SERVICE MANUAL

R150WVS PRO

HYUNDAI CONSTRUCTION EQUIPMENT

SERVICE MANUAL

COMFORT INTELLIGENCE ™

HYDRAULIL EXCAVATOR

R150WVS PRO

HD HYUNDAI CONSTRUCTION EQUIPMENT

Printed in Korea (2021. 11)

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CONTENTS

SECTION 1 GENERAL

SECTION 2 STRUCTURE AND FUNCTION

SECTION 3 HYDRAULIC SYSTEM

SECTION 4 ELECTRICAL SYSTEM

SECTION 5 MECHATRONICS SYSTEM

SECTION 6 TROUBLESHOOTING

SECTION 7 MAINTENANCE STANDARD

SECTION 8 DISASSEMBLY AND ASSEMBLY

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.

2. HOW TO READ THE SERVICE MANUAL

Distribution and updating

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

Filing method

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

Revised edition mark (①②③…)

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

Revisions

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

Symbols

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

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

3. CONVERSION TABLE

Method of using the Conversion Table

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

Example

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

   Convert 55mm into inches.

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

   (2) Locate the number 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
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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/cm^2 to lbf/in^2

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

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

TEMPERATURE

Fahrenheit-Centigrade Conversion.

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

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

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

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

℃		℉	℃		℉	℃		℉	℃		℉
-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

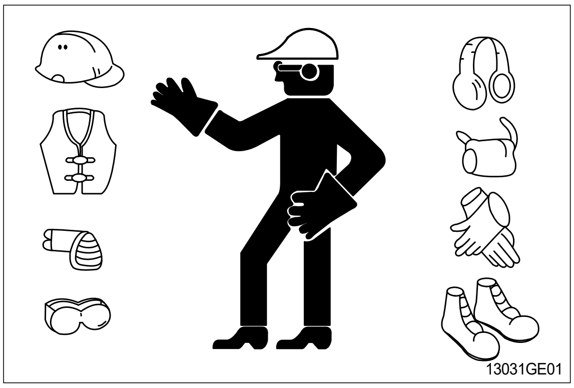
GROUP 1 SAFETY

FOLLOW SAFE PROCEDURE

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

WEAR PROTECTIVE CLOTHING

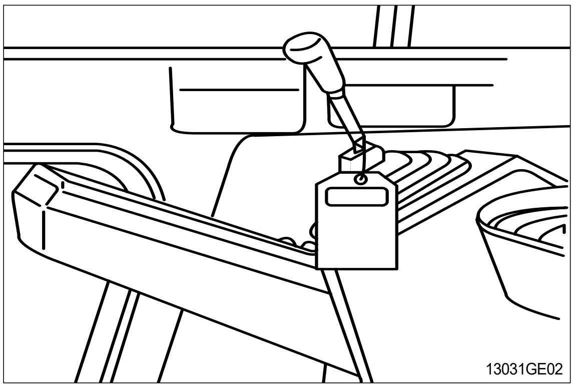
Wear close fitting clothing and safety equipment appropriate to the job.



13031GE01

WARN OTHERS OF SERVICE WORK

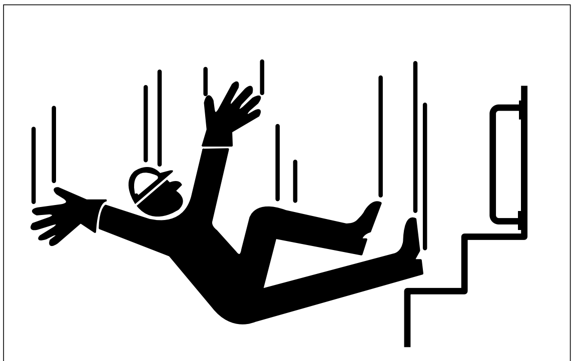
Unexpected machine movement can cause serious injury.
Before performing any work on the excavator, attach a「**Do Not Operate**」tag on the right side control lever.



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.



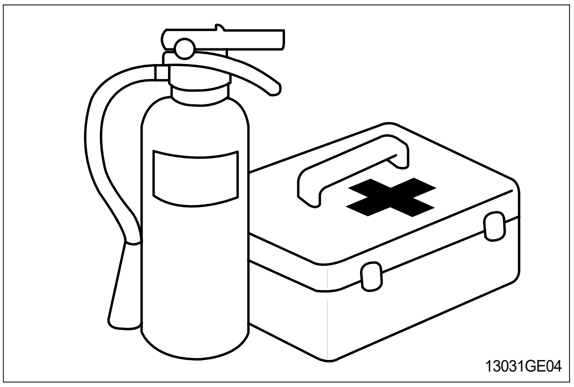
13031GE03

PREPARE FOR EMERGENCIES

Be prepared if a fire starts.

Keep a first aid kit and fire extinguisher handy.

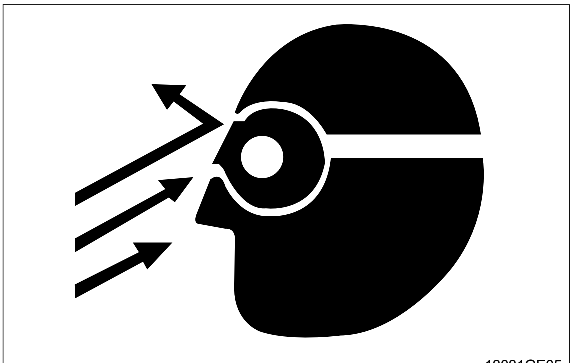
Keep emergency numbers for doctors, ambulance service, hospital, and fire department near your telephone.



13031GE04

PROTECT AGAINST FLYING DEBRIS

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

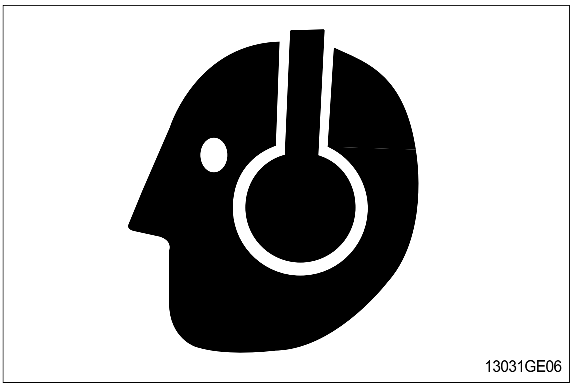


13031GE05

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.

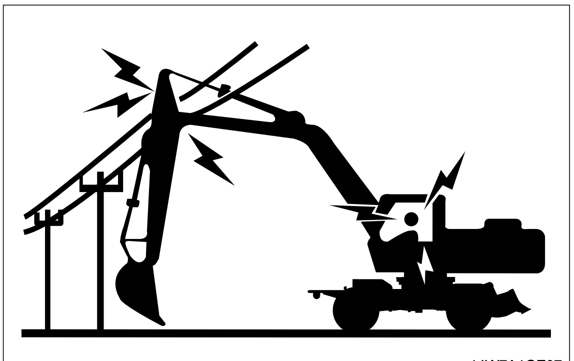


13031GE06

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.

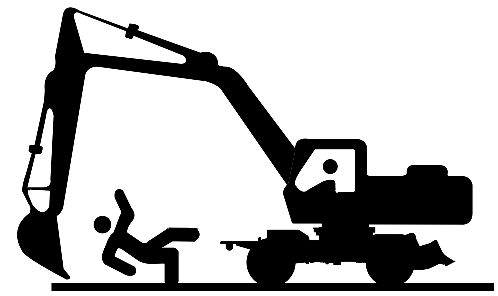


14W7A1GE07

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.



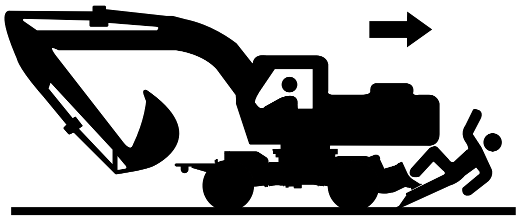
14W7A1GE08

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.

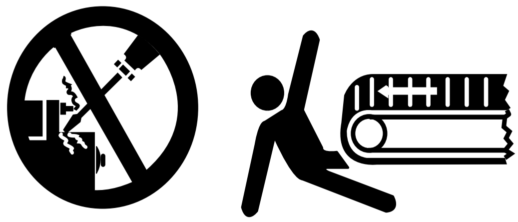


14W7A1GE09

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

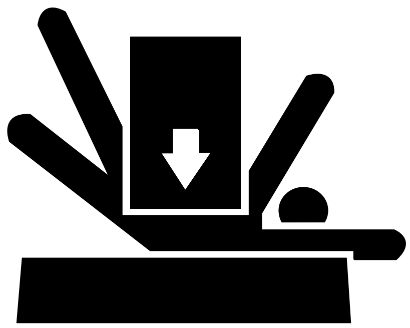
Before working on the machine:

- 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.

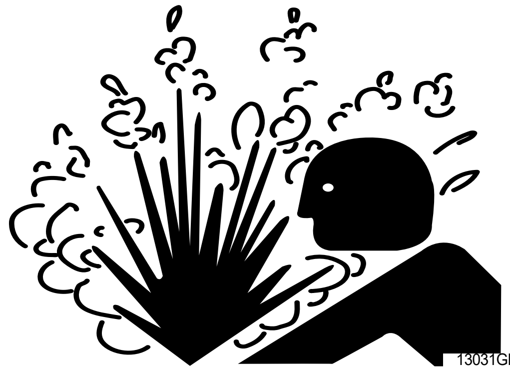


13031GE10

SERVICE COOLING SYSTEM SAFELY

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

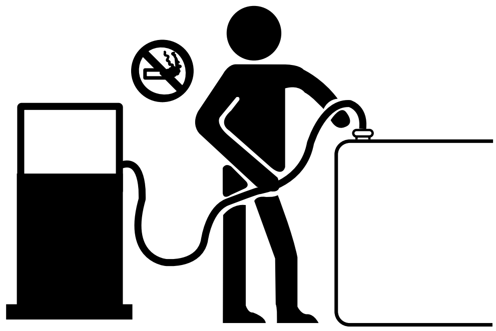
Shut off engine. Only remove filler cap when cool enough to touch with bare hands.



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.

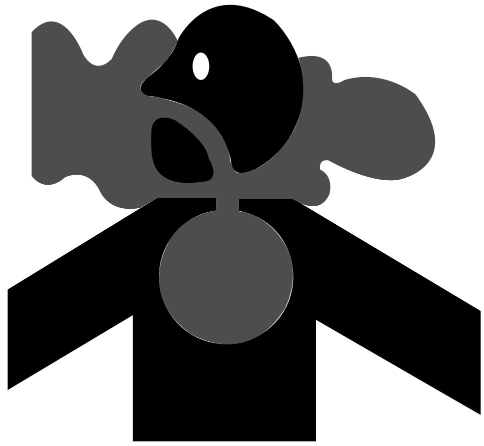
Do not store oily rags ; they can ignite and burn spontaneously.

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

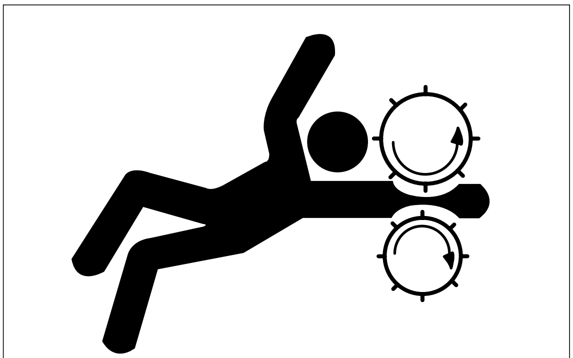
Illuminate your work area adequately but safely. Use a portable safety light for working inside or under the machine. Make sure the bulb is enclosed by a wire cage. The hot filament of an accidentally broken bulb can ignite spilled fuel or oil.

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.

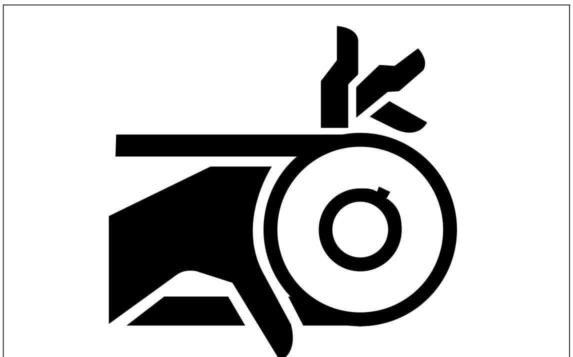


13031GE16

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

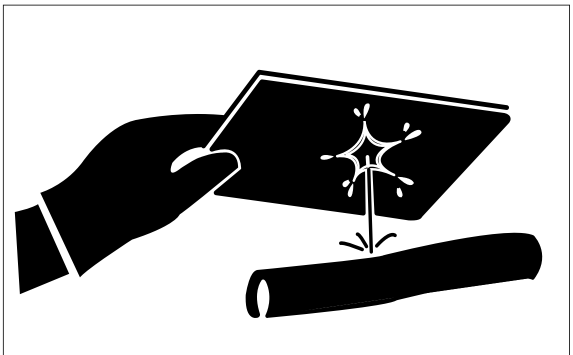
Escaping fluid under pressure can penetrate the skin causing serious injury.

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.

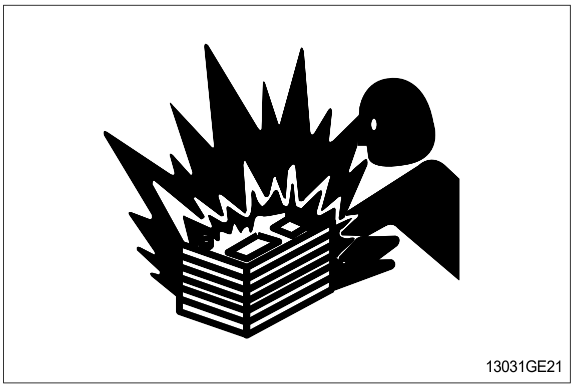
13031GE20

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:

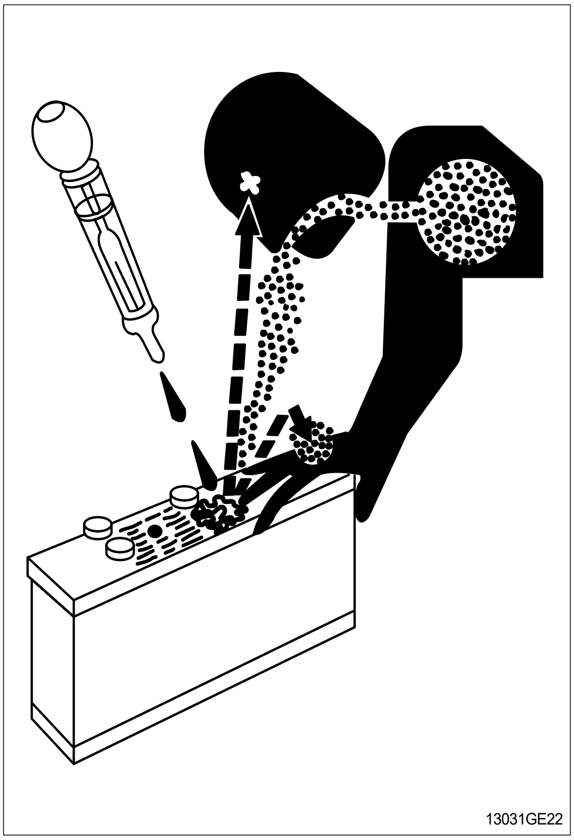
1. Filling batteries in a well-ventilated area.
2. Wearing eye protection and rubber gloves.
3. Avoiding breathing fumes when electrolyte is added.
4. Avoiding spilling of dripping electrolyte.
5. Use proper jump start procedure.

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

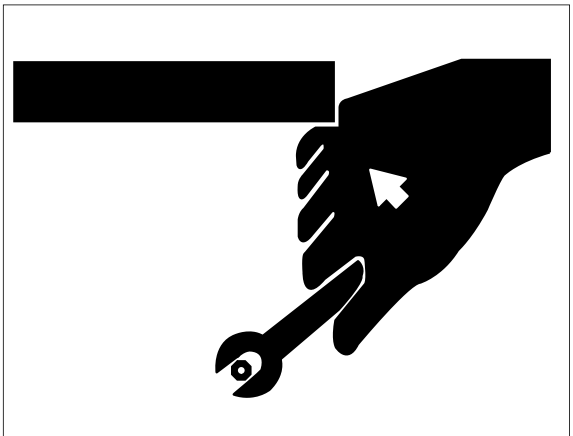
USE TOOLS PROPERLY

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.)



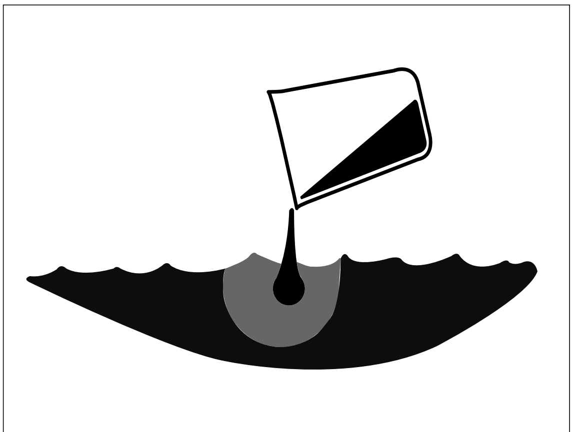
13031GE23

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.

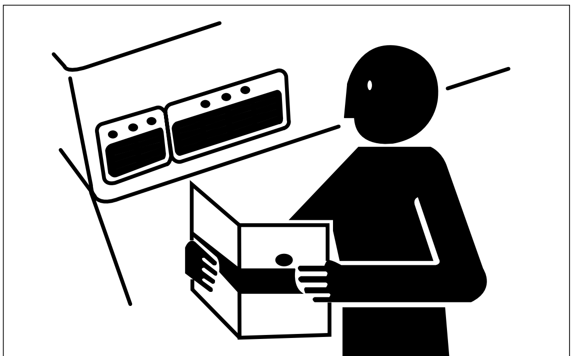
DO NOT pour oil into the ground, down a drain, or into a stream, pond, or lake. Observe relevant environmental protection regulations when disposing of oil, fuel, coolant, brake fluid, filters, batteries, and other harmful waste.



13031GE24

REPLACE SAFETY SIGNS

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



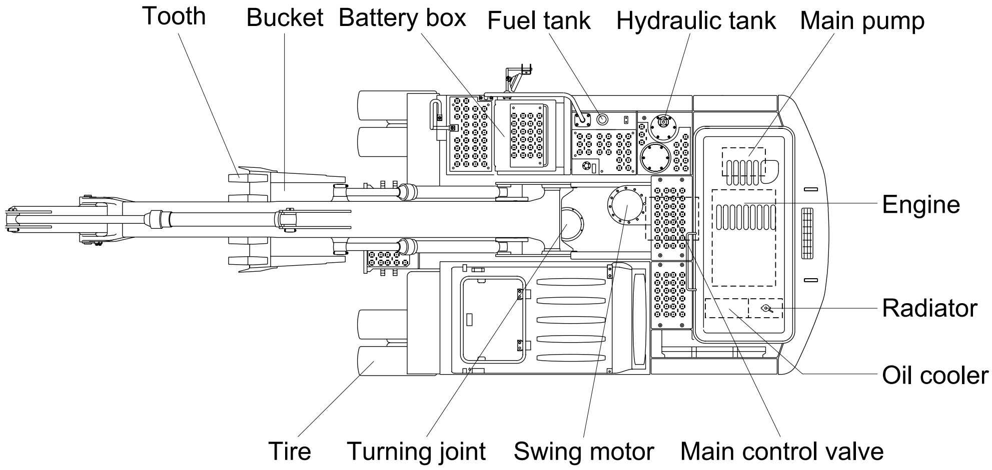
13031GE25

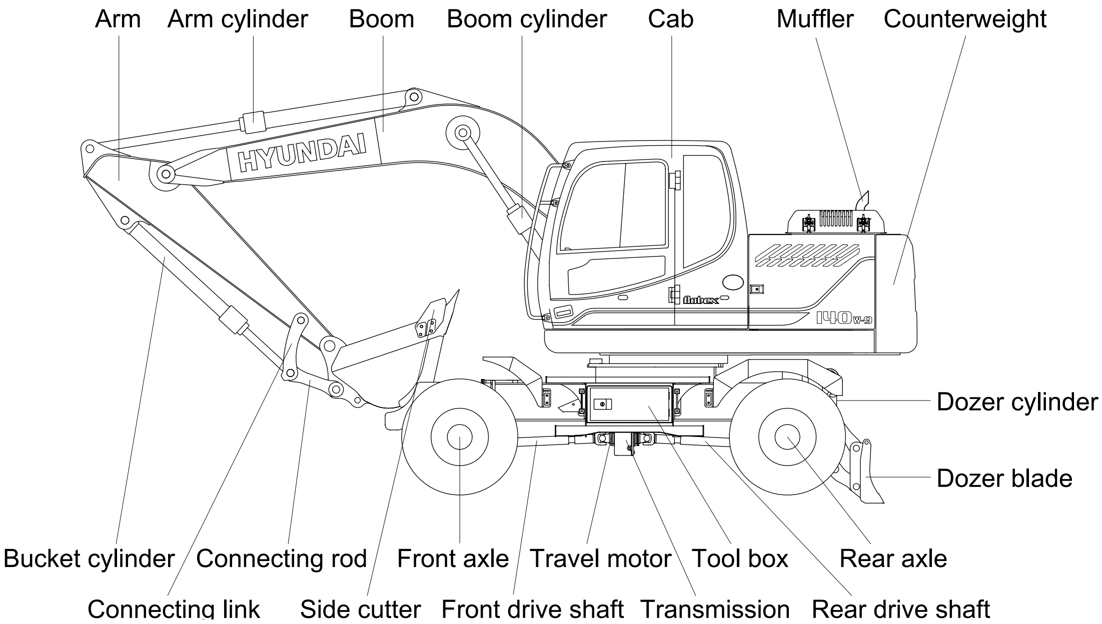
LIVE WITH SAFETY

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

GROUP 2 SPECIFICATIONS

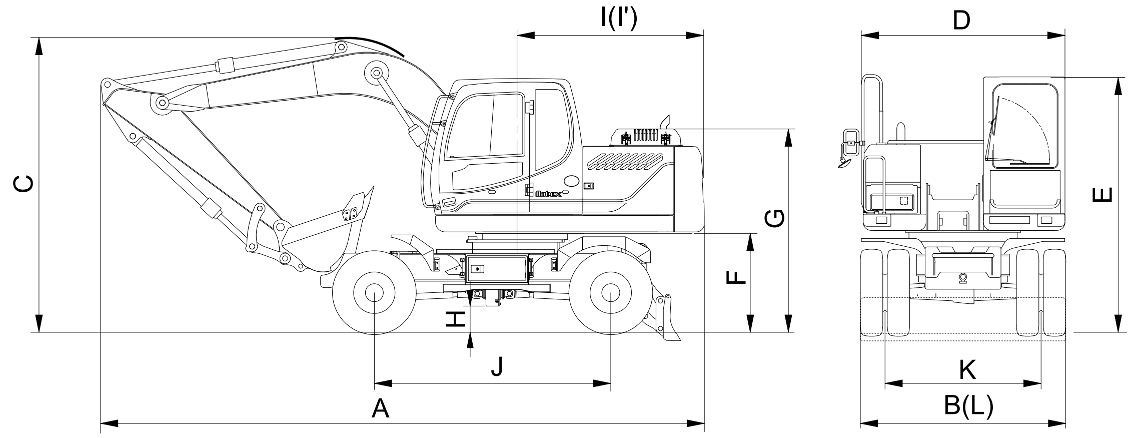
1. MAJOR COMPONENT





2.SPECIFICATIONS

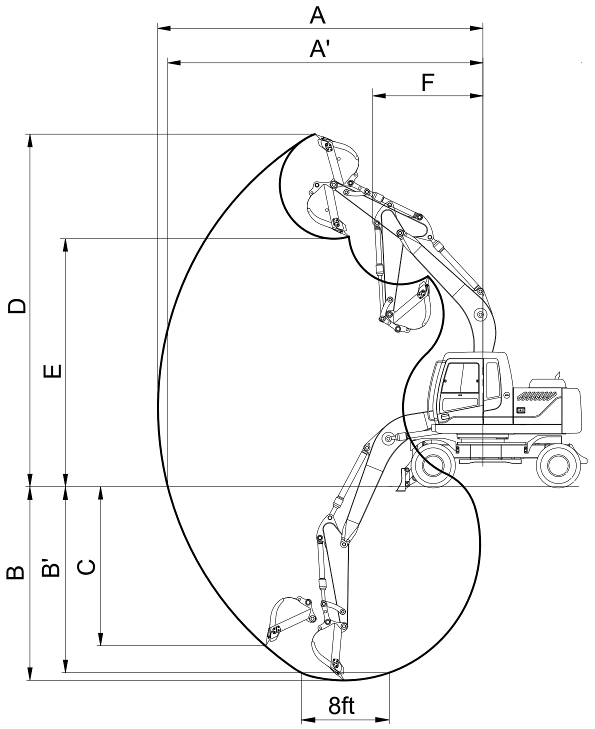
1)4.6 m (15' 1") ONE PIECE BOOM, 2.1 m (6' 11") ARM AND REAR DOZER BLADEARM



Description		Unit	Specification
Operating weight		kg (lb)	13780 (30380)
Bucket capacity (SAE heaped), standard		m^3 (yd^3)	0.58 (0.76)
Overall length	A	mm (ft-in)	7760 (25' 6")
Overall width	B		2495 (8' 2")
Overall height	C		3500 (11' 6")
Upperstructure width	D		2475 (8' 1")
Cab height	E		3140 (10' 4")
Ground clearance of counterweight	F		1233(4' 0")
Engine cover height	G		2320 (7' 7")
Minimum ground clearance	H		365 (1' 2")
Rear-end distance	I		2310 (7' 6")
Rear-end swing radius	I'		2310 (7' 6")
Wheel base	J		2800 (9' 2")
Tread	K		1944 (6' 5")
Dozer blade width	L		2490 (8' 2")
Travel speed	Low	km/hr (mph)	10(5.3)
	High		38(23.6)
	Creep		3.8 (2.4)
Swing speed		rpm	11
Gradeability		Degree (%)	35 (70)
Max traction force		kgf (lbf)	8500 (18740)

3. WORKING RANGE

1)4.6 m (15' 1") MONO BOOM



Description		1.9 m (6' 3") Arm	*2.1 m (6' 11") Arm	2.5 m (8' 2") Arm	3.0 m (9' 10") Arm
Max digging reach	A	7750 mm (25' 5")	7920 mm (26' 0")	8320 mm (27' 4")	8780 mm (28'10")
Max digging reach on ground	A'	7530 mm (24' 8")	7700 mm (25' 3")	8120 mm (26' 8")	8590 mm (28' 2")
Max digging depth	B	4650 mm (15' 3")	4850 mm (15'11")	5250 mm (17' 3")	5750 mm (18'10")
Max digging depth (8 ft level)	B'	4390 mm (14' 5")	4600 mm (15' 1")	5040 mm (16' 6")	5570 mm (18' 3")
Max vertical wall digging depth	C	4350 mm (14' 3")	4460 mm (14' 8")	5030 mm (16' 6")	5550 mm (18' 3")
Max digging height	D	8400 mm (27' 7")	8470 mm (27' 9")	8790 mm (28'10")	9070 mm (29' 9")
Max dumping height	E	5960 mm (19' 7")	6040 mm (16'10")	6350 mm (20'10")	6620 mm (21' 9")
Min swing radius	F	2620 mm (8' 7")	2670 mm (8' 10")	2650 mm (8' 8")	2670 mm (8' 9")
Bucket digging force	SAE	87.3 [94.8] kN	87.3 [94.8] kN	87.3 [94.8] kN	87.3 [94.8] kN
		8800 [9660] kgf	8800 [9660] kgf	8800 [9660] kgf	8800 [9660] kgf
		19620 [21300] lbf	19620 [21300] lbf	19620 [21300] lbf	19620 [21300] lbf
	ISO	102 [110.8] kN	102 [110.8] kN	102 [110.8] kN	102 [110.8] kN
		10400 [11290] kgf	10100 [11060] kgf	10400 [11290] kgf	10400 [11290] kgf
		22930 [24890] lbf	22270 [24170] lbf	22930 [24890] lbf	22930 [24890] lbf
Arm digging force	SAE	76.5 [83.1] kN	73.6 [79.9] kN	62.8 [68.2] kN	55.9 [60.7] kN
		7800 [8470] kgf	7500 [8140] kgf	6400 [6950] kgf	5700 [6190] kgf
		17200 [18670] lbf	16530 [17950] lbf	14110 [15320] lbf	12570 [13640] lbf
	ISO	80.4 [87.3] kN	77.4 [84.1] kN	65.7 [71.4] kN	57.9 [62.8] kN
		8200 [8900] kgf	7900 [8580] kgf	6700 [7270] kgf	5900 [6410] kgf
		18080 [19630] lbf	17420 [18910] lbf	14770 [16040] lbf	13010 [14120] lbf

* : Standard [ ] : Power boost

4. WEIGHT

1) MONO BOOM

Item	R150WVSPRO	
	kg	lb
Upperstructure assembly	5090	11220
Main frame weld assembly	1145	2525
Engine assembly	485	1069
Main pump assembly	100	220
Main control valve assembly	80	175
Swing motor assembly	107	235
Hydraulic oil tank assembly	180	400
Fuel tank assembly	140	310
Counterweight	1650	3640
Cab assembly	500	1100
Lower frame weld assembly	1550	3420
Swing bearing	186	410
Travel motor assembly	60	130
Turning joint	120	265
Transmission assembly	140	310
Front axle assembly	540	1190
Rear axle assembly	450	990
Dozer blade assembly (rear)	400	880
Front attachment assembly (4.6m boom, 2.1 m arm, 0.58 m^3 SAE heaped bucket)	2400	5290
4.6 m boom assembly	870	1918
2.1 m arm assembly	385	850
0.58 m^3 SAE heaped bucket assembly	480	1060
Boom cylinder assembly	130	285
Arm cylinder assembly	160	350
Bucket cylinder assembly	100	220
Bucket control link assembly	80	175
Oscillating cylinder assembly	30	70
Blade cylinder assembly (rear)	55	120

5. LIFTING CAPACITIES

1) HX150WVSPRO

4.60 m (15' 1") boom, 2.1 m (6'11") arm equipped with 0.58 m^3 (SAE heaped) bucket and rear dozer blade down with 1700 kg counterweight.

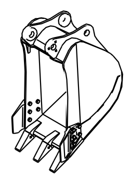
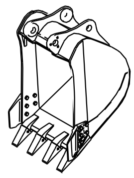
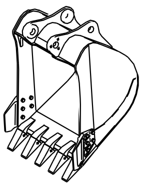
- : Rating over-front
- : Rating over-side or 360 degree

Load point height		Load radius								At max. reach		
		1.5 m (5.0 ft)		3.0 m (10.0 ft)		4.5 m (15.0 ft)		6.0 m (20.0 ft)		Capacity		Reach
												m (ft)
6.0 m	kg					*3130	*3130			*3050	1950	6.43
(20.0 ft)	lb					*6900	*6900			*6720	4300	(21.1)
4.5 m	kg					*3540	*3540	*3210	2120	*3160	1520	7.23
(15.0 ft)	lb					*7800	*7800	*7080	4670	*6970	3350	(23.7)
3.0 m	kg			*6620	6450	*4510	3310	*3770	2040	3230	1340	7.59
(10.0 ft)	lb			*14590	14220	*9940	7300	*8310	4500	7120	2950	(24.9)
1.5 m	kg			*8650	5730	*5580	3060	*4230	1930	3180	1300	7.59
(5.0 ft)	lb			*19070	12630	*12300	6750	*9330	4250	7010	2870	(24.9)
Ground	kg			*9090	5510	*6240	2900	*4540	1860	3420	1390	7.24
Line	lb			*20040	12150	*13760	6390	*10010	4100	7540	3060	(23.8)
-1.5 m	kg	*7380	*7380	*9530	5530	*6240	2860			*3760	1700	6.45
(-5.0 ft)	lb	*16270	*16270	*21010	12190	*13760	6310			*8290	3750	(21.2)
-3.0 m	kg	*11710	*11710	*7990	5690	*5240	2950					
(-10.0 ft)	lb	*25820	*25820	*17610	12540	*11550	6500					

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

6. BUCKET SELECTION GUIDE

1) GENERAL BUCKET

		
0.23 m^3 SAE heaped bucket	0.40, 0.46 m^3 SAE heaped bucket	0.52, ※0.58, 0.65, 0.71 m^3 SAE heaped bucket

Capacity		Width		Weight	Recommendation						
					*4.6 m (15' 1") Mono boom				4.9 m (16' 9") Hyd adjustable boom		
SAE heaped	CECE heaped	Without side cutter	With side cutter		1.9 m arm (6' 3")	*2.1 m arm (6' 11")	2.5 m arm (8' 2")	3.0 m arm (9' 10")	1.9 m arm (6' 3")	2.1 m arm (6' 11")	2.5 m arm (8' 2")
0.23 m^3 (0.30 yd^3)	0.20 m^3 (0.26 yd^3)	520 mm (20.5")	620 mm (24.4")	335 kg (740 lb)							
0.40 m^3 (0.52 yd^3)	0.35 m^3 (0.46 yd^3)	760 mm (29.9")	860 mm (33.9")	410 kg (900 lb)							
0.46 m^3 (0.60 yd^3)	0.40 m^3 (0.52 yd^3)	850 mm (33.5")	950 mm (37.4")	435 kg (960 lb)							
0.52 m^3 (0.68 yd^3)	0.45 m^3 (0.59 yd^3)	935 mm (36.8")	1035 mm (40.7")	460 kg (1010 lb)							
※0.58 m^3 (0.76 yd^3)	0.50 m^3 (0.65 yd^3)	1030 mm (40.6")	1130 mm (44.5")	480 kg (1060 lb							
0.65 m^3 (0.85 yd^3)	0.55 m^3 (0.72 yd^3)	1110 mm (43.7")	1210 mm (47.6")	500 kg (1100 lb)							
0.71 m^3 (0.93 yd^3)	0.60 m^3 (0.78 yd^3)	1205 mm (47.4")	1305 mm (51.4")	540 kg (1190 lb)							

※ : Standard bucket

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

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

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

7. SPECIFICATIONS FOR MAJOR COMPONENTS

1) ENGINE

Item	Specification
Model	Cummins QSB 7
Type	4-cycle turbocharged diesel engine, low emission
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	17.2 : 1
Rated gross horse power (SAE J1995)	168Hp (124 kW) at 2050 rpm
Maximum torque	65.8kgf · m (475lbf · ft) at 1200 rpm
Engine oil quantity	24 l (6.3U.S. gal)
Dry weight	485kg (1069lb)
High idling speed	1450 ± 50 rpm
Low idling speed	800 ± 50 rpm
Rated fuel consumption	151.4g/Hp · hr at 1900 rpm
Starting motor	24 V - 7.8kW
Alternator	24 V - 90 A
Battery	2 × 12 V × 120 Ah

2) MAIN PUMP

Item	Specification
Type	Variable displacement tandem axis piston pumps
Capacity	2 × 80 cc/rev
Maximum pressure	350 kgf/cm^2 (4980 psi) [380 kgf/cm^2 (5400 psi)]
Rated oil flow	2 × 172 l/min (45.4 U.S. gpm / 37.8 U.K. gpm)
Rated speed	2150 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	32.3 l /min (8.3 U.S. gpm/6.9 U.K. gpm)

4) MAIN CONTROL VALVE

Item	Specification
Type	11 spools two-block
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	72 cc/rev
Relief pressure	280 kgf/cm^2(3978 psi)
Braking system	Automatic, spring applied hydraulic released
Braking torque	36.8kgf · m (266lbf · ft)
Brake release pressure	20.4~50 kgf/cm^2 (289~711 psi)
Reduction gear type	2 - stage planetary

6) TRAVEL MOTOR

Item	Specification
Type	Variable displacement bent-axis axial piston motor
Relief pressure	400kgf/cm^2 (5689psi)
Counter balance valve	Applied
Capacity	107 cc/rev

7) POWER TRAIN

Item	Description		Specification
Transmission	Type		2 speed power shift transmission
	Gear ratio	1st	4.87
		2nd	1.20
Parking brake	Type		Multi disc brake integrated in transmission
	Maximum braking torque		2124 kgf · m (15360 lbf · ft)
Axle	Type		4 wheel drive with differential
	Gear ratio		16.0
	Brake		Multi disc brake

8) REMOTE CONTROL VALVE

Item		Specification
Type		Pressure reducing type
Operating pressure	Minimum	6.5 kg/cm^2 (92 psi)
	Maximum	26 kg/cm^2 (370 psi)
Single operation stroke	Lever	61 mm (2.4 in)

9) CYLINDER

Item			Specification
Boom cylinder		Bore dia × Rod dia × Stroke	ø 105 × ø 75 × 1075mm
		Cushion	Extend only
Arm cylinder		Bore dia × Rod dia × Stroke	ø 115 × ø 80 × 1138mm
		Cushion	Extend and retract
Bucket cylinder		Bore dia × Rod dia × Stroke	ø 100 × ø 70 × 850mm
		Cushion	Extend only
Dozer cylinder	Rear	Bore dia × Rod dia × Stroke	ø 100 × ø 65 × 236mm
		Cushion	Extend only
Outrigger cylinder		Bore dia × Rod dia × Stroke	ø 110 × ø 75 × 475mm
		Cushion	-
Adjust cylinder		Bore dia × Rod dia × Stroke	ø 145 × ø 90 × 613mm
		Cushion	Extend only
Adjust boom cylinder		Bore dia × Rod dia × Stroke	ø 105 × ø 75 × 975mm
		Cushion	Extend only

10) BUCKET

Item	Capacity		Tooth quantity	Width	
	SAE heaped	CECE heaped		Without side cutter	With side cutter
Standard	※ 0.58 m^3 (0.76 yd^3)	0.50 m^3 (0.65 yd^3)	5	1030 mm (39.4")	1130 mm (44.5")
Option	0.23 m^3 (0.30 yd^3)	0.20 m^3 (0.26 yd^3)	3	520 mm (20.5")	620 mm (24.4")
	0.40 m^3 (0.52 yd^3)	0.35 m^3 (0.46 yd^3)	4	760 mm (29.9")	860 mm (33.9")
	0.46 m^3 (0.60 yd^3)	0.40 m^3 (0.52 yd^3)	4	850 mm (33.5")	950 mm (37.4")
	0.52 m^3 (0.68 yd^3)	0.45 m^3 (0.59 yd^3)	5	935 mm (36.8")	1035 mm (40.7")
	0.65 m^3 (0.85 yd^3)	0.55 m^3 (0.72 yd^3)	5	1110 mm (43.7")	1210 mm (47.6")
	0.71 m^3 (0.93 yd^3)	0.60 m^3 (0.78 yd^3)	5	1205 mm (47.4")	1305 mm (51.4")
	◎ 0.55 m^3 (0.72 yd^3)	0.45 m^3 (0.59 yd^3)	-	1800 mm (70.9")	-
	★ 0.45 m^3 (0.59 yd^3)	0.40 m^3 (0.52 yd^3)	-	1520 mm (59.8")	-

◎ : Slope finishing bucket

★ : Ditch cleaning bucket

8. RECOMMENDED OILS

Use only oils listed below or equivalent.
Do not mix different brand oil.

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	24 (6.3)	★SAE 5W-40 SAE 30 SAE 10W SAE 10W-30 SAE 15W-40
Transmission case	Engine oil	2.5 (0.7)	
Swing drive	Gear oil	2.5 (0.7)★1 3.5 (1.0)	★SAE 75W-90 SAE 85W-140
Swing drive	Grease	0.35 (0.1)	★NLGI NO.1 NLGI NO.2
Front axle	Gear oil	Center : 9.0(2.37) Hub : 2.4×2 (0.63×2)	SAE 85W-90 LSD or UTTO
Rear axle	Gear oil	Center : 11.2(2.95 Hub : 2.4×2 (0.63×2)	
Hydraulic tank	Hydraulic oil	Tank: 124 (32.8) System: 240 (67.9	★ISO VG 15 ISO VG 32 ISO VG 46 ISO VG 68
Fuel tank	Diesel fuel	270 (71.3)	★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★1	19.5 (5.2)	Ethylene glycol base permanent type (50 : 50) ★Ethylene glycol base permanent type (60 : 40)

SAE : Society of Automotive Engineers
API : American Petroleum Institute
ISO : International Organization for Standardization
NLGI : National Lubricating Grease Institute
ASTM : American Society of Testing and Materia
UTTO : Universal Tractor Transmission Oil

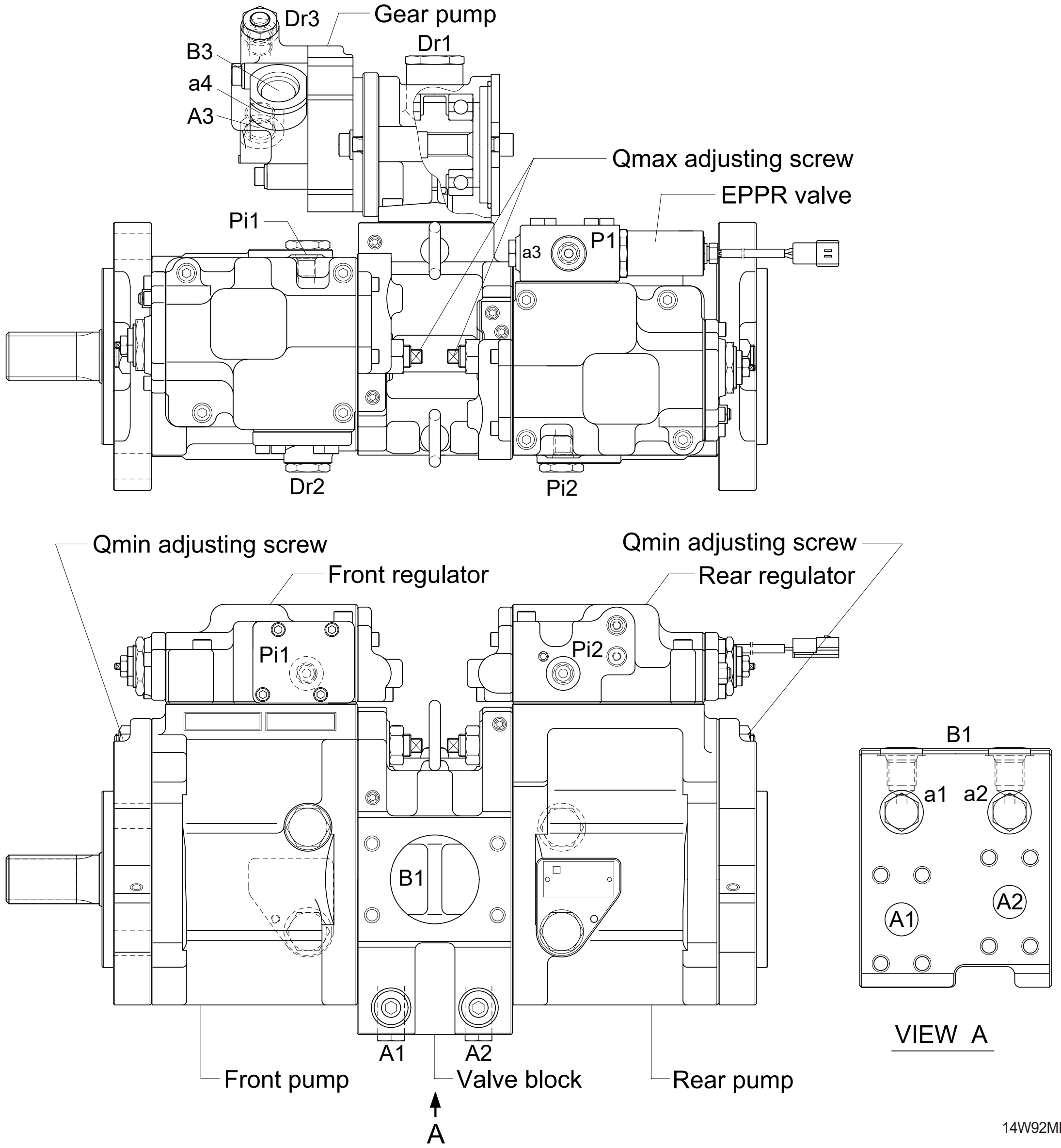
★ : Cold region
Russia, CIS, Mongolia
★1 : Soft water
City water or distilled water
★2 : Service when the grease inlet exists on the equipment

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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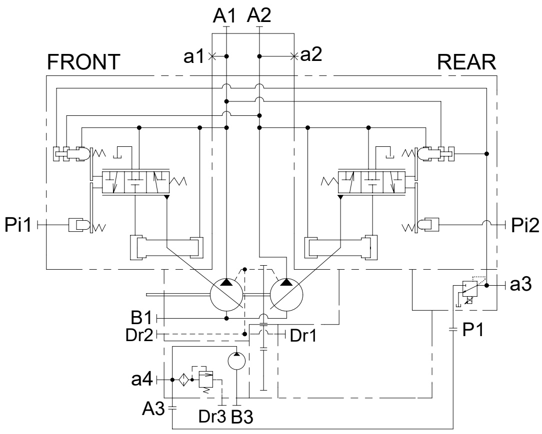
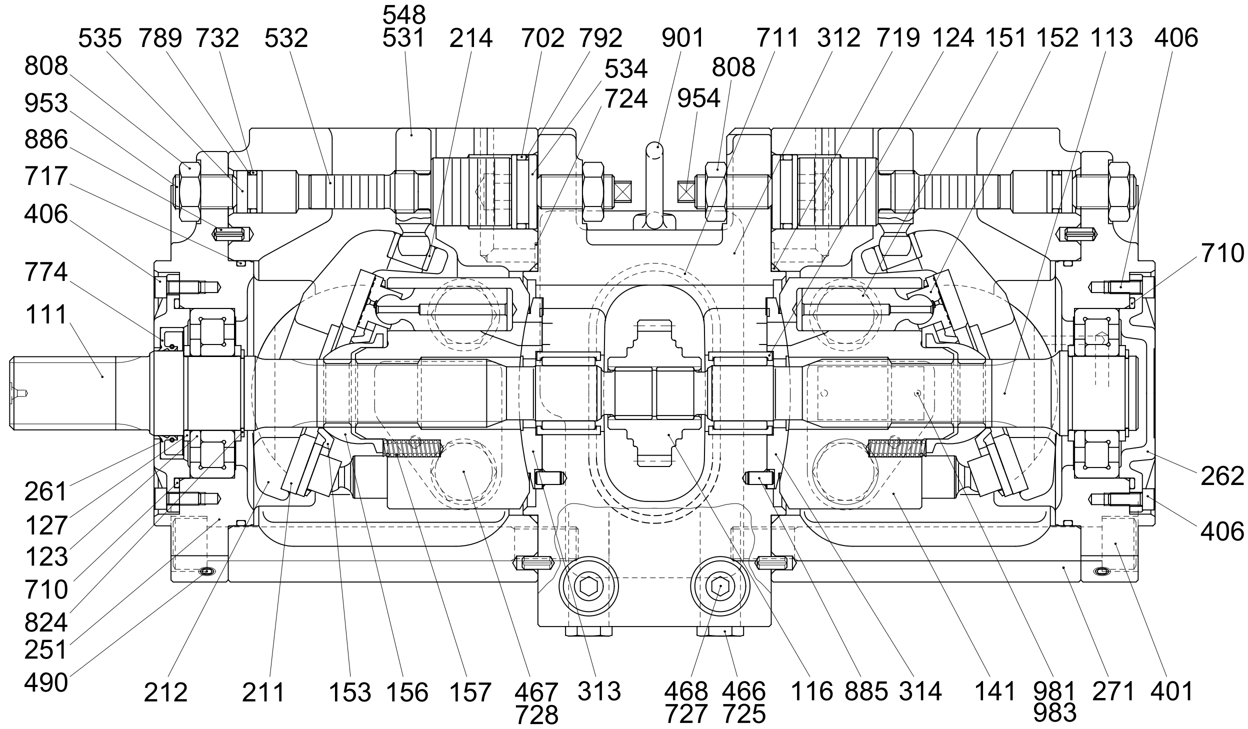


Hydraulic circuit

Port	Port name	Port size
A1,2	Delivery port	SAE6000psi 3/4"
B1	Suction port	SAE2500psi 2 1/2"
Dr1	Drain port	PF 3/4 - 20
Dr2	Drain port	PF 1/2 - 19
Dr3	Drain port	PF 3/8 - 15
Pi1, i2	Pilot port	PF 1/4 - 15
P1	EPPR valve primary port	PF 1/4 - 15
a1,2,3	Gauge port	PF 1/4 - 15
a4	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

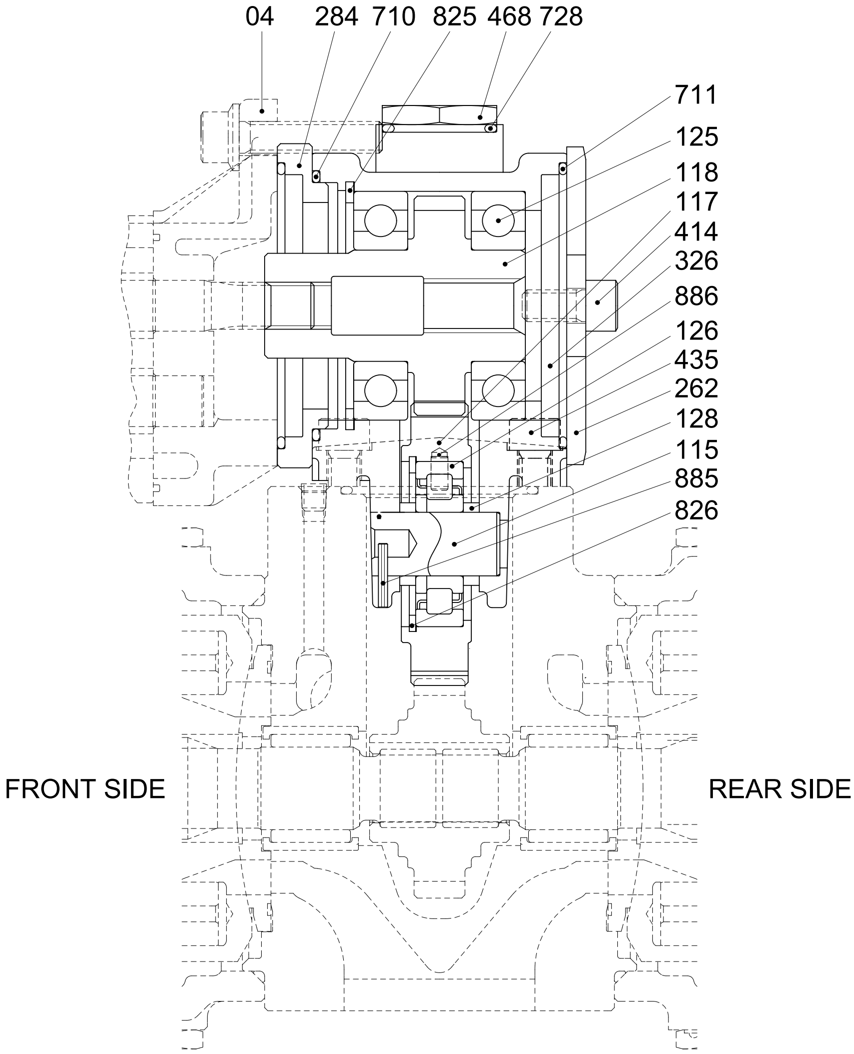
1) MAIN PUMP (1/2)

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



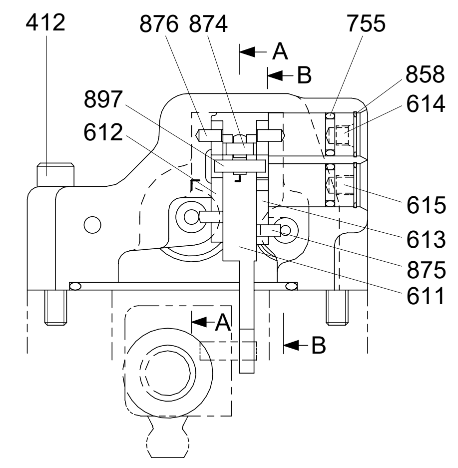
111 Drive shaft (F)
113 Drive shaft (R)
116 Gear
123 Roller bearing
124 Needle bearing
127 Bearing spacer
141 Cylinder block
151 Piston
152 Shoe
153 Push-plate
156 Bushing
157 Cylinder spring
211 Shoe plate
212 Swash plate
214 Bushing
251 Support
261 Seal cover (F)
262 Seal cover (R)
271 Pump casing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

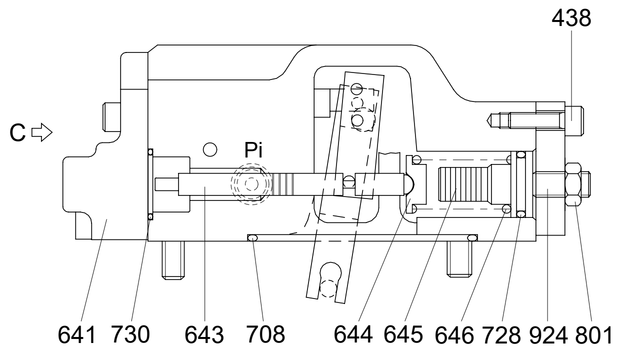
MAIN PUMP (2/2)



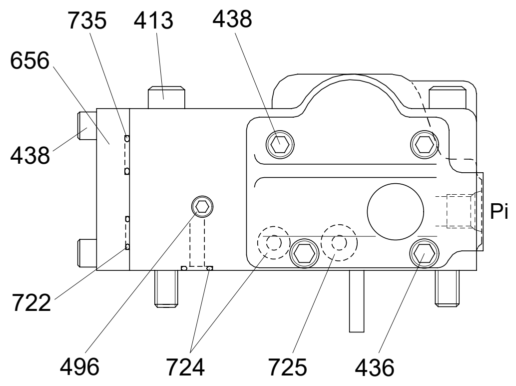
04	Gear pump	262	Cover	711	O-ring
115	Shaft	284	Plate	728	O-ring
117	Gear No. 2	326	Gear case	825	Retainer ring
118	Gear No. 3	414	Screw	826	Retainer ring
125	Ball bearing	435	Hexagon socket bolt	885	Spring pin
126	Roller bearing	468	Plug	886	Pin
128	Bearing spacer	710	O-ring		

2) REGULATOR (1/2)

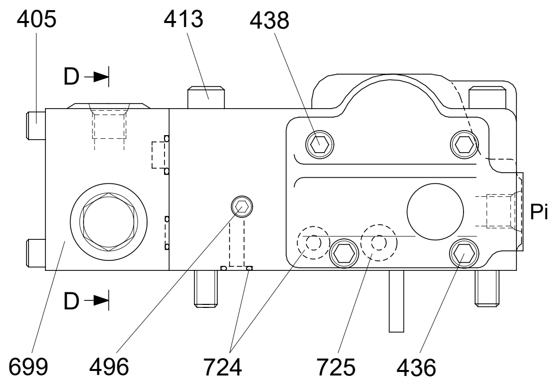




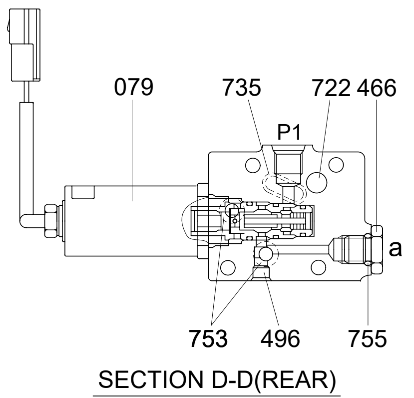
SECTION B-B



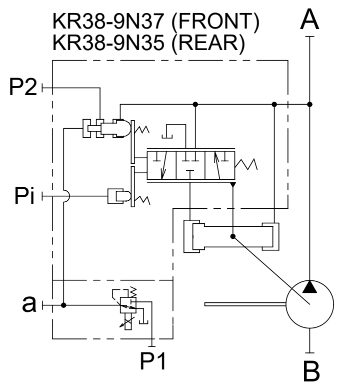
VIEW C (FRONT)



VIEW C (REAR)

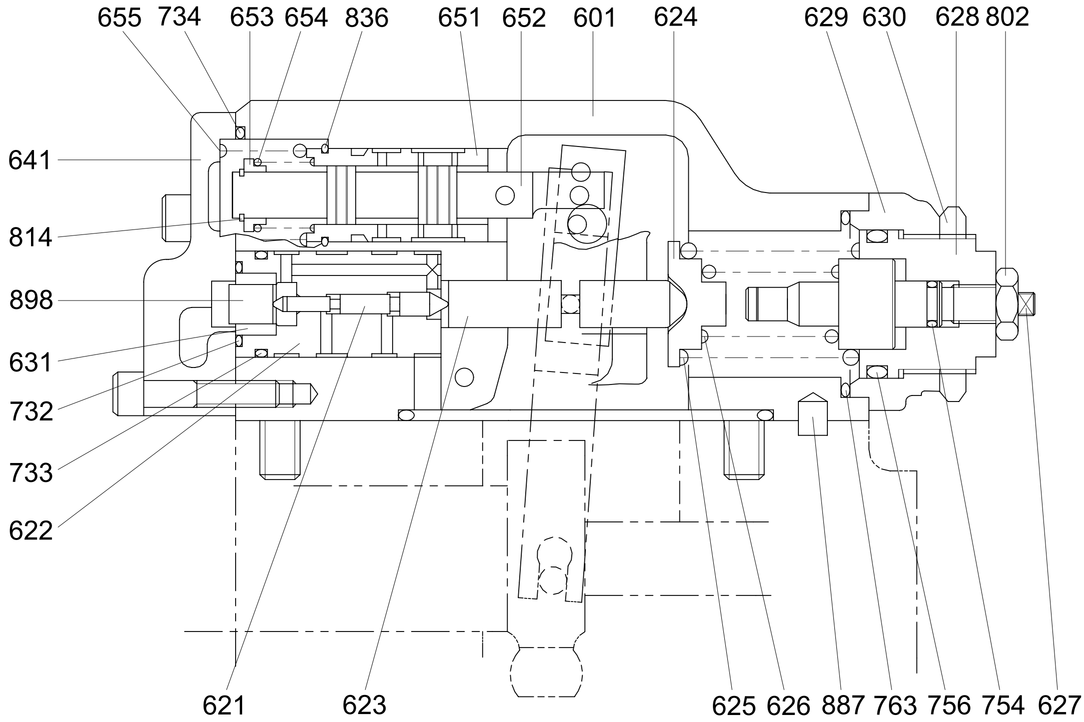


SECTION D-D(REAR)



Port	Port name	Port size
A	Delivery port	3/4"
B	Suction port	2 1/2"
Pi	Pilot port	PF 1/4-15
P1	EPPR valve primary port	PF 1/4-15
P2	Companion delivery port	Internal
a	Gauge port	PF 1/4-15

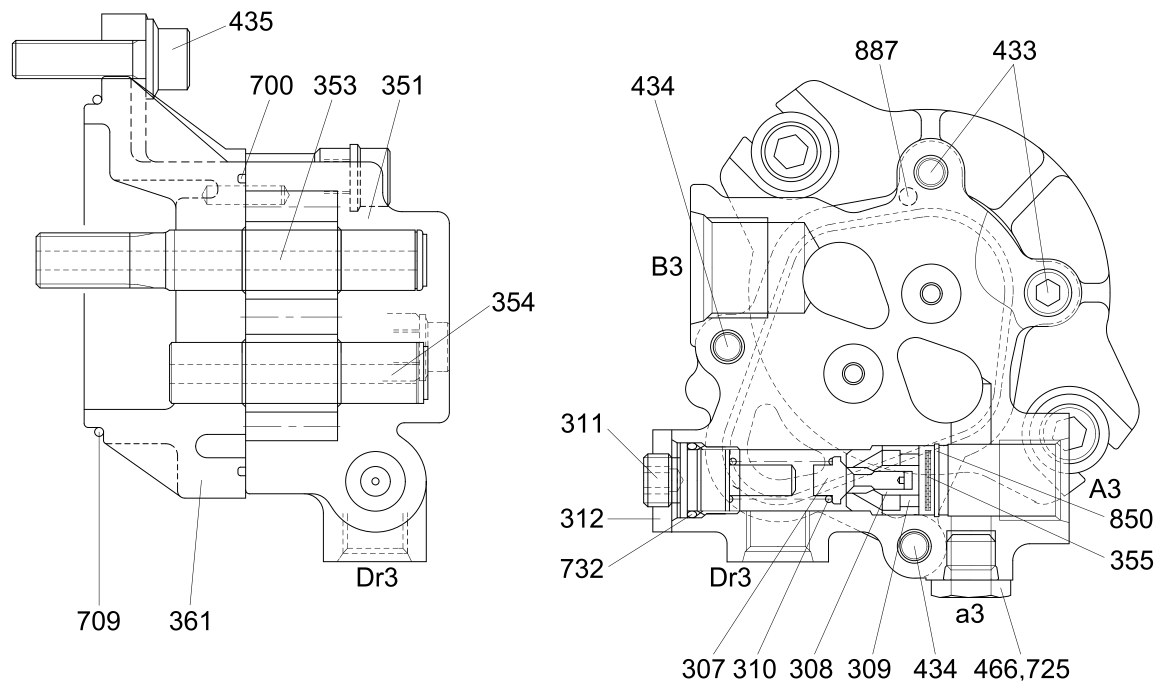
REGULATOR (2/2)



SECTION A-A

079	EPPR valve assembly	629	Cover (C)	733	O-ring
405	Hexagon socket screw	630	Lock nut	734	O-ring
412	Hexagon socket screw	631	Sleeve, Pf	735	O-ring
413	Hexagon socket screw	641	Pilot cover	753	O-ring
436	Hexagon socket screw	643	Pilot piston	754	O-ring
438	Hexagon socket screw	644	Spring seat (Q)	755	O-ring
466	Plug	645	Adjust stem (Q)	756	O-ring
496	Plug	646	Pilot spring	763	O-ring
601	Casing	651	Sleeve	801	Nut
611	Feed back lever	652	Spool	802	Nut
612	Lever (1)	653	Spring seat	814	Snap ring
613	Lever (2)	654	Return spring	836	Snap ring
614	Fulcrum plug	655	Set spring	858	Snap ring
615	Adjust plug	656	Block cover	874	Pin
621	Compensator piston	699	Valve casing	875	Pin
622	Piston case	708	O-ring	876	Pin
623	Compensator rod	722	O-ring	887	Pin
624	Spring seat (C)	724	O-ring	897	Pin
625	Outer spring	725	O-ring	898	Pin
626	Inner spring	728	O-ring	924	Set screw
627	Adjust stem (C)	730	O-ring		
628	Adjust screw (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	709	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.

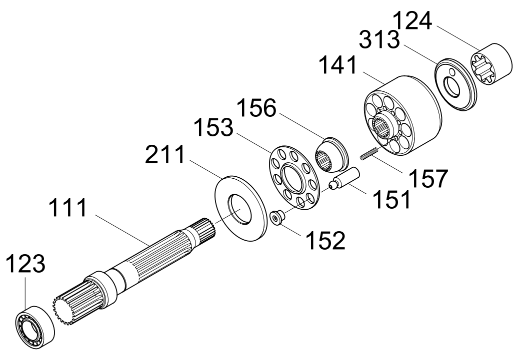
(1) Rotary group

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.



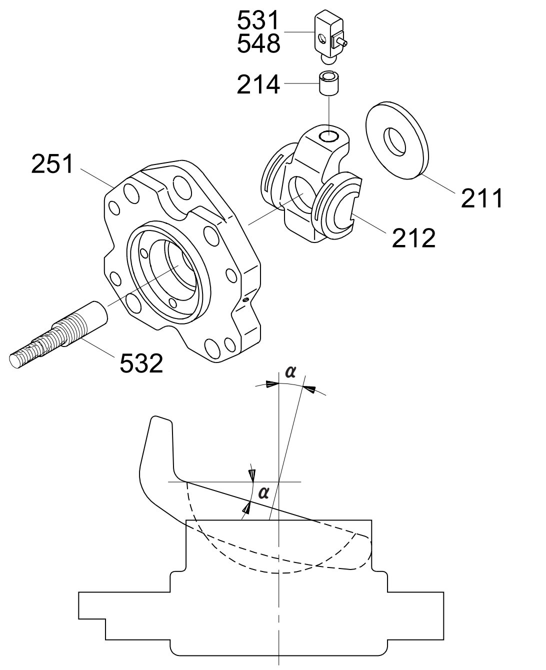
21092MP06

(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 (α)



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(3) Valve block group

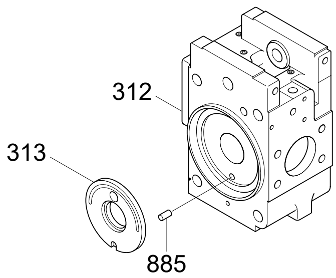
The valve block group consists of valve block (312), valve plate (313) and valve plate pin (885).

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

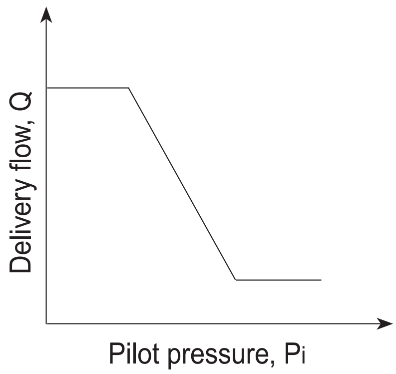
Regulator consists of the negative flow control, total horse power control and power shift control function.

(1) Negative flow control

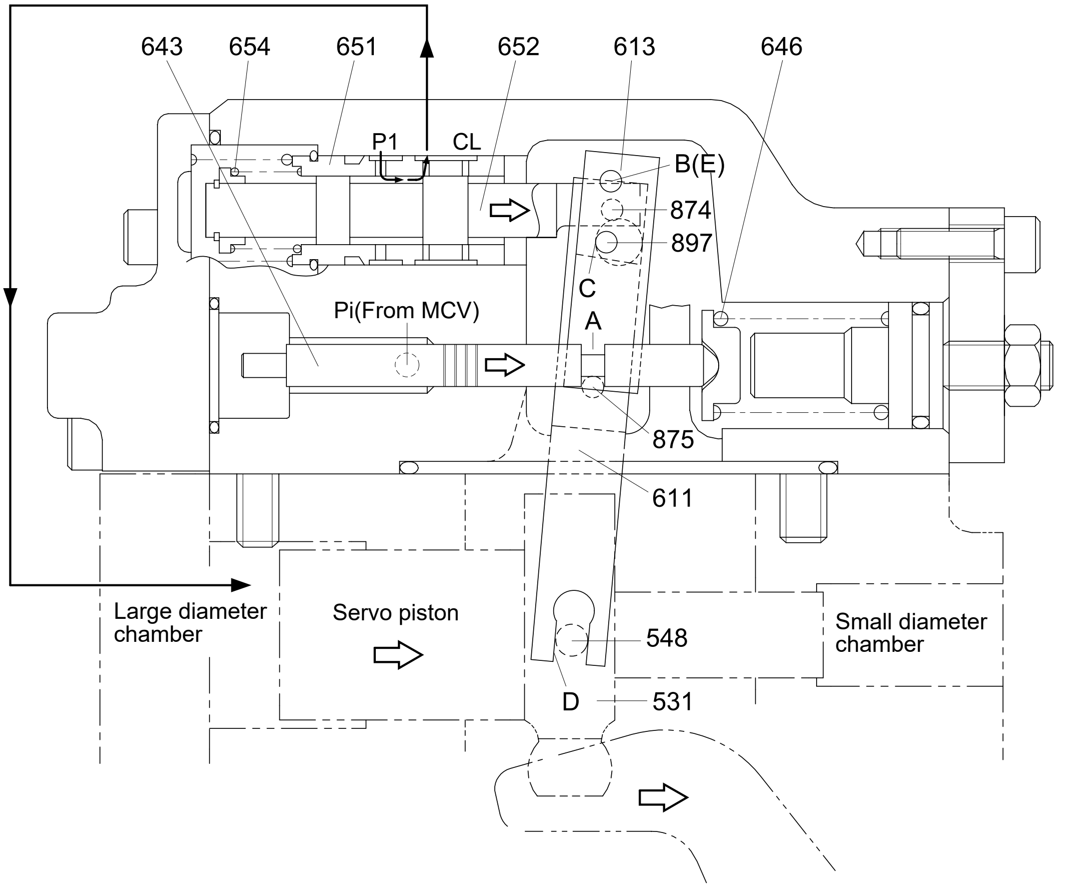
By changing the pilot pressure Pi, the pump tilting angle (delivery flow) is regulated arbitrarily, as shown in the figure.

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

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



① Flow reducing function



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

The groove (A) in the pilot piston is fitted with the pin (875) that is fixed to lever 2 (613). Therefore, when the pilot piston moves, lever 2 rotates around the fulcrum of point B [fixed by the fulcrum plug (614) and pin (875)]. Since the large hole section (C) of lever 2 contains a protruding pin (897) fixed to the feedback lever (611), the pin (897) moves to the right as lever 2 rotates. Since the opposing-flat section (D) of the feedback lever is fitted with the pin (548) fixed by the tilting pin (531) that swings the swash plate, the feedback lever rotates around the fulcrum of point D, as the pin (897) moves.

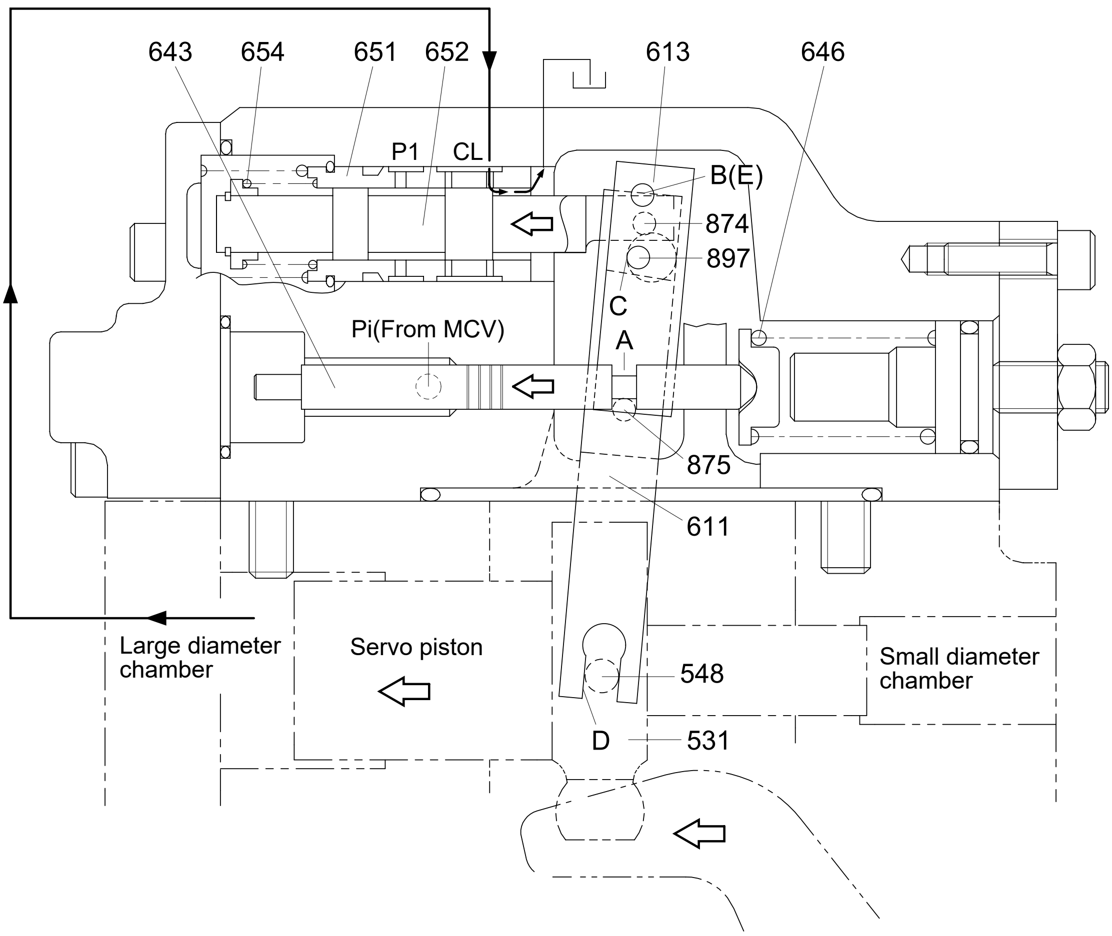
Since the feedback lever is connected with the spool (652) via the pin (874), the spool moves to the right.

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

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

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

② Flow increasing function



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

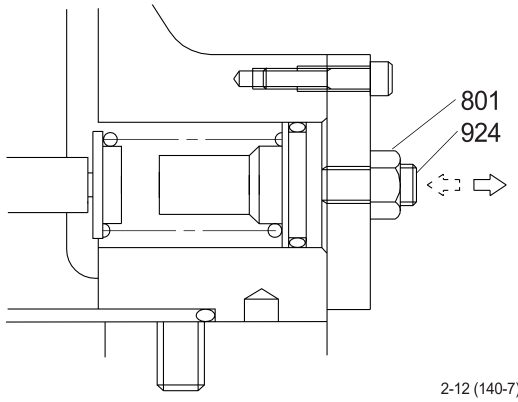
As the servo piston moves, point D also moves to the left, the feedback lever rotates around the fulcrum of point C, and the spool moves to the right till the opening between the spool and sleeve is closed.

③ Adjustment of flow control characteristic

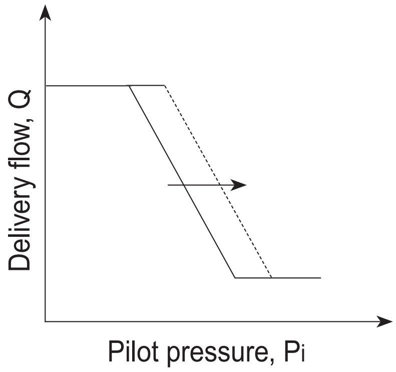
The flow control characteristic can be adjusted with the adjusting screw.

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

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



2-12 (140-7)



※ 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)
2100	+1/4	+1.53	+10

(2) Total horsepower control

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

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

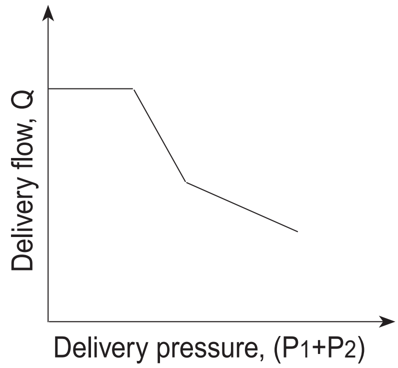
Since the regulator is of the simultaneous total horsepower type that operates by the sum of load pressures of the two pumps in the tandem double-pump system, the prime mover is automatically prevented from being overloaded, irrespective of the load condition of the two pumps, when horsepower control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

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

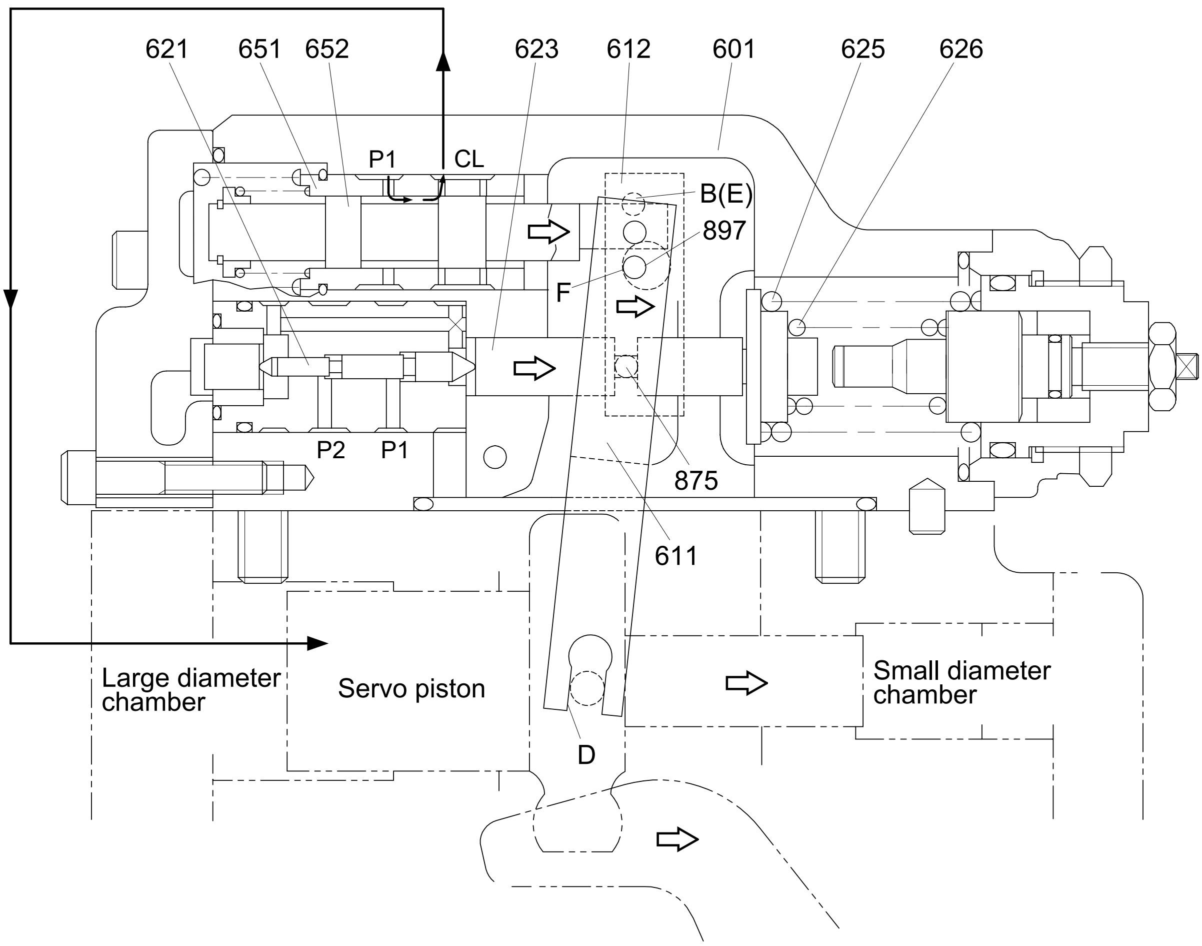
$Tin = P1 \times q/2\pi + P2 \times q/2\pi$

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

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



① Overload preventive function



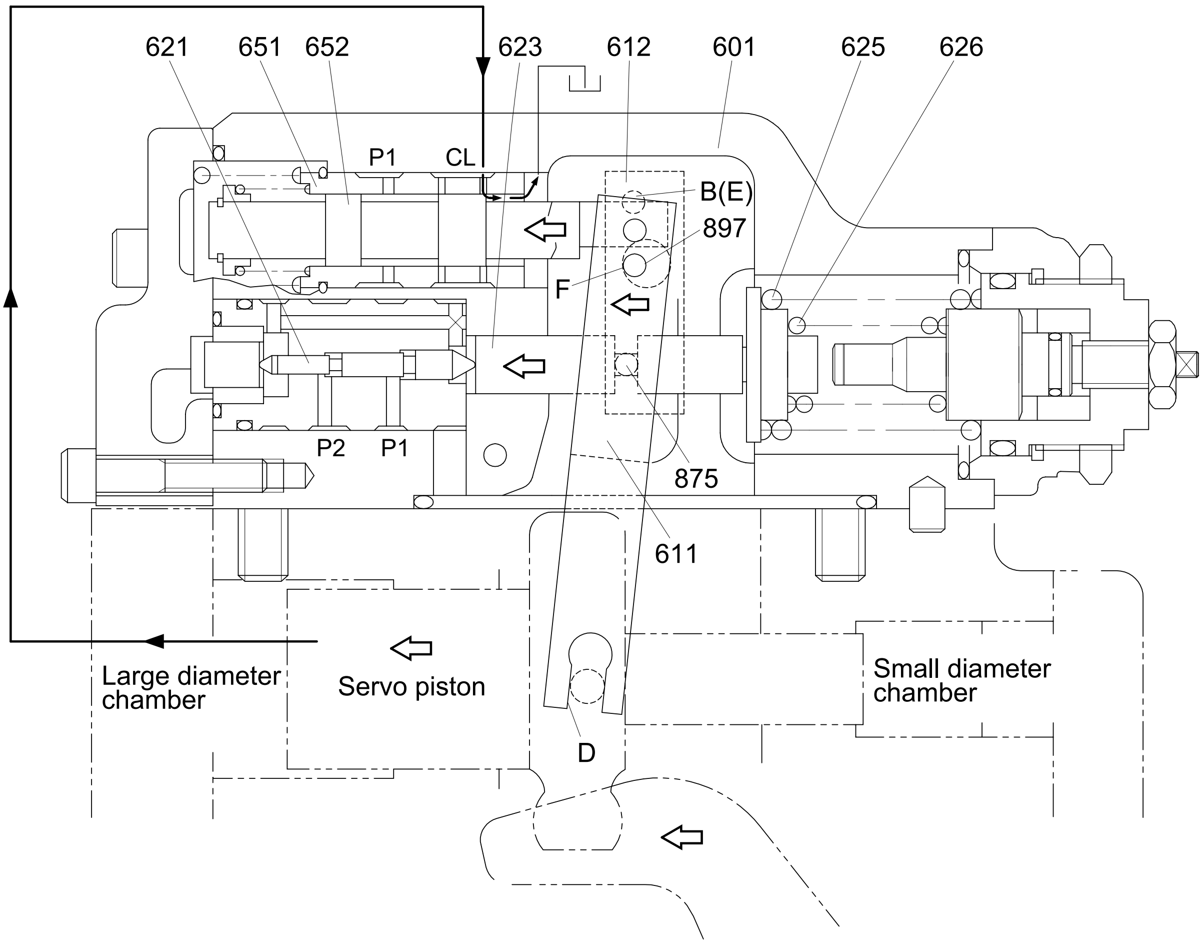
When the self pump delivery pressure P1 or the companion pump delivery pressure P2 rises, it acts on the stepped part of the compensating piston (621). It presses the compensating rod (623) to the right till the force of the outer spring (625) and inner spring (626) balances with the hydraulic force.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

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

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

The movement of the servo piston is transmitted to the feedback lever via point D. Then the feedback lever rotates around the fulcrum of point F and the spool is shifted to the left. The spool moves till the opening between the spool (652) and sleeve (651) is closed.

② Flow reset function



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

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

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

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

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

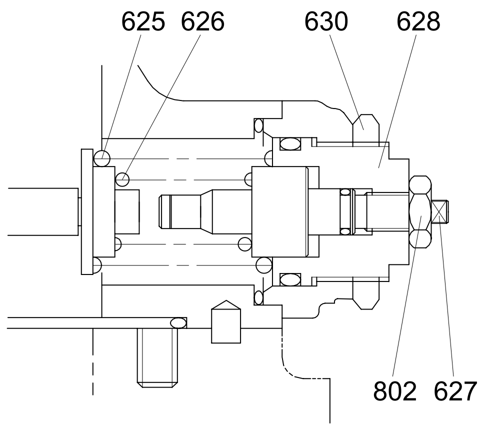
④ **Adjustment of input horsepower**

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

a. **Adjustment of outer spring**

Adjust it by loosening the hexagon nut (630) and by tightening (or loosening) the adjusting screw C (628).

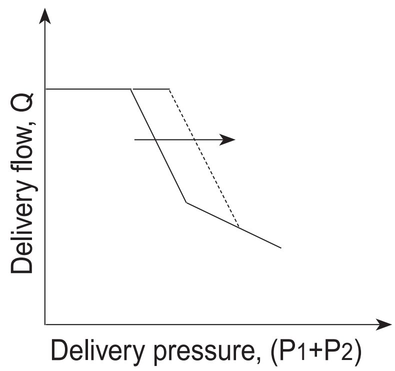
Tightening the screw shifts the control chart to the right and increases the input horsepower as shown in the figure. Since turning the adjusting screw C (628) by N turns changes the setting of the inner spring (626), return the adjusting stem C (627) by N×A turns at first. (A=1.73)



2107A2MP07A

※ **Adjusting value**

Speed	Adjustment of input horsepower		
	Tightening amount of adjusting screw (C) (628)	Compensating control starting pressure change amount	Input torque change amount
(min^{-1})	(Turn)	(kgf/cm^2)	(kgf · m)
2100	+1/4	+17.7	+3.58



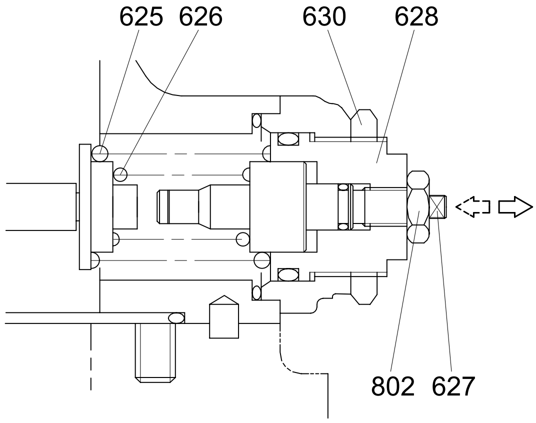
b. Adjustment of inner spring

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

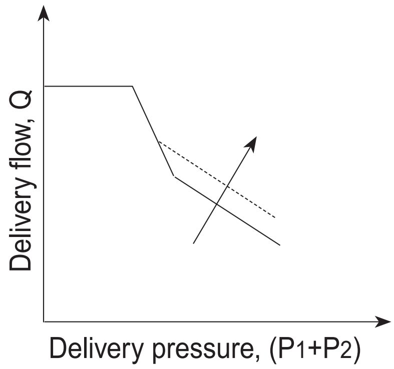
Tightening the screw increases the flow and then the input horsepower as shown in the figure.

※ Adjusting value

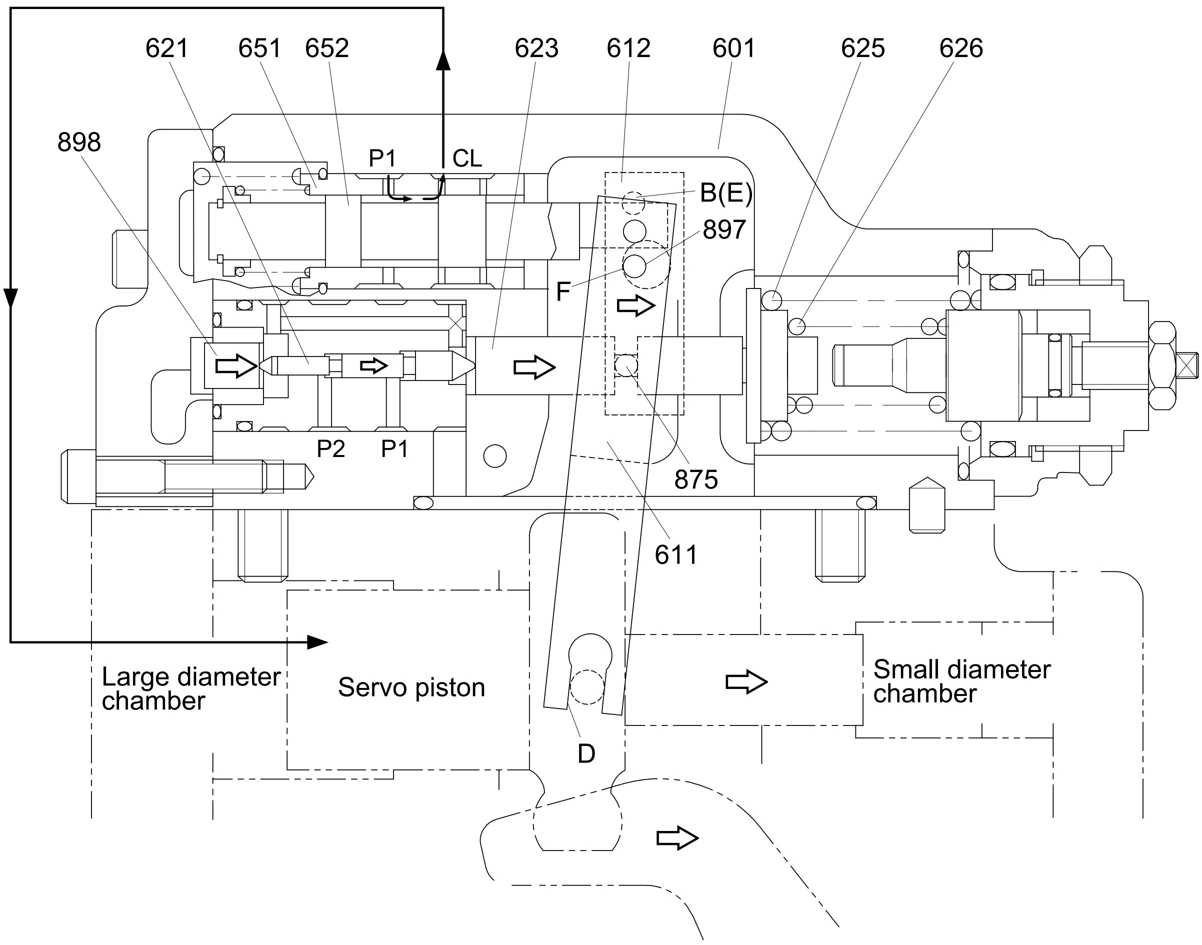
Speed	Adjustment of input horsepower		
	Tightening amount of adjusting stem (C) (627)	Flow change amount	Input torque change amount
(min^{-1})	(Turn)	(l /min)	(kgf · m)
2100	+1/4	+8.8	+3.8



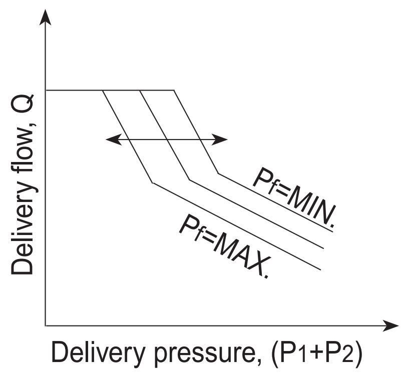
2107A2MP08



(3) Power shift control



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

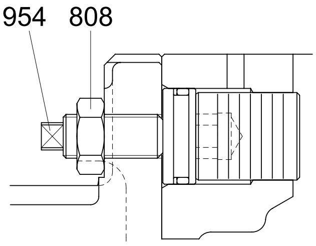


This function permits arbitrary setting of the pump output power, thereby providing the optimum power level according to the operating condition.
The power shift pressure Pf controls the set horsepower of the pump to a desired level, as shown in the figure.
As the power shift pressure Pf rises, the compensating rod (623) moves to the right via the pin (898) and compensating piston (621).
This decreases the pump tilting angle and then the set horsepower in the same way as explained in the overload preventive function of the horsepower control. On the contrary, the set horsepower rises as the power shift pressure Pf falls.

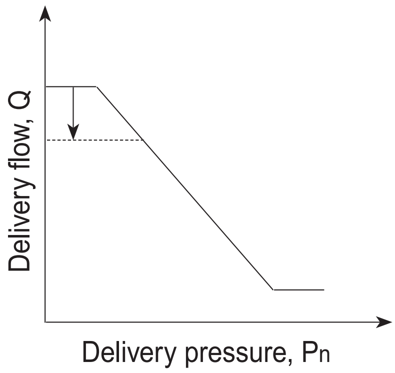
(4) Adjustment of maximum and minimum flows

① Adjustment of maximum flow

Adjust it by loosening the hexagon nut (808) and by tightening (or loosening) the set screw (954).
The maximum flow only is adjusted without changing other control characteristics.

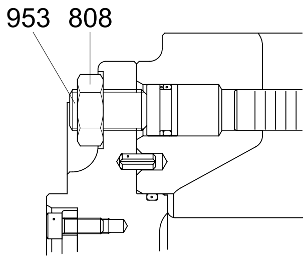


Speed	Adjustment of max flow	
	Tightening amount of adjusting screw (954)	Flow change amount
(min^{-1})	(Turn)	(l /min)
2100	+1/4	-3.4

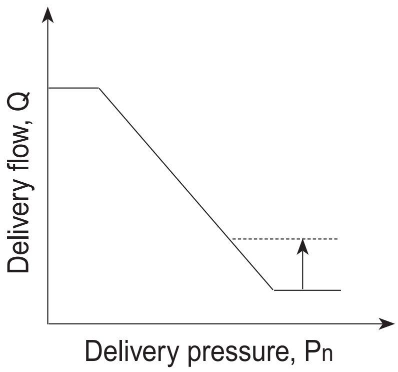


② Adjustment of minimum flow

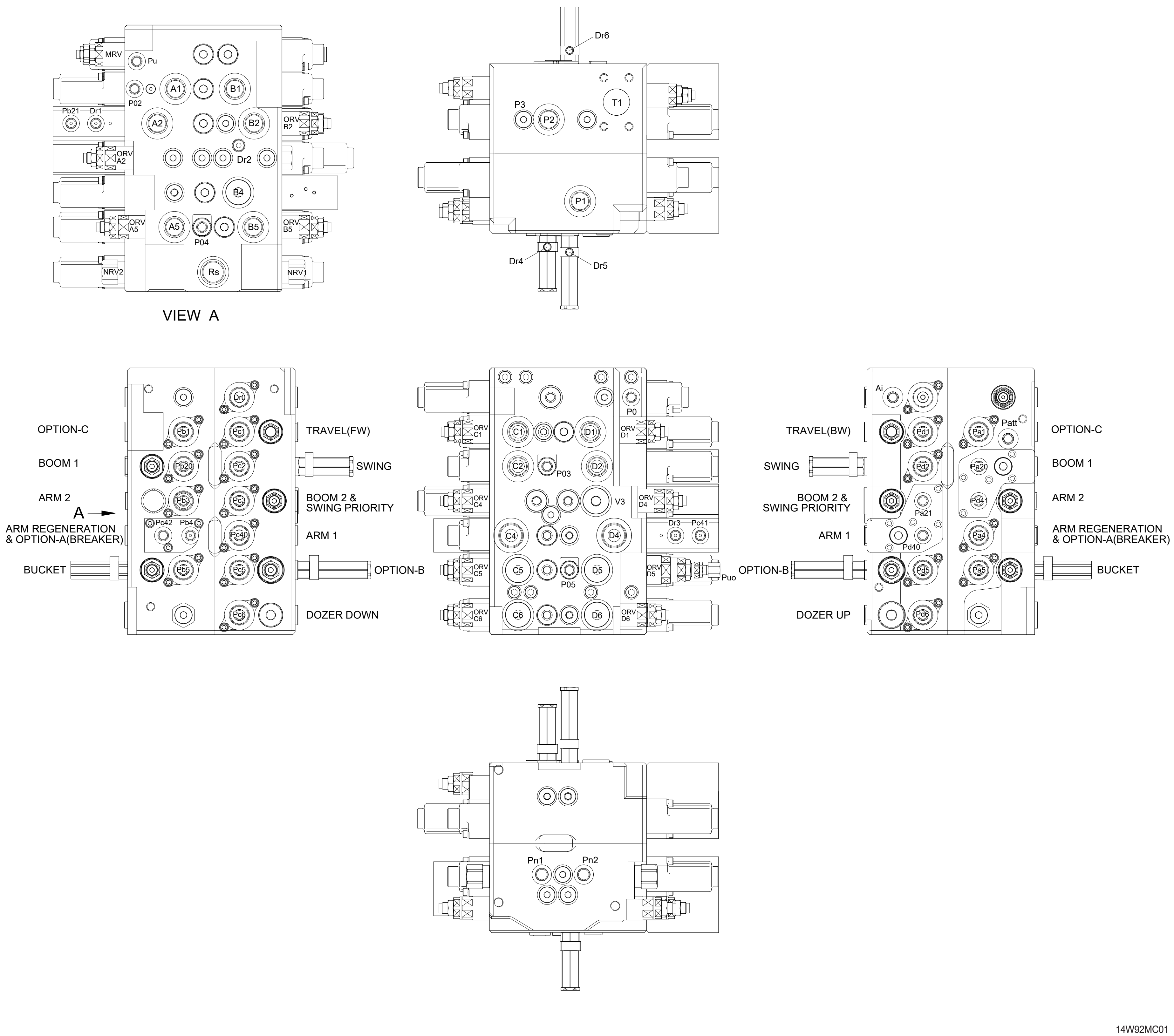
Adjust it by loosening the hexagon nut (808) and by tightening (or loosening) the hexagonal socket head set screw (953). Similarly to the adjustment of the maximum flow, other characteristics are not changed.
However, remember that, if tightened too much, the required horsepower during the maximum delivery pressure (or during relieving) may increase.



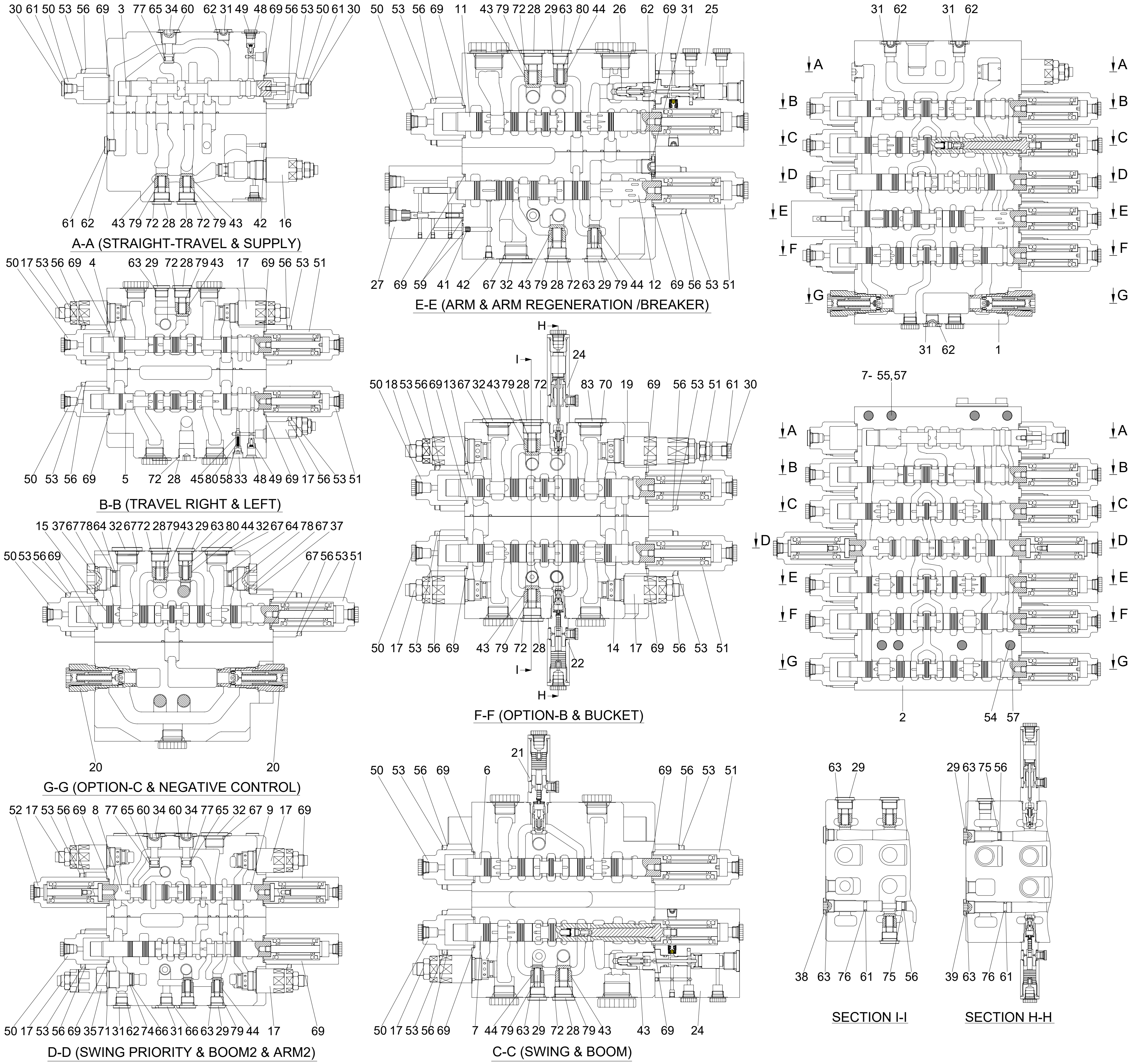
Speed	Adjustment of min flow	
	Tightening amount of adjusting screw (953)	Flow change amount
(min^{-1})	(Turn)	(l /min)
2100	+1/4	+3.4



1. STRUCTURE

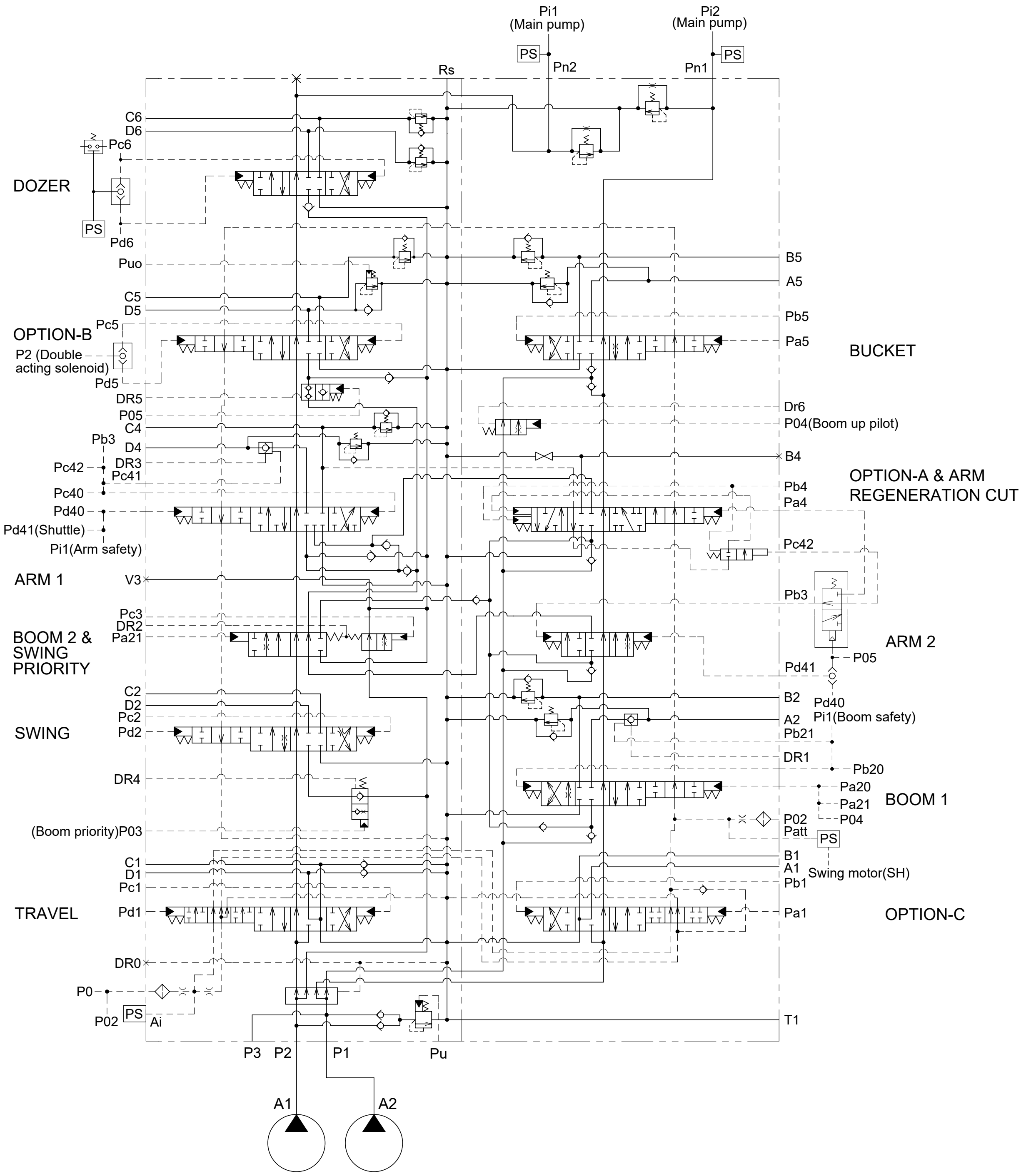


Mark	Port name	Port size	Tightening torque
Rs	Make up for swing motor	UNF 1 3/16	18 kgf · m (130 lbf · ft)
Pa1	Option C pilot port	PF 1/4	3.5~3.9 kgf · m (25.3~28.2 lbf · ft)
Pb1	Option C pilot port		
Pc1	Travel pilot port (FW)		
Pd1	Travel pilot port (BW)		
Pa20	Boom up pilot port		
Pa21	Boom up confluence pilot port		
Pb20	Boom down pilot port		
Pb21	Boom holding valve pilot port		
Pc2	Swing pilot port (RH)		
Pd2	Swing pilot port (LH)		
Pb3	Arm in confluence pilot port		
Pc3	Swing priority pilot port		
Pa4	Option A pilot port (breaker)		
Pb4	Arm in regeneration cut port		
Pc40	Arm in pilot port		
Pc41	Arm holding valve pilot port		
Pc42	Arm in regen-cut signal selector port		
Pd40	Arm out pilot port		
Pd41	Arm out confluence pilot port		
Pa5	Bucket in pilot port		
Pb5	Bucket out pilot port		
Pc5	Option B pilot port		
Pd5	Option B pilot port		
Pc6	Dozer down pilot port		
Pd6	Dozer up pilot port		
P0	Pilot pressure port		
Pu	Main relief pressure up		
Ai	Auto idle signal port		
Patt	Auto idle signal-attachment		
P02	Pilot signal port		
P03	Boom priority pilot port		
P04	Boom parallel orifice pilot port		
P05	Breaker summation pilot port		
P3	Quick clamp port		
Puo	Pilot pressure port		
Dr0	Drain port (travel straight)		
Dr1	Drain port (boom holding valve)		
Dr2	Drain port (boom2 & swing priority)		
Dr3	Drain port (arm holding valve)		
Pn1	Negative control signal port (P1 port side)	PF 3/8	7~8 kgf · m (50.6~57.8 lbf · ft)
Pn2	Negative control signal port (P2 port side)		
A1	Option C port	PF 3/4	15~18 kgf · m (109~130 lbf · ft)
B1	Option C port		
C1	Travel motor port (FW)		
D1	Travel motor port (BW)		
B2	Boom rod side port		
C2	Swing motor port (RH)		
D2	Swing motor port (LH)		
B4	Option A port (breaker)		
A5	Bucket head side port		
B5	Bucket rod side port		
C5	Option B port		
D5	Option B port		
C6	Dozer down port		
D6	Dozer up port		
P1	Pump port (P1 side)		
P2	Pump port (P2 side)		
A2	Boom head side port	PF 1	20~25 kgf · m (115~180 lbf · ft)
C4	Arm head side port		
D4	Arm rod side port		
Dr4	Drain port (swing logic valve)	PF 1/8	1.5~1.9 kgf · m (10.8~13.7 lbf · ft)
Dr5	Drain port (flow summation)		
Dr6	Drain port (bucket load check)		
T1	Return port	SAE3000, 1 1/2 (M12 × 1.75)	8.5~11.5 kgf · m (61.5~83.1 lbf · ft)



1	Housing-P1	41	Plug-orifice
2	Housing-P2	42	Plug
3	Spool-straight travel	43	Load check-poppet
4	Spool-travel	44	Load check-poppet
5	Spool-option C	45	Signal-poppet
6	Spool-swing	46	Travel straight-sleeve
7	Spool-boom 1	47	Travel straight-piston
8	Spool-swing priority	48	Orifice signal
9	Spool-boom 2	49	Coin type filter
10	Spool-arm 2	50	Pilot cap
11	Spool-arm 1	51	Pilot cap
12	Spool-arm regeneration & breaker	52	Pilot cap
		53	Socket bolt
13	Spool-option B	54	Socket bolt
14	Spool-bucket	55	Socket bolt
15	Spool-dozer	56	Washer
16	Main relief valve	57	Spring washer
17	Overload relief valve	58	O-ring
18	Overload relief valve	59	O-ring
19	Overload relief valve	60	O-ring
20	Negacon relief valve	61	O-ring
21	Swing logic valve	62	O-ring
22	Bucket logic valve	63	O-ring
23	Option on-off valve	64	O-ring
24	Holding valve kit A1	65	O-ring
25	Holding valve kit A2	66	O-ring
26	Holding valve kit B	67	O-ring
27	Regeneration block	68	O-ring
28	Plug	69	O-ring
29	Plug	70	O-ring
30	Plug	71	O-ring
31	Plug	72	O-ring
32	Plug	73	O-ring
33	Plug	74	Backup-ring
34	Plug-parallel	75	Backup-ring
35	Plug-relief cat	76	Backup-ring
36	Plug-relief cat	77	Backup-ring
37	Plug-relief cat	78	Backup-ring
38	Plug-bucket	79	Load check spring
39	Plug-bucket parallel	80	Load check spring
40	Plug-option	81	Poppet signal spring

2. HYDRAULIC CIRCUIT



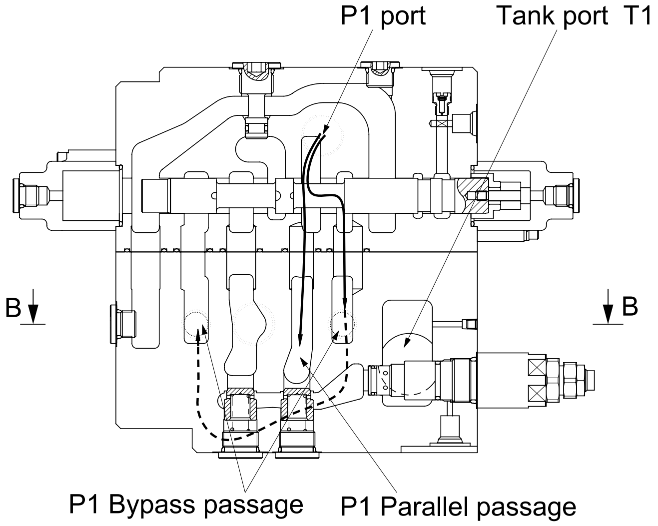
3. FUNCTION

1) CONTROL IN NEUTRAL

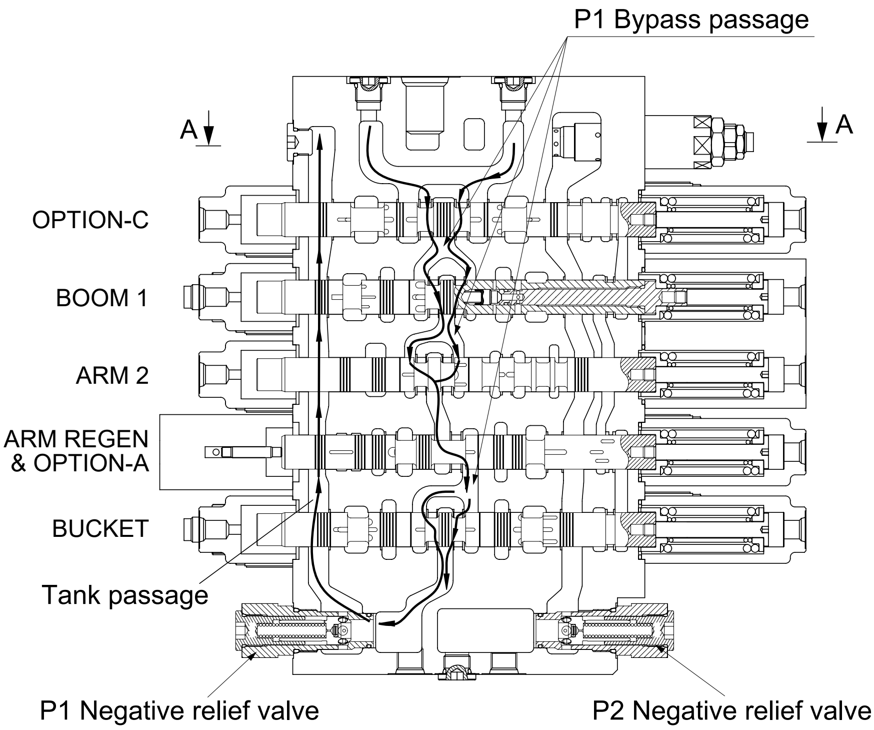
(1) P1 SIDE

The hydraulic fluid from pump A2 flows into the main control valve through the inlet port "P1", into the P1 bypass passage and P1parallel passage.

The hydraulic fluid from the pump A2 is directed to the tank through the bypass passage of spools : option C, boom 1, arm 2, arm regeneration & option A and bucket, the negative relief valve of P1, tank passage, and the tank port "T1"



SECTION A-A

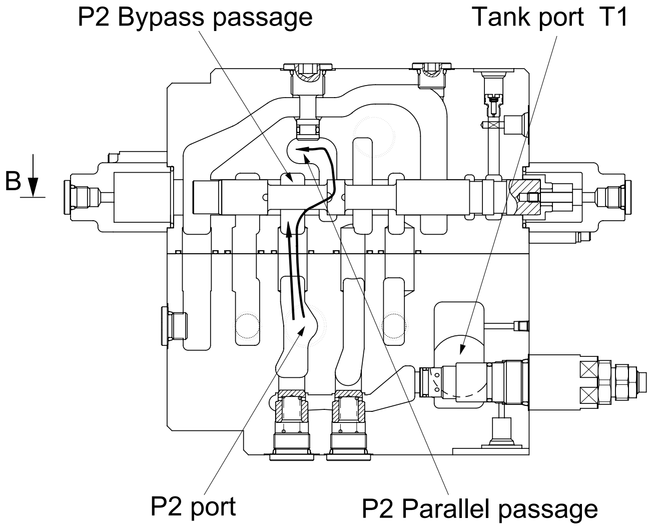


SECTION B-B

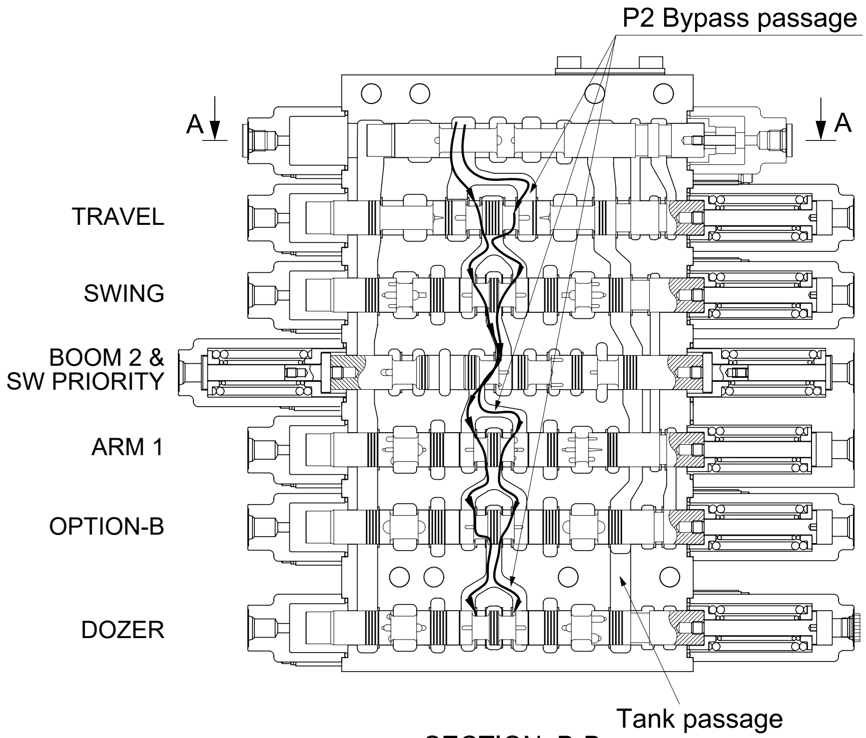
(2) P2 SIDE

The hydraulic fluid from pump A1 flows into the main control valve through the inlet port "P2", into the P2 bypass passage and P2 parallel passage.

The hydraulic fluid from the pump A1 is directed to the tank through the bypass passage of spools : travel, swing, boom 2 & swing priority, arm 1, option "B" and dozer, the negative relief valve of P2, tank passage and the tank port "T1".



SECTION A-A



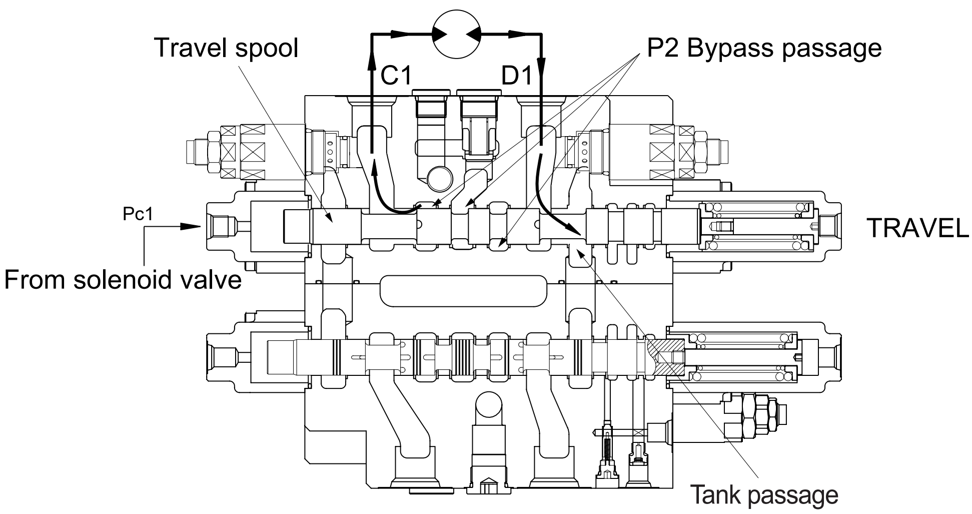
SECTION B-B

2) TRAVEL OPERATION

(1) TRAVEL FORWARD OPERATION

During the travel forward operation, the pilot pressure from the solenoid valve is supplied to the port Pc1 of the spring opposite side, and it shifts travel spool in the right direction against springs. Hydraulic fluid from the pump A1 flows into the travel spool through the bypass passage.

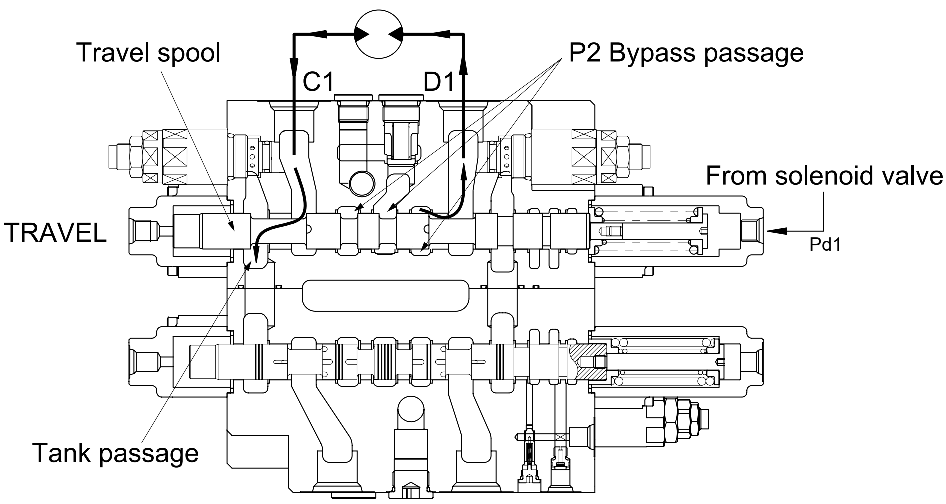
Then the bypass passage is shut off by the movement of the travel spool, it is directed to the travel motor through port C1. At the same time, the hydraulic fluid from the travel motor through port D1 returns to the tank passage through the travel spool.



(2) TRAVEL REVERSE OPERATION

During the travel reverse operation, the pilot pressure from the solenoid valve is supplied to the port Pd1 of the spring side, and it shifts travel spool in the left direction. Hydraulic fluid from the pump A1 flows into the travel spool through the bypass passage.

Then the bypass passage is shut off by the movement of the travel spool, it is directed to the travel motor through port D1. At the same time, the hydraulic fluid from the travel motor through port C1 returns to the tank passage through the travel spool.



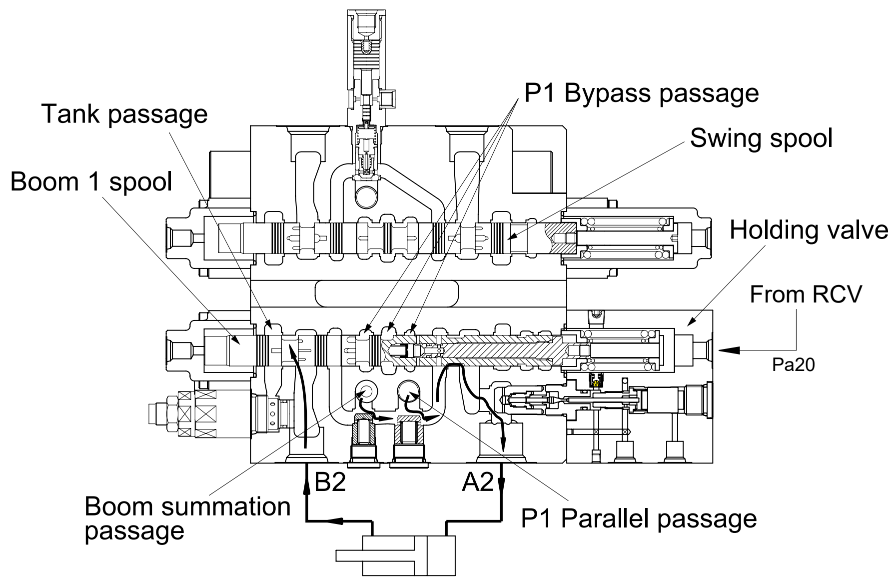
3) BOOM OPERATION

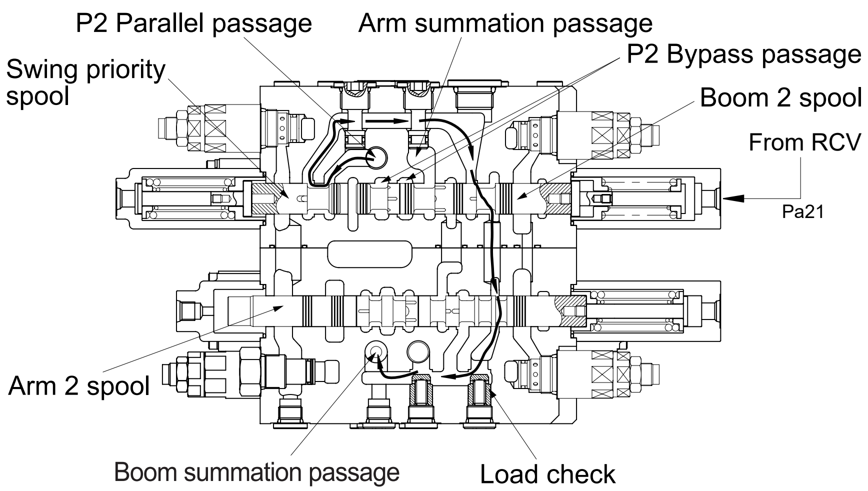
(1) BOOM UP OPERATION

During boom up operation, the pilot secondary pressure from RCV is supplied to the port Pa20 of the spring side and shifts the boom 1 spool in the left direction. The bypass passage is shut off by the movement of the boom 1 spool and the hydraulic oil fluid from pump A2 is entered P1 parallel passage and then passes through the load check, bridge passage and boom holding valve then flows into the port A2. Following this it flows into the head side of the boom cylinder. (In this case, the boom holding valve is free flow condition)

At the same time, the pilot pressure from RCV is supplied to the port Pa21 of the spring side of boom 2 and shifts the boom 2 spool. The bypass passage is shut off by the movement of the boom 2 spool and the hydraulic oil fluid from pump A1 entered boom summation passage via the P2 parallel passage, the land of the swing priority spool, notch of the boom 2 spool, arm 2 spool and the check. The flows combine in passage and are directed to port A2 and head side of boom cylinder.

At the same time, the flow from rod side of the boom cylinder return to the boom 1 spool through the port B2. Thereafter it is directed to the hydraulic oil tank through the tank passage.





(2) BOOM DOWN OPERATION

During the boom lowing operation, the pilot pressure from RCV is supplied to the port Pb20 of the spring opposite side and shifts the boom 1 spool in the right direction.

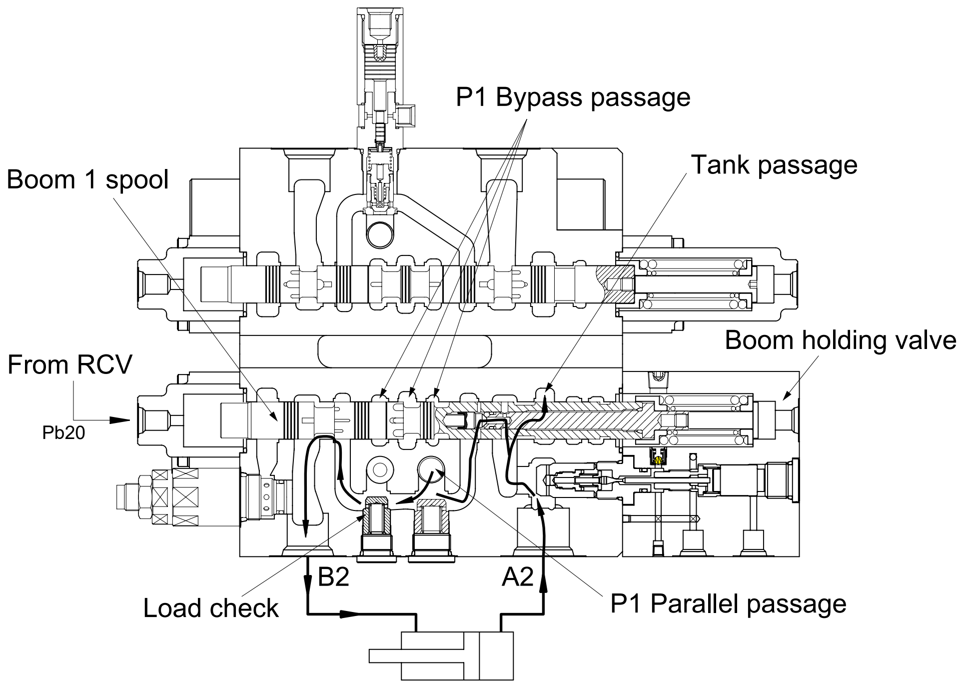
The bypass passage is shut off by the movement of the boom 1 spool and the hydraulic fluid from the pump A2 enters the parallel passage and is directed to the port B2 through the load check. Following this, it flows into the rod side of the boom cylinder.

At the same time, the return flow from the head side of the boom cylinder returns to the port A2 and boom holding valve. And it is directed to the hydraulic oil tank through opened tank passage by movement of the boom 1 spool.

Meanwhile some of return flow is directed to P1 parallel passage through the internal passage of the boom 1 spool. (boom regeneration)

In this case, the holding valve is open condition, for details of the boom holding valve, see page following page.

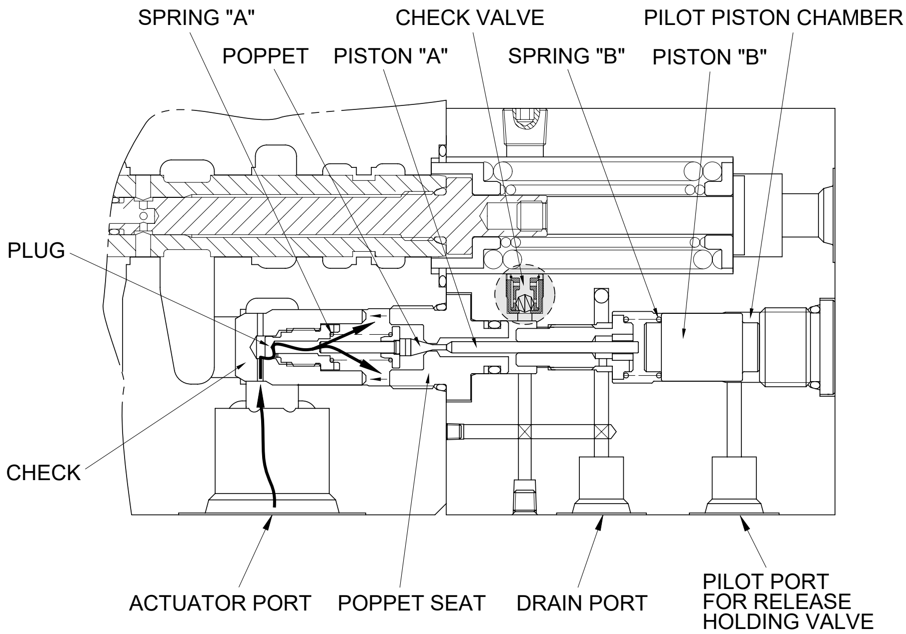
During the boom lowering operation, the fluid from A1 pump is not summation.



4) HOLDING VALVE OPERATION

(1) HOLDING OPERATION

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

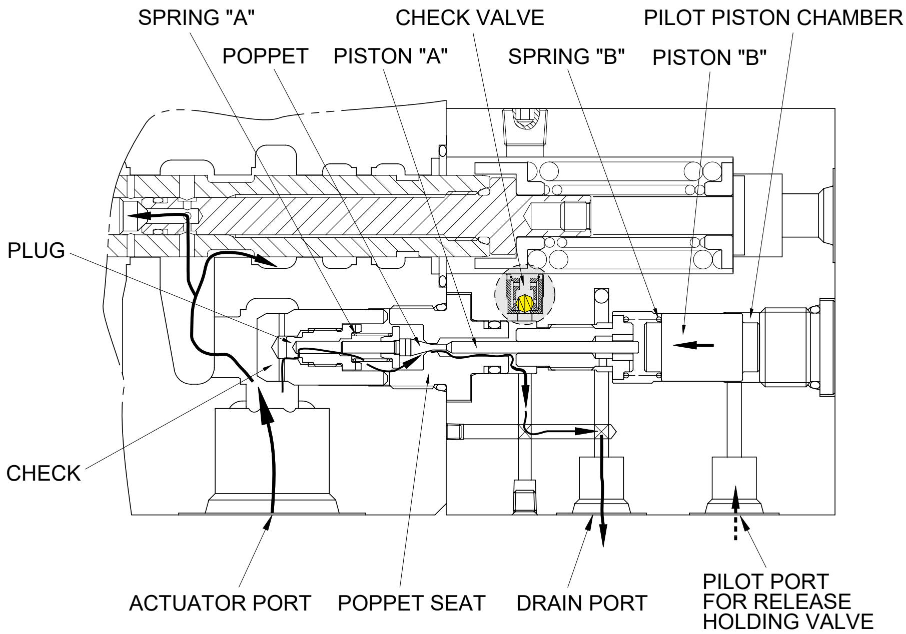


(2) RELEASE HOLDING OPERATION

The pilot pressure is supplied to the pilot port for release holding valve and shifts the piston "B" in the left direction against the spring "B", and shifts the poppet in the left direction through piston "B" and piston "A" against spring "B" and shifts the spool in the left side.

At same time, the return fluid from actuator returns to the drain port through the periphery hole of check, crevice of the check and the plug, the periphery hole of the plug, in side of holding valve, crevice of the poppet and the poppet seat, the periphery hole of the poppet seat, crevice of socket and spool and internal passage of spool.

When the poppet is opened, pressure of inside of holding valve is decreased and the return fluid from actuator returns to the tank passage through the notch of spool.



5) BUCKET OPERATION

(1) BUCKET IN OPERATION

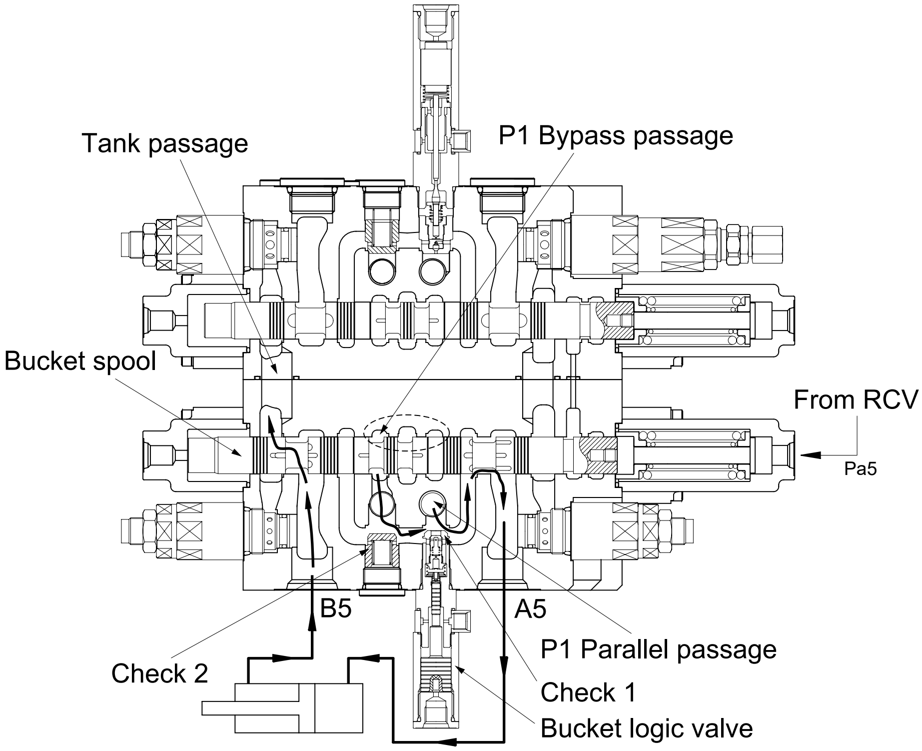
During the bucket in operation, the pilot secondary pressure from RCV is supplied to port Pa5 of the spring side and shifts the bucket spool in the left direction.

The bypass passage is shut off by the movement of the bucket spool and the hydraulic fluid from pump A2 entered P1 parallel passage and is directed to the port A5 through the check 1 of bucket logic valve.

At the same time, the hydraulic fluid from P1 bypass passage is directed to the port A5 through the check 2.

Following this it flows into the head side of the bucket cylinder.

The return flow from the rod side of the bucket cylinder returns to the bucket spool through the port B5. Thereafter it is directed to the hydraulic oil tank through the tank passage.



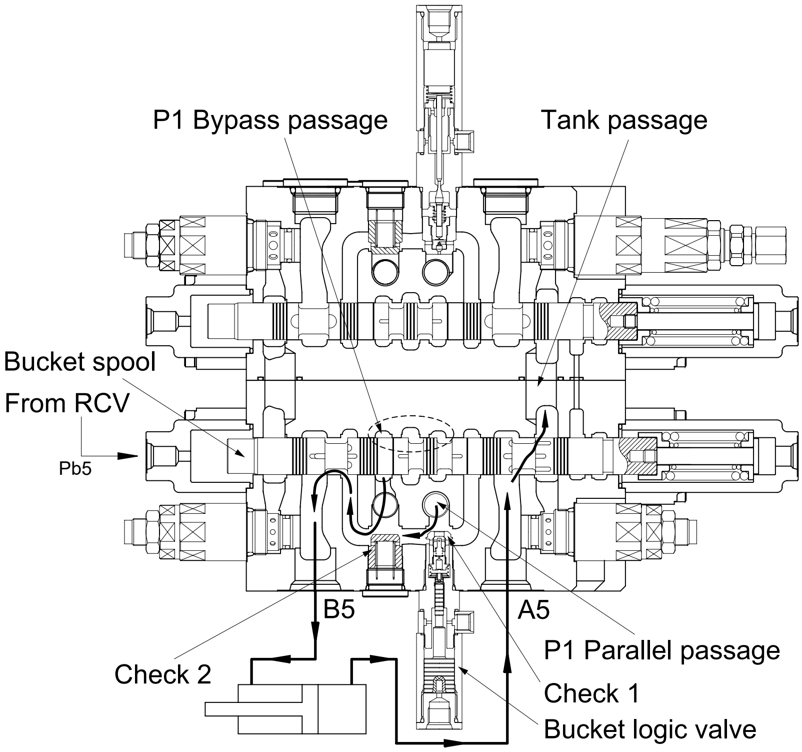
(2) BUCKET OUT OPERATION

During the bucket out operation, the pilot secondary pressure from RCV is supplied to port Pb5 of the spring opposite side and shifts the bucket spool in the right direction.

The bypass passage is shut off by the movement of the bucket spool and the hydraulic fluid from pump A2 entered P1 parallel passage and is directed to the port B5 through the check 1 of bucket logic valve.

At the same time, the hydraulic fluid from P1 bypass passage is directed to the port B5 through the check 2.

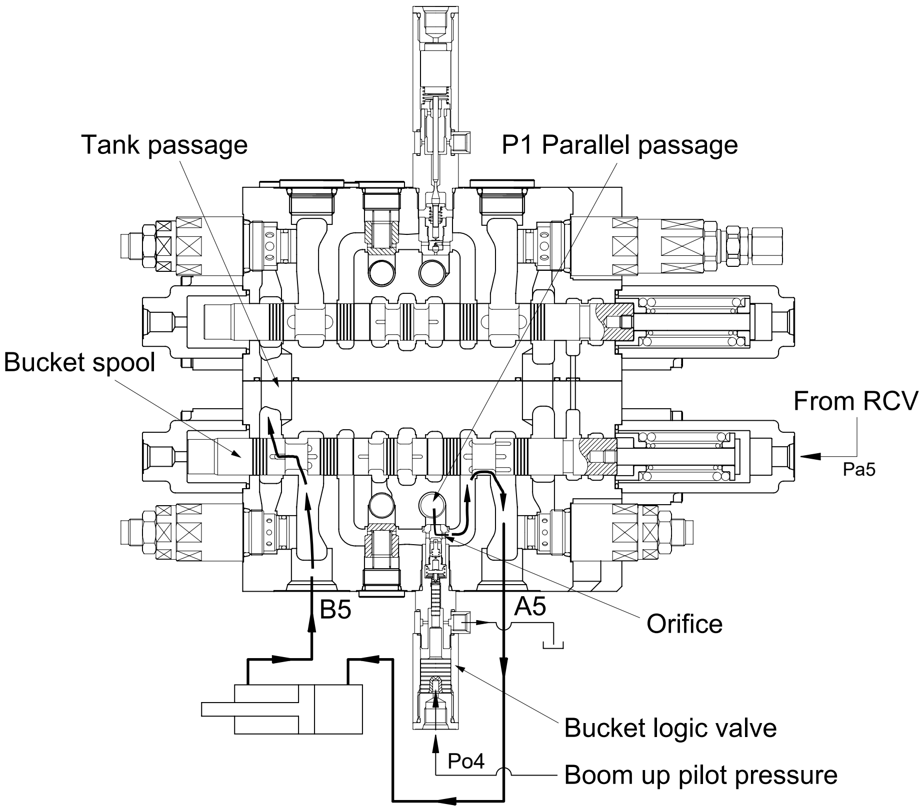
The return flow from the head side of the bucket cylinder returns to the hydraulic oil tank through the port A5 and the tank passage.



(3) BUCKET IN OPERATION WITH BOOM OPERATION

When combined operation, mostly same as previous page but the fluid from P1 bypass passage is empty.

So only the fluid from P1 parallel passage is supplied to the bucket cylinder. Also, parallel passage is installed the orifice of bucket logic valve for supplying the fluid from pump A2 to the boom operation prior to the bucket operation. In case of the bucket out operation with boom



6) SWING OPERATION

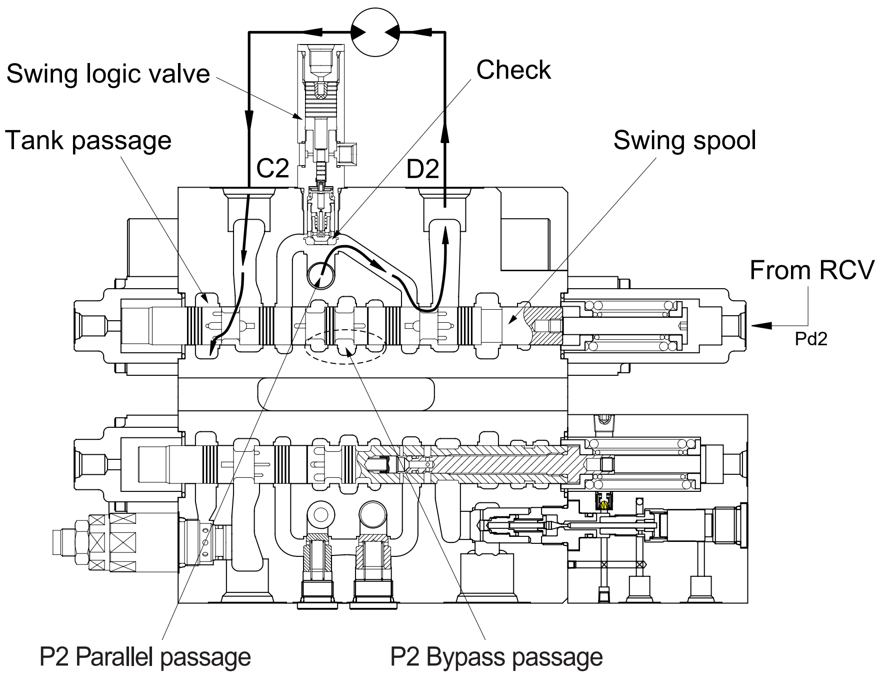
(1) SWING LEFT & RIGHT OPERATION

During the swing left operation, the pilot secondary pressure from the RCV is supplied to the port Pd2 of the spring side and shift the swing spool in left direction. The bypass passage is shut off by the movement of the swing spool and the hydraulic fluid from pump A1 flows into swing spool through the P2 parallel passage. Then it is directed to swing motor through the port D2.

As the result, swing motor turns and flow from the swing motor returns to the hydraulic oil tank through the port C2, swing spool and the tank passage.

In case of swing right operation, the operation is similar to swing left operation but the pilot secondary pressure from the RCV is supplied to the port Pc2 of the spring opposite side.

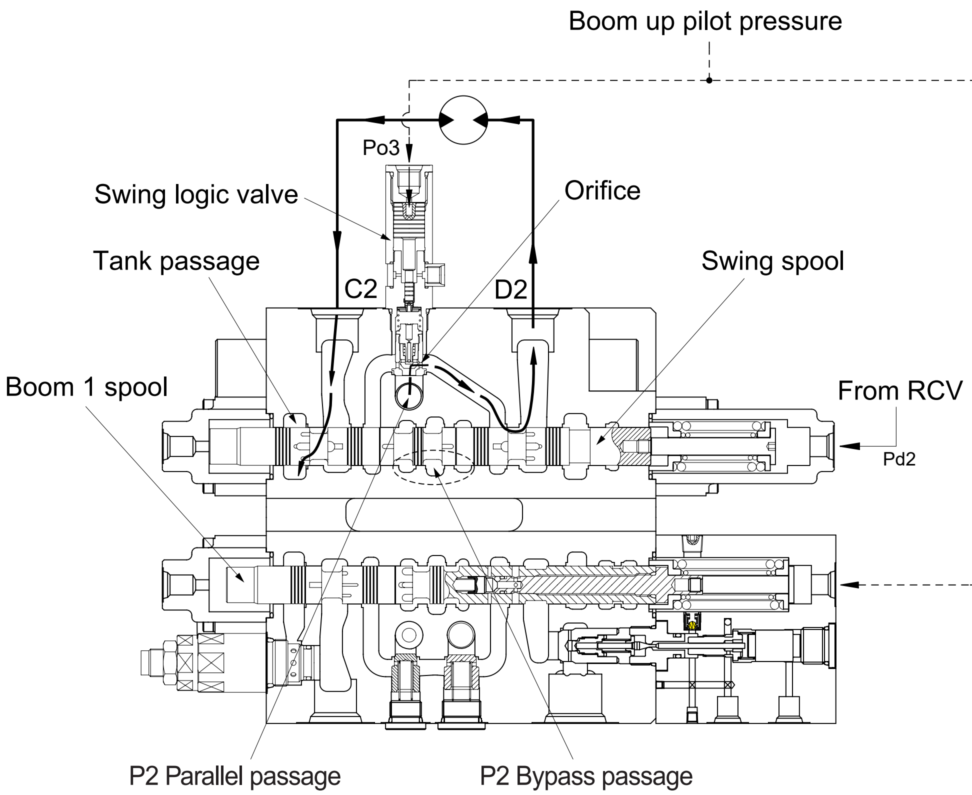
Accordingly, the hydraulic fluid from pump A1 flows into swing motor through the port C2 and returns to the hydraulic oil tank through the port D2 and the tank passage.



(2) SWING LEFT OPERATION WITH ARM OR BOOM OPERATION

When combined operation, mostly same as previous page but the fluid from P2 bypass passage is empty.

So only the fluid from parallel passage is supplied to the swing motor. Also, parallel passage is installed the orifice of swing logic valve for supplying the fluid from pump A1 to the boom or the arm operation prior to the swing operation. In case of the swing right operation with arm or boom



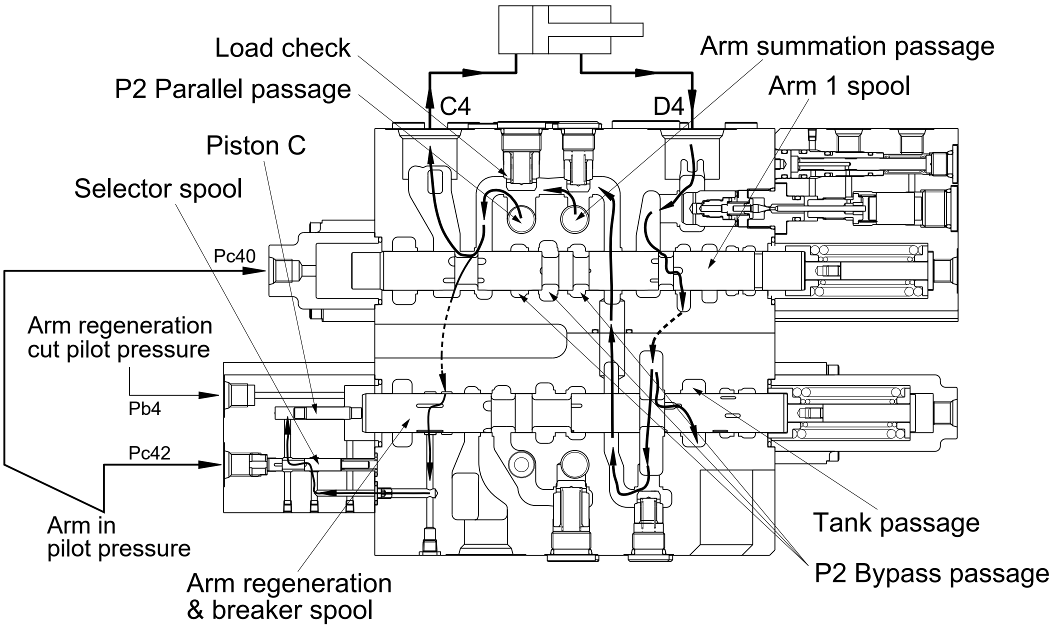
7) ARM OPERATION

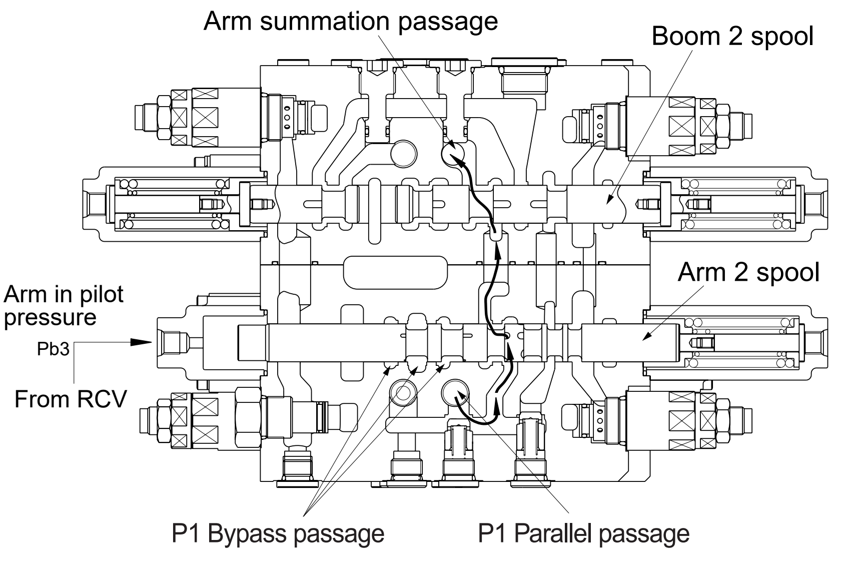
(1) ARM IN OPERATION

During arm in operation, the pilot secondary pressure from the RCV is supplied to the port Pc40 of spring opposite side and shifts arm 1 spool in the right direction.

The bypass passage is shut off by the movement of the arm 1 spool and the hydraulic oil from the pump A1 flows into the arm cylinder head side through P2 parallel passage, the load check valve, bridge passage and the port C4.

At same time, the pilot secondary pressure from the RCV is supplied to the port Pb3 of spring opposite side and shifts arm 2 spool in the right direction. The bypass passage is shut off by the movement of the arm 2 spool and the hydraulic fluid from the pump A2 flows into the arm summation passage through P1 parallel passage, the check valve, the arm 2 spool and the boom 2 spool. Then it entered the arm cylinder head side with hydraulic fluid from arm 1 spool.



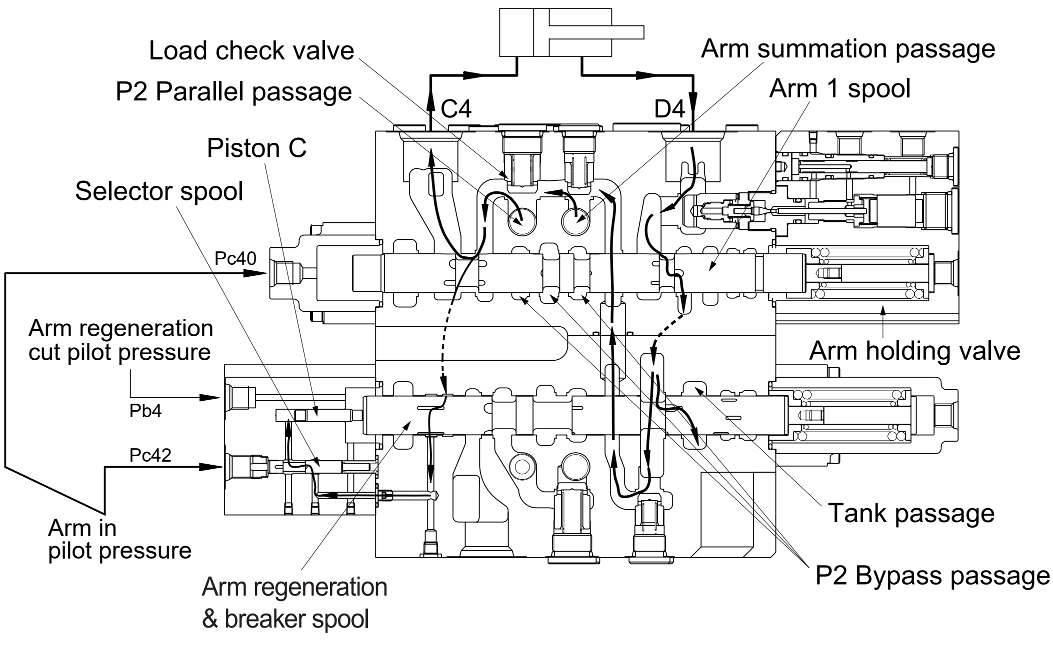


ARM REGENERATION

The return flow from the arm cylinder rod side is pressurized by self weight of arm and so, returns to port D4. The pressurized oil returning to port D4 enters the arm regeneration & breaker spool through the arm holding valve and the arm 1 spool. It is supplied the arm cylinder head through internal passage. This is called the arm regeneration function.

The amount of regeneration fluid is changed by movement of the arm regeneration spool. A few fluids after P2 parallel passage is push piston "C" through the notch of arm regeneration spool and selector spool. At this time, the selector spool is opened by pilot pressure from RCV.
Then, the arm regeneration spool shifts to right side and flow to tank pass increases and regeneration flow decreases. Therefore, pressure of arm cylinder head increases, then, arm regeneration flow decreases.

Furthermore, the arm regeneration cut pressure is supplied to the port Pb4 of spring opposite side and arm regeneration spool is move into the right direction fully. The flow from the arm cylinder rod is returned to the hydraulic oil tank and regeneration function is not activated. (The return fluid is maximum condition)



(2) ARM OUT OPERATION

During arm out operation, the pilot secondary pressure from RCV is supplied to the port Pd40 of spring side and shifts arm 1 spool in the left direction.

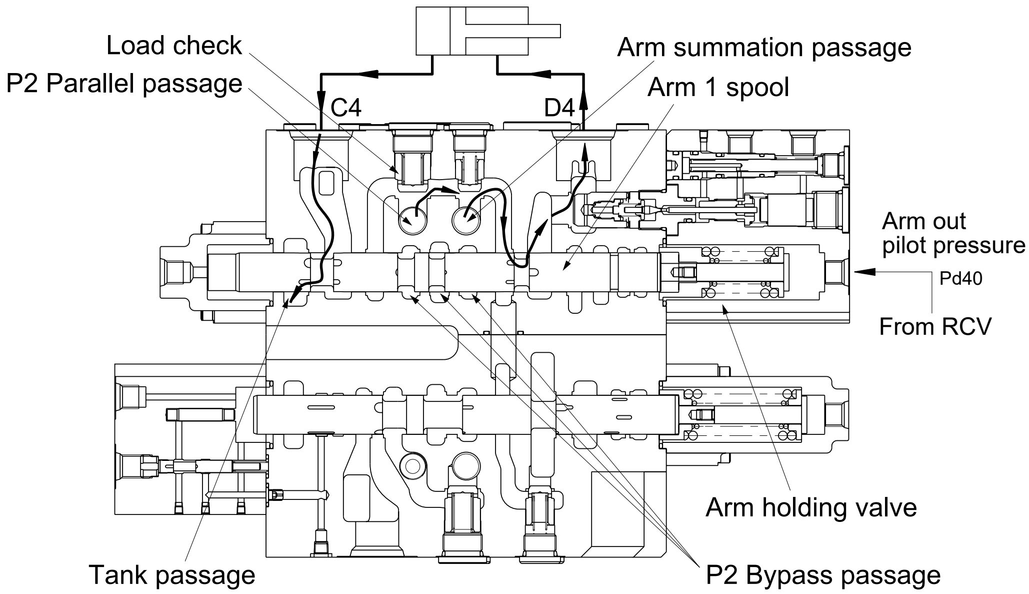
The bypass passage is shut off by the movement of the arm 1 spool and the hydraulic fluid from pump A1 flows into arm 1 spool through the P2 parallel passage. Then it enters into the arm cylinder rod side through the load check, bridge passage, arm holding valve and the port D4.

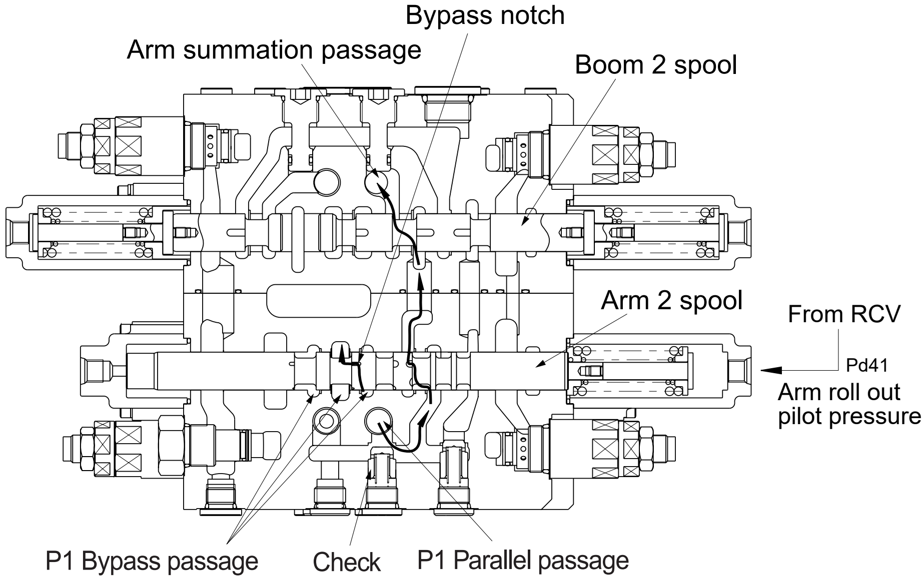
Also, the pilot secondary pressure from RCV is supplied to the port Pd41 of spring side and shifts arm 2 spool in the left direction.

The bypass passage is shut off by the movement of the arm 2 spool and some of the hydraulic fluid from pump A2 bypassed through bypass notch. The rest of hydraulic fluid from pump A2 flows into the arm summation passage through P1 parallel passage, the check valve, arm 2 spool and boom 2 spool.

Then it enters into the arm cylinder rod side with the fluid from the arm 1 spool.

The return flow from the arm cylinder head side returns to the hydraulic tank through the port C4, the arm 1 spool and tank passage.



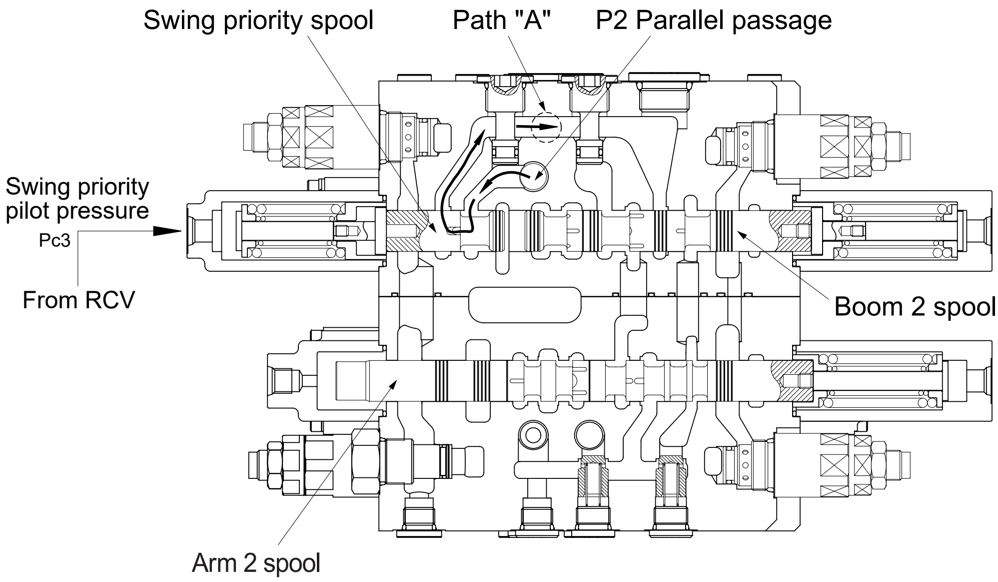


8) SWING PRIORITY FUNCTION

During swing priority operation, the pilot secondary pressure is supplied to the port Pc3 of the spring side of the swing priority spool and shift swing priority spool in the right direction.

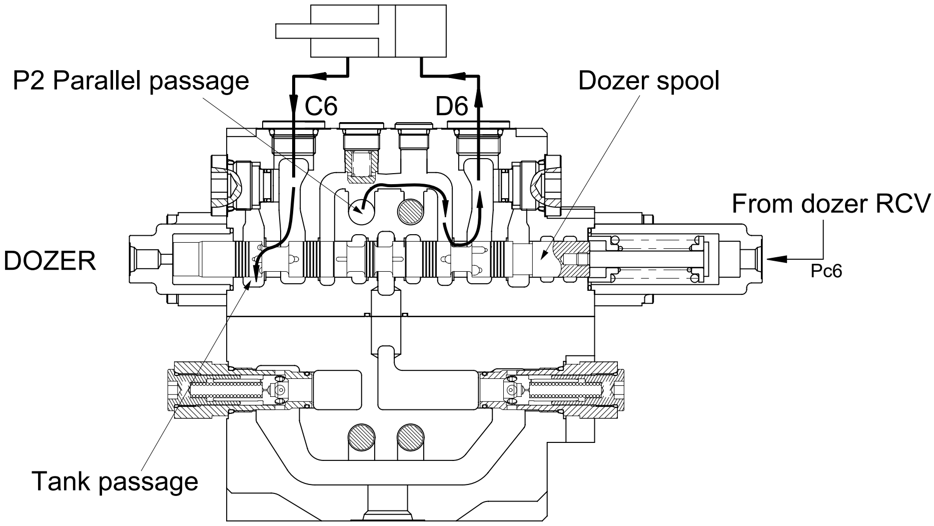
The hydraulic fluid from P2 parallel passage flows into the parallel passage of arm 1 side through swing priority spool and the path "A" and also flows into the boom 2 spool.

When the swing priority spool is neutral condition, the passage is same as normal condition. But due to shifting of the swing priority spool, the fluid from pump A1 flows to swing side more then the boom 2, arm 1, option B and dozer spools to make the swing operation most preferential.

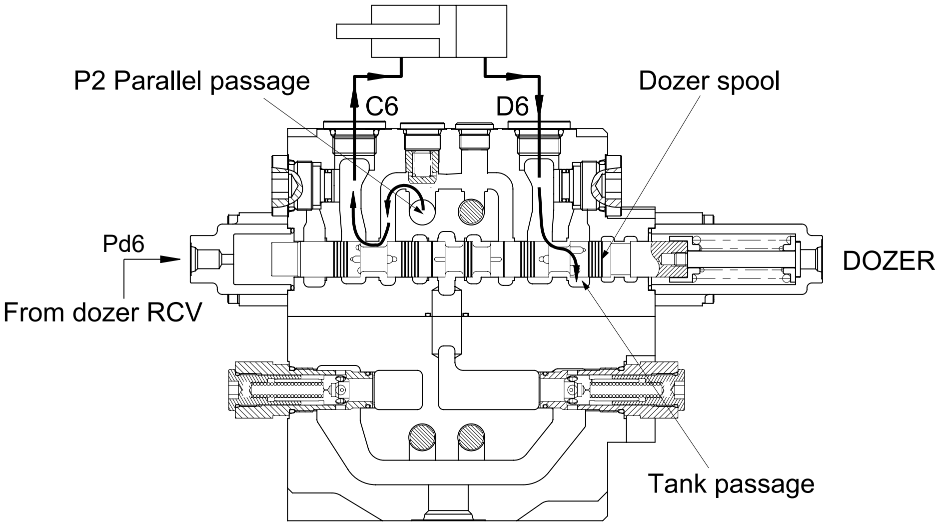


9) DOZER OPERATION

(1) Dozer down operation



(2) Dozer up operation



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During the dozer down operation, the pilot pressure from the dozer control valve is supplied into the port Pc6 of the spring side and it shifts the dozer spool in the left direction.

The hydraulic fluid from the pump A1 enters the parallel passage and is direction to the head side of the dozer cylinder through port D6.

The return flow from the rod side of the dozer cylinder returns to the dozer spool through C6 port. Thereafter it is directed to the hydraulic tank through tank passage.

In case of the dozer up operation, operation is similar.

10) NEGATIVE RELIEF VALVE OPERATION

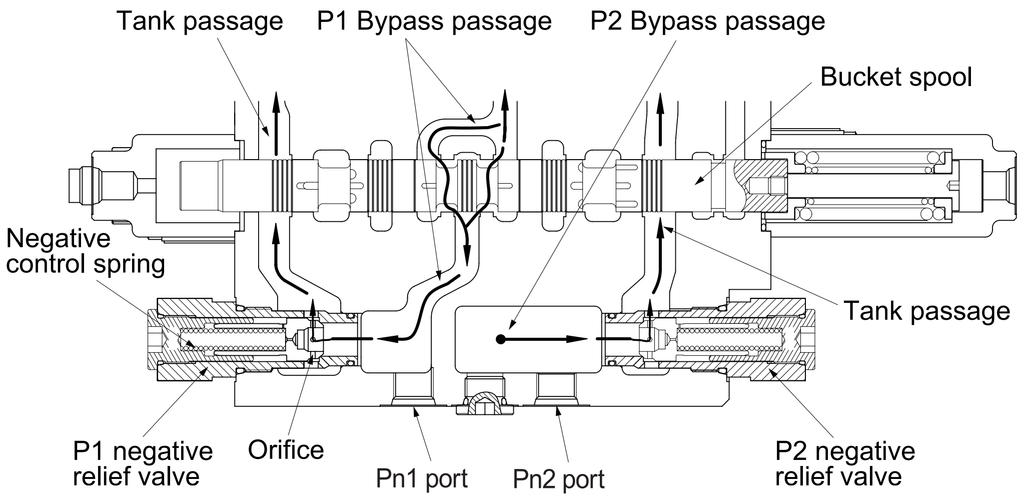
When no function is being actuated on P1 side, the hydraulic fluid from the pump A2, flows into the tank passage through the P1 bypass passage and orifice. The restriction caused by this orifice thereby pressurizes. This pressure is transferred as the negative control signal pressure Pn1 to the pump A2 regulator.

It controls the pump regulator so as to minimize the discharge of the pump A2.

The bypass passage is shut off when the shifting of one or more spools and the flow through bypass passage became zero. The pressure of negative control signal becomes zero and the discharge of the pump A2 becomes maximum.

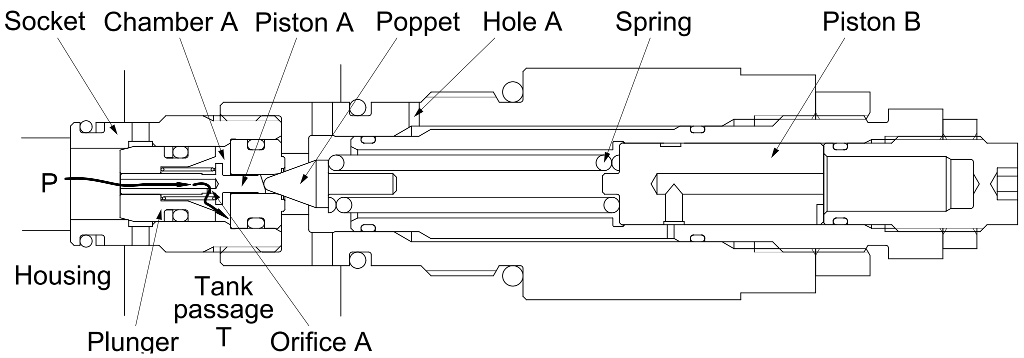
The negative control pressure reaches to the set level, the hydraulic fluid in the passage pushes open negative control valve and escapes into the return passage.

For the pump A1 the same negative control principle.

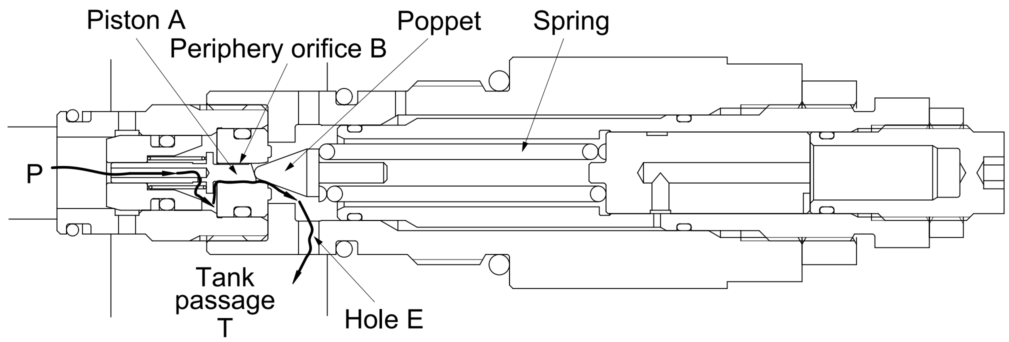


11) OPERATION OF MAIN RELIEF VALVE

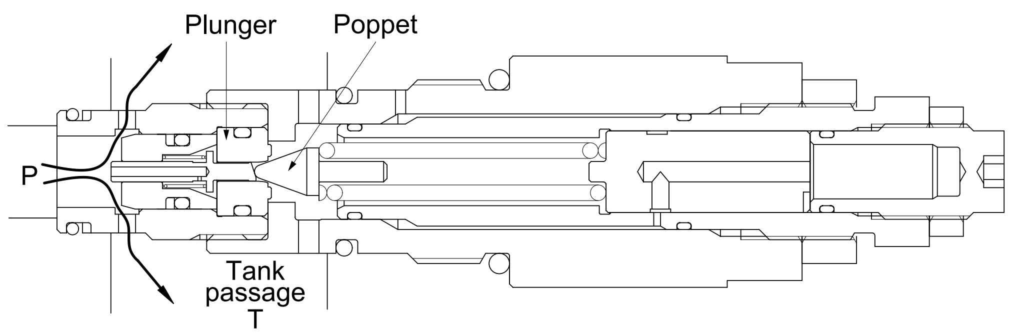
(1) The pressurized oil passes through the orifice (A) of the plunger is filled up in chamber A of the inside space, and seats the plunger against the housing securely.



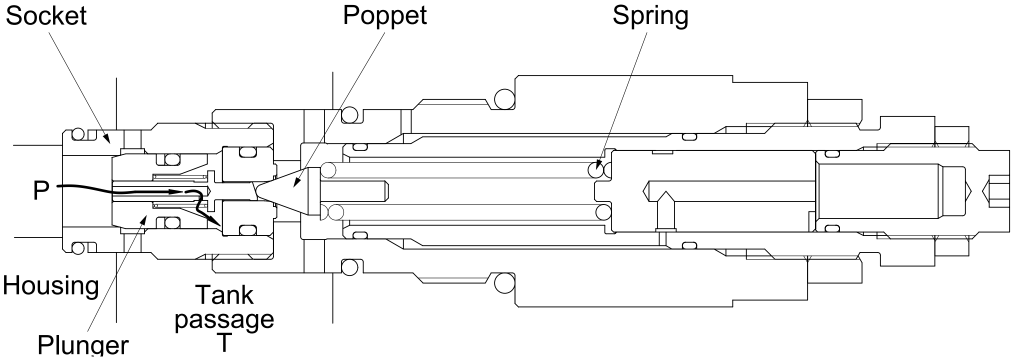
(2) When the pressure at (P) becomes equal to the set pressure of the spring the hydraulic oil passes through the piston (A) pushes open the poppet and flows to tank passage (T) through the plunger internal passage, periphery orifice A, chamber A, periphery orifice B and the hole (E).



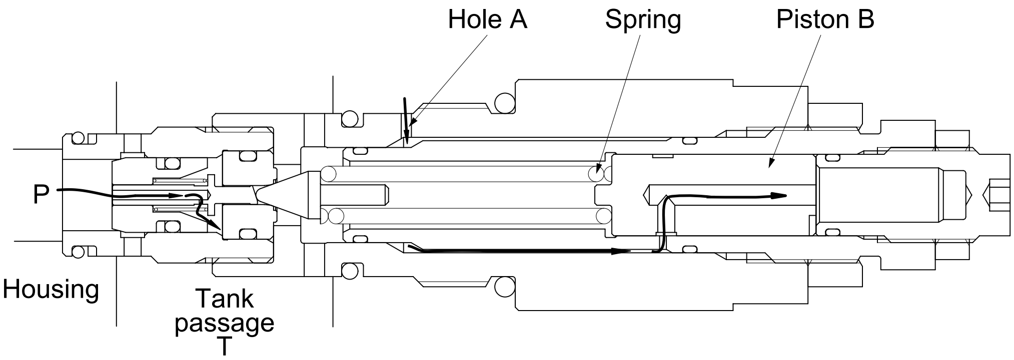
(3) Opening the poppet causes the pressure in chamber A to fall and the plunger to open. As the result the pressurized oil at port P runs into tank passage (T).



(4) The pressure at port P becomes lower than set pressure of the spring, the poppet is seated by spring force. Then the pressure at port P becomes equal to set pressure of the spring and the plunger is seated to the socket.



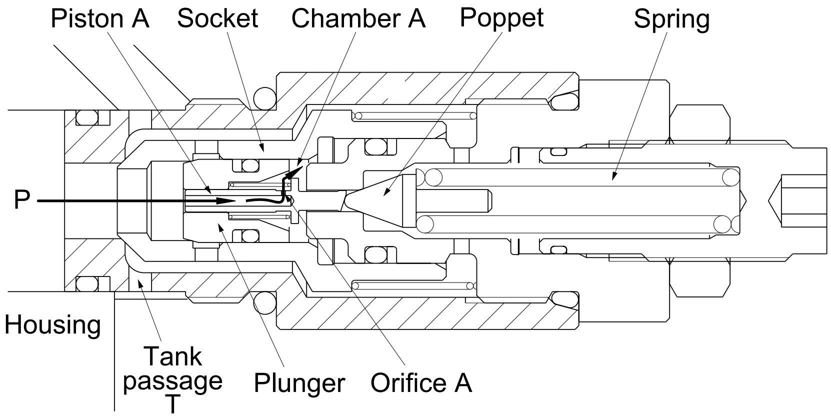
(5) When the power boost switch is ON, the pilot pressure enters through hole A.
It pushes the piston (B) in the left direction to increase the force of the spring and change the relief set pressure to the high pressure.



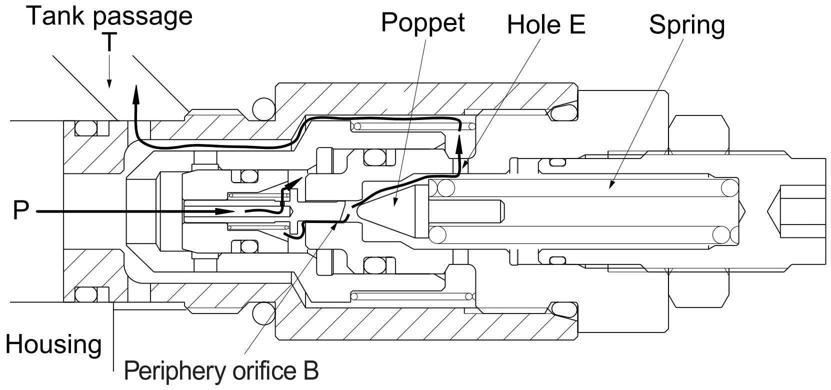
12) OPERATION OF OVERLOAD RELIEF VALVE

FUNCTION AS RELIEF VALVE

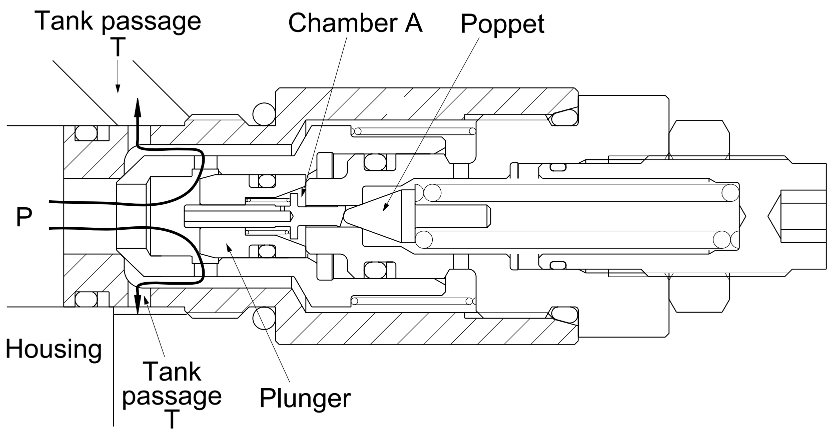
(1) The pressurized oil passes through the piston A and orifice A is filled up in chamber A of the inside space and seat the plunger against the socket and the socket against the housing securely.



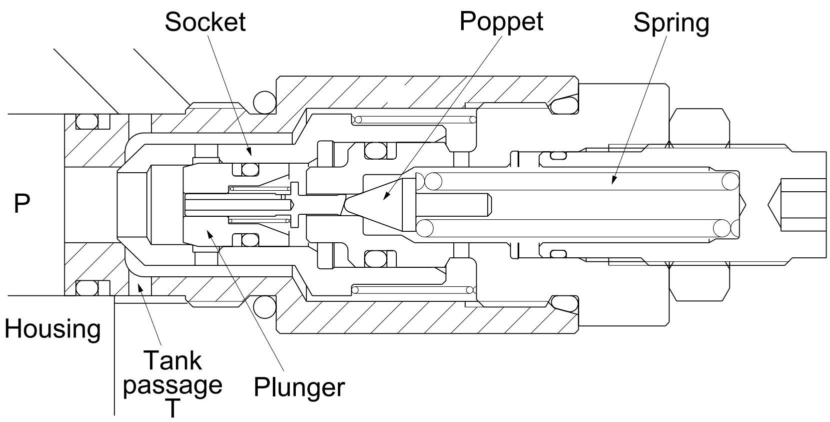
(2) When the pressure at port P becomes equal to the set pressure of the spring, the pressurized oil pushes open the poppet and flows to tank passage (T) through the plunger internal passage, orifice A, chamber A, periphery orifice B and hole E.



(3) Opening of the poppet causes the pressure in chamber A to fall and the plunger to open. As the result the pressurized oil at port P runs into tank passage (T).

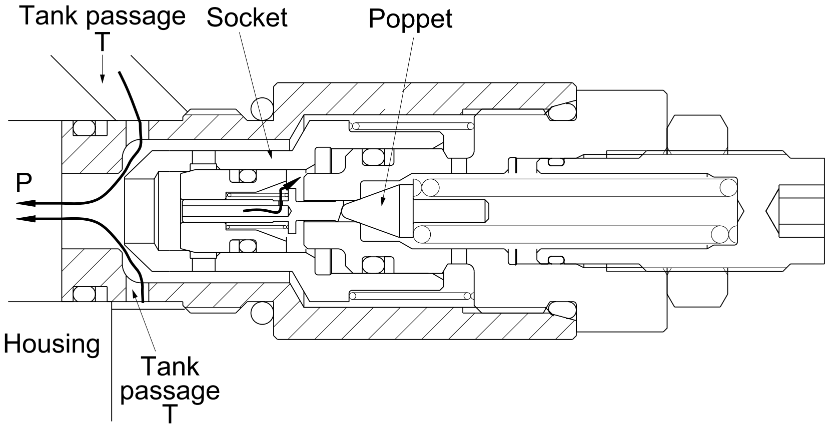


(4) The pressure at port P becomes lower than set pressure of the spring, the poppet is seated by spring force. Then the pressure at port P becomes equal to set pressure of the spring and the plunger is seated to the socket.



MAKE-UP FUNCTION

(5) When negative pressure exists at port P, the oil is supplied through tank passage (T). When the pressure at tank passage (T) becomes higher than that of at port P, the socket moves in the right direction. Then, sufficient oil passes around the socket from tank passage (T) to port P and fills up the space.

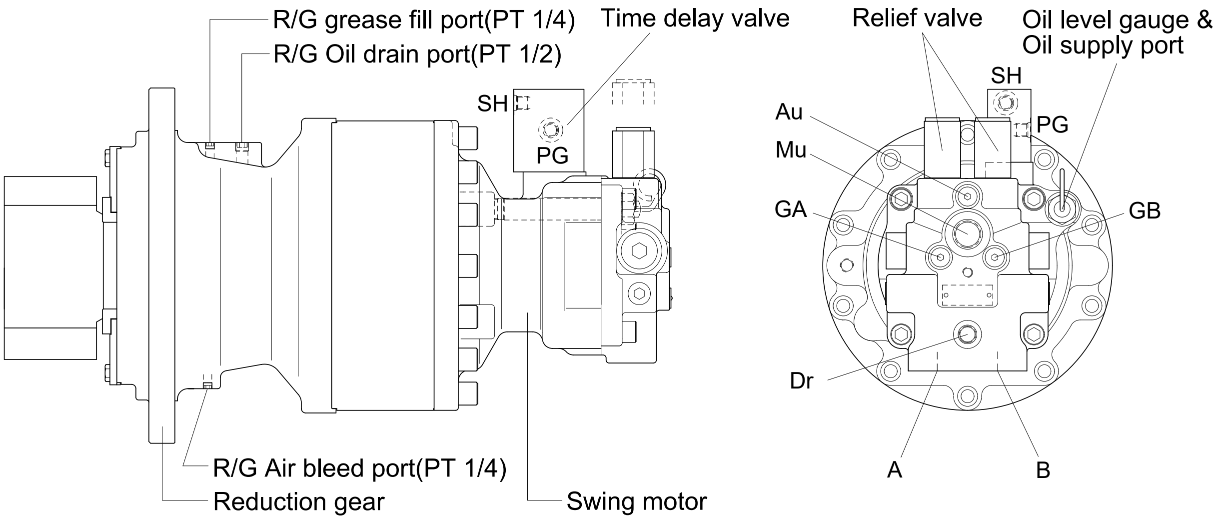


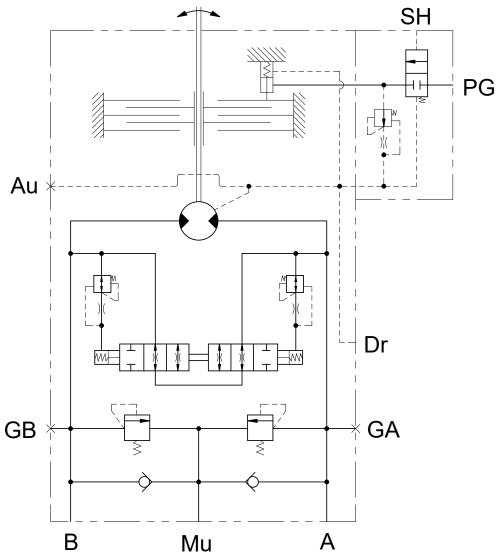
GROUP 3 SWING DEVICE

1. STRUCTURE

Swing device consists swing motor, swing reduction gear.

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

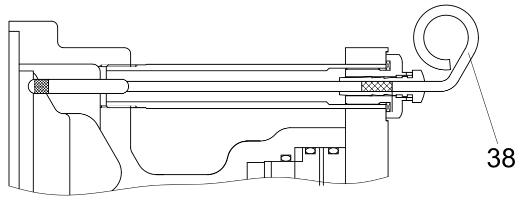




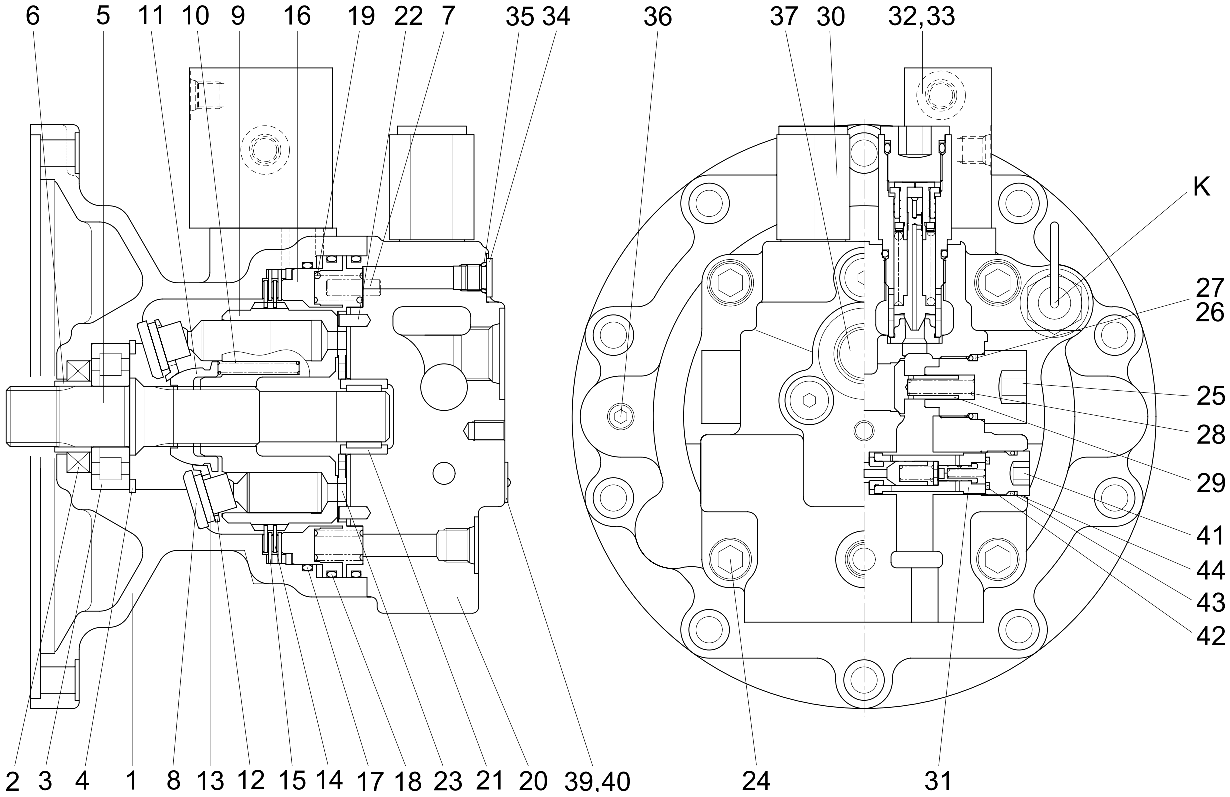
Hydraulic circuit

Port	Port name	Port size
A	Main port	ø 13
B	Main port	ø 13
Dr	Drain port	PF 3/8
Mu	Make up port	PF 3/4
SH	Brake release pilot port	PF 1/4
PG	Brake release stand by port	PF 1/4
GA, GB	Gage port	PF 1/4
Au	Air vent port	PF 1/4

1) SWING MOTOR

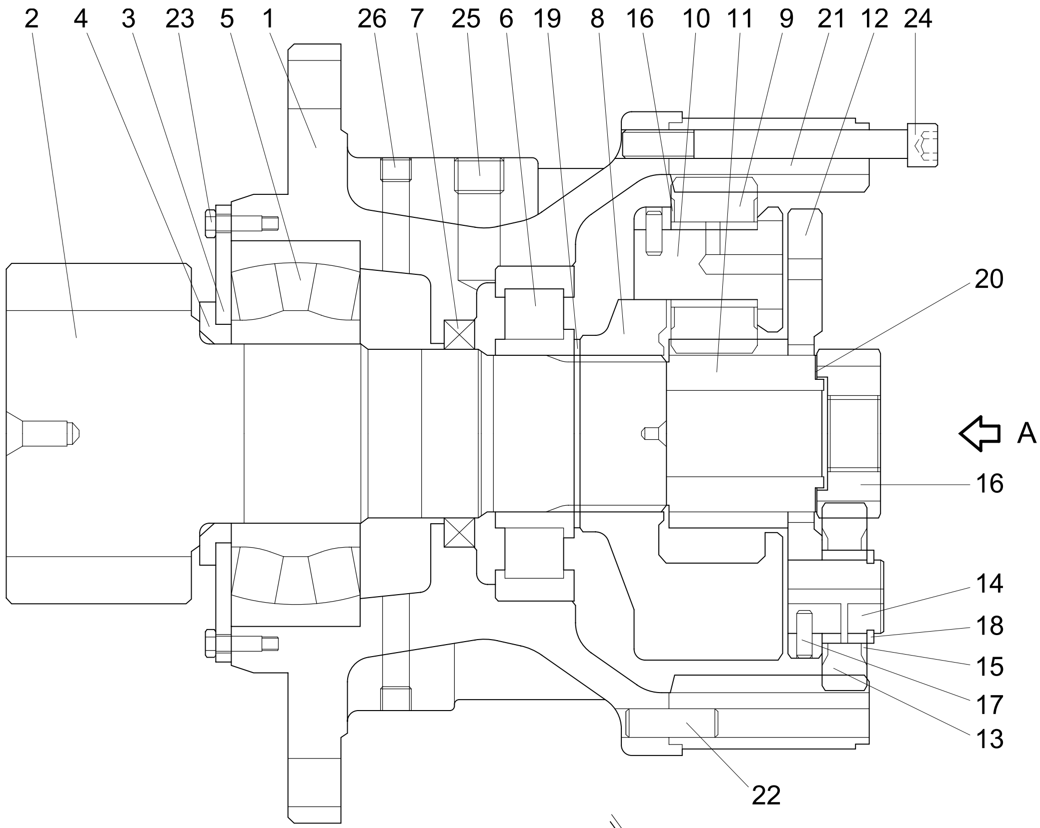


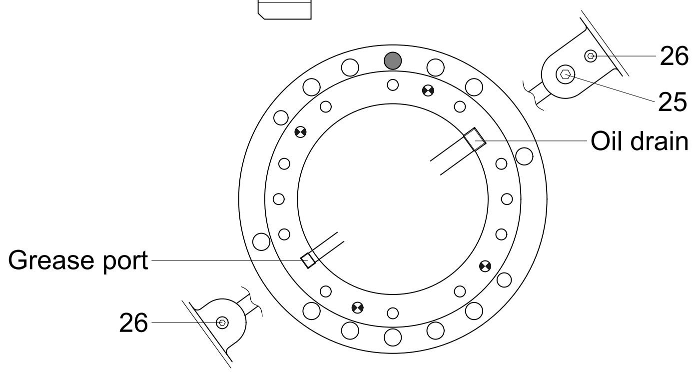
DETAIL K



1	Body	16	Brake piston	31	Anti-rotating valve
2	Oil seal	17	O-ring	32	Time delay valve
3	Roller bearing	18	O-ring	33	Wrench bolt
4	Snap ring	19	Brake spring	34	Plug
5	Drive shaft	20	Rear cover	35	O-ring
6	Bushing	21	Needle bearing	36	Plug
7	Pin	22	Pin	37	Plug
8	Shoe plate	23	Valve plate	38	Level gauge
9	Cylinder block	24	Wrench bolt	40	Rivet
10	Spring	25	Plug	41	Plug
11	Ball guide	26	Back up ring	42	O-ring
12	Set plate	27	O-ring	43	O-ring
13	Piston assembly	28	Spring	44	Back up ring
14	Friction plate	29	Check		
15	Separate plate	30	Relief valve		

2) REDUCTION GEAR





VIEW A

1	Casing	10	Pin No.2 assembly	19	Stop ring
2	Drive shaft	11	Sun gear No. 2	20	Side plate No. 1
3	Cover plate	12	Carrier No. 1	21	Ring gear
4	Spacer	13	Planet gear No. 1	22	Knock pin
5	Roller bearing	14	Pin No.1	23	Hexagonal bolt
6	Roller bearing	15	Thrust washer (B)	24	Socket head bolt
7	Oil seal	16	Sun gear No. 1	25	Plug
8	Carrier No. 2	17	Spring pin	26	Plug
9	Planet gear No. 2	18	Stop ring		

2. PRINCIPLE OF DRIVING

1) GENERATING THE TURNING FORCE

The high hydraulic supplied from a hydraulic pump flows into a cylinder (9) through valve cover of motor (20), and valve plate (23).

The high hydraulic is built as flowing on one side of Y-Y line connected by the upper and lower sides of piston (13).

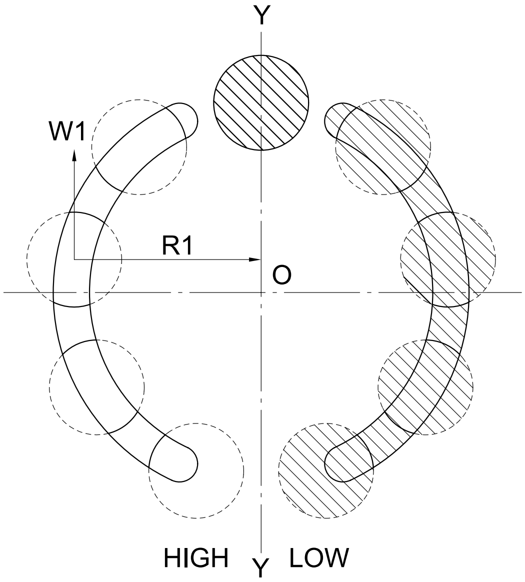
The high hydraulic can generate the force, $F1=P \times A$ (P : supplied pressure, A : water pressure area), like following pictures, working on a piston.

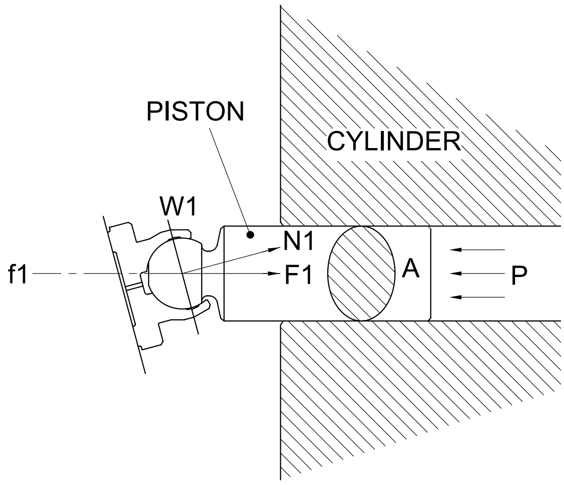
This force, F1, is divided as N1 thrust partial pressure and W1 radial partial pressure, in case of the plate of a tilt angle, α .

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

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

This torque transfers the turning force to a cylinder (9) through a piston; because a cylinder is combined with a turning axis and spline, a turning axis rotates and a turning force is sent.





