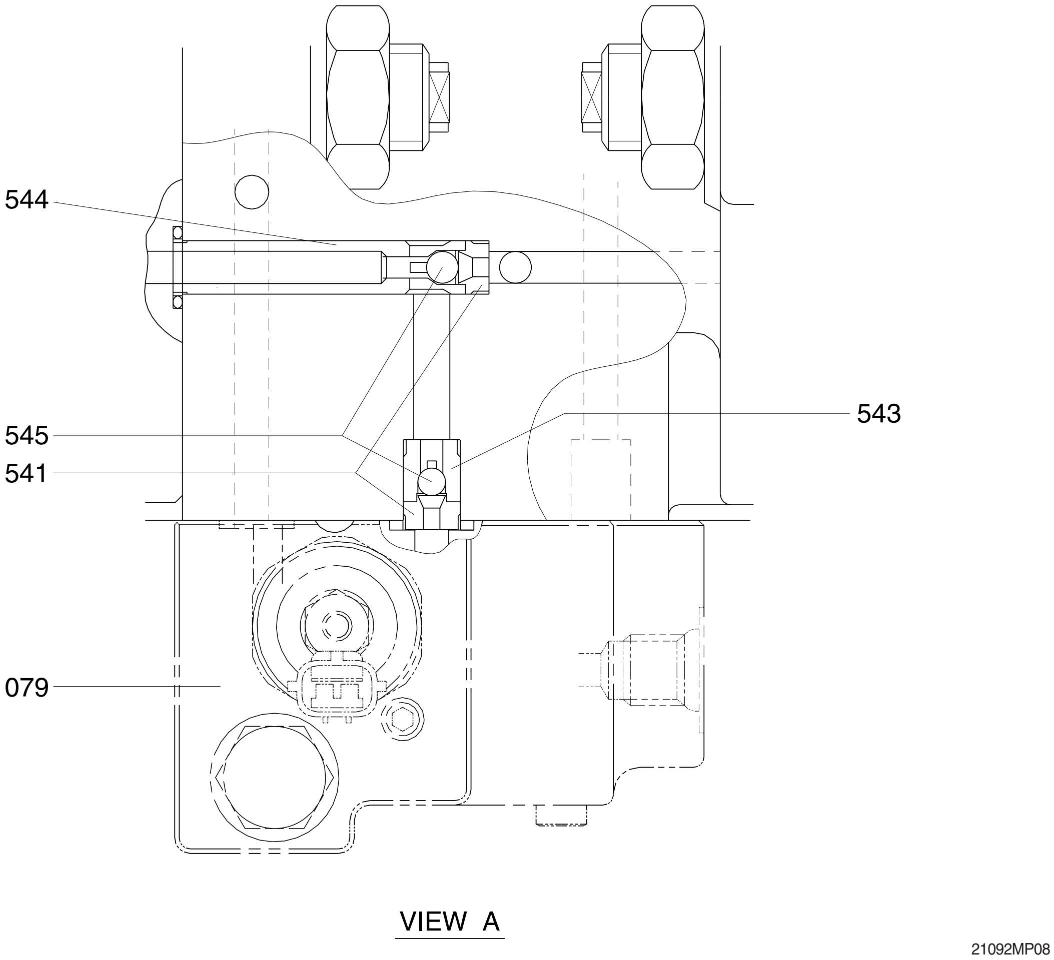


SECTION B-B

21092MP02

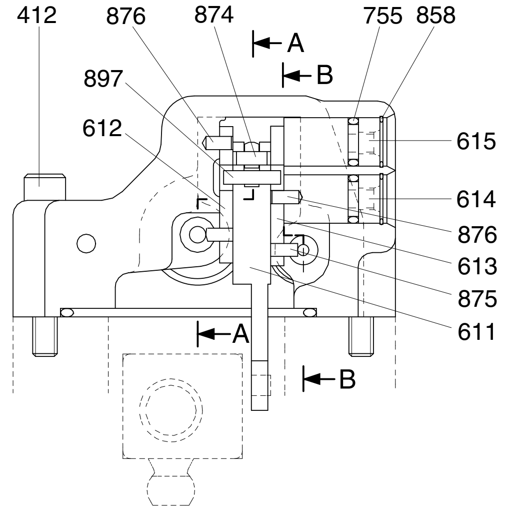
04	Gear pump	271	Pump casing	710	O-ring
111	Drive shaft (F)	312	Valve block	717	O-ring
113	Drive shaft (R)	313	Valve plate (R)	724	O-ring
116	Gear	314	Valve plate (L)	725	O-ring
123	Roller bearing	326	Cover	726	O-ring
124	Needle bearing	401	Hexagon socket bolt	728	O-ring
127	Bearing spacer	406	Hexagon socket bolt	732	O-ring
141	Cylinder block	414	Hexagon socket bolt	774	Oil seal
151	Piston	466	VP Plug	789	Back up ring
152	Shoe	467	VP plug	792	Back up ring
153	Set plate	468	VP Plug	806	Hexagon head nut
156	Bushing	490	Plug	808	Hexagon head nut
157	Cylinder spring	531	Tilting pin	824	Snap ring
211	Shoe plate	532	Servo piston	885	Pin
212	Swash plate	534	Stopper (L)	886	Spring pin
214	Bushing	535	Stopper (S)	901	Eye bolt
251	Support	548	Pin	953	Set screw
261	Seal cover (F)	702	O-ring	954	Set screw

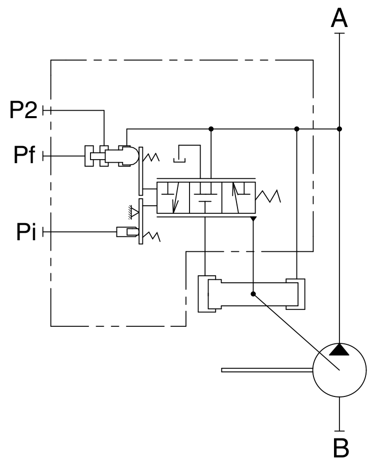
MAIN PUMP (2/2)

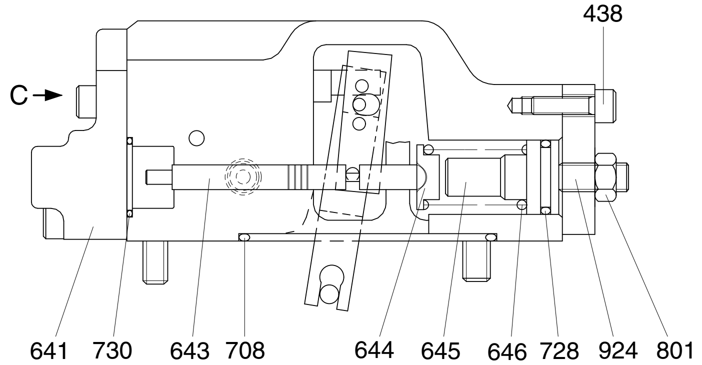


079	Proportional reducing valve	543	Stopper 1	545	Steel ball
541	Seat	544	Stopper 2		

2) REGULATOR (1/2)

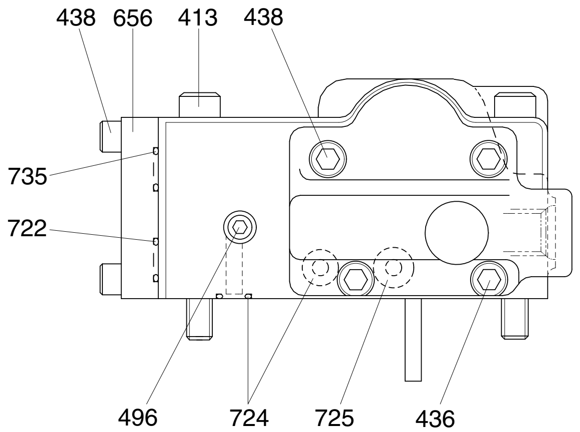






SECTION B-B

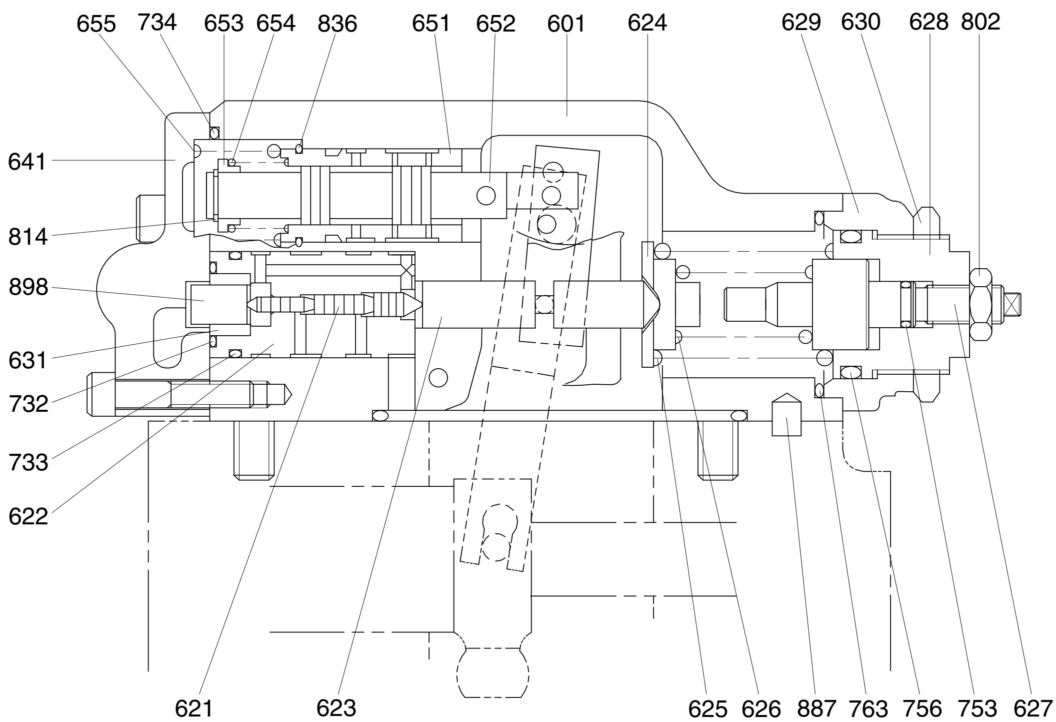
210WF2MP03



VIEW C

Port	Port name	Port size
A	Delivery port	1"
B	Suction port	2 1/2"
Pi	Pilot port	PF 1/4-15
Pf	Power shift port	-
P2	Companion delivery port	-

REGULATOR (2/2)

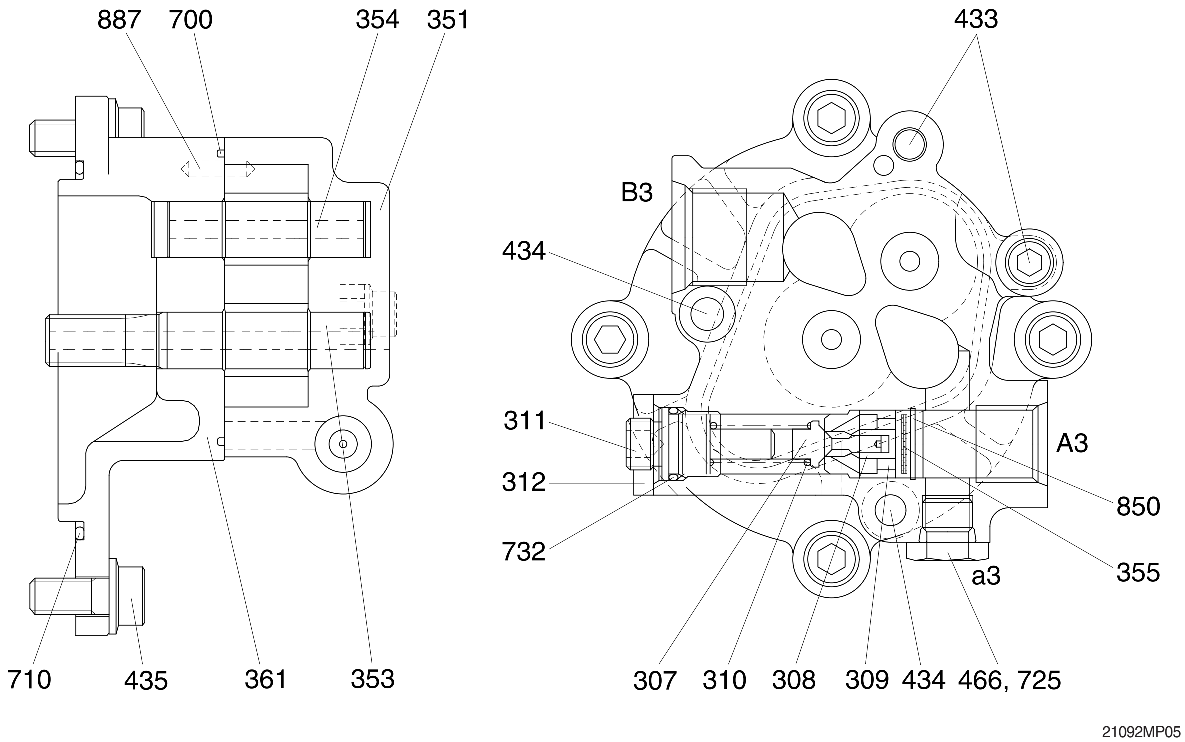


SECTION A-A

210WF2MP04

412	Hexagon socket screw	630	Lock nut	733	O-ring
413	Hexagon socket screw	631	Sleeve, pf	734	O-ring
436	Hexagon socket screw	641	Pilot cover	735	O-ring
438	Hexagon socket screw	643	Pilot piston	753	O-ring
496	Plug	644	Spring seat (Q)	755	O-ring
601	Casing	645	Adjust stem (Q)	756	O-ring
611	Feed back lever	646	Pilot spring	763	O-ring
612	Lever (1)	651	Sleeve	801	Nut
613	Lever (2)	652	Spool	802	Nut
614	Fulcrum plug	653	Spring seat	814	Snap ring
615	Adjust plug	654	Return spring	836	Snap ring
621	Compensator piston	655	Set spring	858	Snap ring
622	Piston case	656	Block cover	874	Pin
623	Compensator rod	708	O-ring	875	Pin
624	Spring seat (C)	722	O-ring	876	Pin
625	Outer spring	724	O-ring	887	Pin
626	Inner spring	725	O-ring	897	Pin
627	Adjust stem (C)	728	O-ring	898	Pin
628	Adjust screw (C)	730	O-ring	924	Set screw
629	Cover (C)	732	O-ring		

3) GEAR PUMP



307	Poppet	353	Drive gear	466	Plug
308	Seat	354	Driven gear	700	Ring
309	Spring seat	355	Filter	710	O-ring
310	Spring	361	Front case	725	O-ring
311	Screw	433	Flange socket	732	O-ring
312	Nut	434	Flange socket	850	Snap ring
351	Gear case	435	Flange socket	887	Pin

2. FUNCTION

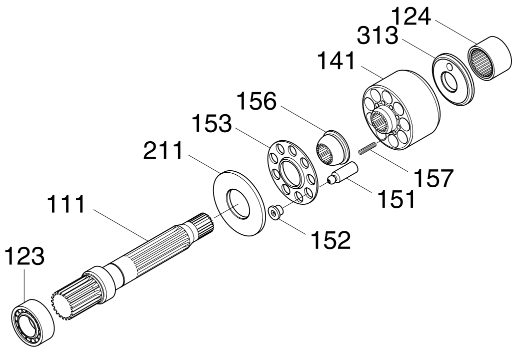
1) MAIN PUMP

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

(1) Rotary group

The rotary group consists of drive shaft (F) (111), cylinder block (141), piston shoes (151,152), set plate (153), spherical bushing (156) and cylinder spring (157). The drive shaft is supported by bearing (123,124) at its both ends.

The shoe is caulked to the piston to from a spherical coupling. It has a pocket to relieve thrust force generated by loading pressure and the take hydraulic balance so that it slides lightly over the shoe plate (211). The sub group composed by a piston and a shoe is pressed against the shoe plate by the action of the cylinder spring via a retainer and a spherical bush. Similarly, the cylinder block is pressed against valve plate (313) by the action of the cylinder spring.



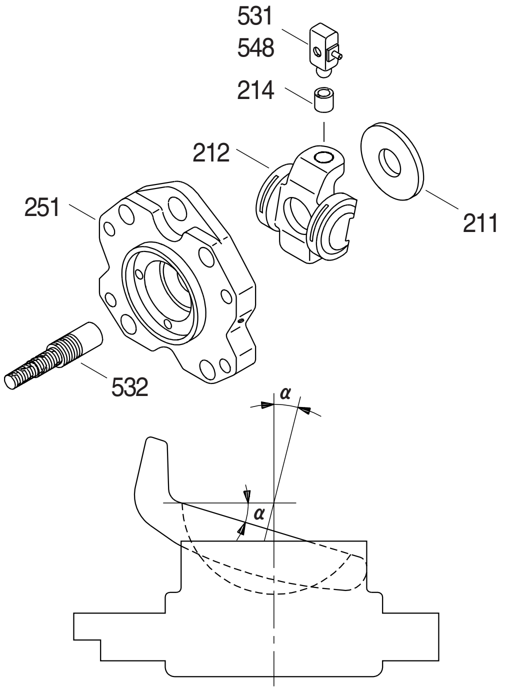
21092MP06

(2) Swash plate group

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

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

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



2-7

(3) Valve block group

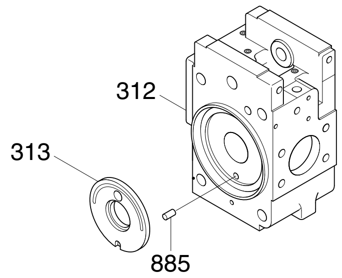
The valve block group consists of valve block (312), valve plate (313) and valve plate pin(885).

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

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

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

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



21092MP07

2) REGULATOR

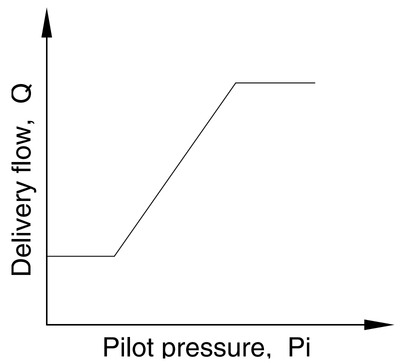
Regulator consists of the positive flow control, constant horse power control and variable horse power control function.

(1) Positive flow control

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

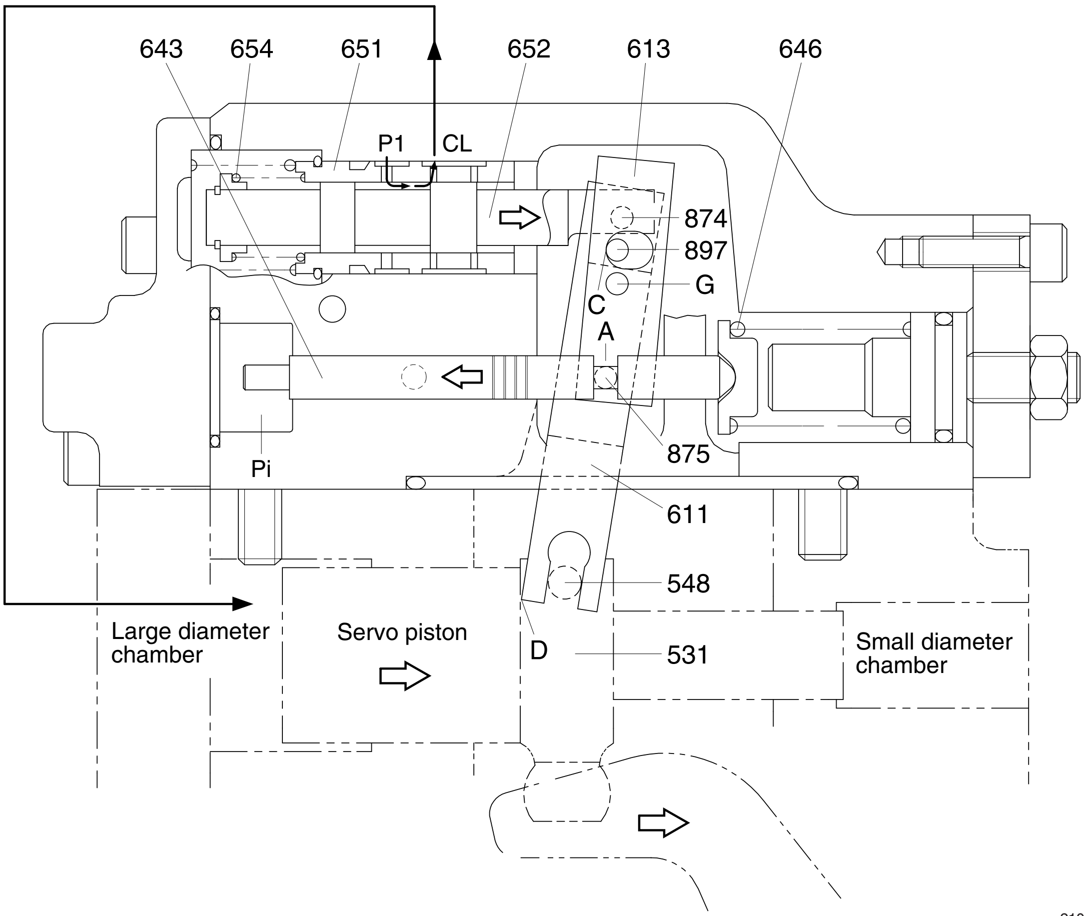
This regulator is of the positive flow control in which the delivery flow Q increases as the pilot pressure Pi rises.

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



21092MP10

① Flow reducing function



21092MP12

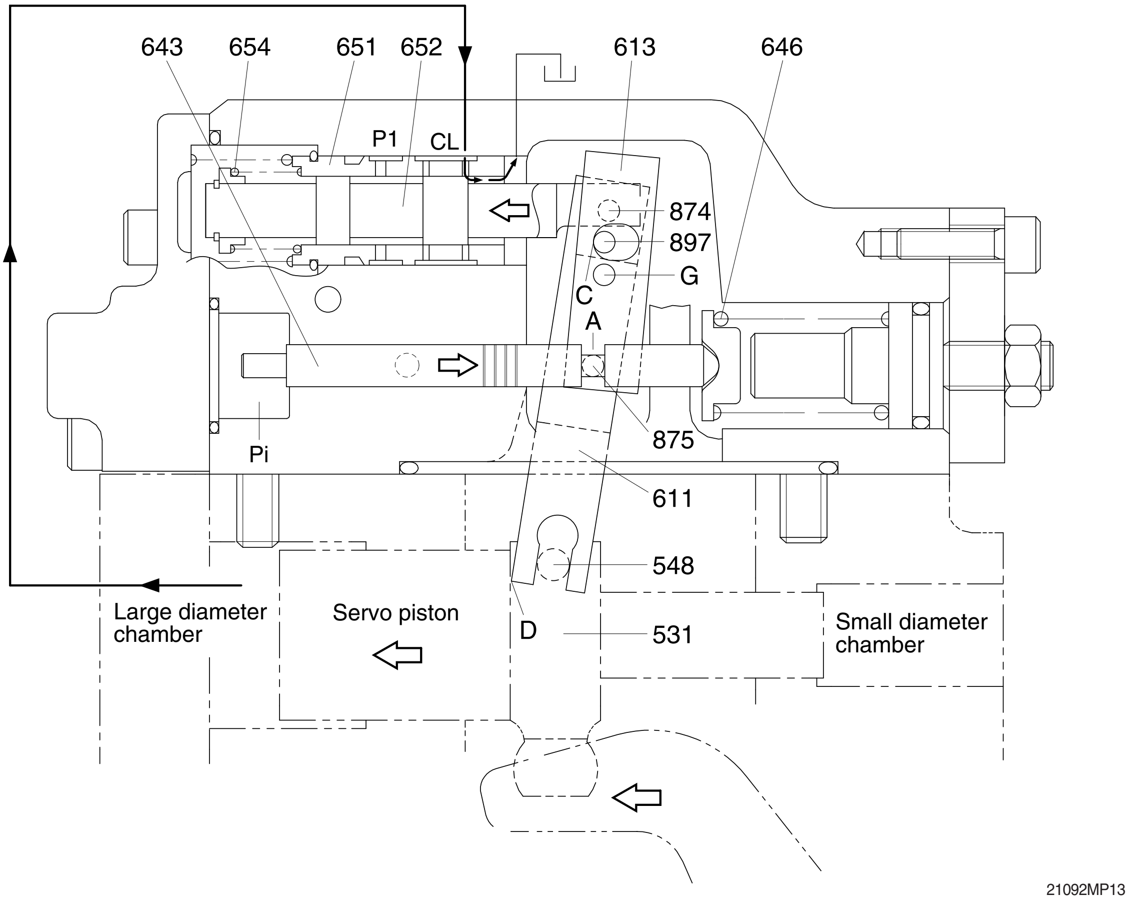
As the pilot pressure Pi decreases, the pilot piston (643) moves to the left by the action of the pilot spring (646) and causes lever 2 (613) to rotate around the fulcrum of point G. Since the pin (897) is pressed against the large hole section (C) of lever 2 by the action of the return spring (654) via the spool (652), pin (874), and feedback lever (611), the feedback lever rotates around the fulcrum of point D as lever 2 rotates, and shifts the spool to the right.

The movement of the spool causes the delivery pressure P1 to connect to port CL through the spool and to be admitted to the large diameter section of the servo piston. The delivery pressure P1 that is constantly admitted to the small diameter section of the servo piston moves the servo piston to the right due to the area difference, resulting in decrease of the tilting angle.

When the servo piston moves to the right, point D also moves to the right. The spool is fitted with the return spring (654) and is tensioned to the left at all times, and so the pin (897) is pressed against the large hole section (C) of lever 2.

Therefore, as point D moves, the feedback lever rotates around the fulcrum of point C, and the spool is shifted to the left. This causes the opening between the sleeve (651) and spool (652) to close slowly, and the servo piston comes to a complete stop when it closes completely.

② Flow increasing function



As the pilot pressure Pi rises, the pilot piston (643) moves to the right to a position where the force of the pilot spring (646) balances with the hydraulic force.

The groove (A) in the pilot piston is fitted with the pin (875) that is fixed to lever 2 (613). Therefore, when the pilot piston moves, lever 2 rotates around the fulcrum of point G [fixed by the fulcrum plug (614) and pin (875)]. Since the large hole section (C) of lever 2 contains a protruding pin (897) fixed to the feedback lever (611), the pin (897) moves to the left as lever 2 rotates.

Port CL opens a way to the tank port as the spool moves. This deprives the large diameter section of the servo piston of pressure, and shifts the servo piston to the left by the discharge pressure P1 in the small diameter section, resulting in an increase in the flow rate.

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

Adjustment of flow control characteristic

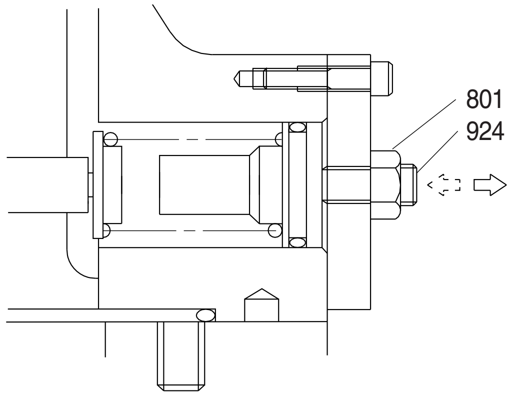
The flow control characteristic can be adjusted with the adjusting screw.

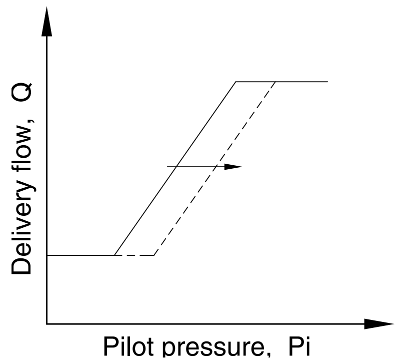
Adjust it by loosening the hexagon nut (801) and by tightening (or loosening) the hexagonal socket head screw (924).

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

※ Adjusting value

Speed	Adjustment of flow control characteristic		
	Tightening amount of adjusting screw(924)	Flow control starting pressure change amount	Flow change amount
(min $^{-1}$)	(Turn)	(kgf/cm^2)	(l /min)
1900	+1/4	+1.1	-17.6





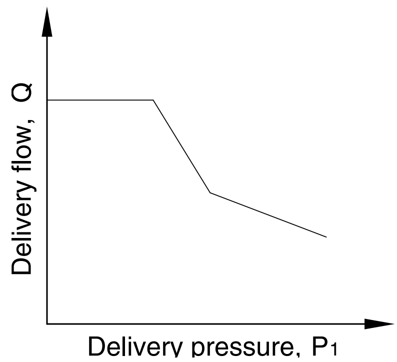
21092MP11

(2) Constant horsepower control

The regulator decreases the pump tilting angle (delivery flow) automatically to limit the input torque within a certain value with a rise in the delivery pressure P1 of the self pump.
(The input horsepower is constant when the speed is constant.)
Since the regulator is of the simultaneous constant horsepower type that operates by the sum of load pressures of the two pumps in the tandem double-pump system, the prime mover is automatically prevented from being overloaded, irrespective of the load condition of the two pumps, when horsepower control is under way.
Since this regulator is of the simultaneous constant horsepower type, it controls the tilting angles (displacement volumes) of the two pumps to the same value as represented by the following equation :

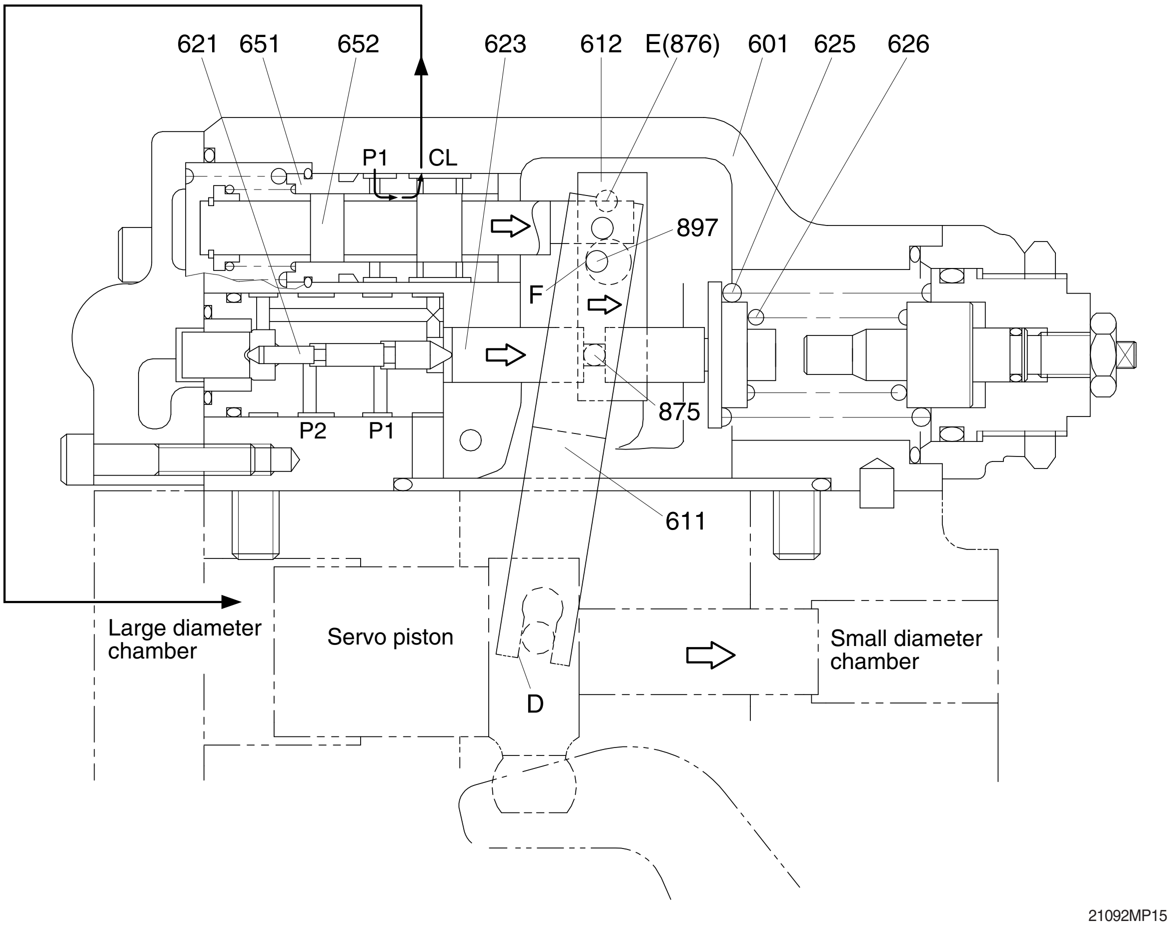
$Tin = P1 \times q/2 + P2 \times q/2$
$= (P1+P2) \times q/2$

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



21092MP19

① Overload preventive function

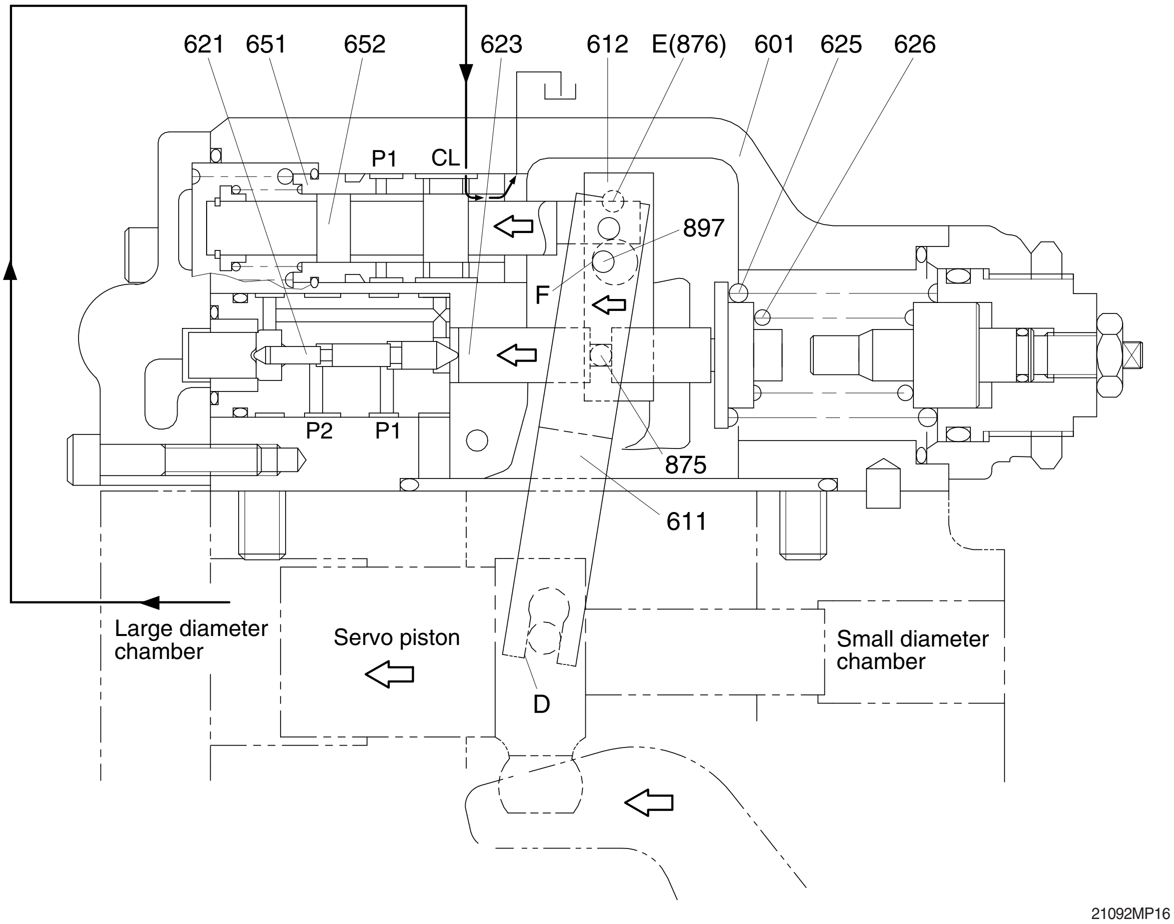


When the self pump delivery pressure P1 rises, it acts on the stepped part of the compensating piston (621). It presses the compensating rod (623) to the right till the force of the outer spring (625) and inner spring (626) balances with the hydraulic force. The movement of the compensating rod is transmitted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

Lever 1 rotates around the pin (876) (E) fixed to the casing (601).

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

② Flow reset function



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

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

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

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

As mentioned above, flow control and horsepower control tilting angle commands are transmitted to the feedback lever and spool via the large-hole sections (C & F) of levers 1 and 2. However, since sections C and F have the pins (Ø4) protruding from the large hole (Ø8), only the lever lessening the tilting angle contacts the pin (897) ; the hole (Ø8) in the lever of a larger tilting angle command is freed without contacting the pin (897). Such a mechanical selection method permits preference of the lower tilting angle command of the flow control and horsepower control.

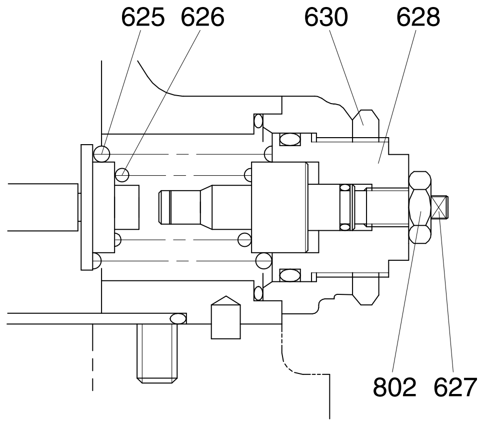
Adjustment of input horsepower

④

a. **Adjustment of outer spring**

Adjust it by loosening the hexagon nut (630) and by tightening (or loosening) the adjusting screw C (628). Tightening the screw shifts the control chart to the right and increases the input horsepower as shown in the figure.

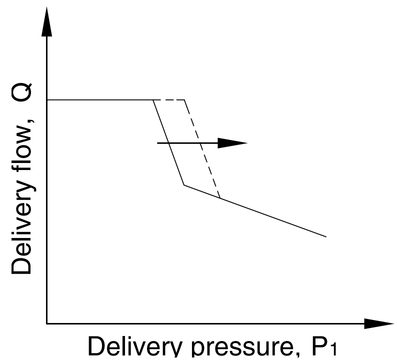
Since turning the adjusting screw C by N turns changes the setting of the inner spring (626), return the adjusting stem C (627) by N×A turns at first.(A=1.78)



2107A2MP07

※ **Adjusting value**

Speed	Adjustment of input horsepower		
	Tightening amount of adjusting screw(627)	Compensating control starting pressure change amount	Input torque change amount
(min $^{-1}$)	(Turn)	(kgf/cm²)	(kgf·m)
1900	+1/4	+15.9	+4.0



21092MP17

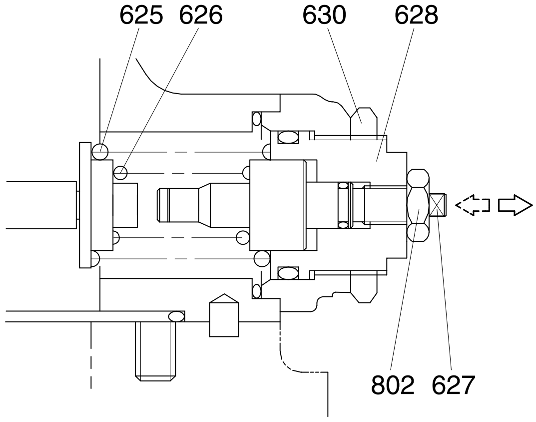
b. **Adjustment of inner spring**

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

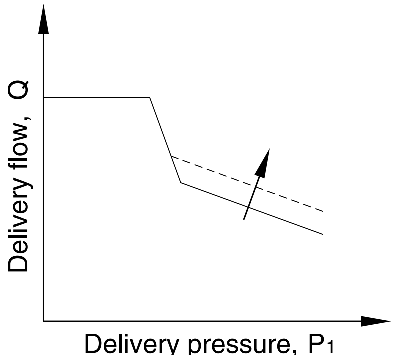
Tightening the screw increases the flow and then the input horsepower as shown in the figure.

※ Adjusting valve

Speed	Adjustment of input horsepower		
	Tightening amount of adjusting stem (C) (627)	Flow change amount	Input torque change amount
(min^{-1})	(Turn)	(l/min)	(kgf·m)
1900	+1/4	+11.3	+4.7



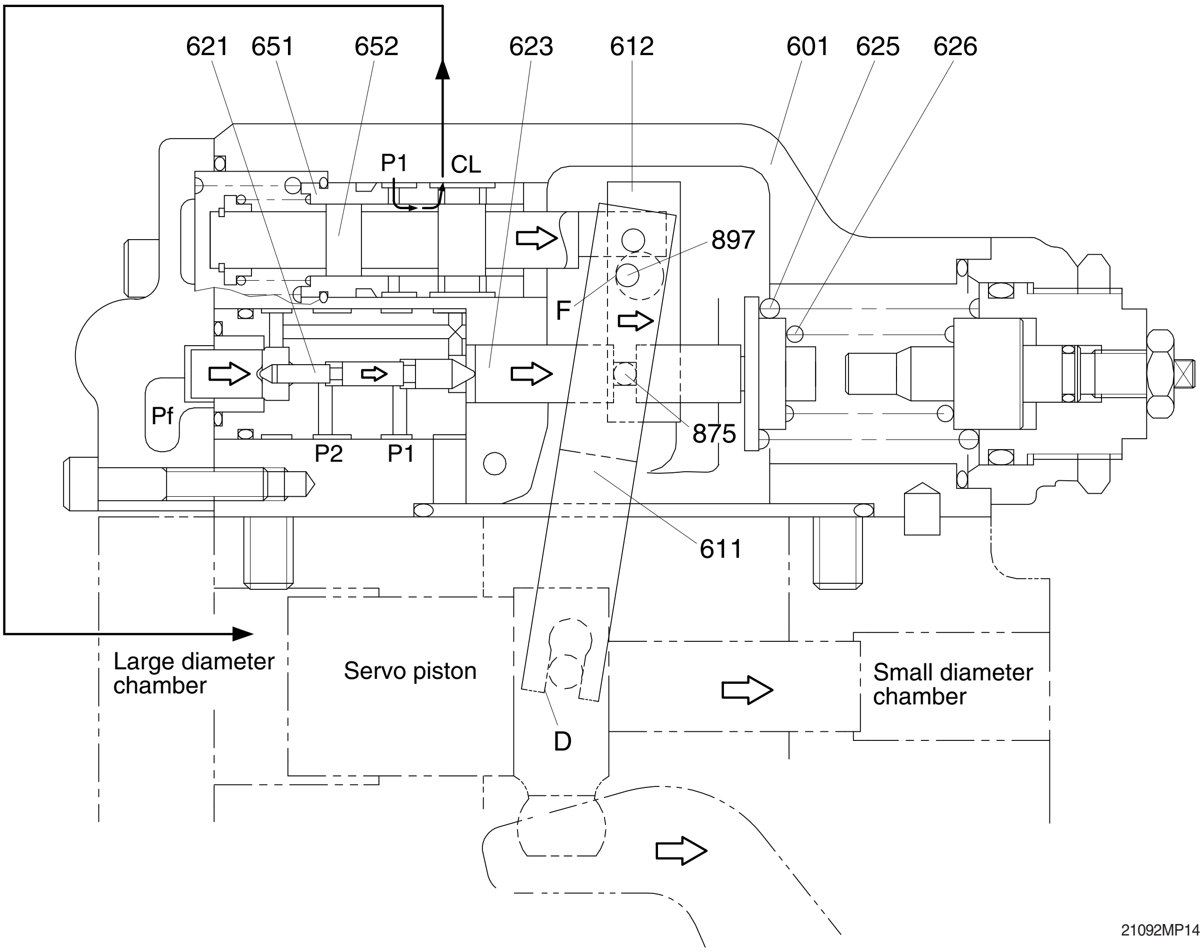
2107A2MP08



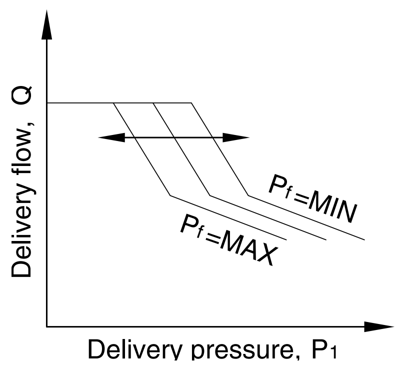
21092MP18

(3) Variable horsepower control

Variable horsepower control can be obtained by supplying pilot pressure.



21092MP14



21092MP20

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

Only one proportional pressure reducing valve is provided.

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

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

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

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

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

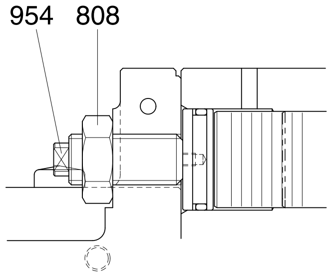
(4) Adjustment of maximum and minimum flows

The regulator can adjust the maximum and minimum flows with the adjusting screws.

① Adjustment of maximum flow

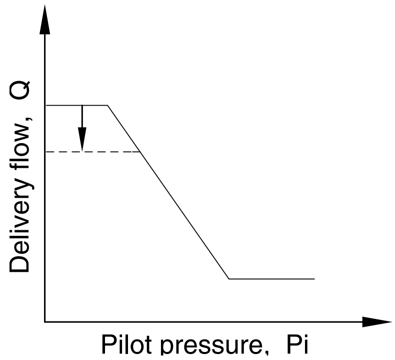
Adjust it by loosening the hexagon nut (808) and by tightening (or loosening) the set screw (954).

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



21092MP23

Speed (min -1)	Adjustment of max flow	
	Tightening amount of adjusting screw (954) (Turn)	Flow change amount (l /min)
1900	+1/4	-5.5

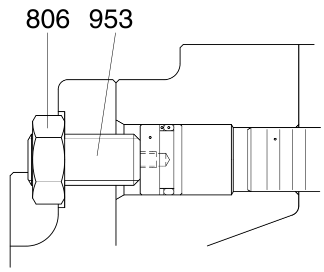


21092MP21

② Adjustment of minimum flow

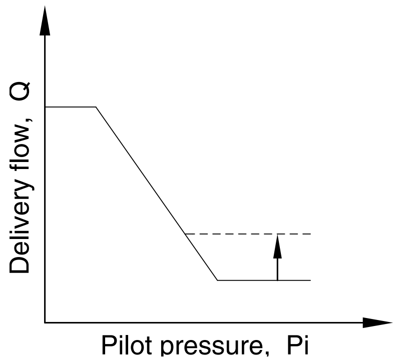
Adjust it by loosening the hexagon nut (806) and by tightening (or loosening) the hexagonal socket head set screw (953). Similarly to the adjustment of the maximum flow, other characteristics are not changed.

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



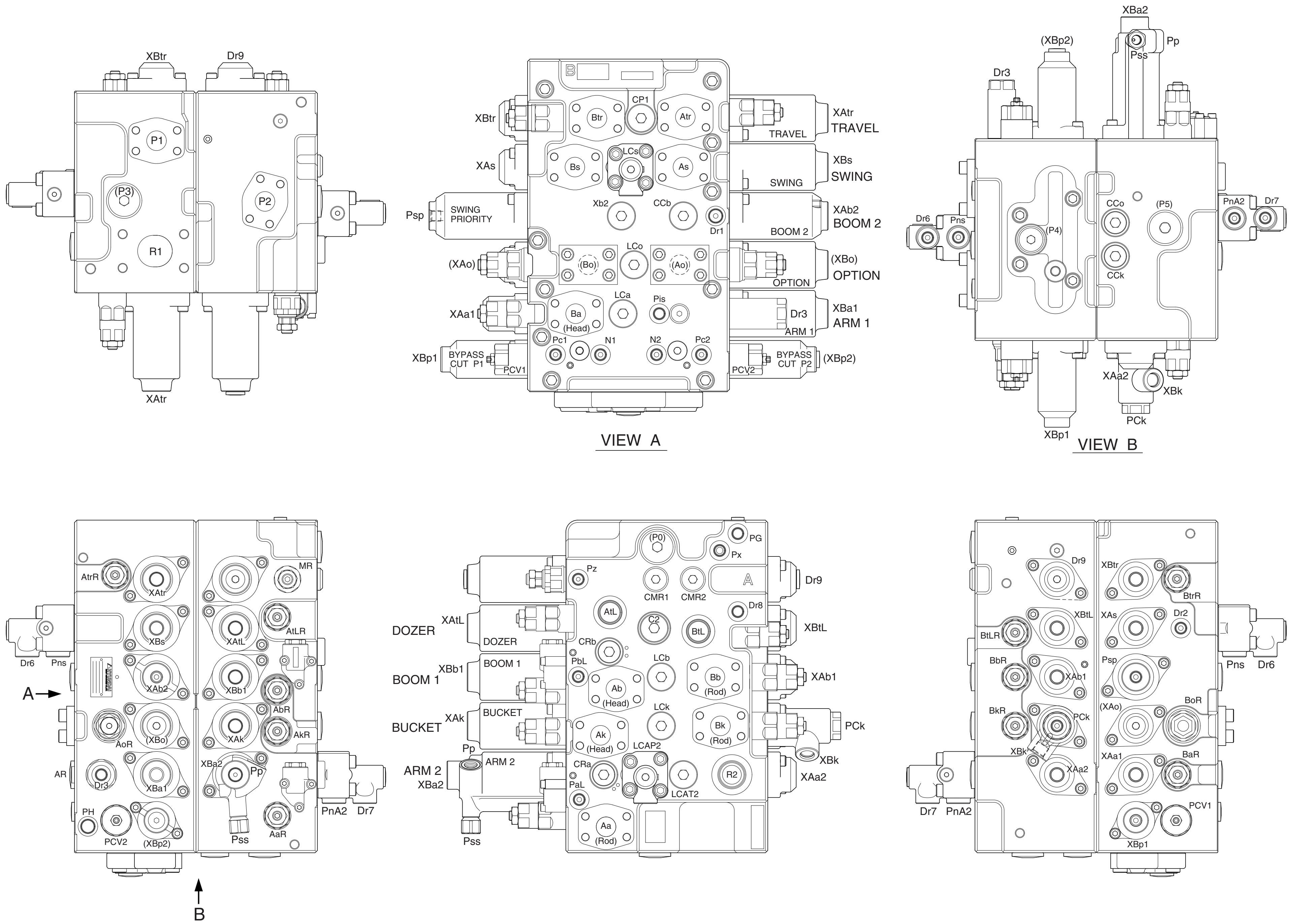
21092MP24

Speed (min -1)	Adjustment of min flow	
	Tightening amount of adjusting screw (953) (Turn)	Flow change amount (l /min)
1900	+1/4	+4.4



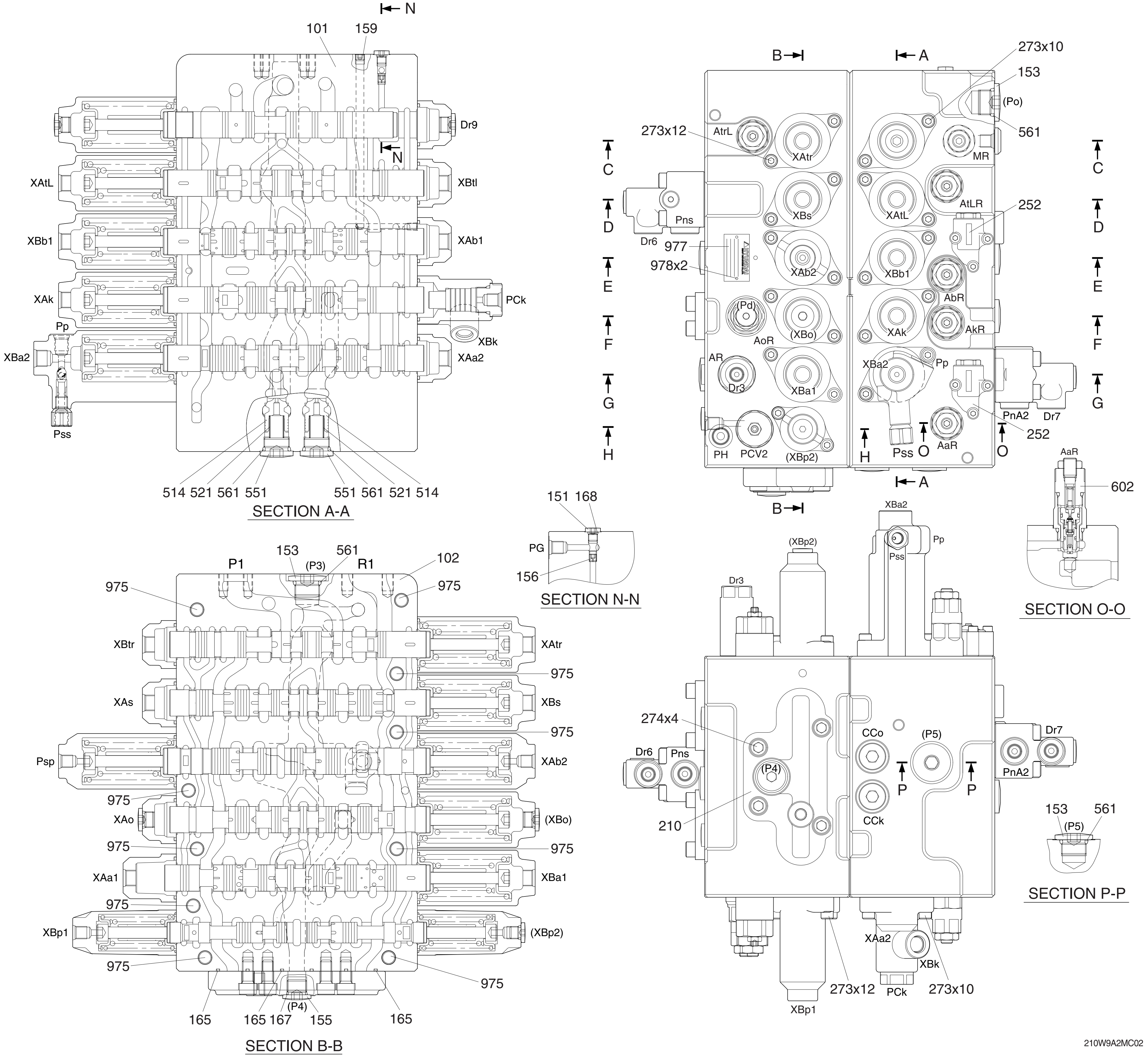
21092MP22

1. STRUCTURE

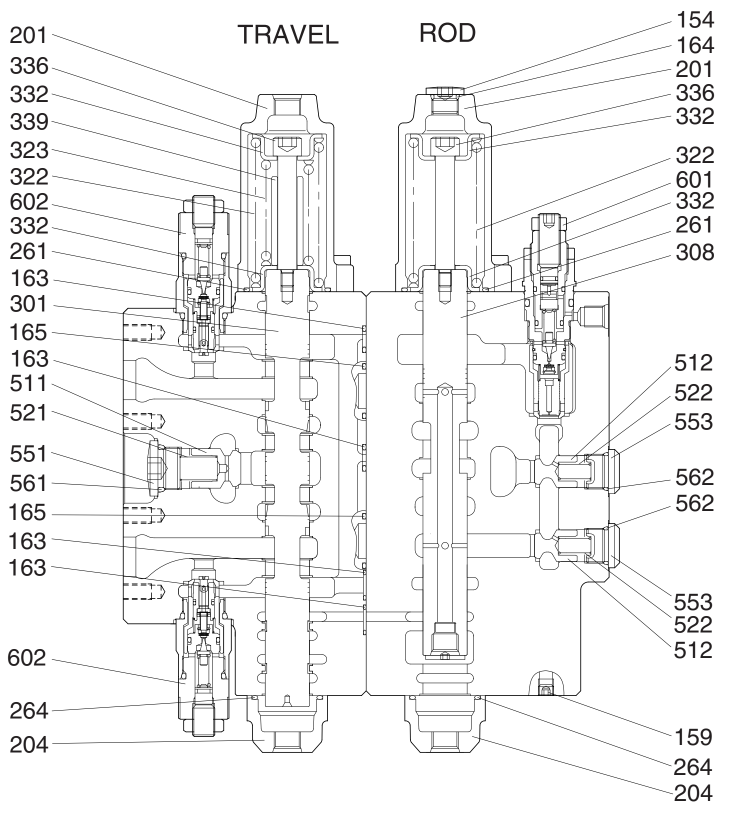


210WF2MC01

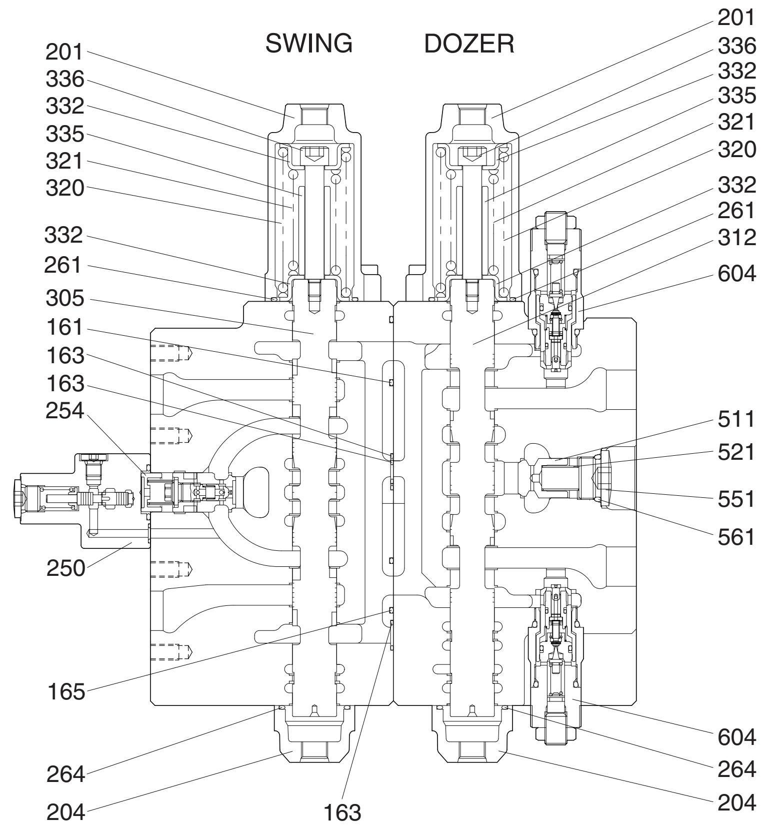
Mark	Port name	Port size	Tightening torque
R2	Make up port for swing	PF 1	20~25 kgf · m (115~180 lbf · ft)
XAtr	Travel forward pilot port	PF 3/8	7~8 kgf · m (50.6~57.8 lbf · ft)
XBtr	Travel reverse pilot port		
(XAo)	Optional pilot port		
(XBo)	Optional pilot port		
XAk	Bucket in pilot port		
XBk	Bucket out pilot port		
XAb1	Boom up pilot port		
XBb1	Boom down pilot port		
XAa2	Arm out confluence pilot port		
XBa2	Arm in confluence pilot port		
XAtL	Dozer down pilot port		
XBtL	Dozer up pilot port		
XAs	Swing right pilot port		
XBs	Swing left pilot port		
XAa1	Arm out pilot port		
XBa1	Arm in pilot port		
PH	Pilot pressure port		
Dr1	Drain port		
Dr9	Drain port		
Pw	Pressure port for auto idle signal	PF 1/4	3.5~3.9 kgf · m (25.3~28.2 lbf · ft)
Dr8	Drain port		
Pz	Main relief set pressure up pilot pressure port		
PG	Pilot pressure port		
Dr2	Drain port		
Dr3	Drain port		
Dr6	Drain port		
Dr7	Drain port		
Pns	Swing logic valve pilot port		
PaL	Lock valve pilot port (arm rod side)		
PbL	Lock valve pilot port (boom head side)		
XAb2	Boom up confluence pilot port		
Psp	Swing priority pilot port		
XBp1	Bypass cut spool pilot port (P1 side)		
(XBp2)	Bypass cut spool pilot port (P2 side)		
Pc1	Posi-nega pressure port (P1 side)		
Pc2	Posi-nega pressure port (P2 side)		
PCk	Bucket in stroke limiter pilot port		
Pis	Arm regeneration cut pilot port		
(N1)	Nega-con pressure port (P1 side)		
(N2)	Nega-con pressure port (P2 side)		
PnA2	Arm2 logic valve pilot port		
Pss	Shuttle-swing pilot pressure port		
Pp	Shuttle-swing or arm in pressure port		
Atr	Travel forward port	M10	5~6.6 kgf · m (36.1~47.7 lbf · ft)
Btr	Travel reverse port		
(Ao)	Optional port		
(Bo)	Optional port		
Ak	Bucket cylinder head side port		
Bk	Bucket cylinder rod side port		
Ab	Boom cylinder head side port		
Bb	Boom cylinder rod side port		
As	Swing motor right port		
Bs	Swing motor left port		
Aa	Arm cylinder rod side port		
Ba	Arm cylinder head side port		
P1	Pump port (P1 side)		
P2	Pump port (P2 side)		
R1	Return port	M12	8.5~11.2 kgf · m (61.5~81.1 lbf · ft)
AtL	Dozer cylinder head side port	PF 3/4	15.3~18.4 kgf · m (110.6~133 lbf · ft)
BtL	Dozer cylinder rod side port		
(P0)	Quick clamp solenoid valve supply port		
(P3)	-		
(P5)	-		
(P4)	-	PF 1/2	10~12.2 kgf · m (72.3~88.2 lbf · ft)



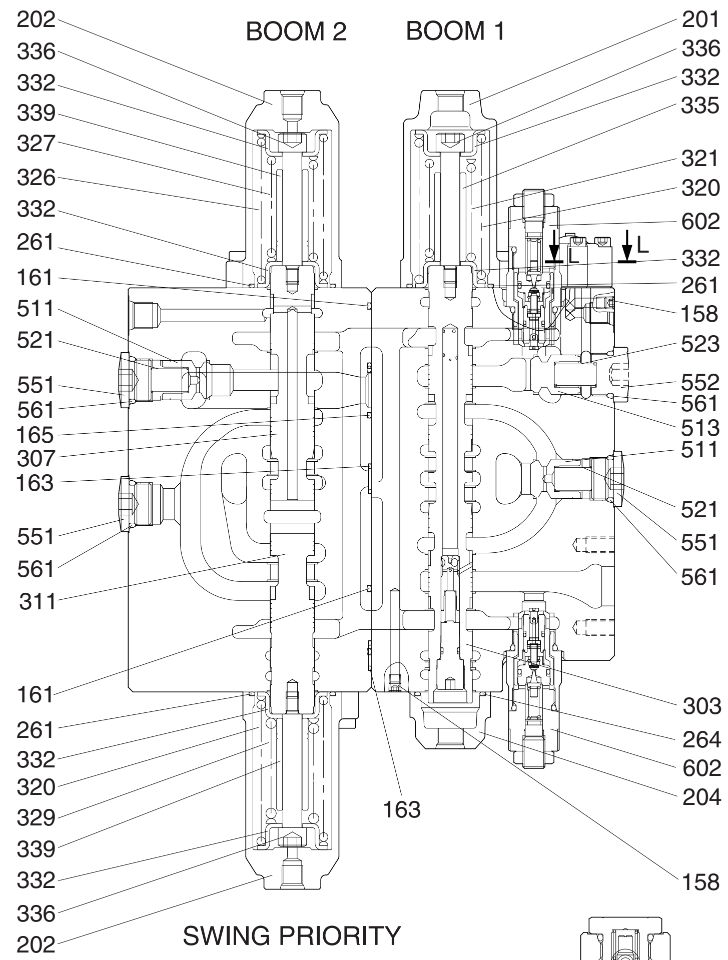
101	P2 housing	306	Arm 2 spool
102	P1 housing	307	Boom 2 spool
151	Plug	308	Rod spool
152	Plug	309	Spool (option)
153	Plug	310	Bypass cut spool
154	Plug	311	Swing priority spool
155	Plug	312	Dozer spool
156	Orifice	320	Spring
158	Plug	321	Spring
159	Plug	322	Spring
161	O-ring	323	Spring
162	O-ring	326	Spring
163	O-ring	327	Spring
164	O-ring	329	Spring
165	O-ring	331	Spring seat
167	O-ring	332	Spring seat
168	O-ring	333	Bolt
201	Cover	335	Stopper
202	Cover	336	Bolt
203	Cover	337	Stopper
204	Cover	339	Stopper
205	Cover	370	Spring
206	Cover	371	Spring
207	Cover	511	Poppet
209	Flange	512	Poppet
210	Plate	513	Poppet
211	Piston	514	Poppet
250	Logic control valve assy	521	Spring
251	Logic control valve assy	522	Spring
252	Lock valve selector sub assy	523	Spring
254	Swing Logic poppet assy	551	Plug
256	Arm 2 Logic poppet assy	552	Plug
257	Arm regeneration cut sub assy	553	Plug
258	Plug	561	O-ring
259	Plug	562	O-ring
261	O-ring	601	Main relief valve assy
262	O-ring	602	Port relief valve assy
264	O-ring	603	Port relief valve assy
273	Socket bolt	604	Port relief valve assy
274	Socket bolt	611	Posi-nega conversion valve assy
301	Travel spool	971	Screw
302	Arm 1 spool sub assy	975	Screw
303	Boom 1 spool sub assy	977	Name plate
304	Bucket spool	978	Pin
305	Swing spool		



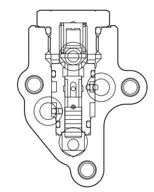
SECTION C-C

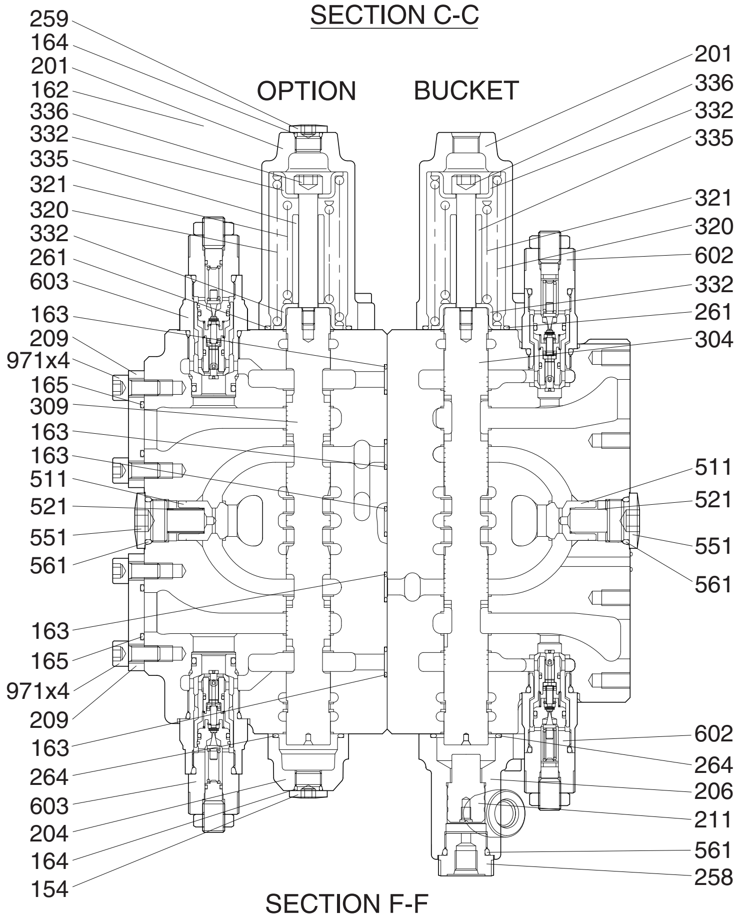


SECTION D-D

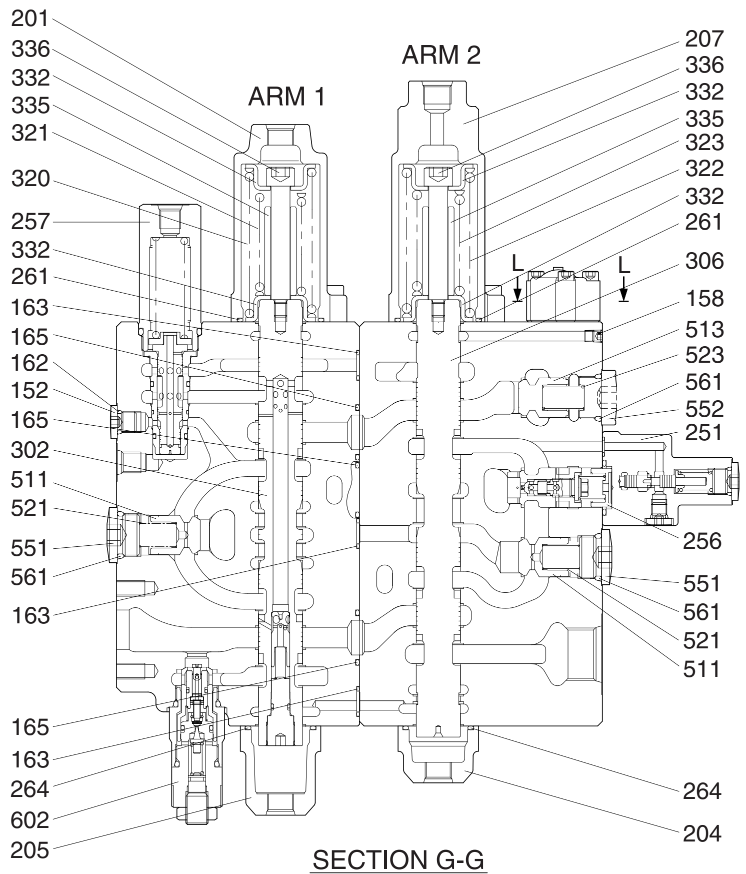


SECTION E-E

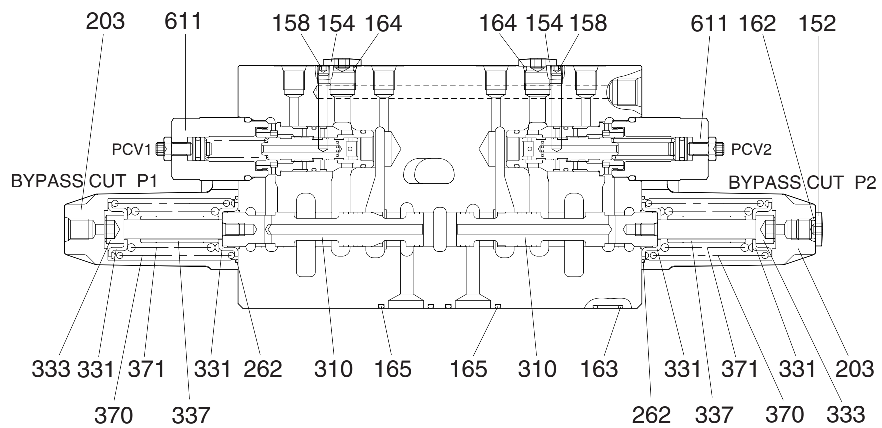

SECTION L-L



SECTION F-F



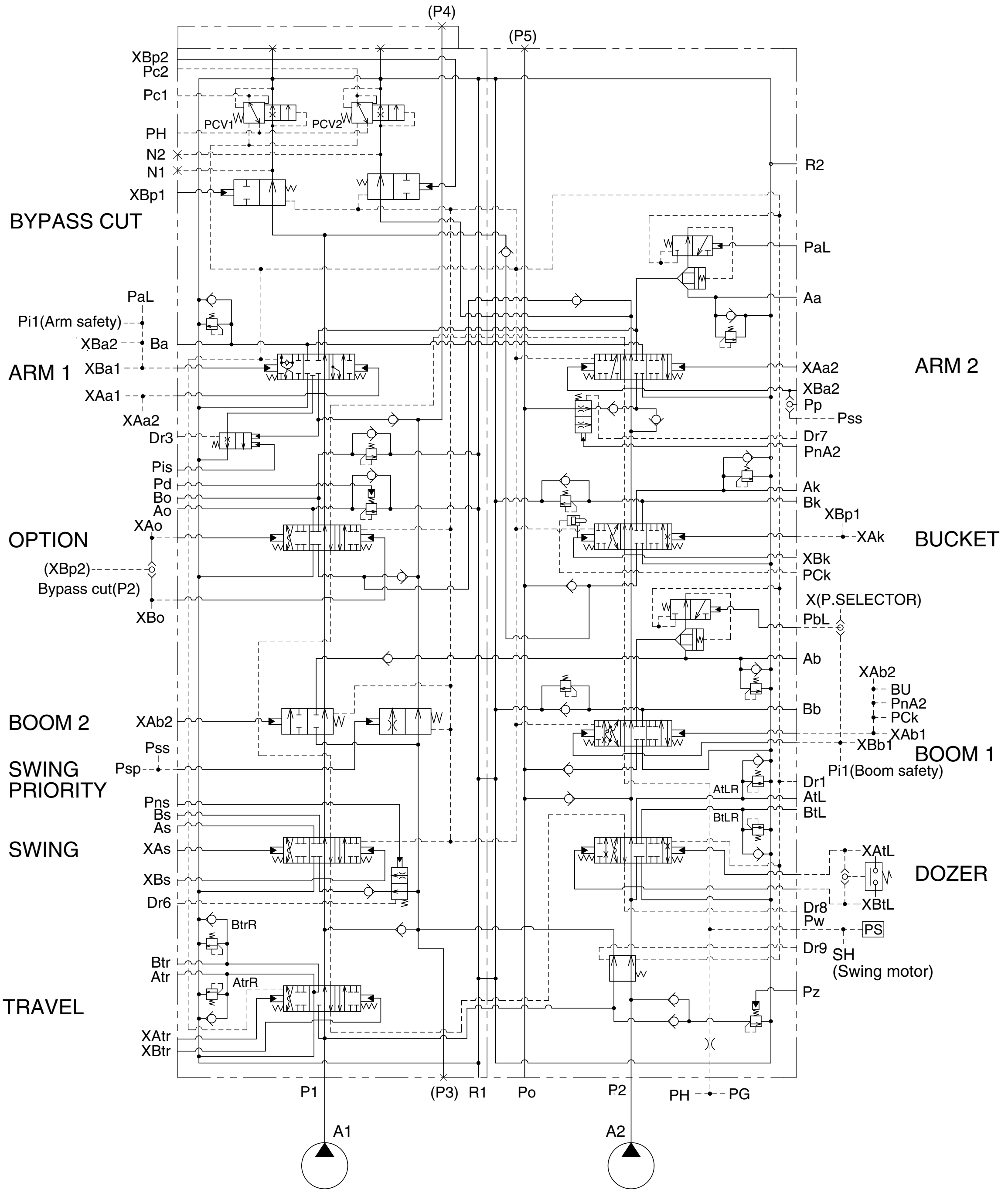
SECTION G-G



SECTION H-H

210WF2MC03

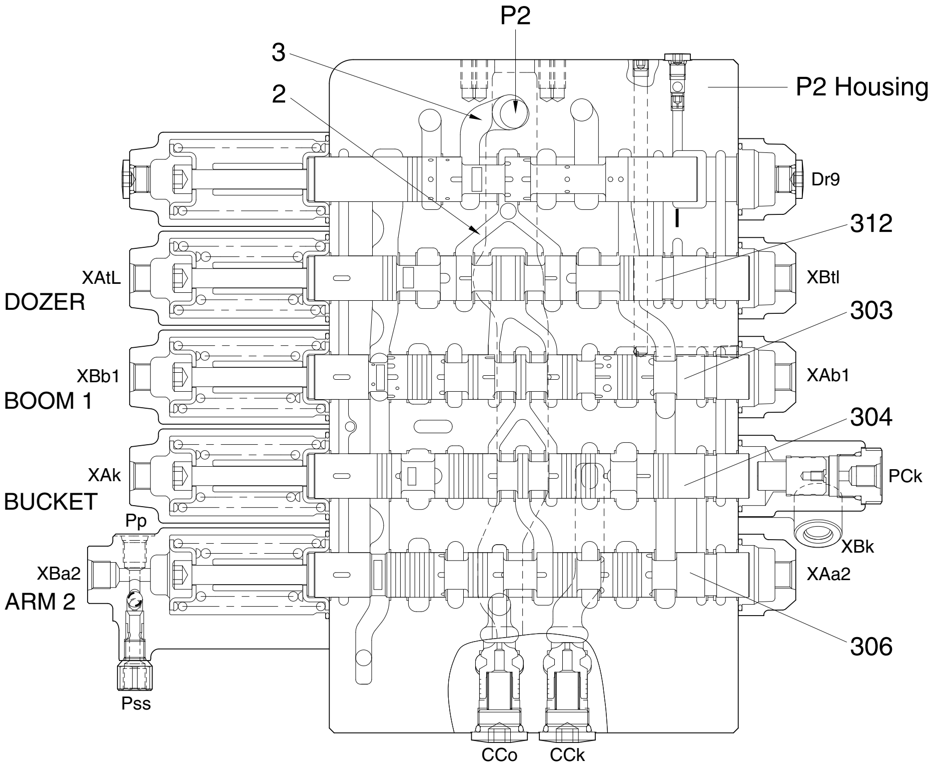
2. HYDRAULIC CIRCUIT



210WF2MC04

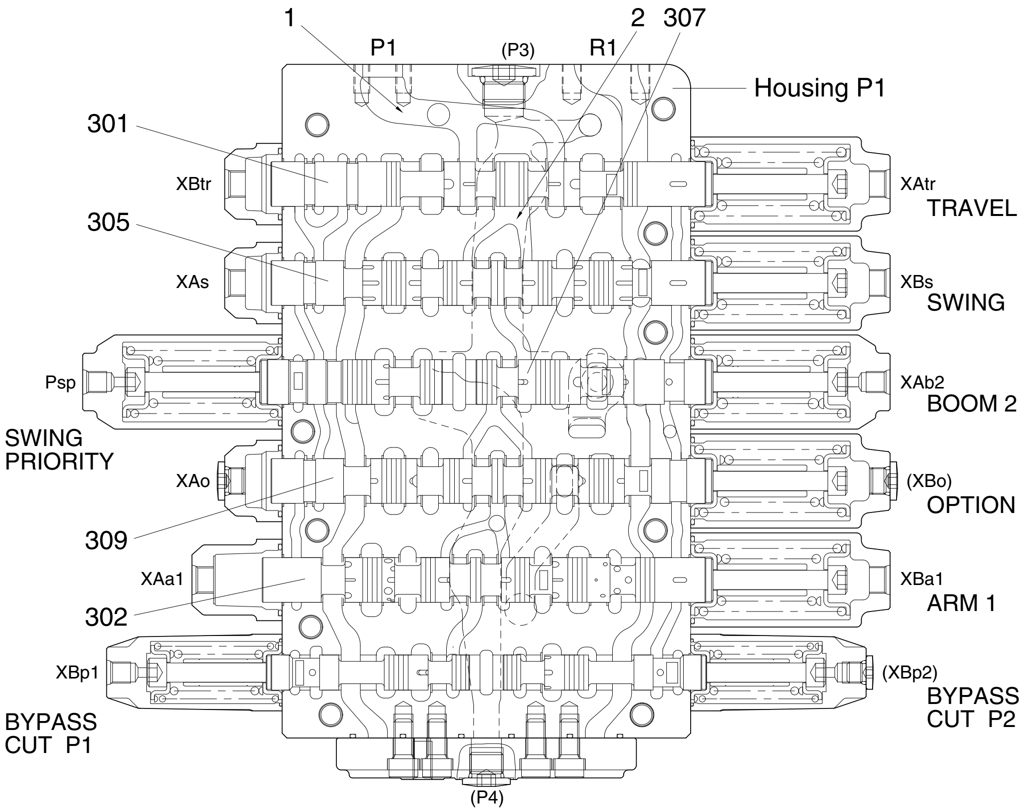
3. FUNCTION

1) CONTROL IN NEUTRAL POSITION



SPOOL SECTION(P2)

20W92MC05



SPOOL SECTION(P1)

20W92MC06A

When all spools are in the neutral positions, the pressurized oil discharged from the hydraulic pump (A1) passes through Port P1, the main path (1), the bypass circuit (2) passing the spools for travel (301), swing (305), boom confluence (boom 2; 307), option (309) and arm 1 (302), and the arm 1 side posi-nega conversion valve (611), and returns to the hydraulic oil tank through the tank port (R1).

The positive control signal pressure (Pi1) of the arm 1 side posi-nega conversion valve (611) is led from Port Pc1 to the regulator (Pi1) on the hydraulic pump (A1) side, and controls the pump discharge flow rate to its minimum value.

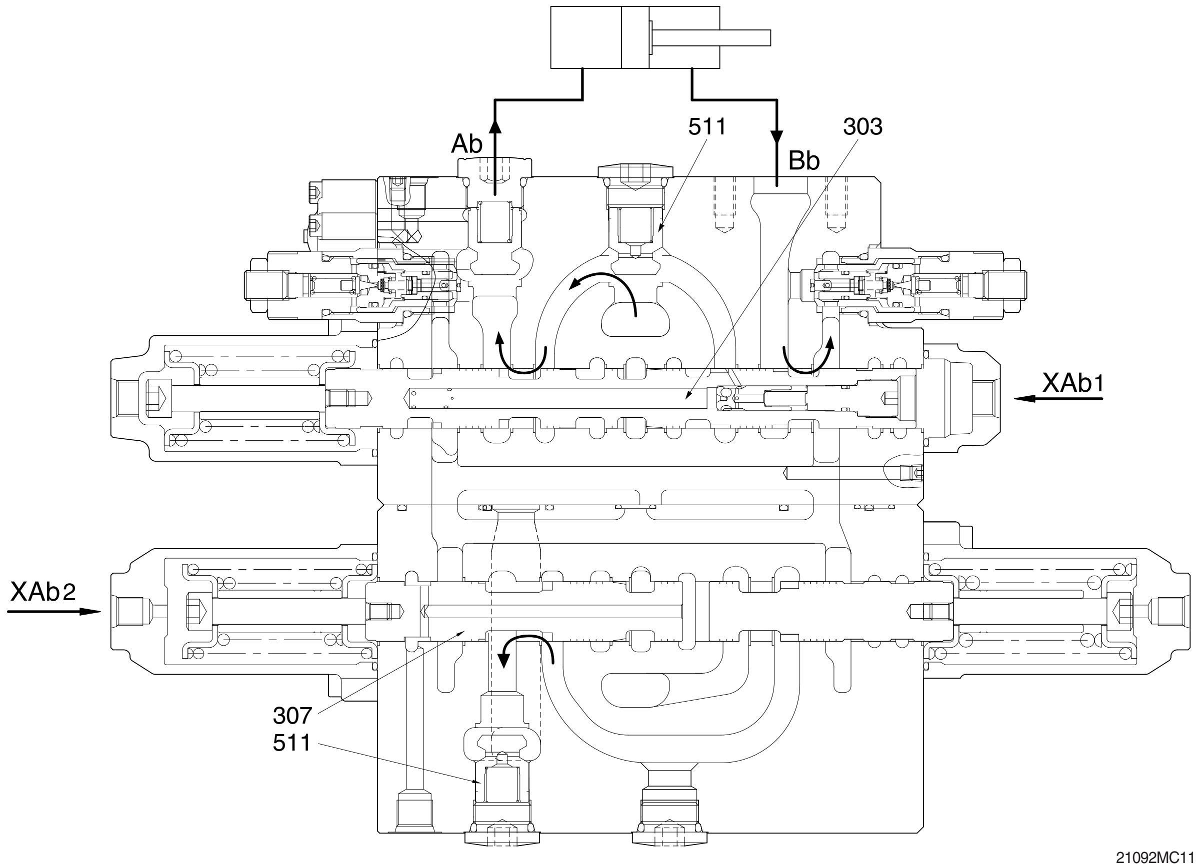
The oil discharged from the hydraulic pump (A2) passes through Port P2, the main path (3), the bypass circuit (2) passing the spools for dozer (312), boom 1 (303), bucket (304) and arm 2 (306), and the boom1 side posi-nega conversion valve (611), and returns to the hydraulic oil tank through the tank port (R1).

The positive control signal pressure (Pi2) of the boom 1 side posi-nega conversion valve (611) is led from Port Pc2 to the regulator (Pi2) on the hydraulic pump (A2) side, and controls the pump discharge flow rate to its minimum value.
When any of nine main spools is changed over, the bypass circuit (2) is cut off and the hydraulic oil at Port N1 or N2 in the negative control circuit is shut off.

2) EACH SPOOL OPERATION

(1) Boom control

① Boom up operation



Pilot circuit

Since the boom 1 spool (303) transfers and shuts off the side-bypass path, the pressure at Port Px increases.

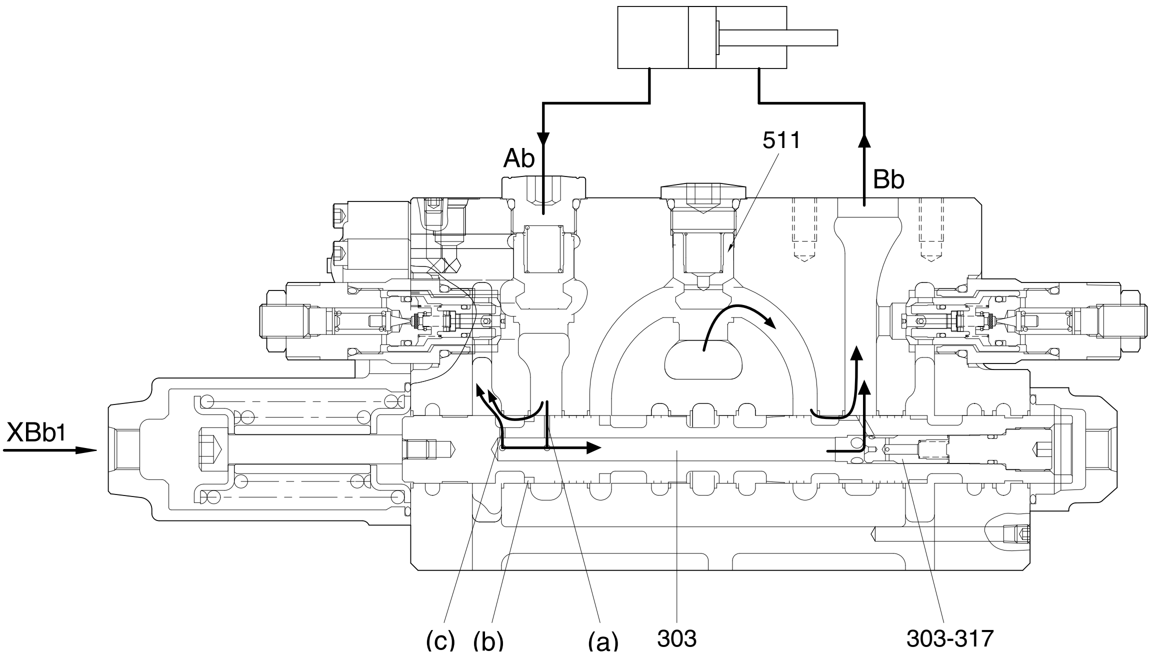
Main circuit

During the boom up operation, the pilot pressure enters through Port XAb1 and moves the boom 1 spool (303) in the left direction. The pressurized oil entering through Port P2 passes through the main path (3) and flows to the bypass circuit (2), but the bypass circuit (2) is shut off due to transfer of the boom 1 spool (303). Therefore, the pressurized oil flows into the parallel circuit, pushes open the check valve (511), and flows through the U-shaped path to the boom 1 spool (303). Then, it flows around the periphery of the boom 1 spool (303) to Port Ab, and is supplied to the boom cylinder head side.

At the same time, the pilot pressure enters also through Port XAb2 to transfer the boom 2 spool (307) in the right direction. Though the pressurized oil enters into Port P1, the bypass circuit (2) is shut off due to transfer of the boom 2 spool (307). Therefore, the hydraulic oil flows in the parallel circuit and flows through the U-shaped path to the boom 2 spool (307). Then, the hydraulic oil passes through the periphery of the boom 2 spool (307), pushes open the check valve (511), joins into Port Ab in the inside path, and is supplied to the boom cylinder head side. (Boom confluent flow)

On the other hand, the return oil from the boom cylinder rod side enters through Port Bb and returns to the hydraulic oil tank through the tank port (R1).

② Boom down operation



21092MC12

Pilot circuit

Since the boom 1 spool (303) transfers and shuts off the side-bypass path, the pressure at Port Px increases. Then, the pressure enters also through Port PbL and the release signal is sent to the lock valve (252).

Main circuit

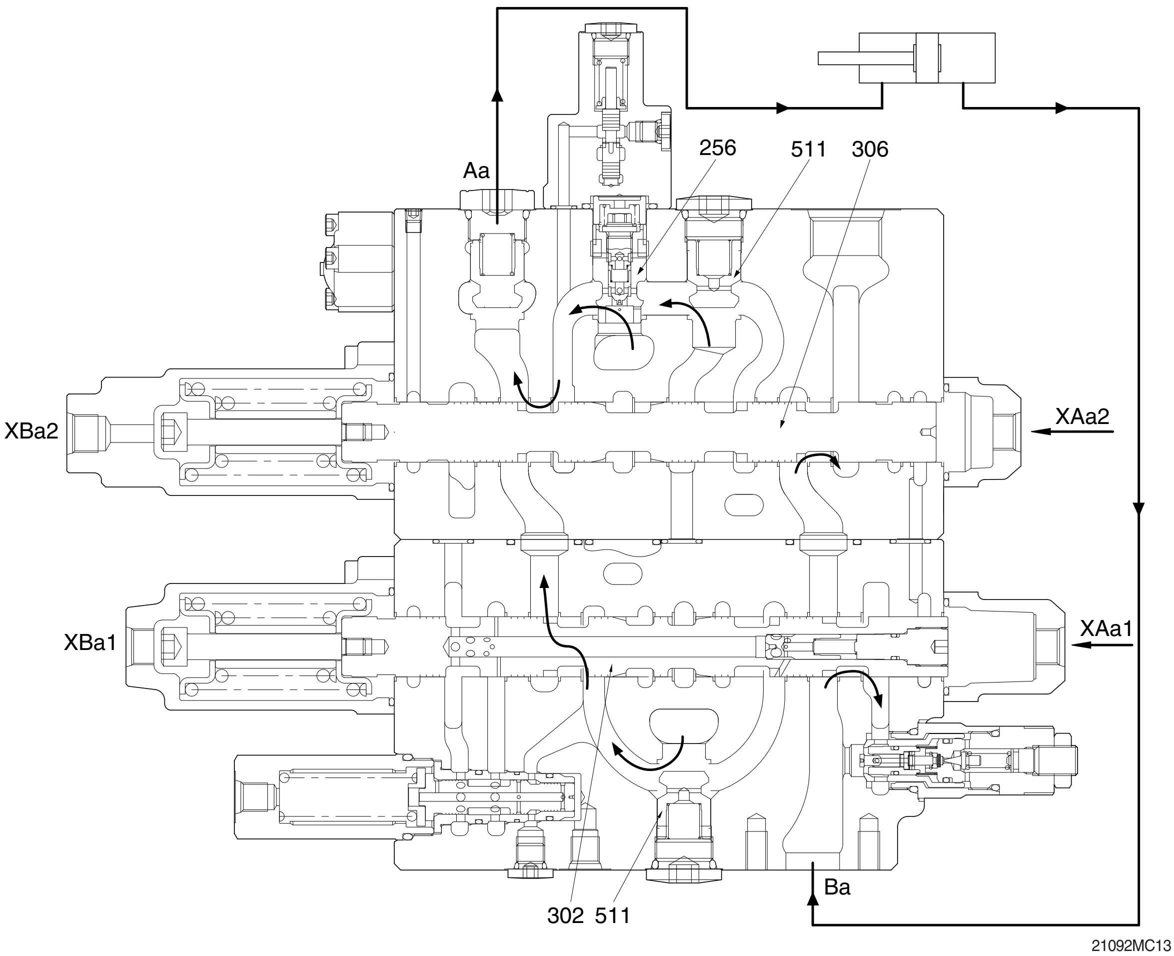
During the boom down operation, the pilot pressure enters through Port XBb1 and transfers the boom 1 spool (303) in the right direction. The pressurized oil entering through Port P2 passes through the main path (3) and flows to the bypass circuit (2), but the bypass circuit (2) is shut off due to transfer of the boom 1 spool (303). Therefore, the pressurized oil flows into the parallel circuit, pushes open the check valve (511), and flows through the U-shaped path to the boom 1 spool (303). Then, it flows around the periphery of the boom 1 spool (303) to Port Bb and is supplied to the boom cylinder rod side.

On the other hand, the return oil from the boom cylinder head side passes to the holes (a) and the notches (b) of the boom 1 spool (303).

Since this return oil has a sufficient pressure caused by the weight of the boom, it passes through the path inside the spool, pushes the poppet (303-317) in the spool in the right direction, flows around the outside of the spool. Then, it is supplied again to the boom cylinder rod side as hydraulic oil to lower the boom. (Boom regeneration)
Besides, a part of the return oil from the boom cylinder flows from the hole (c) into the tank.

(2) Arm control

① Arm out operation



Pilot circuit

Since the arm 2 spool (306) transfers and shuts off the side-bypass path, the pressure at Port Px increases.

Main circuit

During the arm out operation, the pilot pressure enters through Ports XAa1 and XAa2. When the pressure enters through Port XAa1 and XAa2, the spools transfer in the left direction. The hydraulic oil entering through Port P1 passes through the main path (1) and flows to the bypass circuit (2), but the bypass circuit is shut off due to transfer of the arm 1 spool (302).

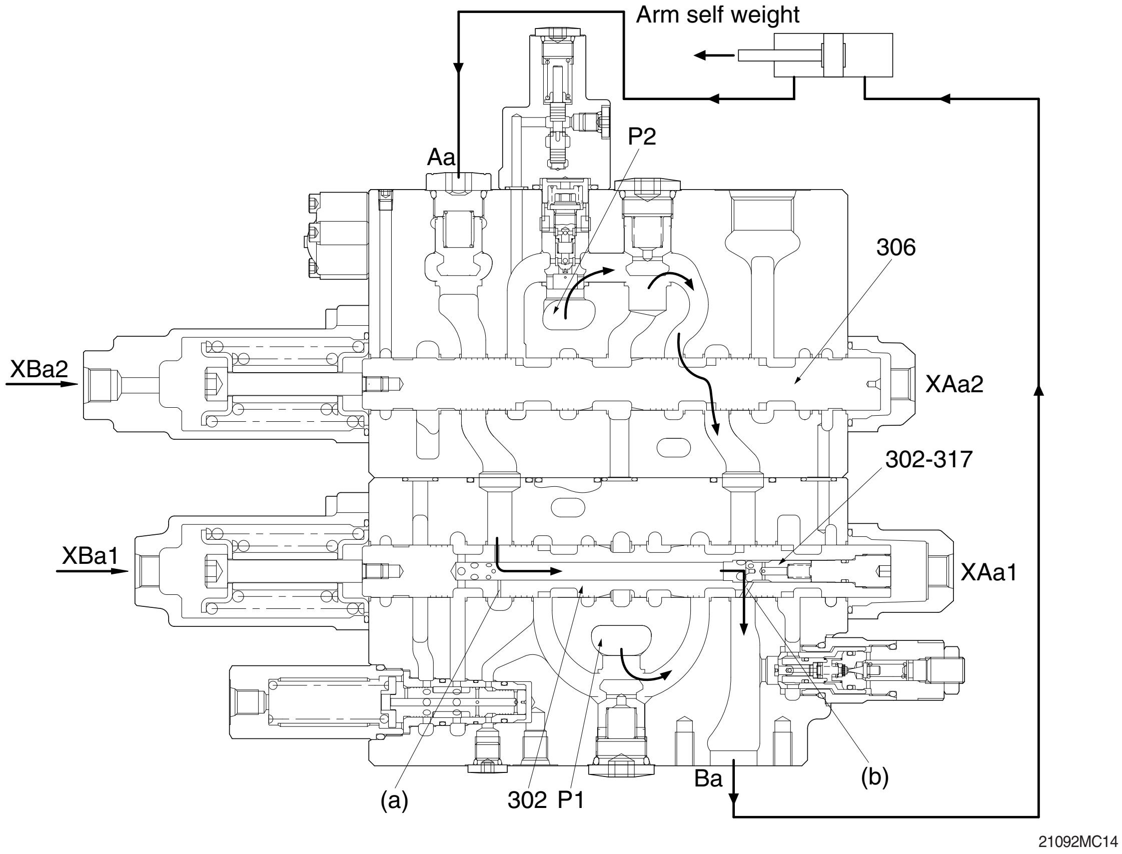
Therefore, the hydraulic oil from the parallel circuit pushes open the check valve (511) and flows through the U-shaped path to the arm 1 spool (302). Then, it flows around the periphery of the arm 1 spool (302) and the arm 2 spool (306) to Port Aa, and is supplied to the arm cylinder rod side.

On the other hand, the hydraulic oil entering through Port P2 passes in the main path (3), and flows into the bypass circuit (2), and the bypass circuit is shut off due to transfer of the arm 2 spool (306). The hydraulic oil from the parallel circuit pushes open the logic poppet (256) and the hydraulic oil from the bypass circuit (2) pushes open the check valve (511) and flows through the U-shaped path to the arm 2 spool (306). Then, it flows around the periphery of the arm 2 spool (306) in the inside path and joins into Port Aa.

Besides, the return oil from the arm cylinder head side passes through Port Ba, flows into tank line in arm 1 side and in arm 2 side, and returns to the hydraulic oil tank through the tank port (R1).

② Arm in operation

· During light load only



Pilot circuit

Since the arm 2 spool (306) transfers and shuts off the side-bypass path, the pressure at Port Px increases. Then, the pressure enters also through Port PaL and the release signal is sent to the lock valve (252).

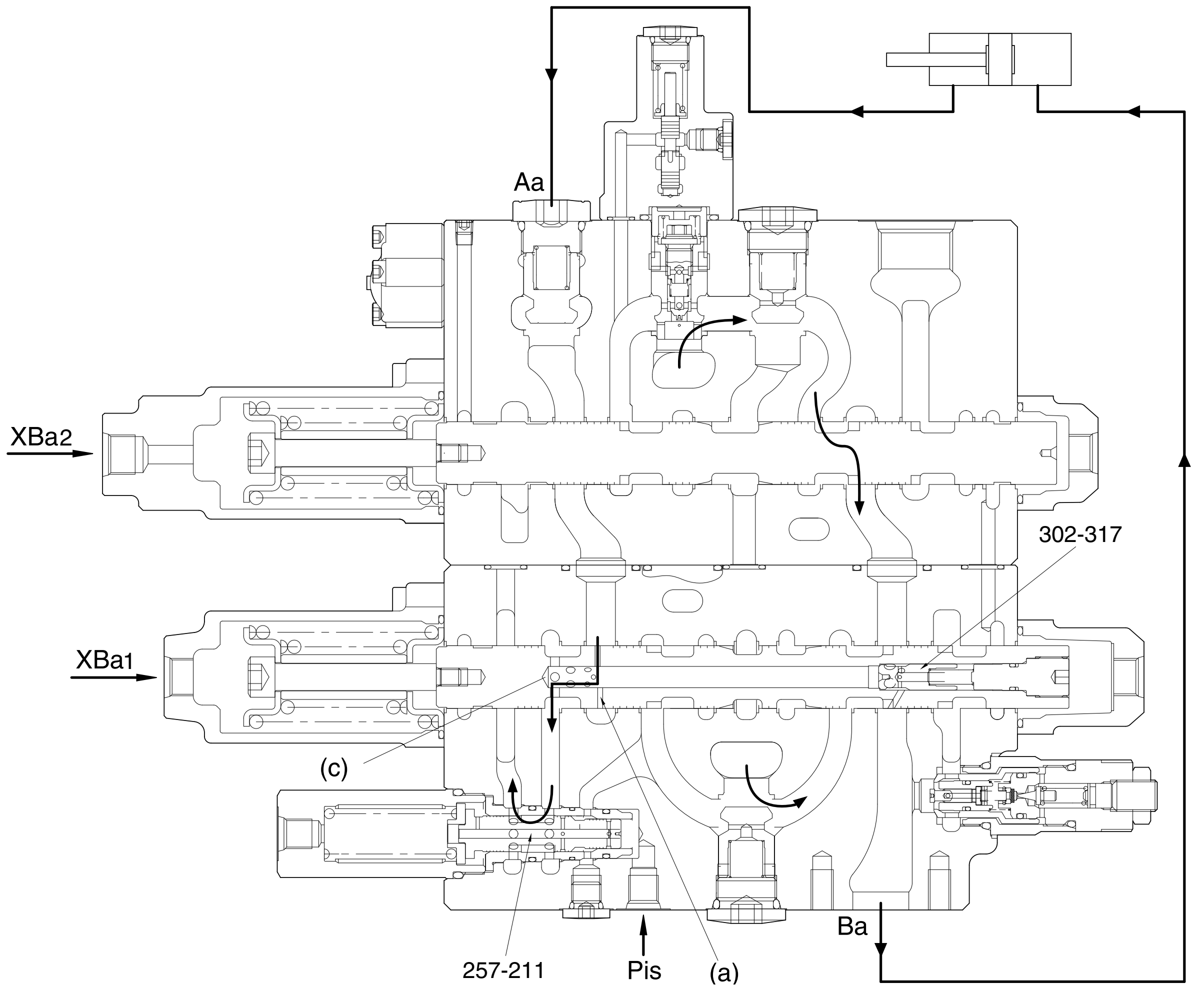
Main circuit

During the arm in operation, the pilot pressure enters through Ports XBa1 and XBa2. When the pressure enters through Port XBa1 and Port XBa2, the spools transfer in the right direction Fig. MC14. The hydraulic oil entering through Port P1 passes through the main path (1) and flows to the bypass circuit (2), but the bypass circuit is shut off due to transfer of the arm 1 spool (302). Therefore, the hydraulic oil from the parallel circuit pushes open the check valve (511) and flows through the U-shaped path to the arm 1 spool (302). Then, it flows around the periphery of the arm 1 spool (302) to Port Ba, and is supplied to the arm cylinder head side.

On the other hand, the hydraulic oil entering through Port P2 passes in the main path (3), and flows into the bypass circuit (2), and the bypass circuit is shut off due to transfer of the arm 2 spool (306). The hydraulic oil from the parallel circuit pushes open the logic poppet (256) and the hydraulic oil from the bypass circuit (2) pushes open the check valve (511) and flows through the U-shaped path to the arm 2 spool (306). Then, it flows around the periphery of the arm 2 spool (306) and the arm 1 spool (302) in the inside path and joins into Port Ba.

Besides, the return oil from the arm cylinder rod side is pressurized by self-weight of the arms and so on, and returns to Port Aa. The pressurized oil returning to Port Aa enters into the spool through the periphery hole (a) of the arm 1 spool (302). During a light load only, it pushes open the check valve (302-317) and joins into Port Ba from the spool hole (b). The rest of oil returns to the hydraulic oil tank through the tank port (R1). This is called the arm regeneration function.

· The pressure in the arm cylinder head side increases

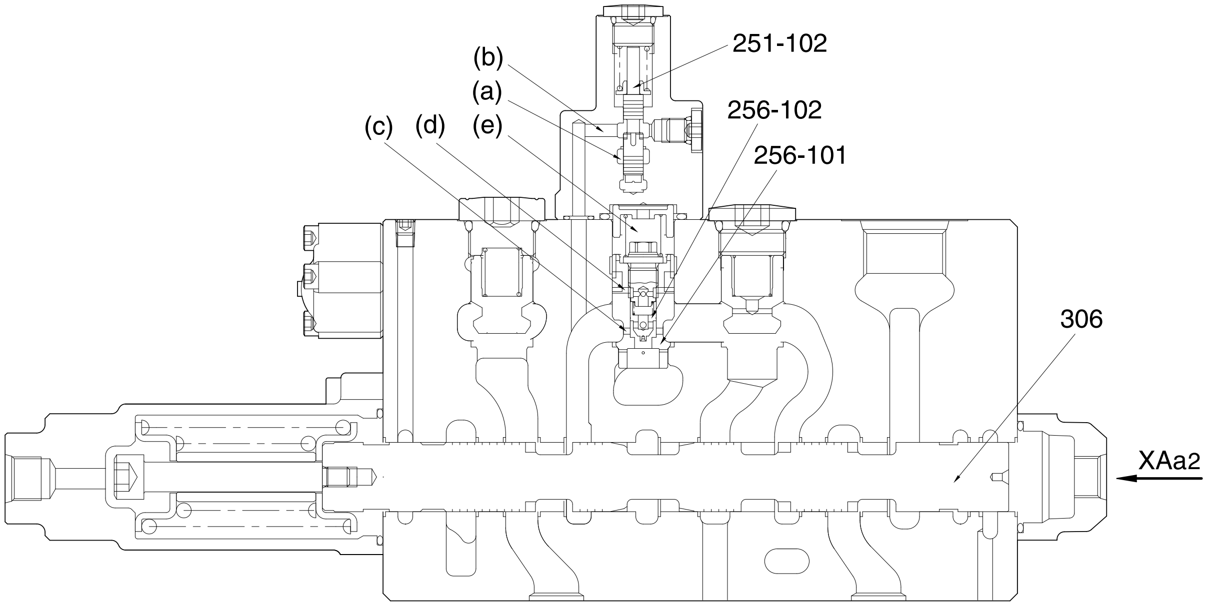


21092MC15

When the pressure in the arm cylinder head side and the U-shaped path increases, the arm regeneration cut spool (257-211) is transferred in the left direction, and at the same time the check valve (302-317) is closed by its backpressure. This shuts off the arm regeneration function, and the return oil from the arm cylinder rod side enters from Port Aa through the periphery hole (a) of the arm 1 spool (302) into the spool, flows to the arm regeneration cut valve (257) through the periphery hole (c) of the arm 1 spool (302), and returns through the tank port (R1) to the hydraulic oil tank.

When the Pilot Port Pis of the arm regeneration cut spool (257-211) is pressurized, a part of the return oil from the arm cylinder rod side flows to the arm regeneration cut valve (257) and returns through the tank port (R1) to the hydraulic oil tank. (Variable arm regeneration)

③ Arm 2 logic control valve operation



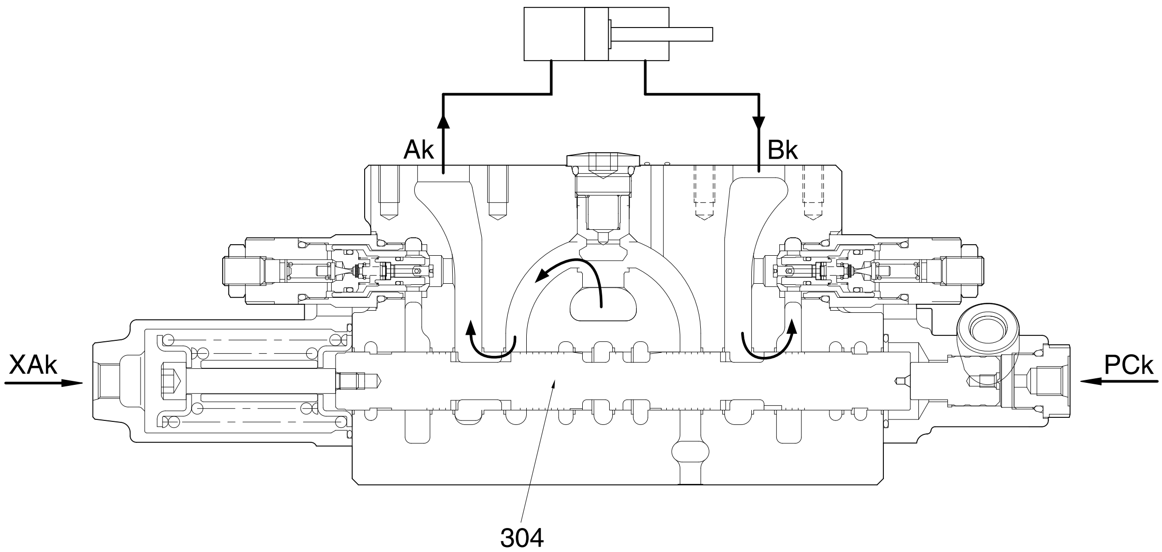
21092MC16

During both the arm in operation and the boom up operation, the pilot pressure enters through Ports XBa1, XBa2, XAb1, XAb2, PaL and PnA2. The pressure PnA2 transfers the spool (251-102) in the arm 2 logic control valve to the top direction, and the path from (a) to (b) is closed. Hereby, the pressurized oil pushes open the poppet (256-102), passes in the path (c) and (d), enters into the chamber (e), and the poppet (256-101) is pushed to the casing seat. Therefore, the most of pressurized oil entering through Port P2 flows to the boom 1 spool (303) than the arm 2 spool (306) to make the boom hoisting operation most preferential.

On the other hand, in the independent arm in operation, the pilot pressure does not enter through Ports PnA2, and the path from (a) to (b) is not closed, and the hydraulic oil of the chamber (e) flows to the path (a) and (b). The pressurized oil entering through Port P2 pushes open the poppet (256-101) and flows to the arm 2 spool (306).

(3) Bucket control

① Bucket in operation



Pilot circuit

Since the bucket spool (304) transfers and shuts off the side-bypass path, the pressure at Port Px increases. Then, the pressure enters also through Port XBp1.

Main circuit

During the bucket in operation, the pilot pressure enters through Port XAk and transfers the bucket spool (304) in the right direction. The pressurized oil entering through Port P2 passes through the main path (3) and flows through the bypass circuit (2), but the bypass circuit (2) is shut off due to transfer of the bucket spool (304). Therefore, the pressurized oil flows into the parallel circuit, pushes open the check valve (511), and flows through the U-shaped path to the bucket spool (304). Then, it flows through the periphery of the spool to Port Ak and is supplied to the bucket cylinder head side.

On the other hand, the return oil from the bucket cylinder rod side enters through Port Bk, passes around the periphery of the spool, and returns to the hydraulic oil tank through the tank port (R1).

During both the boom up operation and bucket in operation, the pilot pressure enters through Port PCk and the bucket spool transfers in the half stroke not full stroke. Therefore, the most of pressurized oil entering through Port P2 flows to the boom 1 spool (303) than the bucket spool (304) to make the boom up operation most preferential.

② Bucket out operation

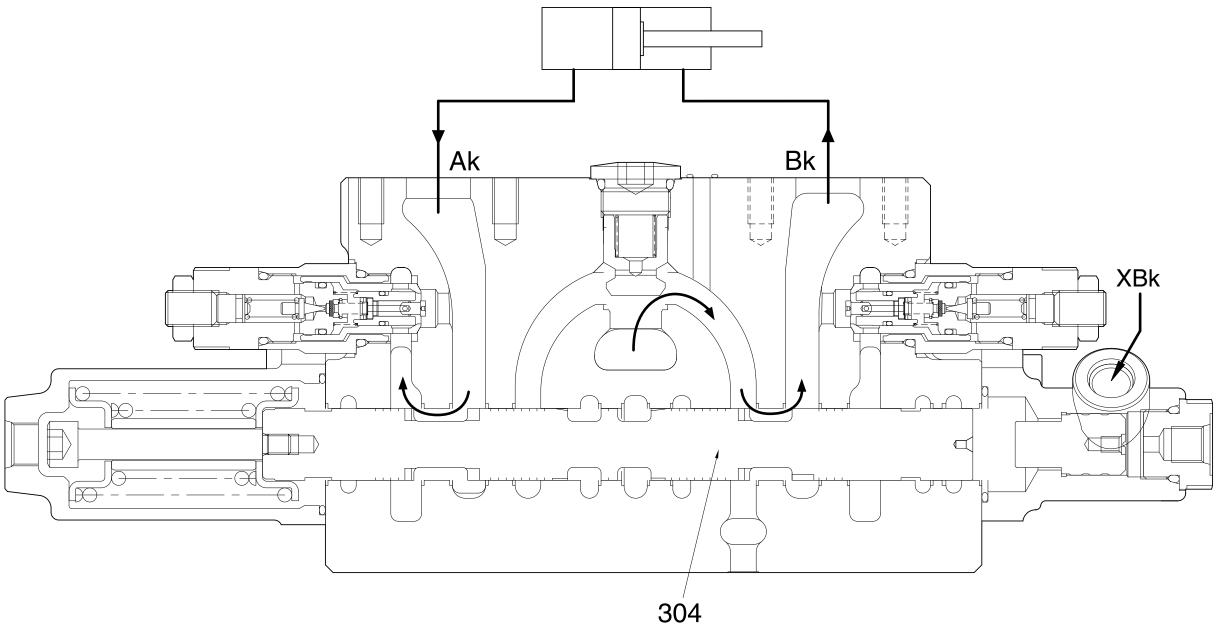
Pilot circuit

Since the bucket spool (304) transfers and shuts off the side-bypass path, the pressure at Port Px increases.

Main circuit

During the bucket out operation, the pilot pressure enters through Port XBk and transfers the bucket spool (304) in the left direction. The pressurized oil entering through Port P2 passes through the main path (3) and flows through the bypass circuit (2), but the bypass circuit (2) is shut off due to transfer of the bucket spool (304). Therefore, the pressurized oil flows into the parallel circuit, pushes open the check valve (511), and flows through the U-shaped path to the bucket spool (304). Then, it flows through the periphery of the spool to Port Bk and is supplied to the bucket cylinder rod side.

On the other hand, the return oil from the bucket cylinder head side enters through Port Ak, passes around the periphery of the spool, and returns to the hydraulic oil tank through the tank port (R1).

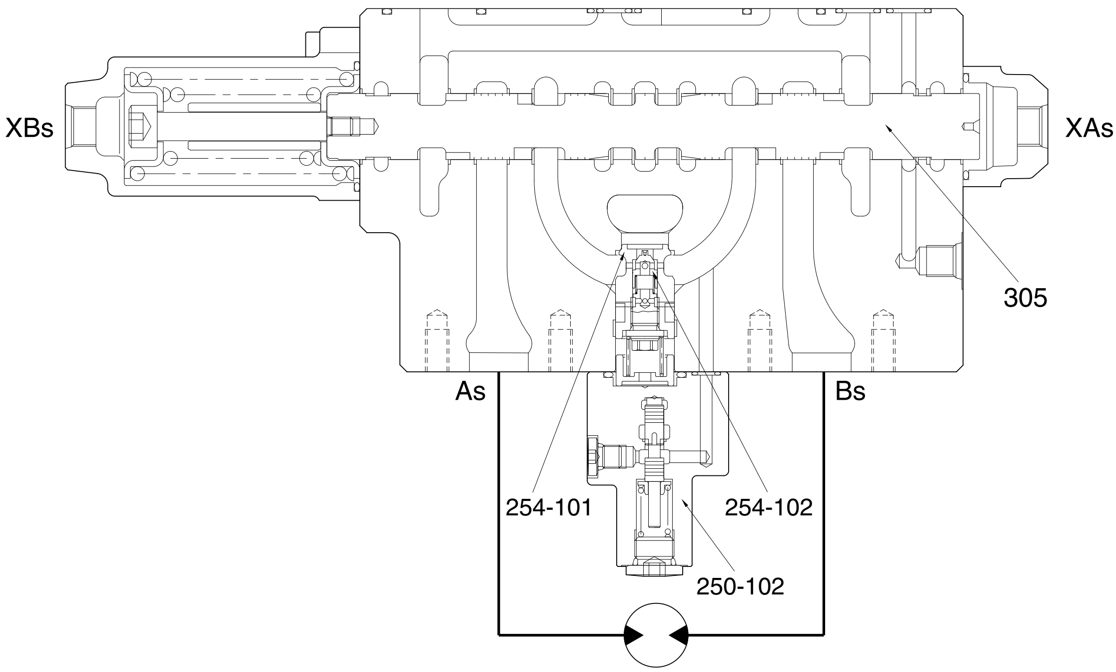


21092MC18A

③ Bucket in confluence

During the bucket in operation, the pilot pressure enters also through Port XBp1 and transfers the bypass-cut spool (313). The pressurized oil entering through Port P1 passes through the main path (1) and flows through the bypass circuit (2), but the bypass circuit (2) is shut off due to transfer of the bypass-cut spool (313). Therefore, the pressurized oil pushes open the check valve CCk (514), and flows through inside path and the U-shaped path to the bucket spool (304).

(4) Swing control



① Swing operation

Pilot circuit

Since the swing spool (305) transfers and shuts off the side-bypass path, the pressure at Port Px increases.

Main circuit

During the swing operation, the pilot pressure enters through Port XAs (or XBs) and transfers the swing spool (305). The pressurized oil entering through Port P1 passes through the main path (1) and flows through the bypass circuit (2), but the bypass circuit (2) is shut off due to transfer of the swing spool (305). Therefore, the pressurized oil flows into the parallel circuit, pushes open the check valve (511), and flows through the U-shaped path to the swing spool (305). Then, it flows through the periphery of the spool to Port As (or Bs) and is supplied to the swing motor.

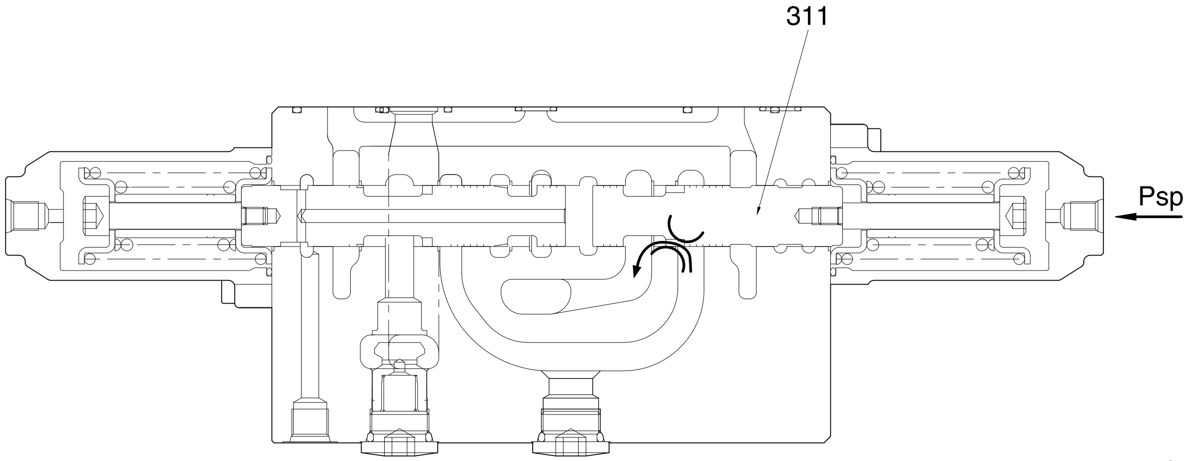
On the other hand, the return oil from the swing motor enters Port Bs (or As) and returns to the hydraulic oil tank through the tank port (R1).

② Swing logic control valve operation

During both the swing operation and the boom up operation, the pilot pressure enters through Ports XBs (or XAs), XAb1, XAb2 and Pns. The pressure Pns transfers the spool (250-102) in swing logic control valve. Hereby, the pressurized oil pushes open the poppet (254-102), and the poppet (254-101) is pushed to the casing seat. Therefore, the most of pressurized oil entering through Port P1 flows to the boom 2 spool (307) than the swing spool (305) to make the boom up operation most preferential.

On the other hand, in the independent swing operation, the pilot pressure does not enter through Ports Pns. The pressurized oil entering through Port P1 pushes open the poppet (254-101) and flows to the swing spool (305).

③ Swing operation preference function



21092MC20

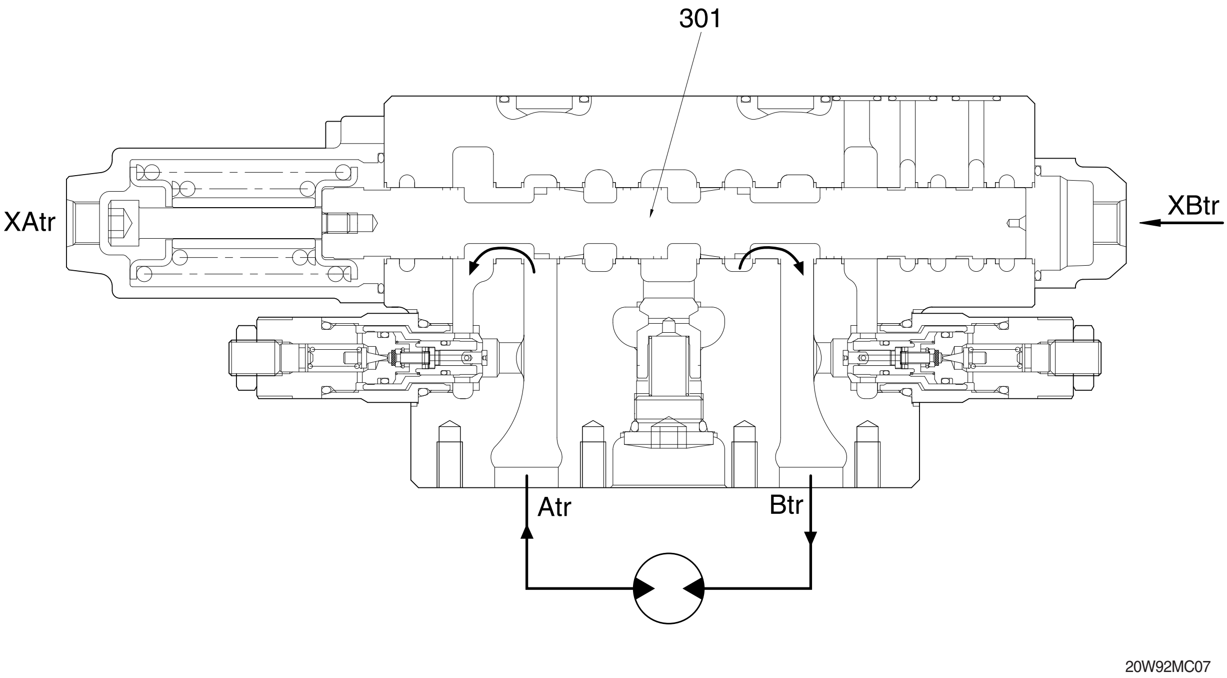
Pilot circuit

The pilot pressure enters through Port Psp to transfer the swing priority spool (311).

Main circuit

Due to transfer of the swing priority spool (311), the open area of the swing priority spool decreases, and the most of the pressurized oil entering through Port P1 flows to the swing side to make the swing operation most preferential.

(5) Travel control



Pilot circuit

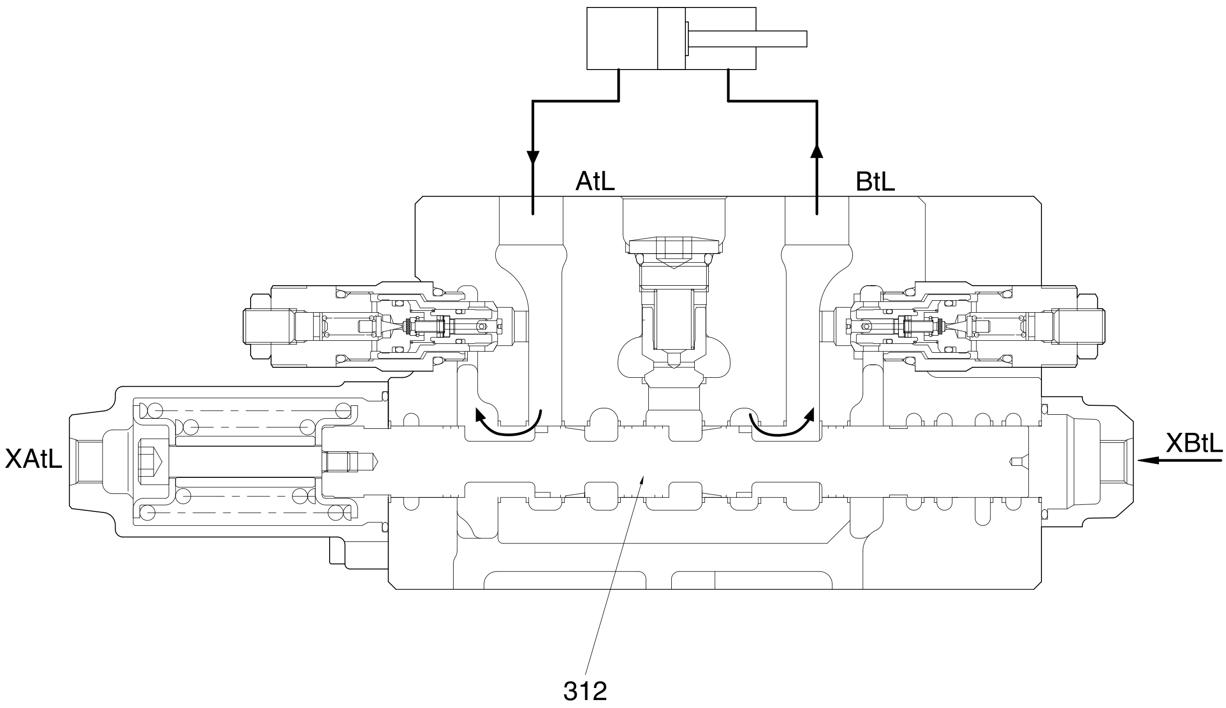
Since the travel spool (301) transfers and shuts off the side-bypass path, the pressure at Port Pw increases.

Main circuit

When Pilot Port XBtr of the travel spool (301) is pressurized, the bypass circuit (2) in the arm 1 side is shut off and the working fluid discharged from the hydraulic pump (A1) through Port Btr and flows to the travel motor.

On the other hand, the return oil from the travel motor passes flows from Port Atr to the travel spool (301) and returns to the hydraulic oil tank through the tank port (R1).
In the case of the opposite operation (when the pilot pressure is applied to Ports XAtr of the control valve), the operation is similar.

(6) Dozer operation



20W92MC08

Pilot circuit

Since the dozer spool (312) transfers and shuts off the side-bypass path, the pressure at Port Pw increases.

Main circuit

When Pilot Port XBtL of the dozer spool (312) is pressurized, the bypass circuit (2) in the boom 1 side is shut off and the working fluid discharged from the hydraulic pump (A2) through Port BtL and flows to the dozer cylinder rod side.

On the other hand, the return oil from the dozer cylinder rod side passes flows from Port AtL to the dozer spool (312) and returns to the hydraulic oil tank through the tank port (R1).
In the case of the opposite operation (when the pilot pressure is applied to Ports XAtL of the control valve), the operation is similar.

3) FUNCTION OF LOCK VALVE

The lock valve (252) is fitted between the arm cylinder rod side and the arm 2 spool (306). It decreases the leakage by the pressure of the cylinder.

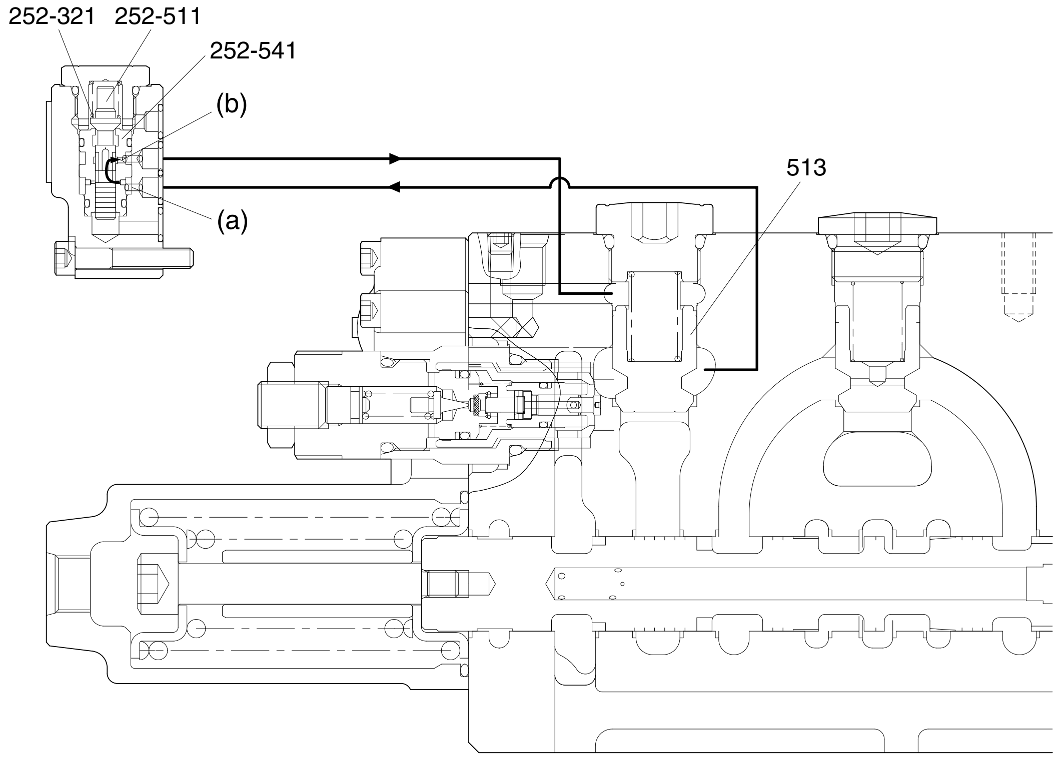
Another lock valve (252) is similarly fitted between the boom cylinder head side and the boom 1 spool (303). It decreases the leakage by the pressure of the cylinder.

(1) Neutral positions of spools

The following is the case of the boom 1 spool (303). (The case of the arm 2 spool (306) is in the same way.)

During the boom 1 spool (303) is in the neutral position, the lock valve (252) is kept in the position shown in figure. The spool (252-511) in the lock valve is pushed to the seat of the sleeve (252-541) by the force of the spring (252-321).

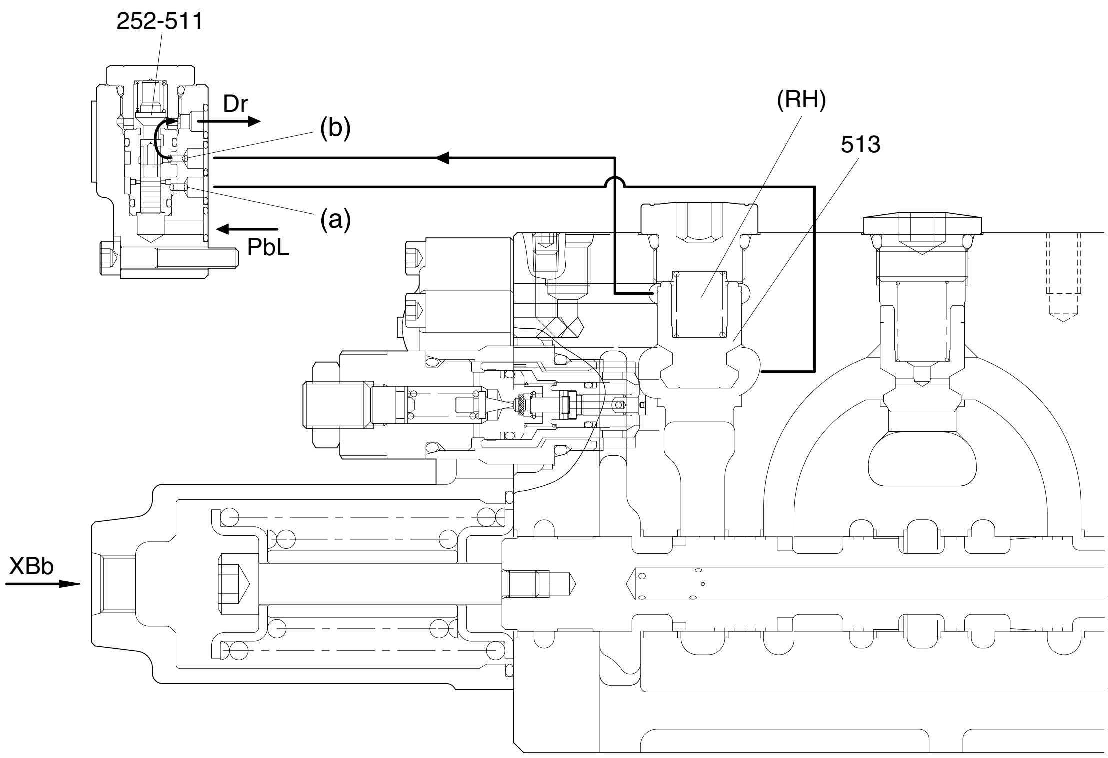
In this position, the pressurized oil from the boom cylinder head side enters through the hole (a), the periphery of the spool (252-511) in the lock valve and the hole (b), and it pushes the poppet (513) to the casing seat, and the leakage is decreased.



21092MC35

(2) Boom down operation

During the boom down operation, the pilot pressure enters through Port PbL and XBb1. The pilot pressure transfers the spool (252-511) in the lock valve assy in the top direction. By the transfer of the spool (252-511), firstly the hole (a) is blocked and the pressurized oil from the boom cylinder head side does not enter to the spring chamber (RH). Secondly, the oil in the spring chamber (RH) enters through the hole (b) and flows to drain circuit. Therefore, the poppet (513) is lifted by the pressure of the boom cylinder head side and the function of the lock valve (252) is released.



21092MC36

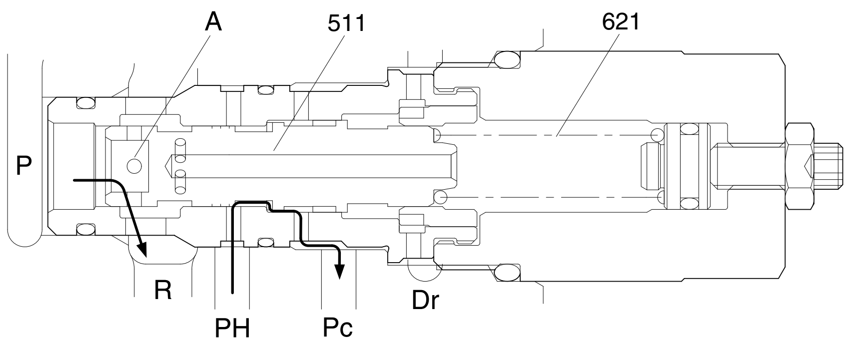
(3) Boom up operation

During the boom up operation, the pilot pressure enters through Port XAb1. The oil flowing from the boom 1 spool pushes open the poppet (513) and flows to Port Ab.

4) Posi-Nega Conversion Valve

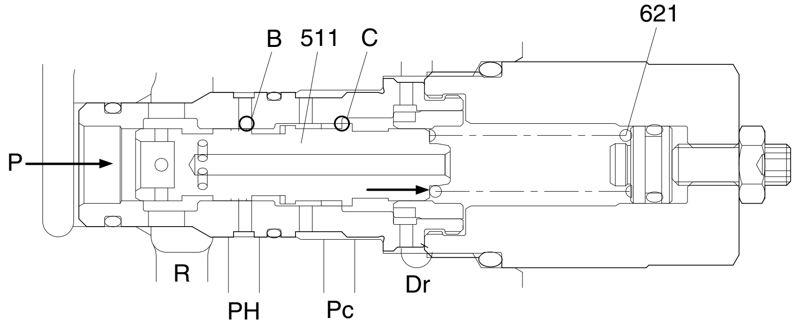
The posi-nega conversion valve is installed between the downstream of the center bypass path and the low-pressure path, and functions as follows:

(1) The delivery oil (flow rate Q) from the pump is led to the path P after passing the center by-pass path (2).
Then, it flows to the path R passing through the orifice A. On the other hand, the primary pressure oil from the port PH flows to the port Pc1 (or Pc2) through the periphery of the spool (511). On that occasion, the spool (511) remains to be pressed by the spring (621) if the pressure at the path P and the pressure at the port Pc1 (or Pc2) are below the preset pressure.

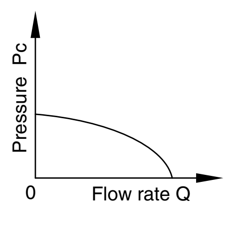


21092MC30

(2) When the flow rate Q increases and the pressure at the path P increases, the spool (511) begins to move to the right, and so adjusts the Pc1 (or Pc2) pressure at the notches of the path B and C that the pressure at the path P and the Pc1 (or Pc2) pressure are balanced with the spring (621) at the set pressure. When the pressure at the path P rises, the Pc1 (or Pc2) pressure is lowered. The relationship between the flow rate Q of the hydraulic oil flowing from the path P to the path R and the pressure at the port Pc1 (or Pc2) is as shown in graph.

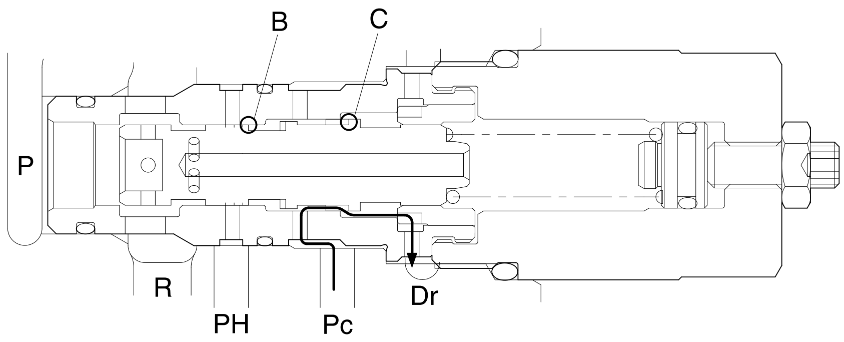


21092MC31



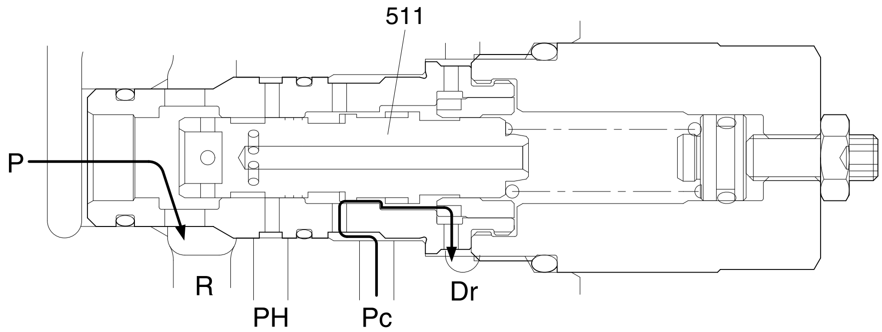
21092MC34

(3) The pressure at Pc1 (or Pc2) is used for the control of pump discharge flow rate, and the pump discharge flow rate can be reduced by lowering the Pc1 (or Pc2) port pressure.



21092MC32

(4) If the flow rate Q increases more than required, the spool strokes to largely open the P – R line, generating the relieving condition.



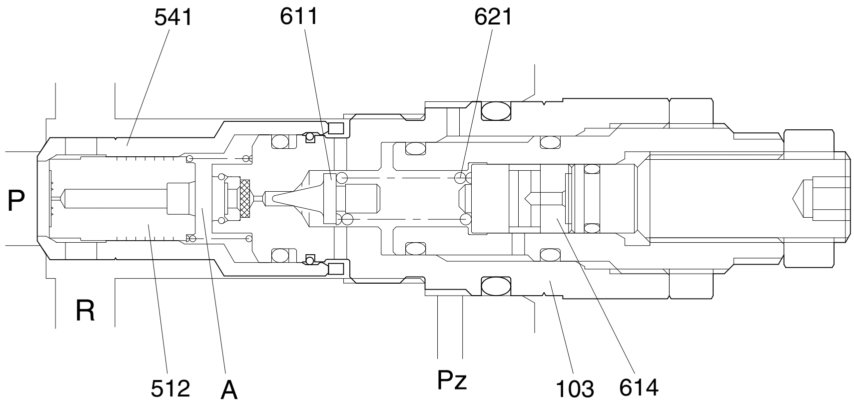
21092MC33

5) CIRCUIT PRESSURE PROTECTION

The control valve has two kinds of relief valve to limit the pressure in a circuit.

(1) Main relief valve

The main relief valve is fitted in the P2 housing and functions as follows.



21092MC25

① The hydraulic oil is filled up in the inside space chamber (A) from the path (P) through a hole of the seat (541) and a restriction of the plunger (512), and seats the plunger (512) against the seat (541) securely.

② When the pressure in the path (R) becomes equal to the set load of the spring (621), the poppet (611) opens to make the hydraulic oil flow through a hole of the plug (103), around the poppet (611) and into the low pressure path (R).

③ Opening of the poppet (611) causes the pressure in the chamber (A) to fall and the plunger (512) to open. As the result the pressurized oil in the path (R) runs into the low pressure path (R) directly.

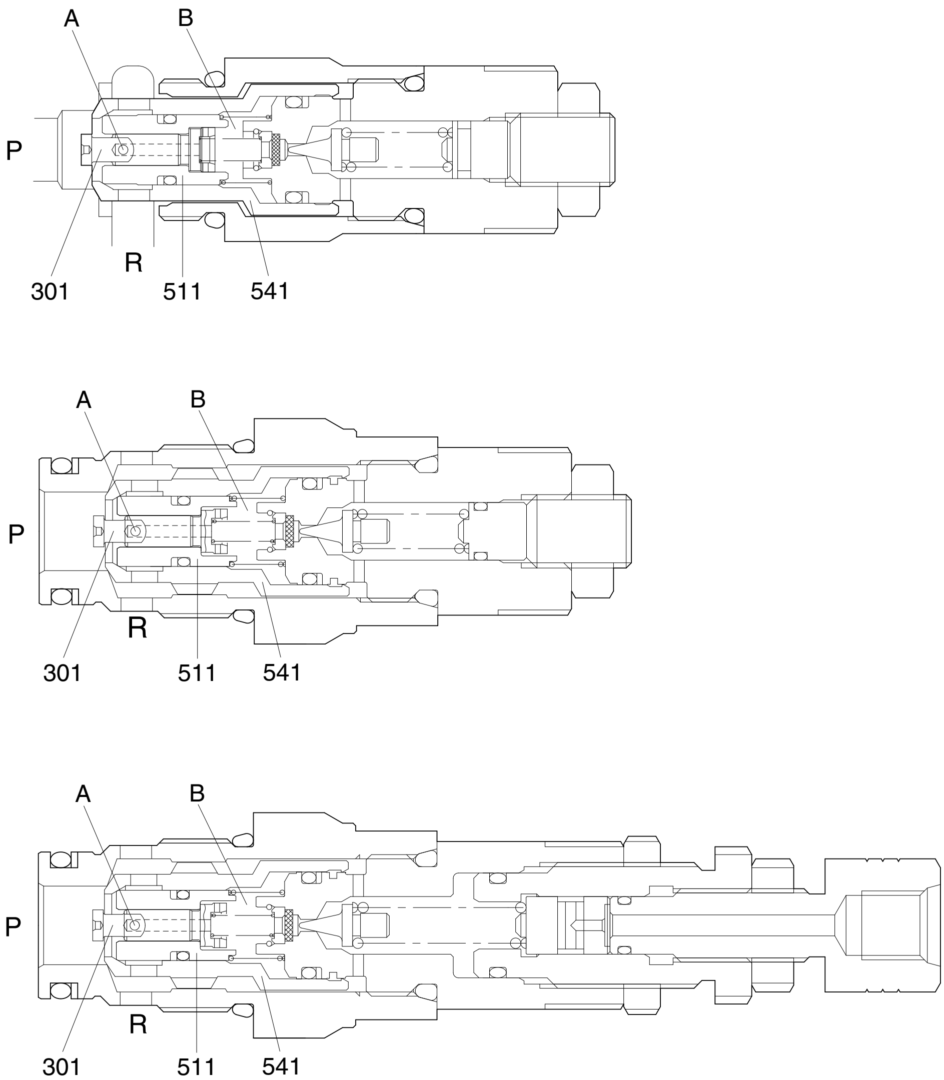
④ When the pressurized oil higher than pressure 30 kgf/cm^2 enters through the port Pz, it pushes the piston (614) to change the relief set pressure of the spring (621) to the high pressure.

(2) Port relief valve

The port relief valve is fitted between the cylinder port and low-pressure path. In addition to the relief valve, this serves also as an anti-cavitation check valve, and functions as follows:

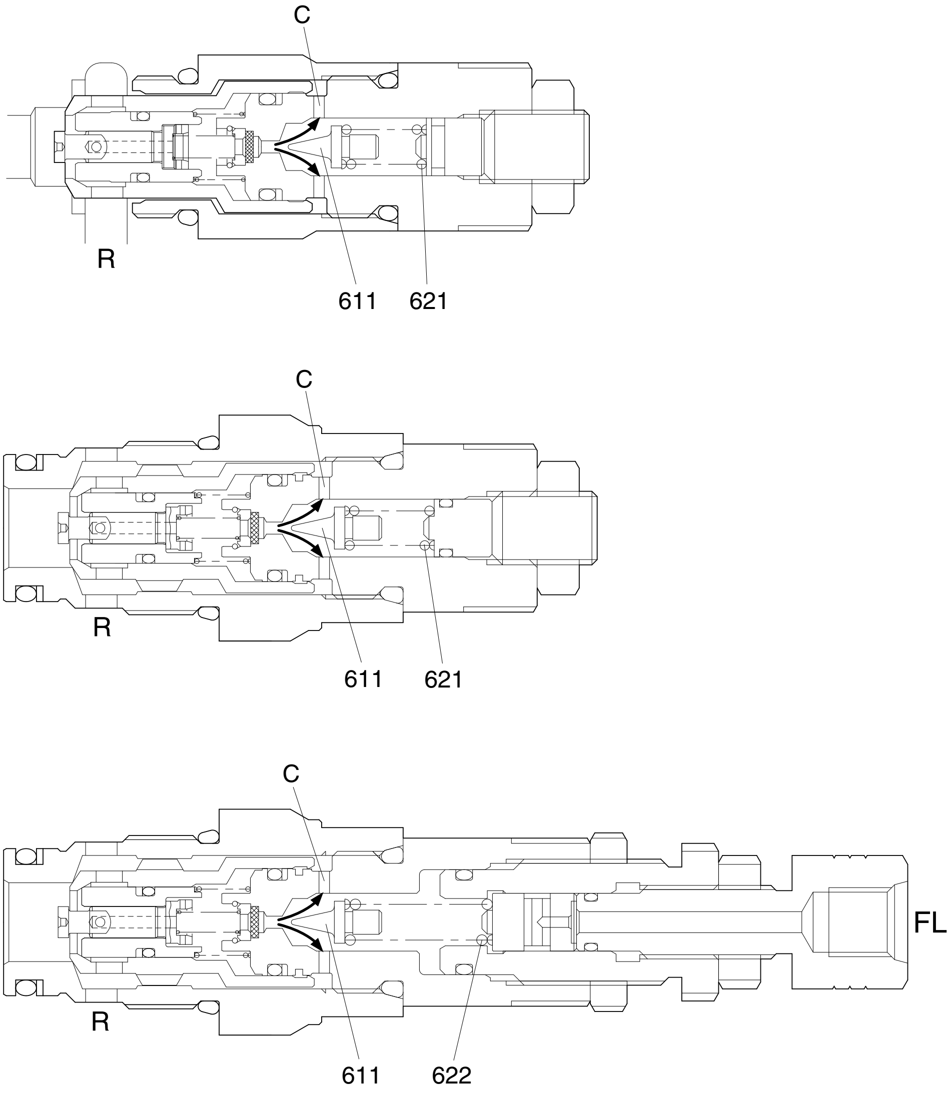
① Function as relief valve

a. The pressurized oil passes through Hole A of the piston (301), is filled up in Chamber B of the inside space, and seat the plunger (511) against the seat (541) securely.



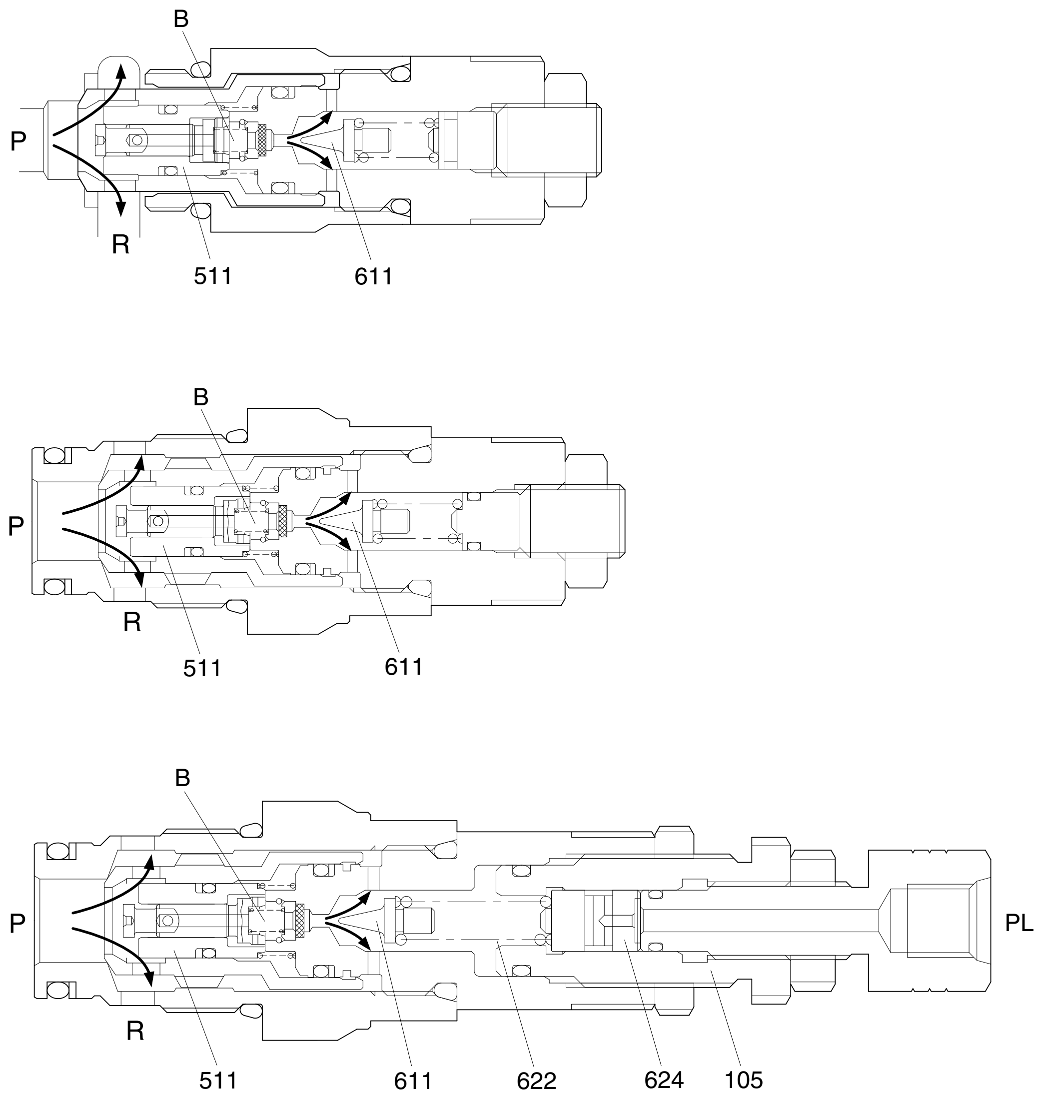
21092MC26

b. When the pressure in the path (P) becomes equal to the set pressure of the spring (621 or 622), the pressurized oil pushes open the poppet (611), flows around it, and flows to the low pressure path (R) through hole C.



21092MC27

c. Opening of the poppet (611) causes the pressure in Chamber B to fall and the plunger (511) to open. As the result the pressurized oil in the path (P) runs into the low pressure path (R) directly.

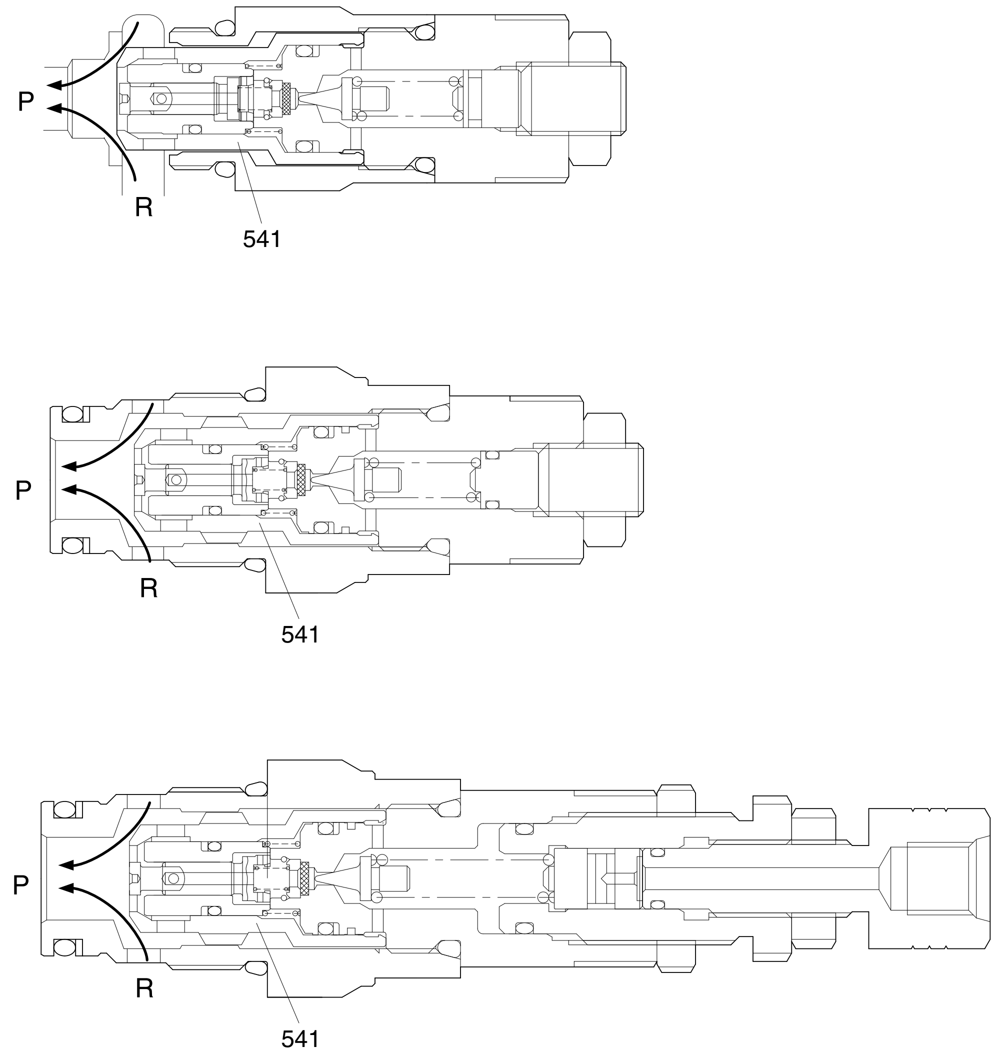


21092MC28

d. When the pressurized oil higher than pressure 25 kgf/cm^2 enters through the port PL, it pushes the piston (624) to change the relief set pressure of the spring (622) to the high pressure.

② **Function as Anti-Cavitation Check Valve**

When any negative pressure exists in the path (P), the oil is supplied through the path (R). When the pressure at (R) becomes higher than that in the path (P), the seat (541) moves in the right direction. Then, sufficient oil passes around the seat (541) from the path (R) to the path (P) and prevents cavitation.



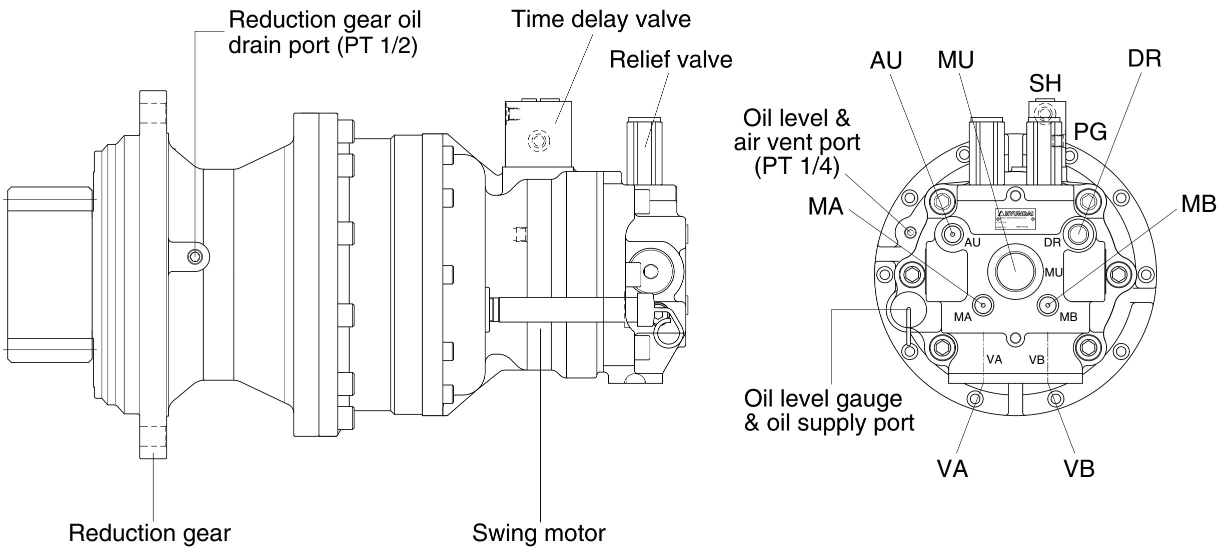
21092MC29

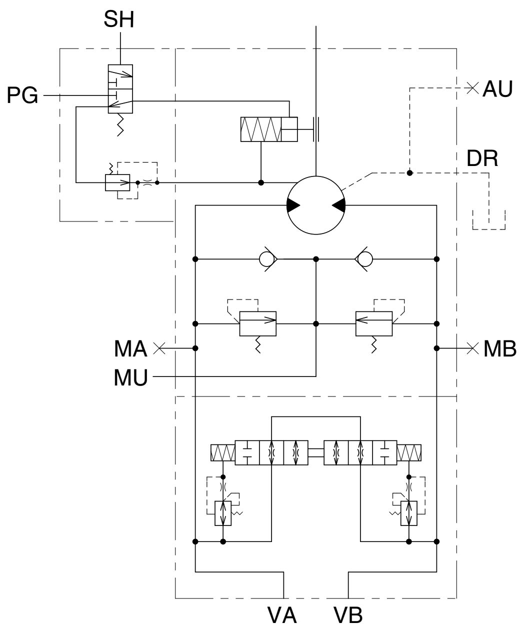
GROUP 3 SWING DEVICE (TYPE 1, 2)

1. STRUCTURE

Swing device consists swing motor, swing reduction gear.

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



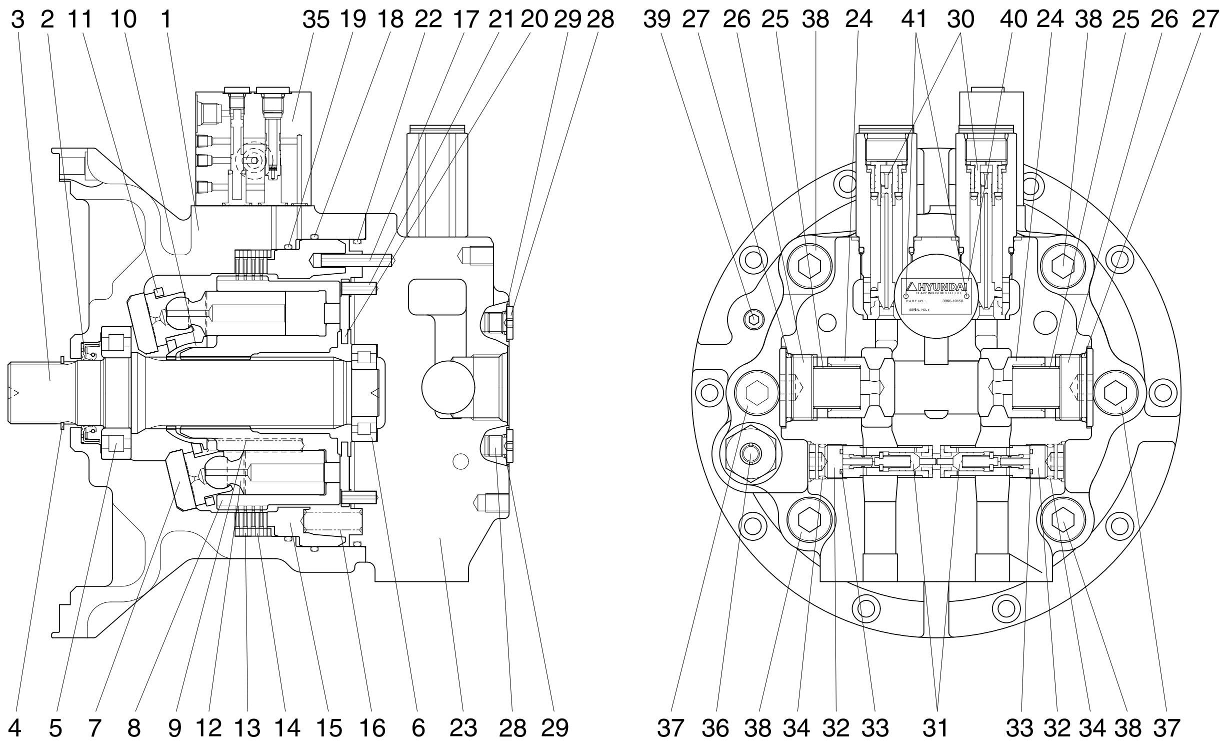


Hydraulic circuit

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

210WF2SM01

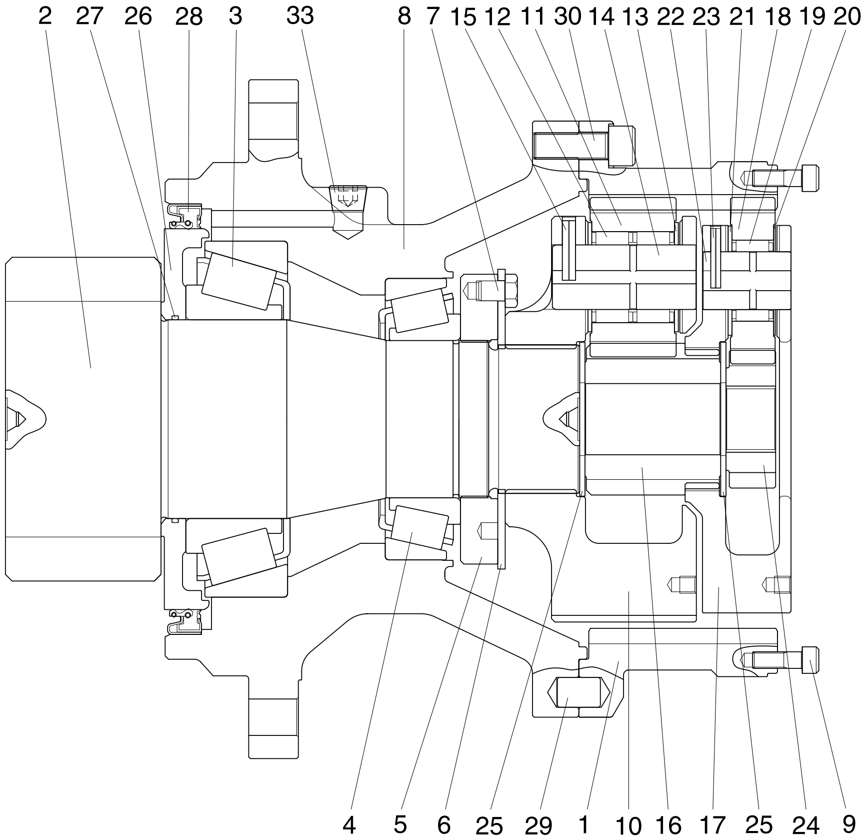
1) SWING MOTOR



210WF2SM02

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

2) REDUCTION GEAR



210WF2SM03

1	Ring gear	12	Needle bearing 2	23	Spring pin 1
2	Drive shaft	13	Thrust washer 2	24	Sun gear 1
3	Taper roller bearing	14	Carrier pin 2	25	Thrust plate
4	Taper roller bearing	15	Spring pin 2	26	Sleeve
5	Ring nut	16	Sun gear 2	27	O-ring
6	Lock plate	17	Carrier 1	28	Oil seal
7	Hexagon bolt	18	Planetary gear 1	29	Parallel pin
8	Casing	19	Needle bearing 1	30	Socket bolt
9	Socket bolt	20	Thrust washer 1	33	Plug
10	Carrier 2	21	Thrust washer 1		
11	Planetary gear 2	22	Carrier pin 1		

2. PRINCIPLE OF DRIVING

2.1 Generating the turning force

The high hydraulic supplied from a hydraulic pump flows into a cylinder block (8) through valve casing of motor (23), and valve plate (20).

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

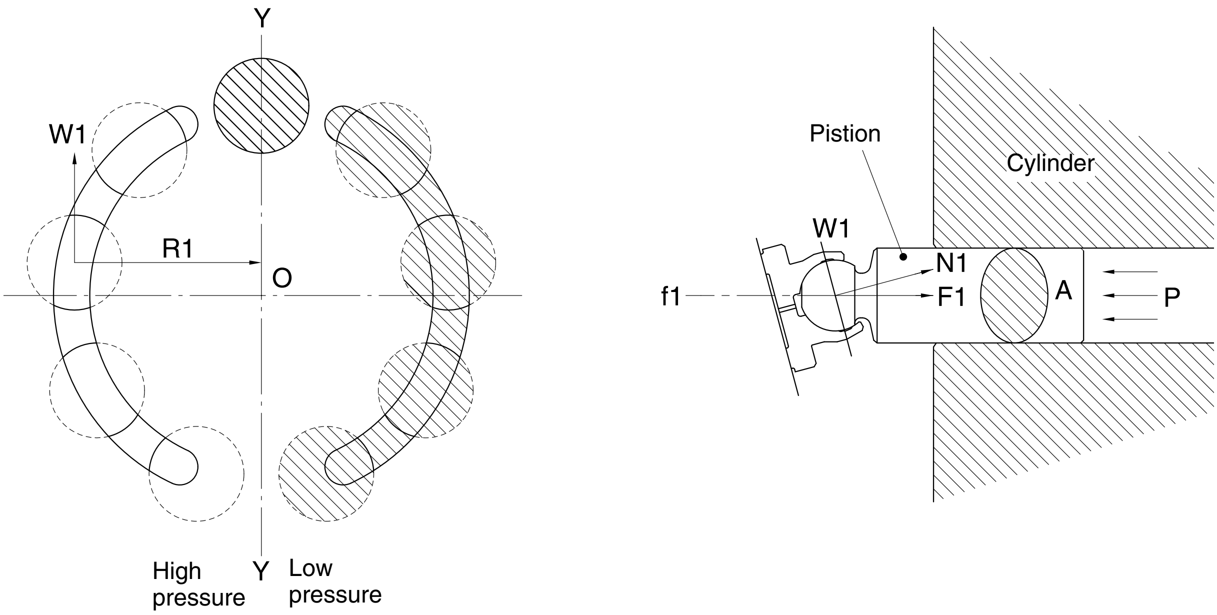
The high hydraulic can generate the force, F1=P×A (P : supplied pressure, A : water pressure area), like following pictures, working on a piston.

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

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

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

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



21078TM05

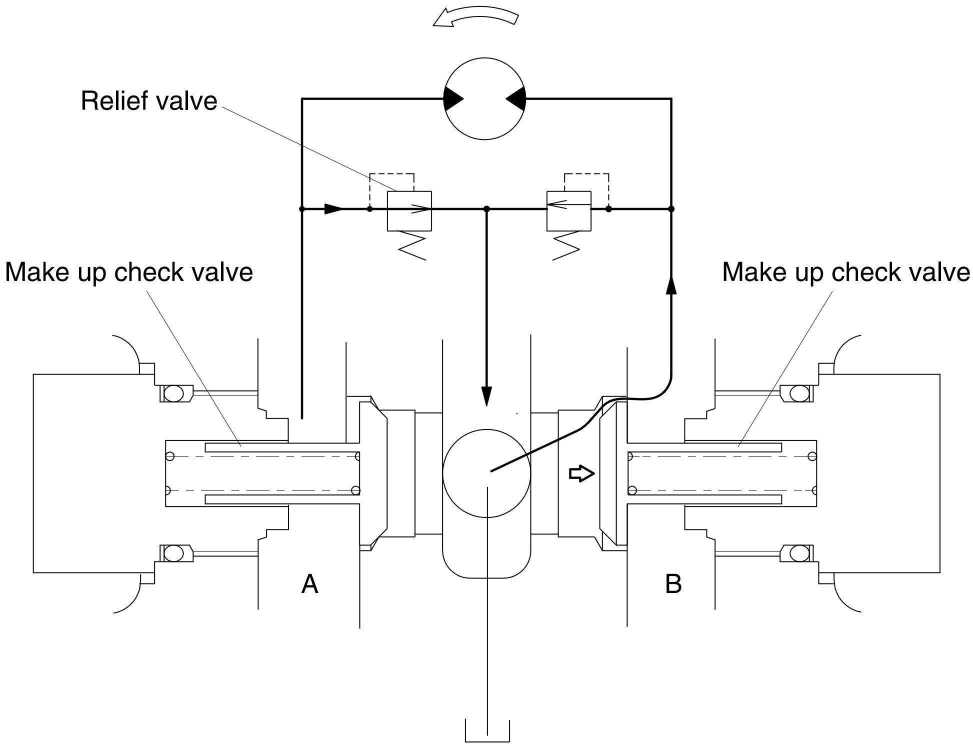
2) MAKE UP VALVE

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

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

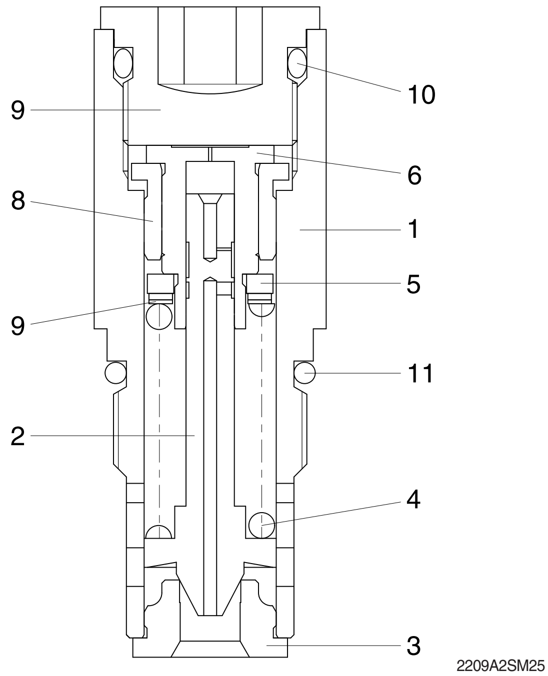
Pressurized oil into the port B, the motor rotate counterclockwise.

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



21092SM04

3) RELIEF VALVE



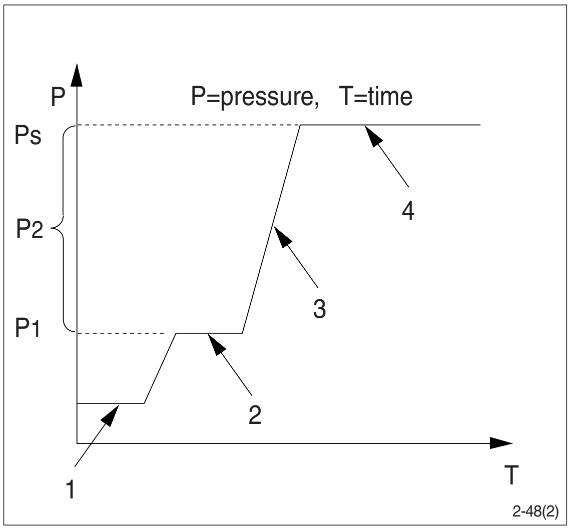
1	Sleeve
2	Poppet
3	Poppet seat
4	Spring
5	Spring seat
6	Shim
7	Piston
8	Stopper
9	Plug
10	O-ring
11	O-ring

(1) Construction of relief valve

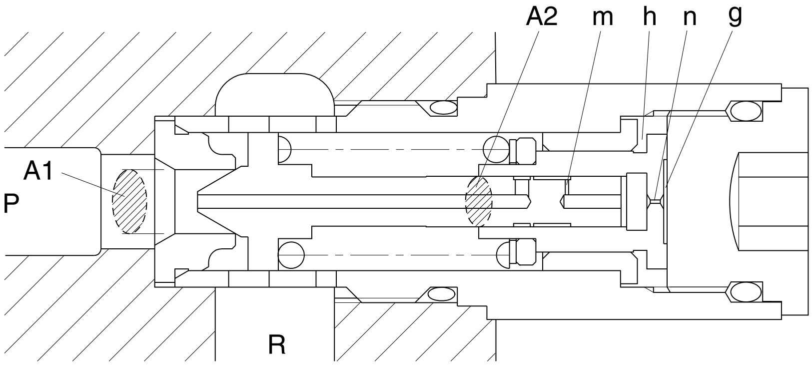
The valve casing contains two cartridge type relief valves that stop the regular and reverse rotations of the hydraulic motor. The relief valves relieve high pressure at start or at stop of swing motion and can control the relief pressure in two steps, high and low, in order to insure smooth operation.

(2) Function of relief valve

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



① Ports (P,R) at tank pressure.

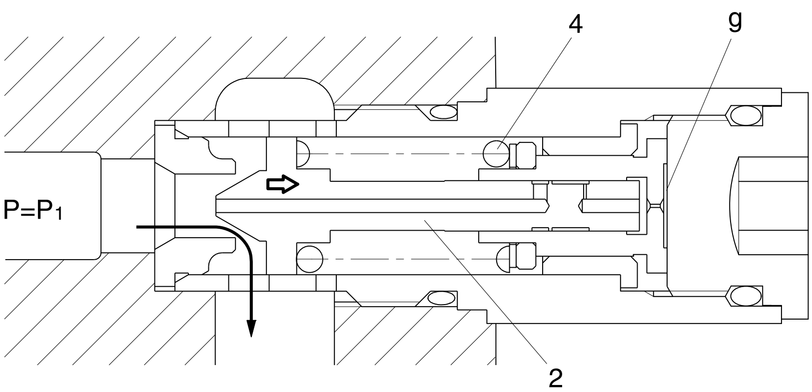


2209A2SM26

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

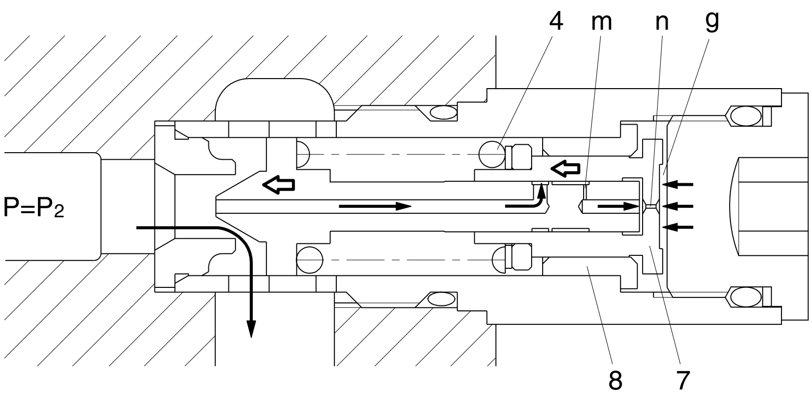
$P_1 \times A_1 = Fsp + Pg \times A_2$

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



2209A2SM27

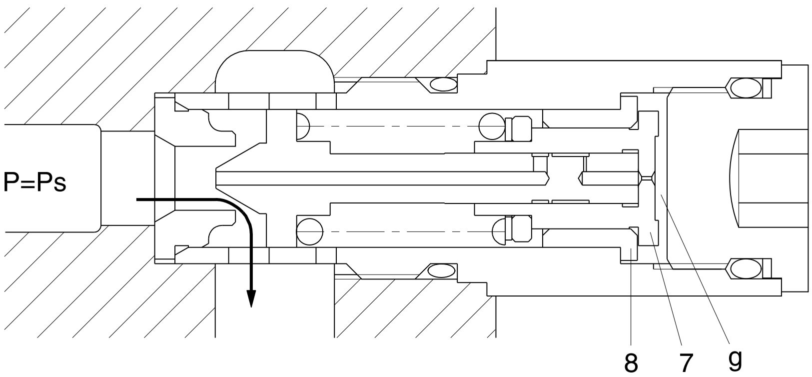
③ The oil flow chamber g via orifice m and n. When the pressure of chamber g reaches the preset force (F_{SP}) of spring (4), the piston (7) moves left and stop the piston (7) hits the bottom of bushing (8).



2209A2SM28

④ When piston (7) hits the bottom of bushing (8), it stops moving to the left any further. As the result, the pressure in chamber (g) equals (Ps).
$Ps \times A_1 = Fsp + Ps \times A_2$

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



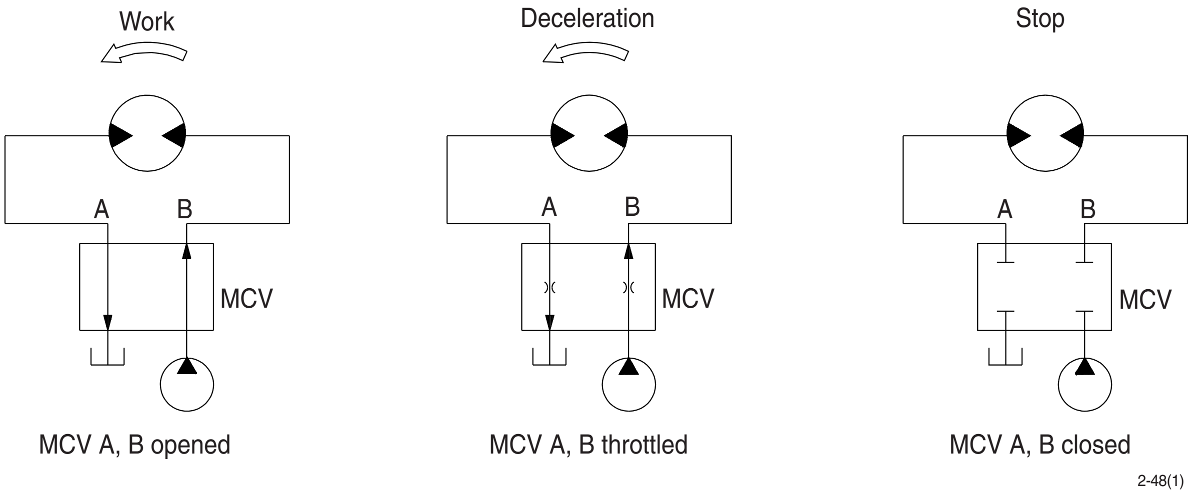
2209A2SM29

4) BRAKE SYSTEM

(1) Control valve swing brake system

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

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



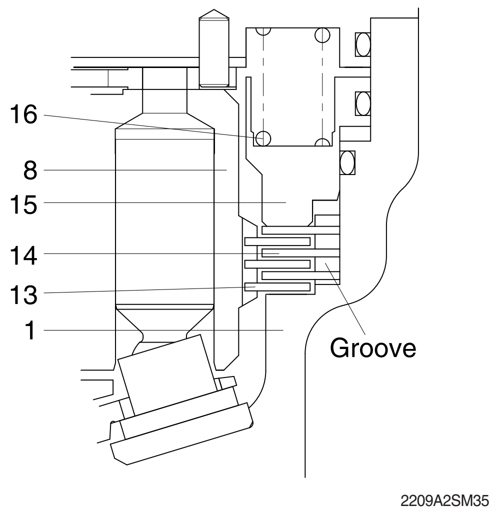
(2) Mechanical swing parking brake system

This is function as a parking brake only when all of the RCV lever (except swing, arm in) are not operated.

① Brake assembly

Circumferential rotation of separate plate (14) is constrained by the groove located at casing (1). When housing is pressed down by brake spring (16) through friction plate (13), separate plate (14) and parking piston (15), friction force occurs there.

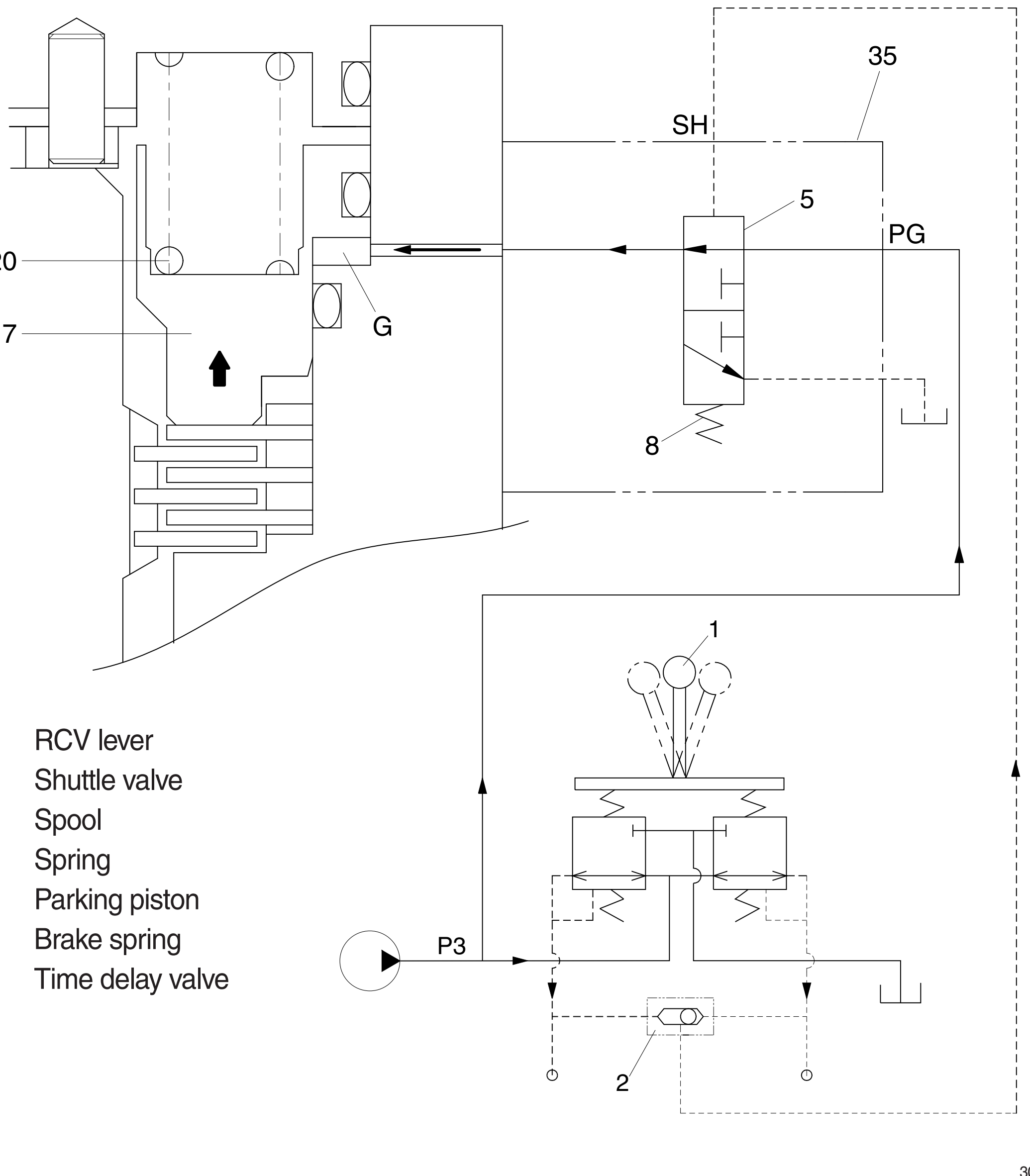
Cylinder block (8) is constrained by this friction force and brake acts, while brake releases when hydraulic force exceeds spring force.



1	Casing	14	Separate plate
8	Cylinder block	15	Parking piston
13	Friction plate	16	Brake spring

② Operating principle

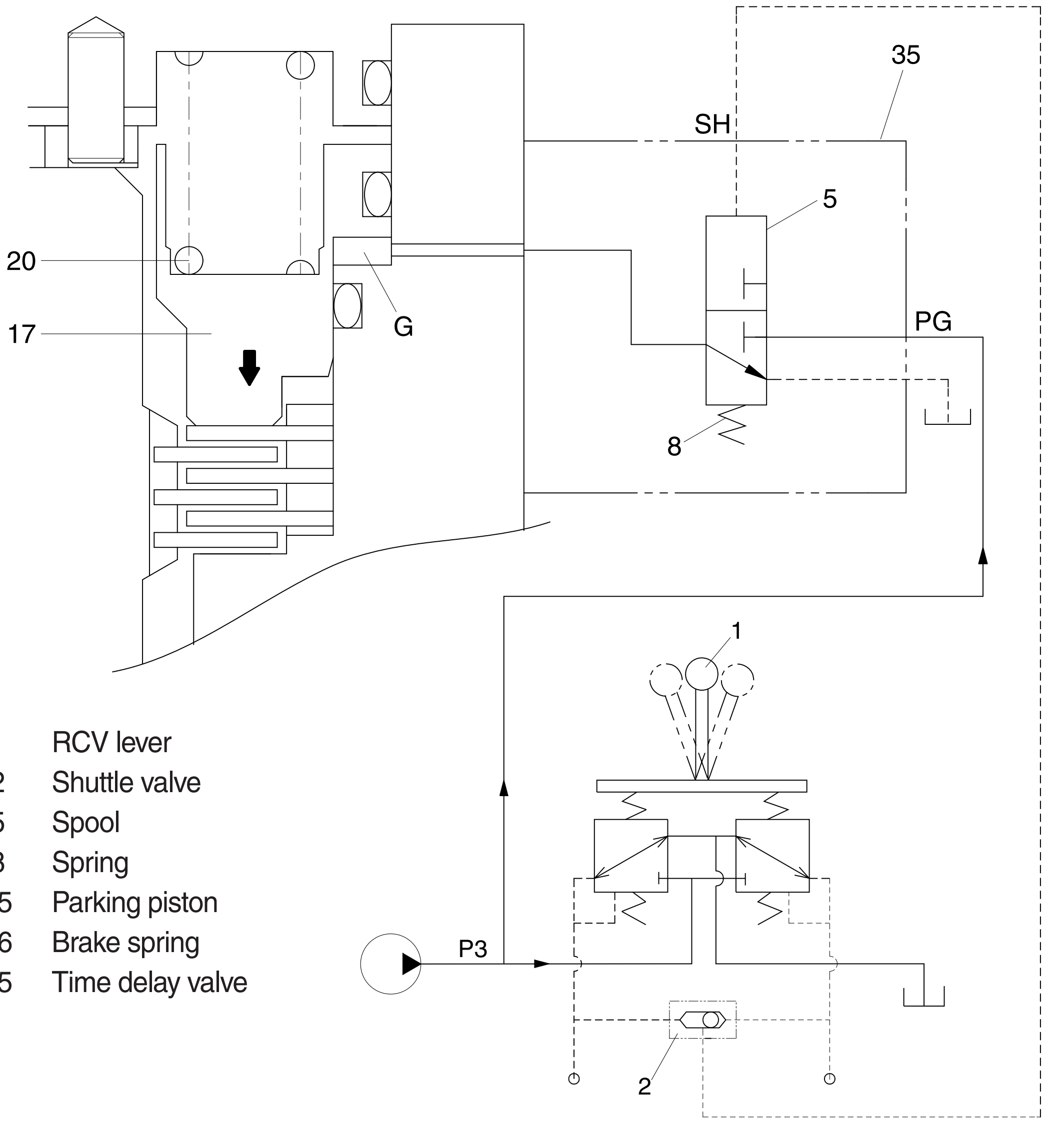
a. When the RCV lever (1) is set to the swing or arm in operating position, the pilot oil go to SH of the time delay valve (35).
   This pressure moves spool (5) to the leftward against the force of the spring(8), so pilot pump charged oil (P3) goes to the chamber G through port PG.
   This pressure is applied to move the parking piston (15) to the upward against the force of the brake spring (16). Thus, it releases the brake force.



1	RCV lever
2	Shuttle valve
5	Spool
8	Spring
15	Parking piston
16	Brake spring
35	Time delay valve

300L2SM04

b. When all of the RCV lever (1) are set the neutral position, the spool (5) returns to the top.
Then, the parking piston (15) is moved lower by spring force and the return oil from the chamber G flows back to tank port.
At this time, the brake works.



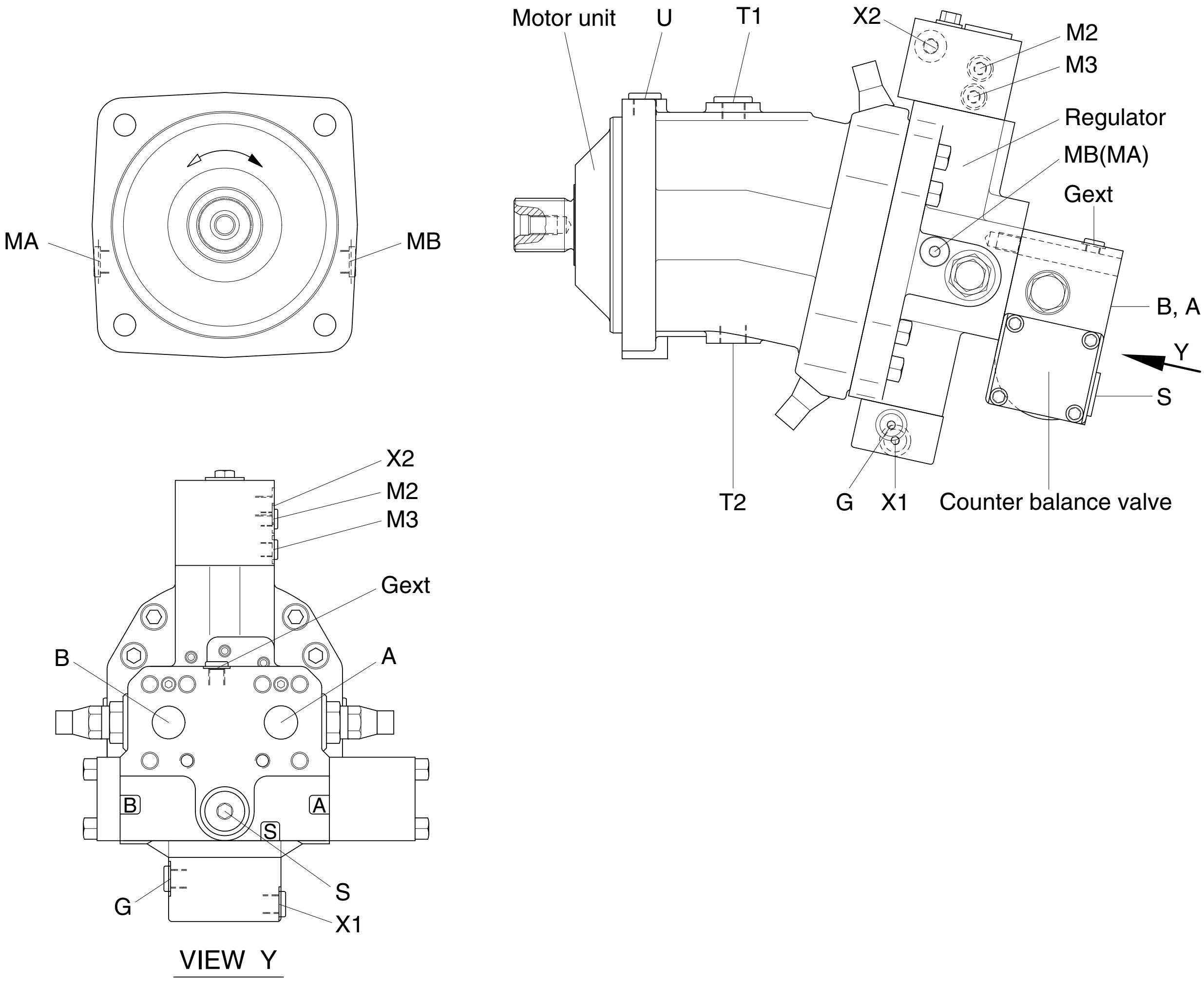
1	RCV lever
2	Shuttle valve
5	Spool
8	Spring
15	Parking piston
16	Brake spring
35	Time delay valve

300L2SM05

GROUP 4 TRAVEL MOTOR

1. CONSTRUCTION

Travel motor consists motor unit, regulator and counter balance valve.



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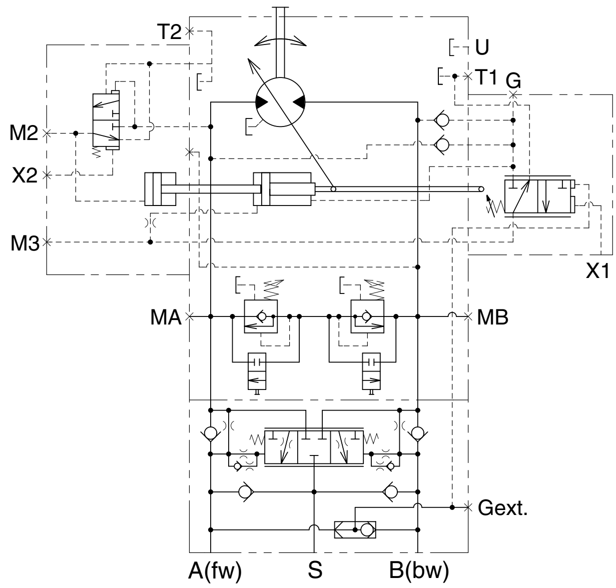
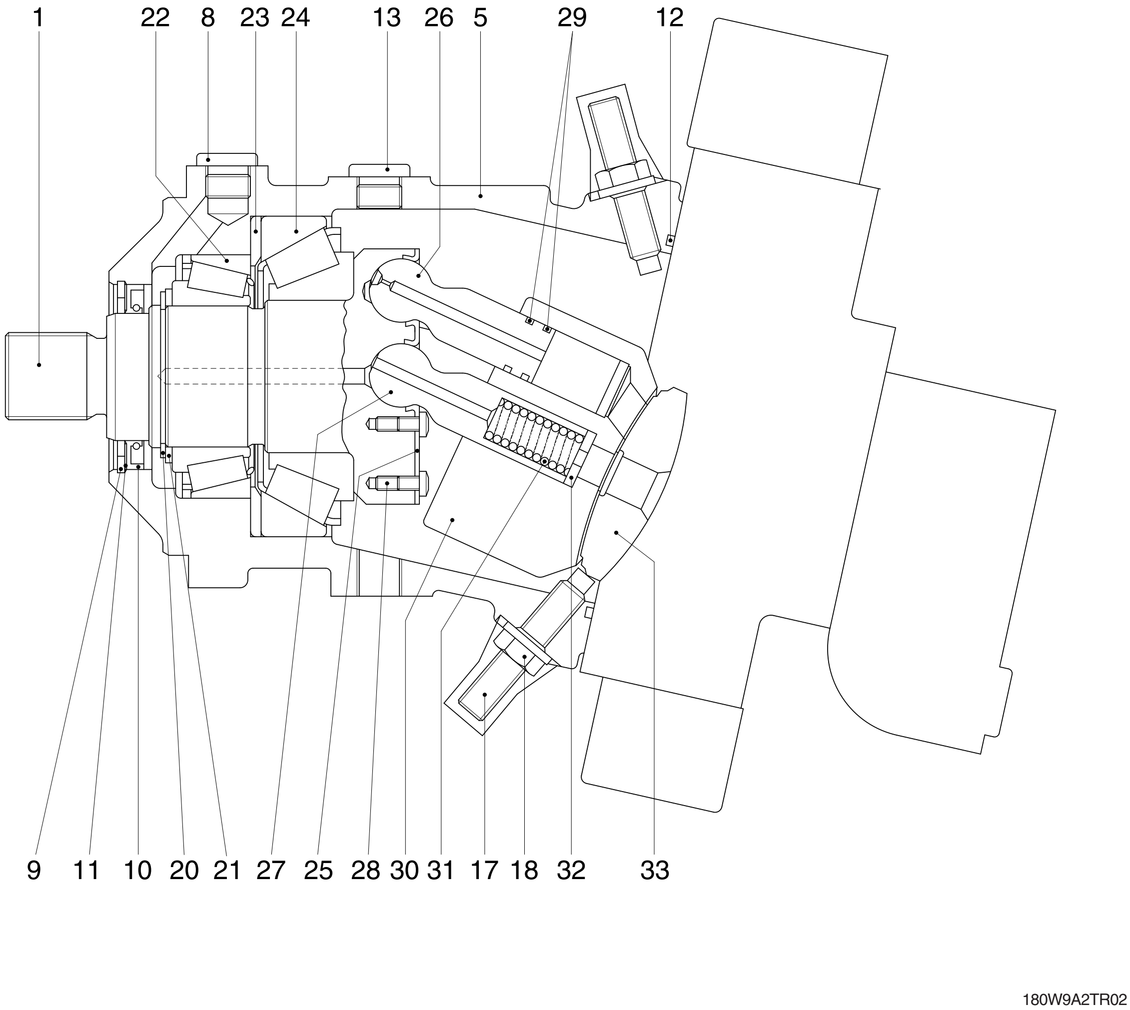


Hydraulic circuit

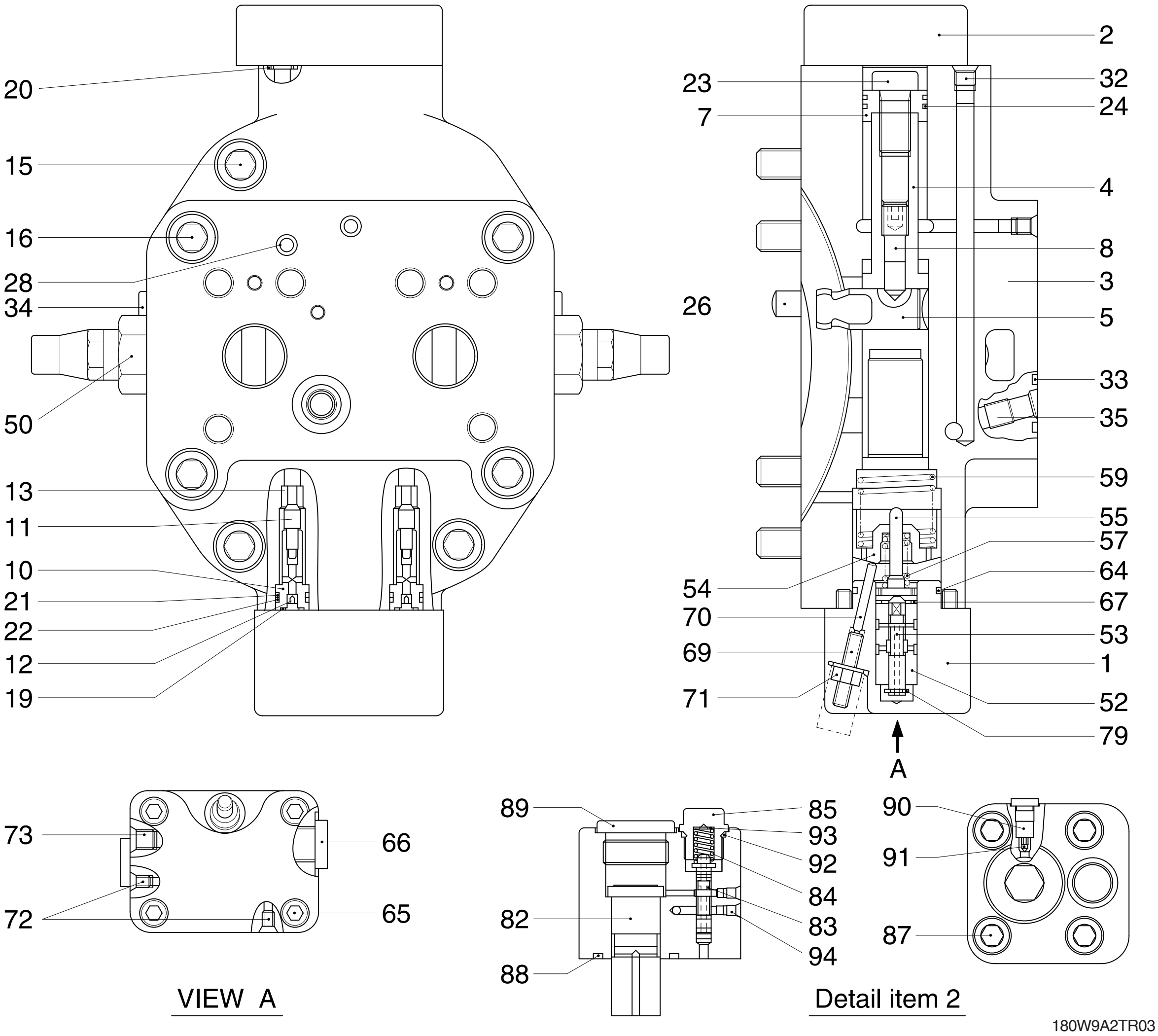
Port	Port name	Port size
A, B	Main port	SAE 1 1/4"
G	N.A	M14×1.5 - 12
M1	Gauge port	M14×1.5 - 12
X1	Pilot pressure port	M14×1.5 - 12
X2	Pilot pressure port	M14×1.5 - 12
T1	Drain port	PF 3/4 - 17
T2	Drain port	PF 3/4 - 12
U	Flushing port	PF 1/2 - 16
S	Make up port	M27×2.0 - 16
MA, MB	Gauge port	M18×1.5 - 12
M2, M3	Gauge port	M10×1.0 - 8
Gext	Brake release port	M12×1.5 - 12.5

1) MOTOR UNIT



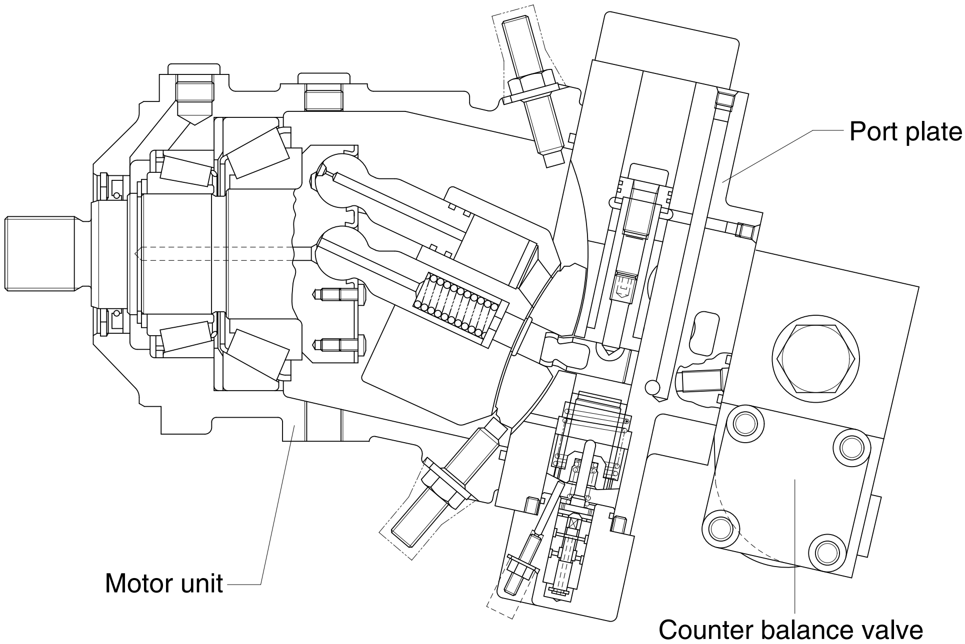
1	Drive shaft	17	Threaded pin	26	Piston
5	Housing	18	Seal lock nut	27	Center pin
8	Locking screw	20	Retaining ring	28	Pan head screw
9	Retaining ring	21	Back up plate	29	Steel sealing ring
10	Shaft seal ring	22	Taper roller bearing	30	Cylinder block
11	Back up plate	23	Shim	31	Pressure spring
12	O-ring	24	Taper roller bearing	32	Adjustment shim
13	Locking screw	25	Retaining plate	33	Control lens

2) REGULATOR



1	Control housing	24	Square ring	70	Cylinder pin
2	Stroke limiter	26	Cylinder pin	71	Seal lock nut
3	Port plate	28	Double break off pin	72	Double break off pin
4	Positioning piston	32	Double break off pin	73	Double break off pin
5	Positioning trunnion	33	O-ring	79	Retaining disc
7	Piston	34	Locking screw	82	Piston
8	Threaded pin	50	Relief valve	83	Control piston
10	Valve guide	52	Control bushing	84	Pressure spring
11	Bolt	53	Control piston	85	Locking screw
12	Throttle screw	54	Adjusting bushing	87	Socket head screw
13	Bushing	55	Spring collar	88	O-ring
15	Socket head screw	57	Pressure spring	89	Locking screw
16	Socket head screw	59	Pressure spring	90	Locking screw
19	O-ring	64	O-ring	91	Orifice
20	O-ring	65	Socket head screw	92	O-ring
21	O-ring	66	Locking screw	93	Shim
22	Back up ring	67	Retaining ring	94	Double break off pin
23	Socket head screw	69	Threaded pin		

2. FUNCTION



180W9A2TR05

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.

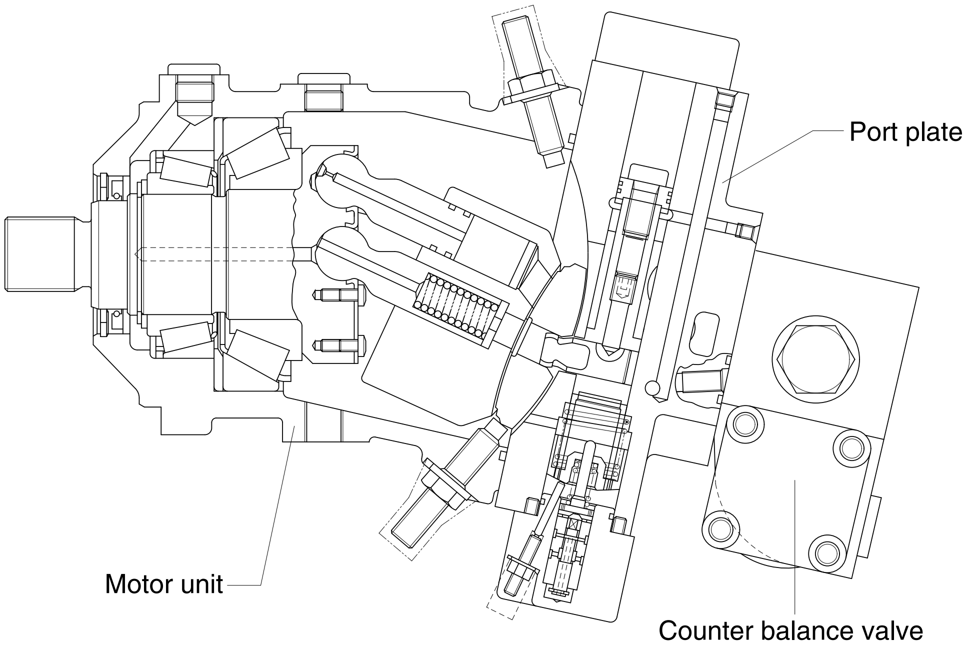
In case of constant pump flow volume and high pressure
- The output speed is increased at smaller swivel angle, the torque is reduced
- The torque rises at swivel angle increase, the output speed is decreased

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.



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) COUNTER BALANCE VALVE

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

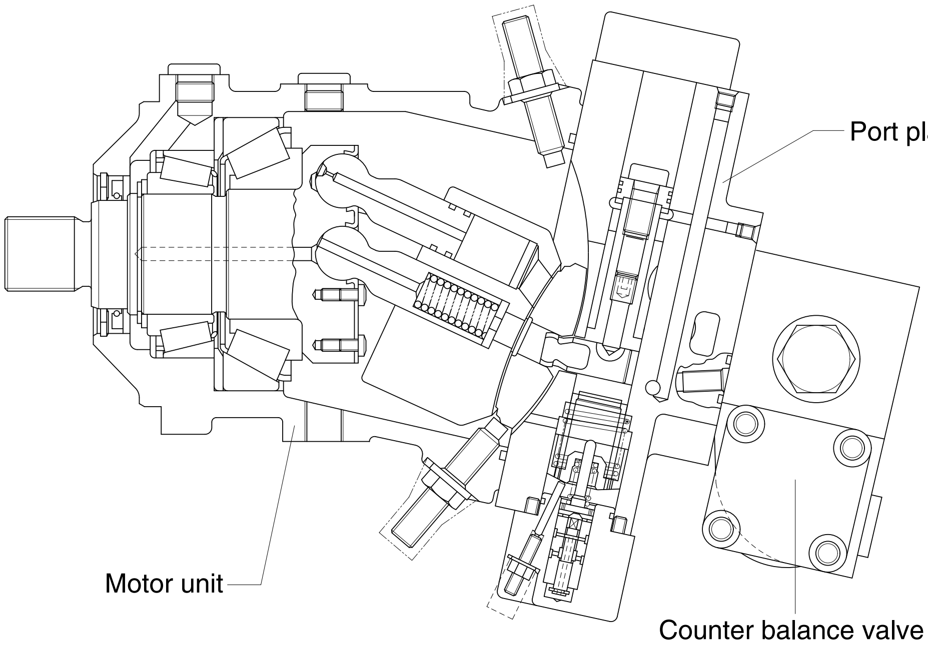
5) FUNCTION AS TO CIRCUIT DIAGRAM

Check valves in the inlet line A and B for by passing of the counter balance valve.
At traveling forward the return oil flow is controlled by a counter balance spool. At drop in inlet pressure the counter balance 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 counter balance 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.

※ Counter balance valves do not replace the service and parking brake.



180W9A2TR05

6) INSTALLATION

The housing must be filled entirely with oil and shall also not run empty at rotary group standstill.

7) FILTRATION

According to purity class 9 as to NAS 1638, 6 as to SAE, ASTM, AIA and 18/15 as to ISO/DIS 4406.

8) PRESSURE

Ports A or B : Normal 400 bar, peak pressure 450 bar

Port A + B : Pressure summation below 700 bar

Max permissible intermittent case pressure : 6 bar

9) DIRECTION OF ROTATION/ DIRECTION OF FLOW

With view on the drive shaft - clockwise/ A to B; Counter-clockwise / B to A

10) LEAKAGE OIL TEMPERATURE

In the bearing area max permitted -25 °C to +80 °C; Short time operation -40 °C to +115 °C

11) COMMISSIONING

Fill the housing entirely with oil through highest located T port. Also connect the leakage oil pipe at this port. After commissioning check sealing and make visual control of the complete installation.

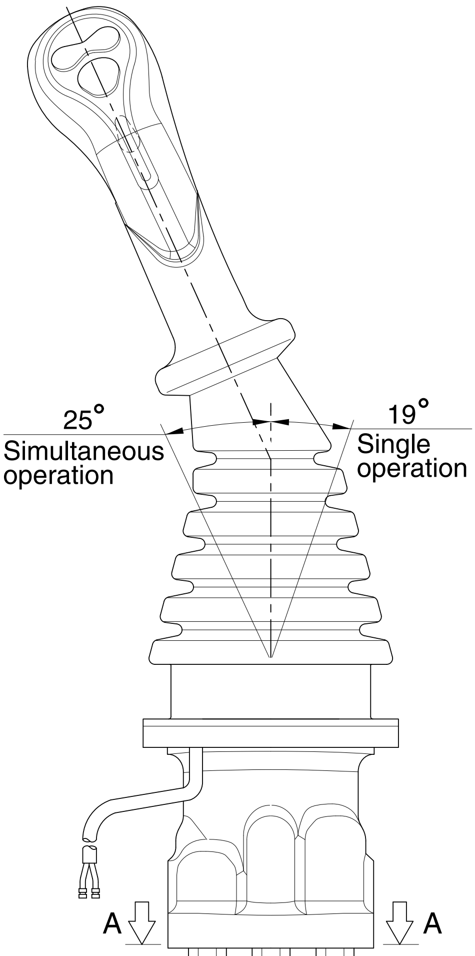
GROUP 5 RCV LEVER

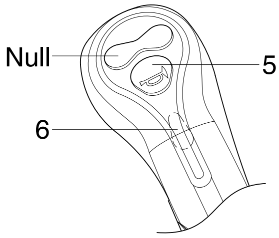
1. STRUCTURE

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.

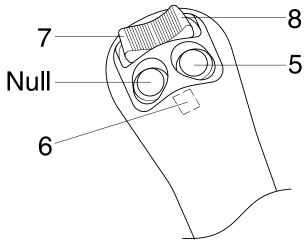
※ **Refer to the parts manual for the types of the RCV lever.**

1) TYPE M1, M3, M5





TYPE M1, M3

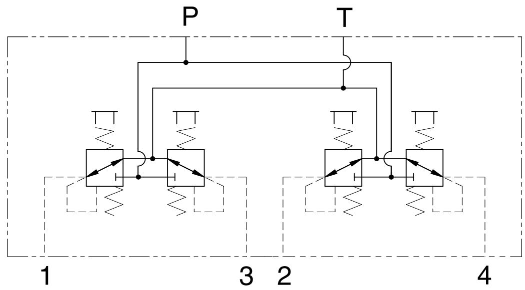


TYPE M5

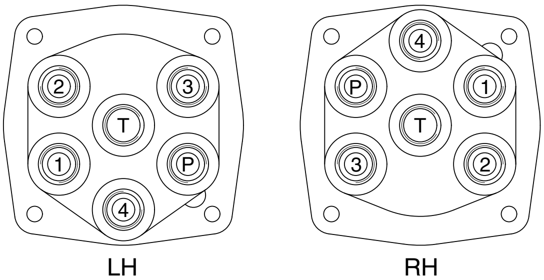
Switches

Type	No.	LH	RH
M1, M3	5	One touch decel	Horn
	6	Power boost	Breaker
M5	5	One touch decel	Horn
	6	Power boost	Null
	7	CCW rotation	Close
	8	CW rotation	Open

※ Number 7 and 8 : Option attachment



Hydraulic circuit



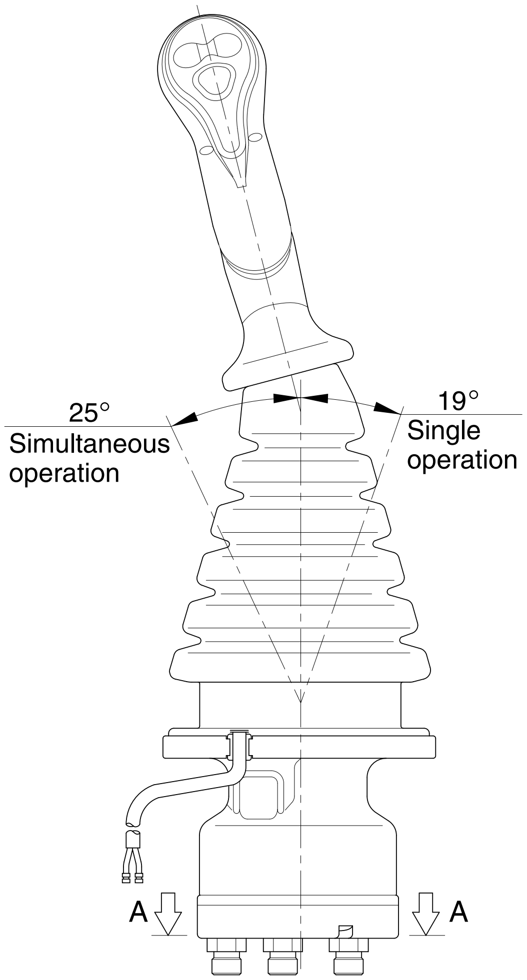
VIEW A-A

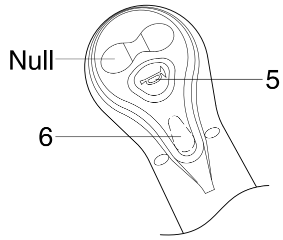
Pilot ports

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

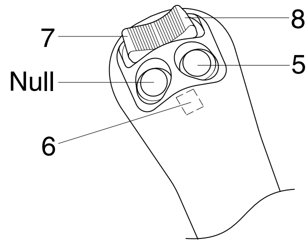
300L2RL01

2) TYPE M2, M4, M6





TYPE M2, M4

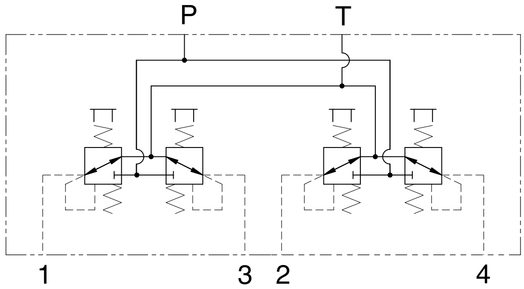


TYPE M6

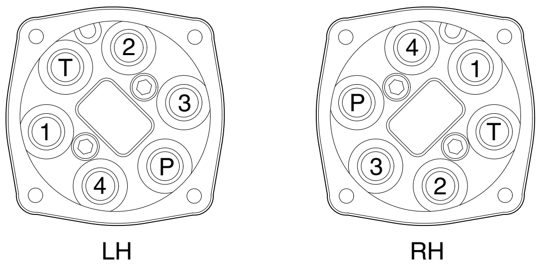
Switches

Type	No.	LH	RH
M2, M4	5	One touch decel	Horn
	6	Power boost	Breaker
M6	5	One touch decel	Horn
	6	Power boost	Null
	7	CCW rotation	Close
	8	CW rotation	Open

※ Number 7 and 8 : Option attachment



Hydraulic circuit



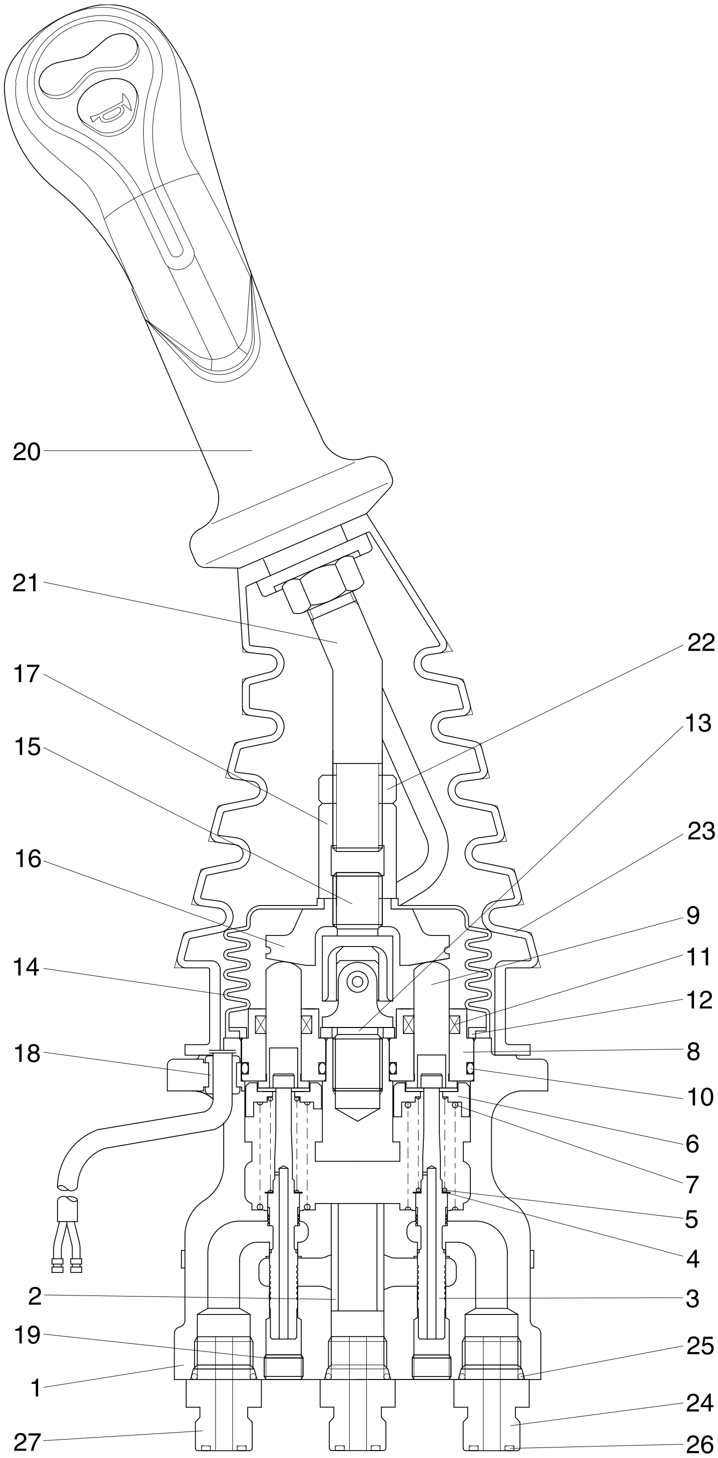
VIEW A-A

Pilot ports

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

300L2RL05

3) CROSS SECTION



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

300L2RL06

Item numbers are based on the type M1.

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

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

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

2. FUNCTIONS

1) FUNDAMENTAL FUNCTIONS

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

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

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

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

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

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

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

2) FUNCTIONS OF MAJOR SECTIONS

Item numbers are based on the type M1.

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

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

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

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

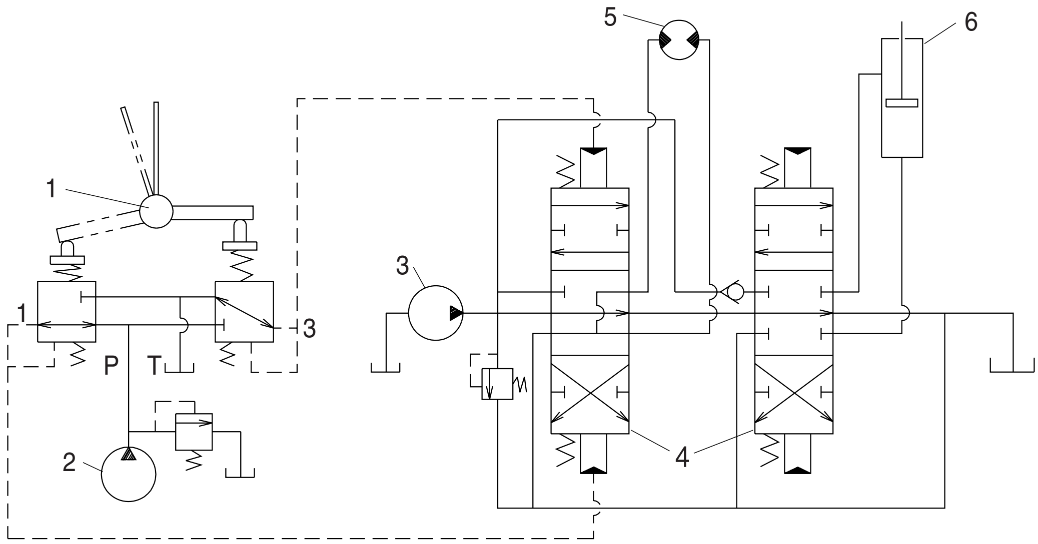
The spring (7) works on the case (1) and spring seat (6) and tries to return the push rod (9) to the zero-displacement position irrespective of the output pressure, securing its resetting to the center position.

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

3) OPERATION

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

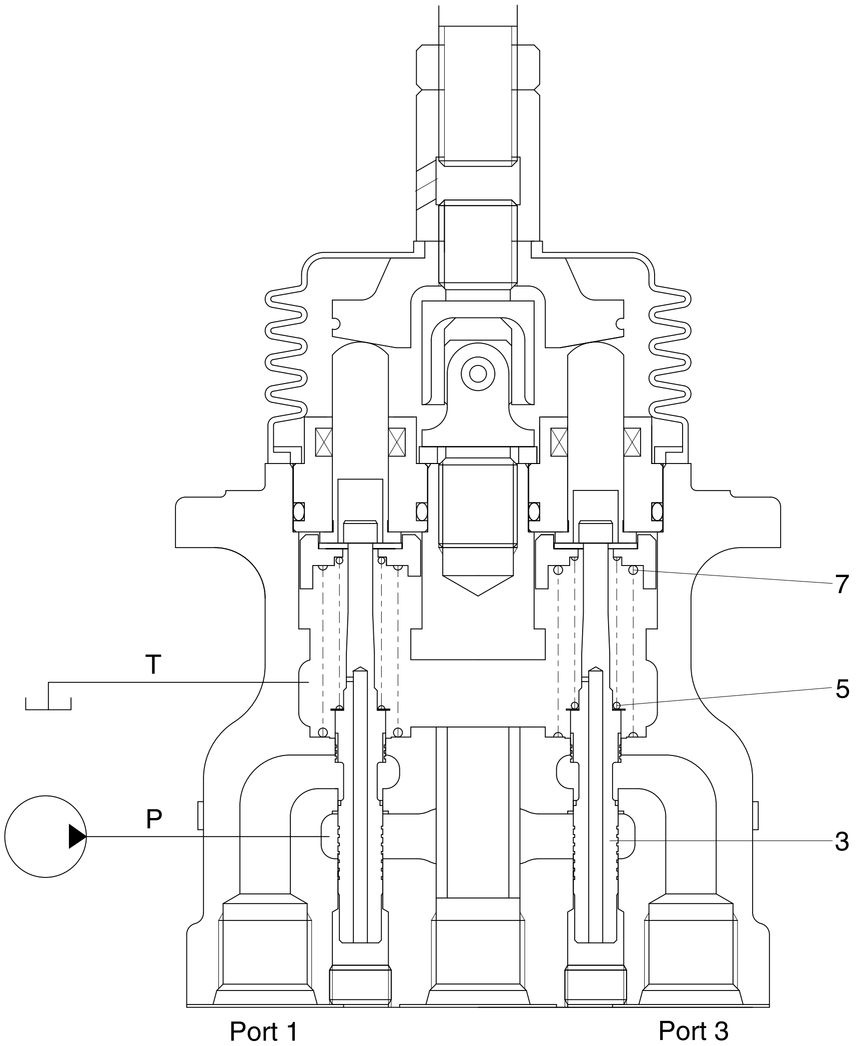
The diagram shown below is the typical application example of the pilot valve.



2-70

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

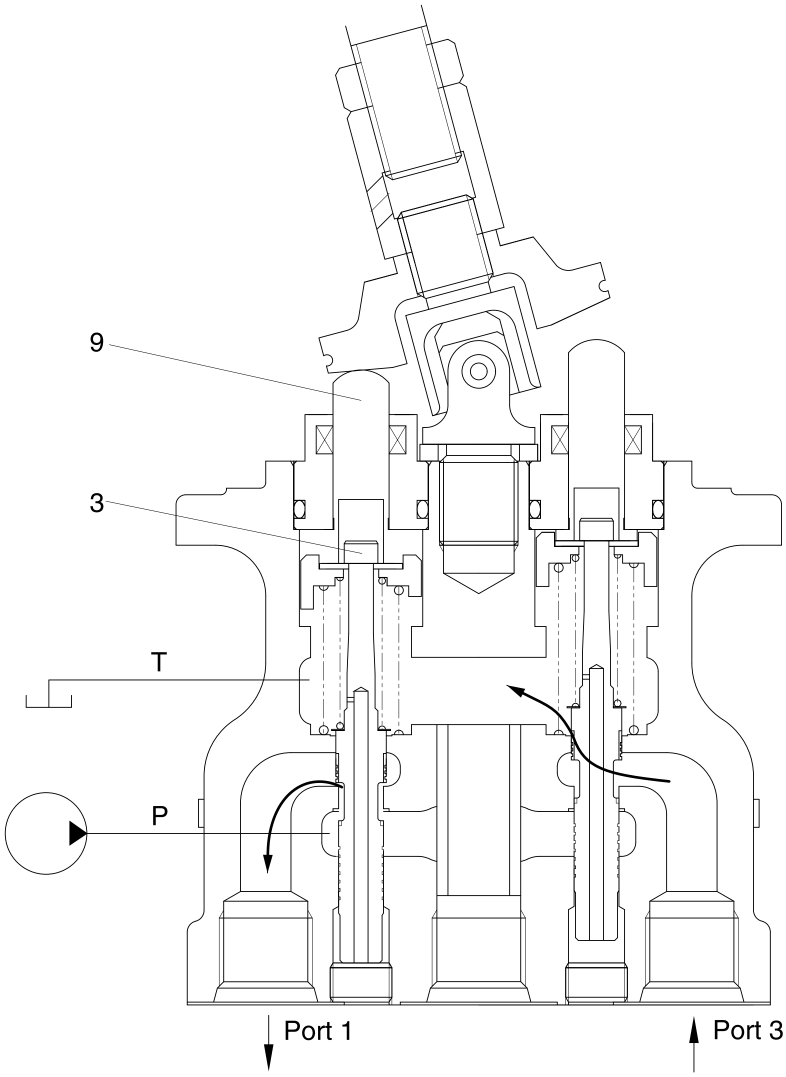
(1) Case where handle is in neutral position



300L2RL03

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

(2) Case where handle is tilted



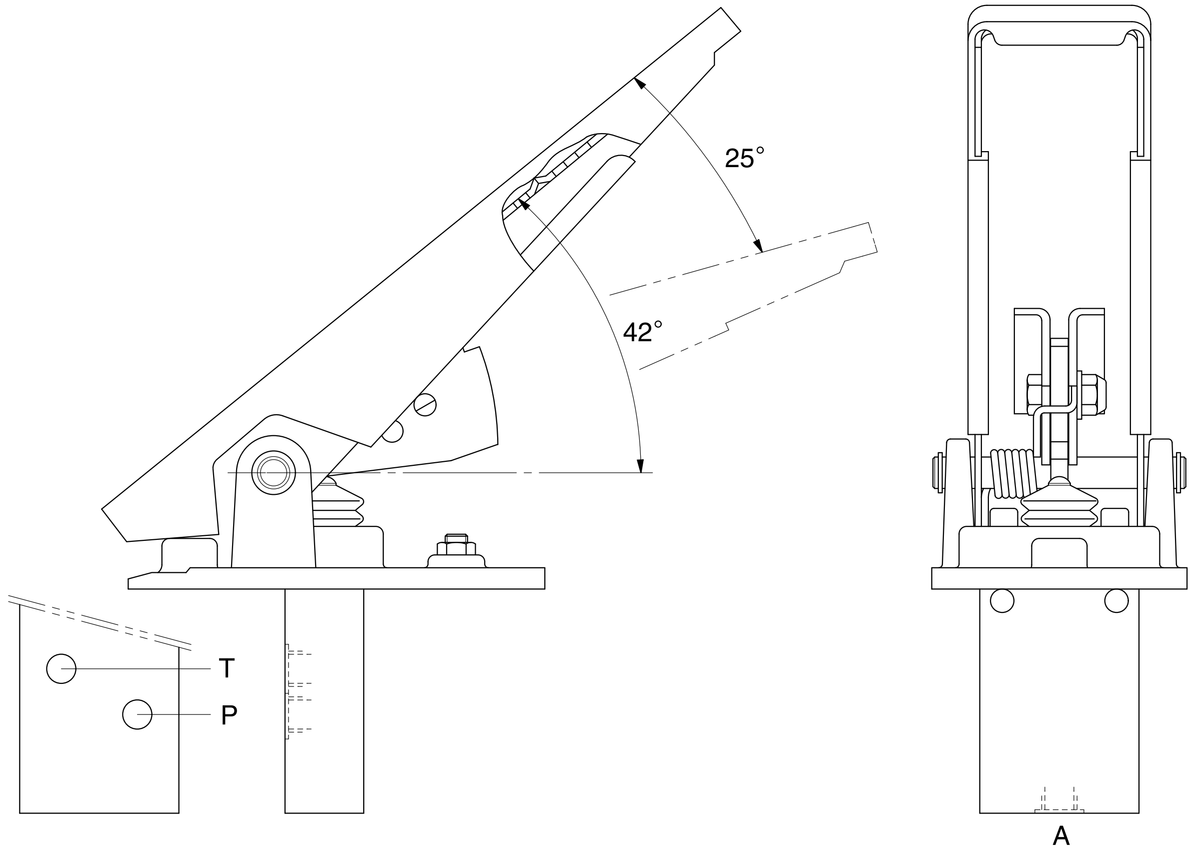
300L2RL04

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

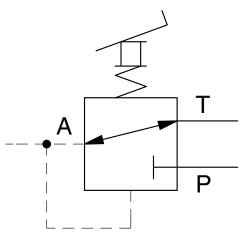
GROUP 6 ACCELERATOR PEDAL

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.



17032RP01



Hydraulic circuit

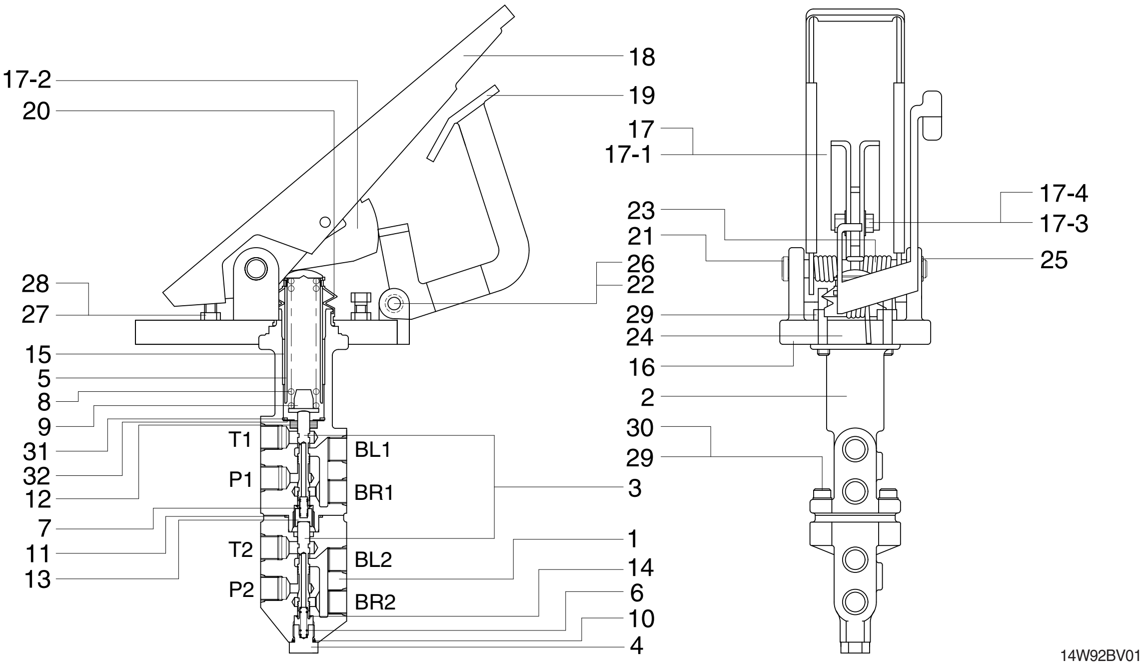
17032RP01(2)

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

GROUP 7 BRAKE PEDAL (VALVE)

1. STRUCTURE

The casing (spacer) has the oil inlet port A (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.

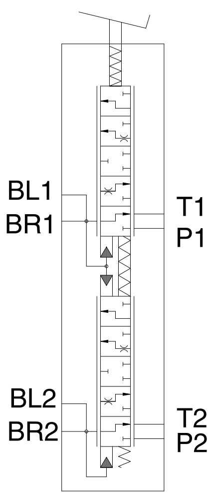


14W92BV01

1 Lower body
2 Upper body
3 Spool
4 Plug
5 Holder
6 Lower spring
7 Upper spring
8 Main spring
9 Spring retainer
10 O-ring
11 O-ring
12 Oil seal

13 Spring Guide
14 Snap ring
15 DU bushing
16 Pedal plate
17 Pedal assy
17-1 Pedal
17-2 Lock plate
17-3 Hex bolt
17-4 Plain washer
18 Pedal cover
19 Latch
20 Bellows

21 Lock pin 1
22 Lock pin 2
23 Torsion spring 1
24 Torsion spring 2
25 Retainer ring
26 E-ring
27 Hex bolt
28 Hex nut
29 Socket head bolt
30 Spring washer
31 Plat washer
32 Retainer ring



14W72BV02

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 spring assembly (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 spring assembly (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) 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

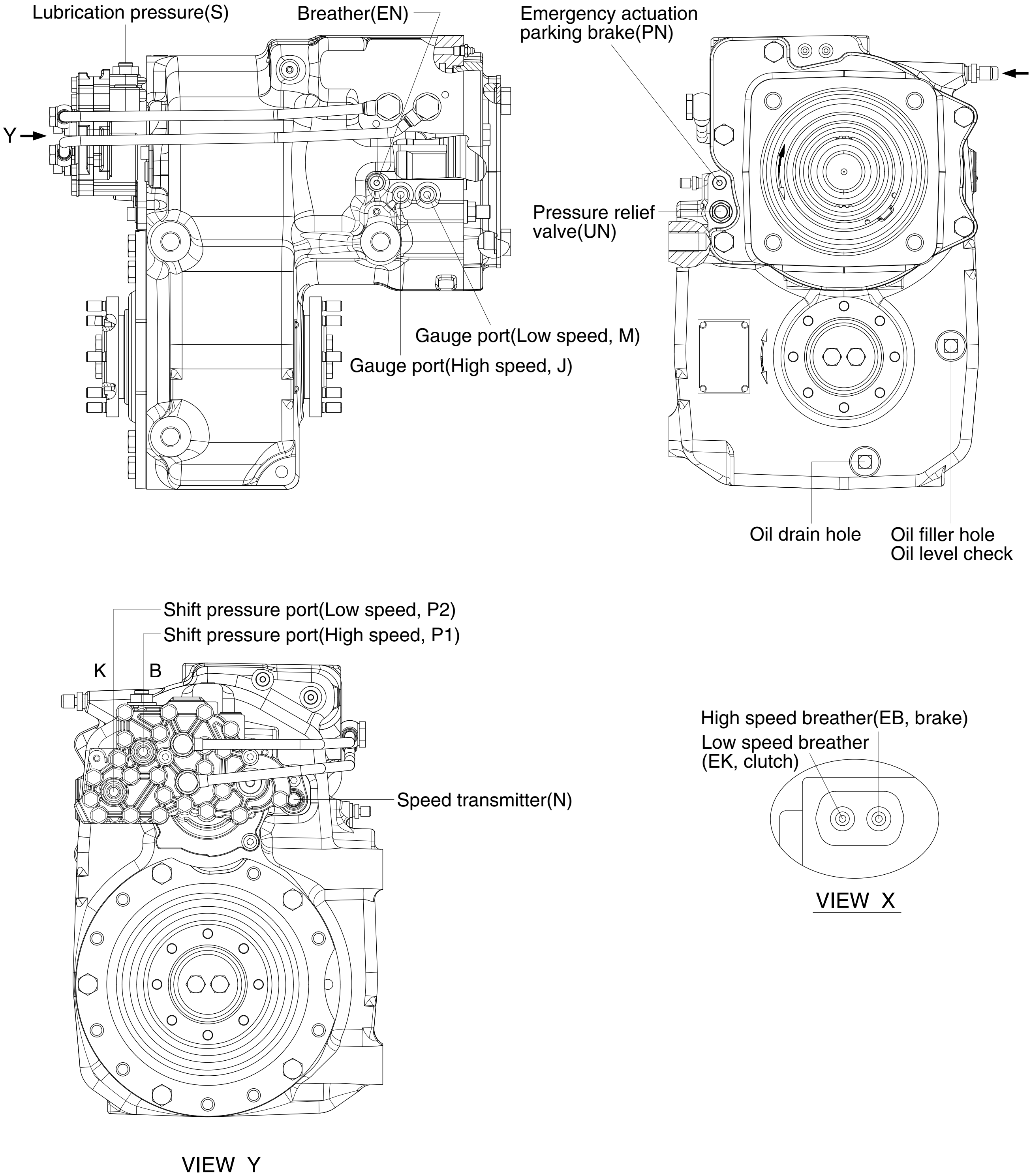
Pedal restriction screw (29) on pedal plate (16) below pedal (17) is used to limit the braking pressure.

6) FAILURE OF A CIRCUIT

In the event of the lower circuit failing, the upper circuit will remain operational. Spring assembly (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 spring assembly (8) and spool (3).

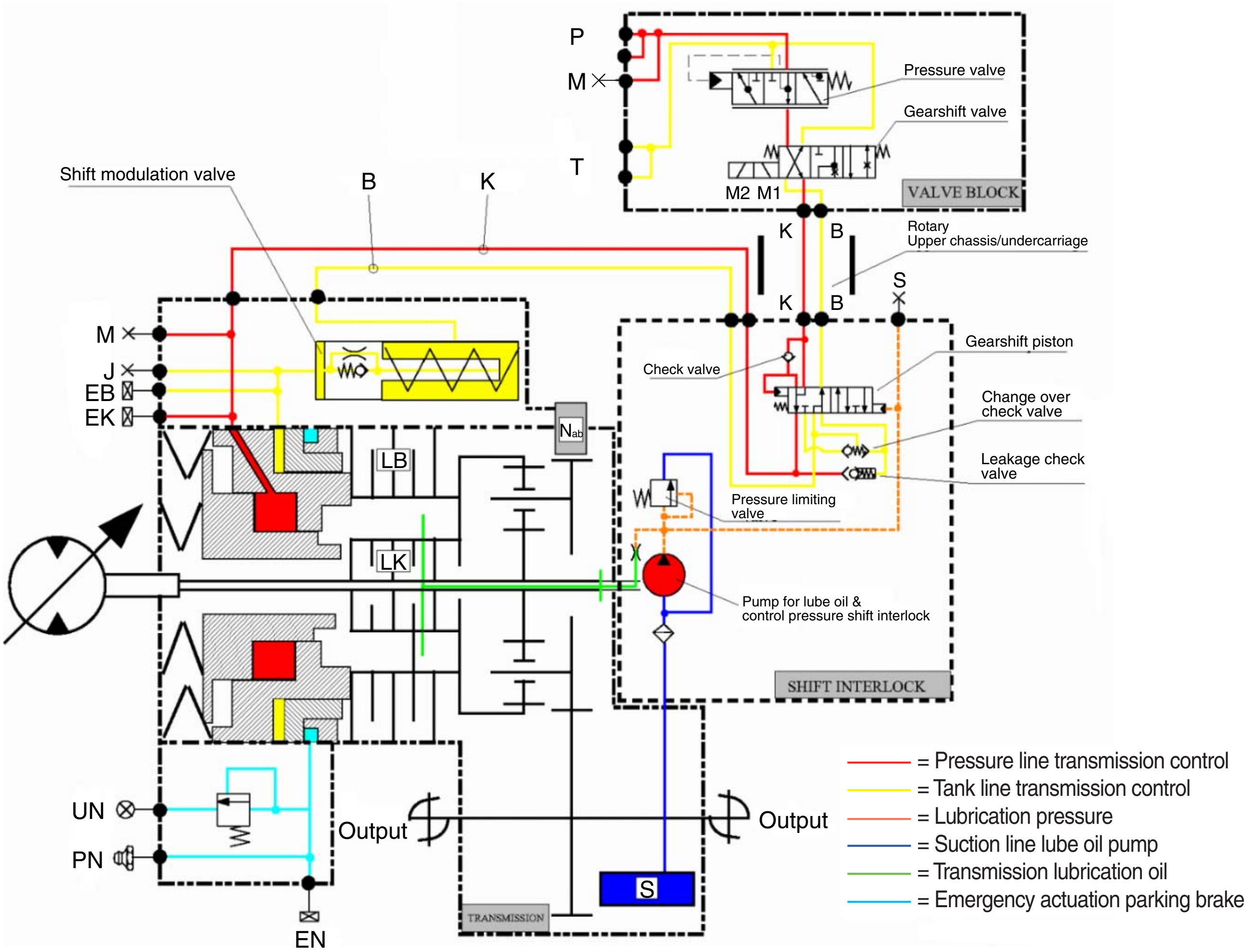
GROUP 8 TRANSMISSION

1. STRUCTURE



180W9A2TM01

2. TRANSMISSION DIAGRAM



14W7A2TM02

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

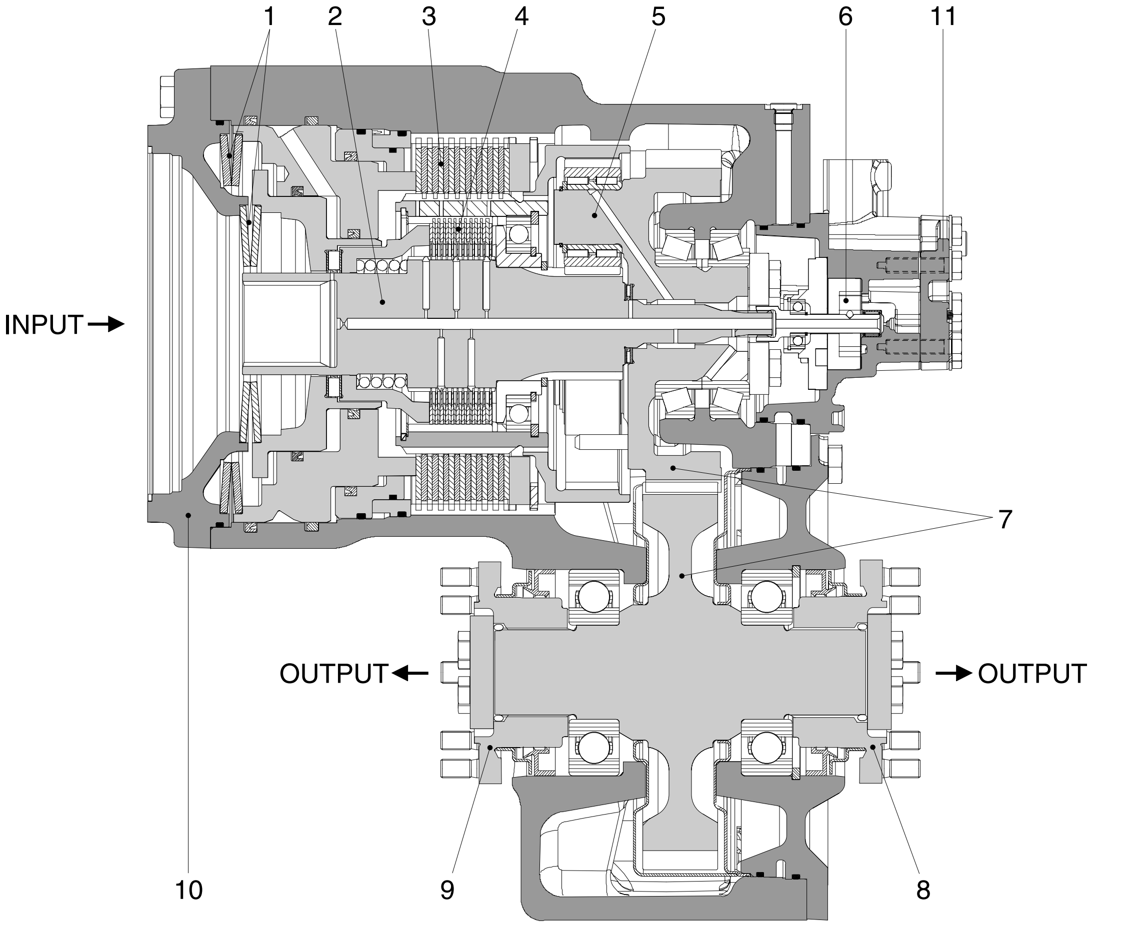
Connections-Valve block :
P : System pressure transmission control
T : Tank
B : Brake
K : Clutch

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		

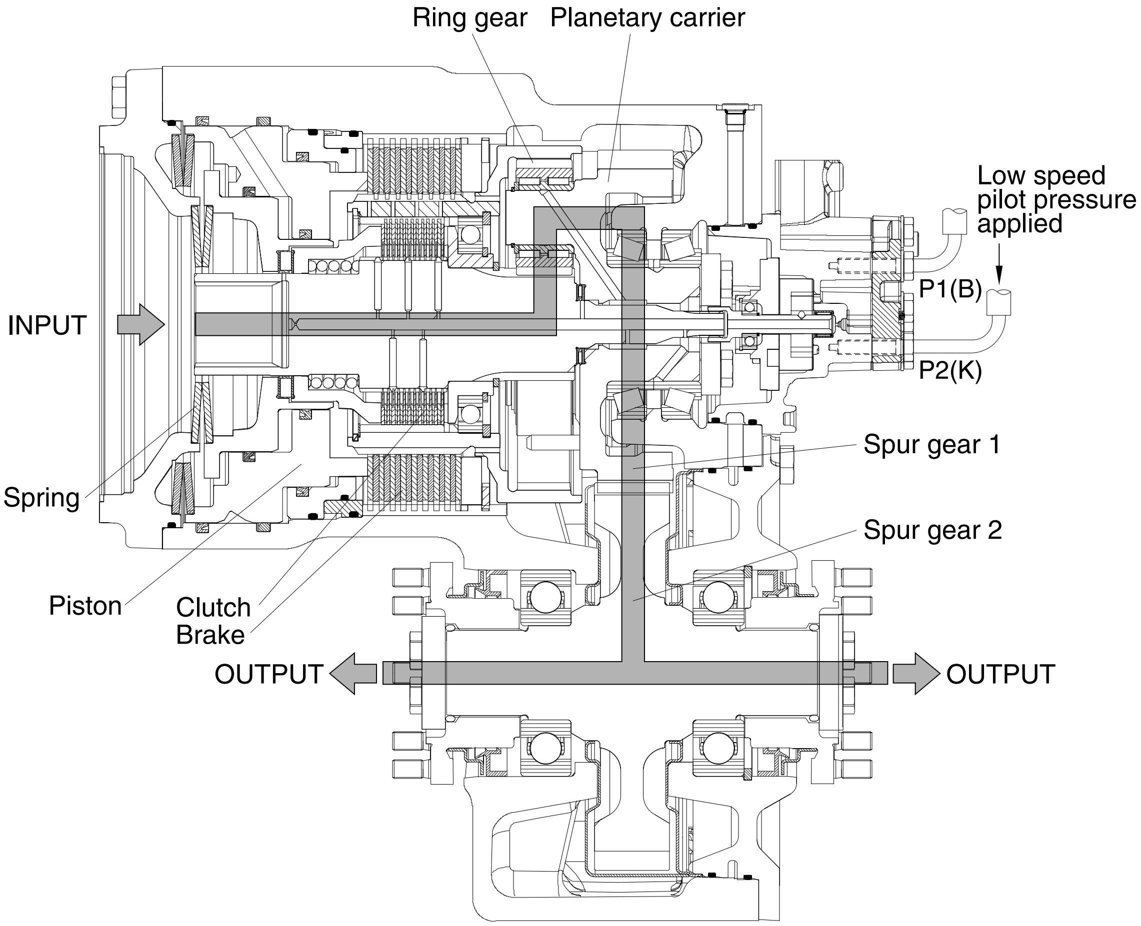
Coaxially-mounted variable displacement travel motor (10) with specific displacement 107 cm^3/rev.

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.