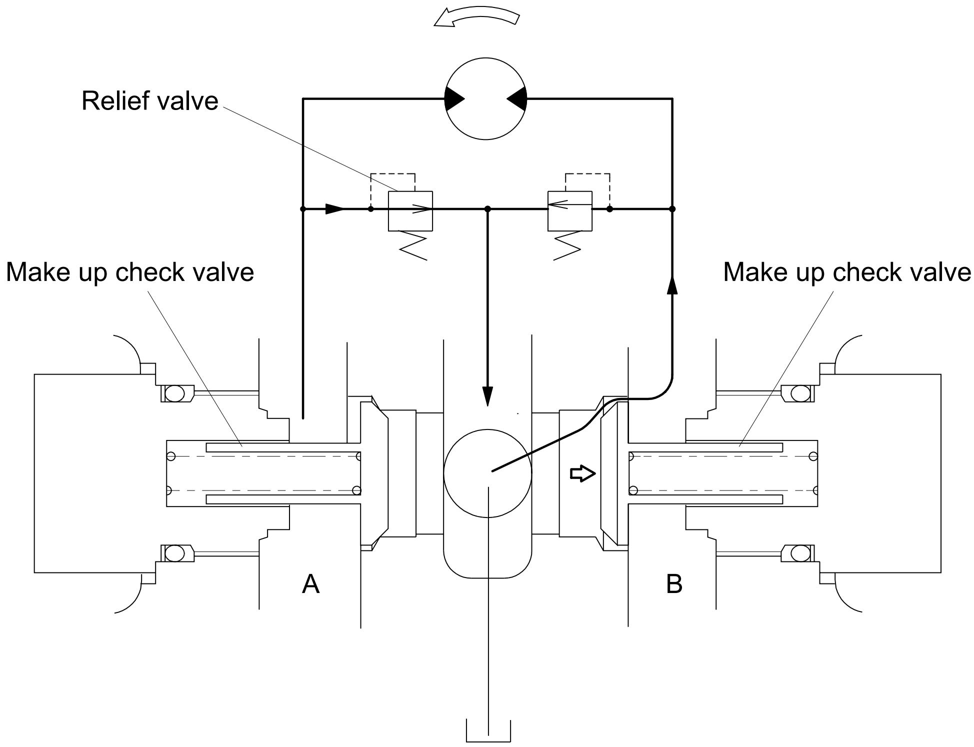
2) MAKE UP VALVE

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

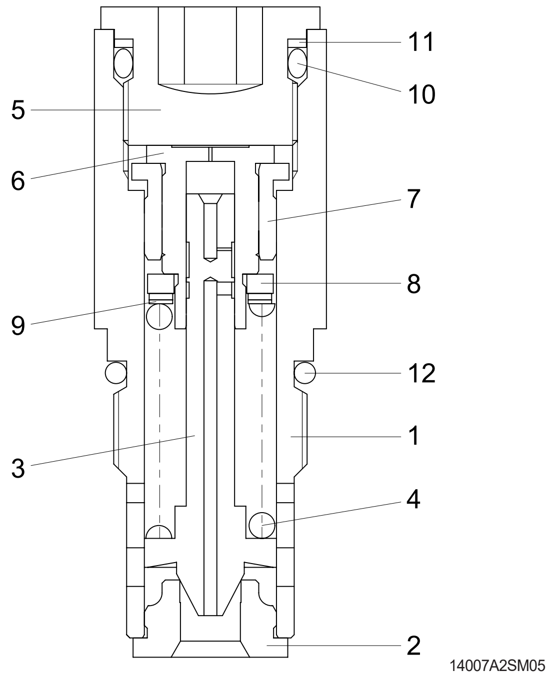
A make up valve is provided immediately before the port leading to the hydraulic oil tank to secure feed pressure required when the hydraulic motor makes a pumping action. The boost pressure acts on the hydraulic motor's feed port via the make up valve.

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

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



3) RELIEF VALVE



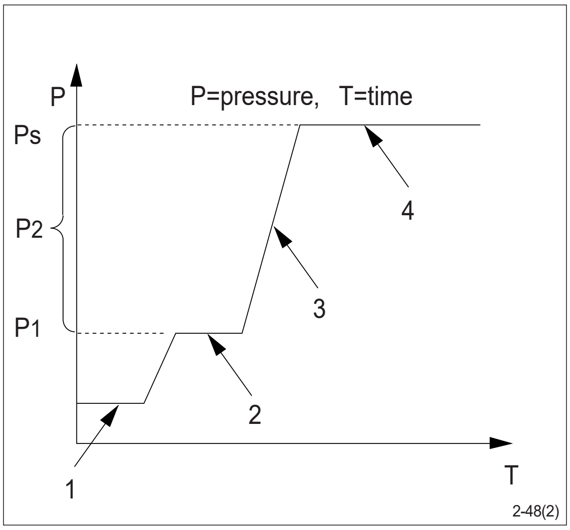
1	Body
2	Seat
3	Plunger
4	Spring
5	Adjusting screw
6	Piston
7	Bushing
8	Spring seat
9	Shim
10	O-ring
11	Back up ring
12	O-ring

(1) Construction of relief valve

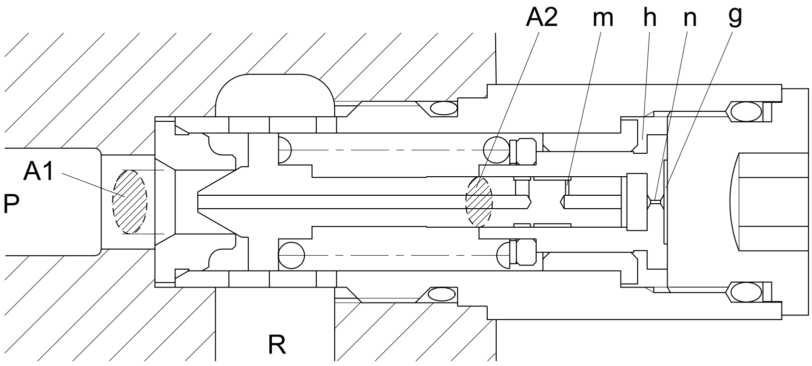
The valve casing contains two cartridge type relief valves that stop the regular and reverse rotations of the hydraulic motor. The relief valves relieve high pressure at start or at stop of swing motion and can control the relief pressure in two steps, high and low, in order to insure smooth operation.

(2) Function of relief valve

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



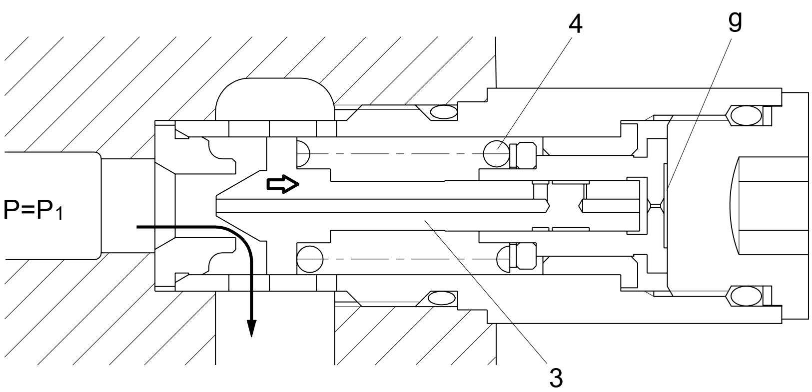
① Ports (P,R) at tank pressure.



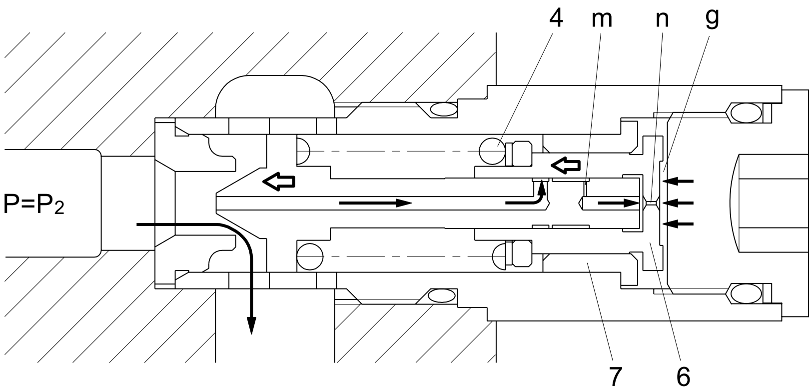
② When hydraulic oil pressure ($P \times A_1$) reaches the preset force (F_{SP}) of spring (4), the plunger (3) moves to the right as shown.

$P_1 \times A_1 = F_{sp} + P_g \times A_2$

$$P_1 = \frac{F_{sp} + P_g \times A_2}{A_1}$$



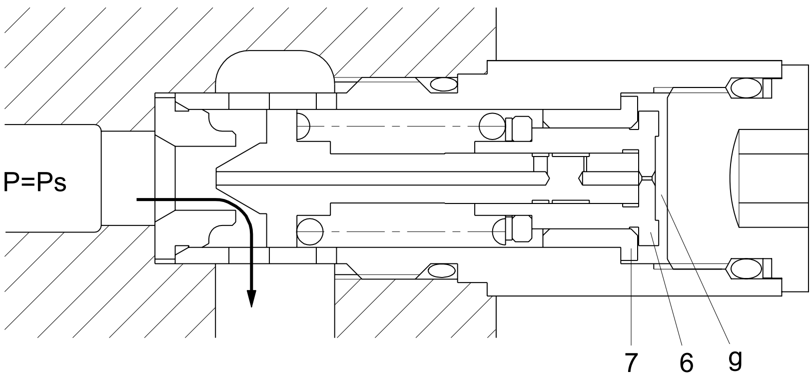
③ The oil flow chamber g via orifice m and n. When the pressure of chamber g reaches the preset force (F_{SP}) of spring (4), the piston (6) moves left and stop the piston (6) hits the bottom of bushing (7).



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

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

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

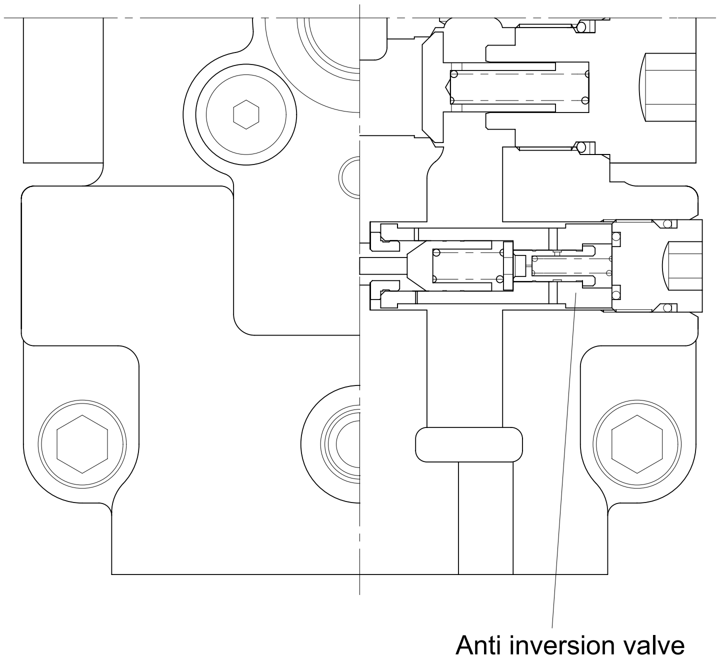


4) ANTI-INVERSION VALVE

In the event of swing motor operates switch part to drive and stop the swing part. By the action of pump on motor, there is brake on both-side of port because of the block on both sides.

Swing part is stopped by pressure of brake (in order words, 4-5 times of inversion)

Under the operating condition, the side of anti-inversion blocks off both ports but bypassing compressed oil which is blocked in processing of anti-inversion fixed time and amount to inverse port, prevent increasing pressure of motor and decrease inversing action.

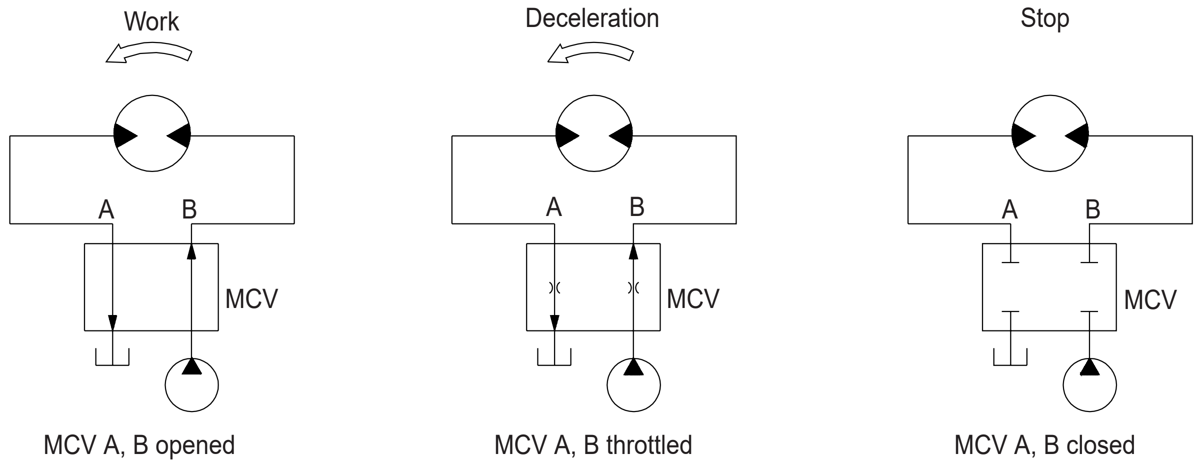


5) BRAKE SYSTEM

(1) Control valve swing brake system

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

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



2-48(1)

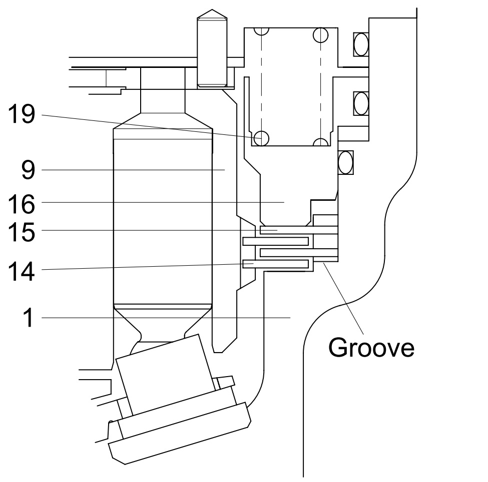
(2) Mechanical swing parking brake system

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

① Brake assembly

Circumferential rotation of separate plate (15) is constrained by the groove located at housing (1). When housing is pressed down by brake spring (19) through friction plate (14), separate plate (15) and brake piston (16), friction force occurs there.

Cylinder block (9) is constrained by this friction force and brake acts, while brake releases when hydraulic force exceeds spring force.



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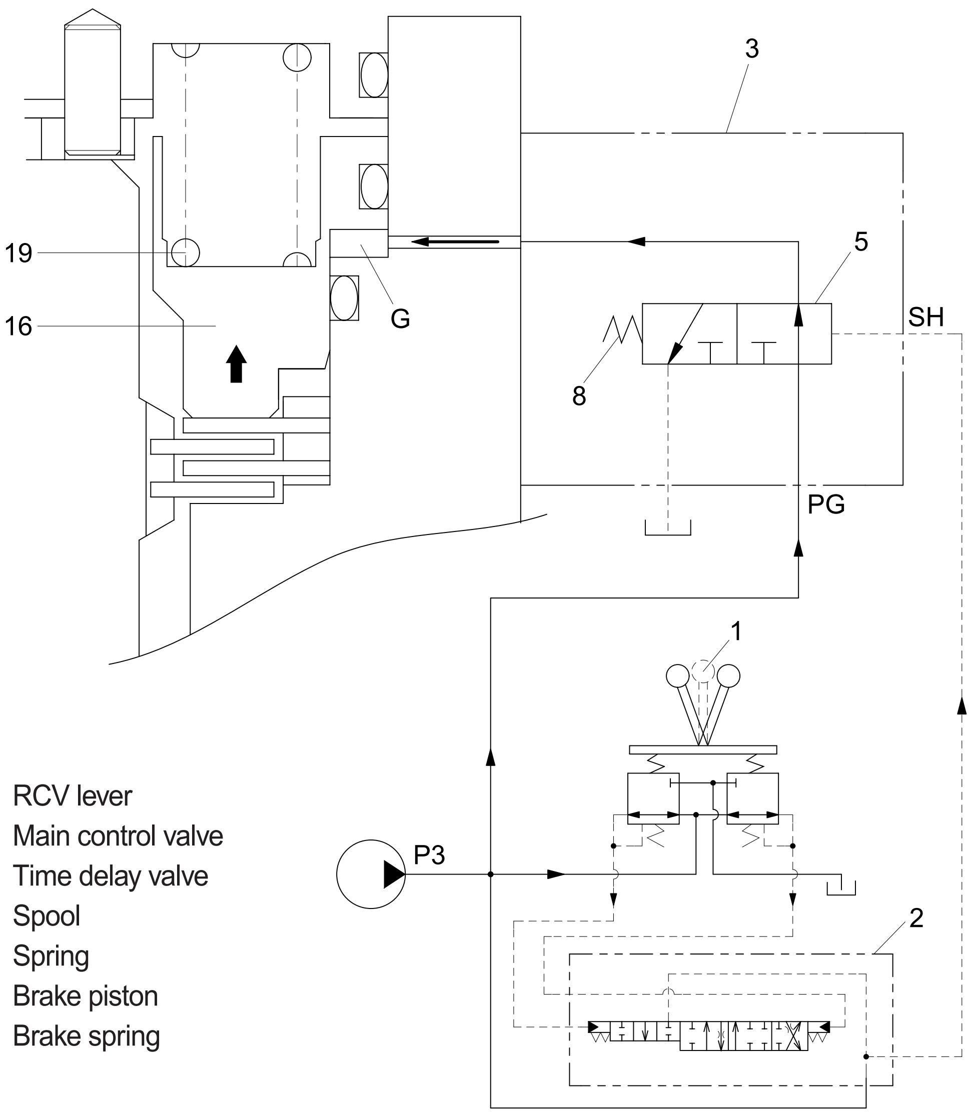
1	Housing	15	Separate plate
9	Cylinder block	16	Brake piston
14	Friction plate	19	Spring

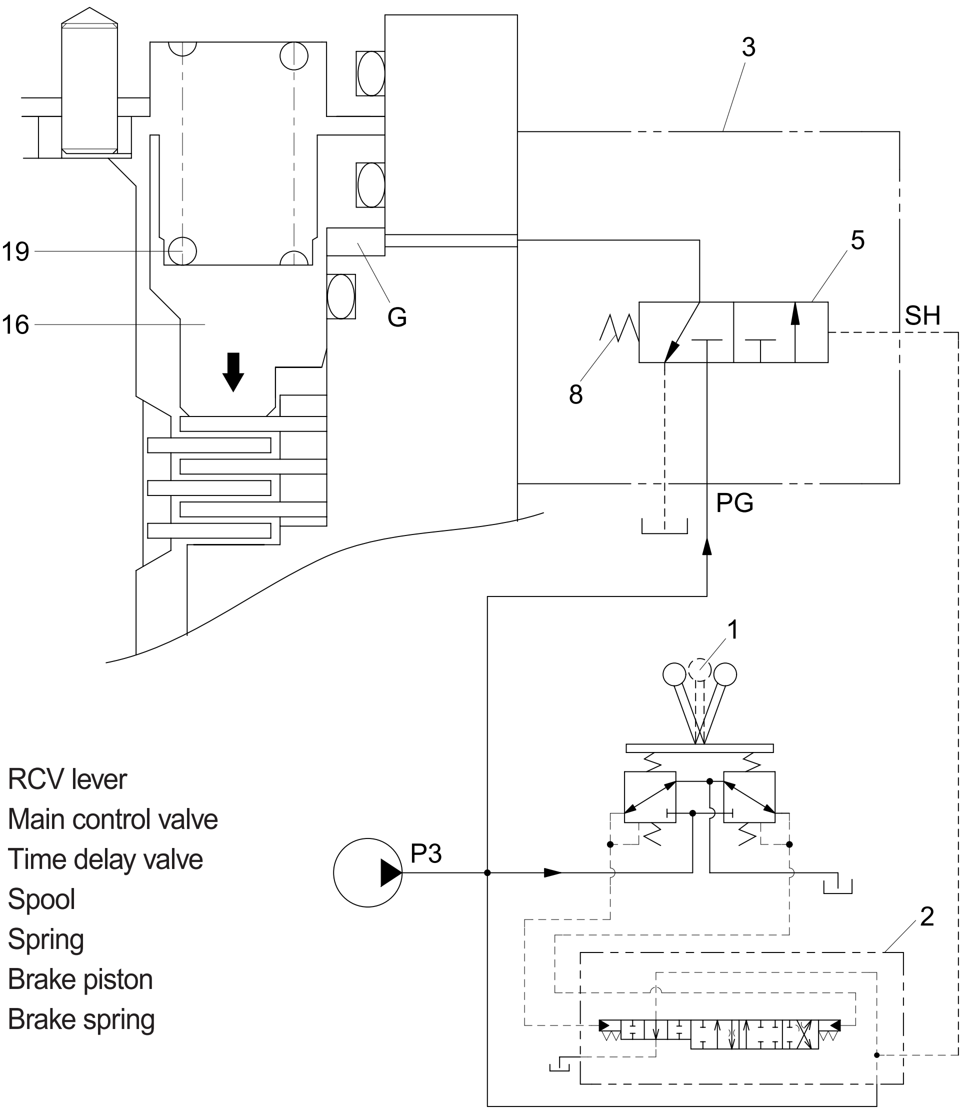
② Operating principle

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



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

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

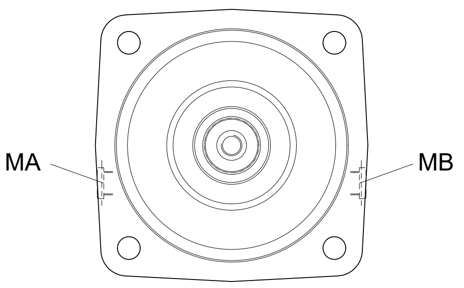


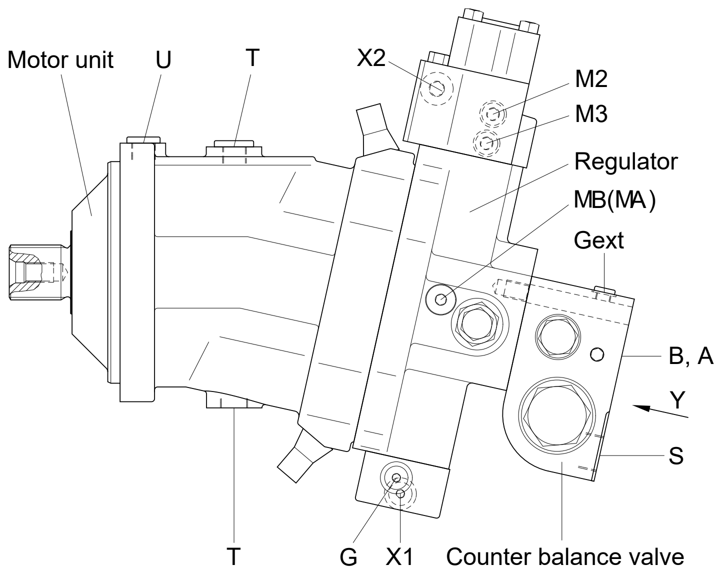
1	RCV lever
2	Main control valve
3	Time delay valve
5	Spool
8	Spring
16	Brake piston
19	Brake spring

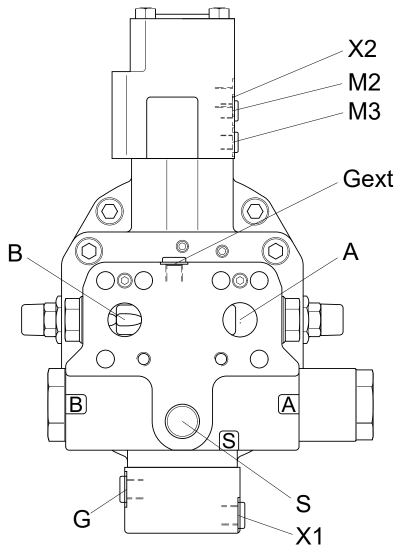
GROUP 4 TRAVEL MOTOR (-#0406)

1. CONSTRUCTION

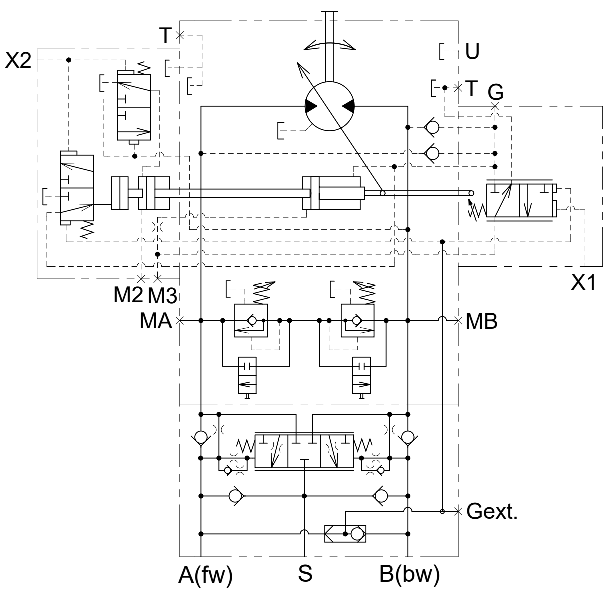
Travel motor consists motor unit, regulator and counter balance valve.







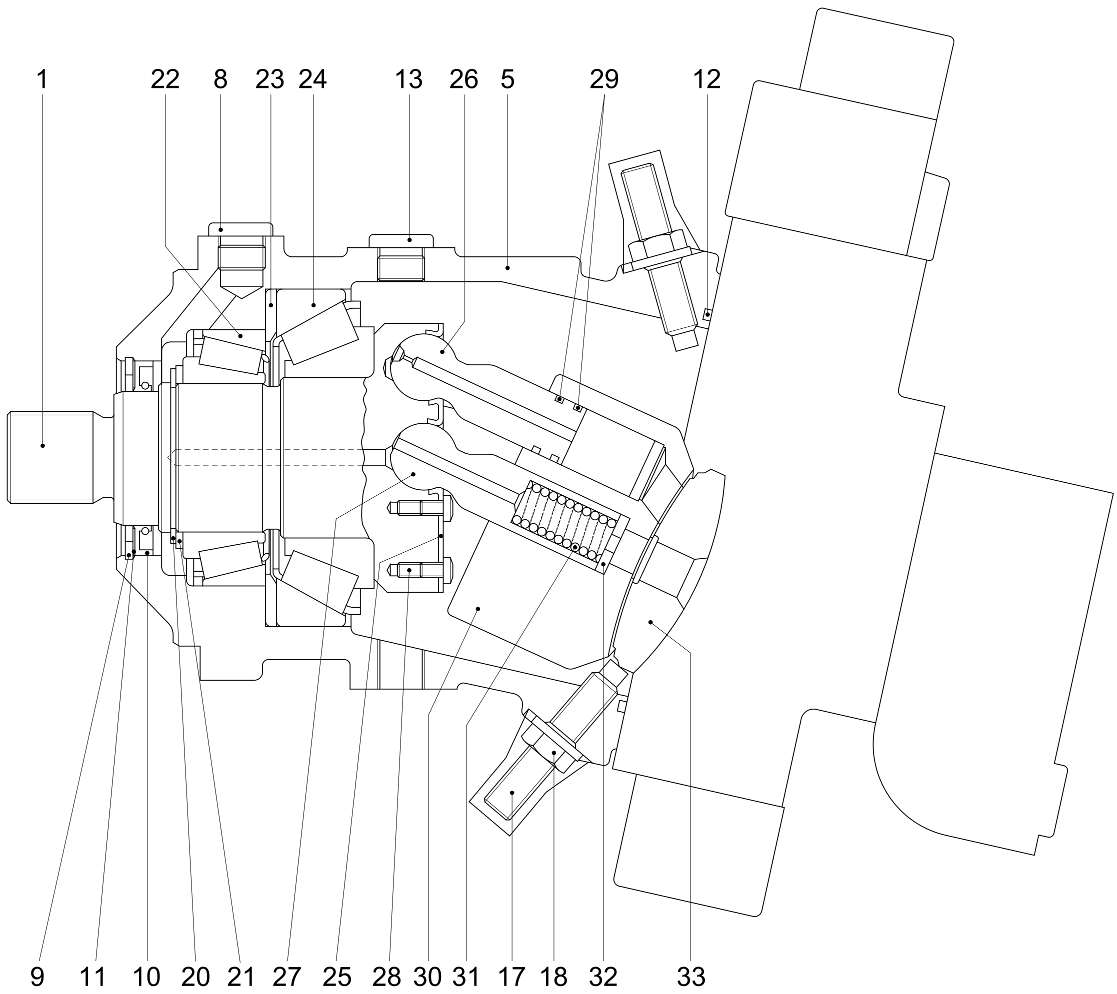
VIEW Y



Hydraulic circuit

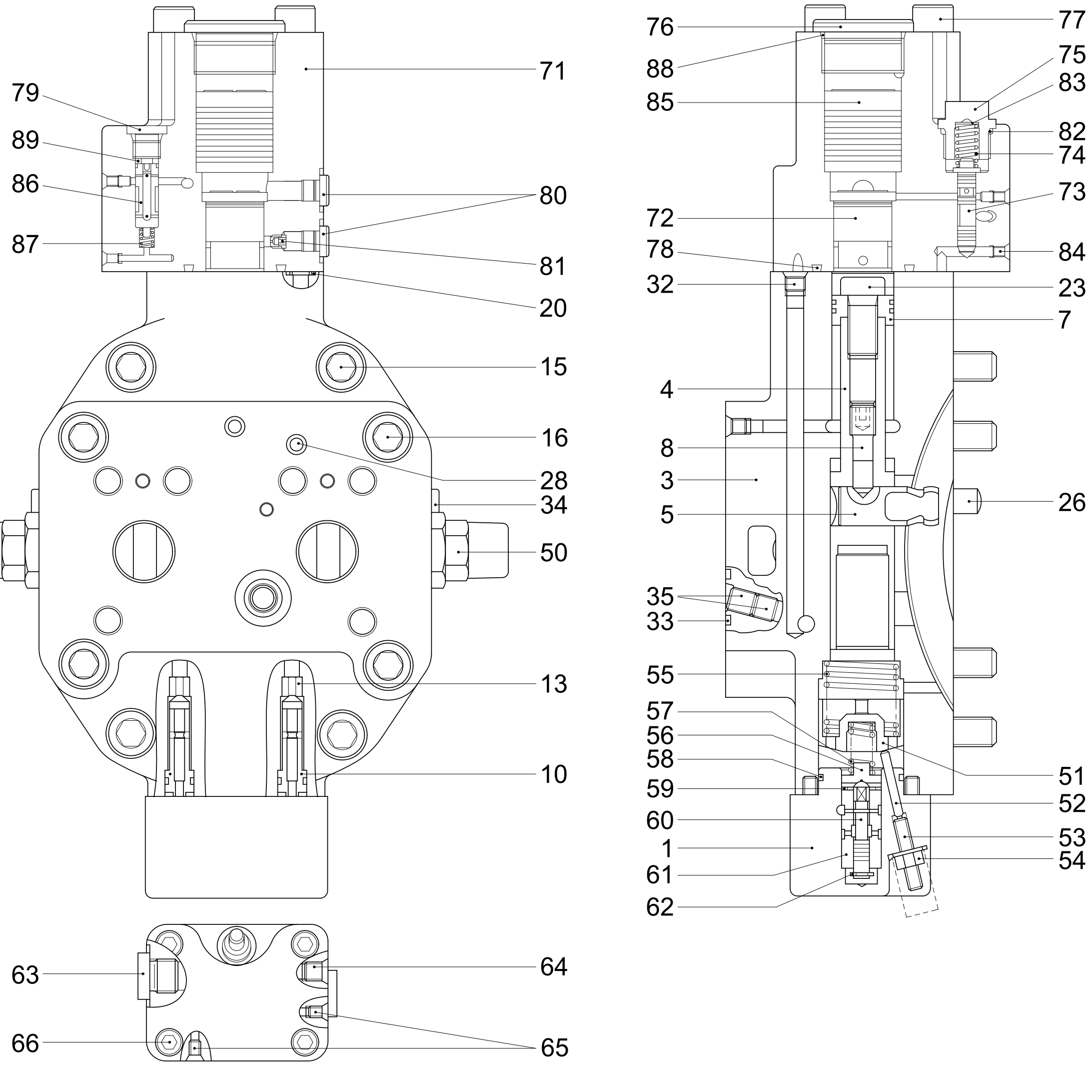
Port	Port name	Port size
A, B	Main port	SAE 6000psi 1"
G	N.A	M14×1.5-12
M1	Gauge port	M14×1.5-12
X1	Pilot pressure port	M14×1.5-12
X2	Pilot pressure port	M14×1.5-11.5
T	Drain port	PF 1/2-16
U	Flushing port	PF 1/2-16
S	Make up port	M27×2.0-14
MA, MB	Gauge port	M18×1.5-12
M2, M3	Gauge port	M10×1.0-8
Gext	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



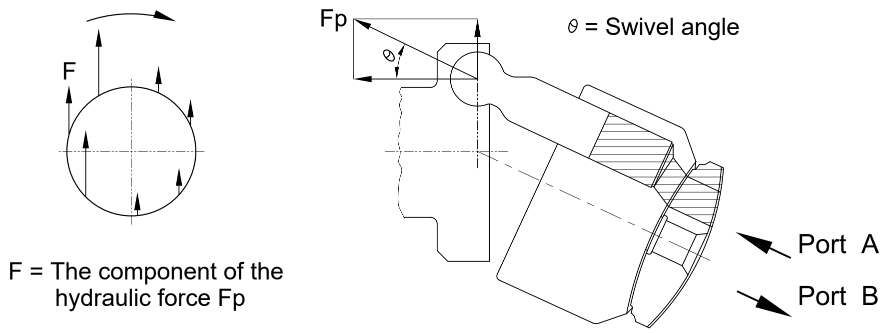
1	Control housing	50	Relief valve	72	Piston
2	Stroke limiter	51	Adjusting bushing	73	Control piston
3	Port plate	52	Cylinder pin	74	Pressure spring
4	Positioning piston	53	Threaded pin	75	Locking screw
5	Positioning trunnion	54	Seal lock nut	76	Locking screw
7	Piston	55	Pressure spring	77	Socket head screw
8	Threaded pin	56	Spring collar	78	O-ring
10	Check valve	57	Pressure spring	79	Locking screw
13	Valve seat	58	O-ring	80	Locking screw
15	Socket head screw	59	Retaining ring	81	Orifice
16	Socket head screw	60	Control piston	82	O-ring
20	O-ring	61	Control bushing	83	Shim
23	Socket head screw	62	Retaining disc	84	Double break off pin
26	Cylinder pin	63	Locking screw	85	Piston
28	Double break off pin	64	Double break off pin	86	Control piston
32	Double break off pin	65	Double break off pin	87	Pressure spring
33	O-ring	66	Socket head screw	88	O-ring
34	Locking screw	71	Housing	89	Shim

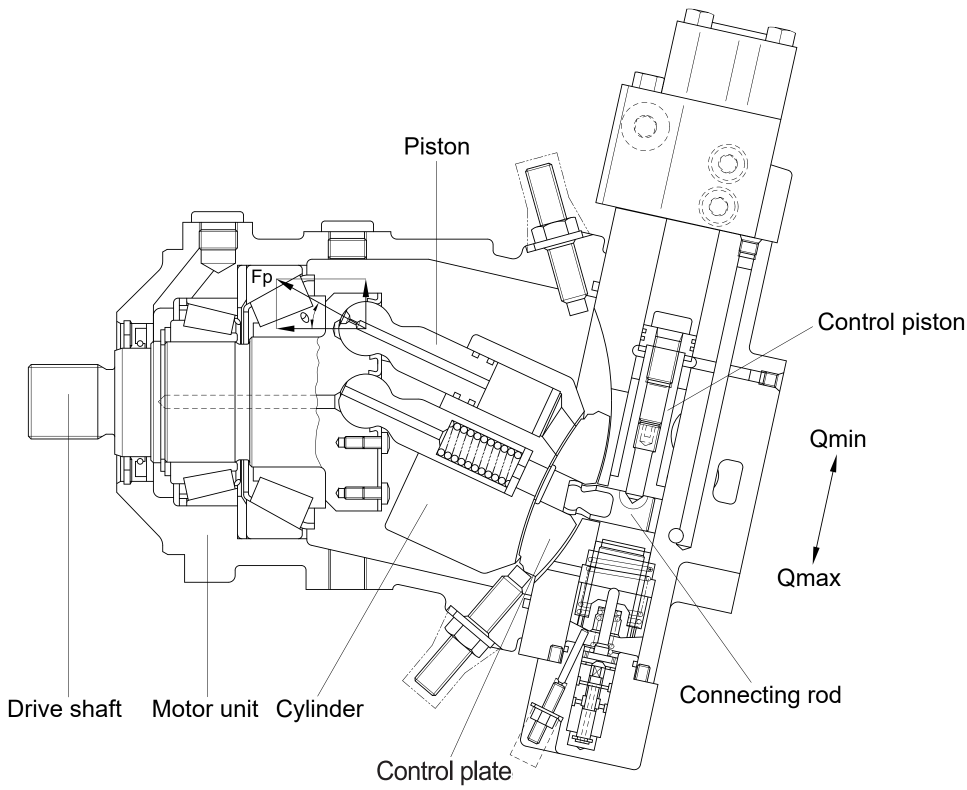
2. TRAVEL MOTOR FUNCTION

The direction of the drive shaft rotation is dependent on which is the port, port A or port B, the pressure oil shall be connected to.

When the pressure oil is led into the cylinder in which seven pistons are flexibly mounted in a circular formation, pistons press the shaft and set it in rotation. One piston travels one stroke during one rotation, which results in that oil is sucked and discharged. As each of seven pistons continuously acts such movement in turn, the drive shaft can do rotary movement smoothly. The component of the hydraulic force acting on the piston produces turning effect. Therefore, as the swivel angle becomes larger, the turning effect becomes larger. In addition, as the travel angle becomes larger, the displacement becomes larger, which results in that the operating speed becomes slower.

The control plate is connected to the control piston by means of the connecting rod, and the swivel angle is dependent on the position of the control piston.





3. REGULATOR FUNCTION

HA function

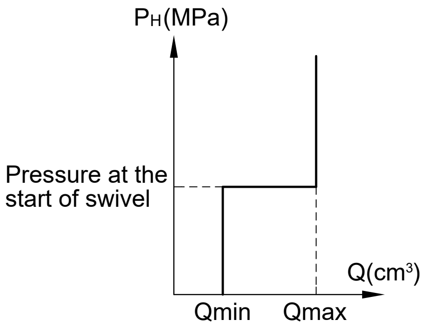
By sensing the load, the displacement varies.

HA operation

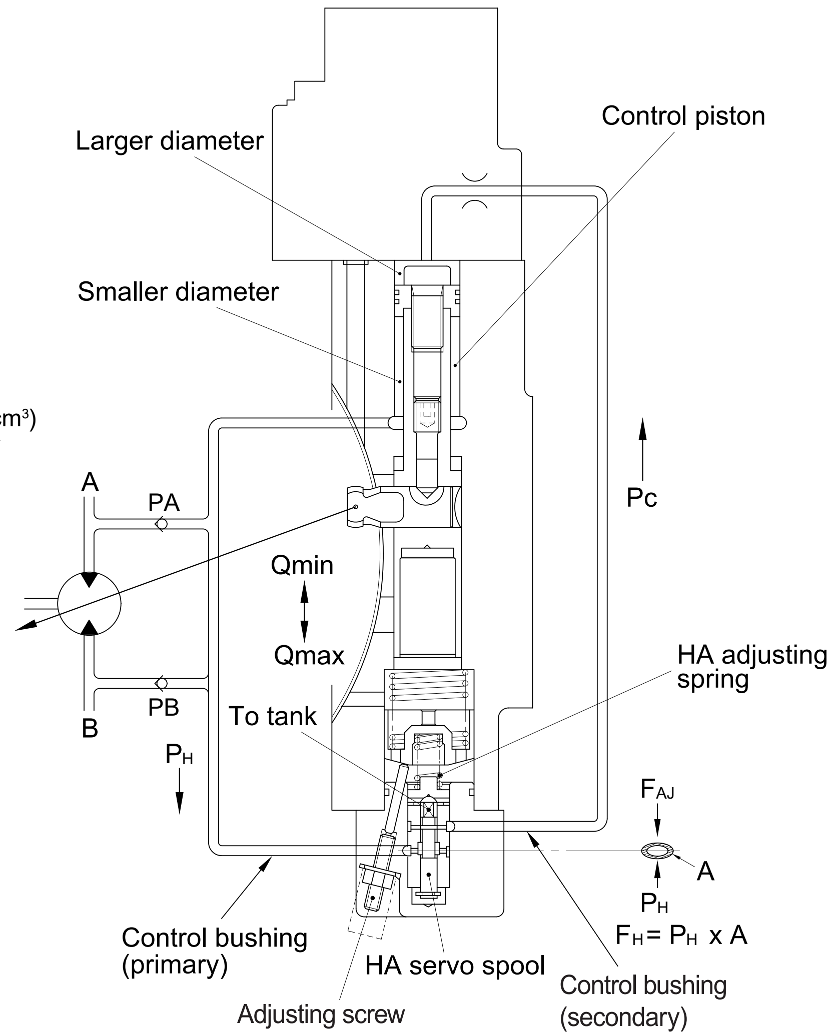
The high pressure PH at the either side of port A or port B is selected by the shuttle valve fitted in the counter balance valve, and it is led into the smaller diameter of the control piston and the spool.

If the circuit pressure value is lower than the pressure value at the start of swivel, the control pressure Pc acting on the larger diameter of the control piston becomes zero, and thus the swivel angle is the minimum. On the contrary, if the circuit pressure value is higher than the pressure value at the start of swivel, the spool is shifted and the control pressure increases, which causes the control piston to move toward the larger swivel angle.

The traveling speed is variable in proportion to the load pressure, by means of the function above. When the load pressure is high, for example, at starting or at climbing a slope, the swivel angle is set to be the maximum, and the torque is be the maximum. And as the load pressure drops down, the swivel angle is getting smaller, which results in higher speed of traveling. When the load pressure is low, for example, traveling on the flat, the swivel angle is set to be the minimum, which results in the maximum speed of traveling.



HA characteristic



4. RETARDING FUNCTION

When the travel motor operates as a pump at putting on a brake or going down a hill, it causes braking pressure (counter pressure). By using this braking pressure, the displacement will be a little bit larger, which results in a better braking performance. We call that retarding function.

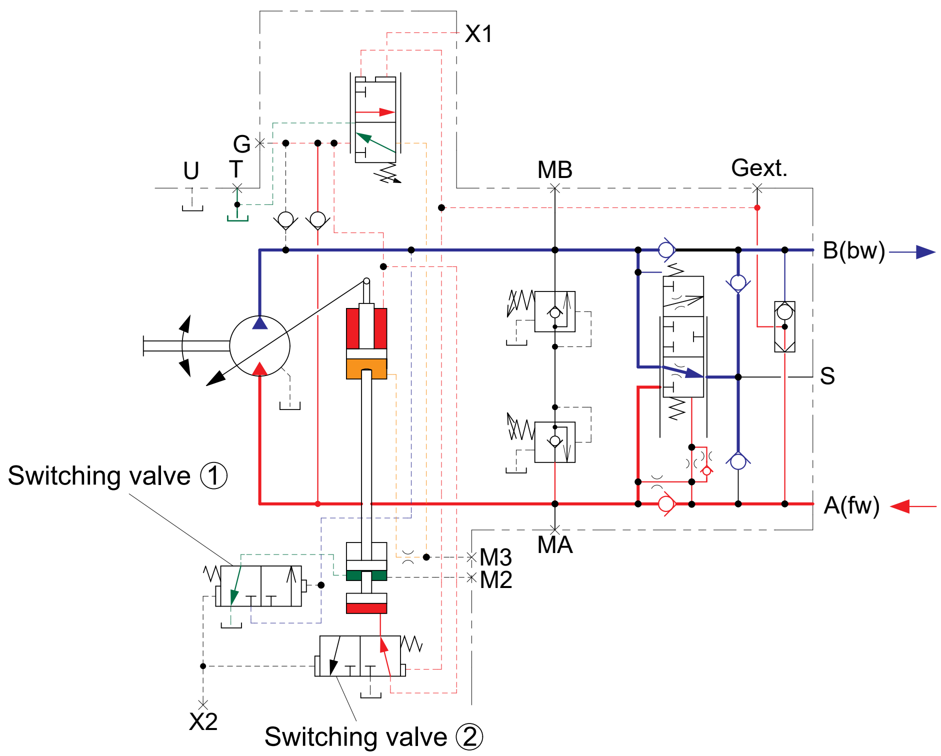
Because there are some concerns that the cavitation occurs when the variation of the displacement is large, it is necessary to select the proper displacement (Qmid) with considering the conditions and the feeling over the real machine.

In running at port A pressurized (Fig TR07), the pressure at port MB becomes a high pressure at the brake. When that pressure exceeds the setting pressure of the switching valve ①, the switching valve ① shifts and the high pressure line connects with port M2. This causes the control piston to move toward the larger swivel angle and thus the displacement becomes a middle displacement (Qmid) (Fig TR08). In this case, the pressure at port X2 is unloaded.

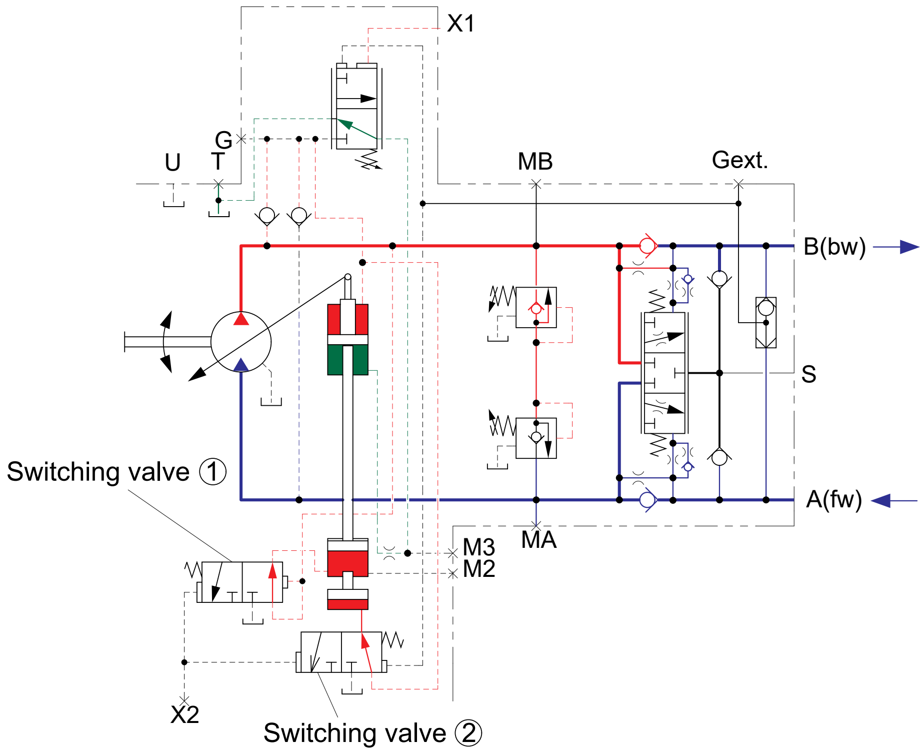
We recommend that the pressure at the start of swivel be about 2 MPa lower than the setting pressure of the switching valve ① and the setting pressure of relief valve be about 4 MPa higher than the setting pressure of the switching valve ①. Furthermore, by pressurizing port X2, the switching valve ① is kept off-state and the displacement doesn't changes (Fig TR09).

※ : The switching valve ② has the function to select the displacement in proportion to the gear ratio (first gear or second gear), by pressurizing port X2, the switching valve ② becomes on-state and the minimum displacement at first gear is selected.

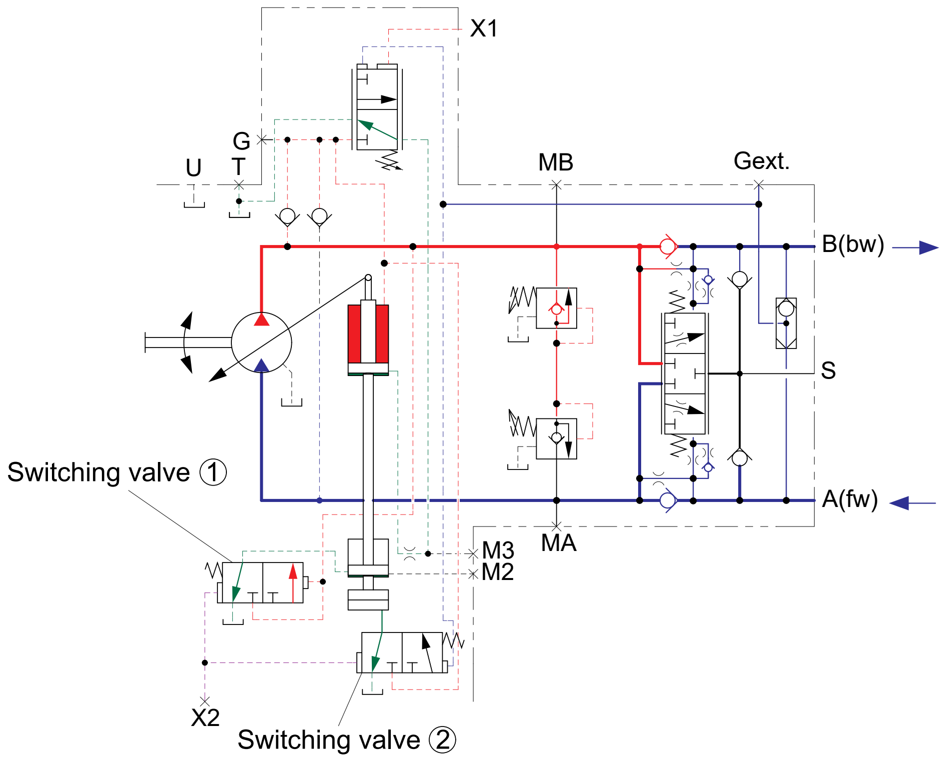
1) IN RUNNING : Port X2 : unloaded



2) IN BRAKING : Port X2 : unloaded



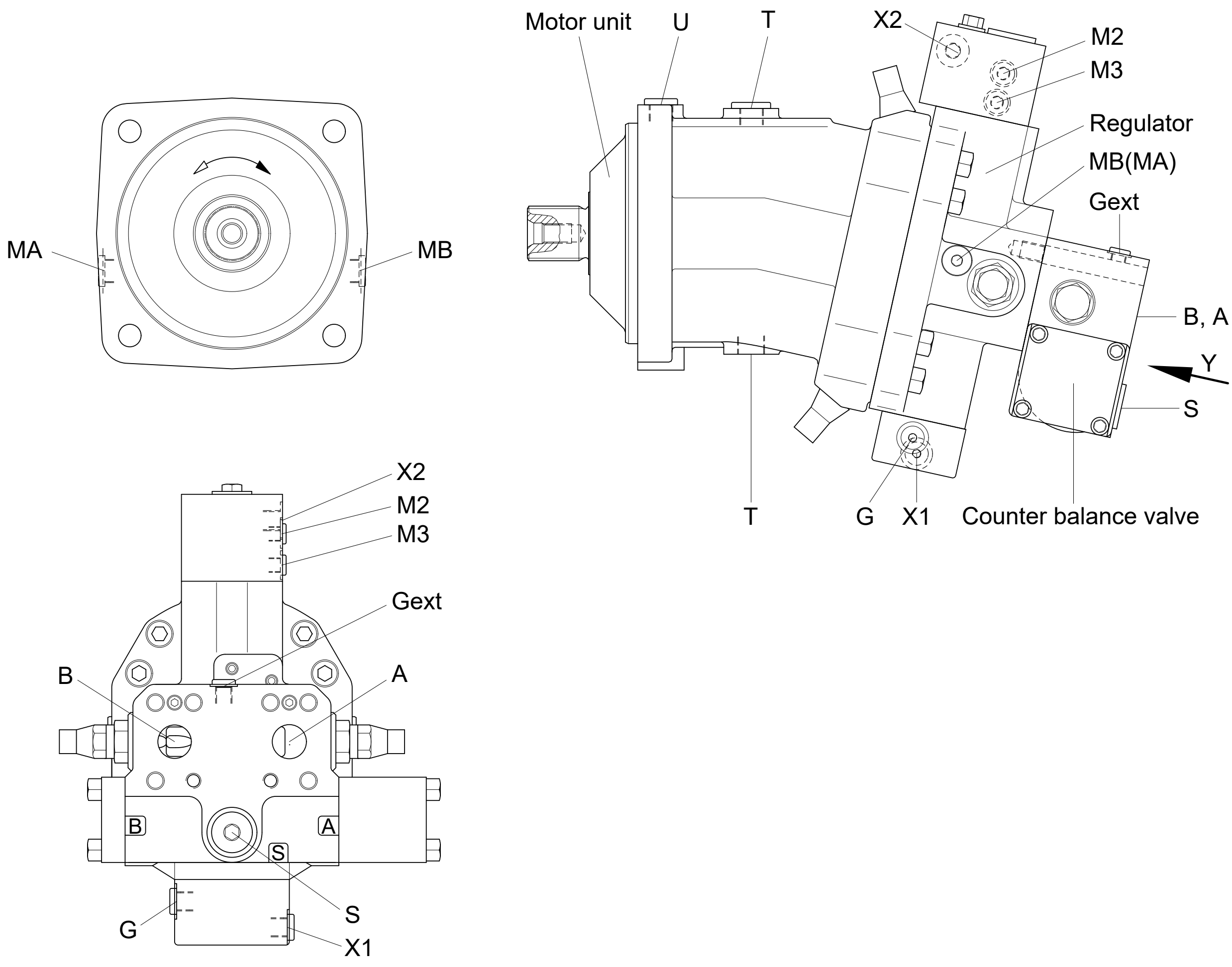
3) IN BRAKING : Port X2 : pressurized



GROUP 4 TRAVEL MOTOR (#0407-)

1. CONSTRUCTION

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



VIEW Y

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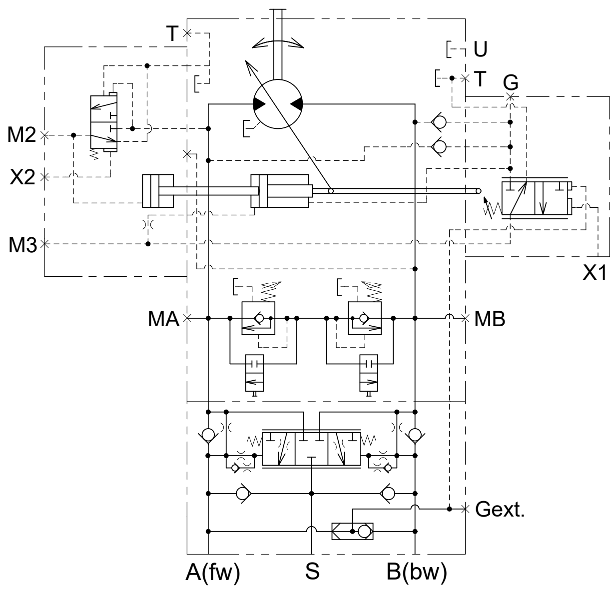
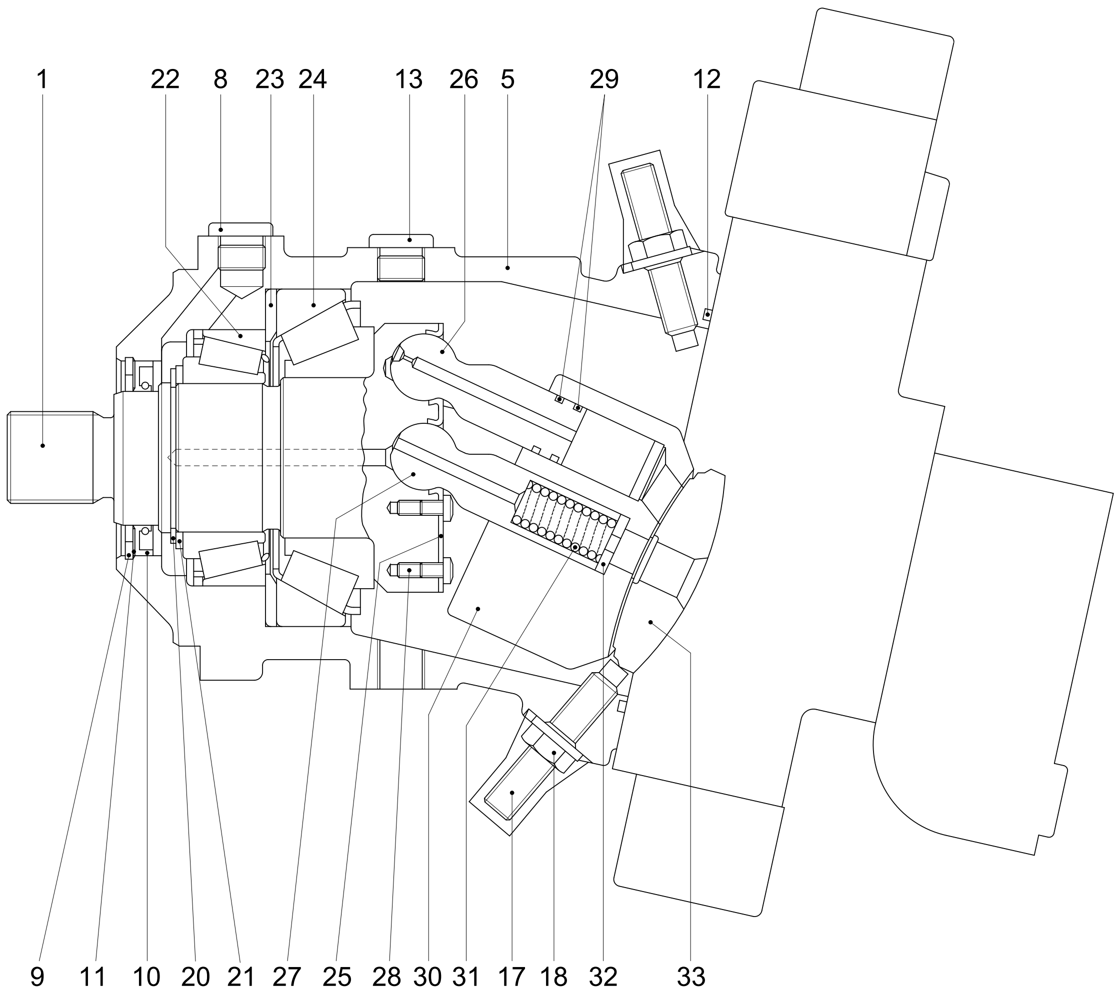


Hydraulic circuit

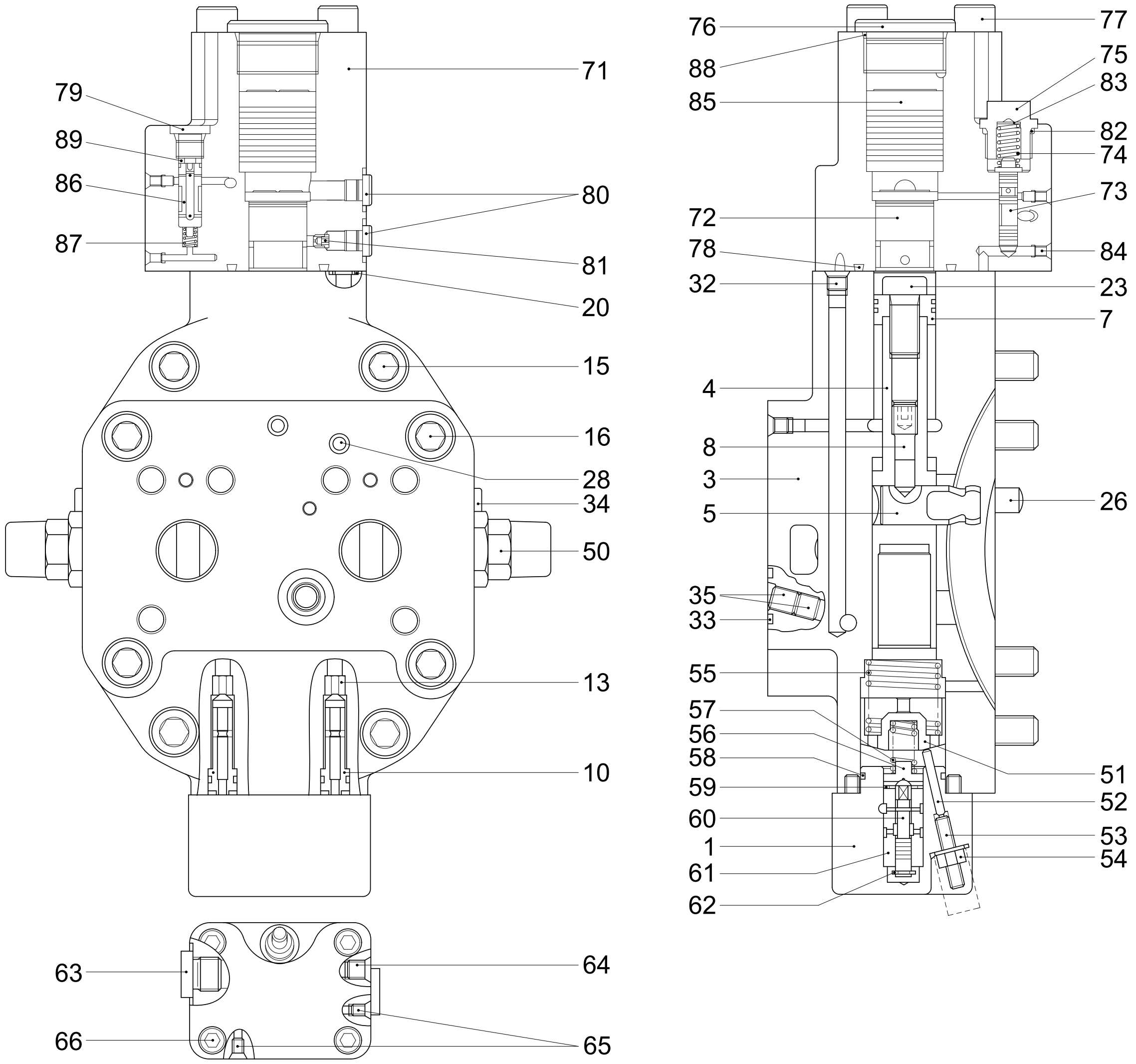
Port	Port name	Port size
A, B	Main port	SAE 1"
G	N.A	M14 × 1.5-12
M1	Gauge port	M14 × 1.5-12
X1	Pilot pressure port	M14 × 1.5-12
X2	Pilot pressure port	M14 × 1.5-11.5
T	Drain port	PF 1/2-16
U	Flushing port	PF 1/2-16
S	Make up port	M27 × 2.0-14
MA, MB	Gauge port	M18 × 1.5-12
M2, M3	Gauge port	M10 × 1.0-8
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	50	Relief valve	72	Piston
2	Stroke limiter	51	Adjusting bushing	73	Control piston
3	Port plate	52	Cylinder pin	74	Pressure spring
4	Positioning piston	53	Threaded pin	75	Locking screw
5	Positioning trunnion	54	Seal lock nut	76	Locking screw
7	Piston	55	Pressure spring	77	Socket head screw
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16	Socket head screw	60	Control piston	82	O-ring
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32	Double break off pin	65	Double break off pin	87	Pressure spring
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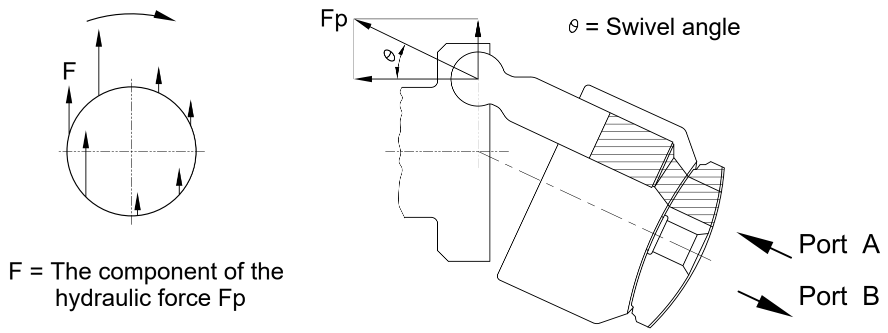
34	Locking screw	71	Housing	89	Shim

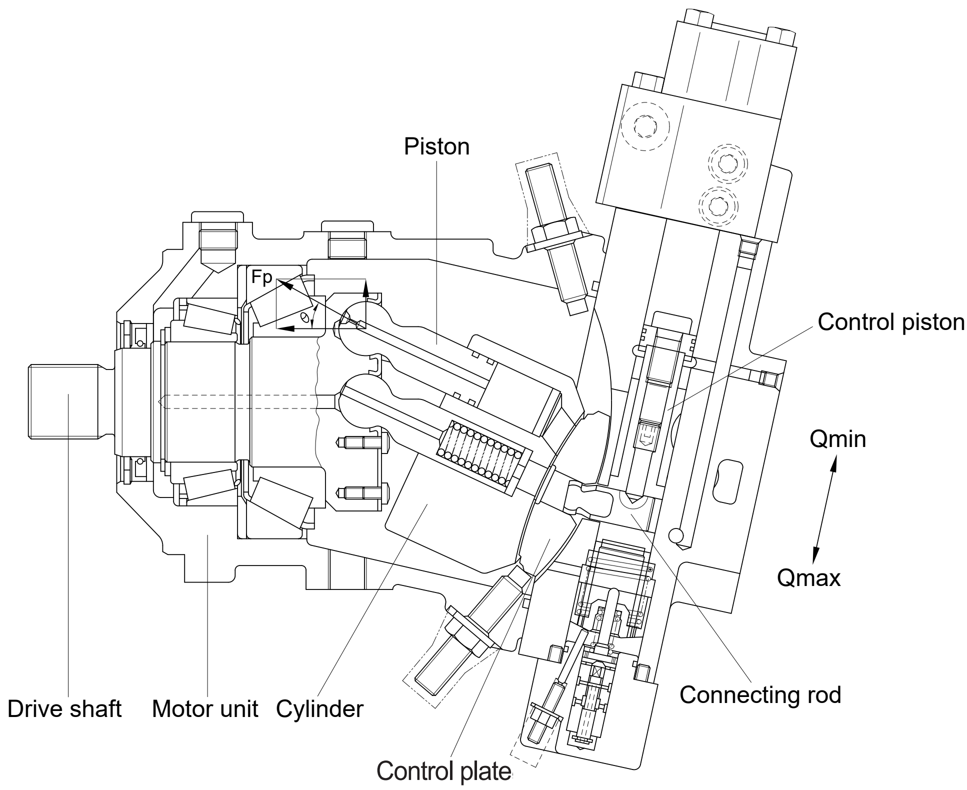
2. TRAVEL MOTOR FUNCTION

The direction of the drive shaft rotation is dependent on which is the port, port A or port B, the pressure oil shall be connected to.

When the pressure oil is led into the cylinder in which seven pistons are flexibly mounted in a circular formation, pistons press the shaft and set it in rotation. One piston travels one stroke during one rotation, which results in that oil is sucked and discharged. As each of seven pistons continuously acts such movement in turn, the drive shaft can do rotary movement smoothly. The component of the hydraulic force acting on the piston produces turning effect. Therefore, as the swivel angle becomes larger, the turning effect becomes larger. In addition, as the travel angle becomes larger, the displacement becomes larger, which results in that the operating speed becomes slower.

The control plate is connected to the control piston by means of the connecting rod, and the swivel angle is dependent on the position of the control piston.





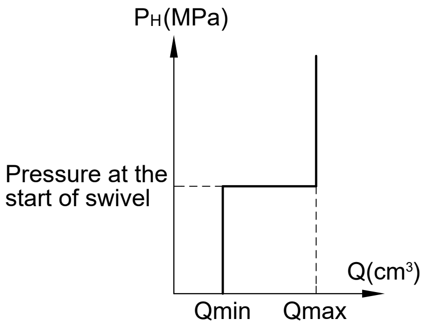
3. REGULATOR FUNCTION

HA function

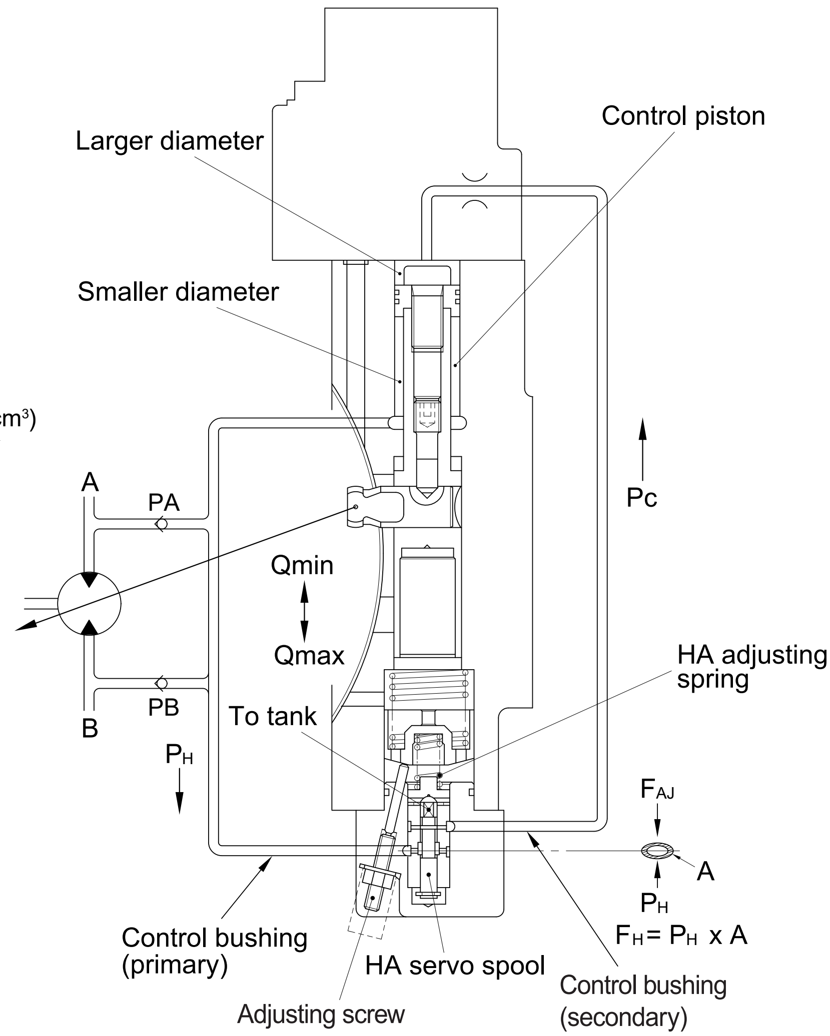
By sensing the load, the displacement varies.

HA operation

The high pressure PH at the either side of port A or port B is selected by the shuttle valve fitted in the counter balance valve, and it is led into the smaller diameter of the control piston and the spool.
If the circuit pressure value is lower than the pressure value at the start of swivel, the control pressure Pc acting on the larger diameter of the control piston becomes zero, and thus the swivel angle is the minimum. On the contrary, if the circuit pressure value is higher than the pressure value at the start of swivel, the spool is shifted and the control pressure increases, which causes the control piston to move toward the larger swivel angle.
The traveling speed is variable in proportion to the load pressure, by means of the function above. When the load pressure is high, for example, at starting or at climbing a slope, the swivel angle is set to be the maximum, and the torque is be the maximum. And as the load pressure drops down, the swivel angle is getting smaller, which results in higher speed of traveling. When the load pressure is low, for example, traveling on the flat, the swivel angle is set to be the minimum, which results in the maximum speed of traveling.



HA characteristic



4. RETARDING FUNCTION

When the travel motor operates as a pump at putting on a brake or going down a hill, it causes braking pressure (counter pressure). By using this braking pressure, the displacement will be a little bit larger, which results in a better braking performance. We call that retarding function.

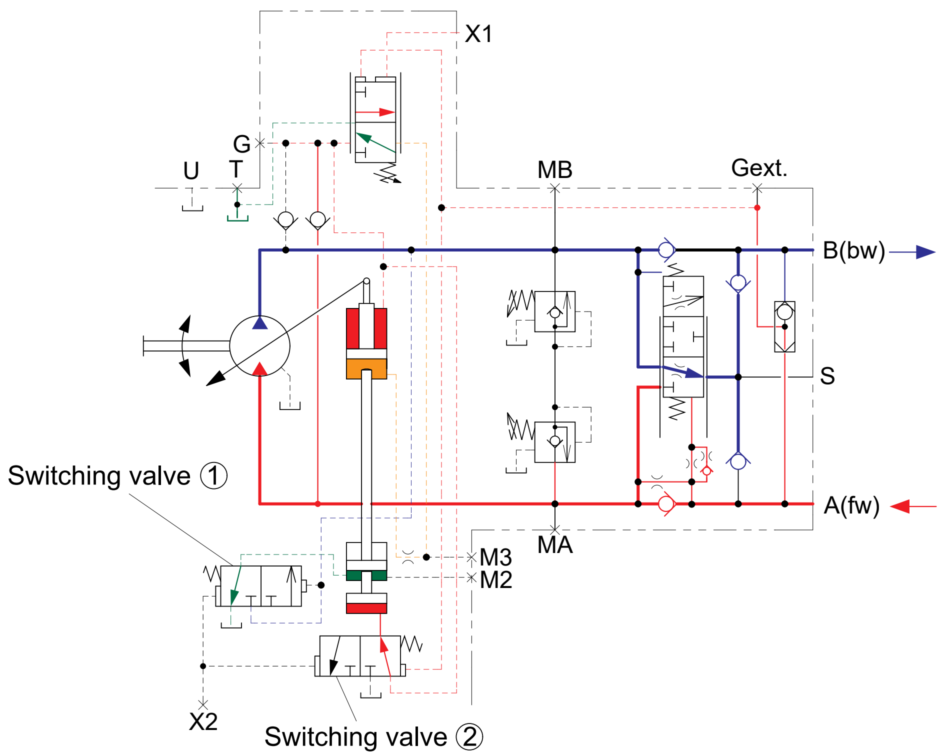
Because there are some concerns that the cavitation occurs when the variation of the displacement is large, it is necessary to select the proper displacement (Qmid) with considering the conditions and the feeling over the real machine.

In running at port A pressurized (Fig TR07), the pressure at port MB becomes a high pressure at the brake. When that pressure exceeds the setting pressure of the switching valve ①, the switching valve ① shifts and the high pressure line connects with port M2. This causes the control piston to move toward the larger swivel angle and thus the displacement becomes a middle displacement (Qmid) (Fig TR08). In this case, the pressure at port X2 is unloaded.

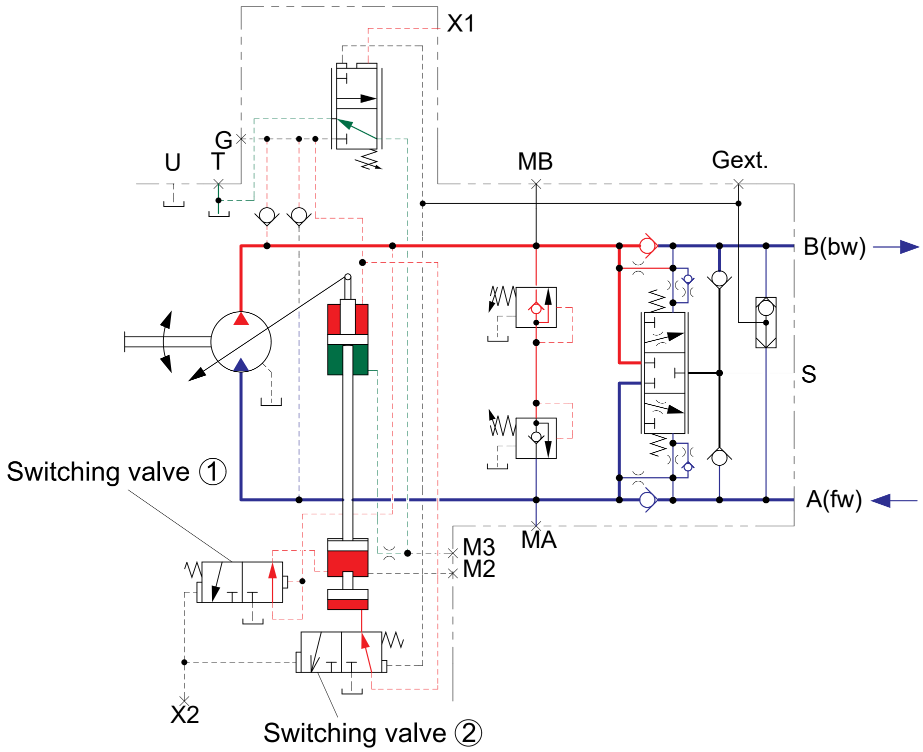
We recommend that the pressure at the start of swivel be about 2 MPa lower than the setting pressure of the switching valve ① and the setting pressure of relief valve be about 4 MPa higher than the setting pressure of the switching valve ①. Furthermore, by pressurizing port X2, the switching valve ① is kept off-state and the displacement doesn't changes (Fig TR09).

※ : The switching valve ② has the function to select the displacement in proportion to the gear ratio (first gear or second gear), by pressurizing port X2, the switching valve ② becomes on-state and the minimum displacement at first gear is selected.

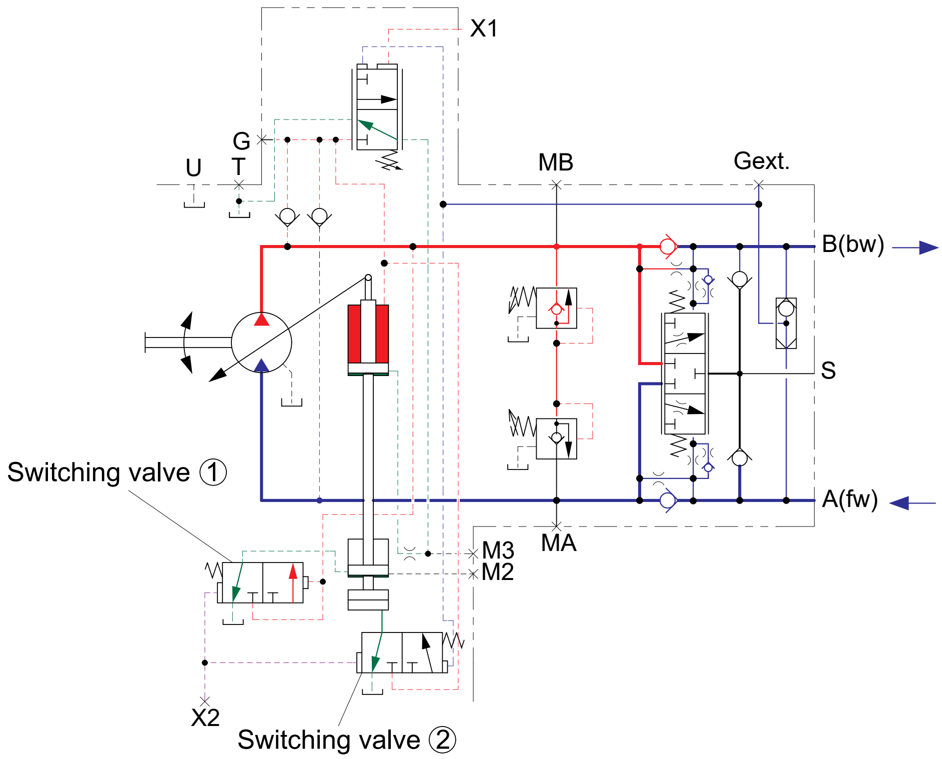
1) **IN RUNNING :** Port X2 : unloaded



2) IN BRAKING : Port X2 : unloaded

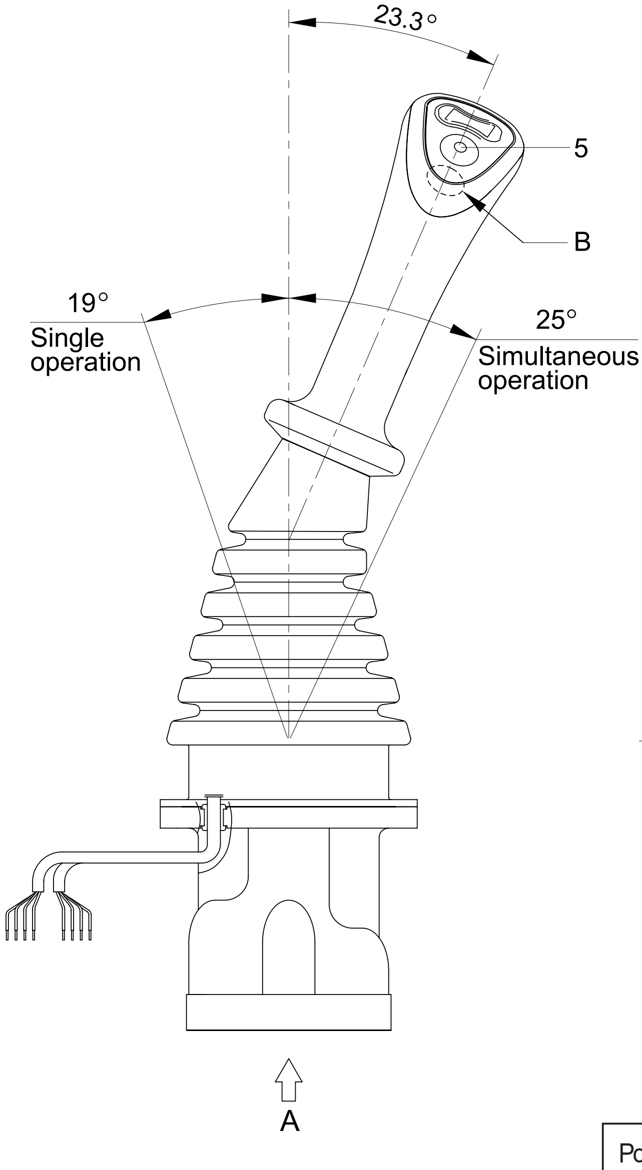


3) IN BRAKING : Port X2 : pressurized



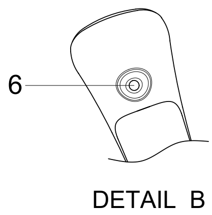
1. STRUCTURE

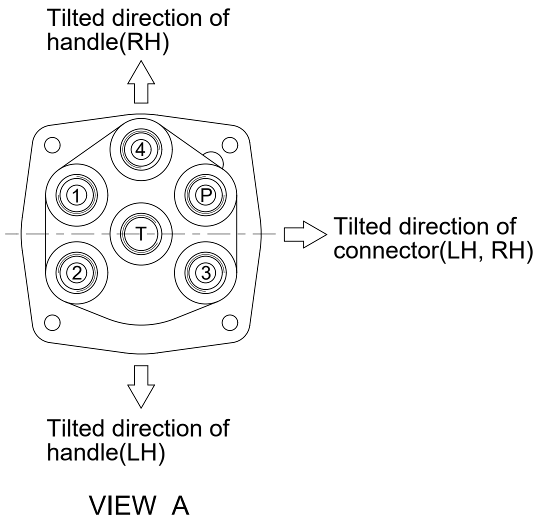
The casing has the oil inlet port P (primary pressure) and the oil outlet port T (tank). In addition the secondary pressure is taken out through ports 1, 2, 3 and 4 provided at the bottom face.

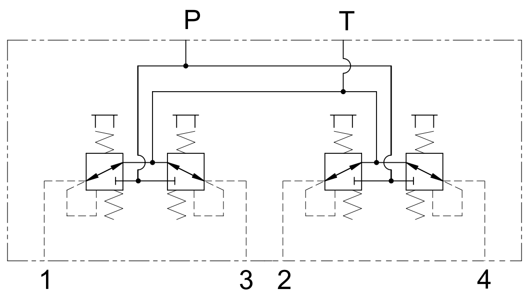


Switches

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







Hydraulic circuit

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

21092RL01

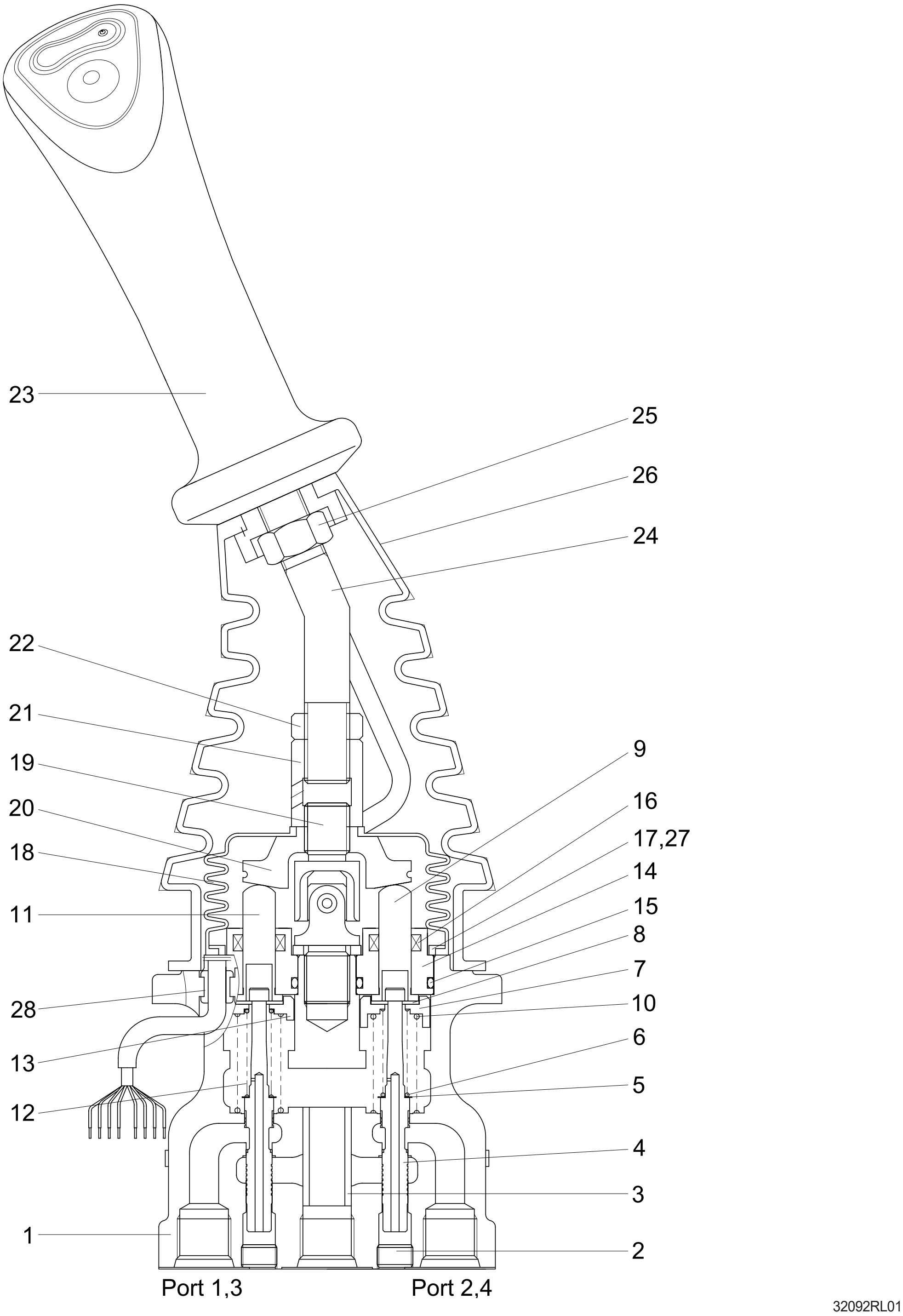
CROSS SECTION

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

The pressure reducing section is composed of the spool (4), spring (6) for setting secondary pressure, return spring (10), stopper (8), spring seat (7, 13) and shim (5). The spring for setting the secondary pressure has been generally so preset that the secondary pressure is 5 to 20.5 kgf/cm^2 (depending on the type). The spool is pushed against the push rod (9, 11) by the return spring.

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

CROSS SECTION



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

2. FUNCTIONS

1) FUNDAMENTAL FUNCTIONS

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

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

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

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

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

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

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

2) FUNCTIONS OF MAJOR SECTIONS

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

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

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

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

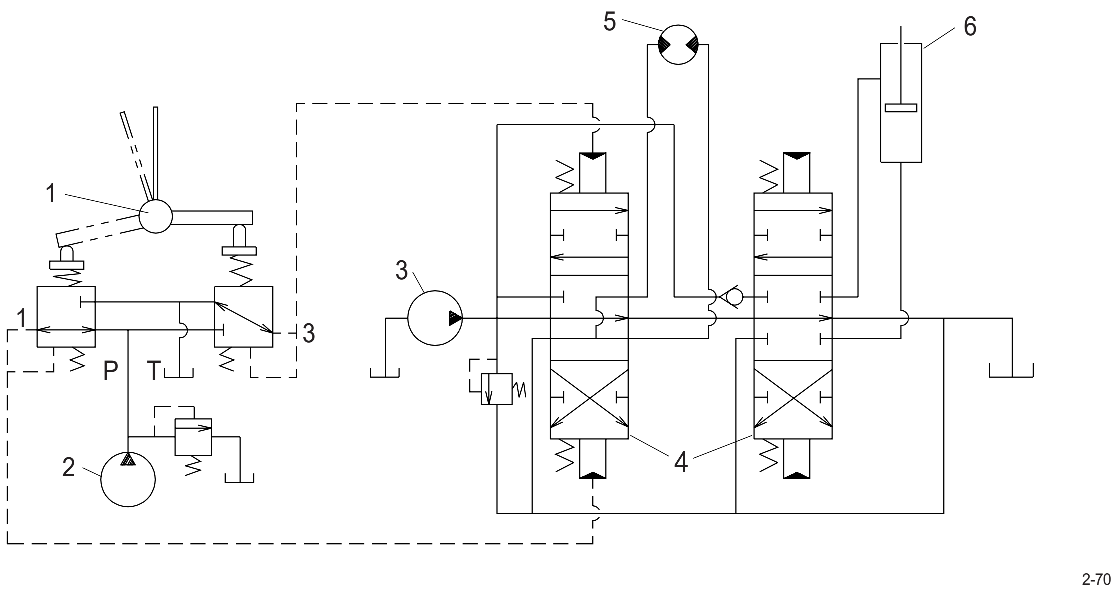
The spring (10) works on the case (1) and spring seat (7, 13) and tries to return the push rod (9,11) to the zero-displacement position irrespective of the output pressure, securing its resetting to the center position.

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

3) OPERATION

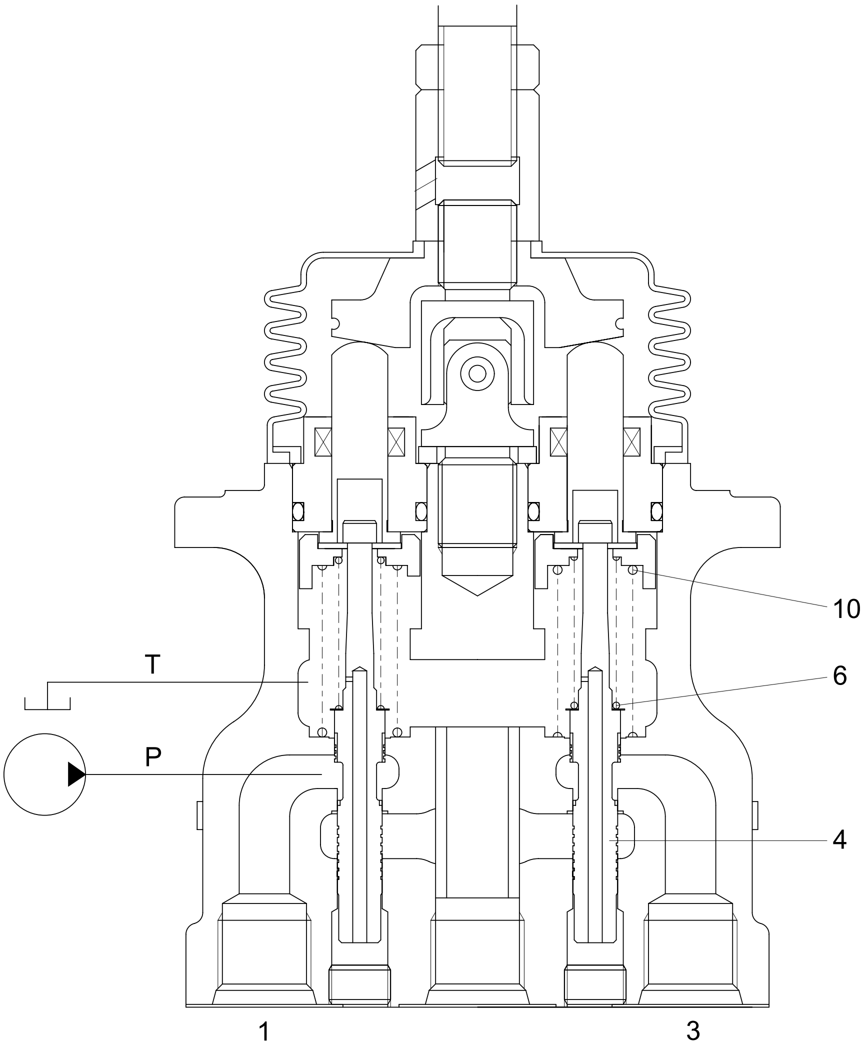
The operation of the pilot valve will be described on the basis of the hydraulic circuit diagram shown below and the attached operation explanation drawing.

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



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

(1) Case where handle is in neutral position



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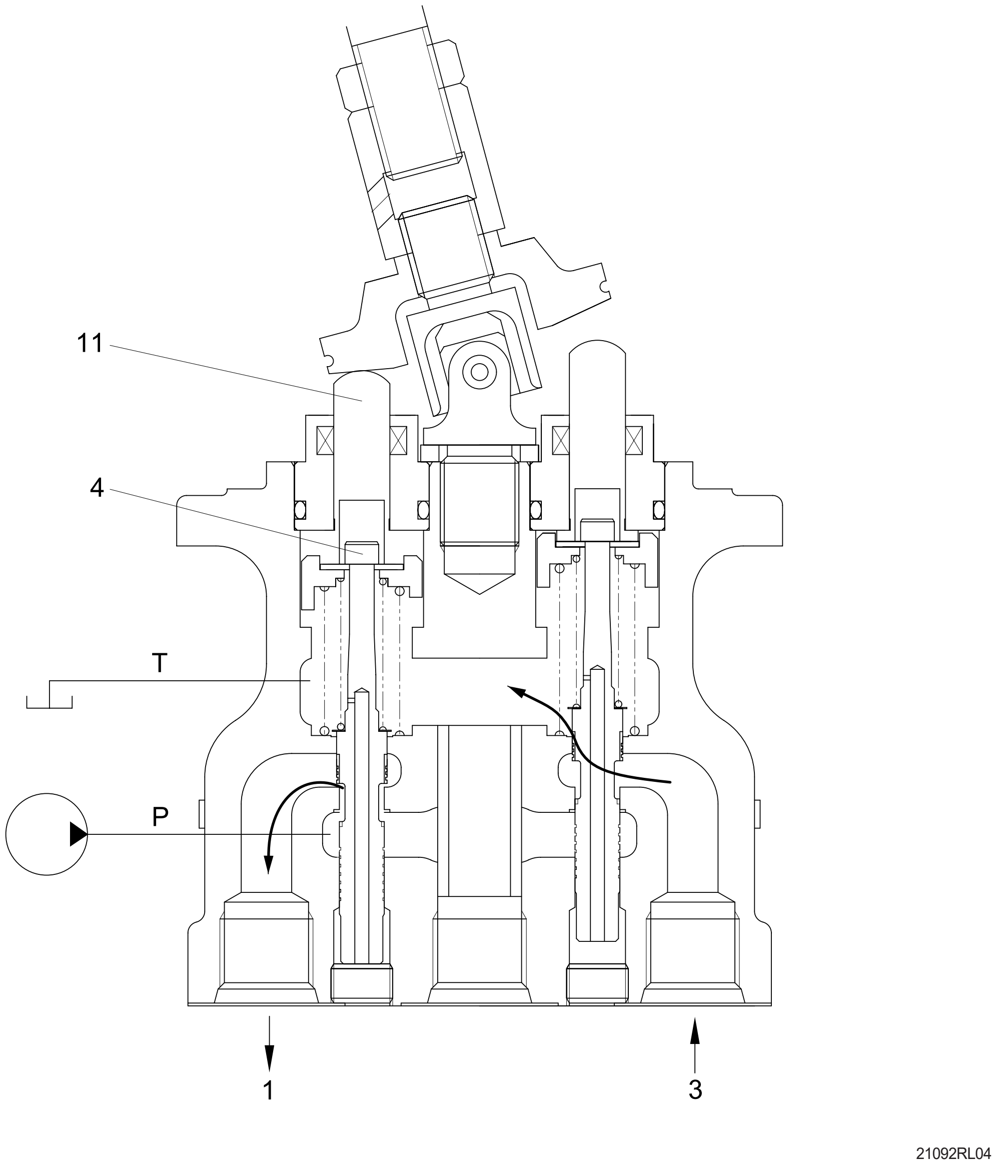
The force of the spring (6) that determines the output pressure of the pilot valve is not applied to the spool (4). Therefore, the spool is pushed up by the spring (10) to the position of port (1, 3) in the operation explanation drawing. Then, since the output port is connected to tank port T only, the output port pressure becomes equal to tank pressure.

(2) Case where handle is tilted



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

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

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

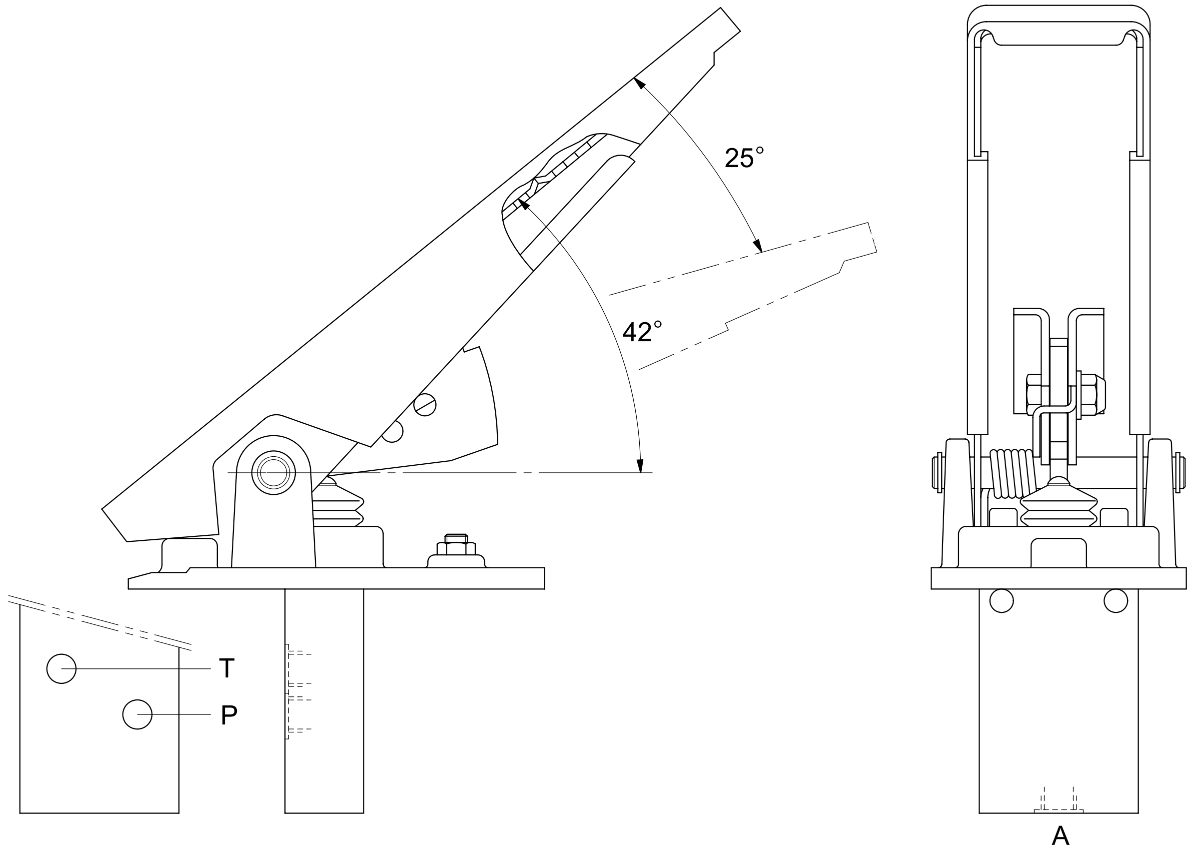
In this manner the secondary pressure is kept at the constant value.

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

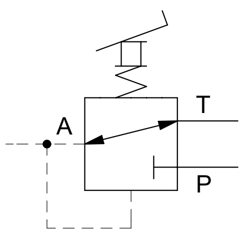
GROUP 6 ACCELERATOR PEDAL

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

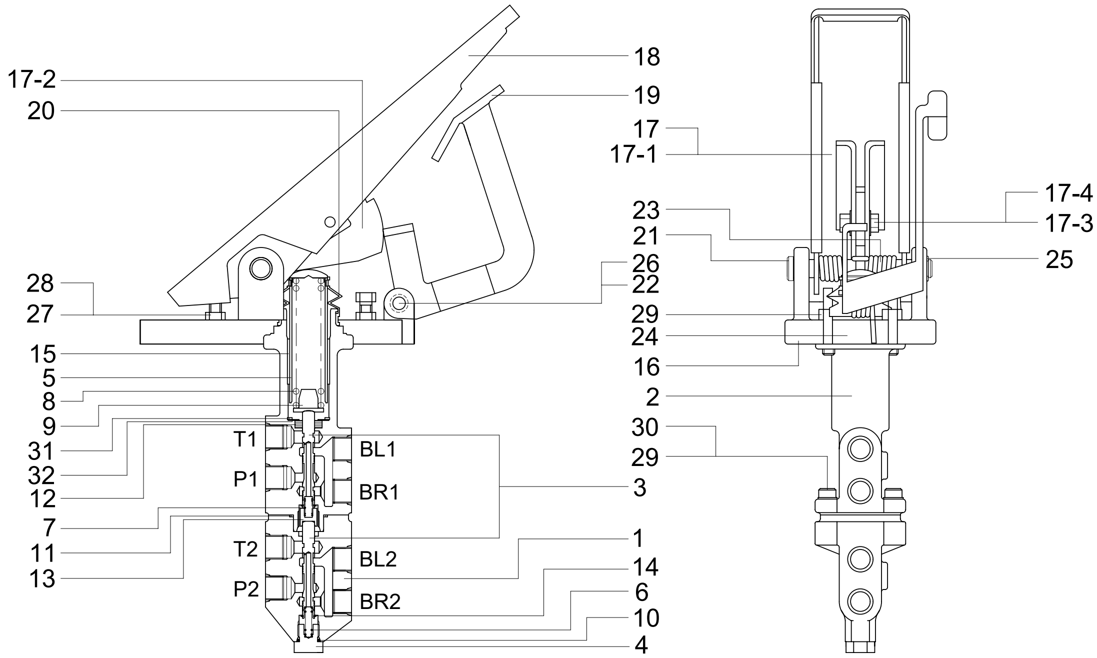
17032RP01(2)

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

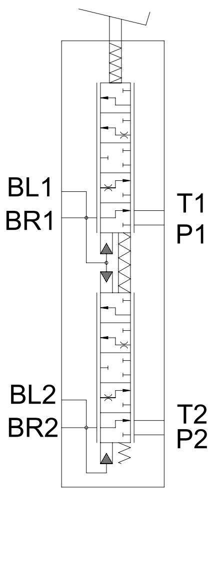
GROUP 7 BRAKE PEDAL (VALVE)

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.



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



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	

14W72BV02

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.

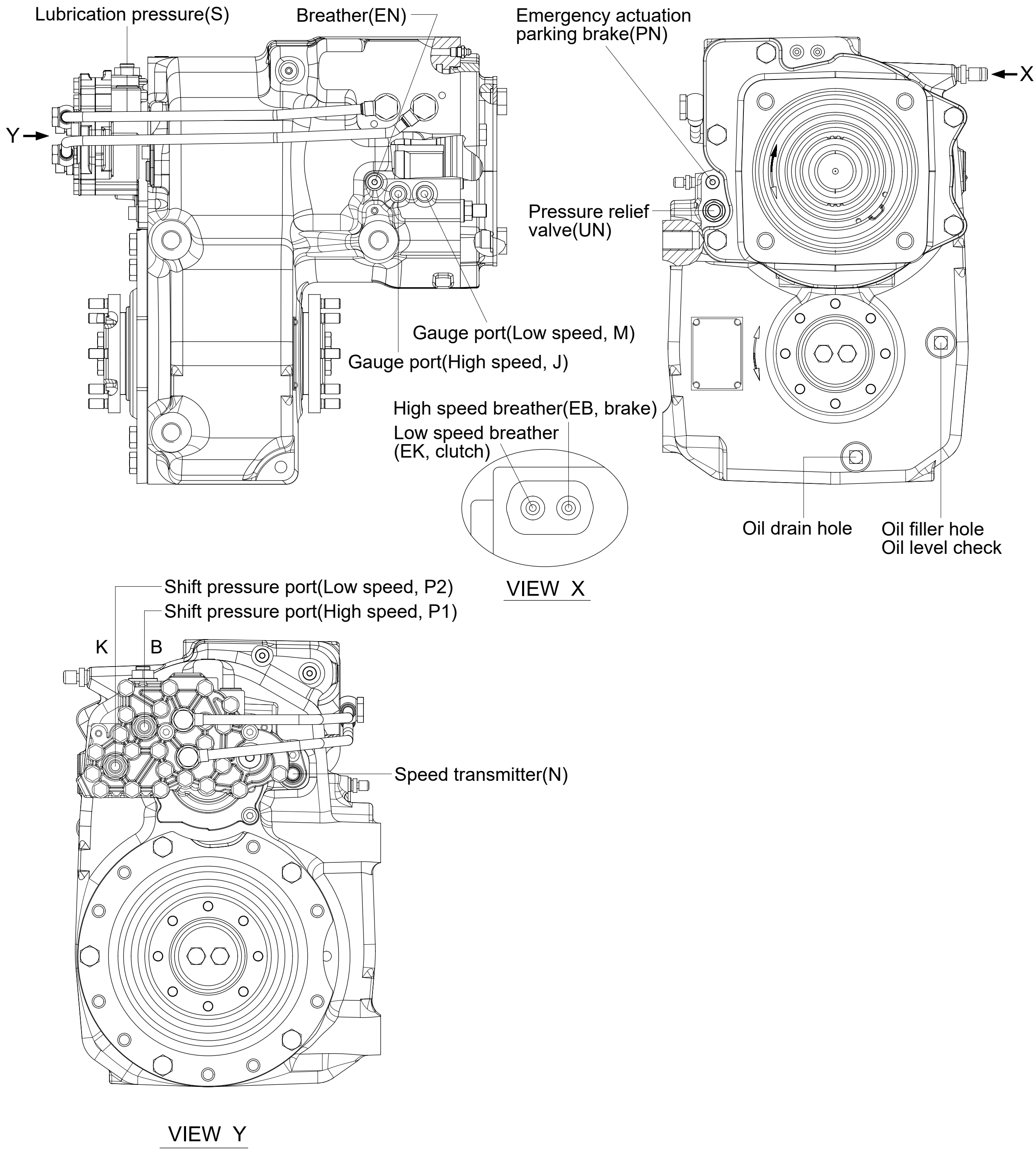
5) LIMITING THE BRAKING PRESSURE

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

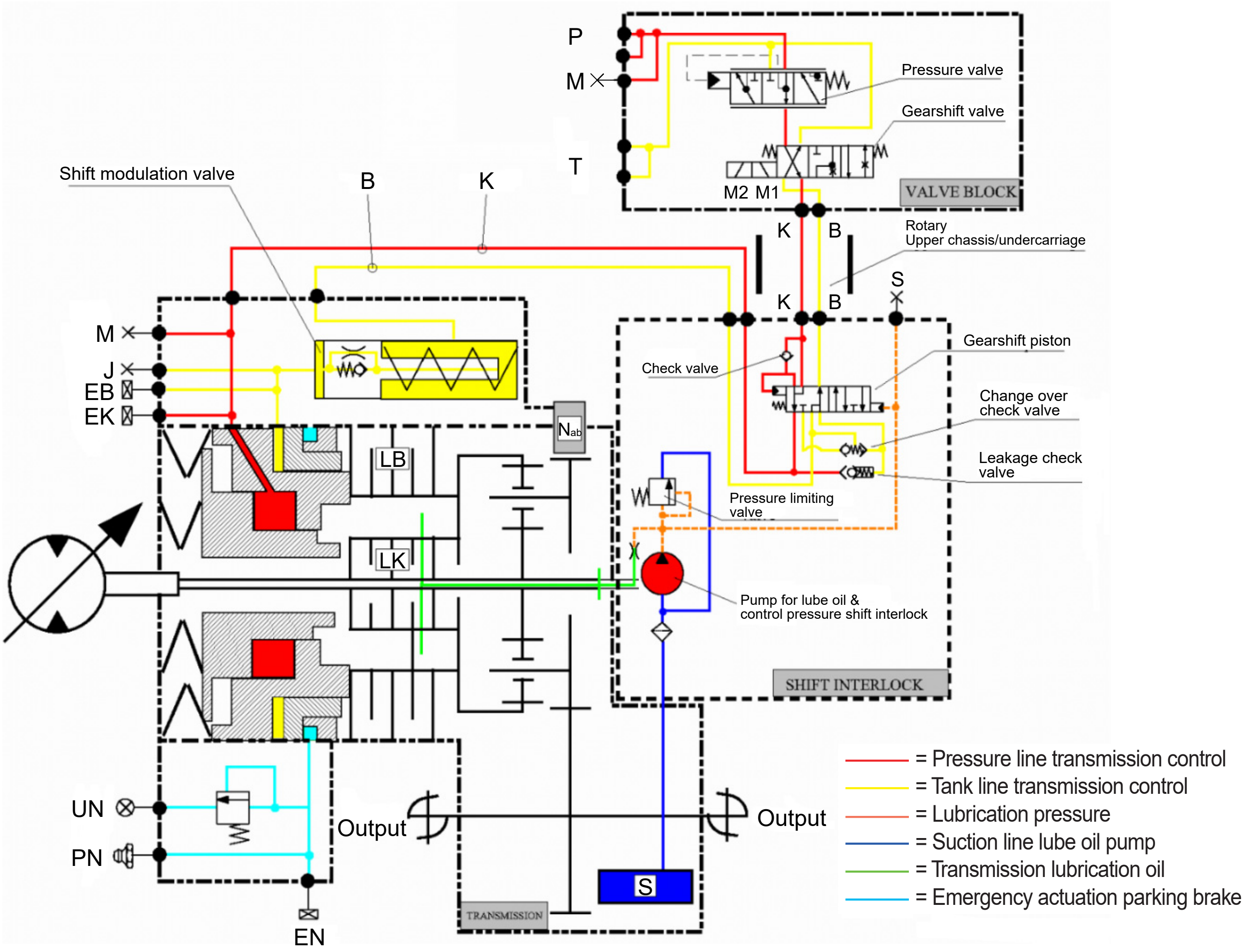
6) FAILURE OF A CIRCUIT

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).

1. STRUCTURE


Lubrication pressure(S)
Breather(EN)
Emergency actuation parking brake(PN)
X
Y
Pressure relief valve(UN)
Gauge port(Low speed, M)
Gauge port(High speed, J)
High speed breather(EB, brake)
Low speed breather (EK, clutch)
Oil drain hole
Oil filler hole
Oil level check
VIEW X
Shift pressure port(Low speed, P2)
Shift pressure port(High speed, P1)
K
B
Speed transmitter(N)
VIEW Y

2. TRANSMISSION DIAGRAM



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

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

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

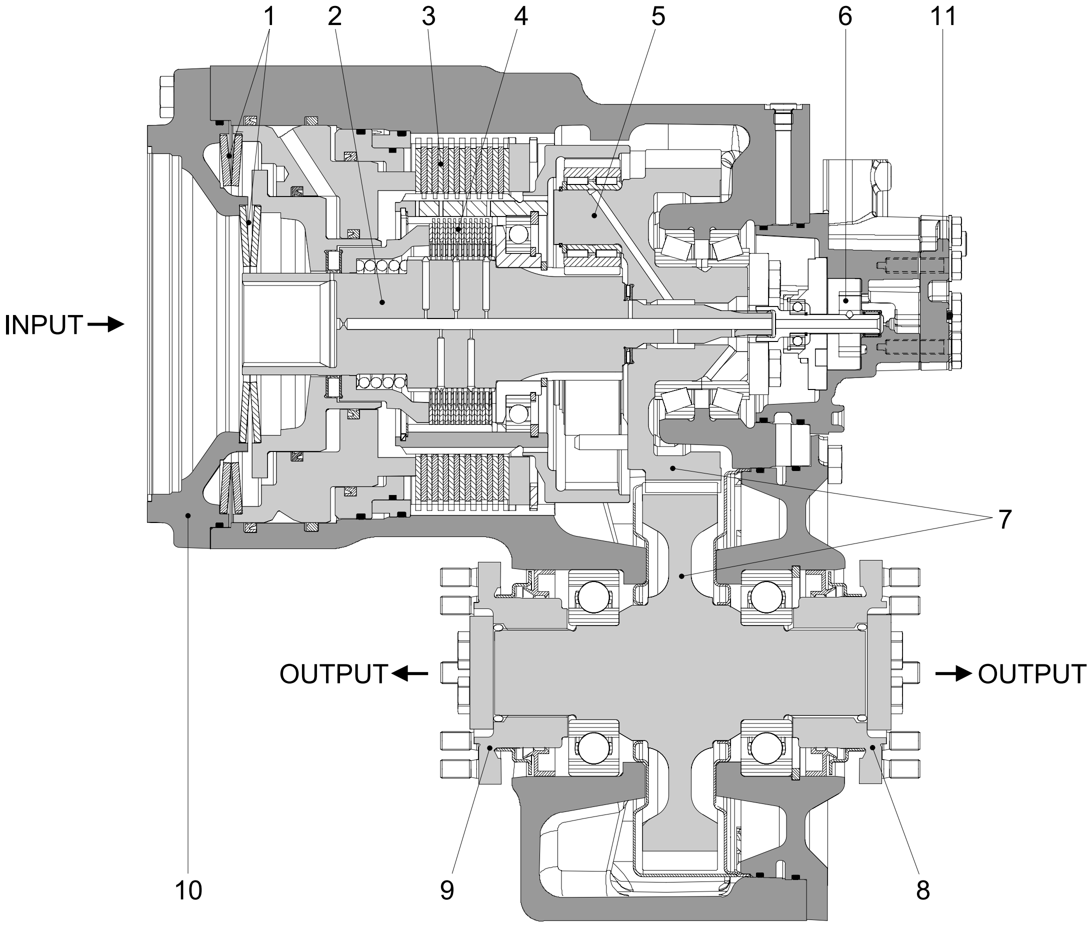
Connections-Valve block :
P : System pressure transmission control
T : Tank
B : Brake
K : Clutch

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

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

3. OPERATION OF TRANSMISSION

1) DESCRIPTION



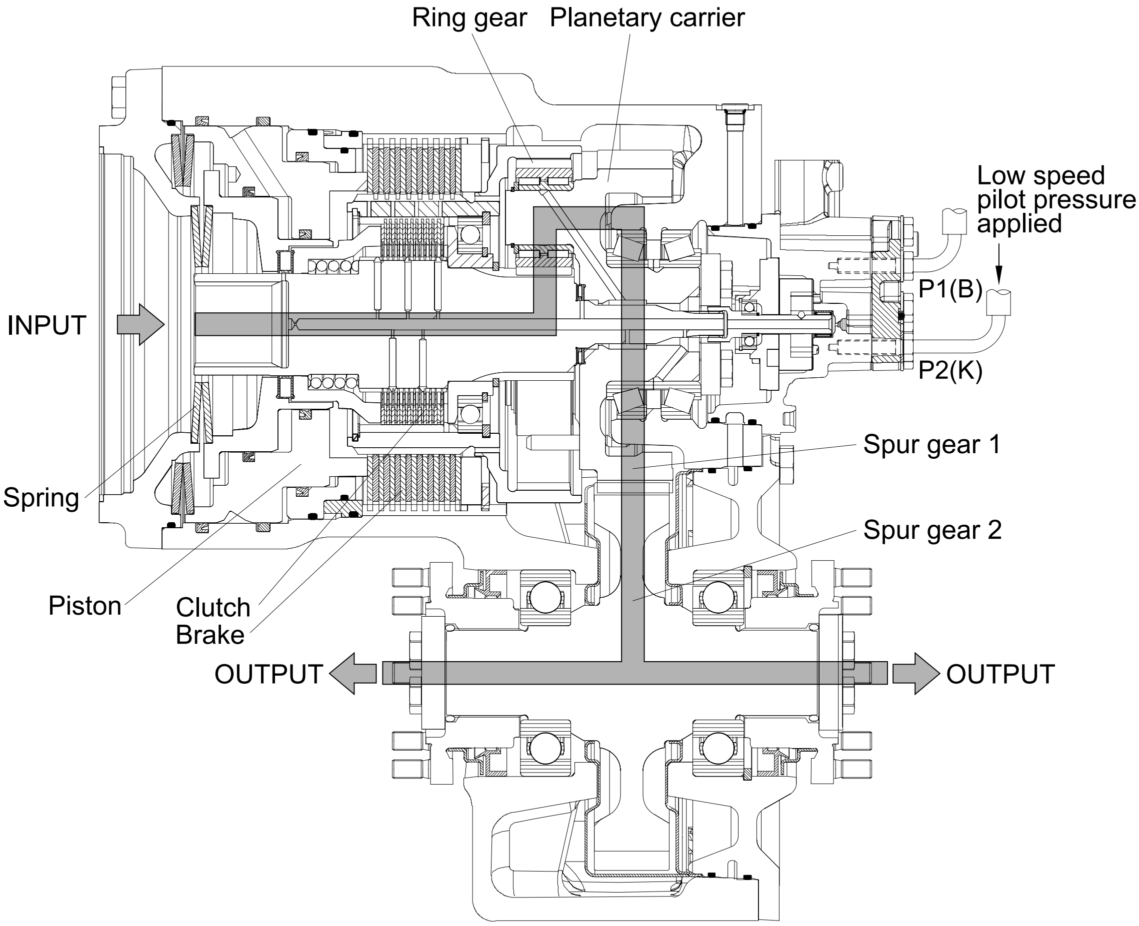
1	Cup spring	5	Planetary drive	9	Output flange-Front axle
2	Input shaft	6	Lub oil pump	10	Travel motor attachment
3	Disk brake	7	Spur gear drive	11	Shift interlock
4	Disk clutch	8	Output flange-Rear axle		

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

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

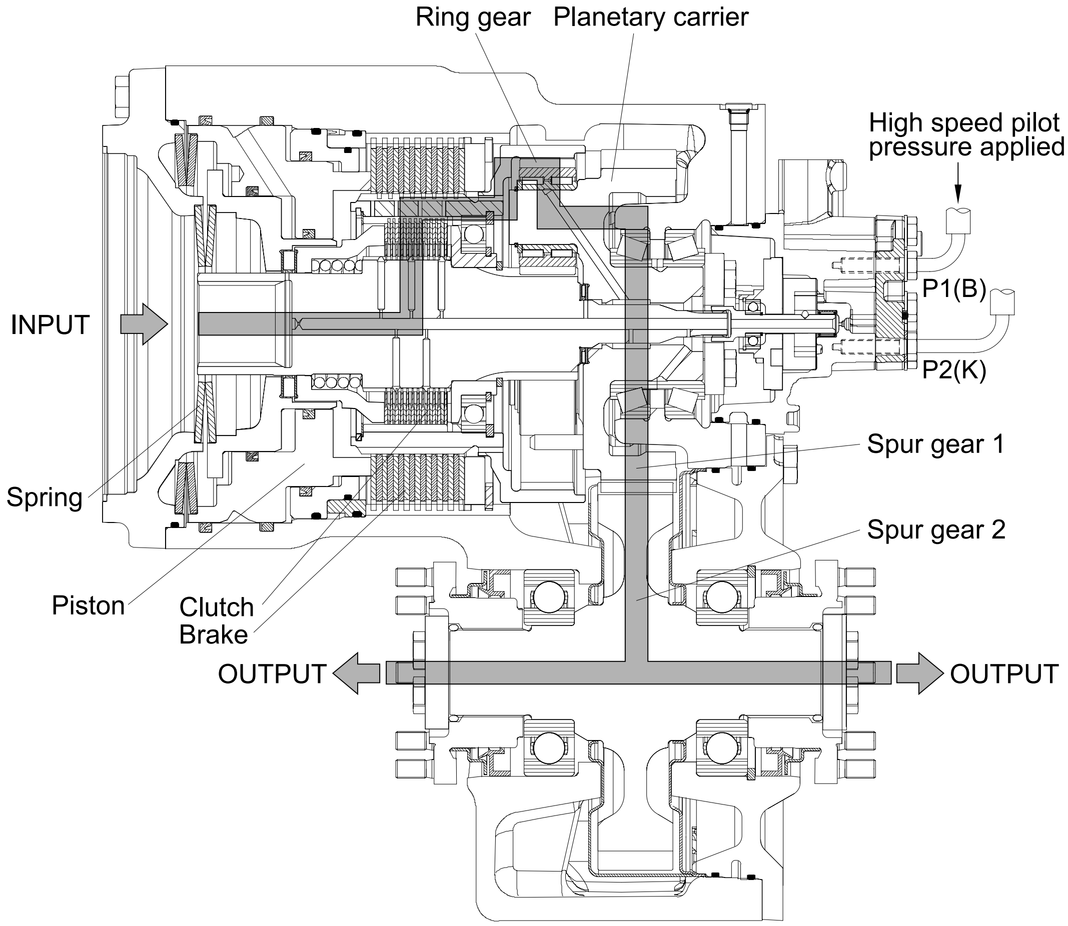
The powershift mechanism for the planet drive comprises a rotating multi-disk clutch (4) underneath a multi-disk brake (3) rigidly connected to the housing. Both are closed by spring pressure (2) and released hydraulically.
The shift interlock (11) prevents downshifts at high machine speeds and thus prevents over-rotation of the travel motor. If the low speed gear is selected while the high speed gear is engaged and input speed is above approx. 1000rpm, 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)



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)



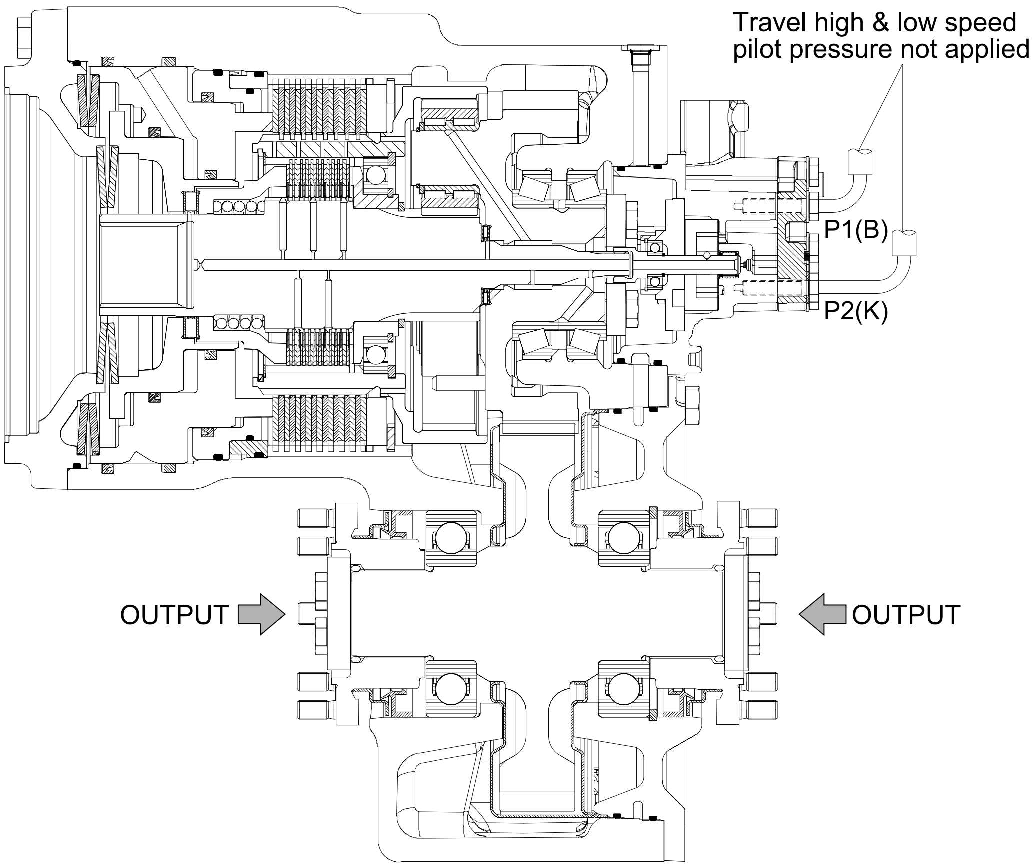
In high speed operation, the clutch is held closed under spring pressure and the brake is hydraulically opened.

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



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 1000rpm (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 : 135kg

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

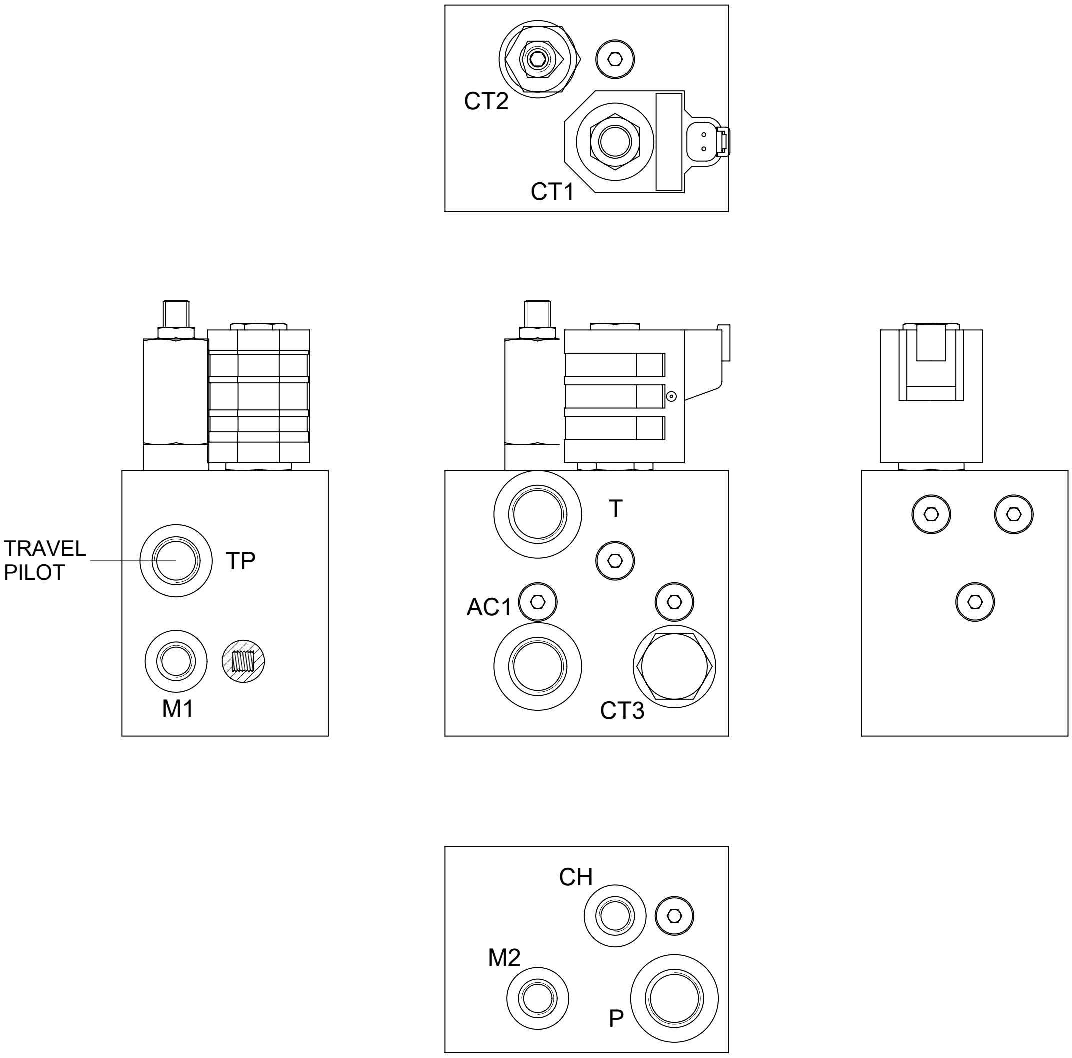
(2) Oil flow
① Min oil flow at 24+1 kgf/cm^2 counter pressure (low engine speed) : 5.5 l /min
② Max oil flow : 25 l /min

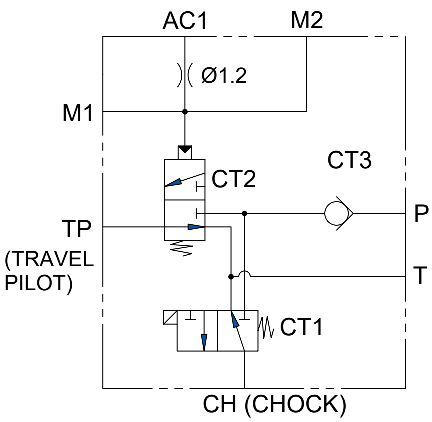
(3) Residual pressure
① Max residual pressure in control line to tank connection P1 and P2 : 1.0 kgf/cm^2

(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

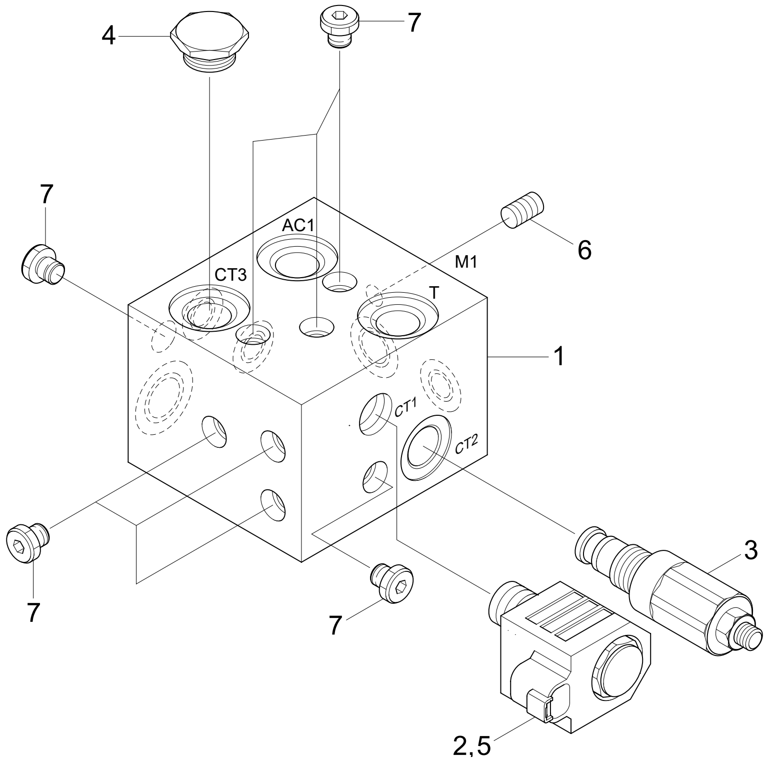




Hydraulic circuit

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

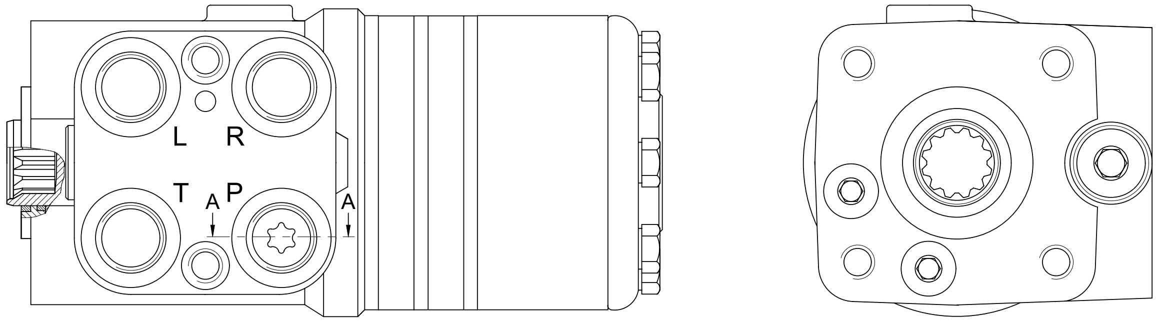
2. COMPONENT

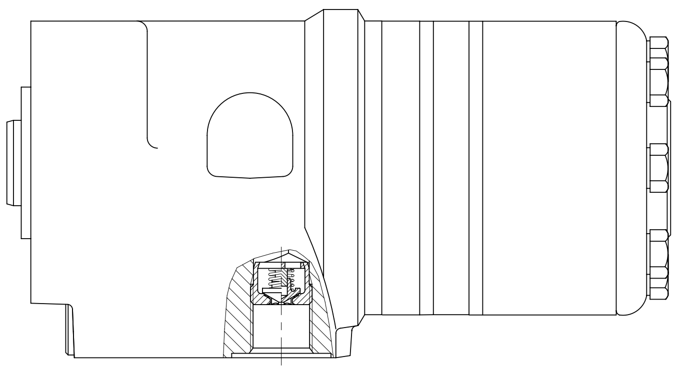


1	Body	5	Coil
2	Solenoid valve	6	Orifice
3	POD valve	7	Plug
4	Check valve		

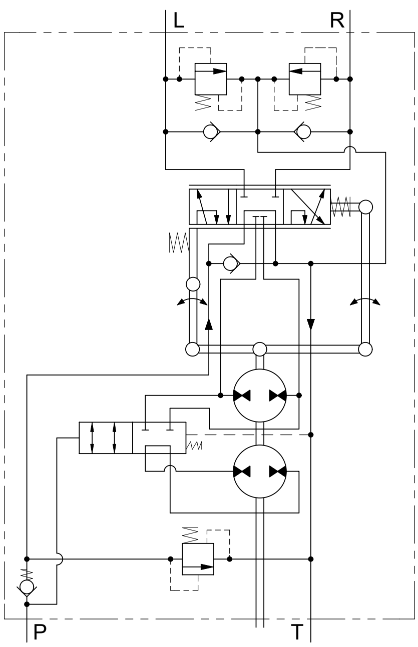
GROUP 10 STEERING VALVE

1. STRUCTURE





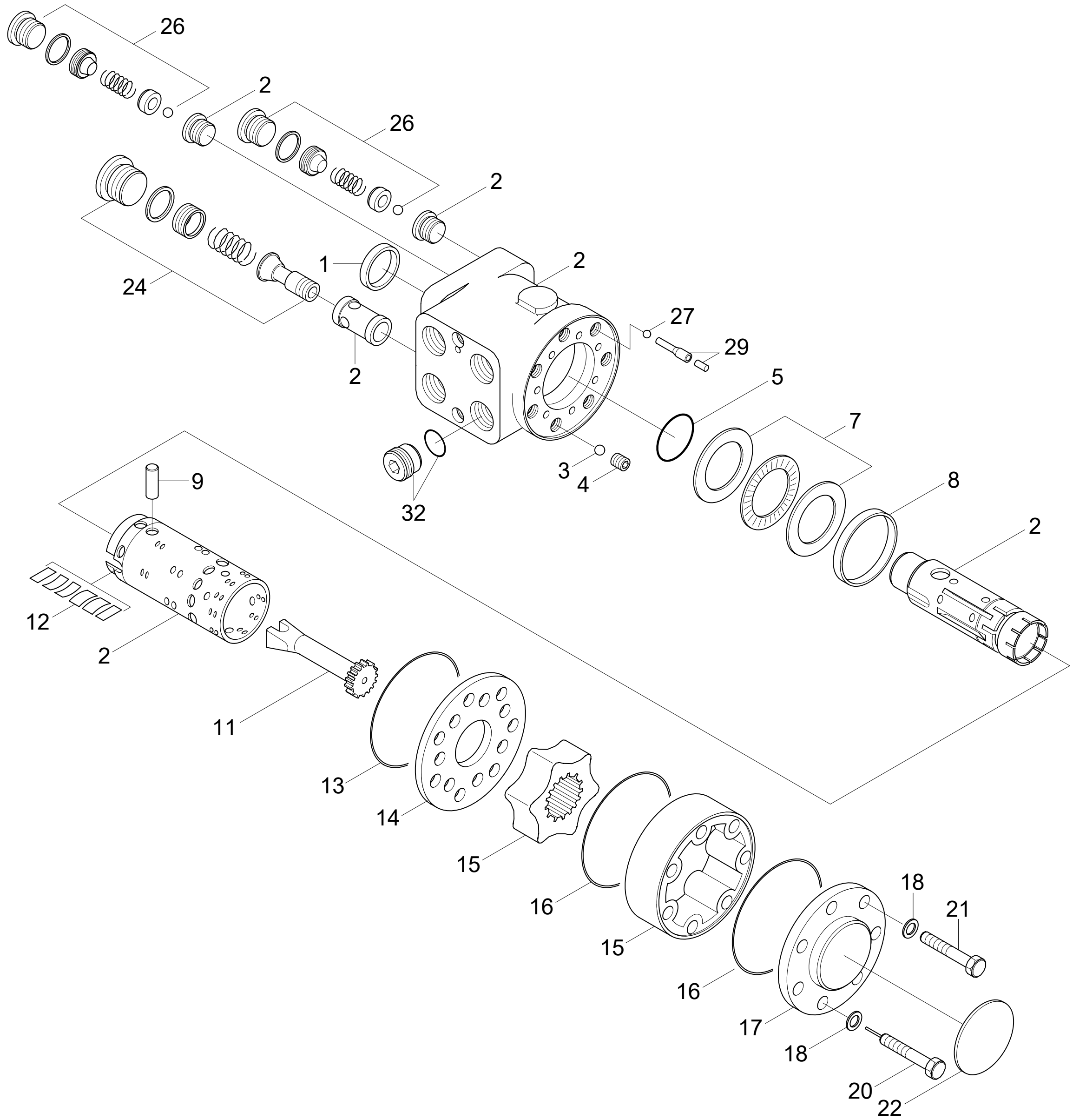
SECTION A-A



Hydraulic circuit

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

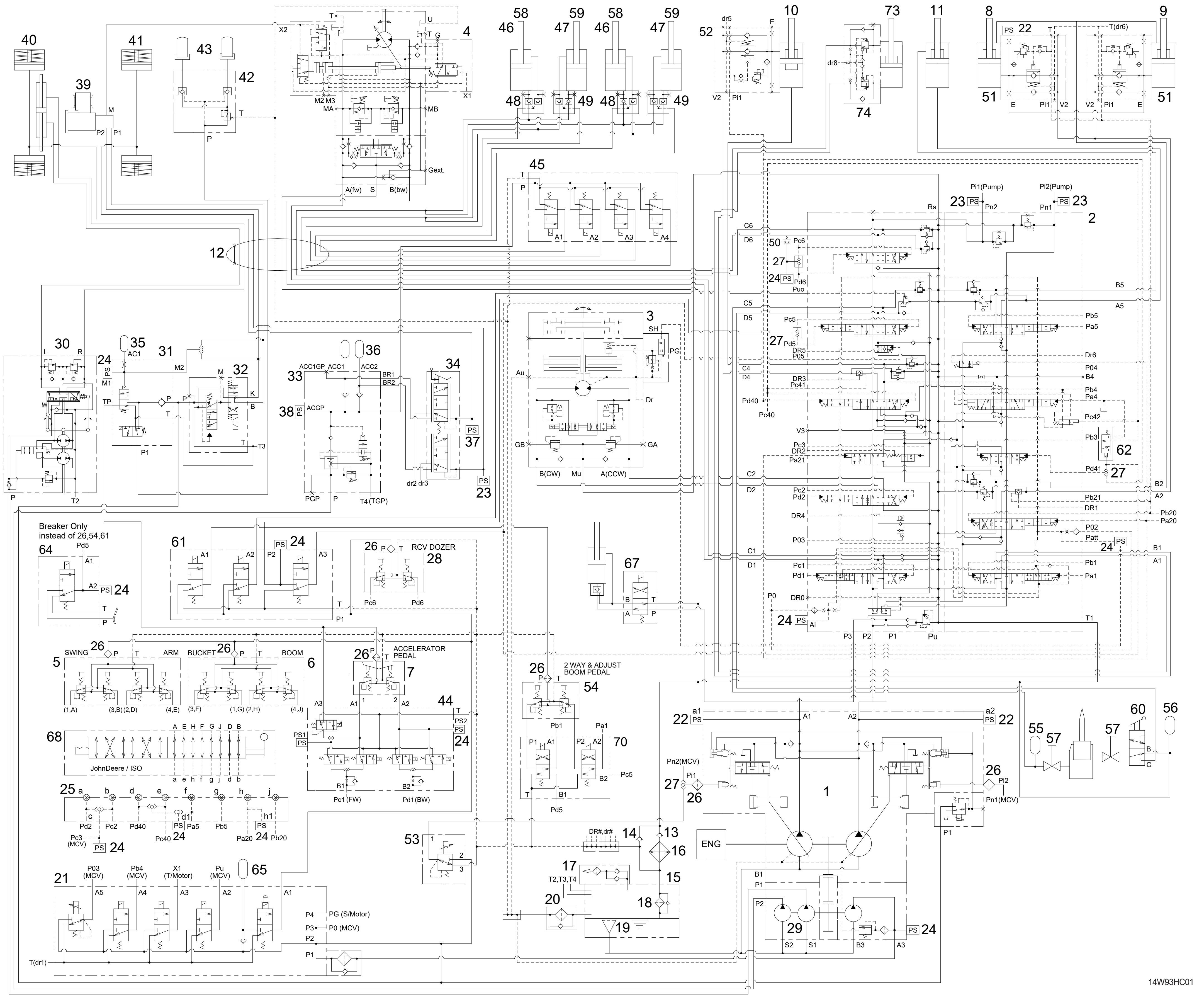
2. COMPONENTS



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

SECTION 3 HYDRAULIC SYSTEM

GROUP 1 HYDRAULIC CIRCUIT



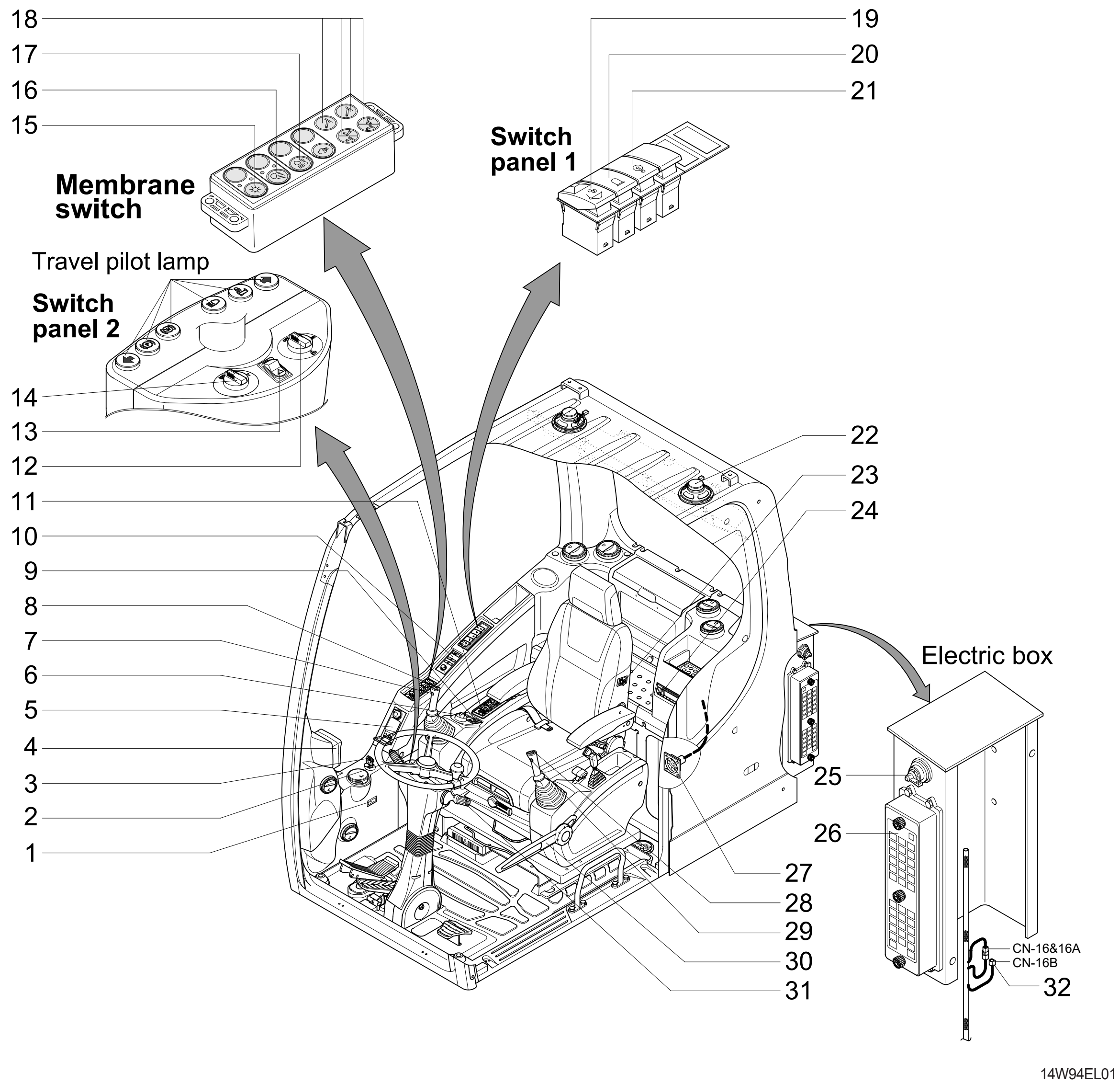
1 Main pump
2 Main control valve
3 Swing motor
4 Travel motor
5 RCV lever(LH)
6 RCV lever(RH)
7 Accelerator pedal
8 Boom cylinder(LH)
9 Boom cylinder(RH)
10 Arm cylinder
11 Bucket cylinder
12 Turning joint
13 Check valve
14 Check valve
15 Hydraulic tank
16 Oil cooler
17 Air breather
18 Bypass valve & return element
19 Strainer assy
20 Drain filter
21 5 solenoid valve & pilot line filter
22 Pressure sensor(500k)
23 Pressure sensor(100k)
24 Pressure sensor(50k)
25 Shuttle block
26 Last guard filter
27 Shuttle valve
28 RCV dozer(option)
29 Power train pump
30 Steering valve
31 Travel control valve
32 TCV valve
33 Brake supply valve
34 Brake valve
35 Accumulator(option)
36 Accumulator(option)
37 Pressure sensor(5k)
38 Pressure sensor(200k)
39 Transmission
40 Front axle
41 Rear axle
42 Locking valve
43 Oscillating cylinder
44 5 solenoid valve(option)
45 4 solenoid valve(option)
46 Outrigger cylinder(LH, option)
47 Outrigger cylinder(RH, option)
48 Pilot check valve(LH, option)
49 Pilot check valve(RH, option)
50 Pressure switch(option)
51 Boom safety lock valve(option)
52 Arm safety lock valve(option)
53 EPPR valve(option)
54 2 way & adjust boom pedal(option)
55 Accumulator(option)
56 Accumulator(option)
57 Stop valve(option)
58 Dozer cylinder(LH, option)
59 Dozer cylinder(RH, option)
60 Breaker selector valve(option)
61 Solenoid valve(option)
62 Selector valve(option)
64 Breaker solenoid valve(option)
65 Accumulator(option)
67 Quick clamp solenoid valve(option)
68 Pattern change valve(option)
70 Selector solenoid valve(option)
73 Adjustable boom cylinder(option)
74 Adjustable boom safety lock valve(option)

SECTION 4 ELECTRICAL SYSTEM

SECTION 4 ELECTRICAL SYSTEM

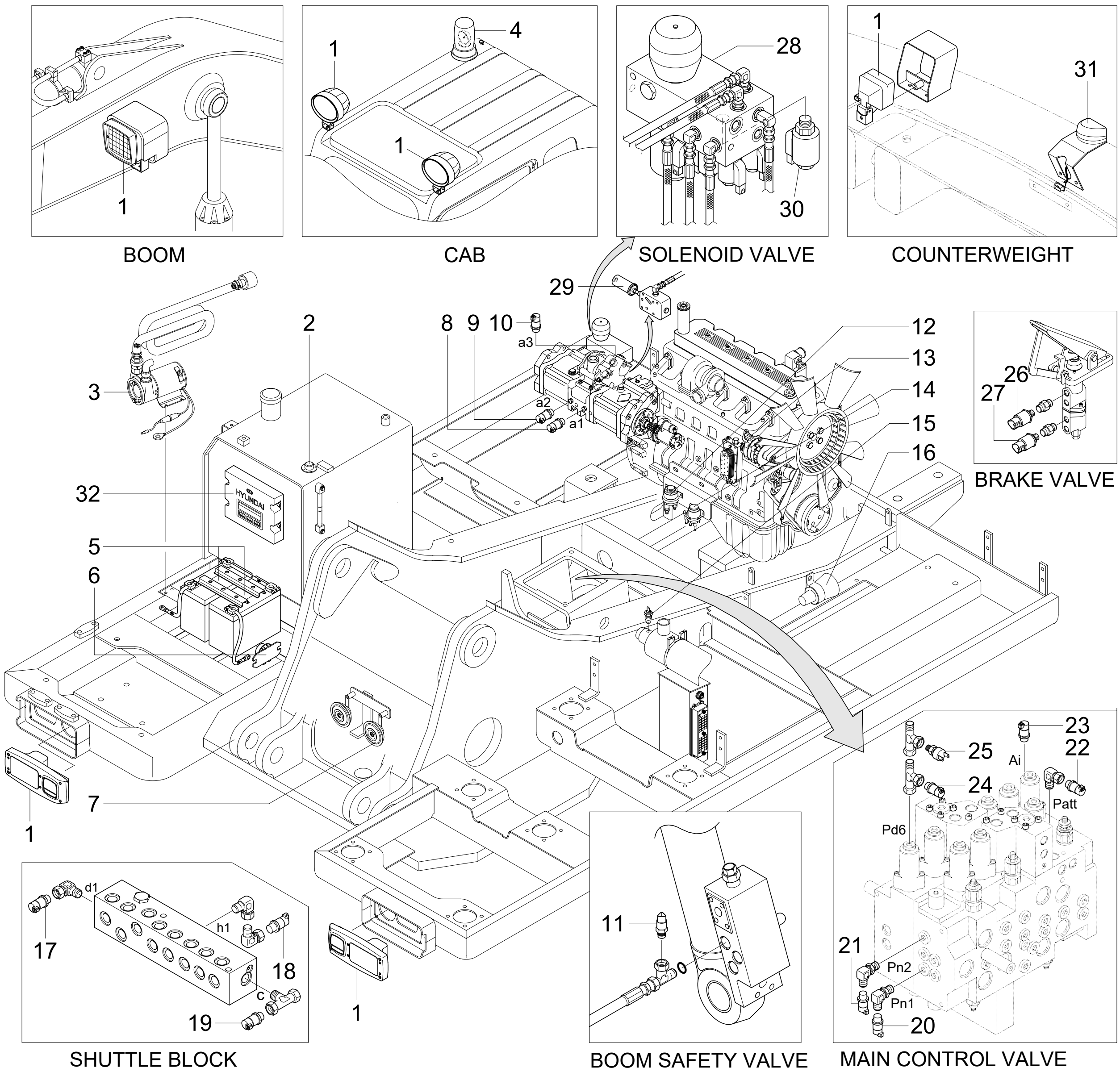
GROUP 1 COMPONENT LOCATION

1. LOCATION 1



1	Service meter	12	Ram lock switch	23	Heated seat switch
2	Multi function switch (RH)	13	Hazard switch	24	Radio & CD/MP3 player
3	Start switch	14	Select switch 2	25	Master switch
4	Cluster	15	Main light switch	26	Fuse & relay box
5	Handsfree	16	Work light switch	27	RS232 & J1939 service socket
6	Accel dial	17	Cab light switch	28	One touch decel switch
7	Breaker operation switch	18	Select switch 1	29	Power max switch
8	Horn switch	19	Quick clamp switch	30	Safety lever
9	Creep switch	20	Beacon switch	31	Multi function switch (LH)
10	Remote controller	21	Overload switch	32	Emergency engine connector
11	Air conditioner switch	22	Speaker		

2. LOCATION 2



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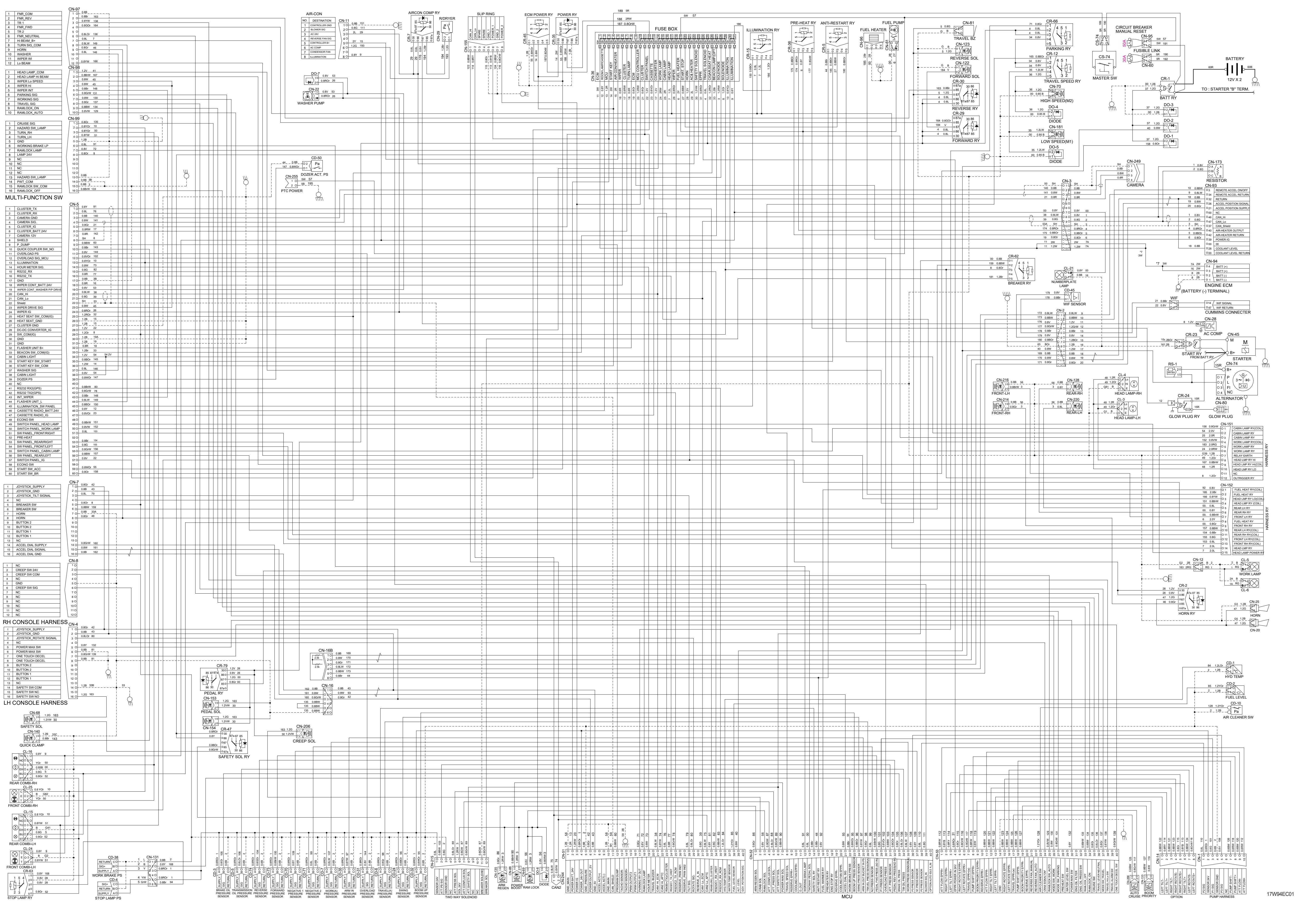
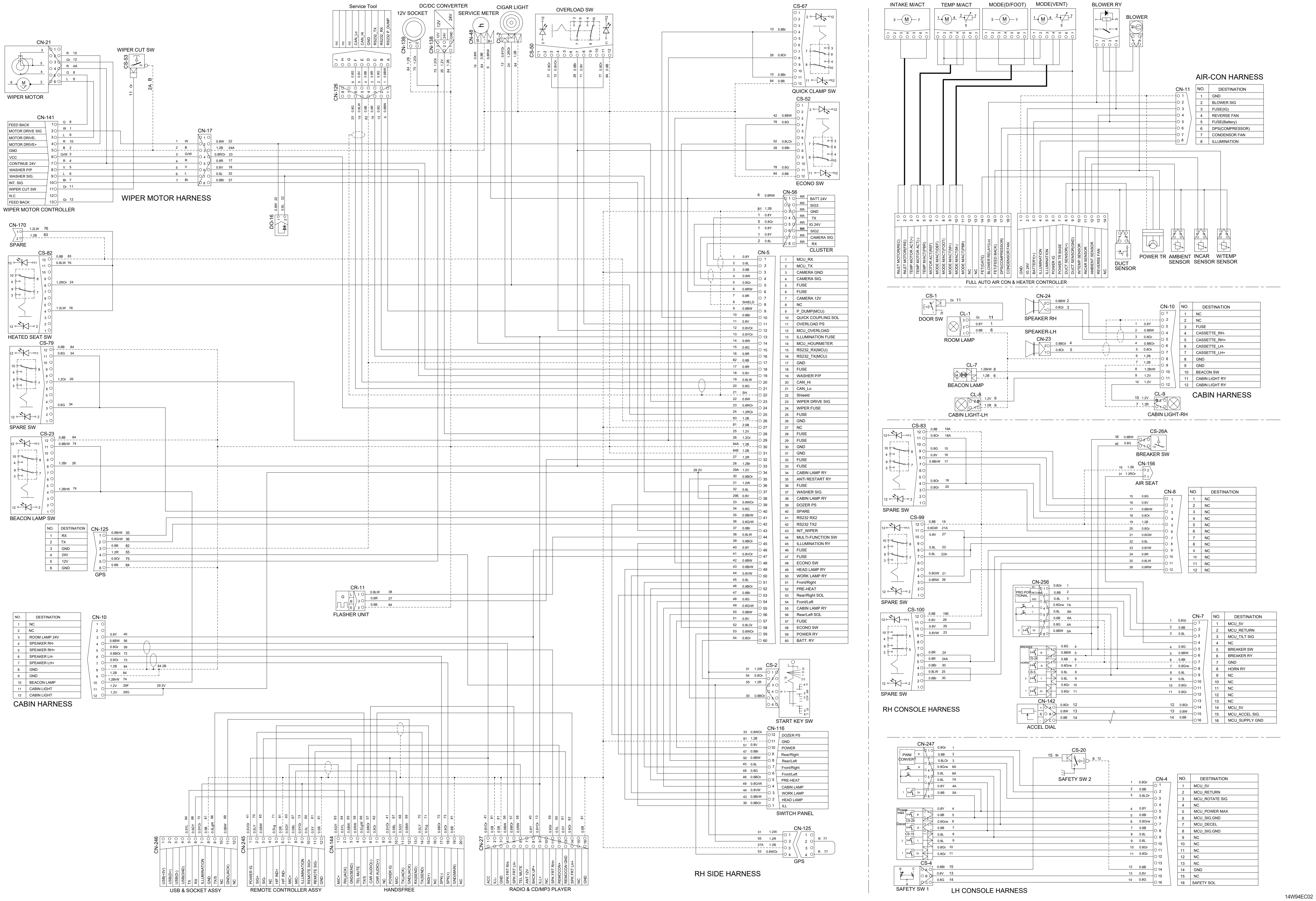
1	Lamp	12	Start relay	23	Travel pressure sensor
2	Fuel sender	13	Alternator	24	Dozer pressure sensor
3	Fuel filler pump	14	Heater relay	25	Dozer pressure switch
4	Beacon lamp	15	Air cleaner switch	26	Working pressure sensor
5	Battery	16	Travel alarm buzzer	27	Brake lamp pressure sensor
6	Battery relay	17	Arm/Bucket in pressure sensor	28	Solenoid valve
7	Horn	18	Boom up pressure sensor	29	Pump EPPR valve
8	P1 pressure sensor	19	Swing pressure sensor	30	Boom priority EPPR valve
9	P2 pressure sensor	20	Nega 1 pressure sensor	31	Rear camera
10	P3 pressure sensor	21	Nega 2 pressure sensor	32	MCU
11	Overload pressure sensor	22	Attach pressure sensor		

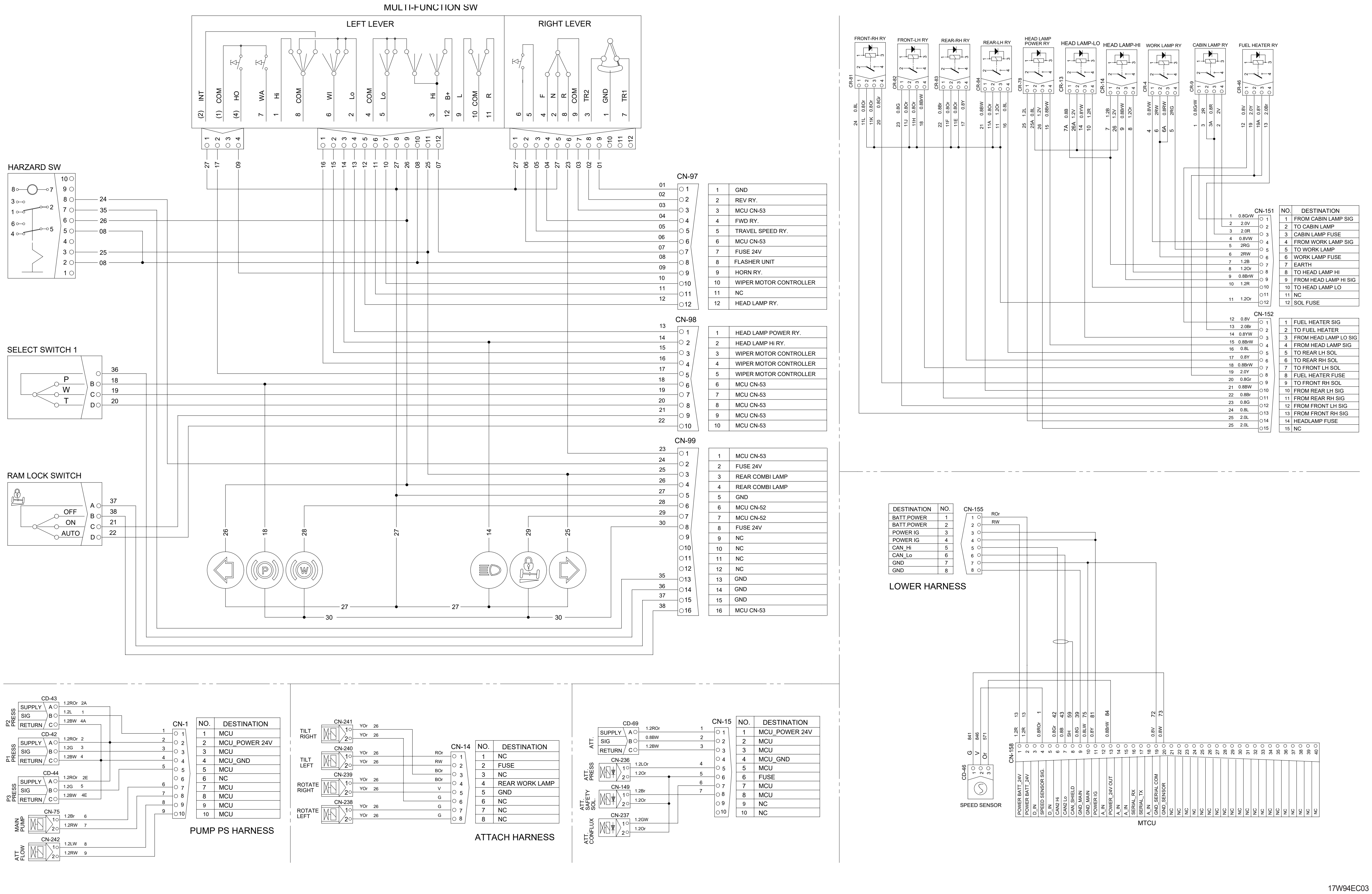
GROUP 2 ELECTRICAL CIRCUIT (1/3)



· ELECTIRC CIRCUIT (2/3)



· ELECTRIC CIRCUIT (3/3)



CN-97

NO.	DESTINATION
1	GND
2	REV RY.
3	MCU CN-53
4	FWD RY.
5	TRAVEL SPEED RY.
6	MCU CN-53
7	FUSE 24V
8	FLASHER UNIT
9	HORN RY.
10	WIPER MOTOR CONTROLLER
11	NC
12	HEAD LAMP RY.