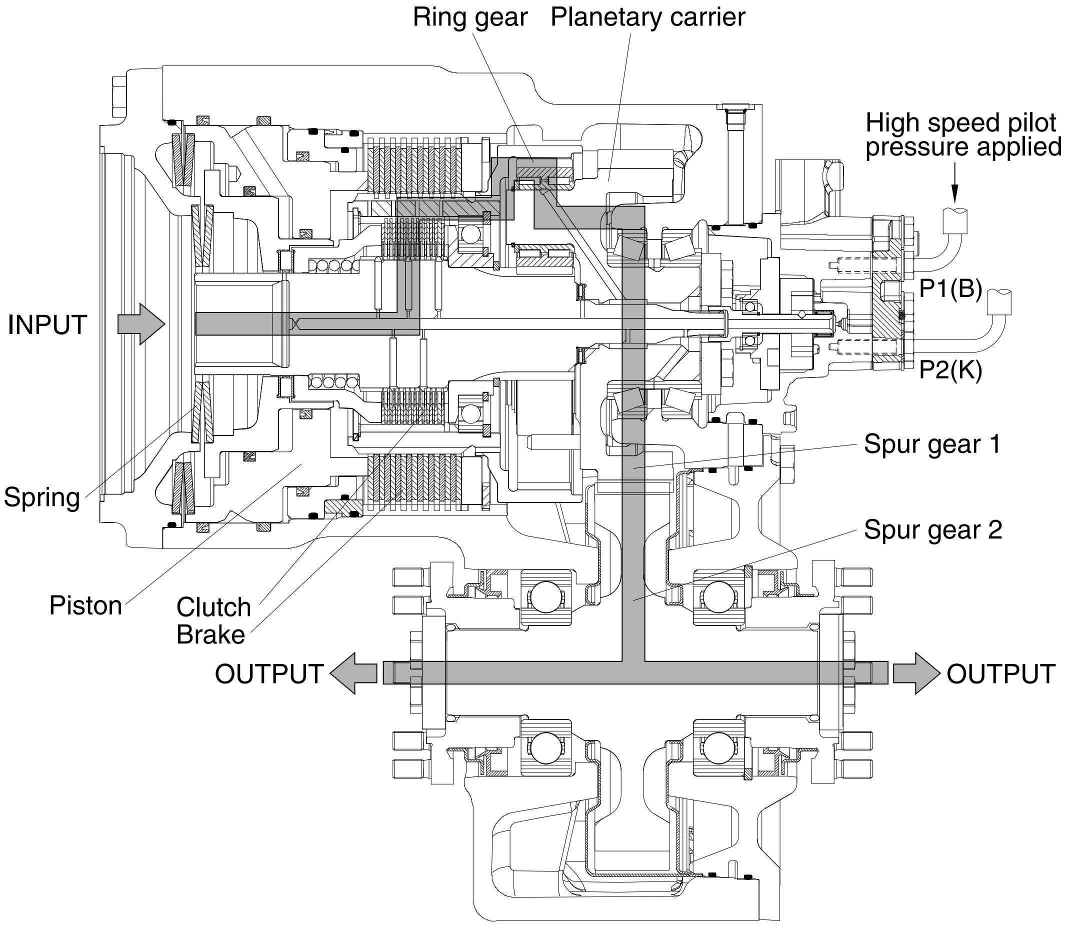
2) LOW SPEED (forward & reverse)



14W7A2TM04

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)



14W7A2TM05

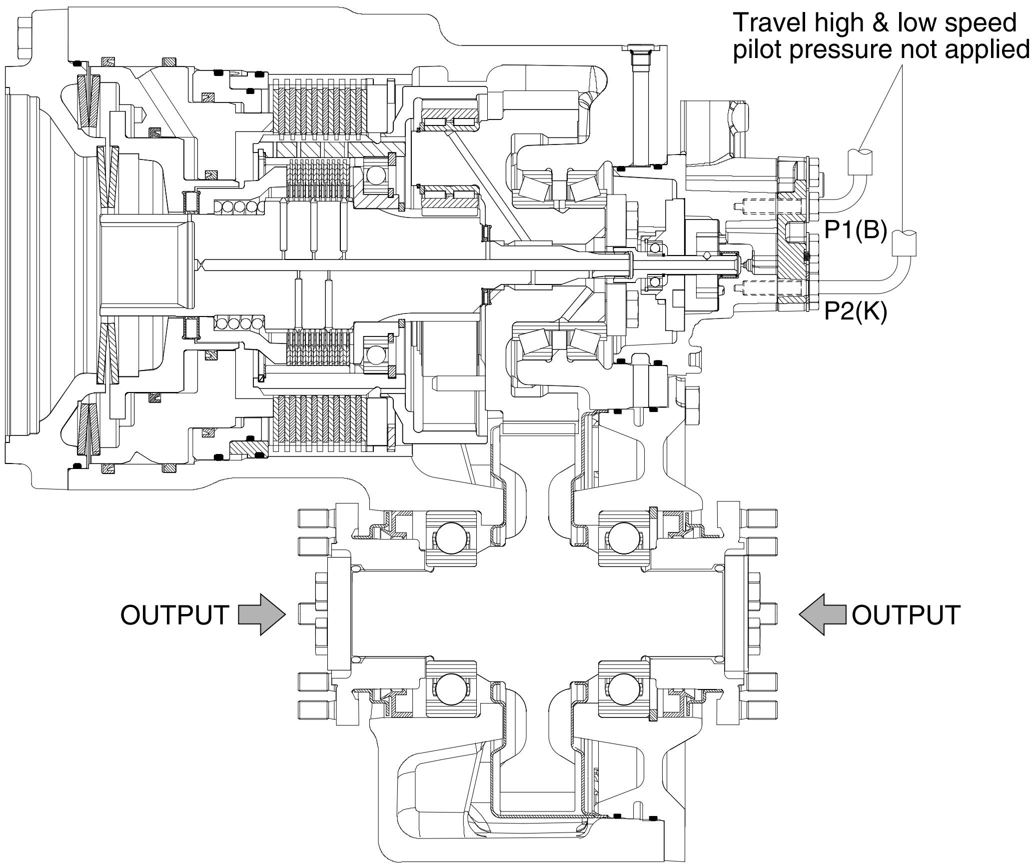
In high speed operation, the clutch is held closed under spring pressure and the brake is hydraulically opened.

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



14W7A2TM06

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

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+1 kgf/cm^2
② Definition of lubricants : API GL-5, SAE 10W-30, 15W-40

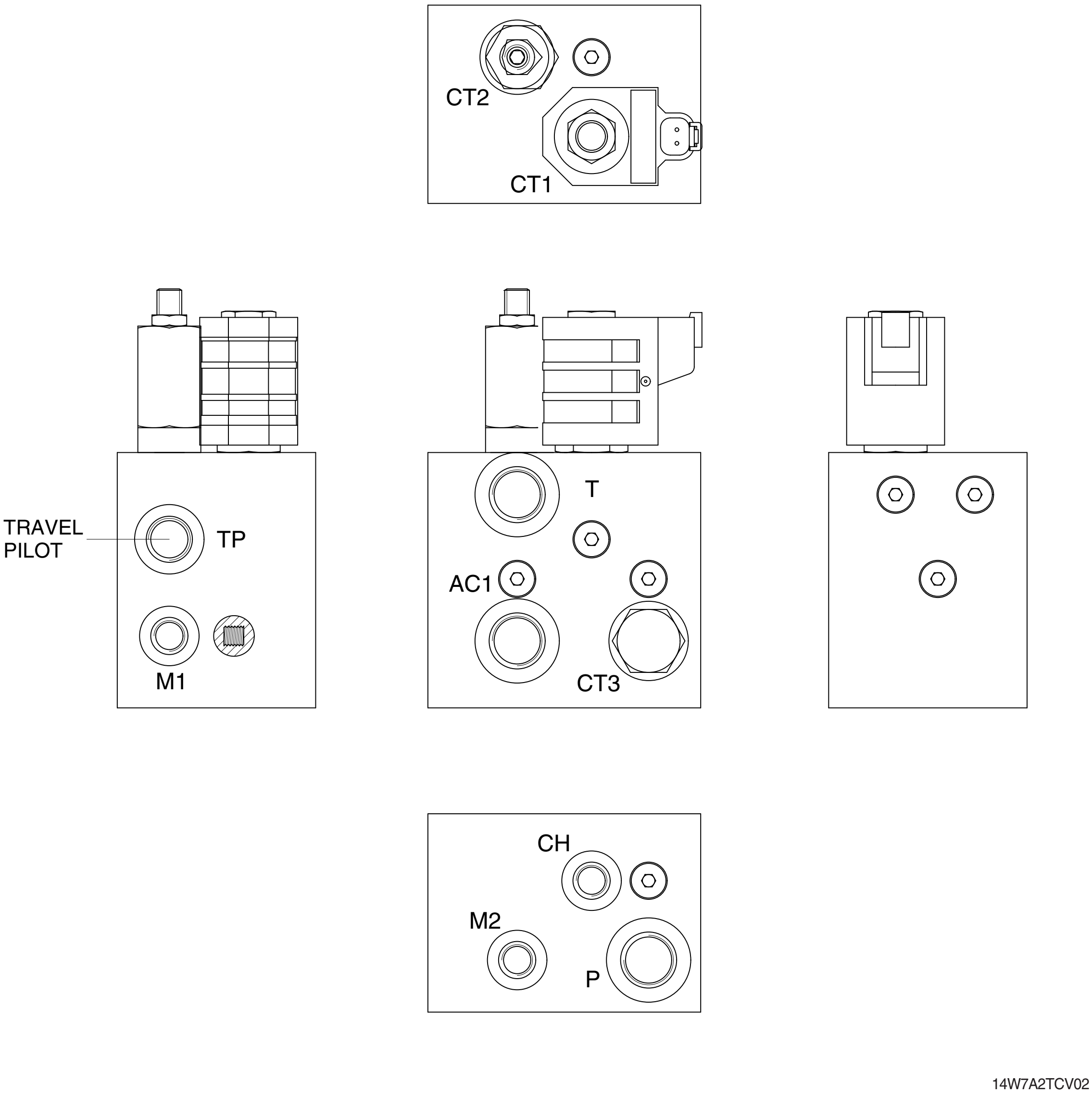
(2) Oil flow
① Min oil flow at 24+1 kgf/cm^2 counter pressure (low engine speed) : 5.5 l /min
② Max oil flow : 25 l /min

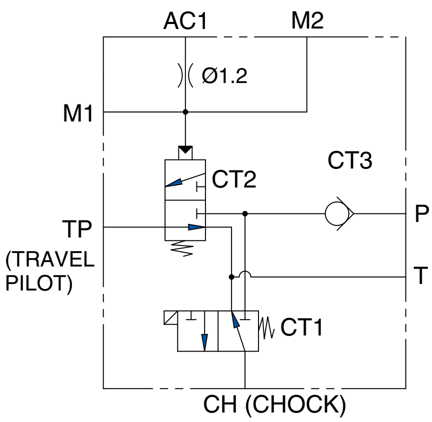
(3) Residual pressure
① Max residual pressure in control line to tank connection P1 and P2 : 1.0 kgf/cm^2

(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

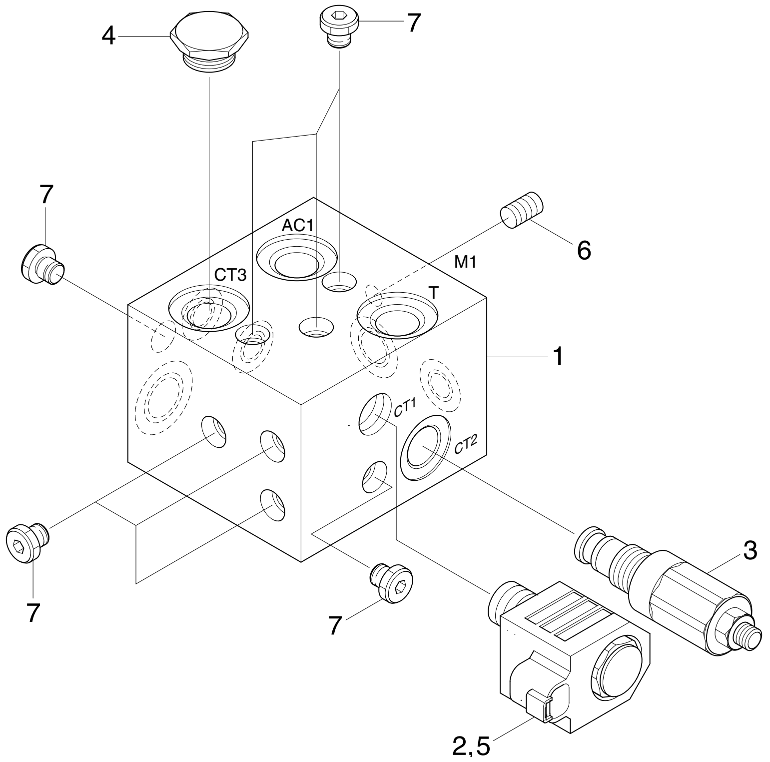




Hydraulic circuit

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

2. COMPONENT

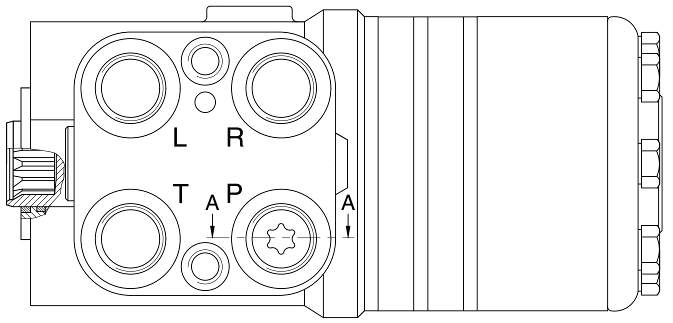


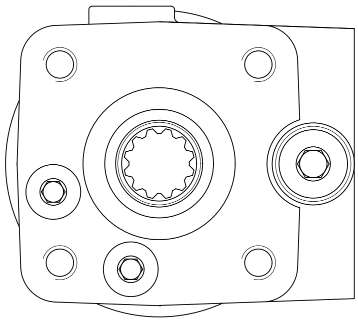
14W7A2TCV01

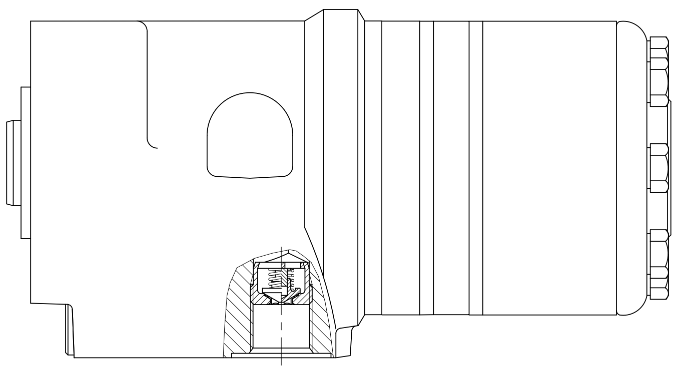
1	Body	5	Coil
2	Solenoid valve	6	Orifice
3	POD valve	7	Plug
4	Check valve		

GROUP 10 STEERING VALVE

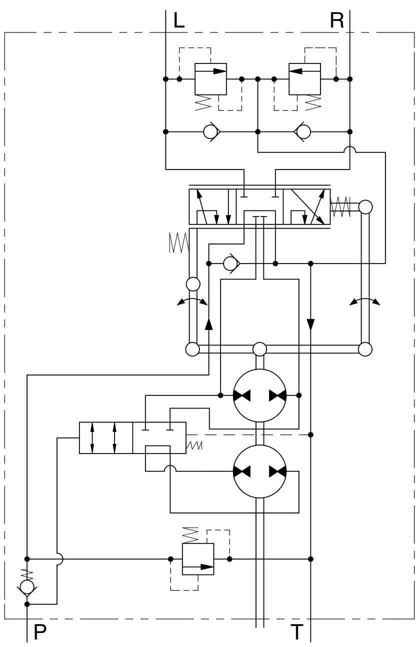
1. STRUCTURE







SECTION A-A

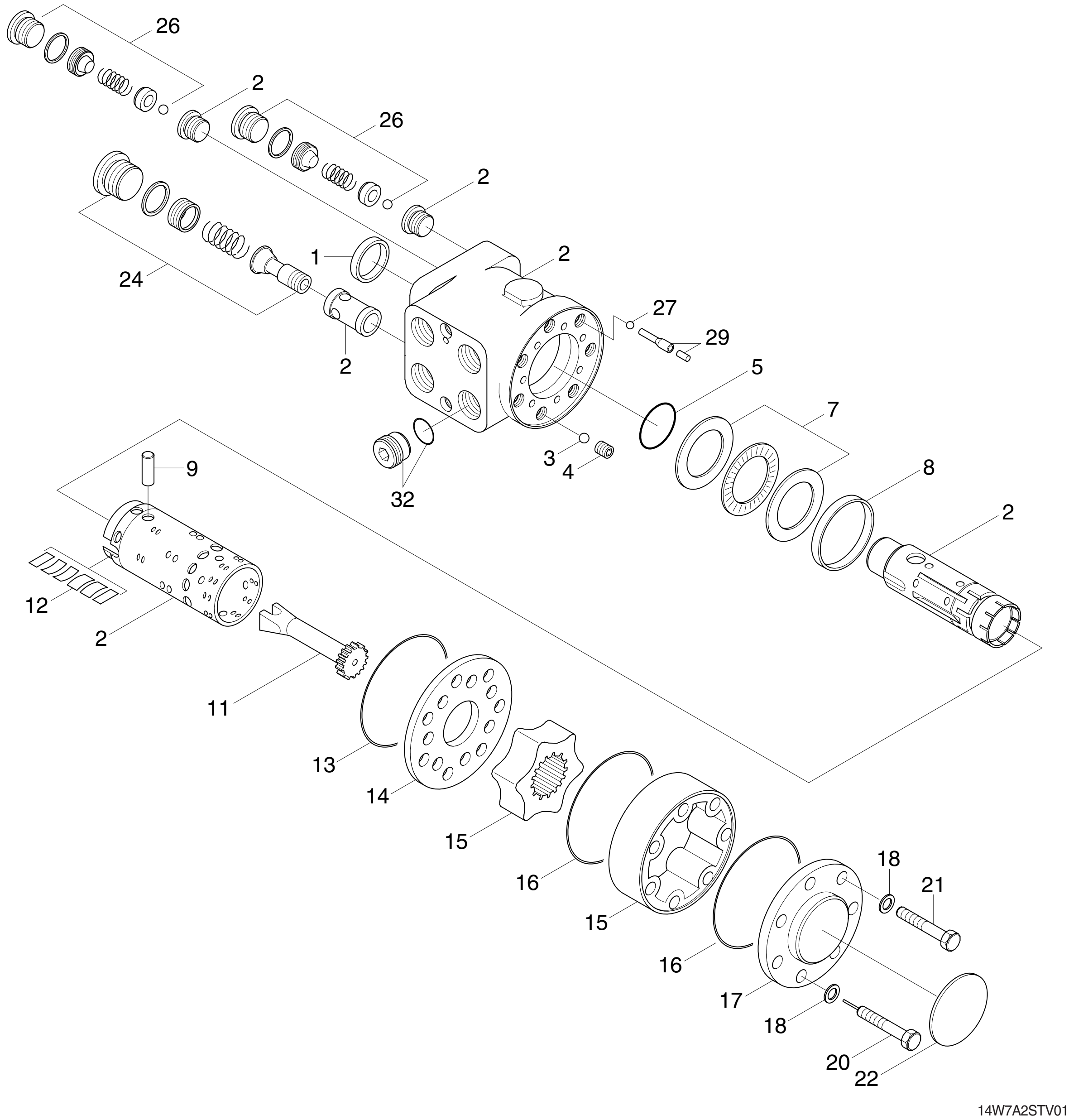


Hydraulic circuit

Port	Port name	Port size
L	Left port	3/4-16UNF
R	Right port	
T	Tank port	
P	Pump port	

14W92SV01

2. COMPONENTS



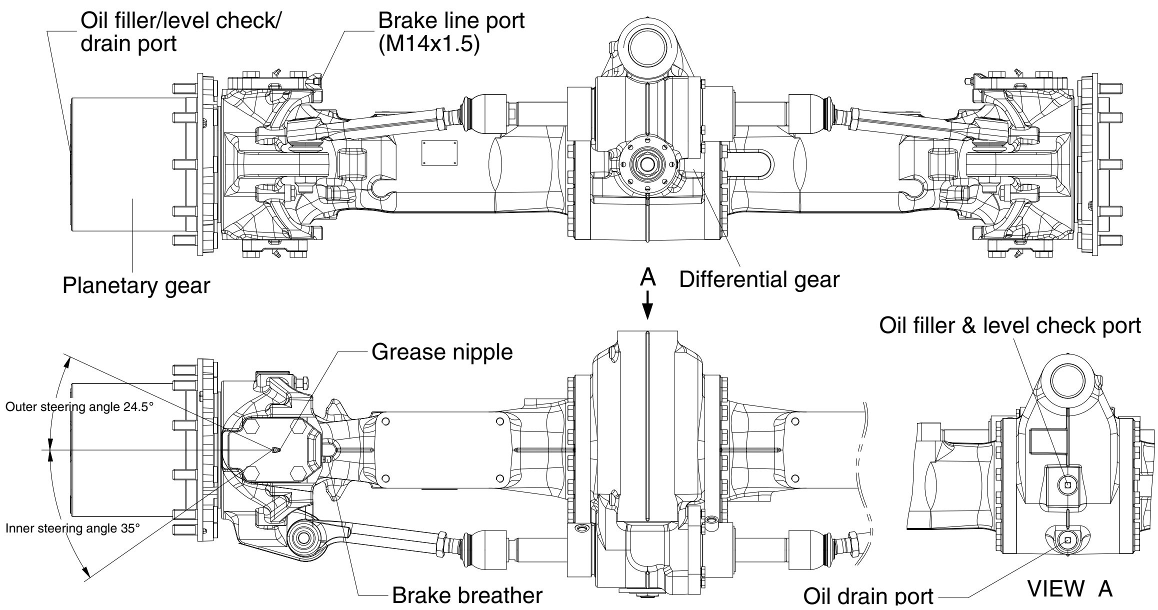
1	Dust seal	11	Shaft	20	Pin screw
2	Housing, spool, sleeve	12	Spring set	21	Screw
3	Ball	13	O-ring	22	Name plate
4	Bushing	14	Distributor plate	24	Pressure relief valve
5	O-ring	15	Gear wheel set	26	Shock valve
7	Bearing assy	16	O-ring	27	Ball
8	Ring	17	End cover	29	Bushing
9	Cross pin	18	Washer	32	Check valve

GROUP 11 AXLE

1. OPERATION

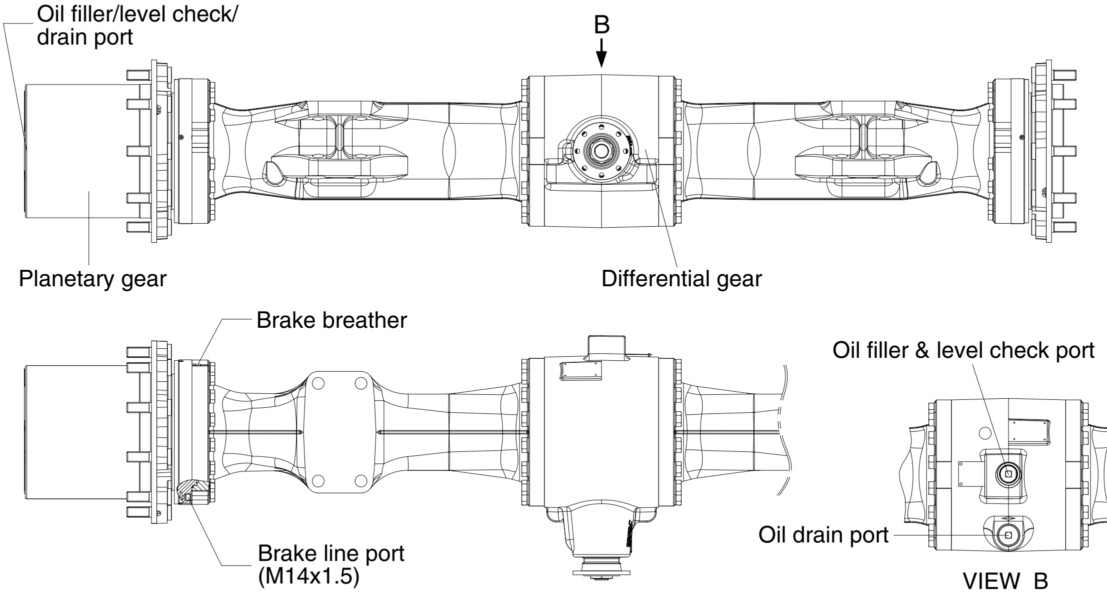
- The power from the engine passes through main pump, travel motor and transmission and drive shafts, and is then sent to the front and rear axles.
  Inside the axles, the power passes from the bevel pinion to the bevel gear and is sent at right angles.
- At the same time, the speed is reduced and passes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



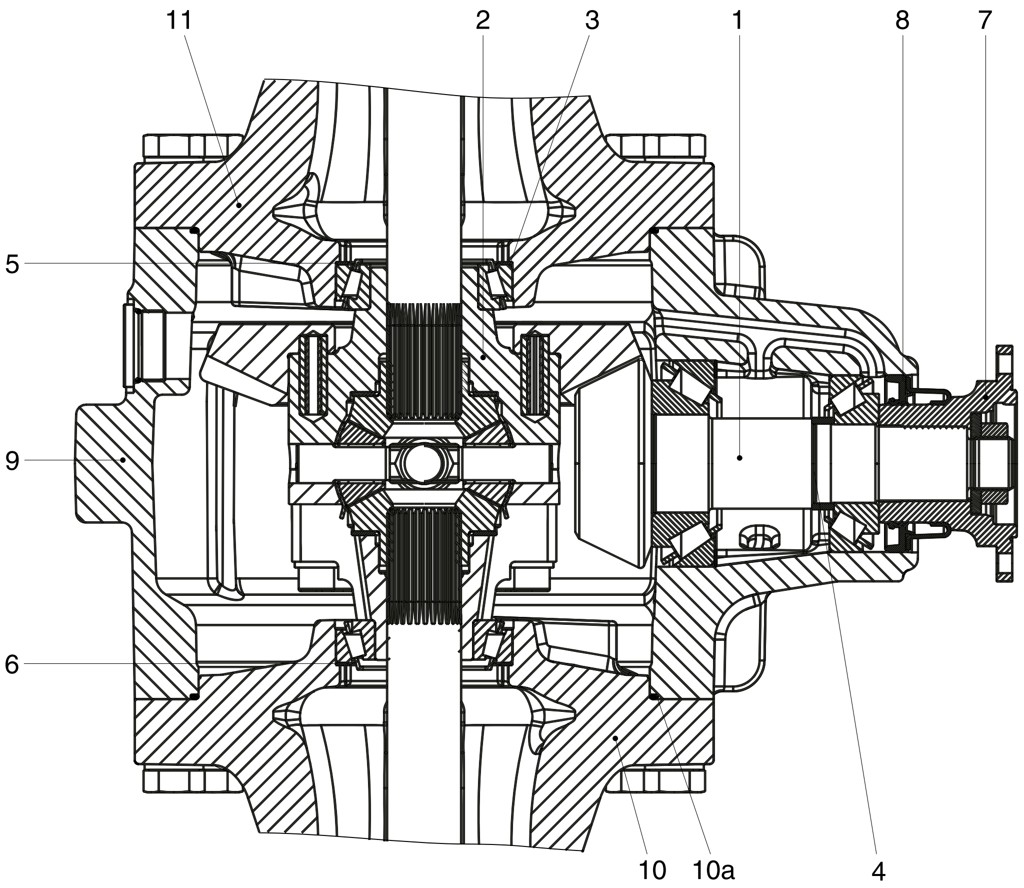
20W7A2AX01

2) REAR AXLE



20W7A2AX01A

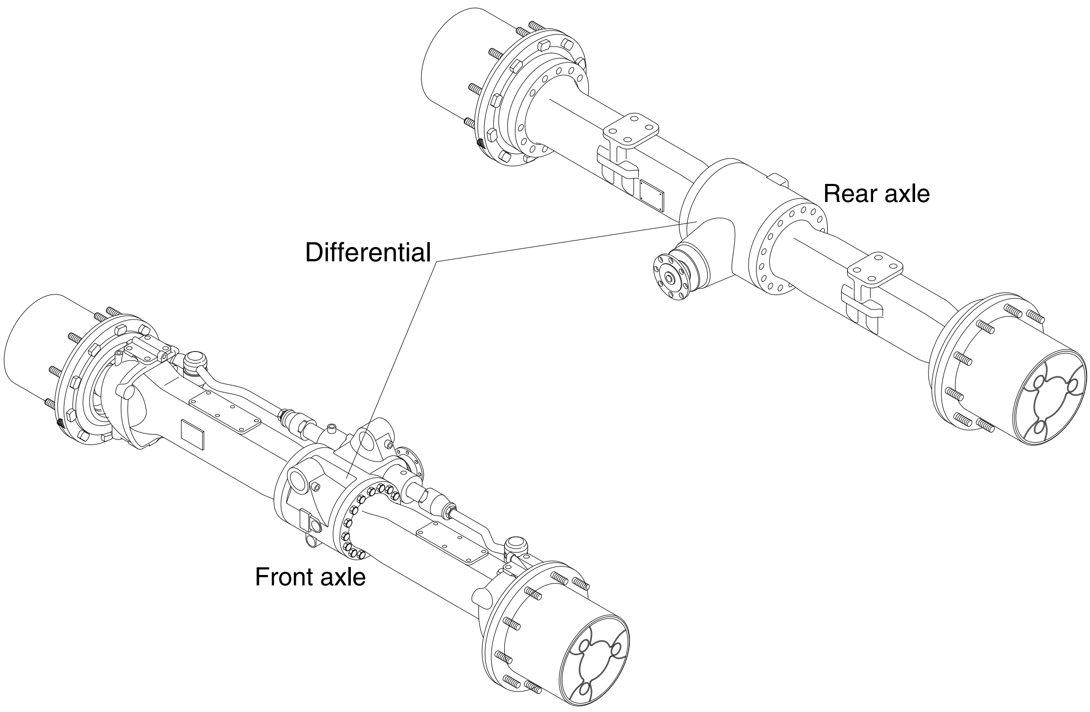
2. SECTION OF DIFFERENTIAL



17W7A2AX02

1 Drive pinion
2 Differential (with crown wheel)
3 Shim for contact pattern (bevel gear set)
4 Spacer ring (bearing rolling moment / pinion bearing)
5 Shim for backlash
6 Shim (bearing rolling moment / differential bearing)
7 Input flange
8 Seal ring
9 Axle drive housing
10 Axle housing
10a O-ring
11 Axle housing (crown wheel side)

3. DIFFERENTIAL



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.

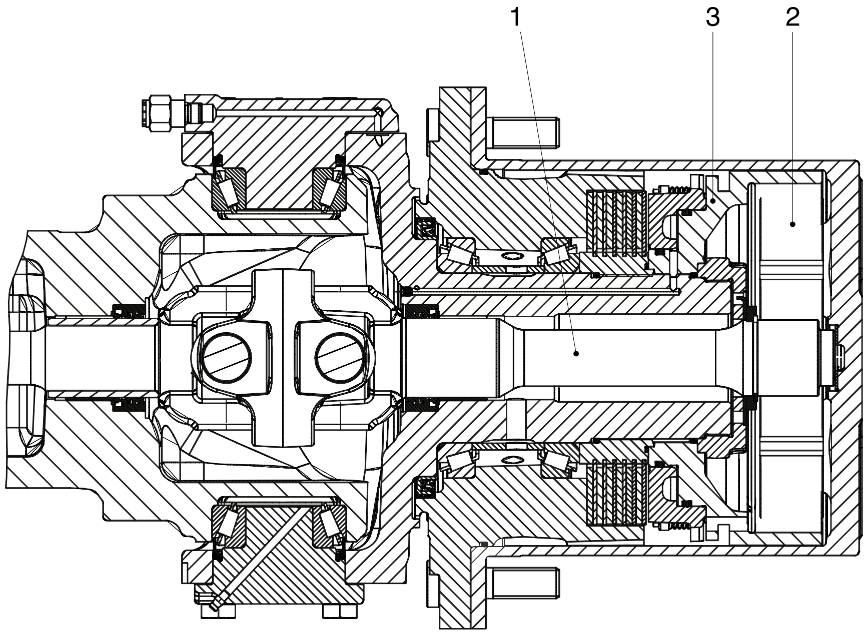
In addition, the differential also servers as an equalizer when going around curves. If the mechanical connection from the transmission to the universal drive shaft, differential, shaft, and planetary gears to the wheels would be rigid, every steering movement would strain the axle construction and would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

4. FINAL DRIVE

1) FRONT AXLE



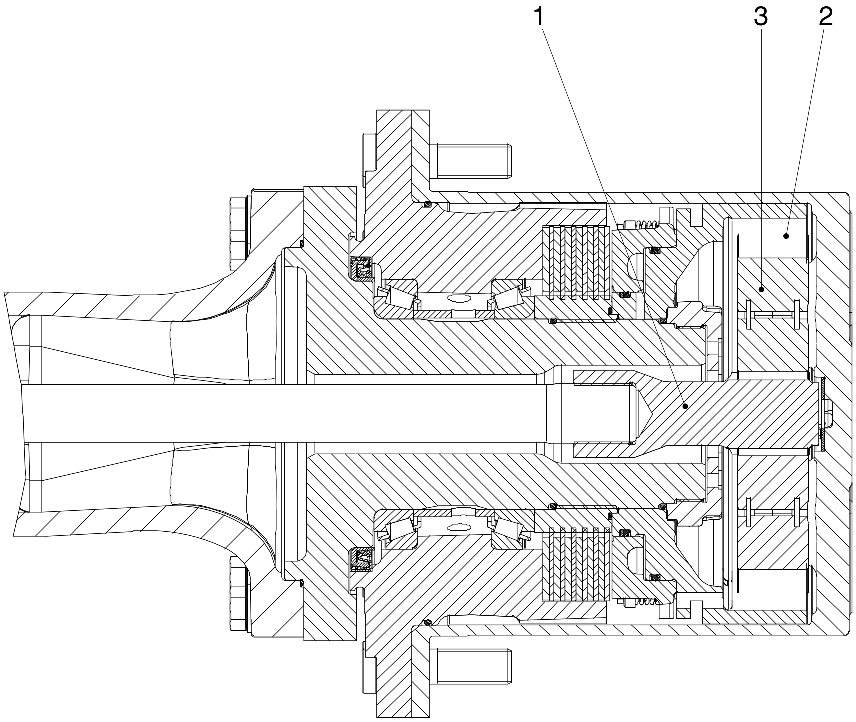
17W7A2AX04

1	Joint fork	2	Planetary gear	3	Ring gear

(1) To gain a large drive force, the final drive uses a planetary gear system to reduce the speed and send drive force to the tires.

(2) The power transmitted from the differential through joint fork (1) is transmitted to planetary gear (2). The planetary gear rotates around the inside of a fixed ring gear (3) and in this way transmits rotation at a reduced speed to the planetary carrier.
This power is then sent to the wheels which are installed to the planetary carriers.

2) REAR AXLE



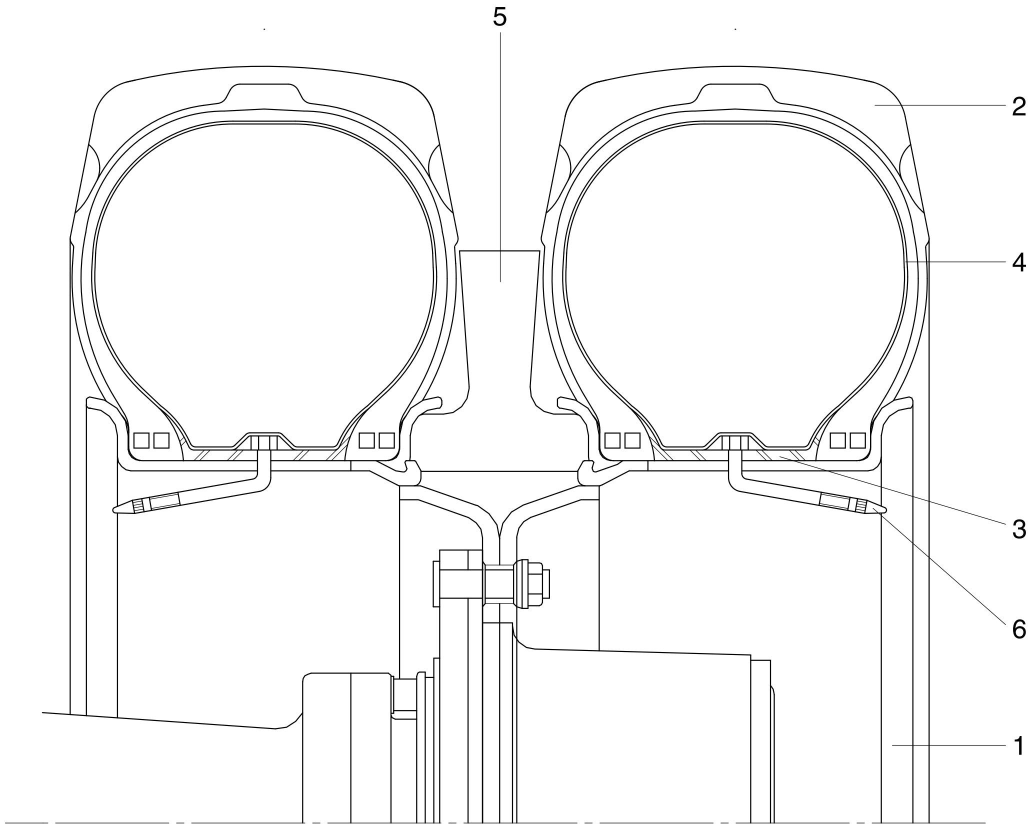
17W7A2AX05

1 Sun gear shaft 2 Planetary gear 3 Ring gear

(1) To gain a large drive force, the final drive uses a planetary gear system to reduce the speed and send drive force to the tires.

(2) The power transmitted from the differential through sun gear shaft (1) is transmitted to planetary gear (2). The planetary gear rotates around the inside of a fixed ring gear (3) and in this way transmits rotation at a reduced speed to the planetary carrier.
This power is then sent to the wheels which are installed to the planetary carriers.

5. TIRE AND WHEEL



17032TI01

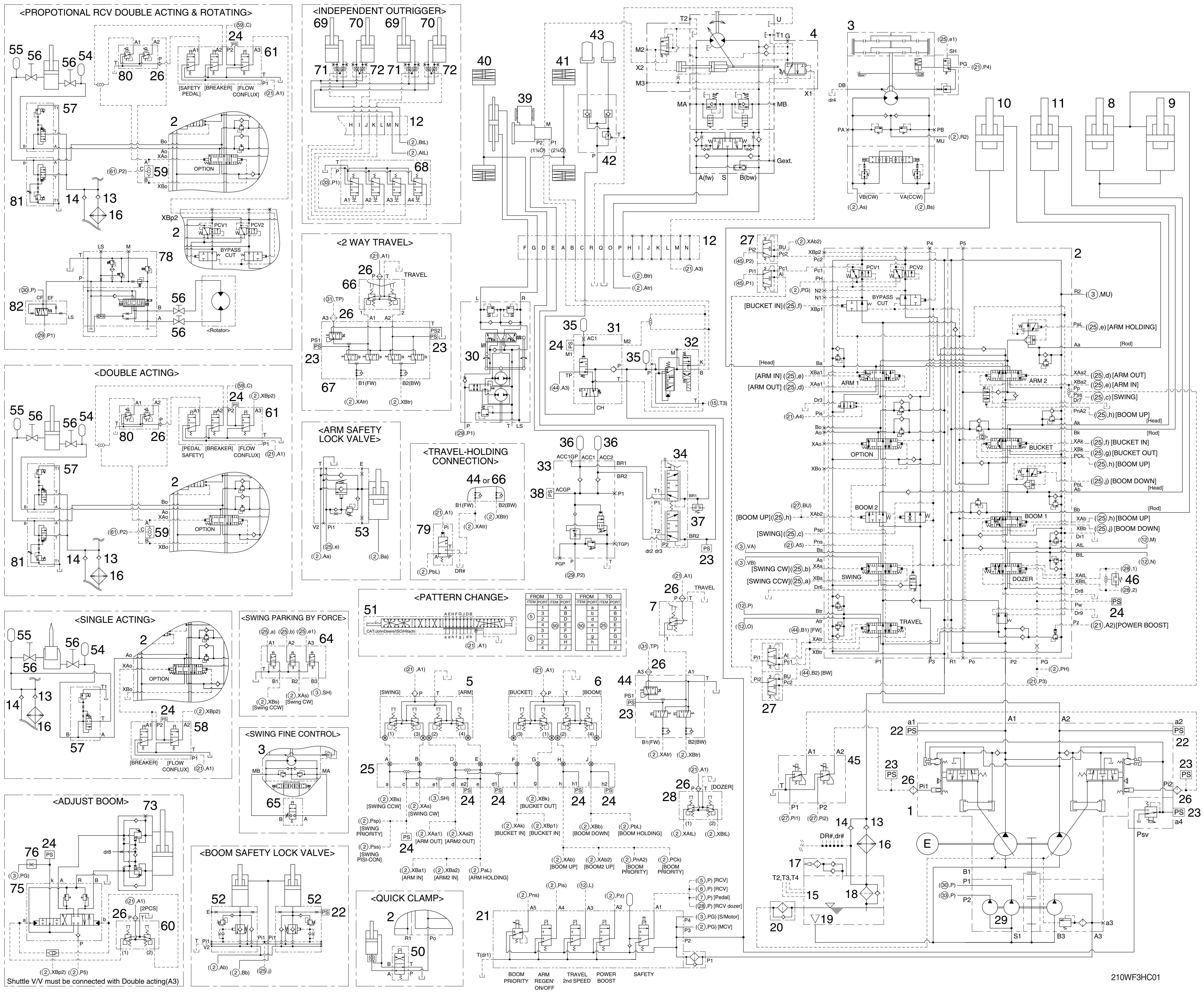
1	Wheel rim	3	Flap	5	Stone resister ring
2	Tire	4	Tube	6	Valve assembly

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

GROUP 1 HYDRAULIC CIRCUIT

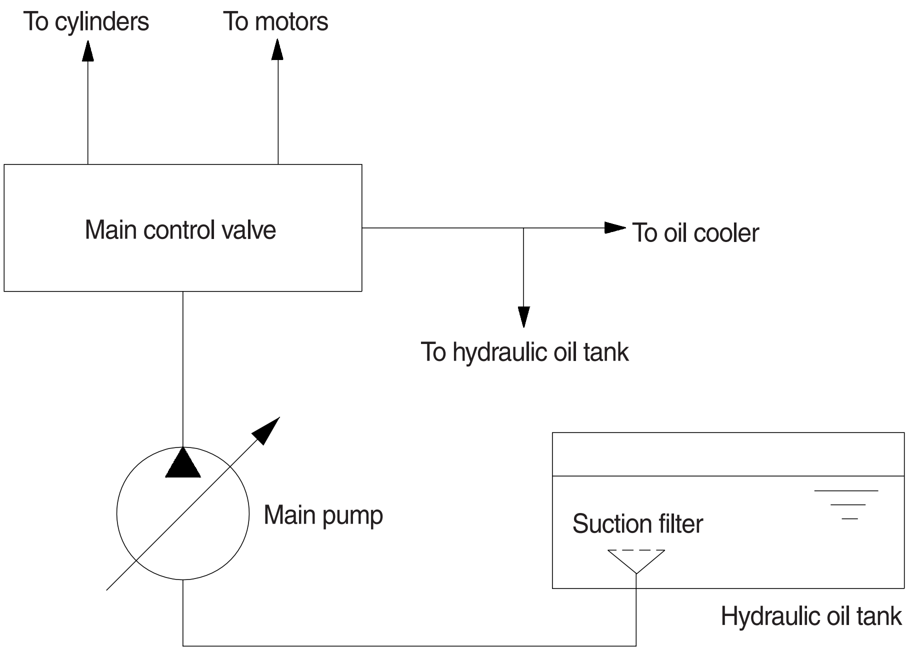


1 Main pump
2 Main control valve
3 Swing motor
4 Travel motor
5 RCV lever(LH)
6 RCV lever(RH)
7 RCV pedal
8 Boom cylinder(LH)
9 Boom cylinder(RH)
10 Arm cylinder
11 Bucket cylinder
12 Turning joint
13 Check valve
14 Check valve
15 Hydraulic tank
16 Oil cooler
17 Air breather
18 Bypass valve & return element
19 Strainer
20 Drain filter
21 Pilot filter & 5 solenoid valve
22 Pressure sensor
23 Pressure sensor
24 Pressure sensor
25 Shuttle block
26 Last guard filter
27 Shuttle valve
28 RCV dozer lever(option)
29 Power train pump
30 Steering valve
31 Travel control valve
32 Transmission control valve
33 Brake supply valve
34 Brake valve
35 Accumulator
36 Accumulator
37 Pressure switch(5k)
38 Pressure sensor(200k)
39 Transmission
40 Front axle
41 Rear axle
42 Locking valve
43 Oscillating cylinder
44 3 solenoid valve
45 2 EPPR solenoid valve
46 Pressure switch
50 Quick clamp solenoid valve(option)
51 Pattern change valve(option)
52 Boom safety lock valve(option)
53 Arm safety lock valve(option)
54 Accumulator(option)
55 Accumulator(option)
56 Stop valve(option)
57 Propotional relief valve(option)
58 Solenoid valve(option)
59 Shuttle valve(option)
60 2 way pedal(option)
61 Solenoid valve(option)
64 Solenoid valve(option)
65 Solenoid valve(option)
66 RCV pedal(2 way, option)
67 5 solenoid valve(option)
68 4 solenoid valve(option)
69 Outrigger/dozer cylinder(LH, option)
70 Outrigger/dozer cylinder(RH, option)
71 Pilot check valve(LH, option)
72 Pilot check valve(RH, option)
73 Adjustable boom cylinder(option)
75 Control valve(option)
76 Propotional relief valve(option)
78 Propotional valve(option)
79 Pilot selector valve(option)
80 2 EPPR valve(option)
81 Propotional relief valve(option)
82 Priority valve(option)

GROUP 2 MAIN CIRCUIT

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

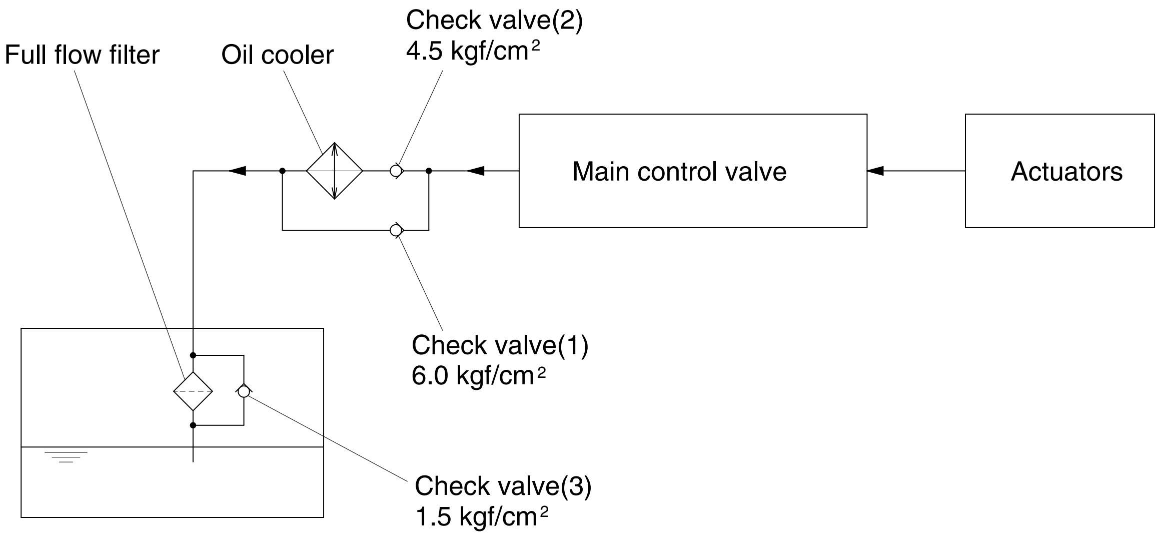
1. SUCTION AND DELIVERY CIRCUIT



3-2 (290LC-7)

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

2. RETURN CIRCUIT



20W73CI01

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 4.5 kgf/cm^2 (64 psi) and 6.0 kgf/cm^2 (85 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 6.0 kgf/cm^2 (85 psi), the oil returns directly to the hydraulic tank, resulting in the oil temperature being raised quickly at an appropriate level.

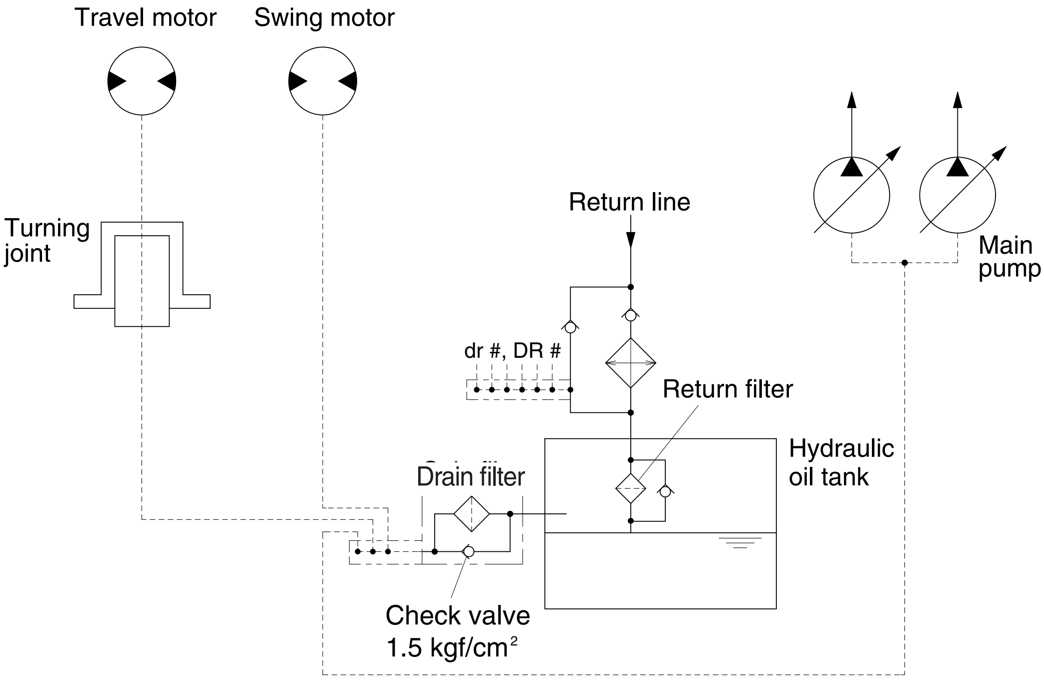
When the oil cooler is clogged, the oil returns directly to the hydraulic tank through bypass check valve (1).

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.

3. DRAIN CIRCUIT



14W93CI02

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/cm^2 (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 respective motor casing and joins with each other. This oil passes through turning joint and returns to the hydraulic tank after being filtered by drain filter.

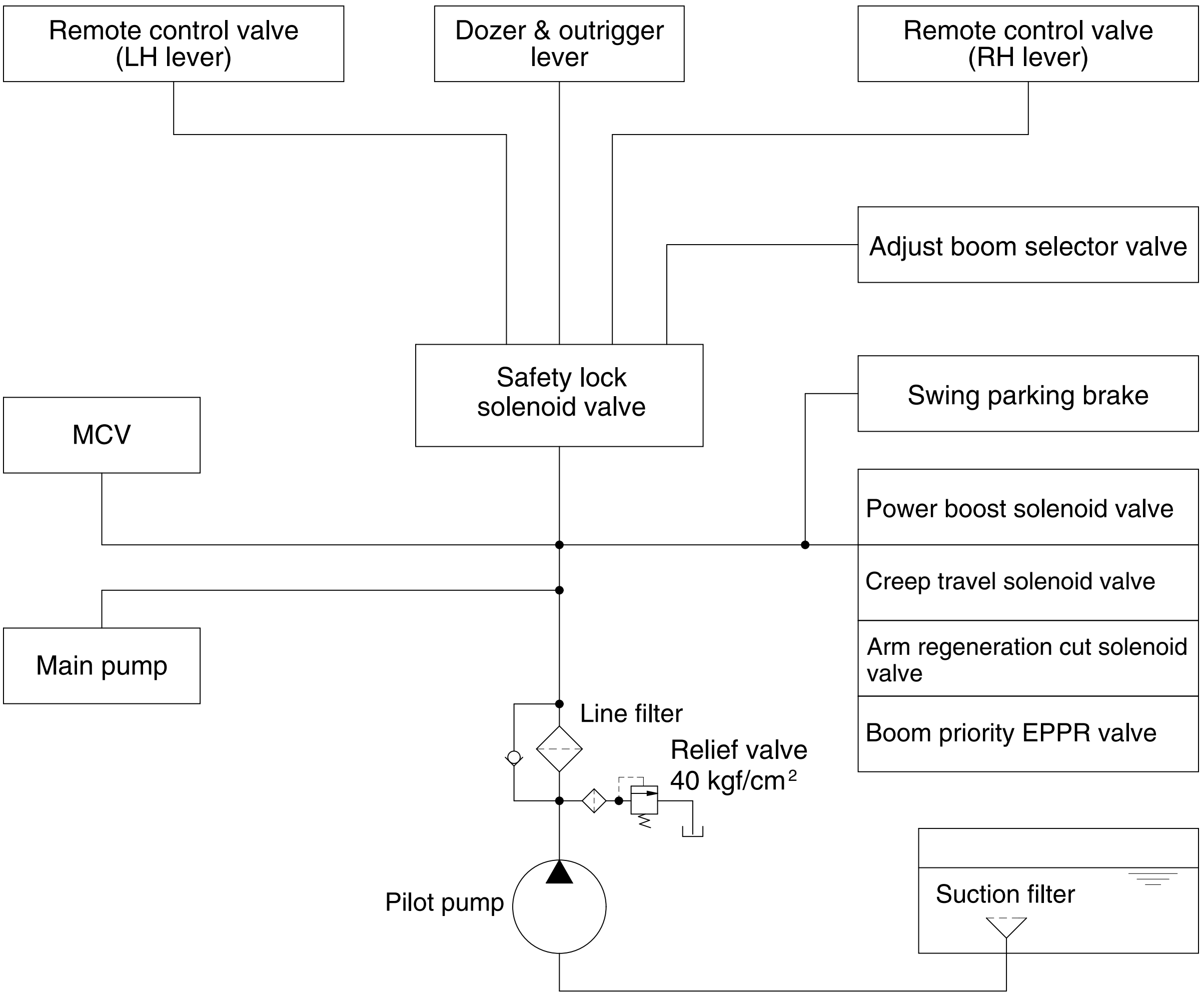
2) SWING MOTOR DRAIN CIRCUIT

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

3) MAIN PUMP DRAIN CIRCUIT

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

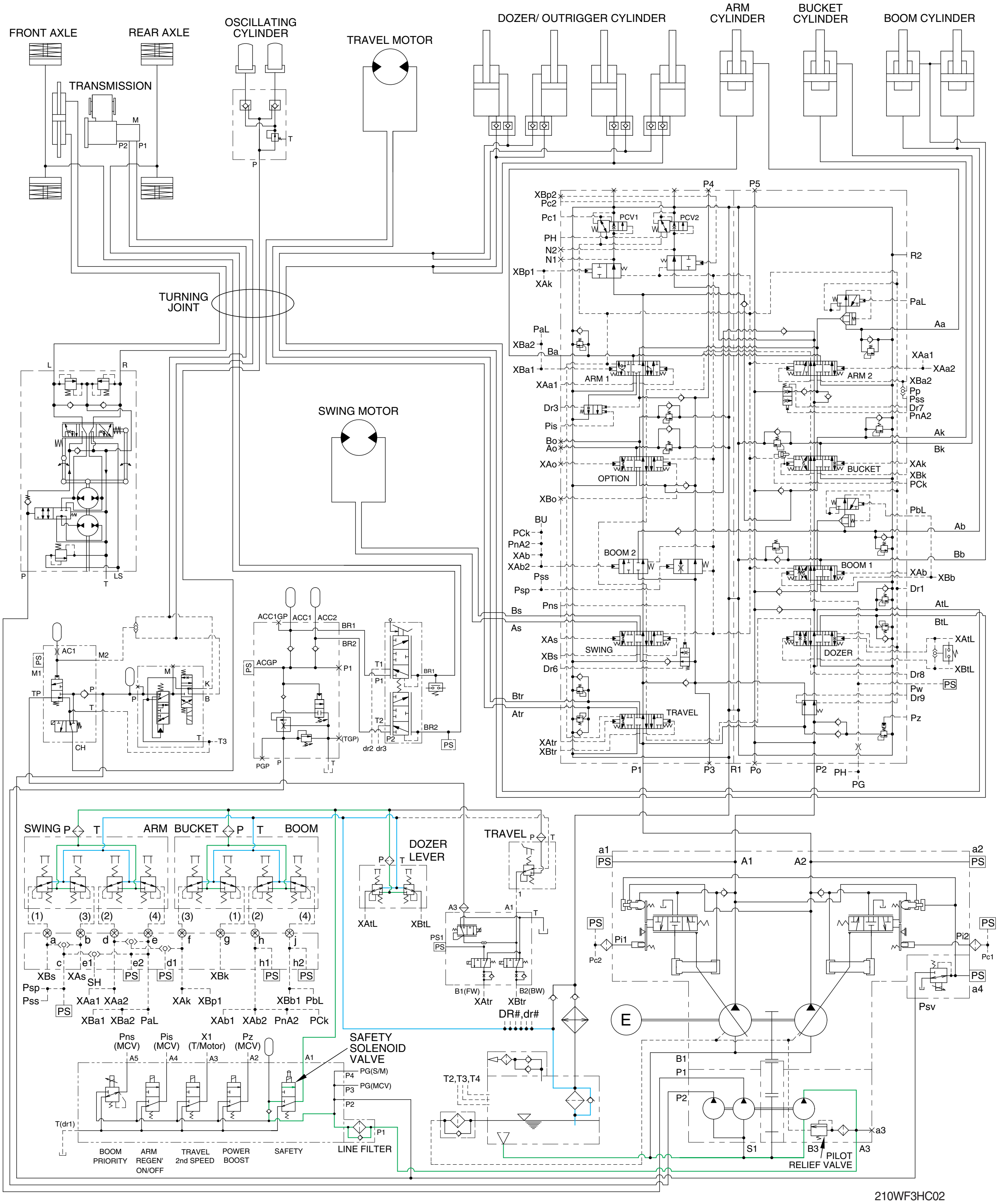
GROUP 3 PILOT CIRCUIT



20W93CI01

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

1. SUCTION, DELIVERY AND RETURN CIRCUIT



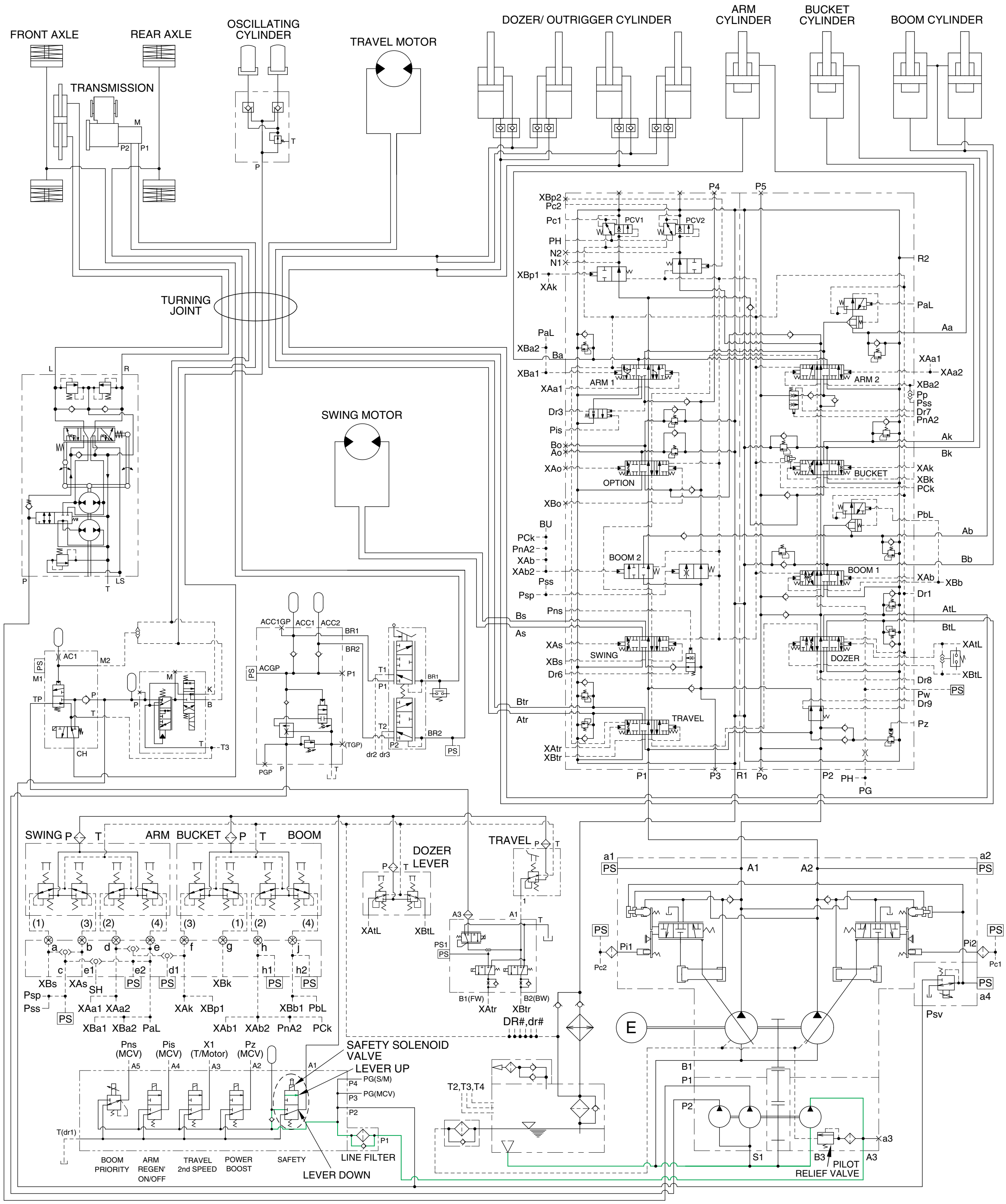
210WF3HC02

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

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

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

2. SAFETY SOLENOID VALVE (SAFETY LEVER)

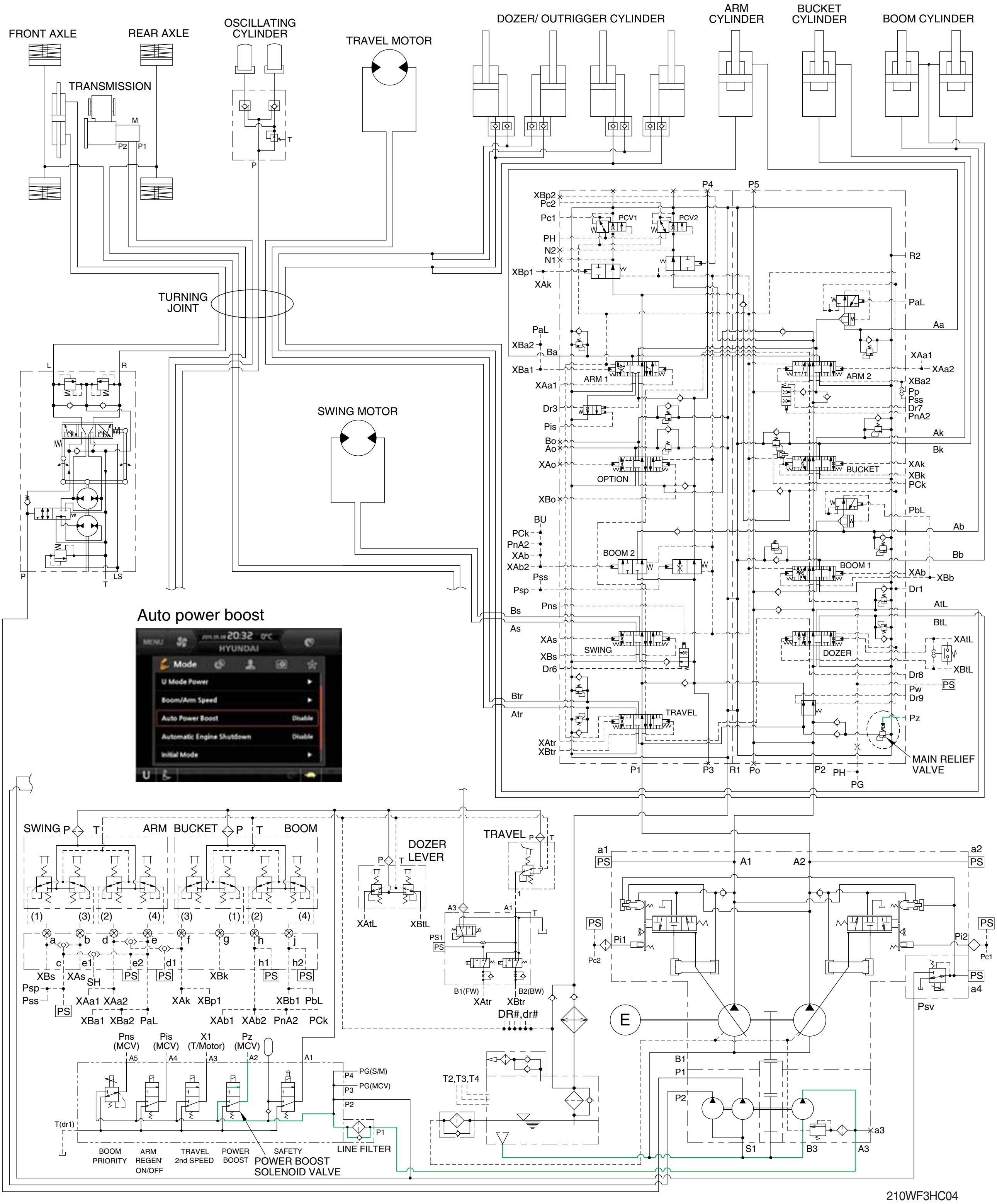


210WF3HC03

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.

3. MAIN RELIEF PRESSURE CHANGE SYSTEM

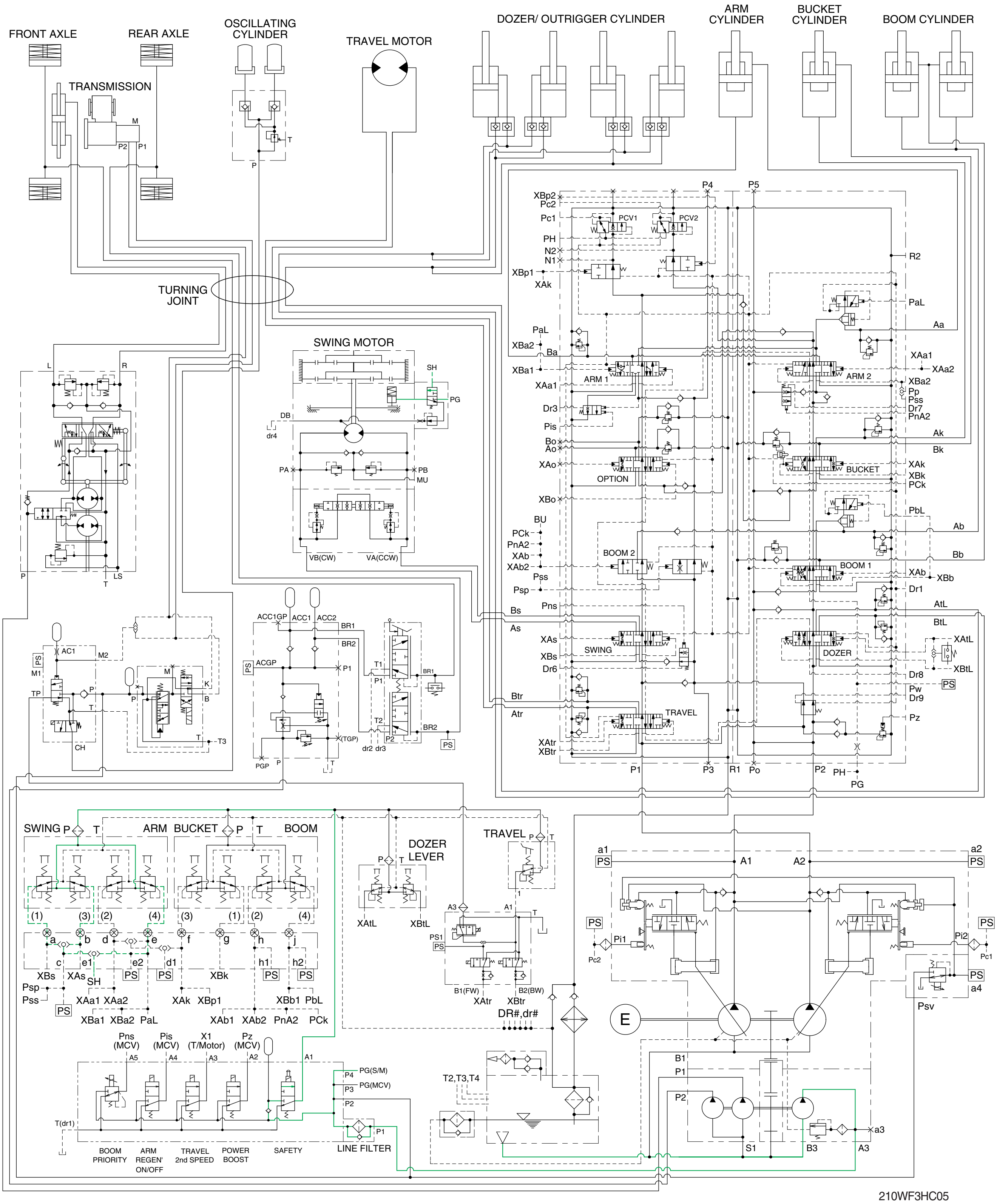


210WF3HC04

When the power boost switch on the left control lever is pushed ON, the power boost solenoid valve is actuated, the discharged oil from the pilot pump flows into Pz 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.

4. SWING PARKING BRAKE RELEASE



210WF3HC05

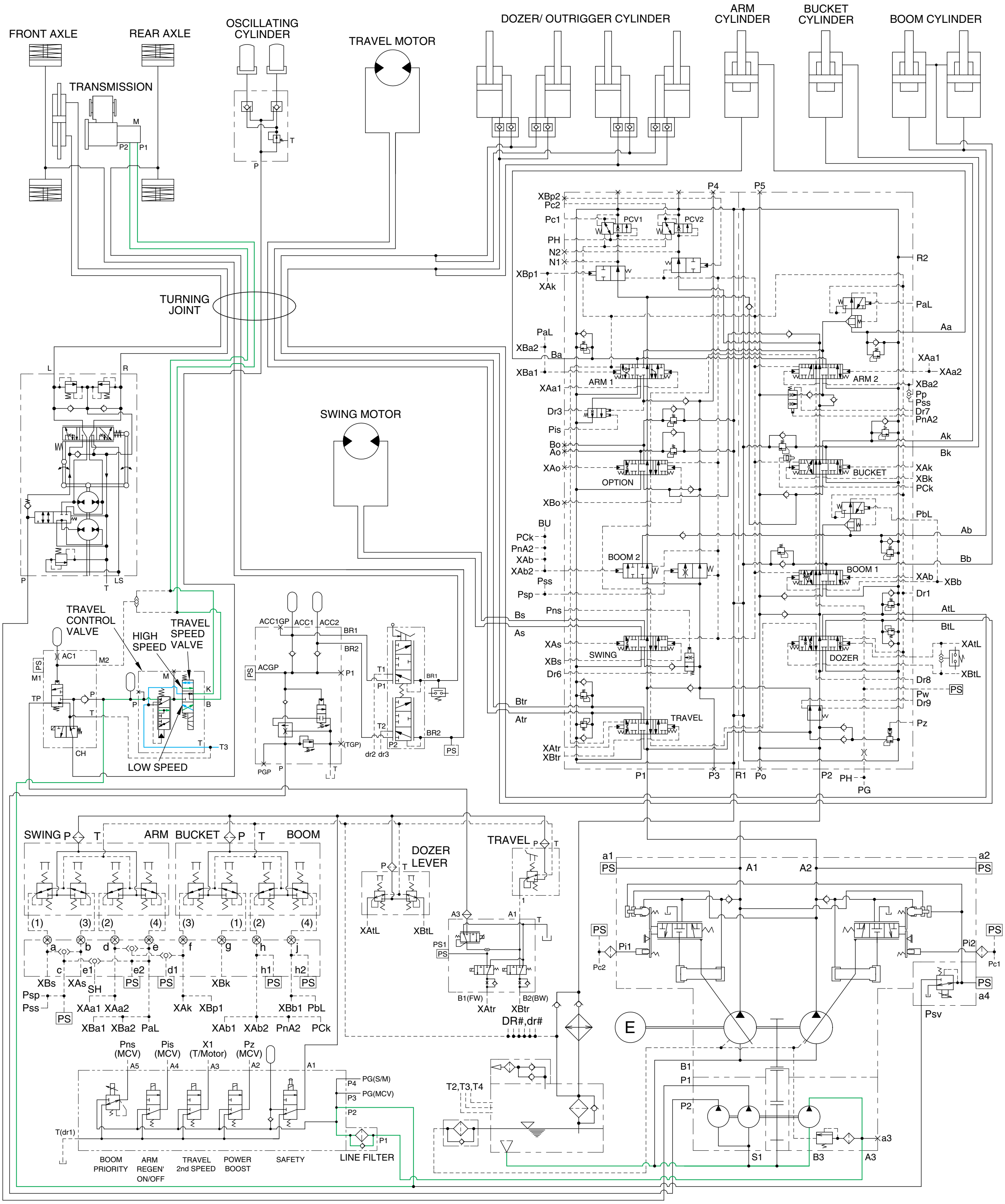
When swing control lever or arm in control lever is tilted, the pilot oil flows into SH port of time delay valve.

This pressure moves spool so, discharged oil from pilot pump flows into swing motor PG port.

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

When the all of the RCV lever are set in the neutral position, oil in the swing motor disc cylinder is drained, thus the brake is applied.

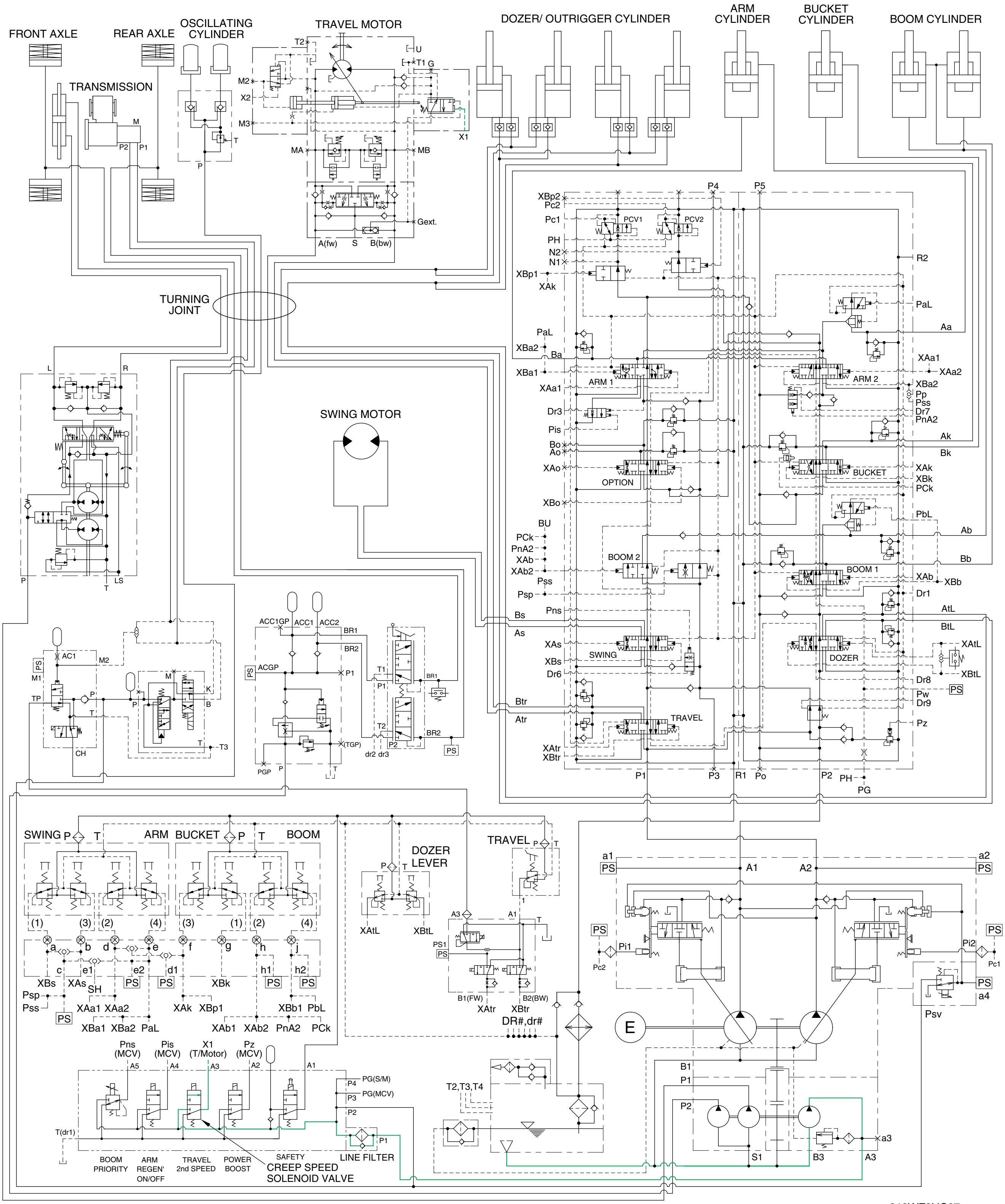
5. TRAVEL SPEED SELECTION SYSTEM



210WF3HC06

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

6. CREEP TRAVEL SYSTEM



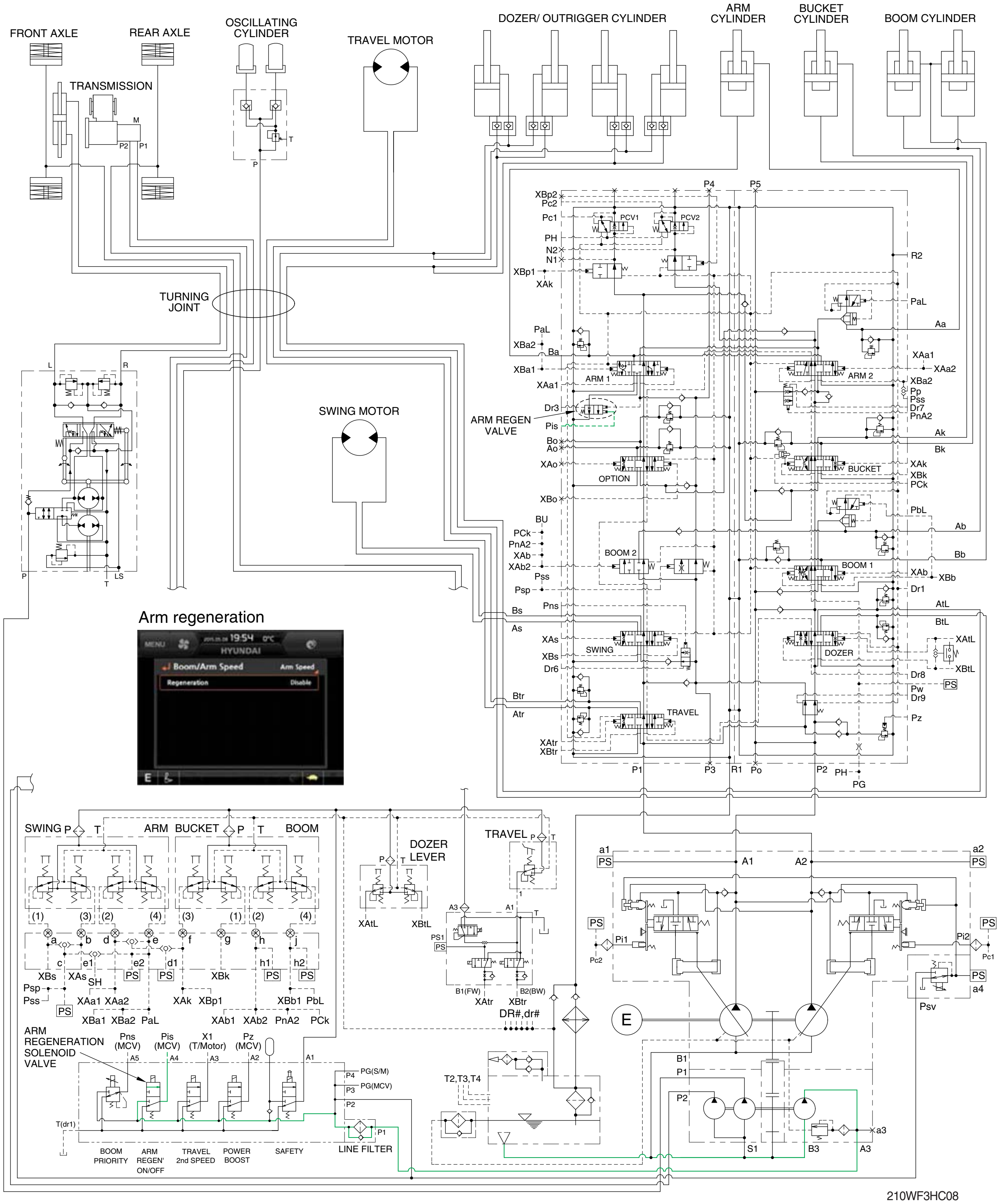
210WF3HC07

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

The discharged oil from the pilot pump flows into **X1** port of travel motor through solenoid valve.

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

7. ARM REGENERATION CUT SYSTEM



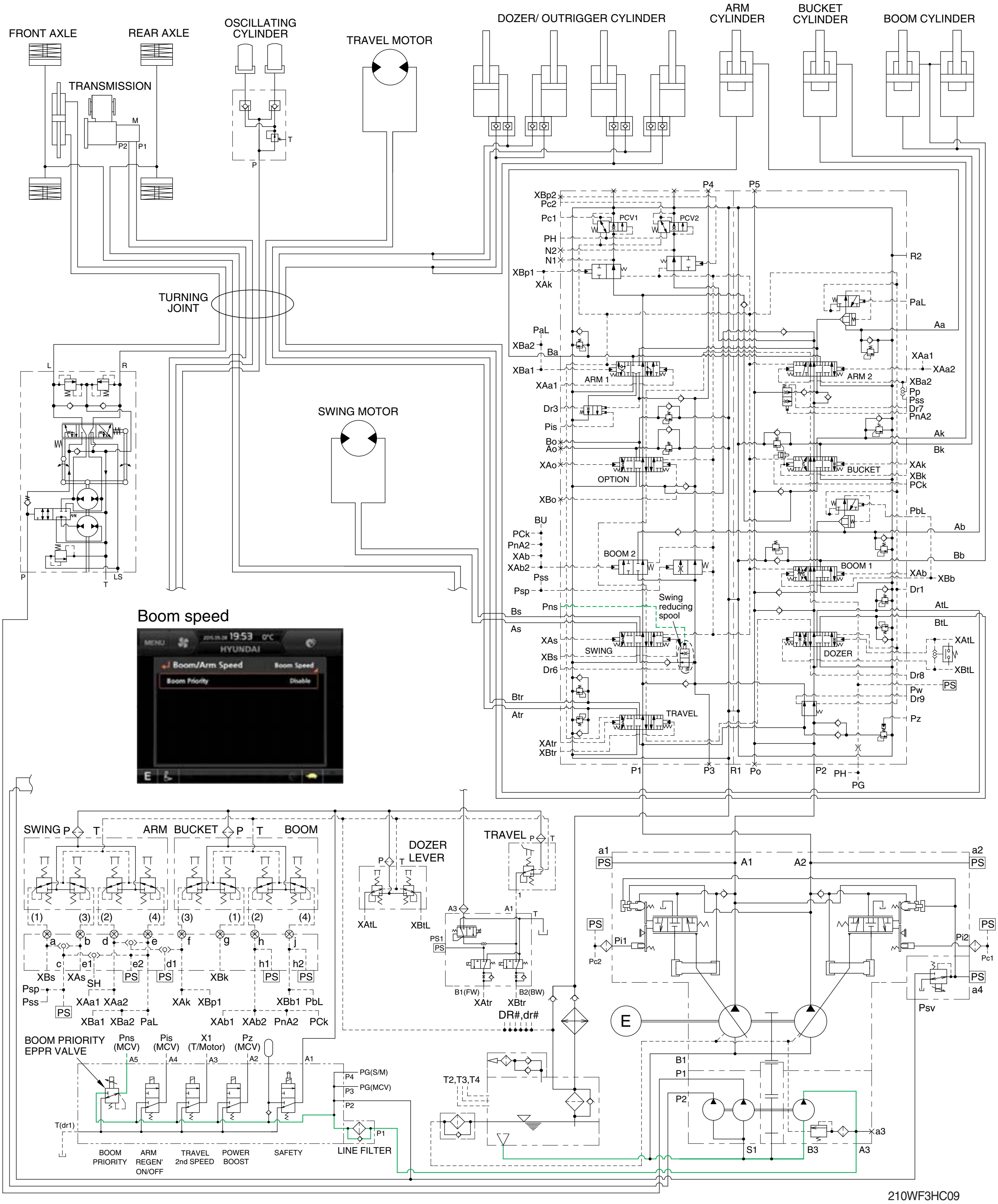
When the arm regeneration is selected to disable on the cluster, the arm regeneration solenoid valve is activated. The pilot oil from pilot pump flows into **Pis** port in main control valve through solenoid valve and the arm regeneration spool is shifted to left.

Then, the oil from arm regeneration passage returns to tank and the arm regeneration function is deactivated.

When the arm regeneration is selected to enable on the cluster, the arm regeneration function is activated and arm in operation speed is increased.

Refer to page 2-30 for the arm regeneration function.

8. BOOM PRIORITY SYSTEM



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

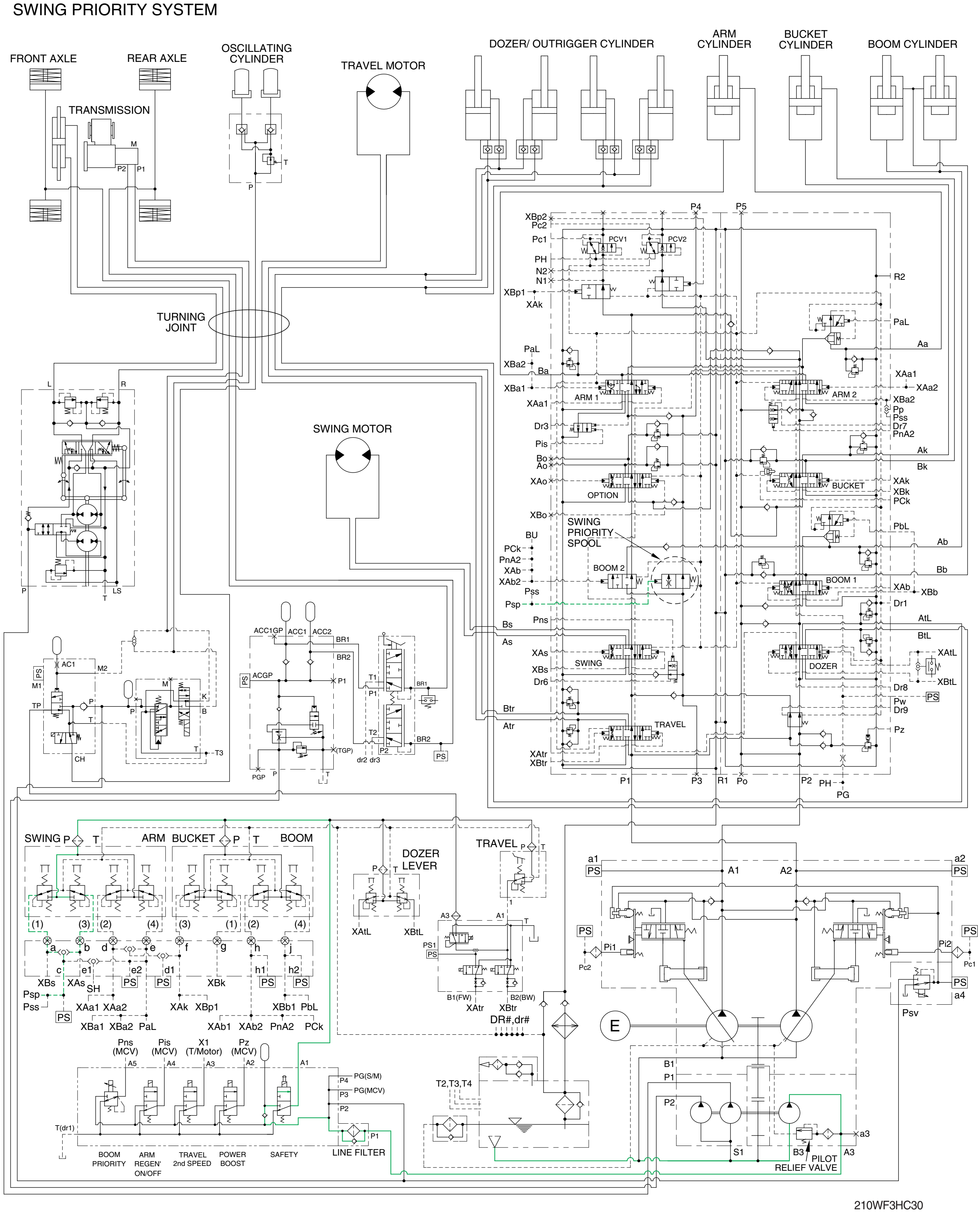
To increase working efficiency, swing speed reducing system is used.

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

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

The boom up speed can be adjusted by the cluster. Refer to page 3-22 of the operator's manual.

9. SWING PRIORITY SYSTEM



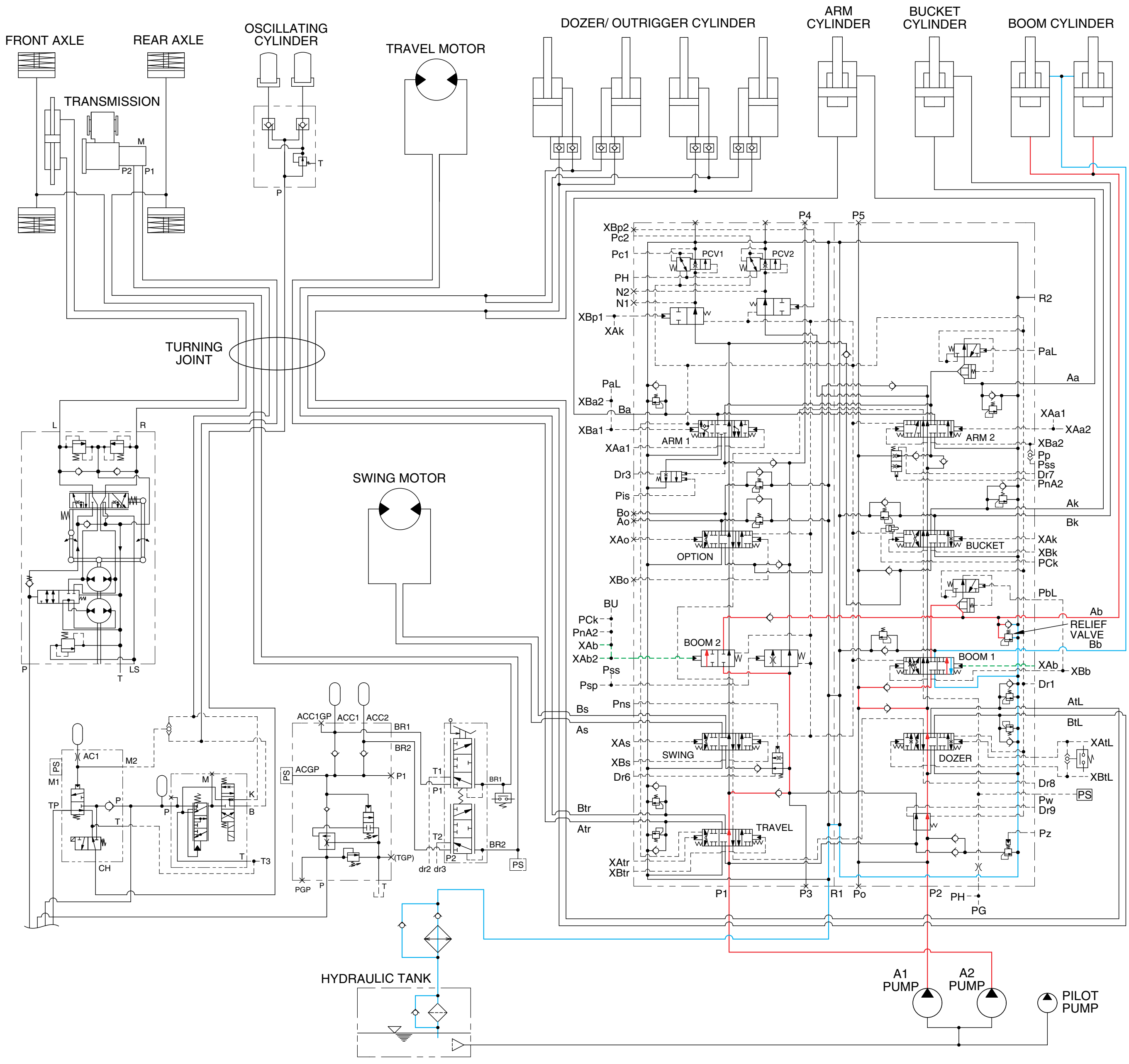
When carrying out the combined operation of swing and arm of the left control valve, the swing speed can be lowered than arm speed.

Psp pressure from the swing shuttle block changes the swing priority spool and then the oil flow rate is decreased to the next section to make the swing operation most preferential.

This is called the swing priority system. For details, refer to page 2-36.

GROUP 4 SINGLE OPERATION

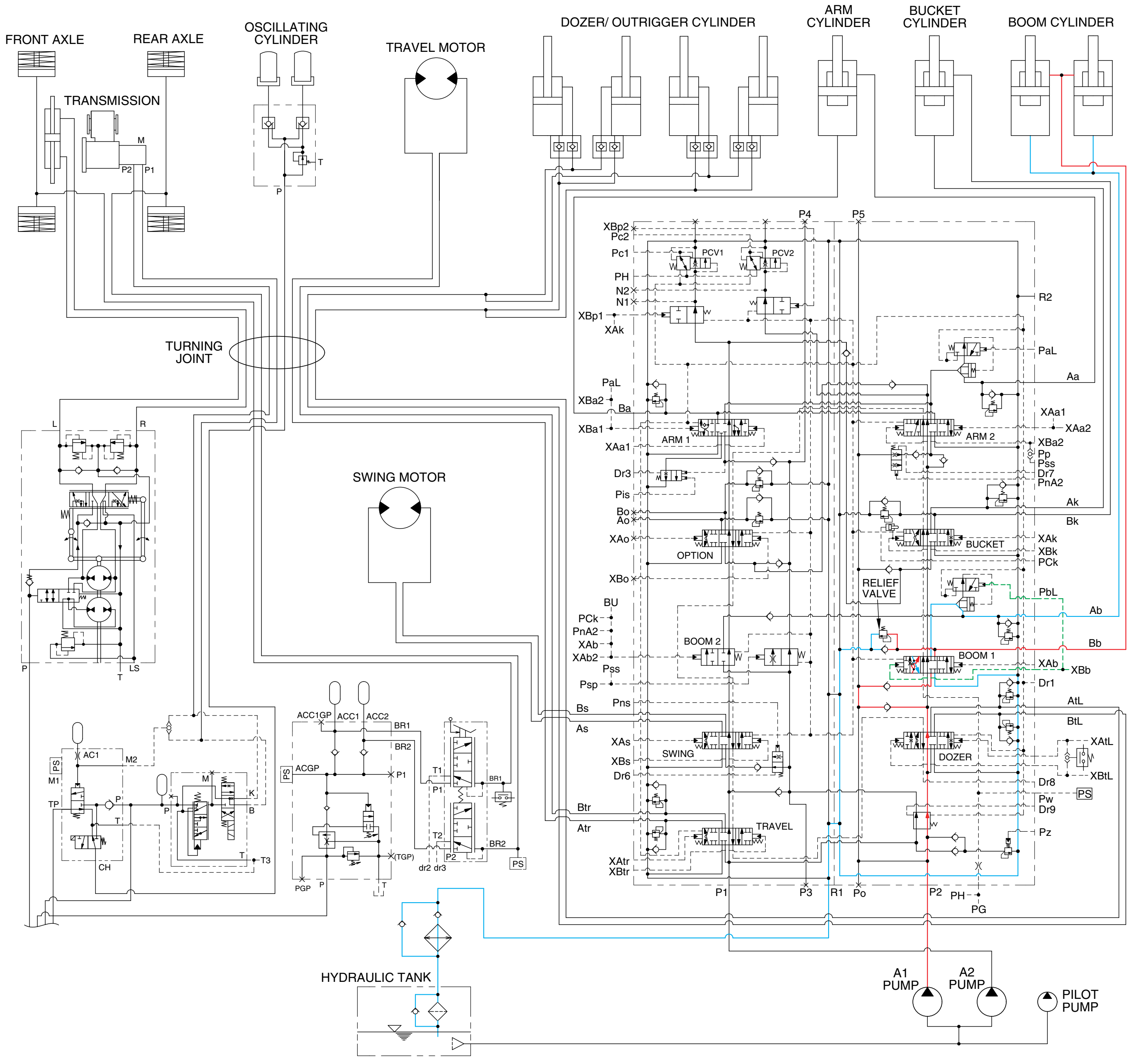
1. BOOM UP OPERATION



210WF3HC10

When the right control lever is pulled back, the boom spools in the main control valve are moved to the up position by the pilot oil pressure from the remote control valve.
The oil from the A1 and A2 pump flows into the main control valve and then goes to the large chamber of boom cylinders. At the same time, the oil from the small chamber of boom cylinders returns to the hydraulic oil tank through the boom 1 spool in the main control valve. When this happens, the boom goes up. The excessive pressure in the boom cylinder head side is prevented by relief valve. When the boom is up and the control lever is returned to neutral position, the circuit for the holding pressure at the head side of the boom cylinder is closed by the boom holding valve. This prevents the hydraulic drift of boom cylinder.

2. BOOM DOWN OPERATION



210WF3HC11

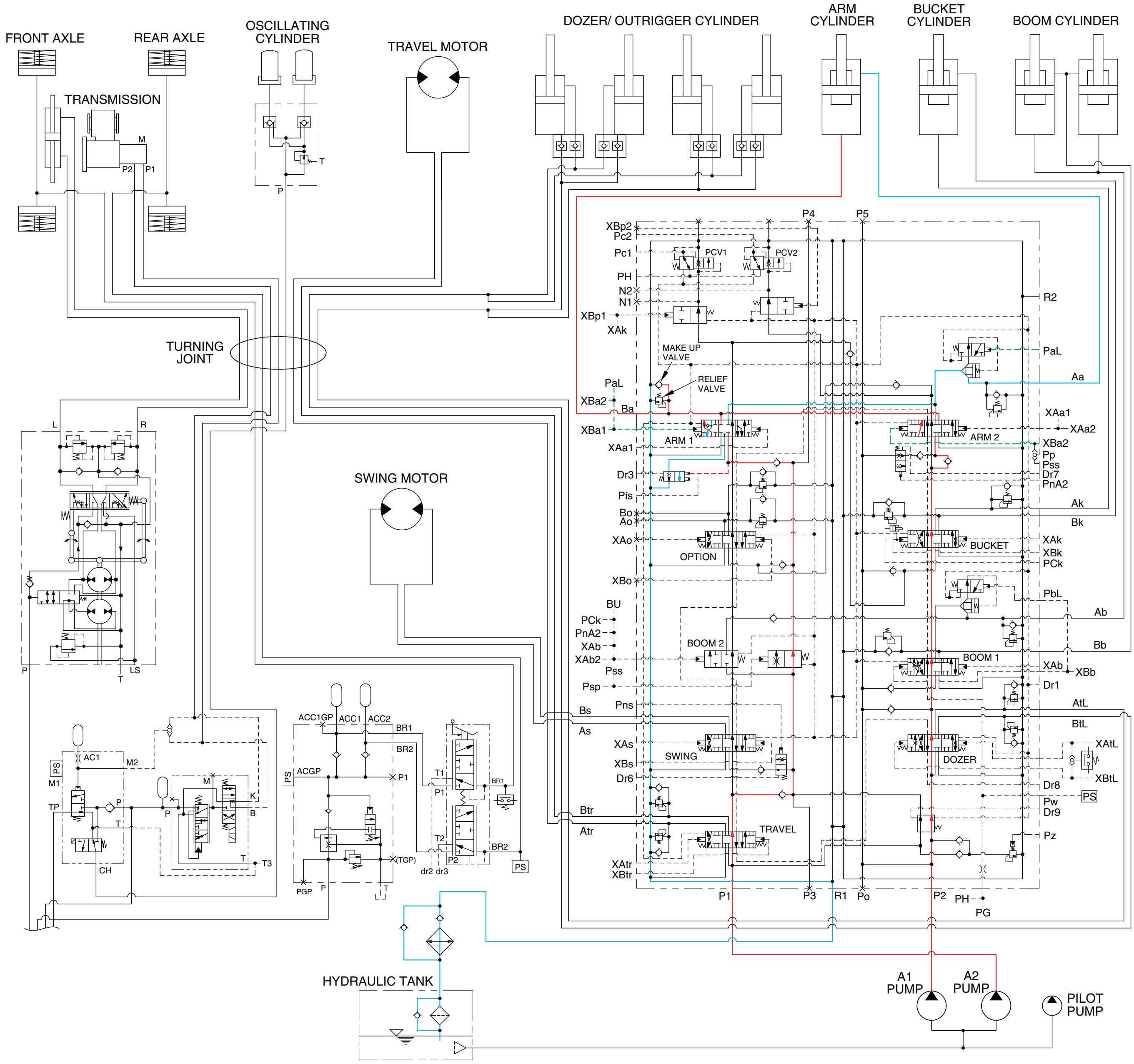
When the right control lever is pushed forward, the boom 1 spool in the main control valve is moved to the down position by the pilot oil pressure from the remote control valve.

The oil from the A1 pump flows into the main control valve and then goes to the small chamber of boom cylinders. At the same time, the oil from the large chamber of boom cylinders returns to the hydraulic tank through the boom 1 spool in the main control valve.

When the down speed of boom is faster, the oil returned from the large chamber of boom cylinder combines with the oil from the A1 pump, and flows into the small chamber of the cylinder.

This prevents cylinder cavitation by the negative pressure when the A1 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.

3. ARM IN OPERATION



210WF3HC12

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

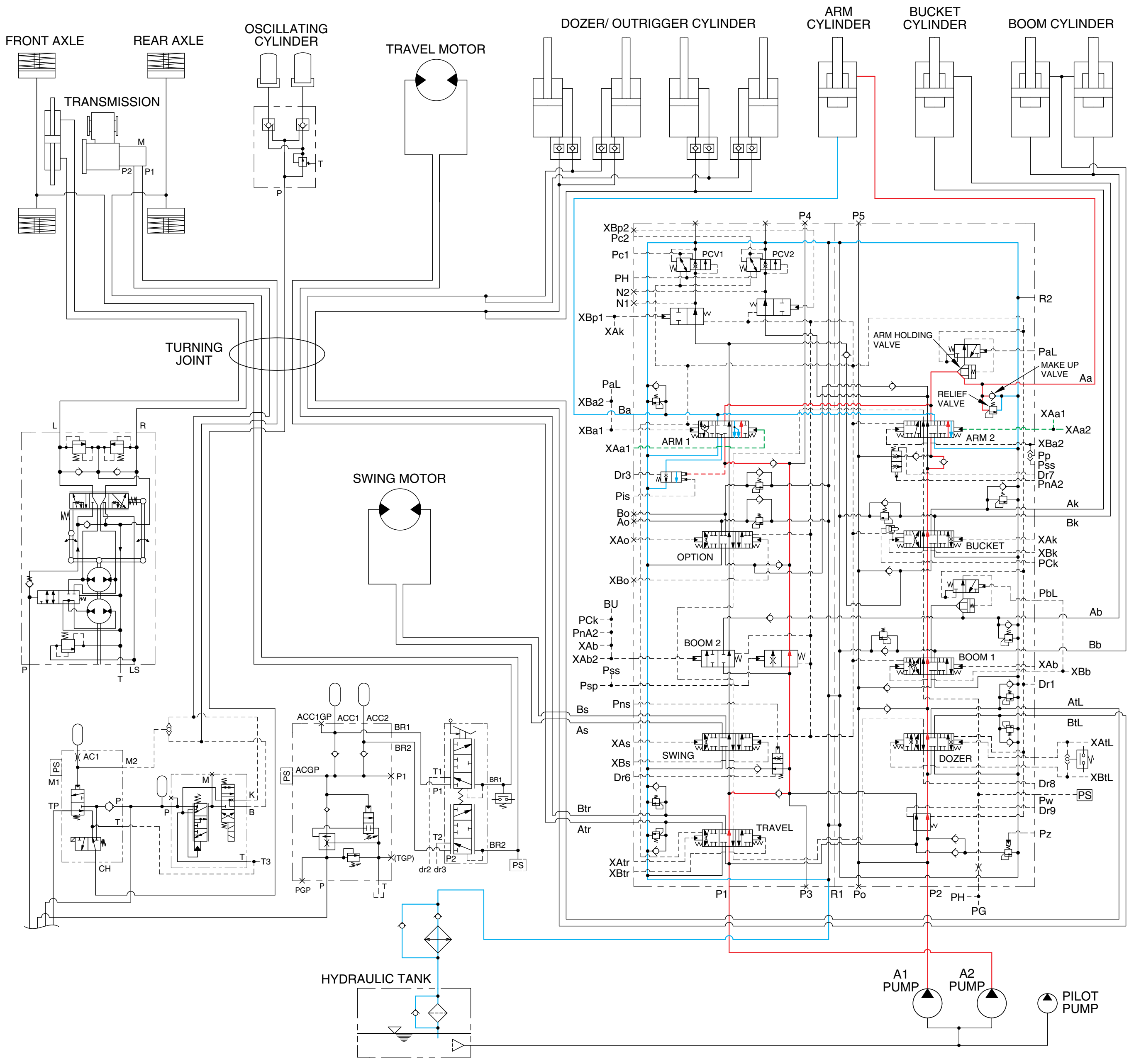
The oil from the A1 and A2 pump flows into the main control valve and then goes to the large chamber of arm cylinder.

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

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

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

4. ARM OUT OPERATION

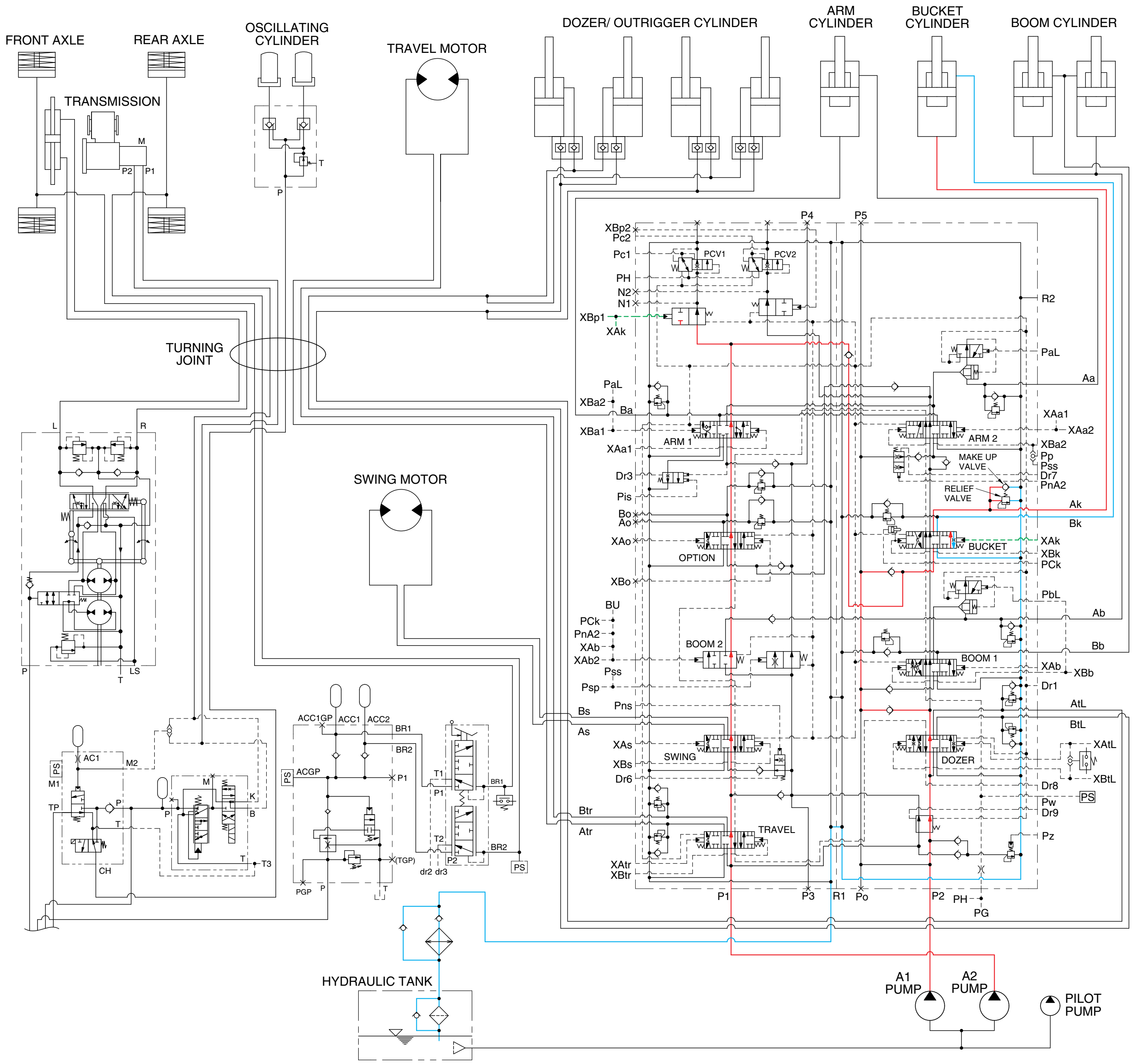


210WF3HC13

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 from the remote control valve.

The oil from the A1 and A2 pump flows into the main control valve and then goes to the small chamber of arm cylinder. At the same time, the oil from the large chamber of arm cylinder returns to the hydraulic oil tank through the arm spools in the main control valve. When this happens, the arm rolls out. The excessive pressure in the arm cylinder rod side is prevented by relief valve. When the arm is roll out and the control lever is returned to neutral position, the circuit for the holding pressure at the rod side of the arm cylinder is closed by the arm holding valve. This prevent the arm drift of arm cylinder. The cavitation which will happen to the rod side of the arm cylinder is also prevented by the make-up valve in the main control valve.

5. BUCKET IN OPERATION



210WF3HC14

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 from the remote control valve.

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

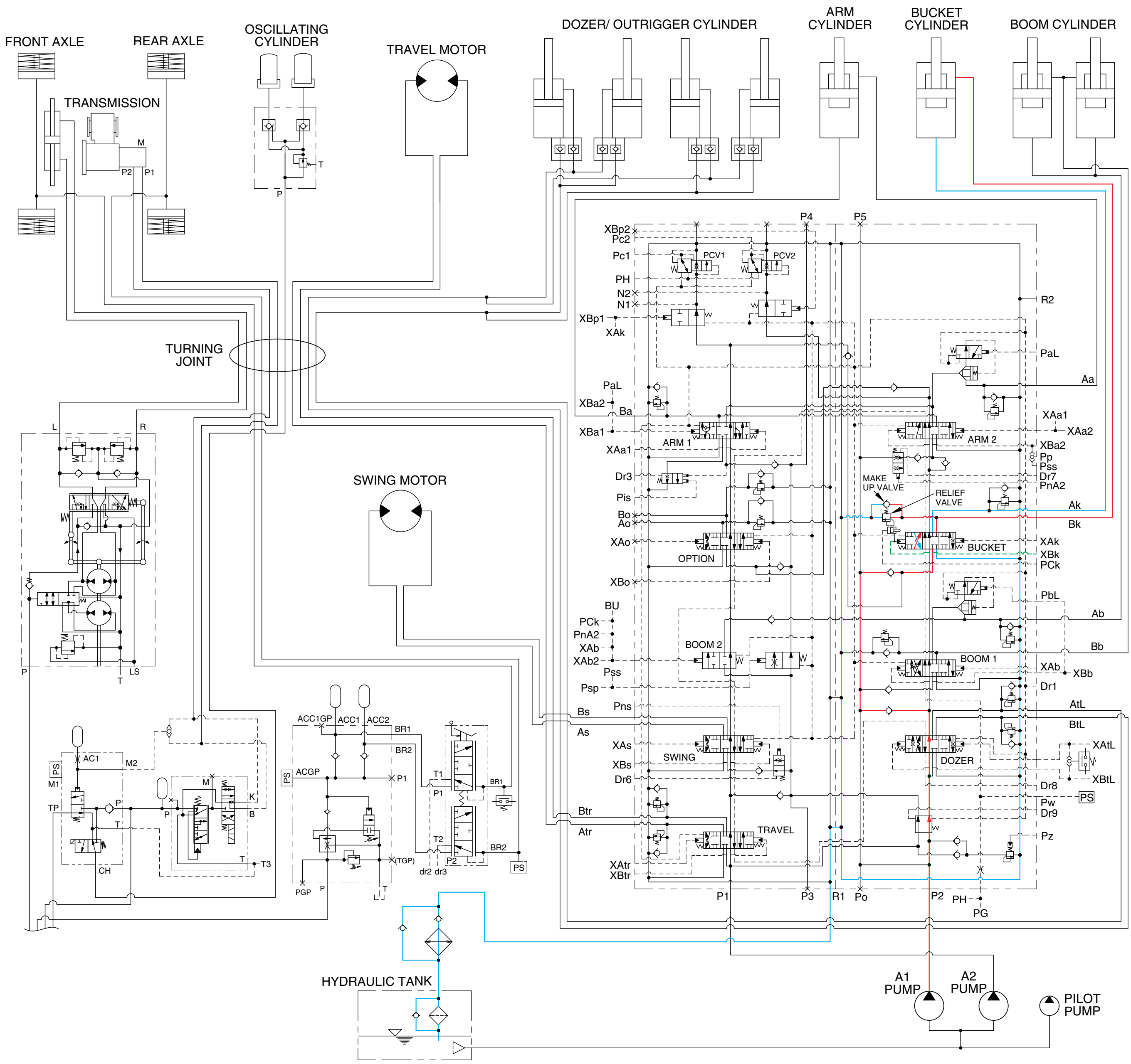
The oil from the A2 pump flows into the large chamber of bucket cylinder through confluence oil passage in the main control valve by bypass cut pilot pressure (XBp1).

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.

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 from the remote control valve.

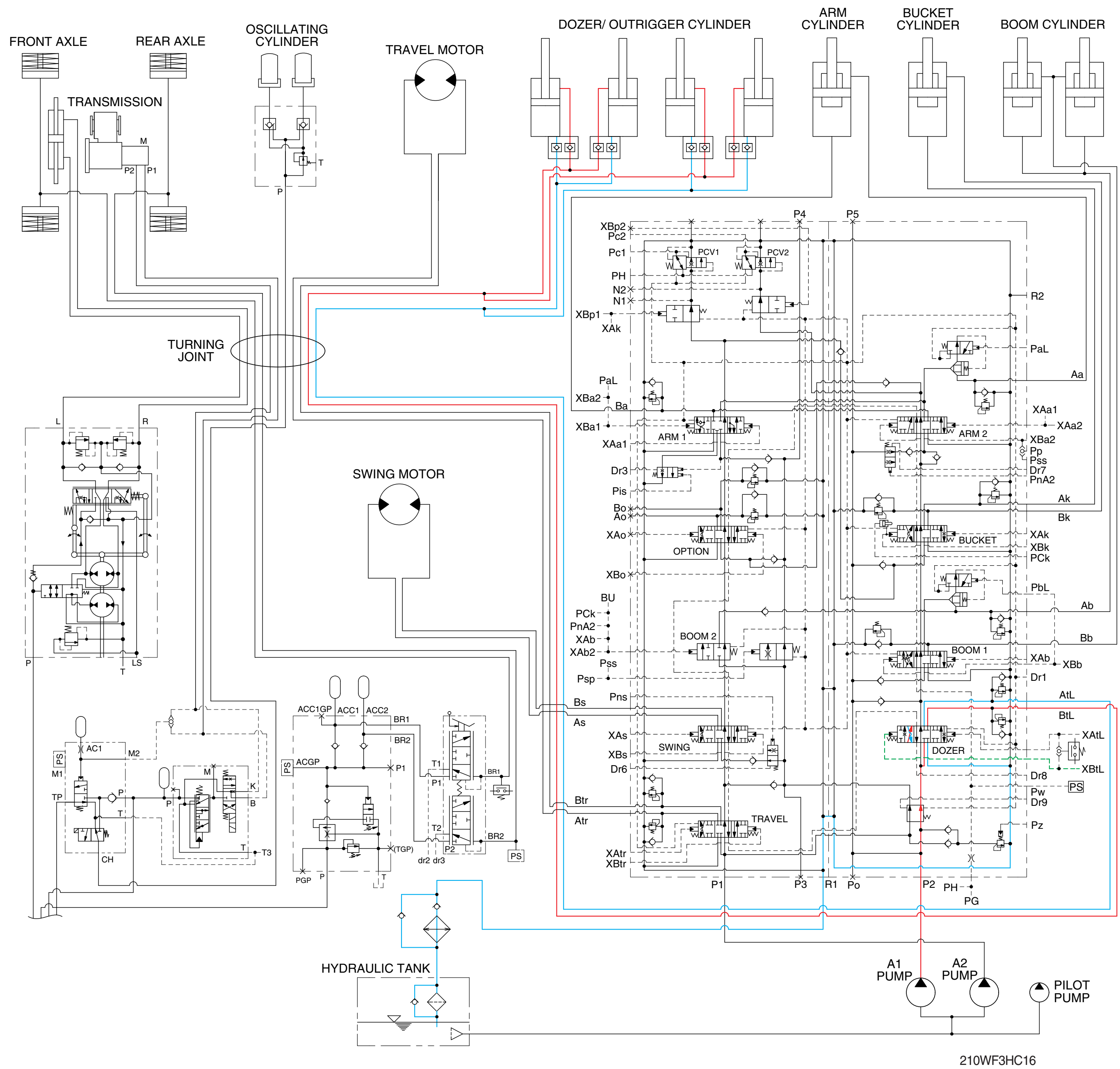
The oil from the A1 pump flows into the main control valve and then goes to the small chamber of bucket cylinder.

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

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

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

7. DOZER/OUTRIGGER UP OPERATION



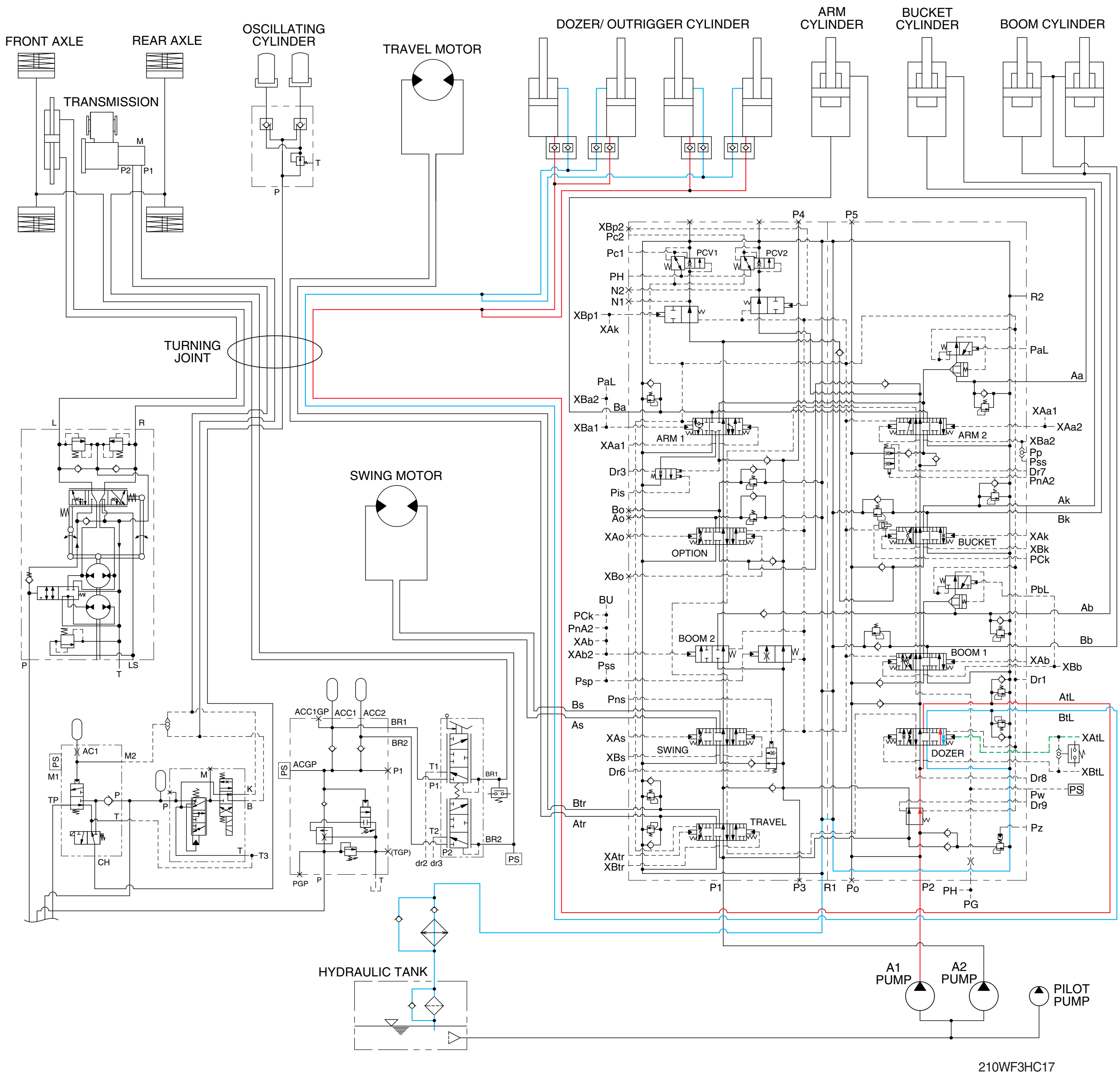
When the dozer control lever is pulled back, the dozer spool in the main control valve is moved to the dozer up position by the pilot oil pressure from the remote control valve.

The oil from the A1 pump flows into the main control valve and then goes to the small chamber of rear actuator cylinder (dozer or outrigger).

The other case, the oil flows into the small chamber of front actuator cylinder (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.

8. DOZER/OUTRIGGER DOWN OPERATION



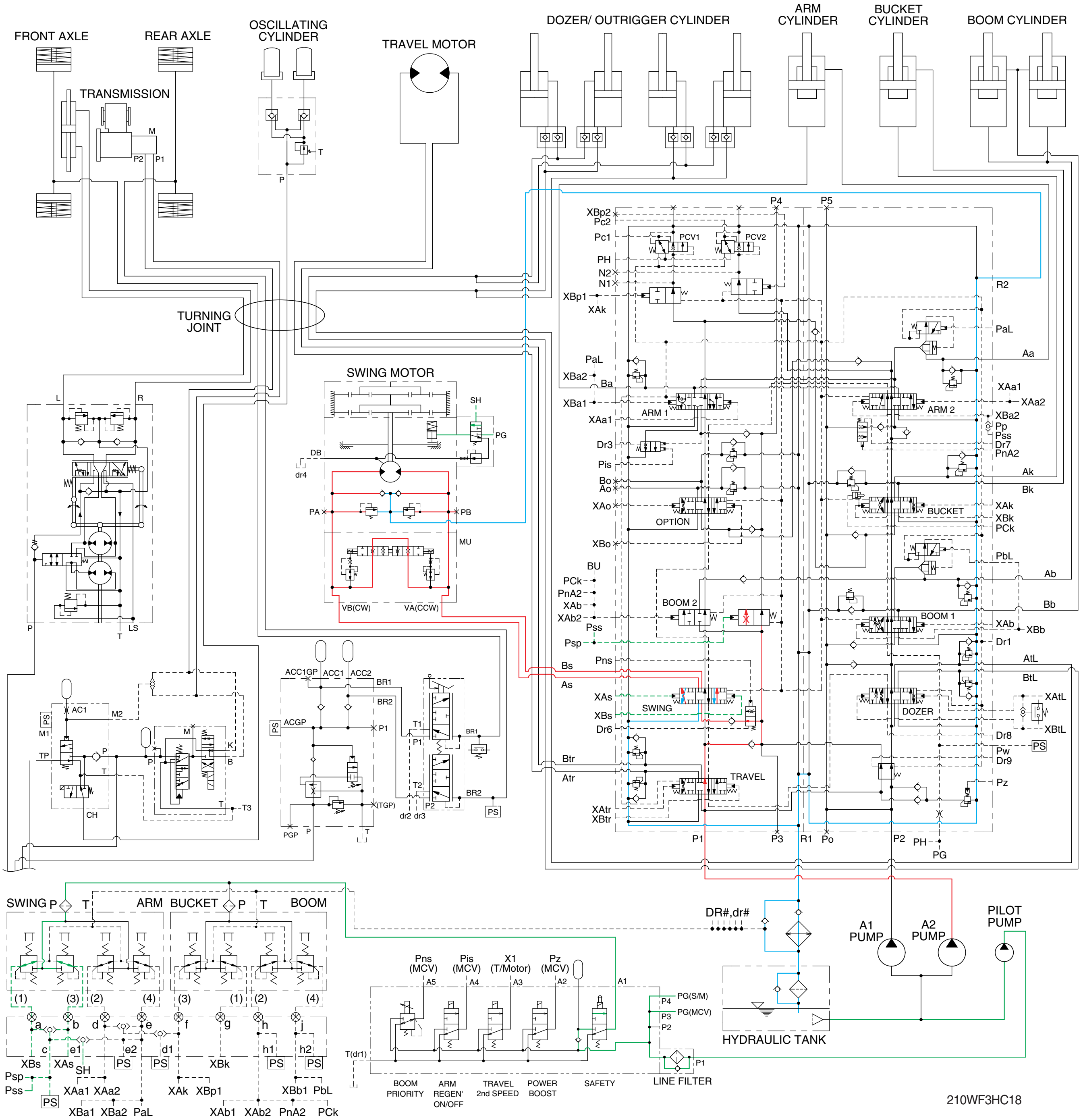
When the dozer control lever is pushed forward, the dozer spool in the main control valve is moved to the dozer down position by the pilot oil pressure from the remote control valve.

The oil from the A1 pump flows into the main control valve and then goes to the large chamber of rear actuator cylinder (dozer or outrigger).

The other case, the oil flows into the large chamber of front actuator cylinder (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.

9. SWING OPERATION



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 from the remote control valve.

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

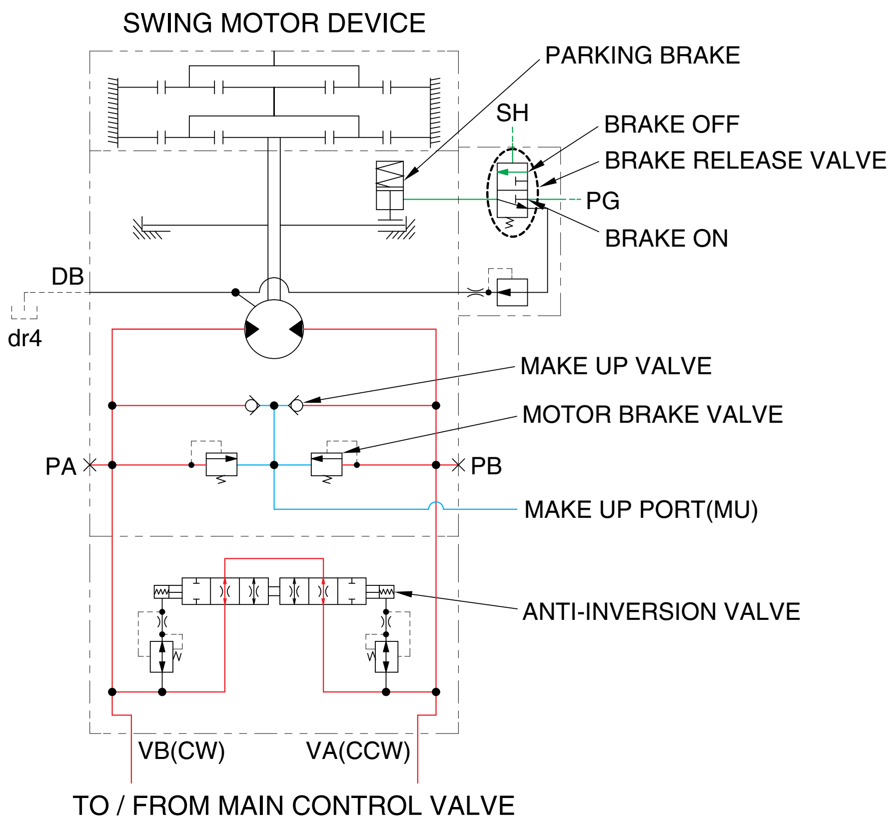
The oil from the A2 pump flows into the main control valve and then goes to the swing motor.

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

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

The swing parking brake, make up valve and the motor brake valve are provided in the swing motor. The cavitation which will happen to the swing motor is also prevented by the make up valve in the swing motor itself.

SWING CIRCUIT OPERATION



210WF3HC18A

1) MOTOR BRAKE VALVE

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

2) MAKE UP VALVE

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

3) PARKING BRAKE

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

PARKING BRAKE "OFF" OPERATION

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

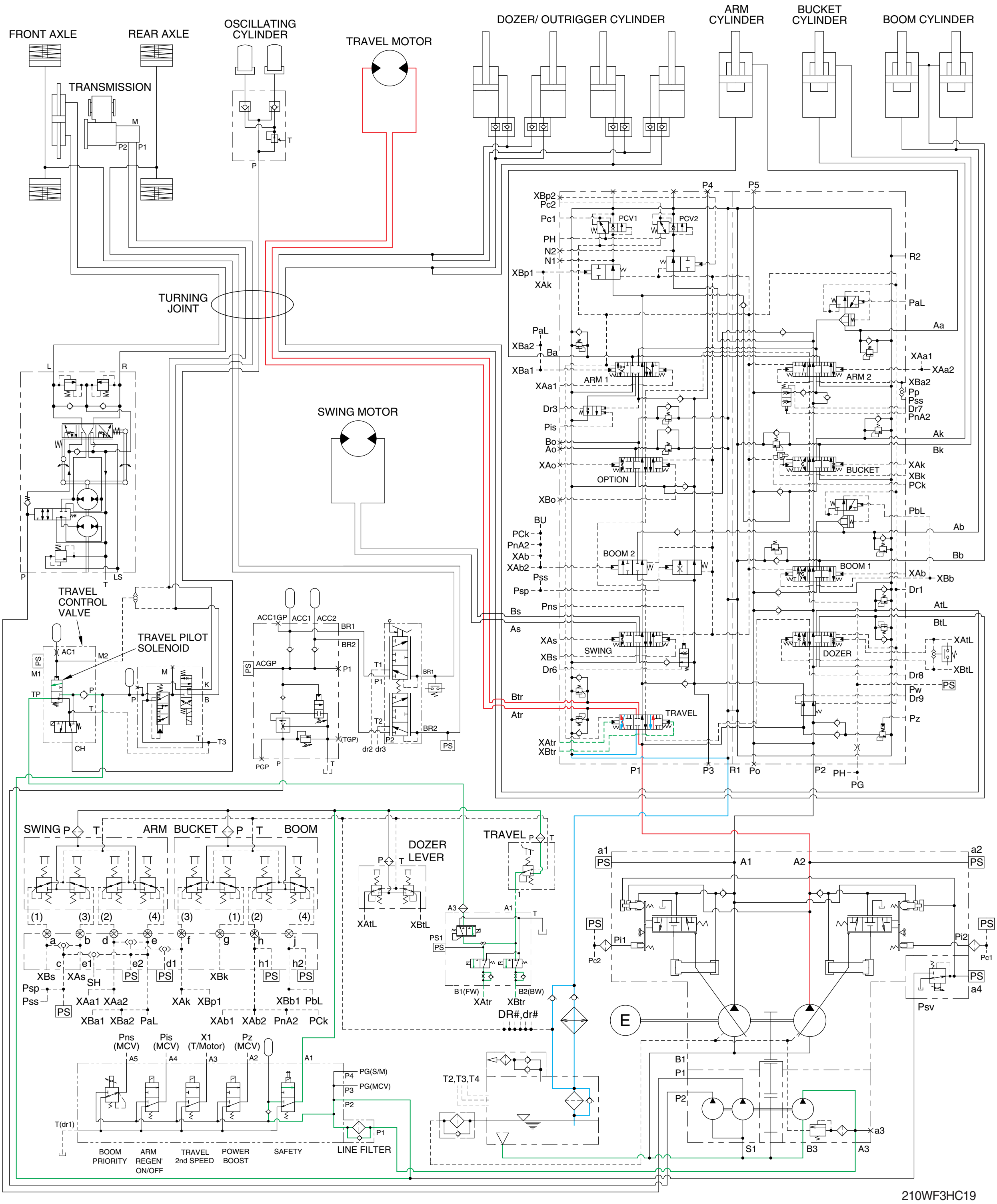
PARKING BRAKE "ON" OPERATION

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

4) ANTI-INVERSION VALVE

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

10. TRAVEL FORWARD AND REVERSE OPERATION

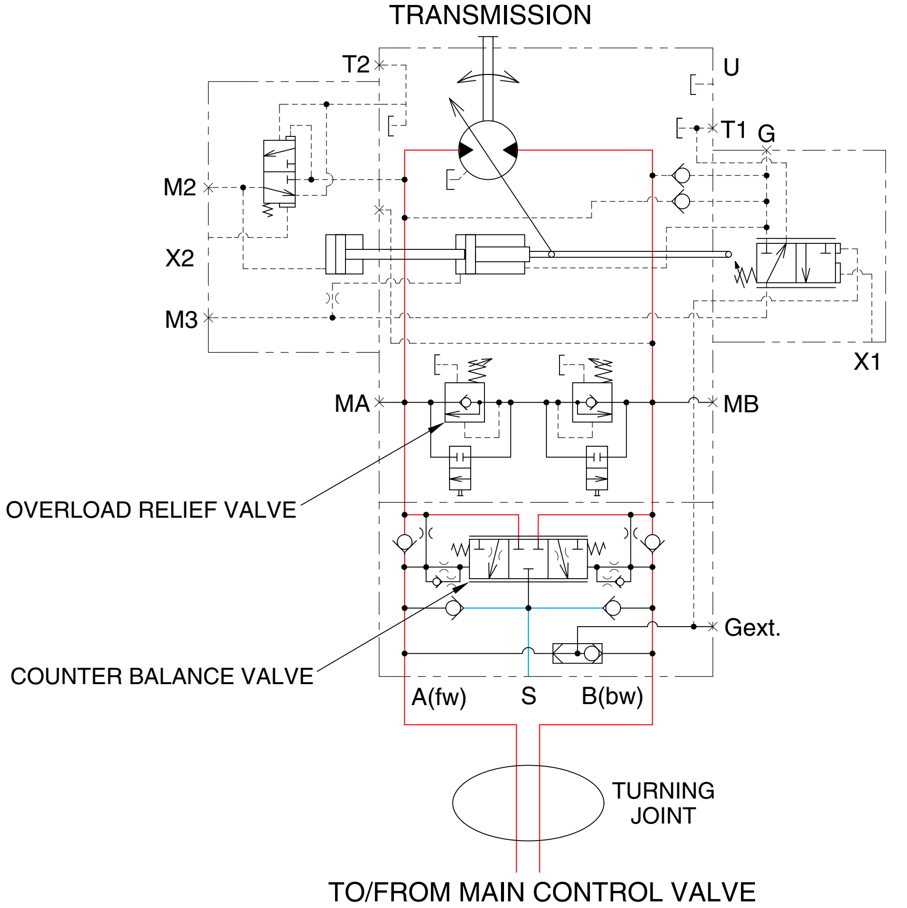


When the RH multifunction switch is placed in forward or reverse position, the travel spool in the main control valve is moved to the forward or reverse position by the pilot oil pressure from pilot pump through the travel pilot solenoid of travel control valve. The oil from the A2 pump flows into the 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 valve in the main control valve.

TRAVEL CIRCUIT OPERATION



180W9A3HC19A

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

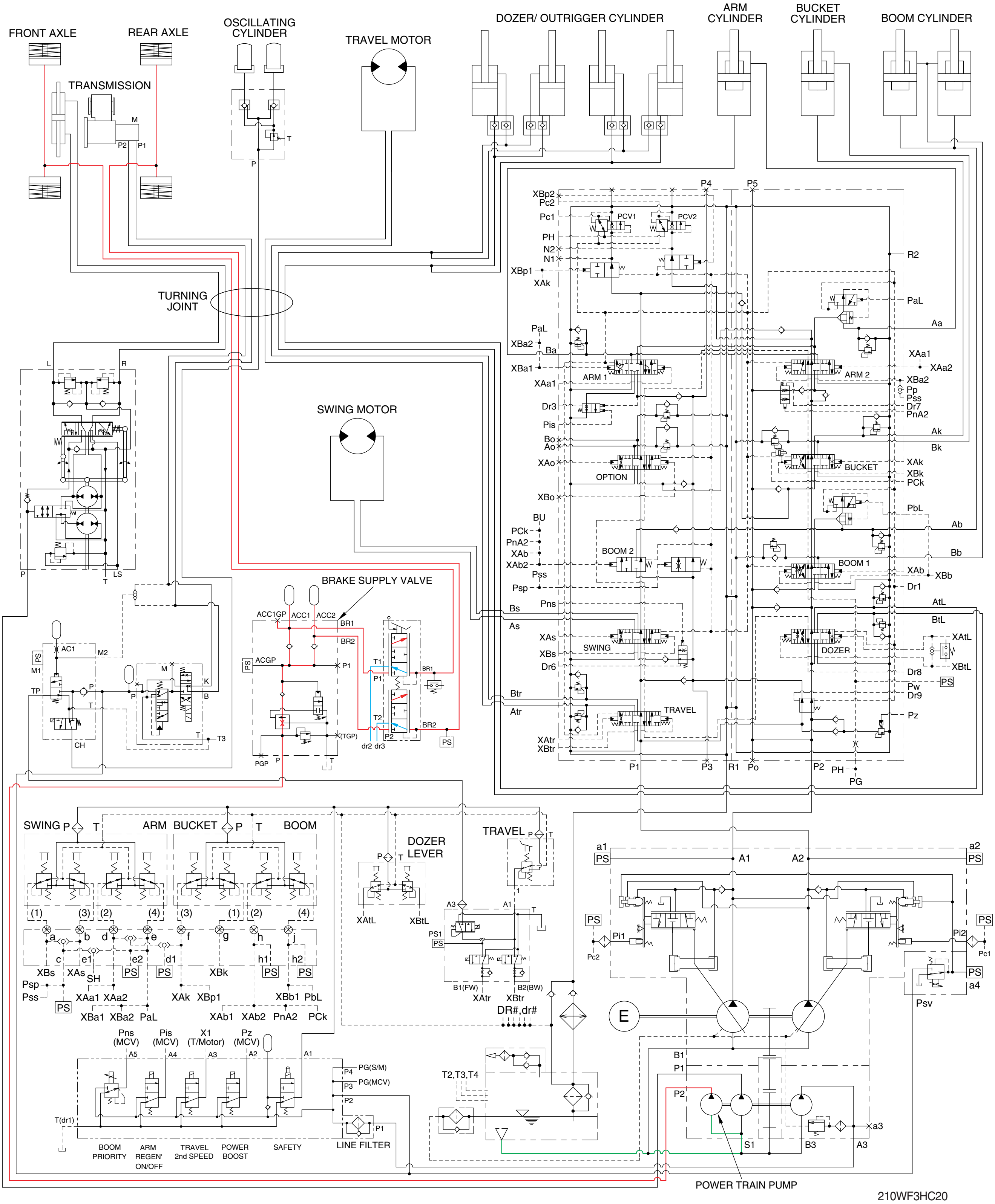
1) COUNTER BALANCE VALVE

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/cm² 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.

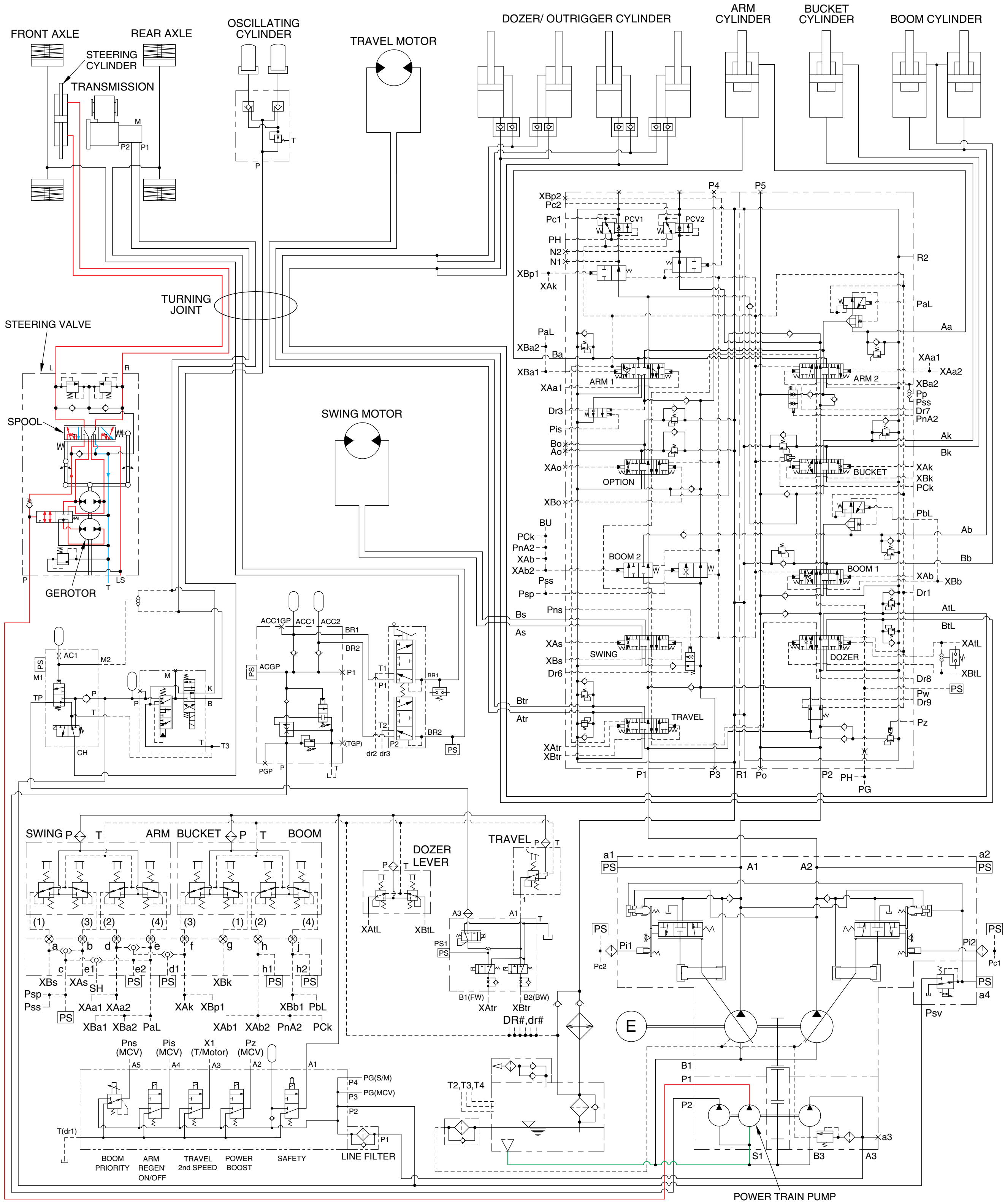
11. SERVICE BRAKE SYSTEM



When the brake pedal (valve) is pushed, the discharged oil from the power train pump (P2) flows into the front and rear axle brake disc through the solenoid valve of brake supply valve.

This pressure is applied to axle brake disc, thus the brake is applied.

12. STEERING CIRCUIT OPERATION



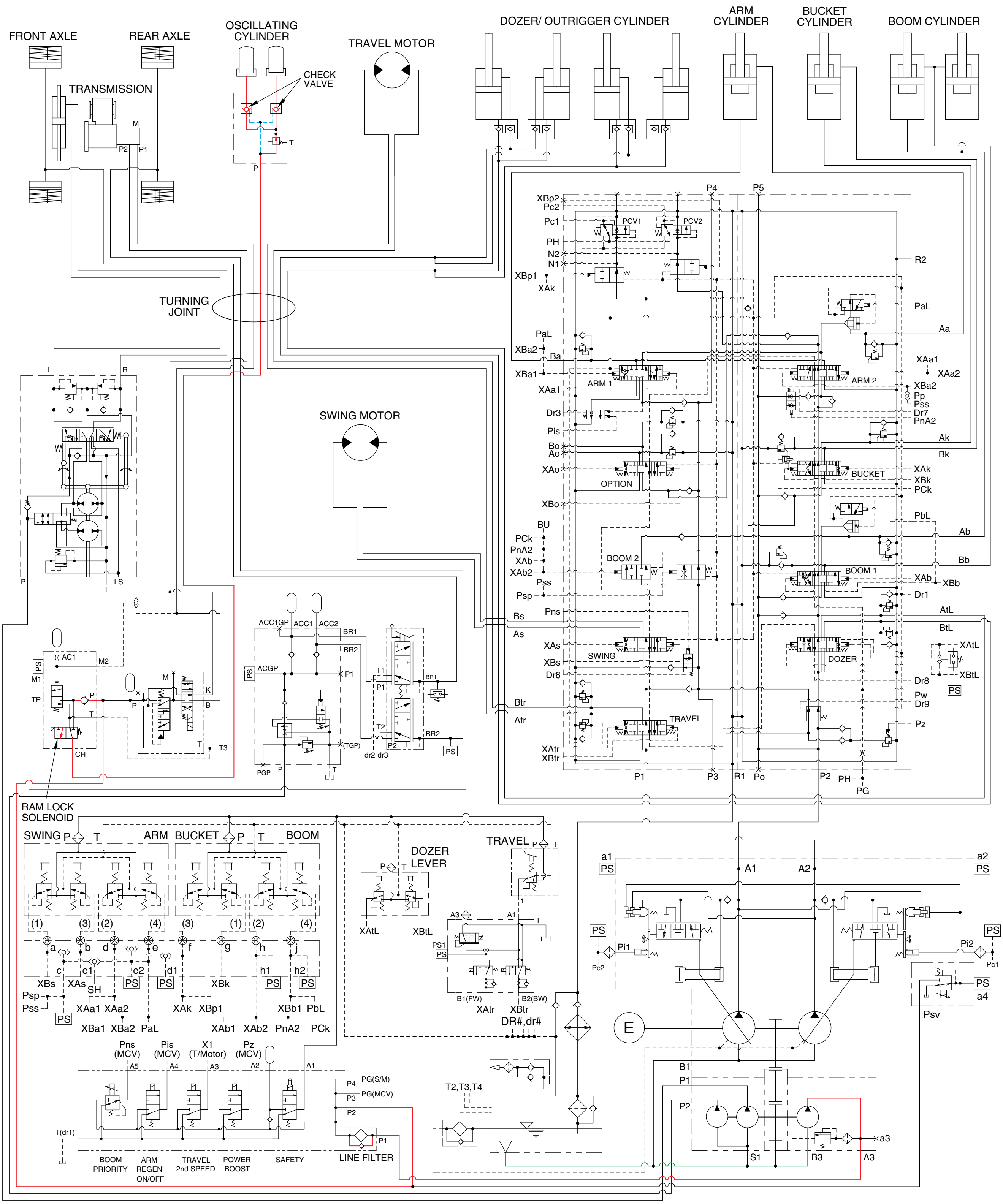
210WF3HC21

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 power train pump (P1) flows into steering cylinder through spool and gerotor within the steering valve.

Then the steering direction is applied.

13. RAM LOCK CIRCUIT OPERATION



210WF3HC22

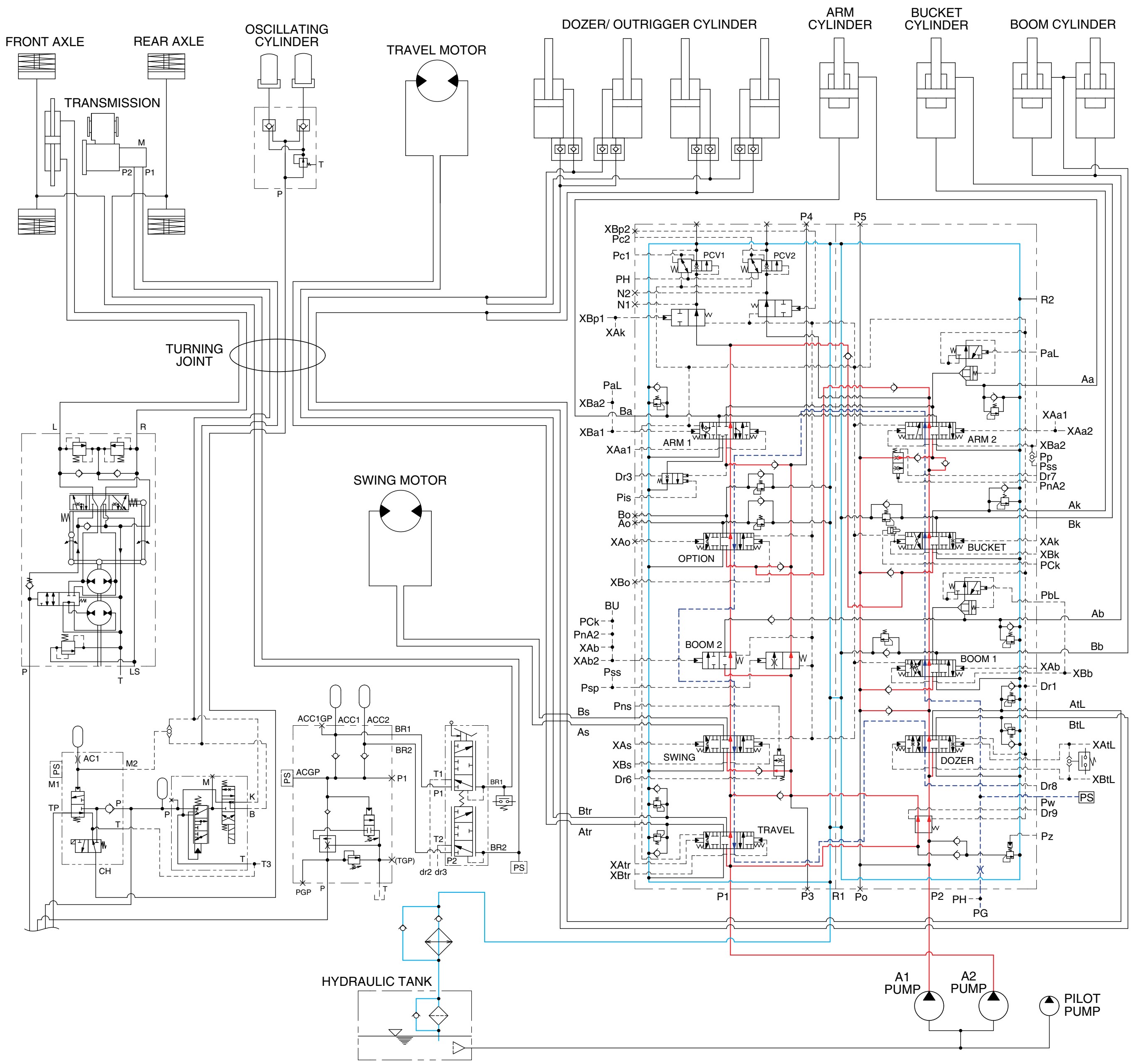
When the ram lock switch on the dashboard of the steering column is selected to OFF position, the ram lock solenoid is changed over.

Thus, the oil discharged from the pilot 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).

GROUP 5 COMBINED OPERATION

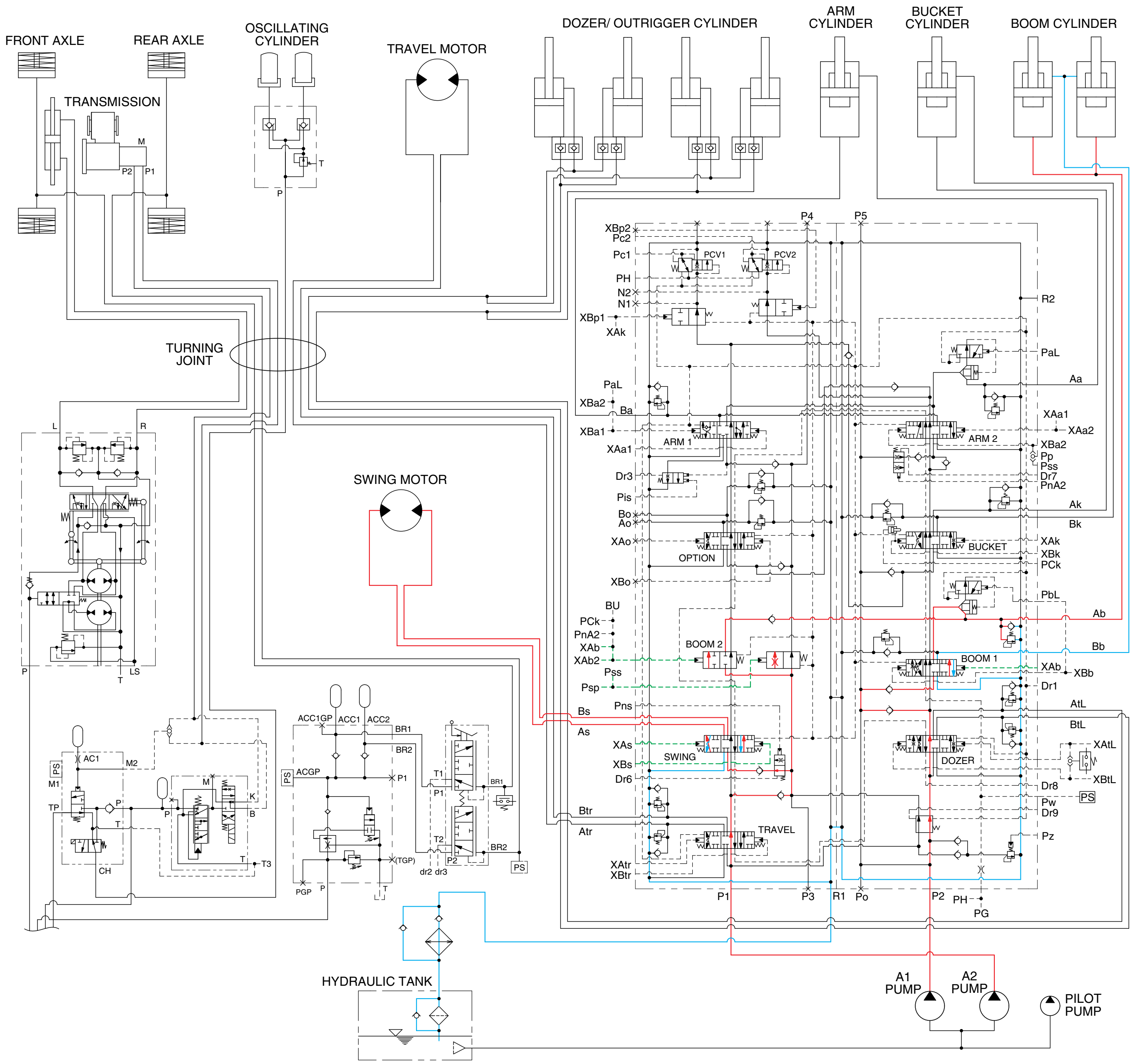
1. OUTLINE



210WF3HC23

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

2. COMBINED SWING AND BOOM UP OPERATION



210WF3HC24

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

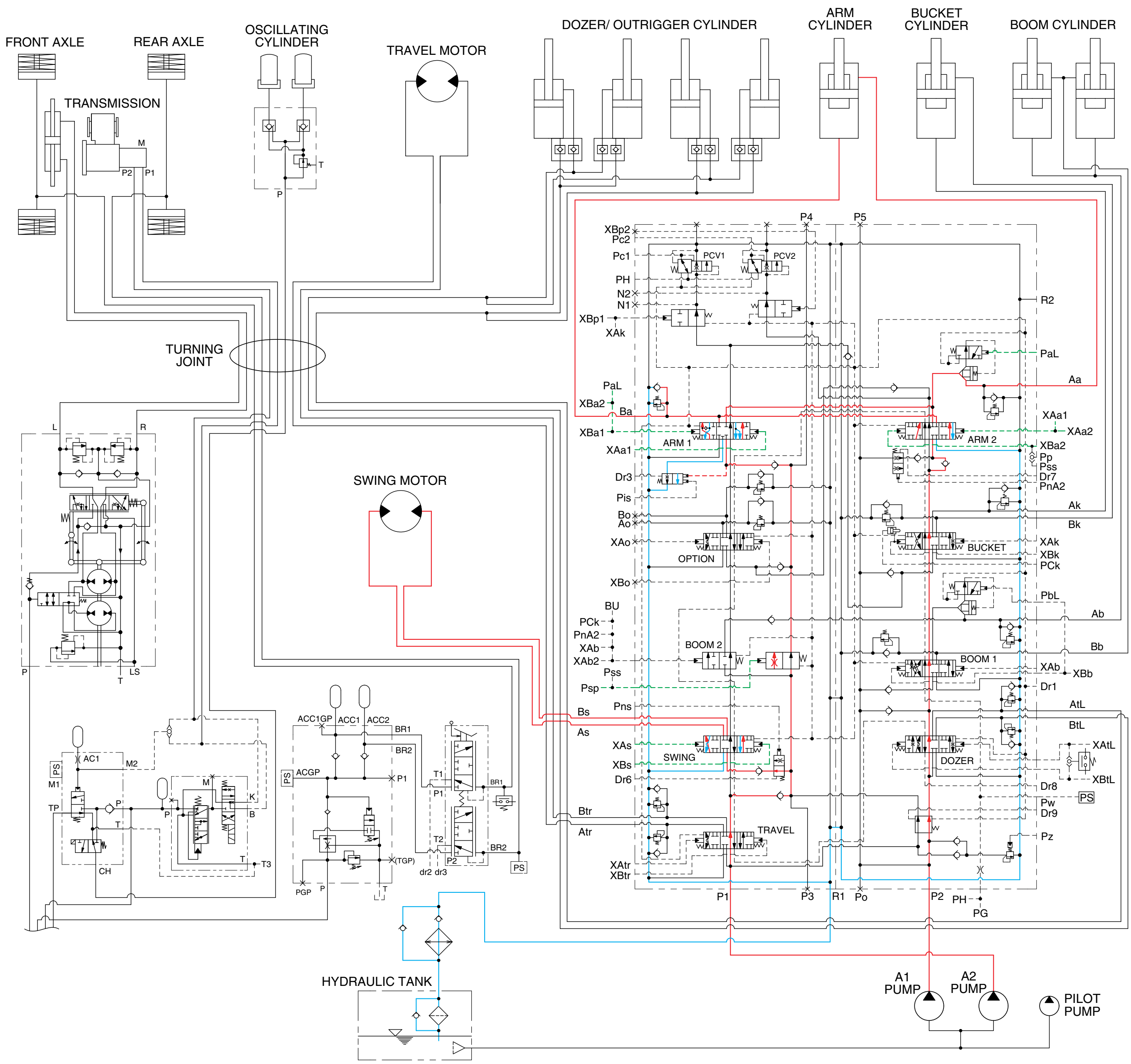
The oil from the A2 pump flows into the swing motor through swing spool and the boom cylinder through boom 2 spool.

The oil from the A1 pump flows into the boom cylinders through the boom 1 spool in the right control valve.

The super structure swings and the boom is operated.

Refer to page 3-13 for the boom priority system.

3. COMBINED SWING AND ARM OPERATION



210WF3HC25

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

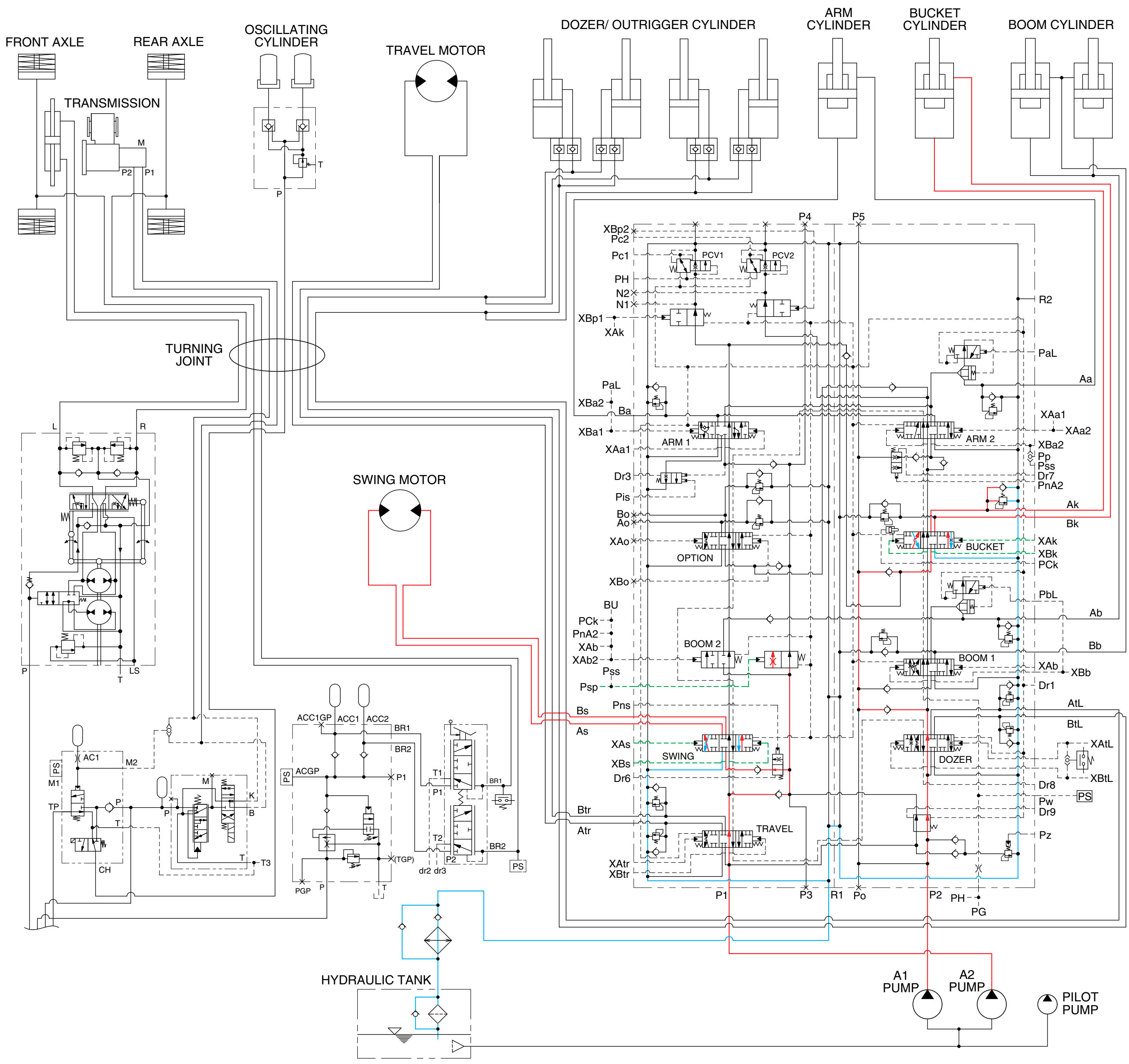
The oil from the A2 pump flows into the swing motor through swing spool and the arm cylinder through arm 1 spool.

The oil from the A1 pump flows into the arm cylinder through the arm 2 spool of the right control valve.

The super structure swings and the arm is operated.

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

4. COMBINED SWING AND BUCKET OPERATION



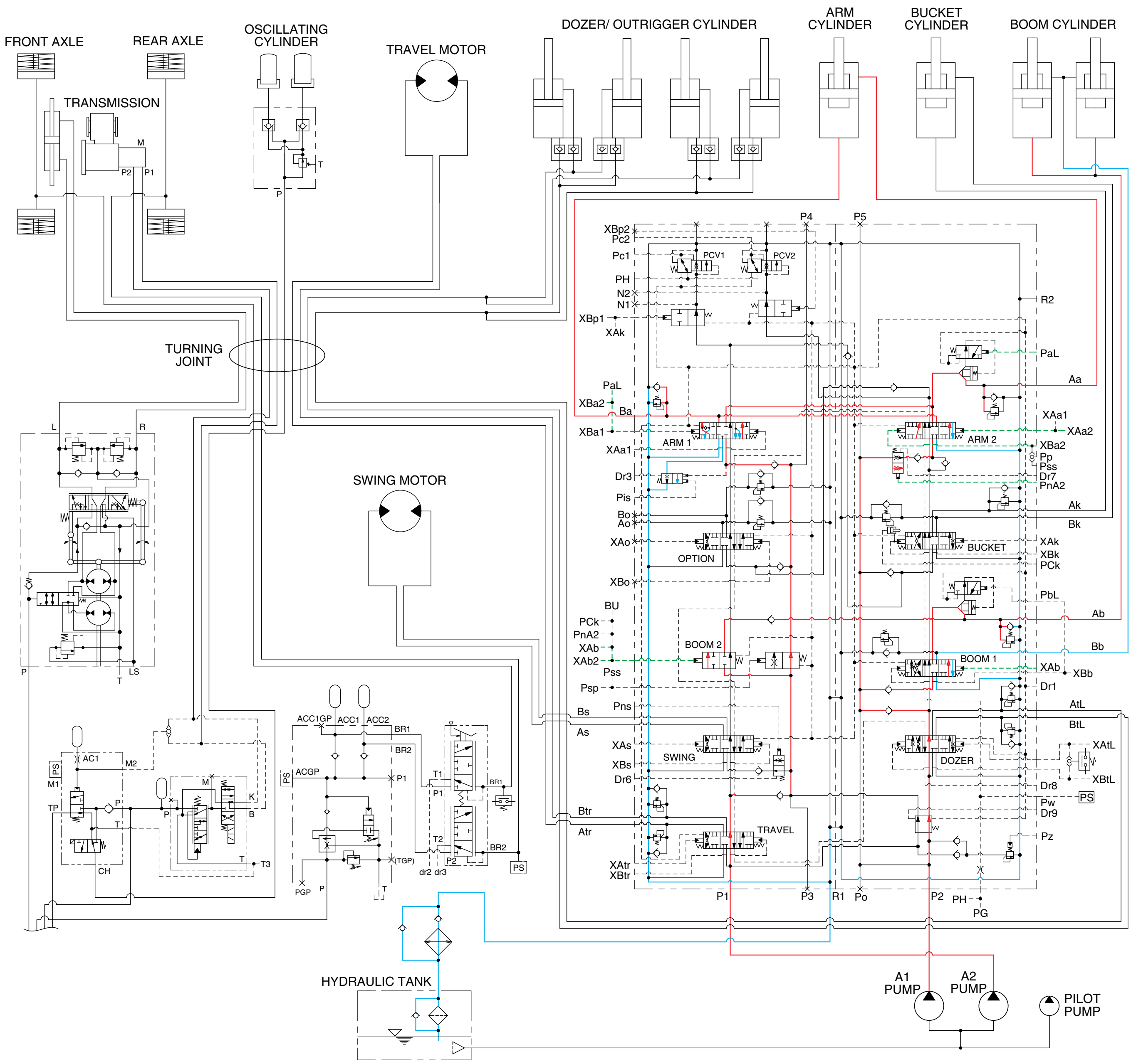
When the swing and bucket functions are operated simultaneously, the swing spool and bucket spool in the main control valve are moved to the functional position by the pilot oil pressure from the remote control valve.

The oil from the A2 pump flows into the swing motor through the swing spool in the left control valve.

The oil from the A1 pump flows into the bucket cylinder through the bucket spool in the right control valve.

The super structure swings and the bucket is operated.

5. COMBINED BOOM UP AND ARM OPERATION



210WF3HC27

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

The oil from the A2 pump flows into the boom cylinders and the arm cylinder through the boom 2 spool and arm 1 spool in the left control valve.

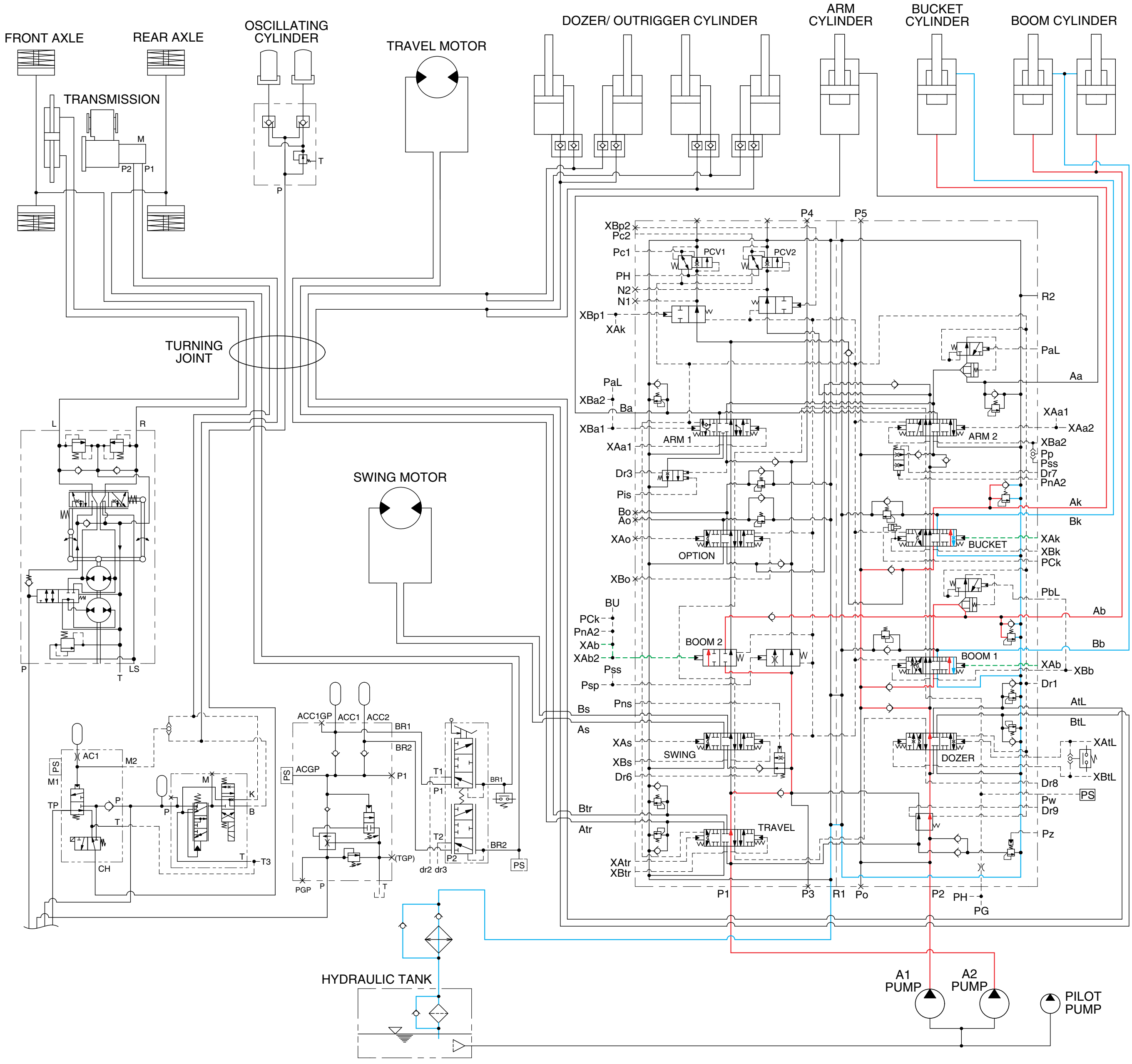
The oil from the A1 pump flows into the boom cylinders and arm cylinder through the boom 1 spool and arm 2 spool and the parallel and confluence oil passage in the right control valve.

During the boom up and arm in or out functions are operated simultaneously, the pilot oil pressure PnA2 transfers the arm 2 logic spool to the up direction.

Therefore, the most of pressurized oil from the A1 pump flows into boom 1 spool than the arm 2 spool to make the boom up operation more preferential. This is called the boom up operation preference function.

The boom up and arm are operated.

6. COMBINED BOOM UP AND BUCKET IN OPERATION



210WF3HC28

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

The oil from the A2 pump flows into the boom cylinders through the boom 2 spool in the left control valve.

The oil from the A1 pump flows into the boom cylinders and bucket cylinder through the boom 1 spool and bucket spool and the parallel and confluence oil passage in the right control valve.

During the boom up and bucket in functions are operated simultaneously, the pilot pressure flows into the bucket spool limit piston through port PCk. This transfers the bucket spool in the half stroke not full stroke.

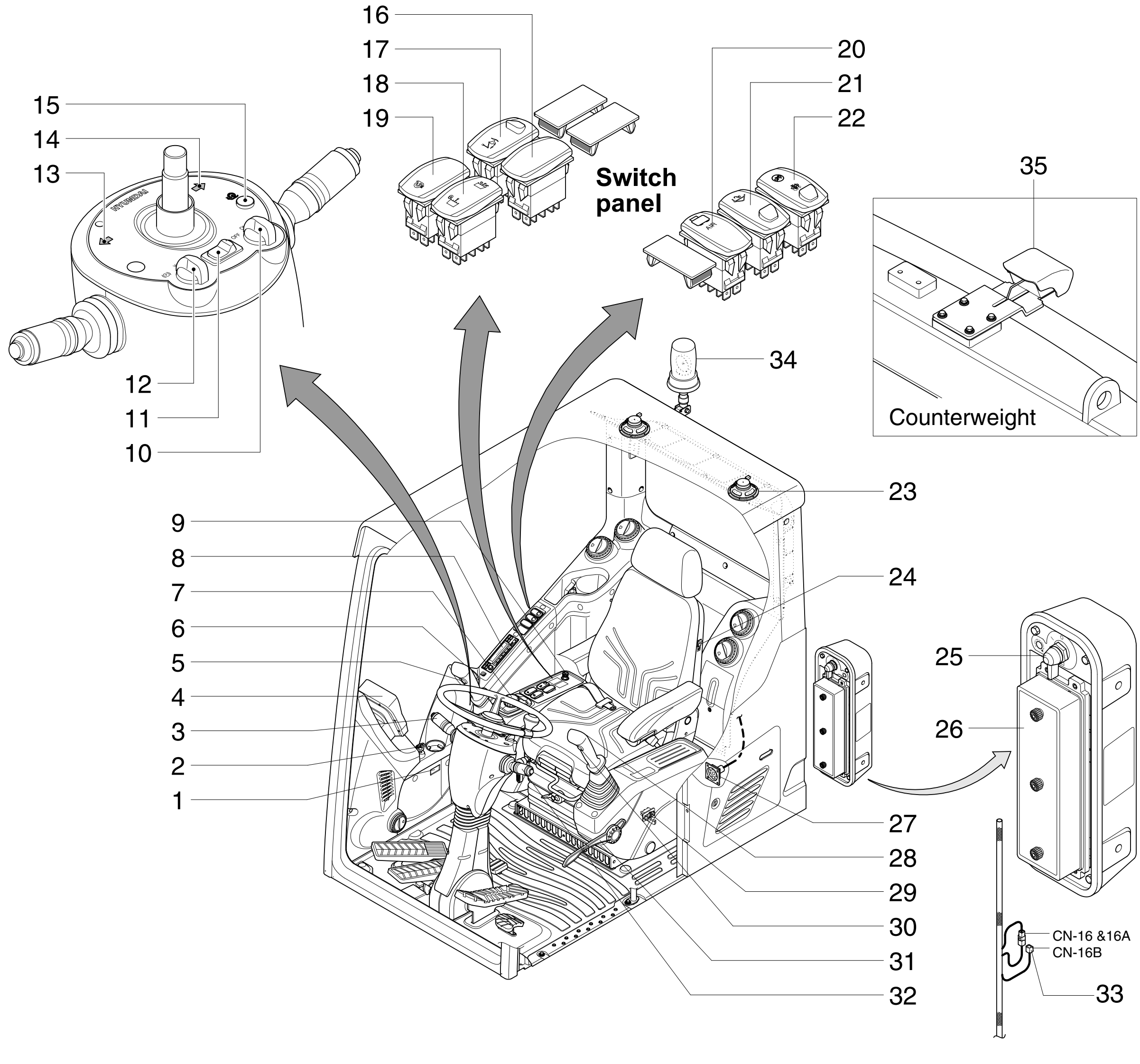
Therefore, the most of pressurized oil from the A1 pump flows into boom 1 spool than the bucket spool to make the boom up operation more preferential. This is called the boom up operation preference function.

The boom up and bucket in are operated.

SECTION 4 ELECTRICAL SYSTEM

GROUP 1 COMPONENT LOCATION

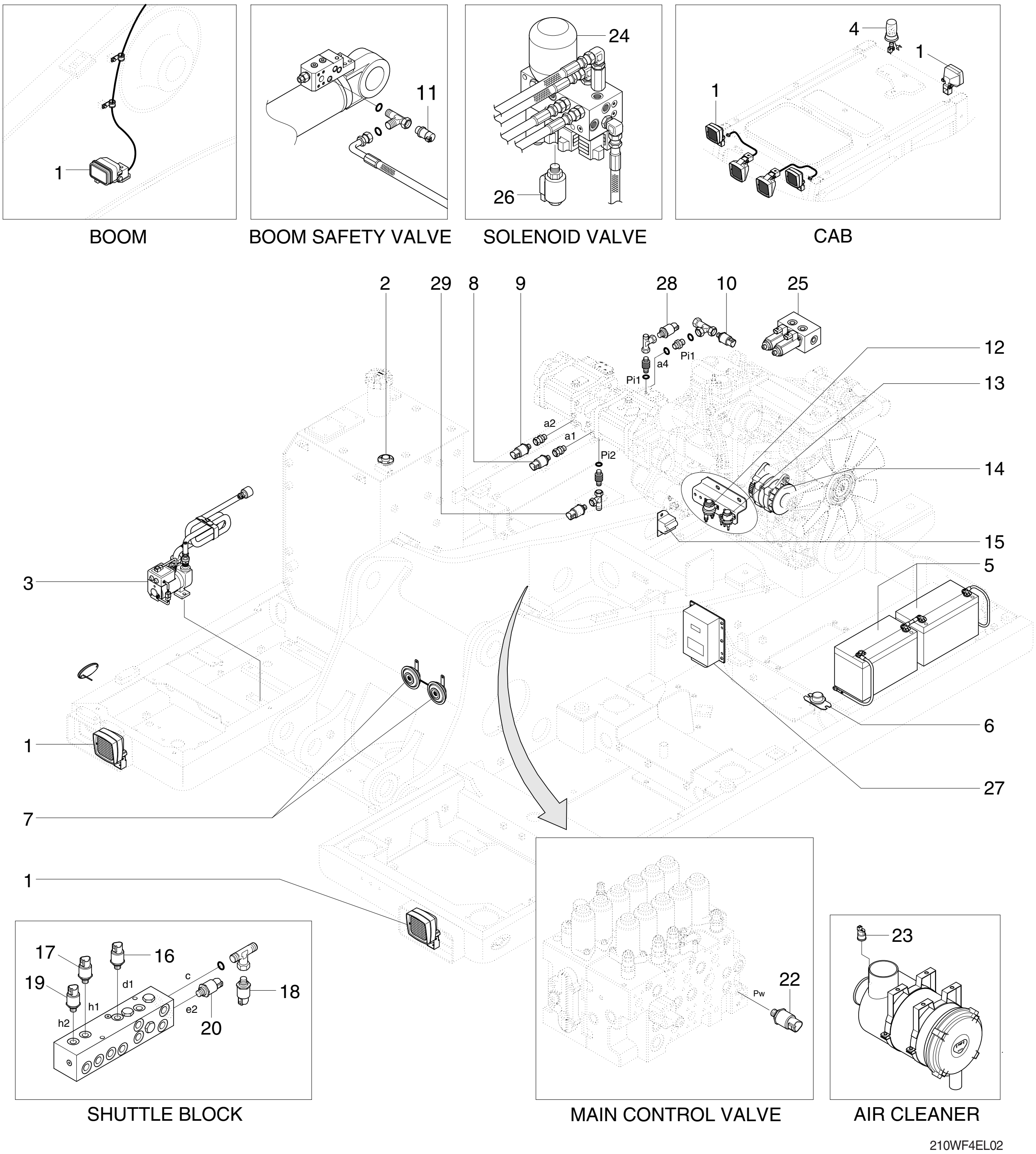
1. LOCATION 1



210WF4EL01

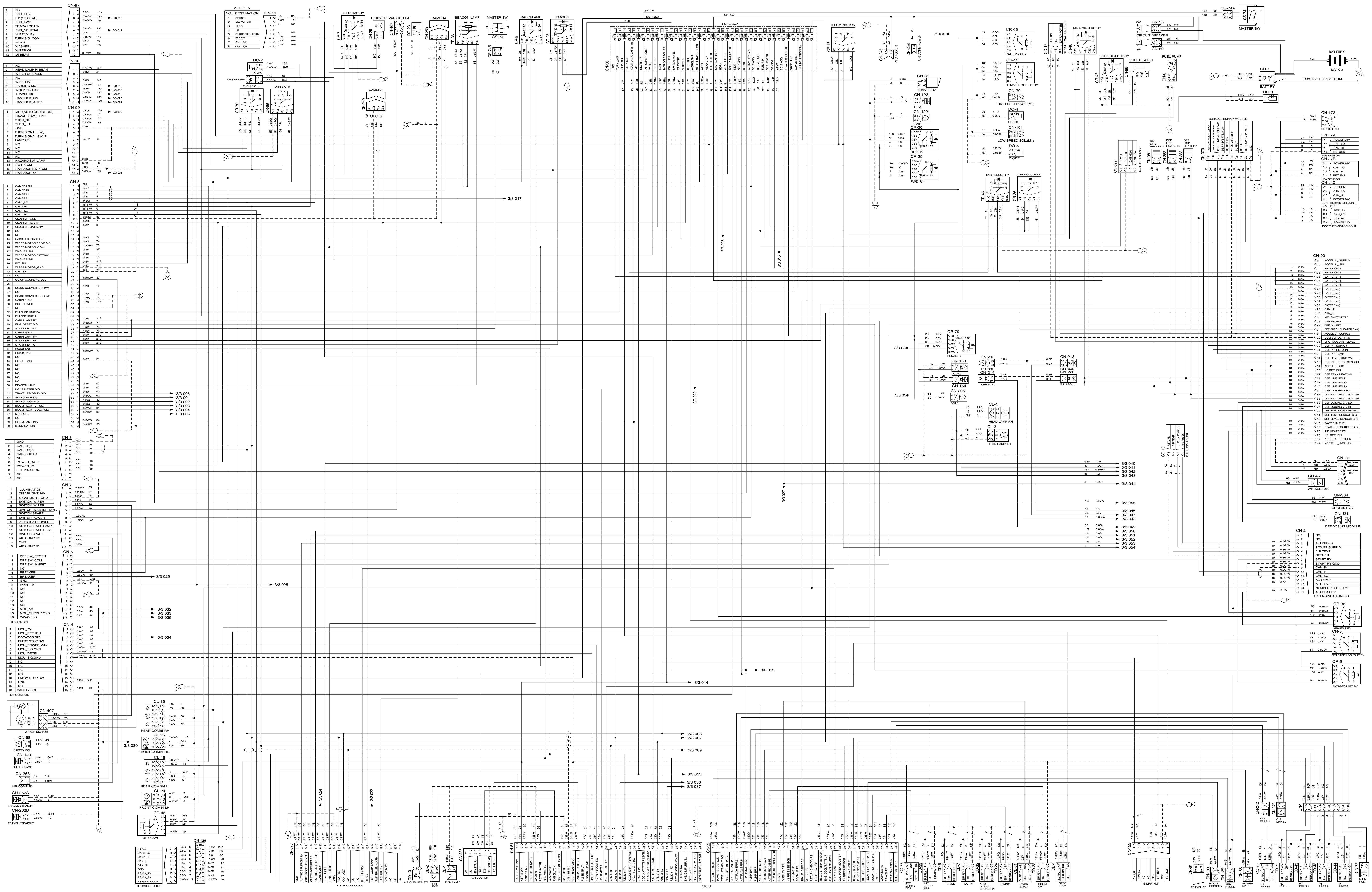
1	Service meter	13	Left turning pilot lamp	25	Master switch
2	Start switch	14	Right turning pilot lamp	26	Fuse & relay box
3	Multi function switch (RH)	15	Creep button	27	RS232 & J1939 service socket
4	Cluster	16	Option attach switch	28	One touch decel switch
5	Breaker operation switch	17	Boom floating switch	29	Emergency engine stop switch
6	Horn switch	18	Swing lock/fine switch	30	Power max switch
7	Haptic controller	19	Creep switch	31	Safety lever
8	Radio & USB player	20	Air compressor switch	32	Multi function switch (LH)
9	Cigar lighter	21	Quick clamp switch	33	Emergency engine speed control connector
10	Ram lock rotary switch	22	SCR system cleaning switch		
11	Hazard switch	23	Speaker	34	Beacon lamp
12	Select rotary switch	24	Heated seat switch	35	Rear view camera

2. LOCATION 2



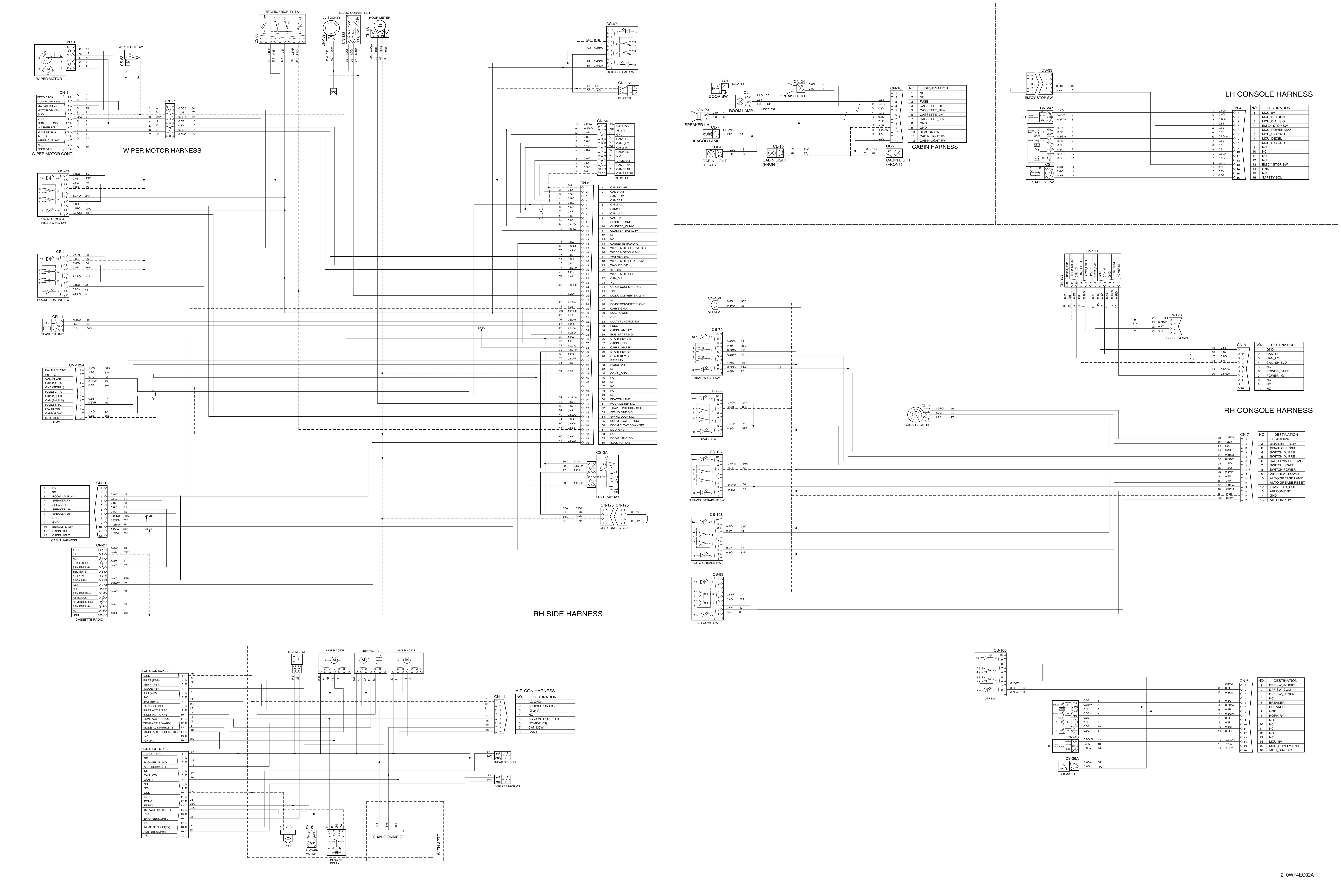
1	Lamp	11	Overload pressure sensor	22	Travel pressure sensor
2	Fuel sender	12	Start relay	23	Air cleaner sensor
3	Fuel filler pump	13	Heater relay	24	Solenoid valve
4	Beacon lamp	14	Alternator	25	Pump EPPR valve
5	Battery	15	Travel alarm buzzer	26	Boom priority EPPR valve
6	Battery relay	16	Arm/Bucket in pressure sensor	27	MCU
7	Horn	17	Boom up pressure sensor	28	Nega 1 pressure sensor
8	P1 pressure sensor	18	Swing pressure sensor	29	Nega 2 pressure sensor
9	P2 pressure sensor	19	Boom down pressure sensor		
10	EPPR pressure sensor	20	Arm in pressure sensor		

· ELECTRICAL CIRCUIT (1/6, SERIAL NO. : -#0230)

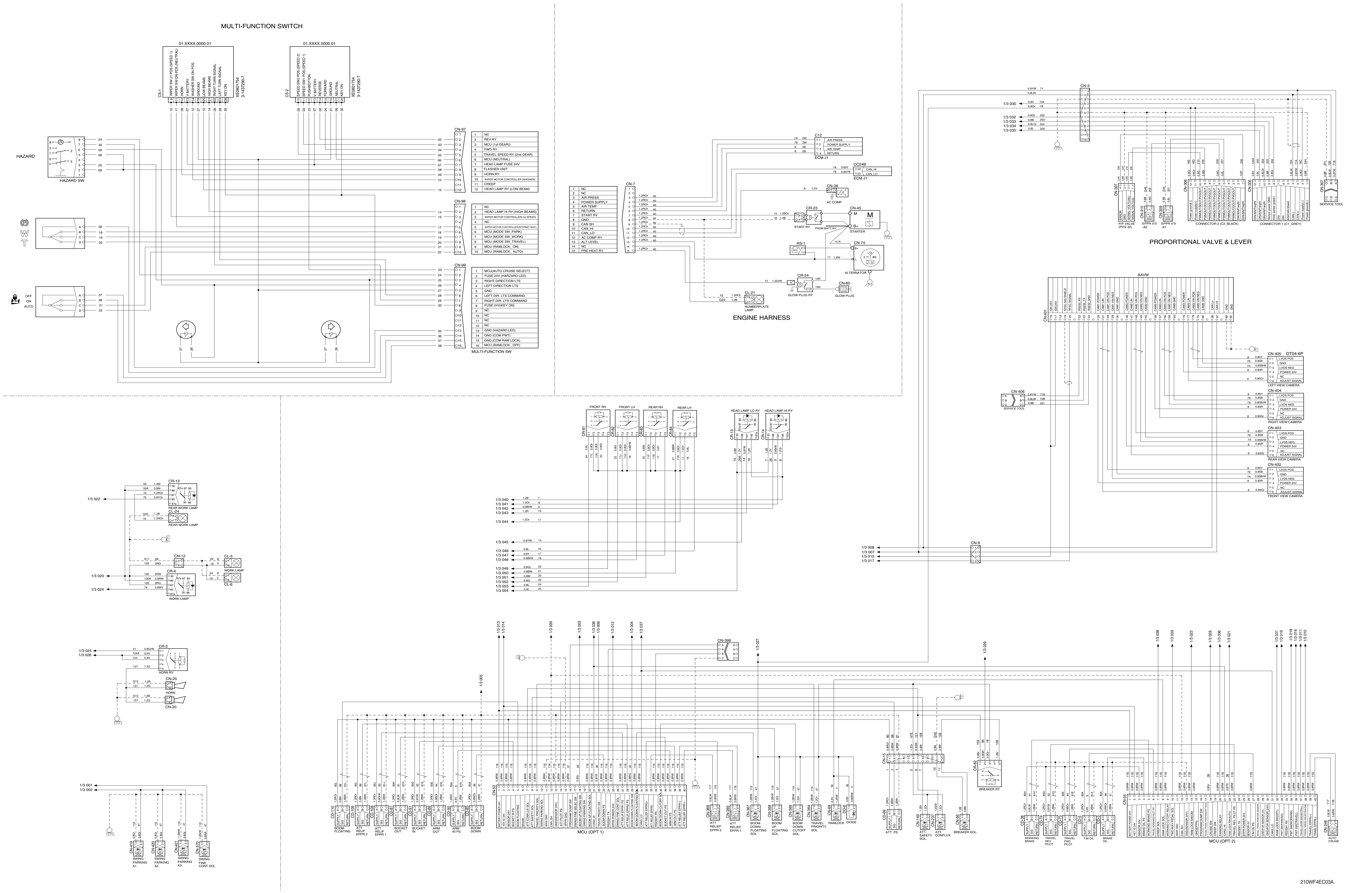


210WF4EC01A

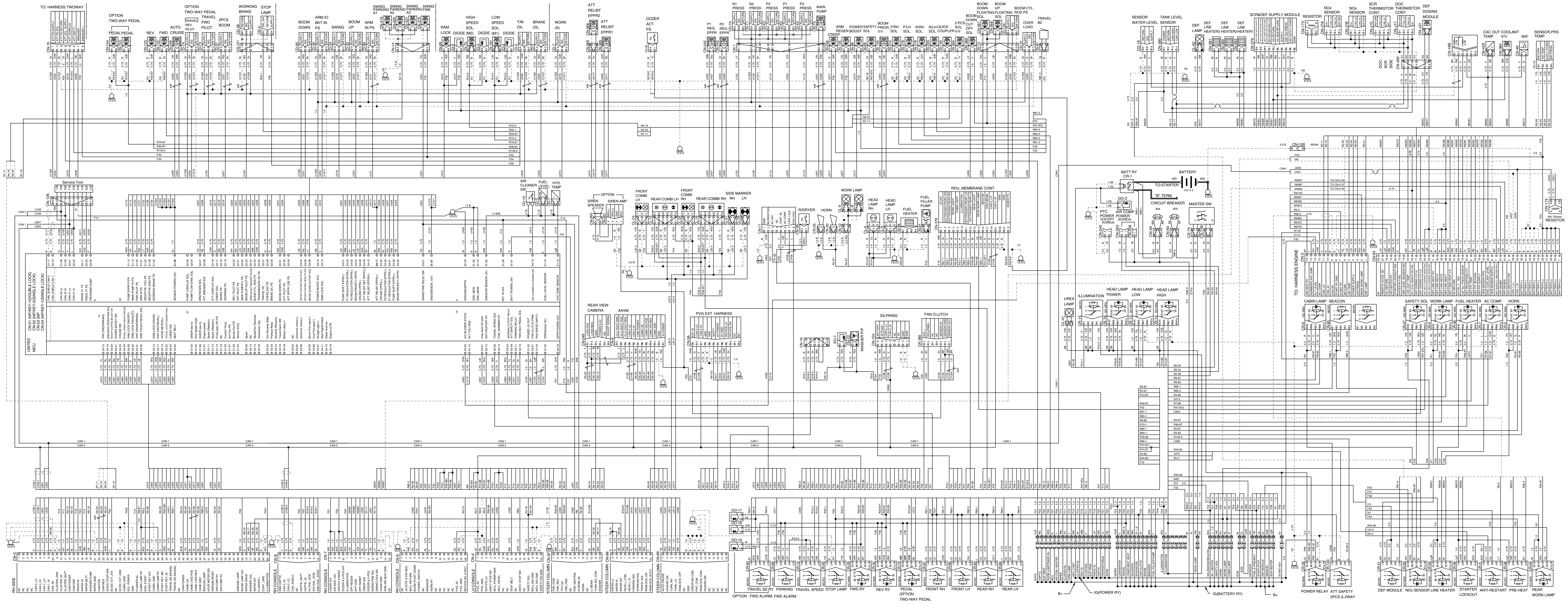
· ELECTRICAL CIRCUIT (2/6, SERIAL NO. : -#0230)



· ELECTRICAL CIRCUIT (3/6, SERIAL NO. : -#0230)

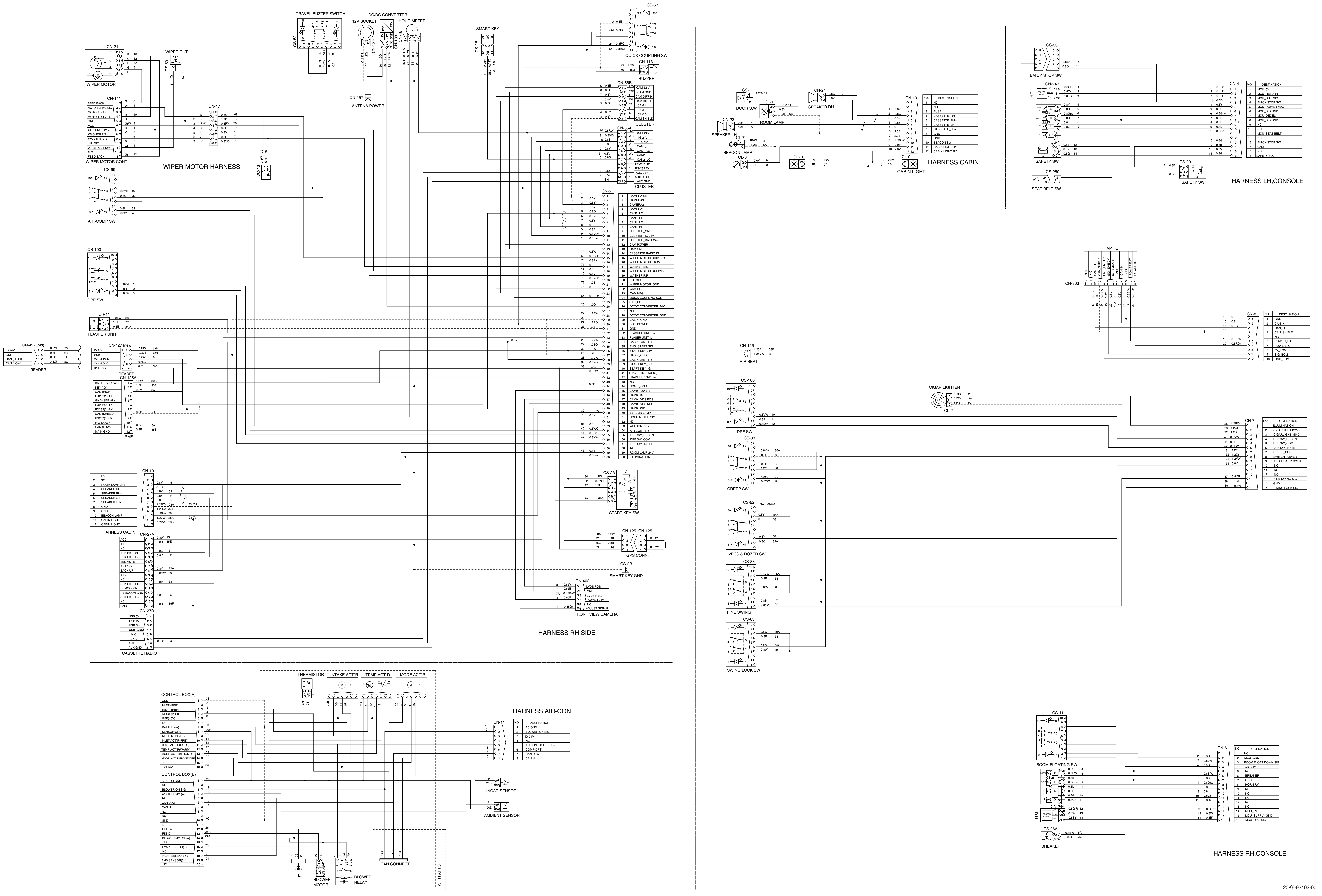


· ELECTRICAL CIRCUIT (4/6, SERIAL NO. : #0231-)

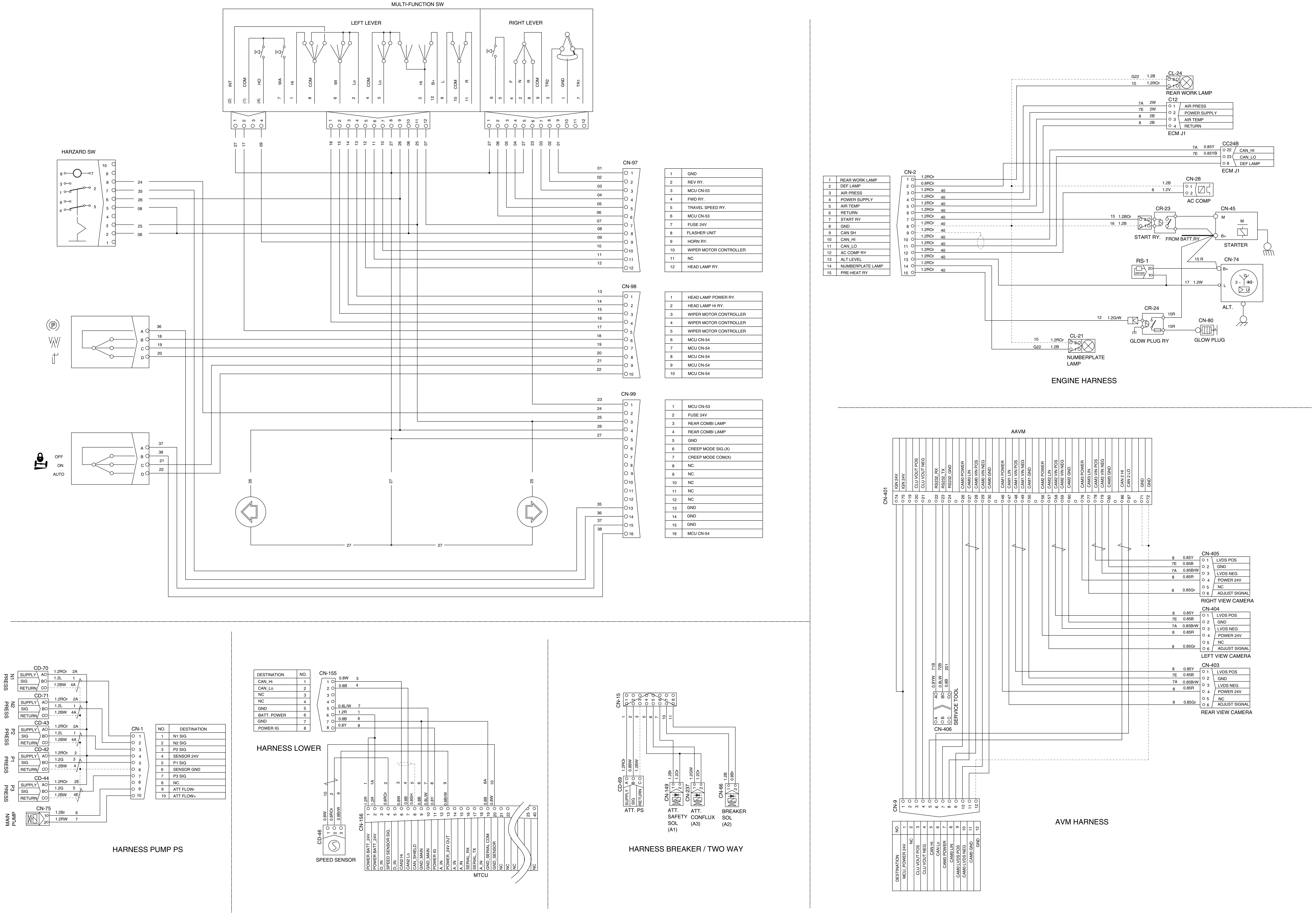


20K6-92202-00

· ELECTRICAL CIRCUIT (5/6, SERIAL NO. : #0231-)



· ELECTRICAL CIRCUIT (6/6, SERIAL NO. : #0231-)



20K6-92300-01

MEMORANDUM

1. POWER CIRCUIT

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

1) OPERATING FLOW

Battery → Battery relay → Circuit breaker [CN-95] → Master switch [CS-74]

- → Fuse box [No.1] → MCU [CN-52 (8), CN-53 (25), CN-54 (25)]
- → Fuse box [No.2] → I/conn [CN-8 (6)] → Slipring [CN-155 (2)]
- → Fuse box [No.3] → Engine ECM [CN-93 (1, 25, 26, 27, 28)]
- → Fuse box [No.4] → Slipring [CN-155 (6)]
- → Fuse box [No.5] → NOx sensor relay [CR-102 (30)]
- → Fuse box [No.6] → I/conn [CN-5 (59)]
  - → I/conn [CN-10 (3)] → Room lamp [CL-1 (2)]
    - → Door switch [CS-1]
  - → Radio & USB player [CN-27 (8)]
- → Fuse box [No.7] → MCU [CN-51 (1)]
- → Fuse box [No.8]
  - → Master switch [CS-74B (2)→(1)] → I/conn [CN-5 (36)]
    - → Start switch [CS-2 (1)]
    - → GPS connection [CN-125 (1)]
    - → RMS [CN-125A (1)]
  - → Power relay [CR-35 (30)]
- → Fuse box [No.9] → I/conn [CN-11 (4)]
- → Fuse box [No.10] → I/conn [CN-5 (18)] → I/conn [CN-17 (5)]
  - → Wiper motor controller [CN-141 (7)]
  - → Wiper motor [CN-21 (4)]
- → Fuse box [No.11] → I/conn [CN-5 (11)]
  - → Hour meter [CN-48 (1)]
  - → Cluster [CN-56 (1)]
- → Fuse box [No.12] → I/conn [CN-5 (32)] → Flasher unit [CR-11 (1)]

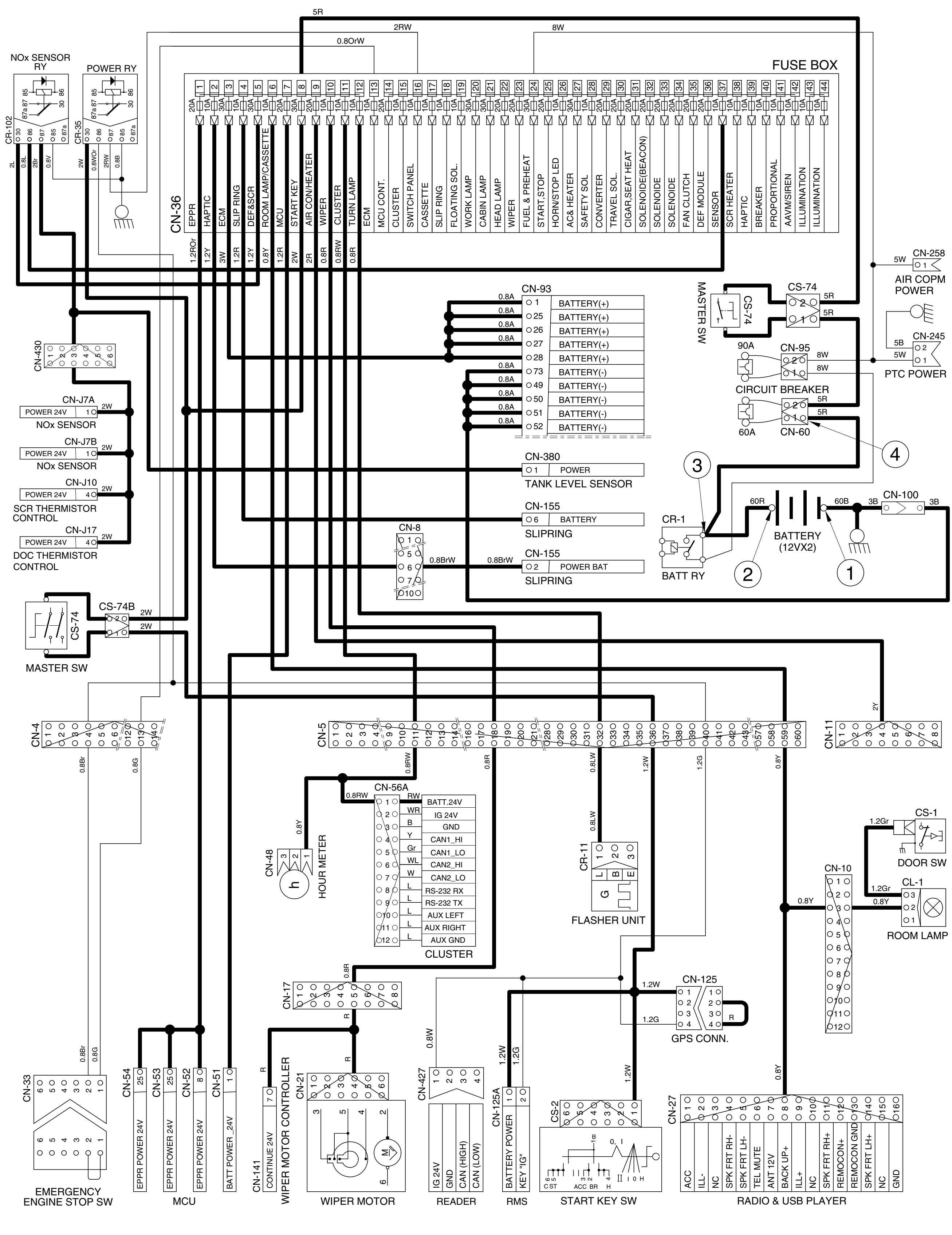
I/conn : Intermediate connector

2) CHECK POINT

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

※ GND : Ground

POWER CIRCUIT



210WF4EL03

2. STARTING CIRCUIT

1) OPERATING FLOW

Battery(+) terminal → Battery relay [CR-1] → Circuit breaker [CN-60] → Master switch [CS-74] → Fuse box [No.8] → Master switch [CS-74B] → I/conn [CN-5(36)] → Start switch [CS-2(1)]

(1) When start key switch is in ON position

→ Start switch ON [CS-2 (2)] → I/conn [CN-5 (39)] → Battery relay [CR-1]
→ Battery relay operating (all power is supplied with the electric component)
→ Start switch ON [CS-2 (3)] → GPS conn [CN-125 (2)→(4)] → RMS [CN-125A (2)]
→ I/conn [CN-5 (40)]

→ Power relay [CR-35 (86) → (87)] → Fuse box [No.16]
→ I/conn [CN-4 (4)] → Emergency engine stop sw [CS-33 (2) → (1)]
→ I/conn [CN-4 (14)] → Fuse box [No. 13]

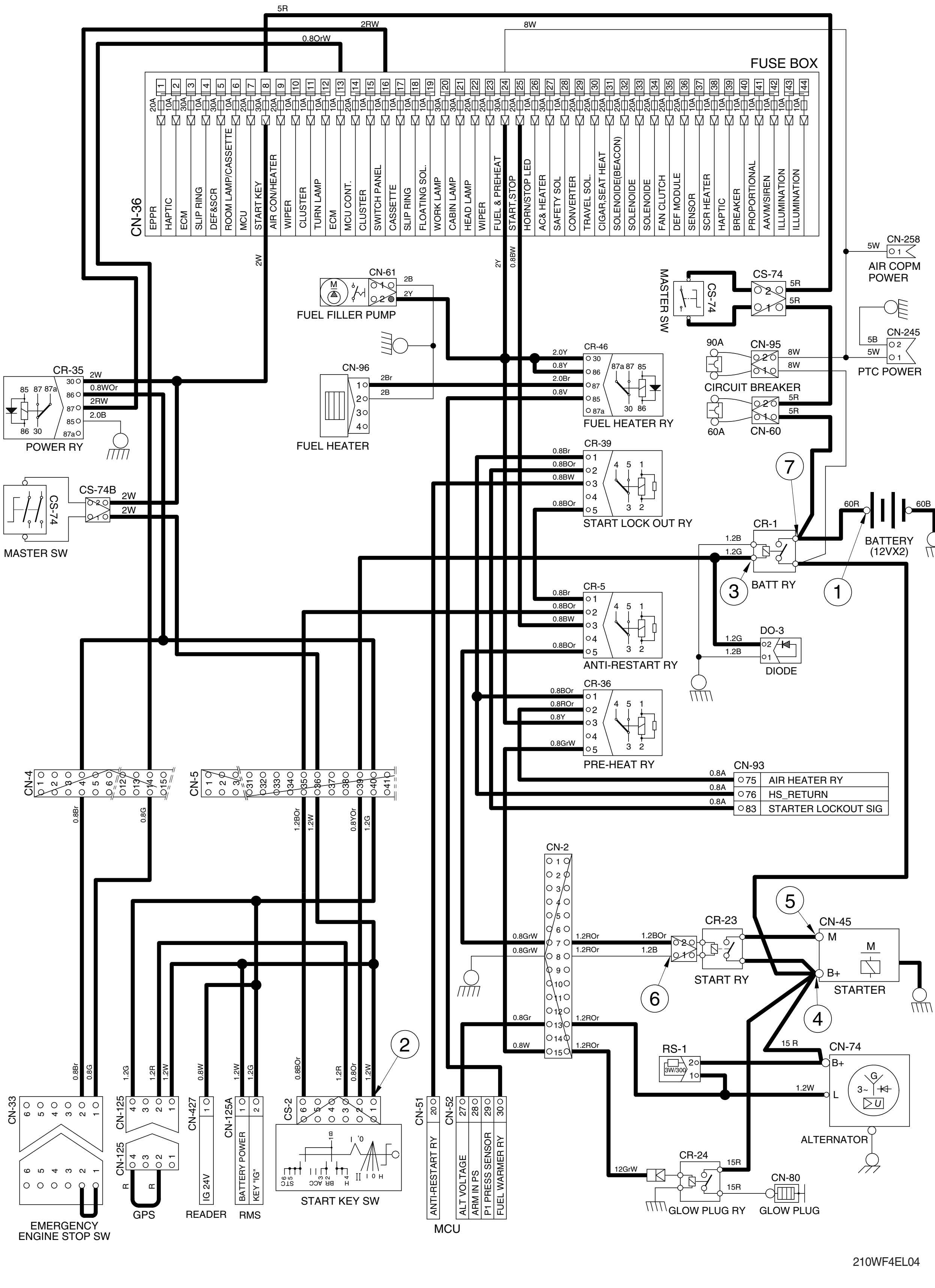
(2) When start key switch is in START position

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

2) CHECK POINT

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

STARTING CIRCUIT



3. CHARGING CIRCUIT

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

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

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

1) OPERATING FLOW

(1) Warning flow

Alternator [CN-74 (L)] → I/conn [CN-2 (13)] → MCU alternator level [CN-52 (27)]
Cluster charging warning lamp (via CAN interface)

(2) Charging flow

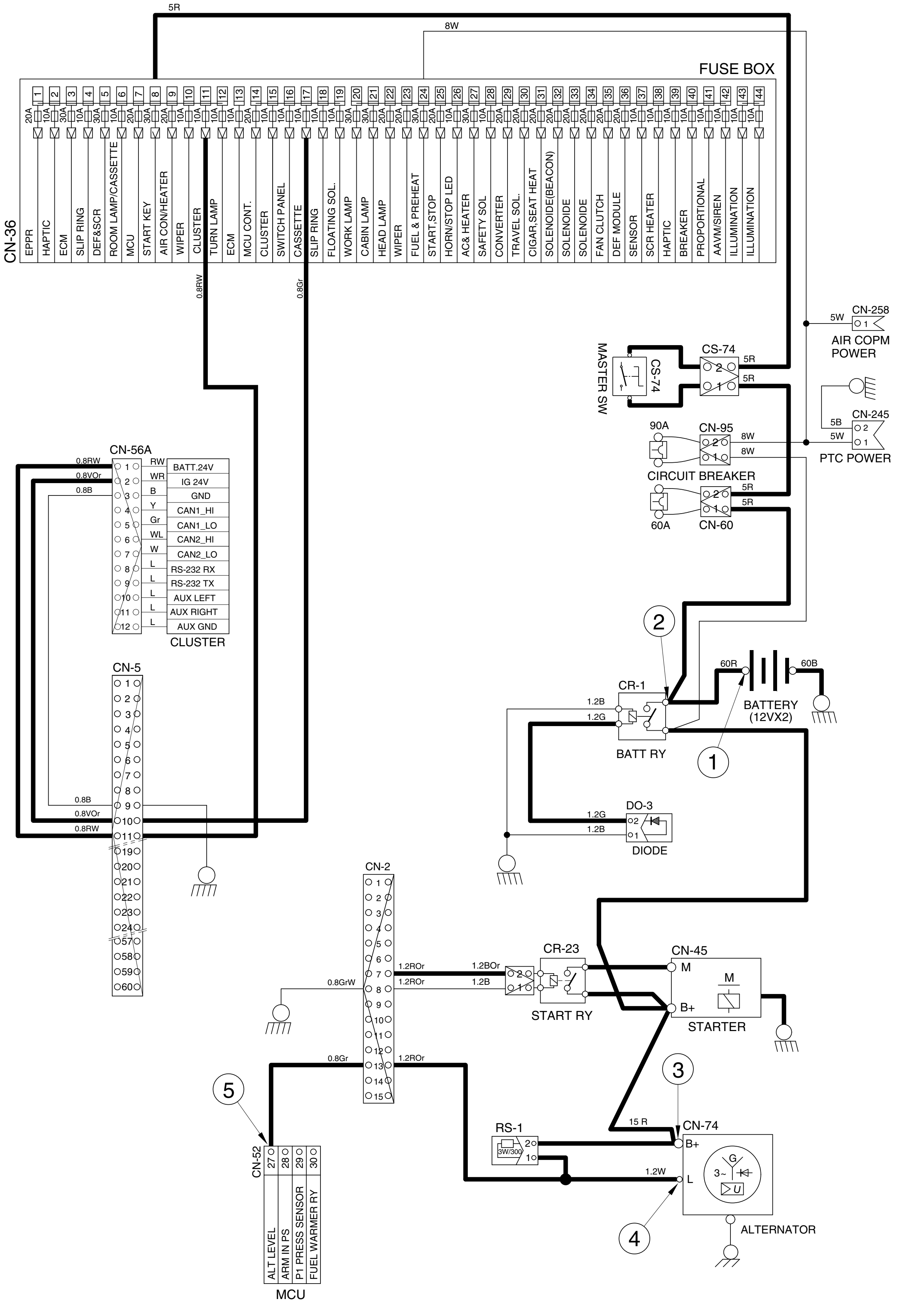
Alternator [CN-74 (B^+)] → Battery relay(M8) → Battery(+) terminal
→ Circuit breaker [CN-60] → Master switch [CS-74]
→ Fuse box

2) CHECK POINT

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

※ GND : Ground

CHARGING CIRCUIT



210WF4EL05

4. HEAD AND WORK LIGHT CIRCUIT

1) OPERATING FLOW

Fuse box (No.22) → Head light low relay [CR-13 (30)]
→ Head light high relay [CR-14 (30)]
→ I/conn [CN-97 (7)] → Multifunction sw left lever [(12)]

Fuse box (No.20) → Work light relay [CR-4 (30, 86)]
→ Rear work light relay [CR-44 (30, 86)]

(1) Head light switch ON

Head light switch ON [CN-376 (13)]
→ Head light power relay [CR-78 (85) →(87)] → I/conn [CR-98 (1)]
→ Multifunction sw left lever [(4) → (5)] → I/conn [CN-97 (12)]
→ Head light low relay [CR-13 (86)→(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-4 (85) → (87)]
→ I/conn [CN-12 (1)] → Work light ON [CL-5 (2), CL-6 (2)]

(3) Rear work light switch ON

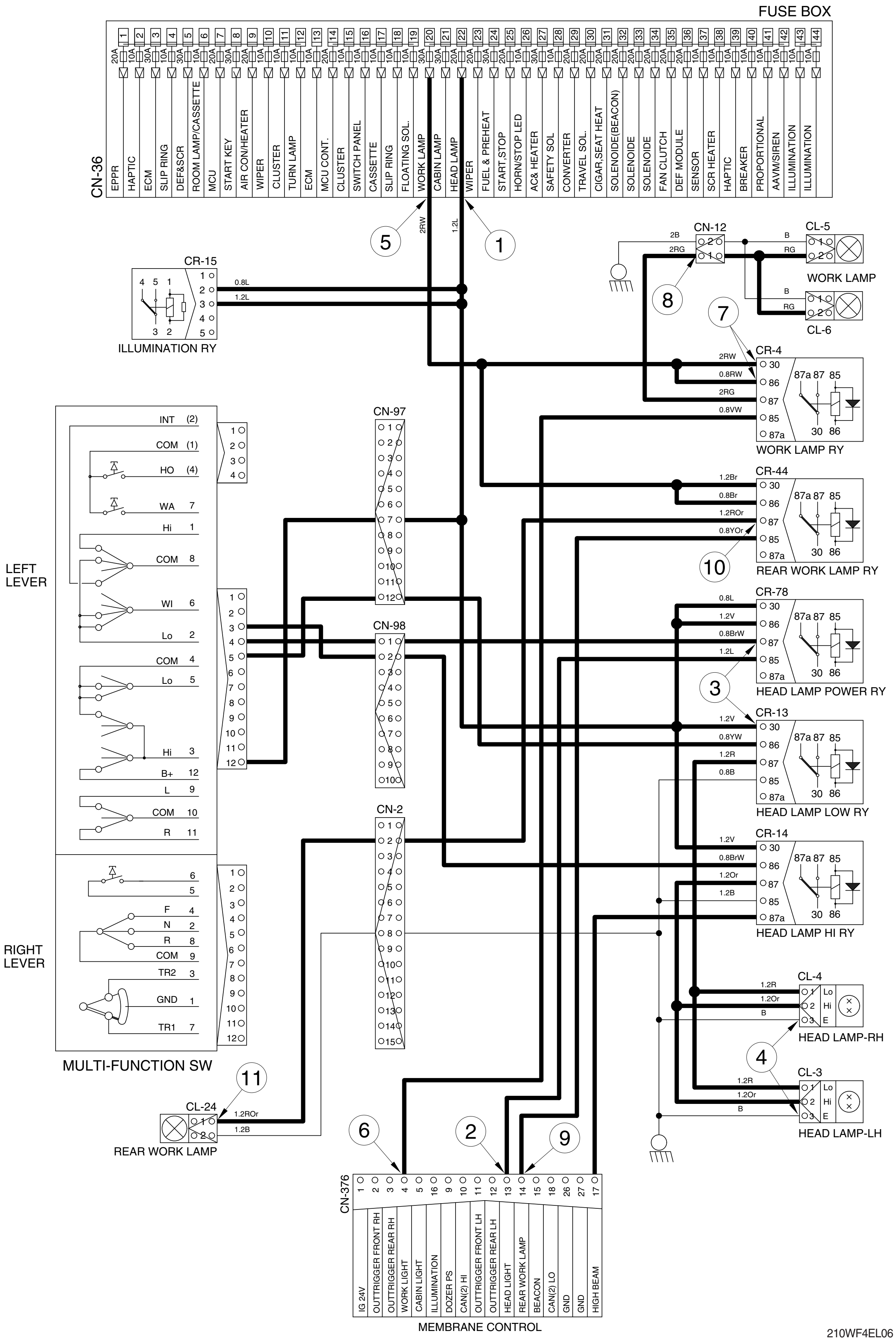
Work light switch ON [CN-376 (14)] → Rear work light relay [CR-44 (85) → (87)]
→ I/conn [CN-2 (2)] → Rear work light ON [CL-24 (1)]

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

HEAD AND WORK LIGHT CIRCUIT



5. BEACON LAMP AND CAB LIGHT CIRCUIT

1) OPERATING FLOW

Fuse box (No.32) → Beacon lamp relay [CR-85 (2, 3)]
Fuse box (No.21) → Cab light relay [CR-9 (30, 86)]

(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

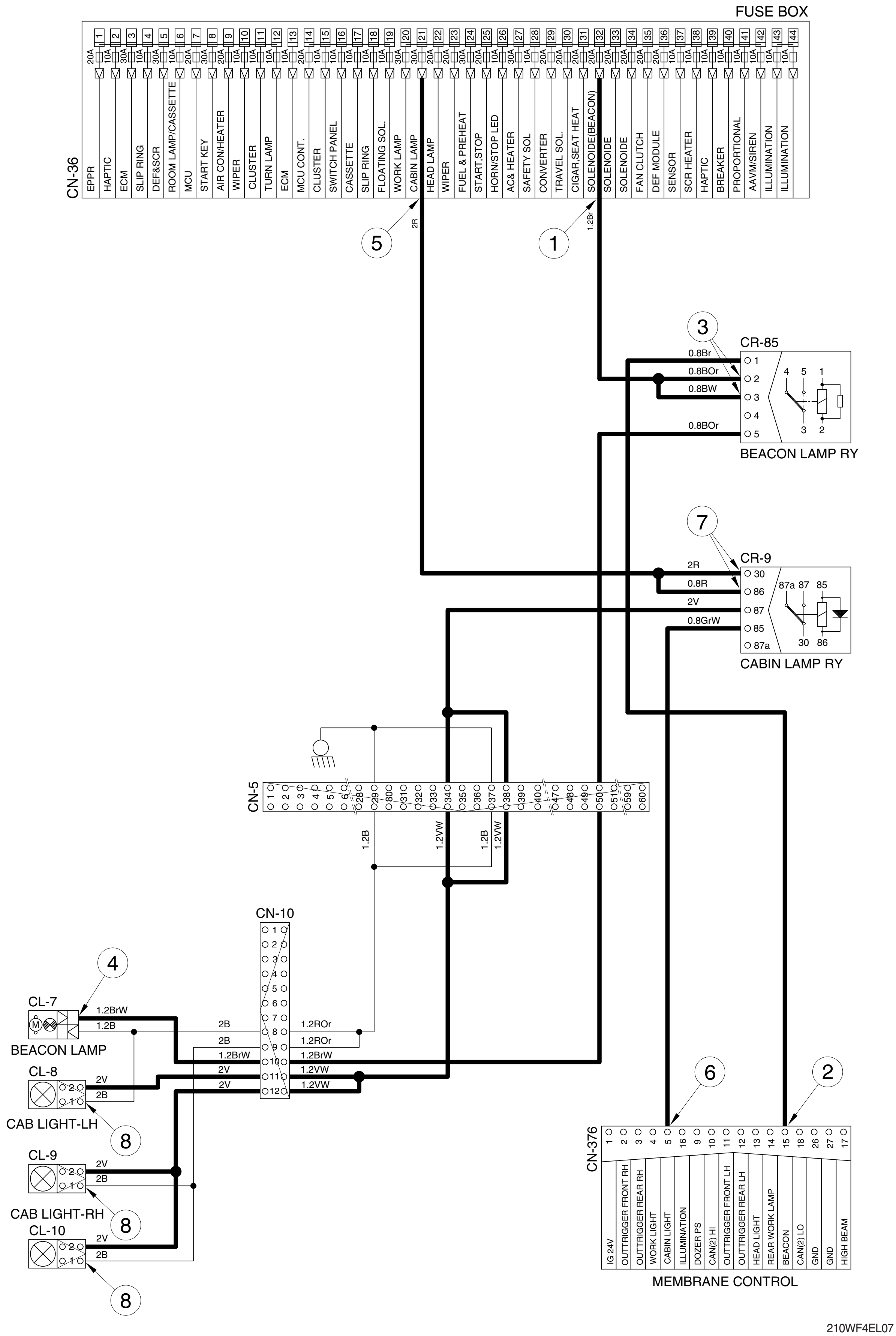
Cab light switch ON [CN-376 (5)] → Cab lamp relay [CR-9 (85) → (87)]
→ I/conn [CN-5 (34, 38)] → I/conn [CN-10 (11)] → Cab light ON [CL-8 (2)]
→ I/conn [CN-10 (12)] → Cab light ON [CL-9 (2), CL-10 (2)]

2) CHECK POINT

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

※ GND : Ground

BEACON LAMP AND CAB LIGHT CIRCUIT



6. WIPER AND WASHER CIRCUIT

1) OPERATING FLOW

(1) Key switch ON

Fuse box (No.22) → I/conn [CN-97 (7)] → Multifunction sw left lever [12]

Fuse box (No.10) → I/conn [CN-5 (18)] → I/conn [CN-17 (5)] → Wiper motor controller [CN-141(7)]
→ Wiper motor [CN-21(4)]

Fuse box (No.23) → I/conn [CN-5 (16)] → I/conn [CN-17 (4)] → Wiper motor controller [CN-141 (6)]
→ Washer pump [CN-22 (2)]

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

Wiper switch ON [Multifunction sw left lever (2)] → I/conn [CN-98 (5)] → I/conn [CN-5 (20)]
→ I/conn [CN-17 (8)] → Wiper motor controller [CN-141 (10)→(3)]
→ Wiper motor intermittently operating [CN-21 (6)]

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

Wiper switch ON [Multifunction sw left lever (1, 2)] → I/conn [CN-98 (3, 4)] → I/conn [CN-5 (15)]
→ I/conn[CN-17(2)] → Wiper motor controller [CN-141(2)→(4)] → Wiper motor operating [CN-21 (2)]

(4) Washer switch ON

Washer switch ON [Multifunction sw left lever (7)] → I/conn [CN-97 (10)] → I/conn [CN-5 (17)]
→ I/conn [CN-17 (7)] → Wiper motor controller [CN-141 (9)→(8)]
→ I/conn [CN-17 (6)] → I/conn [CN-5 (19)] → Washer pump [CN-22 (1)] → Washer operating
→ Wiper switch ON [Multifunction sw left lever (1, 2)] → I/conn [CN-98 (3, 4)]
→ I/conn [CN-5 (15)] → I/conn [CN-17 (2)] → Wiper motor controller [CN-141 (2) → (4)]
→ Wiper motor operating [CN-21 (2)]

(5) Auto parking (when switch OFF)

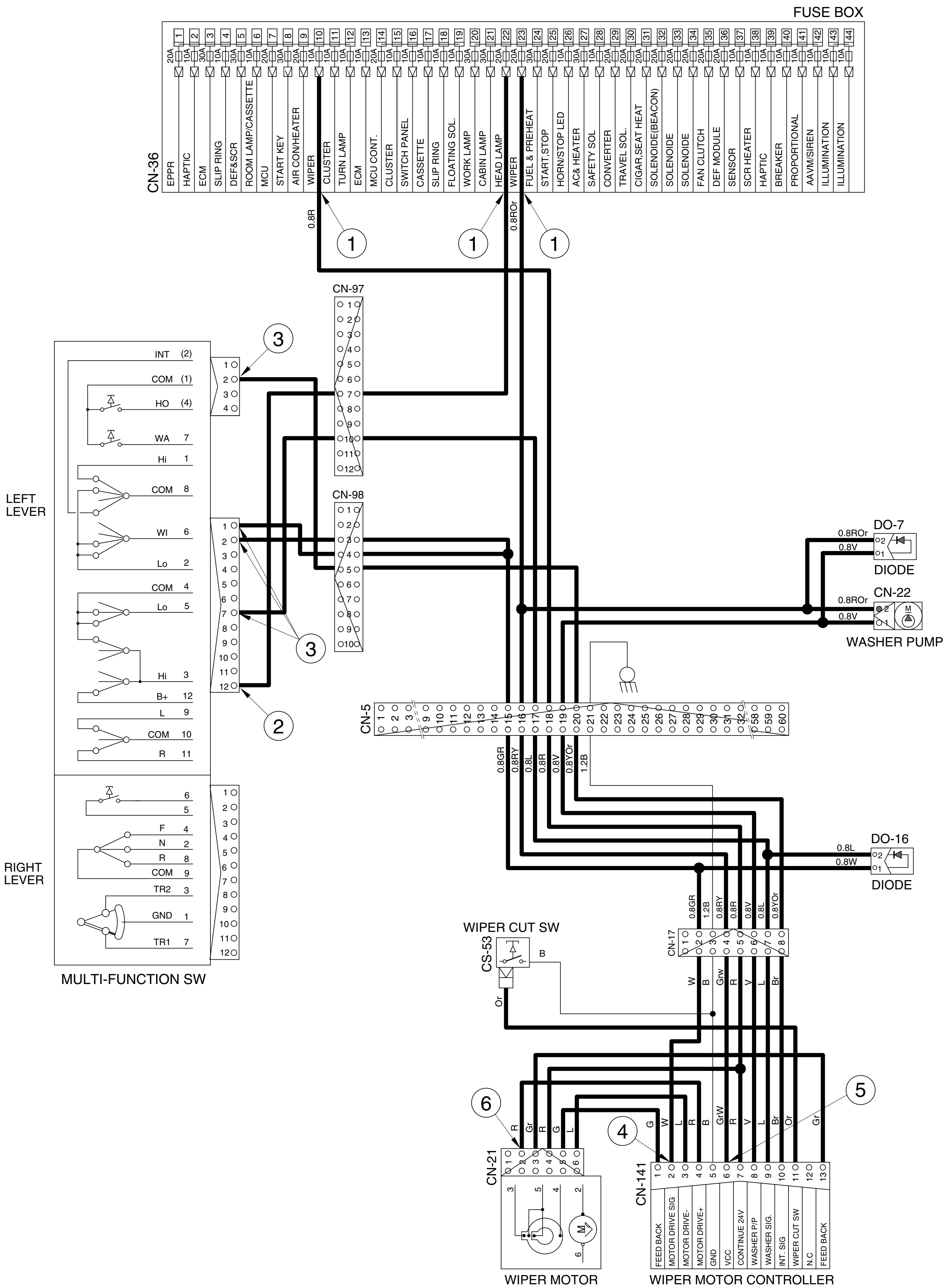
Switch OFF [Multifunction sw left lever OFF position] → Wiper motor parking position by wiper motor controller

2) CHECK POINT

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

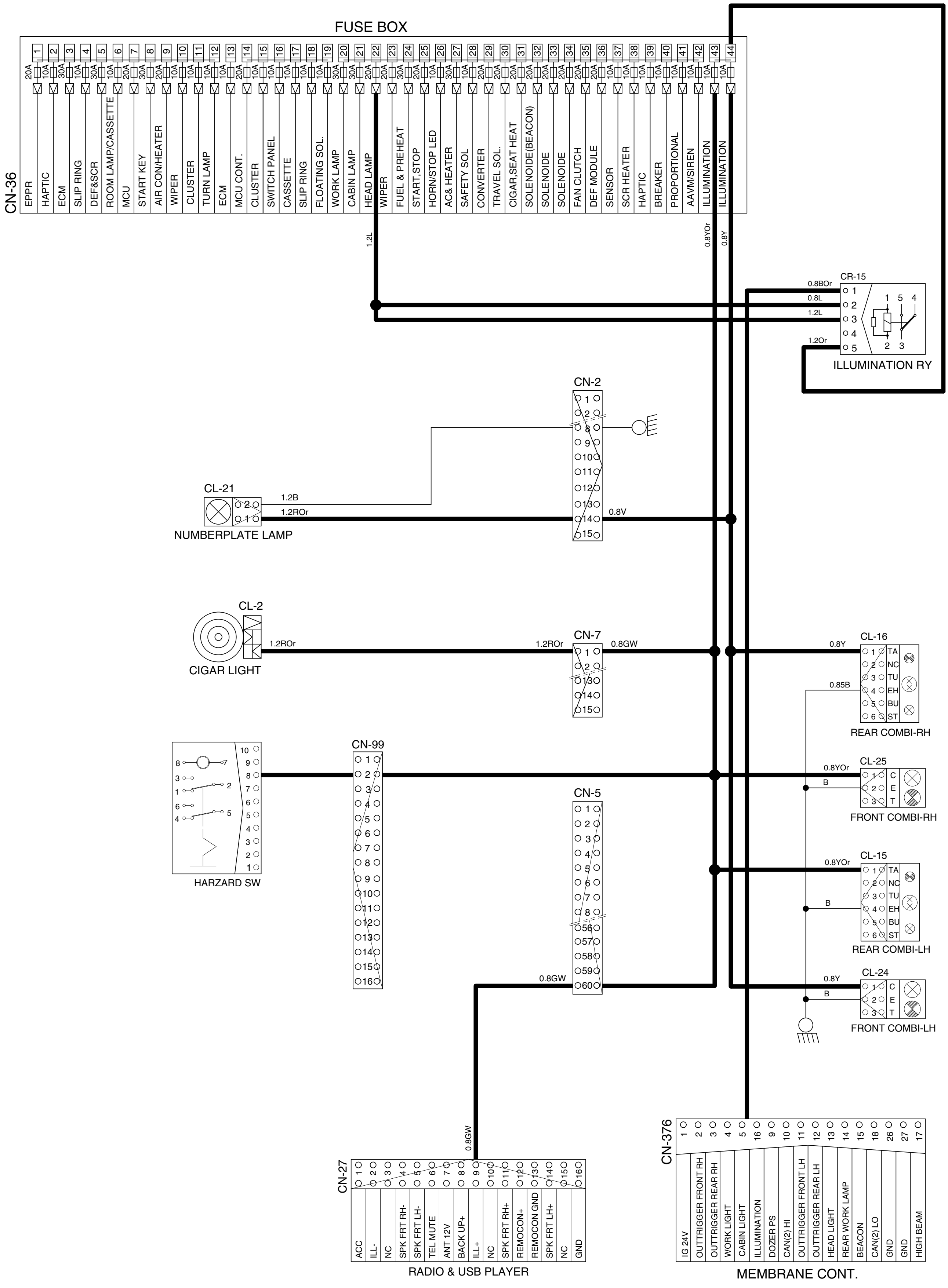
※ GND : Ground

WIPER AND WASHER CIRCUIT

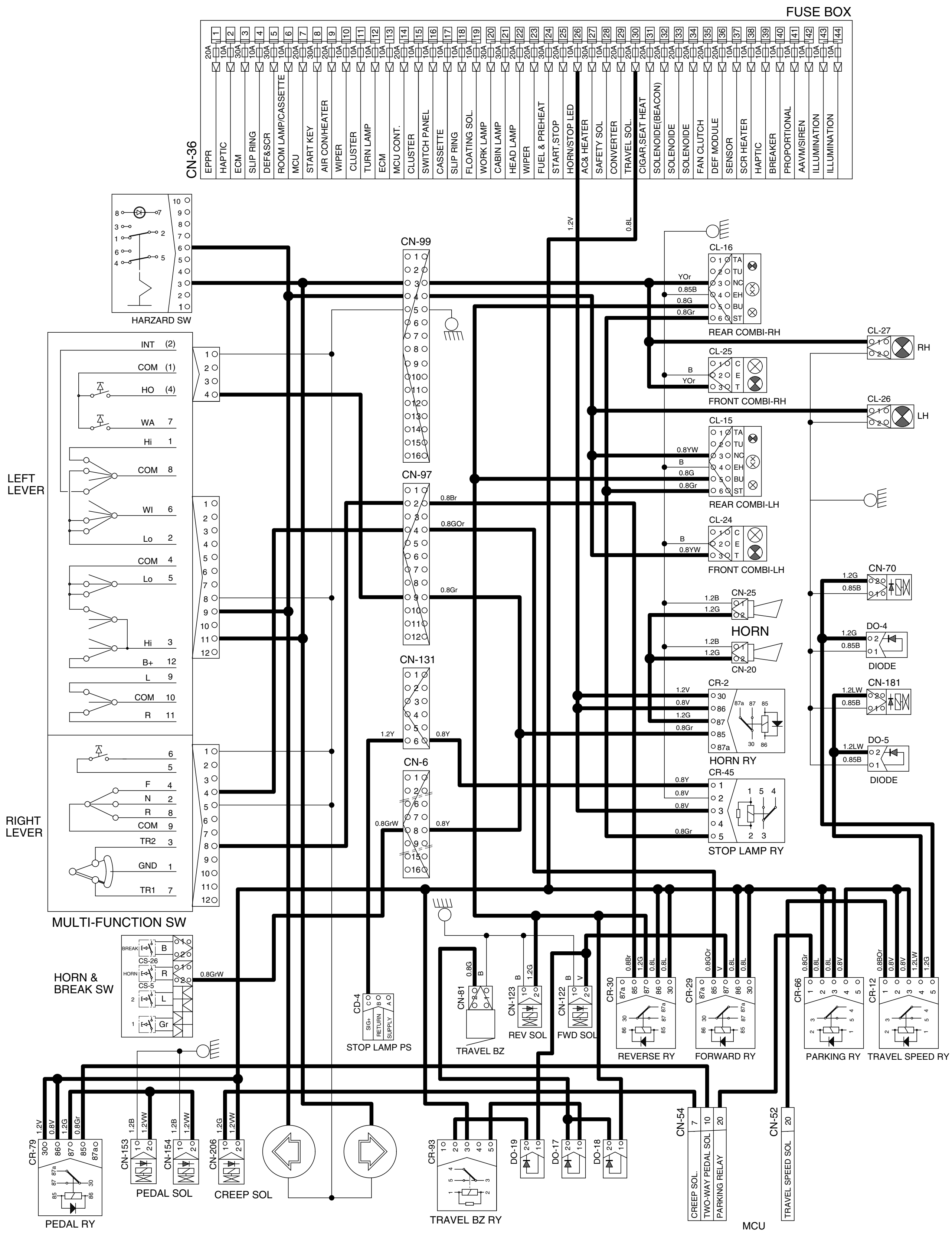


210WF4EL08

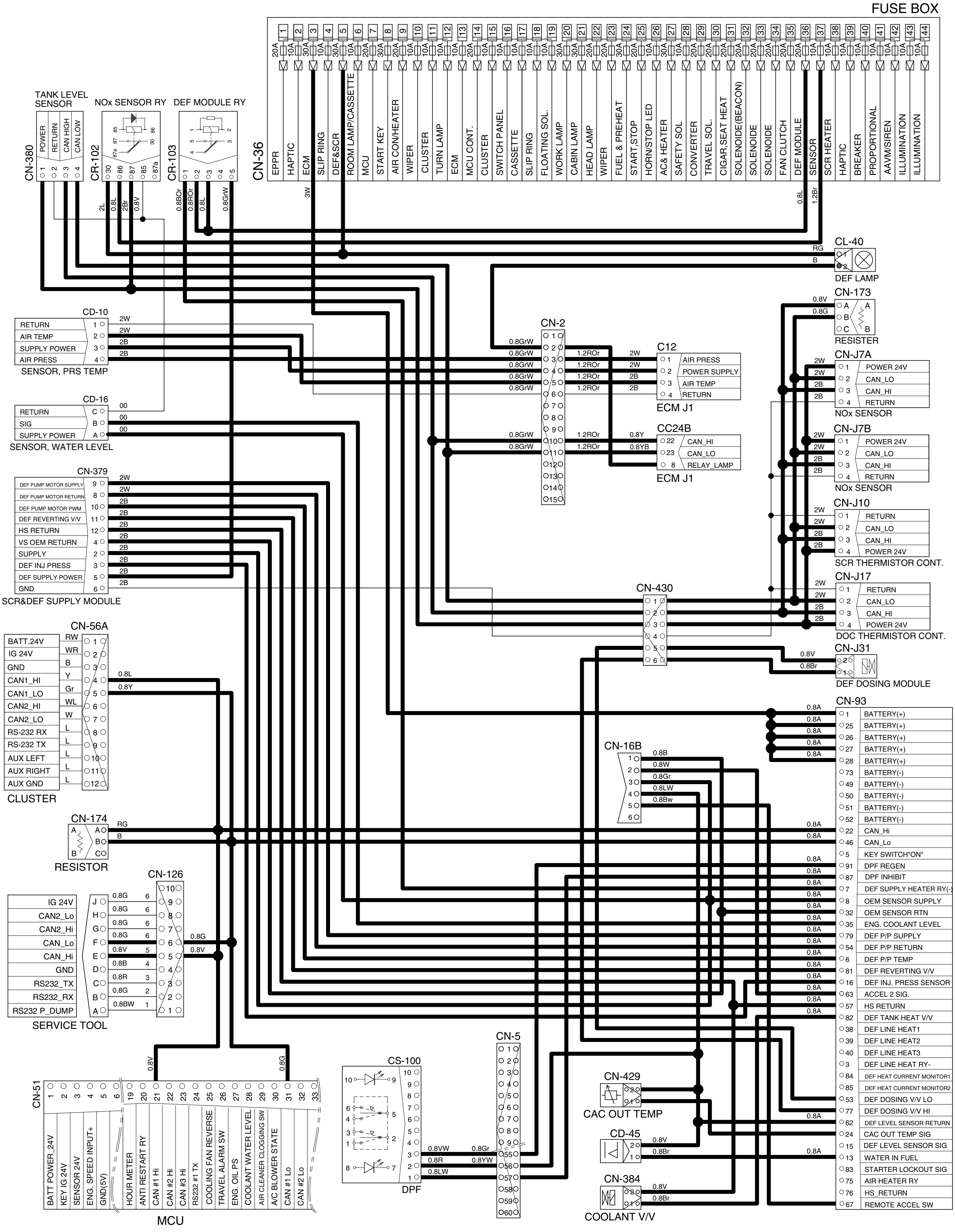
ILLUMINATION CIRCUIT



COMBINATION LAMP CIRCUIT

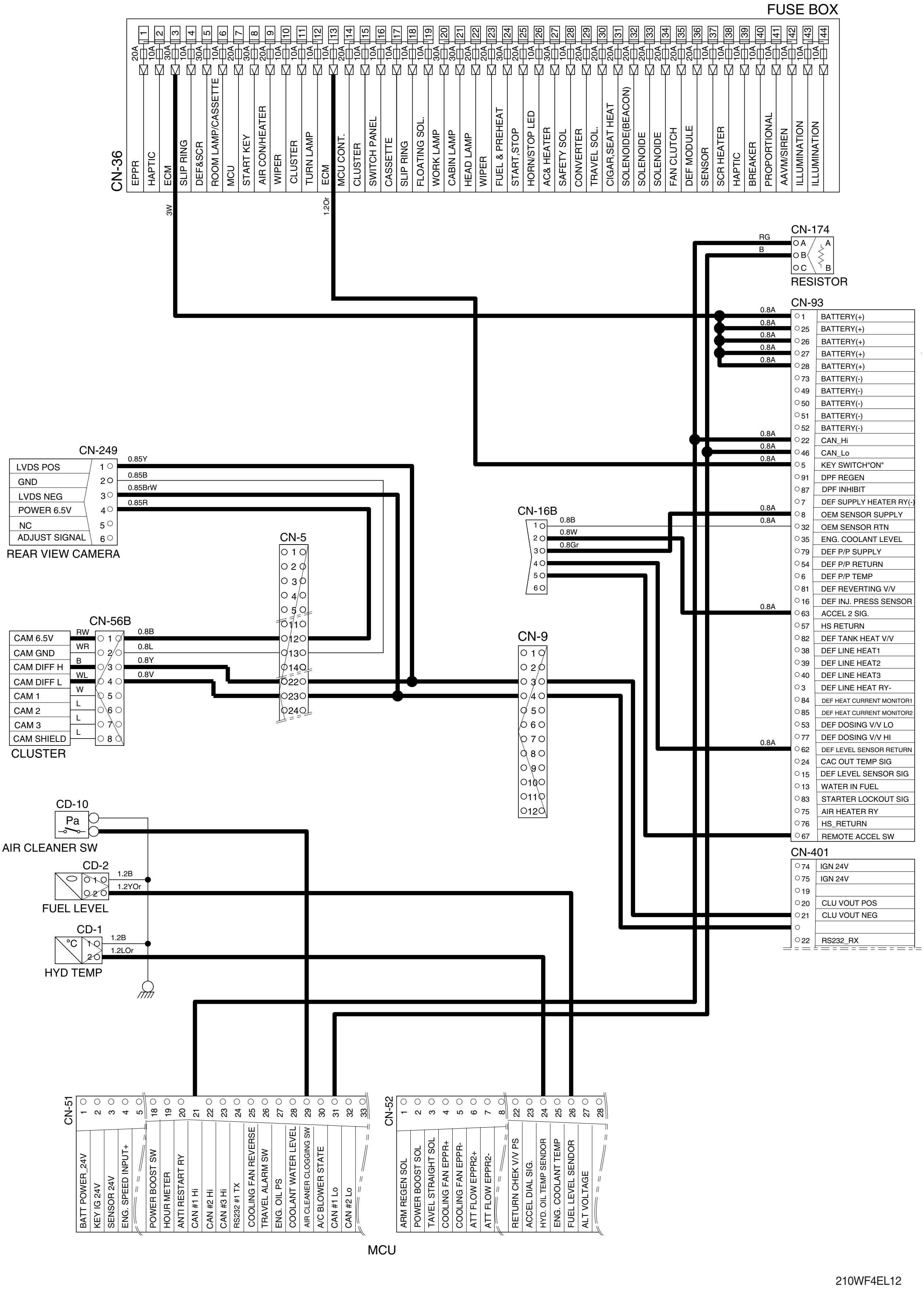


CONTROLLER CIRCUIT

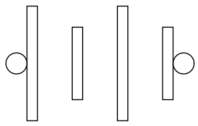
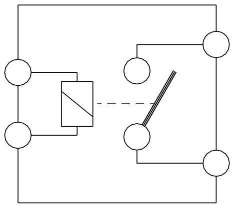
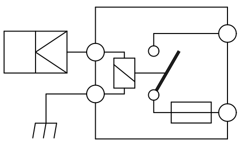
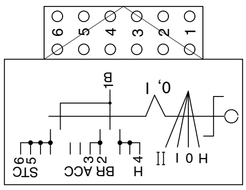
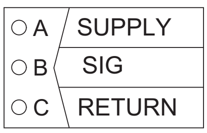
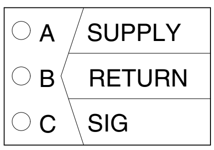


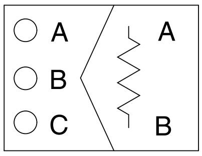
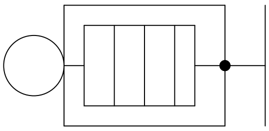
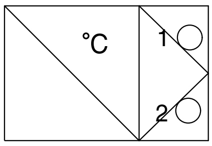
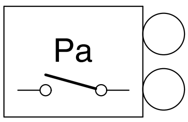
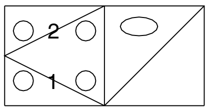
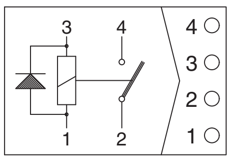
210WF4EL11

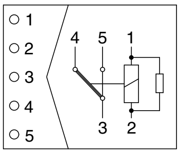
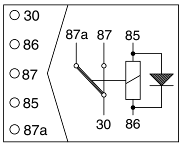
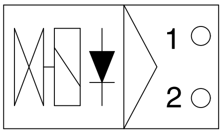
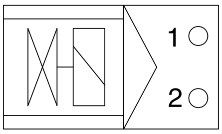
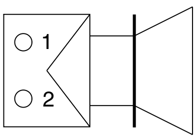
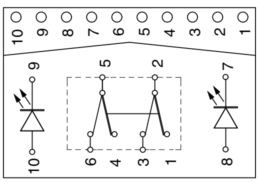
MONITORING CIRCUIT

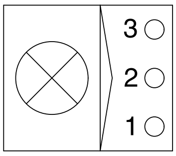
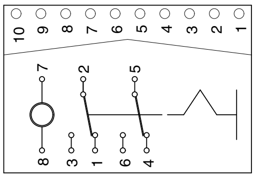
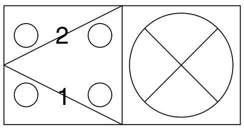
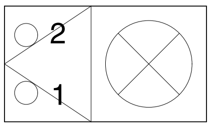
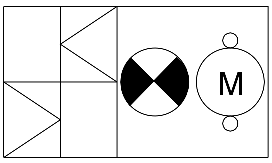
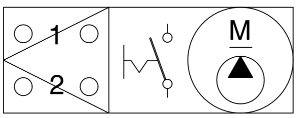


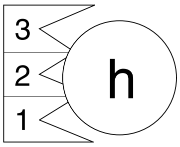
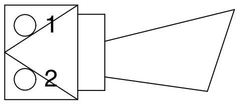
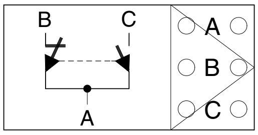
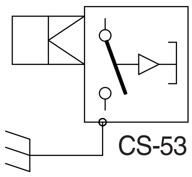
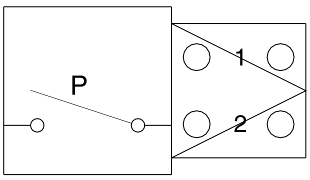
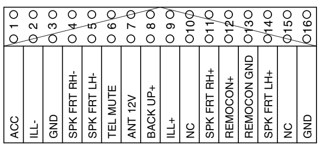
GROUP 3 ELECTRICAL COMPONENT SPECIFICATION

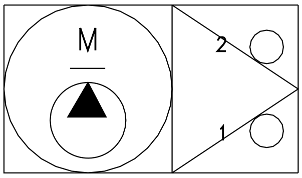
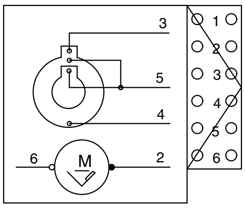
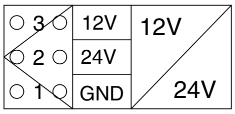
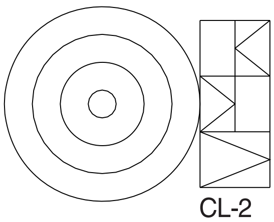
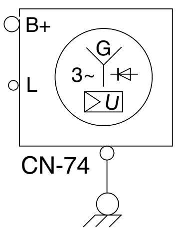
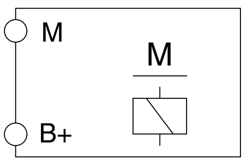
Part name	Symbol	Specifications	Check
Battery		12V × 100Ah (2EA)	※ Check specific gravity 1.280 over : Over charged 1.280 ~ 1.250 : Normal 1.250 below : Recharging
Battery relay	 CR-1	Rated load : 24V 100A (continuity) 1000A (30 seconds)	※ Check coil resistance(M4 to M4) Normal : About 50 Ω ※ Check contact Normal : ∞ Ω
Glow plug relay	 CR-24	24V 200A	※ Check contact Normal : 0.942 Ω (For terminal 1-GND)
Start key	 CS-2A	B-BR : 24V 1A B-ACC : 24V 10A B-ST : 24V 40A	※ Check contact OFF : ∞ Ω (for each terminal) ON : 0 Ω (for terminal 1-3 and 1-2) START : 0 Ω (for terminal 1-5)
Pressure sensor	 CD-3 CD-5 CD-6 CD-7 CD-16 CD-24 CD-31 CD-32 CD-33 CD-33A CD-35 CD-38 CD-42 CD-43 CD-44 CD-69 CD-70 CD-71 CD-73 CD-74 CD-85 CD-90 CD-100 CD-124	8~30V	※ Check contact Normal : 0.1 Ω
Stop lamp pressure sensor	 CD-4	8~30V	※ Check contact Normal : 0.1 Ω