CN-98

NO.	DESTINATION
1	HEAD LAMP POWER RY.
2	HEAD LAMP Hi RY.
3	WIPER MOTOR CONTROLLER
4	WIPER MOTOR CONTROLLER
5	WIPER MOTOR CONTROLLER
6	MCU CN-53
7	MCU CN-53
8	MCU CN-53
9	MCU CN-53
10	MCU CN-53

CN-99

NO.	DESTINATION
1	MCU CN-53
2	FUSE 24V
3	REAR COMBI LAMP
4	REAR COMBI LAMP
5	GND
6	MCU CN-52
7	MCU CN-52
8	FUSE 24V
9	NC
10	NC
11	NC
12	NC
13	GND
14	GND
15	GND
16	MCU CN-53

CN-151

NO.	DESTINATION
1	FROM CABIN LAMP SIG
2	TO CABIN LAMP
3	CABIN LAMP FUSE
4	FROM WORK LAMP SIG
5	TO WORK LAMP
6	WORK LAMP FUSE
7	EARTH
8	TO HEAD LAMP HI
9	FROM HEAD LAMP HI SIG
10	TO HEAD LAMP LO
11	NC
12	SOL FUSE

CN-152

NO.	DESTINATION
1	FUEL HEATER SIG
2	TO FUEL HEATER
3	FROM HEAD LAMP LO SIG
4	FROM HEAD LAMP SIG
5	TO REAR LH SOL
6	TO REAR RH SOL
7	TO FRONT LH SOL
8	FUEL HEATER FUSE
9	TO FRONT RH SOL
10	FROM REAR LH SIG
11	FROM REAR RH SIG
12	FROM FRONT LH SIG
13	FROM FRONT RH SIG
14	HEADLAMP FUSE
15	NC

CN-155 (LOWER HARNESS)

DESTINATION	NO.
BATT.POWER	1
BATT.POWER	2
POWER IG	3
POWER IG	4
CAN_Hi	5
CAN_Lo	6
GND	7
GND	8

CN-1 (PUMP PS HARNESS)

NO.	DESTINATION
1	MCU
2	MCU_POWER 24V
3	MCU
4	MCU_GND
5	MCU
6	NC
7	MCU
8	MCU
9	MCU
10	MCU

CN-14 (ATTACH HARNESS)

NO.	DESTINATION
1	NC
2	FUSE
3	NC
4	REAR WORK LAMP
5	GND
6	NC
7	NC
8	NC

CN-15

NO.	DESTINATION
1	MCU_POWER 24V
2	MCU
3	MCU
4	MCU_GND
5	MCU
6	FUSE
7	MCU
8	MCU
9	NC
10	NC

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 → Fusible link [CN-60] → Master switch [CS-74]

- → Fuse box [No.1] → I/conn [CN-3 (14)] → Engine ECM [CN -94 (3, 4)]
- → Fuse box [No.2] → I/conn [CN-5 (46)]
  - → I/conn [CN -10 (3)] → Room lamp [CL-1 (2)]
    - → Door switch [CS-1]
  - → Radio & CD/MP3 player [CN-27 (8)]
- → Fuse box [No.3] → MCU [CN-51 (2)]
- → Fuse box [No.4]
  - → I/conn [CN-5 (36)]
    - → Start switch [CS-2 (1)]
    - → GPS connection [CN-125 (1)]
  - → Power relay [CR-35 (30)]
  - → ECM power relay [CR-45 (3)]
- → Fuse box [No.5] → I/conn [CN-11 (5)]
  - → AC & Heater controller (3)
  - → Blower relay
- → Fuse box [No.6] → I/conn [CN - 5 (18)] → I/conn [CN -17 (5)]
  - → Wiper motor controller [CN-141 (7)]
  - → Wiper motor [CN-21 (4)]
- → Fuse box [No.7] → I/conn [CN - 5 (6)] → Cluster [CN -56 (1)]

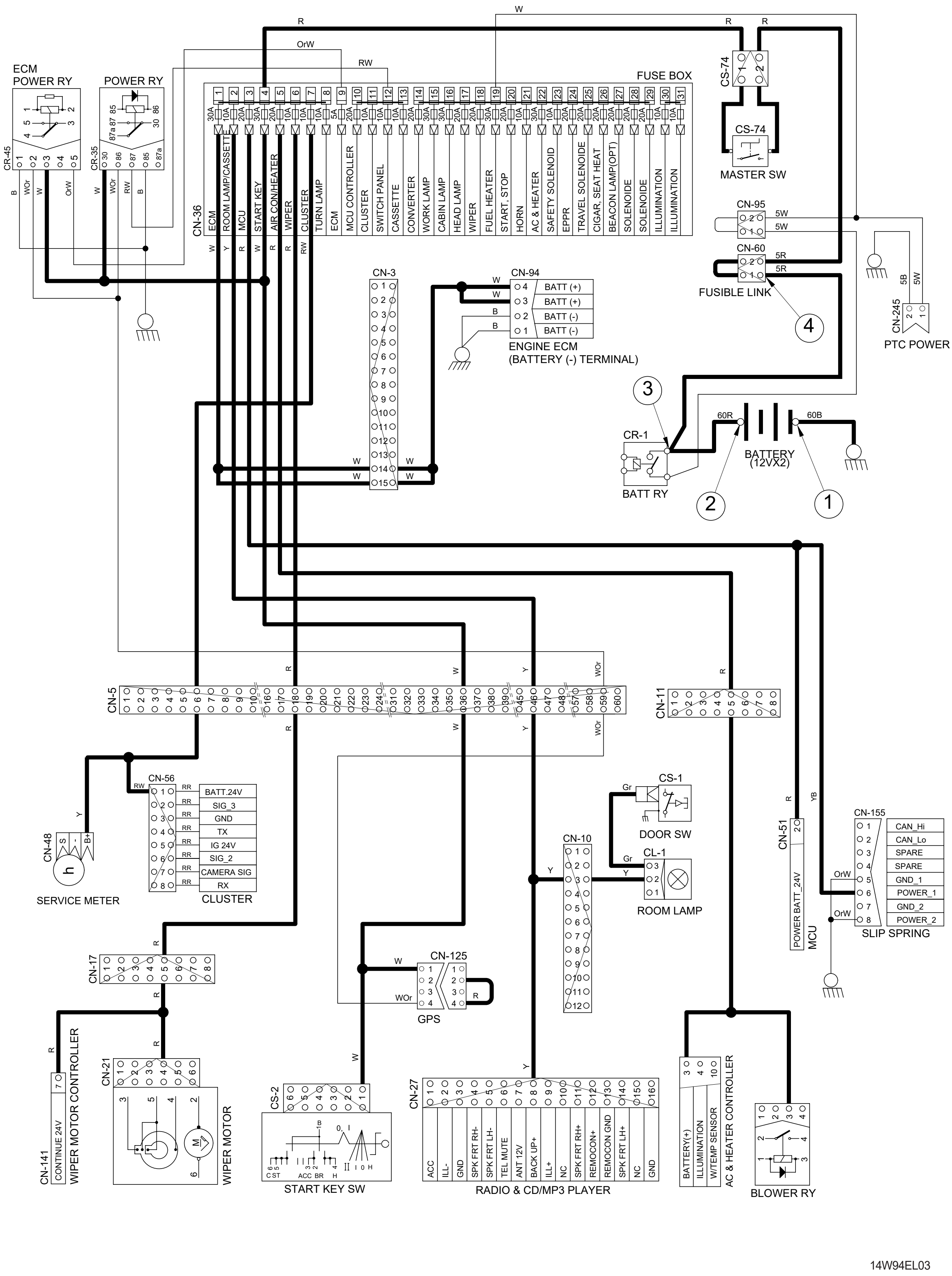
I/conn : Intermediate connector

2) CHECK POINT

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

※ GND : Ground

POWER CIRCUIT



2. STARTING CIRCUIT

1) OPERATING FLOW

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

(1) When start key switch is in ON position

→ Start switch ON [CS-2 (2)] → I/conn [CN-5 (60)] → Battery relay [CR-1]
→ Battery relay operating (all power is supplied with the electric component)

→ Start switch ON [CS-2 (3)] → GPS connection [CN-125 (2)→(4)] → I/conn [CN-5 (59)]
→ Power relay [CR-35 (86) (87)] → Fuse box [No.12]
→ ECM power relay [CR-45 (2)→(5)] → Fuse box [No.9]

(2) When start key switch is in START position

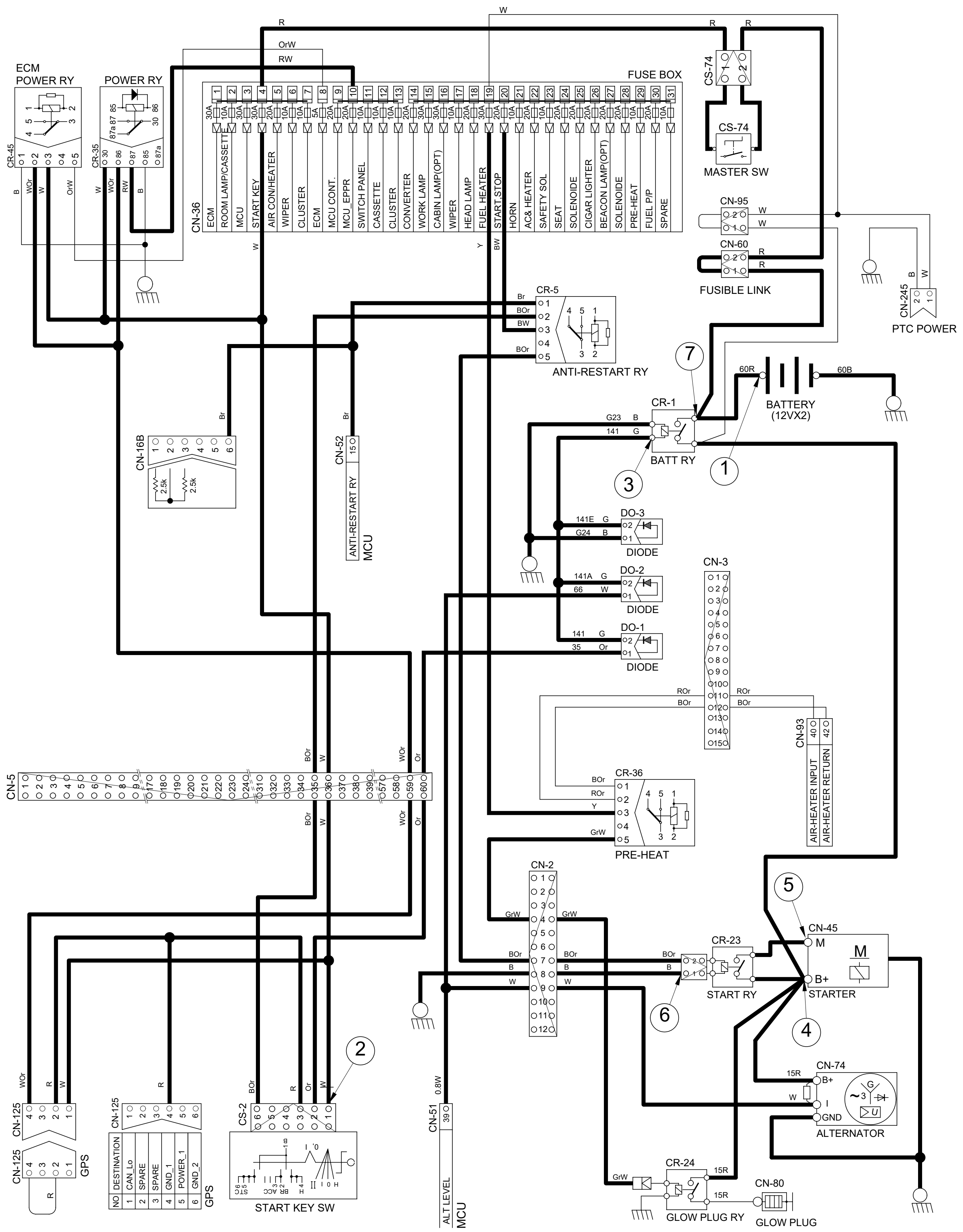
Start switch START [CS-2 (5)] → I/conn [CN-5 (35)] → Anti-restart relay [CR-5 (2) (5)] → I/conn [CN-2 (7)] → Start relay [CR-23]

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)	20~25 V

※ GND : Ground

STARTING CIRCUIT



3. CHARGING CIRCUIT

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

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

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

1) OPERATING FLOW

(1) Warning flow

Alternator "I" terminal → I/conn [CN-2 (9)] → MCU alternator level [CN-51 (39)]
Cluster charging warning lamp(Via serial interface)

(2) Charging flow

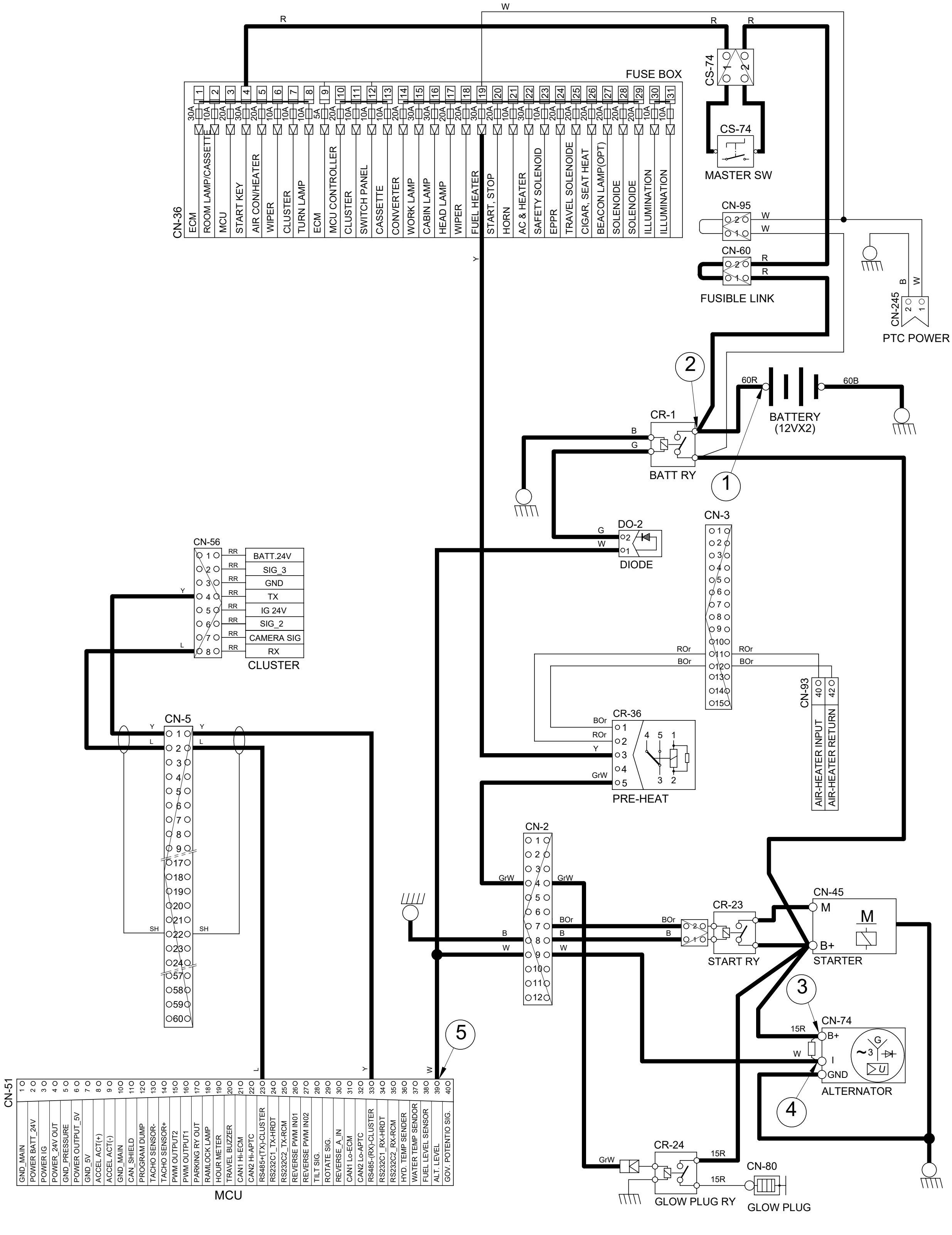
Alternator "B^+" terminal → Battery relay(M8) → Battery(+) terminal
→ Fusible link [CN-60] → Master switch [CS-74]
→ Fuse box

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 I terminal) ⑤ - GND (MCU)	20~30 V

※ GND : Ground

CHARGING CIRCUIT



4. HEAD AND WORK LIGHT CIRCUIT

1) OPERATING FLOW

Fuse box (No.17) → Head light relay [CN-152 (14)→(4)] →I/conn [CN-98 (1)]
→ Multifunction sw left lever [(4)→(5)] → I/conn [CN-97 (12)] → Head light relay [CN-152 (3)]
Fuse box (No.15) → Work light relay [CN-151 (6)]

(1) Head light switch ON

Head light switch ON [CN-116 (2)] →I/conn [CN-5 (49)]
→ Head light power relay [CN-152 (15) → CN-151 (10)] → Head light ON [CL-3 (1)], CL-4 (1)]

(2) Work light switch ON

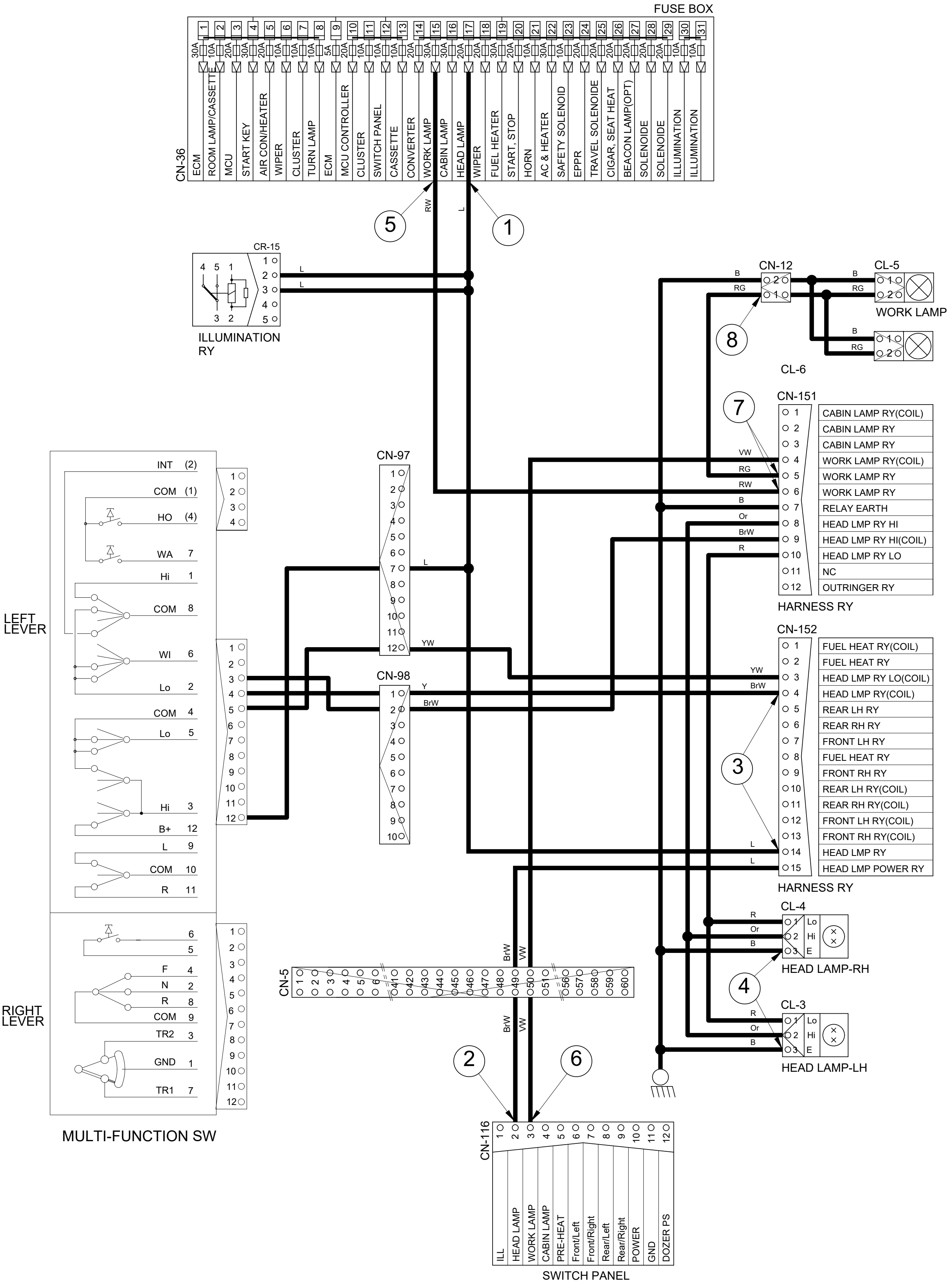
Work light switch ON [CN-116 (3)] → I/conn [CN-5 (50)] → Work light relay [CN-151 (4)→(5)]
→ I/conn [CN-12 (1)] → Work light ON [CL-5 (2), CL-6 (2)]

2) CHECK POINT

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

※ GND : Ground

HEAD AND WORK LIGHT CIRCUIT



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5. BEACON LAMP AND CAB LIGHT CIRCUIT

1) OPERATING FLOW

Fuse box (No.27) → I/conn [CN-5 (33)] → Beacon lamp switch [CN-23 (8)]
Fuse box (No.16) → Cab light relay [CN-151 (3)]

(1) Beacon lamp switch ON

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

(2) Cab light switch ON

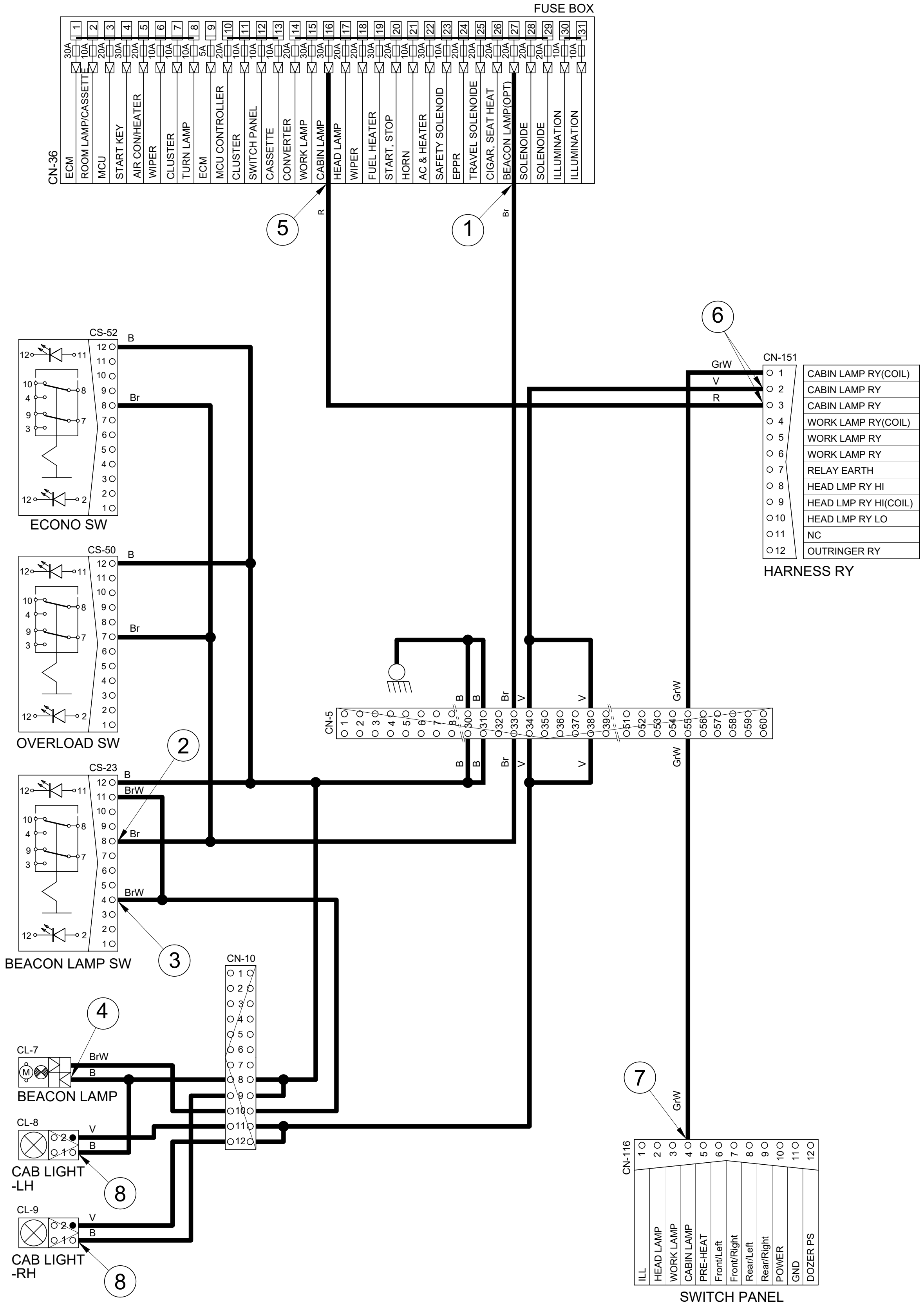
Cab light switch ON [CN-116 (4)] → I/conn [CN-5 (55)] → Cabin lamp relay [CR-151 (1)→ (2)]
→ I/conn [CN-5 (34, 38)] → I/conn [CN-10 (11)] → Cab light ON [CL-8 (2)]
→ I/conn [CN-10 (12)] → Cab light ON [CL-9 (2)]

2) CHECK POINT

Engine	Start switch	Check point	Voltage
STOP	ON	① - GND (fuse box) ② - GND (switch power input) ③ - GND (switch power output) ④ - GND (beacon lamp)	20~25 V
STOP	ON	⑤ - GND (fuse box) ⑥ - GND (cabin light relay) ⑦ - GND (switch power output) 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.17) → I/conn [CN-97 (7)] → Multifunction sw left lever [12]

Fuse box (No.6) → I/conn [CN-5 (18)] → I/conn [CN-17 (5)] → Wiper motor controller [CN-141(7)]
→ Wiper motor [CN-21(4)]

Fuse box (No.18) → I/conn [CN-5 (24)] → I/conn [CN-17 (4)] → Wiper motor controller [CN-141 (6)]
→ Washer pump [CN-22 (2)]

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

Wiper switch ON [Multifunction sw left lever (2)] → I/conn [CN-98 (5)] → I/conn [CN-5 (43)]
→ 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 (23)]
→ 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 (37)]
→ 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 (23)] → I/conn[CN-17 (2)] → Wiper motor controller [CN-141 (2)→(4)]
→ Wiper motor operating [CN-21 (2)]

(5) Auto parking (when switch OFF)

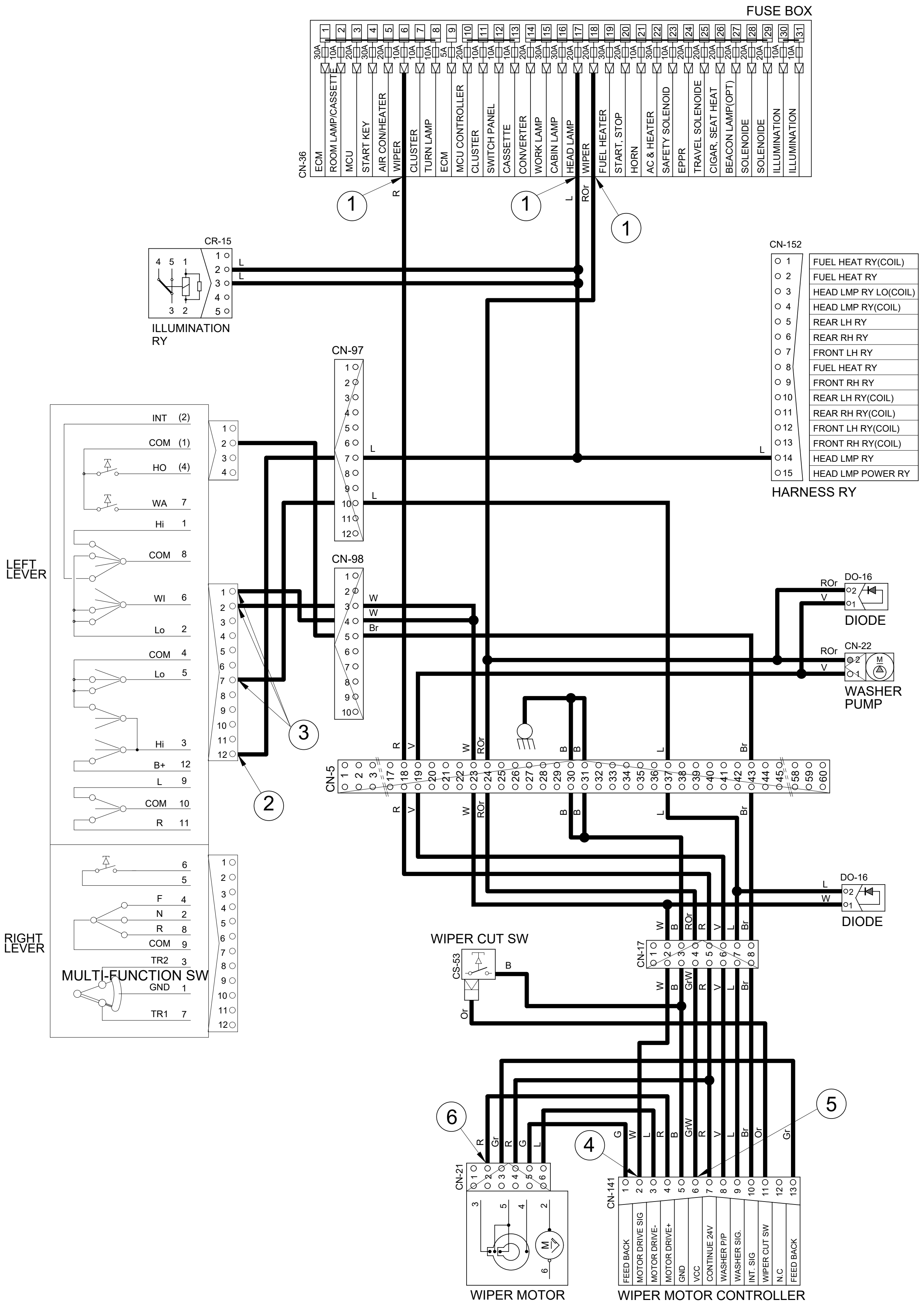
Switch OFF [Multifunction sw left lever OFF position] → Wiper motor parking position by wiper motor controller

2) CHECK POINT

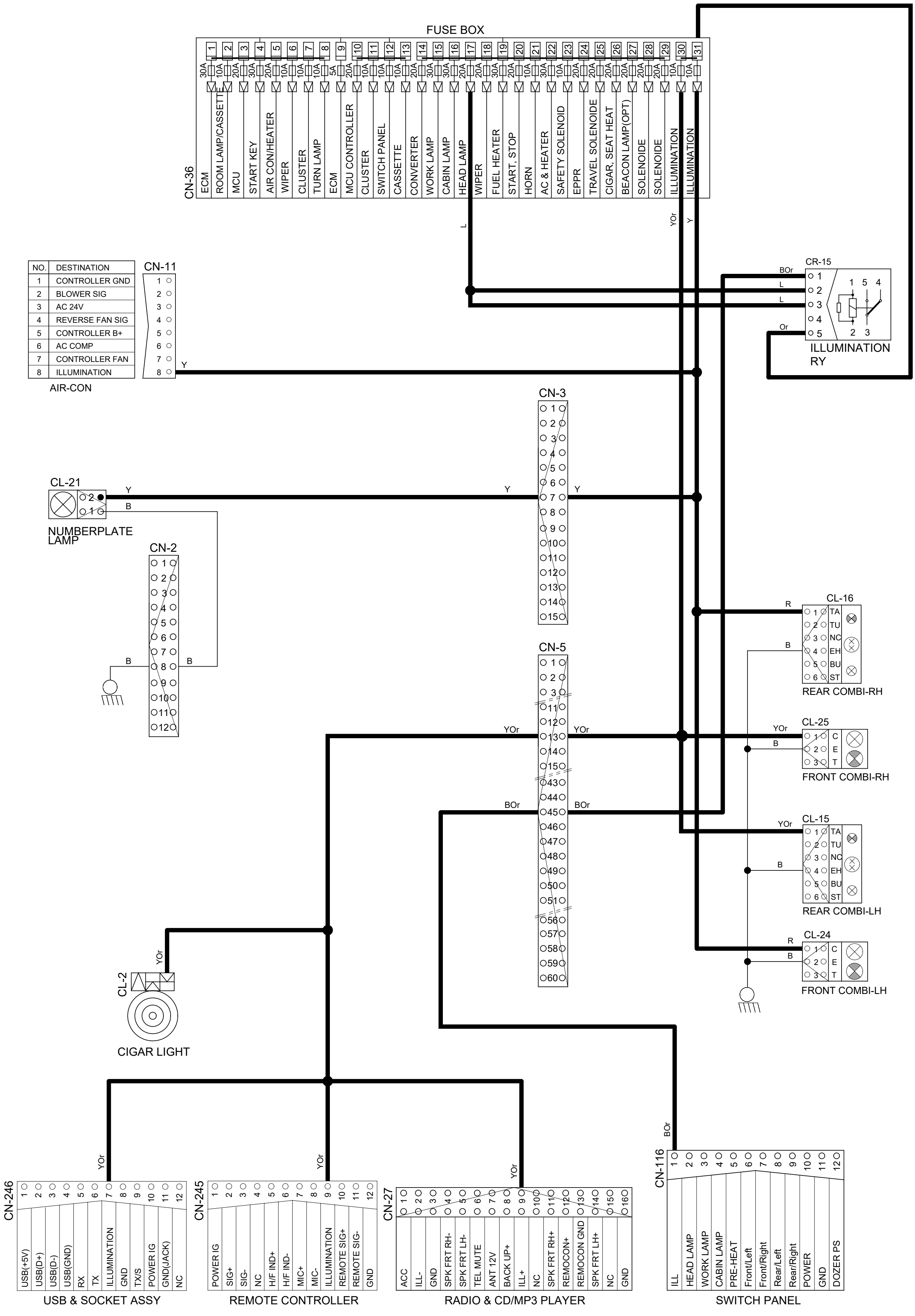
Engine	Start switch	Check point	Voltage
STOP	ON	① - GND (fuse box) ② - GND (switch power input)	24 V
		③ - GND (switch power output) ④ - GND (wiper power output)	0~5 V
		⑤ - GND (wiper power input)	24 V
		⑥ - GND (wiper motor)	0 or 24 V

※ GND : Ground

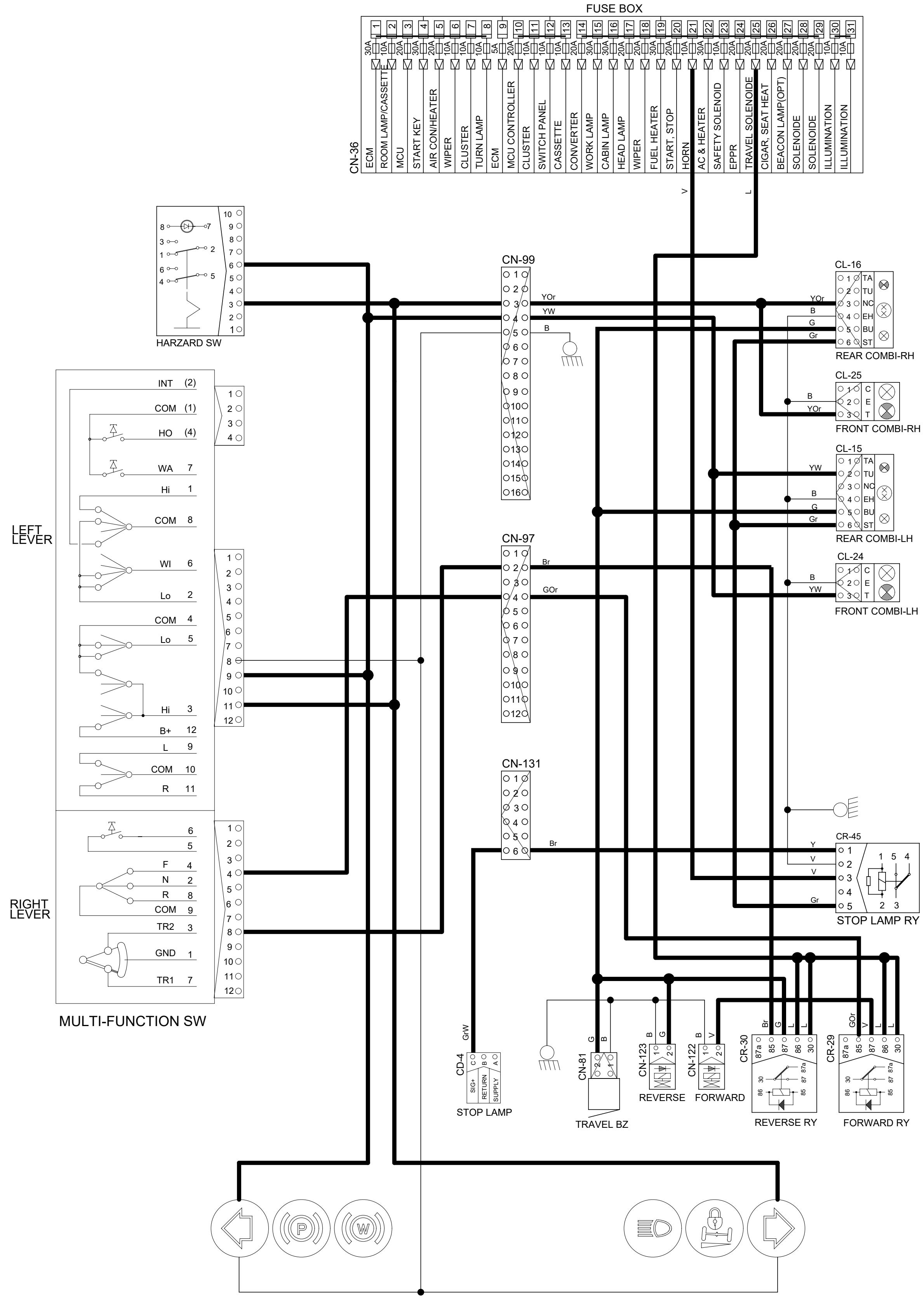
WIPER AND WASHER CIRCUIT



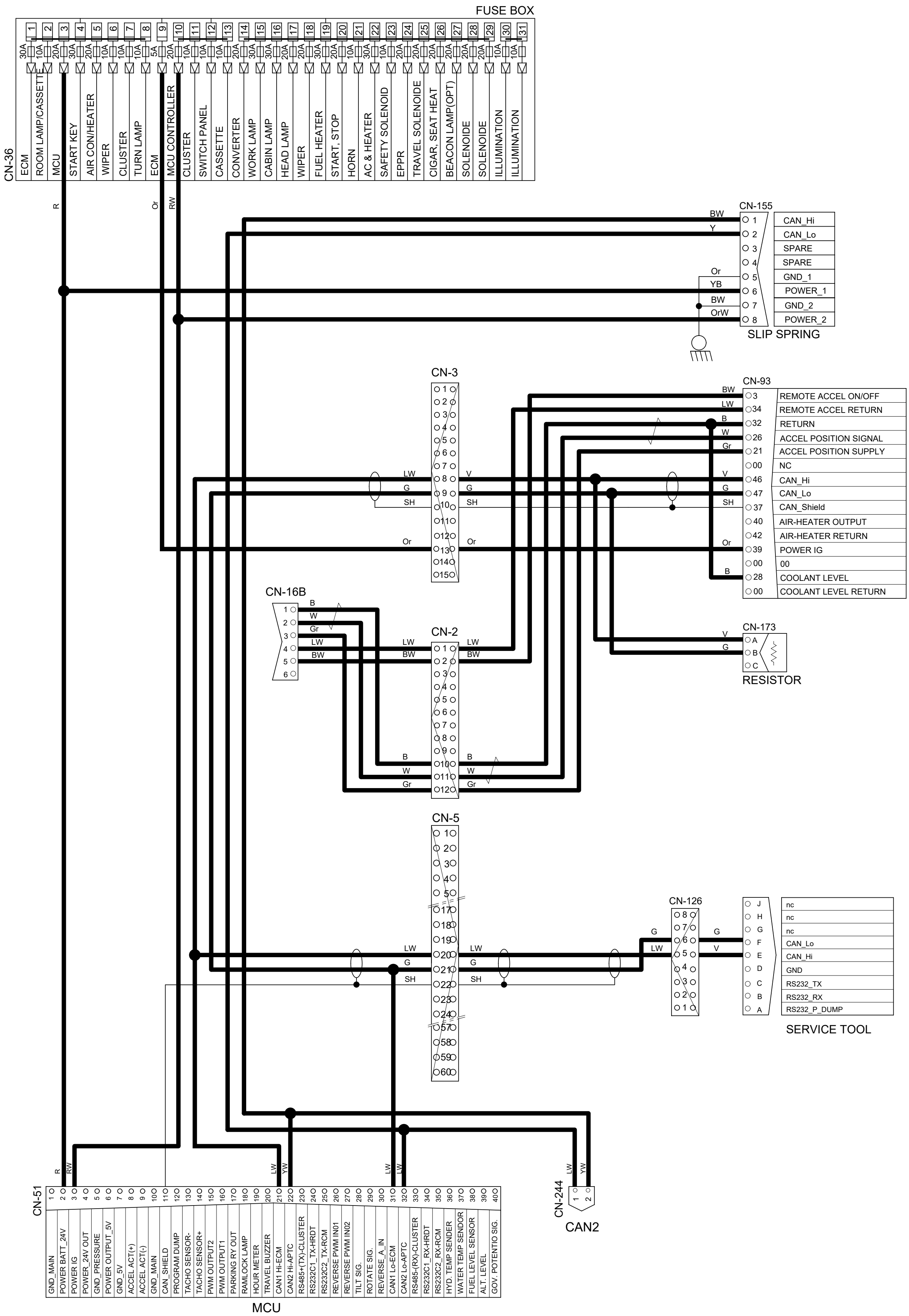
ILLUMINATION CIRCUIT



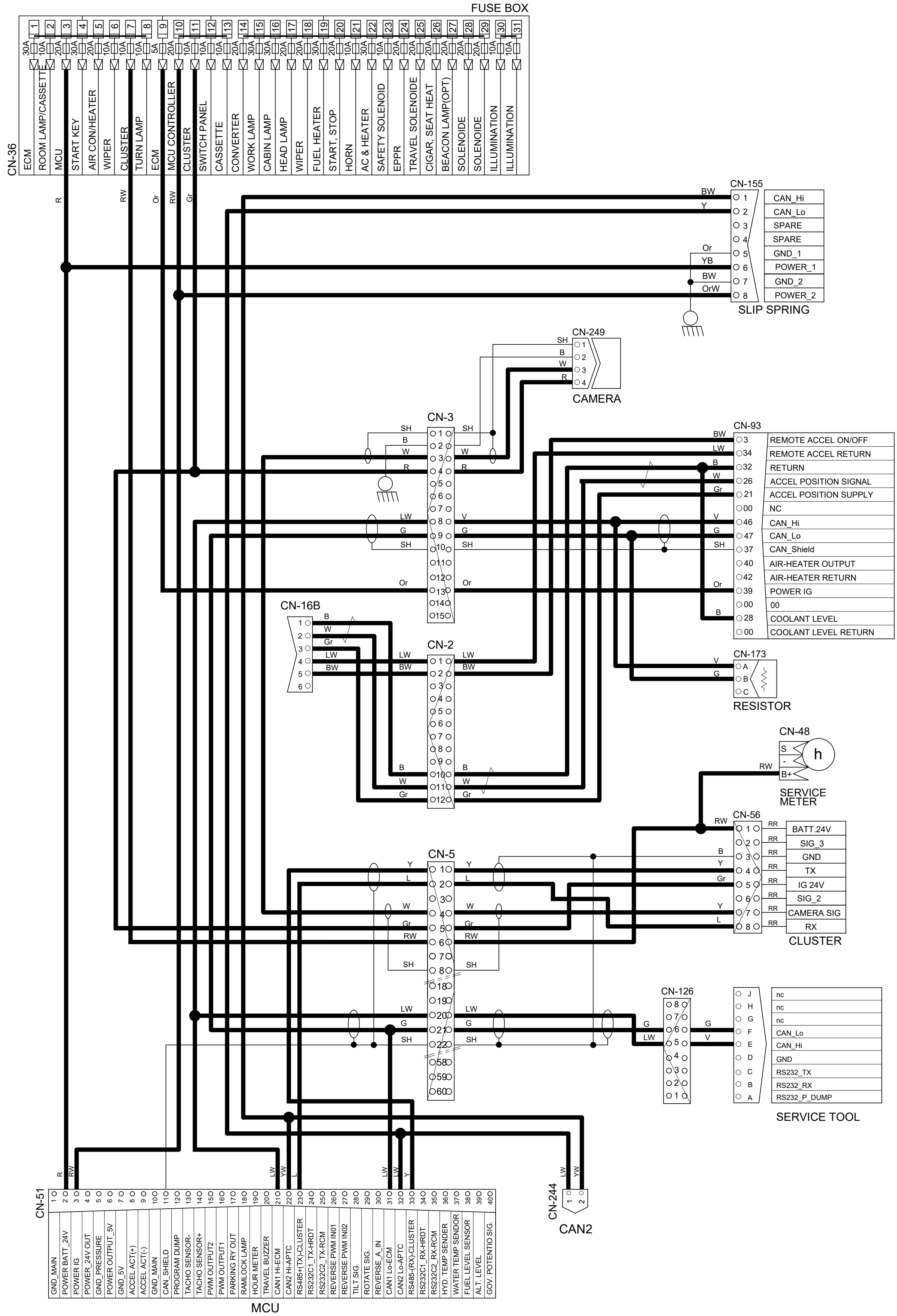
COMBINATION LAMP CIRCUIT



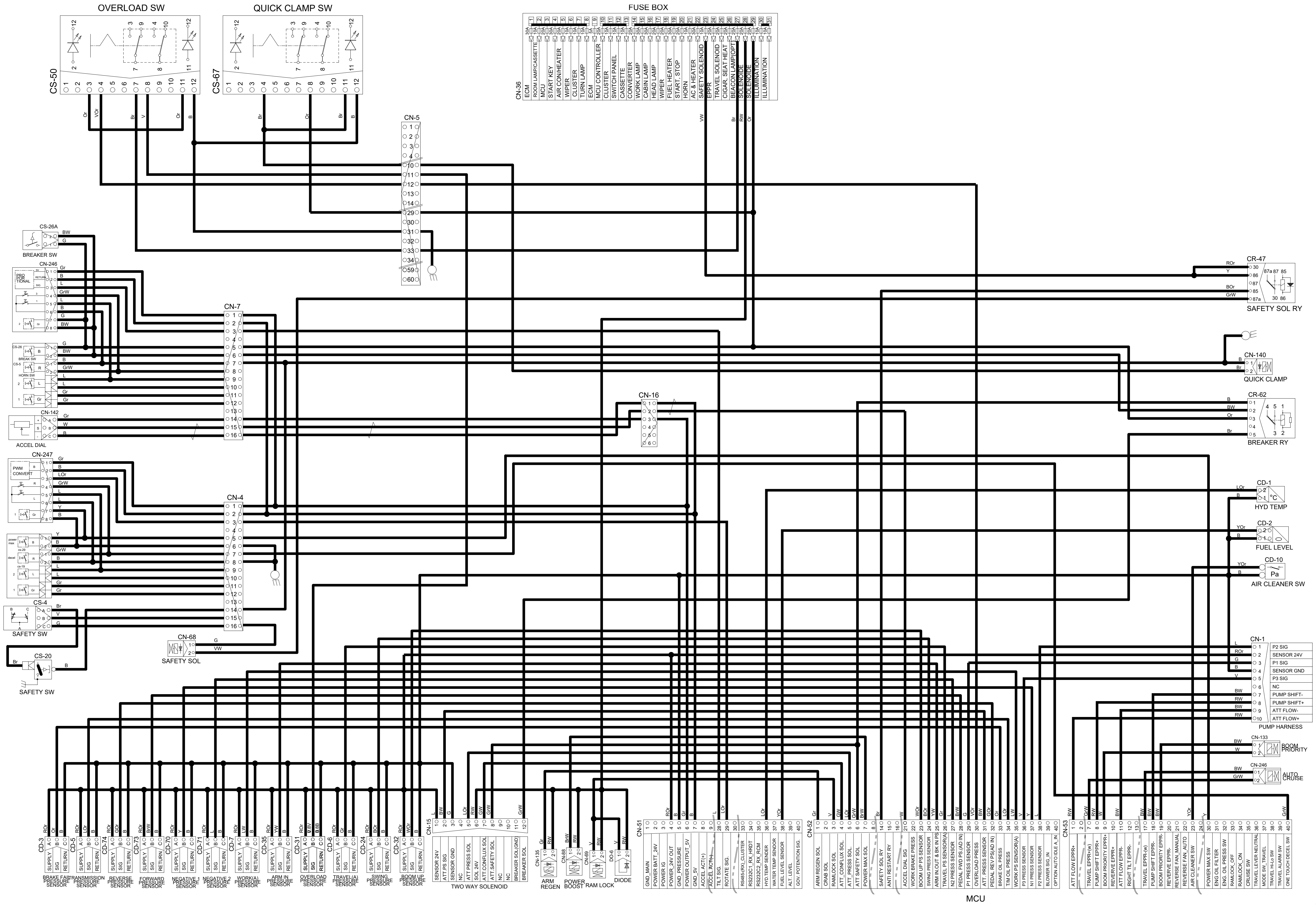
CONTROLLER CIRCUIT



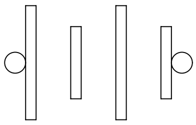
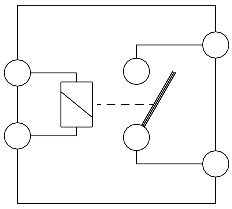
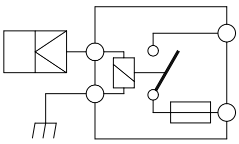
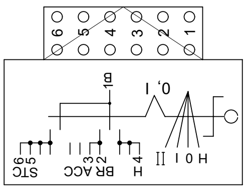
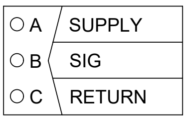
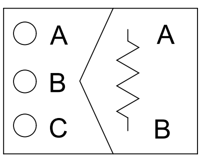
MONITORING CIRCUIT

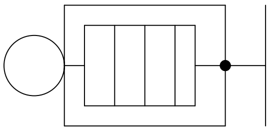
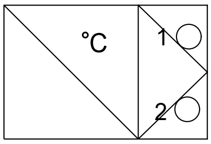
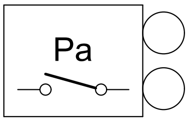
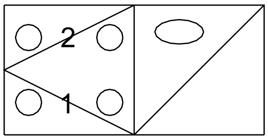
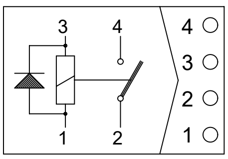
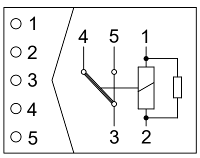


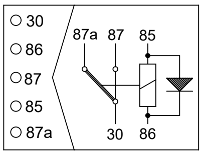
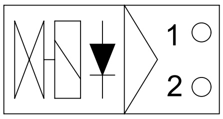
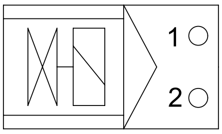
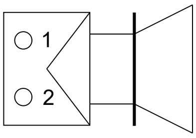
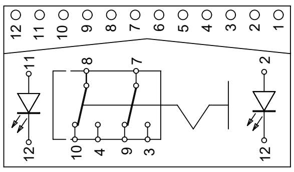
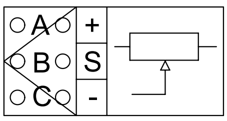
ELECTRIC CIRCUIT FOR HYDRAULIC

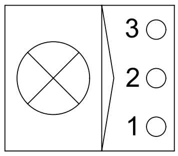
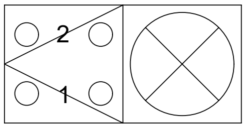
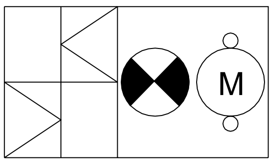
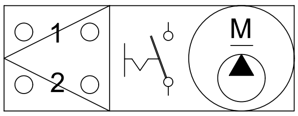
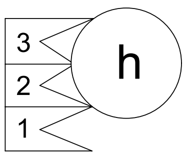
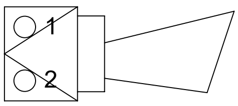


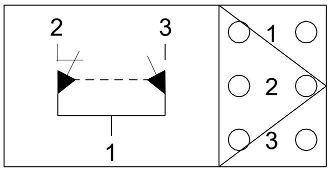
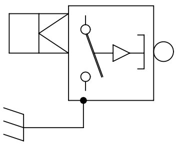
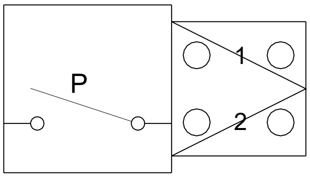
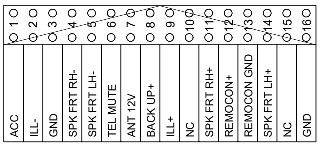
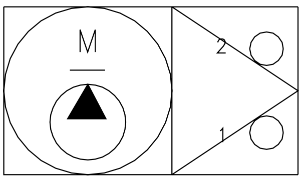
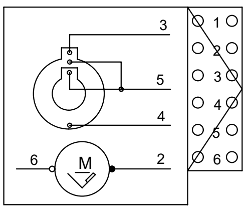
GROUP 3 ELECTRICAL COMPONENT SPECIFICATION

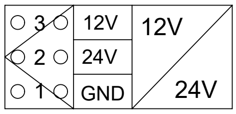
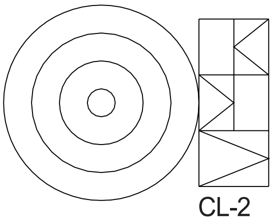
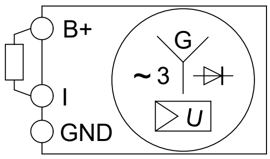
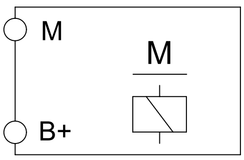
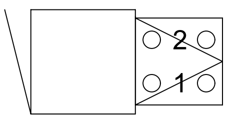
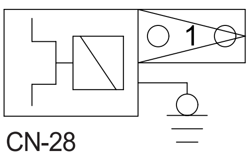
Part name	Symbol	Specifications	Check
Battery		12V × 100Ah (2EA)	※ Check specific gravity 1.280 over : Over charged 1.280 ~ 1.250 : Normal 1.250 below : Recharging
Battery relay	 CR-1	Rated load : 24V 100A (continuity) 1000A (30seconds)	※ Check coil resistance(M4 to M4) Normal : About 50 Ω ※ Check contact Normal : ∞ Ω
Glow plug relay	 CR-24	24V 200A	※ Check contact Normal : 0.942 Ω (For terminal 1-GND)
Start key	 CS-2	B-BR : 24V 1A B-ACC : 24V 10A B-ST : 24V 40A	※ Check contact OFF : ∞ Ω (for each terminal) ON : 0 Ω (for terminal 1-3 and 1-2) START : 0 Ω (for terminal 1-5)
Pressure sensor	 CD-3 CD-4 CD-5 CD-6 CD-7 CD-24 CD-31 CD-32 CD-35 CD-38 CD-42 CD-43 CD-44 CD-69 CD-70 CD-73 CD-74	8~30V	※ Check contact Normal : 0.1 Ω
Resistor	 CN-173	4W	※ Check resistance A-B : 120 Ω

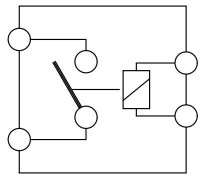
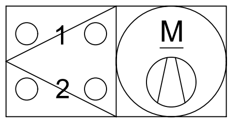
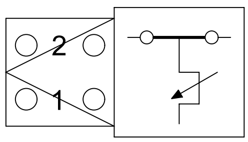
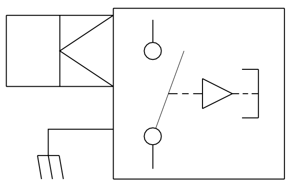
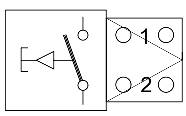
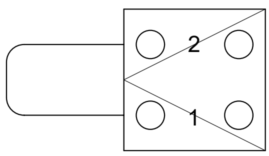
Part name	Symbol	Specifications	Check
Glow plug	 CN-80	24V 200A	※ Check resistance 0.25~0.12 Ω
Temperature sensor (hydraulic)	 CD-1	-	※ Check resistance 50°C : 804 Ω 80°C : 310 Ω 100°C : 180 Ω
Air cleaner pressure switch	 CD-10	(N.O TYPE)	※ Check contact High level : ∞ Ω Low level : 0 Ω
Fuel sender	 CD-2	-	※ Check resistance Full : 50 Ω 6/12 : 350 Ω 11/12 : 100 Ω 5/12 : 400 Ω 10/12 : 150 Ω 4/12 : 450 Ω 9/12 : 200 Ω 3/12 : 500 Ω 8/12 : 250 Ω 2/12 : 550 Ω 7/12 : 300 Ω 1/12 : 600 Ω Empty warning : 700 Ω
Relay (air con blower)		24V 20A	※ Check resistance Normal : About 200 Ω (for terminal 1-3) 0 Ω (for terminal 2-4)
Relay	 CR-5 CR-12 CR-15 CR-36 CR-45 CR-62 CR-63 CR-66	24V 16A	※ Check resistance Normal : About 160 Ω (for terminal 1-2) 0 Ω (for terminal 3-4) ∞ Ω (for terminal 3-5)

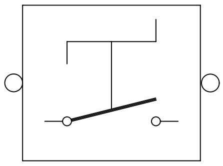
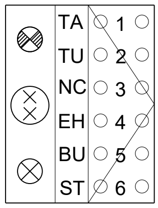
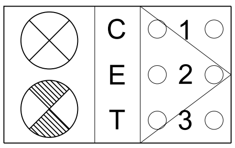
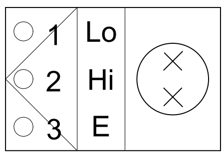
Part name	Symbol	Specifications	Check
Relay	 CR-2 CR-4 CR-7 CR-9 CR-13 CR-29 CR-30 CR-35 CR-47 CR-79	24V 16A	※ Check resistance Normal : About 160 Ω (for terminal 85-86) 0 Ω (for terminal 30-87a) ∞ Ω (for terminal 30-87)
Solenoid valve	 CN-68 CN-69 CN-70 CN-88 CN-122 CN-123 CN-128 CN-135 CN-140 CN-149 CN-153 CN-154 CN-181 CN-206 CN-214 CN-216 CN-220 CN-236 CN-237	24V 1A	※ Check resistance Normal : 15~25 Ω (for terminal 1-2)
EPPR valve	 CN-75 CN-133 CN-238 CN-239 CN-240 CN-241 CN-242 CN-246	700mA	※ Check resistance Normal : 15~25 Ω (for terminal 1-2)
Speaker	 CN-23(LH) CN-24(RH)	4 Ω 20W	※ Check resistance Normal : A few Ω
Switch (locking type)	 CS-23 CS-52 CS-67 CS-79 CS-82 CS-83 CS-99 CS-100	24V 8A	※ Check contact Normal ON : 0 Ω (for terminal 3-7, 4-8) ∞ Ω (for terminal 7-9, 8-10) OFF : ∞ Ω (for terminal 3-7, 4-8) 0 Ω (for terminal 7-9, 8-10)
Accel dial	 CN-142	-	※ Check resist Normal : About 5k Ω (for terminal A-C) ※ Check voltage Normal : About 5V (for terminal A-C) : 2~4.5V (for terminal C-B)

Part name	Symbol	Specifications	Check
Room lamp	 CL-1	24V 10W	※ Check disconnection Normal : 1.0 Ω ON : 0 Ω (For terminal 1-2) ∞ Ω (For terminal 1-3) OFF : ∞ Ω (For terminal 1-2) 0 Ω (For terminal 1-3)
Work lamp, Cab lamp, Number plate lamp	 CL-5 CL-6 CL-8 CL-9 CL-21	24V 65W (H3 Type)	※ Check disconnection Normal : 1.2 Ω
Beacon lamp	 CL-7	21V 70W (H1 Type)	※ Check disconnection Normal : A few Ω
Fuel filler pump	 CN-61	24V 10A 35 l /min	※ Check resistance Normal : 1.0 Ω
Service meter	 CN-48	16 ~ 32V	※ Check operation Supply power(24V) to terminal No.2 and connect terminal No.1 and ground
Horn	 CN-20 CN-25	DC22 ~ 28V 2A	※ Check operation Supply power(24V) to each terminal and connect ground.

Part name	Symbol	Specifications	Check
Safety switch 1	 CS-4	24V 15A (N.C TYPE)	※Check contact Normal : 0 Ω (for terminal 1-2) ∞ Ω (for terminal 1-3) Operating : ∞ Ω (for terminal 1-2) 0 Ω (for terminal 1-3)
Safety switch 2, Wiper cut switch	 CS-20 CS-53	24V (N.O TYPE)	※Check contact Normal : 0 Ω (one pin to ground)
Receiver dryer	 CN-29	24V 2.5A	※Check contact Normal : ∞ Ω
Radio & CD/MP3 plalyer	 CN-27	24V 2A	※Check voltage 20~25V (for terminal 1-3, 3-8)
Washer pump	 CN-22	24V 3.8A	※Check contact Normal : 10.7 Ω (for terminal 1-2)
Wiper motor	 CN-21	24V 2A	※Check disconnection Normal : 7 Ω (for terminal 2-6)

Part name	Symbol	Specifications	Check
DC/DC Converter	 CN-138	12V 3A	24V (1-2) 12V (1-3)
Cigar lighter	 CL-2	24V 5A 1.4W	※Check coil resistance Normal : About 1M Ω ※Check contact Normal : ∞ Ω Operating time : 5~15sec
Alternator	 CN-74	Delco Remy 24V 55A	※Check contact Normal : 0 Ω (for terminal B^+-I) Normal : 24~27.5V
Starter	 CN-45	Denso 24V 4.5kW	※Check contact Normal : 0.1 Ω
Travel alarm	 CN-81	24V 0.5A	※Check contact Normal : 5.2 Ω
Aircon compressor	 CN-28	24V 79W	※Check contact Normal : 13.4 Ω

Part name	Symbol	Specifications	Check
Start relay	 CR-23	24V 300A	※Check contact Normal : 0.94 Ω (for terminal 1-2)
Blower motor		24V 9.5A	※Check resistance Normal : 2.5 Ω (for terminal 1-2)
Duct sensor (switch)		1°C OFF 4°C ON	※Check resistance Normal : 0 Ω (for terminal 1-2), the atmosphere temp : Over 4°C
Door switch	 CS-1	24V 2W	※Check resistance Normal : About 5M Ω
Switch (power max, one touch decal, horn, breaker)	 CS-5 CS-19 CS-26 CS-26A CS-29	24V 6A	※Check resistance Normal : ∞ Ω
Fusible link	 CN-60 CN-95	60A	※Check disconnection normal : 0 Ω (connect ring terminal and check resist between terminal 1 and 2)

Part name	Symbol	Specifications	Check
Master switch	 CS-74	6 - 36V	※Check disconnection Normal : 0.1 Ω
Rear combination lamp-LH,RH	 CL-15 CL-16	24V 21W×3 24V 10W	※Normal : 4.8 Ω (For terminal 1-4) Normal : 2.1 Ω (For terminal 2-4, 4-5, 4-6)
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)

GROUP 4 CONNECTORS

1. CONNECTOR DESTINATION

Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CN-1	AMP	10	I/conn (Frame harness-Pump PS harness)	S816-010002	S816-110002
CN-2	AMP	12	I/conn (Frame harness-Engine harness)	S816-012002	S816-112002
CN-3	AMP	15	I/conn (Frame harness-Engine harness)	2-85262-1	368301-1
CN-4	AMP	16	I/conn (Console harness LH-Frame harness)	368047-1	368050-1
CN-5	DEUTSCH	60	I/conn (Side harness RH-Frame harness)	DRB16-60SAE-L018	DRB14-60PAE-L018
CN-7	AMP	16	I/conn (Console harness RH-Frame harness)	368047-1	368050-1
CN-8	AMP	12	I/conn (Console harness RH-Frame harness)	S816-012002	S816-112002
CN-10	DEUTSCH	12	I/conn (Cab harness-Side harness RH)	DT06-12S-EP06	DT04-12P-BE02
CN-11	DEUTSCH	8	I/conn (Frame harness-Aircon harness)	DT06-8S-EP06	-
CN-12	DEUTSCH	2	I/conn (Frame harness-Boom wire harness)	DT06-2S-EP06	DT04-2P-E005
CN-14	AMP	8	I/conn (Frame harness-Attachment harness)	S816-008002	S816-108002
CN-15	AMP	10	I/conn (Frame harness-Two way harness)	S816-010002	S816-110002
CN-16	AMP	6	Emergency engine start & speed control	S816-006002	S816-106002
CN-17	DEUTSCH	8	I/conn (Wiper motor harness-Side harness RH)	DT06-8S-EP06	DT04-8P
CN-20	MOLEX	2	Horn	36825-0211	-
CN-21	AMP	6	Wiper motor	925276-0	-
CN-22	KET	2	Washer pump	MG640605	-
CN-23	KET	2	Speaker-LH	MG610070	-
CN-24	KET	2	Speaker-RH	MG610070	-
CN-25	MOLEX	2	Horn	36825-0211	-
CN-27	KUM	16	Radio & CD/MP3 player	PK145-16017	-
CN-28	KUM	1	Aircon compressor	NMWP01F-B	-
CN-29	KET	2	Receiver dryer	MG640795	-
CN-36	-	-	Fuse & relay box	21Q7-10910	-
CN-45	RING-TERM	-	Starter motor B^+	S820-308000	-
CN-48	KET	1	Service meter	2-520193-2	-
CN-51	DEUTSCH	40	MCU	DRC26-40SA	-
CN-52	DEUTSCH	40	MCU	DRC26-40SB	-
CN-53	DEUTSCH	40	MCU	DRC26-40SC	-
CN-56	AMP	8	Cluster	-	S816-108002
CN-60	AMP	2	Fusible link	21N4-01320	S813-130201
CN-61	DEUTSCH	2	Fuel filler pump	DT06-2S-EP06	-
CN-66	DEUTSCH	2	Breaker solenoid	DT06-2S-EP06	-
CN-68	DEUTSCH	2	Safety solenoid	DT06-2S-EP06	-
CN-69	DEUTSCH	2	Ram lock solenoid	DT06-2S-EP06	-

Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CN-70	DEUTSCH	2	Travel high solenoid	DT06-2S-EP06	-
CN-74	KET	2	Alternator "I" terminal	MG640-188-4	-
CN-75	AMP	2	Pump EPPR	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	DEUTSCH	50	ECM	DRC26-50S-04	-
CN-94	DEUTSCH	4	ECM earth	DTP06-4S-EP06	-
CN-95	YAZAKI	2	Fusible link	21N4-01311	7122-4125-50
CN-96	AMP	4	Fuel warmer	2-967325-3	-
CN-97	AMP	12	Multifunction switch	-	S816-112002
CN-98	AMP	10	Multifunction switch	-	S816-112002
CN-99	AMP	16	Multifunction switch	-	368050-1
CN-116	AMP	12	Switch panel	176116	-
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-126	AMP	8	Service tool	S816-008002	S816-108002
CN-133	DEUTSCH	2	Boom priority solenoid	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
CN-142	DEUTSCH	3	Accel dial	DT06-3S-EP06	-
CN-144	KET	20	Handsfree	MG610240	-
CN-147	AMP	4	Fuel heater	2-967325-3	-
CN-149	DEUTSCH	2	Attach safety solenoid	DT06-2S-EP06	-
CN-156	DEUTSCH	2	Air seat	DT04-2P-E005	-
CN-157	AMP	1	Antena power	S822-014002	-
CN-170	AMP	2	Heated seat	S816-002002	S816-102002
CN-173	DEUTSCH	3	Resistor	DT06-3S-EP06	DT04-3P-EP10
CN-181	DEUTSCH	2	Travel low speed solenoid	DT06-2S-EP06	-
CN-236	DEUTSCH	2	Attach pressure solenoid	DT06-2S-EP06	-
CN-237	DEUTSCH	2	Attach conflux solenoid	DT06-2S-EP06	-
CN-242	DEUTSCH	2	Attach flow solenoid	DT06-2S-EP06	DT04-2P-E005
CN-244	TYCO	2	CAN 2	3-1393292-8	-
CN-245	AMP	12	Remote controller assy	368542-1	-
CN-246	AMP	12	USB & Socket assy	174045-2	-

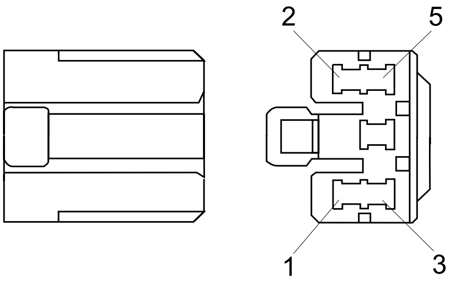
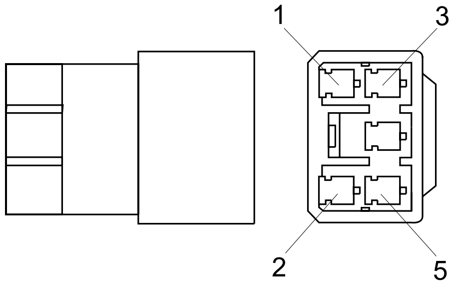
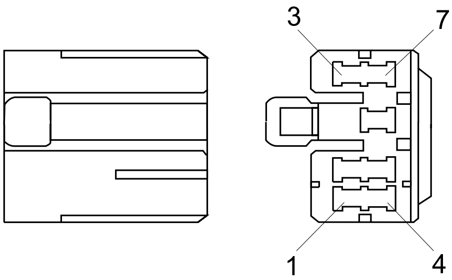
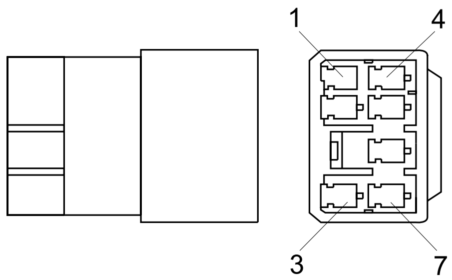
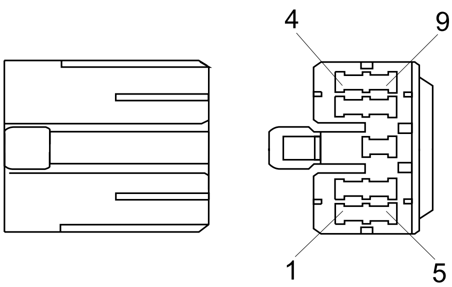
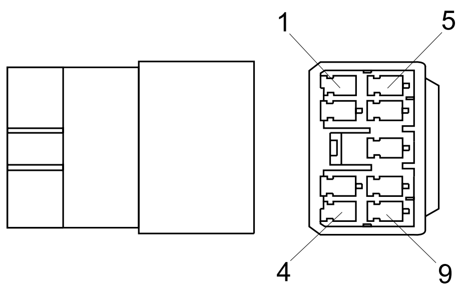
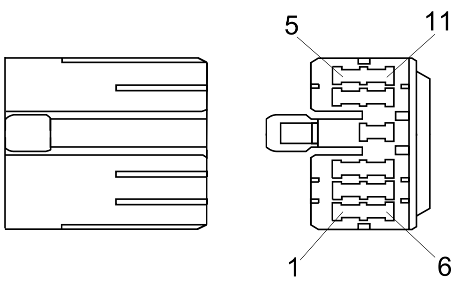
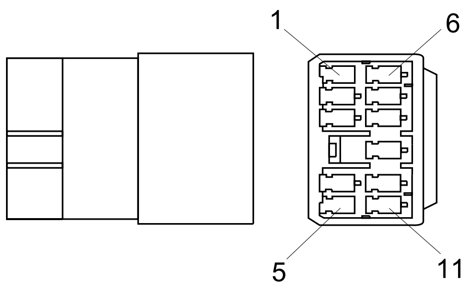
Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CN-247	DEUTSCH	8	PWM convert	DT06-08SA-EP06	DT04-8P
CN-249	DEUTSCH	4	Rear view camera	DT06-4S-EP06	DT04-4P-E005
CN-255	AMP	2	PTC Power	S813-030201	-
CN-256	AMP	8	Proportional	-	S816-108002
CN-266	DEUTSCH	2	Auto cruise solenoid	DT06-2S-EP06	-
CN-276	DEUTSCH	60	MTCU	DRC26-40SA	-
· Relay					
CR-1	RING-TERM	-	Battery relay	ST730135-2	-
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	-	-
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-45	-	5	ECM power relay	-	-
CR-46	-	5	Fuel warmer relay	-	-
CR-47	-	5	Safety solenoid relay	-	-
CR-62	-	5	Breaker relay	-	-
CR-66	-	5	Parking relay	-	-
CR-79	-	5	Pedal relay	-	-
· Switch					
CS-1	SHUR	1	Door switch	S822-014002	S822-114002
CS-2	WP	6	Start key switch	S814-006100	-
CS-4	DEUTSCH	3	Safety switch 1	DT06-3S-EP06	-
CS-5	DEUTSCH	2	Horn switch	-	DT04-2P-E005
CS-19	DEUTSCH	2	One touch decel switch	-	DT04-2P-E005
CS-20	AMP	1	Safety switch 2	S822-014002	-
CS-23	SWF	12	Beacon lamp switch	SWF589790	-
CS-26	DEUTSCH	2	Breaker switch	DT06-2S-EP06	-

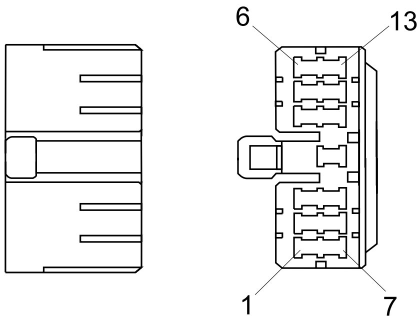
Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CS-26A	AMP	2	Breaker pedal switch	S816-002002	S816-102002
CS-27	SWF	10	Breaker switch	SWF 593757	-
CS-29	DEUTSCH	2	Power max switch	DT06-2S-EP06	-
CS-50	SWF	12	Overload switch	SWF589790	-
CS-52	SWF	12	Econo switch	SWF 589790	-
CS-53	AMP	1	Wiper cut switch	S822-014002	-
CS-67	SWF	12	Quick clamp switch	SWF 589790	-
CS-73	SWF	12	Reverse & fan switch	SWF 589790	-
CS-74	AMP	2	Master switch	S813-030201	-
CS-79	SWF	12	Spare switch	SWF 589790	-
CS-82	SWF	12	Heated seat switch	SWF 589790	-
CS-83	SWF	12	Spare switch	SWF589790	-
CS-99	SWF	12	Spare switch	SWF 589790	-
CS-100	SWF	12	Spare switch	SWF 589790	-
CS-142	DEUTSCH	3	Accel dial switch	DT06-3S-EP06	-
· Light					
CL-1	KET	3	Room lamp	MG651032	-
CL-2	AMP	1	Cigar light	S822-014002	S822-114002
CL-3	DEUTSCH	3	Head lamp-LH	S810-003702	-
CL-4	DEUTSCH	3	Head lamp-RH	S810-003702	DT04-2P-E005
CL-5	DEUTSCH	2	Work lamp-LH	DT06-2S-EP06	DT04-2P
CL-6	DEUTSCH	2	Work lamp-RH	DT06-2S-EP06	DT04-2P
CL-7	SHUR	1	Beacon lamp	S822-014002	S822-114002
CL-8	DEUTSCH	2	Cab light-LH	DT04-2S-EP06	DT-2P-E005
CL-9	DEUTSCH	2	Cab light-RH	DT04-2S-EP06	DT04-2P-E005
CL-10	DEUTSCH	2	Cab light-RH	DT06-2S-EP06	-
CL-15	AMP	6	Rear combination lamp-LH	S814-006100	-
CL-16	AMP	6	Rear combination lamp-RH	S814-006100	-
CL-21	KET	2	Number plate lamp	S814-002100	-
CL-24	AMP	3	Front combination lamp-LH	S814-003100	-
CL-25	AMP	3	Front combination lamp-RH	S814-003100	-
· 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	-
CD-6	DEUTSCH	3	Travel pressure sensor	S814-003100	-
CD-7	DEUTSCH	3	Working pressure sensor	S814-003100	-

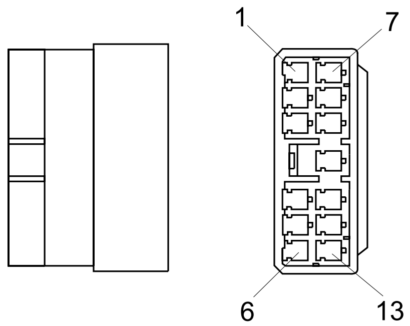
Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CD-10	RING TERM	-	Air cleaner switch	ST730135-2	-
CD-24	DEUTSCH	3	Swing pressure sensor	DT06-3S-EP06	-
CD-31	DEUTSCH	3	Overload pressure sensor	DT06-3S-EP06	-
CD-32	DEUTSCH	3	Boom up pressure sensor	DT06-3S-EP06	-
CD-35	DEUTSCH	3	Arm & bucket in 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	3	Outrigger action pressure sensor	S814-00310	-
CD-69	DEUTSCH	3	Attach pressure sensor	DT06-3S-EP06	-
CD-70	DEUTSCH	3	N1 pressure sensor	DT06-3S-EP06	-
CD-71	DEUTSCH	3	N2 pressure sensor	DT06-3S-EP06	-
CD-73	DEUTSCH	3	Travel forward pressure sensor	DT06-3S-EP06	-
CD-74	DEUTSCH	3	Travel reverse pressure sensor	DT06-3S-EP06	-

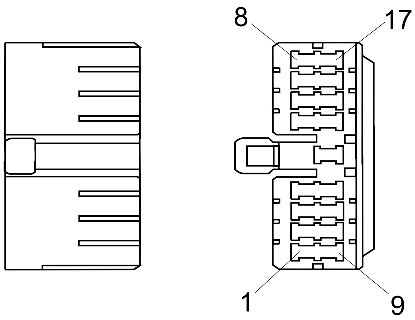
2. CONNECTION TABLE FOR CONNECTORS

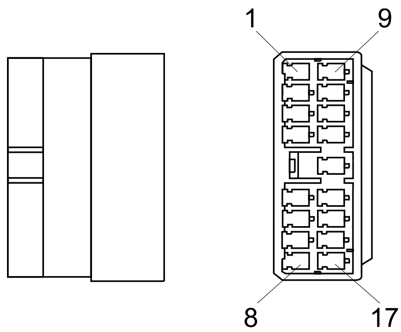
1) PA TYPE CONNECTOR

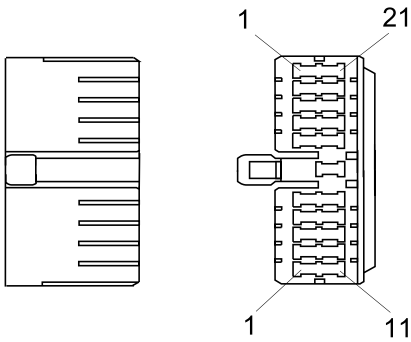
No. of pin	Receptacle connector (female)	Plug connector (male)
5	 S811-005002	 S811-105002
7	 S811-007002	 S811-107002
9	 S811-009002	 3S811-109002
11	 S811-011002	 S811-111002

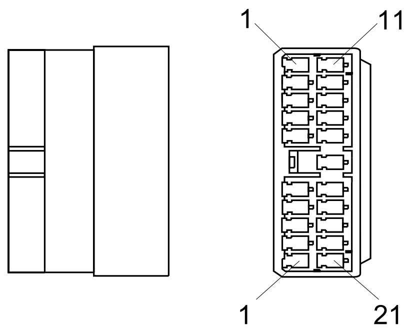
<table>
<tr><th>No. of pin</th><th>Receptacle connector (female)</th><th>Plug connector (male)</th></tr>
<tr><td>13</td><td>

S811-013002</td><td>

S811-113002</td></tr>
<tr><td>17</td><td>

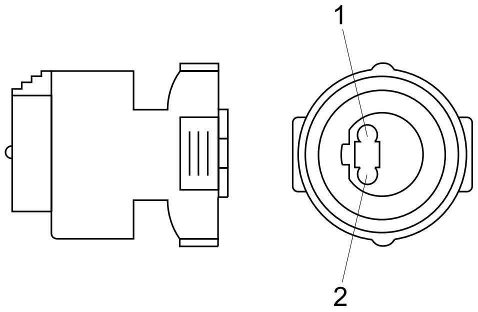
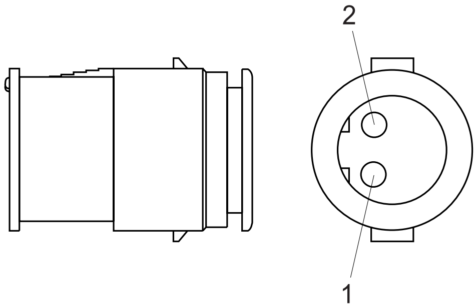
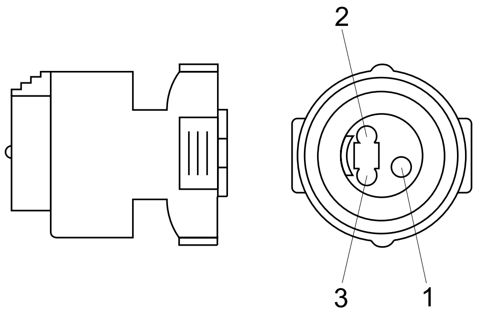
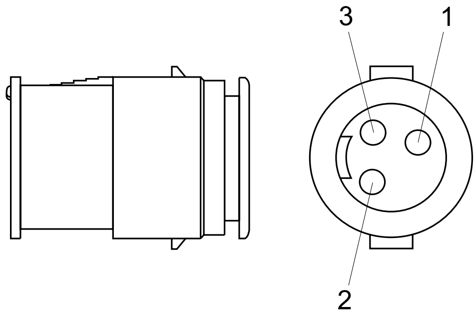
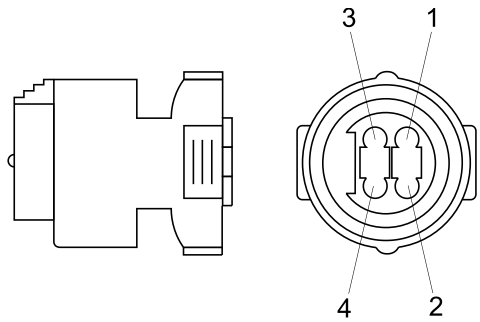
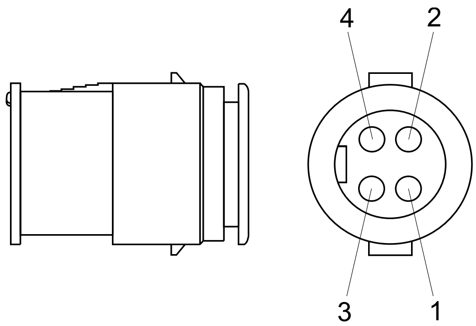
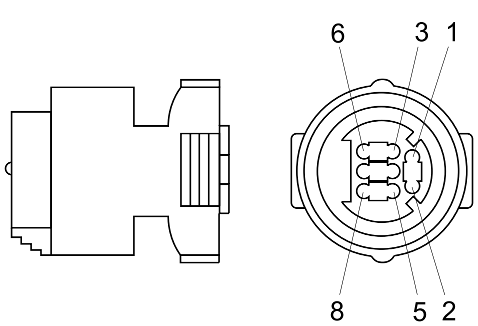
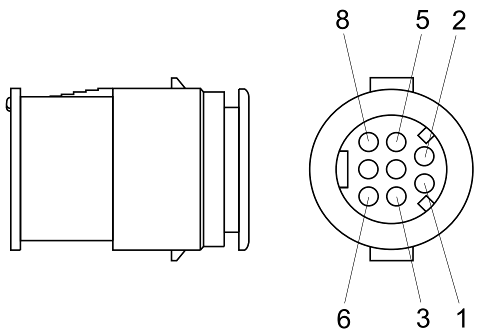
S811-017002</td><td>

S811-117002</td></tr>
<tr><td>21</td><td>

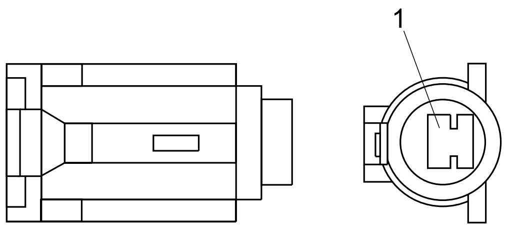
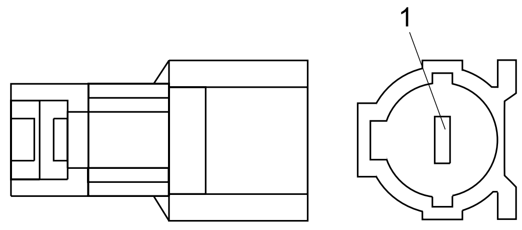
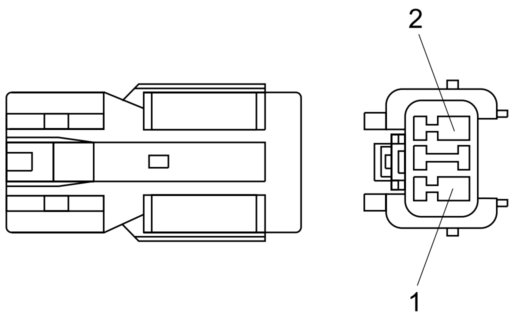
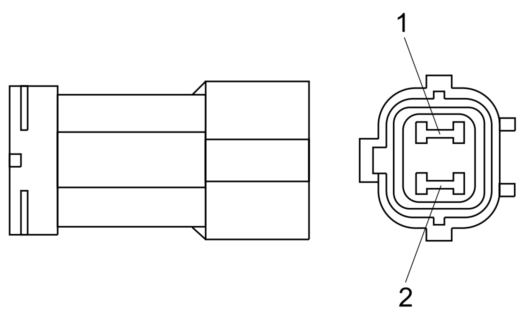
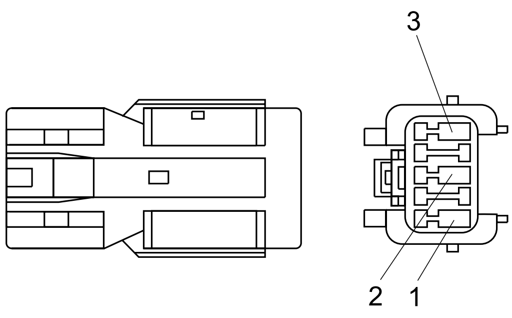
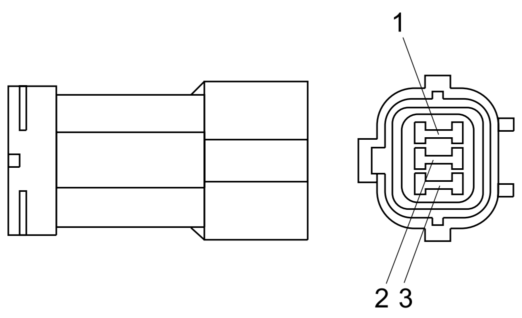
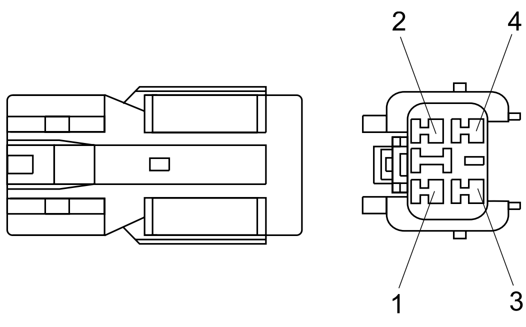
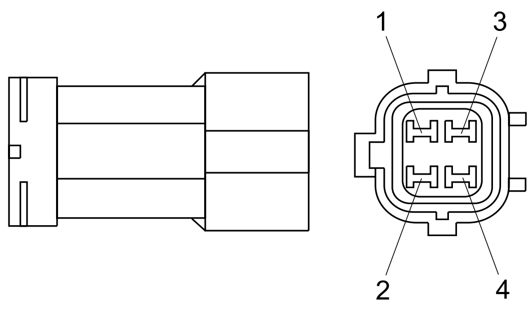
S811-021002</td><td>

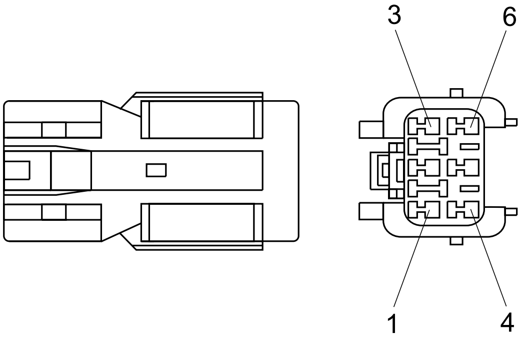
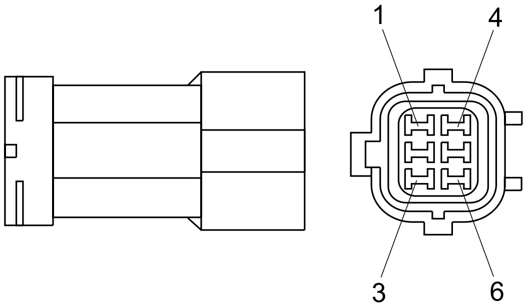
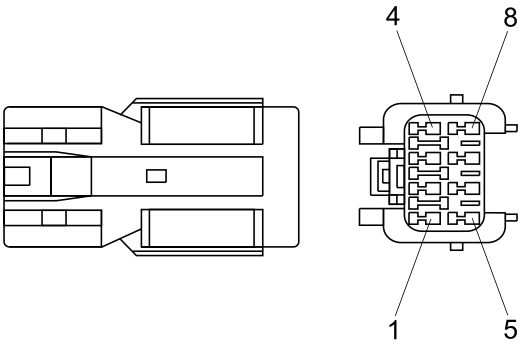
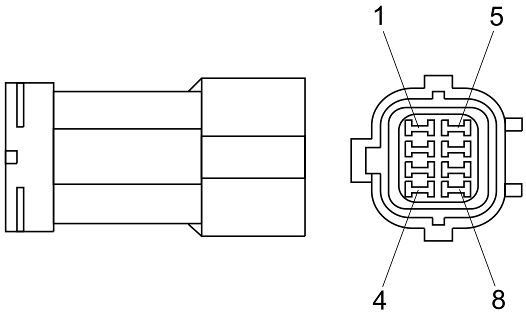
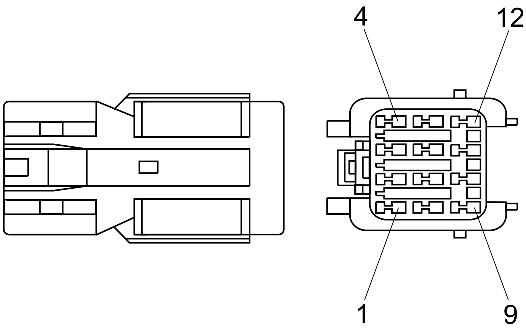
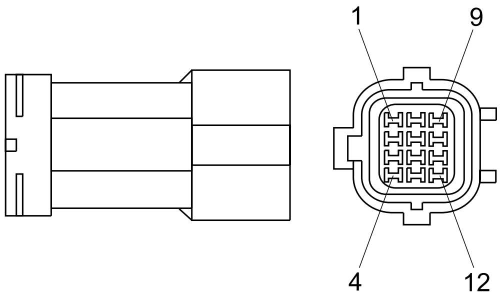
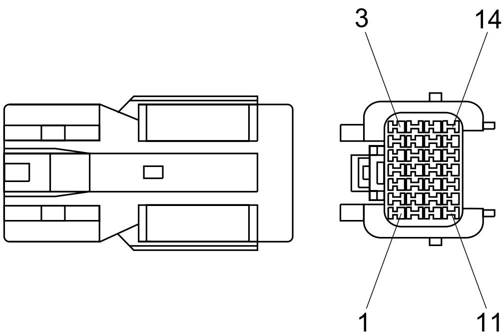
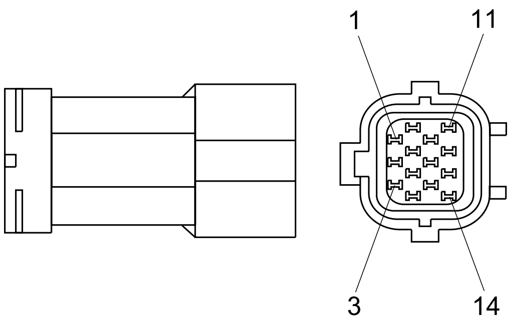
S811-121002</td></tr>
</table>

2) J TYPE CONNECTOR

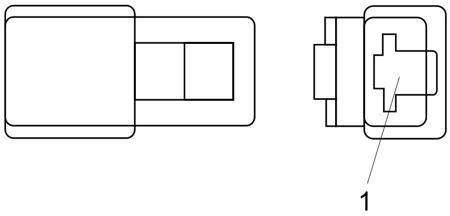
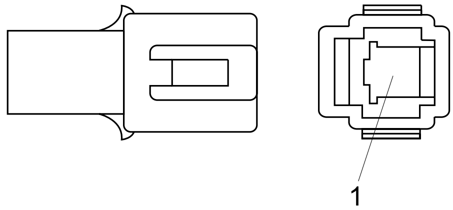
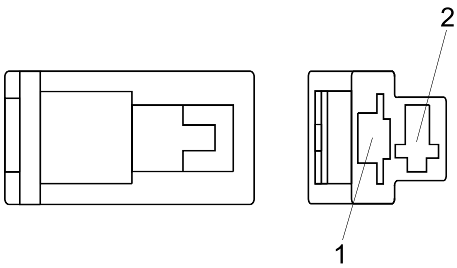
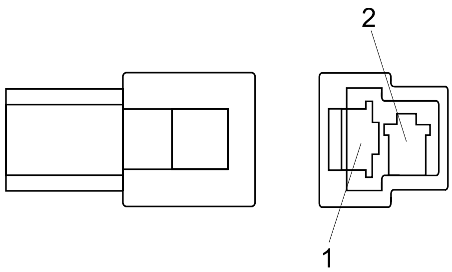
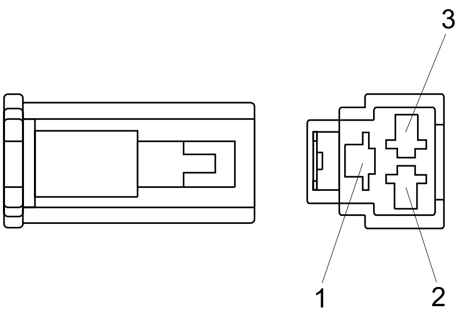
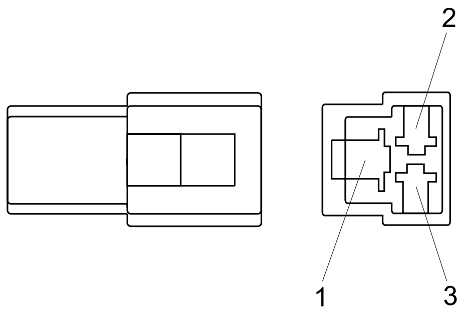
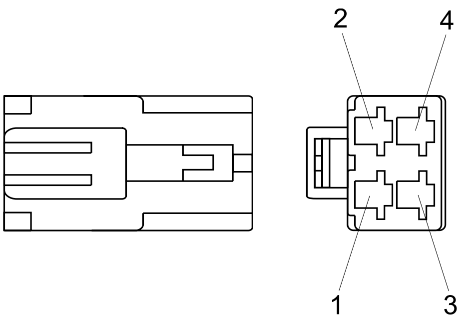
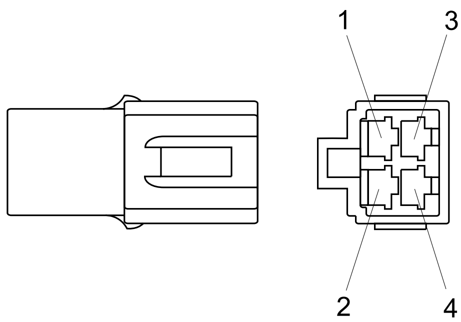
No. of pin	Receptacle connector (female)	Plug connector (male)
2	 S816-002001	 S816-102001
3	 S816-003001	 S816-103001
4	 S816-004001	 S816-104001
8	 S816-008001	 S816-108001

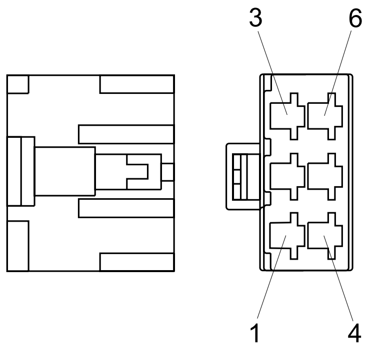
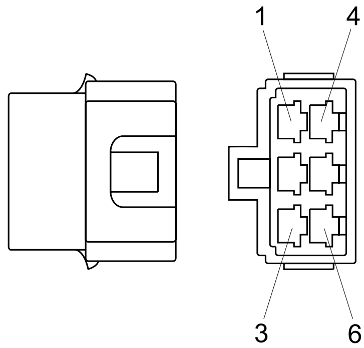
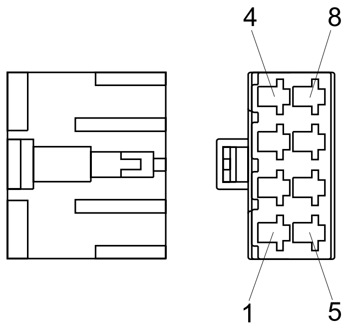
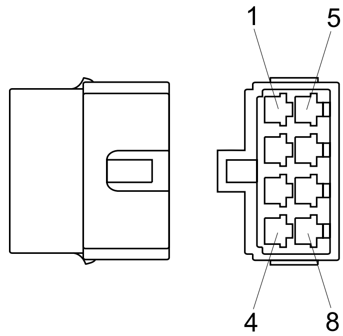
3) SWP TYPE CONNECTOR

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

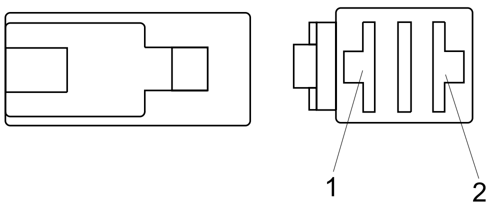
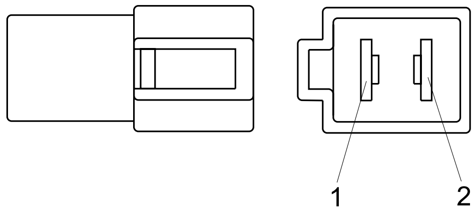
No. of pin	Receptacle connector (female)	Plug connector (male)
6	 S814-006000	 S814-106000
8	 S814-008000	 S814-108000
12	 S814-012000	 S814-112000
14	 S814-014000	 S814-114000

4) CN TYPE CONNECTOR

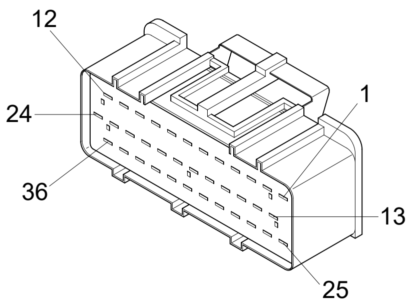
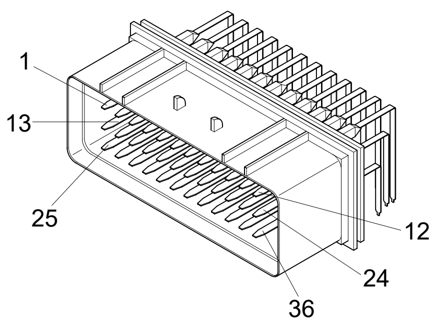
No. of pin	Receptacle connector (female)	Plug connector (male)
1	 S810-001202	 S810-101202
2	 S810-002202	 S810-102202
3	 S810-003202	 S810-103202
4	 S810-004202	 S810-104202

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

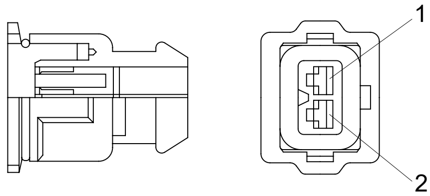
5) 375 FASTEN TYPE CONNECTOR

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

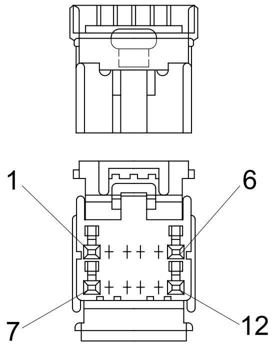
6) AMP ECONOSEAL CONNECTOR

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

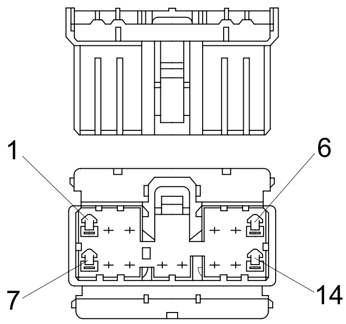
7) AMP TIMER CONNECTOR

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

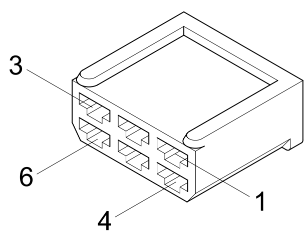
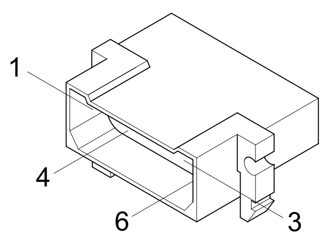
8) AMP 040 MULTILOCK CONNECTOR

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

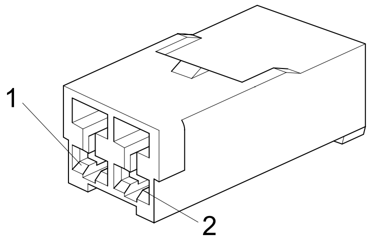
9) AMP 070 MULTILOCK CONNECTOR

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

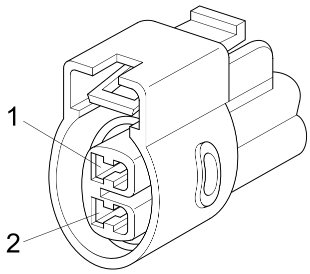
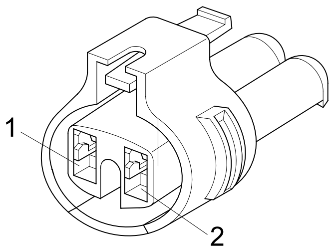
10) AMP FASTIN - FASTON CONNECTOR

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

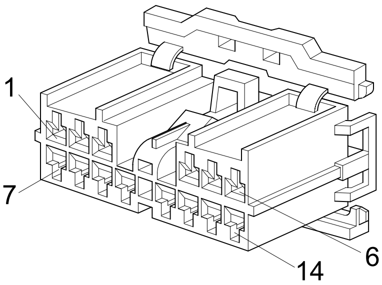
11) KET 090 CONNECTOR

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

12) KET 090 WP CONNECTORS

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

13) KET SDL CONNECTOR

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

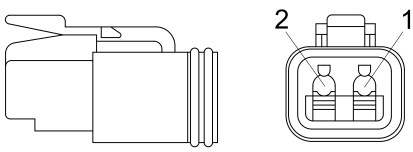
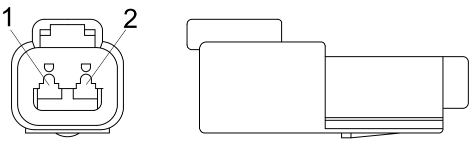
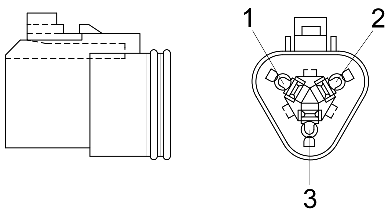
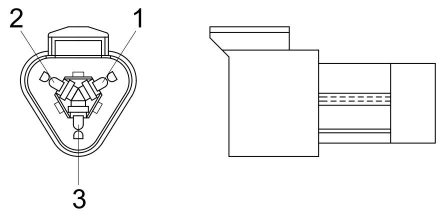
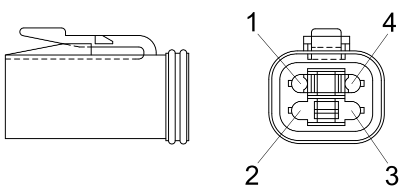
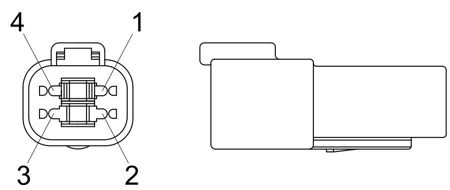
14) DEUTSCH DT CONNECTORS

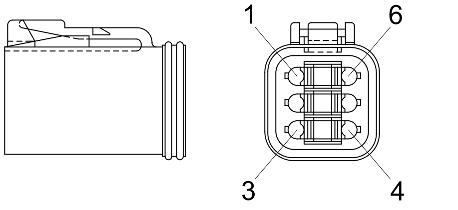
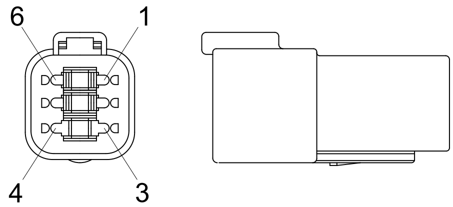
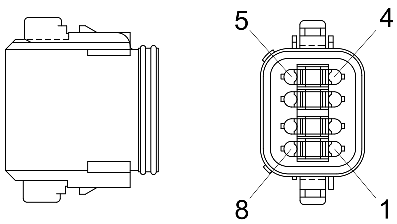
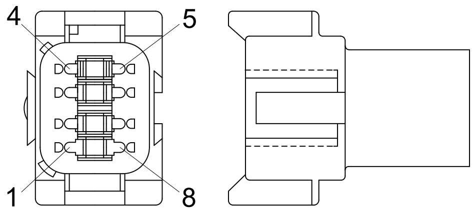
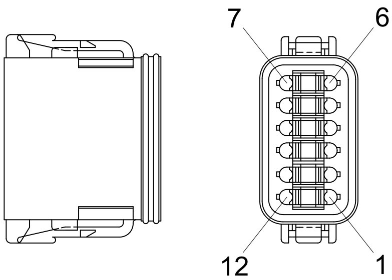
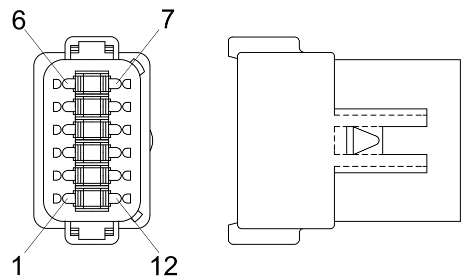
DT 06 - 3S - ★★★★

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

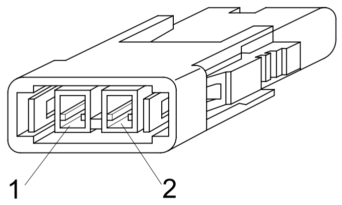
※ Modification

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

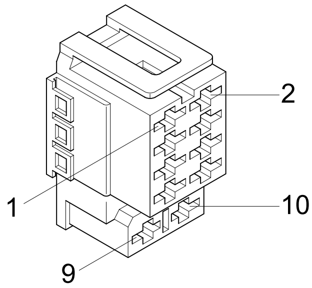
No. of pin	Receptacle connector (female)	Plug connector (male)
2	 DT06-2S	 DT04-2P
3	 DT06-3S	 DT04-3P
4	 DT06-4S	 DT04-4P

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

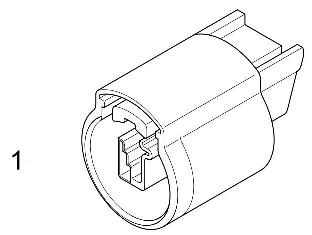
15) MOLEX 2CKTS CONNECTOR

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

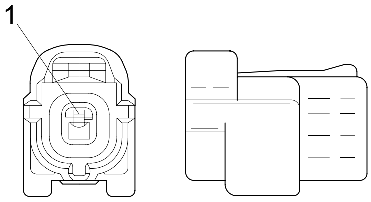
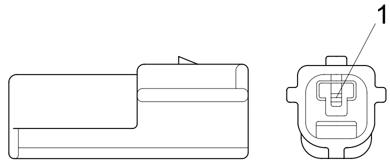
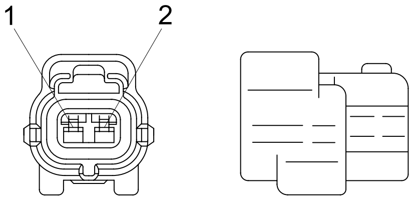
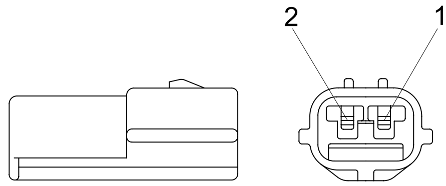
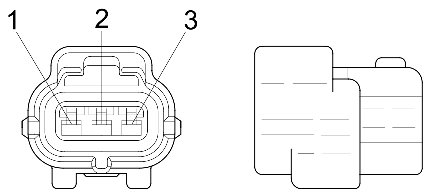
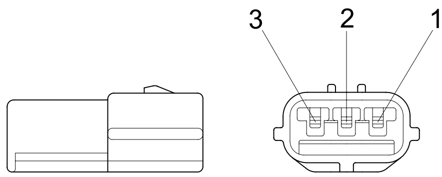
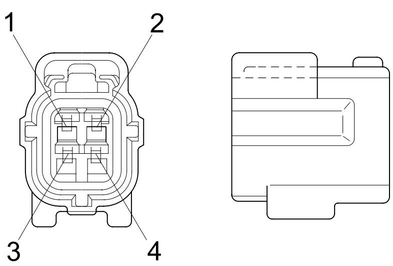
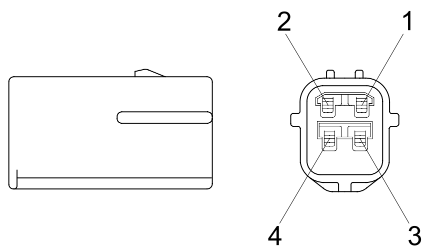
16) ITT SWF CONNECTOR

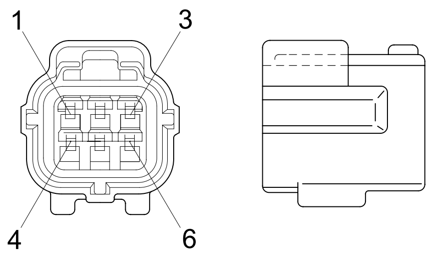
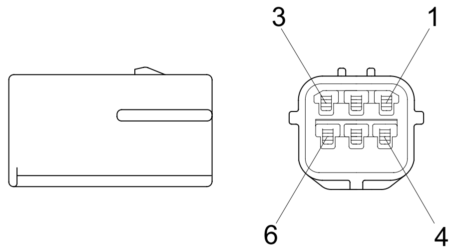
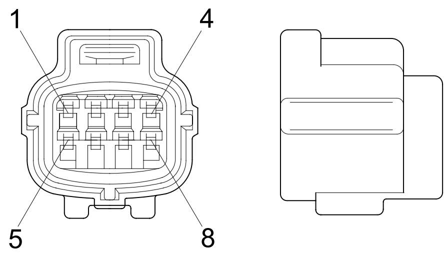
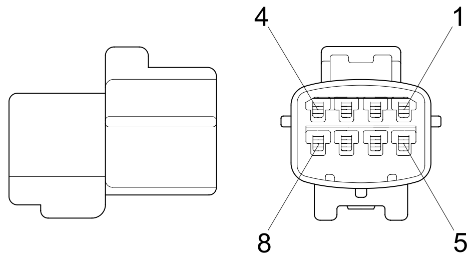
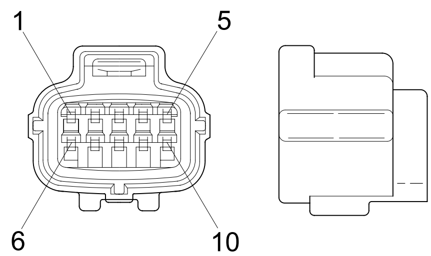
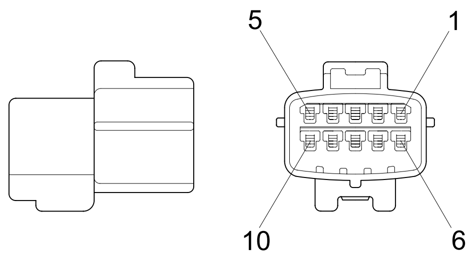
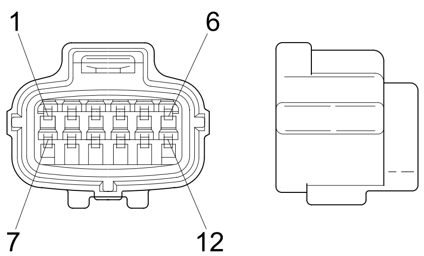
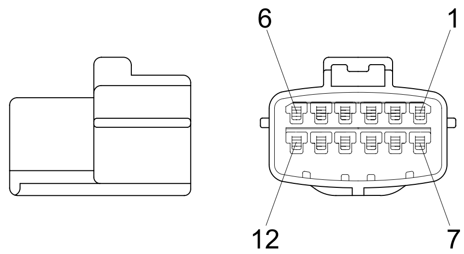
No. of pin	Receptacle connector (female)	Plug connector (male)
10	 SWF593757	

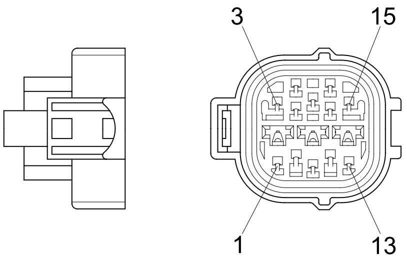
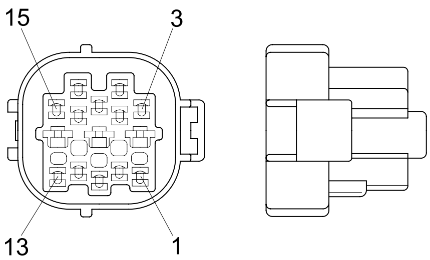
17) MWP NMWP CONNECTOR

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

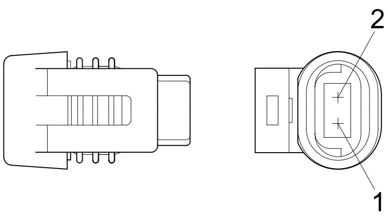
18) ECONOSEAL J TYPE CONNECTORS

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

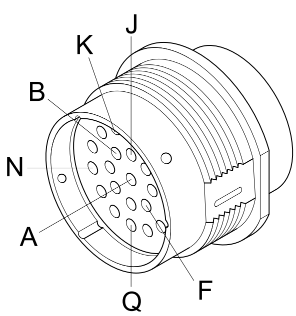
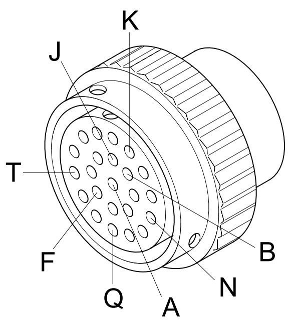
No. of pin	Receptacle connector (female)	Plug connector (male)
6	 S816-006002	 S816-106002
8	 S816-008002	 S816-108002
10	 S816-010002	 S816-110002
12	 S816-012002	 S816-112002

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

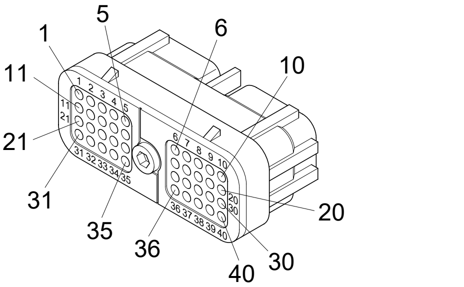
19) METRI-PACK TYPE CONNECTOR

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

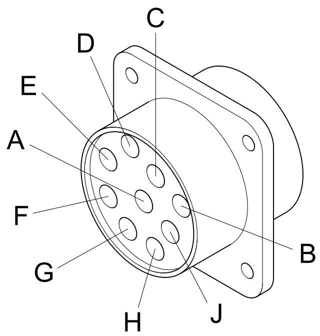
20) DEUTSCH HD30 CONNECTOR

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

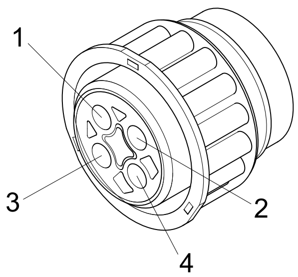
21) DEUTSCH MCU CONNECTOR

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

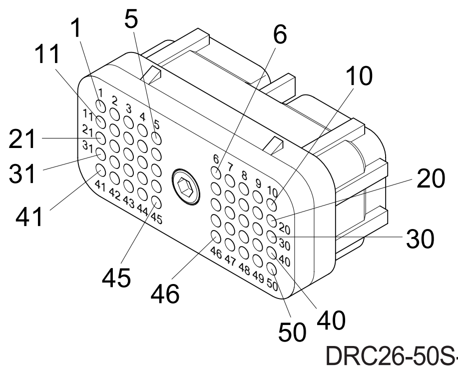
22) DEUTSCH SERVICE TOOL CONNECTOR

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

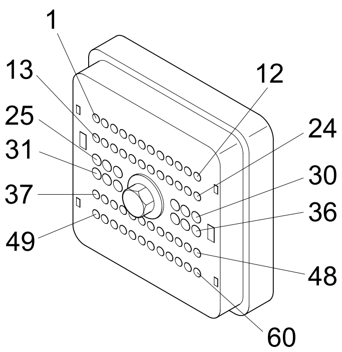
23) AMP FUEL WARMER CONNECTOR

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

24) DEUTSCH ENGINE ECM CONNECTOR

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

25) DEUTSCH INTERMEDIATE CONNECTOR

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

SECTION 5 MECHATRONICS SYSTEM

本部需要配置的部分做记号
如果能提供的资料请回信

如果无法提供相关内容时考虑删除

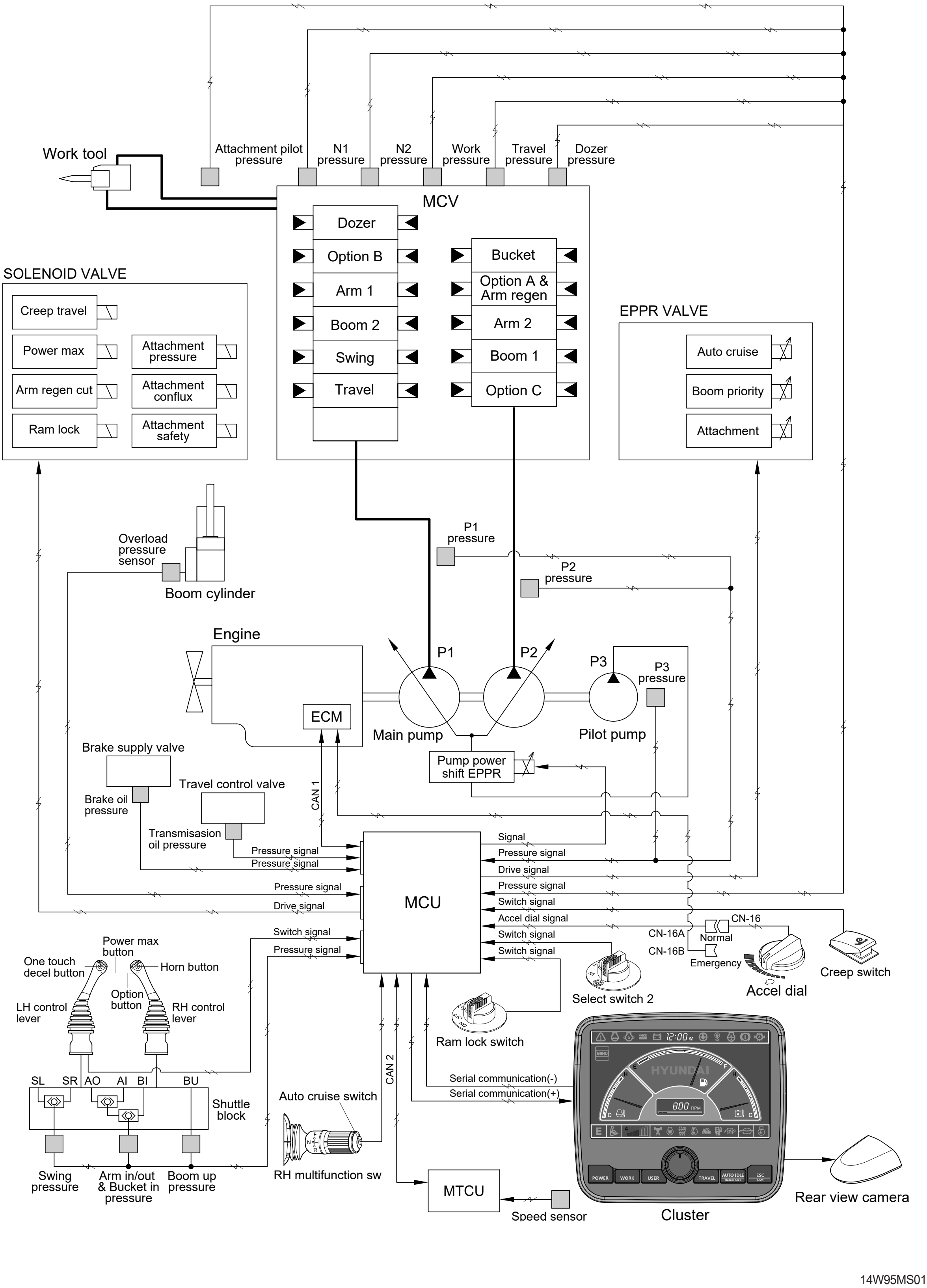
SECTION 5 MECHATRONICS SYSTEM

GROUP 1 OUTLINE

The NEW 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.

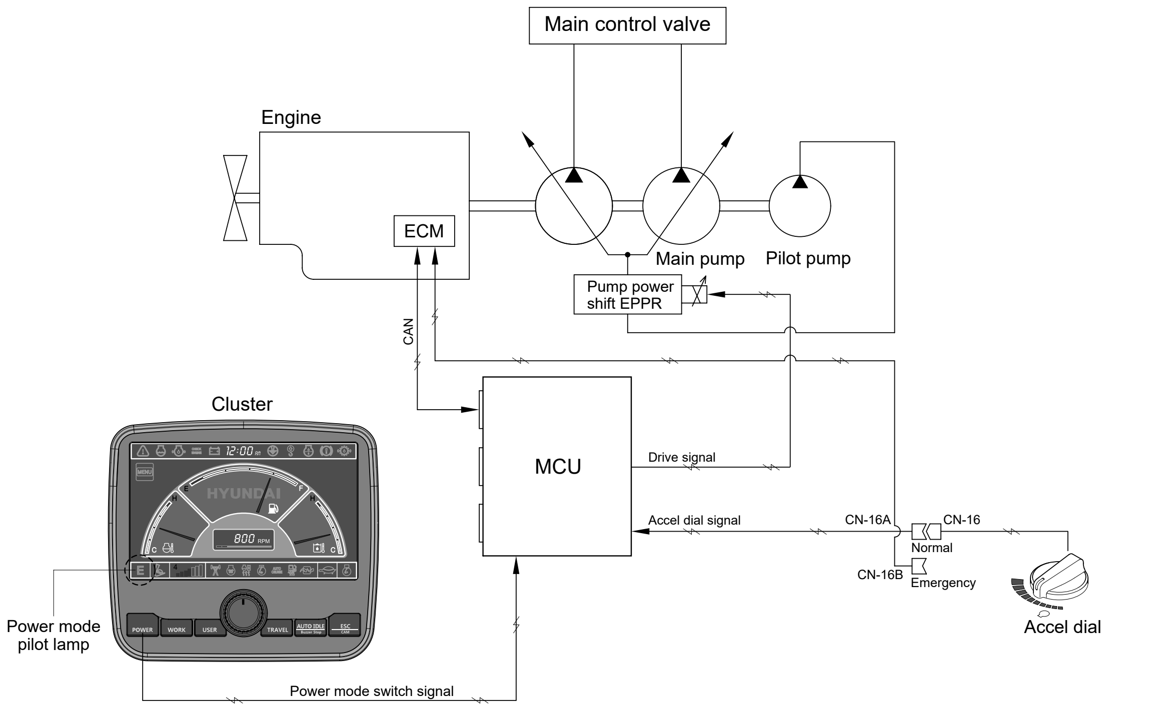
- NEW CAPO SYSTEM
  - Mode selection system
    - Power mode selection (P, S, E)
    - Work mode selection
    - User mode system (U)
  - Auto deceleration system
  - Power boost system
  - Travel control system
    - 1, 2 Speed control system
    - Auto cruise control system
    - Creep travel control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

SYSTEM DIAGRAM



GROUP 2 MODE SELECTION SYSTEM

1. POWER MODE SELECTION SYSTEM



14W95MS02

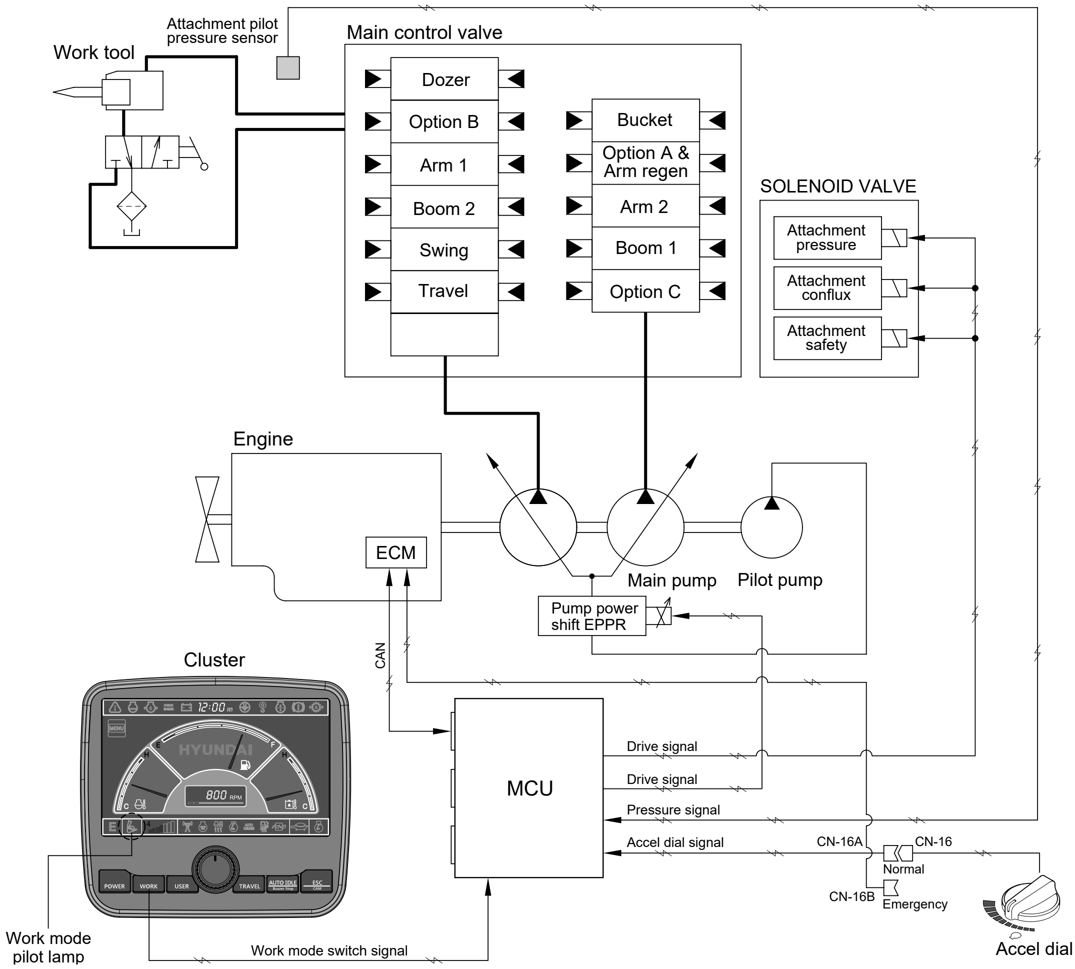
Mode selection system (micro computer based electro-hydraulic pump and engine mutual control system) optimizes the engine and pump performance.
The combination of 3 power modes (P, S, E) and accel dial position (10 set) makes it possible to use the engine and pump power more effectively corresponding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

Power mode	Application	Engine rpm				Power shift by EPPR valve			
		Standard		Option		Standard		Option	
		Unload	Load	Unload	Load	Current (mA)	Pressure (kgf/cm^2)	Current (mA)	Pressure (kgf/cm^2)
P	Heavy duty power	1450±50	-	1550±50		330±30	10±3	250±30	5±3
S	Standard power	1300±50	-	1400±50		400±30	15±3	330±30	10±3
E	Economy operation	1200±50	-	1300±50		400±30	15±3	330±30	10±3
AUTO DECEL	Engine deceleration	1000±100	-	1000±100		700±30	40±2	700±30	40±2
One touch decel	Engine quick deceleration	800±100	-	800±100		700±30	40±2	700±30	40±2
KEY START	Key switch start position	800±100	-	800±100		700±30	40±2	700±30	40±2

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

2. WORK MODE SELECTION SYSTEM

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



1) GENERAL WORK MODE (bucket)

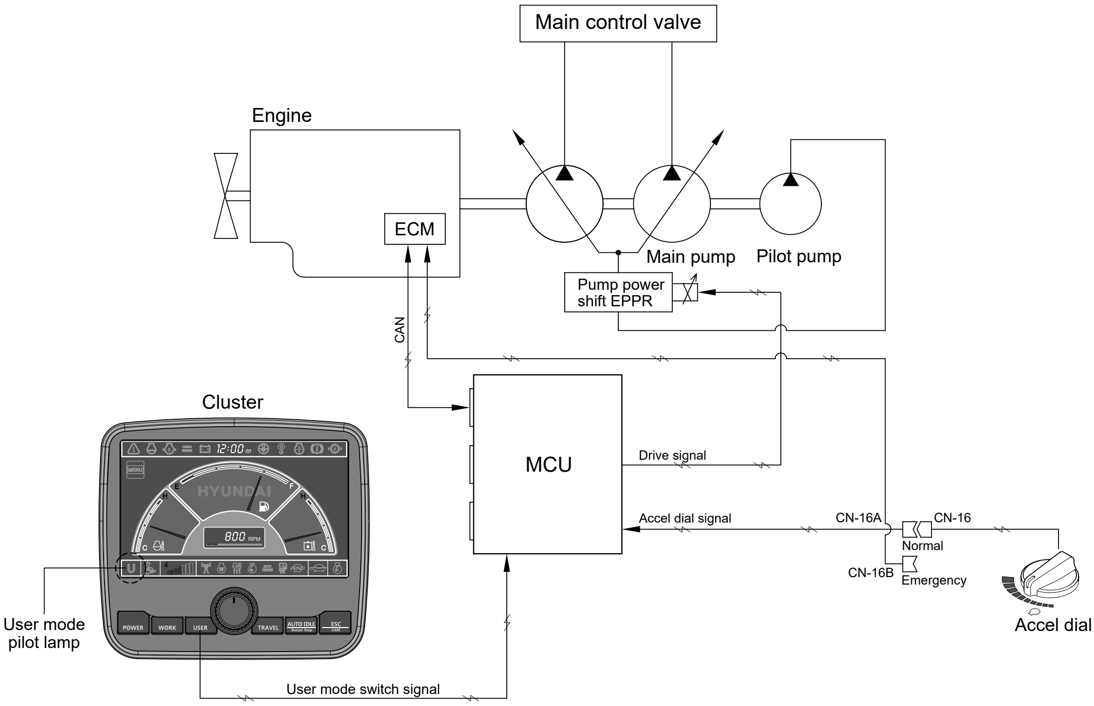
This mode is used to general digging work.

2) ATT WORK MODE (breaker, crusher)

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

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

3. USER MODE SELECTION SYSTEM

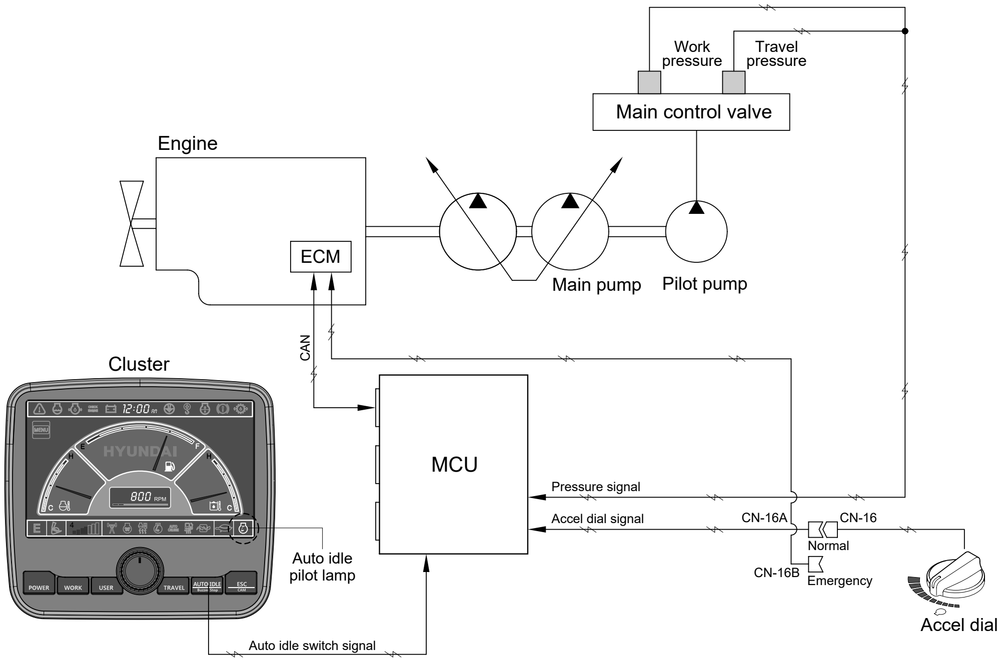


1) High idle rpm, auto idle rpm and EPPR pressure can be adjusted and memorized in the U-mode.

2) LCD segment vs parameter setting

Step (▮)	Engine speed (rpm)	Idle speed (rpm)	Power shift (bar)
1	1150	800 (low idle)	0
2	1200	850	3
3	1250	900	6
4	1300	950	9
5	1350	1000 (decel rpm)	12
6	1400	1050	16
7	1450	1100	20
8	1500	1150	26
9	1600	1200	32
10	1700	1250	38

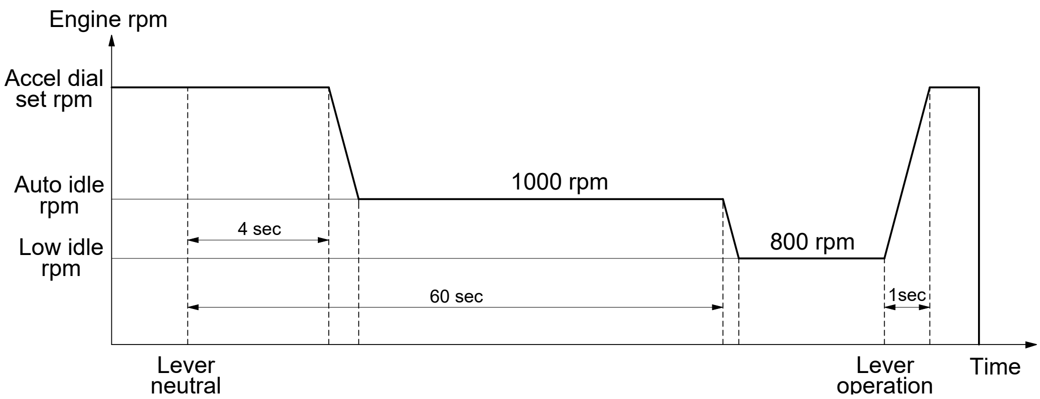
GROUP 3 AUTOMATIC DECELERATION SYSTEM



1. WHEN AUTO IDLE PILOT LAMP ON

When all of the work equipment control levers including swing and travel levers are at neutral for 4 seconds, MCU sends throttle command to ECM to reduce the engine speed to 1000 rpm. If the control levers are at neutral for 1 minute, MCU reduces the engine speed to 800 rpm. As the result of reducing the engine speed, fuel consumption and noise are effectively cut down during non-operation of the control levers.

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

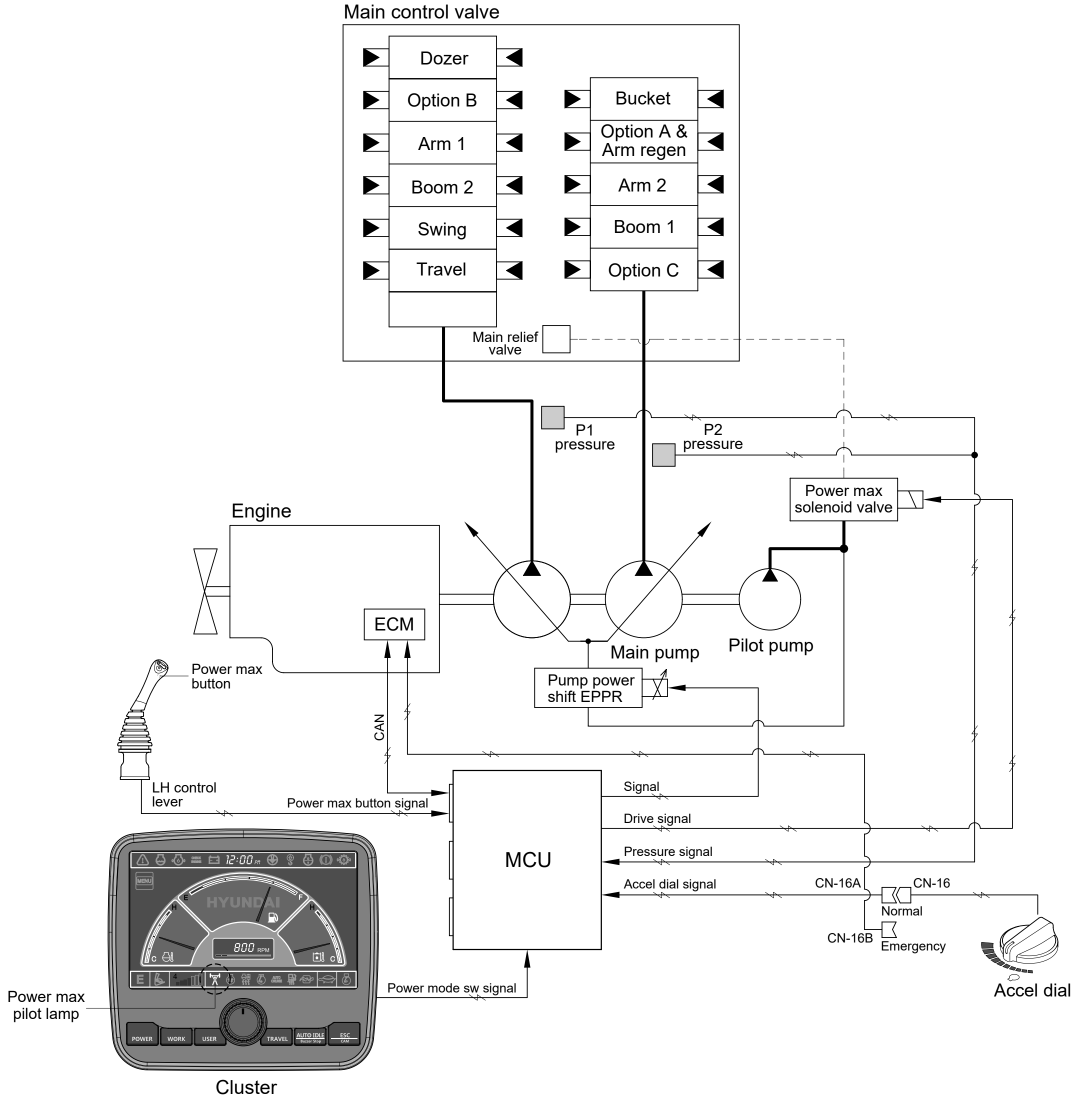


2. WHEN AUTO IDLE PILOT LAMP OFF

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

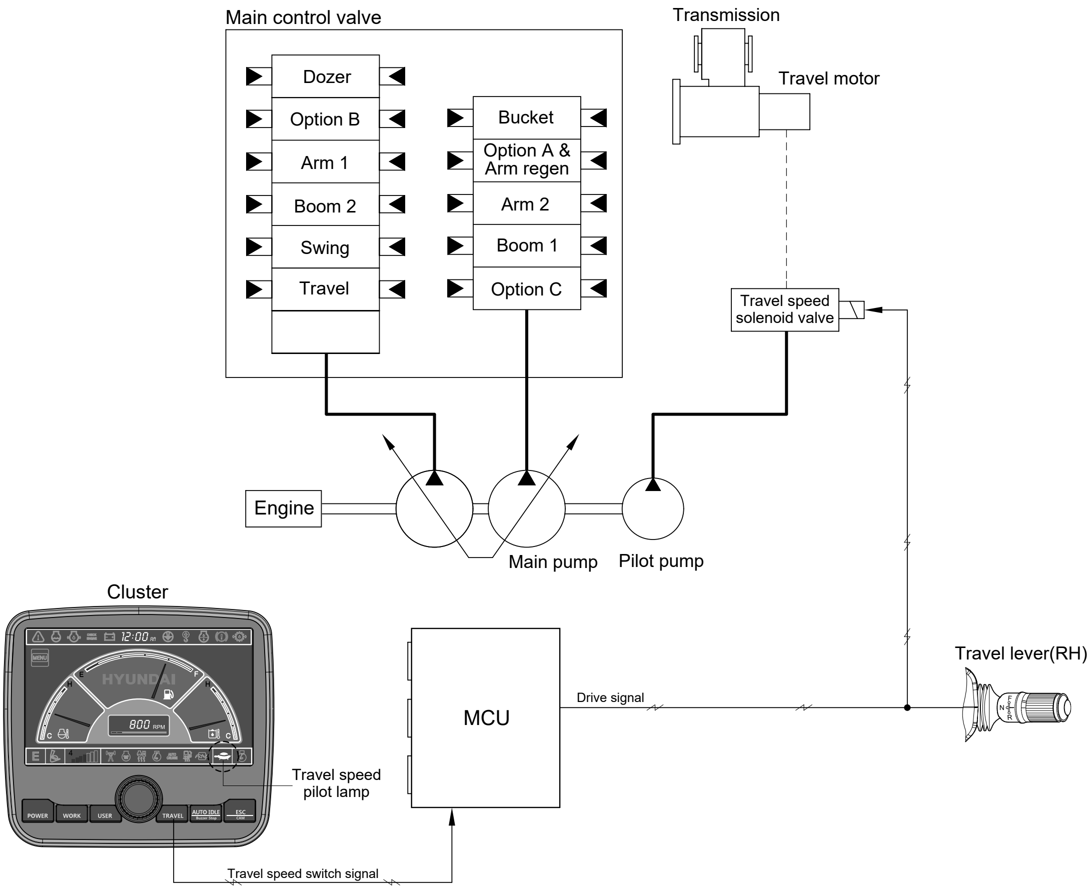


- When the power boost switch on the left control lever knob is pushed ON, the power mode is set P mode and maximum digging power is increased by 10 %.
- When the power boost function is activated, the power boost solenoid valve pilot pressure raises the set pressure of the main relief valve to increase 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

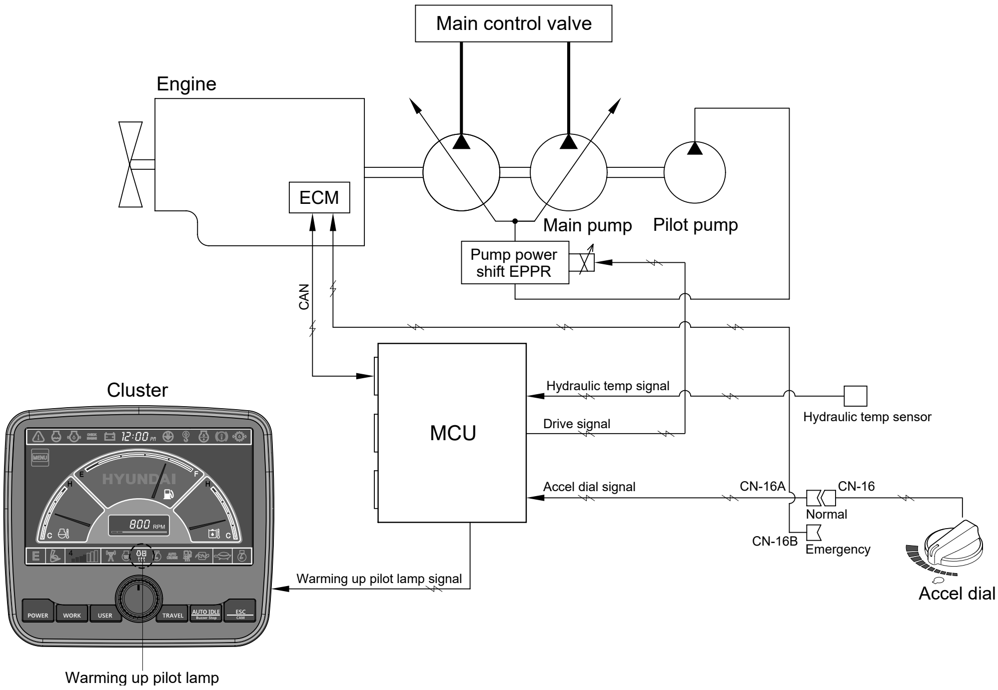


Travel speed can be switched manually by turning the travel speed switch on the RH multifunction switch.

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

※ Default : Turtle (Low)

GROUP 6 AUTOMATIC WARMING UP SYSTEM



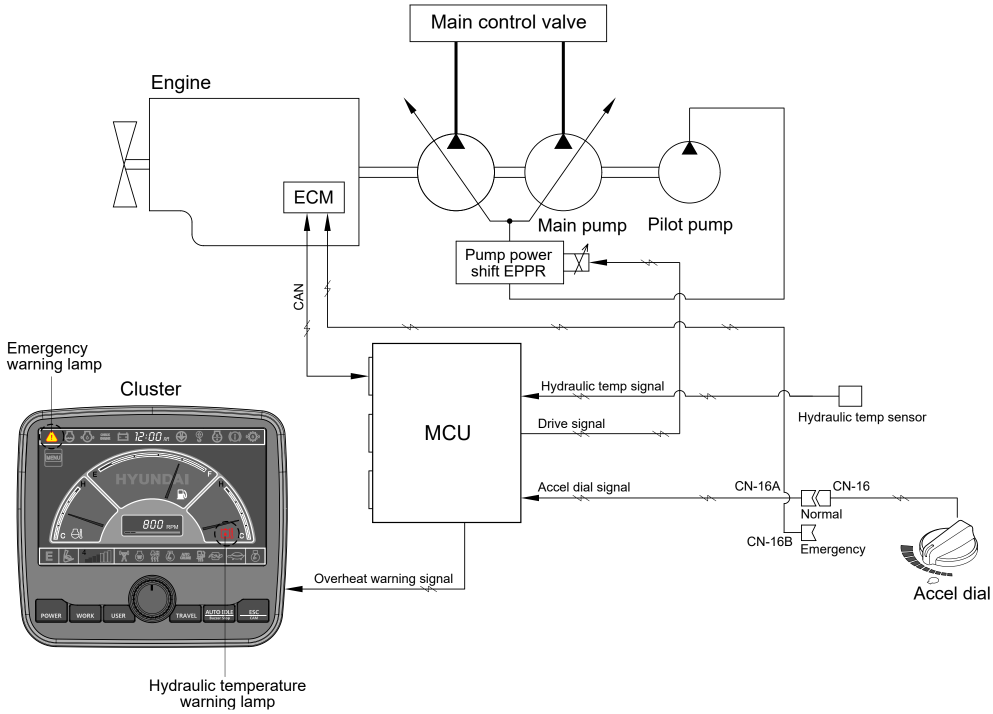
1. The MCU receives the engine coolant temperature from the ECM, and if the coolant temperature is below 30°C, it increases the engine speed from key start rpm to 1000 rpm. At this time the mode does not change. If the coolant temperature sensor has fault, the hydraulic oil temperature signal is substituted.

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

3. LOGIC TABLE

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

GROUP 7 ENGINE OVERHEAT PREVENTION SYSTEM

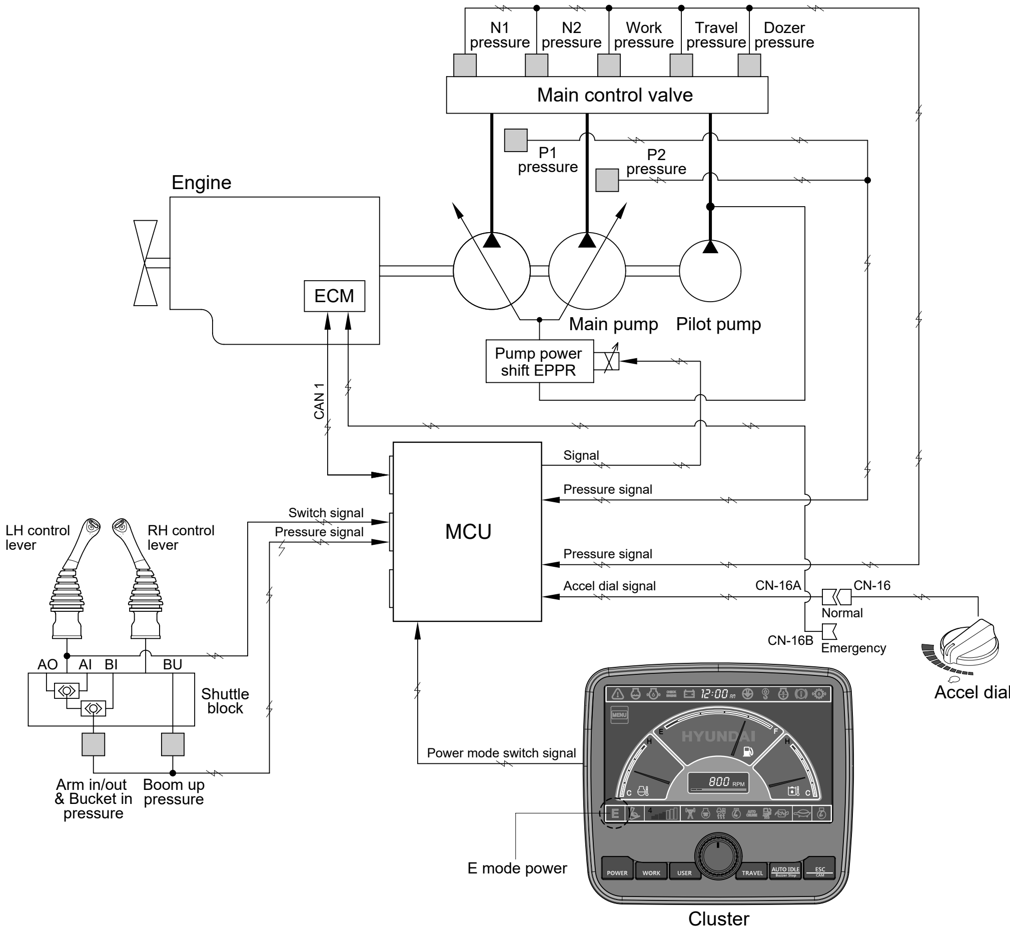


1. If the engine coolant temperature or the hydraulic oil temperature is overheated over 100°C, the warning lamp is ON and the pump input torque or the engine speed is reduced as below logic table.

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 or hydraulic oil temperature : Above 105°C	- Emergency warning lamp pops up on the center of LCD and the buzzer sounds. - Engine speed is reduced after 10 seconds.
	Canceled	- Coolant temperature : Less than 103°C - Hydraulic oil temperature : Less than 100°C	- Return to pre-set the engine speed. - Hold pump absorption torque on the first step warning.

GROUP 8 VARIABLE POWER CONTROL SYSTEM

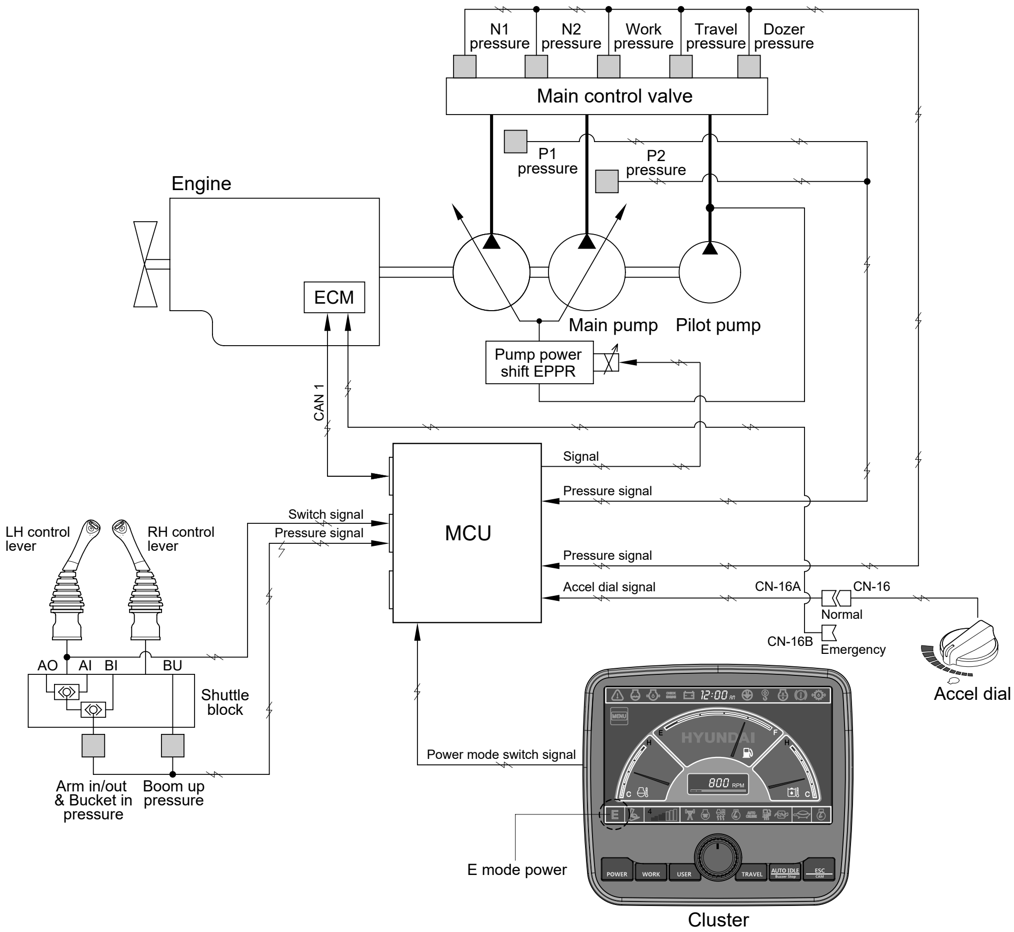


· The variable power control system controls the engine and pump mutual power according to RCV lever stroke and pump load.
It makes fuel saving and smooth control at precise work.

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

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

GROUP 9 ATTACHMENT FLOW CONTROL SYSTEM

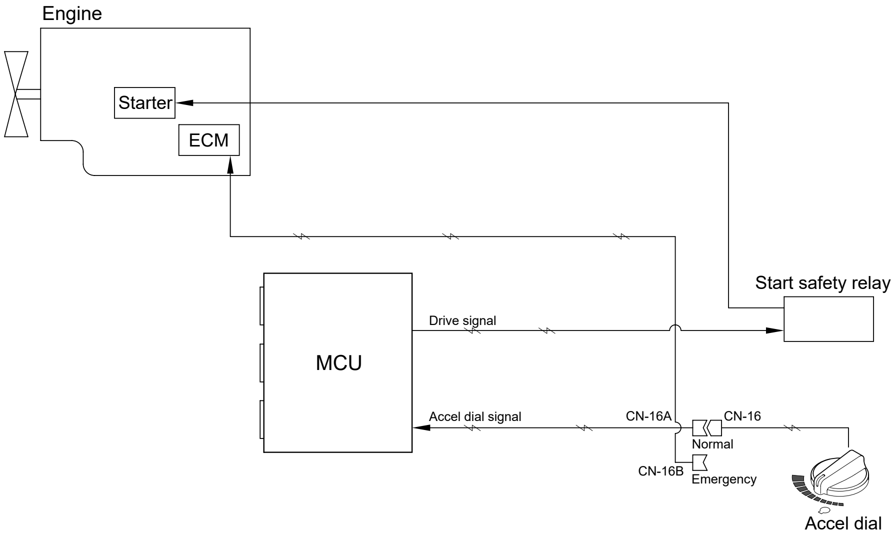


· The system is used to control the pump delivery flow according to set of the work tool on the cluster by the attachment flow EPPR valve.

Description	Work tool	
	Breaker	Crusher
Flow level	Max 7 step, reduced 10 lpm each step	Max 4 step, reduced 20 lpm each step
Attach safety solenoid	ON	ON
Attach pressure solenoid	OFF	ON
Attach conflux solenoid	OFF	ON/OFF

※ Refer to the page 5-45 for the attachment kinds and max flow.

GROUP 10 ANTI-RESTART SYSTEM



1. ANTI-RESTART FUNCTION

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

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

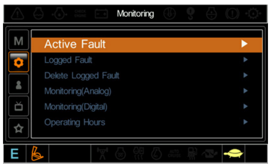
GROUP 11 SELF-DIAGNOSTIC SYSTEM

1. OUTLINE

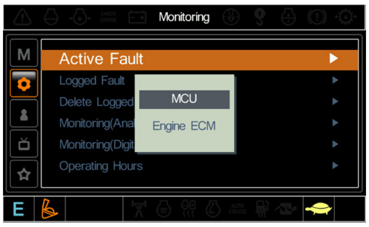
When any abnormality occurs in the NEW CAPO system caused by electric parts malfunction and by open or short circuit, the MCU diagnoses the problem and sends the error codes to the cluster and also stores them in the memory.

2. MONITORING

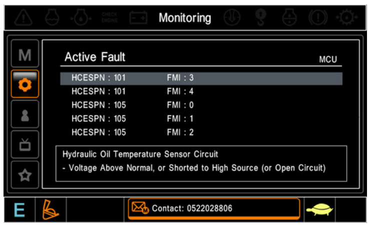
1) Active fault



21093CD66



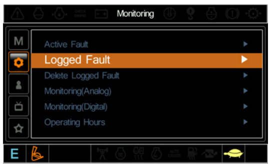
21093CD66A



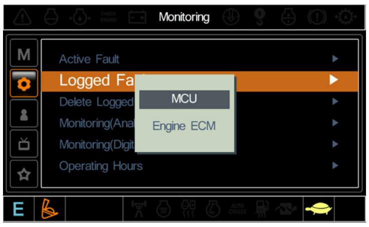
21093CD66B

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

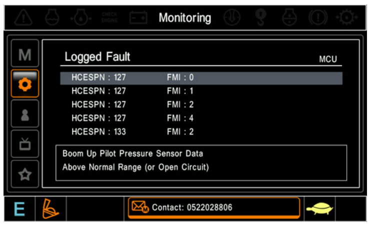
2) Logged fault



21093CD66C



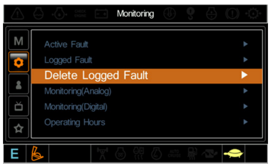
21093CD66D



21093CD66E

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

3) Delete fault



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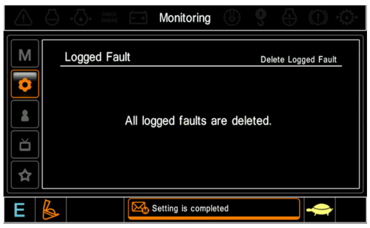

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· The logged faults of the MCU or engine ECM can be deleted by this menu.

3. MACHINE ERROR CODES TABLE

Error code		Description
HCESPN	FMI	
101	3	Hydraulic oil temperature sensor circuit - Voltage above normal, or shorted to high source.
	4	Hydraulic oil temperature circuit - Voltage below normal, or shorted to low source.
105	0	Working pressure sensor data above normal range.
	1	Working pressure sensor data below normal range.
	2	Working pressure sensor data error.
	4	Working pressure sensor circuit - Voltage below normal, or shorted to Low source.
108	0	Travel oil pressure sensor data above normal range.
	1	Travel oil pressure sensor data below normal range.
	2	Travel oil pressure sensor data error.
	4	Travel oil pressure sensor circuit - Voltage below normal, or shorted to low source.
120	0	Main pump 1 (P1) pressure sensor data above normal range.
	1	Main pump 1 (P1) pressure sensor data below normal range.
	2	Main pump 1 (P1) pressure sensor data error.
	4	Main pump 1 (P1) pressure sensor circuit - Voltage below normal, or shorted to low source.
121	0	Main pump 2 (P2) pressure sensor data above normal range.
	1	Main pump 2 (P2) pressure sensor data below normal range.
	2	Main pump 2 (P2) pressure sensor data error.
	4	Main pump 2 (P2) pressure sensor circuit - Voltage below normal, or shorted to low source.
122	0	Overload pressure sensor data above normal range.
	1	Overload pressure sensor data below normal range.
	2	Overload pressure sensor data error.
	4	Overload pressure sensor circuit - Voltage below normal, or shorted to low source.
123	0	Negative 1 pressure sensor data above normal range.
	1	Negative 1 pressure sensor data below normal range.
	2	Negative 1 pressure sensor data error.
	4	Negative 1 pressure sensor circuit - Voltage below normal, or shorted to low source.
124	0	Negative 2 Pressure sensor data above normal range.
	1	Negative 2 Pressure sensor data below normal range.
	2	Negative 2 Pressure sensor data error.
	4	Negative 2 Pressure sensor circuit - Voltage below normal, or shorted to low source.
125	0	Pilot pump (P3) pressure sensor data above normal range.
	1	Pilot pump (P3) pressure sensor data below normal range.
	2	Pilot pump (P3) pressure sensor data error.
	4	Pilot pump (P3) pressure sensor circuit - Voltage below normal, or shorted to low source.
127	0	Boom up pilot pressure sensor data above normal range.
	1	Boom up pilot pressure sensor data below normal range.
	2	Boom up pilot pressure sensor data error.
	4	Boom up pilot pressure sensor circuit - Voltage below normal, or shorted to low source.
133	0	Arm in/out & bucket in pilot pressure sensor data above normal range.
	1	Arm in/out & bucket in pilot pressure sensor data below normal range.
	2	Arm in/out & bucket in pilot pressure sensor data error.
	4	Arm in/out & bucket in pilot pressure sensor circuit - Voltage below normal, or shorted to low source.

Error code		Description
HCESPN	FMI	
135	0	Swing pilot pressure sensor data above normal range.
	1	Swing pilot pressure sensor data below normal range.
	2	Swing pilot pressure sensor data error.
	4	Swing pilot pressure sensor circuit - Voltage below normal, or shorted to low source.
138	0	Attachment pilot pressure sensor data above normal range.
	1	Attachment pilot pressure sensor data below normal range.
	2	Attachment pilot pressure sensor data error.
	4	Attachment pilot pressure sensor circuit - Voltage below normal, or shorted to low source.
140	5	Pump EPPR valve circuit - Current below normal, or open circuit.
	6	Pump EPPR valve circuit - Current above normal.
141	5	Boom priority EPPR valve circuit - Current below normal, or open circuit.
	6	Boom priority EPPR valve circuit - Current above normal.
143	5	Travel EPPR valve circuit - Current below normal, or open circuit.
	6	Travel EPPR valve circuit - Current above normal.
144	5	Attachment flow EPPR valve circuit - Current below normal, or open circuit.
	6	Attachment flow EPPR valve circuit - Current above normal.
145	5	Remote cooling fan EPPR valve circuit - Current below normal, or open circuit.
	6	Remote cooling fan EPPR valve circuit - Current above normal.
150	5	Left rotate EPPR valve circuit - Current below normal, or open circuit.
	6	Left rotate EPPR valve circuit - Current above normal.
151	5	Right rotate EPPR valve circuit - Current below normal, or open circuit.
	6	Right rotate EPPR valve circuit - Current above normal.
152	5	Left tilt EPPR valve circuit - Current below normal, or open circuit.
	6	Left tilt EPPR valve circuit - Current above normal.
153	5	Right tilt EPPR valve circuit - Current below normal, or open circuit.
	6	Right tilt EPPR valve circuit - Current above normal.
166	5	Power max solenoid circuit - Current below normal, or open circuit.
	6	Power max solenoid circuit - Current above normal.
167	5	Travel speed solenoid circuit - Current below normal, or open circuit.
	6	Travel speed solenoid circuit - Current above normal.
168	5	Attachment pressure solenoid circuit - Current below normal, or open circuit.
	6	Attachment pressure solenoid circuit - Current above normal.
169	5	Attachment conflux solenoid circuit - Current below normal, or open circuit.
	6	Attachment conflux solenoid circuit - Current above normal.
170	5	Arm regeneration solenoid circuit - Current below normal, or open circuit.
	6	Arm regeneration solenoid circuit - Current above normal.
171	5	Attachment safety solenoid circuit - Current below normal, or open circuit.
	6	Attachment safety solenoid circuit - Current above normal.
181	5	Remote cooling fan reverse solenoid circuit - Current below normal, or open circuit.
	6	Remote cooling fan reverse solenoid circuit - Current above normal.
301	3	Fuel level sensor circuit - Voltage above normal, or shorted to high source.
	4	Fuel level sensor circuit - Voltage below normal, or shorted to low source.
304	3	Engine coolant temperature sensor circuit - Voltage above normal, or shorted to high source.
	4	Engine coolant temperature sensor circuit - Voltage below normal, or shorted to low source.
310	8	Engine speed signal error - Abnormal frequency or pulse width.
322	3	Engine preheat relay circuit - Voltage above normal, or shorted to high source.
	4	Engine preheat relay circuit - Voltage below normal, or shorted to low source.
325	3	Fuel warmer relay circuit - Voltage above normal, or shorted to high source.
	4	Fuel warmer relay circuit - Voltage below normal, or shorted to low source.

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

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 that the primary engine speed sensor and the backup engine speed sensor signals are reversed.	Fueling to injectors is disabled and the engine can not be started.
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 has exceeded the maximum limit for the given engine rating.	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 circuit.	Severe derate in power output of the engine. Limp home power only.
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 signal circuit.	Severe derate in power output of the engine. Limp home power only.
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 circuit.	Remote accelerator will not operate. Remote accelerator position will be set to zero percent.
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. Remote accelerator position will be set to zero percent.
135 100 3	Engine oil rifle pressure 1 sensor circuit - Voltage above normal, or shorted to high source. High signal voltage detected at the engine oil pressure circuit.	None on performance. No engine protection for oil pressure.
141 100 4	Engine oil rifle pressure 1 sensor circuit - Voltage below normal, or shorted to low source. Low signal voltage detected at engine oil pressure circuit.	None on performance. No engine protection for oil pressure.
143 100 18	Engine oil rifle pressure - Data valid but below normal operational range - Moderately severe level.	None on performance.
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.	Possible white smoke. Fan will stay ON if controlled by ECM. No engine protection for engine coolant temperature.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
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.	Possible white smoke. Fan will stay ON if controlled by ECM. No engine protection for engine coolant temperature.
146 110 16	Engine Coolant Temperature - Data Valid but Above Normal Operational Range - Moderately Severe Level. Engine coolant temperature signal indicates engine coolant temperature is above engine protection warning limit.	Progressive power derate increasing in severity from time of alert.
147 91 1	Accelerator Pedal or Lever Position 1 Sensor Circuit Frequency - Data Valid but Below Normal Operational Range - Most Severe Level. A frequency of less than 100 Hz has been detected at the frequency throttle input to the ECM.	Severe derate in power output of the engine. Limp home power only.
148 91 0	Accelerator Pedal or Lever Position Sensor 1 - Data Valid but Above Normal Operational Range - Most Severe Level. A frequency of more than 1500 Hz has been detected at the frequency throttle input to the ECM.	Severe derate in power output of the engine. Limp home power only.
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 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.
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.	Possible white smoke. Fan will stay ON if controlled by ECM. No engine protection for intake manifold air temperature.
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.	Possible white smoke. Fan will stay ON if controlled by ECM. No engine protection for intake manifold air temperature.
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 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.
187 520195 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.
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.	None on performance.
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.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
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 520195 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.	Fuel injection disabled until engine speed falls below the overspeed limit.
235 111 1	Coolant Level - Data Valid but Below Normal Operational Range - Most Severe Level. Low engine coolant level detected.	Progressive power 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.
237 644 2	External Speed Command Input (Multiple Unit Synchronization) - Data Erratic, Intermittent, or Incorrect. Communication between multiple engines may be intermittent.	
238 520196 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.	Possible hard starting and rough running.
241 84 2	Wheel-based vehicle speed - Data erratic, intermittent, or incorrect. The ECM lost the vehicle speed signal.	Engine speed limited to ,maximum engine speed without VSS parameter value. Cruise control, gear-down protection, and road speed governor will not work.
242 84 10	Wheel-based vehicle speed sensor circuit tampering has been detected - Abnormal rate of change. Signal indicates an intermittent connection or VSS tampering.	Engine speed limited to maximum engine speed without VSS parameter value. Cruise control, gear-down protection, and road speed g+H53overnor 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.
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 will run poorly at idle. Engine will have low power. Fuel pressure will be higher than commanded.
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 will not run or engine will run poorly.
281 1347 7	Fuel pump pressurizing assembly 1 - Mechanical system not responding properly or out of adjustment.	Engine will not run or possible low power.
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.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
287 91 19	SAE J1939 multiplexed accelerator pedal or lever sensor system - received network data In error. The OEM vehicle electronic control unit (VECM) detected a fault with its accelerator pedal.	Engine may only idle or engine will not accelerate to full speed.
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.	The engine will not respond to the remote throttle. Engine may only idle. The primary or cab accelerator may be able to be used.
292 441 14	Auxiliary temperature Sensor Input 1 - Special instructions.	Possible engine power derate.
293 441 3	Auxiliary temperature sensor input 1 circuit - Voltage above normal, or shorted to high source. High signal voltage or open circuit detected at the OEM auxiliary temperature circuit.	None on performance.
294 441 4	Auxiliary temperature sensor input 1 circuit - Voltage below normal, or shorted to low source. Low signal voltage detected at the OEM auxiliary temperature circuit.	None on performance.
296 1388 14	Auxiliary pressure sensor input 1 - Special instructions.	Possible engine power derate.
297 1388 3	Auxiliary pressure sensor input 1 circuit - Voltage above normal, or shorted to high source. High signal voltage detected at the OEM pressure circuit.	None on performance.
298 1388 4	Auxiliary pressure sensor input 1 circuit - Voltage below normal, or shorted to low source. Low signal voltage or open circuit detected at the OEM pressure circuit.	None on performance.
319 251 2	Real time clock power interrupt - Data erratic, intermittent, or incorrect. Real time clock lost power.	None on performance. Data in the ECM will not have accurate time and date information.
322 651 5	Injector solenoid driver cylinder 1 circuit - Current below normal, or open circuit. High resistance detected on injector number 1 circuit or no current detected at number 1 injector driver or return pin when the voltage supply at the harness is on.	Engine can possibly misfire or run rough.
323 655 5	Injector solenoid driver cylinder 5 circuit - Current below normal, or open circuit. High resistance detected on injector number 5 circuit or no current detected at number 5 injector driver or return pin when the voltage supply at the harness is on.	Engine can possibly misfire or run rough.
324 653 5	Injector solenoid driver cylinder 3 circuit - Current below normal, or open circuit. High resistance detected on injector number 3 circuit or no current detected at number 3 injector driver or return pin when the voltage supply at the harness is on.	Engine can possibly misfire or run rough.
325 656 5	Injector solenoid driver cylinder 6 circuit - Current below normal, or open circuit. High resistance detected on injector number 6 circuit or no current detected at number 6 injector driver or return pin when the voltage supply at the harness is on.	Engine can possibly misfire or run rough.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
331 652 5	Injector solenoid driver cylinder 2 circuit - Current below normal, or open circuit. High resistance detected on injector number 2 circuit or no current detected at number 2 injector driver or return pin when the voltage supply at the harness is on.	Engine can possibly misfire or run rough.
332 654 5	Injector solenoid driver cylinder 4 circuit - Current below normal, or open circuit. High resistance detected on injector number 4 circuit or no current detected at number 4 injector driver or return pin when the voltage supply at the harness is on.	Engine can possibly misfire or run rough.
334 110 2	Engine coolant temperature - Data erratic, intermittent, or incorrect. The engine coolant temperature reading is not changing with engine operating conditions.	The ECM will estimate engine coolant temperature.
342 630 13	Electronic calibration code incompatibility - Out of calibration. An incompatible calibration has been detected in the ECM.	Possible no noticeable performance effects, engine dying, or hard starting.
343 620 12	Engine control module warning internal hardware failure - Bad intelligent device or component. Internal ECM failure.	No performance effects or possible severe power derate.
351 627 12	Injector power supply - Bad intelligent device or component. The ECM measured injector boost voltage is low.	Possible smoke, low power, engine misfire, and/or engine will not start.
352 1079 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.
386 1079 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 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.	Possible white smoke, loss of power, or hard starting.
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.
429 97 4	Water in fuel indicator sensor circuit - Voltage below normal, or shorted to low source. Low voltage detected at the water in fuel circuit.	None on performance. No water in fuel warning available.
431 558 2	Accelerator pedal or lever idle validation switch - Data erratic, intermittent, or incorrect. Voltage detected simultaneously on both idle validation and off-idle validation switches.	Engine will only idle.
432 558 13	Accelerator pedal or lever idle validation circuit - Out of calibration. Voltage at idle validation on-idle and off-idle circuit does not match accelerator pedal position.	Engine will only idle.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
435 100 2	Engine oil rifle pressure - Data erratic, intermittent, or incorrect. An error in the engine oil pressure switch signal was detected by the ECM.	None on performance. No engine protection for oil pressure.
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 stop running or 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.	Possible electrical damage to all electrical components.
449 157 0	Injector metering rail 1 pressure - Data valid but above normal operational range - Most severe level.	None or possible engine noise associated with higher injection pressures (especially at idle or light load). Engine power is reduced.
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.
488 157 16	Intake manifold 1 temperature - Data valid but above normal operational range - Moderately severe level. Intake manifold air temperature signal indicates intake manifold air temperature is above the engine protection warning limit.	Progressive power derate increasing in severity from time of alert.
497 1377 2	Multiple unit synchronization switch - Data erratic, intermittent, or incorrect.	
523 611 2	Auxiliary intermediate (PTO) speed switch validation - Data erratic, intermittent, or incorrect.	None on performance.
527 702 3	Auxiliary input/output 2 circuit - Voltage above normal, or shorted to high source. High signal voltage or open circuit has been detected at the auxiliary input/output 2 circuit.	None on performance.
528 93 2	Auxiliary alternate torque validation switch - Data erratic, intermittent, or incorrect.	None on performance.
529 703 3	Auxiliary input/output 3 circuit - Voltage above normal, or shorted to high source. Low signal voltage has been detected at the auxiliary input/output 2 circuit.	
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.	The ECM will estimate fuel pressure and power is reduced.
554 157 2	Injector metering rail 1 pressure - Data erratic, Intermittent, or incorrect. The ECM has detected that the fuel pressure signal is not changing.	Possibly hard to start, low power, or engine smoke.

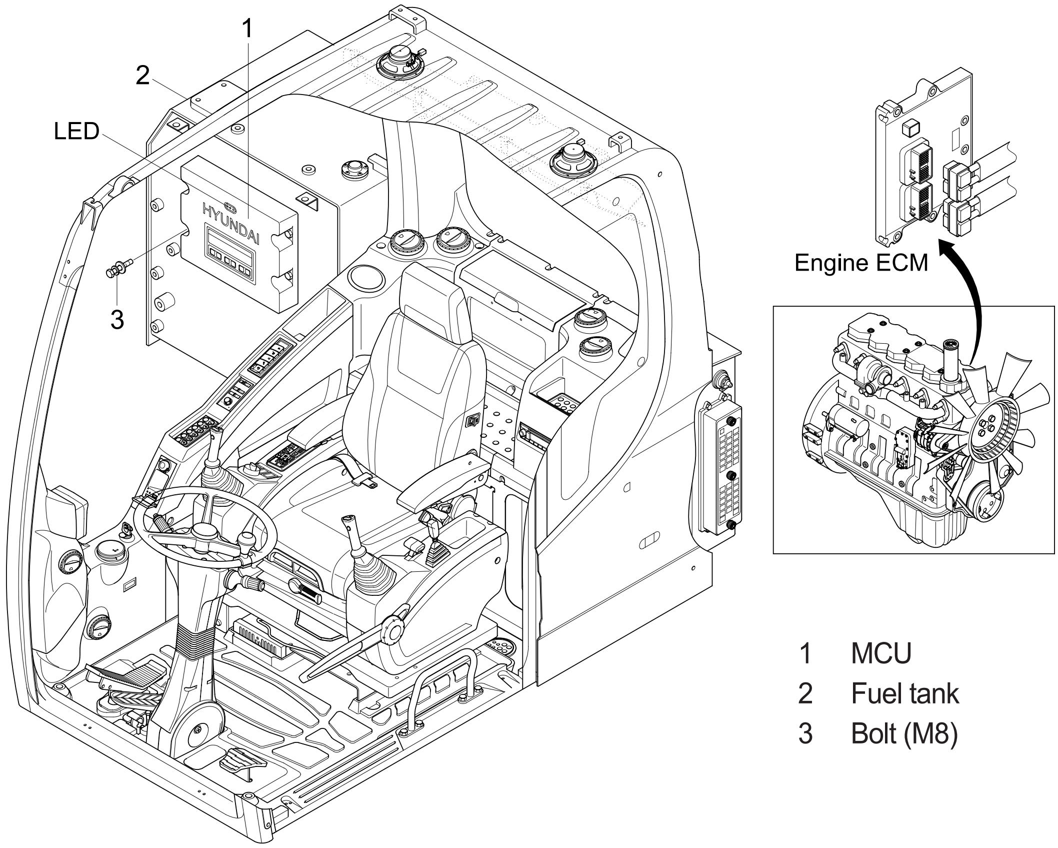
Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
559 157 18	Injector metering rail 1 pressure - Data Valid but Below Normal Operational Range - Moderately Severe Level. The ECM has detected that fuel pressure is lower than commanded pressure.	Either the engine will not start or the engine will not have starter lockout protection.
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.	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.	Engine power derate. The ECM uses an estimated turbocharger speed.
595 103 16	Turbocharger 1 speed - Data valid but above normal operational range - Moderately severe level. High turbocharger speed has been detected.	Amber lamp will light until high battery voltage condition is corrected.
599 640 14	Auxiliary commanded dual output shutdown - Special instructions.	None or possible engine noise associated with higher injection pressures (especially at idle or light load). Engine power is reduced.
687 103 18	Turbocharger 1 speed - Data valid but below normal operational range - Moderately severe level. Low turbocharger speed detected by the ECM.	Engine can run rough. Possibly poor starting capability. Engine runs using backup speed sensor. Engine power is reduced.
689 190 2	Engine crankshaft speed/position - Data erratic, intermittent, or incorrect. Loss of signal from crankshaft sensor.	Engine power derate.
691 1172 3	Turbocharger 1 compressor inlet temperature 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 tempera	Engine will run derated. Excessive black smoke, hard start, and rough idle possible.
731 723 7	Engine speed / position camshaft and crankshaft misalignment - Mechanical system not responding properly or out of adjustment. mechanical misalignment between the crankshaft and camshaft engine speed sensors.	Possible no noticeable performance effects, engine dying, or hard starting.
757 611 31	Electronic control module data lost - Condition exists. Severe loss of data from the ECM.	Possible poor starting. Engine power derate.
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 engine power derate.
779 703 11	Auxiliary equipment sensor input 3 - Root cause not known.	Possible no noticeable performance effects or engine dying or hard starting. Fault information, trip information, and maintenance monitor data may be inaccurate.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
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).	Engine will shut down.
1633 625 2	OEM datalink cannot transmit - Data erratic, intermittent, or incorrect. Communications within the OEM datalink network is intermittent.	Engine will only idle.
2185 520197 3	Sensor supply 4 circuit - Voltage above normal, or shorted to high source. High voltage detected at +5 volt sensor supply circuit to the accelerator pedal position sensor.	Engine will only idle.
2186 520197 4	Sensor supply 4 circuit - Voltage below normal, or shorted to low source. Low voltage detected at +5 volt sensor supply circuit to the accelerator pedal position sensor.	Possibly hard to start, low power, or engine smoke.
2249 157 1	Injector metering rail 1 pressure - Data valid but below normal operational range - Most severe level. The ECM has detected that fuel pressure is lower than commanded pressure.	Engine may be difficult to start.
2265 1075 3	Electric lift pump for engine fuel supply circuit - Voltage above normal, or shorted to high source. High voltage or open detected at the fuel lift pump signal circuit.	Engine may be difficult to start.
2266 1075 4	Electric lift pump for engine fuel supply circuit - Voltage below normal, or shorted to low source. Low signal voltage detected at the fuel lift pump circuit.	Possible low power.
2311 633 31	Electronic fuel injection control valve circuit - Condition exists. Fuel pump actuator circuit resistance too high or too low.	Engine may exhibit misfire as control switches from the primary to the backup speed sensor. Engine power is reduced while the engine operates on the backup speed sensor.
2321 190 2	Engine crankshaft speed/position - Data erratic, intermittent, or incorrect. crankshaft engine speed sensor intermittent synchronization.	Possible low power.
2322 723 2	Engine camshaft speed / position sensor - Data erratic, intermittent, or incorrect. Camshaft engine speed sensor intermittent synchronization.	Engine power derate.
2345 103 10	Turbocharger 1 Speed - Abnormal rate of change. The turbocharger speed sensor has detected an erroneous speed value.	Engine power derate.
2346 2789 15	Turbocharger turbine inlet temperature (Calculated) - Data valid but above normal operational range - Least severe level. Turbocharger turbine inlet temperature has exceeded the engine protection limit.	Engine power derate.
2347 2790 15	Turbocharger compressor outlet temperature (Calculated) - Data valid but above normal operational range - Least severe level.	Engine brake on cylinders 1, 2, and 3 can not be activated or exhaust brake will not operate.
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.	Variable geometry turbocharger will go to the open position.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
2384 641 4	VGT actuator driver circuit - Voltage below normal, or shorted to low source. Low voltage detected at turbocharger control valve circuit.	Variable geometry turbocharger may be in either the open or closed position.
2385 641 3	VGT actuator driver circuit - Voltage above normal, or shorted to high source. Open circuit or high voltage detected at turbocharger control valve circuit.	The intake air heaters may be ON or OFF all the time.
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.	Can not control transmission.
2557 697 3	Auxiliary PWM driver 1 circuit - Voltage above normal, or shorted to high source. High signal voltage detected at the analog torque circuit.	Can not control transmission.
2558 697 4	Auxiliary PWM driver 1 circuit - Voltage below normal, or shorted to low source. Low signal voltage detected at the analog torque circuit.	Power derate and possible engine shutdown if engine protection shutdown feature is enabled.
2973 102 2	Intake manifold 1 pressure - Data erratic, intermittent, or incorrect. The ECM has detected an intake manifold pressure signal that is too high or low for current engine operating conditions.	

GROUP 12 ENGINE CONTROL SYSTEM

1. MCU and Engine ECM (Electronic Control Module)



2. MCU ASSEMBLY

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

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

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

G : green, R : red, Y : yellow

GROUP 13 EPPR VALVE

1. PUMP EPPR VALVE

1) COMPOSITION

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

(1) Electro magnet valve

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

(2) Spool valve

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

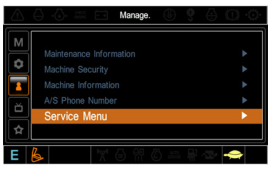
(3) Pressure and electric current value for each mode

Mode		Pressure		Electric current (mA)	Engine rpm (at accel dial 10)
		kgf/cm²	psi		
Standard (Stage : 1.0)	P	10 ± 3	142 ± 40	330 ± 30	1450 ± 50
	S	15 ± 3	213± 40	400 ± 30	1300 ± 50
	E	15 ± 3	213 ± 40	400 ± 30	1200 ± 50
Option (Stage : 2.0)	P	5 ± 3	71± 40	250 ± 30	1550 ± 50
	S	10 ± 3	142 ± 40	330 ± 30	1400 ± 50
	E	10 ± 3	142 ± 40	330 ± 30	1300 ± 50

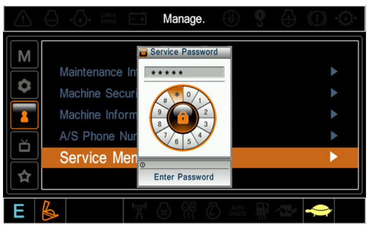
2) HOW TO SWITCH THE STAGE (1.0↔2.0) ON THE CLUSTER

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

- Management
  · Service menu

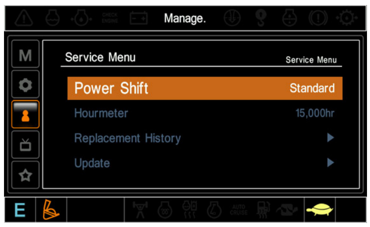


21093CD67M

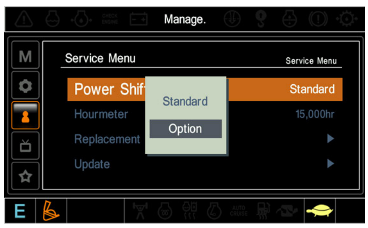


Enter the password

21093CD67N



21093CD67P

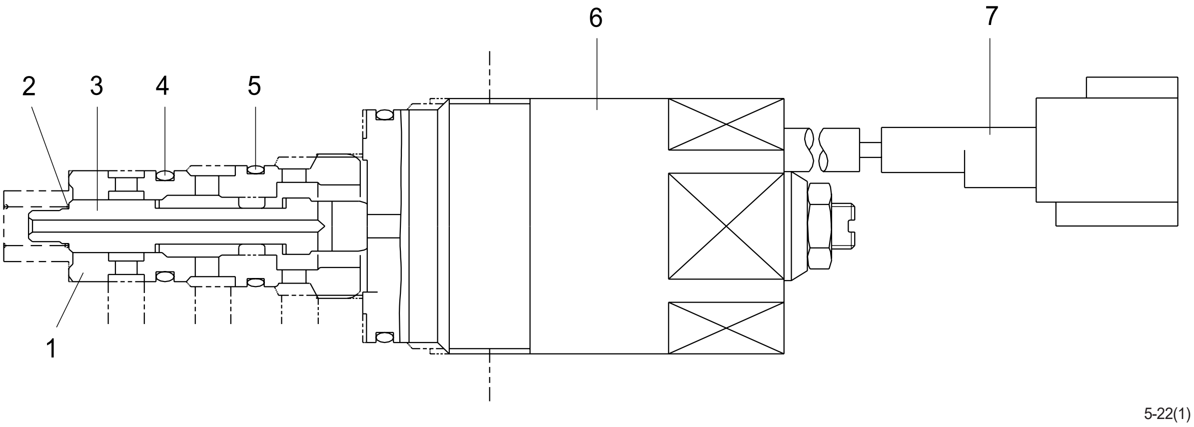


21093CD67ZZ

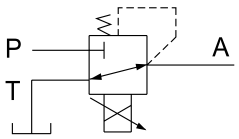
· Power shift (standard/option) : Power shift pressure can be set by option menu.

3) OPERATING PRINCIPLE (pump EPPR valve)

(1) Structure



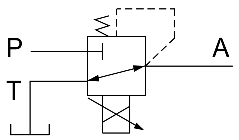
1	Sleeve	4	O-ring	6	Solenoid valve
2	Spring	5	O-ring	7	Connector
3	Spool				

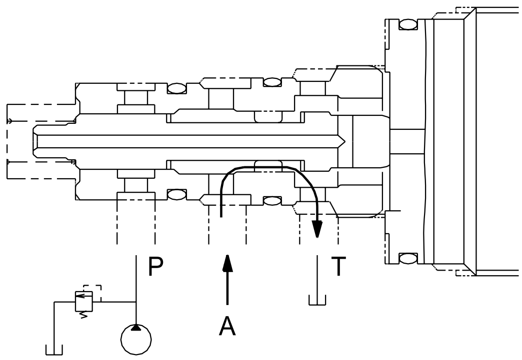


P Pilot oil supply line (pilot pressure)
T Return to tank
A Secondary pressure to flow regulator at main pump

(2) Neutral

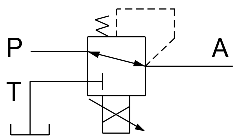
Pressure line is blocked and A oil returns to tank.

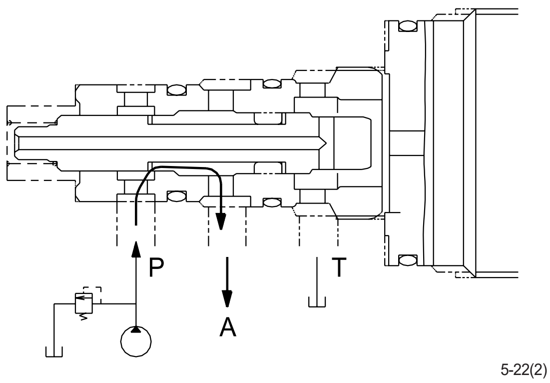




(3) Operating

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.

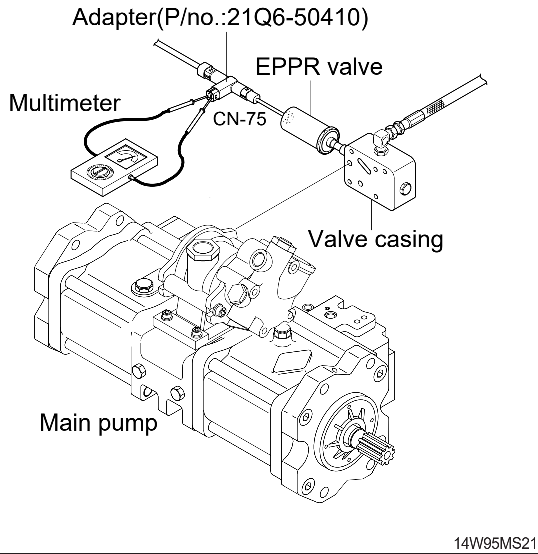
③ Start engine.

④ Set S-mode and cancel auto decel mode.

⑤ Position the accel dial at 10.

⑥ If rpm display show approx 1400±50 rpm check electric current at bucket circuit relief position.

Spec : 100~700 mA



(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.

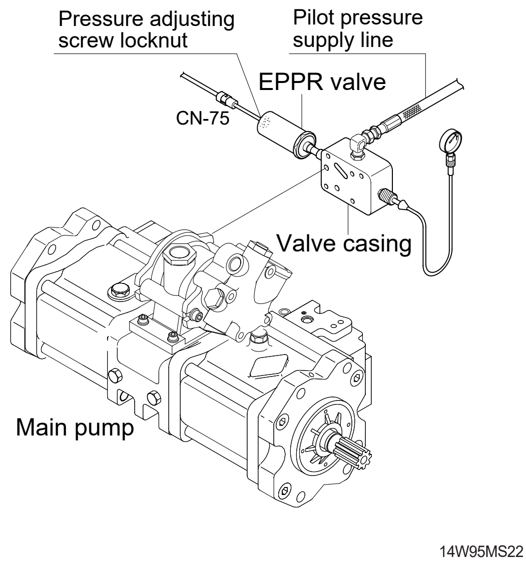
④ Position the accel dial at 10.

⑤ If rpm display show approx 1400±50 rpm check pressure at relief position of bucket circuit by operating bucket control lever.

⑥ If pressure is not correct, adjust it.

⑦ After adjust, test the machine.

Spec : 2~25 kgf/cm^2 (30~350 psi)



2. BOOM PRIORITY EPPR VALVE

1) COMPOSITION

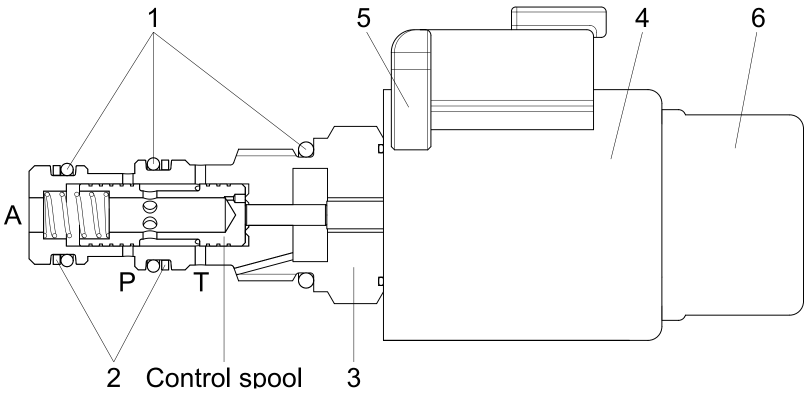
The boom priority EPPR valve is built in a manifold and mainly consisting of valve body and coil. This EPPR valve installed under the solenoid valve.

2) CONTROL

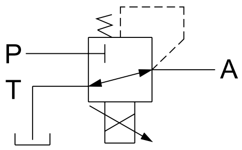
The boom priority EPPR valve has to be controlled by a specific electronic amplifier card, which is supplying the coil with a current 580 mA at 30 Ω and 24 V.

3) OPERATING PRINCIPLE

(1) Structure



21095MS14



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

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

(2) Operation

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

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

(3) Maximum pressure relief

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

2) EPPR VALVE CHECK PROCEDURE

(1) Check electric current value at EPPR valve

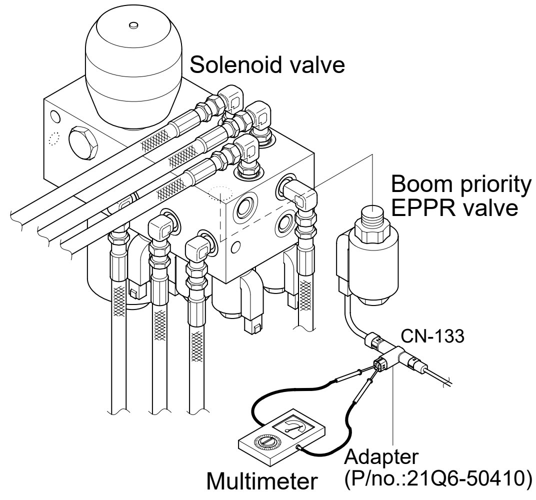
① Disconnect connector CN-133 from EPPR valve.

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

③ Start engine.

④ If rpm display approx 1400±50 rpm 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)

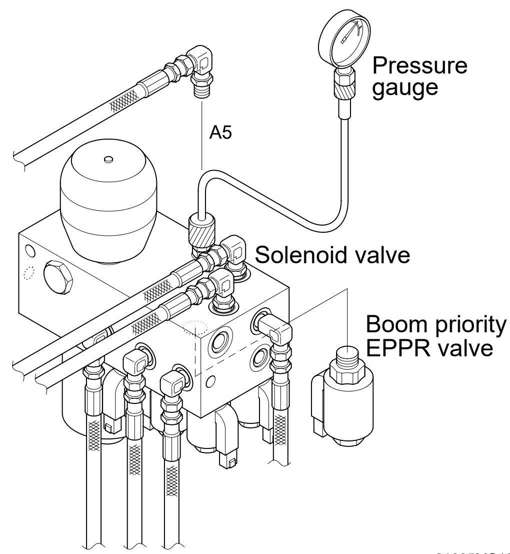
② Start engine.

③ If rpm display approx 1400±50 rpm check pressure at relief position of bucket circuit by operating bucket control lever.

④ If pressure is not correct, adjust it.

⑤ After adjust, test the machine.

Spec : 12~37 kgf/cm^2 (170~530 psi)
(bucket relief operation)



21095MS16

1. OUTLINE

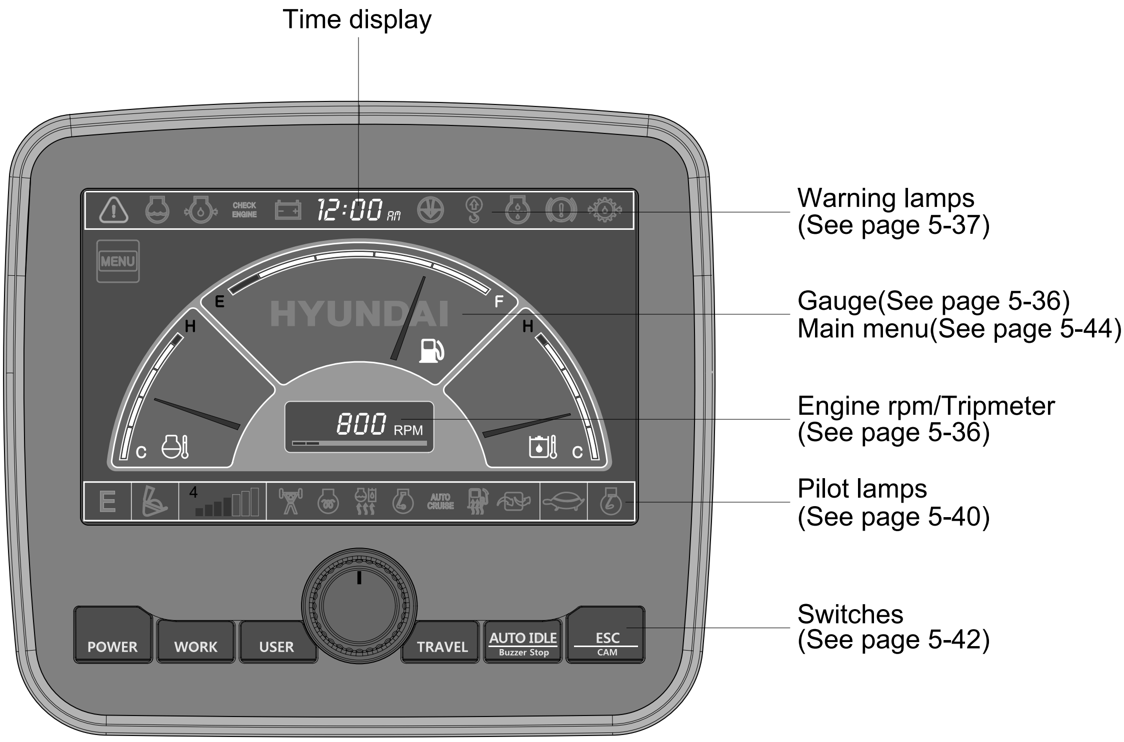
Monitoring system consists of the monitor part and switch part.

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



14W95MS30

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 to1000 rpm.

※ Others same as above.

③ When abnormal condition

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

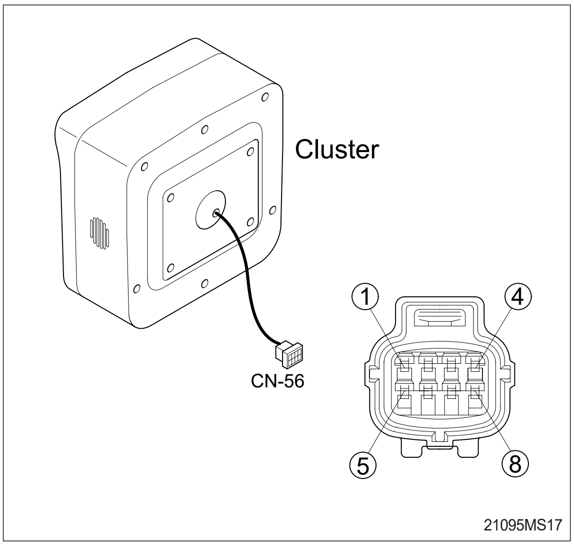
b. If BUZZER STOP switch is pressed, buzzer sound is canceled but the lamp warning lights up until normal condition.

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

3. CLUSTER CONNECTOR

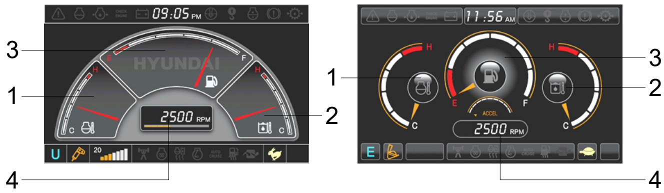
No.	Name	Signal
1	Battery 24V	20~32V
2	Signal 3	NTSC
3	GND	-
4	Serial + (TX)	0~5V
5	Power IG (24V)	20~32V
6	Signal 2	NTSC
7	Camera signal	NTSC
8	Serial - (RX)	0~5V

※ NTSC : the united states National Television Systems Committee



2) GAUGE

(1) Operation screen

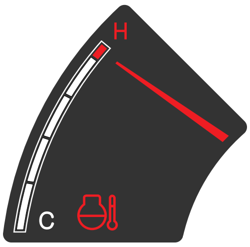


21093CD07A

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

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

(2) Engine coolant temperature gauge



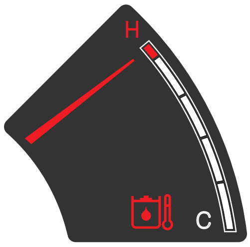
21093CD07G

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

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

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

(3) Hydraulic oil temperature gauge



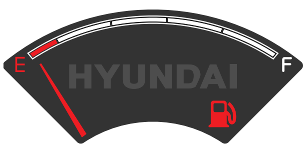
21093CD07E

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

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

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

(4) Fuel level gauge



21093CD07F

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

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

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

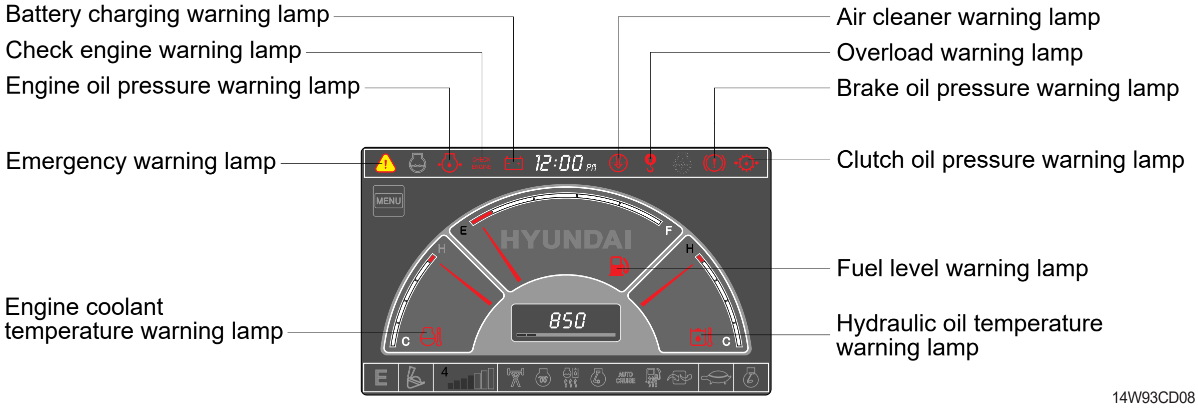
(5) RPM / Tripmeter display

21093CD02D

① This displays the engine speed or the tripmeter.

※ Refer to page 5-54 for details.

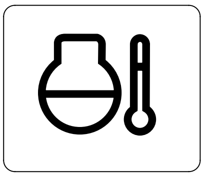
3) WARNING LAMPS



14W93CD08

※ Each warning lamp on the top of the LCD pops up on the center of LCD and the buzzer sounds when the each warning is happened. The pop-up warning lamp moves to the original position and blinks when the select switch is pushed. And the buzzer stops.
Refer to page 5-43 for the select switch.

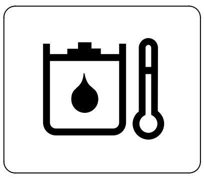
(1) Engine coolant temperature


21093CD08A

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

② The pop-up lamp moves to the original position and blinks when the select switch is pushed. Also, the buzzer stops and lamp keeps blink.
③ Check the cooling system when the lamp keeps ON.

(2) Hydraulic oil temperature


21093CD08C

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

② The pop-up lamp moves to the original position and blinks when the select switch is pushed. Also, the buzzer stops and lamp keeps blink.
③ Check the hydraulic oil level and hydraulic oil cooling system.

(3) Fuel level


21093CD08B

① This warning lamp blinks and the buzzer sounds when the level of fuel is below 31 ℓ (8.2 U.S. gal).
② Fill the fuel immediately when the lamp blinks.

(4) Emergency warning lamp

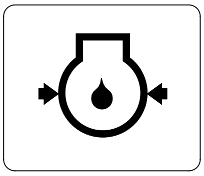
21093CD30

① This lamp pops up and the buzzer sounds when each of the below warnings is happened.
- Engine coolant overheating (over 107°C)
- Hydraulic oil overheating (over 105°C)
- Pump EPPR circuit abnormal or open
- Attachment flow EPPR circuit abnormal or open
- MCU input voltage abnormal
- Accel dial circuit abnormal or open
- Cluster communication data error
- Engine ECM communication data error

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

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

(5) Engine oil pressure warning lamp

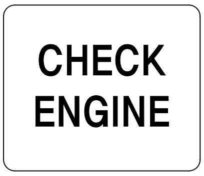


21093CD32

① This lamp blinks when the engine oil pressure is low.

② If the lamp blinks, shut OFF the engine immediately. Check oil level.

(6) Check engine warning lamp



21093CD33

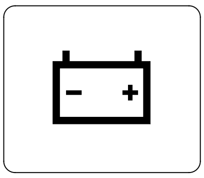
① This lamp blinks when the communication between MCU and engine ECM on the engine is abnormal, or if the cluster received any fault code from engine ECM.

② Check the communication line between them.
If the communication line is OK, then check the fault codes on the cluster.

29093CD03

③ This lamp blinks when "Engine check water in fuel" is displayed in the message box then check water separator.

(7) Battery charging warning lamp

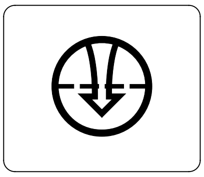


21093CD34

① This lamp blinks when the battery charging voltage is low.

② Check the battery charging circuit when this lamp blinks.

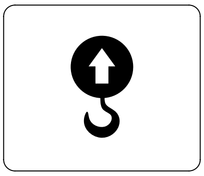
(8) Air cleaner warning lamp



21093CD35

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

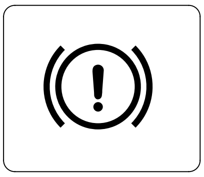
(9) Overload warning lamp (opt)



21093CD36

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

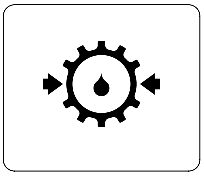
(10) Brake oil pressure warning lamp



14W93CD95

① This lamp blinks when the oil pressure of service brake drops below the normal range.
② Stop the engine and check for its cause.
※ Do not operate until any problems are corrected.

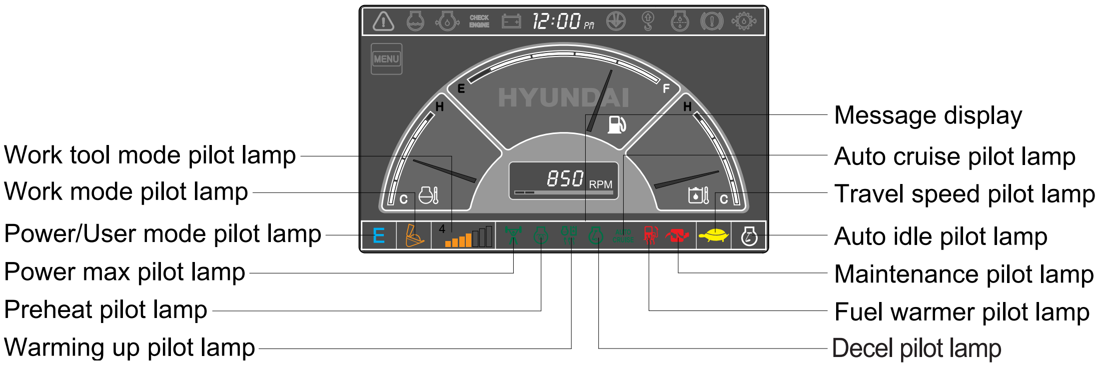
(11) Clutch oil pressure warning lamp



14W93CD96

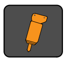
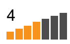
① This lamp blinks when the oil pressure of the transmission drops.
② Stop the engine and check the transmission system.

4) PILOT LAMPS

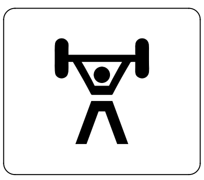


14W93CD09

(1) Mode pilot lamps

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

(2) Power max pilot lamp

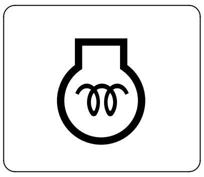

21093CD38

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 page operator's manual 3-26 for power max function.

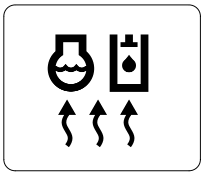
(3) Preheat pilot lamp



21093CD39

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

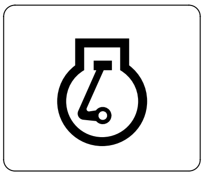
(4) Warming up pilot lamp



21093CD40

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.

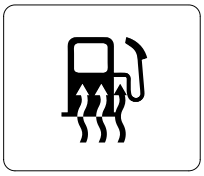
(5) Decel pilot lamp



21093CD41

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 3-26.**

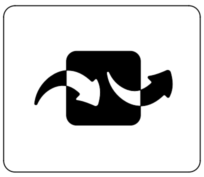
(6) Fuel warmer pilot lamp



21093CD43

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

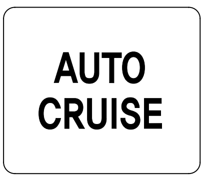
(7) Maintenance pilot lamp



21093CD44

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.

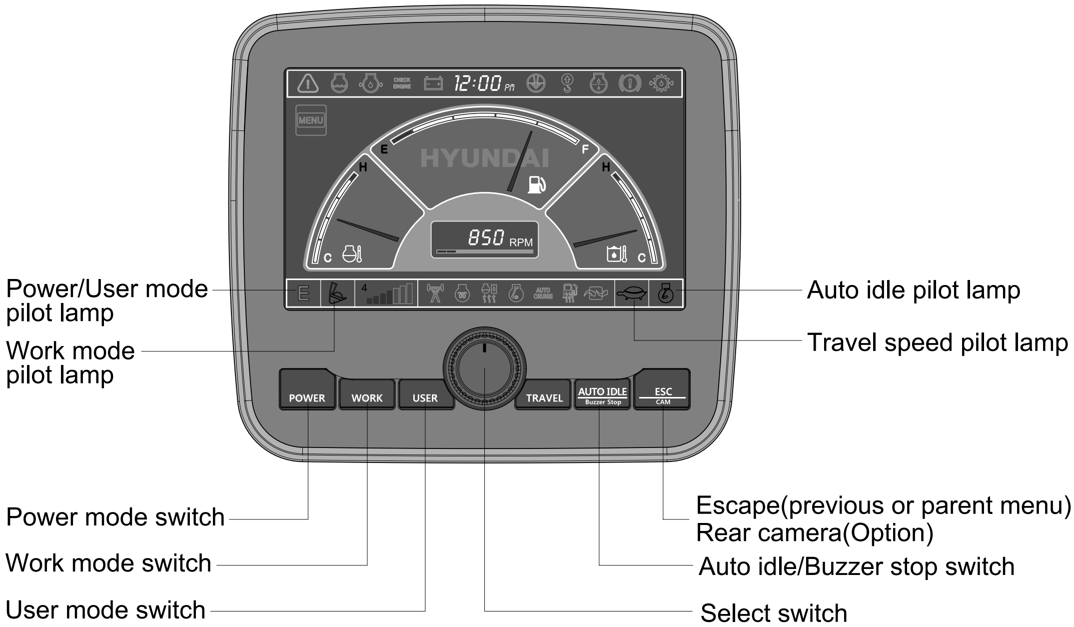
(8) Auto cruise pilot lamp



14W93CD42

① This lamp will be ON when pushing auto cruise switch end of the RH multifunction switch while forward high speed driving.
② The auto cruise function is keeped uniform motion traveling.

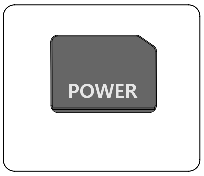
5) SWITCHES



14W93CD45

※ When the switches are selected, the pilot lamps are displayed on the LCD. Refer to the page 3-7 for details.

(1) Power mode switch

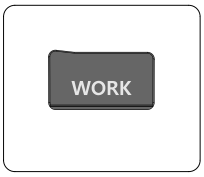


21093CD45A

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

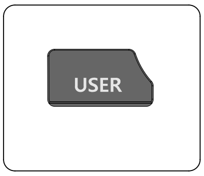


21093CD45C

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 4-6 for details.

(3) User mode switch

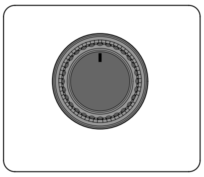


21093CD45D

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

② Refer to the page 5-45 for another set of user mode.

(4) Select switch



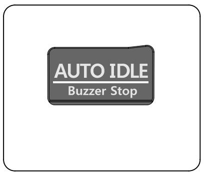
21093CD45E

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

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

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

(5) Auto idle/ buzzer stop switch

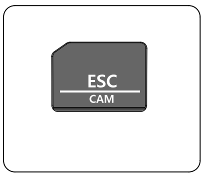


21093CD45F

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

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

(6) Escape/Camera switch



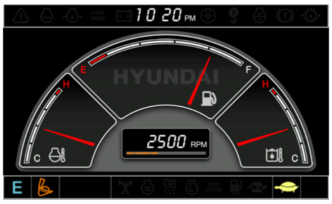
21093CD45H

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

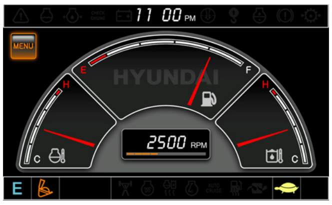
② In the operation screen, pushing this switch will display the view of the camera on the machine (if equipped).
Please refer to page 5-55 for the camera.

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

6) MAIN MENU

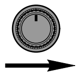


21093CD64



21093CD64A

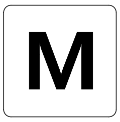
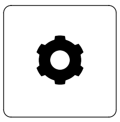
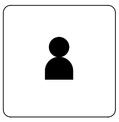
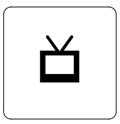
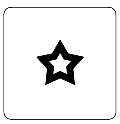
Press



21093CD64B

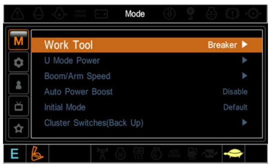
※ Please refer to select switch, page 5-43 for selection and change of menu and input value.

(1) Structure

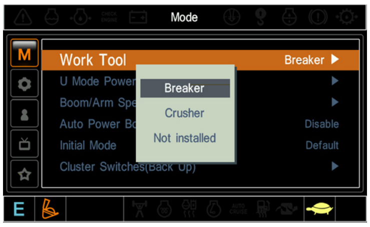
No	Main menu	Sub menu	Description
1	 Mode 21093CD64D	Work tool U mode power Boom/Arm speed Auto power boost Initial mode Cluster switch (back up)	Breaker, Crusher, Not installed User mode only Boom speed, Arm speed Enable, Disable Default, U mode Switch function
2	 Monitoring 21093CD64E	Active fault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

(2) Mode setup

① Work tool

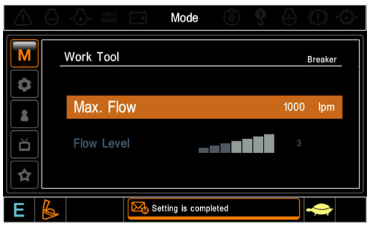


21093CD65



21093CD65A

A



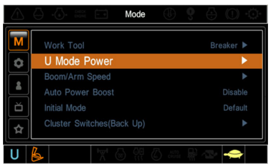
21093CD65B

B

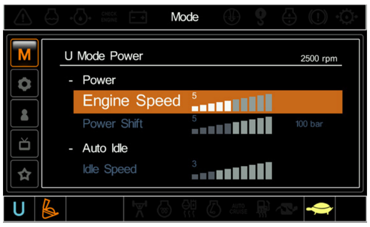
- A : Select one installed optional attachment.
- B : Max flow - Set the maximum flow for the attachment.
  Flow level - Reduce the operating flow from maximum flow.
  Breaker - Max 7 steps, Reduced 10 lpm each step.
  Crusher - Max 4 steps, Reduced 20 lpm each step.

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

② U mode power



21093CD65D

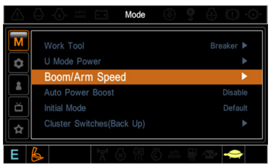


21093CD65E

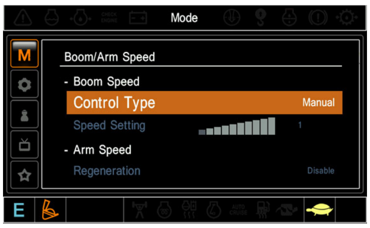
Step (▮)	Engine speed (rpm)	Idle speed (rpm)	Power shift (bar)
1	1150	800 (low idle)	0
2	1200	850	3
3	1250	900	6
4	1300	950	9
5	1350	1000 (decel rpm)	12
6	1400	1050	16
7	1450	1100	20
8	1500	1150	26
9	1600	1200	32
10	1700	1250	38

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

③ Boom/Arm speed



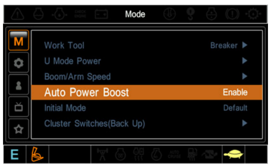
21093CD65F



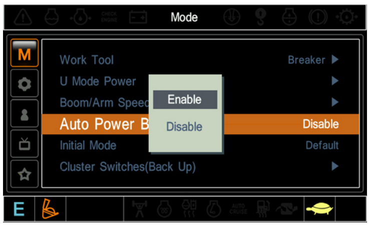
21093CD65G

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

④ Auto power boost



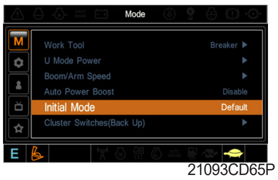
21093CD65L



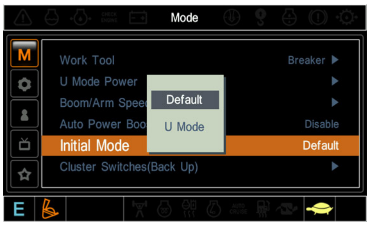
21093CD65M

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

⑤ Initial mode



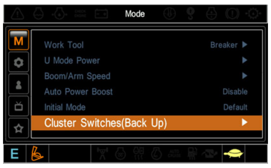
21093CD65P



21093CD65Q

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

⑥ Cluster switch (back up)



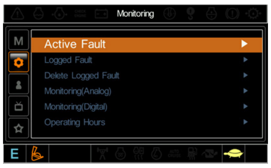
21093CD65S

21093CD65T

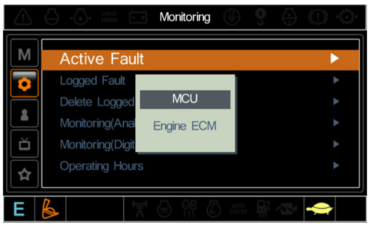
- The cluster switch can be selected and changed by this menu when the switches are abnormal on the cluster.
- In order to exit "Cluster switch" mode, please put the cursor on the ESC/CAM switch by turning the select switch and push the select switch.
- In "Cluster switch", other switches except "Select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

(3) Monitoring

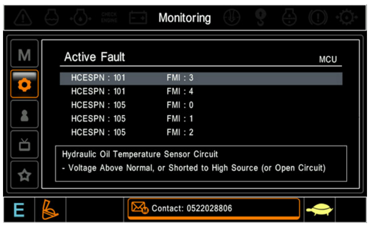
① Active fault



21093CD66



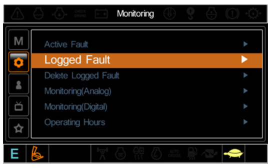
21093CD66A



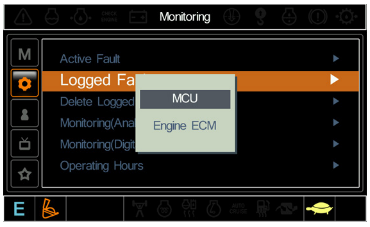
21093CD66B

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

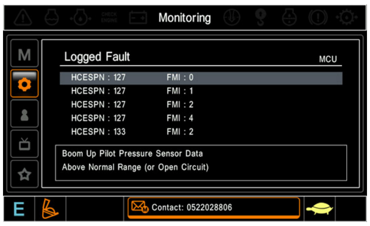
② Logged fault



21093CD66C



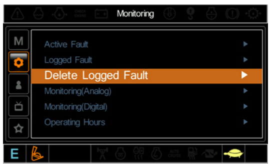
21093CD66D



21093CD66E

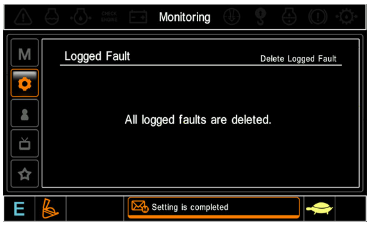
· The logged faults of the MCU or engine ECM can be checked by this menu.

③ Delete logged fault



21093CD66F

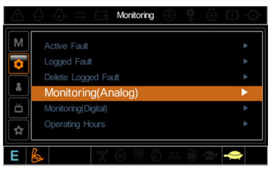
21093CD66G



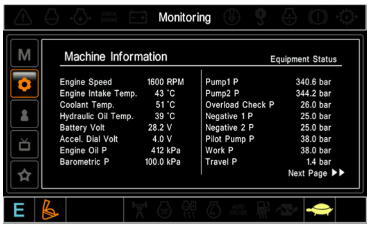
21093CD66H

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

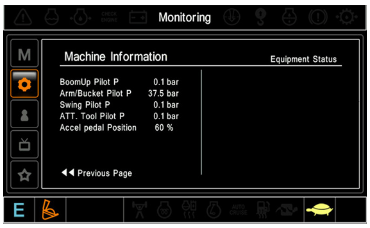
④ Monitoring(Analog)



21093CD66J



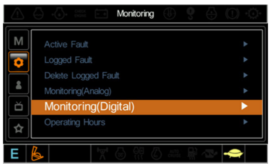
21093CD66K



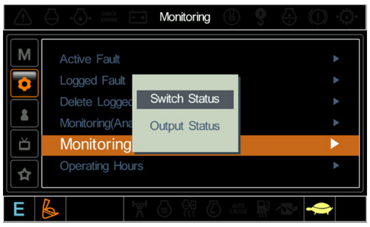
21093CD66L

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

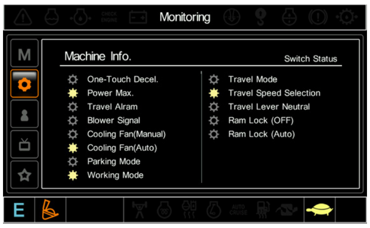
⑤ Monitoring (digital)



21093CD66M



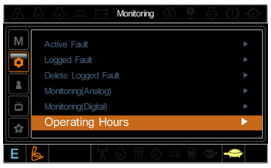
21093CD66N



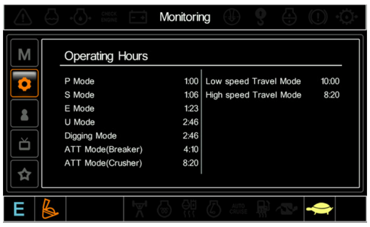
21093CD66P

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

⑥ Operating hours



21093CD66Q

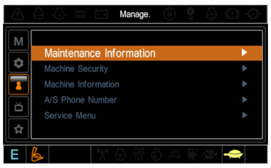


21093CD66R

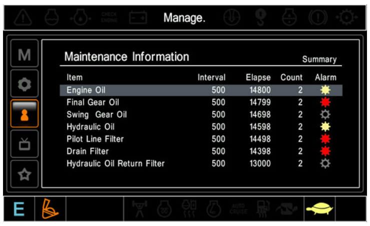
· The operating hour of each mode can be confirmed by this menu.

(4) Management

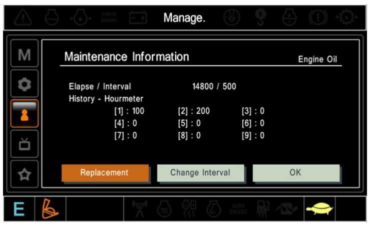
① Maintenance information



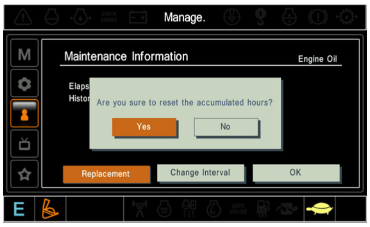
21093CD67



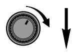
21093CD67A

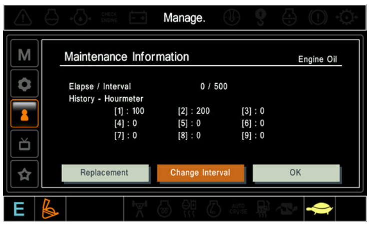


21093CD67Q

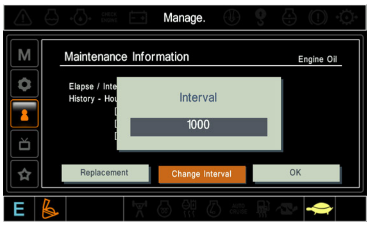


21093CD67R





21093CD67S



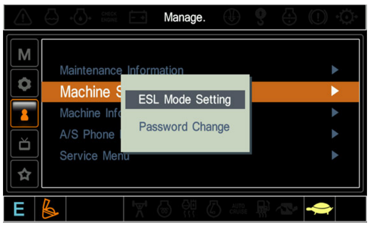
21093CD67T

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

No	Item	Interval	No	Item	Interval
1	Engine oil	500	11	Hydraulic tank breather	1000
3	Swing gear oil	1000	12	Air cleaner (inner)	500
4	Hydraulic oil	5000	13	Radiator coolant	2000
5	Pilot line filter	1000	14	Swing gear pinion grease	1000
6	Drain filter	1000	15	Transmission oil	1000
7	Hydraulic oil return filter	1000	16	Front axle differential gear oil	1500
8	Engine oil filter	500	17	Rear axle differential gear oil	1500
9	Fuel filter	500	18	Axle planetary gear oil	1500
10	Pre-filter	500			

② Machine security

21093CD67C



21093CD67D

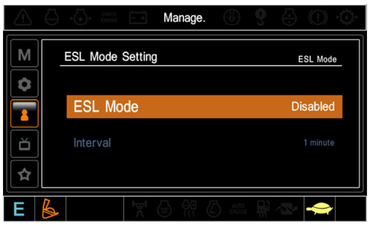
21093CD67E

· ESL mode

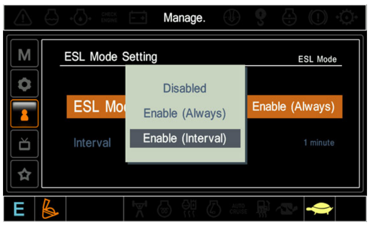
- ESL : Engine Starting Limit
- ESL mode is designed to be a theft deterrent or will prevent the unauthorized operation of the machine.
- If the ESL mode was selected Enable, the password will be required when the start switch is turned ON.
- Disable : Not used ESL function

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

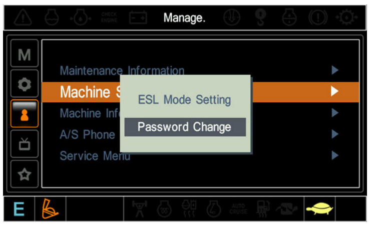
  Enable (interval) : The password is required when the operator start engine first. But the operator can restart the engine within the interval time without inputting the password.
  The interval time can be set maximum 4 hours.



21093CD67EE



21093CD67H

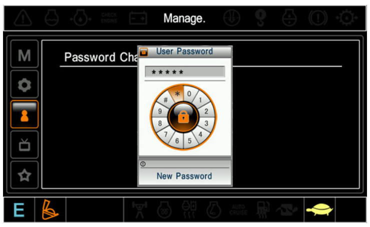


21093CD67U

Enter the current password 21093CD67V

· Password change

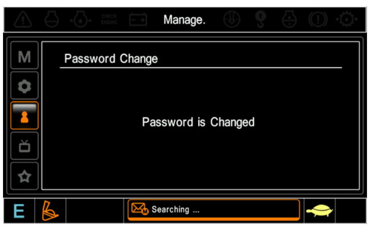
- The password is 5~10 digits.



Enter the new password 21093CD67VV

21093CD67XX

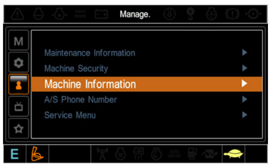
Enter the new password again



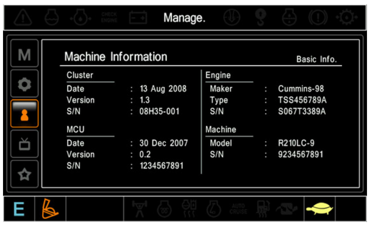
21093CD67X

The new password is stored in the MCU.

③ Machine Information



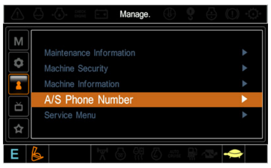
21093CD67F



21093CD67G

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

④ A/S phone number



21093CD67J

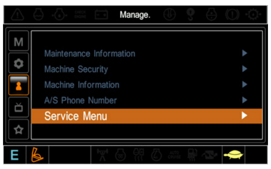
21093CD67K

21093CD67L

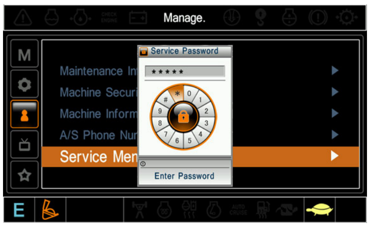
21093CD67Z

21093CD67Y

⑤ Service menu

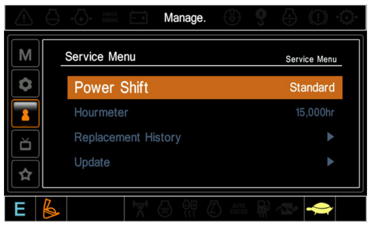


21093CD67M

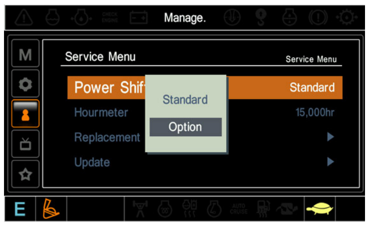


Enter the password

21093CD67N



21093CD67P



21093CD67ZZ

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

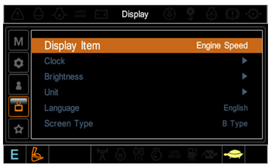
· Hourmeter : Operating hours since the machine line out can be checked by this menu.

· Replacement history : Replacement history of the MCU and cluster can be checked by this menu.

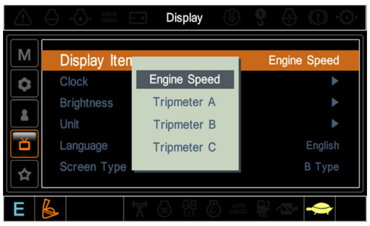
· Update : Firm ware can be upgraded by this menu. (the USB port is located under the cluster)

(5) Display

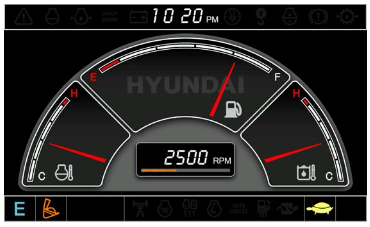
① Display item



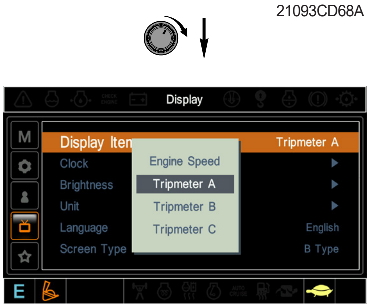
21093CD68



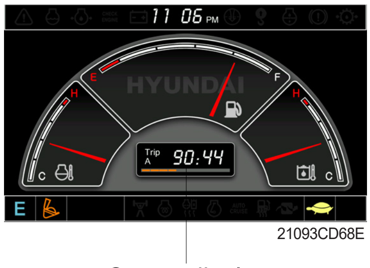
21093CD68A



21093CD68W



21093CD68B

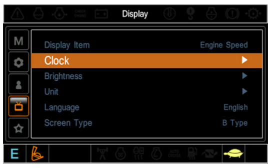


21093CD68E

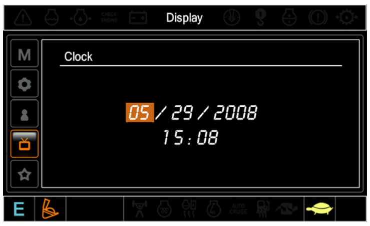
Center display

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

② Clock



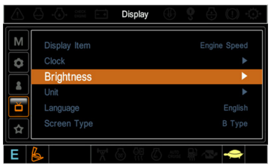
21093CD68C



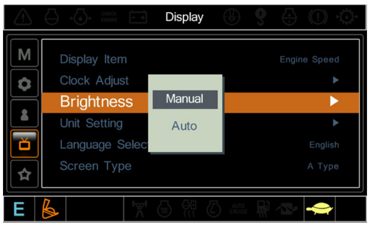
21093CD68D

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

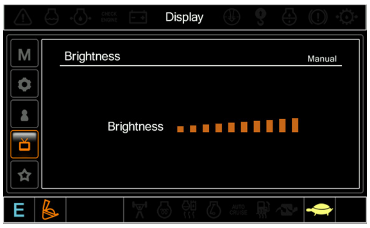
③ Brightness



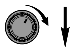
21093CD68F

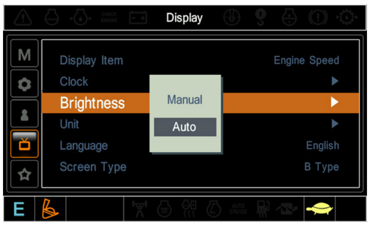


Manual (1st~10th step) 21093CD68G

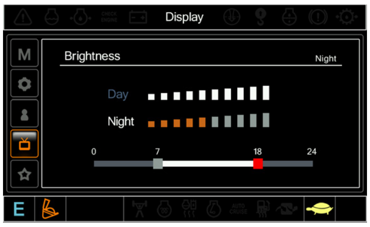


21093CD68H





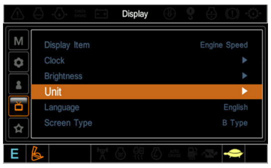
Auto (day/night) 21093CD68J



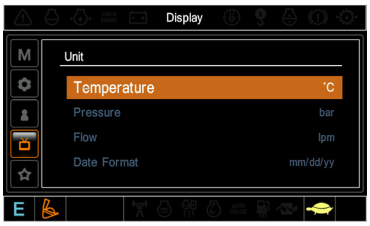
21093CD68K

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

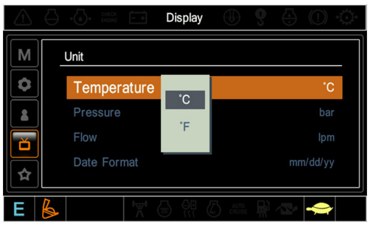
④ Unit



21093CD68L



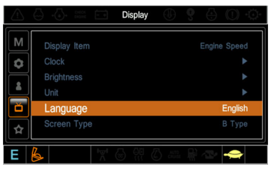
21093CD68M



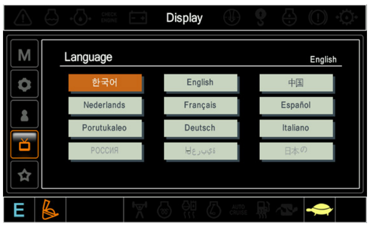
21093CD68N

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

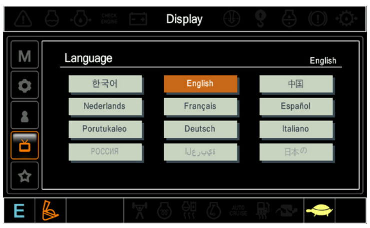
⑤ Language



21093CD68R



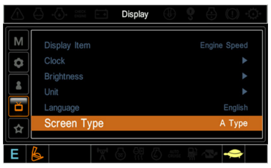
21093CD68S



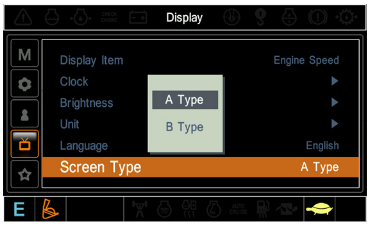
21093CD68T

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

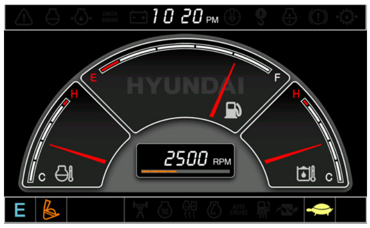
⑥ Screen type



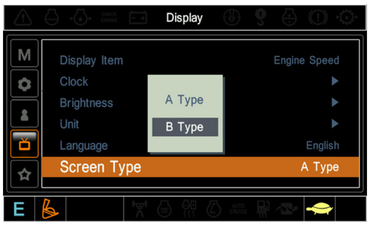
21093CD68U



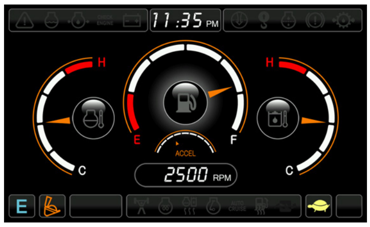
A Type 21093CD68V



Standard 21093CD68W



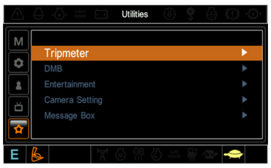
B Type 21093CD68X



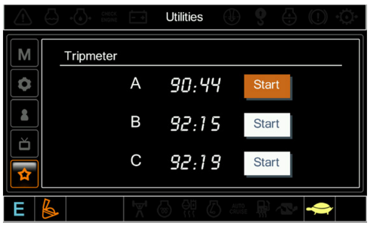
Option 21093CD68Y

(6) Utilities

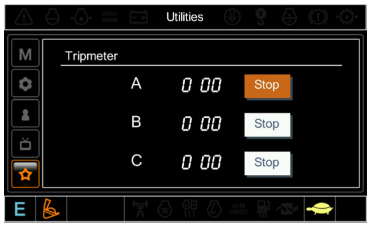
① Tripmeter



21093CD69



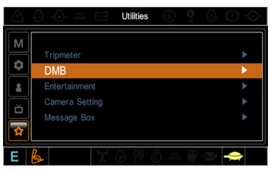
21093CD69A



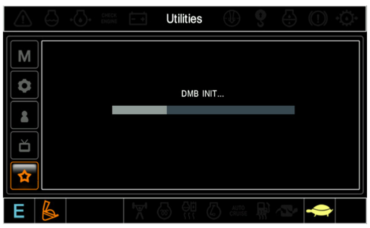
21093CD69B

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

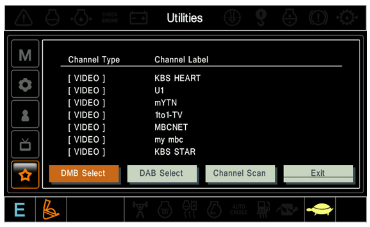
② DMB



21093CD69C



21093CD69D

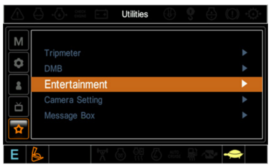


21093CD69E

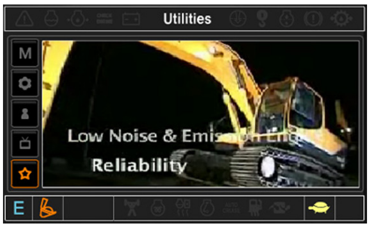
· DMB select : TV channel can be selected by this menu.
· DAB select : Audio channel can be selected by this menu.
· Channel scan : This menu can be used other region for TV/Audio.
· Exit : Exit DMB menu

③ Entertainment

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

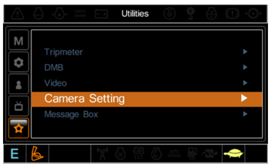


21093CD69F

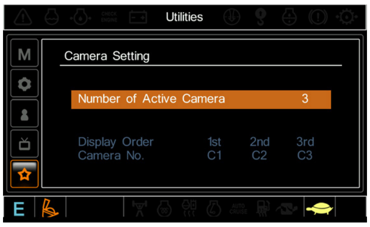


21093CD69G

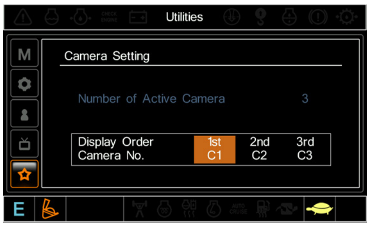
④ Camera setting



21093CD69J



21093CD69K



21093CD69L

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

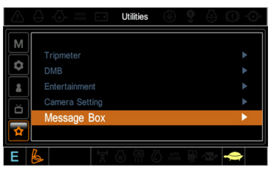
21093CD69M

21093CD69N

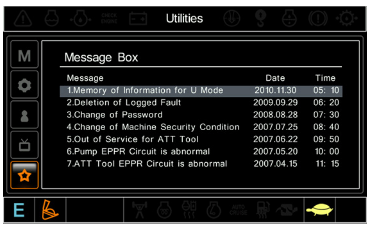
· If the camera was not equipped, this menu is not useful.
· In the operation screen, if the ESC/CAM switch is pushed, the first ordered display camera will be viewed.
· Turning the select switch in clockwise direction, the next ordered will be shown and in counter-clockwise direction, the previously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

⑤ Message box

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



21093CD69Q



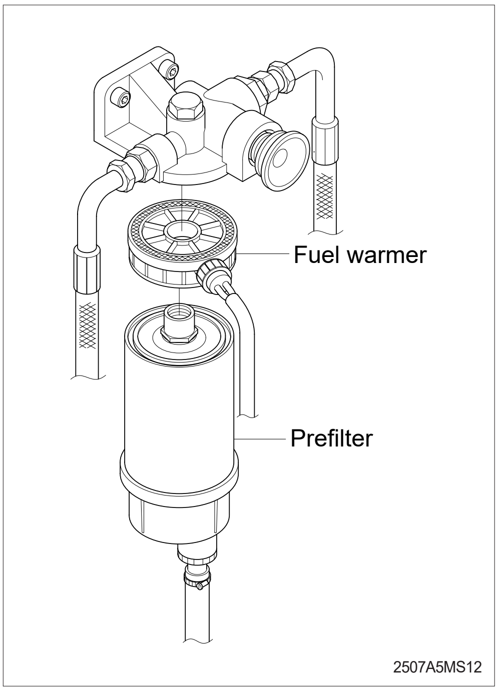
21093CD69R

1. SPECIFICATION

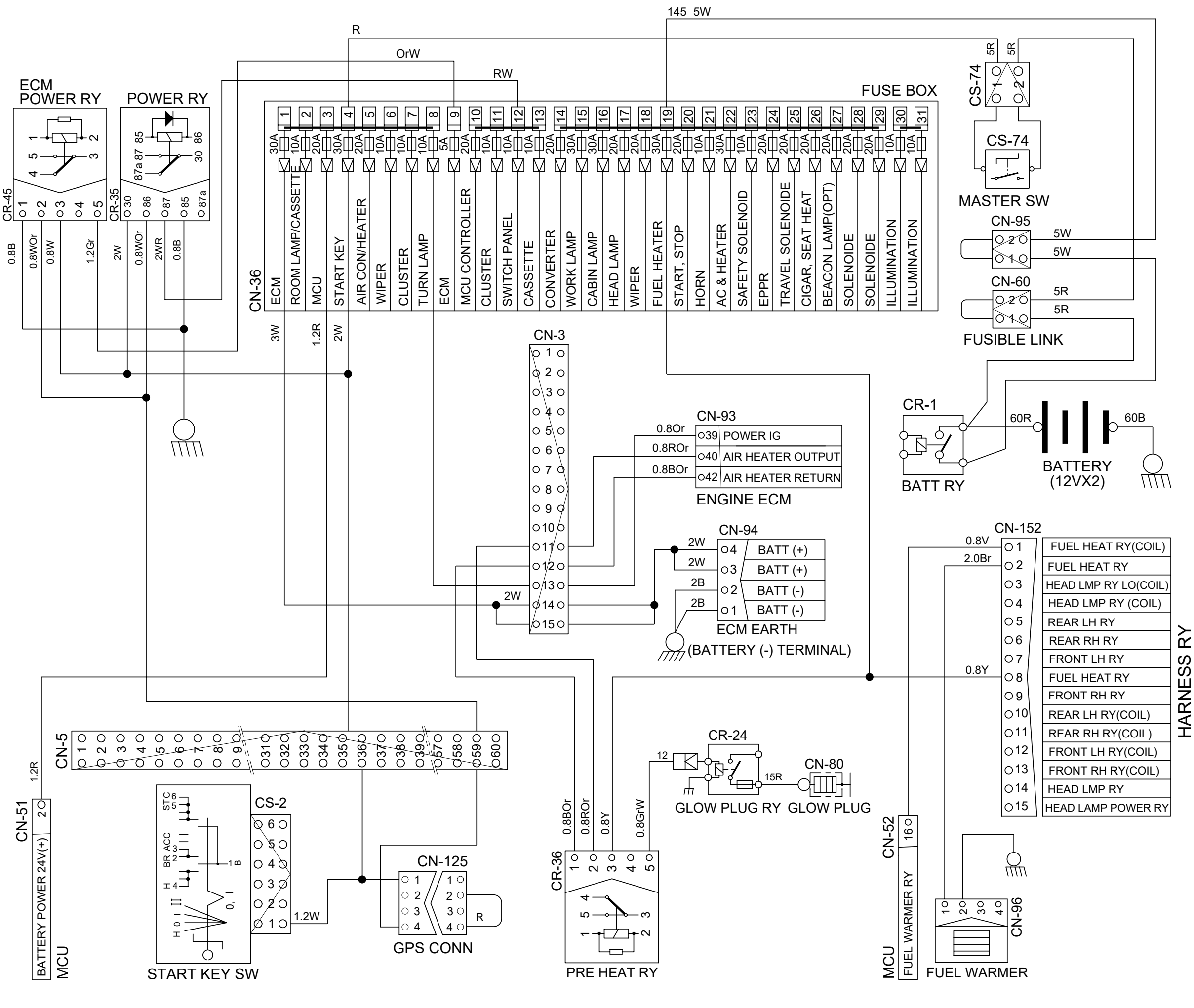
1) Operating voltage : 24$\pm$4 V
2) Power : 350$\pm$50 W
3) Current : 15 A

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

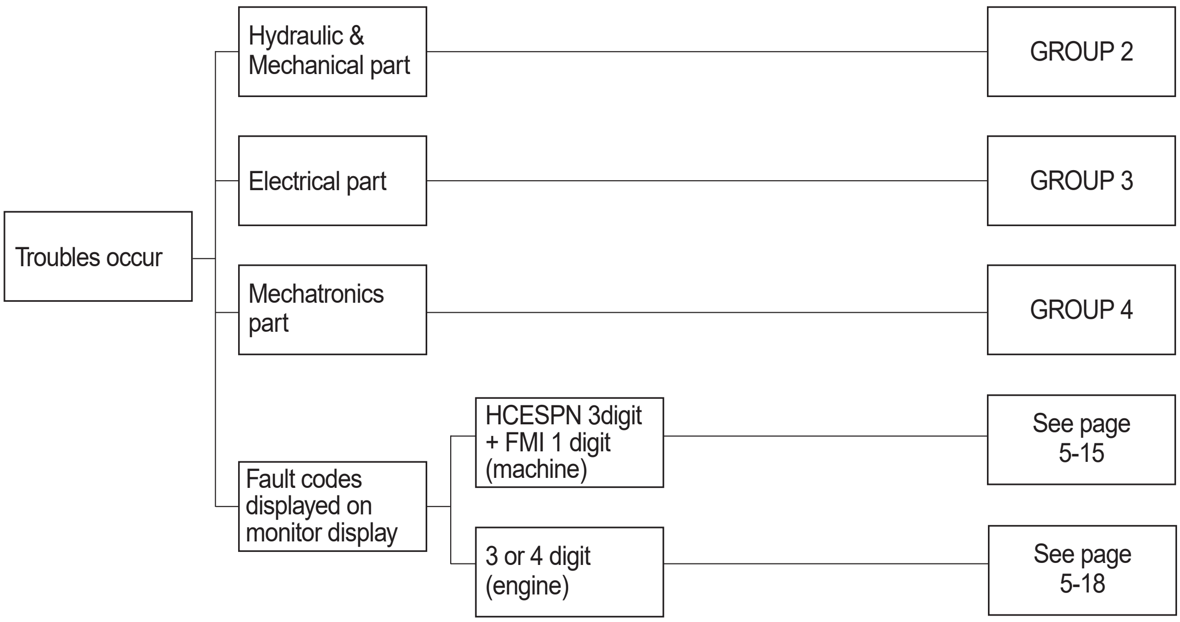
GROUP 1 BEFORE TROUBLESHOOTING

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.**

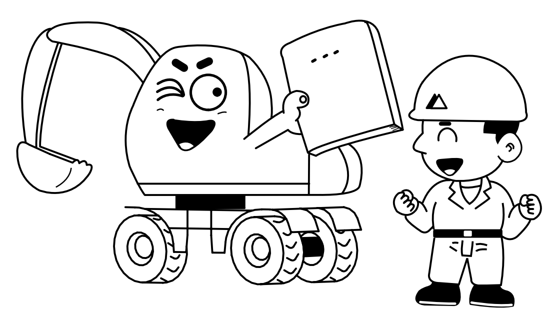


2. DIAGNOSING PROCEDURE

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.

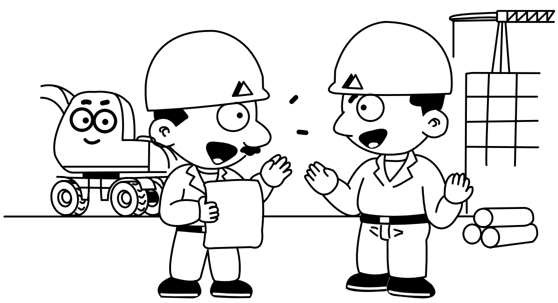


17W31SH02

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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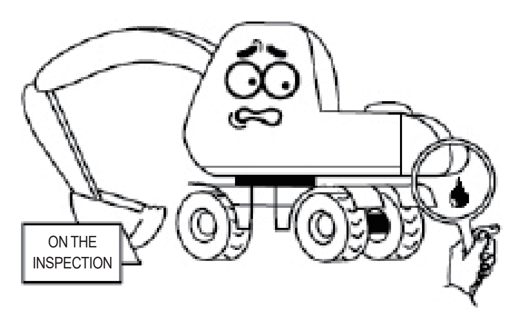
STEP 3. Inspect the machine

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

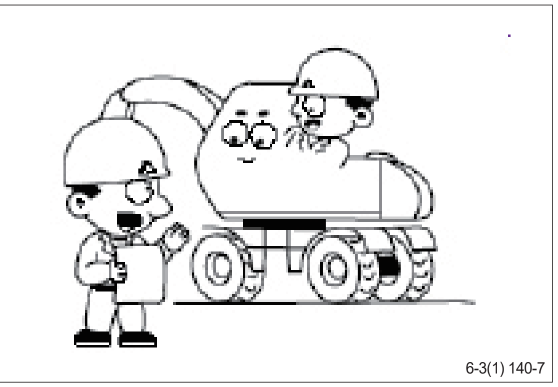
And also check the electrical system including batteries, as the troubles in the electrical system such as low battery voltage, loose connections and blown out fuses will result in malfunction of the controllers causing total operational failures of the machine.



6-2(3) 140-7

STEP 4. Inspect the trouble actually on the machine

In case that some trouble cannot be confirmed, obtain the details of the malfunction from the operator.
Also, check if there are any in complete connections of the wire harnesses are or not.



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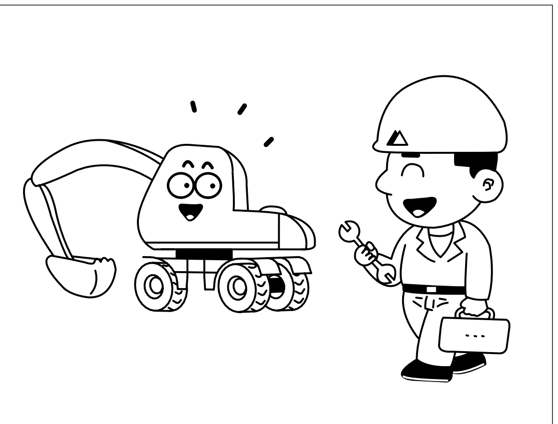
STEP 5. Perform troubleshooting

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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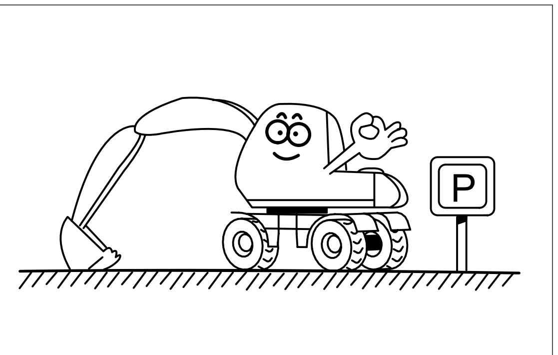
STEP 6. Trace a cause

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.



17W31SH44

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.

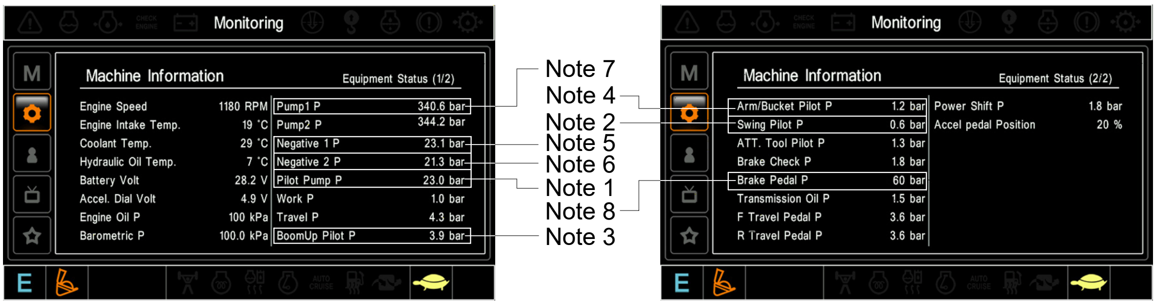
(3) When carrying out troubleshooting, do not hurry to disassemble the components.
It will become impossible to find the cause of the problem.

(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 14W96HS01

(2) Specification

No.	Description	Specification
Note 1	Pilot pump pressure	40^{+2}_{0} bar
Note 2	Swing pilot pressure	0~40 bar
Note 3	Boom up pilot pressure	0~40 bar
Note 4	Arm/bucket pilot pressure	0~40 bar
Note 5	P1 pump control pressure	0~25 bar
Note 6	P2 pump control pressure	0~25 bar
Note 7	Pump 1 pressure	350 bar
Note 8	Brake pedal pressure	60±3 bar

2. DRIVE SYSTEM

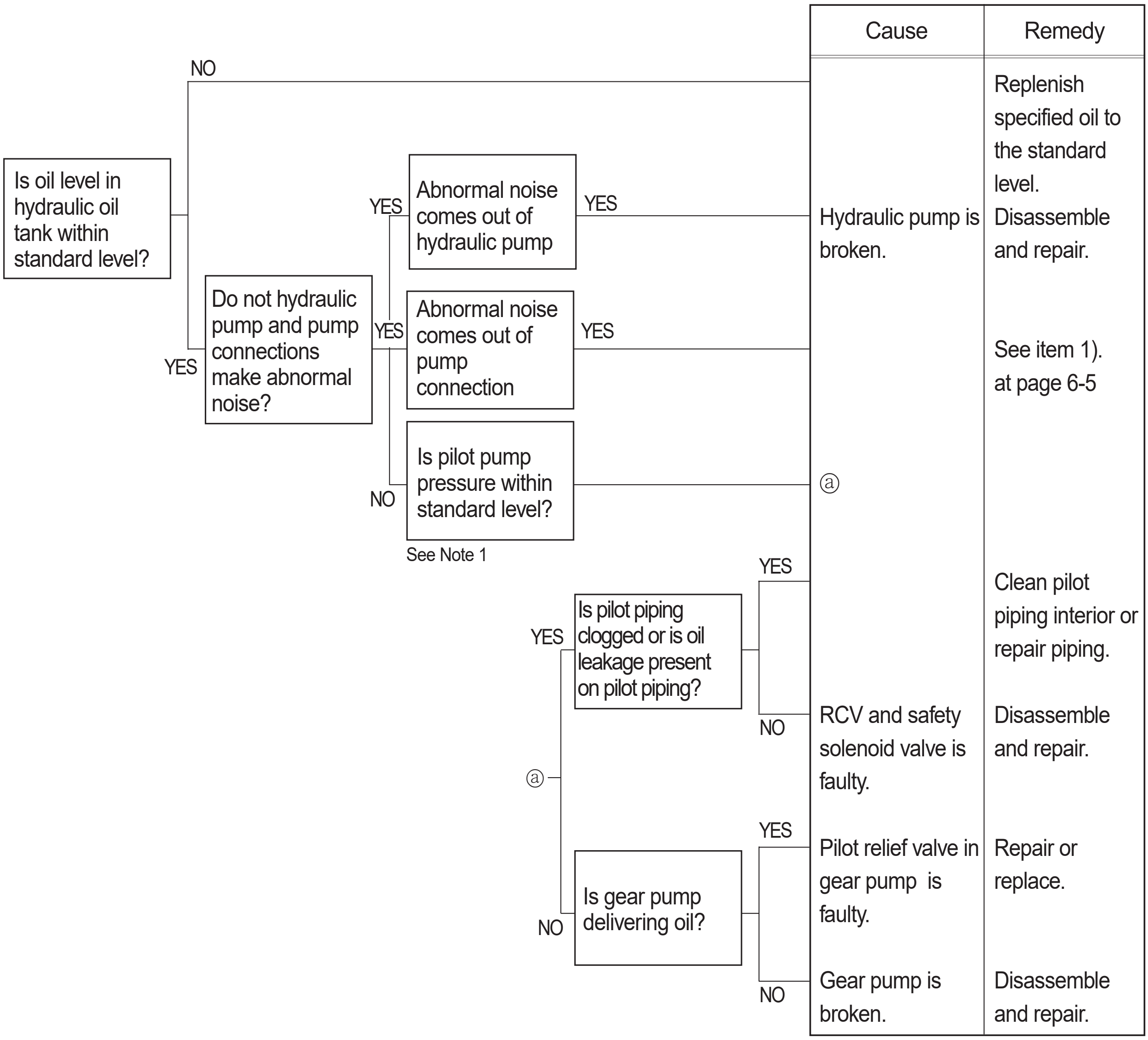
1) UNUSUAL NOISE COMES OUT OF PUMP CONNECTION

Remove dust plug under engine flywheel and check if rubber pieces or particles are not present.

- YES → Coupling element is broken. / Disassemble and repair.
- NO → Coupling hub spline is worn or hub fastening setscrew is slack.
  - YES → Replace hub or retighten setscrew.
  - NO → If hydraulic pump or engine is suspected as a culprit refer to this manual "Structure and function".

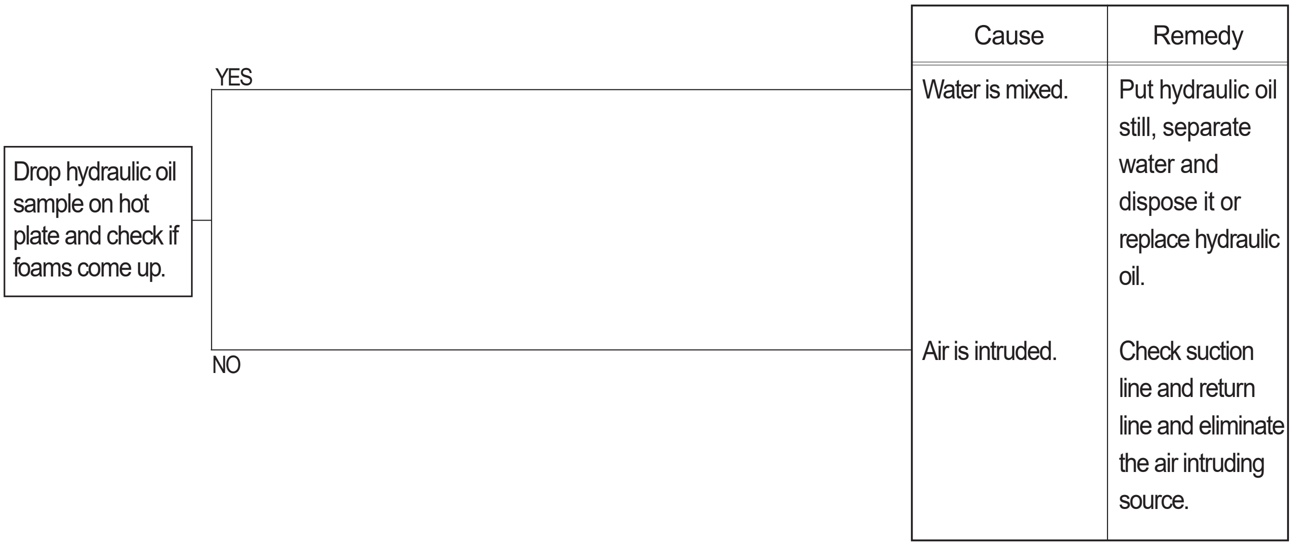
Cause	Remedy
Coupling element is broken.	Disassemble and repair.
	Replace hub or retighten setscrew.

2) ENGINE STARTS BUT MACHINE DOES NOT OPERATE AT ALL

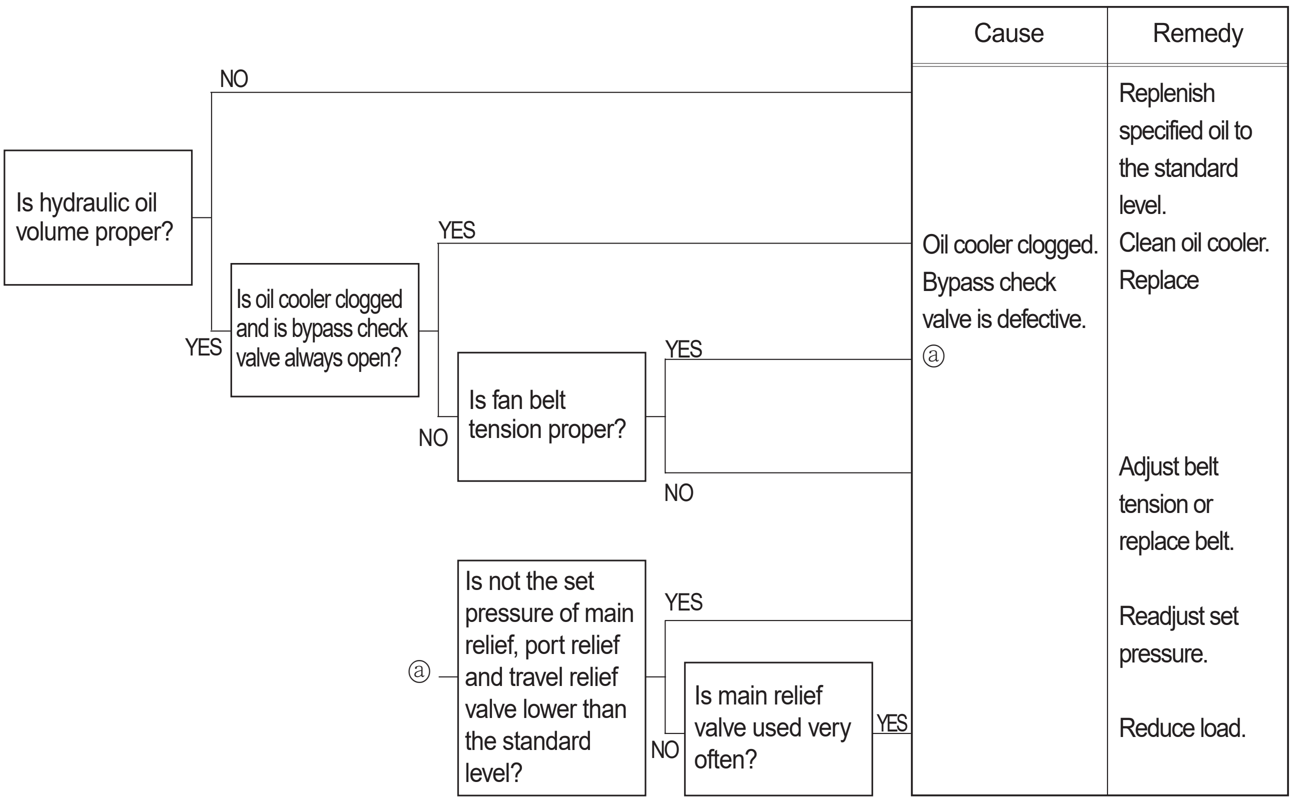


3. HYDRAULIC SYSTEM

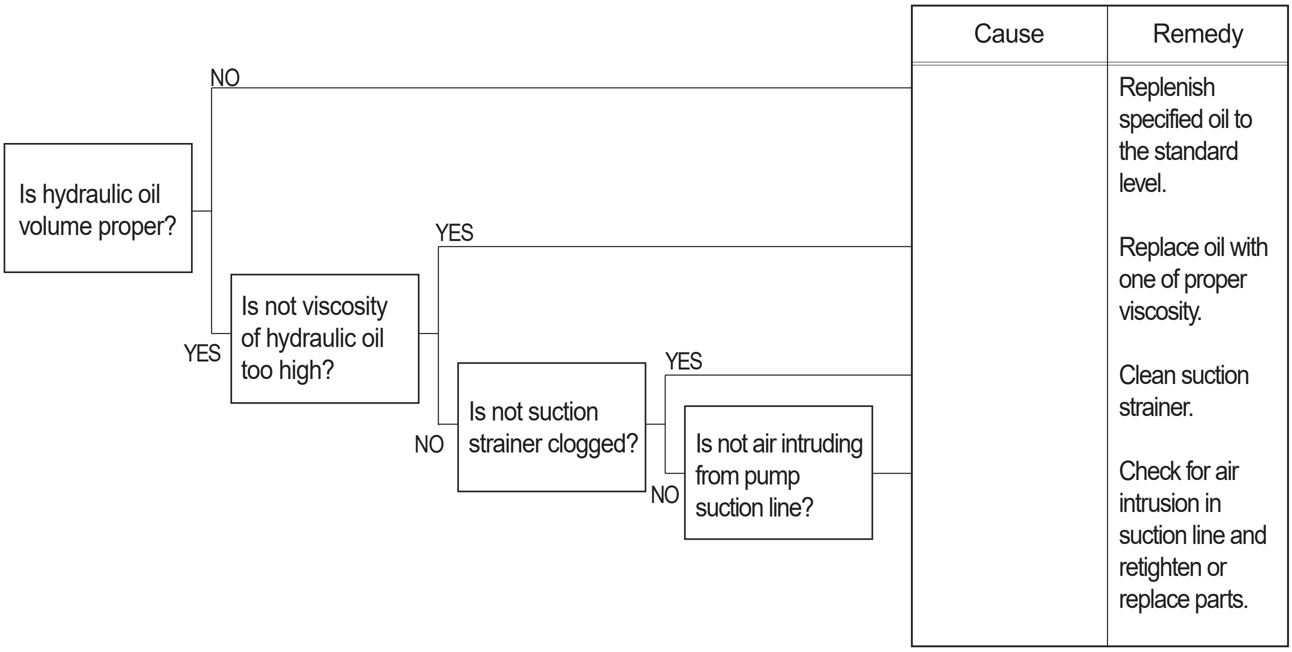
1) HYDRAULIC OIL IS CLOUDY



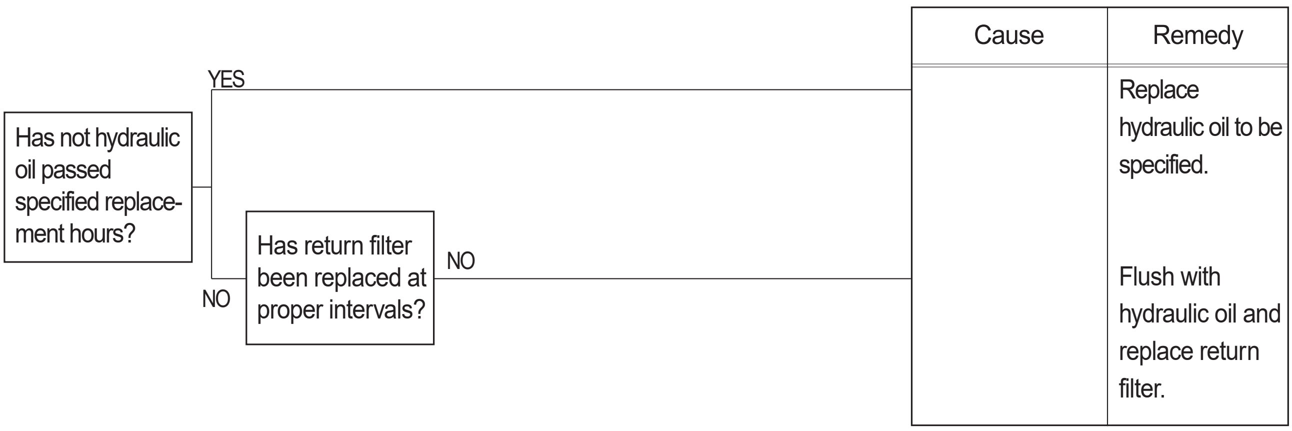
2) HYDRAULIC OIL TEMPERATURE HAS RISEN ABNORMALLY



3) CAVITATION OCCURS WITH PUMP

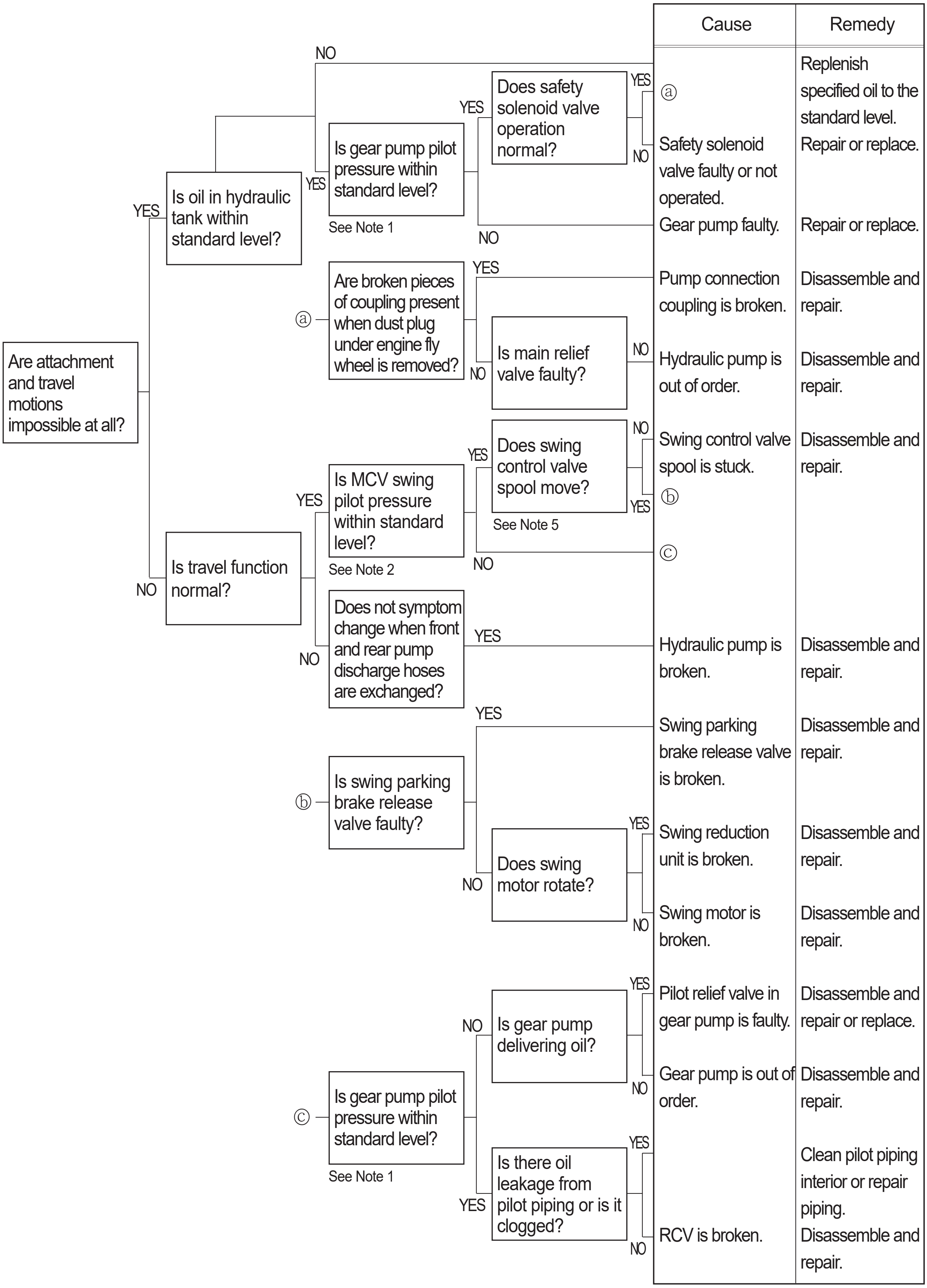


4) HYDRAULIC OIL IS CONTAMINATED

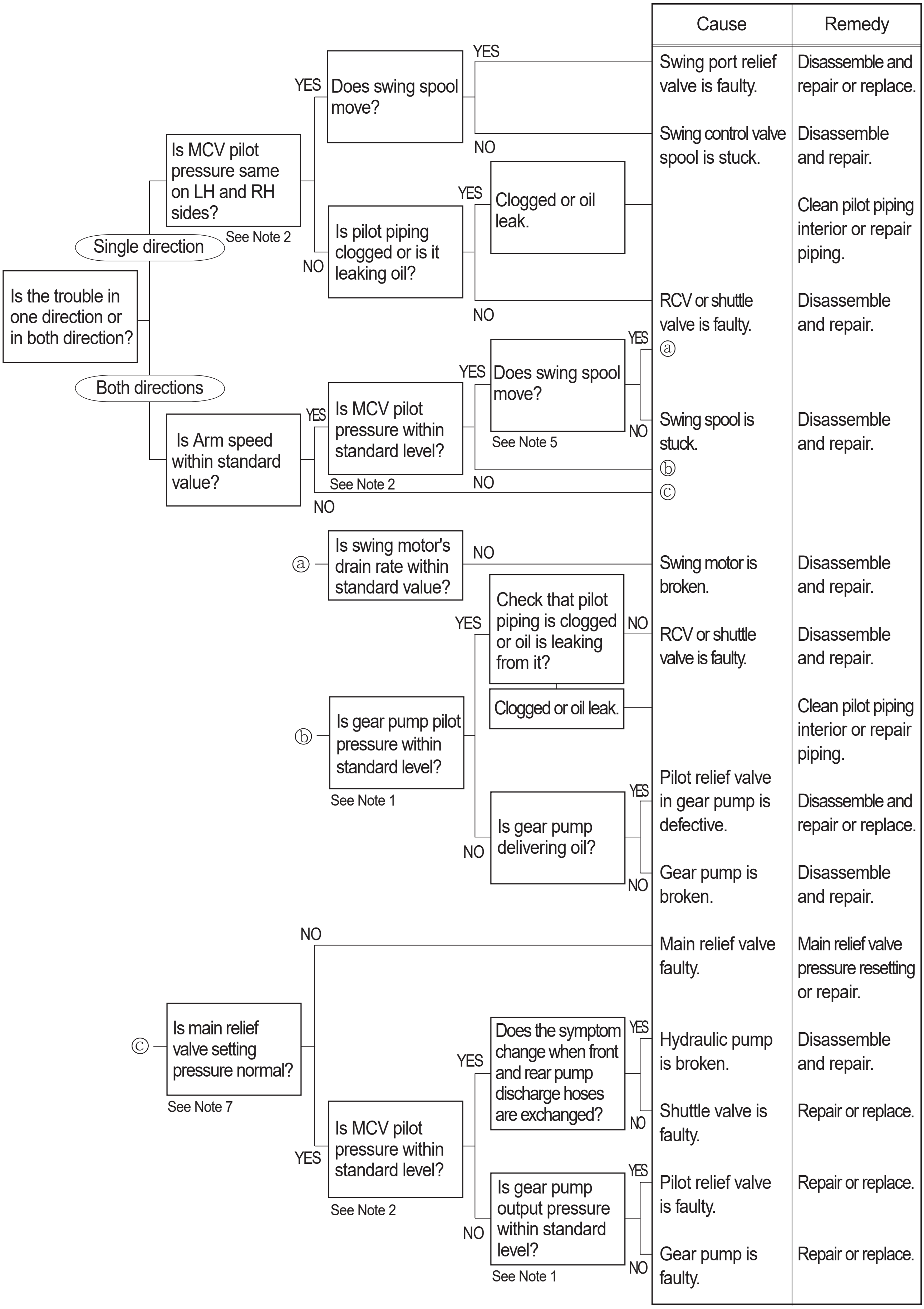


4. SWING SYSTEM

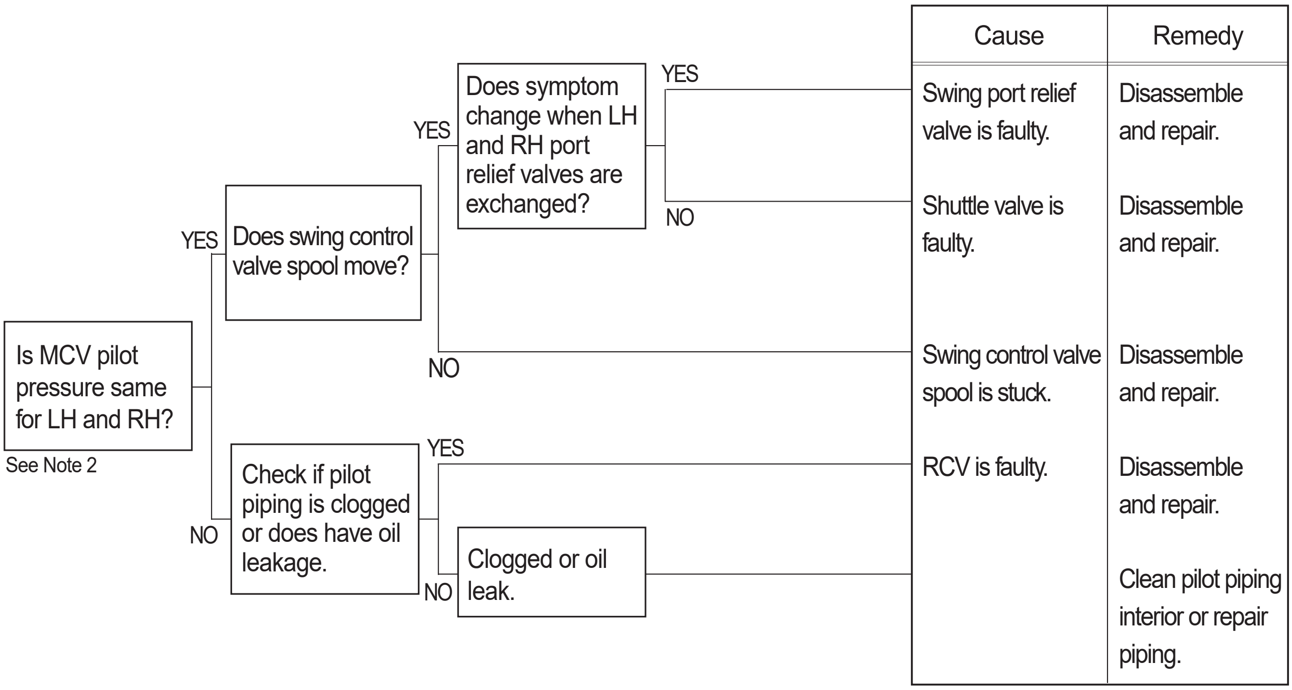
1) BOTH LH AND RH SWING ACTIONS ARE IMPOSSIBLE



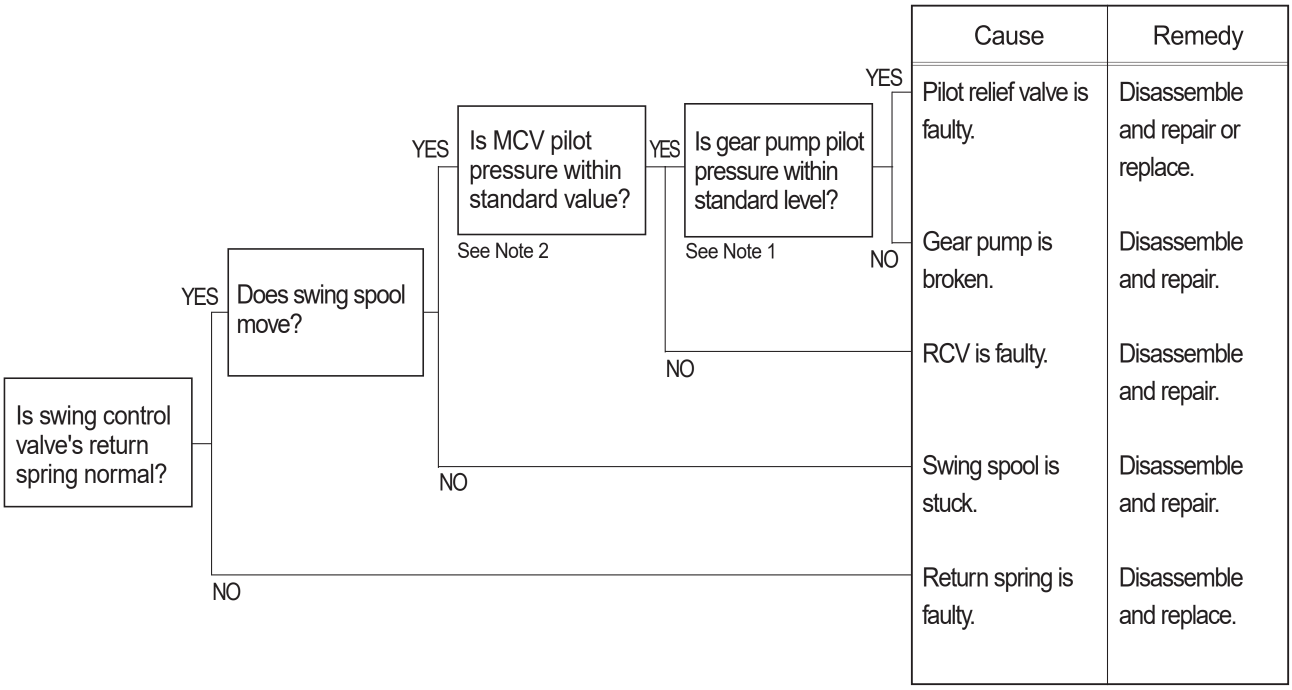
2) SWING SPEED IS LOW



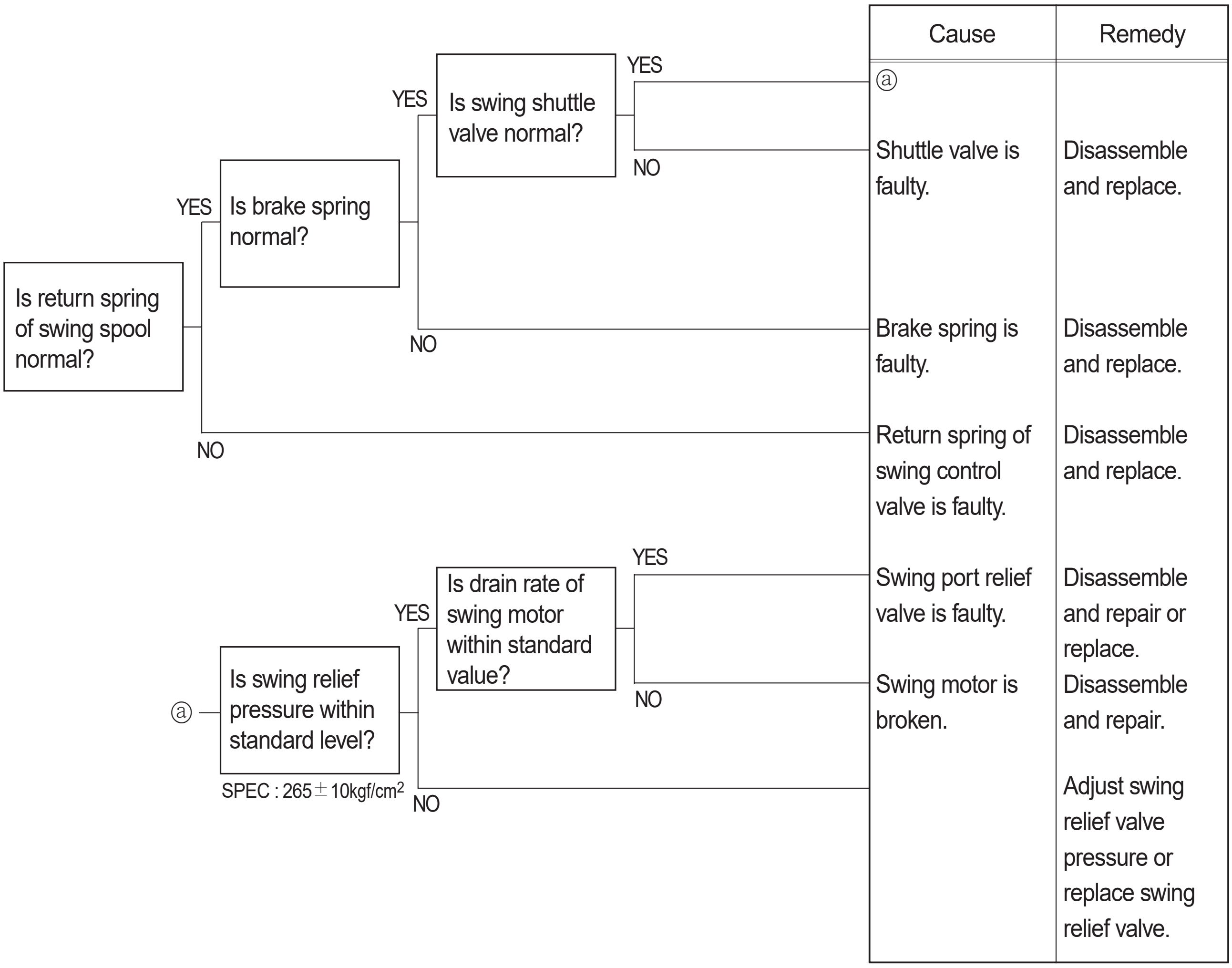
3) SWING MOTION IS IMPOSSIBLE IN ONE DIRECTION



4) MACHINE SWINGS BUT DOES NOT STOP

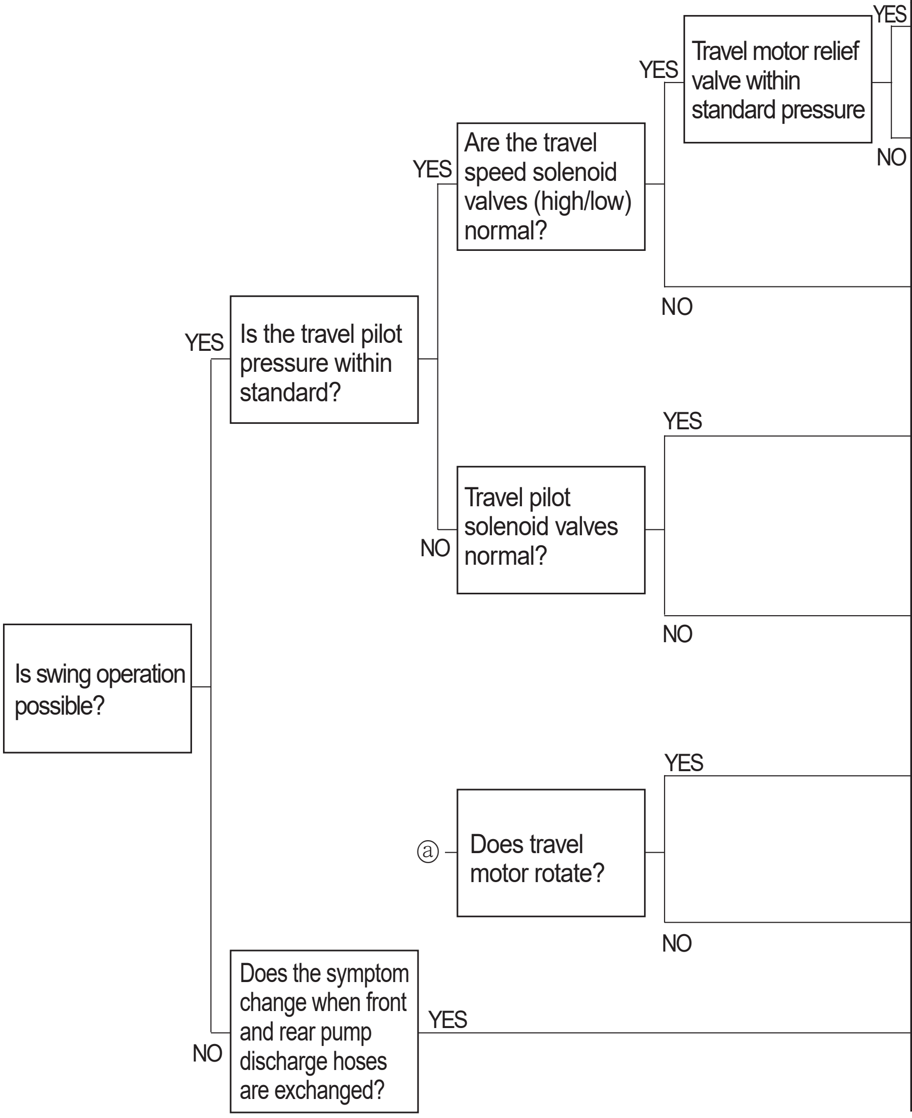


5) THE SWING UNIT DRIFTS WHEN THE MACHINE IS AT REST ON A SLOPE



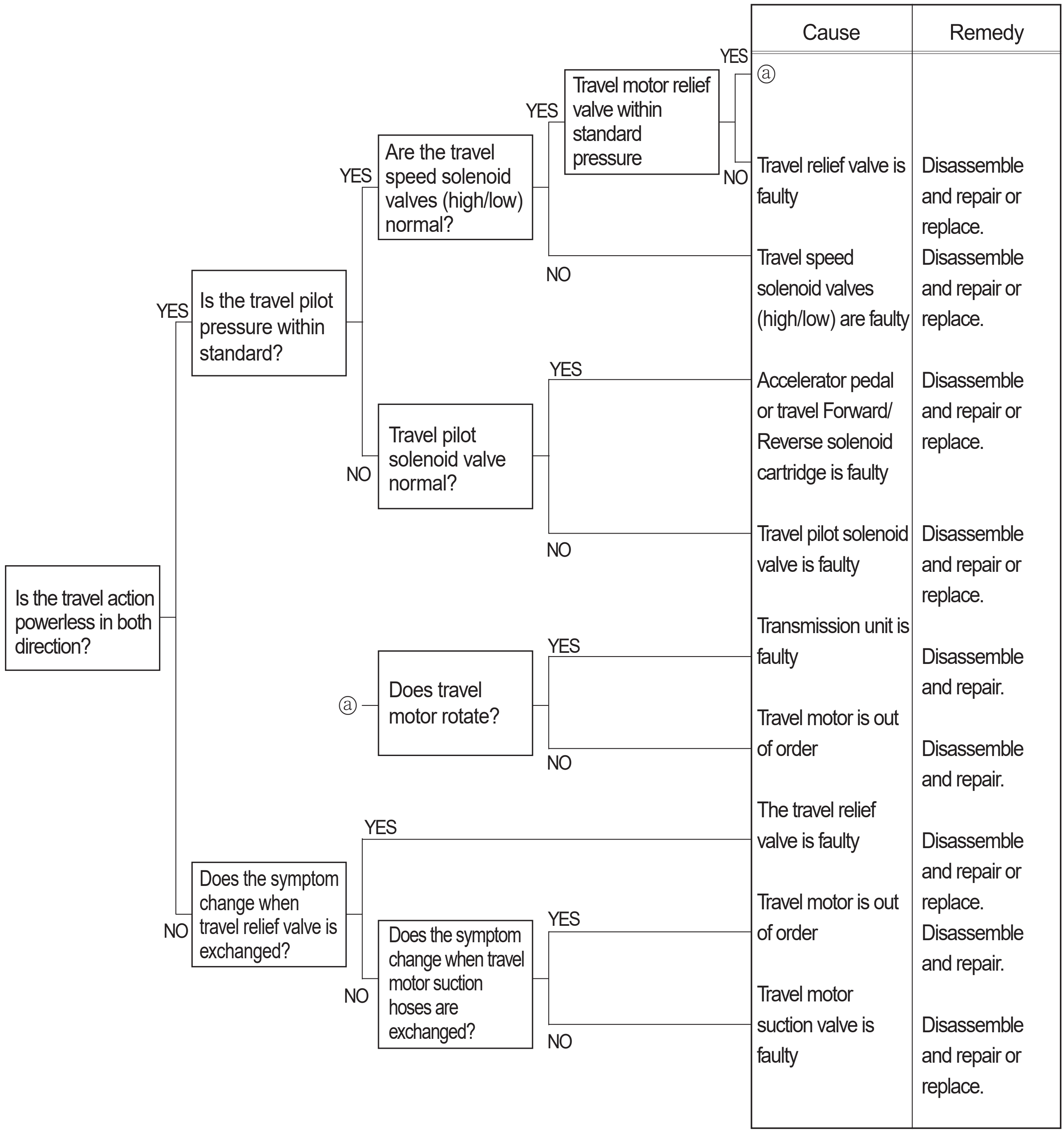
5. TRAVEL SYSTEM

1) TRAVEL DOES NOT FUNCTION



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

Symptom	Cause	Remedy
The hydraulic motor does not get started	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

Symptom	Cause	Remedy
It takes time to accelerate the motor	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.

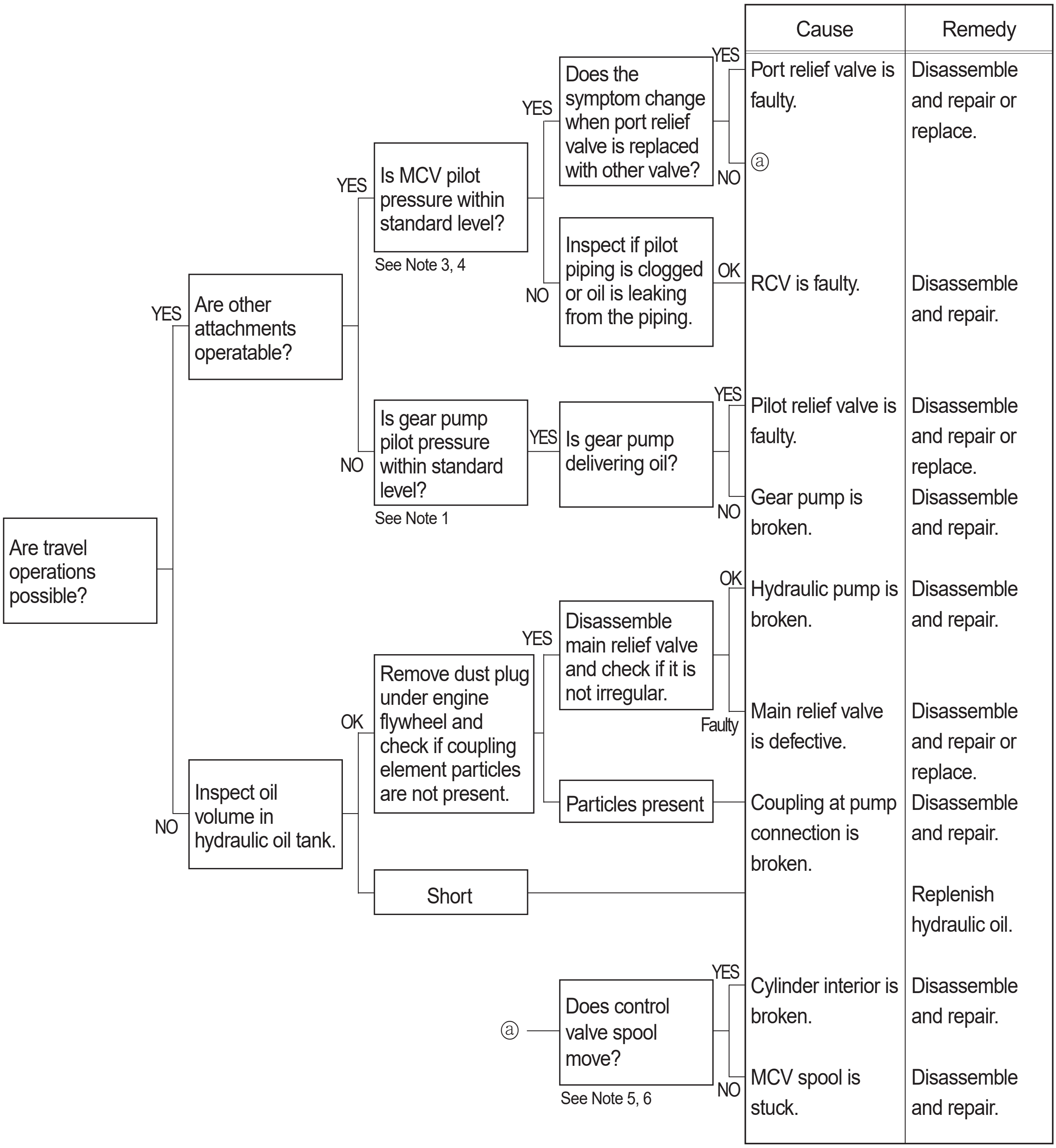
6) EXTRAORDINARY NOISE IS HEARD WHEN SUDDENLY REDUCING THE SPEED FROM THE HIGH-SPEED MODE

It takes time to accelerate the motor

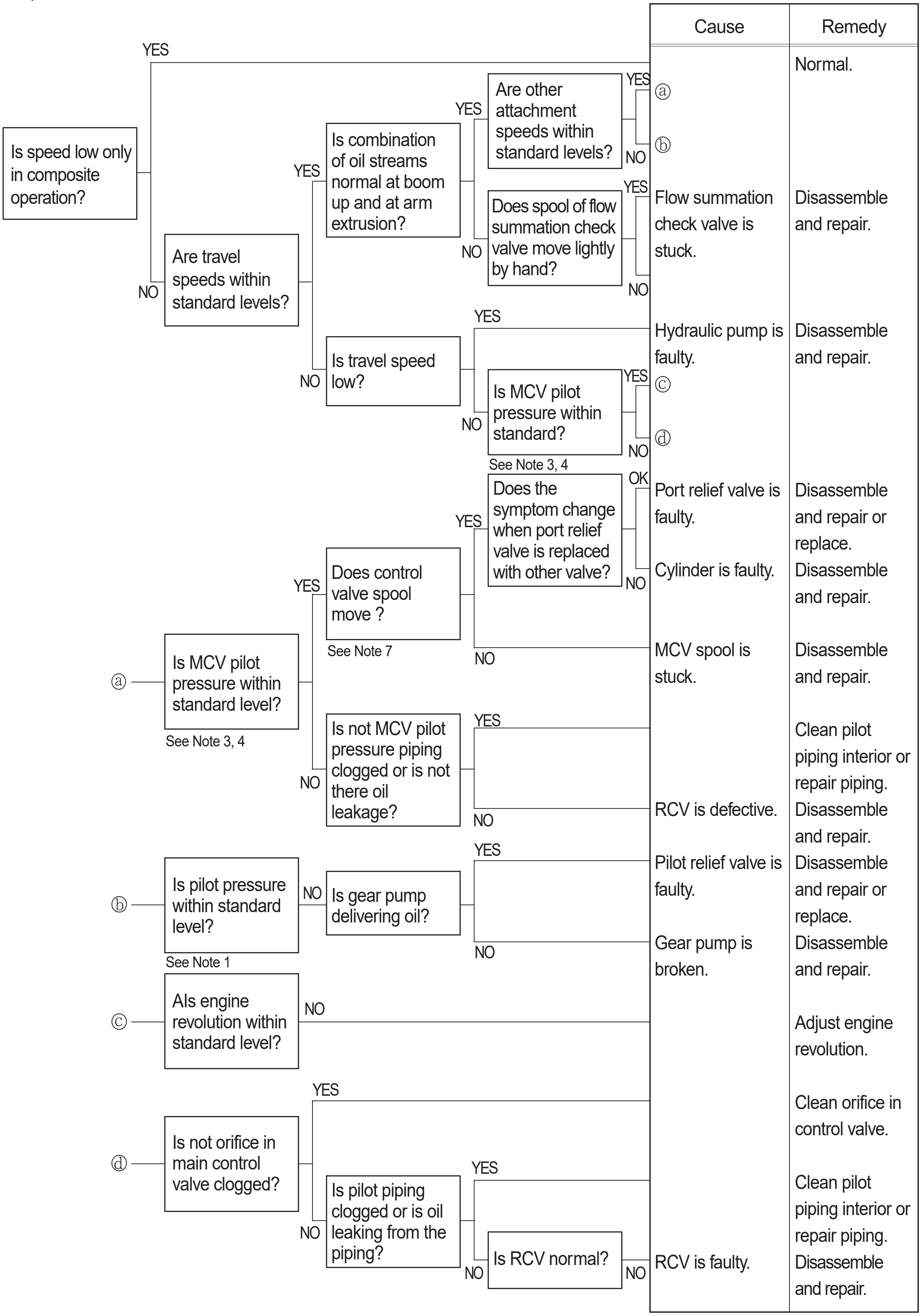
Cause	Remedy
The anti-cavitation valve does not not work properly.	Screw the fitting bolts one more time with correct tightening torque. If the valve turns out to be damaged, is should be repaired.

6. ATTACHMENT SYSTEM

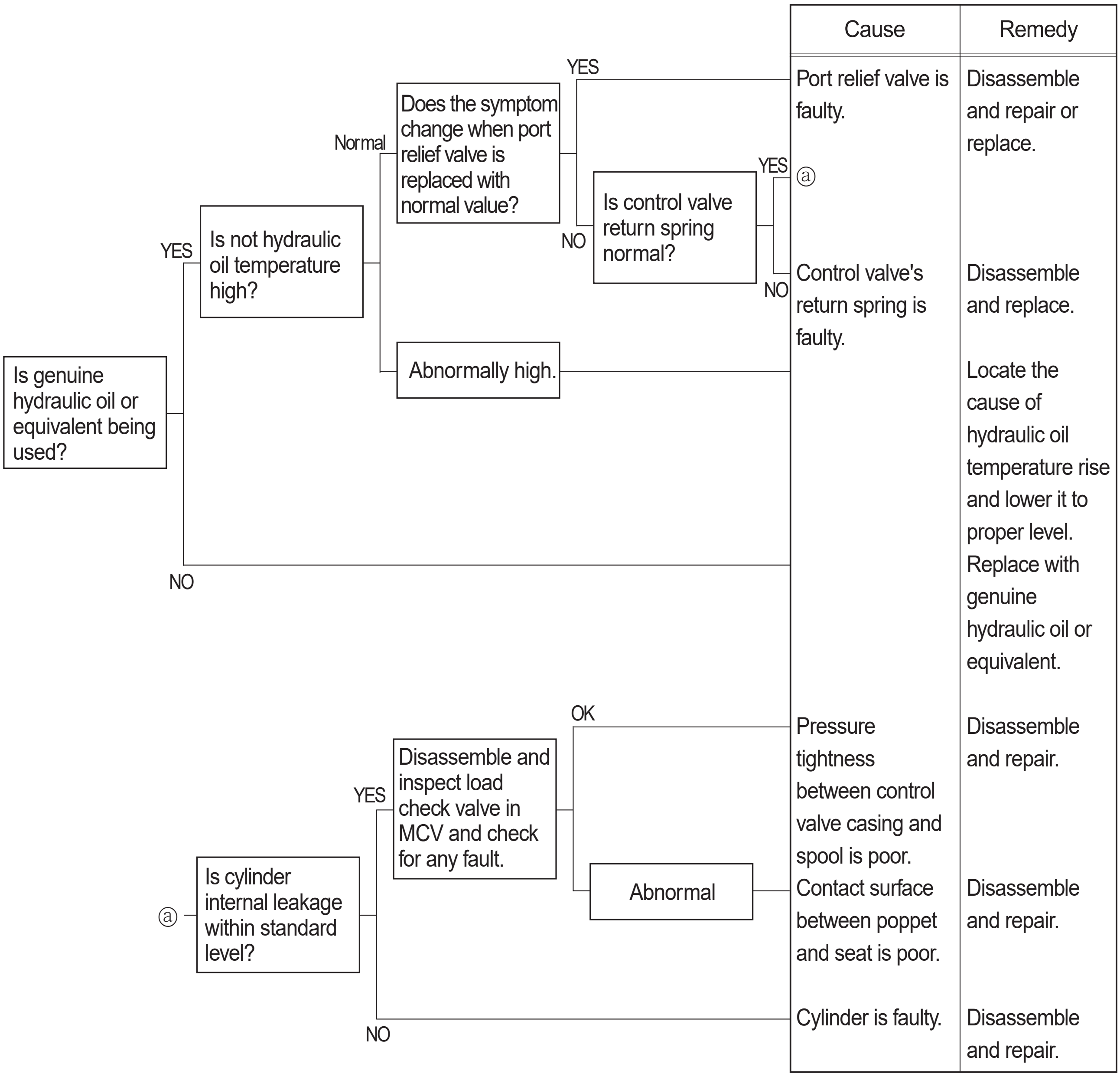
1) BOOM OR ARM ACTION IS IMPOSSIBLE AT ALL



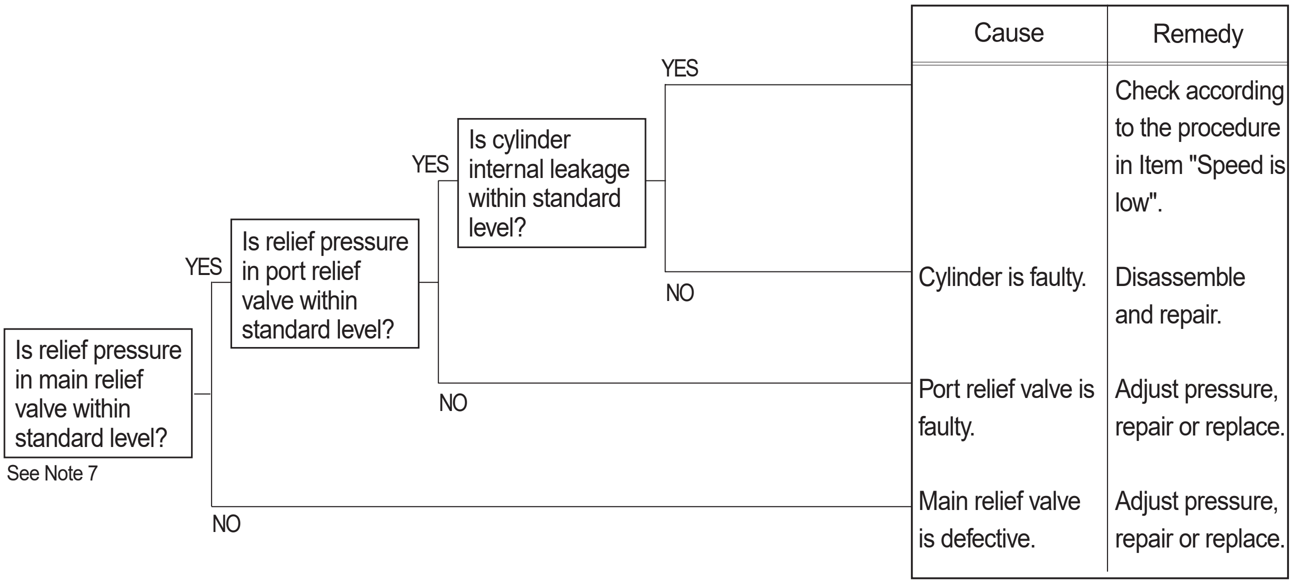
2) BOOM, ARM OR BUCKET SPEED IS LOW



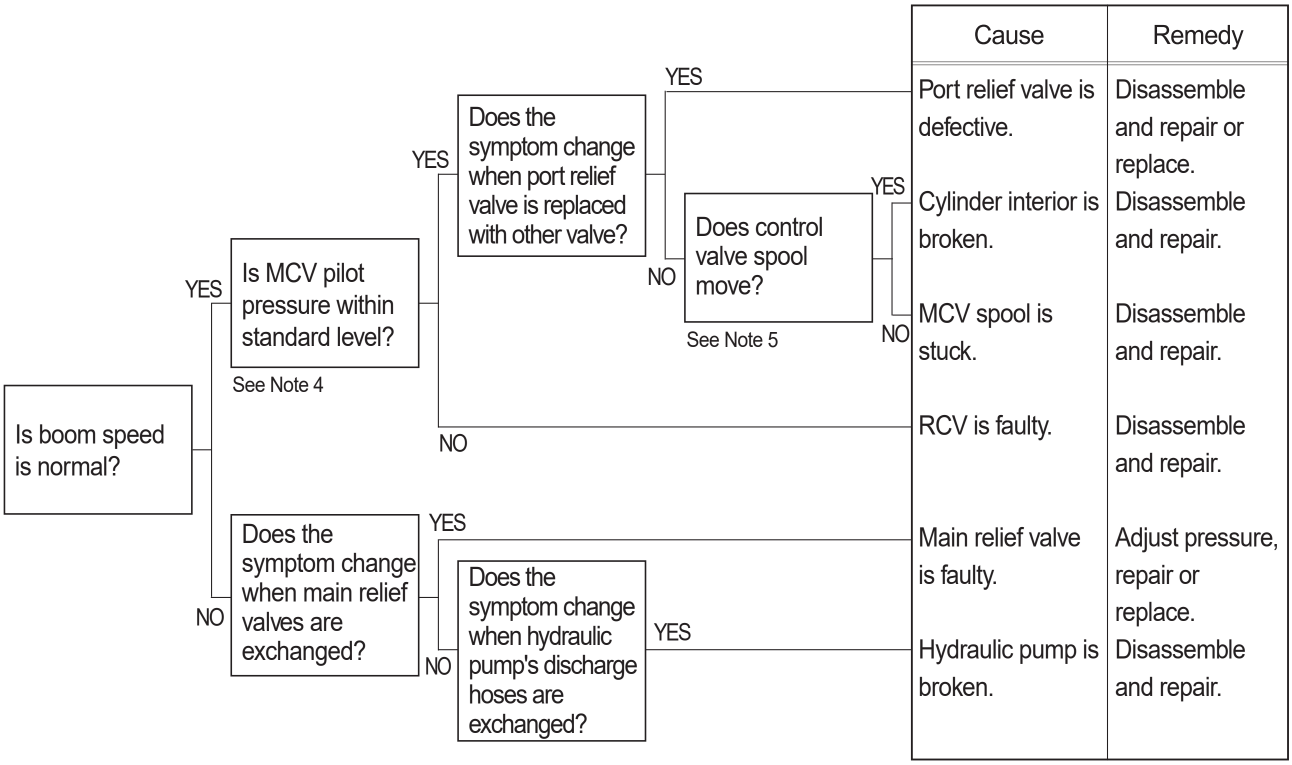
3) BOOM, ARM OR BUCKET CYLINDER EXTENDS OR CONTRACTS ITSELF AND ATTACHMENT FALLS



4) BOOM, ARM OR BUCKET POWER IS WEAK



5) ONLY BUCKET OPERATION IS TOTALLY IMPOSSIBLE



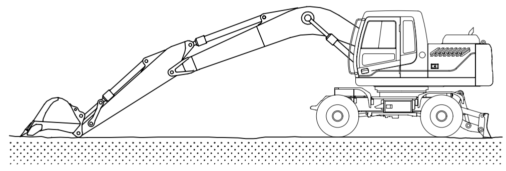
6) BOOM MAKES A SQUEAKING NOISE WHEN BOOM IS OPERATED

Is boom foot pin greased sufficiently?

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

※ HOW TO CHECK INTERNAL BOOM CYLINDER LEAKAGE

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



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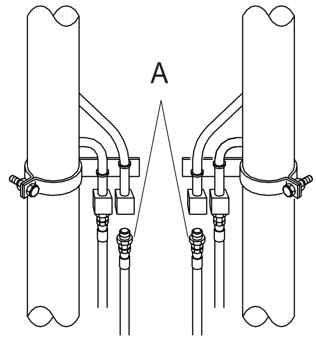
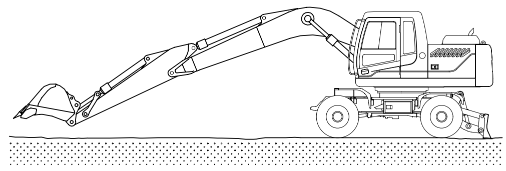
2. Disconnect hose (A) from rod side of boom cylinder and drain oil from cylinders and hose. (put cups on piping and hose ends)



(210-7) 6-20(2)

3. Raise bucket OFF the ground by retracting the arm cylinder rod.

   If oil leaks from piping side and boom cylinder rod is retracted there is an internal leak in the cylinder.
   If no oil leaks from piping side and boom cylinder rod is retracted, there is an internal leak in the control valve.



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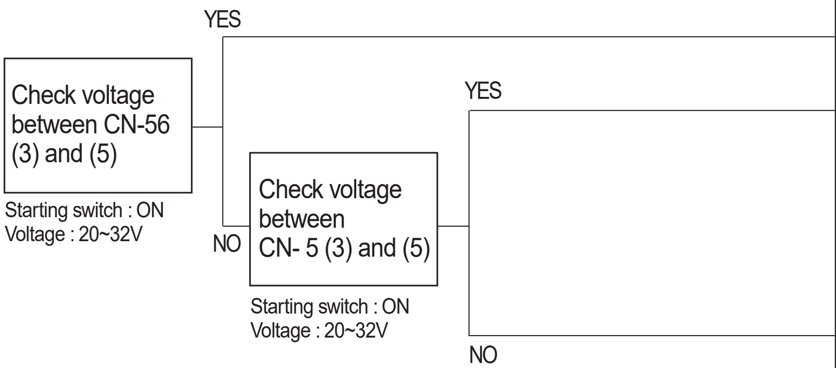
7. FRONT AXLE AND REAR AXLE

Problem	Cause	Correction
Insufficient braking	1. Incorrect adjustment	Inspect disc thickness and if discs are usable readjust brakes to the specifications in the manual.
	2. Brake discs worn out	Inspect disc thickness and replace if necessary.
	3. Incorrect brake fluid	Replace all seals in axle and master cylinder that have made contact with the incorrect fluid and all brake hoses. If incorrect fluid leaked into axle oil, seals and O-rings in axle must be replaced.
	4. Loss of brake fluid	Inspect for and repair any leaks in outside circuit or master cylinder. If caused by incorrect brake fluid see correction No.3. If leak is to the outside replace the O-rings between the center and intermediate housings. If leak is to the inside replace above O-rings and brake piston O-rings.
	5. Overheated axle causing brake fluid to vaporize. (Brake return when axle cools)	See “overheating” problem.
Soft brake pedal	6. Air in brake circuit	Bleed air in brake circuit.
Ineffective safety brake	7. Incorrect adjustment	See correction No.1.
	8. Brake disc worn out	See correction No.2.
Overheating	9. Oil level wrong	Drain, flush and refill oil to proper level.
	10. Too small of a brake gap	Readjust brakes to the specifications.
	11. Park brake dragging	Unlock the brake and adjust the correct gap.
	12. Incorrect brake fluid in system	See correction No.3.
	13. No free-pedal at master cylinder	Readjust brake pedal.
	14. Restriction in brake lines	Inspect for and replace damage lines.
	15. Restriction in return line of brake servo system	Inspect for and replace damaged return line. Inspect for and remove any filter, tee’d in line or any other source of back pressure from the return line.
	16. Incorrect lubricant	Change the retaining rings of the brake circuit and brake pump.
Diff-lock inoperative	17. If manual control, loose or misadjusted linkage	Inspect and correct linkage and readjust.
	18. If hydraulic control, problems in the hydraulic or electrical circuits of the machine.	Refer to the hydraulic or electrical section in this manual.
	19. If hydraulic control problems in actuating cylinder(noteable through loss of hydraulic oil or increase of the oil level in axle)	Rebuilt cylinder.
	20. If with limit slip differential, worn discs	Replace discs.

Problem	Cause	Correction
Oil coming out of breather	21. Leak in internal brake system	See correction No.2 and No.3.
	22. Leak in diff-lock actuating cylinder	See correction No.19.
Nospin indexing noise when driving straight ※With nospin, fatigue damage can occur on the side with the larger tire.	23. Unequal tire pressure left and right	Inflate tires to the recommended pressure in this manual, or until the rolling radius is equal.
	24. Different style, size or brand of tires between left and right hand side	Change tires to make the rolling radius equal. Vary the tire pressure within the specifications until the rolling radius is equal.
Noise during coast and under power the same	25. Wheel bearings damaged	Replace and adjust
Noise under power greater than during coast	26. Low oil level	Refill oil to proper level
	27. Incorrect lubricant	See correction No.16.
	28. Ring and pinion worn	Inspect through top cover. Replace and adjust.
	29. Worn ring and pinion bearings	Replace and adjust
	30. Worn planetary gears or bearings	Replace.
Noise during coast greater than under power	31. Loose pinion nut	Inspect ring, pinion and pinion bearings. If undamaged, retighten nut.
	32. Only pinion bearing damaged	See correction No.29.
Noise during turn (Without nospin)	33. Worn spider and/or side gears	Replace.
A stick slip noise when going from forward to reverse	34. Worn or damaged cardan shaft	Inspect and replace.
	35. Loose wheel	Inspect for wheel and wheel stud damage. Replace if needed and retorque lugnuts.
	36. Articulation box joint and achsel shaft damaged	Inspect and replace.
	37. Spider pins loose in diff-carrier	Inspect through top cover. Replace.
	38. Damaged or missing spider and/or side gear washers	See correction No.33.

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

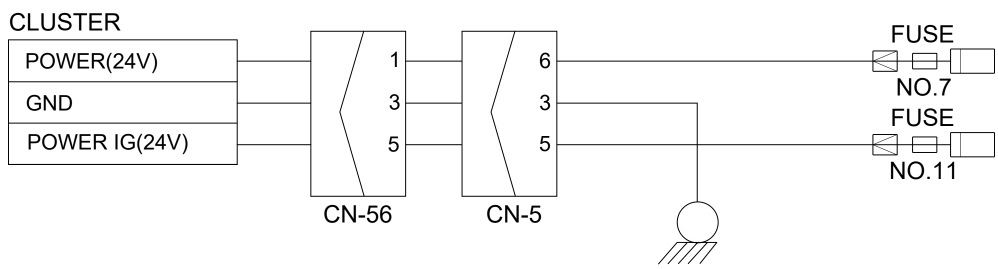
- Before disconnecting the connector, always turn the starting switch OFF.
- Before carrying out below procedure, check all the related connectors are properly inserted and short of fuse No.7, 11.
- After checking, insert the disconnected connectors again immediately unless otherwise specified.



Cause	Remedy
Defective cluster	Replace
Disconnection in wiring harness or poor contact between CN-5-CN-56	Repair or replace (after clean)
Disconnection in wiring harness or poor contact between CN-5 (3) -GND or fuse No.7, 11	Repair or replace (after clean)

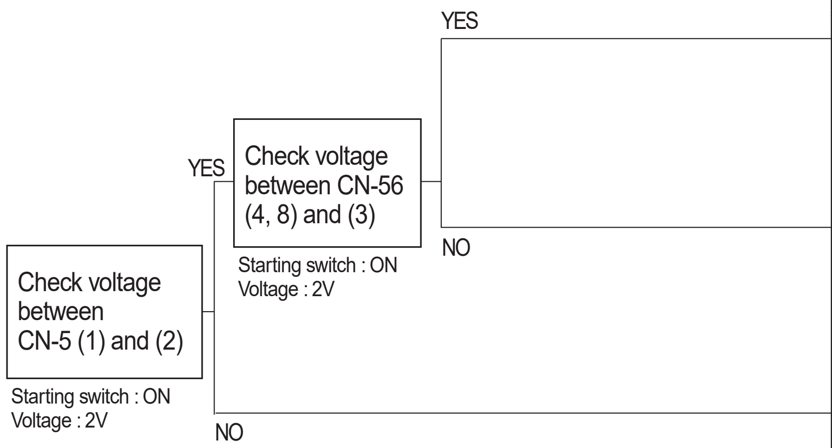
Check voltage

YES	20~32V
NO	0V



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

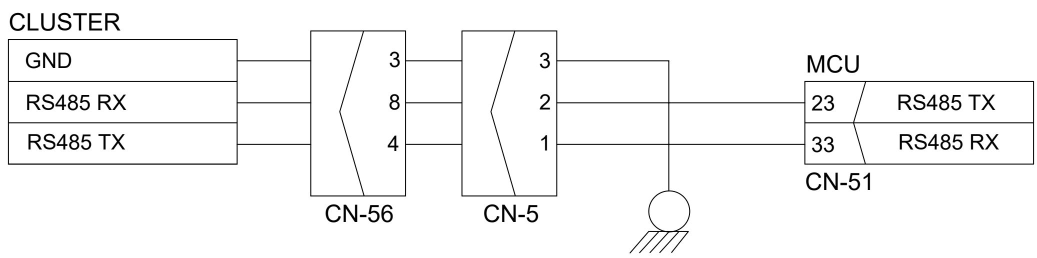
· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.



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

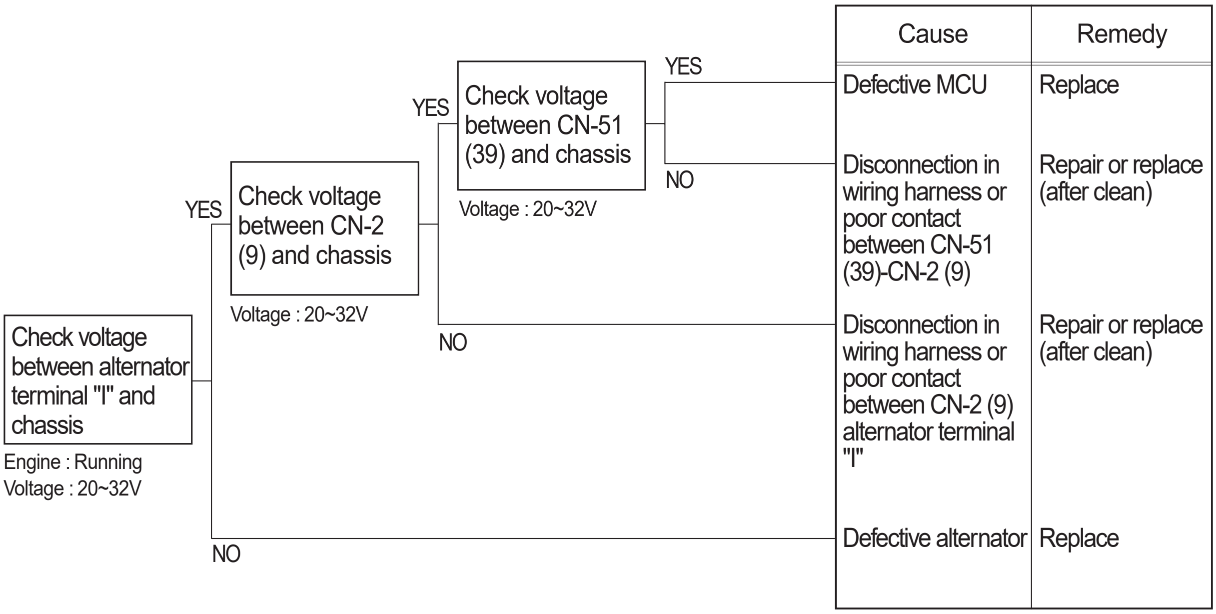
Check voltage

YES	2V
NO	0V



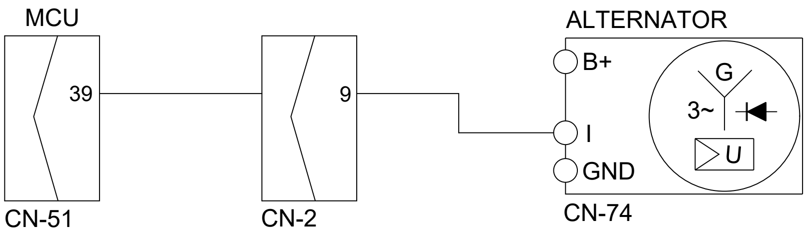
3. BATTERY CHARGING WARNING LAMP LIGHTS UP(Starting switch : ON)

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



Check voltage

YES	20~32V
NO	0V



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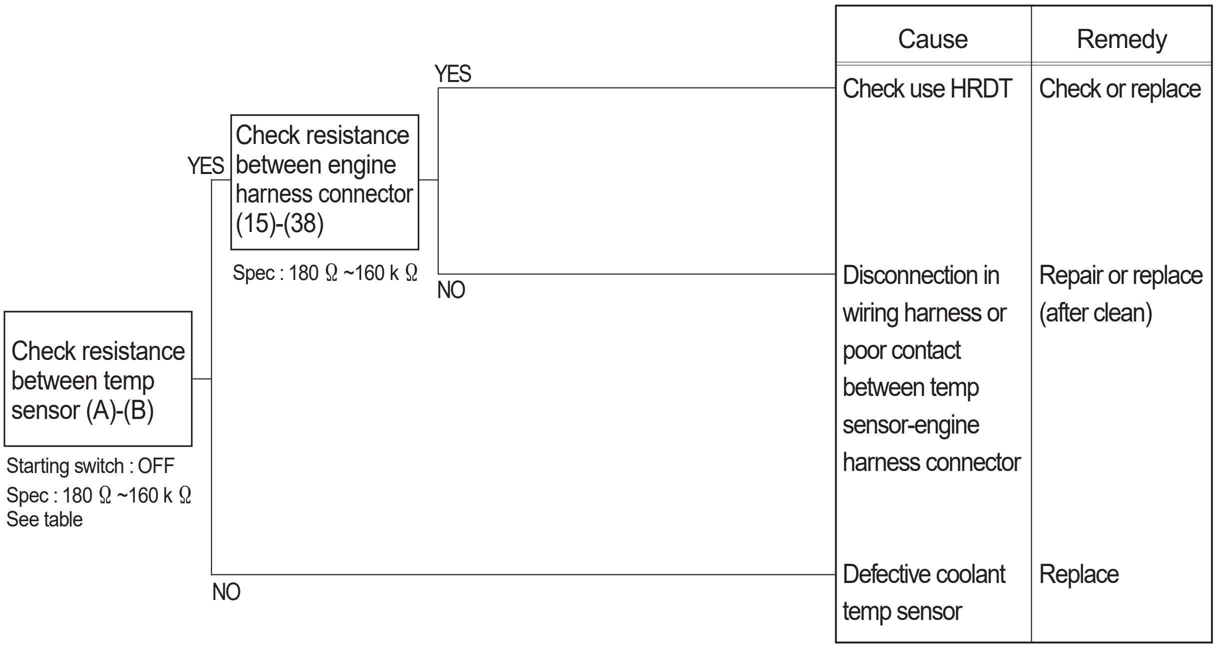
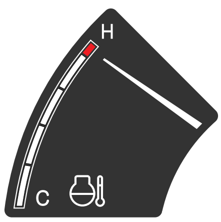
4. WHEN COOLANT OVERHEAT WARNING LAMP LIGHTS UP (engine is started)

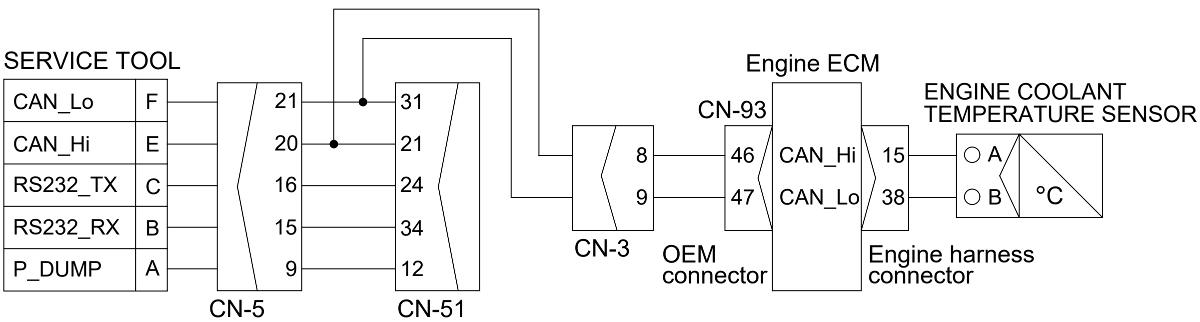
· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.





Check Table

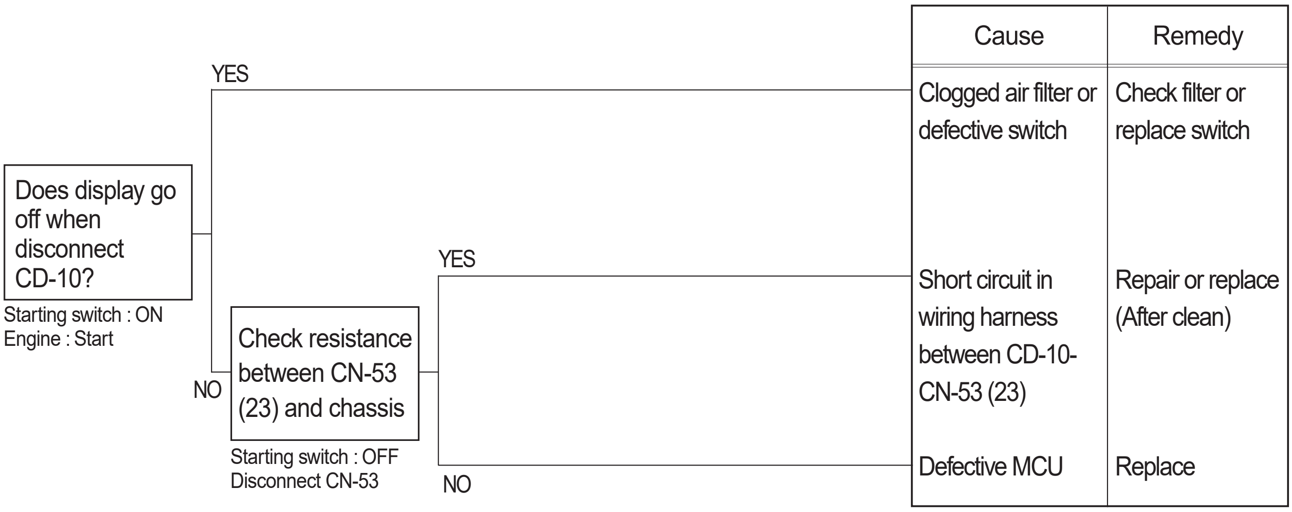
Temperature (°C)	0	25	50	80	95
Resistance (k Ω)	30~37	9.3~10.7	3.2~3.8	1.0~1.3	0.7~0.8



21096ES04

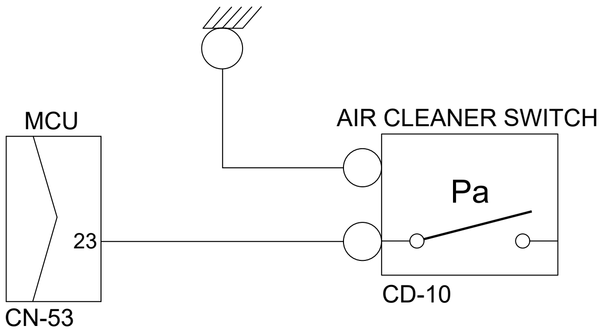
5. WHEN AIR CLEANER WARNING LAMP LIGHTS UP (engine is started)

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



Check resistance

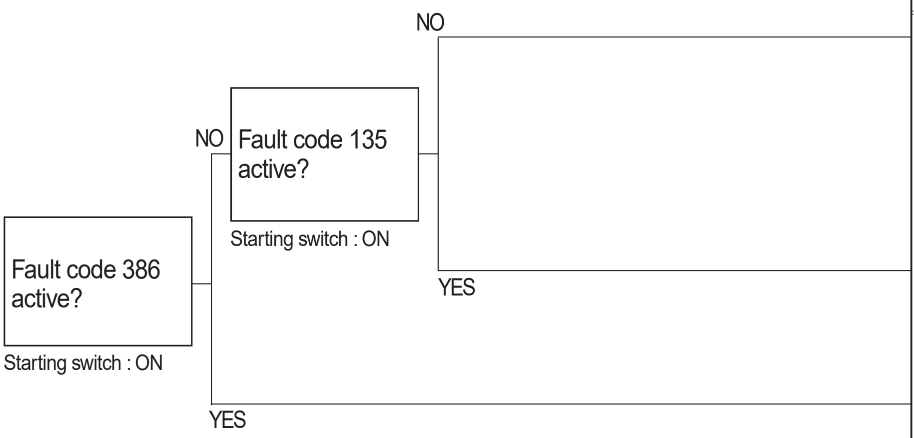
YES	MAX 1Ω
NO	MIN 1MΩ



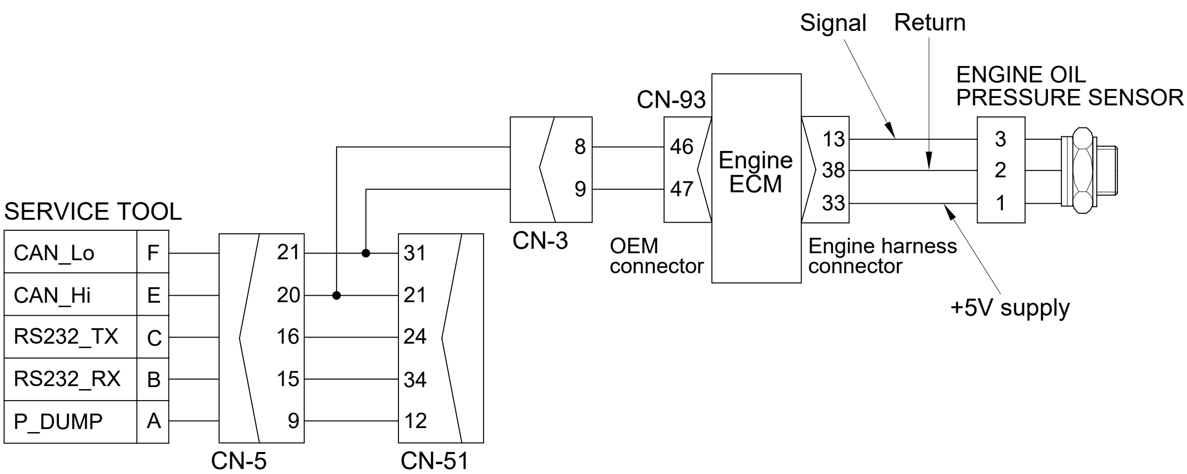
21096ES05

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

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



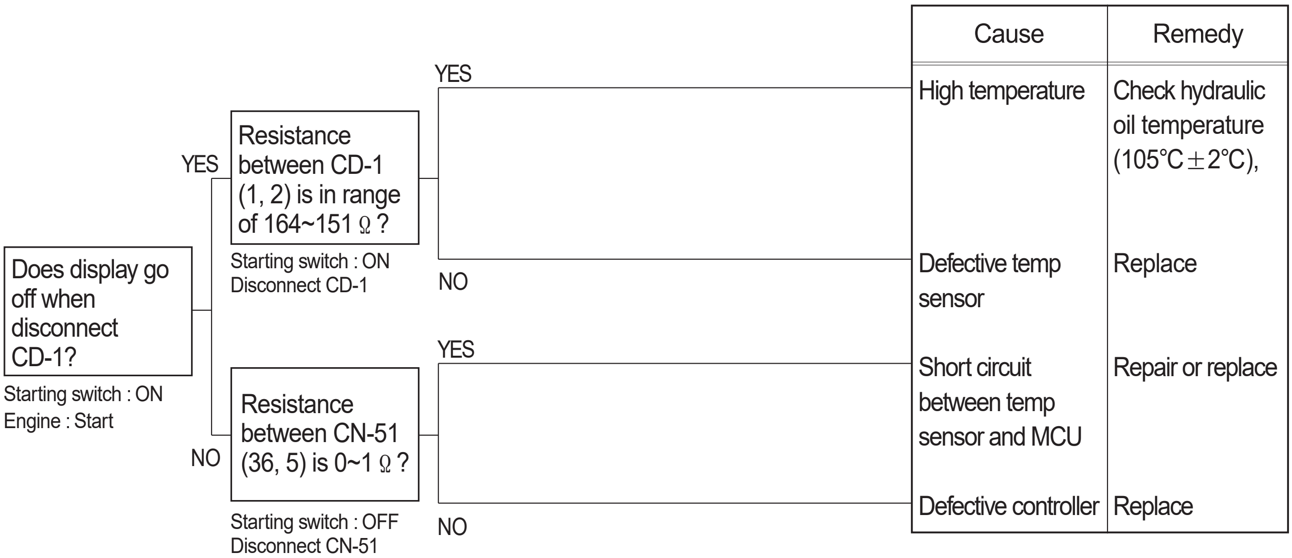
Cause	Remedy
Defective circuit, sensor or ECM.	Contact Cummins.
Voltage above normal or shorted to high source	Refer to engine fault code 135
Voltage above normal or shorted to high source	Refer to engine fault code 386

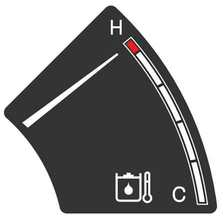


21096ES06

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

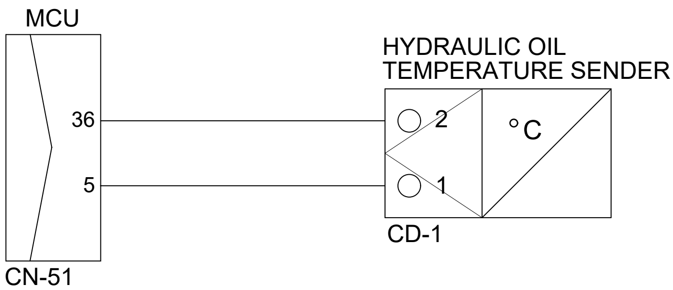
· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.





Check Table

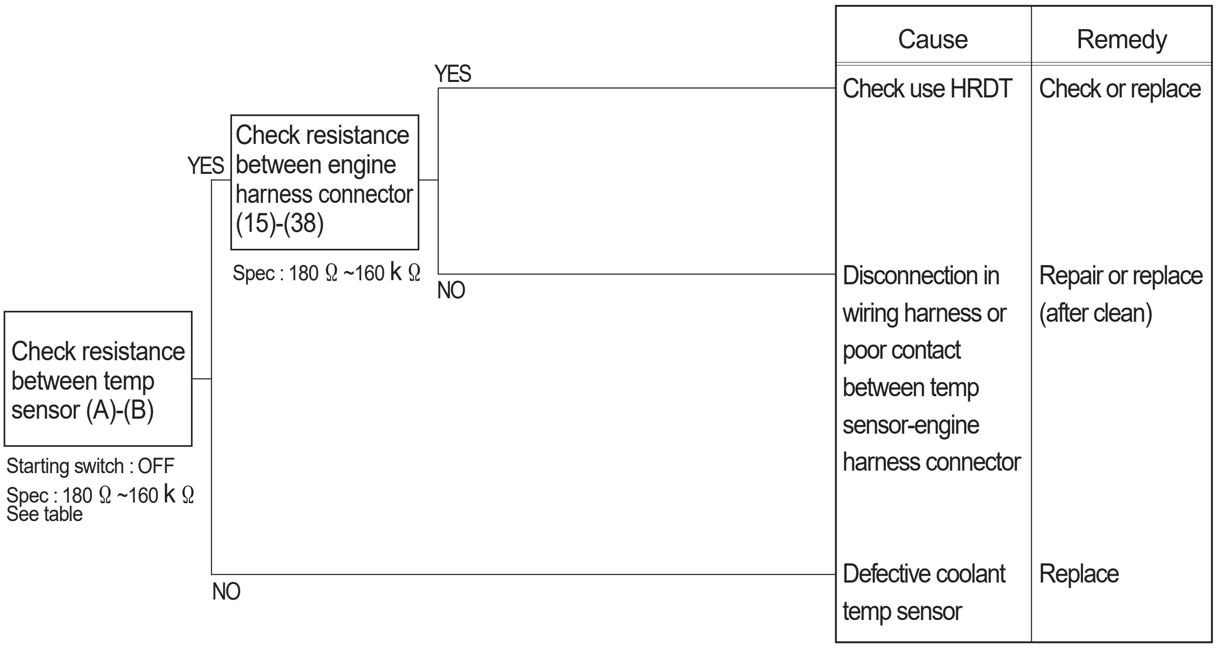
Temperature (°C)	~ -30	~ -10	~ 0	~ 40	~ 70	~ 80	~ 90	~ 100	105~
Resistance (kΩ)	22.22 ~31.78	8.16 ~10.74	5.18 ~ 6.6	1.06 ~1.28	0.39 ~0.476	0.322 ~0.298	0.243 ~0.219	0.185 ~0.167	0.164 0.151

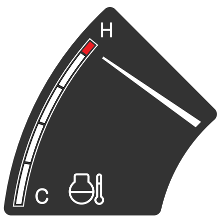


21096ES07

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

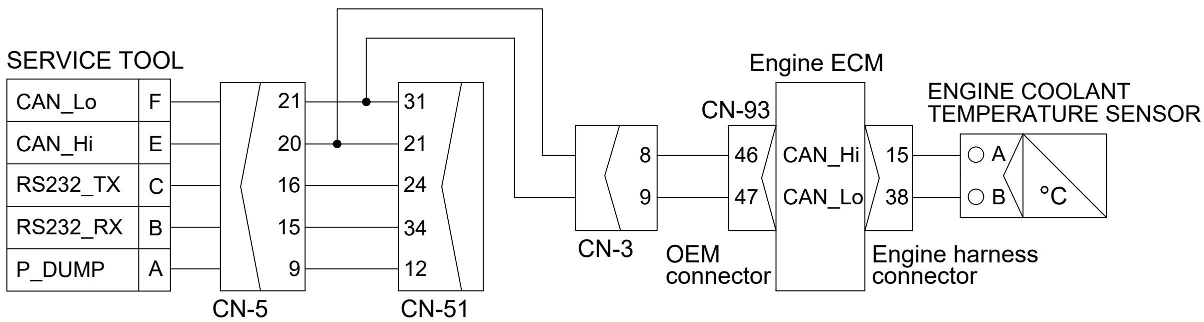
· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.





Check Table

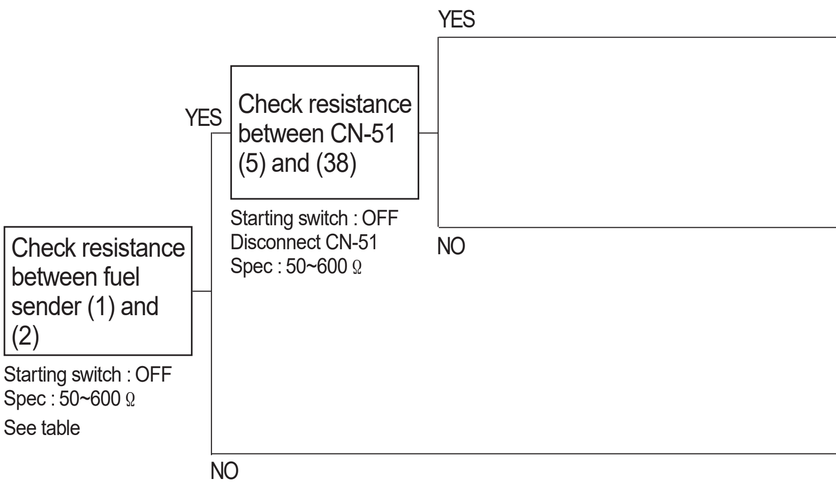
Temperature (°C)	0	25	50	80	95
Resistance (kΩ)	30~37	9.3~10.7	3.2~3.8	1.0~1.3	0.7~0.8



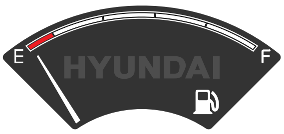
21096ES04

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.

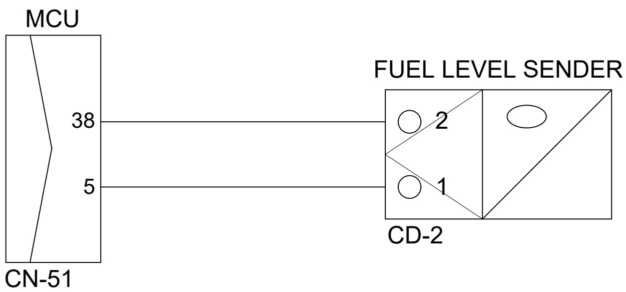


Cause	Remedy
Defective MCU or cluster	Replace
Disconnection in wiring harness or poor contact between fuel sender-MCU	Repair or replace
Defective fuel sender	Replace



Check Table

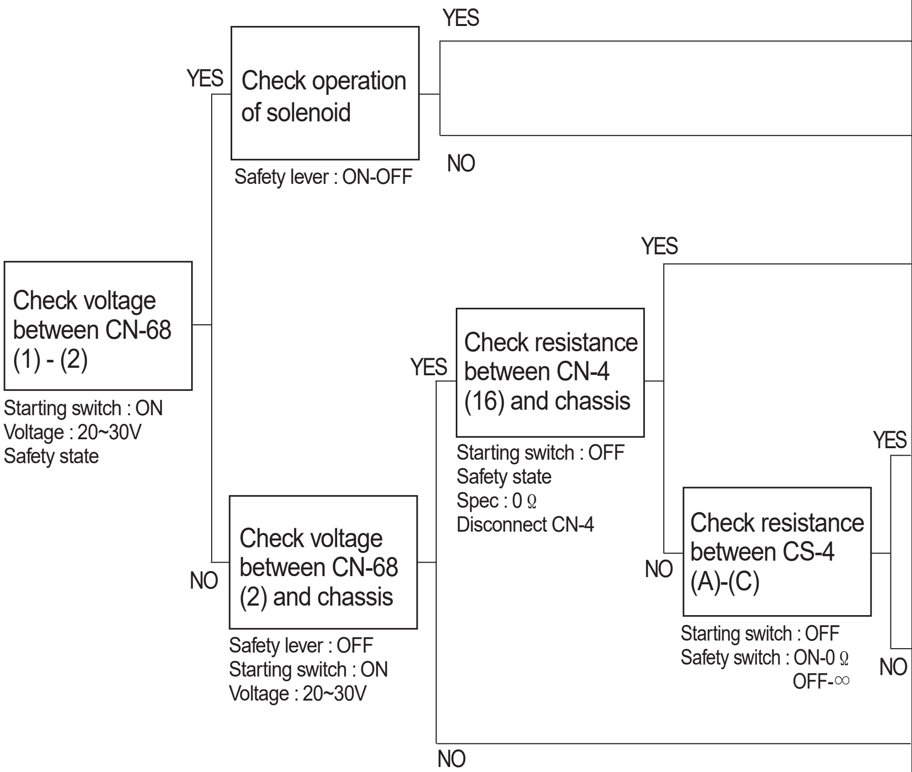
Range	Resistance (Ω)	Range	Resistance (Ω)
Full	50	5/12	400
11/12	100	4/12	450
10/12	150	3/12	500
9/12	200	2/12	550
8/12	250	1/12	600
7/12	300	Empty warning	700
6/12	350	-	-



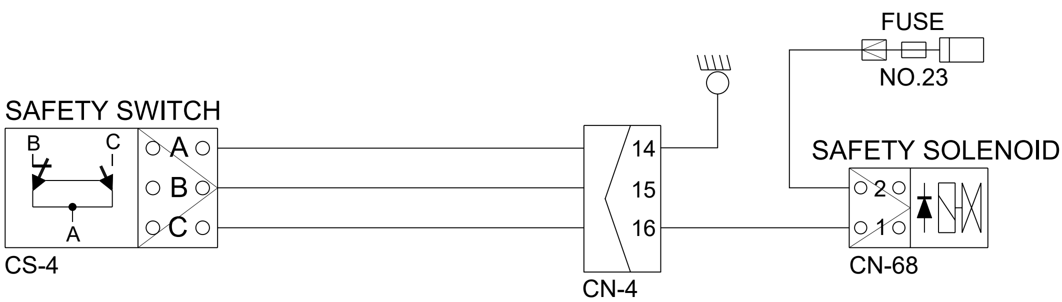
21096ES09

10. WHEN SAFETY SOLENOID DOES NOT OPERATE

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



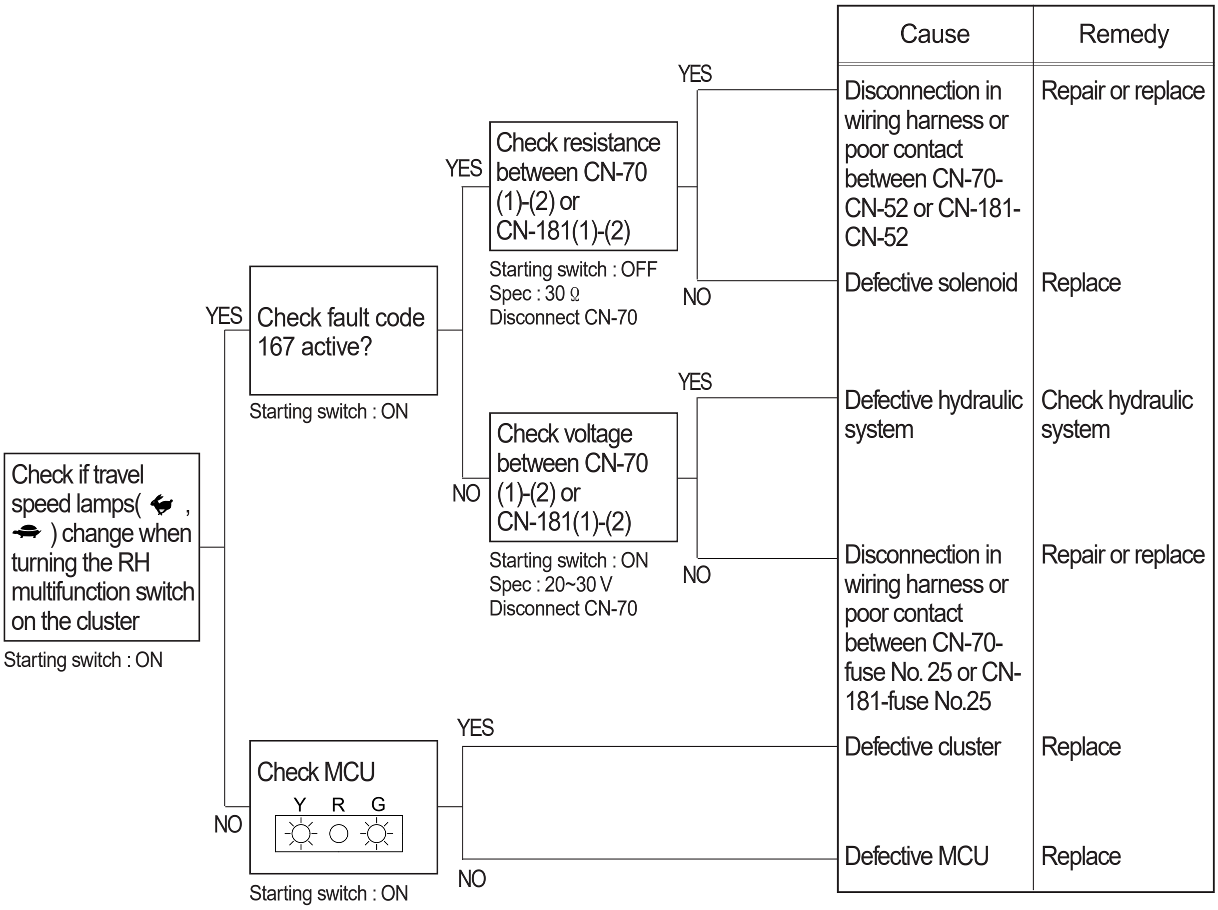
Cause	Remedy
Hydraulic system malfunction	Check hydraulic system
Defective solenoid	Replace
Disconnect in wiring harness or poor contact between CN-4-CN-68	Repair or replace (after clean)
Disconnect in wiring harness or poor contact between CN-4-CS-4	Repair or replace (after clean)
Defective safety switch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

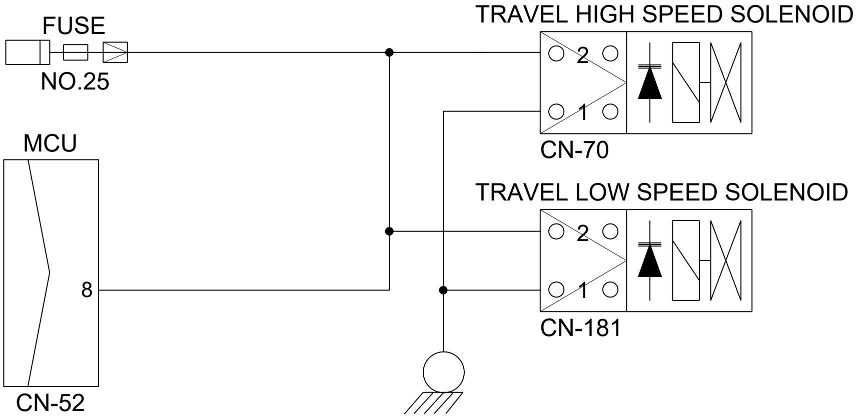


21096ES10

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

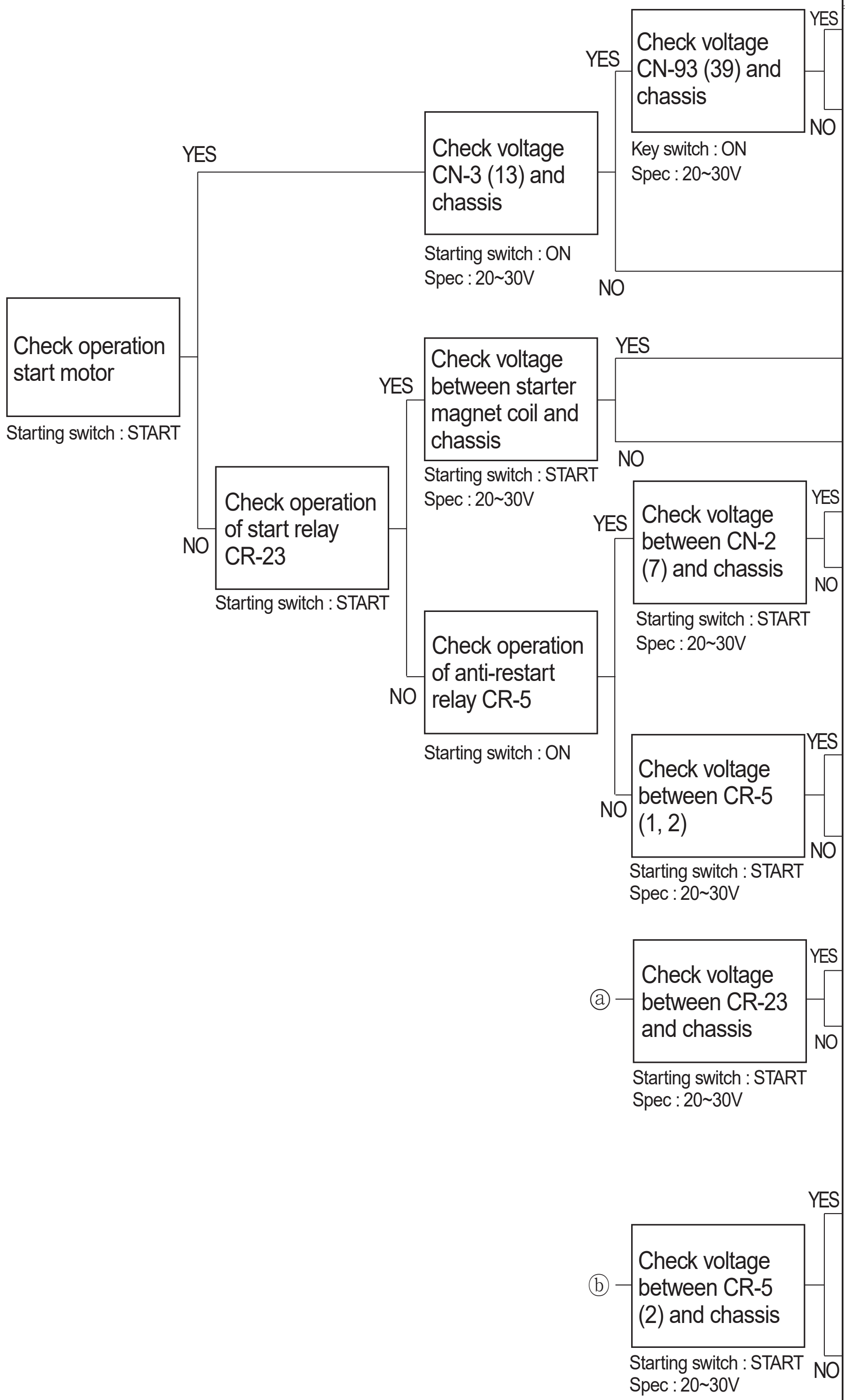
- Before disconnecting the connector, always turn the starting switch OFF.
- Before carrying out below procedure, check all the related connectors are properly inserted and short of fuse No.25 .
- After checking, insert the disconnected connectors again immediately unless otherwise specified.



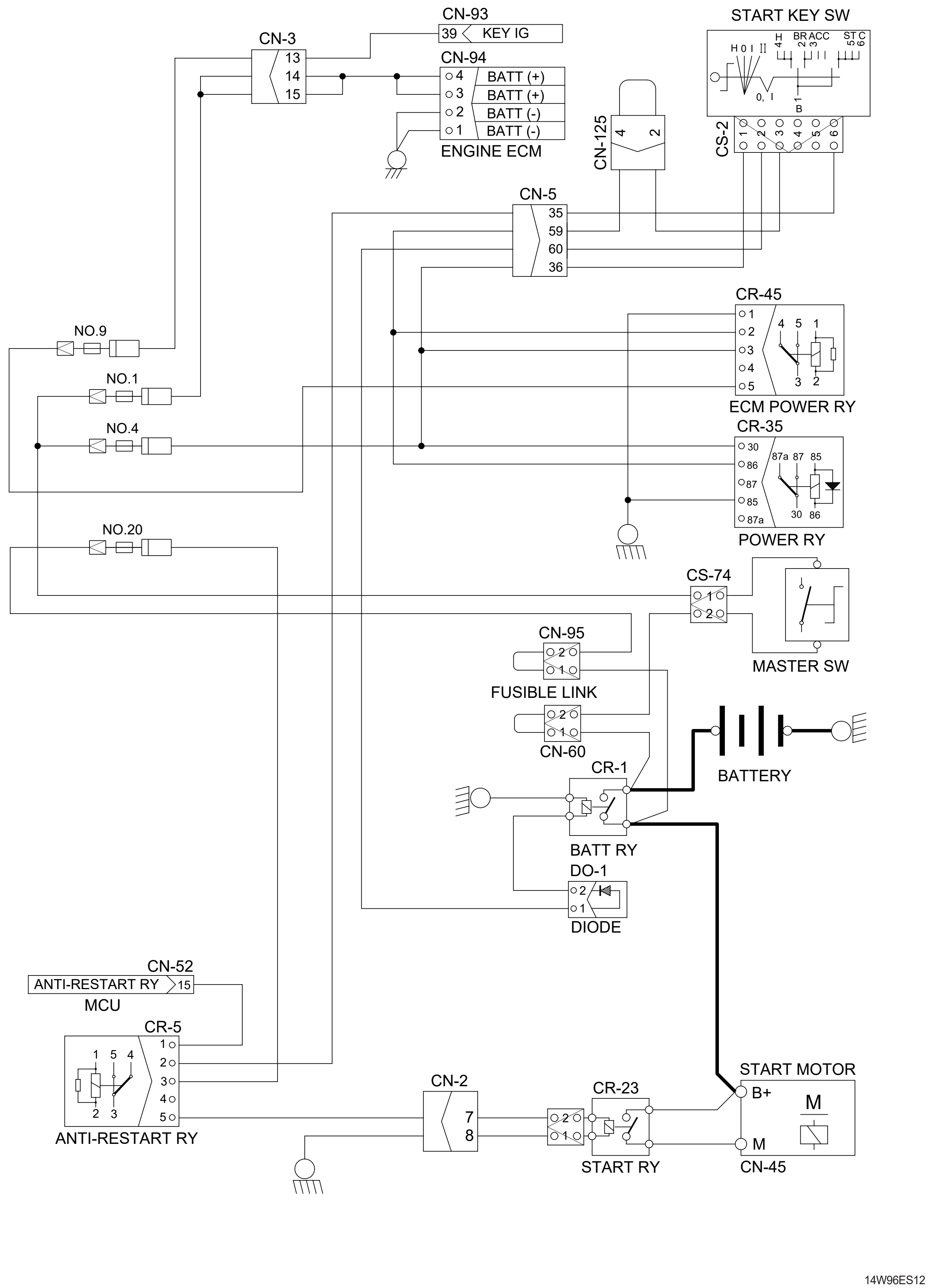


12. WHEN ENGINE DOES NOT START (lights up condition)

- Before disconnecting the connector, always turn the starting switch OFF.
- Before carrying out below procedure, check all the related connectors are properly inserted and short of fuse No. 1, 4, 9, 20.
- After checking, insert the disconnected connectors again immediately unless otherwise specified.

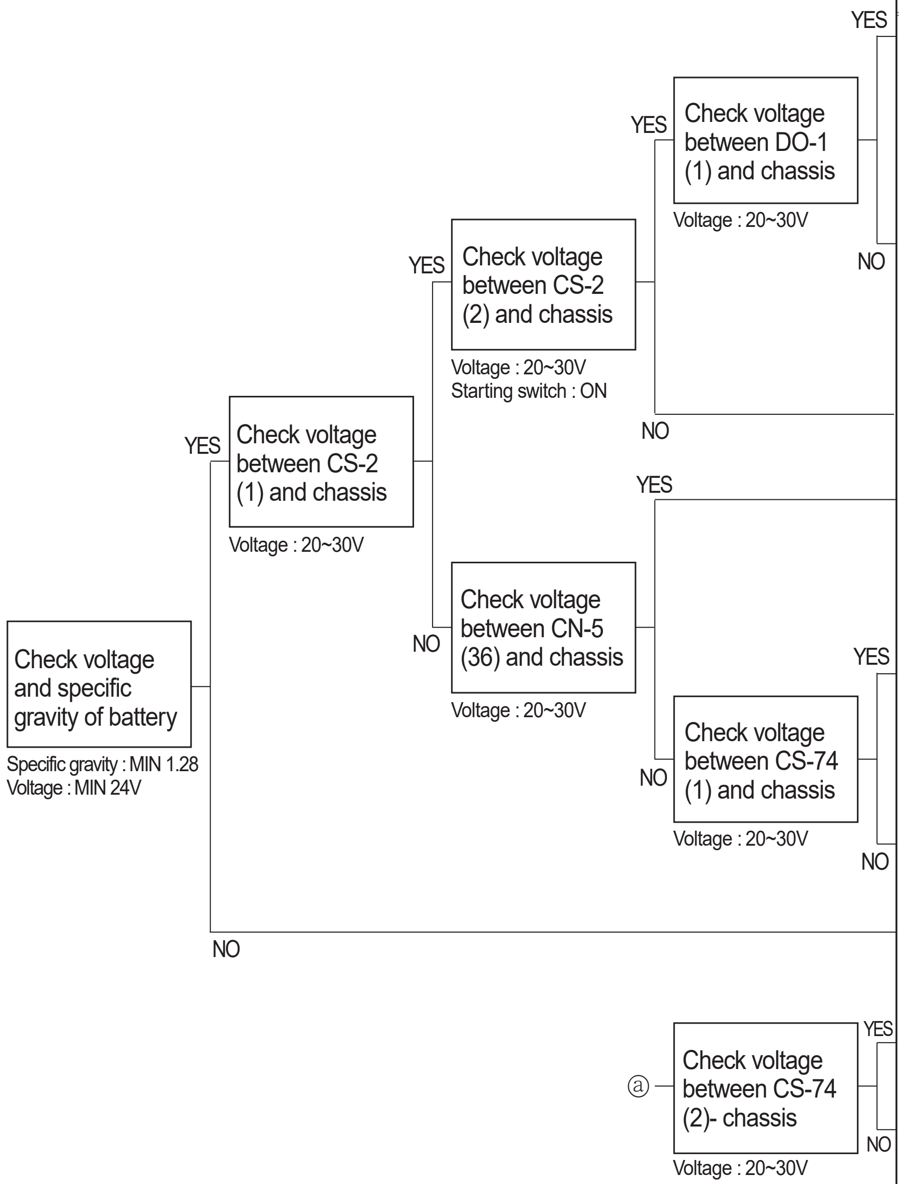


Cause	Remedy
Defective ECM or battery	Replace
Disconnection in wiring harness or poor contact between CN-3 (13) -CN-93 (39)	Repair or replace
Defective ECM power relay CR-45	Replace
Defective magnet of start motor	Replace
Defective start relay	Replace
ⓐ	
Disconnection in wiring harness or poor contact between CN-2 (7) -CR-5 (5)	Repair or replace
Defective anti-restart relay	Replace
ⓑ	
Defective start relay	Replace
Disconnection in wiring harness or poor contact between CN-2-CR-5	Repair or replace
Disconnection in wiring harness or poor contact between CN-52 (15)-CR-5 (1)	Repair or replace
Disconnection in wiring harness or poor contact between CS-2 (6)-CR-5 (2)	Repair or replace

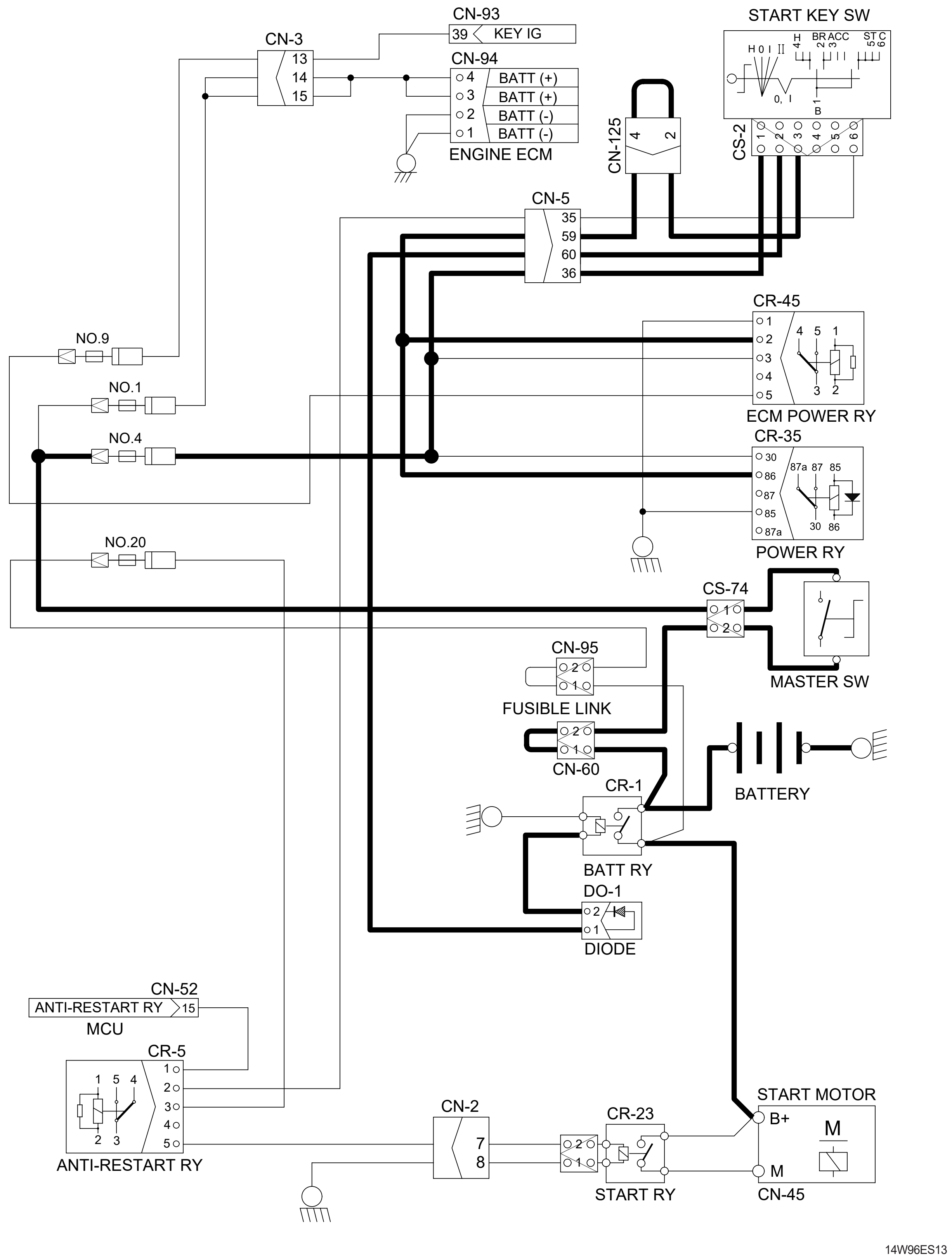


13. WHEN STARTING SWITCH ON DOES NOT OPERATE

· 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.

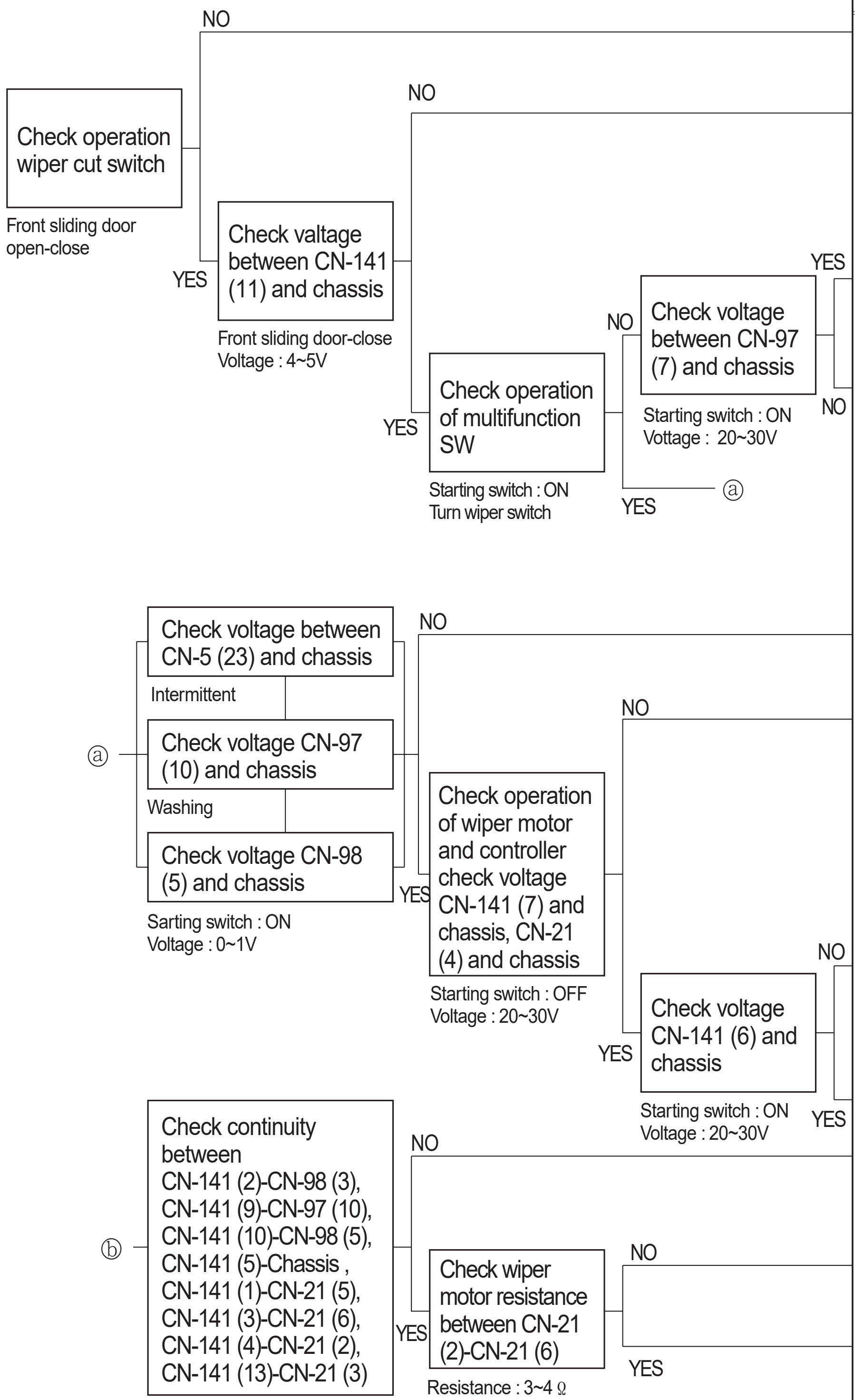


Cause	Remedy
Disconnection in wiring harness or poor contact between DO-1 (1)-CR-1 or defective battery relay	Repair or replace (after clean)
Disconnection in wiring harness or poor contact between CS-2 (2)-CN-5(60)- DO-1 (1)	Repair or replace (after clean)
Defective start switch	Replace
Disconnection in wiring harness or poor contact between CS-2 (1)-CN-5 (36)	Replace
Disconnection in wiring harness or poor contact between CS-74 (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)

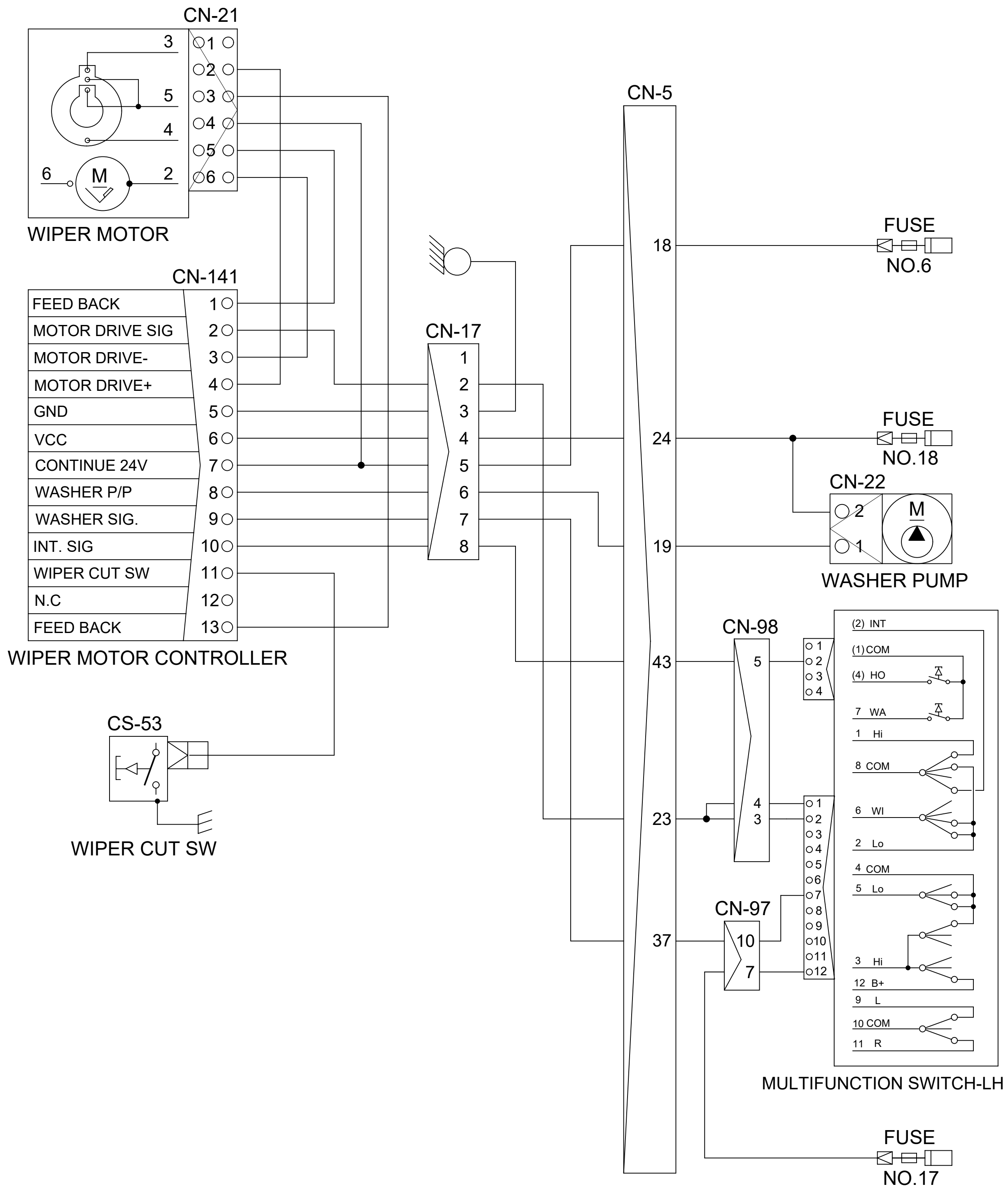


14. WHEN STARTING SWITCH IS TURNED ON, WIPER MOTOR DOES NOT OPERATE

· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted and the fuse No. 6, 17 and 18 is not blown out.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.



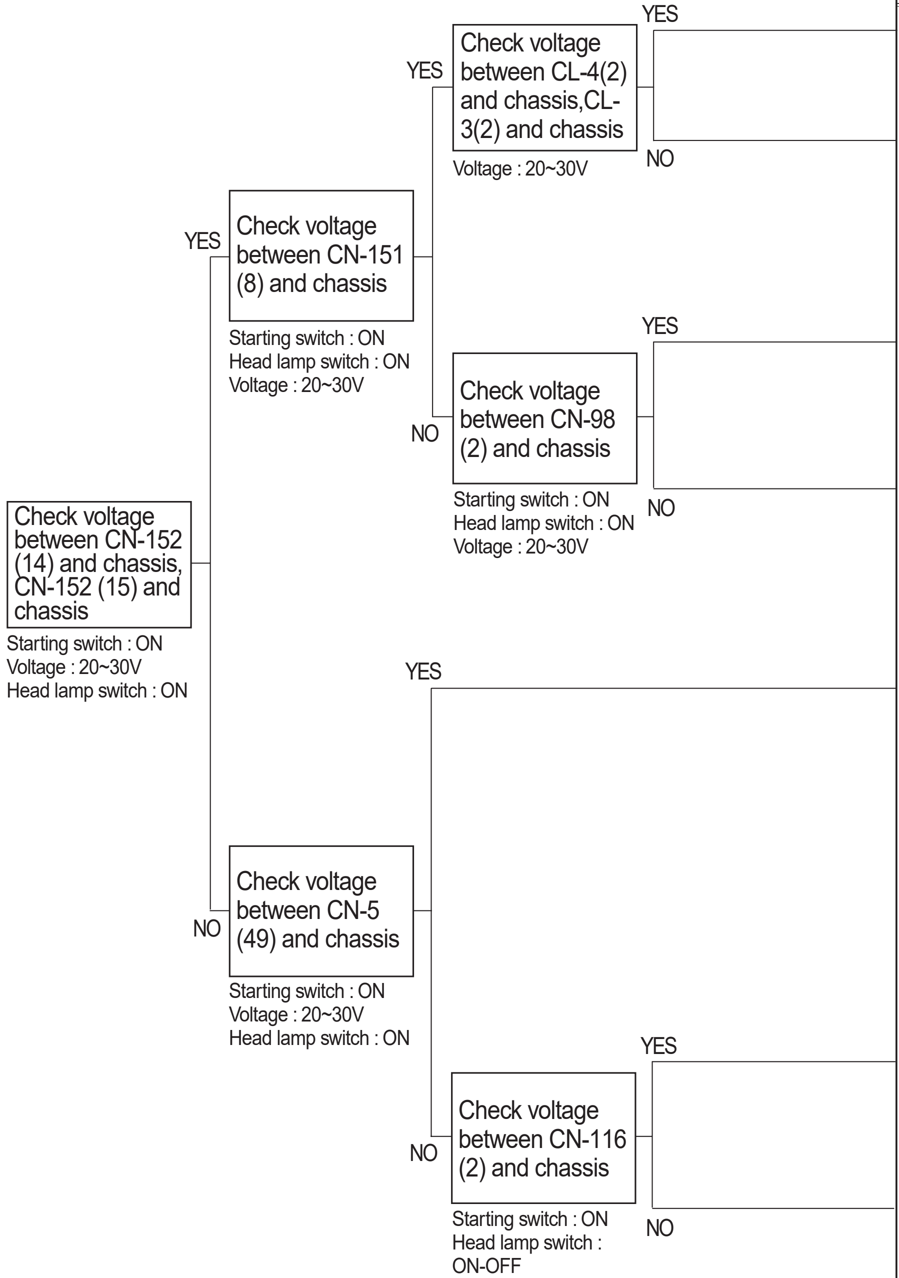
Cause	Remedy
Defective wiper cut switch	Replace
Short circuit in wiring harness or poor contact between CN-141 (11)- CS-53	Repair or replace (after clean)
Defective multifunction switch	Replace
1)Recheck fuse No.17 2)Disconnection in wiring harness or poor contact between CN-97(7)-Fuse	Replace Repair or replace (after clean)
Defective multifunction switch	Replace
1) Recheck fuse No.6 2) Disconnection in wiring harness or poor contact between CN-141(7)-Fuse, CN-21(4)-Fuse	Replace Repair or replace (after clean)
1) Recheck fuse No.18 2) Disconnection CN-141(6)-Fuse	Replace Repair or replace (after clean)
ⓑ	
Disconnection in wiring harness or poor contact	Repair or replace (after clean)
Defective wiper motor	Replace
Defective wiper motor controller	Replace



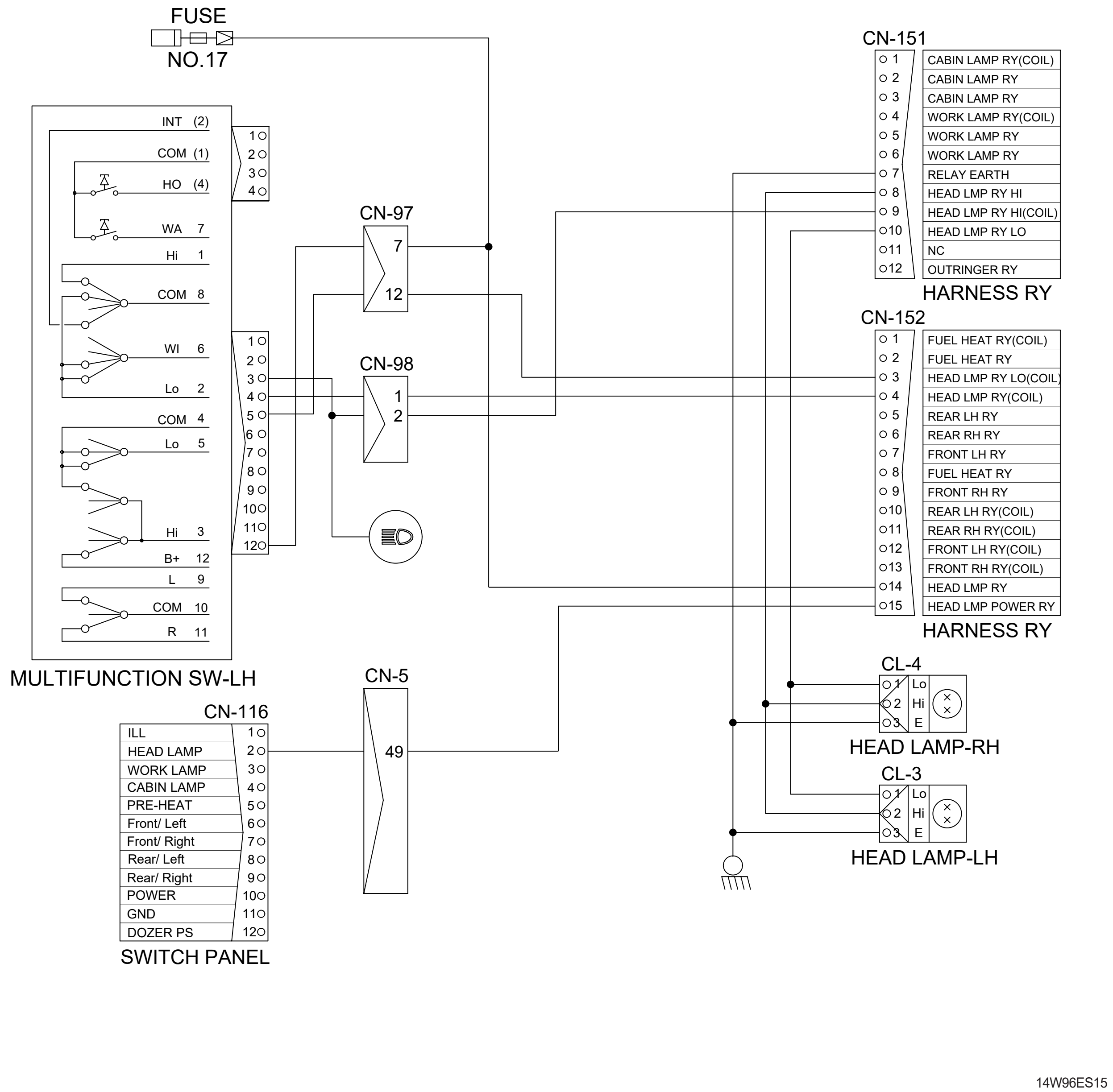
14W96ES14

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.17.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.

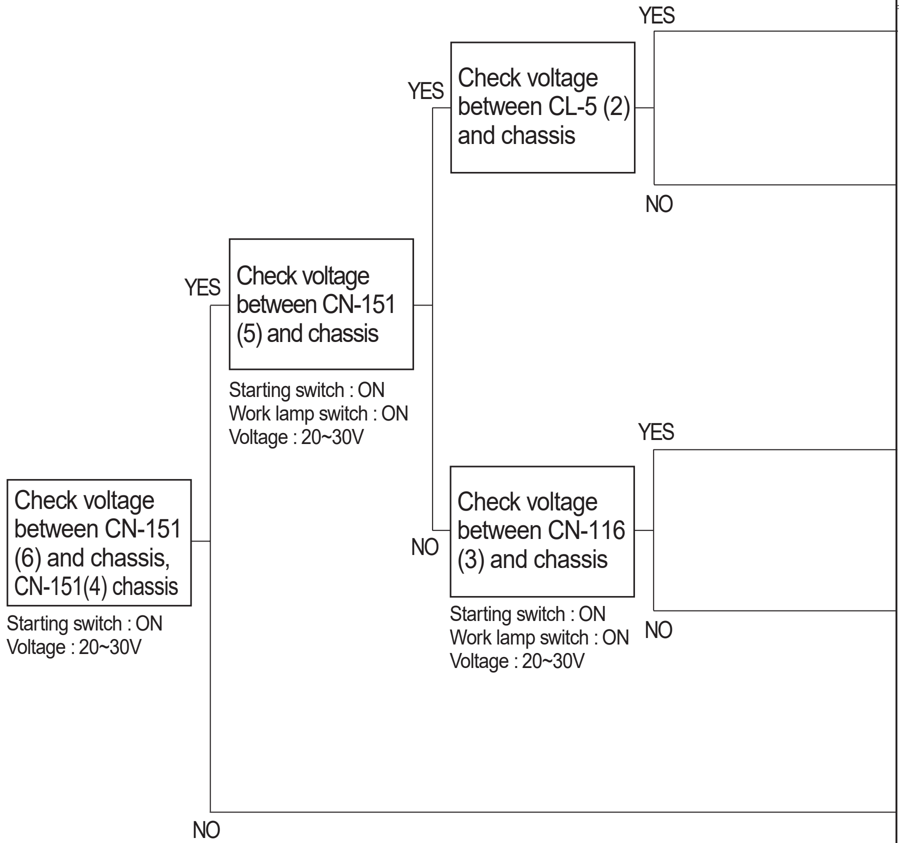


Cause	Remedy
Defective bulb	Replace
Disconnection in wiring harness or poor contact between CN-151 (8)-CL-4 (1) or CN-151(8)-CL-3(2)	Repair or replace (after clean)
Defective multifunction switch	Replace
Disconnection in wiring harness or poor contact between CN-98 (2)-CN-151 (9)	Repair or replace (after clean)
Disconnection in wiring harness or poor contact between CN-152 (14) and chassis or CN-152 (15)-chassis	Repair or replace (after clean)
Recheck fuse No. 17	Replace
Defective switch panel	Replace
Disconnection in wiring harness or poor contact between CN-5(49) and CN-116(2)	Repair or replace (after clean)

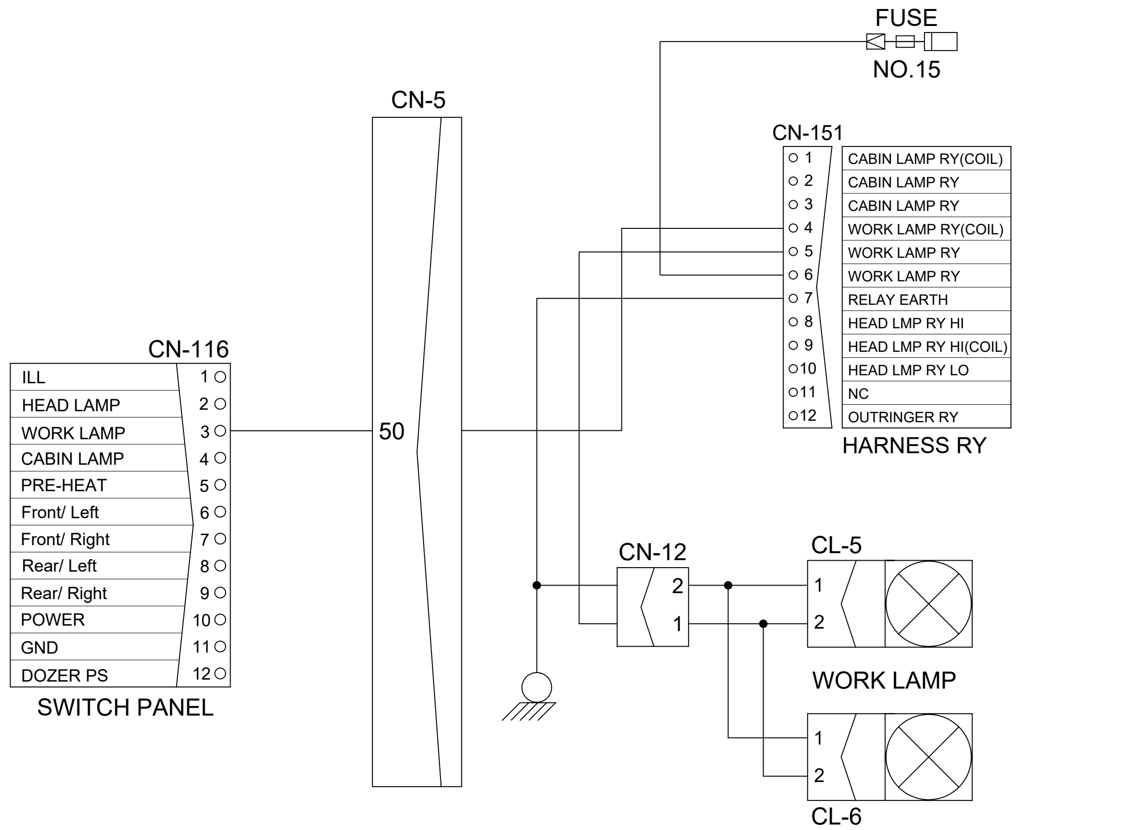


16. WHEN STARTING SWITCH IS TURNED ON, WORK LAMP DOES NOT LIGHTS UP

· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted and short of fuse No.15.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.



Cause	Remedy
Defective bulb	Replace
Disconnection in wiring harness or poor contact between CN-151 (5)-CL-5 (2)	Repair or replace (after clean)
Defective switch panel	Replace
Disconnection in wiring harness or poor contact between CN-151 (5)-CN-116 (3)	Repair or replace (after clean)
Disconnection in wiring harness or poor contact between CN-151 (6) and chassis or CN-151 (4) and chassis	Repair or replace (after clean)
Recheck fuse No.15	Replace

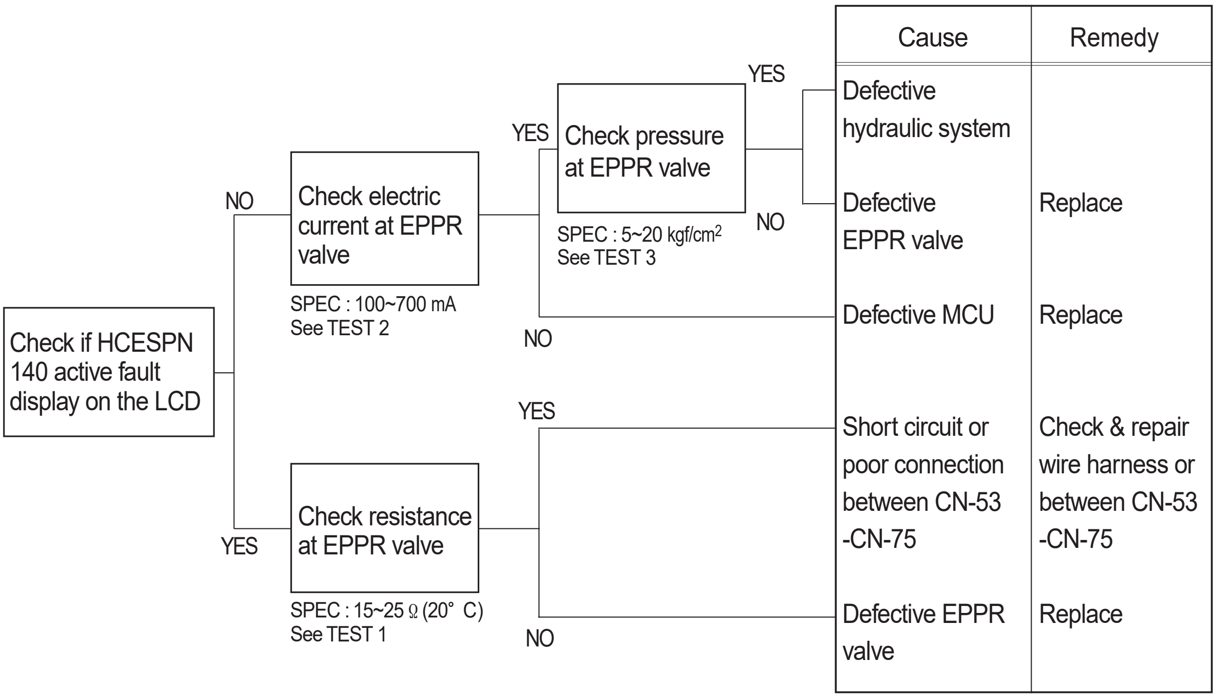


14W96ES16

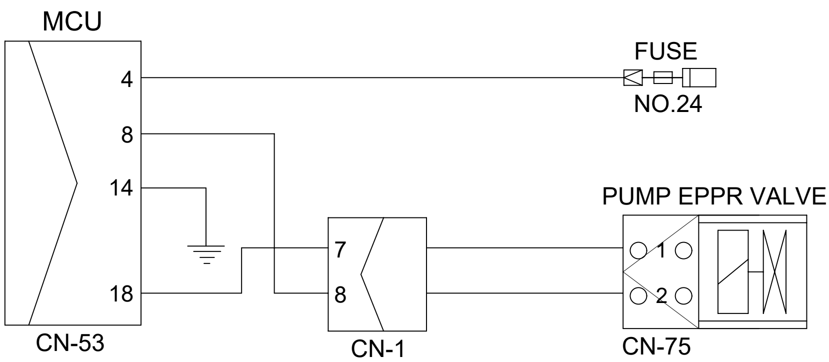
1. ALL ACTUATORS SPEED ARE SLOW

※ Boom, Arm, Bucket, Swing and travel speed are slow, but engine speed is good.
※ Spec : P-mode 1500 ± 50 rpm S -mode 1400 ± 50 rpm E-mode 1300 ± 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



14W96MS01

2) TEST PROCEDURE

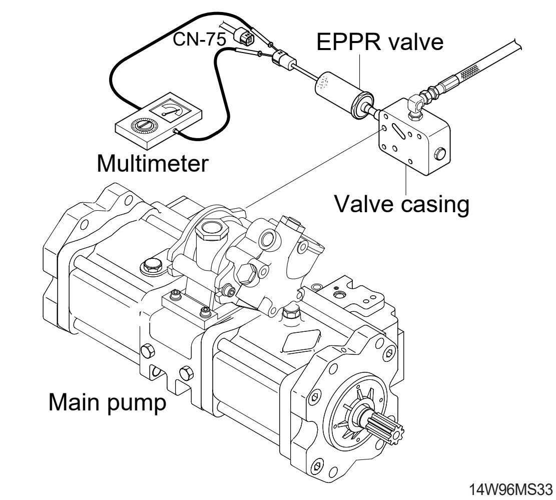
(1) Test 1 : Check resistance at connector CN-75.

① Starting key OFF.

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

③ Check resistance between 2 lines as figure.

SPEC : 15~25 Ω (20°C)



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

① Disconnect connector CN-75 from EPPR valve.

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

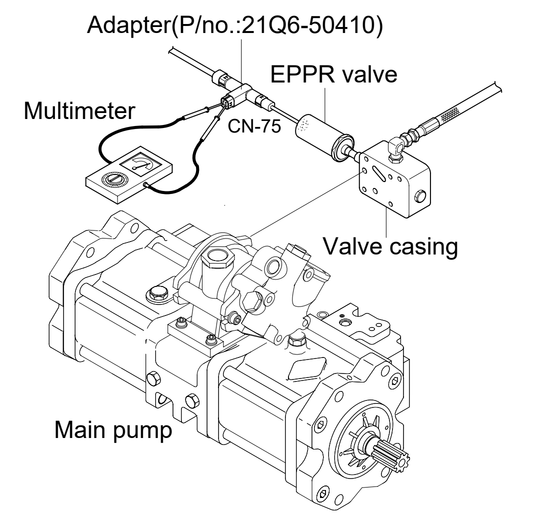
③ Start engine.

④ Set S-mode and cancel auto decel mode.

⑤ Position the accel dial at 10.

⑥ If rpm display approx 1400±50 rpm check electric current at bucket circuit relief position.

Spec : 100~700 mA



(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 710 psi)

② Start engine.

③ Set S-mode and cancel auto decel mode.

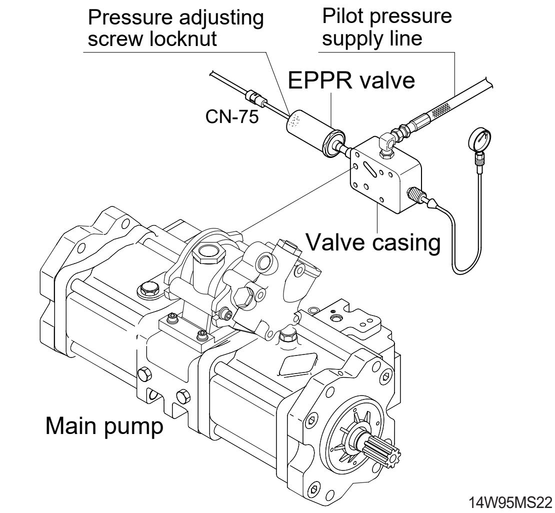
④ Position the accel dial at 10.

⑤ If rpm display approx 1400±50 rpm check pressure at relief position of bucket circuit by operating bucket control lever.

⑥ If pressure is not correct, adjust it.

⑦ After adjust, test the machine.

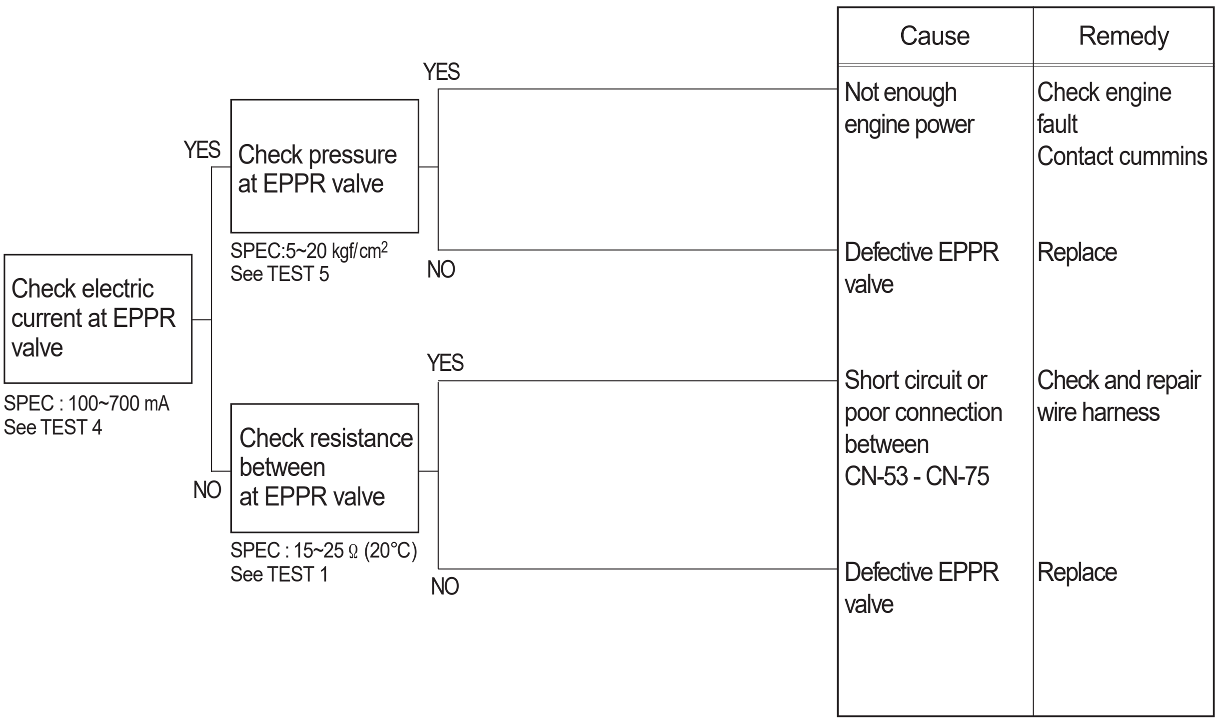
Spec : 2~25 kgf/cm^2 (30~350 psi)



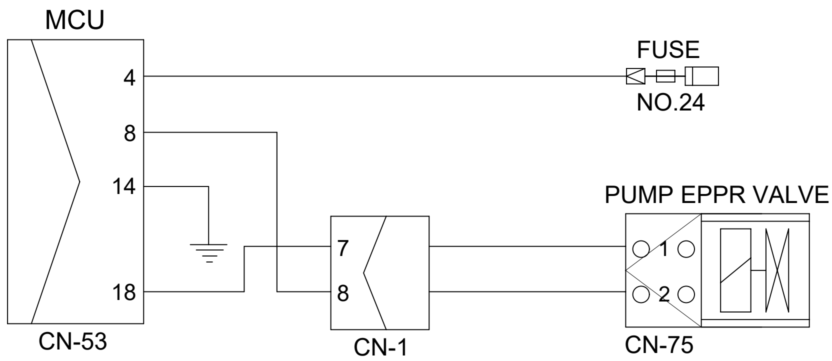
2. ENGINE STALL

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

1) INSPECTION PROCEDURE



Wiring diagram

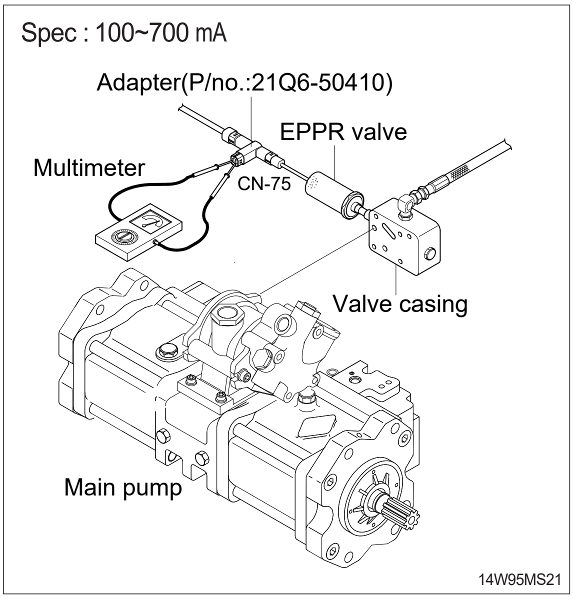


14W96MS01

2) TEST PROCEDURE

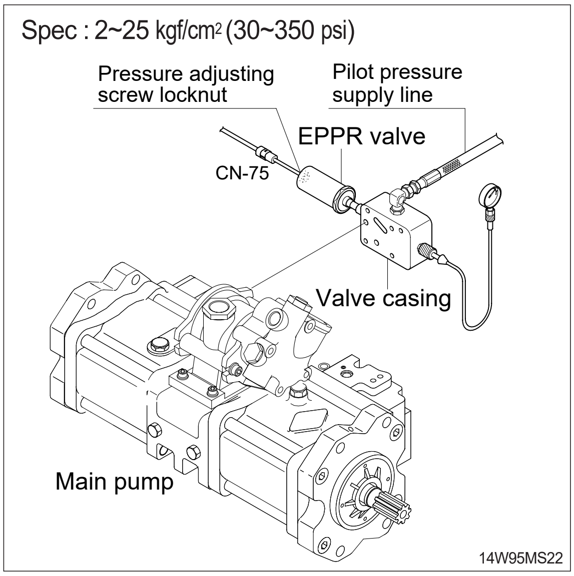
(1) Test 4 : Check electric current at EPPR valve.

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. Position the accel dial at 10.
⑤ If rpm display approx 1400±50 rpm
⑥ check electric current at bucket circuit relief position.



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

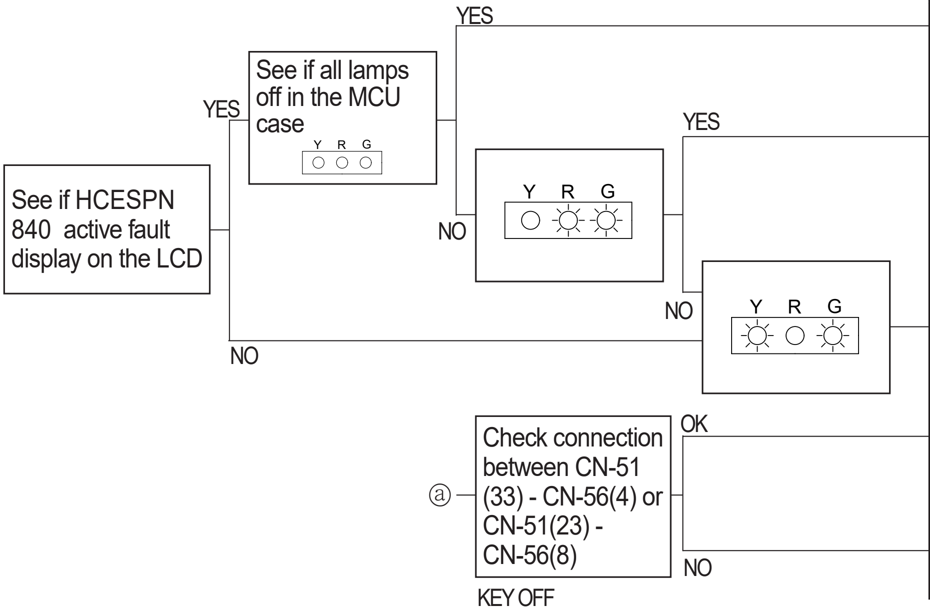
① Remove plug and connect pressure gauge as figure.
  · Gauge capacity : 0 to 50 kgf/cm2 (0 to 710 psi)
② Start engine.
③ Set S-mode and cancel auto decel mode.
④ Position the accel dial at 10.
⑤ If rpm display approx 1400±50 rpm check pressure at relief position of bucket circuit by operating bucket control lever.
⑥ If pressure is not correct, adjust it.
⑦ After adjust, test the machine.



3. MALFUNCTION OF CLUSTER OR MODE SELECTION SYSTEM

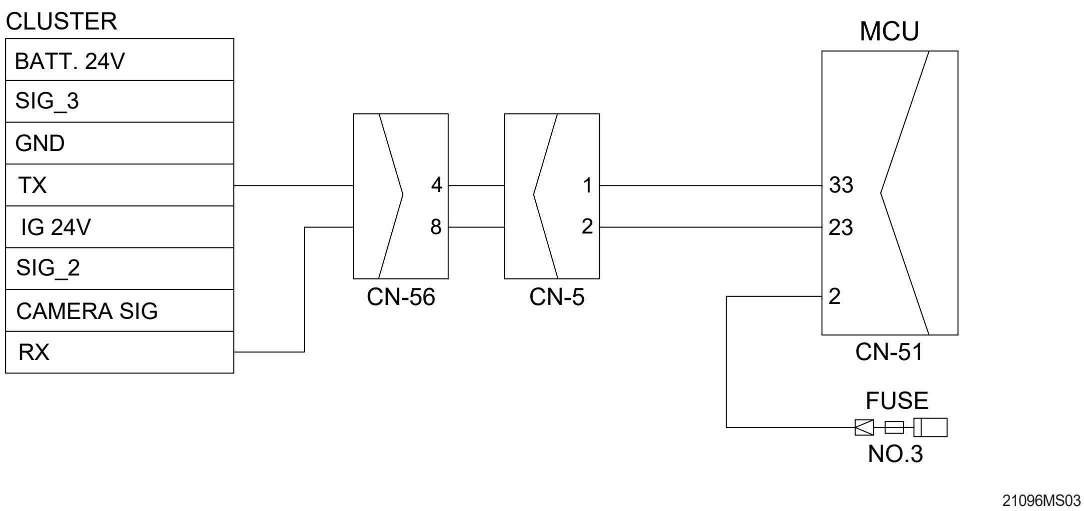
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
No power supply to the MCU	Check fuse No.3
MCU failure	Replace
ⓐ	
Cluster failure	Replace
No connection	Check and repair

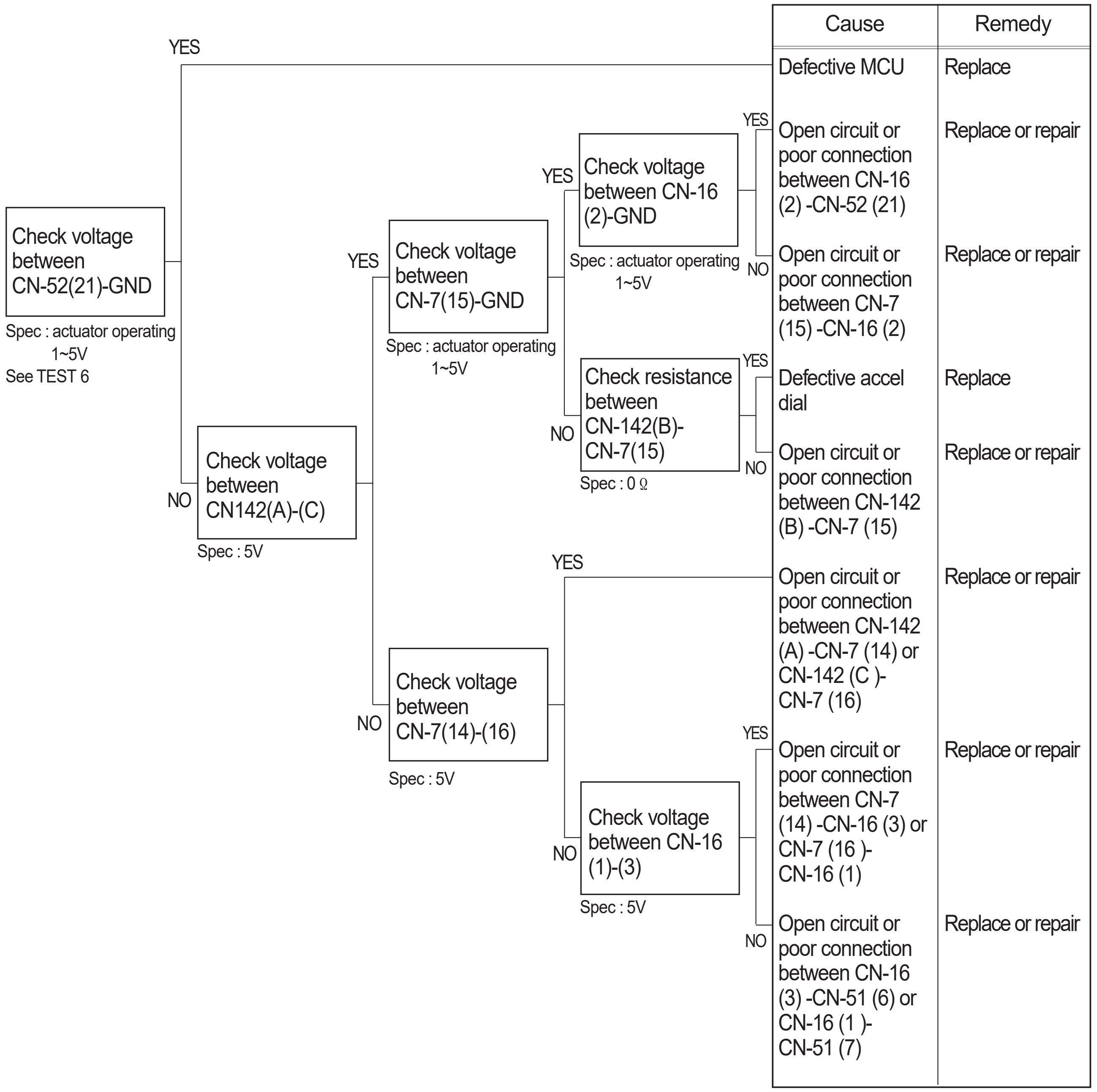
Wiring diagram

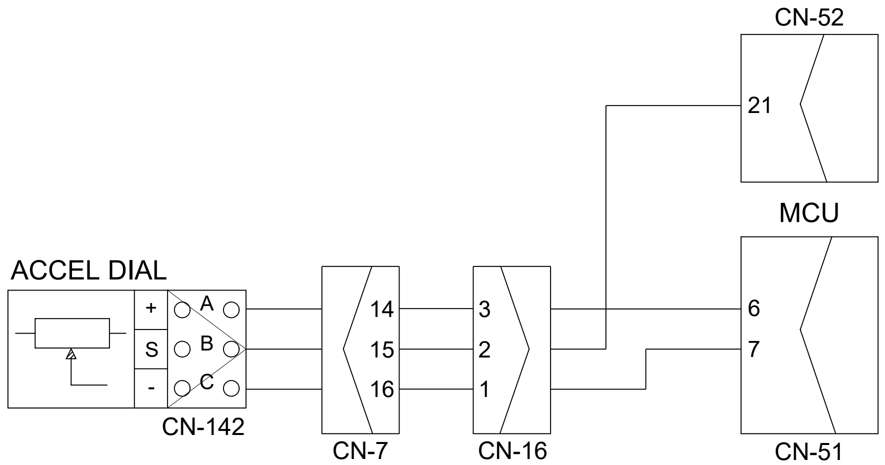


4. MALFUNCTION OF ACCEL DIAL

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

1) INSPECTION PROCEDURE





21096MS04

2) TEST PROCEDURE

(1) Test 6 : Check voltage at CN-52(21) and ground.