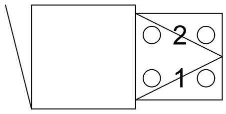
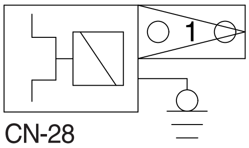
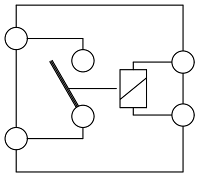
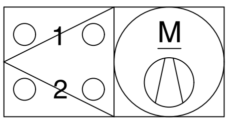
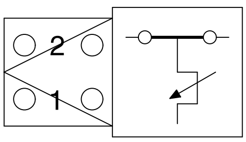
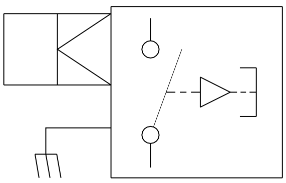
Part name	Symbol	Specifications	Check
Resistor	 CN-173 CN-174	4W	※ Check resistance A-B : 120 Ω
Glow plug	 CN-80	24V 200A	※ Check resistance 0.25~0.12 Ω
Temperature sensor (hydraulic, CAC outlet)	 CD-1 CN-429	-	※ Check resistance 50˚C : 804 Ω 80˚C : 310 Ω 100˚C : 180 Ω
Air cleaner pressure switch	 CD-10	N.O TYPE	※ Check contact High level : ∞ Ω Low level : 0 Ω
Fuel sender	 CD-2	-	※ Check resistance Full : 50 Ω 6/12 : 350 Ω 11/12 : 100 Ω 5/12 : 400 Ω 10/12 : 150 Ω 4/12 : 450 Ω 9/12 : 200 Ω 3/12 : 500 Ω 8/12 : 250 Ω 2/12 : 550 Ω 7/12 : 300 Ω 1/12 : 600 Ω Empty warning : 700 Ω
Relay (air con blower)		24V 16A	※ Check resistance Normal : About 200 Ω (for terminal 1-3) 0 Ω (for terminal 2-4)

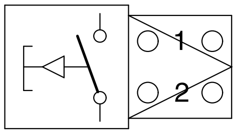
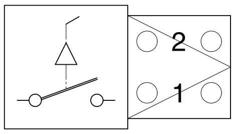
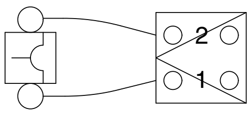
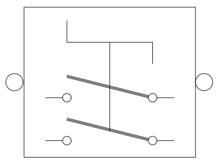
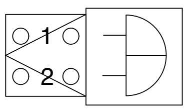
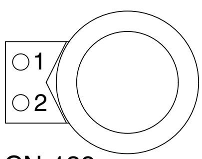
Part name	Symbol	Specifications	Check
Relay	 CR-5 CR-12 CR-15 CR-36 CR-39 CR-45 CR-66 CR-81 CR-82 CR-83 CR-84 CR-85 CR-93 CR-103	24V 16A	※ Check resistance Normal : About 160 Ω (for terminal 1-2) 0 Ω (for terminal 3-4) ∞ Ω (for terminal 3-5)
Relay	 CR-2 CR-4 CR-7 CR-9 CR-13 CR-14 CR-29 CR-30 CR-35 CR-44 CR-46 CR-47 CR-78 CR-79 CR-102 CR-104	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-135 CN-140 CN-149 CN-153 CN-154 CN-181 CN-206 CN-214 CN-216 CN-218 CN-220 CN-237 CN-264 CN-361 CN-362 CN-367 CN-368 CN-369 CN-370 CN-419 CN-420 CN-421	24V 1A	※ Check resistance Normal : 15~25 Ω (for terminal 1-2)
EPPR valve	 CN-75 CN-133 CN-242 CN-246 CN-309 CN-310 CN-365 CN-366 CN-378	700mA	※ Check resistance Normal : 15~25 Ω (for terminal 1-2)
Speaker	 CN-23(LH) CN-23(RH) CN-260	20W	※ Check resistance Normal : A few Ω
Switch (locking type)	 CS-52 CS-67 CS-83 CS-99 CS-108 CS-111	24V 1.5A	※ Check contact Normal ON : 0 Ω (for terminal 3-7, 4-8) ∞ Ω (for terminal 7-9, 8-10) OFF : ∞ Ω (for terminal 3-7, 4-8) 0 Ω (for terminal 7-9, 8-10)

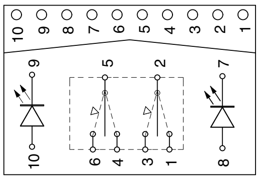
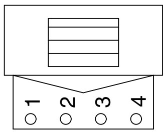
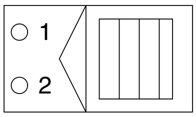
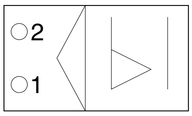
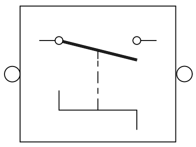
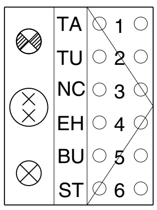
Part name	Symbol	Specifications	Check
Room lamp	 CL-1	24V 10W	※ Check disconnection Normal : 1.0 Ω ON : 0 Ω (For terminal 1-2) ∞ Ω (For terminal 1-3) OFF : ∞ Ω (For terminal 1-2) 0 Ω (For terminal 1-3)
Hazard switch		24V 1.5A	※ Check contact Normal ON : 0 Ω (For terminal 2-3, 5-6) ∞ Ω (For terminal 2-10, 5-4) OFF : ∞ Ω (For terminal 2-3, 5-6) 0 Ω (For terminal 2-10, 5-4)
Head lamp, Work lamp, Cab lamp	 CL-3 CL-4 CL-5 CL-6 CL-8 CL-9 CL-10 CL-24	24V 65W (H3 Type)	※ Check disconnection Normal : 1.2 Ω
Number plate lamp	 CL-21	-	-
Beacon lamp	 CL-7	21V 70W (H1 Type)	※ Check disconnection Normal : A few Ω
Fuel filler pump	 CN-61	24V 10A 35 ℓ /min	※ Check resistance Normal : 1.0 Ω

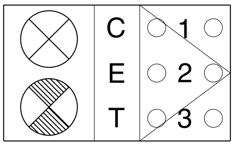
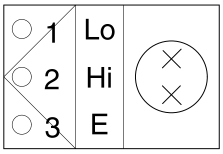
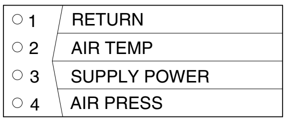
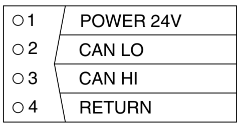
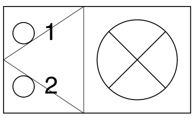
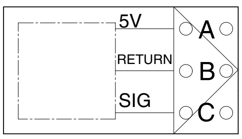
Part name	Symbol	Specifications	Check
Hour meter	 CN-48	16~32V	※ Check operation Supply power(24V) to terminal No.2 and connect terminal No.1 and ground
Horn	 CN-20 CN-25	DC22~28V 2A	※ Check operation Supply power(24V) to each terminal and connect ground.
Safety switch	 CS-20	24V 15A (N.C TYPE)	※ Check contact Normal : 1.0 Ω ON : 0 Ω (for terminal A-B) ∞ Ω (for terminal A-C) OFF : ∞ Ω (for terminal A-B) 0 Ω (for terminal A-C)
Wiper cut switch	 CS-53	24V (N.O TYPE)	※ Check contact Normal : 0 Ω (one pin to ground)
Receiver dryer	 CN-29	24V 2.5A	※ Check contact Normal : ∞ Ω
Radio & USB player	 CN-27A	24V 2A	※ Check voltage 20~25V (for terminal 1-3, 3-8)

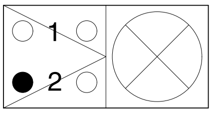
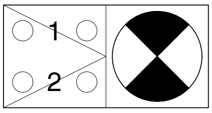
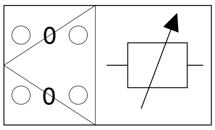
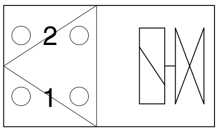
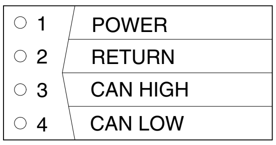
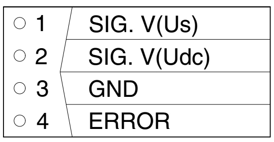
Part name	Symbol	Specifications	Check
Washer pump	 CN-22	24V 3.8A	※ Check contact Normal : 10.7 Ω (for terminal 1-2)
Wiper motor	 CN-21	24V 2A	※ Check disconnection Normal : 7 Ω (for terminal 2-6)
DC/DC Converter	 CN-138	12V 3A	※ Check voltage 24V (for terminal 1-2) 12V (for terminal 1-3)
Cigar lighter	 CL-2	24V 5A 1.4W	※ Check coil resistance Normal : About 1M Ω ※ Check contact Normal : ∞ Ω Operating time : 5~15sec
Alternator	 CN-74	Delco Remy 24V 95A	※ Check contact Normal : 0 Ω (for terminal B^+-L) Normal : 24~27.5V
Starter	 CN-45	Denso 24V 4.8kW	※ Check contact Normal : 0.1 Ω

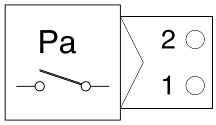
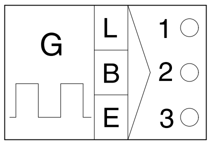
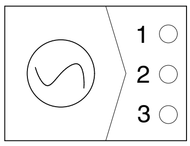
Part name	Symbol	Specifications	Check
Travel alarm	 CN-81	24V 0.5A	※ Check contact Normal : 5.2 Ω
Aircon compressor	 CN-28	24V 79W	※ Check contact Normal : 13.4 Ω
Start relay	 CR-23	24V 300A	※ Check contact Normal : 0.94 Ω (for terminal 1-2)
Blower motor		24V 9.5A	※ Check resistance Normal : 2.5 Ω (for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

Part name	Symbol	Specifications	Check
Switch (power max, one touch decel, horn, breaker)	 CS-5 CS-19 CS-26 CS-29	24V 6A	※ Check resistance Normal : ∞ Ω
Breaker selection switch	 CS-26A	-	-
Circuit breaker	 CN-60 CN-95	CN-60 : 60A CN-95 : 90A	※ Check disconnection Normal : 0 Ω (connect ring terminal and check resist between terminal 1 and 2)
Master switch	 CS-74B	6-36V	※ Check disconnection Normal : 0.1 Ω
Quick clamp buzzer	 CN-113	24V 200mA 107±4dB	-
Socket	 CN-139	12V 10A	-

Part name	Symbol	Specifications	Check
Switch	 CS-73 CS-100	24V 8A	※ Check contact Normal ON : 0 Ω (for terminal 3-7, 4-8) ∞ Ω (for terminal 7-9, 8-10) OFF : ∞ Ω (for terminal 3-7, 4-8) 0 Ω (for terminal 7-9, 8-10)
Fuel heater	 CN-96	-	-
DEF/AdBlue® line heater	 CN-381 CN-382 CN-383	-	-
WIF sensor	 CD-45	-	※ Check disconnection Normal : 68.8~4.94 Ω
Master switch	 CS-74	6 - 36V	※ Check disconnection Normal : 0.1 Ω
Rear combination lamp-LH,RH	 CL-15 CL-16	24V 21W × 2 LED	※ Normal : 4.8 Ω (For terminal 1-4) Normal : 2.1 Ω (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	※Normal : 4.8 Ω (For terminal 1-2) Normal : 2.1 Ω (For terminal 2-3)
Head lamp -LH, RH	 CL-3 CL-4	24V 75/70W	※Normal : 1.0 Ω (For terminal 1-3, 2-3) Normal : 1.5 Ω (For terminal 1-2)
PRS temp sensor	 CD-10	5.0V 0.2A	※ Check contact Normal 0 Ω (for terminal 1-2, 47.5 Ω) ∞ Ω (for terminal 3-1, 1k Ω) ∞ Ω (for terminal 4-1, 1k Ω)
DEF/AdBlue® sensor	 CN-J7A CN-J7B CN-J10 CN-J17	-	-
DEF/AdBlue® fill up warning lamp (LED)	 CL-40	-	-
Proportional valve sensor	 CN-246 CN-247	-	-

Part name	Symbol	Specifications	Check
DEF/AdBlue® lamp	 CL-41	-	-
Side marker lamp	 CL-26 CL-27	-	-
Air conditioner temperature sensor (incar, ambient)		-	-
EPPR valve	 CN-384 CN-J31	24V 700mA	※Check resistance Normal : 15~25 Ω (For terminal 1-2)
DEF/AdBlue® tank level senosr	 CN-380	-	-
Proportional valve sensor	 CN-308	-	-

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	-	-

GROUP 4 CONNECTORS

1. CONNECTOR DESTINATION

Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CN-1	AMP	10	I/conn (Frame harness-Pump PS harness)	S816-010002	S816-110002
CN-2	-	15	I/conn (Frame harness-Engine harness)	2-85262-1	-
CN-3	TYCO	12	I/conn (Frame harness-AAVM harness)	174661-2	368537-1
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)	368050-1	368047-1
CN-7	AMP	15	I/conn (Console harness RH-Frame harness)	2-85262-1	2-85262-1
CN-8	AMP	10	I/conn (Console harness RH-Frame harness)	S816-010002	174655-2
CN-9	DEUTSCH	12	I/conn (Frame harness-AAVM harness)	DT06-12SA-P021	DT04-12PA-P021
CN-10	DEUTSCH	12	I/conn (Cab harness-Side harness RH)	DT06-12S-EP06	DT04-12PA-P021
CN-11	DEUTSCH	8	I/conn (Frame harness-Aircon harness)	DT06-8S-EP06	-
CN-11	-	3	Flasher unit	S810-003702	-
CN-12	DEUTSCH	2	I/conn (Boom wire harness-Frame harness)	DT06-2S-EP06	DT04-2P-E004
CN-13	AMP	6	Boom floating pressure sensor	174262-2	174264-2
CN-13	AMP	4	Swing lock & fine control	174257-2	-
CN-13	DELPHI	2	Swing lock & fine control	-	12162197
CN-15	TYCO	8	I/conn (Frame harness-Two way harness)	174982-2	-
	AMP			-	174984-2
CN-16	AMP	6	Emergency engine start & speed control	S816-006002	S816-106002
CN-17	AMP	8	I/conn (Side harness RH-Wiper motor harness)	S816-008002	S816-108202
CN-18	TYCO	2	Washer pump 2	174352-2	-
CN-20	MOLEX	2	Horn	36825-0211	-
CN-21	AMP	6	Wiper motor	S810-006202	-
CN-22	KET	2	Washer pump 1	MG640605	-
CN-23	KET	2	Speaker-LH	MG610070	-
CN-24	KET	2	Speaker-RH	MG610070	-
CN-25	MOLEX	2	Horn	36825-0211	-
CN-27A	KUM	16	Radio & USB player	PK145-16017	-
CN-27B	AMP	8	USB player	-	174984-2
CN-28	KUM	1	Aircon compressor	NMWP01F-B	-
CN-29	KET	2	Receiver dryer	MG640795	-
CN-36	-	-	Fuse & relay box	21Q7-10910	-
CN-45	RING-TERM	-	Starter motor B^+	S820-310000	-
	KET			ST710246-25	-
CN-48	KET	1	Service meter	2-520193-2	-

Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CN-51	DEUTSCH	40	MCU	DRC26-40SA	-
CN-52	DEUTSCH	40	MCU	DRC26-40SB	-
CN-53	DEUTSCH	40	MCU	DRC26-40SC	-
CN-56A	AMP	8	Cluster	-	174984-2
CN-56B	AMP	12	Cluster	-	174663-2
CN-60	YAZAKI	2	Circuit breaker	-	7222-4220-30
CN-61	DEUTSCH	2	Fuel filler pump	DT06-2S-EP06	-
CN-66	DEUTSCH	2	Breaker solenoid	DT06-2S-EP06	DT04-2P-E004
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	S820-105000	-
CN-74	RING-TERM	1	Alternator "B" terminal	S820-108000	-
CN-75	AMP	2	Pump EPPR valve	S816-002002	-
CN-80	RING-TERM	-	Glow plug	S820-306000	-
CN-81	DEUTSCH	2	Travel buzzer solenoid	DT06-2S-EP06	-
CN-88	DEUTSCH	2	Power max solenoid	DT06-2S-EP06	-
CN-93	DELPHI	-	Engine harness	13964577	-
CN-95	YAZAKI	2	Circuit breaker	-	7222-4220-30
CN-96	AMP	4	Fuel warmer	2-967325-3	-
CN-97	AMP	12	Multifunction switch	MG640944-5	-
CN-98	DEUTSCH	10	Multifunction switch	-	DT04-4P-E005
CN-99	-	16	Multifunction switch	-	2-85262-1
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	RMS	DT06-12S-P021	DT04-12PA-P021
CN-126	TYCO	4	Service tool	2-1418390-1	S816-110002
CN-126	DEUTSCH	4	RS232	DT06-4S	DT06-4P
CN-128	DEUTSCH	2	Rear combi solenoid - LH	DT06-2S-EP06	-
CN-131	-	6	I/conn (work brake, stop lamp sensor)	S816-006002	-
	TYCO			-	174352-2
CN-133	DEUTSCH	2	Boom priority EPPR valve	DT06-2S-EP06	-
CN-135	DEUTSCH	2	Arm regeneration solenoid	DT06-2S-EP06	-
CN-138	FASTEN	3	DC/DC Converter	S810-003202	-
CN-139	FASTEN	2	12V socket	172434-2	-
CN-140	DEUTSCH	2	Quick clamp solenoid	DT06-2S-EP06	DT04-2P-E005
CN-141	AMP	13	Wiper motor controller	172498-1	DT04-3P-EP10

Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CN-147	AMP	4	Fuel heater	2-967325-3	-
CN-149	DEUTSCH	2	Attach safety solenoid	DT06-2S-EP06	DT04-2P-E004
CN-153	DEUTSCH	2	Travel safety solenoid	DT06-2S-EP06	DT04-2S-E005
CN-154	DEUTSCH	2	Travel safety solenoid	DT06-2S-EP06	DT04-2S-E005
CN-155	DEUTSCH	8	Slipling, I/conn (MTCU-Lower harness)	DT06-8S-EP06	DT04-8P-E003
CN-156	DEUTSCH	60	TMCU	DRC26-40SA	-
CN-156	DEUTSCH	2	Seat heat	-	DT04-2P
CN-157	AMP	1	Antena power	S822-014002	-
CN-173	DEUTSCH	3	Resistor	DT06-3S-EP06	DT04-3P-EP10
CN-174	DEUTSCH	3	Resistor	DT06-3S-EP06	DT04-3P-EP10
CN-181	DEUTSCH	2	Travel low speed solenoid	DT06-2S-EP06	-
CN-206	DEUTSCH	2	Creep solenoid	DT06-2S-EP06	-
CN-214	DEUTSCH	2	Front combi solenoid - RH	DT06-2S-EP06	-
CN-216	DEUTSCH	2	Front combi solenoid - LH	DT06-2S-EP06	-
CN-220	DEUTSCH	2	Rear combi solenoid - RH	DT06-2S-EP06	-
CN-237	DEUTSCH	2	Attach conflux solenoid	DT06-2S-EP06	DT04-2P-E004
CN-242	TYCO	2	Attachment EPPR 1	174352-2	-
CN-243	TYCO	2	Attachment EPPR 2	174352-2	-
CN-245	ECI	2	PTC Power	180900-0	-
CN-246	FCI	4	PTC power	180900-0	-
CN-246	DEUTSCH	3	Joystick	DT06-3S	DT06-3P
CN-246	DEUTSCH	2	Cruise solenoid	DT06-2S-EP06	-
CN-247	DEUTSCH	3	PVG signal	DT06-3S	DT06-3P
CN-249	DEUTSCH	4	Rear view camera	DT06-4S-EP06	DT04-4P-E005
CN-258	KET	1	Air compressor	MG640944-5	MG650943-5
CN-260	DEUTSCH	2	Siren speaker	DT06-6S-EP06	174352
CN-261	KET	6	Siren amp	MG610049	-
CN-263	DEUTSCH	2	Air compressor	DT06-2S-EP06	DT04-2P-E005
CN-305	DEUTSCH	12	AAVM	DTM06-12SB	-
CN-306	DEUTSCH	12	AAVM	DTM06-12SA	-
CN-307	DEUTSCH	5	Service tool	DT06-3S-EP06	DT06-3P-E005
CN-307	-	4	PVG32	2-967059-1	-
CN-309	DEUTSCH	2	A1 EPPR valve	DT06-2S-EP06	-
CN-310	DEUTSCH	2	A2 EPPR valve	DT06-2S-EP06	-
CN-363	-	12	Haptic controller	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-EP06	DT04-2P-EP05
CN-370	DEUTSCH	2	Swing fine control solenoid	DT06-2S-EP06	DT04-2P-EP05

Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CN-376	TYCO	23	RDU	7706087-2	-
CN-379	TYCO	12	SCR supply module	2-1703639-1	-
CN-381	DELPHI	2	DEF/AdBlue® line heater 1	12162194	-
CN-382	DELPHI	2	DEF/AdBlue® line heater 2	12162194	-
CN-383	DELPHI	2	DEF/AdBlue® line heater 3	12162194	-
CN-384	DEUTSCH	2	Coolant valve	DT06-2S-EP06	-
CN-385	-	-	Fan clutch	965570	-
CN-398	DEUTSCH	4	RS 232	DT04-4S-E005	DT06-4P-E005
CN-399	TYCO	-	DEF/AdBlue® tank level sensor	1-967325-1	-
CN-401	FCI	90	AAVM controller	-	-
CN-402	DEUTSCH	6	Front view camera	DT06-6S-P021	DT04-6P-P021
CN-403	DEUTSCH	6	Rear view camera	-	DT06-4P-EP14
CN-404	DEUTSCH	6	Left view camera	-	DT06-4P-EP14
CN-405	DEUTSCH	6	Right view camera	-	DT06-4P-EP14
CN-406	DEUTSCH	3	RS 232	DT06-3S-EP06	DT06-3P-E005
CN-407	DEUTSCH	4	Lower wiper motor	DT06-4S-E006	DT06-4P-E005
CN-419	DEUTSCH	2	Swing parking	DT06-2S-EP06	-
CN-420	DEUTSCH	2	Swing parking	DT06-2S-EP06	-
CN-427	MOLEX	4	Reader	039012040	026013096
		12		5557-12R	5559-12P
CN-429	DELPHI	2	CAC out temperature	12162197	-
CN-430	DEUTSCH	6	I/conn (Side harness RH-Aftertreatment harness)	DT06-6S-EP06	DT06-6P-E005
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	5-1418390-1	-
CN-J17	TYCO	4	DOC thermistor	4-1418390-1	-
CN-J31	BOSCH	2	DEF/AdBlue® dosing module	1_928_403_874	-
· Relay					
CR-1	RING-TERM	-	Battery relay	ST710289-2	-
CR-2	-	5	Horn relay	-	-
CR-4	-	5	Working lamp relay	-	-
CR-5	-	5	Anti restart relay	-	-
CR-7	-	5	Aircon compressor relay	-	-
CR-9	-	5	Cabin lamp relay	-	-
CR-11	AMP	3	Flasher unit relay	S810-003702	-
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	-	-

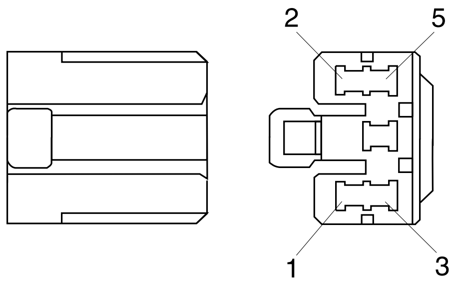
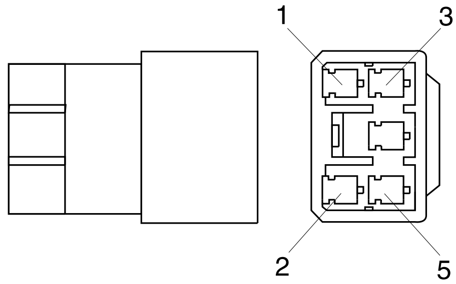
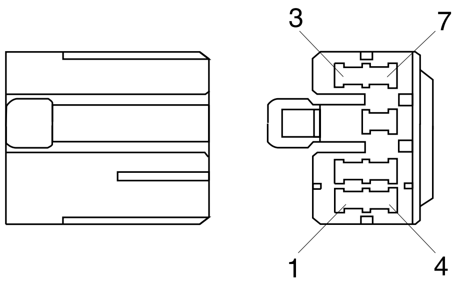
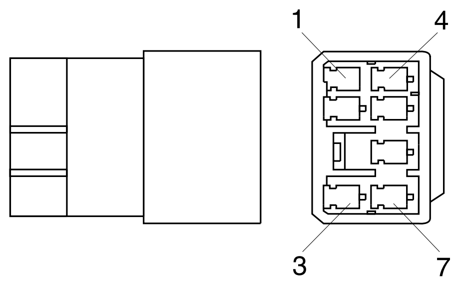
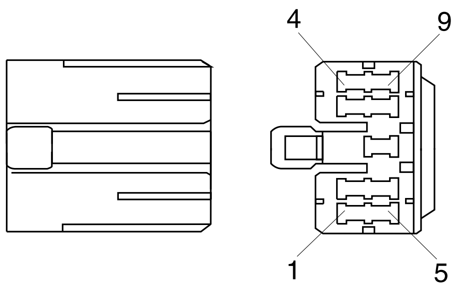
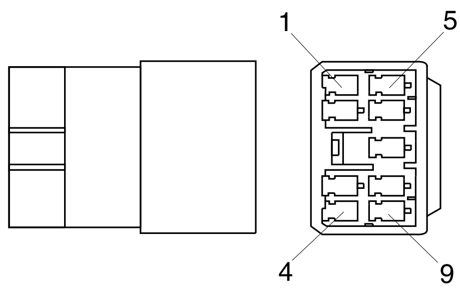
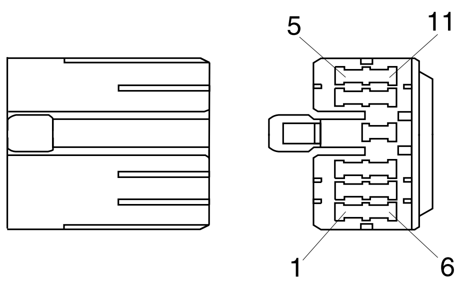
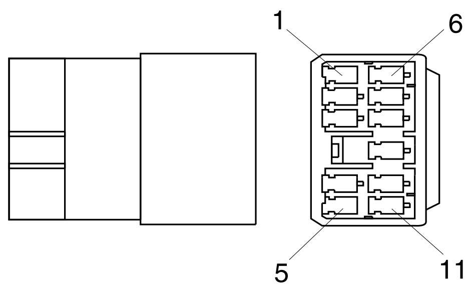
Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CR-23	KET	2	Start relay	S814-002001	S814-102001
CR-24	RING TERM	1	Preheat relay	S822-014000	-
CR-29	-	5	Travel forward relay	-	-
CR-30	-	5	Travel reverse relay	-	-
CR-35	-	5	Power relay	-	-
CR-36	-	5	Preheat relay	-	-
CR-39	-	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-66	-	5	Parking relay	-	-
CR-78	-	5	Head lamp power relay	-	-
CR-79	-	5	Pedal relay	-	-
CR-81	-	5	Front combination relay - RH	-	-
CR-82	-	5	Front combination relay - LH	-	-
CR-83	-	5	Rear combination relay - RH	-	-
CR-84	-	5	Rear combination relay - LH	-	-
CR-85	-	5	Beacon lamp relay	-	-
CR-93	-	5	Travel buzzer lamp relay	-	-
CR-102	-	5	NOx sensor relay	-	-
CR-103	-	5	DEF module relay	-	-
CR-104	-	5	Line heater relay	-	-
· Switch					
CS-1	SHUR	1	Door switch	S822-014002	S822-114002
CS-2A	WP	6	Start key switch	S814-006100	-
CS-2B	DEUTSCH	3	Smart key	DT06-3S-EP06	DT06-3P-E005
CS-4	DEUTSCH	3	Safety switch 1	DT06-3S	-
CS-5	DEUTSCH	2	Horn switch	-	DT04-2P
CS-19	DEUTSCH	2	One touch decel switch	-	DT04-2P
CS-20	DEUTSCH	3	Safety switch 2	-	DT04-3P
CS-26	DEUTSCH	2	Breaker switch	DT06-2S	-
CS-29	DEUTSCH	2	Power max switch	DT06-2S	-
CS-32	CARLING	10	Creep switch	VC2-01	-
CS-33	AMP	6	Emergency engine stop switch	S816-006002	S816-106002
CS-50	CARLING	10	Travel priority switch	VC2-01	-
CS-52	CARLING	10	Travel buzzer	VC2-01	-
CS-52	CARLING	10	2 PCS & dozer switch	VC2-01	-

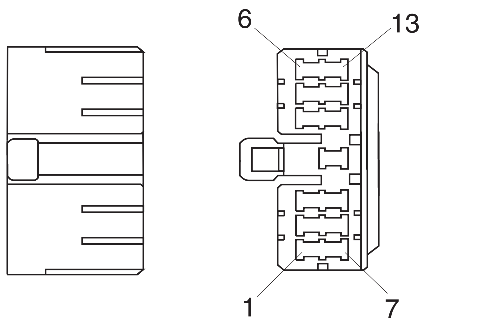
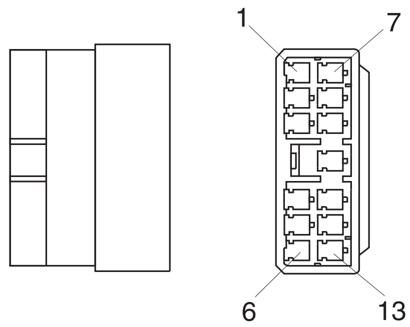
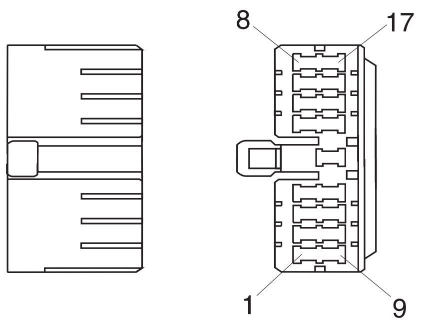
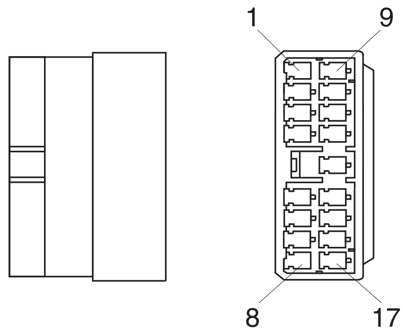
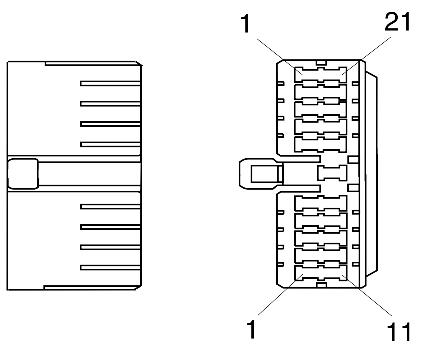
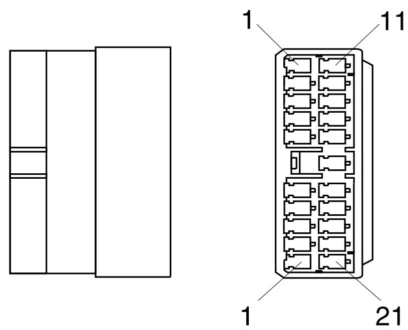
Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CS-53	AMP	1	Wiper cut switch	S822-014002	-
CS-67	CARLING	10	Quick clamp switch	VC2-01	-
CS-73	CARLING	10	Swing lock & fine switch	VC2-01	-
CS-74A	TYCO	2	Master switch	7706087-2	-
CS-74B	DEUTSCH	2	Master switch	DT06-2S-EP06	-
CS-78	CARLING	10	Lower wiper switch	VC2-01	
CS-99	CARLING	10	Air compressor switch	VC2-01	-
CS-100	CARLING	10	SCR switch	VC2-01	-
CS-108	CARLING	10	Auto grease switch	VC2-01	-
CS-111	CARLING	10	Boom floating switch	VC2-01	-
· Light					
CL-1	KET	3	Room lamp	MG651032	-
CL-2	AMP	1	Cigar lighter	S822-014002	S822-114002
CL-3	KET	3	Head lamp-LH	MG632278	-
CL-4	KET	3	Head lamp-RH	MG632278	-
CL-5	DEUTSCH	2	Work lamp-LH	DT06-2S-EP06	-
CL-6	DEUTSCH	2	Work lamp-RH	DT06-2S-EP06	-
CL-7	SHUR	1	Beacon lamp	S822-014002	S822-114002
CL-8	DEUTSCH	2	Cab light-LH	DT06-2S-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	PB625-06027	-
CL-16	AMP	6	Rear combination lamp-RH	PB625-06027	-
CL-21	KET	2	Number plate lamp	S814-002001	-
CL-24	AMP	3	Front combination lamp-LH	24L1-05100	-
CL-24	DEUTSCH	2	Rear work lamp	DT06-2S-EP06	DT04-2P-E005
CL-25	AMP	3	Front combination lamp-RH	24L1-05100	-
CL-26	-	3	Side marker-LH	12110293	-
CL-27	-	3	Side marker-RH	12110293	-
CL-40	DEUTSCH	2	DEF/AdBlue® lamp	DT06-2S-EP06	-
CL-41	DELPHI	2	DEF/AdBlue® Fill up warning lamp	12162197	-
· Sensor, sendor					
CD-1	AMP	2	Hydraulic oil temp sender	85202-1	-
CD-2	DEUTSCH	2	Fuel 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	-

Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CD-6	DEUTSCH	3	Travel pressure sensor	DT06-3S-EP06	-
CD-7	DEUTSCH	3	Working pressure sensor	DT06-3S-EP06	-
CD-9	DEUTSCH	3	Arm in pressure sensor	DT06-3S-EP06	-
CD-10	SUMITOMO	4	PRS temperature sensor	6098-0144	-
CD-10	AMP	2	Air cleaner switch	85202-1	-
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-E004
CD-32	DEUTSCH	3	Boom up pressure sensor	DT06-3S-EP06	-
CD-35	DEUTSCH	3	Arm in & out pressure sensor	DT06-3S-EP06	-
CD-38	DEUTSCH	3	Work brake pressure sensor	DT06-3S-EP06	-
CD-42	DEUTSCH	3	Pump pressure 1	DT06-3S-EP06	-
CD-43	DEUTSCH	3	Pump pressure 2	DT06-3S-EP06	-
CD-44	DEUTSCH	3	Pump pressure 3	DT06-3S-EP06	-
CD-45	DEUTSCH	2	WIF sensor	DT06-2S-EP06	-
CD-46	AMP	3	Speed sensor	282087	-
CD-50	AMP	2	Outrigger action pressure sensor	DT06-3S-EP06	-
CD-69	DEUTSCH	3	Attach pressure sensor	DT06-3S-EP06	DT04-3P-E004
CD-70	DEUTSCH	3	N1 pressure sensor	DT06-3S-EP06	-
CD-71	DEUTSCH	3	N2 pressure sensor	DT06-3S-EP06	-
CD-73	DEUTSCH	3	Travel forward pressure sensor	DT06-3S-EP06	-
CD-74	DEUTSCH	3	Travel reverse pressure sensor	DT06-3S-EP06	-
CD-85	DEUTSCH	3	Boom down pressure sensor	DT06-3S-EP06	-
CD-100	DEUTSCH	3	Outrigger pressure sensor	DT06-3S-EP06	-
CD-421	DEUTSCH	2	Swing parking	DT06-2S-EP06	-
CD-421	DEUTSCH	2	Swing fine control solenoid	DT06-2S-EP06	-

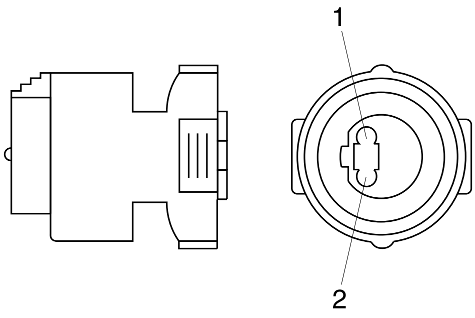
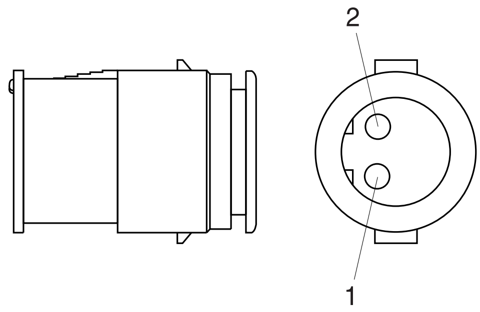
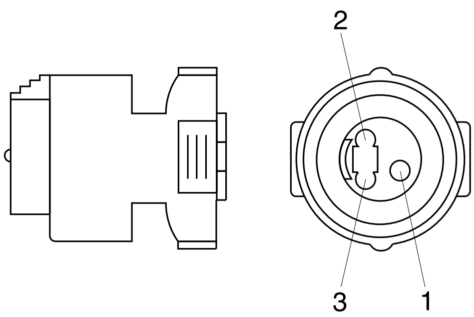
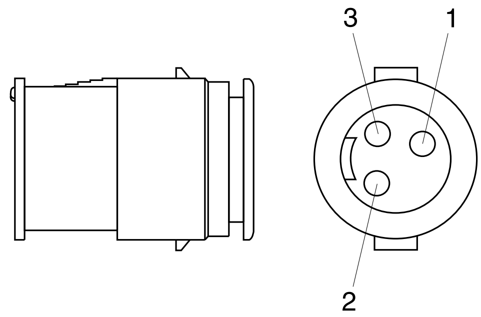
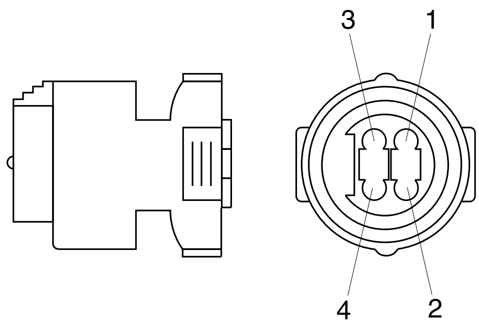
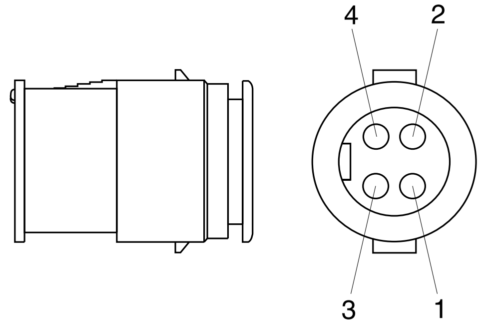
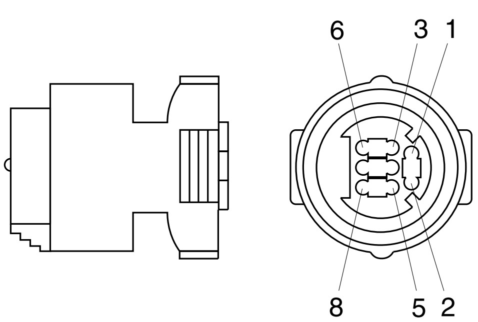
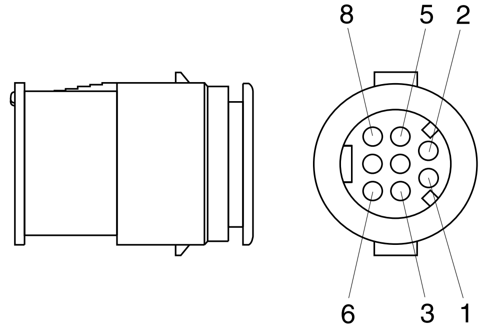
2. CONNECTION TABLE FOR CONNECTORS

1) PA TYPE CONNECTOR

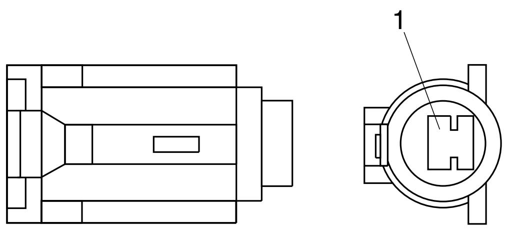
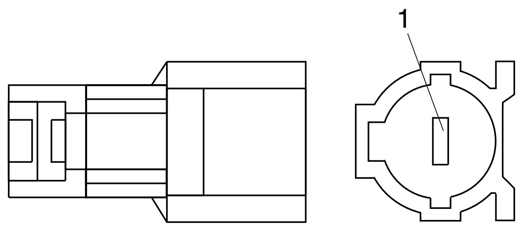
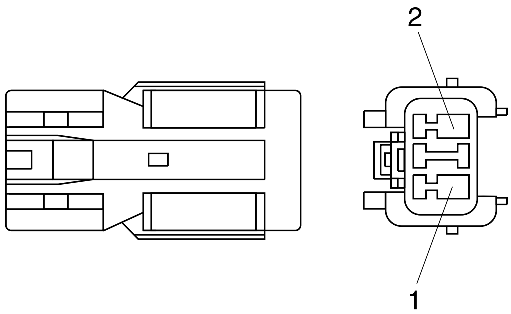
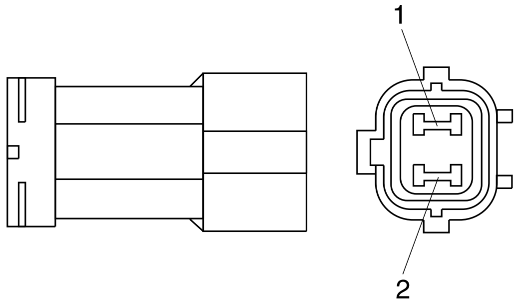
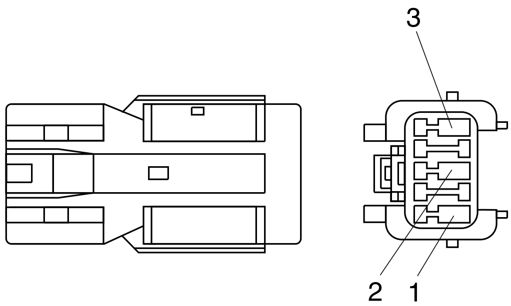
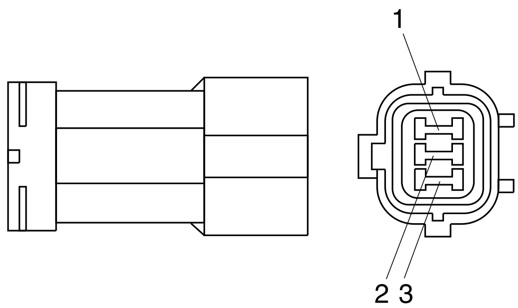
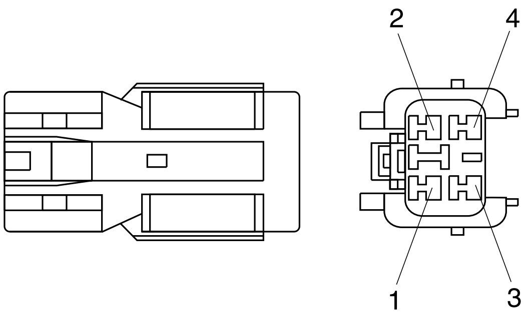
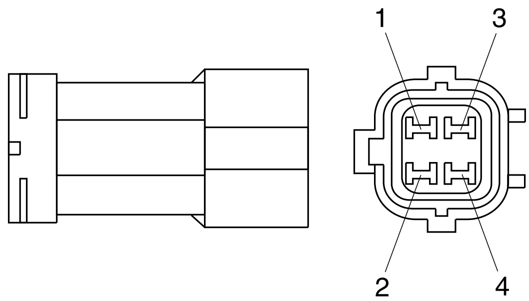
No. of pin	Receptacle connector (female)	Plug connector (male)
5	 S811-005002	 S811-105002
7	 S811-007002	 S811-107002
9	 S811-009002	 3S811-109002
11	 S811-011002	 S811-111002

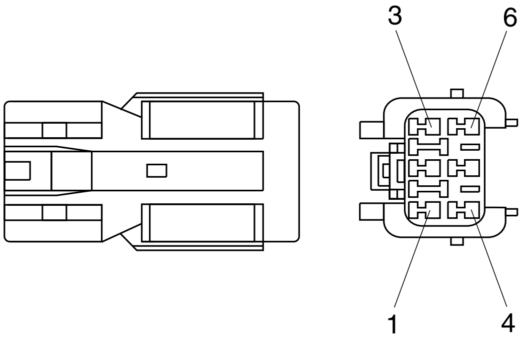
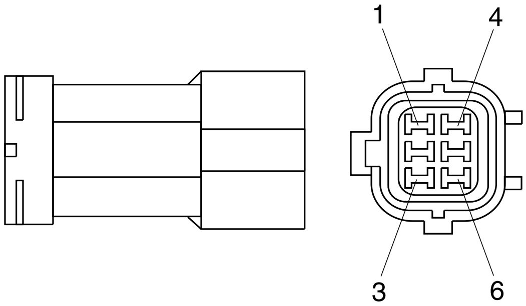
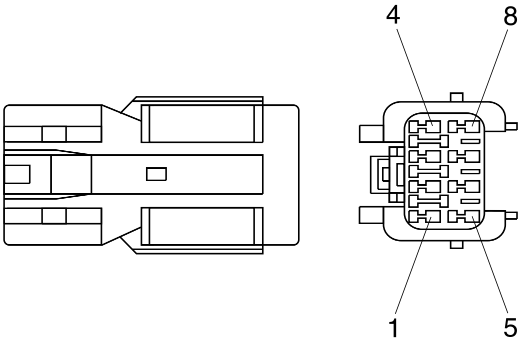
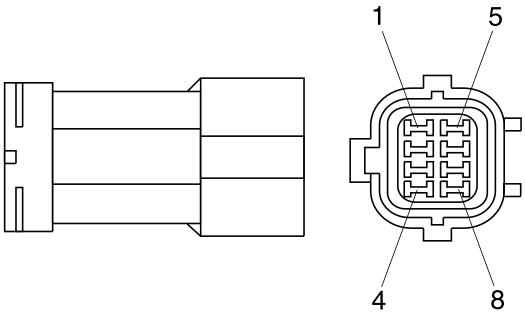
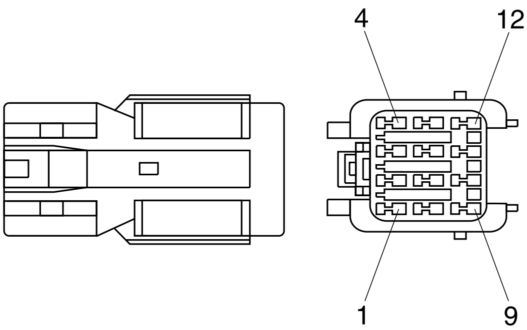
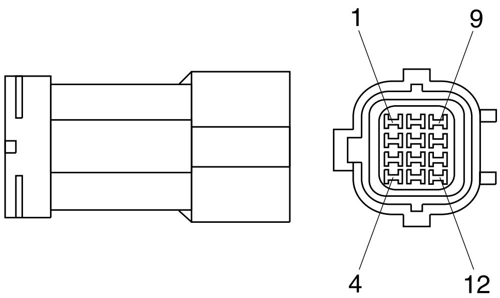
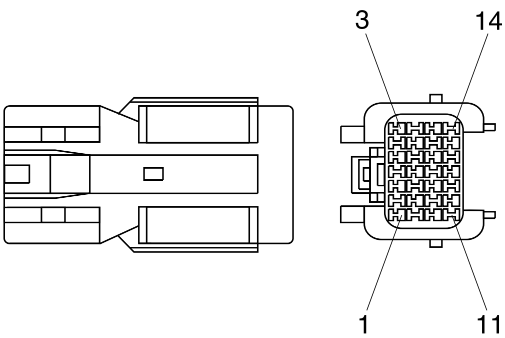
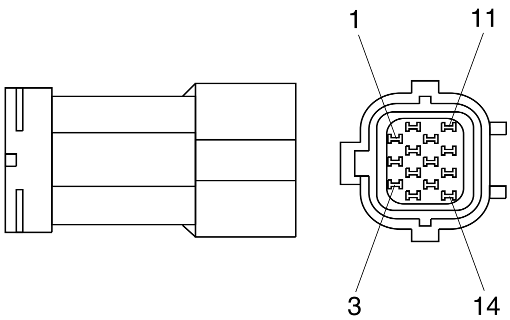
No. of pin	Receptacle connector (female)	Plug connector (male)
13	 S811-013002	 S811-113002
17	 S811-017002	 S811-117002
21	 S811-021002	 S811-121002

2) J TYPE CONNECTOR

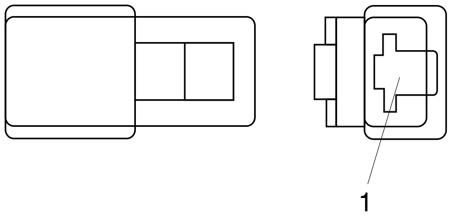
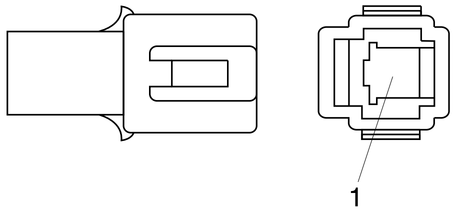
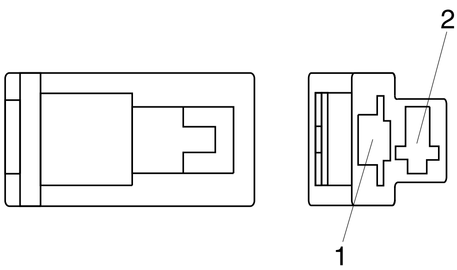
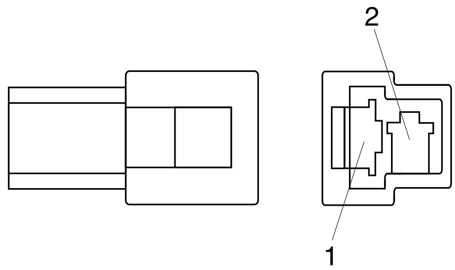
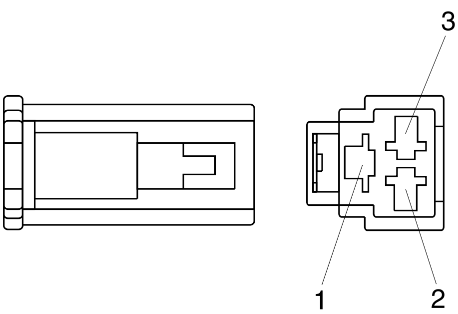
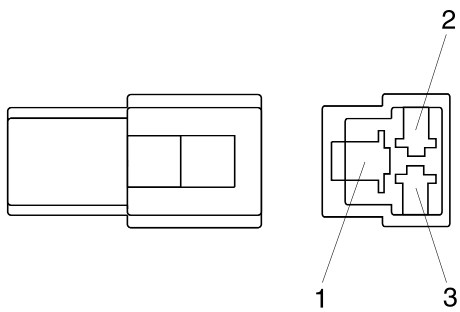
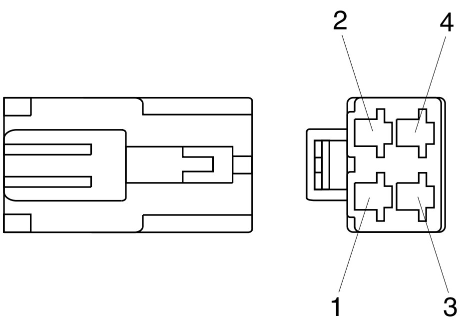
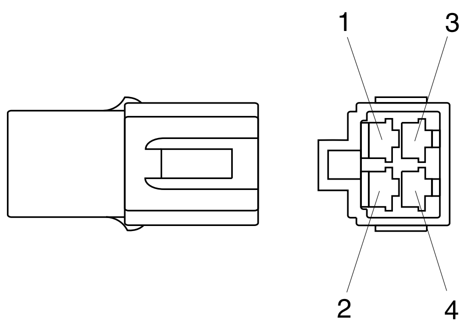
No. of pin	Receptacle connector (female)	Plug connector (male)
2	 S816-002001	 S816-102001
3	 S816-003001	 S816-103001
4	 S816-004001	 S816-104001
8	 S816-008001	 S816-108001

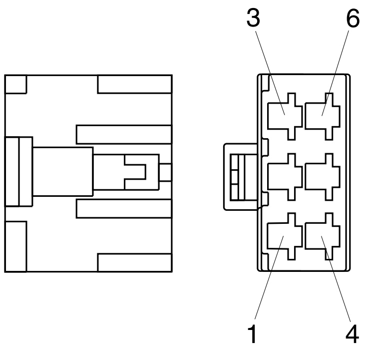
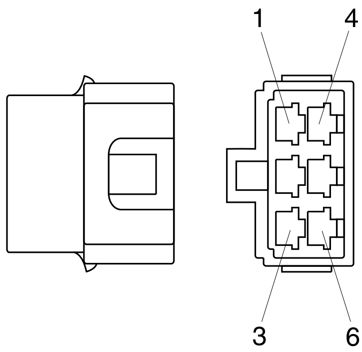
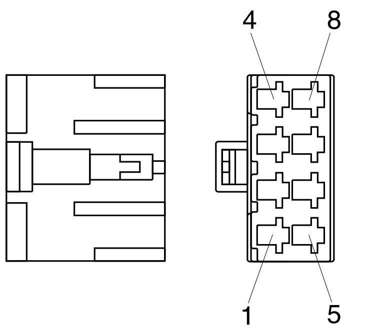
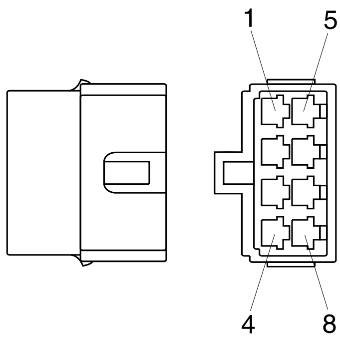
3) SWP TYPE CONNECTOR

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

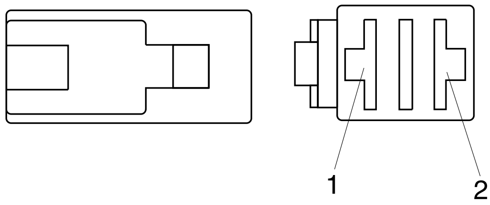
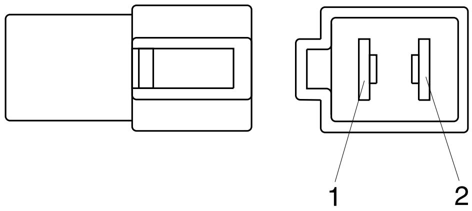
No. of pin	Receptacle connector (female)	Plug connector (male)
6	 S814-006000	 S814-106000
8	 S814-008000	 S814-108000
12	 S814-012000	 S814-112000
14	 S814-014000	 S814-114000

4) CN TYPE CONNECTOR

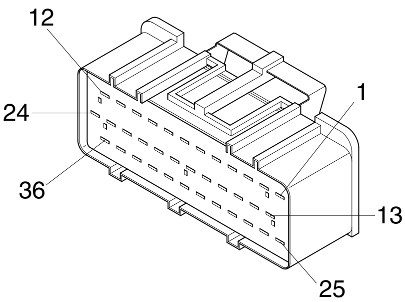
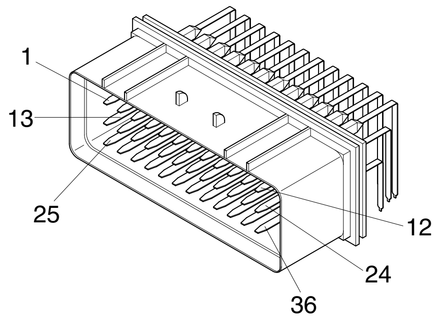
No. of pin	Receptacle connector (female)	Plug connector (male)
1	 S810-001202	 S810-101202
2	 S810-002202	 S810-102202
3	 S810-003202	 S810-103202
4	 S810-004202	 S810-104202

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

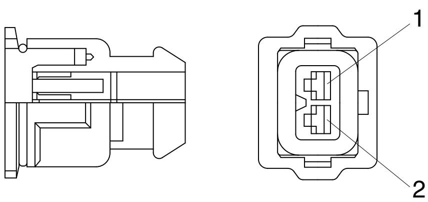
5) 375 FASTEN TYPE CONNECTOR

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

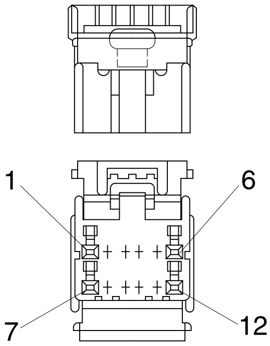
6) AMP ECONOSEAL CONNECTOR

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

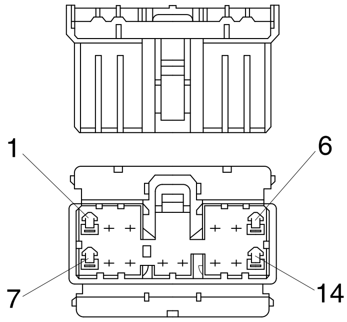
7) AMP TIMER CONNECTOR

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

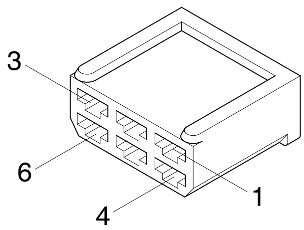
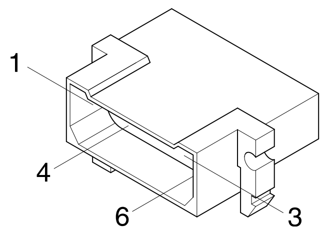
8) AMP 040 MULTILOCK CONNECTOR

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

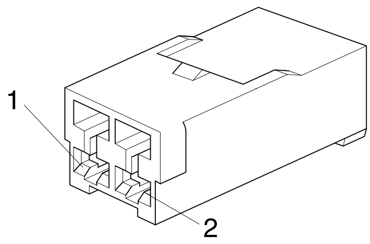
9) AMP 070 MULTILOCK CONNECTOR

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

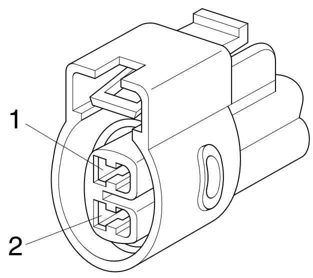
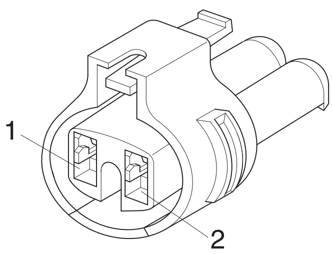
10) AMP FASTIN - FASTON CONNECTOR

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

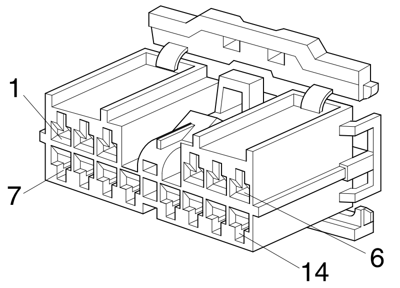
11) KET 090 CONNECTOR

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

12) KET 090 WP CONNECTORS

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

13) KET SDL CONNECTOR

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

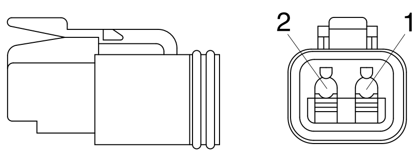
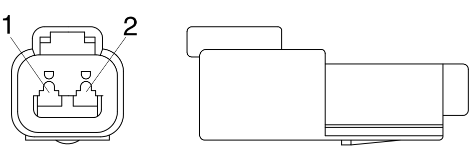
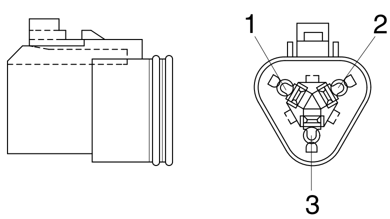
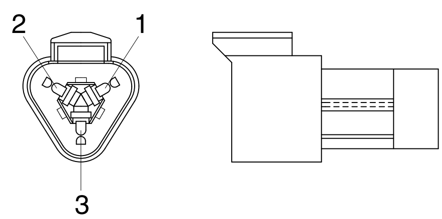
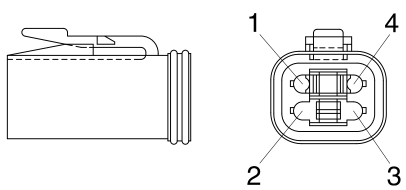
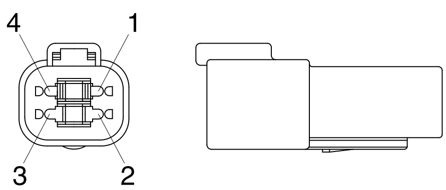
14) DEUTSCH DT CONNECTORS

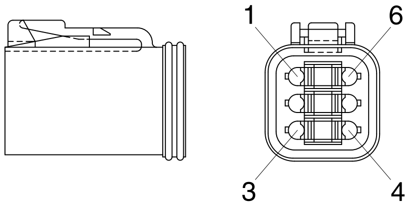
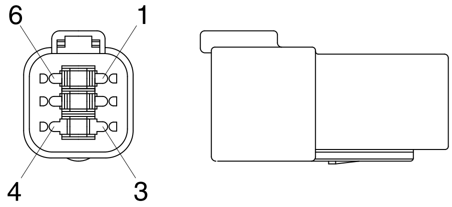
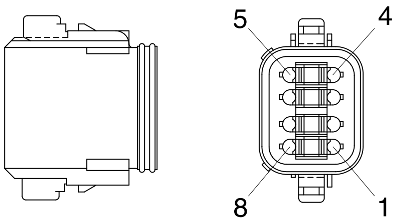
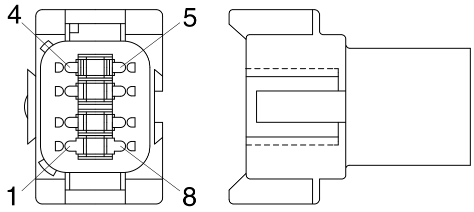
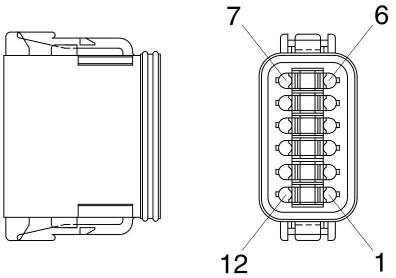
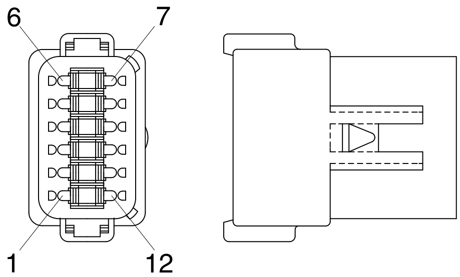
DT 06 - 3S - ★★★★

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

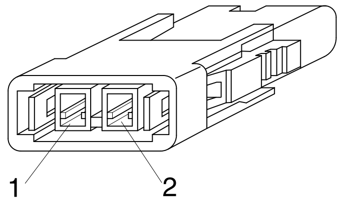
※ Modification

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

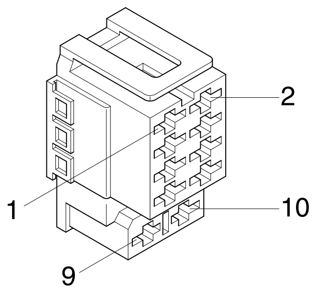
No. of pin	Receptacle connector (female)	Plug connector (male)
2	 DT06-2S	 DT04-2P
3	 DT06-3S	 DT04-3P
4	 DT06-4S	 DT04-4P

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

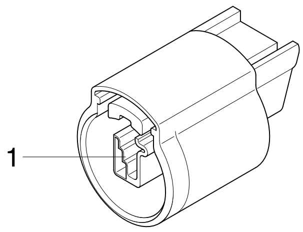
15) MOLEX 2CKTS CONNECTOR

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

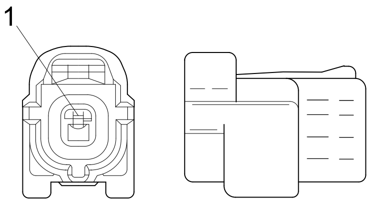
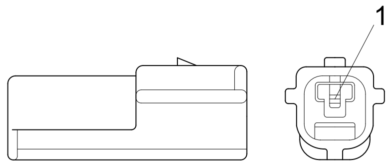
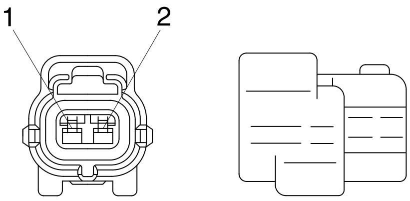
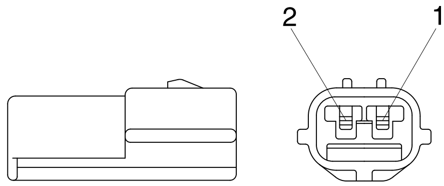
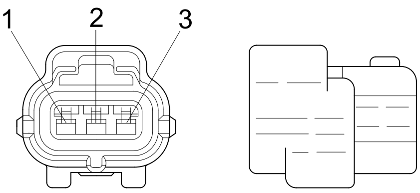
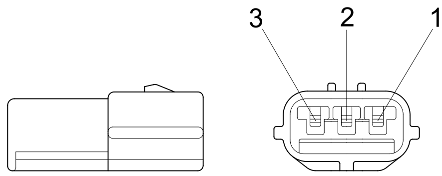
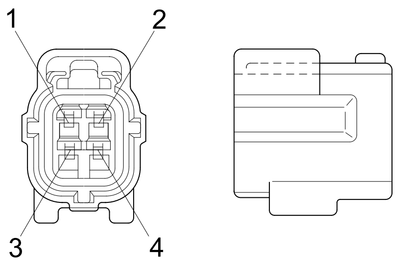
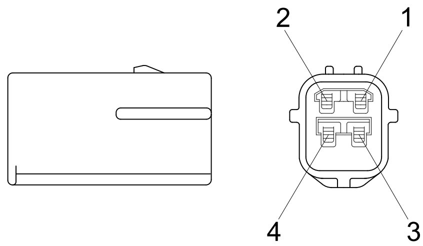
16) ITT SWF CONNECTOR

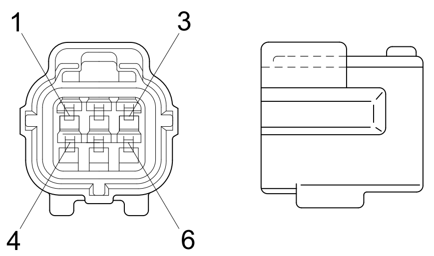
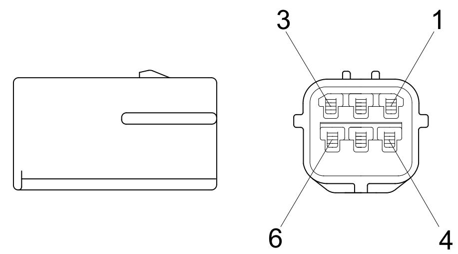
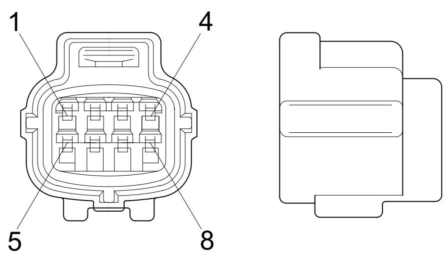
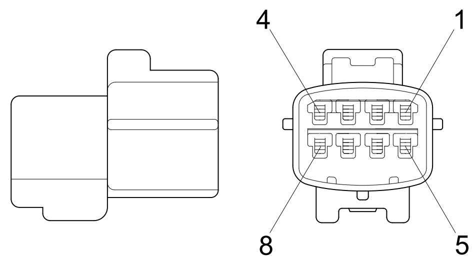
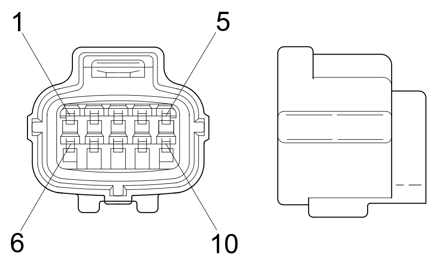
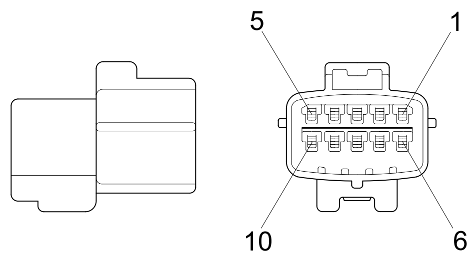
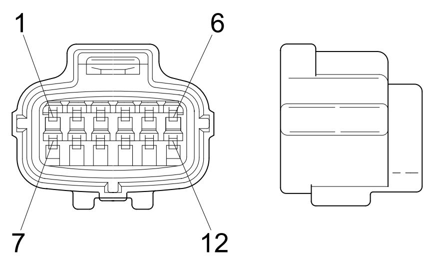
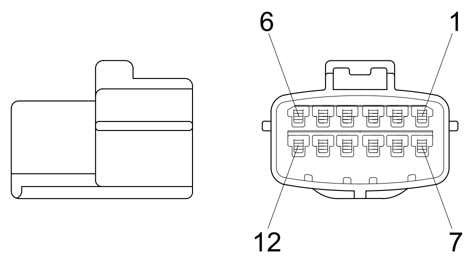
No. of pin	Receptacle connector (female)	Plug connector (male)
10	 SWF593757	

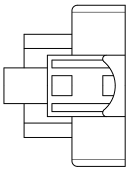
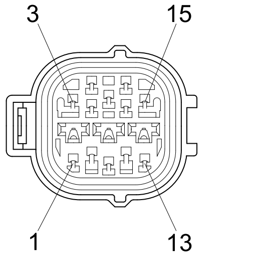
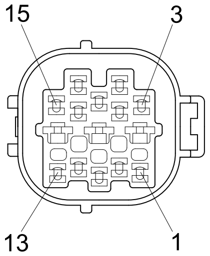
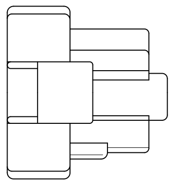
17) MWP NMWP CONNECTOR

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

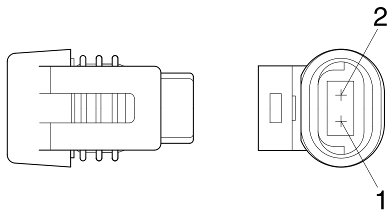
18) ECONOSEAL J TYPE CONNECTORS

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

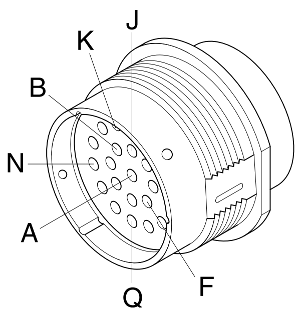
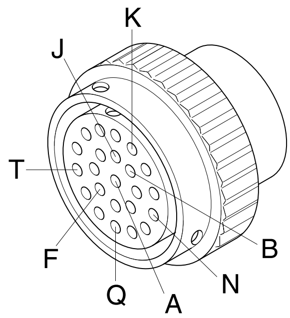
No. of pin	Receptacle connector (female)	Plug connector (male)
6	 S816-006002	 S816-106002
8	 S816-008002	 S816-108002
10	 S816-010002	 S816-110002
12	 S816-012002	 S816-112002

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

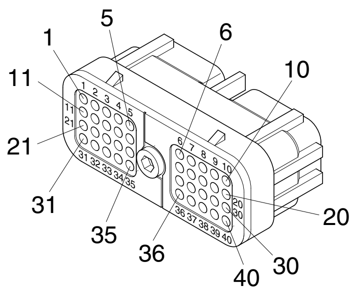
19) METRI-PACK TYPE CONNECTOR

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

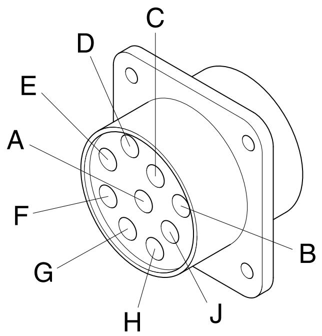
20) DEUTSCH HD30 CONNECTOR

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

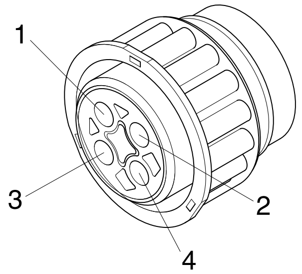
21) DEUTSCH MCU CONNECTOR

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

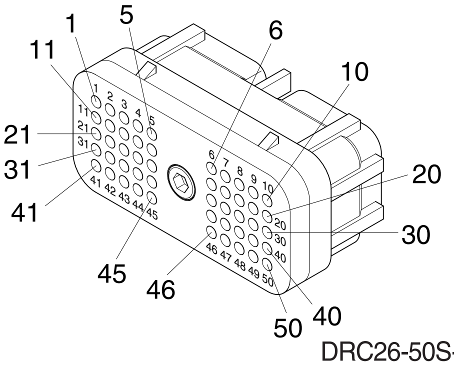
22) DEUTSCH SERVICE TOOL CONNECTOR

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

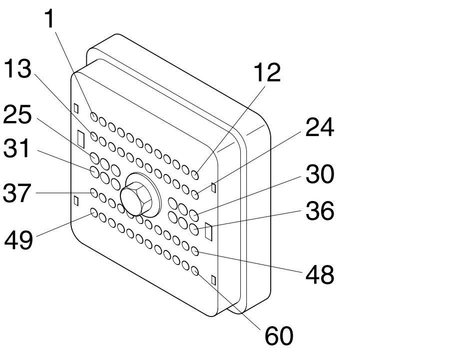
23) AMP FUEL WARMER CONNECTOR

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

24) DEUTSCH ENGINE ECM CONNECTOR

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

25) DEUTSCH INTERMEDIATE CONNECTOR

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

SECTION 5 MECHATRONICS SYSTEM

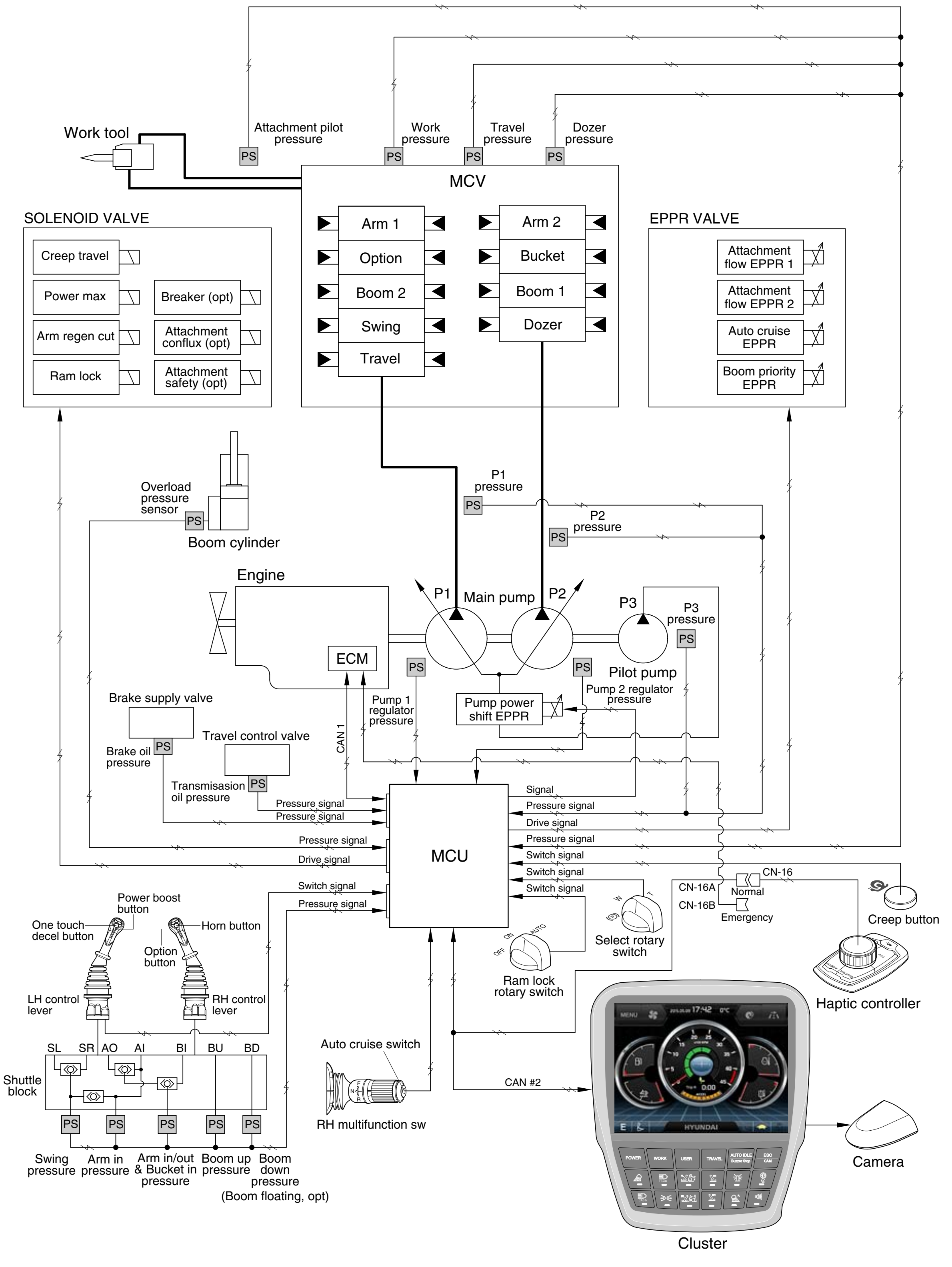
SECTION 5 MECHATRONICS SYSTEM

GROUP 1 OUTLINE

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

- ADVANCED CAPO SYSTEM
  - Mode selection system
    - Power mode selection (P, S, E)
    - Work mode selection
    - User mode system (U)
  - Auto deceleration system
  - Power boost system
  - Travel speed control system
    - 1, 2 Speed control system
    - Auto cruise control system
    - Creep travel control system
  - Automatic warming up system
  - Engine overheat prevention system
  - Variable power control system
  - Attachment flow control system
  - Boom floating control system
  - Intelligent power control system
  - Anti-restart system
  - Self-diagnostic system
    - MCU & cluster protection
    - Open-short diagnosis & error code display
    - Machine error & ECM fault code display
  - Machine monitoring system
    - Machine condition monitoring
    - Electric signal monitoring
  - One touch deceleration system

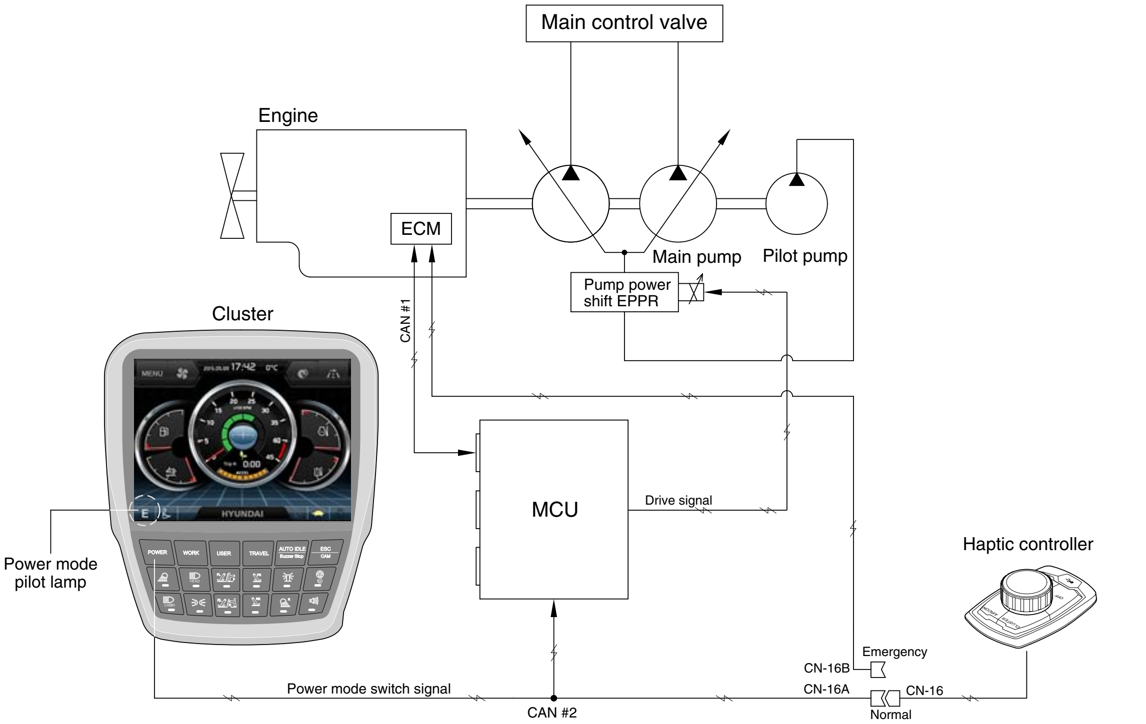
SYSTEM DIAGRAM



210WF5MS01

GROUP 2 MODE SELECTION SYSTEM

1. POWER MODE SELECTION SYSTEM



210WF5MS02

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

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

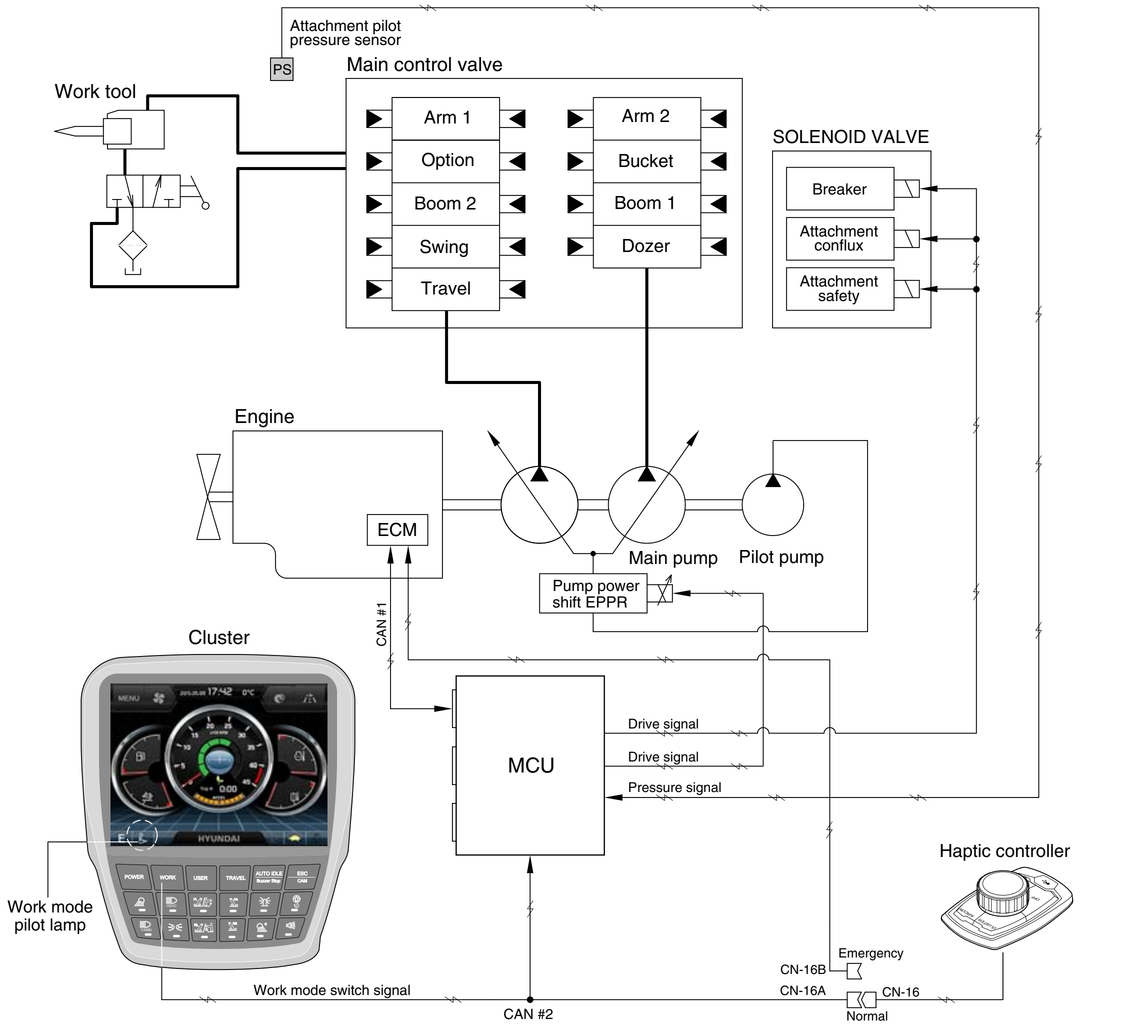
Power mode	Application	Engine rpm				Power shift by EPPR valve			
		Standard		Option		Standard		Option	
		Unload	Load	Unload	Load	Current (mA)	Pressure (kgf/cm^2)	Current (mA)	Pressure (kgf/cm^2)
P	Heavy duty power	1600±50	1750±50	1700±50	1700±50	330±30	10 (~5)	295±30	8.5 (~8.5)
S	Standard power	1450±50	1600±50	1500±50	1500±50	365±30	18 (~8)±3	363±30	12.5 (~12.5)±3
E	Economy operation	1350±50	1500±50	1350±50	1500±50	4000±30	15 (~10)±3	450±30	17.5 (~12.5)±3
AUTO DECEL	Engine deceleration	1000±100	-	1000±100	-	700±30	38±3	700±30	38±3
One touch decel	Engine quick deceleration	850±100	-	850±100	-	700±30	38±3	700±30	38±3
KEY START	Key switch start position	850±100	-	850±100	-	700±30	38±3	700±30	38±3

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

※ (~*) : Load

2. WORK MODE SELECTION SYSTEM

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



210WF5MS03

1) GENERAL WORK MODE (bucket)

This mode is used to general digging work.

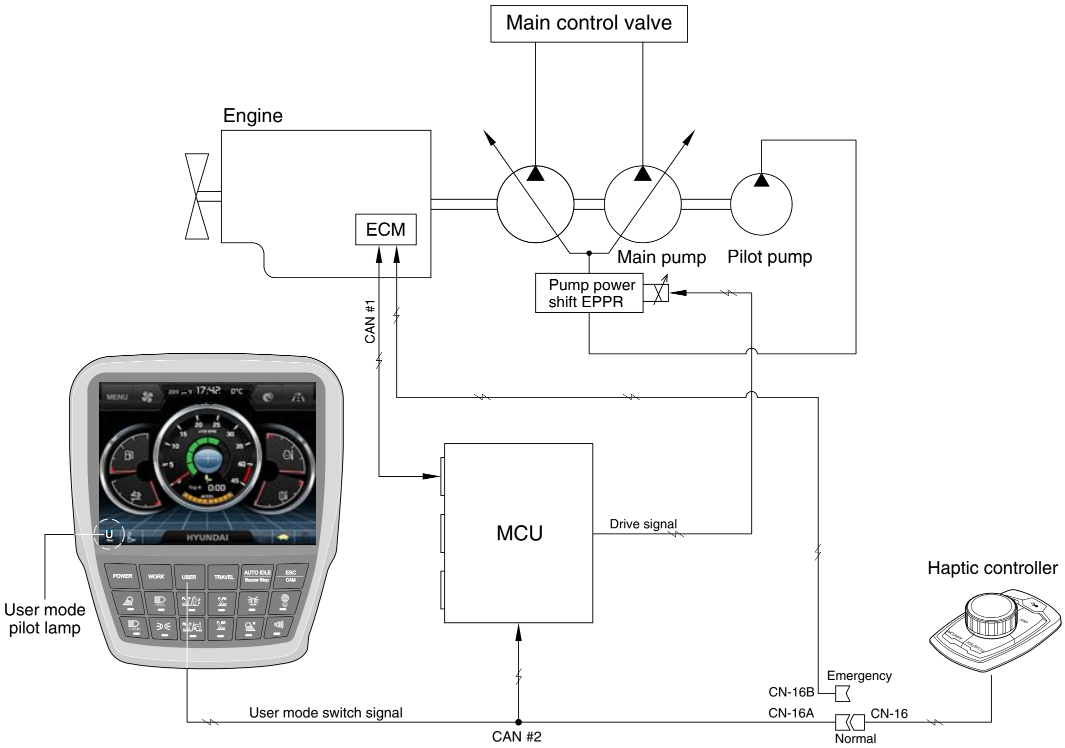
2) ATT WORK MODE (breaker, crusher)

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

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

★ When breaker operating button is pushed.

3. USER MODE SELECTION SYSTEM



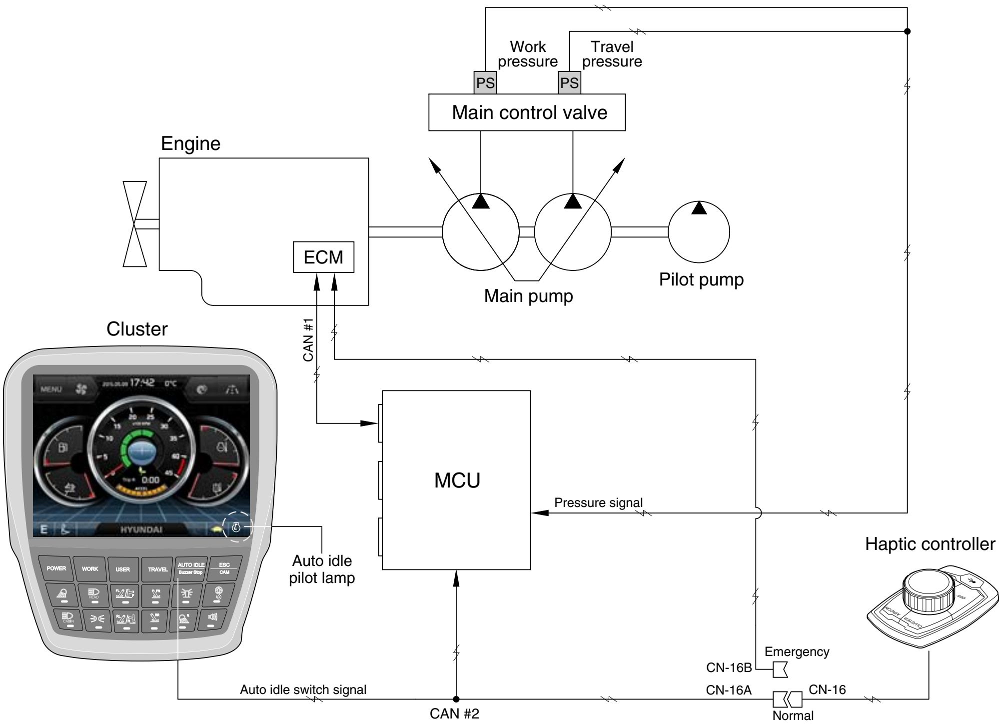
210WF5MS04

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

2) LCD segment vs parameter setting

Step (▮)	Engine speed (rpm)	Idle speed (rpm)	Power shift (bar)
1	1300	750	0
2	1400	800	3
3	1500	850	6
4	1600	900	9
5	1700	950	12
6	1800	1000 (auto decel)	16
7	1850	1050	20
8	1900	1100	26
9	1950	1150	32
10	2000	1200	38

GROUP 3 AUTOMATIC DECELERATION SYSTEM

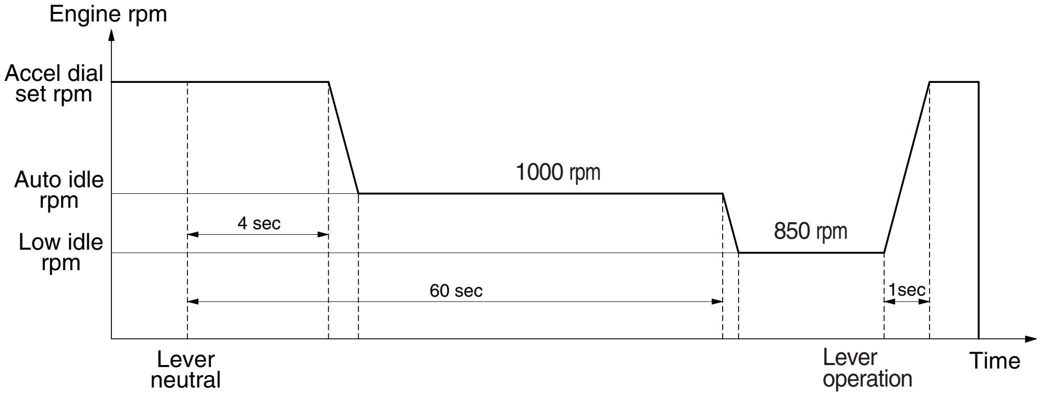


210WF5MS05

1. WHEN AUTO IDLE PILOT LAMP ON

When all of the work equipment control levers including swing and travel levers are at neutral for 4 seconds, MCU sends throttle command to ECM to reduce the engine speed to 1000 rpm. If the control levers are at neutral for 1 minute, MCU reduces the engine speed to 850 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.



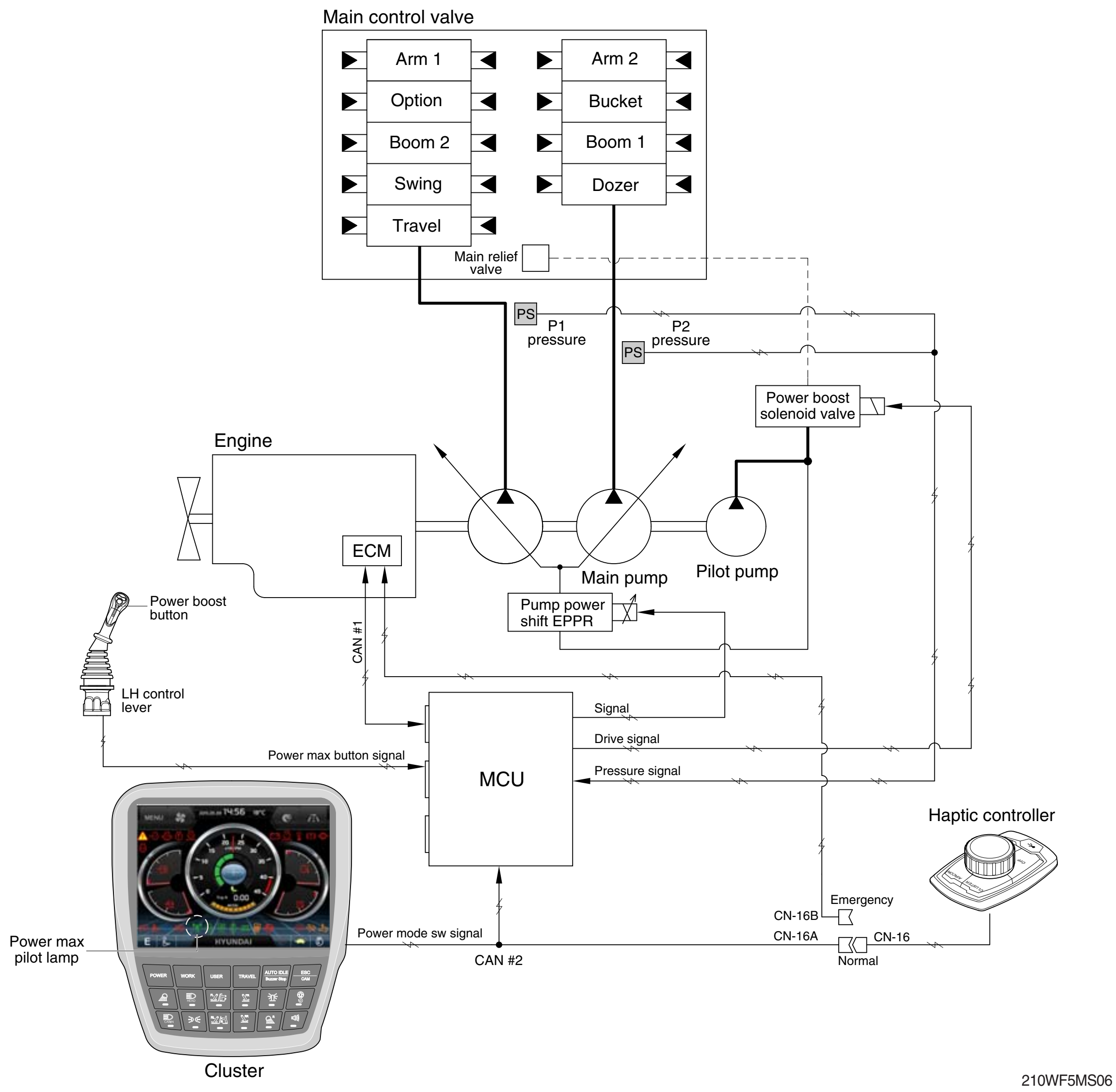
21095MS05

2. WHEN AUTO IDLE PILOT LAMP OFF

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

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

GROUP 4 POWER BOOST SYSTEM



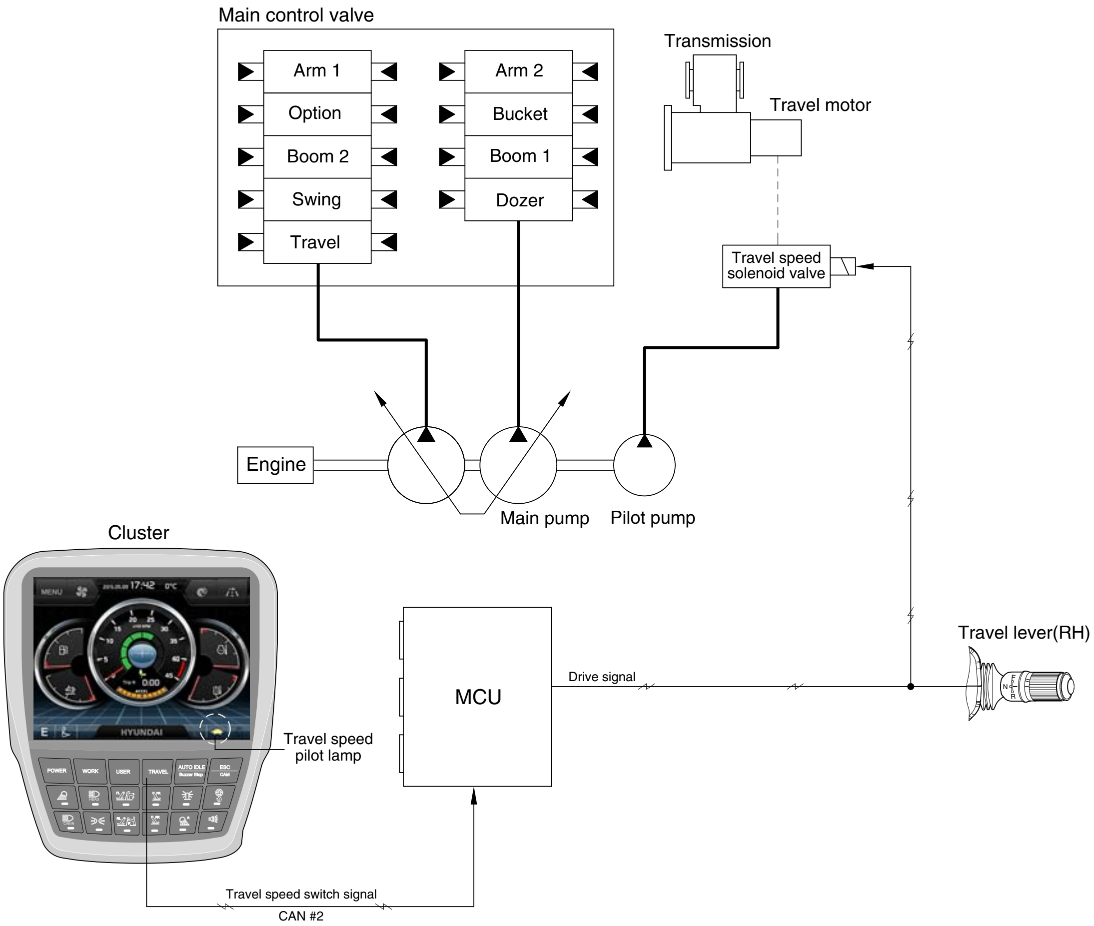
· When the power boost switch on the left control lever knob is pushed ON, the power mode is set P mode and maximum digging power is increased by 10 %.

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

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

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

GROUP 5 TRAVEL SPEED CONTROL SYSTEM



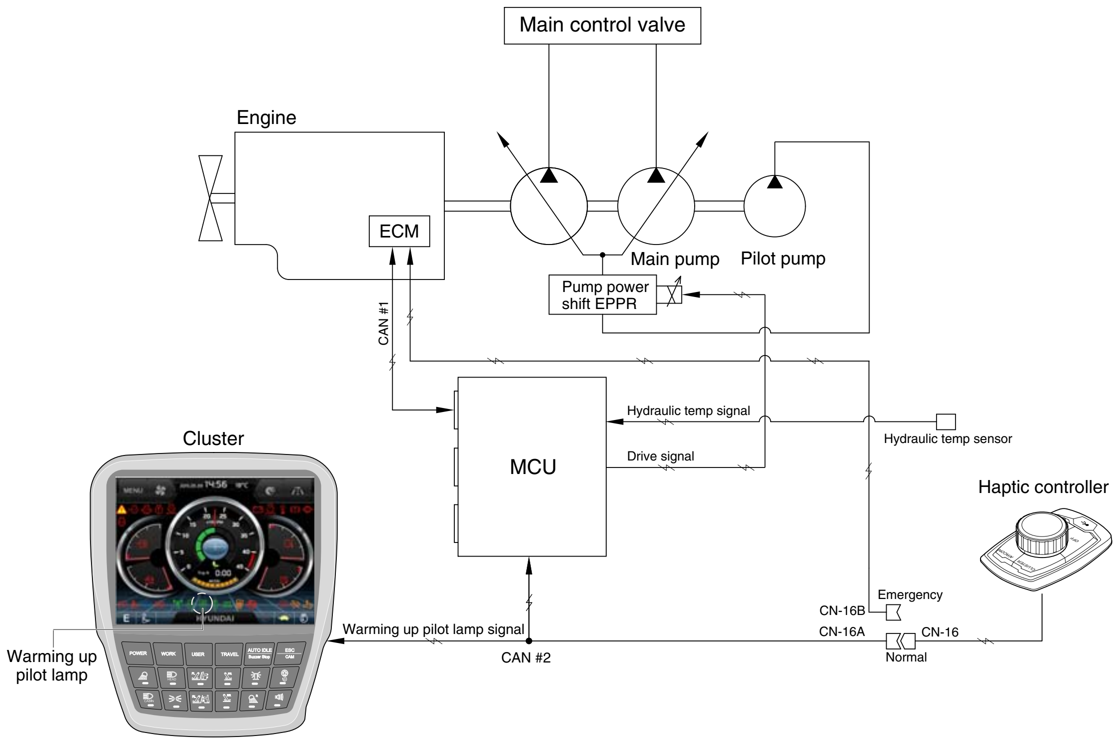
210WF5MS07

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



210WF5MS08

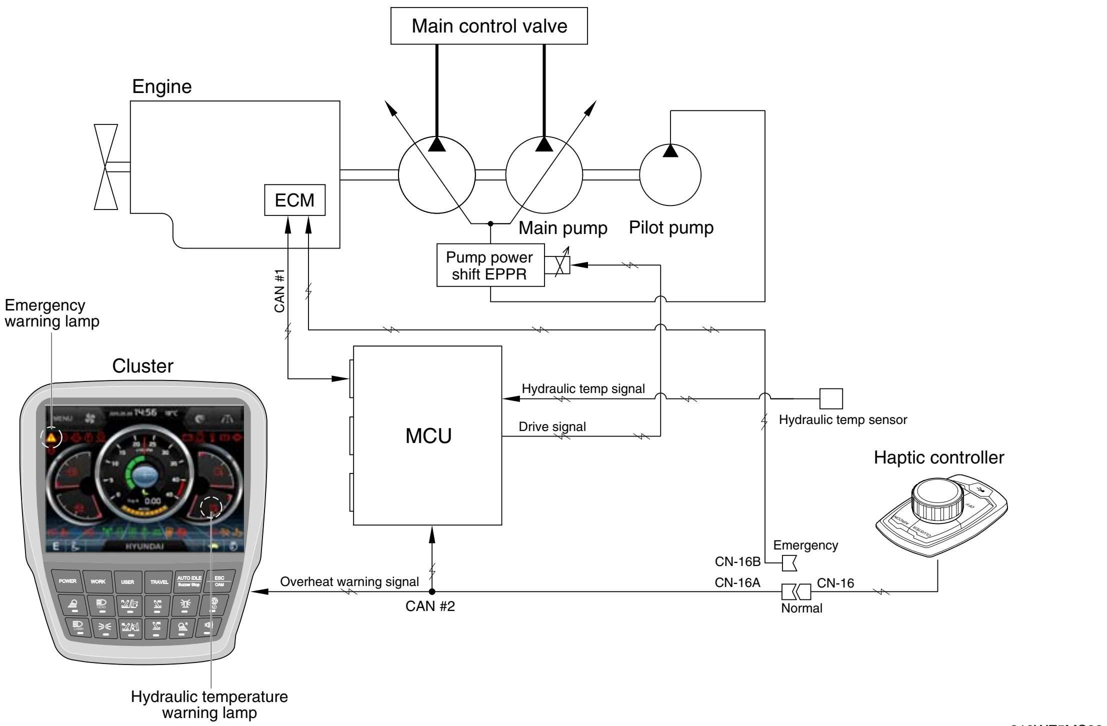
1. The MCU receives the engine coolant temperature from the ECM, and if the coolant temperature is below 30˚C, it increases the engine speed from key start rpm to 1200 rpm. At this time the mode does not change. If the coolant temperature sensor has fault, the hydraulic oil temperature signal is substituted.

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



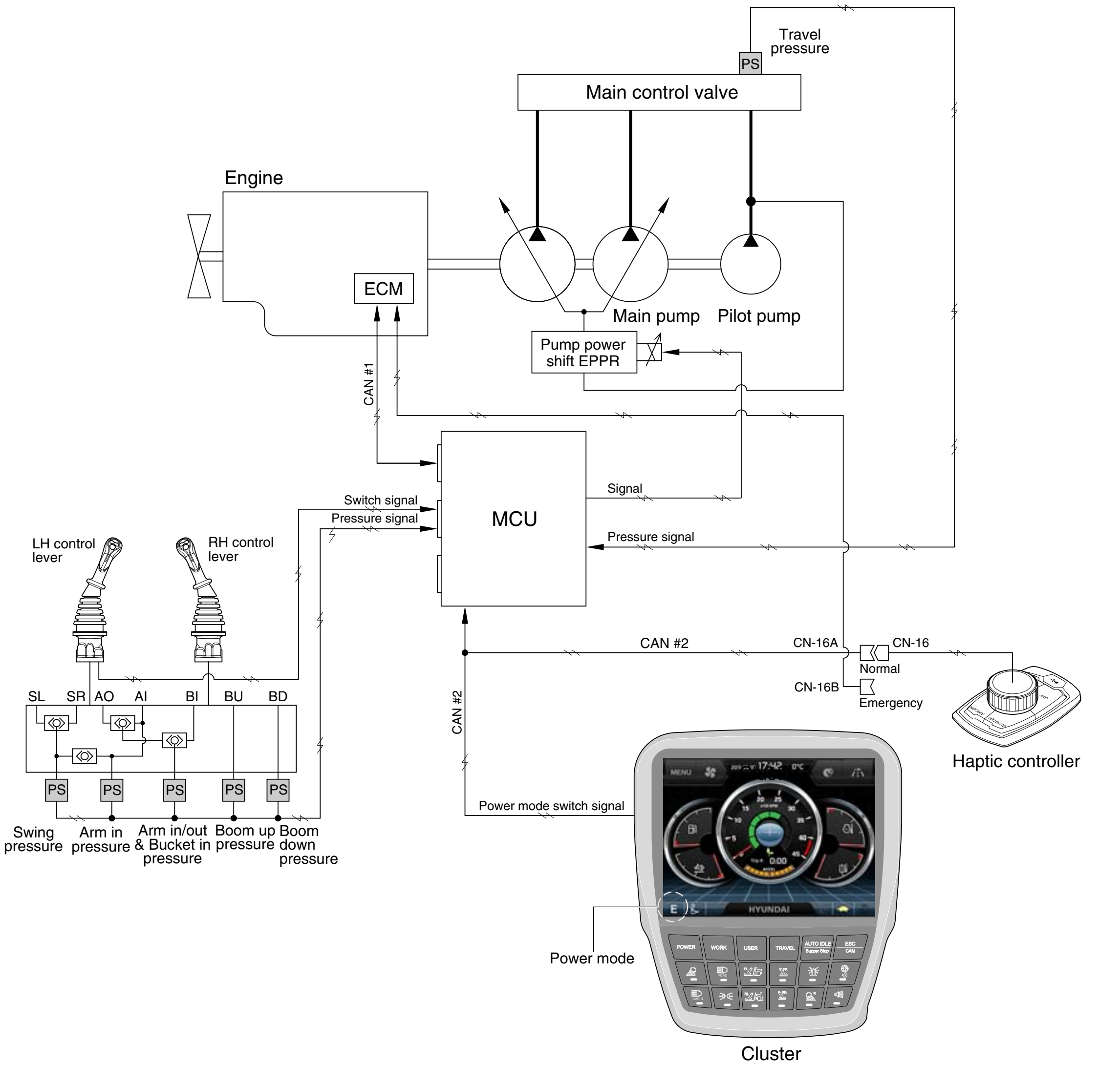
210WF5MS09

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

2. LOGIC TABLE

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

GROUP 8 VARIABLE POWER CONTROL SYSTEM



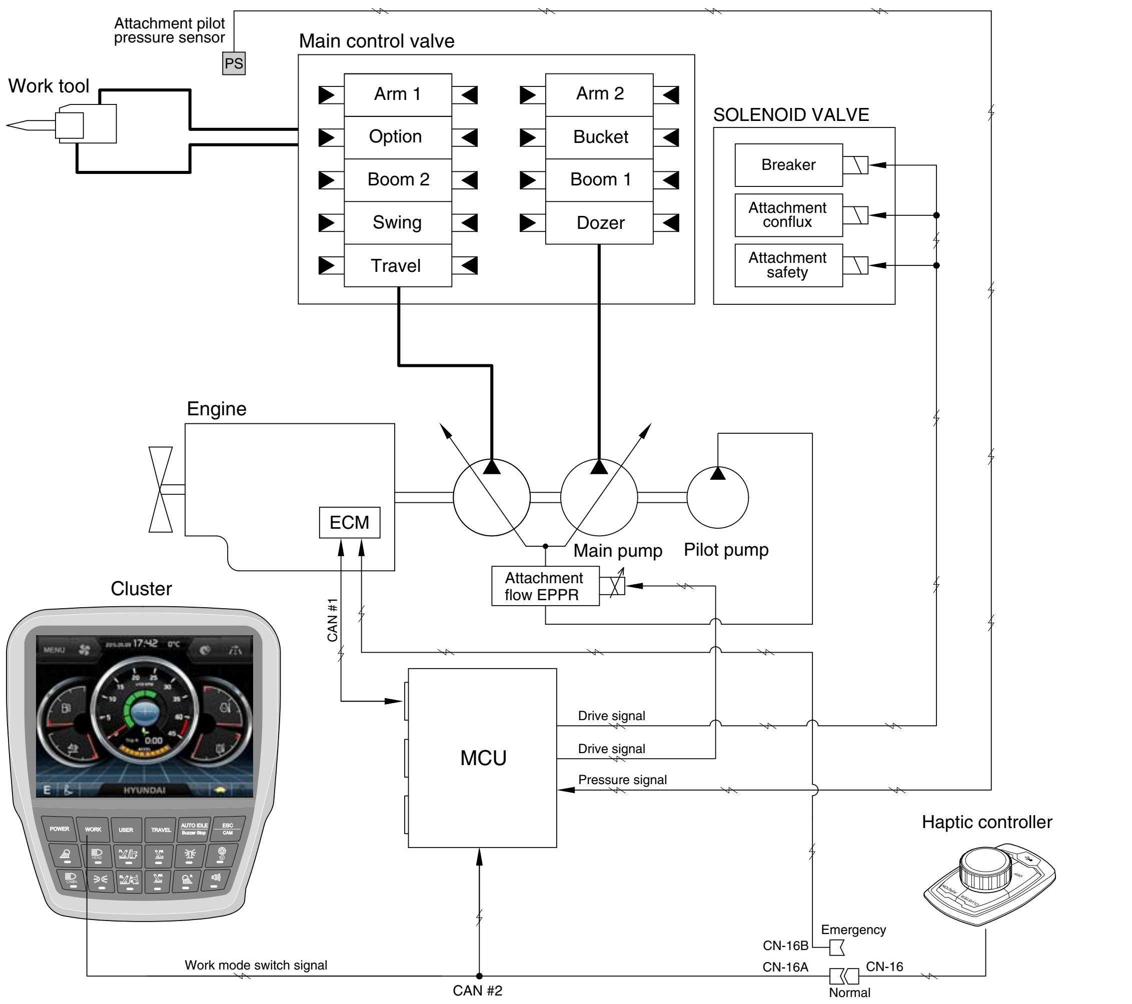
210WF5MS10

· 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



210WF5MS11

· 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.

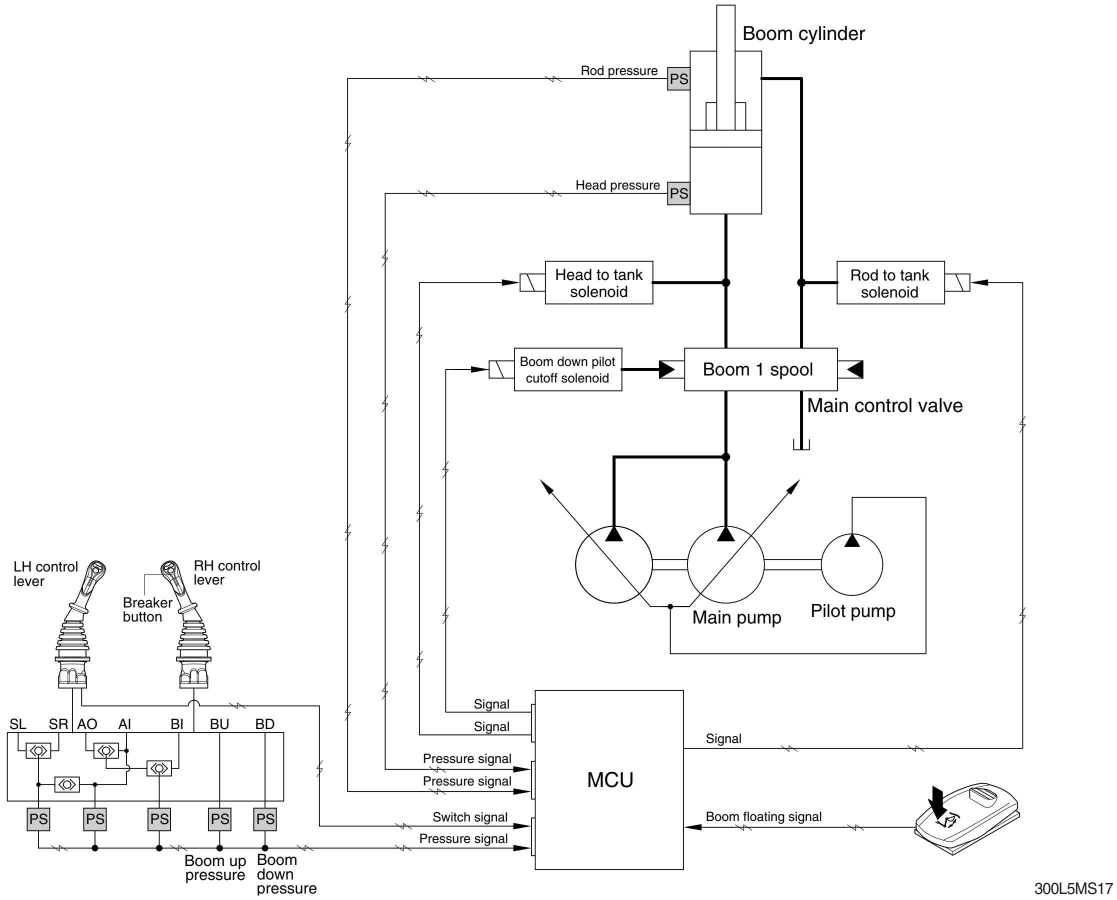
Description	Work tool		
	Breaker		Crusher
Flow level	1 pump mode	100 ~ 180 lpm	100 ~ 440 lpm
	2 pump mode★1	100 ~ 290 lpm	
Attach safety solenoid	-		ON
Attach conflux solenoid	ON/OFF		ON/OFF
Breaker solenoid★	ON		-

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

★ When breaker operating button is pushed.

★1 2 pump mode (Eco breaker mode) : Increase the range of maximum flow rate.

GROUP 10 BOOM FLOATING CONTROL SYSTEM



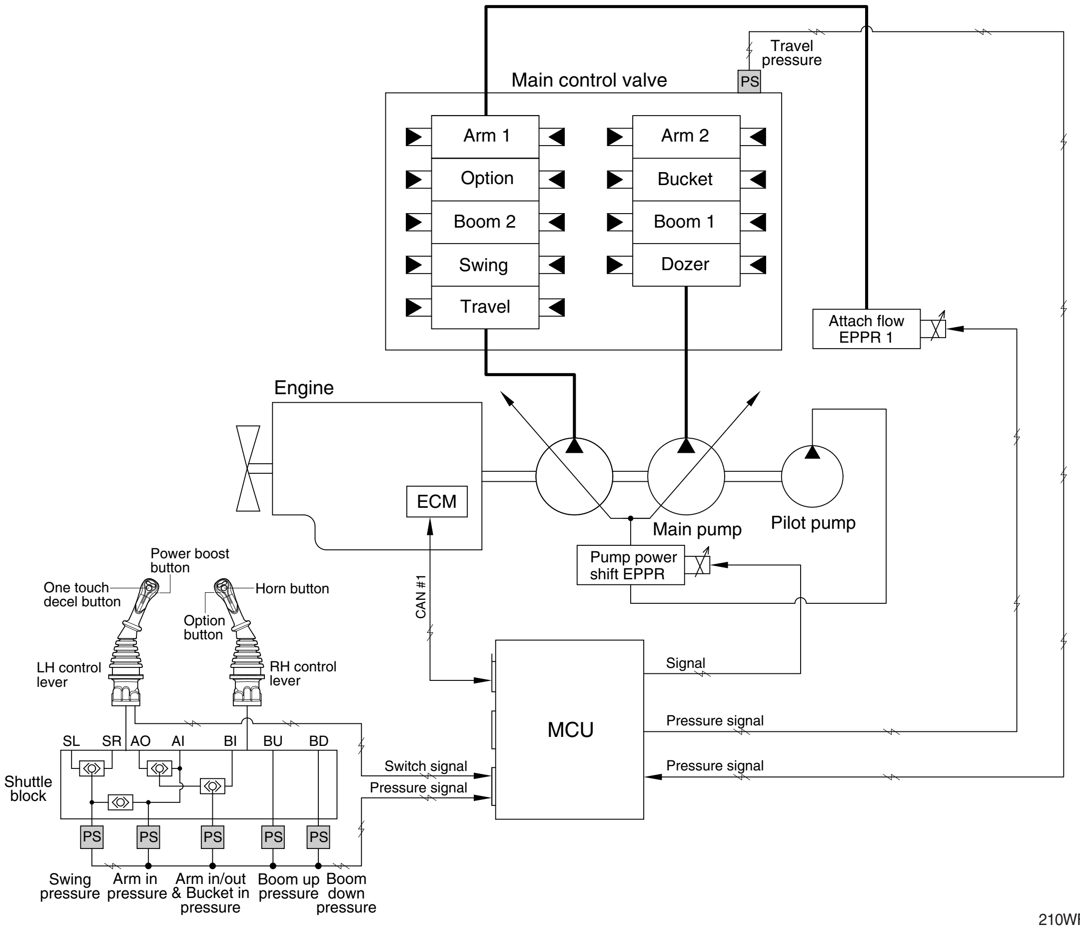
· Boom floating automatically controls boom cylinder along the ground by operating arm cylinder only.

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

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

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

GROUP 11 INTELLIGENT POWER CONTROL SYSTEM



210WF5MS18

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

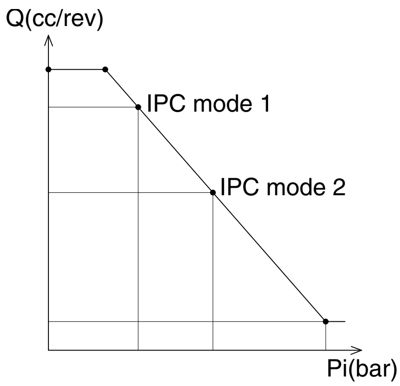
Condition★1	Function
IPC mode : ON★2 Boom up Arm in Not travel motion Not swing motion	Limitation of pump flow rate : Activated
None of upper condition	Limitation of pump flow rate : Canceled

★1 AND condition

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

2. IPC MODE SELECTION

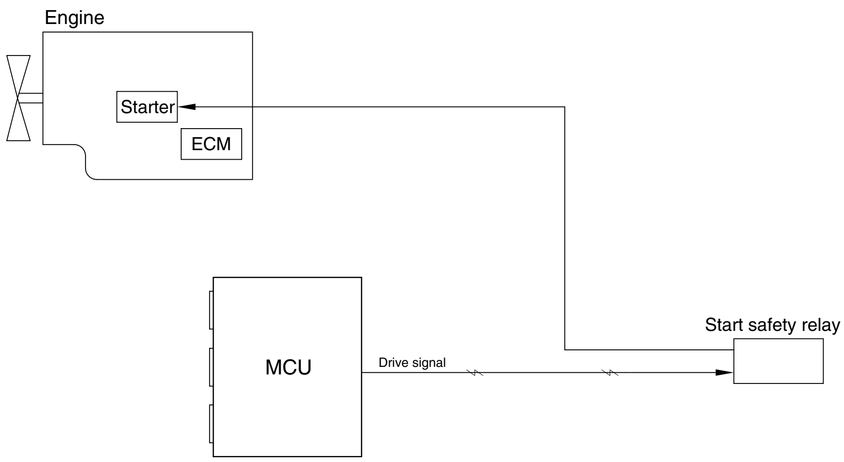
IPC mode ON/OFF and the levels of flow rate limit can be selected at "Monitor > Management"



300L5MS19

IPC mode	Description
IPC mode 1 (Default)	IPC mode ON, limit level 1
IPC mode 2	IPC mode ON, limit level 2
Not used	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

210WF3CD120

210WF3CD121

210WF3CD125

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

2) Logged fault

210WF3CD128

210WF3CD126

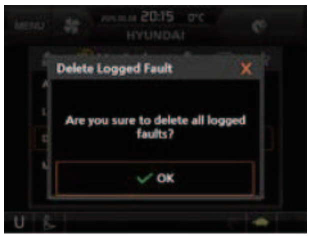
210WF3CD123

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

3) Delete logged fault

210WF3CD134

210WF3CD126



210WF3CD127

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

3. MACHINE ERROR CODES TABLE

DTC		Diagnostic Criteria	Application		
HCESPN	FMI		G	C	W
101	3	10 seconds continuous, Hydraulic Oil Temp. Measurement Voltage > 3.8V	●		
	4	10 seconds continuous, Hydraulic Oil Temp. Measurement Voltage < 0.3V	●		
		(Results / Symptoms) 1. Monitor – Hydraulic oil temperature display failure 2. Control Function – Fan revolutions control failure (Checking list) 1. CD-1 (#2), CN-52 (#24) Checking Open/Short 2. CD-1 (#1), CN-51 (#5) Checking Open/Short			
105	0	10 seconds continuous, Working Press. Sensor Measurement Voltage > 5.2V	●		
	1	10 seconds continuous, 0.3V≤ Working Press. Sensor Measurement Voltage < 0.8V	●		
	4	10 seconds continuous, Working Press. Sensor Measurement Voltage < 0.3V	●		
		(Results / Symptoms) 1. Monitor – Working Press. display failure 2. Control Function – Auto Idle operation failure, Engine variable horse power control operation failure (Checking list) 1. CD-7 (#B) – CN-52 (#37) Checking Open/Short 2. CD-7 (#A) – CN-51 (#3) Checking Open/Short 3. CD-7 (#C) – CN-51 (#13) Checking Open/Short			
108	0	10 seconds continuous, Travel Oil Press. Sensor Measurement Voltage > 5.2V		●	
	1	10 seconds continuous, 0.3V ≤ Travel Oil Press. Sensor Measurement Voltage < 0.8V	●		
	4	10 seconds continuous, Travel Oil Press. Sensor Measurement Voltage < 0.3V	●		
		(Results / Symptoms) 1. Monitor – Travel Oil Press. display failure 2. Control Function – Auto Idle operation failure, Engine variable horse power control operation failure, IPC operation failure, Driving alarm operation failure (Checking list) 1. CD-6 (#B) – CN-52 (#38) Checking Open/Short 2. CD-6 (#A) – CN-51 (#3) Checking Open/Short 3. CD-6 (#C) – CN-51 (#13) Checking Open/Short			

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

<table>
<tr><th colspan="2">DTC</th><th rowspan="2">Diagnostic Criteria</th><th colspan="3">Application</th></tr>
<tr><th>HCESPN</th><th>FMI</th><th>G</th><th>C</th><th>W</th></tr>
<tr><td rowspan="4">120</td><td>0</td><td>10 seconds continuous, Main Pump 1 (P1) Press. Sensor Measurement Voltage > 5.2V</td><td>●</td><td></td><td></td></tr>
<tr><td>1</td><td>10 seconds continuous, 0.3V ≤ Main Pump 1 (P1) Press. Sensor Measurement Voltage < 0.8V</td><td>●</td><td></td><td></td></tr>
<tr><td>4</td><td>10 seconds continuous, Main Pump 1 (P1) Press. Sensor Measurement Voltage < 0.3V</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Monitor – Main Pump 1 (P1) Press. display failure
2. Control Function – Automatic voltage increase operation failure, Overload at compensation control failure
(Checking list)
1. CD-42 (#B) – CN-52 (#29) Checking Open/Short
2. CD-42 (#A) – CN-51 (#3) Checking Open/Short
3. CD-42 (#C) – CN-51 (#13) Checking Open/Short</td></tr>
<tr><td rowspan="4">121</td><td>0</td><td>10 seconds continuous, Main Pump 2 (P2) Press. Sensor Measurement Voltage > 5.2V</td><td>●</td><td></td><td></td></tr>
<tr><td>1</td><td>10 seconds continuous, 0.3V≤ Main Pump 2 (P2) Press. Sensor Measurement Voltage < 0.8V</td><td>●</td><td></td><td></td></tr>
<tr><td>4</td><td>10 seconds continuous, Main Pump 2 (P2) Press. Sensor Measurement Voltage < 0.3V</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Monitor – Main Pump 2 (P2) Press. display failure
2. Control Function – Automatic voltage increase operation failure, Overload at compensation control failure
(Checking list)
1. CD-43 (#B) – CN-52 (#12) Checking Open/Short
2. CD-43 (#A) – CN-51 (#3) Checking Open/Short
3. CD-43 (#C) – CN-51 (#13) Checking Open/Short</td></tr>
<tr><td rowspan="3">122</td><td>1</td><td>(when you had conditions mounting pressure sensor)
10 seconds continuous, 0.3V ≤ Overload Press. Sensor Measurement Voltage < 0.8V</td><td>●</td><td></td><td></td></tr>
<tr><td>4</td><td>(when you had conditions mounting pressure sensor)
10 seconds continuous, Overload Press. Sensor Measurement Voltage < 0.3V</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Monitor – Overload Press. display failure
2. Control Function – Overload warning alarm failure
(Checking list)
1. CD-31 (#B) – CN-52 (#16) Checking Open/Short
2. CD-31 (#A) – CN-51 (#3) Checking Open/Short
3. CD-31 (#C) – CN-51 (#13) Checking Open/Short</td></tr>
</table>

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

DTC		Diagnostic Criteria	Application		
HCESPN	FMI		G	C	W
123	0	10 seconds continuous, Negative 1 Press. Sensor Measurement Voltage > 5.2V	●		
	1	10 seconds continuous, 0.3V≤ Negative 1 Press. Sensor Measurement Voltage < 0.8V	●		
	4	10 seconds continuous, Negative 1 Press. Sensor Measurement Voltage < 0.3V	●		
		(Results / Symptoms) 1. Monitor – Negative 1 Press. display failure 2. Control Function – IPC operation failure, Option attachment flow control operation failure (Checking list) 1. CD-70 (#B) – CN-52 (#33) Checking Open/Short 2. CD-70 (#A) – CN-51 (#3) Checking Open/Short 3. CD-70 (#C) – CN-51 (#13) Checking Open/Short			
124	0	10 seconds continuous, Negative 2 Press. Sensor Measurement Voltage > 5.2V	●		
	1	10 seconds continuous, 0.3V≤ Negative 2 Press. Sensor Measurement Voltage < 0.8V	●		
	4	10 seconds continuous, Negative 2 Press. Sensor Measurement Voltage < 0.3V	●		
		(Results / Symptoms) 1. Monitor – Negative 2 Press. display failure 2. Control Function – Option attachment flow control operation failure (Checking list) 1. CD-71 (#B) – CN-52 (#17) Checking Open/Short 2. CD-71 (#A) – CN-51 (#3) Checking Open/Short 3. CD-71 (#C) – CN-51 (#13) Checking Open/Short			
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 (#19) Checking Open/Short 2. CD-32 (#A) – CN-51 (#3) Checking Open/Short 3. CD-32 (#C) – CN-5 1(#13) Checking Open/Short			

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

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

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

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

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

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

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

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

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

DTC		Diagnostic Criteria	Application		
HCESPN	FMI		G	C	W
164	4	(Detection) (When Working Cutoff Relay is Off) 10 seconds continuous, Working Cutoff Relay drive unit Measurement Voltage ≤ 3.0V (Cancellation) (When Working Cutoff Relay is Off) 3 seconds continuous, Working Cutoff Relay drive unit Measurement Voltage > 3.0V			●
	6	(Detection) (When Working Cutoff Relay is On) 10 seconds continuous, Working Cutoff Relay drive current > 6.5 A (Cancellation) (When Working Cutoff Relay is On) 3 seconds continuous, Working Cutoff Relay drive current ≤ 6.5 A			●
	(Results / Symptoms) 1. Control Function – (Wheel Excavator) In driving mode, attachment hydraulic pilot pressure cut off failure (Checking list) 1. CR-47 (#85) – CN-54 (#9) Checking Open/Short 2. CR-47 (#30, #86) – CN-45 (#B+ term) Checking Open/Short				
166	4	(Detection) (When Power Max Solenoid is Off) 10 seconds continuous, Power Max Solenoid drive unit Measurement Voltage ≤ 3.0V (Cancellation) (When Power Max Solenoid is Off) 3 seconds continuous, Power Max Solenoid drive unit Measurement Voltage > 3.0V	●		
	6	(Detection) (When Power Max Solenoid is On) 5 seconds continuous, Power Max Solenoid drive current > 4.5 A (Cancellation) (When Power Max Solenoid is On) 3 seconds continuous, Power Max Solenoid drive current ≤ 4.5 A	●		
	(Results / Symptoms) 1. Control Function – Voltage increase operation failure (Checking list) 1. CN-88 (#1) – CN-52 (#2) Checking Open/Short 2. CN-88 (#2) – CN-45 (#B+ term) Checking Open/Short				

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

<table>
<tr><th colspan="2">DTC</th><th rowspan="2">Diagnostic Criteria</th><th colspan="3">Application</th></tr>
<tr><th>HCESPN</th><th>FMI</th><th>G</th><th>C</th><th>W</th></tr>
<tr><td rowspan="4">167</td><td rowspan="2">4</td><td>(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</td><td></td><td>●</td><td></td></tr>
<tr><td>(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</td><td></td><td></td><td>●</td></tr>
<tr><td>6</td><td>(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</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Control Function – driving in 1/2 transmission operation failure
(Checking list)
1. CN-70 (#1) – CN-52(#20) Checking Open/Short
2. CN-70 (#2) – CN-45(#B+ term) Checking Open/Short</td></tr>
</table>

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

<table>
<tr><th colspan="2">DTC</th><th rowspan="2">Diagnostic Criteria</th><th colspan="3">Application</th></tr>
<tr><th>HCESPN</th><th>FMI</th><th>G</th><th>C</th><th>W</th></tr>
<tr><td rowspan="3">169</td><td>4</td><td>Monitor – Selecting attachment(breaker / crusher)
(Detection)
(When Attachment Conflux Solenoid is Off)
10 seconds continuous, Attachment Conflux Solenoid drive unit Measurement Voltage ≤ 3.0V
(Cancellation)
(When Attachment Conflux Solenoid is Off)
3 seconds continuous, Attachment Conflux Solenoid drive unit Measurement Voltage > 3.0V</td><td>●</td><td></td><td></td></tr>
<tr><td>6</td><td>(Detection)
(When Attachment Conflux Solenoid is On)
10 seconds continuous, Attachment Conflux Solenoid drive Current > 6.5 A
(Cancellation)
(When Attachment Conflux Solenoid is On)
3 seconds continuous, Attachment Conflux Solenoid drive Current ≤ 6.5 A</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(Results / symptoms)
1. Control Function – Option attachment flow control – Joining operation failure
(Eco breaker mode, crusher mode)
(Checking list)
1. CD-237 (#1) – CN-53 (#7) Checking Open/Short
2. CD-237 (#2) – CR-35 (#87) Checking Open/Short</td></tr>
<tr><td rowspan="3">170</td><td>4</td><td>(Model Parameter) mounting Arm Regenerating Solenoid
(Detection)
(When Arm Regeneration Solenoid is Off)
10 seconds continuous, Arm Regeneration Solenoid drive unit Measurement Voltage ≤ 3.0V
(Cancellation)
(When Arm Regeneration Solenoid is Off)
3 seconds continuous, Arm Regeneration Solenoid drive unit Measurement Voltage > 3.0V</td><td>●</td><td></td><td></td></tr>
<tr><td>6</td><td>(Detection)
(When Arm Regeneration Solenoid is On)
10 seconds continuous, Arm Regeneration Solenoid drive current > 4.5 A
(Cancellation)
(When Arm Regeneration Solenoid is On)
3 seconds continuous, Arm Regeneration Solenoid drive current ≤ 4.5 A</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(Detection)
(When Arm Regeneration Solenoid is On)
10 seconds continuous, Arm Regeneration Solenoid drive current > 4.5 A
(Cancellation)
(When Arm Regeneration Solenoid is On)
3 seconds continuous, Arm Regeneration Solenoid drive current ≤ 4.5 A</td></tr>
</table>

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

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. CD-149 (#1) – CN-53 (#8) Checking Open/Short 2. CD-149 (#2) – CR-35 (#87) Checking Open/Short				
179	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. CD-66 (#1) – CN-53 (#9) Checking Open/Short 2. CD-66 (#2) – CN-45 (#B+ term) Checking Open/Short 3. CD-66 (#C) – CN-51 (#13) Checking Open/Short				

※ 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 (not applicable)				
188	5	(Detection) (When Attachment Flow EPPR 1 current is equal or more than 300 mA) 10 seconds continuous, Attachment Flow EPPR drive current < 100 mA (Cancellation) (When Attachment Flow EPPR 1 current is equal or more than 300 mA) 3 seconds continuous, Attachment Flow EPPR drive current ≥ 100 mA	●		
	6	(Detection) 10 seconds continuous, Attachment Flow EPPR 1 drive current > 1.0 A (Cancellation) 3 seconds continuous, Attachment Flow EPPR 1 drive current ≤ 1.0 A	●		
	(Results / Symptoms) 1. Control Function – IPC operation failure, Option attachment flow control operation failure (Checking list) 1. CN-242 (#2) – CN-52 (#39) Checking Open/Short 2. CN-242 (#1) – CN-52 (#40) Checking Open/Short				

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

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

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

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-53 (#5) Checking Open/Short 2. CD-124 (#A) – CN-53 (#3) Checking Open/Short 3. CD-124 (#C) – CN-53 (#13) Checking Open/Short				
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-368 (#1) – CN-53 (#20) Checking Open/Short 2. CD-368 (#2) – CR-35 (#87) 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 (#35) Checking Open/Short 2. CD-369 (#2) – CR-35 (#87) 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. CD-365 (#2) – CN-53 (#39) Checking Open/Short 2. CD-365 (#1) – CN-53 (#40) Checking Open/Short				

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

<table>
<tr><th colspan="2">DTC</th><th rowspan="2">Diagnostic Criteria</th><th colspan="3">Application</th></tr>
<tr><th>HCESPN</th><th>FMI</th><th>G</th><th>C</th><th>W</th></tr>
<tr><td rowspan="3">222</td><td>5</td><td>Monitor – Selecting attachment(crusher)
(Detection)
(When ATT Relief Setting EPPR 2 Current is equal or more than 10 mA)
10 seconds continuous, ATT Relief Setting EPPR 2 drive current = 0 mA
(Cancellation)
(When ATT Relief Setting EPPR 2 Current is equal or more than 10 mA)
3 seconds continuous, ATT Relief Setting EPPR 2 drive current ≥ 10mA</td><td>●</td><td></td><td></td></tr>
<tr><td>6</td><td>(Detection)
10 seconds continuous, ATT Relief Setting EPPR 2 drive current > 1.0 A
(Cancellation)
3 seconds continuous, ATT Relief Setting EPPR 2 drive current ≤ 1.0 A</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Control Function – Option attachment flow control – P2 relief pressure setting failure
(Checking list)
1. CD-366 (#2) – CN-53 (#32) Checking Open/Short
2. CD-366 (#1) – CN-53 (#33) Checking Open/Short</td></tr>
<tr><td rowspan="3">301</td><td>3</td><td>10 seconds continuous, Fuel Level Measurement Voltage > 3.8V</td><td>●</td><td></td><td></td></tr>
<tr><td>4</td><td>10 seconds continuous, Fuel Level Measurement Voltage < 0.3V</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Monitor – Fuel remaining display failure
(Checking list)
1. CD-2 (#2) – CN-52 (#26) Checking Open/Short
2. CD-2 (#1) – CN-51 (#5) Checking Open/Short</td></tr>
<tr><td rowspan="3">325</td><td>4</td><td>(Model Parameter) mounting Fuel Warmer Relay
(Detection)
(When Fuel Warmer Relay is Off)
10 seconds continuous, Fuel Warmer Relay drive unit
Measurement Voltage ≤ 3.0V
(Cancellation)
(When Fuel Warmer Relay is Off)
3 seconds continuous, Fuel Warmer Relay drive unit
Measurement Voltage > 3.0V</td><td>●</td><td></td><td></td></tr>
<tr><td>6</td><td>(Detection)
(When Fuel Warmer Relay is On)
10 seconds continuous, Fuel Warmer Relay drive current > 4.5 A
(Cancellation)
(When Fuel Warmer Relay is On)
3 seconds continuous, Fuel Warmer Relay drive current ≤ 4.5 A</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Control Function – Fuel warmer operation failure
(Checking list)
1. CR-46 (#85) – CN-52 (#30) Checking Open/Short
2. CR-46 (#86) – CN-45 (#B+ term) Checking Open/Short</td></tr>
</table>

※ 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-5 (#B) – CN-54 (#27) Checking Open/Short 2. CD-5 (#A) – CN-54 (#3) Checking Open/Short 3. CD-5 (#C) – CN-54 (#13) Checking Open/Short				
503	0	10 seconds continuous, Brake Oil Press. Sensor Measurement Voltage > 5.2V			●
	1	10 seconds continuous, 0.3V≤ Brake Oil Press. Sensor Measurement Voltage < 0.8V			●
	4	10 seconds continuous, Brake Oil Press. Sensor Measurement Voltage < 0.3V			●
	(Results / Symptoms) 1. Monitor – Brake Oil Press. display failure, Brake Oil low pressure warning failure (Checking list) 1. CD-3 (#B) – CN-54 (#4) Checking Open/Short 2. CD-3 (#A) – CN-54 (#3) Checking Open/Short 3. CD-3 (#C) – CN-54 (#13) Checking Open/Short				
505	0	10 seconds continuous, Working Brake Press. Sensor Measurement Voltage > 5.2V			●
	1	10 seconds continuous, 0.3V≤ Working Brake Press. Sensor Measurement Voltage < 0.8V			●
	4	10 seconds continuous, Working Brake Press. Sensor Measurement Voltage < 0.3V			●
	(Results / Symptoms) 1. Monitor – Working Brake Oil Press. display failure, Working Brake Oil low pressure warning failure (Checking list) 1. CD-38 (#B) – CN-54 (#5) Checking Open/Short 2. CD-38 (#A) – CN-54 (#3) Checking Open/Short 3. CD-38 (#C) – CN-54 (#13) Checking Open/Short				

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

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

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

<table>
<tr><th colspan="2">DTC</th><th rowspan="2">Diagnostic Criteria</th><th colspan="3">Application</th></tr>
<tr><th>HCESPN</th><th>FMI</th><th>G</th><th>C</th><th>W</th></tr>
<tr><td rowspan="3">525</td><td>4</td><td>(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</td><td></td><td></td><td>●</td></tr>
<tr><td>6</td><td>(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</td><td></td><td></td><td>●</td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Control Function – Ram lock control operation failure
(Checking list)
1. CN-69 (#1) – CN-54 (#8) Checking Open/Short
2. CN-69 (#2) – CN-45 (#B+ term) Checking Open/Short</td></tr>
<tr><td rowspan="3">527</td><td>4</td><td>(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</td><td></td><td></td><td>●</td></tr>
<tr><td>6</td><td>(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</td><td></td><td></td><td>●</td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Control Function – Creep mode operation failure
(Checking list)
1. CN-206 (#1) – CN-54 (#7) Checking Open/Short
2. CN-206 (#2) – CN-45 (#B+ term) Checking Open/Short</td></tr>
</table>

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

DTC		Diagnostic Criteria	Application		
HCESPN	FMI		G	C	W
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-54 (#6) Checking Open/Short 2. CD-73 (#A) – CN-54 (#3) Checking Open/Short 3. CD-73 (#C) – CN-54 (#13) Checking Open/Short				
531	1	10 seconds continuous, 0.3V≤ Travel Reverse Press. Sensor Measurement Voltage < 0.8V			●
	4	10 seconds continuous, Travel Reverse Press. Sensor Measurement Voltage < 0.3V			●
	(Results / Symptoms) 1. Monitor – Travel Reverse Press. display failure 2. Control Function – Driving interoperability power control operation failure (Checking list) 1. CD-74 (#B) – CN-54 (#23) Checking Open/Short 2. CD-74 (#A) – CN-54 (#3) Checking Open/Short 3. CD-74 (#C) – CN-54 (#13) Checking Open/Short				
705	0	10 seconds continuous, Battery input Voltage > 35V	●		
	1	10 seconds continuous, Battery input Voltage < 18V	●		
	(Results / Symptoms) 1. Control Function – Startup impossibility (Checking list) 1. CS-74A (#1) – CN-51 (#1) Checking Open/Short				
707	1	(When Engine is equal or more than 400 rpm) 10 seconds continuous, Alternator Node L Measurement Voltage < 18V (In case 12v goods, Alternator Node L Measurement Voltage < 9V)	●		
	(Results / Symptoms) 1. Control Function – Battery charging circuit failure (Checking list) 1. CS-74A (#1) – CN-51 (#2) Checking Open/Short				

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

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

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

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

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

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

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

4. ENGINE FAULT CODE

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
111 629 12	Engine control module critical internal failure - Bad intelligent device or component. Error internal to the ECM related to memory hardware failures or internal ECM voltage supply circuits.	Possible no noticeable performance effects, engine dying, or hard starting.
115 612 2	Engine magnetic crankshaft speed/position lost both of two signals - Data erratic, intermittent, or incorrect. The ECM has detected the primary and backup speed sensor signals are connected backwards.	The engine will shut down or will not start.
122 102 3	Intake manifold 1 pressure sensor circuit - Voltage above normal, or shorted to high source. High signal voltage detected at the intake manifold pressure circuit.	Engine power derate.
123 102 4	Intake manifold 1 pressure sensor circuit - Voltage below normal, or shorted to low Source. Low signal voltage or open circuit detected at the intake manifold pressure circuit.	Engine power derate.
124 102 16	Intake manifold 1 pressure - Data valid but above normal operational range - Moderately severe level. Intake manifold pressure is above the maximum operating limit.	Engine power derate.
125 102 18	Intake Manifold 1 Pressure - Data valid but below normal operating range - Moderately severe level. Intake manifold pressure is below the minimum operating limit.	Engine power derate.
131 91 3	Accelerator pedal or lever position sensor 1 circuit - Voltage above normal, or shorted to high source. High voltage detected at accelerator pedal position number 1 circuit.	The engine will operate in limp home mode.
132 91 4	Accelerator pedal or lever position sensor 1 circuit - Voltage below normal, or shorted to low source. Low voltage detected at accelerator pedal position number 1 signal circuit.	The engine will operate in limp home mode.
133 974 3	Remote accelerator pedal or lever position sensor 1 circuit - Voltage above normal, or shorted to high source. High voltage detected at remote accelerator pedal position signal circuit.	Remote accelerator will not operate.
134 974 4	Remote accelerator pedal or lever position sensor 1 circuit - Voltage below normal, or shorted to low source. Low voltage detected at remote accelerator pedal position signal circuit.	Remote accelerator will not operate.
143 100 18	Engine oil rifle pressure - Data valid but below normal operational range - Moderately severe level. Engine oil pressure signal indicates engine oil pressure is below the engine protection warning limit.	Engine power derate.

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
144 110 3	Engine coolant temperature 1 sensor circuit - Voltage above normal, or shorted to high source. High signal voltage or open circuit detected at engine coolant temperature circuit.	Fan will stay ON if controlled by ECM.
145 110 4	Engine coolant temperature 1 sensor circuit - Voltage below normal, or shorted to low source. Low signal voltage detected at engine coolant temperature circuit.	Fan will stay ON if controlled by ECM.
146 110 16	Engine coolant temperature - Data valid but above normal operational range - Moderately severe level. Engine coolant temperature is above engine protection warning limit.	Progressive power and/or speed derate increasing in severity from time of alert. If the engine protection shutdown feature is enabled, the engine will shut down 30 seconds after the red stop lamp starts flashing.
151 110 0	Engine coolant temperature - Data valid but above normal operational range - Most severe level. Engine coolant temperature signal indicates engine coolant temperature above engine protection critical limit.	Progressive power and/or speed derate increasing in severity from time of alert. If the engine protection shutdown feature is enabled, the engine will shut down 30 seconds after the red stop lamp starts flashing.
153 105 3	Intake manifold 1 temperature sensor circuit - Voltage above normal, or shorted to high source. High signal voltage detected at intake manifold air temperature circuit.	Fan will stay ON if controlled by ECM.
154 105 4	Intake manifold 1 temperature sensor circuit - Voltage below normal, or shorted to low source. Low signal voltage detected at intake manifold air temperature circuit.	Fan will stay ON if controlled by ECM.
155 105 0	Intake manifold 1 temperature - Data valid but above normal operational range - Most severe level. Intake manifold air temperature signal indicates intake manifold air temperature above engine protection critical limit.	Progressive power and/or speed derate increasing in severity from time of alert. If the engine protection shutdown feature is enabled, the engine will shut down 30 seconds after the red stop lamp starts flashing.
175 3464 3	Electronic throttle control actuator driver circuit - Voltage above normal, or shorted to high source. A short circuit to battery or open circuit has been detected in the engine intake air throttle actuator signal circuit.	Possible reduced engine performance.
176 3464 4	Electronic throttle control actuator driver circuit - Voltage below normal, or shorted to low source. A short circuit to ground has been detected in the engine intake air throttle actuator signal circuit.	Possible reduced engine performance.
177 3464 7	Electronic throttle control actuator - Mechanical system not responding or out of adjustment. The engine intake air throttle actuator has failed the auto zero span check.	Possible reduced engine performance.
187 3510 4	Sensor supply 2 circuit - Voltage below normal, or shorted to low source. Low voltage detected at the sensor supply number 2 circuit.	Engine power derate.
195 111 3	Coolant level sensor 1 circuit - Voltage above normal, or shorted to high source. High signal voltage detected at engine coolant level circuit.	None on performance.

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
196 111 4	Coolant level sensor 1 circuit - Voltage below normal, or shorted to low source. Low signal voltage detected at engine coolant level circuit.	None on performance.
197 111 18	Coolant level - Data valid but below normal operational range - Moderately severe level. Low coolant level has been detected.	Engine power derate.
221 108 3	Barometric pressure sensor circuit - Voltage above normal, or shorted to high source. High signal voltage detected at barometric pressure circuit.	Engine power derate.
222 108 4	Barometric pressure sensor circuit - Voltage below normal, or shorted to low source. Low signal voltage detected at barometric pressure circuit.	Engine power derate.
227 3510 3	Sensor supply 2 circuit - Voltage above normal, or shorted to high source. High voltage detected at sensor supply number 2 circuit.	Engine power derate.
234 190 0	Engine crankshaft speed/position - Data valid but above normal operational range - Most severe level. Engine speed signal indicates engine speed above engine protection limit.	Engine power derate.
238 3511 4	Sensor supply 3 circuit - Voltage below normal, or shorted to low source. Low voltage detected on the +5 volt sensor supply circuit to the engine speed sensor.	Engine may run rough, may stop running, may not start, or may be difficult to start.
239 3511 3	Sensor supply 3 circuit - Voltage above normal or shorted to high source. High voltage detected on the 5 volt sensor supply circuit to the engine speed sensor.	Engine may run rough, may stop running, may not start, or may be difficult to start.
241 84 2	Wheel-based vehicle speed - Data erratic, intermittent, or incorrect. The ECM lost the vehicle speed signal or is reading an erratic value.	Engine speed limited to ,maximum engine speed without VSS parameter value. Cruise control, gear-down protection, and road speed governor will not work.
245 647 4	Fan control circuit - Voltage below normal, or shorted to low source. Low signal voltage detected at the fan control circuit when commanded on.	The fan may stay on continuously or not run at all.
249 171 3	Ambient air temperature sensor 1 circuit - Voltage above normal or shorted to high source. High signal voltage detected at ambient air temperature circuit.	Possible reduced engine performance.
256 171 4	Ambient air temperature sensor 1 circuit - Voltage below normal or shorted to low source. Low voltage detected at ambient air temperature circuit.	Possible reduced engine performance.
271 1347 4	Fuel pump pressurizing assembly 1 circuit - Voltage below normal, or shorted to low source. Low signal voltage detected at the fuel pump actuator circuit.	Engine power derate.

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
272 1347 3	Fuel pump pressurizing assembly 1 circuit - Voltage above normal, or shorted to high source. High signal voltage or open circuit detected at the fuel pump actuator circuit.	Engine may run rough, may stop running, may not start, or may be difficult to start.
285 639 9	SAE J1939 multiplexing PGN timeout error - Abnormal update rate. The ECM expected information from a multiplexed device but did not receive it soon enough or did not receive it at all.	At least one multiplexed device will not operate properly.
286 639 13	SAE J1939 multiplexing configuration error - Out of calibration. The ECM expected information from a multiplexed device but only received a portion of the necessary information.	At least one multiplexed device will not operate properly.
288 974 19	Sae J1939 multiplexing remote accelerator pedal or lever position sensor circuit - Received network data in error. The oem vehicle electronic control unit (VECM) detected a fault with the remote accelerator.	Remote accelerator will not operate.
295 108 2	Barometric pressure - Data erratic, intermittent, or incorrect. An error in the barometric pressure sensor signal was detected by the ECM.	Engine power derate.
322 651 5	Injector solenoid driver cylinder 1 circuit - Current below normal, or open circuit. Current detected at injector 1 when voltage is turned OFF.	Engine power derate.
323 655 5	Injector solenoid driver cylinder 5 circuit - Current below normal, or open circuit. Current detected at injector 5 when voltage is turned OFF.	The current to the injector is shut OFF. Engine power derate.
324 653 5	Injector solenoid driver cylinder 3 circuit - Current below normal, or open circuit. Current detected at injector 3 when voltage is turned OFF.	The current to the injector is shut OFF. Engine power derate.
325 656 5	Injector solenoid driver cylinder 6 circuit - Current below normal, or open circuit. Current detected at injector 6 when voltage is turned OFF.	The current to the injector is shut OFF. Engine power derate.
331 652 5	Injector solenoid driver cylinder 2 circuit - Current below normal, or open circuit. Current detected at injector 2 when voltage is turned OFF.	The current to the injector is shut OFF. Engine power derate.
332 654 5	Injector solenoid driver cylinder 4 circuit - Current below normal, or open circuit. Current detected at injector 4 when voltage is turned OFF.	The current to the injector is shut OFF. Engine power derate.
334 110 2	Engine coolant temperature - Data erratic, intermittent, or incorrect. The engine coolant temperature sensor is reading an erratic value at initial key ON.	None on performance.

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
338 1267 3	Idle shutdown vehicle accessories relay driver circuit - Voltage above normal, or shorted to high source. Open circuit or short to voltage source detected at the idle shutdown vehicle accessory/ignition bus relay circuit.	Vehicle accessories or ignition bus loads controlled by the idle shutdown relay will not power up.
339 1267 4	Idle shutdown vehicle accessories relay driver circuit - Voltage below normal, or shorted to low source. Low voltage detected at the idle shutdown vehicle accessory or ignition bus relay circuit when commanded ON.	Vehicle accessories or ignition bus loads controlled by the idle shutdown relay will not power up.
343 629 12	Engine control module warning internal hardware failure - Bad intelligent device or component. ECM power supply errors have been detected.	Engine power derate.
346 630 12	Engine control module calibration memory software - Bad intelligent device or component. Invalid switch configuration adjustable parameter setting have been detected by the engine control module (ECM).	Various optional switch inputs to the ECM may not operate correctly.
351 627 12	Injector power supply - Bad intelligent device or component. The ECM measured injector boost voltage is low.	Engine power derate.
352 3509 4	Sensor supply 1 circuit - Voltage below normal, or shorted to low source. Low voltage detected at sensor supply number 1 circuit.	Engine power derate.
383 729 5	Engine intake air heater 1 circuit - Current below normal or open circuit. A malfunctioning engine intake air heater circuit has been detected.	Engine may not start or may be difficult to start.
386 3509 3	Sensor supply 1 circuit - Voltage above normal, or shorted to high source. High voltage detected at sensor supply number 1 circuit.	Engine power derate.
415 100 1	Engine oil rifle pressure - Data valid but below normal operational range - Most severe level. Oil pressure signal indicates oil pressure below the engine protection critical limit.	Progressive power and/or speed derate increasing in severity from time of alert. If engine protection shutdown feature is enabled, engine will shut down 30 seconds after red stop lamp starts flashing.
418 97 15	Water in fuel indicator - Data valid but above normal operational range - Least severe level. water has been detected in the fuel filter.	None on performance.
427 639 9	J1939 data link - Abnormal update rate. Communication between the engine control module (ECM) and another device on the SAE J1939 data link has been lost.	Engine will only idle.
428 97 3	Water in fuel indicator sensor circuit - Voltage above normal, or shorted to high source. High voltage detected at the water in fuel circuit.	None on performance. No water in fuel warning available.
435 100 2	Engine oil rifle pressure - Data erratic, intermittent, or incorrect. The engine oil pressure sensor is reading an erratic value.	None on performance.

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
436 105 2	Intake manifold 1 temperature - Data erratic, intermittent, or incorrect. The intake manifold temperature sensor is reading an erratic value at initial key on or while the engine is running.	Possible reduced engine performance.
441 168 18	Battery 1 voltage - Data valid but below normal operational range - Moderately severe level. ECM supply voltage is below the minimum system voltage level.	Engine may run rough, may stop running, may not start, or may be difficult to start.
442 168 16	Battery 1 Voltage - Data valid but above normal operational range - Moderately severe level. ECM supply voltage is above the maximum system voltage level.	None on performance.
451 157 3	Injector metering rail 1 pressure sensor circuit - Voltage above normal, or shorted to high source. High signal voltage detected at the rail fuel pressure sensor circuit.	Power and/or speed derate.
452 157 4	Injector metering rail 1 pressure sensor circuit - Voltage below normal, or shorted to low source. Low signal voltage detected at the rail fuel pressure sensor circuit.	Power and/or speed derate.
483 1349 3	Injector metering rail 2 pressure sensor circuit - Voltage above normal or shorted to high source. High signal voltage detected at the fuel rail 2 pressure sensor circuit.	Possible reduced engine performance.
484 1349 4	Injector metering rail 2 pressure sensor circuit - Voltage below normal or shorted to low source. Low signal voltage detected at the fuel rail 2 pressure sensor circuit.	Possible reduced engine performance.
515 3514 3	Sensor supply 6 circuit - Voltage above normal or shorted to high source. High voltage detected on the +5 volt sensor supply circuit to the fuel rail pressure sensor.	Engine power derate.
516 3514 4	Sensor supply 6 circuit - Voltage below normal or shorted to low source. Low voltage detected on the +5 volt sensor supply circuit to the fuel rail pressure sensor.	Engine power derate.
553 157 16	Injector metering rail 1 pressure - Data valid but above normal operational range - Moderately severe level. The ECM has detected that fuel pressure is higher than commanded pressure.	Possible reduced engine performance.
555 101 16	Crankcase pressure - Data valid but above normal operational range - Moderately severe level. The crankcase breather filter requires maintenance.	None on performance.
556 101 0	Crankcase pressure - Data valid but above normal operational range - Most severe level. The crankcase breather filter requires maintenance.	None on performance.

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
559 157 18	Injector metering rail 1 pressure - Data valid but below normal operational range - Moderately severe level. The ECM has detected that fuel pressure is lower than commanded pressure.	Possibly hard to start or low power. Engine could possibly not start.
584 677 3	Starter relay driver circuit - Voltage above normal, or shorted to high source. Open circuit or high voltage detected at starter lockout circuit.	Either the engine will not start or the engine will not have starter lockout protection.
585 677 4	Starter relay driver circuit - Voltage below normal, or shorted to low source. Low voltage detected at starter lockout circuit.	Either the engine will not start or the engine will not have starter lockout protection.
595 103 16	Turbocharger 1 speed - Data valid but above normal operating range - Moderately severe level. High turbocharger speed has been detected by the ecm.	Engine power derate.
596 167 16	Electrical charging system voltage - Data valid but above normal operational range - Moderately severe level. High battery voltage detected by the battery voltage monitor feature.	None on performance.
597 167 18	Electrical charging system voltage - Data valid but below normal operational range - Moderately severe level. Low battery voltage detected by the battery voltage monitor feature.	None on performance.
649 1378 31	Engine oil change interval - Condition exists. Change engine oil and filter.	None on performance.
687 103 18	Turbocharger 1 speed - Data valid but below normal operational range - Moderately severe level. Low turbocharger speed detected by the ECM.	Engine power derate. The ECM uses an estimated turbocharger speed.
689 190 2	Engine crankshaft speed/position - Data erratic, intermittent, or incorrect. The ECM has detected an error in the engine speed signal.	Possible reduced engine performance.
691 1172 3	Turbocharger 1 compressor inlet temperature sensor circuit - Voltage above normal, or shorted to high source. High signal voltage detected at turbocharger compressor inlet air temperature circuit.	Engine power derate.
692 1172 4	Turbocharger 1 compressor inlet temperature circuit - Voltage below normal, or shorted to low source. Low signal voltage detected at turbocharger compressor inlet air temperature circuit.	Engine power derate.
693 1172 2	Turbocharger 1 compressor intake temperature - Data erratic, intermittent, or incorrect. A temperature too high or low for the operating conditions has been detected by the turbocharger compressor intake temperature sensor.	Possible reduced engine performance.

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
731 723 7	Engine speed / position camshaft and crankshaft misalignment - Mechanical system not responding properly or out of adjustment. Engine position signal from the crankshaft position sensor and camshaft position sensor do not match.	Engine power derate.
755 157 7	Injector metering rail 1 pressure - Mechanical system not responding or out of adjustment. The ECM has detected a difference in the 2 fuel rail pressure signals.	Possible reduced engine performance.
778 723 2	Engine camshaft speed / position sensor - Data erratic, intermittent, or incorrect. The ECM has detected an error in the camshaft position sensor signal.	Possible reduced engine performance.
784 1590 2	Adaptive cruise control mode - Data erratic, intermittent, or incorrect. Loss of communication with adaptive cruise control.	Adaptive cruise control will not operate. Standard cruise control may not operate.
1117 627 2	Power supply lost with ignition on - Data erratic, intermittent, or incorrect. Supply voltage to the ECM fell below 6.2 volts momentarily, or the ECM was not allowed to power down correctly (retain battery voltage for 30 seconds after key OFF).	Possible no noticeable performance.
1139 651 7	Injector solenoid driver cylinder 1 - Mechanical system not responding or out of adjustment. The ECM has detected an error with the injection timing or quantity.	Possible reduced engine performance.
1141 652 7	Injector solenoid driver cylinder 2 - Mechanical system not responding or out of adjustment. The ECM has detected an error with the injection timing or quantity.	Possible reduced engine performance.
1142 653 7	Injector solenoid driver cylinder 3 - Mechanical system not responding or out of adjustment. The ECM has detected an error with the injection timing or quantity.	Possible reduced engine performance.
1143 654 7	Injector solenoid driver cylinder 4 - Mechanical system not responding or out of adjustment. The ECM has detected an error with the injection timing or quantity.	Possible reduced engine performance.
1144 655 7	Injector solenoid driver cylinder 5 - Mechanical system not responding or out of adjustment. The ECM has detected an error with the injection timing or quantity.	Possible reduced engine performance.
1145 656 7	Injector solenoid driver cylinder 6 - Mechanical system not responding or out of adjustment. The ECM has detected an error with the injection timing or quantity.	Possible reduced engine performance.
1228 27 2	Egr valve position - Data erratic, intermittent, or Incorrect. The EGR valve is unable to meet commanded position.	Possible reduced engine performance.

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
1239 2623 3	Accelerator pedal or lever position sensor 2 circuit - Voltage above normal or shorted to high source. High voltage detected at accelerator pedal position number 2 signal circuit.	The engine will operate in limp home mode.
1241 2623 4	Accelerator pedal or lever position sensor 2 circuit - Voltage below normal or shorted to low source. Low voltage detected at accelerator pedal position number 2 signal circuit.	The engine will operate in limp home mode.
1242 91 2	Accelerator pedal or lever position sensor 1 and 2 - Data erratic, intermittent, or incorrect. Accelerator position sensor number 1 and number 2 are reading different values.	The engine will only idle.
1515 91 19	Sae J1939 multiplexed accelerator pedal or lever sensor system - Received network data in error. The J1939 multiplexing controller has indicated a malfunction of the multiplexed accelerator pedal.	The engine will only idle.
1654 1323 31	Engine misfire cylinder 1- Condition exists. Engine misfire has been detected in cylinder number 1.	Possible reduced engine performance.
1655 1324 31	Engine misfire cylinder 2 - Condition exists. Engine misfire has been detected in cylinder number 2.	Possible reduced engine performance.
1656 1325 31	Engine misfire cylinder 3 - Condition exists. Engine misfire has been detected in cylinder number 3.	Possible reduced engine performance.
1657 1326 31	Engine misfire cylinder 4 - Condition exists. Engine misfire has been detected in cylinder number 4.	Possible reduced engine performance.
1658 1327 31	Engine misfire cylinder 5 - Condition exists. Engine misfire has been detected in cylinder number 5.	Possible reduced engine performance.
1659 1328 31	Engine misfire cylinder 6 - Condition exists. Engine misfire has been detected in cylinder number 6.	Possible reduced engine performance.
1668 1761 4	Aftertreatment diesel exhaust fluid tank level sensor circuit - Voltage below normal or shorted to low source. Low signal voltage detected at the aftertreatment diesel exhaust fluid tank level sensor circuit.	Possible reduced engine performance.
1669 1761 3	Aftertreatment diesel exhaust fluid tank level sensor circuit - Voltage above normal or shorted to high source. High signal voltage detected at the catalyst tank level sensor circuit.	Possible reduced engine performance.
1673 1761 1	Aftertreatment diesel exhaust fluid tank level - Data valid but below normal operating range - Most severe level. The aftertreatment diesel exhaust fluid tank level has fallen below the critical warning level.	Possible reduced engine performance.

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
1677 3031 4	Aftertreatment diesel exhaust fluid tank temperature sensor - Voltage below normal or shorted to low source. Low signal voltage detected at the diesel exhaust fluid tank temperature sensor circuit.	Possible reduced engine performance.
1678 3031 3	Aftertreatment diesel exhaust fluid tank temperature sensor - Voltage above normal or shorted to high source. High signal voltage or open circuit detected at the diesel exhaust fluid tank temperature sensor circuit.	Possible reduced engine performance.
1679 3031 2	Aftertreatment diesel exhaust fluid tank temperature - Data erratic, intermittent, or incorrect. The diesel exhaust fluid tank temperature sensor has indicated a tank temperature too high or too low for the ambient conditions.	Possible reduced engine performance.
1682 3362 31	Aftertreatment diesel exhaust fluid dosing unit input lines - Condition exists. The aftertreatment diesel exhaust fluid dosing unit is unable to prime.	Possible reduced engine performance.
1683 3363 3	Aftertreatment diesel exhaust fluid tank heater - Voltage above normal or shorted to high source. High signal voltage detected at the aftertreatment diesel exhaust fluid tank heater circuit.	Possible reduced engine performance.
1684 3363 4	Aftertreatment diesel exhaust fluid tank heater - Voltage below normal, or shorted to low source. Low signal voltage detected at the aftertreatment diesel exhaust fluid tank heater circuit.	Possible reduced engine performance.
1691 100 18	Aftertreatment diesel oxidation catalyst conversion efficiency - Data valid but below normal operating range - Moderately severe level. The temperature increase across the aftertreatment catalyst is lower than expected.	Possible frequent need for aftertreatment regeneration.
1695 3513 3	Sensor supply 5 - Voltage above normal or shorted to high source. High voltage detected at sensor supply 5 circuit in the oem harness.	the engine will operate in limp home mode.
1696 3513 4	Sensor supply 5 - Voltage below normal or shorted to low source. Low voltage detected at sensor supply number 5 circuit in the oem harness.	the engine will operate in limp home mode.
1712 3363 18	Aftertreatment diesel exhaust fluid tank heater - Data valid but below normal operating range - Moderately severe level. The aftertreatment diesel exhaust fluid tank heater is unable to thaw the frozen diesel exhaust fluid.	Possible reduced engine performance.

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
1713 3363 16	Aftertreatment diesel exhaust fluid tank heater - Data valid but above normal operating range - Moderately severe level. The diesel exhaust fluid tank heater is continuously in the on position.	None on performance.
1718 1322 31	Engine misfire for multiple cylinders - Condition exists. Engine misfire has been detected in multiple cylinder numbers.	Possible reduced engine performance.
1776 2634 3	Power relay driver circuit - Voltage above normal or shorted to high source. High voltage detected at power relay driver circuit.	Possible reduced engine performance.
1777 2634 4	Power relay driver circuit - Voltage below normal or shorted to low source. An open circuit or low voltage has been detected at the power relay circuit.	Possible reduced engine performance.
1843 101 3	Crankcase pressure circuit - Voltage above normal or shorted to high source. High signal voltage detected at the crankcase pressure circuit.	None on performance.
1844 101 4	Crankcase pressure circuit - Voltage below normal or shorted to low source. Low signal voltage detected at the crankcase pressure circuit.	None on performance.
1866 411 2	Exhaust gas recirculation valve delta pressure - Data erratic, intermittent, or incorrect. An error in the EGR delta pressure signal was detected at initial key on or the sensor failed the autozero test.	possible reduced engine performance.
1867 412 2	Engine gas recircuilation temperature - Data erratic, intermittent, or incorrect. Engine misfire has been detected in multiple cylinder numbers.	Possible reduced engine performance.
1879 3251 3	Aftertreatment diesel particulate filter differential pressure sensor circuit - Voltage above normal or shorted to high source. High signal voltage detected at the aftertreatment differential pressure sensor circuit.	possible reduced engine performance.
1881 3251 4	Aftertreatment diesel particulate filter differential pressure sensor circuit - Voltage below normal or shorted to low source. Low signal voltage or open circuit detected at the aftertreatment differential pressure sensor circuit.	possible reduced engine performance.
1883 3251 2	Aftertreatment diesel particulate filter differential pressure sensor - Data erratic, intermittent, or incorrect. The aftertreatment diesel particulate filter differential pressure sensor is reading an erratic value at initial key on or during engine operation.	possible reduced engine performance.

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
1885 3216 4	Aftertreatment intake NOx sensor circuit - Voltage below normal or shorted to low source. An internal circuit error has been detected by the aftertreatment intake NOx sensor.	Possible reduced engine performance.
1887 3226 4	Aftertreatment outlet NOx sensor circuit - Voltage below normal or shorted to low source. An internal circuit error has been detected by the aftertreatment outlet NOx sensor.	Possible reduced engine performance.
1896 2791 13	EGR valve controller - Out of calibration. The EGR valve has failed the automatic calibration procedure at initial key ON.	Possible reduced engine performance.
1921 3251 0	Aftertreatment diesel particulate filter differential pressure - Data valid but above normal operating range - Moderately severe level. The soot load of the aftertreatment diesel particulate filter has exceeded the recommended limits.	Possible reduced engine performance.
1922 3251 0	Aftertreatment diesel particulate filter differential pressure - Data valid but above normal operating range - Most severe level. The soot load of the aftertreatment diesel particulate filter has exceeded the recommended limits. Engine protection derate is enabled.	Possible reduced engine performance.
1938 3597 1	Ecu power output supply voltage 1 - Data valid but below normal operational range - Moderately severe level. Low battery voltage detected by the VGT actuator.	Possible reduced engine performance.
1942 101 2	Crankcase pressure - Data erratic, intermittent, or incorrect. The ECM has detected that the crankcase pressure signal is reading an erratic value at initial key ON or during engine operation.	None on performance.
1961 2791 0	EGR valve control circuit calculated over temperature - Data valid but above normal operational range - Least severe level. High EGR valve driver temperature has been detected.	Possible reduced engine performance.
1962 641 0	VGT Actuator driver over temperature (calculated) - Data valid but above normal operating range - Least severe level. High internal VGT actuator temperature has been detected.	None on performance.
1974 101 16	Crankcase pressure - Data valid but above normal operating range - Moderately severe level. The crankcase breather filter requires maintenance.	None on performance.

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
1993 4795 31	Aftertreatment diesel particulate filter missing - Condition exists. The aftertreatment diesel particulate filter in the exhaust system is not present.	Active aftertreatment diesel particulate filter regeneration will be disabled.
2185 3512 3	Sensor supply 4 circuit - Voltage above normal, or shorted to high source. High voltage detected at 5 VDC sensor supply circuit to the accelerator pedal position sensor.	Engine will only idle.
2186 3512 4	Sensor supply 4 circuit - Voltage below normal, or shorted to low source. Low voltage detected at 5 VDC sensor supply circuit to the accelerator pedal position sensor.	Engine will only idle.
2198 641 11	VGT Actuator driver circuit - Root cause not known. Intermittent communication between the smart VGT controller and the ECM has been detected. The VGT controller is not interpreting the J1939 message from the ECM correctly.	Possible reduced engine performance.
2272 27 4	EGR Valve position circuit - Voltage below normal or shorted to low source. Low signal voltage has been detected at the EGR valve position sensor circuit	Possible reduced engine performance.
2273 411 3	Exhaust gas recirculation valve delta pressure sensor circuit - Voltage above normal or shorted to high source. High signal voltage detected at the EGR differential pressure sensor circuit.	Possible reduced engine performance.
2274 411 4	Exhaust gas recirculation valve delta pressure sensor circuit - Voltage below normal or shorted to low source. Low signal voltage detected at the EGR differential pressure sensor circuit.	Possible reduced engine performance.
2288 103 15	Turbocharger 1 speed - Data valid but above normal operating range - Least severe level. High turbocharger speed has been detected by the ECM.	Possible reduced engine performance.
2311 633 31	Electronic fuel injection control valve circuit - Condition exists. Fuel pump actuator circuit resistance too high or too low, or an intermittent connection has been detected.	Possible reduced engine performance.
2322 723 2	Engine camshaft speed / position sensor - Data erratic, intermittent, or incorrect. Camshaft engine speed sensor intermittent synchronization.	None on performance.
2349 2791 5	EGR Valve control circuit - Current below normal or open circuit. Motor terminal or motor coil open circuit has been detected by the ECM.	Possible reduced engine performance.

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
2353 2791 6	EGR Valve control circuit - Current above normal or grounded circuit. A short circuit to ground has been detected in the EGR valve motor circuit.	Possible reduced engine performance.
2372 95 16	Fuel filter differential pressure - Data valid but above normal operational range - Moderately severe level. Excessive fuel flow restriction to the high pressure fuel pump has been detected.	Possible reduced engine performance.
2373 1209 3	Exhaust gas pressure sensor circuit - Voltage above normal or shorted to high source. High signal voltage detected at the exhaust gas pressure circuit.	Possible reduced engine performance.
2374 1209 4	Exhaust gas pressure sensor circuit - Voltage below normal or shorted to low source. Low signal voltage detected at the exhaust gas pressure circuit.	Possible reduced engine performance.
2375 412 3	Exhaust gas recirculation temperature sensor circuit - Voltage above normal or shorted to high source. High signal voltage detected at EGR temperature circuit.	Possible reduced engine performance.
2376 412 4	Exhaust gas recirculation temperature sensor circuit - Voltage below normal or shorted to low source. Low signal voltage detected at EGR temperature circuit.	Possible reduced engine performance.
2377 647 3	Fan control circuit - Voltage above normal, or shorted to high source. Open circuit or high voltage detected at the fan control circuit.	The fan can stay on continuously or **not** run at all.
2387 641 7	VGT Actuator driver circuit (motor) - Mechanical system not responding or out of adjustment. The smart VGT controller has detected incorrect stop limits, or the VGT is unable to move to the closed position.	Possible reduced engine performance.
2398 171 2	Ambient air temperature - Data erratic, intermittent, or incorrect. The ambient air temperature sensor is reading an erratic value.	Possible reduced engine performance.
2448 111 17	Coolant level - Data valid but below normal operational range - Least severe level. Low engine coolant level detected.	none on performance.
2449 641 13	Vgt actuator controller - Out of calibration. The VGT actuator has been installed incorrectly.	Possible reduced engine performance.
2468 102 3	Engine crankshaft speed/position - Data valid but above normal operating range - Moderately severe level. The engine speed has exceeded a critical limit.	Engine will be shut down.
2554 1209 2	Exhaust gas pressure - Data erratic, intermittent or incorrect. The exhaust gas pressure sensor is reading an erratic value.	possible reduced engine performance.

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
2555 729 3	Intake air heater 1 circuit - Voltage above normal, or shorted to high source. High voltage detected at the intake air heater signal circuit.	The intake air heaters may be ON or OFF all the time.
2556 729 4	Intake air heater 1 circuit - Voltage below normal, or shorted to low source. Low voltage detected at the intake air heater signal circuit.	The intake air heaters may be ON or OFF all the time.
2634 641 12	VGT Actuator controller - Bad intelligent device or component. An internal error has been detected by the smart VGT controller.	Possible reduced engine performance.
2636 641 9	VGT Actuator driver circuit - abnormal update rate. No communications on the J1939 data link between the engine ECM and the smart VGT controller.	Possible reduced engine performance.
2638 5298 17	Aftertreatment diesel oxidation catalyst conversion efficiency - Data valid but below normal operating range - Least severe level. The temperature increase across the aftertreatment diesel oxidation catalyst is lower than expected.	Possible frequent need for aftertreatment regeneration.
2639 3251 15	Aftertreatment diesel particulate filter differential pressure - Data valid but above normal operating range - Least severe level. The soot load of the aftertreatment diesel particulate filter has exceeded the recommended limits.	Possible reduced engine performance.
2646 110 32	Engine coolant temperature - Condition exists. The EGR valve was closed to reduce engine coolant temperature.	Possible reduced engine performance.
2718 520325 31	Brake switch and accelerator pedal position incompatible - Condition exists. The ECM has detected the brake pedal and accelerator pedal were depressed simultaneously.	The engine will operate in limp home mode.
2771 3226 9	Aftertreatment outlet NOx sensor - Abnormal update rate. No communications or an invalid data transfer rate detected on the J1939 data link between the ECM and the aftertreatment outlet NOx sensor.	Possible reduced engine performance.
2777 3703 31	Particulate trap active regeneration inhibited due to inhibit switch - Condition exists. Regeneration of the diesel particulate filter has been prevented due to the permit switch being disabled.	Possible frequent need for aftertreatment regeneration.
2961 412 15	Exhaust gas recirculation temperature - Data valid but above normal operational range - Least severe level. EGR temperature has exceeded the engine protection limit.	Possible reduced engine performance.
2962 412 16	Exhaust gas recirculation temperature - Data valid but above normal operational range - Moderately severe level. EGR temperature has exceeded the engine protection limit.	Possible reduced engine performance.

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
2963 110 15	Engine coolant temperature - Data valid but above normal operational range - Least severe level. Engine coolant temperature is above the engine protection warning limit.	Progressive power and/or speed derate increasing in severity from time of alert. If the Engine protection shutdown feature is enabled, the engine will shut down 30 seconds after the red STOP lamps starts flashing.
2964 105 15	Intake manifold 1 temperature - Data valid but above normal operational range - Least severe level. Intake manifold air temperature signal indicates intake manifold air temperature is above engine protection warning limit.	Progressive power and/or speed derate increasing in severity from time of alert. If the Engine protection shutdown feature is enabled, the engine will shut down 30 seconds after the red STOP lamps starts flashing.
2973 102 2	Intake manifold 1 pressure - Data erratic, intermittent, or incorrect. The intake manifold pressure sensor is reading an erratic value.	Possible reduced engine performance.
2976 3361 2	Aftertreatment diesel exhaust fluid dosing unit temperature - Data erratic, intermittent, or incorrect. An internal error has been detected in the aftertreatment diesel exhaust fluid dosing unit.	Possible reduced engine performance.
3133 3610 3	Aftertreatment diesel particulate filter outlet pressure sensor circuit - Voltage above normal, or shorted to high source. High signal voltage detected at the aftertreatment diesel particulate filter outlet pressure sensor circuit.	Possible reduced engine performance.
3134 3610 4	Aftertreatment diesel particulate filter outlet pressure sensor circuit - Voltage below normal, or shorted to low source. Low signal voltage detected at the aftertreatment diesel particulate filter outlet pressure sensor circuit.	Possible reduced engine performance.
3135 3610 2	Aftertreatment diesel particulate filter outlet pressure - Data erratic, intermittent or incorrect. The aftertreatment diesel particulate filter outlet pressure sensor is reading an erratic value at initial key ON or during engine operation.	Possible reduced engine performance.
3146 4363 3	Aftertreatment SCR outlet temperature sensor circuit - Voltage above normal or shorted to high source. High signal voltage detected at the SCR outlet temperature sensor circuit.	Possible reduced engine performance.
3147 4363 4	Aftertreatment SCR outlet temperature sensor circuit - Voltage below normal or shorted to low source. Low signal voltage detected at the SCR outlet temperature sensor circuit.	Possible reduced engine performance.
3148 4363 2	Aftertreatment SCR outlet temperature sensor - Data erratic, intermittent, or incorrect. The SCR outlet temperature sensor is not changing with engine operating conditions.	Possible reduced engine performance.
3151 4794 31	Aftertreatment SCR catalyst system missing - Condition exists. The aftertreatment SCR catalyst in the exhaust system is not present.	Possible reduced engine performance.

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
3165 4363 0	Aftertreatment SCR outlet temperature - Data valid but above normal operational range - Most severe level. The SCR outlet temperature sensor reading has exceeded the maximum engine protection temperature limit.	Possible reduced engine performance.
3168 3936 16	Aftertreatment diesel particulate filter system - Data valid but above normal operating range - Moderately severe level. The system has detected a malfunction in the filtering capability of the aftertreatment diesel particulate filter.	None on performance.
3186 1623 9	Tachograph output shaft speed - Abnormal update rate. No communication or an invalid data transfer rate has been detected on the J1939 data link between the ECM and the tachograph output shaft speed sensor.	None on performance.
3213 1623 19	Tachograph output shaft speed - Received network data in error. The J1939 multiplexing controller has indicated a malfunction of the tachograph output shaft speed sensor.	None on performance.
3228 3216 2	Aftertreatment Intake NOx sensor - Data erratic, intermittent, or incorrect. An incorrect NOx sensor reading has been detected by the aftertreatment intake NOx sensor.	Possible reduced engine performance.
3232 3216 9	Aftertreatment Intake NOx sensor - Abnormal update rate. No communication or an invalid data transfer rate has been detected on the J1939 data link between the ECM and the aftertreatment intake NOx sensor.	Possible reduced engine performance.
3235 4363 16	Aftertreatment SCR outlet temperature - Data valid but above normal operating range - Moderately severe level. The SCR outlet temperature sensor reading has exceeded the maximum temperature limit.	Possible reduced engine performance.
3237 4340 3	Aftertreatment diesel exhaust fluid line heater 1 circuit - Voltage above normal or shorted to high source. High signal voltage detected at the diesel exhaust fluid line heater 1 circuit.	Possible reduced engine performance.
3238 4340 4	Aftertreatment diesel exhaust fluid line heater 1 circuit - Voltage below normal, or shorted to low source. Low signal voltage detected at the diesel exhaust fluid line heater 1 circuit.	Possible reduced engine performance.
3239 4342 3	Aftertreatment diesel exhaust fluid line heater 2 circuit - Voltage above normal or shorted to high source. High signal voltage detected at the diesel exhaust fluid line heater 2 circuit.	Possible reduced engine performance.
3241 4342 4	Aftertreatment diesel exhaust fluid line heater 2 circuit - Voltage below normal, or shorted to low source. Low signal voltage detected at the diesel exhaust fluid line heater 2 circuit.	Possible reduced engine performance.

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
3242 3363 7	Aftertreatment diesel exhaust fluid tank heater - Mechanical system not responding or out of adjustment. The aftertreatment diesel exhaust fluid temperature did not increase when the aftertreatment diesel exhaust fluid tank heater was commanded ON.	Possible reduced engine performance.
3243 3060 18	Engine cooling system monitor - Data valid but below normal operating range - Moderately severe level. The engine is not warming up as expected.	None on performance.
3251 4765 16	Aftertreatment diesel oxidation catalyst intake temperature - Data valid but above normal operating range - Moderately severe level. The diesel oxidation catalyst intake temperature sensor reading has exceeded the maximum temperature limit.	Progressive power and/or speed derate increasing in severity from time of alert. If the Engine protection shutdown feature is enabled, the engine will shut down 30 seconds after the red STOP lamps starts flashing.
3253 3242 16	Aftertreatment diesel particulate filter intake temperature - Data valid but above normal operating range - Moderately severe level. The aftertreatment diesel particulate filter intake temperature sensor reading has exceeded the maximum engine protection temperature limit.	Progressive power and/or speed derate increasing in severity from time of alert. If the Engine protection shutdown feature is enabled, the engine will shut down 30 seconds after the red STOP lamps starts flashing.
3254 3242 15	Aftertreatment diesel particulate filter intake temperature - Data valid but above normal operating range - Least severe level. The aftertreatment diesel particulate filter intake temperature sensor reading has exceeded the maximum engine protection temperature limit.	Possible reduced engine performance.
3255 3246 16	Aftertreatment diesel particulate filter outlet temperature - Data valid but above normal operating range - Moderately severe level. The aftertreatment diesel particulate filter outlet temperature sensor reading has exceeded the maximum engine protection temperature limit.	Progressive power and/or speed derate increasing in severity from time of alert. If the engine protection shutdown feature is enabled, the engine will shut down 30 seconds after the red STOP lamps starts flashing.
3256 3246 15	Aftertreatment diesel particulate filter outlet temperature - Data valid but above normal operating range - Least severe level. The aftertreatment diesel particulate filter outlet temperature sensor reading has exceeded the maximum engine protection temperature limit.	Possible reduced engine performance.
3258 4340 5	Aftertreatment diesel exhaust fluid line heater 1 circuit - Current below normal or open circuit. Open circuit detected in the diesel exhaust fluid line heater 1.	Possible reduced engine performance.
3261 4342 5	Aftertreatment diesel exhaust fluid line heater 2 circuit - Current below normal or open circuit. Open circuit detected in the diesel exhaust fluid line heater 2.	Possible reduced engine performance.

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
3311 3242 0	Aftertreatment diesel particulate filter intake temperature - Data valid but above normal operating range - Most severe level. The aftertreatment diesel particulate filter intake temperature sensor reading has exceeded the maximum engine protection temperature limit.	Progressive power and/or speed derate increasing in severity from time of alert. If the engine protection shutdown feature is enabled, the engine will shut down 30 seconds after the red STOP lamps starts flashing.
3312 3246 0	Aftertreatment diesel particulate filter outlet temperature - Data valid but above normal operating range - Most severe level. The aftertreatment diesel particulate filter outlet temperature sensor reading has exceeded the maximum engine protection temperature limit.	Progressive power and/or speed derate increasing in severity from time of alert. If the engine protection shutdown feature is enabled, the engine will shut down 30 seconds after the red STOP lamps starts flashing.
3313 4765 4	Aftertreatment diesel oxidation catalyst intake temperature sensor circuit - Voltage below normal or shorted to low source. Low signal voltage detected at the catalyst intake sensor circuit.	Possible reduced engine performance.
3314 4765 3	Aftertreatment diesel oxidation catalyst intake temperature sensor circuit - Voltage above normal or shorted to high source. High signal voltage detected at the catalyst intake temperature sensor circuit.	Possible reduced engine performance.
3315 4765 2	Aftertreatment diesel oxidation catalyst intake temperature - Data erratic, intermittent, or incorrect. The aftertreatment diesel oxidation catalyst intake temperature sensor is not changing with engine operating conditions.	Possible reduced engine performance.
3316 3242 4	Aftertreatment diesel particulate filter intake temperature sensor circuit - Voltage below normal or shorted to low source. Low signal voltage detected at the aftertreatment diesel particulate filter intake temperature sensor circuit.	Possible reduced engine performance.
3317 3242 3	Aftertreatment diesel particulate filter intake temperature sensor circuit - Voltage above normal or shorted to high source. High signal voltage or open circuit detected at the aftertreatment diesel particulate filter intake temperature sensor circuit.	Possible reduced engine performance.
3318 3242 2	Aftertreatment diesel particulate filter intake temperature - Data erratic, intermittent, or incorrect. The aftertreatment diesel particulate filter intake temperature is not changing with engine operating conditions.	Possible reduced engine performance.
3319 3246 3	Aftertreatment diesel particulate filter outlet temperature sensor circuit - Voltage above normal or shorted to high source. High signal voltage or open circuit detected at the aftertreatment diesel particulate filter outlet temperature sensor circuit.	Possible reduced engine performance.

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
3321 3246 4	Aftertreatment diesel particulate filter outlet temperature sensor circuit - Voltage below normal or shorted to low source. Low signal voltage detected at the aftertreatment diesel particulate filter outlet temperature sensor circuit.	Possible reduced engine performance.
3322 3246 2	Aftertreatment diesel particulate filter outlet temperature - Data erratic, intermittent, or incorrect. The aftertreatment diesel particulate filter outlet temperature is not changing with engine operating conditions.	Possible reduced engine performance.
3326 91 9	SAE J1939 Multiplexed accelerator pedal or lever sensor system - Abnormal update rate. The ECM expected information from a multiplexed accelerator pedal or lever sensor but did not receive it soon enough or did not receive it at all.	Engine will only idle.
3328 191 9	Transmission output shaft speed - Abnormal update rate. No communication or an invalid data transfer rate has been detected on the J1939 data link between the ECM and the transmission output shaft speed sensor.	None on performance.
3342 4752 18	Engine exhaust gas recirculation cooler efficiency - Data valid but below normal operating range - Moderately severe level. The EGR cooler is not cooling the recirculated exhaust gas sufficiently.	None on performance.
3343 5285 18	Engine charge-air cooler efficiency - Data valid but below normal operating range - Moderately severe level. The engine charge air cooler is not cooling the intake air flow sufficiently.	None on performance.
3361 102 10	Intake manifold 1 pressure - Abnormal rate of change. The VGT position reading is stuck.	Possible reduced engine performance.
3366 111 18	Coolant level - Data valid but below normal operating range - Moderately severe level. Very low engine coolant level detected.	None on performance.
3374 1818 31	Roll over protection brake control active - Condition exists. The ECM received a message from the anti-lock braking (ABS) controller, inhibiting cruise control operation.	Cruise control could possibly not operate.
3375 5397 31	Aftertreatment diesel particulate filter regeneration too frequent - Condition exists. The system has detected the need for an active regeneration has occurred too soon following the last active regeneration.	None on performance.
3376 5319 31	Aftertreatment diesel particulate filter incomplete regeneration - Condition exists. The system has detected that the aftertreatment diesel particulate filter differential pressure is too high following an active regeneration.	Possible frequent need for aftertreatment regeneration.

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
3382 3058 18	Engine exhaust gas recirculation (EGR) system - Data valid but below normal operating range - Moderately severe level. Measured egr flow is lower than commanded.	Possible reduced engine performance.
3383 3058 16	Engine exhaust gas recirculation (EGR) system - Data valid but above normal operating range - Moderately severe Level. Measured EGR flow is higher than commanded.	Possible reduced engine performance.
3394 4766 18	Aftertreatment 1 diesel oxidation catalyst outlet gas temperature - Data valid but below normal operating range - Moderately severe level. The diesel oxidation catalyst outlet Temperature is below the operating limit	Possible frequent need for aftertreatment regeneration.
3396 3750 31	Diesel particulate filter 1 conditions not met for active regeneration - Condition exists. The aftertreatment temperatures are not warm enough for aftertreatment injection.	Possible frequent need for aftertreatment regeneration.
3418 191 19	Transmission output shaft speed - Received network data in error. The J1939 multiplexing controller has indicated a malfunction of the transmission output shaft speed sensor.	None on performance.
3422 4344 3	Aftertreatment diesel exhaust fluid line heater 3 circuit - Voltage above normal or shorted to high source. High signal voltage detected at the diesel exhaust fluid line heater 3 circuit.	Possible reduced engine performance.
3423 4344 4	Aftertreatment diesel exhaust fluid line heater 3 circuit - Voltage below normal, or shorted to low source. Low signal voltage detected at the diesel exhaust fluid line heater 3 circuit.	Possible reduced engine performance.
3425 4344 5	Aftertreatment diesel exhaust fluid line heater 3 circuit - Current below normal or open circuit. Open circuit detected in the diesel exhaust fluid line heater 3.	Possible reduced engine performance.
3488 563 9	Anti-lock braking (ABS) controller - Abnormal update rate. No communication or an invalid data transfer rate has been detected on the J1939 data link between the ECM and the anti-lock braking (ABS) controller.	None on performance.
3492 251 10	Real time clock - Abnormal rate of change. The real time clock indicates a stuck engine off timer.	None on performance.
3494 1081 7	Engine wait to start lamp - Mechanical system not responding or out of adjustment. Wait to Start lamp has malfunction.	None on performance.
3497 1761 17	Aftertreatment diesel exhaust fluid tank level - Data valid but below normal operating range - Least severe level. The aftertreatment diesel exhaust fluid tank level is low.	None on performance.

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
3498 1761 18	Aftertreatment diesel exhaust fluid tank level - Data valid but below normal operating range - Moderately severe level. The aftertreatment diesel exhaust fluid tank level is very low.	None on performance.
3525 84 19	Wheel-based vehicle speed - Received network data in error. The J1939 multiplexing controller has indicated a malfunction of the wheel-based vehicle speed sensor.	Engine speed limited to maximum engine speed without VSS parameter value. Cruise control, gear-down protection, and road speed governor will not work.
3526 84 9	Wheel-Based vehicle speed - Abnormal update rate. No communication or an invalid data transfer rate has been detected on the J1939 data link between the ECM and the wheel-based vehicle speed sensor.	Engine speed limited to maximum engine speed without VSS parameter value. Cruise control, gear-down protection, and road speed governor will not work.
3527 558 19	Accelerator pedal or lever idle validation switch - Received network data in error. The J1939 multiplexing controller has indicated a malfunction of the accelerator pedal or lever idle validation switch.	The engine will only idle.
3528 558 9	Accelerator pedal or lever idle validation switch - Abnormal update rate. No communication or an invalid data transfer rate has been detected on the J1939 data link between the ECM and the accelerator pedal or lever idle validation switch.	Engine will only idle.
3531 171 9	Ambient air temperature - Abnormal update rate. No communication or an invalid data transfer rate has been detected on the J1939 data link between the ECM and the ambient air temperature sensor.	Possible reduced engine performance.
3532 171 19	Ambient air temperature - Received network data in error. The J1939 multiplexing controller has indicated a malfunction of the ambient air temperature sensor.	Possible reduced engine performance.
3539 51 3	Engine intake throttle actuator position sensor circuit - Voltage above normal, or shorted to high source. High signal voltage detected at the engine intake air throttle position sensor circuit.	Possible reduced engine performance.
3541 51 4	Engine intake throttle actuator position sensor circuit - Voltage below normal, or shorted to low source. Low signal voltage detected at the engine intake air throttle position sensor circuit.	Possible reduced engine performance.
3542 51 2	Engine intake throttle actuator position sensor - Data erratic, intermittent or incorrect. The engine intake air throttle posistion feedback is erratic or incorrect.	Possible reduced engine performance.
3545 3226 10	Aftertreatment outlet NOx sensor circuit - Abnormal rate of change. The aftertreatment outlet NOx sensor reading is not valid.	None on performance.

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
3547 4096 31	Aftertreatment diesel exhaust fluid tank empty - Condition exists. The diesel exhaust fluid tank is empty.	Possible reduced engine performance.
3555 1081 9	Engine wait to start lamp - Abnormal update rate. A loss of communication has been detected.	None on performance.
3556 1081 19	Engine wait to start lamp - Received network data in error. The ECM received an invalid signal on the SAE J1939 datalink.	None on performance.
3558 3361 3	Aftertreatment diesel exhaust fluid dosing unit - Voltage above normal or shorted to high source. High signal voltage detected at the aftertreatment diesel exhaust fluid dosing unit.	Possible reduced engine performance.
3559 3361 4	Aftertreatment diesel exhaust fluid dosing unit - Voltage below normal or shorted to low source. Low signal voltage detected at the aftertreatment diesel exhaust fluid dosing unit.	Possible reduced engine performance.
3562 5491 3	Aftertreatment diesel exhaust fluid line heater relay - Voltage above normal or shorted to high source. High signal voltage detected at the diesel exhaust fluid line heater relay.	Possible reduced engine performance.
3563 5491 4	Aftertreatment diesel exhaust fluid line heater relay - Voltage below normal or shorted to low source. Low signal voltage detected at the diesel exhaust fluid line heater relay.	Possible reduced engine performance.
3567 5394 5	Aftertreatment diesel exhaust fluid dosing valve - Current below normal or open circuit. A circuit error has been detected in the aftertreatment diesel exhaust fluid dosing valve circuit.	Possible reduced engine performance.
3568 5394 7	Aftertreatment diesel exhaust fluid (DEF) Dosing valve - Mechanical system not responding or out of adjustment. A mechanical malfunction has been detected in the DEF dosing valve.	Possible reduced engine performance.
3571 4334 3	Aftertreatment diesel exhaust fluid pressure sensor - Voltage above normal or shorted to high source. High signal voltage detected at the aftertreatment diesel exhaust fluid pressure sensor circuit.	Possible reduced engine performance.
3572 4334 4	Aftertreatment diesel exhaust fluid pressure sensor - Voltage below normal or shorted to low source. Low signal voltage detected at the diesel exhaust fluid pressure sensor circuit.	Possible reduced engine performance.
3574 4334 18	Aftertreatment diesel exhaust fluid pressure sensor - Data valid but below normal operating range - Moderately severe level. Low diesel exhaust fluid pressure has been detected in the dosing unit.	Possible reduced engine performance.

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
3575 4334 16	Aftertreatment diesel exhaust fluid pressure sensor - Data valid but above normal operating range - Moderately severe level. The diesel exhaust fluid dosing unit has detected a blockage in the diesel exhaust fluid return flow.	Possible reduced engine performance.
3577 4376 3	Aftertreatment diesel exhaust fluid return valve - Voltage above normal or shorted to high source. High signal voltage detected at the aftertreatment diesel exhaust fluid return valve.	Possible reduced engine performance.
3578 4376 4	Aftertreatment diesel exhaust fluid return valve - Voltage below normal, or shorted to low source. Low signal voltage detected at the diesel exhaust fluid return valve.	Possible reduced engine performance.
3582 4364 18	Aftertreatment SCR catalyst conversion efficiency - Data valid but below normal operating range - Moderately severe level. NOx conversion across the SCR catalyst is too low.	Possible reduced engine performance.
3583 5031 10	Aftertreatment outlet NOx sensor heater - Abnormal rate of change. The aftertreatment outlet NOx sensor heater is unable to maintain its normal operating temperature.	None on performance.
3596 4334 2	Aftertreatment diesel exhaust fluid pressure sensor - Data erratic, intermittent, or incorrect. The diesel exhaust fluid pressure sensor has reported a reading too high or low for the operating conditions.	Possible reduced engine performance.
3649 5024 10	Aftertreatment Intake NOx sensor heater - Abnormal rate of change. The aftertreatment intake NOx sensor heater is unable to maintain its normal operating temperature.	None on performance.
3681 3228 2	Aftertreatment outlet NOx sensor power supply - Data erratic, intermittent, or incorrect. The aftertreatment outlet NOx sensor indicates that the power supply to the sensor is incorrect.	None on performance.
3682 3218 2	Aftertreatment Intake NOx sensor power supply - Data erratic, entermittent or encorrect. The aftertreatment intake NOx sensor indicates that the power supply to the sensor is incorrect.	None on performance.
3697 630 12	Engine control module calibration memory - Bad intelligent device or component. Error internal to the ECM related to engine software failures.	Engine may not start or may be difficult to start.
3712 5246 0	Aftertreatment SCR operator inducement - Data valid but above normal operational range - Most severe level. Critical SCR related fault codes have been active for an extended period of time and require immediate attention.	Vehicle speed will be limited to 8 ㎞ [5 miles] per hour.

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
3714 1569 31	Engine protection torque derate - Condition exists. Critical fault codes related to engine operation are active.	Possible reduced engine performance.
3715 188 16	Engine speed at idle - Data valid but below normal operating range - Moderately severe level. The engine speed at idle has exceeded the governed idle speed.	Possible reduced engine performance.
3716 188 18	Engine speed at idle - Data valid but below normal operational range - Moderately severe level. Engine is not maintaining the governed idle speed.	None on performance.
3717 3226 13	Aftertreatment outlet NOx sensor - Out of calibration. A calibration mismatch between the aftertreatment outlet NOx sensor and the ECM has been detected.	None on performance.
3718 3216 13	Aftertreatment intake NOx - Out of calibration. A calibration mismatch between the aftertreatment intake NOx sensor and the ECM has been detected.	None on performance.
3724 168 17	Battery 1 voltage - Data valid but below normal operating range - Least severe level. Low voltage to the EGR valve device driver has been detected.	Possible reduced engine performance.
3725 3216 10	Aftertreatment Intake NOx sensor - Abnormal rate of change. The aftertreatment intake NOx sensor reading is not valid.	None on performance.
3727 5571 7	High pressure common rail fuel pressure relief valve - Mechanical system not responding or out of adjustment. The fuel rail high-pressure relief valve has opened at a lower than expected pressure.	Possible reduced engine performance.
3737 1675 31	Engine starter mode overcrank protection - Condition exists. The starter motor has been temporarily disabled in order to prevent starter damage.	Starter operation is prohibited until the starter motor has adequately cooled.
3741 5571 0	High pressure common rail fuel pressure relief valve - Data valid but above normal operational range - Most severe level. The fuel rail pressure relief valve has opened due to high fuel rail pressure.	Engine may run rough, may stop running, may not start, or may be difficult to start.
3749 3226 20	Aftertreatment outlet NOx sensor - Data not rational - Drifted high. An offset in the outlet NOx sensor reading has been detected.	None on performance.
3838 2978 9	Estimated engine parasitic losses - Percent torque - Abnormal update rate. A loss of communication has been detected.	None on performance.
3843 5603 9	Cruise control disable command - Abnormal update rate. No communication or an invalid data transfer rate has been detected on the J1939 data link between the ECM and the cruise control.	None on performance.

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
3844 5605 31	Cruise control pause command - Condition exists. The adaptive cruise control has dropped out and must be manually engaged.	Cruise control could possibly not operate.
3845 5603 31	Cruise control disable command - Condition exists. The adaptive cruise control has dropped out and must be manually engaged.	Cruise control could possibly not operate.
3899 5848 4	Aftertreatment 1 SCR Intermediate NH3 sensor - Voltage below normal, or shorted to low source. A circuit error has been detected in the NH3 sensor.	None on performance.
3911 5848 9	Aftertreatment SCR Intermediate NH3 sensor - Abnormal update rate. Loss of communication with the aftertreatment SCR intermediate NH3 sensor.	Possible reduced engine performance.
3912 5853 10	Aftertreatment SCR Intermediate NH3 sensor heater - Abnormal rate of change. A malfunction of the aftertreatment SCR intermediate NH3 sensor heater has been detected.	Possible reduced engine performance.
3932 5851 16	Aftertreatment SCR Intermediate NH3 gas sensor power supply - Data valid but above normal operating range - Moderately severe level. High battery voltage supply detected at the aftertreatment SCR intermediate NH3 sensor.	Possible reduced engine performance.
3933 5851 18	Aftertreatment SCR Intermediate NH3 gas sensor power supply - Data valid but below normal operating range - Moderately severe level. Low battery voltage supply detected at the aftertreatment SCR intermediate NH3 sensor.	Possible reduced engine performance.
3934 5851 2	Aftertreatment SCR Intermediate NH3 gas sensor power supply - Data erratic, intermittent or incorrect. Intermittent battery voltage supply detected at the aftertreatment SCR intermediate NH3 sensor.	Possible reduced engine performance.
3935 5848 13	Aftertreatment SCR Intermediate NH3 sensor - Out of calibration. Incorrect trim resistance has been detected in the aftertreatment SCR intermediate NH3 sensor.	Possible reduced engine performance.
3936 5848 12	Aftertreatment SCR Intermediate NH3 sensor - Bad intelligent device or component. An internal error of the aftertreatment SCR intermediate NH3 sensor has been detected.	Possible reduced engine performance.
3937 5848 10	Aftertreatment 1 SCR Intermediate NH3 sensor - Abnormal rate of change. The aftertreatment SCR intermediate NH3 sensor reading is NOT valid.	Possible reduced engine performance.

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
4149 2623 8	Accelerator pedal or lever position sensor 2 circuit frequency - Abnormal frequency or pulse width or period. The accelerator pedal position sensor reading is out of range.	The engine will operate in Limp Home mode.
4151 5742 9	Aftertreatment diesel particulate filter temperature sensor module - Abnormal update rate. No communications on the J1939 data link between the ECM and the aftertreatment diesel particulate filter temperature sensor module.	Possible reduced engine performance.
4152 5743 9	Aftertreatment selective catalytic reduction temperature sensor module - Abnormal update rate. No communications on the J1939 data link between the ECM and the aftertreatment SCR temperature sensor module.	Possible reduced engine performance.
4155 5746 3	Aftertreatment 1 diesel exhaust fluid dosing unit heater relay - Voltage above normal, or shorted to high source. High signal voltage detected at the aftertreatment diesel exhaust fluid dosing unit heater relay circuit.	Possible reduced engine performance.
4156 5746 4	Aftertreatment 1 diesel exhaust fluid dosing unit heater relay - Voltage below normal, or shorted to low source. Low signal voltage detected at the aftertreatment diesel exhaust fluid dosing unit heater relay circuit.	Possible reduced engine performance.
4157 4376 7	Aftertreatment diesel exhaust fluid return valve - Mechanical system not responding or out of adjustment. A stuck aftertreatment diesel exhaust fluid return valve has been detected.	None on performance.
4158 5742 12	Aftertreatment diesel particulate filter temperature sensor module - Bad intelligent device or component. An internal error has been detected in the aftertreatment diesel particulate filter temperature sensor module.	Possible reduced engine performance.
4159 5743 12	Aftertreatment selective catalytic reduction temperature sensor module - Bad intelligent device or component. An internal error has been detected in the aftertreatment SCR temperature sensor module.	Possible reduced engine performance.
4161 5742 3	Aftertreatment diesel particulate filter temperature sensor module - Voltage above normal, or shorted to high source. High battery supply voltage detected at the aftertreatment diesel particulate filter temperature sensor module.	Possible reduced engine performance.
4162 5742 4	Aftertreatment diesel particulate filter temperature sensor module - Voltage below normal, or shorted to low source. Low battery supply voltage detected at the aftertreatment diesel particulate filter temperature sensor module.	Possible reduced engine performance.

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
4163 5742 16	Aftertreatment diesel particulate filter temperature sensor module- Data valid but above normal operating range - Moderately severe level. High internal temperature detected in the aftertreatment diesel particulate filter temperature sensor module.	Possible reduced engine performance.
4164 5743 3	Aftertreatment selective catalytic reduction temperature sensor module - Voltage above normal, or shorted to high source. High battery supply voltage detected at the aftertreatment SCR temperature sensor module.	Possible reduced engine performance.
4165 5743 4	Aftertreatment selective catalytic reduction temperature sensor module - Voltage below normal, or shorted to low source. Low battery supply voltage detected at the aftertreatment SCR temperature sensor module.	Possible reduced engine performance.
4166 5743 16	Aftertreatment selective catalytic reduction temperature sensor module - Data valid but above normal operating range - Moderately severe level. High internal temperature detected in the aftertreatment SCR temperature sensor module.	Possible reduced engine performance.
4168 5745 3	Aftertreatment diesel exhaust fluid dosing unit heater - Voltage above normal, or shorted to high source. The aftertreatment diesel exhasut fluid dosing unit heater is detected to be stuck on.	None on performance.
4169 5745 5	Aftertreatment diesel exhaust fluid dosing unit heater - Voltage below normal, or shorted to low source. The aftertreatment diesel exhasut fluid dosing unit heater is detected to be stuck off.	Possible reduced engine performance.
4171 5745 18	Aftertreatment diesel exhaust fluid dosing unit heater - Data valid but below normal operating range - Moderately severe level. The aftertreatment diesel exhaust fluid dosing unit failed to thaw.	Possible reduced engine performance.
4213 3695 2	Aftertreatment diesel particulate filter regeneration inhibit switch - Data erratic, intermittent or incorrect. The diesel particulate filter regeneration permit switch is stuck in the OFF or INHIBIT position.	Possible frequent need for aftertreatment regeneration.
4215 563 31	Anti-lock braking (ABS) Active - Condition exists. Cruise control was paused due to an anti-wheel slip message from teh ABS controller.	Adaptive cruise control will not operate. Standard cruise control may not operate.
4244 4337 2	Aftertreatment diesel exhaust fluid dosing temperature - Data erratic, intermittent or incorrect. The aftertreatment diesel exhaust fluid dosing temperature is irrational.	None on performance.

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
4245 5798 2	Aftertreatment diesel exhaust fluid dosing unit heater temperature - Data erratic, intermittent or incorrect. The aftertreatment diesel exhaust fluid dosing unit heater temperature is irrational.	None on performance.
4249 4337 10	Aftertreatment diesel exhaust fluid dosing temperature - Abnormal rate of change. The aftertreatment diesel exhaust fluid dosing unit temperature is stuck.	None on performance.
4251 5798 10	Aftertreatment 1 diesel exhaust fluid dosing unit heater temperature - Abnormal rate of change. The aftertreatment diesel exhaust fluid dosing unit heater temperature sensor reading is stuck.	None on performance.
4252 1081 31	Engine wait to start lamp - Condition exists. The received signal does not match the commanded signal.	None on performance.
4259 5742 11	Aftertreatment diesel particulate filter temperature sensor module - Root cause not known. Intermittent battery voltage supply detected at the aftertreatment diesel particulate filter temperature sensor module.	Possible reduced engine performance.
4261 5743 11	Aftertreatment selective catalytic reduction temperature sensor module - Root cause not known. Intermittent battery voltage supply detected at the aftertreatment SCR temperature sensor module.	Possible reduced engine performance.
4279 5848 21	Aftertreatment 1 SCR Intermediate NH3 - Data not rational - Drifted low. An in range low failure has been detected.	Possible reduced engine performance.
4281 5848 2	Aftertreatment SCR Intermediate NH3 - Data erratic, intermittent or incorrect. The aftertreatment SCR intermediate NH3 sensor reading is stuck.	None on performance.
4284 5793 9	Desired engine fueling state - Abnormal update rate. A valid message from the transmission ECU has NOT been received.	Engine may not start or may be difficult to start.
4289 91 8	Accelerator pedal or lever position sensor 1 circuit frequency - Abnormal frequency or pulse width or period. The accelerator pedal position sensor reading is out of range.	The engine will operate in limp home mode.
4452 520668 31	Aftertreatment outlet NOx sensor closed loop operation - Condition exists. The maximum dosing adjustment has been reached.	Possible reduced engine performance.
4453 520669 31	Aftertreatment intermediate NH3 sensor closed loop operation - Condition exists. The maximum dosing adjustment has been reached.	None on performance.
4517 237 13	Vehicle Identification number - Out of calibration. The vehicle identification number has not been programmed into the ECM.	None on performance.

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
4518 5862 3	Aftertreatment SCR Intermediate gas temperature sensor circuit - Voltage above normal, or shorted to high source. High signal voltage detected at the aftreatment SCR intermediate temperature sensor circuit.	Possible reduced engine performance.
4519 5862 4	Aftertreatment SCR Intermediate gas temperature sensor circuit - Voltage below normal, or shorted to low source. Low signal voltage detected at the aftertreatment SCR intermediate temperature sensor circuit.	Possible reduced engine performance.
4521 5862 2	Aftertreatment SCR Intermediate gas temperature sensor - Data erratic, intermittent or incorrect. The aftertreatment SCR intermediate temperature sensor reading is irrational.	Possible reduced engine performance.
4524 5862 0	Aftertreatment SCR intermediate gas temperature - Data valid but above normal operational range - Most severe level. The aftertreatment SCR intermediate temperature sensor reading is above the engine protection limit.	Progressive power and/or speed derate increasing in severity from time of alert. If the engine protection shutdown feature is enabled, the engine will shut down 30 seconds after the red STOP lamps starts flashing.
4525 5862 16	Aftertreatment 1 SCR intermediate gas temperature - Data valid but above normal operating range - Moderately severe level. High SCR Intermediate temperature detected.	Progressive power and/or speed derate increasing in severity from time of alert. If the engine protection shutdown feature is enabled, the engine will shut down 30 seconds after the red STOP lamps starts flashing.
4526 521 2	Brake pedal position - Data erratic, intermittent or incorrect. The values of the 2 brake switch signals do not match.	None on performance.
4572 3031 9	Aftertreatment diesel exhaust fluid tank temperature - Abnormal update rate. The ECM lost communication with the aftertreatment diesel exhaust fluid tank temperature sensor.	Possible reduced engine performance.
4584 3936 14	Aftertreatment diesel particulate filter system - Special instructions. The incorrect aftertreatment diesel particulate filter system has been installed with the engine.	Engine will be shut down.
4585 4792 14	Aftertreatment 1 SCR catalyst system - Special instructions. The incorrect SCR system has been Installed.	Engine will be shut down.
4612 520701 31	Engine intake manifold pressure system monitor - Condition exists. The engine is unable to meet the air handling system commands.	Possible reduced engine performance.
4658 4331 18	Aftertreatment SCR actual dosing reagent quantity - Data valid but below normal operating range - Moderately severe level. Low aftertreatment diesel exhaust fluid flow detected.	Possible reduced engine performance.

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
4691 5585 18	Engine injector metering rail 1 cranking pressure - Data valid but below normal operating range - Moderately severe level. The fuel rail pressure during cranking is too low for the engine to start.	Engine may not start or may be difficult to start.
4713 5357 31	Engine fuel injection quantity error for multiple cylinders - Condition exists. A malfunction of all fuel injectors has been detected.	Engine may run rough, may stop running, may not start, or may be difficult to start.
4726 1239 16	Engine fuel leakage - Data valid but above normal operating range - Moderately severe level. Fuel rail pressure decay has been detected.	Engine may run rough, may stop running, may not start, or may be difficult to start.
4727 157 15	Injector metering rail 1 pressure - Data valid but above normal operating range - Least severe level. A self pumping condition has been detected in the fuel system.	Possible reduced engine performance.
4731 3031 13	Aftertreatment diesel exhaust fluid tank temperature sensor - Out of calibration. The received datalink message was not valid.	Possible reduced engine performance.
4732 1761 13	Aftertreatment diesel exhaust fluid tank level sensor - Out of calibration. The received datalink message was not valid.	None on performance.
4739 1761 11	Aftertreatment 1 diesel exhaust fluid tank level sensor - Root cause not known. An unknown error has been detected with the aftertreatment diesel exhaust fluid tank level sensor.	Possible reduced engine performance.
4769 1761 10	Aftertreatment 1 diesel exhaust fluid tank level sensor - Abnormal rate of change. A valid diesel exhaust fluid tank level reading has NOT been received.	Possible reduced engine performance.
4865 6303 3	Engine coolant level 2 sensor circuit - Voltage above normal, or shorted to high source. High signal voltage detected at the engine coolant level 2 circuit.	None on performance.
4866 6303 4	Engine coolant level 2 sensor circuit - Voltage below normal, or shorted to low source. Low signal voltage detected at the engine coolant level 2 circuit.	None on performance.
4956 520750 13	Engine variable geometry turbo (VGT) software - Out of calibration. VGT software does not match application.	Possible reduced engine performance.
4957 520750 31	Engine variable geometry turbo (VGT) software - Condition exists. The VGT actuator and ECM software is not compatible.	Possible reduced engine performance.

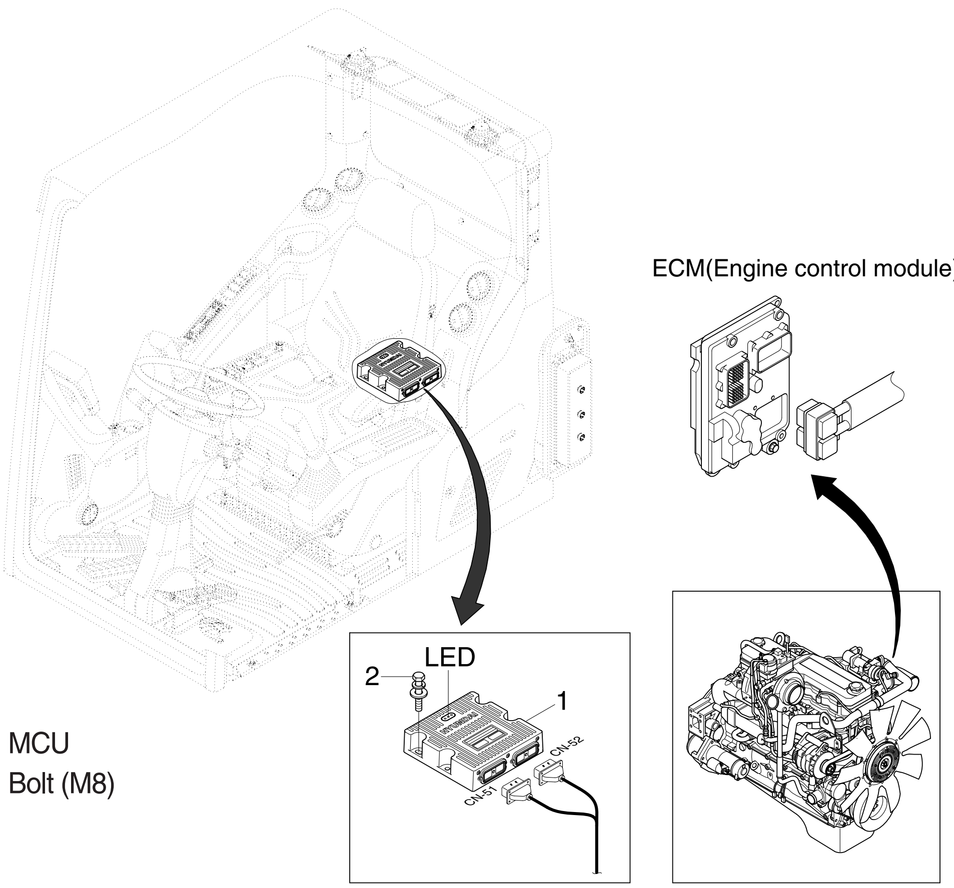
※ Some fault codes are not applied to this machine.

5. AAVM FAULT CODE

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

GROUP 14 ENGINE CONTROL SYSTEM

1. MCU and Engine ECM (Electronic Control Module)



1 MCU
2 Bolt (M8)

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2. MCU ASSEMBLY

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

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

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

G : green, R : red, Y : yellow

GROUP 15 EPPR VALVE

1. PUMP EPPR VALVE

1) COMPOSITION

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

(1) Electro magnet valve

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

(2) Spool valve

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

(3) Pressure and electric current value for each mode

Mode		Pressure		Electric current (mA)	Engine rpm (at accel dial 10)
		kgf/cm^2	psi		
Standard	P	10	142	330 ± 30	1600 ± 50
	S	13 ± 3	185 ± 40	365 ± 30	1450 ± 50
	E	15 ± 3	213 ± 40	400 ± 30	1350 ± 50
Option	P	8.5	121	295 ± 30	1700 ± 50
	S	12.5 ± 3	178 ± 40	363 ± 30	1500 ± 50
	E	17.5 ± 3	249 ± 40	450 ± 30	1350 ± 50

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

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

- Management
  · Service menu

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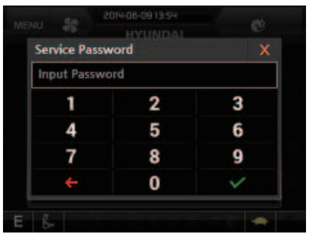
→



Enter the password 290F3CD126

→

290F3CD150

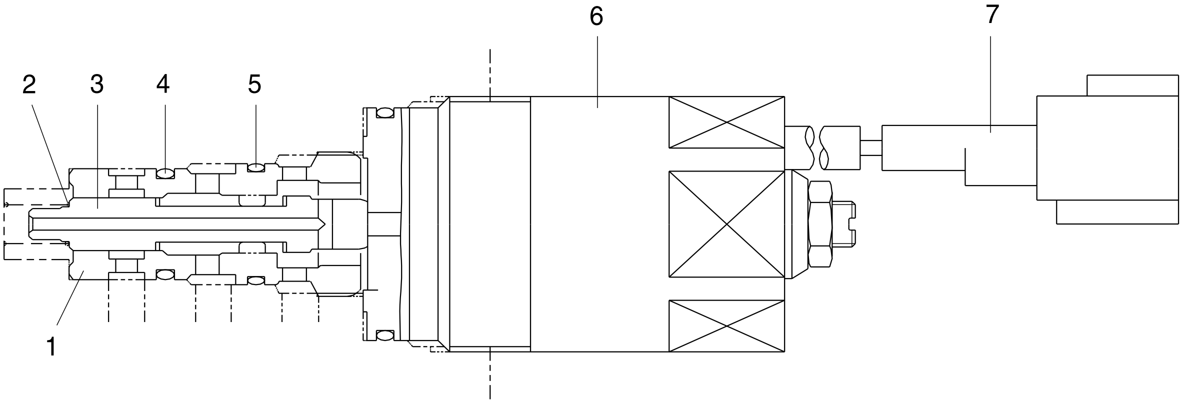
↓

290F3CD151

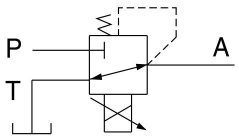
· Power shift (standard/option) : Power shift pressure can be set by option menu.

3) OPERATING PRINCIPLE (pump EPPR valve)

(1) Structure



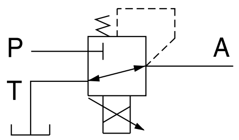
1	Sleeve	4	O-ring	6	Solenoid valve
2	Spring	5	O-ring	7	Connector
3	Spool				

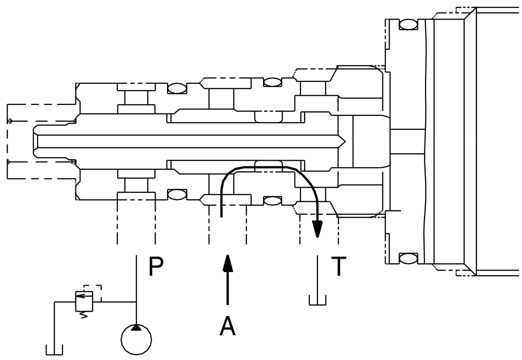


P Pilot oil supply line (pilot pressure)
T Return to tank
A Secondary pressure to flow regulator at main pump

(2) Neutral

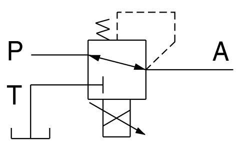
Pressure line is blocked and A oil returns to tank.

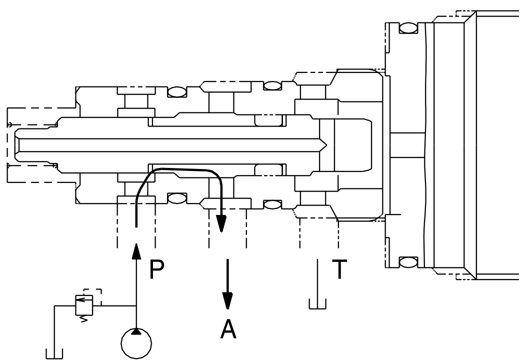




(3) Operating

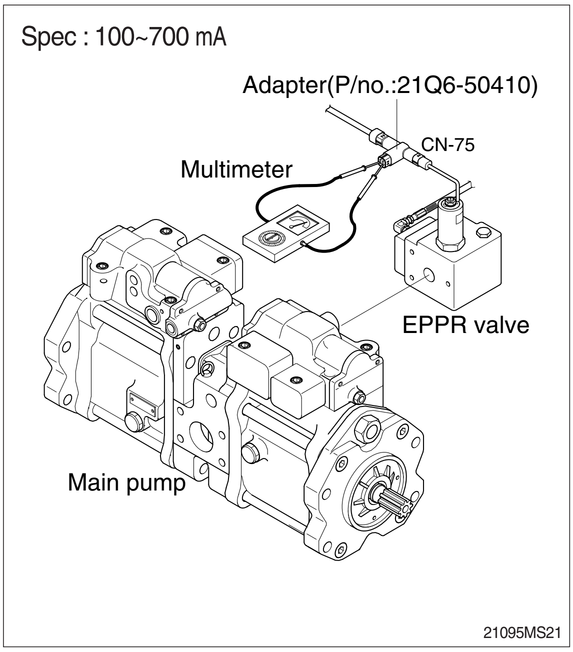
Secondary pressure enters into A.





4) EPPR VALVE CHECK PROCEDURE

(1) Check electric current value at EPPR valve



① Disconnect connector CN-75 from EPPR valve.

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

③ Start engine.

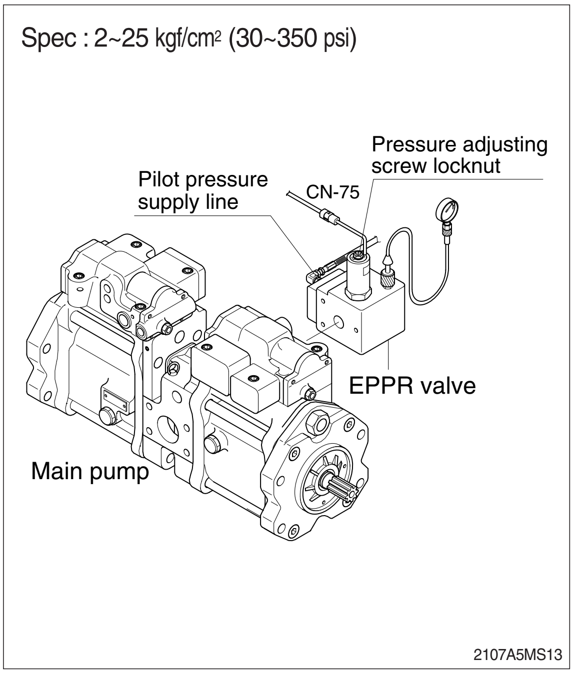
④ Set S-mode and cancel auto decel mode.

⑤ Position the accel dial at 10.

⑥ If rpm display show approx 1450±50 rpm check electric current at bucket circuit relief position.

⑦ Check electric current at bucket circuit relief position.

(2) Check pressure at EPPR valve



① Remove plug and connect pressure gauge as figure.

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

② Start engine.

③ Set S-mode and cancel auto decel mode.

④ Position the accel dial at 10.

⑤ If tachometer show approx 1450±50 rpm check pressure at relief position of bucket circuit by operating bucket control lever.

⑥ If pressure is not correct, adjust it.

⑦ After adjust, test the machine.

2. BOOM PRIORITY EPPR VALVE

1) COMPOSITION

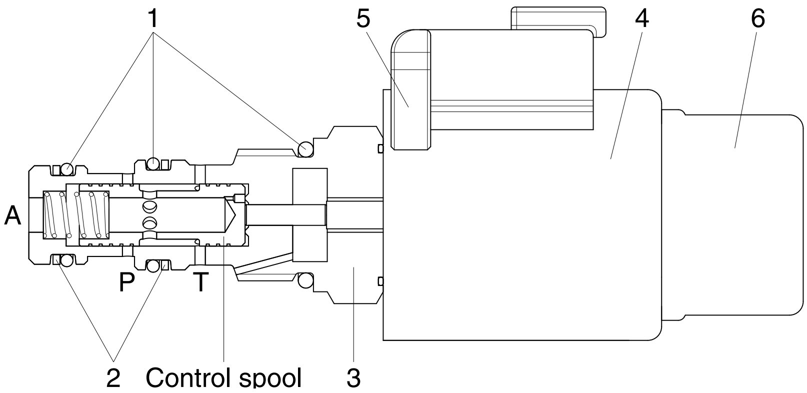
The boom priority EPPR valve is built in a manifold and mainly consisting of valve body and coil. This EPPR valve installed under the solenoid valve.

2) CONTROL

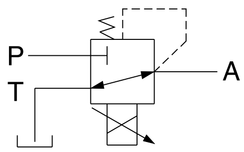
The boom priority EPPR valve has to be controlled by a specific electronic amplifier card, which is supplying the coil with a current 580 mA at 30Ω and 24 V.

3) OPERATING PRINCIPLE

(1) Structure



21095MS14



P : Pilot supply line
T : Return to tank
A : Secondary pressure to flow MCV

1	O-ring	3	Valve body	5	Connector
2	Support ring	4	Coil	6	Cover cap

(2) Operation

In de-energized mode the inlet port (P) is closed and the outlet port (A) is connected to tank port (T).

In energized mode the solenoid armature presses onto the control spool with a force corresponding to the amount of current. This will set a reduced pressure at port A. The setting is proportional to the amount of current applied.

(3) Maximum pressure relief

If a pressure from outside is applied on port A the valve may directly switch to tank port (T) and protect the system before overload.

2) EPPR VALVE CHECK PROCEDURE

(1) Check electric current value at EPPR valve

① Disconnect connector CN-133 from EPPR valve.

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

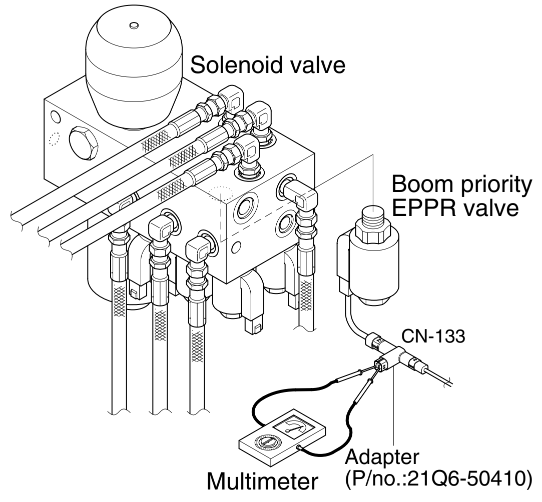
③ Start engine.

④ Set S-mode and cancel auto decel mode.

⑤ If rpm display approx 1450±50 rpm disconnect one wire harness from EPPR valve.

⑥ Check electric current in case of combined boom up and swing operation.

Spec : 400~600 mA
(combined boom up and swing operation)



21095MS15

(2) Check pressure at EPPR valve

① Remove hose from A5 port and connect pressure gauge as figure.
· Gauge capacity : 0 to 50 kgf/cm^2 (0 to 725 psi)

② Start engine.

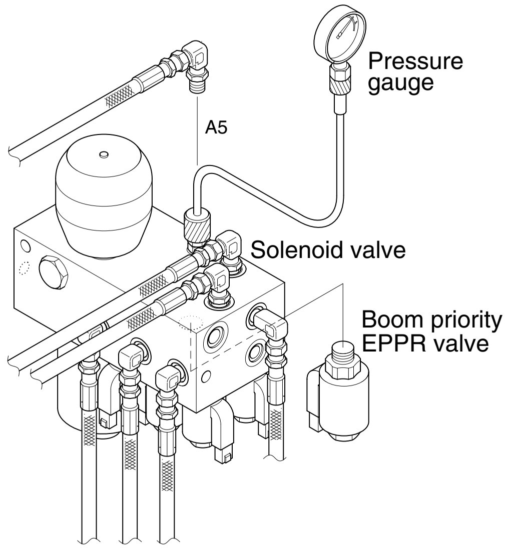
③ Set S-mode and cancel auto decel mode.

④ If rpm display approx 1450±50 rpm check pressure (In case of combined boom up and swing operation).

⑤ If pressure is not correct, adjust it.

⑥ After adjust, test the machine.

Spec : 12~37 kgf/cm^2 (170~530 psi)
(combined boom up and swing operation)



21095MS16

1. OUTLINE

Monitoring system consists of the monitor part and switch part.

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

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

2. CLUSTER

1) MONITOR PANEL

210WF5MS20

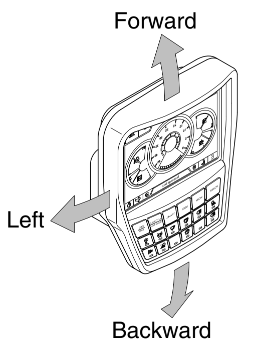
※ The warning lamp pops up and/or blinks and the buzzer sounds when the machine has a problem.

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

※ This cluster is adjustable.

· Vertical (forward/backward) : each 15°

· Horizontal (left only) : 8°



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2) CLUSTER CHECK PROCEDURE

(1) Start key : ON

① Check monitor

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

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

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

a. Engine rpm display : 0 rpm

b. Engine coolant temperature gauge : White range

c. Hydraulic oil temperature gauge : White range

d. Fuel level gauge : White range

③ Indicating lamp state

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

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

c. Travel speed pilot lamp : Low (turtle)

(2) Start of engine

① Check machine condition

a. RPM display indicates at present rpm

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

※ When normal condition : All warning lamp OFF

c. Work mode selection : General work

d. Power mode selection : E mode or U mode

e. Travel speed pilot lamp : Low (turtle)

② When warming up operation

a. Warming up pilot lamp : ON

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

※ Others same as above.

③ When abnormal condition

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

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

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

3. CLUSTER CONNECTOR

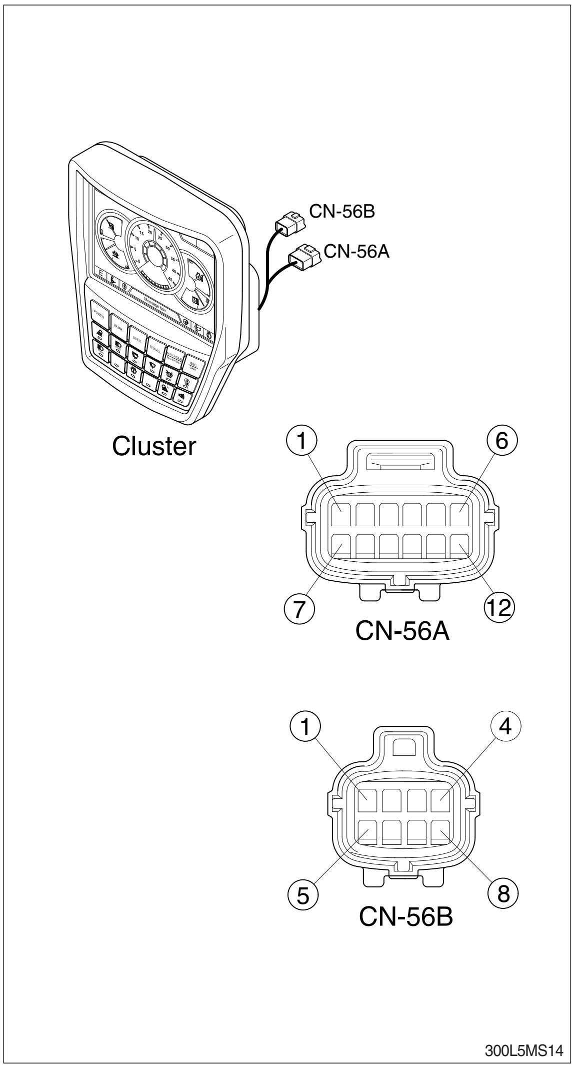
1) CN-56A

No.	Name	Signal
1	Battery 24V	20~32V
2	Power IG (24V)	20~32V
3	GND	-
4	CAN 1 (H)	0~5V
5	CAN 1 (L)	0~5V
6	CAN 2 (H)	20~32V
7	CAN 2 (L)	20~32V
8	RS-232 (RX)	±15V
9	RS-232 (TX)	±15V
10	Aux left	0~5V
11	Aux right	0~5V
12	Aux GND	-

2) CN-56B

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

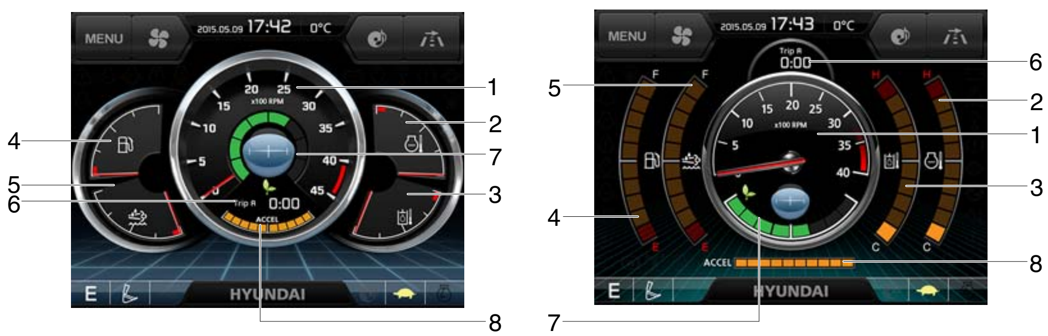
NTSC : National Television System Committee



2) GAUGE

(1) Operation screen

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



210WF3CD51

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

※ Operation screen type can be set by the screen type menu of the display. Refer to page 5-91 for details.

(2) RPM / Speed gauge

210WF3CD49

① This display the engine speed.

(3) Engine coolant temperature gauge

290F3CD53

① This gauge indicates the temperature of coolant.

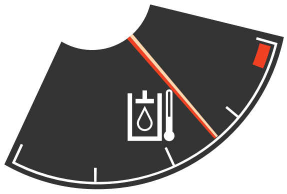
· White range : 40-107˚C (104-225˚F)

· Red range : Above 107˚C (225˚F)

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

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

(4) Hydraulic oil temperature gauge



290F3CD54

① This gauge indicates the temperature of hydraulic oil.

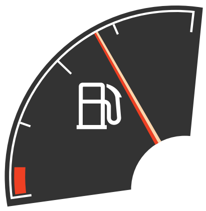
· White range : 40-105˚C(104-221˚F)

· Red range : Above 105˚C(221˚F)

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

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

(5) Fuel level gauge



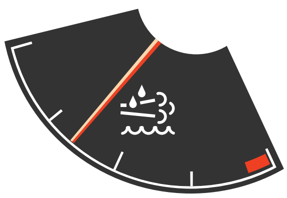
290F3CD55

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

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

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

(6) DEF/AdBlue® Level gauge



290F3CD57

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

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

③ Do not pour DEF/AdBlue® any more when the DEF/AdBlue® fill up warning lamp lights ON.

※ Refer to page 5-71.

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

(7) Tripmeter display

290F3CD56

① This displays the engine the tripmeter.

※ Refer to page 5-93 for details.

(8) Eco gauge

210WF3CD58

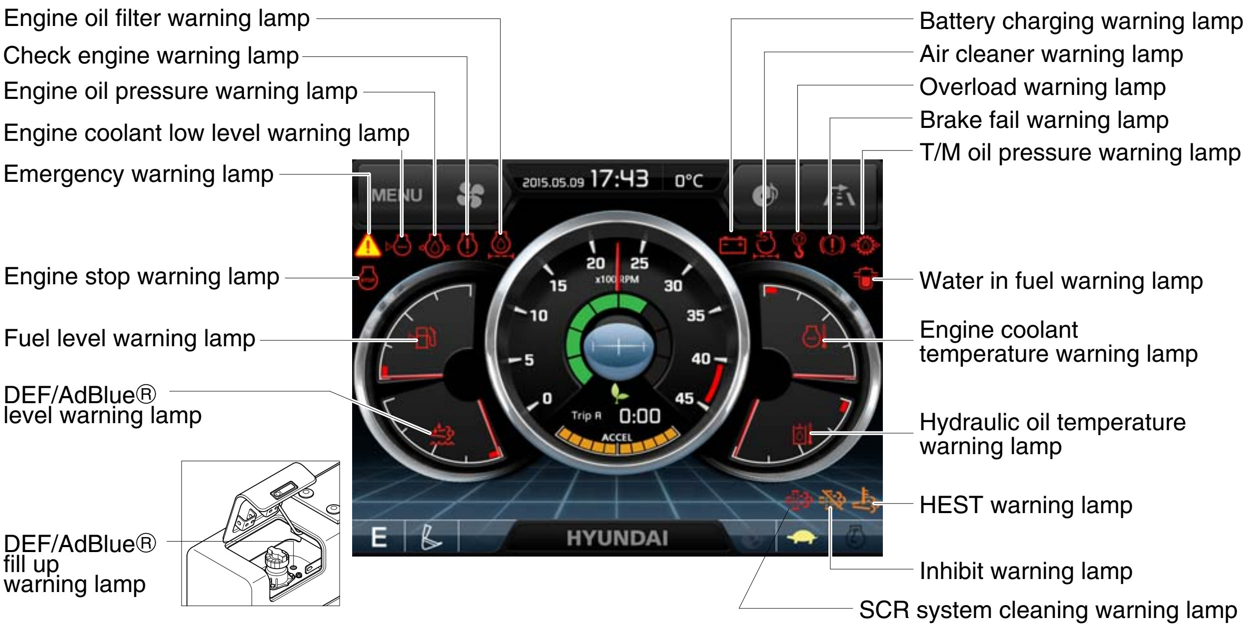
① This gauge indicates the fuel consumption rate and machine load status. So that operators can be careful with fuel economy.
② The fuel consumption rate or machine load is higher, the number of segment is increased.
③ The color of Eco gauge indicates operation status.
- White : Idle operation
- Green : Economy operation
- Yellow : Non-economy operation at a medium level.
- Red : Non-economy operation at a high level.

(9) Accel dial gauge

290F3CD59

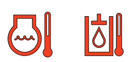
① This gauge indicates the level of accel dial.

3) WARNING LAMPS



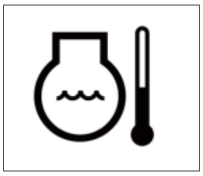
210WF3CD60

※ Warning lamps and buzzer

Warnings	When error happened	Lamps and buzzer
All warning lamps except below	Warning lamp pops up on the center of the LCD and the buzzer sounds	· The pop-up warning lamp moves to the original position and blinks, and the buzzer stops when ; - the buzzer stop switch (AUTO IDLE Buzzer Stop) is pushed - the knob of the haptic controller is pushed - the lamp of the LCD is touched
	Warning lamp pops up on the center of the LCD and the buzzer sounds	· The pop-up warning lamp moves to the original position and light ON or blinks, and the buzzer stops when ; - the buzzer stop switch (AUTO IDLE Buzzer Stop) is pushed - the knob of the haptic controller is pushed - the lamp of the LCD is touched ※ **Refer to page 5-71 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 and lights ON, and the buzzer stops when 2 seconds elapsed.
	Warning lamp pops up on the center of the LCD and the buzzer sounds	· The pop-up warning lamp moves to the original position and blinks, and the buzzer stops when 2 seconds elapsed.
	Warning lamp pops up on the center of the LCD and the buzzer sounds	※ **Refer to page 5-66 for details.**

※ Refer to page 5-76 for the buzzer stop switch (AUTO IDLE Buzzer Stop) and operator's manual page 3-67 for the haptic controller.

(1) Engine coolant temperature warning lamp



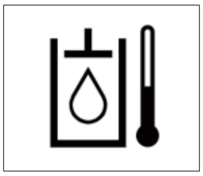
290F3CD61

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

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

③ Check the cooling system when the lamps keep blink.

(2) Hydraulic oil temperature warning lamp



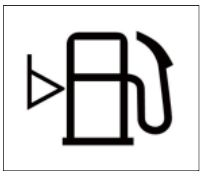
290F3CD62

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

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

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

(3) Fuel level warning lamp



290F3CD63

① This warning lamp pops up and the buzzer sounds when the level of fuel is below 55 ℓ (14.5 U.S. gal).

② Fill the fuel immediately when the lamp blinks.

(4) Emergency warning lamp

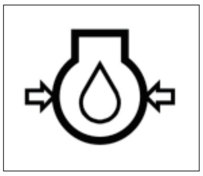
290F3CD64

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

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

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

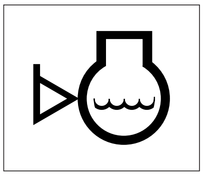
(5) Engine oil pressure warning lamp



290F3CD65

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

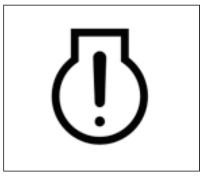
(6) Engine coolant low level warning lamp



760F3CD58

① This warning lamp pops up and the buzzer sounds when the level of coolant is low.
② Fill the coolant immediately when the lamp is ON.

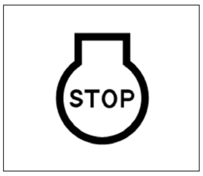
(7) Check engine warning lamp



290F3CD66

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

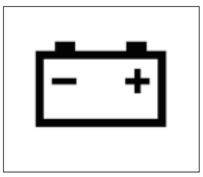
(8) Engine stop warning lamp



290F3CD252

① This warning lamp pops up and the buzzer sounds when 30 minutes elapsed with empty condition of the DEF/AdBlue® tank, stop the engine immediately and check the DEF/AdBlue® tank.
② Fill the DEF/AdBlue® immediately in the DEF/AdBlue® tank.
※ Refer to page 5-71.
③ This lamp pops up and the buzzer sounds when the stationary SCR system cleaning is not performed.
※ Refer to page 5-69.
※ Please contact your HD Hyundai Construction Equipment service center or local dealer.

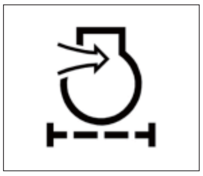
(9) Battery charging warning lamp



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.

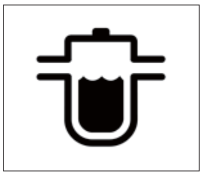
(10) Air cleaner warning lamp



290F3CD68

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

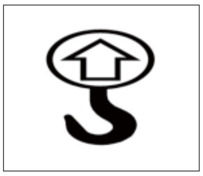
(11) Water in fuel warning lamp



210WF3CD02

① This warning lamp pops up and the buzzer sounds when the water separator is full of water or malfunctioning.
※ **When this lamp blinks, stop the machine and spill water out of the separator.**

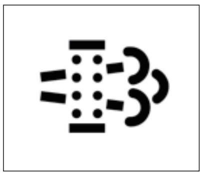
(12) Overload warning lamp (opt)



290F3CD69

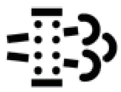
① When the machine is overload, the overload warning lamp pops up and the buzzer sounds during the overload switch is ON. (if equipped)
② The pop-up warning lamp moves to the original position and blinks, and the buzzer stops when 2 seconds elapsed.
③ Reduce the machine load.

(13) SCR (selective catalytic reduction) system cleaning warning lamp

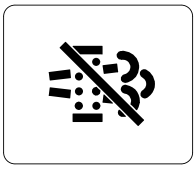


290F3CD70

① This warning lamp lights ON or blinks when the SCR system cleaning is needed as table below.

Warning lamp			Description
SCR	Check engine	Stop engine	
			
Off	Off	Off	· Automatic SCR system cleaning
Blink	Off	Off	· The status of a manual (stationary) SCR system cleaning when the SCR system cleaning switch has been activated. ※ **Refer to page 3-11.**
On	On	Off	· The aftertreatment SCR system needs to be cleaned immediately. · Engine power will be reduced automatically if action is not taken. ※ The SCR system cleaning can be accomplished by : - Changing to more challenging duty cycle. - Performing a manual SCR system cleaning.
On	On	On	· These lamps will be ON when a stationary (manual) SCR system cleaning is not performed. · Stop the engine immediately. · Please contact your HD Hyundai Construction Equipment service center or local dealer.

(14) SCR system cleaning inhibit warning lamp

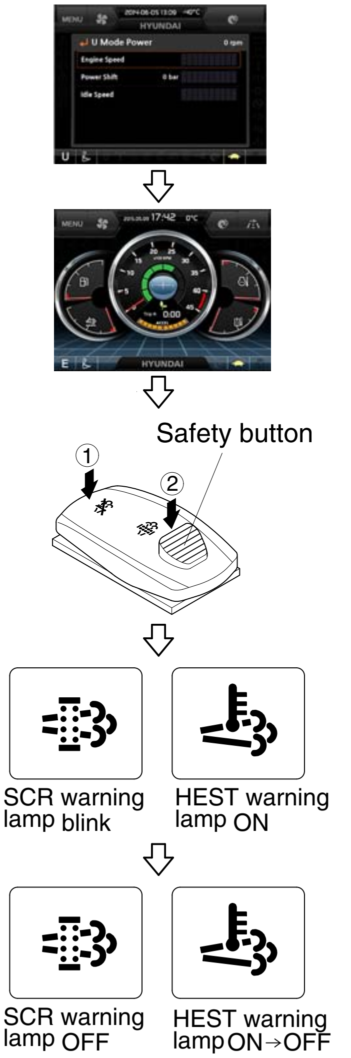


2609A3CD20

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

※ **Refer to the operator's manual page 3-43 for the SCR system cleaning switch.**

※ Manual SCR system cleaning



210WF3CD73

※ Manual SCR system cleaning applies if the machine is in a fireproof area.

※ To stop a manual SCR system cleaning before it has completed, set to the SCR 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 SCR system cleaning.

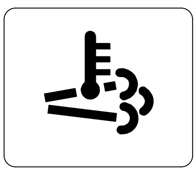
※ Refer to the operator's manual page 3-43 for the SCR system cleaning switch operation.

※ The engine speed may increase to 950~1050 rpm and SCR system cleaning begins and it will take approximately 20~60 minutes.

③ The SCR system cleaning warning lamp will blink and HEST warning lamp will light ON during the SCR system cleaning is operating.

④ The SCR system cleaning and/or HEST warning lamp will light OFF when the SCR system cleaning is completed.

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


2609A3CD21

① This warning lamp indicates, when illuminated, that exhaust temperatures are high due to SCR system cleaning.

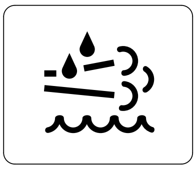
② The lamp will also illuminate during a manual SCR system cleaning.

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 will be common for the lamp to illuminate on and off during normal equipment operation as the engine completes SCR system cleaning.

(16) DEF/AdBlue® level warning lamp



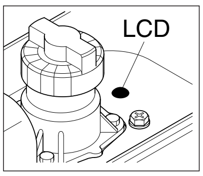
290F3CD257

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

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

Warning lamp			Description
DEF/AdBlue® level 	Check engine 	Stop engine 	
On	Off	Off	· The DEF/AdBlue® level has fallen below the initial warning level (10%).
Blink	Off	Off	· The DEF/AdBlue® level has fallen below the critical warning level (5%).
Blink	On	Off	· The DEF/AdBlue® level has fallen below the initial derate level (2.5%). · The engine power will be limited automatically.
Blink	On	On	· This is happened when 30 minutes 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 persent gauge reading.

(17) DEF/AdBlue® fill up warning lamp



290F3CD272

① This lamp lights ON when the DEF/AdBlue® tank is completely filled with DEF/AdBlue®.

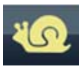
※ Fill the tank with the DEF/AdBlue® after start switch ON and then turn OFF the start switch.

※ Do not pour DEF/AdBlue® any more when this lamp lights ON. Otherwise DEF/AdBlue® tank may freeze and burst in winter season.

4) PILOT LAMPS

210WF3CD74

(1) Mode pilot lamps

No	Mode	Pilot lamp	Selected mode
1	Power mode		Heavy duty power work mode
			Standard power mode
			Economy power mode
2	User mode		User preferable power mode
3	Work mode		General operation 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

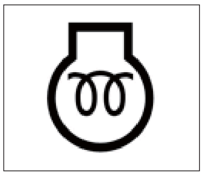
290F3CD78

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

② The power max function is operated maximum 8 seconds.

※ Refer to the operator's manual page 3-42 for power max function.

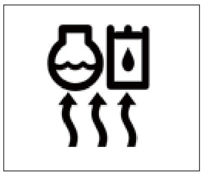
(3) Preheat pilot lamp



290F3CD79

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

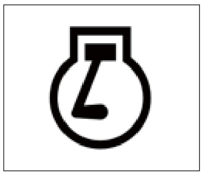
(4) Warming up pilot lamp



290F3CD80

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

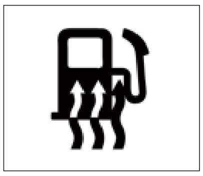
(5) Decel pilot lamp



290F3CD81

① Operating one touch decel switch on the RCV lever makes the lamp ON.
② Also, the lamp will be ON and engine speed will be lowered automatically to save fuel consumption when all levers and pedals are at neutral position, and the auto idle function is selected.
※ **One touch decel is not available when the auto idle pilot lamp is turned ON.**
※ **Refer to the operator's manual page 3-42.**

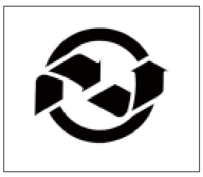
(6) Fuel warmer pilot lamp



290F3CD82

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

(7) Maintenance pilot lamp



290F3CD83

① This lamp will be ON when the consuming parts are needed to change or replace. It means that the change or replacement interval of the consuming parts remains below 30 hours.
② Check the message in maintenance information of main menu. Also, this lamp lights ON for 3 minutes when the start switch is ON position.
※ **Refer to the page 5-86.**

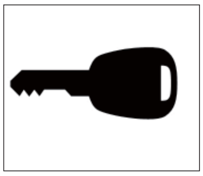
(8) Entertainment pilot lamp

290F3CD84

① This lamp is on when audio or video files are playing.

※ Refer to the page 5-92.

(9) Smart key pilot lamp (opt)



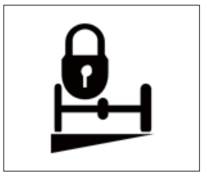
290F3CD214

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

② This lamp is red when the a authentication fails, green when succeeds.

※ Refer to the page 5-87.

(10) Ram lock pilot lamp

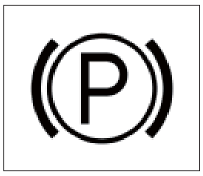


210WF3CD04

① This lamp is on when the ram lock switch is set to the LOCK position.

※ Refer to the operator's manual page 3-47.

(11) Parking pilot lamp

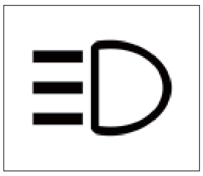


210WF3CD05

① This lamp is on when the the parking switch is set to the parking position.

※ Refer to the operator's manual page 3-47.

(12) High beam pilot lamp



210WF3CD06

① The lamp is on 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.