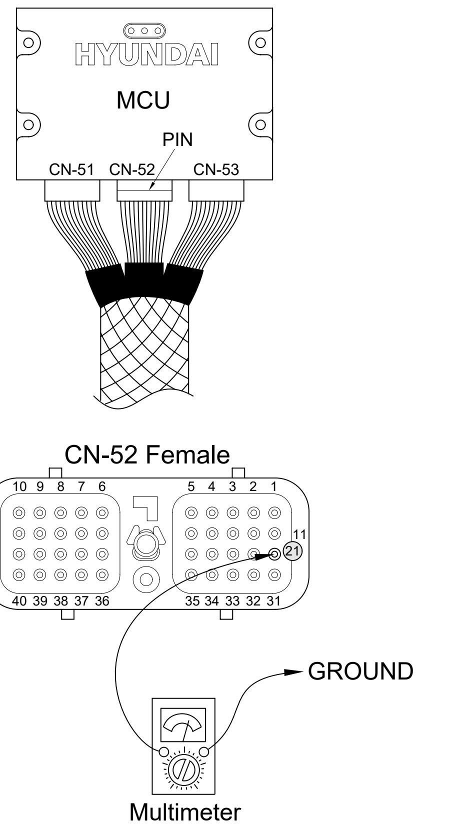
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (21) of CN-52.

③ Starting key ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V

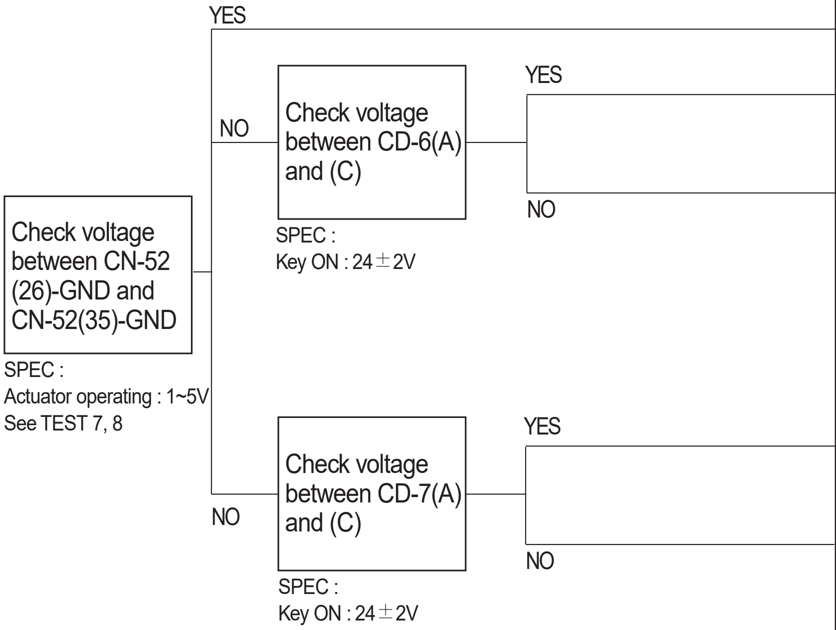


5. AUTO DECEL SYSTEM DOES NOT WORK

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

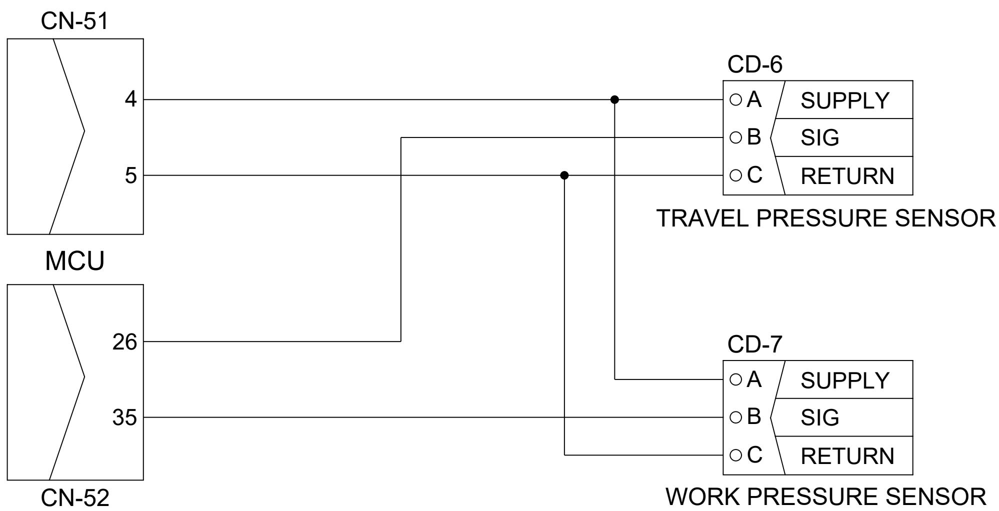
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective MCU	Replace
Defective travel pressure switch	Replace
Short circuit or poor connection between CN-51(4)-CD-6(A) and / or CN-51(5)-CD-6(C) (fault code 108 displayed)	Replace or repair
Defective work pressure sensor	Replace
Short circuit or poor connection between CN-51(4)-CD-7(A) and / or CN-51(5)-CD-7(C) (fault code 105 displayed)	Replace or repair

Wiring diagram



21096MS05

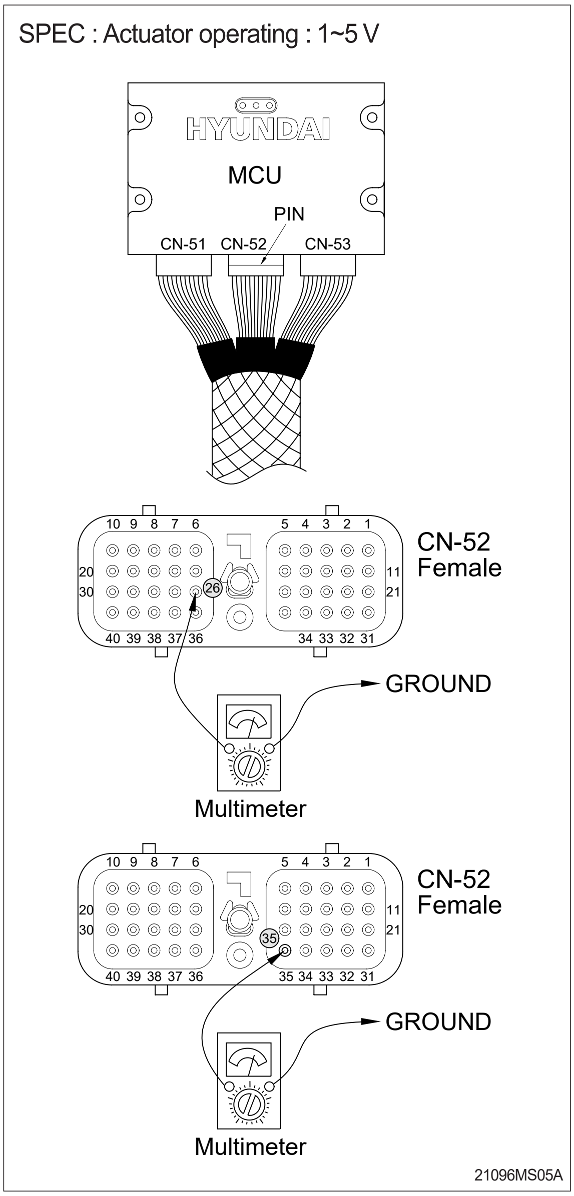
2) TEST PROCEDURE

(1) Test 7 : Check voltage at CN-52(26) and ground.

① Prepare 1 piece of thin sharp pin, steel or copper.
② Insert prepared pin to rear side of connectors : One pin to (26) of CN-52.
③ Starting key ON.
④ Check voltage as figure.

(2) Test 8 : Check voltage at CN-52(35)and ground.

① Prepare 1 piece of thin sharp pin, steel or copper
② Insert prepared pin to rear side of connectors : One pin to (35) of CN-52.
③ Starting key ON.
④ Check voltage as figure.

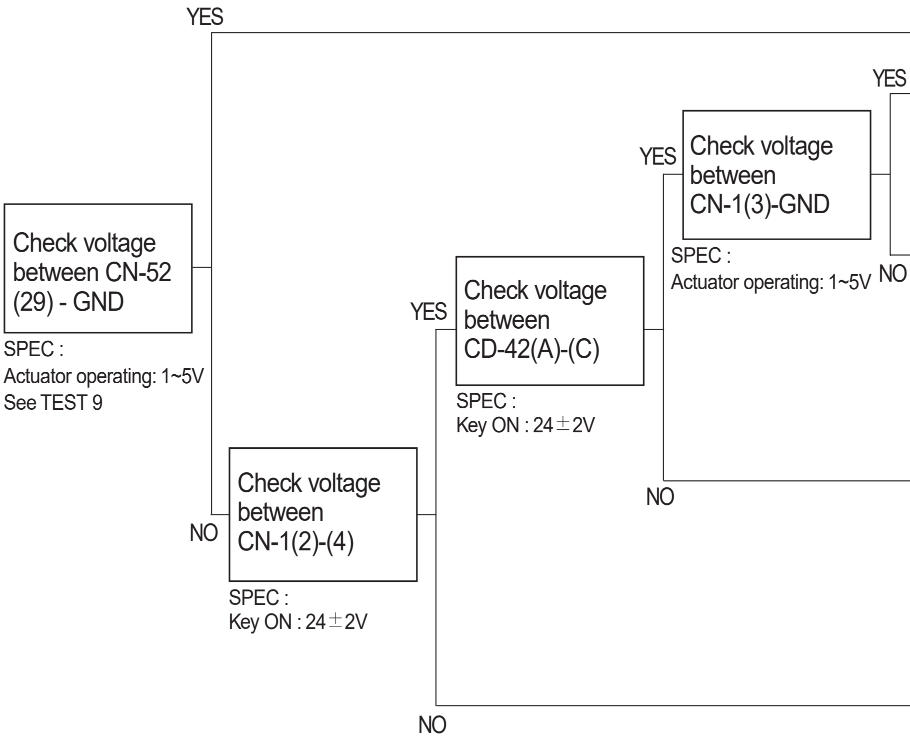


6. MALFUNCTION OF PUMP 1 PRESSURE SENSOR

· Fault code : HCESPN 120, FMI 0~4

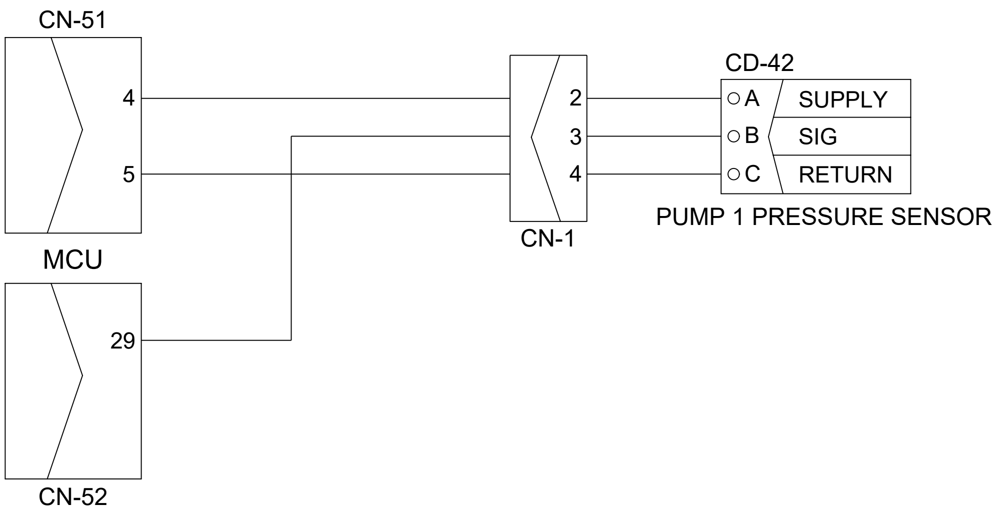
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective MCU	Replace
Short circuit or poor connection between CN-52-(29)-CN-1(3)	Replace or repair
Detective P1 pressure sensor	Replace or repair
Short circuit or poor connection between CN-1(3)-CD-42(B)	Replace or repair
Short circuit or poor connection between CD-42(A)-CN-1(2) or CD-42(C)-CN-1(4)	Replace or repair
Short circuit or poor connection between CN-1(2)-CN-51(4) or CN-1 (4) - CN-51(5)	Replace or repair

Wiring diagram



21096MS06

2) TEST PROCEDURE

(1) Test 9 : Check voltage at CN-52(29) and ground.

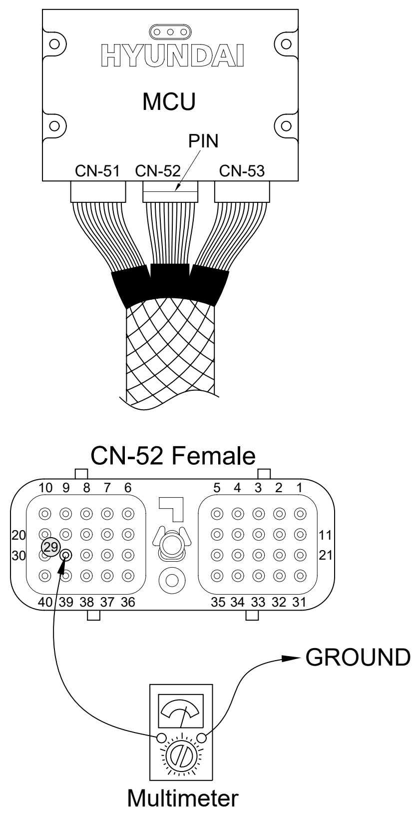
① Prepare 1 piece of thin sharp pin, steel or copper.

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



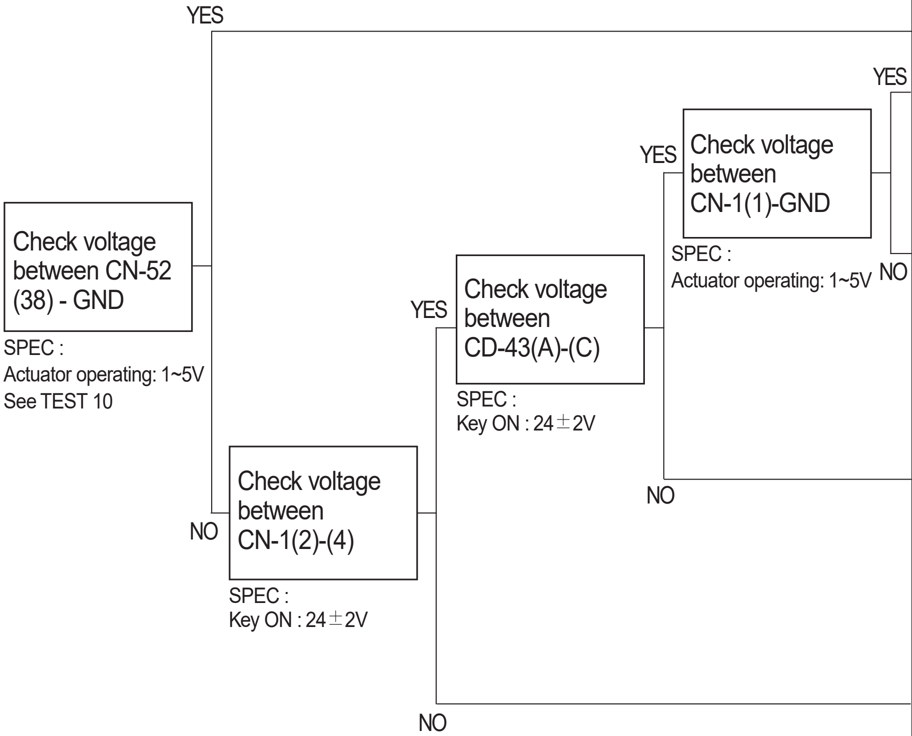
21096MS06A

7. MALFUNCTION OF PUMP 2 PRESSURE SENSOR

· Fault code : HCESPN 121, FMI 0~4

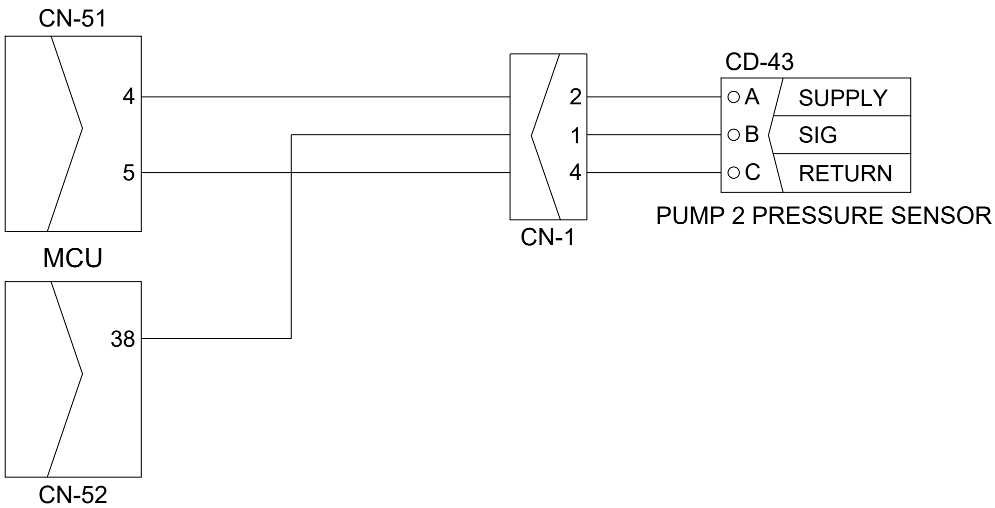
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective MCU	Replace
Short circuit or poor connection between CN-52-(38)-CN-1(1)	Replace or repair
Detective P2 pressure sensor	Replace or repair
Short circuit or poor connection between CN-1(1)-CD-43(B)	Replace or repair
Short circuit or poor connection between CD-43(A)-CN-1(2) or CD-43(C)-CN-1(4)	Replace or repair
Short circuit or poor connection between CN-1(2)-CN-51(4) or CN-1(4) - CN-51(5)	Replace or repair

Wiring diagram



21096MS07

2) TEST PROCEDURE

(1) Test 10 : Check voltage at CN-52(38) and ground.

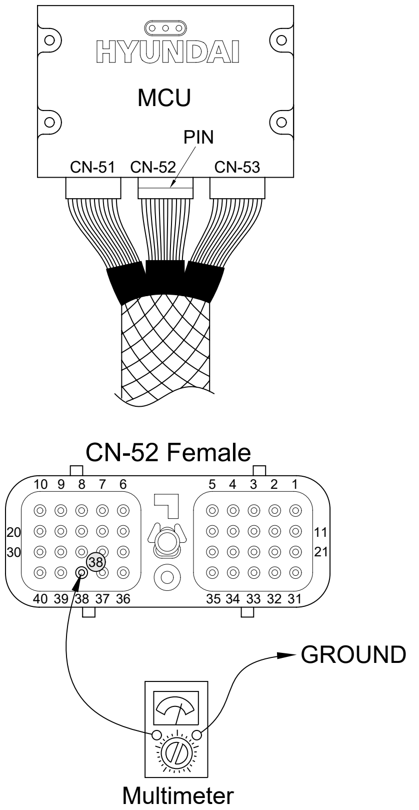
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (38) of CN-52.

③ Starting key ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V



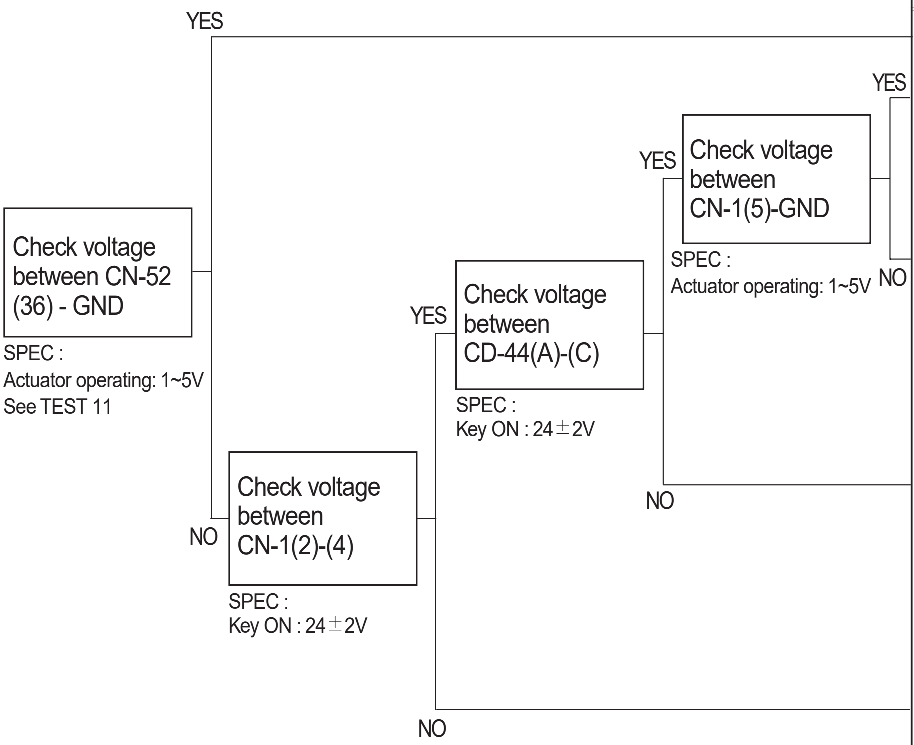
21096MS07A

8. MALFUNCTION OF PUMP 3 PRESSURE SENSOR

- Fault code : HCESPN 125, FMI 0~4

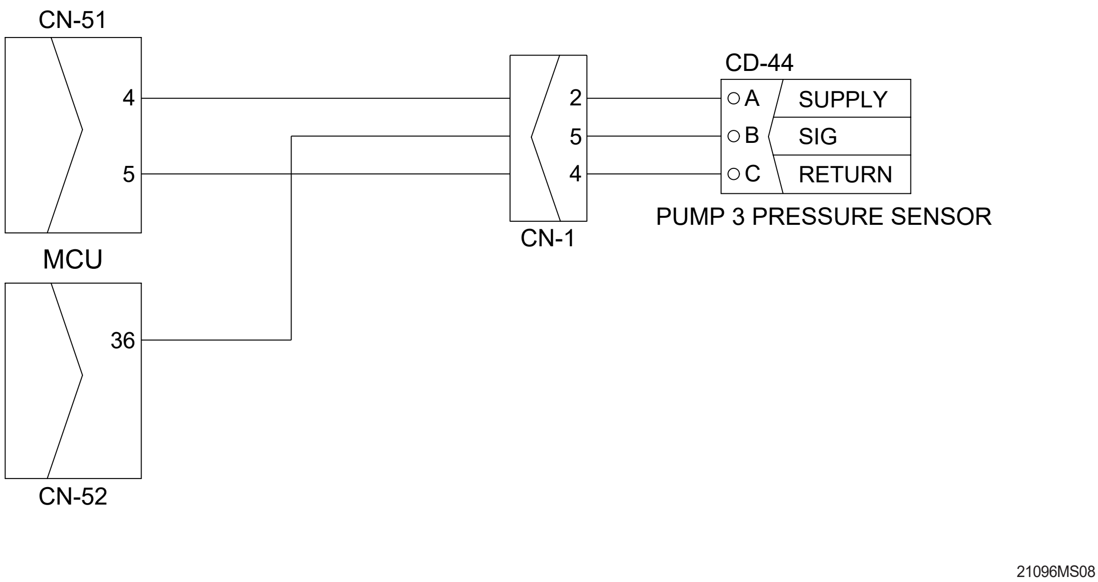
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective MCU	Replace
Short circuit or poor connection between CN-52-(36)-CN-1(5)	Replace or repair
Detective P3 pressure sensor	Replace or repair
Short circuit or poor connection between CN-1(5)-CD-44(B)	Replace or repair
Short circuit or poor connection between CD-44(A)-CN-1(2) or CD-44(C)-CN-1(4)	Replace or repair
Short circuit or poor connection between CN-1(2)-CN-51(4) or CN-1 (4) - CN-51(5)	Replace or repair

Wiring diagram



2) TEST PROCEDURE

(1) **Test 11** : Check voltage at CN-52(36) and ground.

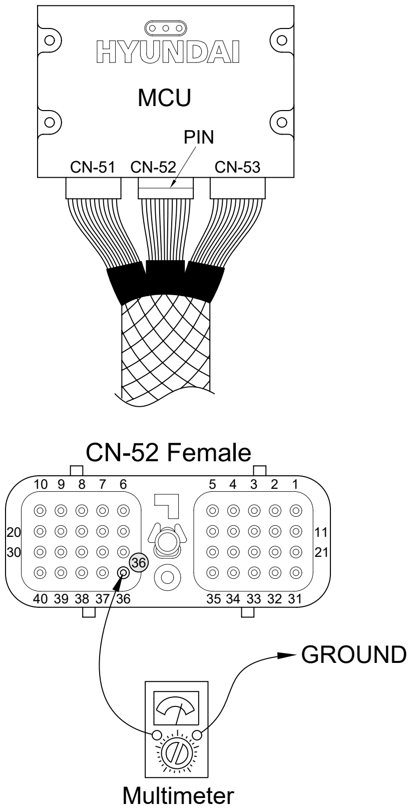
① Prepare 1 piece of thin sharp pin, steel or copper.

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



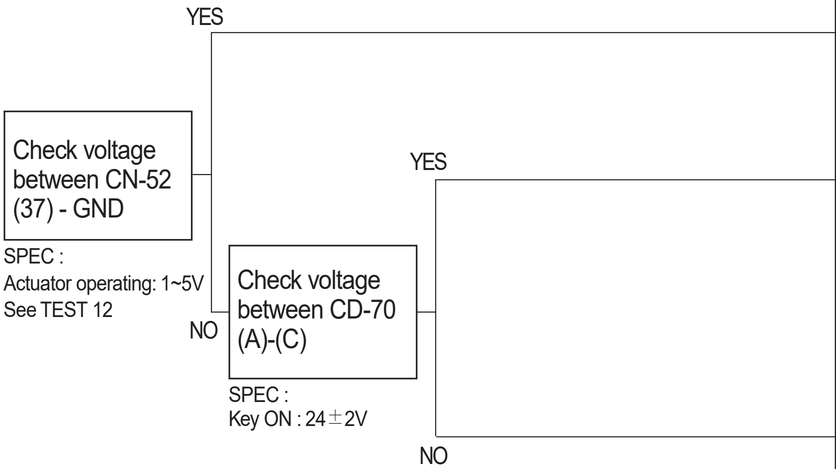
21096MS08A

9. MALFUNCTION OF NEGATIVE 1 PRESSURE SENSOR

· Fault code : HCESPN 123, FMI 0~4

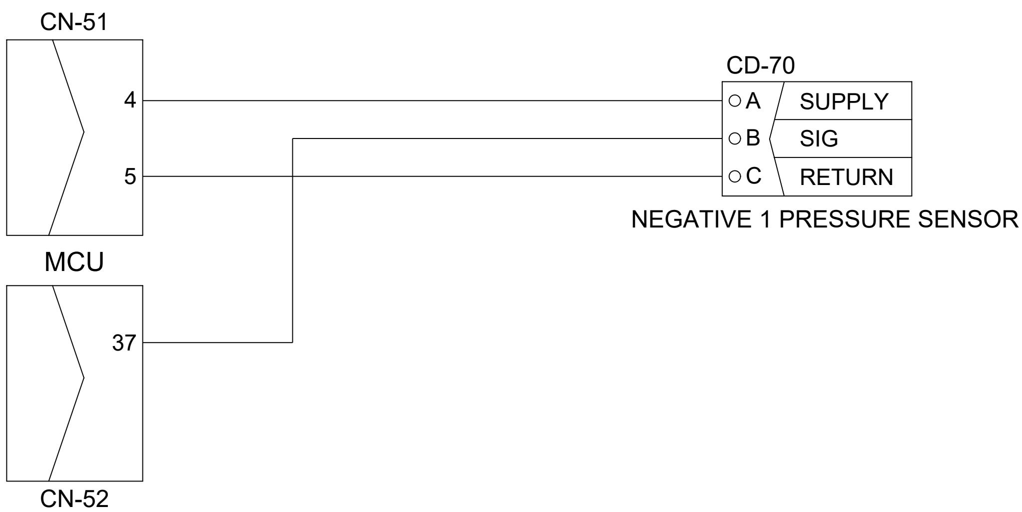
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective MCU	Replace
Detective N1 pressure sensor	Replace or repair
Short circuit or poor connection between CN-52 (37)-CD-70 (B)	Replace or repair
Short circuit or poor connection between CD-70 (A)-CN-51(4) or CD-70(C)- CN-51 (5)	Replace or repair

Wiring diagram



21096MS09

2) TEST PROCEDURE

(1) Test 12 : Check voltage at CN-52(37) and ground.

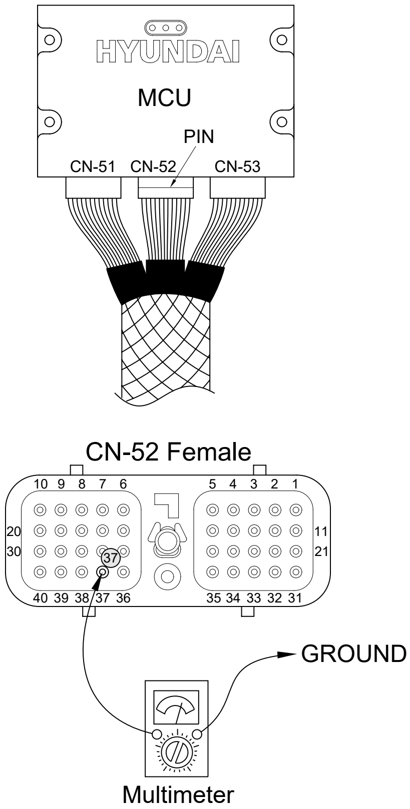
① Prepare 1 piece of thin sharp pin, steel or copper.

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



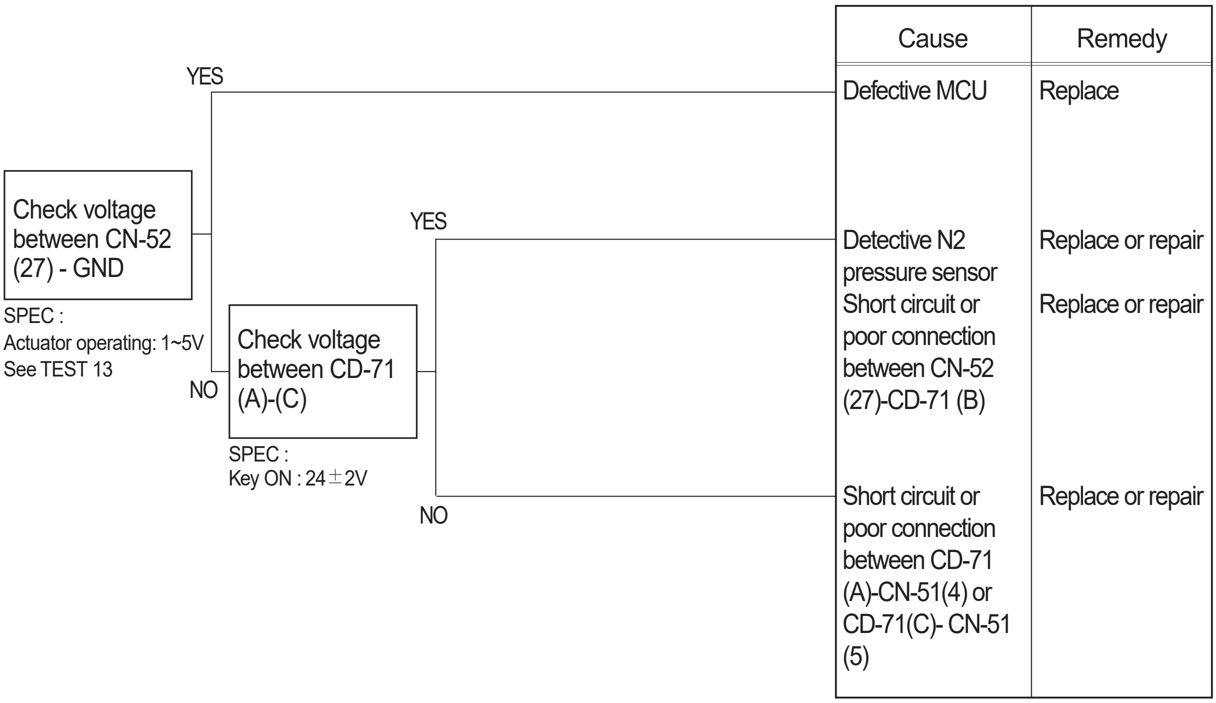
21096MS09A

10. MALFUNCTION OF NEGATIVE 2 PRESSURE SENSOR

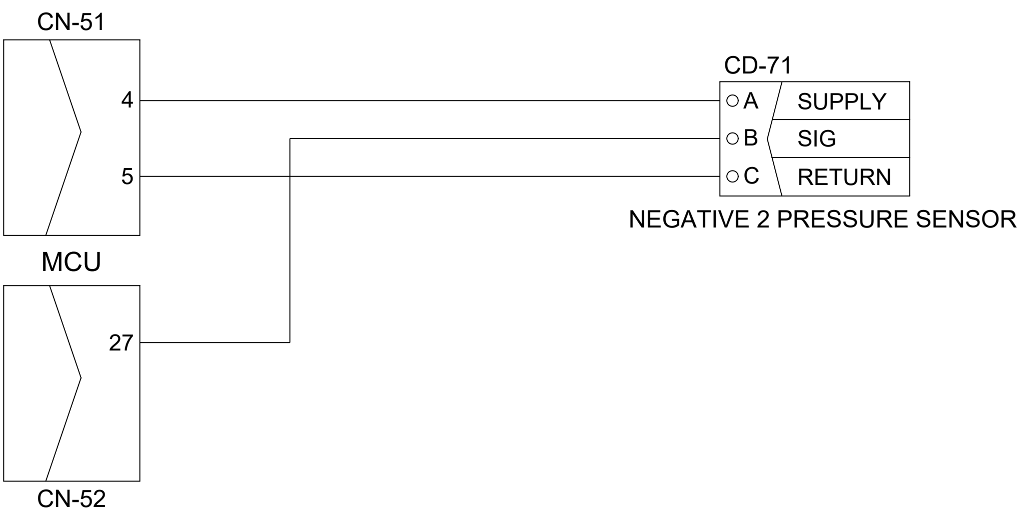
· Fault code : HCESPN 124, FMI 0~4

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

1) INSPECTION PROCEDURE



Wiring diagram



21096MS10

2) TEST PROCEDURE

(1) Test 13 : Check voltage at CN-52(27) and ground.

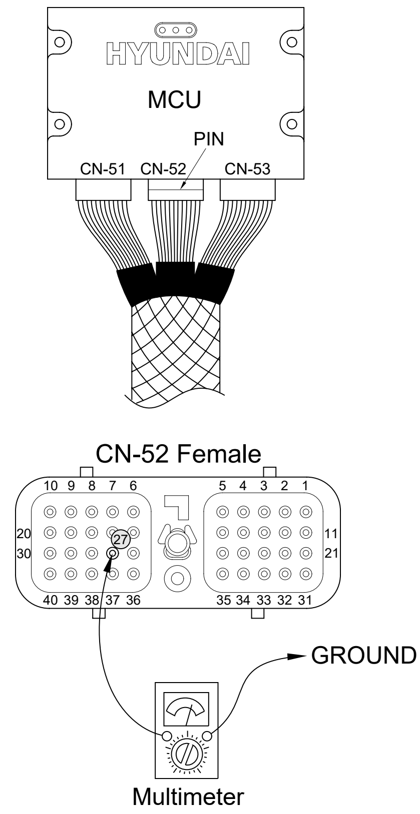
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (27) of CN-52.

③ Starting key ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V



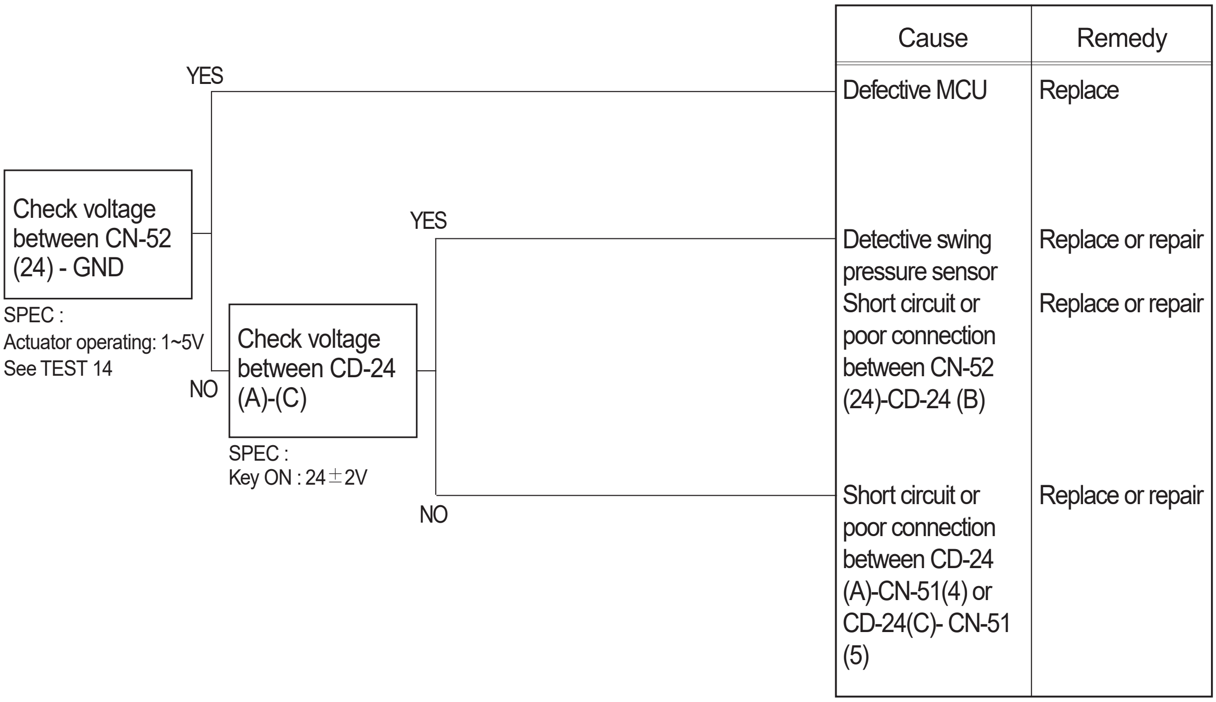
21096MS10A

11. MALFUNCTION OF SWING PRESSURE SENSOR

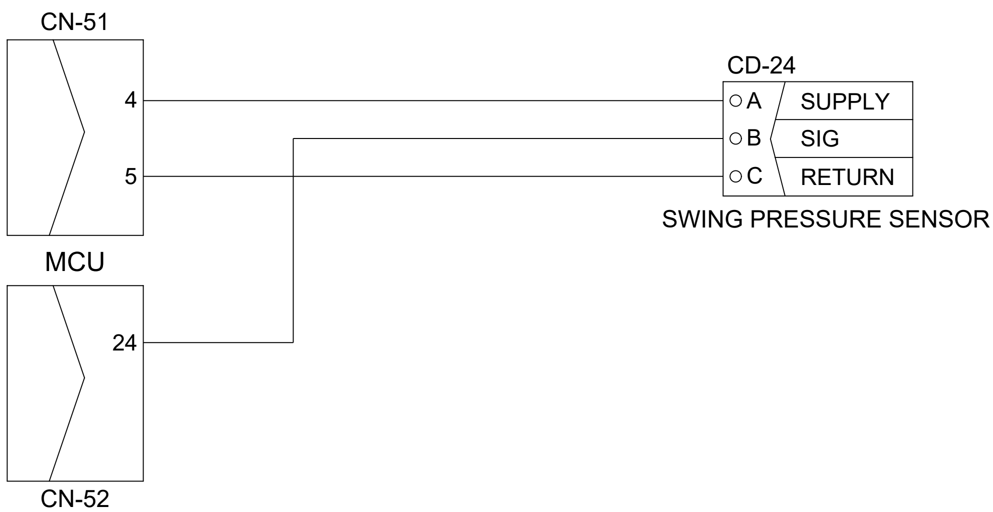
· Fault code : HCESPN 135, FMI 0~4

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

1) INSPECTION PROCEDURE



Wiring diagram



21096MS11

2) TEST PROCEDURE

(1) Test 14 : Check voltage at CN-52(24) and ground.

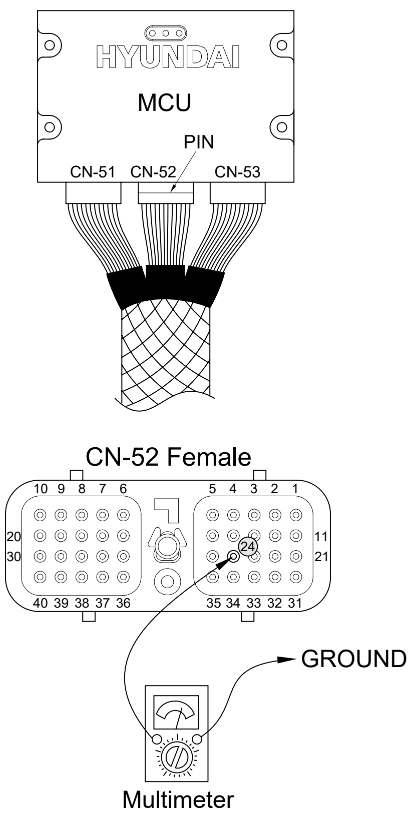
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (24) of CN-52.

③ Starting key ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V



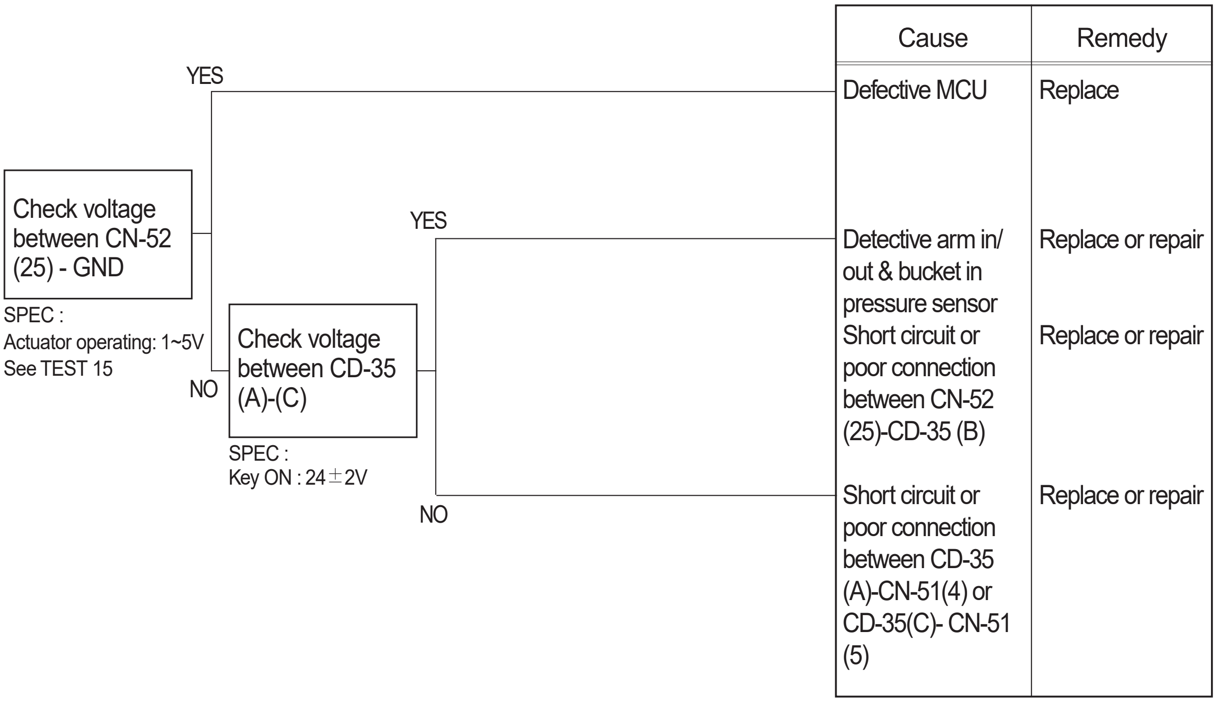
21096MS11A

12. MALFUNCTION OF ARM IN/OUT & BUCKET IN PRESSURE SENSOR

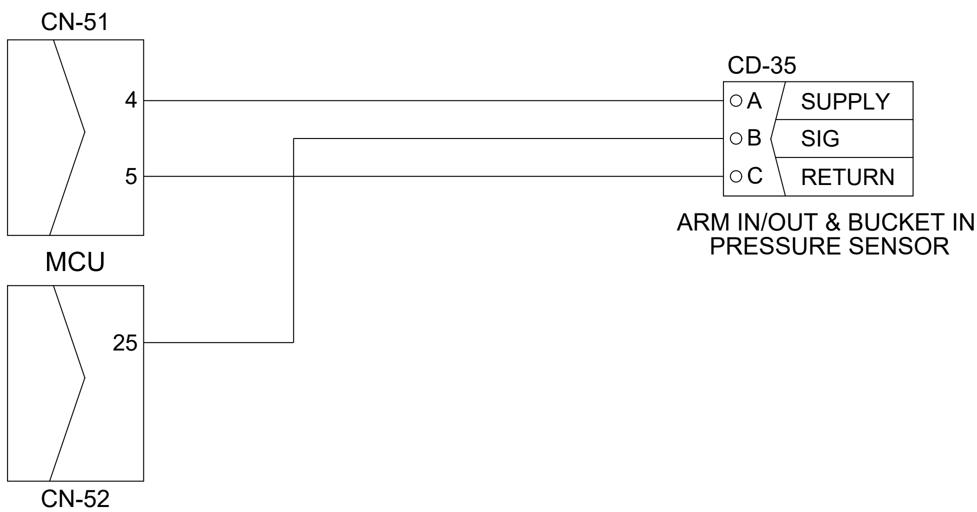
· Fault code : HCESPN 133, FMI 0~4

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

1) INSPECTION PROCEDURE



Wiring diagram



21096MS12

2) TEST PROCEDURE

(1) Test 15 : Check voltage at CN-52(25) and ground.

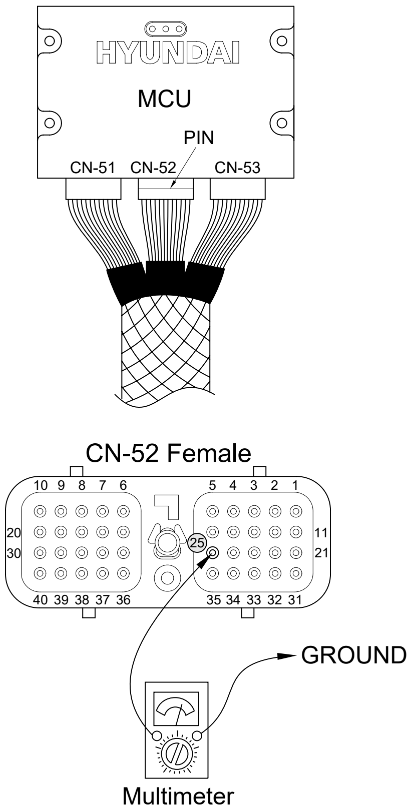
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (25) of CN-52.

③ Starting key ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V



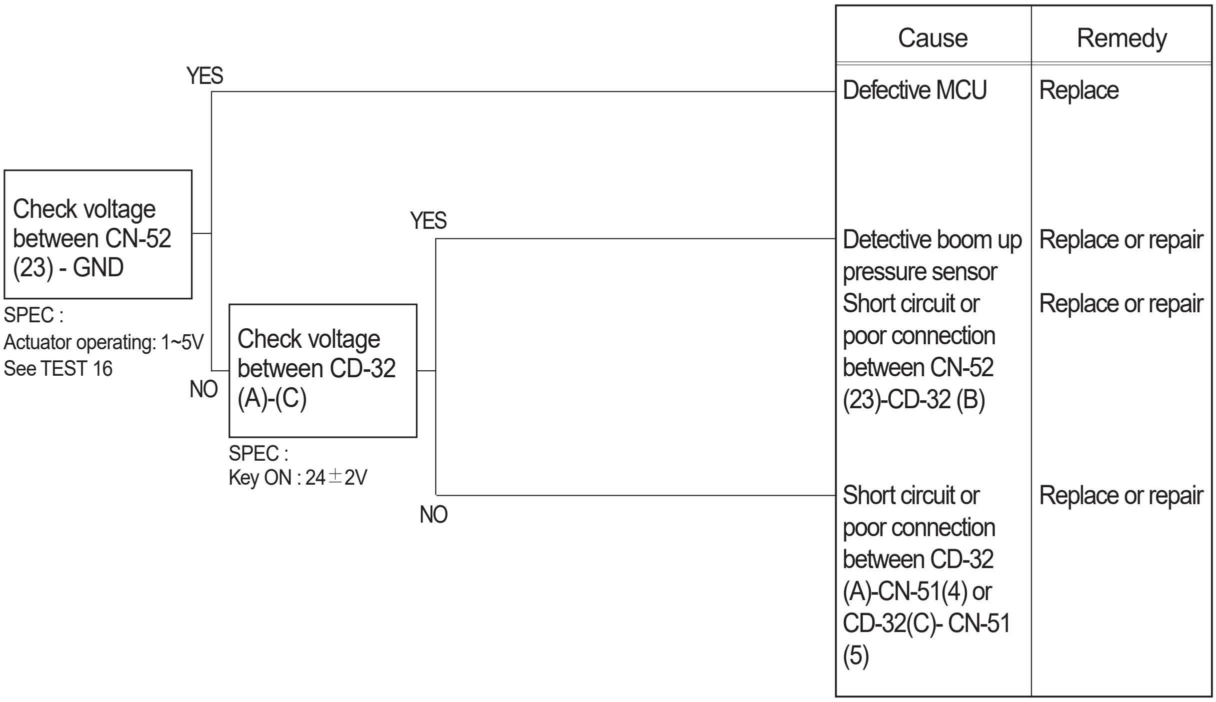
21096MS12A

13. MALFUNCTION OF BOOM UP PRESSURE SENSOR

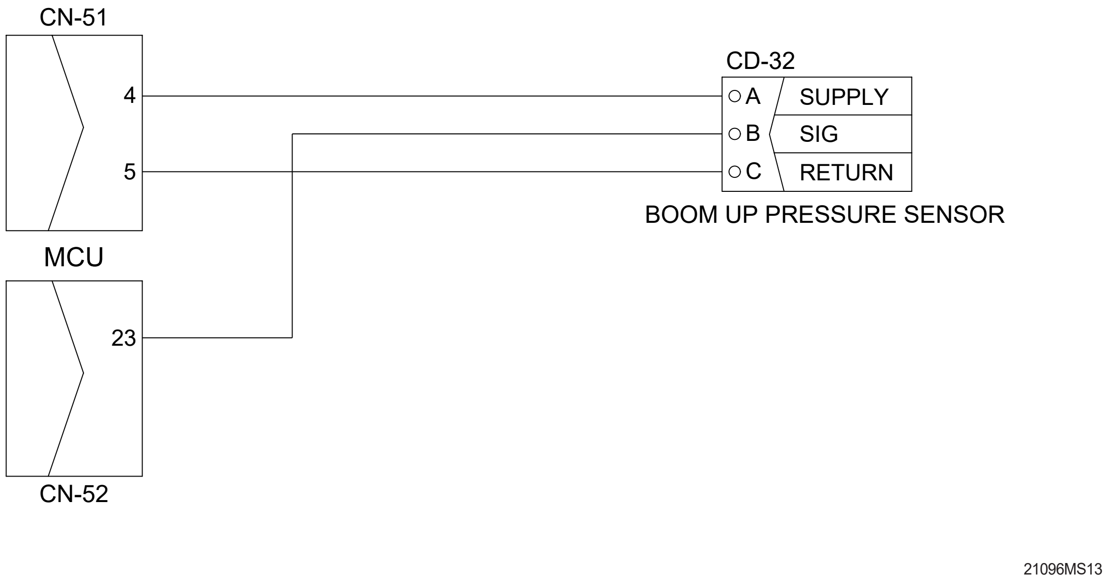
· Fault code : HCESPN 127, FMI 0~4

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

1) INSPECTION PROCEDURE



Wiring diagram



2) TEST PROCEDURE

(1) Test 16 : Check voltage at CN-52(23) and ground.

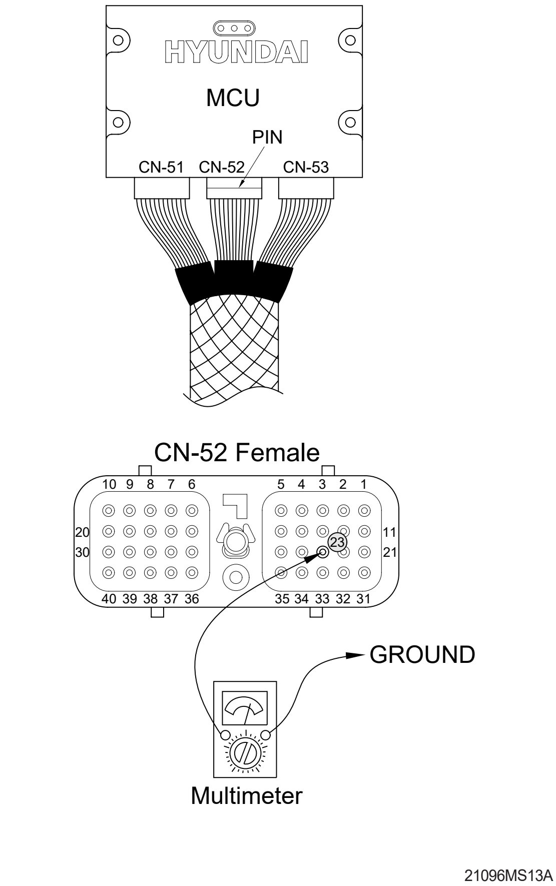
① Prepare 1 piece of thin sharp pin, steel or copper.

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

③ Starting key ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V

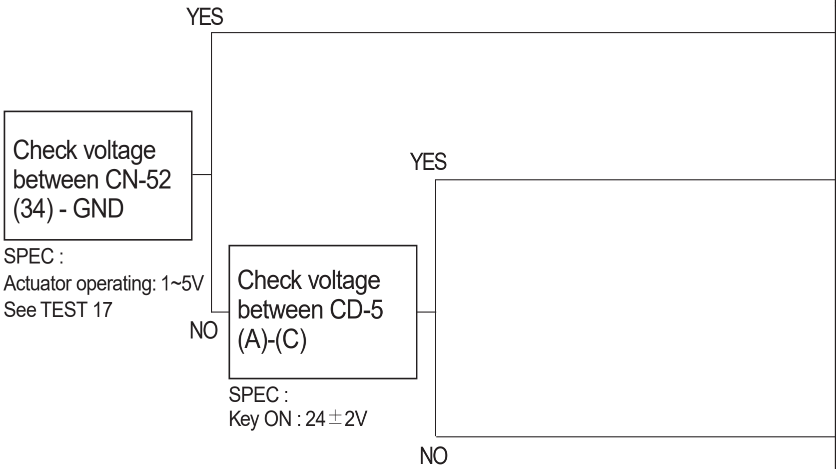


14. MALFUNCTION OF TRANSMISSION OIL PRESSURE SENSOR

· Fault code : HCESPN 501, FMI 0~4

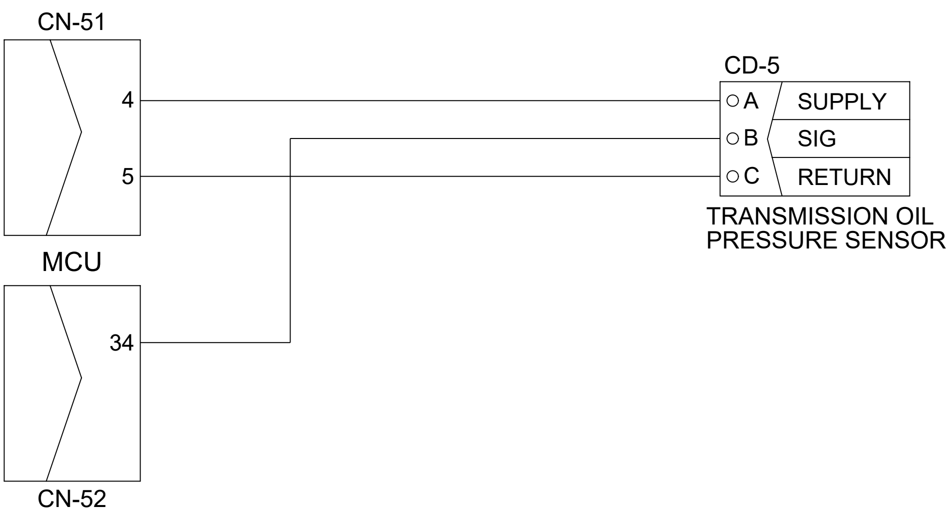
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective MCU	Replace
Detective boom up pressure sensor	Replace or repair
Short circuit or poor connection between CN-52 (34)-CD-5 (B)	Replace or repair
Short circuit or poor connection between CD-5 (A)-CN-51(4) or CD-5(C)- CN-51 (5)	Replace or repair

Wiring diagram



2) TEST PROCEDURE

(1) Test 17 : Check voltage at CN-52(34) and ground.

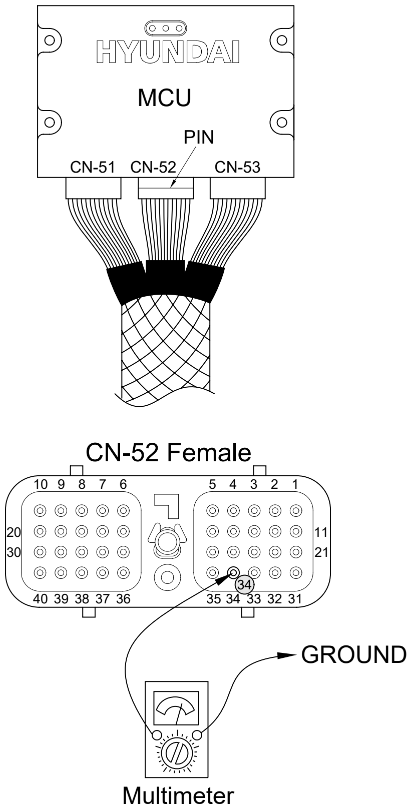
① Prepare 1 piece of thin sharp pin, steel or copper.

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

③ Starting key ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V

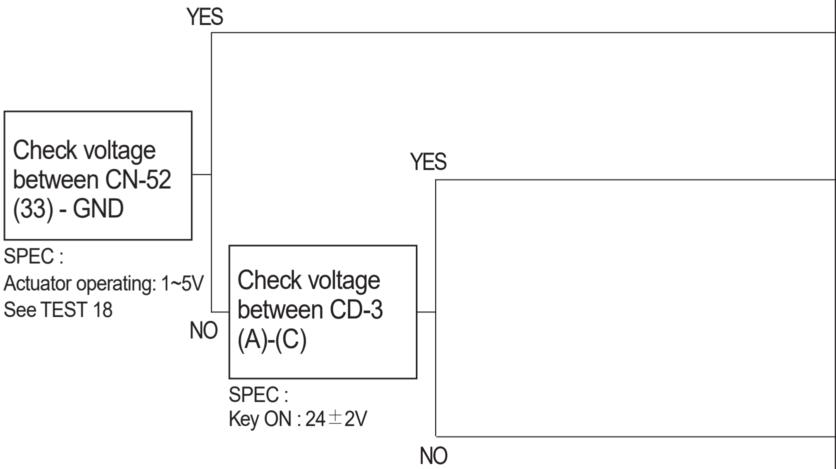


15. MALFUNCTION OF BRAKE OIL PRESSURE SENSOR

· Fault code : HCESPN 503, FMI 0~4

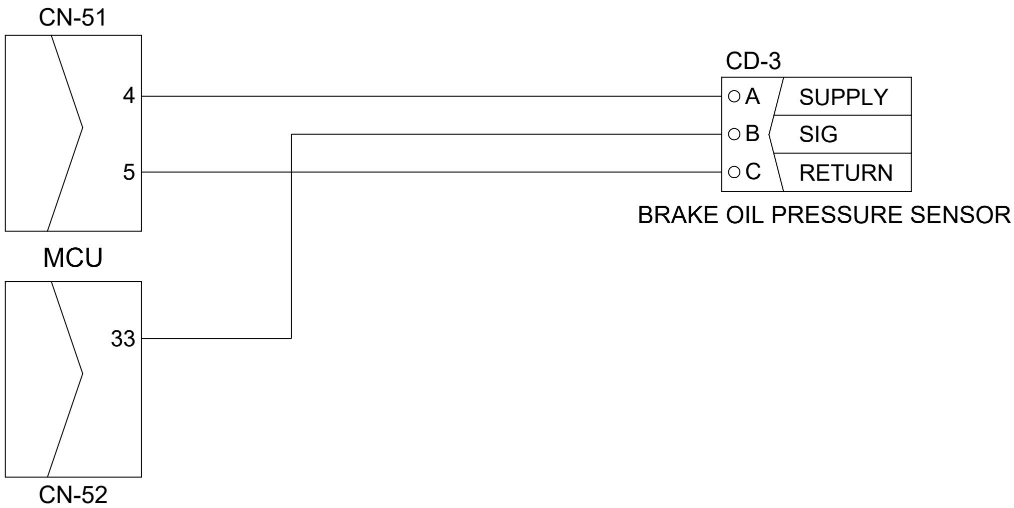
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective MCU	Replace
Detective boom up pressure sensor	Replace or repair
Short circuit or poor connection between CN-52 (33)-CD-3 (B)	Replace or repair
Short circuit or poor connection between CD-3 (A)-CN-51(4) or CD-3 (C)- CN-51 (5)	Replace or repair

Wiring diagram



14W96MS21

2) TEST PROCEDURE

(1) Test 18 : Check voltage at CN-52(33) and ground.

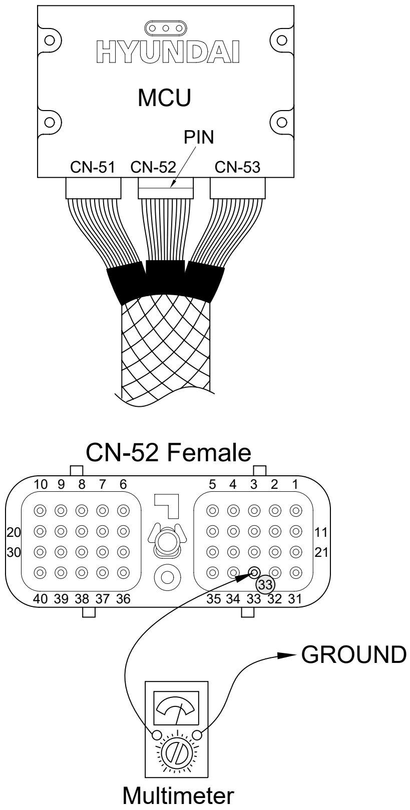
① Prepare 1 piece of thin sharp pin, steel or copper.

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



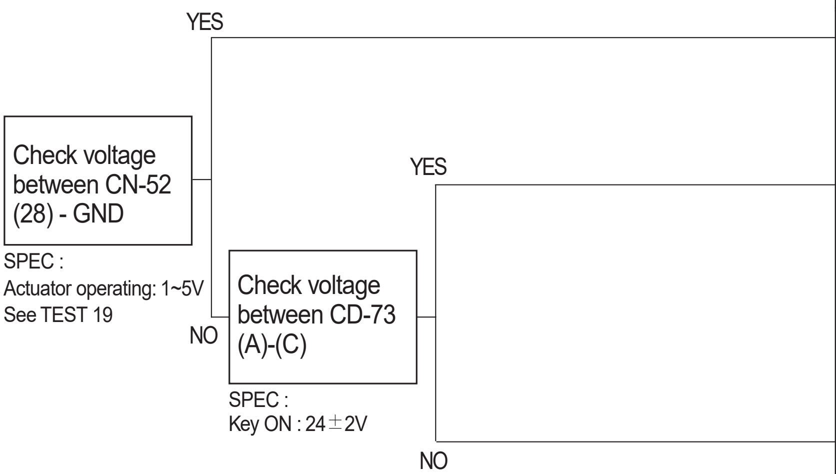
14W96MS21A

16. MALFUNCTION OF TRAVEL FORWARD PRESSURE SENSOR

· Fault code : HCESPN 530, FMI 0~4

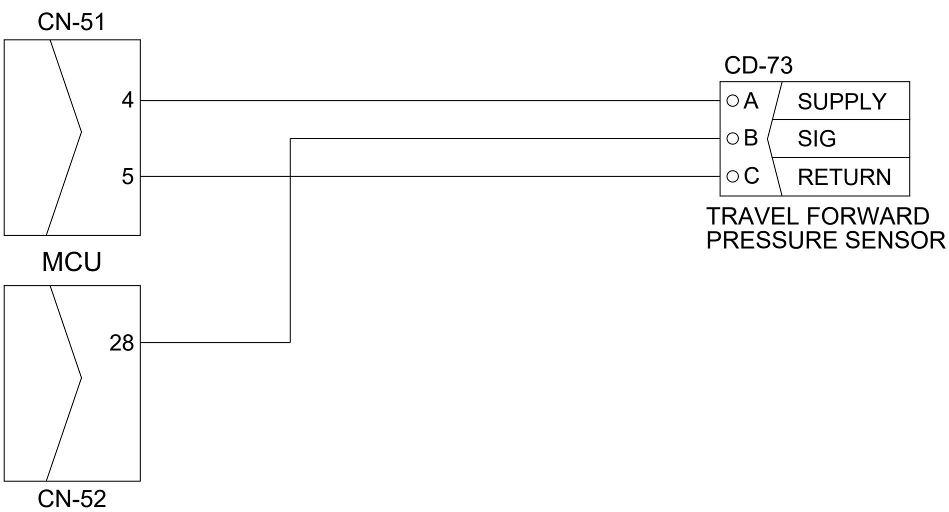
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective MCU	Replace
Detective boom up pressure sensor	Replace or repair
Short circuit or poor connection between CN-52 (28)-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



14W96MS22

2) TEST PROCEDURE

(1) Test 19 : Check voltage at CN-52(28) and ground.

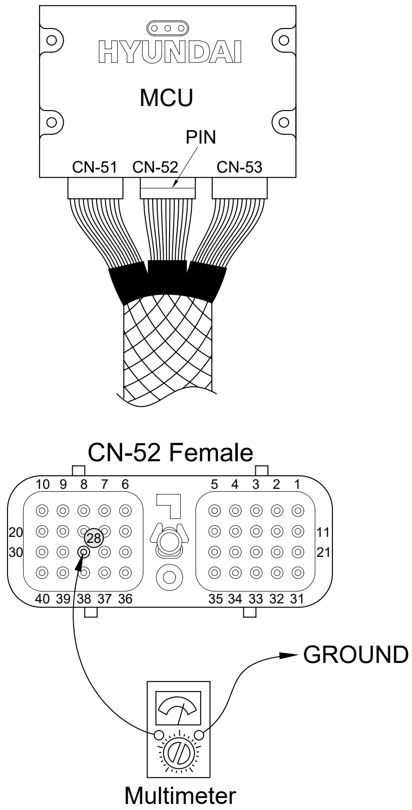
① Prepare 1 piece of thin sharp pin, steel or copper.

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

③ Starting key ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V



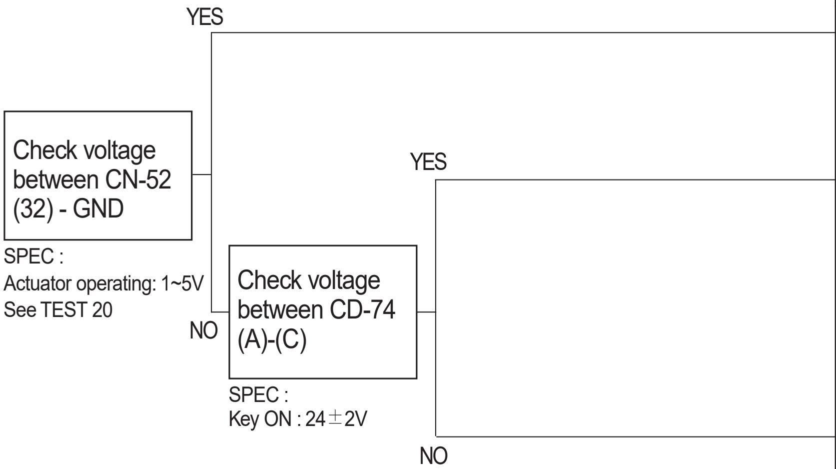
14W96MS22A

17. MALFUNCTION OF TRAVEL REVERSE PRESSURE SENSOR

· Fault code : HCESPN 531, FMI 0~4

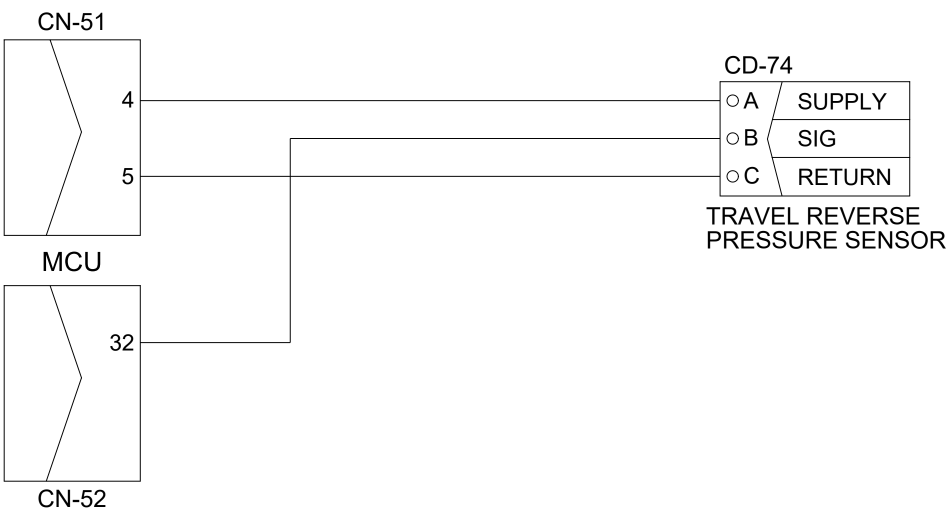
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective MCU	Replace
Detective boom up pressure sensor	Replace or repair
Short circuit or poor connection between CN-52 (32)-CD-74 (B)	Replace or repair
Short circuit or poor connection between CD-74 (A)-CN-51(4) or CD-74(C)- CN-51 (5)	Replace or repair

Wiring diagram



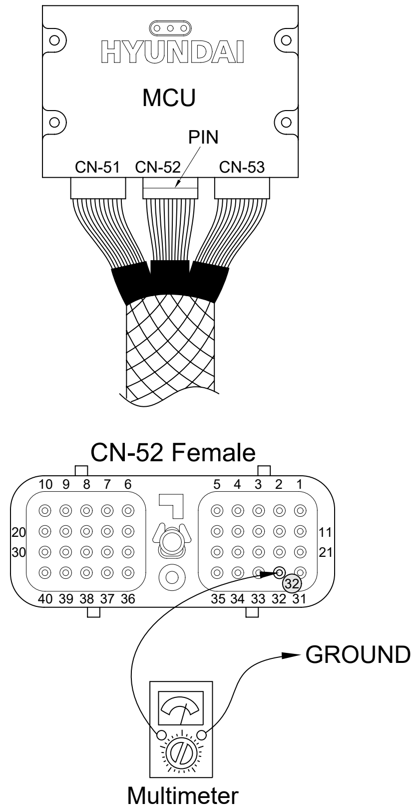
14W96MS23

2) TEST PROCEDURE

(1) Test 20 : 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



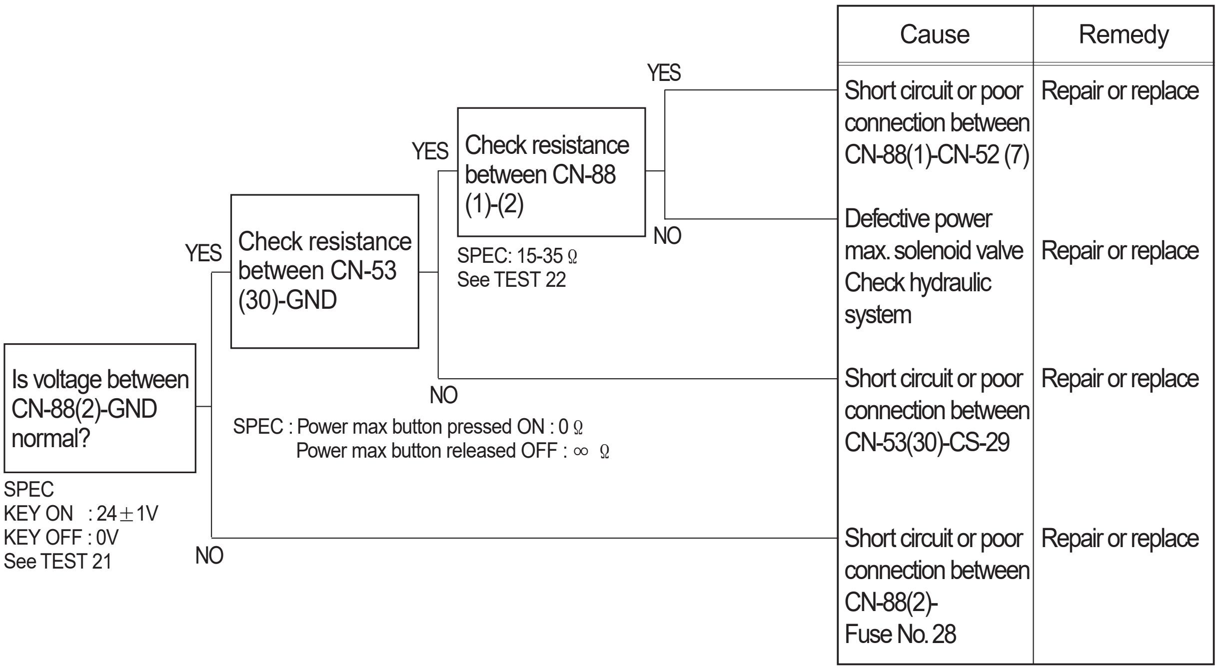
14W96MS23A

18. MALFUNCTION OF POWER MAX

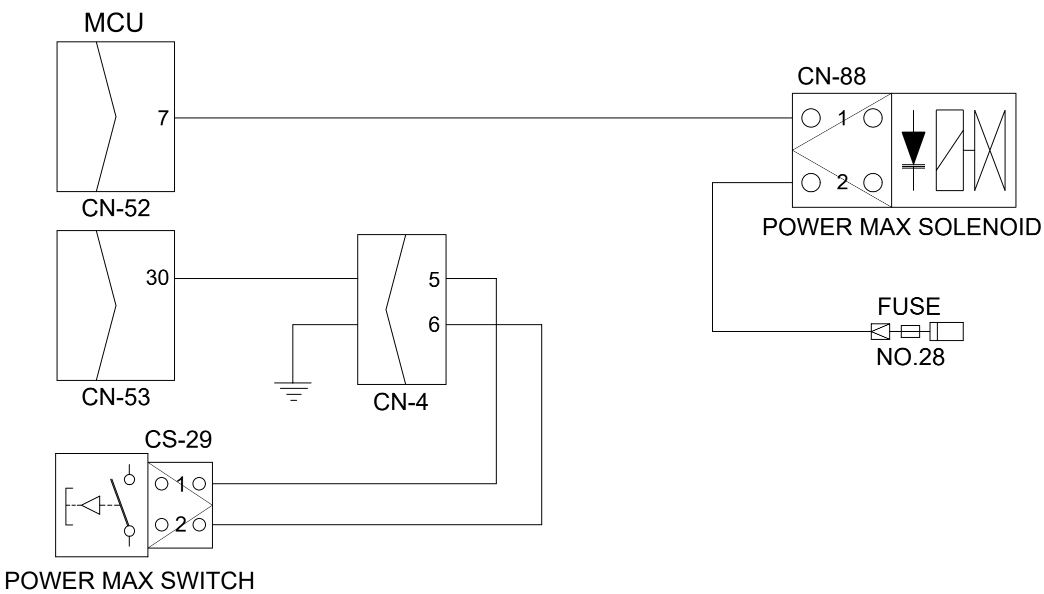
· Fault code : HCESPN 166, FMI 4 or 6

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

1) INSPECTION PROCEDURE



Wiring diagram



21096MS14

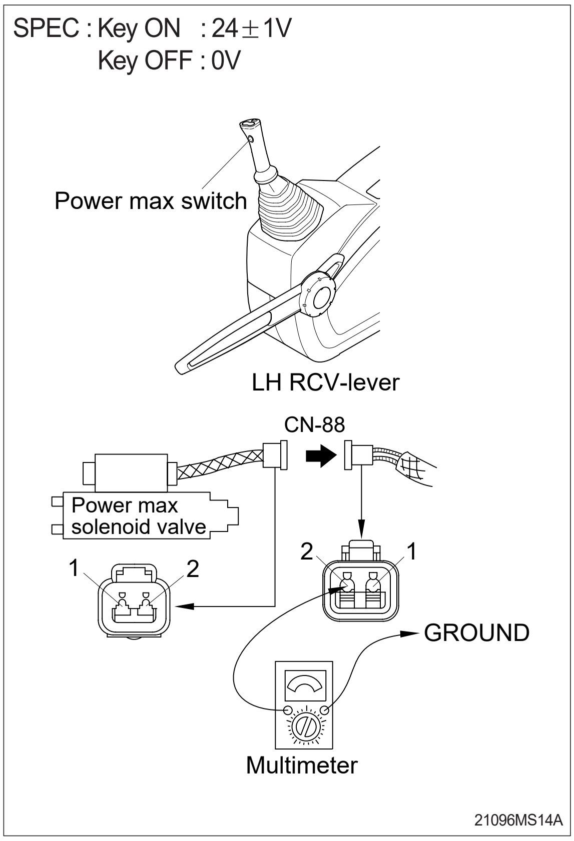
2) TEST PROCEDURE

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

① Disconnect connector CN-88 from power max solenoid valve.

② Start key ON.

③ Check voltage as figure.

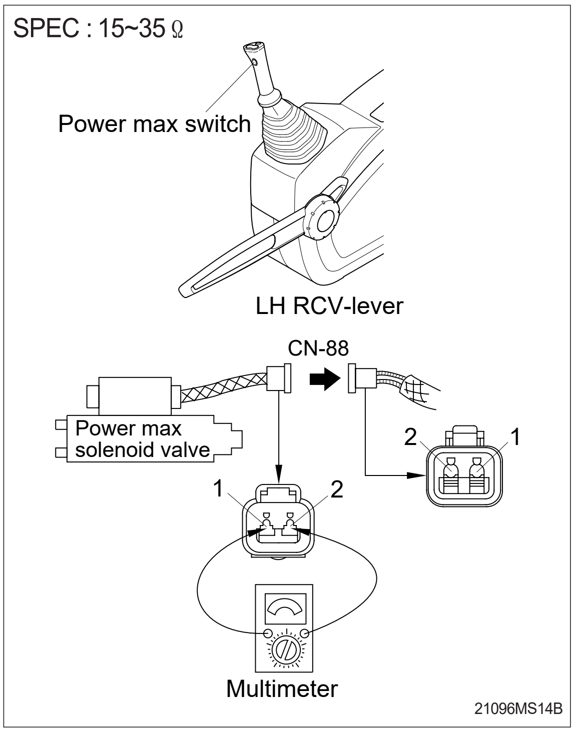


(2) Test 22: Check resistance of the solenoid valve between CN-88(1)-(2).

① Starting key OFF.

② Disconnect connector CN-88 from power max solenoid valve.

③ Check resistance as figure.



19. MALFUNCTION OF 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.

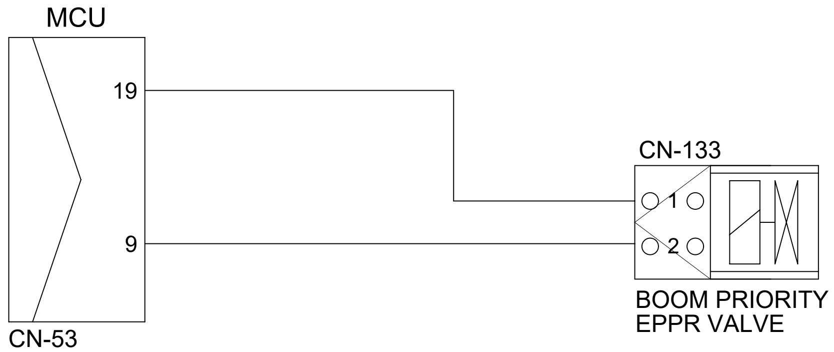
1) INSPECTION PROCEDURE

Check resistance between CN-133(1)-(2)

SPEC : 20~30V
KEY : ON

	Cause	Remedy
YES	Short circuit or poor connection between CN-53(19)-CN-133 (1) or CN-53(9)-CN-133(2)	Repair or replace
NO	Defective EPPR valve	Repair or replace

Wiring diagram



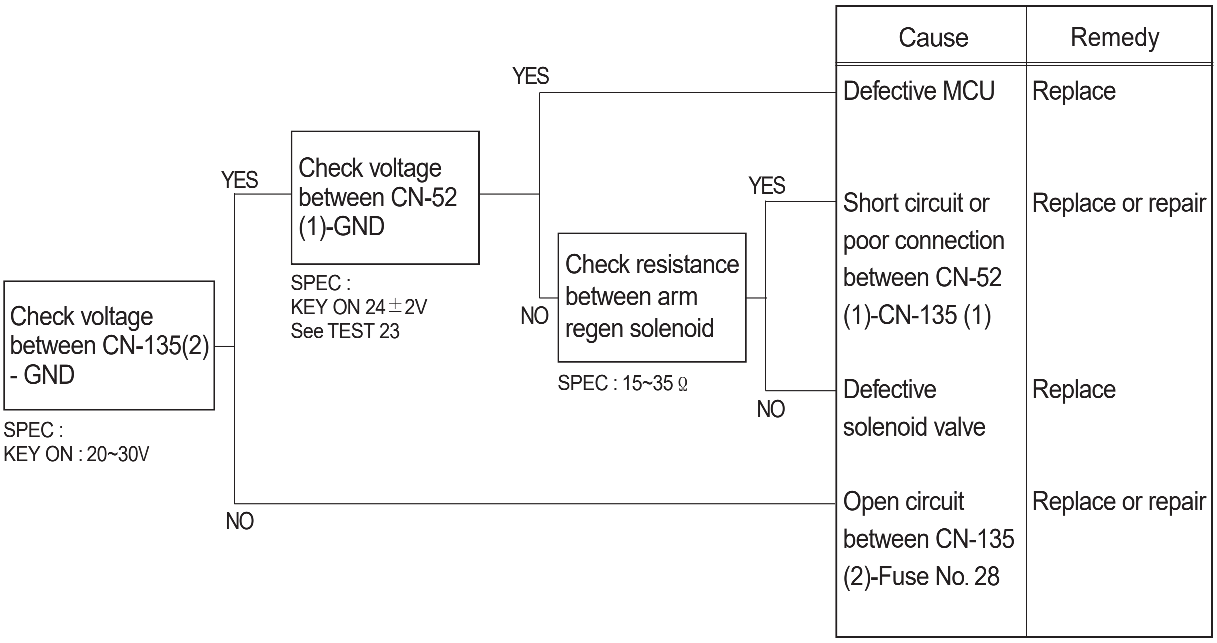
21096MS15

20. MALFUNCTION OF ARM REGENERATION SOLENOID

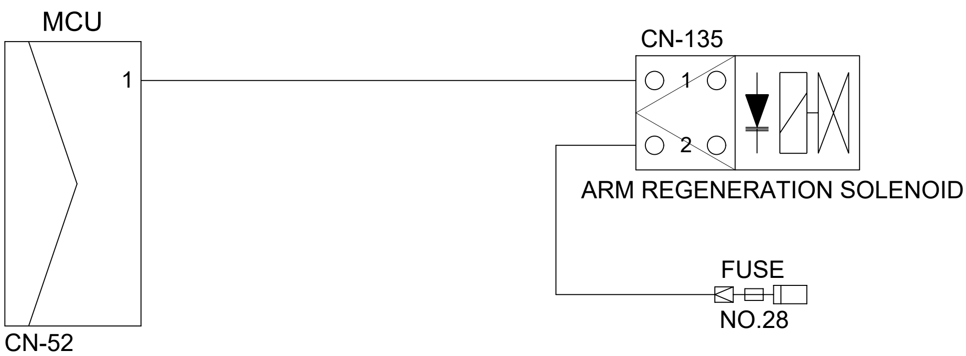
· Fault code : HCESPN 170, FMI 4 or 6

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

1) INSPECTION PROCEDURE



Wiring diagram



21096MS16

2) TEST PROCEDURE

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

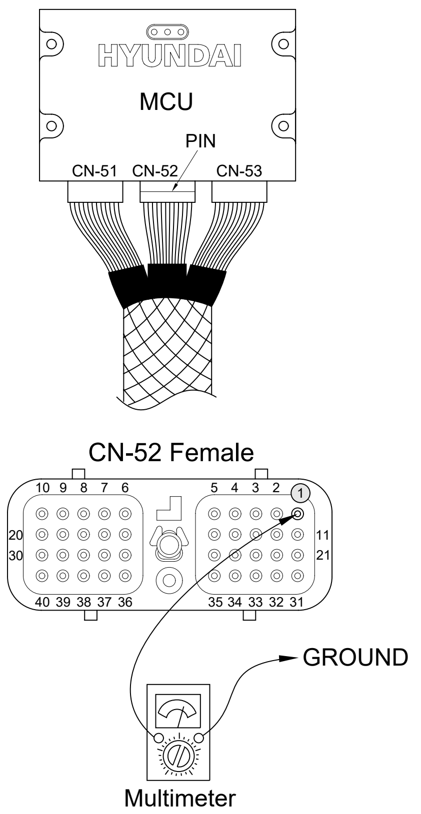
① Prepare 1 piece of thin sharp pin, steel or copper.

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



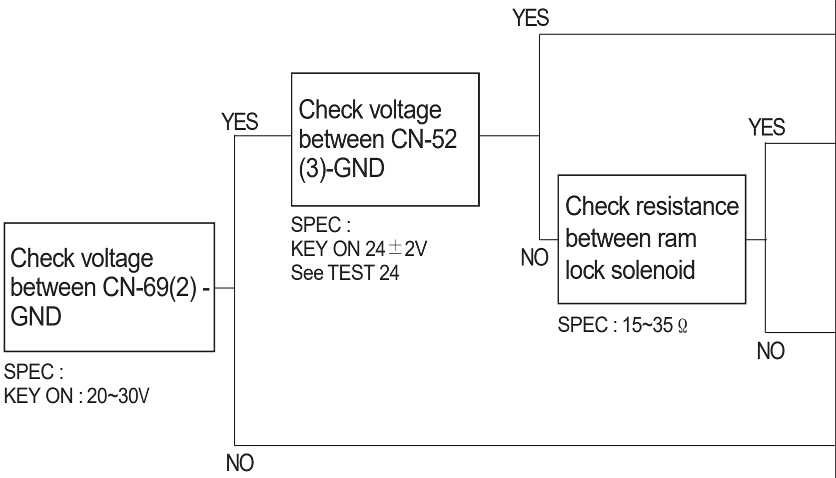
21096MS16A

21. MALFUNCTION OF RAM LOCK SOLENOID

· Fault code : HCESPN 525, FMI 5 or 6

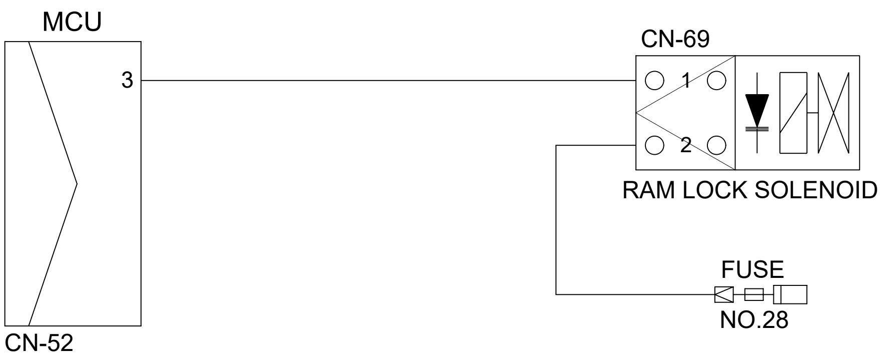
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective MCU	Replace
Short circuit or poor connection between CN-52 (3)-CN-69 (1)	Replace or repair
Defective solenoid valve	Replace
Open circuit between CN-69 (2)-Fuse No. 28	Replace or repair

Wiring diagram



14W96MS25

2) TEST PROCEDURE

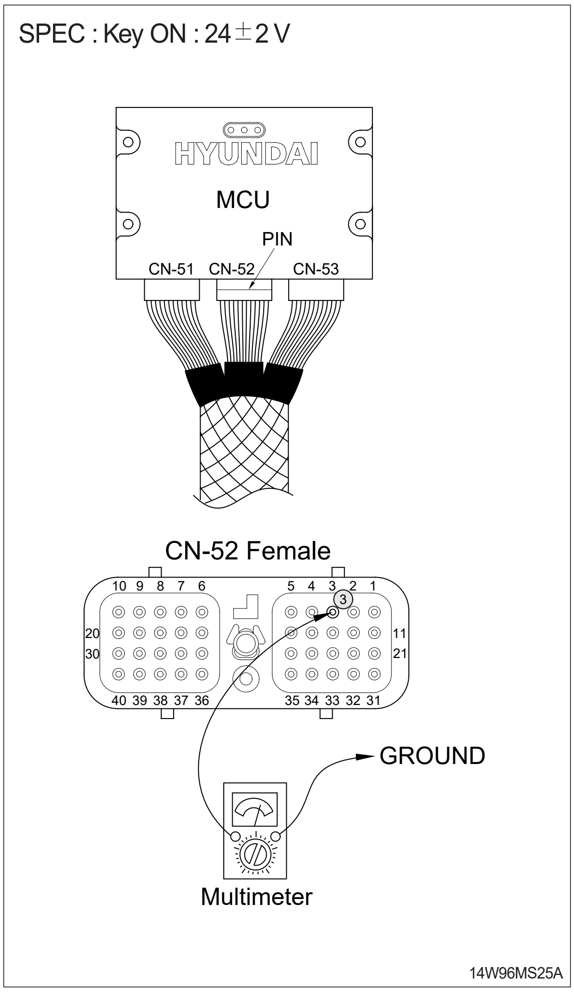
(1) Test 24 : Check voltage at CN-52(3) and ground.

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.



SECTION 7 MAINTENANCE STANDARD

GROUP 1 OPERATIONAL PERFORMANCE TEST

1. PURPOSE

Performance tests are used to check:

1) OPERATIONAL PERFORMANCE OF A NEW MACHINE

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

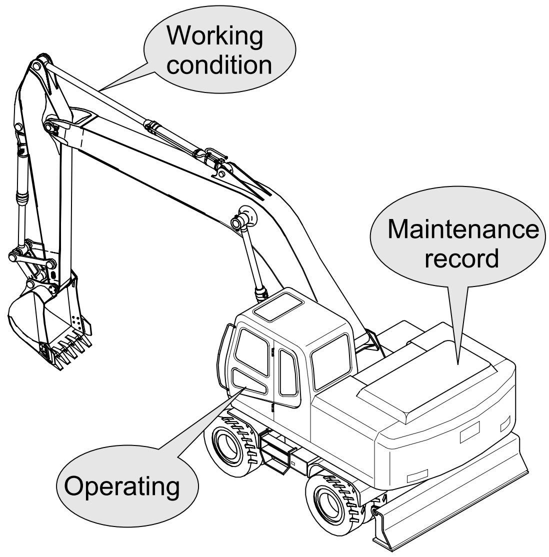
2) OPERATIONAL PERFORMANCE OF A WORKING MACHINE

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

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

3) OPERATIONAL PERFORMANCE OF A REPAIRED MACHINE

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

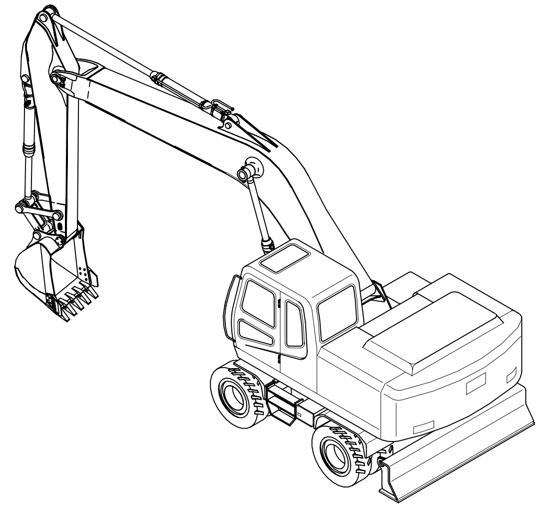


14W77MS01

2. TERMINOLOGY

1) STANDARD

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

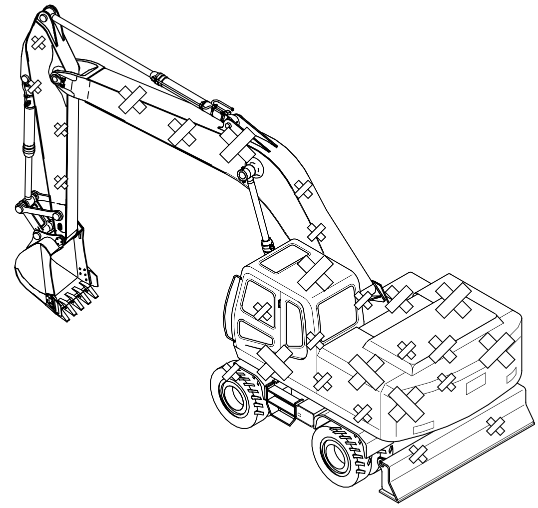


140W77MS02

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.

(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.

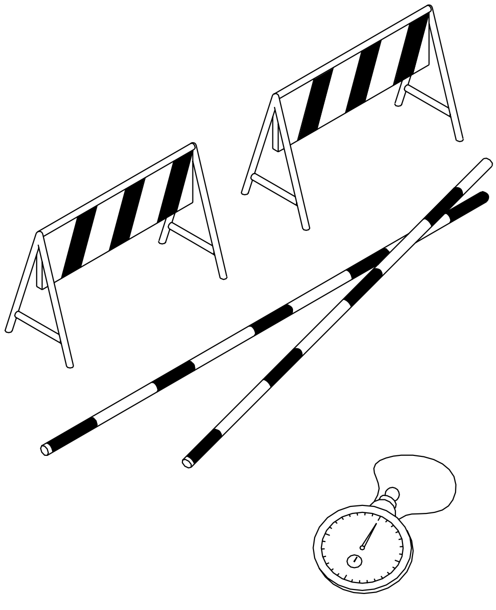
④ Avoid polluting the machine and the ground with leaking oil. Use oil pans to catch escaping oil. Pay special attention to this when removing hydraulic pipings.

(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.



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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

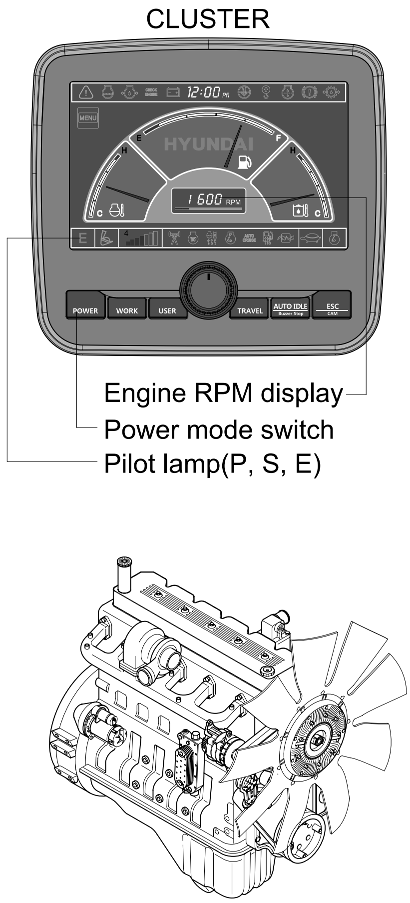
① Start the engine. The engine will run at start idle speed. Measure engine speed with a engine rpm display.

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.



14W97MS03

(4) Evaluation

The measured speeds should meet the following specifications.

Unit : rpm

Model	Engine speed	Standard	Remarks
HW150VSPRO	Start idle	800±50	
	P mode	1500±50	
	S mode	1400±50	
	E mode	1300±50	
	Auto decel	1000±50	
	One touch decel	800±50	

3) TRAVEL SPEED

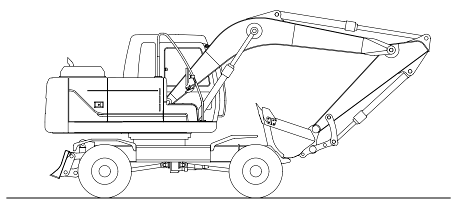
(1) Measure the time require for the excavator to travel a 50m at high speed and a 20m at low speed test run.

(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.



14W97MS04

(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.

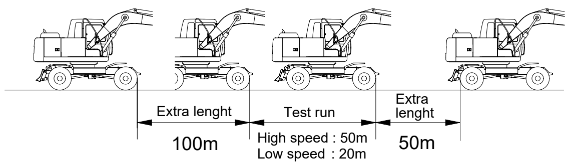
· Power mode switch : P mode

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.



14W97MS05

(4) Evaluation

The average measured time should meet the following specifications.

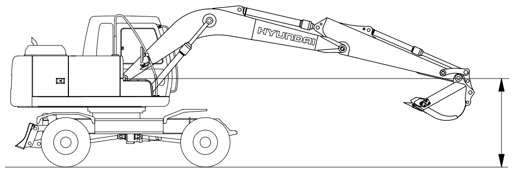
Unit : Seconds

Model	Travel speed	Standard	Maximum allowable	Remarks
HW150VSPRO	Low speed	9	11.3	Seconds / 20 m
	High speed	5.8	7.2	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.



14W96MS06

(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.

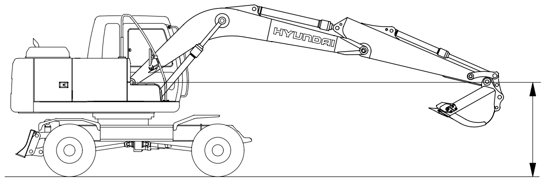
(4) Evaluation
The time required for 3 swings should meet the following specifications.

Unit : Seconds / 3 revolutions

Model	Power mode switch	Standard	Maximum allowable
HW150VSPRO	P mode	16.0±1.5	17.5

5) SWING FUNCTION DRIFT CHECK

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



14W97MS06

(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.

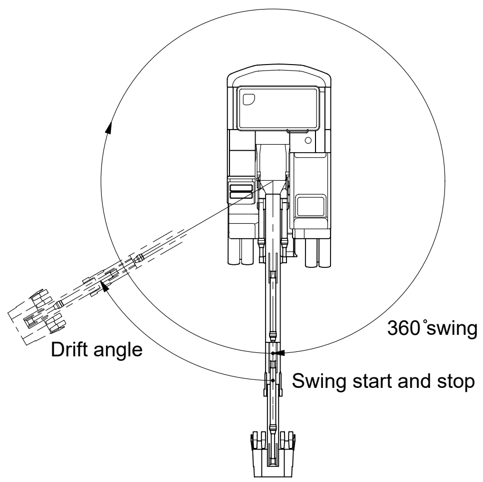
· Power mode switch : P mode

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

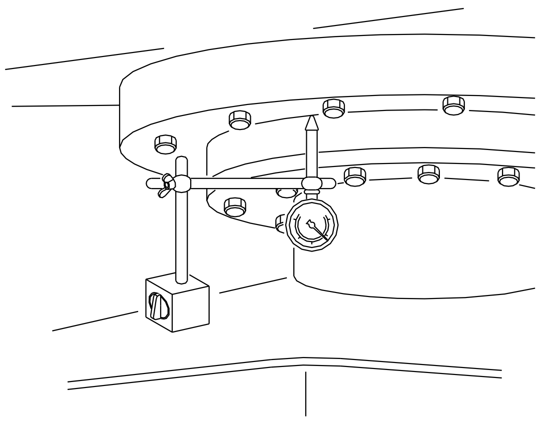
The measured drift angle should be within the following specifications.

Unit : Degree

Model	Power mode switch	Standard	Maximum allowable	Remarks
HW150VSPRO	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.



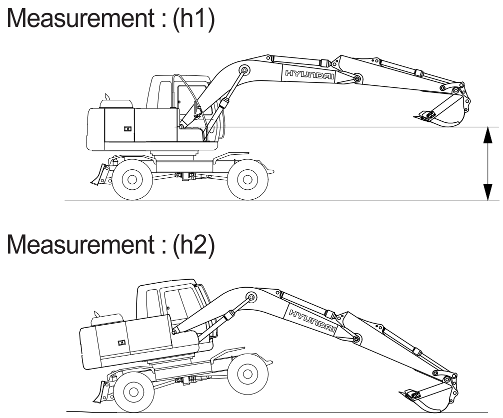
7-10(1) 140-7

(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



14W97MS08

(4) Evaluation

The measured drift should be within the following specifications.

Unit : mm

Model	Standard	Maximum allowable	Remarks
HW150VSPRO	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.

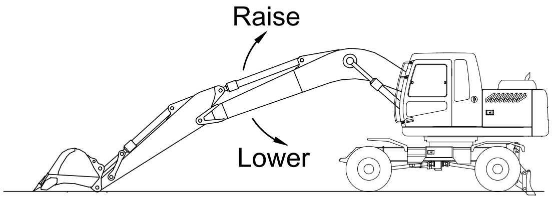
④ Keep the hydraulic oil temperature at 50±5°C.

(3) Measurement

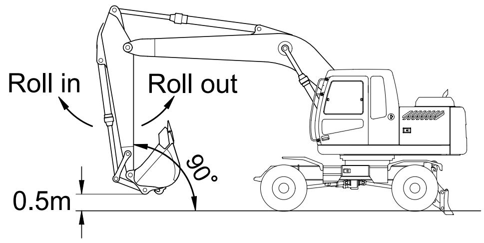
① Select the following switch positions.
- Power mode switch : P mode

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.

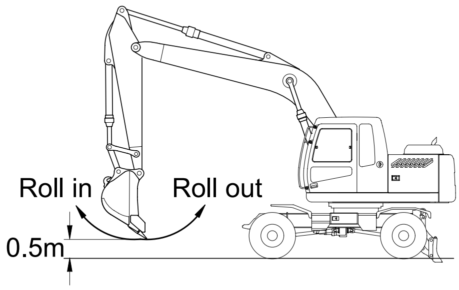
Boom cylinder



Arm cylinder



Bucket cylinder



14W97MS09

- 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

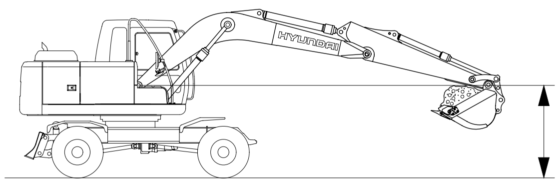
The average measured time should meet the following specifications.

Unit : Seconds

Model	Function		Standard	Maximum allowable	Remarks
HW150VSPRO	Boom raise		3.3±0.4	4.0	
	Boom lower		2.7±0.4	3.6	
	Arm in		2.3±0.3	3.4	
	Arm out		2.5±0.3	3.5	
	Bucket load		3.6±0.4	4.0	
	Bucket dump		2.1±0.3	2.6	

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±5℃.

(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
HW150VSPRO	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℃.

(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
HW150VSPRO	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
HW150VSPRO	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.

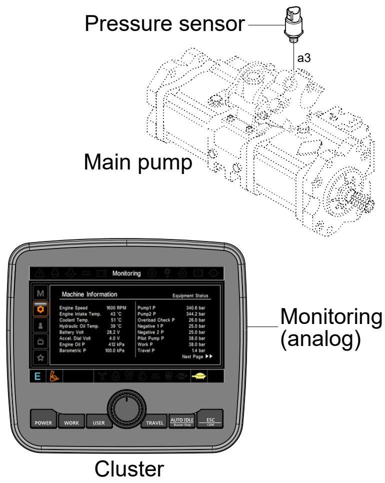
(2) Measurement

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.



14W97MS12

(3) Evaluation

The average measured pressure should meet the following specifications:

Unit : kgf / cm^2

Model	Kind of lever	Standard	Maximum allowable	Remarks
HW150VSPRO	M mode	40^{+2}	-	

12) FOR TRAVEL SPEED SELECTING PRESSURE

(1) Preparation

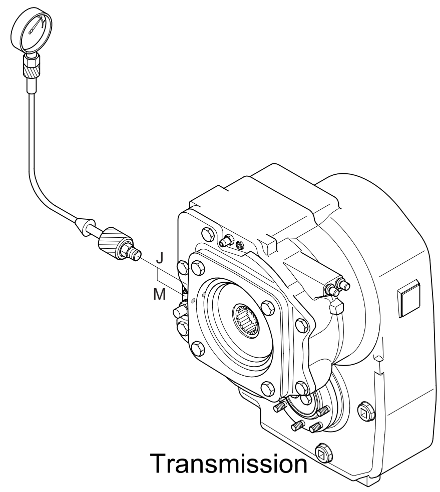
① Stop the engine.

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.



Transmission

(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

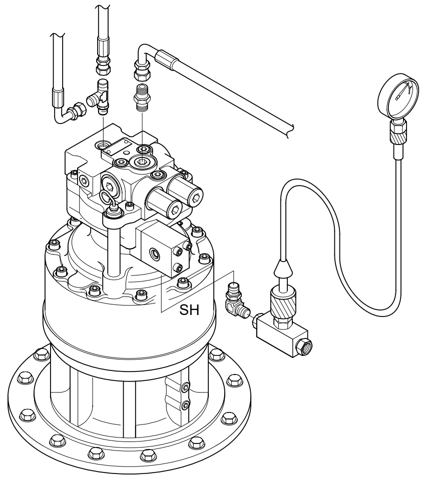
The average measured pressure should be within the following specifications.

Unit : kgf / cm^2

Model	Travel speed mode	Standard		Allowable limits		Remarks
		J port	M port	J port	M port	
HW150VSPRO	Low Speed	-	33+2	-	30~35	
	High Speed	33+2	-	30~35	-	

13) SWING PARKING BRAKE RELEASING PRESSURE

(1) Preparation



① Stop the engine.
② Loosen the cap and relieve the pressure in the hydraulic tank by pushing the top of the air breather.
③ The pressure release L wrench to bleed air.
④ Install a connector and pressure gauge assembly to swing motor SH port, as shown.
⑤ Start the engine and check for oil leakage from the adapter.
⑥ Keep the hydraulic oil temperature at 50±5°C.

(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.

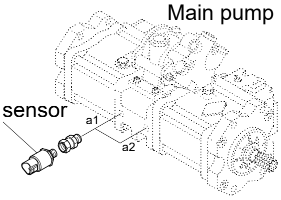
(3) Evaluation

The average measured pressure should be within the following specifications.

Unit : kgf / cm^2

Model	Description	Standard	Allowable limits	Remarks
HW150VSPRO	Brake disengaged	40	Over 9	
	Brake applied	0	-	

14) MAIN PUMP DELIVERY PRESSURE



(1) Preparation

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

(2) Measurement

① Select the following switch positions.

· Power mode switch : P mode

② Measure the main pump delivery pressure in the P mode (high idle).

(3) Evaluation

The average measured pressure should meet the following specifications.

Unit : kgf / cm^2

Model	Engine speed	Standard	Allowable limits	Remarks
HW150VSPRO	High idle	40^{+2}_{0}	-	

15) SYSTEM PRESSURE REGULATOR RELIEF SETTING

(1) Preparation

① Keep the hydraulic oil temperature at 50±5℃.

(2) Measurement

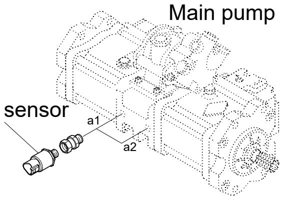
① Select the following switch positions.

・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.



Cluster

(3) Evaluation

The average measured pressure should be within the following specifications.

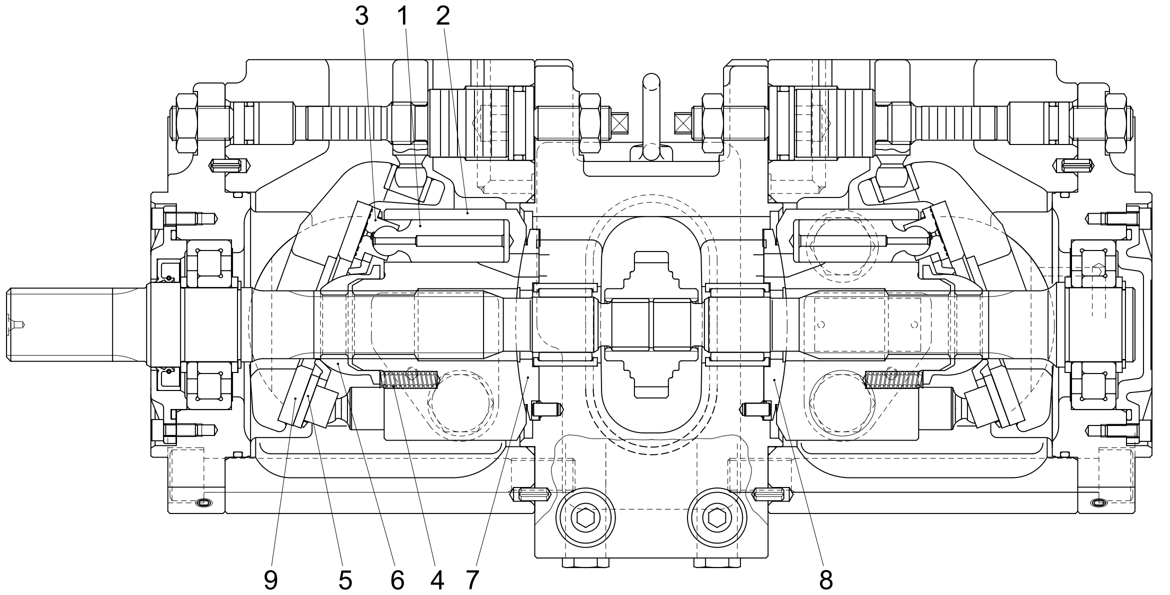
Unit : kgf / cm^2

Model	Function to be tested	Standard	Port relief setting at 20lpm
HW150VSPRO	Boom, Arm, Bucket	350 (380)±10	400±10
	Travel	400±10	-
	Swing	285±10	-

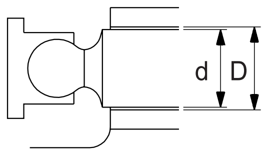
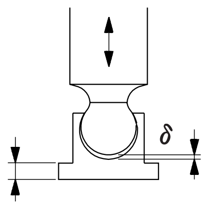
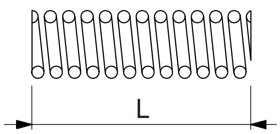
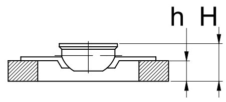
(   ) : Power boost

GROUP 2 MAJOR COMPONENT

1. MAIN PUMP



14W7A7MP01

Part name & inspection item		Standard dimension	Recommended replacement value	Counter measures
Clearance between piston (1) & cylinder bore (2) (D-d)		0.028	0.056	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)		3.9	3.7	
Free height of cylinder spring(4) (L)		31.3	30.5	Replace cylinder spring.
Combined height of set plate(5)(H) & spherical bushing(6)(h) (H-h)		19.0	18.3	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		

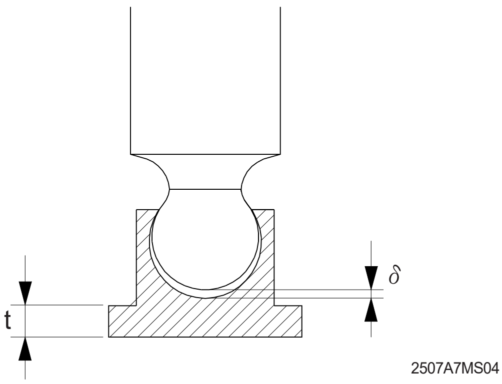
2. MAIN CONTROL VALVE

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.

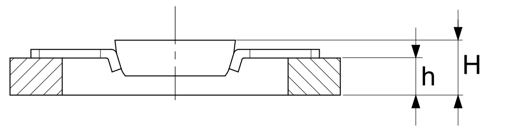
3. SWING DEVICE

1) WEARING PARTS

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



2507A7MS04



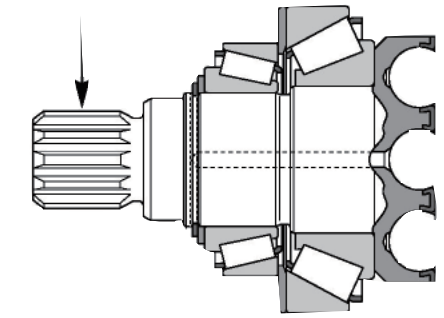
2507A7MS05

2) SLIDING PARTS

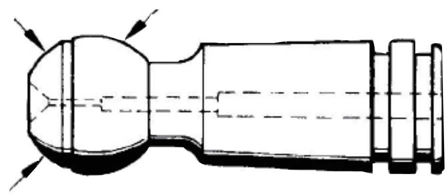
Part name	Standard roughness	Allowable roughness	Remark
Shoe	0.8-Z (Ra=0.2) (LAPPING)	3-Z (Ra=0.8)	
Shoe plate	0.4-Z (Ra=0.1) (LAPPING)	3-Z (Ra=0.8)	
Cylinder	1.6-Z (Ra=0.4) (LAPPING)	12.5-Z (Ra=3.2)	
Valve plate	0.8-Z (Ra=0.2) (LAPPING)	6.3-Z (Ra=1.6)	

4. TRAVEL MOTOR

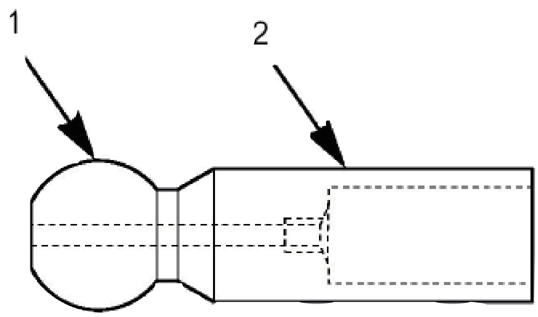
1) Free of corrosion, erosion or fretting; no damage to splines or keyways.


14W7TM052

2) **Pistons**
No scoring and no pittings.

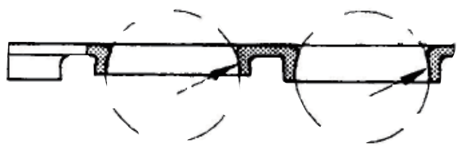

14W7TM053

3) **Center pin**
No scoring and no pittings.



14W7TM054

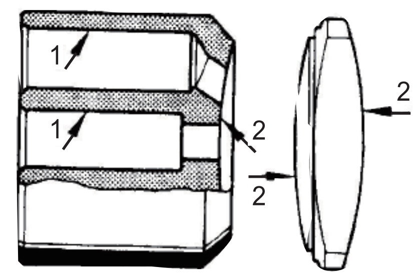
4) **Retaining plate**
No scoring and no evidence of wear.


14W7TM055

5) Cylinder block/control lens

① Bores free of scoring, no evidence of wear.

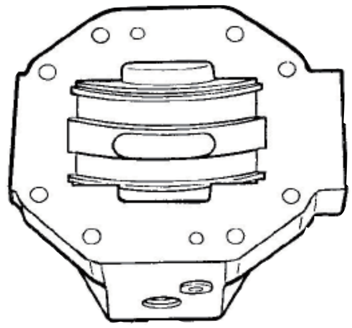
② Faces smooth and even, free of cracks and scoring.



14W7TM056

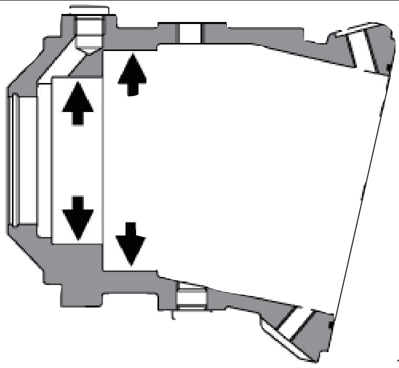
6) Control housing

Sliding surface and side guides free of scoring and no wear.

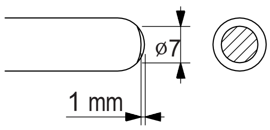

14W7TM057

7) Visual check

Bearing areas free of scoring and no evidence of wear.

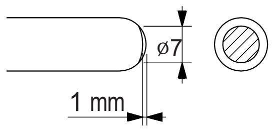

14W7TM058

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 1mm.	
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.	

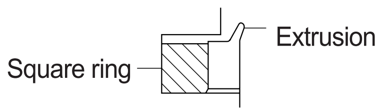
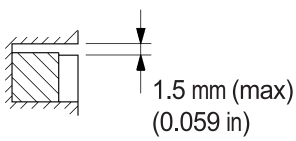
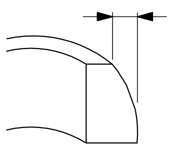
Notes 1. It is desirable to replace seal materials, such as O-rings, every disassembling. However, they may be reused, after being confirmed to be free of damage.

6. ACCELERATOR PEDAL

Maintenance check item	Criteria	Remark
Leakage	The valve is to be replaced when the leakage effect to the system. For example, the primary pressure drop.	Conditions : Primary pressure : 40 kgf/cm^2 Oil viscosity : 23 cSt
Spool	This is to be replaced when the sliding surface has worn more than 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 th top end has worn more than 1mm.	
Play at operating section	The pin, shaft, and joint of the operating section are to be replaced when their plays become more than 2mm due to wears or so on.	When a play is due to looseness of a tightened section, adjust it.
Operation stability	When abnormal noises, hunting, primary pressure drop, etc. are generated during operation, and these cannot be remedied, referring to section 6 troubleshooting, replace the related parts.	

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

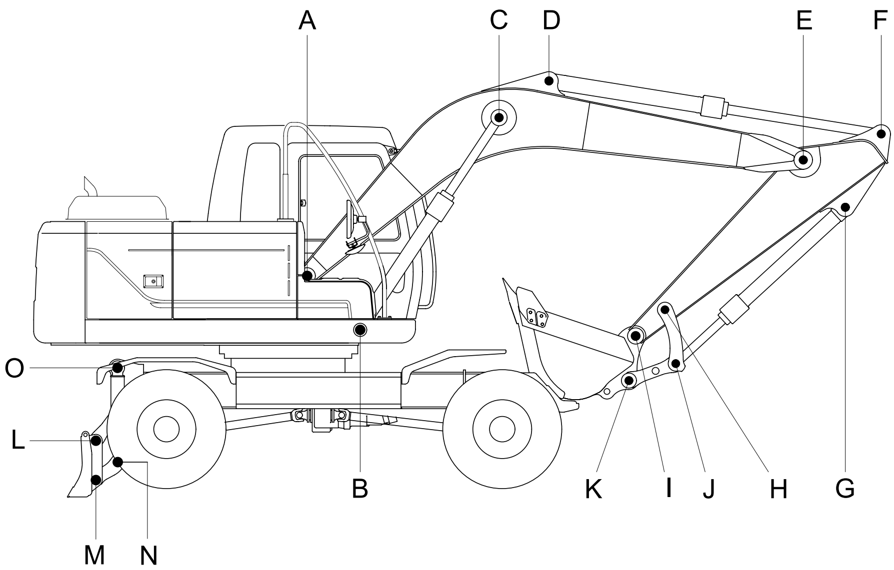
7. TURNING JOINT

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)	
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 Rust is not present on plating Scratches are not present	· Replace or replate · Replace or replate · Recondition, replate or replace
	· Rod	· Wear of O.D.	· Recondition, replate or replace
Cylinder tube	· Bushing at mounting part	· Wear of I.D.	· Replace
	· Weld on bottom	· Presence of crack	· Replace
	· Weld on head	· Presence of crack	· Replace
	· Weld on hub	· Presence of crack	· Replace
	· Tube interior	· Presence of faults	· Replace if oil leak is seen
	· Bushing at mounting part	· Wear on inner surface	· Replace
Gland	· Bushing	· Flaw on inner surface	· Replace if flaw is deeper than coating

GROUP 3 WORK EQUIPMENT



Unit : mm

Mark	Measuring point (pin and bushing)	Normal value	Pin		Bushing		Remedy & Remark
			Recomm. service limit	Limit of use	Recomm. service limit	Limit of use	
A	Boom rear	70	69	68.5	70.5	71	Replace
B	Boom cylinder head	70	69	68.5	70.5	71	〃
C	Boom cylinder rod	70	69	68.5	70.5	71	〃
D	Arm cylinder head	70	69	68.5	70.5	71	〃
E	Boom front	70	69	68.5	70.5	71	〃
F	Arm cylinder rod	70	69	68.5	70.5	71	〃
G	Bucket cylinder head	70	69	68.5	70.5	71	〃
H	Arm link	65	64	63.5	65.5	66	〃
I	Bucket and arm link	65	64	63.5	65.5	66	〃
J	Bucket cylinder rod	70	69	68.5	70.5	71	〃
K	Bucket link	65	64	63.5	65.5	66	〃
L	Dozer link (B)	55	54	53.5	55.5	56	〃
M	Dozer link (A)	55	54	53.5	55.5	56	〃
N	Dozer cylinder rod	65	64	63.5	65.5	66	〃
O	Dozer cylinder head	65	64	63.5	65.5	66	〃

SECTION 8 DISASSEMBLY AND ASSEMBLY

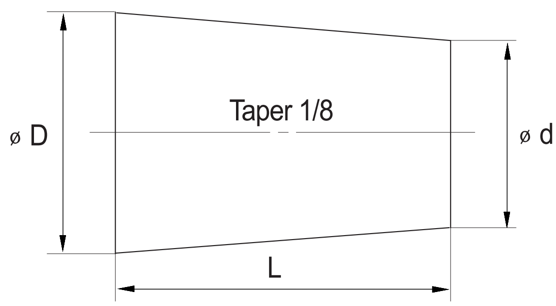
SECTION 8 DISASSEMBLY AND ASSEMBLY

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	55±3.5	398±25.3
2		Engine mounting bolt (bracket-frame, RR)	M24 × 3.0	90±7.0	651±50.6
3		Engine mounting bolt (engine-bracket)	M12 × 1.75	10.0±1.0	72.3±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	4.8±0.3	34.7±2.2
7		Main pump mounting bolt	M16 × 2.0	25.0±2.5	181±18.1
8		Main control valve mounting bolt	M12 × 1.75	12.2±1.3	88.2±9.4
9		Travel motor mounting bolt	M16 × 2.0	29.6±3.2	214±23.1
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	12.3±1.3	89±9.4
13	Power train system	Swing motor mounting bolt	M16 × 2.0	29.6±3.2	214±23.1
14		Swing bearing upper mounting bolt	M18 × 2.5	41.3±4.5	299±32.5
15		Swing bearing lower mounting bolt	M16 × 1.5	31.3±3.2	226±23.1
16		Real axle mounting bolt, nut	M20 × 2.5	58±6.3	419±45.5
17		Transmission bracket mounting bolt	M20 × 2.5	58.4±6.4	422±46.3
18		Transmission mounting bolt	M20 × 2.5	29.7±4.5	215±32.5
19		Oscillating cylinder mounting bolt	M22 × 1.5	83.2±9.2	602±66.5
20		Oscillating cylinder support bolt	M12 × 1.75	12.3±2.5	88.9±18.1
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	M27 × 3.0	140±15	1013±108
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 each components disassembly and assembly.

2. TORQUE CHART

The torques given are standard figures. Any figures specifically described in this manual has priority.

1) BOLT AND NUT

(1) Coarse thread

Bolt size	8T		10T	
	kg · m	lb · ft	kg · m	lb · ft
M 6 × 1.0	0.9 ~ 1.3	6.5 ~ 9.4	1.1 ~ 1.7	8.0 ~ 12.3
M 8 × 1.25	2.0 ~ 3.0	14.5 ~ 21.7	2.7 ~ 4.1	19.5 ~ 29.7
M10 × 1.5	4.0 ~ 6.0	28.9 ~ 43.4	5.5 ~ 8.3	39.8 ~ 60.0
M12 × 1.75	7.4 ~ 11.2	53.5 ~ 81.0	9.8 ~ 15.8	70.9 ~ 114
M14 × 2.0	12.2 ~ 16.6	88.2 ~ 120	16.7 ~ 22.5	121 ~ 163
M16 × 2.0	18.6 ~ 25.2	135 ~ 182	25.2 ~ 34.2	182 ~ 247
M18 × 2.5	25.8 ~ 35.0	187 ~ 253	35.1 ~ 47.5	254 ~ 344
M20 × 2.5	36.2 ~ 49.0	262 ~ 354	49.2 ~ 66.6	356 ~ 482
M22 × 2.5	48.3 ~ 63.3	349 ~ 458	65.8 ~ 98.0	476 ~ 709
M24 × 3.0	62.5 ~ 84.5	452 ~ 611	85.0 ~ 115	615 ~ 832
M30 × 3.0	124 ~ 168	898 ~ 1214	169 ~ 229	1223 ~ 1656
M36 × 4.0	174 ~ 236	1261 ~ 1704	250 ~ 310	1808 ~ 2242

(2) Fine thread

Bolt size	8T		10T	
	kg · m	lb · ft	kg · m	lb · ft
M 8 × 1.0	2.2 ~ 3.4	15.9 ~ 24.6	3.0 ~ 4.4	21.7 ~ 31.8
M10 × 1.2	4.5 ~ 6.7	32.5 ~ 48.5	5.9 ~ 8.9	42.7 ~ 64.4
M12 × 1.25	7.8 ~ 11.6	56.4 ~ 83.9	10.6 ~ 16.0	76.7 ~ 116
M14 × 1.5	13.3 ~ 18.1	96.2 ~ 131	17.9 ~ 24.1	130 ~ 174
M16 × 1.5	19.9 ~ 26.9	144 ~ 195	26.6 ~ 36.0	192 ~ 260
M18 × 1.5	28.6 ~ 43.6	207 ~ 315	38.4 ~ 52.0	278 ~ 376
M20 × 1.5	40.0 ~ 54.0	289 ~ 391	53.4 ~ 72.2	386 ~ 522
M22 × 1.5	52.7 ~ 71.3	381 ~ 516	70.7 ~ 95.7	511 ~ 692
M24 × 2.0	67.9 ~ 91.9	491 ~ 665	90.9 ~ 123	658 ~ 890
M30 × 2.0	137 ~ 185	990 ~ 1339	182 ~ 248	1314 ~ 1796
M36 × 3.0	192 ~ 260	1390 ~ 1880	262 ~ 354	1894 ~ 2562

2) PIPE AND HOSE (FLARE type)

Thread size (PF)	Width across flat (mm)	kgf · m	lbf · ft
1/4"	19	4	28.9
3/8"	22	5	36.2
1/2"	27	9.5	68.7
3/4"	36	18	130.2
1"	41	21	151.9
1-1/4"	50	35	253.2

3) PIPE AND HOSE (ORFS type)

Thread size (UNF)	Width across flat (mm)	kgf · m	lbf · ft
9/16-18	19	4	28.9
11/16-16	22	5	36.2
13/16-16	27	9.5	68.7
1-3/16-12	36	18	130.2
1-7/16-12	41	21	151.9
1-11/16-12	50	35	253.2

4) FITTING

Thread size	Width across flat (mm)	kgf · m	lbf · ft
1/4"	19	4	28.9
3/8"	22	5	36.2
1/2"	27	9.5	68.7
3/4"	36	18	130.2
1"	41	21	151.9
1-1/4"	50	35	253.2

GROUP 3 PUMP DEVICE

1. REMOVAL AND INSTALL

1) REMOVAL

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

(2) Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping

(3) Loosen the breather slowly to release the pressure inside the hydraulic tank.

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

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

· Hydraulic tank quantity : 124 ℓ (32.8 U.S. gal)

(5) Remove socket bolts (13) and disconnect hoses (1,2).

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

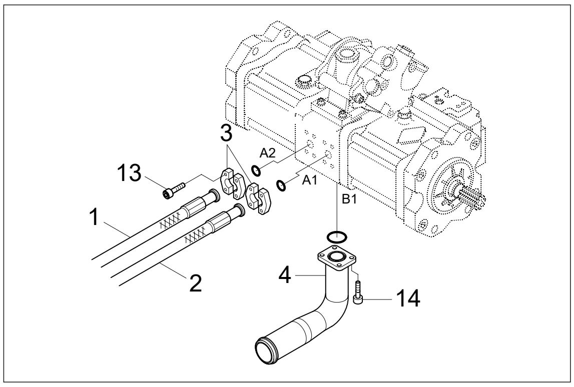
(7) Remove socket bolts (14) and disconnect pump suction pipe (4).

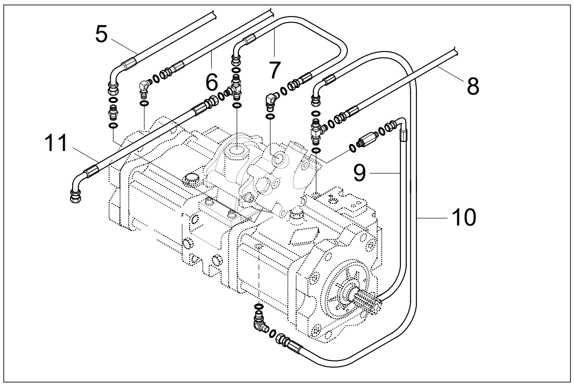
※ When pump suction tube is disconnected, the oil inside the piping will flow out, so catch it in oil pan.

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

· Weight : 100 kg (220 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.

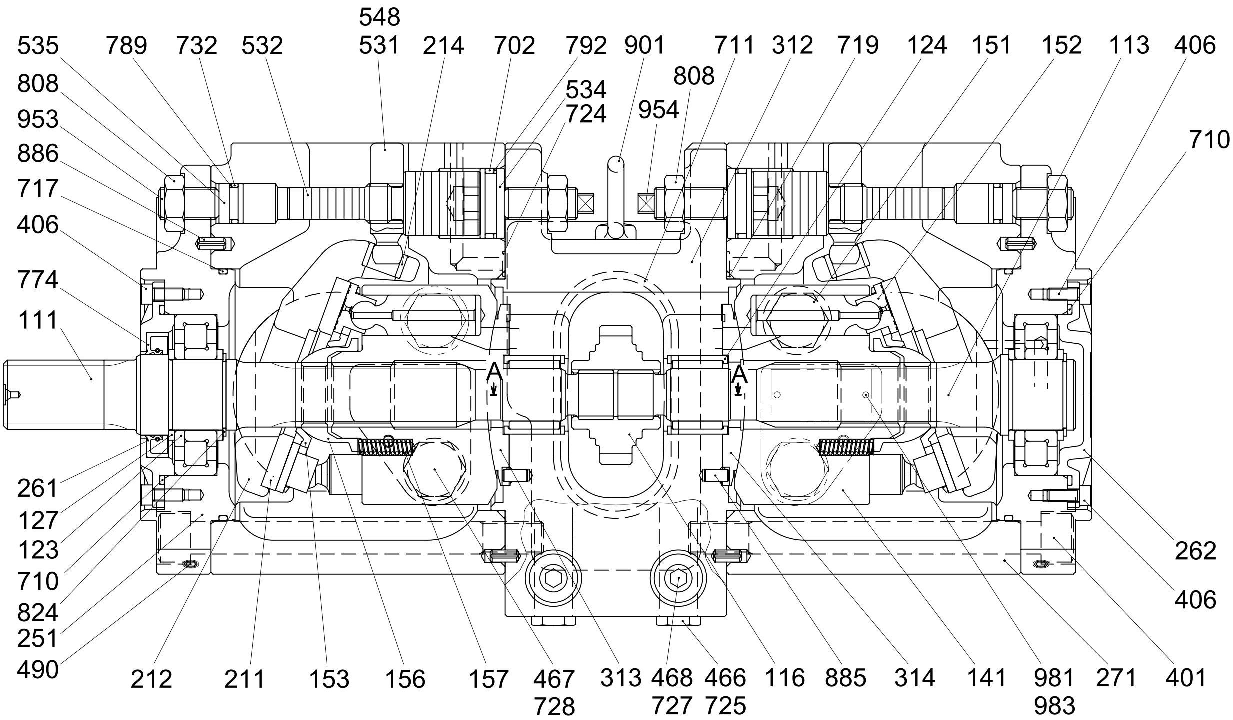
(6) Bleed the air from the hydraulic pump.
① Remove the air vent plug (2EA).
② Tighten plug lightly.
③ Start the engine, run at low idling, and check oil come out from plug.
④ Tighten plug.

(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)

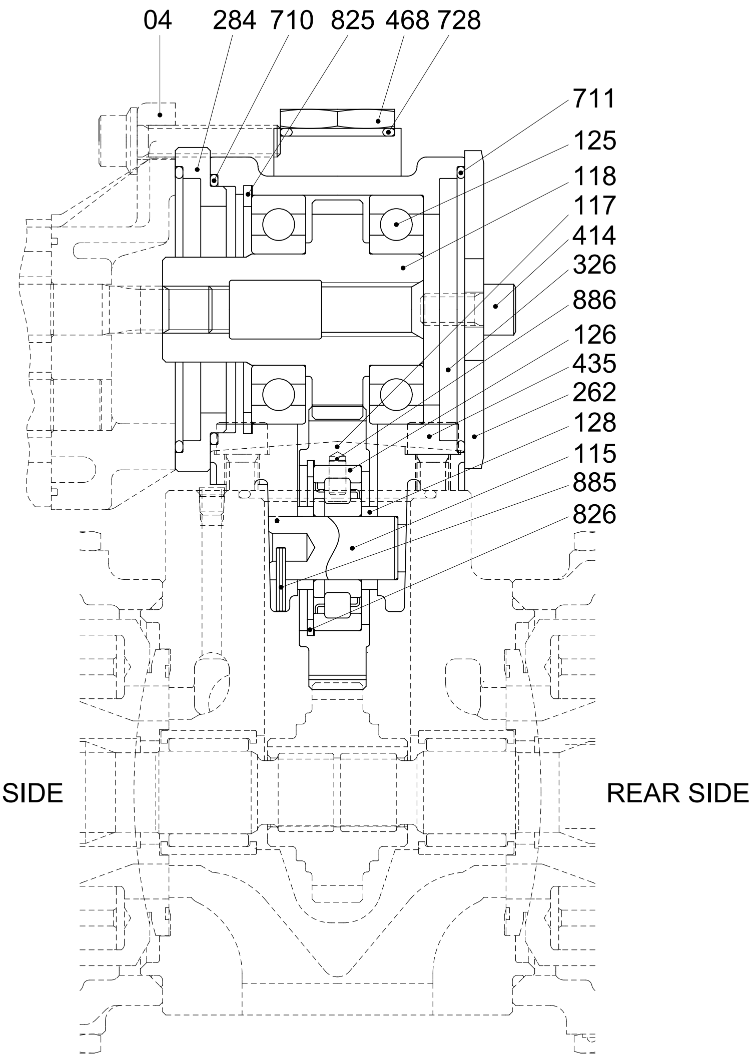
1) STRUCTURE



14W72SF02

111	Drive shaft (F)	312	Valve block	724	O-ring
113	Drive shaft (R)	313	Valve plate (R)	725	O-ring
116	Gear	314	Valve plate (L)	727	O-ring
123	Roller bearing	401	Hexagon socket bolt	728	O-ring
124	Needle bearing	406	Hexagon socket bolt	732	O-ring
127	Bearing spacer	466	VP Plug	774	Oil seal
141	Cylinder block	467	VP Plug	789	Back up ring
151	Piston	468	VP Plug	792	Back up ring
152	Shoe	490	Plug	808	Hexagon head nut
153	Push-plate	531	Tilting pin	824	Snap ring
156	Bushing	532	Servo piston	885	Pin
157	Cylinder spring	534	Stopper (L)	886	Spring pin
211	Shoe plate	535	Stopper (S)	901	Eye bolt
212	Swash plate	548	Pin	953	Set screw
214	Bushing	702	O-ring	954	Set screw
251	Support	710	O-ring	981	Plate
261	Seal cover (F)	711	O-ring	983	Pin
262	Seal cover (R)	717	O-ring		
271	Pump casing	719	O-ring		

MAIN PUMP (2/2)

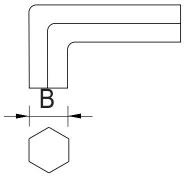


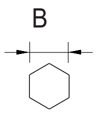
04	Gear pump	262	Cover	711	O-ring
115	Shaft	284	Plate	728	O-ring
117	Gear No.2	326	Gear case	825	Retainer ring
118	Gear No.3	414	Screw	826	Retainer ring
125	Ball bearing	435	Hexagon socket bolt	827	Retainer ring
126	Roller bearing	468	Plug	885	Spring pin
128	Bearing spacer	710	O-ring	886	Pin

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	-

Name	B	Hexagon bolt	Hexagon nut	VP plug (PF thread)
Double ring spanner, socket wrench, double (single) open end spanner 	-	Hexagon 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

Tool name	Part name
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. 10×8×200
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.

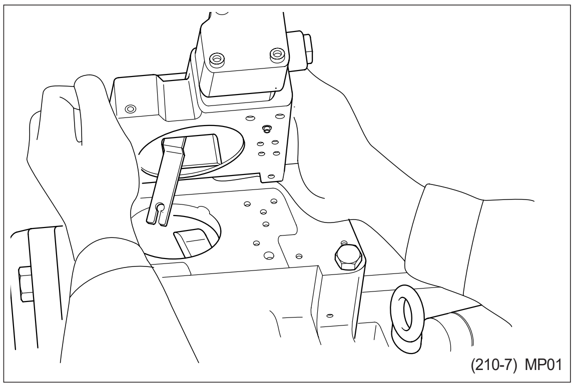
※ Select clean place.

※ 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.



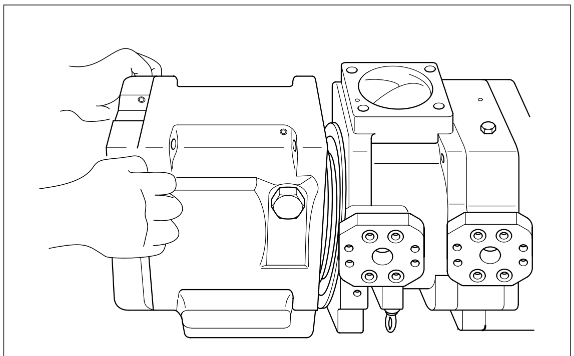
(210-7) MP01

(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).

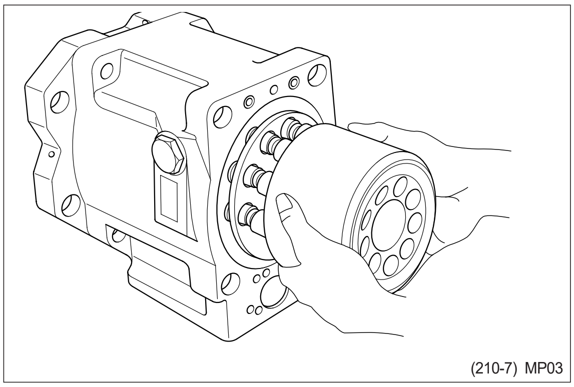
※ Before bringing this surface down, spread rubber sheet on workbench without fail to prevent this surface from being damaged.



(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.

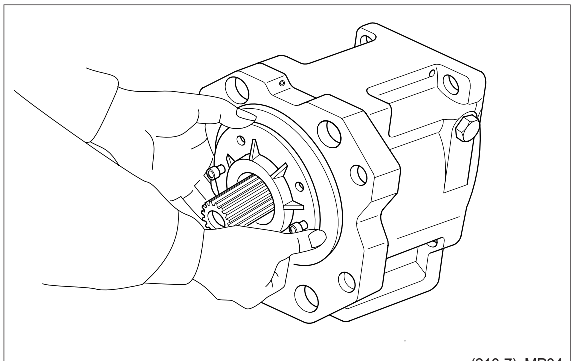


(210-7) MP03

(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.

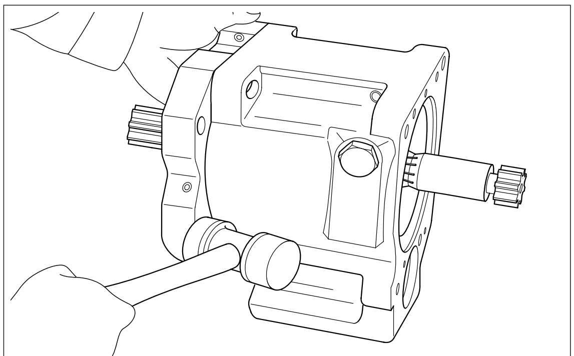
※ Since oil seal is fitted on seal cover (F), take care not to damage it in removing cover.



(210-7) MP04

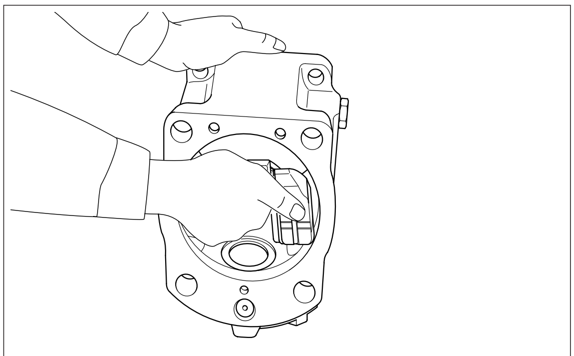
(9) Remove hexagon socket head bolts (408) and then seal cover (R, 262).
In case fitting a gear pump, first, remove gear pump.

(10) Tapping lightly fitting flange section of swash plate support (251) on its pump casing side, separate swash plate support from pump casing.



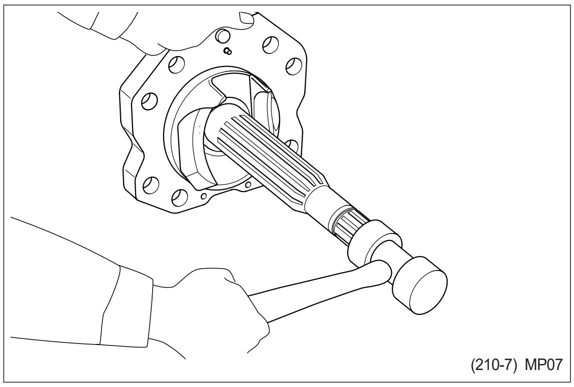
(210-7) MP05

(11) Remove shoe plate (211)and swash plate (212) from pump casing (271).



(210-7) MP06

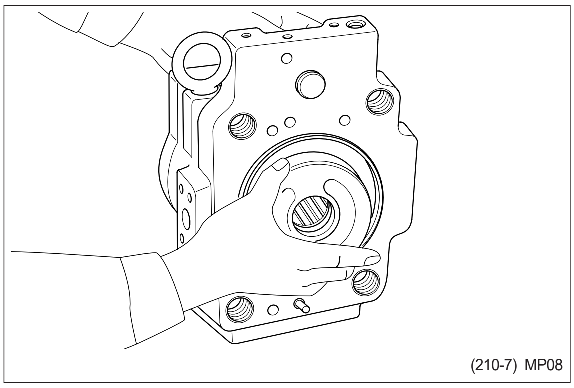
(12) Tapping lightly shaft ends of drive shafts (111, 113) with plastic hammer, take out drive shafts from swash plate supports.



(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.

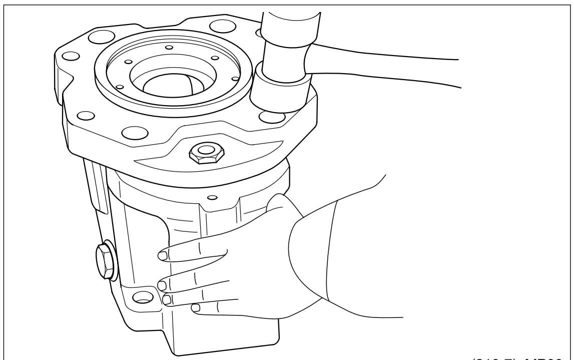
⑤ For fitting bolts, plug, etc., prepare a torque wrench or so on, and tighten them with torques shown in page 8-11, 12.

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.

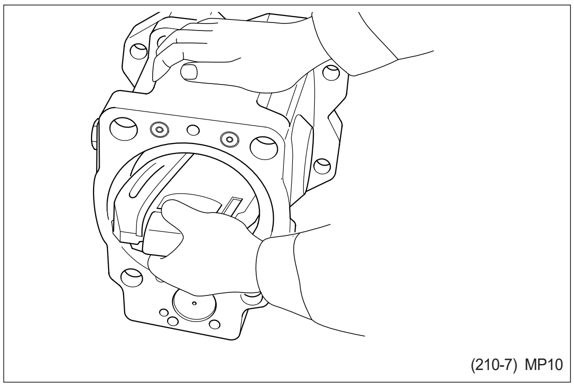
※ After servo piston, tilting pin, stopper (L) and stopper (S) are removed, fit them soon to pump casing in advance for reassembling.

※ 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.

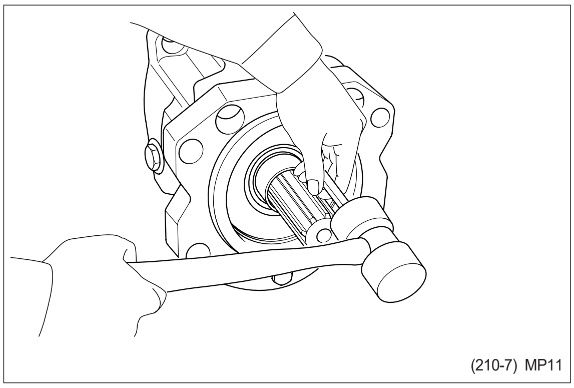


(210-7) MP09

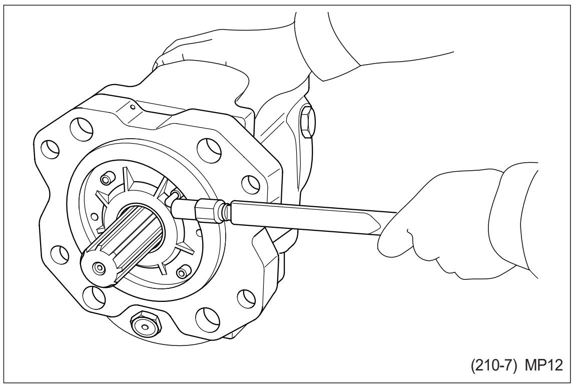
(3) Place pump casing with its regulator fitting surface down, fit tilting bush of swash plate to tilting pin (531) and fit swash plate (212) to swash plate support (251) correctly.
※ Confirm with fingers of both hands that swash plate can be removed smoothly.
※ Apply grease to sliding sections of swash plate and swash plate support, and drive shaft can be fitted easily.


(210-7) MP10

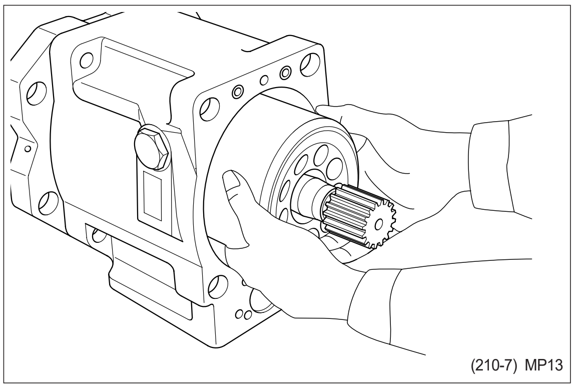
(4) To swash plate support (251), fit drive shaft (111) set with bearing (123), bearing spacer (127) and snap ring (824).
※ Do not tap drive shaft with hammer or so on.
※ Assemble them into support, tapping outer race of bearing lightly with plastic hammer.
Fit them fully, using steel bar or so on.


(210-7) MP11

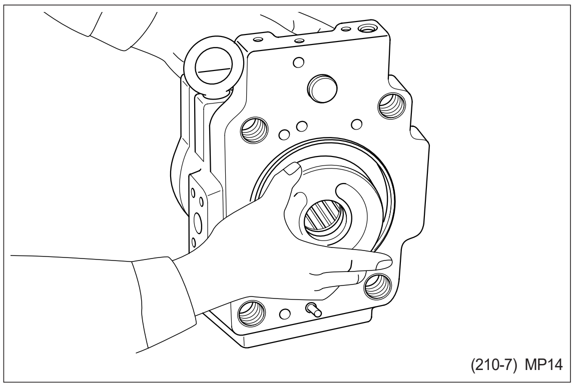
(5) Assemble seal cover (F, 261) to pump casing (271) and fix it with hexagon socket head bolts (406).
※ Apply grease lightly to oil seal in seal cover (F).
※ Assemble oil seal, taking full care not to damage it.
※ For tandem type pump, fit rear cover (263) and seal cover (262) similarly.


(210-7) MP12

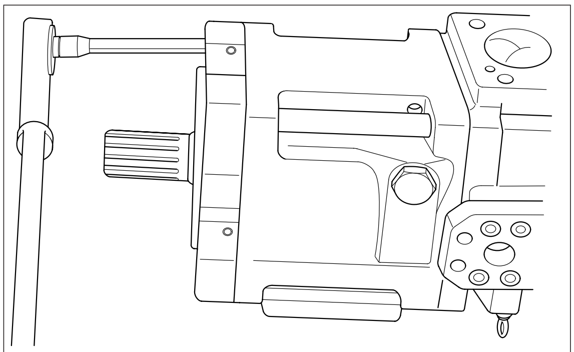
(6) Assemble piston cylinder subassembly 〔cylinder block (141), piston subassembly (151, 152), set plate (153), spherical bush (156), spacer (158) and cylinder spring (157)〕.
Fit spline phases of retainer and cylinder.
Then, insert piston cylinder subassembly into pump casing.


(210-7) MP13

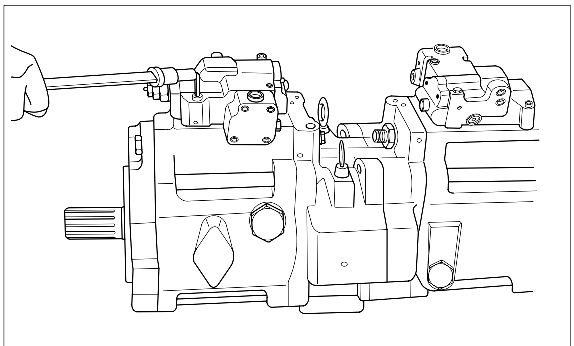
(7) Fit valve plate (313) to valve block (312), entering pin into pin hole.
※ Take care not to mistake suction / delivery directions of valve plate.


(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

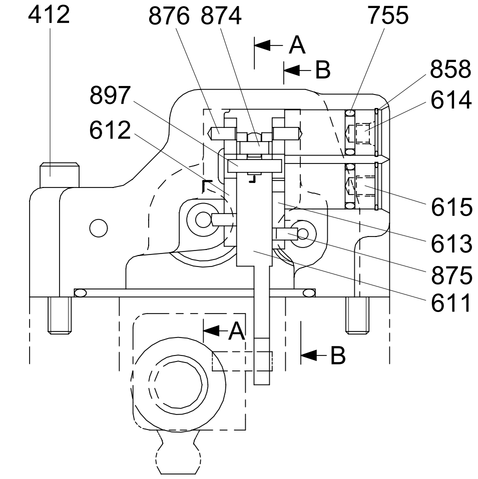
(9) Putting feedback pin of tilting pin into feedback lever of regulator, fit regulator and tighten hexagon socket head bolts (412, 413).
※ Take care not to mistake regulator of front pump for that of rear pump.

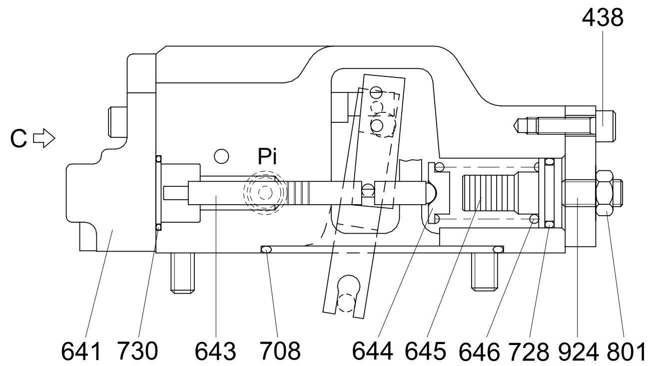

(210-7) MP17

(10) Fit drain port plug (468).
This is the end of reassembling procedures.

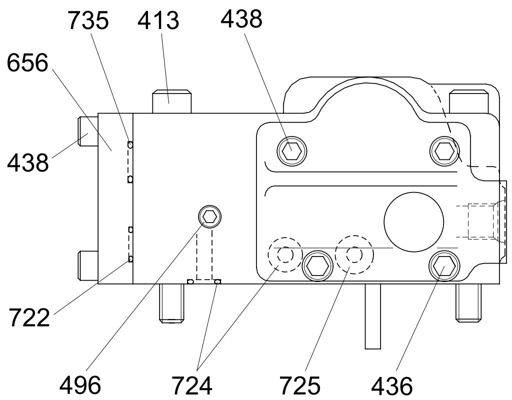
3. REGULATOR

1) STRUCTURE (1/2)

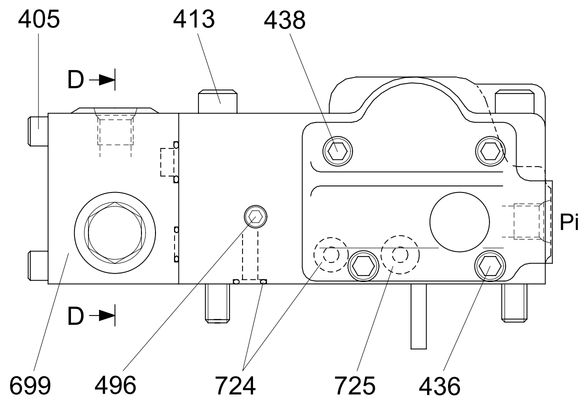




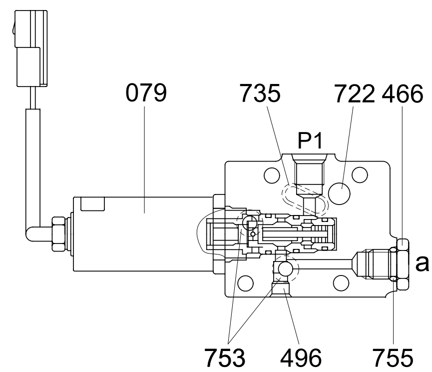
SECTION B-B



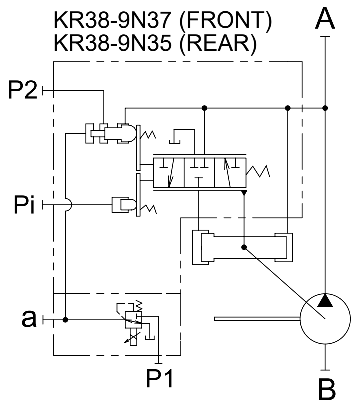
VIEW C (FRONT)



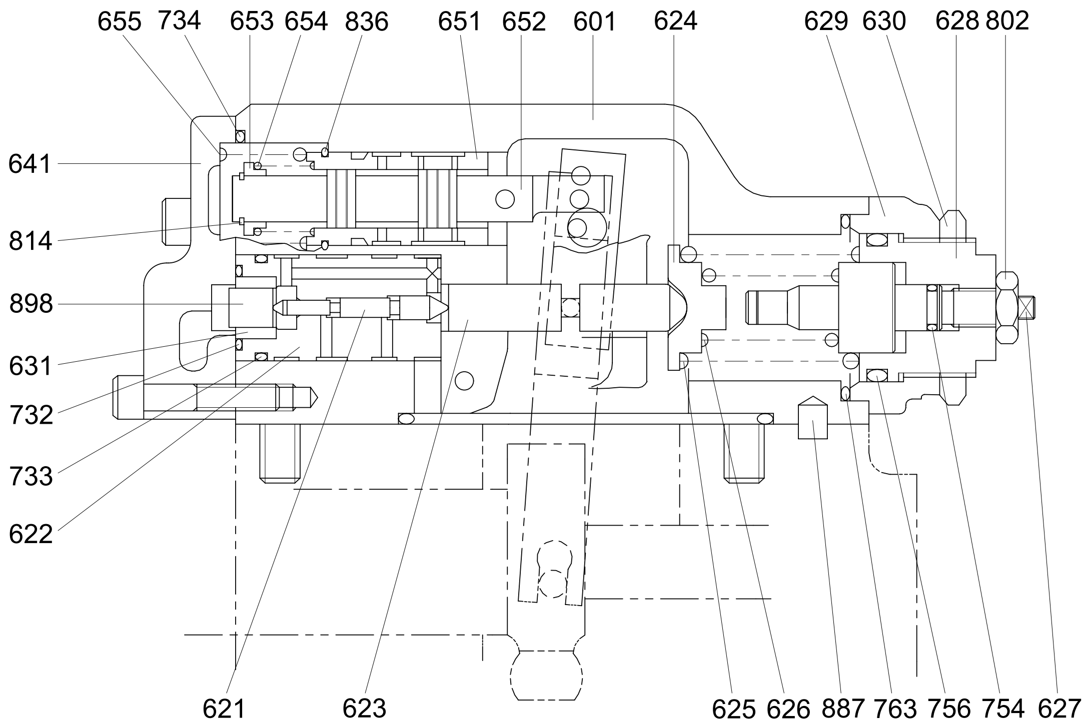
VIEW C (REAR)



SECTION D-D(REAR)



REGULATOR (2/2)



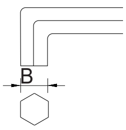
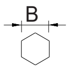
SECTION A-A

405	Hexagon socket screw	629	Cover (C)	732	O-ring
412	Hexagon socket screw	630	Lock nut	733	O-ring
413	Hexagon socket screw	631	Sleeve, kf	734	O-ring
436	Hexagon socket screw	641	Pilot cover	735	O-ring
438	Hexagon socket screw	643	Pilot piston	753	O-ring
466	Plug	644	Spring seat (Q)	754	O-ring
496	Plug	645	Adjust stem (Q)	755	O-ring
601	Casing	646	Pilot spring	756	O-ring
611	Feed back lever	651	Sleeve	763	O-ring
612	Lever (1)	652	Spool	801	Nut
613	Lever (2)	653	Spring seat	802	Nut
614	Fulcrum plug	654	Return spring	814	Snap ring
615	Adjust plug	655	Set spring	836	Snap ring
621	Compensator piston	656	Block cover	858	Snap ring
622	Piston case	699	Valve casing	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

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="12">Part name</th></tr>
<tr><td>Name</td><td>B</td><td colspan="3">Hexagon socket head bolt</td><td colspan="3">PT plug (PT thread)</td><td colspan="3">PO plug (PF thread)</td><td colspan="3">Hexagon socket head setscrew</td></tr>
<tr><td rowspan="3">Allen wrench </td><td>4</td><td colspan="3">M5</td><td colspan="3">BP-1/16</td><td colspan="3">-</td><td colspan="3">M 8</td></tr>
<tr><td>5</td><td colspan="3">M6</td><td colspan="3">BP-1/8</td><td colspan="3">-</td><td colspan="3">M10</td></tr>
<tr><td>6</td><td colspan="3">M8</td><td colspan="3">BP-1/4</td><td colspan="3">PO-1/4</td><td colspan="3">M12, M14</td></tr>
<tr><td rowspan="2">Double ring spanner, socket wrench, double (single) open end spanner </td><td>-</td><td colspan="4">Hexagon head bolt</td><td colspan="4">Hexagon nut</td><td colspan="4">VP plug (PF thread)</td></tr>
<tr><td>6</td><td colspan="4">M 8</td><td colspan="4">M 8</td><td colspan="4">-</td></tr>
<tr><td colspan="2">Adjustable angle wrench</td><td colspan="12">Small size, Max 36 mm</td></tr>
<tr><td colspan="2">Screw driver</td><td colspan="12">Minus type screw driver, Medium size, 2 sets</td></tr>
<tr><td colspan="2">Hammer</td><td colspan="12">Plastic hammer, 1 set</td></tr>
<tr><td colspan="2">Pliers</td><td colspan="12">For snap ring, TSR-160</td></tr>
<tr><td colspan="2">Steel bar</td><td colspan="12">4 × 100 mm</td></tr>
<tr><td colspan="2">Torque wrench</td><td colspan="12">Capable of tightening with the specified torques</td></tr>
<tr><td colspan="2">Pincers</td><td colspan="12">-</td></tr>
<tr><td colspan="2">Bolt</td><td colspan="12">M4, Length : 50 mm</td></tr>
</table>

(2) Tightening torque

Part name	Bolt size	Torque		Wrench size	
		kgf · m	lbf · ft	in	mm
Hexagon socket head bolt (material : SCM435)	M 5	0.7	5.1	0.16	4
	M 6	1.2	8.7	0.20	5
	M 8	3.0	21.7	0.24	6
	M10	5.8	42.0	0.31	8
	M12	10.0	72.3	0.39	10
	M14	16.0	116	0.47	12
	M16	24.0	174	0.55	14
	M18	34.0	246	0.55	14
	M20	44.0	318	0.67	17
PT 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.

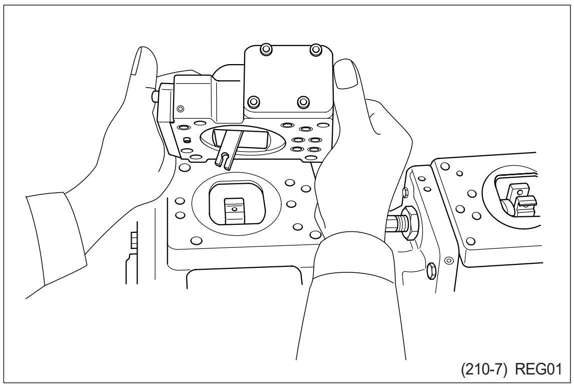
※ Choose a clean place.

※ 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.



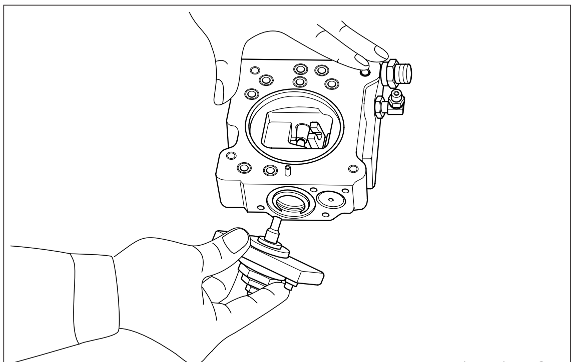
(210-7) REG01

(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).

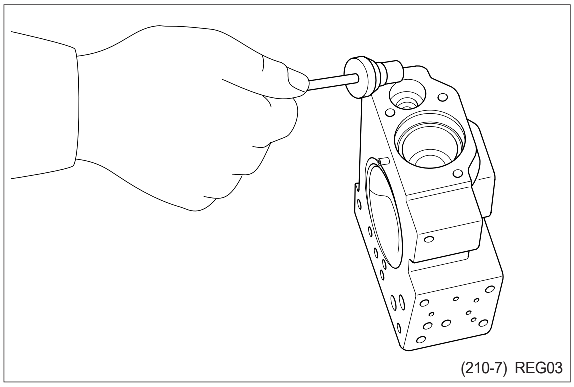
※ Do not loosen these screws and nuts.

If they are loosened, adjusted pressure-flow setting will vary.

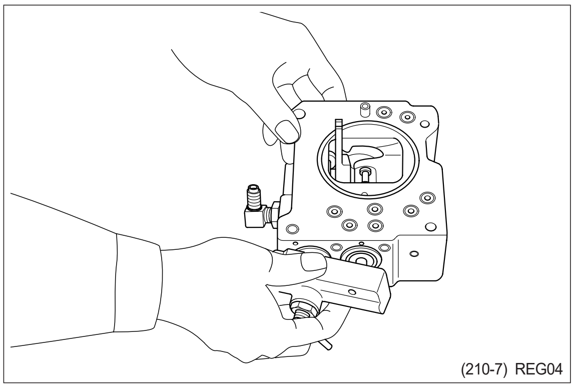


(210-7) REG02

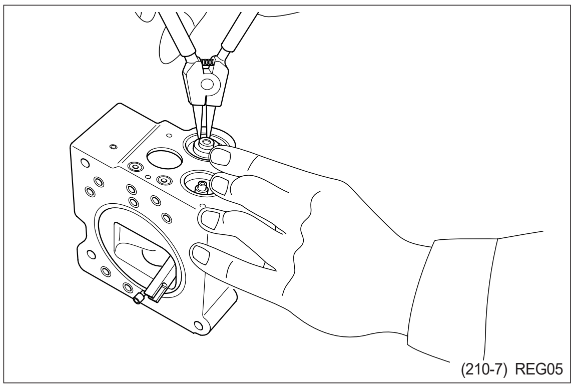
(5) After removing cover (C, 629) subassembly, take out outer spring (625), inner spring (626) and spring seat (C, 624) from compensating section.
Then draw out adjusting ring (Q, 645), pilot spring (646) and spring seat (644) from pilot section.
※ Adjusting ring (Q,645) can easily be drawn out with M4 bolt.


(210-7) REG03

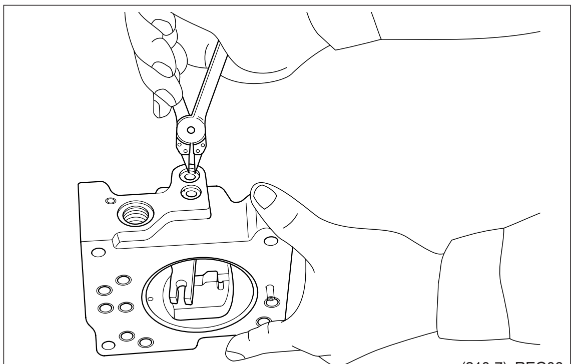
(6) Remove hexagon socket head screws (436, 438) and remove pilot cover (641).
After removing pilot cover, take out set spring (655) from pilot section.

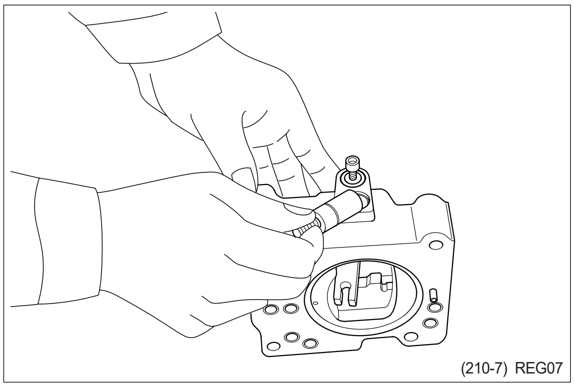

(210-7) REG04

(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.

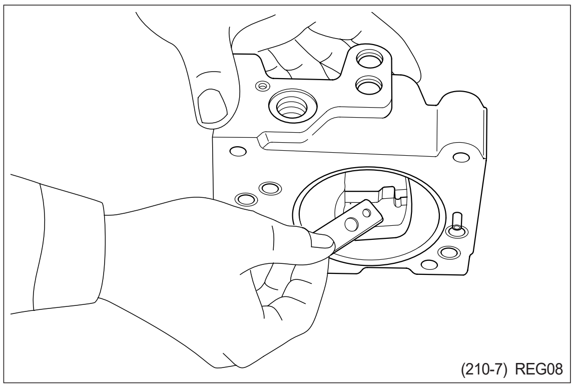

(210-7) REG06



(210-7) REG07

(9) Remove lever (2, 613). Do not draw out pin (875).

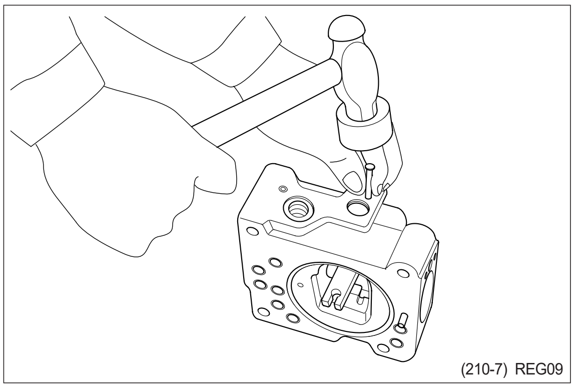
※ Work will be promoted by using pincers or so on.



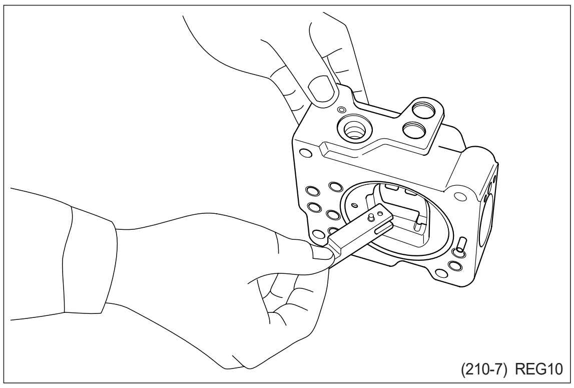
(210-7) REG08

(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.

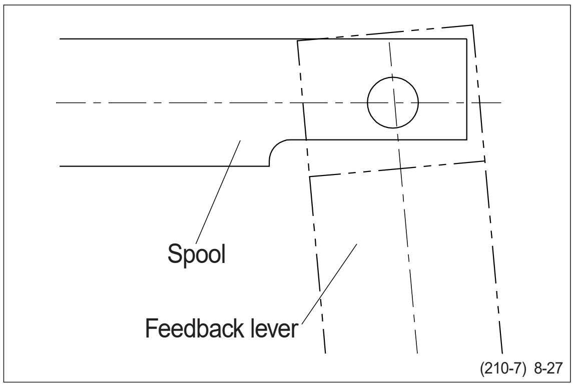
(2) Put compensating rod (623) into compensating hole of casing (601).

(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.

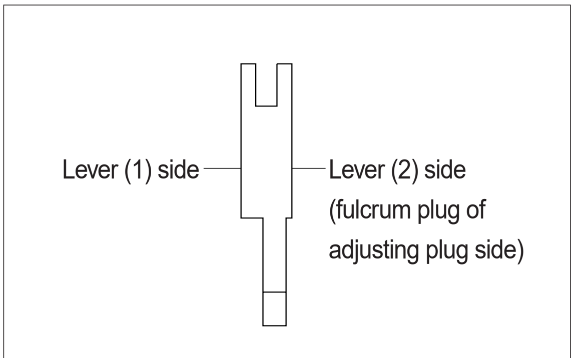
※ Confirm that spool and sleeve slide smoothly in casing without binding.

※ Pay attention to orientation of spool.



(210-7) 8-27

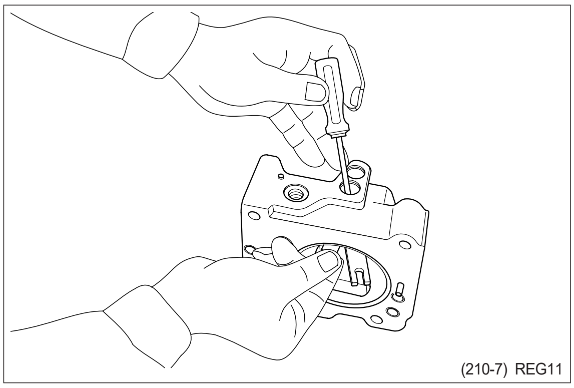
(5) Fit feedback lever (611), matching its pin hole with pin hole in spool.
Then insert pin (874).
※ Insert pin in feedback lever a little to ease operation.
※ Take care not to mistake direction of feedback lever.



(210-7) 8-28

(6) Put pilot piston (643) into pilot hole of casing.
※ Confirm that pilot piston slides smoothly without binding.

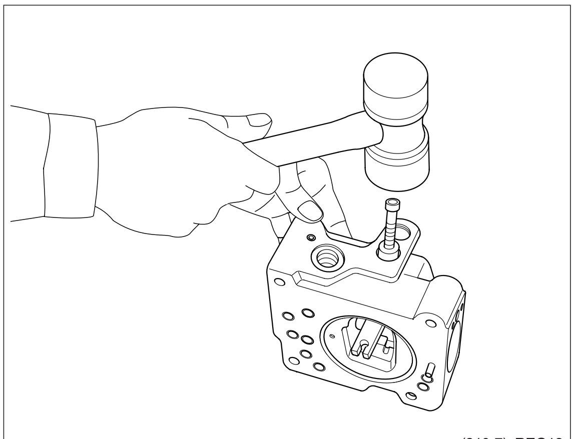
(7) Put pin force-fitted in lever (2, 613) into groove of pilot piston.
Then fix lever (2).



(210-7) REG11

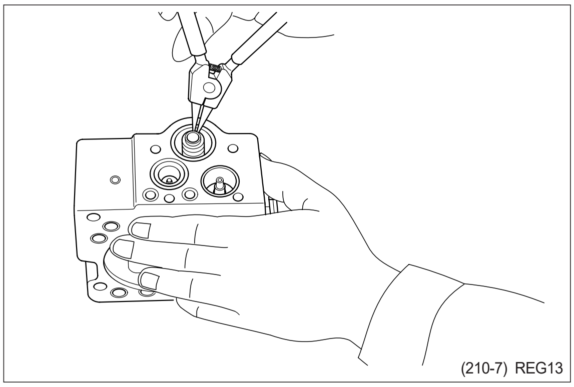
(8) Fit fulcrum plug (614) so that pin force-fitted in fulcrum plug (614) can be put into pin hole of lever (2).
Then fix locking ring (858).

(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.



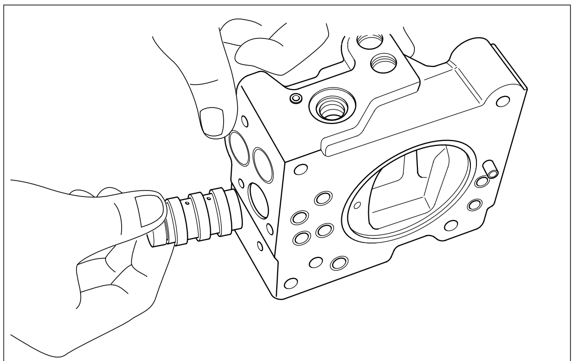
(210-7) REG12

(10) Fit return spring (654) and spring seat (653) into spool hole and attach snap ring (814).



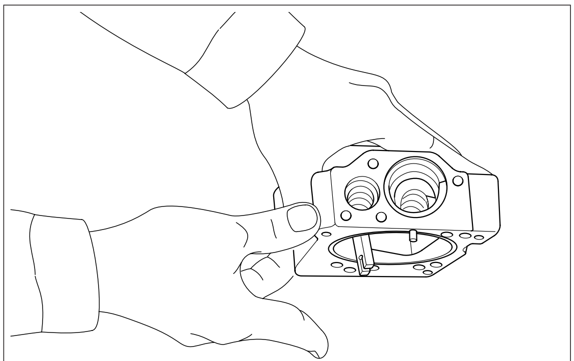
(210-7) REG13

(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

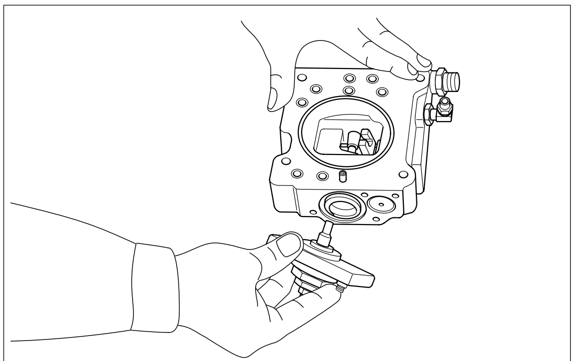
(12) Put spring seat (644), pilot spring (646) and adjusting ring (Q, 645) into pilot hole.
Then fix spring seat (624), inner spring (626) and outer spring (625) into compensating hole.

※ 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

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

(2) Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

(3) Loosen the breather slowly to release the pressure inside the hydraulic tank.

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

※ When pipes and hoses are disconnected, the oil inside the piping will flow out, so catch it in oil pan.

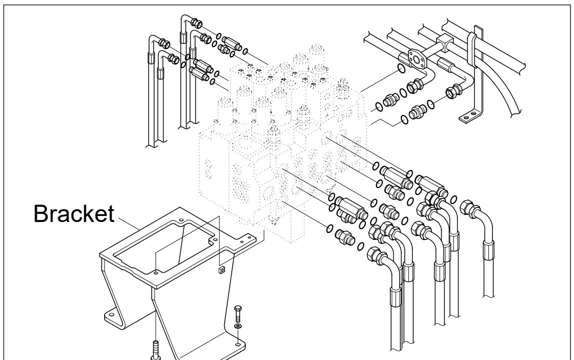
13031GE18

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

(5) Remove bolts and disconnect pipe.

(6) Disconnect pilot line hoses.

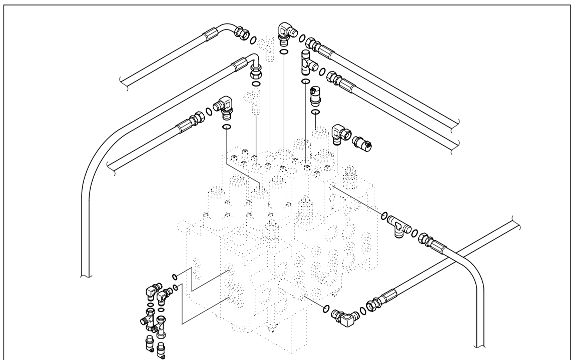
(7) Disconnect pilot piping.



14W98MC01

(8) Sling the control valve assembly and remove the control valve mounting bolt and bracket.
- · Weight : 80kg(175lb)

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



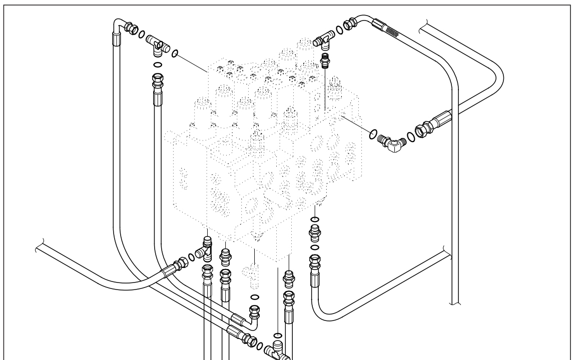
14W98MC02

2) INSTALL

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

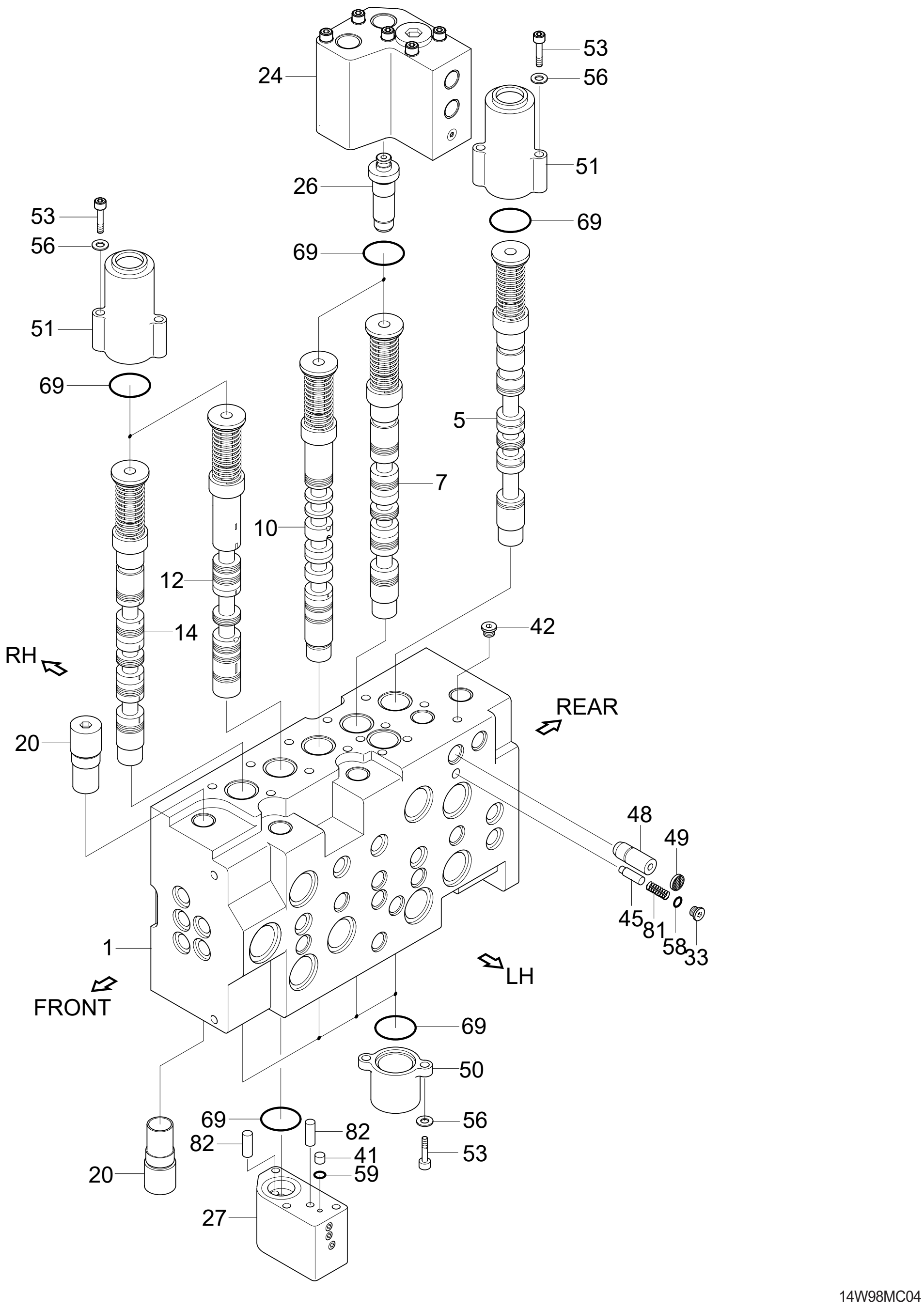
(2) Bleed the air from below items.
- ① Cylinder (Boom, arm, bucket)
- ② Swing motor
- ③ Travel motor
- ※ See each item removal and install.

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



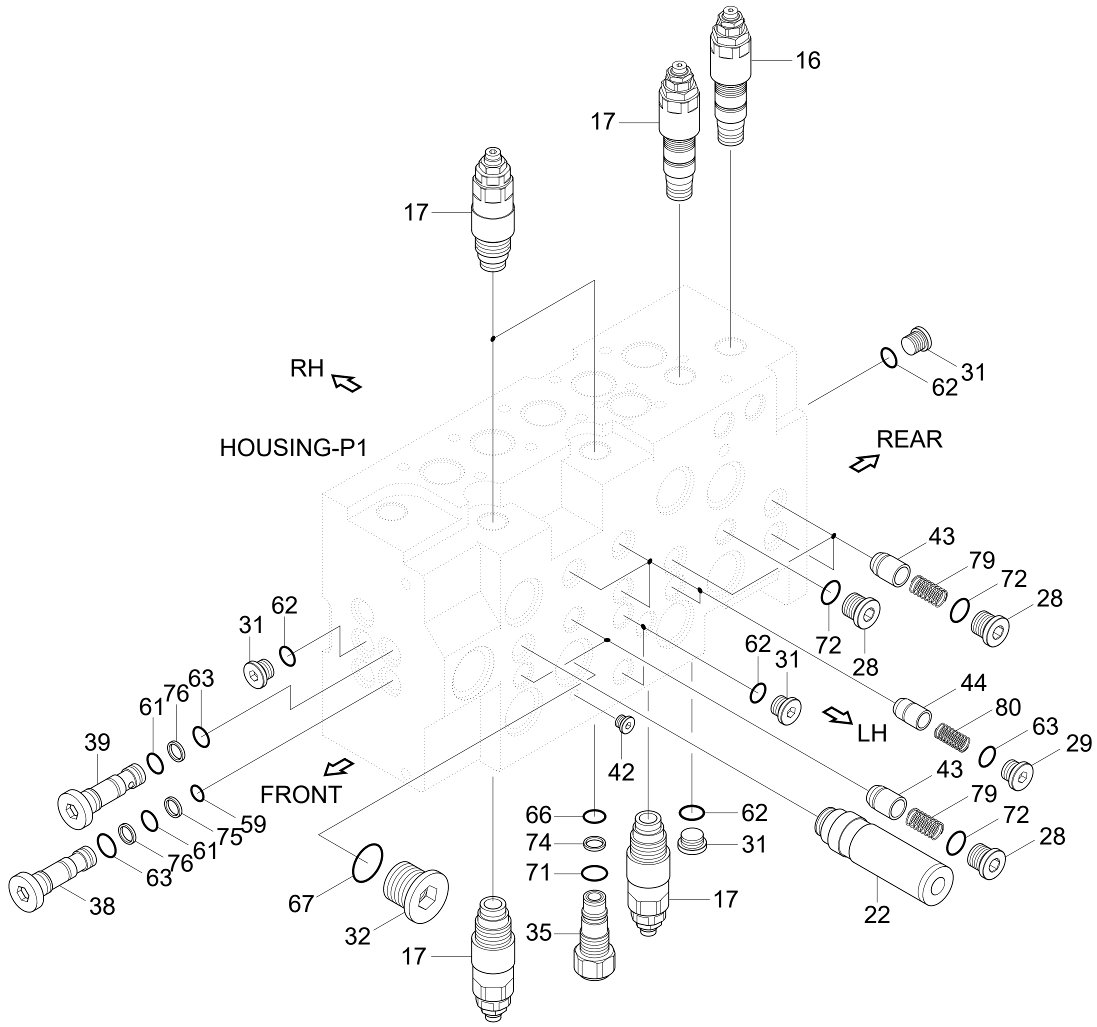
14W98MC03

2. STRUCTURE (1/4)



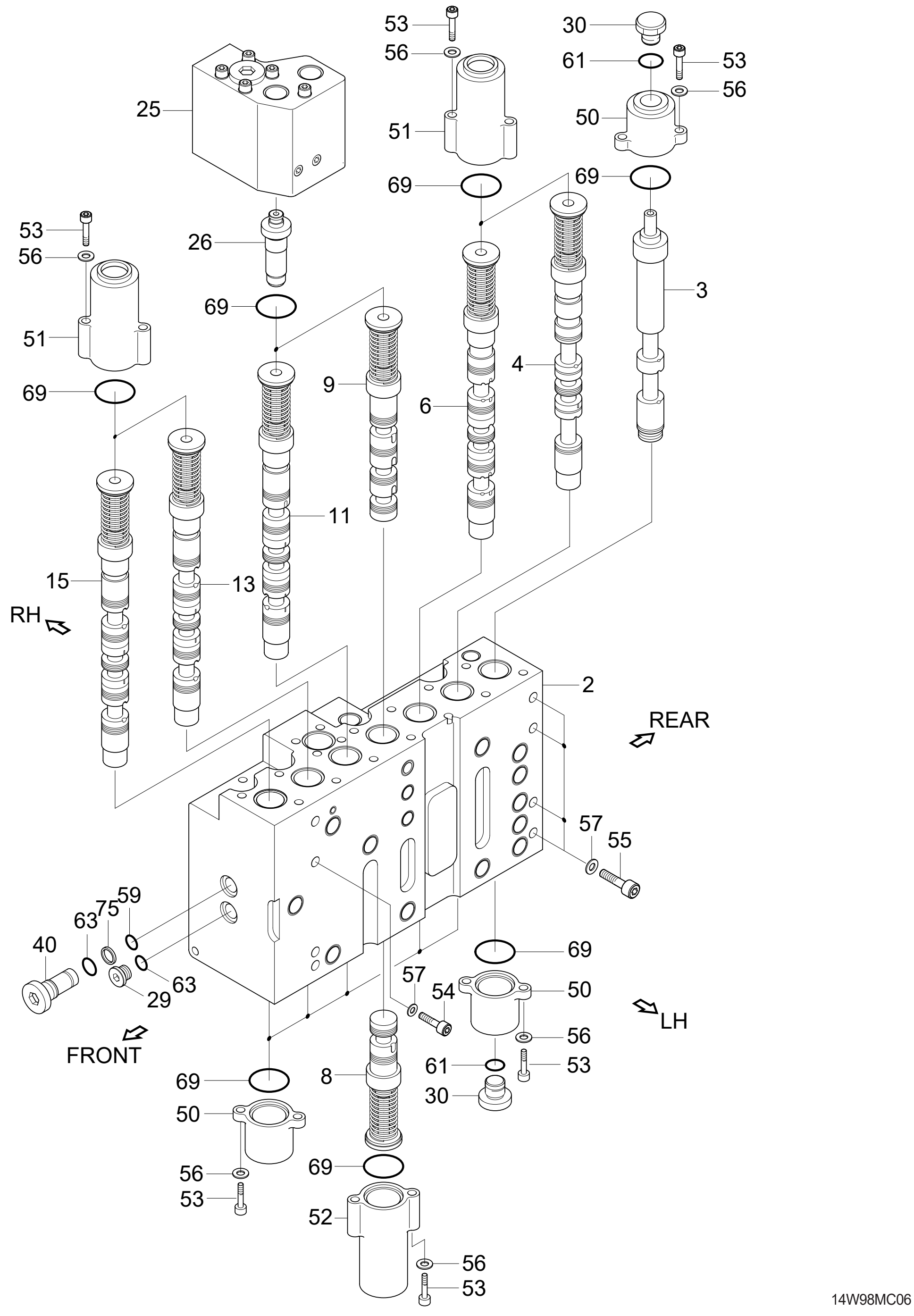
1	Housing-P1	27	Regeneration block	53	Socket head bolt
5	Spool assy-option C	33	Plug	56	Plain washer
7	Spool assy-boom 1	41	Orifice	58	O-ring
10	Spool assy-arm 2	42	Plug	59	O-ring
12	Spool assy-arm regen	45	Poppet	69	O-ring
14	Spool assy-bucket	48	Orifice	81	Spring
20	Nega con relief valve	49	Coin type filter	82	Pin-regeneration
24	Holding valve kit A1	50	Pilot A cap		
26	Lock valve kit B	51	Pilot B1 cap		

STRUCTURE (2/4)



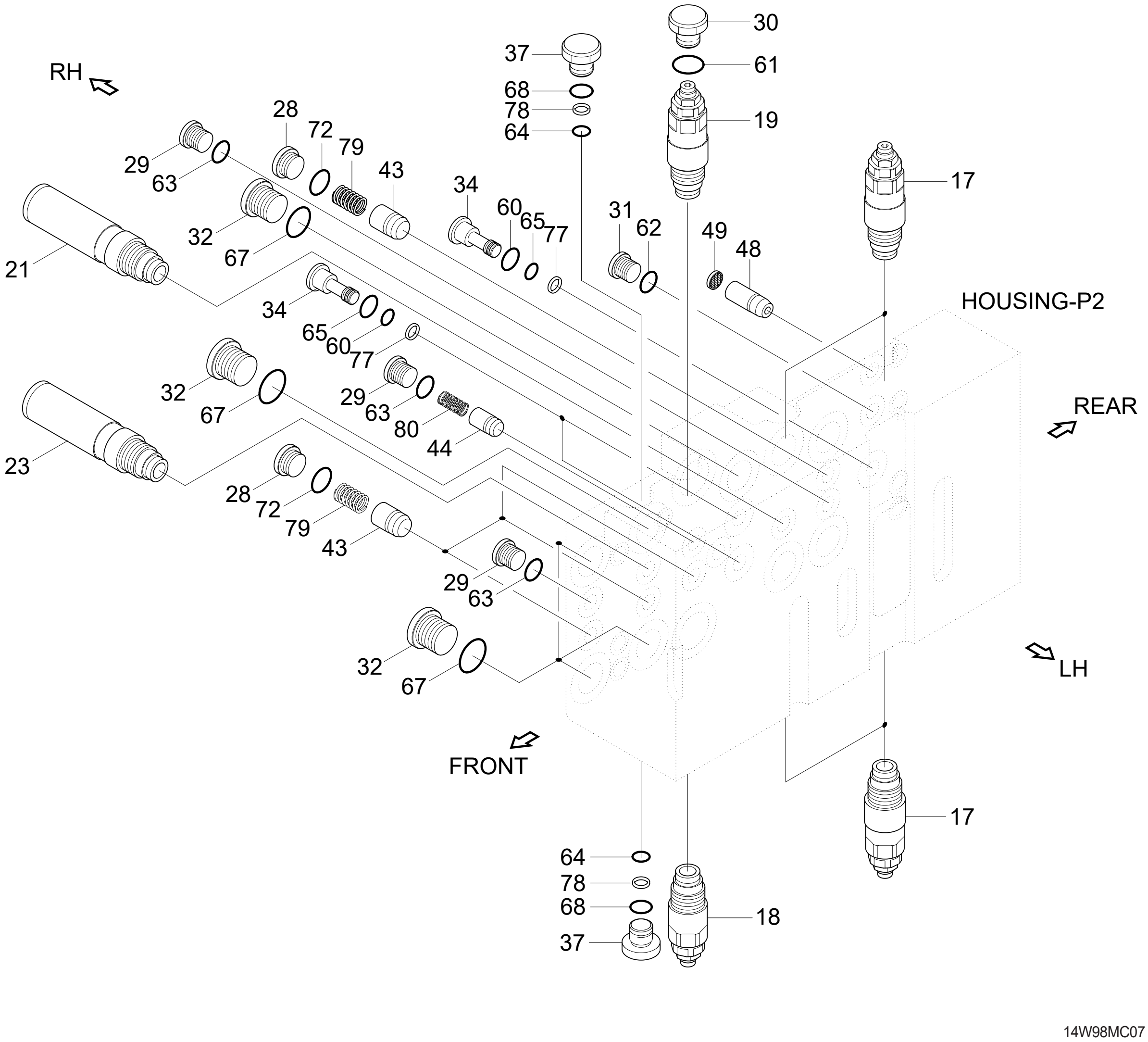
16	Main relief valve	39	Plug	67	O-ring
17	Overload relief valve	42	Plug	71	O-ring
22	Bucket logic valve	43	Poppet 1	72	O-ring
28	Plug	44	Poppet 2	74	Back up ring
29	Plug	59	O-ring	75	Back up ring
31	Plug	61	O-ring	76	Back up ring
32	Plug	62	O-ring	79	Spring
35	Plug	63	O-ring	80	Spring
38	Plug	66	O-ring		

STRUCTURE (3/4)



2	Housing-P2	25	Holding valve kit-A2	54	Socket head bolt
3	Spool assy	26	Lock valve kit-B	55	Socket head bolt
4	Spool assy-travel	29	Plug	56	Plain washer
6	Spool assy-swing	30	Plug	57	Spring washer
8	Spool assy-swing priority	40	Plug	59	O-ring
9	Spool assy-boom 2	50	Pilot A cap	61	O-ring
11	Spool assy-arm 1	51	Pilot B1 cap	63	O-ring
13	Spool assy-option B	52	Pilot B2 cap	69	O-ring
15	Spool assy-dozer	53	Socket head bolt	75	Back up ring

STRUCTURE (4/4)



17	Overload relief valve	34	Plug	64	O-ring
18	Overload relief valve	37	Plug	65	O-ring
19	Overload relief valve	43	Poppet 1	67	O-ring
21	Swing logic valve	44	Poppet	68	O-ring
23	ON/OFF valve-option	48	Orifice	72	O-ring
28	Plug	49	Coin type filter	77	Back up ring
29	Plug	60	O-ring	78	Back up ring
30	Plug	61	O-ring	79	Spring
31	Plug	62	O-ring	80	Spring
32	Plug	63	O-ring		

3. DISASSEMBLY AND ASSEMBLY

1) GENERAL PRECAUTIONS

(1) All hydraulic components are manufactured to a high precision. Consequently, before disassembling and assembling them, it is essential to select an especially clean place.