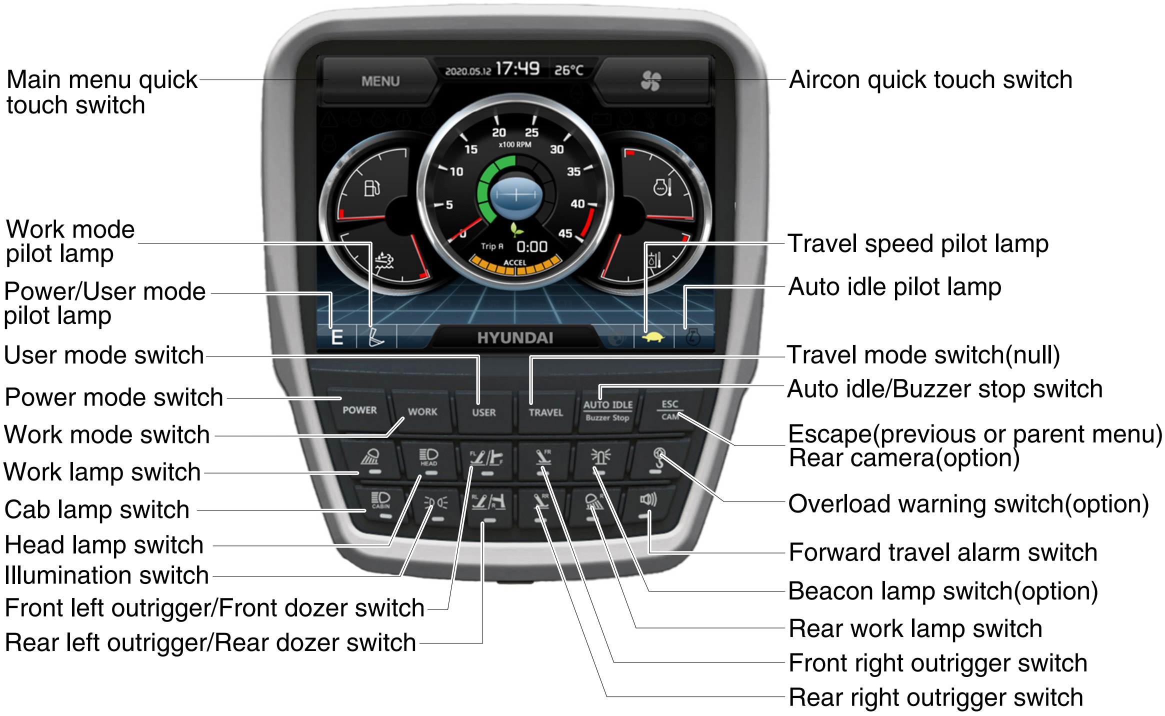
(13) Working brake pilot lamp

210WF3CD07

① This lamp is ON when the working brake switch is set to working position.

※ Refer to the operator's manual page 3-47.

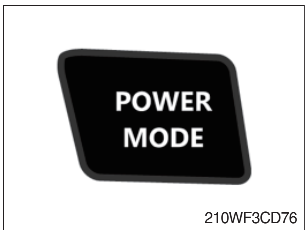
5) SWITCHES



210WF3CD86A

※ When some of the switches are selected, the pilot lamps are displayed on the LCD. Refer to the page 3-13 for details.

(1) Power mode switch

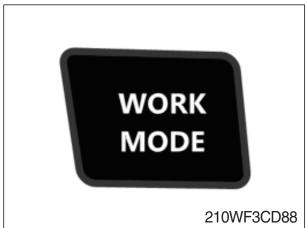


210WF3CD76

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

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

(2) Work mode switch



210WF3CD88

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

※ Refer to the operator's manual page 4-7 for details.

(3) User mode switch

210WF3CD89

① This switch is used to memorize the current machine operating status in the MCU and activate the memorized user mode.
- · Memory : Automatically saved after key OFF.
- · Action : Push this switch.
- · Cancel : Push this switch once more.

② Refer to page 5-81 for another set of user mode.

(4) Auto idle/ buzzer stop switch

210WF3CD90

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.

(5) Travel mode switch (null)

210WF3CD91

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

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

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

(6) Escape/Camera switch

210WF3CD92

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 5-93 for the camera.

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

(7) Work lamp switch

210WF3CD93

① This switch is used to operate the work lamp.

② The pilot lamp is turned ON when operating the switch.

(8) Head lamp switch

210WF3CD94

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

(9) 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 is turned ON when operating the switch.
※ **Please check the installed equipment (outrigger or dozer) on your machine before selecting the switch.**
※ **Refer to the operator's manual page 3-49 for the dozer and outrigger lever.**

(10) Front right outrigger switch

210WF3CD96

① This switch is used to select the front right outrigger operation if equipped.
② The pilot lamp is turned ON when operating the switch.
※ **Refer to the operator's manual page 3-49 for the dozer and outrigger lever.**

(11) Rear left outrigger/Rear dozer switch

210WF3CD100

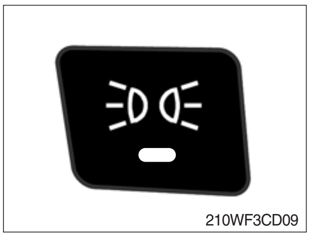
① This switch is used to select the rear left outrigger or rear dozer blade operation.
② The pilot lamp is turned ON when operating the switch.
※ **Please check the installed equipment (outrigger or dozer) on your machine before selecting the switch.**
※ **Refer to the operator's manual page 3-49 for the dozer and outrigger lever.**

(12) Rear right outrigger switch

210WF3CD08

① This switch is used to select the rear right outrigger operation if equipped.
② The pilot lamp is turned ON when operating the switch.
※ **Refer to the operator's manual page 3-49 for the dozer and outrigger lever.**

(13) Illumination switch


210WF3CD09

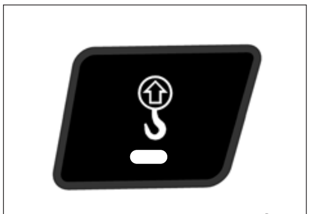
① This switch is used to turn on the clearance lamp and all panel lamps.
② The pilot lamp is turned ON when operating the switch.

(14) Beacon lamp switch


210WF3CD97

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

(15) Overload warning switch


210WF3CD98

① When this switch turned ON, buzzer makes sound and overload warning lamp blinks in case that the machine is overload.
② When it turned OFF, buzzer stops and warning lamp goes out.
③ The pilot lamp is turned ON when operating the switch.
⚠ **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.**

(16) Cab lamp switch

210WF3CD99

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

(17) Rear work lamp switch

210WF3CD10

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

(18) Travel alarm switch


210WF3CD101

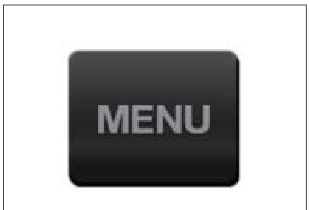
① The alarm makes sound when the machine travels to backward.
· This switch is for Crawler excavators only.

(19) Air conditioner quick touch switch


210WF3CD216

① This switch used to select air conditioner control mode.
※ Refer to page 5-95.

(20) Main menu quick touch switch



210WF3CD217

① This switch is to activate the main menu in the cluster.
※ Refer to page 5-80.

(21) Entertainment quick touch switch

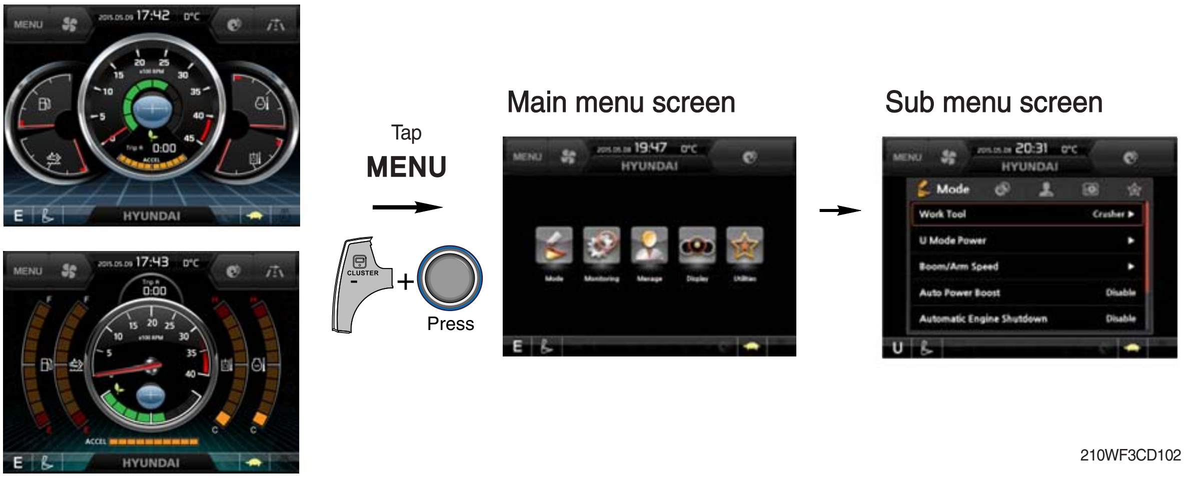

210WF3CD218

① This switch is to activate the entertainment control menu in the cluster (video player, audio player, smart terminal).
※ Refer to page 5-92.

6) MAIN MENU

※ You can select or set the menu by the haptic controller or touch screen.
On the operation screen, tap MENU to access the main menu screen.
On the sub menu screen, you can tap the menu bar to access functions or applications.

· Operation screen



210WF3CD102

※ Please refer to the haptic controller, the operator's manual page 3-67 for selection and change of menu and input value.

(1) Structure

No	Main menu	Sub menu	Description
1	 Mode 290F3CD103	Work tool U mode power Boom/Arm speed Auto power boost Auto engine shutdown (option) Initial mode Emergency mode	Breaker, Crusher, Not installed User mode only Boom speed, Arm speed Enable, Disable One time, Always, Disable Key on initial mode, Accel initial mode / step Switch function
2	 Monitoring 290F3CD104	Active fault Logged fault Delete logged fault Monitoring	MCU, Engine ECM MCU, Engine ECM All logged fault delete, Initialization canceled Machine information, Switch status, Output status,
3	 Management 290F3CD105	Fuel rate information Maintenance information Machine security Machine information Contact Service menu Clinometer Update	General record, Hourly, Daily, Mode record Replacement, Change interval oils and filters ESL mode setting, Password change Model, MCU, Monitor, Haptic / switch controller, RMCU, Relay drive unit, FATC, AAVM (opt) A/S phone number, A/S phone number change Power shift, Operating hour, IPC mode, Breaker mode pump acting, EPPR current level, Overload pressure Clinometer setting Cluster, ETC device
4	 Display 290F3CD106	Display item Clock Brightness Unit setup Language selection Screen type	Engine speed, Tripmeter A, Tripmeter B, Tripmeter C Clock Manual, Auto Temperature, Pressure, Flow, Distance, Date format Korean, English, Chinese, ETC A type, B type
5	 Utilities 290F3CD107	Entertainment Tripmeter Camera	Play Video, Audio, Smart terminal. 3 kinds (A, B, C) Number of active, Display order, AAVM (opt)

(2) Mode setup

① Work tool

210WF3CD108

210WF3CD253

A

210WF3CD254

B

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

② U mode power

210WF3CD111

210WF3CD112

Step (▮)	Engine speed (rpm)	Idle speed (rpm)	Power shift (bar)
1	1300	750	0
2	1400	800	3
3	1500	850	6
4	1600	900	9
5	1700	950	12
6	1800	1000 (auto decel)	16
7	1850	1050	20
8	1900	1100	26
9	1950	1150	32
10	2000	1200	38

※One touch decel & low idle : 850 rpm

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

③ Boom/Arm speed

210WF3CD113

210WF3CD114

210WF3CD115

- 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


210WF3CD118

210W3CD117

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

⑤ Automatic engine shutdown (option)


210WF3CD11

210WF3CD12

210WF3CD13

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

⑥ Initial mode


210WF3CD122

210WF3CD119

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

· Accel initial mode
- Last setting value
- User setting value

· Accel initial step
- 0~9 step

⑦ Emergency mode

210WF3CD248

210WF3CD249

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

(3) Monitoring

① Active fault

210WF3CD120

210WF3CD121

210WF3CD125

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

② Logged fault

210WF3CD128

210WF3CD126

210WF3CD123

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

③ Delete logged fault

210WF3CD134

210WF3CD126

210WF3CD127

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

④ Monitoring

210WF3CD172

210WF3CD188

210WF3CD189

· The machine status such as the engine rpm, oil temperature, voltage and pressure etc. can be checked by this menu (Analog input).
· The switch status or output status can be confirmed by this menu (Digital input & Digital output).
· The activated switch or output pilot lamps ● are light ON.

(4) Management

① Fuel rate information

210WF3CD14

210WF3CD15

A

· General record (A)
  - Average fuel rate (left) (from "Reset" to now)
    Fuel consumption devided by engine run time (service meter time).
  - A days fuel used (right)
    Fuel consumption from 24:00 (or "Reset" time) to now (MCU real time).

B

· Hourly record (B)
  - Hourly fuel rates for past 12 hours (service meter time).
  - No record during key-off time.
  - One step shift to the right for every one hour.
  - Automatic deletion for 12 hours earlier data.
  - All hourly records deletion by "Reset".

C

· Daily record (C)
  - Daily fuel consumption for past seven days (MCU real time).
  - No record during key-off time.
  - One step shift to the right at 24:00 for every day.
  - Automatic deletion for 7 days earlier data.
  - All daily records deletion by "Reset".

D

210WF3CD16

· Mode record (D)
  - Average fuel rate for each power mode/accel dial (at least 7) from "Reset" to now.
  - No record during idle.
  - All mode records deletion by "Reset".

② Maintenance information

210WF3CD131

210WF3CD132

210WF3CD133

· Alarm lamp (●) is ON when oil or filter needs to be changed or replaced.
· Replacement : The elapsed time will be reset to zero (0).
· Change interval : The change or replace interval can be changed in the unit of 50 hours.
· Change or relpace interval

No	Item	Interval
1	Engine oil	500
2	Final gear oil	1000
3	Swing gear oil	1000
4	Hydraulic oil	5000
5	Pilot line filter	1000
6	Drain filter	1000
7	Hydraulic oil return filter	1000
8	Engine oil filter	500
9	Fuel filter	500
10	Pre-filter	500
11	Hydraulic tank breather	1000
12	Air cleaner (inner & outer)	4000
13	Radiator coolant	2000
14	Swing gear pinion grease	1000
15	DEF/AdBlue® supply module filter	4500
16	Transmission oil	1000
17	Front axle differential gear oil	1000
18	Rear axle differential gear oil	1000
19	Axle planetary gear oil	1000
20	Crankcase Breather Filter	2000
21	DEF/AdBlue® Tank Filter	4000

③ Machine security

210WF3CD190

210WF3CD135

210WF3CD136

· 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.
- If the ESL mode was selected Enable, the password will be required when the start switch is turned ON.
- Machine security

  Disable : Not used ESL function

  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 maximum 4 hours.

  ※Default password : 00000 + ☑

  ※Password length : (5~10 digit) + ☑
- Smart key (option) : 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 entering is needed.

210WF3CD137

210WF3CD138

· Password change

- The password is 5~10 digits.

210WF3CD190

210WF3CD140

210WF3CD135

Enter the current password

210WF3CD143

Enter the new password again

210WF3CD142

Enter the new password

④ Machine Information

210WF3CD144

210WF3CD145

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

⑤ Contact (A/S phone number)

210WF3CD146

210WF3CD147

210WF3CD148

Enter the new A/S phone number

⑥ Clinometer

210WF3CD152

210WF3CD153

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

⑦ Update (cluster & ETC devices)

210WF3CD17

210WF3CD18

210WF3CD19

210WF3CD21

210WF3CD20

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

⑧ Service menu

210WF3CD149

210WF3CD250

290F3CD151

· Power shift (standard/option) : Power shift pressure can be set by option menu.
· Operating hours : Operating hours since the machine line out can be checked by this menu.
· IPC mode : IPC mode 1, IPC mode 2, Not used.
· Breaker mode pump acting (1 pump/2 pump)
· EPPR current level (attach flow EPPR 1 & 2, boom priority EPPR, attach relief pressure EPPR 1& 2)
· Overload pressure : 100 ~ 350 bar

(5) Display

① Display item

210WF3CD154

210WF3CD155

210WF3CD156

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

② Clock

210WF3CD157

210WF3CD158

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

③ Brightness

210WF3CD159

210WF3CD160

210WF3CD139

210WF3CD141

210WF3CD191

210WF3CD192

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

④ Unit

210WF3CD161

210WF3CD162

290F3CD193

- Temperature : ˚C ↔ ˚F
- Pressure : bar ↔ MPa ↔ kgf/cm²
- Volume : l ↔ gal
- Flow : lpm ↔ gpm
- Distance : km ↔ mile
- Date format : yy/mm/dd ↔ mm/dd/yy ↔ dd-mm-yy

⑤ Language

210WF3CD163

210WF3CD164

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

⑥ Screen type

210WF3CD165

A Type (Default) 290F3CD166

210WF3CD156

B Type (Option) 290F3CD194

210WF3CD167A

(6) Utilities

① Entertainment

210WF3CD195

A

210WF3CD196

210WF3CD219

B

210WF3CD197

210WF3CD220

C

210WF3CD198

210WF3CD199

210WF3CD22

- Video (A) : This menu operates the video play function.
  mp4, mkv, avi files and so on.
- Audio (B) : This menu operates the play music.
  mp3, mp4 files and so on.
- Smart terminal (C) : The menu features a smartphone and operates the miracast.

② Tripmeter

210WF3CD168

210WF3CD169

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

③ Camera setting

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

210WF3CD200

210WF3CD255

210WF3CD256

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

210WF3CD156


290F3CD221

④ AAVM (All Around View Monitoring, option)

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

210WF3CD244

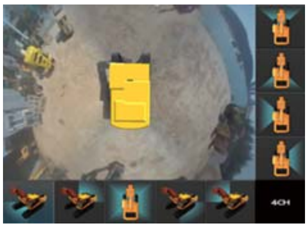
- **Escape button**

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

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

290F3CD156

The beginning screen



AAVM mode 290F3CD222

- **Buzzer stop button**

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

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

290F3CD246

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

290F3CD247

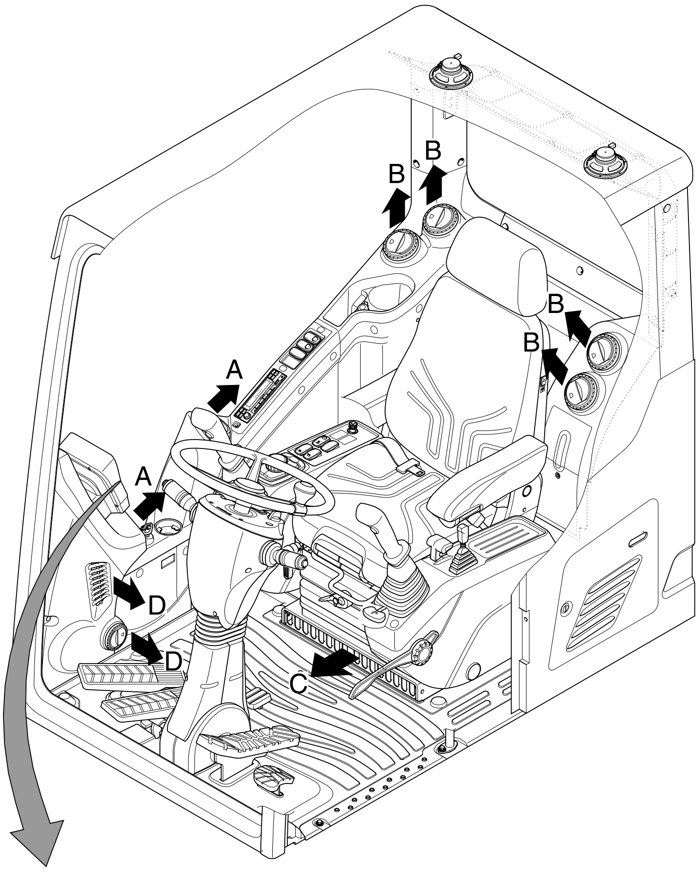
· When the worker or pedestrian go inside of red line (radius 3 ㎙), an internal danger area of equipping on the cluster screen, the warning buzzer sounds and it displays the red rectangular box for the recognition of the worker and pedestrian.
At this time, the operator should stop work immediately,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

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

7) AIR CONDITIONER AND HEATER

Full auto temperature control air conditioner and heater system automatically keeps the optimum condition in accordance with operator's temperature configuration sensing ambient and cabin inside temperature.

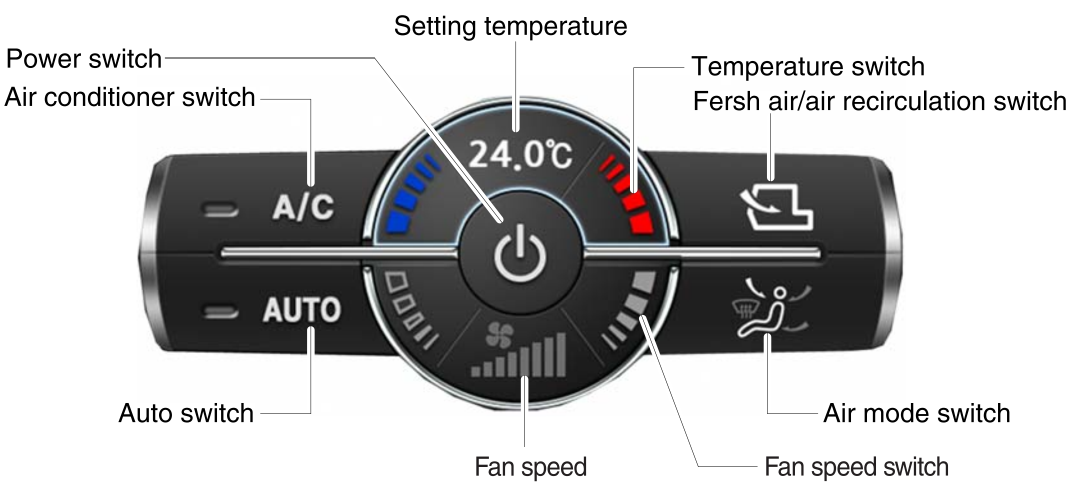
· Location of air flow ducts



Cluster LCD

Cluster : [fan icon] or

Haptic controller : SET



210WF3CD201

※ Haptic controller : Refer to the operator's manual page 3-67.

(1) Power switch


290F3CD251

① This switch makes the system ON/OFF.
Just before the power OFF, set values are stored.
② Default setting values

Function	Air conditioner	In/outlet	LCD	Temperature	Mode
Value	OFF	Inlet	OFF	Previous sw OFF	Previous sw OFF

(2) Air conditioner switch

290F3CD203

① This switch turns the compressor ON/OFF.
※ Air conditioner operates to remove vapor and drains water through a drain hose. Water can be sprayed into the cab in case that the drain cock at the ending point of drain hose has a problem.
In this case, exchange the drain cock.

(3) Auto switch

290F3CD223

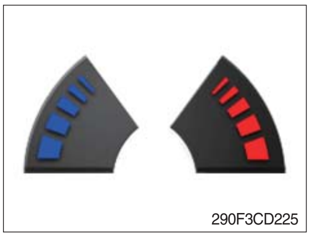
① Auto air conditiner and heater system automatically keeps the optimum condition in accordance with operator's temperature configuration sensing ambient and cabin inside temperature.

(4) Setting temperature

290F3CD224

① Display the temperature setting out.

(5) Temperature switch


290F3CD225

① Setting temperature indication
· Lo (17˚C), 17.5~31.5˚C, Hi (32˚C)
② Max cool and max warm beeps 5 times.
③ The max cool or the max warm position operates as following table.

Temperature	Compressor	Fan speed	In/outlet	Mode
Max cool	ON	Hi (8 step)	Recirculation	Face
Max warm	OFF	Hi (7 step)	Fresh	Def/Foot

④ Temperature unit can be changed between celsius (˚C) and fahrenheit (˚F)
a. Default status (˚C)
b. Push Up/Down temperature switch simultaneously more than 5 second displayed temperature unit change (˚C → ˚F)

(6) Fan speed switch

290F3CD226

① Fan speed is controlled automatically by setted temperature.
② This switch controls fan speed manually.
- There are 8 up/down steps to control fan speed.
- The maximum step or the minimum step beeps 5 times.

(7) Fan speed

290F3CD227

① Steps 1 through 8 to display the amount of wind.

(8) Fresh air/air recirculation switch

290F3CD228

① It is possible to change the air-inlet method.

a. Fresh air ( )
Inhaling air from the outside.

b. Air recirculation ( )
It recycles the heated or cooled air to increase the energy efficiency.

※ Change air occasionally when using recirculation for a long time.

※ Check out the fresh air filter and the recirculation filter periodically to keep a good efficiency.

(9) Air mode switch

290F3CD229

① Operating this switch, it beeps and displays symbol of each mode in order. (Face → Face/Rear → Face/Rear/Foot → Foot → Def/Foot)

Mode switch		Face	Face/Rear	Face/Rear/Foot	Foot	Def/Foot
Outlet	A	●	●	●		
	B		●	●		
	C			●	●	●
	D					●

② When defroster mode operating, FRESH AIR/AIR RECIRCULATION switch turns to FRESH AIR mode and air conditioner switch turns ON.

8) SELF DIAGNOSIS FUNCTION

(1) Diagnostic methods : Diagnostic information window, select

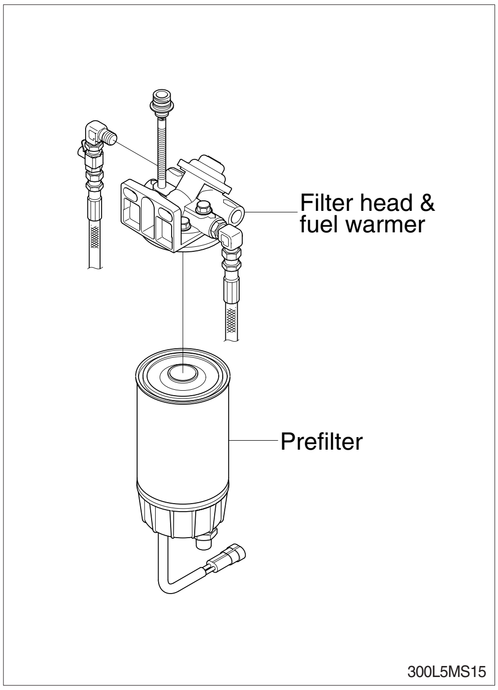
(2) Diagnostic indication (Displays fault)

Fault code	Description	Fail safe function
F01	Ambient temperature sensor open	20˚C alternate value control
F02	Ambient temperature sensor short	
F03	Cab inside temperature sensor open	25˚C alternate value control
F04	Cab inside temperature sensor short	
F05	Evaporate temperature sensor open	0˚C alternate value control
F06	Evaporate temperature sensor short	
F07	Null	-
F08	Null	-
F09	Mode 1 actuator open/short	The alternate value is face
F10	Mode 1 actuator drive circuit malfunction	If not, the alternate value is Def/Foot
F11	Intake actuator open/short	The alternate value is air recirculation
F12	Intake actuator drive circuit malfunction	The alternate fresh air
F13	Temperature actuator open/short	If opening amount is 0 %, the alternate value is 0 %
F14	Temperature actuator drive circuit malfunction	If not, the alternate value is 100 %
F15	Null	-
F16	Null	-

GROUP 17 FUEL WARMER SYSTEM

1. SPECIFICATION

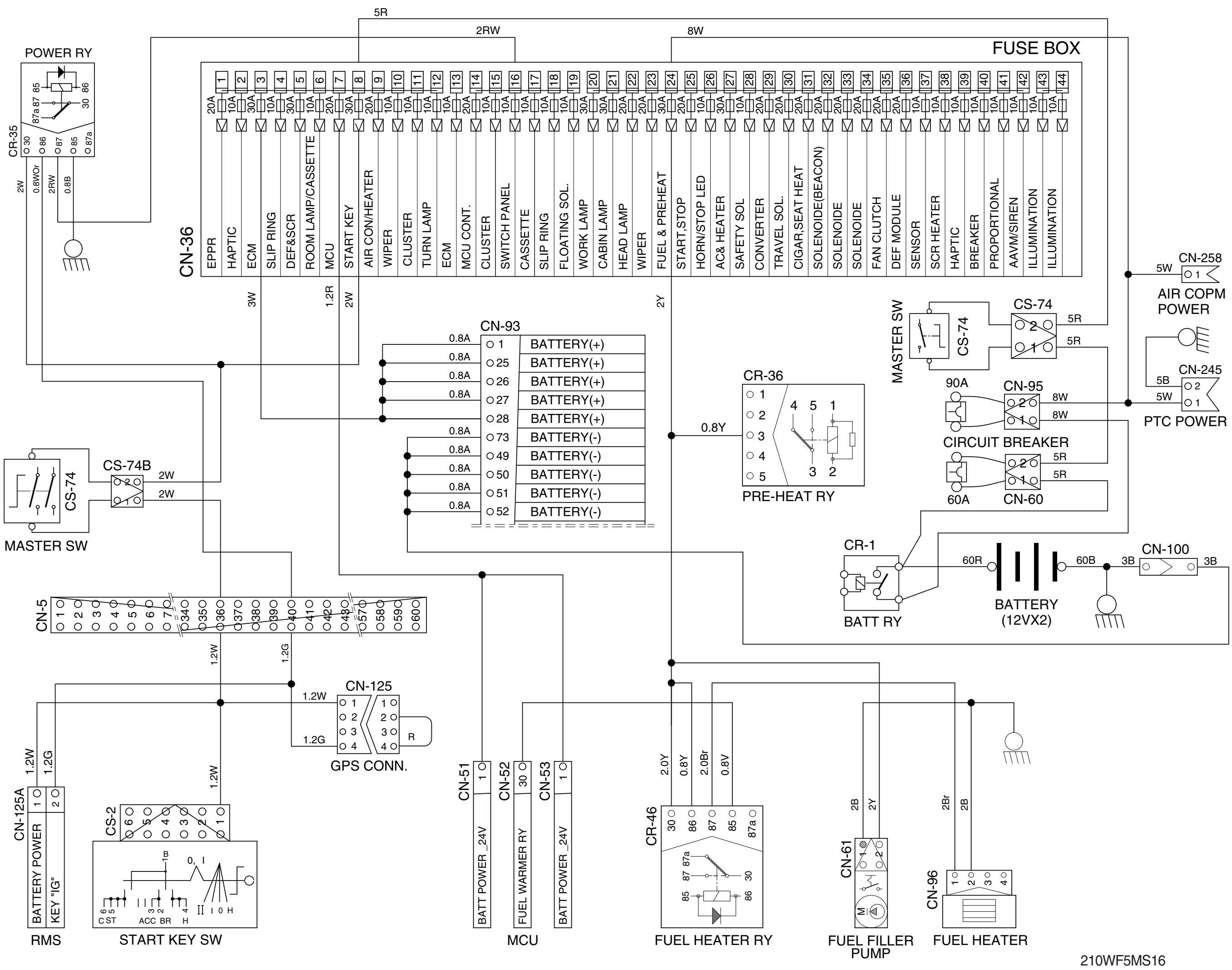
1) Operating voltage : 24±4 V
2) Power : 350±50 W
3) Current : 15 A



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



SECTION 6 TROUBLESHOOTING

SECTION 6 TROUBLESHOOTING

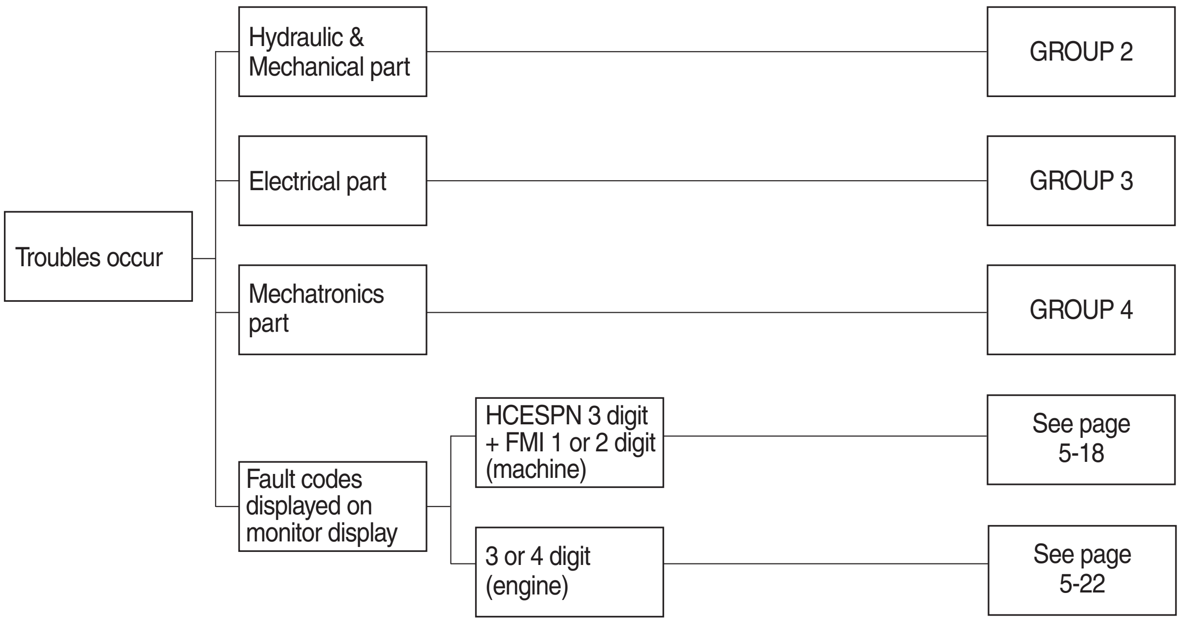
GROUP 1 BEFORE TROUBLESHOOTING

1. INTRODUCTION

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

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

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

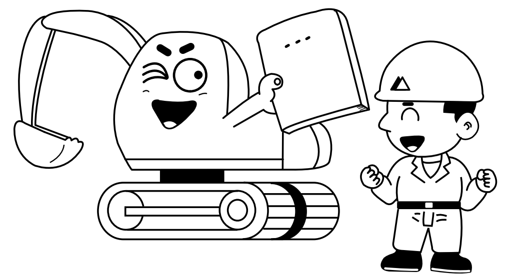


2. DIAGNOSING PROCEDURE

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

STEP 1. Study the machine system

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

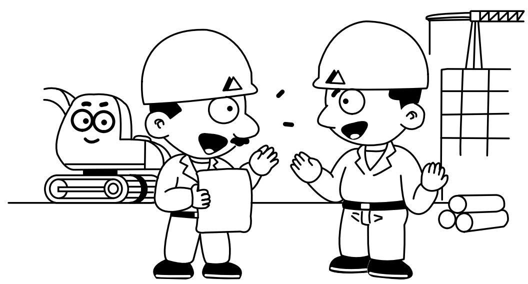


13031SH02

STEP 2. Ask the operator

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

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



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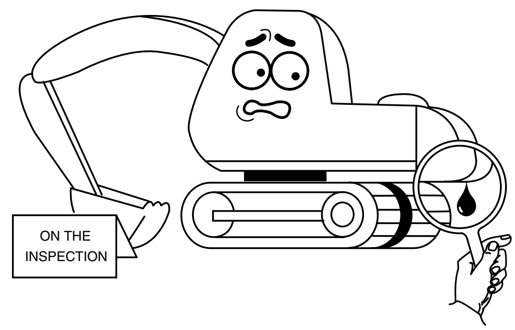
STEP 3. Inspect the machine

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

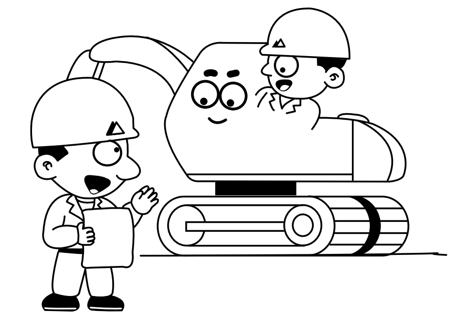
And also check the electrical system including batteries, as the troubles in the electrical system such as low battery voltage, loose connections and blown out fuses will result in malfunction of the controllers causing total operational failures of the machine.



(210-7) 6-2(3)

STEP 4. Inspect the trouble actually on the machine

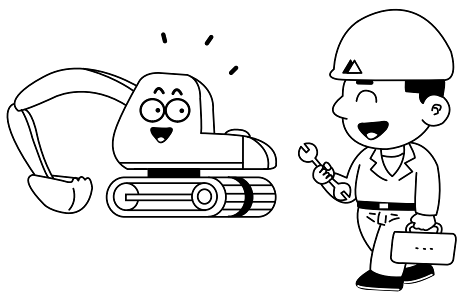
In case that some trouble cannot be confirmed, obtain the details of the malfunction from the operator.
Also, check if there are any in complete connections of the wire harnesses are or not.



(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.



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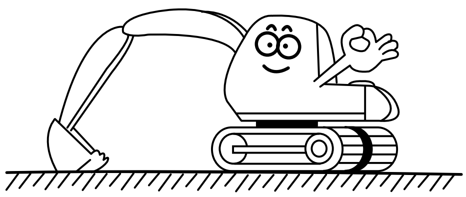
STEP 6. Trace a cause

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.

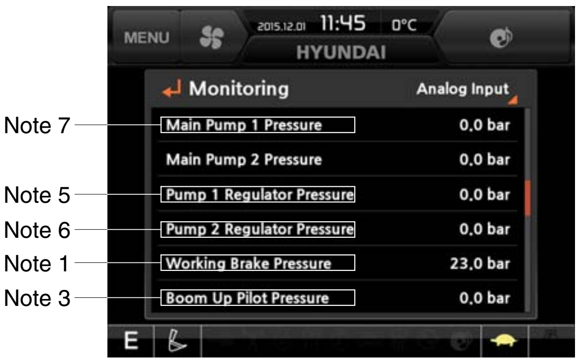
(3) When carrying out troubleshooting, do not hurry to disassemble the components.
It will become impossible to find the cause of the problem.

(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?

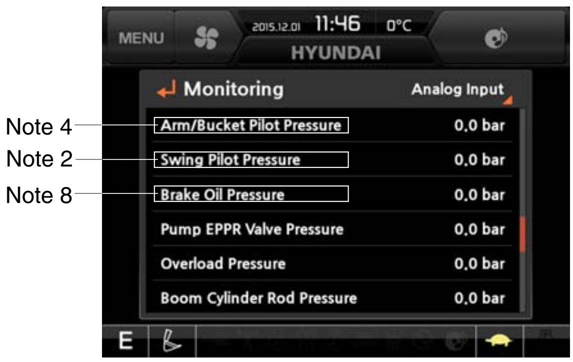
(5) Check before troubleshooting.
① Check oil and fuel level.
② Check for any external leakage of oil from components.
③ Check for loose or damage of wiring and connections.

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

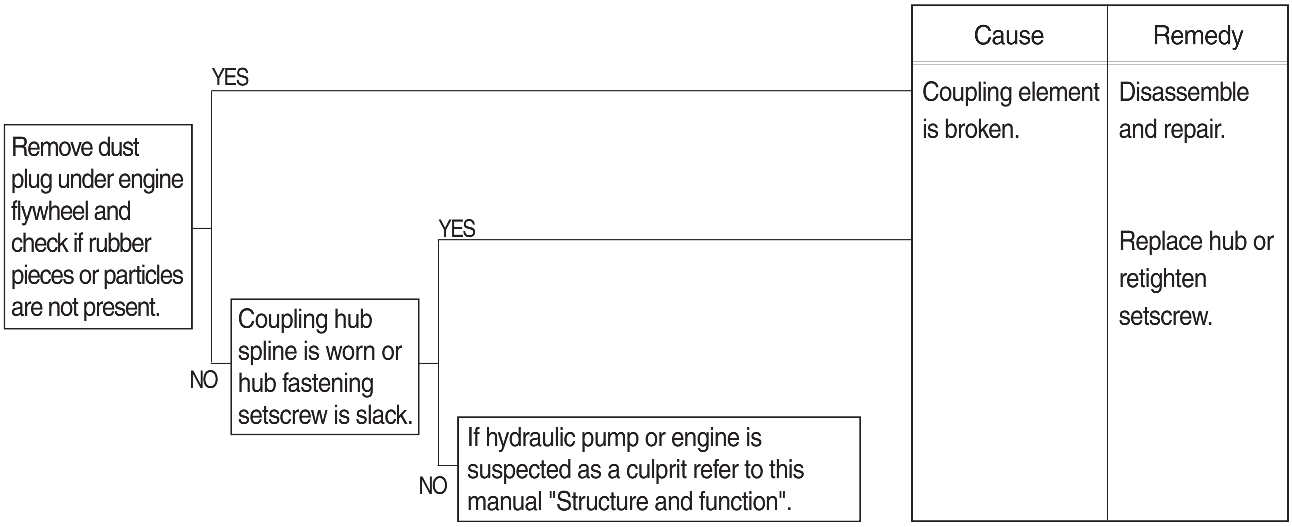
210WF6HS01

(2) Specification

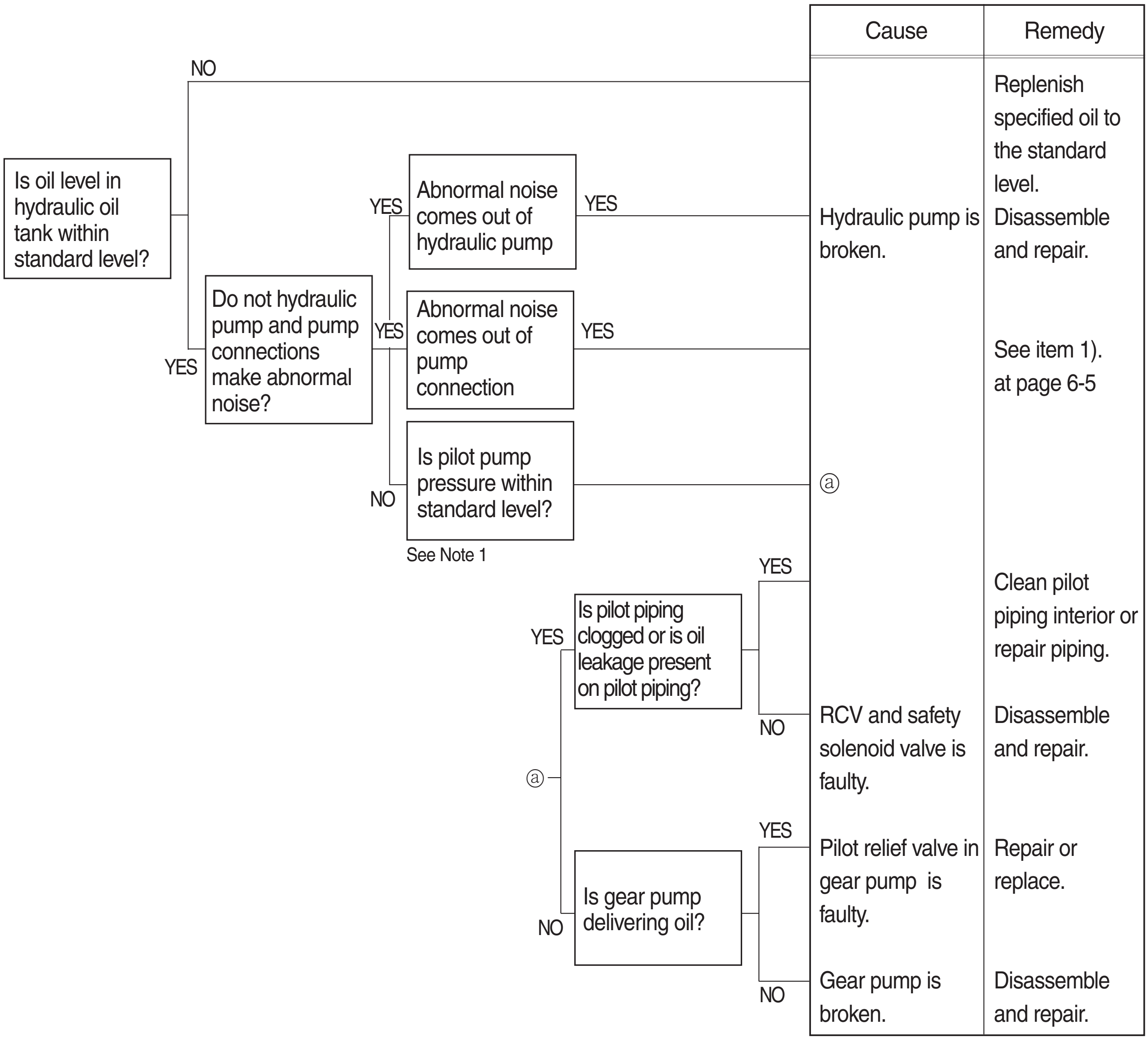
No.	Description	Specification
Note 1	Work pilot pressure	40^{+2}_{0} bar
Note 2	Swing pilot pressure	0~40 bar
Note 3	Boom up pilot pressure	0~40 bar
Note 4	Arm/bucket pilot pressure	0~40 bar
Note 5	Pump 1 regulator pressure	0~50 bar
Note 6	Pump 2 regulator pressure	0~50 bar
Note 7	Pump 1 pressure	350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

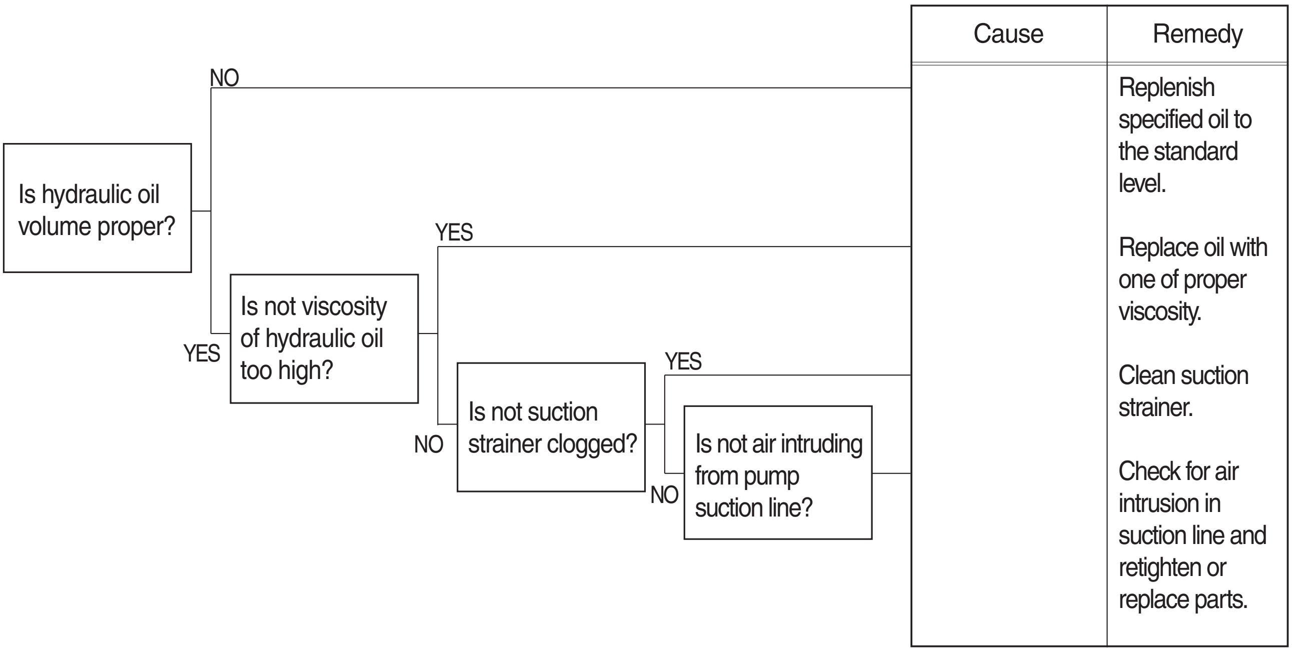
1) HYDRAULIC OIL IS CLOUDY

Check	Result	Cause	Remedy
Drop hydraulic oil sample on hot plate and check if foams come up.	YES	Water is mixed.	Put hydraulic oil still, separate water and dispose it or replace hydraulic oil.
	NO	Air is intruded.	Check suction line and return line and eliminate the air intruding source.

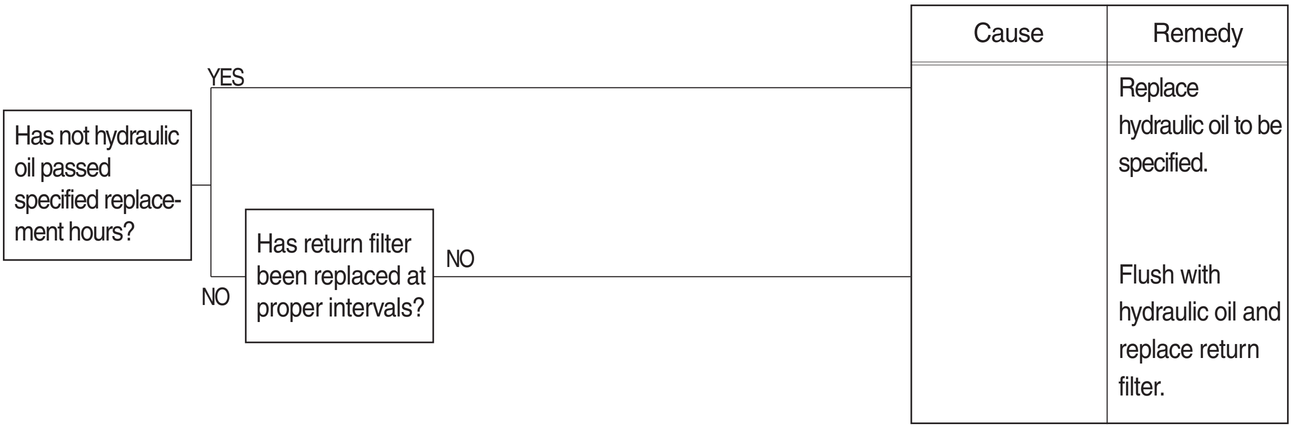
2) HYDRAULIC OIL TEMPERATURE HAS RISEN ABNORMALLY

Check	Result	Cause	Remedy
Is hydraulic oil volume proper?	NO		Replenish specified oil to the standard level.
Is hydraulic oil volume proper? YES → Is oil cooler clogged and is bypass check valve always open?	YES	Oil cooler clogged. Bypass check valve is defective.	Clean oil cooler. Replace
Is oil cooler clogged and is bypass check valve always open? NO → Is fan belt tension proper?	YES	ⓐ	
Is fan belt tension proper?	NO		Adjust belt tension or replace belt.
ⓐ Is not the set pressure of main relief, port relief and travel relief valve lower than the standard level?	YES		Readjust set pressure.
Is not the set pressure ... lower than the standard level? NO → Is main relief valve used very often?	YES		Reduce load.

3) CAVITATION OCCURS WITH PUMP

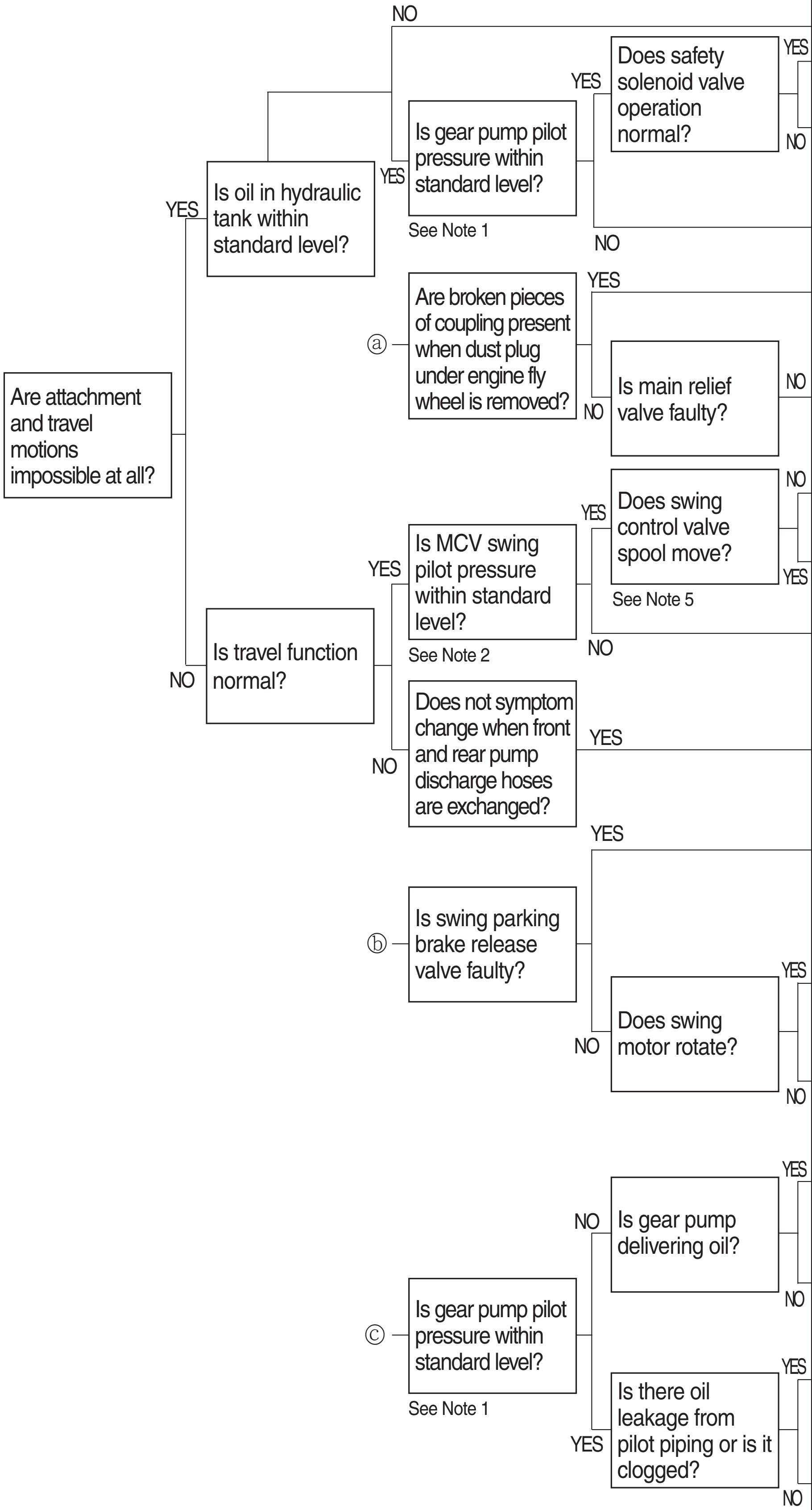


4) HYDRAULIC OIL IS CONTAMINATED



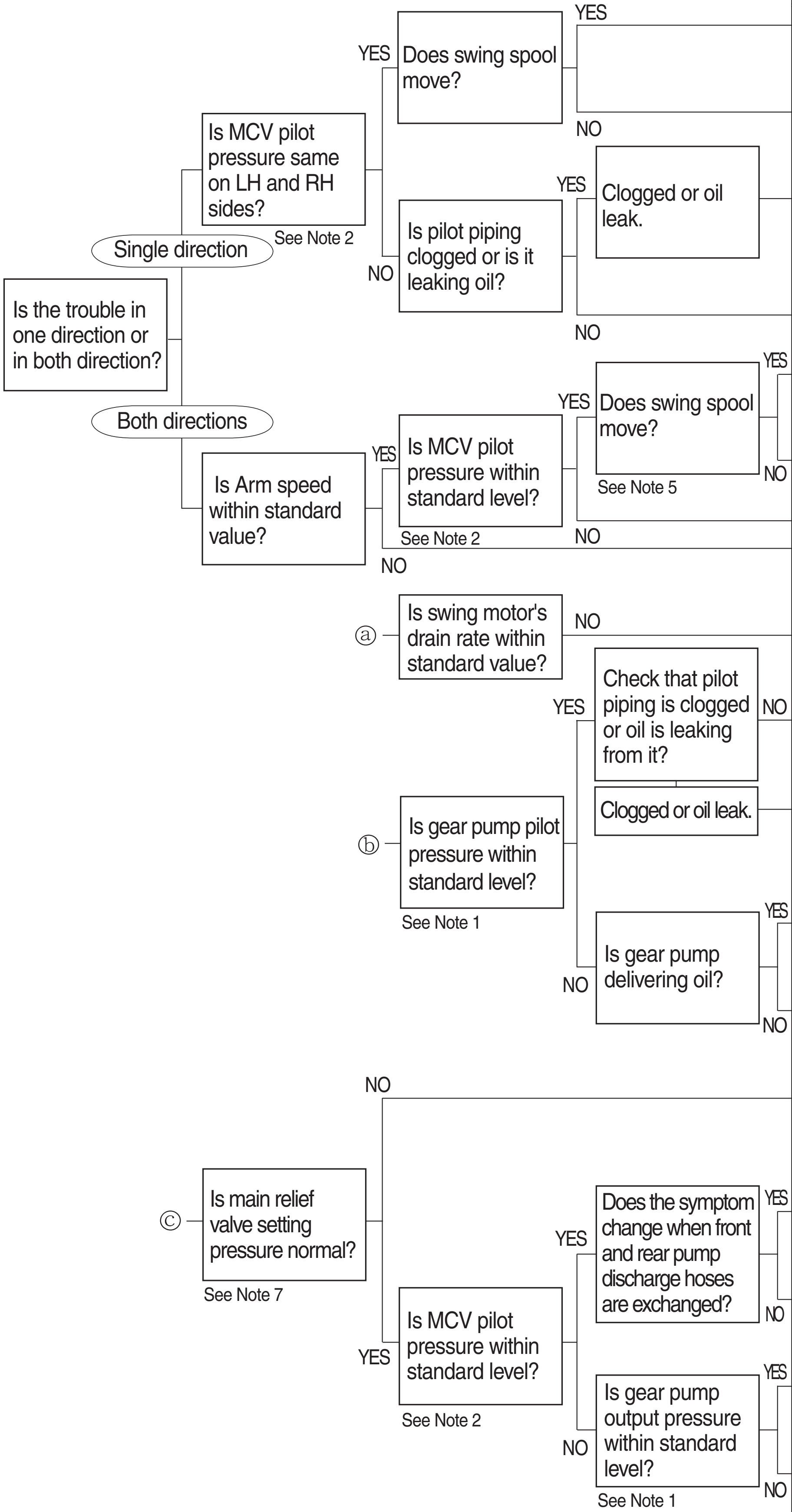
4. SWING SYSTEM

1) BOTH LH AND RH SWING ACTIONS ARE IMPOSSIBLE



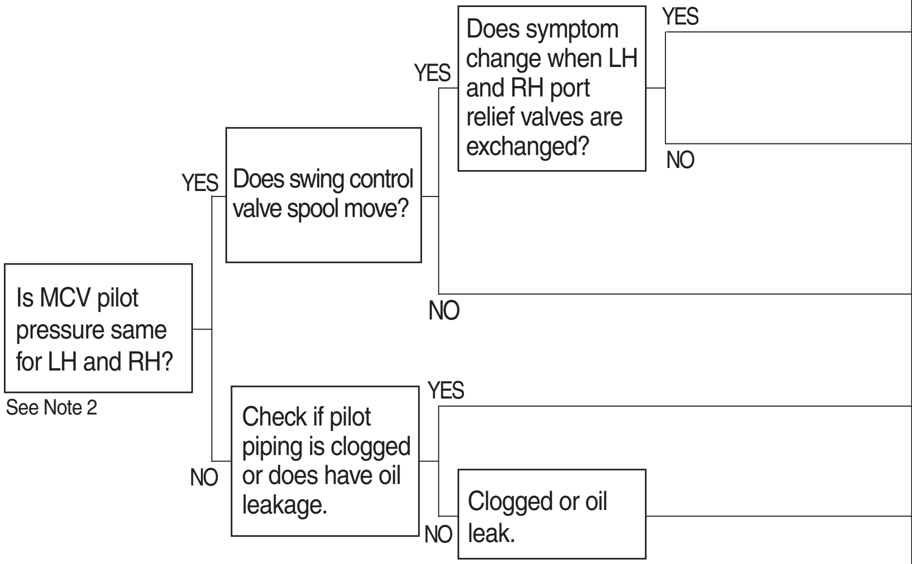
Cause	Remedy
ⓐ	Replenish specified oil to the standard level.
Safety solenoid valve faulty or not operated.	Repair or replace.
Gear pump faulty.	Repair or replace.
Pump connection coupling is broken.	Disassemble and repair.
Hydraulic pump is out of order.	Disassemble and repair.
Swing control valve spool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

2) SWING SPEED IS LOW



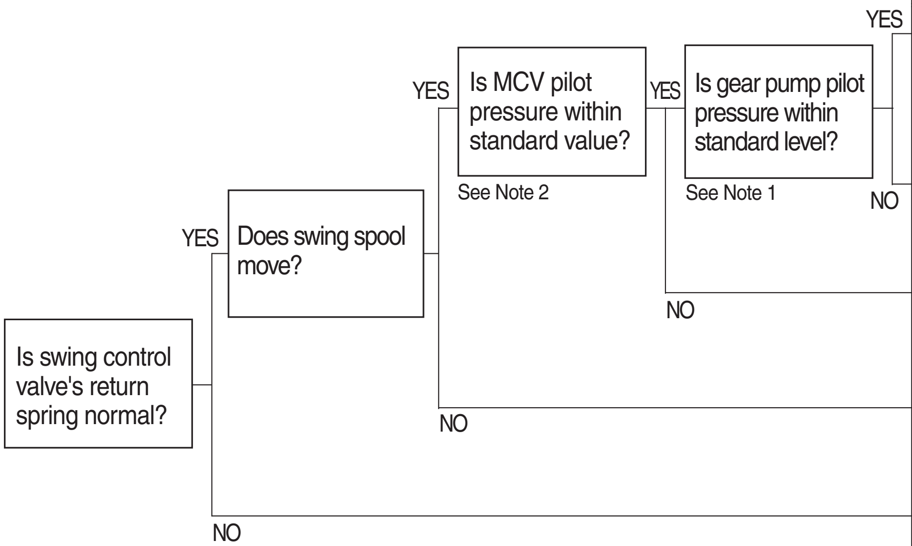
Cause	Remedy
Swing port relief valve is faulty.	Disassemble and repair or replace.
Swing control valve spool is stuck.	Disassemble and repair.
	Clean pilot piping interior or repair piping.
RCV or shuttle valve is faulty.	Disassemble and repair.
Swing spool is stuck.	Disassemble and repair.
Swing motor is broken.	Disassemble and repair.
RCV or shuttle valve is faulty.	Disassemble and repair.
	Clean pilot piping interior or repair piping.
Pilot relief valve in gear pump is defective.	Disassemble and repair or replace.
Gear pump is broken.	Disassemble and repair.
Main relief valve faulty.	Main relief valve pressure resetting or repair.
Hydraulic pump is broken.	Disassemble and repair.
Shuttle valve is faulty.	Repair or replace.
Pilot relief valve is faulty.	Repair or replace.
Gear pump is faulty.	Repair or replace.

3) SWING MOTION IS IMPOSSIBLE IN ONE DIRECTION



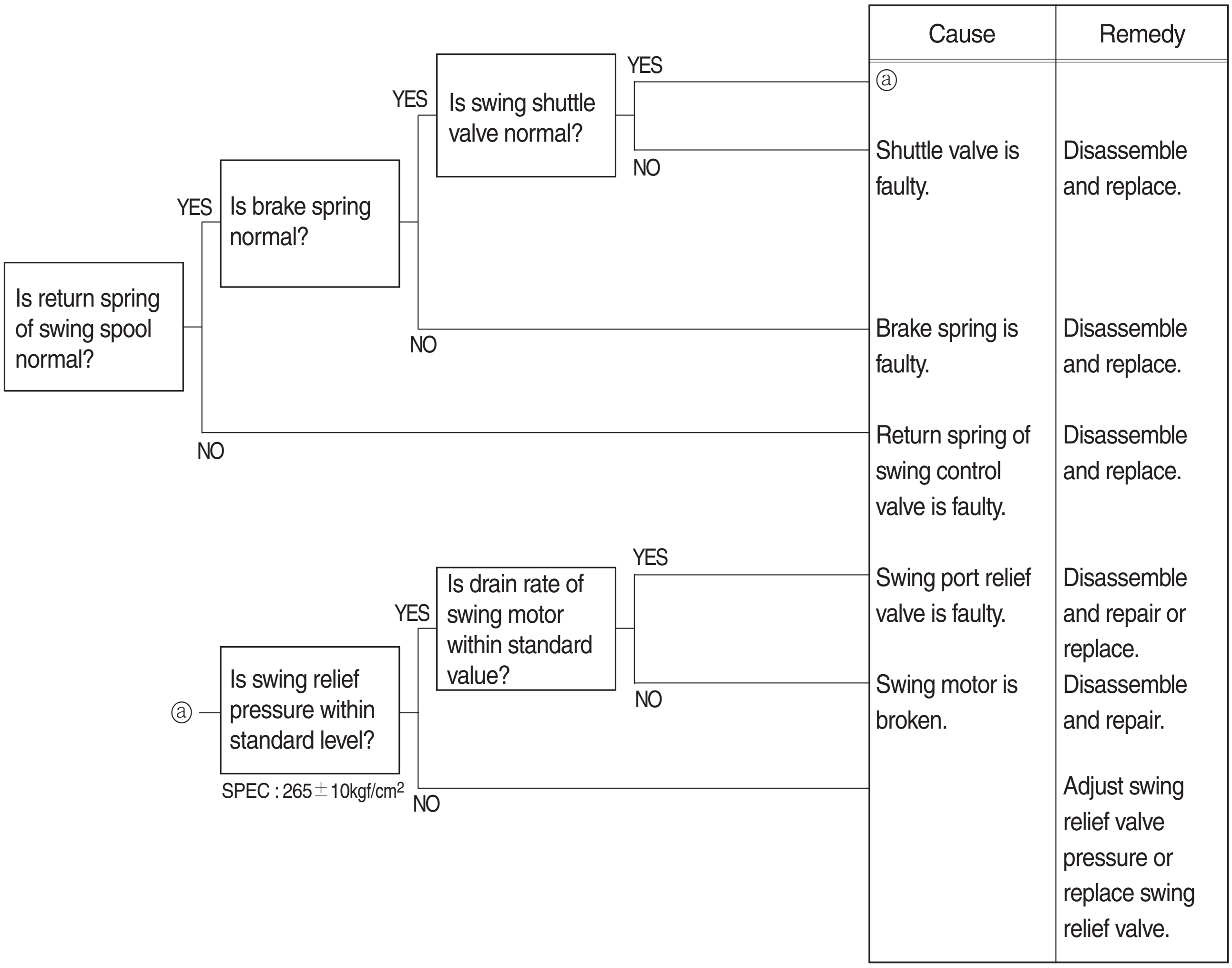
Cause	Remedy
Swing port relief valve is faulty.	Disassemble and repair.
Shuttle valve is faulty.	Disassemble and repair.
Swing control valve spool is stuck.	Disassemble and repair.
RCV is faulty.	Disassemble and repair.
	Clean pilot piping interior or repair piping.

4) MACHINE SWINGS BUT DOES NOT STOP



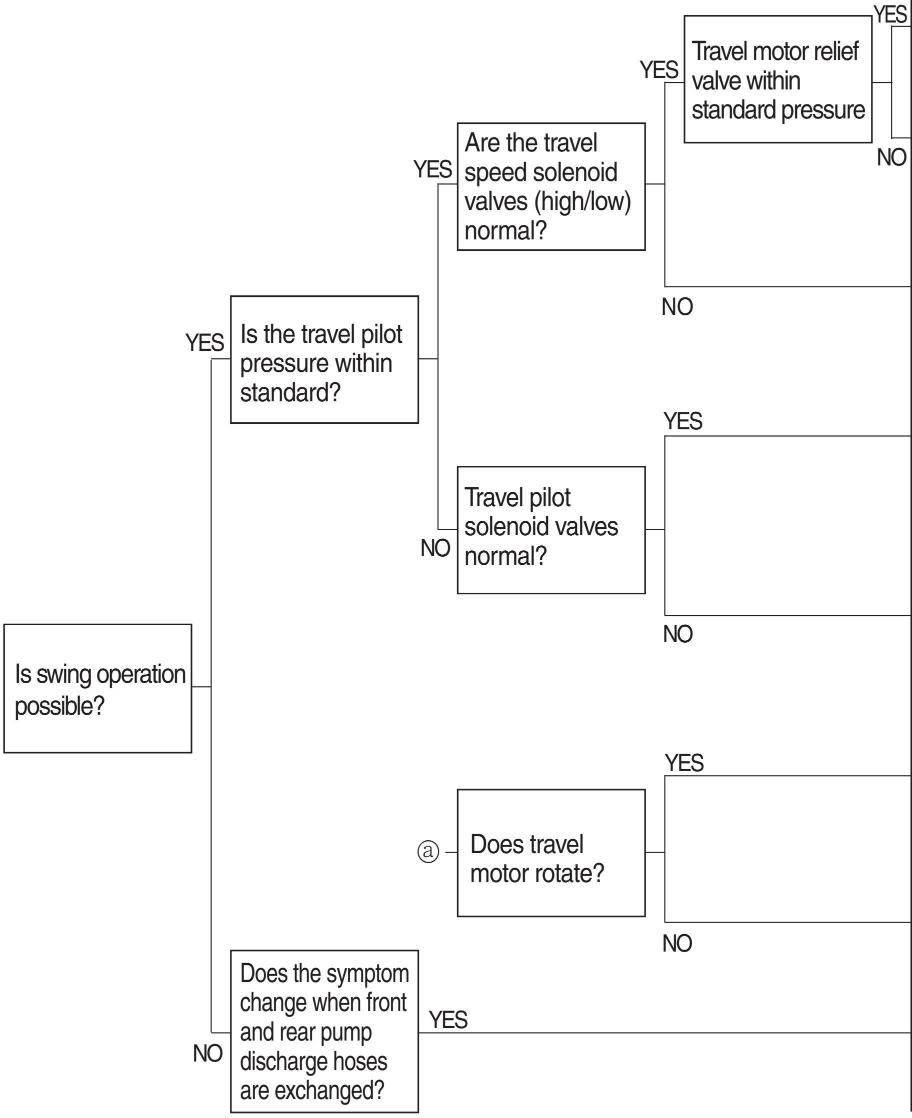
Cause	Remedy
Pilot relief valve is faulty.	Disassemble and repair or replace.
Gear pump is broken.	Disassemble and repair.
RCV is faulty.	Disassemble and repair.
Swing spool is stuck.	Disassemble and repair.
Return spring is faulty.	Disassemble and replace.

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



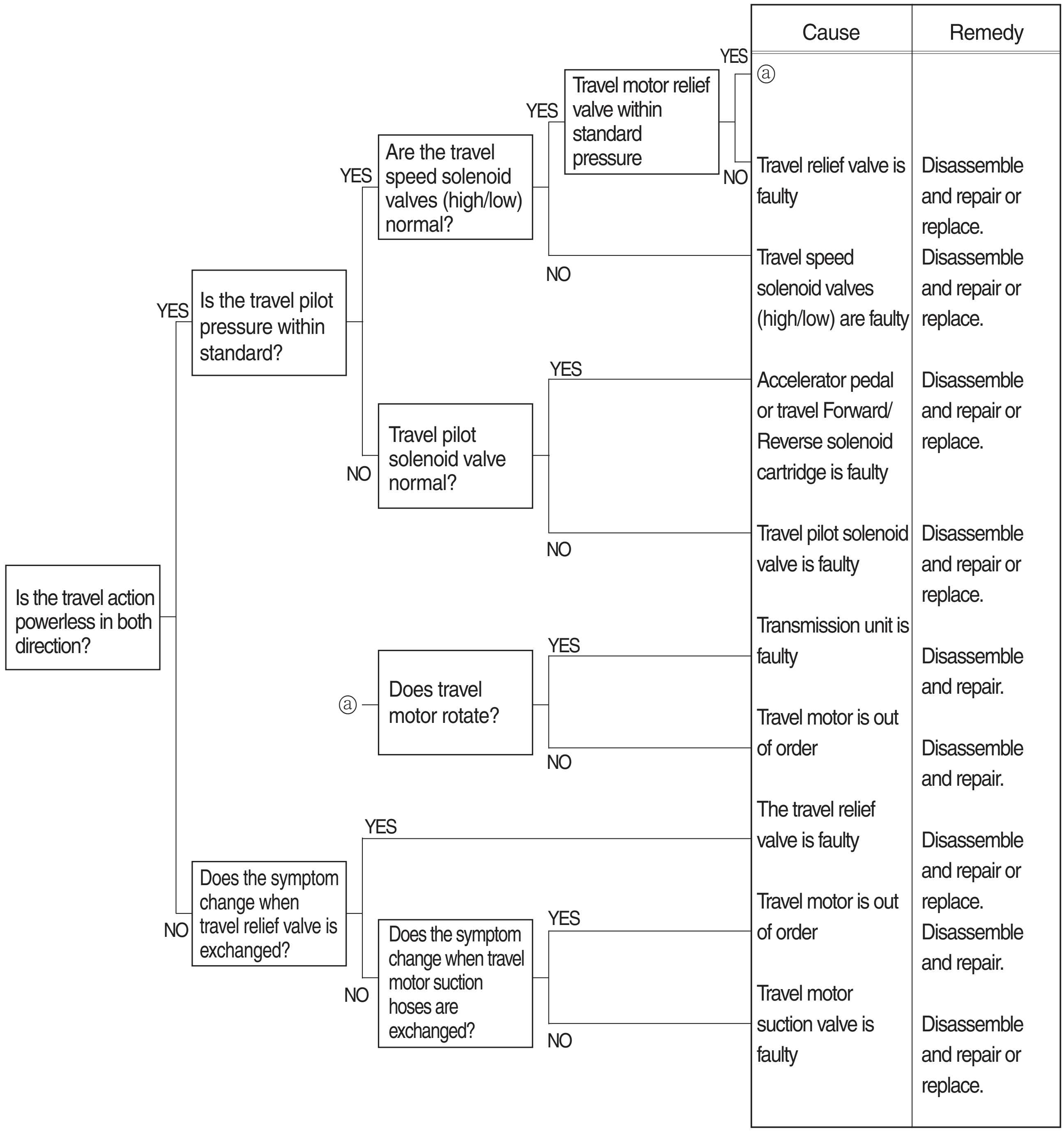
5. TRAVEL SYSTEM

1) TRAVEL DOES NOT FUNCTION



Cause	Remedy
ⓐ	
Travel relief valve is faulty	Disassemble and repair or replace.
Travel speed solenoid valves (high/low) are faulty	Disassemble and repair or replace.
Accelerator pedal or travel Forward/ Reverse solenoid cartridge is faulty	Disassemble and repair or replace.
Travel pilot solenoid valve is faulty	Disassemble and repair or replace.
Transmission unit is faulty	Disassemble and repair.
Travel motor is out of order	Disassemble and repair.
Hydraulic pump is broken	Disassemble and repair.

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.

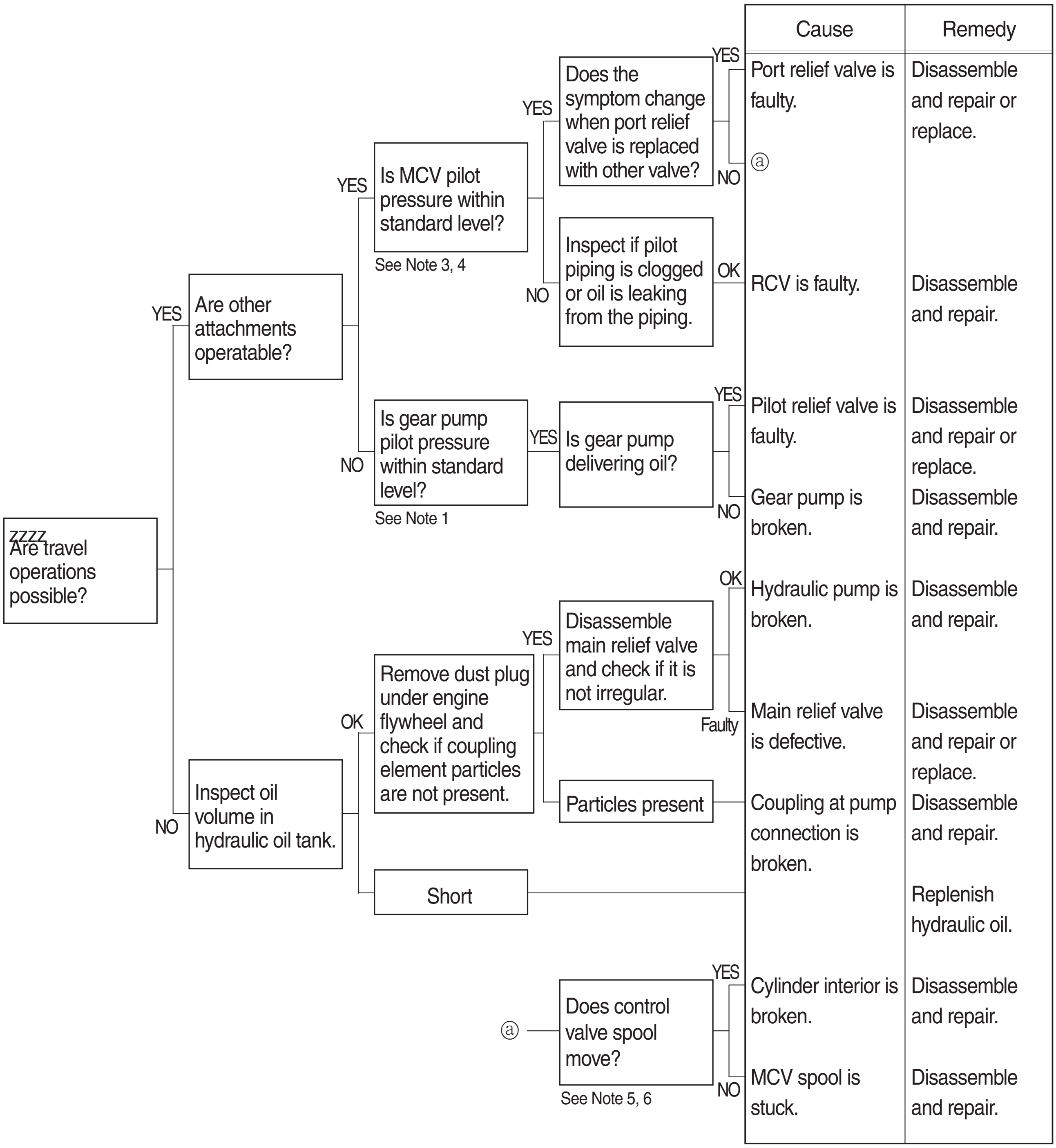
6) EXTRAORDINARY NOISE IS HEARD WHEN SUDDENLY REDUCING THE SPEED FROM THE HIGH-SPEED MODE

It takes time to accelerate the motor

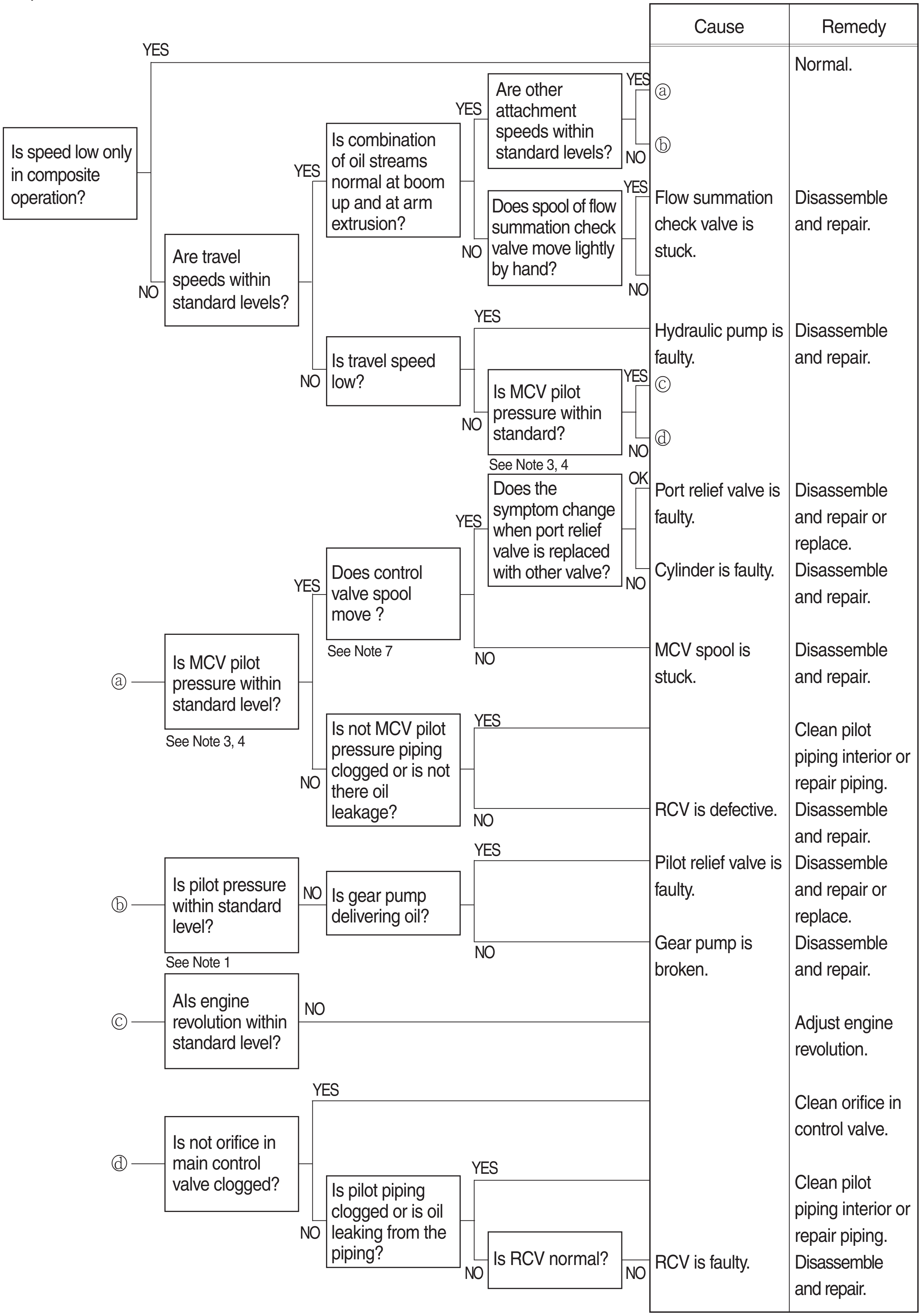
Cause	Remedy
The anti-cavitation valve does not not work properly.	Screw the fitting bolts one more time with correct tightening torque. If the valve turns out to be damaged, is should be repaired.

6. ATTACHMENT SYSTEM

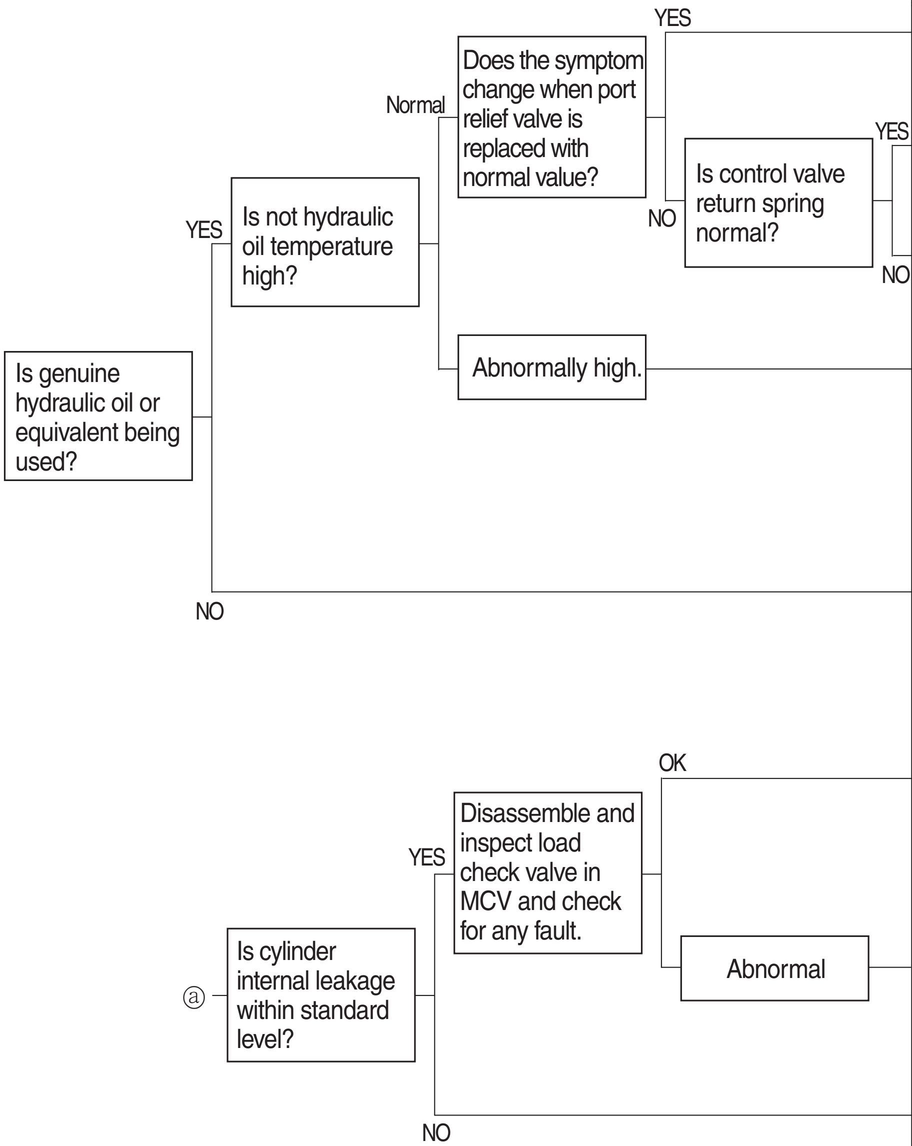
1) BOOM OR ARM ACTION IS IMPOSSIBLE AT ALL



2) BOOM, ARM OR BUCKET SPEED IS LOW

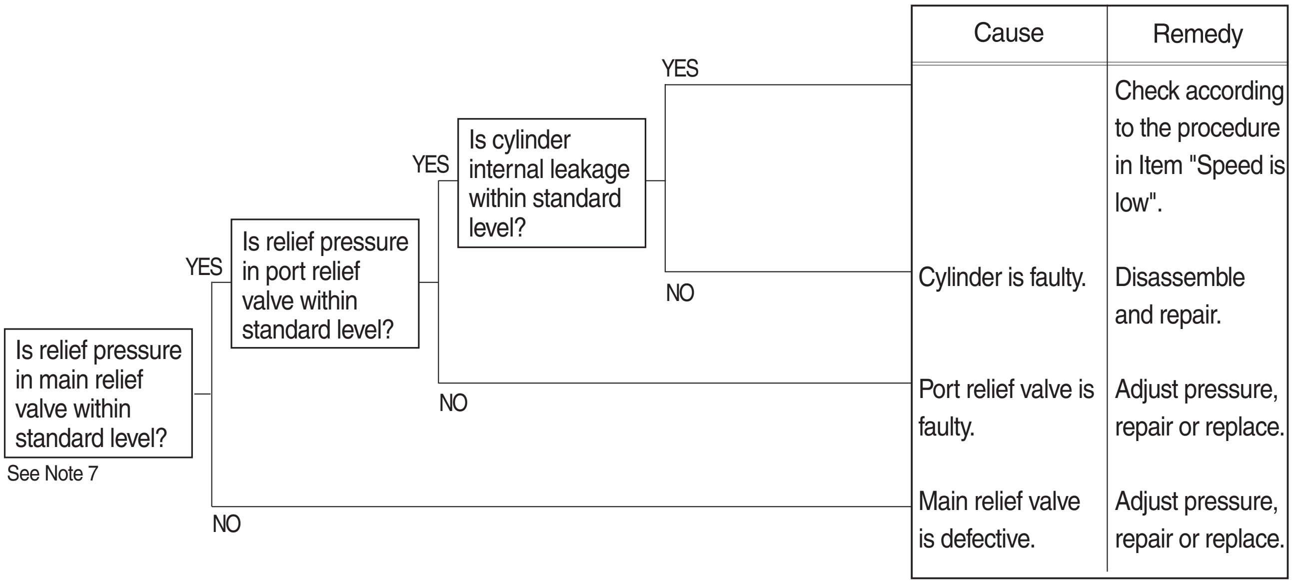


3) BOOM, ARM OR BUCKET CYLINDER EXTENDS OR CONTRACTS ITSELF AND ATTACHMENT FALLS

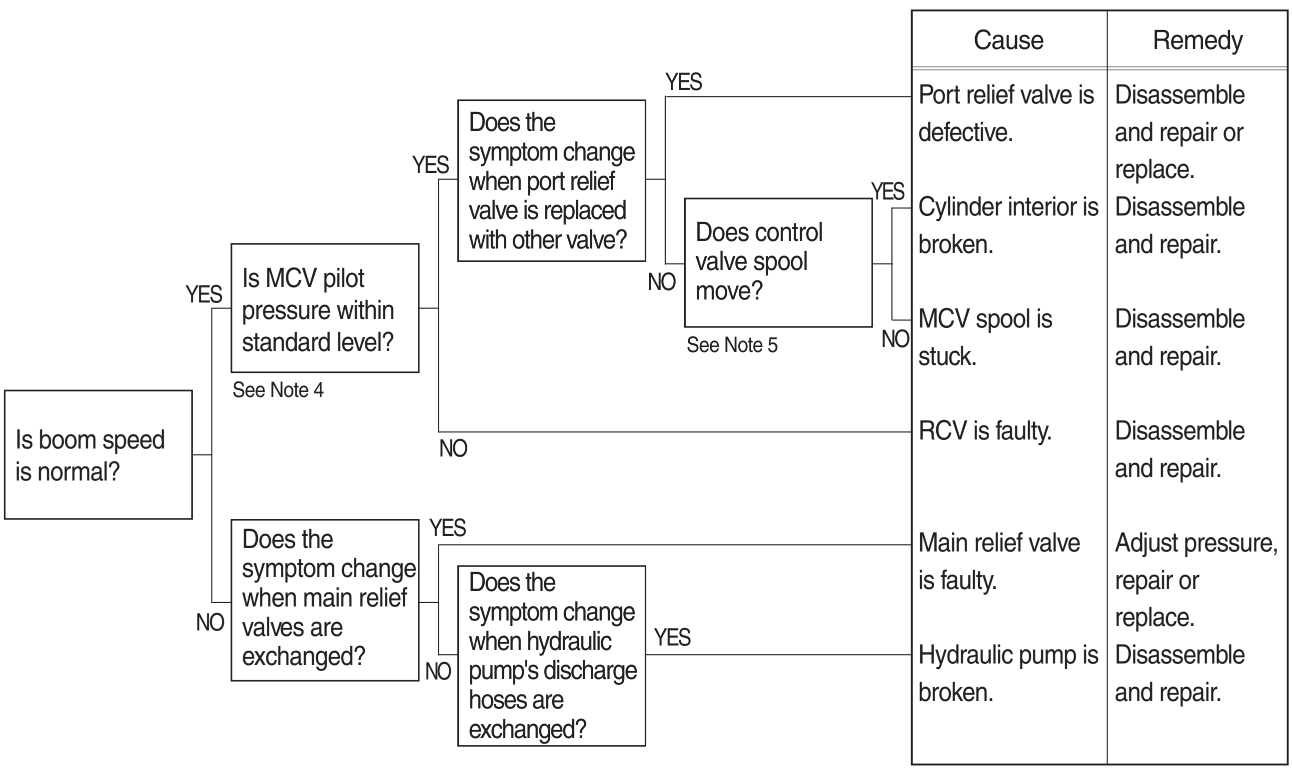


Cause	Remedy
Port relief valve is faulty.	Disassemble and repair or replace.
Control valve's return spring is faulty.	Disassemble and replace.
	Locate the cause of hydraulic oil temperature rise and lower it to proper level.
	Replace with genuine hydraulic oil or equivalent.
Pressure tightness between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

4) BOOM, ARM OR BUCKET POWER IS WEAK



5) ONLY BUCKET OPERATION IS TOTALLY IMPOSSIBLE

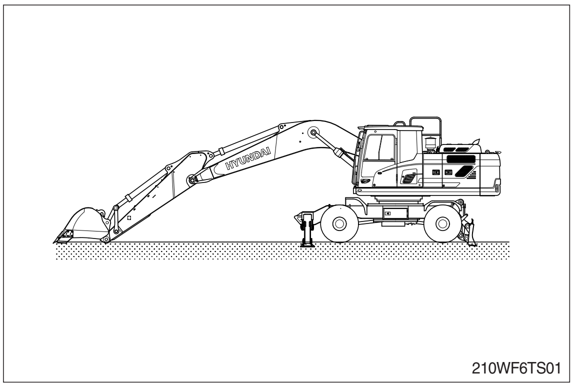


6) BOOM MAKES A SQUEAKING NOISE WHEN BOOM IS OPERATED

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

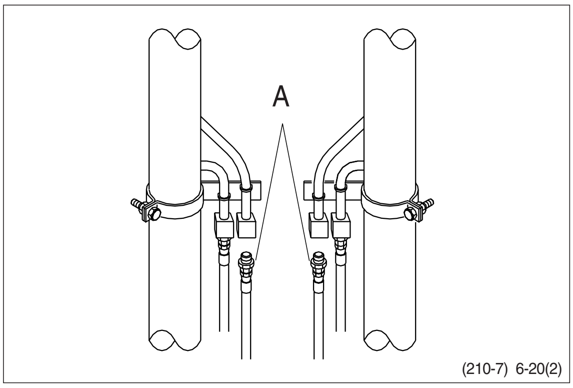
※ HOW TO CHECK INTERNAL BOOM CYLINDER LEAKAGE

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



210WF6TS01

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



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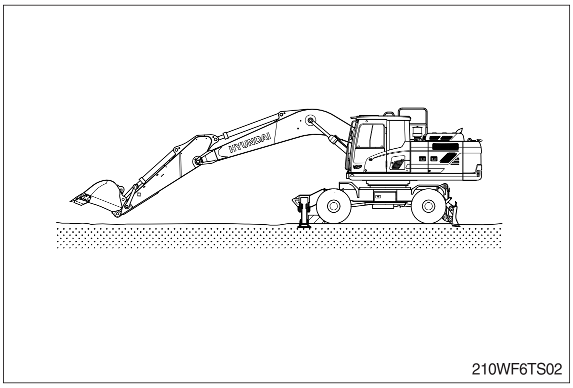
3. Raise bucket OFF the ground by retracting the arm cylinder rod.

   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.



210WF6TS02

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.

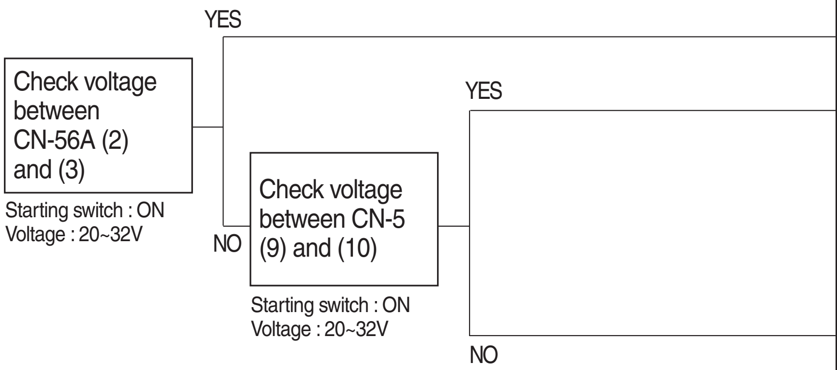
GROUP 3 ELECTRICAL SYSTEM

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

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

· Before carrying out below procedure, check all the related connectors are properly inserted and short of fuse No. 11, 15.

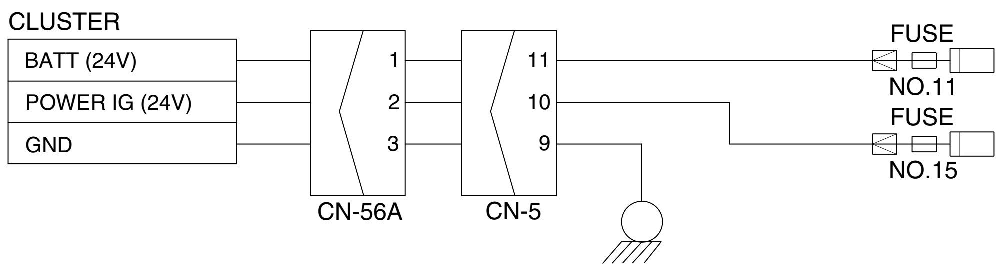
· After checking, insert the disconnected connectors again immediately unless otherwise specified.



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. 11, 15	Repair or replace (after clean)

Check voltage

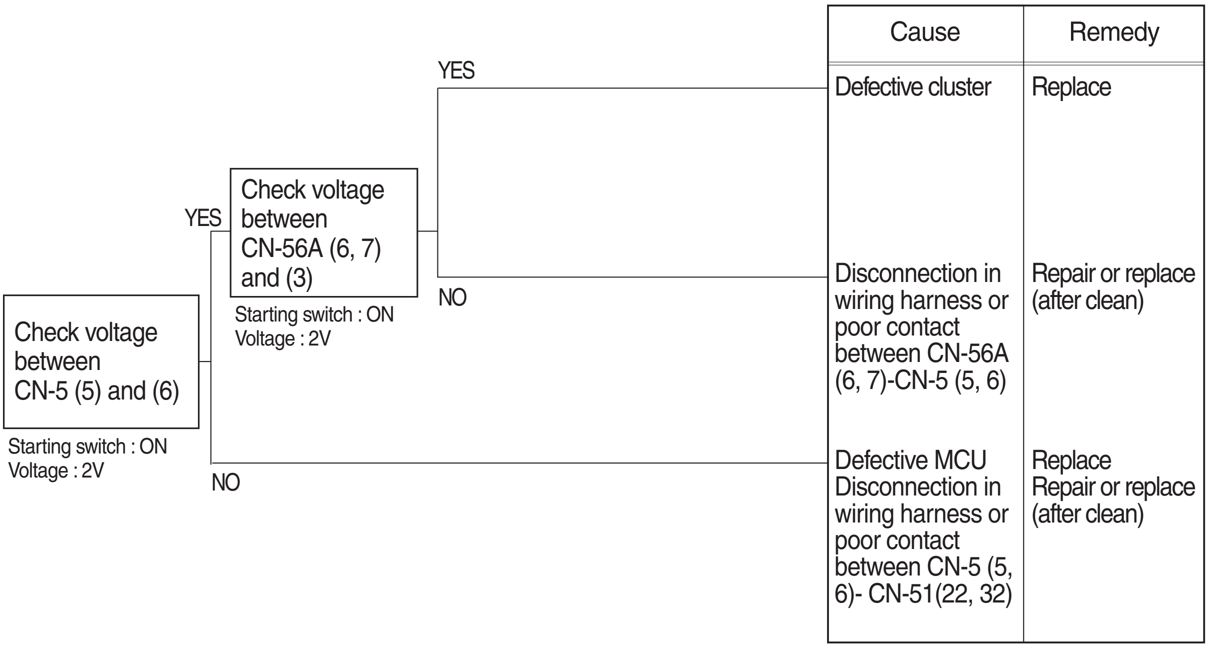
YES	20~32V
NO	0V



210WF6ES01

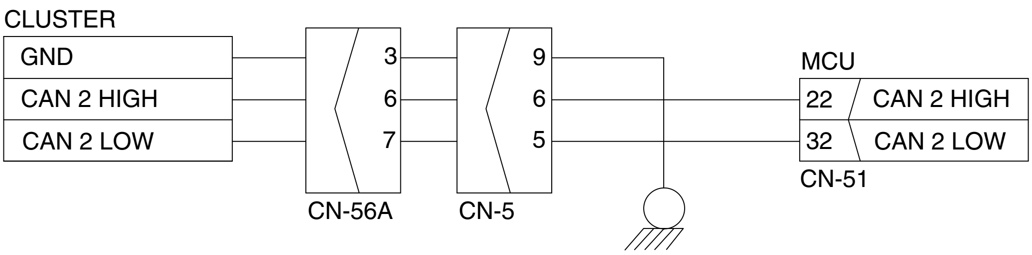
2. COMMUNICATION ERROR FLASHES ON THE CLUSTER (HCESPN 840, FMI 2)

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



Check voltage

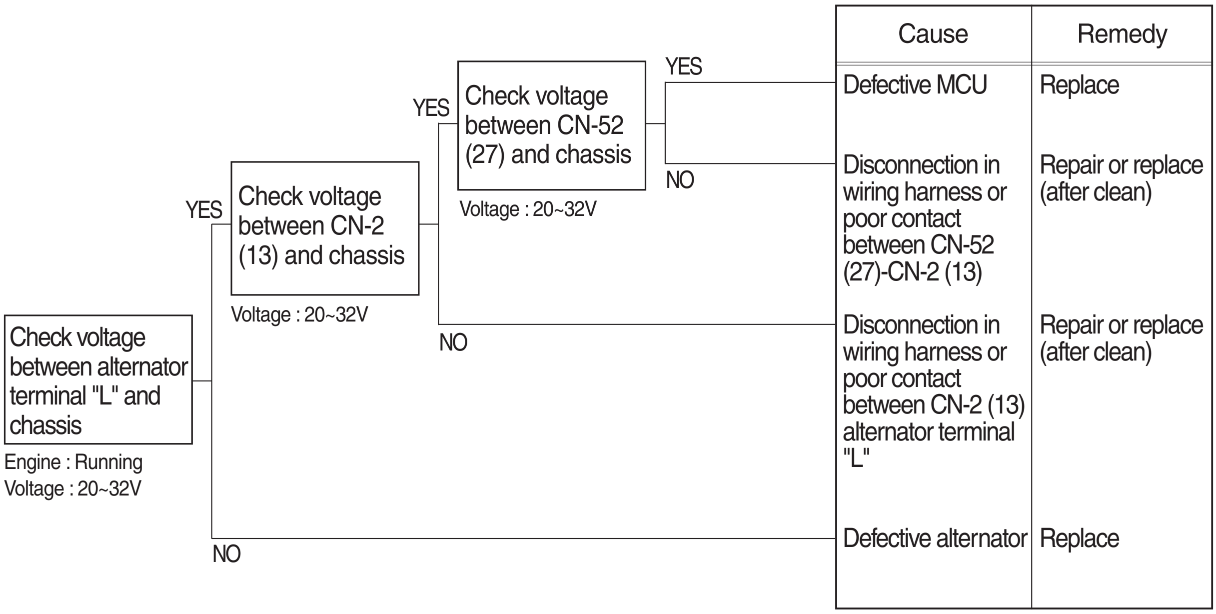
YES	2V
NO	0V



300L6ES02

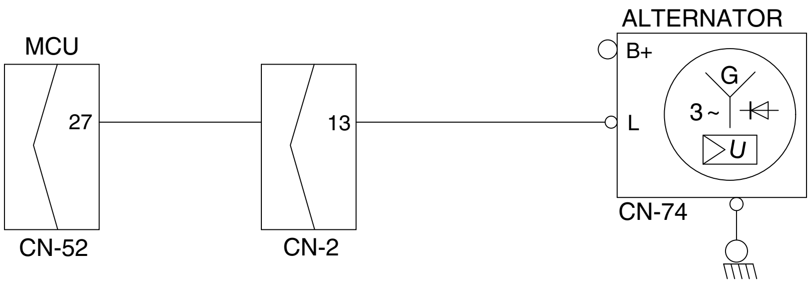
3. BATTERY CHARGING WARNING LAMP LIGHTS UP (Starting switch : ON)

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



Check voltage

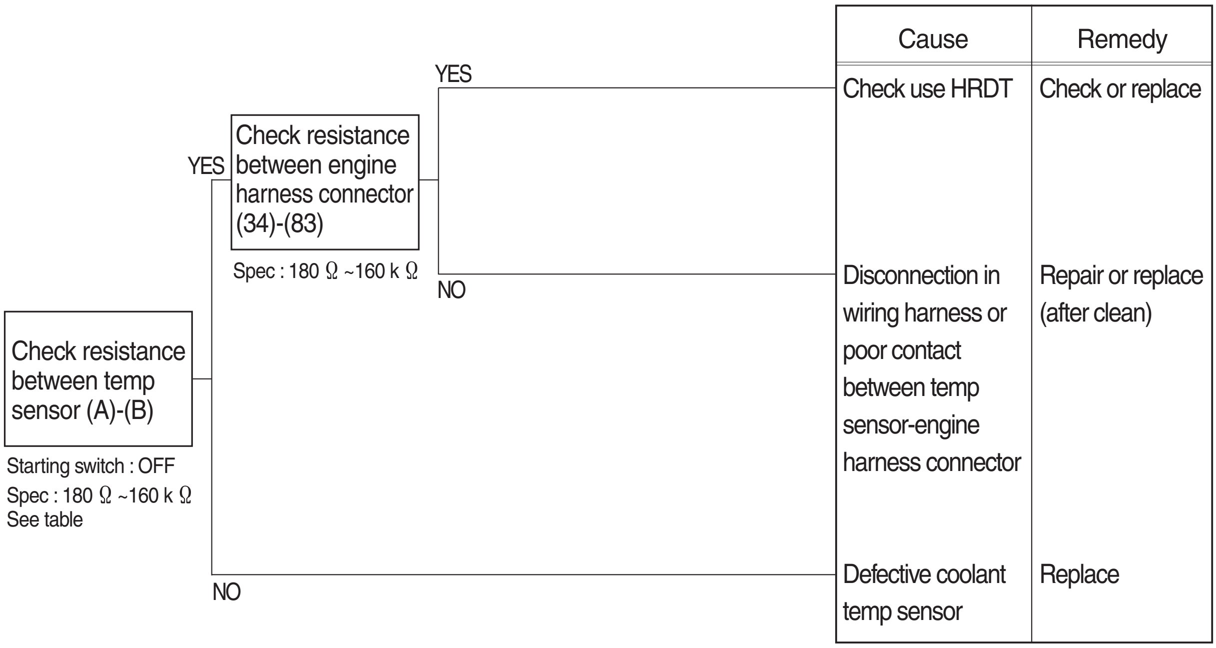
YES	20~32V
NO	0V



300L6ES03

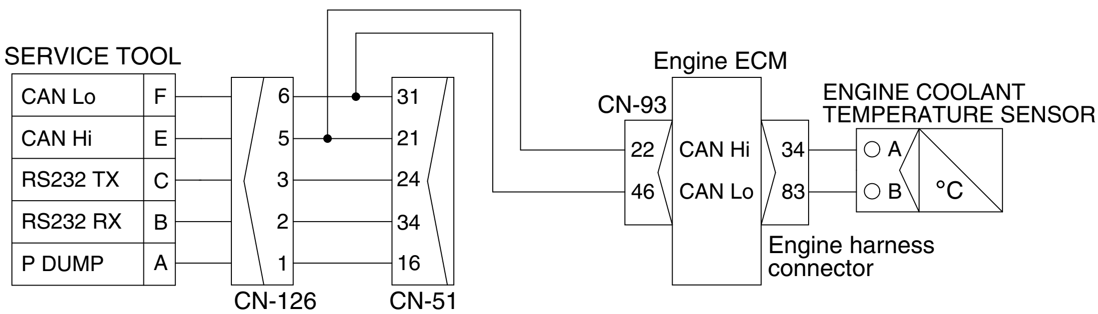
4. WHEN COOLANT OVERHEAT WARNING LAMP LIGHTS UP (engine is started)

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



Check Table

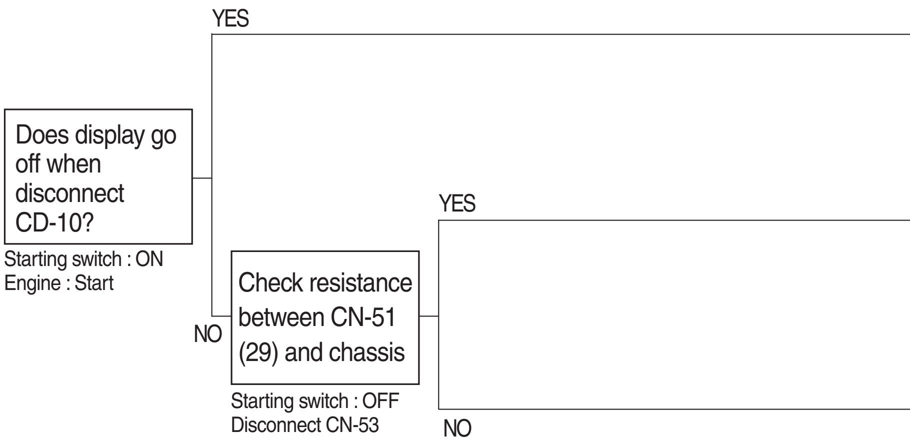
Temperature (˚C)	0	25	50	80	95
Resistance (k Ω)	30~37	9.3~10.7	3.2~3.8	1.0~1.3	0.7~0.8



300L6ES04

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

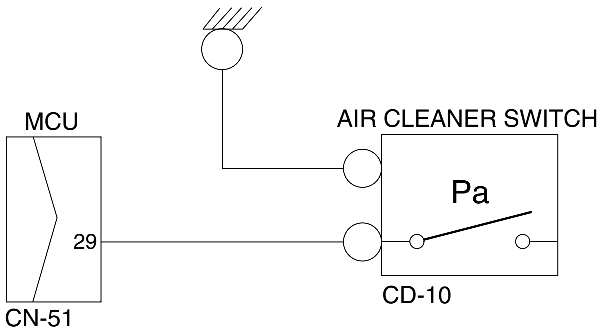
· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.



Cause	Remedy
Clogged air filter or defective switch	Check filter or replace switch
Short circuit in wiring harness between CD-10-CN-51 (29)	Repair or replace (After clean)
Defective MCU	Replace

Check resistance

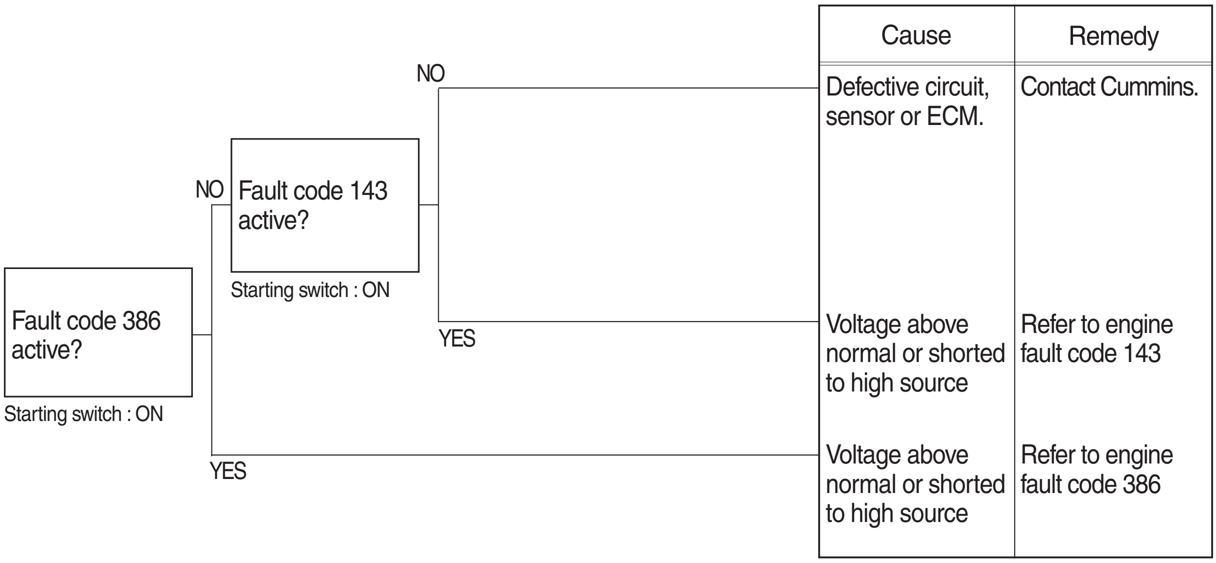
YES	MAX 1Ω
NO	MIN 1MΩ

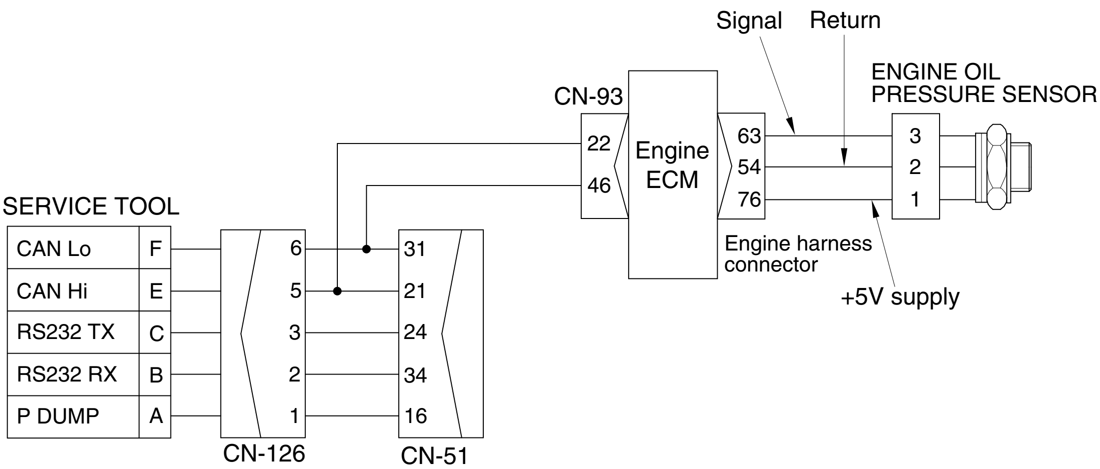


300L6ES06

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

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

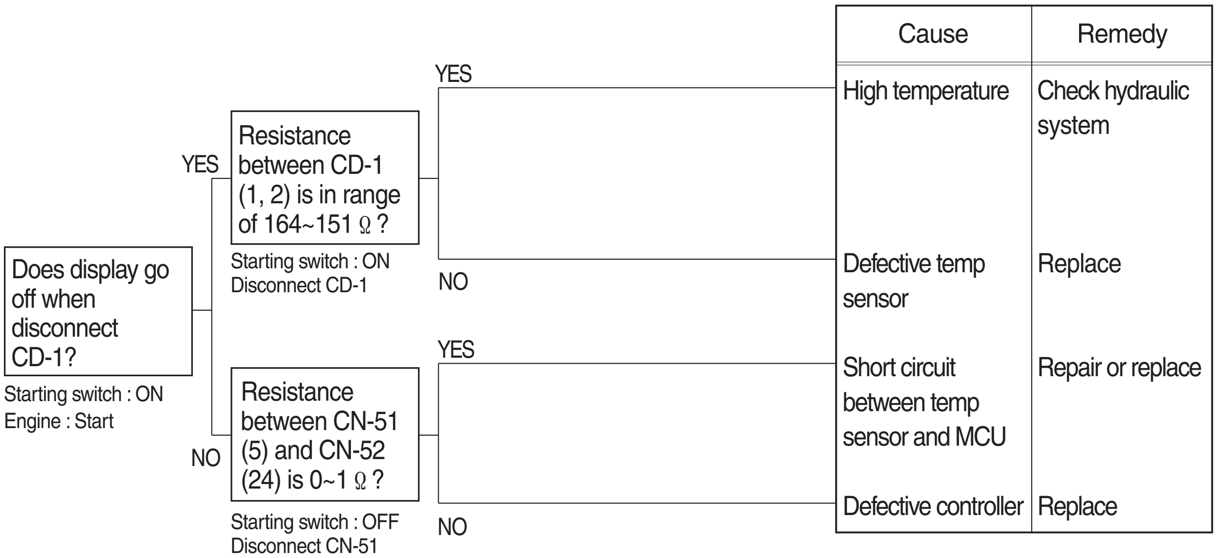


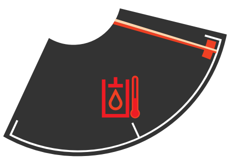


300L6ES07

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

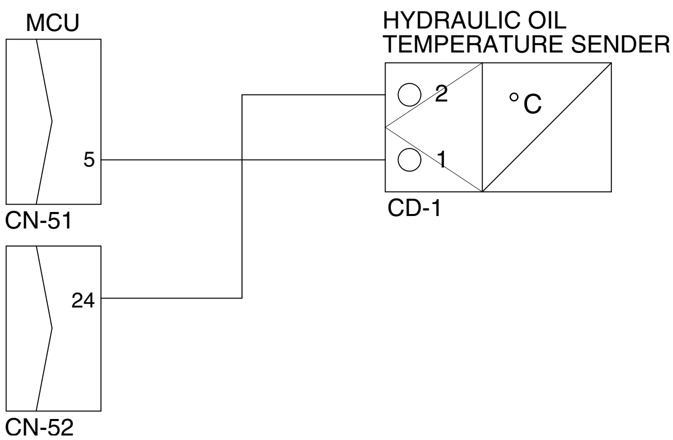
· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.





Check Table

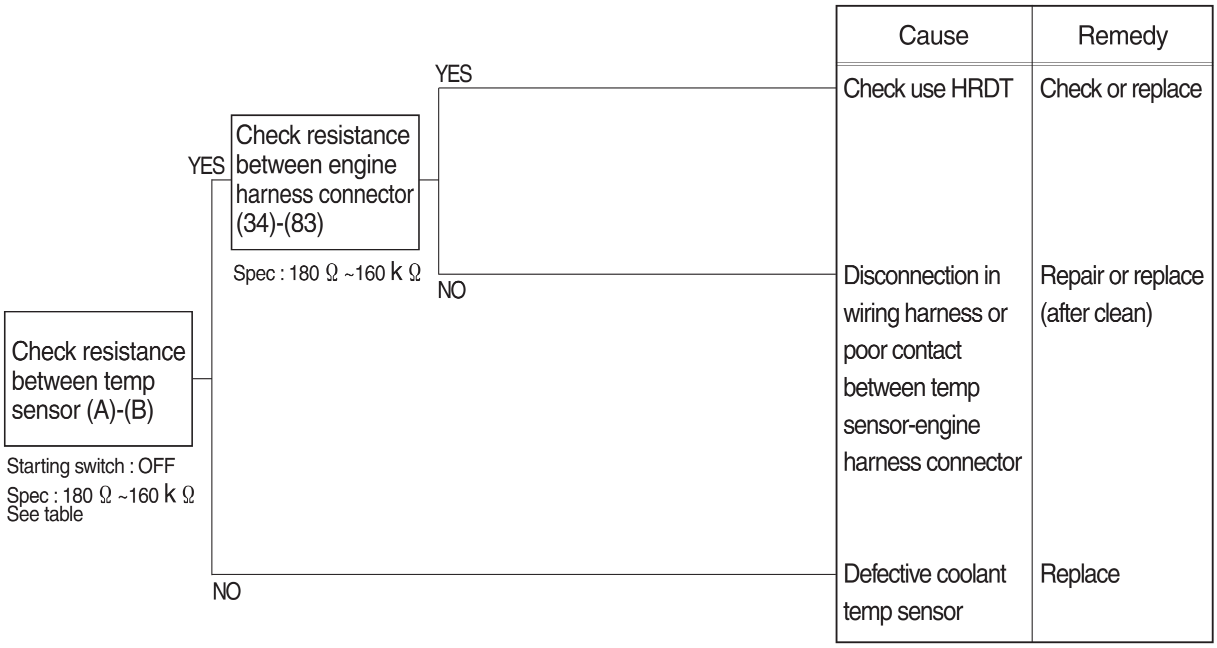
Temperature (˚C)	~ -30	~ -10	~ 0	~ 40	~ 70	~ 80	~ 90	~ 100	105~
Resistance (k Ω)	22.22 ~31.78	8.16 ~10.74	5.18 ~ 6.6	1.06 ~1.28	0.39 ~0.476	0.322 ~0.298	0.243 ~0.219	0.185 ~0.167	0.164 0.151



300L6ES08

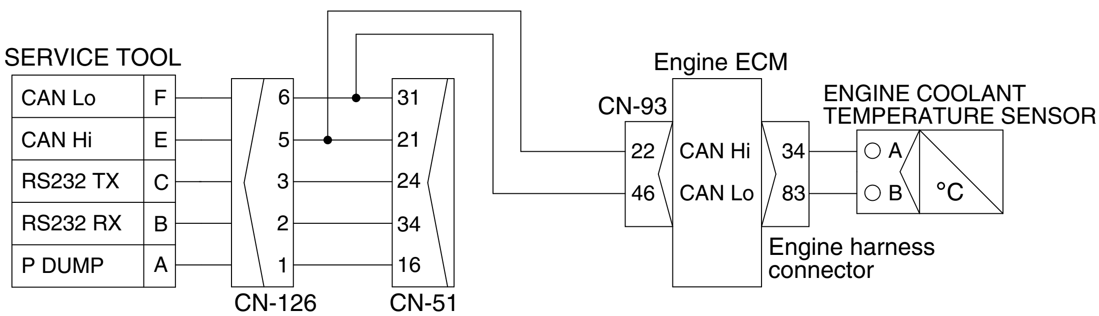
8. WHEN COOLANT TEMPERATURE GAUGE DOES NOT OPERATE

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



Check Table

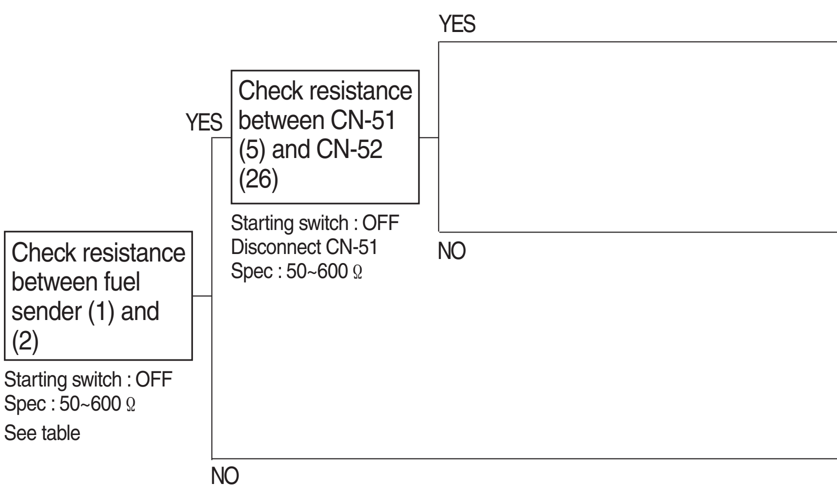
Temperature (˚C)	0	25	50	80	95
Resistance (k Ω)	30~37	9.3~10.7	3.2~3.8	1.0~1.3	0.7~0.8



300L6ES04

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

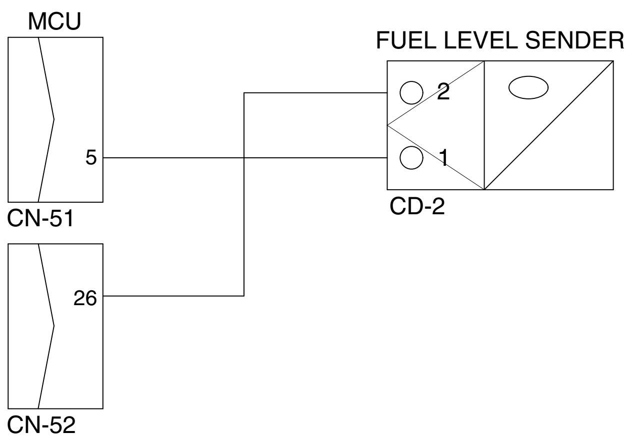
· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.



Cause	Remedy
Defective MCU or cluster	Replace
Disconnection in wiring harness or poor contact between fuel sender-MCU	Repair or replace
Defective fuel sender	Replace

Check Table

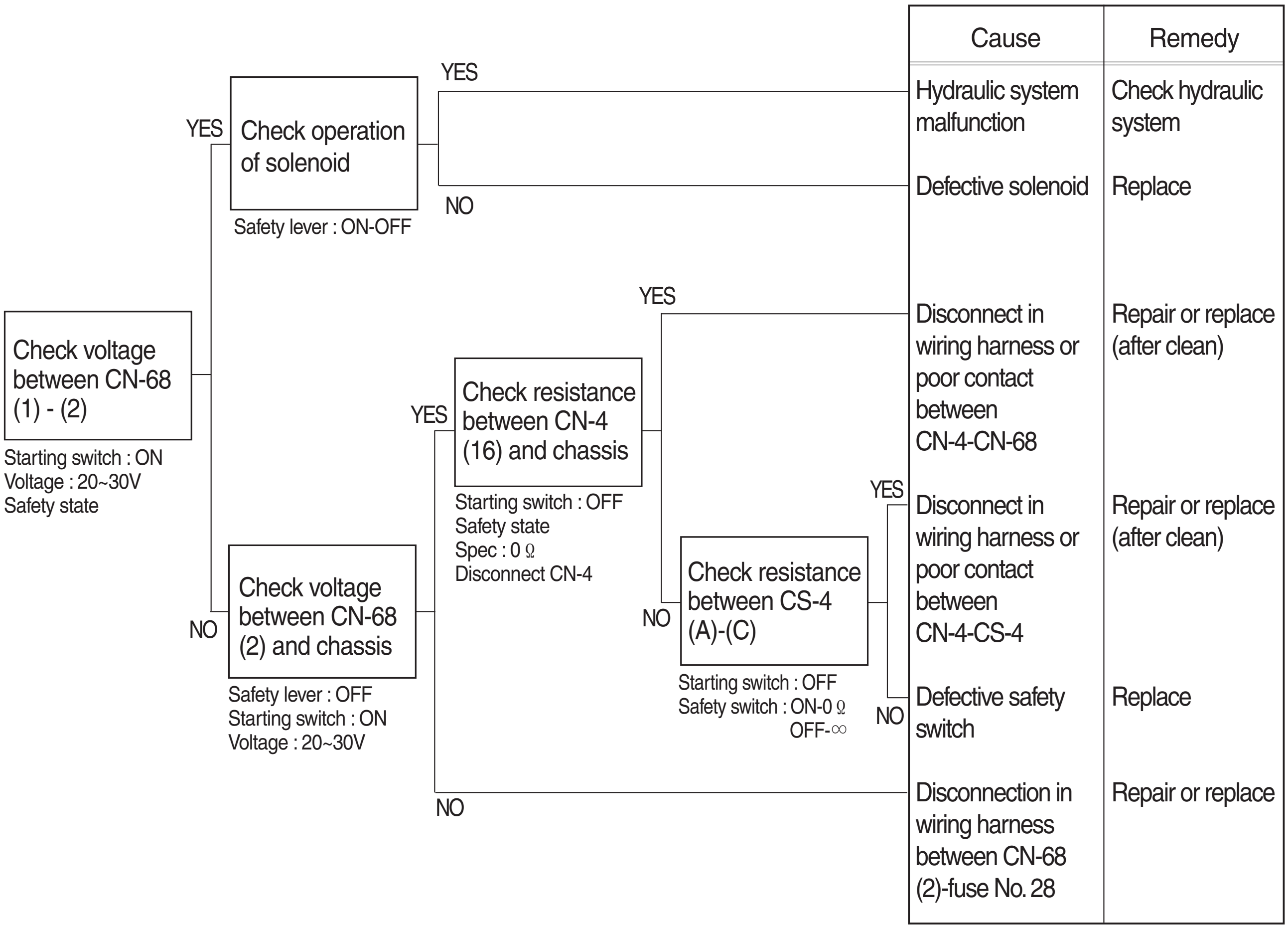
Range	Resistance (Ω)	Range	Resistance (Ω)
Full	50	5/12	400
11/12	100	4/12	450
10/12	150	3/12	500
9/12	200	2/12	550
8/12	250	1/12	600
7/12	300	Empty warning	700
6/12	350	-	-

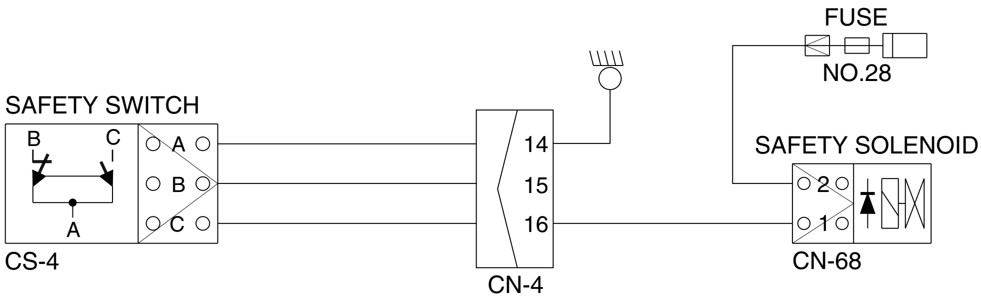


300L6ES10

10. WHEN SAFETY SOLENOID DOES NOT OPERATE

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

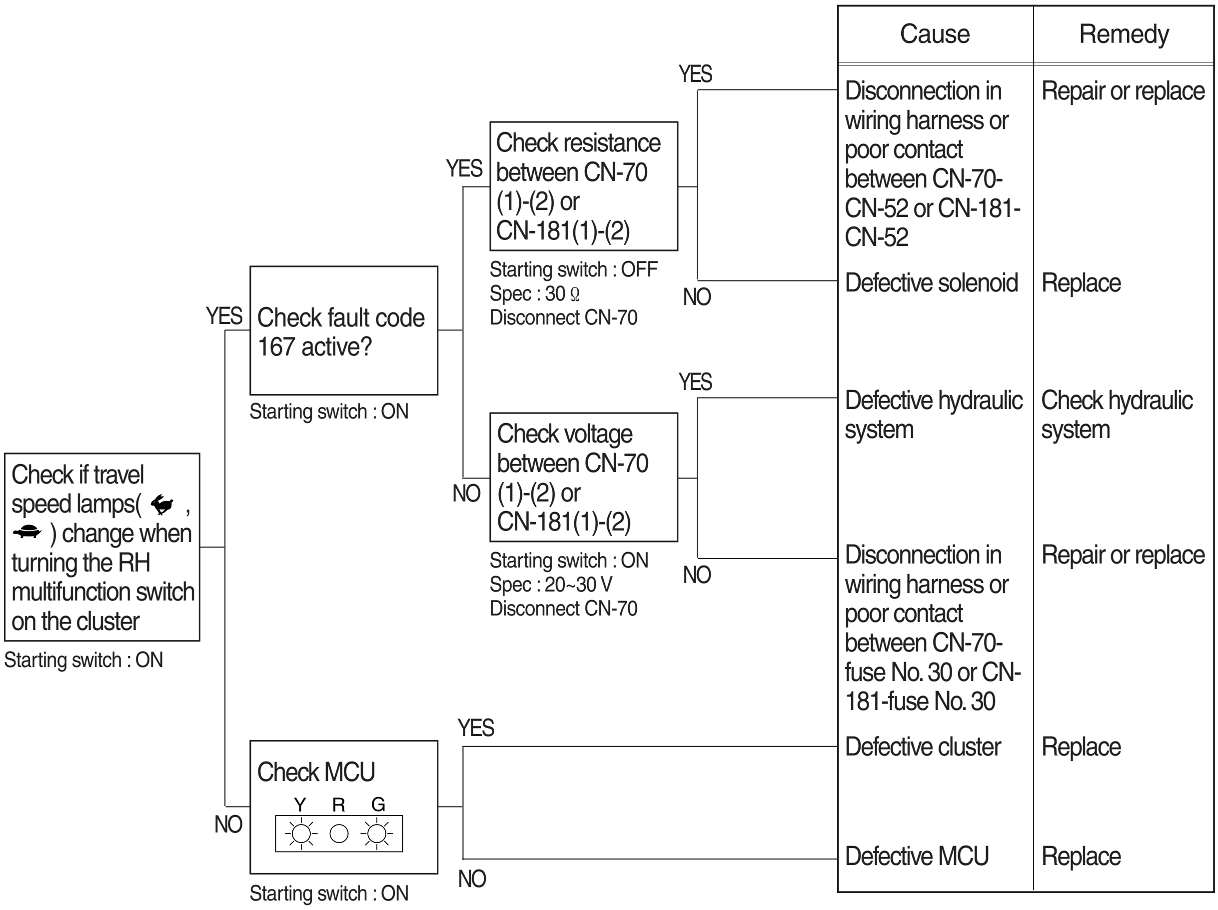


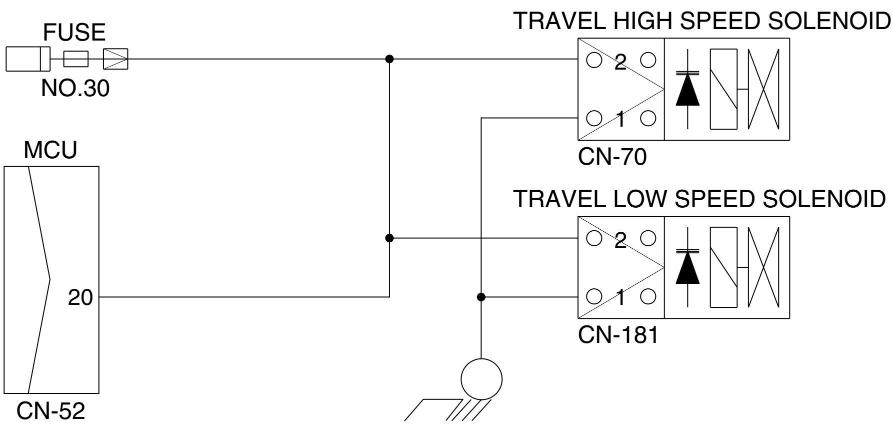


210WF6ES10

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.

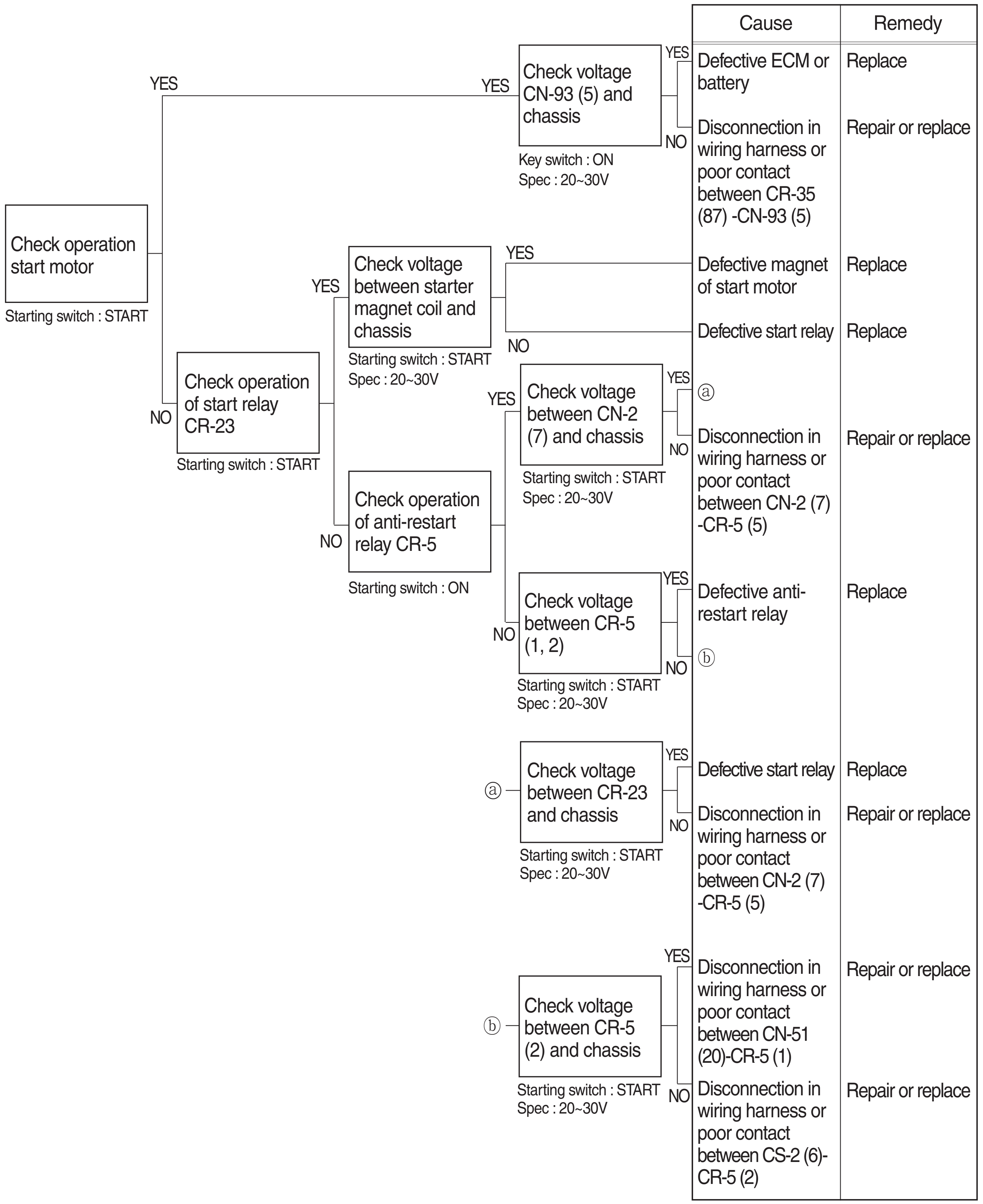


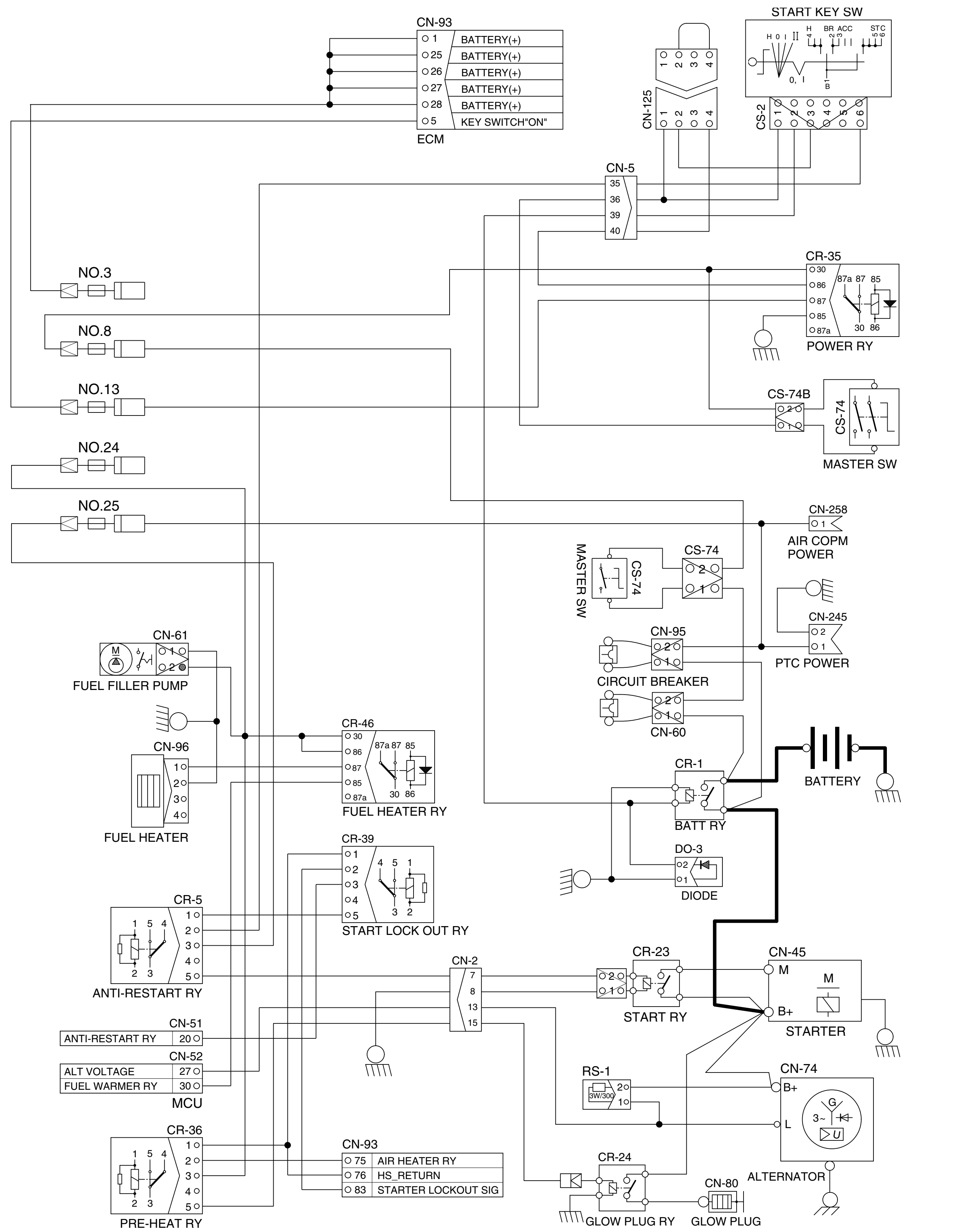


210WF6ES11

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. 3, 8, 13, 24, 25.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.





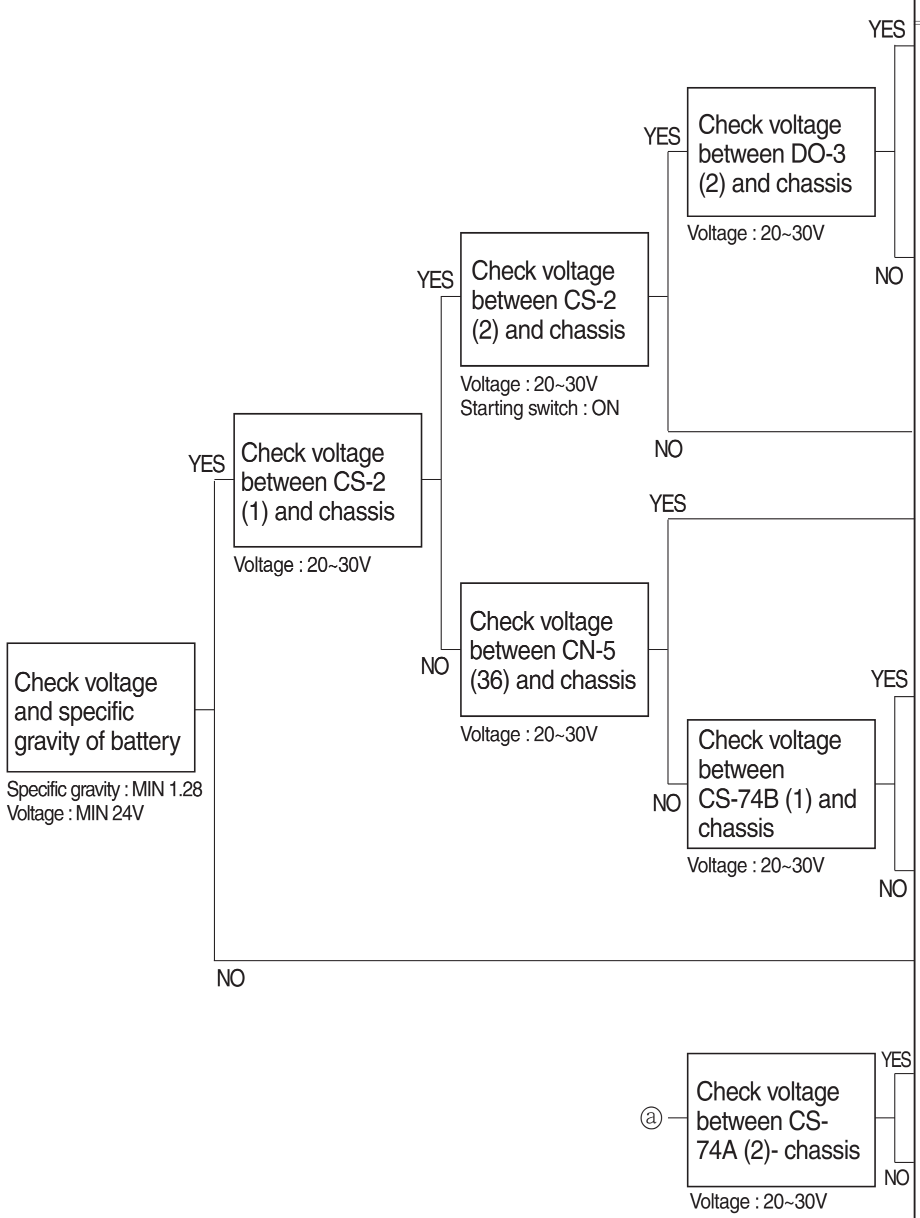
210WF6ES12

13. WHEN STARTING SWITCH ON DOES NOT OPERATE

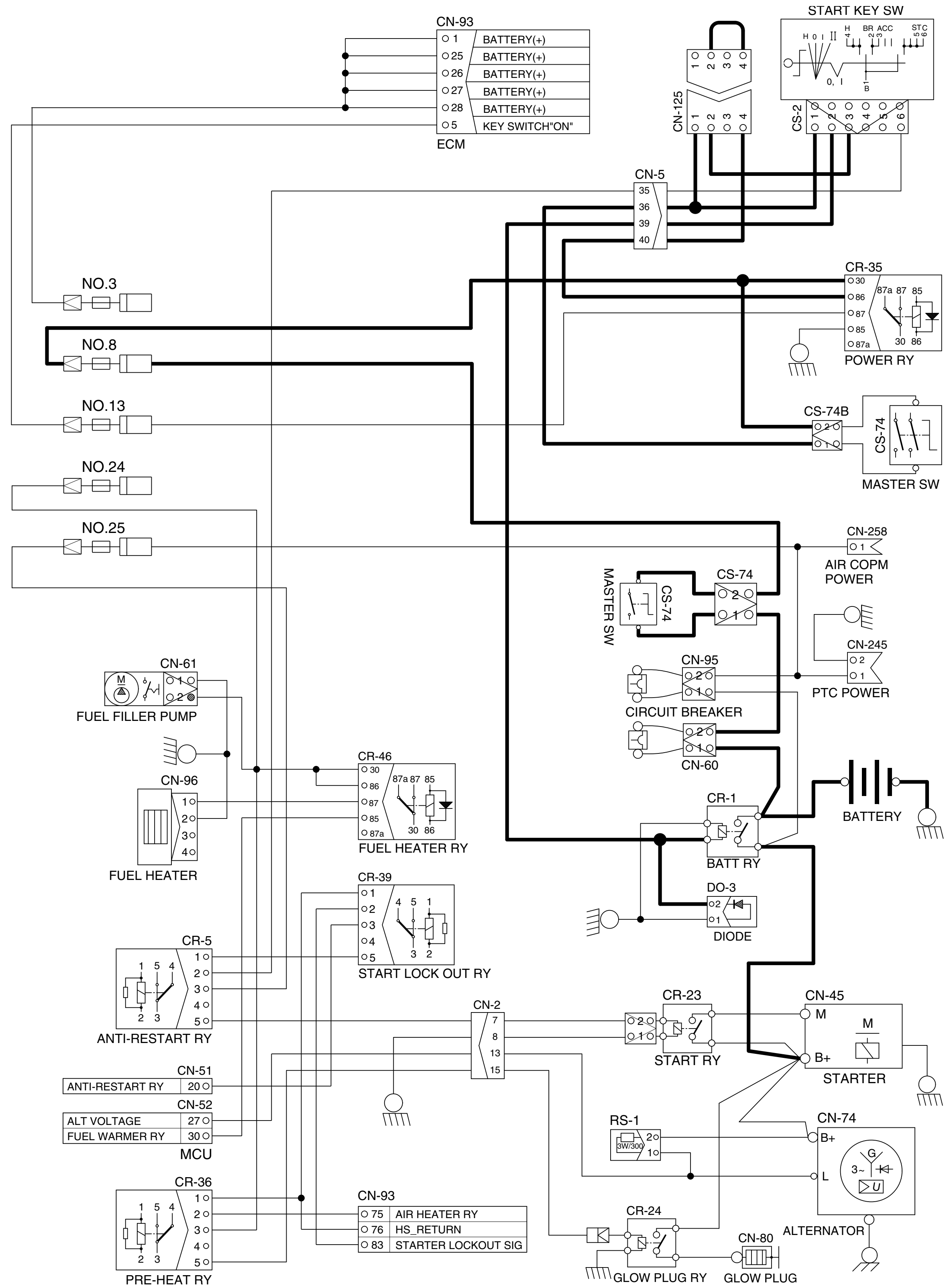
· Before disconnecting the connector, always turn the starting switch OFF.

· Before carrying out below procedure, check all the related connectors are properly inserted, master switch ON and check open circuit of fusible link (CN-60).

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



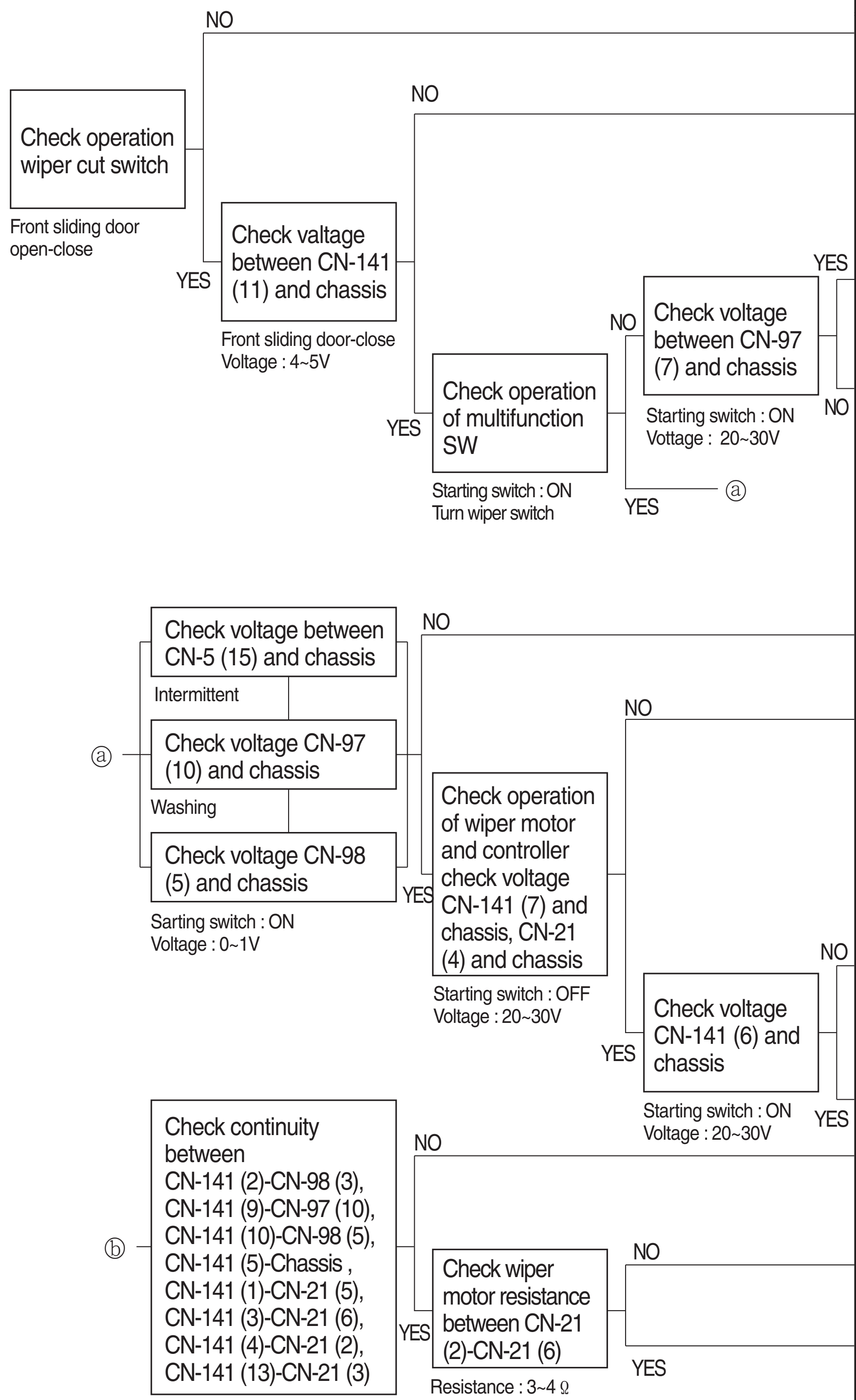
Cause	Remedy
Disconnection in wiring harness or poor contact between DO-3 (2)-CR-1 or defective battery relay	Repair or replace (after clean)
Disconnection in wiring harness or poor contact between CS-2 (2)-CN-5(39)- DO-3 (2)	Repair or replace (after clean)
Defective start switch	Replace
Disconnection in wiring harness or poor contact between CS-2 (1)-CN-5 (36)	Replace
Disconnection in wiring harness or poor contact between CS-74B (1) -CN-5 (36)	Charge or replace (after clean)
ⓐ	
Battery capacity too low	Charge or replace (after clean)
Defective master switch	Replace
Disconnection in wiring harness or poor contact between CS-74 (2) -CR-1	Charge or replace (after clean)



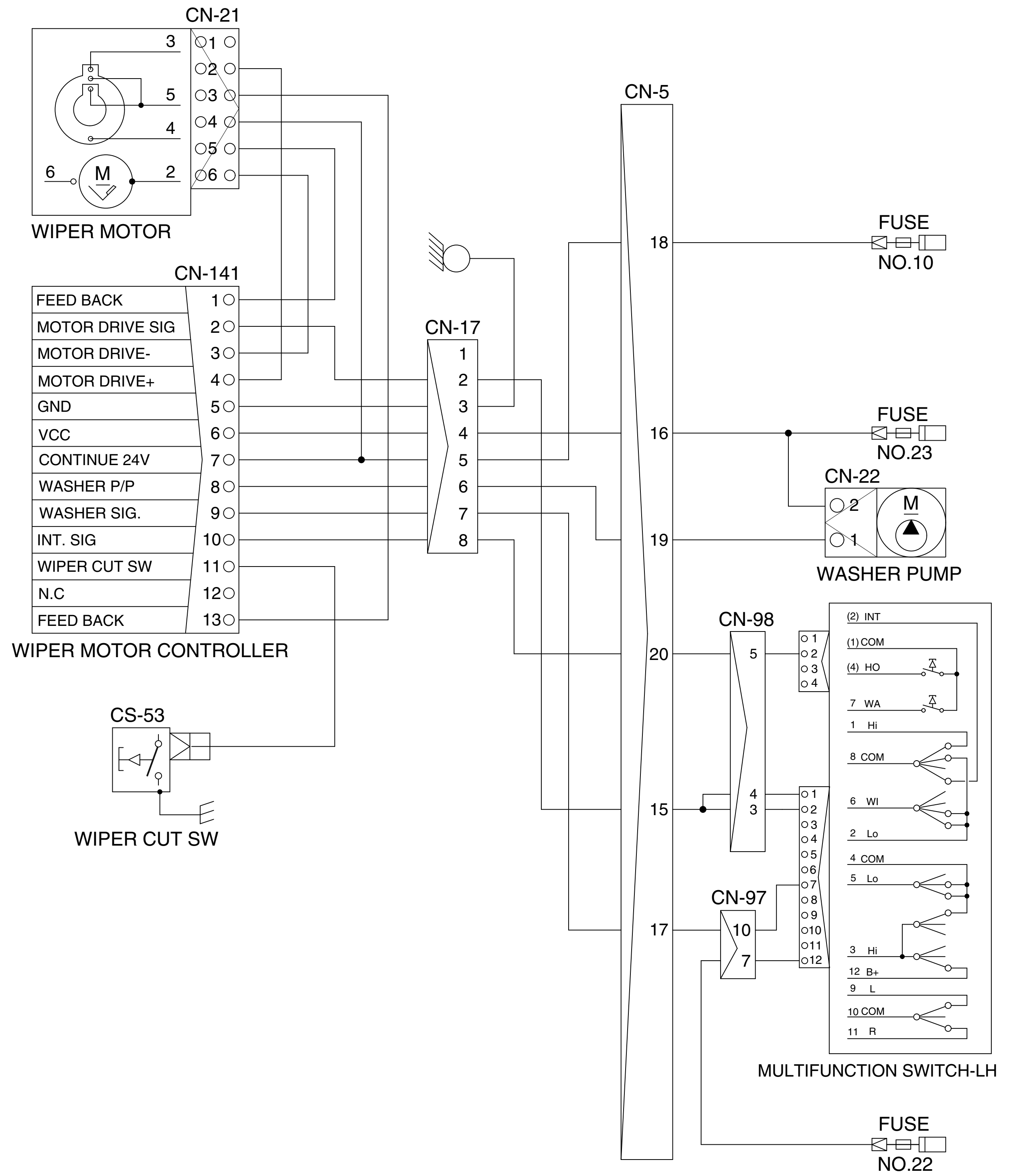
210WF6ES13

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. 10, 22 and 23 is not blown out.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.



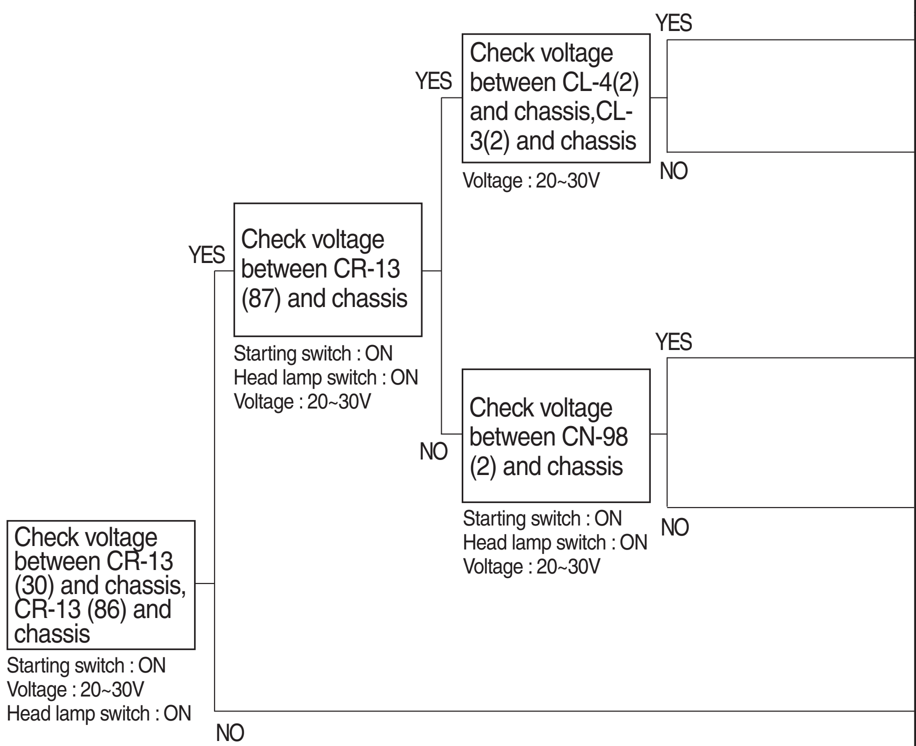
Cause	Remedy
Defective wiper cut switch	Replace
Short circuit in wiring harness or poor contact between CN-141 (11)- CS-53	Repair or replace (after clean)
Defective multifunction switch	Replace
1)Recheck fuse No.22	Replace
2)Disconnection in wiring harness or poor contact between CN-97(7)-Fuse	Repair or replace (after clean)
Defective multifunction switch	Replace
1) Recheck fuse No.10	Replace
2) Disconnection in wiring harness or poor contact between CN-141(7)-Fuse, CN-21(4)-Fuse	Repair or replace (after clean)
1) Recheck fuse No.23	Replace
2) Disconnection CN-141(6)-Fuse	Repair or replace (after clean)
Disconnection in wiring harness or poor contact	Repair or replace (after clean)
Defective wiper motor	Replace
Defective wiper motor controller	Replace



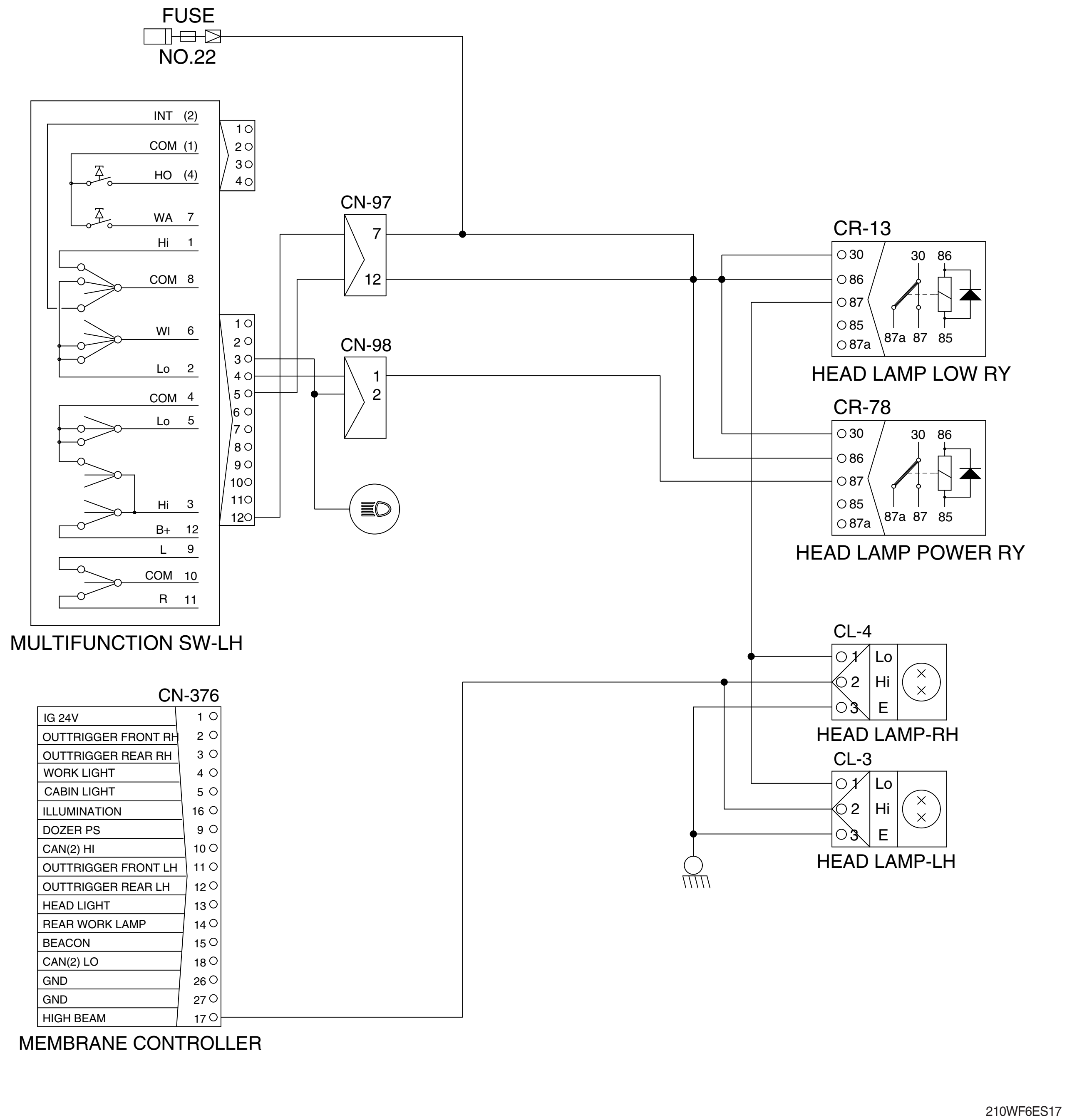
210WF6ES14

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. 22.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.

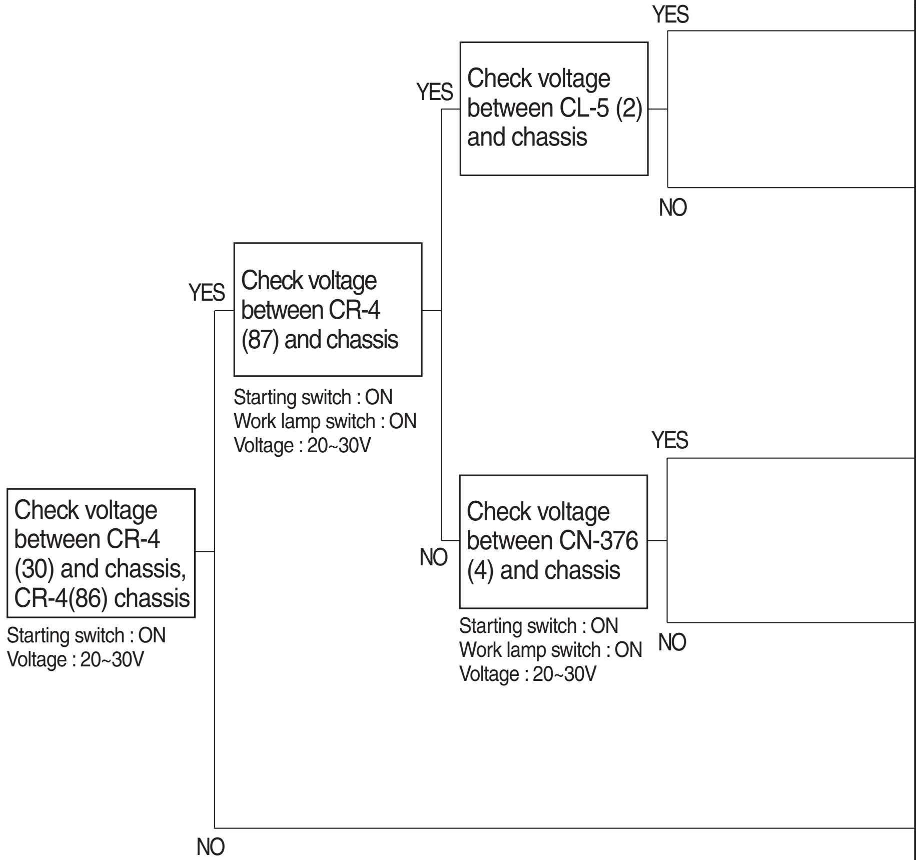


Cause	Remedy
Defective bulb	Replace
Disconnection in wiring harness or poor contact between CR-13 (87)-CL-4 (1) or CR-13(87)-CL-3(2)	Repair or replace (after clean)
Defective multifunction switch	Replace
Disconnection in wiring harness or poor contact between CN-98 (2)-CR-14 (86)	Repair or replace (after clean)
Disconnection in wiring harness or poor contact between CR-13 (30) and chassis or CR-13 (86)-chassis	Repair or replace (after clean)
Recheck fuse No. 22	Replace

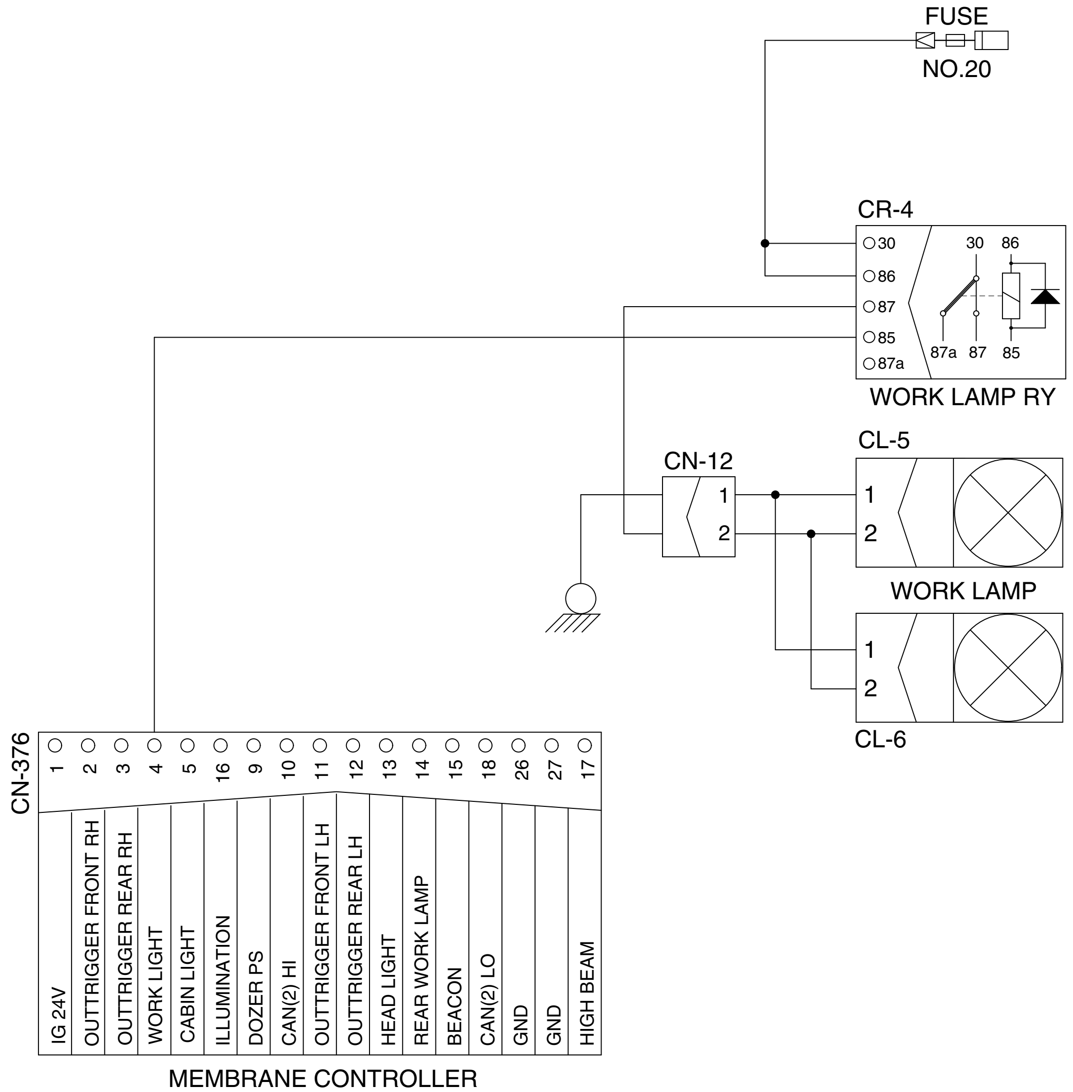


16. WHEN STARTING SWITCH IS TURNED ON, WORK LAMP DOES NOT LIGHTS UP

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



Cause	Remedy
Defective bulb	Replace
Disconnection in wiring harness or poor contact between CR-4 (87)-CL-5 (2)	Repair or replace (after clean)
Defective membrane controller	Replace
Disconnection in wiring harness or poor contact between CR-4 (87)-CN-376 (4)	Repair or replace (after clean)
Disconnection in wiring harness or poor contact between CR-4 (30) and chassis or CR-4 (86) and chassis	Repair or replace (after clean)
Recheck fuse No.20	Replace



210WF6ES16

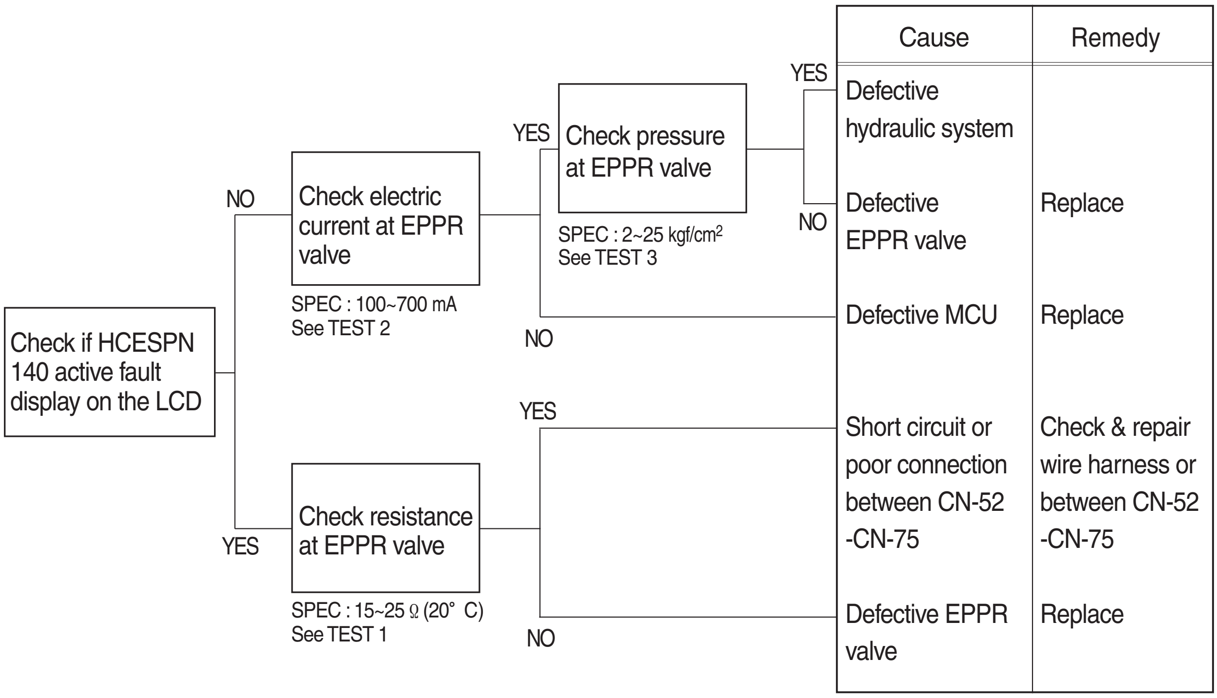
1. ALL ACTUATORS SPEED ARE SLOW

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

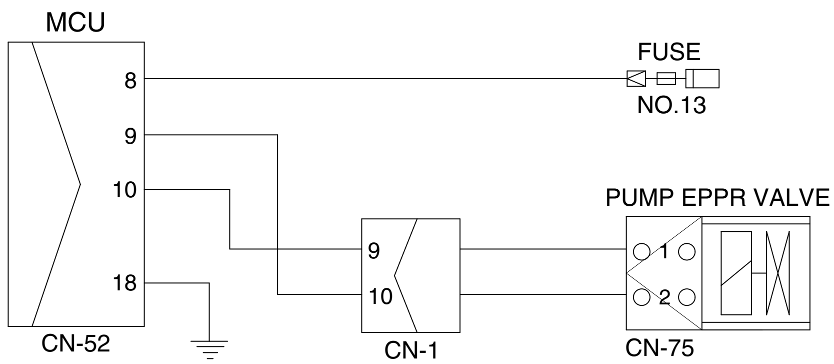
※ Spec : P-mode 1600 ± 50 rpm S -mode 1450 ± 50 rpm E-mode 1350 ± 50 rpm

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

1) INSPECTION PROCEDURE



Wiring diagram



210WF6MS01

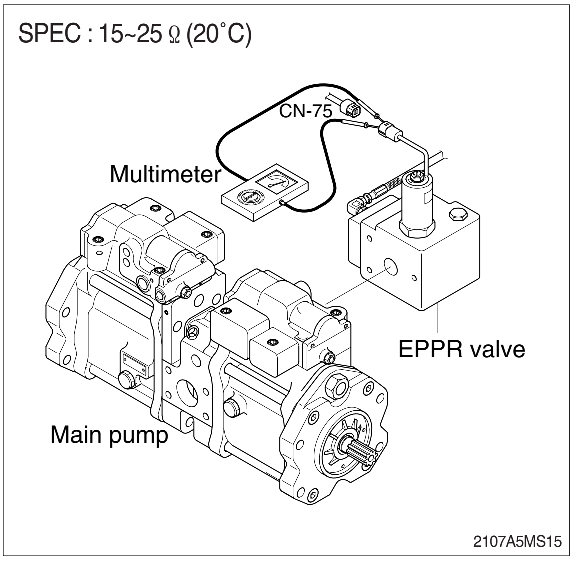
2) TEST PROCEDURE

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

① Starting key OFF.

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

③ Check resistance between 2 lines as figure.



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

① Disconnect connector CN-75 from EPPR valve.

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

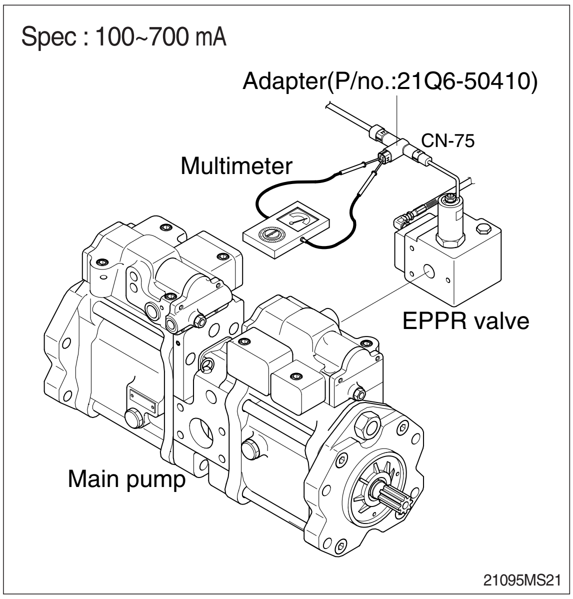
③ Start engine.

④ Set S-mode and cancel auto decel mode.

⑤ Position the accel dial at 10.

⑥ If tachometer show approx 1450±50 rpm disconnect one wire harness from EPPR valve.

⑦ Check electric current at bucket circuit relief position.



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

① Remove plug and connect pressure gauge as figure.

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

② Start engine.

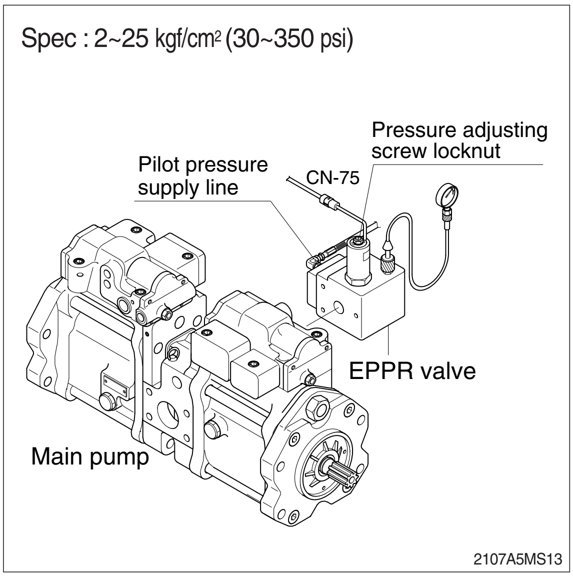
③ Set S-mode and cancel auto decel mode.

④ Position the accel dial at 10.

⑤ If tachometer show approx 1450±50 rpm check pressure at relief position of bucket circuit by operating bucket control lever.

⑥ If pressure is not correct, adjust it.

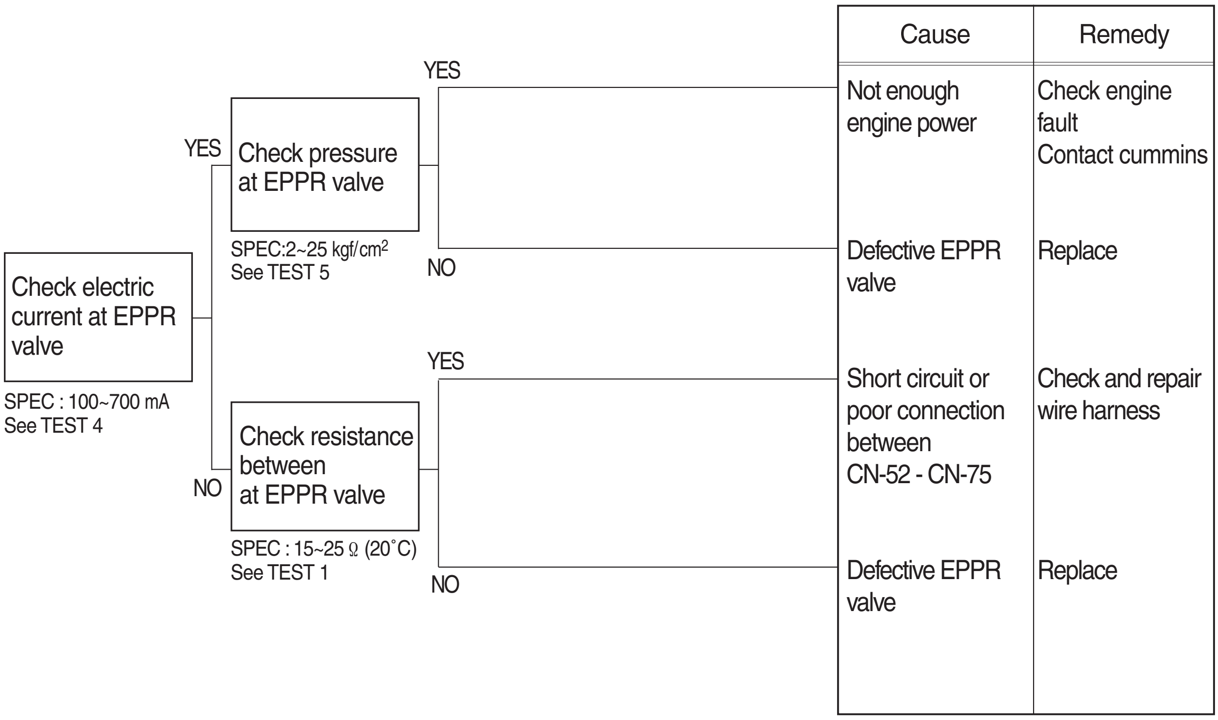
⑦ After adjust, test the machine.



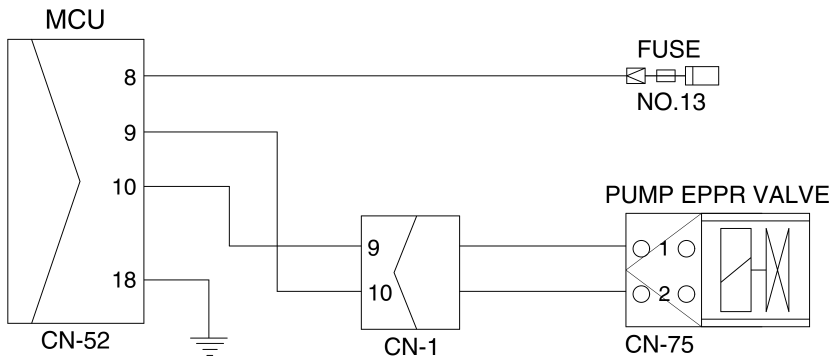
2. ENGINE STALL

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

1) INSPECTION PROCEDURE



Wiring diagram

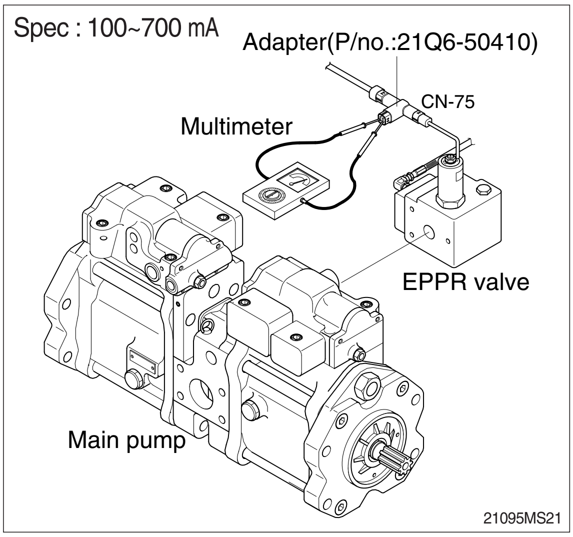


210WF6MS01

2) TEST PROCEDURE

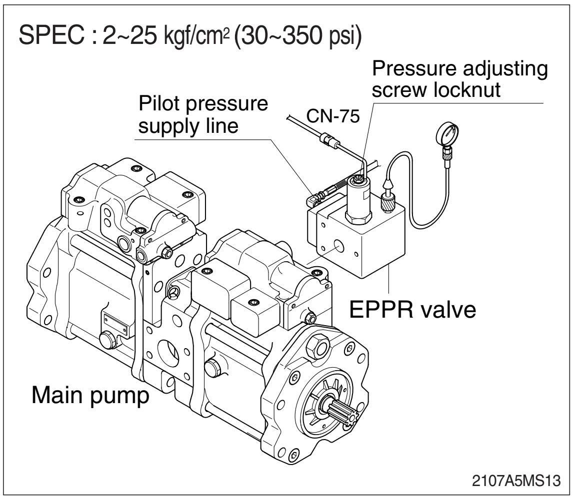
(1) Test 4 : Check electric current at EPPR valve.

① Disconnect connector CN-75 from EPPR valve.
② Insert the adapter to CN-75 and install multimeter as figure.
③ Start engine.
④ Set S-mode and cancel auto decel mode.
⑤ Position the accel dial at 10.
⑥ If rpm show approx 1450±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.

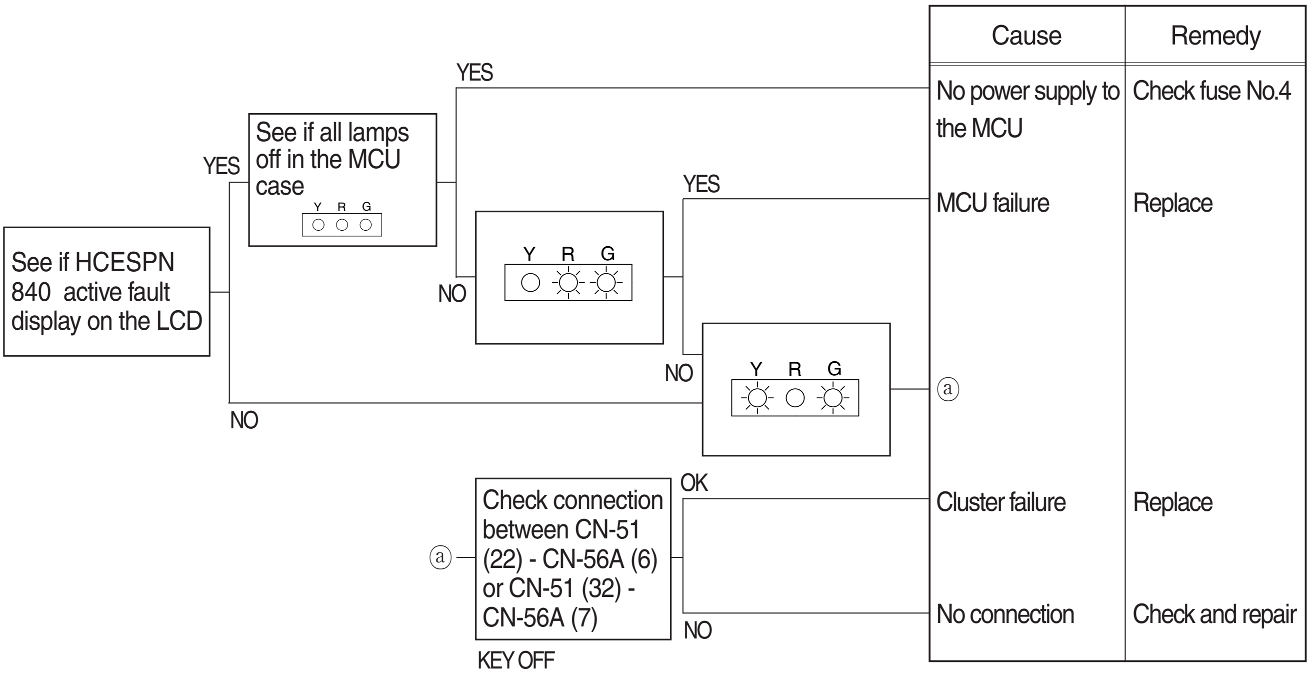
① Remove plug and connect pressure gauge as figure.
  · Gauge capacity : 0 to 50 kgf/cm^2 (0 to 725 psi)
② Start engine.
③ Set S-mode and cancel auto decel mode.
④ Position the accel dial at 10.
⑤ If rpm show approx 1450±50 rpm check pressure at relief position of bucket circuit by operating bucket control lever.
⑥ If pressure is not correct, adjust it.
⑦ After adjust, test the machine.



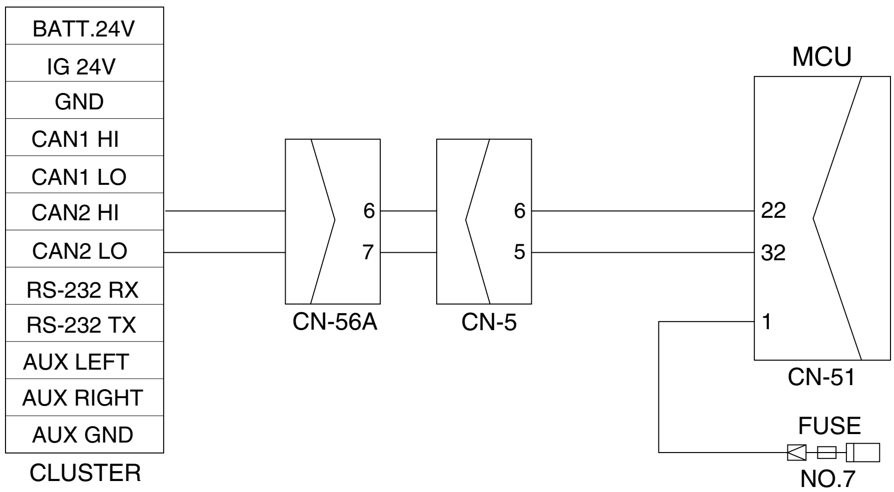
3. MALFUNCTION OF CLUSTER OR MODE SELECTION SYSTEM

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

1) INSPECTION PROCEDURE



Wiring diagram



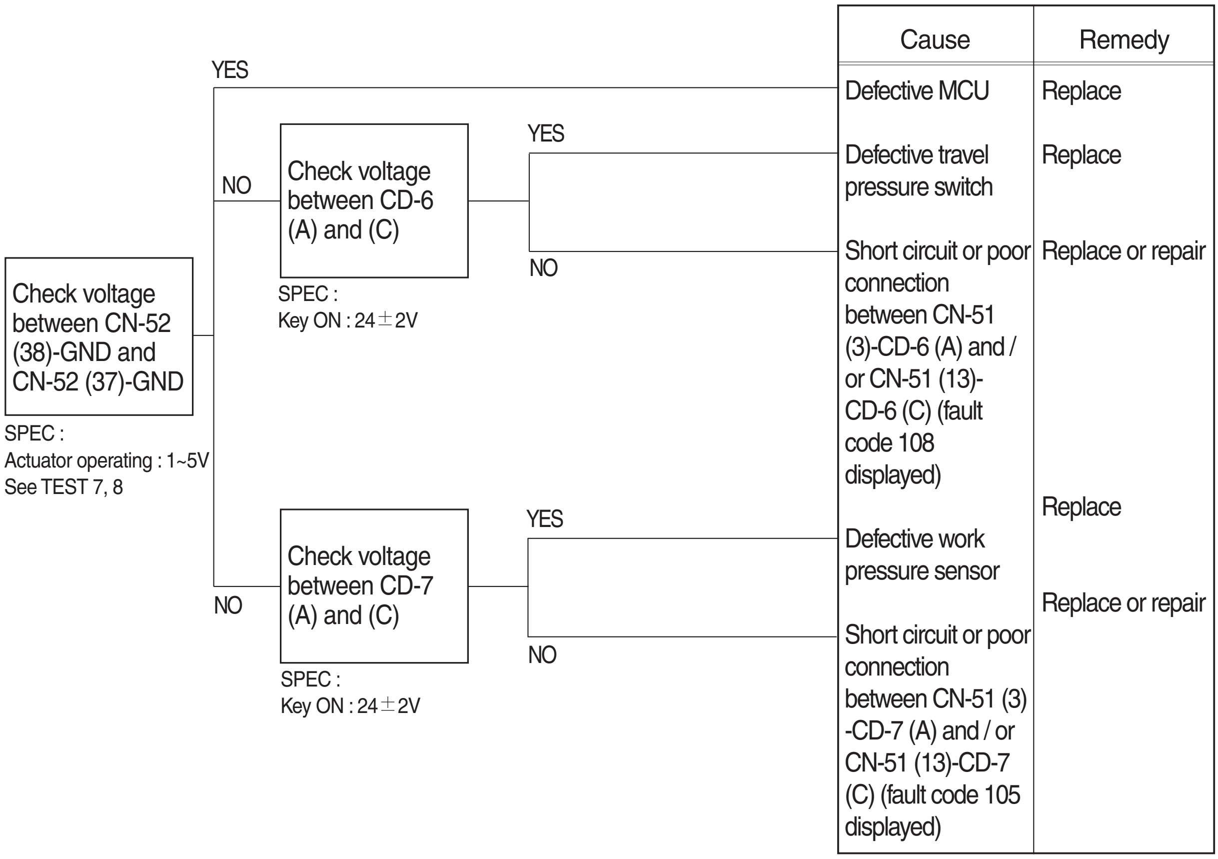
210WF6MS03

4. AUTO DECEL SYSTEM DOES NOT WORK

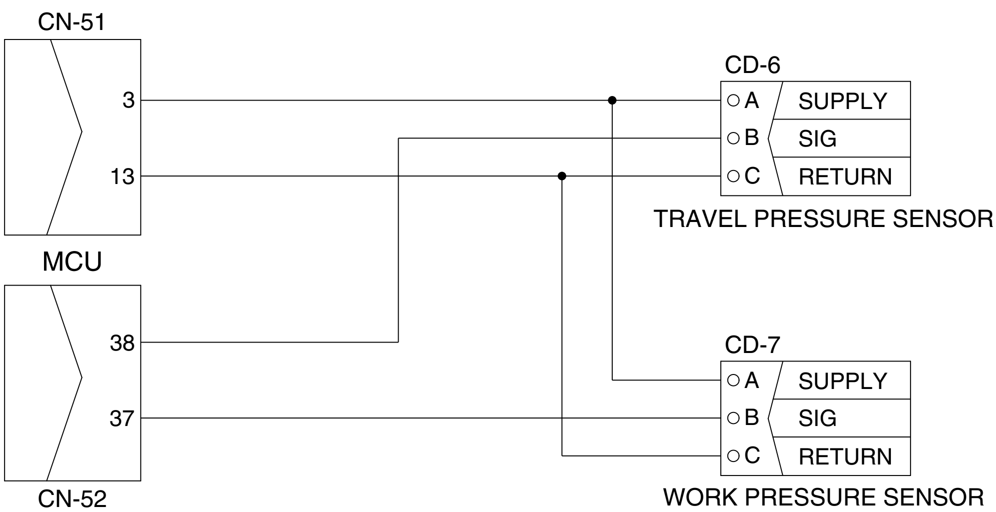
· Fault code : HCESPN 105, FMI 0~4 (work pressure sensor)
  HCESPN 108, FMI 0~4 (travel oil pressure sensor)

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

1) INSPECTION PROCEDURE



Wiring diagram



300L6MS03

2) TEST PROCEDURE

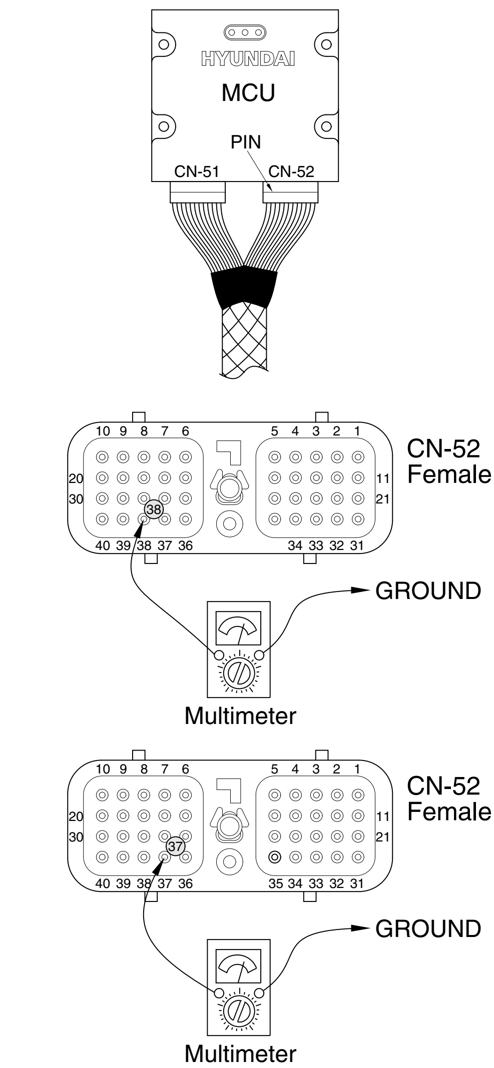
(1) Test 7 : Check voltage at CN-52 (38) and ground.

① Prepare 1 piece of thin sharp pin, steel or copper.
② Insert prepared pin to rear side of connectors : One pin to (38) of CN-52.
③ Starting key ON.
④ Check voltage as figure.

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

① Prepare 1 piece of thin sharp pin, steel or copper
② Insert prepared pin to rear side of connectors : One pin to (37) of CN-52.
③ Starting key ON.
④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V



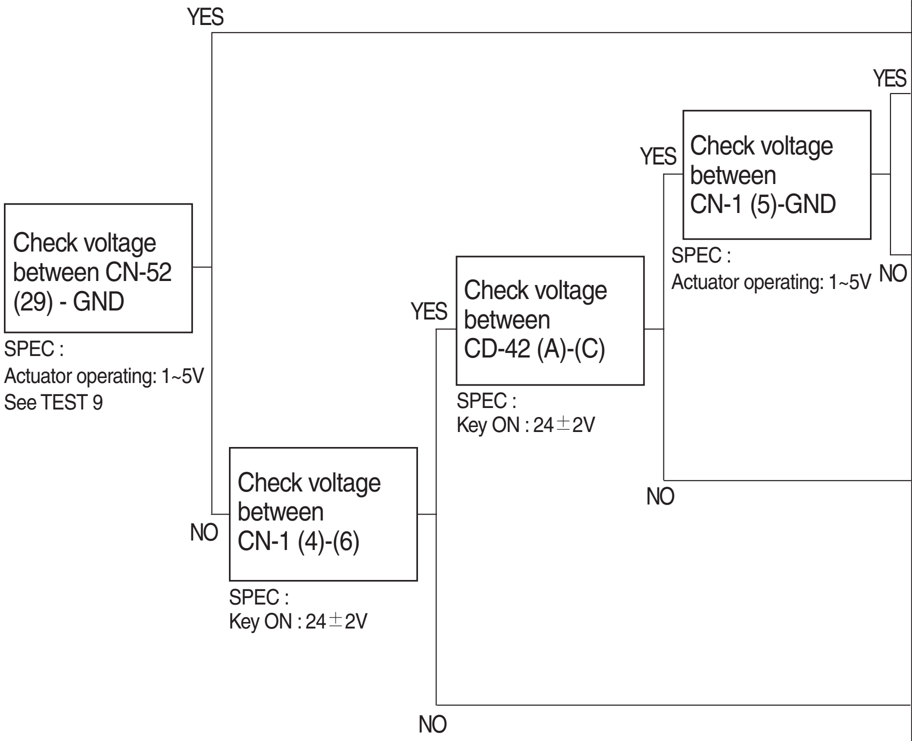
300L6MS04

5. MALFUNCTION OF PUMP 1 PRESSURE SENSOR

· Fault code : HCESPN 120, FMI 0~4

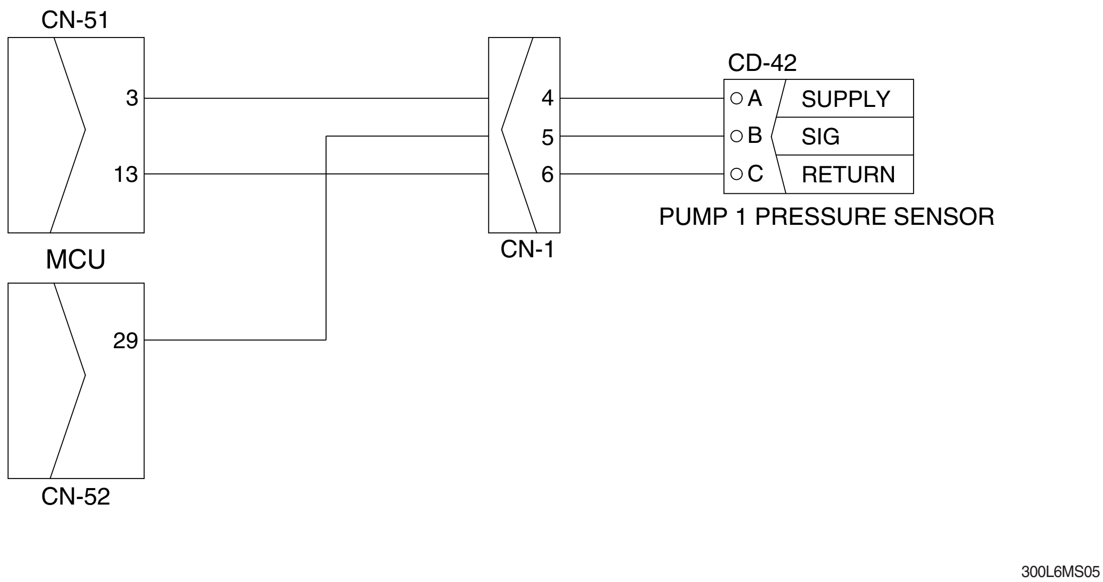
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



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

Wiring diagram



2) TEST PROCEDURE

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

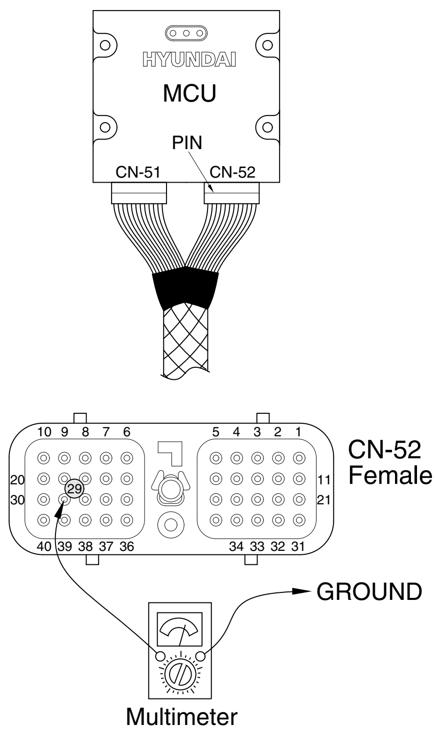
① Prepare 1 piece of thin sharp pin, steel or copper.

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

③ Starting key ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V



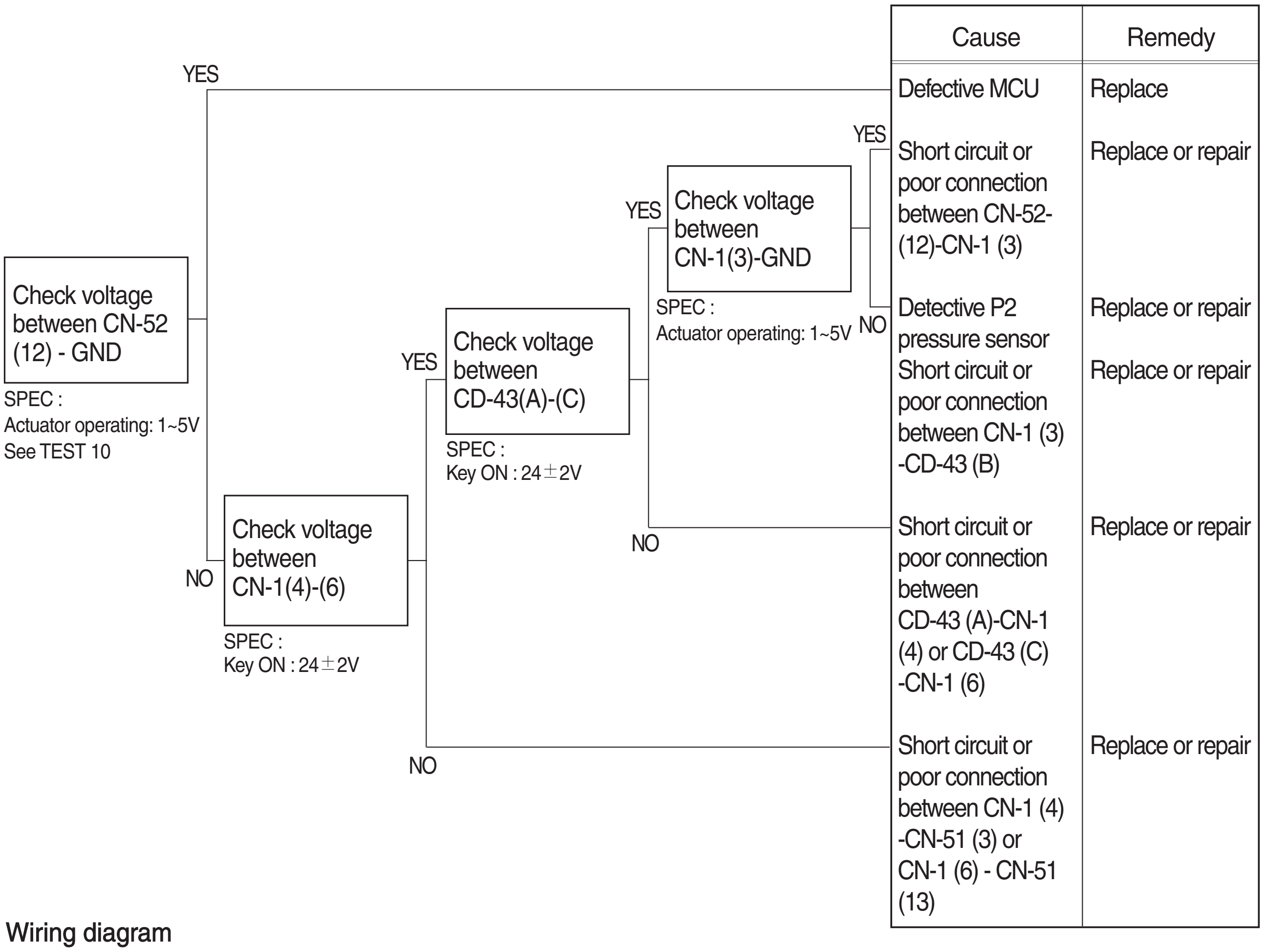
300L6MS06

6. MALFUNCTION OF PUMP 2 PRESSURE SENSOR

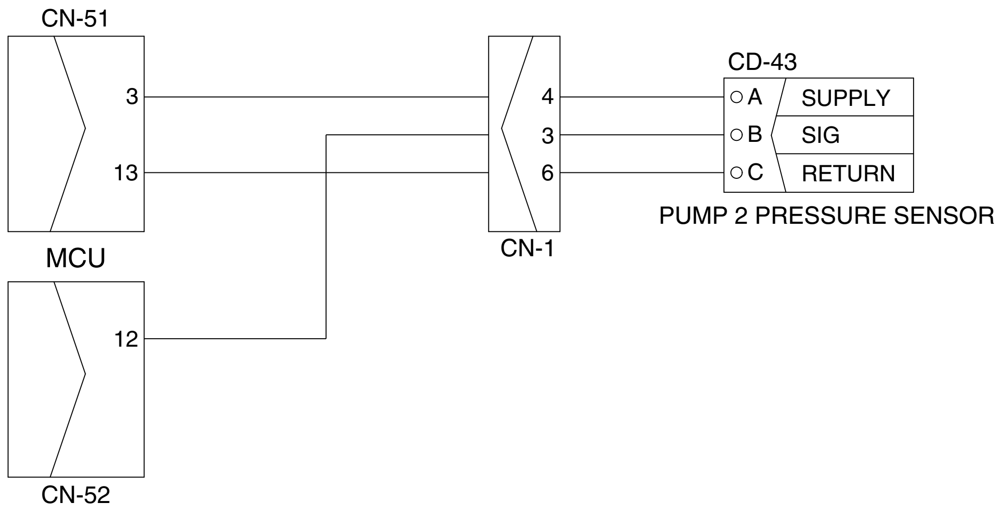
· Fault code : HCESPN 121, FMI 0~4

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

1) INSPECTION PROCEDURE



Wiring diagram



300L6MS07

2) TEST PROCEDURE

(1) Test 10 : Check voltage at CN-52 (12) and ground.

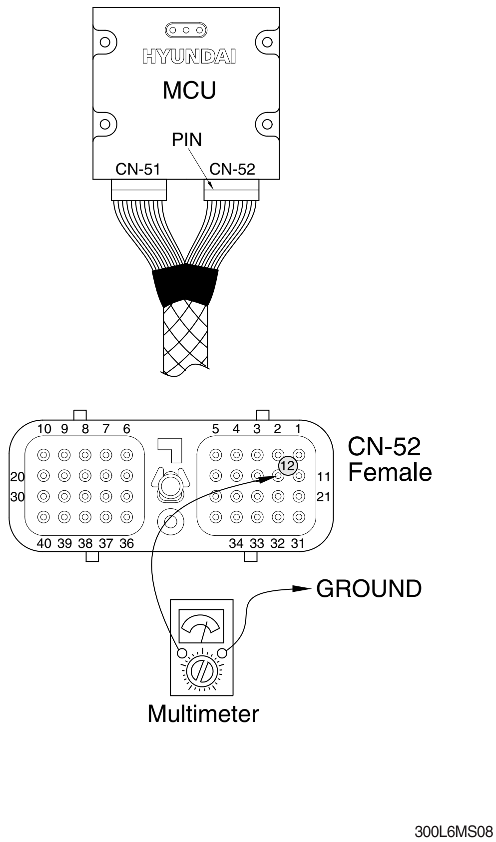
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (12) of CN-52.

③ Starting key ON.

④ Check voltage as figure.

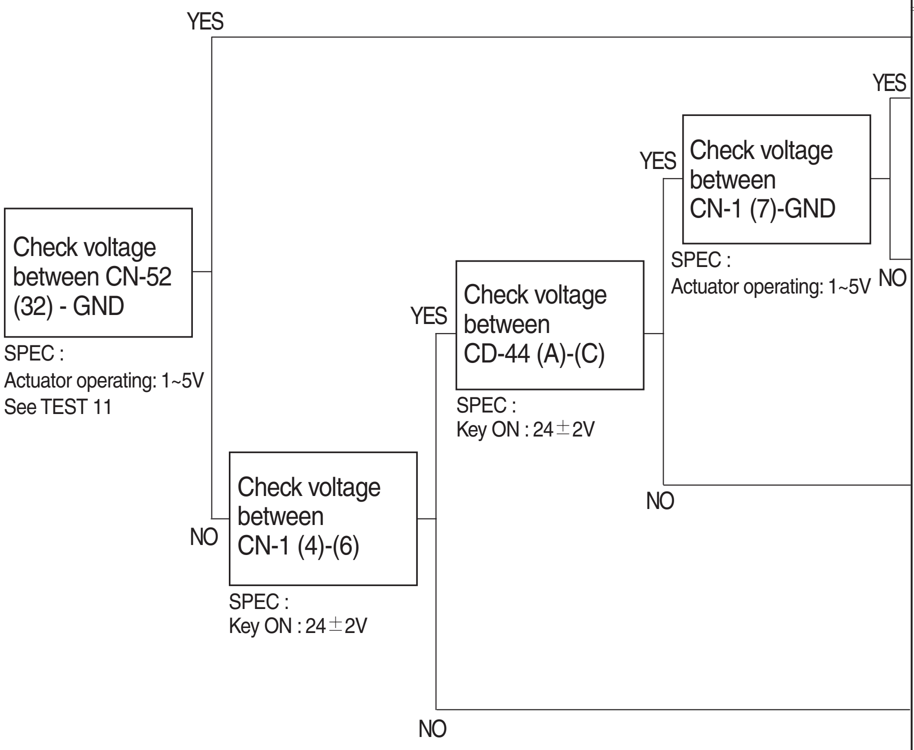
SPEC : Actuator operating : 1~5 V



7. MALFUNCTION OF PUMP 3 PRESSURE SENSOR

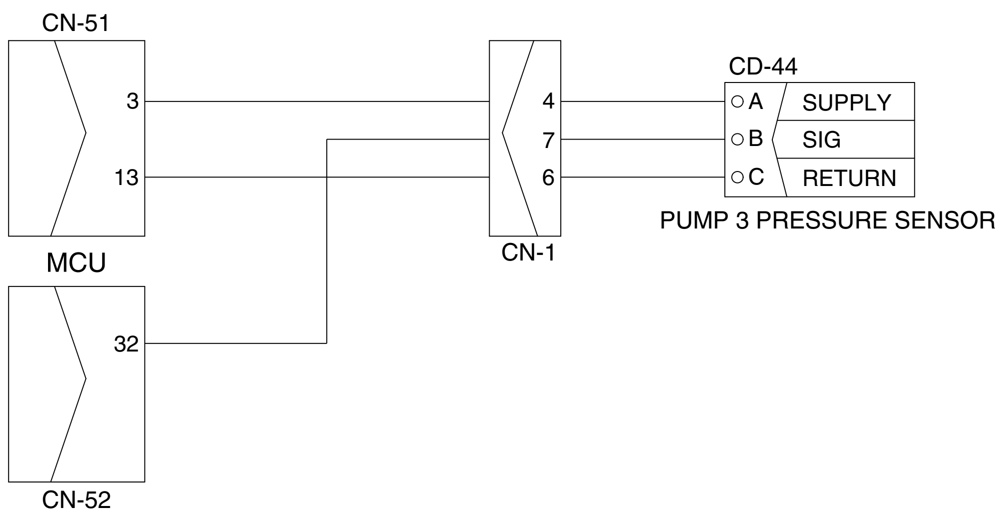
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective MCU	Replace
Short circuit or poor connection between CN-52-(32)-CN-1 (7)	Replace or repair
Detective P3 pressure sensor	Replace or repair
Short circuit or poor connection between CN-1 (7) -CD-44 (B)	Replace or repair
Short circuit or poor connection between CD-44 (A)-CN-1 (4) or CD-44 (C) -CN-1 (6)	Replace or repair
Short circuit or poor connection between CN-1 (4) -CN-51 (3) or CN-1 (6) - CN-51 (13)	Replace or repair

Wiring diagram



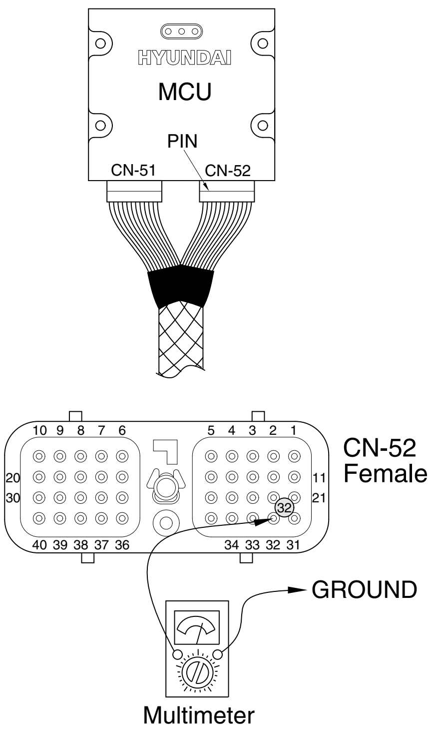
300L6MS09

2) TEST PROCEDURE

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

① Prepare 1 piece of thin sharp pin, steel or copper.
② Insert prepared pin to rear side of connectors : One pin to (32) of CN-52.
③ Starting key ON.
④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V



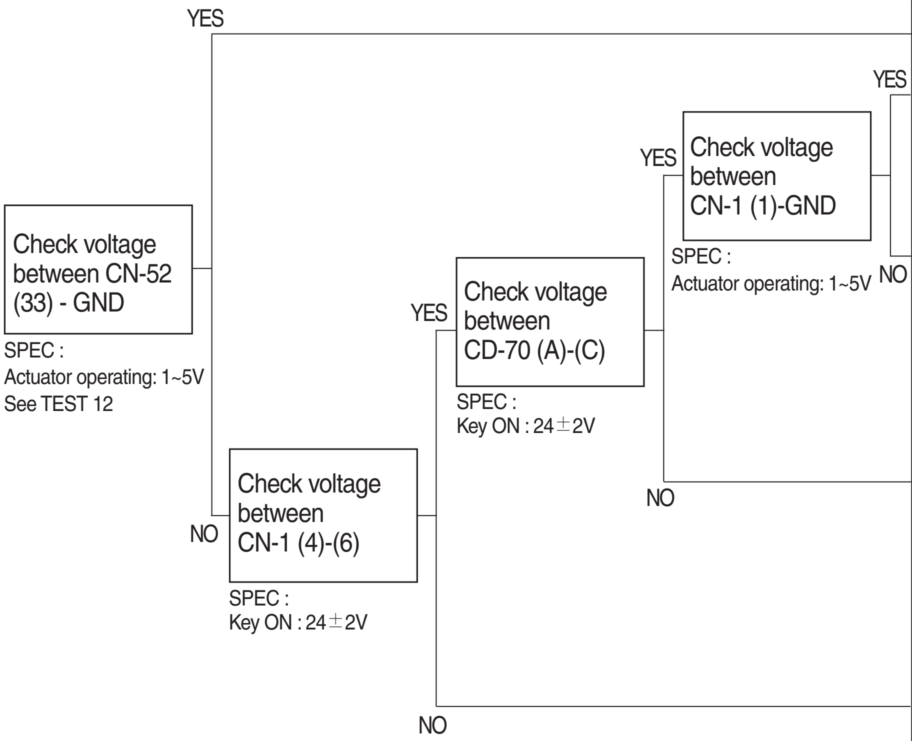
300L6MS10

8. MALFUNCTION OF NEGATIVE 1 PRESSURE SENSOR

· Fault code : HCESPN 123, FMI 0~4

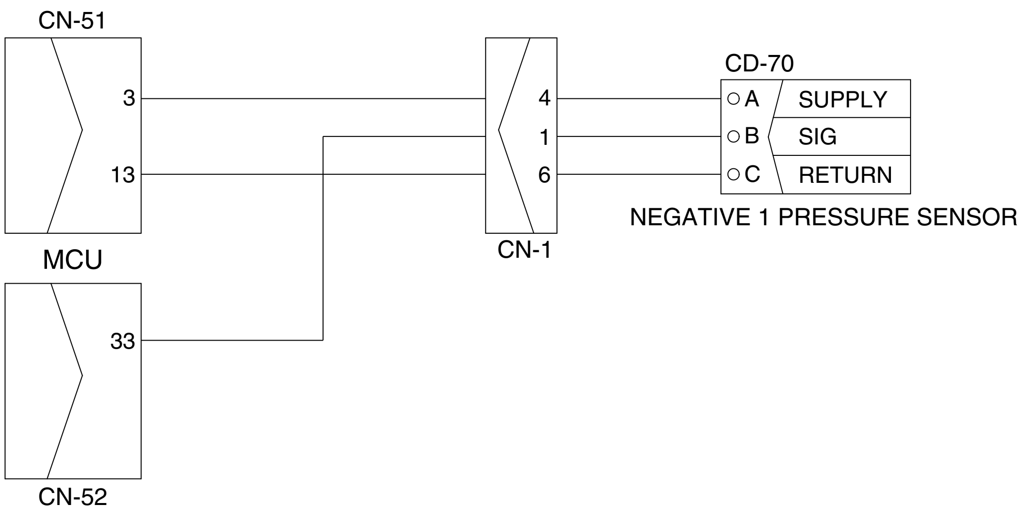
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective MCU	Replace
Short circuit or poor connection between CN-52-(33)-CN-1 (1)	Replace or repair
Detective N1 pressure sensor	Replace or repair
Short circuit or poor connection between CN-1 (1) -CD-70(B)	Replace or repair
Short circuit or poor connection between CD-70 (A)-CN-1 (4) or CD-70 (C) -CN-1 (6)	Replace or repair
Short circuit or poor connection between CN-1 (4) -CN-51 (3) or CN-1 (6) - CN-51 (13)	Replace or repair

Wiring diagram



300L6MS11

2) TEST PROCEDURE

(1) Test 12 : Check voltage at CN-52 (33) and ground.

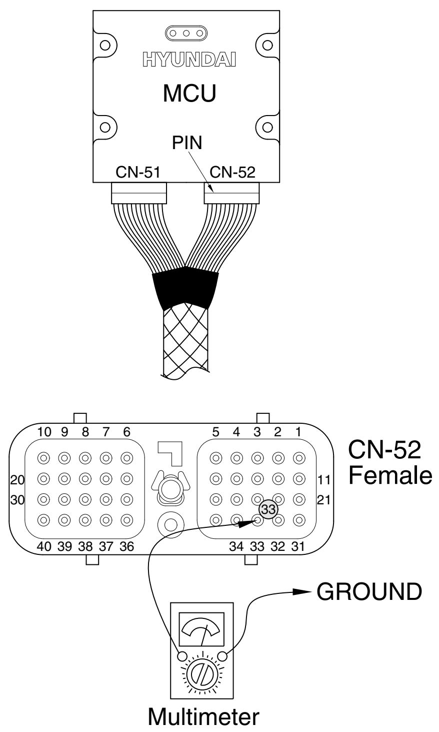
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (33) of CN-52.

③ Starting key ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V



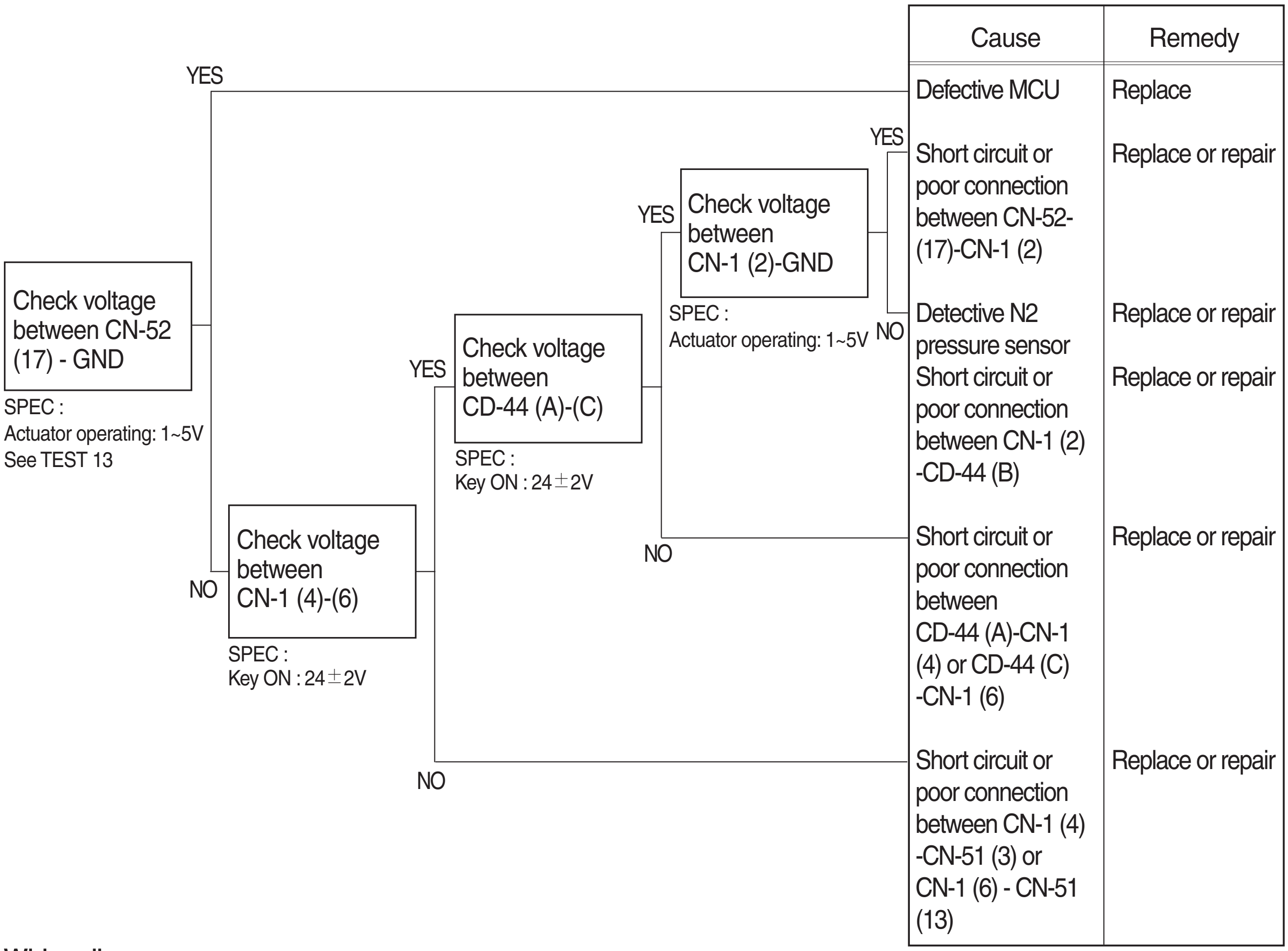
300L6MS12

9. MALFUNCTION OF NEGATIVE 2 PRESSURE SENSOR

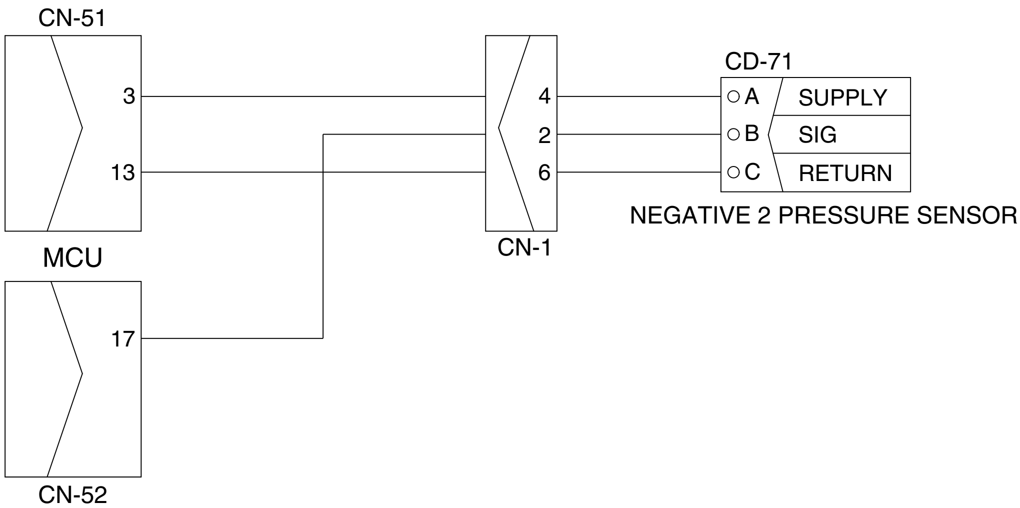
· Fault code : HCESPN 124, FMI 0~4

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

1) INSPECTION PROCEDURE



Wiring diagram



300L6MS13

2) TEST PROCEDURE

(1) Test 13 : Check voltage at CN-52 (17) and ground.

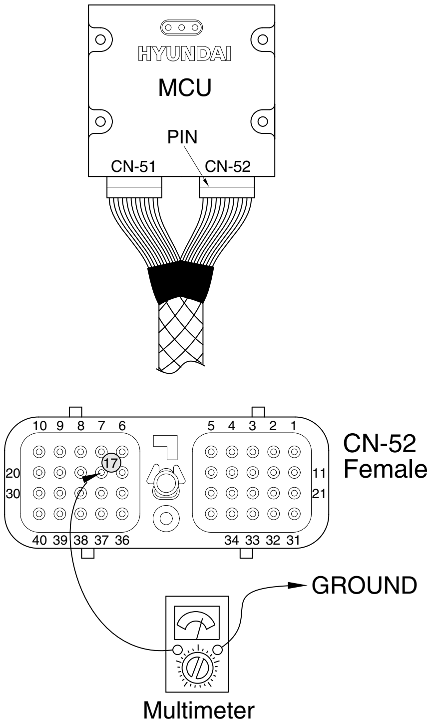
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (17) of CN-52.

③ Starting key ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V



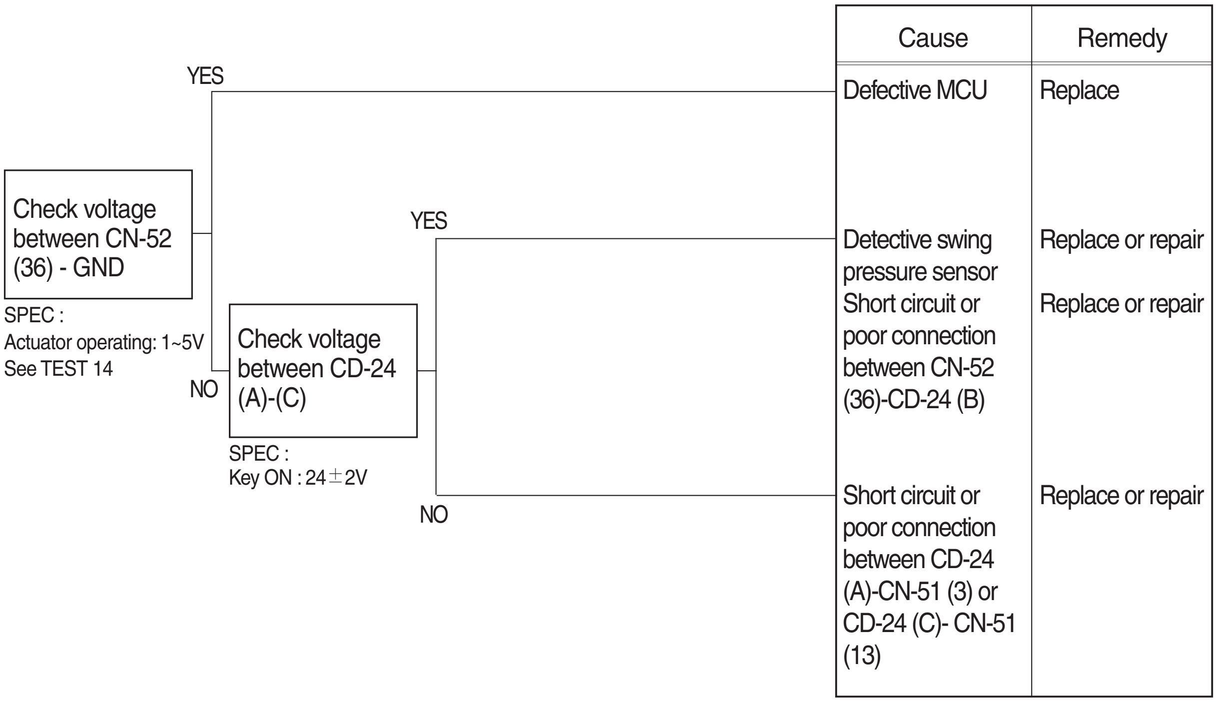
300L6MS14

10. MALFUNCTION OF SWING PRESSURE SENSOR

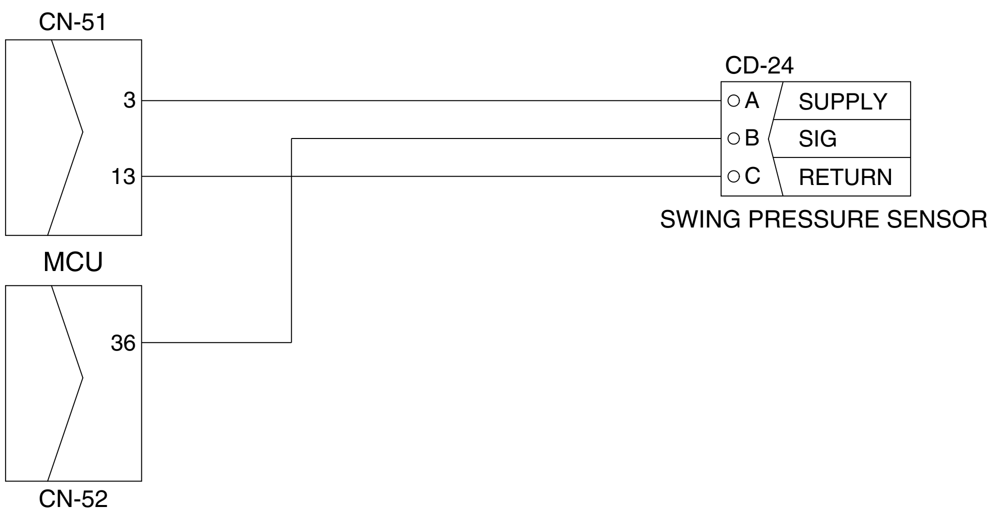
· Fault code : HCESPN 135, FMI 0~4

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

1) INSPECTION PROCEDURE



Wiring diagram



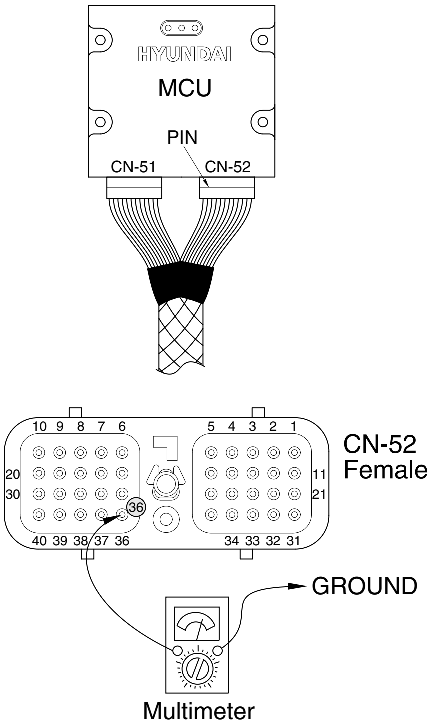
300L6MS15

2) TEST PROCEDURE

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

① Prepare 1 piece of thin sharp pin, steel or copper.
② Insert prepared pin to rear side of connectors : One pin to (36) of CN-52.
③ Starting key ON.
④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V



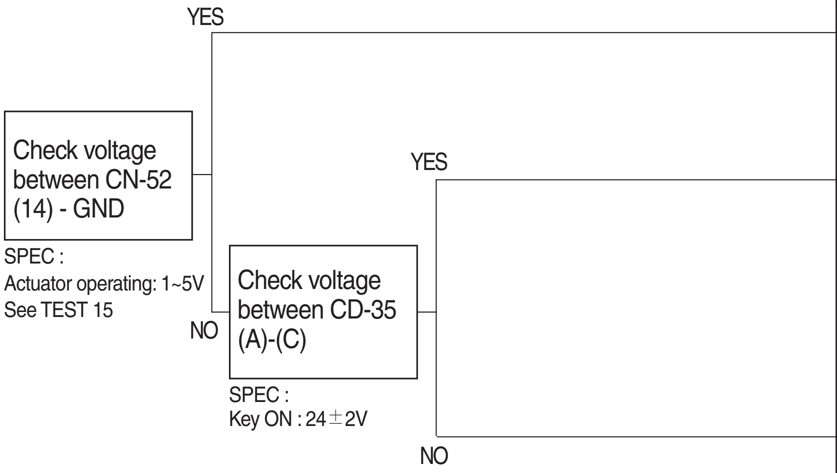
300L6MS16

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

· Fault code : HCESPN 133, FMI 0~4

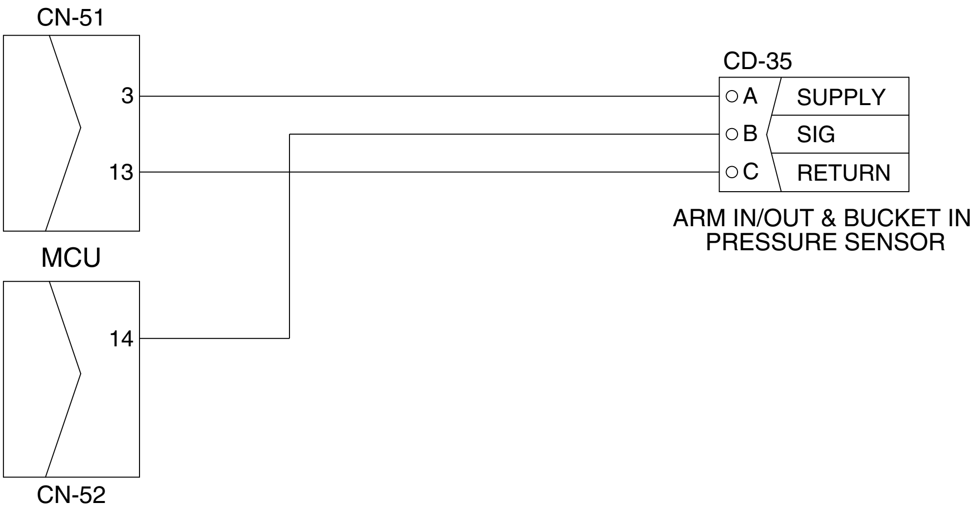
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective MCU	Replace
Detective arm in/out & bucket in pressure sensor	Replace or repair
Short circuit or poor connection between CN-52 (14)-CD-35 (B)	Replace or repair
Short circuit or poor connection between CD-35 (A)-CN-51 (3) or CD-35 (C)- CN-51 (13)	Replace or repair

Wiring diagram



300L6MS17

2) TEST PROCEDURE

(1) Test 15 : Check voltage at CN-52 (14) and ground.

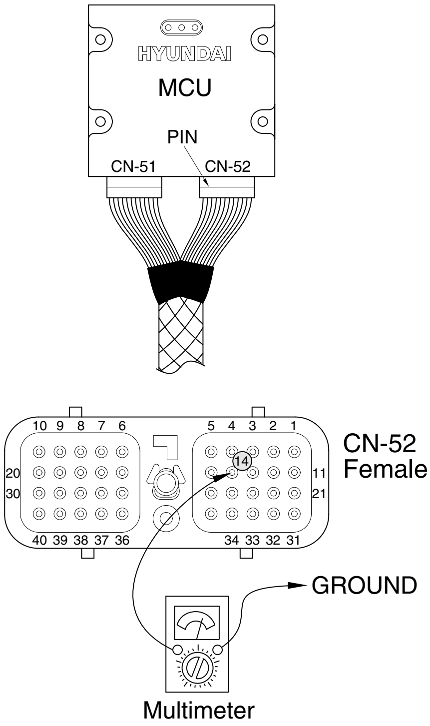
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (14) of CN-52.

③ Starting key ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V



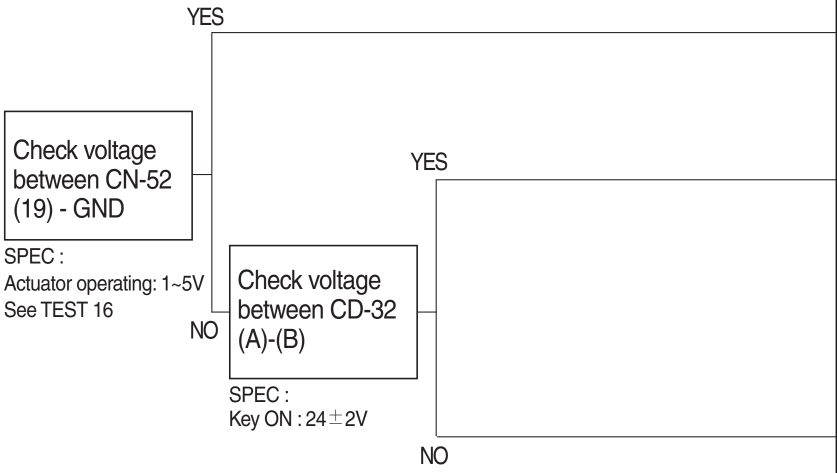
300L6MS18

12. MALFUNCTION OF BOOM UP PRESSURE SENSOR

· Fault code : HCESPN 127, FMI 0~4

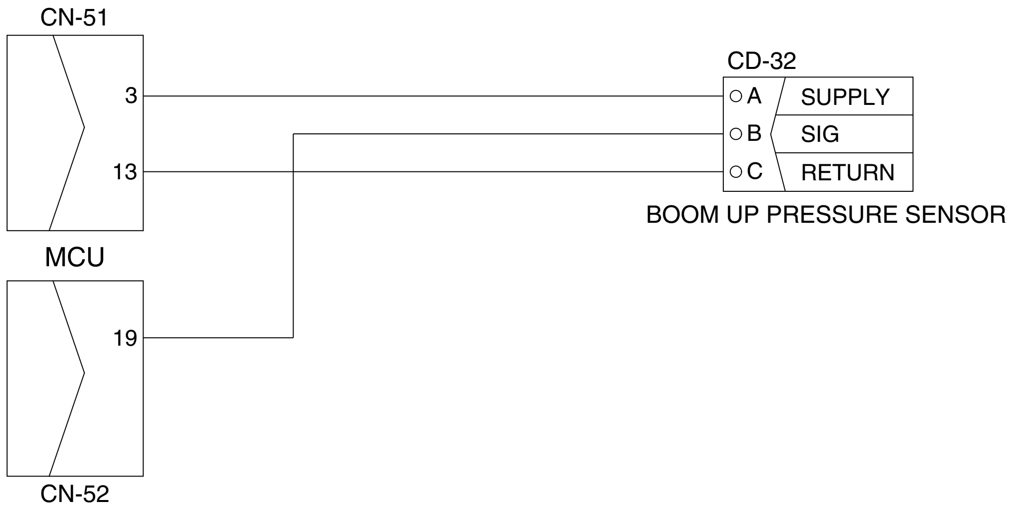
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective MCU	Replace
Detective boom up pressure sensor	Replace or repair
Short circuit or poor connection between CN-52 (19)-CD-32 (B)	Replace or repair
Short circuit or poor connection between CD-32 (A)-CN-51 (3) or CD-32 (C)- CN-51 (13)	Replace or repair

Wiring diagram



300L6MS19

2) TEST PROCEDURE

(1) Test 16 : Check voltage at CN-52 (19) and ground.

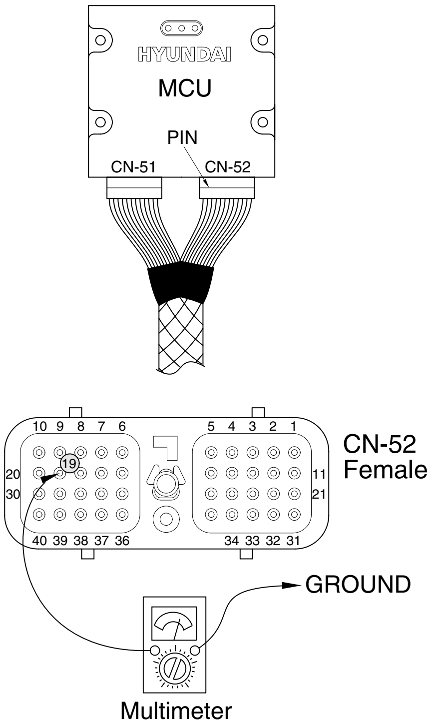
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (19) of CN-52.

③ Starting key ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V



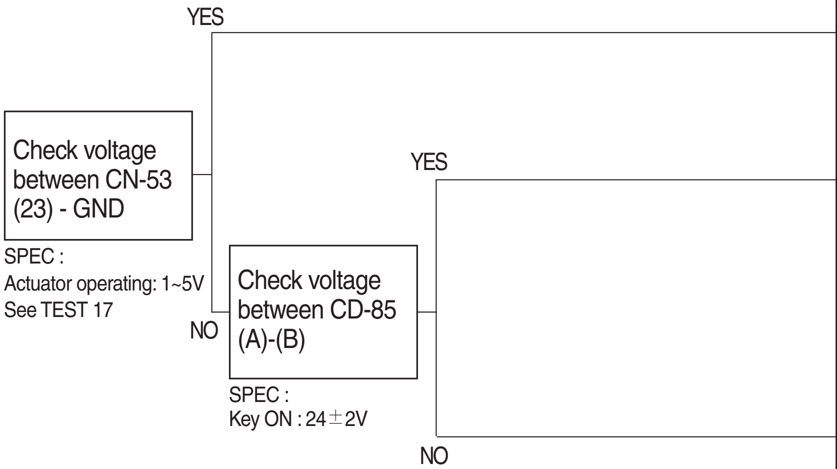
300L6MS20

13. MALFUNCTION OF BOOM DOWN PRESSURE SENSOR

· Fault code : HCESPN 128, FMI 0~4

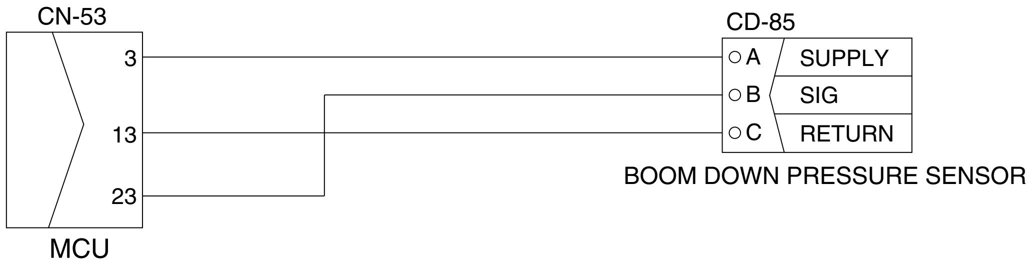
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective MCU	Replace
Detective boom up pressure sensor	Replace or repair
Short circuit or poor connection between CN-53 (23)-CD-85 (B)	Replace or repair
Short circuit or poor connection between CD-85 (A)-CN-53 (3) or CD-85 (C)- CN-51 (13)	Replace or repair

Wiring diagram



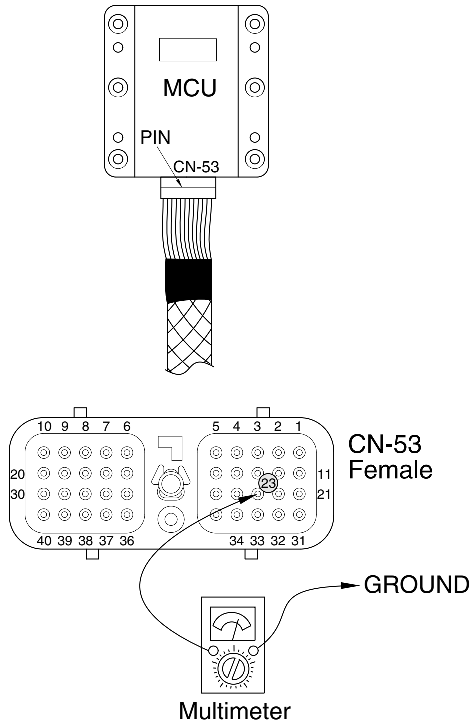
300L6MS25

2) TEST PROCEDURE

(1) Test 17 : Check voltage at CN-53 (23) and ground.

① Prepare 1 piece of thin sharp pin, steel or copper.
② Insert prepared pin to rear side of connectors : One pin to (23) of CN-53.
③ Starting key ON.
④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V



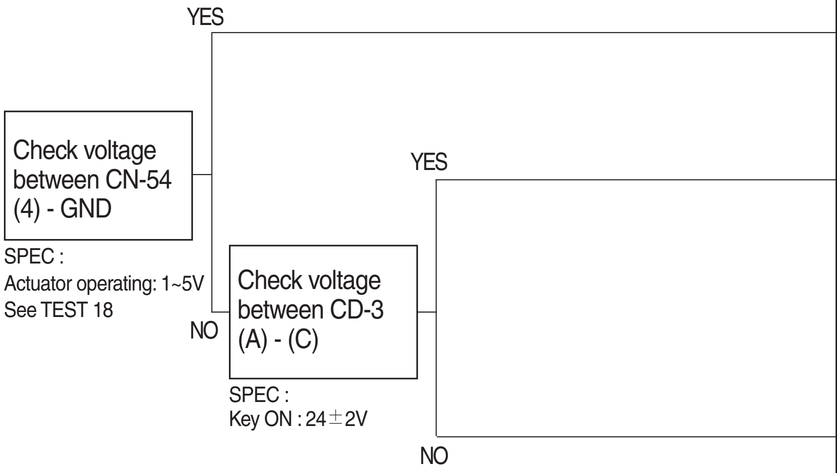
300L6MS26

14. MALFUNCTION OF BRAKE OIL PRESSURE SENSOR

· Fault code : HCESPN 503, FMI 0~4

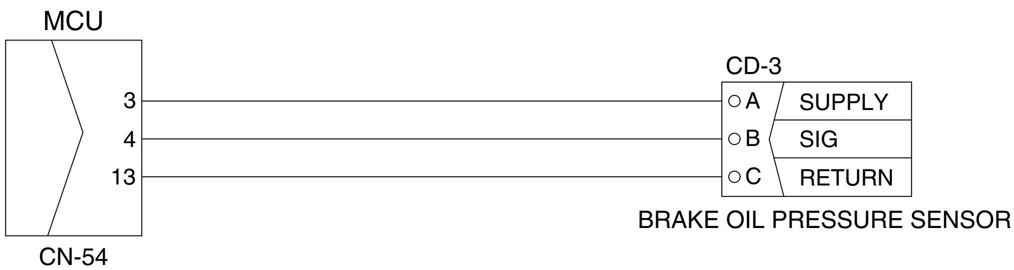
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective MCU	Replace
Detective boom up pressure sensor	Replace or repair
Short circuit or poor connection between CN-54 (4)-CD-3 (B)	Replace or repair
Short circuit or poor connection between CD-3 (A)-CN-51 (3) or CD-3 (C)- CN-51 (13)	Replace or repair

Wiring diagram



210WF6MS14

2) TEST PROCEDURE

(1) Test 18 : Check voltage at CN-54 (4) and ground.

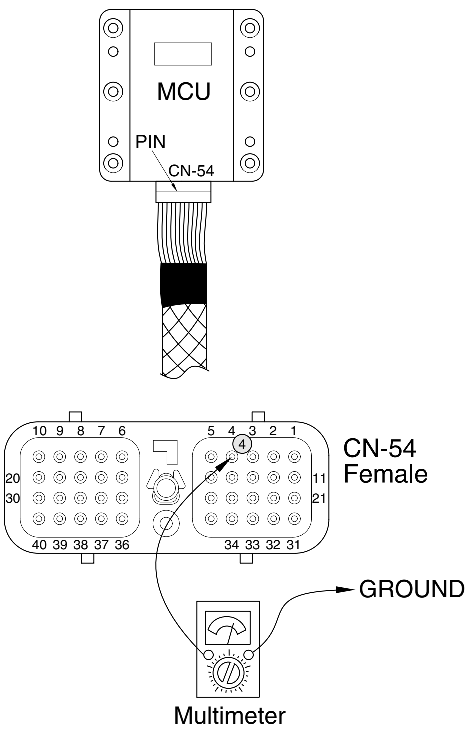
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (4) of CN-54.

③ Starting key ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V



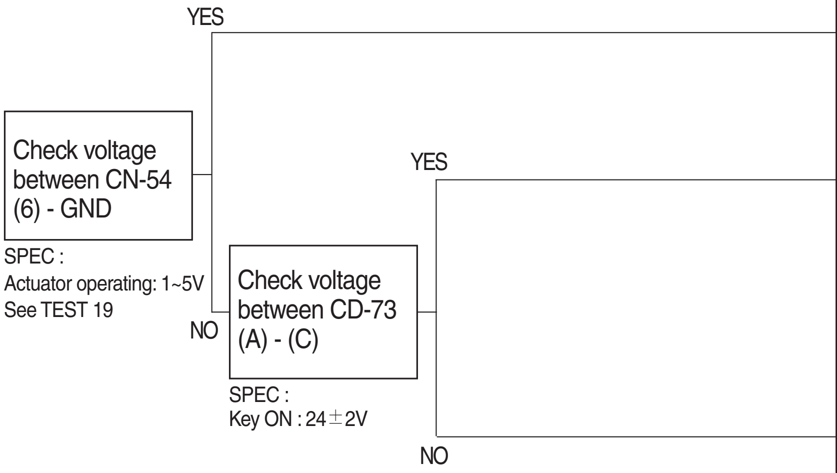
210WF6MS14A

15. MALFUNCTION OF TRAVEL FORWARD PRESSURE SENSOR

· Fault code : HCESPN 530, FMI 0~4

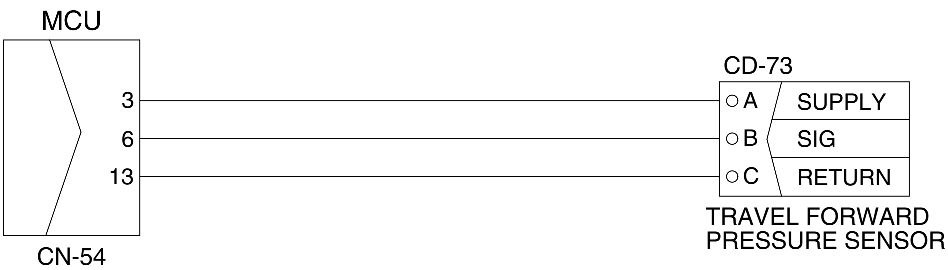
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective MCU	Replace
Detective boom up pressure sensor	Replace or repair
Short circuit or poor connection between CN-54 (6) - CD-73 (B)	Replace or repair
Short circuit or poor connection between CD-73 (A)-CN-51 (4) or CD-73 (C)- CN-51 (5)	Replace or repair

Wiring diagram



210WF6MS15

2) TEST PROCEDURE

(1) Test 19 : Check voltage at CN-54 (6) and ground.