(2) In handling a control valve, pay full attention to prevent dust, sand, etc. from entering into it.

(3) When a control valve is to be remove from the machine, apply caps and masking seals to all ports. Before disassembling the valve, recheck that these caps and masking seals are fitted completely, and then clean the outside of the assembly. Use a proper bench for working. Spread paper or a rubber mat on the bench, and disassemble the valve on it.

(4) Support the body section carefully when carrying or transferring the control valve. Do not lift by the exposed spool, end cover section etc.

(5) After disassembling and assembling of the component it is desired to carry out various tests (for the relief characteristics, leakage, flow resistance, etc.), but hydraulic test equipment is necessary for these tests. Therefore, even when its disassembling can be carried out technically, do not disassemble such components that cannot be tested, adjusted, and so on. Additionally one should always prepare clean cleaning oil, hydraulic oil, grease, etc. beforehand.

2) TOOLS

Before disassembling the control valve, prepare the following tools beforehand.

Name of tool	Quantity	Size (mm)
Vice mounted on bench (soft jaws)	1 unit	
Hexagon wrench	Each 1 piece	5, 6, 10, 12 and 14
Socket wrench	Each 1 piece	27 and 32
Spanner	Each 1 piece	32 (main relief valve, overload relief valve, negative relief valve) 26 (holding valve)

3) DISASSEMBLY

(1) Disassembly of spools without holding valve

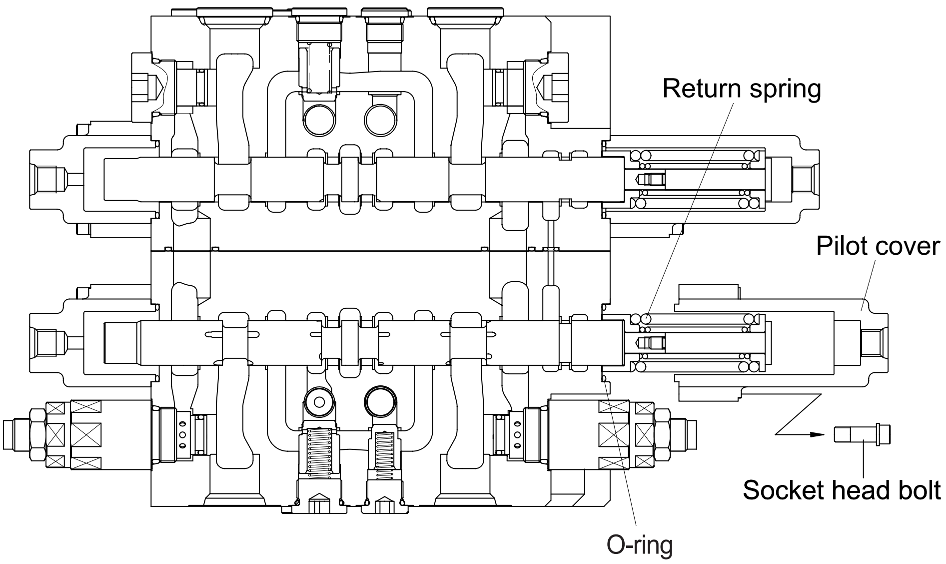
① Loosen hexagon socket head bolts with washer.
(hexagon wrench : 5 ㎜)

② Remove the pilot cover.

※ Pay attention not to lose the O-ring under the pilot cover.

③ Remove the spool assembly from the body by hand slightly.

※ When extracting each spool from its body, pay attention not to damage the body.
※ When extracting each spool assembly, it must be extracted from spring side only.
※ When any abnormal parts are found, replace it with completely new spool assembly.
※ When disassembled, tag the components for identification so that they can be reassembled correctly.



(2) **Disassembly of spools with holding valve** (boom 1, Arm 1 spool)

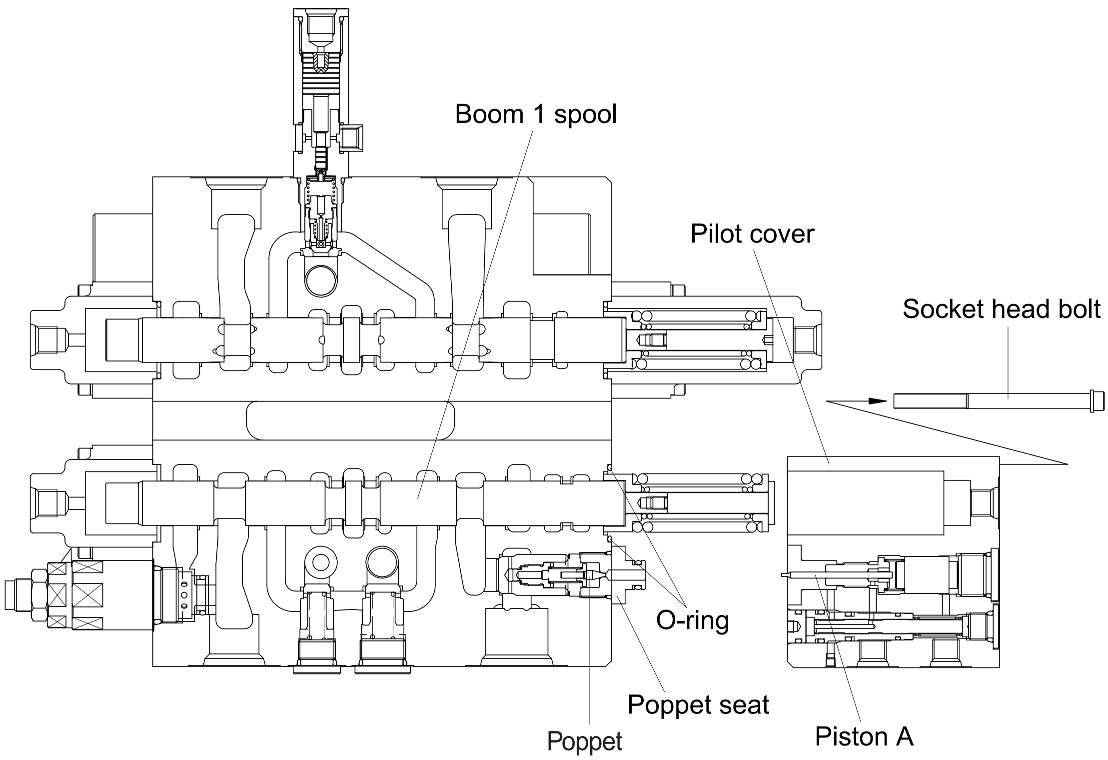
① Loosen hexagon socket head bolts with washer.
(hexagon wrench : 5 ㎜)

② Remove the pilot cover with internal parts.

※ Pay attention not to lose the O-ring and the poppet under the pilot cover.
※ Pay attention not to damage the "piston A" under pilot cover.

③ Remove the spool assembly from the body by hand slightly.

※ When extracting each spool from its body, pay attention not to damage the body.
※ When extracting each spool assembly, it must be extracted from spring side only.
※ When any abnormal parts are found, replace it with completely new spool assembly.
※ When disassembled, tag the components for identification so that they can be reassembled correctly.



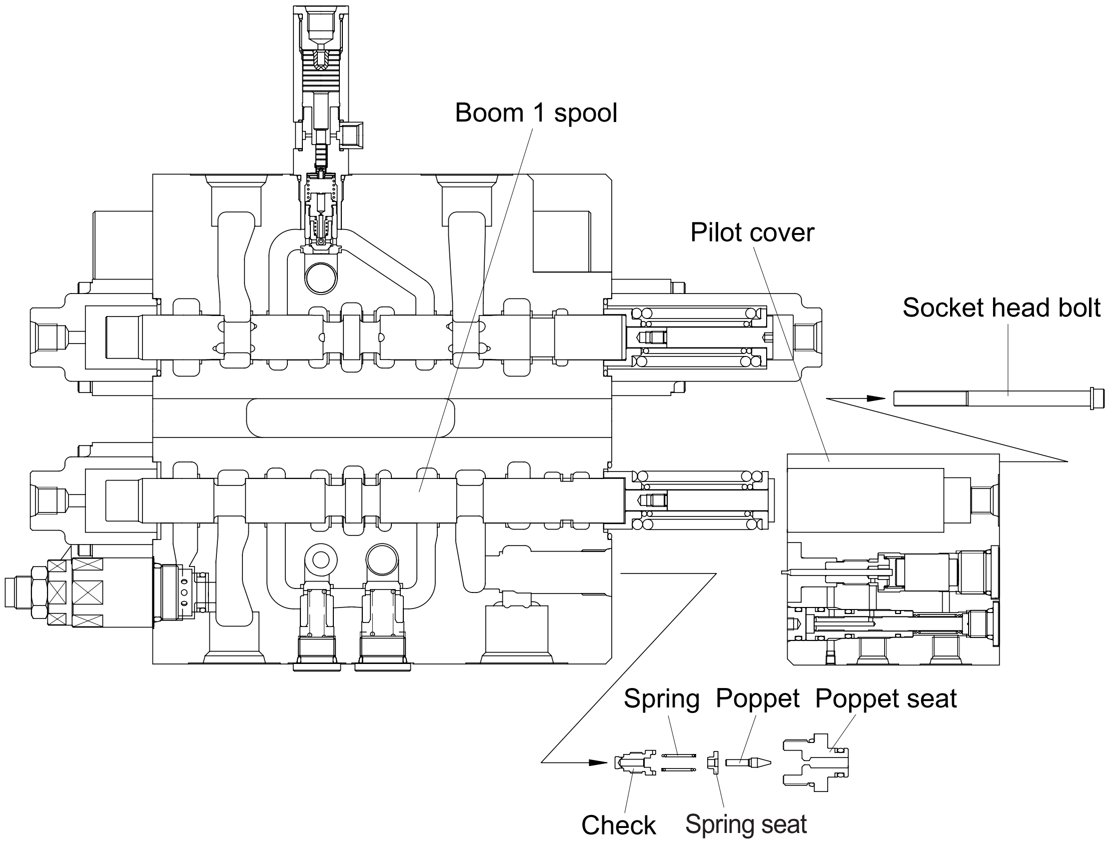
(3) Disassembly of the holding valve

① Remove the pilot cover with the holding valve as described on previous page.

※ Do not disassembled internal parts of the pilot cover.

② Loosen the poppet seat and remove the poppet, spring seat, spring and check.
(spanner : 26 ㎜)

※ Pay attention not to lose the poppet.
※ Do not disassembled internal parts of the check.



(4) Disassembly of the load check valve and the negative relief valve

① The load check valve

a. Fix the body to suitable work bench.

※ Pay attention not to damage the body.

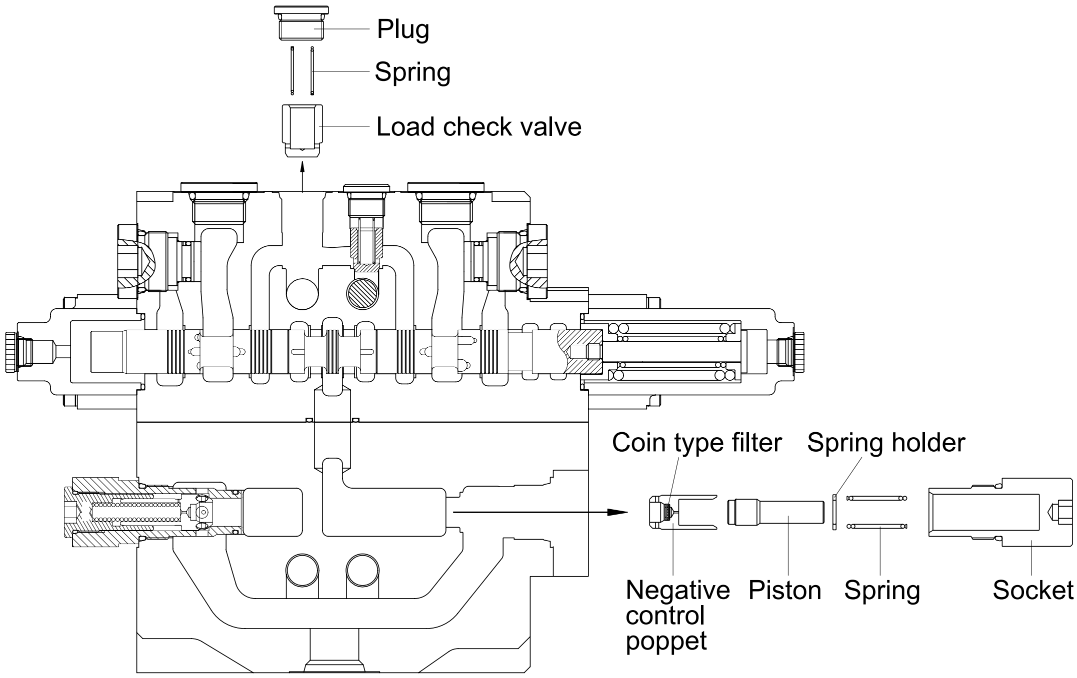
b. Loosen the plug (hexagon wrench : 10 ㎜).

c. Remove the spring and the load check valve with pincers or magnet.

② The negative relief valve

a. Loosen the socket (spanner : 32 ㎜).

b. Remove the spring, spring holder, piston and negative control poppet.



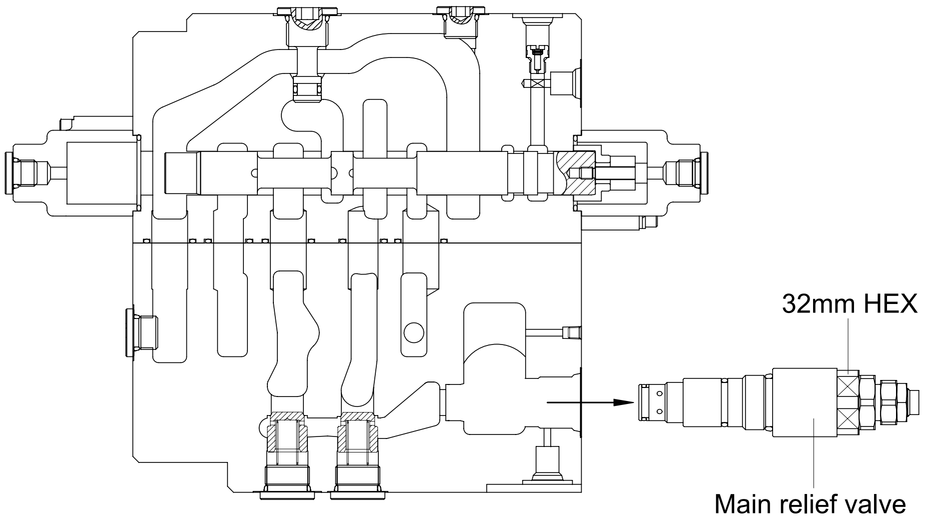
(5) Disassembly of the main and overload relief valve

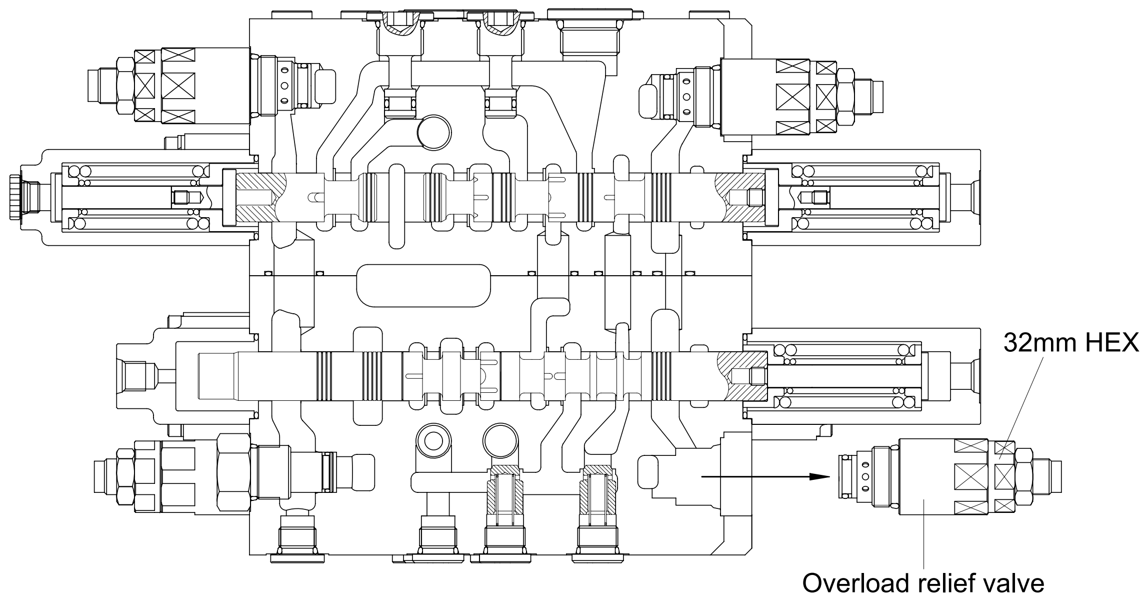
① Fix the body to suitable work bench.

② Remove the main relief valve.
(spanner : 32 mm)

③ Remove the overload relief valve.
(spanner : 32 mm)

※ When disassembled, tag the relief valve for identification so that they can be reassembled correctly.
※ Pay attention not to damage seat face.
※ When any abnormal parts are found, replace it with completely new relief valve assembly.





14W98MC14

(6) Inspection after disassembly

Clean all disassembled parts with clean mineral oil fully, and dry them with compressed air. Then, place them on clean papers or cloths for inspection.

① Control valve

a. Check whole surfaces of all parts for burrs, scratches, notches and other defects.
b. Confirm that seal groove faces of body and block are smooth and free of dust, dent, rust etc.
c. Correct dents and damages and check seat faces within the body, if any, by lapping.
※ Pay careful attention not to leave any lapping agent within the body.
d. Confirm that all sliding and fitting parts can be moved manually and that all grooves and path's are free foreign matter.
e. If any spring is broken or deformed, replace it with new one.
f. When a relief valve does not function properly, repair it, following it's the prescribed disassembly and assembly procedures.
g. Replace all seals and O-rings with new ones.

② Relief valve

a. Confirm that all seat faces at ends of all poppets and seats are free of defects and show uniform and consistent contact faces.
b. Confirm manually that main poppet and seat can slide lightly and smoothly.
c. Confirm that outside face of main poppet and inside face of seat are free from scratches and so on.
d. Confirm that springs are free from breakage, deformation, and wear.
e. Confirm that orifices of main poppet and seat section are not clogged with foreign matter.
f. Replace all O-rings with new ones.
g. When any light damage is found in above inspections, correct it by lapping.
h. When any abnormal part is found, replace it with a completely new relief valve assembly.

4) ASSEMBLY

(1) General precaution

① In this assembly section, explanation only is shown.
For further understanding, please refer to the figures shown in the previous structure & disassembly section.
② Pay close attention to keeping all seals free from handling damage and inspect carefully for damage before using them.
③ Apply clean grease or hydraulic oil to the seal so as to ensure it is fully lubricated before assembly. Do not stretch seals so much as to deform them permanently.
④ In fitting O-rings, pay close attention not to roll them into their final position in addition, a twisted
⑤ O-ring cannot easily untwist itself naturally and could thereby cause inadequate sealing and thereby both internal and external oil leakage.
⑥ Tighten fitting bolts for all sections with a torque wrench adjusted to the respective tightening torque.
⑦ Do not reuse removed O-rings and seals.

(2) Load check valve

① Assemble the load check valve and spring.
② Put O-rings on to plug.
③ Tighten plug to the specified torque.
· Hexagon wrench : 10 mm
· Tightening torque : 6~7 kgf · m (43.4~50.6 lbf · ft)

(3) Negative control relief valve

① Assemble the nega-con poppet, piston, spring holder and spring together into body.
② Put O-ring on to plug and tighten the latter to its specified torque.
· Hexagon wrench : 12 mm
· Tightening torque : 8~9 kgf · m (57.8~65.1 lbf · ft)

(4) Main relief, overload relief valves
Install main relief valve, overload relief valve into the body and tighten to the specified torque.

Component	Tools	Tightening torque	
		kgf · m	lbf · ft
Main relief valve	Spanner 32 mm	8~9	57.8~65.1
Overload relief valve	Spanner 32 mm	8~9	57.8~65.1

(5) Main spools

① Carefully insert the previously assembled spool assemblies into their respective bores within of body.
※ Fit spool assemblies into body carefully and slowly. Do not under any circumstances push them forcibly in.

(6) Pilot covers

① Fit spool covers to the non-spring assembly end of the spool, and tighten the hexagonal socket head bolts to the specified torque.
   · Hexagon wrench : 5 ㎜
   · Tightening torque : 1.0~1.1 ㎏f · m (7.2~7.9 ℓbf · ft)

※ Confirm that O-rings have been fitted.

② Fit spring covers to the spring end for the spools, and tighten hexagon socket head bolts to the specified torque.
   · Hexagon wrench : 5㎜
   · Tightening torque : 1.0~1.1 ㎏f·m (7.2~7.9 lbf·ft)

※ Confirm that O-rings have been fitted.

(7) Holding valves

① Assemble the check, spring seat and poppet together into body.

② Tighten the poppet seat to the specified torque.
   · Spanner : 26 mm
   · Tightening torque : 6~7 ㎏f · m (43.4~50.6 ℓbf · ft)

③ Fit the "piston A" under pilot cover with internal parts into hole on the poppet seat.

④ Tighten hexagon socket head bolt to specified torque.
   · Hexagon wrench : 5mm
   · Tightening torque : 1.0~1.1 ㎏f · m (7.2~7.9 ℓbf · ft)

GROUP 5 SWING DEVICE

1. REMOVAL AND INSTALL OF MOTOR

1) REMOVAL

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

(2) Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

(3) Loosen the breather slowly to release the pressure inside the hydraulic tank.

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

※ When pipes and hoses are disconnected, the oil inside the piping will flow out, so catch it in oil pan.


13031GE18

(4) Disconnect hose assembly (2).

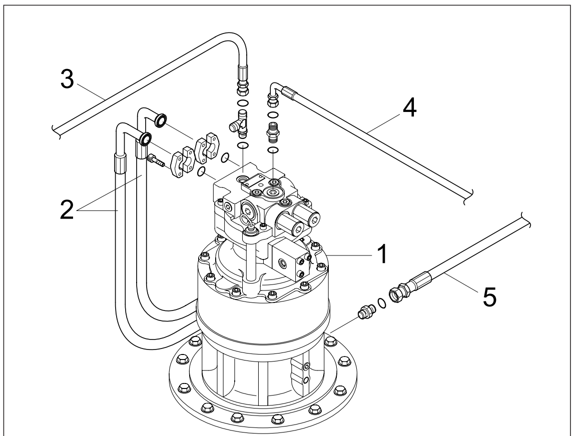
(5) Disconnect pilot line hoses (3, 4, 5, 6, 7, 9).

(6) Sling the swing motor assembly (1) and remove the swing motor mounting socket bolts (10).

· Motor device weight : 32kg (71lb)

(7) Remove the swing motor assembly.

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



14W98SM01

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.

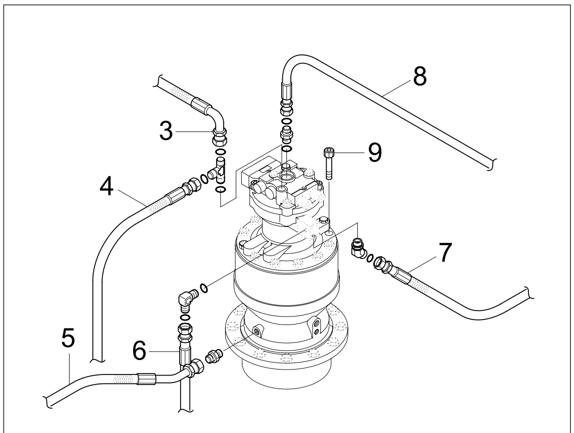
② Pour in hydraulic oil until it overflows from the port.

③ Tighten plug lightly.

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

⑤ Tighten plug fully.

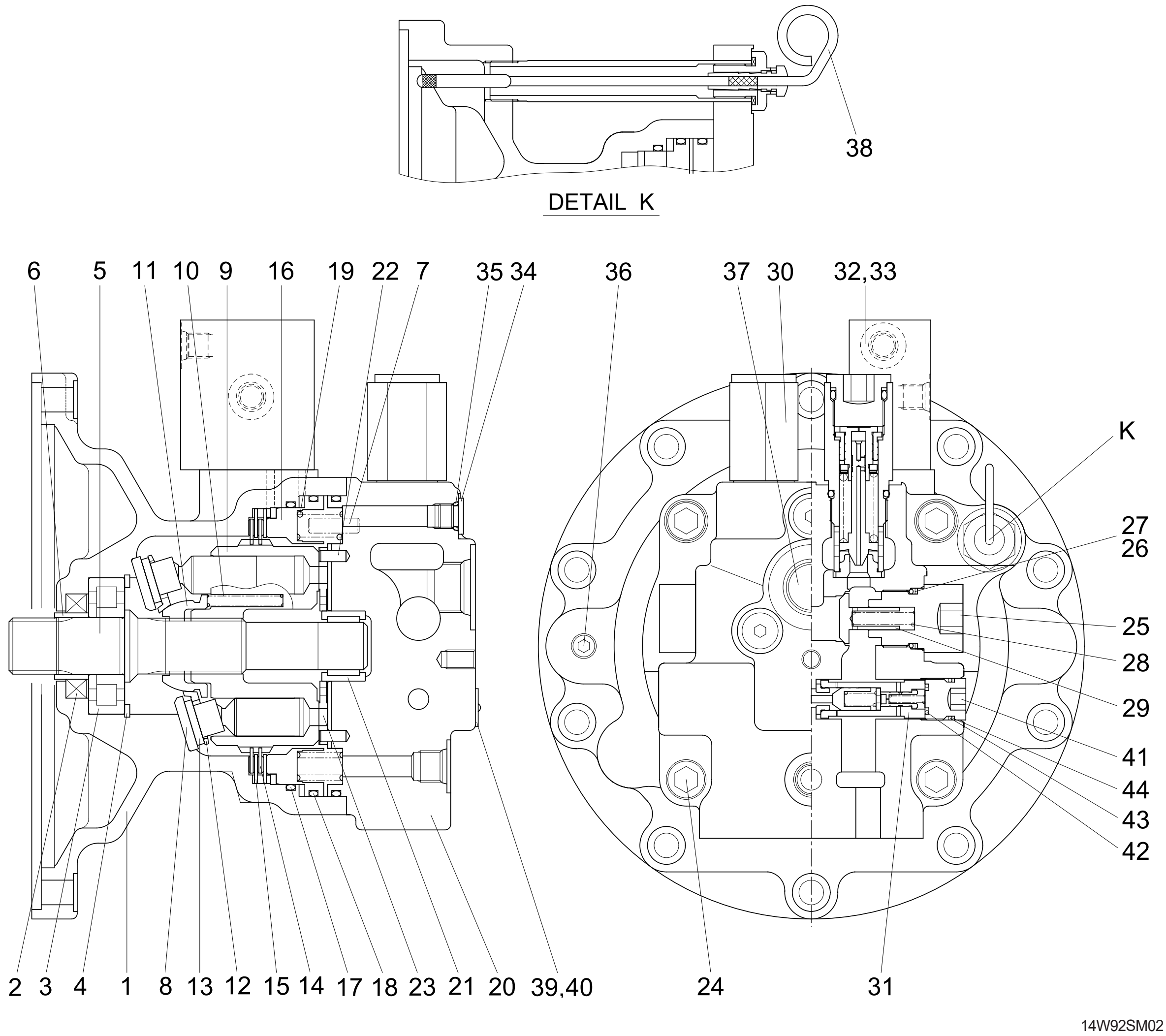
(3) Confirm the hydraulic oil level and check the hydraulic oil leak or not.



14W98SM02

2. DISASSEMBLY AND ASSEMBLY OF SWING MOTOR

1) STRUCTURE

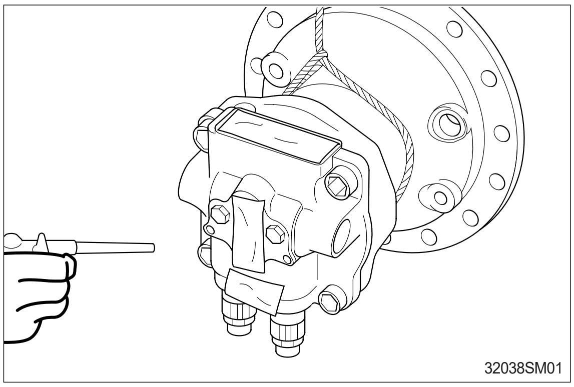


1	Body	16	Brake piston	31	Anti-rotating valve
2	Oil seal	17	O-ring	32	Time delay valve
3	Roller bearing	18	O-ring	33	Wrench bolt
4	Snap ring	19	Brake spring	34	Plug
5	Drive shaft	20	Rear cover	35	O-ring
6	Bushing	21	Needle bearing	36	Plug
7	Pin	22	Pin	37	Plug
8	Shoe plate	23	Valve plate	38	Level gauge
9	Cylinder block	24	Wrench bolt	40	Rivet
10	Spring	25	Plug	41	Plug
11	Ball guide	26	Back up ring	42	O-ring
12	Set plate	27	O-ring	43	O-ring
13	Piston assembly	28	Spring	44	Back up ring
14	Friction plate	29	Check		
15	Separate plate	30	Relief valve		

2) DISASSEMBLY

(1) Lift the motor out. Clean the motor in kerosene and dry with compressed air.

※ To avoid dust inside the motor, mask all the ports of the motor with tapes.



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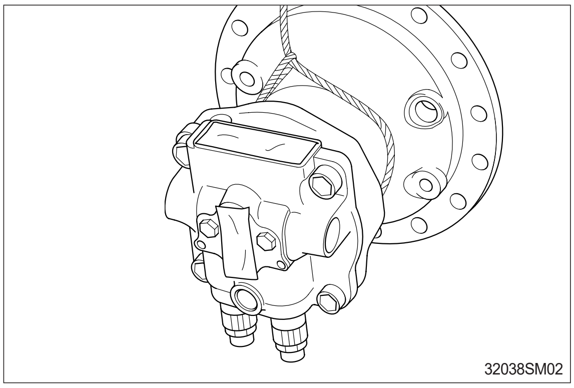
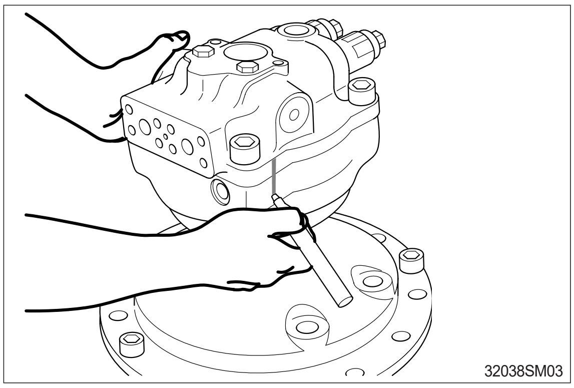
(2) Loosen the drain plug to discharge oil in the body(1).



32038SM02

(3) Fix the drive shaft (5) on the workbench with the end of output shaft down. Put matching marks on body (1) and valve rear cover (20) for easy reassembly.



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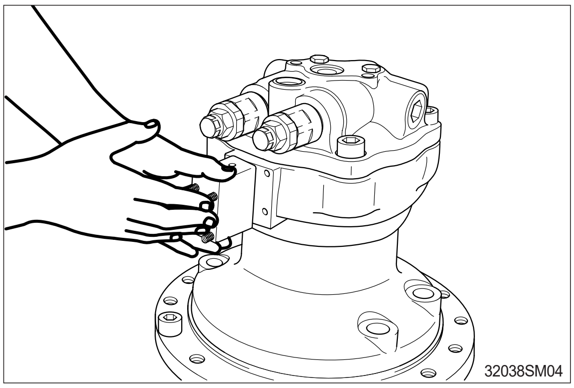
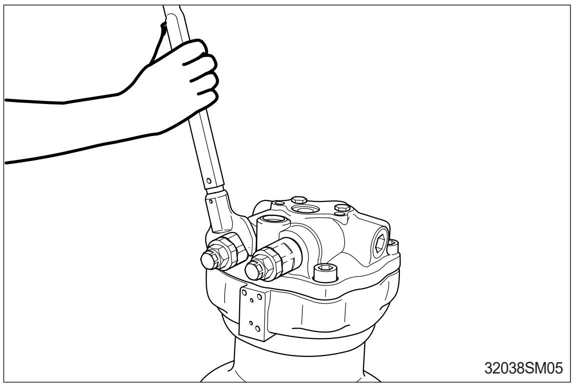
(4) Remove the valve (32).



32038SM04

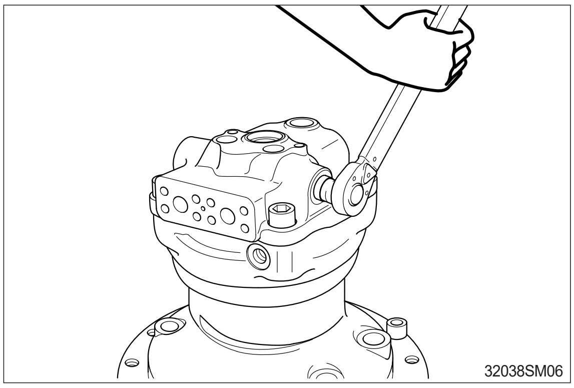
(5) Remove the relief valve (30) from rear cover (20).



32038SM05

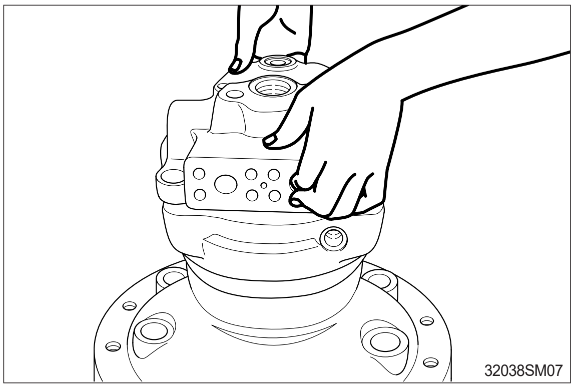
(6) Remove plug (25) from rear cover (20) and spring (28), check (29).

※ Be careful not to damage the check seat assembly.



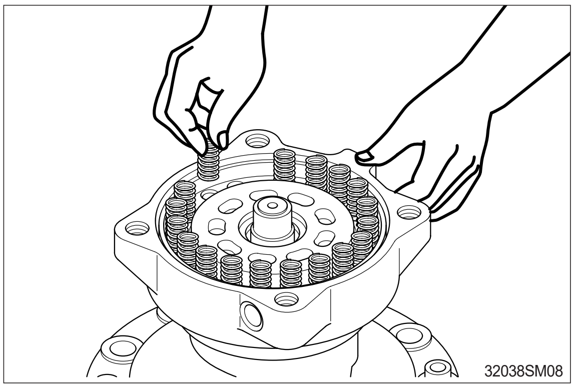
32038SM06

(7) Remove rear cover (20) from body (1). Then, remove the valve plate (23) from rear cover (20) with care.



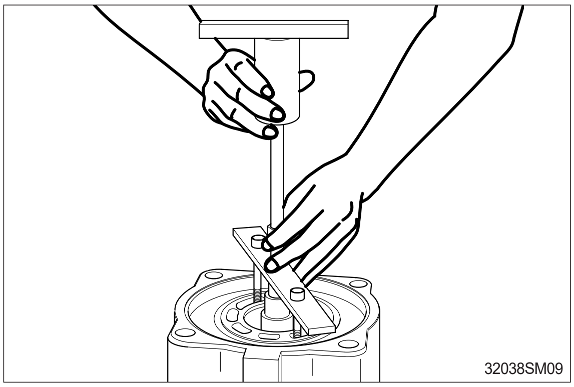
32038SM07

(8) Remove the brake spring (19) from brake piston (16).

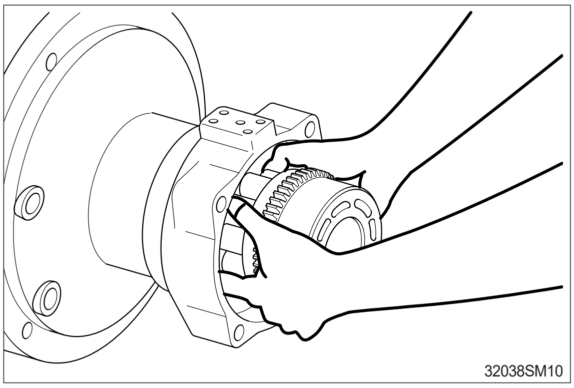


32038SM08

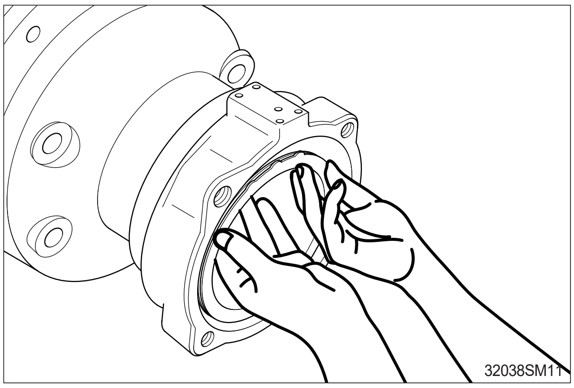
(9) Remove brake piston (16) from body (1).



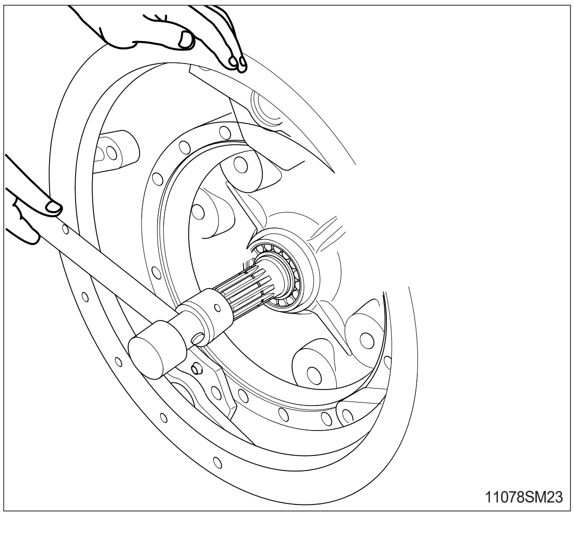
(10) Remove the cylinder (9) from the drive shaft (5) with the motor positioned horizontally. Remove ball guide (11), set plate (12), piston (13) and shoe plate (8).



(11) Remove friction plate (14) and separate plate (15) from body (1).

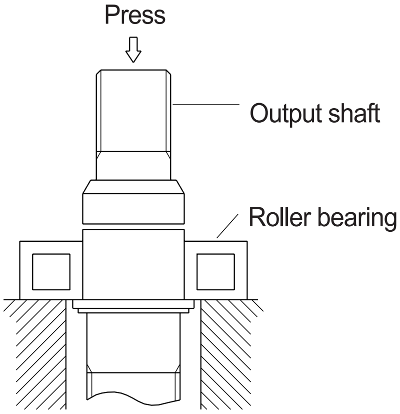


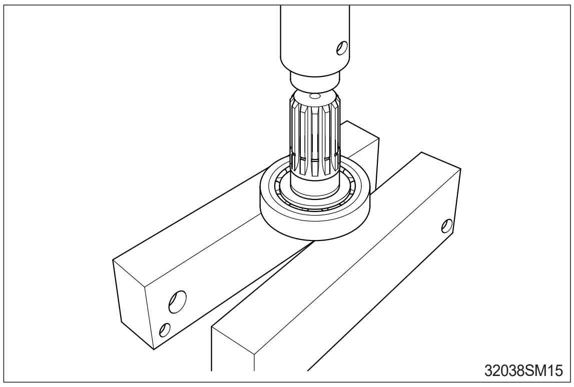
(12) Remove snap ring (4) and remove drive shaft (5) from body (1).



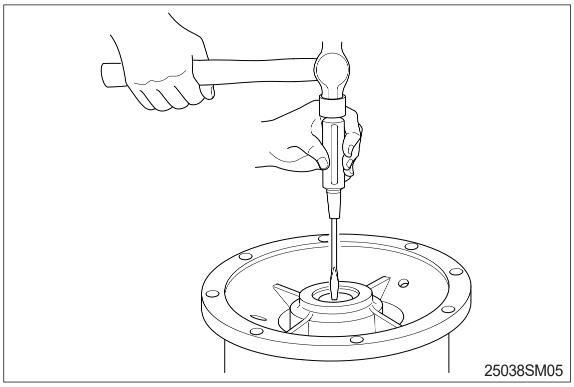
(13) Remove the cone of roller bearing (3) by press.

※ Do not reuse bearings.

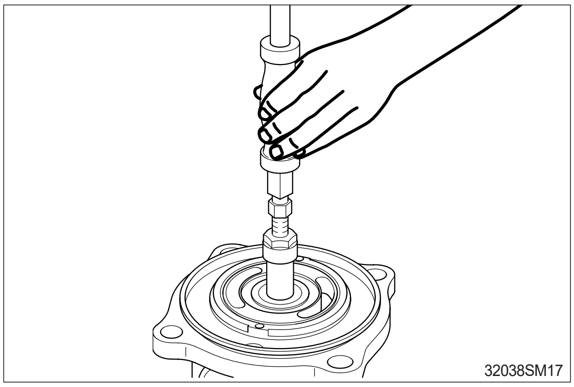




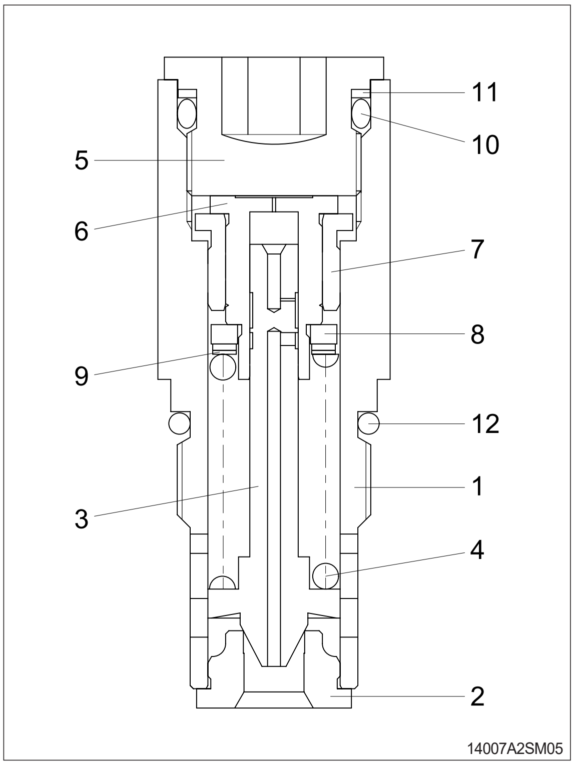
(14) Remove bushing (6) and oil seal (2) from body (1).



(15) Remove the needle bearing (21) from the rear cover (20) by using slide hammer bearing puller.



(16) When disassembling the relief valve, release the adjusting screw (5).
Remove the piston (6), spring seat (8), spring (4) and plunger (3) with the body (1) downwards.

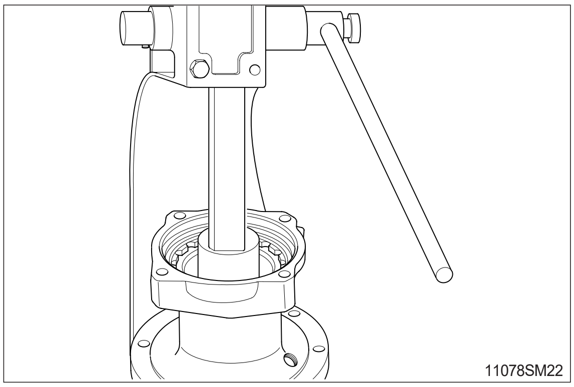


This completes disassembly.

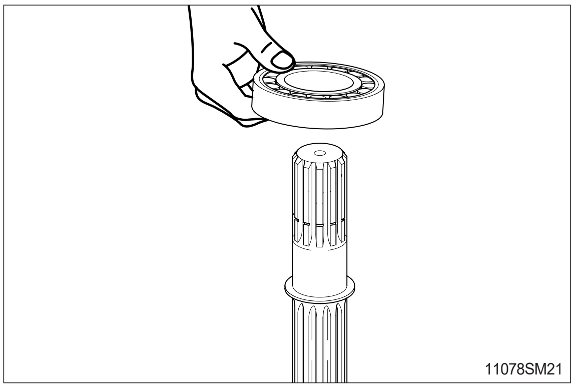
3) ASSEMBLY

Do the reassembly in the reverse procedure of the disassembly.

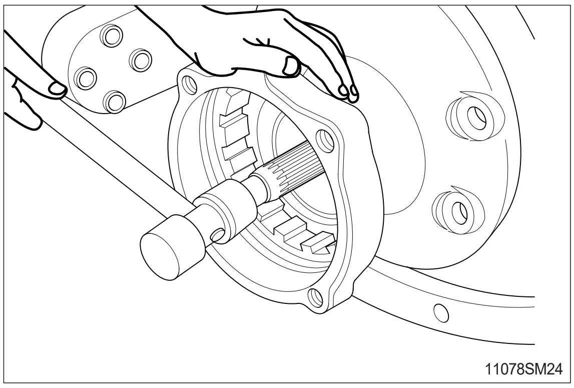
(1) Apply three bond of white color on outer surface of oil seal (2) and insert it to the body (1).



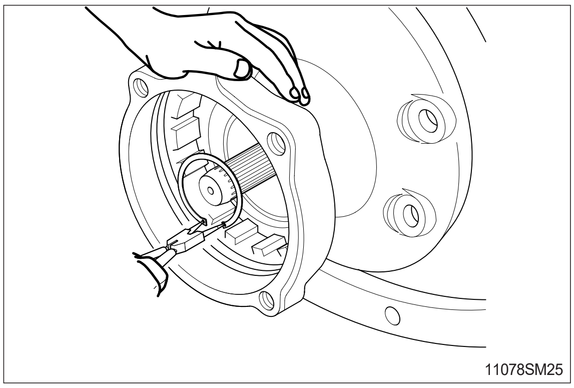
(2) Install the roller bearing (3) to the drive shaft (5).



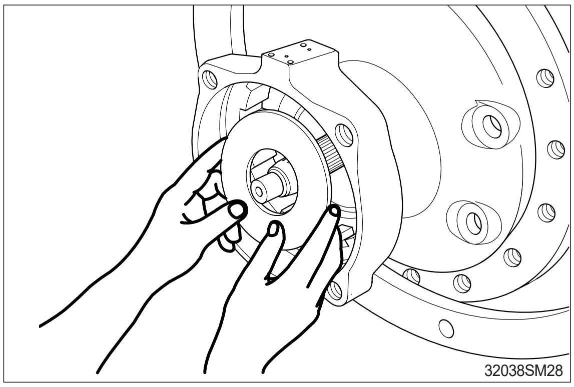
(3) Insert the drive shaft (5) into the body (1) with the plastic hammer lightly.



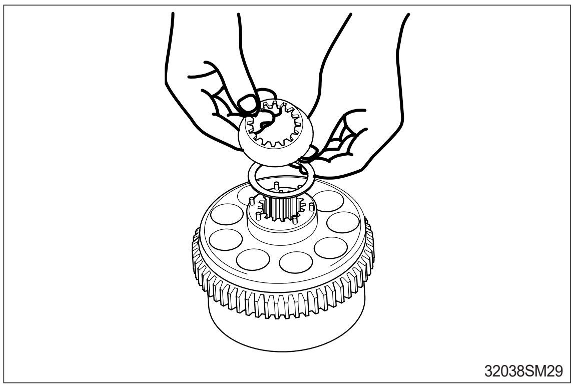
(4) Install the snap ring (4) to the body (1).



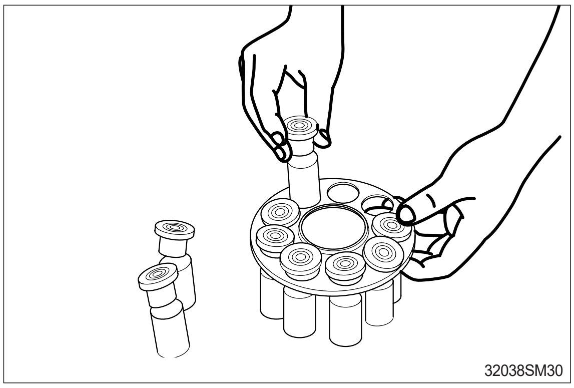
(5) Insert the shoe plate (8) with the body (1) position horizontally.



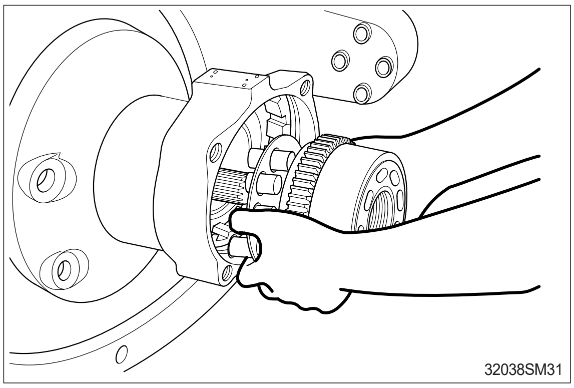
(6) Insert the ball guide (11) into the cylinder (9).



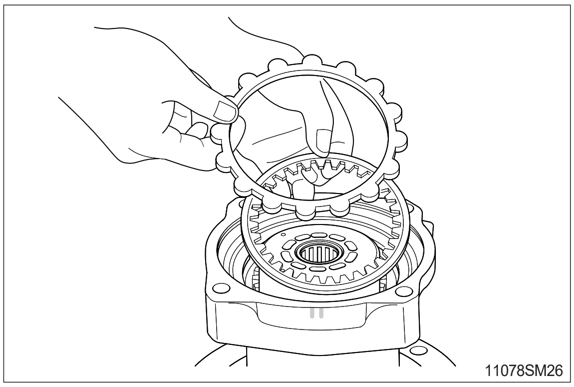
(7) Install the piston sub-assembly (13) to the set plate (12).



(8) Reassemble the piston assembly (9) to the body (1).



(9) Assembly friction plate (14) and separate plate (15) to the body (1).



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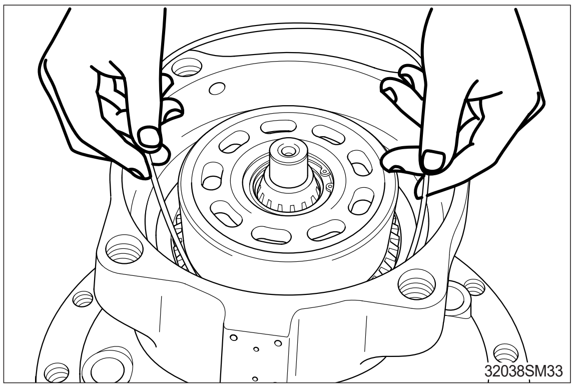
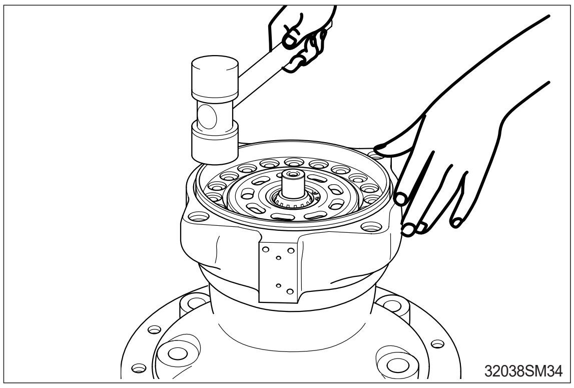
(10) Insert O-ring (17) inside the body (1).



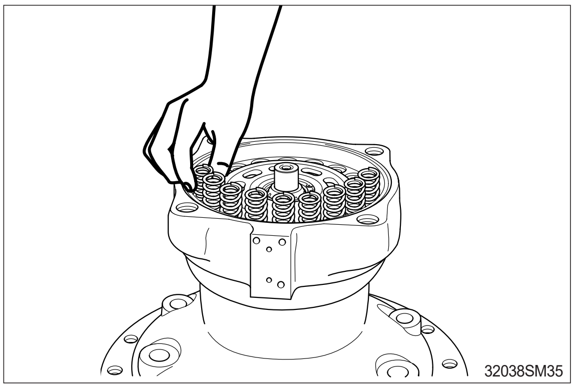
32038SM33

(11) Reassemble brake piston (16) to the body (1).



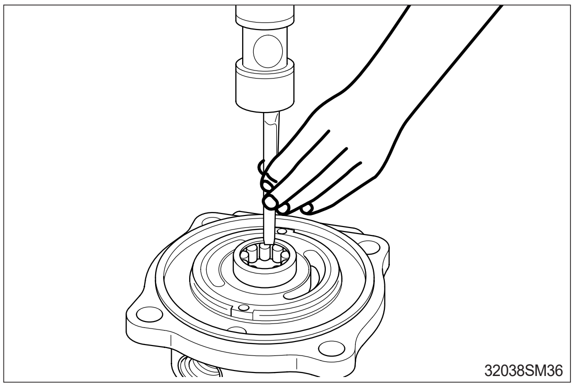
32038SM34

(12) Reassemble brake spring (19) to the brake piston (16).

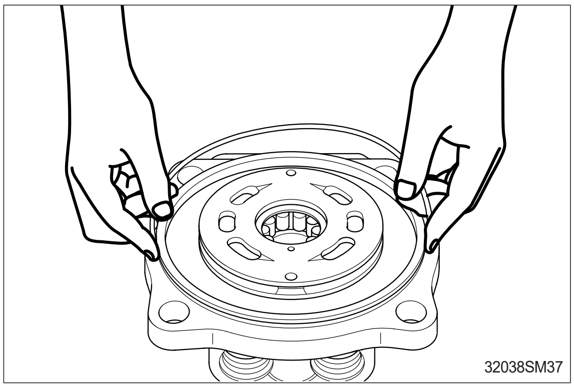


32038SM35

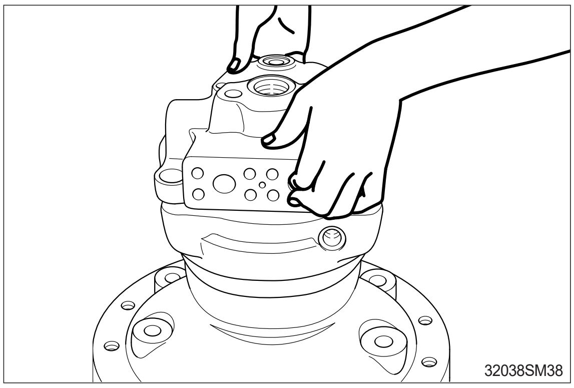
(13) When assembling the needle bearing (21), insert the needle bearing (21) into rear cover (20) by hammering.


32038SM36

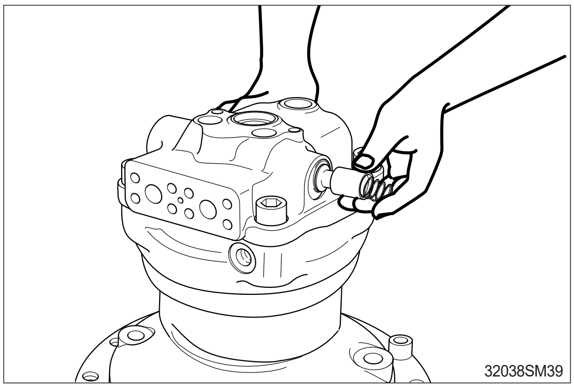
(14) Reassemble valve plate (23) to the rear cover (20) and reassemble O-ring (18).


32038SM37

(15) Connect the rear cover (20) with the body (1) and tighten the wrench bolt (24).

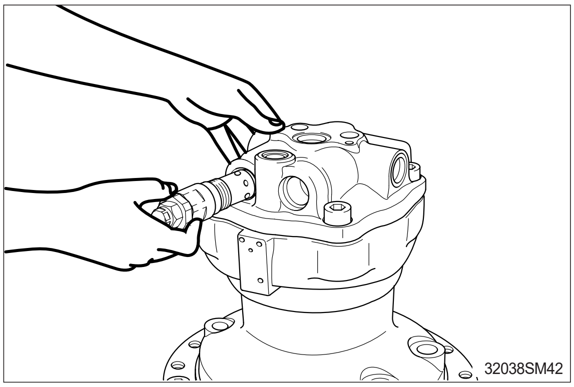

32038SM38

(16) Insert check (29) and spring (28) in the valve casing and install O-ring (27) and back up ring (26). Tighten plug (25) to the rear cover (20).


32038SM39

(17) Insert O-rings to the relief valve (30) and reassemble them to rear cover (20).

This completes assembly.



3. REMOVAL AND INSTALL OF REDUCTION GEAR

1) REMOVAL

(1) Remove the swing motor assembly.
For details, see removal of swing motor assembly.

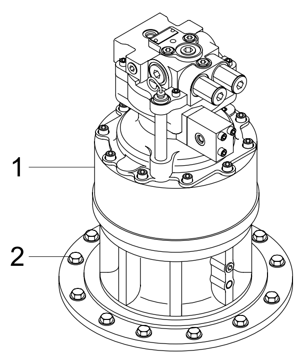
(2) Sling reduction gear assembly (1) and remove mounting bolts (2).

(3) Remove the reduction gear assembly.
· Reduction gear device weight : 60 kg (132 lb)

13031GE18

2) INSTALL

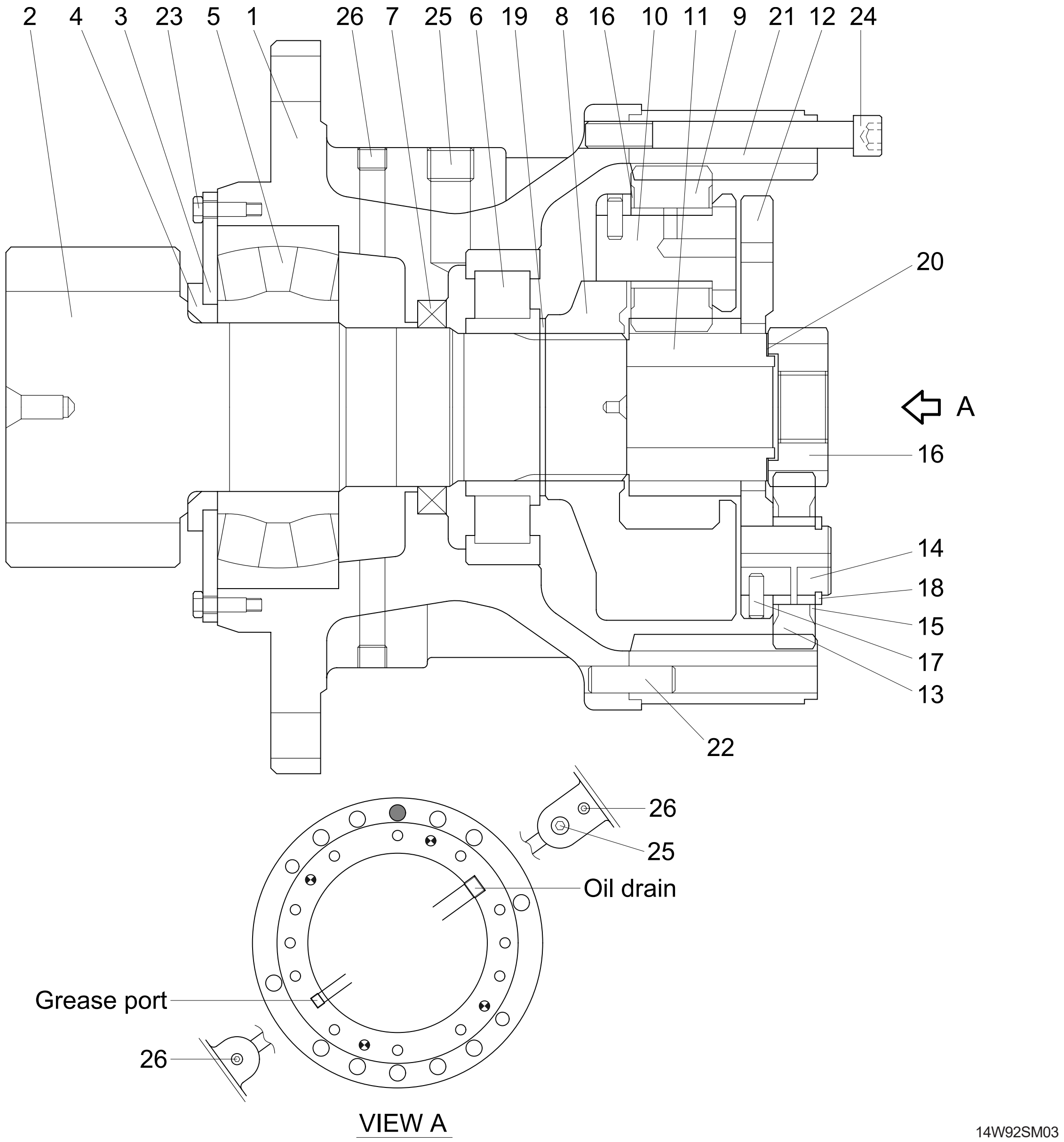
(1) Carry out installation in the reverse order to removal.
· Tightening torque : 29.6±3.2 kgf · m (214±23.1 lbf · ft)



14W98SM03

4. DISASSEMBLY AND ASSEMBLY OF REDUCTION GEAR

1) STRUCTURE

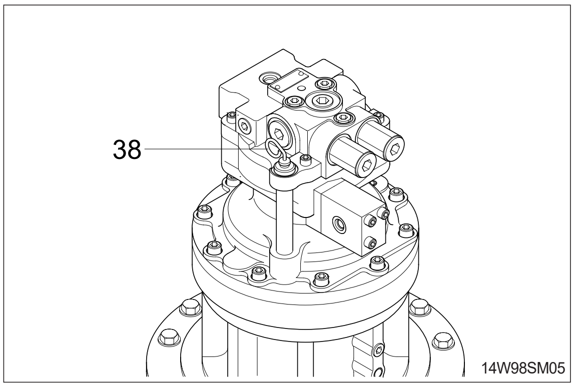


1	Casing	10	Pin No.2 assembly	19	Stop ring
2	Drive shaft	11	Sun gear No. 2	20	Side plate No. 1
3	Cover plate	12	Carrier No. 1	21	Ring gear
4	Spacer	13	Planet gear No. 1	22	Knock pin
5	Roller bearing	14	Pin No.1	23	Hexagonal bolt
6	Roller bearing	15	Thrust washer (B)	24	Socket head bolt
7	Oil seal	16	Sun gear No. 1	25	Plug
8	Carrier No. 2	17	Spring pin	26	Plug
9	Planet gear No. 2	18	Stop ring		

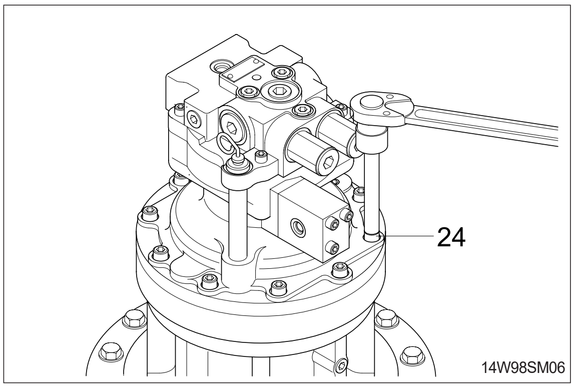
2) DISASSEMBLY

(1) Remove level gauge (38) from the swing motor casing.

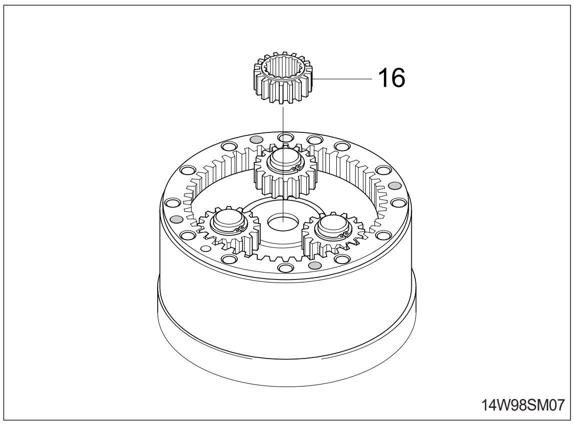
※ Pour the gear oil out of reduction gear into the clean bowl to check out the friction decrease.



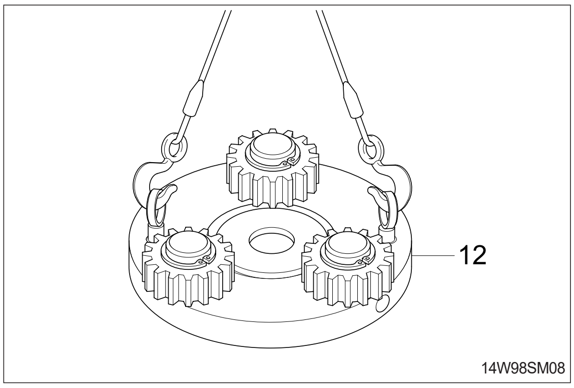
(2) Loosen the socket bolts (24) to separate swing motor from reduction gear.



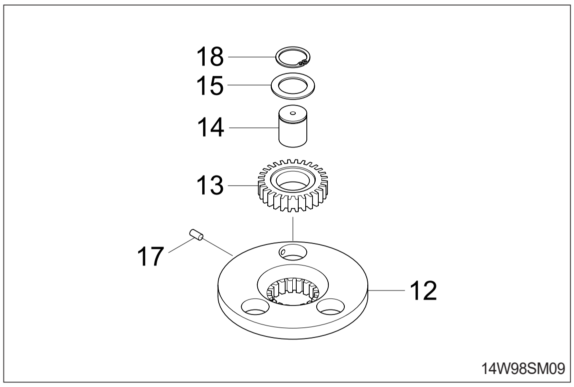
(3) Remove sun gear 1 (16).



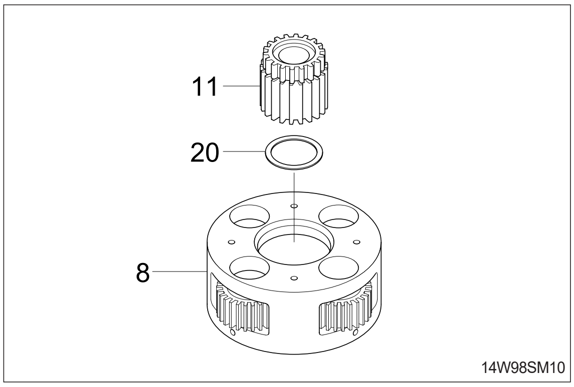
(4) Tighten two M10 eye bolts to carrier 1 (12) and lift up and remove carrier 1 (12) as subassembly.



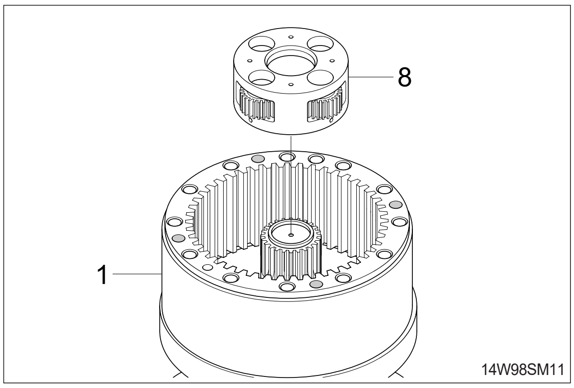
(5) Disassembling carrier 1 (12) assembly.
  ① Remove stop ring (18).
  ② Remove thrust washer (15) and planet gear 1(13) from the carrier 1 (12).
  ③ Using M8 solid drill, crush spring pin (17) so that the pin 1 (14) can be removed by hammering.
  ※ Do not reuse spring pin (17).
  ※ Do not remove pin 1 (14), carrier 1 (12) and spring pin (17) but in case of replacement.
  ※ Put matching marks on the planet gear 1 (13) and the pin 1 (14) for easy reassembly.



(6) Remove sun gear 2 (11) and side plate 1 (20) from carrier 2 (8).



(7) Remove carrier 2 (8) assembly from casing (1).



(8) Disassembling carrier 2 (8) assembly.

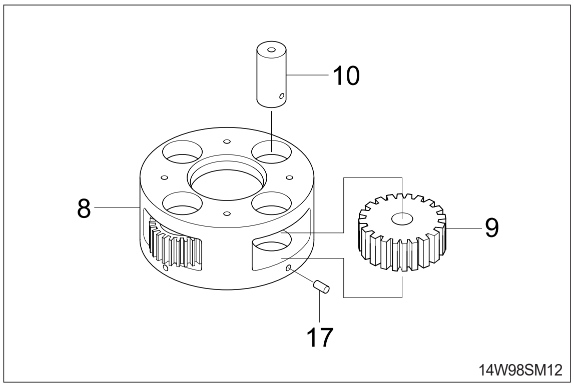
① Using M8 solid drill, crush spring pin (17) so that the pin 2 (10) can be removed.

※ Do not reuse spring pin (17).

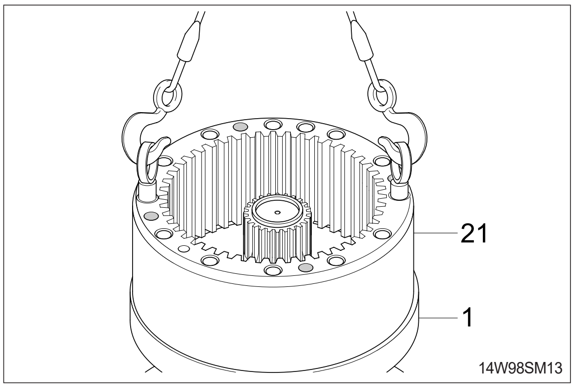
② Remove pin 2 (10) and planet gear 2 (9) from the carrier 2 (8).

※ Put matching marks on the planet gear 2 (9) and the pin 2 (17) for easy reassembly.

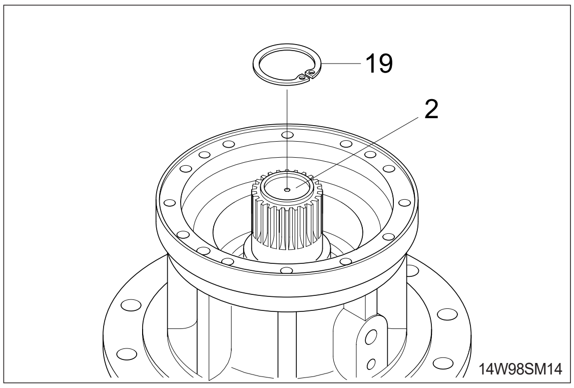
※ Do not disassemble pin 2 (10), carrier 2 (8) and spring pin (17) but in case of replacement.



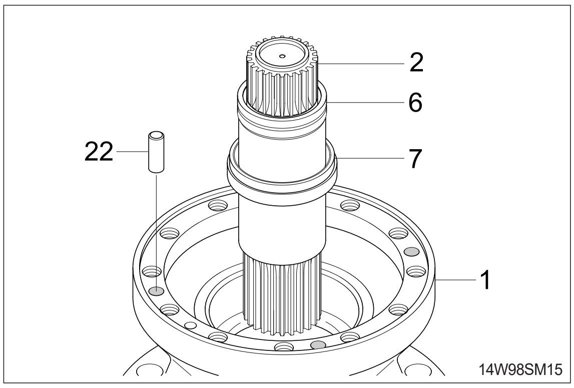
(9) Tighten two M16 eyebolt to the ring gear (21) and then lift the ring gear (21) out of casing (1).



(10) Remove stop ring (19) from the drive shaft (2).

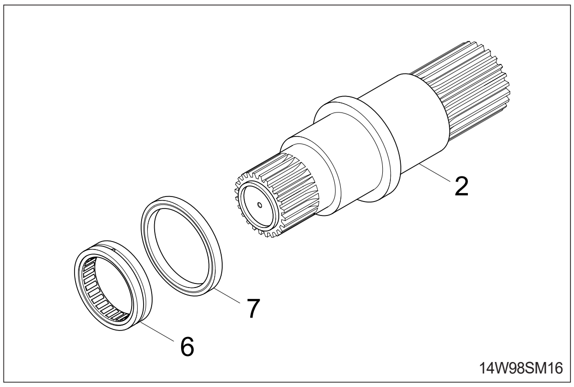


(11) Remove drive shaft (2) with roller bearing (6) and oil seal (7) assembled.
Remove knock pin (22) from the casing (1).

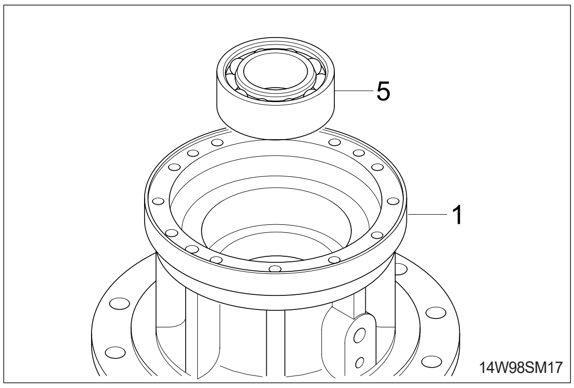


(12) Remove roller bearing (6) and oil seal (7) from the drive shaft (2).

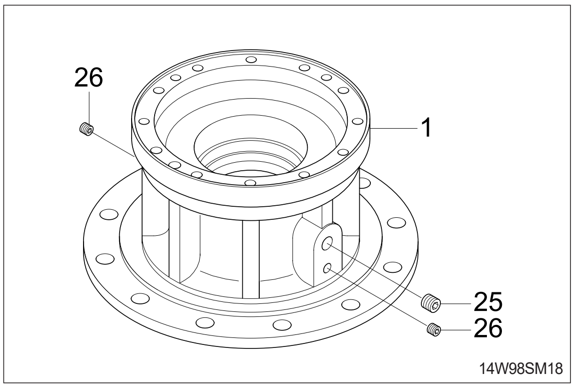
※ Do not reuse oil seal (20) once removed.



(13) Using the bearing disassembly tool, remove roller bearing (5).

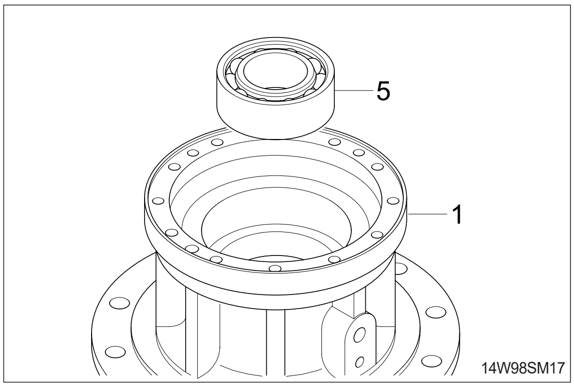


(14) Remove plugs (25, 26) from the casing (1).

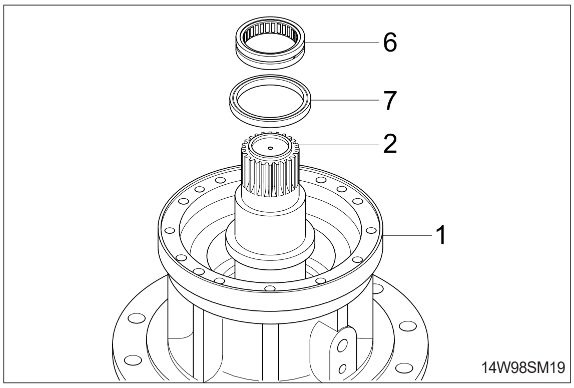


3) ASSEMBLY

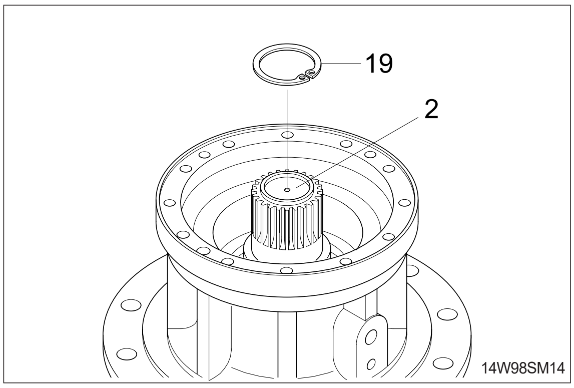
(1) Assemble roller bearing (5) inside the casing (1).



(2) Assemble the drive shaft (2) into the casing (1) and then install oil seal (7) and roller bearing (6).



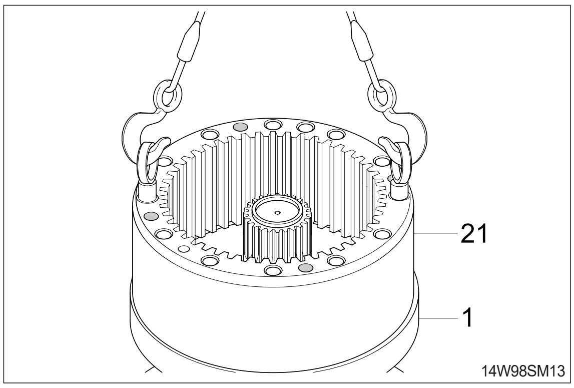
(3) Install stop ring (19) on top of drive shaft (2).



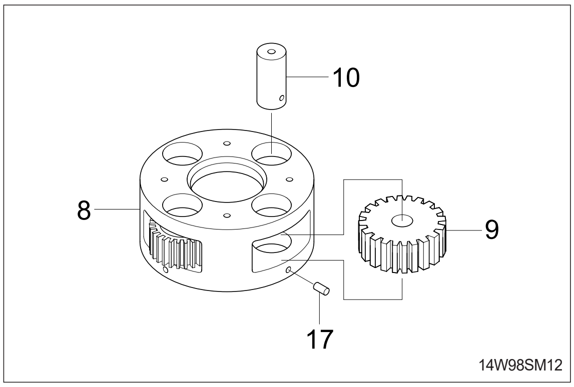
(4) Apply loctite to the tapped holes of casing (1).

(5) Tighten 2 M16 eye bolts to the ring gear (21) and lift up and then assemble it onto the casing (1).

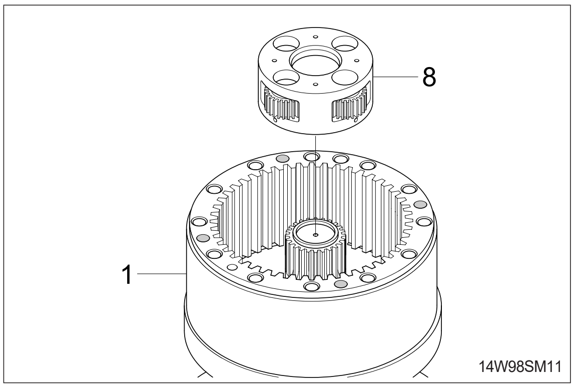
※ Don't fail to coincide the knock pin (22) holes.



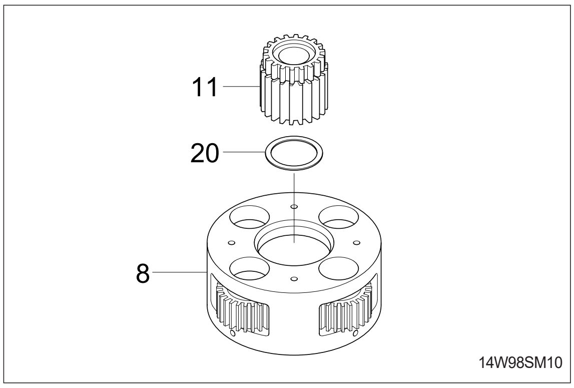
(6) Assembling carrier 2 (8) assembly.
① Install the planet gear 2 (9) inside the carrier 2 (8).
② Assemble the pin 2 (10) to the carrier 2 (8) and then press the spring pin (17) by hammering.
③ Punch 2 points of the spring pin (17) lip.
※ Take care not to mistake the matching marks of each part.



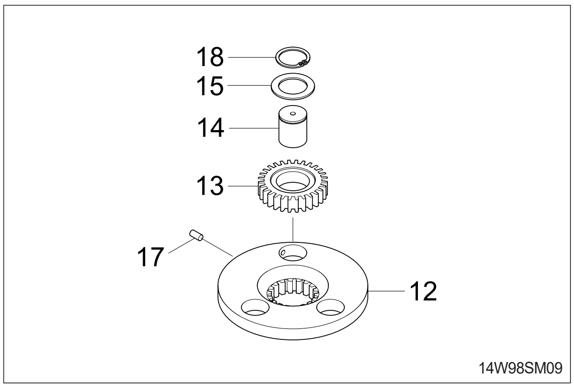
(7) Assemble carrier 2 (8) assembly correctly to the casing (1).



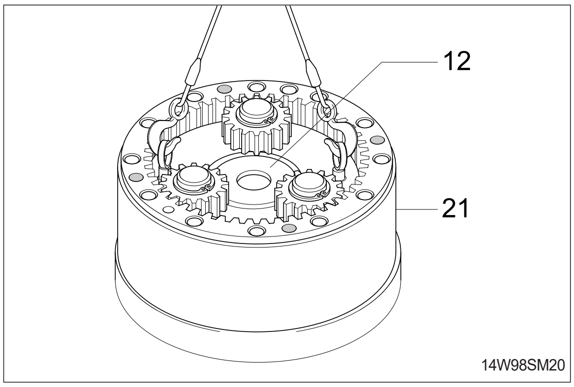
(8) Assemble sun gear 2 (11) and side plate 1 (20) to the center of the carrier 2 (8) assembly.



(9) Assembling carrier 1 (12) assembly.
① Assemble the pin1 (14) to the carrier 1 (12) and then press the spring pin (17) by hammering.
② Punch 2 points of the spring pin's (17) lip.
③ Assemble thrust washer (15), planet gear 1 (13), and then stop ring (18) to the pin 1 (11).
※ Take care not to mistake the matching marks of each part.

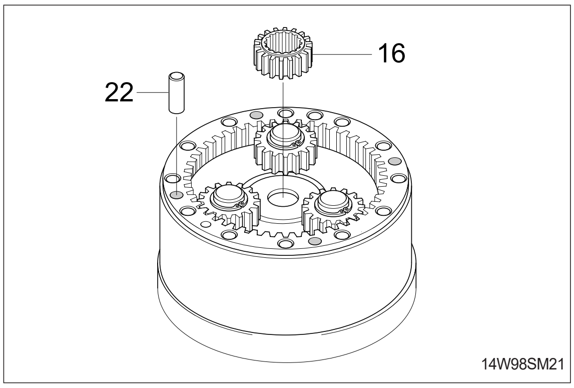


(10) Assemble carrier 1 (12) assembly into the ring gear (21).



(11) Hammer 4 knock pins (22) around the ring gear (21).

(12) Assemble sun gear 1 (16) to the drive shaft of the swing reduction gear.

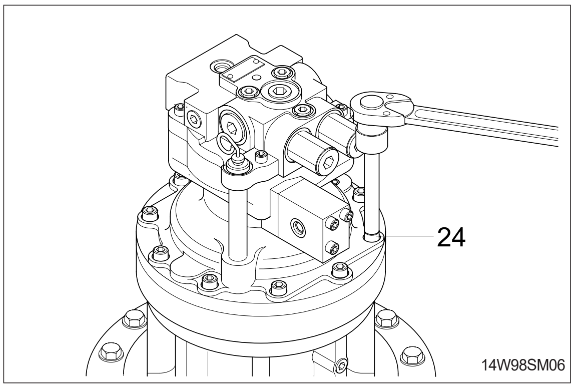


(13) Apply loctite to the tapped holes of the ring gear (21) and then mount swing motor onto the ring gear (21).

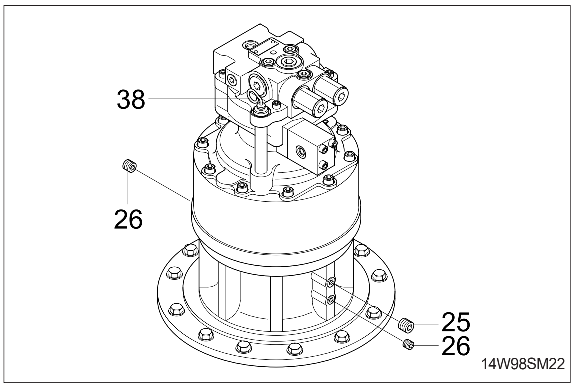
※ Don't fail to coincide the gauge bar hole.

(14) Tighten socket bolts (24) around the swing motor assembly.

・Tightening torque : 13.5 kgf・m (98 lbf・ft)



(15) Assemble plugs (25, 26) and level gauge (38).



GROUP 6 TRAVEL MOTOR

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.

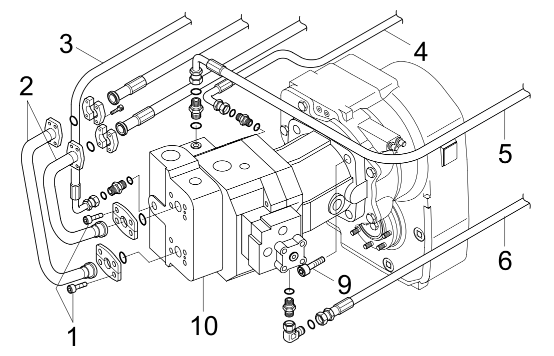
(4) Loosen the socket bolt (1) and remove the pipes (2).

(5) Disconnect hoses (3,4,5,6).

(6) Loosen the socket bolt (9) and remove travel motor (10).

· Weight : 60 ㎏ (130 ㏓)

※ When removing the travel motor assembly, check that all the hoses have been disconnected.



14W98TR01

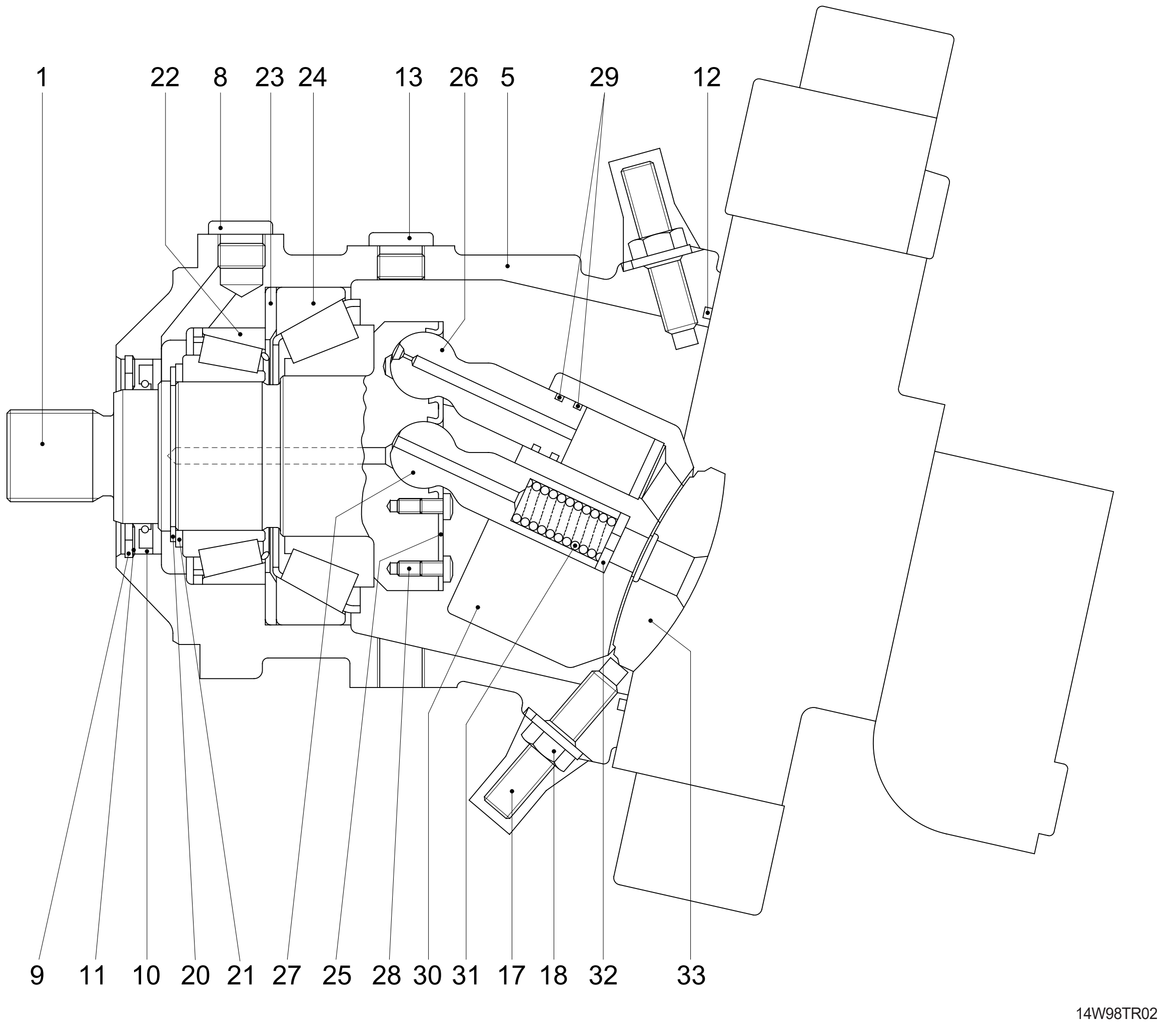
2) INSTALL

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

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

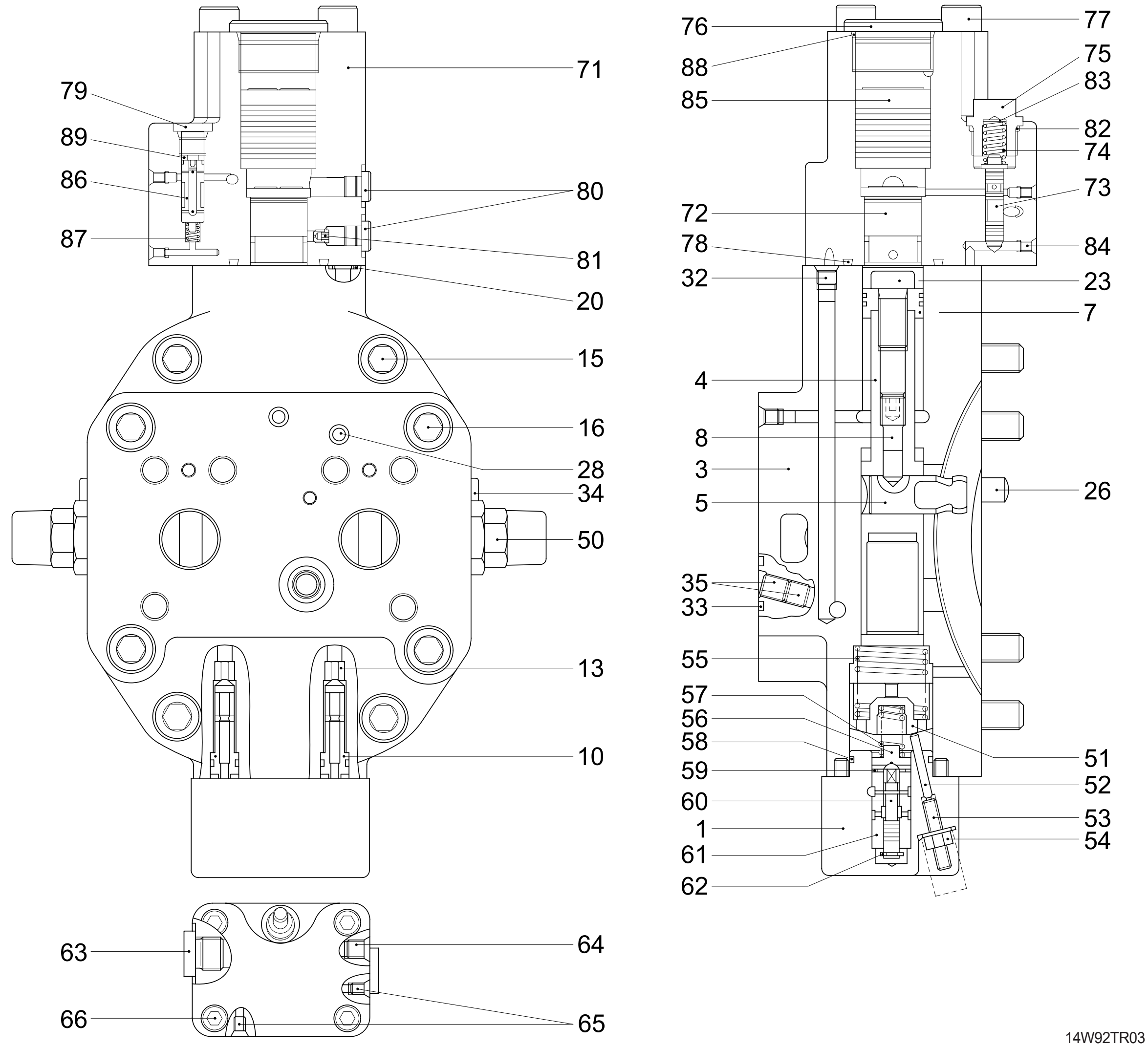
2. STRUCTURE

1) MOTOR UNIT



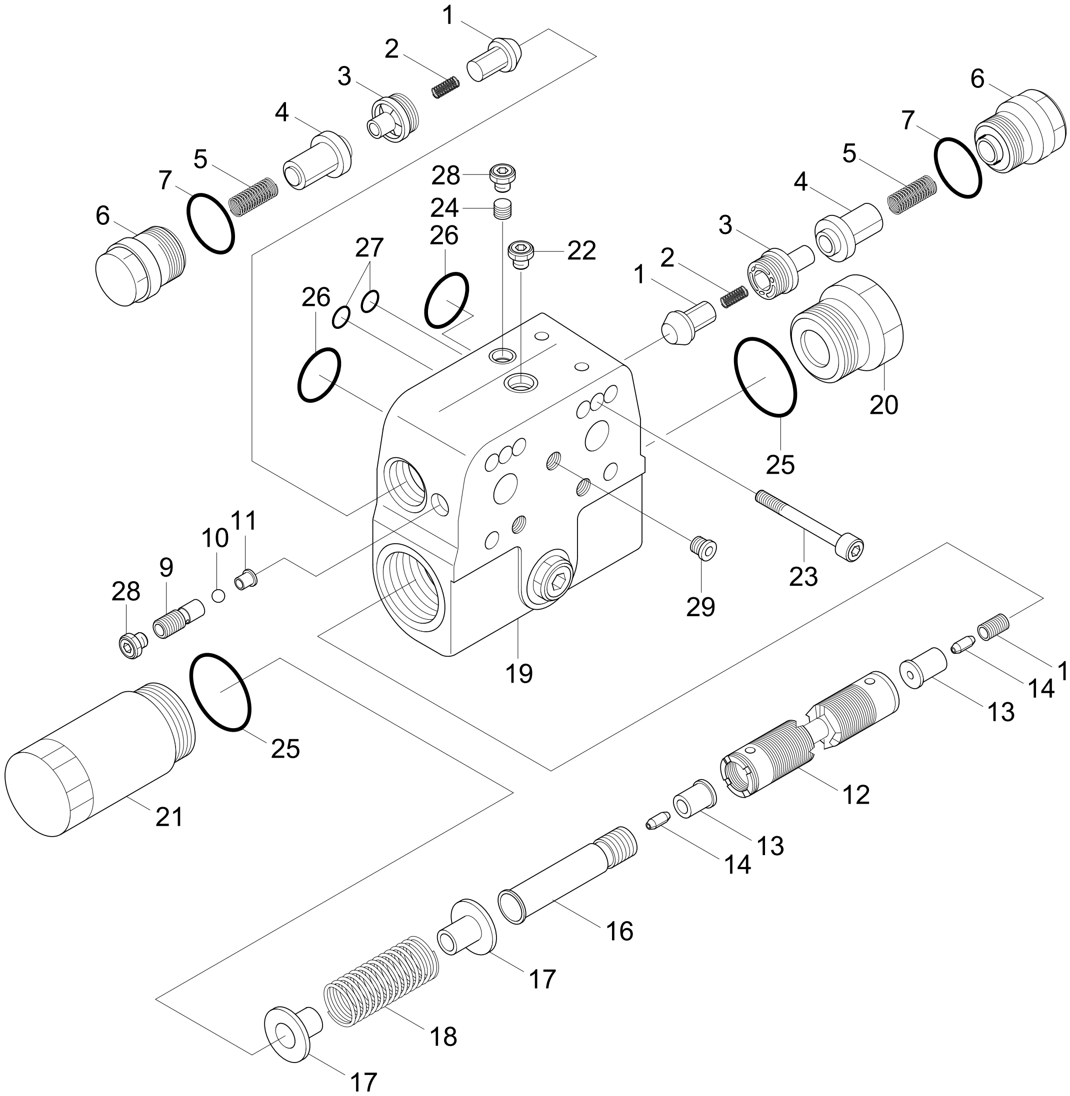
1	Drive shaft	17	Threaded pin	26	Piston
5	Housing	18	Seal lock nut	27	Center pin
8	Locking screw	20	Retaining ring	28	Pan head screw
9	Retaining ring	21	Back up plate	29	Steel sealing ring
10	Shaft seal ring	22	Taper roller bearing	30	Cylinder block
11	Back up plate	23	Shim	31	Pressure spring
12	O-ring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

2) CONTROL UNIT



1	Control housing	50	Relief valve	72	Piston
2	Stroke limiter	51	Adjusting bushing	73	Control piston
3	Port plate	52	Cylinder pin	74	Pressure spring
4	Positioning piston	53	Threaded pin	75	Locking screw
5	Positioning trunnion	54	Seal lock nut	76	Locking screw
7	Piston	55	Pressure spring	77	Socket head screw
8	Threaded pin	56	Spring collar	78	O-ring
10	Check valve	57	Pressure spring	79	Locking screw
13	Valve seat	58	O-ring	80	Locking screw
15	Socket head screw	59	Retaining ring	81	Orifice
16	Socket head screw	60	Control piston	82	O-ring
20	O-ring	61	Control bushing	83	Shim
23	Socket head screw	62	Retaining disc	84	Double break off pin
26	Cylinder pin	63	Locking screw	85	Piston
28	Double break off pin	64	Double break off pin	86	Control piston
32	Double break off pin	65	Double break off pin	87	Pressure spring
33	O-ring	66	Socket head screw	88	O-ring
34	Locking screw	71	Housing	89	Shim

3) COUNTER-BALANCE VALVE



14W98TR05

1	Valve poppet	12	Brake piston	22	Locking screw
2	Pressure spring	13	Valve bushing	23	Socket screw
3	Poppet seat	14	Throttle pin	24	Plug
4	Valve poppet	15	Valve screw	25	O-ring
5	Pressure spring	16	Bolt	26	O-ring
6	Locking screw	17	Spring collar	27	O-ring
7	O-ring	18	Pressure spring	28	Locking screw
9	Valve screw	19	Housing	29	Double brake OFF pin
10	Ball	20	Locking screw		
11	Bushing	21	Locking 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
8-66	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
8-67	76	-	32.6	236
	77	M10 × 1.0	5.2	37.6
	78	M12 × 1.5	3.6	25.8
8-68	20	-	66.3	479
	21	-	66.3	479

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.

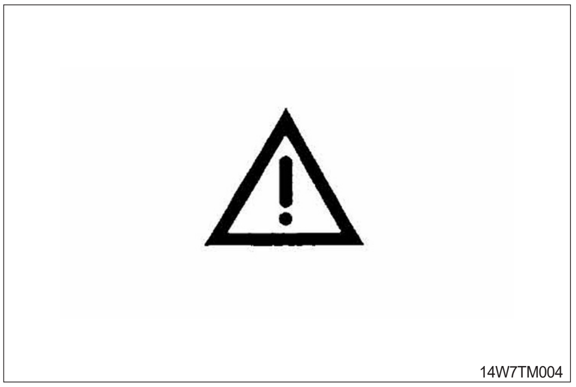
⑤ Wash all parts thoroughly in a suitable solvent.
Dry thoroughly with compressed air.
Do not use the cloths.

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.

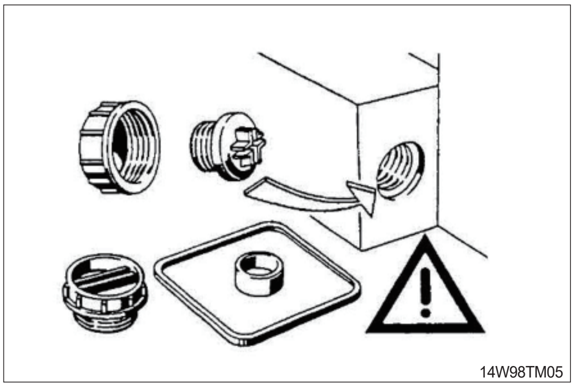
2) SEAL KITS AND COMPONENT GROUPS

Observe the following notices when carrying out repair work at hydraulic aggregates.



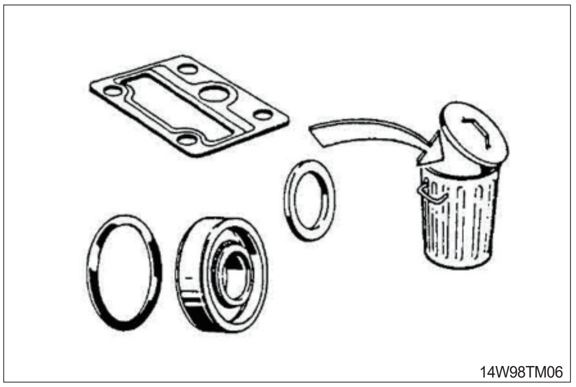
14W7TM004

(1) Close all ports of the hydraulic aggregates.



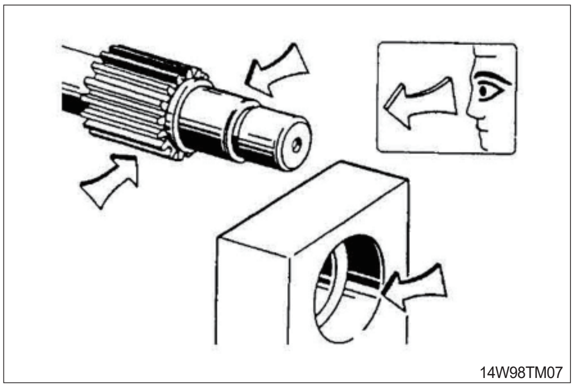
14W98TM05

(2) Replace all seals.
Use only original spare parts.



14W98TM06

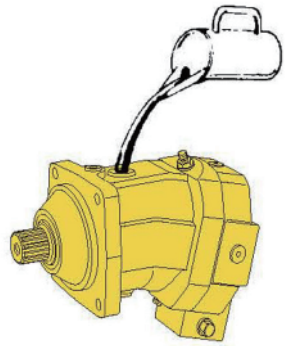
(3) Check all seal and sliding surfaces for wear.
※ Rework of sealing area f.ex. with abrasive paper can damage surface.



14W98TM07

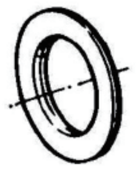
(4) Fill up hydraulic aggregates with hydraulic oil before start up.

※ Without fill up bearing damage happens!



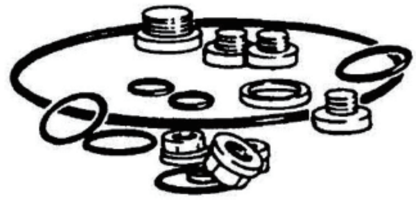
14W98TM08

(5) Seal kit for drive shaft



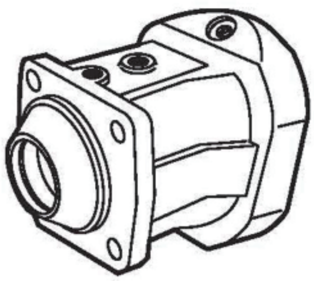
14W98TM09

(6) External seal kit.



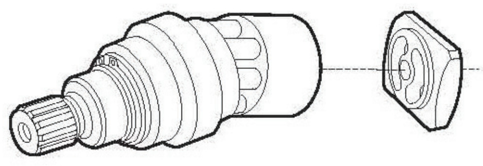
14W98TM10

(7) Housing.

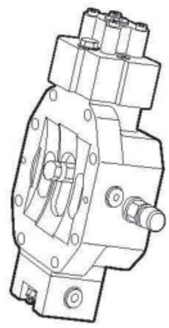


14W98TM11

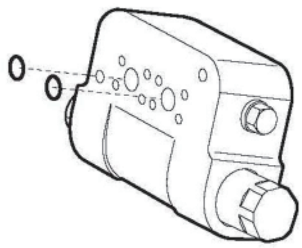
(8) Complete rotary group.


14W98TM12

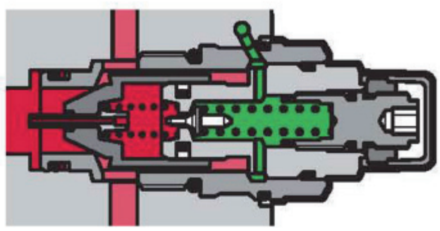
(9) Port plate with control piston.


14W98TM13

(10) Counter balance valve.

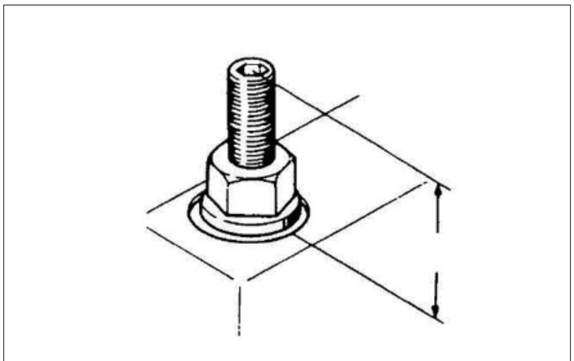

14W98TM14

(11) Relief valve.


14W98TM15

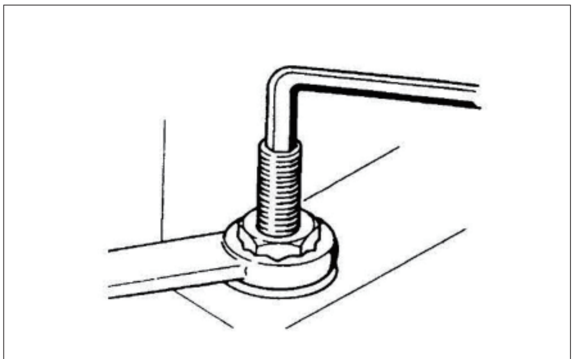
3) SEAL NUT

(1) Replace seal nut.
First measure and record setting height.



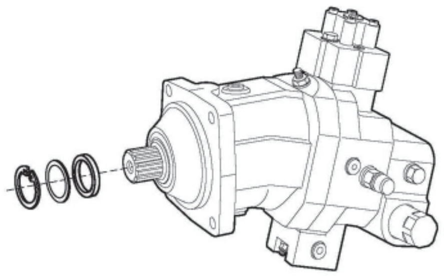
14W98TM16

(2) When tightening, counterhold setting screw, then check setting height.



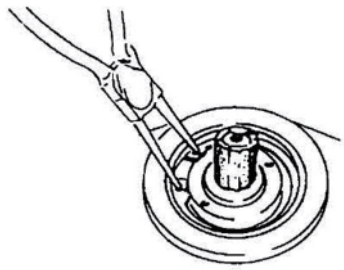
14W98TM17

4) SEALING THE DRIVE SHAFT



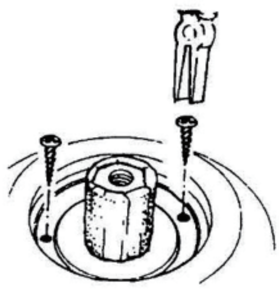
14W98TM18

(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.

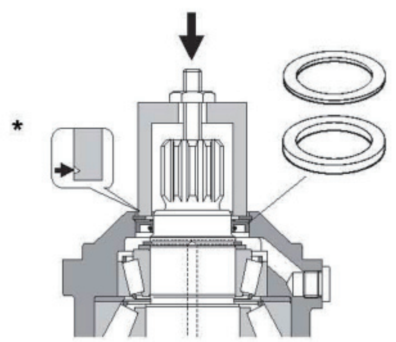


14W98TM20

(3) Press in shaft seal and shim with bush to stop.

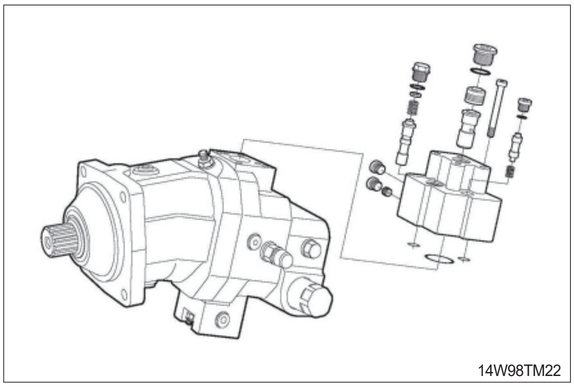
⚠ **Pay attention to pressing depth.**

* Mark for pressing depth.
Assemble retaining ring.



14W98TM21

5) SEALING OF THE CONTROL PARTS


14W98TM22

(1) Disassembly position

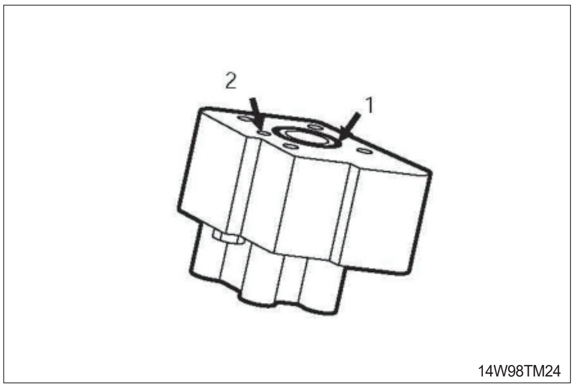
Remove cover pos.1.

14W98TM23

1 O-ring

2 Input flow of oil control

※ Installation position differs according to the control components.



14W98TM24

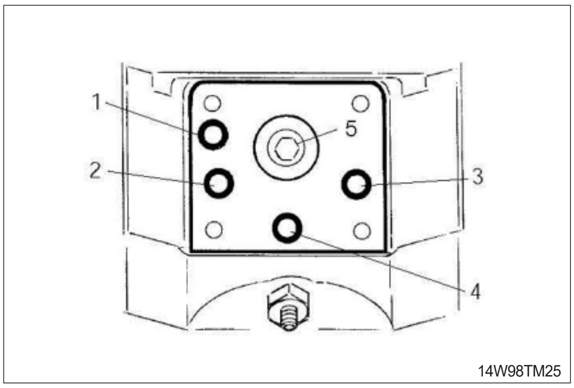
1 Input flow of oil control

2 High pressure / Low pressure

3 High pressure / Low pressure

4 Leakage oil

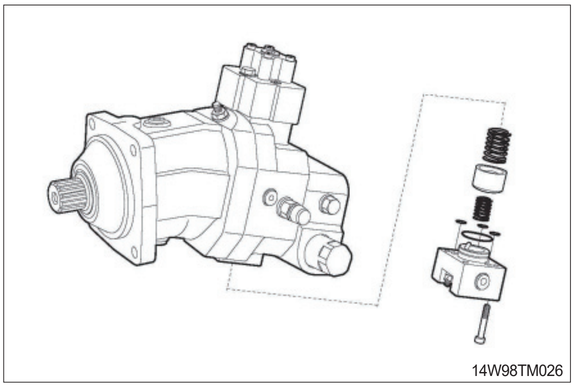
5 Control piston



14W98TM25

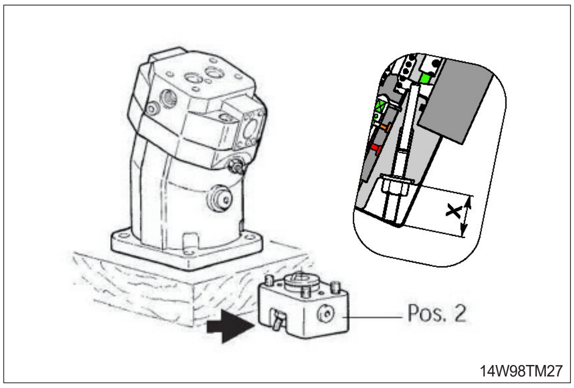
(2) Disassembly position : Remove cover 2.

※ Attention spring load.



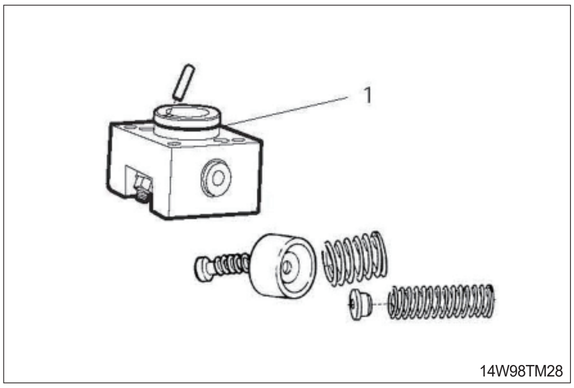
14W98TM026

※ Dimension X : Note dimension (Begin of regulation)



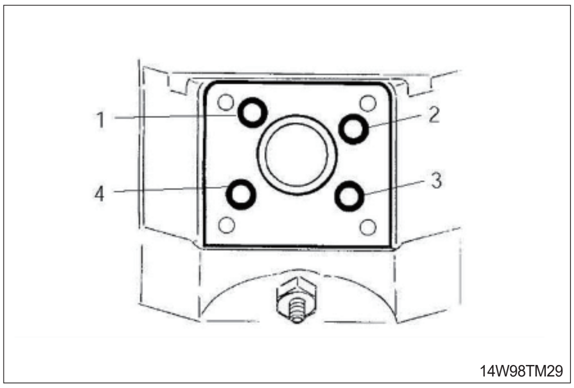
14W98TM27

1 Check of O-ring



14W98TM28

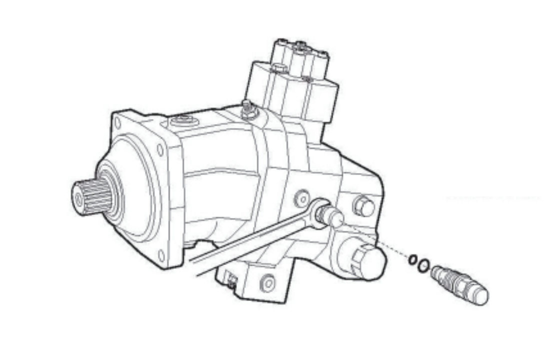
1 O-ring / High pressure-small control position side
2 O-ring / Control pressure
3 O-ring / High pressure-check valve
4 O-ring / High pressure-check valve



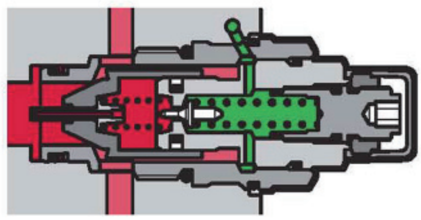
14W98TM29

6) SEALING OF THE RELIEF VALVE / COUNTER BALANCE VALVE

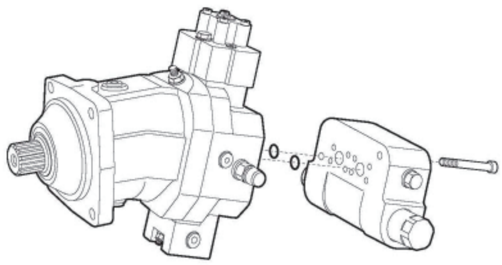
(1) Remove relief valve.


14W98TM32

(2) Inspect
O-ring


14W98TM31

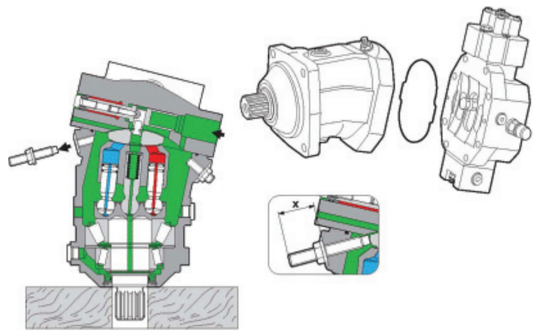
(3) Remove counter-balance valve.
Inspect
O-ring


14W98TM73

7) DISASSEMBLY OF THE PORT PLATE

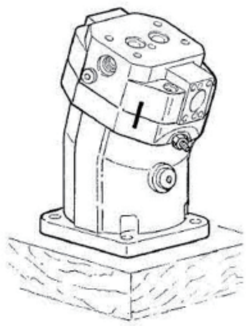
- Note dimension X
- Remove Q_{min} screw
- Swivel rotary group to zero P

※ For disassembly of the port plate, swivel always rotary group to zero position. Piston rings to hang out of the cylinder boring.



14W98TM33

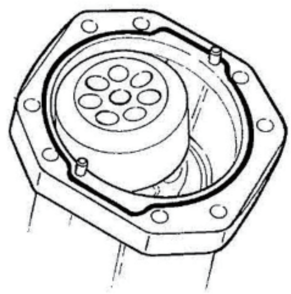
(1) Port plate.
Mark position.   Loosen screws.
Removal.



14W98TM39

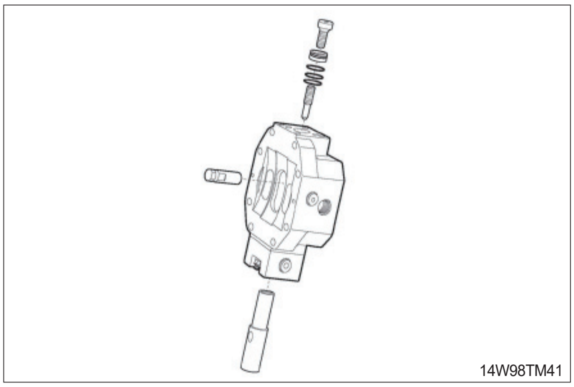
(2) Check O-ring.

※ Stick new O-ring with some grease.
Do not swivel rotary group.
Piston rings to hang out from the cylinder boring.

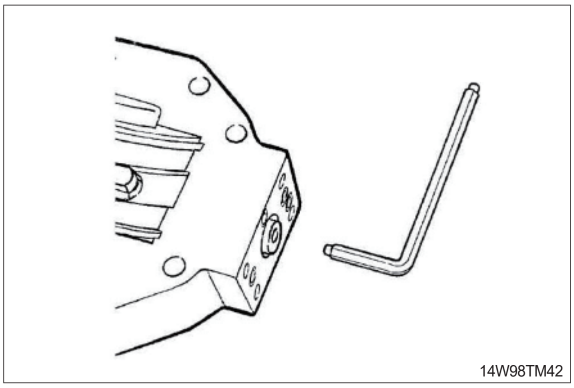


14W98TM40

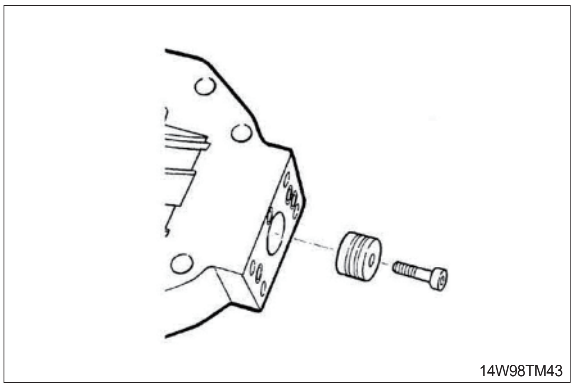
8) REMOVE OF THE POSITIONING PISTON


14W98TM41

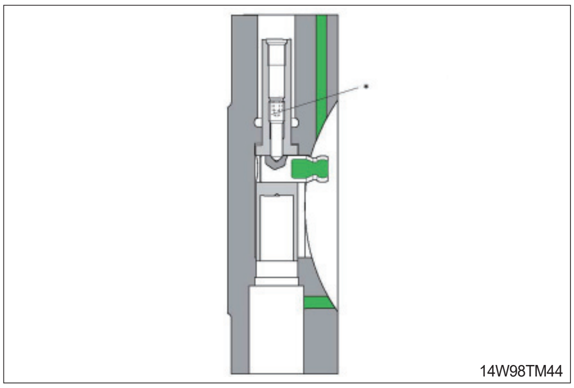
(1) Loosen fixing screw.
Use only socket wrench.


14W98TM42

(2) Remove piston with piston ring.

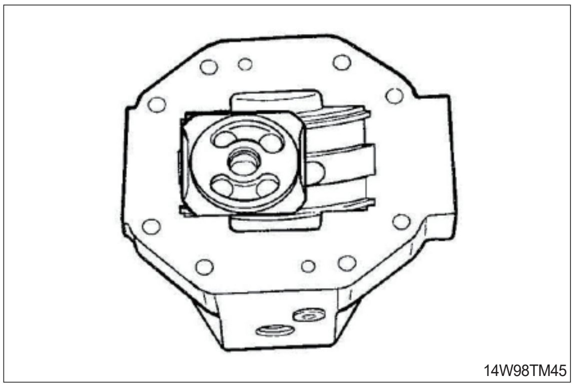

14W98TM43

(3) Warm up fixation screw * for positioning plug via boring (screw glued-to turn out).
※ Use new screw.
Precote coating.
Note tightening torque.

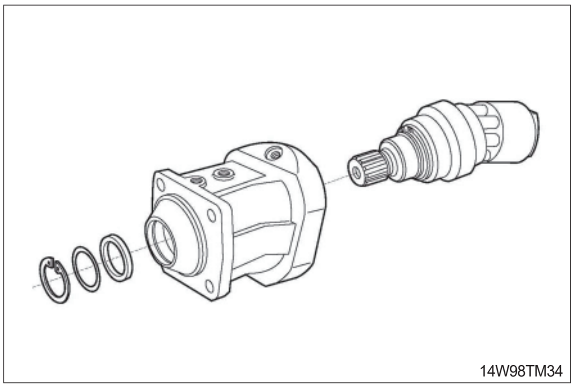


14W98TM44

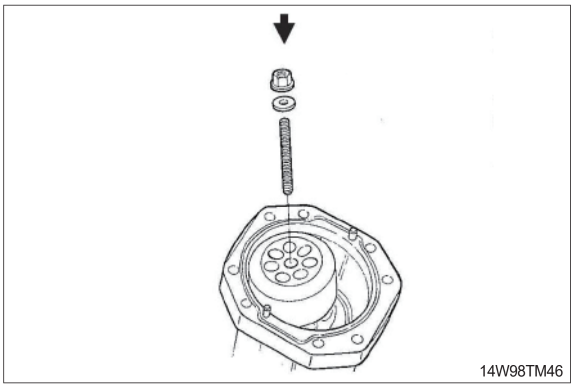
※ Stick control lens in sliding surface with grease. Assembly in reversal order. Mount port plate.
※ Rotary group vertical.


14W98TM45

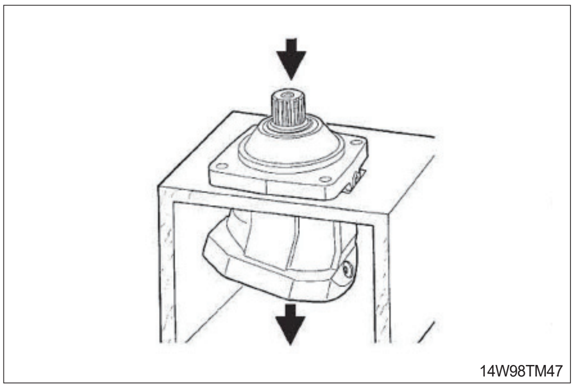
9) REMOVE ROTARY GROUP


14W98TM34

(1) Screw in threaded pin into center pin.
Fix the cylinder with disc and locknut.
M8×105 l

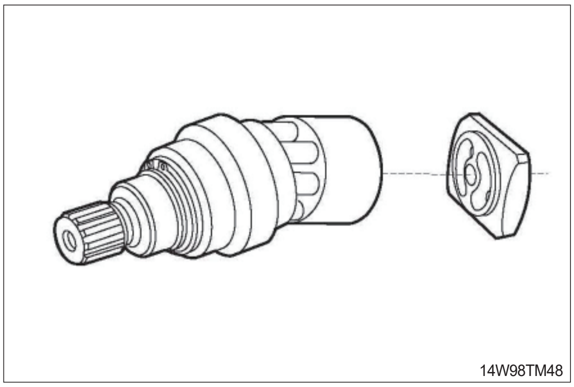

14W98TM46

(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

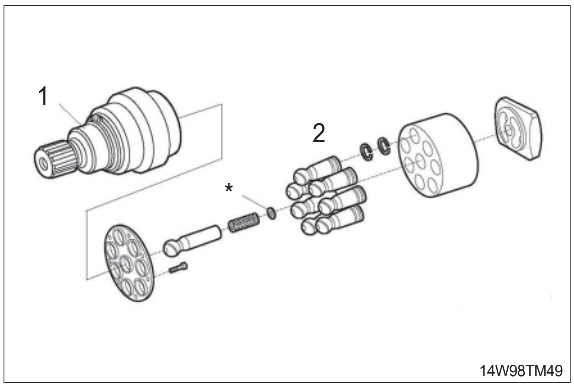
※ Complete rotary group
Setting of hydraulic part necessary.



14W98TM48

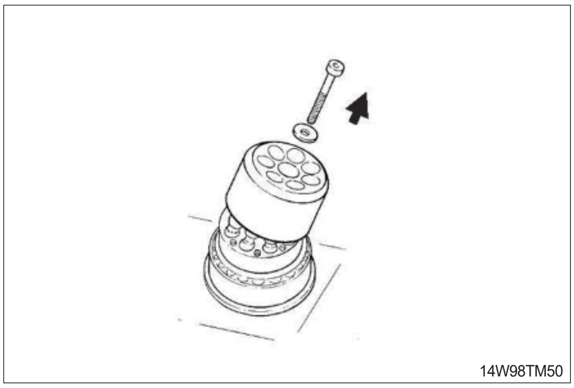
Rotary group

1 Mechanical part : Adjust drive shaft with bearing
2 Hydraulic part : Adjustment necessary



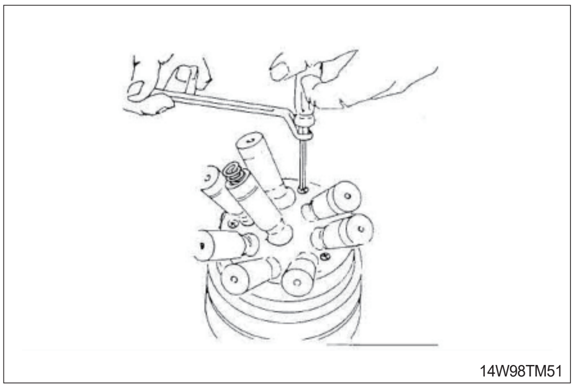
14W98TM49

(1) Remove fixing screw (cylinder).
Remove cylinder.



14W98TM50

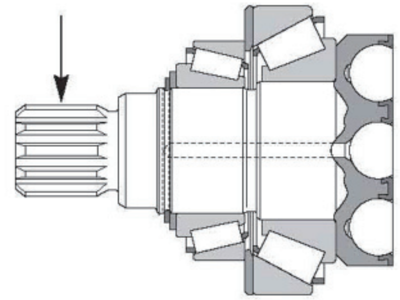
(2) Disassemble retaining plate.
※ Screws are glued.
Use Torx tools.



14W98TM51

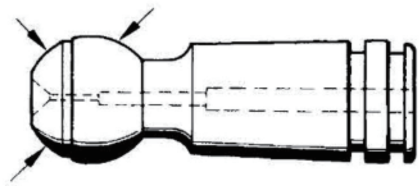
11) INSPECTION INSTRUCTIONS

(1) Free of corrosion, erosion or fretting; No damage to splines or keyways.



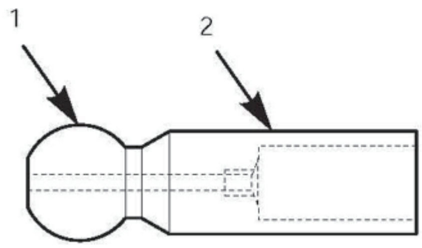
14W98TM52

(2) Pistons
No scoring and no pittings.



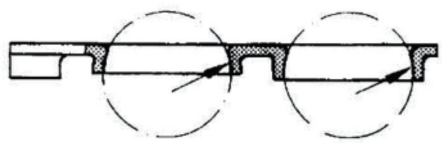
14W98TM53

(3) Center pin
No scoring and no pittings.



14W98TM54

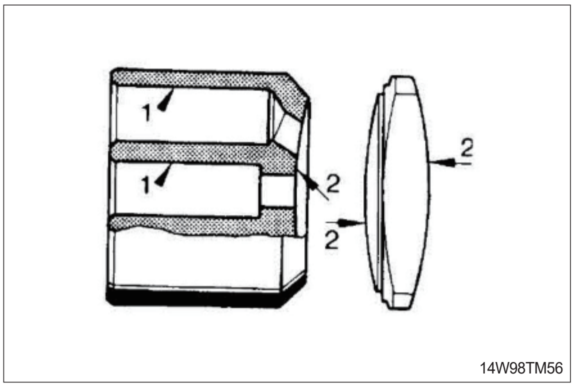
(4) Retaining plate
No scoring and no evidence of wear.



14W98TM55

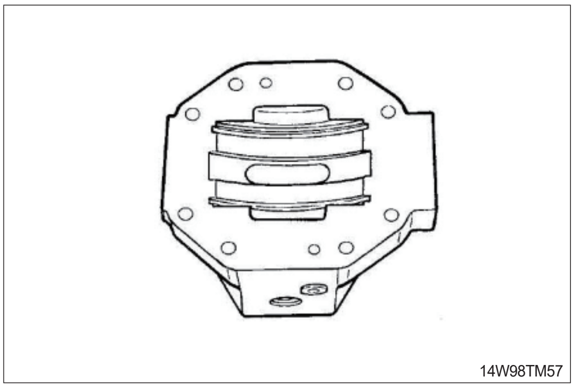
(5) Cylinder block / Control lens

1. Bores free of scoring, no evidence of wear
2. Faces smooth and even, free of cracks and scoring



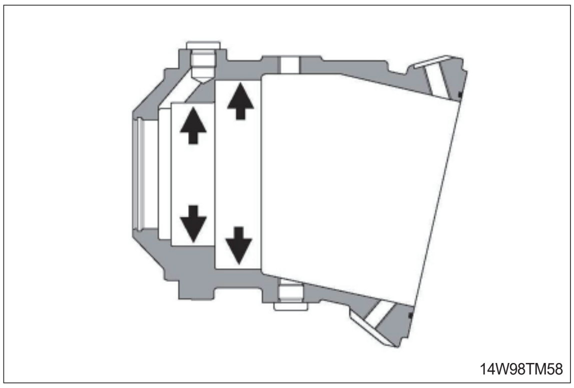
(6) Control housing

Sliding surface and side guides free of scoring and no wear.



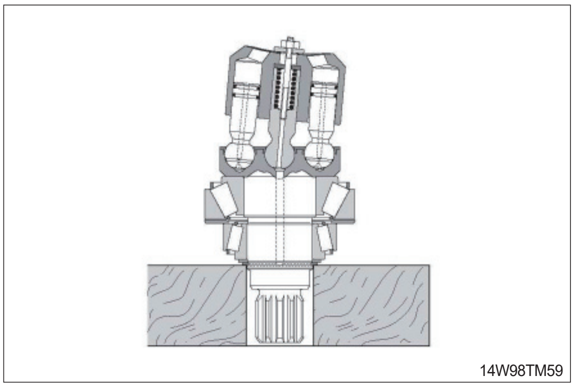
(7) Visual check

Bearing areas free of scoring and no evidence of wear.

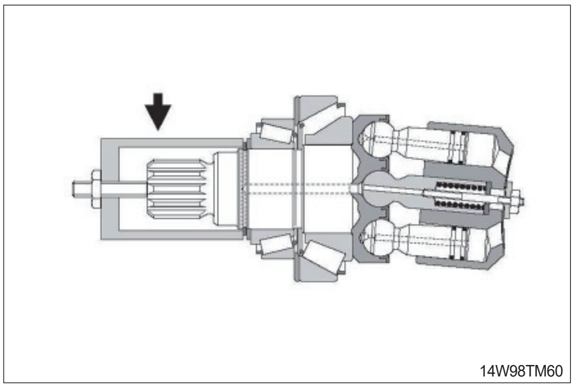


12) ROTARY GROUP ASSEMBLY

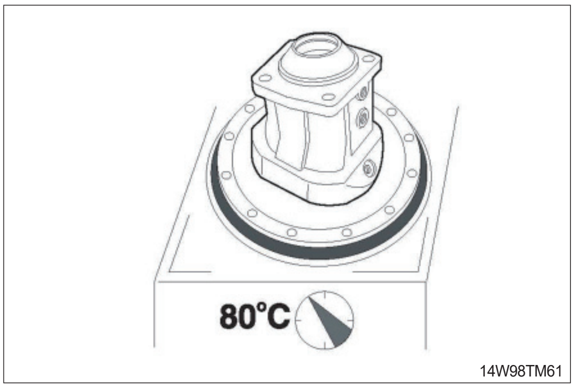
(1) Rotary group completely assembled ready for assembly.



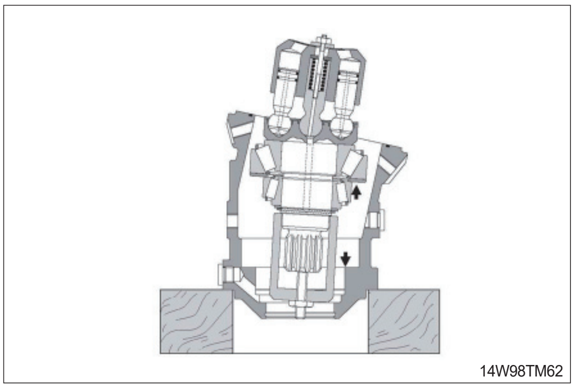
(2) Place assembly sleeve.



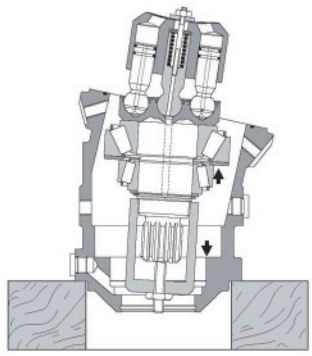
(3) Warm up housing to 80°C.



(4) Insert rotary group into housing to seat position.



(5) Insert rotary group into housing to seat position.

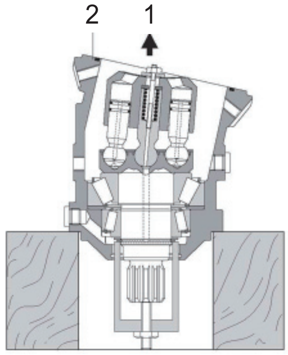


14W98TM63

(6) Fix zero position of cylinder with Q_{max} screw.

1 Disassemble cylinder fixing screw

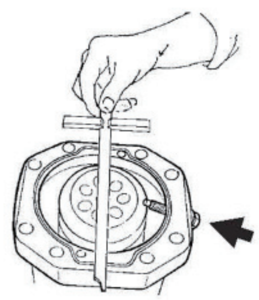
2 Insert O-ring



14W98TM74

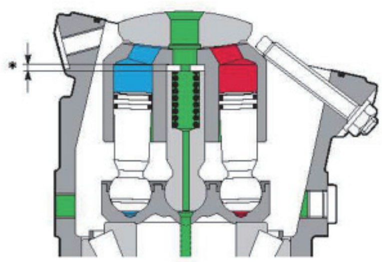
13) ROTARY GROUP ADJUSTMENT

(1) Determine cylinder swivel range to max angle with screw.



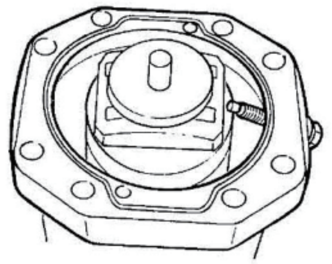
14W98TM64

(2) * Disc



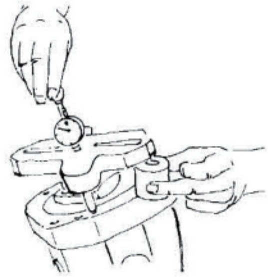
14W98TM65

(3) Place centering disc.



14W98TM66

(4) Mount measuring device.



14W98TM67

(5) Check dimension X.

14W98TM68

14) ASSEMBLY OF THE PORT PLATE

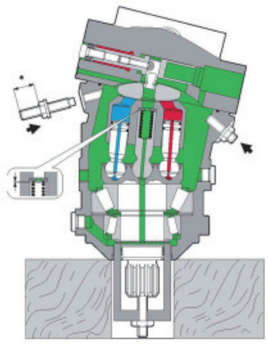
(1) Assemble port plate.

※ Take care of assembly design.
Tighten fixing screws with torque.

(2) Set Q_{min} screw to dimension(*).

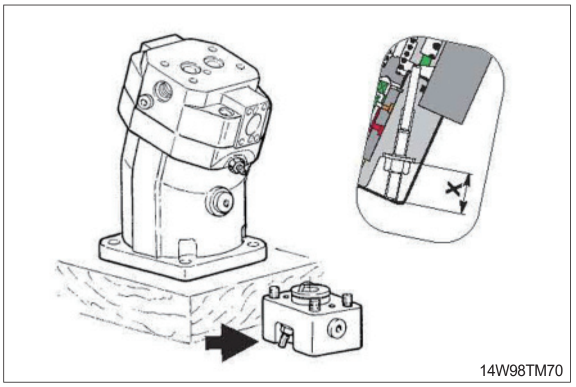
(3) Assemble plug.

(4) Remove assembly sleeve.



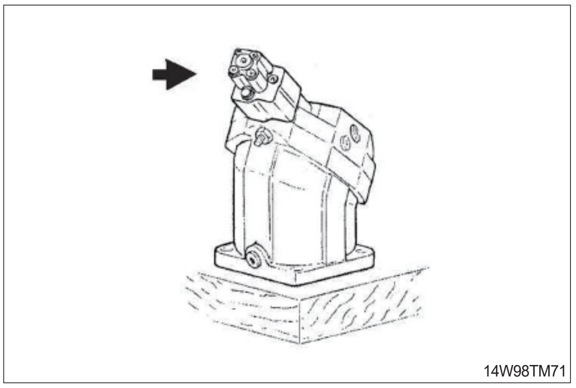
14W98TM69

(5) Assemble control components.



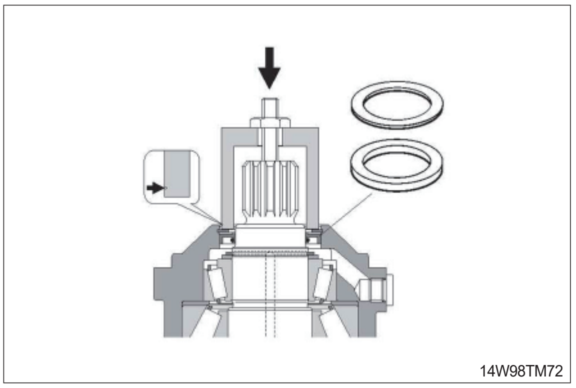
14W98TM70

(6) Assemble cover.



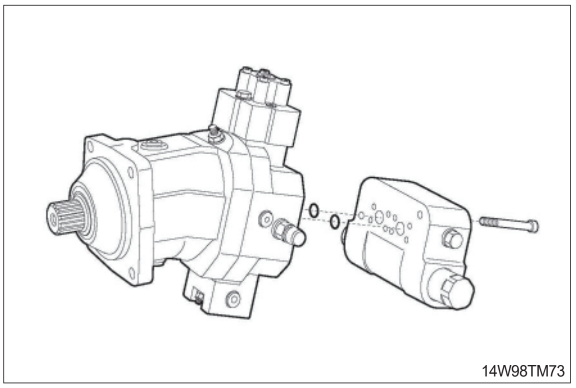
14W98TM71

(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

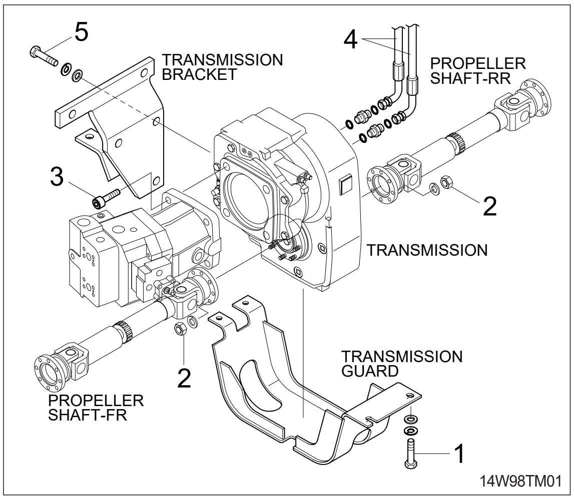
1. REMOVAL AND INSTALL

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 transmission guard plate mounting bolt (1).
(5) Remove the propeller shaft mounting nuts (2).
  · Tightening torque : 5.9±0.6 kgf · m
  (42.7±4.3 lbf · ft)
(6) Remove the travel motor mounting bolt (3).
  · Tightening torque : 29.7±4.5 kgf · m
  (215±32.5 lbf · ft)
(7) Remove the hoses (4).
  Fit blind plugs to the disconnected hoses.
(8) Remove the mounting bolts (5), then remove the transmission device assembly.
  · Weight : 140 kg (310 lb)
  · Tightening torque : 58.4±6.4 kgf · m
  (422±46.3 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.

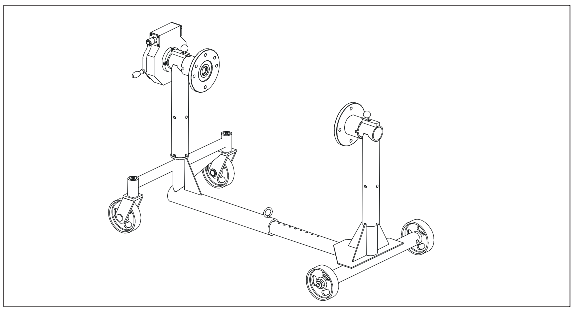
(4) The proper repair of these products requires especially trained personnel.

(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

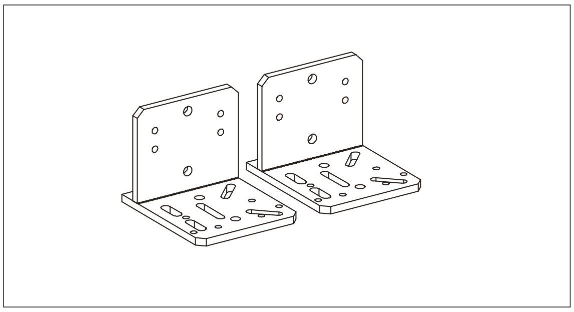
5870 350 000



14WF8TM01

2) Supporting bracket

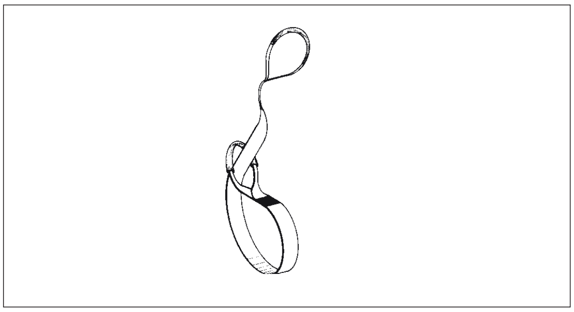
5870 350 106



14WF8TM02

3) Lifting strap

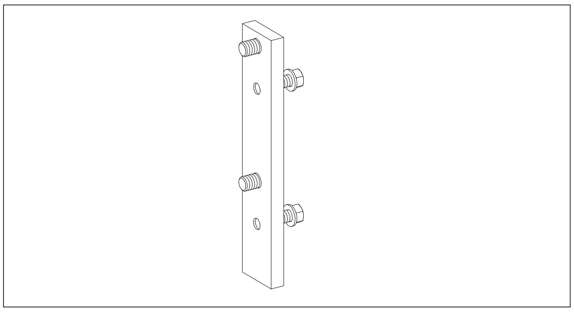
5870 281 026



14WF8TM03

4) Fixture

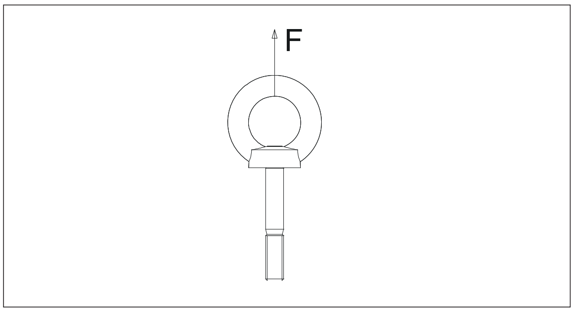
5870 350 079



14WF8TM04

5) Eye bolt assortment

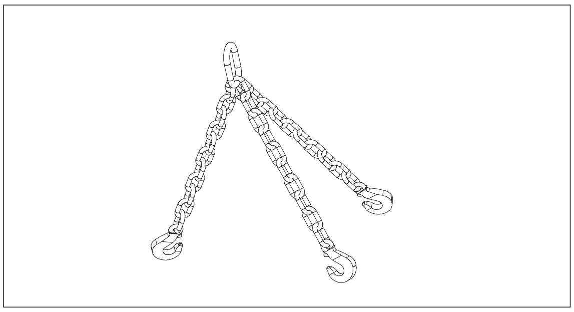
5870 204 002



14WF8TM05

6) Lifting chain

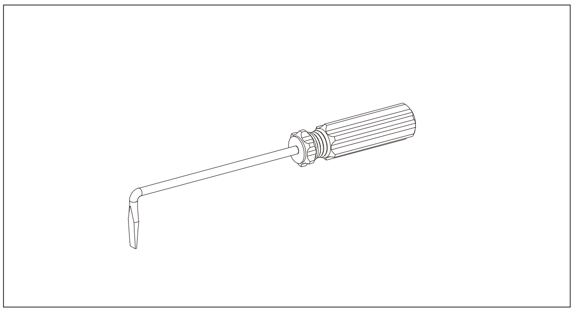
5870 221 047



14WF8TM06

7) Resetting device

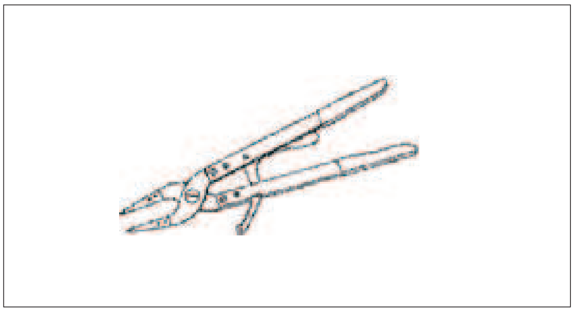
5870 400 001



14WF8TM07

8) Clamping pliers

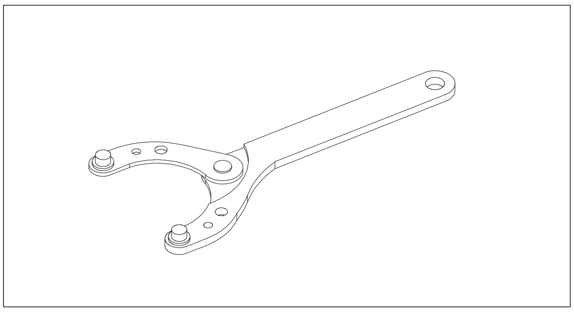
5870 900 021



14WF8TM08

9) Clamping fork

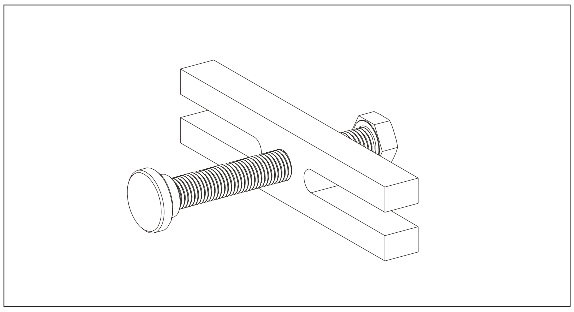
5870 240 025



14WF8TM09

10) Extractor

5870 000 017



14WF8TM10

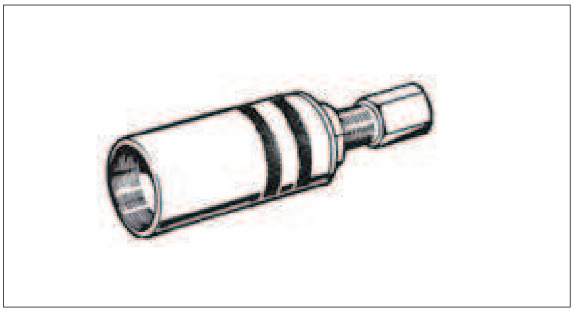
11) Rapid grip

5873 012 021

14WF8TM11

12) Basic tool

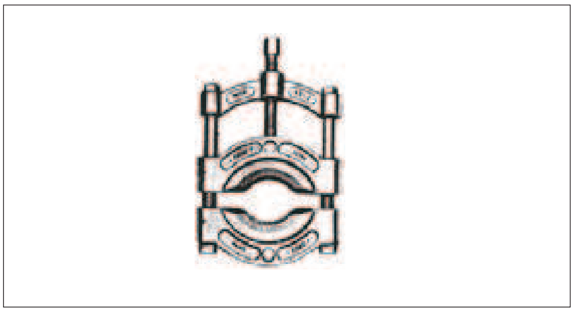
5873 002 001



14WF8TM12

13) Cut-off device

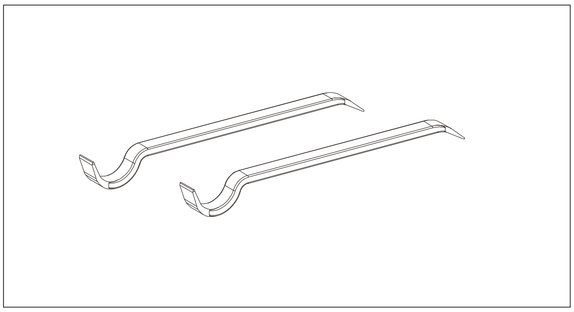
5870 300 028



14WF8TM13

14) Assembly lever

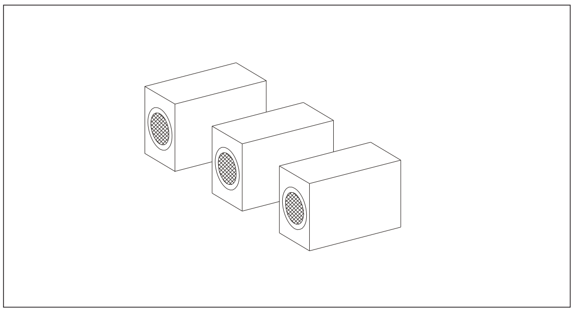
5870 345 036



14WF8TM14

15) Solenoid block

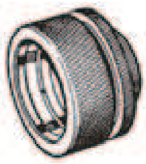
5870 450 003



14WF8TM15

16) Grab sleeve

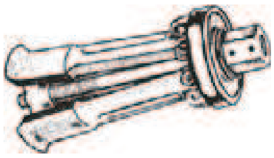
5873 001 037



14WF8TM16

17) Inner extractor

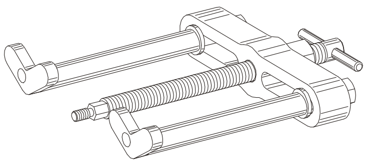
5870 300 019



14WF8TM17

18) Counter support

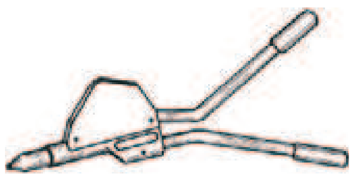
5870 300 020



14WF8TM18

19) Lever riveting tongs

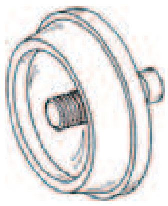
5870 320 016



14WF8TM19

20) Driver tool

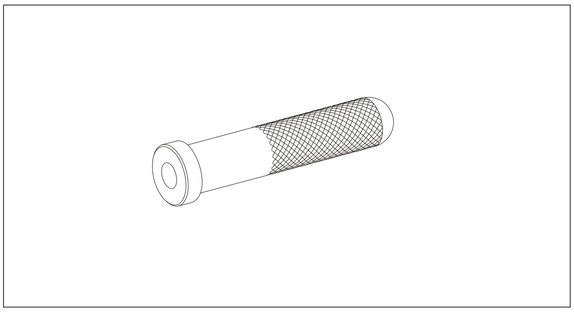
5870 058 073



14WF8TM20

21) Handle

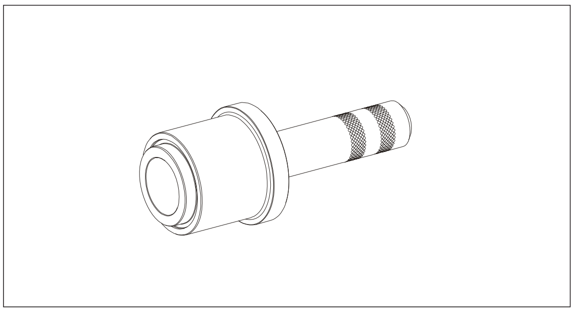
5870 260 002



14WF8TM21

22) Driver tool

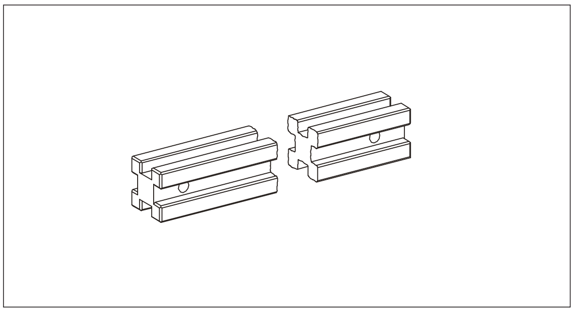
5870 048 281



14WF8TM22

23) Straightedge

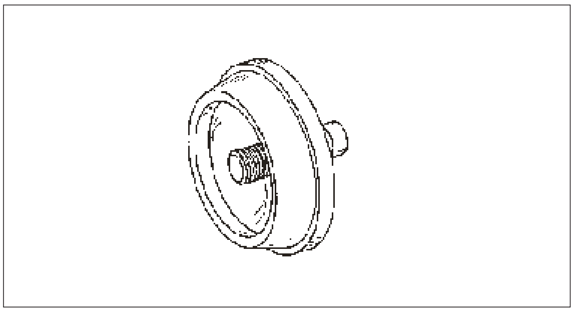
5870 200 108



14WF8TM23

24) Driver tool

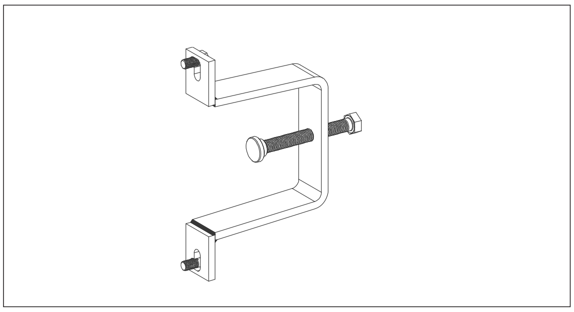
5870 058 078



14WF8TM24

25) Clamping bar

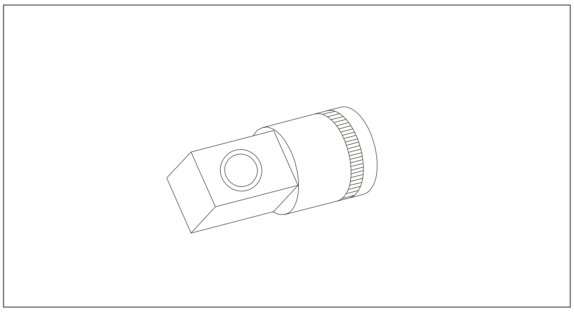
5870 654 049



14WF8TM25

26) Reduction

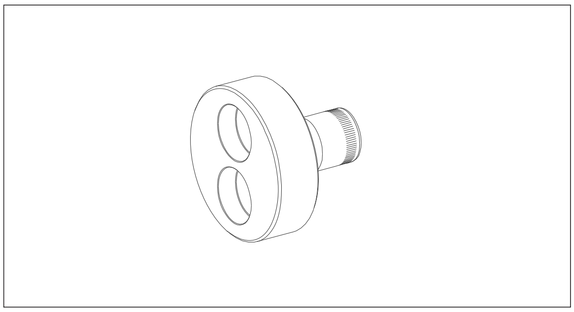
5870 656 056



14WF8TM26

27) Plug insert

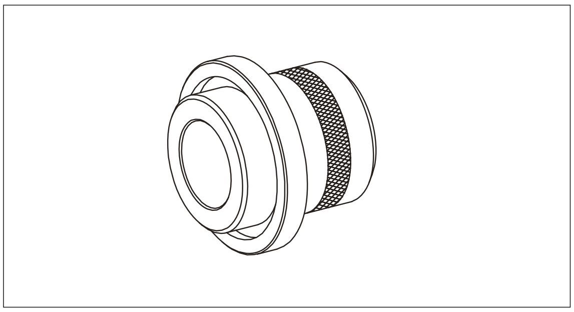
AA00 392 461



14WF8TM27

28) Driver tool

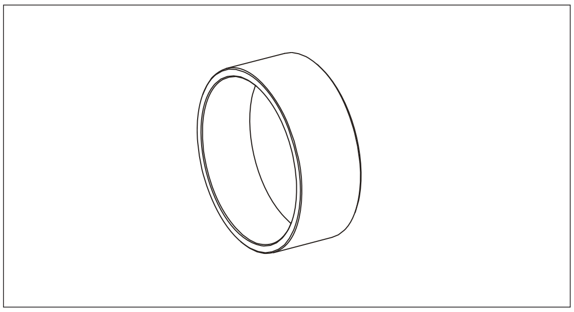
5870 048 279



14WF8TM28

29) Pressure piece

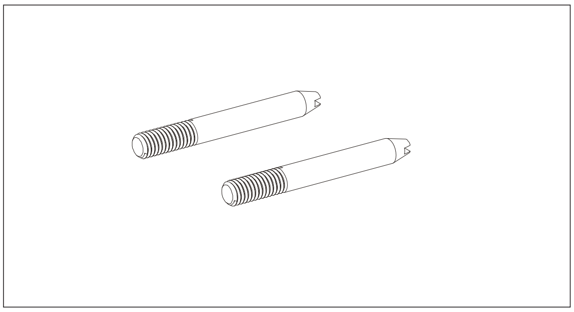
5870 506 150



14WF8TM29

30) Adjusting screws (M12)

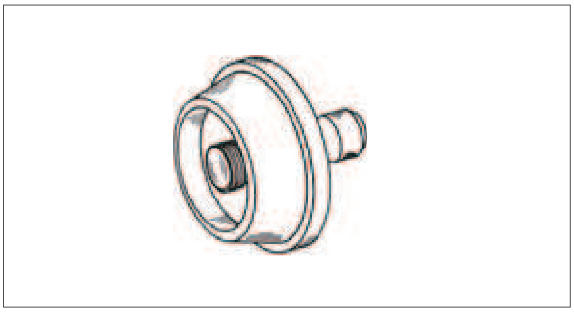
5870 204 021



14WF8TM30

31) Driver tool

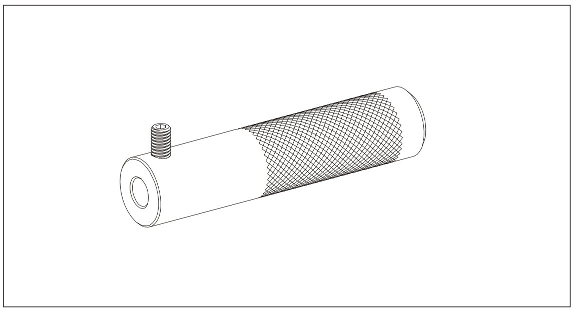
5870 058 051



14WF8TM31

32) Press-fit mandrel

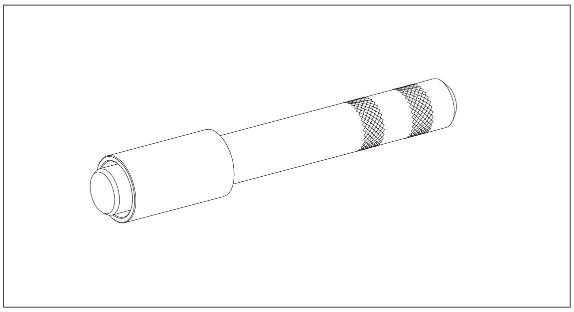
AA00 392 151



14WF8TM32

33) Driver tool

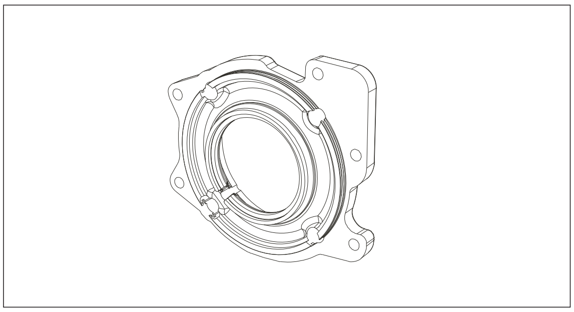
5870 048 283



14WF8TM33

34) Measuring device

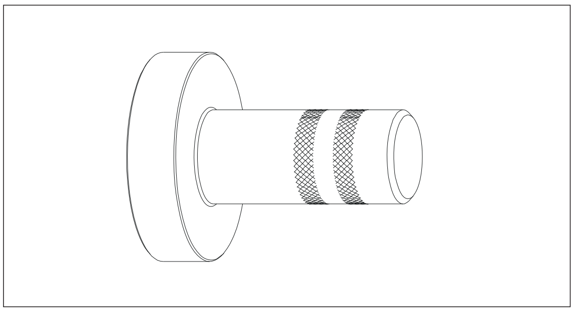
5870 200 131



14WF8TM34

35) Driver tool

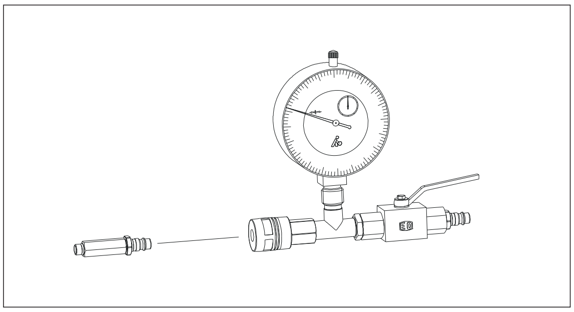
5870 506 161



14WF8TM35

36) Air connection

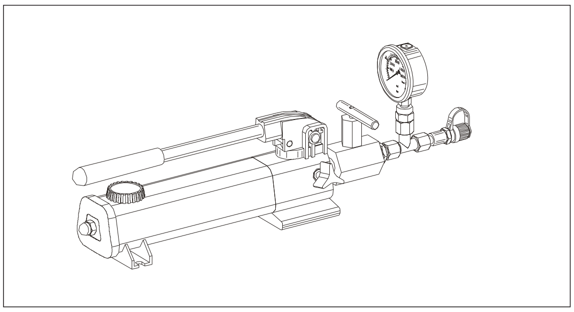
5870 505 012



14WF8TM36

37) HP pump

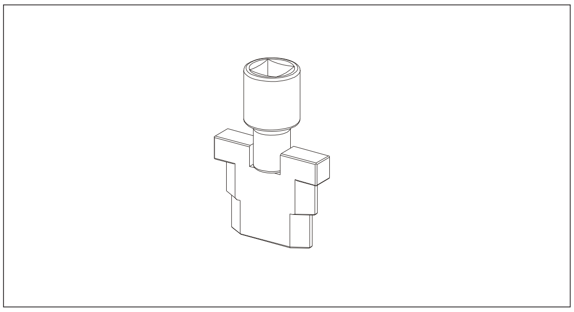
5870 287 007



14WF8TM37

38) Spline mandrel

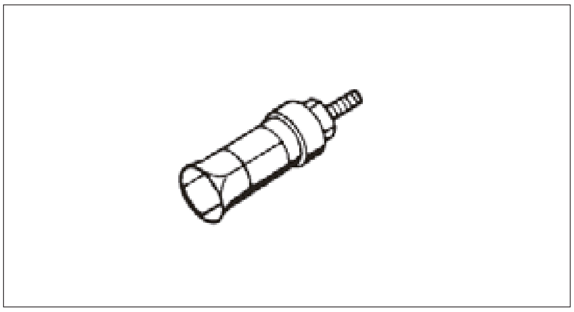
5870 510 039



14WF8TM38

39) Inner extractor

5870 300 012



14WF8TM39

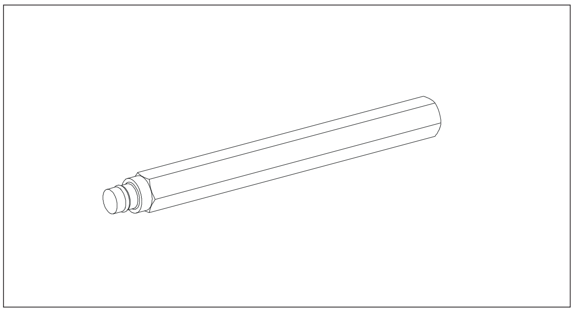
40) Counter support

5870 300 011

14WF8TM40

41) Driver tool

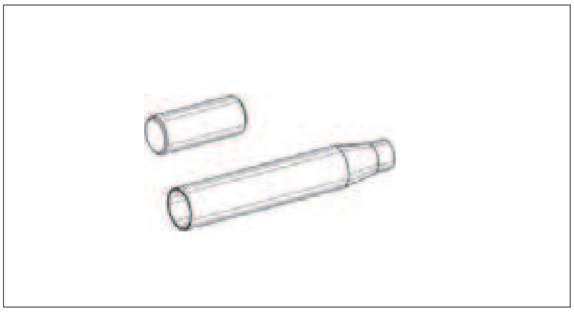
5870 705 003



14WF8TM41

42) Inner installer

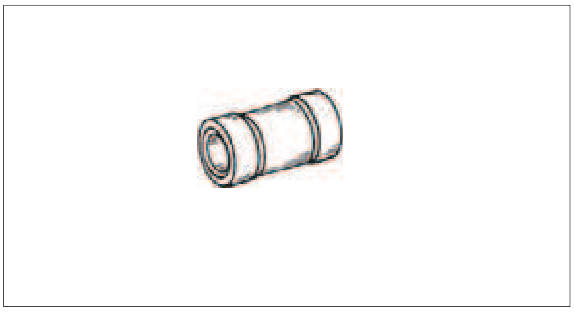
5870 651 055



14WF8TM42

43) Calibrating mandrel

5870 651 056



14WF8TM43

4. COMMERCIAL TOOLS FOR DISASSEMBLY AND REASSEMBLY

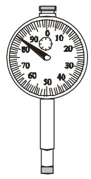
1) Magnetic stand

5870 200 055

14WF8TM44

2) Dial indicator

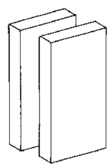
5870 200 057



14WF8TM45

3) Gauge blocks

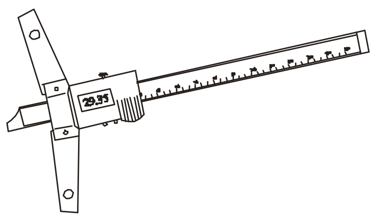
5870 200 066	70 mm
5870 200 067	100 mm



14WF8TM46

4) Digital depth gauge

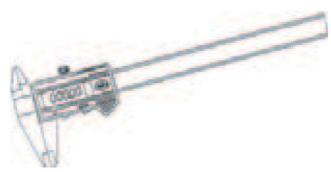
5870 200 072	200 mm
5870 200 114	300 mm



14WF8TM47

5) Digital caliper gauge

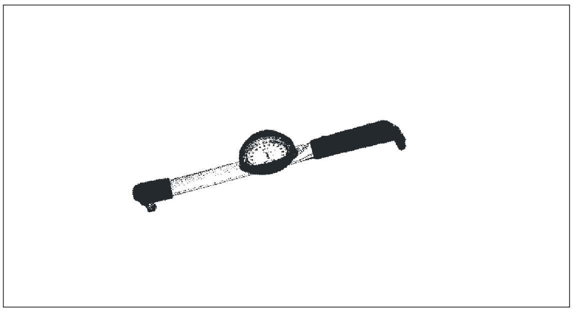
5870 200 109	150 mm



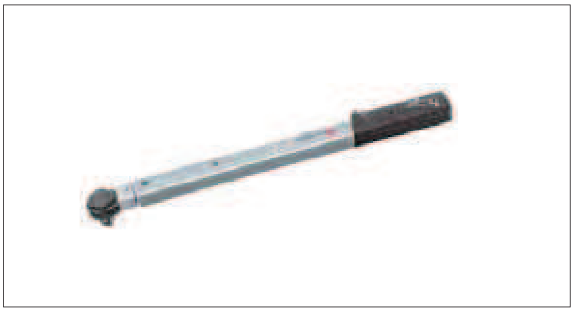
14WF8TM48

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



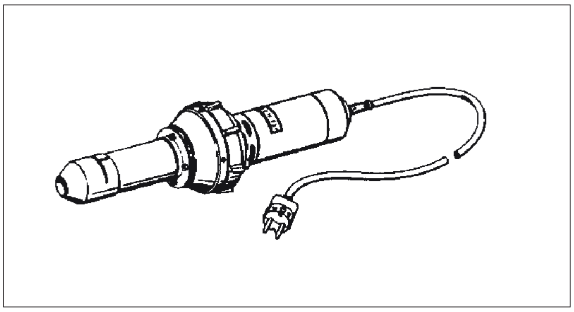
14WF8TM49



14WF8TM50

7) Hot air blower

5870 221 500	230 V
5870 221 501	115 V



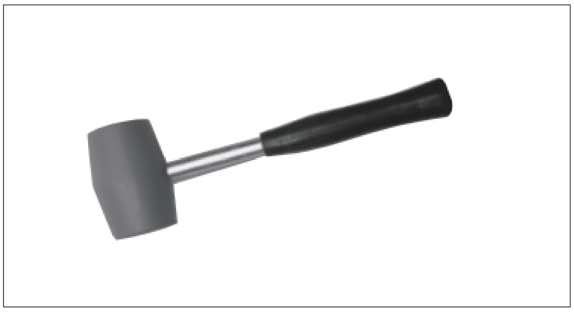
14WF8TM51

8) Plastic hammer

5870 280 004 Ø 60 mm

Substitute nylon insert

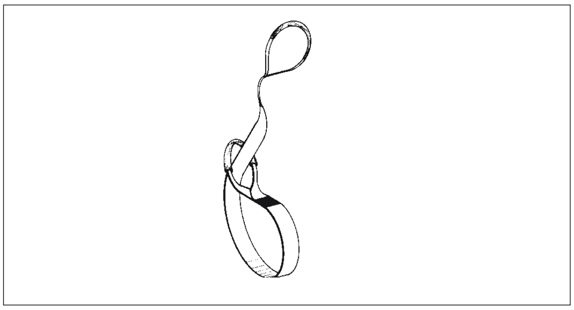
5870 280 006



14WF8TM52

9) Lifting strap

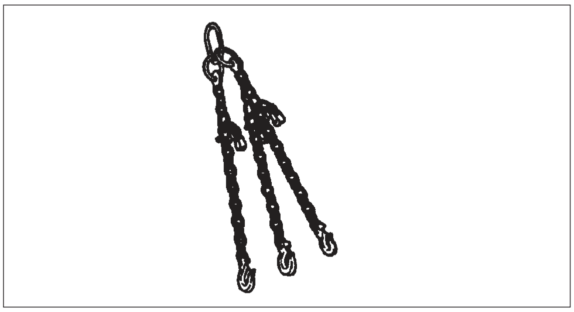
5870 281 026



14WF8TM53

10) Lifting chain

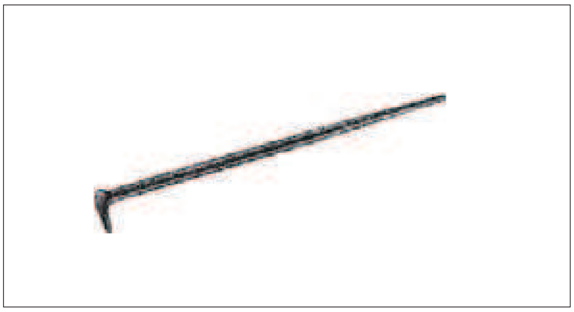
5870 281 047



14WF8TM54

11) Pry bar

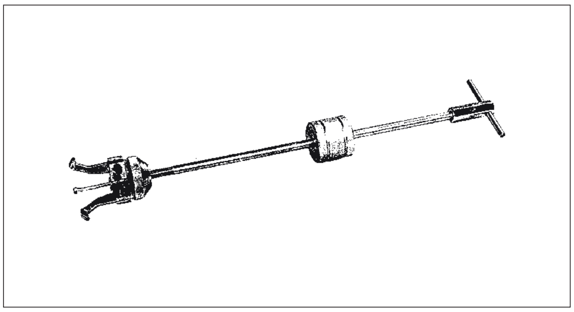
5870 345 071



14WF8TM55

12) Striker

5870 650 004



14WF8TM56

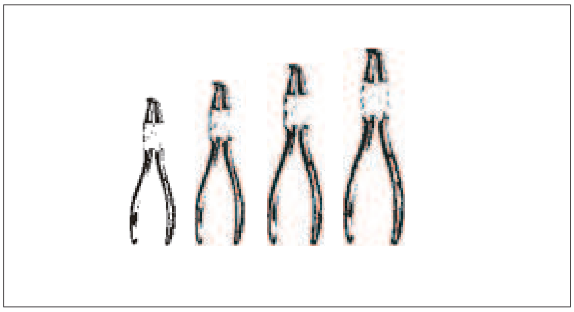
13) Set of internal pliers
I1-I2-I3-I4

5870 900 013

14WF8TM57

14) Set of internal pliers
I11-I21-I31-I41 90˚

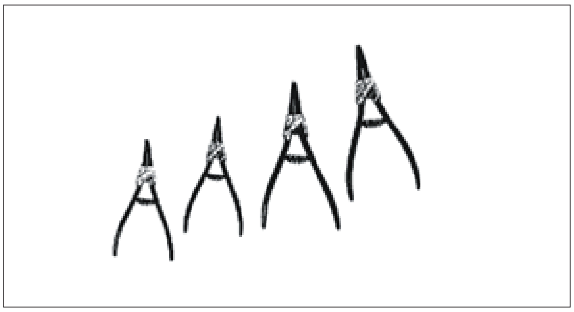
5870 900 014



14WF8TM58

15) Set of external pliers
A1-A2-A3-A4

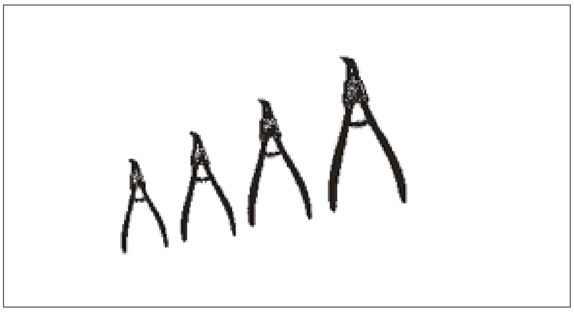
5870 900 015



14WF8TM59

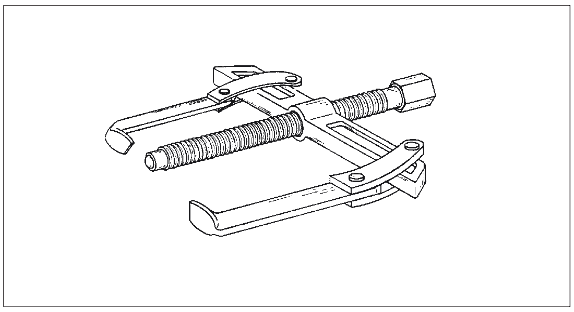
16) Set of external pliers
A01-A02-A03-A04 90˚

5870 900 016



14WF8TM60

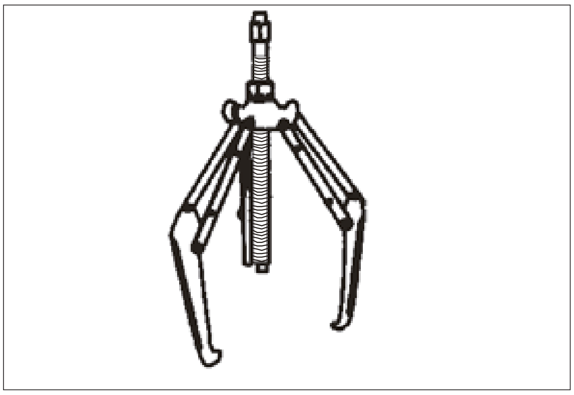
17) Two-armed puller



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

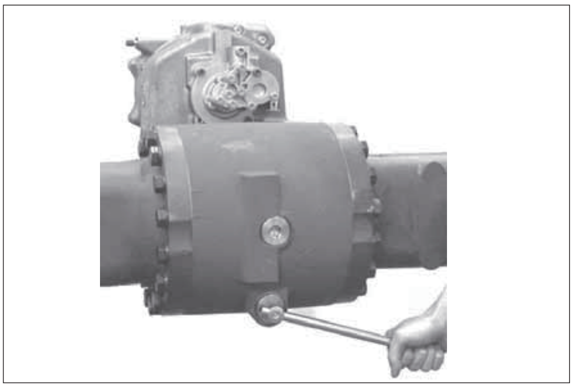
5. SEPARATE TRANSMISSION FROM AXLE HOUSING

(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

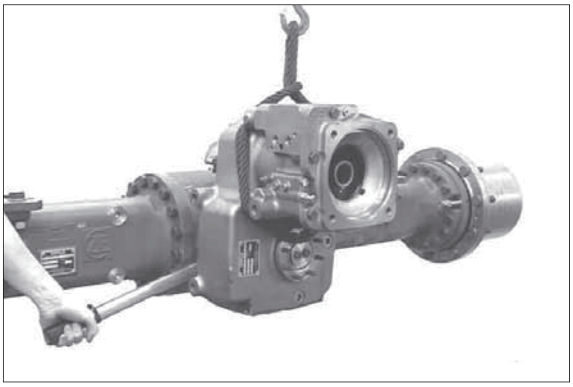
⚠ **Waste oil to be disposed of ecologically.**



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

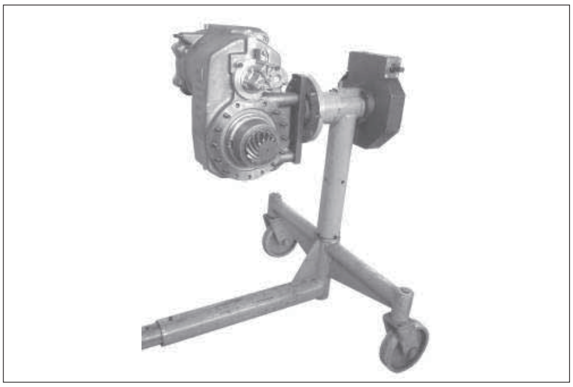


14WF8TM64

6. DISASSEMBLY – BRAKE / CLUTCH / PLANETARY CARRIER

1) Mount transmission to assembly truck.

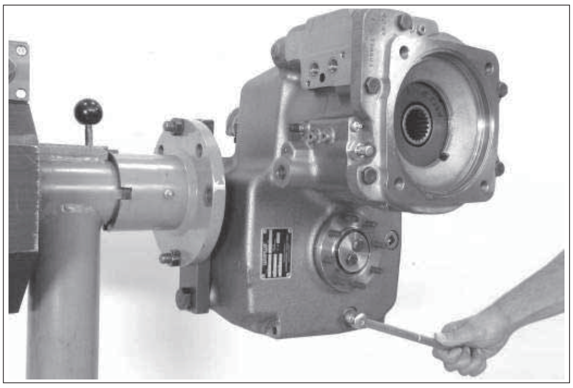
(S) Assembly truck assy. 5870 350 000
(S) Fixture 5870 350 079



14WF8TM65

2) Loosen screw plug and drain oil – use a suitable oil reservoir.

⚠ **Waste oil to be disposed of ecologically.**

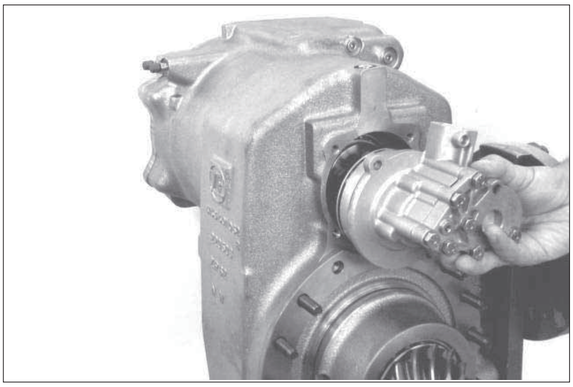


14WF8TM66

Lubrication pump

3) Remove lubrication pump or shift interlock (depending on version, Illustration shows version with Lubrication pump).

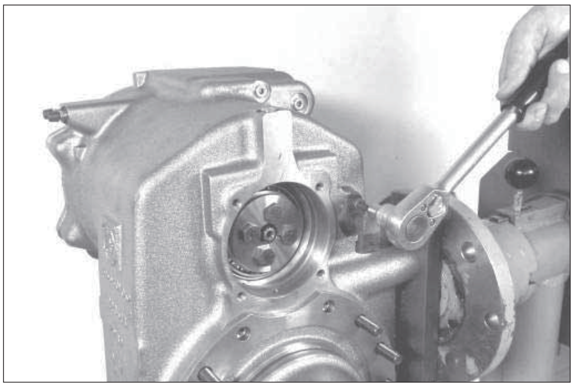
※ Complete disassembly of lubrication pump / shift interlock – see page 8-154-20.



14WF8TM67

Speed sensor

4) Loosen screw and pull off speed sensor.

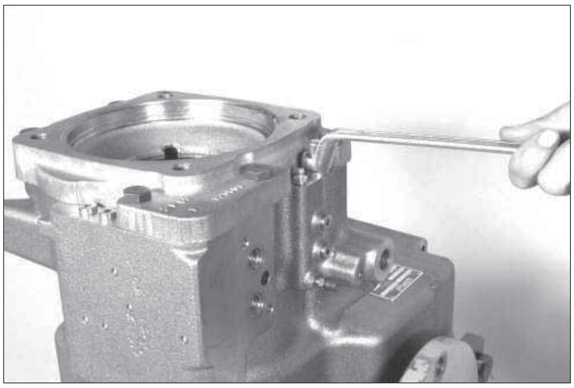


14WF8TM68

Emergency release (Parking brake)

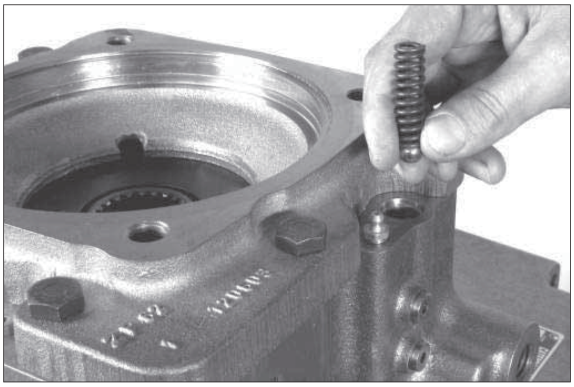
5) Remove breather.
(Illustration 14WF8TM69~14WF8TM72 shows version transmission installation position "Vertical")

※ Position of single connections or breather valves /lubrication nipples etc. as to version transmission installation position Horizontal - see 14WF8TM265.



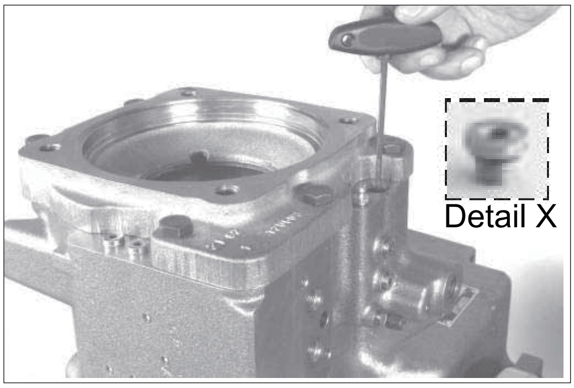
14WF8TM69

6) Remove compression spring and ball.



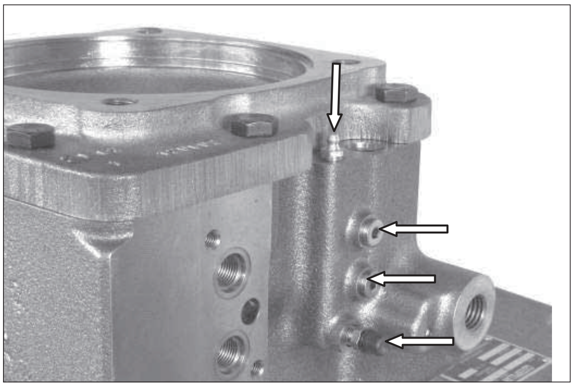
14WF8TM70

7) Remove threaded element (see Detail X) with O-ring from hole.



14WF8TM71

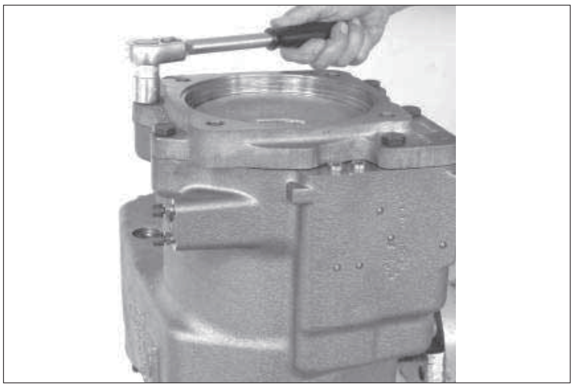
8) Remove lubrication nipple, both screw plugs and breather valve – see arrow.


14WF8TM72

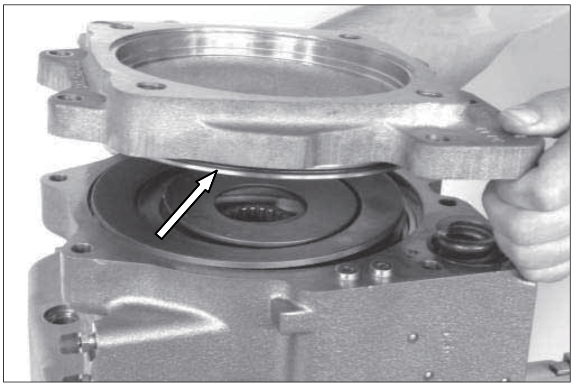
Input housing and modulation valve

9) Loosen threaded joint of input housing evenly.

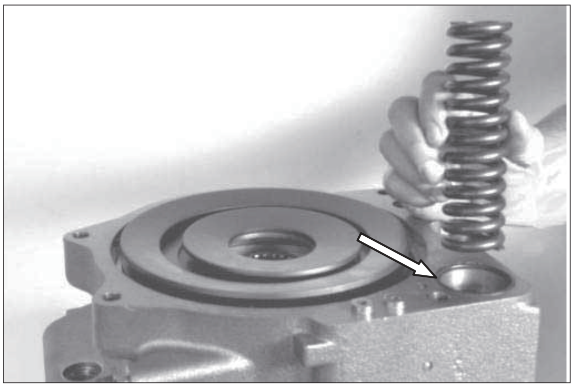
※ Input housing is subject to cup spring and compression spring preload.


14WF8TM73

10) Take off input housing and remove O-ring (arrow).


14WF8TM74

11) Remove compression spring and O-ring (arrow).

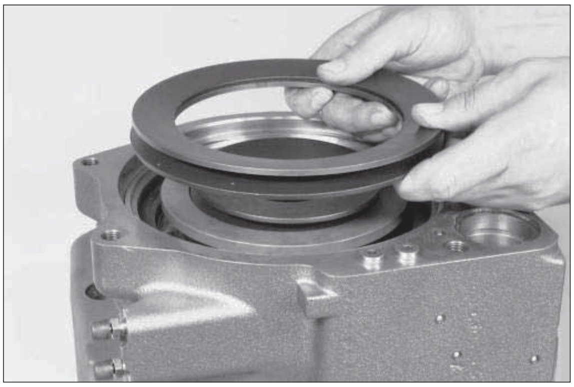

14WF8TM75

12) Pull complete piston out of hole.

14WF8TM76

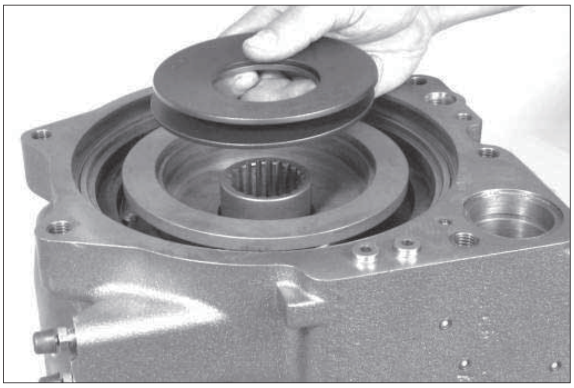
Brake and clutch

13) Remove cup springs from brake.



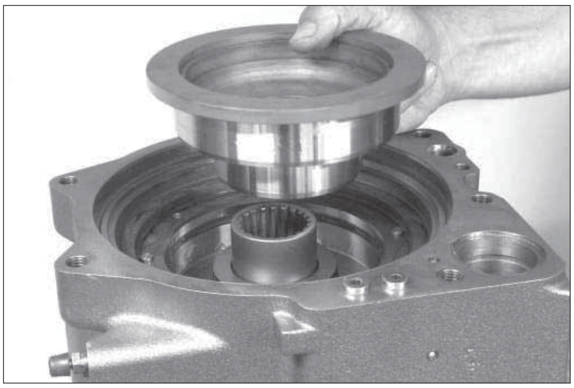
14WF8TM77

14) Remove cup springs from clutch.



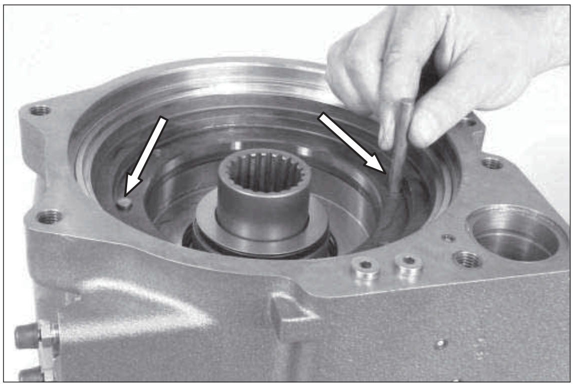
14WF8TM78

15) Remove piston.



14WF8TM79

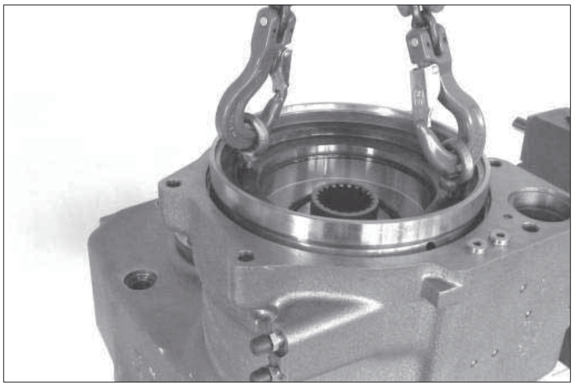
16) Pull off both cyl. pins (arrows).