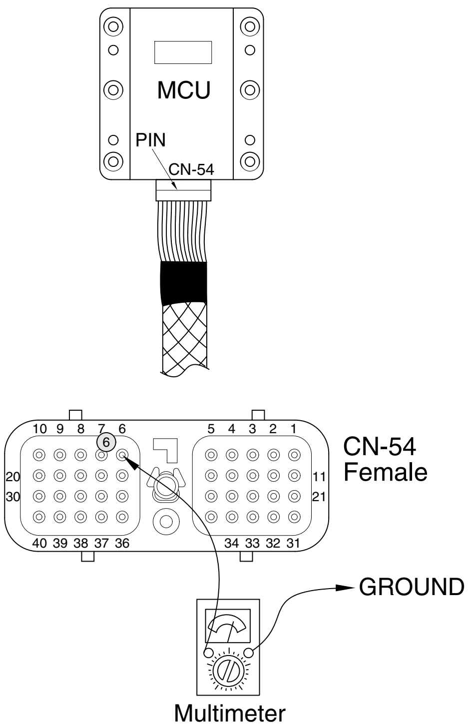
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (6) of CN-54.

③ Starting key ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V



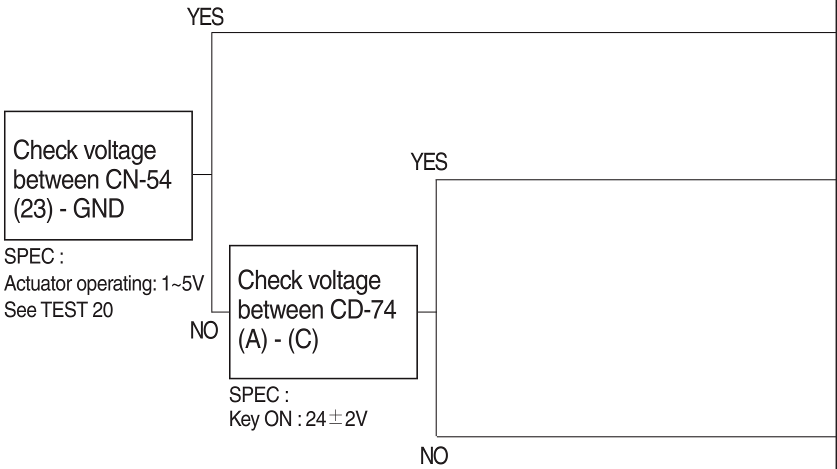
210WF6MS15A

16. MALFUNCTION OF TRAVEL REVERSE PRESSURE SENSOR

· Fault code : HCESPN 531, FMI 0~4

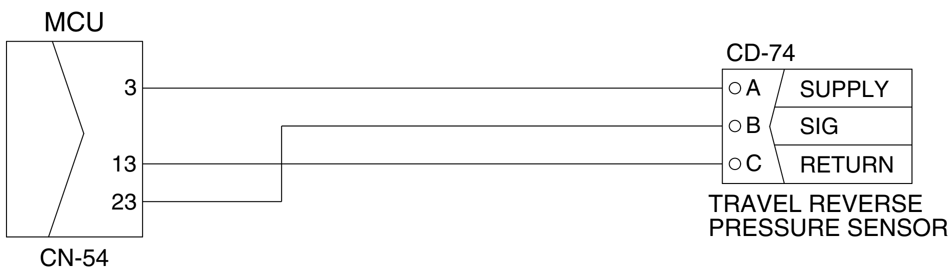
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective MCU	Replace
Detective boom up pressure sensor	Replace or repair
Short circuit or poor connection between CN-54 (23)-CD-74 (B)	Replace or repair
Short circuit or poor connection between CD-74 (A)-CN-54 (3) or CD-74 (C)- CN-54 (13)	Replace or repair

Wiring diagram



210WF6MS16

2) TEST PROCEDURE

(1) Test 20 : Check voltage at CN-54 (23) and ground.

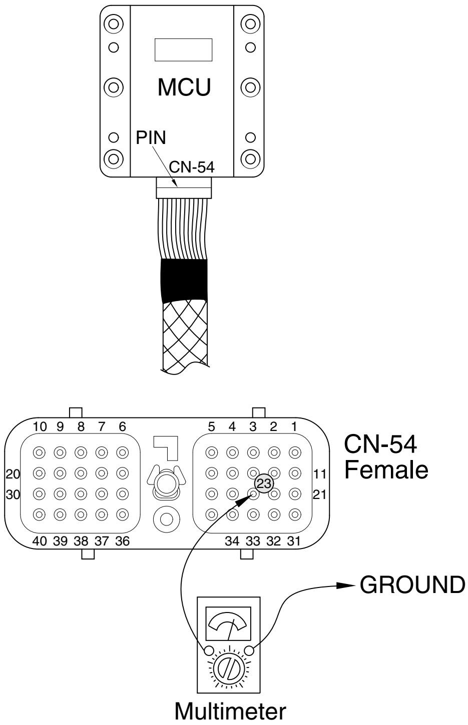
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (23) of CN-54.

③ Starting key ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V



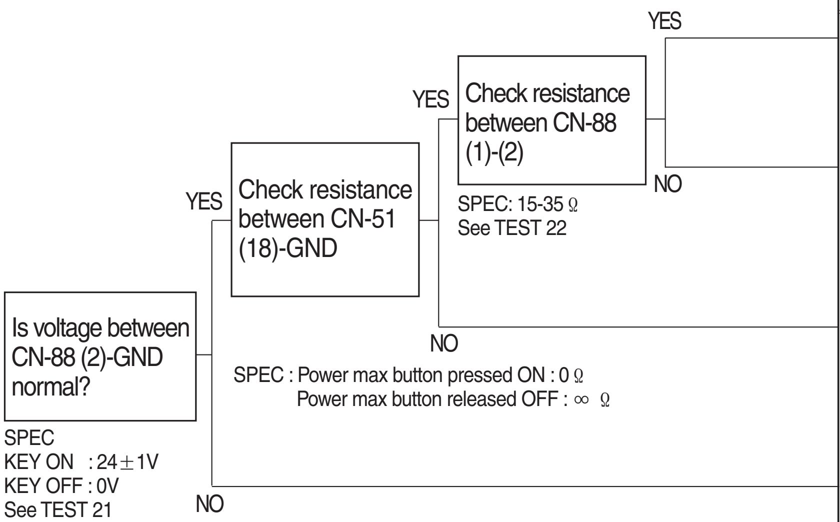
210WF6MS16A

17. MALFUNCTION OF POWER MAX

· Fault code : HCESPN 166, FMI 4 or 6

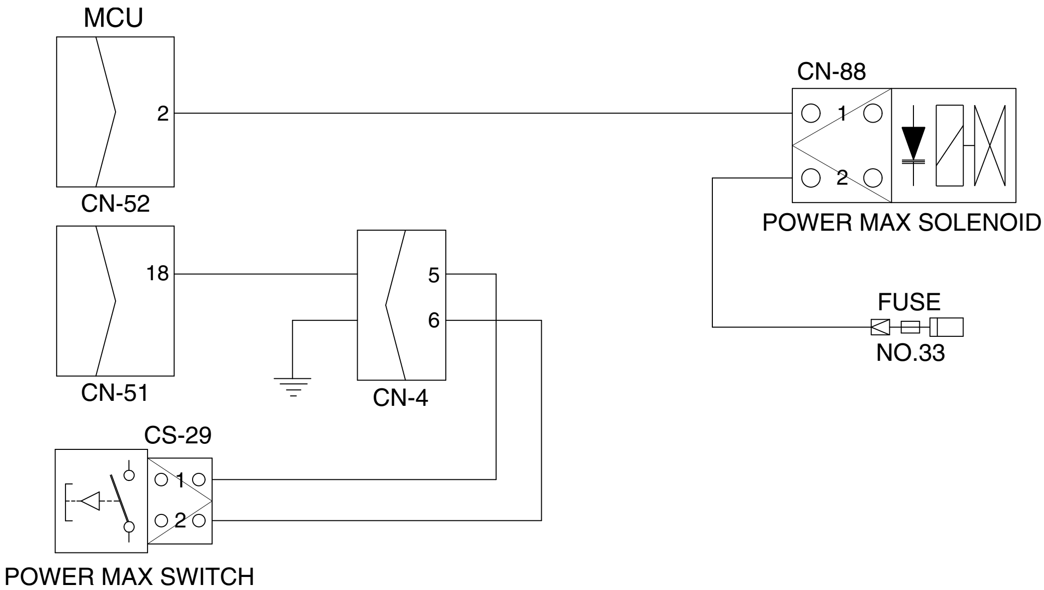
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Short circuit or poor connection between CN-88(1)-CN-52 (2)	Repair or replace
Defective power max. solenoid valve Check hydraulic system	Repair or replace
Short circuit or poor connection between CN-51 (18)-CS-29	Repair or replace
Short circuit or poor connection between CN-88 (2)-Fuse No. 33	Repair or replace

Wiring diagram

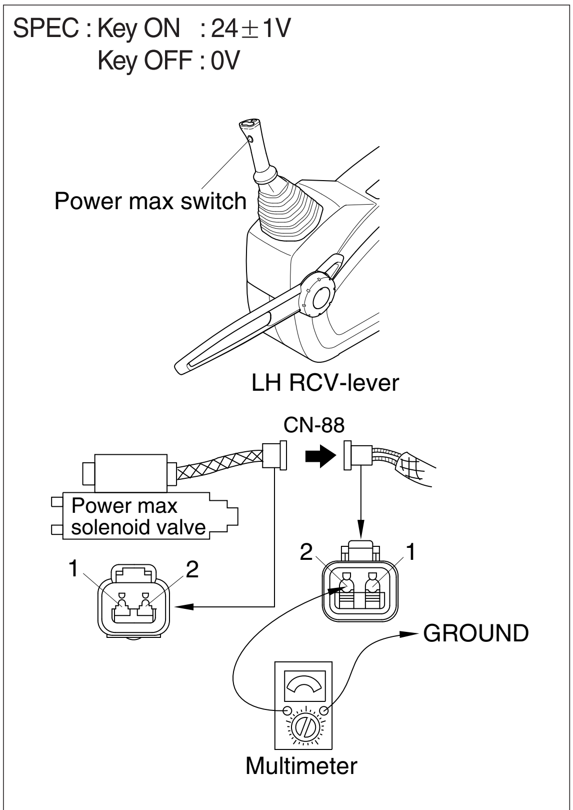


210WF6MS17

2) TEST PROCEDURE

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

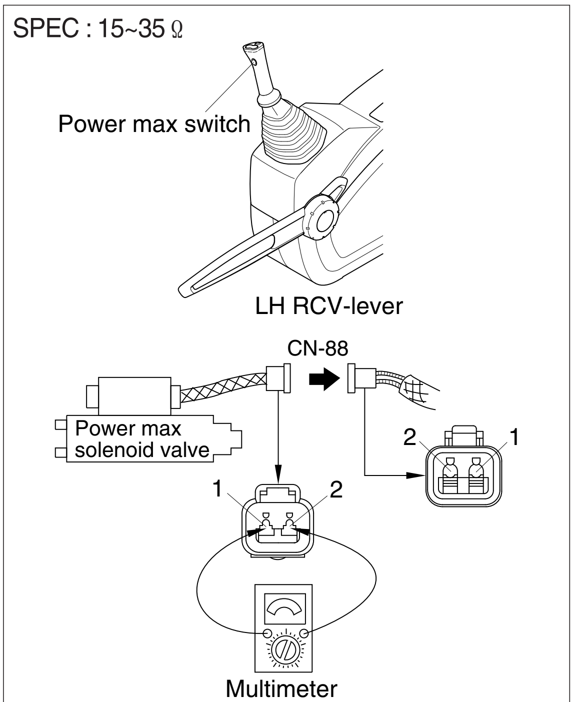
① Disconnect connector CN-88 from power max solenoid valve.
② Start key ON.
③ Check voltage as figure.



21096MS14A

(2) **Test 22**: Check resistance of the solenoid valve between CN-88 (1)-(2).

① Starting key OFF.
② Disconnect connector CN-88 from power max solenoid valve.
③ Check resistance as figure.



21096MS14B

18. MALFUNCTION OF BOOM PRIORITY EPPR VALVE

· Fault code : HCESPN 141, FMI 5 or 6

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

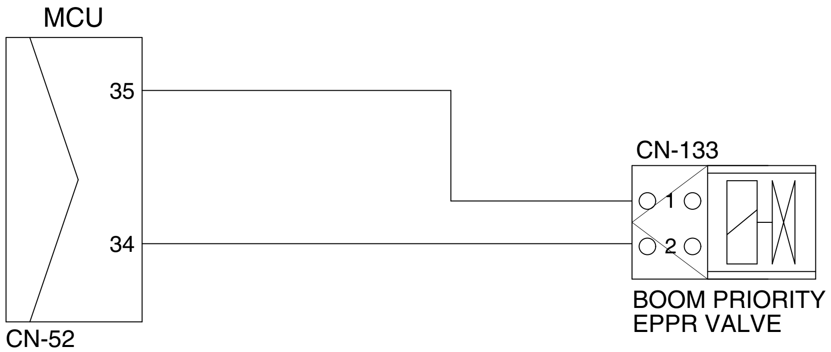
1) INSPECTION PROCEDURE

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

SPEC : 20~30V
KEY : ON

	Cause	Remedy
YES	Short circuit or poor connection between CN-52 (35)-CN-133 (1) or CN-52 (34)-CN-133 (2)	Repair or replace
NO	Defective EPPR valve	Repair or replace

Wiring diagram



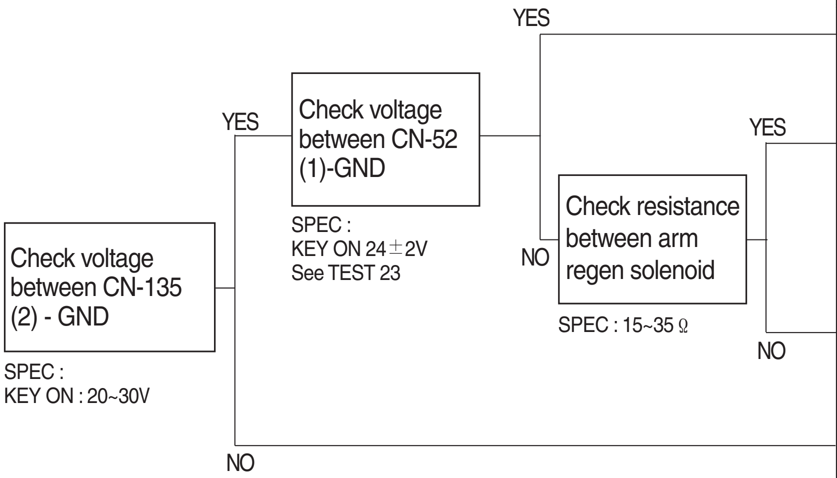
300L6MS23

19. MALFUNCTION OF ARM REGENERATION SOLENOID

· Fault code : HCESPN 170, FMI 4 or 6

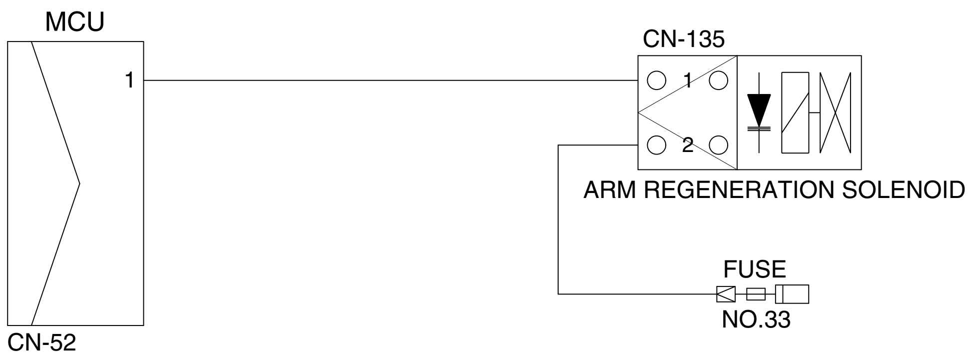
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective MCU	Replace
Short circuit or poor connection between CN-52 (1)-CN-135 (1)	Replace or repair
Defective solenoid valve	Replace
Open circuit between CN-135 (2)-Fuse No. 33	Replace or repair

Wiring diagram



210WF6MS19

2) TEST PROCEDURE

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

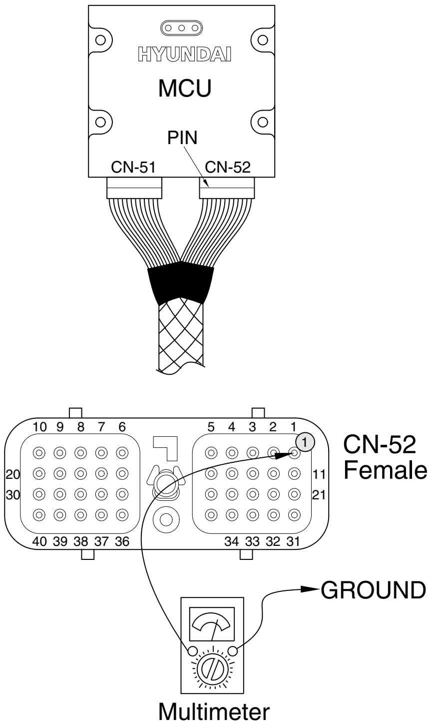
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (1) of CN-52.

③ Starting key ON.

④ Check voltage as figure.

SPEC : Key ON : 24±2 V



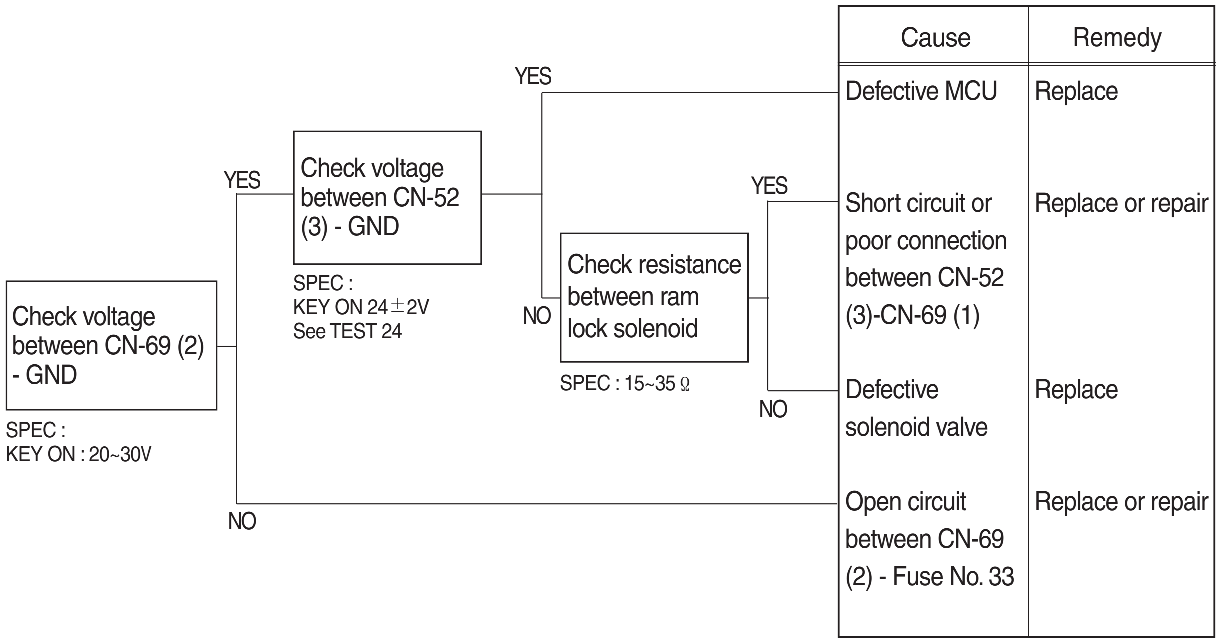
300L6MS22

20. MALFUNCTION OF RAM LOCK SOLENOID

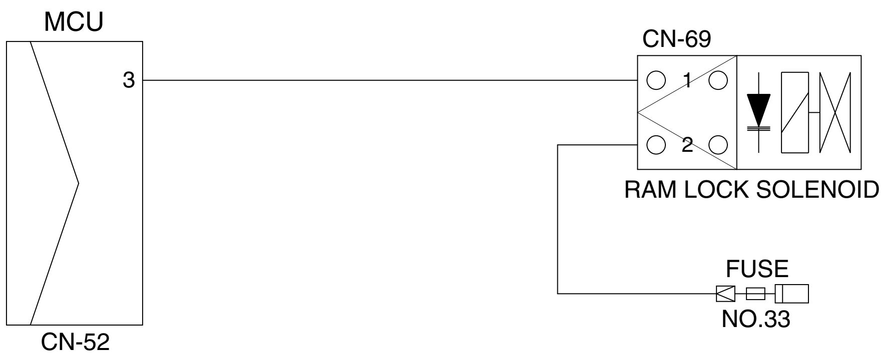
· Fault code : HCESPN 525, FMI 4 or 6

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

1) INSPECTION PROCEDURE



Wiring diagram



210WF6MS25

2) TEST PROCEDURE

(1) Test 24 : Check voltage at CN-52 (3) and ground.

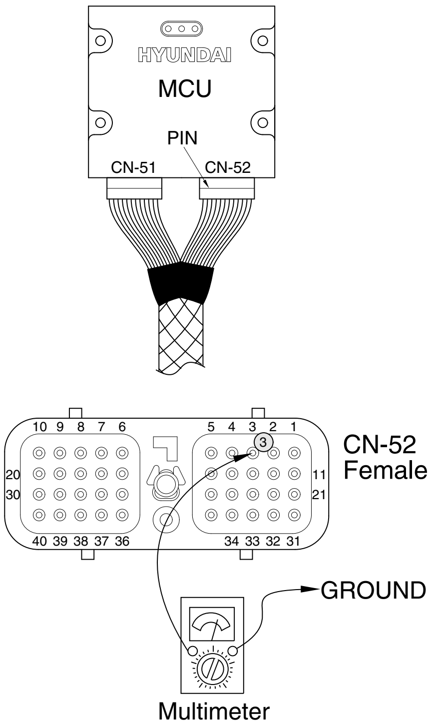
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (3) of CN-52.

③ Starting key ON.

④ Check voltage as figure.

SPEC : Key ON : 24±2 V



210WF6MS20A

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.

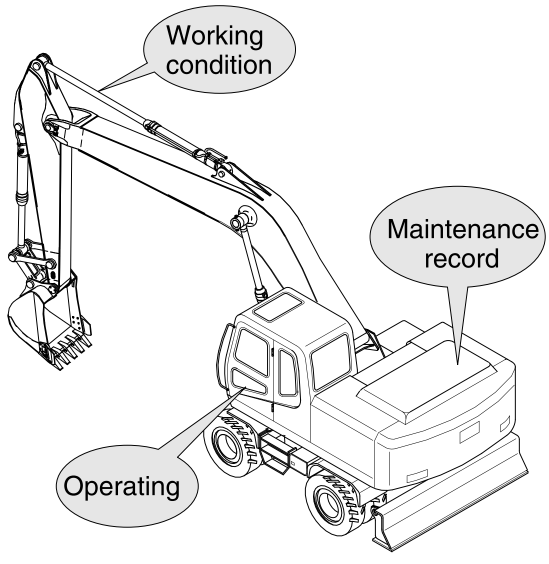
2) OPERATIONAL PERFORMANCE OF A WORKING MACHINE

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.

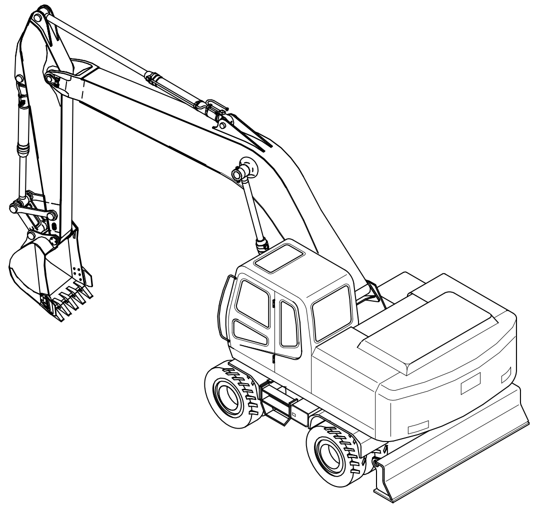


14W77MS01

2. TERMINOLOGY

1) STANDARD

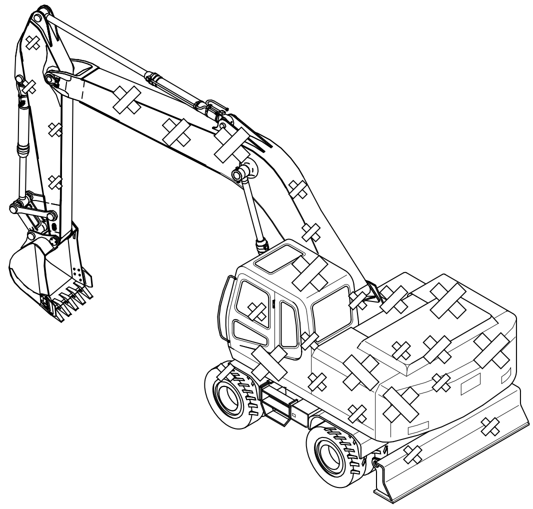
Specifications applied to the brand-new machine, components and parts.



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.



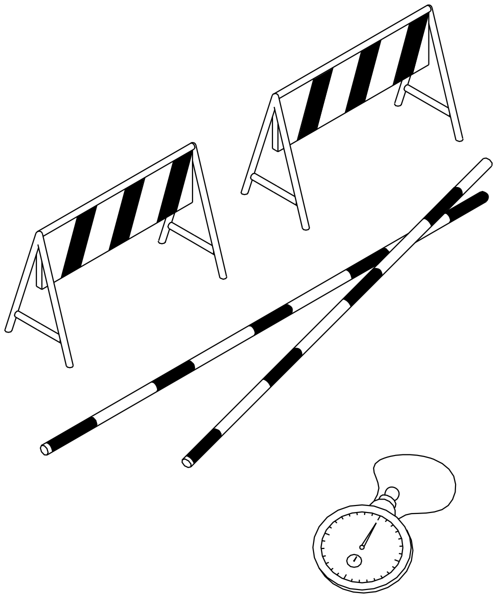
140W77MS03

3. OPERATION FOR PERFORMANCE TESTS

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

The machine

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



(290-7TIER) 7-3

(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.

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

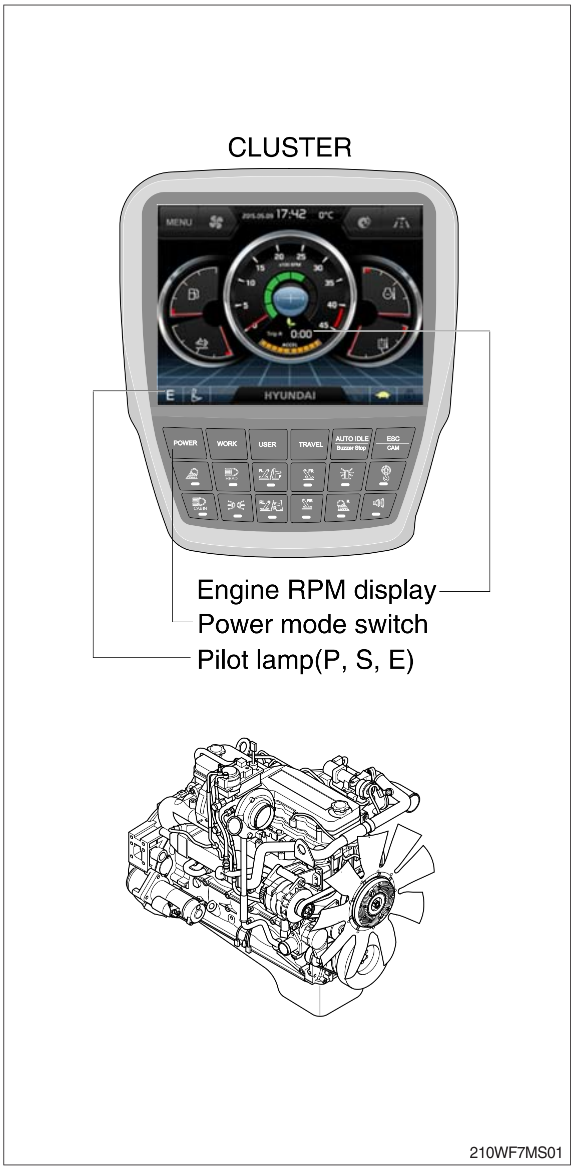
① Start the engine. The engine will run at start idle speed. Measure engine speed with a engine rpm display.

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
HW210	Start idle	850±100	
	P mode	1600±50	
	S mode	1450±50	
	E mode	1350±50	
	Auto decel	1000±100	
	One touch decel	850±50	

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

3) TRAVEL SPEED

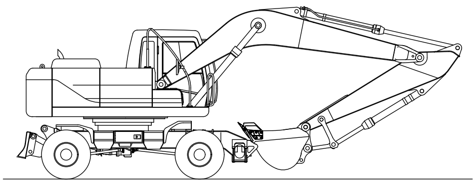
(1) Measure the time require for the excavator to travel a 50 m at high speed and a 20 m at low speed test run.

(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.



20W97MS03

(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.

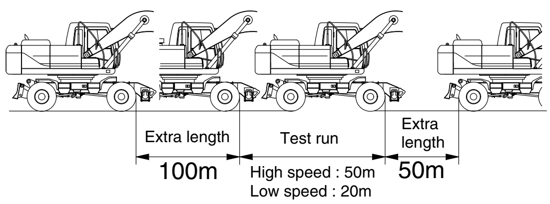
· Power mode switch : P mode

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 20m 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.



20W97MS04

(4) Evaluation

The average measured time should meet the following specifications.

Unit : Seconds

Model	Travel speed	Standard	Maximum allowable	Remarks
HW210	Low speed	7.9	9.9	Seconds / 20 m
	High speed	5.2	6.5	Seconds / 50 m

4) SWING SPEED

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

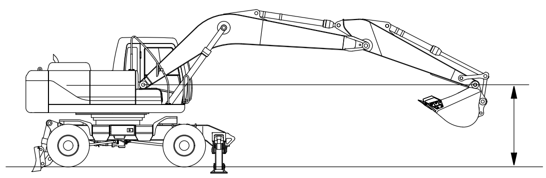
(2) Preparation

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.



20W97MS05

(3) Measurement

① Select the following switch positions.

· Power mode switch : P mode

② Operate swing control lever fully.

③ Swing 1 turn and measure time taken to swing next 3 revolutions.

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

(4) Evaluation

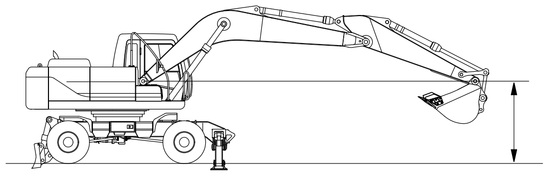
The time required for 3 swings should meet the following specifications.

Unit : Seconds / 3 revolutions

Model	Power mode switch	Standard	Maximum allowable
HW210	P mode	18.6±1.5	23.2

5) SWING FUNCTION DRIFT CHECK

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

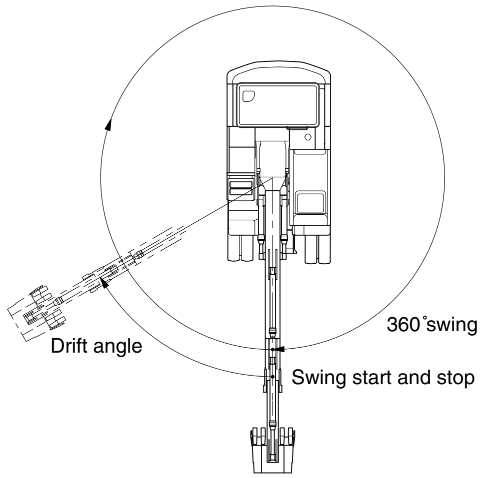

20W97MS05

(2) Preparation

① Check the lubrication of the swing gear and swing bearing.
② Place the machine on flat, solid ground with ample space for swinging. Do not conduct this test on slopes.
③ With the arm rolled out and bucket rolled in, hold the bucket so that the height of the bucket pin is the same as the boom foot pin. The bucket must be empty.
④ Make two chalk marks: one on the swing bearing and one directly below it on the track frame.
⑤ Swing the upperstructure 360˚.
⑥ Keep the hydraulic oil temperature at 50±5˚C.

(3) Measurement

① Conduct this test in the M mode.
② Select the following switch positions.
· Power mode switch : P mode
③ Operate the swing control lever fully and return it to the neutral position when the mark on the upperstructure aligns with that on track frame after swinging 360˚.
④ Measure the distance between the two marks.
⑤ Align the marks again, swing 360˚, then test the opposite direction.
⑥ Repeat steps ④ and ⑤ three times each and calculate the average values.



20W77MS04

(4) Evaluation

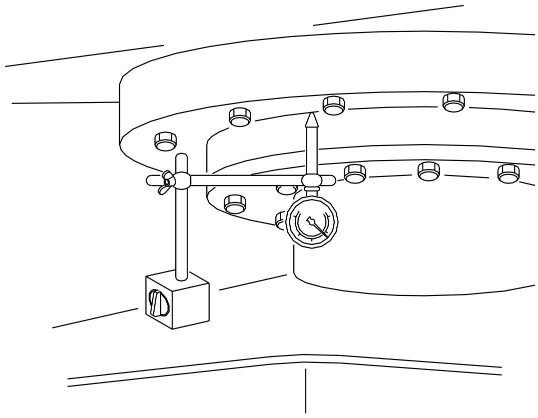
The measured drift angle should be within the following specifications.

Unit : Degree

Model	Power mode switch	Standard	Maximum allowable	Remarks
HW210	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 axle.

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.

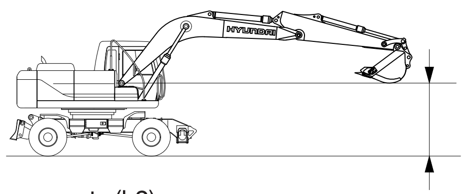
(3) Measurement

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).

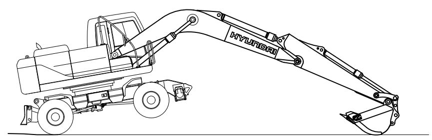
② Lower the bucket to the ground and use it to raise the front axle 50㎝.
Record the dial gauge reading (h2).

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

Measurement : (h1)



Measurement : (h2)



20W97MS06

(4) Evaluation

The measured drift should be within the following specifications.

Unit : mm

Model	Standard	Maximum allowable	Remarks
HW210	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

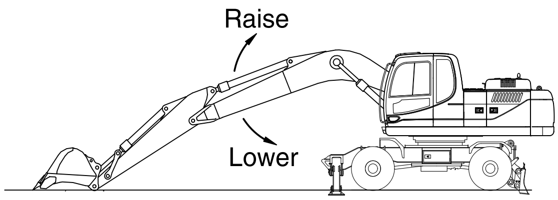
① Select the following switch positions.

· Power mode switch : P mode

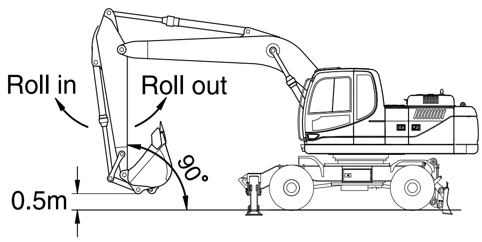
② To measure cylinder cycle times.

- 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.

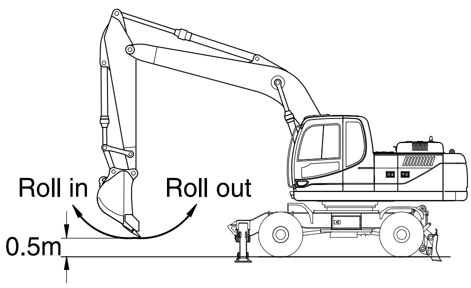
Boom cylinder



Arm cylinder



Bucket cylinder



20W97MS07

- 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
HW210	Boom raise		3.4±0.4	4.1	
	Boom lower		2.8±0.4	3.4	
	Arm in	Regen ON	2.9±0.4	3.5	
		Regen OFF	3.4±0.4	4.1	
	Arm out		2.8±0.3	3.4	
	Bucket load		2.3±0.4	2.8	
	Bucket dump		2.3±0.3	2.8	

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)

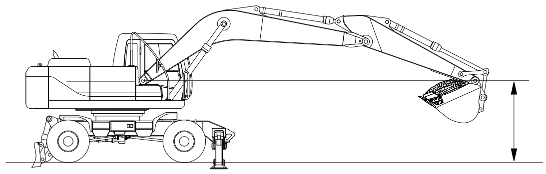
1.5 = Soil specific gravity

② Position the arm cylinder with the rod 20 to 30mm extended from the fully retracted position.

③ Position the bucket cylinder with the rod 20 to 30mm retracted from the fully extended position.

④ With the arm rolled out and bucket rolled in, hold the bucket so that the height of the bucket pin is the same as the boom foot pin.

⑤ Keep the hydraulic oil temperature at $50 \pm 5^\circ C$.



20W97MS08

(3) Measurement

① Stop the engine.

② Five minutes after the engine has been stopped, measure the changes in the positions of the boom, arm and bucket cylinders.

③ Repeat step ② three times and calculate the average values.

(4) The measured drift should be within the following specifications.

Unit : mm / 5 min

Model	Drift to be measured	Standard	Maximum allowable	Remarks
HW210	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
HW210	Boom lever	1.7 or below	2.0	
	Arm lever	1.7 or below	2.0	
	Bucket lever	1.4 or below	2.0	
	Swing lever	1.4 or below	2.0	

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
HW210	Boom lever	112±10	134	
	Arm lever	112±10	134	
	Bucket lever	90±10	112	
	Swing lever	90±10	112	
	Travel lever	139±10	178	

11) PILOT PRIMARY PRESSURE

(1) Preparation

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

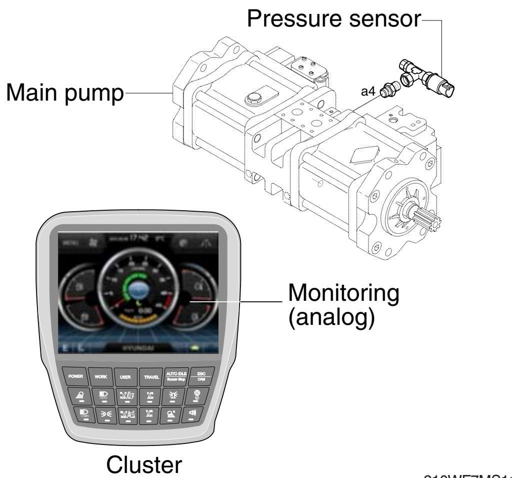
(2) Measurement

① Select the following switch positions.

· Power mode switch : P mode

· Auto decel switch : OFF

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



210WF7MS11

(3) Evaluation

The average measured pressure should meet the following specifications:

Unit : kgf / cm^2

Model	Kind of lever	Standard	Maximum allowable	Remarks
HW210	P mode	40^{+2}_{0}	-	

12) FOR TRAVEL SPEED SELECTING PRESSURE

(1) Preparation

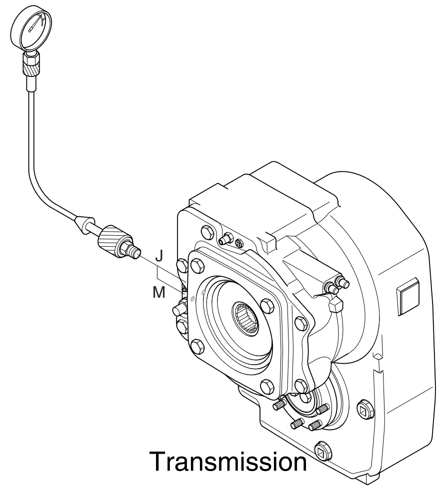
① Stop the engine.

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	
HW210	Low Speed	-	33+2	-	30~35	
	High Speed	33+2	-	30~35	-	

13) SWING PARKING BRAKE RELEASING PRESSURE

(1) Preparation

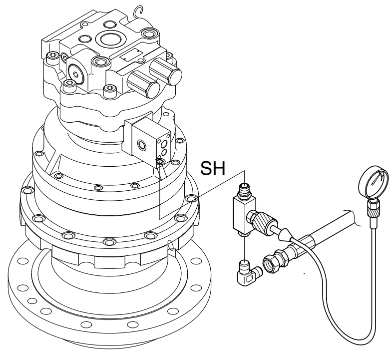
① Stop the engine.

② Loosen the cap and relieve the pressure in the hydraulic tank by pushing the top of the air breather.

③ Install a connector and pressure gauge assembly to swing motor SH port, as shown.

④ Start the engine and check for oil leakage from the adapter.

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



210WF7MS13

(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 / cm^2

Model	Description	Standard	Allowable limits	Remarks
HW210	Brake disengaged	40	Over 3.6	
	Brake applied	0	-	

14) MAIN PUMP DELIVERY PRESSURE

(1) Preparation

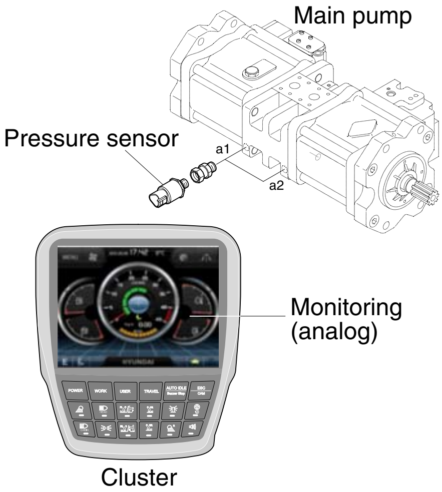
① Keep the hydraulic oil temperature at $50 \pm 5^{\circ}C$.

(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).



210WF7MS14

(3) Evaluation

The average measured pressure should meet the following specifications.

Unit : kgf / cm^2

Model	Engine speed	Standard	Allowable limits	Remarks
HW210	High idle	40^{+2}_{0}	-	

15) SYSTEM PRESSURE REGULATOR RELIEF SETTING

(1) Preparation

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

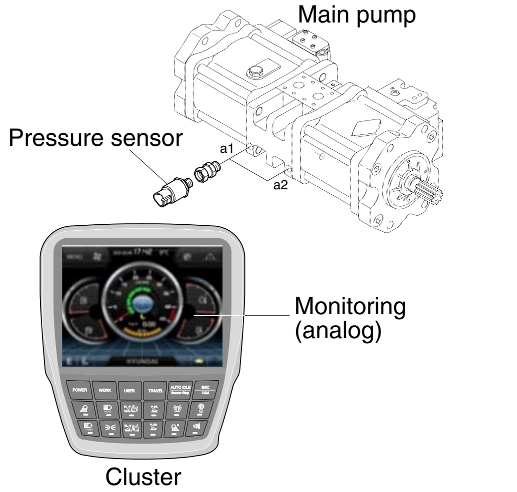
(2) Measurement

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 undercarriage with an immovable object and measure the relief pressure.



210WF7MS14

(3) Evaluation

The average measured pressure should be within the following specifications.

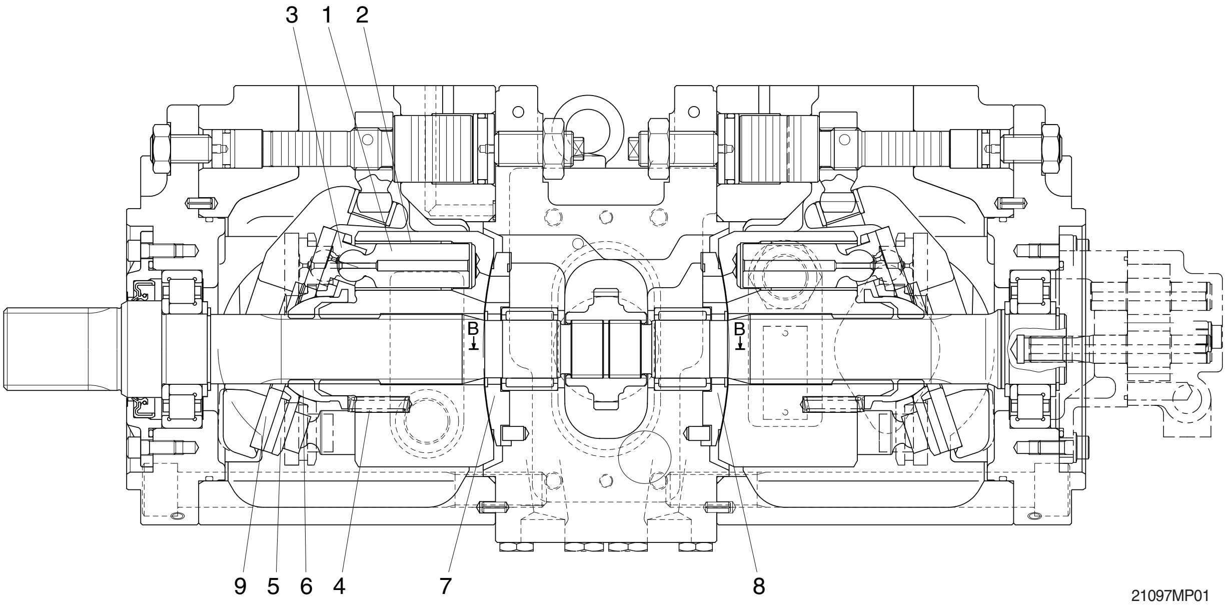
Unit : kgf/cm^2

Model	Function to be tested	Standard	Port relief setting at 20lpm
HW210	Boom, Arm, Bucket	350 (380)±10	400±10
	Travel	380±10	-
	Swing	265±10	-

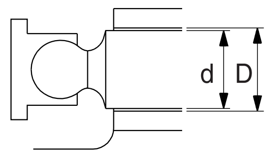
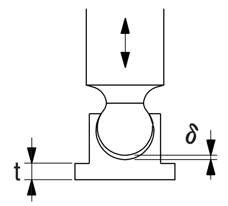
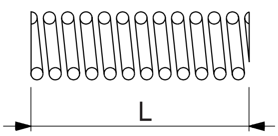
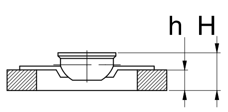
( ) : Power boost

GROUP 2 MAJOR COMPONENT

1. MAIN PUMP



21097MP01

Part name & inspection item		Standard dimension	Recommended replacement value	Counter measures
Clearance between piston (1) & cylinder bore (2) (D-d)		0.039	0.067	Replace piston or cylinder.
Play between piston (1) & shoe caulking section (3) (δ)		0-0.1	0.3	Replace assembly of piston & shoe.
Thickness of shoe (t)		4.9	4.7	
Free height of cylinder spring (4) (L)		41.1	40.3	Replace cylinder spring.
Combined height of set plate (5) & spherical bushing (6) (H-h)		23.0	22.0	Replace retainer or set plate.
Surface roughness for valve plate (sliding face) (7,8), swash plate (shoe plate area) (9), & cylinder (2) (sliding face)	Surface roughness necessary to be corrected	3z		Lapping
	Standard surface roughness (corrected value)	0.4z or lower		

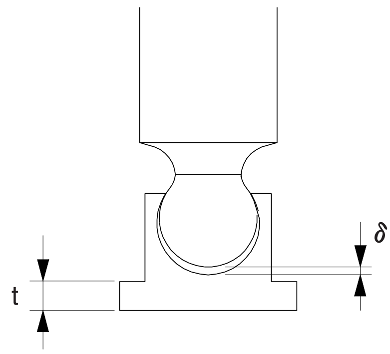
2. MAIN CONTROL VALVE

Part name	Inspection item	Criteria & measure
Casing	· Existence of scratch, rusting or corrosion.	· In case of damage in following section, replace part. - Sliding sections of casing fore and spool, especially land sections applied with holded pressure. - Seal pocket section where spool is inserted. - Seal section of port where O-ring contacts. - Seal section of each relief valve for main, travel, and port. - Other damages that may damage normal functions.
Spool	· Existence of scratch, gnawing, rusting or corrosion. · O-ring seal sections at both ends. · Insert spool in casing hole, rotate and reciprocate it.	· Replacement when its outside sliding section has scratch (especially on seals-contacting section). · Replacement when its sliding section has scratch. · Correction or replacement when O-ring is damaged or when spool does not move smoothly.
Poppet	· Damage of poppet or spring · Insert poppet into casing and function it.	· Correction or replacement when sealing is incomplete. · Normal when it can function lightly without being caught.
Around spring	· Rusting, corrosion, deformation or breaking of spring, spring seat, plug or cover.	· Replacement for significant damage.
Around seal for spool	· External oil leakage. · Rusting, corrosion or deformation of seal plate.	· Correction or replacement. · Correction or replacement.
Main relief valve, port relief valve & negative control relief valve	· External rusting or damage. · Contacting face of valve seat. · Contacting face of poppet. · Abnormal spring. · O-rings, back up rings and seals.	· Replacement. · Replacement when damaged. · Replacement when damaged. · Replacement. · 100% replacement in general.

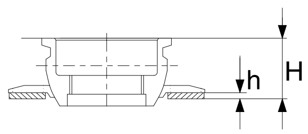
3. SWING DEVICE (TYPE 1, 2)

1) WEARING PARTS

Inspection item	Standard dimension	Recommended replacement value	Counter measures
Clearance between piston and cylinder block bore	0.041	0.060	Replace piston or cylinder block
Thickness of valve plate	6	5.88	Replace
Play between piston and shoe caulking section (δ)	0.025	0.1	Replace assembly of piston and shoe
Thickness of shoe (t)	6.6	6.5	Replace assembly of piston and shoe
Combined height of retainer plate and spherical bushing (H-h)	17.6	17.3	Replace set of retainer plate and sperical bushing
Thickness of friction plate	2.94	2.7	Replace



140W77MS12



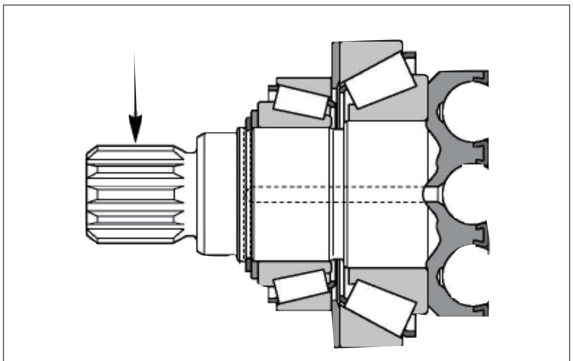
2609A7MS01

2) SLIDING PARTS

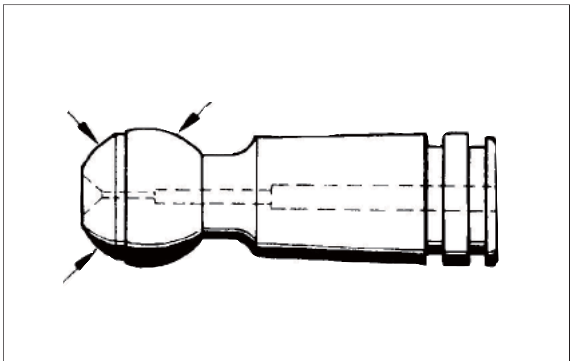
Part name	Standard roughness	Allowable roughness	Remark
Shoe	Rmax=1S (Ra=0.2a) (LAPPING)	4S (Ra=0.1a)	
Shoe plate	Rmax=0.4S (Ra=0.1a) (LAPPING)	3S (Ra=0.8a)	
Cylinder	Rmax=0.4S (Ra=0.1a) (LAPPING)	3S (Ra=0.8a)	
Valve plate	Rmax=0.4S (Ra=0.1a) (LAPPING)	2S (Ra=0.5a)	

4. TRAVEL MOTOR

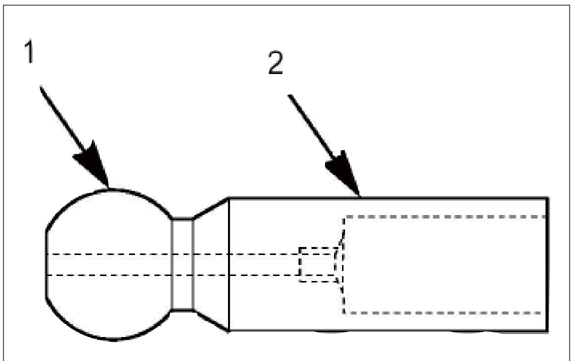
1) Free of corrosion, erosion or fretting; no damage to splines or keyways.


14W7TM052

2) **Pistons**
No scoring and no pittings.

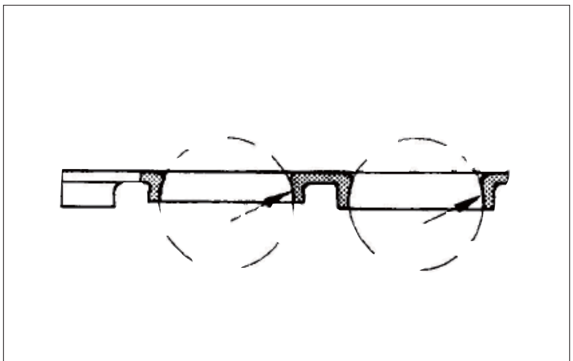

14W7TM053

3) **Center pin**
No scoring and no pittings.



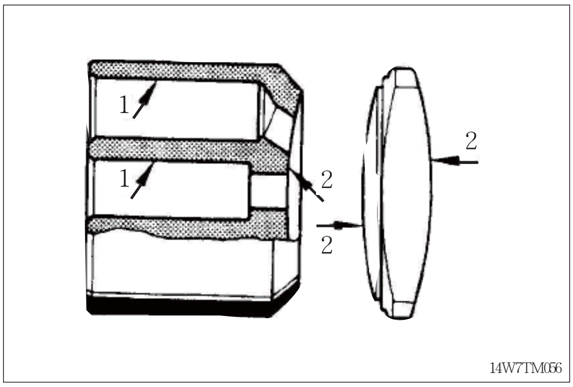
14W7TM054

4) **Retaining plate**
No scoring and no evidence of wear.


14W7TM055

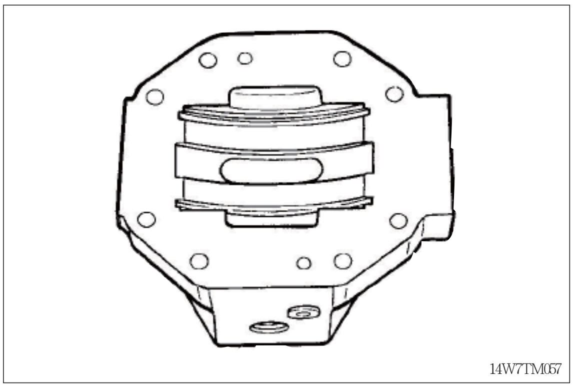
5) **Cylinder block/control lens**

① Bores free of scoring, no evidence of
② wear.
Faces smooth and even, free of cracks and scoring.



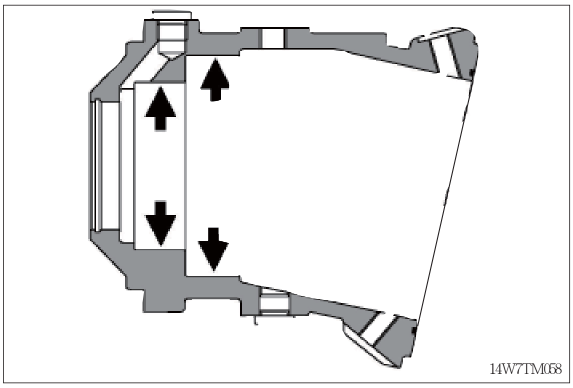
6) **Control housing**

Sliding surface and side guides free of scoring and no wear.

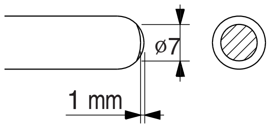


7) **Visual check**

Bearing areas free of scoring and no evidence of wear.



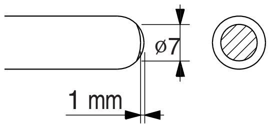
5. RCV LEVER

Maintenance check item	Criteria	Remark
Leakage	The valve is to be replaced when the leakage becomes more than 1000 cc/m at neutral handle position, or more than 2000 cc/m during operation.	Conditions : Primary pressure : 40 kgf/cm^2 Oil viscosity : 23 cSt
Spool	This is to be replaced when the sliding surface has worn more than 10 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 the top end has worn more than 1 mm.	
Play at operating section	The pin, shaft, and joint of the operating section are to be replaced when their plays become more than 2 mm due to wears or so on.	When a play is due to looseness of a tightened section, adjust it.
Operation stability	When abnormal noises, hunting, primary pressure drop, etc. are generated during operation, and these cannot be remedied, referring to section 6. Troubleshooting, replace the related parts.	

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

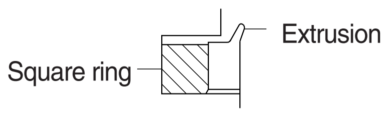
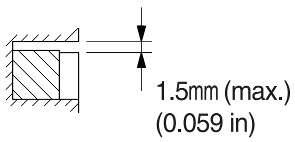
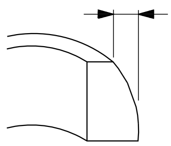
2. When loosening the hexagon socket head cap screw (125), replace the seal washers (121) without fail.

6. RCV PEDAL

Maintenance check item	Criteria	Remark
Leakage	The valve is to be replaced when the leakage effect to the system. For example, the primary pressure drop.	Conditions : Primary pressure : 40 kgf/cm^2 Oil viscosity : 23 cSt
Spool	This is to be replaced when the sliding surface has worn more than 10μ 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 the top end has worn more than 1 mm.	
Play at operating section	The pin, shaft, and joint of the operating section are to be replaced when their plays become more than 2 mm due to wears or so on.	When a play is due to looseness of a tightened section, adjust it.
Operation stability	When abnormal noises, hunting, primary pressure drop, etc. are generated during operation, and these cannot be remedied, referring to section 6. Troubleshooting, replace the related parts.	

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

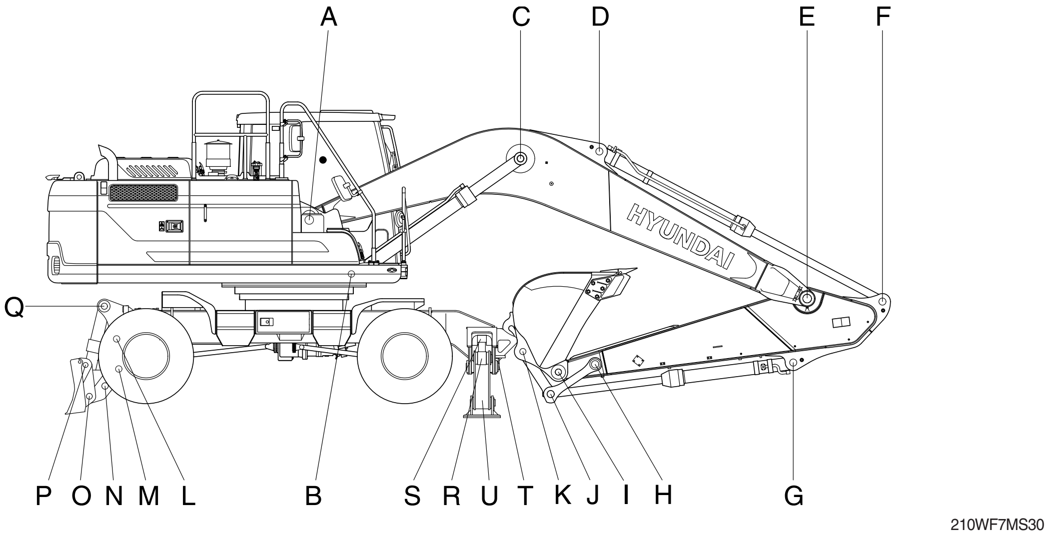
7. TURNING JOINT

Part name		Maintenance standards	Remedy
Body, Stem	Sliding surface with sealing sections.	Plating worn or peeled due to seizure or contamination.	Replace
	Sliding surface between body and stem other than sealing section.	· Worn abnormality or damaged more than 0.1 mm (0.0039 in) in depth due to seizure contamination.	Replace
		· Damaged more than 0.1 mm (0.0039 in) in depth.	Smooth with oilstone.
	Sliding surface with thrust plate.	· Worn more than 0.5 mm (0.02 in) or abnormality.	Replace
		· Worn less than 0.5 mm (0.02 in).	Smooth
		· Damage due to seizure or contamination remediable within wear limit (0.5 mm) (0.02 in).	Smooth
Cover	Sliding surface with thrust plate.	· Worn more than 0.5 mm (0.02 in) or abnormality.	Replace
		· Worn less than 0.5 mm (0.02 in).	Smooth
		· Damage due to seizure or contamination remediable within wear limit (0.5 mm) (0.02 in).	Replace
Seal set	-	· Extruded excessively from seal groove square ring.  	Replace
	-	· Slipper ring 1.5 mm (0.059 in) narrower than seal groove, or narrower than back ring.  	Replace
	-	· Worn more than 0.5 mm (0.02 in) ~ 1.5 mm (MAX.) (0.059 in) 	Replace

8. CYLINDER

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

GROUP 3 WORK EQUIPMENT



Unit : ㎜

Mark	Measuring point (pin and bushing)	Normal value	Pin		Bushing		Remedy & Remark
			Recomm. service limit	Limit of use	Recomm. service limit	Limit of use	
A	Boom rear	90	89	88.5	90.5	91	Replace
B	Boom cylinder head	80	79	78.5	80.5	81	〃
C	Boom cylinder rod	80	79	78.5	80.5	81	〃
D	Arm cylinder head	80	79	78.5	80.5	81	〃
E	Boom front	90	89	88.5	90.5	91	〃
F	Arm cylinder rod	80	79	78.5	80.5	81	〃
G	Bucket cylinder head	80	79	78.5	80.5	81	〃
H	Arm link	70	69	68.5	70.5	71	〃
I	Bucket and arm link	80	79	78.5	80.5	81	〃
J	Bucket cylinder rod	80	79	78.5	80.5	81	〃
K	Bucket link	80	79	78.5	80.5	81	〃
L	Dozer link (B)	70	69	68.5	70.5	71	〃
M	Dozer link (A)	70	69	68.5	70.5	71	〃
N	Dozer cylinder rod	70	69	68.5	70.5	71	〃
O	Dozer link (A)	70	69	68.5	70.5	71	〃
P	Dozer link (B)	70	69	68.5	70.5	71	〃
Q	Dozer cylinder head	70	69	68.5	70.5	71	〃
R	Outrigger cylinder head	80	79	78.5	80.5	81	〃
S	Outrigger cylinder rod	80	79	78.5	80.5	81	〃
T	Outrigger cylinder leg	80	79	78.5	80.5	81	〃
U	Outrigger cylinder foot	80	79	78.5	80.5	81	〃

SECTION 8 DISASSEMBLY AND ASSEMBLY

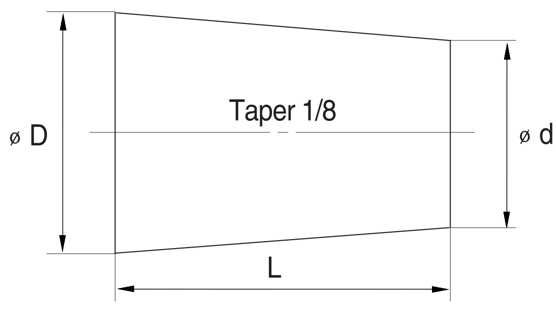
SECTION 8 DISASSEMBLY AND ASSEMBLY

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)	M20 × 2.5	52.1±5.0	370±36.2
2		Engine mounting bolt (bracket-frame, RR)	M20 × 2.5	52.1±5.0	370±36.2
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		Coupling mounting bolt	M18 × 2.5	32.0±1.0	231±7.2
6	Hydraulic system	Main pump housing mounting bolt	M10 × 1.5	6.9±0.5	49.9±3.6
7		Main pump mounting socket bolt (bracket)	M20 × 2.5	52.1±5.0	370±36.2
8		Main control valve mounting bolt	M12 × 1.75	12.8±3.0	92.6±21.7
9		Travel motor mounting bolt	M16 × 2.0	35.6±7.1	257±51.4
10		Fuel tank mounting bolt	M20 × 2.5	46±5.1	333±36.9
11		Hydraulic oil tank mounting bolt	M20 × 2.5	46±5.1	333±36.9
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±8.7	419±62.9
14		Swing bearing upper mounting bolt	M20 × 2.5	57.9±5.8	419±42.0
15		Swing bearing lower mounting bolt	M20 × 2.5	57.9±5.8	419±42.0
16		Real axle mounting bolt, nut	M24 × 2.0	100±10	723±72.3
17		Transmission bracket mounting bolt	M20 × 2.5	39±4.2	282±30.4
18		Transmission mounting bolt	M20 × 2.5	39±4.2	282±30.4
19		Oscillating cylinder mounting bolt	M22 × 1.5	69.4±10.4	502±75.2
20		Oscillating cylinder support bolt	M16 × 2.0	29.7±4.5	215±32.5
21		Wheel nut	M22 × 1.5	60^{+0}_{-5}	$433^{+0}_{-36.2}$
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	Others	Counterweight mounting bolt	M36 × 3.0	337±33	2440±239
25		Cab mounting bolt, nut	M12 × 1.75	12.8±3.0	92.6±21.7
26		Operator's seat mounting bolt	M 8 × 1.25	4.05±0.8	29.3±5.8

※ For tightening torque of engine and hydraulic components, see engine maintenance guide and service manual.

2. TORQUE CHART

Use following table for unspecified torque.

1) BOLT AND NUT

(1) Coarse thread

Bolt size	8.8T		10.9T		12.9T	
	kgf · m	lbf · ft	kgf · m	lbf · ft	kgf · m	lbf · ft
M 6×1.0	0.8 ~ 1.2	5.8 ~ 8.6	1.2 ~ 1.8	8.7 ~ 13.0	1.5 ~ 2.1	10.9 ~ 15.1
M 8×1.25	2.0 ~ 3.0	14.5 ~ 21.6	2.8 ~ 4.2	20.3 ~ 30.4	3.4 ~ 5.0	24.6 ~ 36.1
M10×1.5	4.0 ~ 6.0	29.0 ~ 43.3	5.6 ~ 8.4	40.5 ~ 60.8	6.8 ~ 10.0	49.2 ~ 72.3
M12×1.75	6.8 ~ 10.2	50.0 ~ 73.7	9.6 ~ 14.4	69.5 ~ 104	12.3 ~ 16.5	89.0 ~ 119
M14×2.0	10.9 ~ 16.3	78.9 ~ 117	16.3 ~ 21.9	118 ~ 158	19.5 ~ 26.3	141 ~ 190
M16×2.0	17.9 ~ 24.1	130 ~ 174	25.1 ~ 33.9	182 ~ 245	30.2 ~ 40.8	141 ~ 295
M18×2.5	24.8 ~ 33.4	180 ~ 241	34.8 ~ 47.0	252 ~ 340	41.8 ~ 56.4	302 ~ 407
M20×2.5	34.9 ~ 47.1	253 ~ 340	49.1 ~ 66.3	355 ~ 479	58.9 ~ 79.5	426 ~ 575
M22×2.5	46.8 ~ 63.2	339 ~ 457	65.8 ~ 88.8	476 ~ 642	78.9 ~ 106	570 ~ 766
M24×3.0	60.2 ~ 81.4	436 ~ 588	84.6 ~ 114	612 ~ 824	102 ~ 137	738 ~ 991
M30×3.5	120 ~161	868 ~ 1164	168 ~ 227	1216 ~ 1641	202 ~ 272	1461 ~ 1967

(2) Fine thread

Bolt size	8.8T		10.9T		12.9T	
	kgf · m	lbf · ft	kgf · m	lbf · ft	kgf · m	lbf · ft
M 8×1.0	2.1 ~ 3.1	15.2 ~ 22.4	3.0 ~ 4.4	21.7 ~ 31.8	3.6 ~ 5.4	26.1 ~ 39.0
M10×1.25	4.2 ~ 6.2	30.4 ~ 44.9	5.9 ~ 8.7	42.7 ~ 62.9	7.0 ~ 10.4	50.1 ~ 75.2
M12×1.25	7.3 ~ 10.9	52.8 ~ 78.8	10.3 ~ 15.3	74.5 ~ 110	13.1 ~ 17.7	94.8 ~ 128
M14×1.5	12.4 ~ 16.6	89.7 ~ 120	17.4 ~ 23.4	126 ~ 169	20.8 ~ 28.0	151 ~ 202
M16×1.5	18.7 ~ 25.3	136 ~ 182	26.3 ~ 35.5	191 ~ 256	31.6 ~ 42.6	229 ~ 308
M18×1.5	27.1 ~ 36.5	196 ~ 264	38.0 ~ 51.4	275 ~ 371	45.7 ~ 61.7	331 ~ 446
M20×1.5	37.7 ~ 50.9	273 ~ 368	53.1 ~ 71.7	384 ~ 518	63.6 ~ 86.0	460 ~ 622
M22×1.5	51.2 ~ 69.2	370 ~ 500	72.0 ~ 97.2	521 ~ 703	86.4 ~ 116	625 ~ 839
M24×2.0	64.1 ~ 86.5	464 ~ 625	90.1 ~ 121	652 ~ 875	108 ~ 146	782 ~ 1056
M30×2.0	129 ~ 174	933 ~ 1258	181 ~ 245	1310 ~ 1772	217 ~ 294	1570 ~ 2126

2) PIPE AND HOSE (FLARE type)

Thread size (PF)	Width across flat (mm)	kgf · m	lbf · ft
1/4"	19	4	28.9
3/8"	22	5	36.2
1/2"	27	9.5	68.7
3/4"	36	18	130.2
1"	41	21	151.9
1-1/4"	50	35	253.2

3) PIPE AND HOSE (ORFS type)

Thread size (UNF)	Width across flat (mm)	kgf · m	lbf · ft
9/16-18	19	4	28.9
11/16-16	22	5	36.2
13/16-16	27	9.5	68.7
1-3/16-12	36	18	130.2
1-7/16-12	41	21	151.9
1-11/16-12	50	35	253.2

4) FITTING

Thread size	Width across flat (mm)	kgf · m	lbf · ft
1/4"	19	4	28.9
3/8"	22	5	36.2
1/2"	27	9.5	68.7
3/4"	36	18	130.2
1"	41	21	151.9
1-1/4"	50	35	253.2

GROUP 3 PUMP DEVICE

1. REMOVAL AND INSTALL

1) REMOVAL

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

(2) Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping

(3) Loosen the breather slowly to release the pressure inside the hydraulic tank.

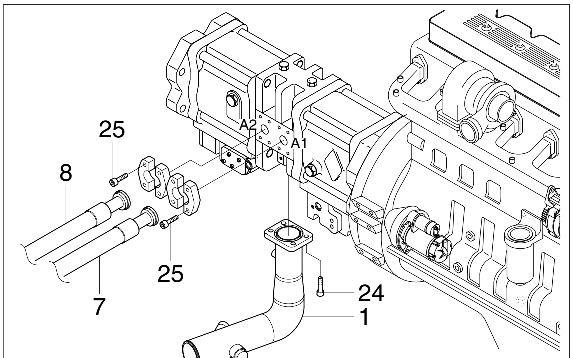
⚠ **Escaping fluid under pressure can penetrate the skin causing serious injury.**

13031GE18

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

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

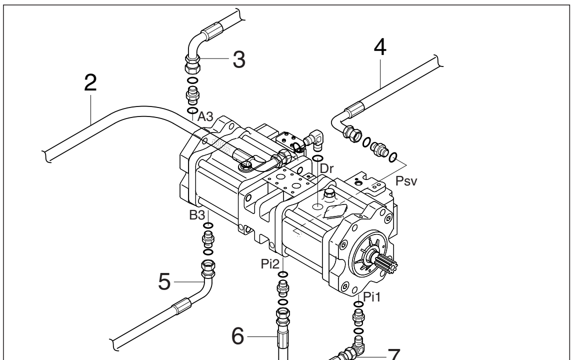
· Hydraulic tank quantity : 160 *l*



21098MP01

(6) Remove socket bolts (25) and disconnect pipe (7, 8).

(7) Disconnect pilot line hoses (2, 3, 4, 5, 6, 7).



21098MP02

(8) Remove socket bolts (24) and disconnect pump suction tube (1).

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

(9) Sling the pump assembly and remove the pump mounting bolts.

· Weight : 140 kg (310 lb)

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

2) INSTALL

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

(2) Remove the suction strainer and clean it.

(3) Replace return filter with new one.

(4) Remove breather and clean it.

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

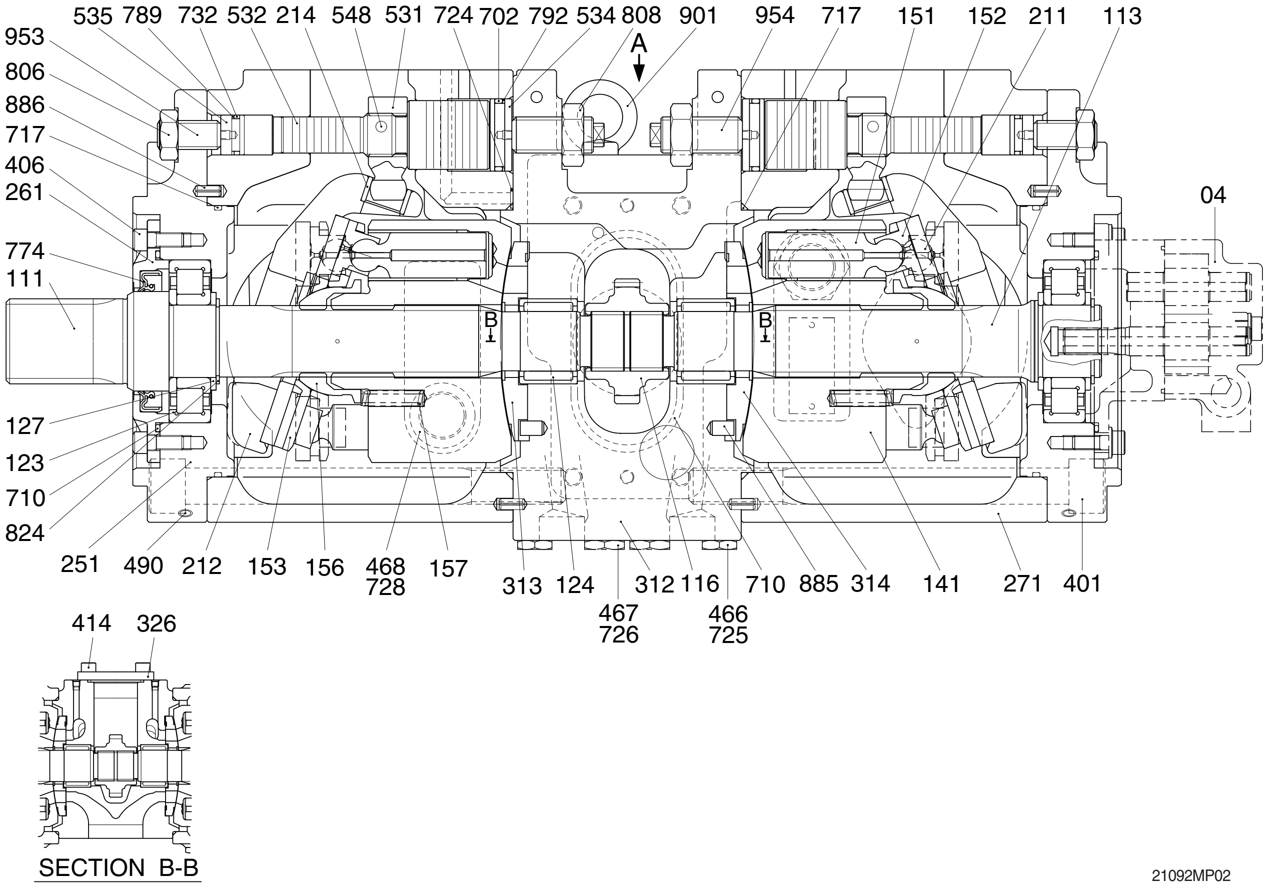
(6) Bleed the air from the hydraulic pump.
① Remove the air vent plug (2EA).
② Tighten plug lightly.
③ Start the engine, run at low idling, and check oil come out from plug.
④ Tighten plug.

(7) Start the engine, run at low idling (3~5 minutes) to circulate the oil through the system.

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

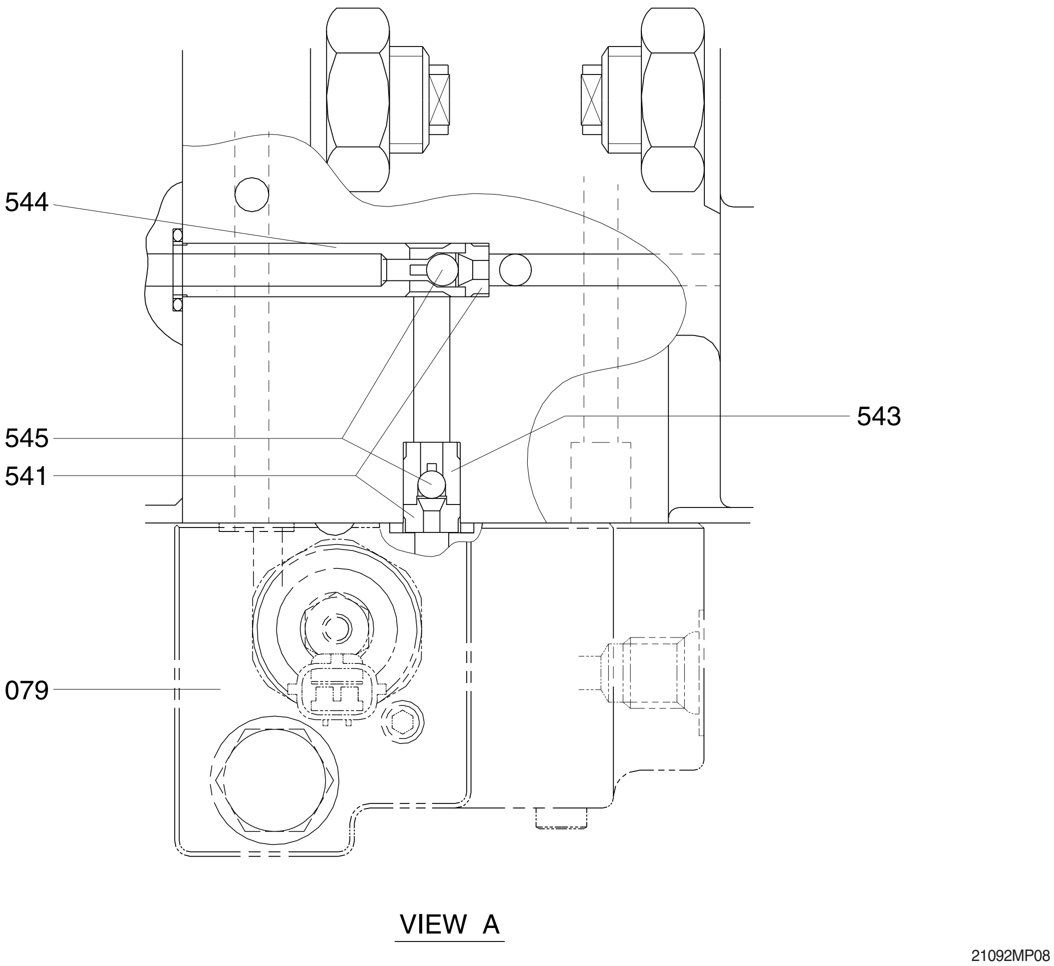
2. MAIN PUMP (1/2)

1) STRUCTURE



04	Gear pump	271	Pump casing	710	O-ring
111	Drive shaft (F)	312	Valve block	717	O-ring
113	Drive shaft (R)	313	Valve plate (R)	724	O-ring
116	Gear	314	Valve plate (L)	725	O-ring
123	Roller bearing	326	Cover	726	O-ring
124	Needle bearing	401	Hexagon socket bolt	728	O-ring
127	Bearing spacer	406	Hexagon socket bolt	732	O-ring
141	Cylinder block	414	Hexagon socket bolt	774	Oil seal
151	Piston	466	VP Plug	789	Back up ring
152	Shoe	467	VP plug	792	Back up ring
153	Set plate	468	VP Plug	806	Hexagon head nut
156	Bushing	490	Plug	808	Hexagon head nut
157	Cylinder spring	531	Tilting pin	824	Snap ring
211	Shoe plate	532	Servo piston	885	Pin
212	Swash plate	534	Stopper (L)	886	Spring pin
214	Bushing	535	Stopper (S)	901	Eye bolt
251	Support	548	Pin	953	Set screw
261	Seal cover (F)	702	O-ring	954	Set screw

MAIN PUMP (2/2)

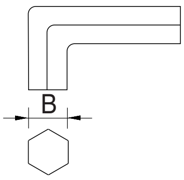
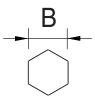


541 Seat
543 Stopper 1
544 Stopper 2
545 Steel ball
079 Proportional reducing valve

2) TOOLS AND TIGHTENING TORQUE

(1) Tools

The tools necessary to disassemble/reassemble the pump are shown in the follow list.

Tool name & size		Part name			
Name	B	Hexagon socket head bolt	PT plug (PT thread)	PO plug (PF thread)	Hexagon socket head setscrew
Allen wrench 	4	M 5	BP-1/16	-	M 8
	5	M 6	BP-1/8	-	M10
	6	M 8	BP-1/4	PO-1/4	M12, M14
	8	M10	BP-3/8	PO-3/8	M16, M18
	17	M20, M22	BP-1	PO-1, 1 1/4, 1 1/2	-
Double ring spanner, socket wrench, double (single) open end spanner 	-	Hexagon socket head bolt	Hexagon nut	VP plug (PF thread)	
	19	M12	M12	VP-1/4	
	24	M16	M16	-	
	27	M18	M18	VP-1/2	
	30	M20	M20	-	
	36	-	-	VP-3/4	
Adjustable angle wrench		Medium size, 1 set			
Screw driver		Minus type screw driver, Medium size, 2 sets			
Hammer		Plastic hammer, 1 set			
Pliers		For snap ring, TSR-160			
Steel bar		Steel bar of key material approx. $10 \times 8 \times 200$			
Torque wrench		Capable of tightening with the specified torques			

(2) Tightening torque

Part name	Bolt size	Torque		Wrench size	
		kgf · m	lbf · ft	in	mm
Hexagon socket head bolt (Material : SCM435)	M 5	0.7	5.1	0.16	4
	M 6	1.2	8.7	0.20	5
	M 8	3.0	21.7	0.24	6
	M10	5.8	42.0	0.31	8
	M12	10.0	72.3	0.39	10
	M14	16.0	116	0.47	12
	M16	24.0	174	0.55	14
	M18	34.0	246	0.55	14
	M20	44.0	318	0.67	17
PT Plug (Material : S45C) ※ Wind a seal tape 1 1/2 to 2 turns round the plug	PT1/16	0.7	5.1	0.16	4
	PT 1/8	1.05	7.59	0.20	5
	PT 1/4	1.75	12.7	0.24	6
	PT 3/8	3.5	25.3	0.31	8
	PT 1/2	5.0	36.2	0.39	10
PF Plug (Material : S45C)	PF 1/4	3.0	21.7	0.24	6
	PF 1/2	10.0	72.3	0.39	10
	PF 3/4	15.0	109	0.55	14
	PF 1	19.0	137	0.67	17
	PF 1 1/4	27.0	195	0.67	17
	PF 1 1/2	28.0	203	0.67	17

3) DISASSEMBLY

(1) Select place suitable to disassembling.

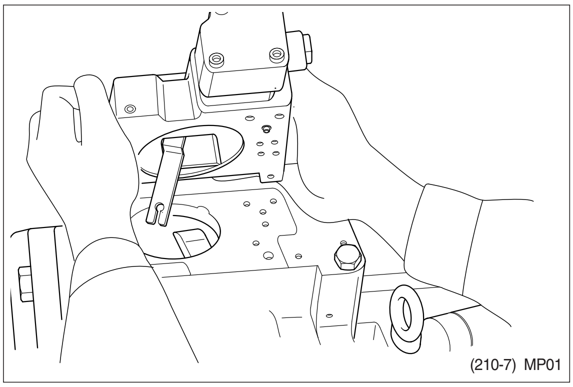
※ Select clean place.

※ Spread rubber sheet, cloth or so on on overhaul workbench top to prevent parts from being damaged.

(2) Remove dust, rust, etc, from pump surfaces with cleaning oil or so on.

(3) Remove drain port plug (468) and let oil out of pump casing (front and rear pump).

(4) Remove hexagon socket head bolts (412, 413) and remove regulator.



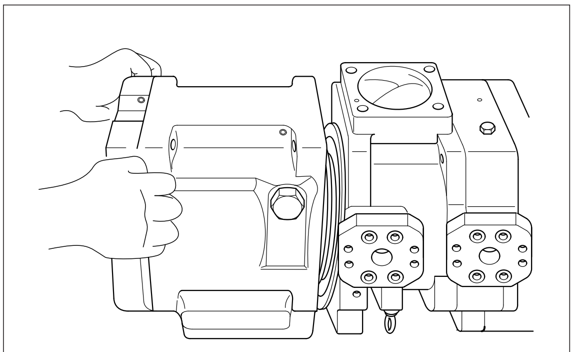
(210-7) MP01

(5) Loosen hexagon socket head bolts (401) which tighten swash plate support (251), pump casing (271) and valve block (312).

※ If gear pump and so on are fitted to rear face of pump, remove them before starting this work.

(6) Place pump horizontally on workbench with its regulator-fitting surface down and separate pump casing (271) from valve block (312).

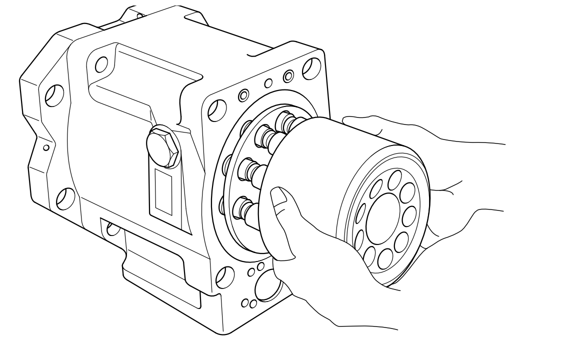
※ Before bringing this surface down, spread rubber sheet on workbench without fail to prevent this surface from being damaged.



(210-7) MP02

(7) Pull cylinder block (141) out of pump casing (271) straightly over drive shaft (111). Pull out also pistons (151), set plate (153), spherical bush (156) and cylinder springs (157) simultaneously.

※ Take care not to damage sliding surfaces of cylinder, spherical bushing, shoes, swash plate, etc.

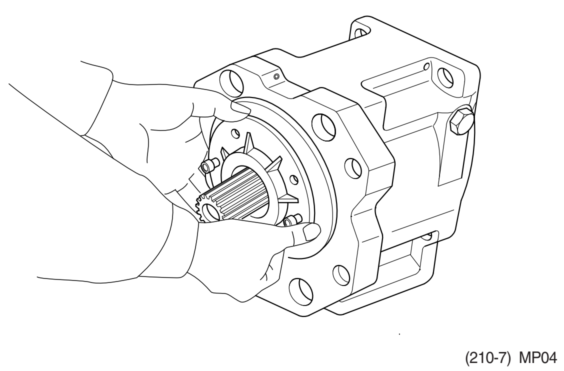


(210-7) MP03

(8) Remove hexagon socket head bolts (406) and then seal cover (F, 261).

※ Fit bolt into pulling out tapped hole of seal cover (F), and cover can be removed easily.

※ Since oil seal is fitted on seal cover (F), take care not to damage it in removing cover.

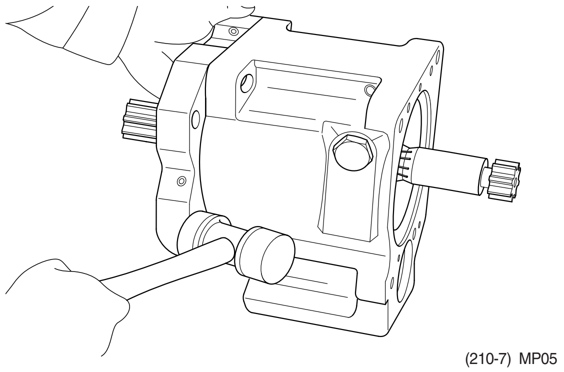


(210-7) MP04

(9) Remove hexagon socket head bolts (408) and then seal cover (R, 262).

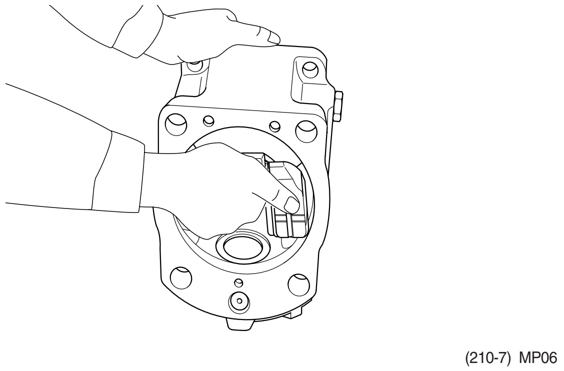
In case fitting a gear pump, first, remove gear pump.

(10) Tapping lightly fitting flange section of swash plate support (251) on its pump casing side, separate swash plate support from pump casing.



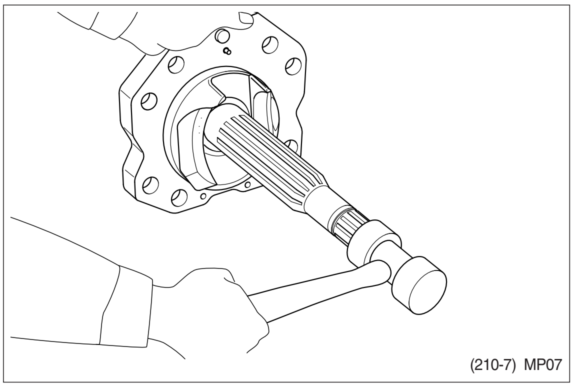
(210-7) MP05

(11) Remove shoe plate (211)and swash plate (212) from pump casing (271).



(210-7) MP06

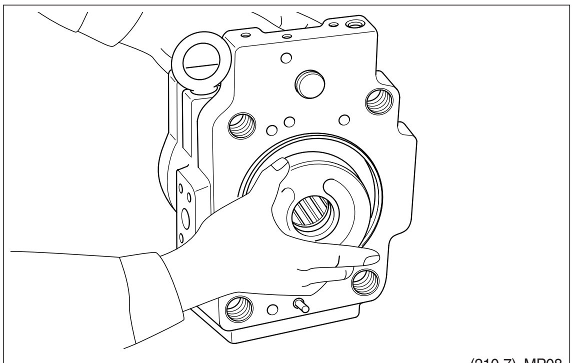
(12) Tapping lightly shaft ends of drive shafts (111, 113) with plastic hammer, take out drive shafts from swash plate supports.



(210-7) MP07

(13) Remove valve plates (313, 314) from valve block (312).

※ These may be removed in work (6).



(210-7) MP08

(14) If necessary, remove stopper (L, 534), stopper (S, 535), servo piston (532) and tilting pin (531) from pump casing (271), and needle bearing (124) and splined coupling (114) from valve block (312).

※ In removing tilting pin, use a protector to prevent pin head from being damaged.

※ Since loctite is applied to fitting areas of tilting pin and servo piston, take care not to damage servo piston.

※ Do not remove needle bearing as far as possible, except when it is considered to be out of its life span.

※ Do not loosen hexagon nuts of valve block and swash plate support.
If loosened, flow setting will be changed.

4) ASSEMBLY

(1) For reassembling reverse the disassembling procedures, paying attention to the following items.

① Do not fail to repair the parts damaged during disassembling, and prepare replacement parts in advance.

② Clean each part fully with cleaning oil and dry it with compressed air.

③ Do not fail to apply clean working oil to sliding sections, bearings, etc. before assembling them.

④ In principle, replace seal parts, such as O-rings, oil seals, etc.

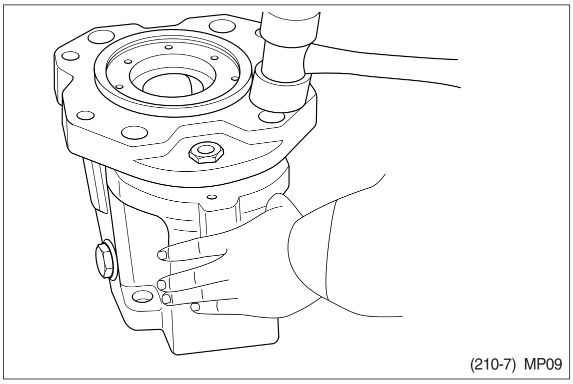
⑤ For fitting bolts, plug, etc., prepare a torque wrench or so on, and tighten them with torques shown in page 8-11, 12.

⑥ For the double-pump, take care not to mix up parts of the front pump with those of the rear pump.

(2) Fit swash plate support (251) to pump casing (271), tapping the former lightly with a hammer.

※ After servo piston, tilting pin, stopper (L) and stopper (S) are removed, fit them soon to pump casing in advance for reassembling.

※ In tightening servo piston and tilting pin, use a protector to prevent tilting pin head and feedback pin from being damaged. In addition, apply loctite (Medium strength) to their threaded sections.

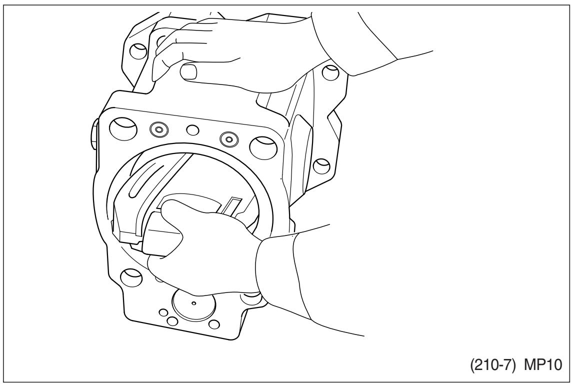


(210-7) MP09

(3) Place pump casing with its regulator fitting surface down, fit tilting bush of swash plate to tilting pin (531) and fit swash plate (212) to swash plate support (251) correctly.

※ Confirm with fingers of both hands that swash plate can be removed smoothly.

※ Apply grease to sliding sections of swash plate and swash plate support, and drive shaft can be fitted easily.



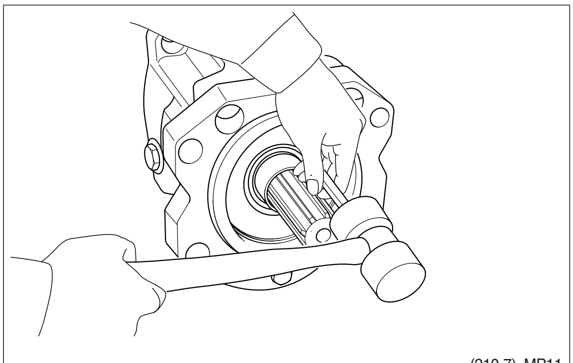
(210-7) MP10

(4) To swash plate support (251), fit drive shaft (111) set with bearing (123), bearing spacer (127) and snap ring (824).

※ Do not tap drive shaft with hammer or so on.

※ Assemble them into support, tapping outer race of bearing lightly with plastic hammer.

Fit them fully, using steel bar or so on.



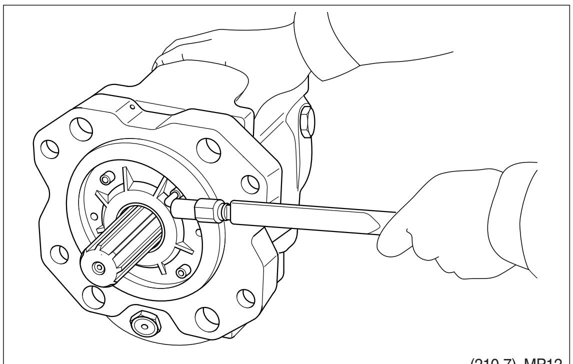
(210-7) MP11

(5) Assemble seal cover (F, 261) to pump casing (271) and fix it with hexagon socket head bolts (406).

※ Apply grease lightly to oil seal in seal cover (F).

※ Assemble oil seal, taking full care not to damage it.

※ For tandem type pump, fit rear cover (263) and seal cover (262) similarly.

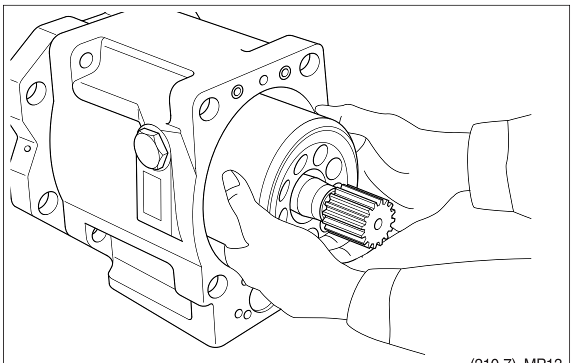


(210-7) MP12

(6) Assemble piston cylinder subassembly 〔cylinder block (141), piston subassembly (151, 152), set plate (153), spherical bush (156), spacer (158) and cylinder spring (157)〕.

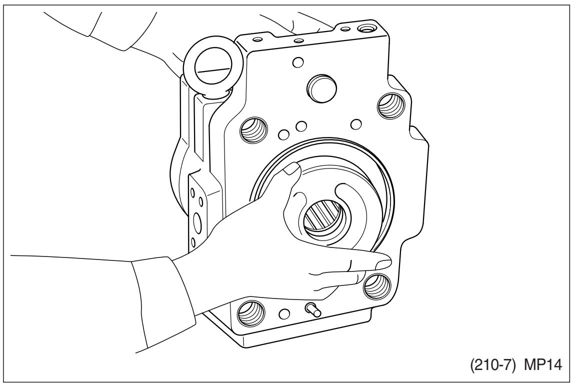
Fit spline phases of retainer and cylinder.

Then, insert piston cylinder subassembly into pump casing.

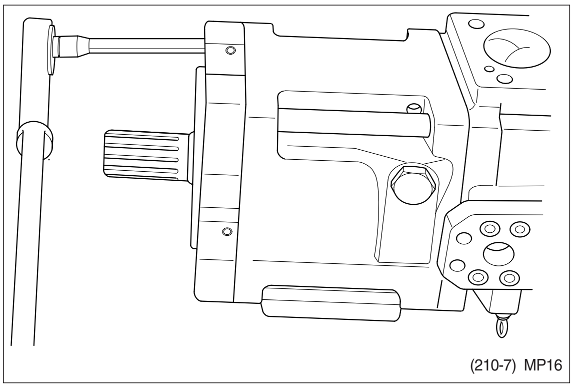


(210-7) MP13

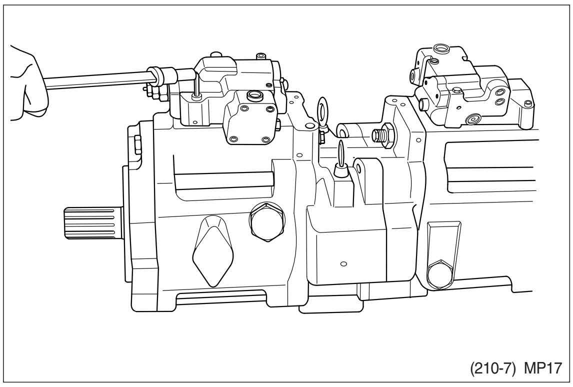
(7) Fit valve plate (313) to valve block (312), entering pin into pin hole.
※ Take care not to mistake suction / delivery directions of valve plate.


(210-7) MP14

(8) Fit valve block (312) to pump casing (271) and tighten hexagon socket head bolts (401).
※ At first assemble this at rear pump side, and this work will be easy.
※ Take care not to mistake direction of valve block.
※ Clockwise rotation (Viewed from input shaft side) - Fit block with regulator up and with delivery flange left, viewed from front side.
※ Counter clockwise rotation (Viewed from input shaft side) - Fit block with delivery flange right, viewed from front side.


(210-7) MP16

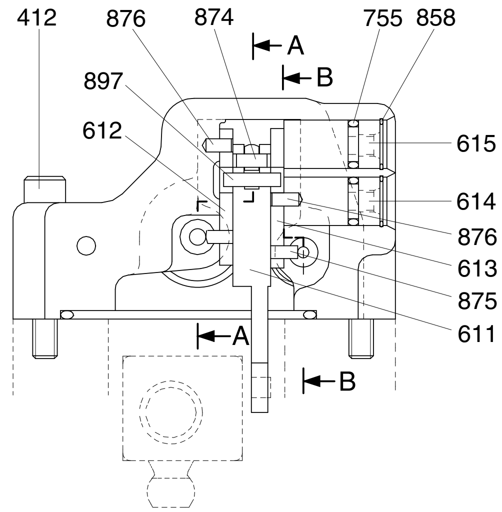
(9) Putting feedback pin of tilting pin into feedback lever of regulator, fit regulator and tighten hexagon socket head bolts (412, 413).
※ Take care not to mistake regulator of front pump for that of rear pump.

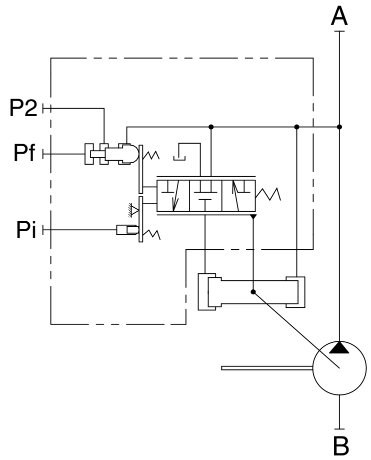

(210-7) MP17

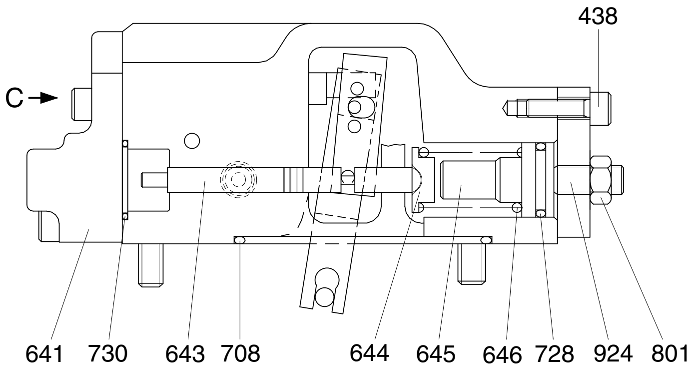
(10) Fit drain port plug (468).
This is the end of reassembling procedures.

3. REGULATOR

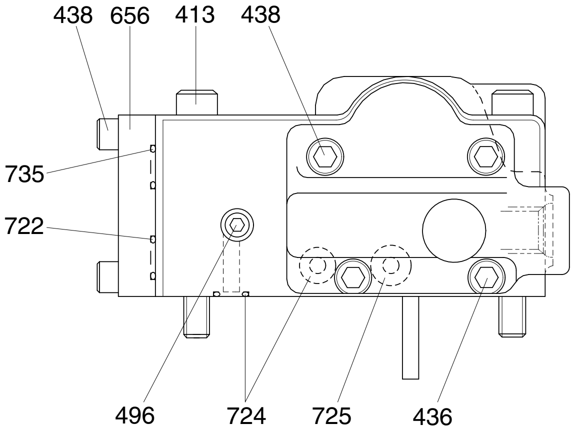
1) STRUCTURE (1/2)







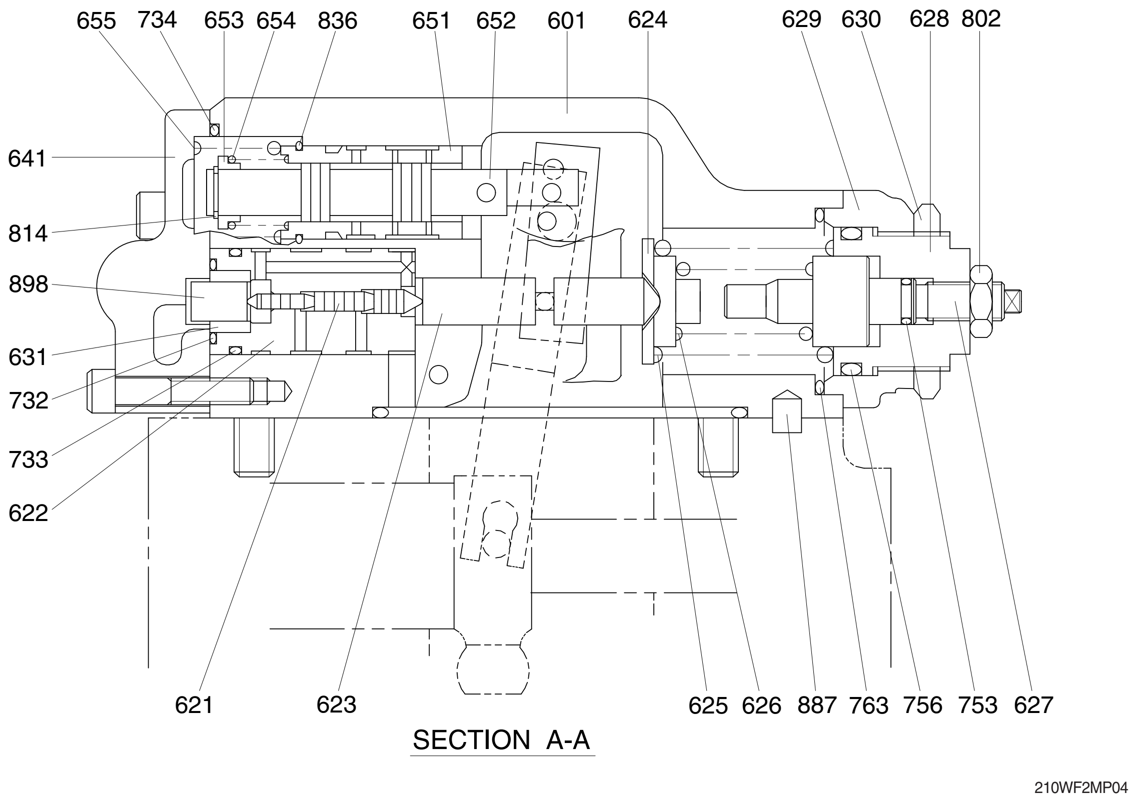
SECTION B-B



VIEW C

210WF2MP03

REGULATOR (2/2)

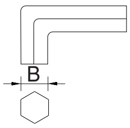
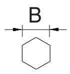


412	Hexagon socket screw	630	Lock nut	733	O-ring
413	Hexagon socket screw	631	Sleeve, pf	734	O-ring
436	Hexagon socket screw	641	Pilot cover	735	O-ring
438	Hexagon socket screw	643	Pilot piston	753	O-ring
496	Plug	644	Spring seat (Q)	755	O-ring
601	Casing	645	Adjust stem (Q)	756	O-ring
611	Feed back lever	646	Pilot spring	763	O-ring
612	Lever (1)	651	Sleeve	801	Nut
613	Lever (2)	652	Spool	802	Nut
614	Fulcrum plug	653	Spring seat	814	Snap ring
615	Adjust plug	654	Return spring	836	Snap ring
621	Compensator piston	655	Set spring	858	Snap ring
622	Piston case	656	Block cover	874	Pin
623	Compensator rod	708	O-ring	875	Pin
624	Spring seat (C)	722	O-ring	876	Pin
625	Outer spring	724	O-ring	887	Pin
626	Inner spring	725	O-ring	897	Pin
627	Adjust stem (C)	728	O-ring	898	Pin
628	Adjust screw (C)	730	O-ring	924	Set screw
629	Cover (C)	732	O-ring		

2) TOOLS AND TIGHTENING TORQUE

(1) Tools

The tools necessary to disassemble/reassemble the pump are shown in the follow list.

<table>
<tr><th colspan="2">Tool name & size</th><th colspan="4">Part name</th></tr>
<tr><td>Name</td><td>B</td><td>Hexagon socket head bolt</td><td>PT plug (PT thread)</td><td>PO plug (PF thread)</td><td>Hexagon socket head setscrew</td></tr>
<tr><td rowspan="3">Allen wrench </td><td>4</td><td>M 5</td><td>BP-1/16</td><td>-</td><td>M 8</td></tr>
<tr><td>5</td><td>M 6</td><td>BP-1/8</td><td>-</td><td>M10</td></tr>
<tr><td>6</td><td>M 8</td><td>BP-1/4</td><td>PO-1/4</td><td>M12, M14</td></tr>
<tr><td rowspan="2">Double ring spanner, socket wrench, double (single) open end spanner </td><td>-</td><td>Hexagon head bolt</td><td colspan="2">Hexagon nut</td><td>VP plug (PF thread)</td></tr>
<tr><td>6</td><td>M 8</td><td colspan="2">M 8</td><td>-</td></tr>
<tr><td colspan="2">Adjustable angle wrench</td><td colspan="4">Small size, Max 36mm</td></tr>
<tr><td colspan="2">Screw driver</td><td colspan="4">Minus type screw driver, Medium size, 2 sets</td></tr>
<tr><td colspan="2">Hammer</td><td colspan="4">Plastic hammer, 1 set</td></tr>
<tr><td colspan="2">Pliers</td><td colspan="4">For snap ring, TSR-160</td></tr>
<tr><td colspan="2">Steel bar</td><td colspan="4">4 × 100 mm</td></tr>
<tr><td colspan="2">Torque wrench</td><td colspan="4">Capable of tightening with the specified torques</td></tr>
<tr><td colspan="2">Pincers</td><td colspan="4">-</td></tr>
<tr><td colspan="2">Bolt</td><td colspan="4">M4, Length : 50 mm</td></tr>
</table>

(2) Tightening torque

Part name	Bolt size	Torque		Wrench size	
		kgf · m	lbf · ft	in	mm
Hexagon socket head bolt (Material : SCM435)	M 5	0.7	5.1	0.16	4
	M 6	1.2	8.7	0.20	5
	M 8	3.0	21.7	0.24	6
	M10	5.8	42.0	0.31	8
	M12	10.0	72.3	0.39	10
	M14	16.0	116	0.47	12
	M16	24.0	174	0.55	14
	M18	34.0	246	0.55	14
	M20	44.0	318	0.67	17
PT Plug (Material : S45C) ※ Wind a seal tape 1 1/2 to 2 turns round the plug	PT1/16	0.7	5.1	0.16	4
	PT 1/8	1.05	7.59	0.20	5
	PT 1/4	1.75	12.7	0.24	6
	PT 3/8	3.5	25.3	0.31	8
	PT 1/2	5.0	36.2	0.39	10
PF Plug (Material : S35C)	PF 1/4	3.0	21.7	0.24	6
	PF 1/2	10.0	72.3	0.39	10
	PF 3/4	15.0	109	0.55	14
	PF 1	19.0	137	0.67	17
	PF 1 1/4	27.0	195	0.67	17
	PF 1 1/2	28.0	203	0.67	17

3) DISASSEMBLY

Since the regulator consists of small precision finished parts, disassembly and assembly are rather complicated.

For this reason, replacement of a regulator assembly is recommended, unless there is a special reason, but in case disassembly is necessary for an unavoidable reason, read through this manual to the end before starting disassembly.

(1) Choose a place for disassembly.

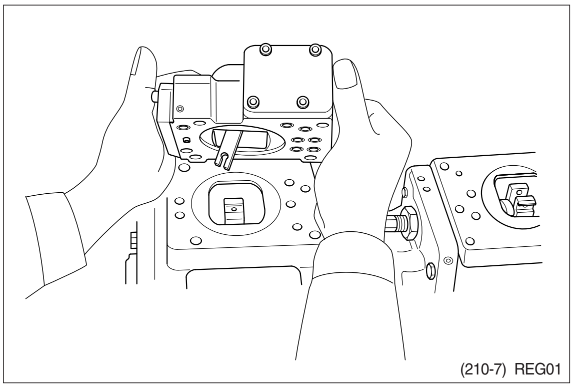
※ Choose a clean place.

※ Spread rubber sheet, cloth, or so on on top of work-bench to prevent parts from being damaged.

(2) Remove dust, rust, etc. from surfaces of regulator with clean oil.

(3) Remove hexagon socket head screw (412, 413) and remove regulator main body from pump main body.

※ Take care not to lose O-ring.



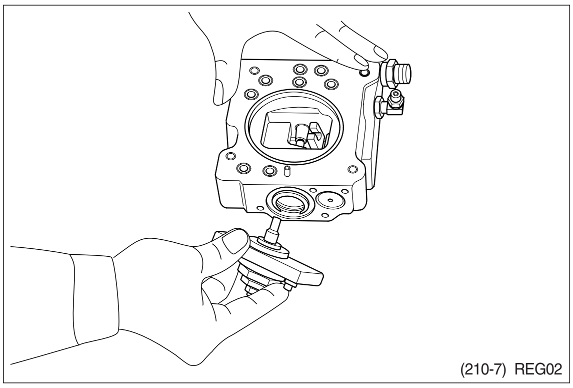
(210-7) REG01

(4) Remove hexagon socket head screw (438) and remove cover (C, 629)

※ Cover (C) is fitted with adjusting screw (C, 628), adjusting ring (C, 627), lock nut (630), hexagon nut (801) and adjusting screw (924).

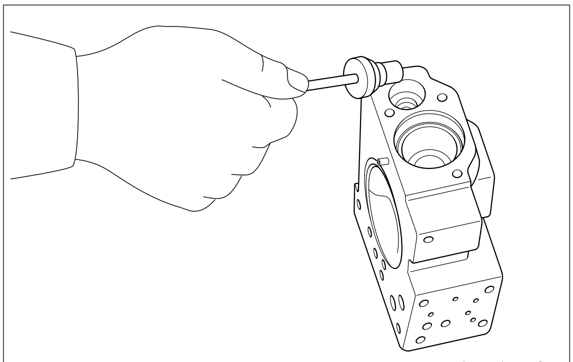
※ Do not loosen these screws and nuts.

If they are loosened, adjusted pressure-flow setting will vary.



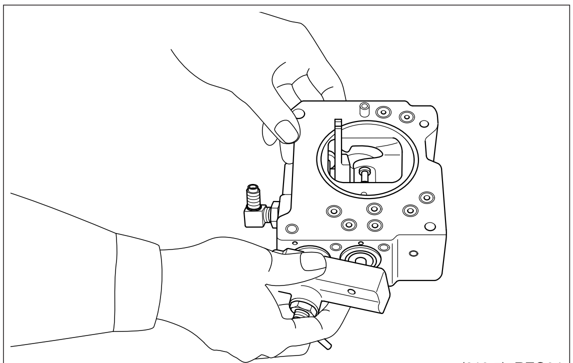
(210-7) REG02

(5) After removing cover (C, 629) subassembly, take out outer spring (625), inner spring (626) and spring seat (C, 624) from compensating section.
Then draw out adjusting ring (Q, 645), pilot spring (646) and spring seat (644) from pilot section.
※ Adjusting ring (Q,645) can easily be drawn out with M4 bolt.



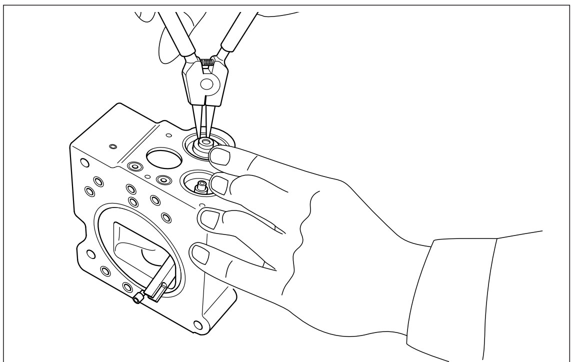
(210-7) REG03

(6) Remove hexagon socket head screws (436, 438) and remove pilot cover (641).
After removing pilot cover, take out set spring (655) from pilot section.



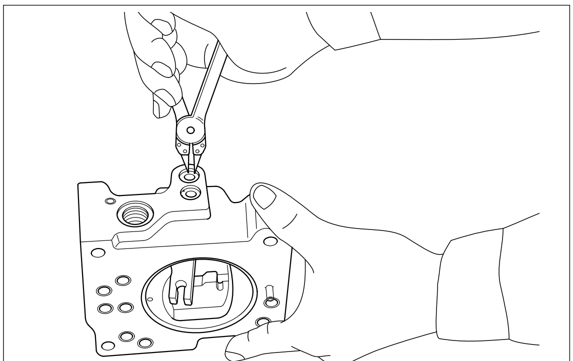
(210-7) REG04

(7) Remove snap ring (814) and take out spring seat (653), return spring (654) and sleeve (651).
※ Sleeve (651) is fitted with snap ring (836).
※ When removing snap ring (814), return spring (654) may pop out.
Take care not to lose it.

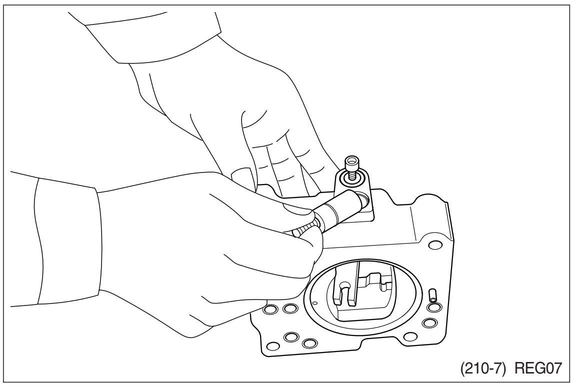


(210-7) REG05

(8) Remove locking ring (858) and take out fulcrum plug (614) and adjusting plug (615).
※ Fulcrum plug (614) and adjusting plug (615) can easily be taken out with M6 bolt.



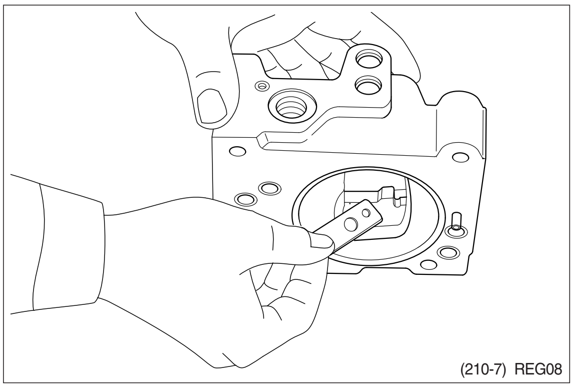
(210-7) REG06



(210-7) REG07

(9) Remove lever (2, 613). Do not draw out pin (875).

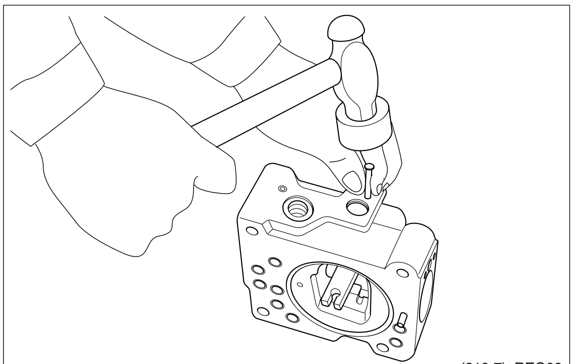
※ Work will be promoted by using pincers or so on.



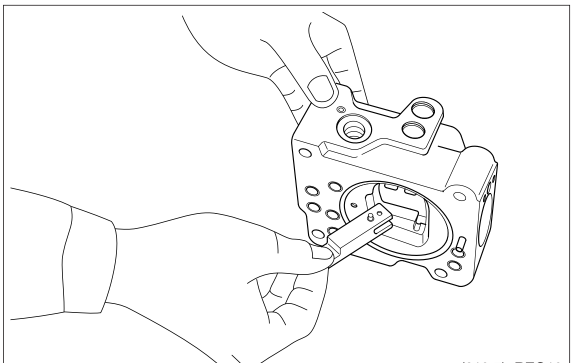
(210-7) REG08

(10) Draw out pin (874) and remove feedback lever (611).

Push out pin (874, 4 mm in dia.) from above with slender steel bar so that it may not interfere with lever (1, 612).



(210-7) REG09



(210-7) REG10

(11) Remove lever (1, 612). Do not draw out pin (875).

(12) Draw out pilot piston (643) and spool (652).

(13) Draw out piston case (622), compensating piston (621) and compensating rod (623).

※ Piston case (622) can be taken out by pushing compensating rod (623) at opposite side of piston case.

This completes disassembly.

4) ASSEMBLY

(1) For assembly, reverse disassembly procedures, but pay attention to the following items.

① Always repair parts that were scored at disassembly.

② Get replacement parts ready beforehand. Mixing of foreign matter will cause malfunction.
Therefore, wash parts well with cleaning oil, let them dry with jet air and handle them in clean place.

③ Always tighten bolts, plugs, etc. to their specified torques.

④ Do not fail to coat sliding surfaces with clean hydraulic oil before assembly.

⑤ Replace seals such as O-ring with new ones as a rule.

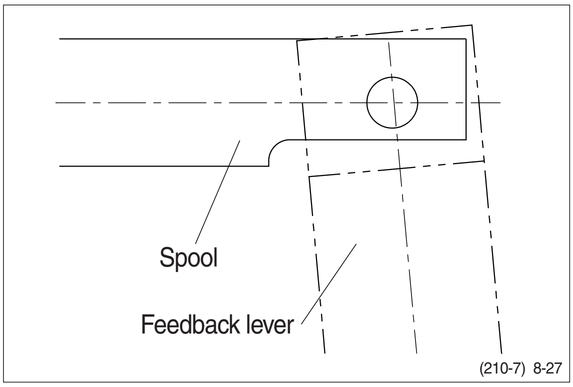
(2) Put compensating rod (623) into compensating hole of casing (601).

(3) Put pin force-fitted in lever (1, 612) into groove of compensating rod and fit lever (1) to pin force-fitted in casing.

(4) Fit spool (652) and sleeve (651) into hole in spool of casing.

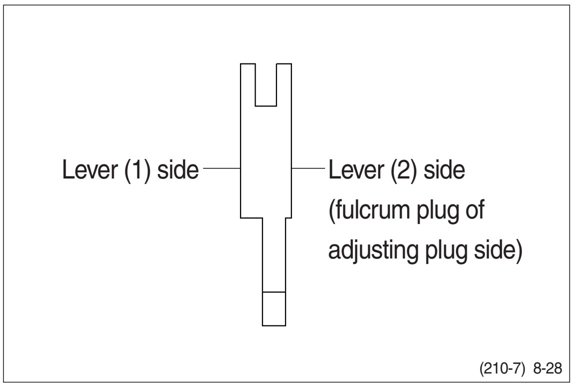
※ Confirm that spool and sleeve slide smoothly in casing without binding.

※ Pay attention to orientation of spool.



(210-7) 8-27

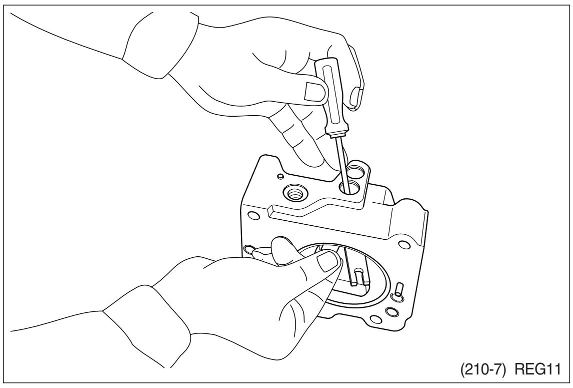
(5) Fit feedback lever (611), matching its pin hole with pin hole in spool.
Then insert pin (874).
※ Insert pin in feedback lever a little to ease operation.
※ Take care not to mistake direction of feedback lever.



(210-7) 8-28

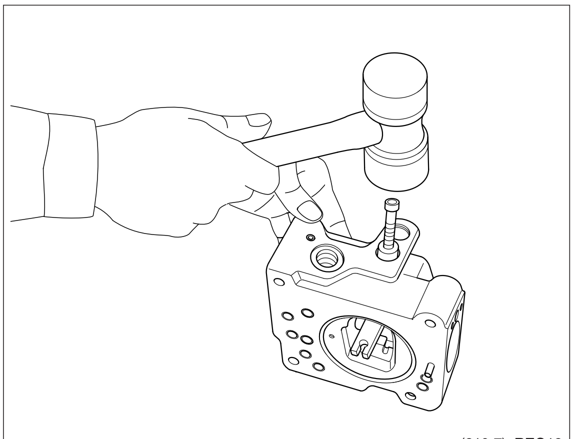
(6) Put pilot piston (643) into pilot hole of casing.
※ Confirm that pilot piston slides smoothly without binding.

(7) Put pin force-fitted in lever (2, 613) into groove of pilot piston.
Then fix lever (2).

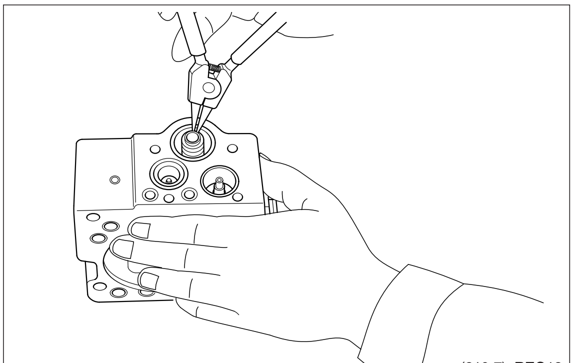

(210-7) REG11

(8) Fit fulcrum plug (614) so that pin force-fitted in fulcrum plug (614) can be put into pin hole of lever (2).
Then fix locking ring (858).

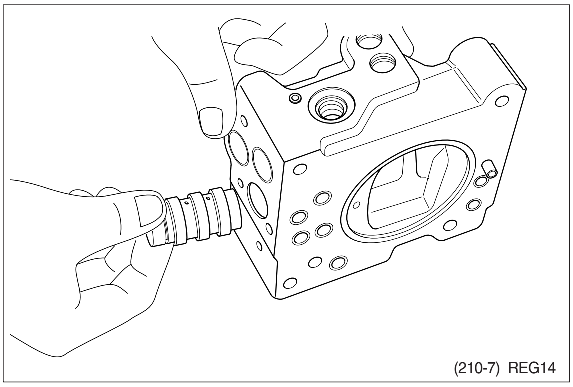
(9) Insert adjusting plug (615) and fit locking ring.
※ Take care not to mistake inserting holes for fulcrum plug and adjusting plug.
At this point in time move feedback lever to confirm that it has no large play and is free from binding.


(210-7) REG12

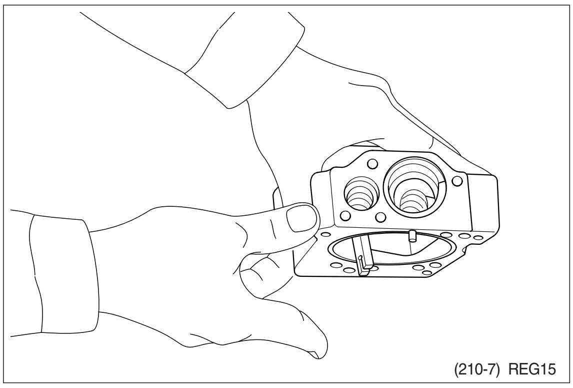
(10) Fit return spring (654) and spring seat (653) into spool hole and attach snap ring (814).


(210-7) REG13

(11) Fit set spring (655) to spool hole and put compensating piston (621) and piston case (622) into compensating hole.
Fit pilot cover (641) and tighten it with hexagonal socket head screws (436, 438).

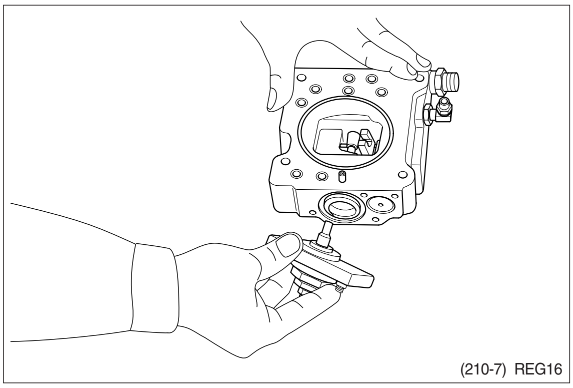

(210-7) REG14

(12) Put spring seat (644), pilot spring (646) and adjusting ring (Q, 645) into pilot hole.
Then fix spring seat (624), inner spring (626) and outer spring (625) into compensating hole.
※ When fitting spring seat, take care not to mistake direction of spring seat.


(210-7) REG15

(13) Install cover (C, 629) fitted with adjusting screws (628), adjusting ring (C, 627), lock nut (630), hexagon nut (801) and adjusting screw (924).
Then tighten them with hexagonal socket head screws (438).

This completes assembly.


(210-7) REG16

GROUP 4 MAIN CONTROL VALVE

1. REMOVAL AND INSTALL OF MOTOR

1) REMOVAL

13031GE18

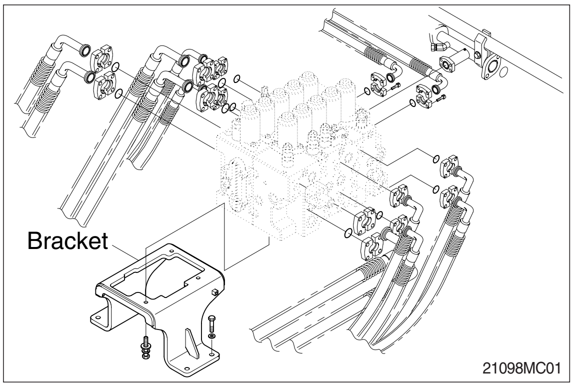
(1) Lower the work equipment to the ground and stop the engine.

(2) Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

(3) Loosen the breather slowly to release the pressure inside the hydraulic tank.

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

※ When pipes and hoses are disconnected, the oil inside the piping will flow out, so catch it in oil pan.



21098MC01

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

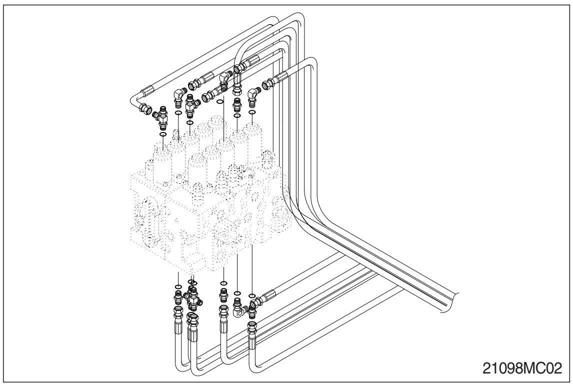
(5) Remove bolts and disconnect pipe.

(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 : 220 kg (485 lb)



21098MC02

(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.

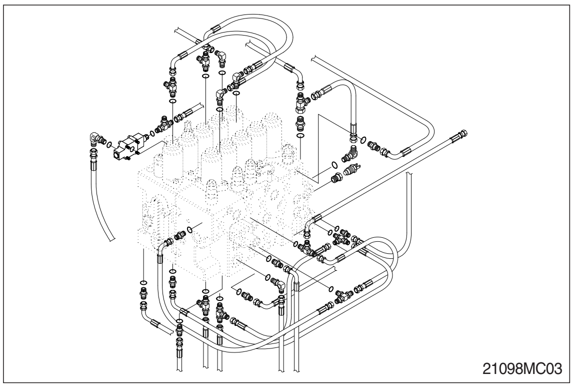
(2) Bleed the air from below items.

① Cylinder (boom, arm, bucket)

② Swing motor

③ Travel motor

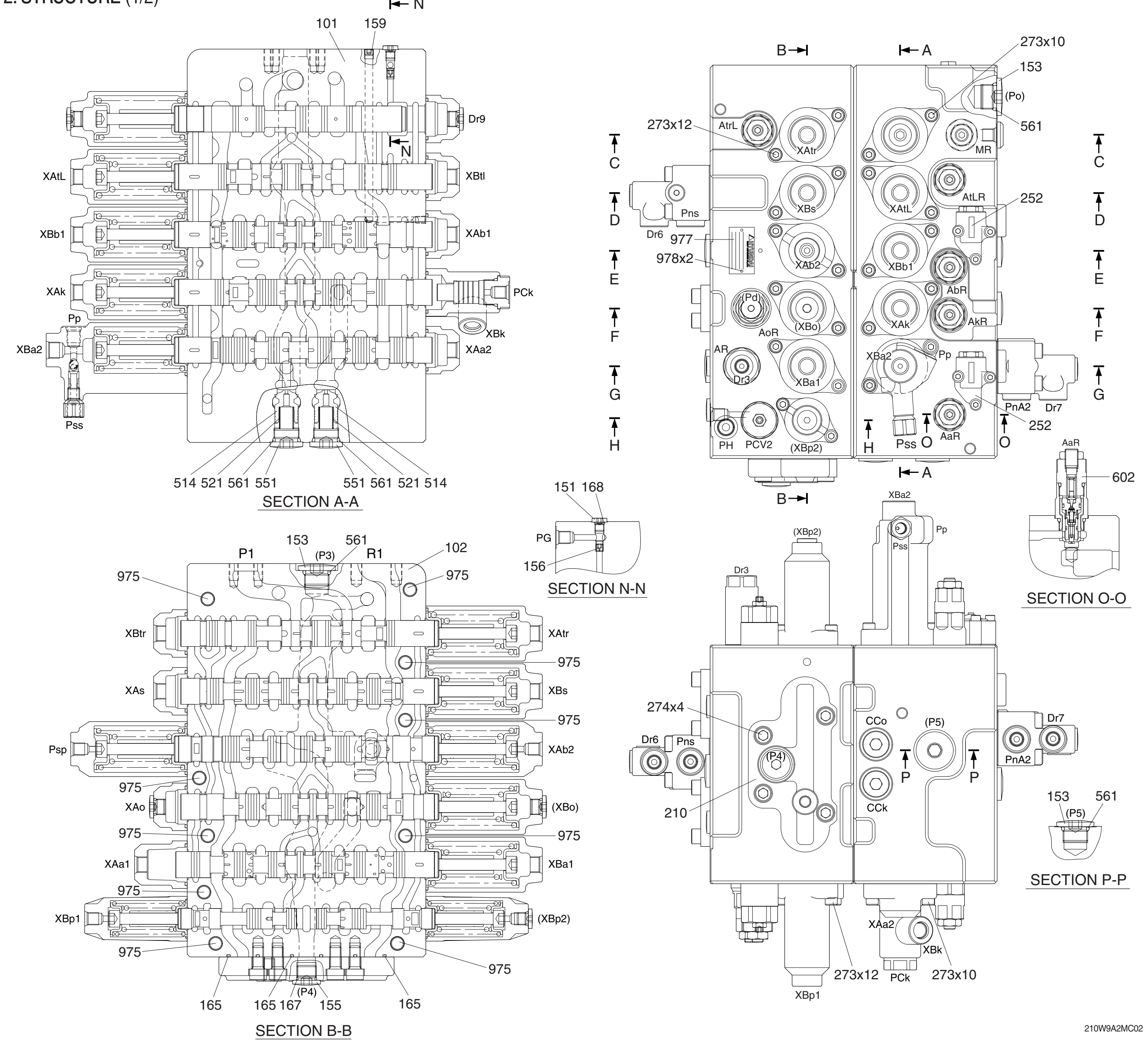
※ See each item removal and install.



21098MC03

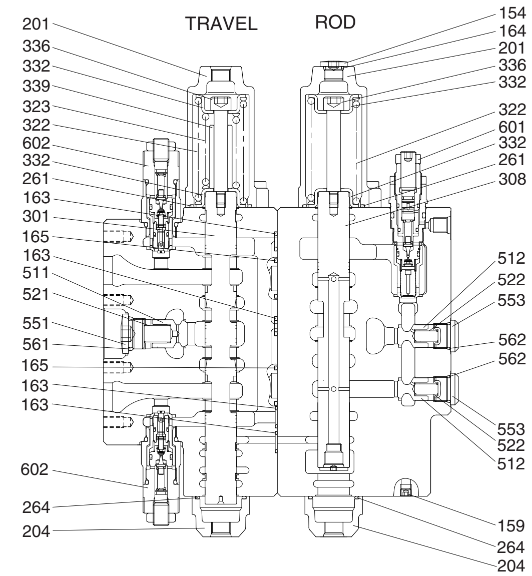
(3) Confirm the hydraulic oil level and recheck the hydraulic oil leak or not.

2. STRUCTURE (1/2)

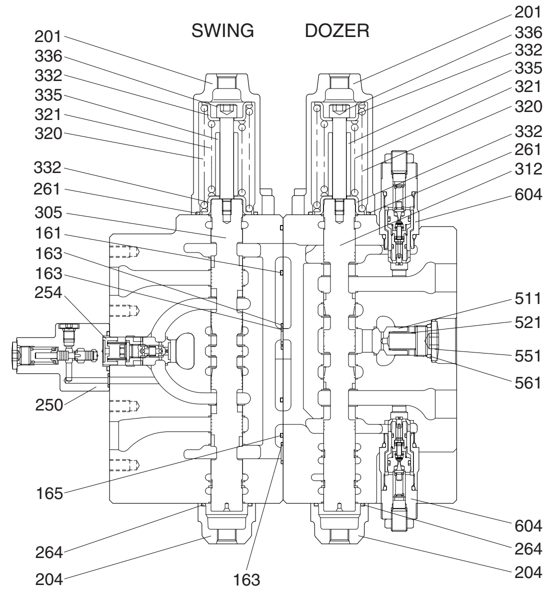


101	P2 housing	306	Arm 2 spool
102	P1 housing	307	Boom 2 spool
151	Plug	308	Rod spool
152	Plug	309	Spool (option)
153	Plug	310	Bypass cut spool
154	Plug	311	Swing priority spool
155	Plug	312	Dozer spool
156	Orifice	320	Spring
158	Plug	321	Spring
159	Plug	322	Spring
161	O-ring	323	Spring
162	O-ring	326	Spring
163	O-ring	327	Spring
164	O-ring	329	Spring
165	O-ring	331	Spring seat
167	O-ring	332	Spring seat
168	O-ring	333	Bolt
201	Cover	335	Stopper
202	Cover	336	Bolt
203	Cover	337	Stopper
204	Cover	339	Stopper
205	Cover	370	Spring
206	Cover	371	Spring
207	Cover	511	Poppet
209	Flange	512	Poppet
210	Plate	513	Poppet
211	Piston	514	Poppet
250	Logic control valve assy	521	Spring
251	Logic control valve assy	522	Spring
252	Lock valve selector sub assy	523	Spring
254	Swing Logic poppet assy	551	Plug
256	Arm 2 Logic poppet assy	552	Plug
257	Arm regeneration cut sub assy	553	Plug
258	Plug	561	O-ring
259	Plug	562	O-ring
261	O-ring	601	Main relief valve assy
262	O-ring	602	Port relief valve assy
264	O-ring	603	Port relief valve assy
273	Socket bolt	604	Port relief valve assy
274	Socket bolt	611	Posi-nega conversion valve assy
301	Travel spool	971	Screw
302	Arm 1 spool sub assy	975	Screw
303	Boom 1 spool sub assy	977	Name plate
304	Bucket spool	978	Pin
305	Swing spool		

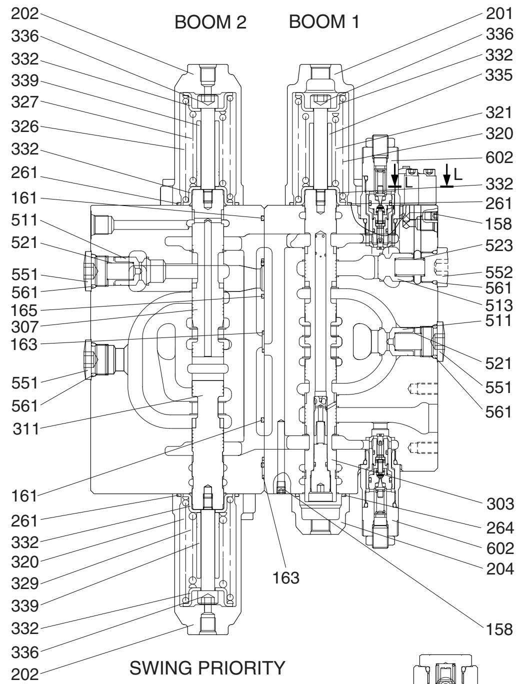
STRUCTURE (2/2)



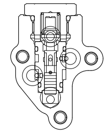
SECTION C-C



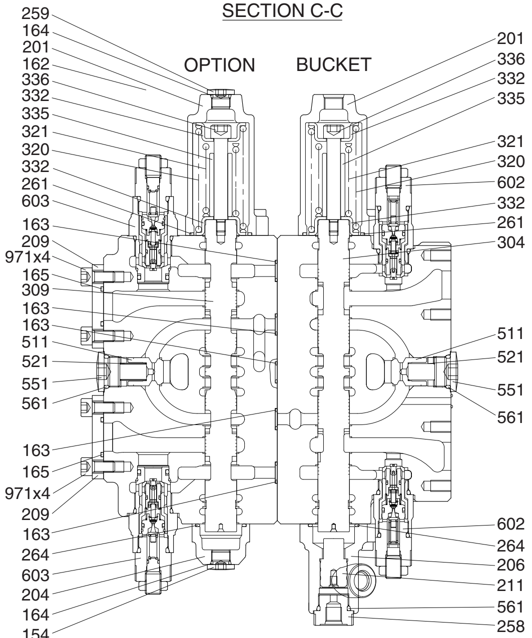
SECTION D-D



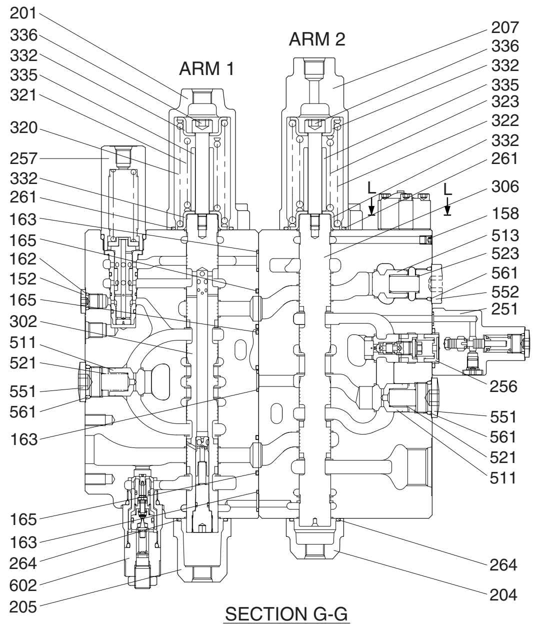
SECTION E-E



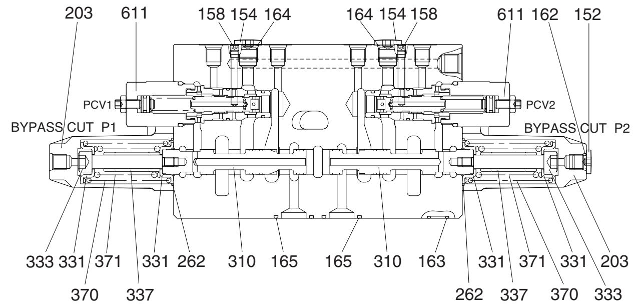
SECTION L-L



SECTION F-F



SECTION G-G



SECTION H-H

210WF2MC03

3. DISASSEMBLY AND ASSEMBLY

1) GENERAL PRECAUTIONS

(1) All hydraulic components are manufactured to a high precision. Consequently, before disassembling and assembling them, it is essential to select an especially clean place.

(2) In handling a control valve, pay full attention to prevent dust, sand, etc. from entering into it.

(3) When a control valve is to be remove from the machine, apply caps and masking seals to all ports. Before disassembling the valve, recheck that these caps and masking seals are fitted completely, and then clean the outside of the assembly. Use a proper bench for working. Spread a paper or rubber mat on the bench, and disassemble the valve on it.

(4) Support the body section carefully when carrying or transferring the control valve. Do not lift by the exposed spool, end cover section etc.

(5) After disassembling and assembling of the component it is desired to carry out various tests (for the relief characteristics, leakage, flow resistance, etc.), but the hydraulic test equipment is necessary for these tests. Therefore, even when its disassembling can be carried out technically, do not disassemble such components that cannot be tested, adjusted, and so on. Additionally one should always prepare clean cleaning oil, hydraulic oil, grease, etc. beforehand.

2) TOOLS

Before disassembling the control valve, prepare the following tools beforehand.

Name of tool	Quantity	Size (mm)
Vice mounted on bench (soft jaws)	1 unit	
Box wrench	Each 1 piece	24, 32, 36
Hexagon key wrench	Each 1 piece	4, 5, 6, 8, 10 and 12
Loctite #262	1 piece	-
Spanner	Each 1 piece	32 (main relief valve, 601) 36 (port relief valve, 603)

3) DISASSEMBLY

The figure in ( ) shown after the part name in the explanation sentence shows its number in the structure figures (8-31~32).

(1) Place control valve on working bench.

※ Disassemble it in clean place and pay attention not to damage flange faces and plate faces.

21098MC37

(2) Disassembling of main spools

· Travel (301), dozer (312), bucket (304), swing (305), option (308), arm 2 (306), boom 2 (307), swing priority (311).

① Loosen the hexagon the socket head bolts (273) and remove the spring cover (201, 202) and the O-ring (261).

· Hexagon key wrench : 6 ㎜

21098MC38

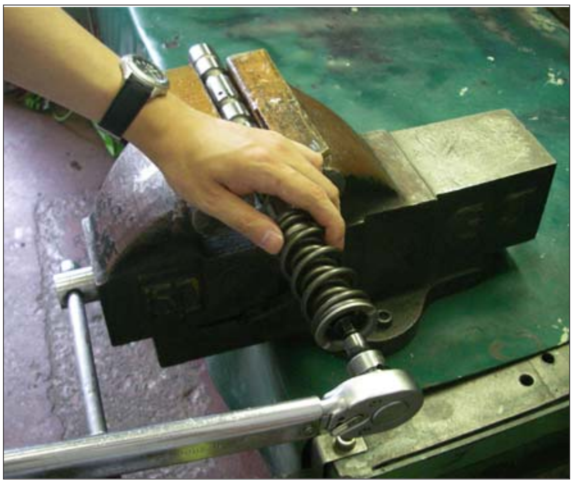
② Pull out the spool, spring, spring seats (322), stopper (335 or 339) and spacer bolt (336) in the spool assembly condition from the casing.

※ When pulling out the spool assembly from housing, pay attention not to damage the housing.

21078MC11

③ Hold the spool in the mouthpiece-attached vise applying a protection plate (aluminum plate and the like) in between. Remove the spacer bolt (336) and disassemble the stopper (335 or 339) and spring seats (332).

· Hexagon key wrench : 10 mm



21098MC40

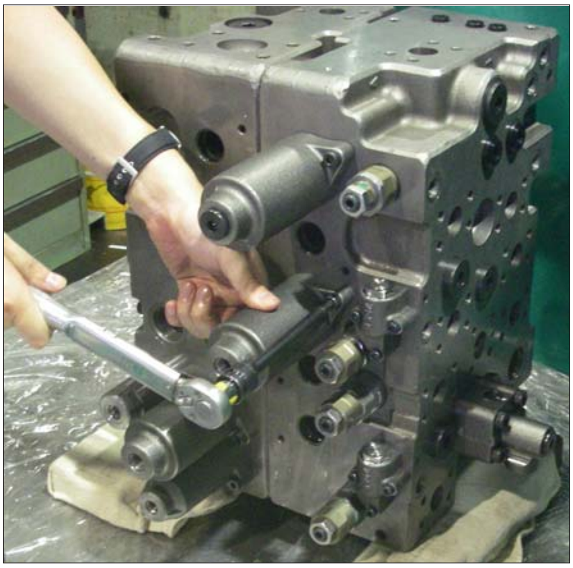
(3) Disassembling of boom 1 spool (303):

① Loosen the hexagon socket head bolts (273), and remove the spring cover (201) and the O-ring (261).

· Hexagon key wrench : 6 mm

② Pull out the boom 1 spool (303), spring (320, 321), spring seats (332), stopper (335) and spacer bolt (336) in the spool assembly condition from the P2 housing (101).

※ When pulling out the spool assembly from P2 housing (101), pay attention not to damage housing.



21098MC41

③ Hold the boom1 spool (303) in the mouthpiece-attached vise applying a protection plate (aluminum plate and the like) in between. Remove the spacer bolt (336), and disassemble the spring (320, 321), spring seats (332) and stopper (335).

· Hexagon key wrench : 10 mm

④ Do not disassemble the boom1 spool (303) more than these conditions.

(4) Disassembling of arm 1 spool (302):

① Loosen the hexagon socket head bolts (273), and remove the spring cover (201) and the O-ring (261).

· Hexagon key wrench : 6 mm

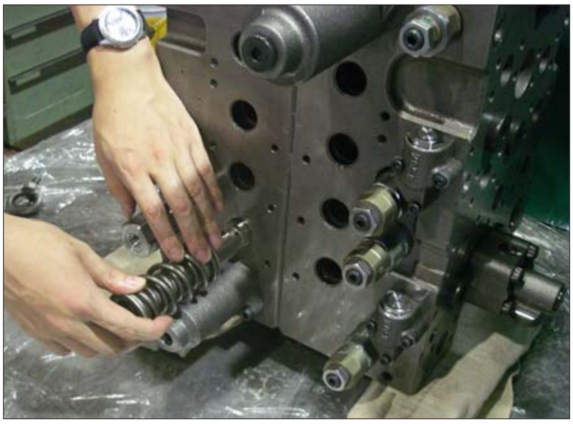
② Pull out the arm 1 spool (302), spring (320, 321), spring seats (332), stopper (335) and spacer bolt (336) in the spool assembly condition from the P1 housing (102).

※ When pulling out the spool assembly from P1 housing(102), pay attention not to damage housing.

③ Hold the arm 1 spool (302) in the mouthpiece-attached vise applying a protection plate (aluminum plate and the like) in between. Remove the spacer bolt (336), and disassemble the spring (320, 321), spring seats (332) and stopper (335).

· Hexagon key wrench : 10 mm

④ Do not disassemble the arm 1 spool (302) more than these conditions.



21098MC42

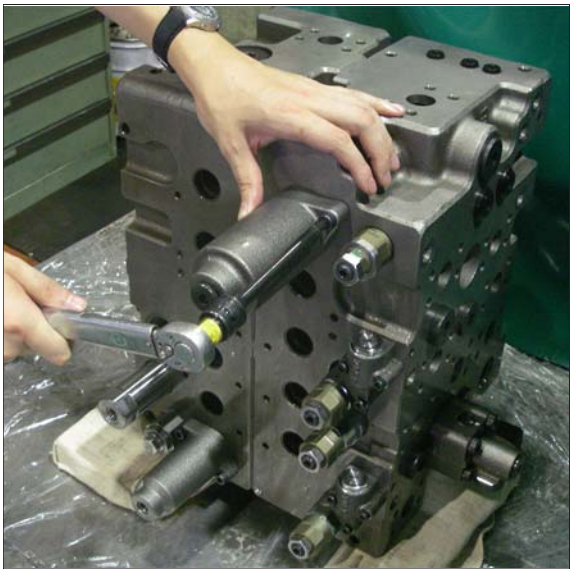
(5) Disassembling of travel straight spool (308):

① Loosen the hexagon socket head bolts (273), and remove the spring cover (201) and the O-ring (261).

· Hexagon key wrench : 6 mm

② Pull out the travel straight spool (308), spring (322, 323), spring seat (332), stopper (335) and spacer bolt (336) in the spool assembly condition from the P2 housing (101).

※ When pulling out the spool assembly from P2 housing (101), pay attention not to damage housing.



21098MC43

③ Hold the travel straight spool (308) in the mouthpiece-attached vise applying a protection plate (aluminum plate and the like) in between. Remove the spacer bolt (336) and disassemble the spring(322, 323), spring seats(332) and stopper (335).

· Hexagon key wrench : 10 mm

④ Do not disassemble the travel straight spool (308) more than these conditions.

(6) Disassembling of bypass cut spool (310, 313):

① Loosen the hexagon socket head bolts (273), and remove the spring cover (203) and the O-ring (262).

· Hexagon key wrench : 6 mm

② Pull out the bypass cut spool (310, 313), spring (370, 371), spring seats (331), stopper (337) and spacer bolt (333) in the spool assembly condition from the P1 housing.

※ When pulling out the spool assembly from P1 housing (102), pay attention not to damage housing.

21098MC44

③ Hold the bypass cut spool (310,313) in the mouthpiece-attached vise applying a protection plate (aluminum plate and the like) in between. Remove the spacer bolt (333) and disassemble the spring (370, 371), spring seats (331) and stopper (337).

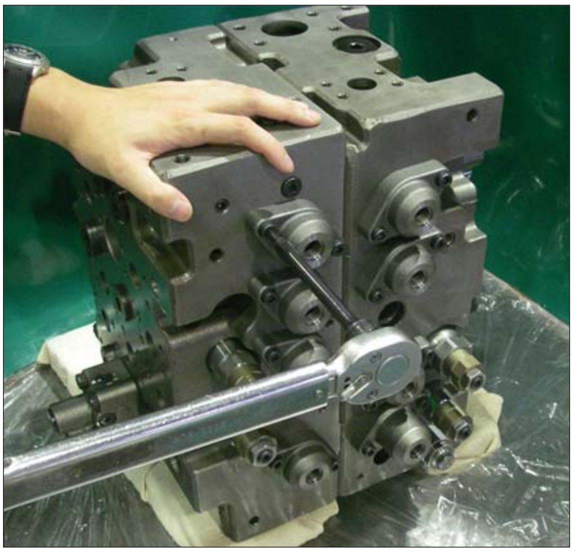
· Hexagon key wrench : 10 mm

21098MC45

(7) Disassembling of spool covers (204, 205, 206):

① Remove the hexagon socket head bolts (273), and remove the spool cover (204, 205, 206) and the O-ring (264).
 · Hexagon key wrench : 6 mm

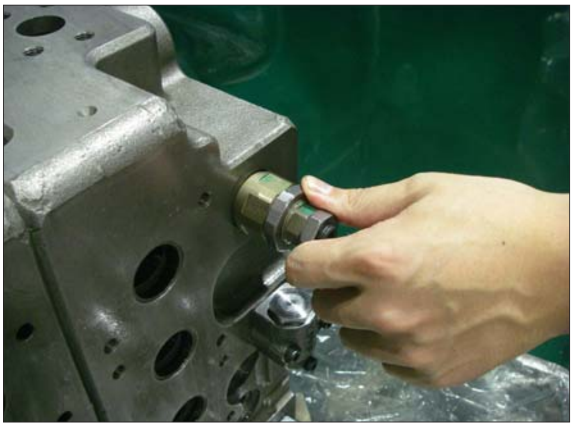
② In removing the bucket spool cover (206), at first loosen the plug (258) before it is removed from the P1 housing (102). After removing the bucket spring cover (206) remove the plug (551), and take out the piston (211).
 · Box wrench : 32 mm



21098MC46

(8) Removal of main relief valve (601) port relief valves (602, 603, 604, 605) :

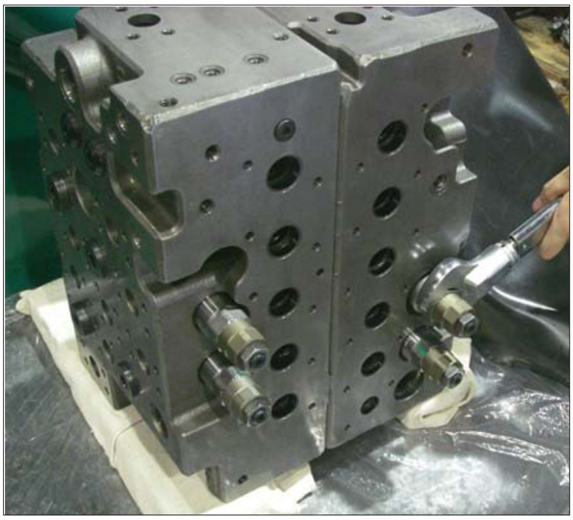
① Remove the main relief valve (601) and the port relief valves (602, 603, 604) from the housing.
Main relief valve (601) : spanner 32 mm
Port relief valve (602) : spanner or box wrench 32 mm
Port relief valve (603) : spanner 36 mm
Port relief valve (604) : spanner or box wrench 36 mm



21098MC47

② Do not disassemble the relief valves more than these conditions.

21098MC48

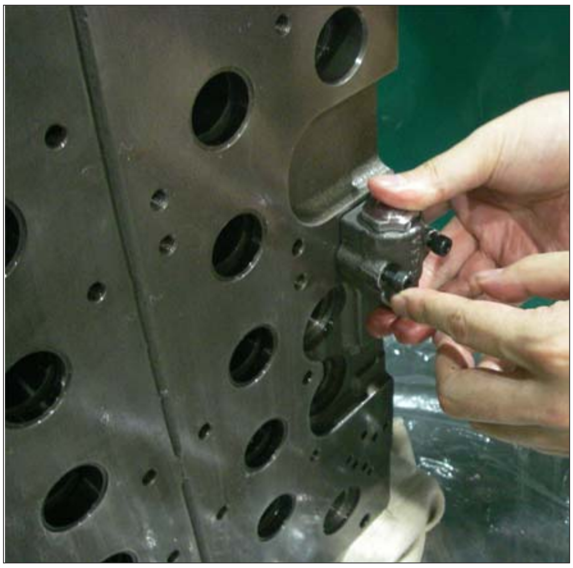


21098MC49

(9) Removal of lock valve selector (252):

① Loosen the hexagon socket head bolts (252-171) and remove the lock valve selector (252) and the O-rings (252-161).
  · Hexagon key wrench : 5 mm

② Do not disassemble the lock valve selector (252) more than these conditions.

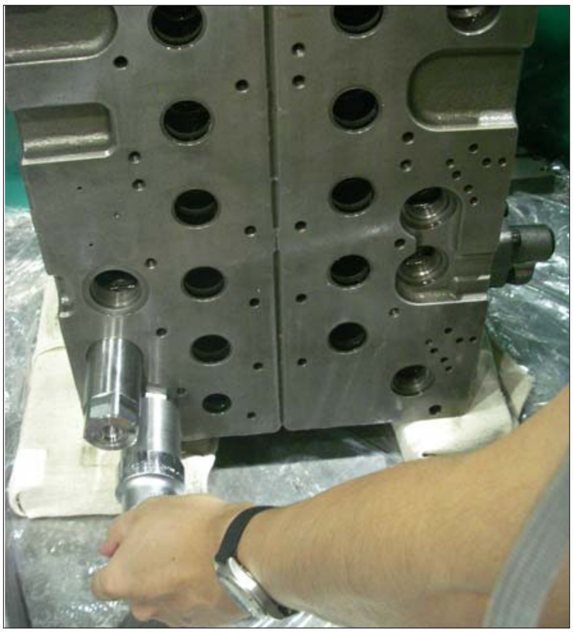


21098MC50

(10) Removal of posi-nega conversion valve (611):

① Remove the posi-nega conversion valve (611) from the P1 housing (102).
  · Box wrench : 36 mm

② Do not disassemble the posi-nega conversion valve (611) more than these conditions.

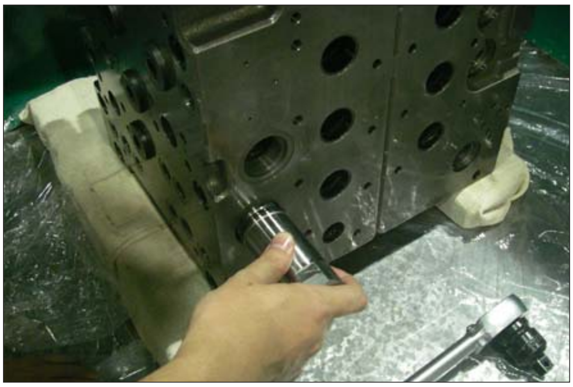


21098MC51

(11) Removal of arm regeneration cut valve (257):

Remove the plug (253), spring (331), spool (211), and sleeve (392) from the P1 housing (102).

· Box wrench : 36 mm

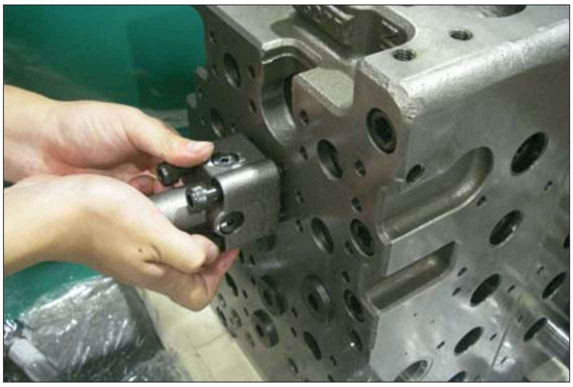


21098MC52

(12) Disassembly of logic control valve (250, 251) and logic poppet (254, 256):

① Loosen the hexagon socket head bolts (250-120, 251-120) and remove the logic control valve (250, 251) and the O-rings (250-112 and 113, 251-112 and 113).

· Hexagon key wrench : 8 mm



21098MC53

② Pull out the logic poppet (254, 256), spring (254-106, 256-106) and spring seat (254-103, 256-103) from the housing.

③ Do not disassemble the logic control valve and the logic poppet more than these condition.

21098MC54

(13) Disassembly of check valve :

① CP1, C2, CCb, LCb, LCo, LCk, LCa, LCAT2

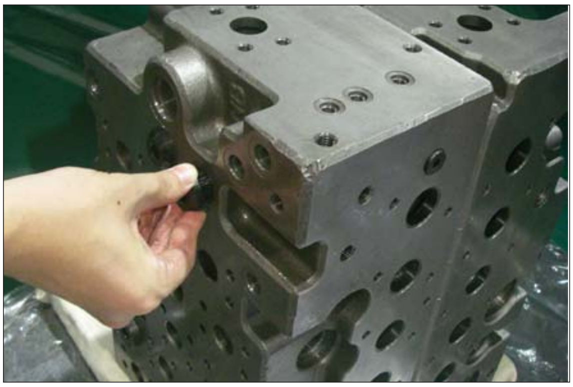
Remove the plug (551) and take out the poppet (511) and the spring (521).

· Hexagon key wrench : 12 mm

② CMR1, CMR2

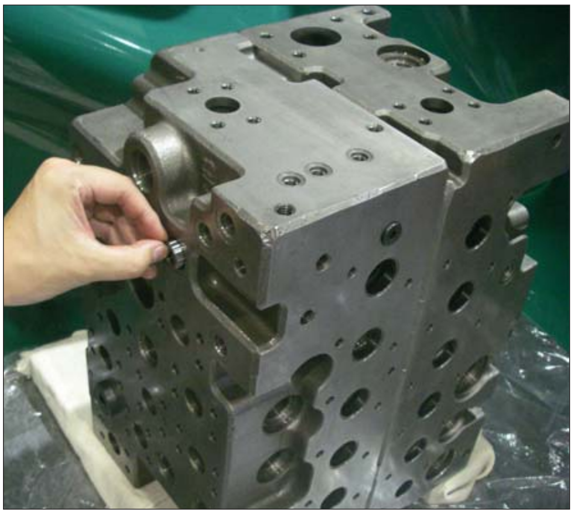
Remove the plug (553) and take out the poppet (512) and the spring (522).

· Hexagon key wrench : 10 mm



21098MC55

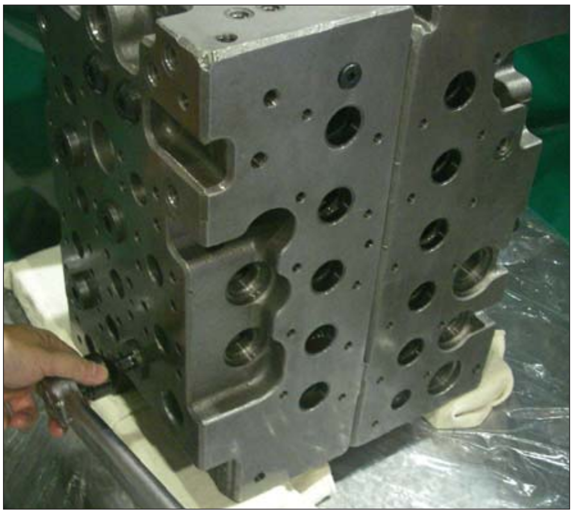
③ CRa, CRb
Remove the plug (552) and take out the poppet (513) and the spring (523).
· Hexagon key wrench : 12 mm



21098MC56

④ CCk, CCo
Remove the plug (551) and take out poppet (514) and the spring (521).
· Hexagon key wrench : 12 mm

⑤ Remove the plug (550) and take out the ball (541), spring (543) and spring seat (542).
· Hexagon key wrench : 6 mm



21098MC57

(14) Disassembly of flanges (209) :
Loosen the hexagon socket head bolts (971) and remove the flange (209) and the O-ring (165).
· Hexagon key wrench : 8 mm

(15) Disassembly of plate (210) :
Loosen the hexagon socket head bolts (274) and remove the plate (210) and the O-rings (165).
· Hexagon key wrench : 10 mm

(16) Disassembly of orifices for signal line :
Do not disassemble the plug (151) and orifice (156) unless required specifically.

(17) Disassembly of casing :

① Except when required specially, do not disassemble the tie bolts of the P1 housing.

② Since the plugs not described in above disassembling procedures are the blind plugs for sacrifice holes and the blind plugs for the housing sanitation, do not disassemble them as far as not required specially.

21098MC58

(18) Inspection after disassembling

Clean all the disassembled parts with clean mineral oil fully, and dry them with compressed air. Then, place them on clean papers or cloths for inspection.

① Control valve

a. Check whole surfaces of all parts for burrs, scratches, notches and other defects.
b. Confirm that the seal groove faces of the housing and the covers are smooth and free of dust, dent, rust etc.
c. Correct dents and damages on check seat faces of housing, if any, by lapping.
※ Pay attention not to leave lapping agent in the housing.
d. Confirm that all sliding and fitting parts can be moved manually and that all grooves and paths are free from foreign matter.
e. If any spring is broken or deformed, replace it with new one.
f. When a relief valve does not function properly, repair it, following its inspection procedures.
g. Replace all the O-rings with new ones.

② Relief valve

a. Confirm that all seat faces at ends of all poppets and seats are free of defects and are uniform contact faces.
b. Confirm manually that main poppet and seat can slide lightly and smoothly.
c. Confirm that outside face of main poppet and inside face of seat are free from scratches and so on.
d. Confirm that orifices of the main poppet and seat section are not clogged with foreign matter.
e. Replace all O-rings with new ones.
f. When any light damage is found in above inspections, correct it by lapping.
g. When any abnormal part is found, replace it with a relief valve assembly.

4) ASSEMBLY

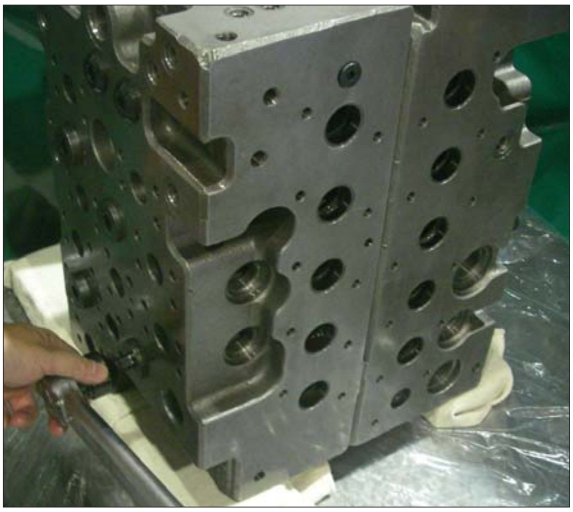
① In this assembling section, explanation only is shown. Refer to figures and photographs shown in disassembling section.
② Figure in ( ) shown after part name in explanation sentence shows number in structure figure.
③ Cautions in assembling O-rings
a. Pay attention to keep O-rings free from defects in its forming and damages in its handling.
b. Apply grease, hydraulic oil or so on to O-rings and seal-fitting sections for full lubrication.
c. Do not stretch O-rings so much to deform them permanently.
d. In fitting O-ring, pay attention not to roll it into its position. In addition, twisted O-ring cannot remove its twisting naturally with ease after being fitted, and causes oil leakage.
e. Tighten fixing the bolts for all sections with a torque wrench to their respective tightening torque.

(1) Assembly of check valve :

① Assemble the poppets (511, 512, 513, 514) and the springs (521, 522, 523) : Put the O-rings (561) onto the plugs (551, 552). Put the O-rings (562) onto the plugs (553). Tighten the plugs (551, 552, 553) with their specified torques.
※ Use the poppets, springs and plugs in following groups.

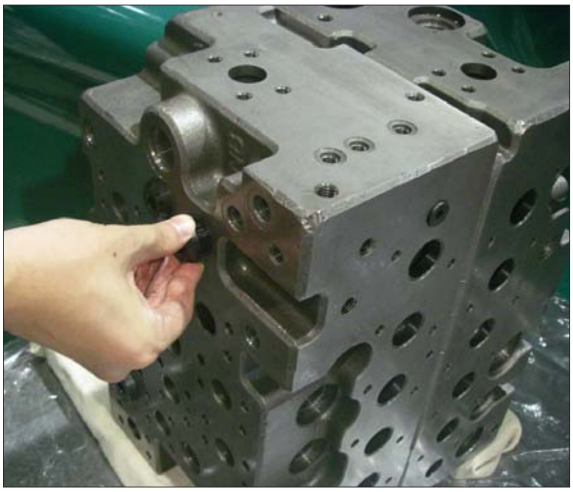
Poppet	Spring	Plug	Remember that
511	521	551	511 in 8 positions
512	522	553	512 in 2 positions
513	523	552	513 in 2 positions
514	521	551	514 in 2 positions

Plug No.	Hexagon key wrench (mm)	Tightening torque (kgf·m)
551	12	23.5 ~ 26.5
552	12	23.5 ~ 26.5
553	10	13.3 ~ 15.3


21098MC57


21098MC56

② Assemble of ball (541), spring Seat (542) and spring (543) : Put the O-ring (166) onto the plug (550), and tighten the plug (550) with specified torque.
  · Hexagon key wrench : 6 mm
  · Tightening torque : 2.55 ~ 2.96 kgf·m
  (18.4~21.4 lbf·ft)


21098MC55

(2) Assembly of plate (210) :
Fit the O-rings (165) to the P1 housing (102), and tighten the hexagon socket head bolts (274) with specified torque.
  · Hexagon key wrench : 10 mm
  · Tightening torque : 10.0 ~ 12.2 kgf·m
  (72.3~88.2 lbf·ft)

So turn the control valve that the plate face may be directed downward.

(3) Assembly of flange (209) :
Fit the O-rings (165) to the flange (209), and tighten the hexagon socket head bolts (971) with specified torque.
  · Hexagon key wrench : 8 mm
  · Tightening torque : 5.0 ~ 6.6 kgf·m
  (36.2~47.7 lbf·ft)

(4) Assemble of logic control valve :
① Put the O-ring (250-115, 251-115) onto the plug (250-111, 251-111).


21098MC53

② Assemble the spool (250-102, 251-102), spring seat (250-104, 251-104) and spring (251-105, 251-105) into the casing (250-101, 251-101) of the logic control valve, and tighten the plug (250-111, 251-111) with specified torque.

· Hexagon key wrench : 8 mm

· Tightening torque : 7.0 ~ 8.1 kgf·m (50.6~58.6 lbf·ft)

21098MC54

③ Assemble the logic poppet (254; poppet, spring, spring seat) into the housing of the control valve.

④ Fit the O-rings (250-112 and 113, 251-112 and 113) to the casing (250-101, 251-101) of the logic control valve, and tighten the hexagon socket head bolts (250-120, 251-120) with specified torque.

· Hexagon key wrench : 8 mm

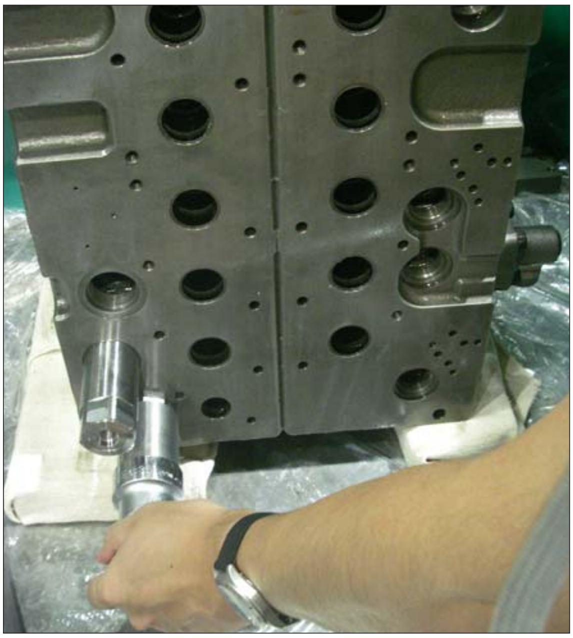
· Tightening torque : 5.0 ~ 6.6 kgf·m (36.2~47.7 lbf·ft)

(5) Assembling of posi-nega conversion valve (611) :

Assemble the posi-nega conversion valve (611) into the P2 housing (101), and tighten it with specified torque.

· Box wrench : 36 mm

· Tightening torque : 7.0 ~ 8.0 kgf·m (50.6~57.9 lbf·ft)



21098MC51

(6) Assembly of arm regeneration cut valve (257) :

Assemble the sleeve (257-212), spool (257-211), and spring (257-231) into the P1 housing (102). Put the O-ring (265) onto the plug (257-253), and tighten with specified torque.

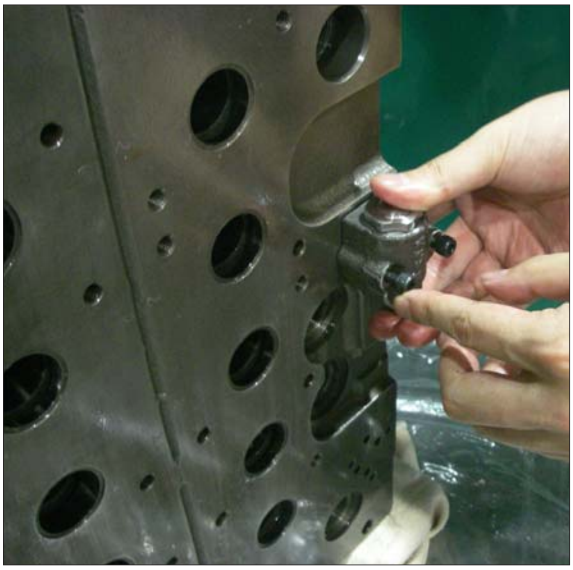
· Box wrench : 36 mm
· Tightening torque : 7.0 ~ 8.0 kgf·m (50.6~57.9 lbf·ft)

21098MC52

(7) Assembling of lock valve selector (252) :

Fit the O-rings (252-161) to the lock valve selector (252) and tighten the hexagon socket head bolts (252-171) with specified torque.

· Hexagon key wrench : 5 mm
· Tightening torque : 1.0 ~ 1.4 kgf·m (7.2~10.1 lbf·ft)

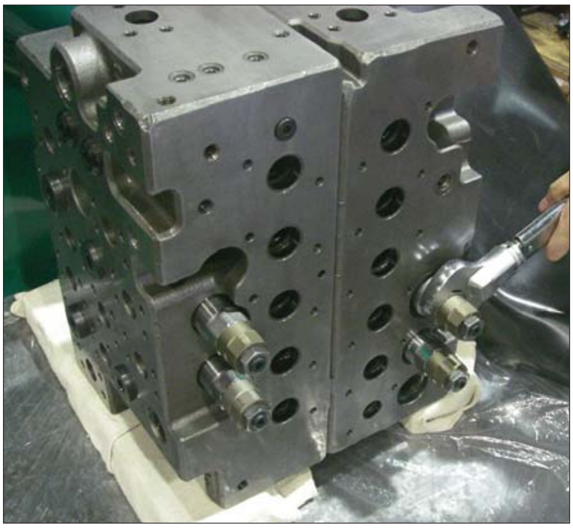


21098MC50

(8) Assembling of main relief valve (601) and port relief valve (602, 603, 604) :

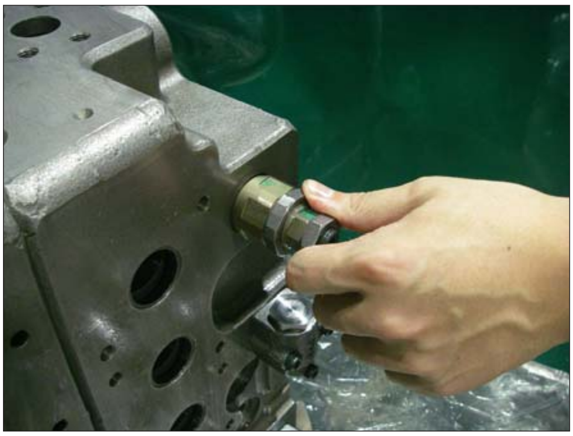
Assemble the main relief valve (601) and the port relief valves (602, 603, 604) to the housing, and tighten them with specified torque.

Item	Tool	Tightening torque (kgf·m)
Main relief valve (601)	Spanner 32	7.0 ~ 8.1
Port relief valve (602)	Spanner 32 or box wrench 32	7.0 ~ 8.1
Port relief valve (603)	Spanner 36	12.2 ~14.3
Port relief valve (604)	Spanner 36 or box wrench 36	12.2 ~14.3



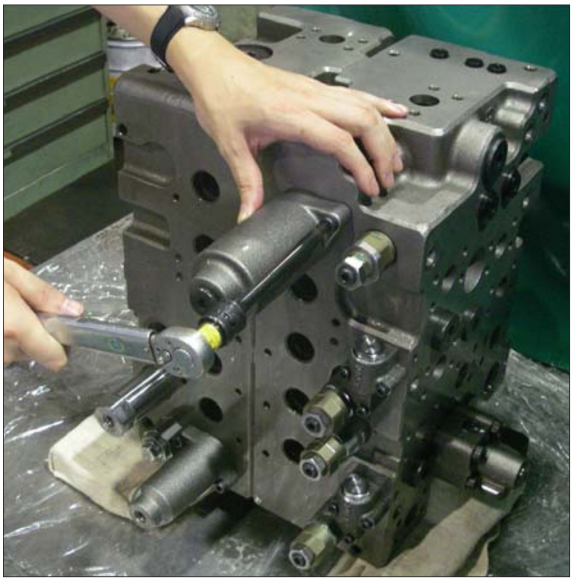
21098MC49

21098MC48



21098MC47

(9) Assemble of travel straight spool (308) :



21098MC43

① Hold the middle of the travel straight spool (308) in the mouthpiece-attached vise applying a protection plate (aluminum plate and the like) in between. Attach the spring seats (332), springs (322, 323) and stopper (335), and tighten the spacer bolt (336) with specified torque.

※ Before tightening the spacer bolt (336), apply loctite #262 to it.

· Hexagon key wrench : 10 mm

· Tightening torque : 1.6 ~ 1.8 kgf·m
(11.6~13.0 lbf·ft)

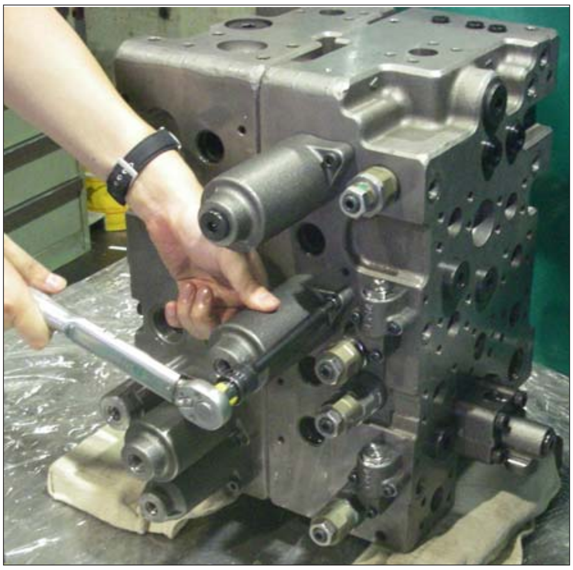
※ Pay attention not to fasten the vise excessively to the shape of the travel straight spool (308) is deformed.

② Insert the spool assemblies of ① items above into the P2 housing (101).

※ Fit spool assemblies into P2 housing (101) carefully and slowly.

※ Do not push them forcibly without fail.

(10) Assembling of boom 1 spool (303) :


21098MC41

① Hold the middle of the boom1 spool (303) in the mouthpiece-attached vise applying a protection plate (aluminum plate and the like) in between. Attach the spring seats (332), springs (320, 321) and stopper (335), and tighten the spacer bolt (336) with specified torque.

※ Before tightening the spacer bolt (336), apply loctite #262 to it.

· Hexagon key wrench : 10 mm

· Tightening torque : 1.6 ~ 1.8 kgf·m (11.6~13.0 lbf·ft)

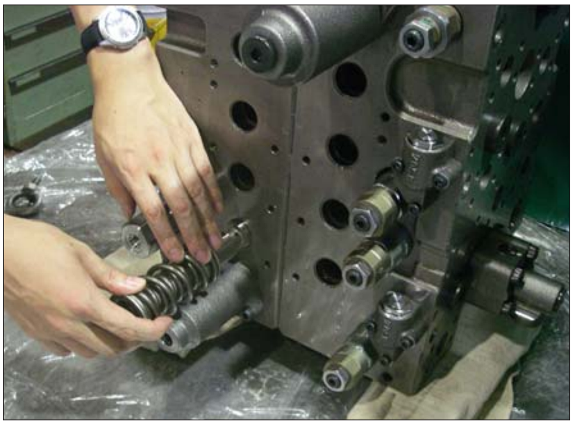
※ Pay attention not to fasten the vise excessively to the shape of the boom 1 spool (303) is deformed.

② Insert the spool assemblies of items ① above into the P2 housing (101).

※ Fit spool assemblies into the P2 housing (101) carefully and slowly.

※ Do not push them forcibly without fail.

(11) Assembling of arm 1 spool (302) :


21098MC42

① Hold the middle of the arm1 spool (302) in the mouthpiece-attached vise applying a protection plate (aluminum plate and the like) in between. Attach the spring seats (332), springs (320, 321) and stopper (335) and tighten the spacer bolt (336) with specified torque.

※ Before tightening the spacer bolt (336), apply loctite #262 to it.

· Hexagon key wrench : 10 mm

· Tightening torque : 1.6 ~ 1.8 kgf·m (11.6~13.0 lbf·ft)

※ Pay attention not to fasten the vise excessively to the shape of the arm 1 spool (302) is deformed.

② Insert the spool assemblies of items ① above into the P1 housing (102).

※ Fit spool assemblies into the P1 housing (102) carefully and slowly.

※ Do not push them forcibly without fail.

(12) Assembling of main spool (travel (301), dozer (312), bucket (304), swing (305), option (309), arm2 (306), boom2 (307), swing priority (311)):

① Hold the middle of each spool in the mouthpiece-attached vise applying a protection plate (aluminum plate and the like) in between. Attach the spring seats (332), springs and stopper (335 or 339) and tighten the spacer bolt (336) with specified torque.

※ Before tightening the spacer bolt (336), apply loctite #262 to it.

· Hexagon key wrench : 10 mm

· Tightening torque : 1.6 ~ 1.8 kgf·m (11.6~13.0 lbf·ft)

※ Pay attention not to fasten the vise excessively to the shape of the spool is deformed.

② Insert the spool assemblies of Items ① above into the P2 housing (101) and P1 housing (102).

※ Fit spool assemblies into P2 housing (101) and P1 housing (102) carefully and slowly.

※ Do not push them forcibly without fail.

21098MC39

21098MC38

(13) Assembling of bypass cut spool (310, 313) :

① Hold the middle of each spool in the mouthpiece-attached vise applying a protection plate (aluminum plate and the like) in between. Attach the spring seats (331), springs (370, 371) and stopper (337) and tighten the spacer bolt (333) with specified torque.

※ Before tightening the spacer bolt (333), apply loctite #262 to it.

· Hexagon key wrench : 10 mm
· Tightening torque : 1.6 ~ 1.8 kgf·m (11.6~13.0 lbf·ft)

※ Pay attention not to fasten the vise excessively to the shape of the bypass cut spool (310, 313) is deformed.

② Insert the spool assemblies of Items ① above into the P1 housing (102).

※ Fit spool assemblies into the P1 housing (102) carefully and slowly.

※ Do not push them forcibly without fail.

21098MC44

(14) Assembling of covers :

① Fit the O-rings (264) to the spool covers (204, 205, 206) to sides reverse to the spring sides of spools, and tighten the hexagon socket head bolts (273) with specified torque.

※ Confirm that O-rings (264) have been fitted to the spool covers (204, 205, 206).

· Hexagon key wrench : 6 mm
· Tightening torque : 2.5 ~ 3.5 kgf·m (18.1~25.3 lbf·ft)

② Bucket spool cover (206) : Assemble piston (355) into bucket spool cover (206). Put O-ring (561) onto plug (258) and tighten it with specified torque.

· Box wrench : 32 mm
· Tightening torque : 15.3 ~ 18.4 kgf·m (111~133 lbf·ft)

③ Fit the O-rings (261, 262) to spring covers (201, 202, 203) to the spring sides of spools, and tighten the hexagon socket head bolts (273) with specified torque.

※ Confirm that O-rings (261,262) have been fitted to spring covers (204, 205, 206).

· Hexagon key wrench : 6 mm
· Tightening torque : 2.5 ~ 3.5 kgf·m (18.1~25.3 lbf·ft)

21098MC46

GROUP 5 SWING DEVICE (TYPE 1, 2)

1. REMOVAL AND INSTALL OF MOTOR

1) REMOVAL

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

(2) Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

(3) Loosen the breather slowly to release the pressure inside the hydraulic tank.

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

※ When pipes and hoses are disconnected, the oil inside the piping will flow out, so catch it in oil pan.


13031GE18

(4) Disconnect hose assembly (2).

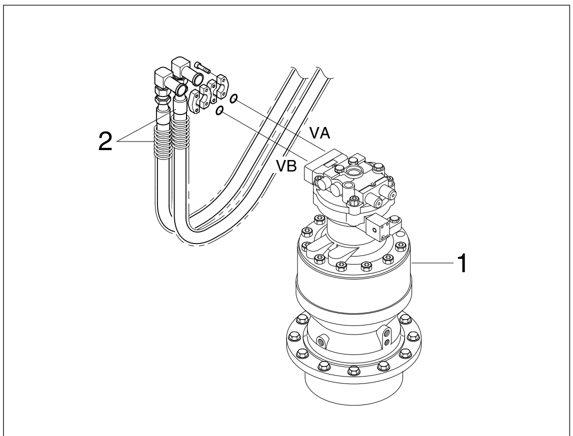
(5) Disconnect pilot line hoses (3, 4, 5, 6, 7, 8).

(6) Sling the swing motor assembly (1) and remove the swing motor mounting socket bolts (9).

· Motor device weight : 61 ㎏ (135 ℔)

(7) Remove the swing motor assembly.

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



2209A8SM21

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.

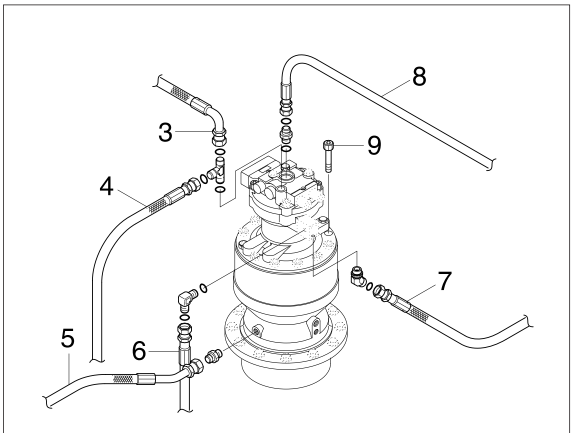
② Pour in hydraulic oil until it overflows from the port.

③ Tighten plug lightly.

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

⑤ Tighten plug fully.

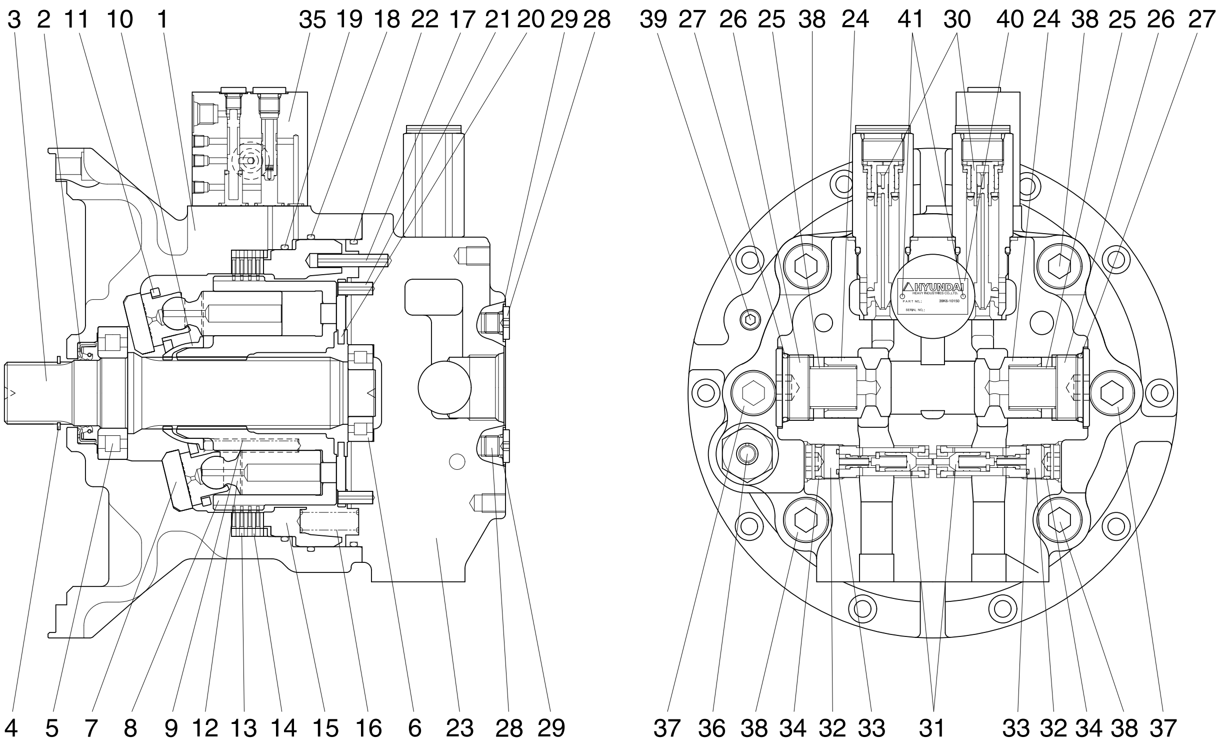
(3) Confirm the hydraulic oil level and check the hydraulic oil leak or not.



2209A8SM22

2. DISASSEMBLY AND ASSEMBLY OF SWING MOTOR

1) STRUCTURE



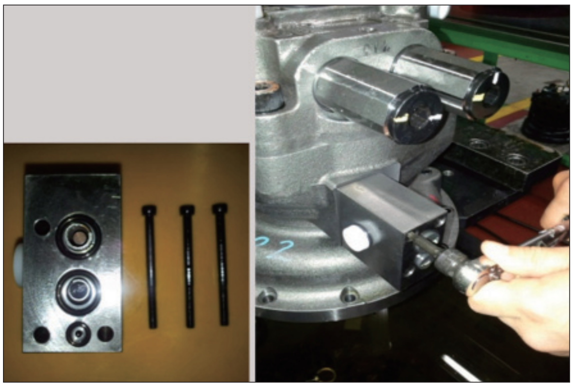
210WF2SM02

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

2) DISASSEMBLY

(1) Disassemble drive shaft

① Unloosing socket bolt (time delay valve, 42) and disassemble time delay valve assy (35) from casing (1).



2209A8SM51

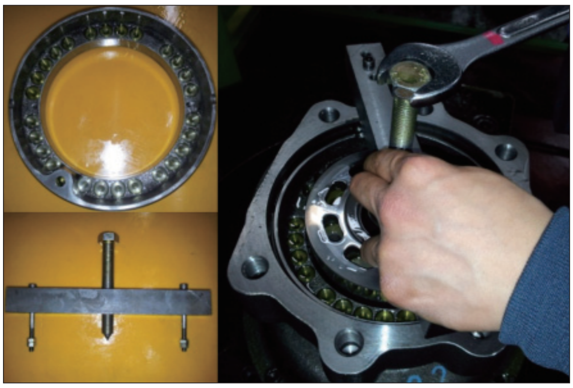
② Disassemble level gauge (36) from casing (1).

2209A8SM52

③ Hang valve casing (23) on hoist, unloose socket bolt (37, 38) and disassemble from casing (1).

2209A8SM53

④ Disassemble spring (16) and using a jig, disassemble parking piston (15) from casing (1).



2209A8SM54

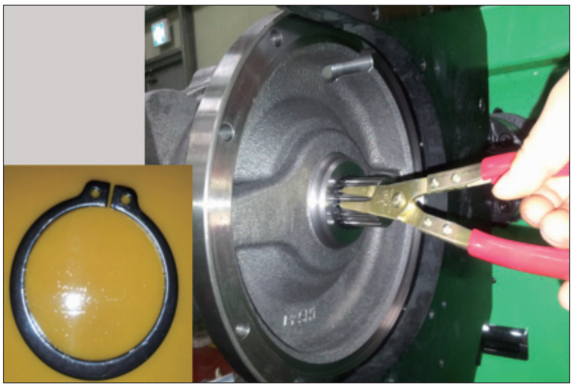
⑤ Disassemble respectively cylinder block sub (8), friction plate (13), separate plate (14) from casing (1).

2209A8SM55

⑥ Disassemble swash plate (7) from casing (1).

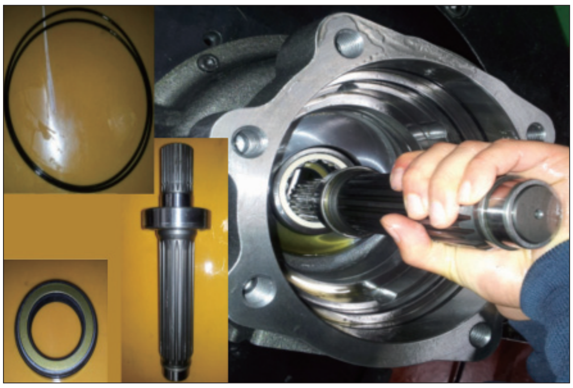
2209A8SM56

⑦ Using a plier jig, disassemble snap ring (4) from casing (1).



2209A8SM57

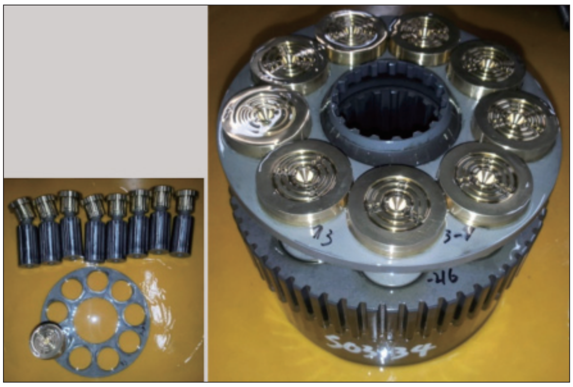
⑧ Disassemble shaft assy (3), oil seal (2) and O-ring (18, 22) from casing (1).



2209A8SM58

(2) Disassemble cylinder block sub

① Disassemble piston assy (12) from cylinder block (8).



2209A8SM59

② Disassemble ball guide (10) and spring (cylinder block, 9) from cylinder block (8).

- Ball guide × 1EA
- Spring × 9EA

2209A8SM60

(3) Disassemble valve casing sub

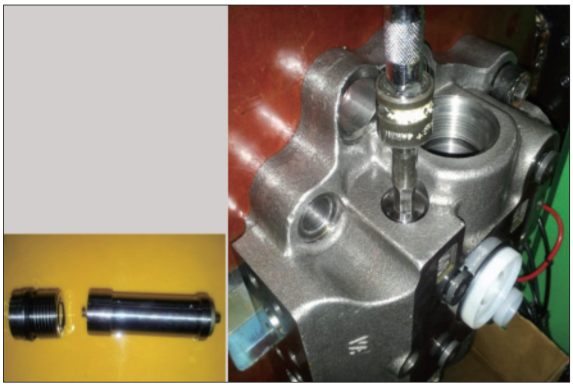
① Disassemble spring pin (17, 21), valve plate (20), O-ring (22) from valve casing (23).

2209A8SM61

② Using a torque wrench, disassemble relief valve (30) from valve casing (23).

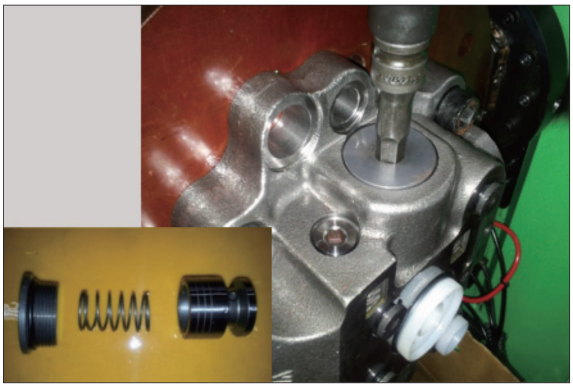
2209A8SM62

③ Using a torque wrench, disassemble plug (32) from valve casing (23) and disassemble O-ring (33, 34) and reactionless valve assy (31).



2209A8SM63

④ Using a torque wrench, disassemble check valve (24) from valve casing (23).



2209A8SM64

⑤ Disassemble plug (28), O-ring (29) from valve casing (23).

2209A8SM65

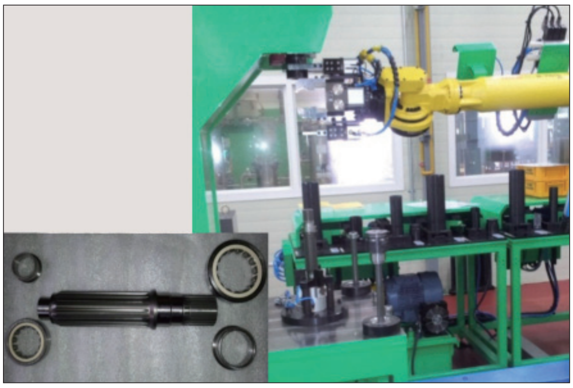
3) ASSEMBLING

(1) Assemble shaft sub

① Put roller bearing (3) on preheater and provide heat to inner race.
(Temperature in conveyor : 120°C for 3~5 minutes)

2209A8SM66

② Using a robot machine, assemble and press preheated roller bearing (3) into shaft (5).

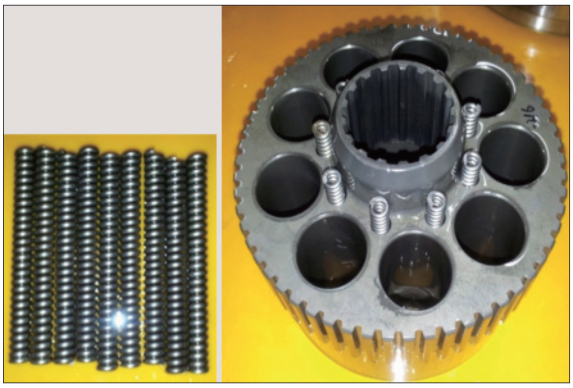


2209A8SM67

(2) Assemble cylinder block sub

① Assemble 9 springs (cylinder block, 9) into cylinder block (8).

・Spring × 9EA



2209A8SM68

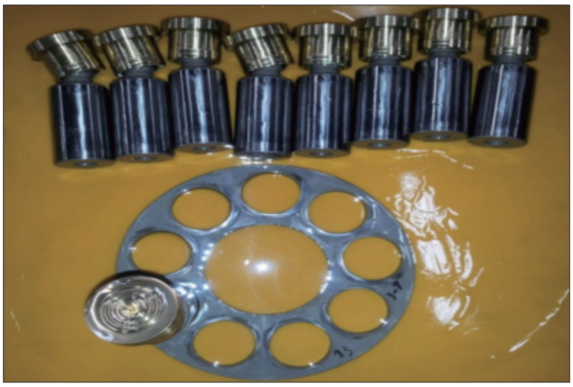
② Assemble ball guide (10) into cylinder block (8).

・Ball guide × 1EA

2209A8SM69

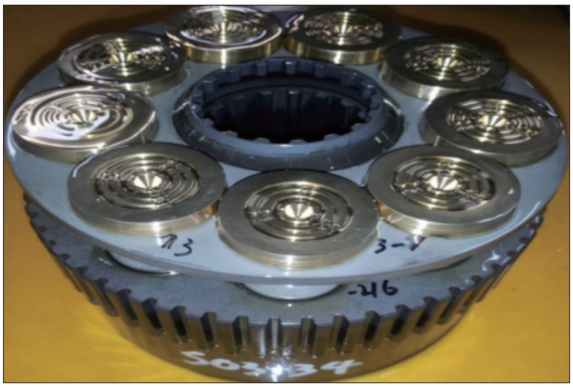
③ Assemble 9 piston assy (12) into retainer plate (11).

- Piston assy × 9EA
- Retainer plate × 1EA



2209A8SM70

④ Assemble parts of procedure ② and ③.



2209A8SM71

(3) Assemble valve casing sub

① **Assemble make up check valve sub**

Assemble check valve (24), O-ring (27), plug (26) in that order and then screw it torque wrench.

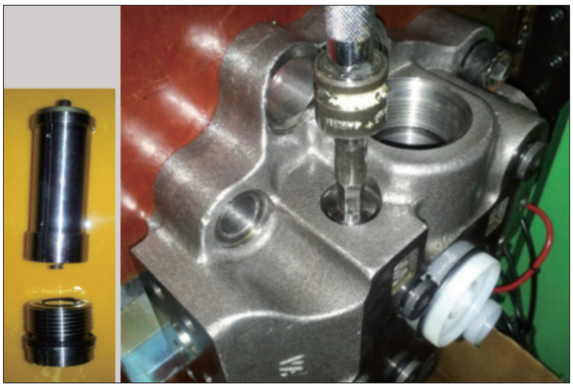
- Make up check valve × 2EA
- Spring × 2EA
- Plug × 2EA
- O-ring × 2EA

2209A8SM72

② **Assemble reactionless valve assy**

Assemble reactionless valve assy (31), plug (32), O-ring (33, 34) in that order and then screw it a torque wrench.

- Reactionless valve assy (31) × 2EA
- Plug (32) × 2EA
- O-ring (33, 34) × 2EA



2209A8SM73

③ Using a torque wrench, assemble relief valve (30) 2 sets into valve casing (23).

・Relief valve (30) × 2EA

2209A8SM74

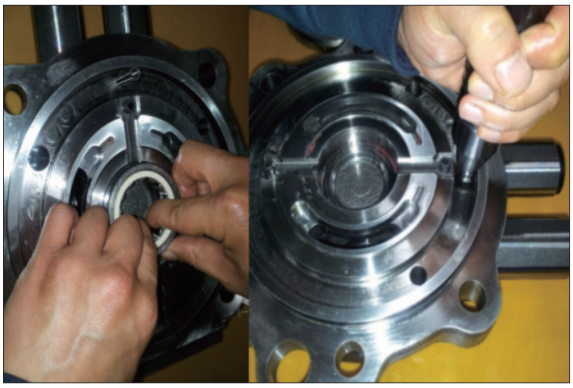
④ Assemble plug (28) and O-ring (27) into valve casing (23).

・Plug (28) × 3EA
・O-ring (27) × 3EA

2209A8SM75

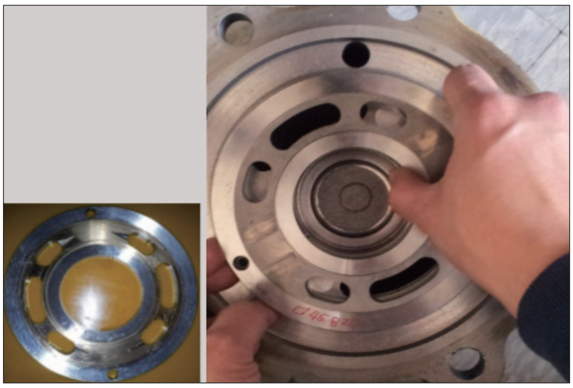
⑤ Assemble roller bearing (6) into valve casing (23) and assemble spring pin (17, 21) into valve casing (23).

・Roller bearing (6) × 1EA
・Spring pin (17, 21) × 1EA



2209A8SM76

⑥ Apply some grease valve plate (20) and assemble it into valve casing (23).



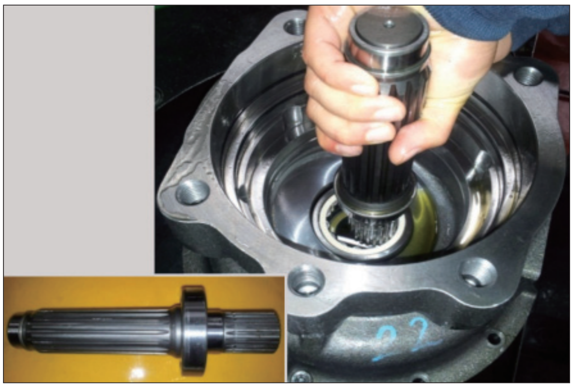
2209A8SM77

(4) Assemble drive shaft sub

① Using a jig, assemble oil sealing (2) into casing (1).

2209A8SM78

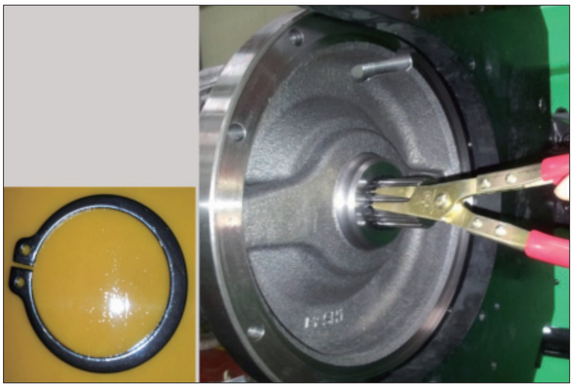
② Fit shaft sub (shaft+roller bearing) into casing (1).



2209A8SM79

③ Using a plier jig, assemble snap ring (4) to shaft (3).

・Snap ring × 1EA



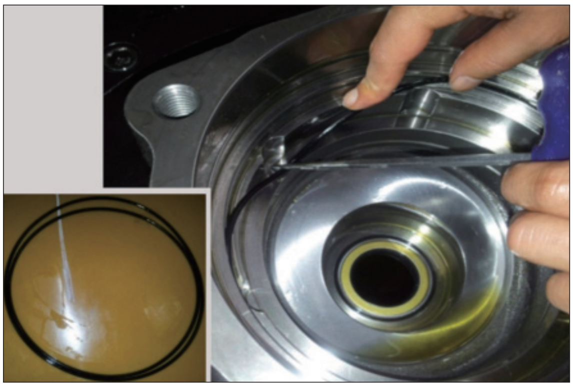
2209A8SM80

④ Apply some grease swash plate (7) and assemble it into casing (1).

・Swash plate × 1EA

2209A8SM81

⑤ Insert O-ring (18, 19) into casing (1).
- O-ring (18) × 1EA
- O-ring (19) × 1EA



2209A8SM82

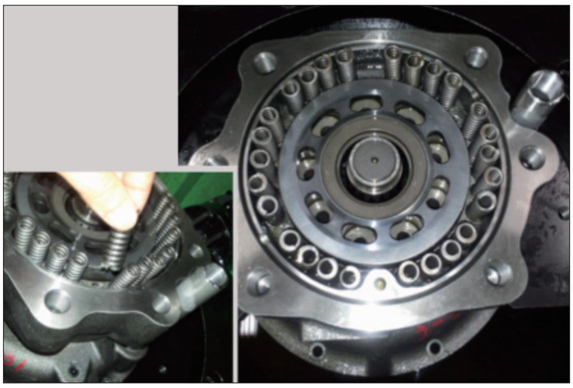
⑥ Assemble cylinder block (8) into casing (1).

2209A8SM83

⑦ Assemble separate plate (14) and friction plate (13) 4 sets into casing (1) and fit parking piston (15) into casing (1) by a jig or a press.
- Separate plate × 4EA
- Friction plate × 4EA
- Parking piston × 1EA

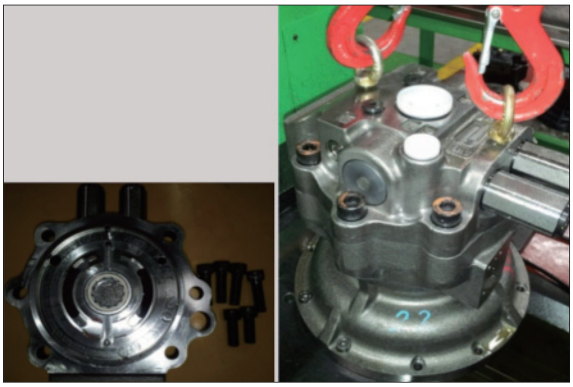
2209A8SM84

⑧ Assemble spring (parking piston, 16) into parking piston (15).
- Spring × 26EA



2209A8SM85

⑨ Lift up valve casing (23) on casing (1) by a crane and assemble it with socket bolts (37, 38).



2209A8SM86

⑩ Assemble level gauge (36) and plug (39) into casing (1).

2209A8SM87

⑪ Assemble time delay valve assy (35) into valve casing (23) with socket bolt (42).

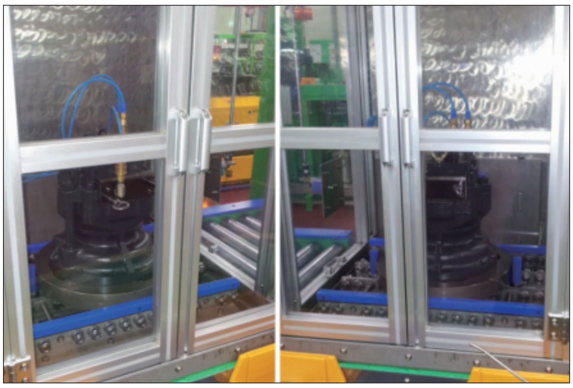
・Time delay valve × 1EA

・Socket bolt × 3EA

2209A8SM88

⑫ Air pressing test

Be sure of leakage, after press air into assembled motor and put it in water for 1 minute (pressure : 2 kgf/cm²).



2209A8SM89

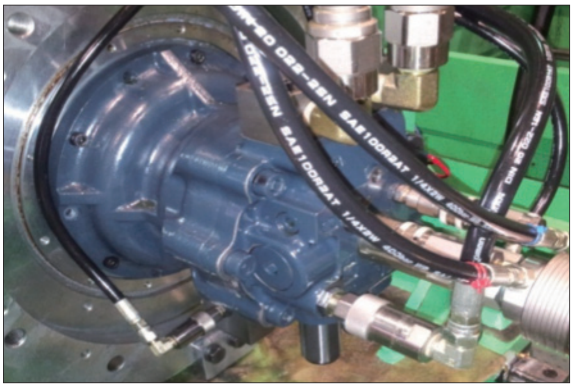
⑬ Leakage check

Place motor on a bench tester and after cleaning motor by color check No.1, paint No.3 and be sure of leakage.

2209A8SM90

⑭ Mount test bench

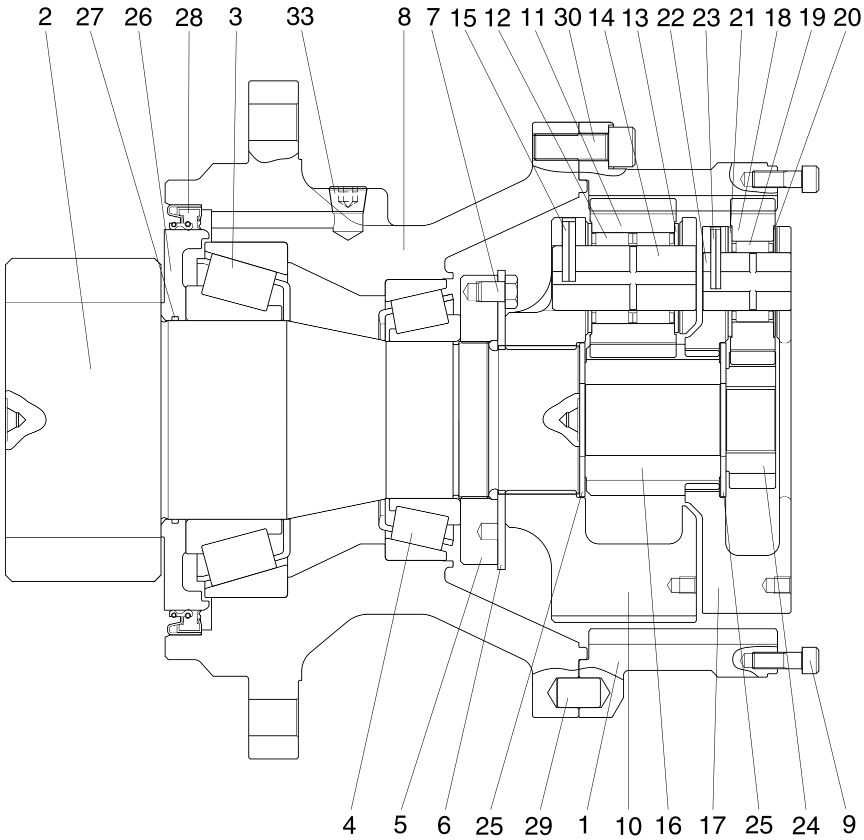
Mounting motor a test bench, test the availability of each part.



2209A8SM91

3. DISASSEMBLY AND ASSEMBLY OF REDUCTION GEAR

1) STRUCTURE



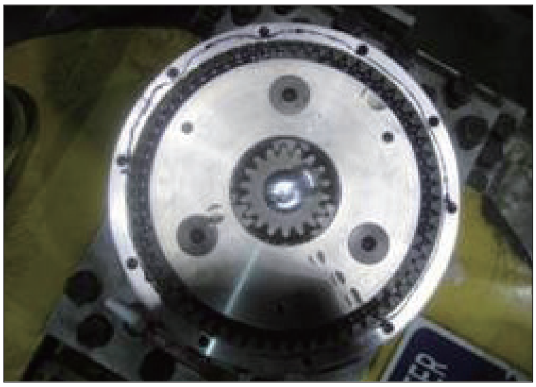
210WF2SM03

1	Ring gear	12	Needle bearing 2	23	Spring pin 1
2	Drive shaft	13	Thrust washer 2	24	Sun gear 1
3	Taper roller bearing	14	Carrier pin 2	25	Thrust plate
4	Taper roller bearing	15	Spring pin 2	26	Sleeve
5	Ring nut	16	Sun gear 2	27	O-ring
6	Lock plate	17	Carrier 1	28	Oil seal
7	Hexagon bolt	18	Planetary gear 1	29	Parallel pin
8	Casing	19	Needle bearing 1	30	Socket bolt
9	Socket bolt	20	Thrust washer 1	33	Plug
10	Carrier 2	21	Thrust washer 1		
11	Planetary gear 2	22	Carrier pin 1		

2) DISASSEMBLY

(1) Preparation

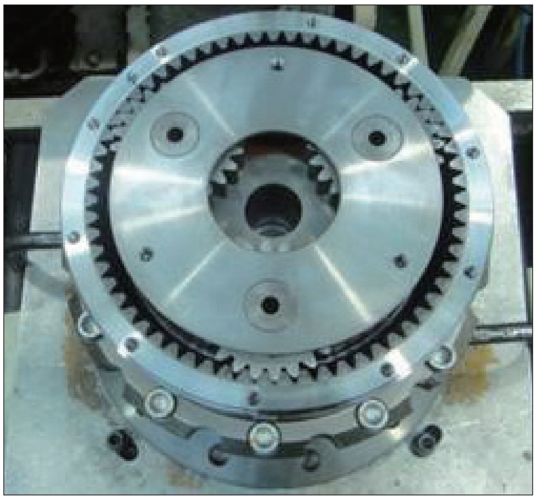
① The reduction gear removed from machine is usually covered with mud.
Wash out side of reduction gear and dry it.
② Setting reduction gear on work stand for disassembling.
③ Mark for mating
Put marks on each mating parts when disassembling so as to reassemble correctly as before.
⚠ Take great care not to pinch your hand between parts while disassembling not let fall parts on your foot while lifting them.



2209A8SM01

(2) Disassembly

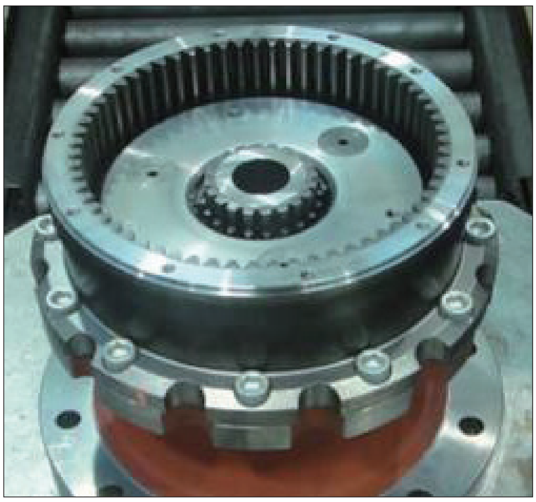
① Remove every "Socket bolt (M10)" that secure swing motor and reduction gear.
② Removing carrier sub assy & sun gear
a. Removing No.1 sun gear from No.1 carrier sub assy.
※ Be sure maintaining it vertical with ground when disassembling No.1 sun gear.



2209A8SM02

b. Removing No.1 carrier sub assy screwing I-bolt to tab hole (M10) in No.1 carrier.
Lifting it gradually maintaining it vertical with ground.

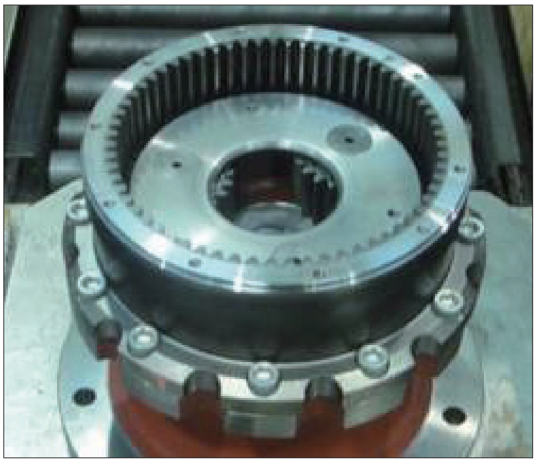
※ It's impossible to disassemble No.1 spring pin. If No.1 spring pin has problem, change whole No.1 carrier sub assy.



2209A8SM03

c. Removing No.2 sun gear from No.2 carrier sub assy.

※ Be sure maintaining it vertical with ground when disassembling No.2 sun gear.



2209A8SM04

d. Removing No.2 carrier sub assy screwing I-bolt to tab hole (M10) in No.2 carrier. Lifting it gradually maintaining it vertical with ground.

※ It's impossible to disassemble No.2 spring pin. If No.2 spring pin has problem, change whole No.2 carrier sub assy.

2209A8SM05

③ Removing ring gear

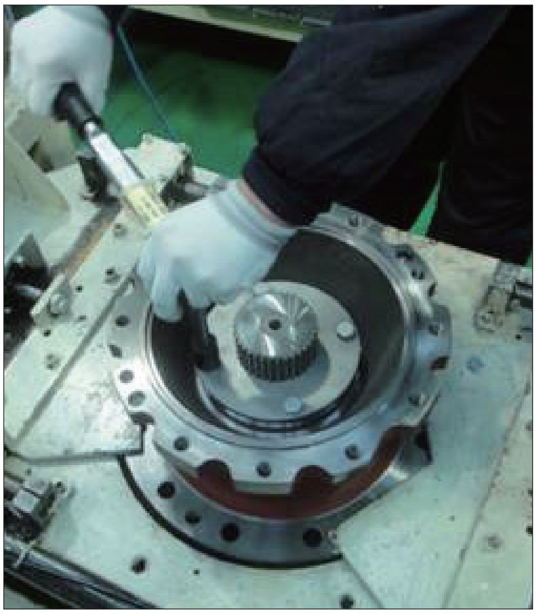
After unscrewing every socket bolt (M16), remove ring gear from casing.

※ Because of liquid gaskets between ring gear and casing, put sharp punch between ring gear and casing and tapping it to remove them.

2209A8SM06

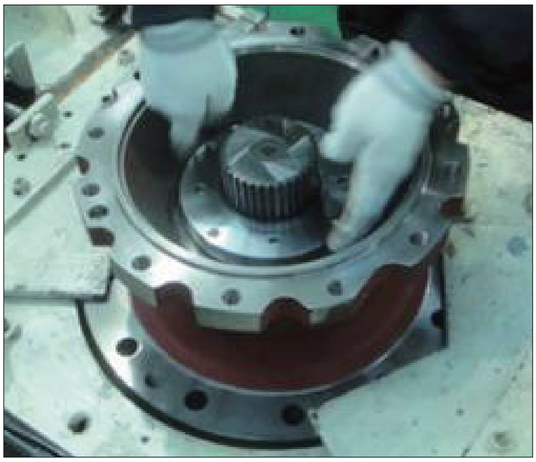
④ Removing drive shaft sub assy

a. Unscrew every hex head bolt (M12) to remove lock plate.



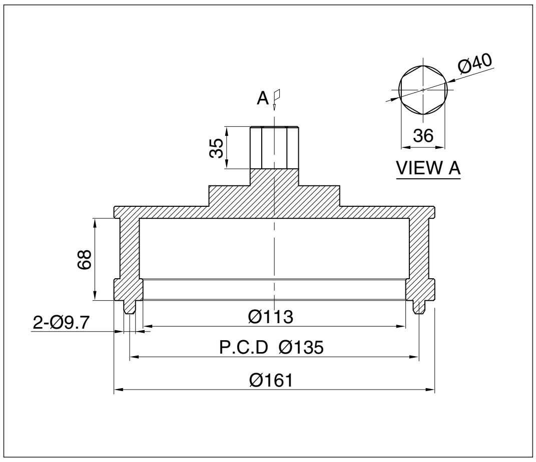
2209A8SM07

b. Rolling ring nut for removing them from drive shaft sub assy.



2209A8SM08

※ Use special tool to roll ring nut to counter clockwise.



220L8SM01

c. Remove drive shaft sub assy from casing.
※ Set a rack for flange of casing, and remove drive shaft sub assy from casing by using press.

2209A8SM09

d. Remove oil seal & taper bearing (small) from casing.
※ Do not re-use oil seal. It is impossible to disassemble drive shaft sub assy.

2209A8SM10

2209A8SM11

4. ASSEMBLY REDUCTION UNIT

1) GENERAL NOTES

(1) Clean every part by kerosene and dry them in a cool and dry place.

(2) Loctite on surface must be removed by solvent.

(3) Check every part for any abnormal.

(4) Each hexagon socket head bolt should be used with loctite #242 applied on its threads.

(5) Apply gear oil slightly on each part before assembling.

⚠ Take great care not to pinch your hand between parts or tools while assembling nor let fall parts on your foot while lifting them.
Inspection before assembling.

Thrust washer
- Check the seizure, abnormal wear or uneven wear.
- Check the unallowable wear.

Gear
- Check the pitting or seizure on tooth surface.
- Check the cracks on the root of tooth.

Bearing
- Rotate it by hands to check such noise or uneven rotation.

2) ASSEMBLING NO.1 CARRIER SUB ASSY

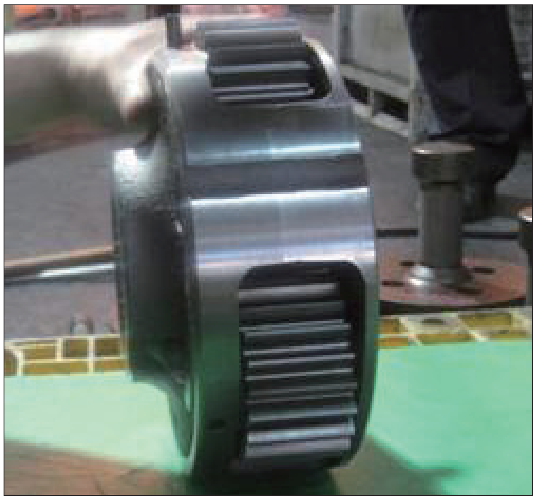
(1) Put thrust plate firmly in No.1 carrier.

2209A8SM12

(2) After assembling No.1 needle bearing to No.1 planetary gear, put a pair of No.1 thrust washer on both sides of bearing and install them to No.1 carrier.

2209A8SM13

(3) Make of spring pin hole No.1 pin and No.1 carrier of spring pin hole in line, press No.1 spring pin into the holes.
Make No.1 spring pin hole head for No.1 planetary gear.



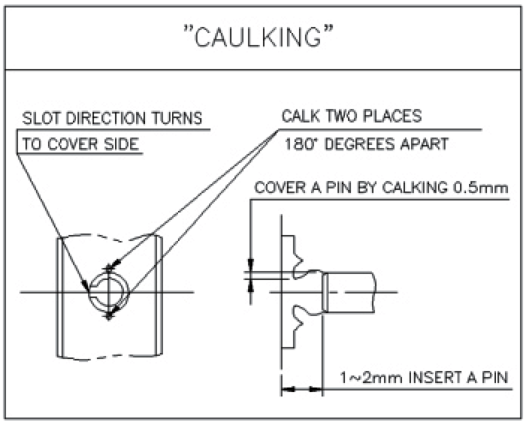
2209A8SM14

(4) Caulk carrier holes to make No.1 spring pin settle down stably.

2209A8SM15

※ Refer to "Caulking details"

Use paint marker for marking after caulking.



2209A8SM16

2) ASSEMBLING NO.2 CARRIER SUB ASSY

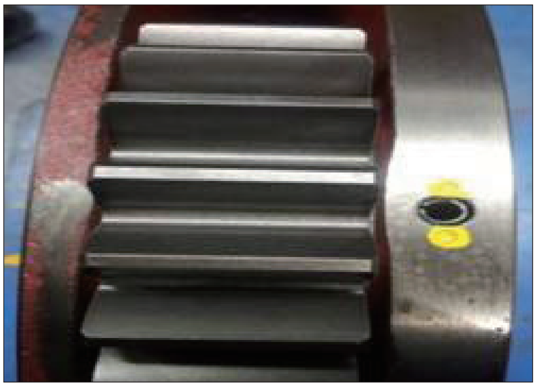
(1) Put thrust plate in firmly No.2 carrier.

2209A8SM17

(2) After assembling No.2 needle bearing to No.2 planetary gear, put 2 pieces of No.2 thrust washer on both sides of bearing and install them to No.2 carrier.

2209A8SM18

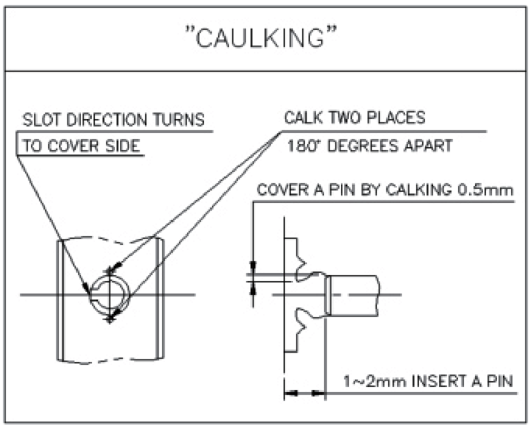
(3) Align No.2 spring pin hole and No.2 carrier spring pin hole, put No.2 spring pin into the holes.
Make No.2 spring pin cutting line face to No.2 planetary gear.



2209A8SM19

(4) Caulk carrier holes to make No.2 spring pin settle down stably.
※ Refer to "Caulking details"

Use paint marker for marking after caulking.



2209A8SM20

3) ASSEMBLING PINION GEAR SUB ASSY

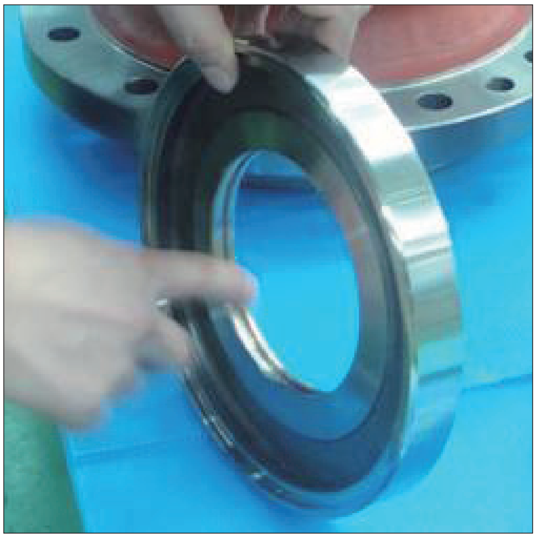
(1) Prepare drive shaft pinion gear vertical with ground.

2209A8SM21

(2) Fully apply grease (albania EP02) to O-ring groove of sleeve.

※ Be sure to maintain it vertical with ground when assembling it.

(3) Put O-ring into O-ring groove of sleeve. Fully apply grease on O-ring.



2209A8SM22

(4) Assemble taper bearing and sleeve into drive shaft using press jig. Use special jig for pressing. Leave no space between sleeve and taper bearing.

2209A8SM23

2209A8SM24

4) ASSEMBLING BEARING CUP & OIL SEAL (PRESSING)

(1) Put top, bottom bearing cup into casing.
Use special jig for pressing. Pay attention to foreign materials while assembling bearing cup.

※ Flip over casing to assemble oil seal.

2209A8SM25

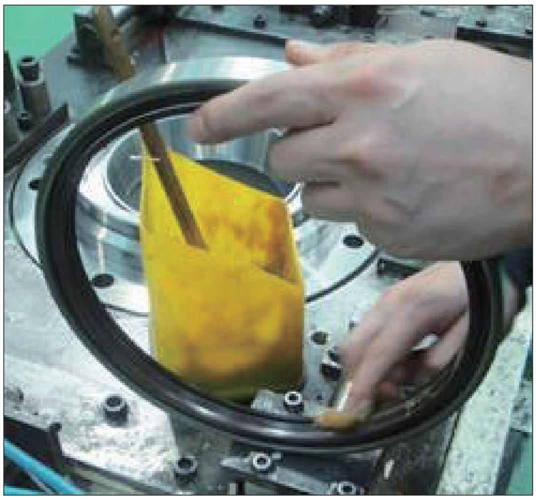
2209A8SM26

(2) Assemble oil seal to casing.
Use special jig for pressing. Pay attention to direction of dust seal and dent.

2209A8SM27

※ WHILE ASSEMBLING OIL SEAL

1. Be sure to set dust seal to gear oil.
2. Before assembling, charge enough grease in oil seal.
3. Before assembling, apply enough grease inside and outside of oil seal.



2209A8SM28

5) ASSEMBLING SHAFT SUB ASSY & RING NUT

(1) After assembling casing & drive shaft sub assy, flip it over.

2209A8SM29

(2) Put drive shaft sub assy into casing.

※ Be sure to maintain it vertical with ground when assembling it.

2209A8SM30

(3) Put taper bearing into it.

Rotate bearing by hands for checking after assembly.

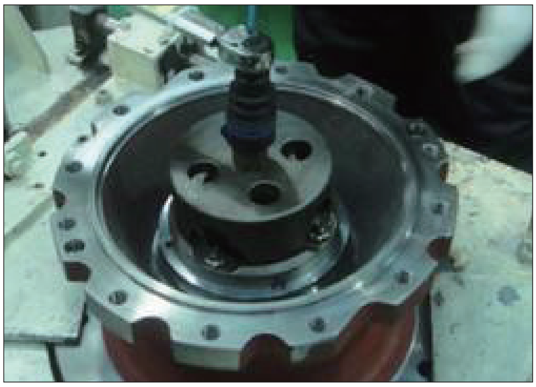
2209A8SM31

(4) Put ring nut into drive shaft sub assy by using special jig.

The tightening torque (M95) = 3.5±0.4 kgf·m
(25.3±2.9 lbf·ft)

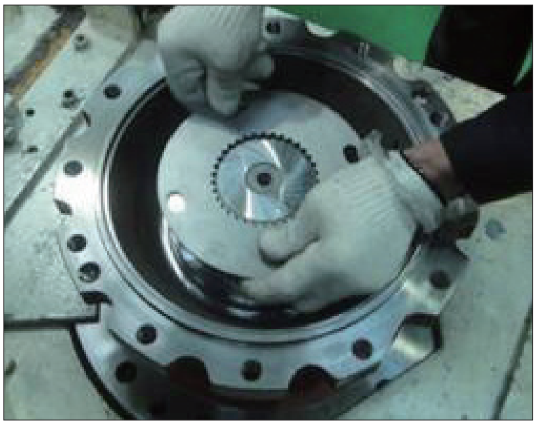
2209A8SM32

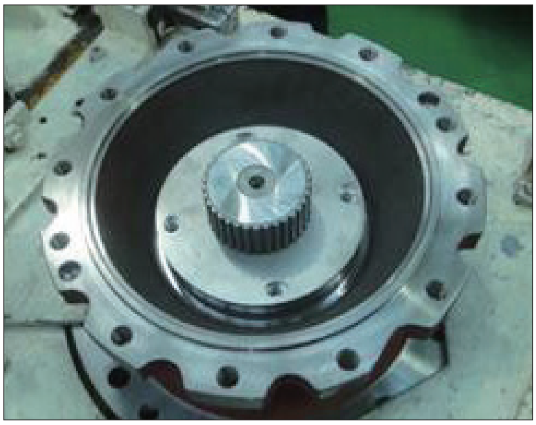
※ Apply enough loctite #242 before screwing bolts.



2209A8SM33

(5) Align bolt screw of ring nut with lock plate's hole.
In case of misalign between bolt screw ring nut and lock plate's hole, put lock plate as near as possible to hole of bolt screw of ring nut and make it in line by increasing tightening torque.


2209A8SM34


2209A8SM35

(6) Screw 4 bolts (M12 × 16) to connect ring nut and lock plate by using torque wrench.
Bolt (M12, 4EA) = 10.9T
The tightening torque = 8.8 ± 0.9 kgf·m
(63.7 ± 6.5 lbf·ft)

※ Apply enough loctite #242 before screwing bolts.


2209A8SM36

(7) Use paint marker for checking surplus parts after assembling.

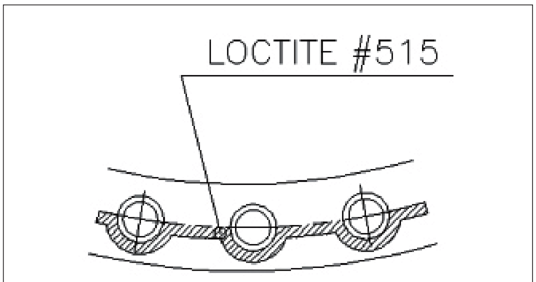

2209A8SM37

6) ASSEMBLING RING GEAR

(1) Apply loctite #515 bottom of casing sub assy contacting with ring gear without disconnection.

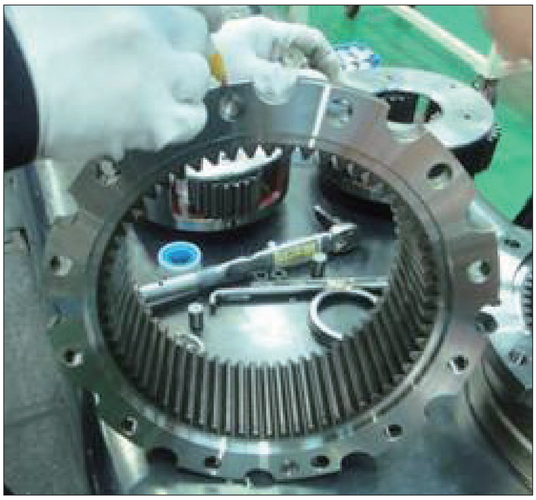
2209A8SM38

Refer to loctite detail.



2209A8SM39

(2) Put parallel pin into hole of casing sub assy. Mark parallel pin position using paint marker.



2209A8SM40

(3) Align ring gear with parallel pin to put them into casing sub assy.
※ Be sure to maintain them vertical with ground while using press.

2209A8SM41

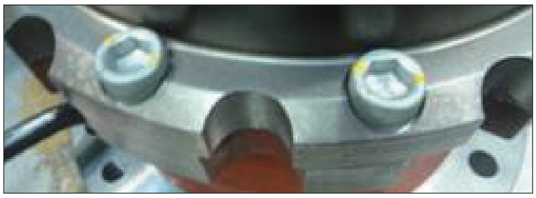
(4) Screw 12 bolts (M16 × 45) to connect casing sub assy and ring gear (01) by using torque wrench.
Bolt (M16, 12EA) = 12.9T
The tightening torque = 27 ± 2.7 kgf·m
(195 ± 19.5 lbf·ft)

※ Apply enough loctite #242 before screwing bolts.

2209A8SM42

(5) Use paint marker for checking surplus parts after assembling.

2209A8SM43



2209A8SM44

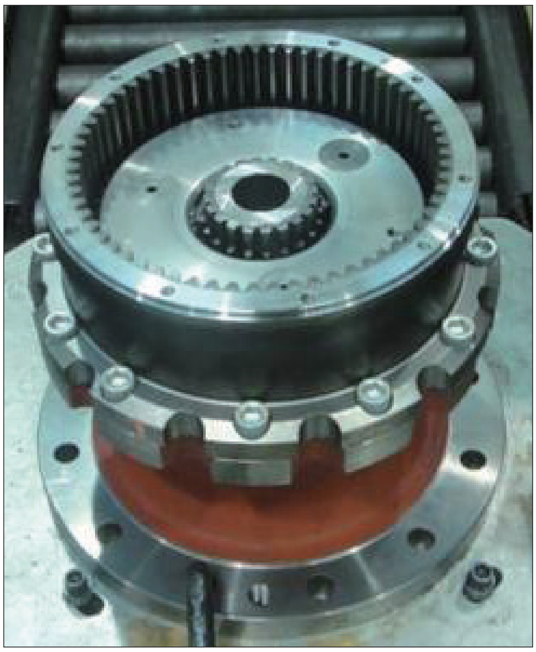
7) ASSEMBLING CARRIER SUB ASSY & SUN GEAR

(1) Put No.2 carrier sub assy along spline of drive shaft spline.

- Screw M10 I-bolt to No.2 carrier sub assy.
- Lifting up No.2 carrier sub assy and align planetary gear and tooth of ring gear by rotating planetary gear by hands.
- Rotate No.2 carrier sub assy by hands to fit No.2 carrier sub assy into drive shaft spline.

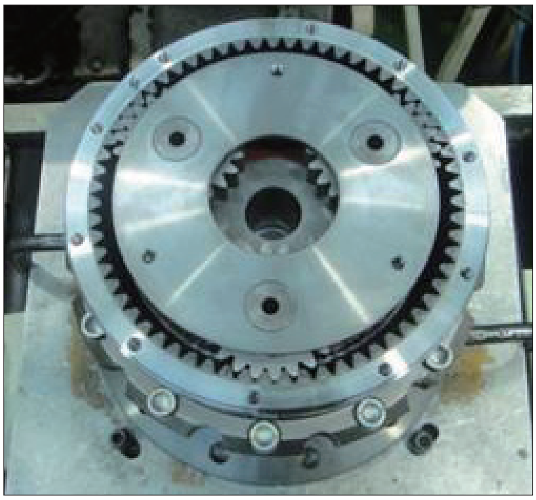
2209A8SM45

(2) Put No.2 sun gear into No.2 carrier sub assy.



2209A8SM46

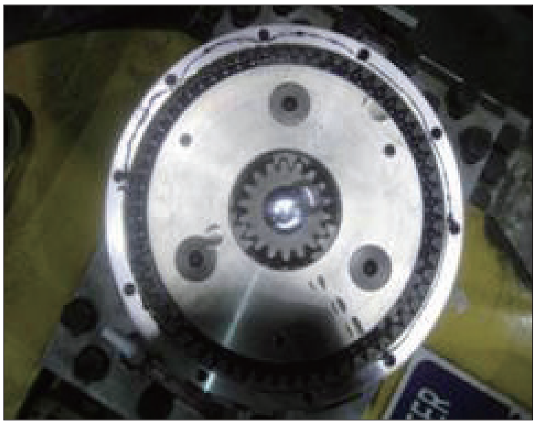
(3) Put No.1 carrier sub assy into No.2 sun gear along spline.
- Screw M10 I-bolt to No.1 carrier sub assy.
- Lifting up No.1 carrier sub assy and align planetary gear and tooth of ring gear by rotating planetary gear by hands.
- Rotate No.1 carrier sub assy by hands to fit No.1 carrier into No.2 sun gear spline.



2209A8SM47

(4) Put No.1 sun gear into No.1 carrier sub assy. Be sure to maintain it vertical with ground. And align with No.1 planetary gear spline.

(5) Rotate No.1 carrier sub assy by hands to check noise.



2209A8SM48

8) MEASURING CLEARANCE & ASSEMBLING NAME PLATE

(1) Check the clearance between ring gear and No.1 sun gear using a tool with dial gauge.

Check the clearance
Dial gauge = -0.3 ~ +2.95

2209A8SM49

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.

13031GE18

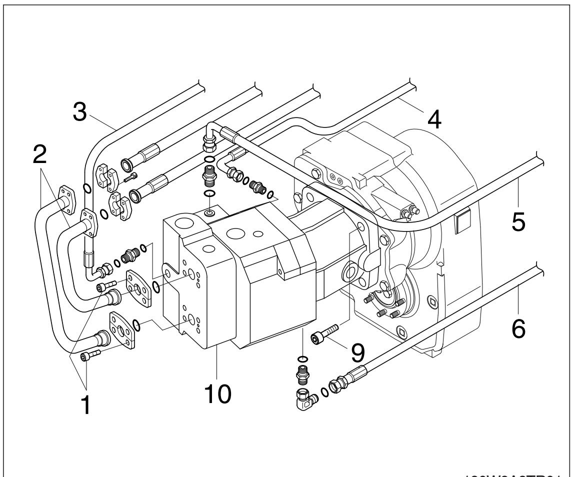
(4) Loosen the socket bolt (1) and remove the pipes (2).

(5) Disconnect hoses (3, 4, 5, 6).

(6) Loosen the socket bolt (9) and remove travel motor (10).

· Weight : 60 kg (130 lb)

※ When removing the travel motor assembly, check that all the hoses have been disconnected.



180W9A8TR01

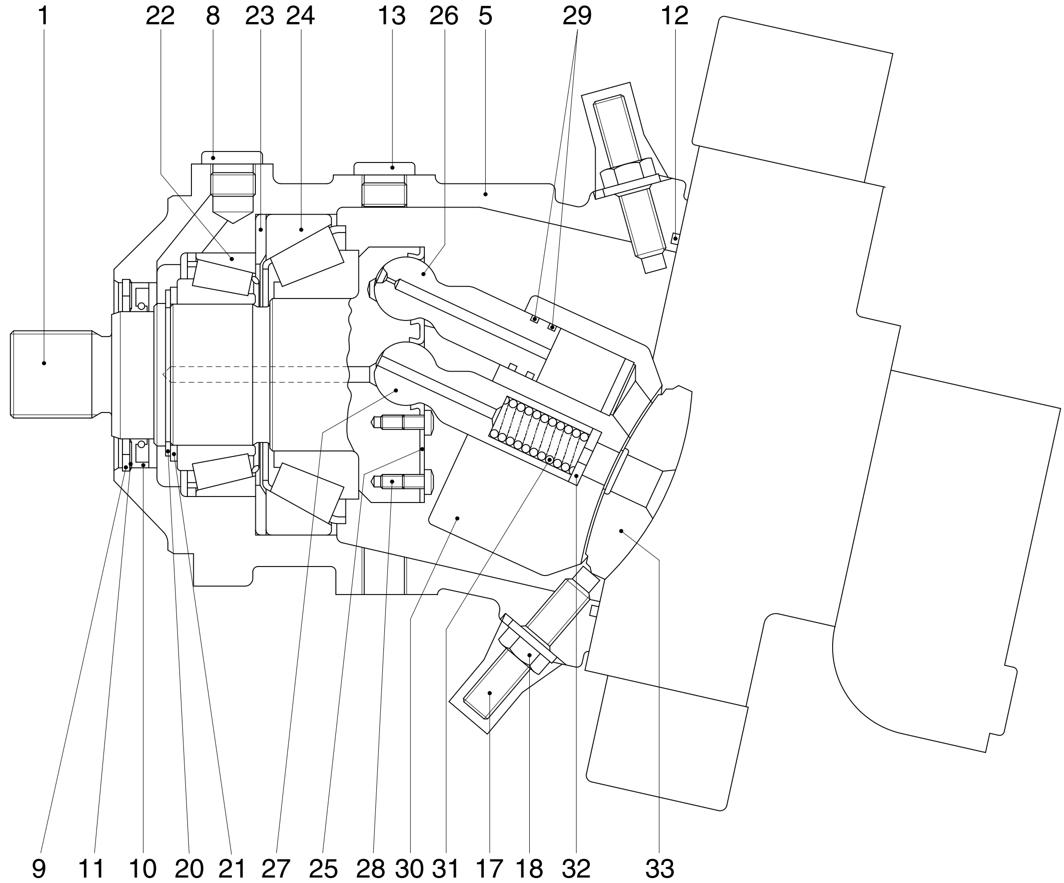
2) INSTALL

(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

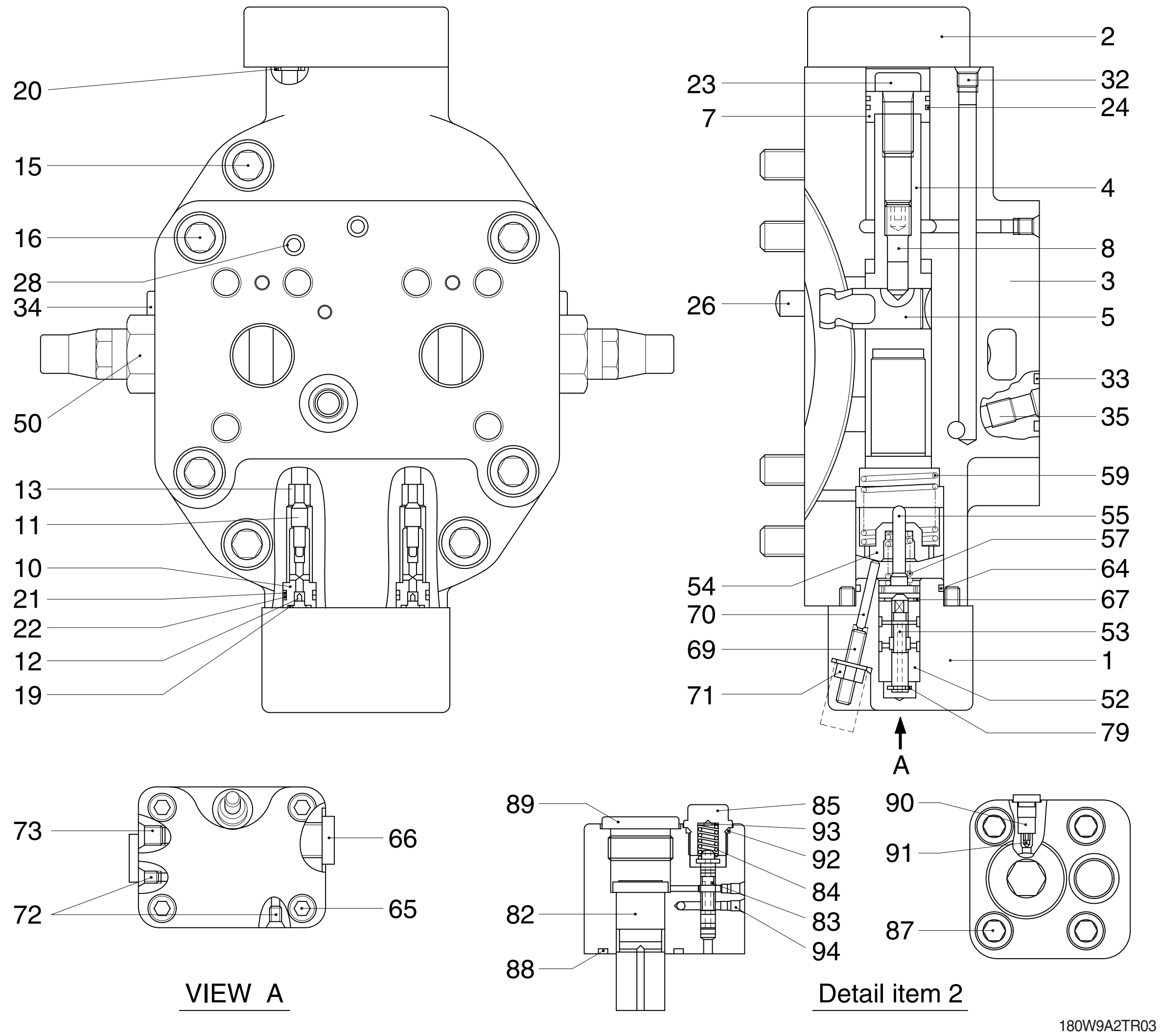
1) MOTOR UNIT



180W9A2TR02

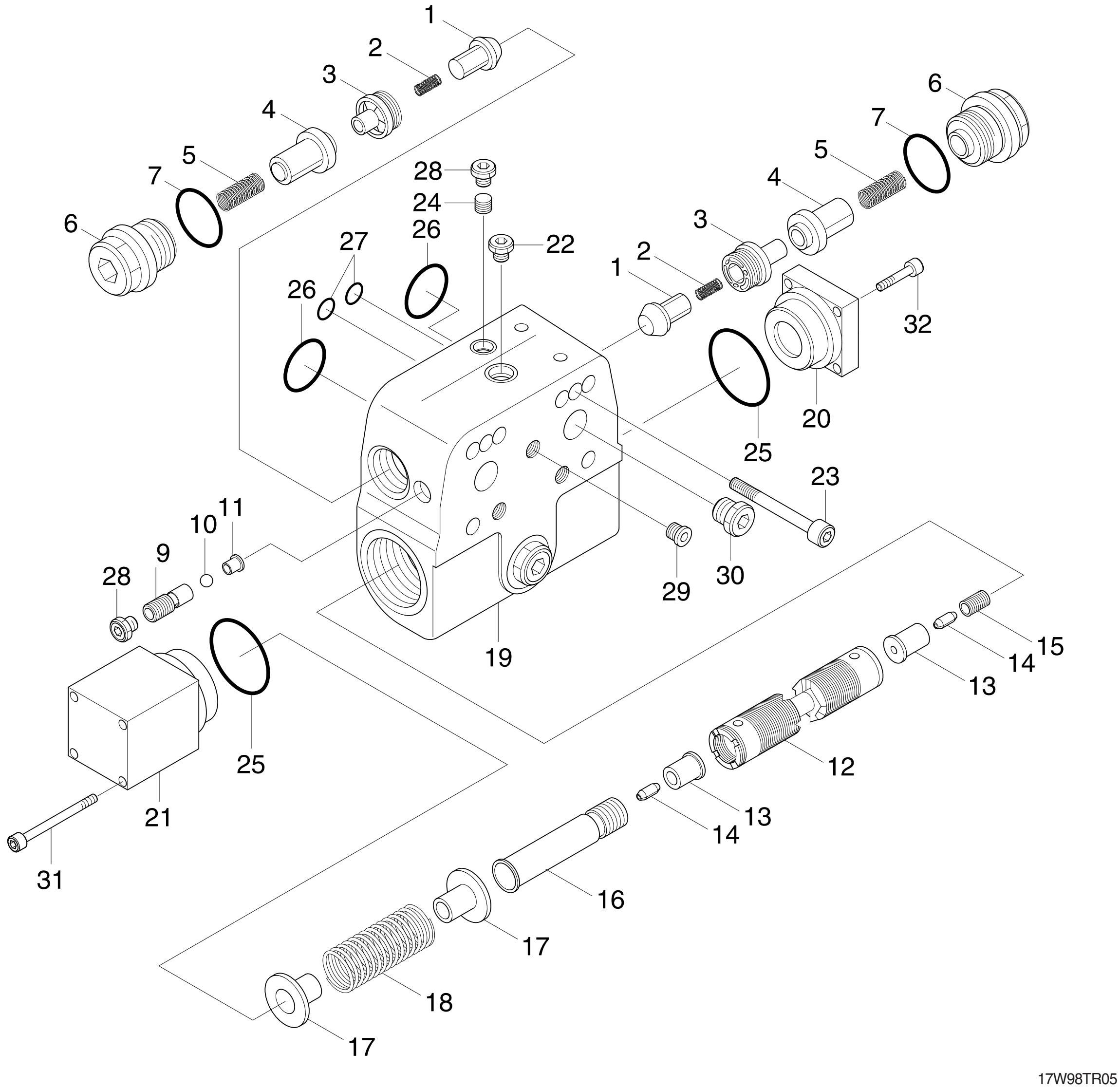
1	Drive shaft	17	Threaded pin	26	Piston
5	Housing	18	Seal lock nut	27	Center pin
8	Locking screw	20	Retaining ring	28	Pan head screw
9	Retaining ring	21	Back up plate	29	Steel sealing ring
10	Shaft seal ring	22	Taper roller bearing	30	Cylinder block
11	Back up plate	23	Shim	31	Pressure spring
12	O-ring	24	Taper roller bearing	32	Adjustment shim
13	Locking screw	25	Retaining plate	33	Control lens

2) CONTROL UNIT



1	Control housing
2	Stroke limiter
3	Port plate
4	Positioning piston
5	Positioning trunnion
7	Piston
8	Threaded pin
10	Valve guide
11	Bolt
12	Throttle screw
13	Bushing
15	Socket head screw
16	Socket head screw
19	O-ring
20	O-ring
21	O-ring
22	Back up ring
23	Socket head screw
24	Square ring
26	Cylinder pin
28	Double break off pin
32	Double break off pin
33	O-ring
34	Locking screw
50	Relief valve
52	Control bushing
53	Control piston
54	Adjusting bushing
55	Spring collar
57	Pressure spring
59	Pressure spring
64	O-ring
65	Socket head screw
66	Locking screw
67	Retaining ring
69	Threaded pin
70	Cylinder pin
71	Seal lock nut
72	Double break off pin
73	Double break off pin
79	Retaining disc
82	Piston
83	Control piston
84	Pressure spring
85	Locking screw
87	Socket head screw
88	O-ring
89	Locking screw
90	Locking screw
91	Orifice
92	O-ring
93	Shim
94	Double break off pin

3) COUNTER-BALANCE VALVE



1	Valve poppet	13	Valve bushing	24	Plug
2	Pressure spring	14	Throttle pin	25	O-ring
3	Poppet seat	15	Valve screw	26	O-ring
4	Valve poppet	16	Bolt	27	O-ring
5	Pressure spring	17	Spring collar	28	Locking screw
6	Locking screw	18	Pressure spring	29	Double brake off pin
7	O-ring	19	Housing	30	Locking screw
9	Valve screw	20	Cover	31	Socket screw
10	Ball	21	Cover	32	Socket screw
11	Bushing	22	Locking screw		
12	Brake piston	23	Socket screw		

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
8-114	8	M22 × 1.5	6.1	44
	13	M26 × 1.5	7.1	51
	18	M12	7.0	50.9
	28	M 6 × 20	1.4	10.3
8-115	76	-	32.6	236
	77	M10 × 1.0	5.2	37.6
	78	M12 × 1.5	3.6	25.8
8-116	20	M12 × 1.5	10.2	73.8
	21	M12 × 1.5	10.2	73.8

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.