14WF8TM80

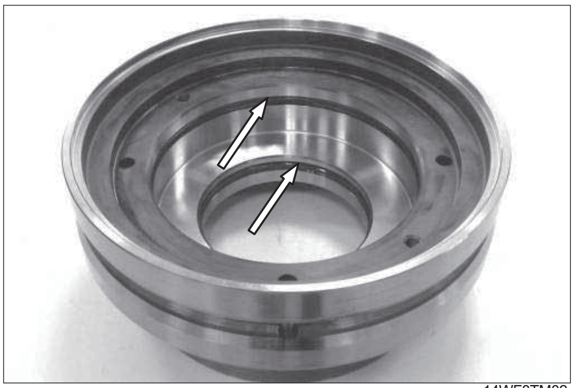
17) Attach 2 (two) eyebolts and pull piston cautiously out of housing – risk of damage.

(S) Eyebolt assortment 5870 204 002
(S) Lifting chain 5870 281 047



14WF8TM81

18) Remove both seals (arrows) from piston.

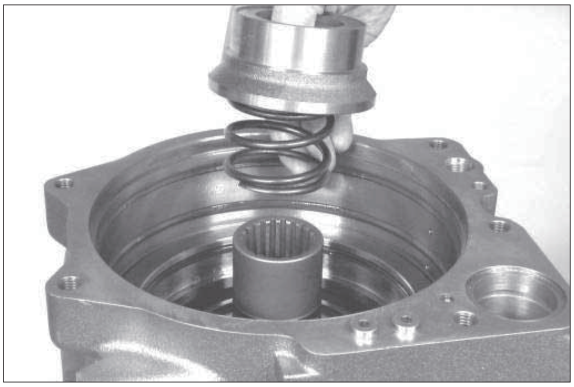


14WF8TM82

19) Remove axial roller cage with both thrust washers.

14WF8TM83

20) Remove pressure piece and compression spring.

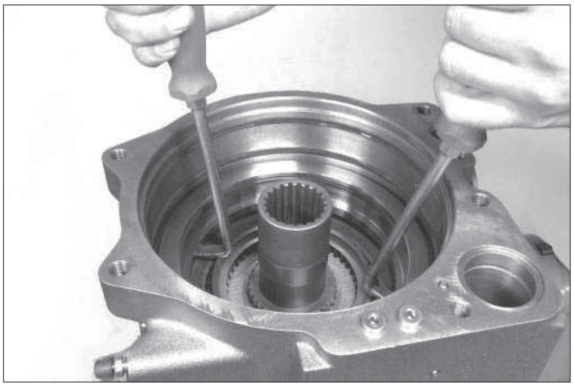


14WF8TM84

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.



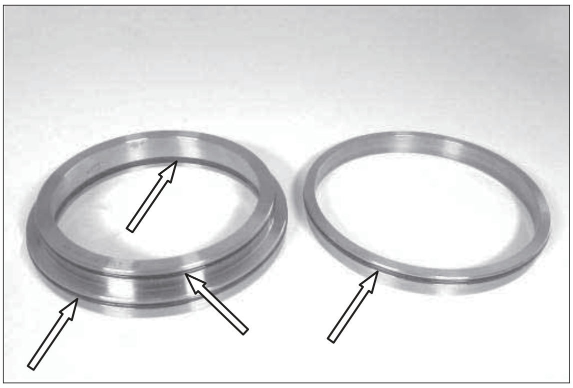
14WF8TM85

22) Remove pressure ring from ring cautiously with lever – risk of damaging sealing surfaces .

(S) Resetting device 5870 400 001

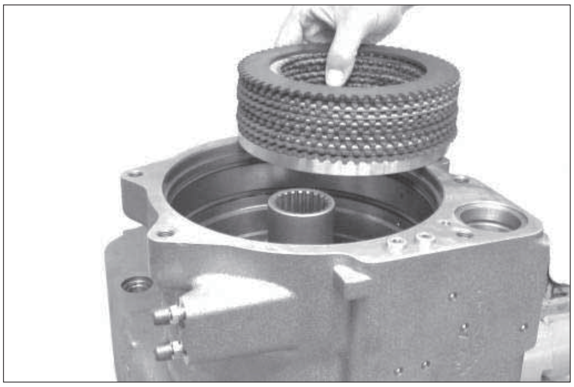
14WF8TM86

23) Remove seal and O-rings (see arrows) from pressure ring and ring.



14WF8TM87

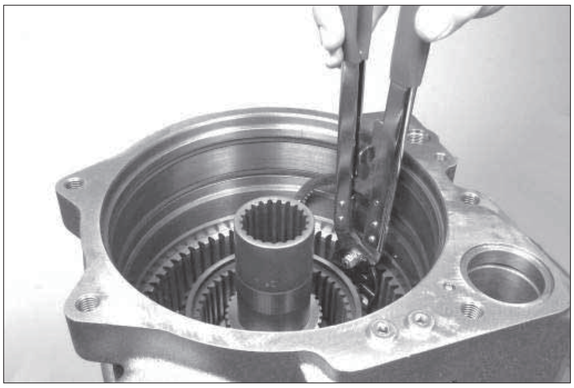
24) Take disk package of brake with end plate(s) out of housing.



14WF8TM88

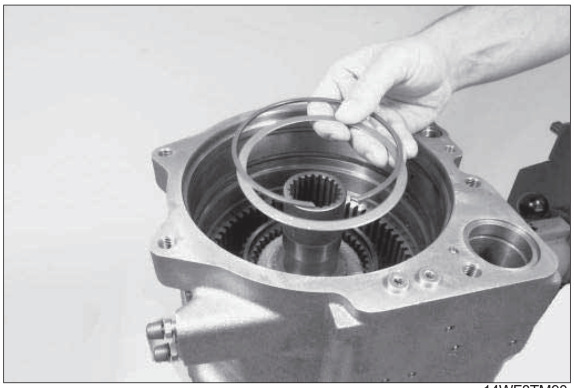
25) Disengage retaining ring.

(S) Clamping pliers 5870 900 021



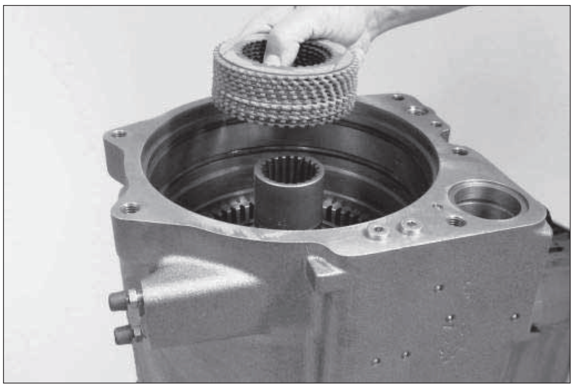
14WF8TM89

26) Remove snap ring and shim.



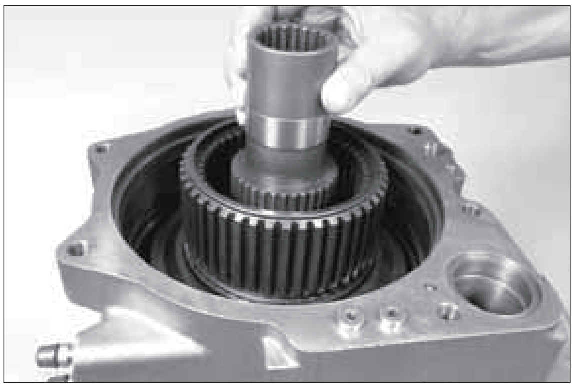
14WF8TM90

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.

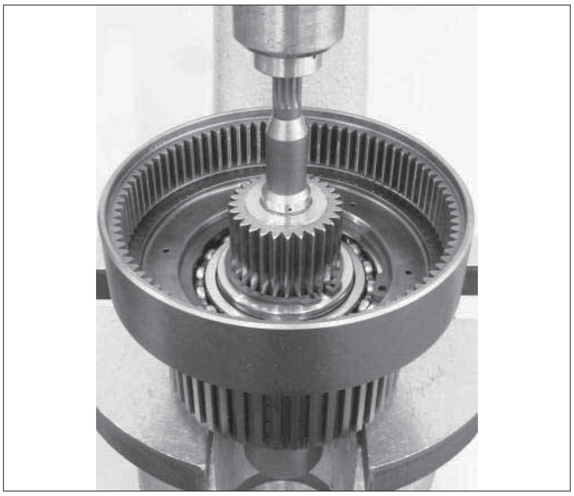


14WF8TM92

29) Unsnap retaining ring.

14WF8TM93

30) Press input shaft out of ball bearing/ring gear.



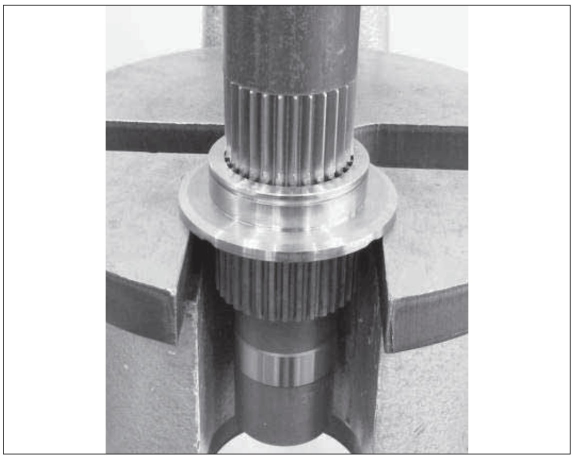
14WF8TM94

31) Unsnap retaining ring.

14WF8TM95

32) Press centering disk from input shaft.

※ In case of extreme press fit – heat centering disk.



14WF8TM96

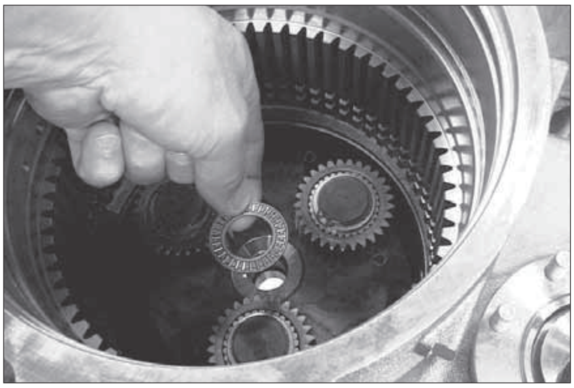
33) Unsnap retaining ring and remove ball bearing.

(S) Clamping pliers 5870 900 021

14WF8TM97

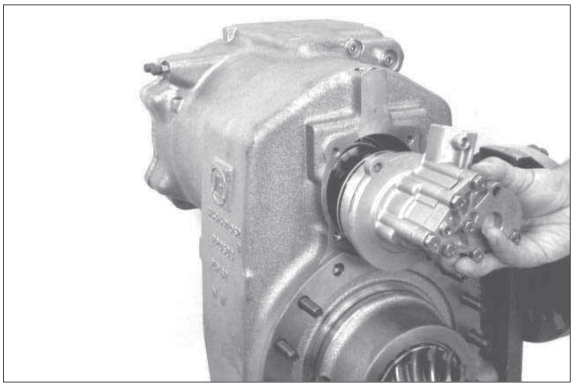
Planetary carrier

34) Remove axial needle cage.



14WF8TM98

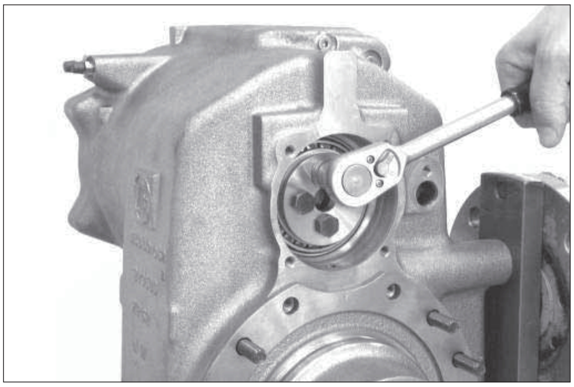
35) If not yet disassembled previously – remove lubrication pump or shift interlock (depending on version).
(Illustration shows version - Lubrication pump).



14WF8TM99

36) Loosen threaded joint and remove disk – fasten output flange by means of clamping fork.

(S) Clamping fork 5870 240 025

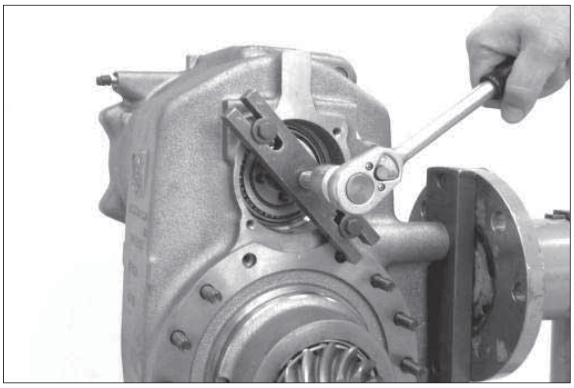


14WF8TM100

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

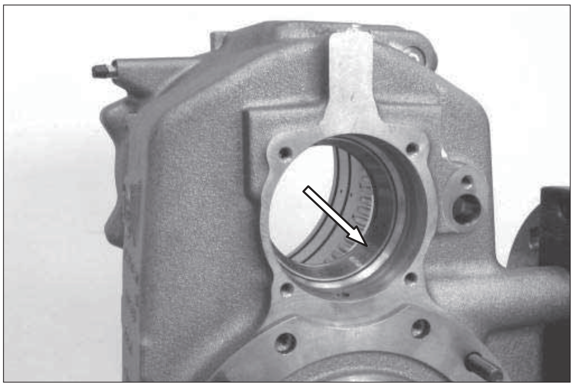
38) Pull second bearing inner ring from planetary carrier.

(S) Rapid grip 5873 012 021
(S) Basic tool 5873 002 001

14WF8TM102

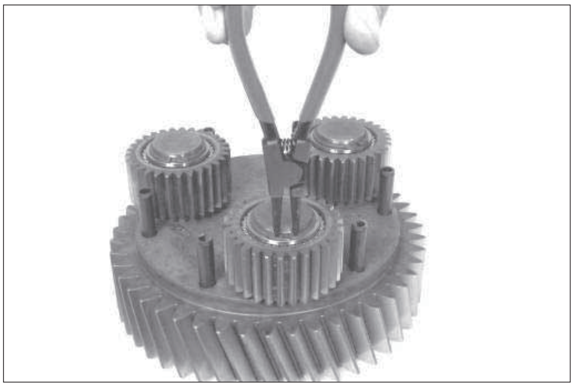
39) If required – force both bearing outer rings (arrow) out of bearing hole.

※ 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.

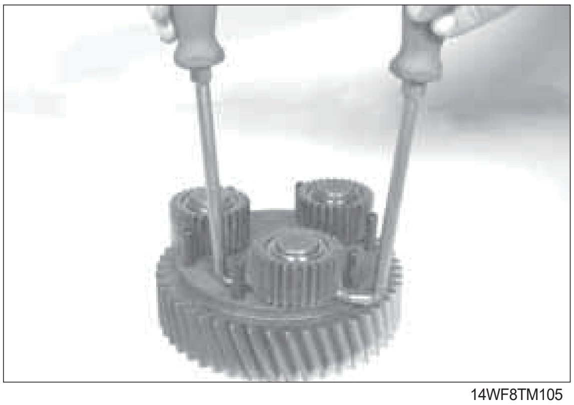


14WF8TM104

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).

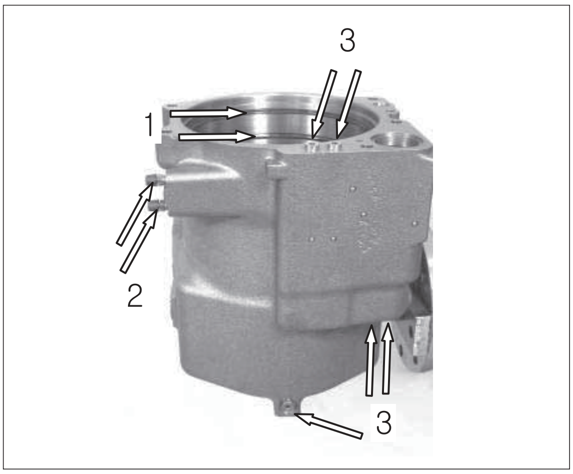


14WF8TM105

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".

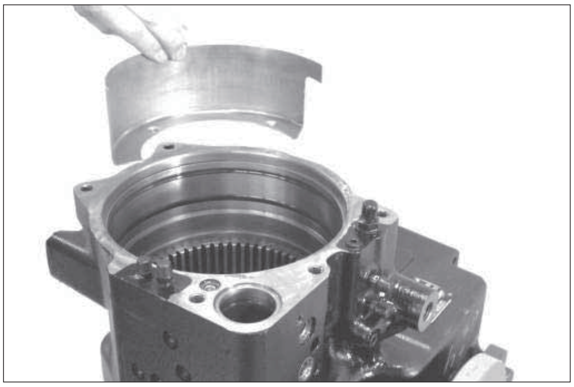


14WF8TM106

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 .



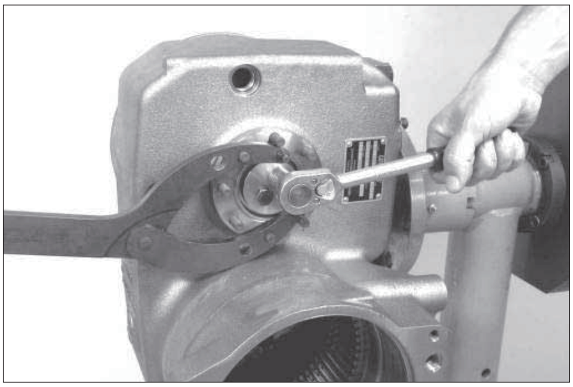
14WF8TM107

7. DISASSEMBLY - OUTPUT

Version "Axle attachment"

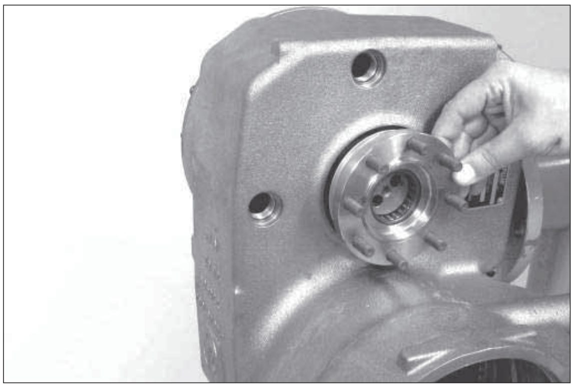
1) Loosen threaded joint, remove cover and O-ring.

※ (S) Clamping fork 5870 240 025



14WF8TM108

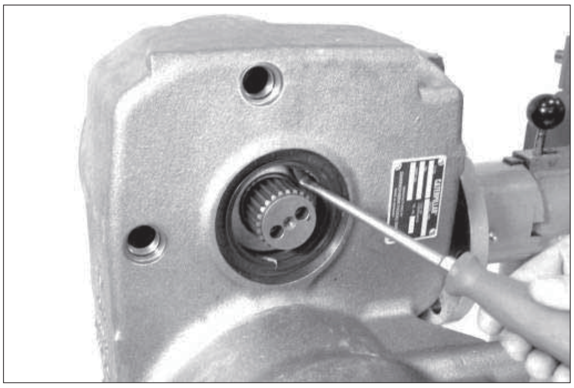
2) Pull off flange.



14WF8TM109

3) Remove shaft seal with a lever.

※ (S) Resetting device 5870 400 001

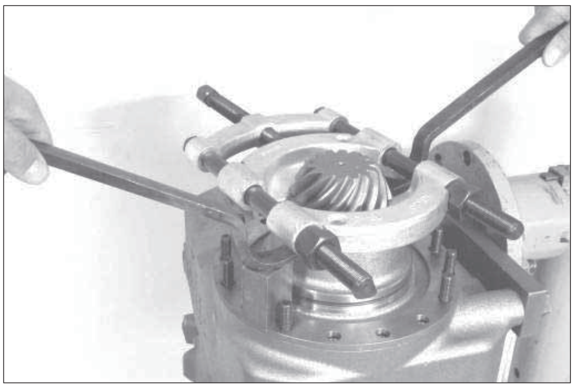


14WF8TM110

4) Fix pinion with fixture and press off.

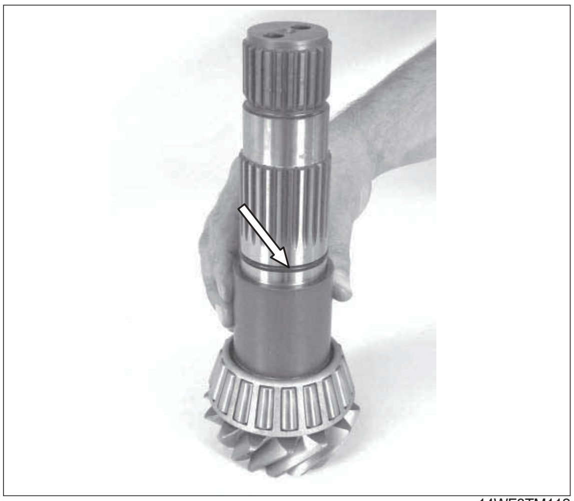
(S) Cut-off device 5870 300 028
(S) Assembly lever 5870 345 036
(S) Solenoid block 5870 450 003

※ Pay attention to releasing bearing inner ring and adjusting ring (rolling torque/pinion bearing) behind.



14WF8TM111

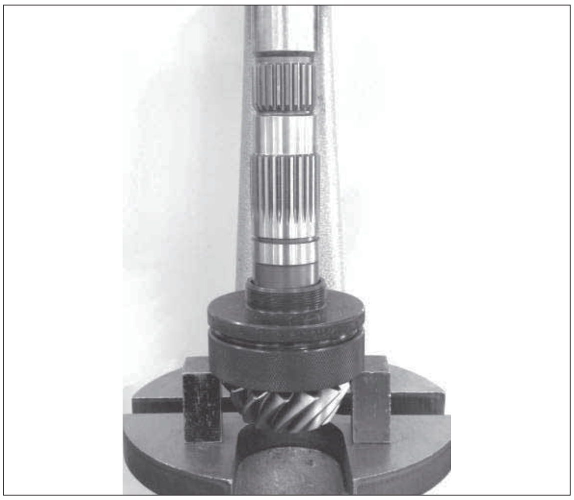
5) Remove O-ring (see arrow) and bush from pinion.



14WF8TM112

6) Press-off bearing inner ring from pinion shaft.

(S) Grab sleeve 5873 001 037
(S) Solenoid block 5870 450 003

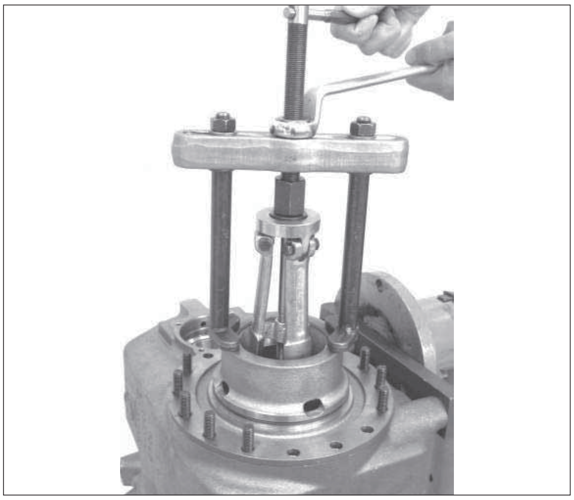


14WF8TM113

7) Pull bearing outer ring out of bearing cover.

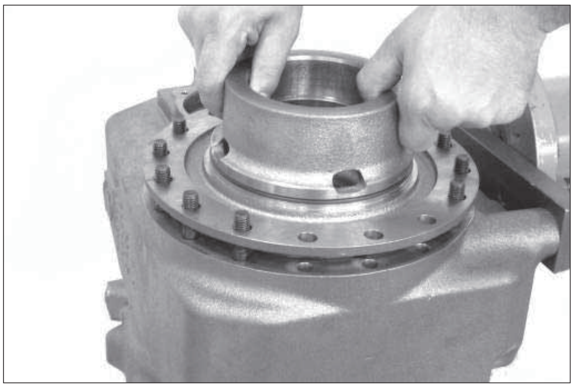
(S) Inner extractor 5870 300 019
(S) Counter support 5870 300 020

※ Pay attention to shim behind (pinion gap setting).



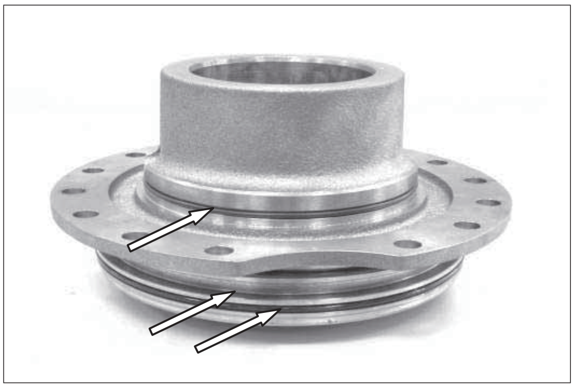
14WF8TM114

8) Pull off bearing cover.



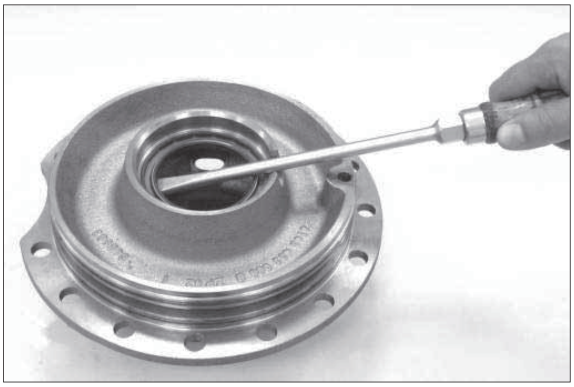
14WF8TM115

9) Remove O-rings (arrows).



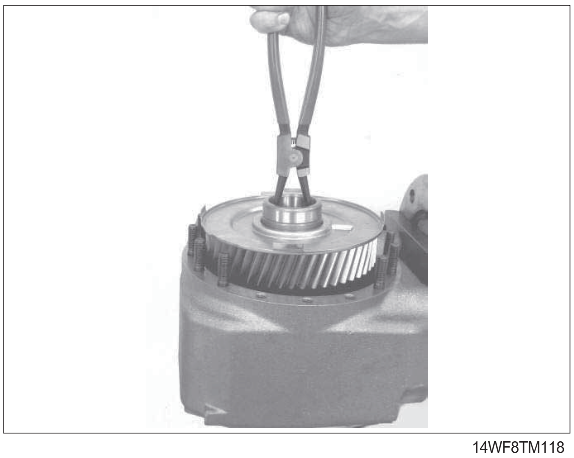
14WF8TM116

10) Remove shaft seal.



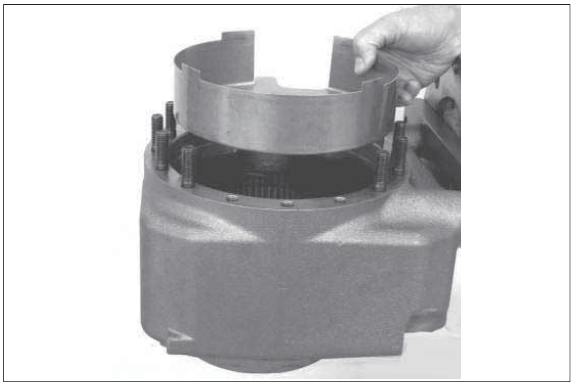
14WF8TM117

11) Lift output gear with oil screen sheet out of housing. Remove oil screen sheet from output gear.



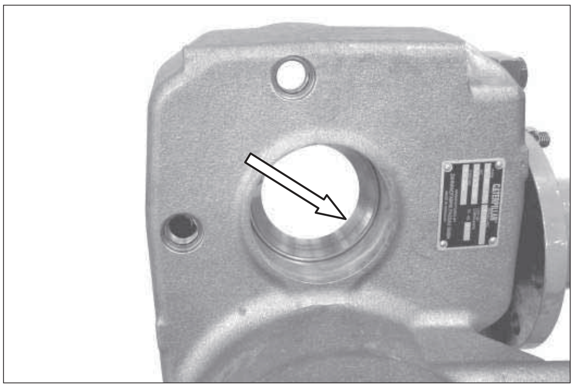
14WF8TM118

12) Remove screen sheet.



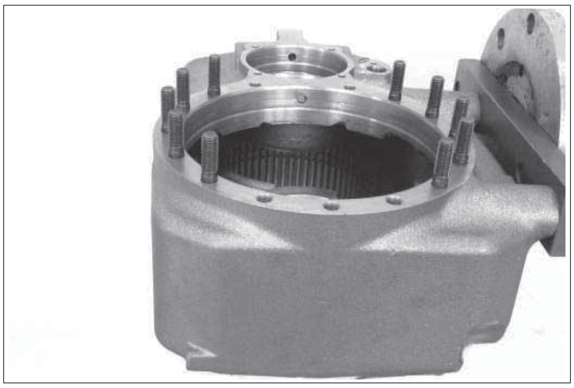
14WF8TM119

13) Disassemble bearing outer ring from housing hole (see arrow).



14WF8TM120

14) If necessary, remove stud bolts.



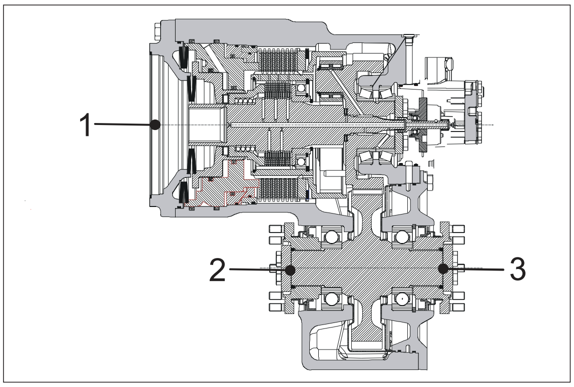
14WF8TM121

Version "Separate installation"

15) 1 = Input

2 = Output – front axle

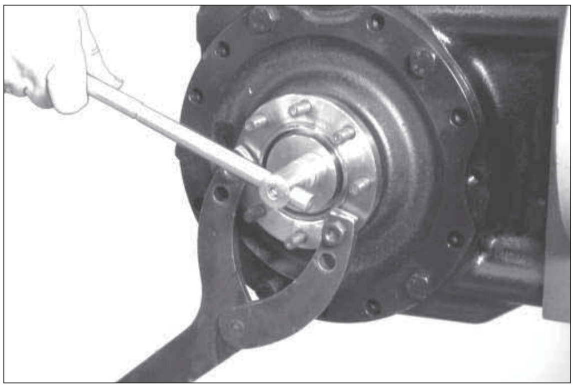
3 = Output – rear axle



14WF8TM122

16) Use clamping fork to fix output flange. Loosen threaded joint, pull off disk, O-ring and flange.

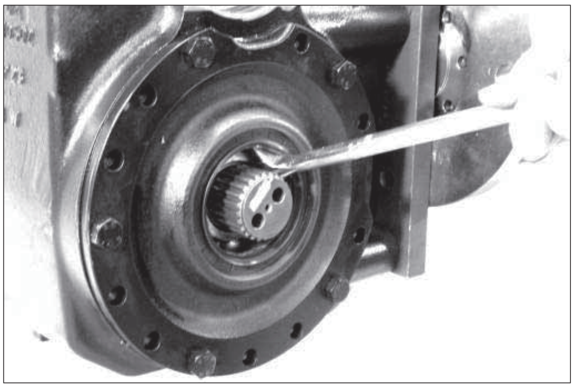
(S) Clamping fork 5870 240 025



14WF8TM123

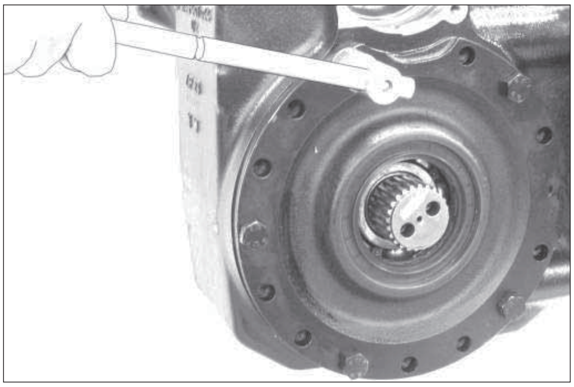
17) Remove shaft seal with a lever.

※ Disassemble second output flange and shaft seal analogously.



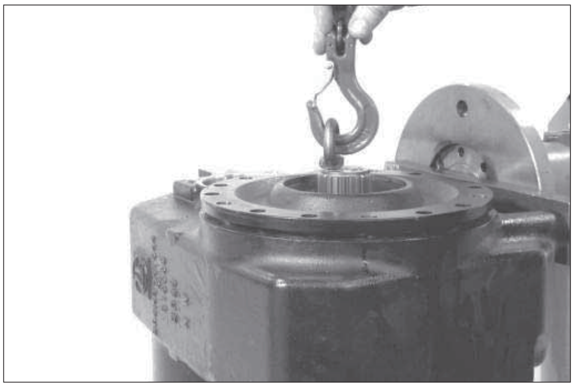
14WF8TM124

18) Loosen threaded joint.



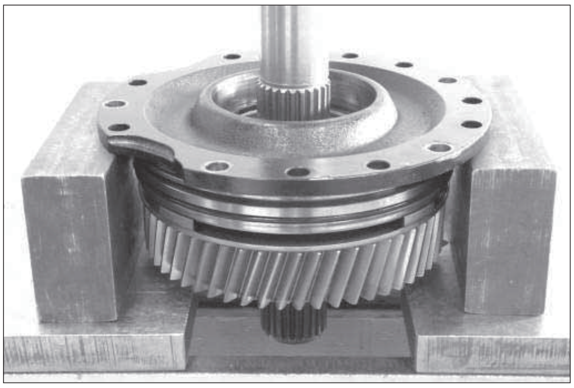
14WF8TM125

19) Use lifting tackle to separate output gear with cover from transmission housing.



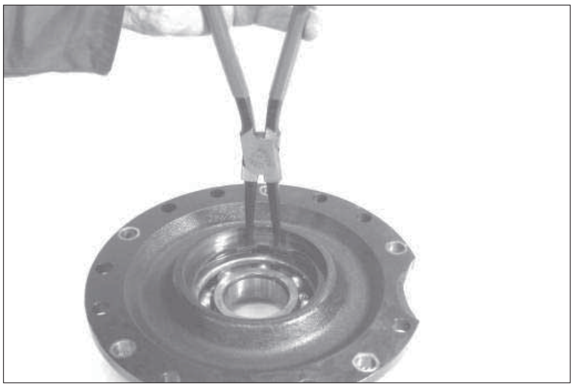
14WF8TM126

20) Press output gear out of ball bearing/cover – remove releasing oil screen sheet.



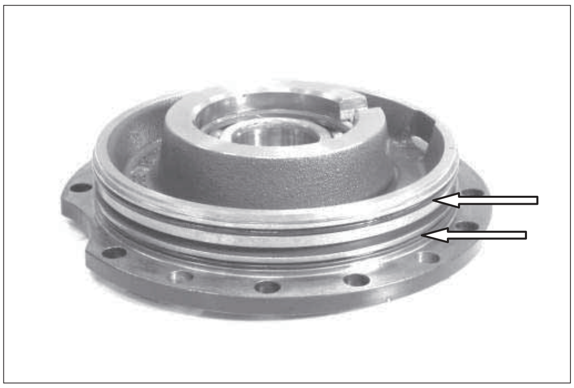
14WF8TM127

21) Unsnap retaining ring and disassemble ball bearing from cover.



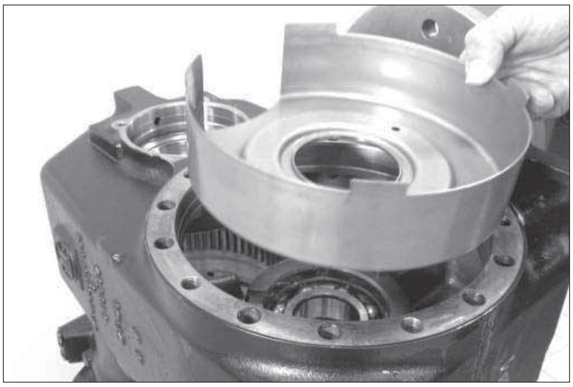
14WF8TM128

22) Remove O-rings (see arrows) from cover.



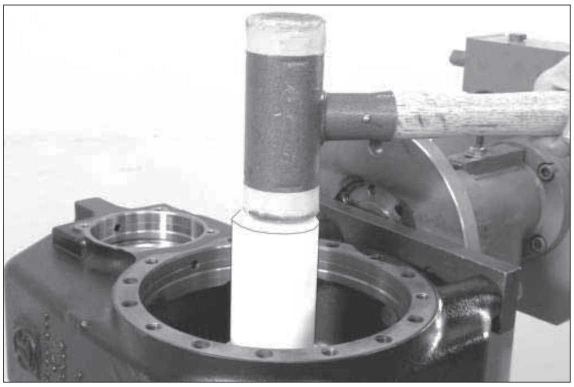
14WF8TM129

23) Remove screen sheet from transmission housing.



14WF8TM130

24) Disassemble ball bearing from housing hole.

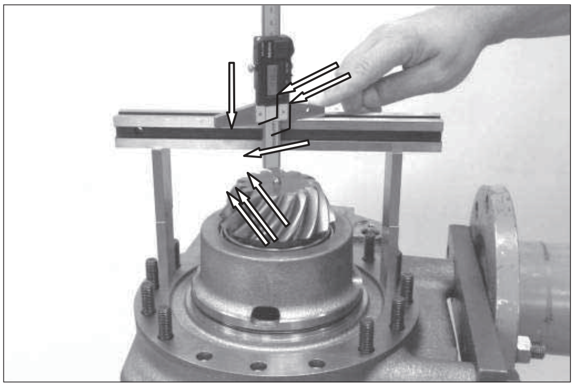


14WF8TM131

8. REASSEMBLY - OUTPUT

1) Seal finished holes (8x) of oil supply holes with screw plugs.

   (S) Lever riveting tongs 5870 320 016



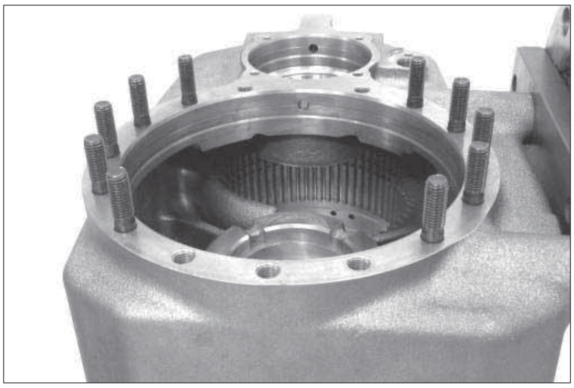
14WF8TM132

Version "Axle attachment"

2) Install stud bolts.

   Tightening torque M_A = 27 Nm

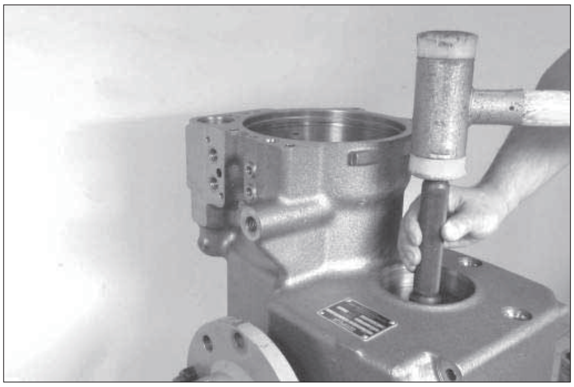
※ Pay attention to installation position.



14WF8TM133

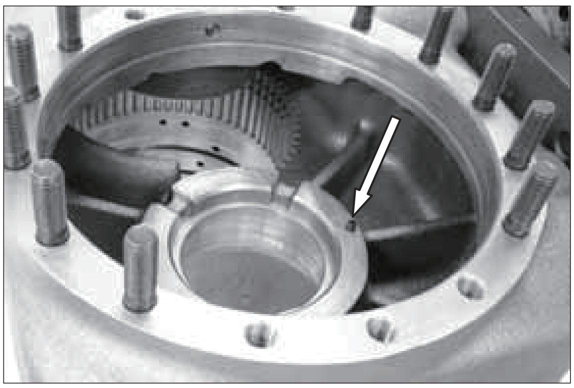
3) Install bearing outer ring until contact.

   (S) Driver tool 5870 058 073
   (S) Handle 5870 260 002



14WF8TM134

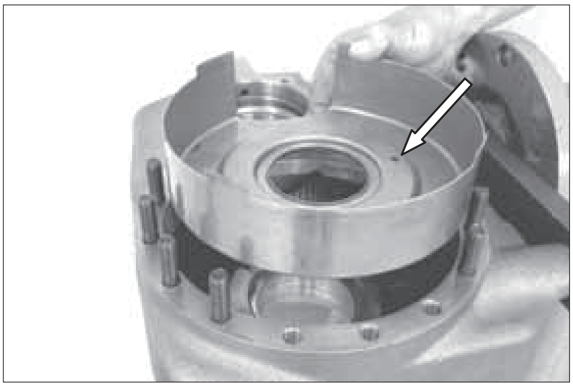
4) Insert slotted pin (see arrow) to the bottom.



14WF8TM135

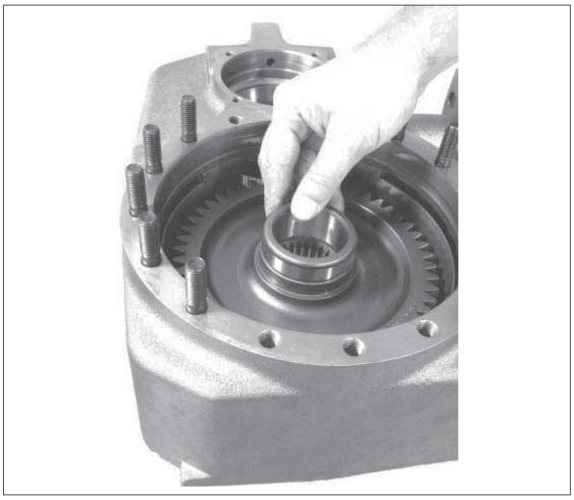
5) Position screen sheet – with slotted pin (see 14WF8TM135) into fixing hole (arrow).

※ Pay attention to installation position, slotted pin = radial fixing of screen sheet.



14WF8TM136

6) Insert output gear with the short collar showing downwards.



14WF8TM137

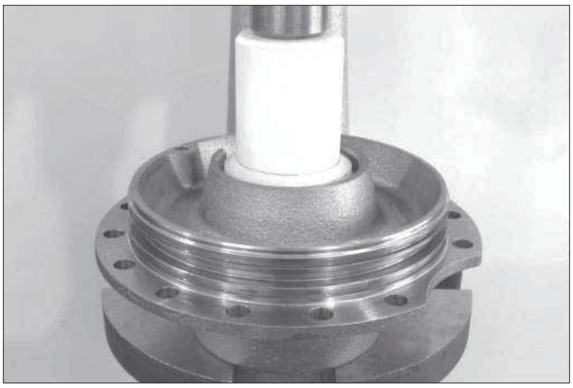
7) Press shaft seal into bearing cover.

(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).

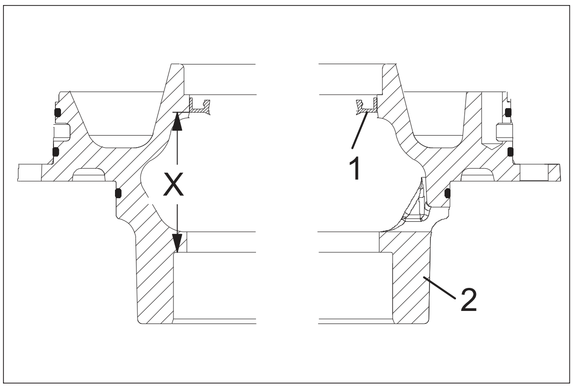
※ Use of specified driver ensures exact installation position of shaft seal.



14WF8TM138

8) 1 = Shaft seal
2 = Bearing cover

X = Installation dimension



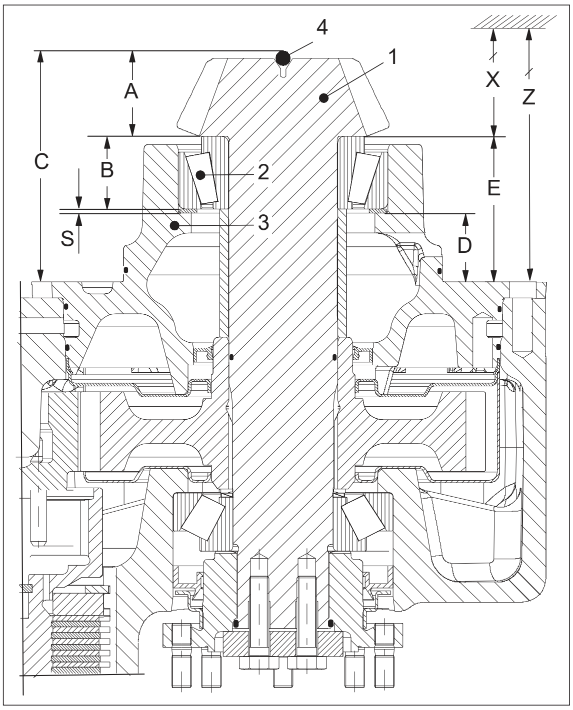
14WF8TM139

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

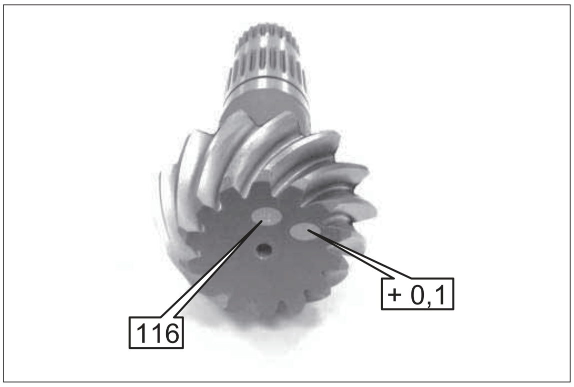
※ Auxiliary dimension A is obligatory to determine reference dimension C – on installed pinion (Fig. 14WF8TM168).

(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

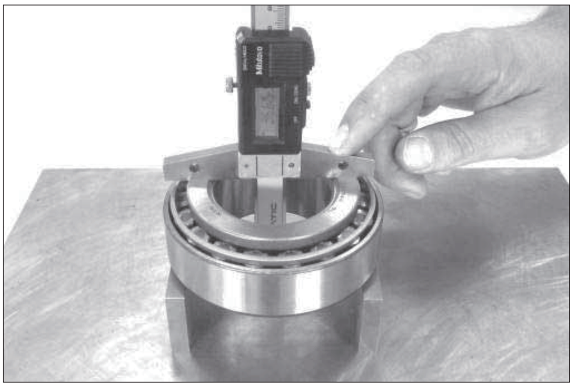


14WF8TM142

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.

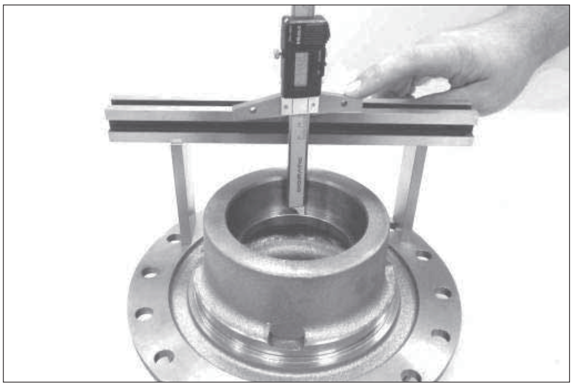
Dim. B = e.g. 36.65 mm - 0.1 mm → 36.55 mm


14WF8TM143

13) Determine dim. D (contact surface/bearing cover to contact/bearing hole).

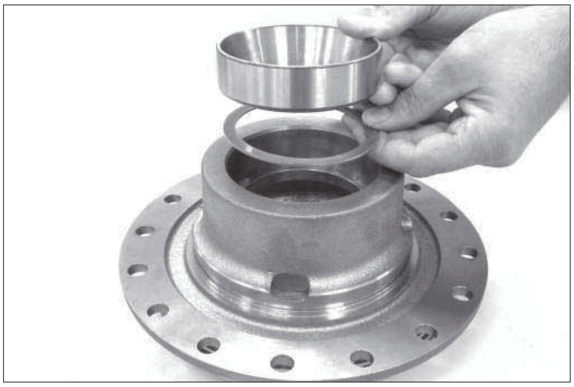
Dim. D = e.g. 35.10 mm

(S) Straightedge (2 sets) 5870 200 066

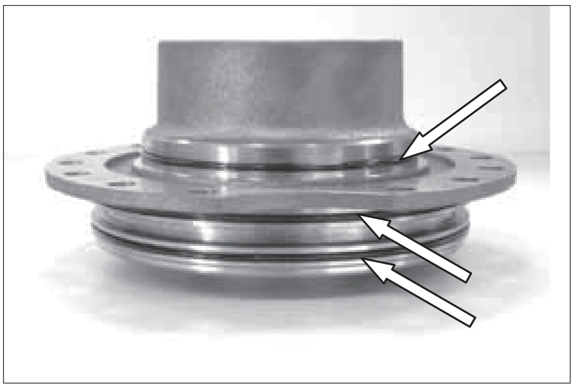

14WF8TM144

14) Insert determined shim(s) S = e.g. 1.35 mm and install bearing outer ring until contact.

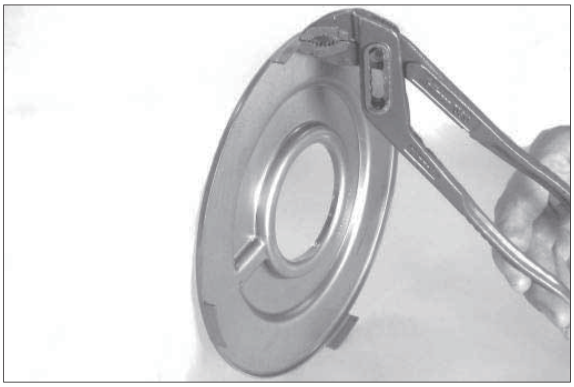
(S) Driver tool	5870 058 078
(S) Handle	5870 260 002


14WF8TM145

15) Oil O-rings (arrows) and insert them into annular grooves of bearing cover.


14WF8TM146

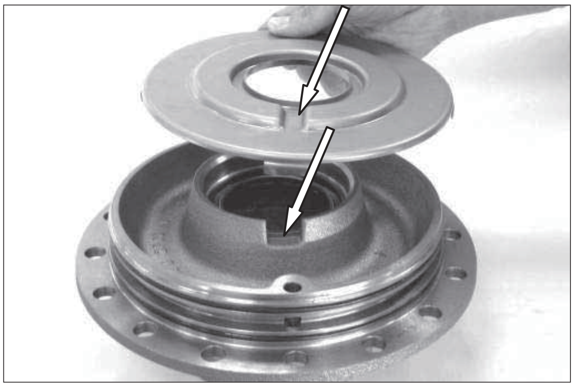
16) Bend edges of fixing straps of oil screen sheet slightly – assembly aid (sheet is fixed to bearing cover – see 14WF8TM148).



14WF8TM147

17) Mount oil screen sheet on bearing cover.

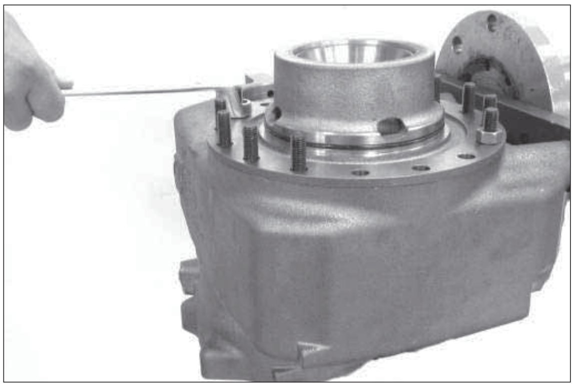
※ Pay attention to installation position – place locating tab of oil screen sheet into recess of bearing cover (see arrow).



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).



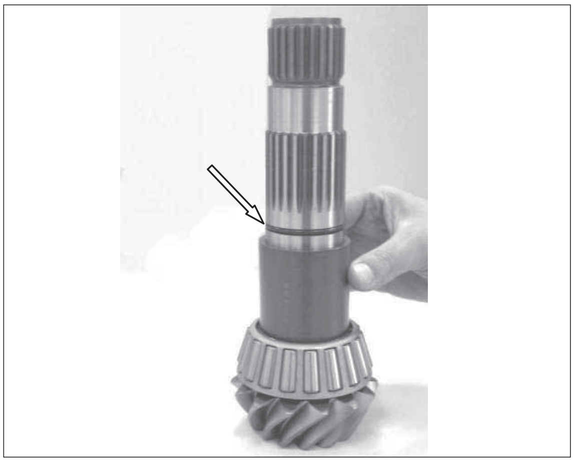
14WF8TM149

19) Install heated bearing inner ring until contact.

※ Adjust bearing inner ring after cooing down.

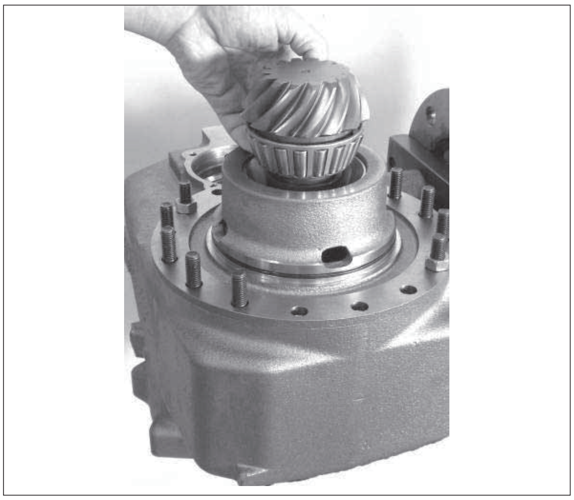
14WF8TM150

20) Mount bush, oil O-ring (arrow) and put it into annular groove.



14WF8TM151

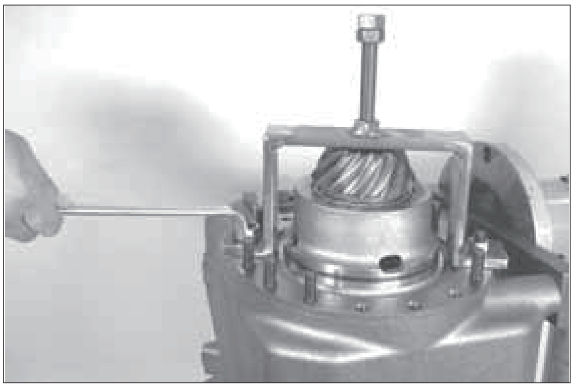
21) Mount preassembled pinion.



14WF8TM152

22) Fix pinion with clamping bar.

(S) Clamping bar 5870 654 049



14WF8TM153

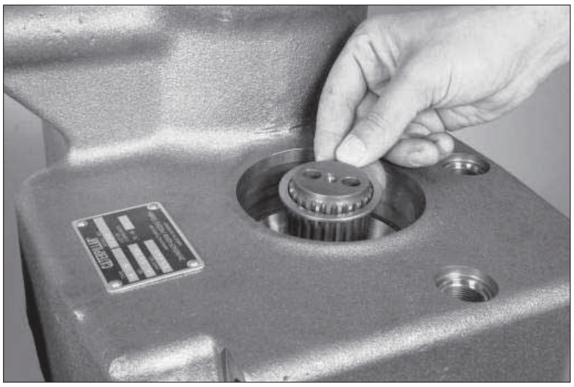
Determine adjusting ring for rolling torque/pinion bearing :

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.



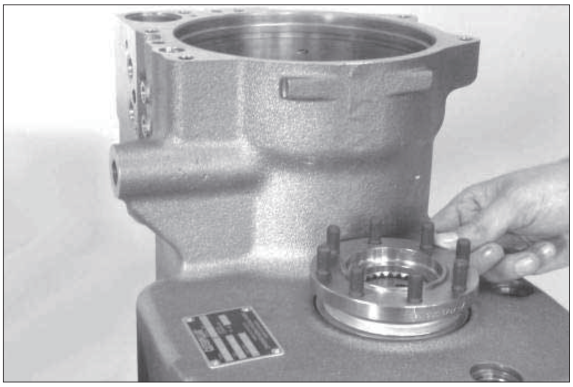
14WF8TM154

24) Insert heated bearing inner ring until contact.

※ Adjust bearing inner ring after cooling down.

14WF8TM155

25) Mount flange.

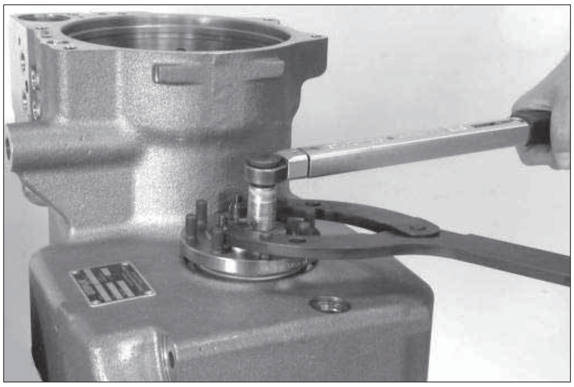


14WF8TM156

26) Place shim and fix flange with hexagon screws.

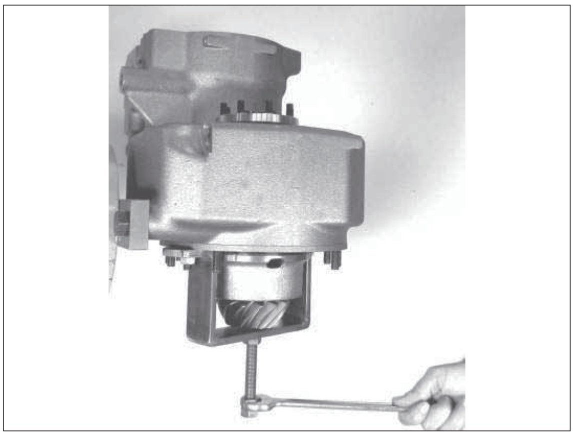
Tightening torque (M 10/10.9) M_A = 68 Nm
(S) Clamping fork 5870 240 025

※ 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

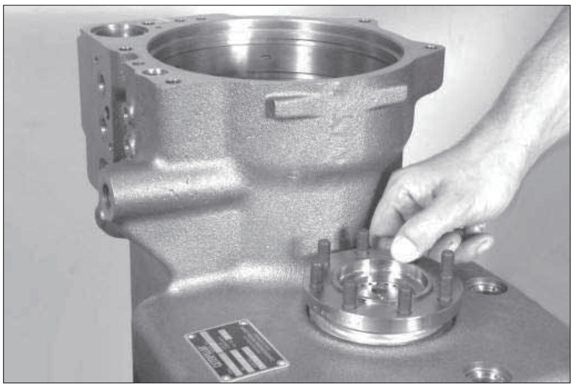
※ When using new roller bearings /for mounted shaft seal, try to achieve the upper value.

※ 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

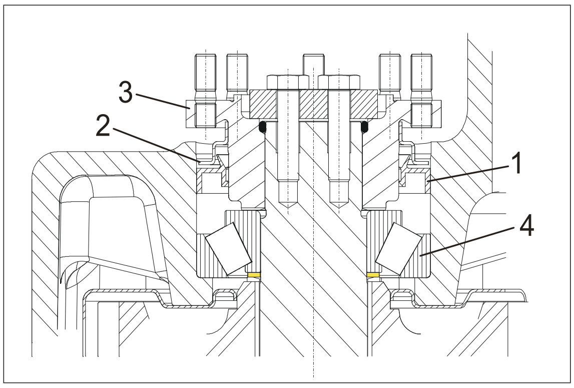
※ For reassembly wet shaft seal on outer diameter with spirit.

※ 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

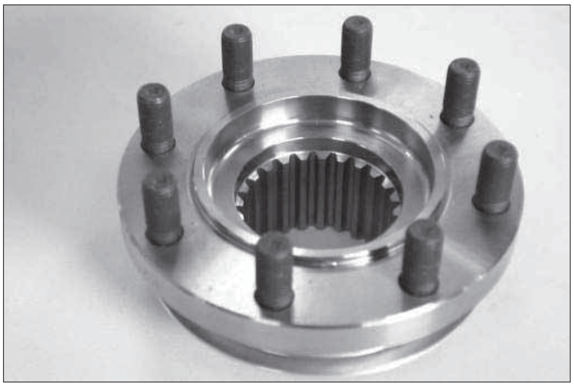


14WF8TM162

32) Install stud bolts.

Tightening torque (M10×1) M_A = 20 Nm

※ Pay attention to installation position.
Install stud bolts with short thread length into flange.

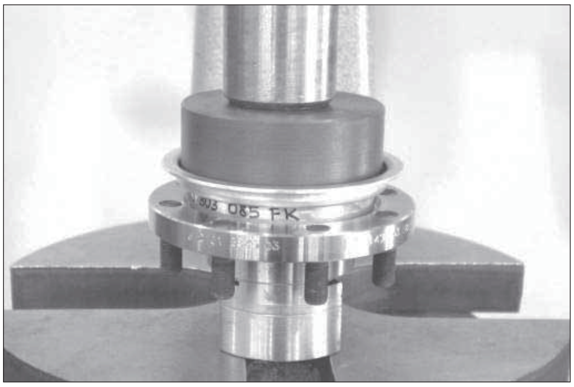


14WF8TM163

33) Install screen sheet (see 14WF8TM162).

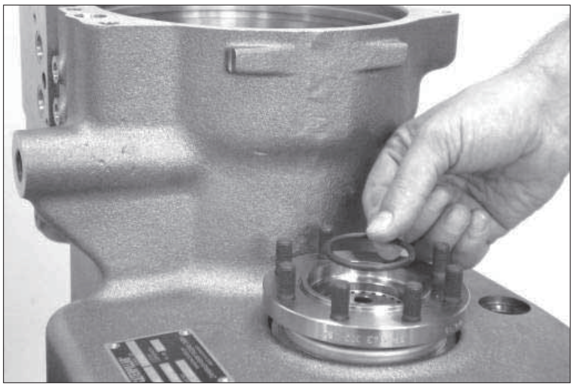
(S) Pressure piece 5870 506 150

※ Use of specified driver tool ensures exact installation position of screen sheet.



14WF8TM164

34) Mount preassembled flange and put O-ring into recess.

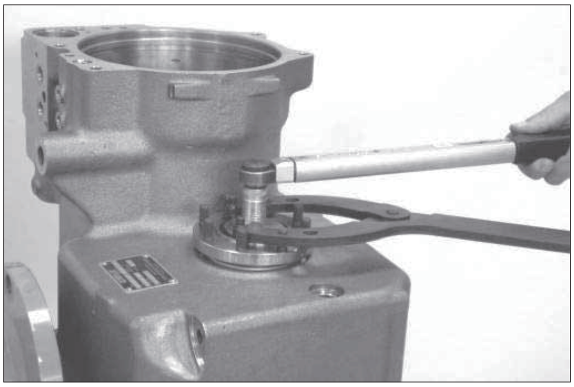


14WF8TM165

35) Place disk and fix it with hexagon screws.

Tightening torque (M 10/10.9) M_A = 68 Nm

(S) Clamping fork 5870 240 025



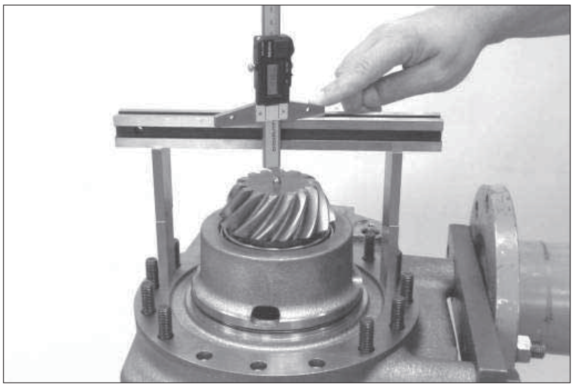
14WF8TM166

Check pinion gap

36) Position ball [use Ø = 7 mm → ball Ø like for determination of auxiliary dimension A into centering hole of the pinion and determine dim. C (see 14WF8TM140), from contact surface/bearing cover to ball.

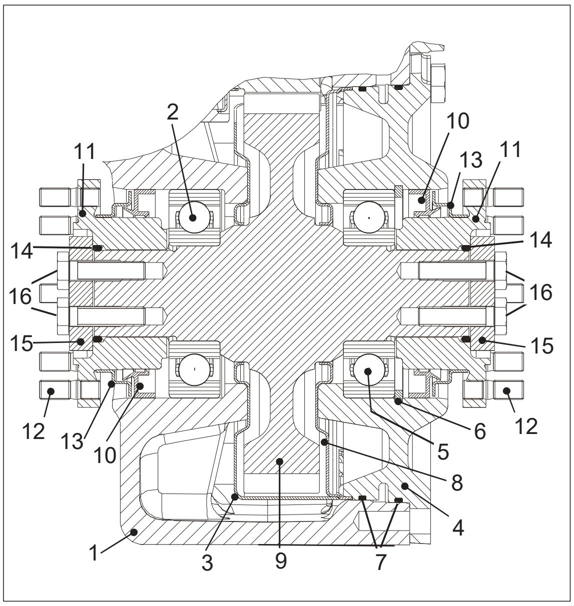
(S) Straightedge 5870 200 108

⚠ **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

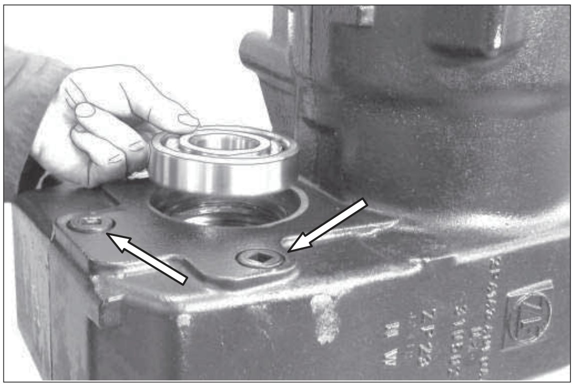


14WF8TM168

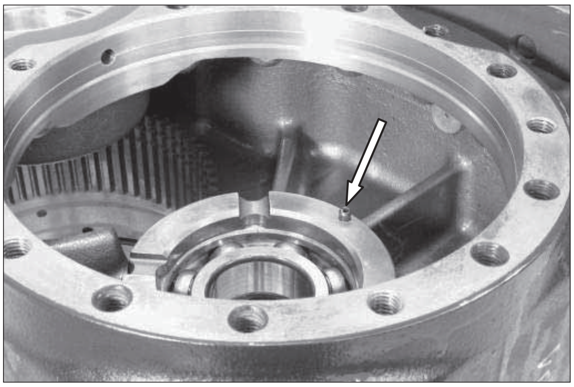
38) Provide screw plugs (see arrows) with new O-ring and install it.

Tightening torque MA = 80 Nm

※ Then insert ball bearing (2) until contact.

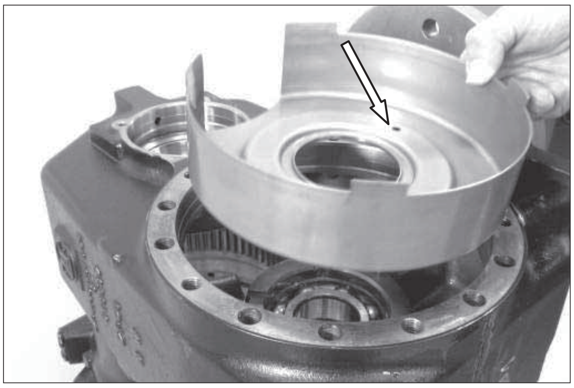

14WF8TM169

39) Rotate transmission by 180˚.
Insert slotted pin (see arrow) to the bottom.


14WF8TM170

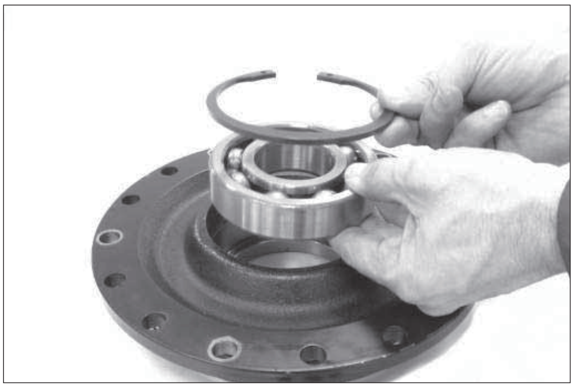
40) Position screen sheet – with slotted pin into fixing hole (arrow).

※ Observe installation position –slotted pin = radial fixing of screen sheet.



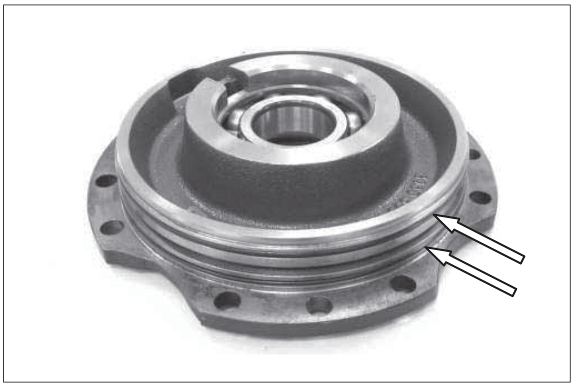
14WF8TM171

41) Insert ball bearing into cover and fix with retaining ring.



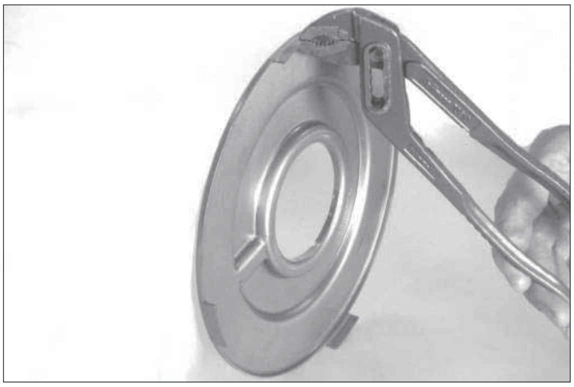
14WF8TM172

42) Oil both O-rings (arrows) and insert them into annular grooves of planetary carrier.



14WF8TM173

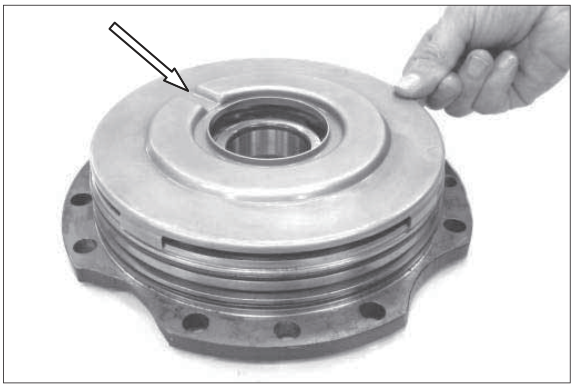
43) Bend edges of fixing straps of oil screen sheet slightly. Assembly aid screen sheet is fixed to bearing cover – see 14WF8TM176).



14WF8TM174

44) Insert oil screen sheet onto bearing cover

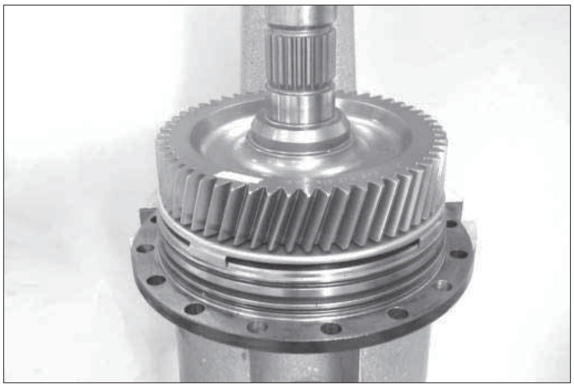
※ Observe installation position - place locating tab (see arrow) into recess of bearing cover (radial fixing).



14WF8TM175

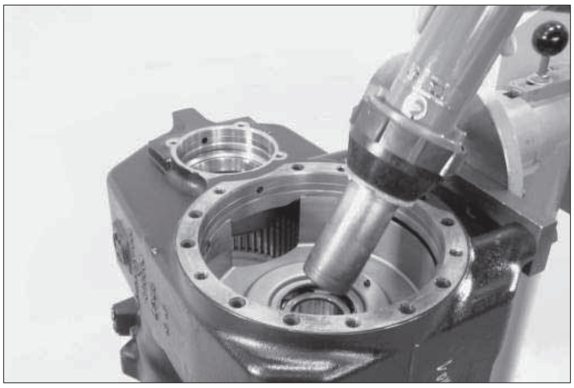
45) Press output gear into ball bearing/bearing cover.

※ Support ball bearing onto bearing inner ring.



14WF8TM176

46) Heat bearing inner ring of ball bearing.

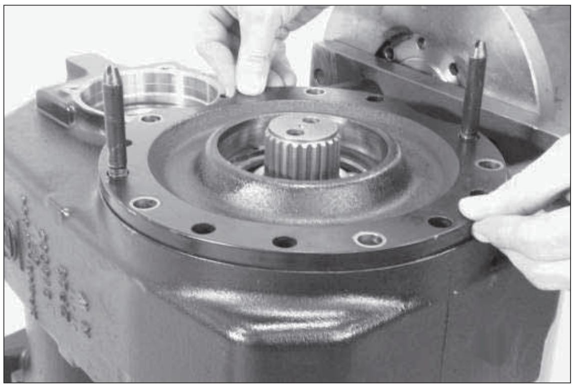


14WF8TM177

47) Attach two adjusting screws and mount preassembled bearing cover/output gear until contact.

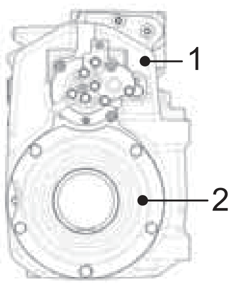
(S) Adjusting screws (M12) 5870 204 021

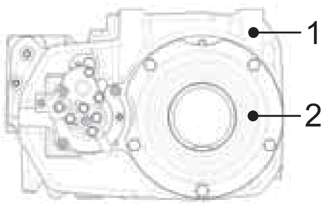
※ Observe installation position of bearing cover (2) in transmission (1) – transmission installation VERTICAL or HORIZONTAL - see detailed sketches below:



14WF8TM178

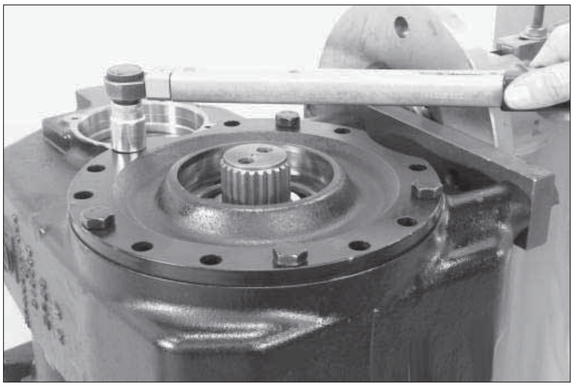
<VERTICAL> <HORIZONTAL>





48) Fix bearing cover by means of hexagon screws.

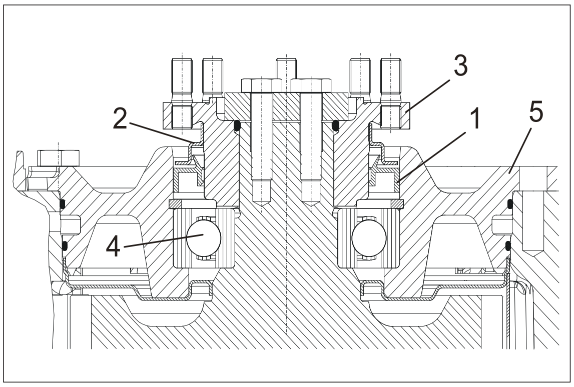
Tightening torque (M 12/8.8)   MA = 80 Nm



14WF8TM181

Shaft seal output flange

49) 1 = Shaft seal
2 = Metal sheet
3 = Output flange
4 = Ball bearing
5 = Bearing cover

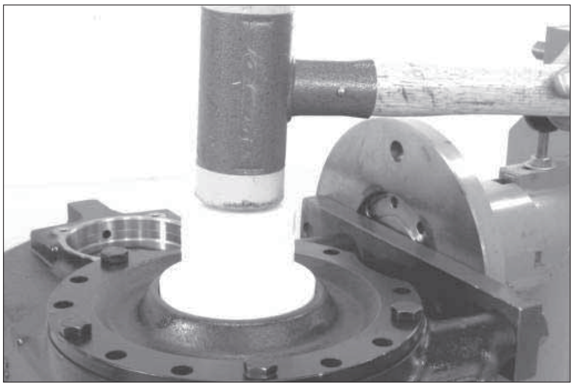


14WF8TM182

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.

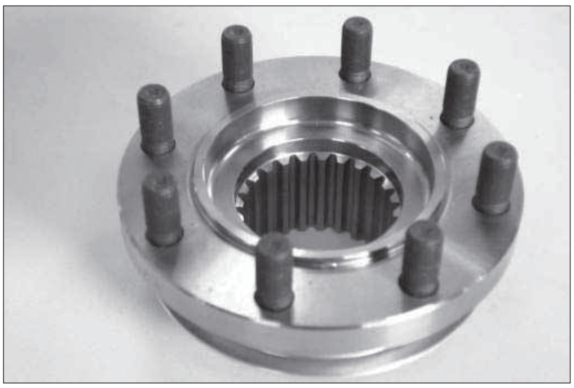


14WF8TM183

51) Install stud bolts.

Tightening torque (M10×1)   MA = 20 Nm

※ Pay attention to installation position.
Install stud bolts with short thread length into flange.

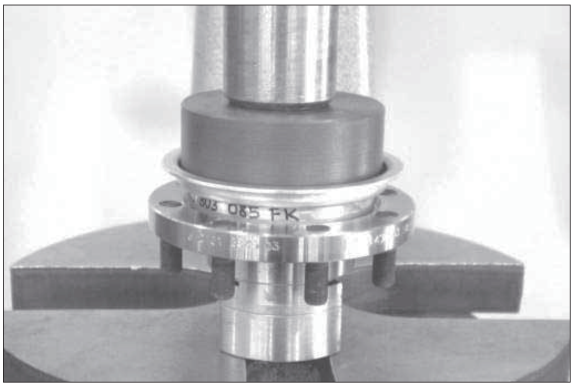


14WF8TM184

52) Install screen sheet (see 14WF8TM183).

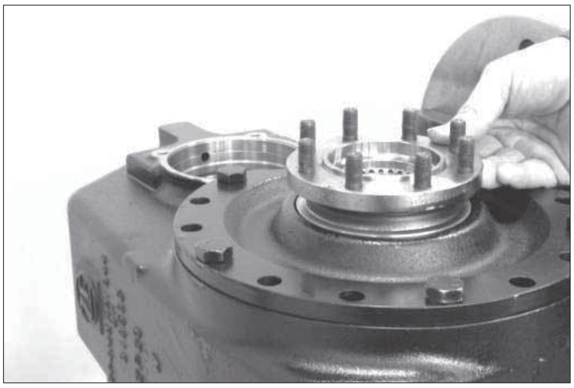
(S) Pressure piece 5870 506 150

※ Use of specified driver tool ensures exact installation position of screen sheet.



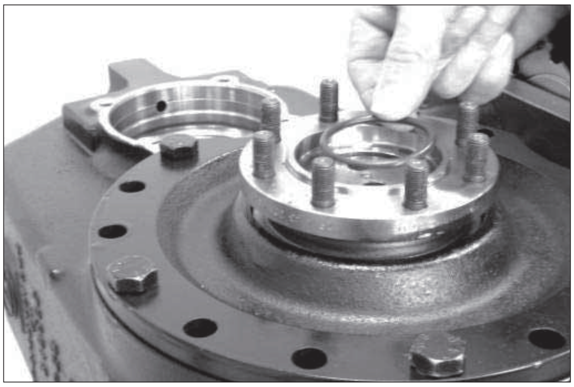
14WF8TM185

53) Install preassembled output flange.



14WF8TM186

54) Insert O-ring.

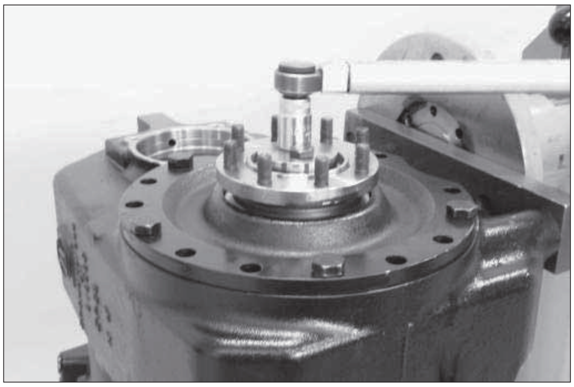


14WF8TM187

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

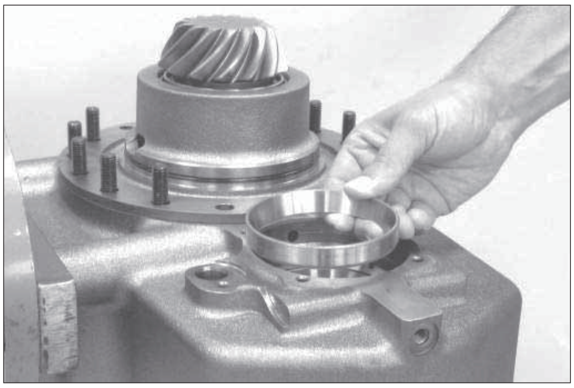
9.REASSEMBLY - BRAKE / CLUTCH / PLANETARY CARRIER

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.

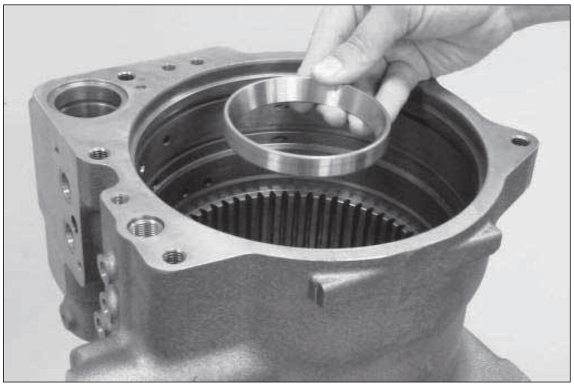


14WF8TM189

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.



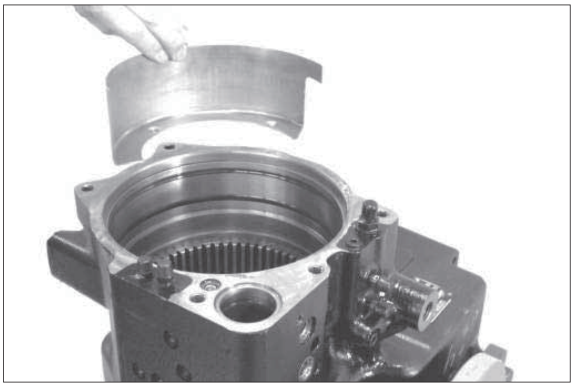
14WF8TM190

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

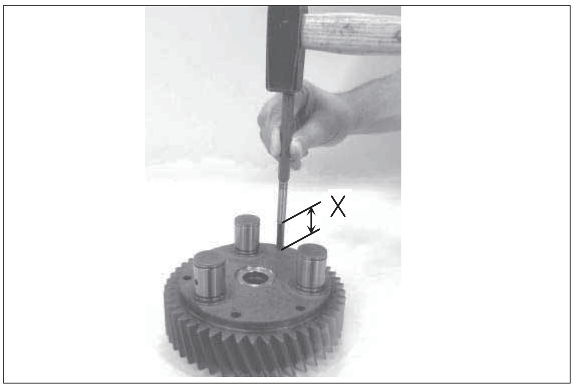
Wet countersunk screws with Loctite type no.243.



14WF8TM191

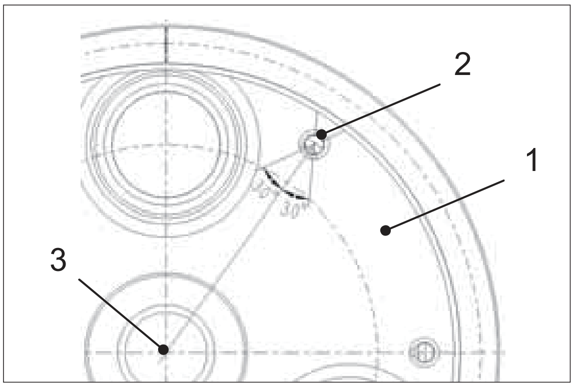
4) Install slotted pins (2) considering installation dimension X and installation position, see 14WF8TM193 (groove showing to center).

(S) Press-fit mandrel AA00 392 151



14WF8TM192

5) 1 = Planetary carrier
   2 = Slotted pin (6x)
   3 = Center (planetary carrier)

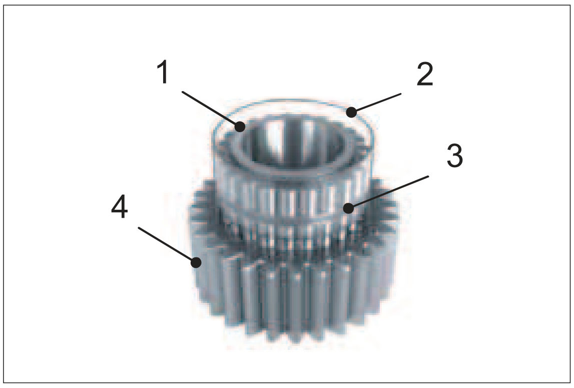


14WF8TM193

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

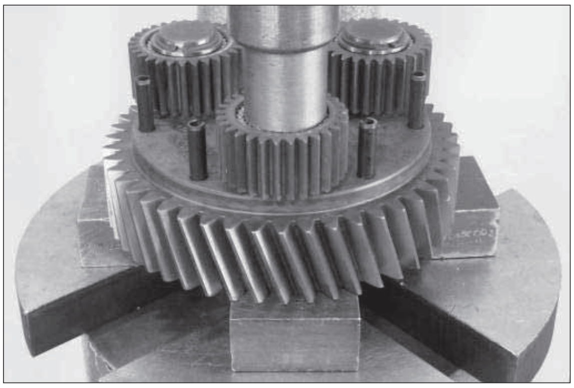


14WF8TM194

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.



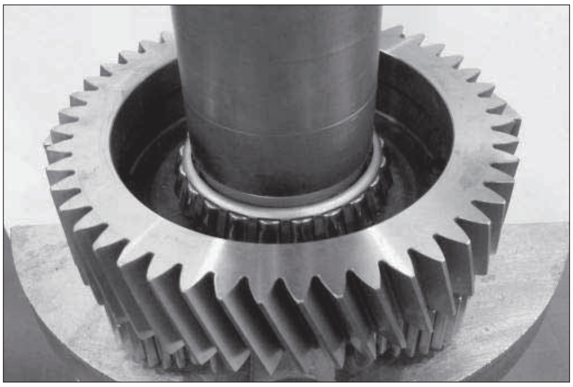
14WF8TM195

8) Engage retaining ring.

※ Adjust retaining ring until contact with groove base.

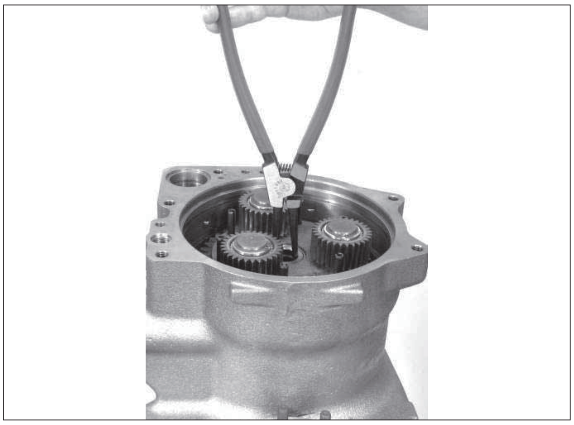
14WF8TM196

9) Press bearing inner ring onto planetary carrier until contact.



14WF8TM197

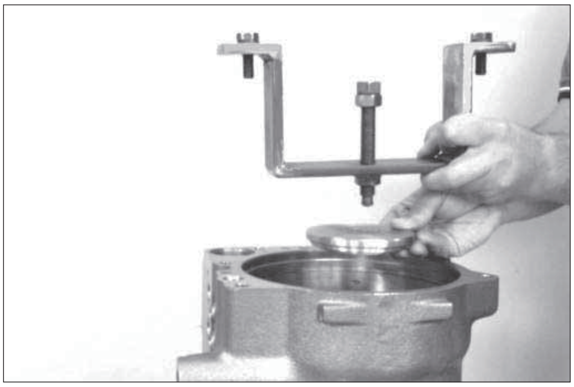
10) Insert preassembled planetary carrier.



14WF8TM198

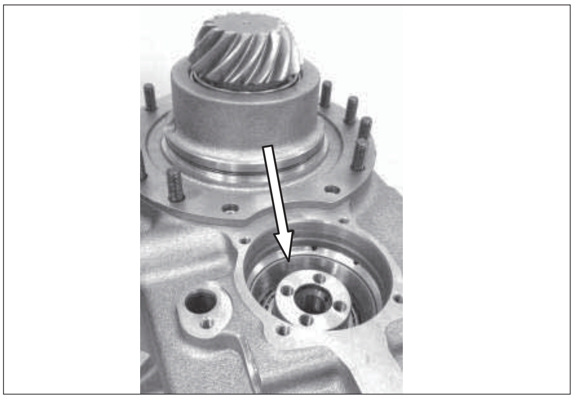
11) Fix planetary carrier with pressure plate and clamping bar.

(S) Clamping bar 5870 654 049



14WF8TM199

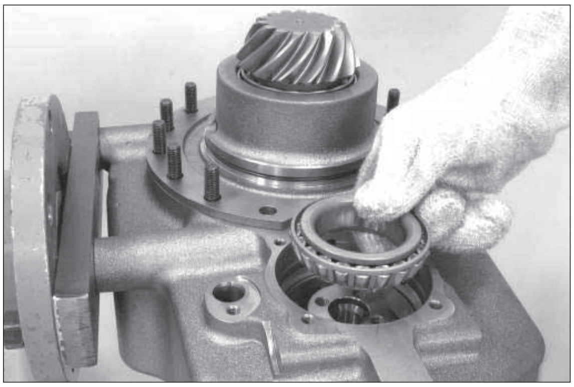
12) Rotate transmission by 180˚.
Check contact of bearing outer ring (see arrow). Reassembly of bearing outer ring, see 14WF8TM189.



14WF8TM200

13) Install heated bearing inner ring until contact.

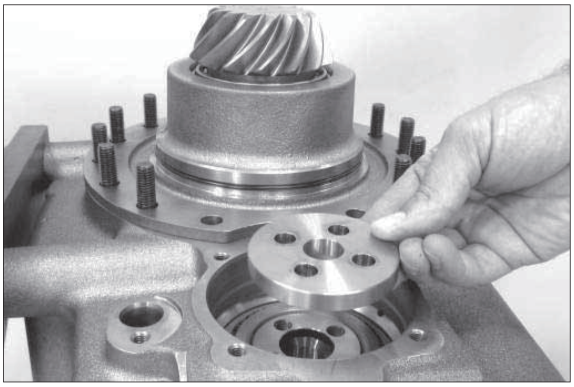
※ Adjust bearing inner ring after cooling down.



14WF8TM201

14) Position disk and manually turn in hexagon screws (fix planetary carrier).

Then remove clamping bar, see 14WF8TM199.

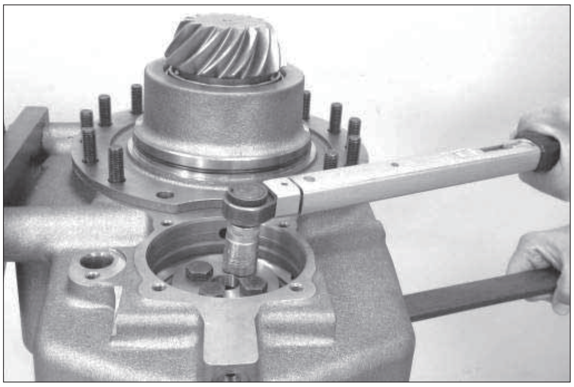


14WF8TM202

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

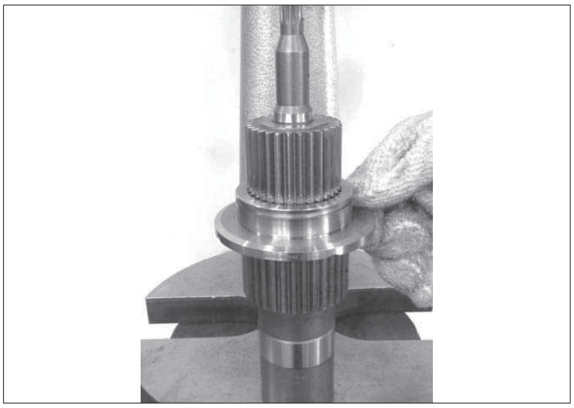
※ While tightening hexagon screws, rotate planetary carrier several times in both directions (roller setting).



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.

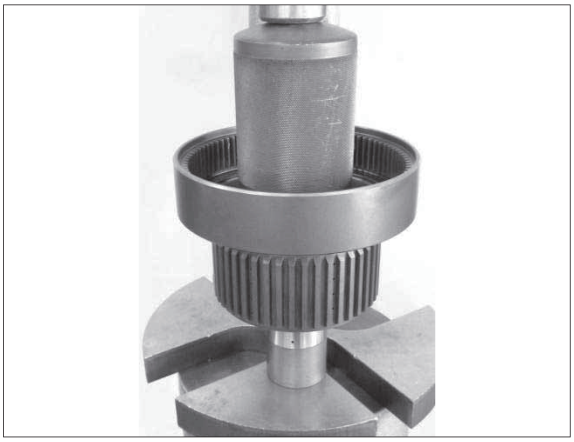
(S) Clamping pliers 5870 900 021

14WF8TM206

19) Heat bearing inner ring of ball bearing.

14WF8TM207

20) Mount preassembled ring gear to input shaft until contact.



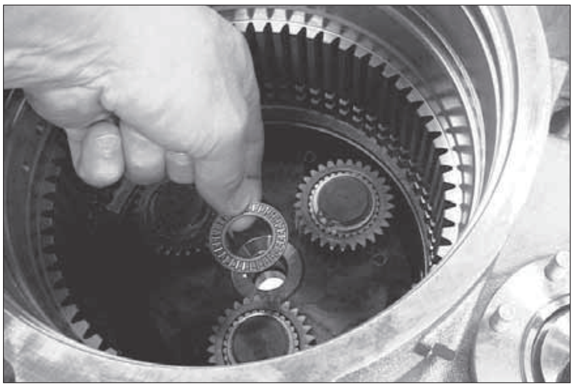
14WF8TM208

21) Engage retaining ring into annular groove of input shaft.

14WF8TM209

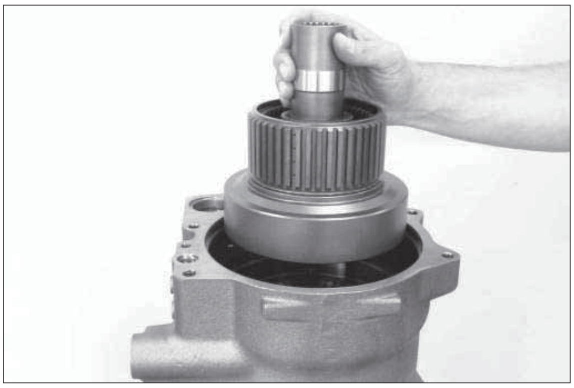
22) Rotate transmission by 180˚.
Insert axial needle cage into recess of planetary carrier.

※ Oil axial needle cage for reassembly.



14WF8TM210

23) Insert preassembled input shaft (with ring gear).

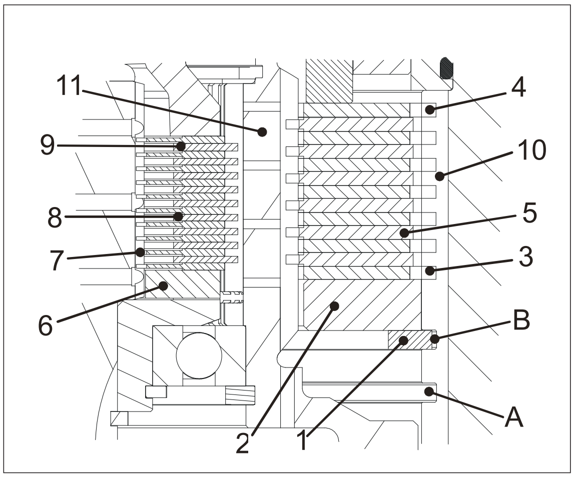


14WF8TM211

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



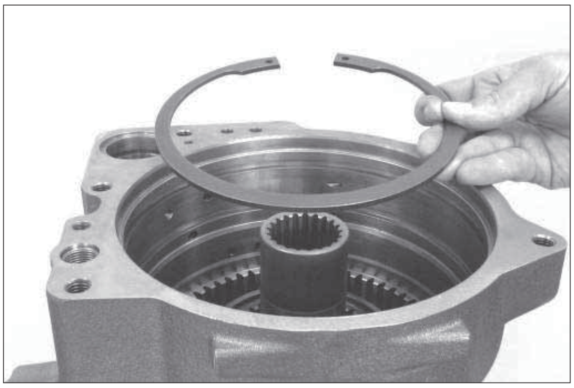
14WF8TM213

Reassembly brake :

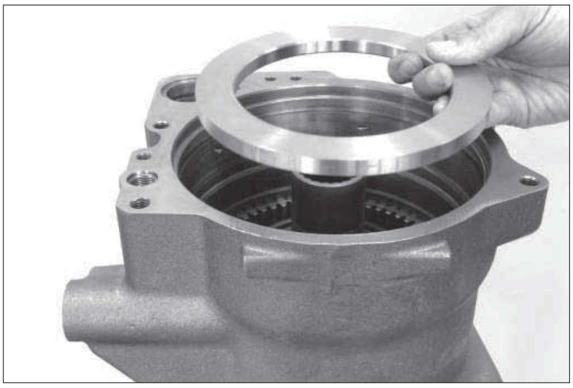
25) Engage retaining ring (1) into annular groove (A).

(S) Clamping pliers 5870 900 021

※ Observe installation position of retaining ring (1).

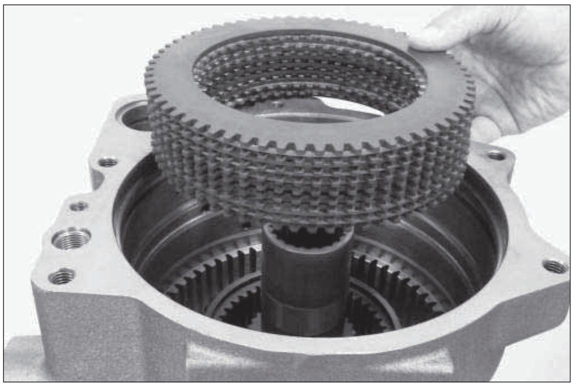

14WF8TM215

26) Insert end plate (2).


14WF8TM216

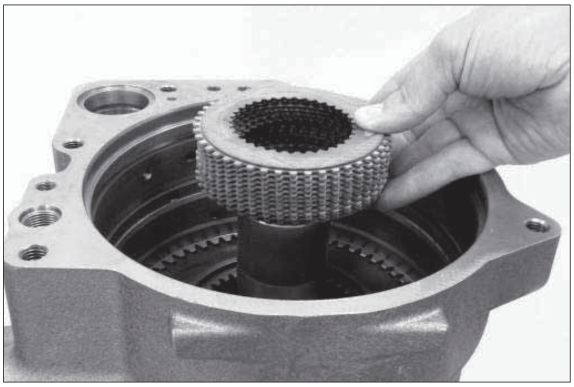
27) Insert disk package alternately, beginning with an outer disk.

※ 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.

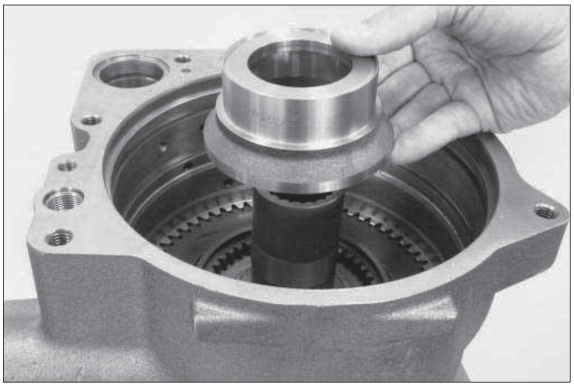

14WF8TM217

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.

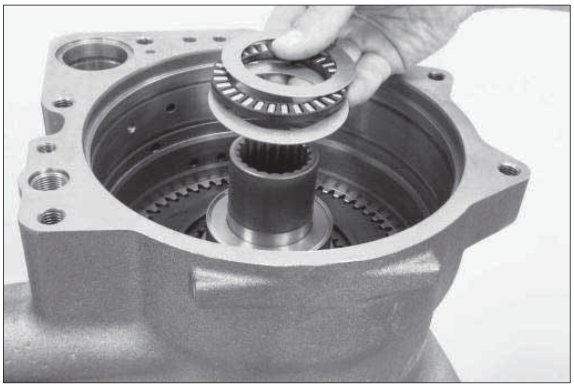

14WF8TM218

29) Mount pressure piece (without compression spring).



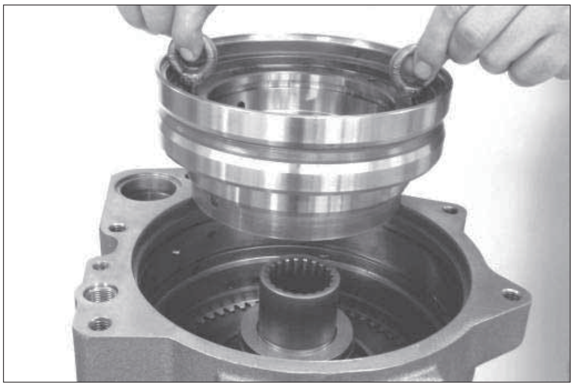
14WF8TM219

30) Oil axial roller cage and mount it with both axial washers (1x each, positioned underneath and onto axial needle cage).



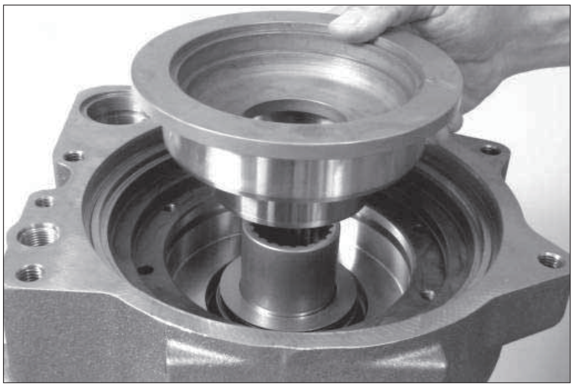
14WF8TM220

31) Insert piston (brake) – without mounted sealing elements.



14WF8TM221

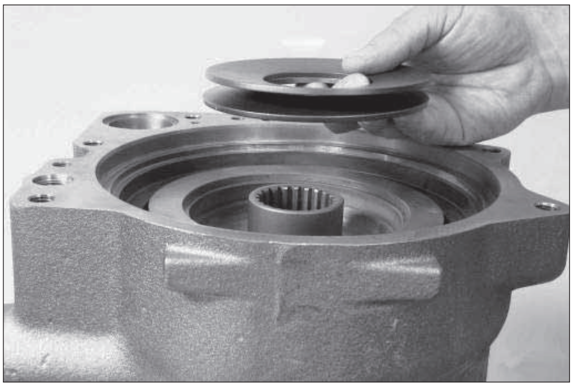
32) Insert piston (clutch) – without mounted sealing elements.



14WF8TM222

33) Insert both cup springs/clutch.

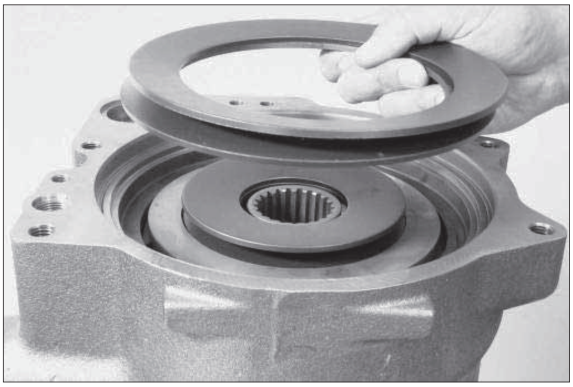
※ Fix cup springs with grease and position them centrically.
※ Observe installation position, see 14WF8TM225.



14WF8TM223

34) Insert both cup springs/brake.

※ Fix cup springs with grease and position them centrically.
※ Observe installation position, see 14WF8TM225.



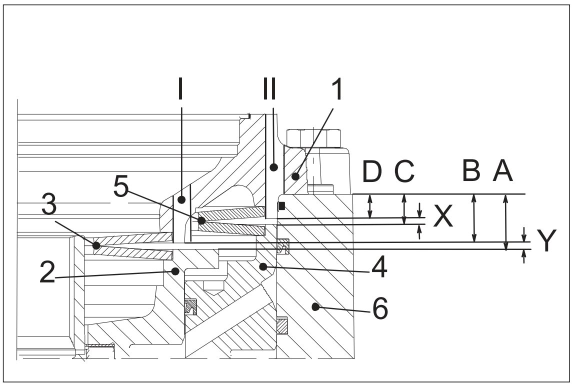
14WF8TM224

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

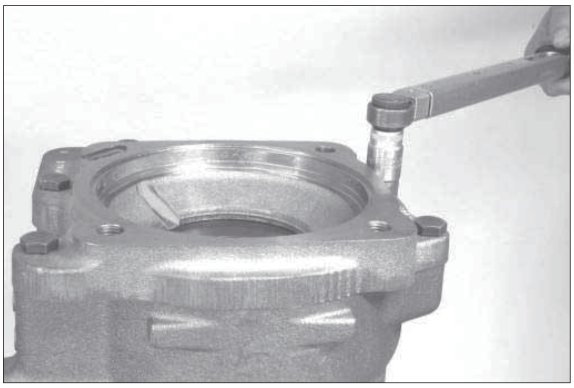
Y = Disk clearance/Clutch → 2.4 +0.3 mm (piston stroke)
X = Disk clearance/Brake → 1.8 + 0.3 mm (piston stroke)



14WF8TM225

36) Locate measuring device evenly with hexagon screws (risk of breakage) until contact.

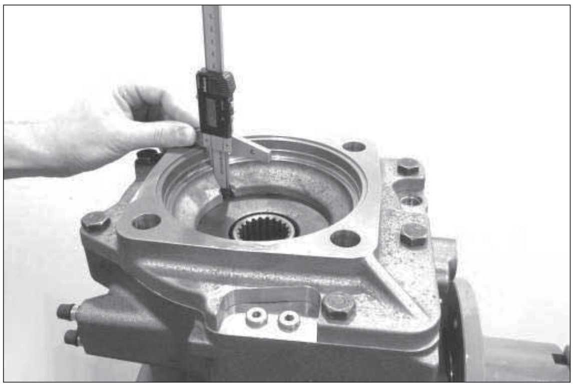
Tightening torque (M 12/8.8) M_A = 80 Nm
(S) Measuring device 5870 200 131



14WF8TM226

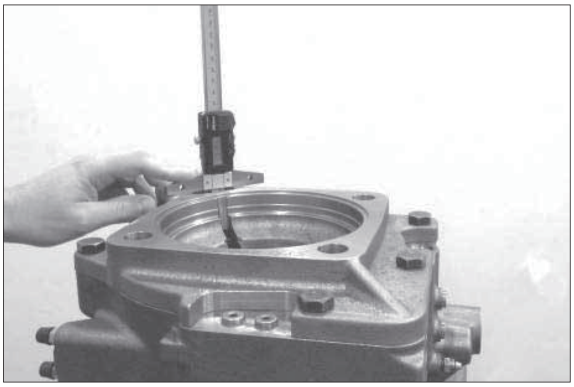
37) Determine dim. A (Measuring hole I) from mounting face/housing to front face/piston (clutch).

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

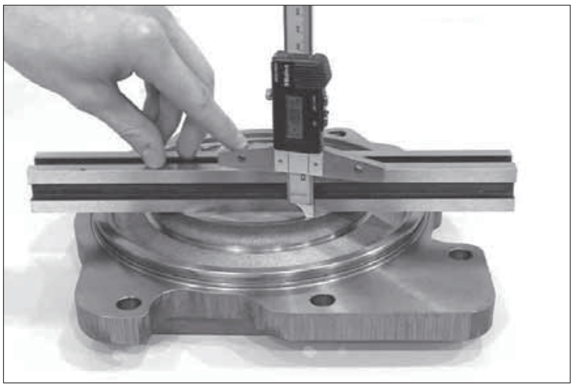

14WF8TM228

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.**

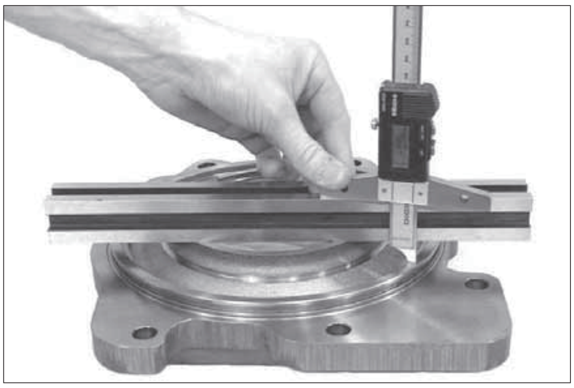

14WF8TM229

40) Determine Dim. D from mounting face/housing to brake piston contact/housing.

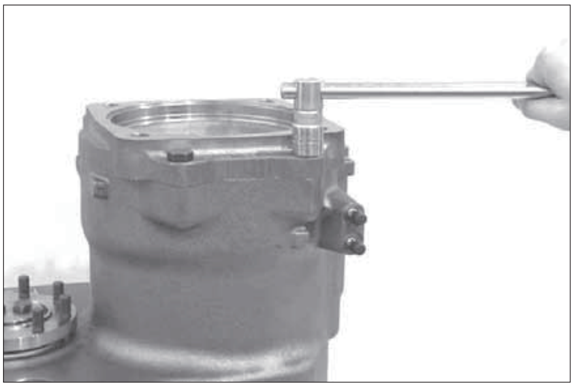
Dim. D e.g. = 9.95 mm
C-D = 1.90 mm (disk clearance)

Disk clearance (piston stroke) Brake = $1.8^{+0.3}$ mm

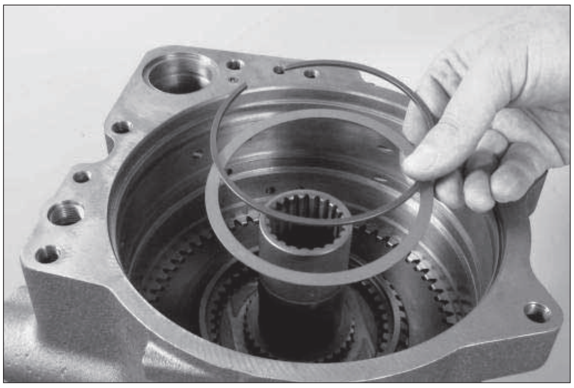
⚠ **If the required disk clearance (piston stroke) is not obtained, correct with a suitable outer disk – see 14WF8TM217.**


14WF8TM230

41) Remove measuring device again – loosen screws evenly.
Remove all cup springs, both pistons, axial roller cage with axial washers and pressure piece.

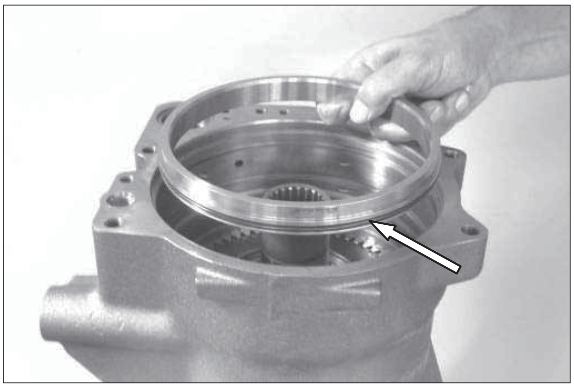

14WF8TM231

42) Insert shim into ring gear and fix by engaging snap ring into annular groove of ring gear.


14WF8TM232

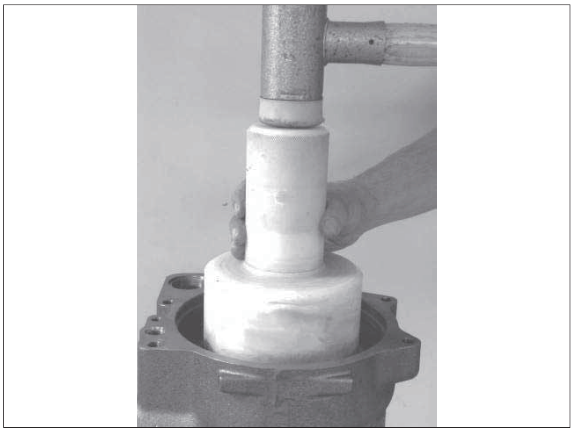
43) Place O-ring (see arrow) into groove and insert ring.

※ Oil sealing surfaces in housing and O-ring for reassembly.
※ Observe installation position

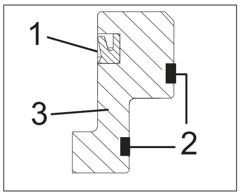

14WF8TM233

44) Mount ring with driver tool until contact.

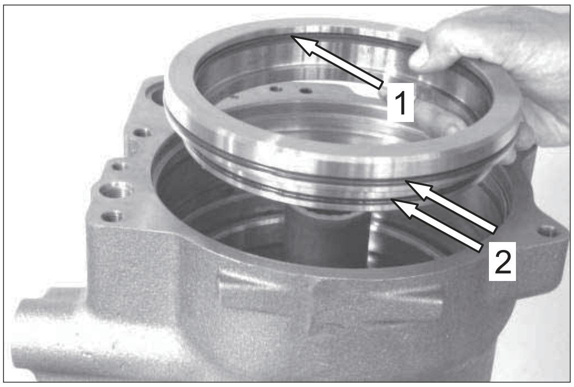
(S) Driver tool 5870 506 161


14WF8TM234

45) Oil sealing surfaces in housing and sealing elements. Insert seal (1) with sealing lip showing to oil sump – also see detail sketch.



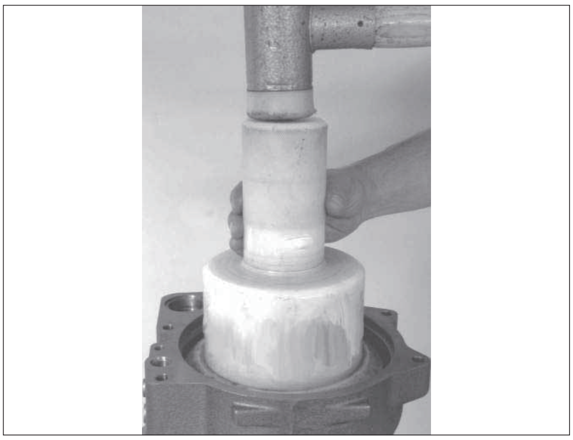
Put both O-rings (2) into annular grooves of pressure ring (3) and insert preassembled pressure ring into housing.



14WF8TM235

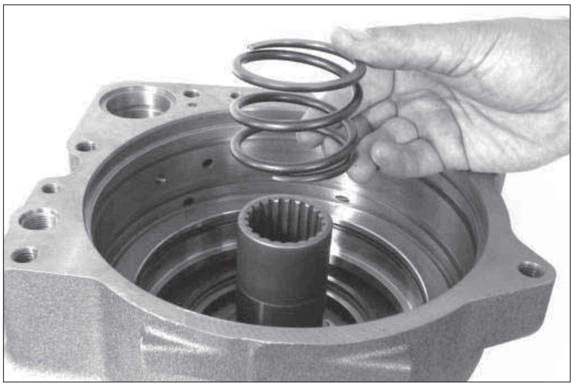
46) Bring pressure ring with driver tool into contact position.

(S) Driver tool 5870 506 161



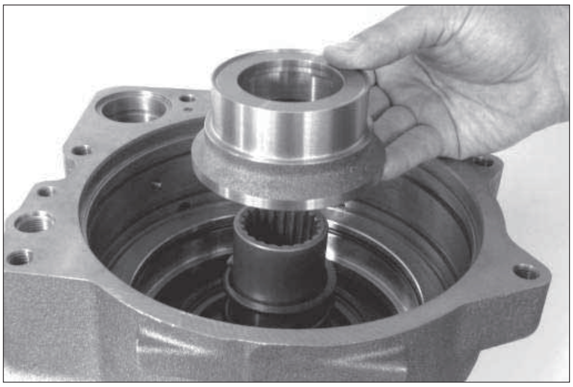
14WF8TM237

47) Insert compression spring until contact.



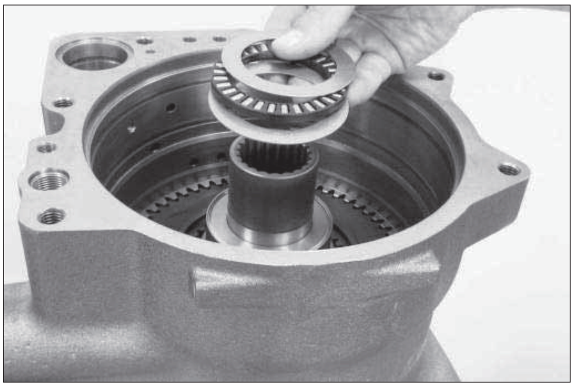
14WF8TM238

48) Insert pressure piece over compression spring until contact.



14WF8TM239

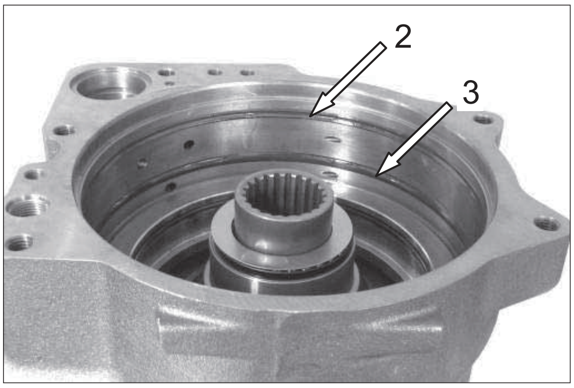
49) Oil axial roller cage and mount it with both axial washers (1x each to be positioned underneath and onto axial needle cage).



14WF8TM240

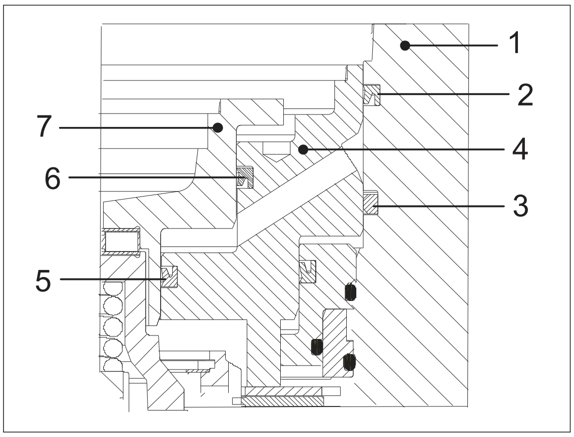
50) Insert seal (2, with sealing lip showing to oil sump) and seal (3) – see 14WF8TM242 into housing (1).

※ Oil sealing elements and sealing surfaces on piston for reassembly.



14WF8TM241

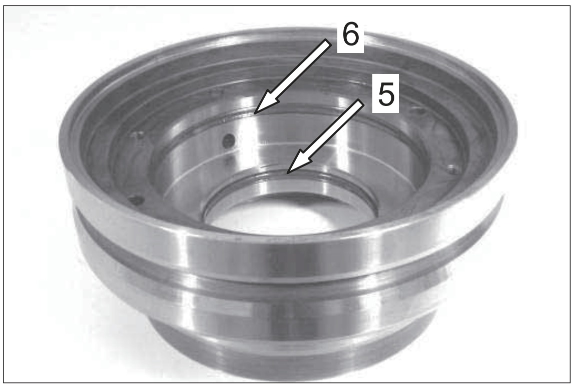
51) 1 = Housing
2 = Seal (with sealing lip)
3 = Seal
4 = Piston / Brake
5 = Seal (with sealing lip)
6 = Seal (with sealing lip)
7 = Piston / Clutch



14WF8TM242

52) Insert seals (5 and 6, see 14WF8TM247), with sealing lips showing to oil sump into piston / brake (4).

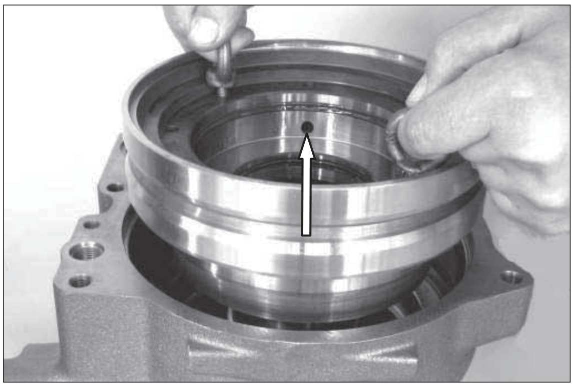
※ Oil sealing surfaces on piston and sealing elements for reassembly.



14WF8TM243

53) Insert preassembled piston/brake until contact.

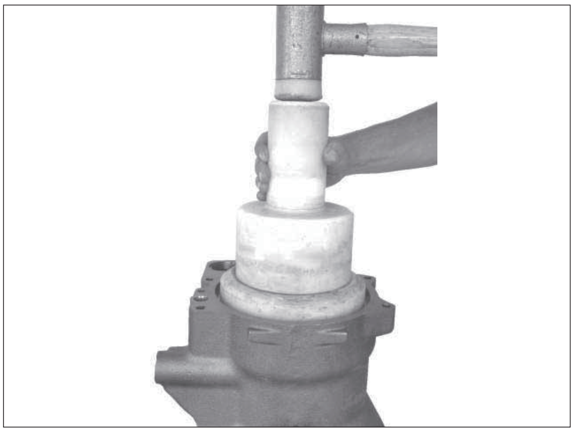
※ Position piston in such a way that oil supply hole (see arrow) is at 12.00 o'clock position.
Observe version as to transmission installation position HORIZONTAL – VERTICAL.



14WF8TM244

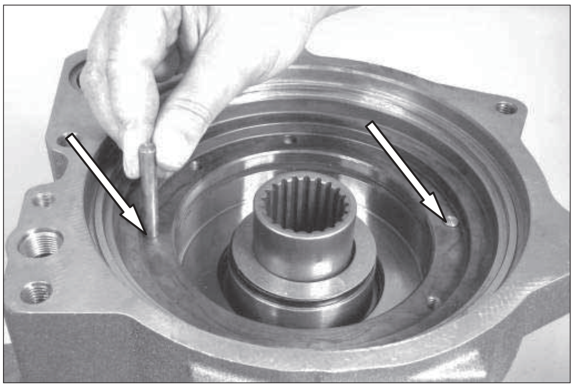
54) Use driver tool to bring piston into contact position.

(S) Driver tool 5870 506 161



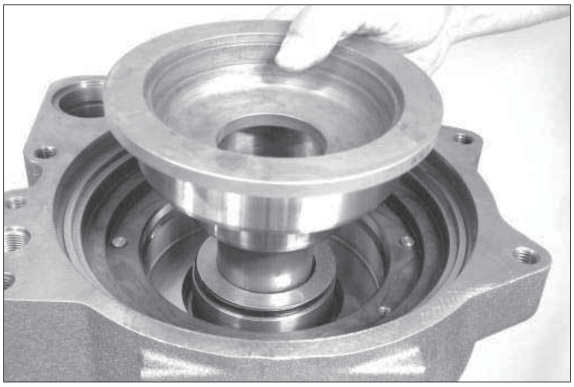
14WF8TM245

55) Insert both cyl. pins (arrow).



14WF8TM246

56) Insert piston/clutch until contact.

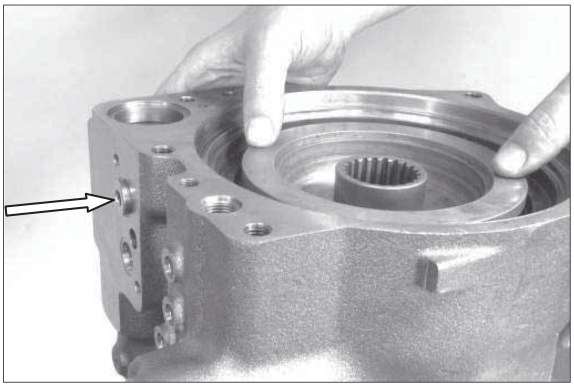


14WF8TM247

57) Press piston axially, against compression spring preload.
Provide screw plug with new O-ring and seal pressure oil supply hole (see arrow).

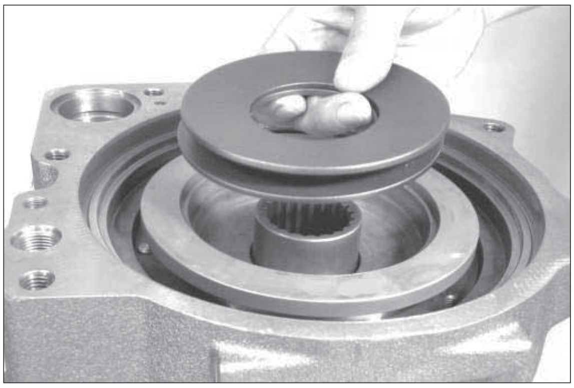
Tightening torque MA = 40 Nm

※ Axial position of piston is maintained (Facilitate assembly for installation of input housing, see 14WF8TM254~ 14WF8TM255).


14WF8TM248

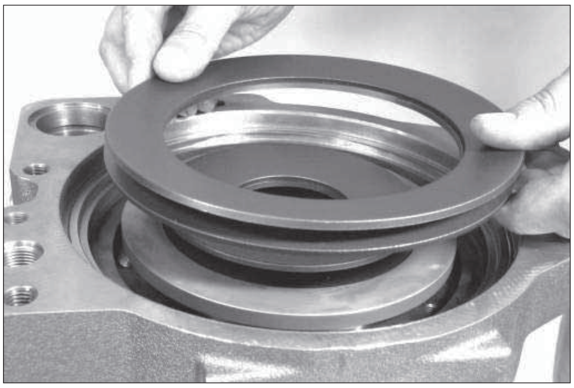
58) Insert both cup springs/clutch.

※ Observe installation position, see also 14WF8TM225.


14WF8TM249

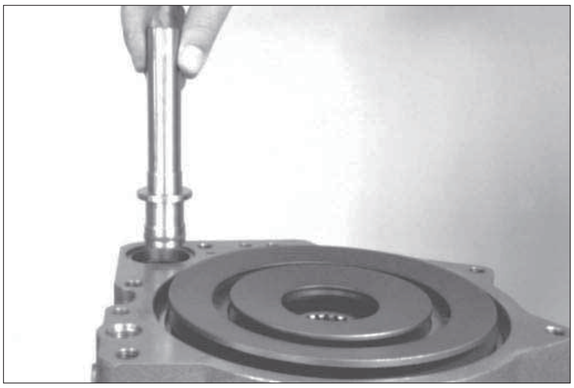
59) Insert both cup springs/brake.

※ Observe installation position – see also 14WF8TM225.

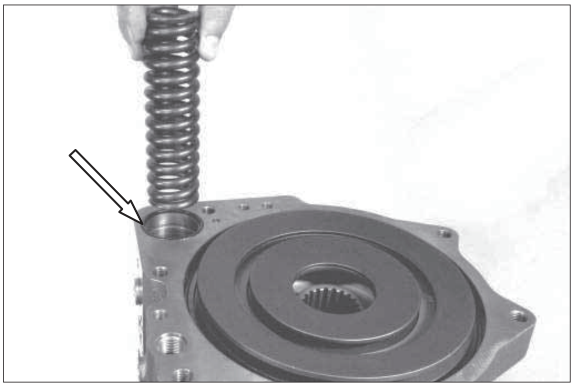

14WF8TM250

Install modulation valve and input housing

60) Insert piston (modulation valve cpl. – can only be replaced as unit).

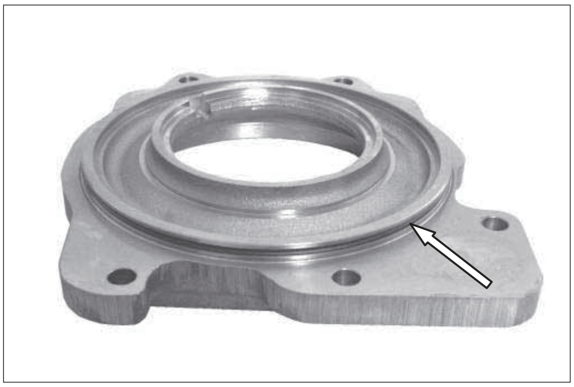

14WF8TM251

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.

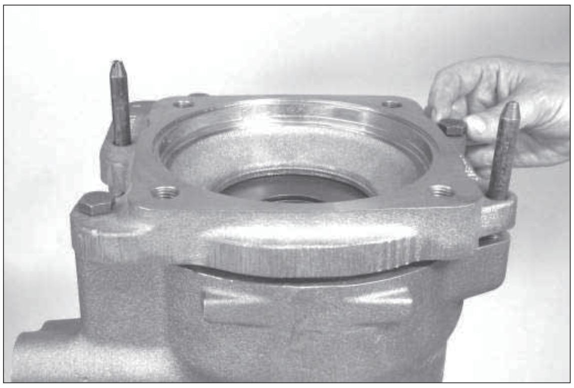


14WF8TM253

63) Insert two adjusting screws (M 12), mount input housing and fix it with hexagon screws.

(S) Adjusting screws (M12) 5870 204 021

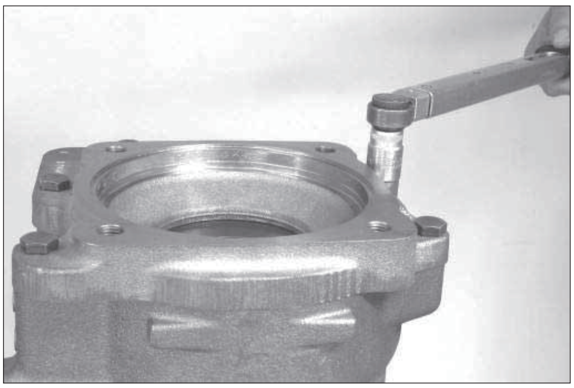
※ For installation of input housing align cup springs centrically.



14WF8TM254

64) Locate input housing evenly with hexagon screws (risk of breakage) until contact.

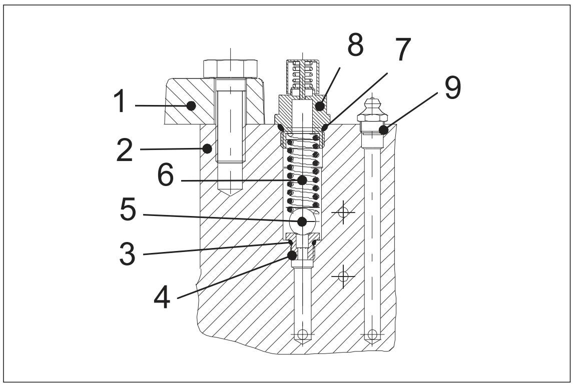
Tightening torque (M 12/8.8) M_A = 80 Nm



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



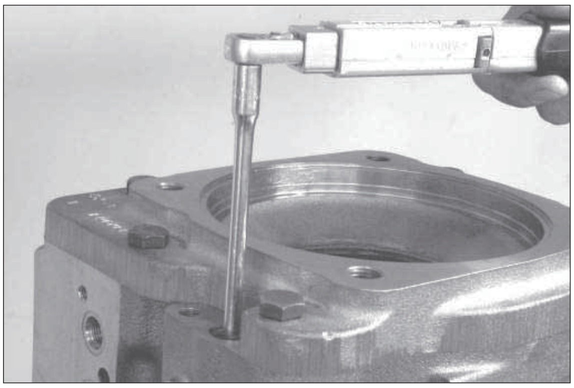
14WF8TM256

※ Position of lubrication nipple for version transmission installation position Horizontal, see 14WF8TM261.

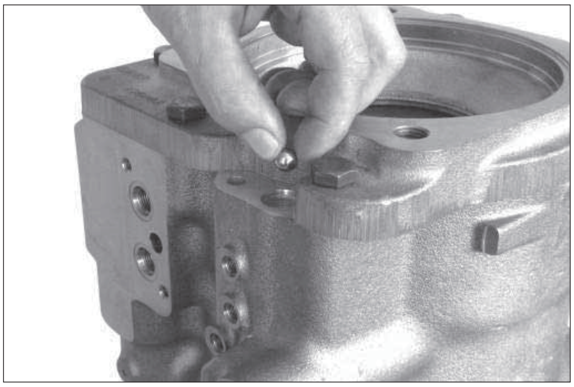
※ Remove protective cap of lubrication nipple only if emergency release is required.

66) Install threaded element (4) with new O-ring (3).

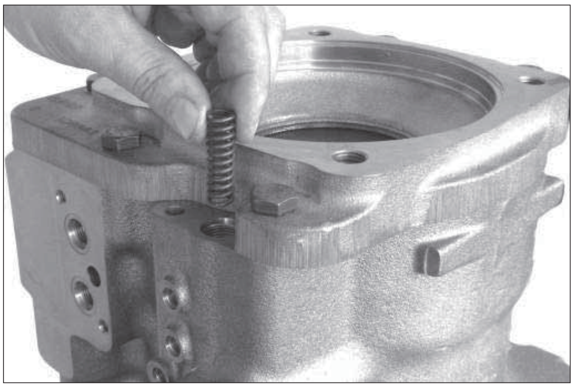
Tightening torque (M 10×1) MA = 15 Nm


14WF8TM257

67) Insert ball (5).


14WF8TM258

68) Insert compression spring (6).


14WF8TM259

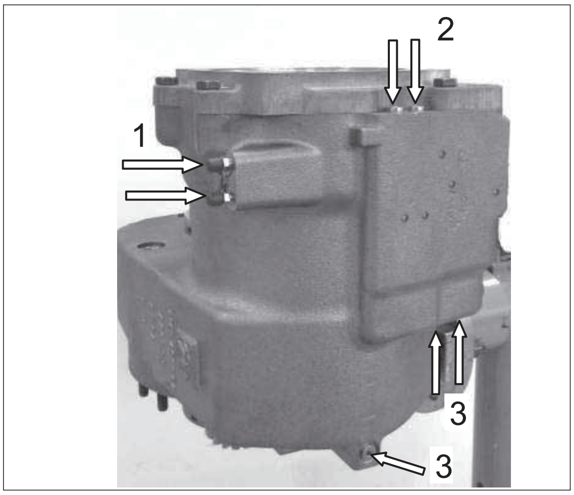
Check emergency release for leak tightness

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.

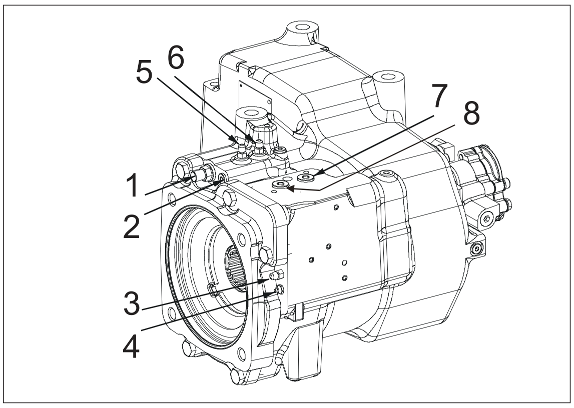
Install both breather valves (1), screw plugs (2) with new seal rings and screw plugs (3) with new O-rings.

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

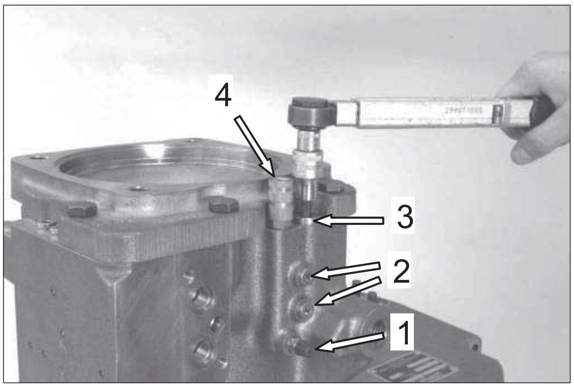
70) 1 = Breather/Pressure relief-valve
(emergency release –parking brake)
2 = Screw plug
3 = Breather valve
(emergency release – parking brake)
4 = Lubrication nipple
(emergency release – parking brake)
5 = Breather valve (multi-disk clutch)
6 = Breather valve (mulit-disk brake)
7 = Pressure oil connection – 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).

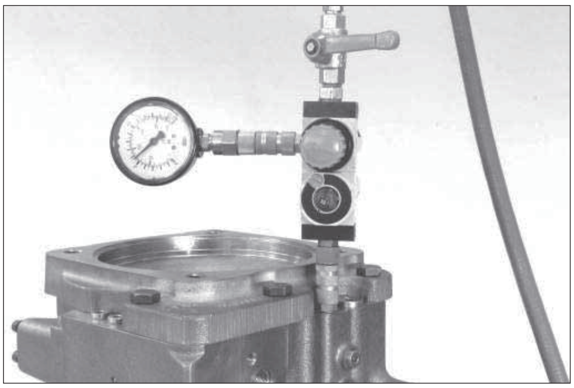
Breather valve (M 10×1) MA = 15 Nm
Screw plug (M 10×1 with O-ring) MA = 20 Nm
Screw plug (M 18×1.5 with O-ring) MA = 35 Nm
Compressed air connect. piece (M 10×1) with seal ring MA = 20 Nm



14WF8TM262

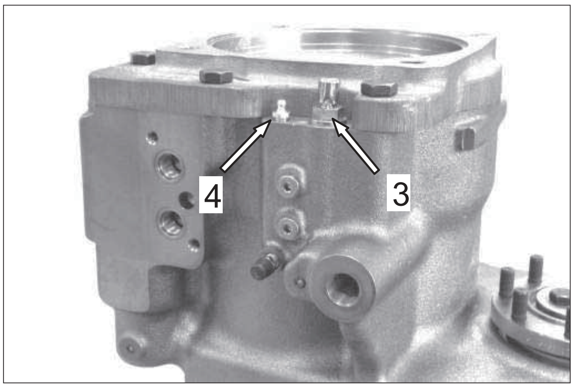
72) Pressurize emergency release with compressed air p = 5 + 1bar and close shut-off valve. During a test duration of 3 minutes no pressure drop is allowed.

(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) M_A = 15 Nm
Breather (M 18×1.5) M_A = 22 Nm



14WF8TM264

Check multi-disk brake and clutch for leak tightness as wells as closing pressure

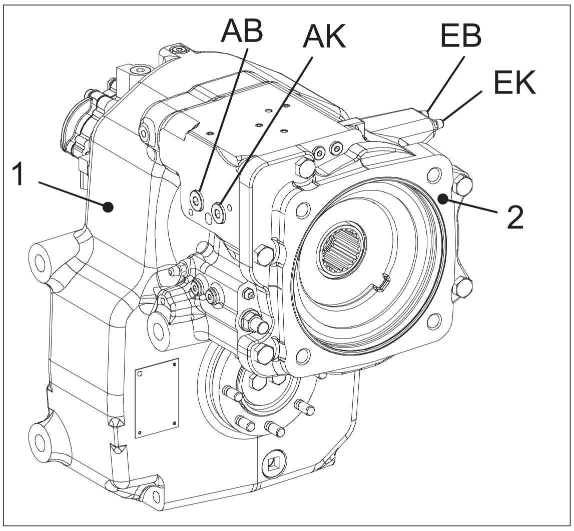
74) 1 = Transmission housing
2 = Input housing

AB = Pressure oil connection – multi-disk brake
AK = Pressure oil connection – multi-disk clutch

EB = Breather valve – multi-disk brake
EK = Breather valve – multi-disk clutch

※ Illustration shows version transmission installation position Vertical.

※ For version Transmission installation position Horizontal, connections and positions of breather valves/lubrication nipple etc. according to illustration in 14WF8TM261 must be considered.

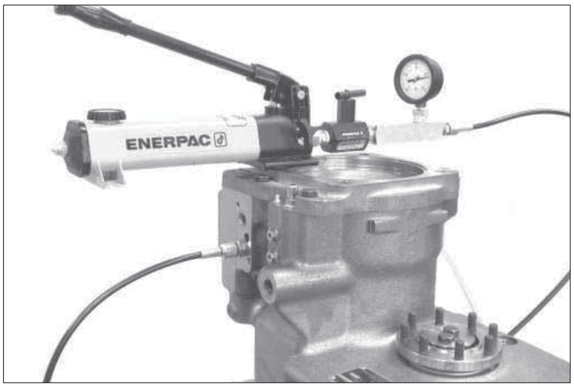


14WF8TM265

Multi-disk brake

75) Connect HP pump (AB – see 14WF8TM265 and 14WF8TM261) and build up pressure of p = 30 (max. 35 bar).
- Bleed pressure chamber several times. Close shut-off valve.
During a test duration of 3 minutes no measurable pressure drop is allowed.

(S) HP pump 5870 287 007



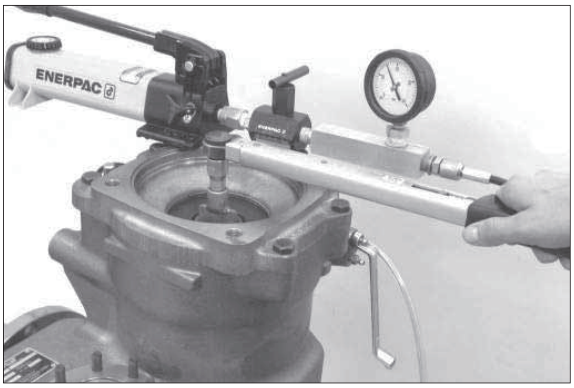
14WF8TM266

Closing pressure test (Cup spring preloading force)

76) When measuring closing pressure, valve block may not be attached to transmission due to by-pass function between brake and clutch.
Connection AK (see 14WF8TM265 and 14WF8TM261) open (not closed and tank connection).

Reduce pressure slowly, when pressure range 12~9 bar (closing pressure) is reached, input shaft must be locked at a tightening torque of 35 Nm.

(S) Spline mandrel 5870 510 039



14WF8TM267

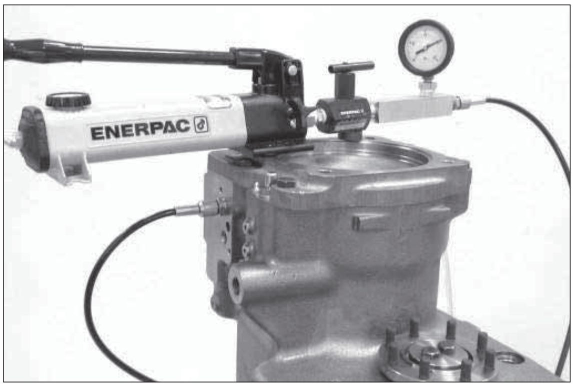
Multi-disk clutch

77) Connect HP-pump (AK see 14WF8TM265 and 14WF8TM261), build up pressure of p = 30~max. 35 bar.

- Relieve pressure chamber several times. Close shut-off valve.

During a test duration of 3 minutes no measurable pressure drop is allowed.

(S) HP-pump 5870 287 007



14WF8TM268

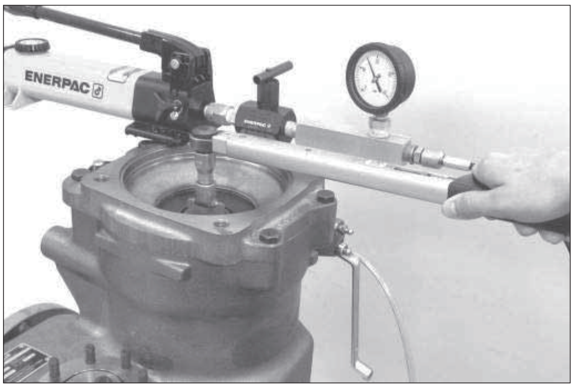
Closing pressure test (Cup spring preloading force)

78) When measuring closing pressure, valve block (only for version with mounted valve block) may not be attached to transmission due to by-pass function between brake and clutch.

Connection AB (see 14WF8TM265 and 14WF8TM261) open (not closed and tank connection).

Reduce pressure slowly, when pressure range 17~13 bar (closing pressure) is reached, input shaft must be locked at a tightening torque of 35 Nm.

(S) Spline mandrel 5870 510 039

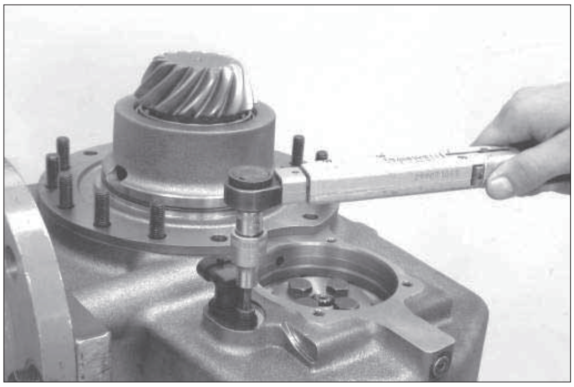


14WF8TM269

Speed sensor

79) Install speed sensor with new O-ring.

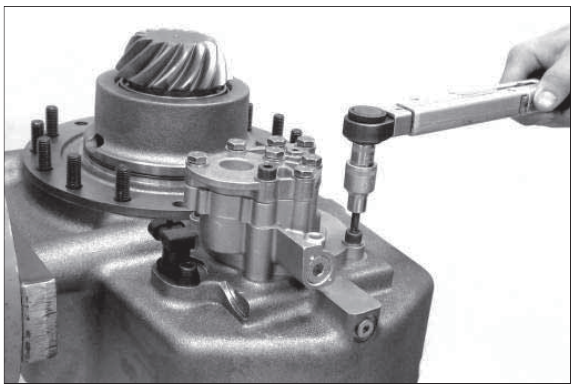
Tightening torque (M 8/8.8) M_A = 23 Nm


14WF8TM270

Lubrication pump/shift interlock

80) Install lubrication pump (with O-rings) or shift interlock – depending on version – (Illustration shows – Lubrication Pump).

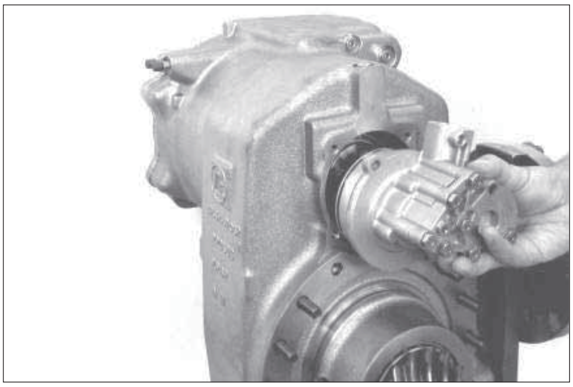
Tightening torque (M 8/10.9) M_A = 23 Nm


14WF8TM271

10.DISASSEMBLY - LUBRICATION PUMP/ SHIFT INTERLOCK and VALVE BLOCK

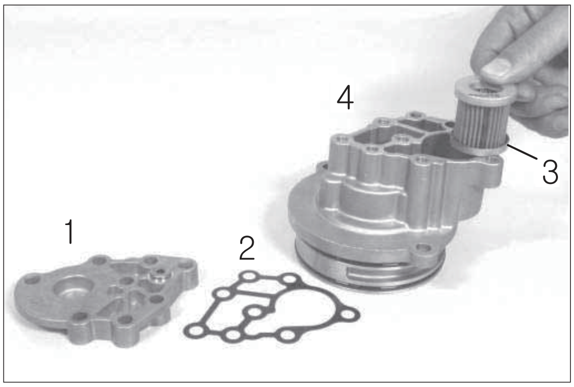
Lubrication pump version

1) Loosen threaded joint and pull off cpl. lubrication pump.



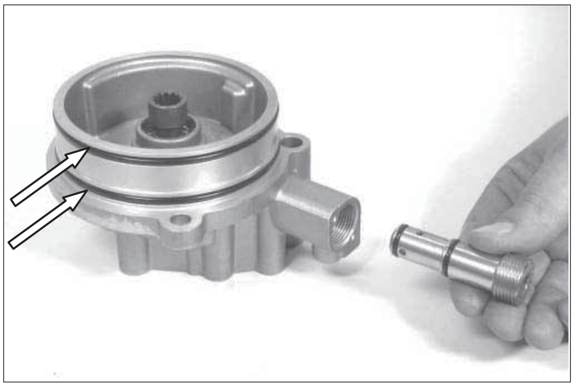
14WF8TM272

2) Loosen cover screws, remove cover (1) with seal (2) and filter (3) from housing (4).



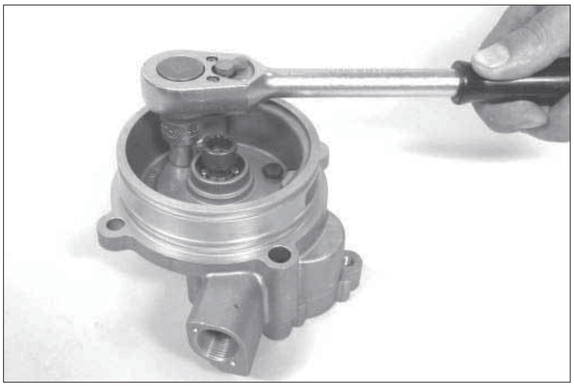
14WF8TM273

3) Remove cpl. pressure limiting valve and both O-rings (arrows).



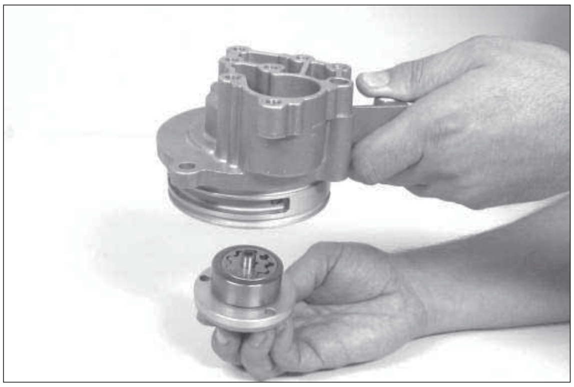
14WF8TM274

4) Keep housing in vertical position, while loosening pump cover screws.


14WF8TM275

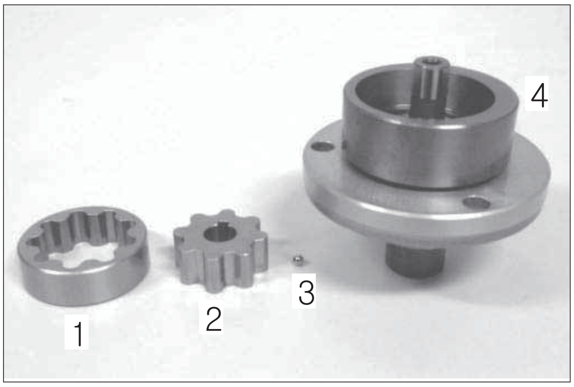
※ Maintain contact position of pump and rotate by 180°- disassembly aid.

5) Then pull pump in vertical position out of housing – pay attention to possibly releasing balls and compression springs.


14WF8TM276

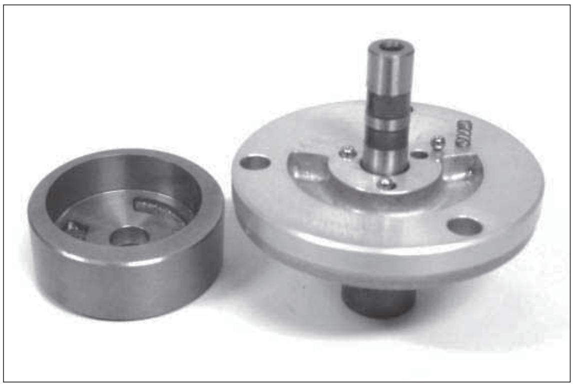
6) Remove outer (1) and inner rotor (2) and take releasing ball [(3) driver] out of control housing (4).

※ Outer, inner rotor and control housing = rotor set

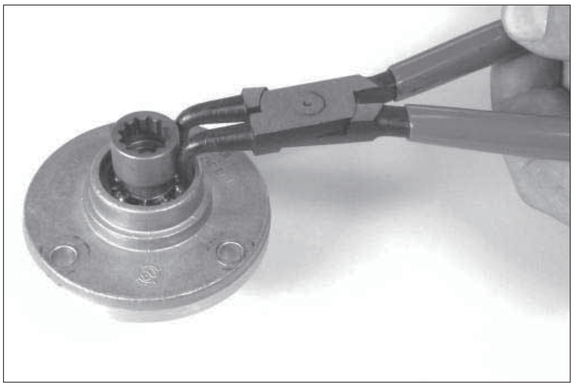


14WF8TM277

7) Remove control housing and releasing balls and compression springs (3 pcs. each).

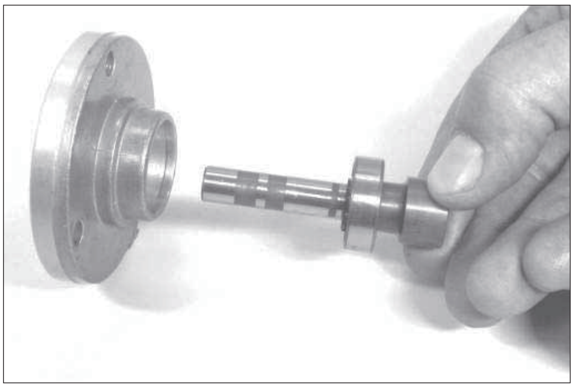

14WF8TM278

8) Unsnap retaining ring.



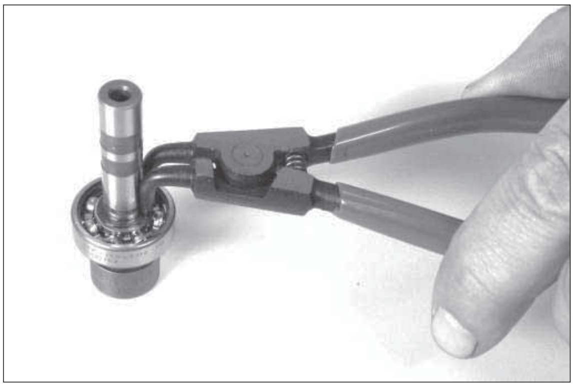
14WF8TM279

9) Pull cpl. pump shaft out of pump cover.



14WF8TM280

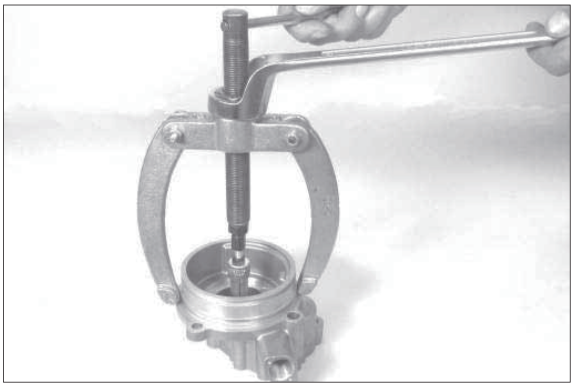
10) Unsnap retaining ring and press ball bearing from shaft.



14WF8TM281

11) Pull needle sleeve out of housing hole.

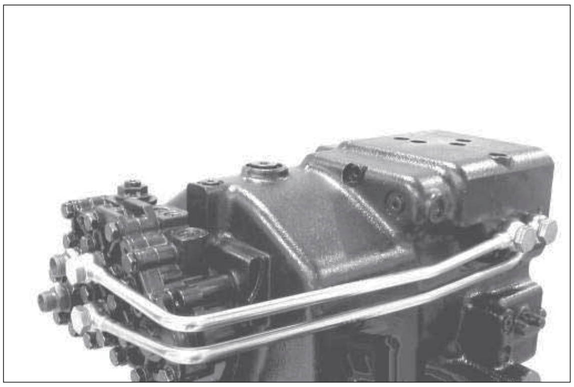
(S) Inner extractor	5870 300 012
(S) Counter support	5870 300 011



14WF8TM282

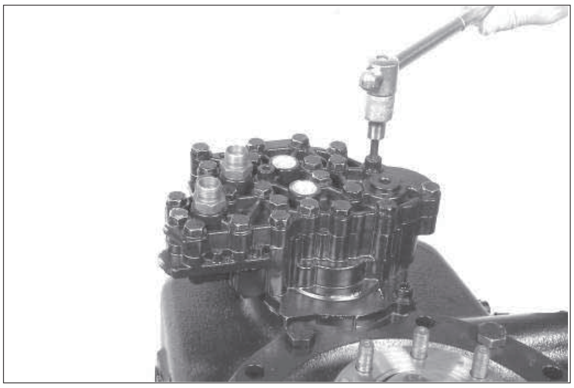
Shift interlock version

12) Disassemble both oil tubes.



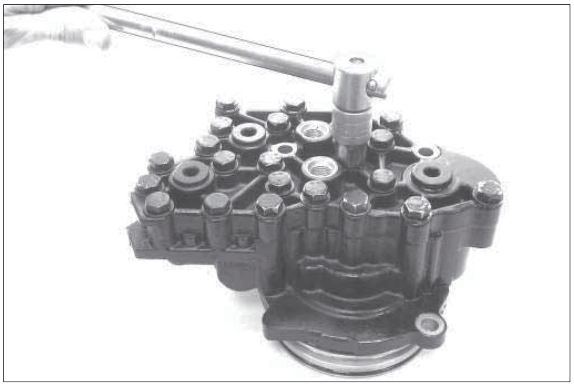
14WF8TM283

13) Loosen threaded joint of shift interlock (3 x cylindrical screws) and remove cpl. shift interlock.



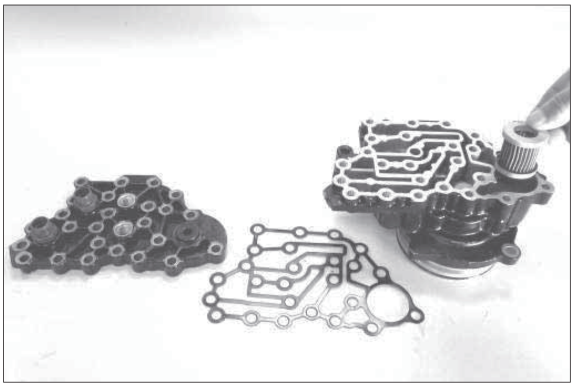
14WF8TM284

14) Loosen cover screws, remove cover and gasket (see also 14WF8TM286).



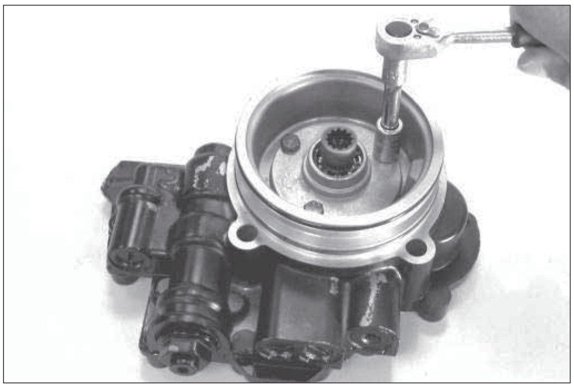
14WF8TM285

15) Take filter out of housing.



14WF8TM286

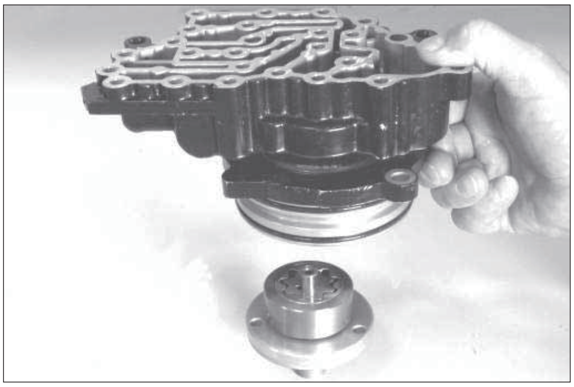
16) Loosen cover screws of pump.



14WF8TM287

※ Maintain contact position of pump and rotate it by 180˚ – disassembly aid.

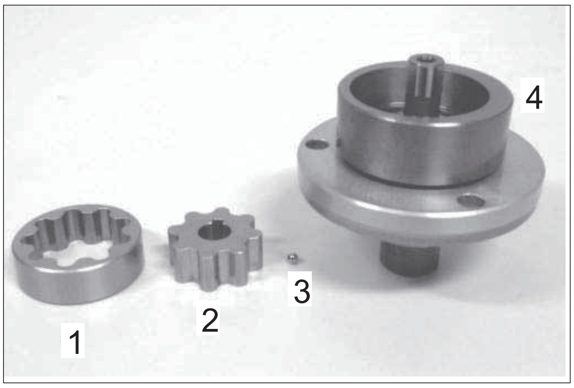
17) Then pull pump in vertical position out of housing – pay attention to possibly releasing balls and compression springs (see 14WF8TM289 and 14WF8TM290).



14WF8TM288

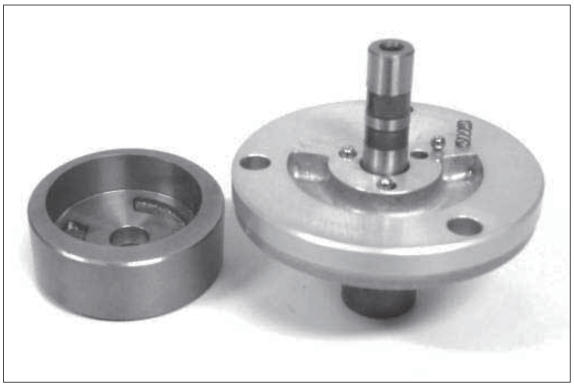
18) Remove outer (1) and inner rotor (2) and take releasing ball [(3) driver] out of control housing (4).

※ Outer, inner rotor and control housing = rotor set



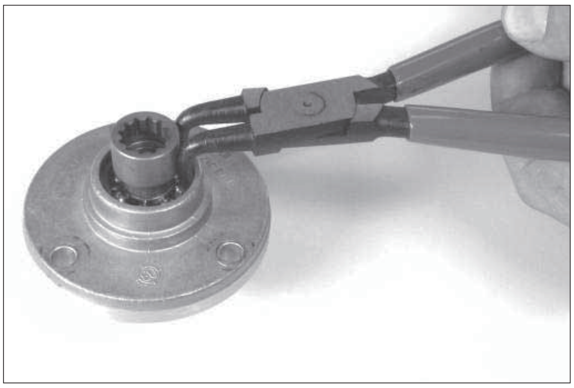
14WF8TM289

19) Remove control housing and releasing balls and compression springs (3 pcs. each).



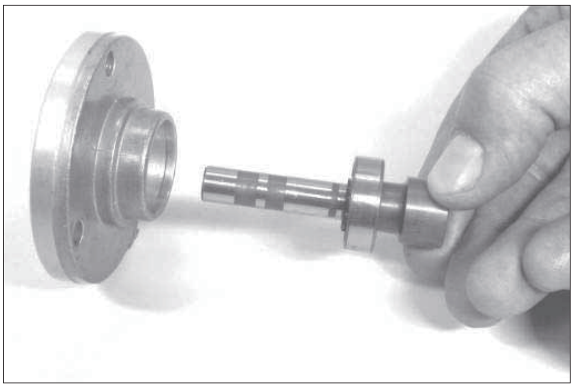
14WF8TM290

20) Unsnap retaining ring.



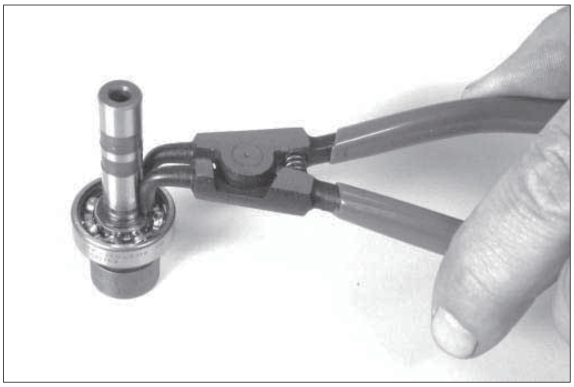
14WF8TM291

21) Pull cpl. pump shaft out of pump cover.



14WF8TM292

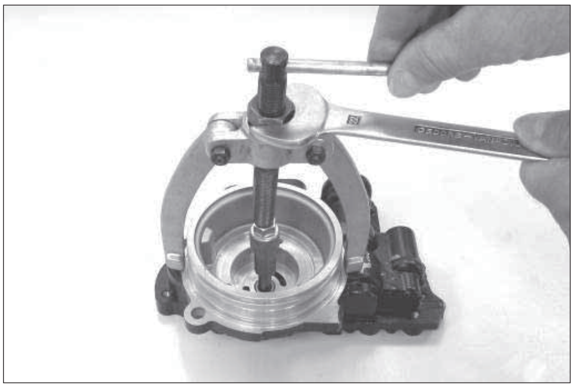
22) Unsnap retaining ring and press ball bearing from shaft.



14WF8TM293

23) Pull needle sleeve out of housing hole.

(S) Inner extractor	5870 300 012
(S) Counter support	5870 300 011

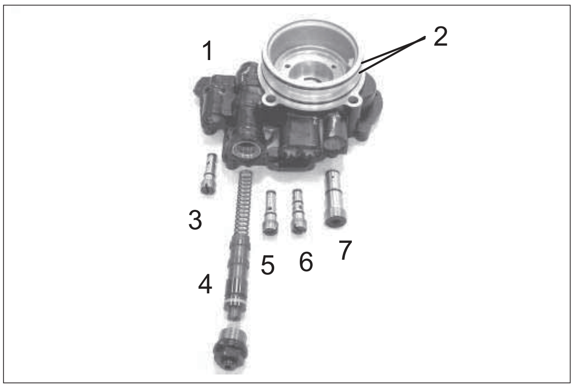


14WF8TM294

24) Remove O-rings and all single parts, remove valves.

1 = Housing
2 = O-rings
3 = Check valve (010)
4 = Shift piston
5 = Check valve (009)
6 = Check valve (008)
7 = Pressure relief valve

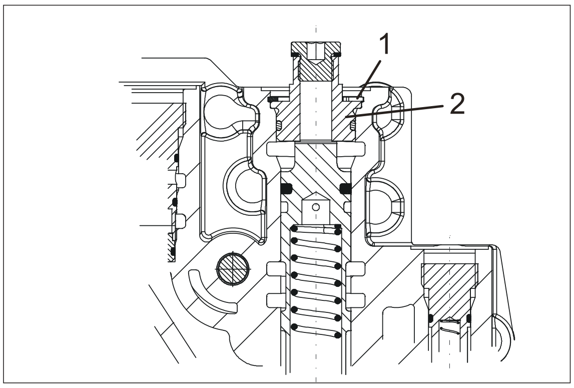
Position 4 (shift piston) shows version with screw plug.



14WF8TM295

25) In sketch 14WF8TM296 version II is shown with plug (2) and retaining ring (1).

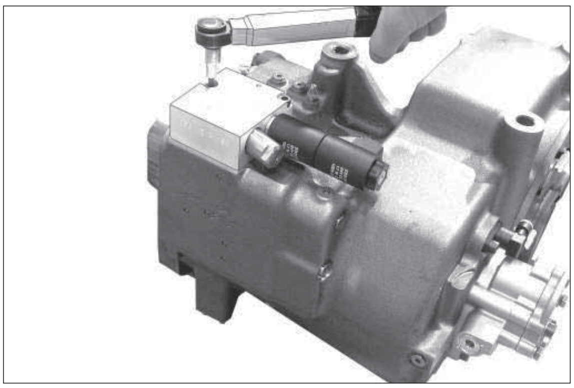
⚠ **When disengaging retaining ring – Pay attention to spring preload. Protect against movement.**



14WF8TM296

Disassemble valve block

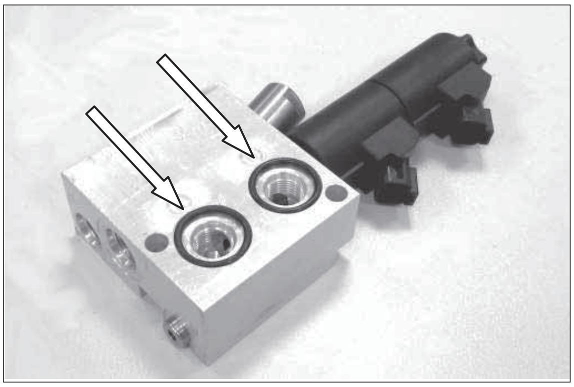
26) Loosen fixing screws and remove cpl. valve block.



14WF8TM297

27) Remove both O-rings (see arrows).

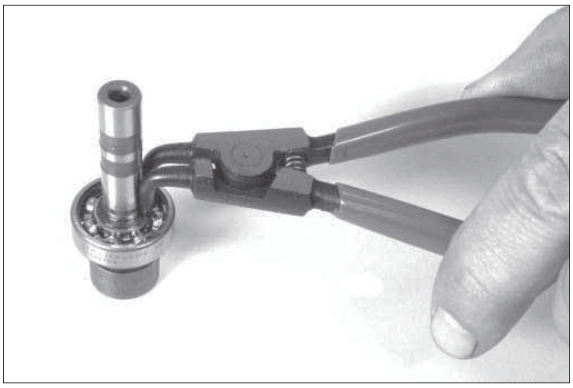
※ Do not further disassemble. Valve block may only be replaced as component.



14WF8TM298

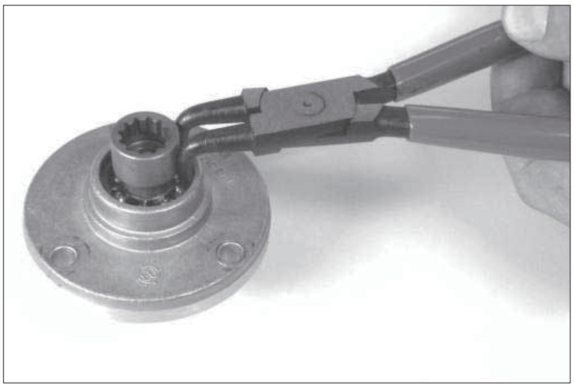
11. REASSEMBLY LUBRICATION PUMP

1) Mount ball bearing onto pump shaft and fix it by engaging retaining ring into annular groove of pump shaft.



14WF8TM299

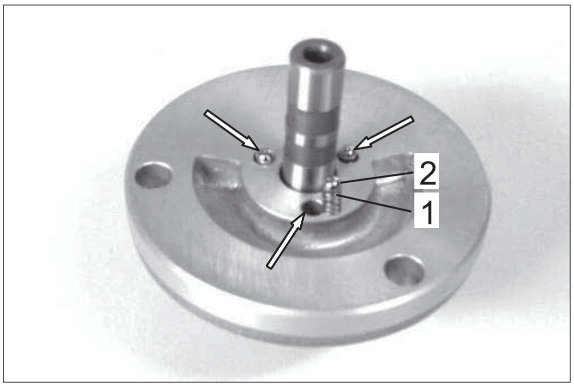
2) Press preassembled pump shaft into pump cover and fix it by engaging retaining ring into annular groove of pump cover.



14WF8TM300

3) Insert compression springs (1) and ball (2) into holes (see arrows - 3x).

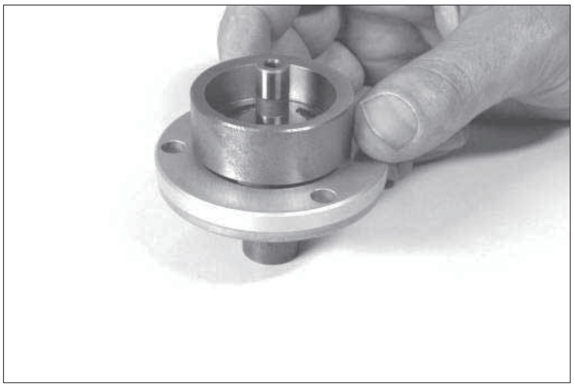
※ Keep preassembled single parts in vertical position–pay attention to position of inserted balls and compression springs (see work steps 14WF8TM301~14WF8TM307).



14WF8TM301

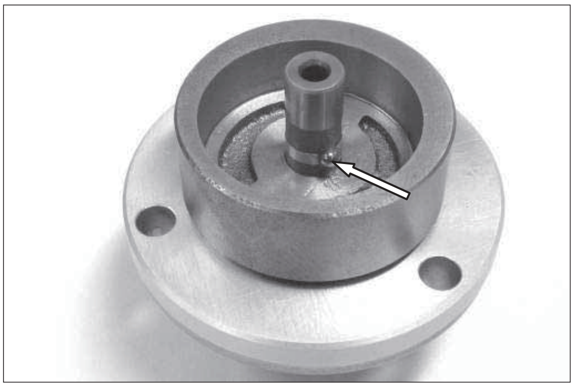
4) Mount control housing.

※ Control housing, inner and outer rotor = rotor set



14WF8TM302

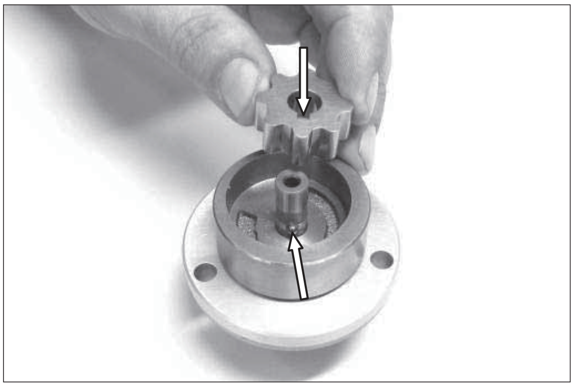
5) Position ball – (see arrow, engagement for inner rotor) with grease into countersink of pump shaft.



14WF8TM303

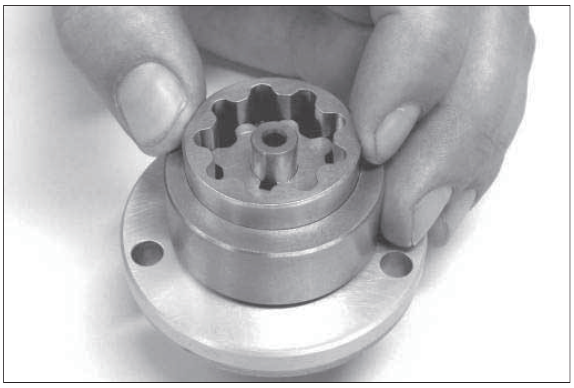
6) Mount inner rotor.

※ Place groove of inner rotor over ball (see arrows).



14WF8TM304

7) Mount outer rotor



14WF8TM305

8) Insert needle sleeve to installation dimension X into housing.

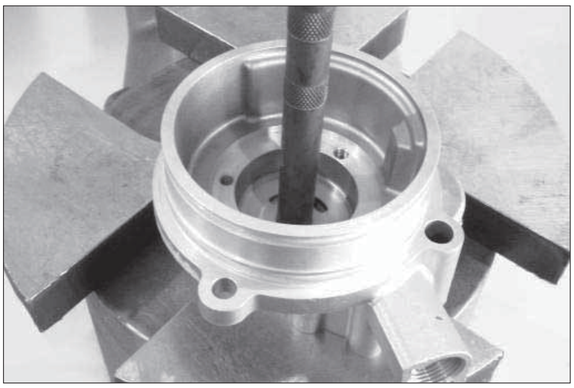
X = 0.2~0.7 mm below plane face / housing

(S) Driver tool 5870 705 003

※ Use of specified driver tool ensures exact installation position.

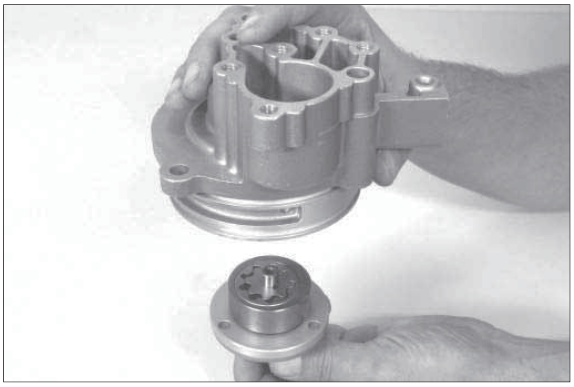
※ Insert needle sleeve with marked front face showing upwards.

※ Check opening of orifice / oil hole in housing bottom.



14WF8TM306

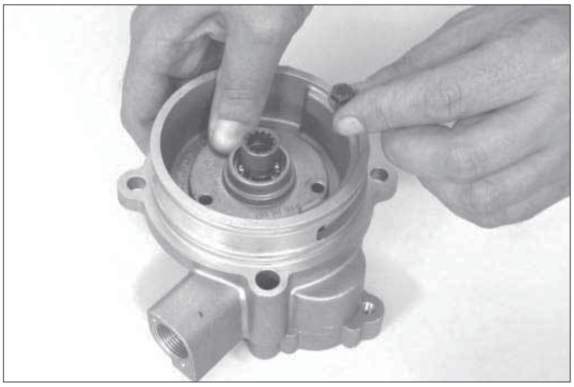
9) Maintain pump in vertical position while inserting housing with mounted needle sleeve onto preassembled pump.



14WF8TM307

10) Rotate housing by 180˚ and fix pump with hexagon screws.

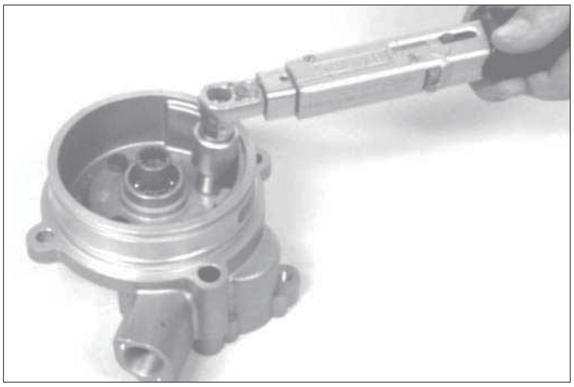
※ Maintain contact position of inserted pump.



14WF8TM308

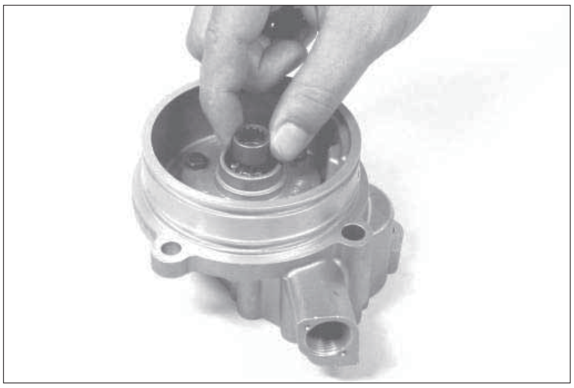
11) Fix pump.

Tightening torque (M6/8.8) M_A = 9.5 Nm



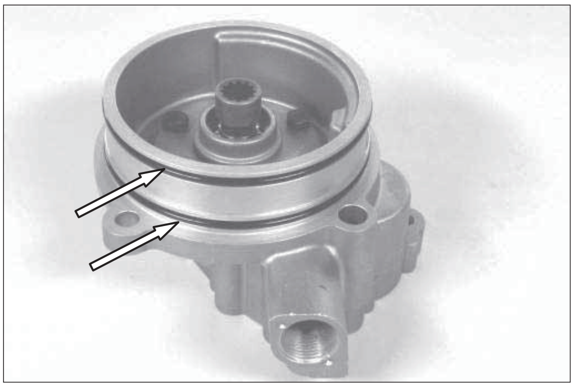
14WF8TM309

12) With counter-turning motions on pump shaft, swiveling of control housing (stop LH/RH in pump cover) is audible.



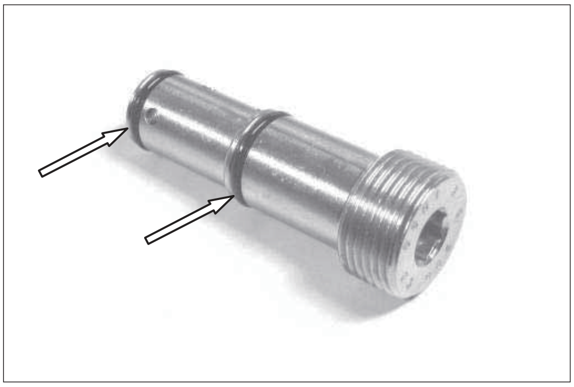
14WF8TM310

13) Oil both O-rings (arrows) and put them into annular groove of housing.



14WF8TM311

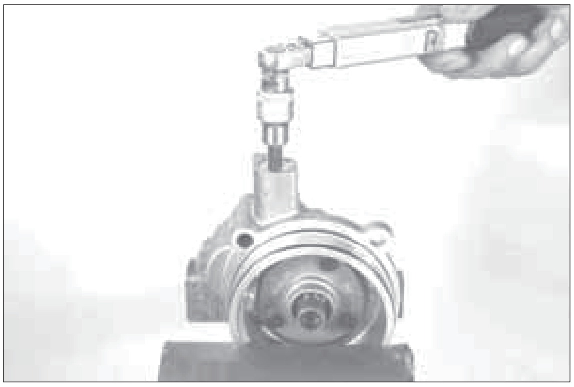
14) Insert O-rings (see arrows) into annular grooves of pressure relief valve.



14WF8TM312

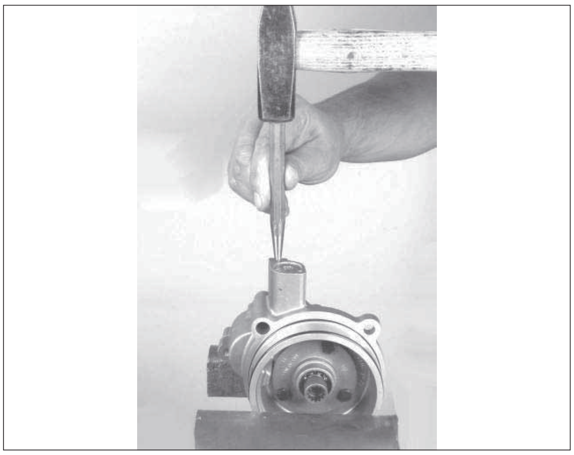
15) Mount pressure relief valve.

Tightening torque M_A = 10 Nm



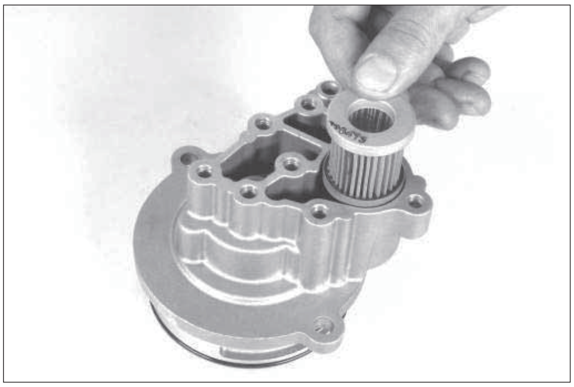
14WF8TM313

16) Secure pressure relief valve by center punch marks (2x).



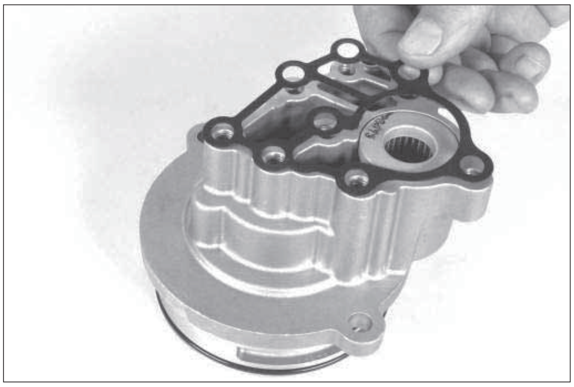
14WF8TM314

17) Insert filter.



14WF8TM315

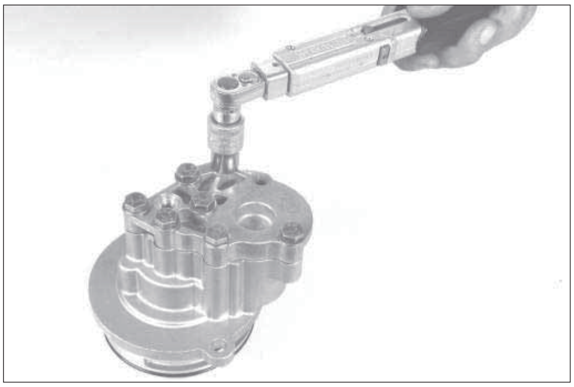
18) Place gasket.



14WF8TM316

19) Place cover and fix it with hexagon screws and disks.

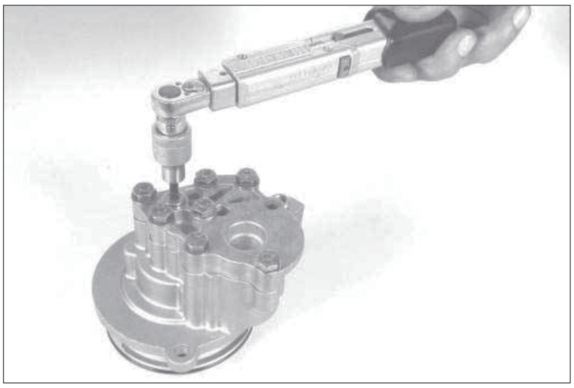
Tightening torque (M8/8.8) M_A = 23 Nm



14WF8TM317

20) Insert screw plug with new O-ring.

Tightening torque (M10 × 1) M_A = 15 Nm

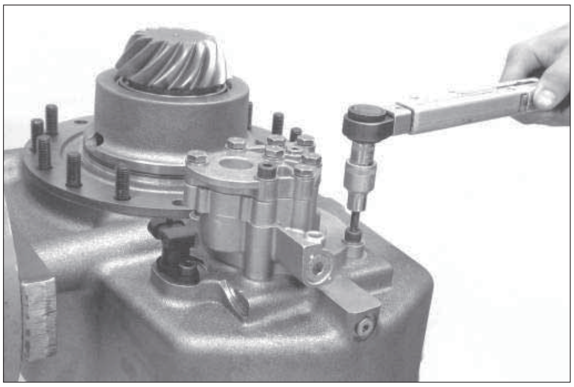


14WF8TM318

21) Mount cpl. lubrication pump and fasten it with cylindrical screws and disks.

Tightening torque (M8/10.9) M_A = 23 Nm

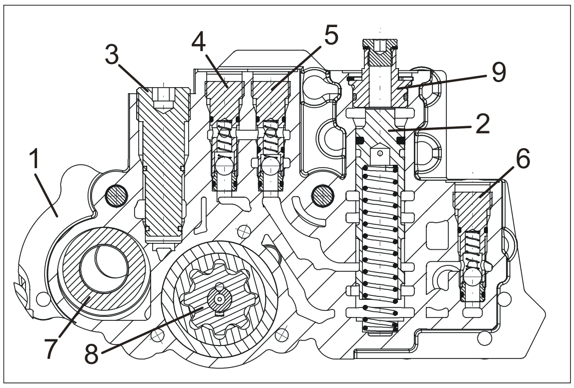
※ Prior to putting the unit into operation, observe the specifications and regulations.



14WF8TM319

12. REASSEMBLY SHIFT INTERLOCK

1) 1 = Housing
   2 = Shift piston
   3 = Pressure relief valve
   4 = Check valve (008)
   5 = Check valve (009)
   6 = Check valve (010)
   7 = Filter
   8 = Lubrication pump
   9 = Plug

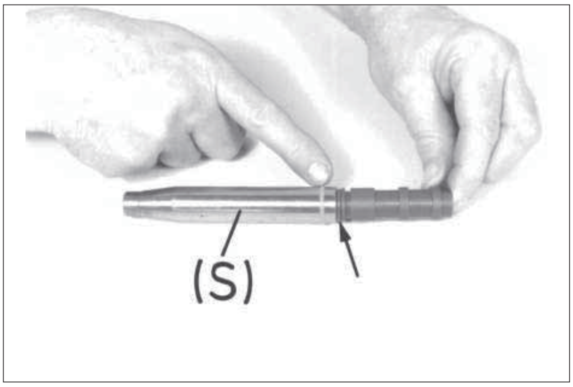


14WF8TM320

2) Put O-ring (see arrow) into annular groove of piston.
   Lead plastic ring by means of inner installer (S) over piston and position it at O-ring.

   (S) Inner installer   5870 651 055

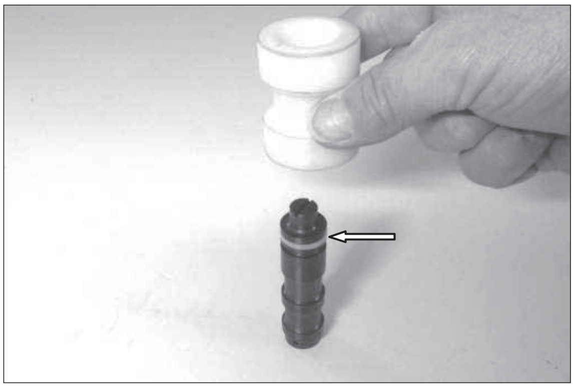
※ Seal consists of plastic ring and O-ring (see 14WF8TM321~14WF8TM322).



14WF8TM321

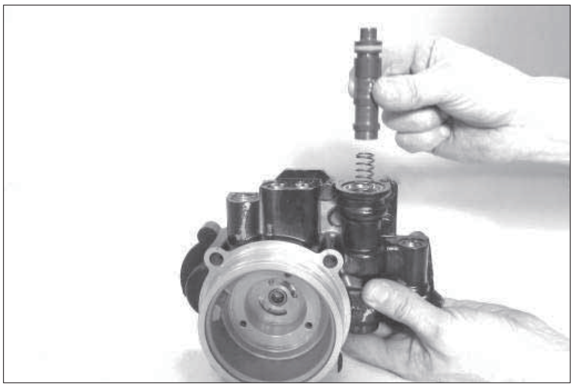
3) Center plastic ring (see arrow) with calibrating mandrel.

   (S) Calibrating mandrel   5870 651 056



14WF8TM322

4) Insert compression spring, oil preassembled piston and install.

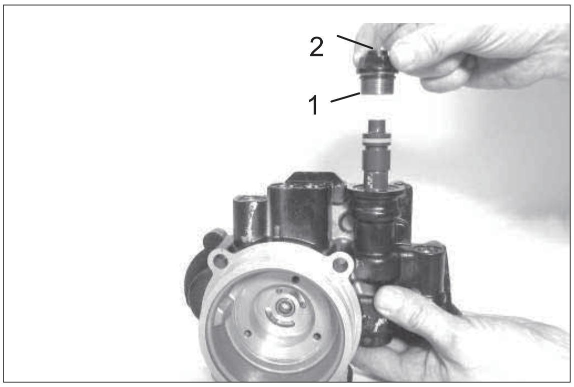


14WF8TM323

Version I :

5) Fix piston with screw plug (1- with O-ring). Install screw plug (2 – with seal ring).

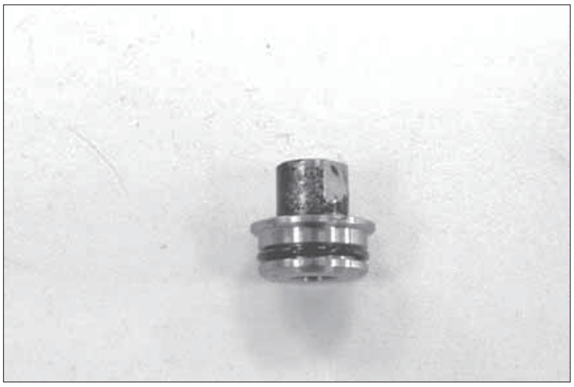
Screw plug (M24×1.5)	M_A = 50 Nm
Screw plug (M10×1)	M_A = 15 Nm



14WF8TM324

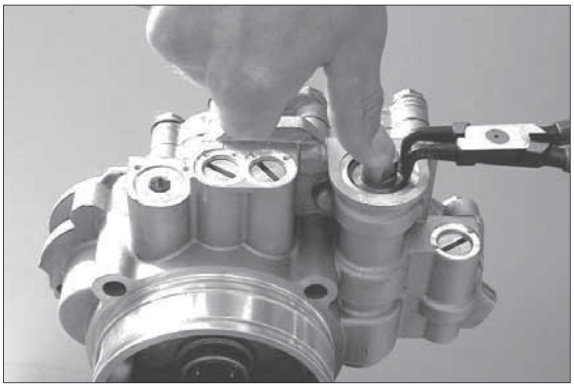
Version II (14WF8TM325 ~ 14WF8TM327) :

6) Oil O-ring and insert it into annular groove of plug.


14WF8TM325

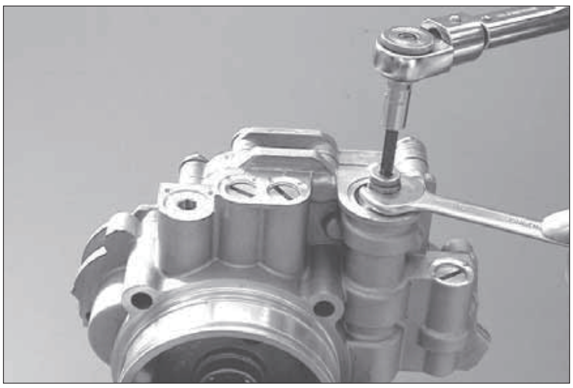
7) Fix plug by engaging retaining ring into annular groove of housing.