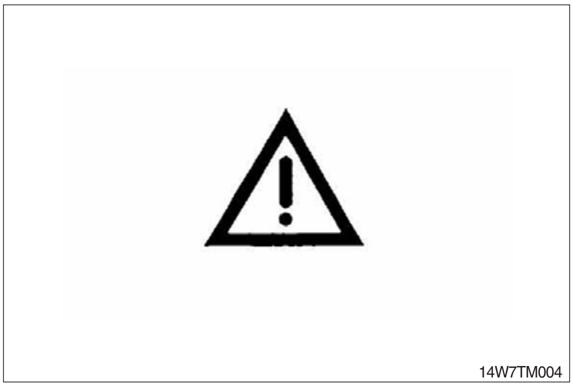
⑤ Wash all parts thoroughly in a suitable solvent.
Dry thoroughly with compressed air.
Do not use the cloths.

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.

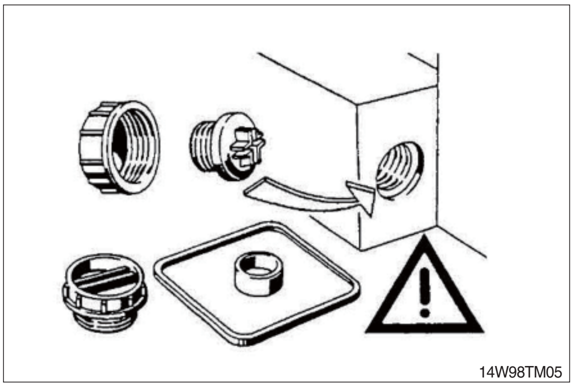
2) SEAL KITS AND COMPONENT GROUPS

Observe the following notices when carrying out repair work at hydraulic aggregates.



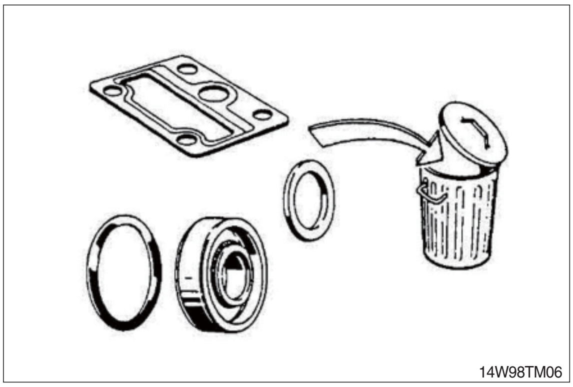
14W7TM004

(1) Close all ports of the hydraulic aggregates.



14W98TM05

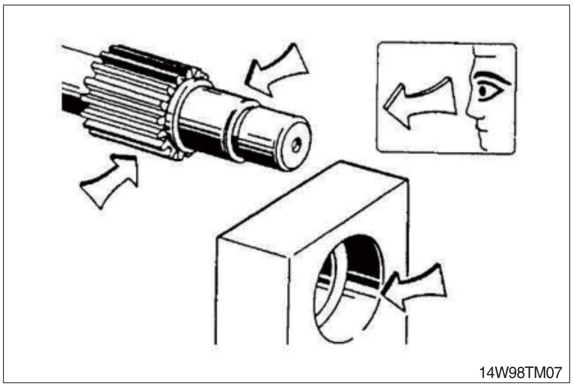
(2) Replace all seals.
Use only original spare parts.



14W98TM06

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

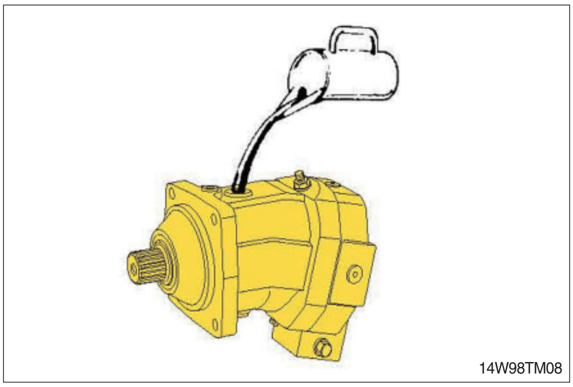
※ Rework of sealing area f.ex. with abrasive paper can damage surface.



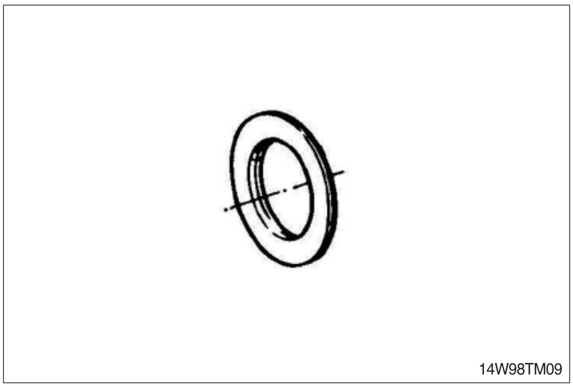
14W98TM07

(4) Fill up hydraulic aggregates with hydraulic oil before start up.

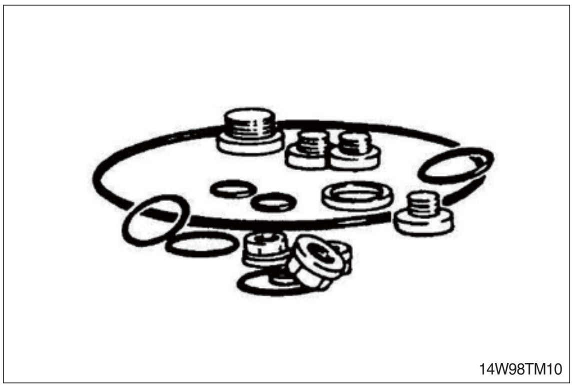
※ Without fill up bearing damage happens!



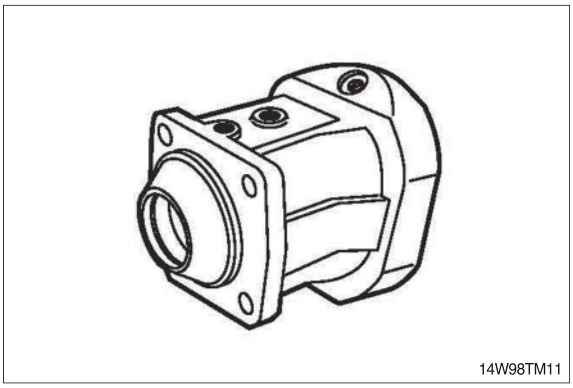
(5) Seal kit for drive shaft



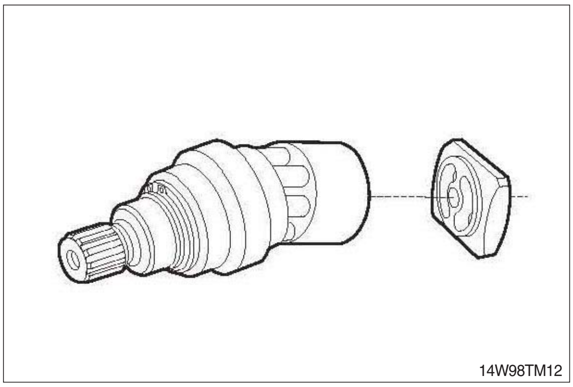
(6) External seal kit.



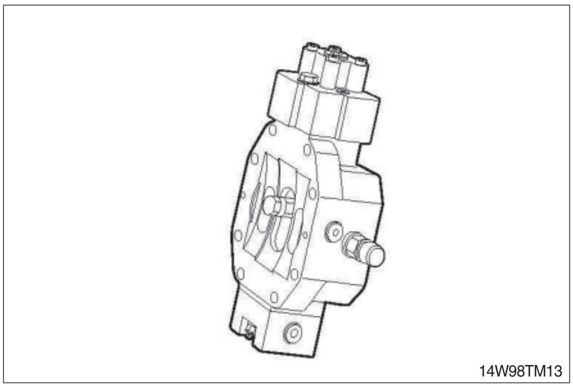
(7) Housing.



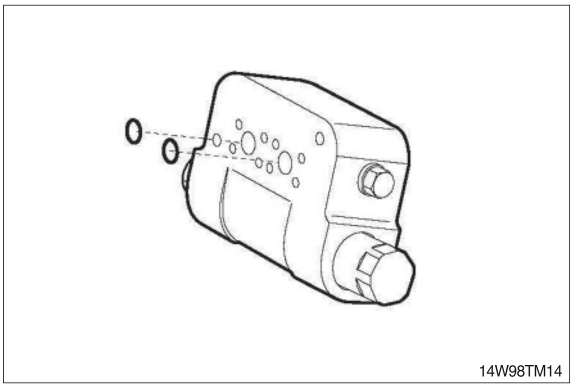
(8) Complete rotary group.



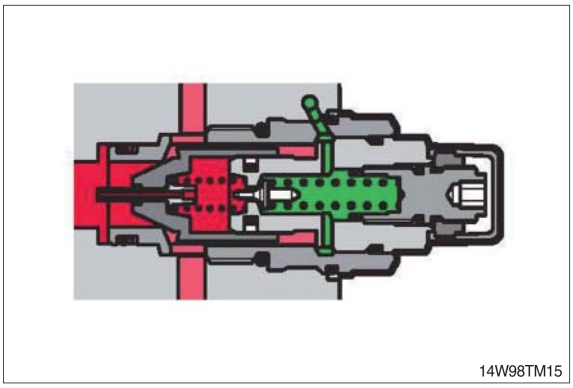
(9) Port plate with control piston.



(10) Counter balance valve.

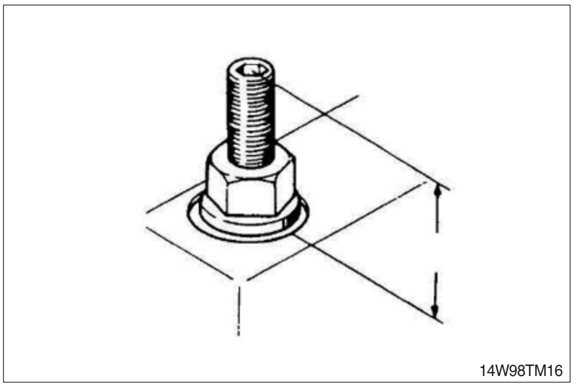


(11) Relief valve.



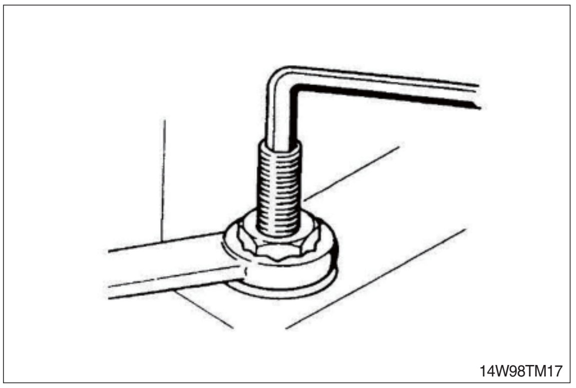
3) SEAL NUT

(1) Replace seal nut.
First measure and record setting height.



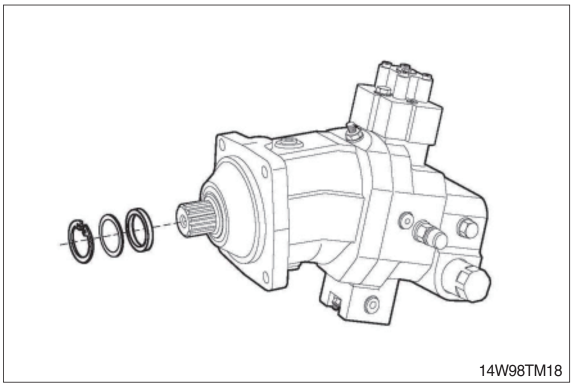
14W98TM16

(2) When tightening, counterhold setting screw, then check setting height.

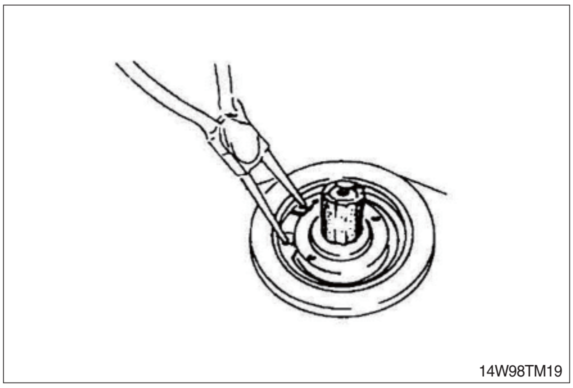


14W98TM17

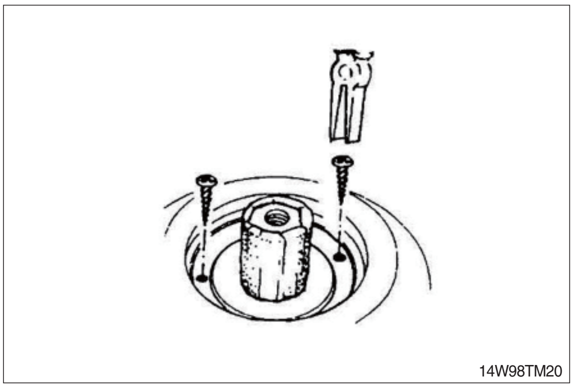
4) SEALING THE DRIVE SHAFT


14W98TM18

(1) Protecting the drive shaft.
Remove retaining ring and shim.


14W98TM19

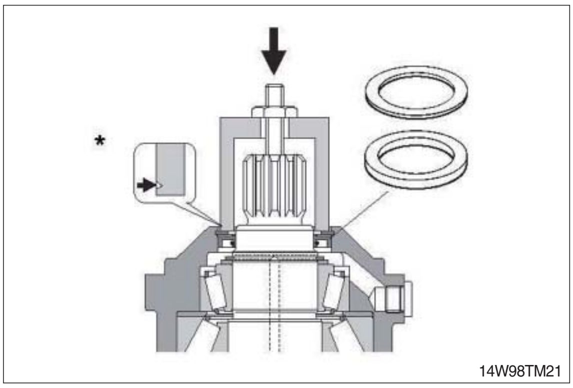
(2) Screw in sheet metal screw into the holes fitted with rubber.
Pull out seal with pliers.


14W98TM20

(3) Press in shaft seal and shim with bush to stop.

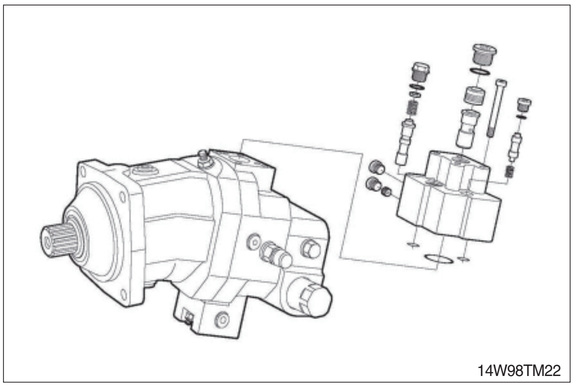
⚠ **Pay attention to pressing depth.**

* Mark for pressing depth.
  Assemble retaining ring.



14W98TM21

5) SEALING OF THE CONTROL PARTS


14W98TM22

(1) Disassembly position

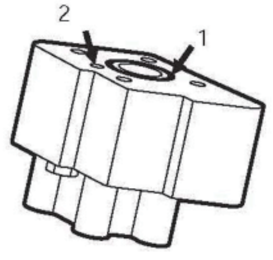
Remove cover pos.1.

14W98TM23

1 O-ring

2 Input flow of oil control

※ Installation position differs according to the control components.



14W98TM24

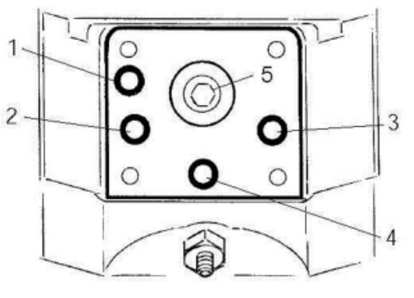
1 Input flow of oil control

2 High pressure / Low pressure

3 High pressure / Low pressure

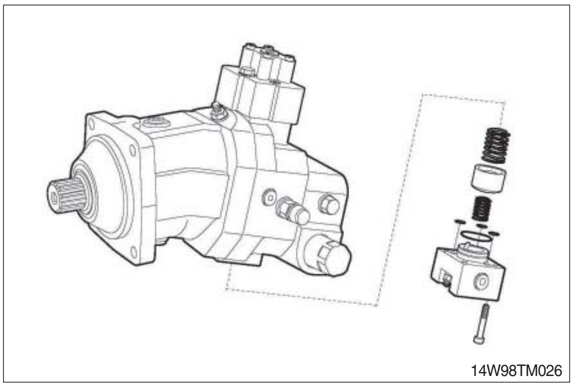
4 Leakage oil

5 Control piston

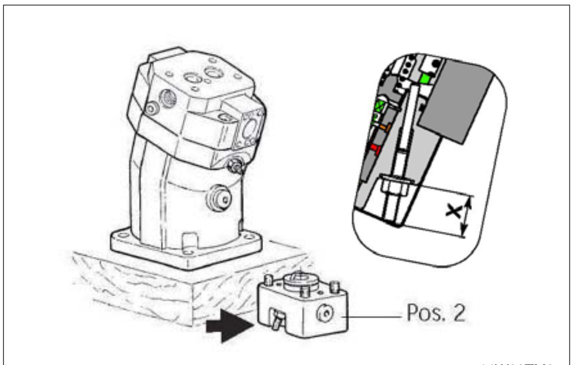


14W98TM25

(2) Disassembly position : Remove cover 2.
※ Attention spring load.

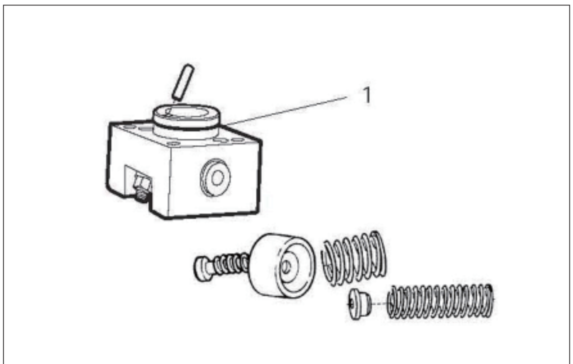

14W98TM026

※ Dimension X : Note dimension (begin of regulation)



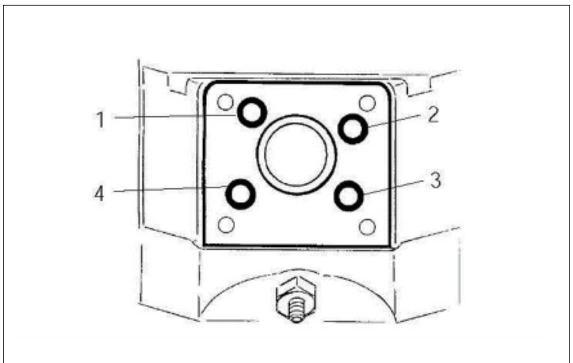
14W98TM27

1 Check of O-ring



14W98TM28

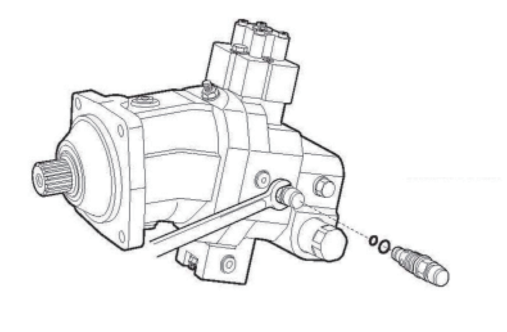
1 O-ring / High pressure-small control position side
2 O-ring / Control pressure
3 O-ring / High pressure-check valve
4 O-ring / High pressure-check valve



14W98TM29

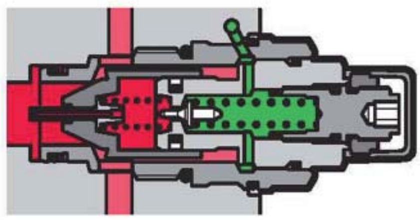
6) SEALING OF THE RELIEF VALVE / COUNTER BALANCE VALVE

(1) Remove relief valve.



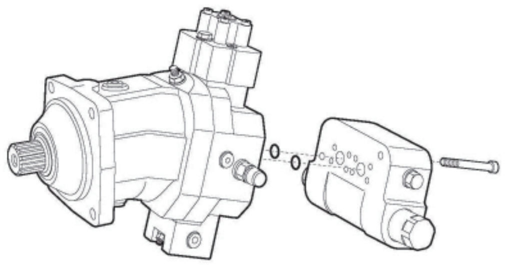
14W98TM32

(2) Inspect
O-ring



14W98TM31

(3) Remove counter-balance valve.
Inspect
O-ring

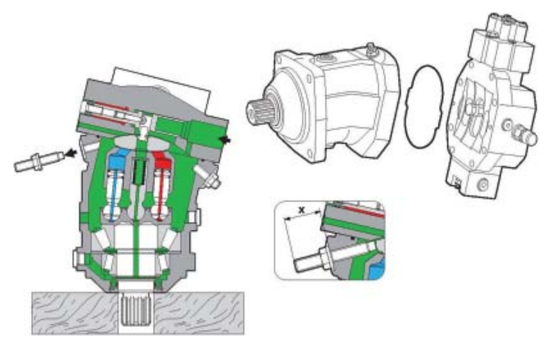


14W98TM73

7) DISSASSEMBLY OF THE PORT PLATE

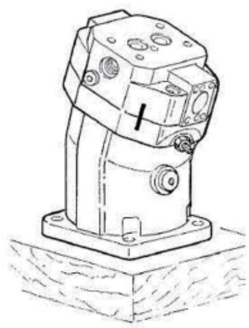
- · Note dimension X
- · Remove Q_{min} screw
- · Swivel rotary group to zero P

※ For disassembly of the port plate, swivel always rotary group to zero position. Piston rings to hang out of the cylinder boring.



14W98TM33

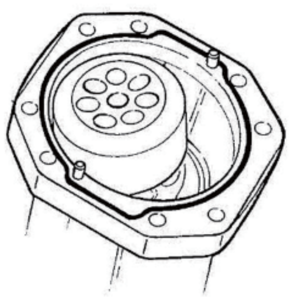
(1) Port plate.
Mark position.   Loosen screws.
Removal.



14W98TM39

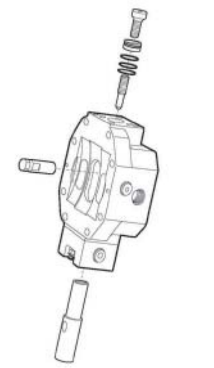
(2) Check O-ring.

※ Stick new O-ring with some grease.
Do not swivel rotary group.
Piston rings to hang out from the cylinder boring.



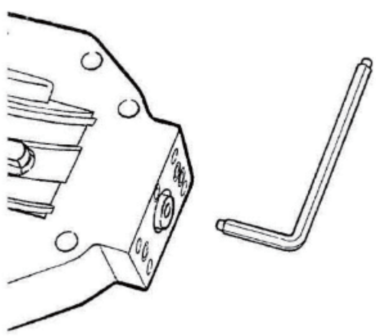
14W98TM40

8) REMOVE OF THE POSITIONING PISTON



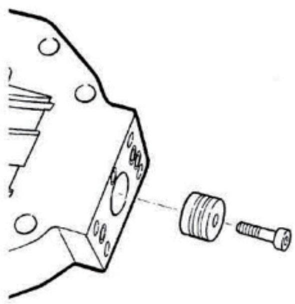
14W98TM41

(1) Loosen fixing screw.
Use only socket wrench.



14W98TM42

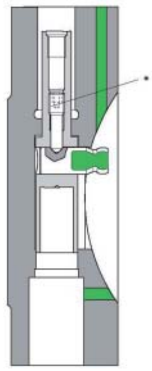
(2) Remove piston with piston ring.



14W98TM43

(3) Warm up fixation screw * for positioning plug via boring (screw glued-to turn out).

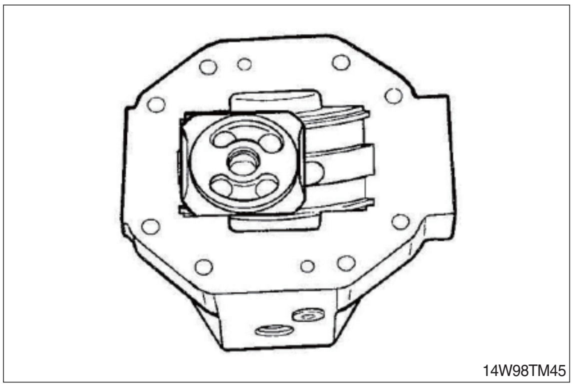
※ Use new screw.
Precote coating.
Note tightening torque.



14W98TM44

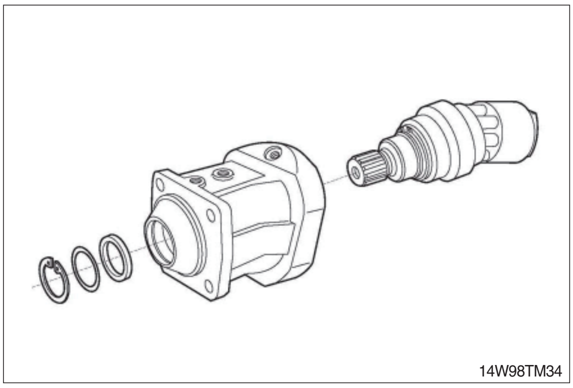
※ Stick control lens in sliding surface with grease. Assembly in reversal order. Mount port plate.

※ Rotary group vertical.



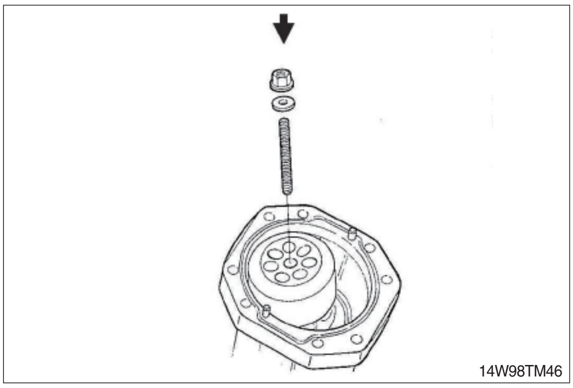
14W98TM45

9) REMOVE ROTARY GROUP



14W98TM34

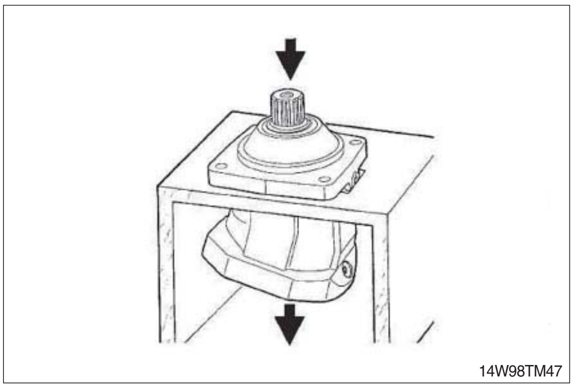
(1) Screw in threaded pin into center pin. Fix the cylinder with disc and locknut. M8×105 l



14W98TM46

(2) Press out rotary group.

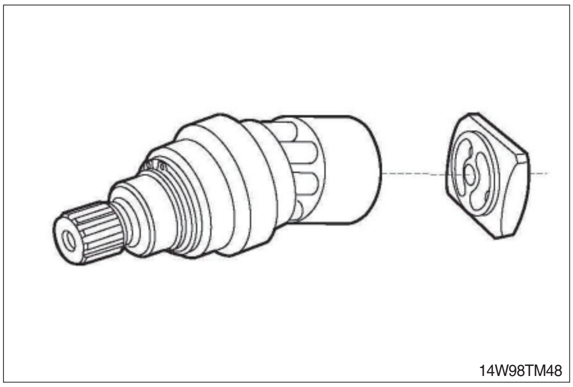
※ If the bearings are used again do not hit on the drive shaft.



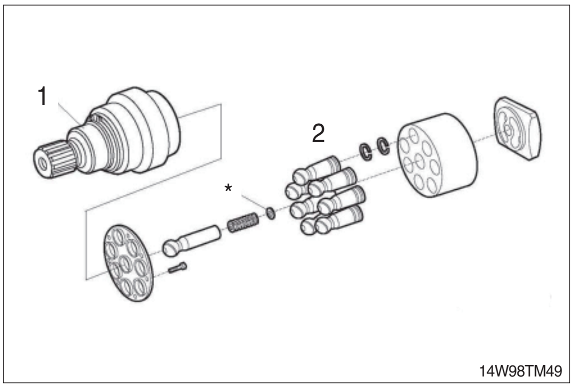
14W98TM47

10) EXCHANGING OF THE ROTARY GROUP

※ Complete rotary group
Setting of hydraulic part necessary.

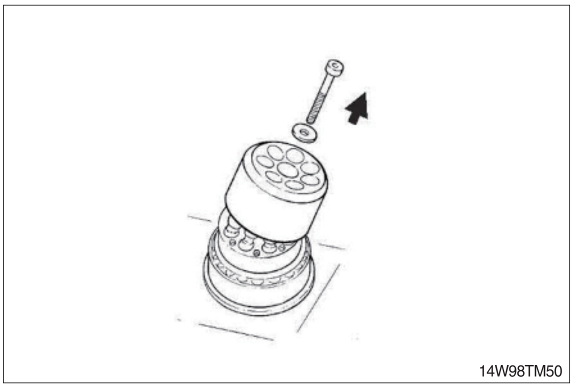

14W98TM48

Rotary group
1 Mechanical part : Adjust drive shaft with bearing
2 Hydraulic part : Adjustment necessary

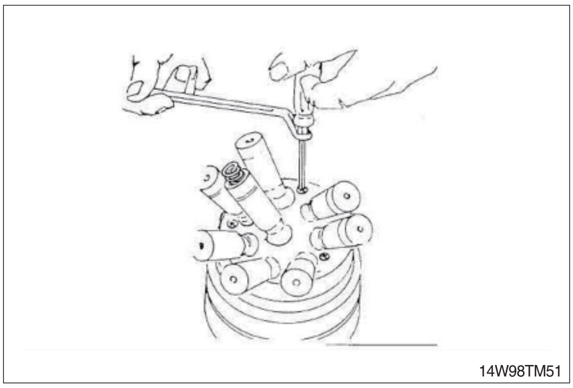


14W98TM49

(1) Remove fixing screw (cylinder).
Remove cylinder.

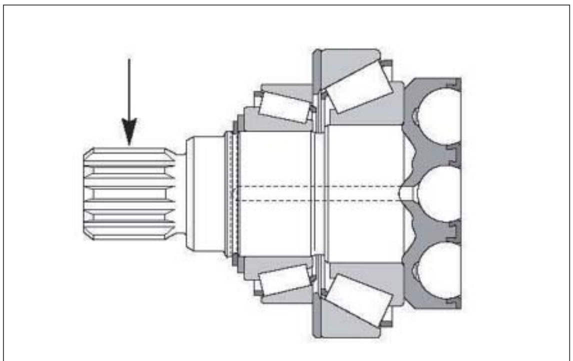

14W98TM50

(2) Disassemble retaining plate.
※ Screws are glued.
Use Torx tools.


14W98TM51

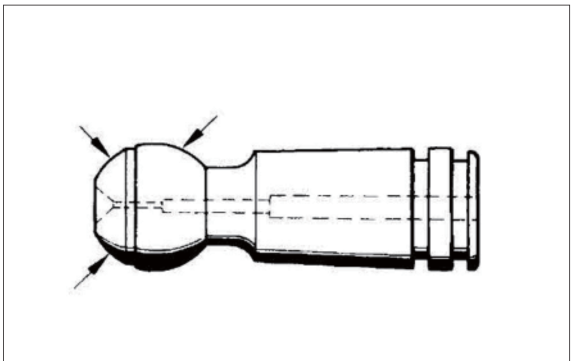
11) INSPECTION INSTRUCTIONS

(1) Free of corrosion, erosion or fretting; No damage to splines or keyways.


14W98TM52

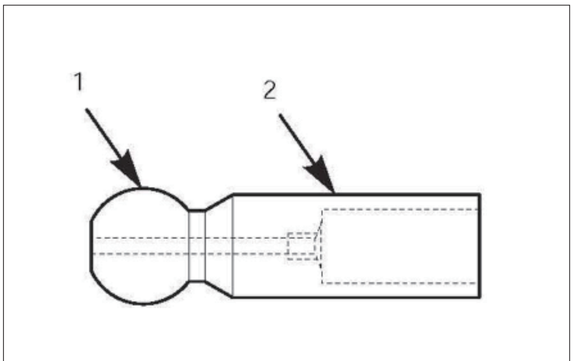
(2) Pistons

No scoring and no pittings.


14W98TM53

(3) Center pin

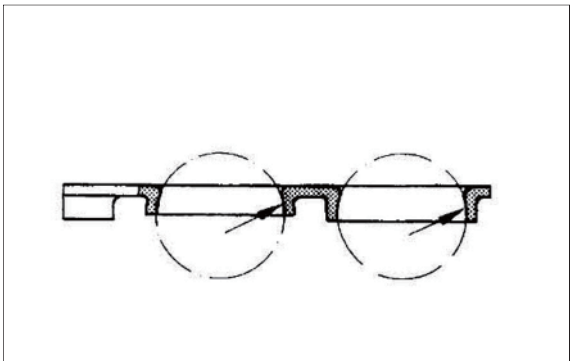
No scoring and no pittings.



14W98TM54

(4) Retaining plate

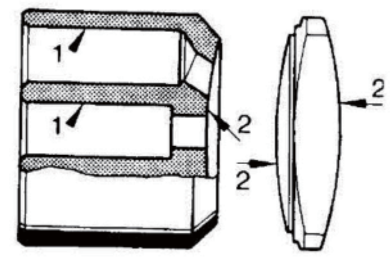
No scoring and no evidence of wear.


14W98TM55

(5) Cylinder block / Control lens

1 Bores free of scoring, no evidence of wear

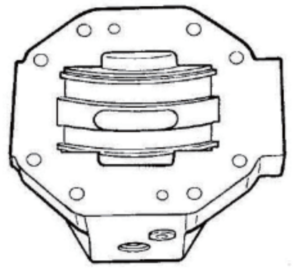
2 Faces smooth and even, free of cracks and scoring



14W98TM56

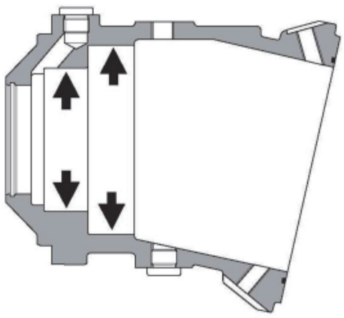
(6) Control housing

Sliding surface and side guides free of scoring and no wear.


14W98TM57

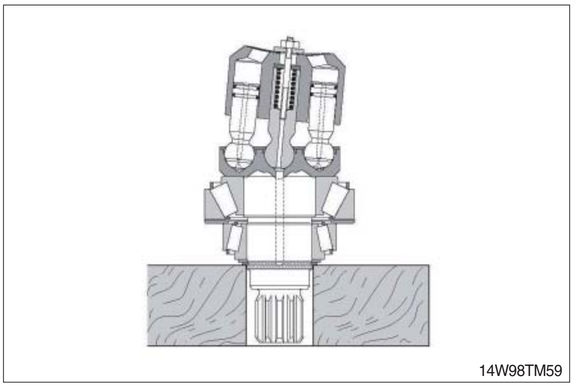
(7) Visual check

Bearing areas free of scoring and no evidence of wear.


14W98TM58

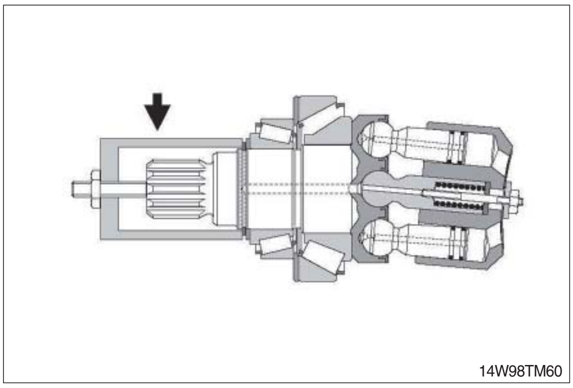
12) ROTARY GROUP ASSEMBLY

(1) Rotary group completely assembled ready for assembly.



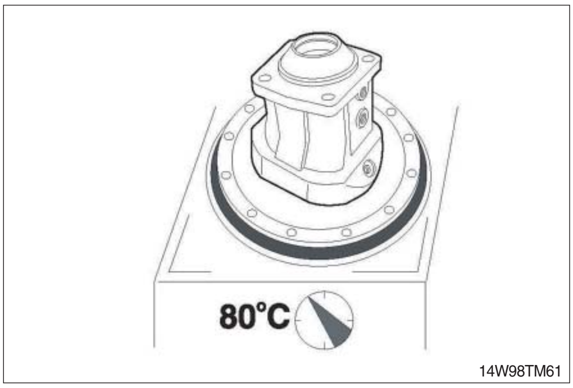
14W98TM59

(2) Place assembly sleeve.



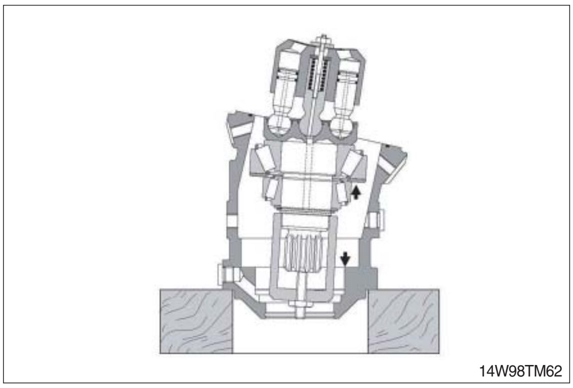
14W98TM60

(3) Warm up housing to 80˚C.



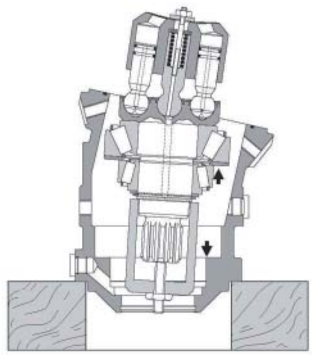
14W98TM61

(4) Insert rotary group into housing to seat position.



14W98TM62

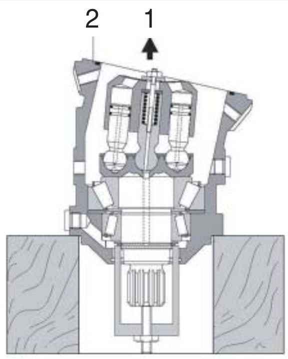
(5) Insert rotary group into housing to seat position.


14W98TM63

(6) Fix zero position of cylinder with Q_{max} screw.

1 Disassemble cylinder fixing screw

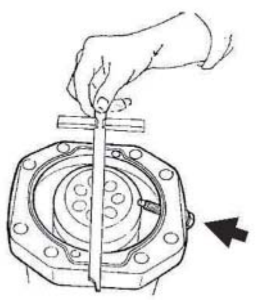
2 Insert O-ring



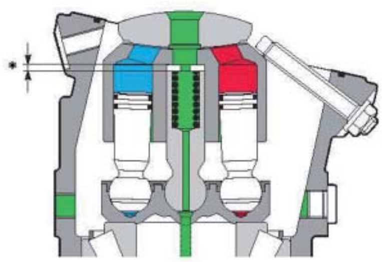
14W98TM74

13) ROTARY GROUP ADJUSTMENT

(1) Determine cylinder swivel range to max angle with screw.

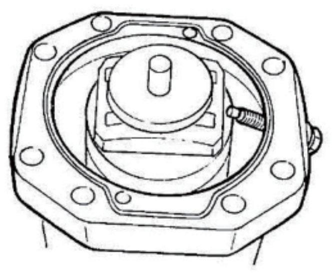

14W98TM64

(2) * Disc



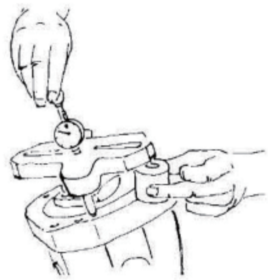
14W98TM65

(3) Place centering disc.



14W98TM66

(4) Mount measuring device.



14W98TM67

(5) Check dimension X.

14W98TM68

14) ASSEMBLY OF THE PORT PLATE

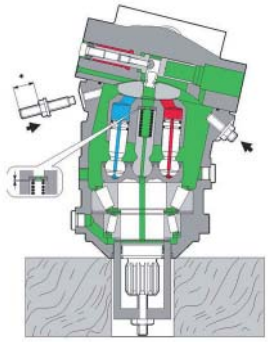
(1) Assemble port plate.

※ Take care of assembly design.
Tighten fixing screws with torque.

(2) Set Q_{min} screw to dimension(*).

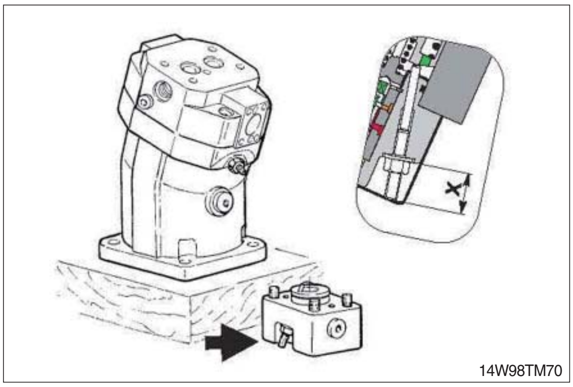
(3) Assemble plug.

(4) Remove assembly sleeve.

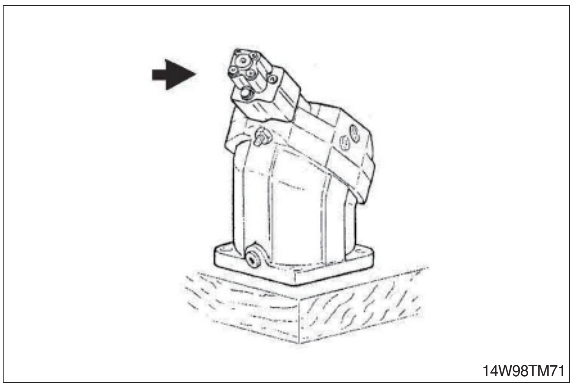


14W98TM69

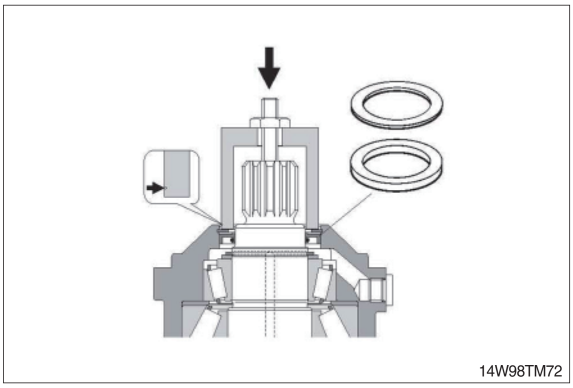
(5) Assemble control components.


14W98TM70

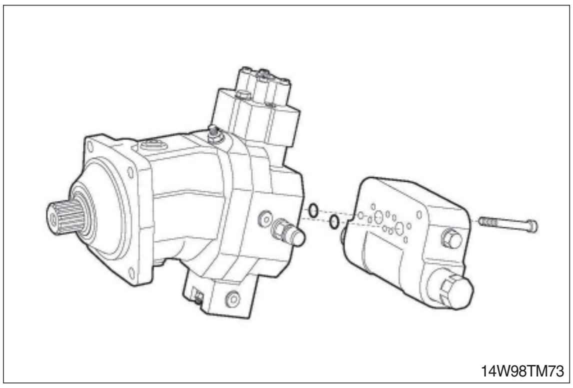
(6) Assemble cover.


14W98TM71

(7) Assemble shaft seal, disc and safety ring.
Press in with assembly sleeve.
※ Take care of press in depth.


14W98TM72

(8) Assemble counter balance valve.

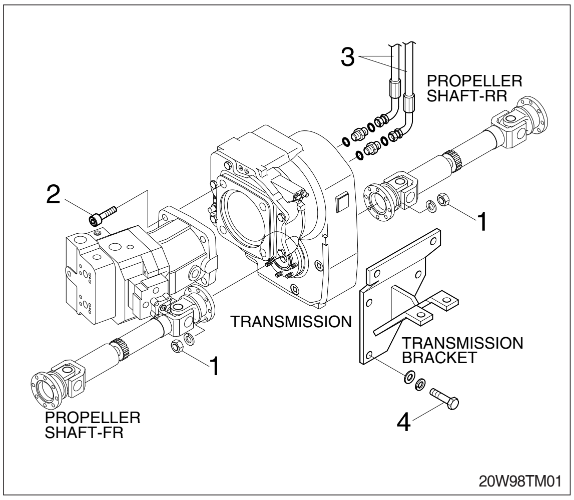

14W98TM73

GROUP 7 TRANSMISSION

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 propeller shaft mounting nuts (1).
·Tightening torque : 5.9±0.6 kgf· m
(42.7±4.3 lbf·ft)
(5) Remove the travel motor mounting bolt (2).
·Tightening torque : 29.6±3.2 kgf· m
(214±23.1 lbf·ft)
(6) Remove the hoses (3).
Fit blind plugs to the disconnected hoses.
(7) Remove the mounting bolts (4), then remove the transmission device assembly.
·Weight : 140 kg (310 lb)
·Tightening torque : 39±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.

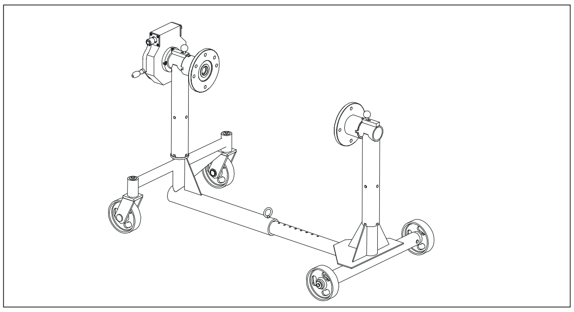
(4) The proper repair of these products requires especially trained personnel.

(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

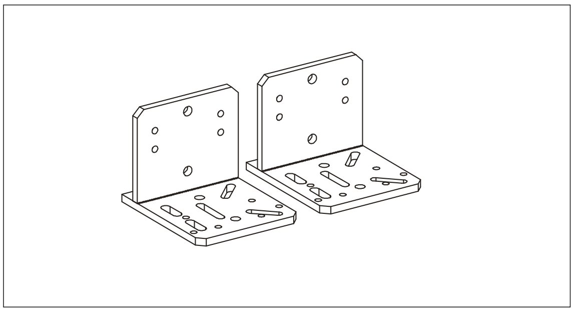
   5870 350 000



14WF8TM01

2) Supporting bracket

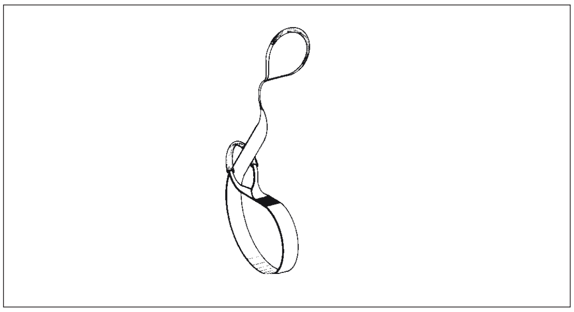
   5870 350 106



14WF8TM02

3) Lifting strap

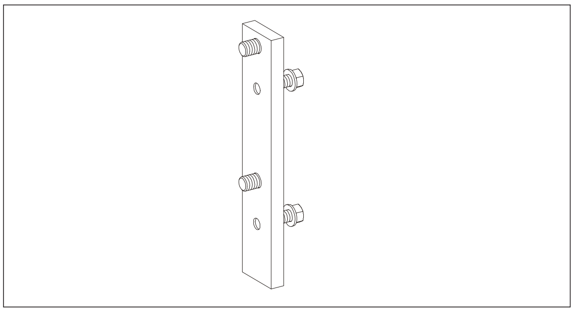
   5870 281 026



14WF8TM03

4) Fixture

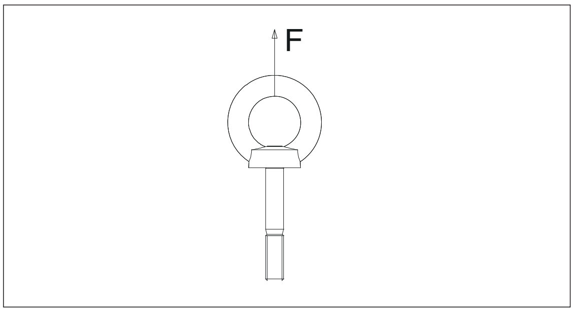
   5870 350 079



14WF8TM04

5) Eye bolt assortment

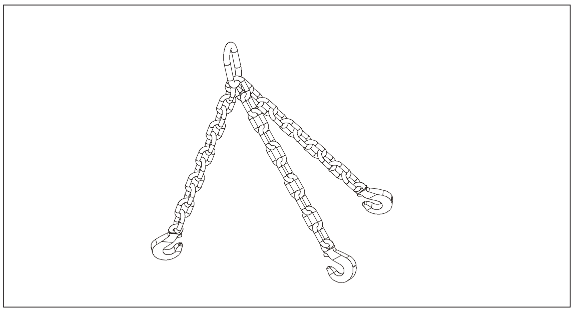
   5870 204 002



14WF8TM05

6) Lifting chain

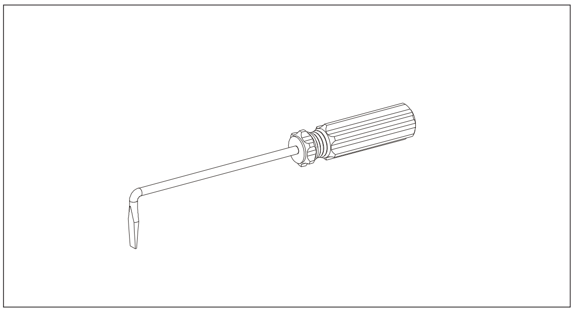
5870 221 047



14WF8TM06

7) Resetting device

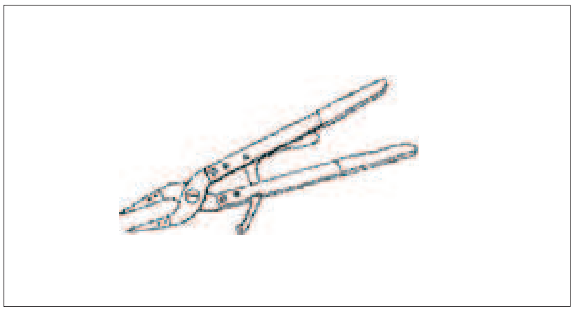
5870 400 001



14WF8TM07

8) Clamping pliers

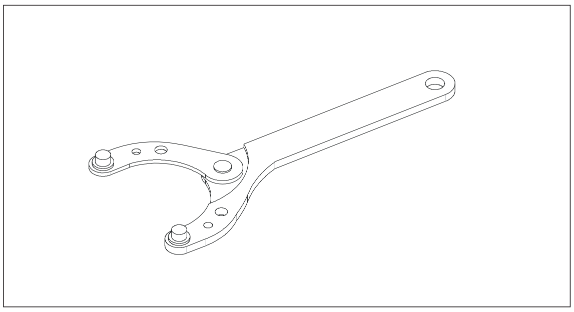
5870 900 021



14WF8TM08

9) Clamping fork

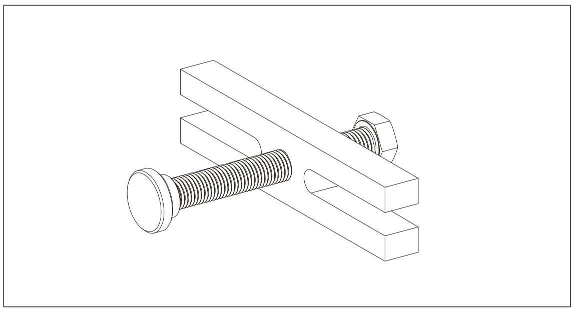
5870 240 025



14WF8TM09

10) Extractor

5870 000 017



14WF8TM10

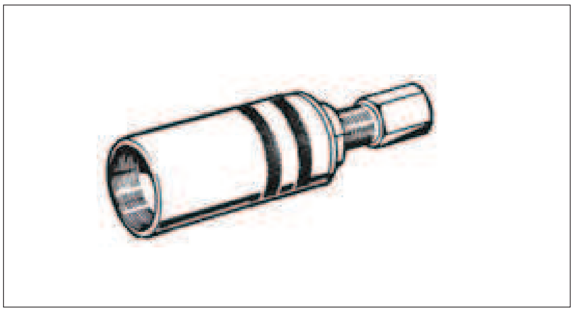
11) Rapid grip

5873 012 021

14WF8TM11

12) Basic tool

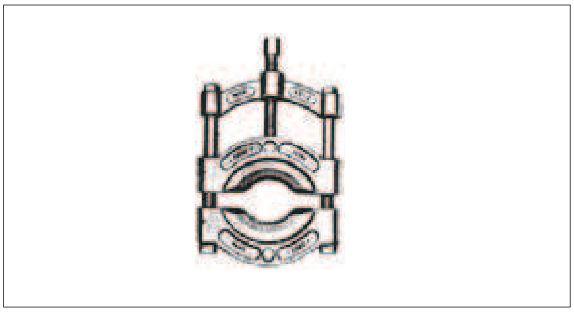
5873 002 001



14WF8TM12

13) Cut-off device

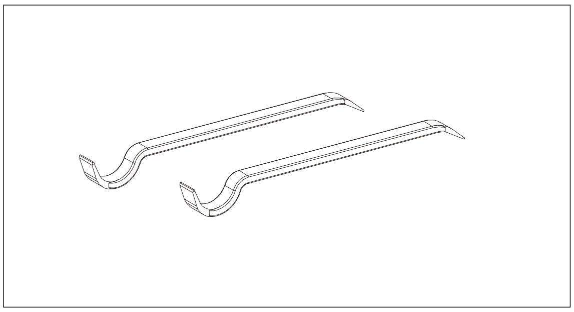
5870 300 028



14WF8TM13

14) Assembly lever

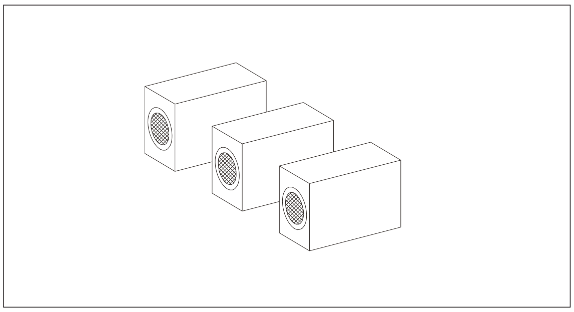
5870 345 036



14WF8TM14

15) Solenoid block

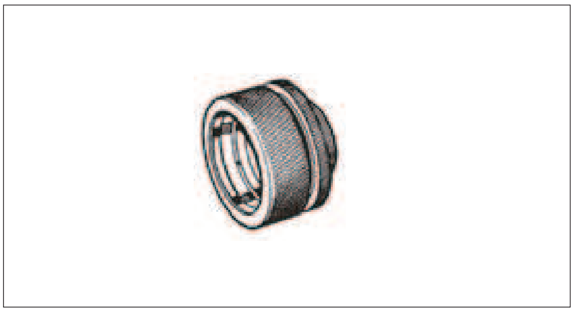
5870 450 003



14WF8TM15

16) Grab sleeve

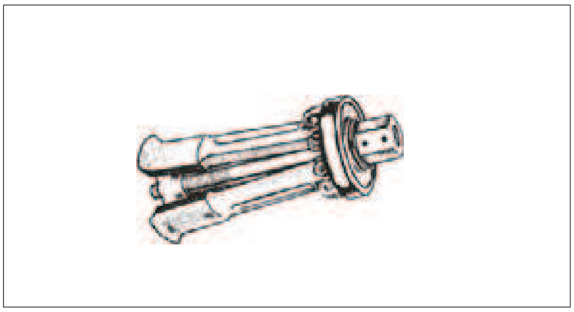
5873 001 037



14WF8TM16

17) Inner extractor

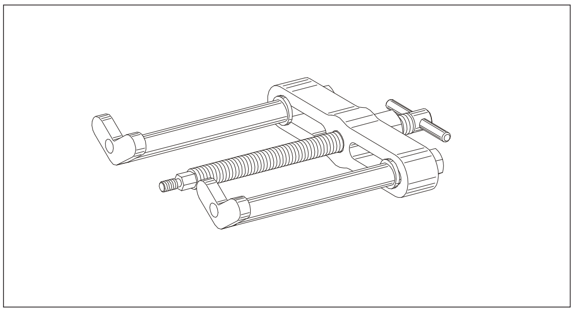
5870 300 019



14WF8TM17

18) Counter support

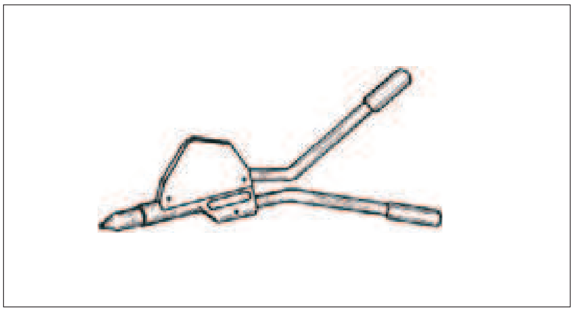
5870 300 020



14WF8TM18

19) Lever riveting tongs

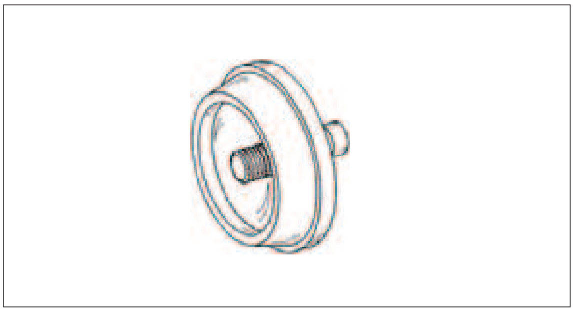
5870 320 016



14WF8TM19

20) Driver tool

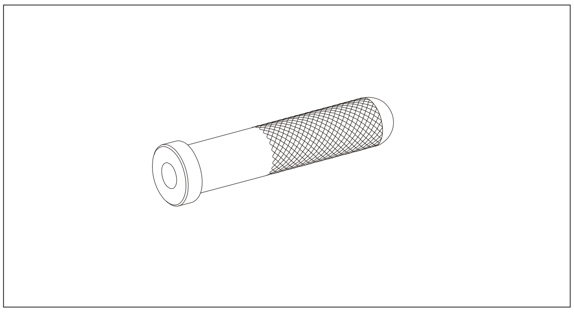
5870 058 073



14WF8TM20

21) Handle

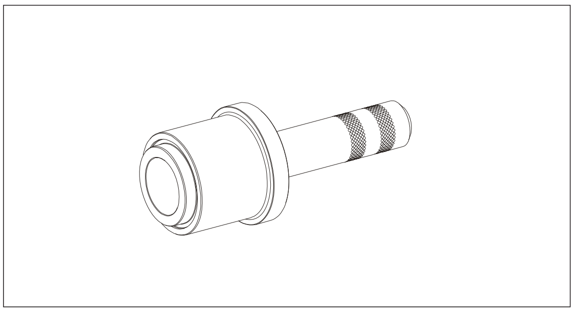
5870 260 002



14WF8TM21

22) Driver tool

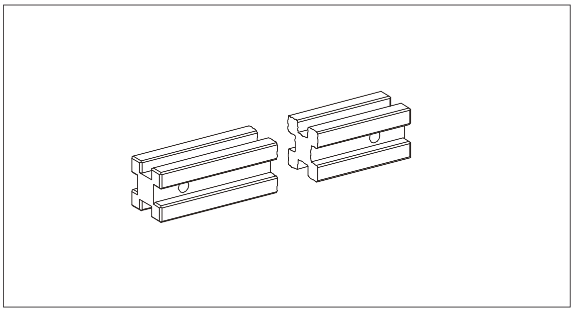
5870 048 281



14WF8TM22

23) Straightedge

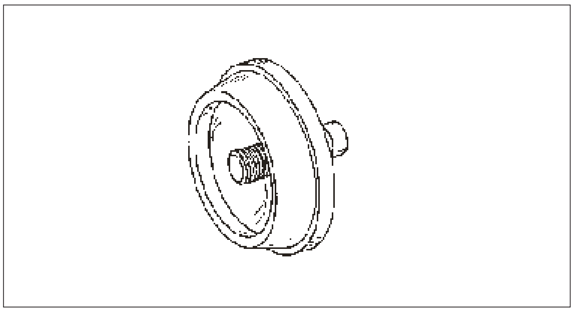
5870 200 108



14WF8TM23

24) Driver tool

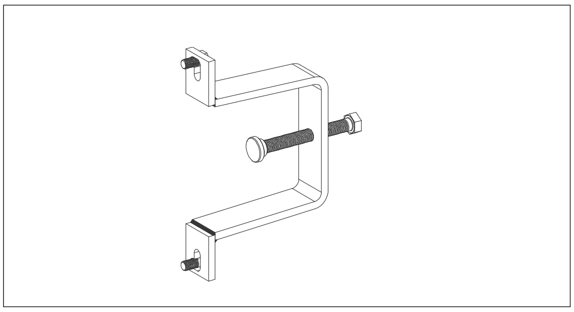
5870 058 078



14WF8TM24

25) Clamping bar

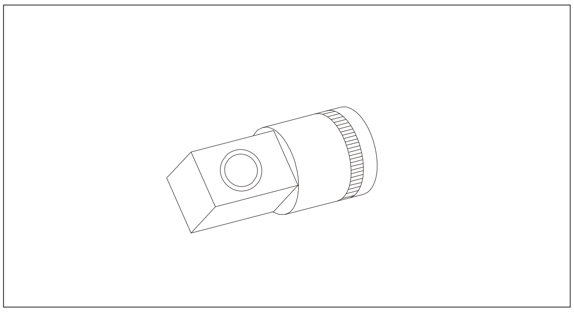
5870 654 049



14WF8TM25

26) Reduction

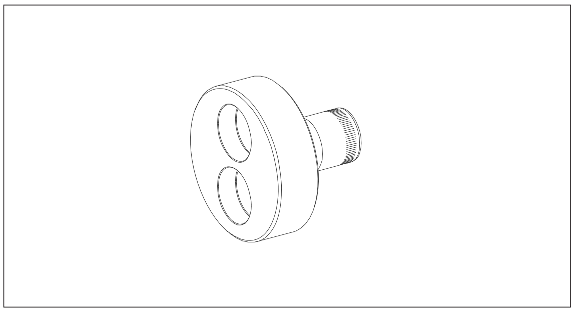
5870 656 056



14WF8TM26

27) Plug insert

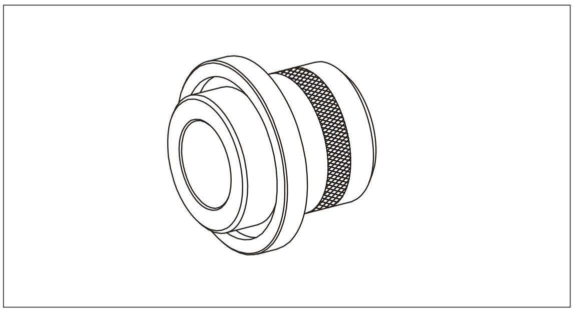
AA00 392 461



14WF8TM27

28) Driver tool

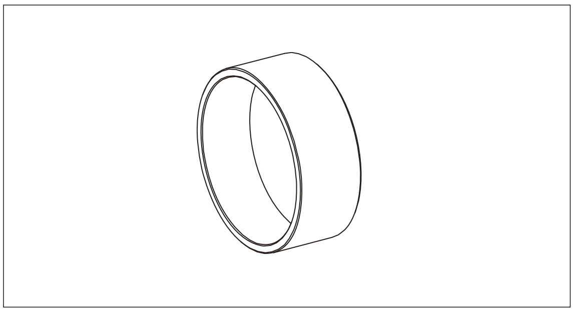
5870 048 279



14WF8TM28

29) Pressure piece

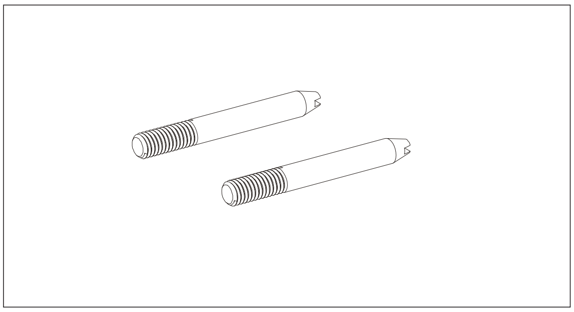
5870 506 150



14WF8TM29

30) Adjusting screws (M12)

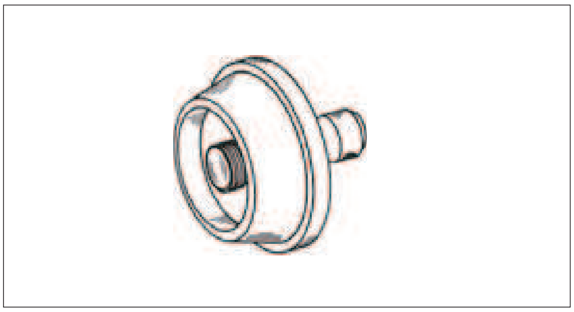
5870 204 021



14WF8TM30

31) Driver tool

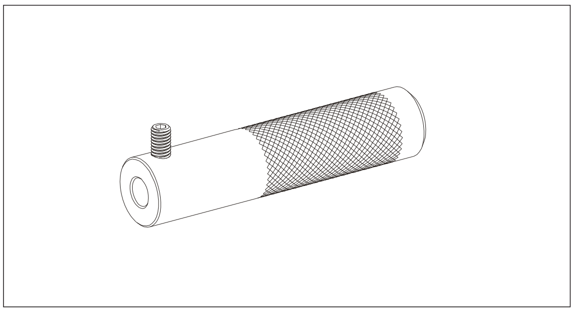
5870 058 051



14WF8TM31

32) Press-fit mandrel

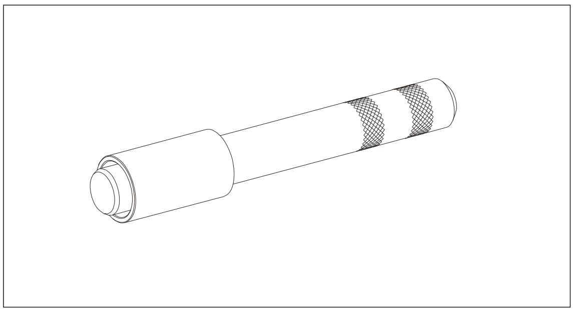
AA00 392 151



14WF8TM32

33) Driver tool

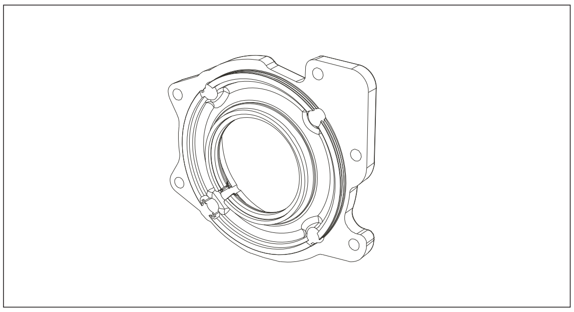
5870 048 283



14WF8TM33

34) Measuring device

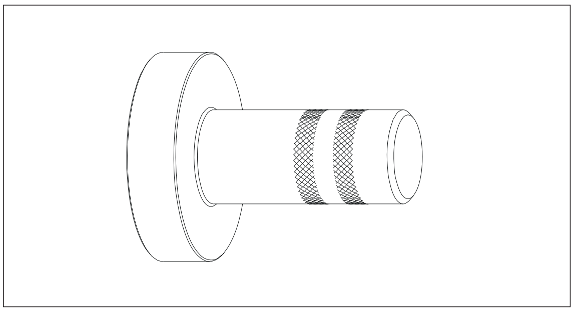
5870 200 131



14WF8TM34

35) Driver tool

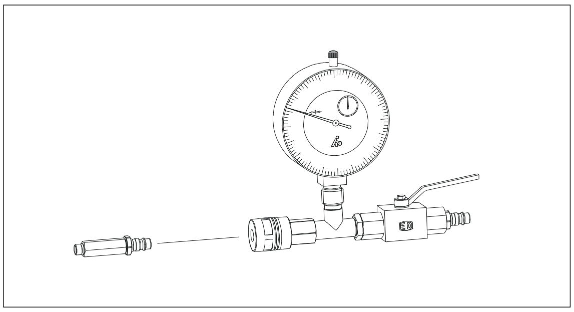
5870 506 161



14WF8TM35

36) Air connection

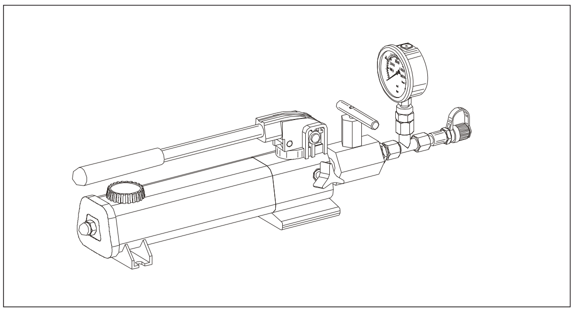
5870 505 012



14WF8TM36

37) HP pump

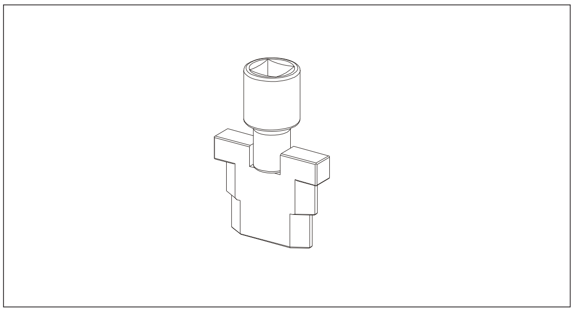
5870 287 007



14WF8TM37

38) Spline mandrel

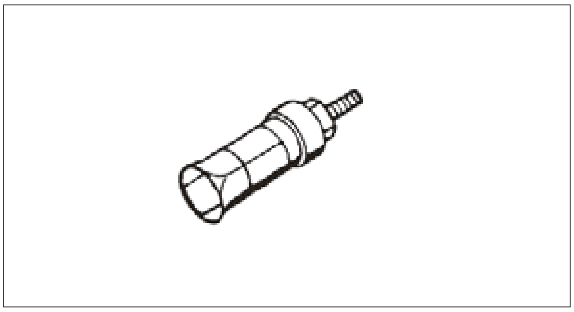
5870 510 039



14WF8TM38

39) Inner extractor

5870 300 012



14WF8TM39

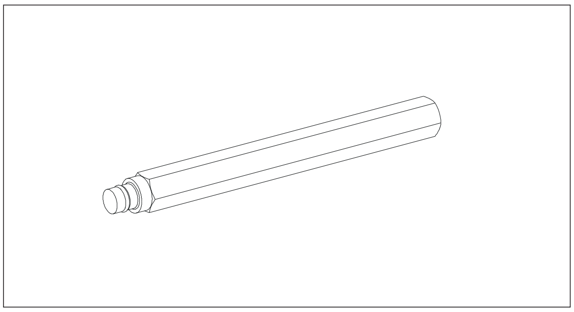
40) Counter support

5870 300 011

14WF8TM40

41) Driver tool

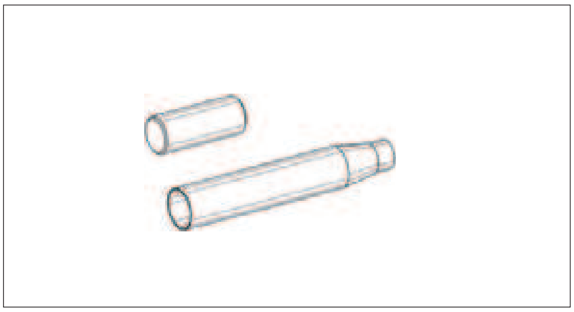
5870 705 003



14WF8TM41

42) Inner installer

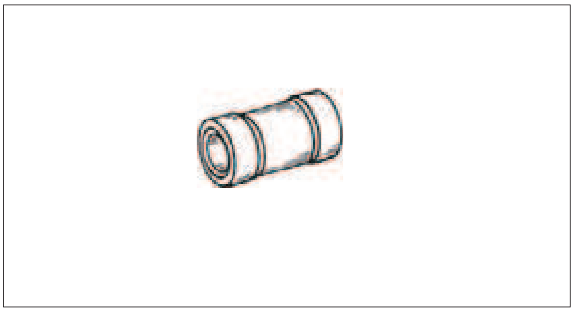
5870 651 055



14WF8TM42

43) Calibrating mandrel

5870 651 056



14WF8TM43

4. COMMERCIAL TOOLS FOR DISASSEMBLY AND REASSEMBLY

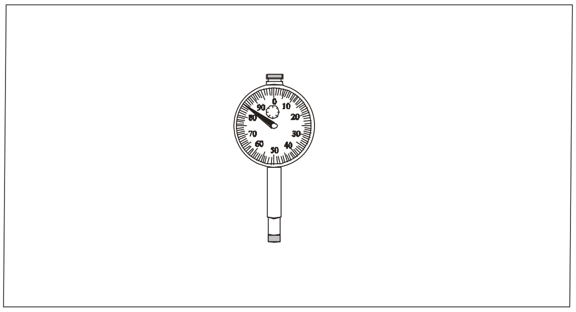
1) Magnetic stand

5870 200 055

14WF8TM44

2) Dial indicator

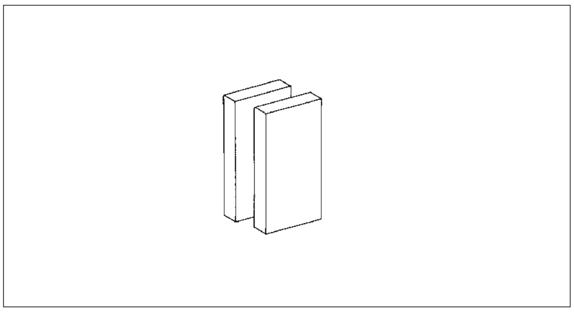
5870 200 057



14WF8TM45

3) Gauge blocks

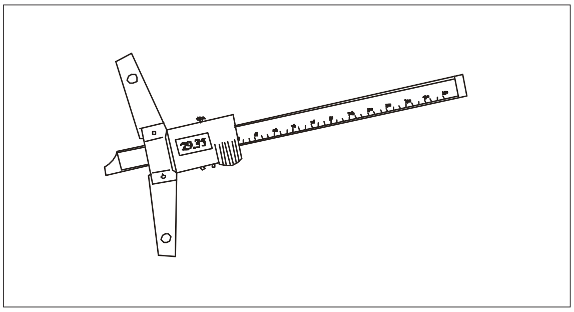
5870 200 066	70 mm
5870 200 067	100 mm



14WF8TM46

4) Digital depth gauge

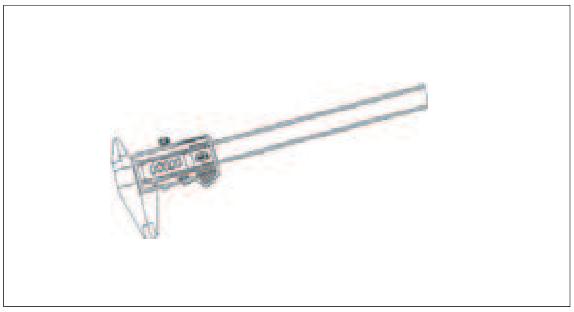
5870 200 072	200 mm
5870 200 114	300 mm



14WF8TM47

5) Digital caliper gauge

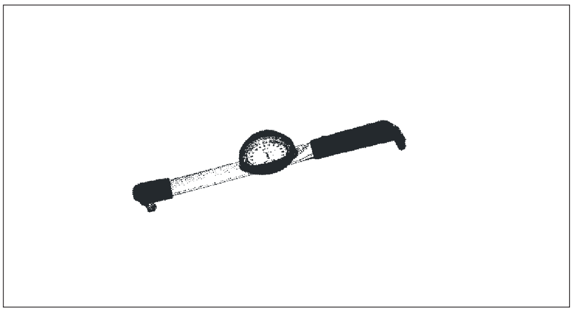
5870 200 109	150 mm



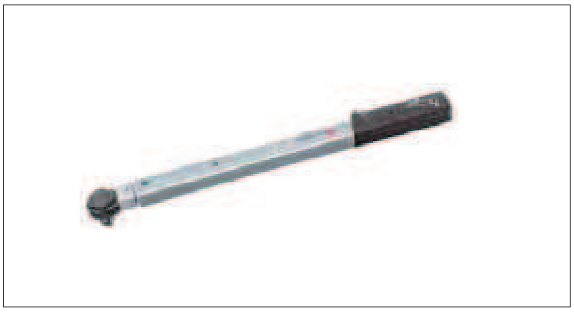
14WF8TM48

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



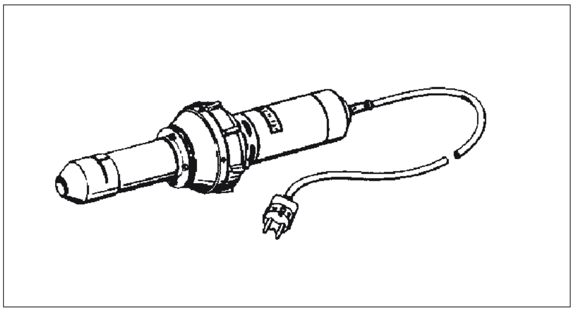
14WF8TM49



14WF8TM50

7) Hot air blower

5870 221 500	230 V
5870 221 501	115 V



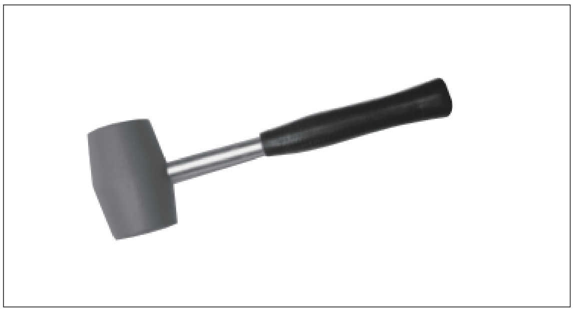
14WF8TM51

8) Plastic hammer

5870 280 004 Ø 60 mm

Substitute nylon insert

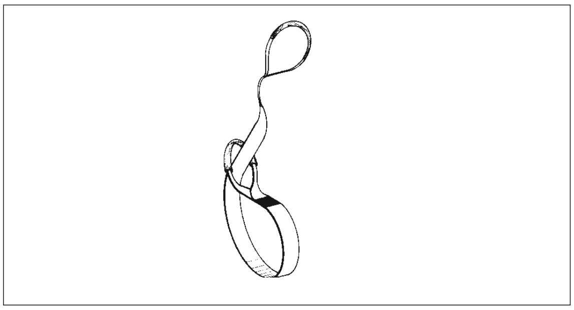
5870 280 006



14WF8TM52

9) Lifting strap

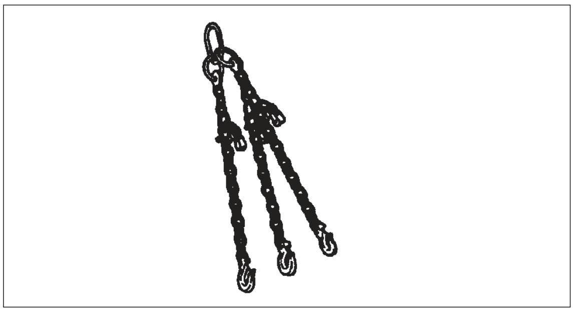
5870 281 026



14WF8TM53

10) Lifting chain

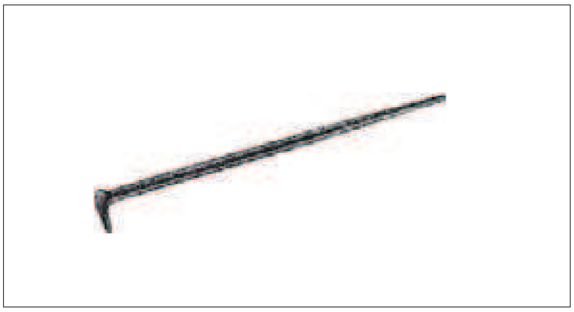
5870 281 047



14WF8TM54

11) Pry bar

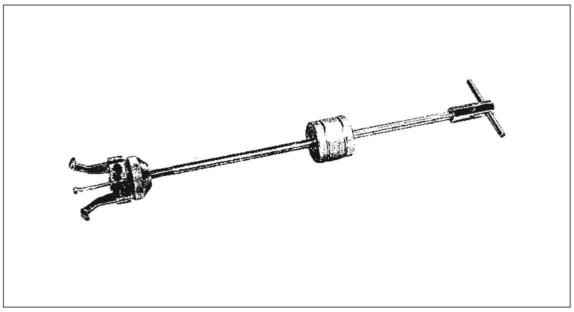
5870 345 071



14WF8TM55

12) Striker

5870 650 004



14WF8TM56

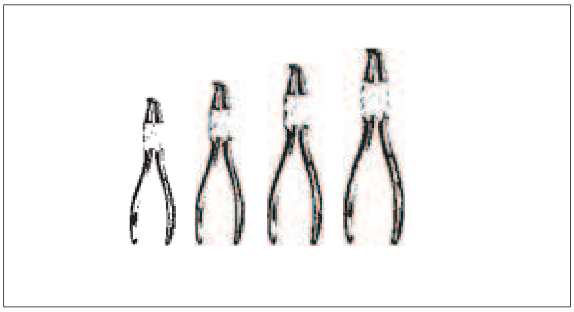
13) Set of internal pliers
I1-I2-I3-I4

5870 900 013

14WF8TM57

14) Set of internal pliers
I11-I21-I31-I41 90˚

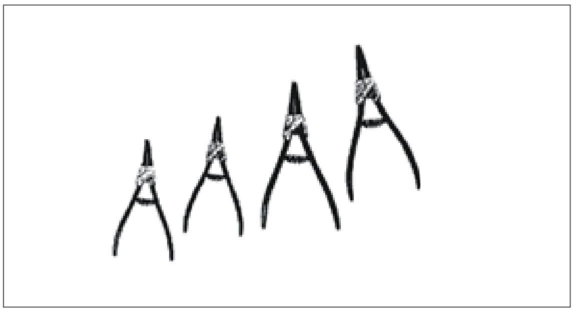
5870 900 014



14WF8TM58

15) Set of external pliers
A1-A2-A3-A4

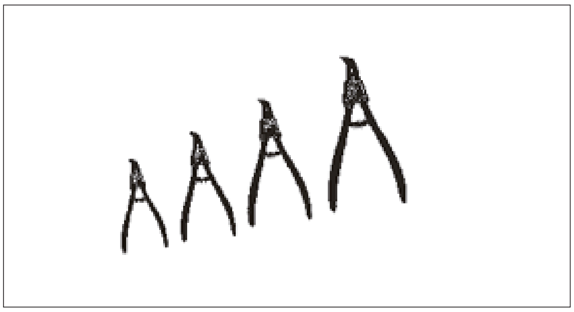
5870 900 015



14WF8TM59

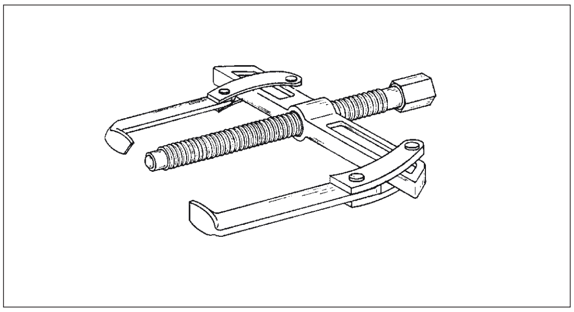
16) Set of external pliers
A01-A02-A03-A04 90˚

5870 900 016



14WF8TM60

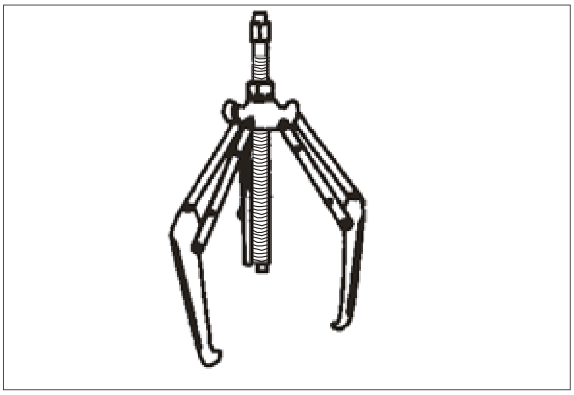
17) Two-armed puller



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

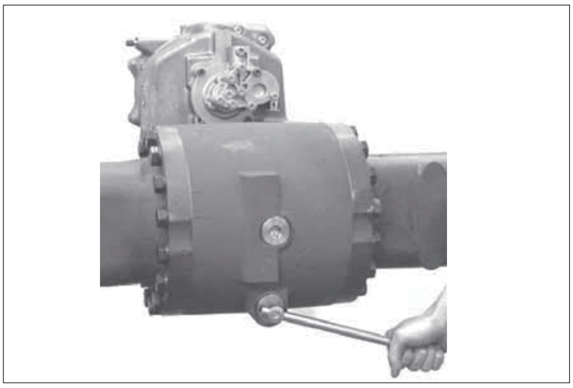
5870 971 001	
Jaw width	85 mm
Throat depth	65 mm
5870 971 002	
Jaw width	130 mm
Throat depth	105 mm
5870 971 003	
Jaw width	230 mm
Throat depth	150 mm
5870 971 004	
Jaw width	295 mm
Throat depth	235 mm
5870 971 005	
Jaw width	390 mm
Throat depth	230 mm
5870 971 006	
Jaw width	640 mm
Throat depth	290 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

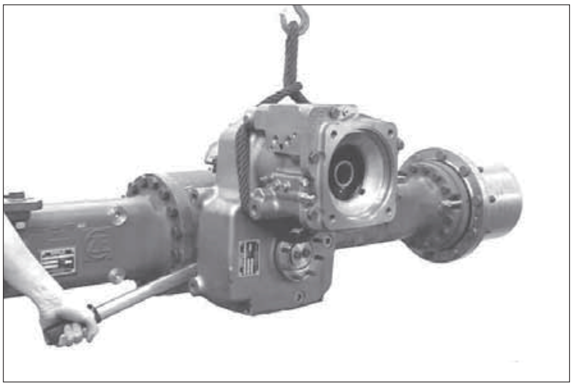
⚠ **Waste oil to be disposed of ecologically.**



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

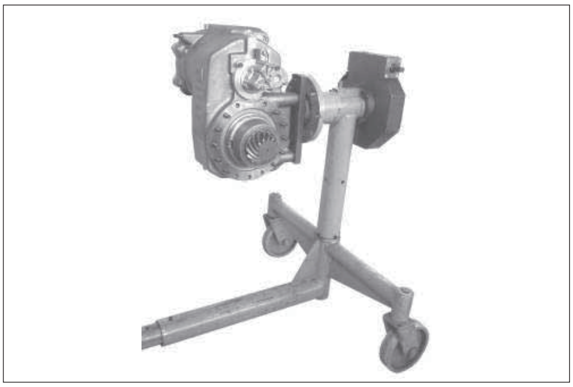


14WF8TM64

6. DISASSEMBLY – BRAKE / CLUTCH / PLANETARY CARRIER

1) Mount transmission to assembly truck.

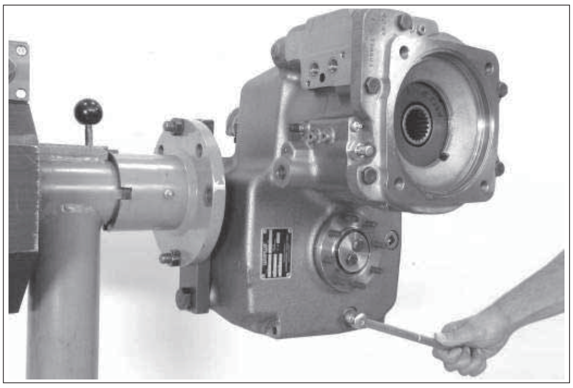
(S) Assembly truck assy. 5870 350 000
(S) Fixture 5870 350 079



14WF8TM65

2) Loosen screw plug and drain oil – use a suitable oil reservoir.

⚠ **Waste oil to be disposed of ecologically.**

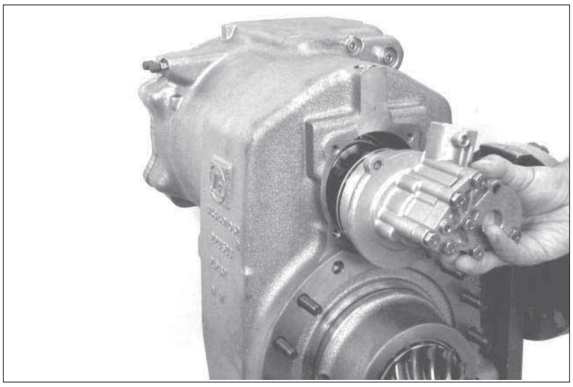


14WF8TM66

Lubrication pump

3) Remove lubrication pump or shift interlock (depending on version, Illustration shows version with Lubrication pump).

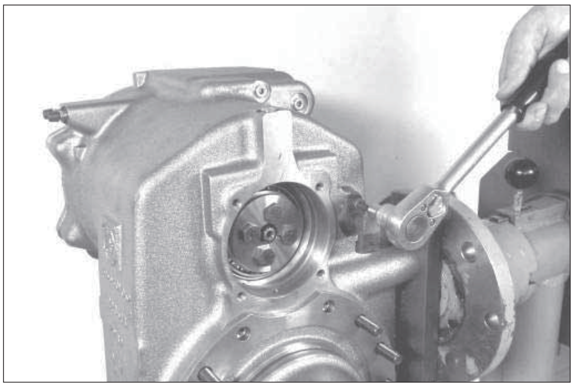
※ Complete disassembly of lubrication pump / shift interlock – see page 8-154-20.



14WF8TM67

Speed sensor

4) Loosen screw and pull off speed sensor.

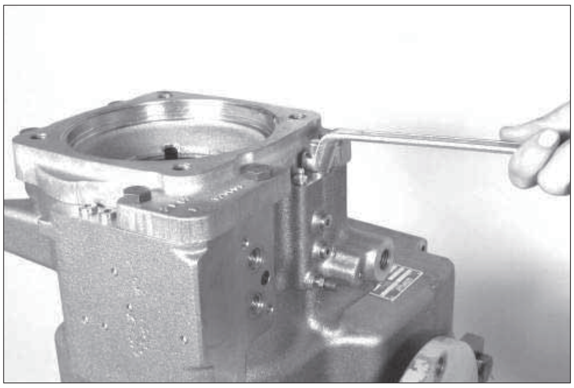


14WF8TM68

Emergency release (Parking brake)

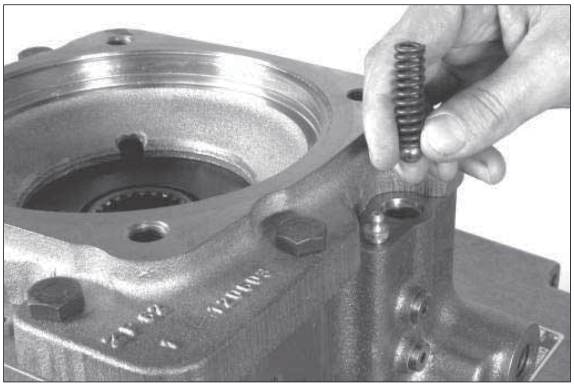
5) Remove breather.
(Illustration 14WF8TM69~14WF8TM72 shows version transmission installation position "Vertical")

※ Position of single connections or breather valves /lubrication nipples etc. as to version transmission installation position Horizontal - see 14WF8TM265.



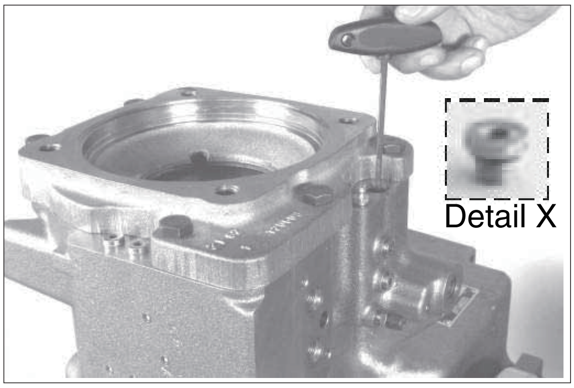
14WF8TM69

6) Remove compression spring and ball.



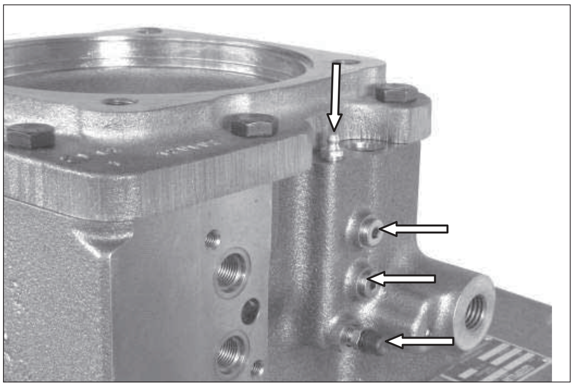
14WF8TM70

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.

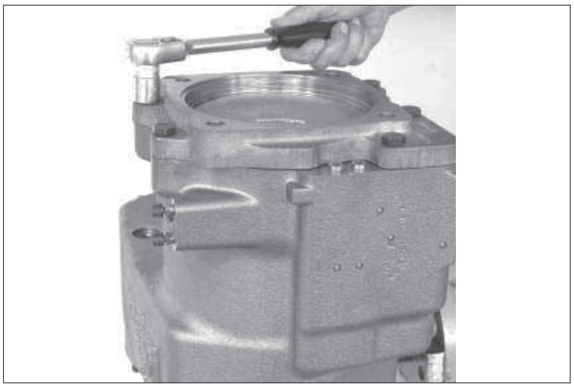


14WF8TM72

Input housing and modulation valve

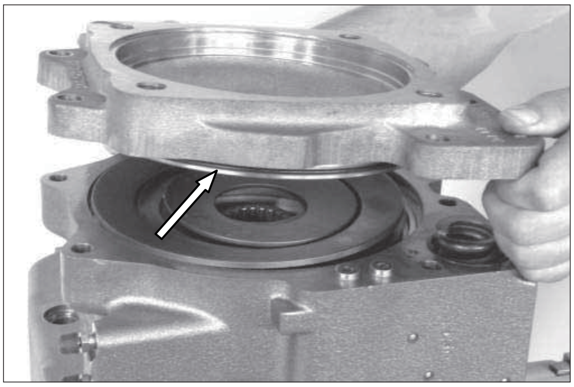
9) Loosen threaded joint of input housing evenly.

※ Input housing is subject to cup spring and compression spring preload.



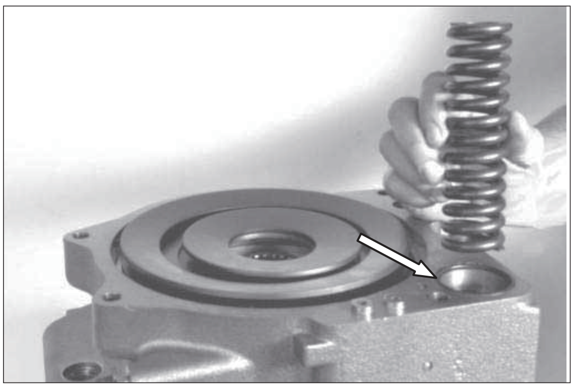
14WF8TM73

10) Take off input housing and remove O-ring (arrow).



14WF8TM74

11) Remove compression spring and O-ring (arrow).



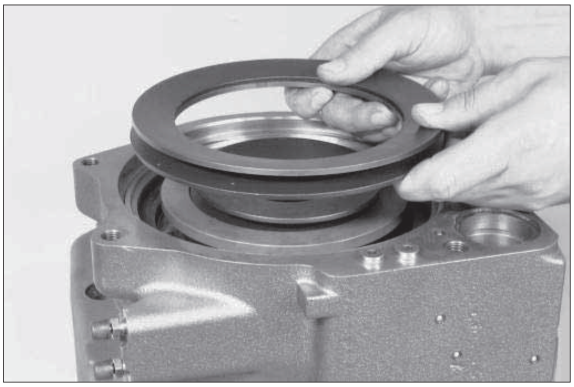
14WF8TM75

12) Pull complete piston out of hole.

14WF8TM76

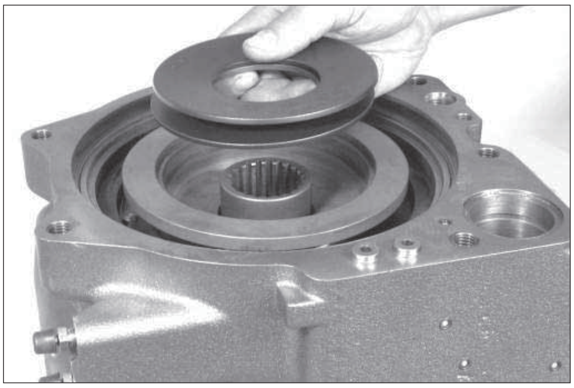
Brake and clutch

13) Remove cup springs from brake.



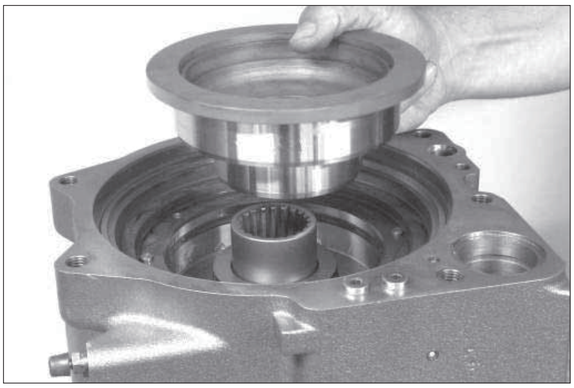
14WF8TM77

14) Remove cup springs from clutch.



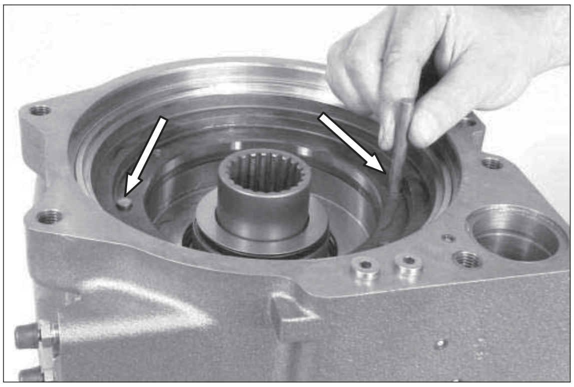
14WF8TM78

15) Remove piston.



14WF8TM79

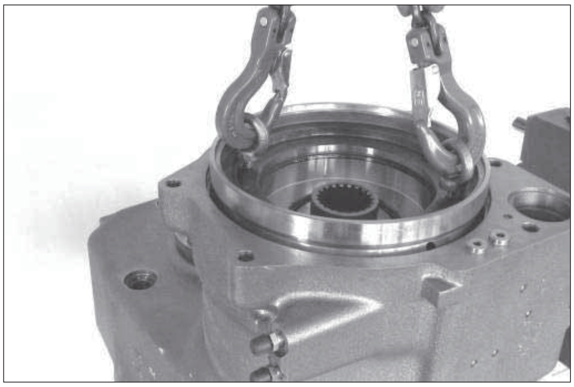
16) Pull off both cyl. pins (arrows).



14WF8TM80

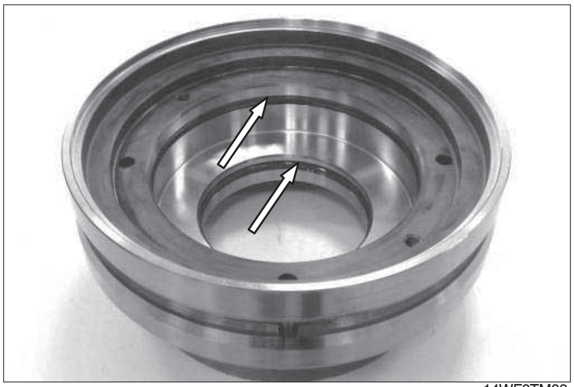
17) Attach 2 (two) eyebolts and pull piston cautiously out of housing – risk of damage.

(S) Eyebolt assortment 5870 204 002
(S) Lifting chain 5870 281 047



14WF8TM81

18) Remove both seals (arrows) from piston.

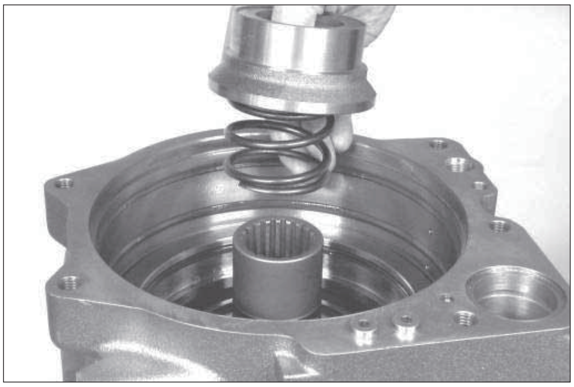


14WF8TM82

19) Remove axial roller cage with both thrust washers.

14WF8TM83

20) Remove pressure piece and compression spring.

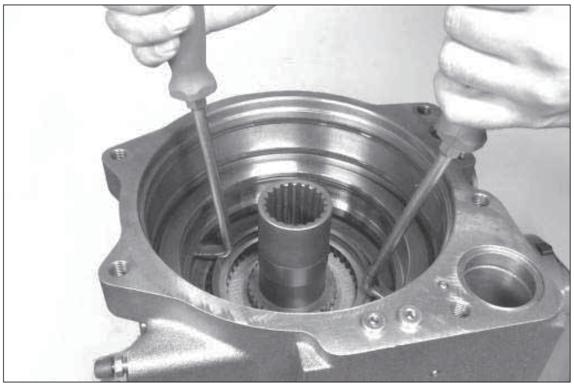


14WF8TM84

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.



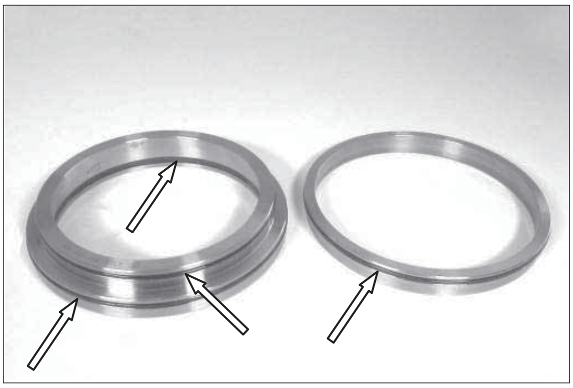
14WF8TM85

22) Remove pressure ring from ring cautiously with lever – risk of damaging sealing surfaces .

(S) Resetting device 5870 400 001

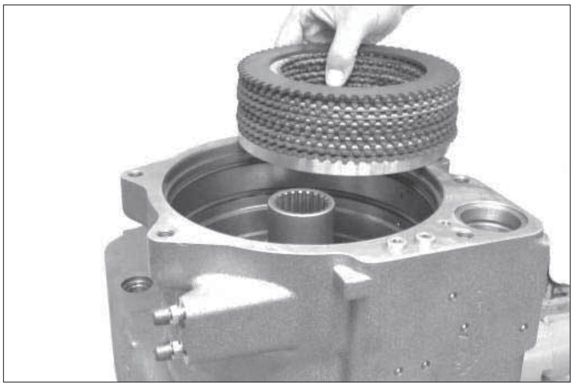
14WF8TM86

23) Remove seal and O-rings (see arrows) from pressure ring and ring.



14WF8TM87

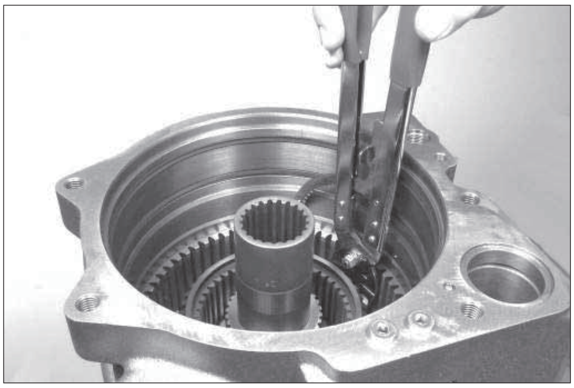
24) Take disk package of brake with end plate(s) out of housing.



14WF8TM88

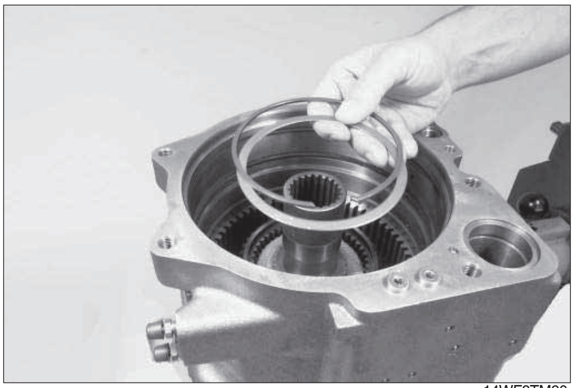
25) Disengage retaining ring.

(S) Clamping pliers 5870 900 021



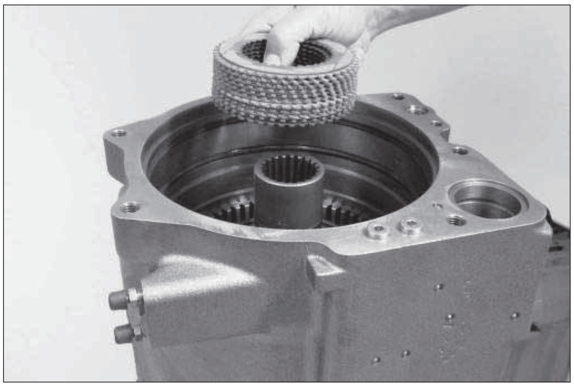
14WF8TM89

26) Remove snap ring and shim.



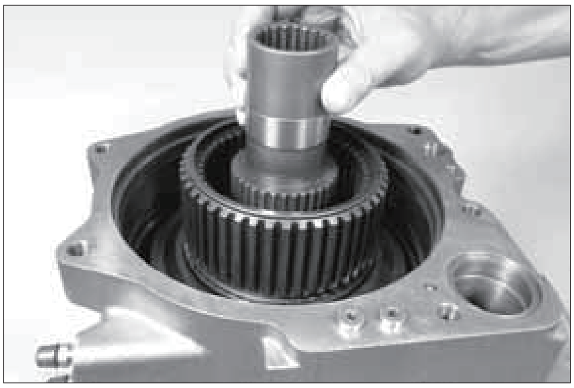
14WF8TM90

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.

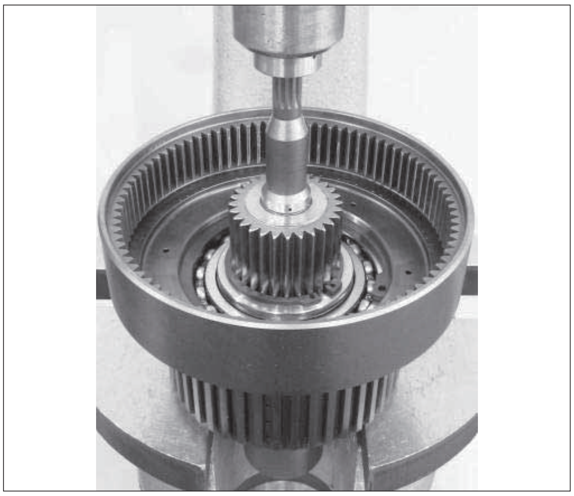


14WF8TM92

29) Unsnap retaining ring.

14WF8TM93

30) Press input shaft out of ball bearing/ring gear.



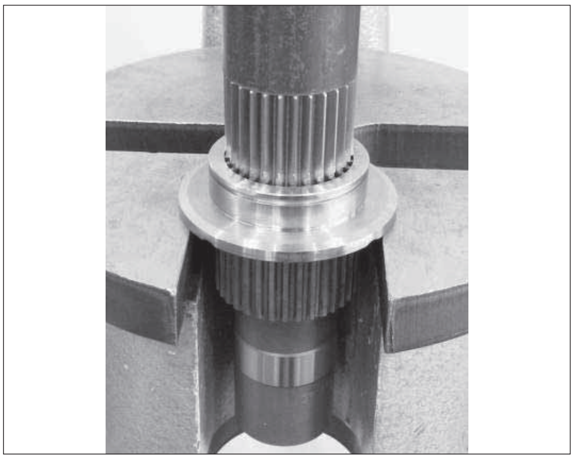
14WF8TM94

31) Unsnap retaining ring.

14WF8TM95

32) Press centering disk from input shaft.

※ In case of extreme press fit – heat centering disk.



14WF8TM96

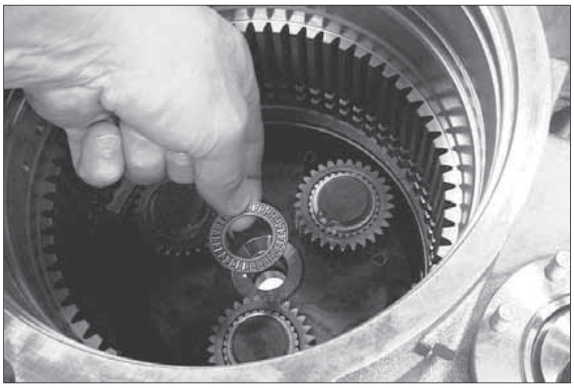
33) Unsnap retaining ring and remove ball bearing.

(S) Clamping pliers 5870 900 021

14WF8TM97

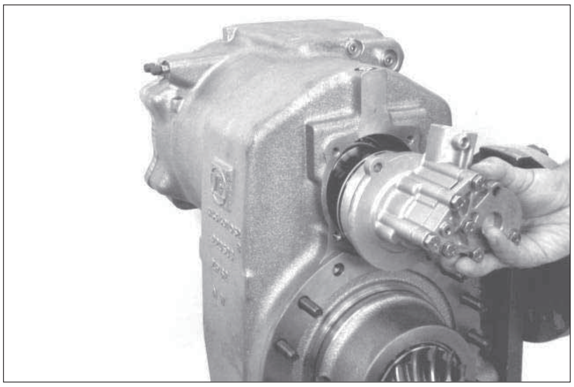
Planetary carrier

34) Remove axial needle cage.



14WF8TM98

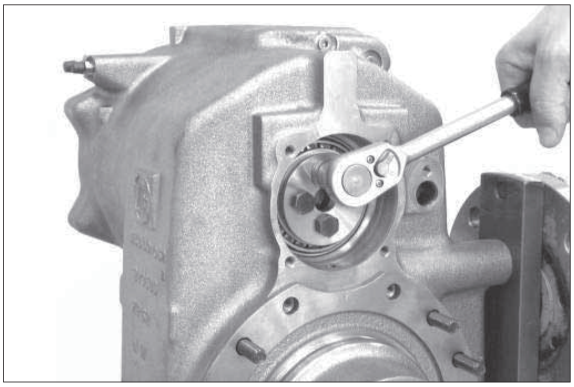
35) If not yet disassembled previously – remove lubrication pump or shift interlock (depending on version).
(Illustration shows version - Lubrication pump).



14WF8TM99

36) Loosen threaded joint and remove disk – fasten output flange by means of clamping fork.

(S) Clamping fork 5870 240 025

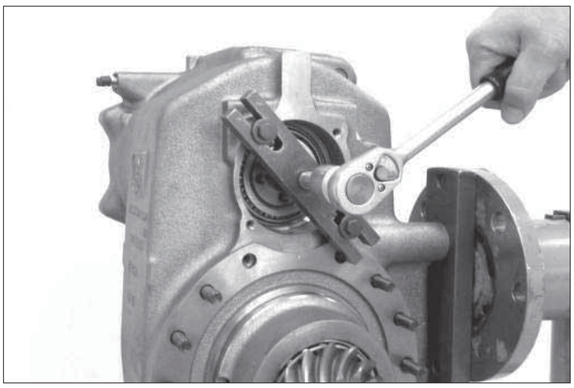


14WF8TM100

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

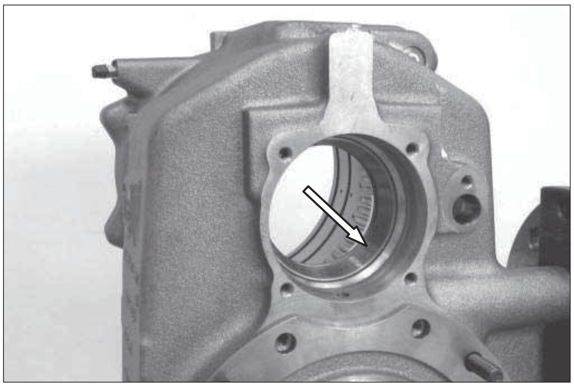
38) Pull second bearing inner ring from planetary carrier.

(S) Rapid grip 5873 012 021
(S) Basic tool 5873 002 001

14WF8TM102

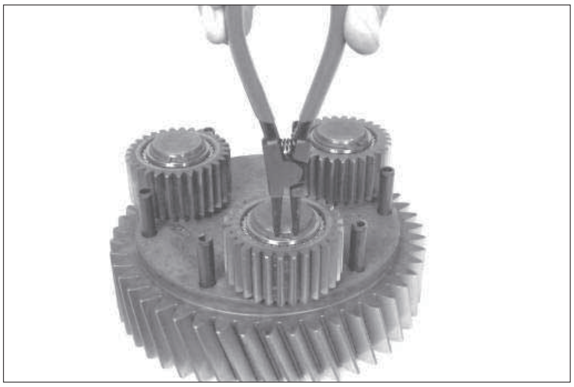
39) If required – force both bearing outer rings (arrow) out of bearing hole.

※ 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.

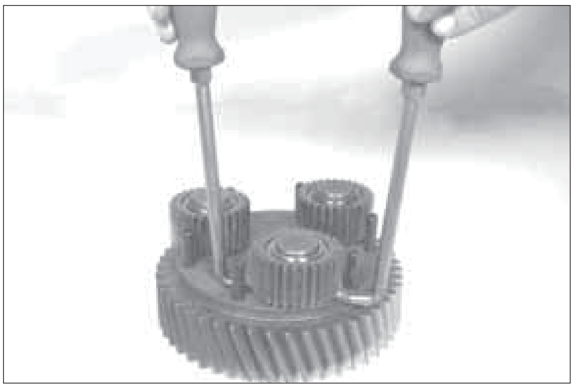


14WF8TM104

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).

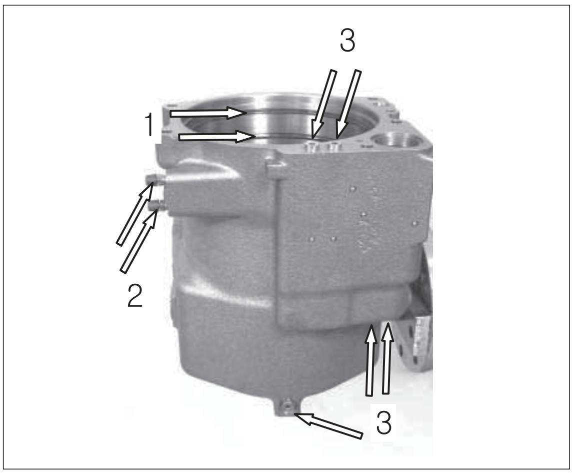


14WF8TM105

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".

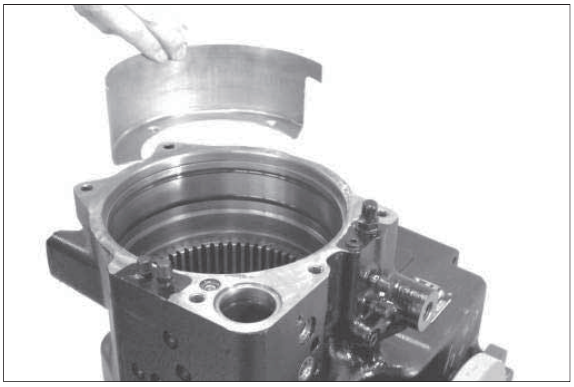


14WF8TM106

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 .



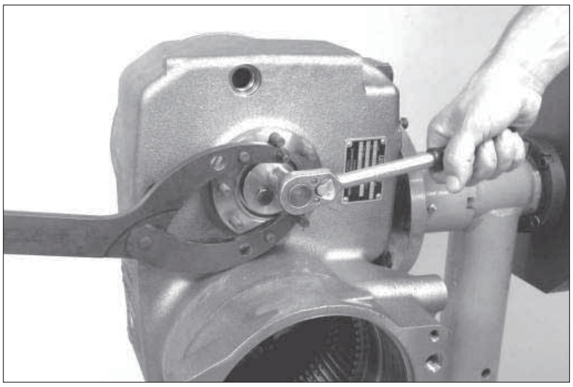
14WF8TM107

7. DISASSEMBLY - OUTPUT

Version "Axle attachment"

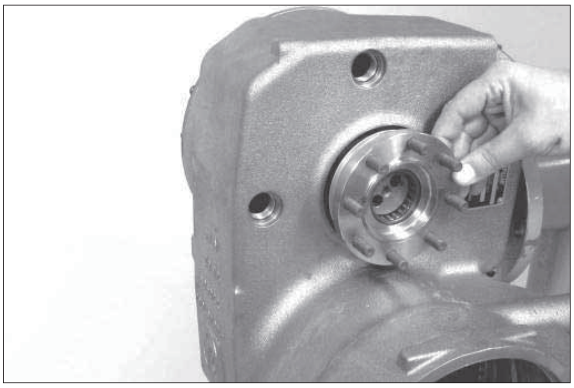
1) Loosen threaded joint, remove cover and O-ring.

※ (S) Clamping fork 5870 240 025



14WF8TM108

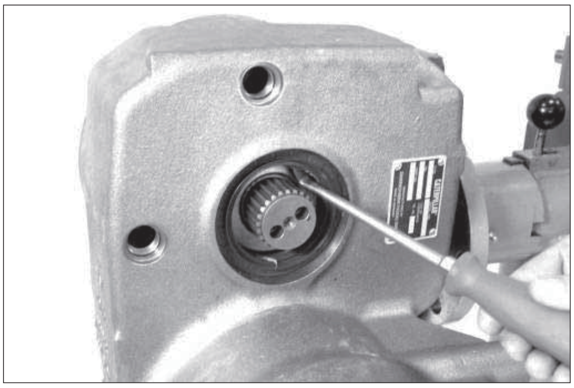
2) Pull off flange.



14WF8TM109

3) Remove shaft seal with a lever.

※ (S) Resetting device 5870 400 001

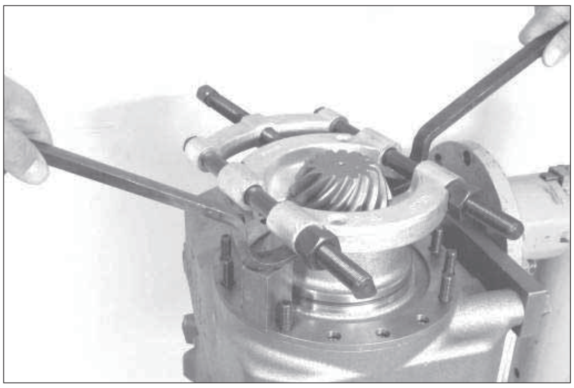


14WF8TM110

4) Fix pinion with fixture and press off.

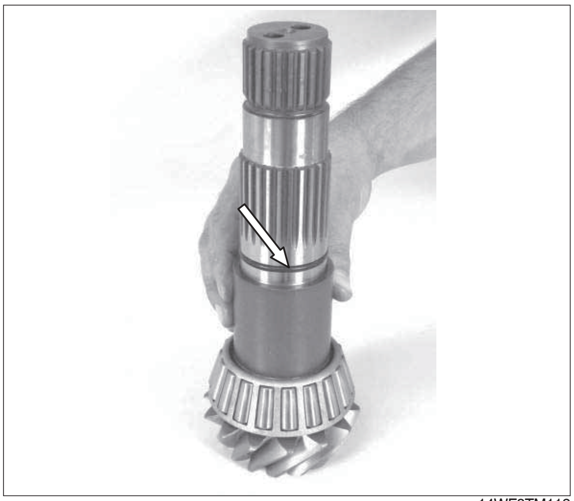
(S) Cut-off device 5870 300 028
(S) Assembly lever 5870 345 036
(S) Solenoid block 5870 450 003

※ Pay attention to releasing bearing inner ring and adjusting ring (rolling torque/pinion bearing) behind.



14WF8TM111

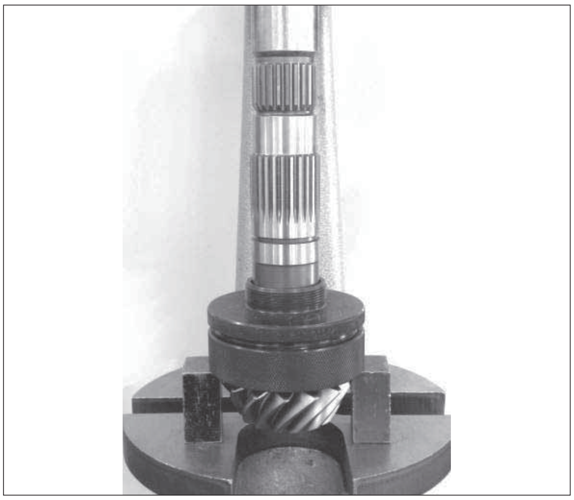
5) Remove O-ring (see arrow) and bush from pinion.



14WF8TM112

6) Press-off bearing inner ring from pinion shaft.

(S) Grab sleeve	5873 001 037
(S) Solenoid block	5870 450 003

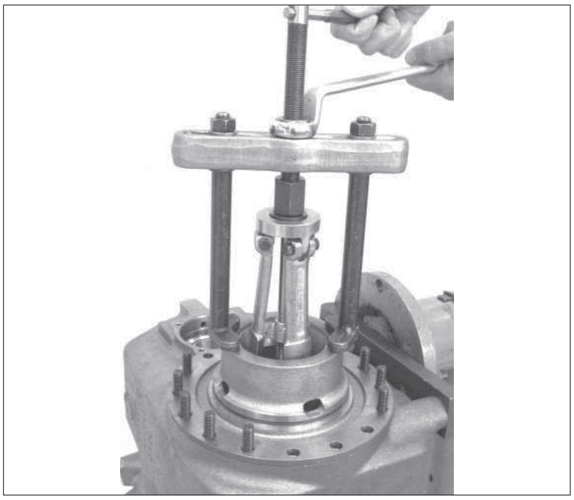


14WF8TM113

7) Pull bearing outer ring out of bearing cover.

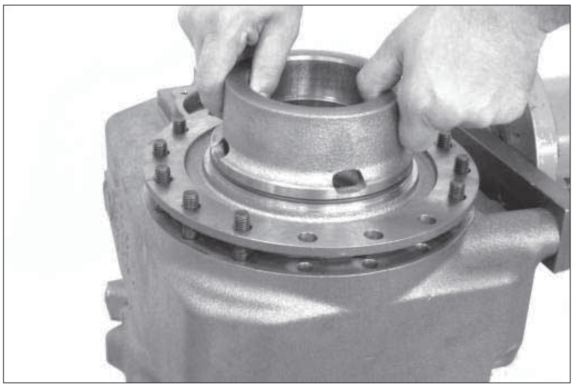
(S) Inner extractor	5870 300 019
(S) Counter support	5870 300 020

※ Pay attention to shim behind (pinion gap setting).



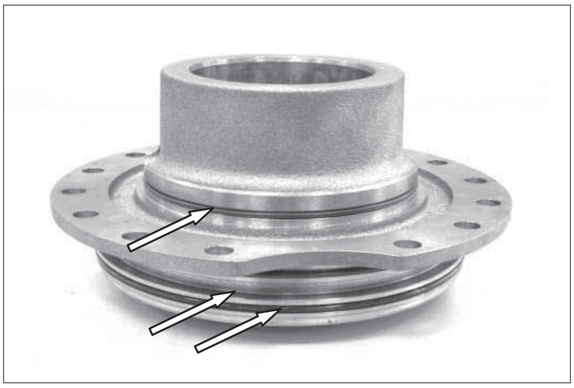
14WF8TM114

8) Pull off bearing cover.



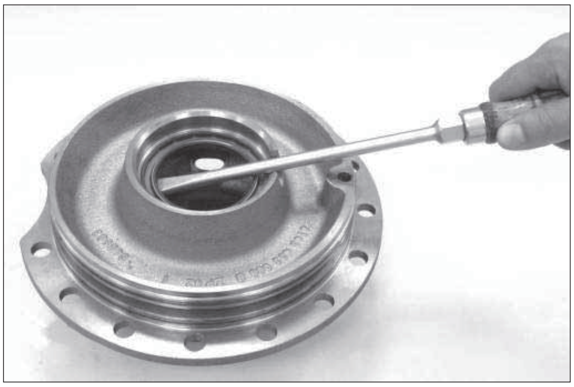
14WF8TM115

9) Remove O-rings (arrows).



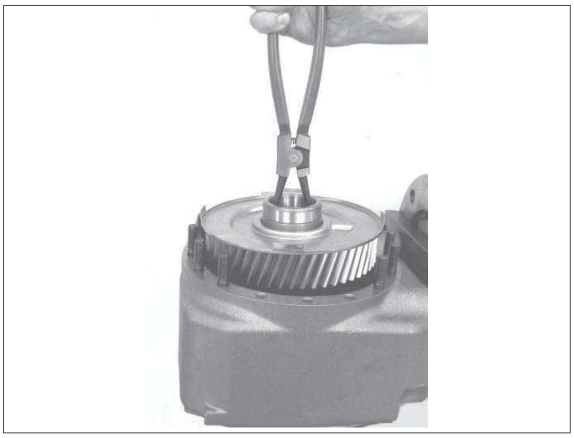
14WF8TM116

10) Remove shaft seal.



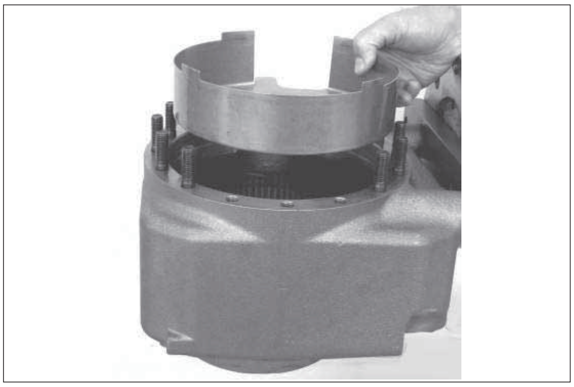
14WF8TM117

11) Lift output gear with oil screen sheet out of housing. Remove oil screen sheet from output gear.



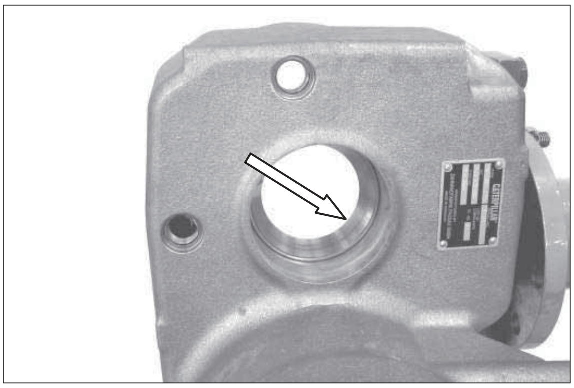
14WF8TM118

12) Remove screen sheet.



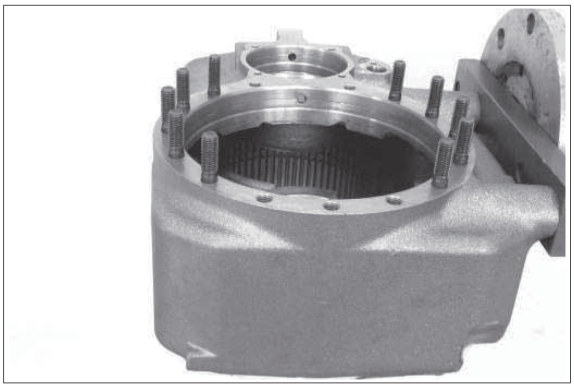
14WF8TM119

13) Disassemble bearing outer ring from housing hole (see arrow).



14WF8TM120

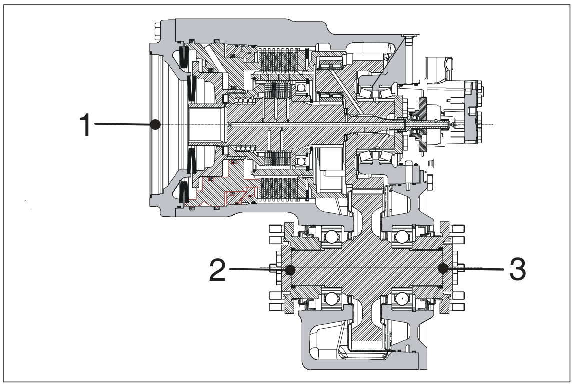
14) If necessary, remove stud bolts.



14WF8TM121

Version "Separate installation"

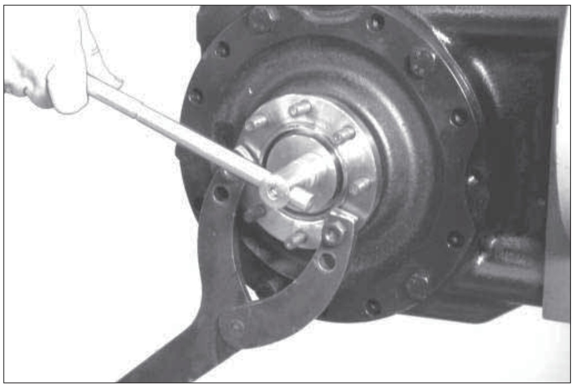
15) 1 = Input
2 = Output – front axle
3 = Output – rear axle



14WF8TM122

16) Use clamping fork to fix output flange.
Loosen threaded joint, pull off disk, O-ring and flange.

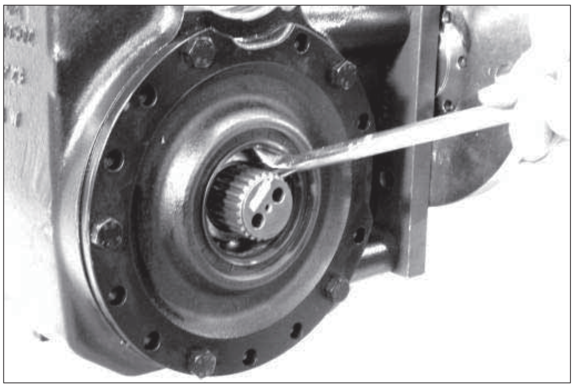
(S) Clamping fork 5870 240 025



14WF8TM123

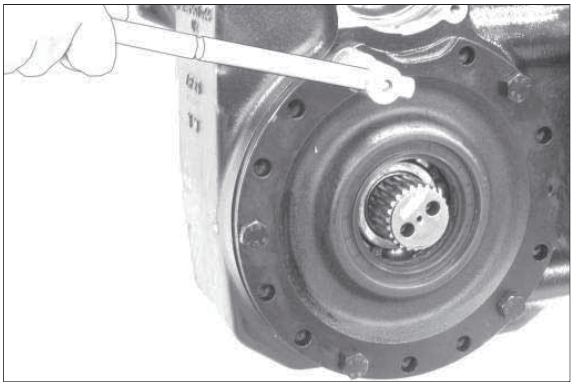
17) Remove shaft seal with a lever.

※ Disassemble second output flange and shaft seal analogously.



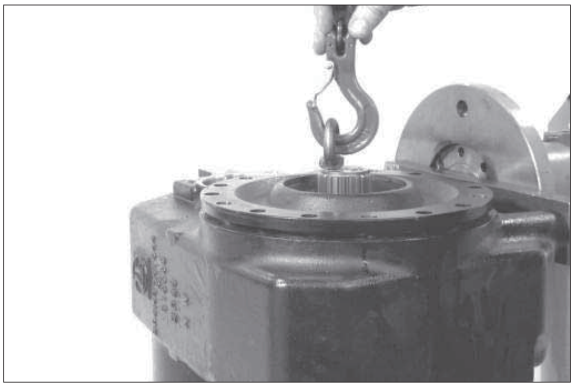
14WF8TM124

18) Loosen threaded joint.



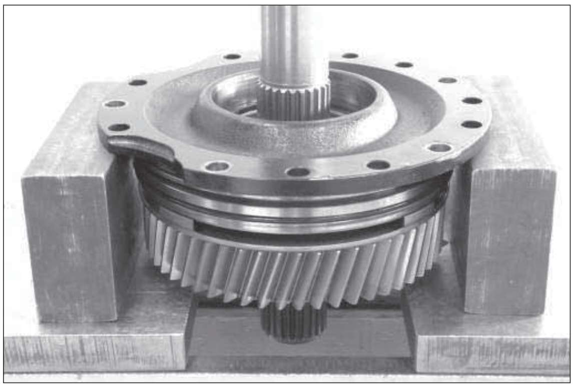
14WF8TM125

19) Use lifting tackle to separate output gear with cover from transmission housing.



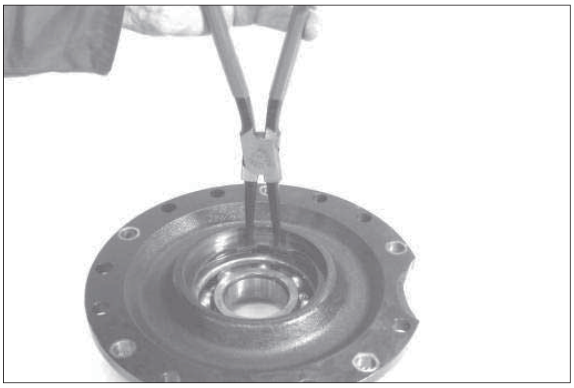
14WF8TM126

20) Press output gear out of ball bearing/cover – remove releasing oil screen sheet.



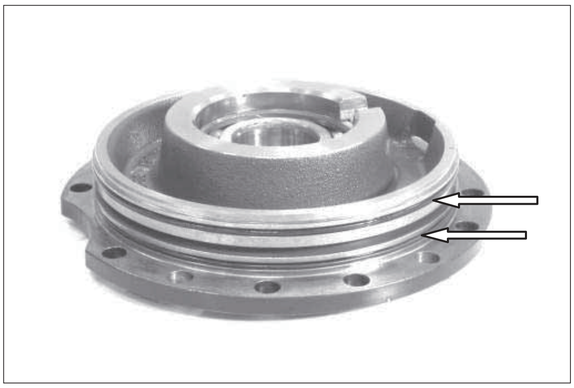
14WF8TM127

21) Unsnap retaining ring and disassemble ball bearing from cover.



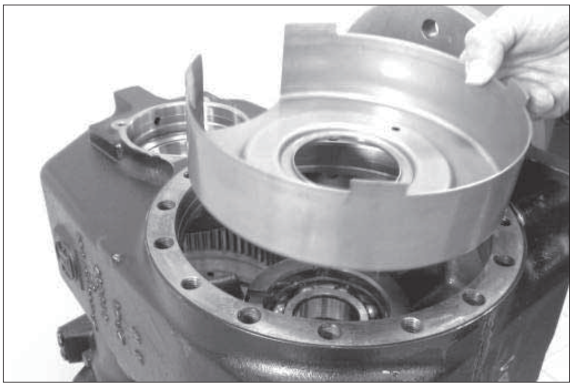
14WF8TM128

22) Remove O-rings (see arrows) from cover.



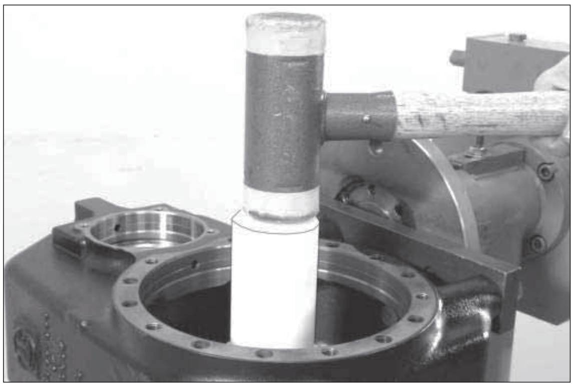
14WF8TM129

23) Remove screen sheet from transmission housing.



14WF8TM130

24) Disassemble ball bearing from housing hole.

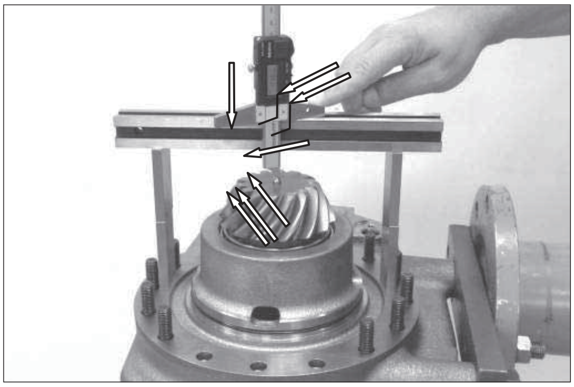


14WF8TM131

8. REASSEMBLY - OUTPUT

1) Seal finished holes (8x) of oil supply holes with screw plugs.

   (S) Lever riveting tongs 5870 320 016



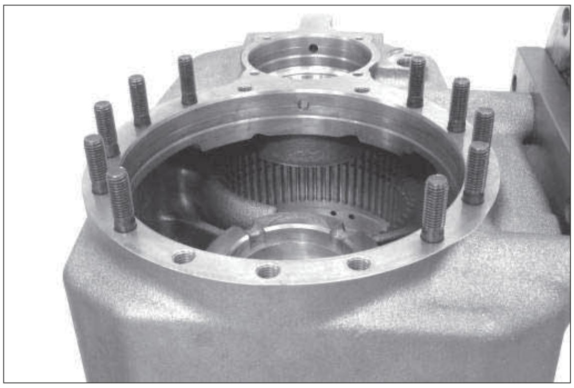
14WF8TM132

Version "Axle attachment"

2) Install stud bolts.

   Tightening torque M_A = 27 Nm

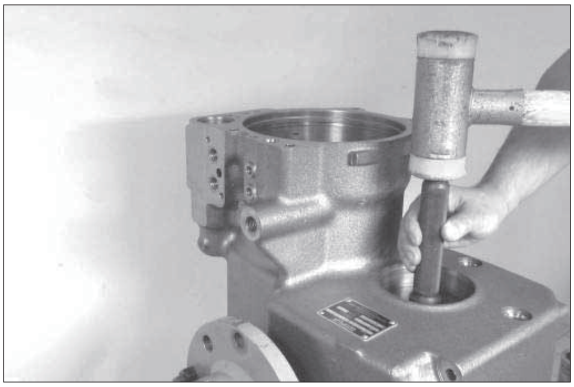
※ Pay attention to installation position.



14WF8TM133

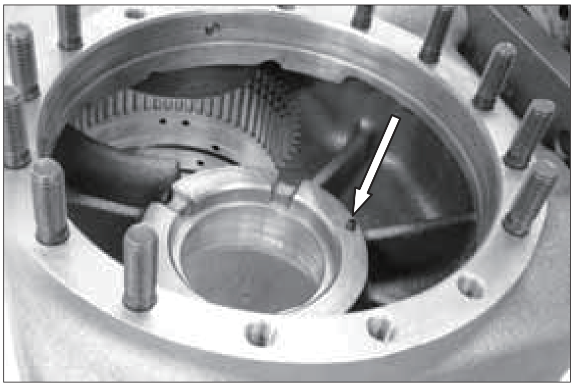
3) Install bearing outer ring until contact.

   (S) Driver tool 5870 058 073
   (S) Handle 5870 260 002



14WF8TM134

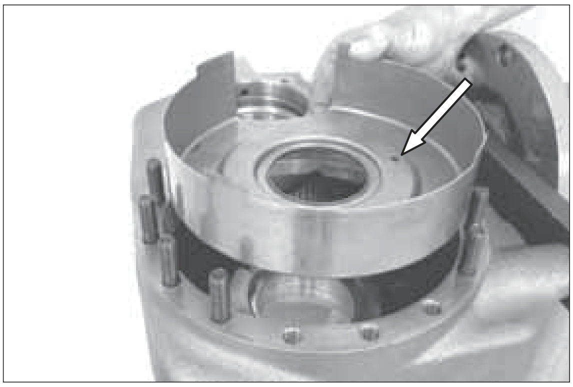
4) Insert slotted pin (see arrow) to the bottom.



14WF8TM135

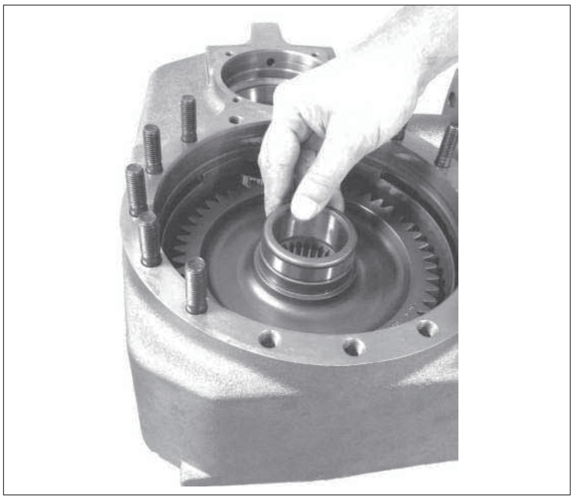
5) Position screen sheet – with slotted pin (see 14WF8TM135) into fixing hole (arrow).

※ Pay attention to installation position, slotted pin = radial fixing of screen sheet.



14WF8TM136

6) Insert output gear with the short collar showing downwards.



14WF8TM137

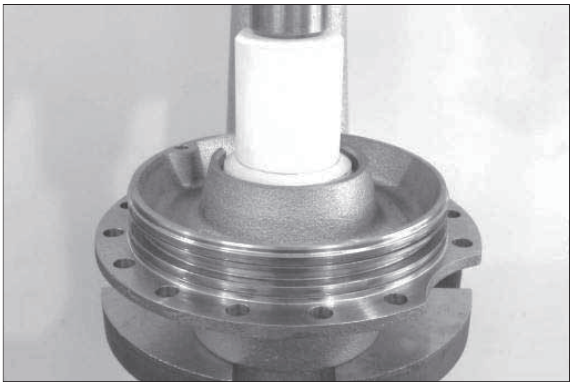
7) Press shaft seal into bearing cover.

(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.

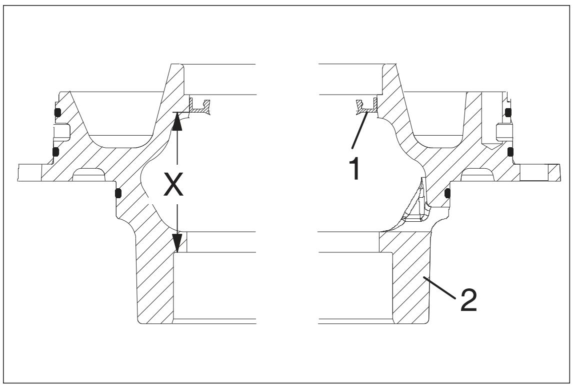


14WF8TM138

8) 1 = Shaft seal

2 = Bearing cover

X = Installation dimension



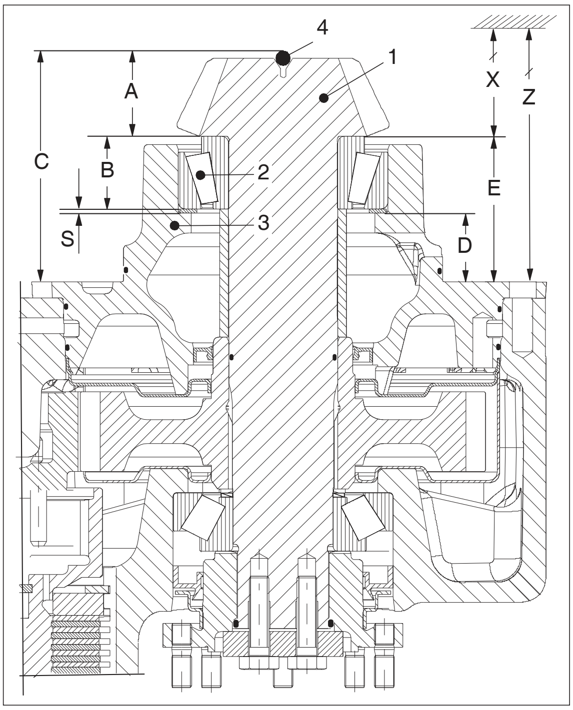
14WF8TM139

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

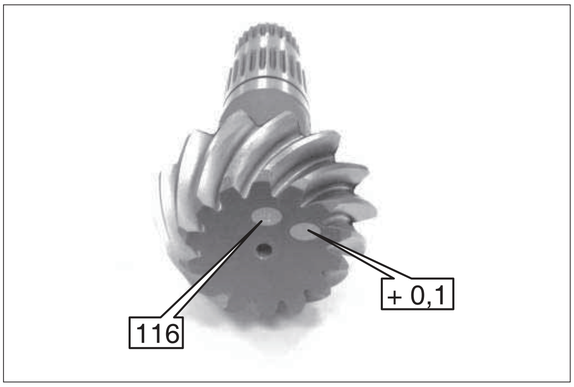
※ Auxiliary dimension A is obligatory to determine reference dimension C – on installed pinion (Fig. 14WF8TM168).

(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

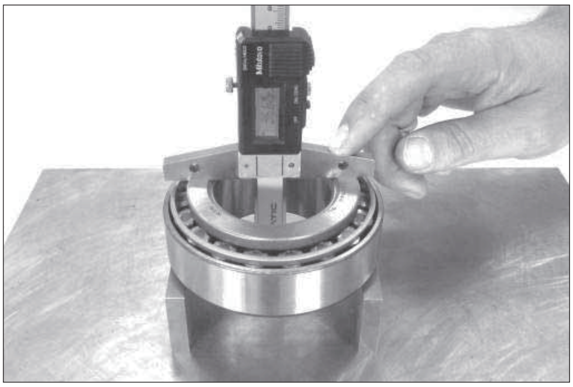


14WF8TM142

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

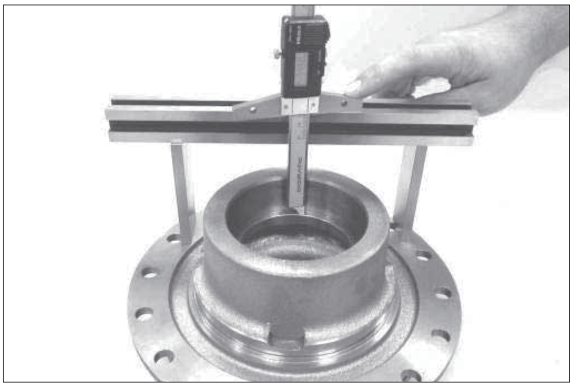


14WF8TM143

13) Determine dim. D (contact surface/bearing cover to contact/bearing hole).

Dim. D = e.g. 35.10 mm

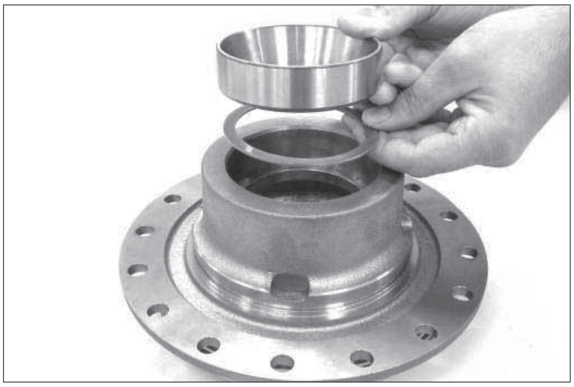
(S) Straightedge (2 sets) 5870 200 066



14WF8TM144

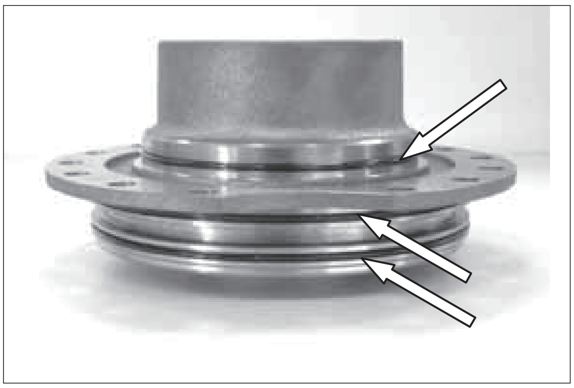
14) Insert determined shim(s) S = e.g. 1.35 mm and install bearing outer ring until contact.

(S) Driver tool	5870 058 078
(S) Handle	5870 260 002



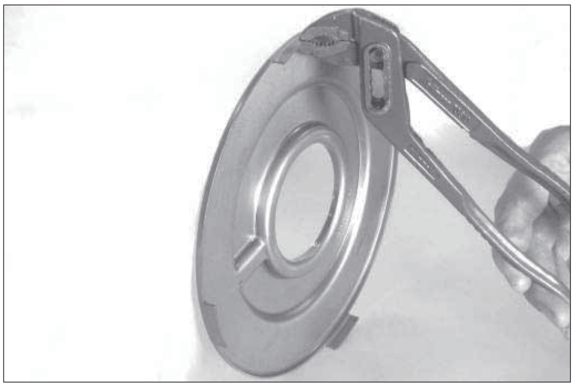
14WF8TM145

15) Oil O-rings (arrows) and insert them into annular grooves of bearing cover.



14WF8TM146

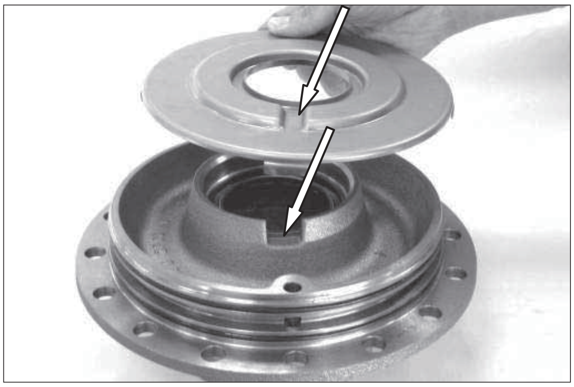
16) Bend edges of fixing straps of oil screen sheet slightly – assembly aid (sheet is fixed to bearing cover – see 14WF8TM148).



14WF8TM147

17) Mount oil screen sheet on bearing cover.

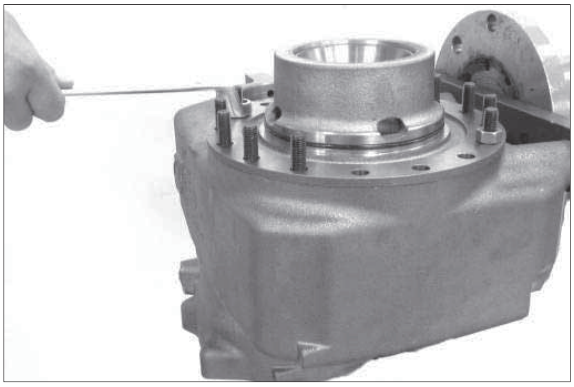
※ Pay attention to installation position – place locating tab of oil screen sheet into recess of bearing cover (see arrow).



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).



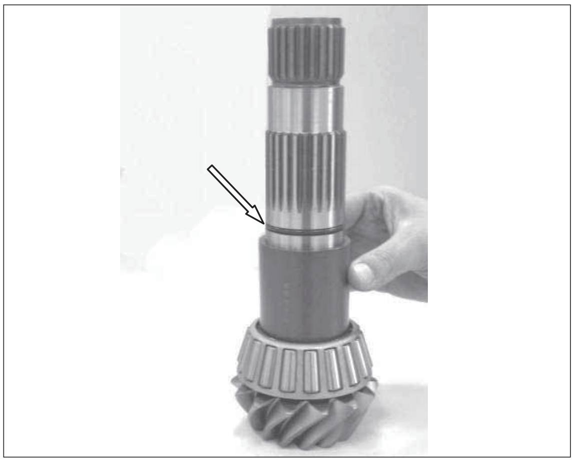
14WF8TM149

19) Install heated bearing inner ring until contact.

※ Adjust bearing inner ring after cooing down.

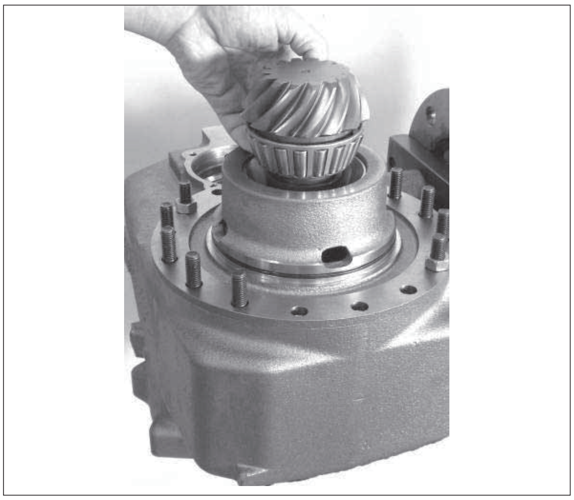
14WF8TM150

20) Mount bush, oil O-ring (arrow) and put it into annular groove.



14WF8TM151

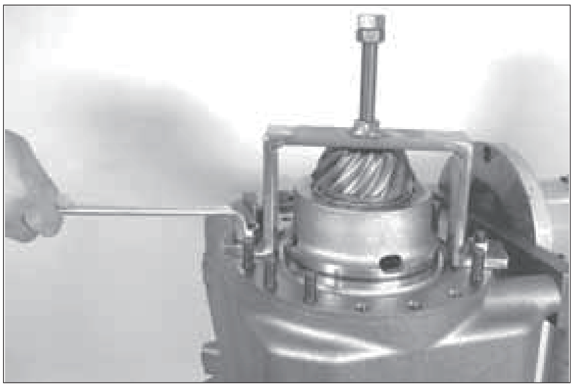
21) Mount preassembled pinion.



14WF8TM152

22) Fix pinion with clamping bar.

(S) Clamping bar 5870 654 049



14WF8TM153

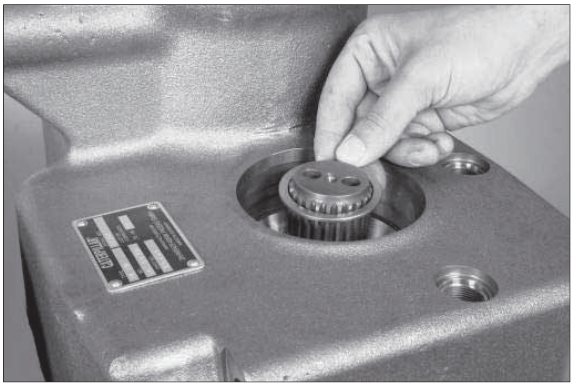
Determine adjusting ring for rolling torque/pinion bearing :

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.



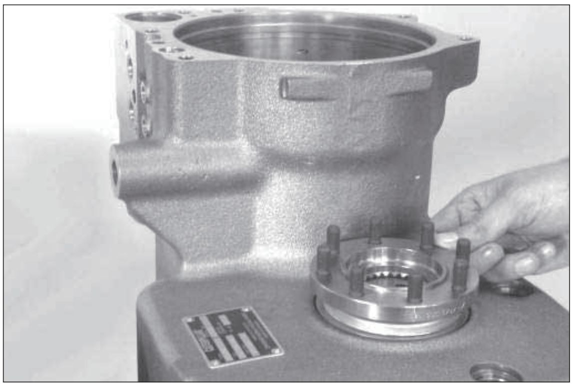
14WF8TM154

24) Insert heated bearing inner ring until contact.

※ Adjust bearing inner ring after cooling down.

14WF8TM155

25) Mount flange.

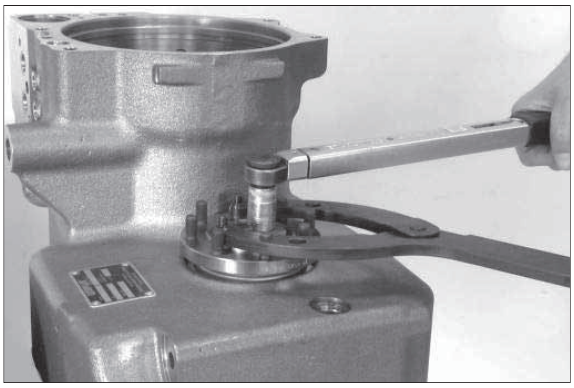


14WF8TM156

26) Place shim and fix flange with hexagon screws.

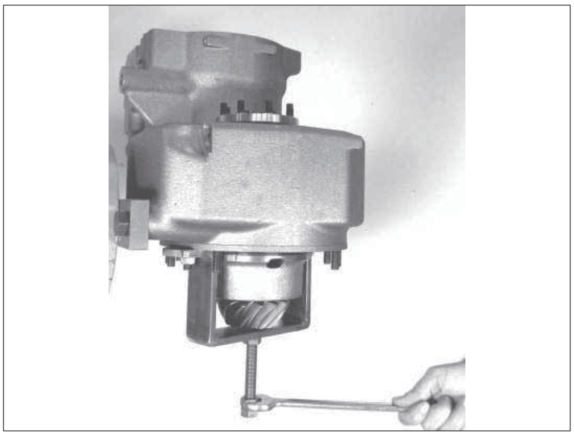
Tightening torque (M 10/10.9) M_A = 68 Nm
(S) Clamping fork 5870 240 025

※ 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

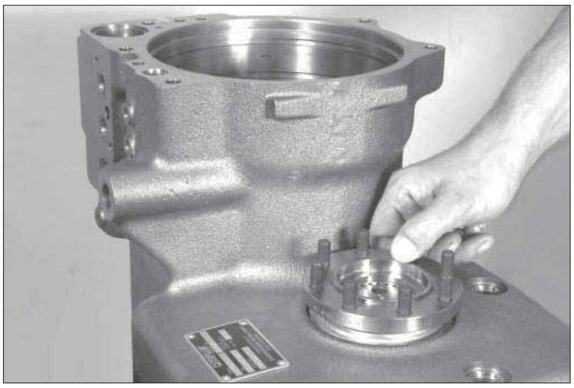
※ When using new roller bearings /for mounted shaft seal, try to achieve the upper value.

※ 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

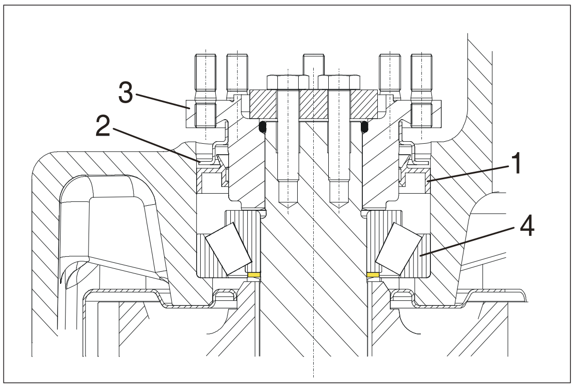
30) Install new shaft seal.

(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

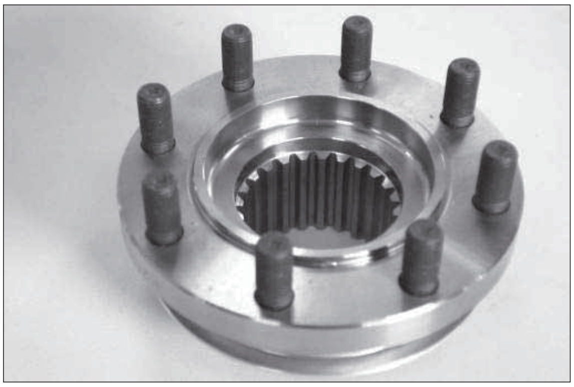


14WF8TM162

32) Install stud bolts.

Tightening torque (M10×1) MA = 20 Nm

※ Pay attention to installation position.
Install stud bolts with short thread length into flange.

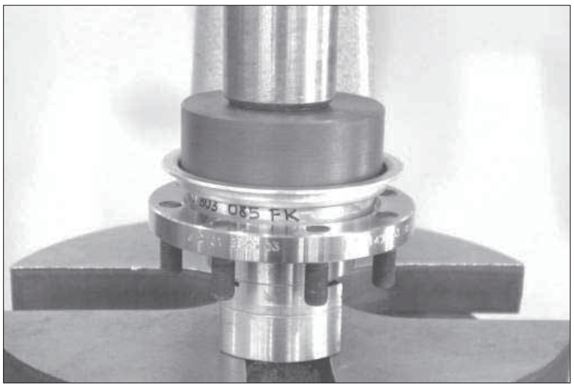


14WF8TM163

33) Install screen sheet (see 14WF8TM162).

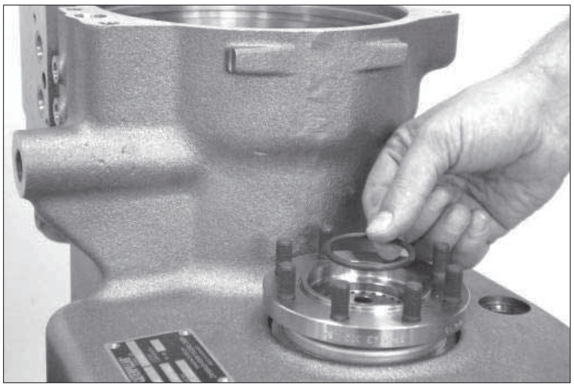
(S) Pressure piece 5870 506 150

※ Use of specified driver tool ensures exact installation position of screen sheet.



14WF8TM164

34) Mount preassembled flange and put O-ring into recess.

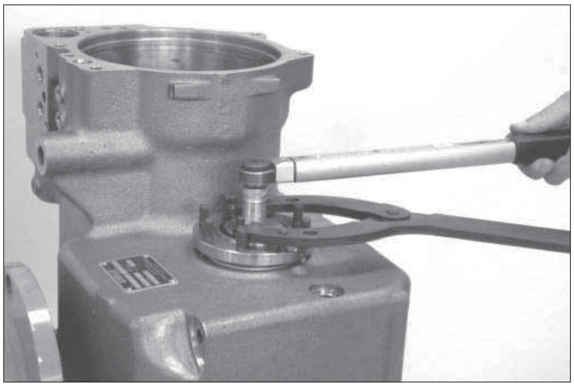


14WF8TM165

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

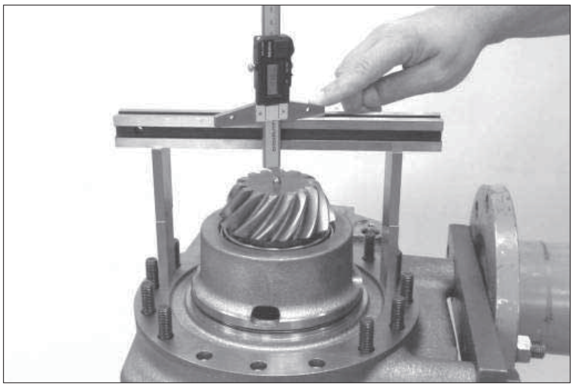
36) Position ball [use Ø = 7 mm → ball Ø like for determination of auxiliary dimension A into centering hole of the pinion and determine dim. C (see 14WF8TM140), from contact surface/bearing cover to ball.

(S) Straightedge 5870 200 108

⚠ If the constant value of dimensionE = 73.00±0.05 mm

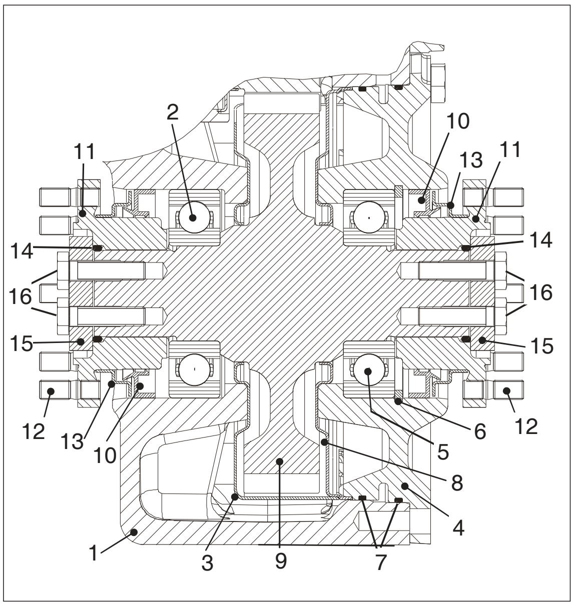
If the constant value of Dim. E = 73.00 ±0.05 mm is not achieved, correct with an adequate shim/pinion gap (see 14WF8TM145).

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.



14WF8TM167

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

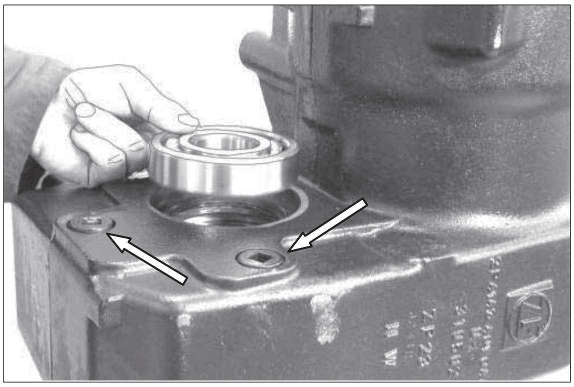


14WF8TM168

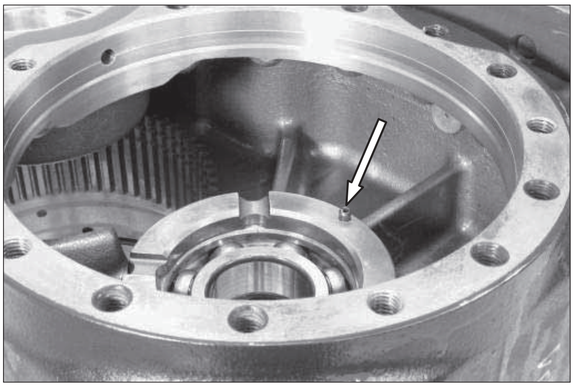
38) Provide screw plugs (see arrows) with new O-ring and install it.

Tightening torque M_A = 80 Nm

※ Then insert ball bearing (2) until contact.

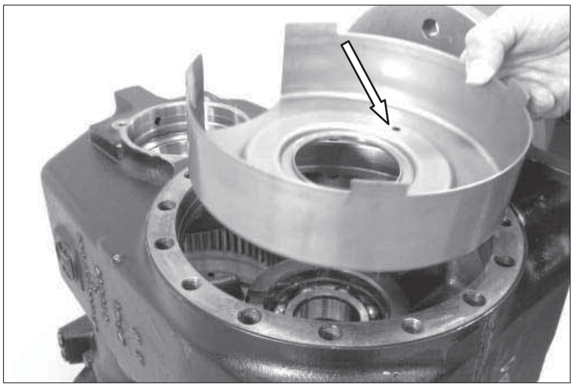

14WF8TM169

39) Rotate transmission by 180˚.
Insert slotted pin (see arrow) to the bottom.


14WF8TM170

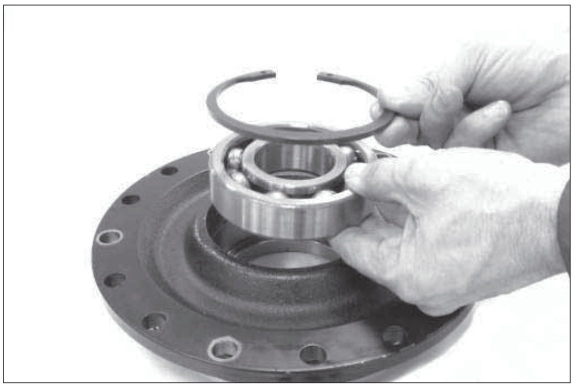
40) Position screen sheet – with slotted pin into fixing hole (arrow).

※ Observe installation position –slotted pin = radial fixing of screen sheet.



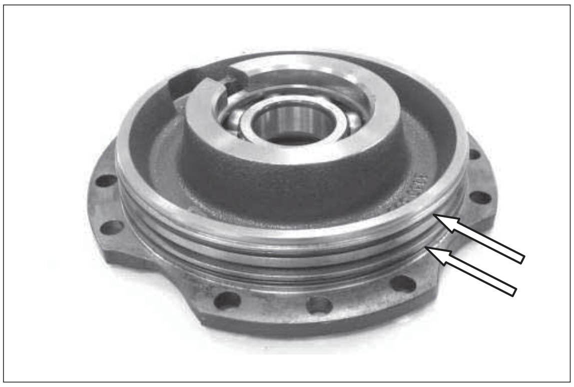
14WF8TM171

41) Insert ball bearing into cover and fix with retaining ring.



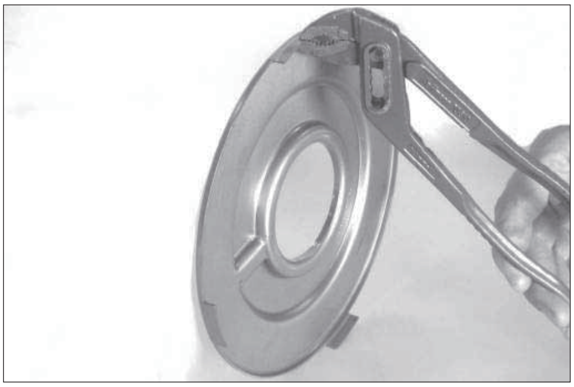
14WF8TM172

42) Oil both O-rings (arrows) and insert them into annular grooves of planetary carrier.



14WF8TM173

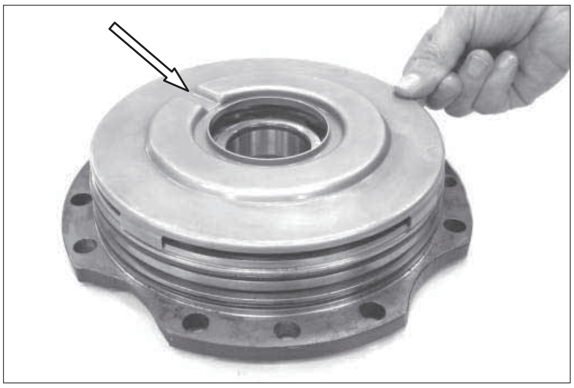
43) Bend edges of fixing straps of oil screen sheet slightly. Assembly aid screen sheet is fixed to bearing cover – see 14WF8TM176).



14WF8TM174

44) Insert oil screen sheet onto bearing cover

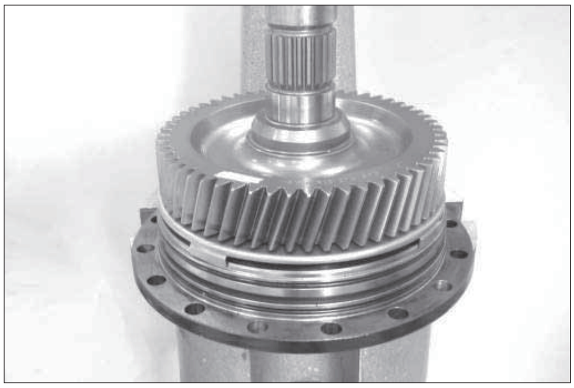
※ Observe installation position - place locating tab (see arrow) into recess of bearing cover (radial fixing).



14WF8TM175

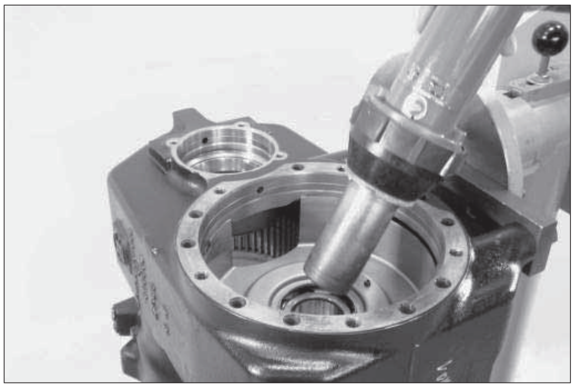
45) Press output gear into ball bearing/bearing cover.

※ Support ball bearing onto bearing inner ring.



14WF8TM176

46) Heat bearing inner ring of ball bearing.

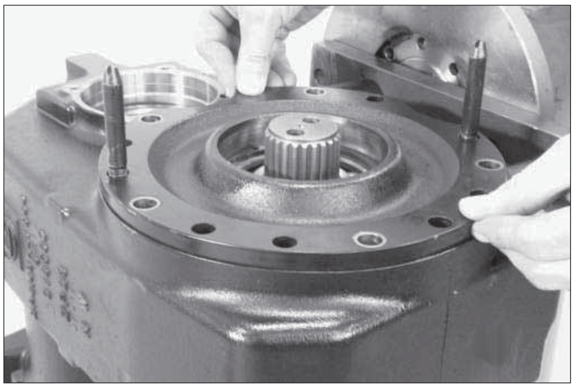


14WF8TM177

47) Attach two adjusting screws and mount preassembled bearing cover/output gear until contact.

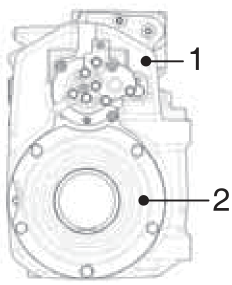
(S) Adjusting screws (M12) 5870 204 021

※ Observe installation position of bearing cover (2) in transmission (1) – transmission installation VERTICAL or HORIZONTAL - see detailed sketches below:

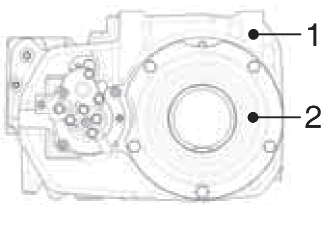


14WF8TM178

<VERTICAL>

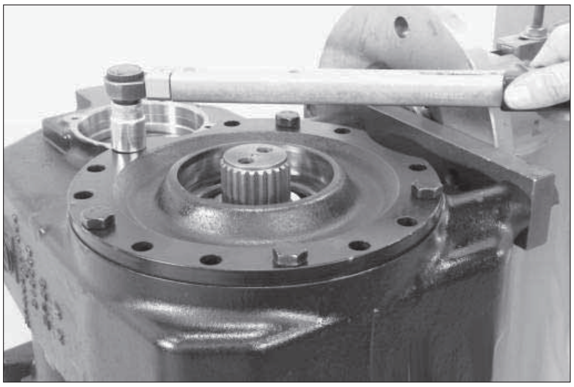


<HORIZONTAL>



48) Fix bearing cover by means of hexagon screws.

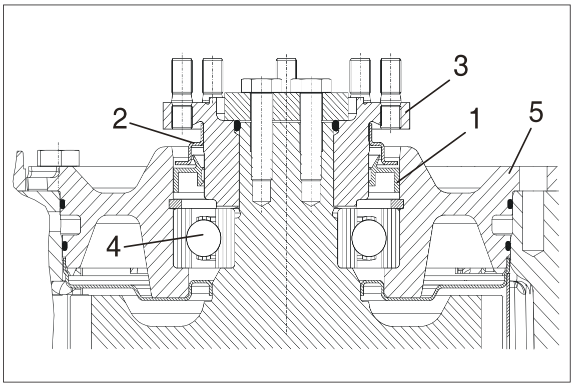
Tightening torque (M 12/8.8) M_A = 80 Nm



14WF8TM181

Shaft seal output flange

49) 1 = Shaft seal
2 = Metal sheet
3 = Output flange
4 = Ball bearing
5 = Bearing cover

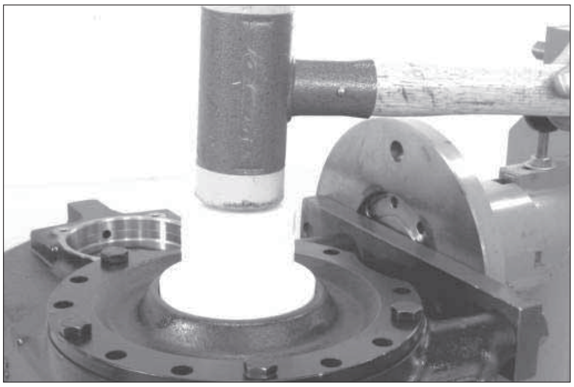


14WF8TM182

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.

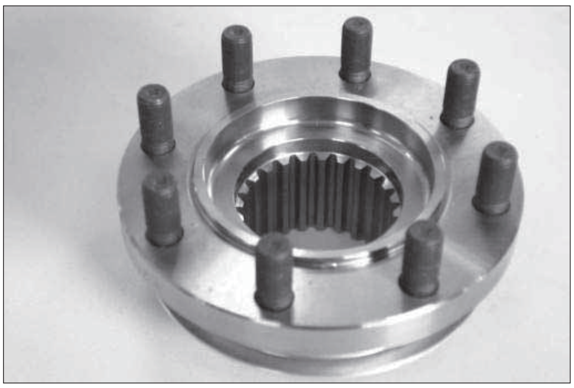


14WF8TM183

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.

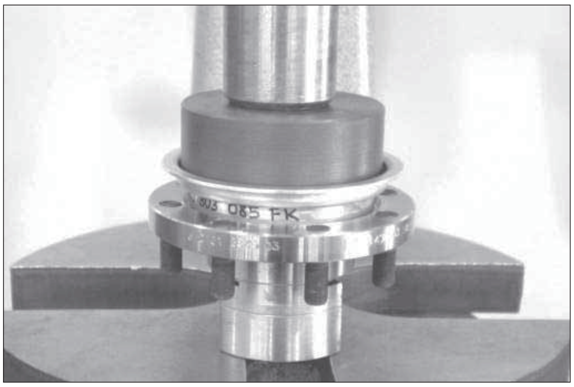


14WF8TM184

52) Install screen sheet (see 14WF8TM183).

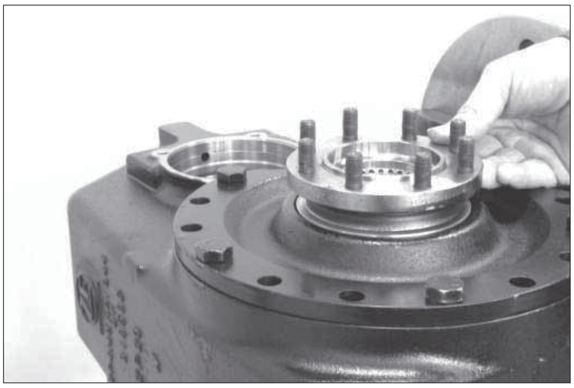
(S) Pressure piece 5870 506 150

※ Use of specified driver tool ensures exact installation position of screen sheet.



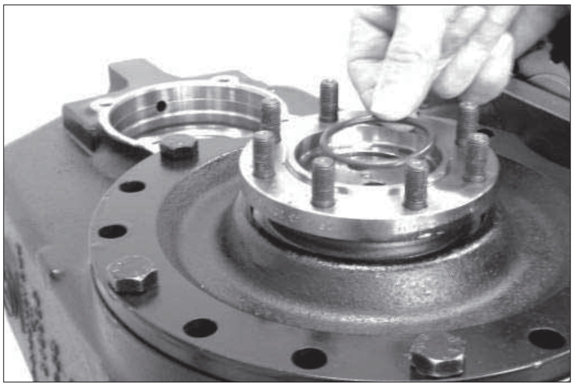
14WF8TM185

53) Install preassembled output flange.



14WF8TM186

54) Insert O-ring.

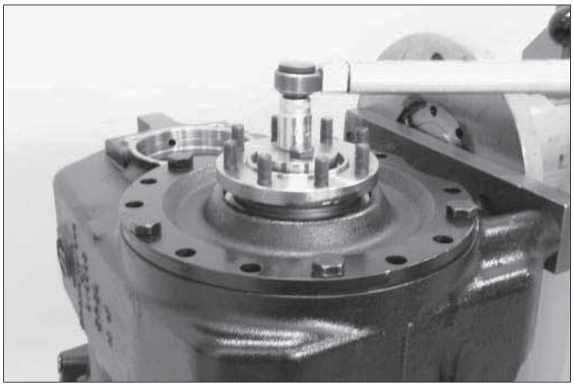


14WF8TM187

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

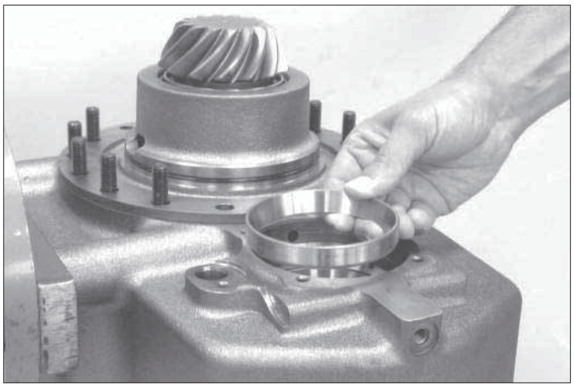
9.REASSEMBLY - BRAKE / CLUTCH / PLANETARY CARRIER

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.

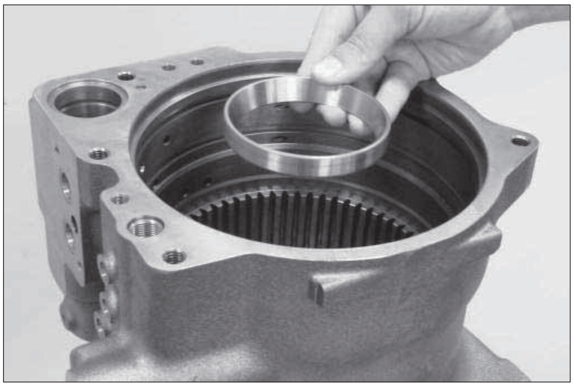


14WF8TM189

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.



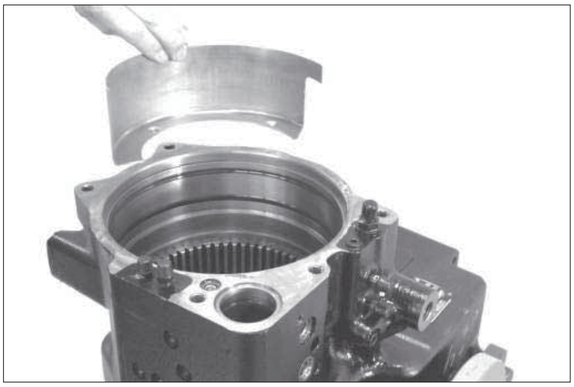
14WF8TM190

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

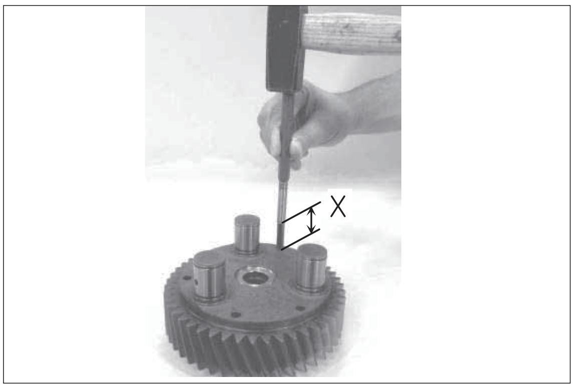
Wet countersunk screws with Loctite type no.243.



14WF8TM191

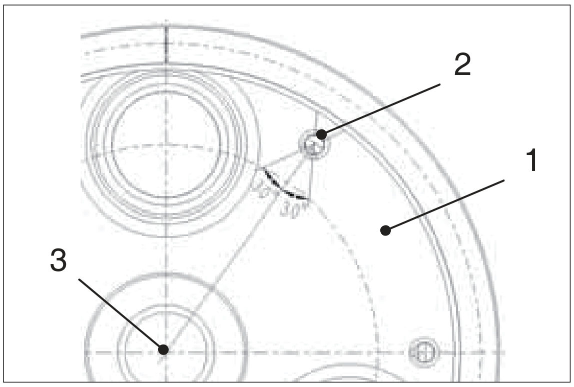
4) Install slotted pins (2) considering installation dimension X and installation position, see 14WF8TM193 (groove showing to center).

(S) Press-fit mandrel AA00 392 151



14WF8TM192

5) 1 = Planetary carrier
   2 = Slotted pin (6x)
   3 = Center (planetary carrier)

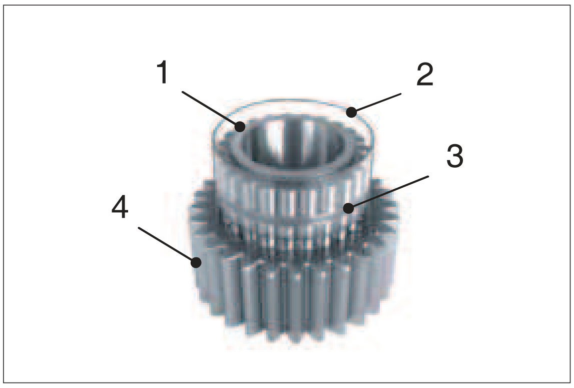


14WF8TM193

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

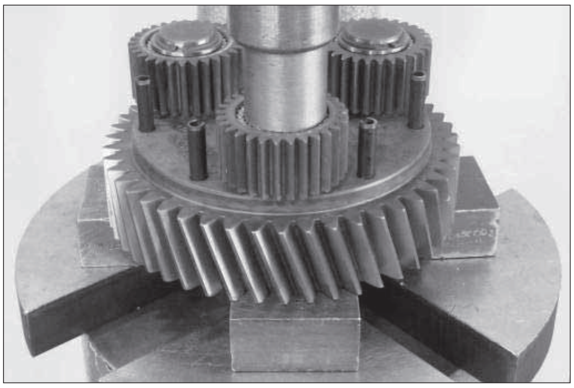


14WF8TM194

7) Press on planetary gear over bearing inner ring until contact.

   (S) Driver tool 5870 048 283

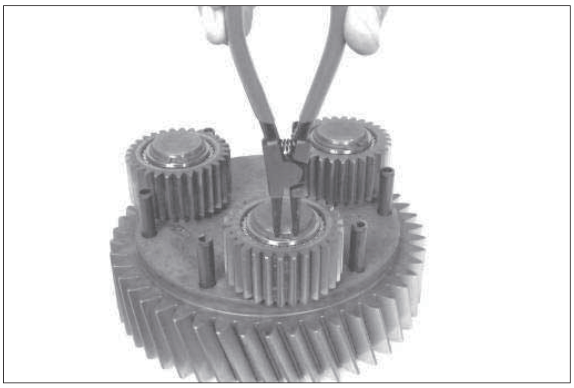
※ Install planetary gears with large radius on cylindrical roller bearing (downwards) towards planetary carrier.



14WF8TM195

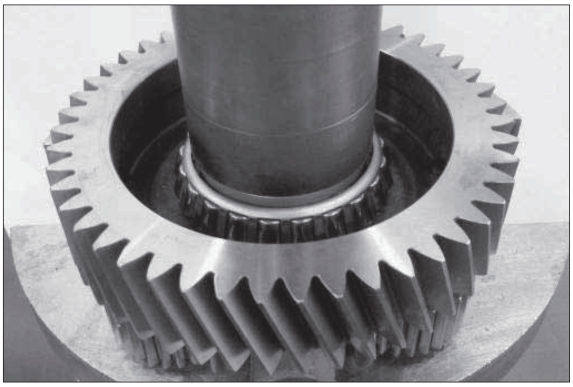
8) Engage retaining ring.

※ Adjust retaining ring until contact with groove base.



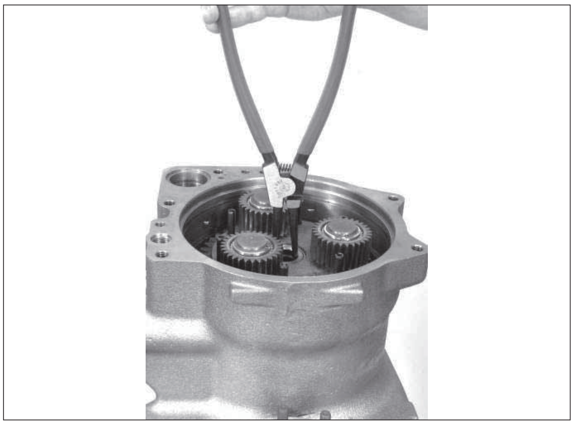
14WF8TM196

9) Press bearing inner ring onto planetary carrier until contact.



14WF8TM197

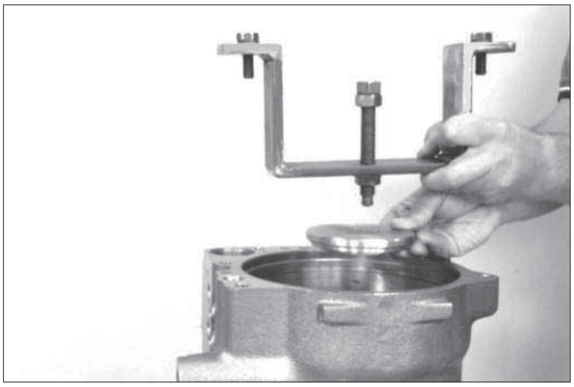
10) Insert preassembled planetary carrier.



14WF8TM198

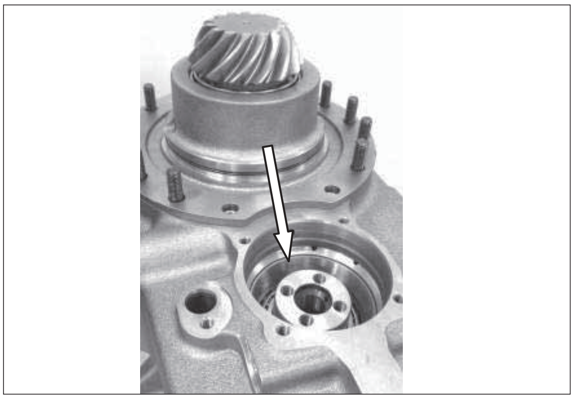
11) Fix planetary carrier with pressure plate and clamping bar.

(S) Clamping bar 5870 654 049



14WF8TM199

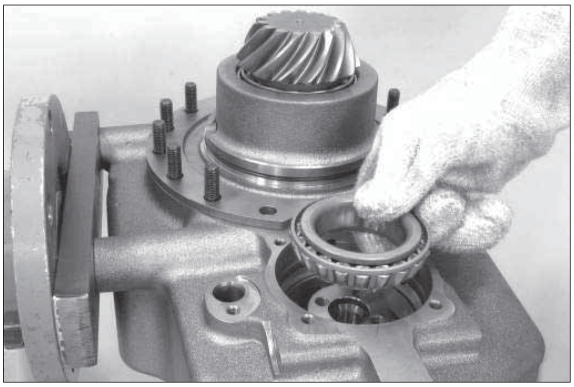
12) Rotate transmission by 180˚.
Check contact of bearing outer ring (see arrow). Reassembly of bearing outer ring, see 14WF8TM189.



14WF8TM200

13) Install heated bearing inner ring until contact.

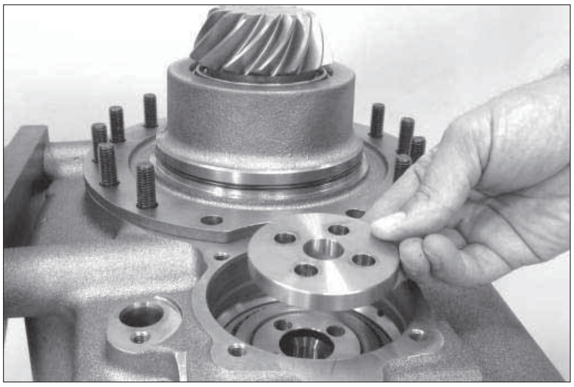
※ Adjust bearing inner ring after cooling down.



14WF8TM201

14) Position disk and manually turn in hexagon screws (fix planetary carrier).

Then remove clamping bar, see 14WF8TM199.

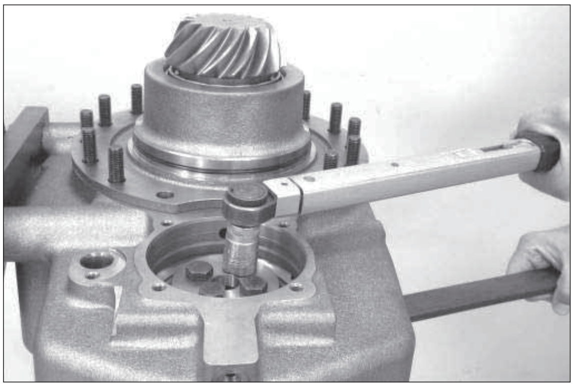


14WF8TM202

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

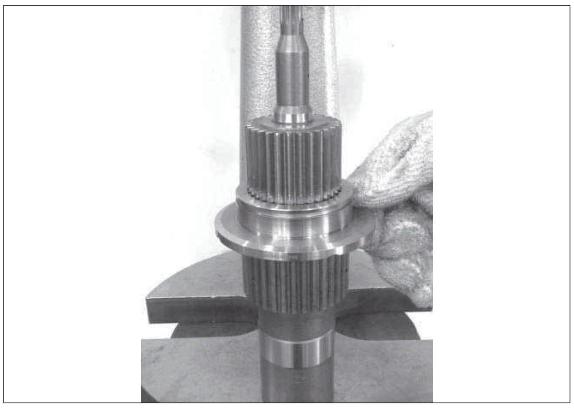
※ While tightening hexagon screws, rotate planetary carrier several times in both directions (roller setting).



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.

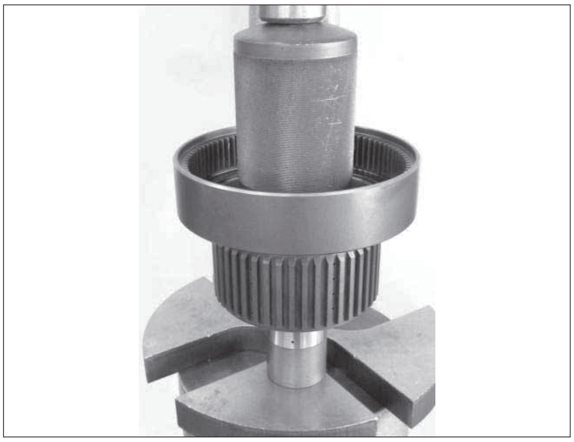
(S) Clamping pliers 5870 900 021

14WF8TM206

19) Heat bearing inner ring of ball bearing.

14WF8TM207

20) Mount preassembled ring gear to input shaft until contact.



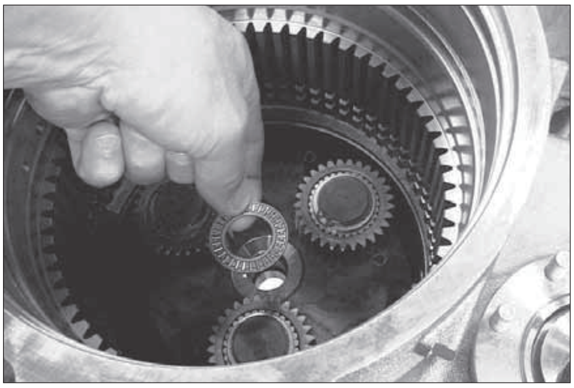
14WF8TM208

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

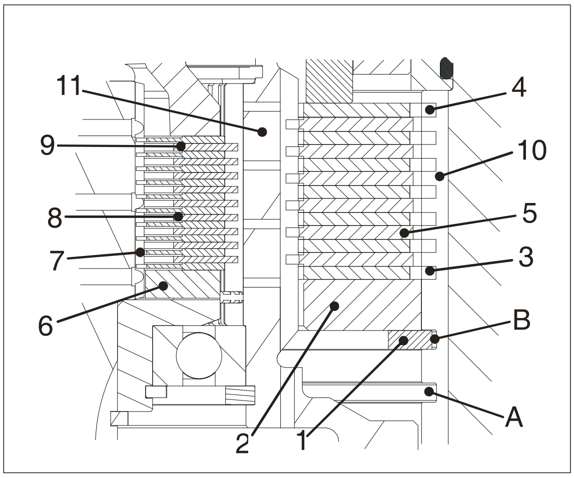
23) Insert preassembled input shaft (with ring gear).

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



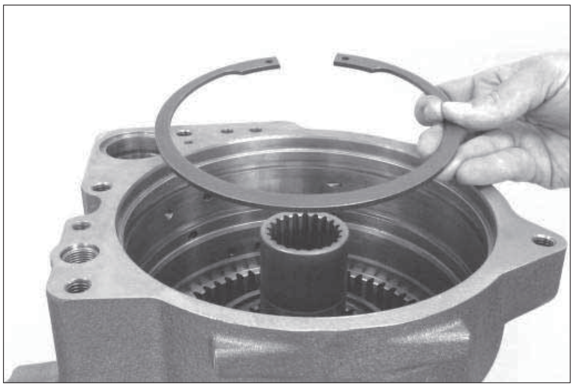
14WF8TM213

Reassembly brake :

25) Engage retaining ring (1) into annular groove (A).

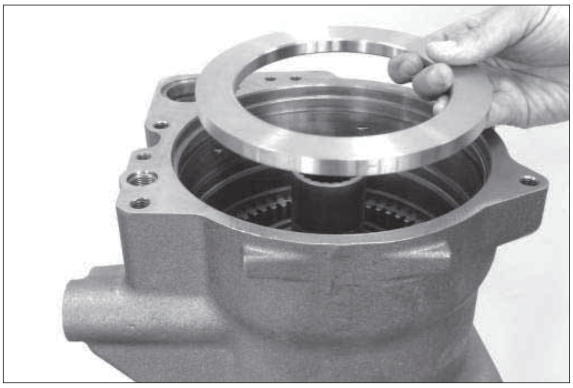
(S) Clamping pliers 5870 900 021

※ Observe installation position of retaining ring (1).



14WF8TM215

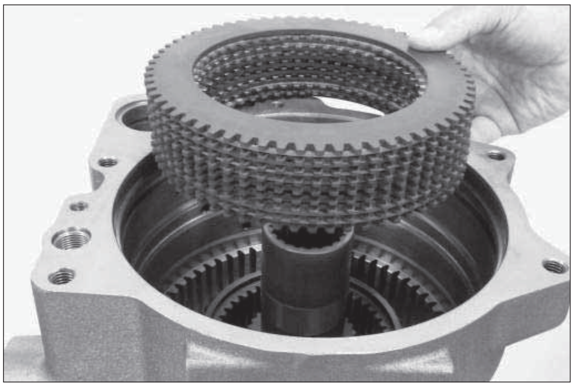
26) Insert end plate (2).



14WF8TM216

27) Insert disk package alternately, beginning with an outer disk.

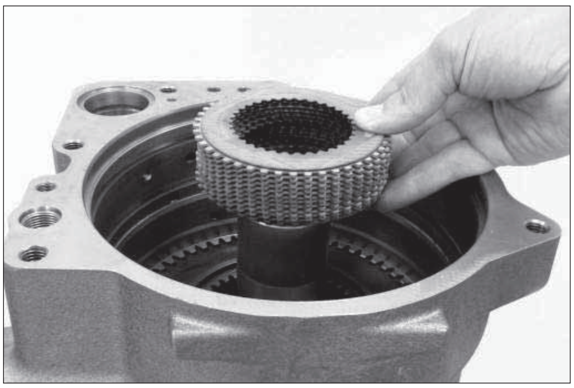
※ Position outer disk (1 pc) s = variable 2.8 ~ 3.7 mm to top of disk package (piston side). With outer disk s = variable, disk clearance/ piston stroke is adjusted - see 14WF8TM229.



14WF8TM217

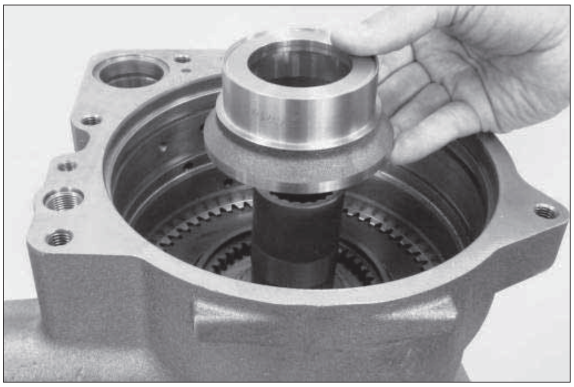
38) Insert disk package alternately, beginning with a lining disk.

※ 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.



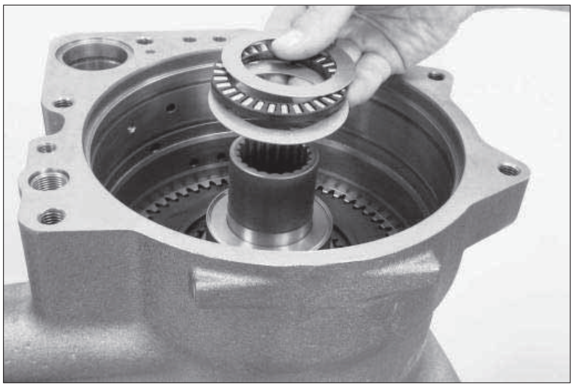
14WF8TM218

29) Mount pressure piece (without compression spring).



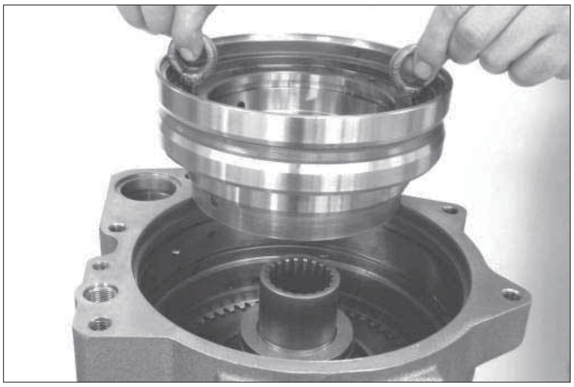
14WF8TM219

30) Oil axial roller cage and mount it with both axial washers (1x each, positioned underneath and onto axial needle cage).



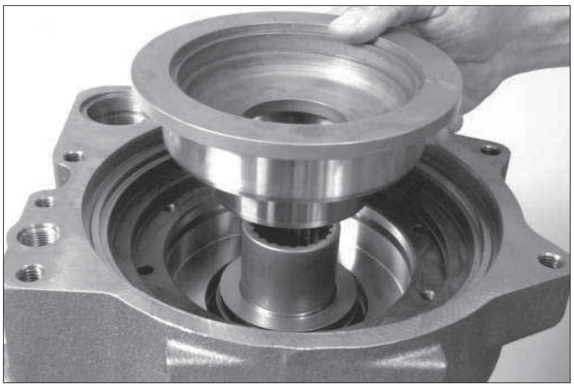
14WF8TM220

31) Insert piston (brake) – without mounted sealing elements.



14WF8TM221

32) Insert piston (clutch) – without mounted sealing elements.

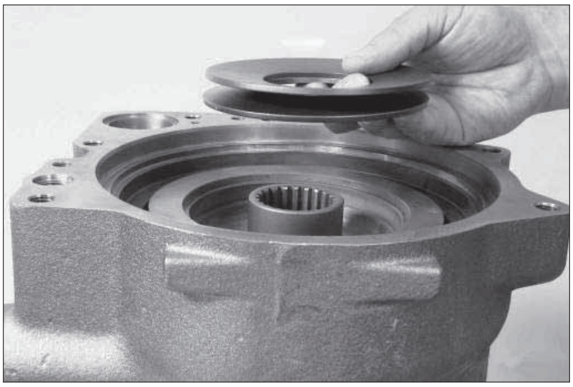


14WF8TM222

33) Insert both cup springs/clutch.

※ Fix cup springs with grease and position them centrically.

※ Observe installation position, see 14WF8TM225.

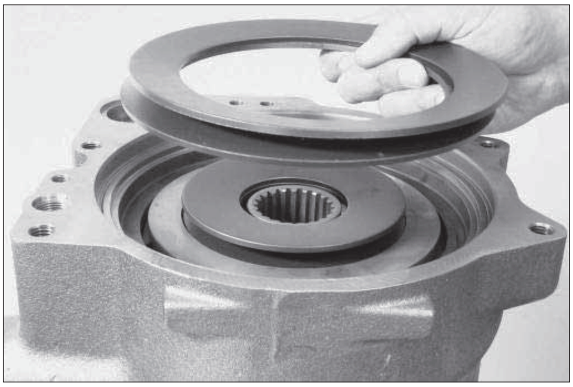


14WF8TM223

34) Insert both cup springs/brake.

※ Fix cup springs with grease and position them centrically.

※ Observe installation position, see 14WF8TM225.



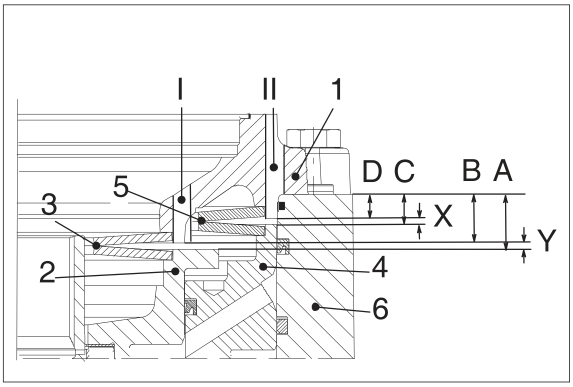
14WF8TM224

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

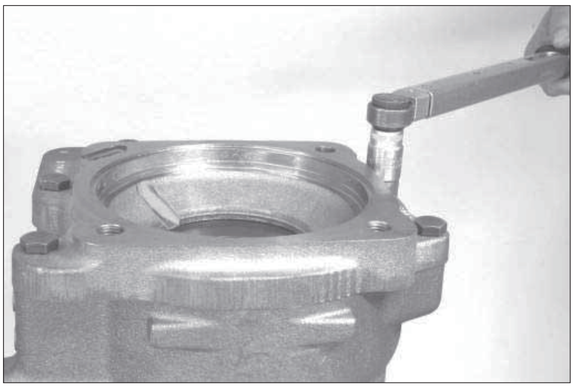
Y = Disk clearance/Clutch → 2.4 +0.3 mm (piston stroke)
X = Disk clearance/Brake → 1.8 + 0.3 mm (piston stroke)



14WF8TM225

36) Locate measuring device evenly with hexagon screws (risk of breakage) until contact.

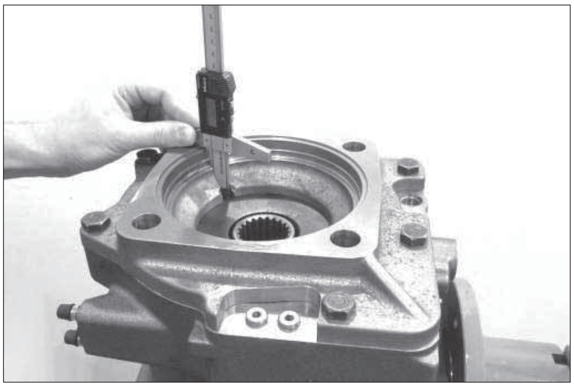
Tightening torque (M 12/8.8) M_A = 80 Nm
(S) Measuring device 5870 200 131



14WF8TM226

37) Determine dim. A (Measuring hole I) from mounting face/housing to front face/piston (clutch).

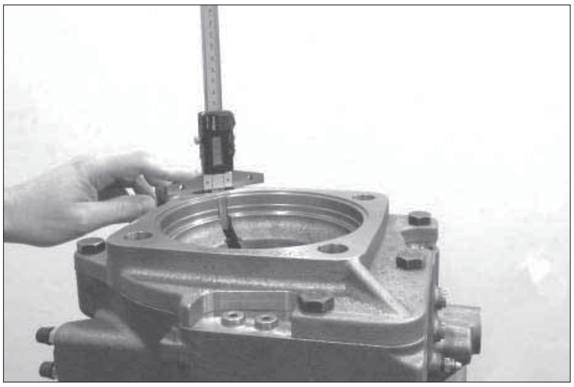
Dim. A e.g. = 22.45 mm
(S) Straightedge 5870 200 108



14WF8TM227

38) Determine Dim. C (Measuring hole II) from mounting face/housing to front face/piston (brake).

Dim. C e.g. = 11.85 mm



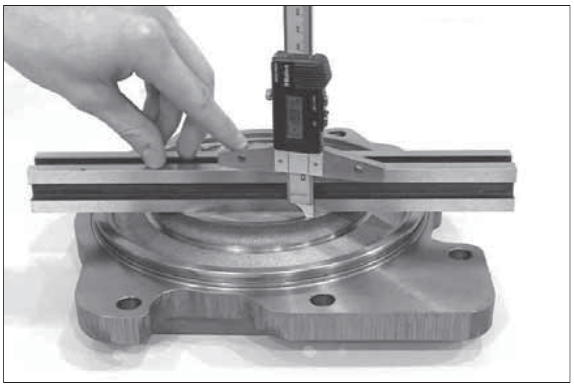
14WF8TM228

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.**



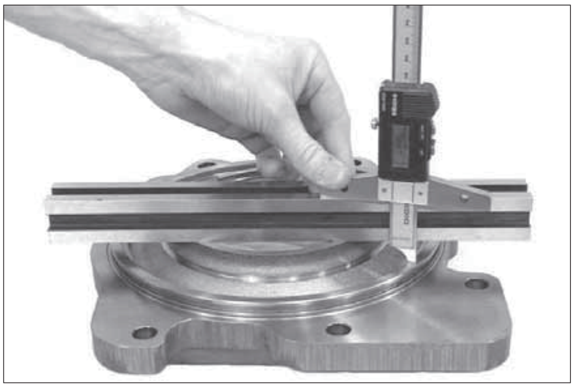
14WF8TM229

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)

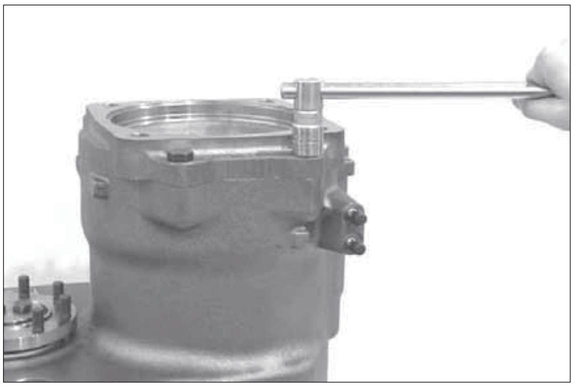
Disk clearance (piston stroke) Brake = $1.8^{+0.3}$ mm

⚠ **If the required disk clearance (piston stroke) is not obtained, correct with a suitable outer disk – see 14WF8TM217.**



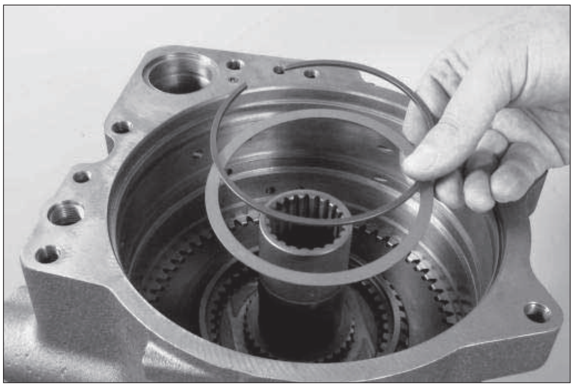
14WF8TM230

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.

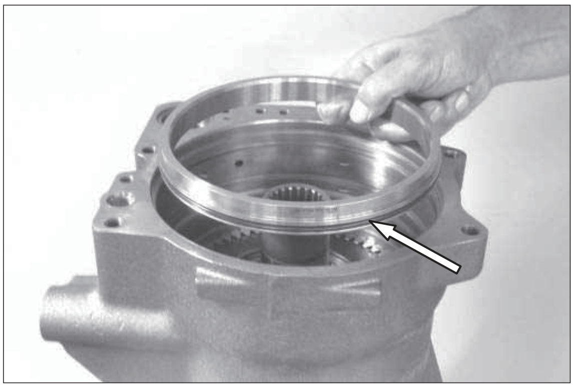


14WF8TM232

43) Place O-ring (see arrow) into groove and insert ring.

※ Oil sealing surfaces in housing and O-ring for reassembly.

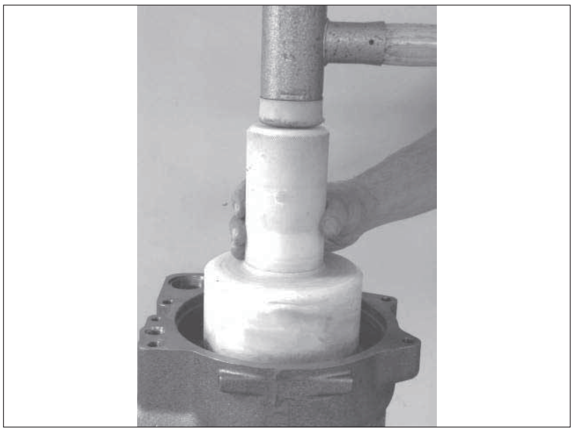
※ Observe installation position



14WF8TM233

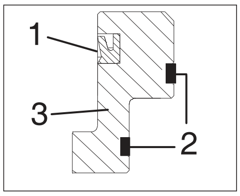
44) Mount ring with driver tool until contact.

(S) Driver tool 5870 506 161

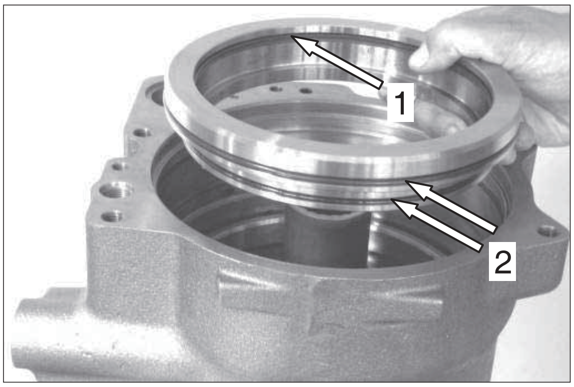


14WF8TM234

45) Oil sealing surfaces in housing and sealing elements. Insert seal (1) with sealing lip showing to oil sump – also see detail sketch.



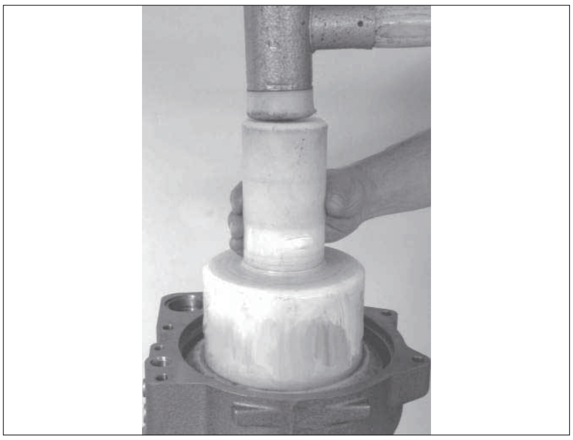
Put both O-rings (2) into annular grooves of pressure ring (3) and insert preassembled pressure ring into housing.



14WF8TM235

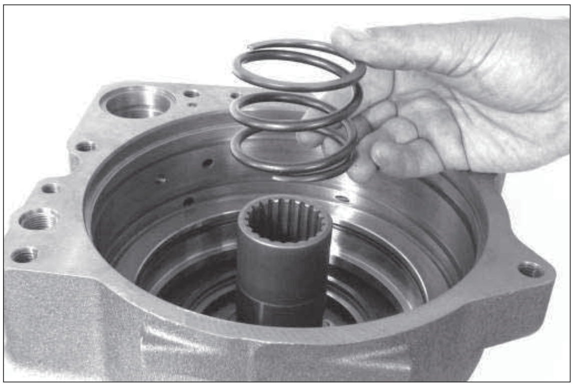
46) Bring pressure ring with driver tool into contact position.

(S) Driver tool 5870 506 161



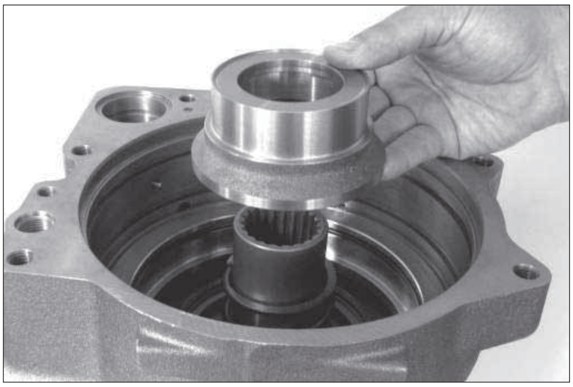
14WF8TM237

47) Insert compression spring until contact.



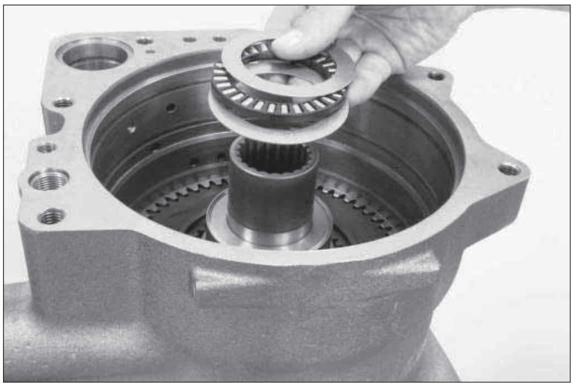
14WF8TM238

48) Insert pressure piece over compression spring until contact.



14WF8TM239

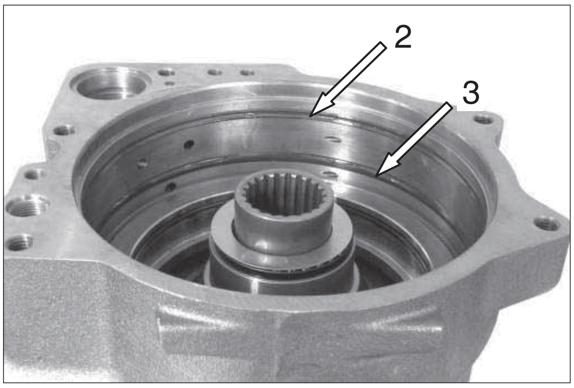
49) Oil axial roller cage and mount it with both axial washers (1x each to be positioned underneath and onto axial needle cage).



14WF8TM240

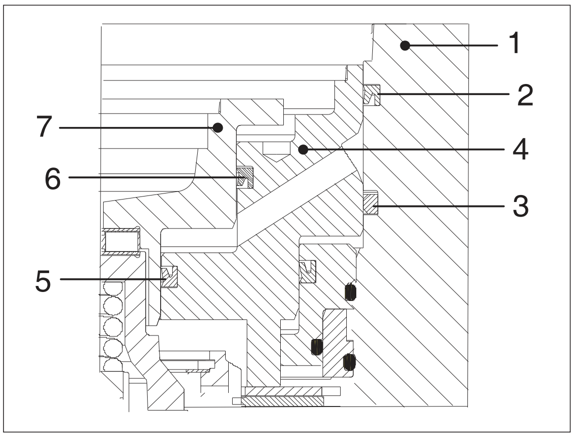
50) Insert seal (2, with sealing lip showing to oil sump) and seal (3) – see 14WF8TM242 into housing (1).

※ Oil sealing elements and sealing surfaces on piston for reassembly.



14WF8TM241

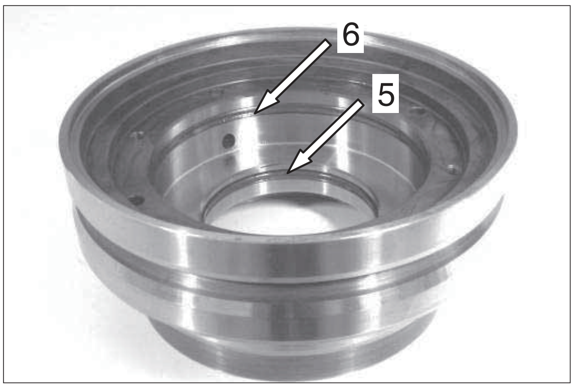
51) 1 = Housing
2 = Seal (with sealing lip)
3 = Seal
4 = Piston / Brake
5 = Seal (with sealing lip)
6 = Seal (with sealing lip)
7 = Piston / Clutch



14WF8TM242

52) Insert seals (5 and 6, see 14WF8TM247), with sealing lips showing to oil sump into piston / brake (4).

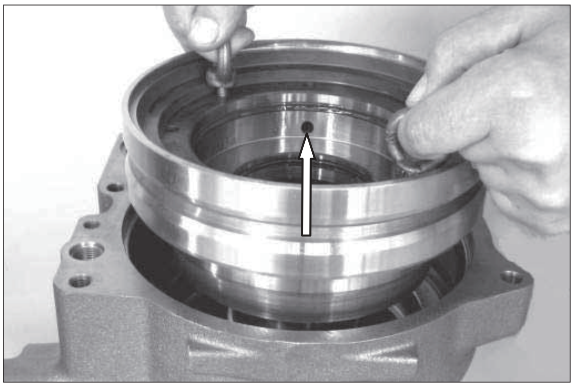
※ Oil sealing surfaces on piston and sealing elements for reassembly.



14WF8TM243

53) Insert preassembled piston/brake until contact.

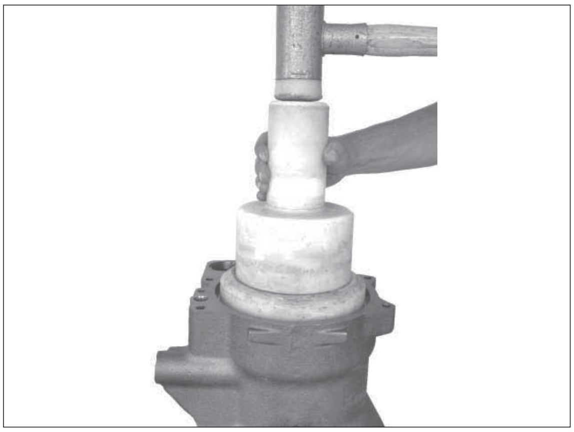
※ Position piston in such a way that oil supply hole (see arrow) is at 12.00 o'clock position.
Observe version as to transmission installation position HORIZONTAL – VERTICAL.



14WF8TM244

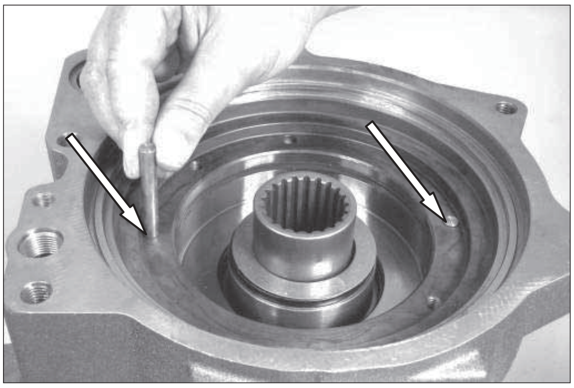
54) Use driver tool to bring piston into contact position.

(S) Driver tool 5870 506 161



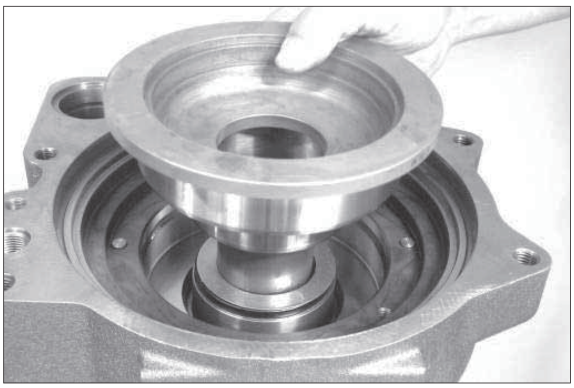
14WF8TM245

55) Insert both cyl. pins (arrow).



14WF8TM246

56) Insert piston/clutch until contact.

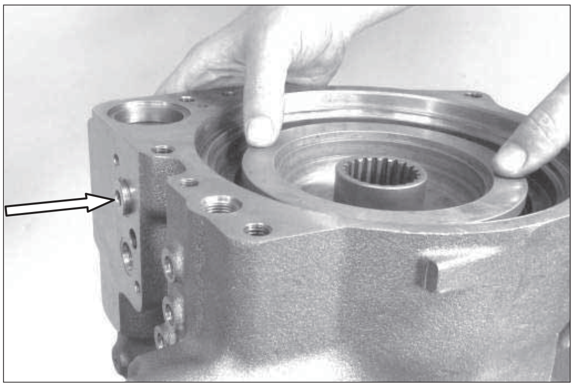


14WF8TM247

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 MA = 40 Nm

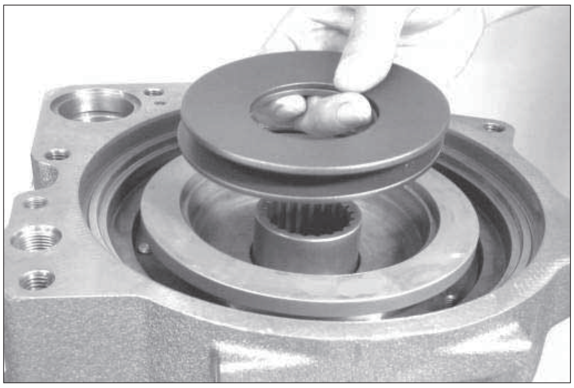
※ Axial position of piston is maintained (Facilitate assembly for installation of input housing, see 14WF8TM254~ 14WF8TM255).



14WF8TM248

58) Insert both cup springs/clutch.

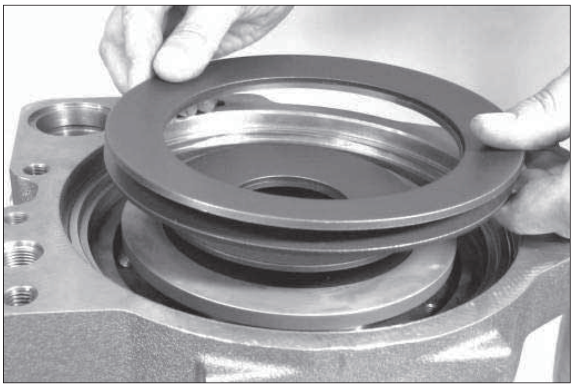
※ Observe installation position, see also 14WF8TM225.



14WF8TM249

59) Insert both cup springs/brake.

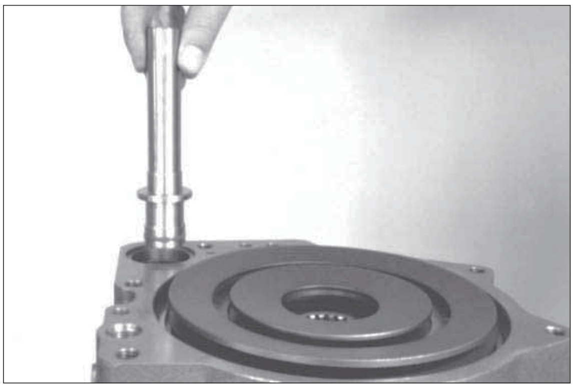
※ Observe installation position – see also 14WF8TM225.



14WF8TM250

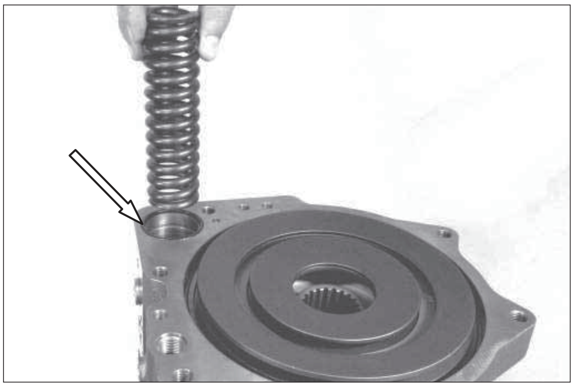
Install modulation valve and input housing

60) Insert piston (modulation valve cpl. – can only be replaced as unit).



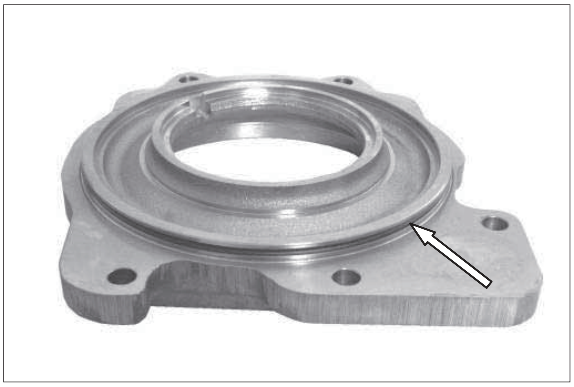
14WF8TM251

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.

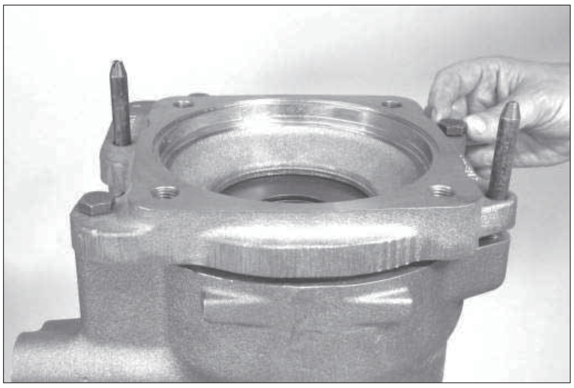


14WF8TM253

63) Insert two adjusting screws (M 12), mount input housing and fix it with hexagon screws.

(S) Adjusting screws (M12)　　5870 204 021

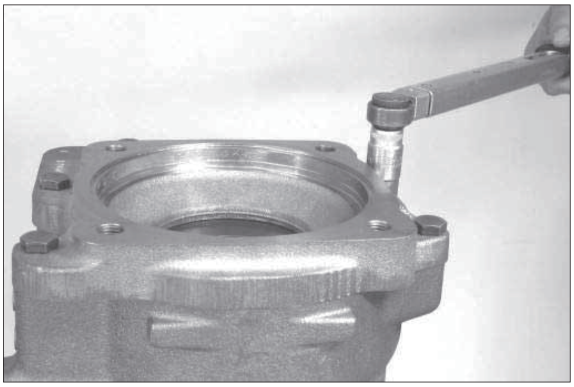
※ For installation of input housing align cup springs centrically.



14WF8TM254

64) Locate input housing evenly with hexagon screws (risk of breakage) until contact.

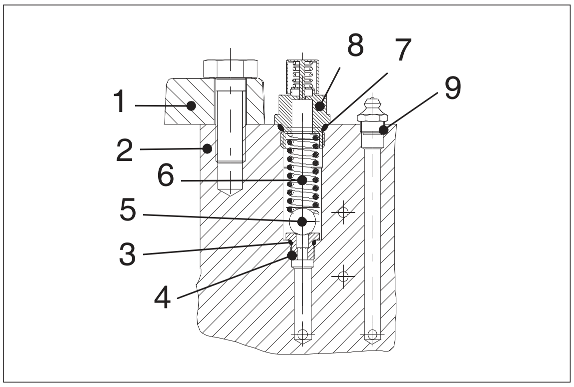
Tightening torque (M 12/8.8)　　M_A = 80 Nm



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



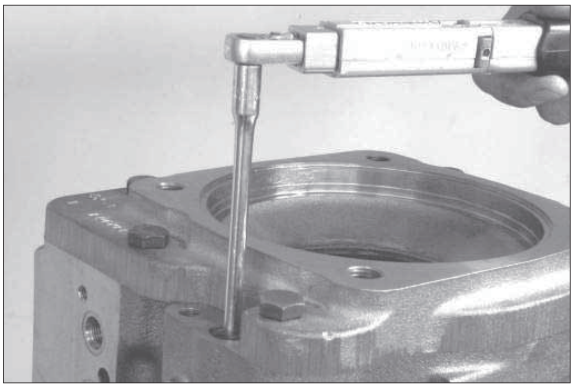
14WF8TM256

※ Position of lubrication nipple for version transmission installation position Horizontal, see 14WF8TM261.

※ Remove protective cap of lubrication nipple only if emergency release is required.

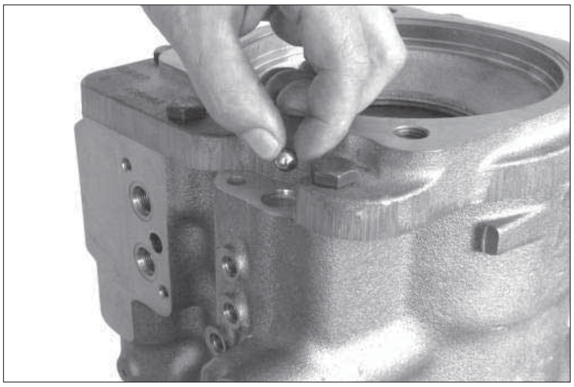
66) Install threaded element (4) with new O-ring (3).

Tightening torque (M 10×1) MA = 15 Nm



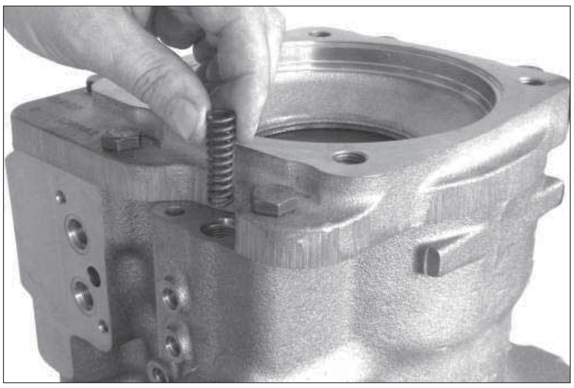
14WF8TM257

67) Insert ball (5).



14WF8TM258

68) Insert compression spring (6).



14WF8TM259

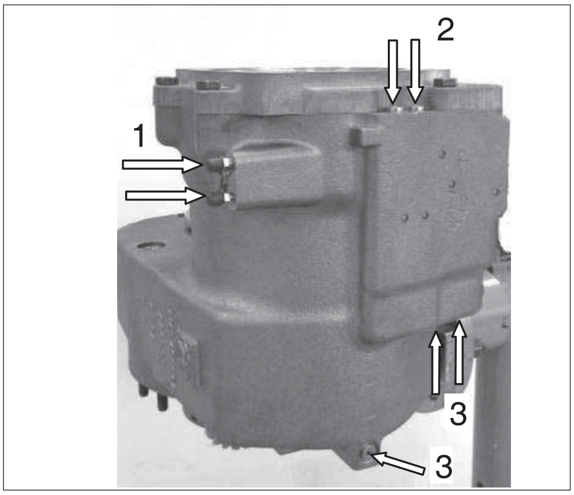
Check emergency release for leak tightness

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.

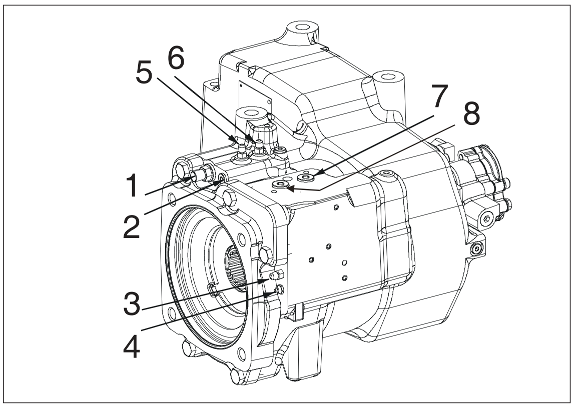
Install both breather valves (1), screw plugs (2) with new seal rings and screw plugs (3) with new O-rings.

Breather valve (M 10×1) MA = 15 Nm
Screw plug (M 10×1 with seal ring) MA = 20 Nm
Screw plug (M 10×1 with O-ring) MA = 20 Nm



14WF8TM260

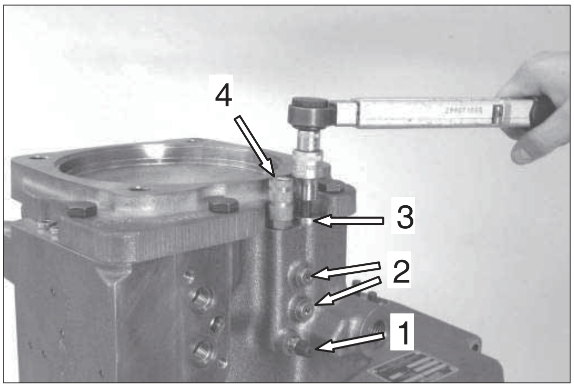
70) 1 = Breather/Pressure relief-valve (emergency release –parking brake)
2 = Screw plug
3 = Breather valve (emergency release – parking brake)
4 = Lubrication nipple (emergency release – parking brake)
5 = Breather valve (multi-disk clutch)
6 = Breather valve (mulit-disk brake)
7 = Pressure oil connection – 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).

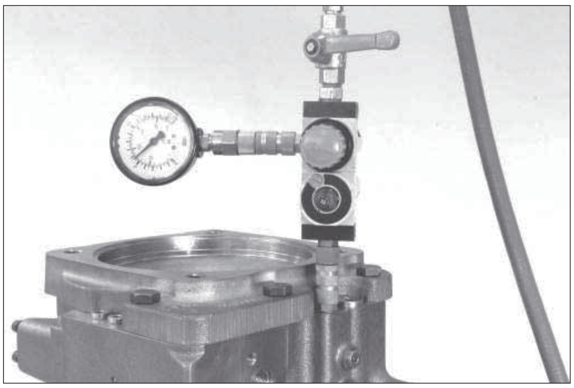
Breather valve (M 10×1) MA = 15 Nm
Screw plug (M 10×1 with O-ring) MA = 20 Nm
Screw plug (M 18×1.5 with O-ring) MA = 35 Nm
Compressed air connect. piece (M 10×1) with seal ring MA = 20 Nm



14WF8TM262

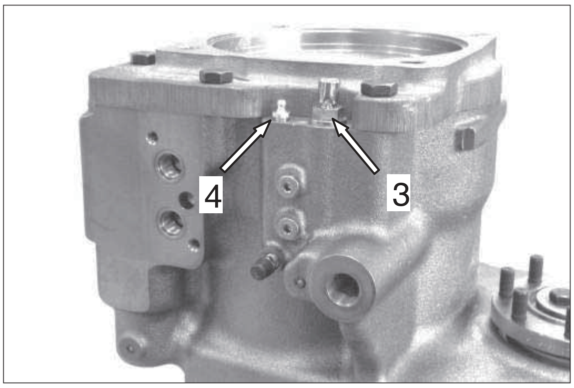
72) Pressurize emergency release with compressed air p = 5 + 1bar and close shut-off valve. During a test duration of 3 minutes no pressure drop is allowed.

(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) MA = 15 Nm
Breather (M 18×1.5) MA = 22 Nm



14WF8TM264

Check multi-disk brake and clutch for leak tightness as wells as closing pressure

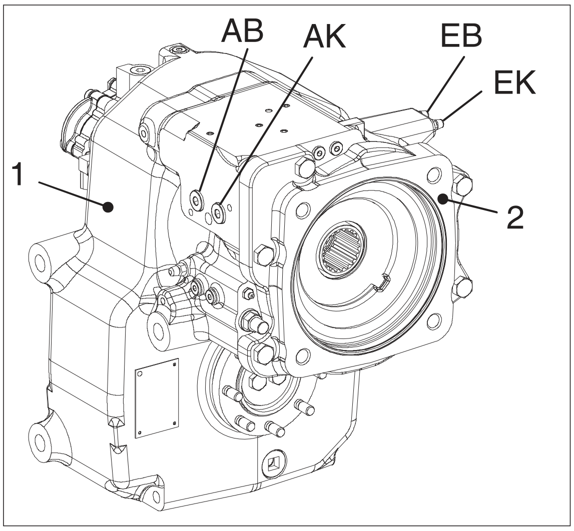
74) 1 = Transmission housing
2 = Input housing

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.

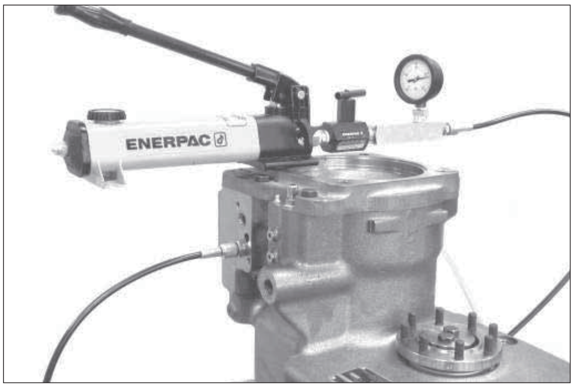


14WF8TM265

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



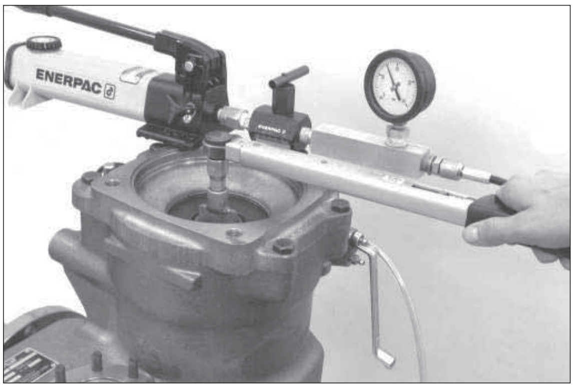
14WF8TM266

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

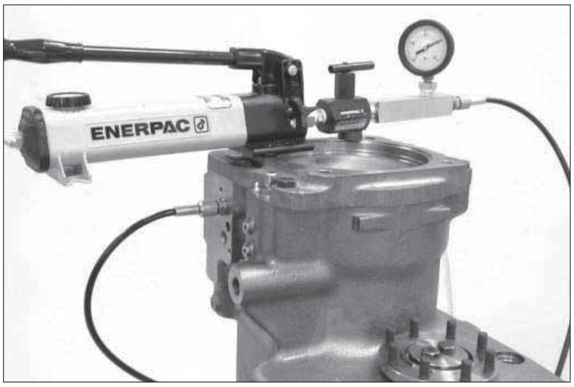


14WF8TM267

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

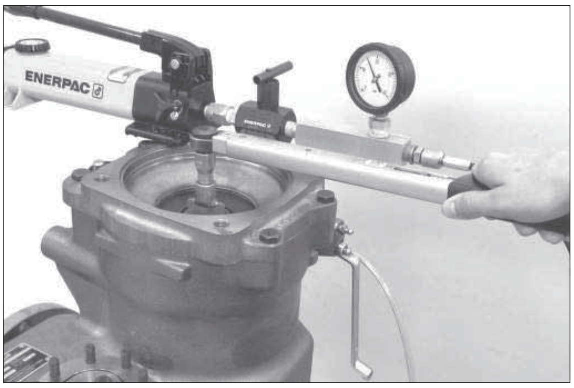


14WF8TM268

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

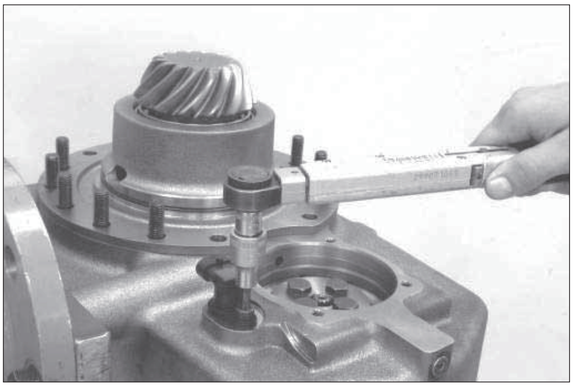


14WF8TM269

Speed sensor

79) Install speed sensor with new O-ring.

Tightening torque (M 8/8.8) MA = 23 Nm

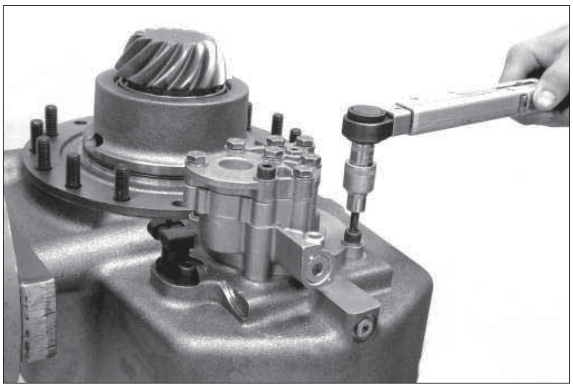


14WF8TM270

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) MA = 23 Nm

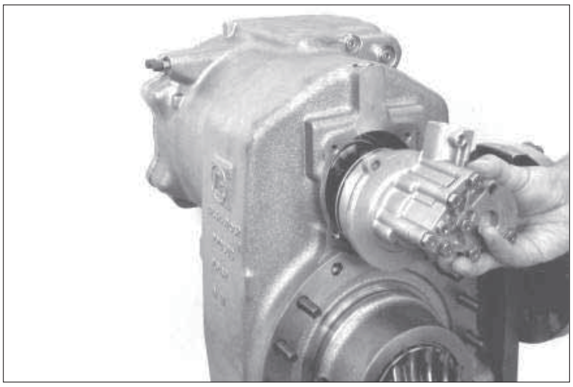


14WF8TM271

10.DISASSEMBLY - LUBRICATION PUMP/ SHIFT INTERLOCK and VALVE BLOCK

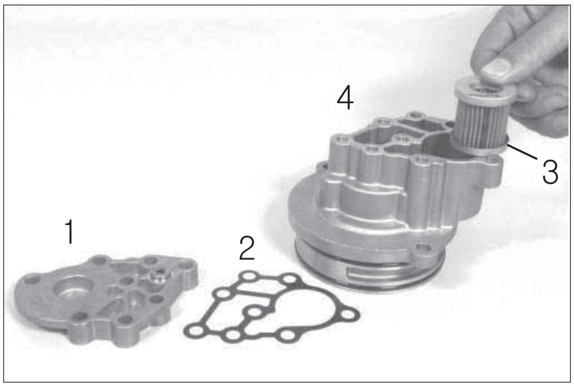
Lubrication pump version

1) Loosen threaded joint and pull off cpl. lubrication pump.



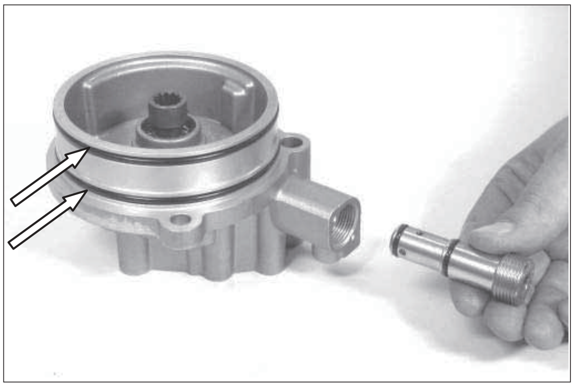
14WF8TM272

2) Loosen cover screws, remove cover (1) with seal (2) and filter (3) from housing (4).



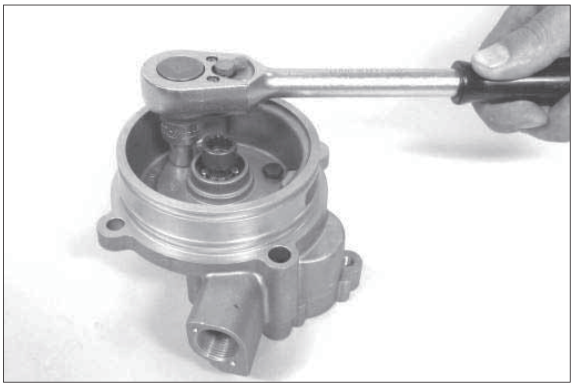
14WF8TM273

3) Remove cpl. pressure limiting valve and both O-rings (arrows).



14WF8TM274

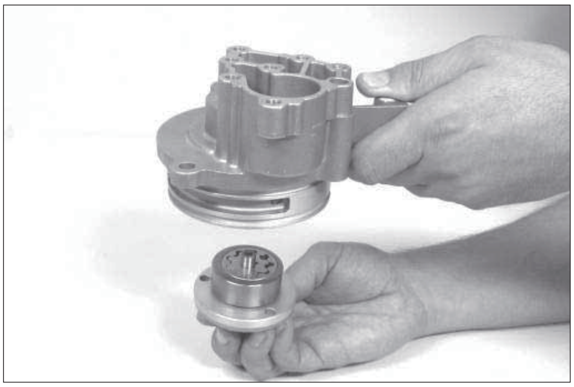
4) Keep housing in vertical position, while loosening pump cover screws.



14WF8TM275

※ Maintain contact position of pump and rotate by 180˚- disassembly aid.

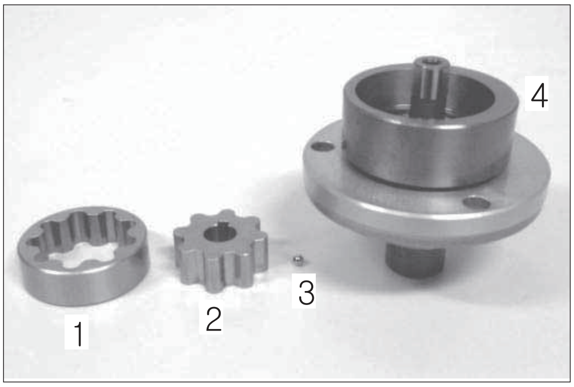
5) Then pull pump in vertical position out of housing – pay attention to possibly releasing balls and compression springs.



14WF8TM276

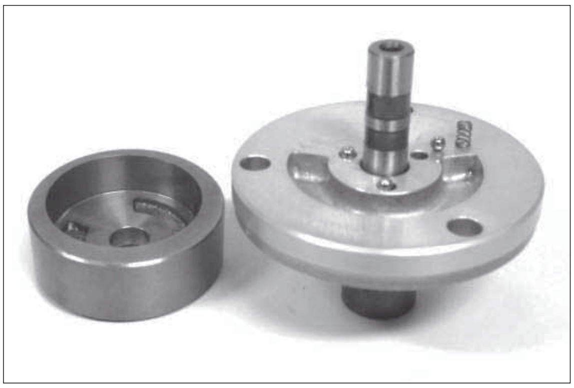
6) Remove outer (1) and inner rotor (2) and take releasing ball [(3) driver] out of control housing (4).

※ Outer, inner rotor and control housing = rotor set



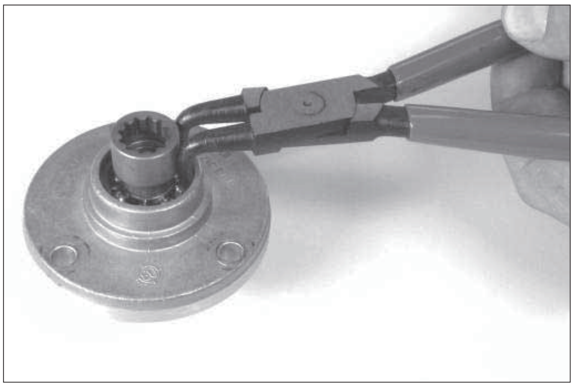
14WF8TM277

7) Remove control housing and releasing balls and compression springs (3 pcs. each).



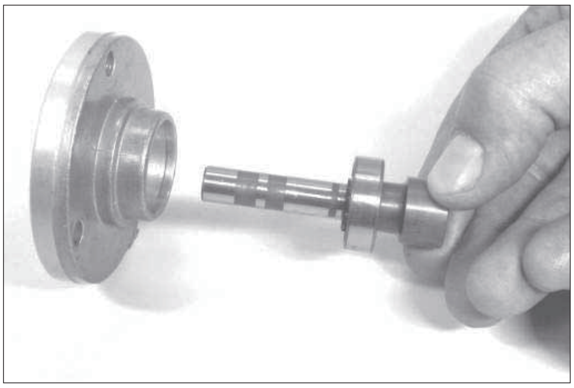
14WF8TM278

8) Unsnap retaining ring.



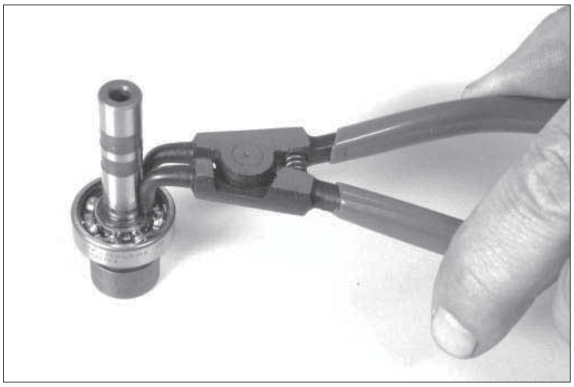
14WF8TM279

9) Pull cpl. pump shaft out of pump cover.



14WF8TM280

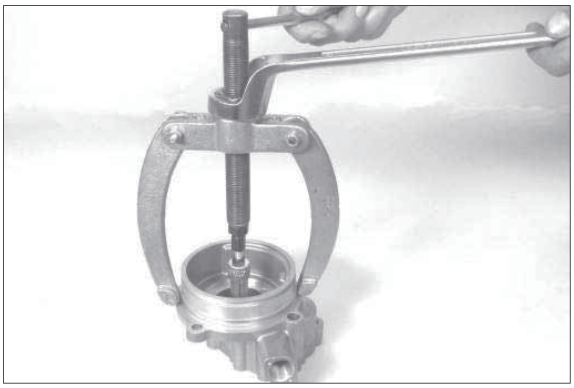
10) Unsnap retaining ring and press ball bearing from shaft.



14WF8TM281

11) Pull needle sleeve out of housing hole.

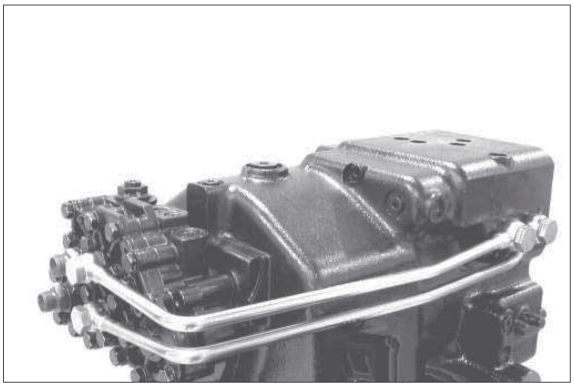
(S) Inner extractor 5870 300 012
(S) Counter support 5870 300 011



14WF8TM282

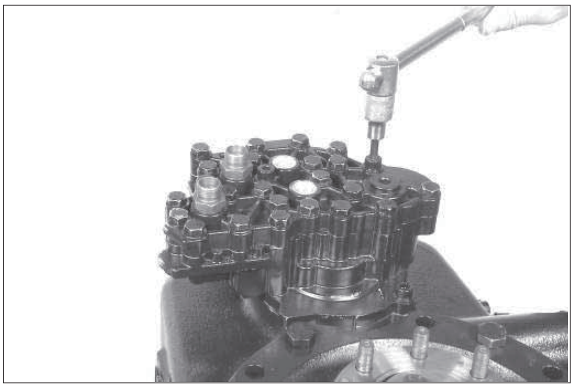
Shift interlock version

12) Disassemble both oil tubes.



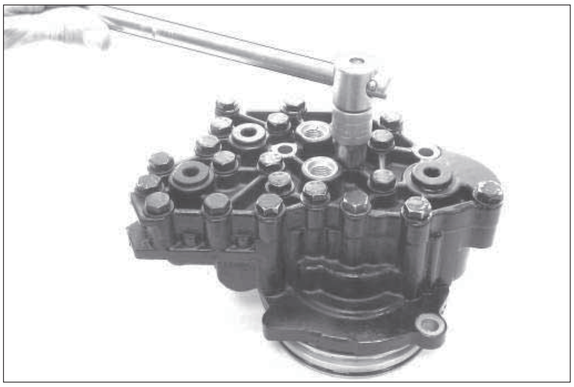
14WF8TM283

13) Loosen threaded joint of shift interlock (3 x cylindrical screws) and remove cpl. shift interlock.



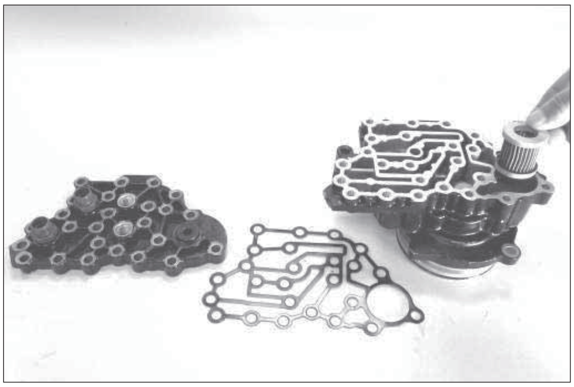
14WF8TM284

14) Loosen cover screws, remove cover and gasket (see also 14WF8TM286).



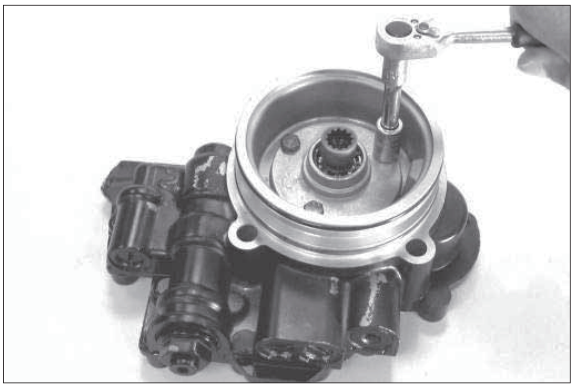
14WF8TM285

15) Take filter out of housing.



14WF8TM286

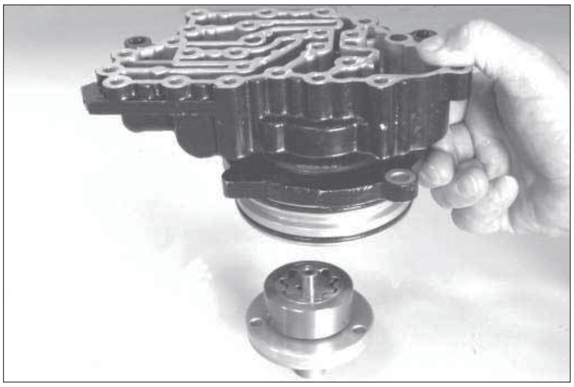
16) Loosen cover screws of pump.



14WF8TM287

※ Maintain contact position of pump and rotate it by 180˚ – disassembly aid.

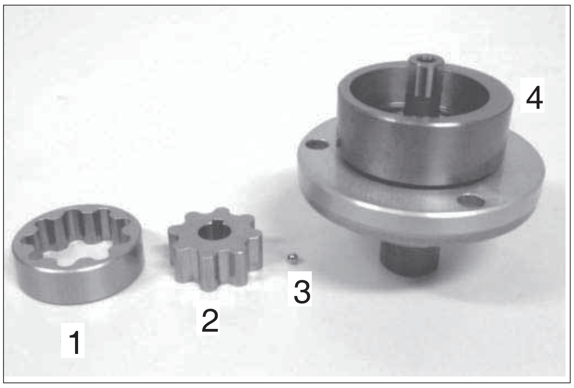
17) Then pull pump in vertical position out of housing – pay attention to possibly releasing balls and compression springs (see 14WF8TM289 and 14WF8TM290).



14WF8TM288

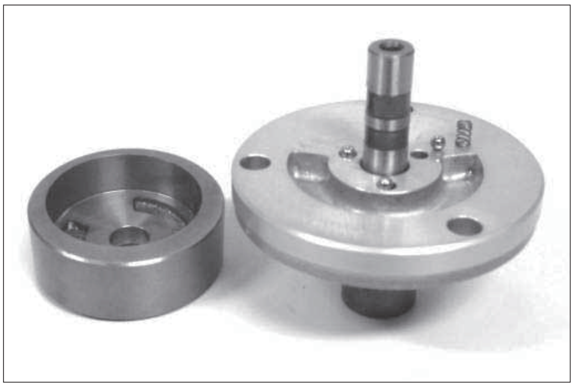
18) Remove outer (1) and inner rotor (2) and take releasing ball [(3) driver] out of control housing (4).

※ Outer, inner rotor and control housing = rotor set



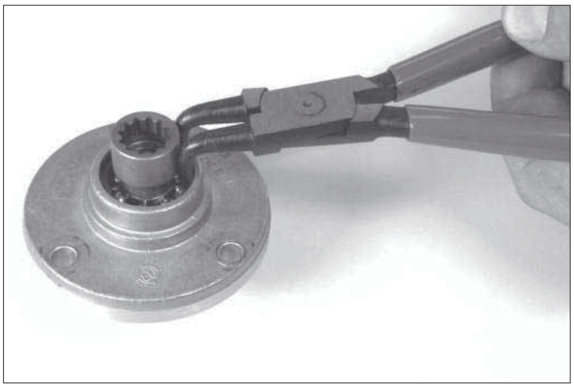
14WF8TM289

19) Remove control housing and releasing balls and compression springs (3 pcs. each).



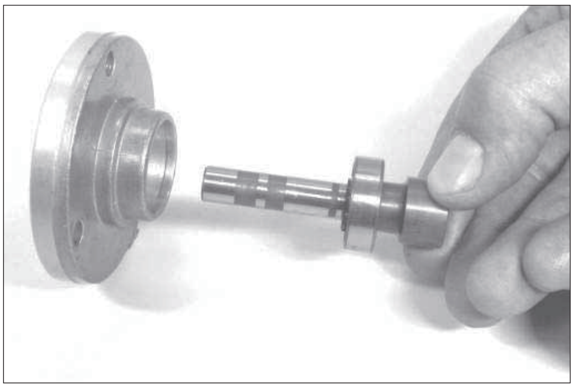
14WF8TM290

20) Unsnap retaining ring.



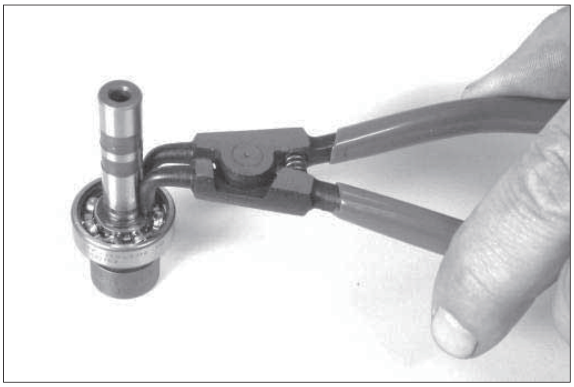
14WF8TM291

21) Pull cpl. pump shaft out of pump cover.



14WF8TM292

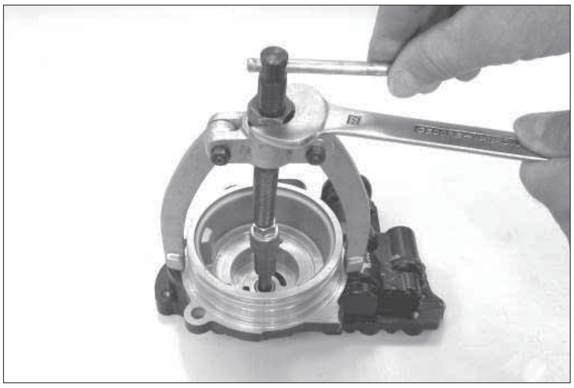
22) Unsnap retaining ring and press ball bearing from shaft.



14WF8TM293

23) Pull needle sleeve out of housing hole.

(S) Inner extractor 5870 300 012
(S) Counter support 5870 300 011

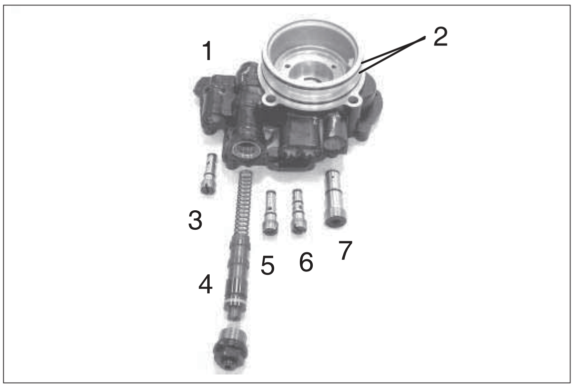


14WF8TM294

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

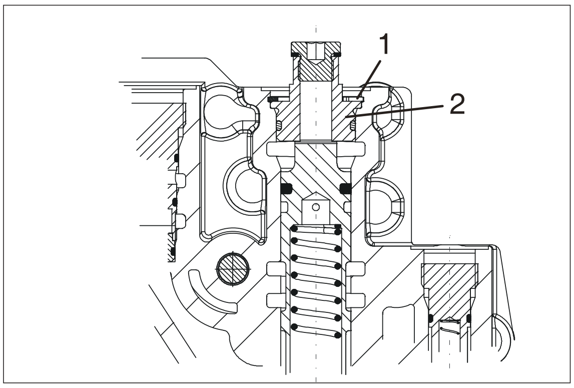
Position 4 (shift piston) shows version with screw plug.



14WF8TM295

25) In sketch 14WF8TM296 version II is shown with plug (2) and retaining ring (1).

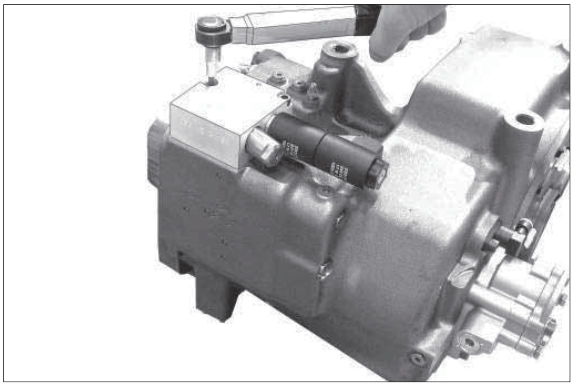
⚠ **When disengaging retaining ring – Pay attention to spring preload. Protect against movement.**



14WF8TM296

Disassemble valve block

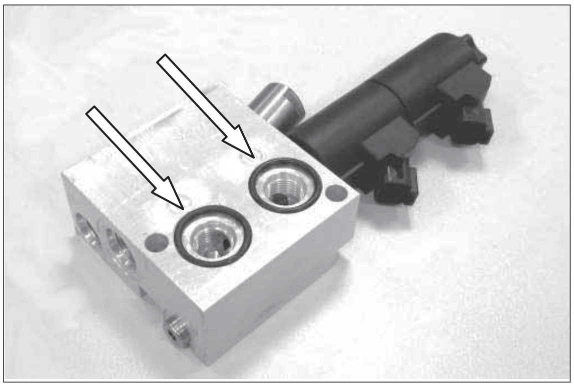
26) Loosen fixing screws and remove cpl. valve block.



14WF8TM297

27) Remove both O-rings (see arrows).

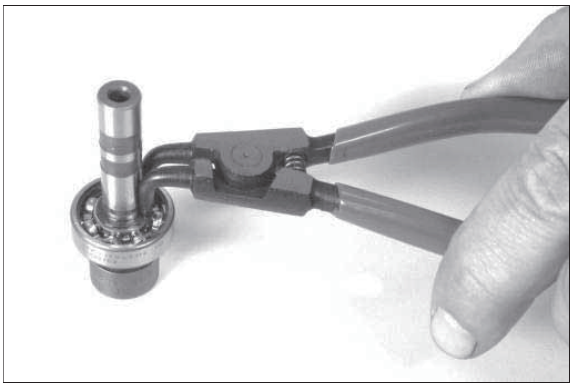
※ Do not further disassemble. Valve block may only be replaced as component.



14WF8TM298

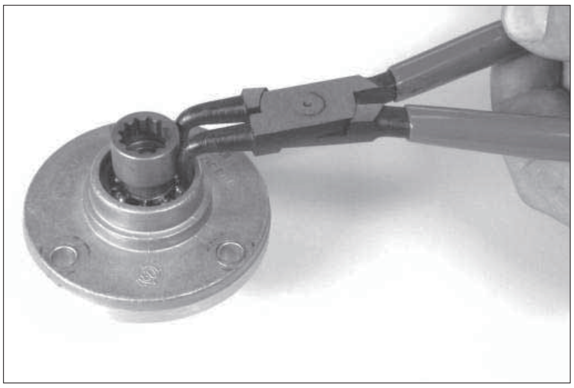
11. REASSEMBLY LUBRICATION PUMP

1) Mount ball bearing onto pump shaft and fix it by engaging retaining ring into annular groove of pump shaft.



14WF8TM299

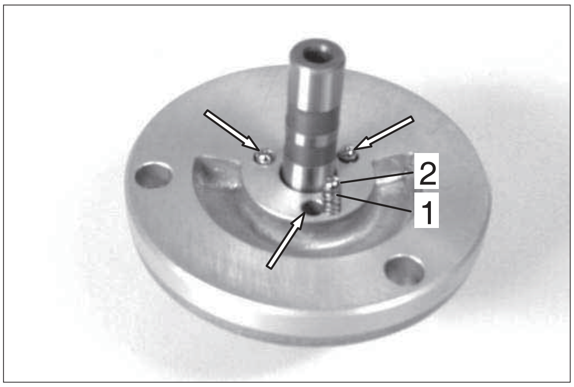
2) Press preassembled pump shaft into pump cover and fix it by engaging retaining ring into annular groove of pump cover.



14WF8TM300

3) Insert compression springs (1) and ball (2) into holes (see arrows - 3x).

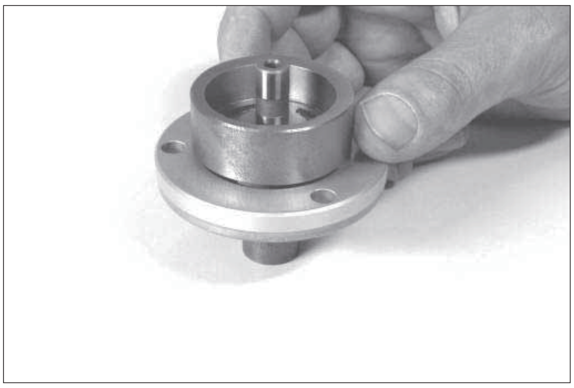
※ Keep preassembled single parts in vertical position–pay attention to position of inserted balls and compression springs (see work steps 14WF8TM301~14WF8TM307).



14WF8TM301

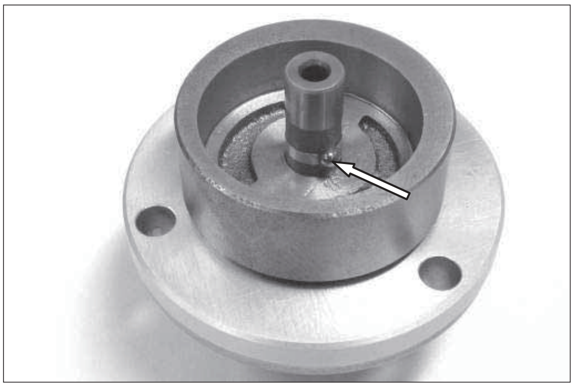
4) Mount control housing.

※ Control housing, inner and outer rotor = rotor set



14WF8TM302

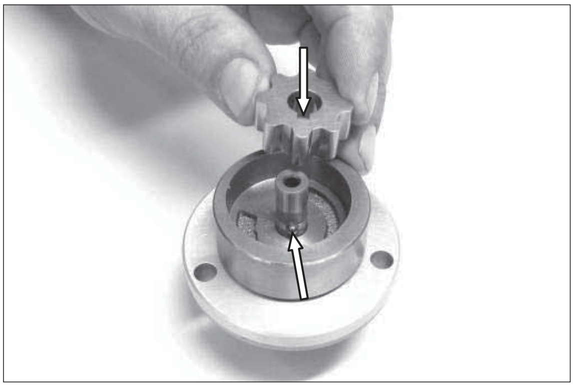
5) Position ball – (see arrow, engagement for inner rotor) with grease into countersink of pump shaft.



14WF8TM303

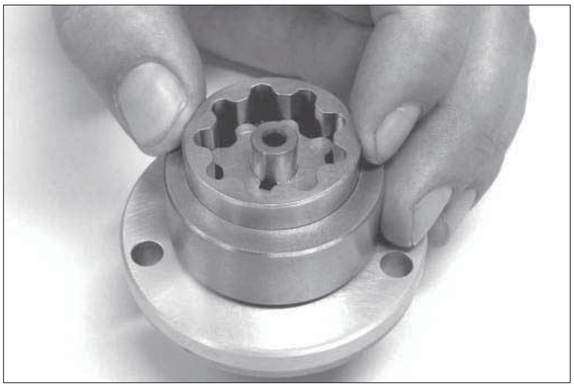
6) Mount inner rotor.

※ 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.

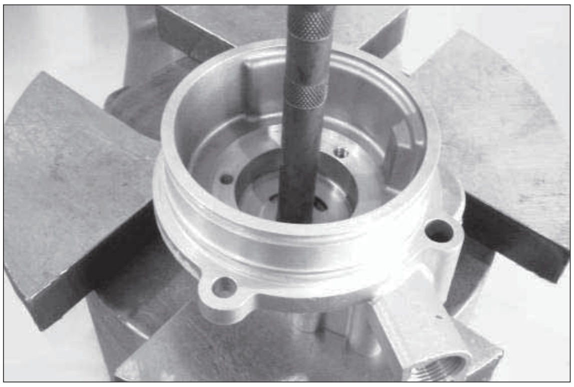
X = 0.2~0.7 mm below plane face / housing

(S) Driver tool 5870 705 003

※ Use of specified driver tool ensures exact installation position.

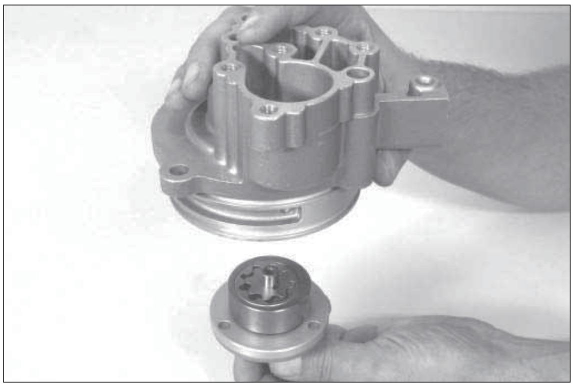
※ Insert needle sleeve with marked front face showing upwards.

※ Check opening of orifice / oil hole in housing bottom.



14WF8TM306

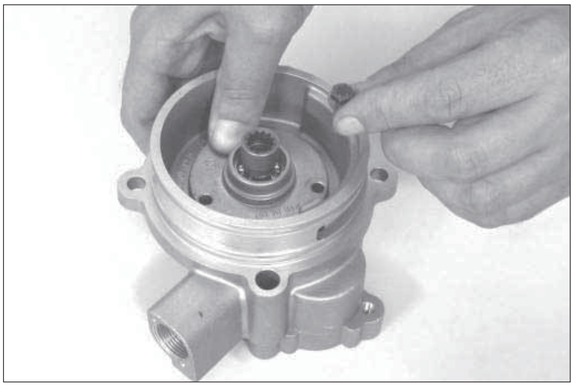
9) Maintain pump in vertical position while inserting housing with mounted needle sleeve onto preassembled pump.



14WF8TM307

10) Rotate housing by 180˚ and fix pump with hexagon screws.

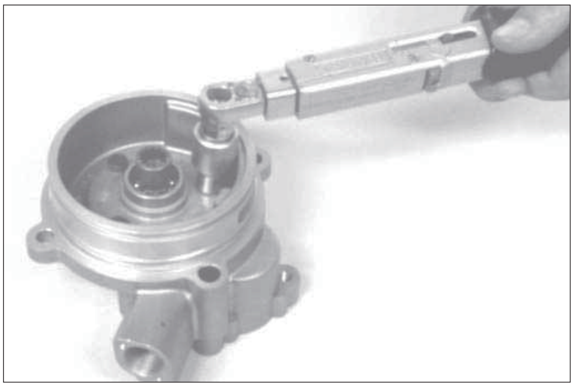
※ Maintain contact position of inserted pump.



14WF8TM308

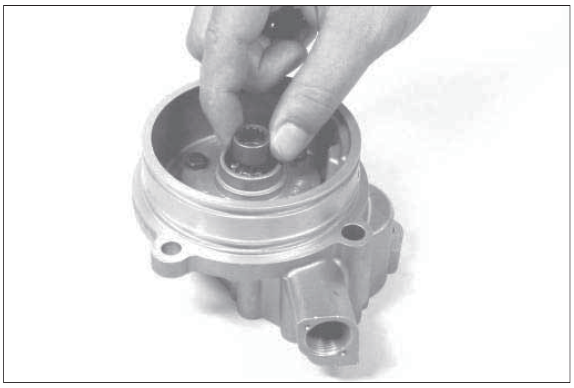
11) Fix pump.

Tightening torque (M6/8.8) M_A = 9.5 Nm



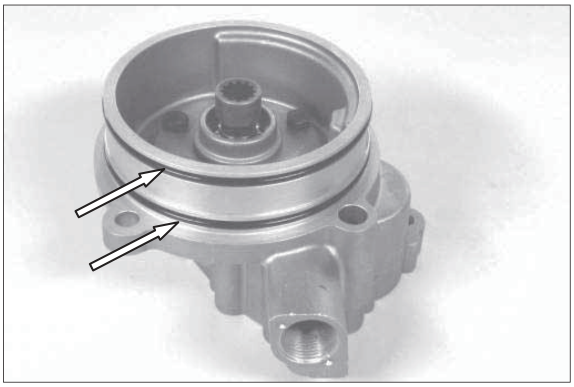
14WF8TM309

12) With counter-turning motions on pump shaft, swiveling of control housing (stop LH/RH in pump cover) is audible.



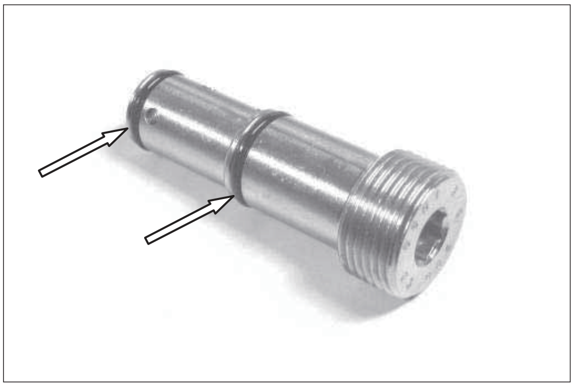
14WF8TM310

13) Oil both O-rings (arrows) and put them into annular groove of housing.



14WF8TM311

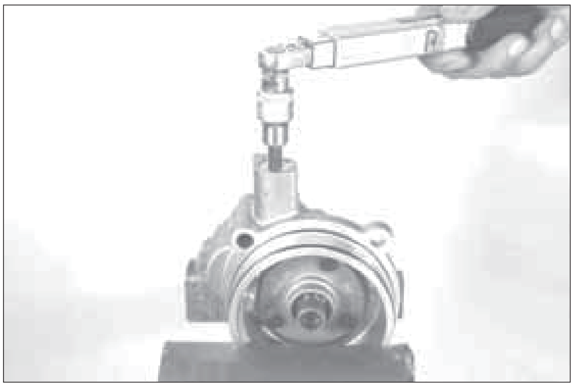
14) Insert O-rings (see arrows) into annular grooves of pressure relief valve.



14WF8TM312

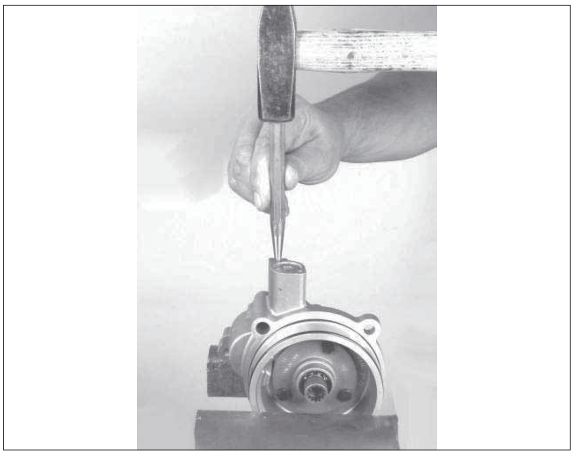
15) Mount pressure relief valve.

Tightening torque M_A = 10 Nm



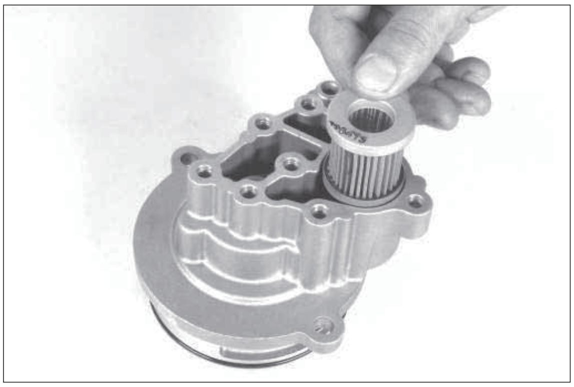
14WF8TM313

16) Secure pressure relief valve by center punch marks (2x).



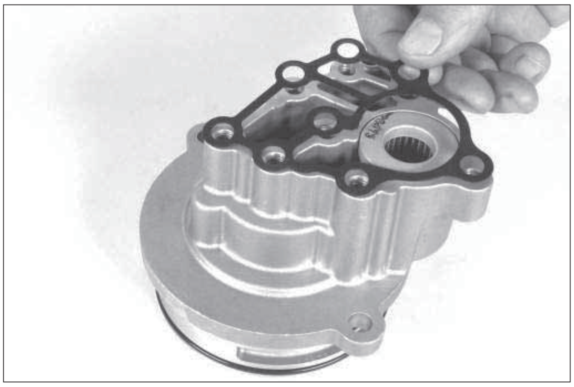
14WF8TM314

17) Insert filter.



14WF8TM315

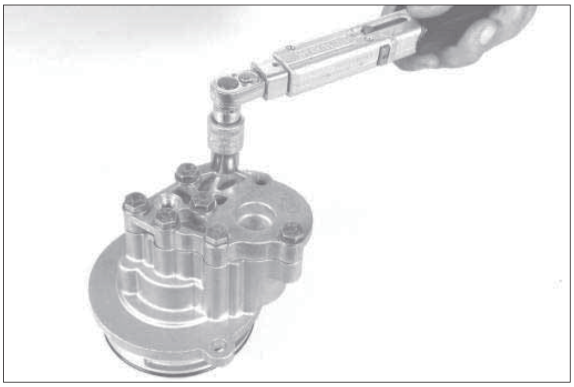
18) Place gasket.



14WF8TM316

19) Place cover and fix it with hexagon screws and disks.

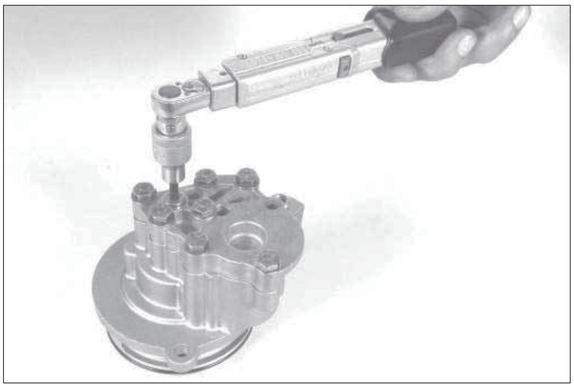
Tightening torque (M8/8.8) M_A = 23 Nm



14WF8TM317

20) Insert screw plug with new O-ring.

Tightening torque (M10×1) M_A = 15 Nm

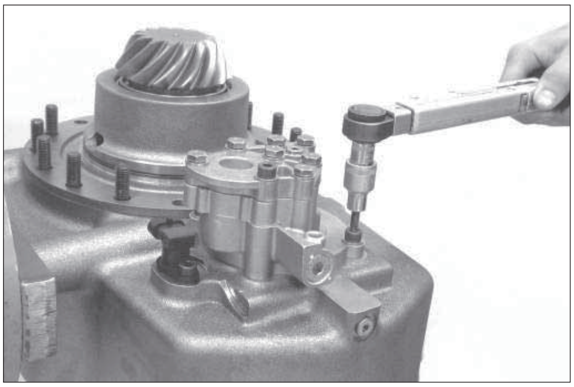


14WF8TM318

21) Mount cpl. lubrication pump and fasten it with cylindrical screws and disks.

Tightening torque (M8/10.9) M_A = 23 Nm

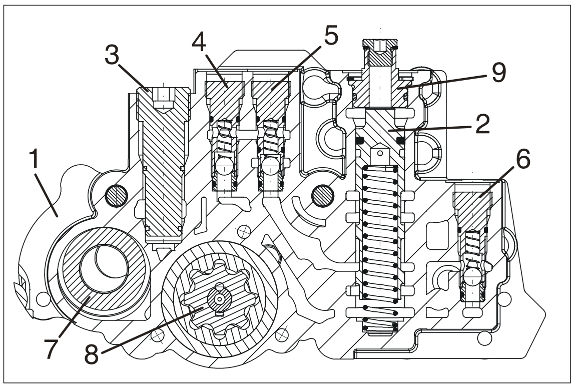
※ Prior to putting the unit into operation, observe the specifications and regulations.



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

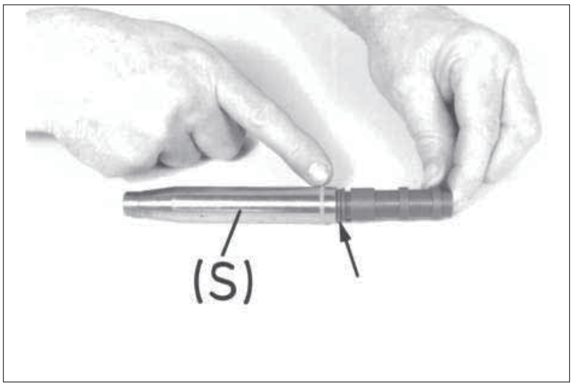


14WF8TM320

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

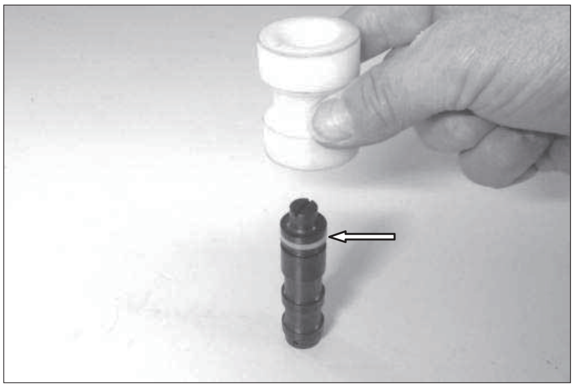
※ Seal consists of plastic ring and O-ring (see 14WF8TM321~14WF8TM322).



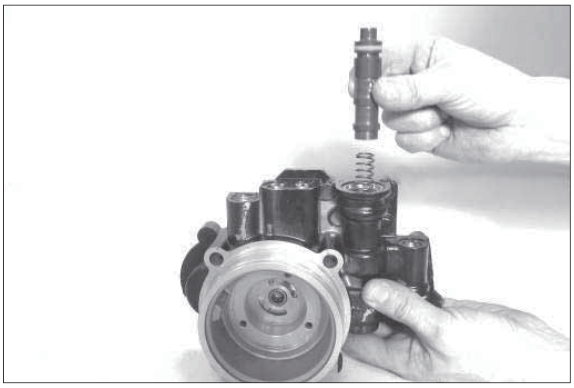
14WF8TM321

3) Center plastic ring (see arrow) with calibrating mandrel.

   (S) Calibrating mandrel 5870 651 056


14WF8TM322

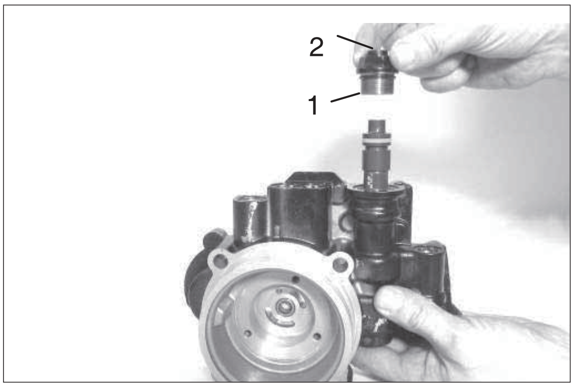
4) Insert compression spring, oil preassembled piston and install.


14WF8TM323

Version I :

5) Fix piston with screw plug (1- with O-ring).
   Install screw plug (2 – with seal ring).

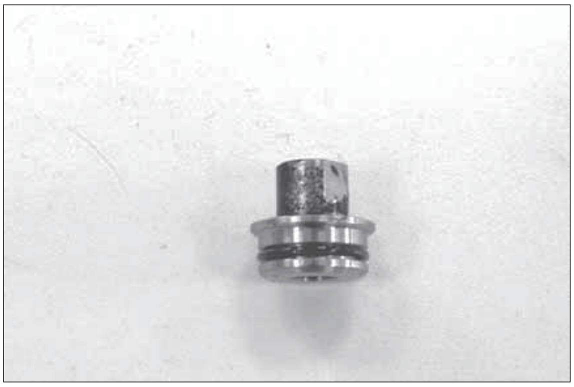
   Screw plug (M24×1.5) M_A = 50 Nm
   Screw plug (M10×1) M_A = 15 Nm



14WF8TM324

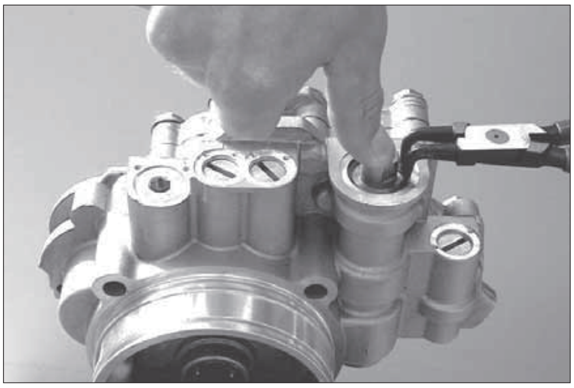
Version II (14WF8TM325 ~ 14WF8TM327) :

6) Oil O-ring and insert it into annular groove of plug.


14WF8TM325

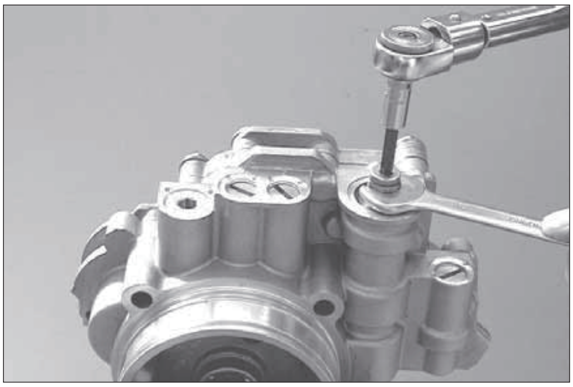
7) Fix plug by engaging retaining ring into annular groove of housing.

※ Pay attention to spring preload – protect against movement.


14WF8TM326

8) Mount screw plug with seal.

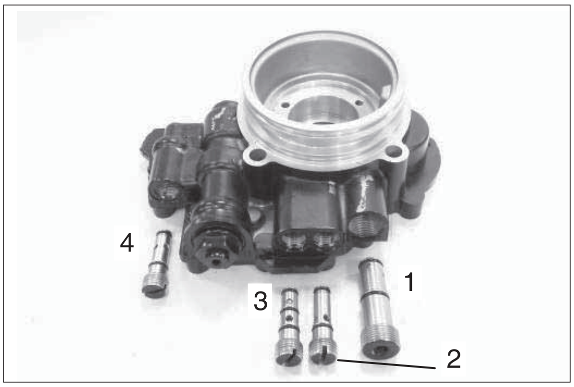
   Tightening torque (M10×1) M_A = 15 Nm


14WF8TM327

9) Install single parts according to adjacent illustration.

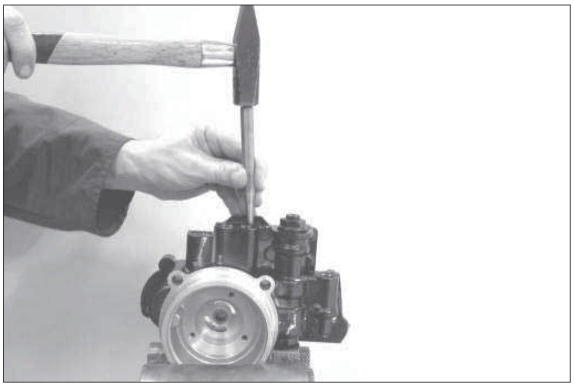
1 = Pressure relief valve cpl. M_A = 10 Nm
2 = Check valve cpl. M_A = 10 Nm
3 = Check valve cpl. M_A = 10 Nm
4 = Check valve cpl. M_A = 10 Nm

※ 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.

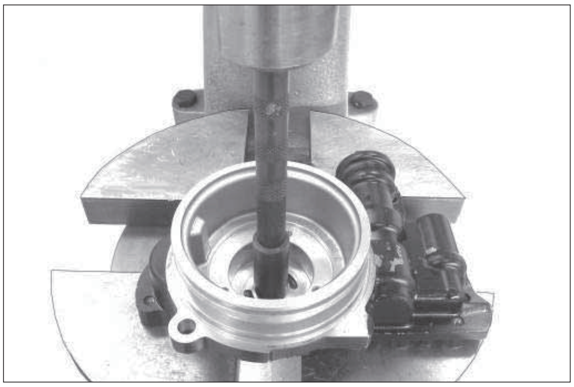

14WF8TM329

11) Insert needle sleeve to installation dimension X into housing.

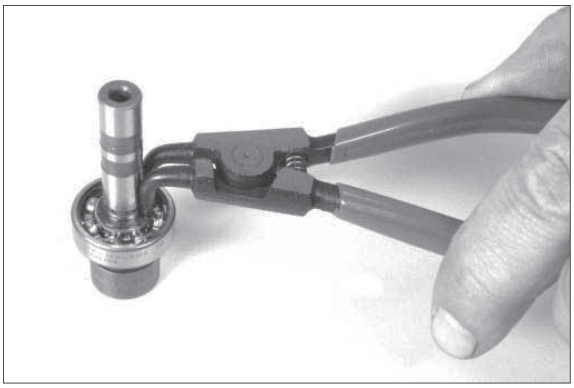
X = 0.2~0.7 mm below plane face/housing

(S) Driver tool 5870 705 003

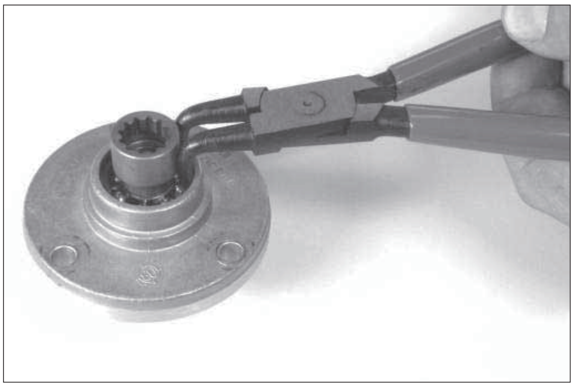
※ Use of specified driver ensures exact installation position.
※ Insert needle sleeve with marked front face showing upwards.
※ Check opening of orifice / oil hole in housing bottom.


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.

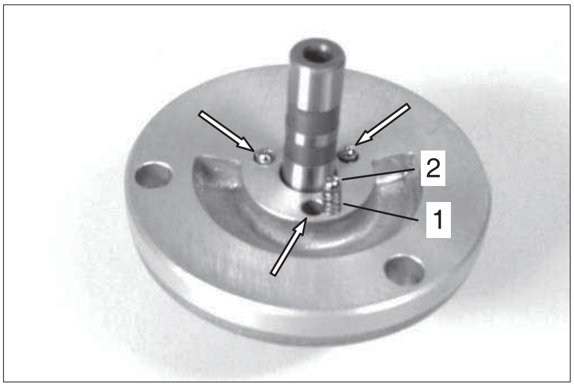


14WF8TM332

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)**

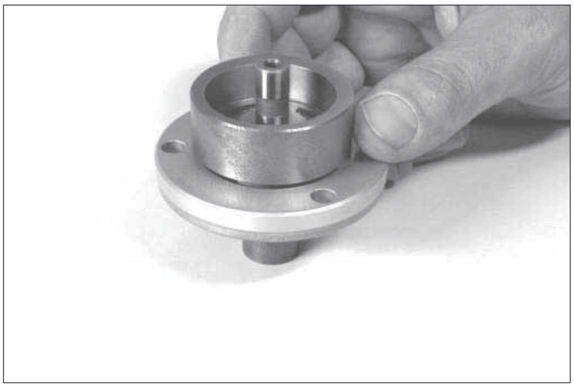
※ Keep preassembled single parts in vertical position – pay attention to position of inserted balls and compression springs (see work steps 14WF8TM333 ~14WF8TM338).



14WF8TM333

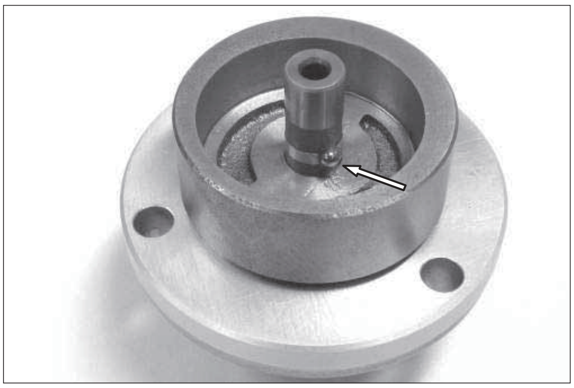
15) Mount control housing.

※ Control housing, inner and outer rotor = rotor set



14WF8TM334

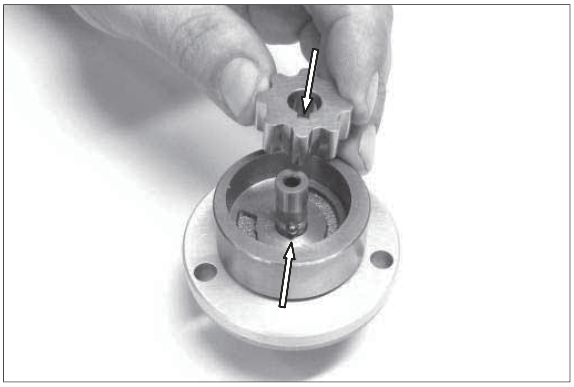
16) Position ball – (see arrow –engagement for inner rotor) with grease into countersink of pump shaft



14WF8TM335

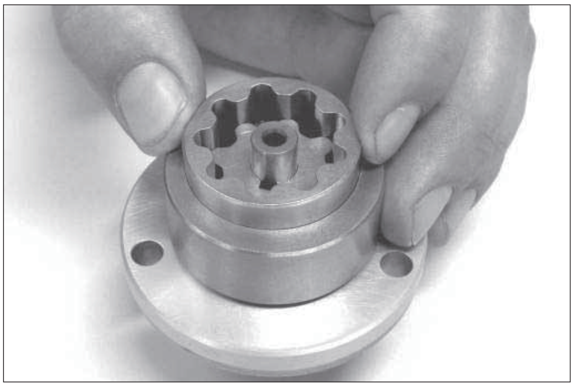
17) Mount inner rotor.

※ Place groove of inner rotor over ball (see arrows).



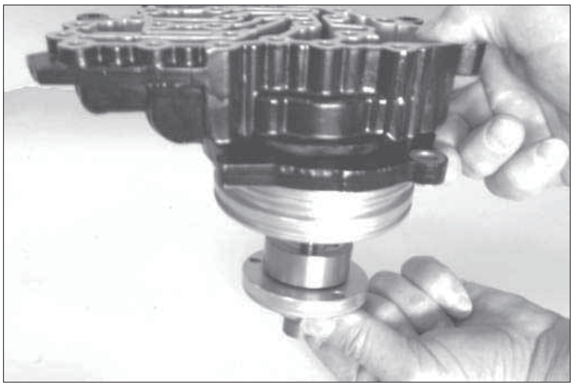
14WF8TM336

18) Mount outer rotor.



14WF8TM337

19) Maintain pump in vertical position while inserting housing with mounted needle sleeve onto preassembled pump.

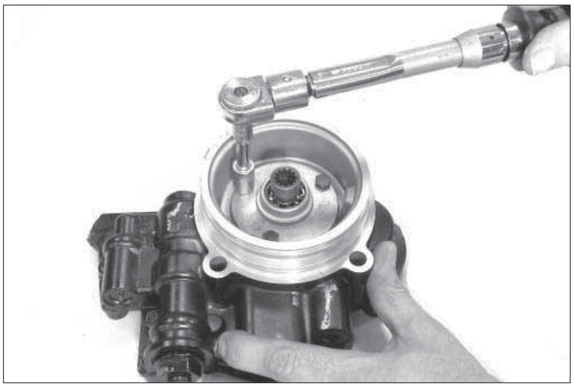


14WF8TM338

20) Rotate housing by 180˚ and fix pump with hexagon screws.

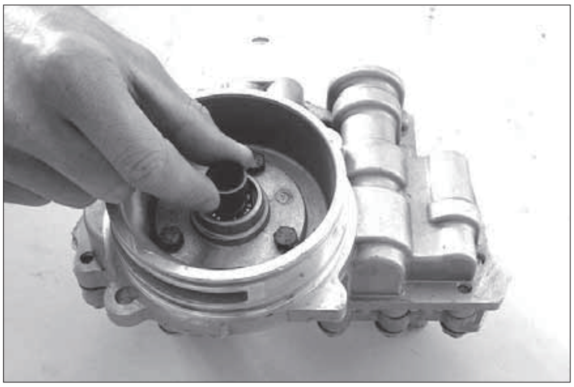
Tightening torque (M6/8.8) M_A = 9.5 Nm

※ Maintain contact position of inserted pump.



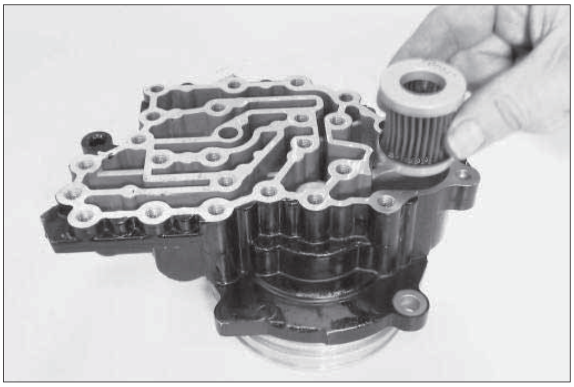
14WF8TM339

21) With counter-turning motions on pump shaft, swiveling of control housing (stop LH/RH in pump cover) is audible.



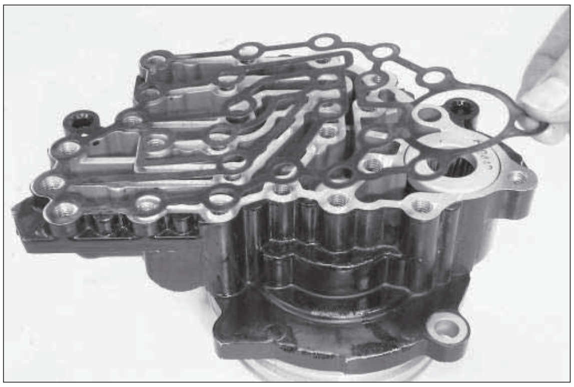
14WF8TM340

22) Insert screen filter.



14WF8TM341

23) Place gasket.

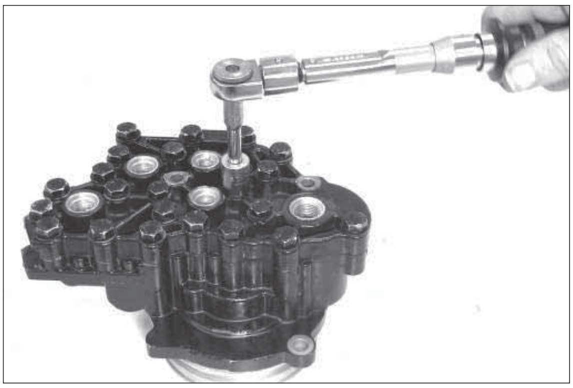


14WF8TM342

24) Place cover and fix with hexagon screws and disks.

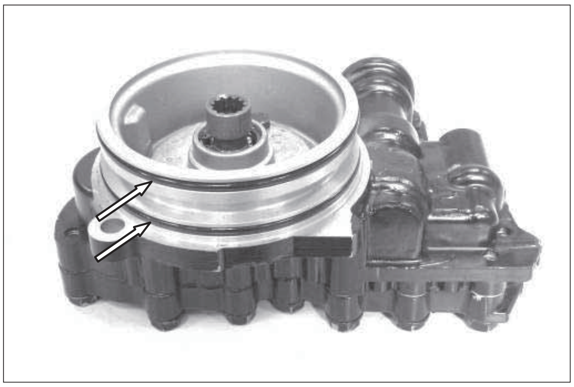
Tightening torque (M8/8.8) M_A = 23 Nm

※ Pay attention to different screw length.



14WF8TM343

25) Oil both O-rings (arrows) and put them into annular groove of housing.

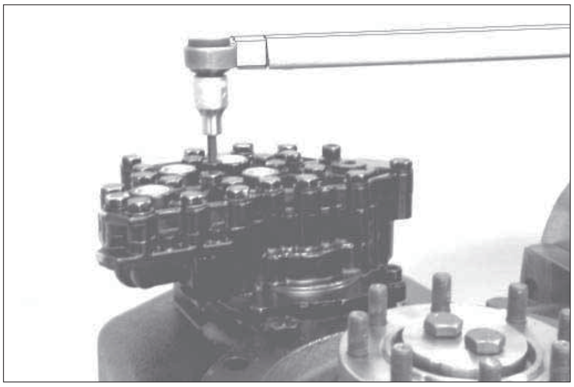


14WF8TM344

26) Insert cpl. shift interlock and fix with cylindrical screws with disks.

Tightening torque (M8/10.9) M_A = 23 Nm

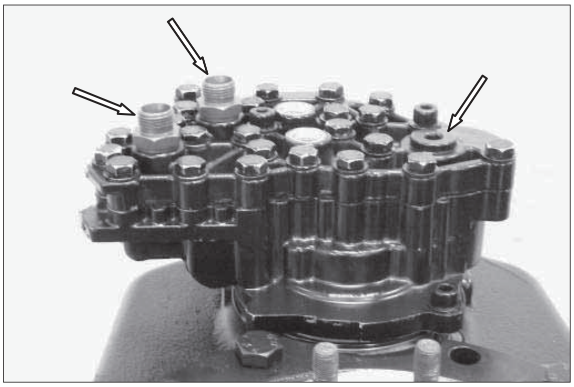
※ Pay attention to different screw length.



14WF8TM345

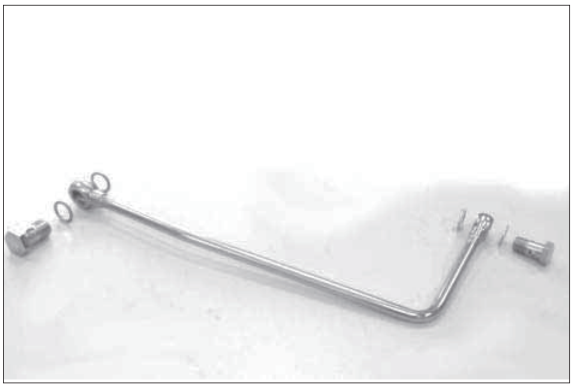
27) Install both screw-in sleeves and screw plug (see arrow) with O-rings.

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

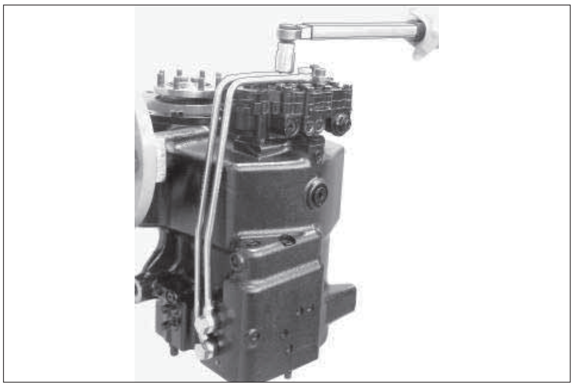


14WF8TM347

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.

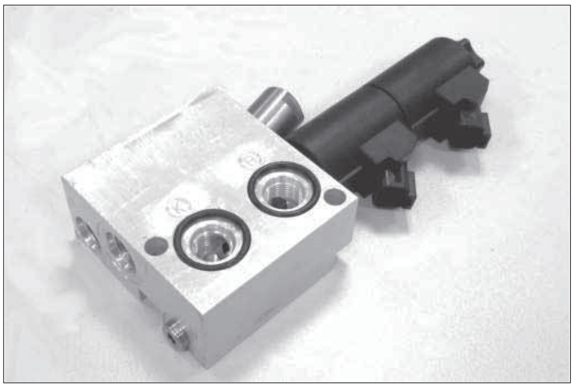


14WF8TM3428

13. VALVE BLOCK (shifting low gear – high gear)

1) Insert O-rings (see arrows) into countersinks of valve block.

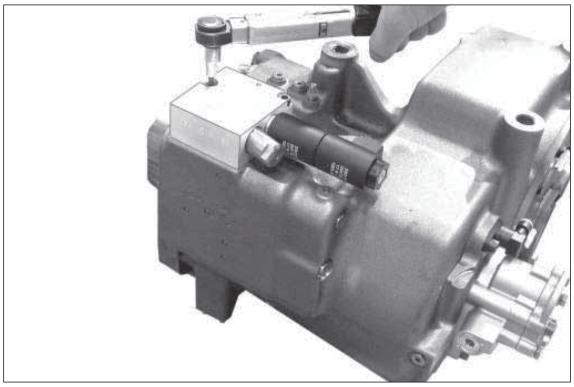
※ Use grease as assembly aid.



14WF8TM349

2) Fix cpl. valve block with cylindrical screws.

Tightening torque (M8/10.9) M_A = 23 Nm

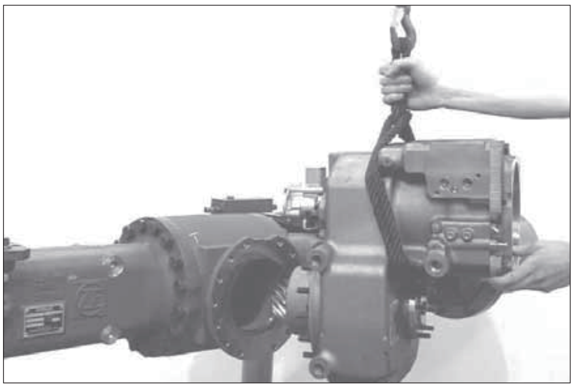


14WF8TM350

14. Mount TRANSMISSION to AXLE (only for version axle attachment)

1) Position complete transmission to axle.

(S) Lifting strap 5870 281 026

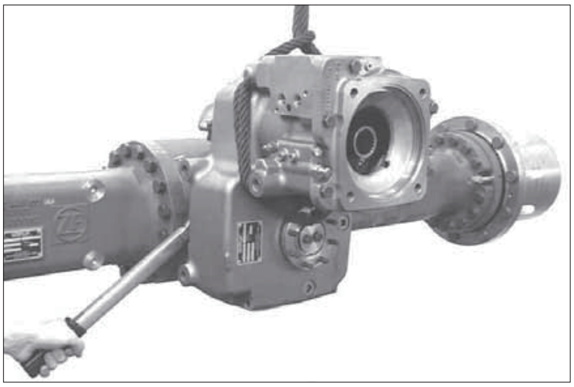


14WF8TM351

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

GROUP 8 STEERING VALVE

1. REMOVAL AND INSTALL

1) REMOVAL

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

(2) Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

(3) Loosen the breather slowly to release the pressure inside the hydraulic tank.

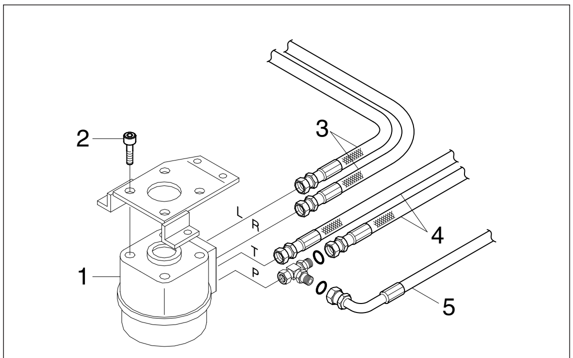
⚠ **Escaping fluid under pressure can penetrate the skin causing serious injury.**


13031GE18

(4) Disconnect steering line hoses (3, 4, 5).

(5) Loosen the socket bolt (2) and remove the steering valve assembly (1).

· Tightening torque : 4.8 ± 0.3 kgf · m (34.7 ± 2.2 lbf · ft)



14W7A8SV01

2) INSTALL

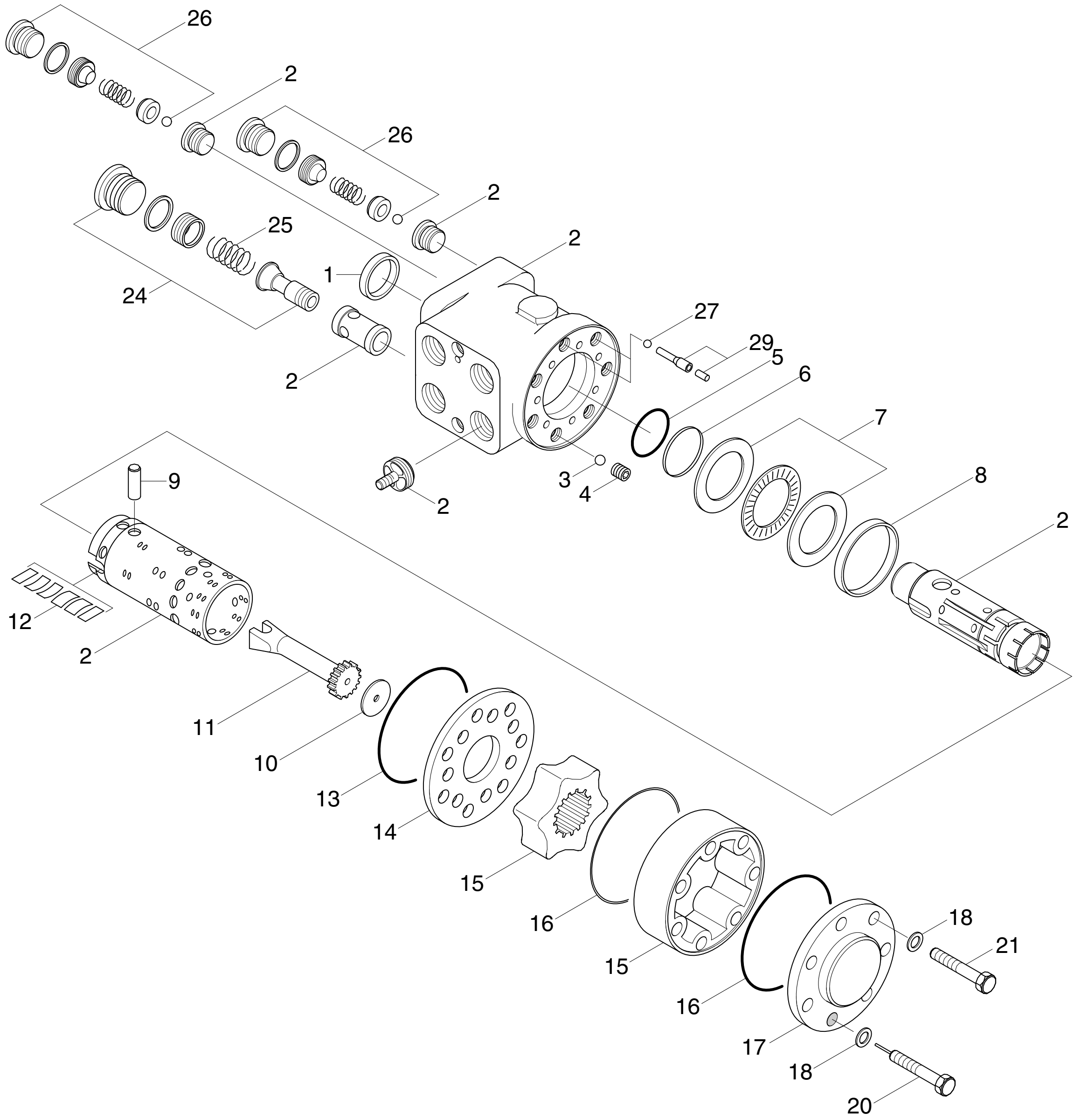
(1) Carry out installation in the reverse order to removal.

(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

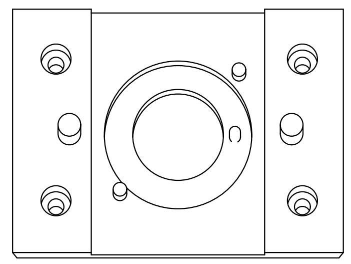


20W72STV01

1	Dust seal	10	Spacer	18	Washer
2	Housing, spool, sleeve	11	Shaft	20	Pin screw
3	Ball	12	Spring set	21	Screw
4	Bushing	13	O-ring	24	Pressure relief valve
5	O-ring	14	Distributor plate	25	Wire spring
7	Bearing assy	15	Gear wheel set	26	Shock valve
8	Ring	16	O-ring	27	Ball
9	Cross pin	17	End cover	29	Bushing

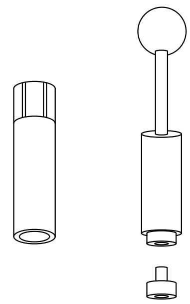
2) TOOLS

(1) Holding tool.



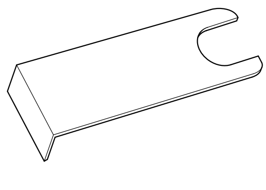
2-1 (200W-3)

(2) Assembly tool for O-ring (5,13,16) and kin-ring (6).



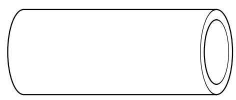
2-2 (200W-3)

(3) Assembly tool for cardan shaft (11).



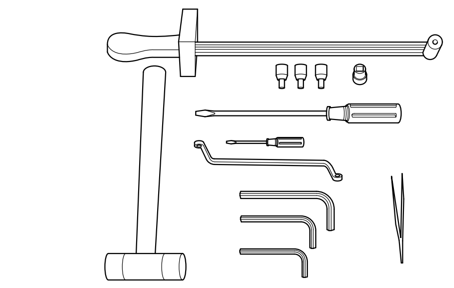
3-1 (200W-3)

(4) Assembly tool for dust seal (1).



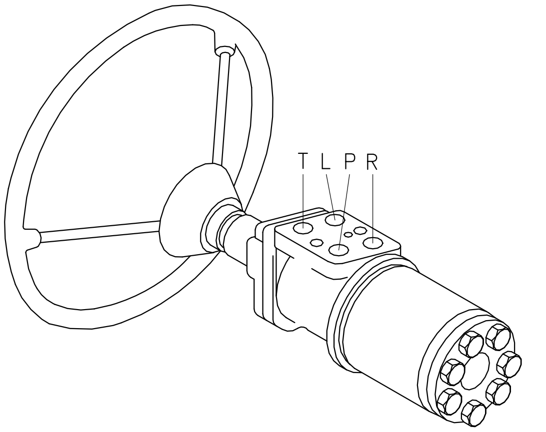
3-2 (200W-3)

(5) Torque wrench : 0~7.1 kgf · m
(0~54.4 lbf · ft)
13 mm socket spanner.
6, 8 mm and 12 mm hexagon sockets.
12 mm screwdriver.
2 mm screwdriver.
13 mm ring spanner.
6,8 mm and 12 mm hexagon socket spanners.
Plastic hammer.
Tweezers.


3-3 (200W-3)

3) TIGHTENING TORQUE AND HYDRAULIC CONNECTIONS

(1) Hydraulic connections



L : Left port
R : Right port
T : Tank
P : Pump

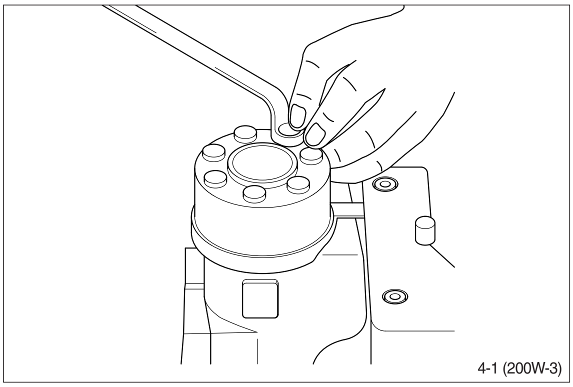
17038SV03

(2) Tightening torque

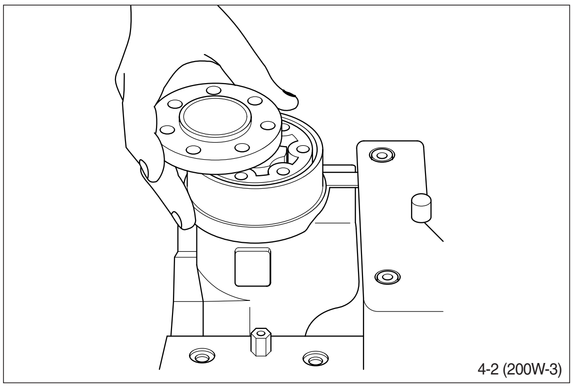
Screwed connection	Max. tightening torque kgf · m (lbf · ft)			
	With cutting edge	With copper washer	With aluminum washer	With O-ring
1.4 BSP.F	4.1 (29.7)	2.0 (14.5)	3.1 (22.4)	-
3/8 BSP.F	6.1 (44.1)	2.0 (14.5)	5.1 (36.9)	-
1/2 BSP.F	10.2 (73.8)	3.1 (22.4)	8.2 (59.3)	-
7/16-20 UNF	-	-	-	2.0 (14.5)
3/4-16 UNF	-	-	-	6.1 (44.1)
M12×1.5	4.1 (29.7)	2.0 (14.5)	3.1 (22.4)	2.0 (14.5)
M18×1.5	7.1 (51.4)	2.0 (14.5)	5.1 (36.9)	5.1 (36.9)
M22×1.5	10.2 (73.8)	3.1 (22.4)	8.2 (59.3)	7.1 (51.4)

4) DISASSEMBLY

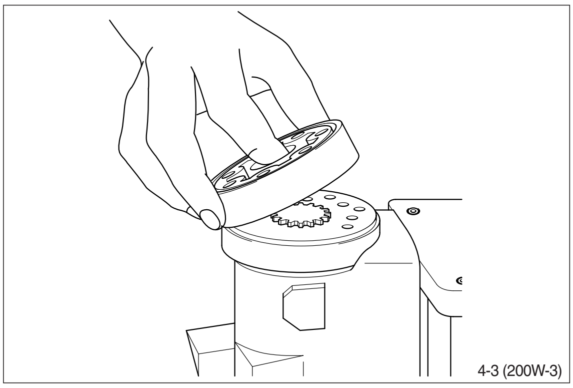
(1) Dissemble steering column from steering valve and place the steering valve in the holding tool.
Screw out the screws in the end cover (6-off plus one special screw).


4-1 (200W-3)

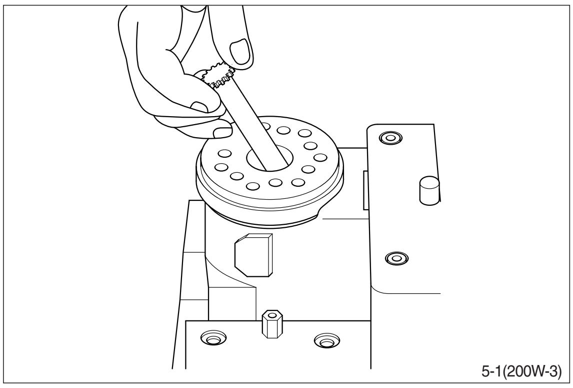
(2) Remove the end cover, sideways.


4-2 (200W-3)

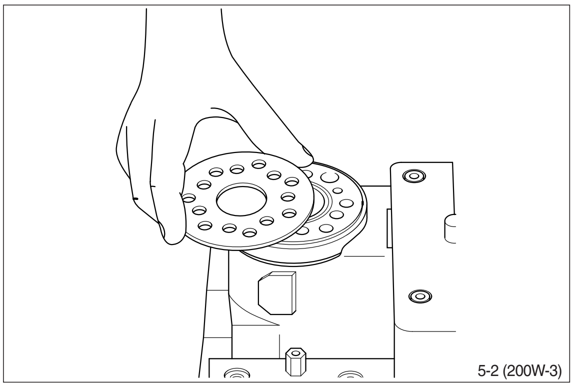
(3) Lift the gearwheel set (with spacer if fitted) off the unit.
Take out the two O-rings.


4-3 (200W-3)

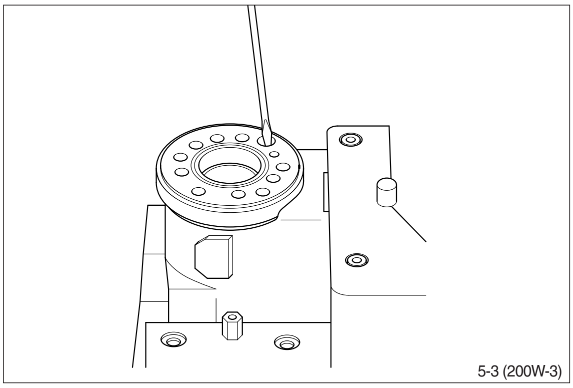
(4) Remove cardan shaft.


5-1(200W-3)

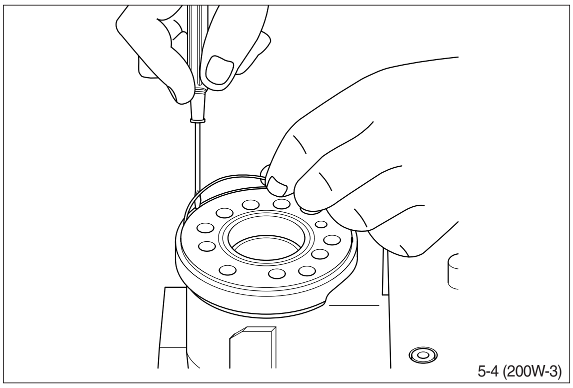
(5) Remove distributor plate.


5-2 (200W-3)

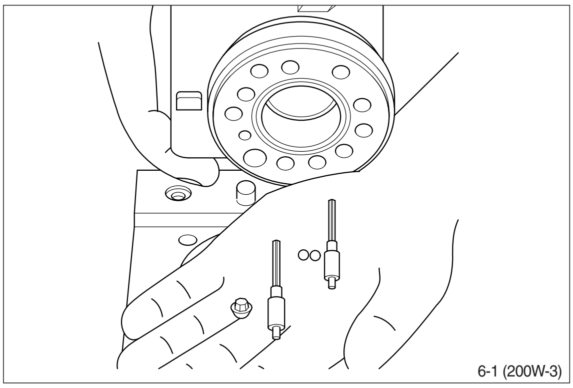
(6) Screw out the threaded bushing over the check valve.


5-3 (200W-3)

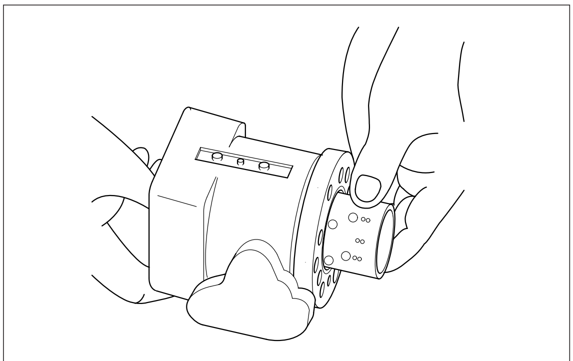
(7) Remove O-ring.


5-4 (200W-3)

(8) Shake out the check valve ball and suction valve pins and balls.

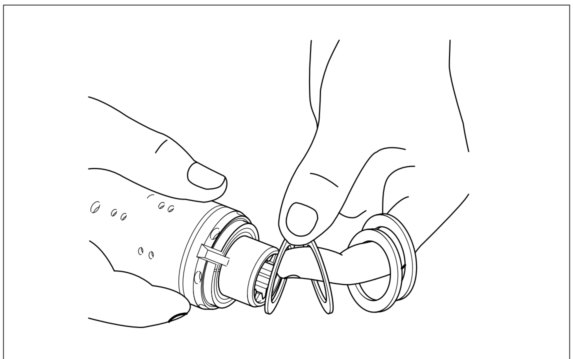

6-1 (200W-3)

(9) Take care to keep the cross pin in the sleeve and spool horizontal. The pin can be seen through the open end of the spool. Press the spool inwards and the sleeve, ring, bearing races and needle bearing will be pushed out of the housing together.



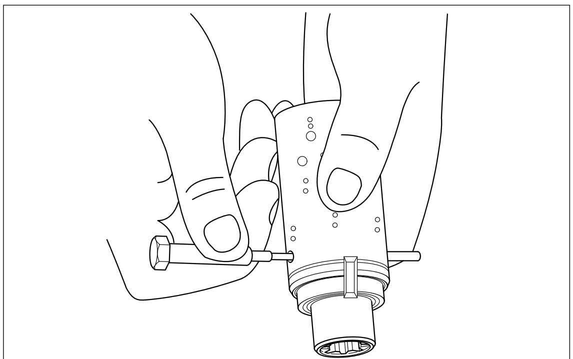
6-2 (200W-3)

(10) Take ring, bearing races and needle bearing from sleeve and spool. The outer(thin)bearing race can sometimes "stick" in the housing, therefore check that it has come out.



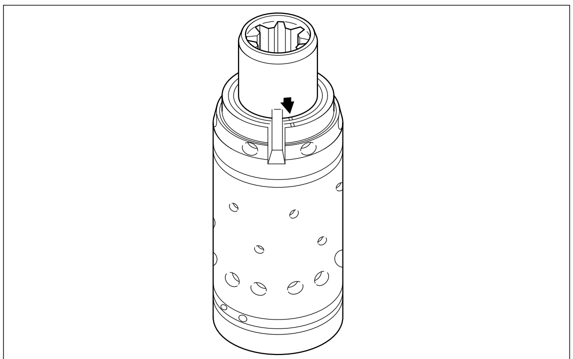
6-3 (200W-3)

(11) Press out the cross pin. Use the special screw from the end cover.



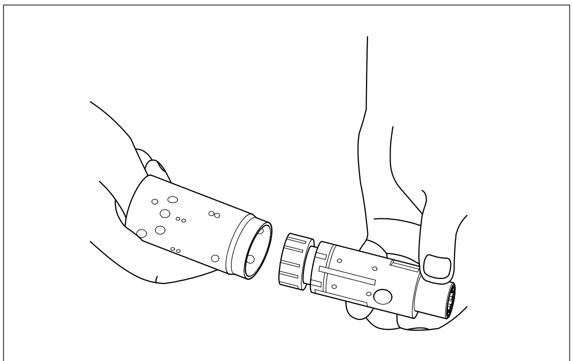
6-4 (200W-3)

※ A small mark has been made with a pumice stone on both spool and sleeve close to one of the slots for the neutral position spring as figure.
If the mark is not visible, remember to leave a mark of your own on sleeve and spool before the neutral position springs are disassembled.



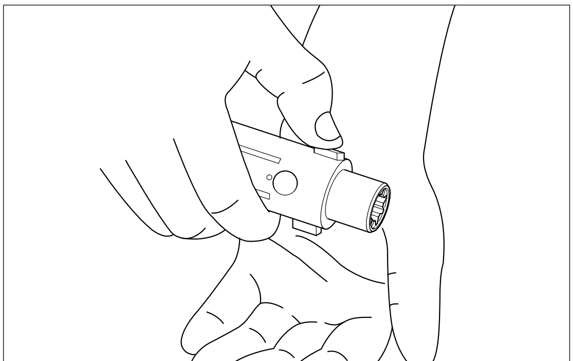
7-1 (200W-3)

(12) Carefully press the spool out of the sleeve.



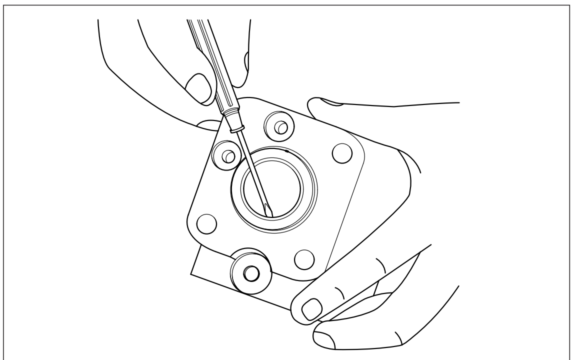
7-2 (200W-3)

(13) Press the neutral position springs out of their slots in the spool.



7-3 (200W-3)

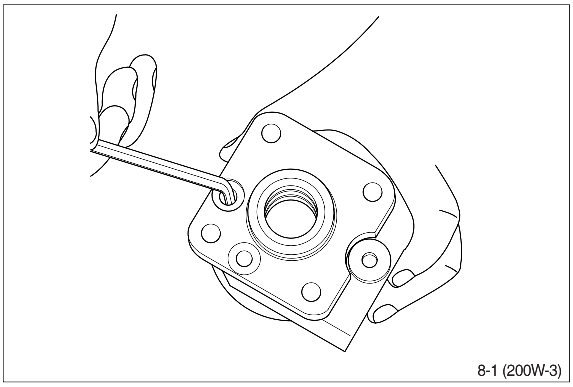
(14) Remove dust seal and O-ring.



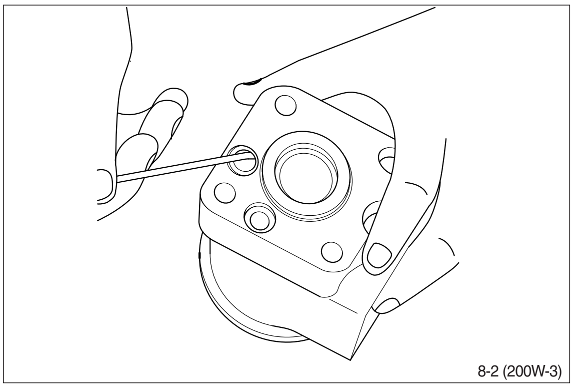
7-4 (200W-3)

(15) Disassemble the dual shock valve

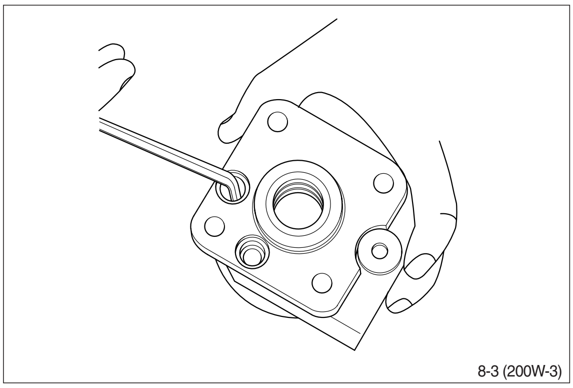
① Remove plugs from shock valves using a 6mm hexagon socket spanner.


8-1 (200W-3)

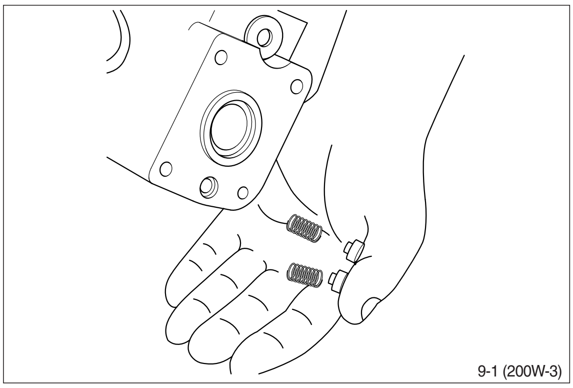
② Remove seal washers (2-off).


8-2 (200W-3)

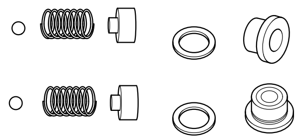
③ Unscrew the setting screws using a 6 mm hexagon socket spanner.


8-3 (200W-3)

④ Shake out the two springs and two valve balls into your hand. The valve seats are bonded into the housing and cannot be removed.


9-1 (200W-3)

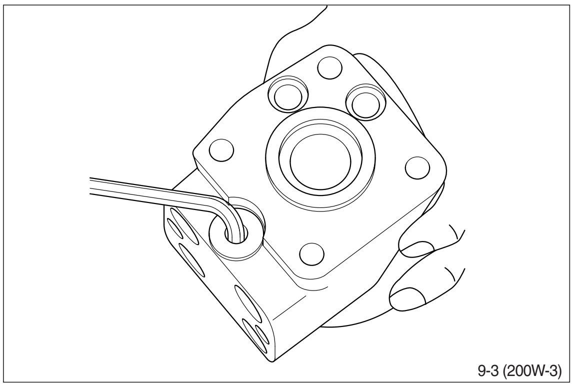
⑤ The dual shock valves are now disassembled.



9-2 (200W-3)

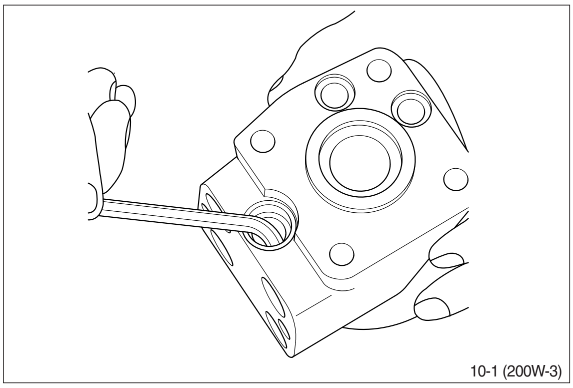
(16) **Disassemble the pressure relief valve** (cartridge)

① Screw out the plug using an 8 mm hexagon socket spanner. Remove seal washers.



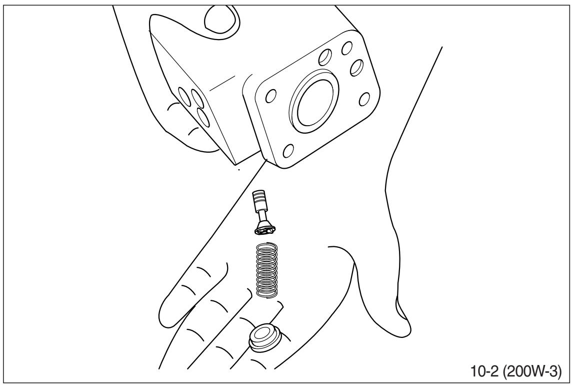
9-3 (200W-3)

② Unscrew the setting screw using an 8mm hexagon socket spanner.



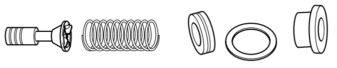
10-1 (200W-3)

③ Shake out spring and piston. The valve seat is bonded into the housing and cannot be removed.



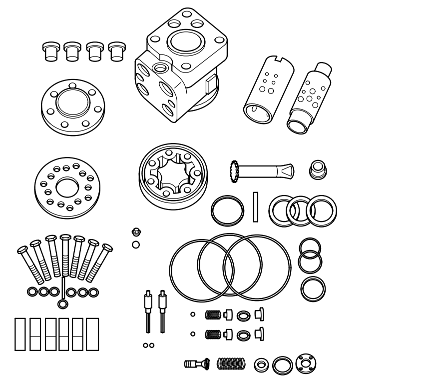
10-2 (200W-3)

④ The pressure relief valve is now disassembled.



10-3 (200W-3)

⑤ The steering valve is now completely disassembled.



12-1 (200W-3)

※ Cleaning

Clean all parts carefully in shellsol K or the like.

※ Inspection and replacement

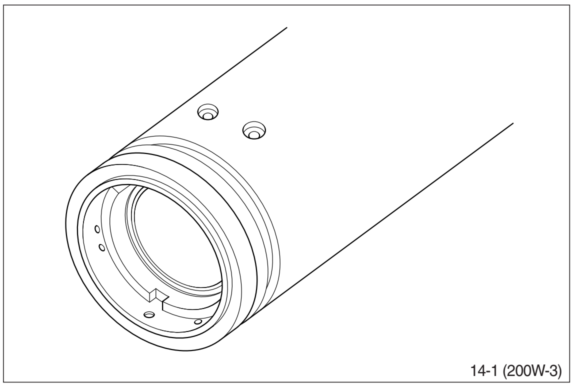
Replace all seals and washers. Check all parts carefully and make any replacements necessary.

※ Lubrication

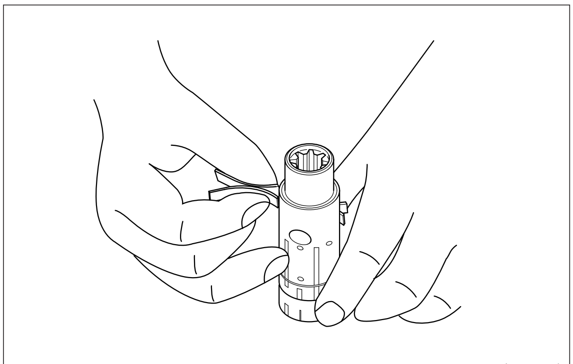
Before assembly, lubricate all parts with hydraulic oil.

5) ASSEMBLY

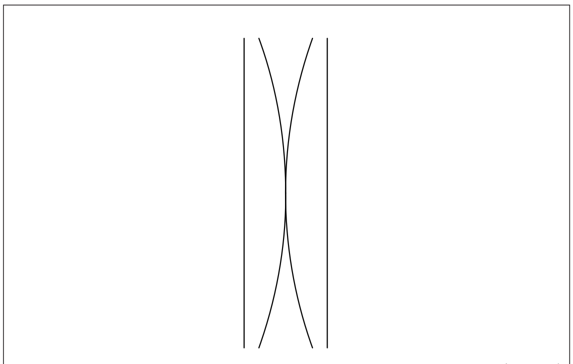
(1) Assemble spool and sleeve.
When assembling spool and sleeve only one of two possible ways of positioning the spring slots is correct. There are three slots in the spool and three holes in the sleeve in the end of the spool / sleeve opposite to the end with spring slots.
Place the slots and holes opposite each other so that parts of the holes in the sleeve are visible through the slots in the spool.


14-1 (200W-3)

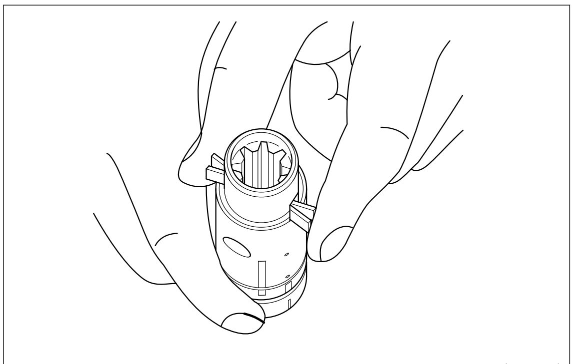
(2) Place the two flat neutral position springs in the slot.
Place the curved springs between the flat ones and press them into place (see assembly pattern).


14-2 (200W-3)

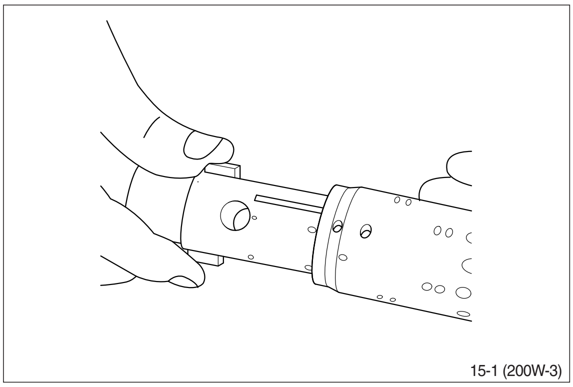
※ Assembly pattern.
· Part no : 150N4035


14-3 (200W-3)

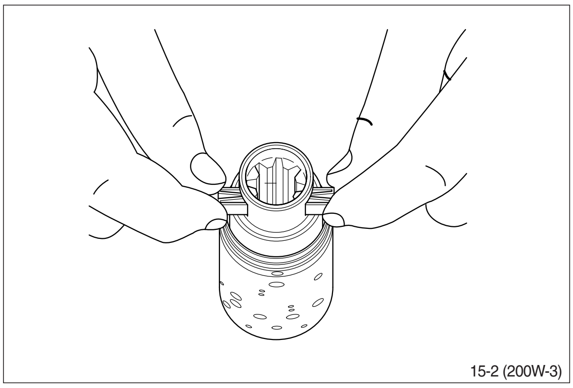
(3) Line up the spring set.


14-4 (200W-3)

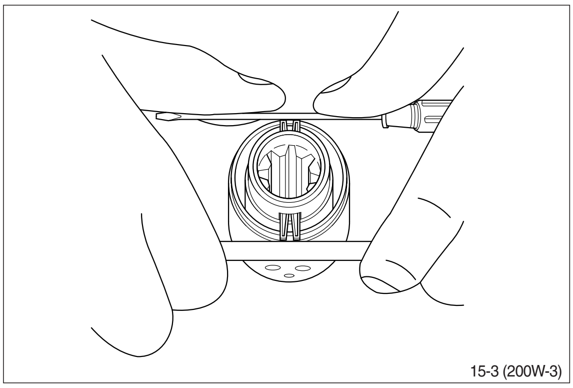
(4) Guide the spool into the sleeve. Make sure that spool and sleeve are placed correctly in relation to each other.


15-1 (200W-3)

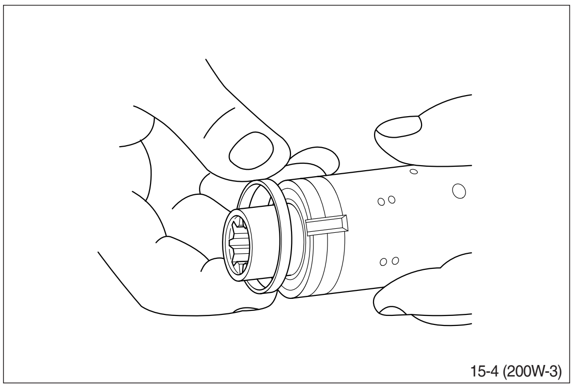
(5) Press the springs together and push the neutral position springs into place in the sleeve.


15-2 (200W-3)

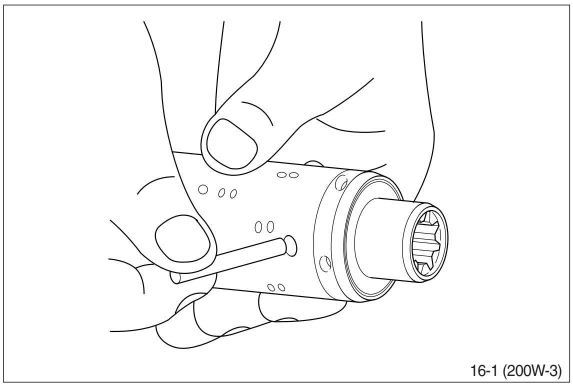
(6) Line up the springs and center them.


15-3 (200W-3)

(7) Guide the ring down over the sleeve.
※ The ring should be able to rotate free of the springs.

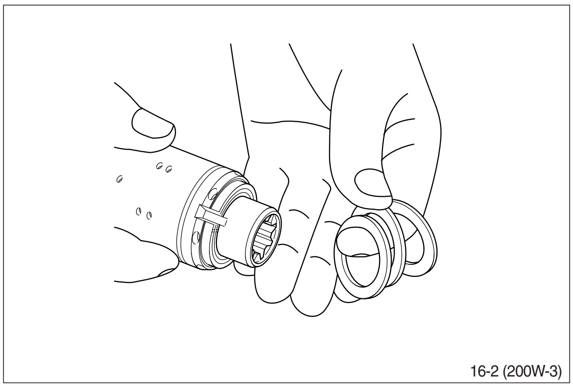

15-4 (200W-3)

(8) Fit the cross pin into the spool / sleeve.



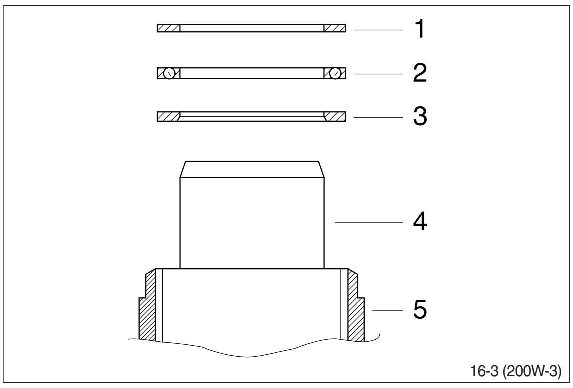
16-1 (200W-3)

(9) Fit bearing races and needle bearing as shown on below drawing.



16-2 (200W-3)

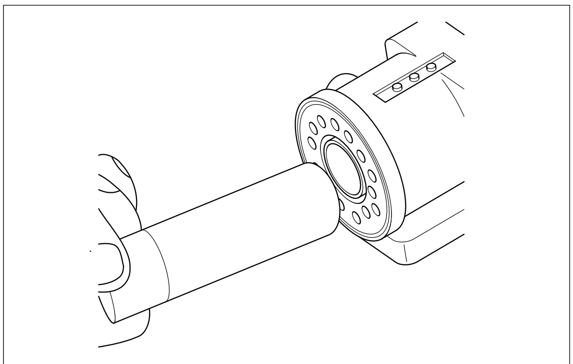
※ Assembly patted for standard bearings
1 Outer bearing race
2 Needle bearing
3 Inner bearing race
4 Spool
5 Sleeve



16-3 (200W-3)

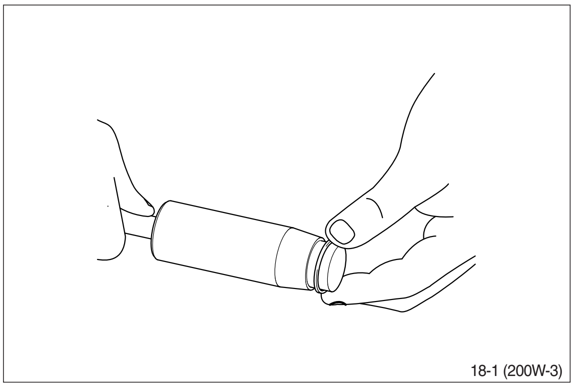
Installation instruction for O-ring

(10) Turn the steering unit until the bore is horizontal. Guide the outer part of the assembly tool into the bore for the spool / sleeve.

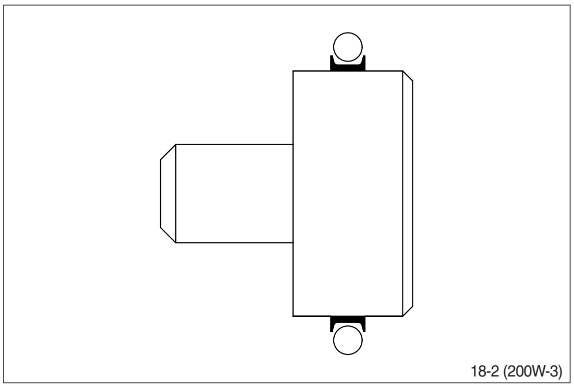


17-1 (200W-3)

(11) Grease O-ring with hydraulic oil and place them on the tool.

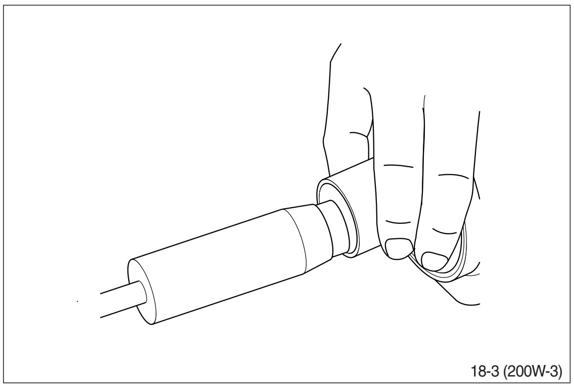


18-1 (200W-3)



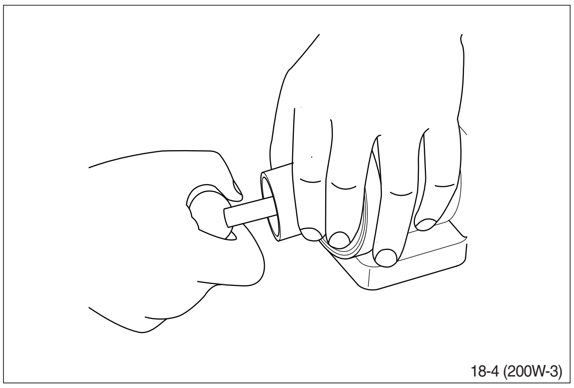
18-2 (200W-3)

(12) Hole 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.



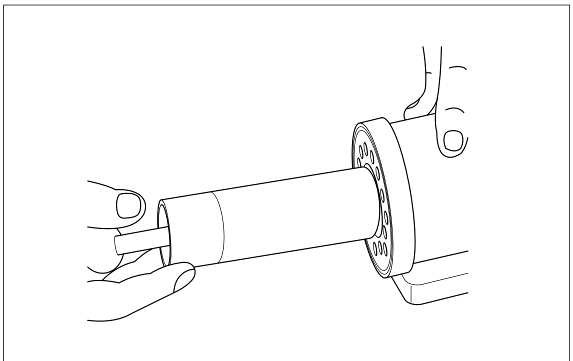
18-3 (200W-3)

(13) Press and turn the O-ring into position in the housing.



18-4 (200W-3)

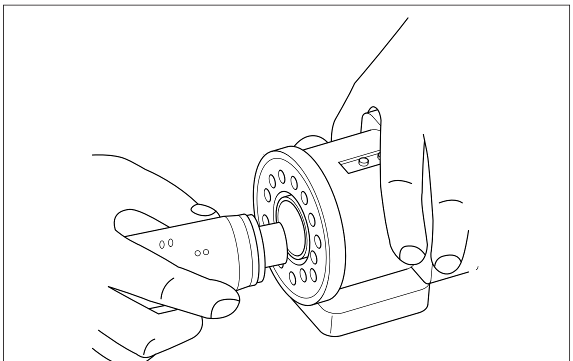
(14) Draw the inner and outer parts of the assembly tool out of the steering unit bore, leaving the guide from the inner part in the bore.



18-5 (200W-3)

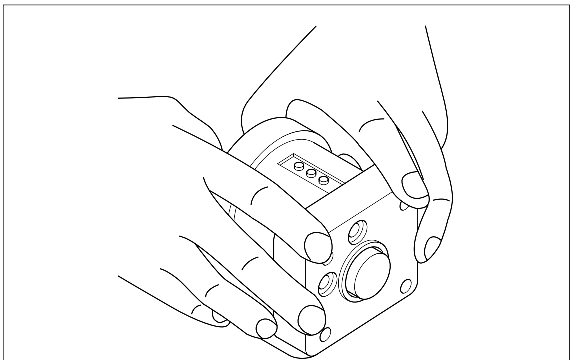
(15) With a light turning movement, guide the spool and sleeve into the bore.

※ Fit the spool set holding the cross pin horizontal.



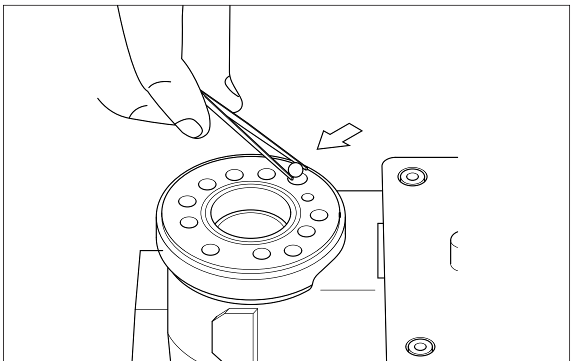
20-1 (200W-3)

(16) The spool set will push out the assembly tool guide. The O-ring is now in position.



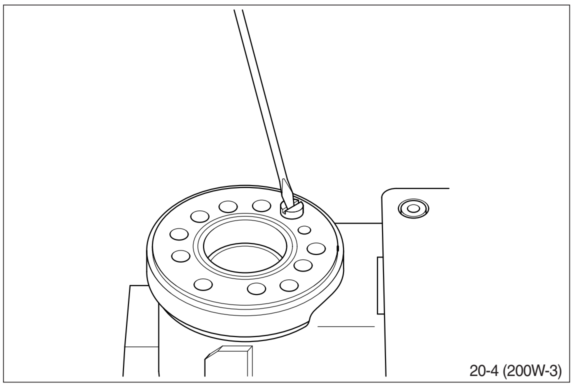
20-2 (200W-3)

(17) Turn the steering unit until the bore is vertical again. Put the check valve ball into the hole indicated by the arrow.



20-3 (200W-3)

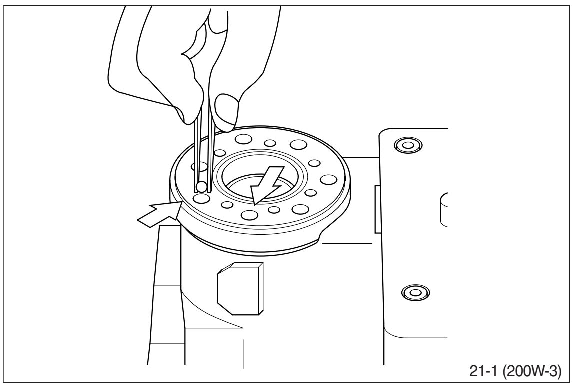
(18) Screw the threaded bush lightly into the check valve bore. The top of the bushing must lie just below the surface of the housing.



20-4 (200W-3)

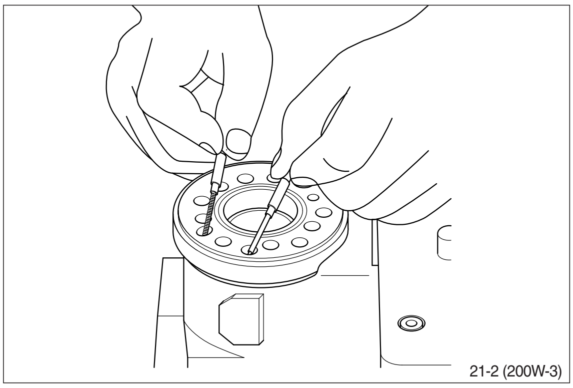
Assembly of the two suction valve

(19) Place a ball in the two holes indicated by the arrows.



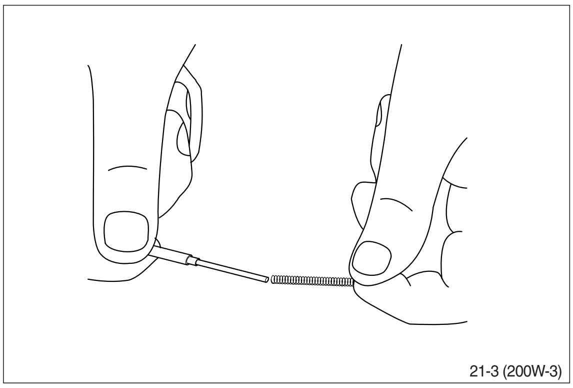
21-1 (200W-3)

(20) Place a pin in the same two holes.



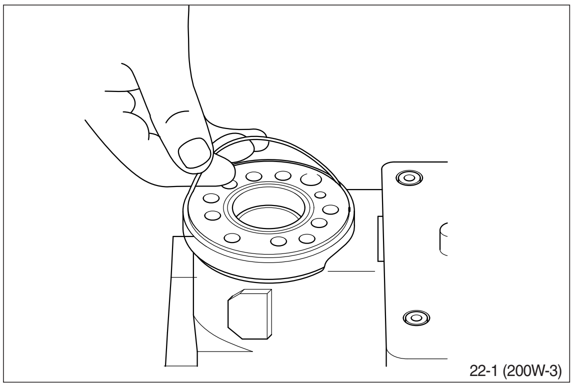
21-2 (200W-3)

(21) In some cases a spring has to be fitted on the pin before it is placed in the housing.



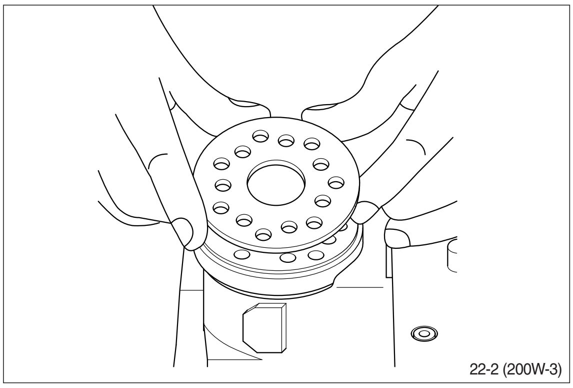
21-3 (200W-3)

(22) Grease the O-ring with mineral oil approx viscosity 500 cST at 20˚C.



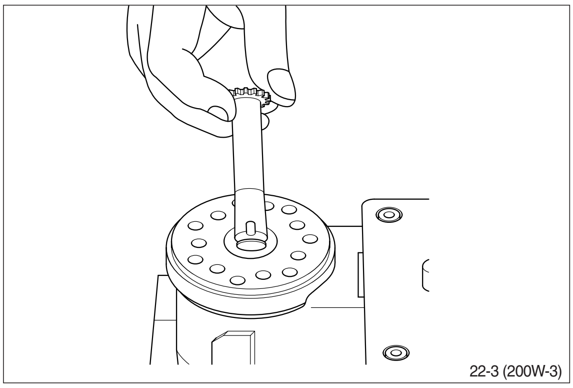
22-1 (200W-3)

(23) Place the distributor plate so that the channel holes match the holes in the housing.



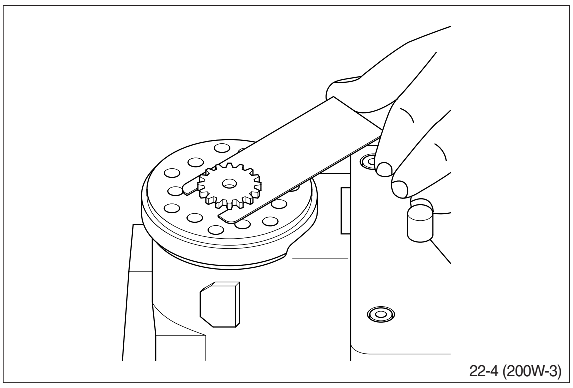
22-2 (200W-3)

(24) Guide the cardan shaft down into the bore so that the slot is parallel with the connection flange.



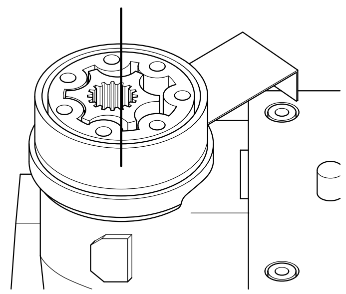
22-3 (200W-3)

(25) Place the cardan shaft as shown so that it is held in position by the mounting fork.



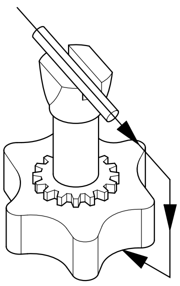
22-4 (200W-3)

(26) Grease the two O-rings with mineral oil approx. viscosity 500 cST at 20˚C and place them in the two grooves in the gear rim. Fit the gearwheel and rim on the cardan shaft.



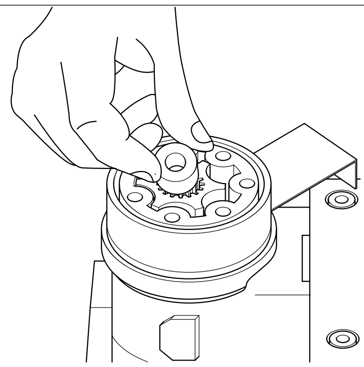
23-1 (200W-3)

(27) Fit the gearwheel (rotor) and cardan shaft so that a tooth base in the rotor is positioned in relation to the shaft slot as shown. Turn the gear rim so that the seven through holes match the holes in the housing.



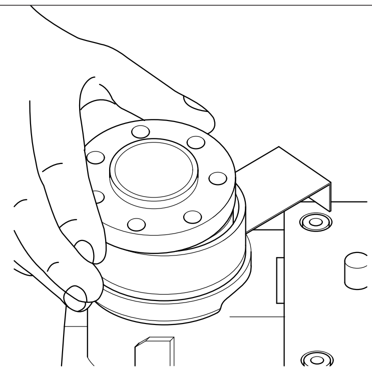
23-2 (200W-3)

(28) Fit the spacer, if any.



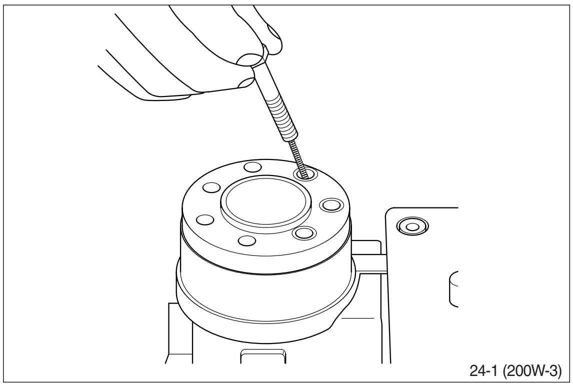
23-3 (200W-3)

(29) Place the end cover in position.



23-4 (200W-3)

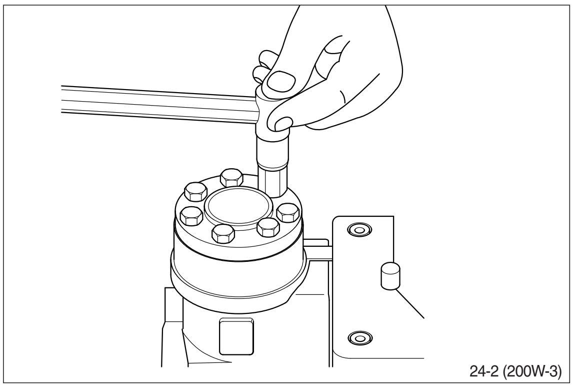
(30) Fit the special screw with washer and place it in the hole shown.



24-1 (200W-3)

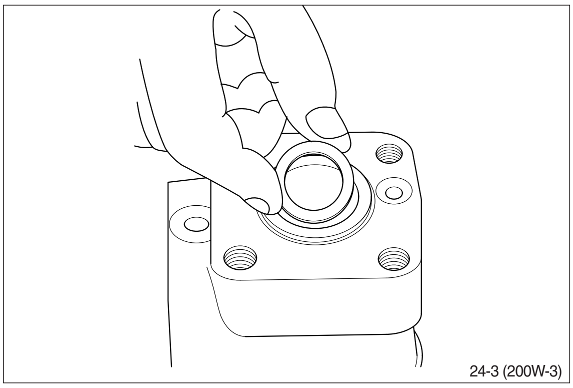
(31) Fit the six screws with washers and insert them. Cross-tighten all the screws and the rolled pin.

· Tightening torque : 3.0±0.6 kgf · m (22.4±4.3 lbf · ft)



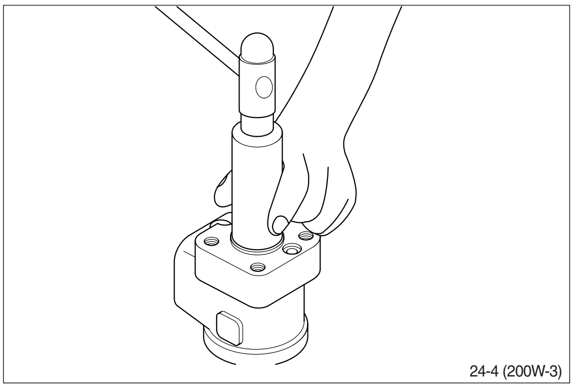
24-2 (200W-3)

(32) Place the dust seal ring in the housing. The dust seal ring must be placed only after the pressure relief valve and shock valves have been fitted.



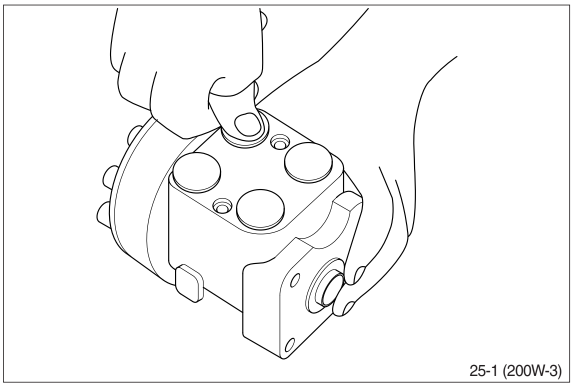
24-3 (200W-3)

(33) Fit the dust seal ring in the housing.



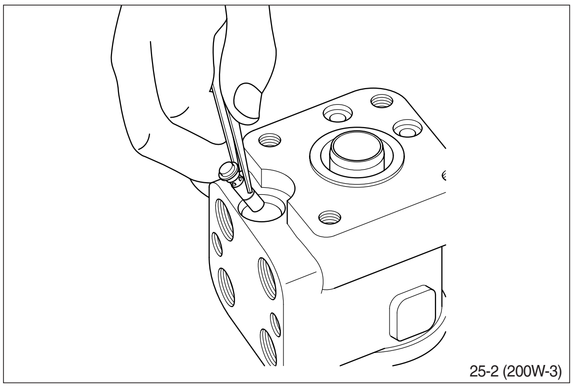
24-4 (200W-3)

(34) Press the plastic plugs into the connection ports.
※ Do not use a hammer!

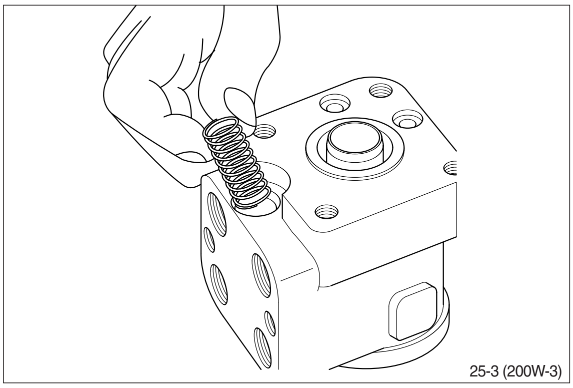

25-1 (200W-3)

Assembly of the pressure relief valve

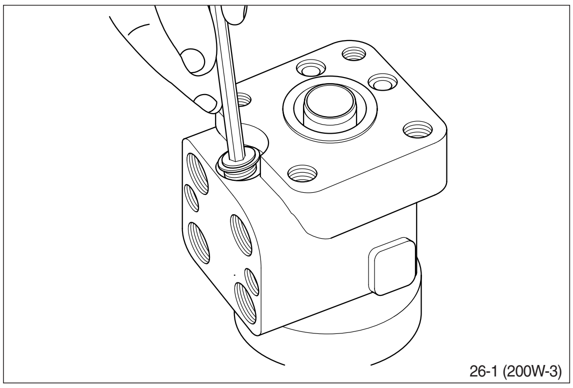
(35) Fit the piston.


25-2 (200W-3)

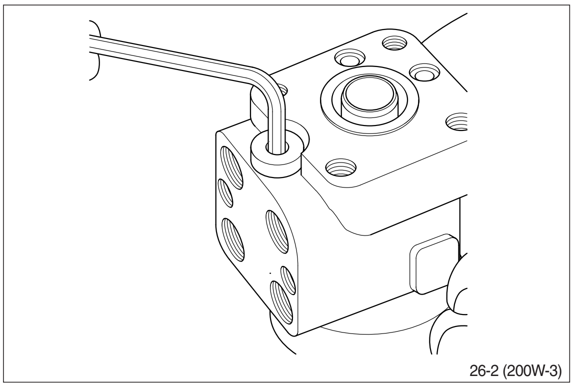
(36) Fit the spring.


25-3 (200W-3)

(37) Screw in the setting screw with an 8mm hexagon socket spanner. Make the pressure setting on a panel or the machine.

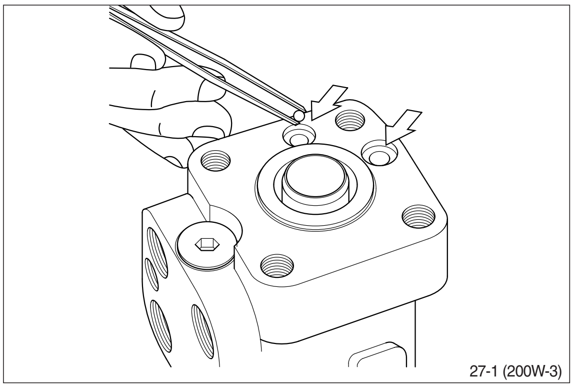

26-1 (200W-3)

(38) Screw plug with dust seal into the housing using an 8mm hexagon socket spanner.
· Tightening torque : 5.1±1.0 kgf · m (36.9±7.2 lbf · ft)

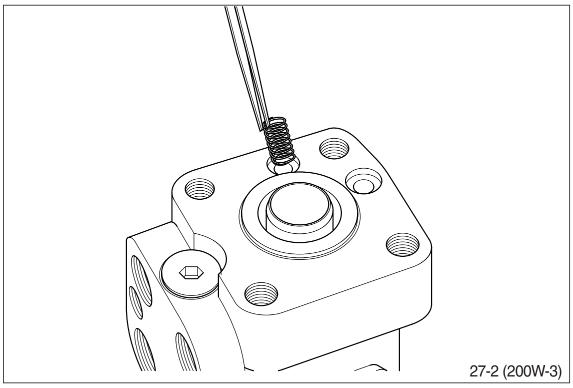

26-2 (200W-3)

Assembly of the dual shock valve

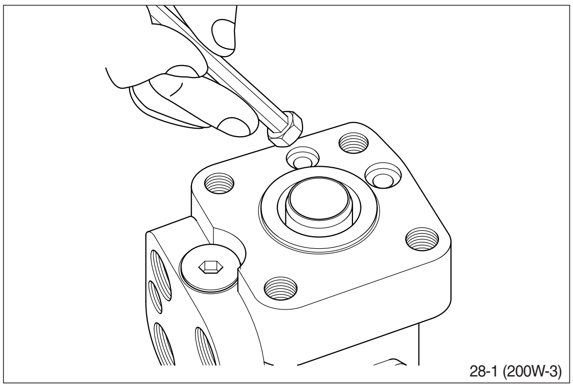
(39) Put a ball in the two holes indicated by the arrows.


27-1 (200W-3)

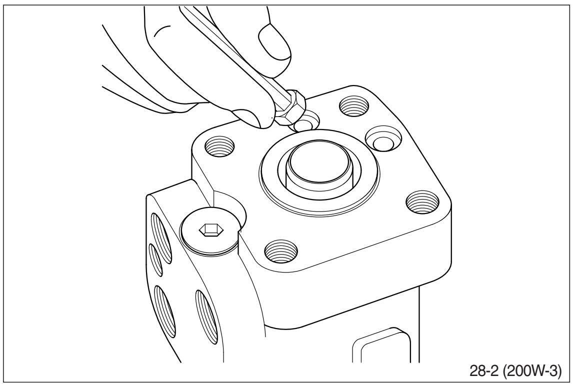
(40) Place springs and valve cones over the two balls.


27-2 (200W-3)

(41) Screw in the two setting screws using a 6mm hexagon socket spanner. Make the pressure setting on a panel or the machine.


28-1 (200W-3)

(42) Screw plug with seal ring into the two shock valves using a 6mm hexagon socket spanner.
- Tightening torque : 3.1 kgf · m (22.4 lbf · ft)


28-2 (200W-3)

Steering valve is now assembled.

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 : $60^{\ 0}_{-5}$ kgf · m
   (433^{+0}_{-36} lbf · ft)

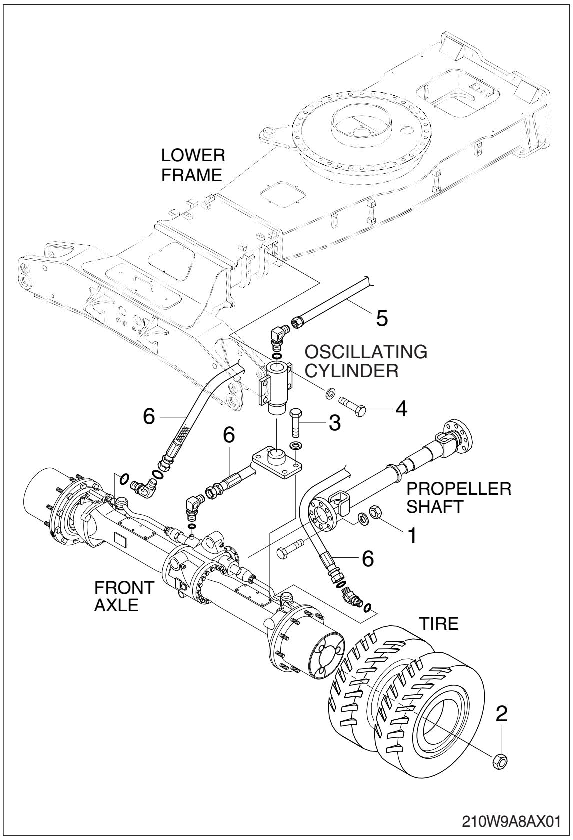
3) Oscillating cylinder supporting mounting bolt (3, M16)
   · Tightening torque : 29.7±4.5 kgf · m
   (215±32.5 lbf · ft)

4) Oscillating cylinder mounting bolt (4, M22)
   · Tightening torque : 69.4±10.4 kgf · m
   (502±75.2 lbf · ft)

5) Pipe assy (5)

6) Hose assy (6)

7) Front axle weight : 740 kg (1630 lb)



210W9A8AX01

3. 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

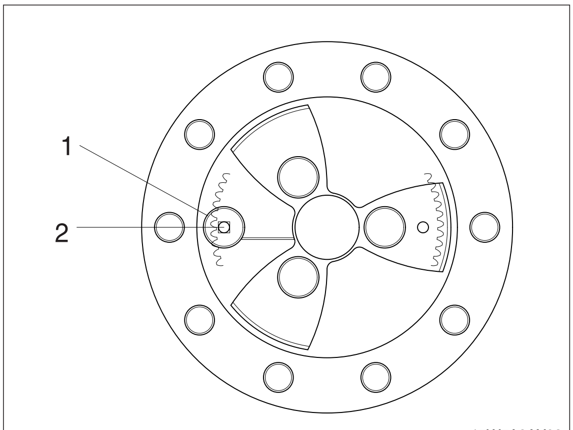
(1) Gear oils with limited - slip additives.

(2) API GL-5

(3) MIL-L-2105D (SAE 85W-90, 85W-140 with LS-Additive)

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

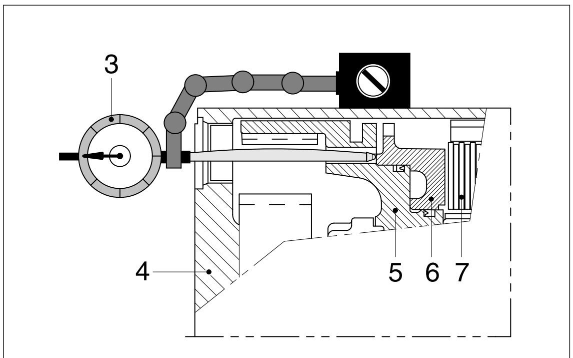


17W7A8AX03

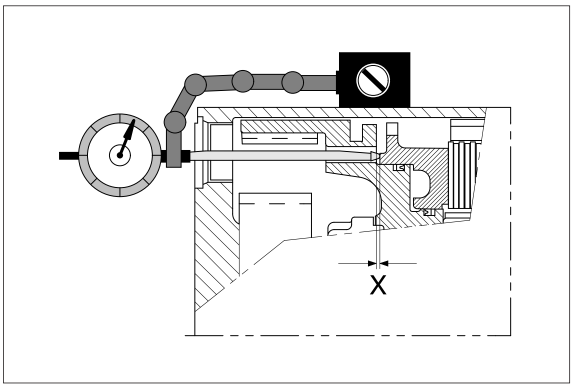
※ To avoid injury when opening the oil drain/oil filler plug (1), due to a possible pressure build-up in the planetary carrier bring drain hole to topmost position (12 o'clock) and carefully unscrew oil drain and filler plug (1).

(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 mm) 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



17W7A8AX04



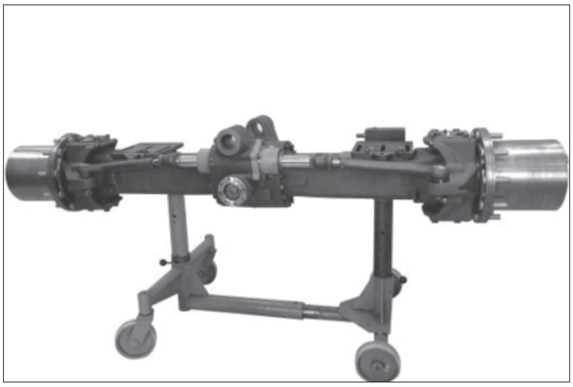
17W7A8AX05

3. DISASSEMBLY

1) STEERING

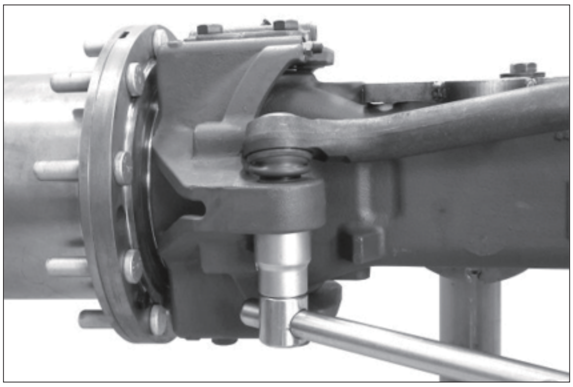
(1) Fix the axle to the assembly truck.

(S) Assembly truck 5870 350 000
(S) Support 5870 350 106



17W98FA001

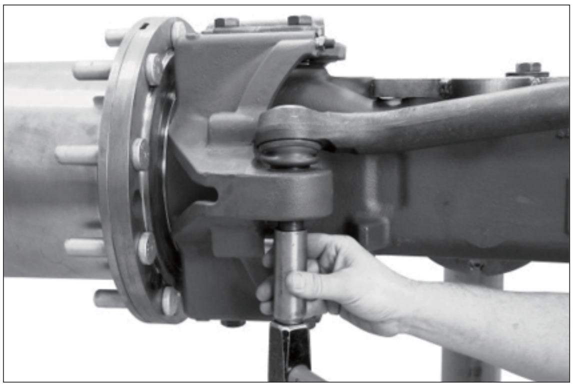
(2) Loosen locknut.



17W98FA002

(3) Force out tie rod from bevel seat.

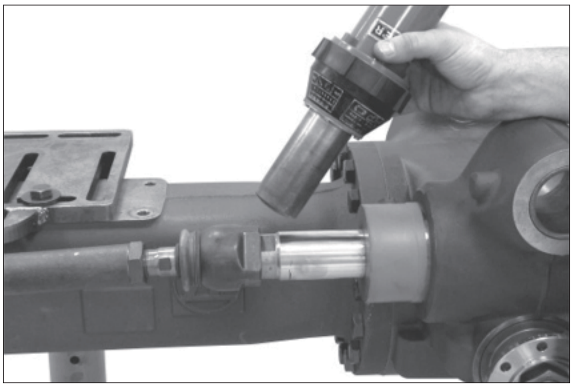
※ Use suitable mandrel (brass or aluminum).



17W98FA003

(4) Warm up piston rod by means of hot air blower.

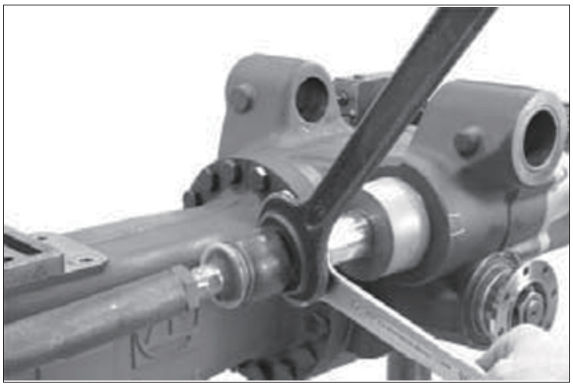
※ Axial joint is installed with Loctite no. 243.



17W98FA004

(5) Separate both tie rods from piston rod.

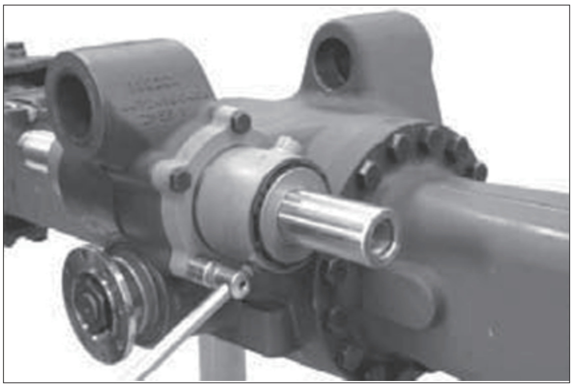
※ If work is just to be done on piston rod, guide or sealing elements, no disassembly of the steering cylinder assy is required.



17W98FA005

(6) Loosen hexagon screws.

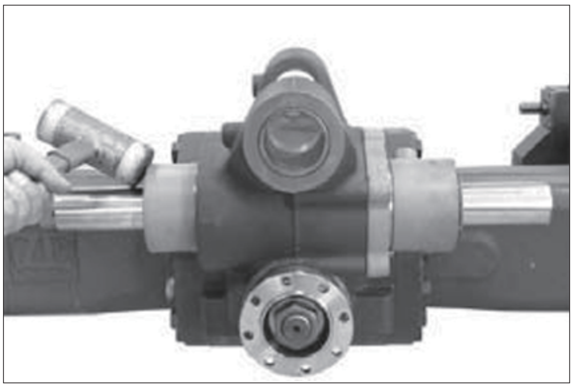
※ Mark radial installation position of steering cylinder to axle housing – assembly aid.



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

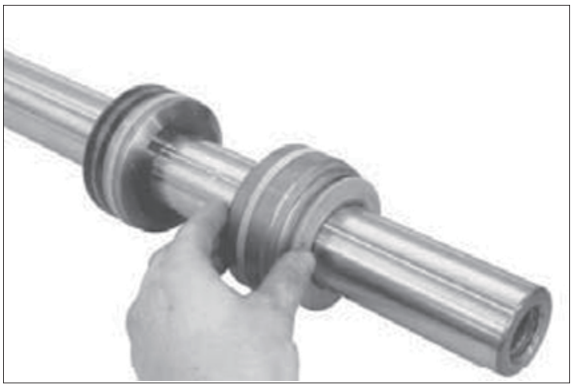
(11) Unsnap retaining ring.

Then drive out piston rod together with brake head from cylinder tube.

17W98FA011

(12) Pull off brake head from the piston rod.

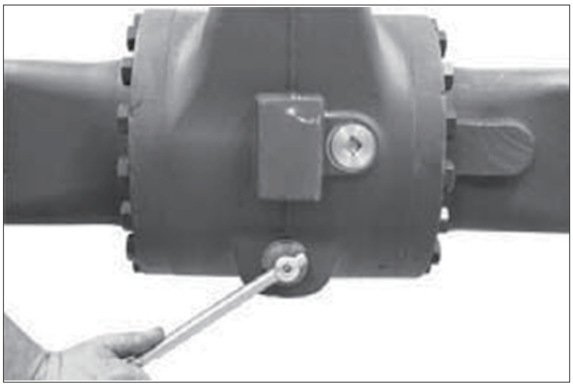
Then remove all sealing elements from piston rod, brake head and cylinder tube.



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.

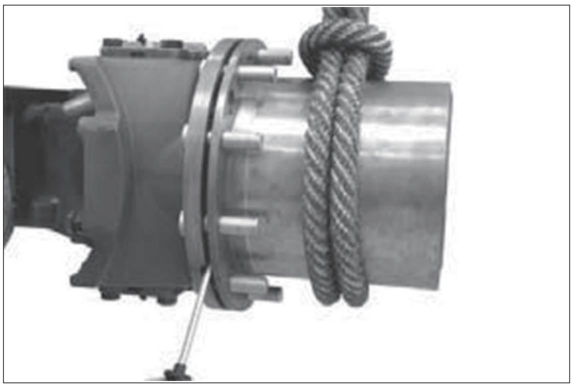
※ To avoid injury due to a possible pressure build-up in the oil system of the planetary carrier, bring oil filler and control plug to 12 o'clock position and carefully unscrew. Then bring drain hole to 6 o'clock position and drain oil.

※ Use suitable collecting basin environmental protection.

17W98FA014

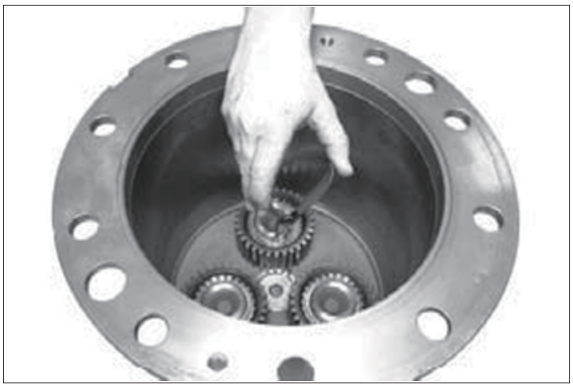
(3) Planetary carrier

Loosen both hexagon screws and separate planetary carrier from hub.



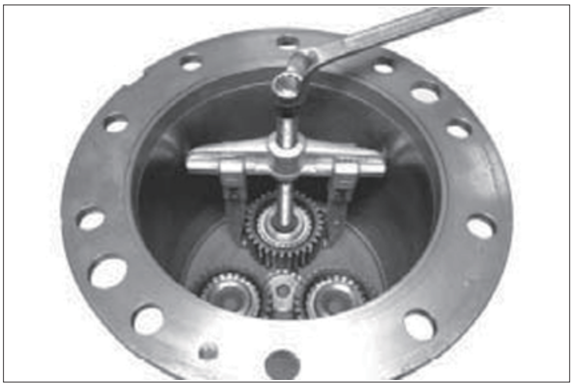
17W98FA015

(4) Unsnap retaining ring.



17W98FA016

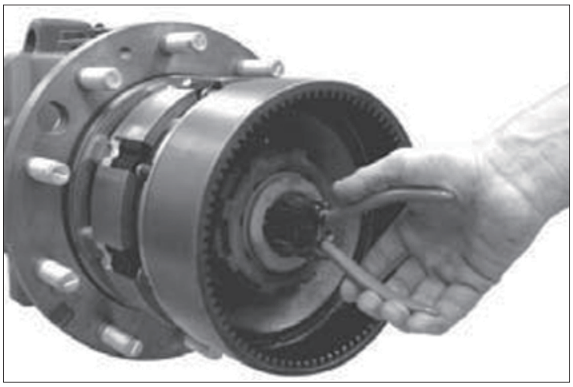
(5) Pull off planetary gear together with cylindrical roller bearing.



17W98FA017

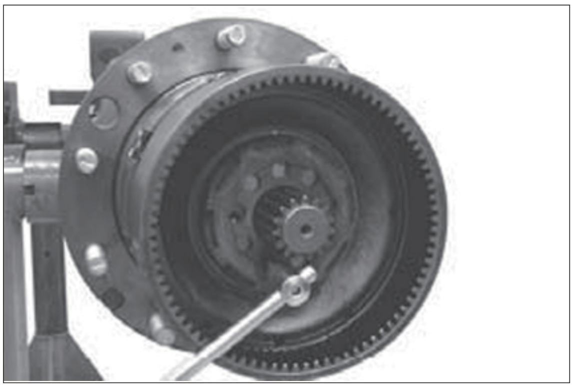
(6) Brake

Unsnap retaining ring and remove both thrust washers.



17W98FA018

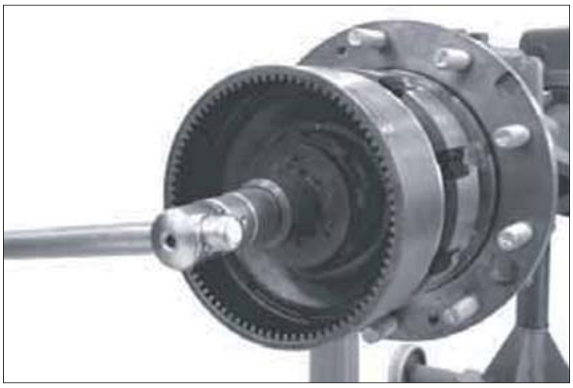
(7) Loosen cylindrical screw (slotted nut fixing).



17W98FA019

(8) Loosen slotted nut.

(S) Socket wrench 5870 656 097

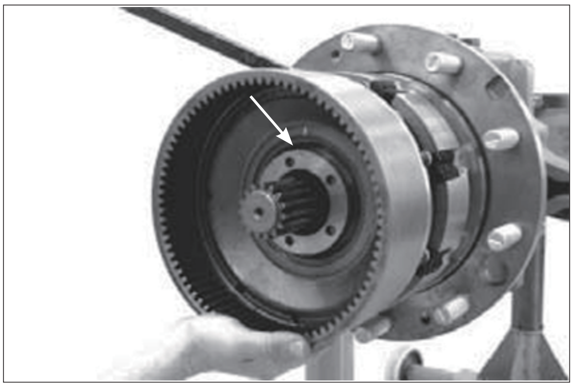


17W98FA020

(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

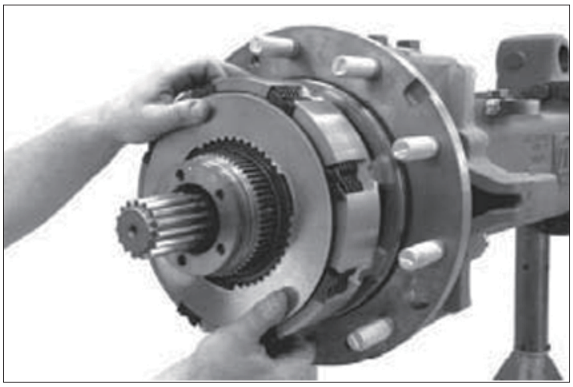
(11) Press off piston from ring gear.

17W98FA023

(12) Remove sealing elements from the annular grooves (see arrows) of the ring gear.

17W98FA024

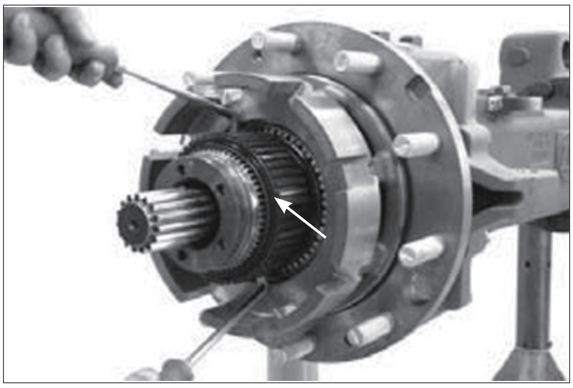
(13) Remove disk package.



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

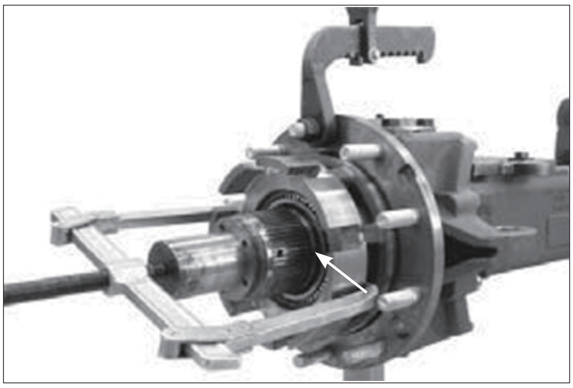
Remove O-ring (see arrow).

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.

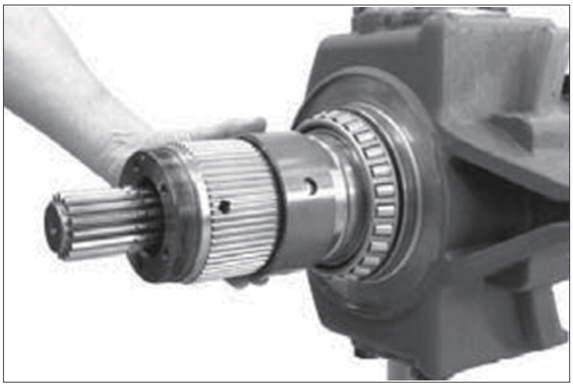


17W98FA027

(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

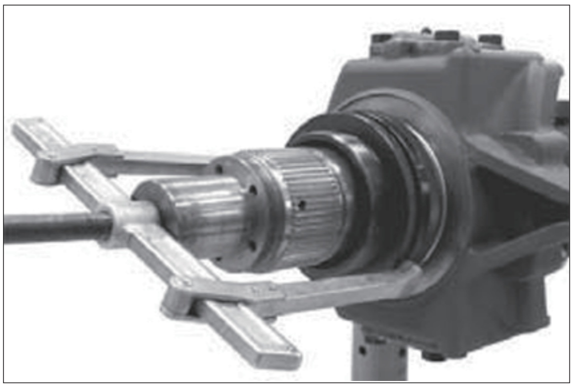
(17) Remove spacer bushing.



17W98FA029

(18) Pull tapered roller bearing from joint housing.

(S) Grab sleeve 5873 004 022
(S) Pressure piece 5870 100 067



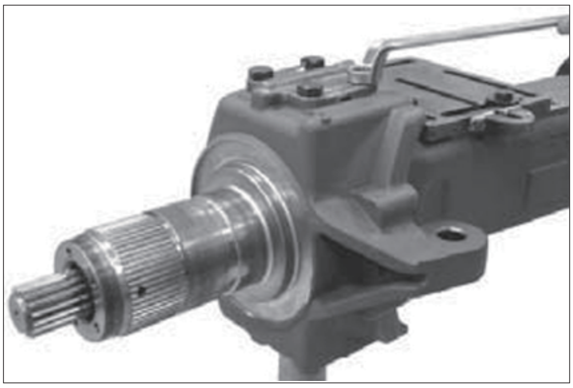
17W98FA030

(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).

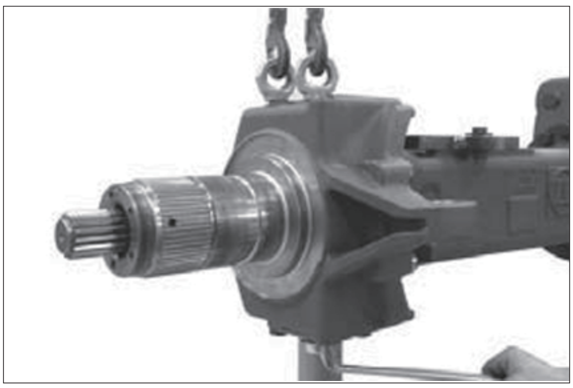


17W98FA031

(20) Secure knuckle housing by means of lifting tackle.

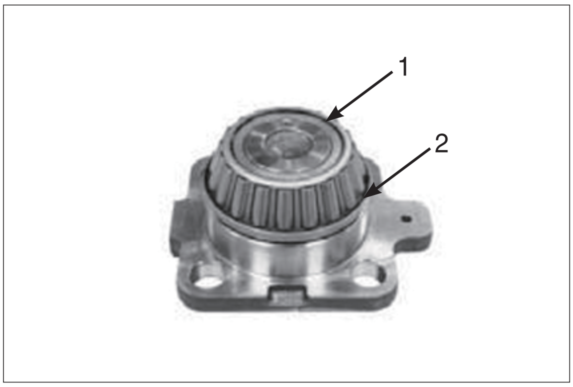
Then loosen threaded joint and remove lower bearing pin.

(S) Eyebolts (M 20) 0636 804 003



17W98FA032

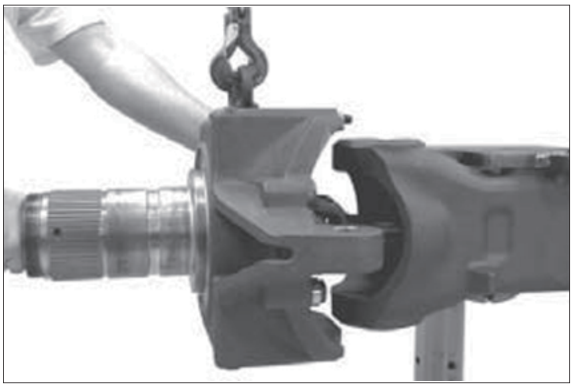
(21) Use lever to remove tapered roller bearing (1) from bearing pin, remove releasing sealing cap (2) and the O-ring lying behind.



17W98FA033

(22) Separate knuckle housing with double u-joint shaft from the axle housing.

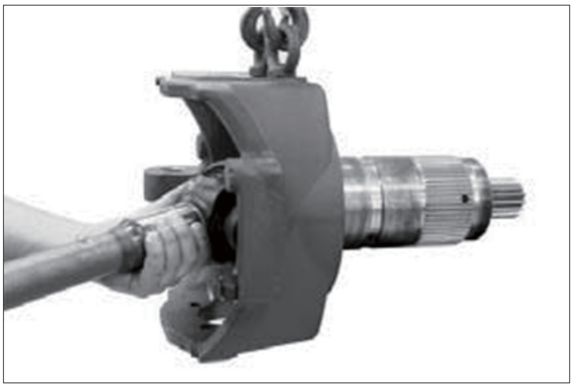
※ Pay attention to shaft seal ring in the axle housing risk of damage.



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

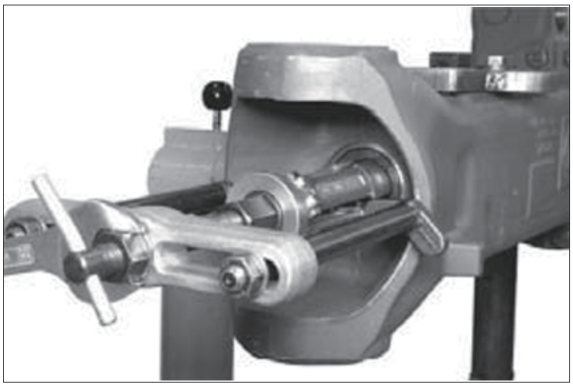
(24) Pull out shaft seal ring and afterwards the bushing behind from the axle housing.

(S) Internal extractor	5870 300 017
(S) Counter support	5870 300 020

17W98FA036

(25) Pull out shaft seal ring and afterwards the bushing behind from the axle housing.

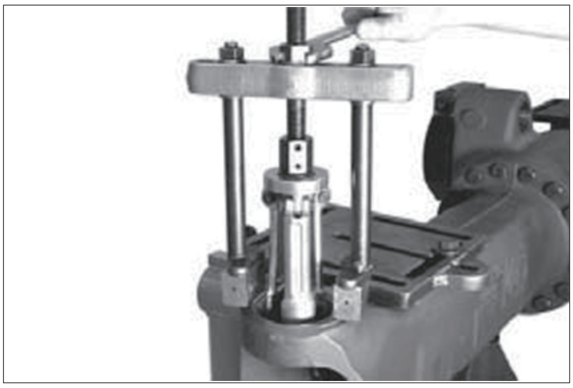
(S) Internal extractor	5870 300 017
(S) Counter support	5870 300 020



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

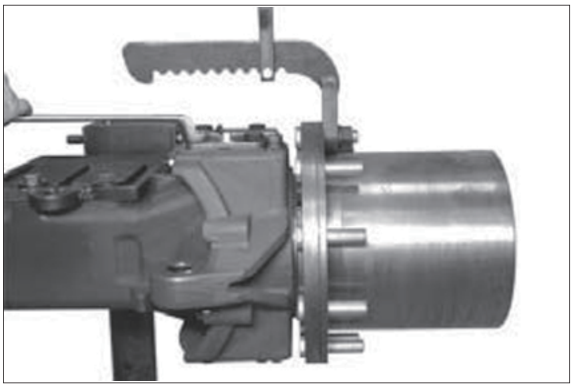
(27) Output assy

※ 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).

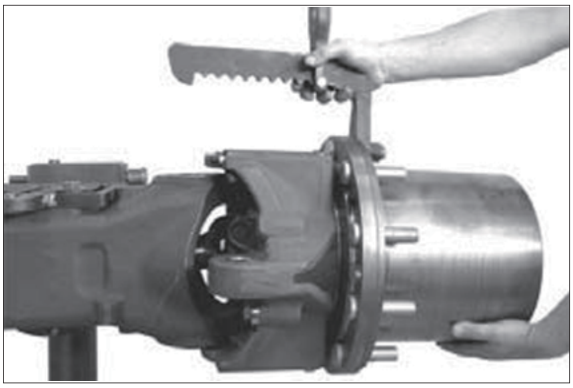
(S) Lifting bracket	5870 281 043

Then loosen threaded joints of both bearing pins.



17W98FA039

(28) Remove both bearing pins and separate the output assy from the axle housing.

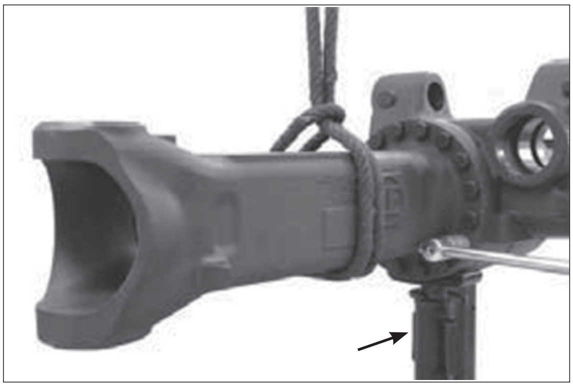


17W98FA040

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.

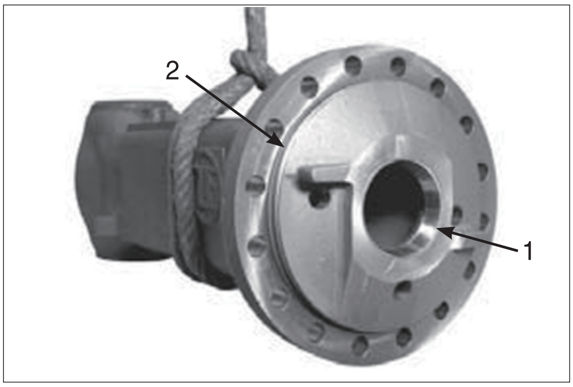
※ Pay attention to possibly releasing differential.



17W98FA041

(2) Pull bearing outer ring (arrow 1) from the bearing hole and remove releasing shim.
Then remove O-ring (arrow 2).

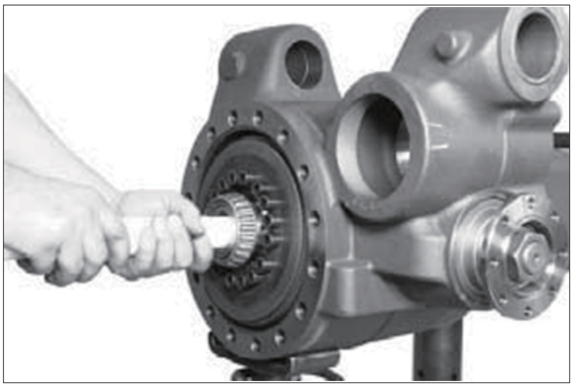
(S) Striker 5870 650 004



17W98FA042

(3) Lift differential out of the axle drive housing.

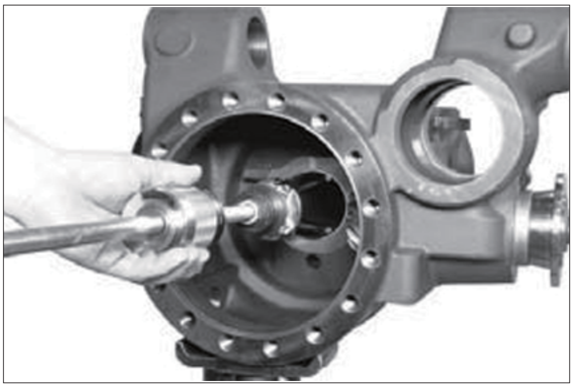
※ Disassembly of the differential is described as of page 8-189.



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

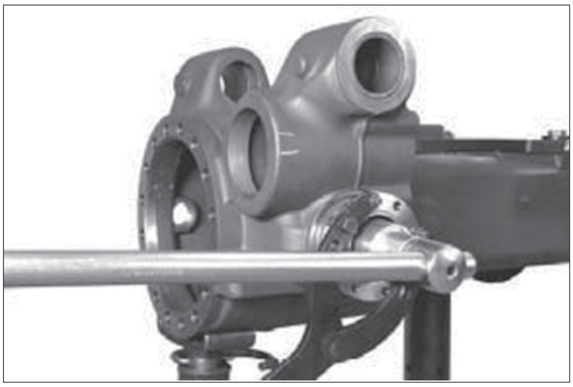


17W98FA044

(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

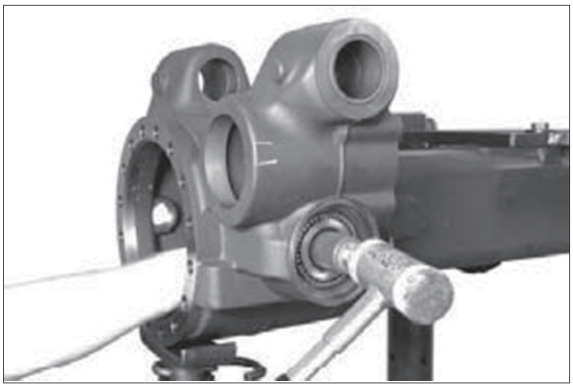
(7) Use a lever to remove the shaft seal ring from the housing hole.

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

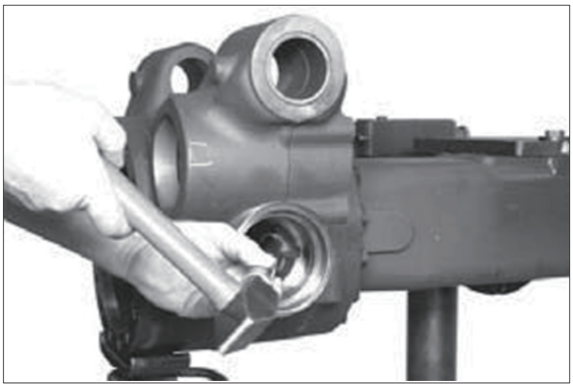
(11) Pull off outer bearing outer ring from bearing hole.

(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.

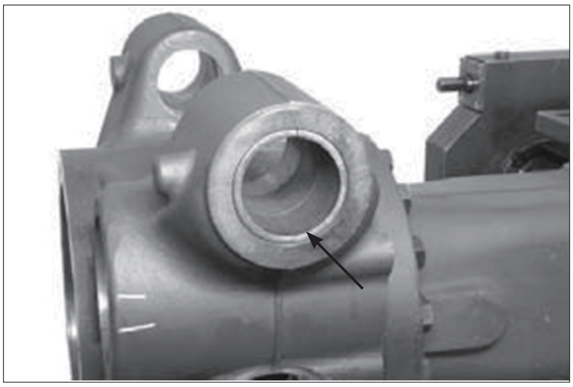
※ Mark shim (with regard to position/bearing allocation) assembly aid.



17W98FA052

(13) If necessary, provide bushings with a separating slot (see arrow) and remove from holes.

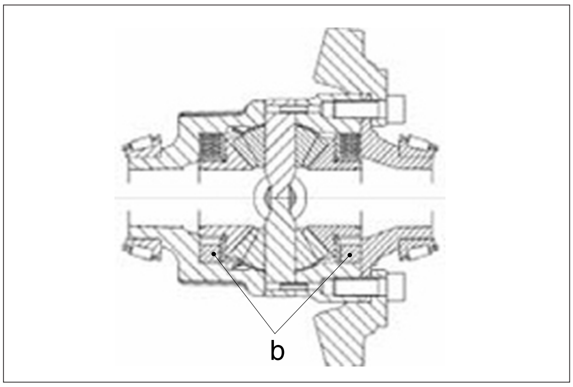
※ Bushings are destroyed by this.



17W98FA053

4) DIFFERENTIAL

(1) Differential - versions:
b = Constant spacers



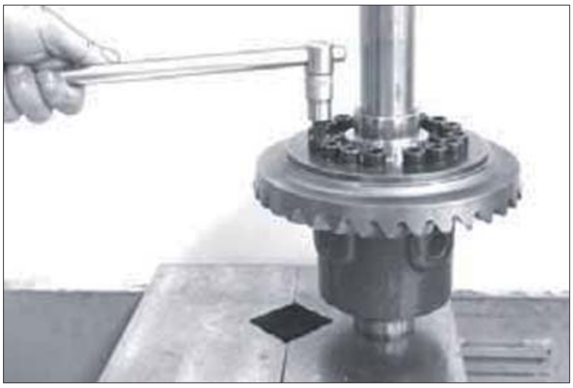
17W98FA054

(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

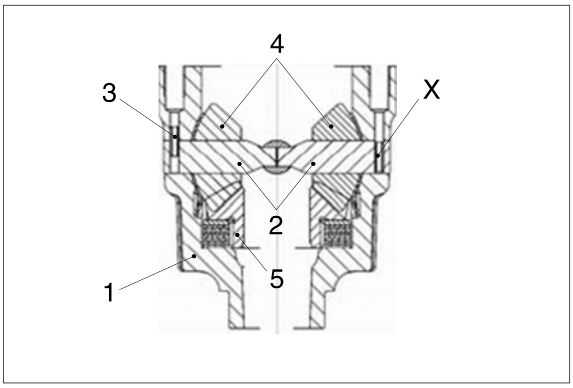
(5) Remove single parts.
Remove axle bevel gear together with thrust washer and constant spacer from the differential carrier.

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

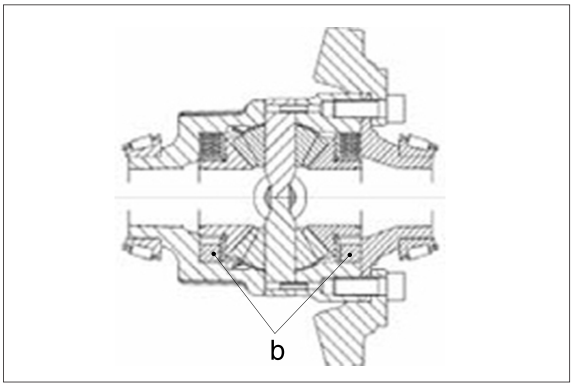
(9) Remove all single parts.

17W98FA062

4. REASSEMBLY

1) DIFFERENTIAL

(1) b = Constant spacers

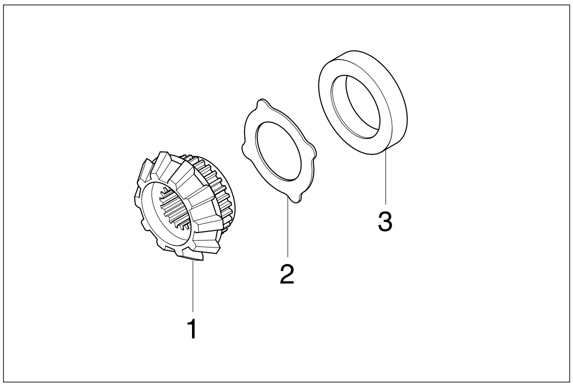


17W98FA054

(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).

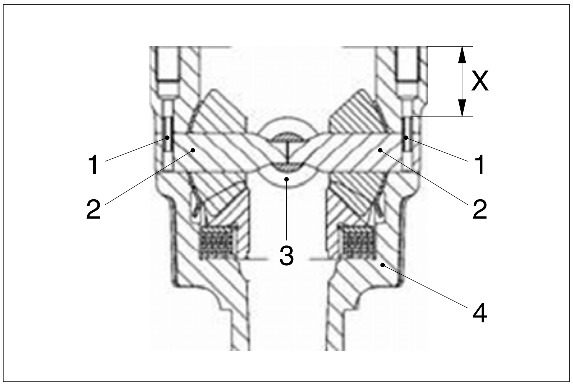
17W98FA068

(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 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.

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.

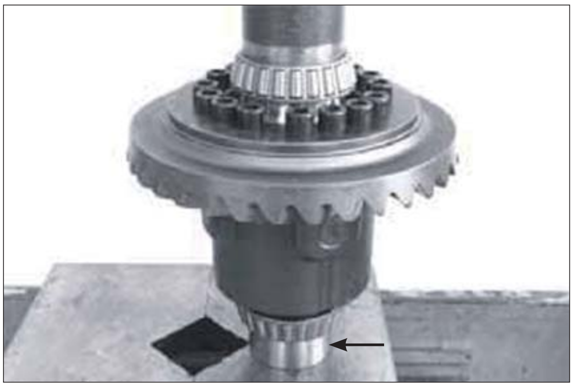
17W98FA074

(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

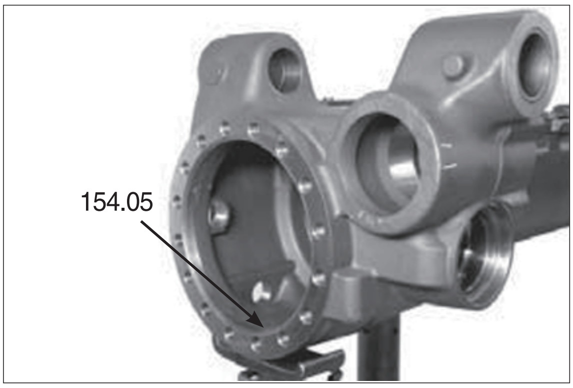
(1) Input pinion

※ 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



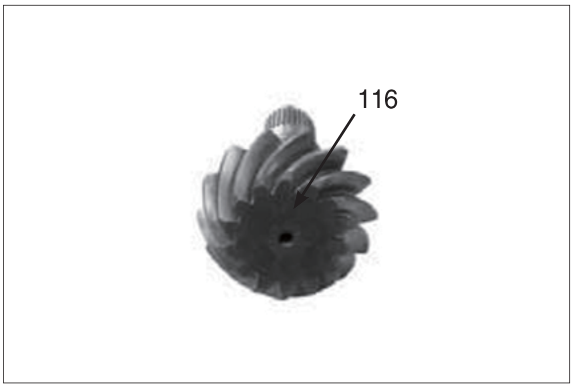
17W98FA077

(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



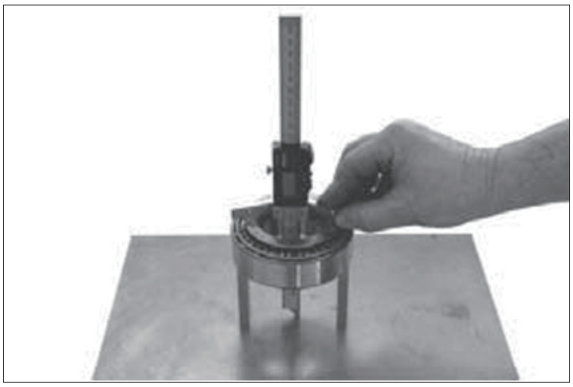
17W98FA078

(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

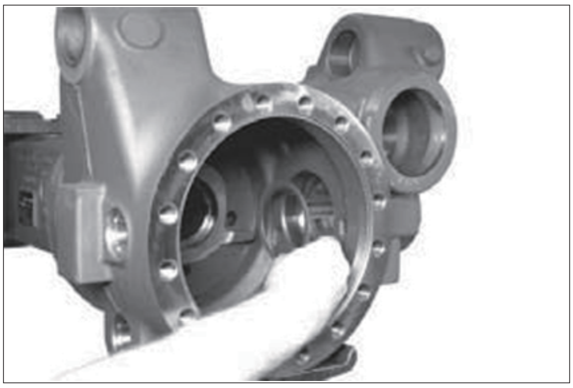


17W98FA079

(5) Calculation example "B" :

Dimension I . . . . 154.05 mm
Dimension X . . . . - 152.50 mm
Difference = shim s = 1.55 mm

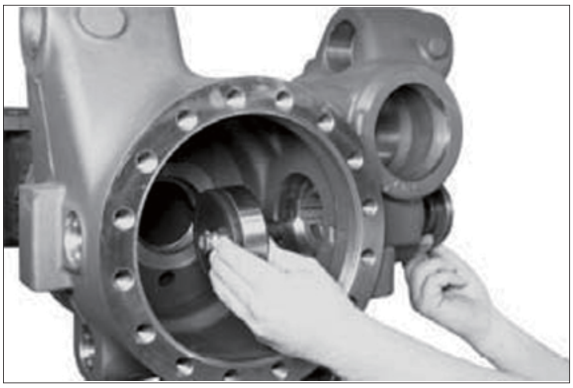
Insert the determined shim (e.g. s = 1.55 mm) into the inner bearing hole.



17W98FA080

(6) Undercool bearing outer ring (see arrow) and bring into contact position in the bearing hole by using the assembly fixture (S).

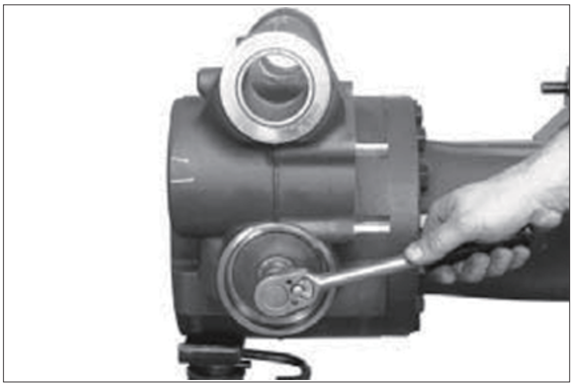
(S) Assembly fixture 5870 345 049
(S) Pressure ring 5870 345 056



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.

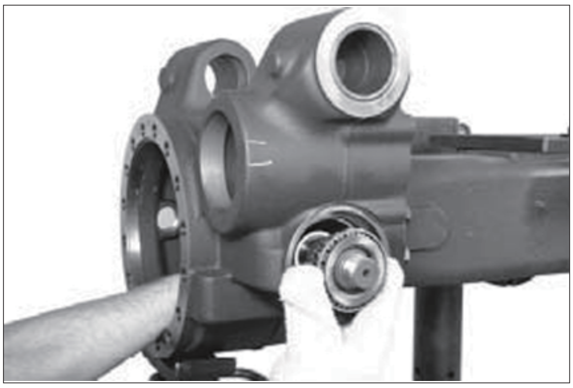
17W98FA083

(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

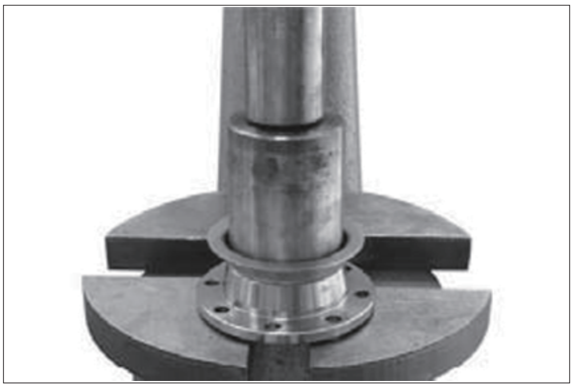
(10) Insert the preassembled input pinion into the axle housing and mount the heated roller bearing until contact is obtained.



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.



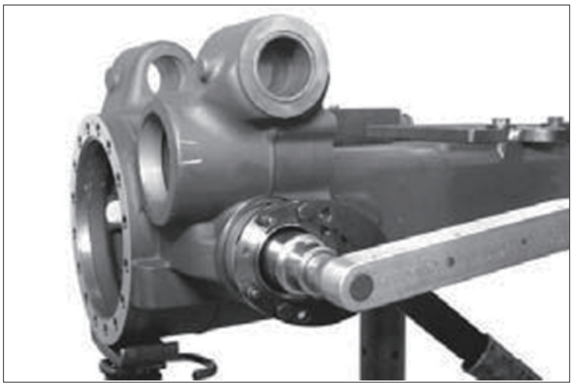
17W98FA086

(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.

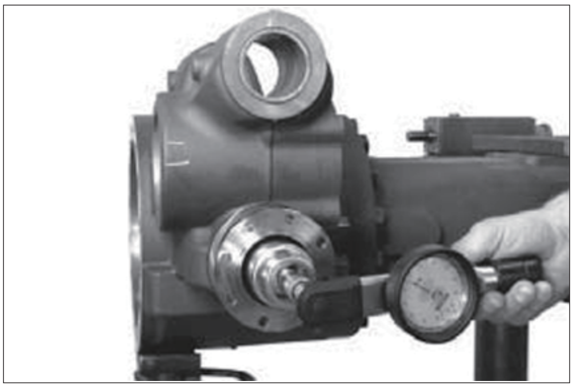


17W98FA087

(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.

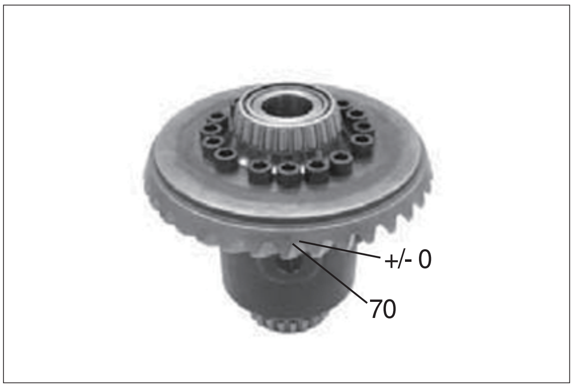


17W98FA088

(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.

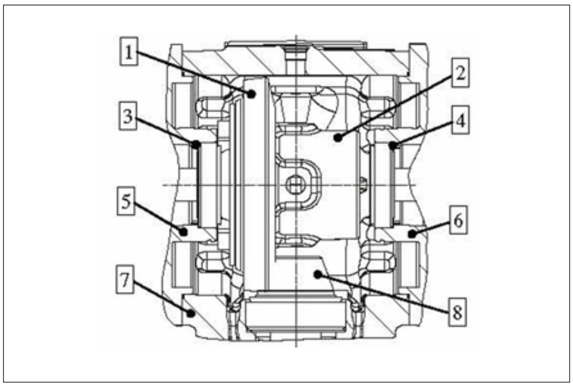
※ Test dimension "70" is stamped into the crown wheel rear. Without + or deviation specification, this corresponds to test dimension / Actual value "70" in the table below.
According to this value the necessary shims are allocated in the table next page.



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

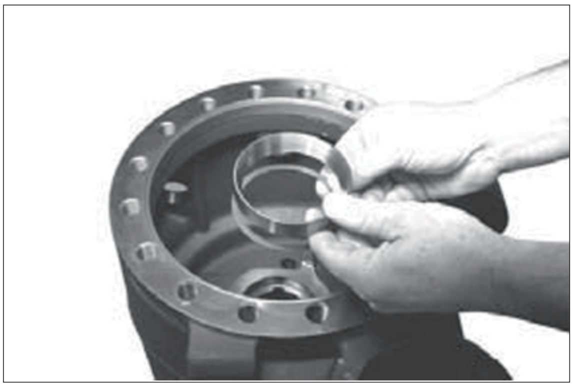
(15) Comment on sketch:

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.	0730 006 518	0730 006 519	0730 006 521	0730 006 522	0730 006 524
Shim/Crown wheel side Required disk thickness	1.35	1.25	1.15	1.05	0.95
Shim no.	0730 006 524	0730 006 522	0730 006 521	0730 006 519	0730 006 518

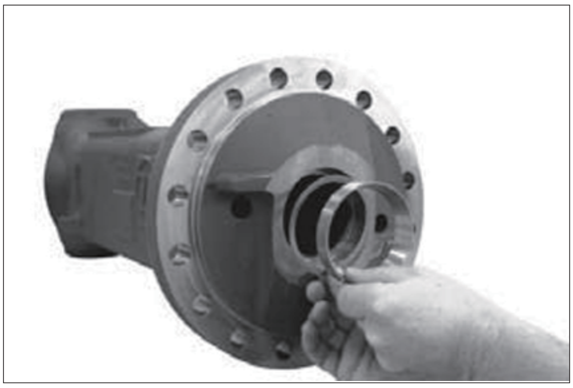
(16) Insert the determined shim (e.g. s = 1.15 mm) and the bearing outer ring into the hole of the axle housing on the differential carrier side.

※ 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.

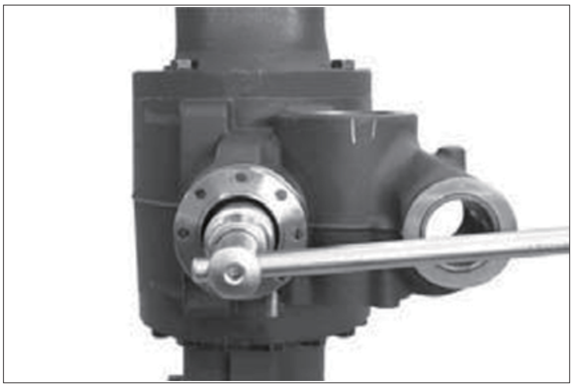
Tightening torque (M18/10.9) . . . . .MA = 390 Nm

※ Preliminarily fix axle housing without O-ring.

17W98FA095

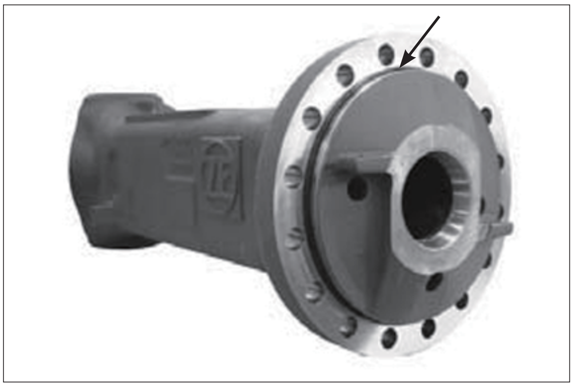
(21) Roll the crown wheel by rotation on the input flange several times in both directions over the input pinion.
Then remove axle housing again and lift differential out of the axle drive housing.
Compare the obtained contact pattern with contact pattern example page 0/4 and 0/5.

※ 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 (M18/12.9) . . . . MA = 440 Nm

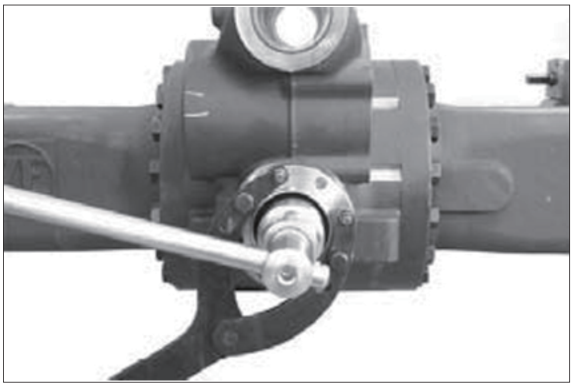
Then bring axle into horizontal position and reassemble the second clamping angle (S) (see also figure FA001).

17W98FA098

(24) **Mount shaft seal ring (input flange)**

Loosen hexagon nut and pull the input flange from the input pinion.

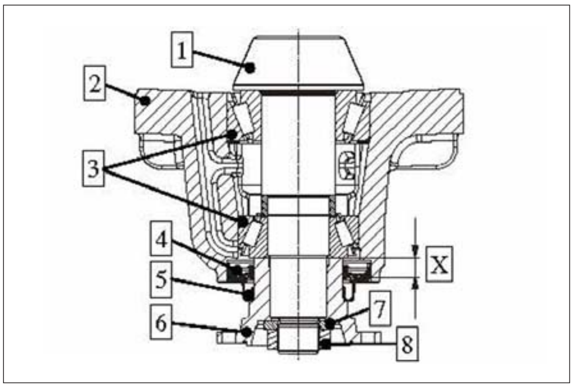
(S) Clamping fork 5870 240 025



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



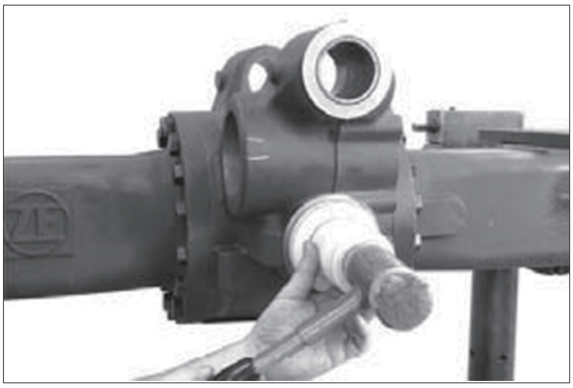
17W98FA100

(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.



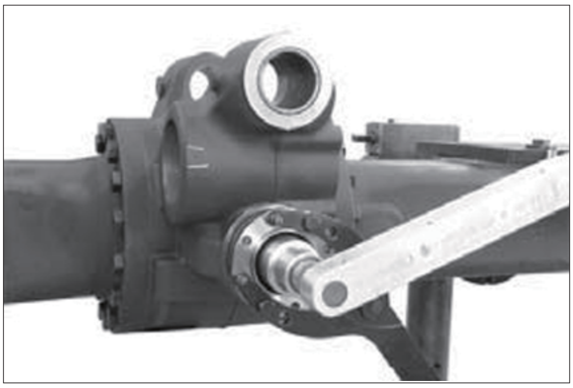
17W98FA101

(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 055 090
(S) Handle	5870 260 002

17W98FA103

(2) Comment on sketch:

1 = Axle housing

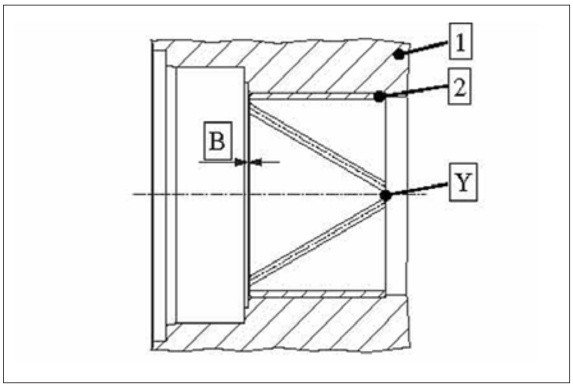
2 = Bushing

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.

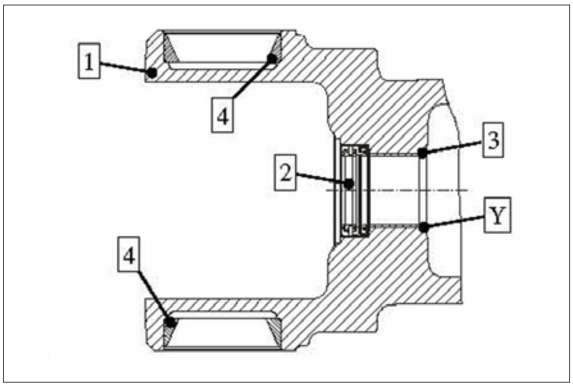
(S) Driver tool	5870 055 090
(S) Handle	5870 260 002

※ 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.

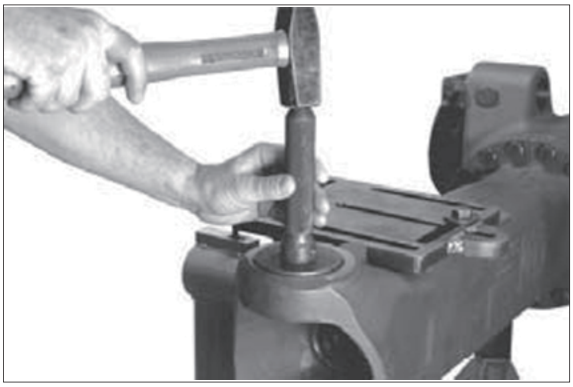
(4) Comment on sketch:
1 = Axle housing
2 = Shaft seal ring
3 = Bushing
4 = Bearing outer rings (pivot bearing)
Y = Lubrication groove outlet (V-point – in 6 o'clock position and on oil chamber side)



17W98FA106

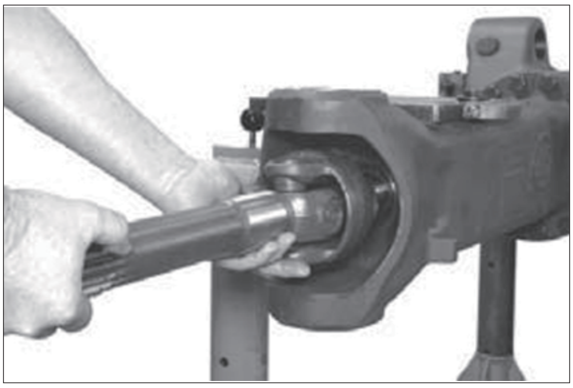
(5) Insert both bearing outer rings into the pivot bearing holes of the axle housing.

(S) Driver tool	5870 058 078
(S) Handle	5870 260 002


17W98FA107

(6) Install the u-joint shaft by inserting the u-joint shaft into the axle bevel gear teeth.

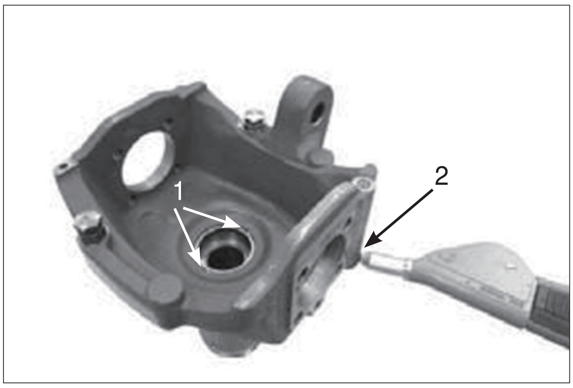
※ Pay attention to shaft seal ring in the axle housing risk of damage.


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

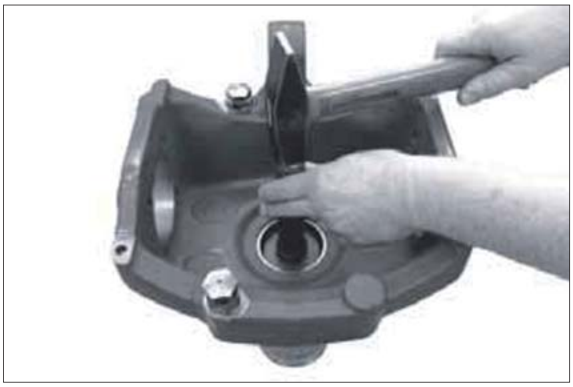
※ Operation is only required when using a new knuckle housing.



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



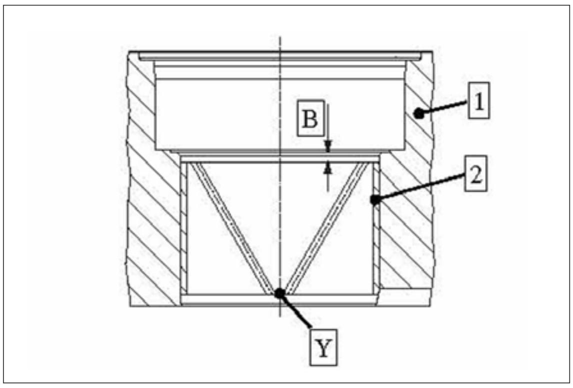
17W98FA110

(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

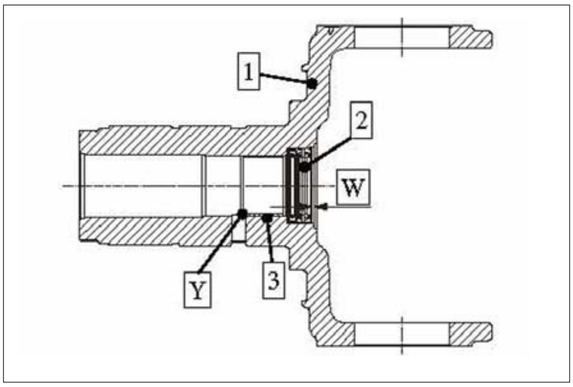
(10) Insert shaft seal ring into the hole of the knuckle housing with the seal lip showing to the oil chamber – considering the installation dimension "W" (see also sketch below).

(S) Driver tool	5870 055 090
(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 .... 3.5±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

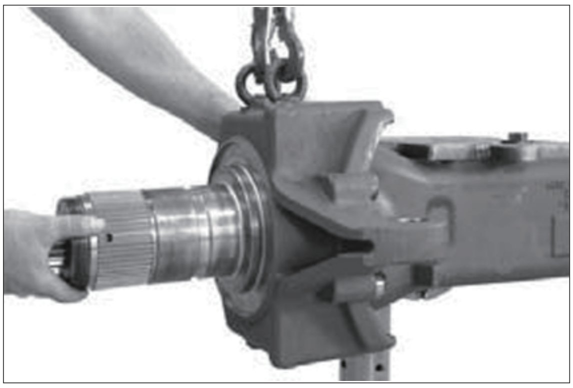
(13) Place sealing cap (see arrow) and mount the tapered roller bearing until contact position is obtained.


17W98FA115

(14) Locate pre-assembled knuckle housing on axle housing and carefully mount u-joint shaft.

(S) Eyebolts (M 20) 0636 804 003

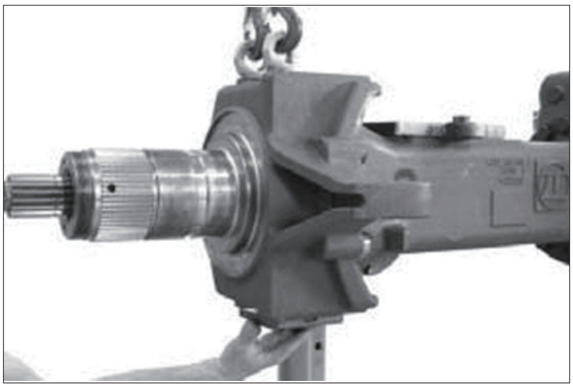
※ Pay attention to shaft seal ring in the knuckle housing risk of danger.



17W98FA116

(15) Insert the pre-assembled lower bearing pin and preliminarily fix with hexagon screws.

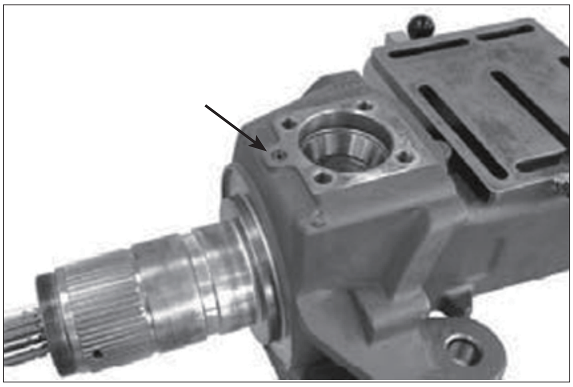
※ Pay attention to installation position mount bearing pin with lubrication nipple showing to axle centre.



17W98FA117

(16) Insert O-ring (see arrow) or O-rings into countersink of the knuckle housing.

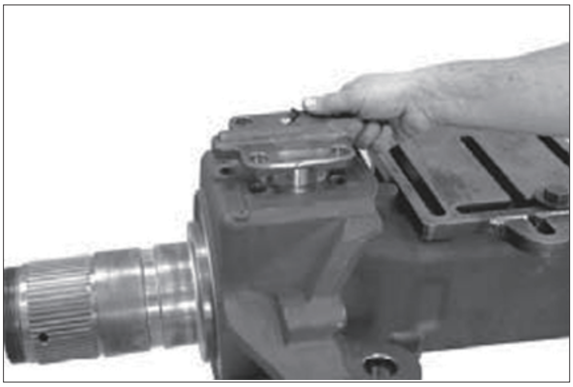
1 ps for version with breather valve in the knuckle housing
2 pcs for version with breather valve in the bearing pin



17W98FA118

(17) Insert pre-assembled upper bearing pin.

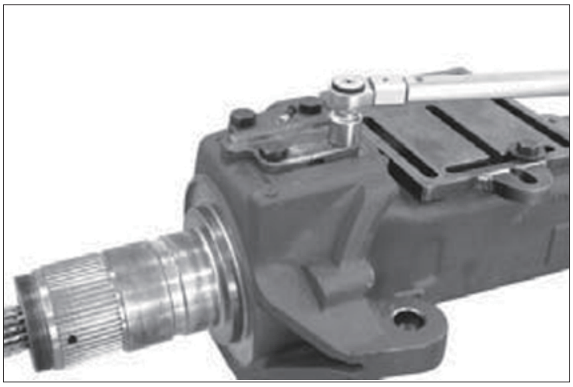
※ Observe installation position mount bearing pin with oil supply holes showing to axle centre.



17W98FA119

(18) Fix both bearing pins definitely.

※ Tightening torque (M 20/10.9) . . . . MA = 560 Nm



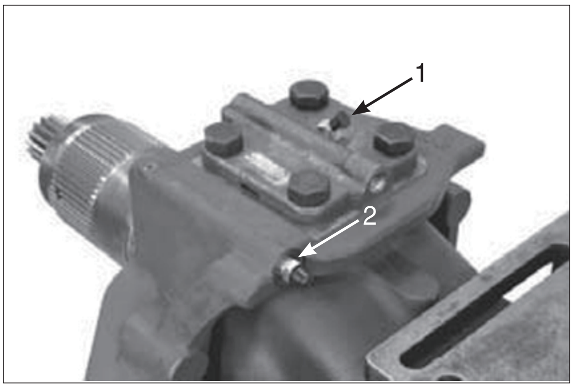
17W98FA120

(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



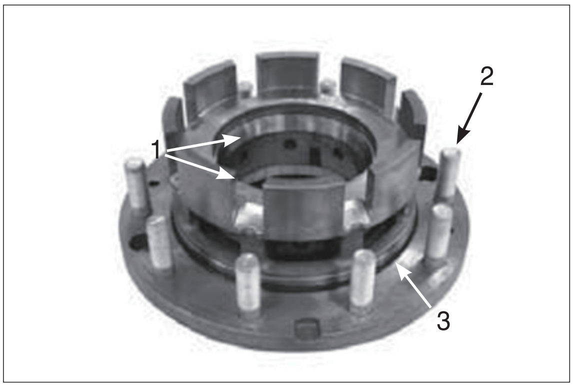
17W98FA121

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.



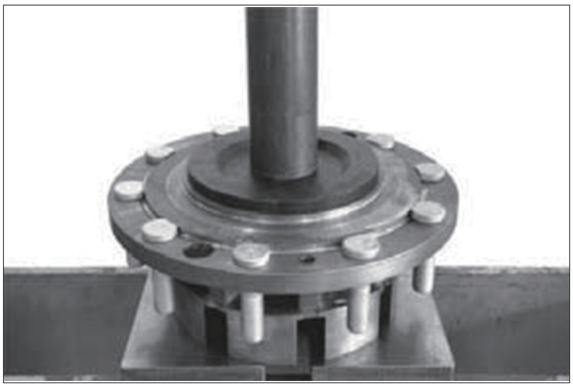
17W98FA122

(2) Press shaft seal ring with the marking "OUT SIDE" showing outside (upwards) into the hub.

(S) Driver tool 5870 051 068

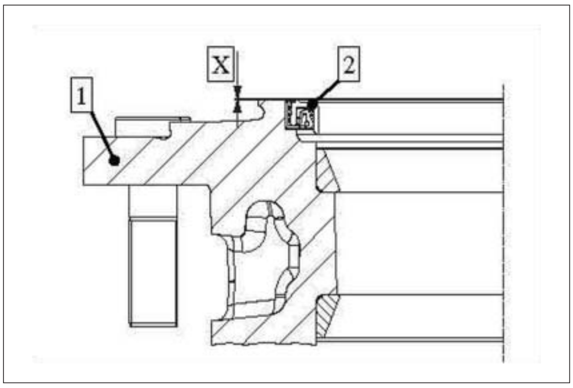
※ Use of the specified driver tool (S) ensures the exact installation position of the shaft seal ring.

※ Wet the outer diameter of the shaft seal ring with Loctite no. 574.


17W98FA123

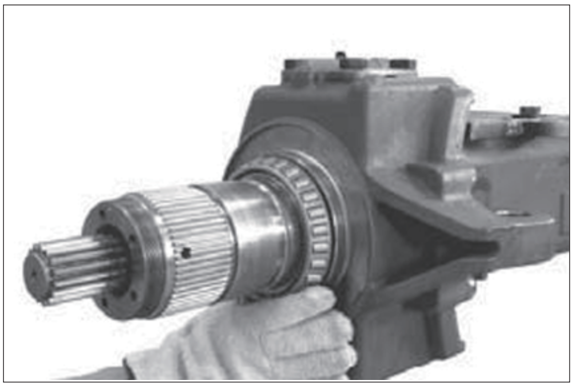
(3) Comment on sketch:

1 = Hub
2 = Shaft seal ring
X = Installation dimension – Shaft seal ring
. . . . 2.5 + 0.5 mm

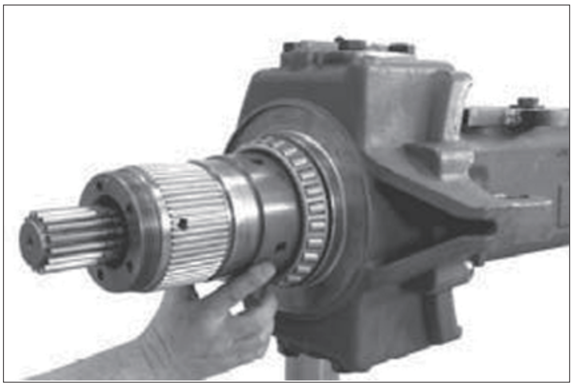


17W98FA124

(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.

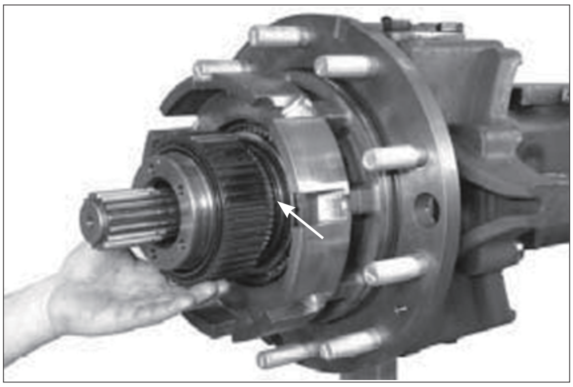
(S) Lifting bracket 5870 281 043

※ 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.

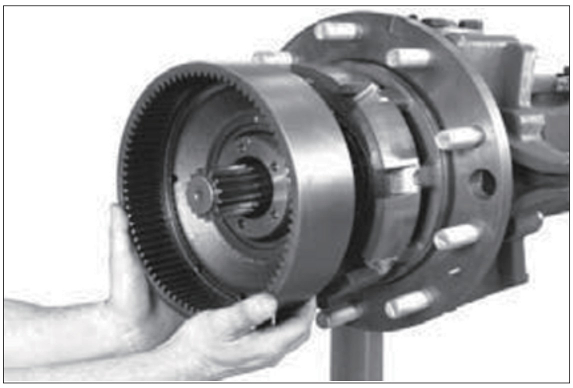
Then install disk carrier.



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.

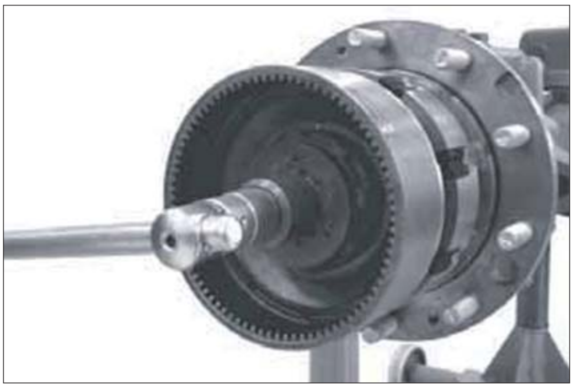
(S) Socket wrench 5870 656 097

※ 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.



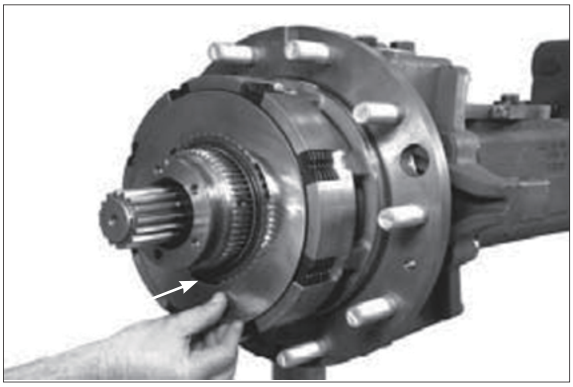
17W98FA131

5) DISK BRAKE

(1) Install disk package alternately starting with an outer disk.

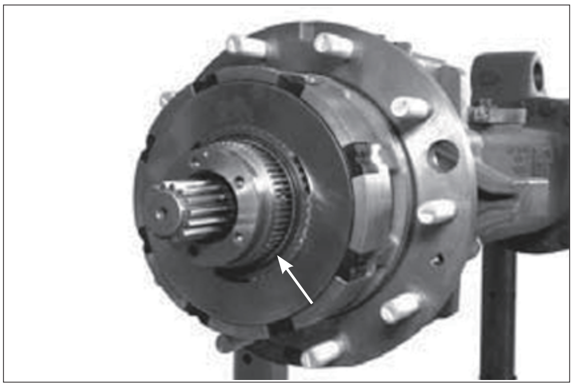
※ Take the actually required disk fitting / arrangement from the corresponding spare parts list.

※ 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

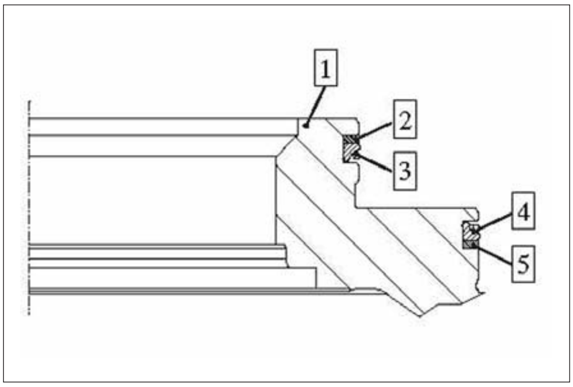
(3) Oil U- and support rings and insert them into the annular grooves of the ring gear.

※ Observe installation position, see sketch below.

17W98FA134

(4) Comment on sketch:

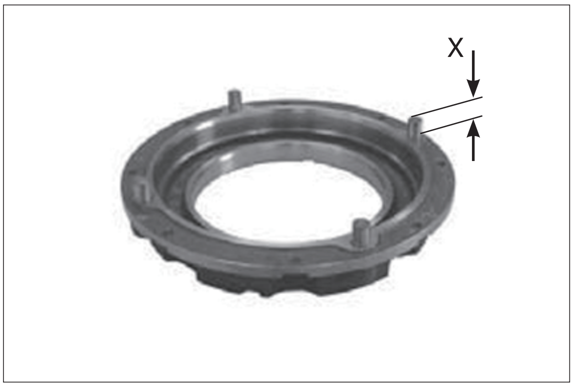
1 = Ring gear
2 = Support ring
3 = U-ring
4 = U-ring
5 = Support ring



17W98FA135

(5) Mount cylindrical pins into piston, considering installation dimension "X".

X = Installation dimension . . . . . 16.00 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).

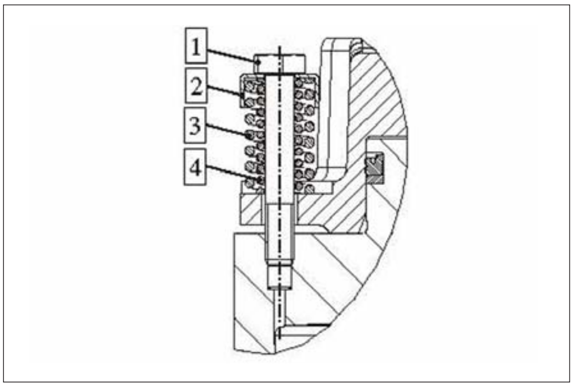
Tightening torque (M 6/8.8) . . . . MA = 8 Nm

※ Use hexagon screws just once.

17W98FA138

(8) Comment on sketch:

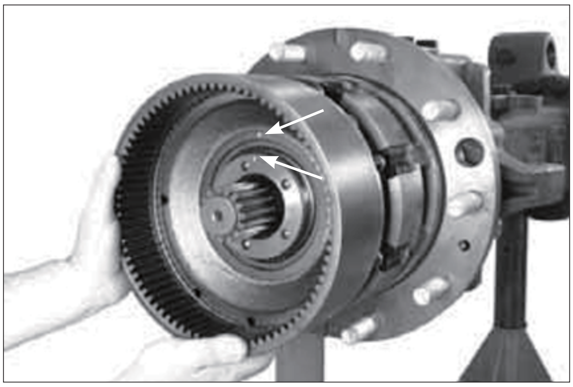
1 = Hexagon screw (special version)
2 = Spring sleeve
3 = Compression spring
4 = Compression spring



17W98FA139

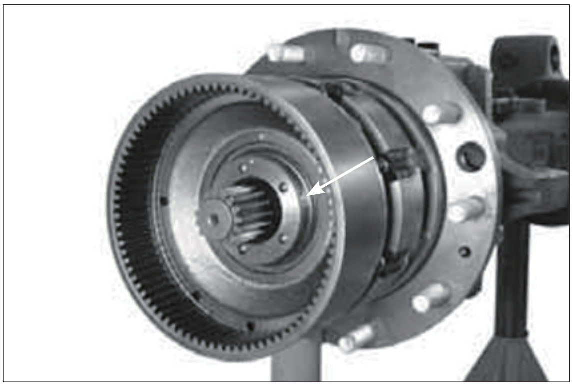
(9) Mount preassembled ring gear considering the installation position (markings O in 12 o'clock position - see arrows).

※ 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 $^{+600}$ 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.

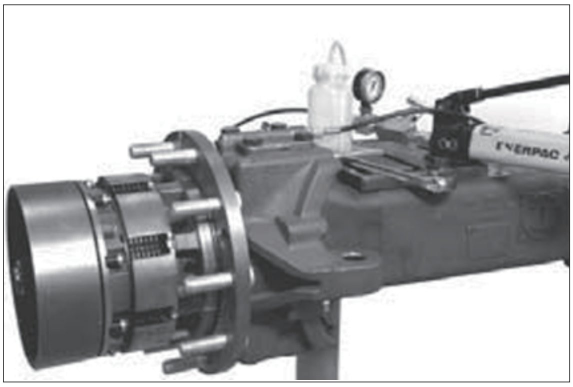
(S) HP pump 5870 287 007
(S) Threaded coupling (M14x1.5) 5870 950 102
(S) Breather bottle 5870 286 072

※ 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**

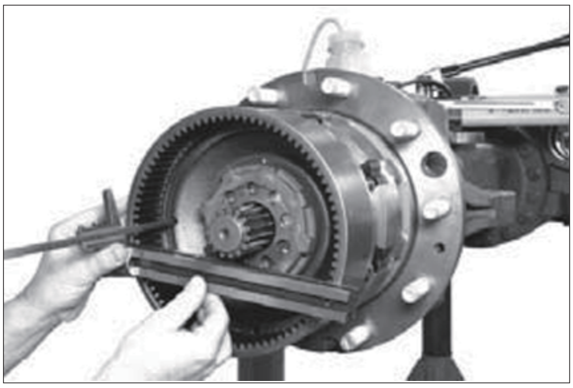
Piston stroke / disk clearance = 0.7 ..... 1.3 mm

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.

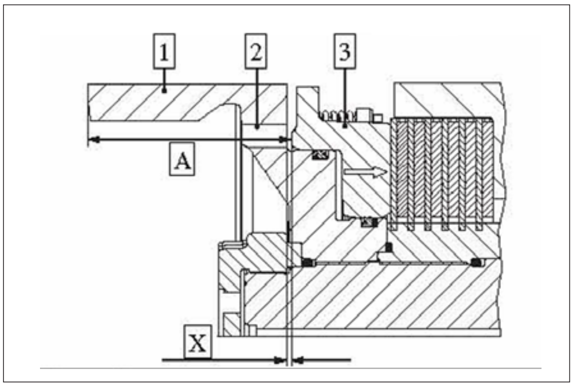


17W98FA144

(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:

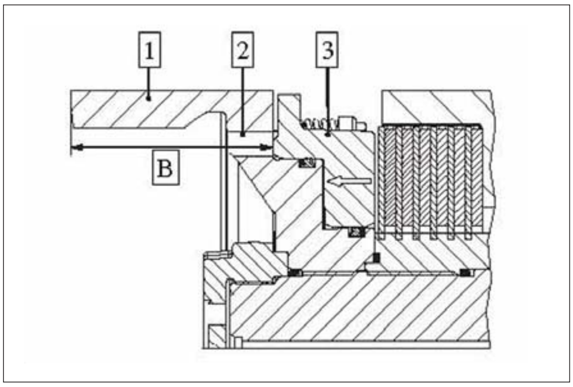
Dimension "A" e.g. . . . . 83.10 mm
Dimension "B" e.g. . . .. - 82.10 mm
Difference = Piston stroke = 1.00 mm

※ 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

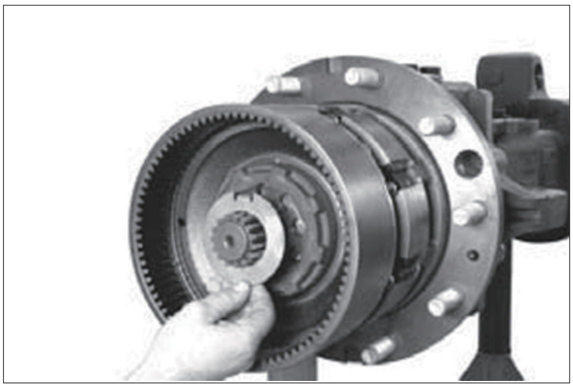
(16) Secure slotted nut with cylindrical screw (please also refer to figure FA142)

Tightening torque (M 10/8.8) . . . . MA = 32 Nm

17W98FA147

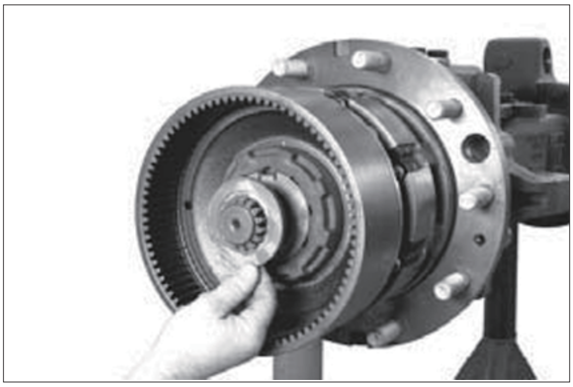
(17) Insert thrust washer.

※ Observe installation position ensure that both lugs of the thrust washer are engaged each in a spare fixing hole of the slotted nut.



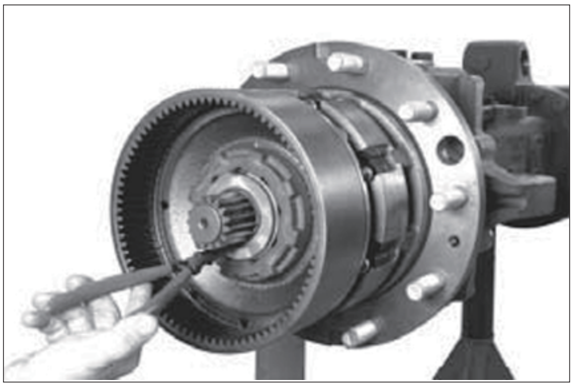
17W98FA148

(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.

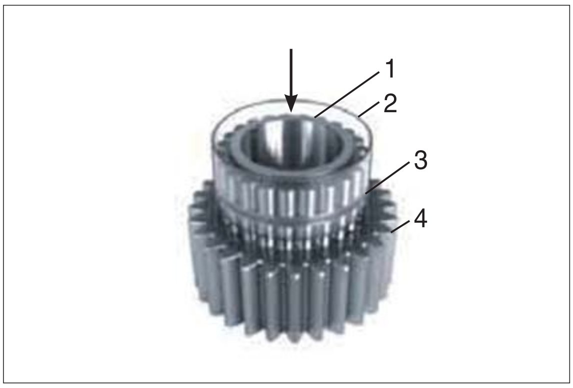
(S) Driver tool 5870 048 263

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.

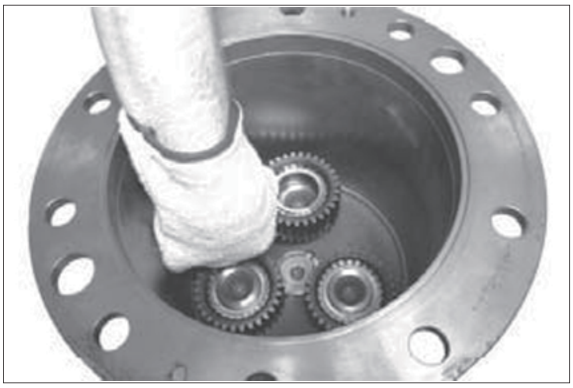
1 = Cylindrical roller bearing
2 = Packaging sleeve
3 = Snap ring
4 = Planetary gear



17W98FA152

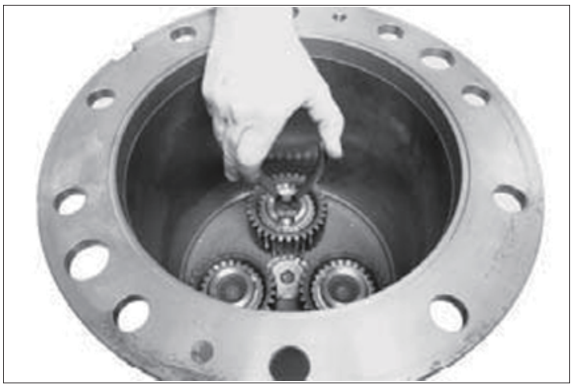
(3) Warm up bearing inner ring and install pre-assembled planetary gear until contact is obtained.

※ Mount bearing inner ring with large radius, showing to the planetary carrier (downwards).



17W98FA153

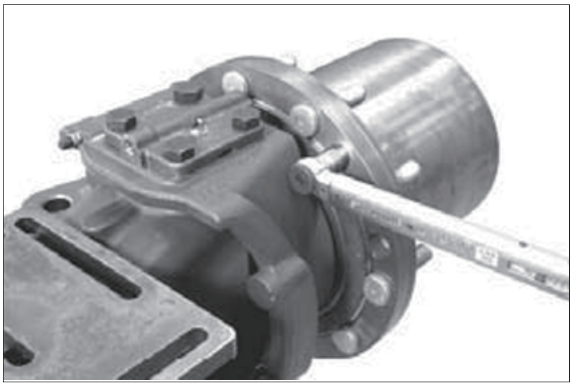
(4) Fix planetary gear by means of retaining ring.



17W98FA154

(5) Install preassembled planetary carrier and fix with hexagon screws.

Tightening torque (M12/8.8) . . . . MA = 55 Nm



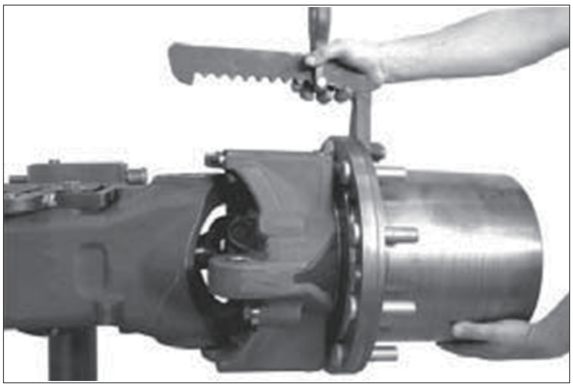
17W98FA155

(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.

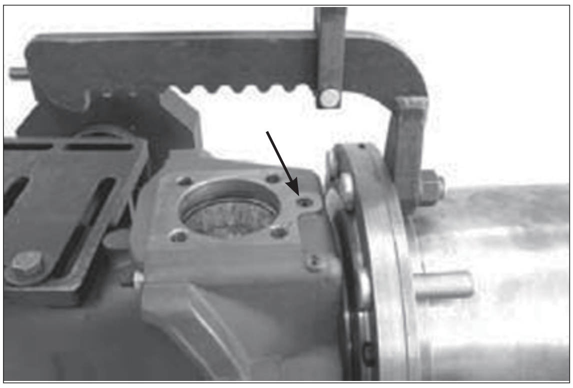


17W98FA156

(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.

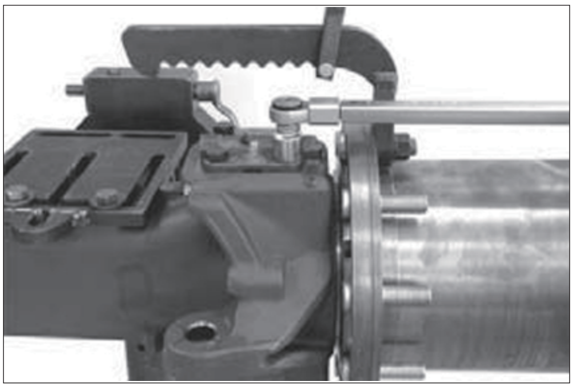


17W98FA157

(8) Mount both bearing pins and fix with hexagon screws or locking screws.

Tightening torque (M 20/10.9) . . . . MA = 560 Nm

※ Observe installation position, mount upper bearing pin with oil supply holes showing to axle centre.

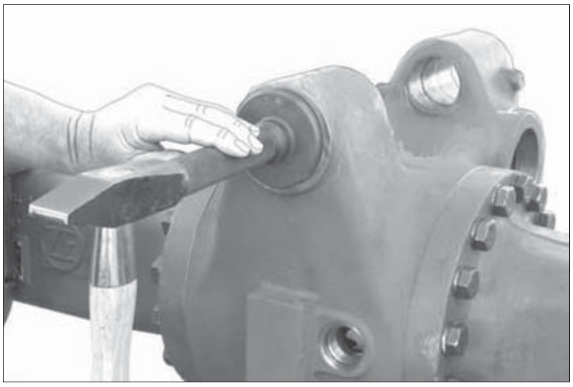


17W98FA158

(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.

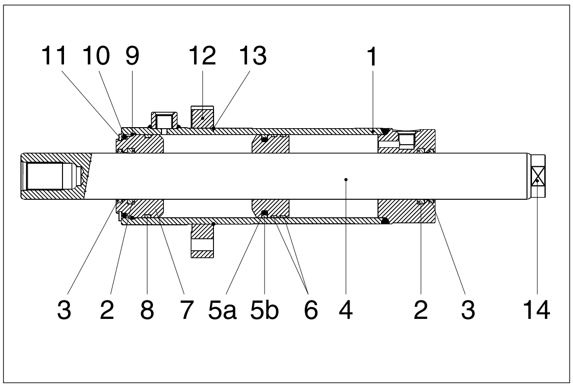
※ Prior to putting the axle into operation, fill in oil.


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)

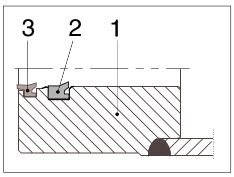


17W98FA160

(2) Preassemble steering
Mount U-ring (2) and scraper (3) in the steering cylinder (1).

※ Observe installation position – see detailed sketch.

Detailed sketch:

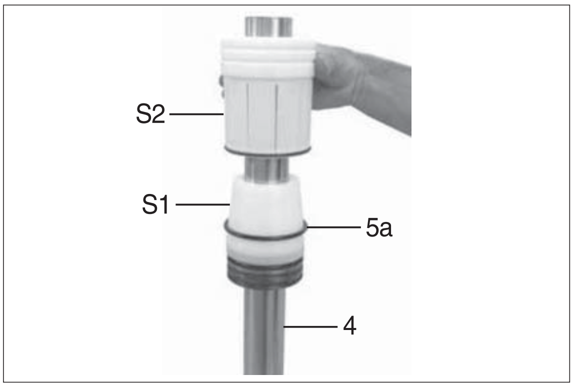



17W98FA161

(3) Position inner installer (S1) on piston rod (4).

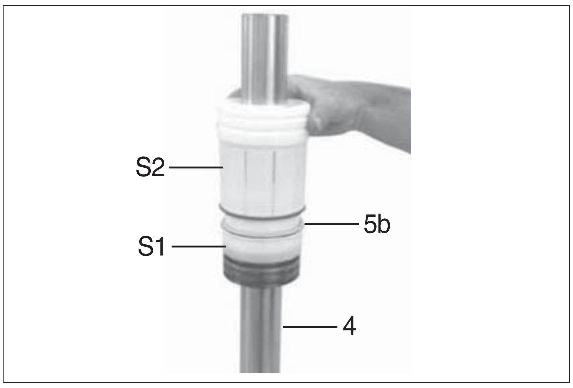
Mount O-ring (5a) and press with inner installer (S2) into annular groove (arrow) of the piston (4).

(S) Inner installer (S1) 5870 651 088
(S) Inner installer (S2) 5870 651 089



17W98FA162

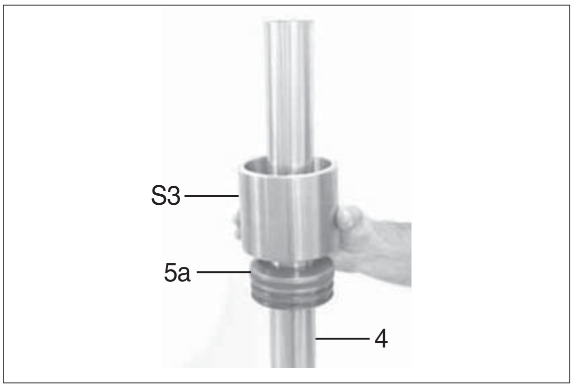
(4) Install form seal ring (5b) and press with inner installer (S2) into the annular groove of the piston (4).



17W98FA163

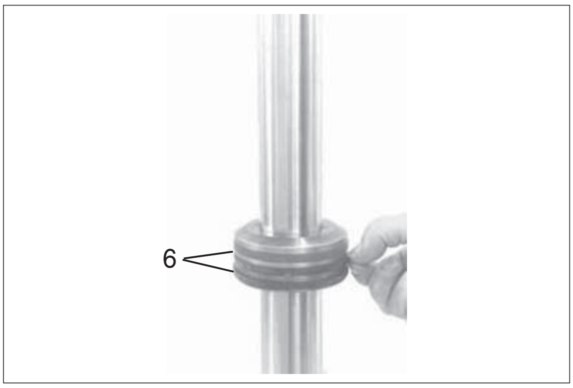
(5) Calibrate form seal ring (5b) with calibration bushing (S3).

(S) Calibration bushing (S3) 5870 651 091



17W98FA164

(6) Place both guide rings (6) into the annular grooves of the piston rod.

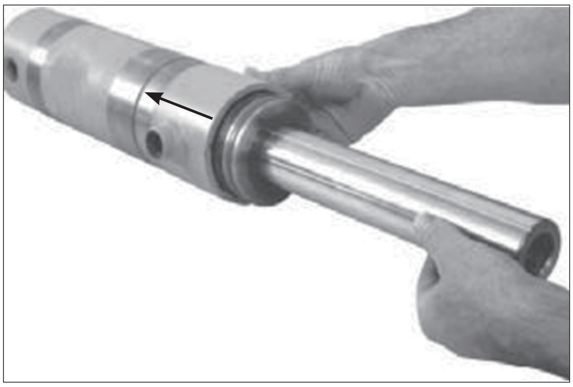


17W98FA165

(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.

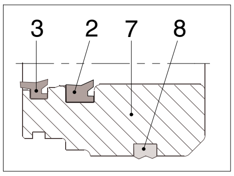


17W98FA166

(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.

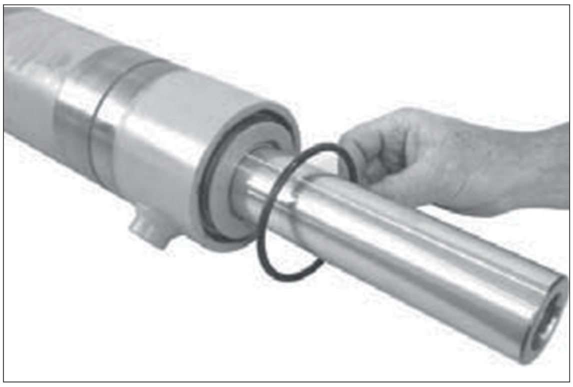
17W98FA168

(10) Engage retaining ring (9) into the groove of the cylinder tube.

17W98FA169

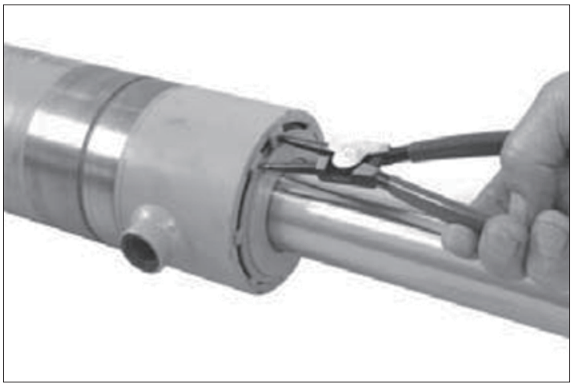
(11) Position the inserted brake head (7) on the snap ring (9) until contact is obtained (arrow).

Only for version with O-ring (see corresponding spare parts list) : Oil O-ring (10) and place into the recess.



17W98FA170

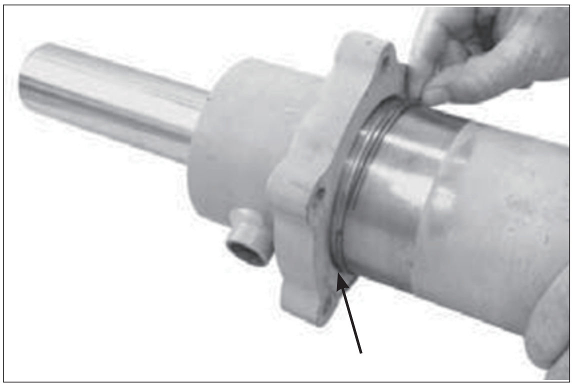
(12) Fix brake head (7) with retaining ring (11).



17W98FA171

(13) Install flange (12) and engage retaining ring (13).

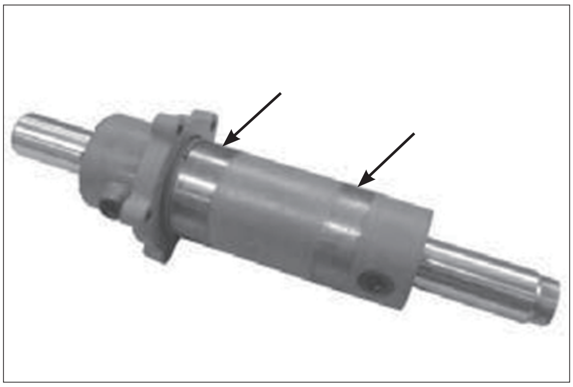
※ Observe installation position of flange mount flange with chamfer (see arrow) showing to the snap ring.



17W98FA172

(14) **Mount steering**

Apply anti-corrosive agent (Weicon Anti-Seize) on contact faces (cylinder tube / axle housing, see arrow).



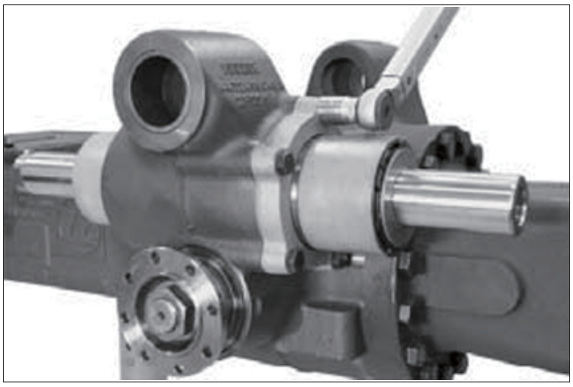
17W98FA173

(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.

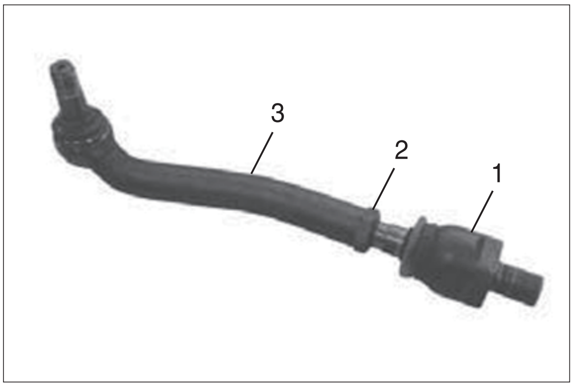
※ Wet the thread of the hexagon screws with Loctite no. 243.



17W98FA174

(16) Bolt hexagon nut (2) and ball joint (3) to axial joint (1).

※ Do not tighten hexagon nut before setting the track.



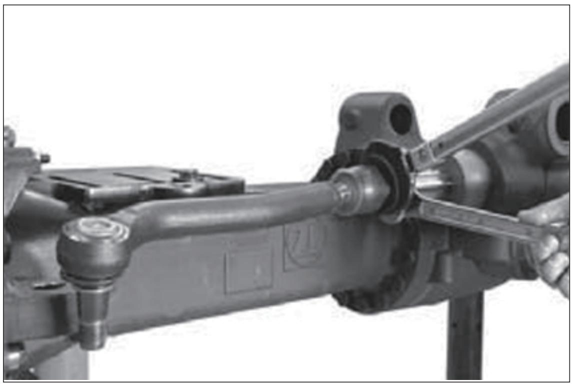
17W98FA175

(17) Fix both tie rods to piston rod (with offset showing to the axle housing).

Tightening torque (M30 × 1.5) . . . . MA = 600 Nm

(S) Socket wrench (SW 55) 5870 656 099

※ Wet thread of the axial joint with Loctite no. 243.

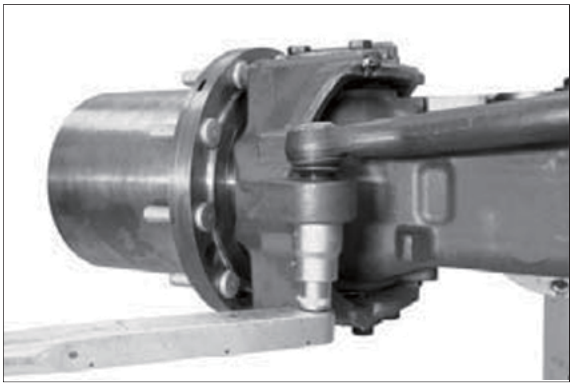


17W98FA176

(18) Install tie rod into knuckle housing and fix with "new" locking nut.

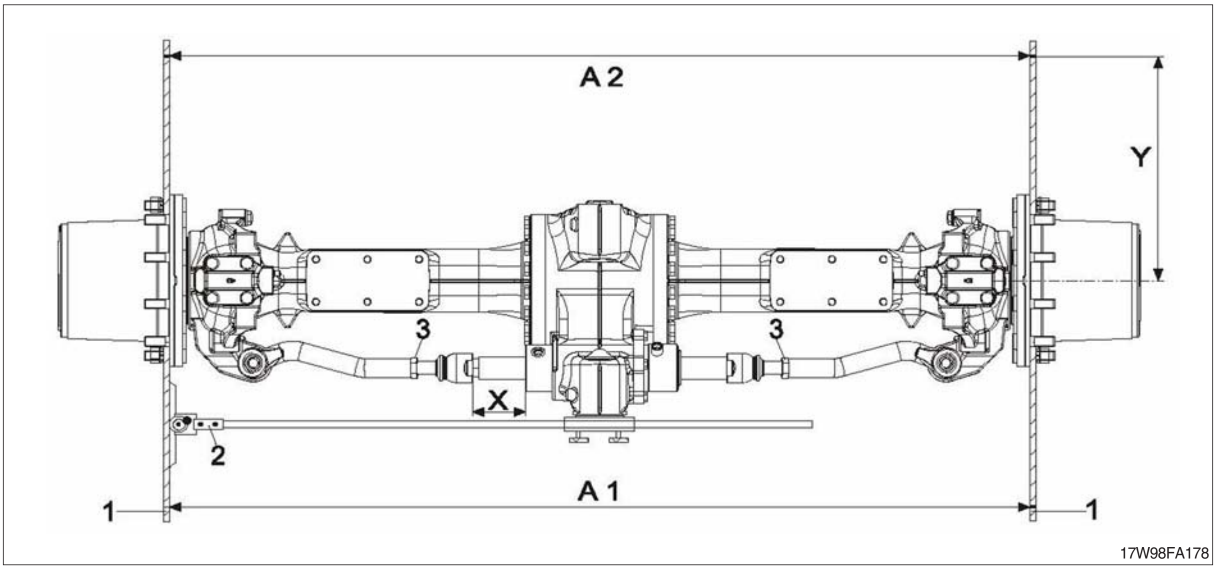
Tightening torque (M 30 × 1.5) . . . . MA = 800 Nm

※ Use locking screws just once.



17W98FA177

(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 = 124 mm (measured from front face/steering cylinder to front 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.

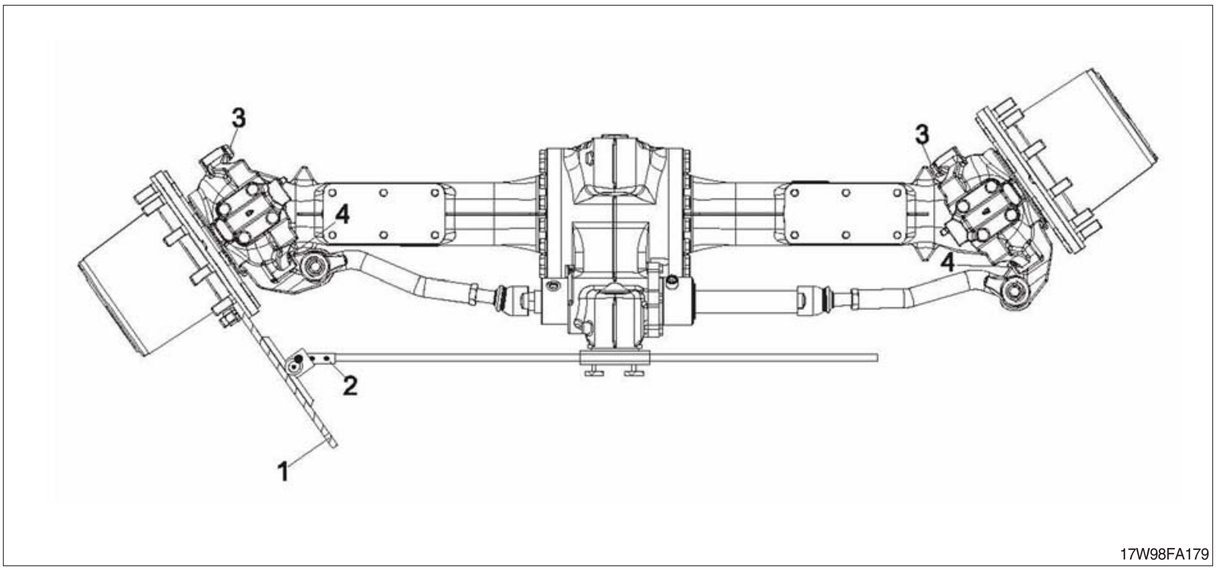
Dimension "Y" = distance between rim center and rim flange.

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

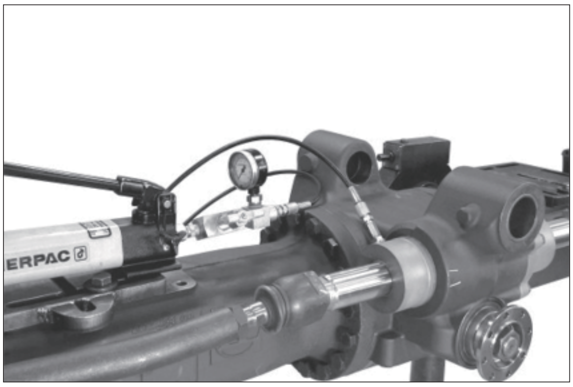
Test pressure p = Build up 200 bar (bleed pressure chamber).

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.

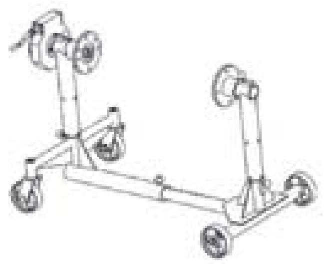
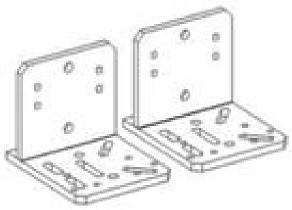
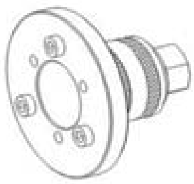
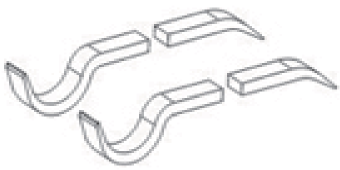
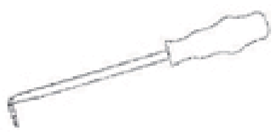
(S) HP pump	5870 287 007
(S) Reduction	5870 950 161
(S) Clutch	0501 207 939

※ Prior to putting the axle into operation fill it with oil.

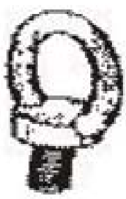
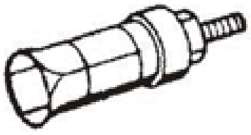


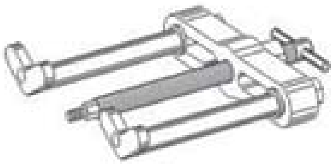
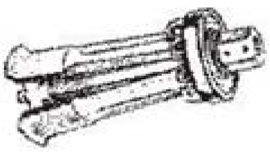
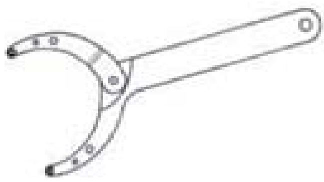
17W98FA180

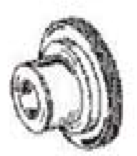
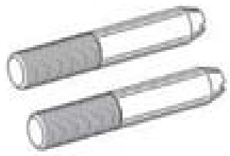
5. SPECIAL TOOLS FOR DISASSEMBLY AND REASSEMBLY

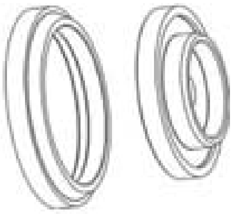
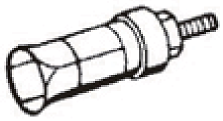
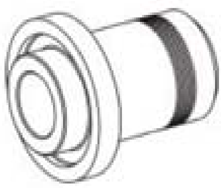
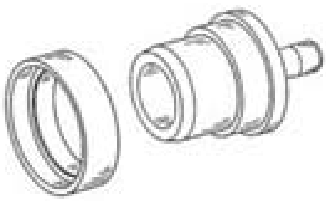
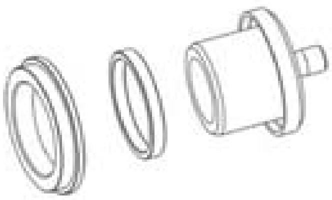
No.	Figure	Designation order no.	Qty	Page
1	 180W9A8FA501	Assembly truck assy with tilting device 5870 350 000	1	8-220 8-287
2	 180W9A8FA502	Supporting bracket 5870 350 106	1	8-220 8-291
3	 180W9A8FA503	Socket wrench 5870 656 097	1	8-224 8-292
4	 180W9A8FA504	Assembly lever 5870 345 036	1	8-225 8-293
5	 180W9A8FA505	Adjusting device 5870 400 001	2	8-226 8-294

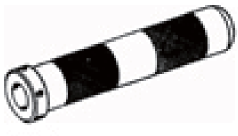
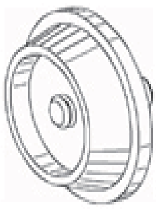
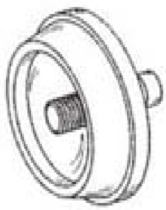
No.	Figure	Designation order no.	Qty	Page
6	 180W9A8FA506	Lifting bracket 5870 281 043	1	8-226, 229, 254, 262 8-296, 320, 328
7	 180W9A8FA507	Pressure piece 5870 100 067 (FR axle) 5870 100 063 (RR axle)	 1 1	8-226, 227 8-294
8	FR axle  180W9A8FA508-1 RR axle  180W9A8FA508-2	Grab sleeve R140W-9A 5873 003 022 (FR axle) 5873 013 015 (RR axle)	1	-
9	 180W9A8FA509	Grab sleeve 5873 004 026	1	8-227 8-295
10	 180W9A8FA510	Grab sleeve 5873 004 022	1	8-227

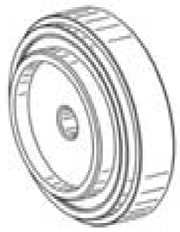
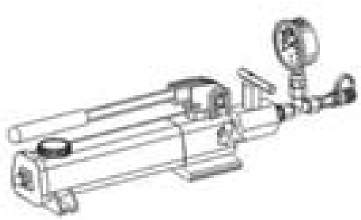
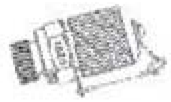
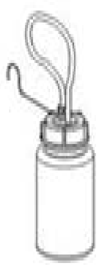
No.	Figure	Designation order no.	Qty	Page
11	 180W9A8FA511	Eyebolts (FR axle) R140W-9A 0636 804 001 (M16)	2	-
12	 180W9A8FA512	Eyebolts (FR axle) R180W-9A 5870 204 085 (M18)	2	-
13	 180W9A8FA513	Eyebolts (FR axle) R210W-9A 0636 804 003 (M20)	2	8-227
14	 180W9A8FA514	Inner installer (FR axle) R140W-9A 5870 300 007 (Ø 46 ~ 56 mm)	1	-
15	 180W9A8FA515	Inner installer (FR axle) 5870 300 017 (Ø 56 ~ 70 mm)	1	8-228, 229

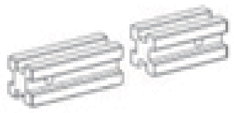
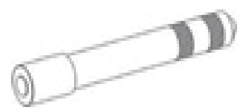
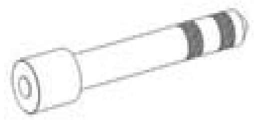
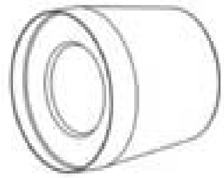
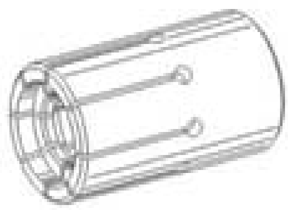
No.	Figure	Designation order no.	Qty	Page
16	 180W9A8FA516	Counter support 5870 300 020	1	8-228, 229, 232 8-300
17	 180W9A8FA517	Inner installer 5870 300 019 (Ø 56 - 110 mm)	1	8-229, 232 8-300
18	 180W9A8FA518	Striker 5870 650 004	1	8-230 8-297, 298, 299
19	 180W9A8FA519	Clamping fork 5870 240 025	1	8-231, 246 8-299, 318
20	 180W9A8FA520	Grab sleeve 5873 001 037	1	8-232 8-300

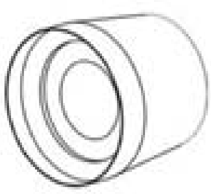
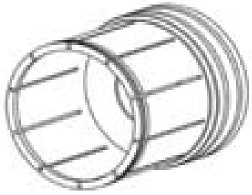
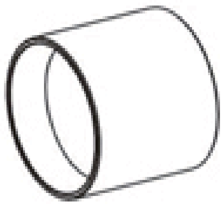
No.	Figure	Designation order no.	Qty	Page
21	 180W9A8FA521	Grab sleeve 5873 011 019	1	8-233 8-301
22	 180W9A8FA522	Basic tool 5873 001 000	1	8-233 8-301
23	 180W9A8FA523	Pressure piece 5870 100 009	1	8-233 8-301
24	 180W9A8FA524	Adjusting screws 5870 204 027 (M12 $\times$ 1.5)	1	8-238 8-306
25	 180W9A8FA525	Assembly fixture 5870 345 049	1	8-240 8-313

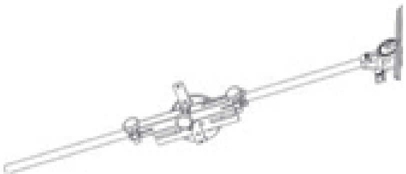
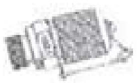
No.	Figure	Designation order no.	Qty	Page
26	 180W9A8FA526	Pressure ring 5870 345 056	1	8-240 8-313
27	 180W9A8FA527	Internal extractor 5870 300 005 (Ø 36 ~ 46 mm)	1	8-244 8-309
28	 180W9A8FA528	Driver tool (FR axle) 5870 048 286	1	8-246
29	 180W9A8FA529	Driver tool (FR axle) R140W-9A 5870 055 081	1	-
30	 180W9A8FA530	Driver tool (FR axle) 5870 055 090	1	8-247, 249

No.	Figure	Designation order no.	Qty	Page
31	 180W9A8FA531	Handle (FR axle) 5870 260 002	1	8-247, 248, 249
32	 180W9A8FA532	Driver tool R140W-9A 5870 058 058	1	-
33	 180W9A8FA533	Driver tool R180W-9A 5870 058 022	1	-
34	 180W9A8FA534	Driver tool (FR axle) 5870 058 078	1	8-248
35	 180W9A8FA535	Lever riveting tongs (RR axle) 5870 320 016	1	8-319

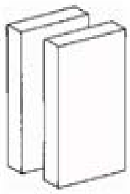
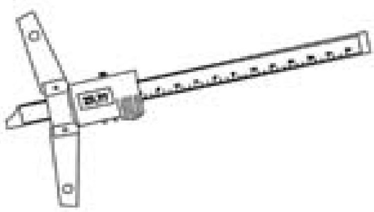
No.	Figure	Designation order no.	Qty	Page
36	 180W9A8FA536	Driver tool R140W-9A / R180W-9A 5870 051 035	1	-
37	 180W9A8FA537	Driver tool R210W-9A 5870 051 068	1	8-253
38	 180W9A8FA538	HP pump 5870 287 007	1	8-258, 270 8-325
39	 180W9A8FA539	Threaded coupling 5870 950 102 (M14×1.5)	1	8-258 8-325
40	 180W9A8FA540	Breather bottle 5870 286 072	1	8-258 8-325

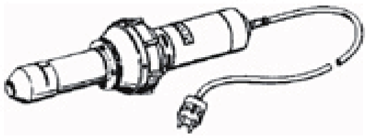
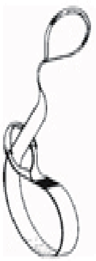
No.	Figure	Designation order no.	Qty	Page
41	 180W9A8FA541	Straightedge 5870 200 022	1	8-259 8-326
42	 180W9A8FA542	Driver tool R140W-9A 5870 048 245	1	-
43	 180W9A8FA543	Driver tool 5870 048 263	1	8-261 8-327
44	 180W9A8FA544	Inner installer (FR axle) 5870 651 086	1	8-264
45	 180W9A8FA545	Inner installer (FR axle) 5870 651 087	1	8-264

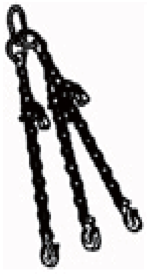
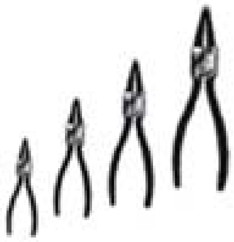
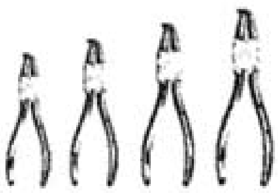
No.	Figure	Designation order no.	Qty	Page
46	 180W9A8FA546	Inner installer (FR axle) 5870 651 088	1	-
47	 180W9A8FA547	Inner installer 5870 651 089	1	-
48	 180W9A8FA548	Calibration bushing 5870 651 090	1	8-264
49	 180W9A8FA549	Calibration bushing 5870 651 091	1	-
50	 180W9A8FA550	Socket wrench (FR axle) R140W-9A / R180W-9A 5870 656 100 (SW 55) 5870 656 097	1	-

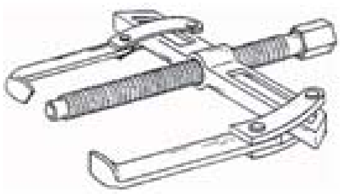
No.	Figure	Designation order no.	Qty	Page
51	 180W9A8FA551	Socket wrench (FR axle) 5870 656 099 (SW 75)	1	8-255, 259
52	 180W9A8FA552	Straightedges (FR axle) 5870 200 029	1	8-268, 269
53	 180W9A8FA553	Measuring device (FR axle) 5870 200 033	1	8-268, 269
54	 180W9A8FA554	Reduction (FR axle) 5870 950 161	1	8-270
55	 180W9A8FA555	Clutch (FR axle) 0501 207 939	1	8-270

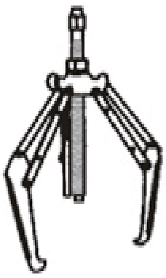
6. COMMERCIAL TOOLS FOR DISASSEMBLY AND REASSEMBLY

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 8-268
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

GROUP 10 REAR AXLE

1. REMOVAL FRONT AXLE

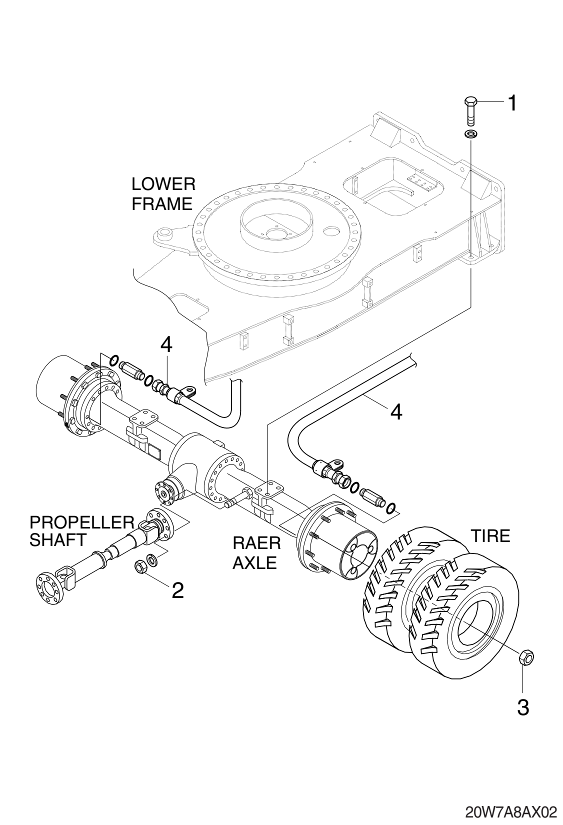
1) Rear axle mounting nut (1, M24)
   · Tightening torque : 100±10 kgf · m
   (723±72.3 lbf · ft)

2) Propeller shaft mounting bolt (2, M10)
   · Tightening torque : 5.9±0.6 kgf · m
   (42.7±4.3 lbf · ft)

3) Wheel nut (3, M22)
   · Tightening torque : $60^{\ 0}_{-5}$ kgf · m
   ($434^{\ 0}_{-36}$ lbf · ft)

4) Hose assy (4)

5) Axle weight : 700 kg (1540 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

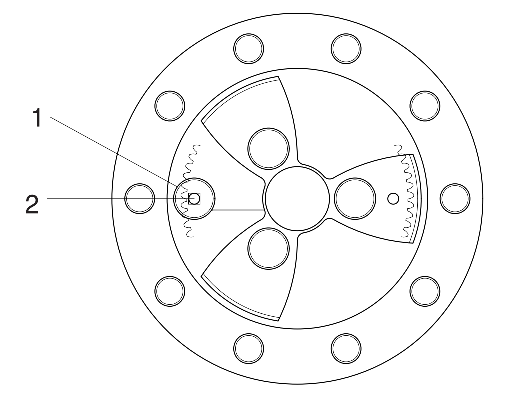
(1) Gear oils with limited - slip additives.

(2) API GL-5

(3) MIL-L-2105D (SAE 85W-90, 85W-140 with LS-Additive)

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

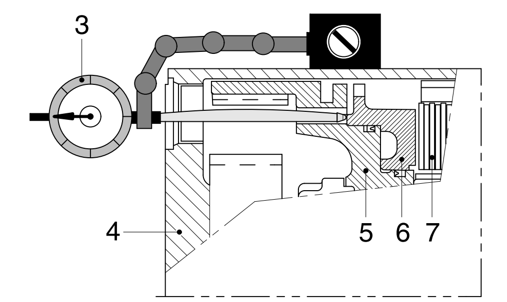


17W7A8AX03

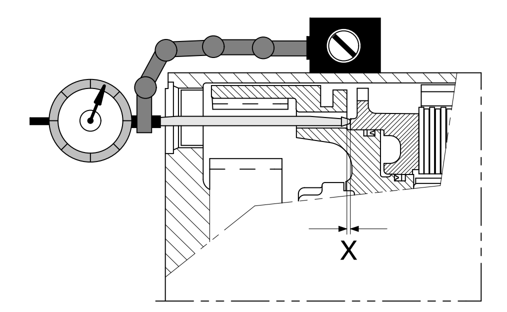
※ To avoid injury when opening the oil drain/ oil filler plug (1), due to a possible pressure build-up in the planetary carrier bring drain hole to topmost position (12 o'clock) and carefully unscrew oil drain and filler plug (1).

(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 mm) 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



17W7A8AX04



17W7A8AX05

3. DISASSEMBLY

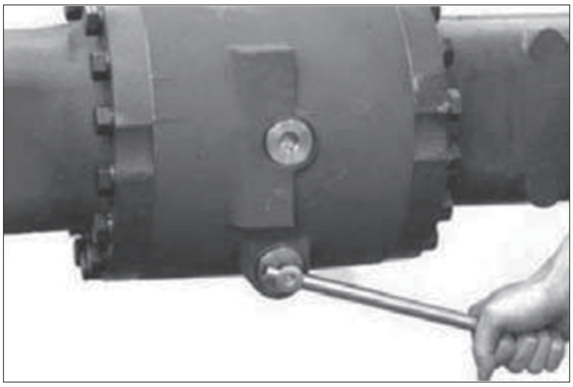
1) OUTPUT

(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.

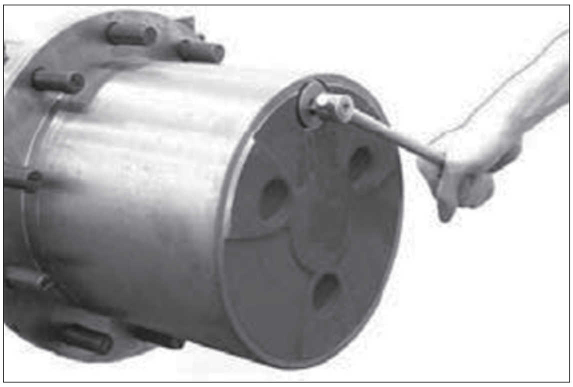


17W98RA002

(3) Loosen screw plug and drain oil from the planetary carrier.

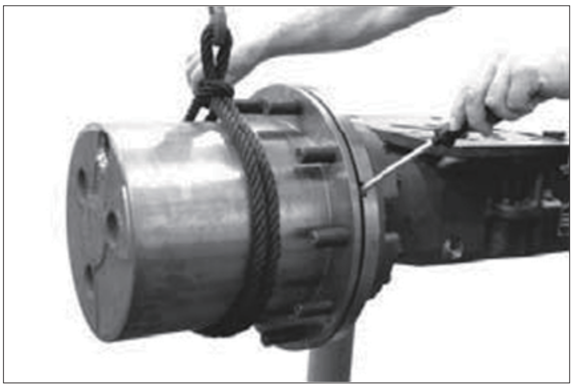
※ To avoid any risk of injury due to a possible pressure buildup in the oil system of the planetary carrier, bring oil filler / level check plug to the uppermost position (12 o'clock) and turn it out carefully.
Then bring drain hole to 6 o'clock position and drain oil.

※ Use suitable oil reservoir environmental protection.



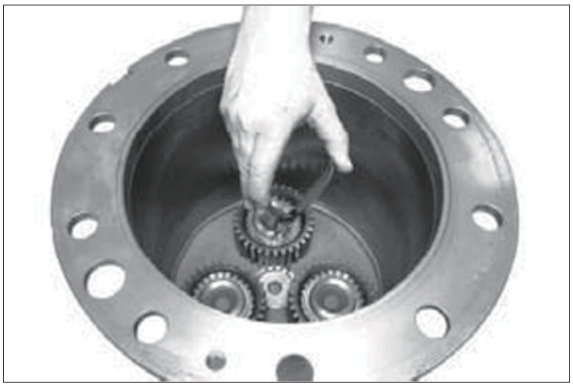
17W98RA003

(4) Planetary carrier
Loosen both hexagon screws and separate planetary carrier from the hub.



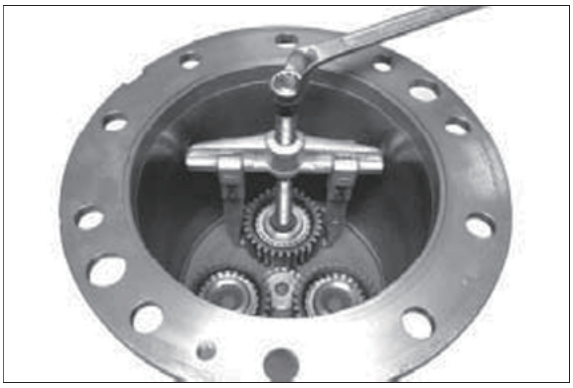
17W98RA004

(5) Snap out retaining ring.



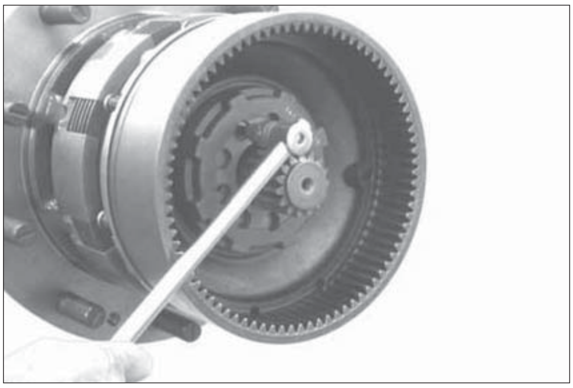
17W98RA005

(6) Pull off planetary gear together with cylindrical roller bearing.



17W98RA006

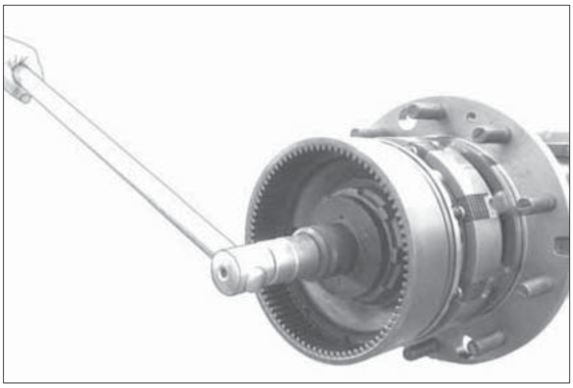
(7) Brake
Loosen cylindrical screw (slotted nut fixing).



17W98RA007

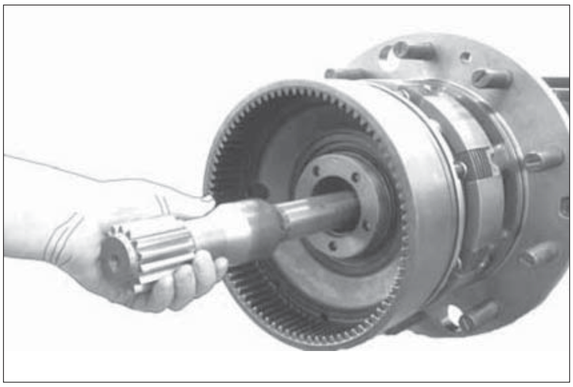
(8) Loosen slotted nut.

(S) Socket wrench 5870 656 097



17W98RA008

(9) Pull sun gear together with stub shaft out of the axle housing.

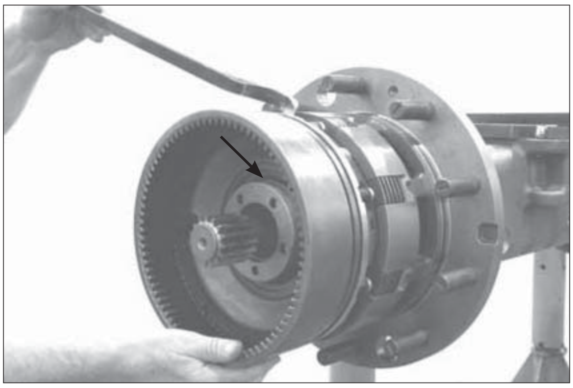


17W98RA009

(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

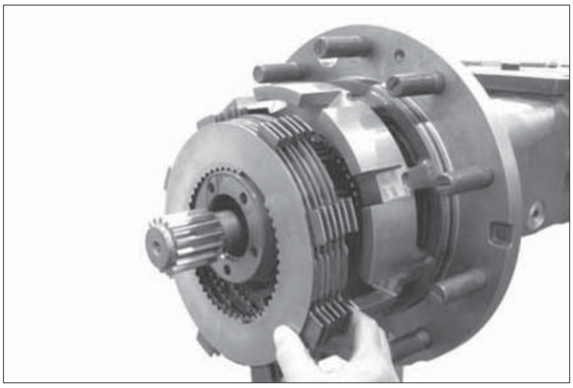
(12) Press piston off the ring gear.

17W98RA012

(13) Remove sealing elements from the annular grooves (see arrows) of the ring gear.

17W98RA013

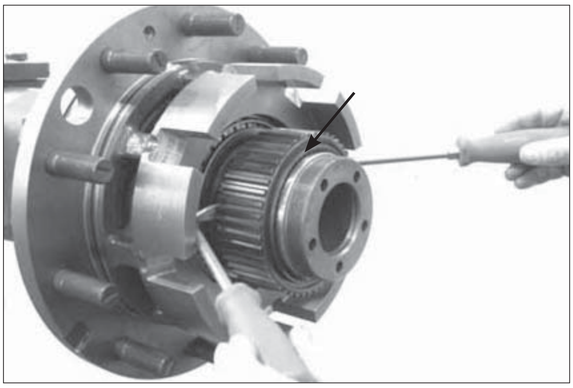
(14) Remove disk package.



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

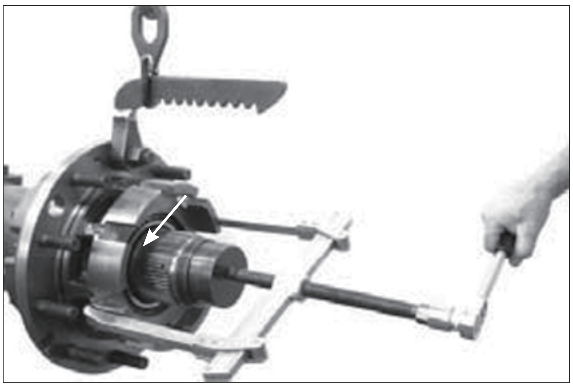
(15) Hub

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.

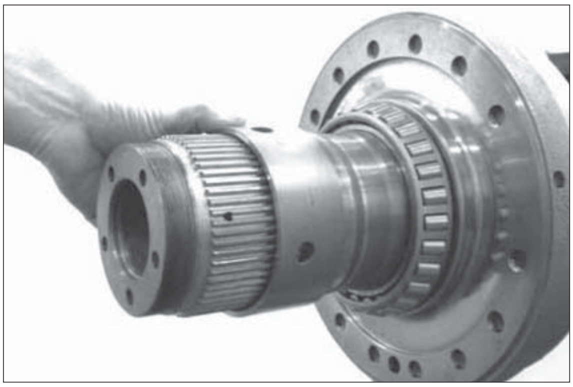


17W98RA016

(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 bush.



17W98RA018

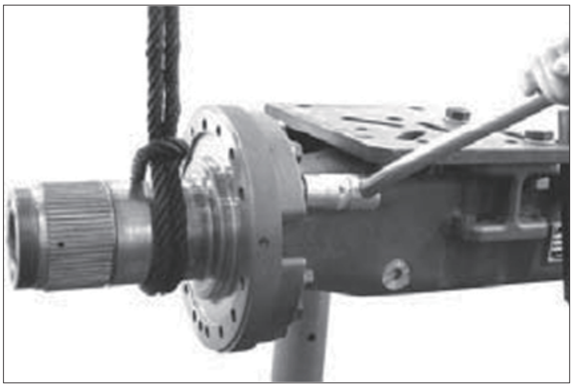
(19) Pull tapered roller bearing off the hub.

(S) Grab sleeve	5873 004 026
(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.



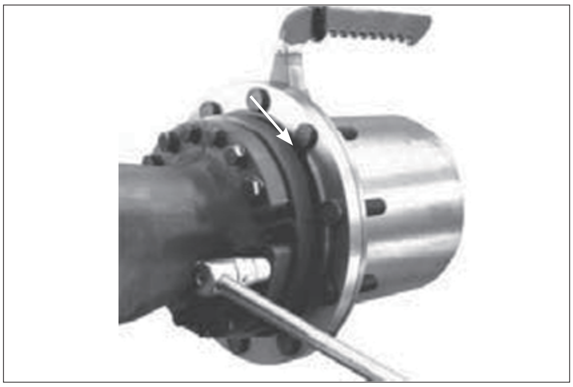
17W98RA020

(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).

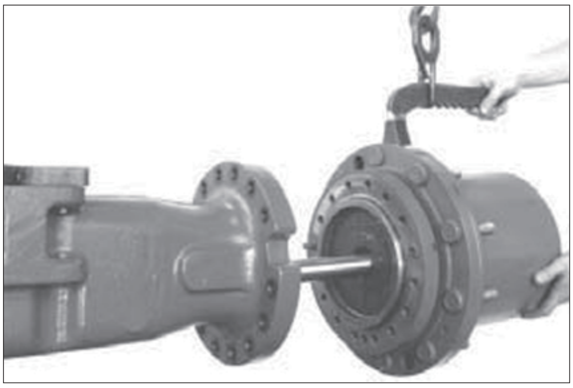
Secure output by means of lifting tackle (S) and loosen threaded joint.

(S) Lifting bracket 5870 281 043



17W98RA021

(22) Separate output assy from the axle housing and pull out stub shaft.



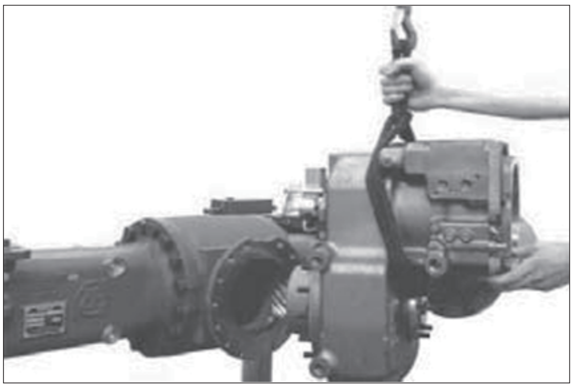
17W98RA022

2) INTPUT

(1) Secure transmission with lifting tackle and loosen threaded joint (transmission/axle drive housing).

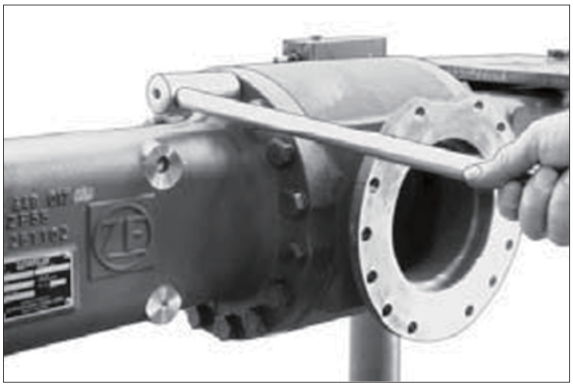
17W98RA023

(2) Separate transmission from the axle.



17W98RA024

(3) Secure axle housing (on crown wheel side) by means of lifting tackle and loosen threaded joint.

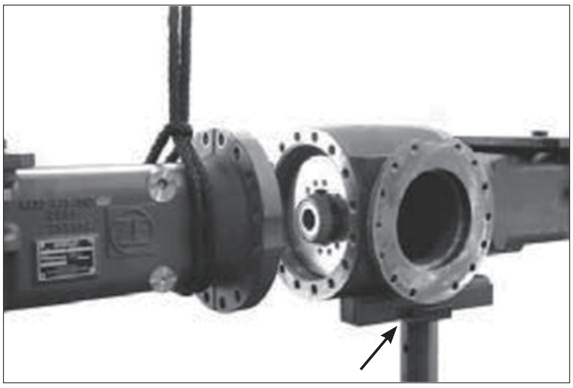


17W98RA025

(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.

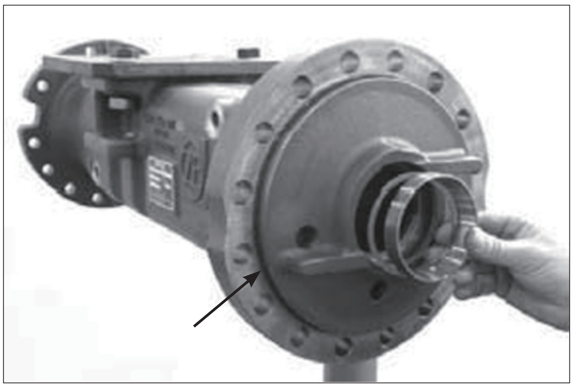


17W98RA026

(5) Pull bearing outer ring out of the bearing hole and remove the releasing shim.

Then remove O-ring (see arrow).

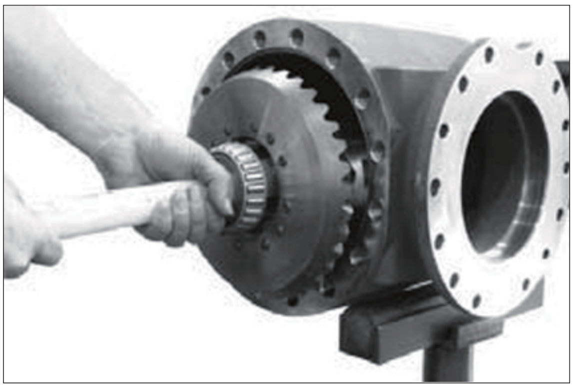
(S) Striker 5870 650 004



17W98RA027

(6) Lift differential out of the axle drive housing.

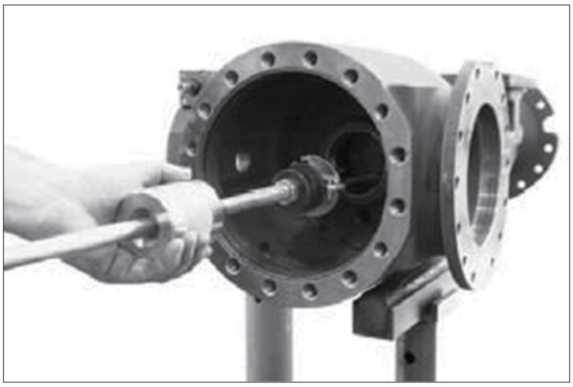
※ Disassembly of the differential see description on page 8-301 and following.



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

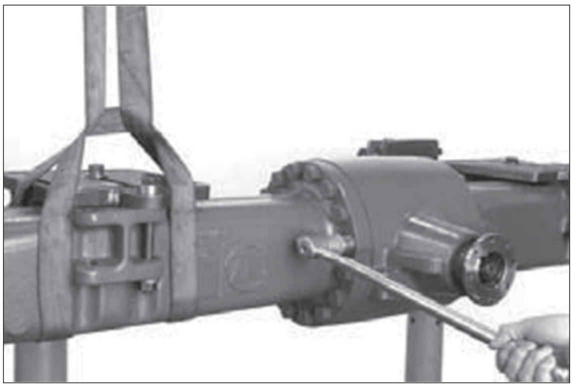


17W98RA029

(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.

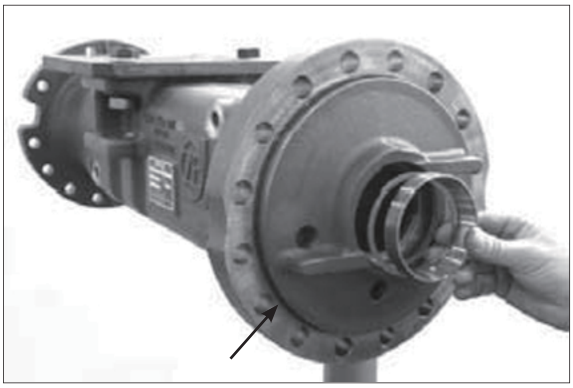


17W98RA030

(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

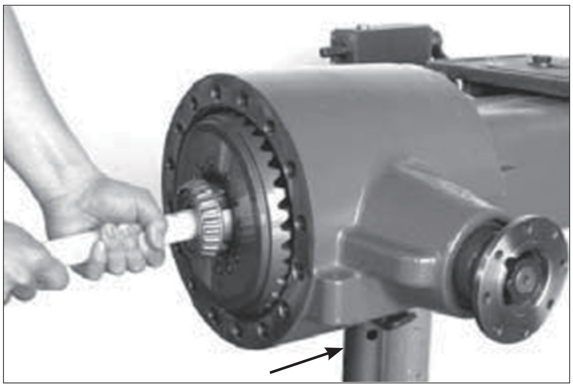


17W98RA031

(10) Support axle at the axle drive housing (see arrow).

Then lift differential out of the axle drive housing.

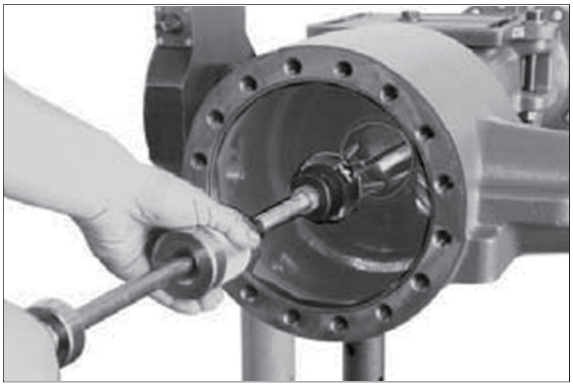
※ Disassembly of the differential see description on page 8-301 and following.



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



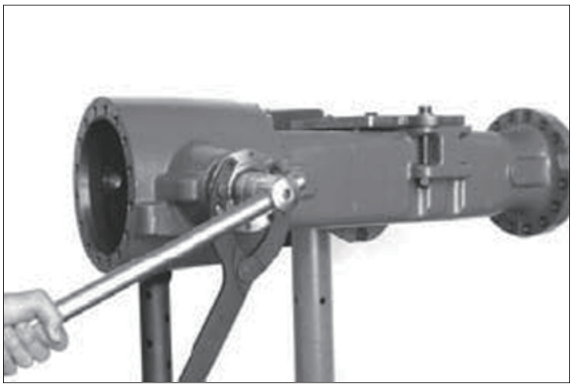
17W98RA033

(12) Heat up hexagon nut with hot-air blower.

Then loosen hexagon nut and remove the releasing washer.

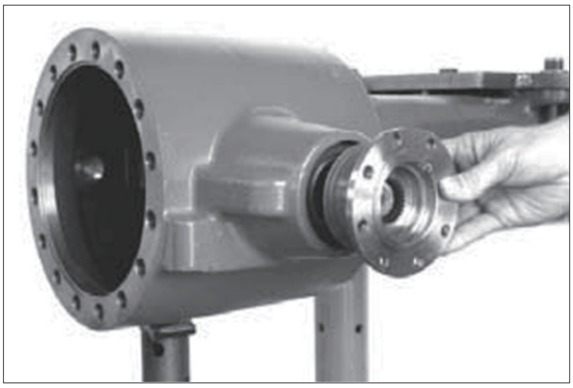
(S) Clamping fork 5870 240 025

※ Hexagon nut is secured with Loctite no. 262.



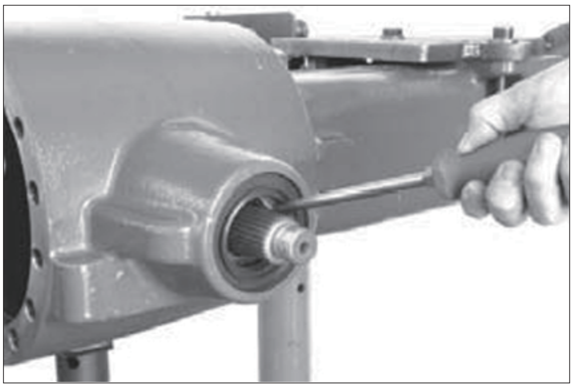
17W98RA034

(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.

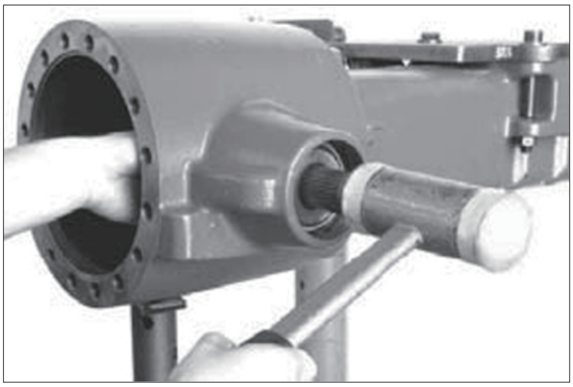


17W98RA036

(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.



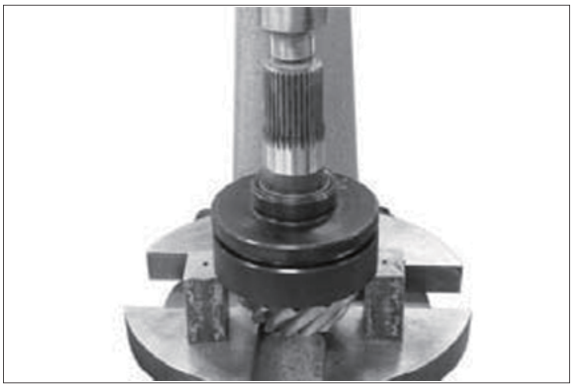
17W98RA037

(16) Remove spacer ring.

17W98RA038

(17) Press roller bearing off the input pinion.

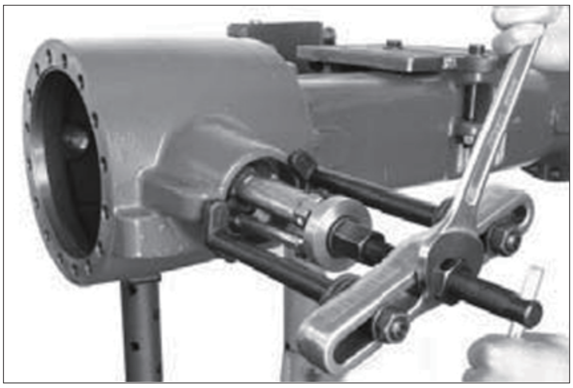
(S) Grab sleeve 5873 001 037



17W98RA039

(18) Pull external bearing outer ring out of the bearing hole.

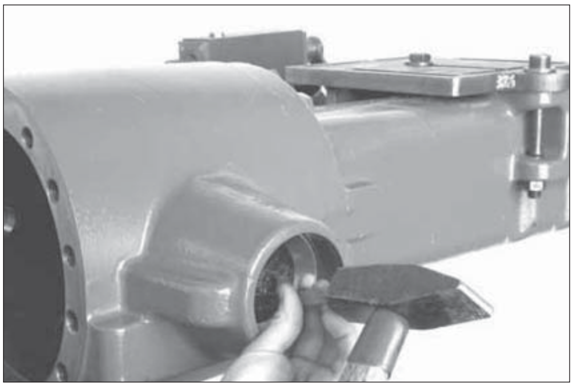
(S) Internal extractor 5870 300 019
(S) Counter support 5870 300 020



17W98RA040

(19) Force bearing outer ring off the inner bearing hole pay attention to the shim behind.

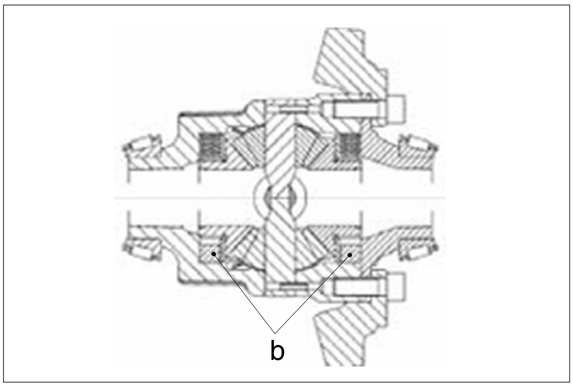
※ Mark shim regarding position/bearing allocation reassembly aid.



17W98RA041

3) DIFFERENTIAL

(1) b = Constant spacers



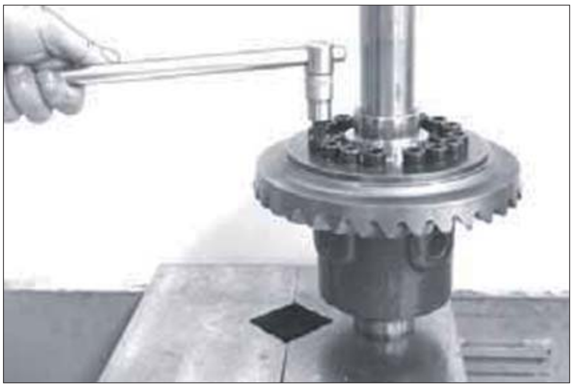
17W98RA042

(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.

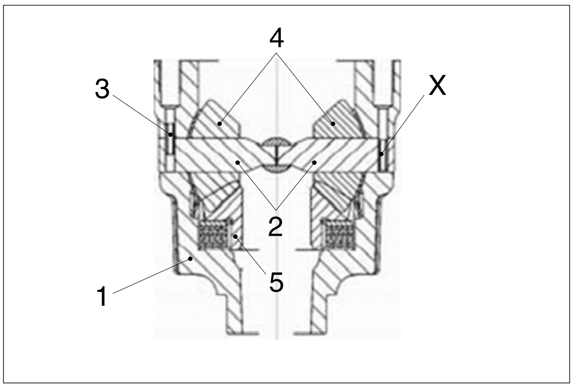
17W98RA046

(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

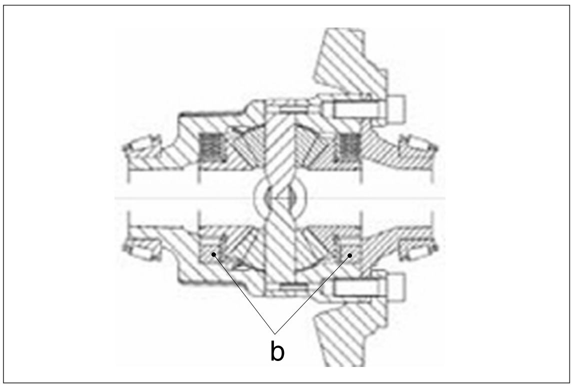
(9) Remove all single parts.

17W98RA050

4. REASSEMBLY

1) DIFFERENTIAL

(1) b = Constant spacers

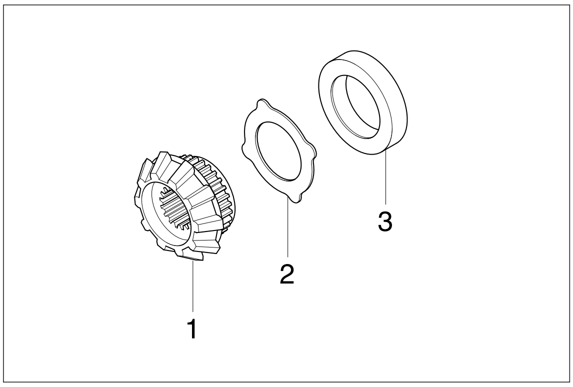


17W98RA042

(2) All outer and inner disks are replaced by a constant spacer (see figure FA054).

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

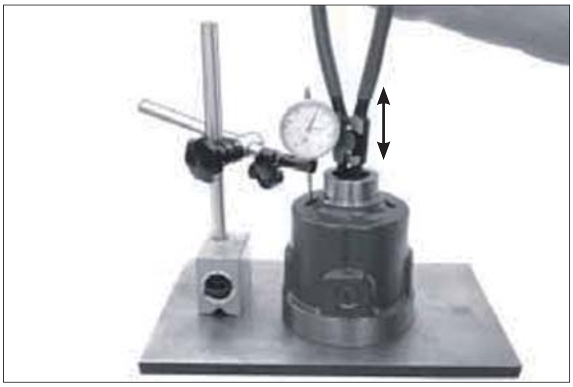
(5) Check axial play of the axle bevel gear 0.0 … 0.15 mm.

※ 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).



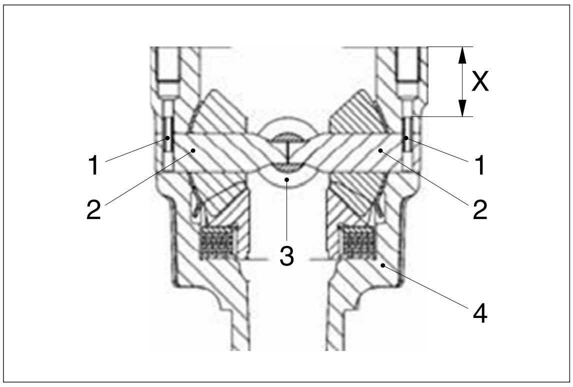
17W98RA056

(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 $\pm$ 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

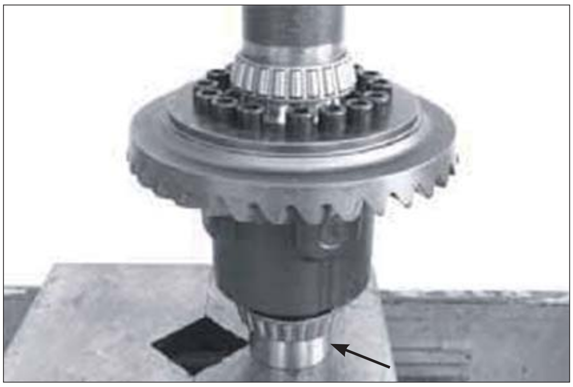
(12) Fix differential with press and tighten crown wheel with cylindrical screws.

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.

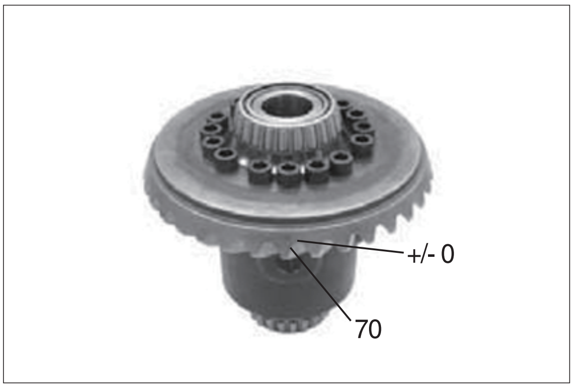


17W98RA064

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)

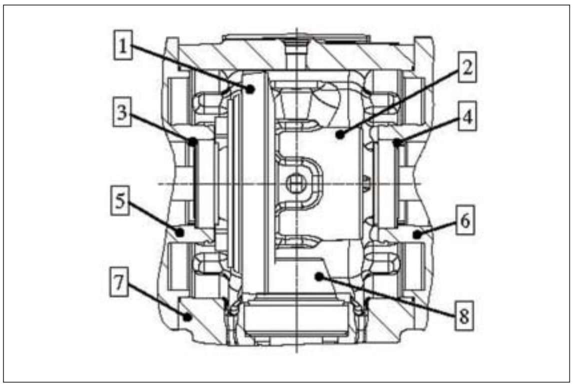


17W98RA065

(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

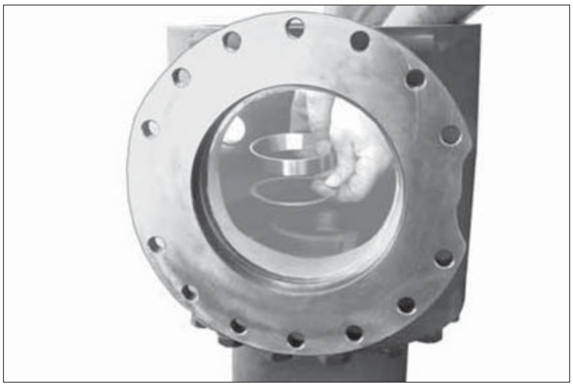
· Legend to sketch:

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.	0730 006 518	0730 006 519	0730 006 521	0730 006 522	0730 006 524
Shim/crown wheel side Required shim thickness	1.35	1.25	1.15	1.05	0.95
Shim No.	0730 006 524	0730 006 522	0730 006 521	0730 006 519	0730 006 518

(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 (M18/12.9) . . . . MA = 440 Nm

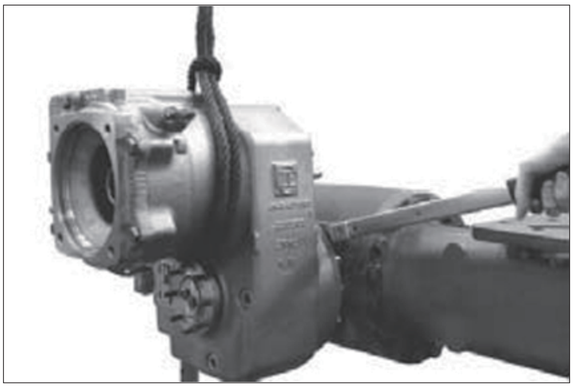
※ Preliminarily fix axle housing without O-ring.

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



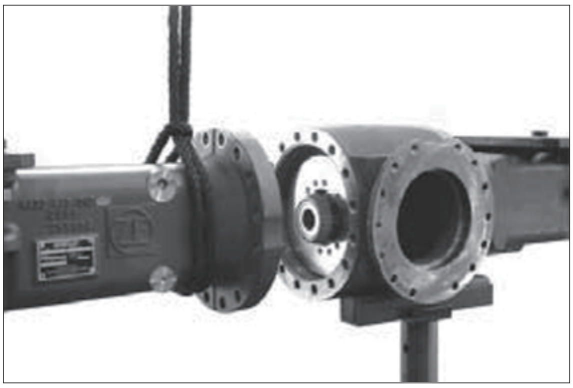
17W98RA072

(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.

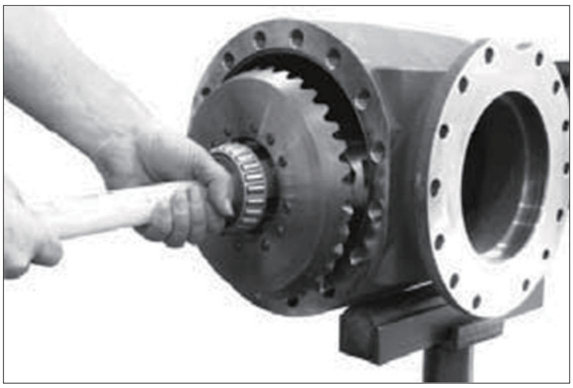
Compare the obtained contact pattern.

※ 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.



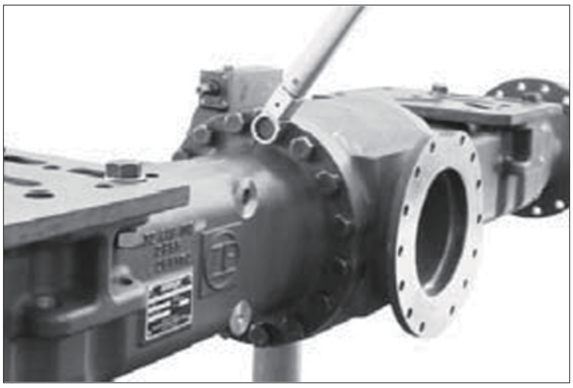
17W98RA074

(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 (M18/12.9) . . . . MA = 440 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 I from the axle drive housing.

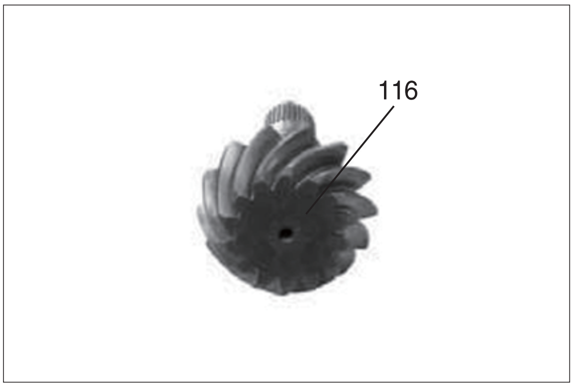
Dim. I e.g. 154.05 mm

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

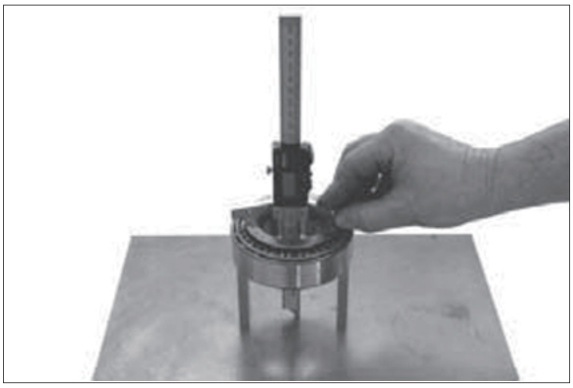
(3) Determine dimension III (bearing width).

※ 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

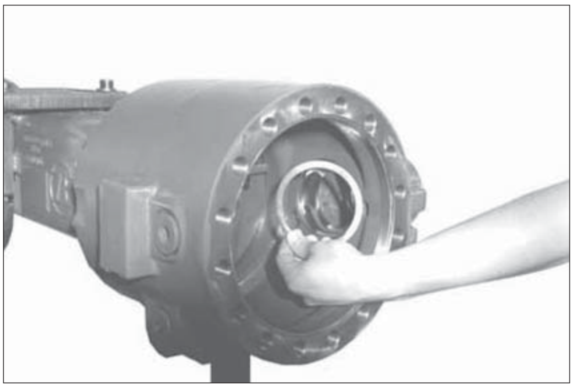
(S) Gage blocks 5870 200 066


17W98RA079

(4) Calculation example :

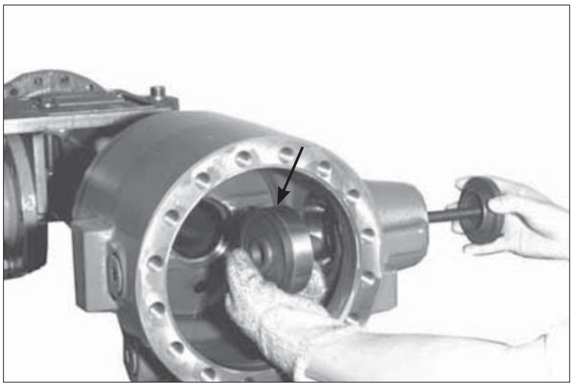
Dimension I . . . . 154.05 mm
Dimension X . . . . - 152.50 mm
Difference = shim s = 1.55 mm

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).

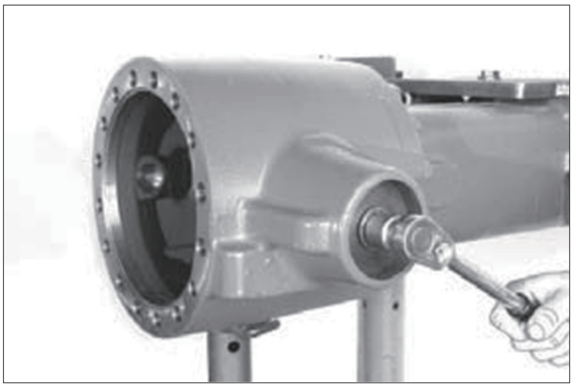
(S) Assembly fixture	5870 345 049
(S) Pressure ring	5870 345 056



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

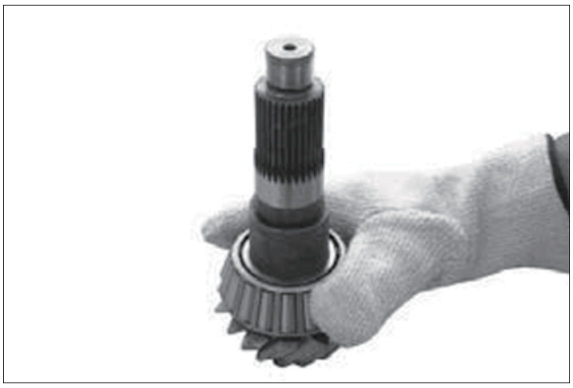


17W98RA082

(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.



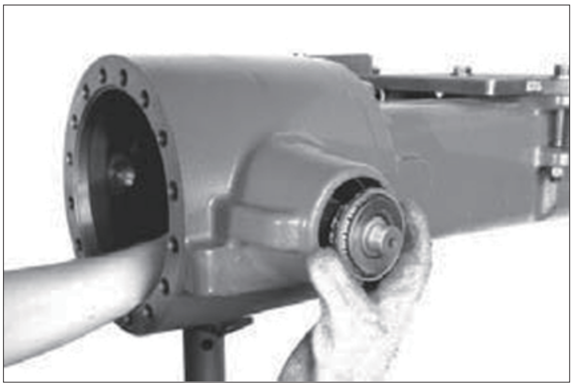
17W98RA083

(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

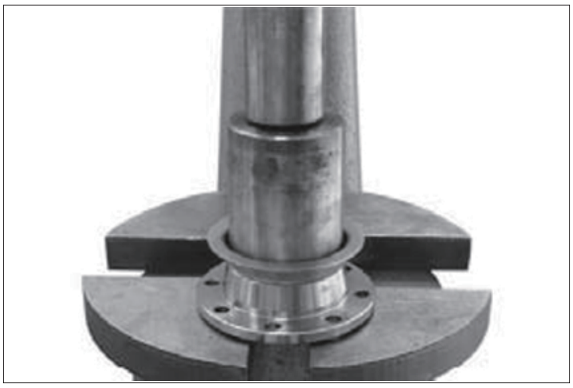
(9) Place the preassembled input pinion into the axle housing and mount the heated roller baring until contact is obtained.



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.



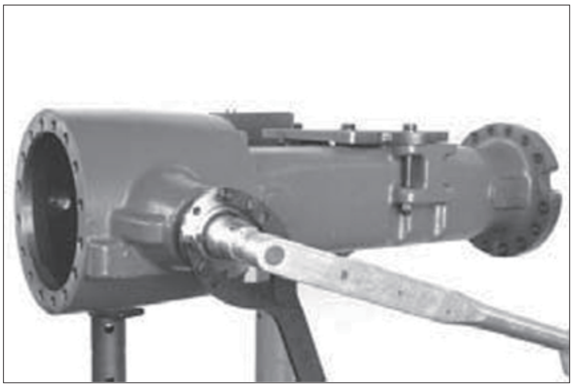
17W98RA086

(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

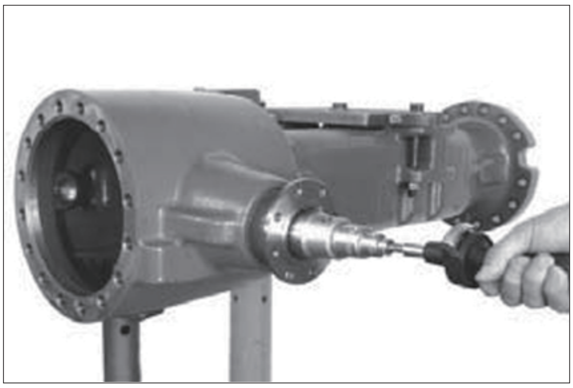
(12) Check rolling torque (1.0 ... 3.0 Nm without shaft seal ring).

※ 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.

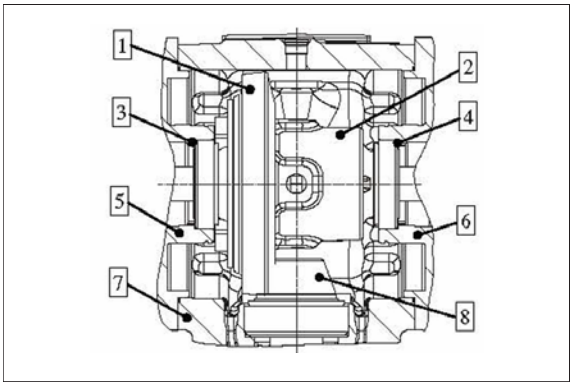
※ The test dimension "70" is stamped into the crown wheel rear side. If no + or deviation is indicated, this value corresponds with the test dimension/ actual value "70" in the table below. According to this value, the required shims are allocated in the table below.

※ 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

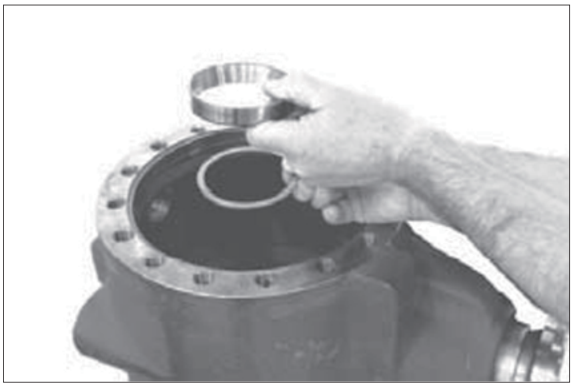


17W98RA090

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.	0730 006 518	0730 006 519	0730 006 521	0730 006 522	0730 006 524
Shim/crown wheel side Required shim thickness	1.35	1.25	1.15	1.05	0.95
Shim No.	0730 006 524	0730 006 522	0730 006 521	0730 006 519	0730 006 518

(15) Place determined shim (e.g. thickness = 1.15 mm) 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 mm) 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.

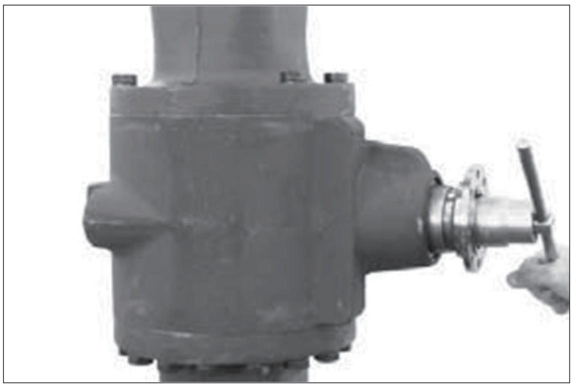
Tightening torque (M18/12.9) .... MA = 440 Nm

※ 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 (M18/12.9) .... MA = 440 Nm

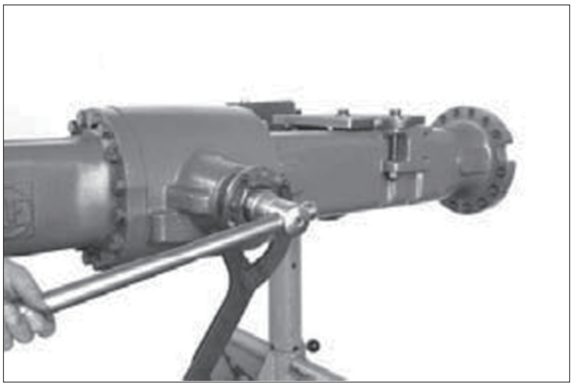
Then bring axle into horizontal position and reassemble the second supporting bracket (S) (see also figure RA001).

17W98RA098

(23) **Fitting of shaft seal ring** (input flange)

Loosen hexagon nut and pull input flange off the input pinion.

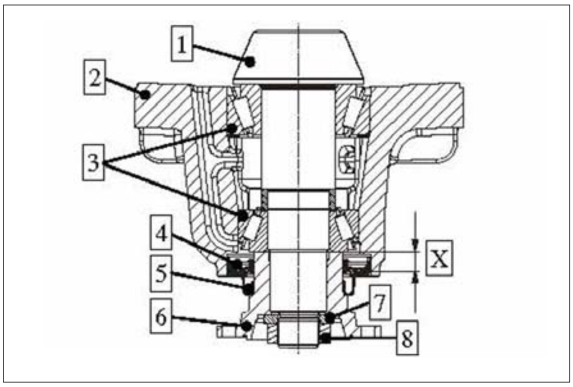
(S) Clamping fork 5870 240 025



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



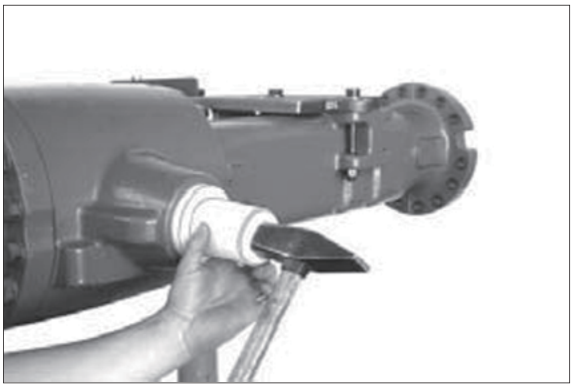
17W98RA100

(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.



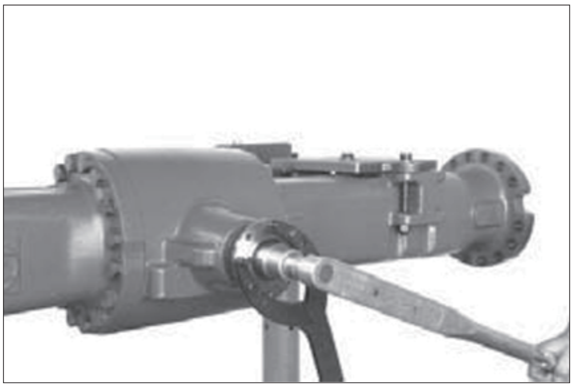
17W98RA101

(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

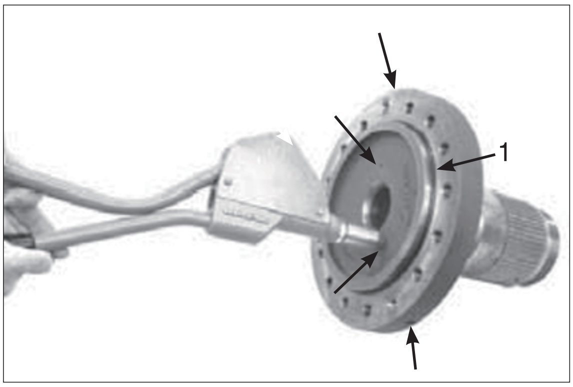
4) OUTTPUT

(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

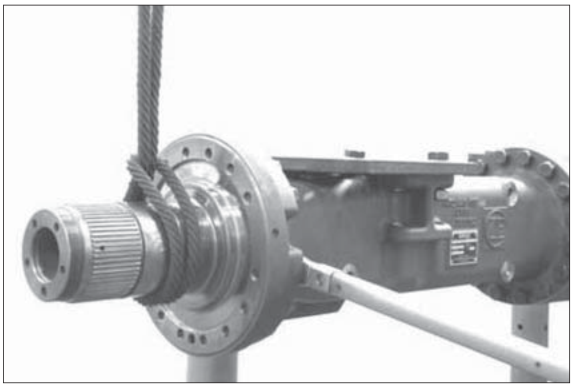


17W98RA103

(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

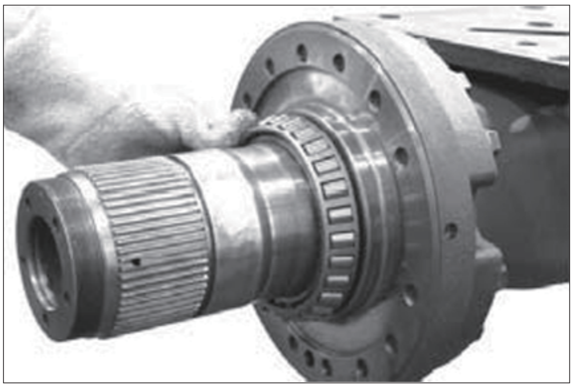
※ Ensure radial installation position. Stamped circle (see arrow) must be in uppermost (12 o'clock) position.



17W98RA104

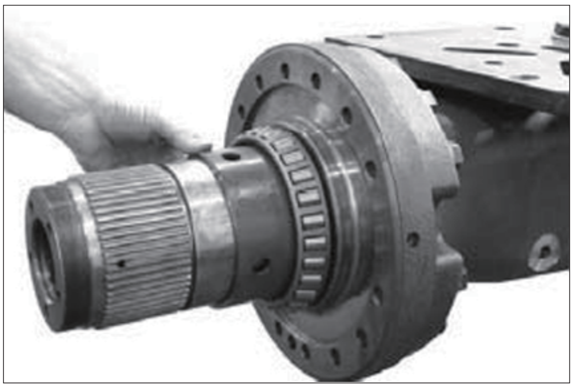
(3) Hub (Hub bearing SET-RIGHT)

Heat up tapered roller bearing and mount it to hub carrier until contact is obtained.



17W98RA105

(4) Mount spacer bushing.

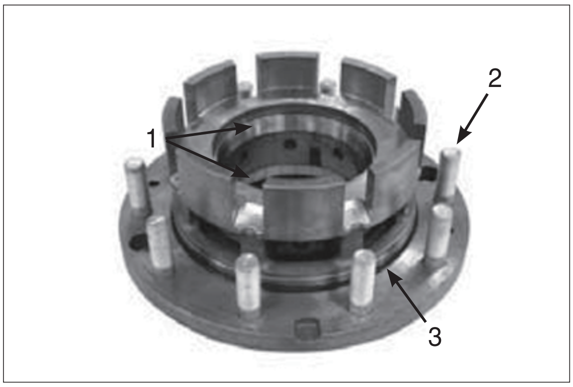


17W98RA106

(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.



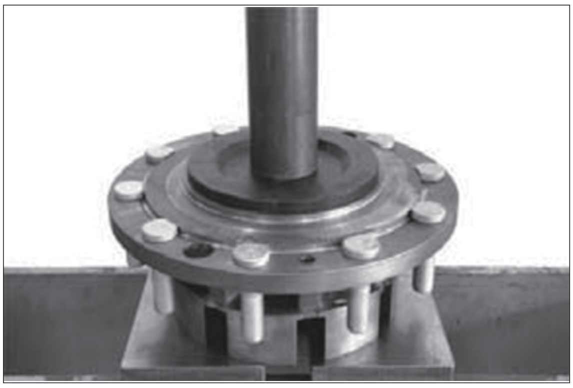
17W98RA107

(6) Press shaft seal ring into the hub, with the marking "OUT SIDE" showing outwards (facing up):

(S) Driver tool 5870 051 068

※ Use of the specified driver tool (S) ensures the exact installation position of the shaft seal ring.

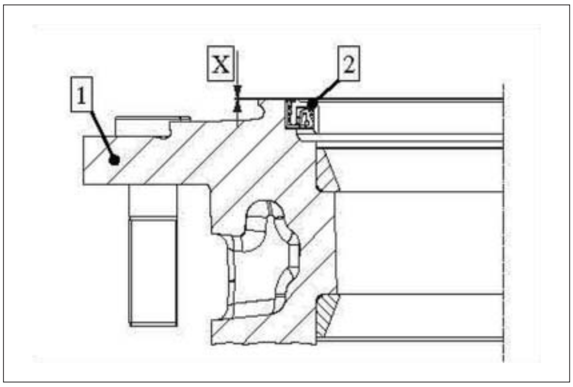
※ Wet outer diameter of the shaft seal ring with Loctite no. 574.



17W98RA108

(7) Legend to sketch:

1 = Hub
2 = Shaft seal ring
X = Installation dimension – shaft seal ring
.... $2.5^{+0.5}$ mm

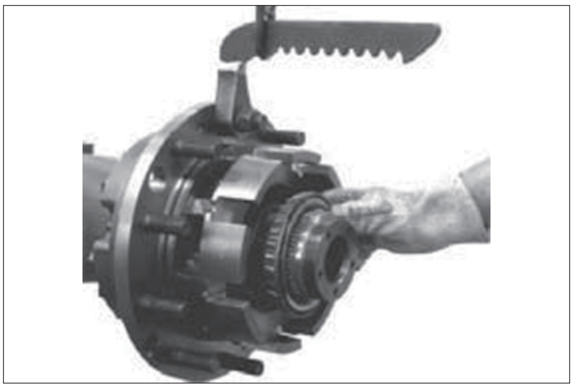


17W98RA109

(8) Mount preassembled hub until contact is obtained and fix it with heated tapered roller bearing.

(S) Lifting bracket 5870 281 043

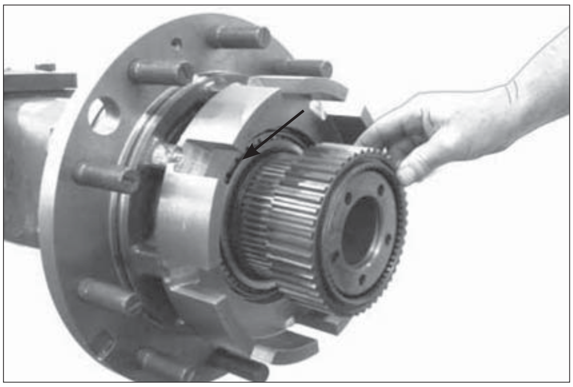
※ Just before fitting, wet sealing lips of shaft seal ring with lubricant.



17W98RA110

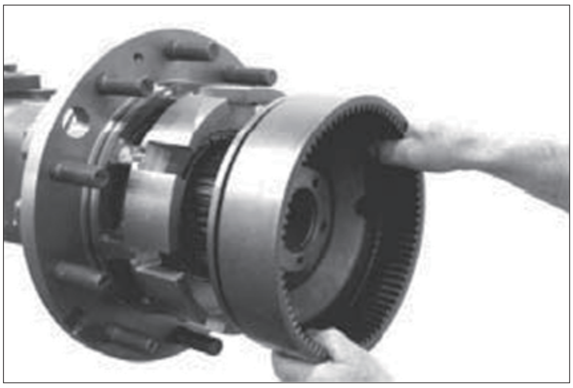
(9) Oil O-ring and insert it into the annular groove (see arrow) of the hub carrier.

Then mount disk carrier.



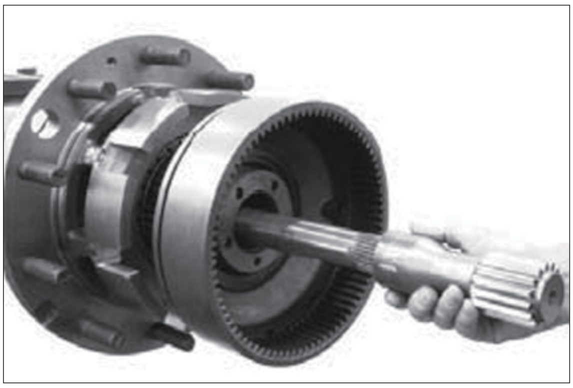
17W98RA111

(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).



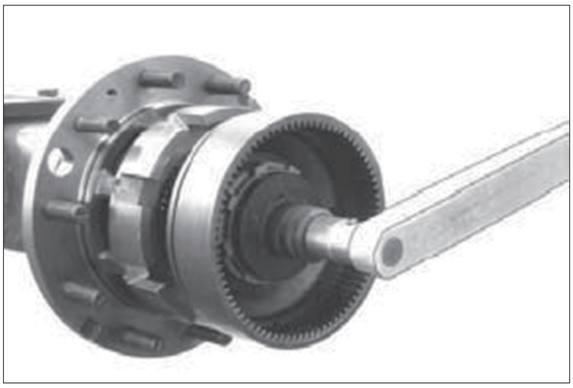
17W98RA113

(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

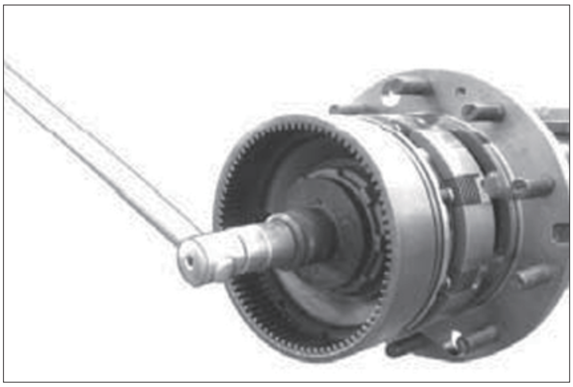
※ While tightening the slotted nut rotate hub in both directions several times roller setting.

※ Apply lubricant to thread of knuckle housing/slotted nut.



17W98RA114

(13) Loosen slotted nut and remove ring gear.



17W98RA115

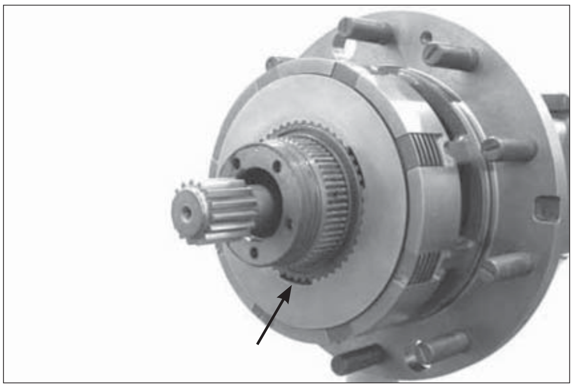
(14) Multi-disk brake

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.

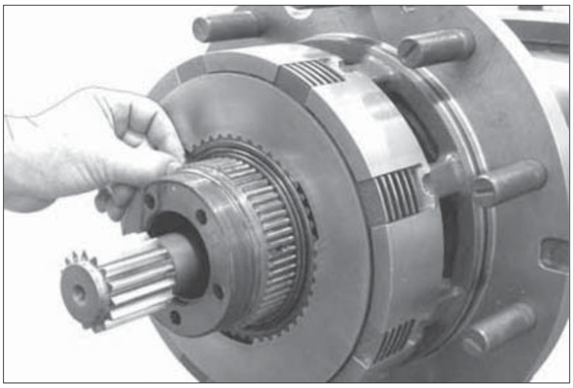
17W98RA116

(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

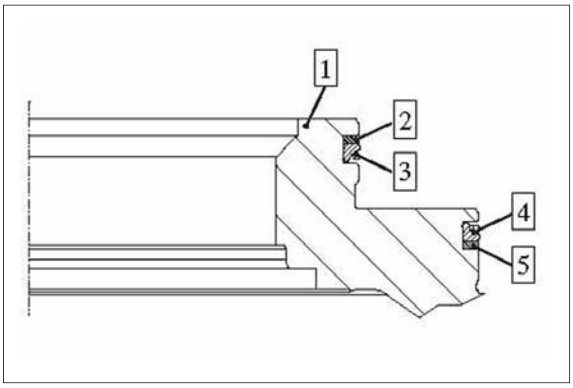
(17) Oil grooved and back-up rings and insert them into the annular grooves of the ring gear.

※ 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 . . . . . .16.00 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).

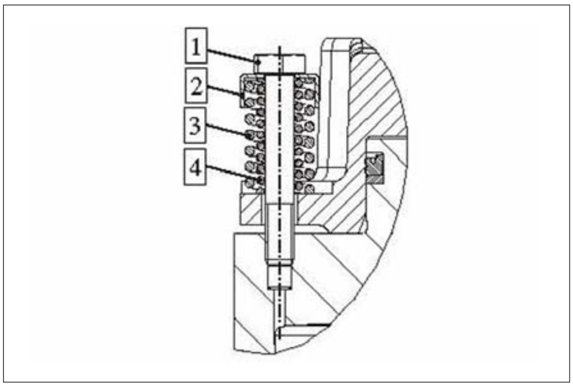
Tightening torque (M 6/8.8) . . . . MA = 8 Nm

※ Use hexagon screws just once.

17W98RA123

(22) Legend to sketch:

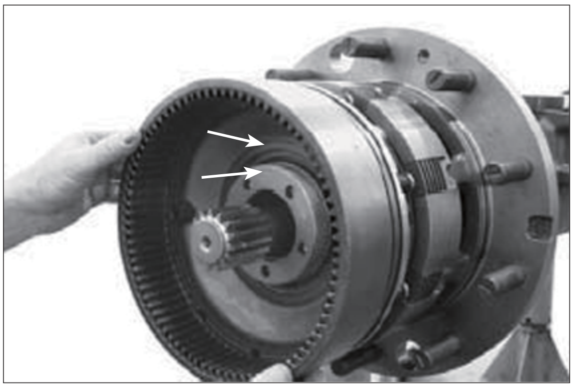
1 = Hexagon screw (special version)
2 = Spring sleeve
3 = Compression spring
4 = Compression spring



17W98RA124

(23) Mount preassembled ring gear, considering the installation position (markings O in 12 o'clock position – see arrows).

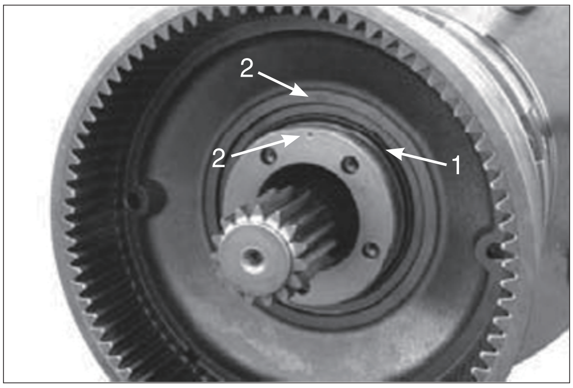
※ Ensure exact toothing position of oil supply holes – hub carrier/ring gear (pressure oil supply to brake piston).



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

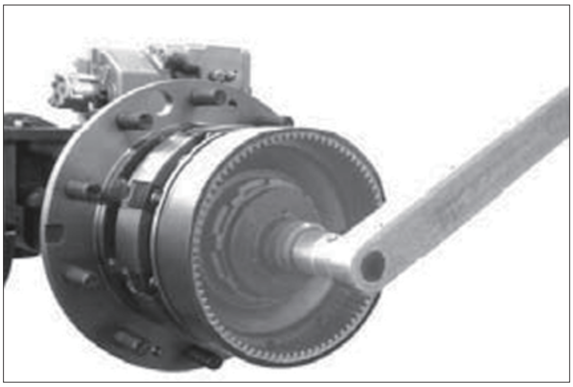
(25) Fix ring gear with slotted nut.

Tightening torque (M110 × 1.5) . . . .
. . . . MA = 1400 + 600 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**

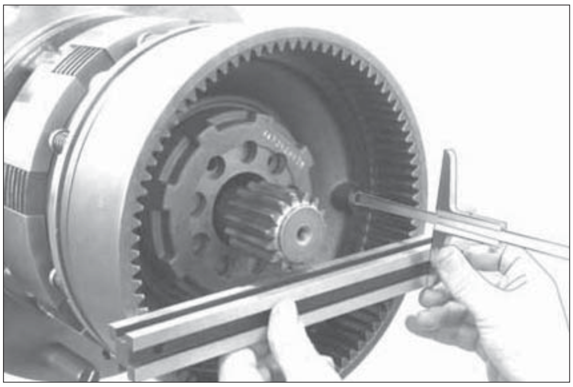
Piston stroke / disk clearance = 0.7 ... 1.3 mm

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.

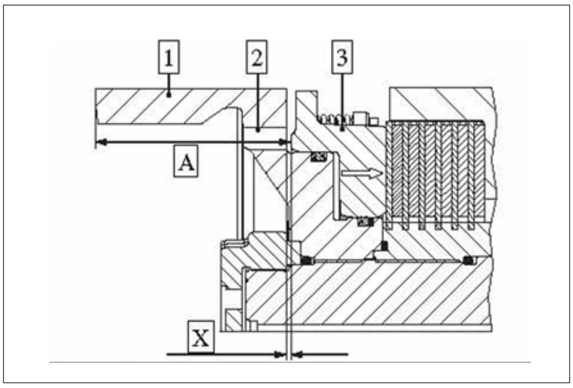


17W98RA129

(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 :

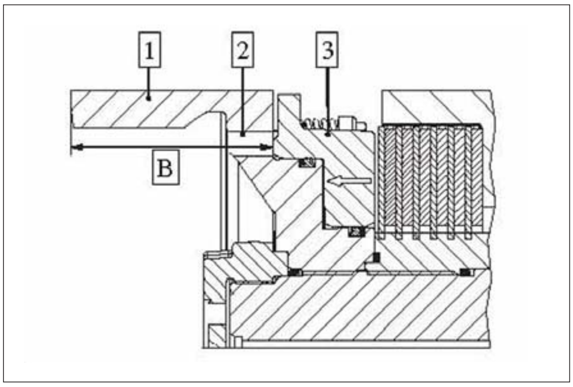
Dimension „A“ e.g. . . . . 83.10 mm
Dimension „B“ e.g. . . . . - 82.10 mm
Difference = piston stroke = 1.00 mm

※ 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

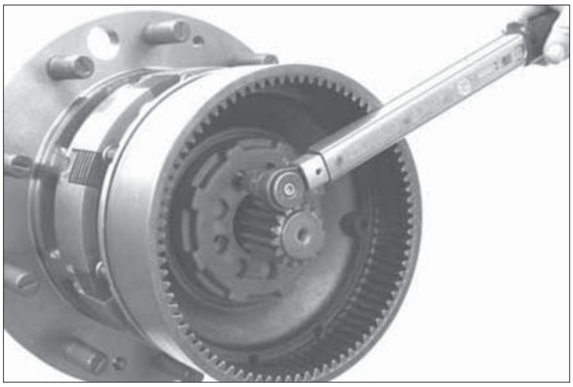
(S) Straightedge 5870 200 022



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.

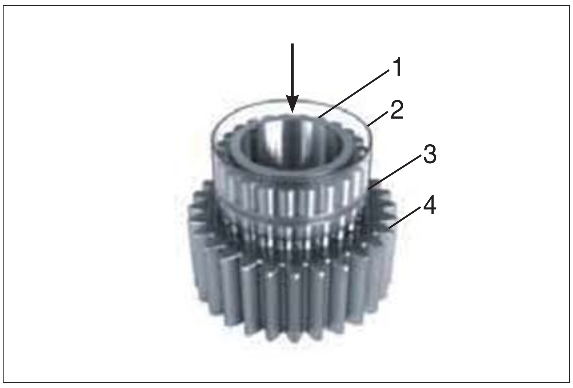
(S) Driver tool 5870 048 263

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.

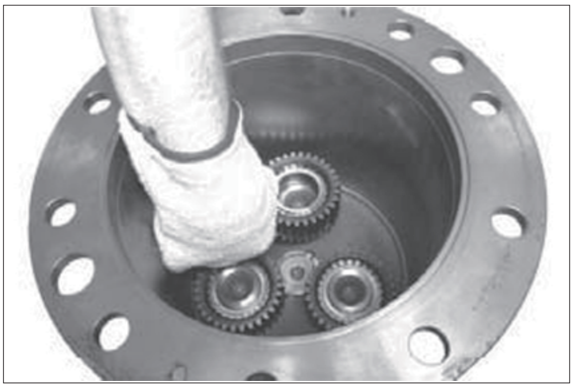
1 = Cylindrical roller bearing
2 = Packaging sleeve
3 = Snap ring
4 = Planetary gear



17W98RA134

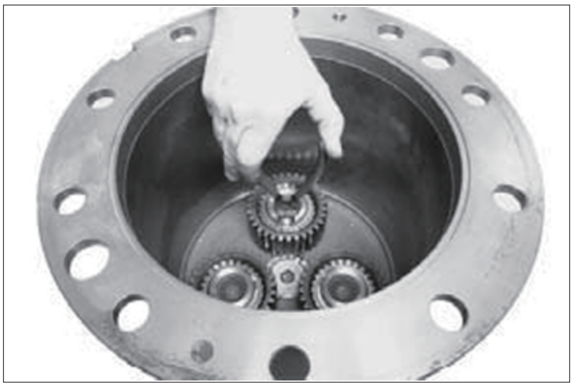
(33) Heat up bearing inner ring and mount preassembled planetary gear until contact is obtained.

※ 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

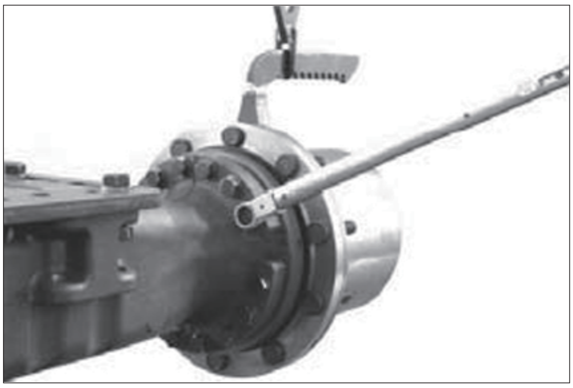
17W98RA137

(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.

GROUP 11 RCV LEVER

1. REMOVAL AND INSTALL

1) REMOVAL


13031GE18

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

(2) Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

(3) Loosen the breather slowly to release the pressure inside the hydraulic tank.

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

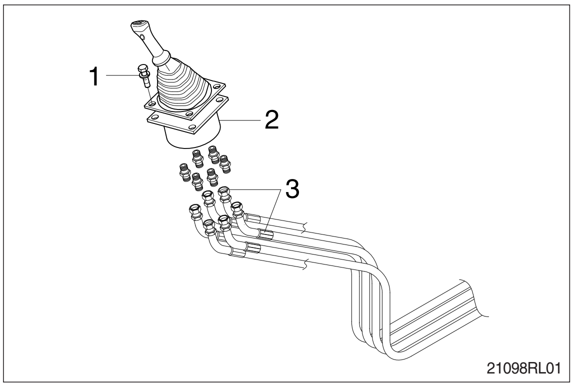
(4) Loosen the socket bolt (1).

(5) Remove the cover of the console box.

(6) Disconnect pilot line hoses (3).

(7) Remove the pilot valve assembly (2).

※ When removing the pilot valve assembly, check that all the hoses have been disconnected.



21098RL01

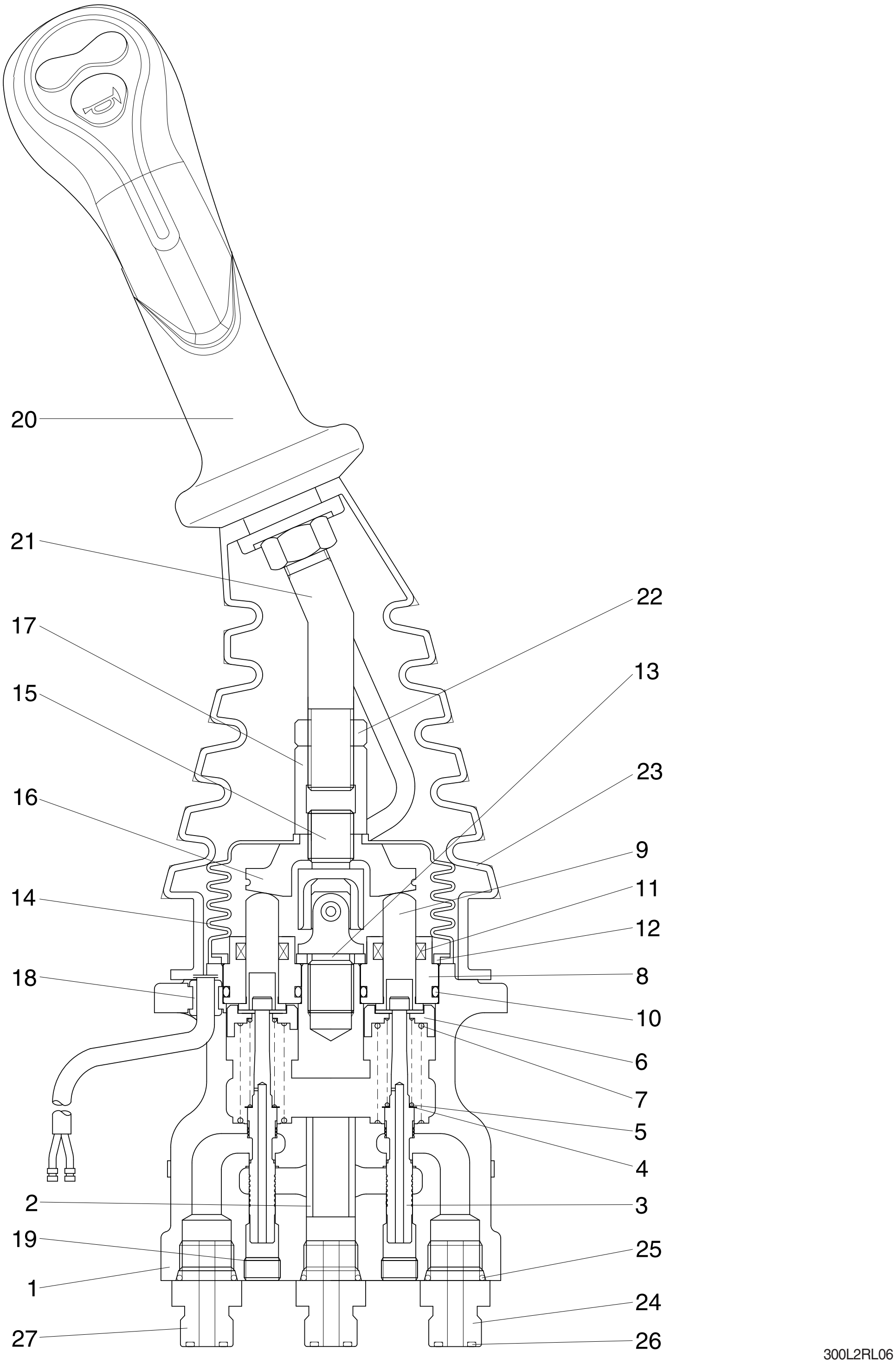
2) INSTALL

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

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

2. DISASSEMBLY AND ASSEMBLY

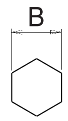
1) STRUCTURE



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

2) TOOLS AND TIGHTENING TORQUE

(1) Tools

Tool name	Remark	
Allen wrench	6	
Spanne	22	
	27	
(+) Driver	Length 150	
(-) Driver	Width 4~5	
Torque wrench	Capable of tightening with the specified torques	

(2) Tightening torque

Part name	Item	Size	Torque	
			kgf · m	lbf · ft
Joint	15	M14	3.5	25.3
Swash plate	16	M14	5.0±0.35	36.2±2.5
Adjusting nut	17	M14	5.0±0.35	36.2±2.5
Lock nut	22	M14	5.0±0.35	36.2±2.5

3) DISASSEMBLY

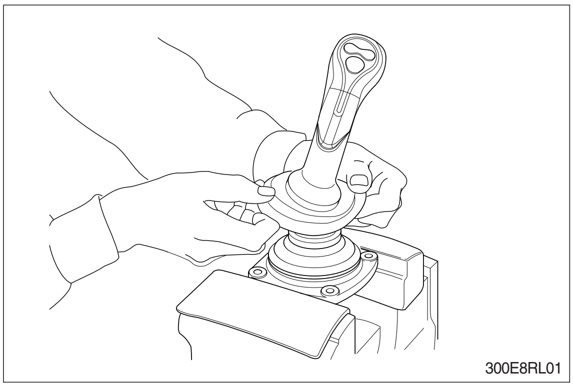
※ Procedures are based on the type M1.

(1) Clean pilot valve with kerosene.

※ Put blind plugs into all ports

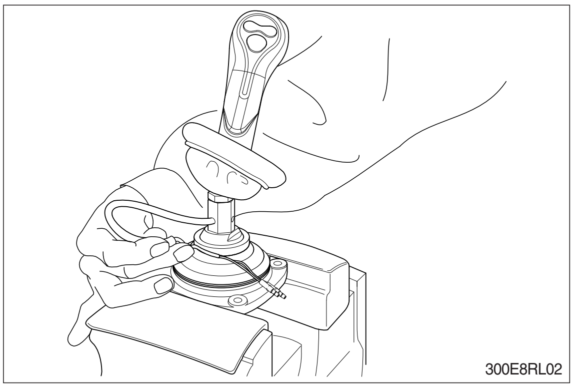
(2) Fix pilot valve in a vise with copper (or lead) sheets.

(3) Remove end of boot (23) from case (1) and take it out upwards.



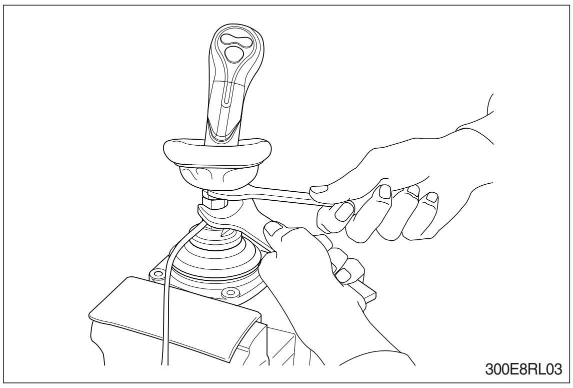
300E8RL01

※ For valve with switch, remove cord also through hole of casing.



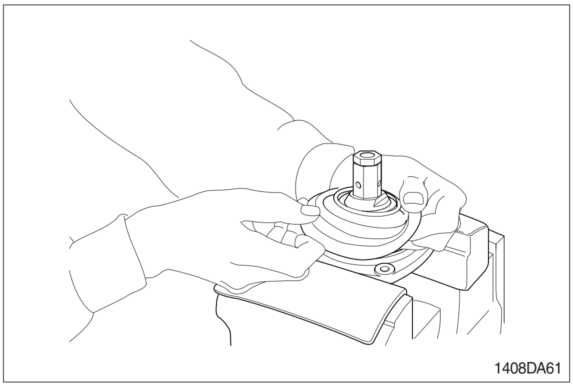
300E8RL02

(4) Loosen lock nut (22) and adjusting nut (17) with spanners on them respectively, and take out handle section as one body.



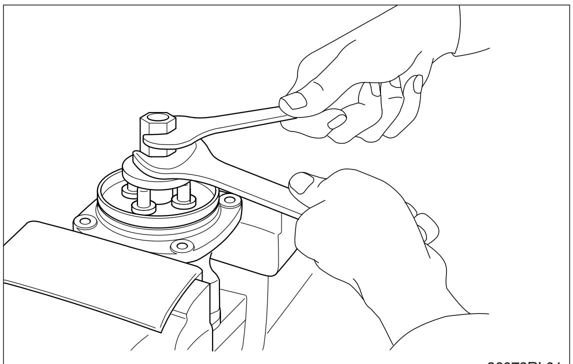
300E8RL03

(5) Remove the boot (14).

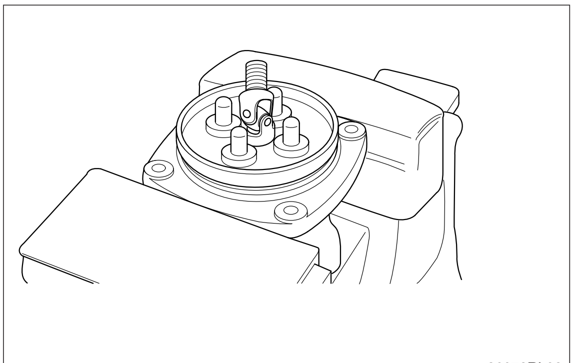


1408DA61

(6) Loosen adjusting nut (17) and swash plate (16) with spanners on them respectively, and remove them.



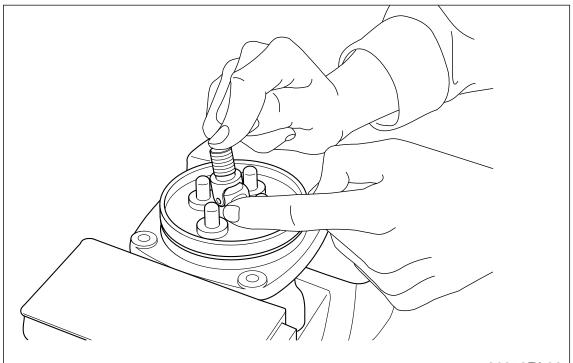
36078RL01



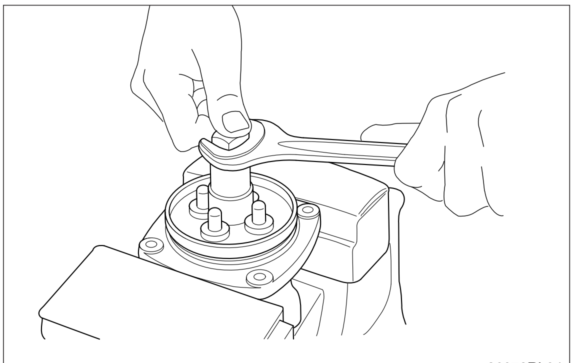
36078RL02

(7) Turn joint anticlockwise to loosen it, utilizing jig (Special tool).

※ When return spring (7) is strong in force, plate (12), plug (8) and push rod (9) will come up on loosening joint.
Pay attention to this.

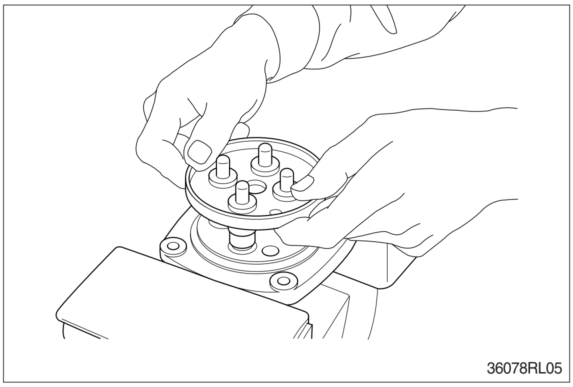


36078RL03



36078RL04

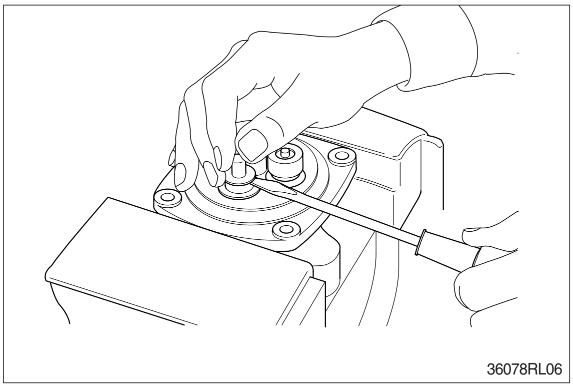
(8) Remove plate (12).


36078RL05

(9) When return spring (7) is weak in force, plug (8) stays in casing because of sliding resistance of O-ring.

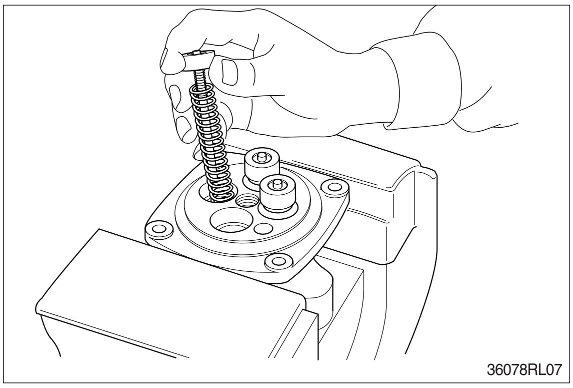
※ Take it out with minus screwdriver. Take it out, utilizing external periphery groove of plug and paying attention not to damage it by partial loading.

※ During taking out, plug may jump up due to return spring (7) force. Pay attention to this.


36078RL06

(10) Remove reducing valve subassembly and return spring (7) out of casing.

※ Record relative position of reducing valve subassembly and return springs.

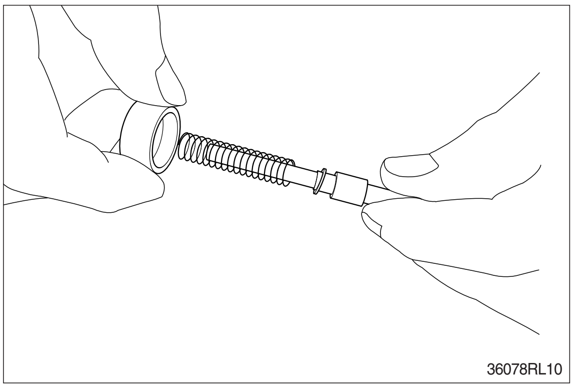

36078RL07

(11) Separate spool (3), spring seat (6), spring (5) and shim (4) individually.

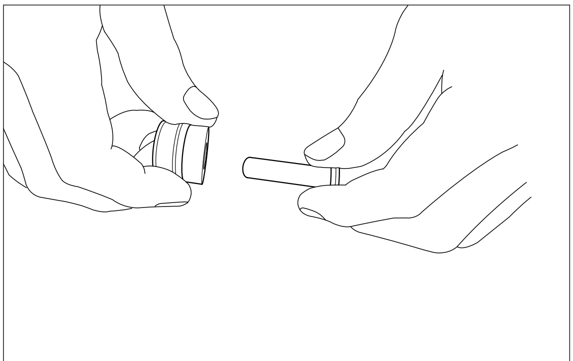
※ Pay attention not to damage spool surface.

※ Record original position of spring seat (6).

※ Until being assembled, they should be handled as one subassembly group.

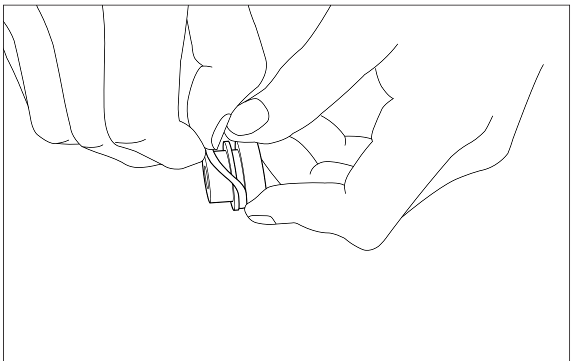

36078RL10

(12) Take push rod (9) out of plug (8).

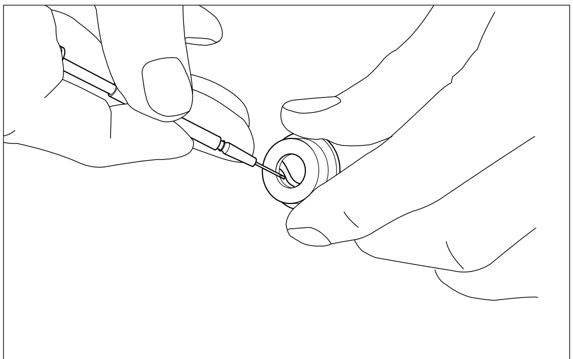


36078RL11

(13) Remove O-ring (10) and seal (11) from plug (8).
Use small minus screwdriver or so on to remove this seal.

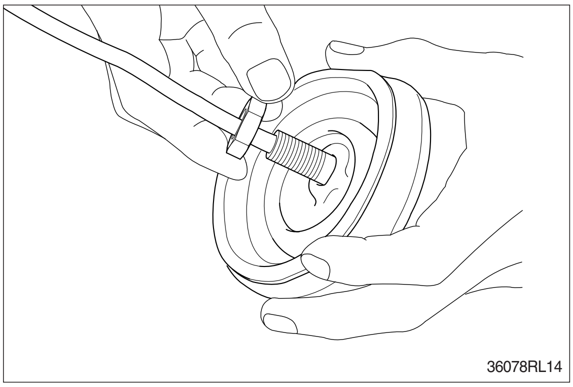


36078RL12

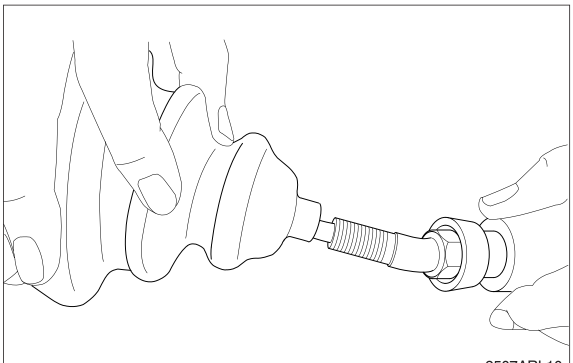


36078RL13

(14) Remove lock nut (22) and then boot (23).



36078RL14



2507ARL10

(15) Cleaning of parts

① Put all parts in rough cleaning vessel filled with kerosene and clean them (rough cleaning).

※ If dirty part is cleaned with kerosene just after putting it in vessel, it may be damaged. Leave it in kerosene for a while to loosen dust and dirty oil.

※ If this kerosene is polluted, parts will be damaged and functions of reassembled valve will be degraded.
Therefore, control cleanliness of kerosene fully.

② Put parts in final cleaning vessel filled with kerosene, turning it slowly to clean them even to their insides (finish cleaning).

※ Do not dry parts with compressed air, since they will be damaged and/or rusted by dust and moisture in air.

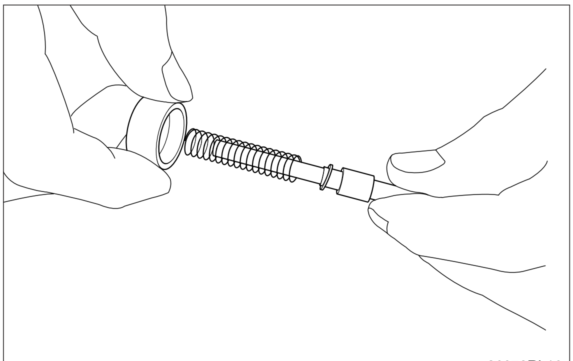
(16) Rust prevention of parts

Apply rust-preventives to all parts.

※ If left as they after being cleaned, they will be rusted and will not display their functions fully after being reassembled.

4) ASSEMBLY

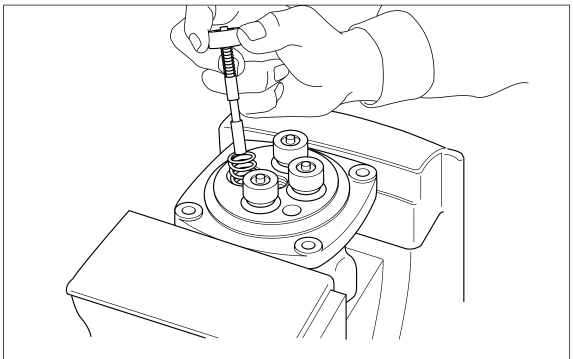
(1) Put shim (4), springs (5) and spring seat (6) onto spool (3) in this order.



36078RL16

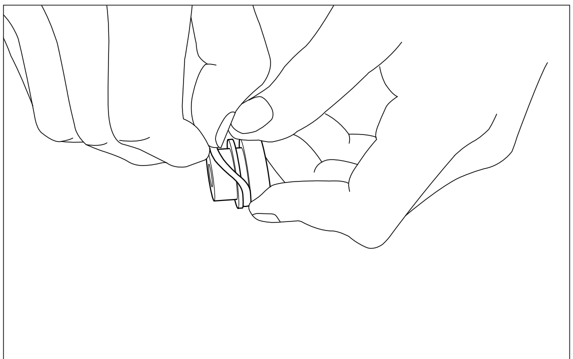
(2) Assemble spring (7) into casing (1).
Assemble reducing valve subassembly into casing.

※ Assemble them to their original positions.



36078RL18

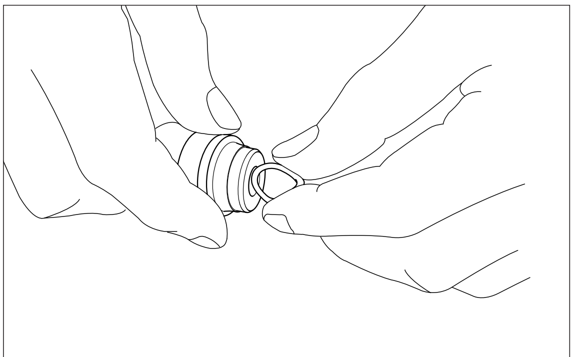
(3) Assemble O-ring (10) onto plug (8).



36078RL19

(4) Assemble seal (11) to plug (8).

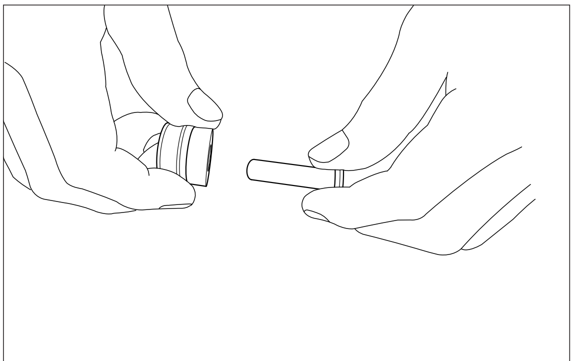
※ Assemble seal in such lip direction as shown below.



36078RL20

(5) Assemble push rod (9) to plug (8).

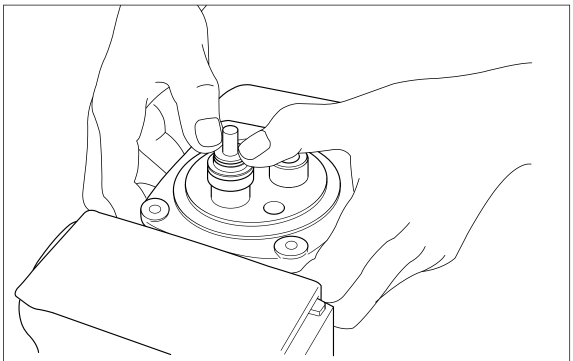
※ Apply working oil on push-rod surface.



36078RL21

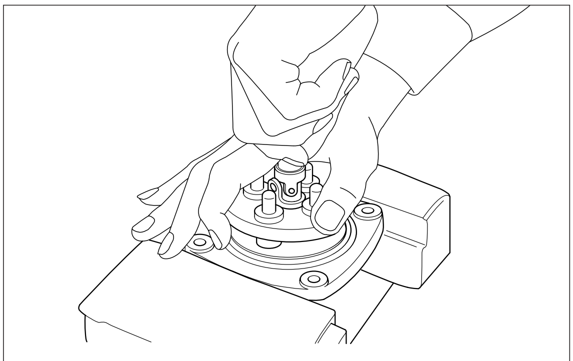
(6) Assemble plug subassembly to casing.

※ When return spring is weak in force, subassembly stops due to resistance of O-ring.



36078RL22

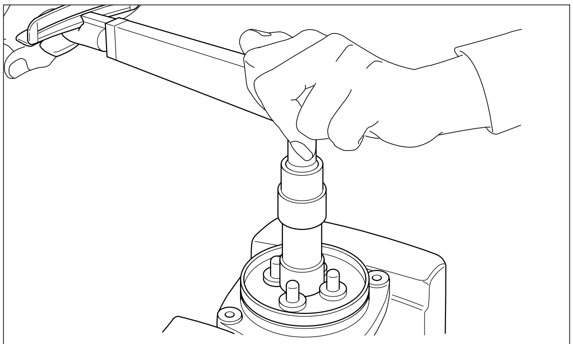
(7) When return spring is strong in force, assemble 4 sets at the same time, utilizing plate (12), and tighten joint (15) temporarily.



36078RL23

(8) Fit plate (12).

(9) Tighten joint (15) with the specified torque to casing, utilizing jig.

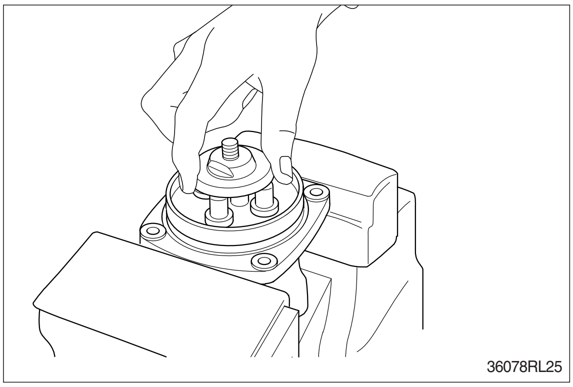


36078RL24

(10) Assemble swash plate (16) to joint (15).

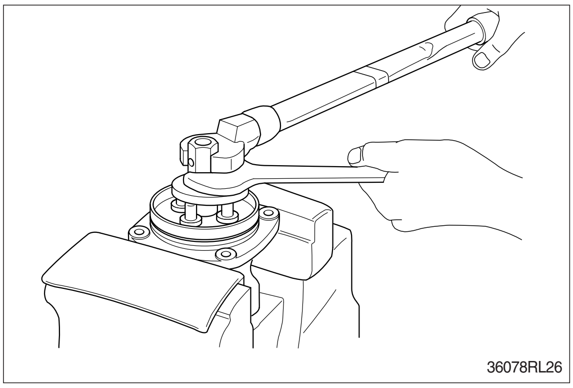
※ Screw it to position that it contacts with 4 push rods evenly.

※ Do not screw it over.

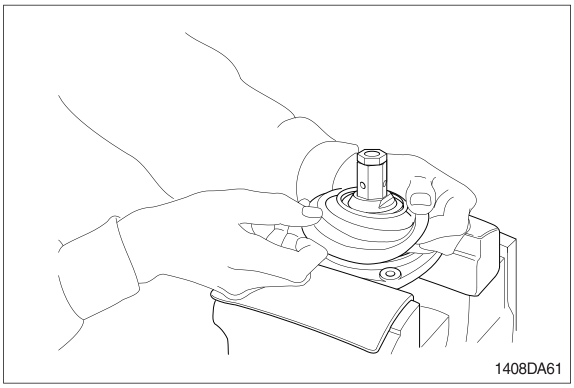


(11) Assemble adjusting nut (17), apply spanner to width across flat of plate (16) to fix it, and tighten adjusting nut to the specified torque.

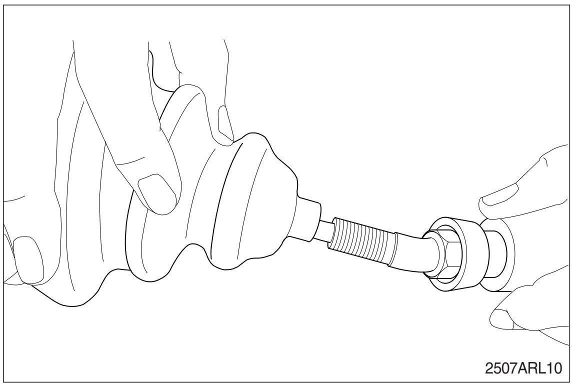
※ During tightening, do not change position of disk.

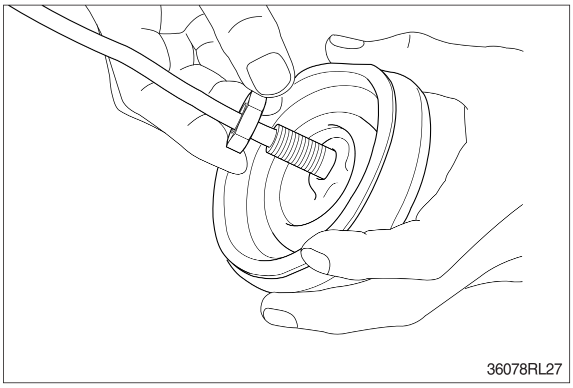


(12) Fit boot (14) to plate.

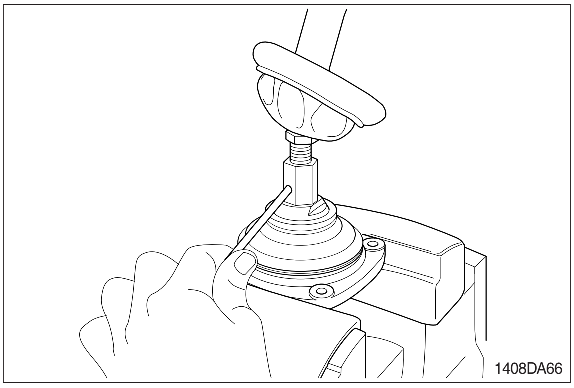


(13) Fit boot (23) and lock nut (22), and handle subassembly is assembled completely.



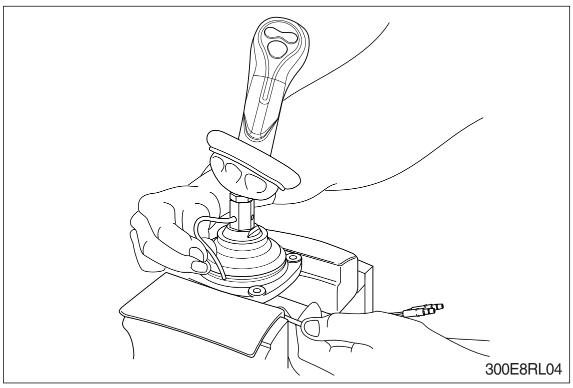


(14) Pull out cord and tube through adjusting nut hole provided in direction 60° to 120° from casing hole.

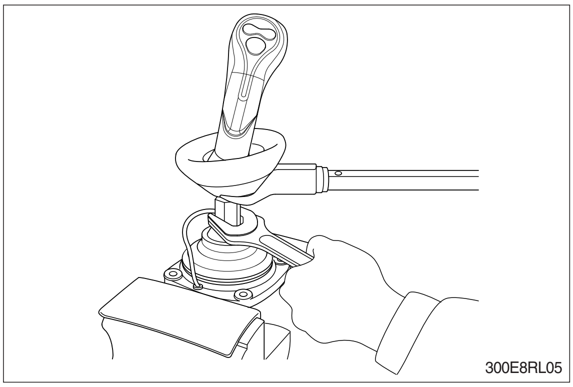


(15) Assemble bushing (18) to plate and pass cord and tube through it.

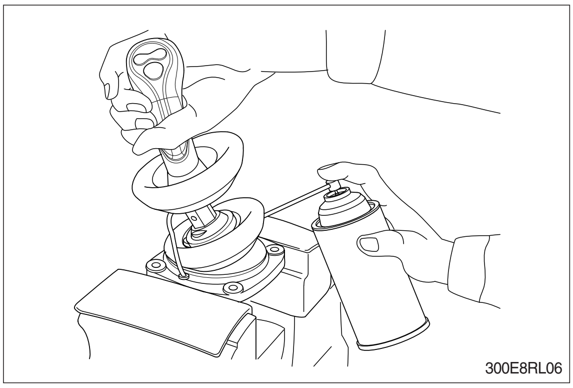
※ Provide margin necessary to operation.



(16) Determine handle direction, tighten lock nut (22) to specified torque to fix handle.

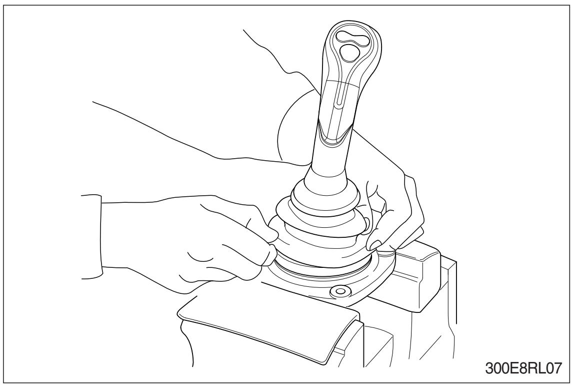


(17) Apply grease to rotating section of joint and contacting faces of disk and push rod.



(18) Assemble lower end of bellows to casing.

(19) Inject volatile rust-preventives through all ports and then put blind plugs in ports.



GROUP 12 TURNING JOINT

1. REMOVAL AND INSTALL

1) REMOVAL

13031GE18

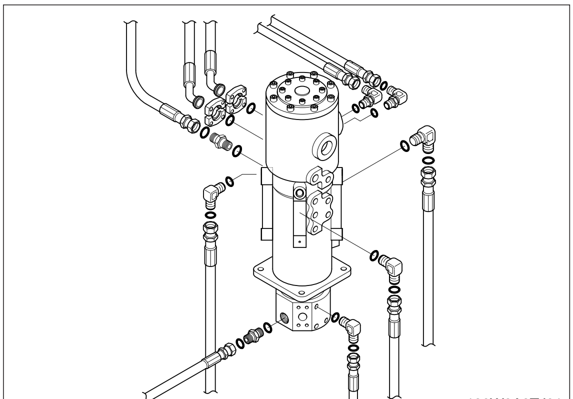
(1) Lower the work equipment to the ground and stop the engine.

(2) Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

(3) Loosen the breather slowly to release the pressure inside the hydraulic tank.

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

※ When pipes and hoses are disconnected, the oil inside the piping will flow out, so catch it in oil pan.



180W9A8TJ01

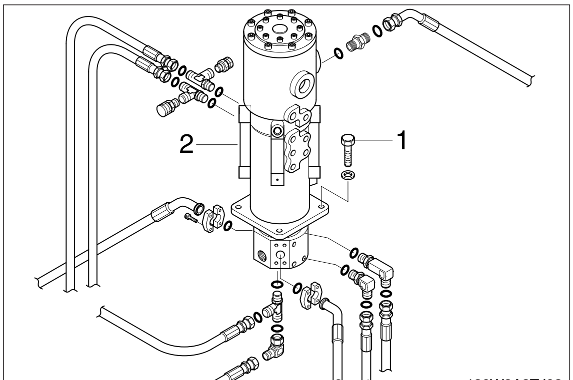
(4) Disconnect all hoses.

(5) Sling the turning joint assembly (1) and remove the mounting bolt (2).

- Weight : 120 kg (265 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 disconnected.



180W9A8TJ02

2) INSTALL

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

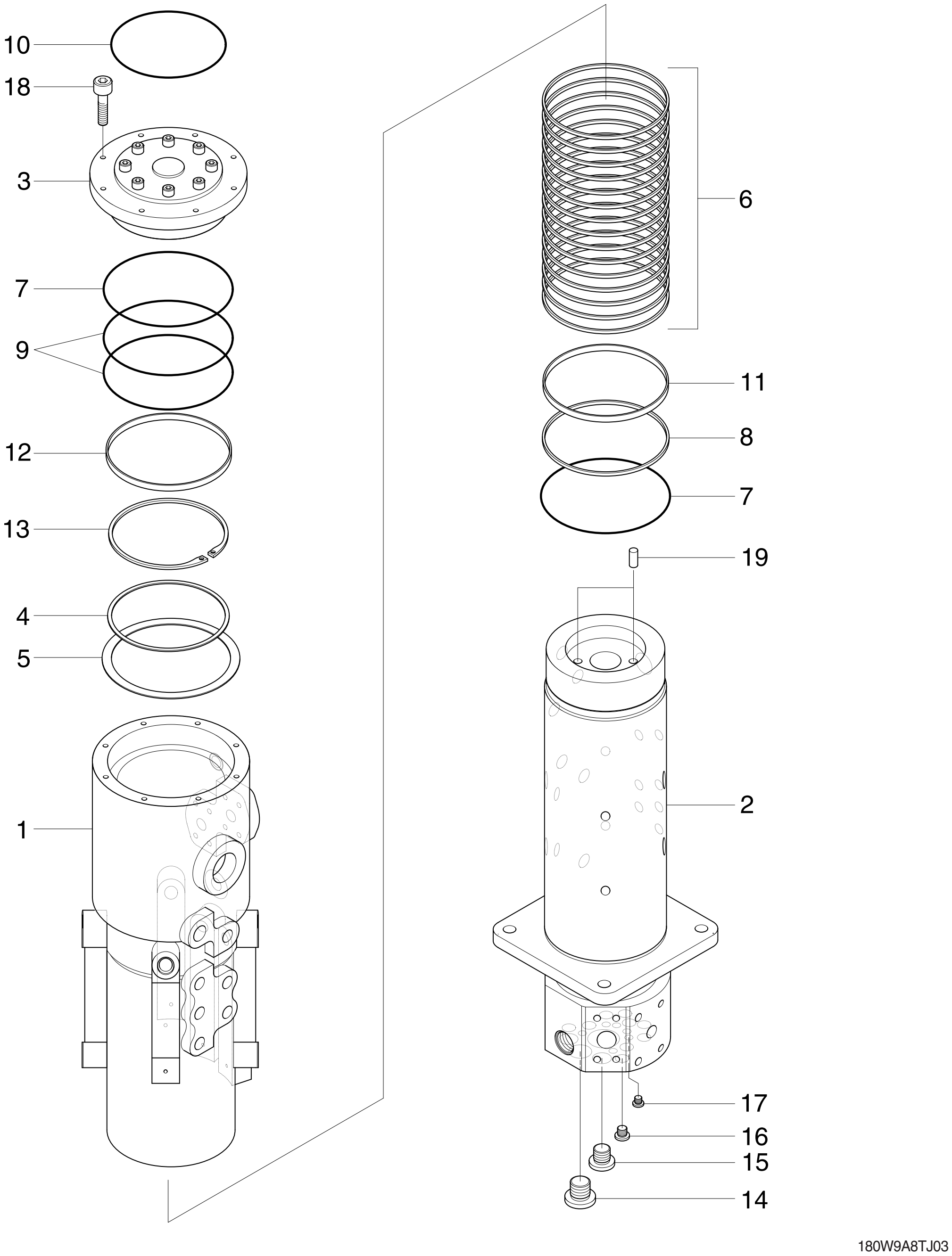
※ Take care of turning joint direction.

※ Assemble hoses to their original positions.

※ Confirm the hydraulic oil level and check the hydraulic oil leak or not.

2. DISASSEMBLY AND ASSEMBLY

1) STRUCTURE

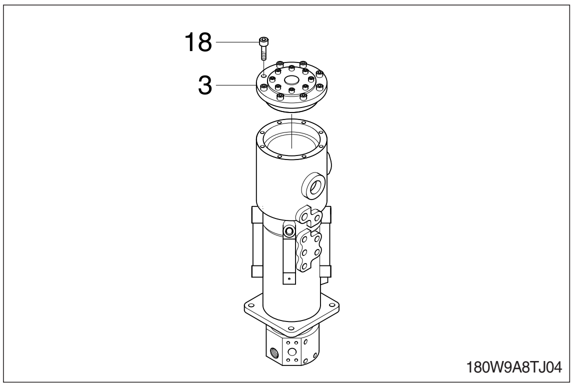


1	Hub	8	O-ring	15	Plug
2	Shaft	9	O-ring	16	Plug
3	Cover	10	O-ring	17	Plug
4	Spacer	11	Wear ring	18	Socket bolt
5	Shim	12	Wear ring	19	Spring pin
6	Slipper seal	13	Retainer ring		
7	O-ring	14	Plug		

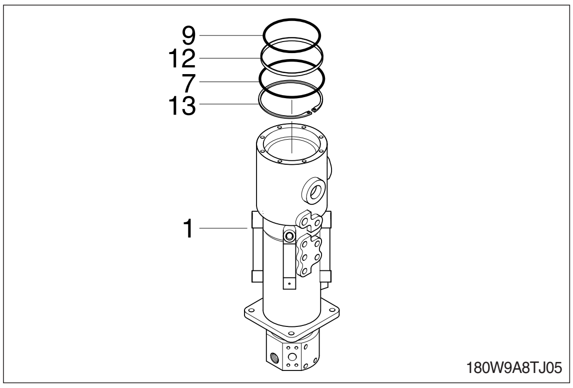
2) DISASSEMBLY

※ Before the disassembly, clean the turning joint.

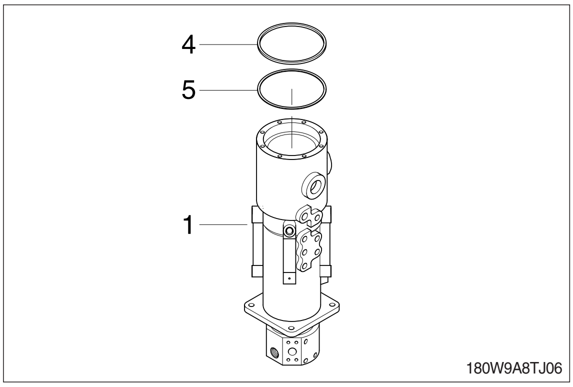
(1) Loosen the socket bolt (18) and remove cover (3).



(2) Remove O-ring (9), wear ring (12), O-ring (7) and retainer ring (13) from hub (1).



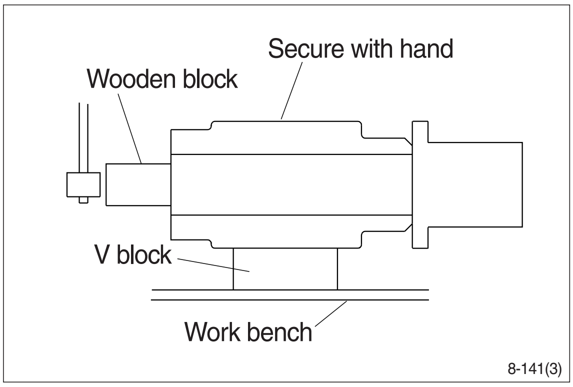
(3) Remove spacer (4) and shim (5) from hub (1).



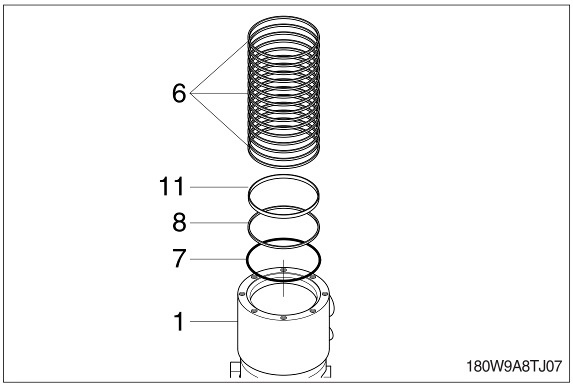
(4) Place hub (1) on a V-block and by using a wood buffer at the shaft end, hit out shaft (2) to about 1/2 from the hub with a hammer.

※ 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).

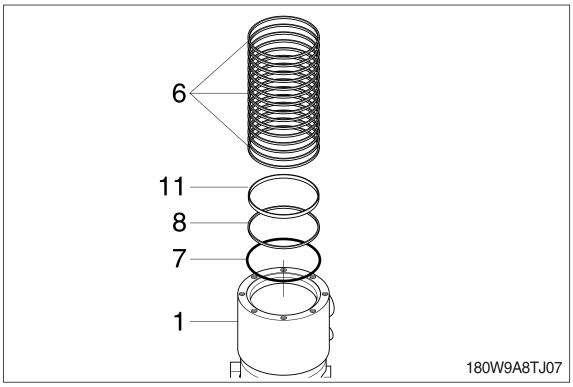


3) ASSEMBLY

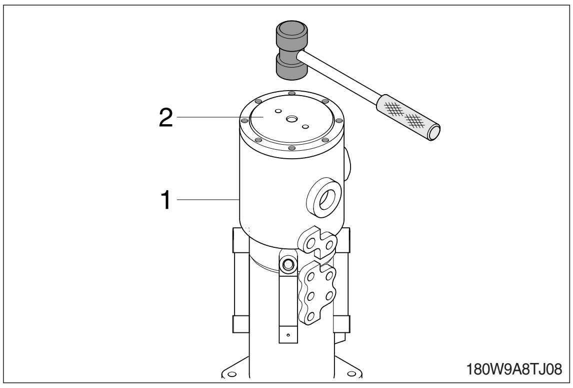
※ Clean all parts.
※ As a general rule, replace oil seals and O-ring.
※ Coat the sliding surfaces of all parts with engine oil or grease before installing.

(1) Fit O-ring (8), seventeen slipper seal (6), and wear ring (11).

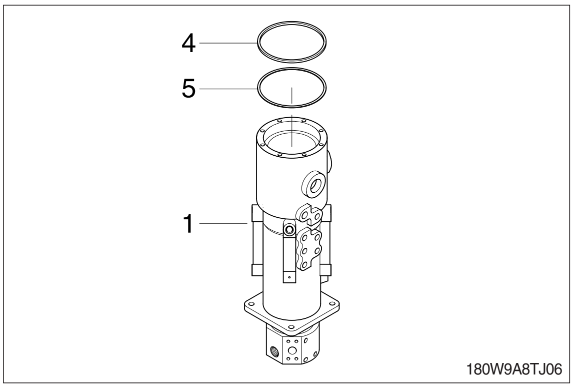
(2) Fit O-ring (7) to shaft (2).



(3) Set shaft (2) on block, tap hub (1) with a plastic hammer to install.

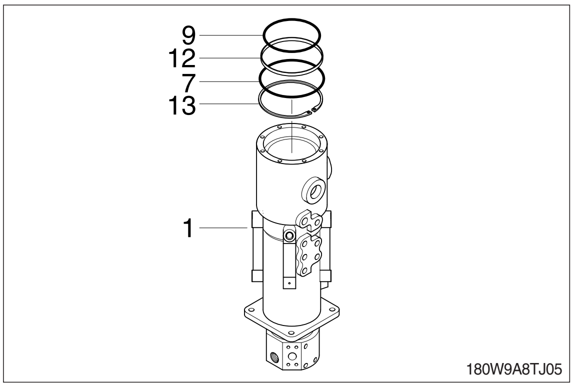


(4) Fit shim (5), and spacer (4) to hub (1) of turning joint upside.



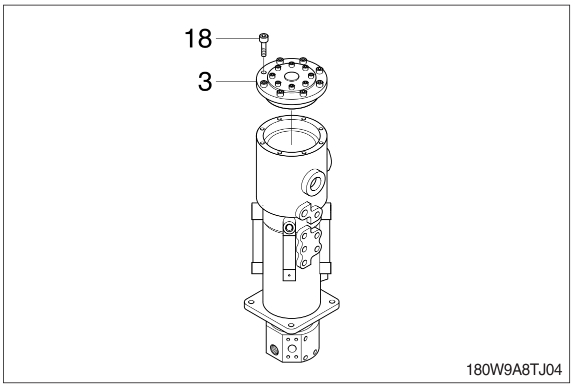
(5) Fit retainer ring (13), O-ring (7) and wear ring (12) to shaft (2).

(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)



GROUP 13 BOOM, ARM, BUCKET, DOZER AND OUTRIGGER CYLINDER

1. REMOVAL AND INSTALL

1) BUCKET CYLINDER

(1) Removal

※ Expand the arm and bucket fully, lower the work equipment to the ground and stop the engine.

※ Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

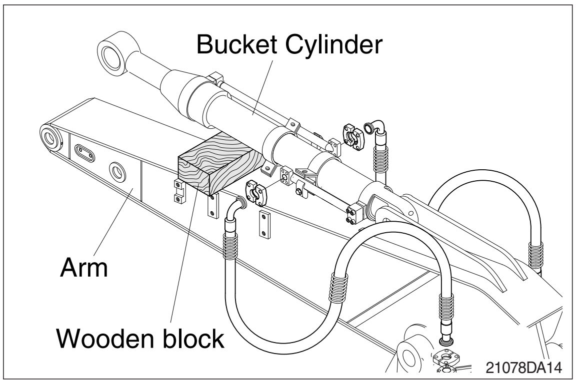
※ Loosen the breather slowly to release the pressure inside the hydraulic tank.

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

※ Fit blind plugs in the hoses after disconnecting them, to prevent dirt or dust from entering.


13031GE18

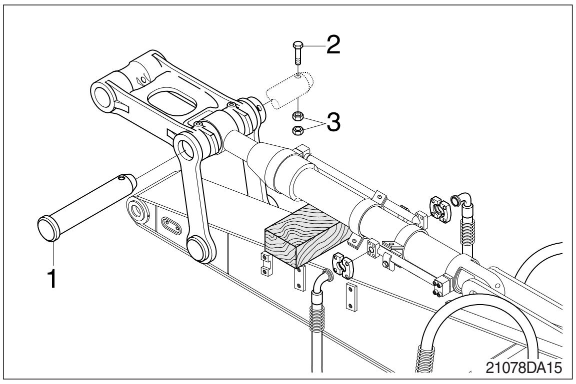
① Set block between bucket cylinder and arm.



21078DA14

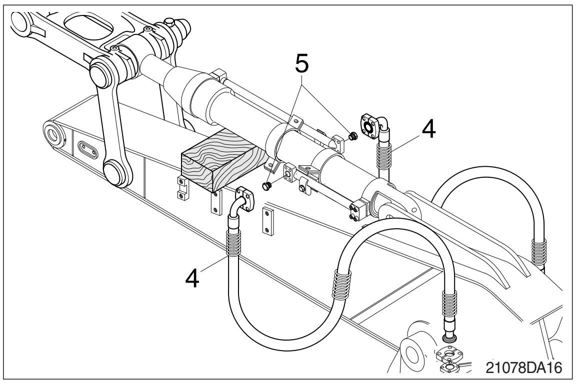
② Remove bolt (2), nut (3) and pull out pin (1).

※ Tie the rod with wire to prevent it from coming out.



21078DA15

③ Disconnect bucket cylinder hoses (4) and put plugs (5) on cylinder pipe.

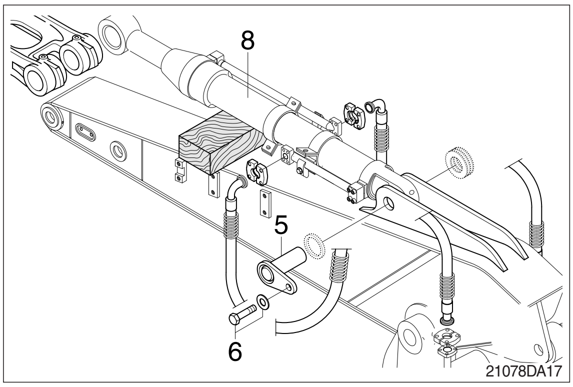


21078DA16

④ Sling bucket cylinder assembly (8) and remove bolt (6) then pull out pin (5).

⑤ Remove bucket cylinder assembly (8).

· Weight : 175 ㎏ (390 ℔)



(2) Install

① Carry out installation in the reverse order to removal.

▲ When aligning the mounting position of the pin, do not insert your fingers in the pin hole.

※ Bleed the air from the bucket cylinder.

※ Confirm the hydraulic oil level and check the hydraulic oil leak or not.

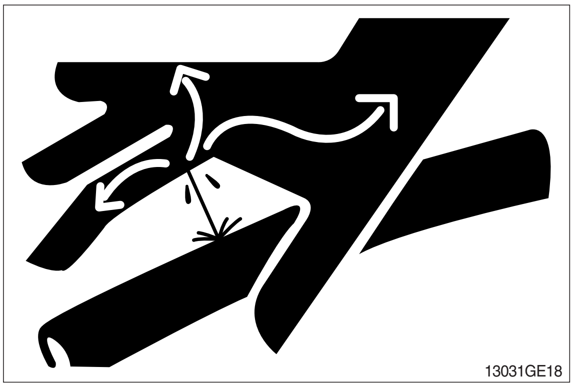
2) ARM CYLINDER

(1) Removal

※ Expand the arm and bucket fully, lower the work equipment to the ground and stop the engine.

※ Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

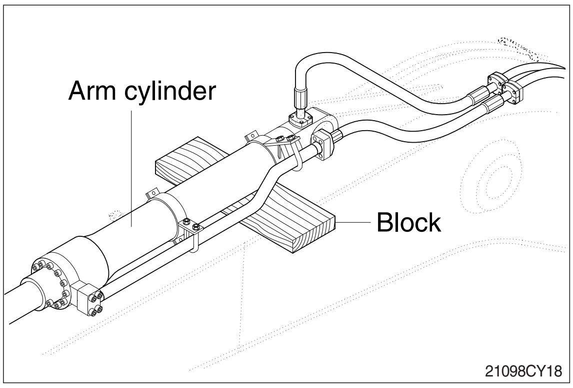
※ Loosen the breather slowly to release the pressure inside the hydraulic tank.



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

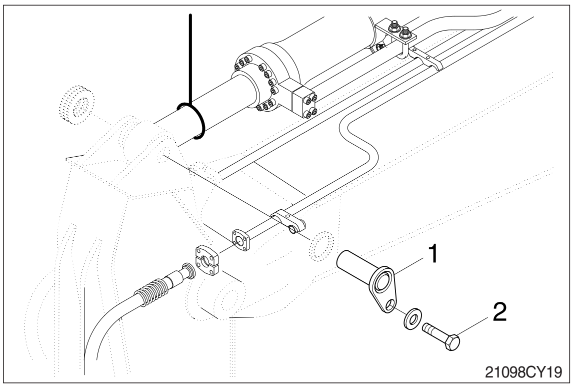
※ Fit blind plugs in the hoses after disconnecting them, to prevent dirt or dust from entering.

① Set block between arm cylinder and boom.



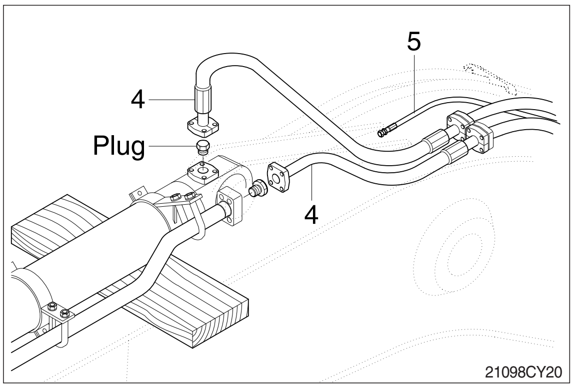
② Remove bolt (2) and pull out pin (1).

※ Tie the rod with wire to prevent it from coming out.



③ Disconnect arm cylinder hoses (4) and put plugs on cylinder pipe.

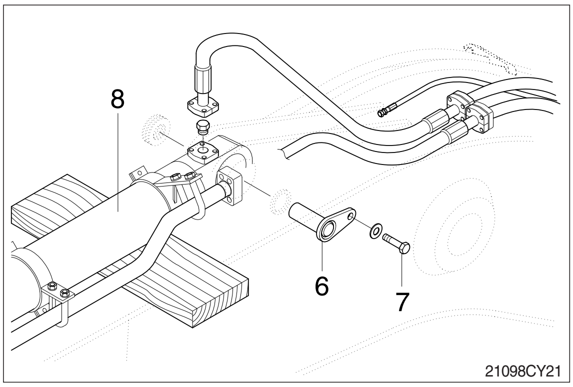
④ Disconnect greasing pipings (5).



⑤ Sling arm cylinder assembly(8) and remove bolt (7) then pull out pin (6).

⑥ Remove arm cylinder assembly (8).

  · Weight : 290 ㎏ (640 ℔)



(2) Install

① Carry out installation in the reverse order to removal.

⚠ **When aligning the mounting position of the pin, do not insert your fingers in the pin hole.**

※ Bleed the air from the arm cylinder.

※ Confirm the hydraulic oil level and check the hydraulic oil leak or not.

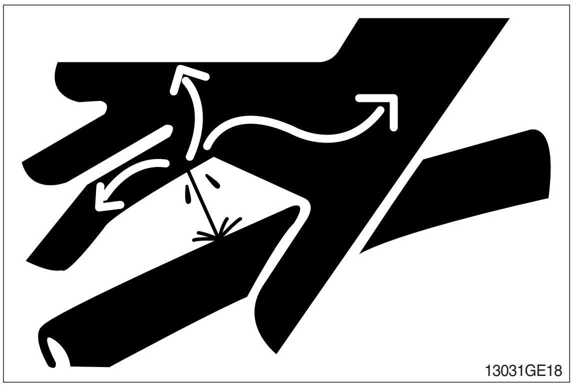
3) BOOM CYLINDER

(1) Removal

※ Expand the arm and bucket fully, lower the work equipment to the ground and stop the engine.

※ Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

※ Loosen the breather slowly to release the pressure inside the hydraulic tank.



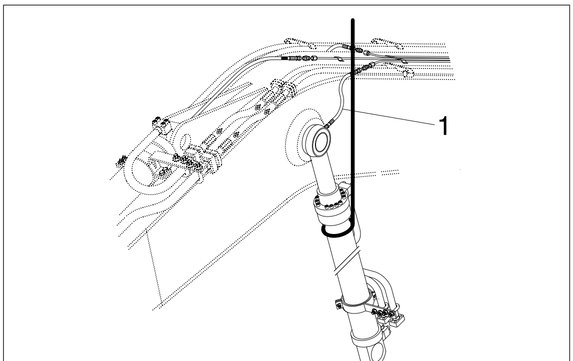
13031GE18

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

※ Fit blind plugs in the hoses after disconnecting them, to prevent dirt or dust from entering.

① Disconnect greasing hoses (1).

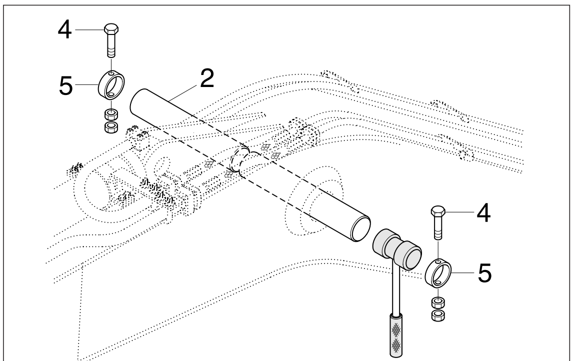
② Sling boom cylinder assembly.



21078DA22

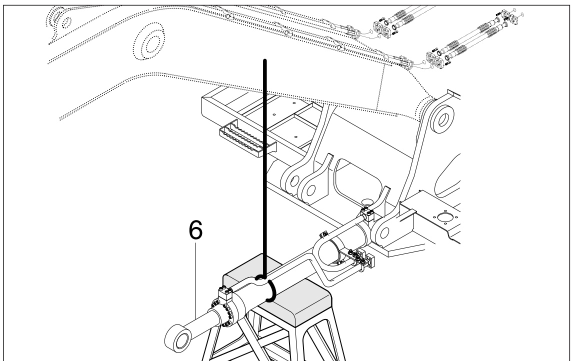
③ Remove bolt (4), stopper (5) and pull out pin (2).

※ Tie the rod with wire to prevent it from coming out.



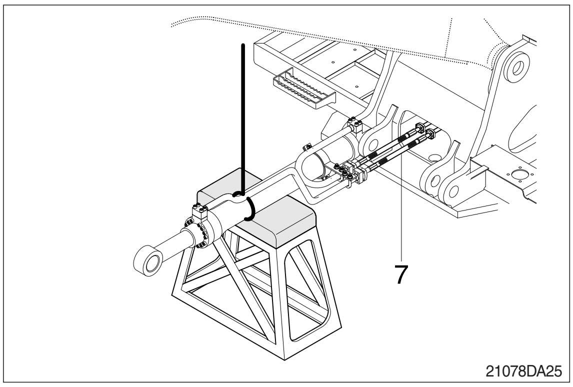
2107A8DA23

④ Lower the boom cylinder assembly (6) on a stand.



21078DA24

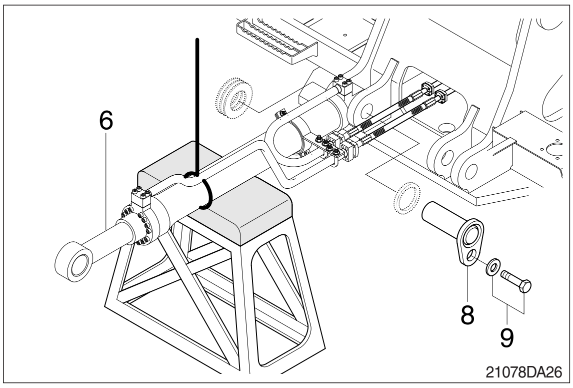
⑤ Disconnect boom cylinder hoses (7) and put plugs on cylinder pipe.



⑥ Remove bolt (9) and pull out pin (8).

⑦ Remove boom cylinder assembly (6).

· Weight : 180 ㎏ (400 ℔)



(2) Install

① Carry out installation in the reverse order to removal.

⚠ **When aligning the mounting position of the pin, do not insert your fingers in the pin hole.**

※ Bleed the air from the boom cylinder.

※ Conformed the hydraulic oil level and check the hydraulic oil leak or not.

4) 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.

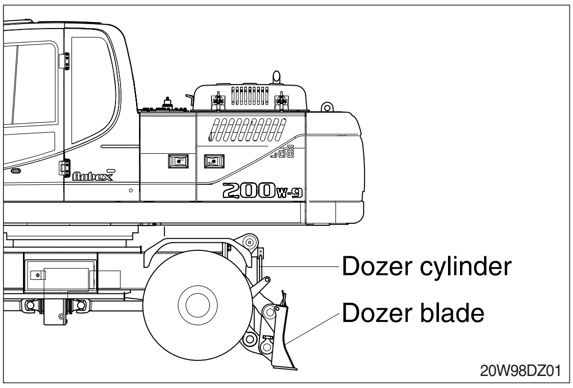
※ Loosen the breather slowly to release the pressure inside the hydraulic tank.

⚠ 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.

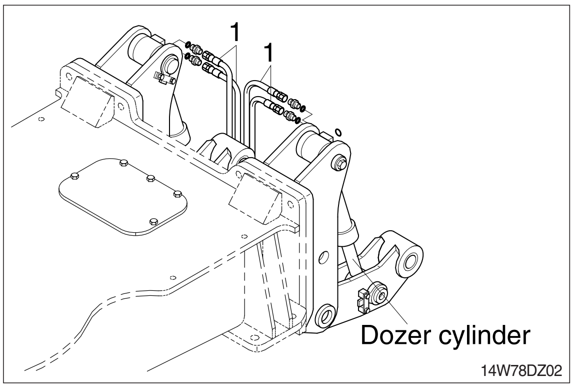
13031GE18

① Lower the dozer blade to the ground.



20W98DZ01

② Disconnect dozer cylinder hoses (1), and put plugs on cylinder pipe.

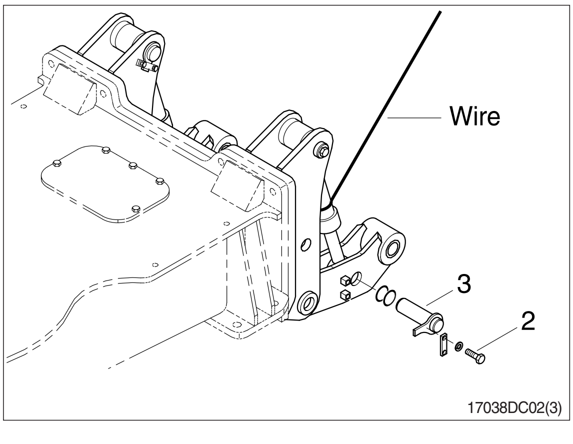


14W78DZ02

③ Sling dozer cylinder assembly.

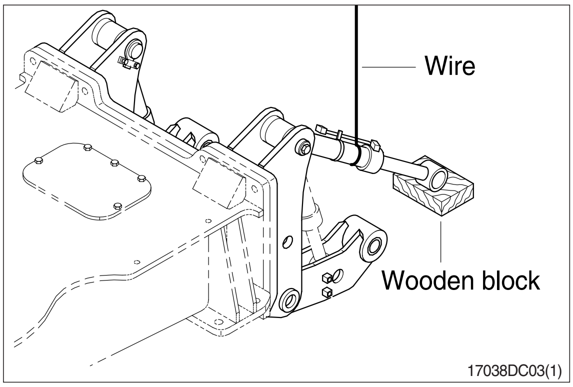
④ Remove bolt (2) and pull out pin (3).

※ Tie the rod with wire to prevent it from coming out.



17038DC02(3)

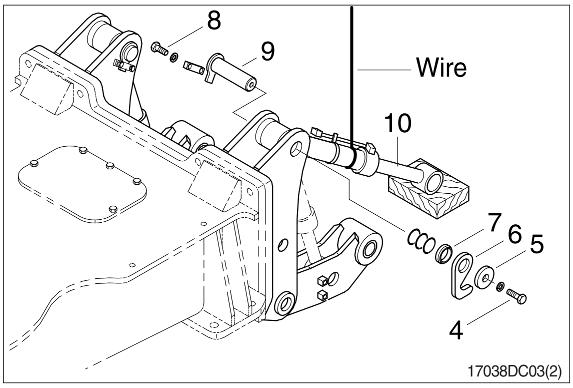
⑤ Lower the dozer cylinder rod side on a wooden block.



⑥ Loosen the bolt (4) and remove lock washer (5), hook plate (6), and spacer (7).

⑦ Remove bolt (8) and pull out pin (9).

⑧ Remove the dozer cylinder assy (10).
  · Weight : 82 ㎏ (180 ㏓)



(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.**

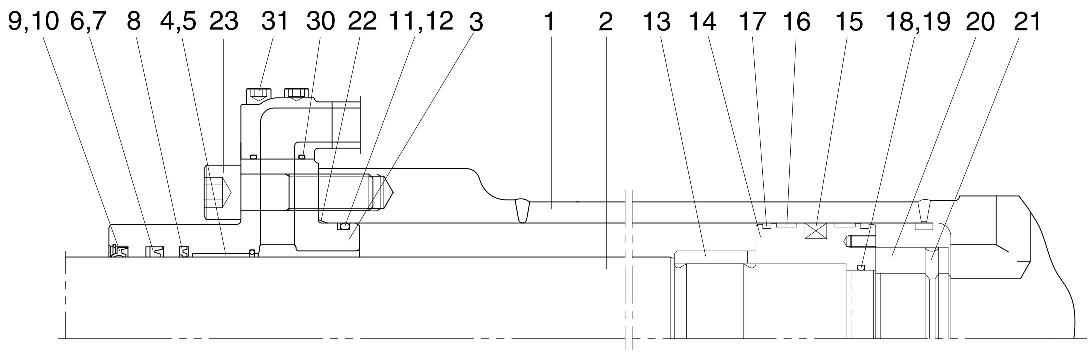
※ Bleed the air from the dozer cylinder.

※ Confirm the hydraulic oil level and check the hydraulic oil leak or not.

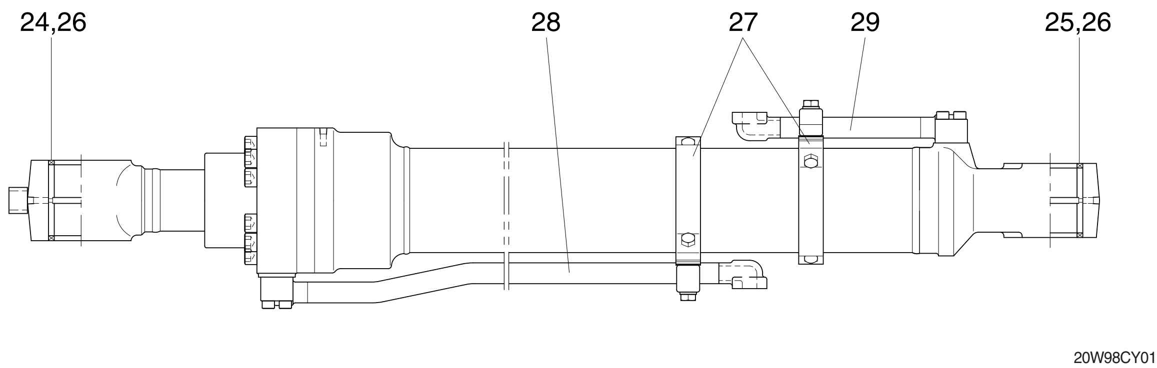
2. DISASSEMBLY AND ASSEMBLY

1) STRUCTURE

(1) Bucket cylinder

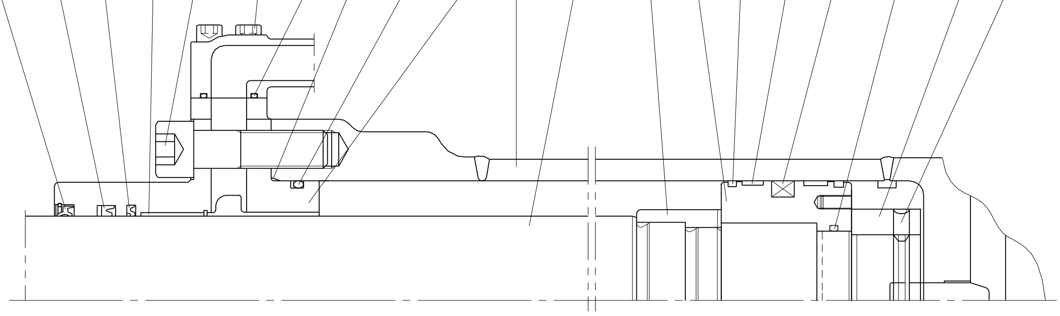


Internal detail

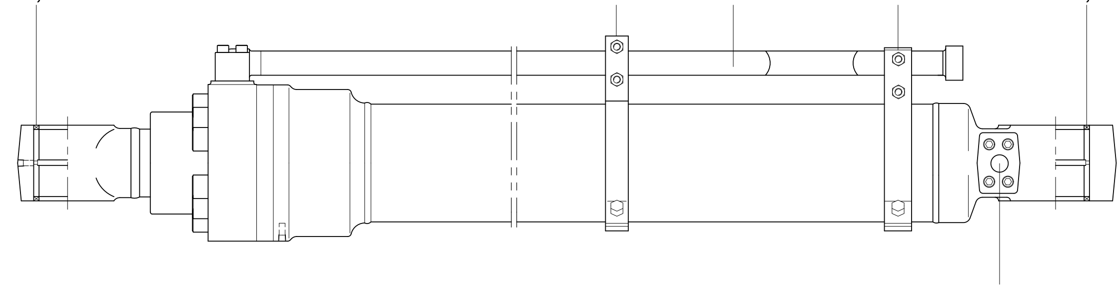


1	Tube assembly	12	Back up ring	23	Hexagon socket bolt
2	Rod assembly	13	Cushion ring	24	Pin bushing
3	Gland	14	Piston	25	Dust seal
4	DU bushing	15	Piston seal	26	Dust seal
5	Snap ring	16	Wear ring	27	Band assembly
6	Rod seal	17	Dust ring	28	Pipe assembly-R
7	Back up ring	18	O-ring	29	Pipe assembly-B
8	Buffer ring	19	Back up ring	30	O-ring
9	Dust wiper	20	Lock nut	31	Hexagon socket bolt
10	Snap ring	21	Hexagon socket set screw		
11	O-ring	22	O-ring		

(2) Arm cylinder

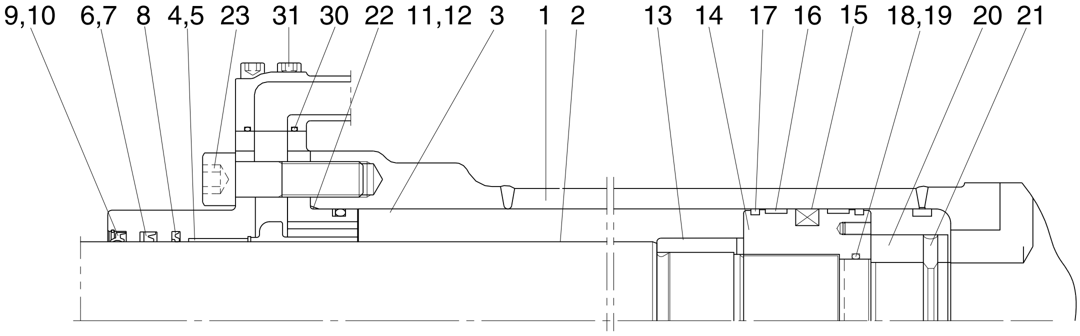


Internal detail

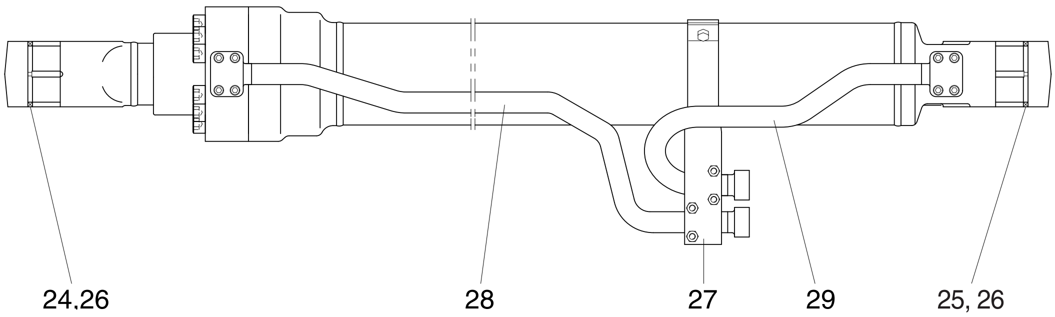


1	Tube assembly	13	Cushion ring	25	Dust seal
2	Rod assembly	14	Piston	26	Check valve
3	Gland	15	Piston seal	27	Coil spring
4	DU bushing	16	Wear ring	28	O-ring
5	Snap ring	17	Dust ring	29	Plug
6	Rod seal	18	O-ring	30	Band assembly-R
7	Back up ring	19	Back up ring	31	Band assembly-B
8	Buffer ring	20	Lock nut	32	Pipe assembly-R
9	Dust wiper	21	Hexagon socket set screw	33	O-ring
10	Snap ring	22	O-ring	34	Hexagon socket bolt
11	O-ring	23	Hexagon socket bolt		
12	Back up ring	24	Pin bushing		

(3) Boom cylinder

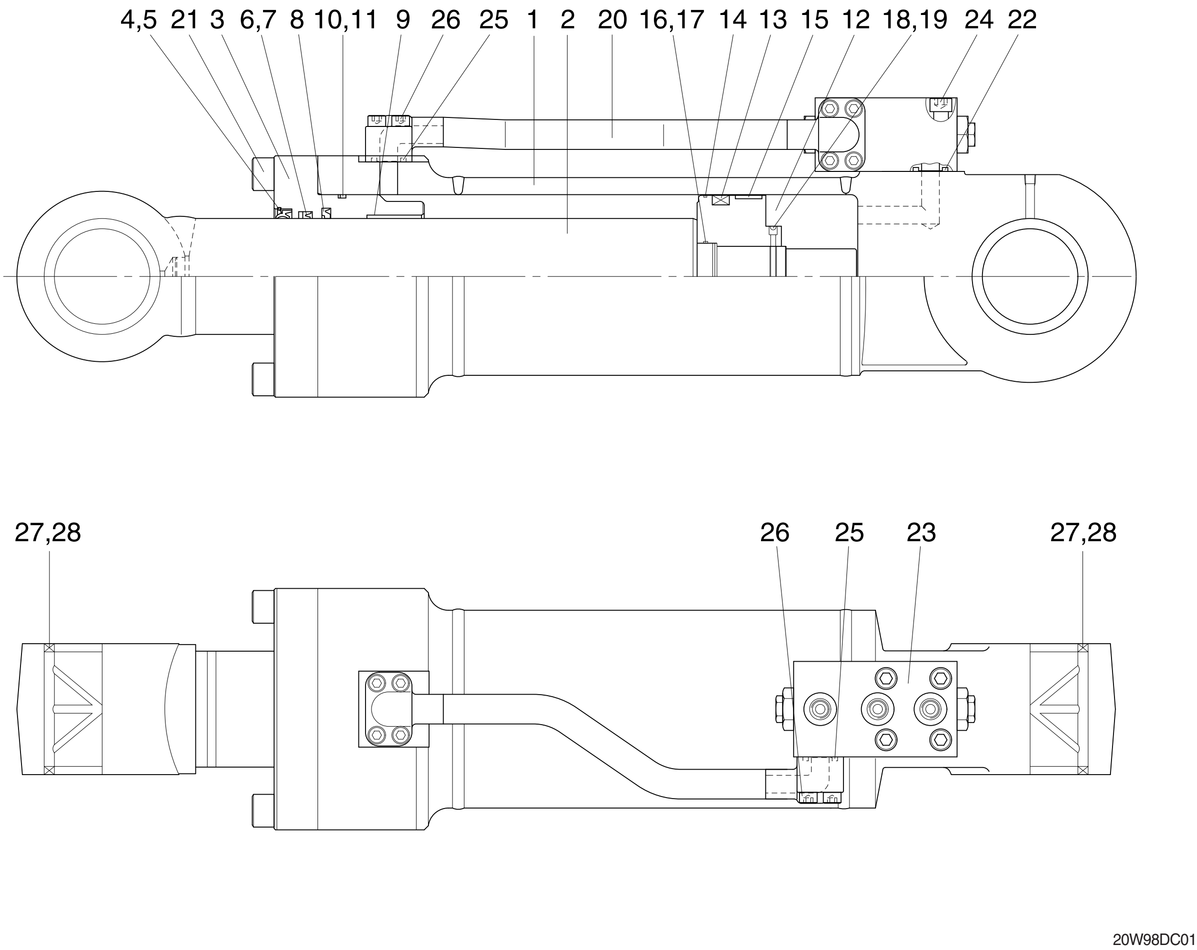


Internal detail



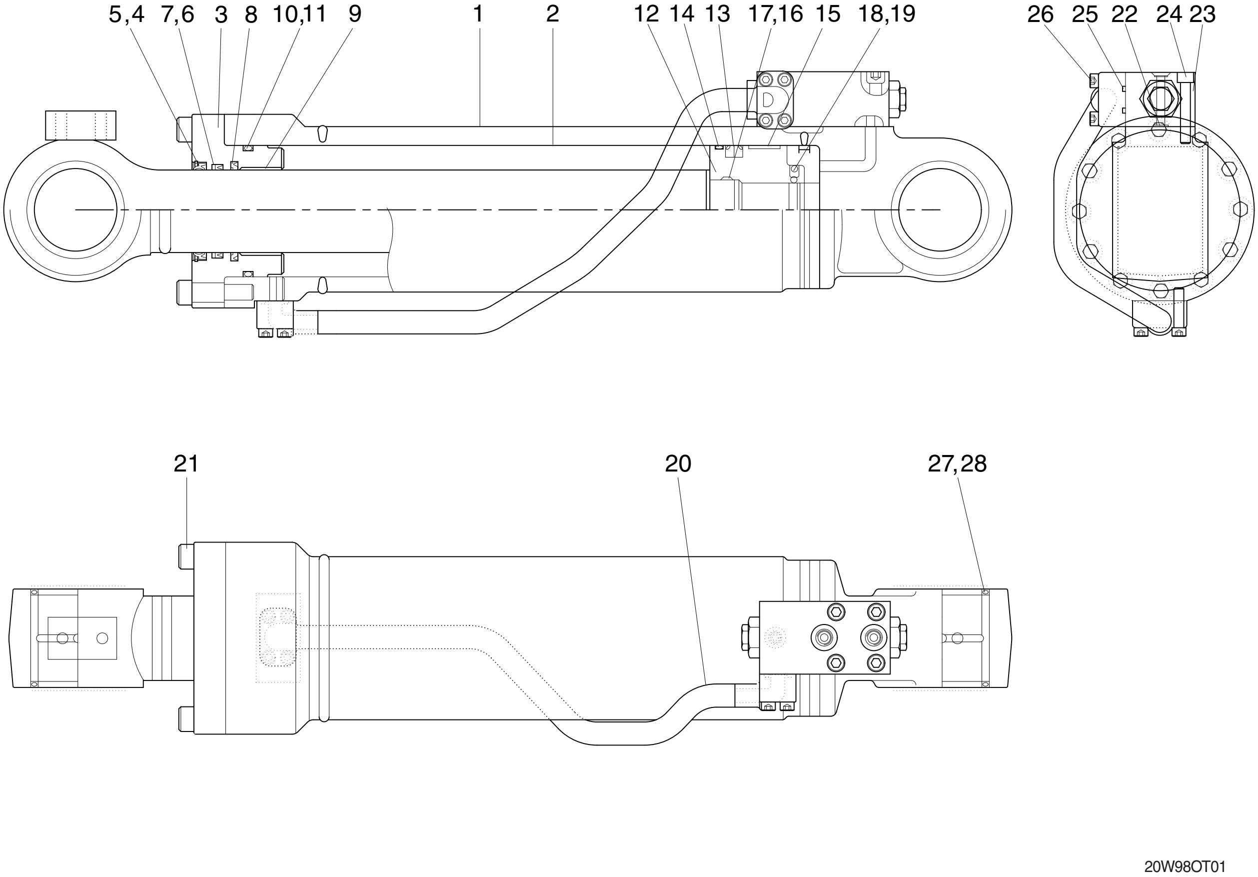
1	Tube assembly	12	Back up ring	23	Hexagon socket bolt
2	Rod assembly	13	Cushion ring	24	Pin bushing
3	Gland	14	Piston	25	Pin bushing
4	DD2 bushing	15	Piston seal	26	Dust seal
5	Snap ring	16	Wear ring	27	Band assembly
6	Rod seal	17	Dust ring	28	Pipe assembly
7	Back up ring	18	O-ring	29	Pipe assembly
8	Buffer ring	19	Back up ring	30	O-ring
9	Dust wiper	20	Lock nut	31	Hexagon socket bolt
10	Snap ring	21	Hexagon socket set screw		
11	O-ring	22	O-ring		

(4) Dozer cylinder



1	Tube assembly	11	Back up ring	21	Hexagon socket bolt
2	Rod assembly	12	Piston	22	O-ring
3	Gland	13	Piston seal	23	Pilot check valve
4	Dust wiper	14	Dust ring	24	Hexagon socket bolt
5	Retainer ring	15	Wear ring	25	O-ring
6	Rod seal	16	O-ring	26	Hexagon socket bolt
7	Back up ring	17	Back up ring	27	Pin bushing
8	Buffer ring	18	Steel ball	28	Dust seal
9	Du bushing	19	Set screw		
10	O-ring	20	Pipe assembly		

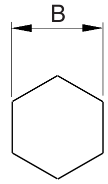
(5) Outrigger cylinder



1	Tube assembly	11	Back up ring	21	Hexagon socket bolt
2	Rod assembly	12	Piston	22	O-ring
3	Gland	13	Piston seal	23	Pilot check valve
4	Dust wiper	14	Dust ring	24	Hexagon socket bolt
5	Retainer ring	15	Wear ring	25	O-ring
6	Rod seal	16	O-ring	26	Hexagon socket bolt
7	Back up ring	17	Back up ring	27	Pin bushing
8	Buffer ring	18	Steel ball	28	Dust seal
9	Du bushing	19	Set screw		
10	O-ring	20	Pipe assembly		

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	23	M16	23±2.0	166±14.5
	Boom cylinder		M16	23±2.0	166±14.5
	Arm cylinder		M18	32±3.0	232±21.7
	Dozer cylinder	21	M16	23±2.0	166±14.5
	Outrigger cylinder				
	Bucket cylinder	31	M10	5.4±0.5	39.1±3.6
	Boom cylinder				
	Arm cylinder	34	M12	9.4±1.0	68.0±7.2
	Dozer cylinder	26	M8	2.7±0.3	19.5±2.2
	Outrigger cylinder				
	Dozer cylinder	24	M10	5.4±0.5	39.1±3.6
	Outrigger cylinder				
Lock nut	Bucket cylinder	20	-	100±10.0	723±72.3
	Boom cylinder		-		
	Arm cylinder		-	150±15.0	1085±109
Piston	Bucket cylinder	14	-	150±15.0	1085±109
	Boom cylinder		-		
	Arm cylinder		-	200±20.0	1447±145
	Dozer cylinder	12	-	140±14.0	1012±101
	Outrigger cylinder		-		

3) DISASSEMBLY

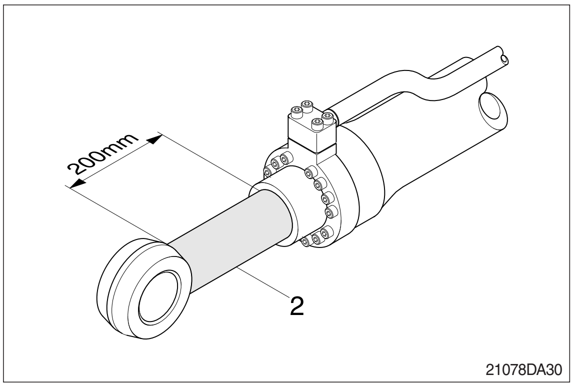
(1) Remove cylinder head and piston rod

※ Procedures are based on the bucket cylinder.

① Hold the clevis section of the tube in a vise.

※ Use mouth pieces so as not to damage the machined surface of the cylinder tube. Do not make use of the outside piping as a locking means.

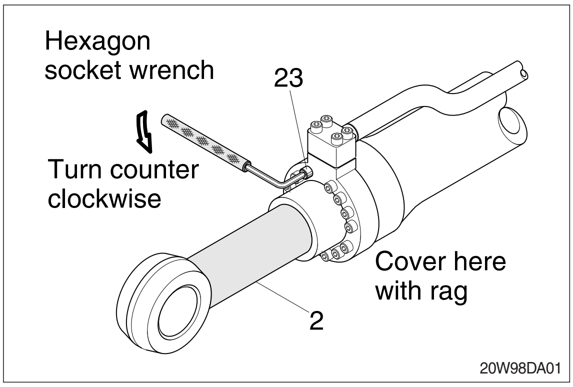
② Pull out rod assembly (2) about 200mm (7.1in). Because the rod assembly is rather heavy, finish extending it with air pressure after the oil draining operation.



21078DA30

③ Loosen and remove socket bolts (23) of the gland in sequence.

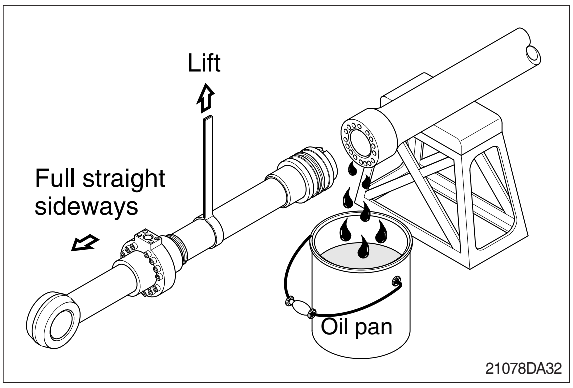
※ Cover the extracted rod assembly (2) with rag to prevent it from being accidentally damaged during operation.



20W98DA01

④ Draw out cylinder head and rod assembly together from tube assembly (1).

※ Since the rod assembly is heavy in this case, lift the tip of the rod assembly (2) with a crane or some means and draw it out. However, when rod assembly (2) has been drawn out to approximately two thirds of its length, lift it in its center to draw it completely.

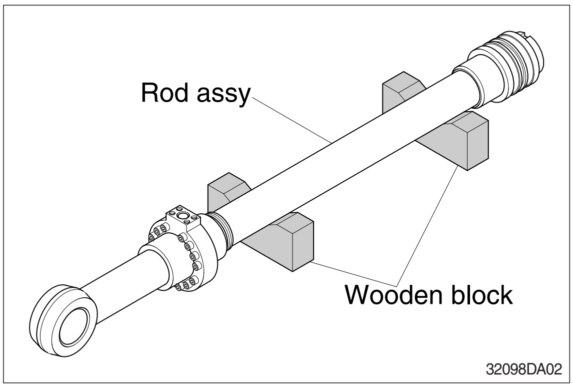


21078DA32

Note that the plated surface of rod assembly (2) is to be lifted. For this reason, do not use a wire sling and others that may damage it, but use a strong cloth belt or a rope.

⑤ Place the removed rod assembly on a wooden V-block that is set level.

※ Cover a V-block with soft rag.

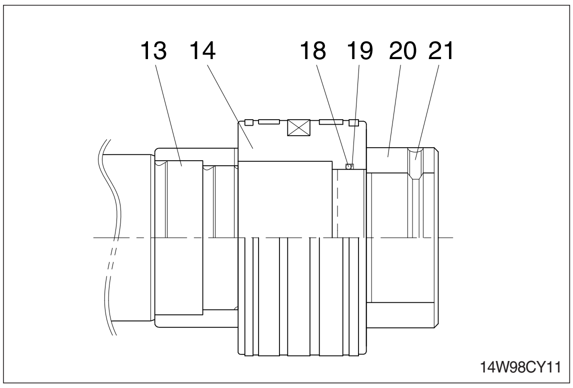


(2) Remove piston and cylinder head

① Loosen and remove socket set screw (21).

※ Since set screw (21) and lock nut (20) is tightened to a high torque, use a hydraulic and power wrench that utilizers a hydraulic cylinder, to remove the lock set screw (21) and lock nut (20).

② Remove piston assembly (14), back up ring (19), and O-ring (18).

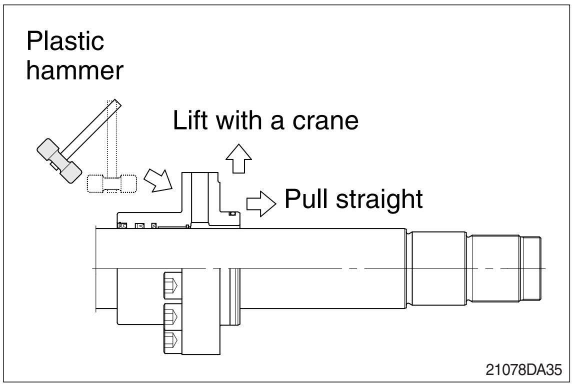


③ Remove the cylinder head assembly from rod assembly (2).

※ If it is too heavy to move, move it by striking the flanged part of cylinder head with a plastic hammer.

※ Pull it straight with cylinder head assembly lifted with a crane.

Exercise care so as not to damage the lip of rod bushing (4) and packing (5,6,7,8,9,10) by the threads of rod assembly (2).

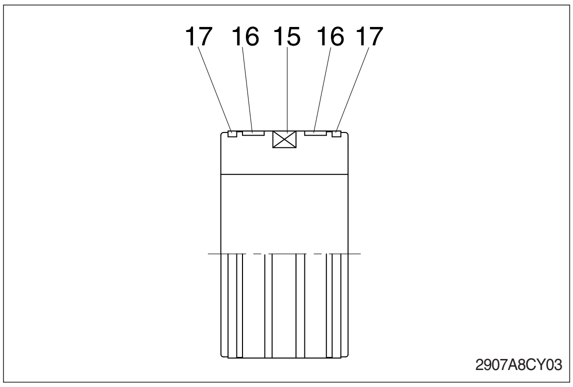


(3) Disassemble the piston assembly

① Remove wear ring (16).

② Remove dust ring (17) and piston seal (15).

※ Exercise care in this operation not to damage the grooves.



(4) Disassemble cylinder head assembly

① Remove back up ring (12) and O-ring (11).

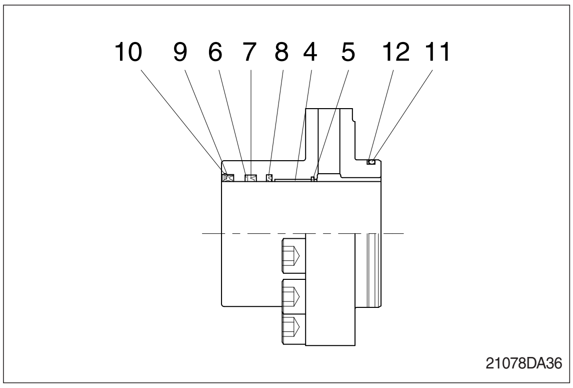
② Remove snap ring (10), dust wiper (9).

③ Remove back up ring (7), rod seal (6), buffer ring (8) and snap ring (5).

※ Exercise care in this operation not to damage the grooves.

※ Do not remove seal and ring, if does not damaged.

※ Do not remove bushing (4).

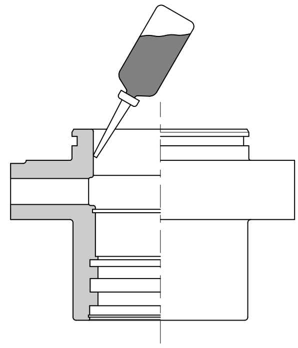


3) ASSEMBLY

(1) Assemble cylinder head assembly

※ Check for scratches or rough surfaces if found smooth with an oil stone.

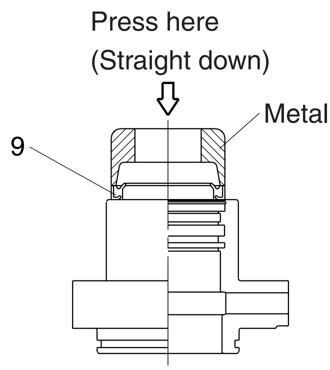
① Coat the inner face of gland (3) with hydraulic oil.



21078DA37

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.

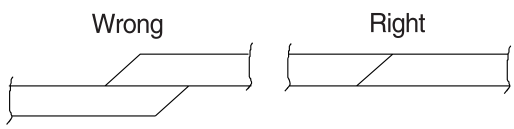


8-157(2)

④ Fit back up ring (7), rod seal (6) and buffer ring (8) to corresponding grooves, in that order.

※ Coat each packing with hydraulic oil before fitting it.

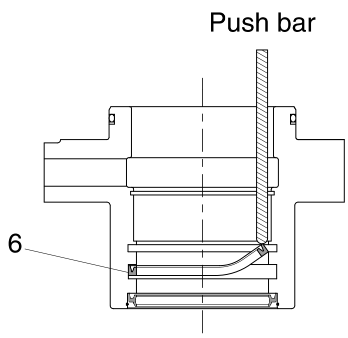
※ Insert the backup ring until one side of it is inserted into groove.



8-157(3)

※ Rod seal (6) has its own fitting direction. Therefore, confirm it before fitting them.

※ Fitting rod seal (6) upside down may damage its lip. Therefore check the correct direction that is shown in fig.

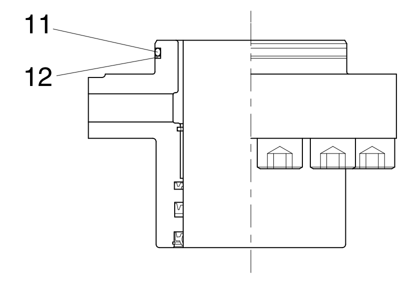


21078DA38

⑤ Fit back up ring (12) to gland (3).

※ Put the backup ring in the warm water of 30~50˚C.

⑥ Fit O-ring (11) to gland (3).

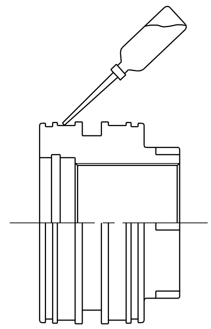


21078DA39

(2) Assemble piston assembly

※ Check for scratches or rough surfaces. If found smooth with an oil stone.

① Coat the outer face of piston (14) with hydraulic oil.

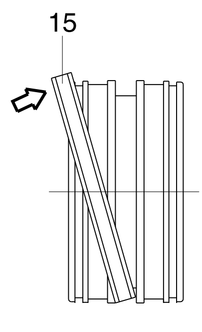


8-158(2)

② Fit piston seal (15) to piston.

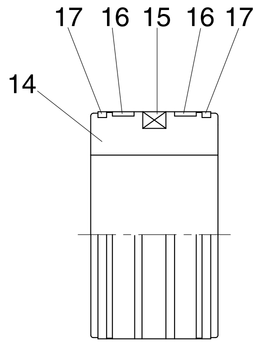
※ Put the piston seal in the warm water of 60~100˚C for more than 5 minutes.

※ After assembling the piston seal, press its outer diameter to fit in.



2907A8CY04

③ Fit wear ring (16) and dust ring (17) to piston (14).



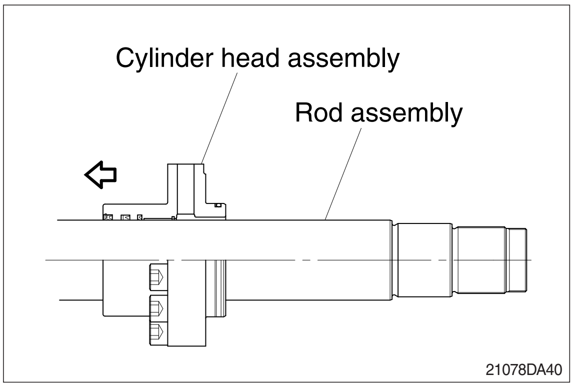
2907A8CY05

(3) Install piston and cylinder head

① Fix the rod assembly to the work bench.

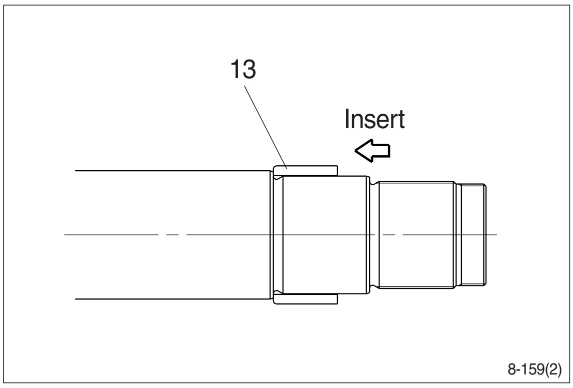
② Apply hydraulic oil to the outer surface of rod assembly (2), the inner surface of piston and cylinder head.

③ Insert cylinder head assembly to rod assembly.



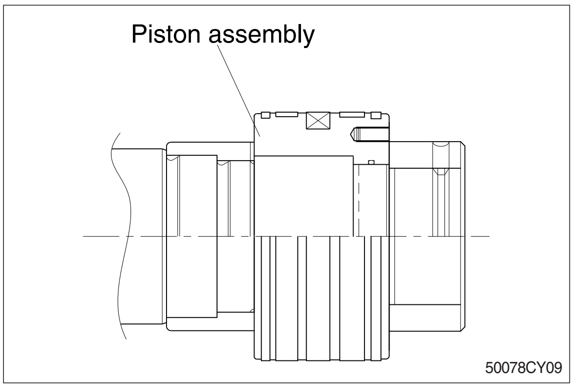
④ Insert cushion ring (13) to rod assembly.

※ Note that cushion ring (13) has a direction in which it should be fitted.



⑤ Fit piston assembly to rod assembly.

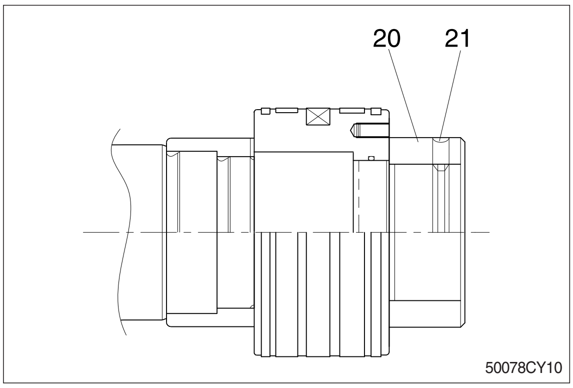
· Tightening torque : 100±10.0 kgf · m (723±72.3 lbf · ft)



⑥ Fit lock nut (20) and tighten the set screw (21).

· Tightening torque :

Item		kgf · m	lbf · ft
Bucket Boom	20	100±10	723±72.3
	21	2.7±0.3	19.6±2.2
Arm	20	150±15	1085±109
	21	5.4±0.5	39.1±3.6



(3) Overall assemble

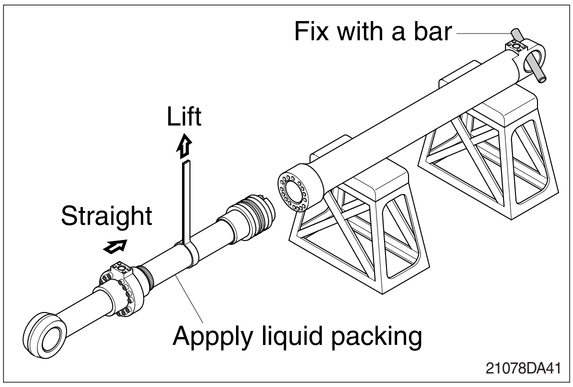
① Place a V-block on a rigid work bench. Mount the tube assembly (1) on it and fix the assembly by passing a bar through the clevis pin hole to lock the assembly.

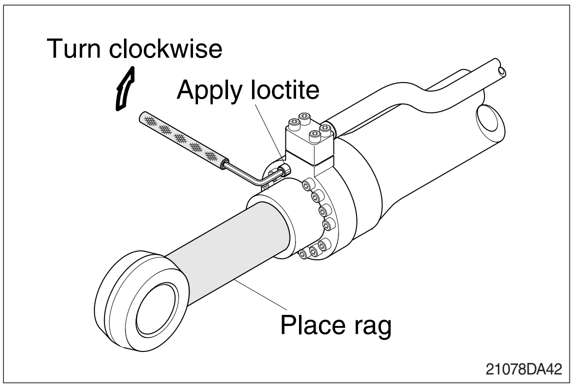
② Insert the rod assembly in to the tube assembly, while lifting and moving the rod assembly with a crane.

※ Be careful not to damage piston seal by thread of tube assembly.

③ Match the bolt holes in the cylinder head flange to the tapped holes in the tube assembly and tighten socket bolts to a specified torque.

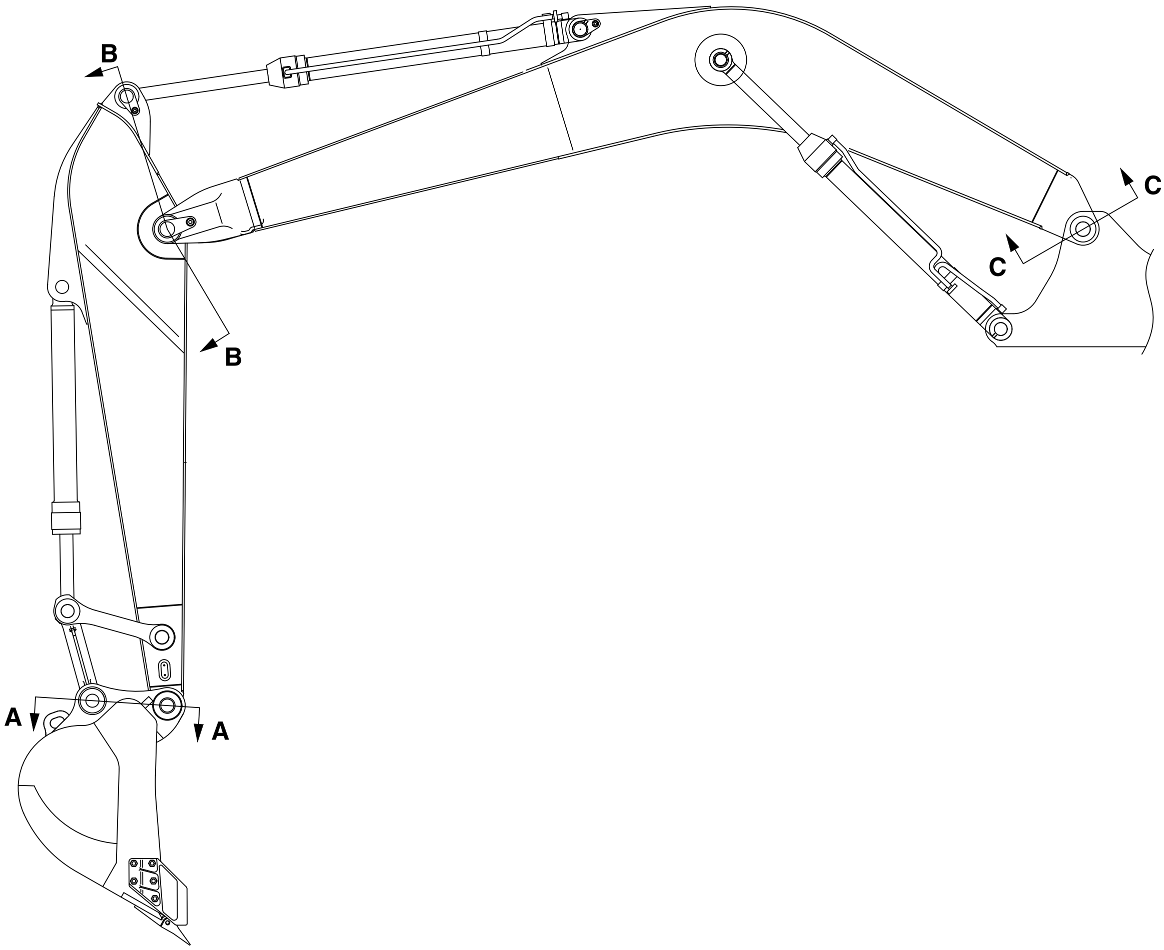
※ Refer to the table of tightening torque.

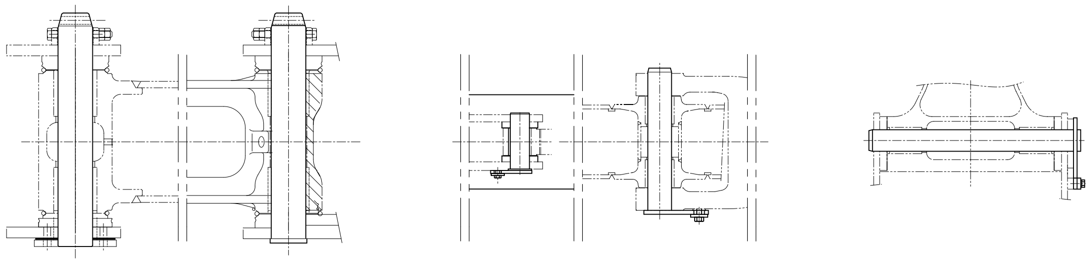




GROUP 14 WORK EQUIPMENT

1. STRUCTURE





SECTION A SECTION B SECTION C

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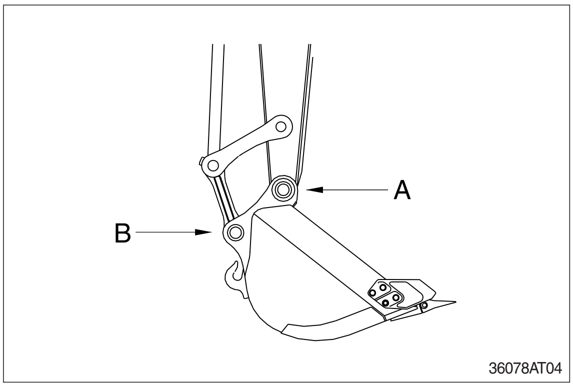
2. REMOVAL AND INSTALL

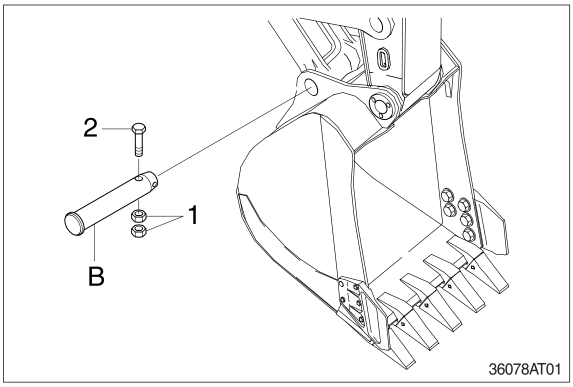
1) BUCKET ASSEMBLY

(1) Removal

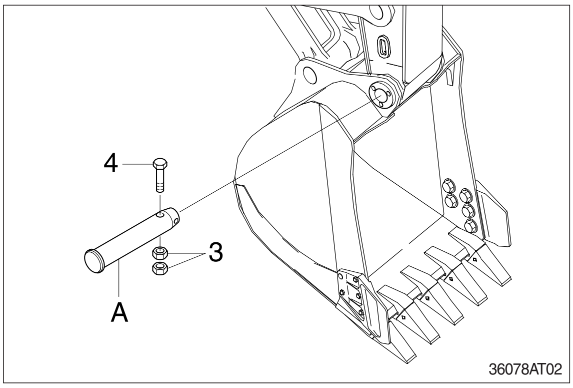
① Lower the work equipment completely to ground with back of bucket facing down.



② Remove nut (1), bolt (2) and draw out the pin (B).



③ Remove nut (3), bolt (4) and draw out the pin (A) then remove the bucket assembly.
  · Weight : 690 ㎏ (1520 ㏈)

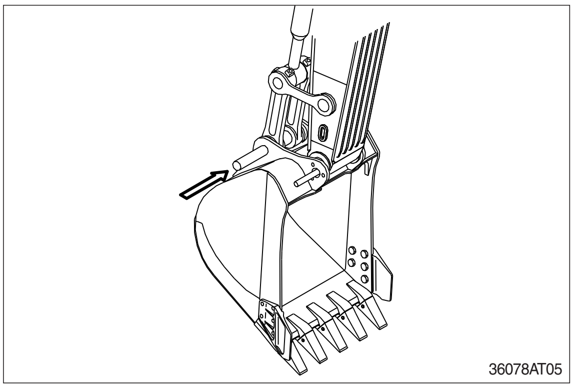


(2) Install

① Carry out installation in the reverse order to removal.

⚠ **When aligning the mounting position of the pin, do not insert your fingers in the pin hole.**

※ Adjust the bucket clearance.
For detail, see **operation manual.**



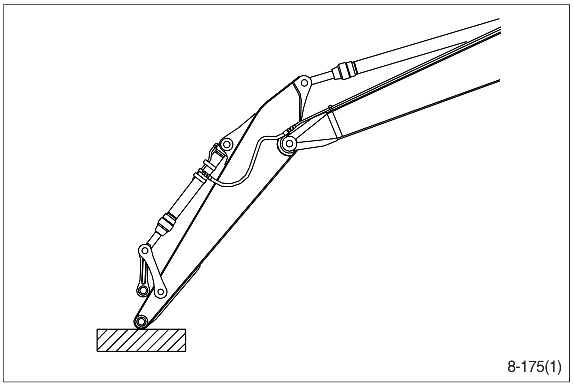
2) ARM ASSEMBLY

(1) Removal

※ Loosen the breather slowly to release the pressure inside the hydraulic tank.

⚠ **Escaping fluid under pressure can penetrated the skin causing serious injury.**

① Remove bucket assembly.
For details, see removal of bucket assembly.



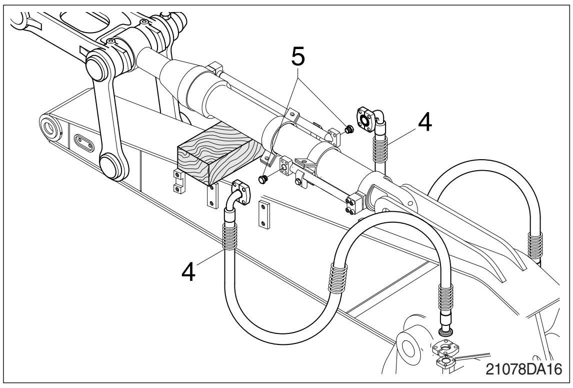
② Disconnect bucket cylinder hose (1).

⚠ **Fit blind plugs (5) in the piping at the chassis end securely to prevent oil from spurting out when the engine is started.**

③ Sling arm cylinder assembly, remove spring, pin stopper and pull out pin.

※ Tie the rod with wire to prevent it from coming out.

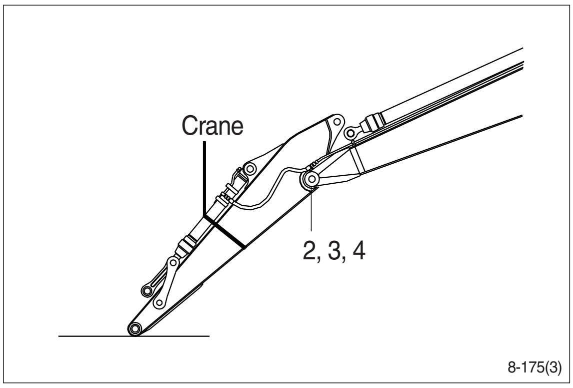
④ For details, see removal of arm cylinder assembly.
Place a wooden block under the cylinder and bring the cylinder down to it.



⑤ Remove bolt (2), plate (3) and pull out the pin (4) then remove the arm assembly.

· Weight : 1040 kg (2290 lb)

※ When lifting the arm assembly, always lift the center of gravity.



(2) Install

① Carry out installation in the reverse order to removal.

⚠ **When lifting the arm assembly, always lift the center of gravity.**

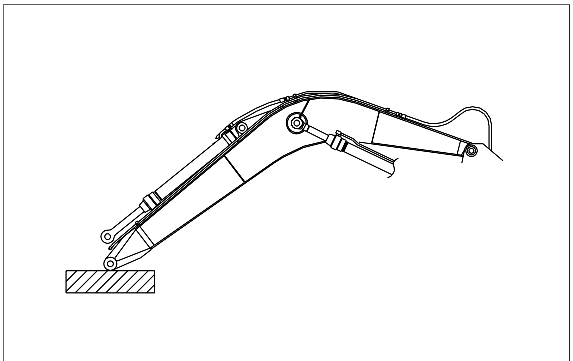
※ Bleed the air from the cylinder.

3) BOOM ASSEMBLY

(1) Removal

① Remove arm and bucket assembly.
For details, see **removal of arm and bucket assembly.**

② Remove boom cylinder assembly from boom.
For details, see **removal of arm cylinder assembly.**



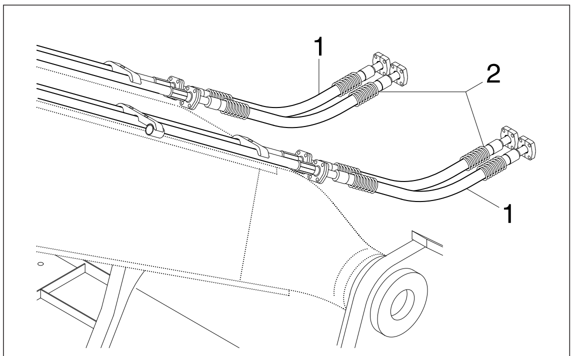
8-176(1)

③ Disconnect head lamp wiring.

④ Disconnect bucket cylinder hose (2) and arm cylinder hose (1).

※ When the hose are disconnected, oil may spurt out.

⑤ Sling boom assembly (3).



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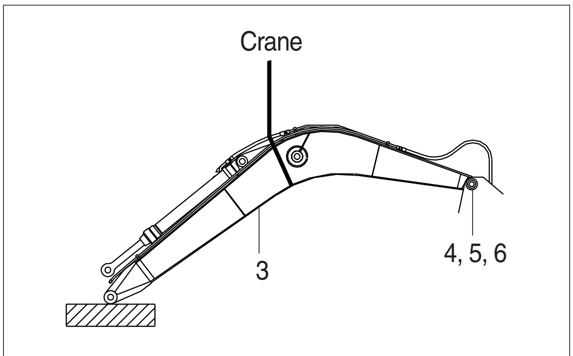
⑥ Remove bolt (4), plate (5) and pull out the pin (6) then remove boom assembly.
· Weight :760 ㎏ (1675 ℔)

※ When lifting the boom assembly always lift the center of gravity.



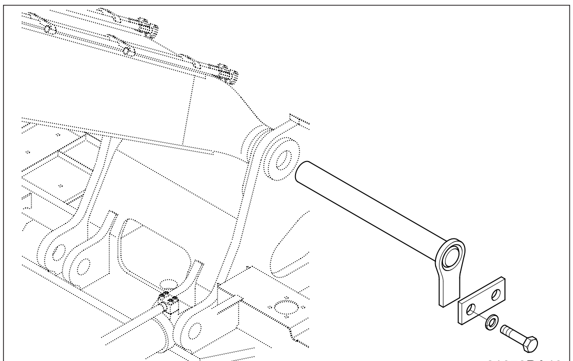
8-176(3)

(2) Install

① Carry out installation in the reverse order to removal.

⚠ **When lifting the arm assembly, always lift the center of gravity.**

※ Bleed the air from the cylinder.



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SECTION 9 COMPONENT MOUNTING TORQUE

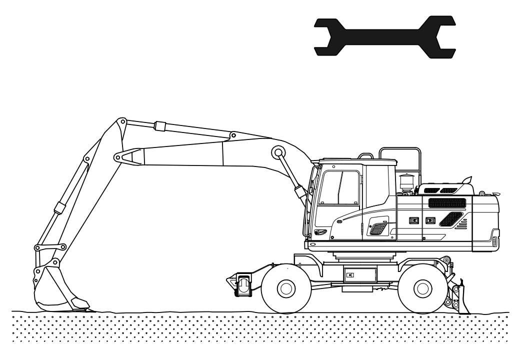
SECTION 9 COMPONENT MOUNTING TORQUE

GROUP 1 INTRODUCTION GUIDE

1. This section shows bolt specifications and standard torque values needed when mounting components to the machine.
2. Use genuine HD Hyundai Construction Equipment spare parts.
   We expressly point out that HD Hyundai Construction Equipment will not accept any responsibility for defects resulted from non-genuine parts.
   In such cases HD Hyundai Construction Equipment cannot assume liability for any damage.

※ Only metric fasteners can be used and incorrect fasteners may result in machine damage or malfunction.

※ Before installation, clean all the components with a non-corrosive cleaner. Bolts and threads must not be worn or damaged.



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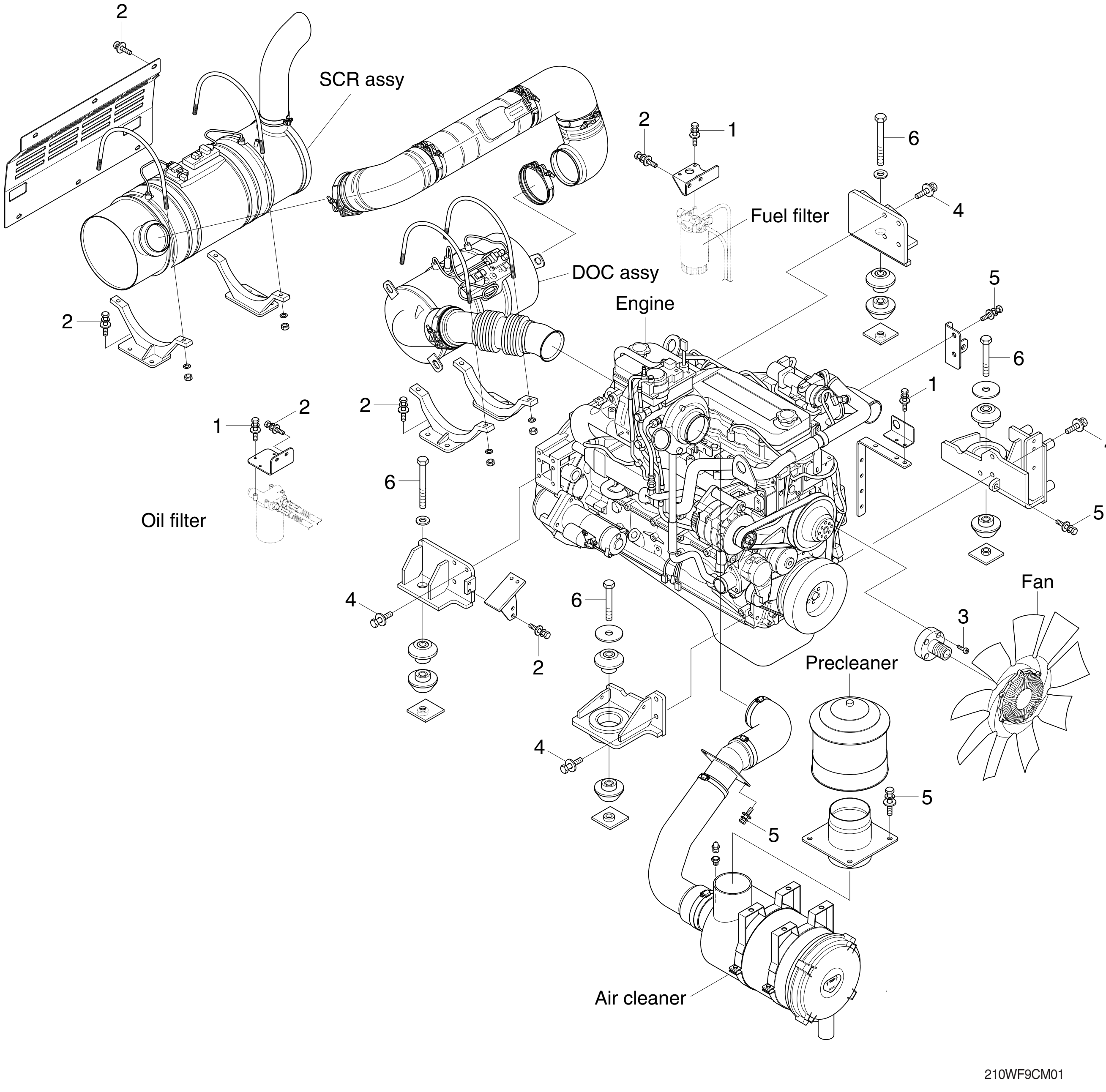
GROUP 2 ENGINE SYSTEM

ENGINE AND ACCESSORIES MOUNTING



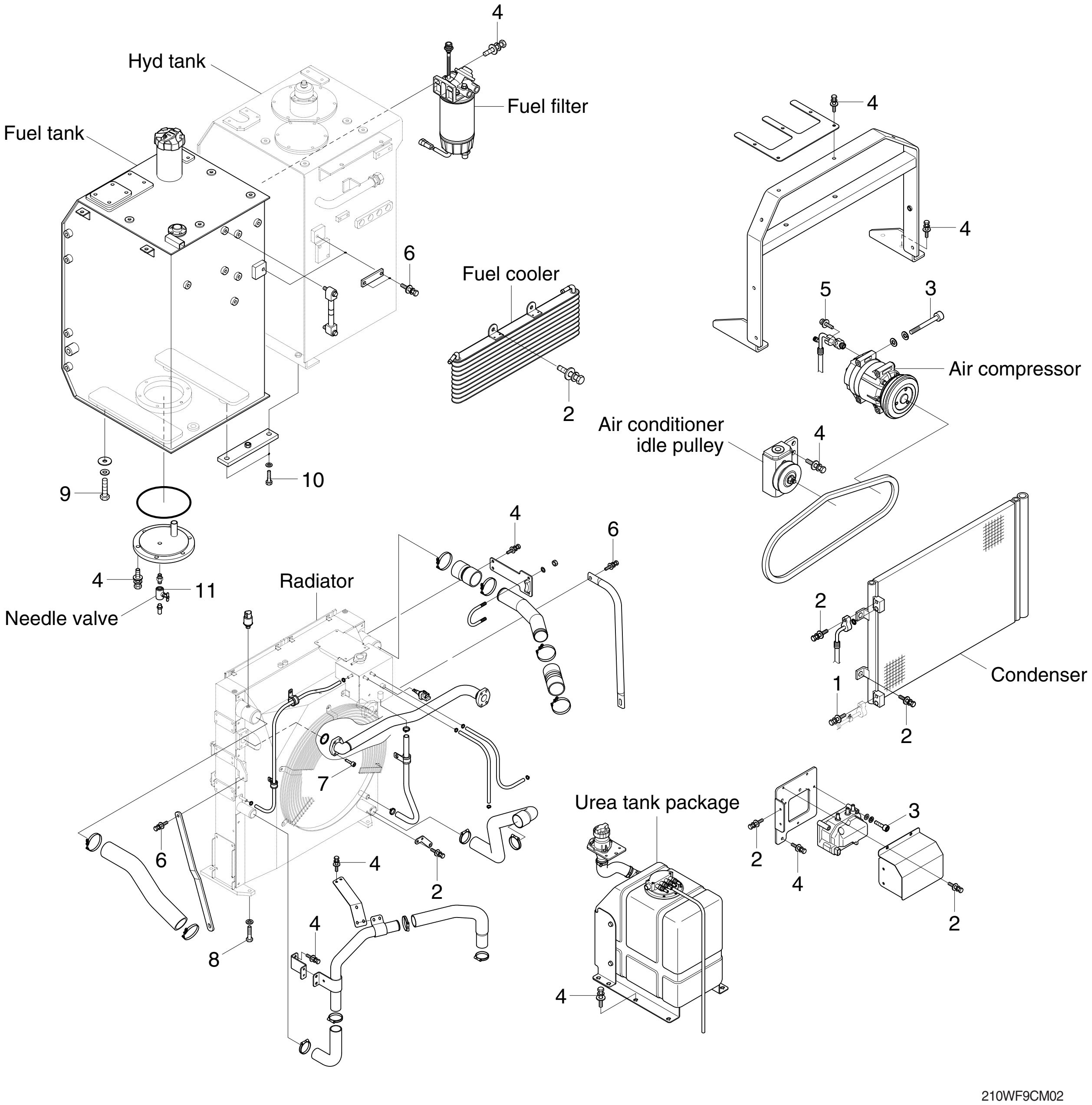
210WF9CM01

· Tightening torque

Item	Size	kgf · m	lbf · ft
1	M 8×1.25	2.5±0.5	18.1±3.6
2	M10×1.5	6.9±1.4	49.9±10.1
3	M10×1.5	8.27±1.7	59.8±12.3

Item	Size	kgf · m	lbf · ft
4	M12×1.75	11.5±1.0	83.2±7.2
5	M12×1.75	12.8±3.0	92.6±21.7
6	M20×2.5	52.1±5.0	370±36.2

COOLING SYSTEM AND FUEL TANK MOUNTING



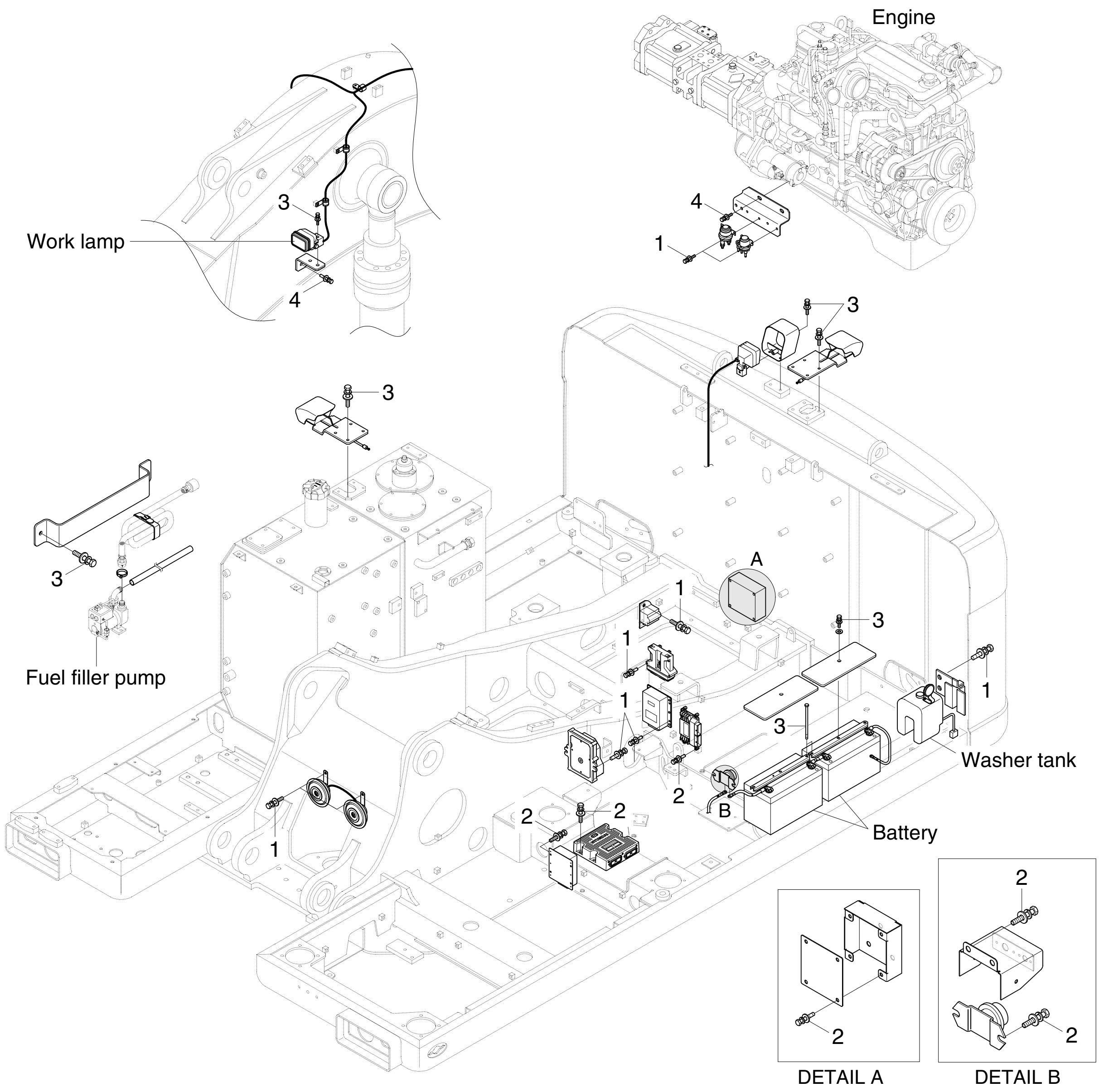
· Tightening torque

Item	Size	kgf · m	lbf · ft
1	M 6×1.0	1.05±0.2	7.6±1.45
2	M 8×1.25	2.5±0.5	18.1±3.6
3	M 8×1.25	4.05±0.8	29.3±5.8
4	M10×1.5	6.9±1.4	49.9±10.1
5	M10×1.25	7.4±1.5	53.5±10.8
6	M12×1.75	12.8±3.0	92.6±21.7

Item	Size	kgf · m	lbf · ft
7	M12×1.75	14.7±2.2	106±15.9
8	M16×2.0	29.7±4.5	215±32.5
9	M20×2.5	46±5.1	333±36.9
10	M20×2.5	57.9±8.7	419±62.9
11	-	2.3±0.6	16.6±4.3

GROUP 3 ELECTRIC SYSTEM

ELECTRIC COMPONENTS MOUNTING 1



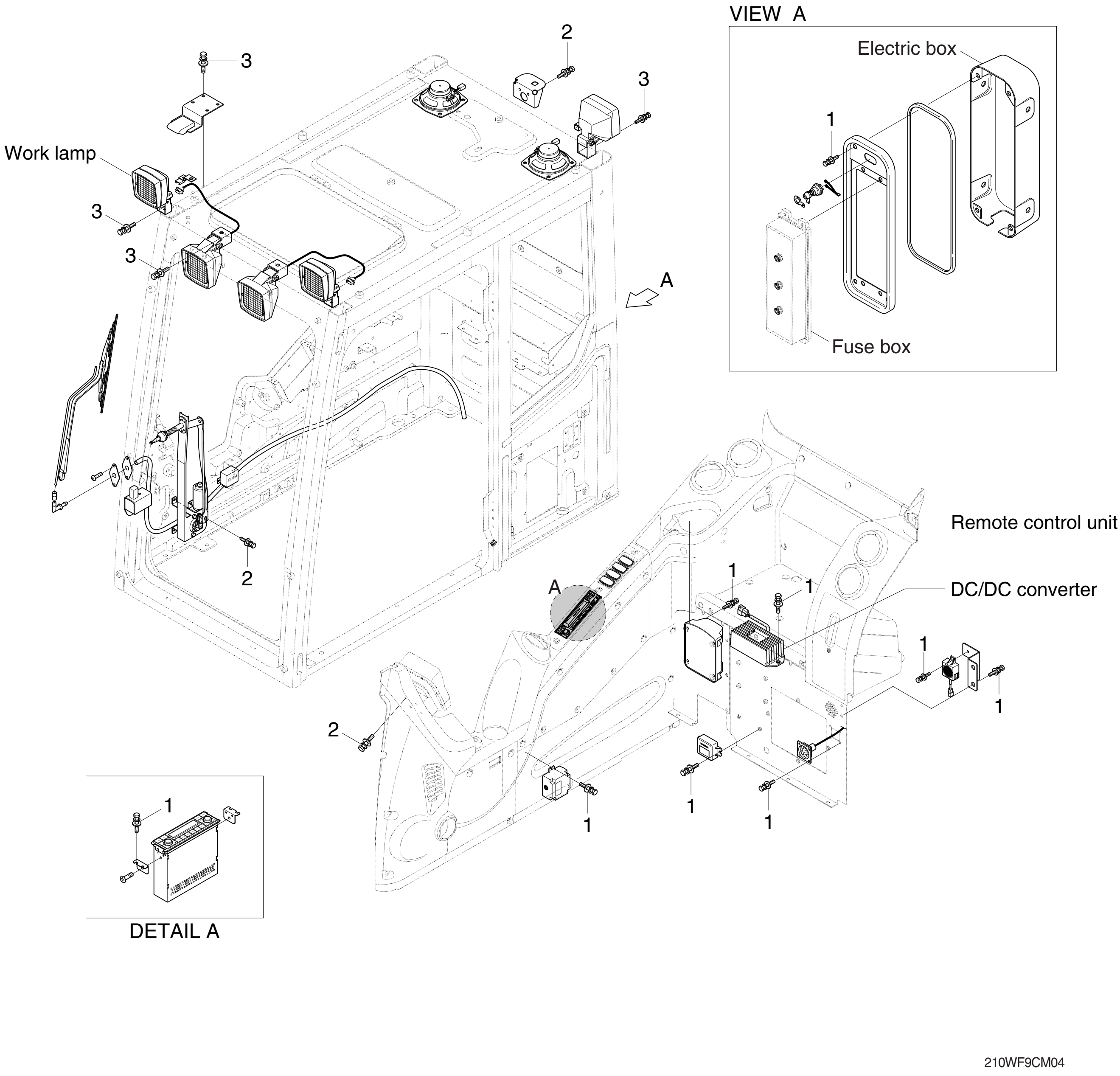
210WF9CM03

· Tightening torque

Item	Size	kgf · m	lbf · ft
1	M 6 × 1.0	1.05 ± 0.2	7.6 ± 1.45
2	M 8 × 1.25	2.5 ± 0.5	18.1 ± 3.6

Item	Size	kgf · m	lbf · ft
3	M10 × 1.5	6.9 ± 1.4	49.9 ± 10.1
4	M12 × 1.75	12.8 ± 3.0	92.6 ± 21.7

ELECTRIC COMPONENTS MOUNTING 2



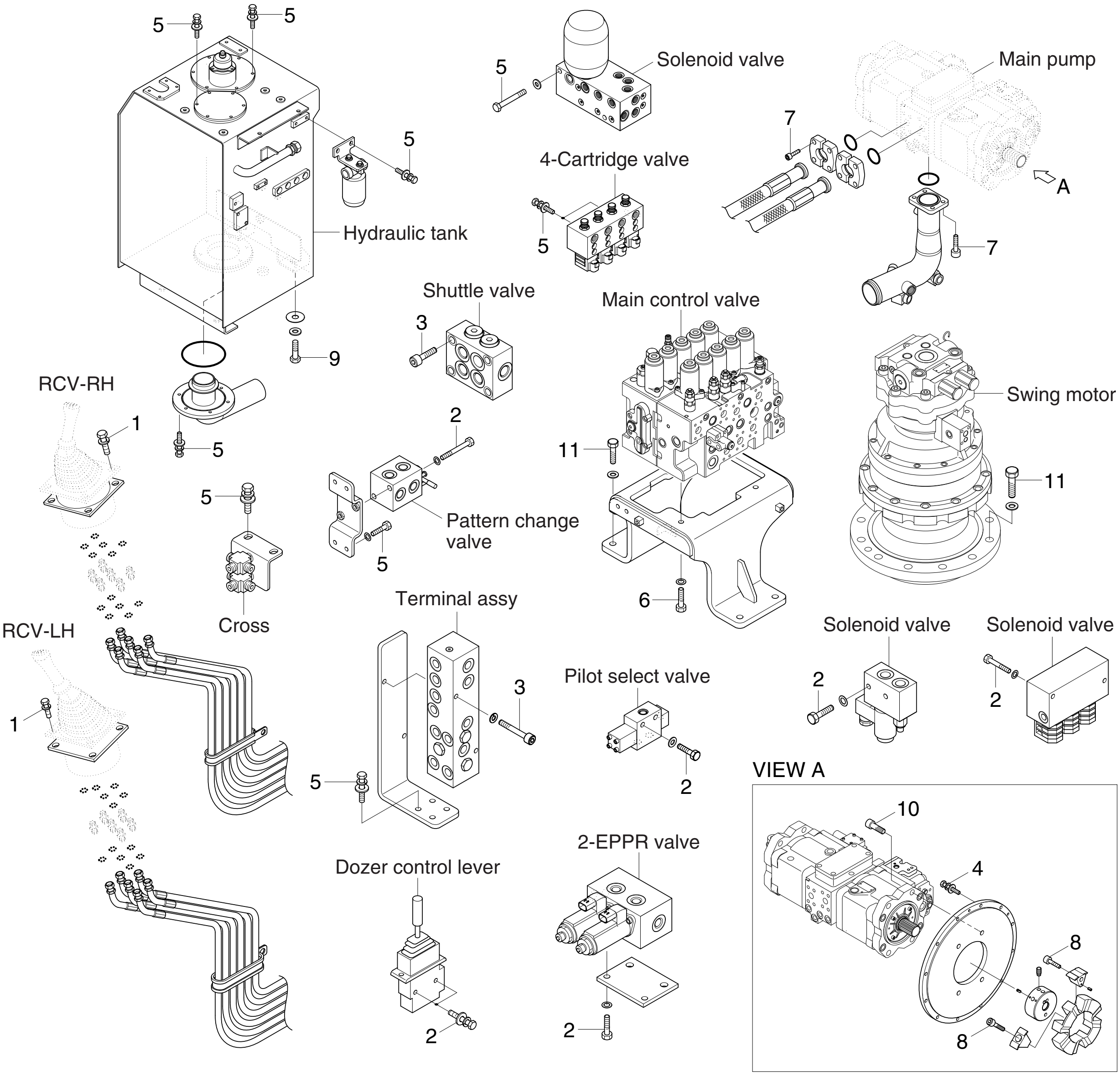
· Tightening torque

Item	Size	kgf · m	lbf · ft
1	M 6 × 1.0	1.05 ± 0.2	7.6 ± 1.45
2	M 8 × 1.25	2.5 ± 0.5	18.1 ± 3.6

Item	Size	kgf · m	lbf · ft
3	M10 × 1.5	6.9 ± 1.4	49.9 ± 10.1

GROUP 4 HYDRAULIC SYSTEM

HYDRAULIC COMPONENTS MOUNTING 1

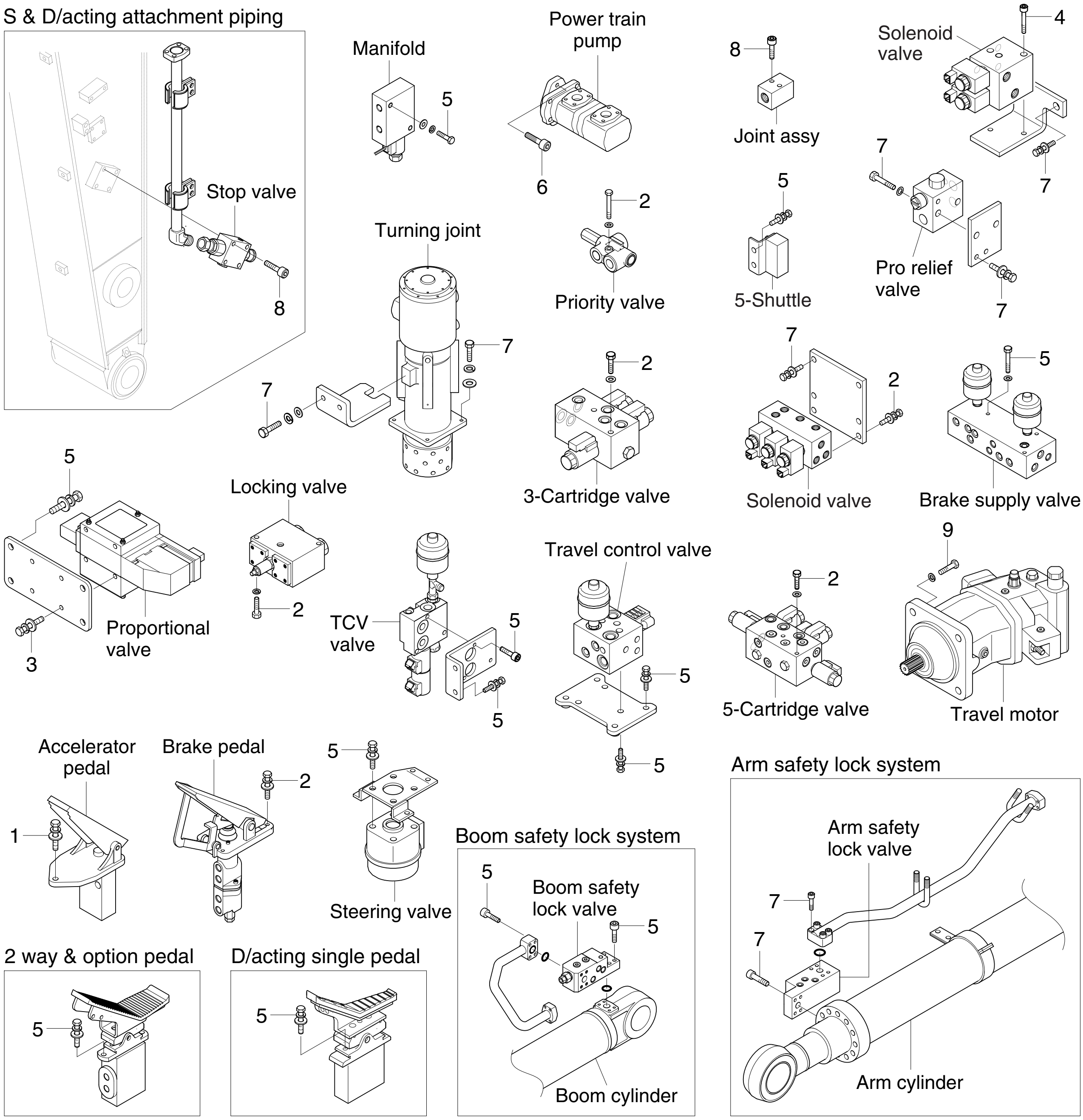


· Tightening torque

Item	Size	kgf · m	lbf · ft
1	M 6×1.0	1.05±0.2	7.6±1.45
2	M 8×1.25	2.5±0.5	18.1±3.6
3	M 8×1.25	4.05±0.8	29.3±5.8
4	M10×1.5	6.9±0.5	49.9±3.6
5	M10×1.5	6.9±1.4	49.9±10.1
6	M12×1.75	12.8±3.0	92.6±21.7

Item	Size	kgf · m	lbf · ft
7	M12×1.75	14.7±2.2	106±15.9
8	M18×2.5	32±1.0	231±7.2
9	M20×2.5	46±5.1	333±36.9
10	M20×2.5	52.1±5.0	370±36.2
11	M20×2.5	57.9±8.7	419±62.9

HYDRAULIC COMPONENTS MOUNTING 2



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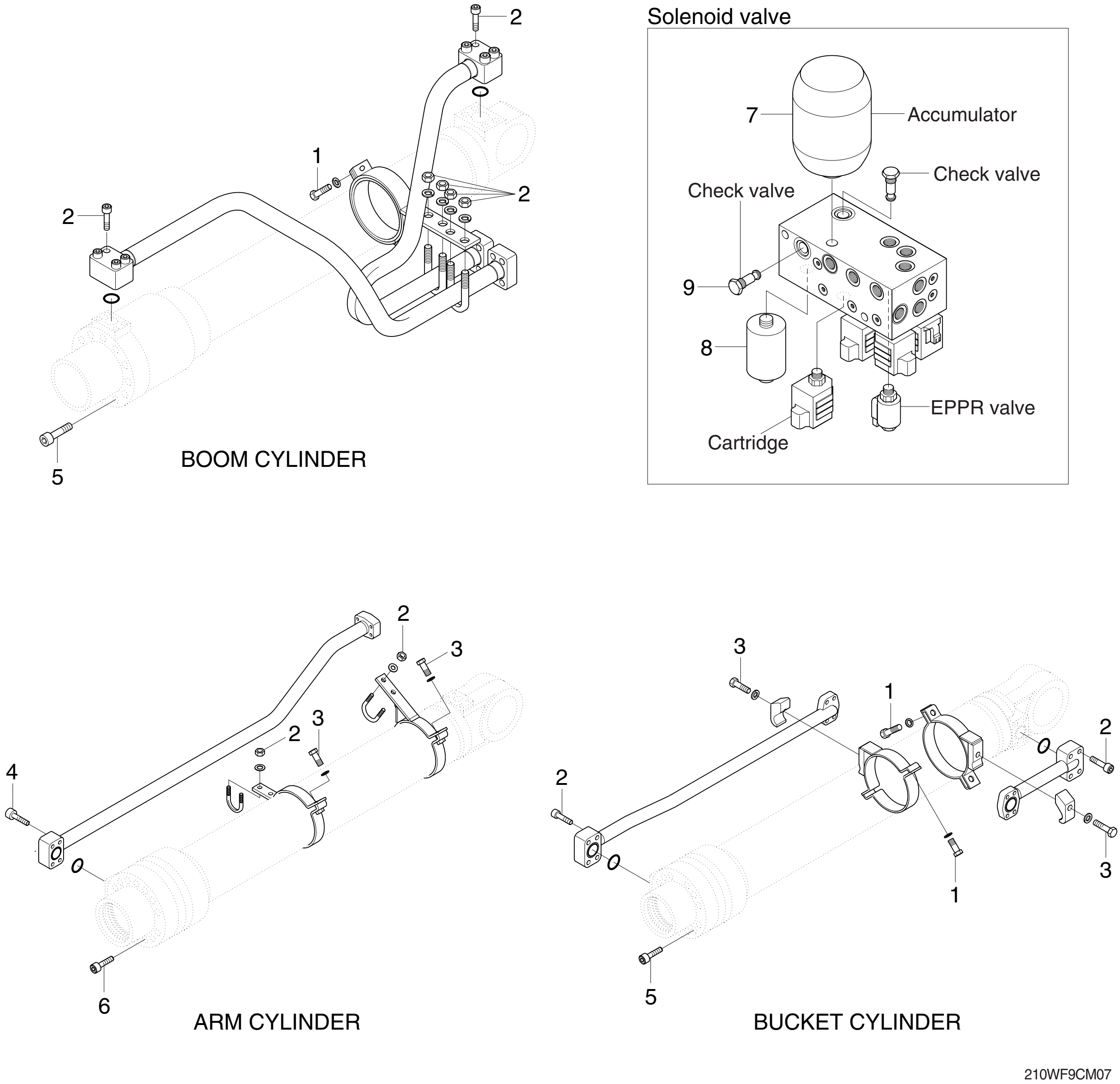
· Tightening torque

Item	Size	kgf · m	lbf · ft
1	M 6×1.0	1.05±0.2	7.6±1.45
2	M 8×1.25	2.5±0.5	18.1±3.6
3	M 8×1.25	3.43±0.7	24.2±5.1
4	M 8×1.25	4.05±0.8	29.3±5.8
5	M10×1.5	6.9±1.4	49.9±10.1

Item	Size	kgf · m	lbf · ft
6	M10×1.5	8.27±1.7	59.8±12.3
7	M12×1.75	12.8±3.0	92.6±21.7
8	M12×1.75	14.7±2.2	106±15.9
9	M16×2.0	35.6±7.1	257±51.4

HYDRAULIC COMPONENTS MOUNTING 3



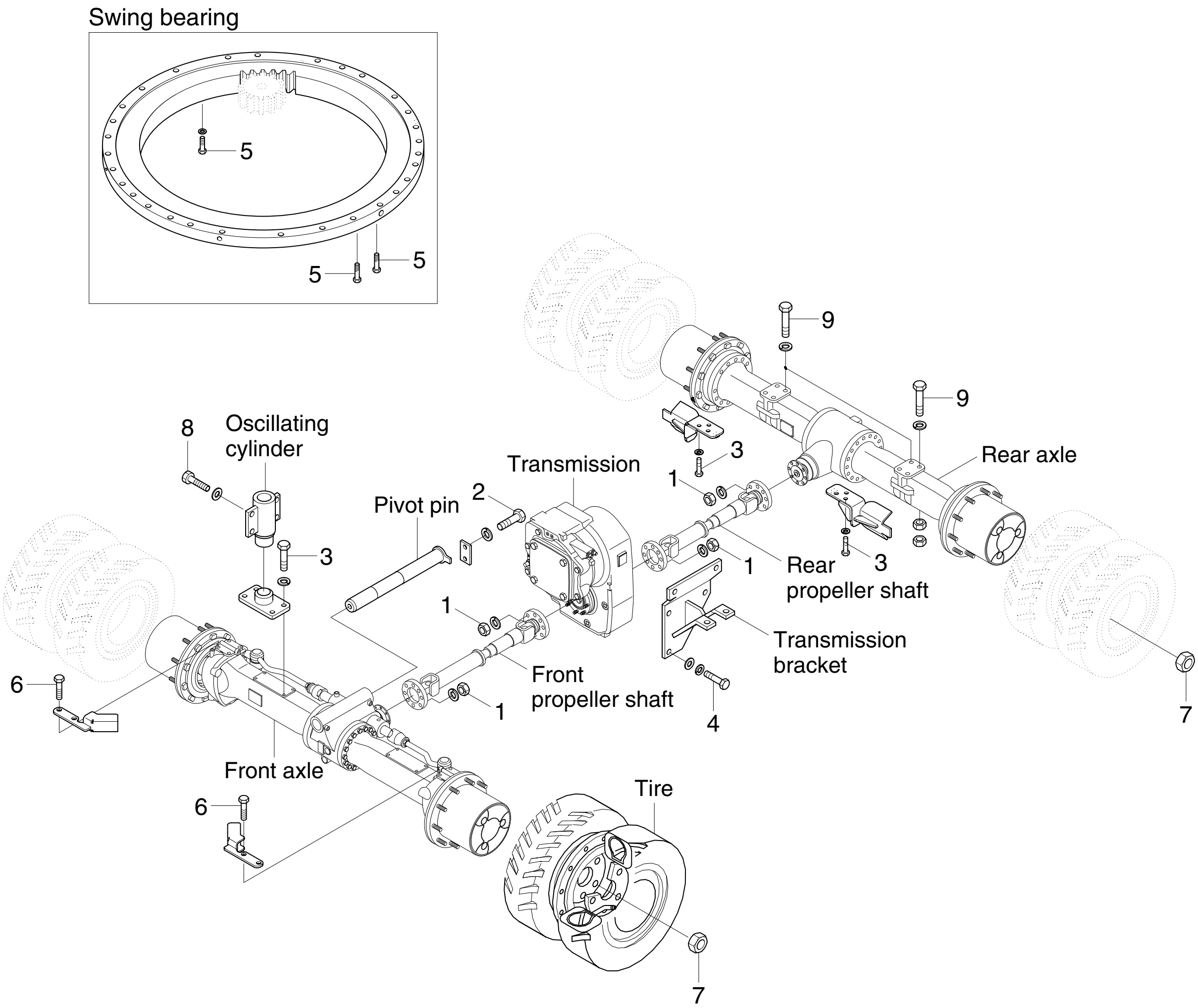
· Tightening torque

Item	Size	kgf · m	lbf · ft
1	M10×1.5	3.2±0.3	23.1±2.2
2	M10×1.5	5.4±0.5	39.1±3.6
3	M12×1.75	5.5±0.6	39.8±4.3
4	M12×1.75	9.4±1.0	68.0±7.2
5	M16×2.0	23±2.0	166±14.5

Item	Size	kgf · m	lbf · ft
6	M18×2.5	32±3.0	232±21.7
7	Accumulator	5.6±0.5	40.5±3.6
8	Line filter	2.5	18.0
9	Check valve	2.5±0.5	18±3.6

GROUP 5 POWER TRAIN SYSTEM

POWER TRAIN MOUNTING



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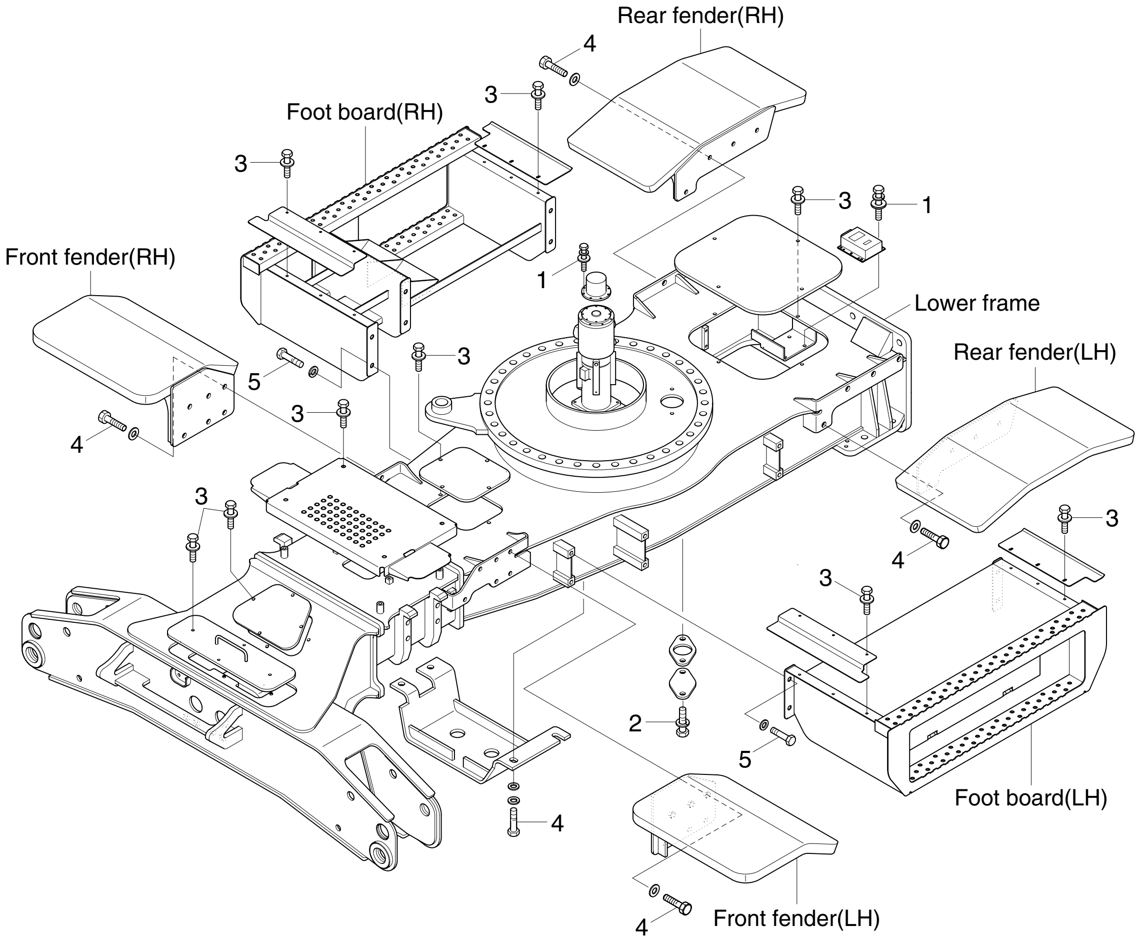
· Tightening torque

Item	Size	kgf · m	lbf · ft
1	M10×1.0	5.9±0.6	42.7±4.3
2	M12×1.75	12.8±3.0	92.6±21.7
3	M16×2.0	29.7±4.5	215±32.5
4	M20×2.5	39±4.2	282±30.4
5	M20×2.5	57.9±5.8	419±42.0

Item	Size	kgf · m	lbf · ft
6	M20×2.5	57.9±8.7	419±62.9
7	M16×1.5	60^{0}_{-5}	$433^{0}_{-36.2}$
8	M22×1.5	69.4±10.4	502±75.2
9	M24×2.0	100±10	723±72.3

COVER AND FOOT BOARD



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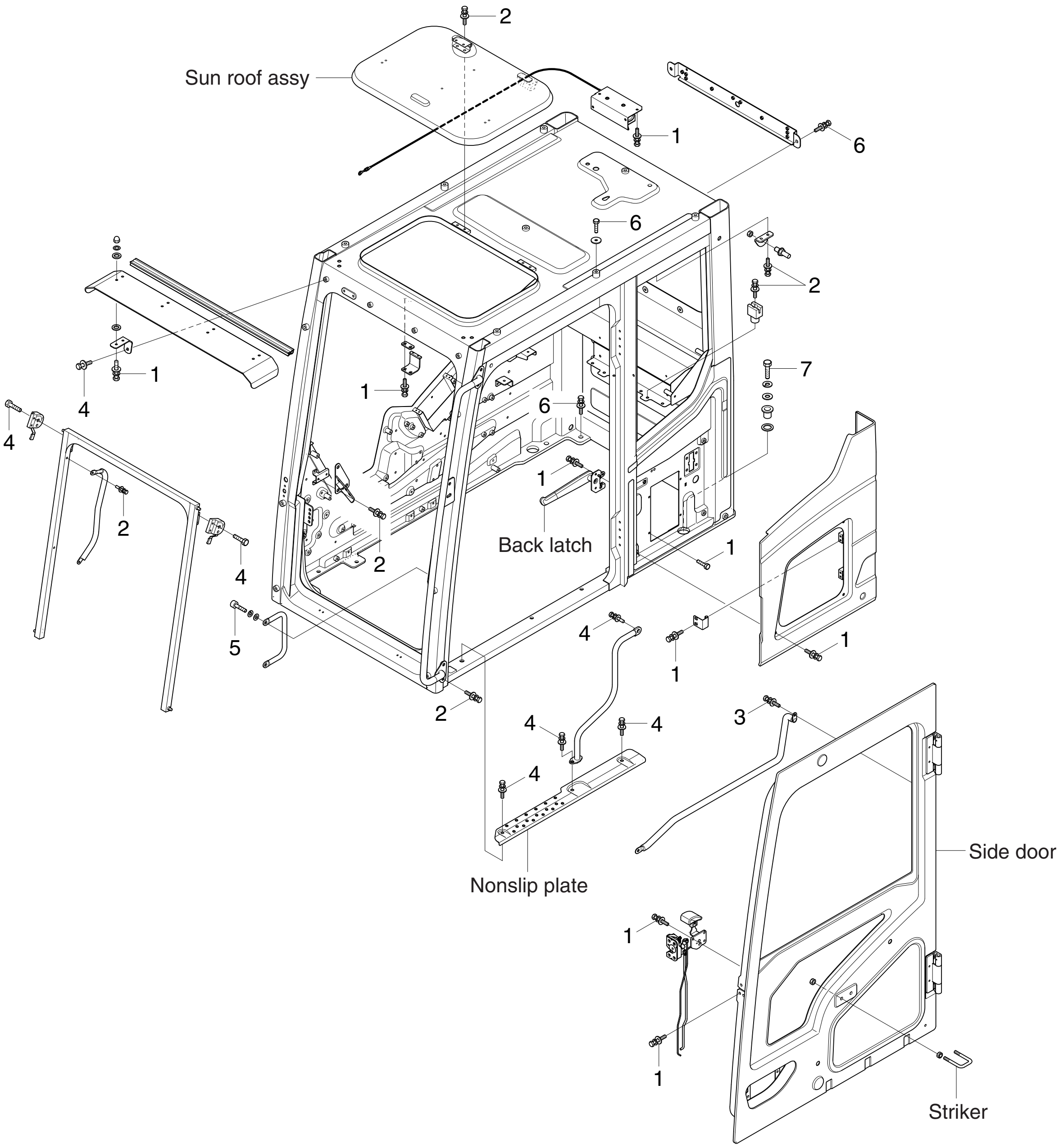
· Tightening torque

Item	Size	kgf · m	lbf · ft
1	M 6×1.0	1.05±0.2	7.6±1.45
2	M10×1.5	6.9±1.4	49.9±10.1
3	M12×1.75	12.8±3.0	92.6±21.7

Item	Size	kgf · m	lbf · ft
4	M16×2.0	29.7±4.5	215±32.5
5	M20×2.5	57.9±8.7	419±62.9

GROUP 6 STRUCTURE

CAB AND ACCESSORIES MOUNTING



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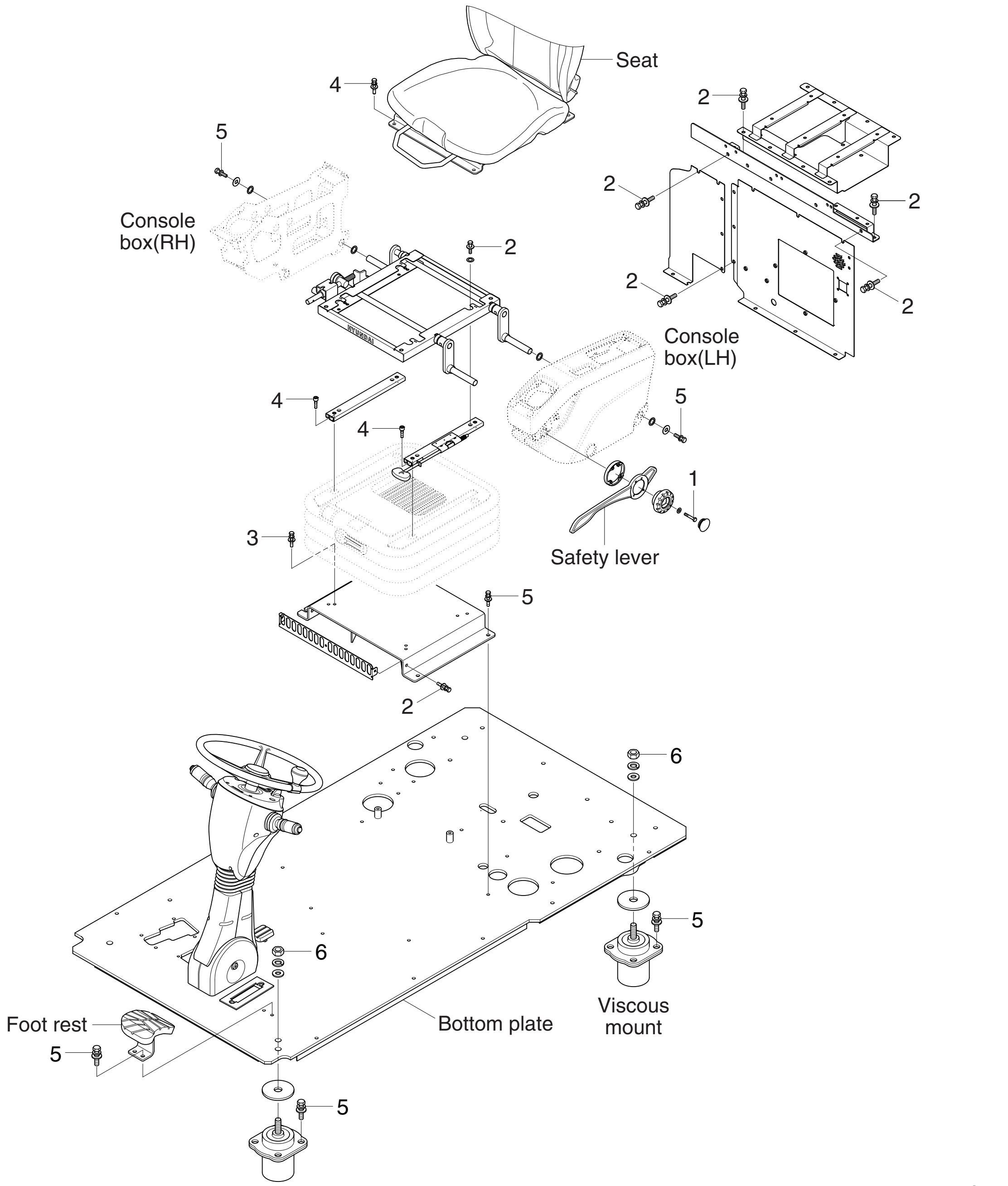
· Tightening torque

Item	Size	kgf · m	lbf · ft
1	M 6×1.0	1.05±0.2	7.6±1.45
2	M 8×1.25	2.5±0.5	18.1±3.6
3	M 8×1.25	3.43±0.7	24.8±5.1
4	M10×1.5	6.9±1.4	49.9±10.1

Item	Size	kgf · m	lbf · ft
5	M10×1.5	8.27±1.7	59.8±12.3
6	M12×1.75	12.8±3.0	92.6±21.7
7	M24×3.0	100±15	723±109

CAB INTERIOR MOUNTING

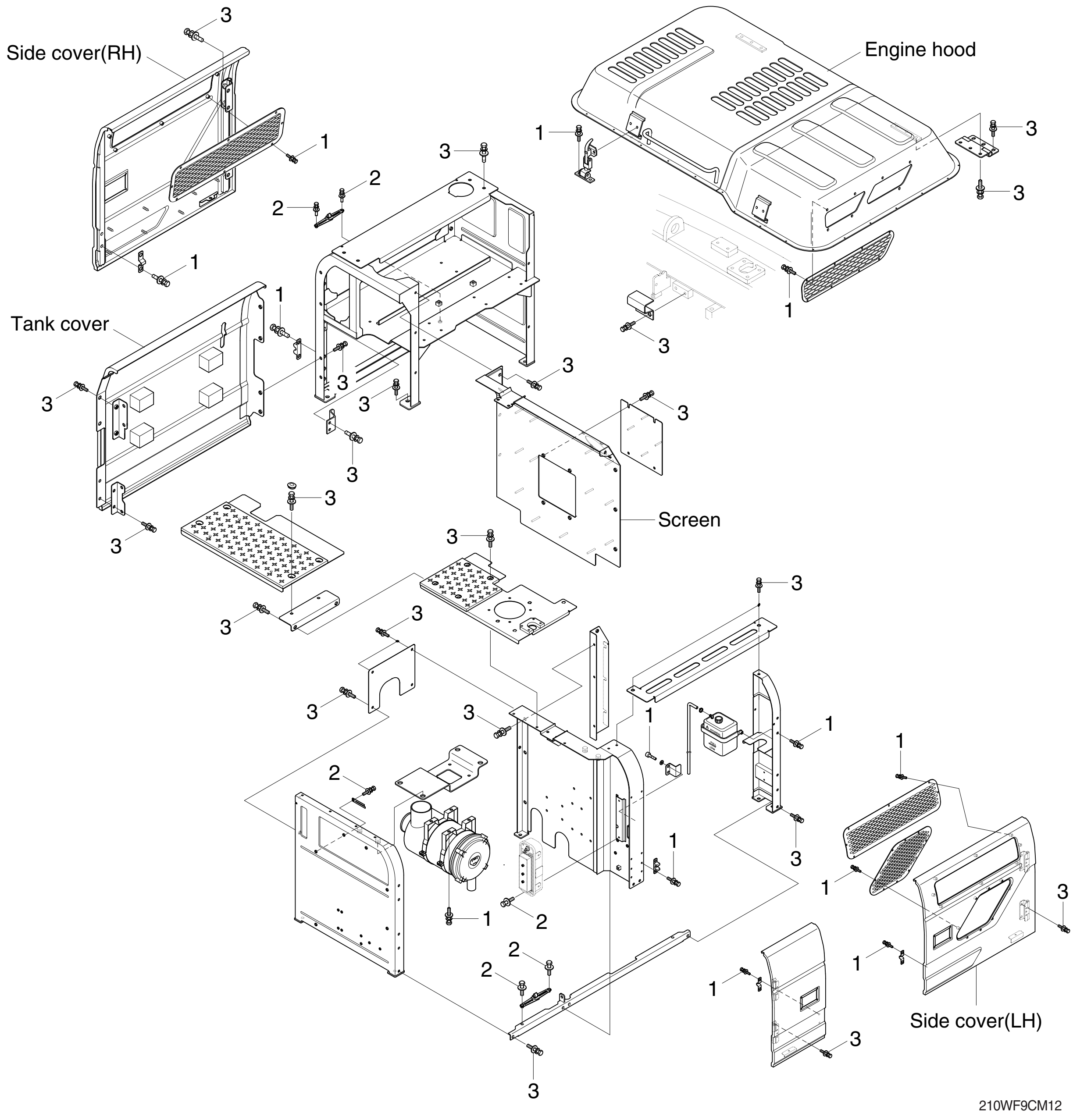


· Tightening torque

Item	Size	kgf · m	lbf · ft
1	M 6×1.0	1.05±0.2	7.6±1.45
2	M 8×1.25	2.5±0.5	18.1±3.6
3	M 8×1.25	3.43±0.7	24.8±5.1

Item	Size	kgf · m	lbf · ft
4	M 8×1.25	4.05±0.8	29.3±5.8
5	M10×1.5	6.9±1.4	49.9±10.1
6	M16×2.0	21.9±3.3	158±23.9

COWL MOUNTING

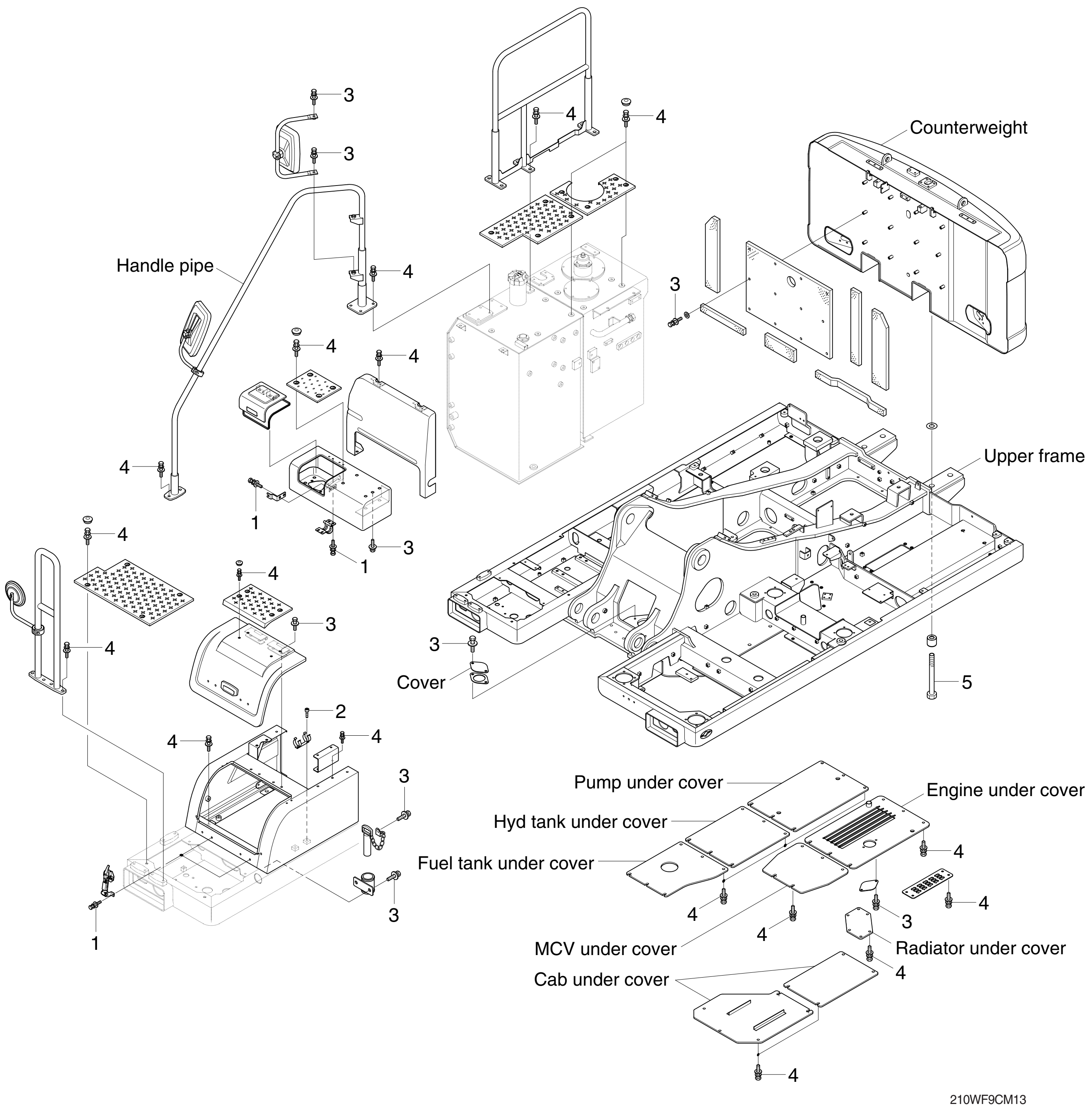


· Tightening torque

Item	Size	kgf · m	lbf · ft
1	M 8×1.25	2.5±0.5	18.1±3.6
2	M10×1.5	6.9±1.4	49.9±10.1

Item	Size	kgf · m	lbf · ft
3	M12×1.75	12.8±3.0	92.6±21.7

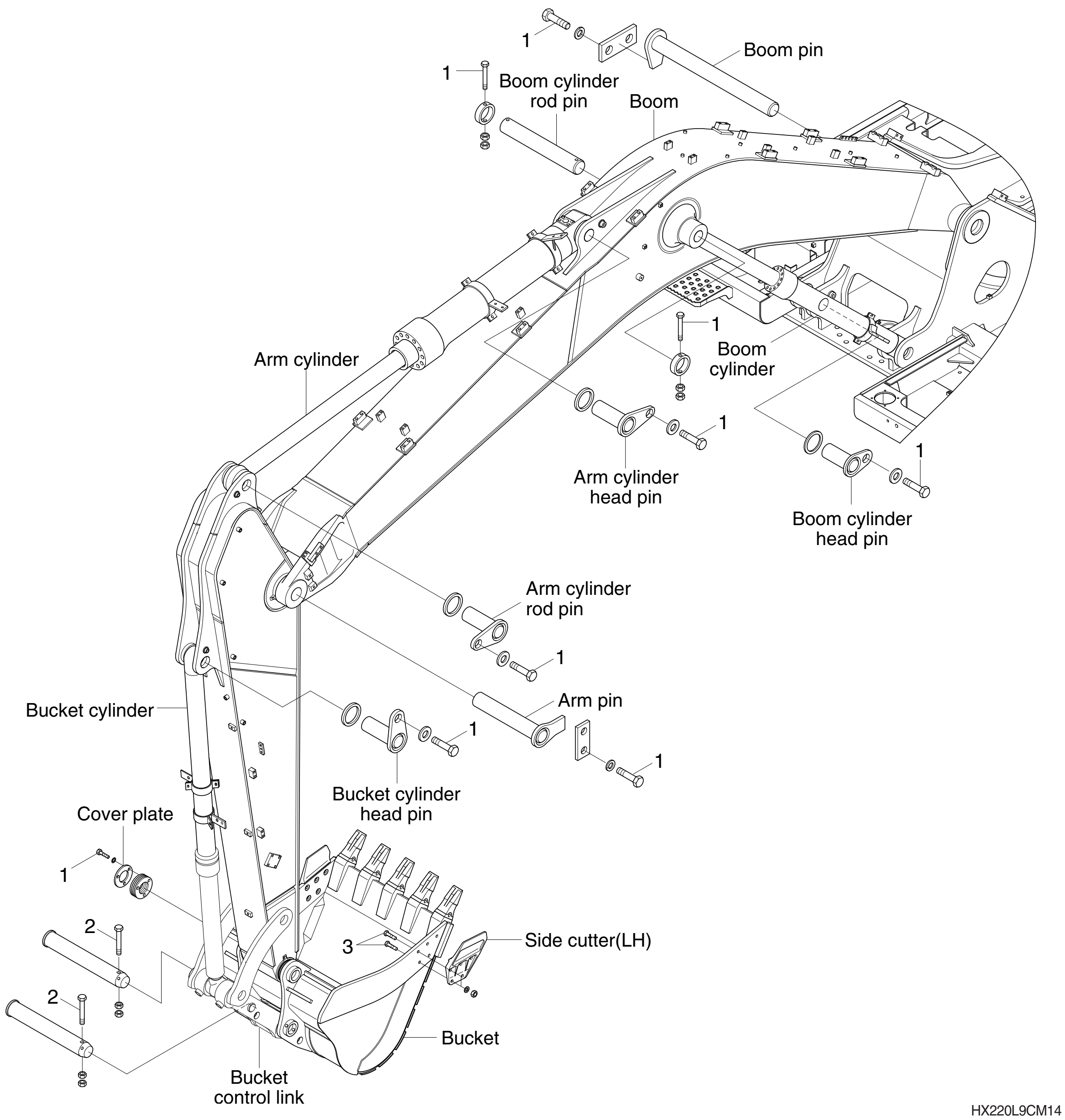
COUNTERWEIGHT AND COVERS MOUNTING



· Tightening torque

Item	Size	kgf · m	lbf · ft
1	M 8×1.25	2.5±0.5	18.1±3.6
2	M 8×1.25	4.05±0.8	29.3±5.8
3	M10×1.5	6.9±1.4	49.9±10.1
4	M12×1.75	12.8±3.0	92.6±21.7
5	M36×3.0	337±33	2440±239

GROUP 7 WORK EQUIPMENT



· Tightening torque

Item	Size	kgf · m	lbf · ft
1	M16 × 2.0	29.7 ± 4.5	215 ± 32.5
2	M20 × 2.5	57.9 ± 8.7	419 ± 62.9
3	M22 × 2.5	81.9 ± 16.1	592 ± 116