※ Pay attention to spring preload – protect against movement.


14WF8TM326

8) Mount screw plug with seal.

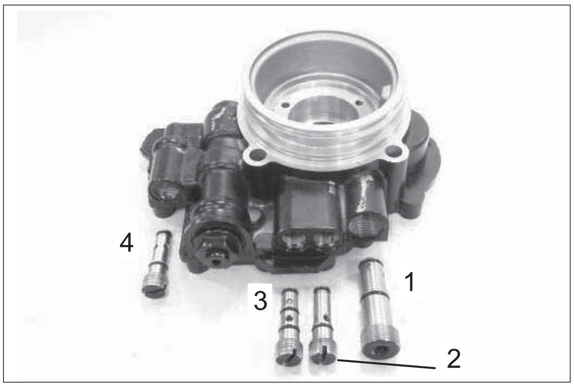
Tightening torque (M10×1) M_A = 15 Nm


14WF8TM327

9) Install single parts according to adjacent illustration.

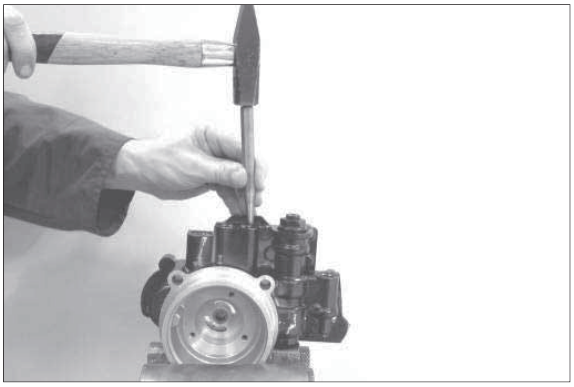
1 = Pressure relief valve cpl. M_A = 10 Nm
2 = Check valve cpl. M_A = 10 Nm
3 = Check valve cpl. M_A = 10 Nm
4 = Check valve cpl. M_A = 10 Nm

※ Observe installation position of the different check valves (see also 14WF8TM320).



14WF8TM328

10) Secure check valves and pressure relief valves with two center punch marks each.

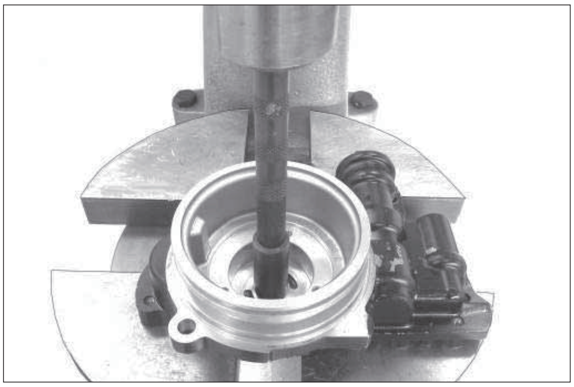

14WF8TM329

11) Insert needle sleeve to installation dimension X into housing.

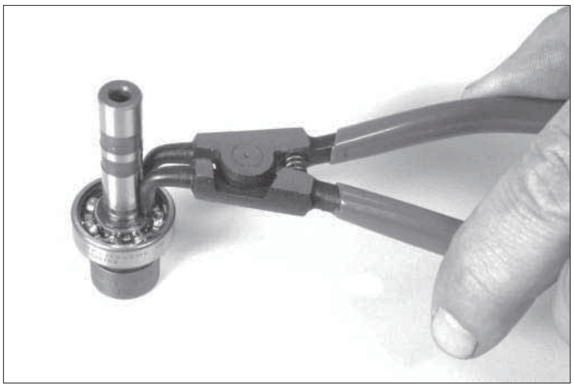
X = 0.2~0.7 mm below plane face/housing

(S) Driver tool 5870 705 003

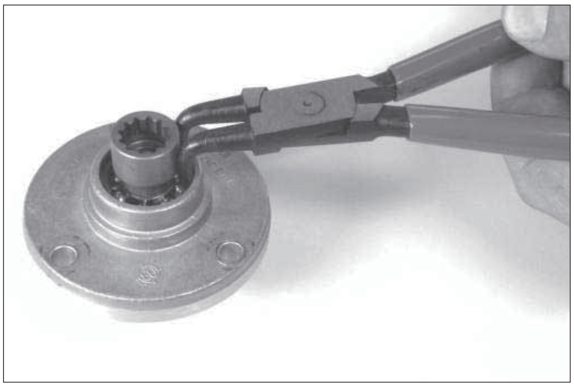
※ Use of specified driver ensures exact installation position.
※ Insert needle sleeve with marked front face showing upwards.
※ Check opening of orifice / oil hole in housing bottom.


14WF8TM330

12) Insert ball bearing onto pump shaft and fix it by engaging retaining ring into annular groove of pump shaft.


14WF8TM331

13) Press preassembled pump shaft into pump cover and fix it by engaging retaining ring into annular groove of pump cover.

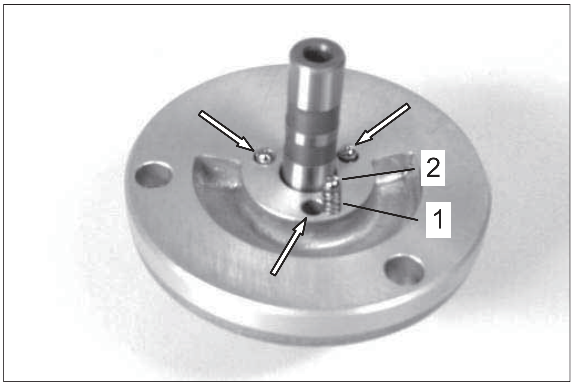


14WF8TM332

14) Insert compression springs (1) and ball (2) into holes (see arrows - 3x).

⚠ **Prior to installation, oil single parts of pump/ rotor set (control housing, inner and outer rotor) – use oil (lubrication)**

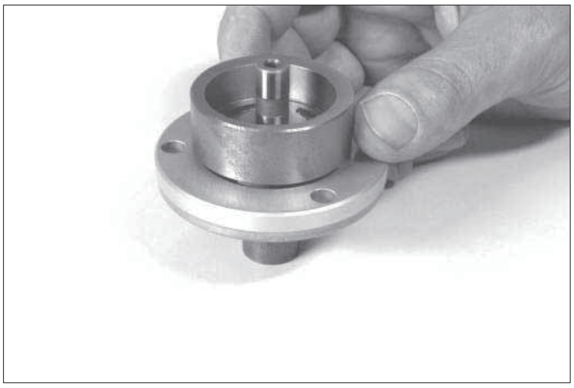
※ Keep preassembled single parts in vertical position – pay attention to position of inserted balls and compression springs (see work steps 14WF8TM333 ~14WF8TM338).



14WF8TM333

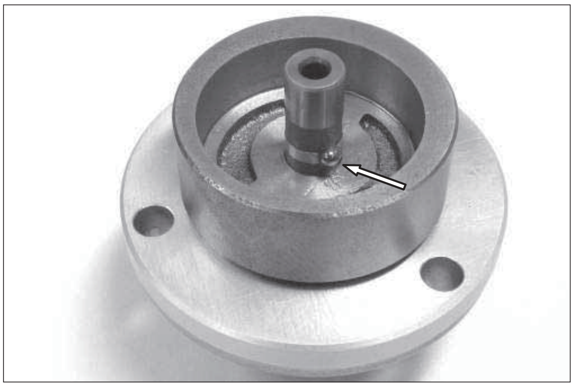
15) Mount control housing.

※ Control housing, inner and outer rotor = rotor set



14WF8TM334

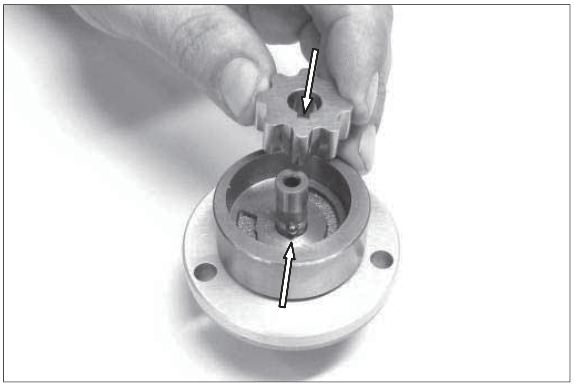
16) Position ball – (see arrow –engagement for inner rotor) with grease into countersink of pump shaft



14WF8TM335

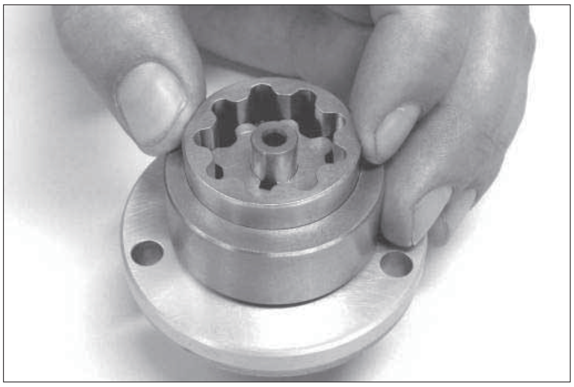
17) Mount inner rotor.

※ Place groove of inner rotor over ball (see arrows).



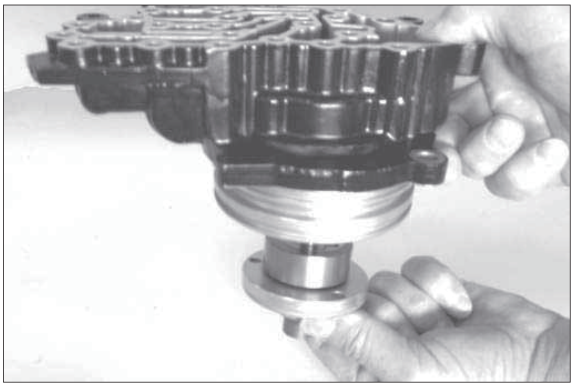
14WF8TM336

18) Mount outer rotor.



14WF8TM337

19) Maintain pump in vertical position while inserting housing with mounted needle sleeve onto preassembled pump.

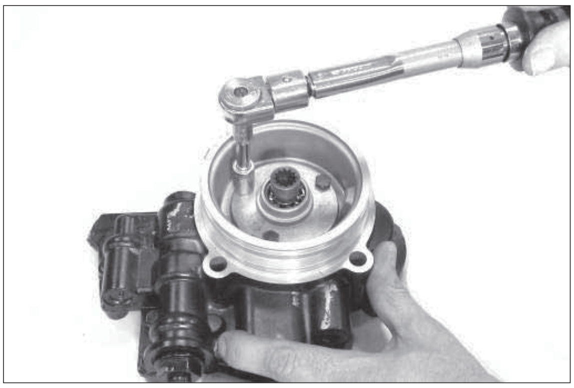


14WF8TM338

20) Rotate housing by 180˚ and fix pump with hexagon screws.

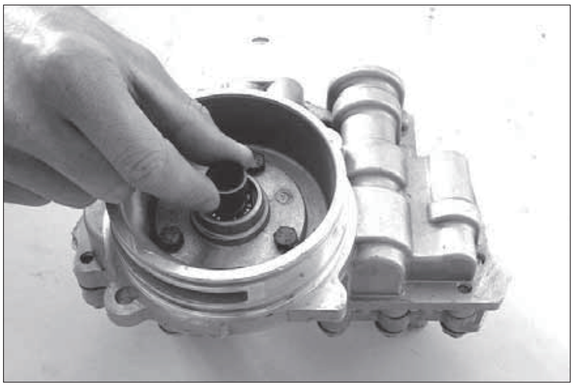
Tightening torque (M6/8.8) M_A = 9.5 Nm

※ Maintain contact position of inserted pump.



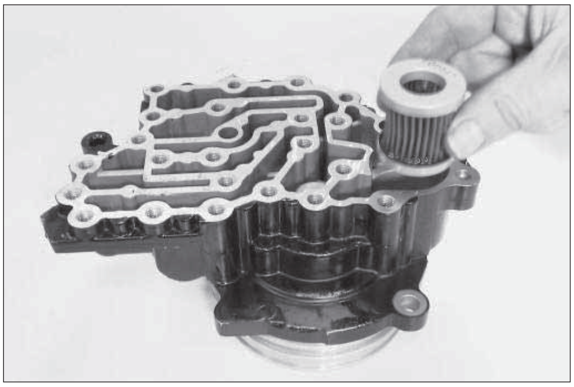
14WF8TM339

21) With counter-turning motions on pump shaft, swiveling of control housing (stop LH/RH in pump cover) is audible.



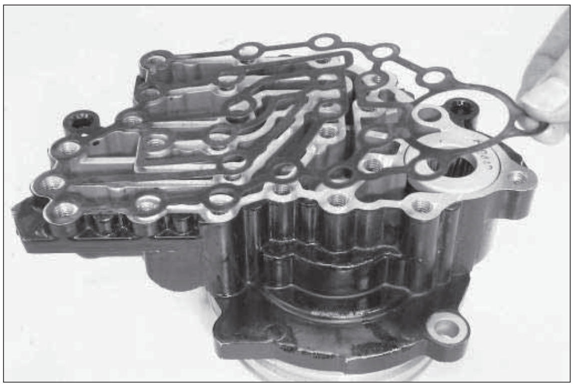
14WF8TM340

22) Insert screen filter.



14WF8TM341

23) Place gasket.

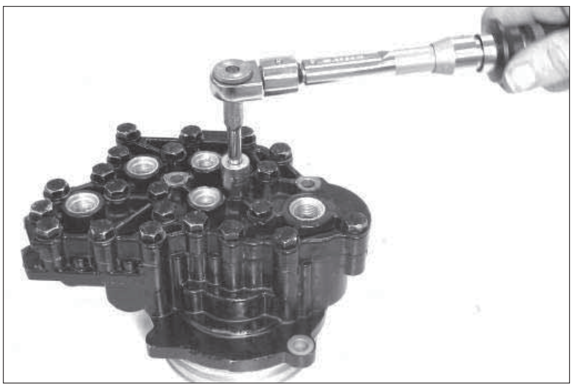


14WF8TM342

24) Place cover and fix with hexagon screws and disks.

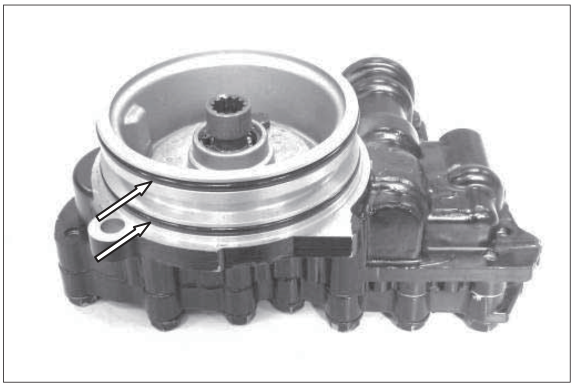
Tightening torque (M8/8.8) M_A = 23 Nm

※ Pay attention to different screw length.



14WF8TM343

25) Oil both O-rings (arrows) and put them into annular groove of housing.

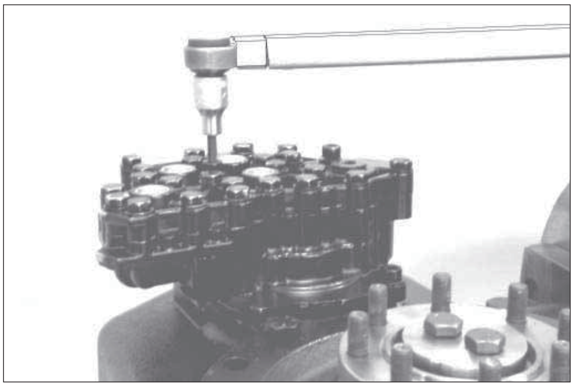


14WF8TM344

26) Insert cpl. shift interlock and fix with cylindrical screws with disks.

Tightening torque (M8/10.9) M_A = 23 Nm

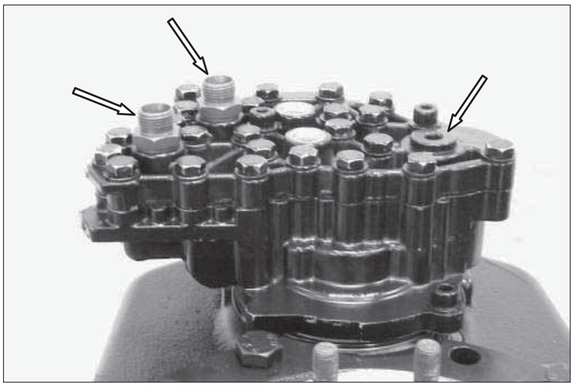
※ Pay attention to different screw length.



14WF8TM345

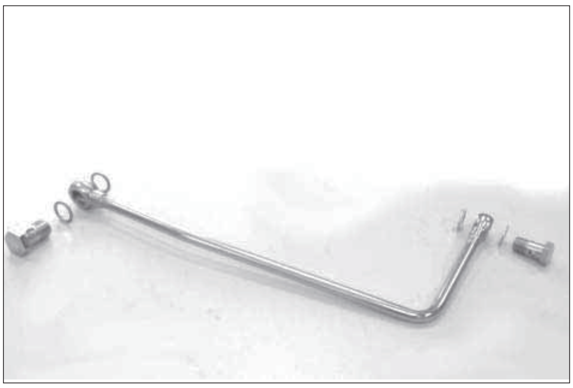
27) Install both screw-in sleeves and screw plug (see arrow) with O-rings.

Screw-in sleeve (M 16×1.5) M_A = 30 Nm
Screw plug (M 18×1.5) M_A = 35 Nm



14WF8TM346

28) 1 = Oil tube
2 = Hollow screw (M16×1.5)
3 = Seal ring
4 = Hollow screw (M14×1.5)
5 = Seal ring

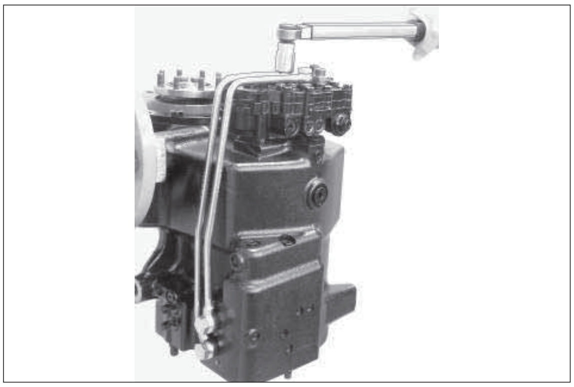


14WF8TM347

29) Mount oil tubes.

Hollow screw (M14×1.5) M_A = 40 Nm
Hollow screw (M16×1.5) M_A = 40 Nm

※ Prior to putting the unit into operation, observe the specifications and regulations.

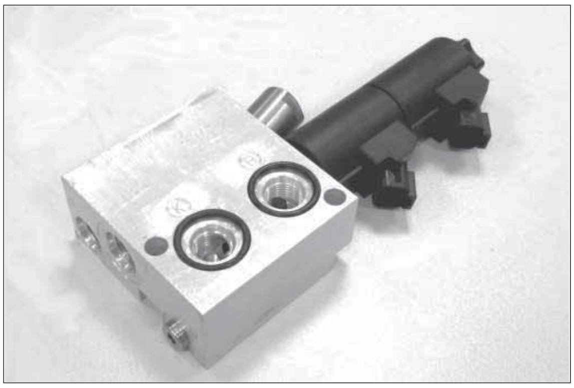


14WF8TM3428

13. VALVE BLOCK (shifting low gear – high gear)

1) Insert O-rings (see arrows) into countersinks of valve block.

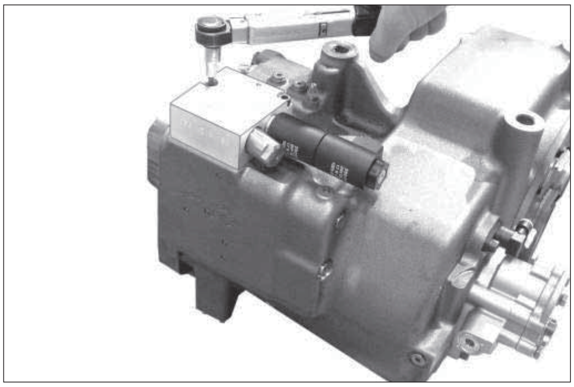
※ Use grease as assembly aid.



14WF8TM349

2) Fix cpl. valve block with cylindrical screws.

Tightening torque (M8/10.9) M_A = 23 Nm

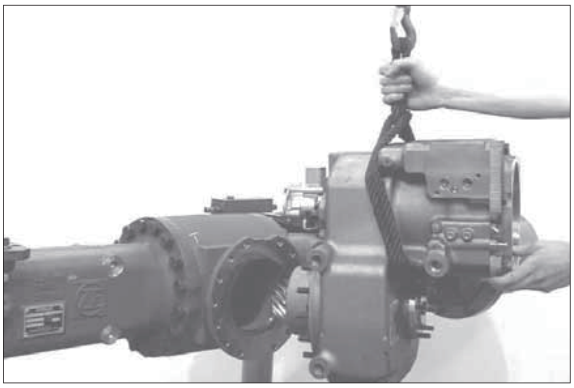


14WF8TM350

14. Mount TRANSMISSION to AXLE (only for version axle attachment)

1) Position complete transmission to axle.

(S) Lifting strap 5870 281 026

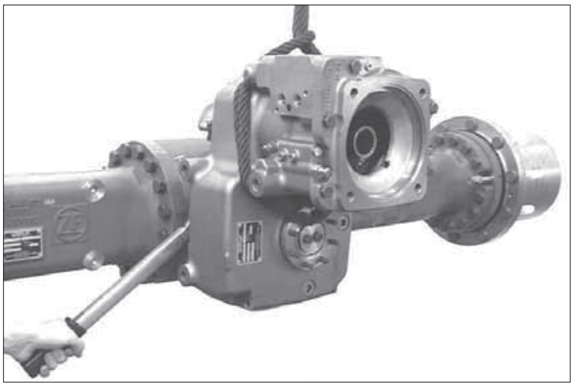


14WF8TM351

2) Fix transmission to axle with hexagon screws and nuts.

Tightening torque (M12/8.8) M_A = 79 Nm

※ Prior to putting the unit into operation, observe the specifications and regulations.



14WF8TM352

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.

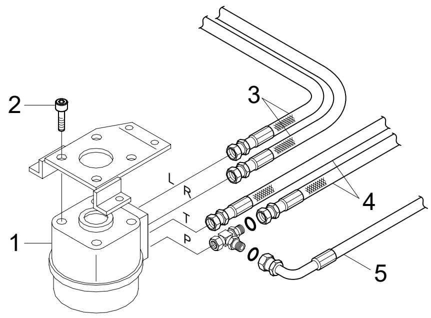
⚠ **Escaping fluid under pressure can penetrate the skin causing serious injury.**

(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)

13031GE18



14W7A8SV01

2) INSTALL

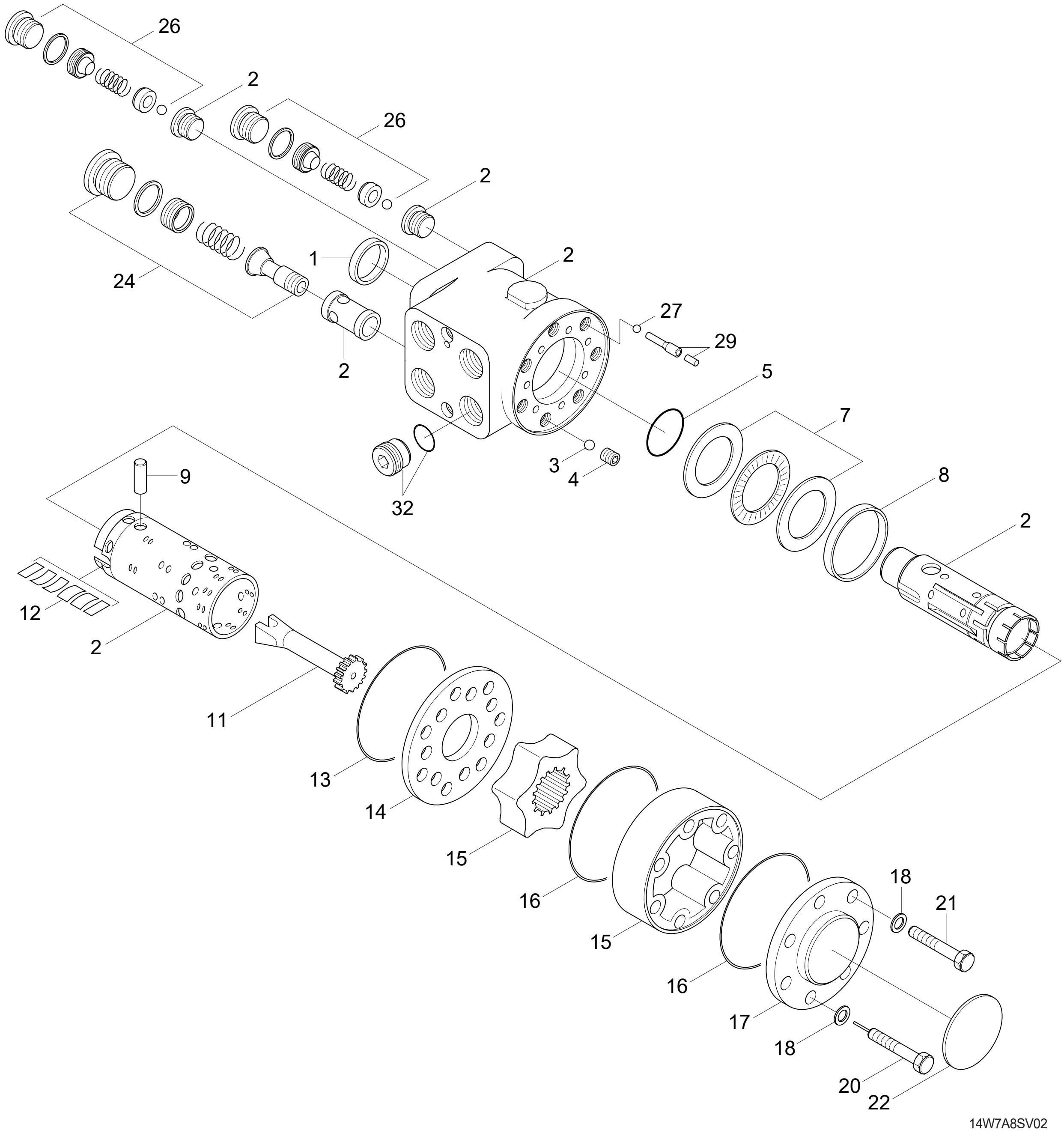
(1) Carry out installation in the reverse order to removal.

(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

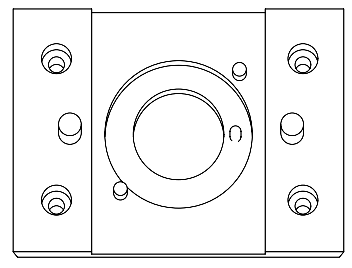


1	Dust seal ring	11	Cardan shaft	20	Pin screw
2	*Housing, spool, sleeve	12	Spring set	21	Screw
3	Ball	13	O-ring	22	Name plate
4	Bushing	14	Distributor plate	24	Relief valve assy
5	O-ring	15	Gear wheel set	26	Shock valve
7	Bearing assy	16	O-ring	27	Ball
8	Ring	17	End cover	29	W/pin bushing
9	Cross pin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

* Housing, spool and sleeve (check valve and the seats for relief and dual shock valves are loctited).

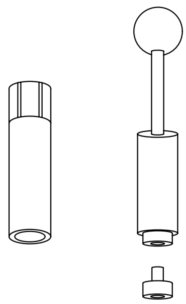
2) TOOLS

(1) Holding tool.



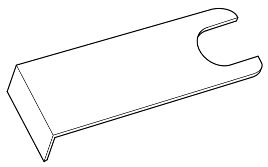
2-1 (200W-3)

(2) Assembly tool for O-ring (5,13,16) and kin-ring (6).



2-2 (200W-3)

(3) Assembly tool for cardan shaft (11).

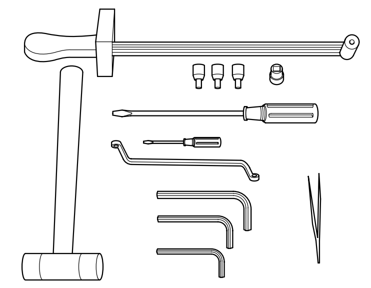


3-1 (200W-3)

(4) Assembly tool for dust seal (1).

3-2 (200W-3)

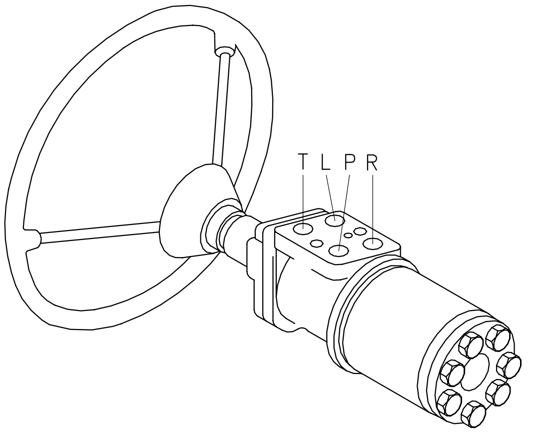
(5) Torque wrench : 0~7.1 kgf · m
(0~54.4 lbf · ft)
13 mm socket spanner.
6, 8 mm and 12 mm hexagon sockets.
12 mm screwdriver.
2 mm screwdriver.
13 mm ring spanner.
6,8 mm and 12 mm hexagon socket spanners.
Plastic hammer.
Tweezers.



3-3 (200W-3)

3) TIGHTENING TORQUE AND HYDRAULIC CONNECTIONS

(1) Hydraulic connections



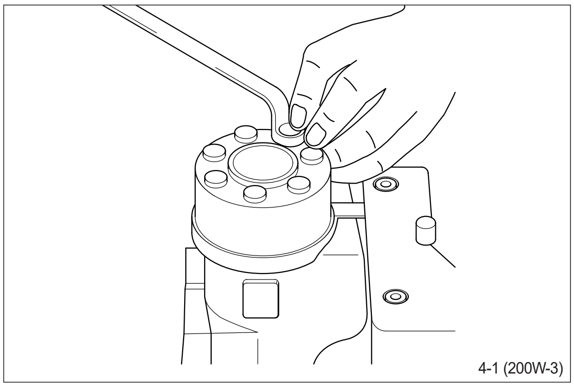
L : Left port
R : Right port
T : Tank
P : Pump

(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)

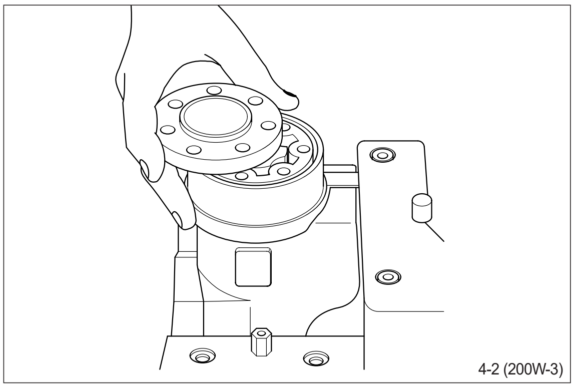
4) DISASSEMBLY

(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).



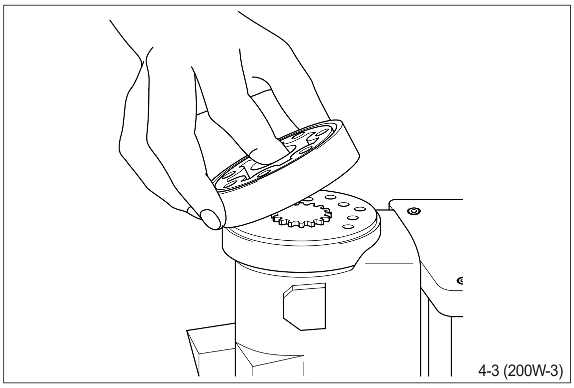
4-1 (200W-3)

(2) Remove the end cover, sideways.



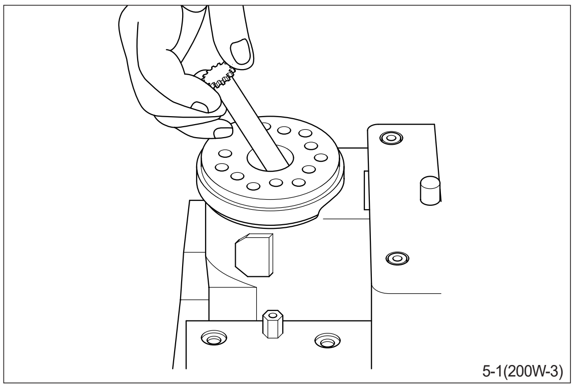
4-2 (200W-3)

(3) Lift the gearwheel set (with spacer if fitted) off the unit.
Take out the two O-rings.



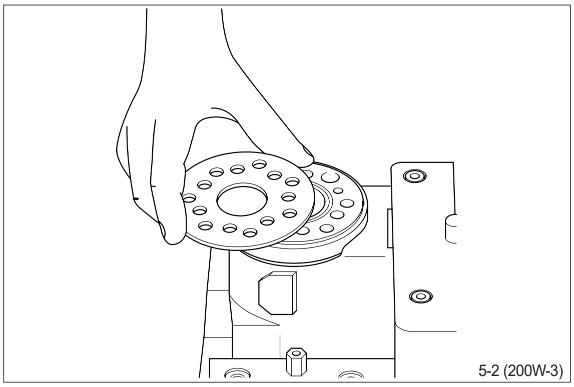
4-3 (200W-3)

(4) Remove cardan shaft.



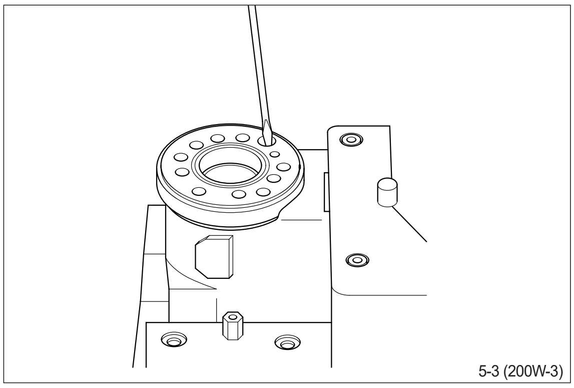
5-1(200W-3)

(5) Remove distributor plate.



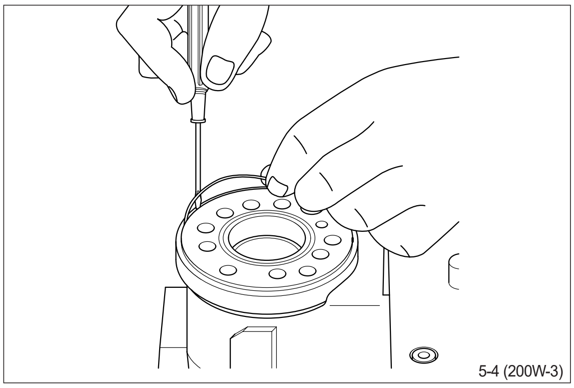
5-2 (200W-3)

(6) Screw out the threaded bushing over the check valve.



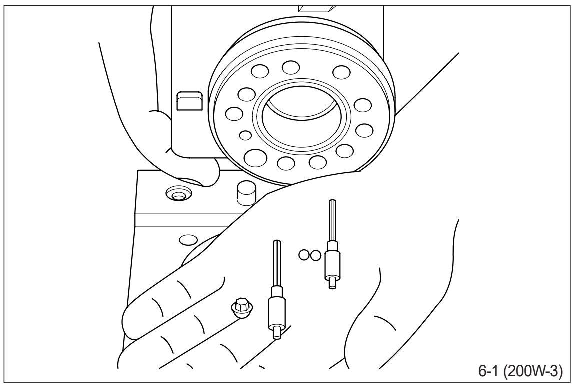
5-3 (200W-3)

(7) Remove O-ring.



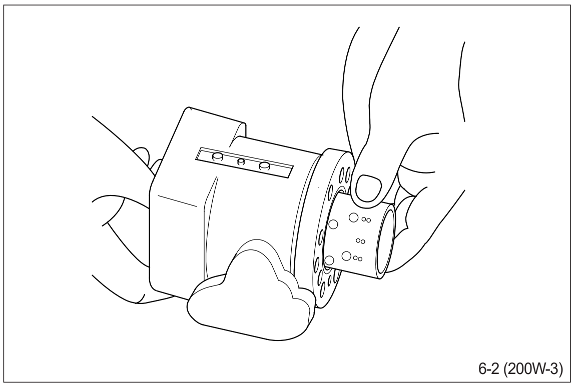
5-4 (200W-3)

(8) Shake out the check valve ball and suction valve pins and balls.

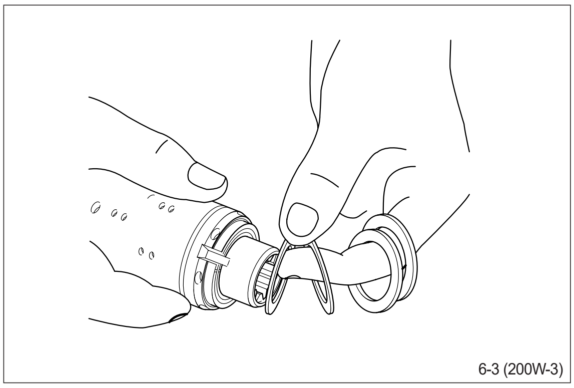


6-1 (200W-3)

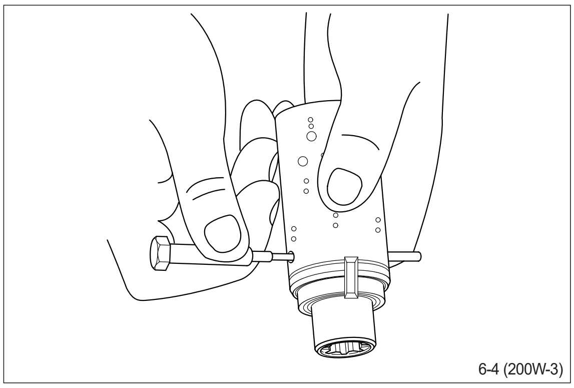
(9) Take care to keep the cross pin in the sleeve and spool horizontal. The pin can be seen through the open end of the spool. Press the spool inwards and the sleeve, ring, bearing races and needle bearing will be pushed out of the housing together.


6-2 (200W-3)

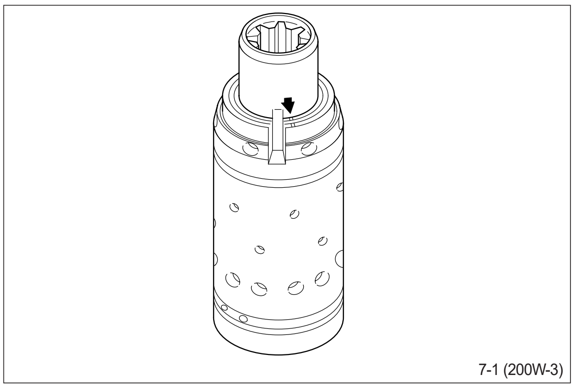
(10) Take ring, bearing races and needle bearing from sleeve and spool. The outer(thin)bearing race can sometimes "stick" in the housing, therefore check that it has come out.


6-3 (200W-3)

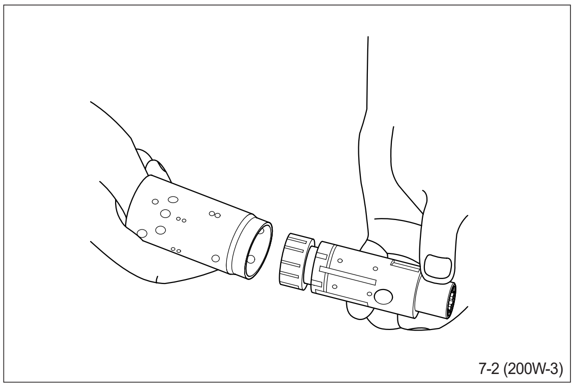
(11) Press out the cross pin. Use the special screw from the end cover.


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.

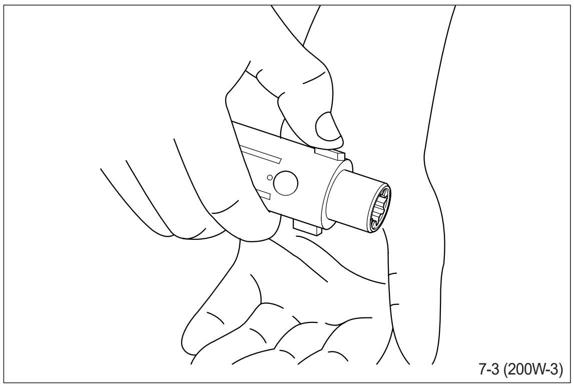

7-1 (200W-3)

(12) Carefully press the spool out of the sleeve.



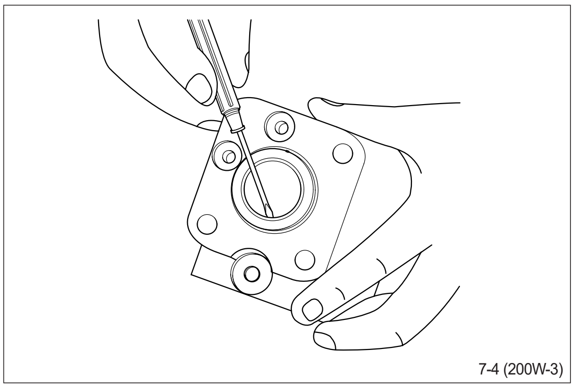
7-2 (200W-3)

(13) Press the neutral position springs out of their slots in the spool.



7-3 (200W-3)

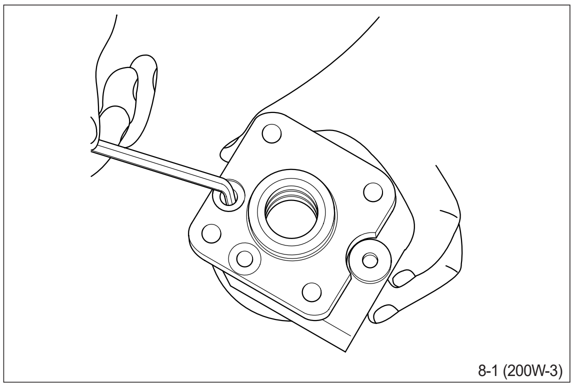
(14) Remove dust seal and O-ring.



7-4 (200W-3)

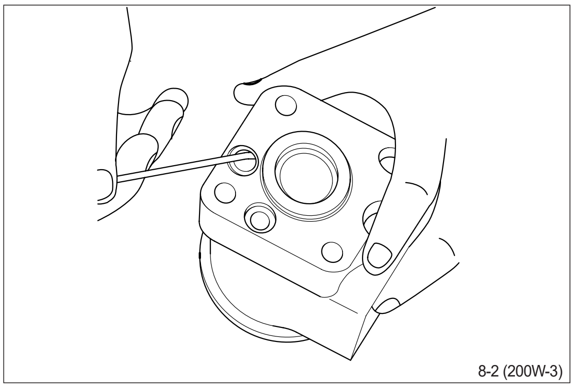
(15) Disassemble the dual shock valve

① Remove plugs from shock valves using a 6㎜ hexagon socket spanner.



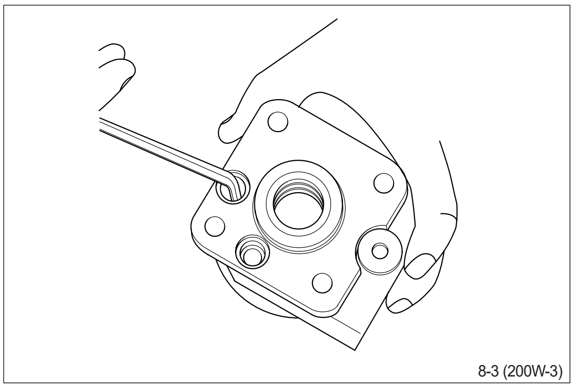
8-1 (200W-3)

② Remove seal washers (2-off).



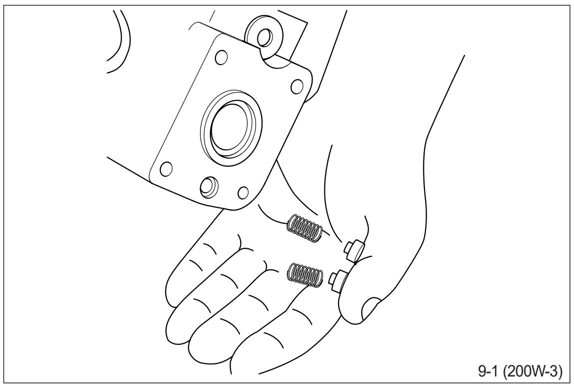
8-2 (200W-3)

③ Unscrew the setting screws using a 6 ㎜ hexagon socket spanner.



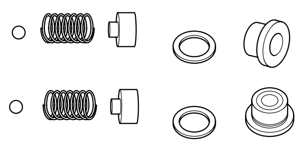
8-3 (200W-3)

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)

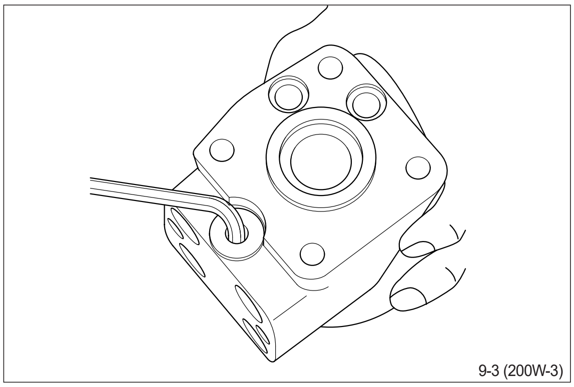
⑤ The dual shock valves are now disassembled.



9-2 (200W-3)

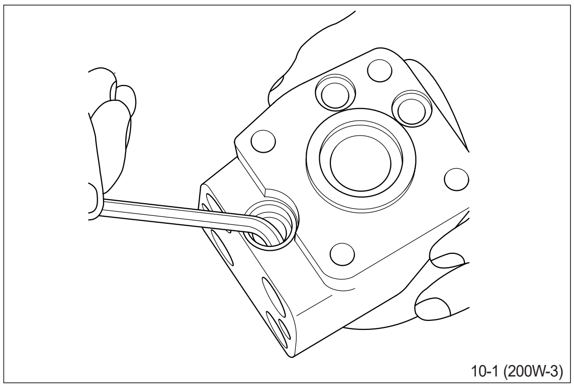
(16) Disassemble the pressure relief valve (cartridge)

① Screw out the plug using an 8 mm hexagon socket spanner. Remove seal washers.



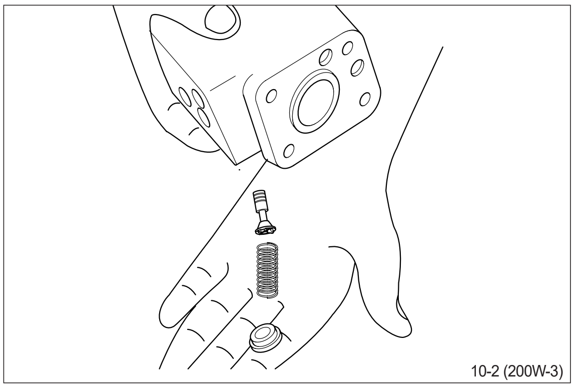
9-3 (200W-3)

② Unscrew the setting screw using an 8mm hexagon socket spanner.



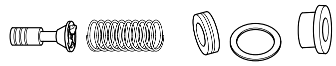
10-1 (200W-3)

③ Shake out spring and piston. The valve seat is bonded into the housing and cannot be removed.



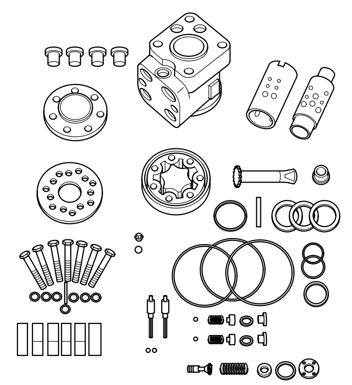
10-2 (200W-3)

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

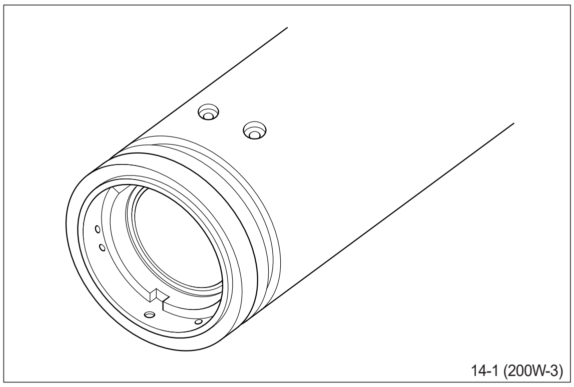
Replace all seals and washers. Check all parts carefully and make any replacements necessary.

※ Lubrication

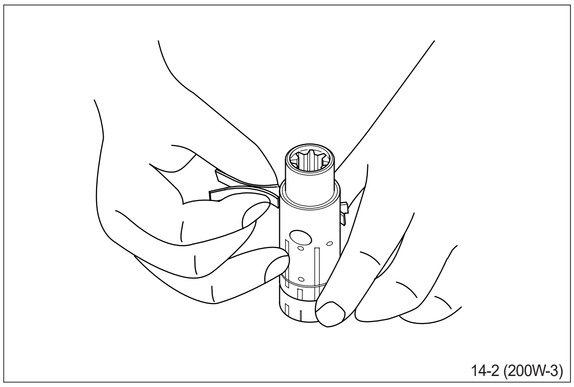
Before assembly, lubricate all parts with hydraulic oil.

5) ASSEMBLY

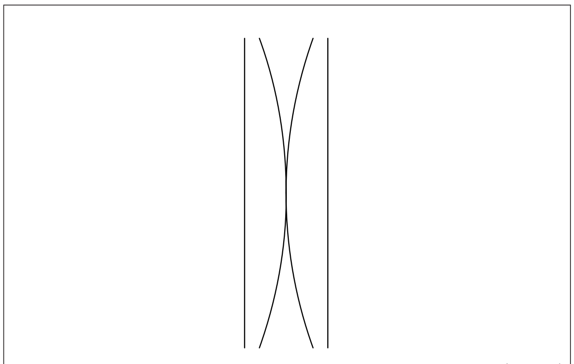
(1) Assemble spool and sleeve.
When assembling spool and sleeve only one of two possible ways of positioning the spring slots is correct. There are three slots in the spool and three holes in the sleeve in the end of the spool / sleeve opposite to the end with spring slots.
Place the slots and holes opposite each other so that parts of the holes in the sleeve are visible through the slots in the spool.


14-1 (200W-3)

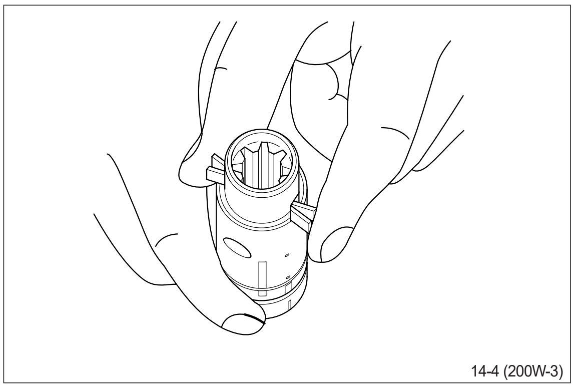
(2) Place the two flat neutral position springs in the slot.
Place the curved springs between the flat ones and press them into place (see assembly pattern).


14-2 (200W-3)

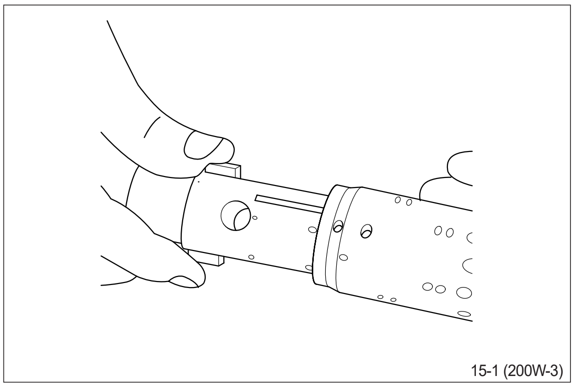
※ Assembly pattern.
· Part no : 150N4035


14-3 (200W-3)

(3) Line up the spring set.

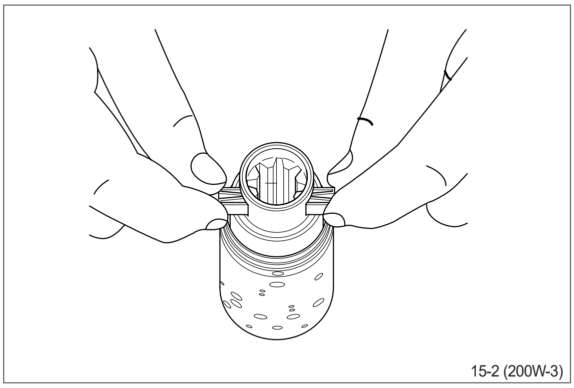

14-4 (200W-3)

(4) Guide the spool into the sleeve. Make sure that spool and sleeve are placed correctly in relation to each other.



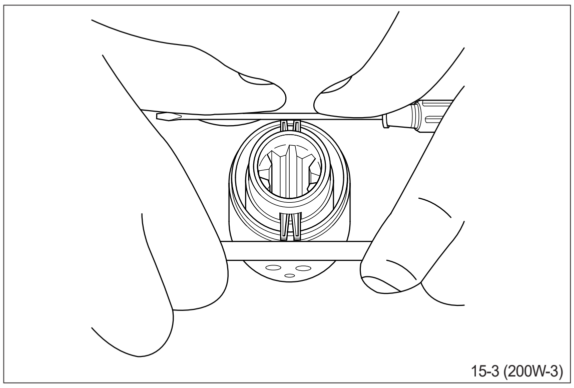
15-1 (200W-3)

(5) Press the springs together and push the neutral position springs into place in the sleeve.



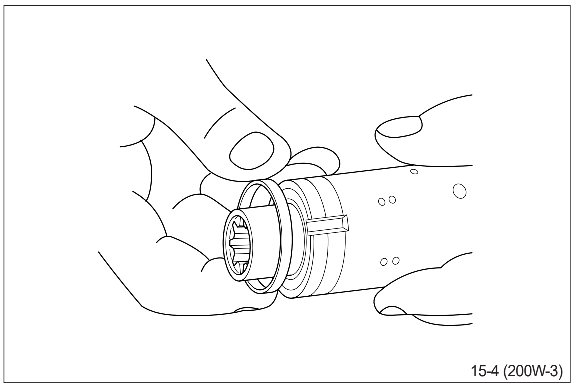
15-2 (200W-3)

(6) Line up the springs and center them.



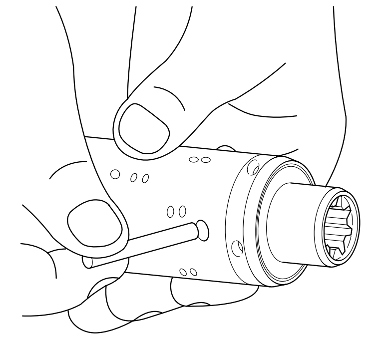
15-3 (200W-3)

(7) Guide the ring down over the sleeve.
※ The ring should be able to rotate free of the springs.



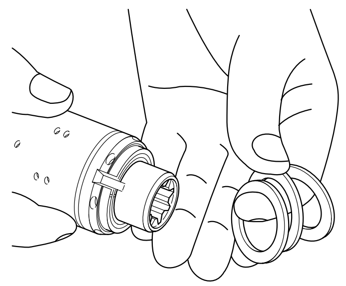
15-4 (200W-3)

(8) Fit the cross pin into the spool / sleeve.



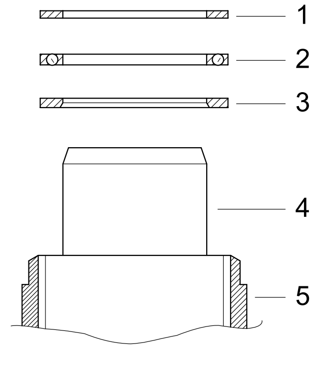
16-1 (200W-3)

(9) Fit bearing races and needle bearing as shown on below drawing.



16-2 (200W-3)

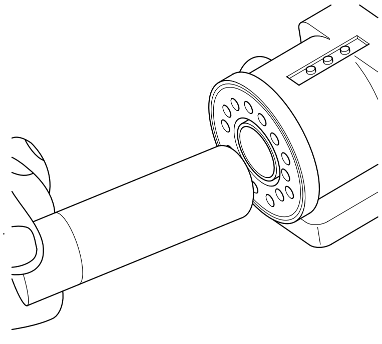
※ Assembly patted for standard bearings
1 Outer bearing race
2 Needle bearing
3 Inner bearing race
4 Spool
5 Sleeve



16-3 (200W-3)

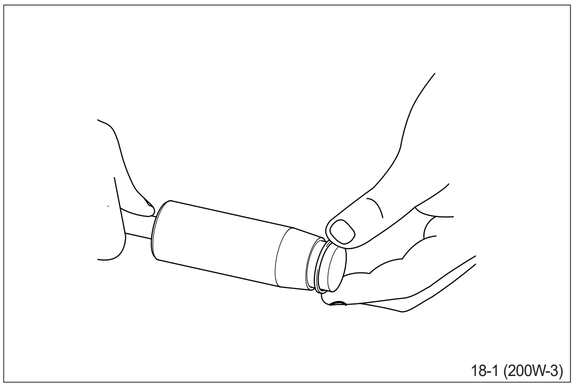
Installation instruction for O-ring

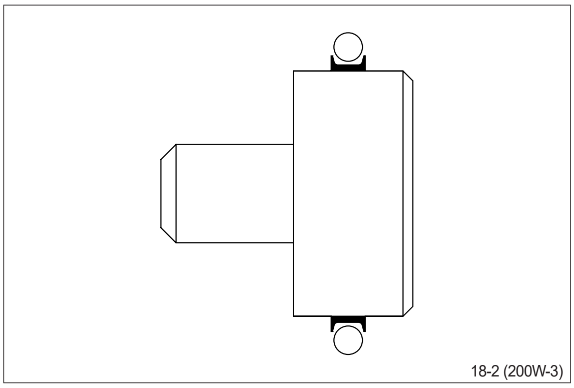
(10) Turn the steering unit until the bore is horizontal. Guide the outer part of the assembly tool into the bore for the spool / sleeve.



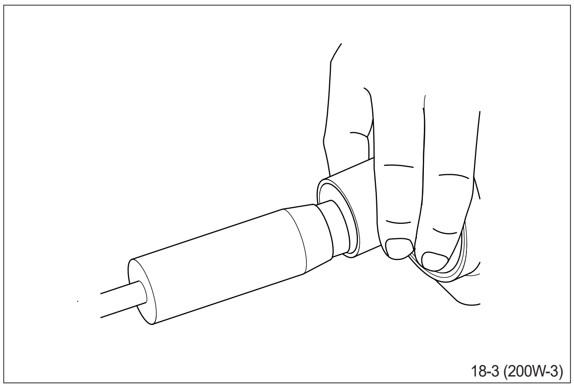
17-1 (200W-3)

(11) Grease O-ring with hydraulic oil and place them on the tool.

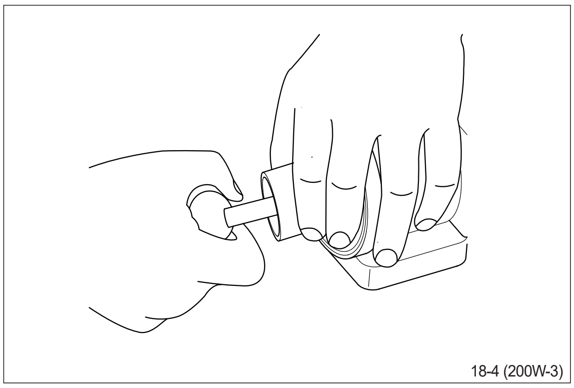

18-1 (200W-3)


18-2 (200W-3)

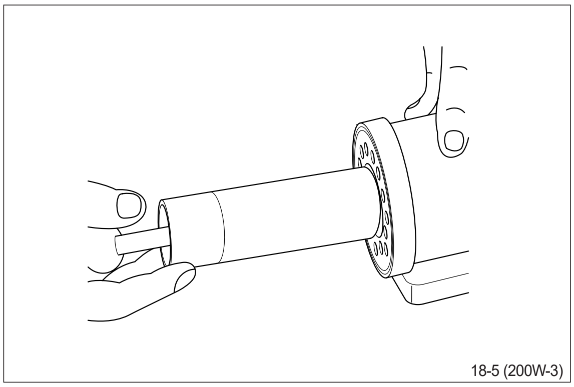
(12) Hole the outer part of the assembly tool in the bottom of the steering unit housing and guide the inner part of the tool right to the bottom.


18-3 (200W-3)

(13) Press and turn the O-ring into position in the housing.


18-4 (200W-3)

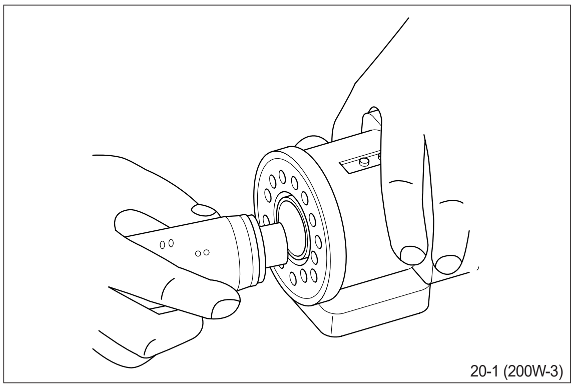
(14) Draw the inner and outer parts of the assembly tool out of the steering unit bore, leaving the guide from the inner part in the bore.



18-5 (200W-3)

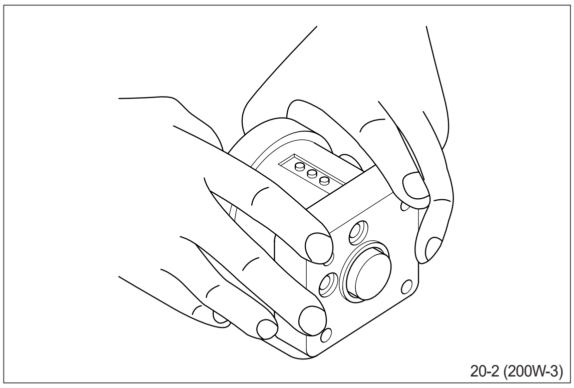
(15) With a light turning movement, guide the spool and sleeve into the bore.

※ Fit the spool set holding the cross pin horizontal.



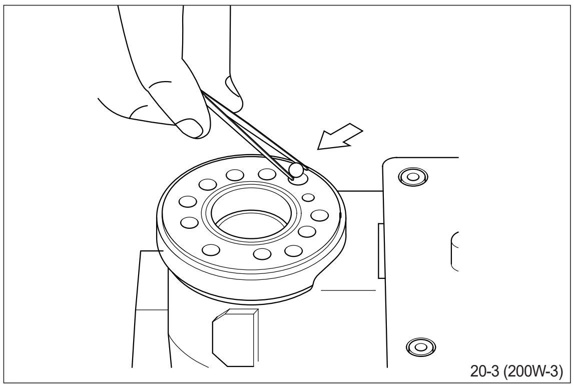
20-1 (200W-3)

(16) The spool set will push out the assembly tool guide. The O-ring is now in position.



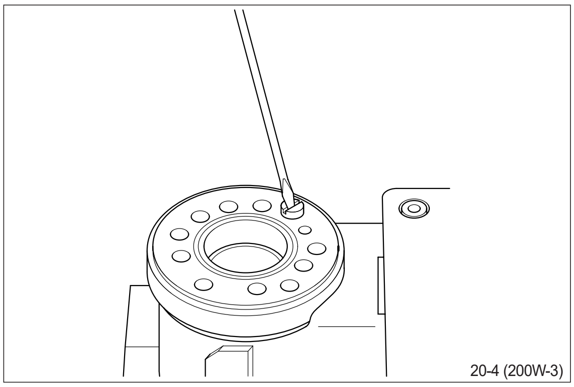
20-2 (200W-3)

(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)

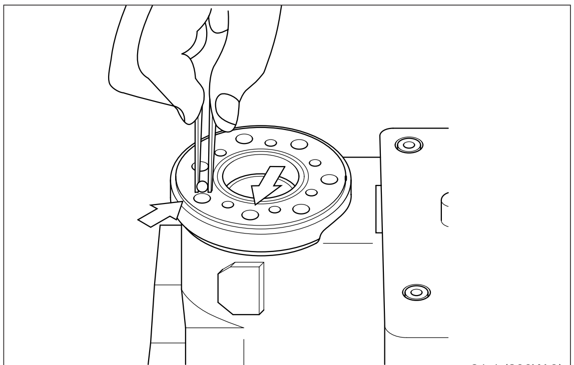
(18) Screw the threaded bush lightly into the check valve bore. The top of the bushing must lie just below the surface of the housing.



20-4 (200W-3)

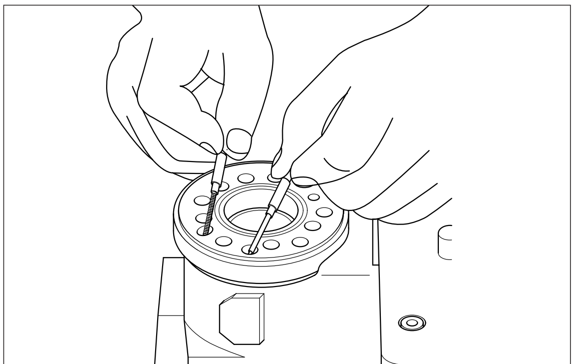
Assembly of the two suction valve

(19) Place a ball in the two holes indicated by the arrows.



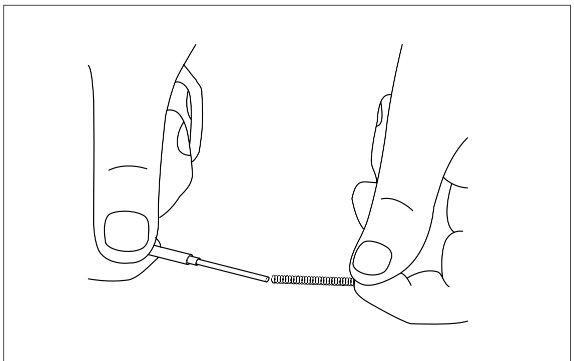
21-1 (200W-3)

(20) Place a pin in the same two holes.



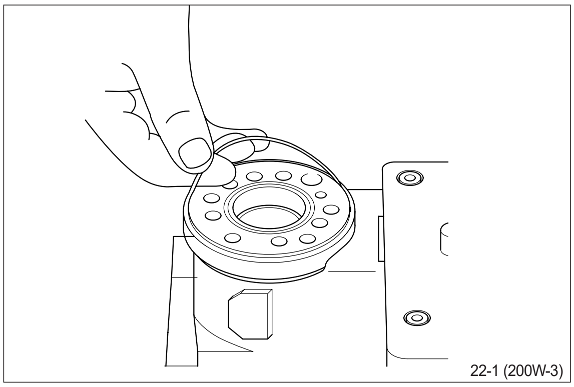
21-2 (200W-3)

(21) In some cases a spring has to be fitted on the pin before it is placed in the housing.



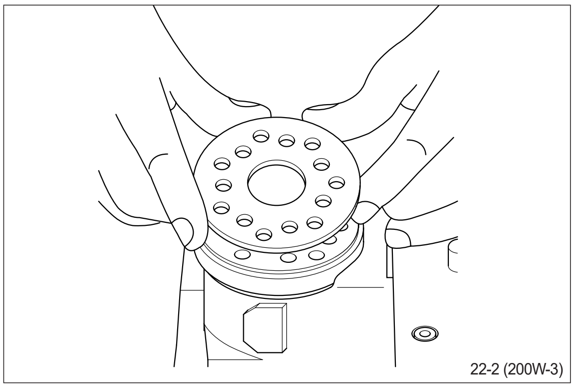
21-3 (200W-3)

(22) Grease the O-ring with mineral oil approx viscosity 500 cST at 20°C.



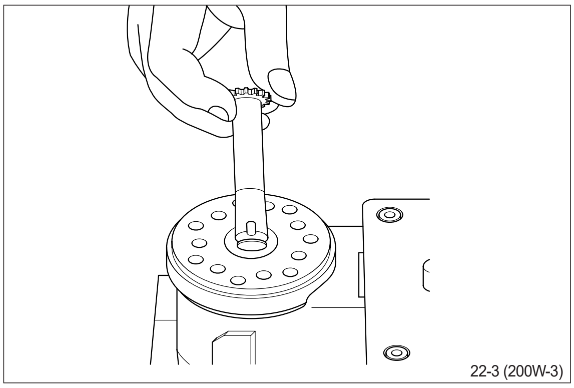
22-1 (200W-3)

(23) Place the distributor plate so that the channel holes match the holes in the housing.



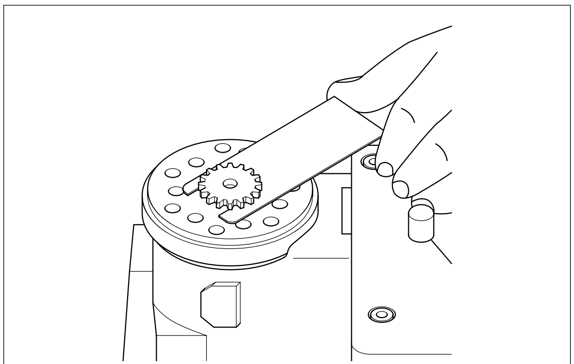
22-2 (200W-3)

(24) Guide the cardan shaft down into the bore so that the slot is parallel with the connection flange.



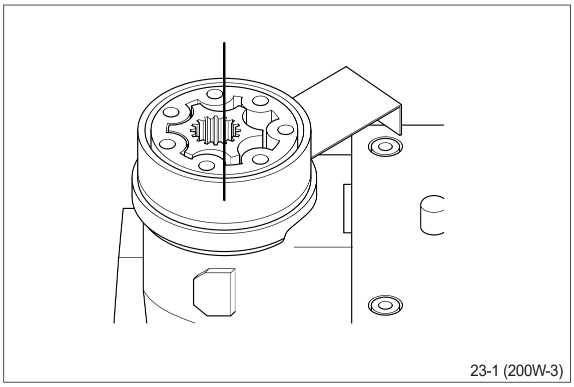
22-3 (200W-3)

(25) Place the cardan shaft as shown so that it is held in position by the mounting fork.

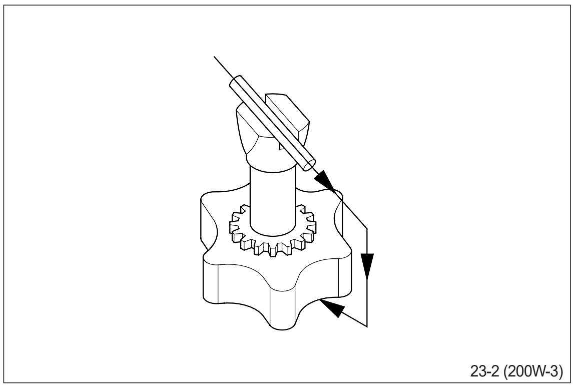


22-4 (200W-3)

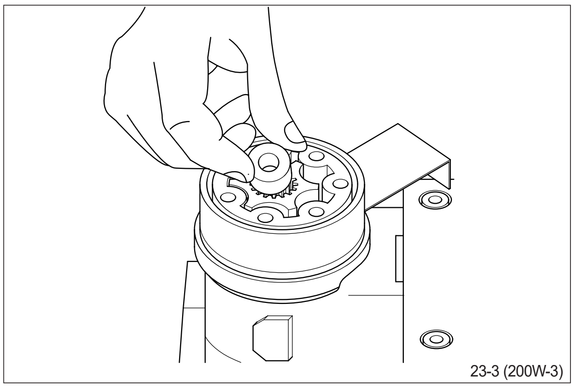
(26) Grease the two O-rings with mineral oil approx. viscosity 500 cST at 20°C and place them in the two grooves in the gear rim. Fit the gearwheel and rim on the cardan shaft.


23-1 (200W-3)

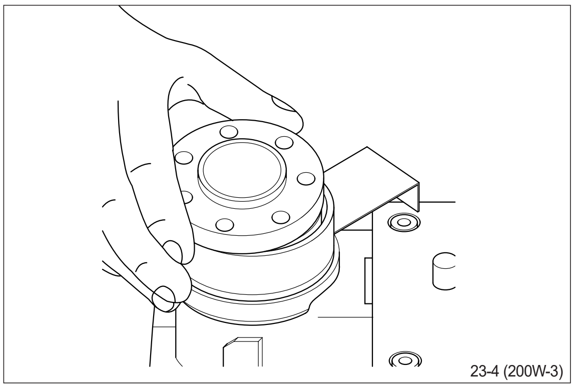
(27) Fit the gearwheel (rotor) and cardan shaft so that a tooth base in the rotor is positioned in relation to the shaft slot as shown. Turn the gear rim so that the seven through holes match the holes in the housing.


23-2 (200W-3)

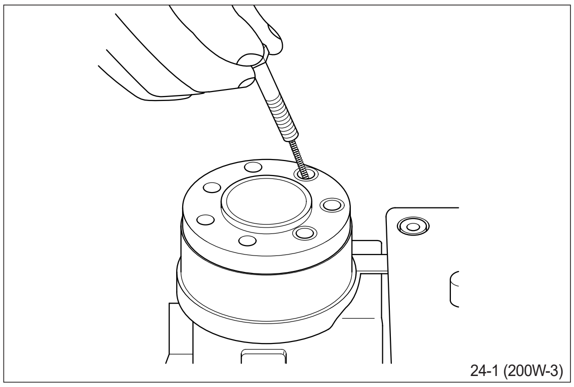
(28) Fit the spacer, if any.


23-3 (200W-3)

(29) Place the end cover in position.


23-4 (200W-3)

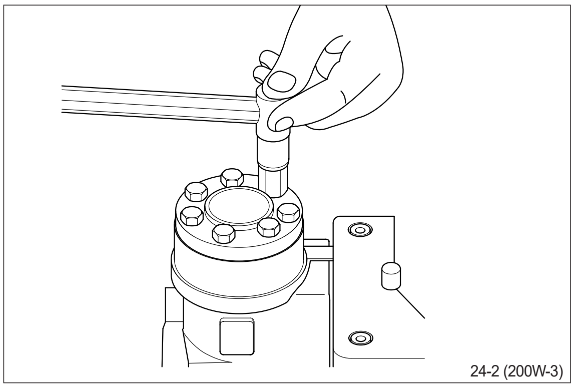
(30) Fit the special screw with washer and place it in the hole shown.



24-1 (200W-3)

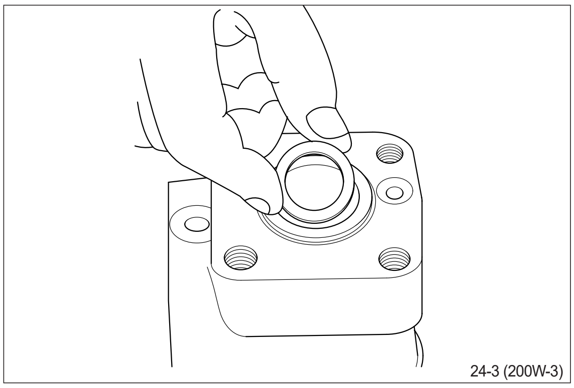
(31) Fit the six screws with washers and insert them. Cross-tighten all the screws and the rolled pin.

· Tightening torque : 3.0±0.6 kgf · m
(22.4±4.3 lbf · ft)



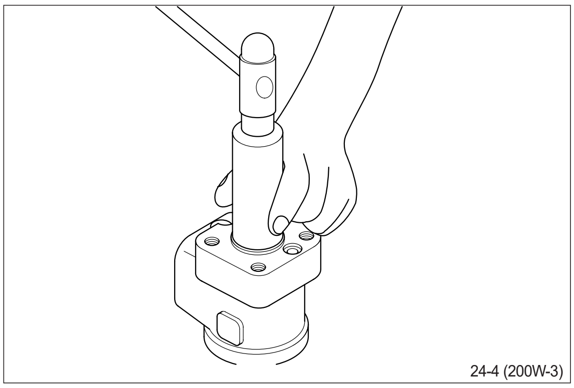
24-2 (200W-3)

(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.



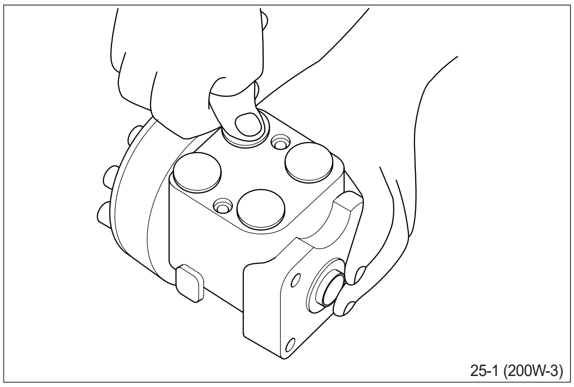
24-3 (200W-3)

(33) Fit the dust seal ring in the housing.



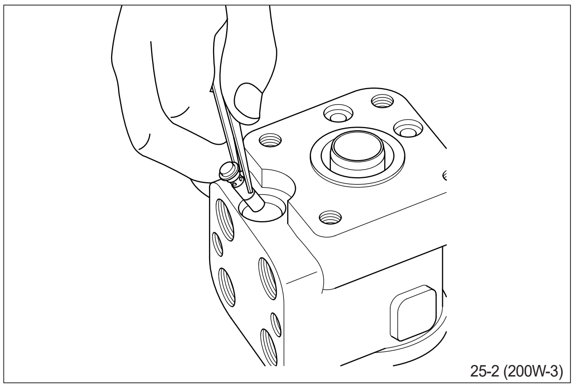
24-4 (200W-3)

(34) Press the plastic plugs into the connection ports.
※ Do not use a hammer!

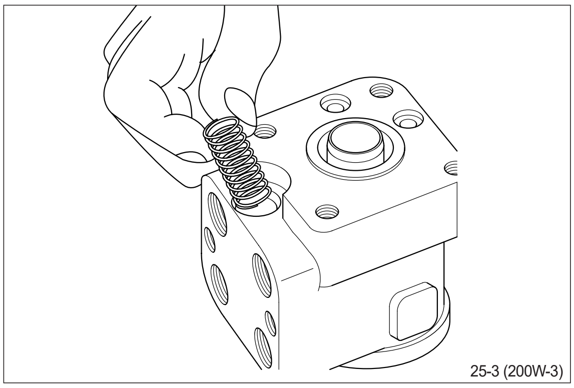

25-1 (200W-3)

Assembly of the pressure relief valve

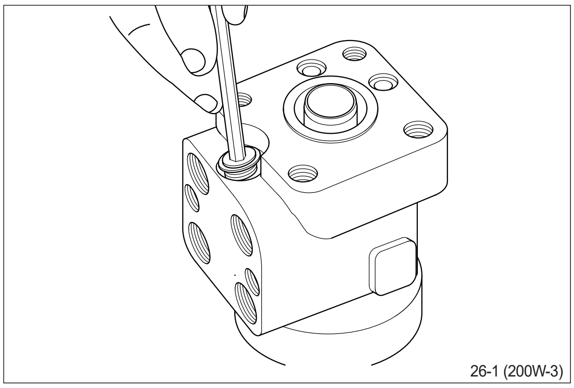
(35) Fit the piston.


25-2 (200W-3)

(36) Fit the spring.

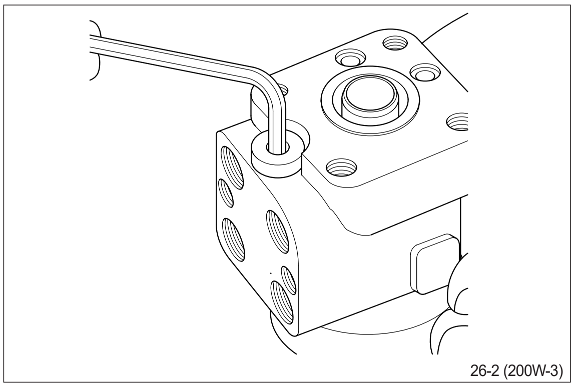

25-3 (200W-3)

(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.

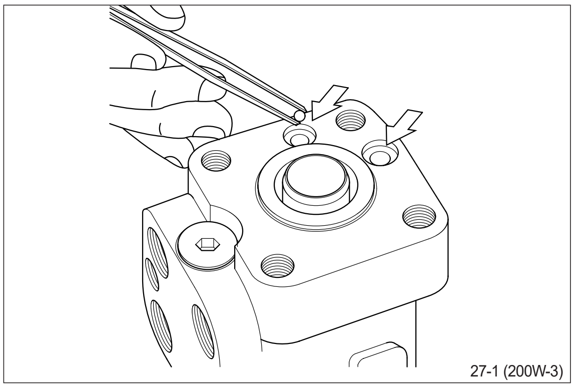
· Tightening torque : 5.1±1.0 kgf · m (36.9±7.2 lbf · ft)



26-2 (200W-3)

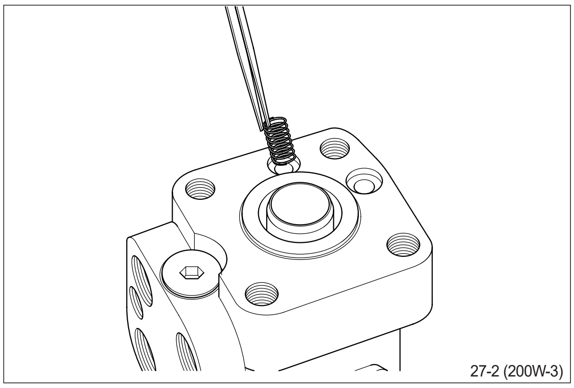
Assembly of the dual shock valve

(39) Put a ball in the two holes indicated by the arrows.



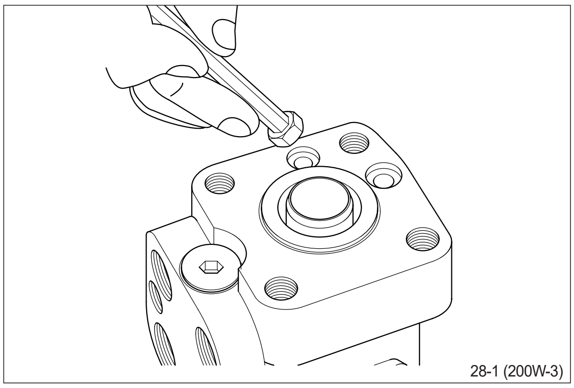
27-1 (200W-3)

(40) Place springs and valve cones over the two balls.



27-2 (200W-3)

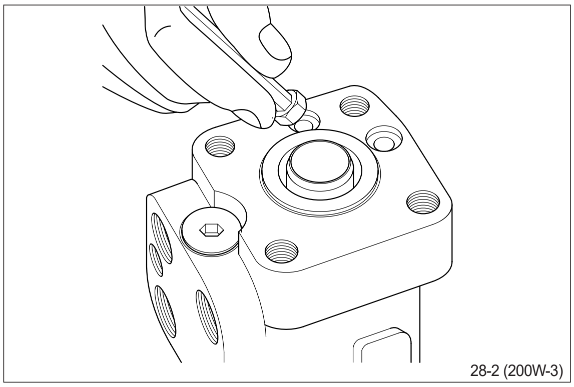
(41) Screw in the two setting screws using a 6mm hexagon socket spanner. Make the pressure setting on a panel or the machine.



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)

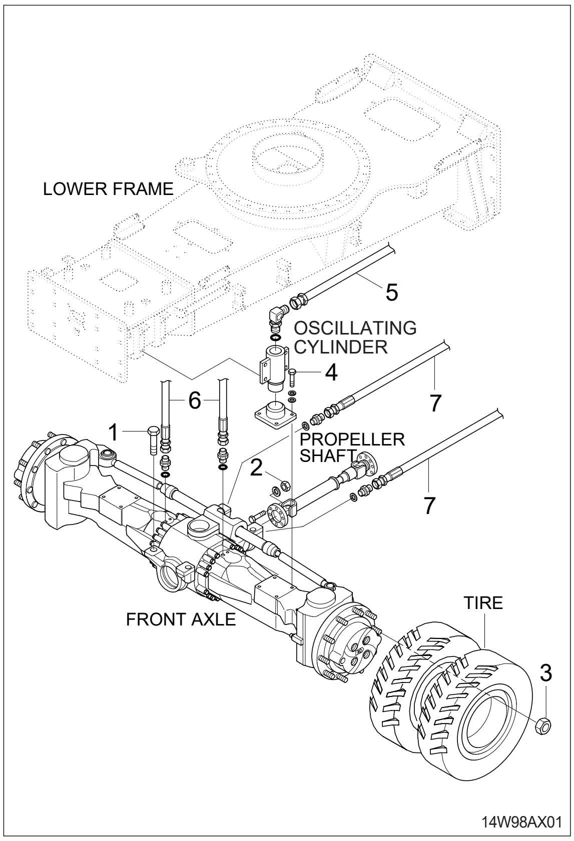
Steering valve is now assembled.

GROUP 9 FRONT AXLE AND REAR AXLE

A. FRONT AND REAR AXLE (up to #0073)

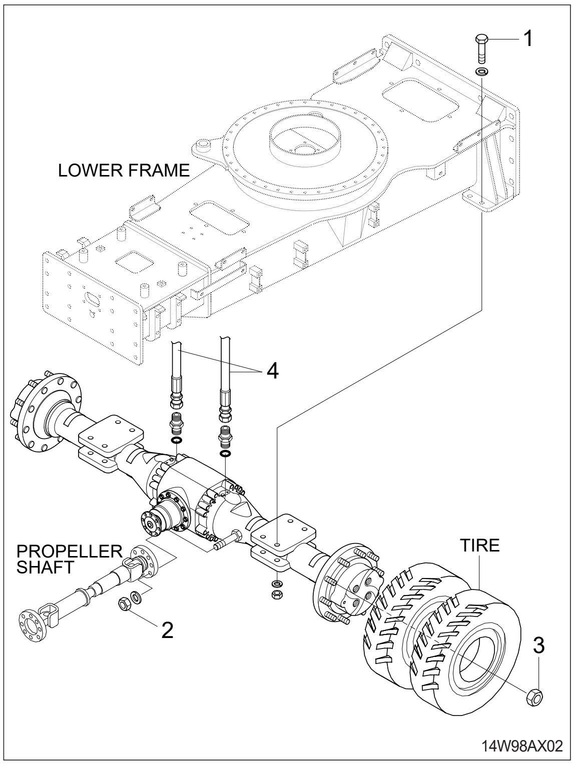
1. REMOVAL FRONT AXLE

1) Front axle mounting bolt (1, M22)
   · Tightening torque : 83.2±9.2 kgf · m
   (602±66.5 lbf · ft)
2) Propeller shaft mounting nut (1, M10)
   · Tightening torque : 5.9±0.6 kgf · m
   (42.7±4.3 lbf · ft)
3) Wheel nut (2, M22)
   · Tightening torque : 60^{+0}_{-5} kgf · m
   ($433^{+0}_{-36.2}$ lbf · ft)
4) Oscillating cylinder supporting mounting bolt (3, M12)
   · Tightening torque : 12.3±2.5 kgf · m
   (88.9±18.1 lbf · ft)
5) Pipe assy (4)
6) Hose assy (5)
7) Front axle weight : 520 kg (1150 lb)



2. REMOVAL REAR AXLE

1) Rear axle mounting bolt and nut (1, M20)
   · Tightening torque : 58±6.3 kgf · m
   (419±45.5 lbf · ft)
2) Propeller shaft mounting nut (2, M10)
   · Tightening torque : 5.9±0.6 kgf · m
   (42.7±4.3 lbf · ft)
3) Wheel nut (3)
   · Tightening torque : 60^{+0}_{-5} kgf · m
   ($433^{+0}_{-36.2}$ lbf · ft)
4) Hose assy (4)
5) Rear axle weight : 480 kg (1060 lb)



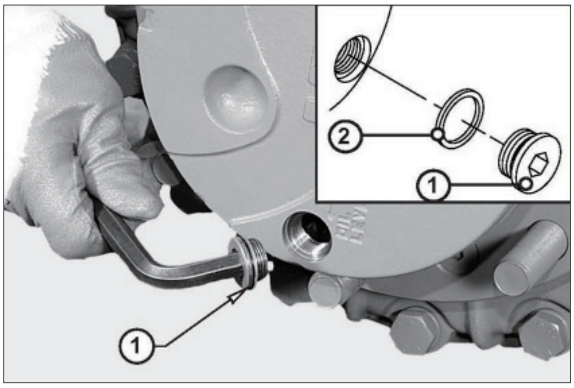
3. GENERAL INSTRUCTIONS

1) During all operations described in this manual, the axle should be fastened onto a trestle, while the other parts mentioned should rest on supporting benches.
2) When removing one of the arms, an anti-tilting safety trestle should be placed under the other arm.
3) When working on an arm that is fitted on the machine, make sure that the supporting trestles are correctly positioned and that the machine is locked lengthways.
4) Do not admit any other person inside the work area; mark off the area, hang warning signs and remove the ignition key from the machine.
5) Use only clean, quality tools; discard all worn, damaged, low-quality or improvised wrenches and tools. Ensure that all dynamometric wrenches have been checked and calibrated.
6) Always wear gloves and non-slip rubber shoes when performing repair work.
7) Should you stain a surface with oil, remove marks straight away.
8) Dispose of all lubricants, seals, rags and solvents once work has been completed. Treat them as special waste and dispose of them according to the relative law provisions obtaining in the country where the axles are being overhauled.
9) Make sure that only weak solvents are used for cleaning purposes; avoid using turpentine, dilutants and toluol-, xylol- based or similar solvents; use light solvents such as kerosene, mineral spirits or water-based, environment friendly solvents.
10) For the sake of clarity, the parts that do not normally need to be removed have not been reproduced in some of the diagrams.
11) The terms RIGHT and LEFT in this manual refer to the position of the operator facing the axle from the side opposite the drive.
12) After repair work has been completed, accurately touch up any coated part that may have been damaged.

4. THE PLANETARY REDUCTION AND AXLE SHAFT

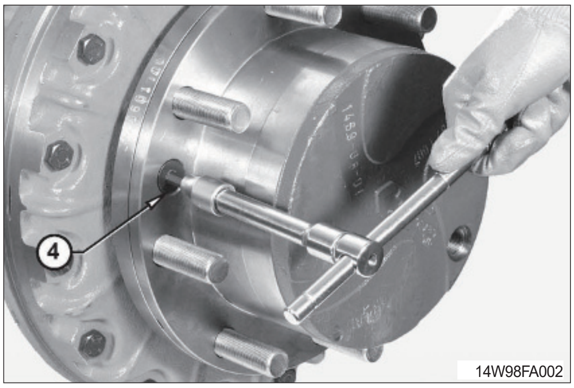
1) DISASSEMBLE

(1) Remove oil-level plug (1) and oil.



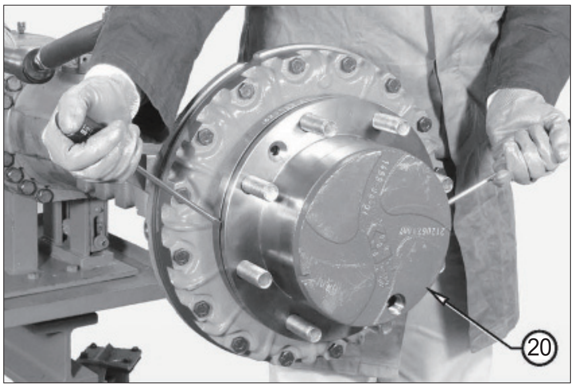
14W98FA001

(2) Remove the securing screws (4) from the planetary carrier cover.



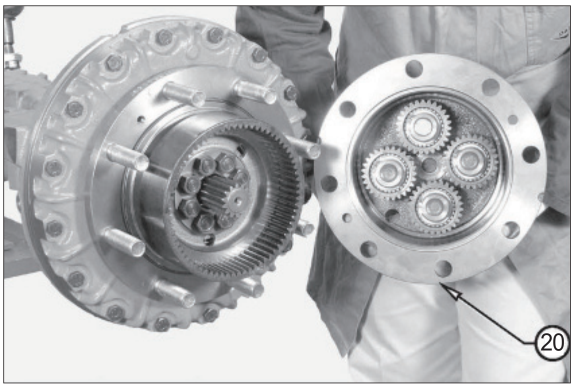
14W98FA002

(3) Disjoint the planetary carrier cover (20) by alternatively forcing a screwdriver into the appropriate slots.



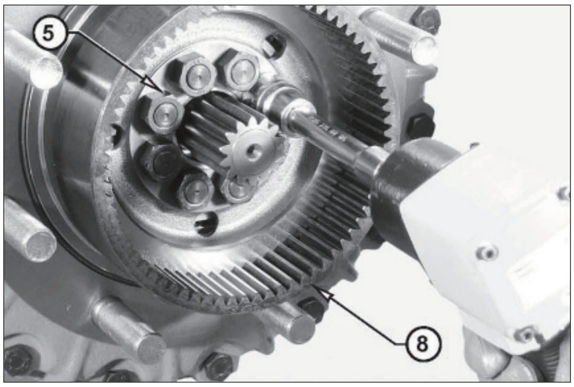
14W98FA003

(4) Remove the complete planetary carrier cover (20) .



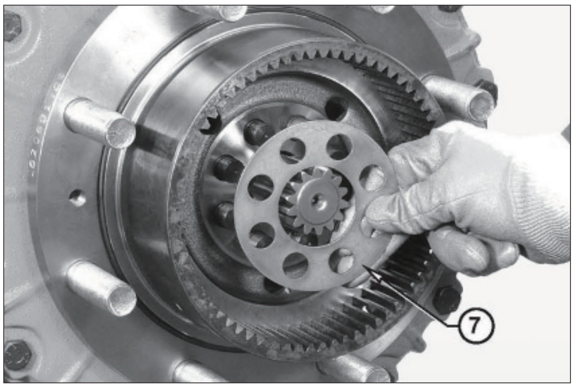
14W98FA004

(5) Unloose and remove the tightening nuts (5) from the crown flange (8).



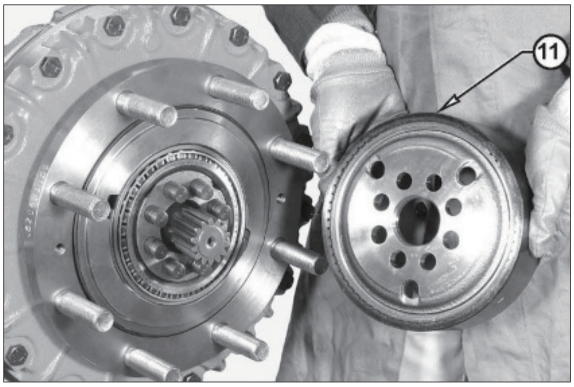
14W98FA005

(6) Remove the safety flange (7).



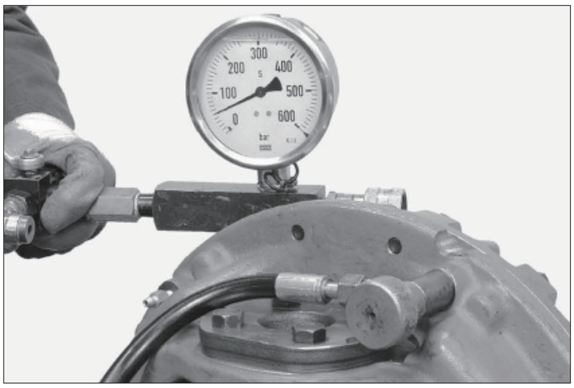
14W98FA006

(7) Using a puller, remove the complete crown flange (11) by acting on the stud bolts.



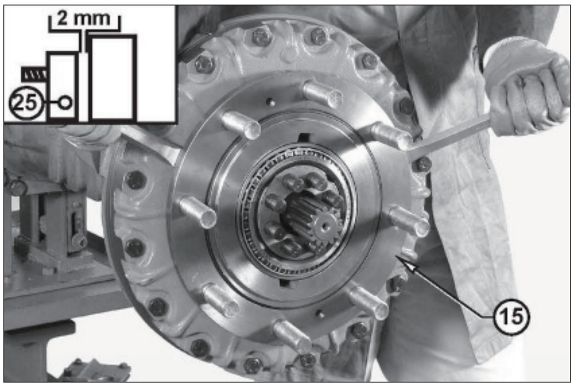
14W98FA007

(8) Engage break circuit pressure at min. 7 bar to block the break discs in position.



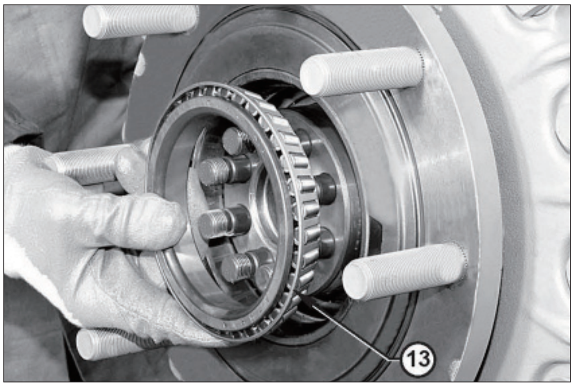
14W98FA008

(9) Using two levers, by hand disjoin the complete hub (15).



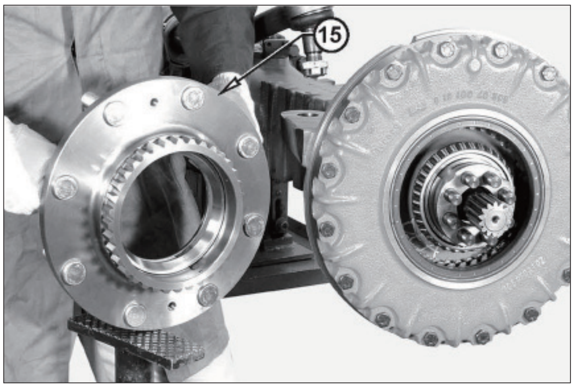
14W98FA009

(10) Remove the external bearing (13).



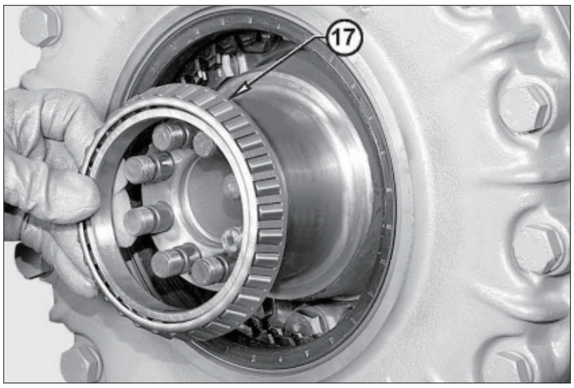
14W98FA010

(11) Extract the hub (15).



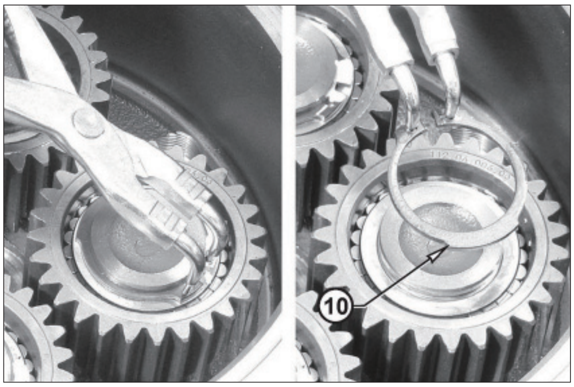
14W98FA011

(12) Remove the internal bearing (17).



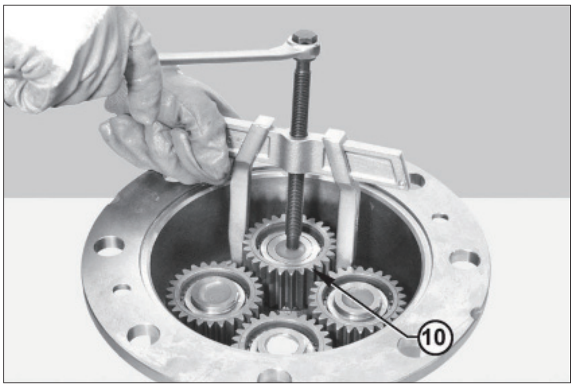
14W98FA012

(13) Remove the snap rings (10).



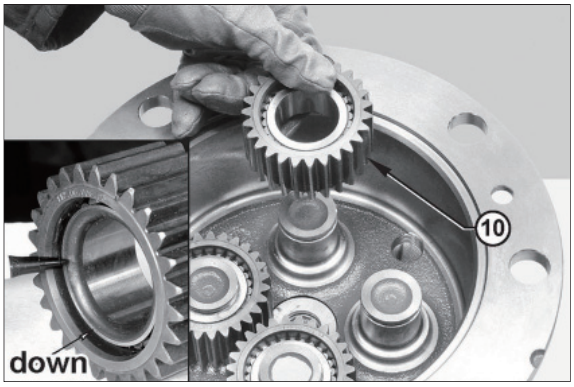
14W98FA013

(14) With the help of an puller, remove the planet wheel gears (10).



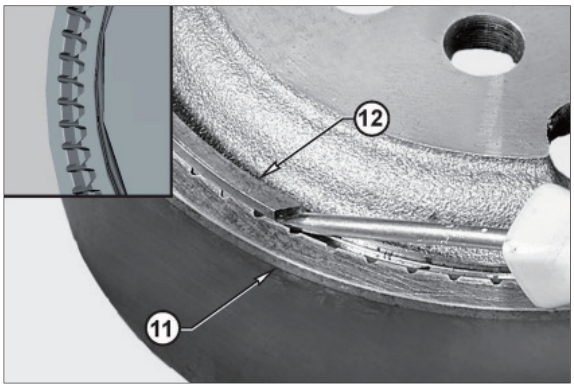
14W98FA014

※ Note down the assembly side of planet wheels.



14W98FA015

(15) Remove the snap ring (12) from the crown (11).



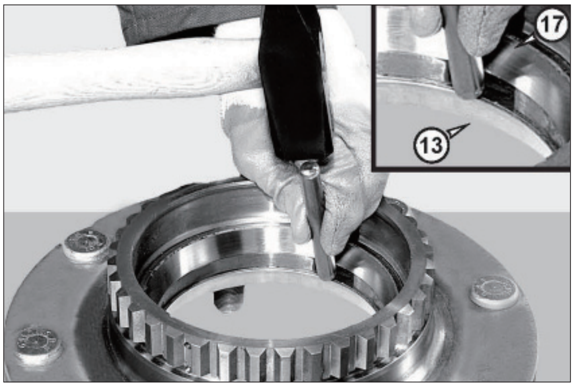
14W98FA016

(16) Remove the crown flange (8).

14W98FA017

(17) Remove the thrust blocks (13, 17) from the bearings forcing a pin driver into the appropriate slots on the hub (15).

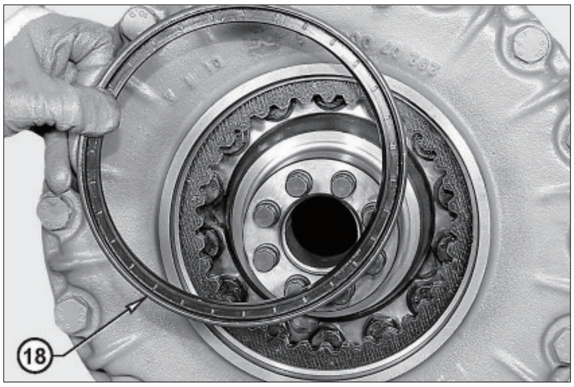
※ Hammer in an alternate way so as to avoid crawling or deformation of the thrust blocks.



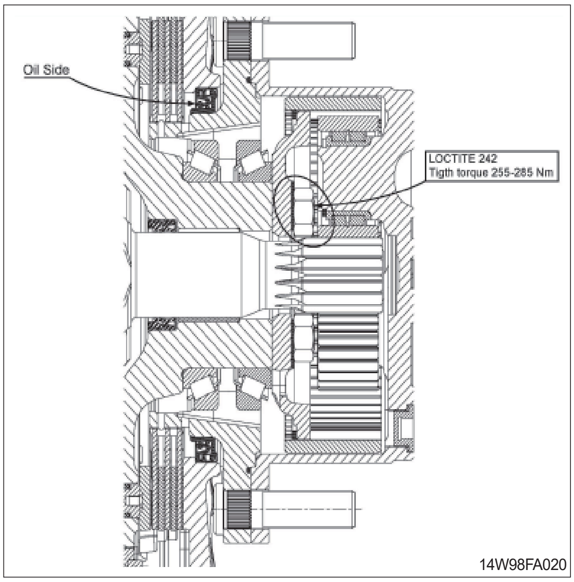
14W98FA018

(18) Remove the sealing ring (18) from the hub.

Note down the assembly sequence.



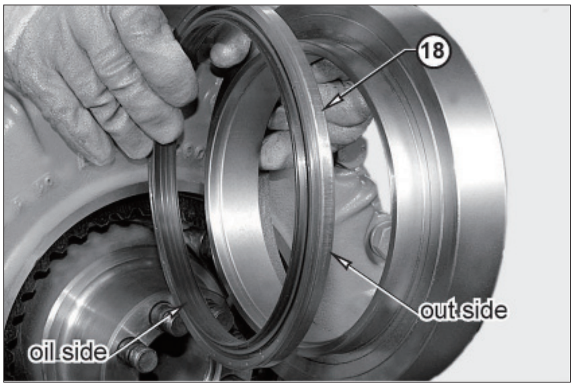
14W98FA019



14W98FA020

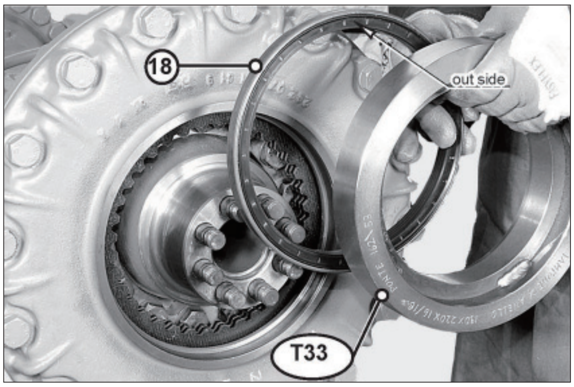
2) ASSEMBLE

(1) Check that the ring (18) is correctly oriented.



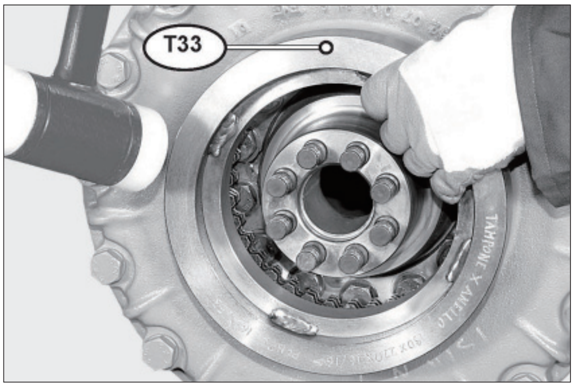
14W98FA021

(2) Apply a sealant for removable seals to the outer surface of the sealing ring (18). Position the sealing ring (18) in the hub.

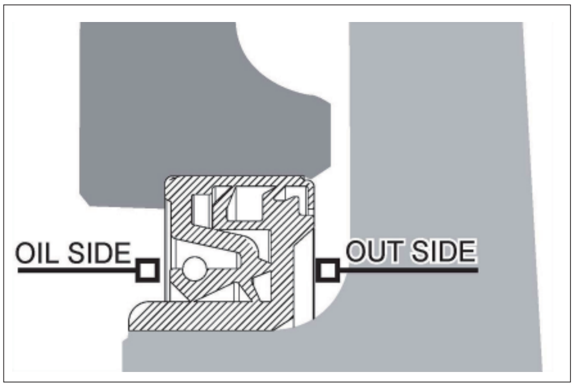


14W98FA022

(3) Assist the insertion of the sealing ring by lightly hammering around the edge with a plastic hammer.

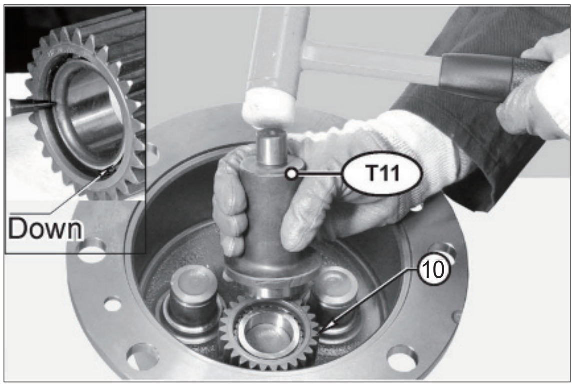


14W98FA023



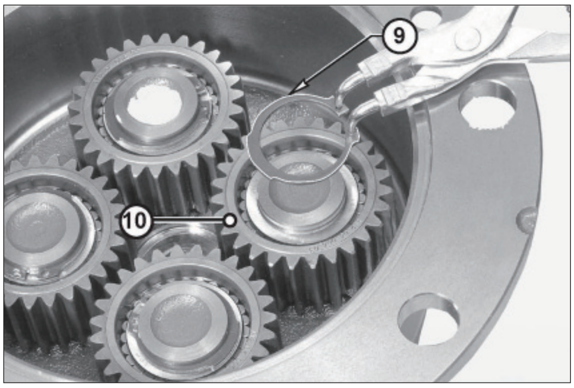
14W98FA024

(4) With the help of tool T11, insert the planet wheel gears (10) into the cover (4). Accurately check the orientation.



14W98FA025

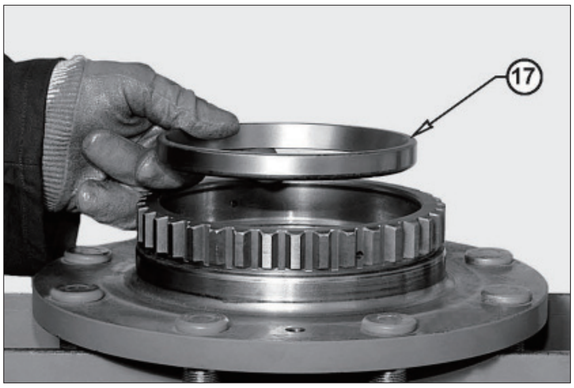
(5) Lock the gears (10) into position by fitting the snap rings (9).



14W98FA026

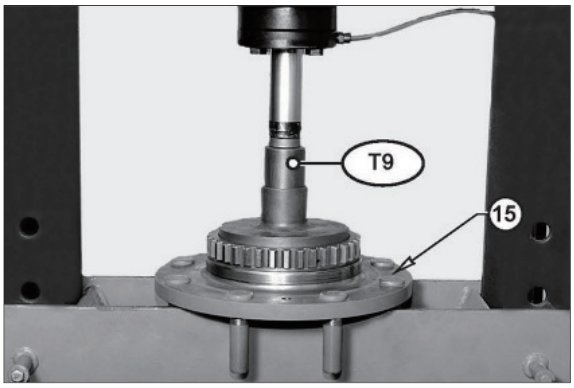
(6) Position the thrust block of the internal bearing (17).

※ Check that the thrust block is correctly oriented.



14W98FA027

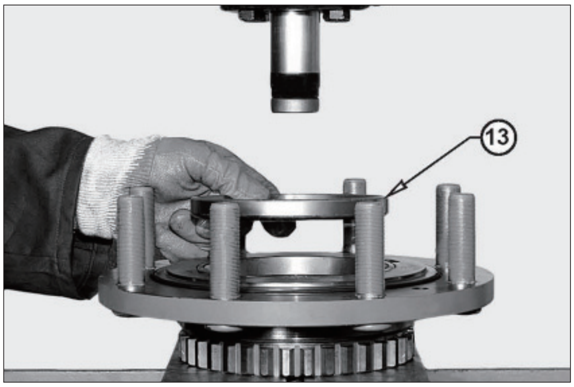
(7) Position the upper part of tool T9 and press the thrust block into the hub (15) all the way down.



14W98FA028

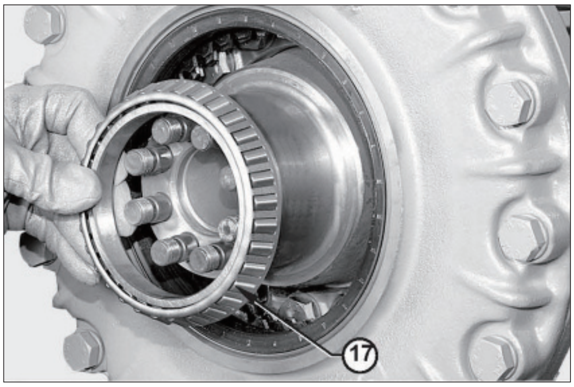
(8) Position the thrust block of the external bearing (13).

※ Check that the thrust block is correctly oriented.



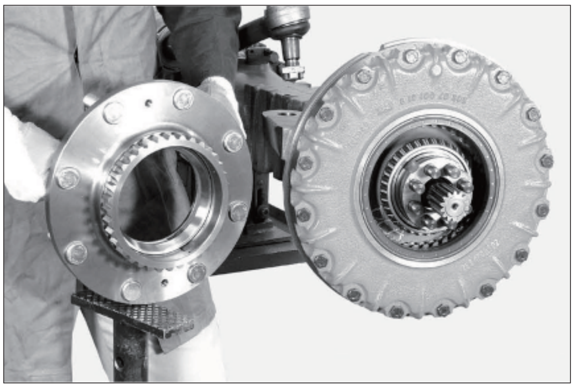
14W98FA029

(9) Install the internal bearing (17).



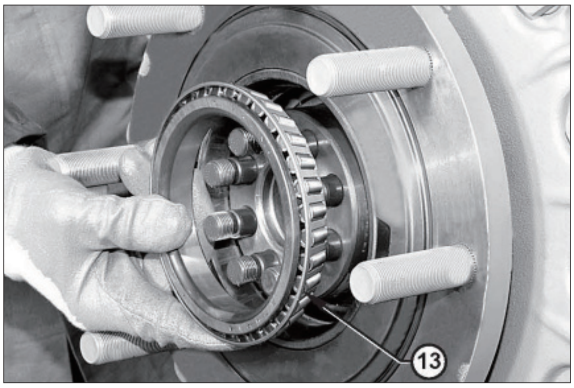
14W98FA030

(10) Install the hub (15).

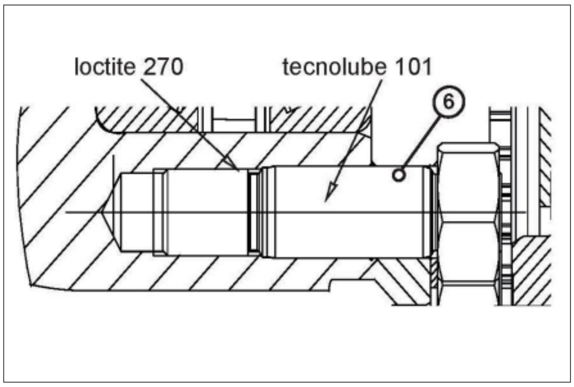


14W98FA031

(11) Install the external bearing (13).

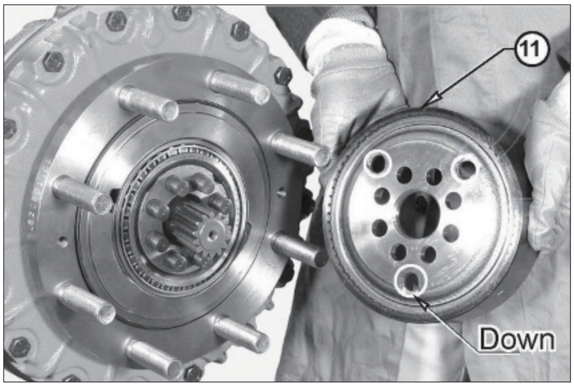


14W98FA032



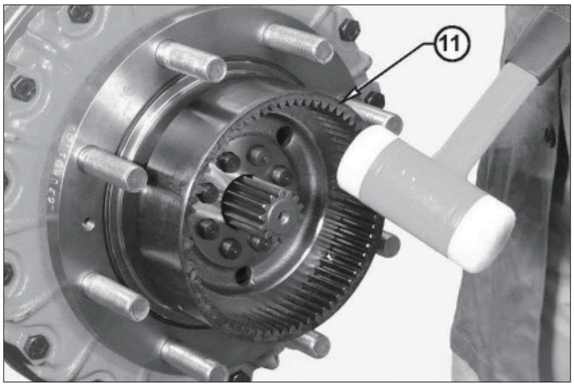
14W98FA033

(12) Fit the complete crown flange (11).



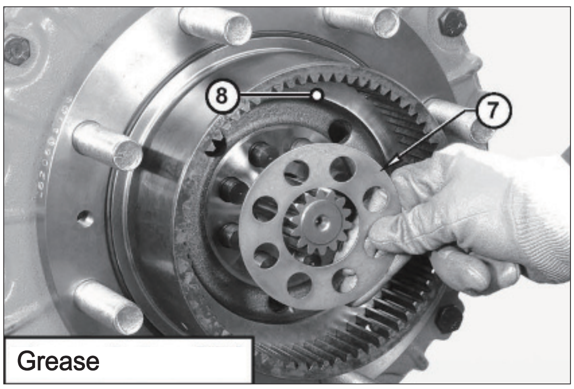
14W98FA034

※ In order to fasten the flange (11), use a plastic hammer and alternately hammer on several equidistant points.



14W98FA035

(13) Apply grease to the surface of the safety flange (7) which touches the crown flange (8).
Fit the safety flange (7).

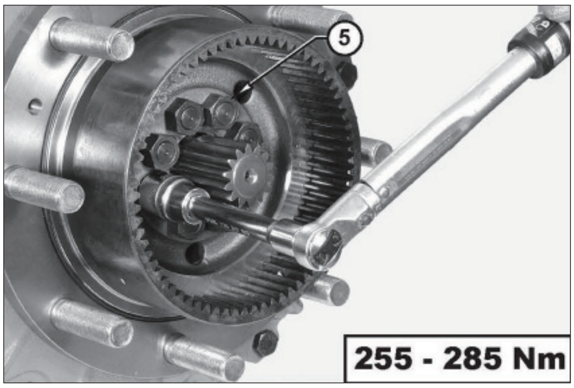


14W98FA036

(14) Apply loctite 242 to the studs and fit in the nuts (5).

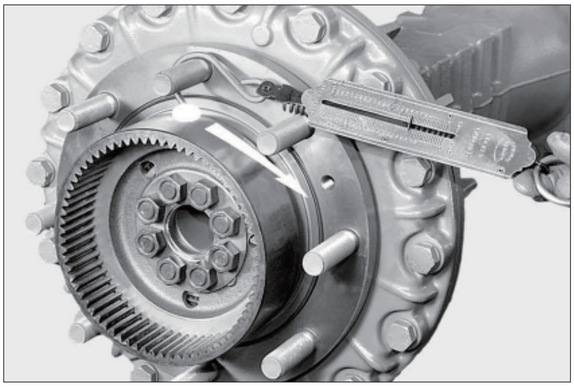
14W98FA037

(15) Cross tighten the nuts (5) in two stages.
Initial torque wrench setting : 120 Nm
Final torque wrench setting : 255~285 Nm



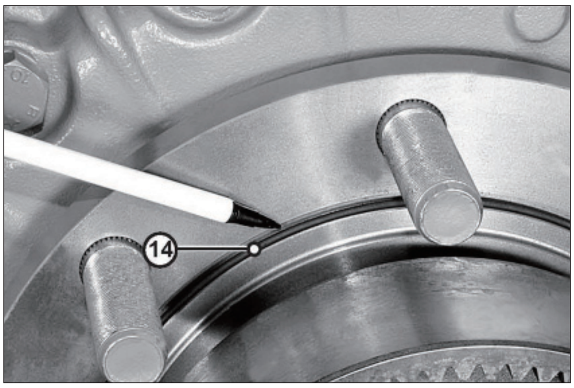
14W98FA038

(16) Check the continuous rolling torque on the hub.
Torque 10~30 Nm.



14W98FA039

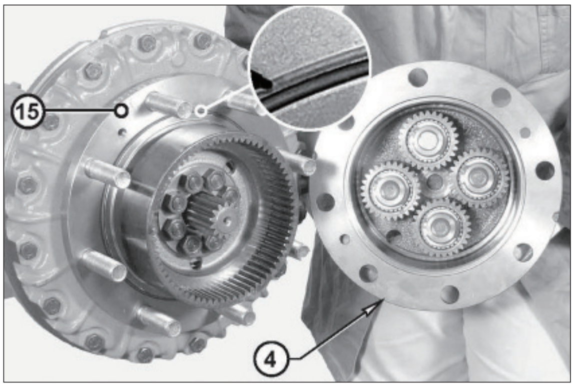
(17) In order to facilitate assembly, apply grease on the O-ring (14).



14W98FA040

(18) Fit the planetary carrier cover (4) onto the hub (15).

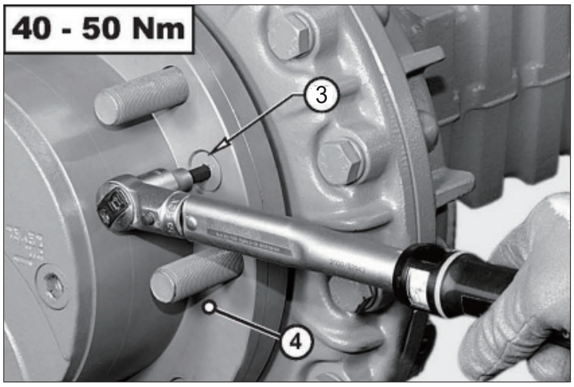
※ Check that the O-ring is in good condition and in position.



14W98FA041

(19) Lock the planetary carrier cover (4) by tightening the screws (3).

Torque wrench setting for screws: 40~50 Nm

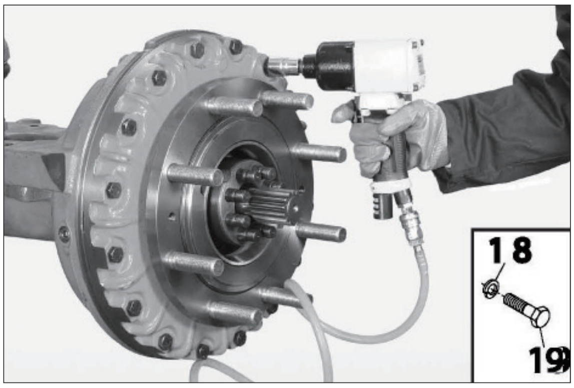


14W98FA042

5. CHECKING WEAR AND REPLACING THE BRAKING DISKS

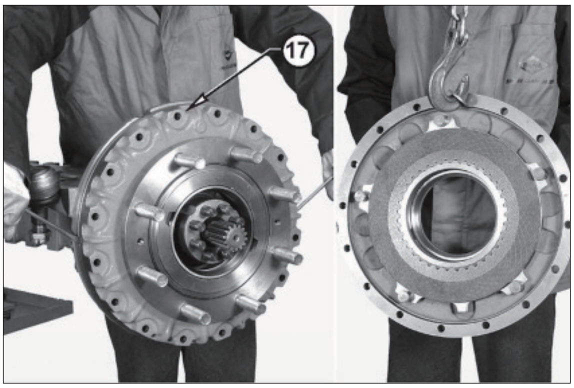
1) DISASSEMBLE THE BRAKING UNIT

(1) Remove fix in screws (19).



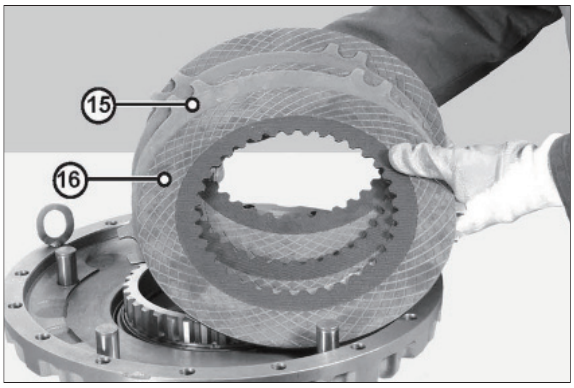
14W98FA043

(2) Disjoin the cover (17) from the hub by alternatively forcing a screwdriver into the appropriate slots.



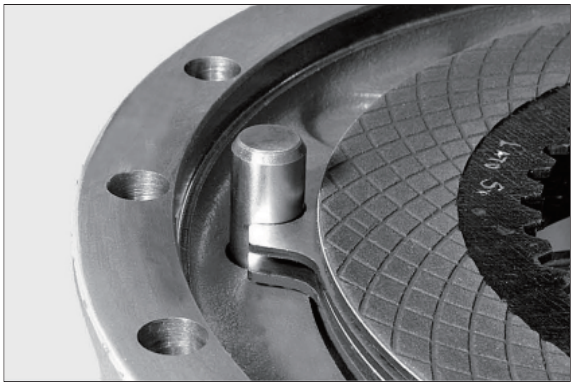
14W98FA044

(3) Remove the braking disks (15, 16) and note down their order of assembly.



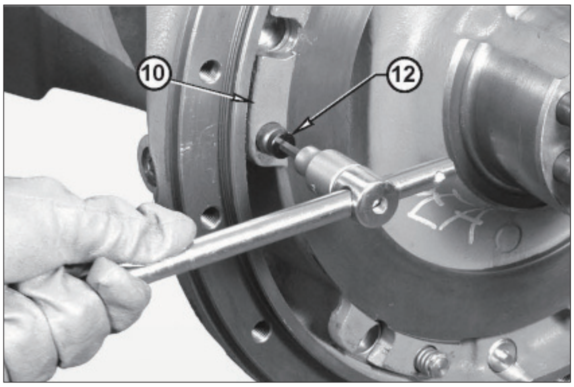
14W98FA045

(4) If the disks do not need replacing, avoid switching their position.



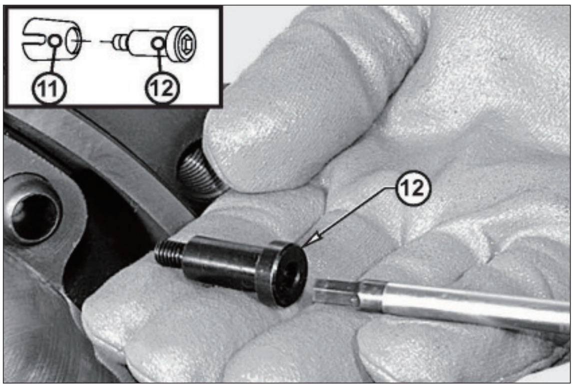
14W98FA046

(5) Remove the pin screws (12) of the counter plate (10).



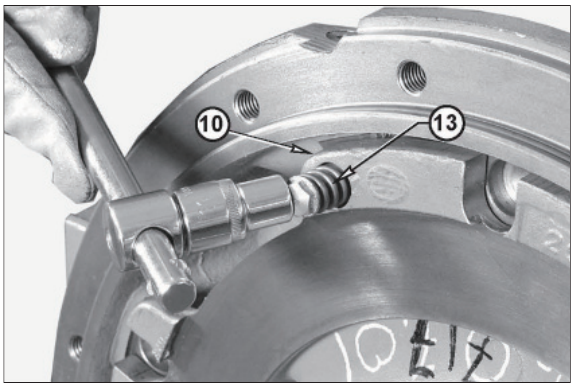
14W98FA047

※ If the screws are to be replaced, note down the different colours for the different brake gap.



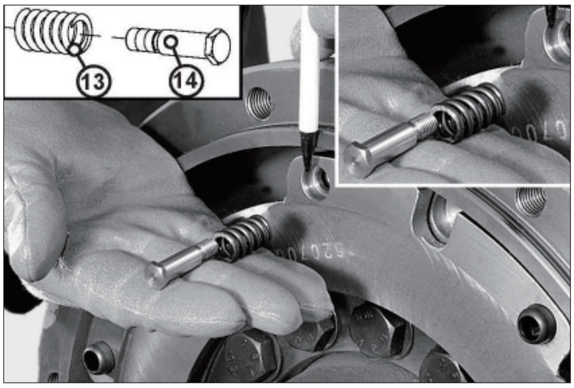
14W98FA048

(6) Remove the reversal springs (13) from counter plate (10).



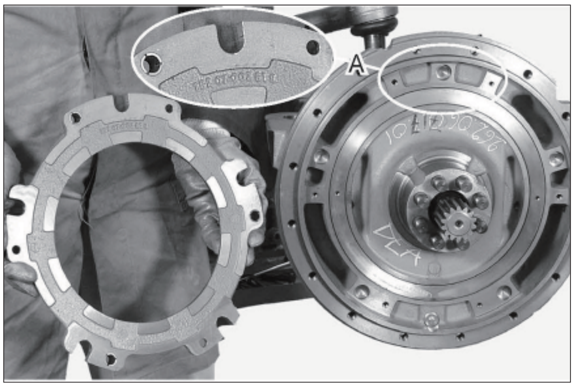
14W98FA049

※ If the springs (13) are weak or deformed they must be replaced.



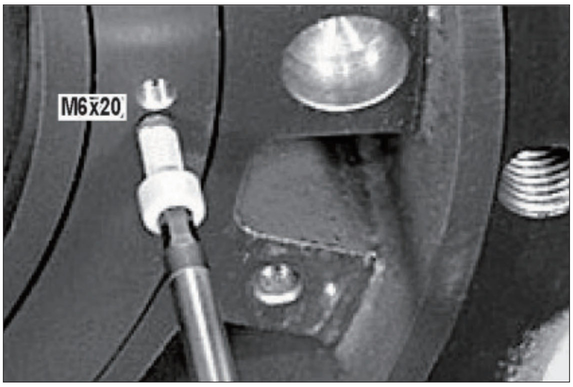
14W98FA050

(7) Remove the intermediate plate (10).
※ Note down the direction the montage (A).



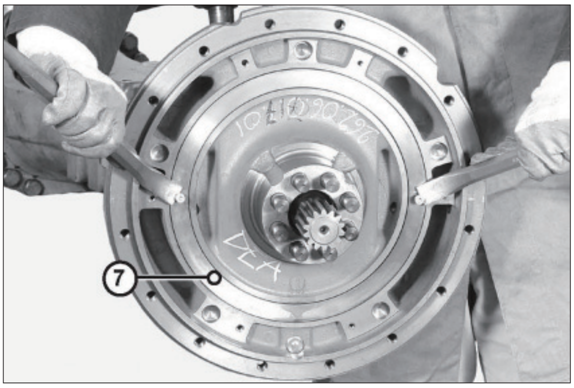
14W98FA051

(8) Tighten two screws M6 × 20 on the piston.



14W98FA052

(9) Using two levers, remove the piston (7).

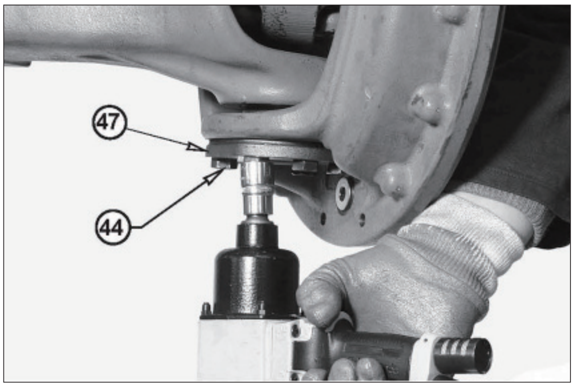


14W98FA053

※ Note down the side for assembly.

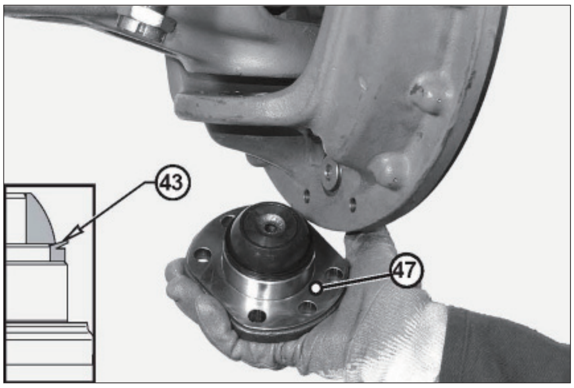
14W98FA054

(10) Unloose and remove the screws (44) from the articulation pin (47).



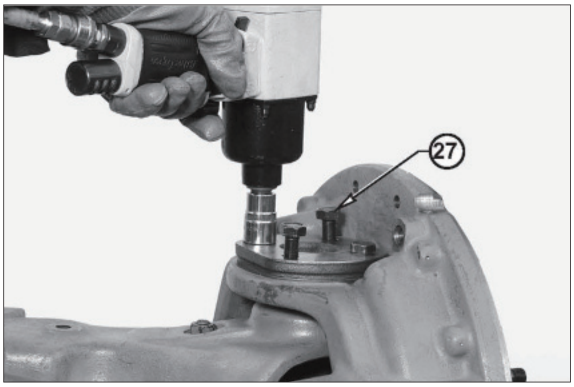
14W98FA055

(11) Remove the bottom articulation pin (47) complete with front sealing ring (43).



14W98FA056

(12) Unloose and remove the screws (27) from the articulation pin (26).

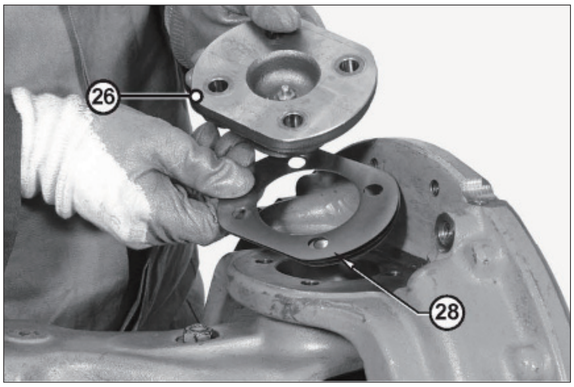


14W98FA057

(13) Using two levers, remove the top articulation pin (26) complete with front seal (29).

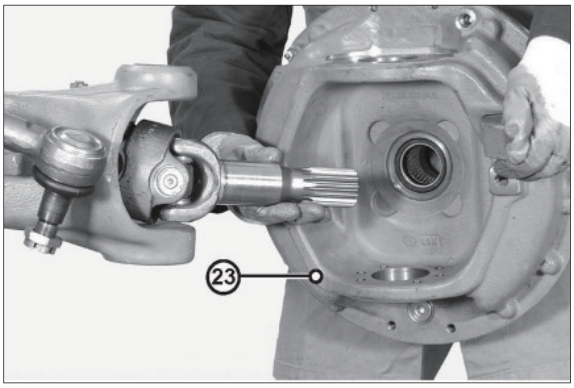
※ Pay attention not to damage the surfaces.

14W98FA058



14W98FA059

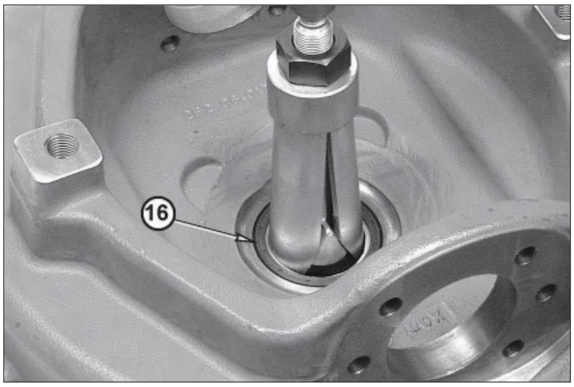
(14) Remove the complete steering case (23).



14W98FA060

(15) Using a puller, take off the sealing ring (16) from the steering case.

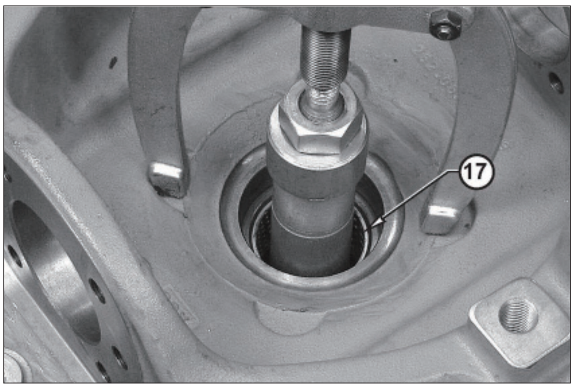
※ Note down the orientations of the sealing rings (16).



14W98FA061

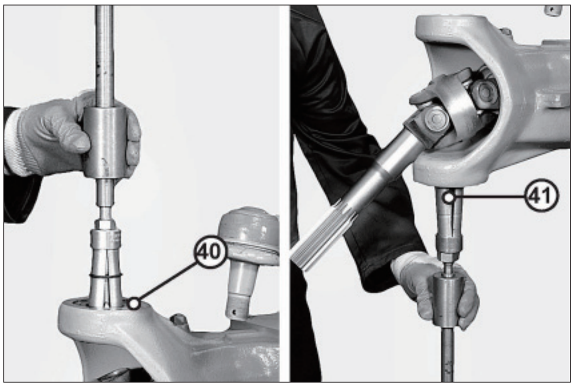
(16) Using a puller, take off the bush (17) from the steering case.

※ Note down the orientations.



14W98FA062

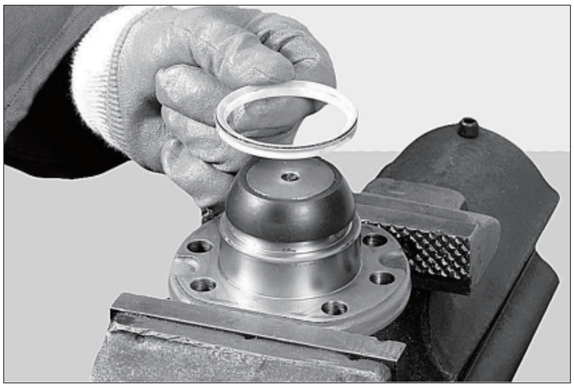
(17) Using a puller for inner parts, remove the top bush (40) and the bottom ball-bush (41).



14W98FA063

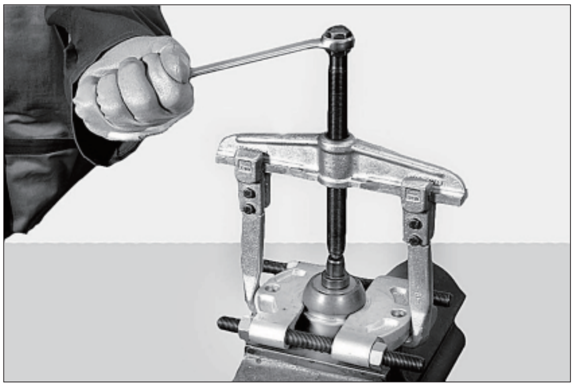
(18) Remove the articulation pins (41) and the front sealing rings (43).

※ Note down the side for assembly.

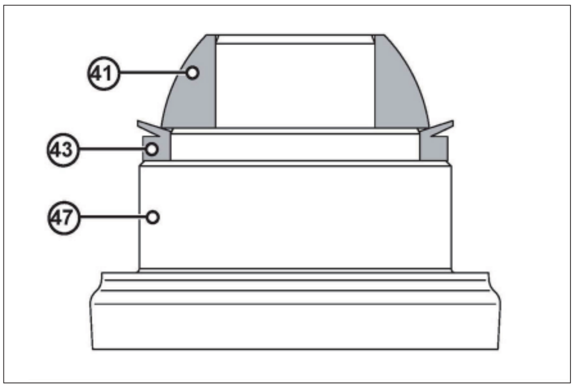


14W98FA064

(19) If the ball cover needs replacing, remove it from the bottom articulation pin.



14W98FA065

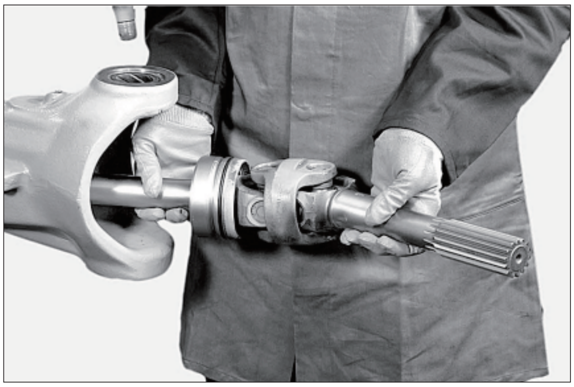


14W98FA066

(20) Unloose and remove the top and bottom check nuts from the dowels.
Remove top and bottom check dowels from the flange or bushing.

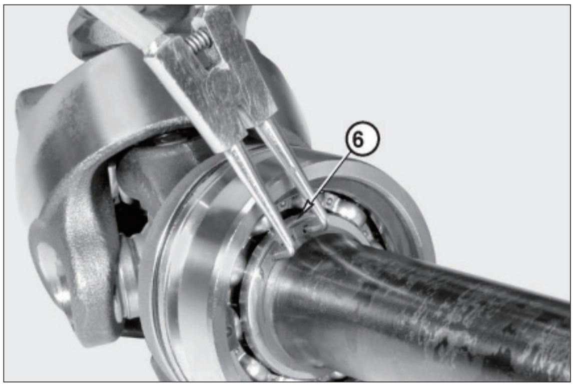
14W98FA067

(21) Remove the U-joint.
※ To remove the U-joint use, if necessary, a plastic hammer or a lever.



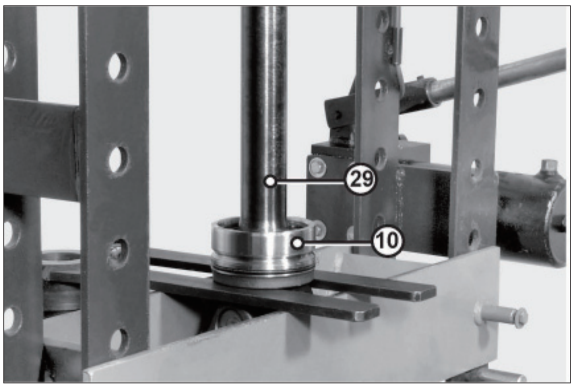
14W98FA068

(22) Remove the snap ring (6) from the bearing.



14W98FA069

(23) Position the entire U-joint (29) under a press and remove the complete bush (10).



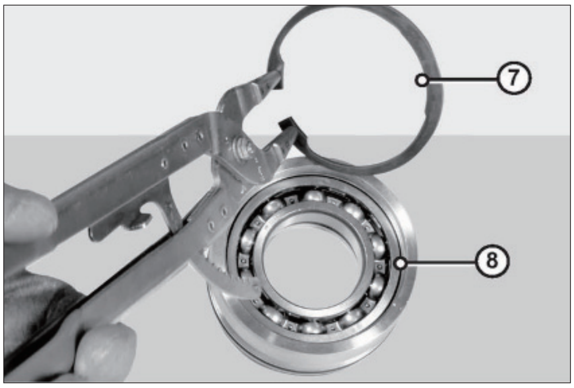
14W98FA070

6. UNIVERSAL-JOINT

※ Front axle only

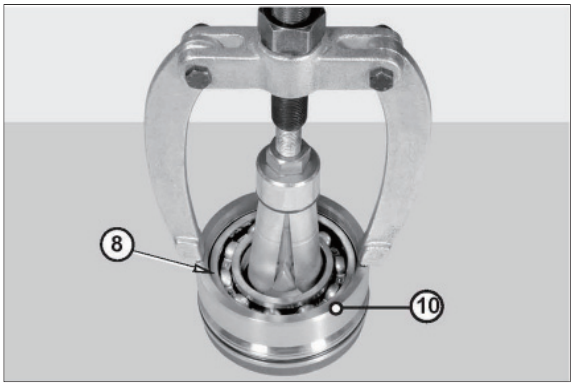
1) REMOVE THE U-JOINT

(1) Remove the snap ring (7) from the bearing (8).



14W98FA071

(2) Use a puller to remove the bearing (8) and by using a tool remove the sealing ring.



14W98FA072

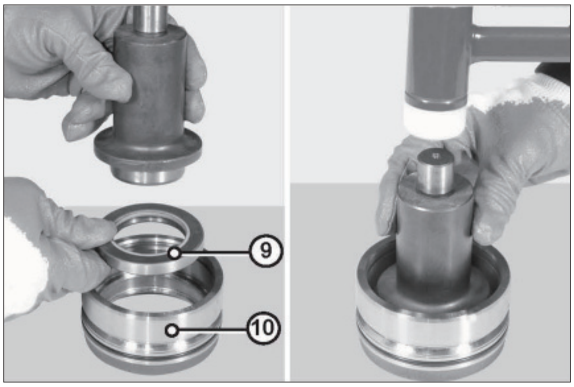
7. STEERING CASE

※ Front axle only

1) INSTALL THE COMPLETE STEERING CASE

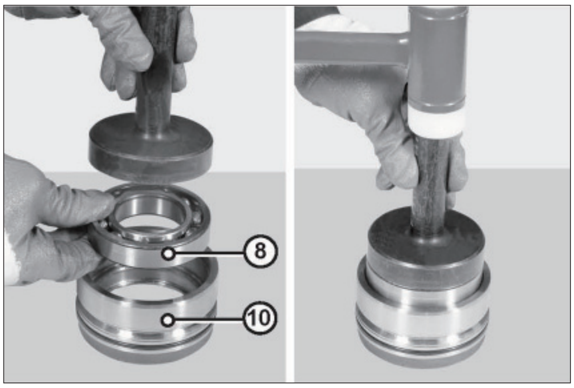
(1) Using tools T3, insert the sealing ring (9) in the bush (10).

※ Carefully check the assembly side of the seal.



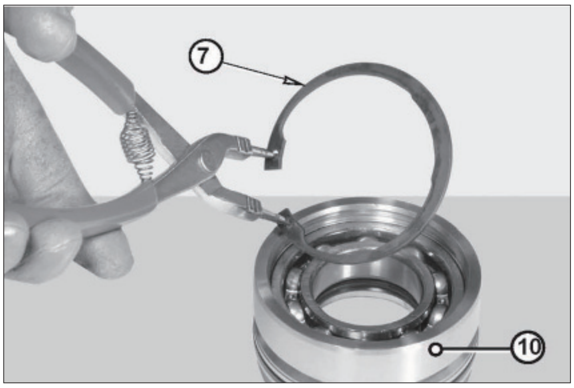
14W98FA073

(2) Using tools T4, insert the bearing (8) in the bush (10).



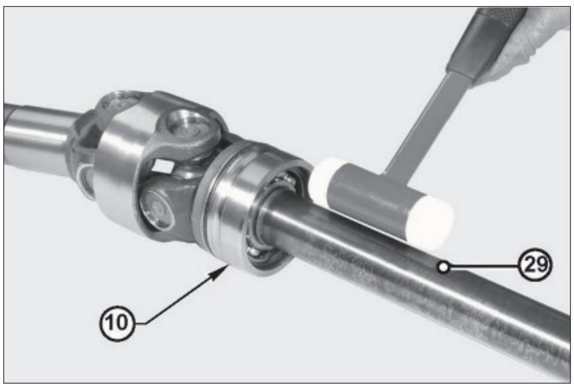
14W98FA074

(3) Fit the snap ring (7) on the bearing (10).



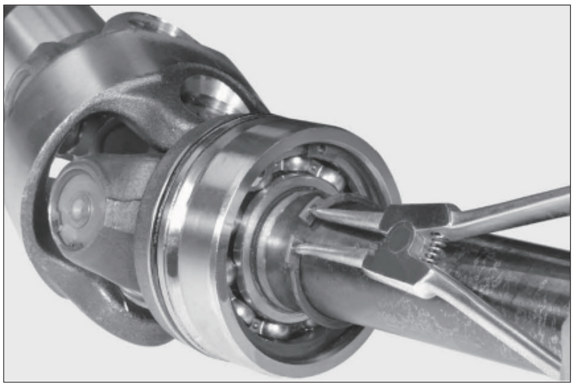
14W98FA075

(4) Fit the flange (10) onto the U-joint (29).

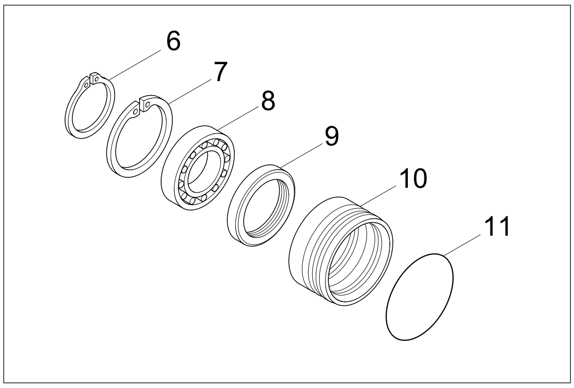


14W98FA076

(5) Fit the snap ring (6) of the bearing (8).



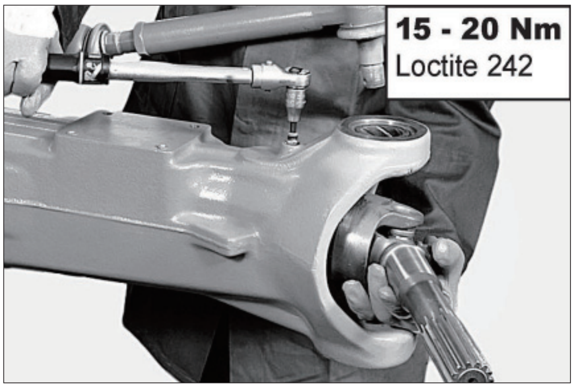
14W98FA077



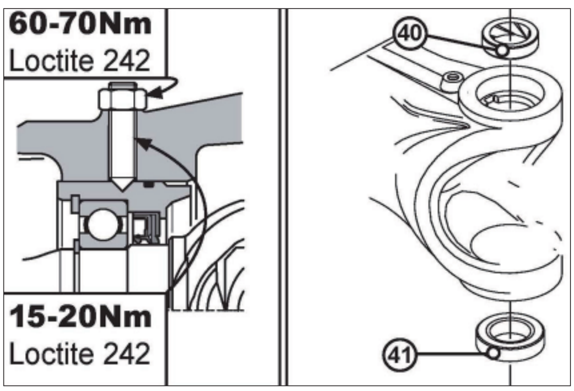
14W98FA078

(6) Insert the U-joint and tighten the top and bottom dowels.
   · Torque wrench setting : 15~20 Nm.

※ For U-joint coming with a bush, center the point of the check dowels in the slot.

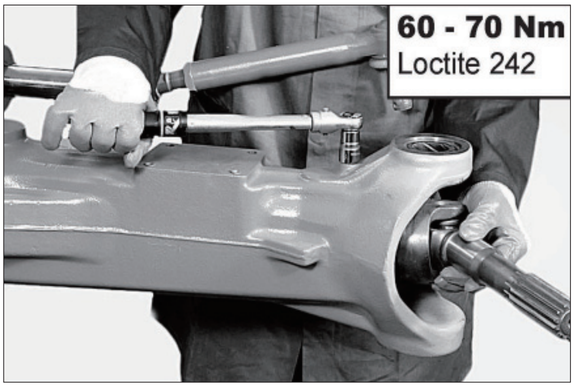


14W98FA079



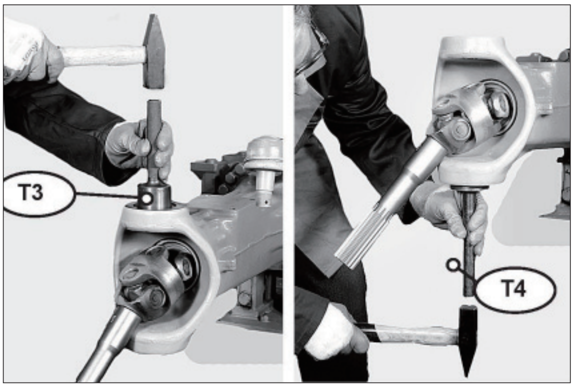
14W98FA080

(7) Screw the check nuts of the dowels and lock them using a dynamometric wrench.
  · Torque wrench setting : 60~70 Nm



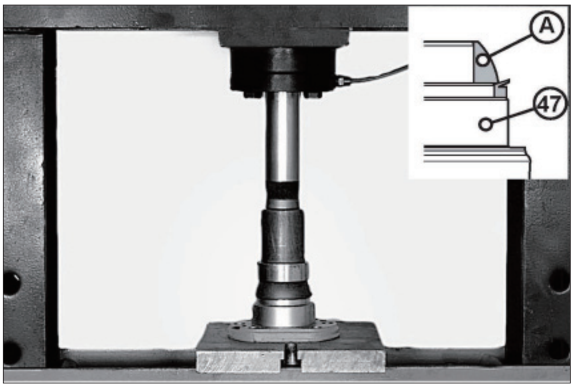
14W98FA081

(8) Lubricate the top bush (7) or the bottom ball bush (10) and fit them into the fulcrum holes of the arm.
Use tools T3 and T4.



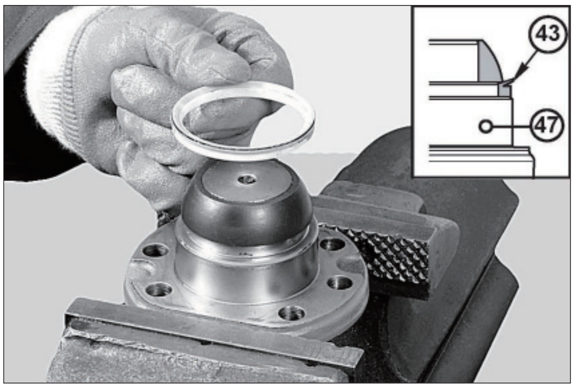
14W98FA082

(9) If the bottom articulation pin (47) has been extracted, position the pin under a press and fit the ball cover A.



14W98FA083

(10) Fit the front sealing ring (43) onto the articulation pin (47).
※ Carefully check that the rings are properly oriented.

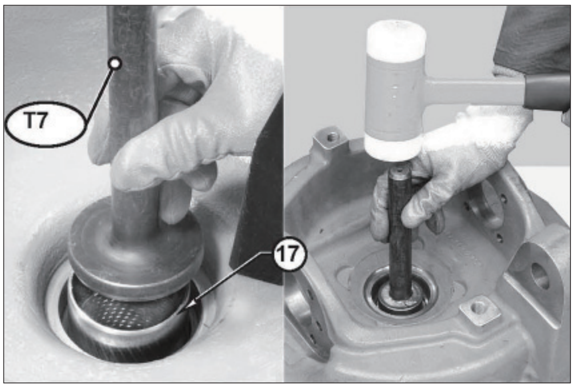


14W98FA084

8. BRAKING UNITS

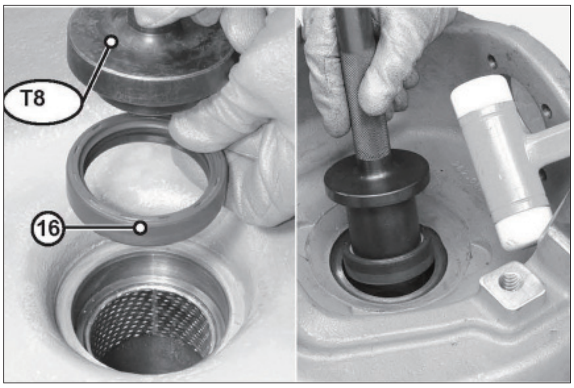
1) ASSEMBLE THE BRAKING UNITS

(1) Using tool T7, lubricate and assemble bearing (17).



14W98FA085

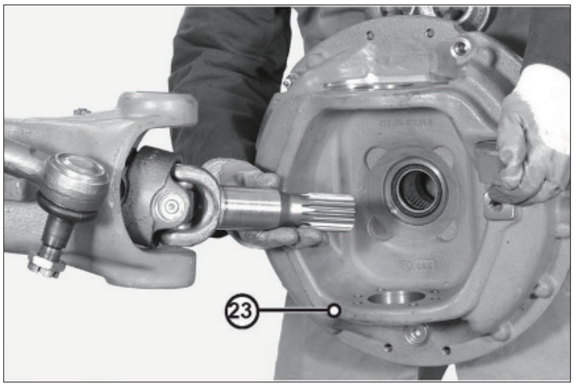
(2) Lubricate the outer surface of the sealing ring (16) and assemble it into it's position by using the tool T8.



14W98FA086

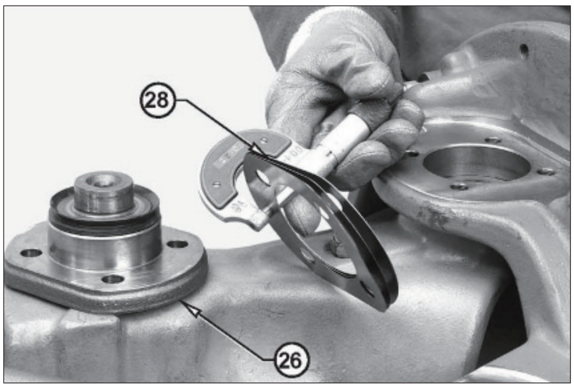
(3) Lubricate the terminal of the U-joint and install the steering case (23).

※ Pay attention don't damage the dust cover rings and the sealing rings.



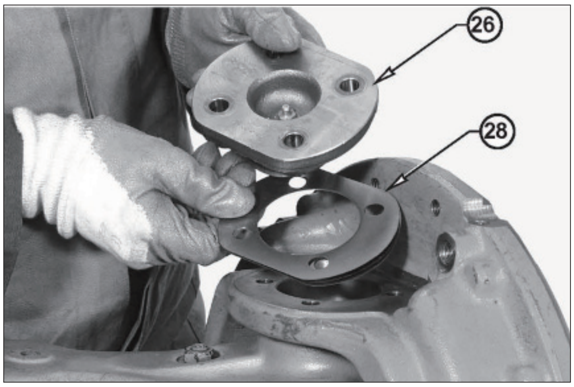
14W98FA087

(4) Prepare a series of shims (28) of 0.4 up to 0.7 mm.
To be assembled under the upper pin (26).



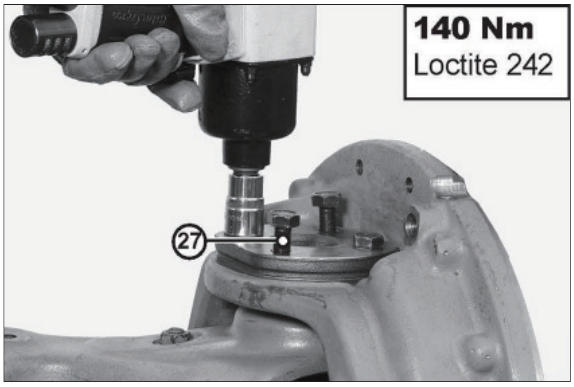
14W98FA088

(5) Lubricate and install the unit in the steering case.



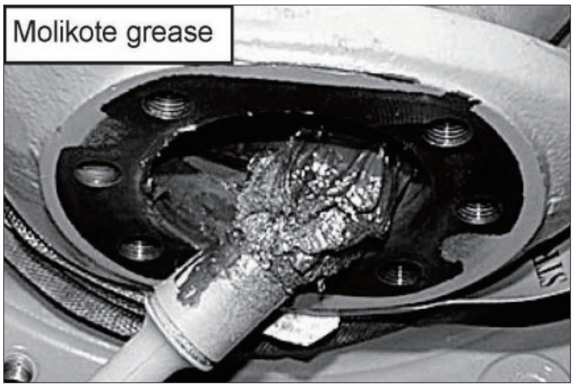
14W98FA089

(6) Tighten the new fittin screws (27) of top articulation pins in sequence using the cross tightening method.
· Torque wrench setting : 140 Nm



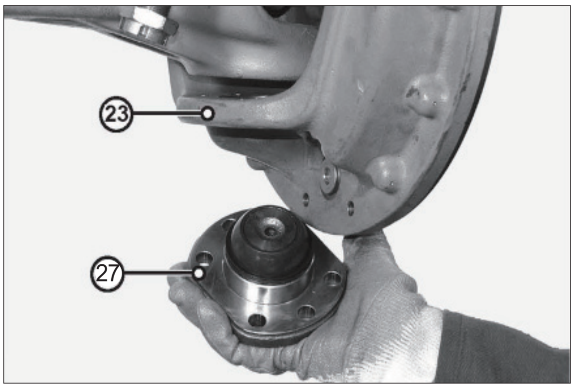
14W98FA090

(7) Lubricate the steering case.



14W98FA091

(8) Fit the unit (43) in the steering case (23). Position the screws (27) and tightly tighten.

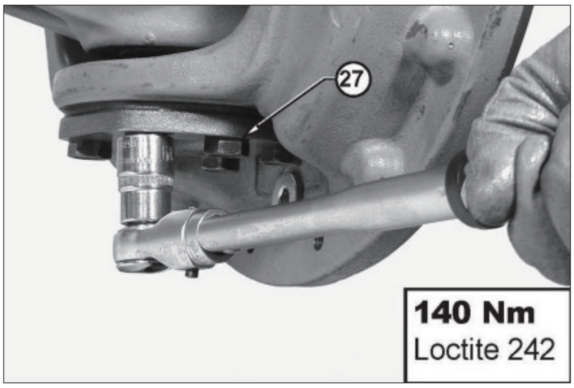


14W98FA092

14W98FA093

(9) Tighten the new screws (27) of bottom articulation pins in sequence using the cross tightening method.

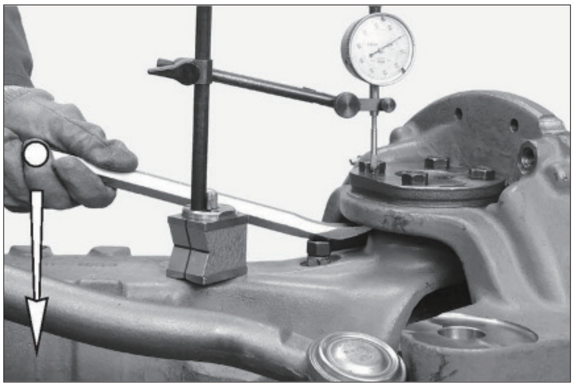
· Torque wrench setting : 140 Nm



14W98FA094

(10) Check by means of a lever that there is no vertical gap.

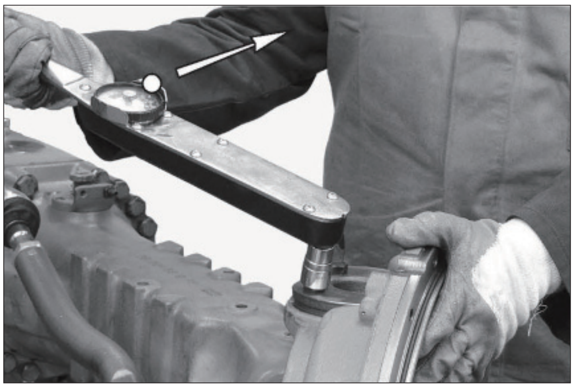
In case there is any gap, determine the width and reduce it by removing shims.



14W98FA095

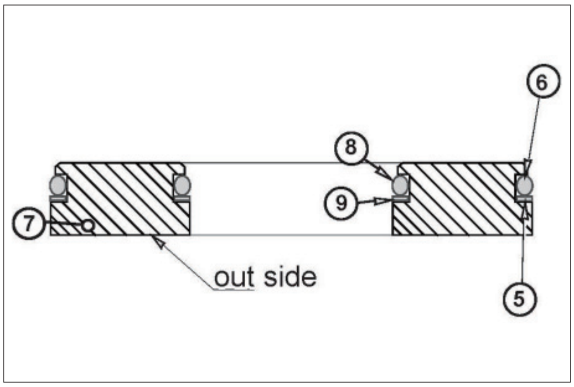
(11) Check the torque of the pins, which has to be between 40 and 80 Nm.

If the preliminary measured value is too high, the shims have to be increased.

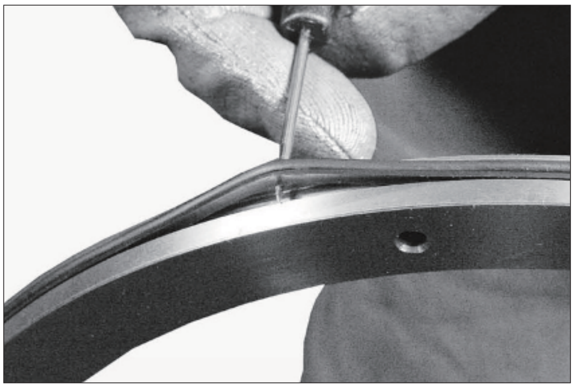


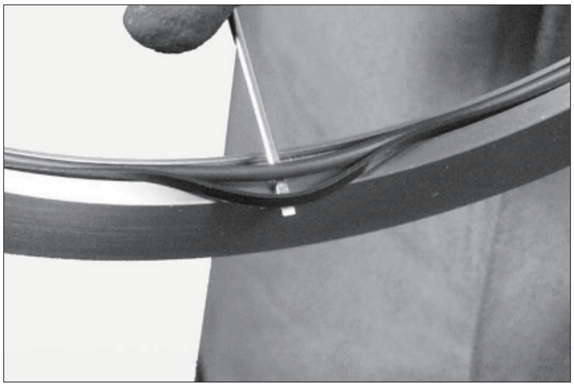
14W98FA096

(12) Accurately clean the piston (9) and the seats of slide and seal.
Replace the O-rings (5) and (8) and the back up rings (6) and (9) ; make sure that the assembly side is correct.
※ Accurately check the positioning of the back up rings (6) and (9).

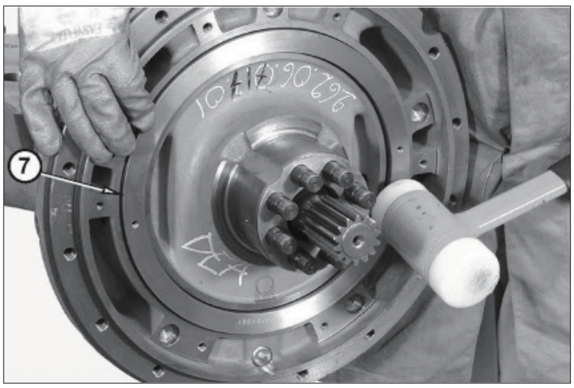


14W98FA097


14W98FA098

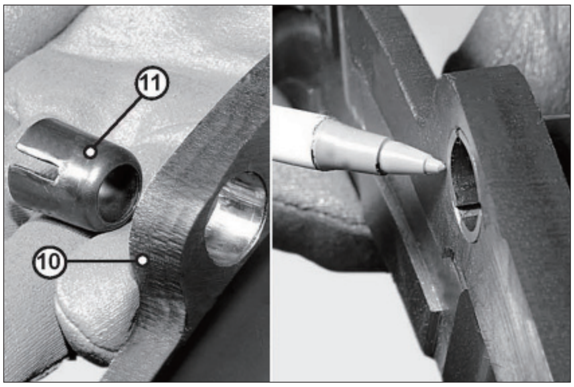

14W98FA099

(13) Insert the piston (7).
※ Check that the O-ring (5, 8) and back-up rings are in good condition and in position.



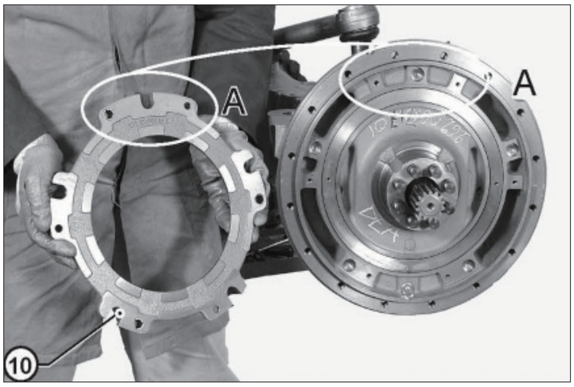
14W98FA100

(14) Before installing the intermediate disk, insert the stroke automatic regulation springs (11) ; place them in line with the intermediate disk (10).



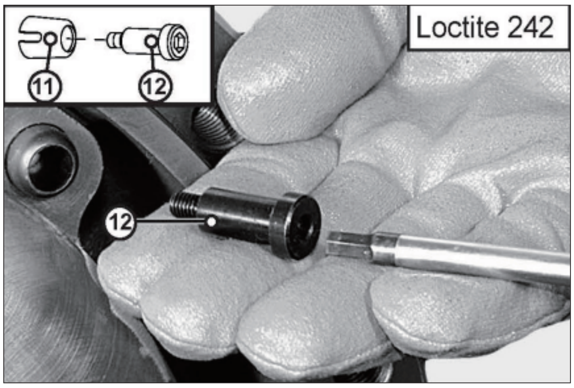
14W98FA101

(15) Install the intermediate disk (10) with the sign position (A).



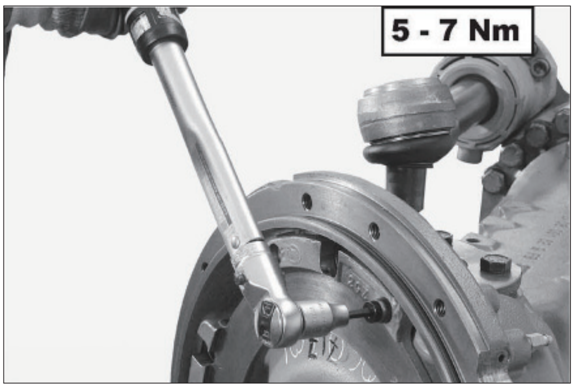
14W98FA102

(16) Apply loctite 270 to the thread, fit the pin screws (12).



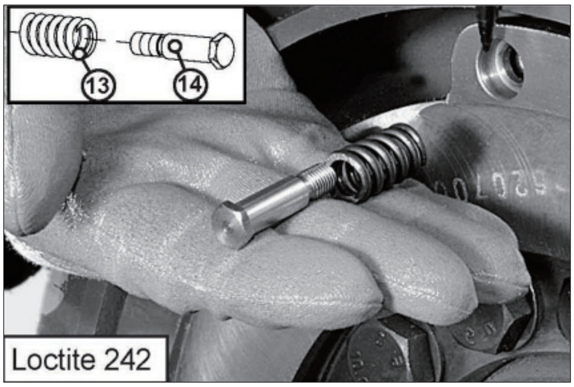
14W98FA103

(17) Use a torque wrench setting of 5~7 Nm.



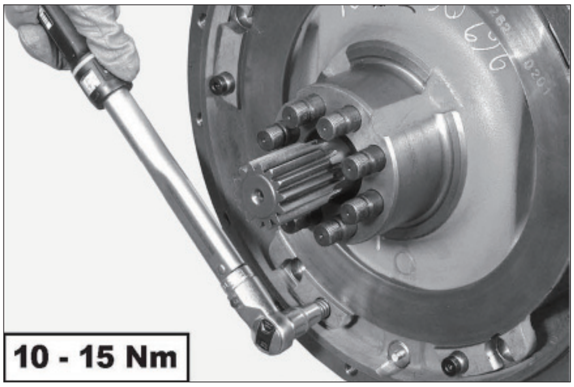
14W98FA104

(18) Apply loctite 270 to the thread, fit the pin screws (14).



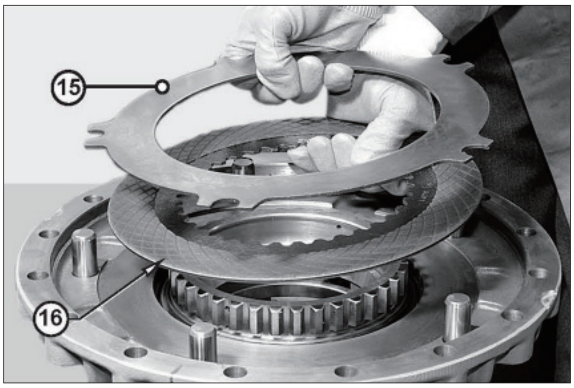
14W98FA105

(19) Use a torque wrench setting of 10-15 Nm.

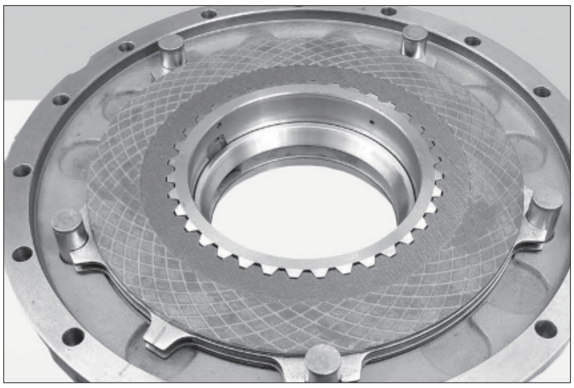


14W98FA106

(20) Slightly lubricate the braking disks (15 ,16).
Fit the braking disks (15, 16) in the arm following the correct sequence.

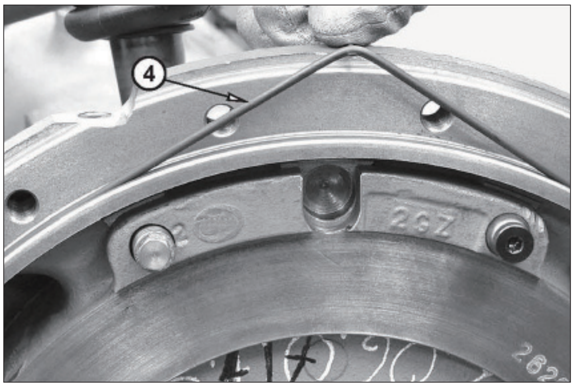


14W98FA107



14W98FA108

(21) Install a new O-ring (4).

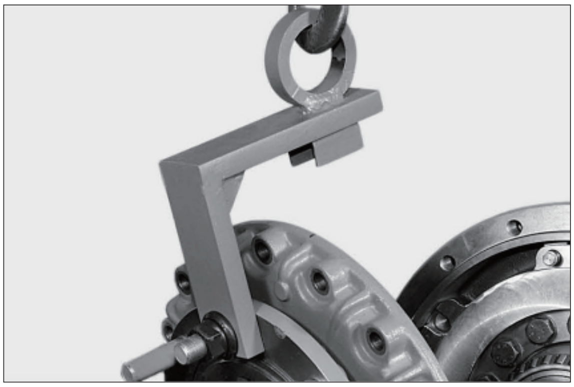


14W98FA109

(22) Install internal bearing.

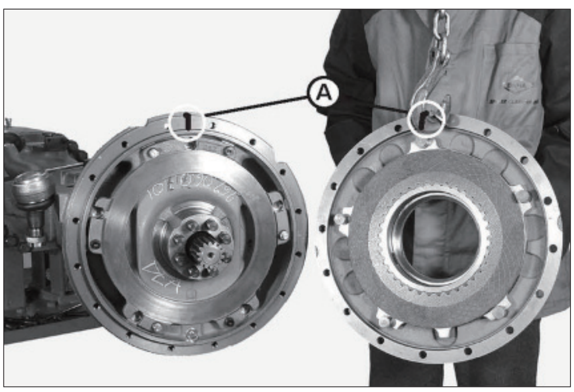
14W98FA110

(23) Before install the cover, secure them onto an appropriate tool.



14W98FA111

(24) Install the cover and hub complete with braking disks with the sign position (A).

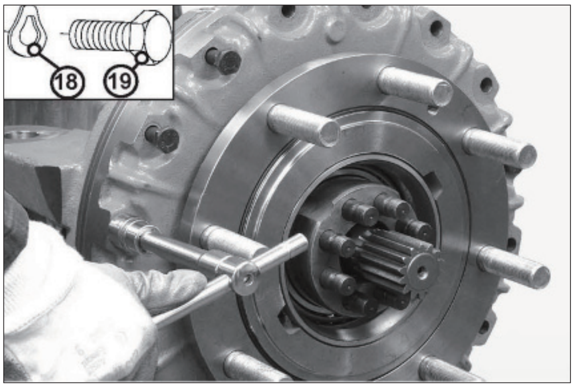


14W98FA112

(25) Slowly install for don't drop the brake disks (15, 16).

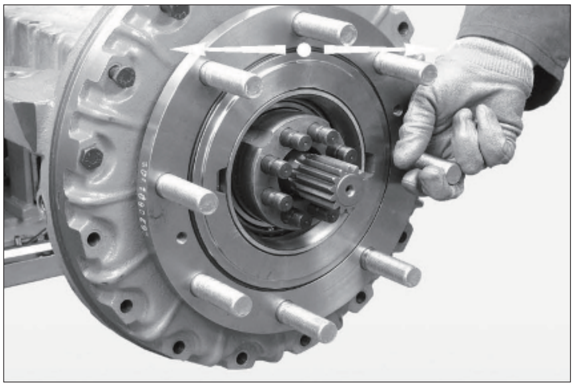
14W98FA113

(26) Turning two screws alternately until the cover is well set, fix the assembly.

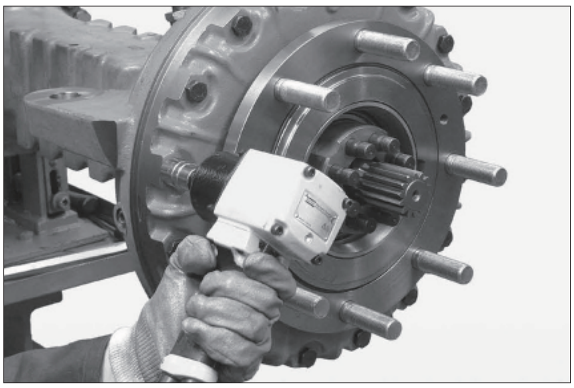


14W98FA114

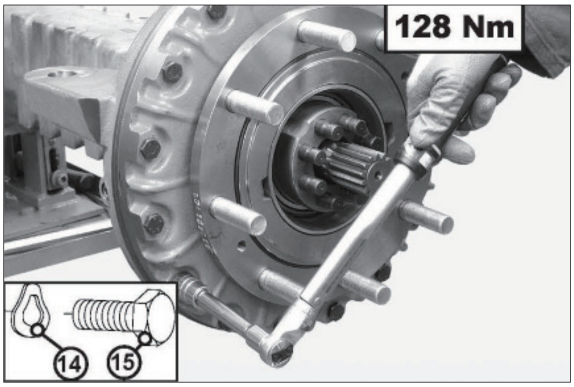
※ Turn the hub and control the free motion. If it blocks, repeat the operation.


14W98FA115

(27) Screw.


14W98FA116

(28) Lock the screws (14, 15) crosswise with a torque wrench setting of 128 Nm.



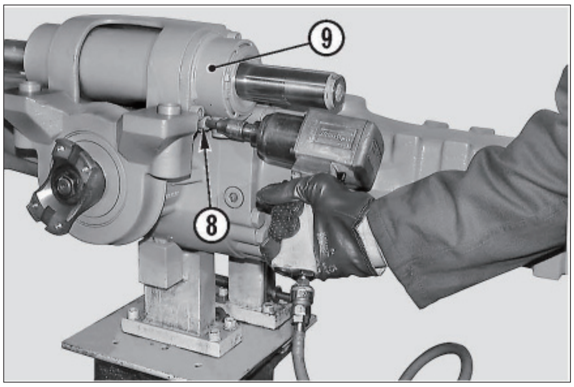
14W98FA117

9. THE STEERING CYLINDER

※ Front axle only

1) REMOVAL

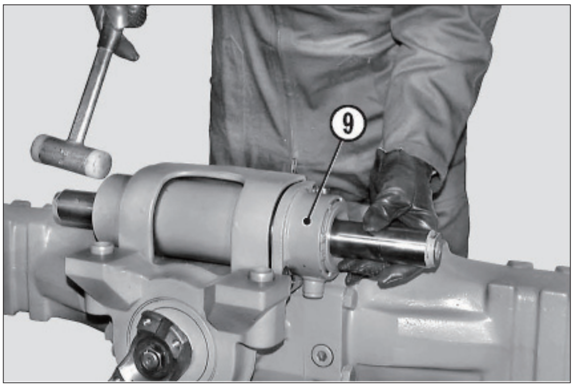
(1) Remove the securing screws (8) from the steering cylinder (9).



14W98FA118

(2) Extract the cylinder (9) using a plastic hammer.

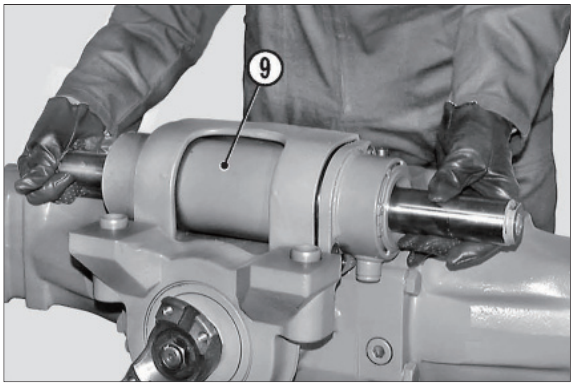
※ For cylinder disassembly, refer to "HOW TO DISASSEMBLE THE STEERING CYLINDER."



14W98FA119

2) INSTALLATION

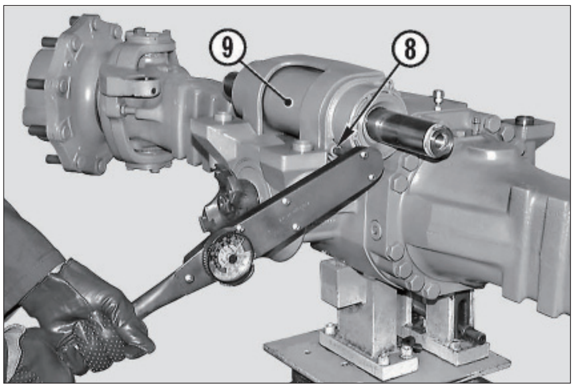
(1) Check that the O-rings (15) of this axle unit are in good condition ; lubricate the seats of the seals (15) and fit the steering cylinder (9) into ins seat.



14W98FA120

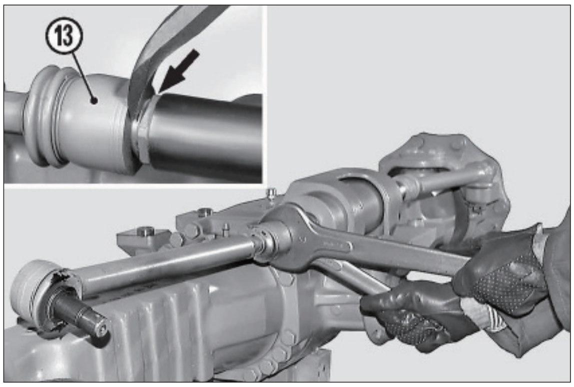
(2) Lock the cylinder by cross-tightening the screws (8).

· Torque wrench setting : 116~128 Nm.



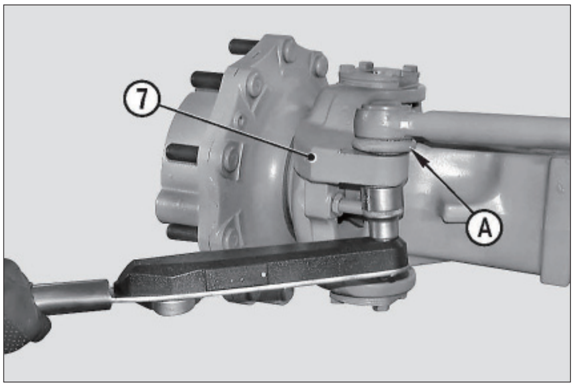
14W98FA121

(3) Apply loctite 242 to the thread and connect the steering bars by screwing the terminals onto the piston stem.
 · Torque wrench setting : 240~270 Nm
※ Versions with coupling require that the rim of the articulation (13) is riveted onto the surfaces of the piston stem.



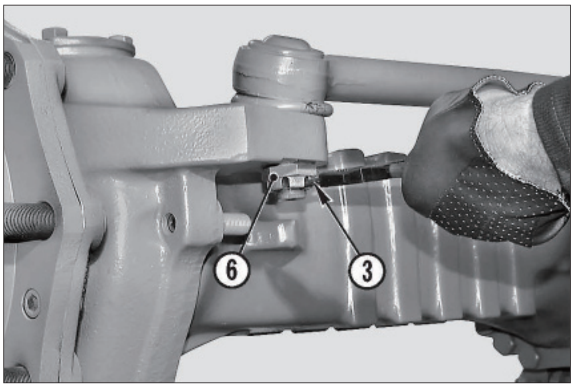
14W98FA122

(4) Insert the pins (4) in the steering case (7) and lock into position using a torque wrench setting of 260-290 Nm.
Find the position of the notching in relation to the hole of the cotter pins and tighten the nut (6) further.
※ Check that rubber guards (A) are intact.



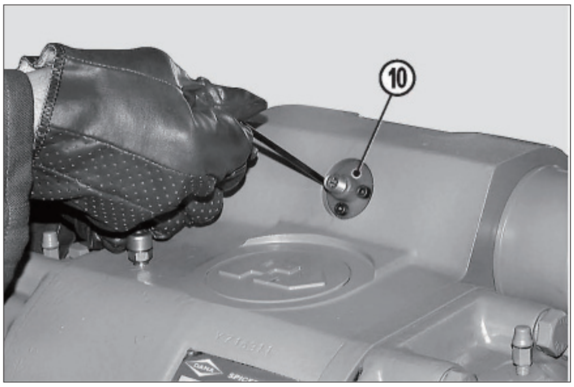
14W98FA123

(5) Insert the cotter pins (3) and bend the safety stems.
※ Use new cotter pins.



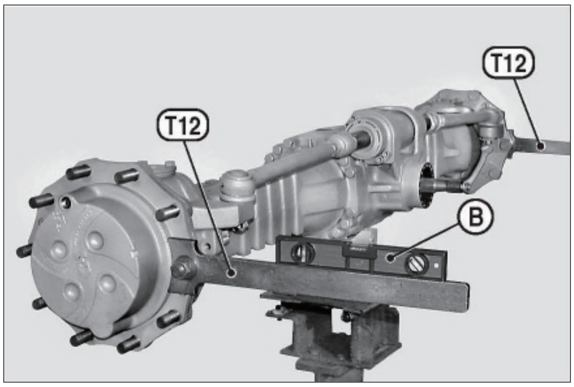
14W98FA124

(6) Install the proximity (1) for checking piston centering - if applicable and tighten the screw (10).
 · Torque wrench setting : 5~6 Nm



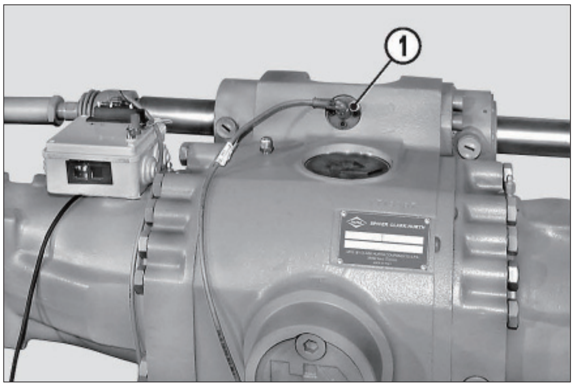
14W98FA125

※ Eliminate the action of the negative brake, if fitted. Apply tools T12 to the hubs and lock them.
Using a level "B", check that tools are perfectly flat and parallel to each other.



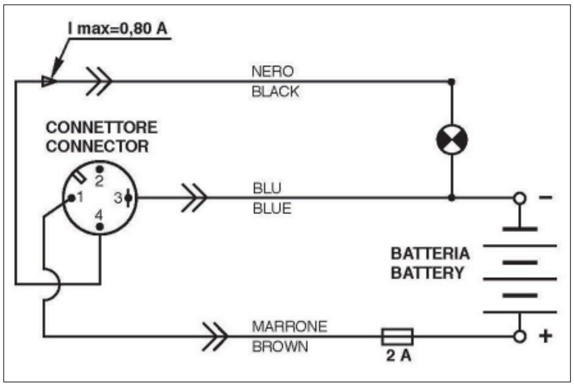
14W98FA126

(7) Connect the sensor (1) to the inspection device according to either diagram.



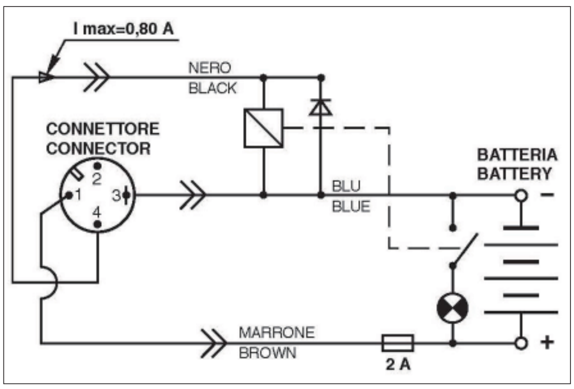
14W98FA127

(8) Sensor connection card, STANDARD version.



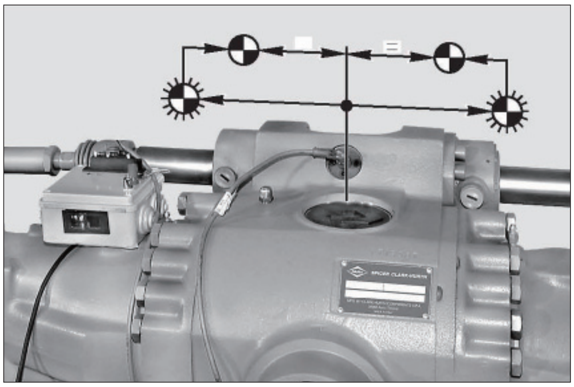
14W98FA128

(9) Sensor connection card, OPTIONAL version.



14W98FA129

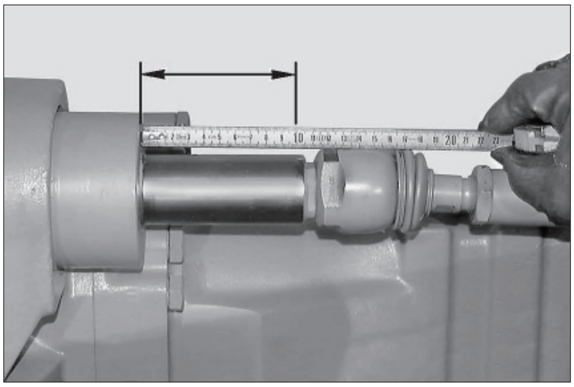
(10) Center the piston by slowly moving it first in one direction then in the other position if half way on the stroke, which is determined by the switching on and off of the signal lamp of the inspection device in the reversal stage.



14W98FA130

(11) Inspect jut "C" in one side of the piston and note down the size for checking later adjustment.

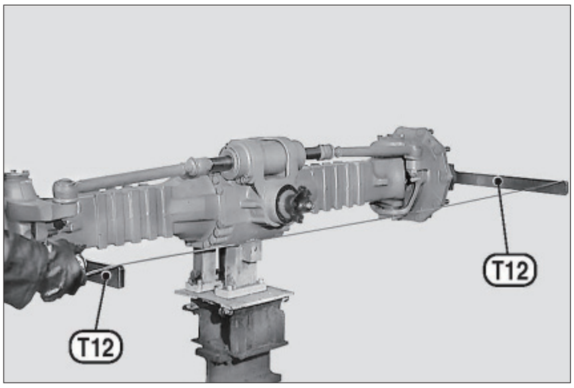
※ If cylinder come without a sensor, the centering of the piston must be carried out on the basis of the maximum stroke.



14W98FA131

(12) Without moving the piston, check front and rear size at the edge of tools T12.

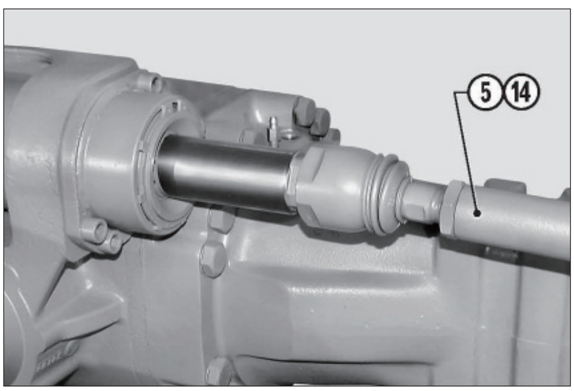
※ In order to check the rear size, rotate the bevel pinion and check that tools T12 are flat.



14W98FA132

(13) If necessary, adjust convergency without moving the centering of the piston and adjust the length of the steering bars (5) or (14).

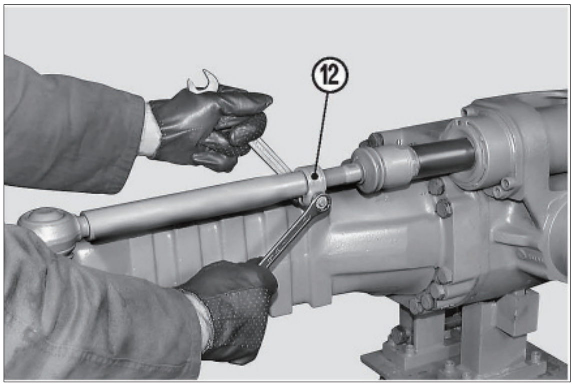
※ With a half turn of screw, the front size is reduced by about 3 mm, whereas the rear one is increased by about 3 mm.



14W98FA133

(14) CONVERGENCY ADJUST ON UNITS WITH COLLAR

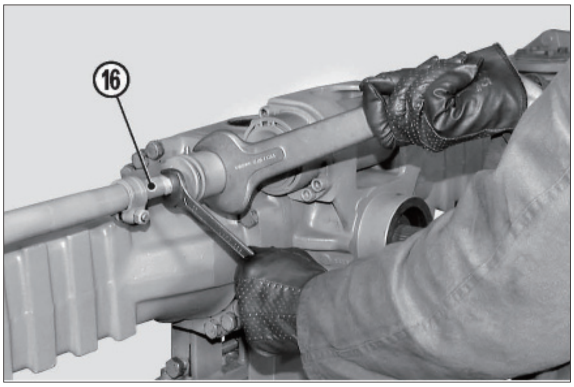
① Unloose the nuts on the collars (12).



14W98FA134

② Rotate the ball-socket joints (16) until convergency has been obtained.
Check that articulations move easily and lock the collars (12).

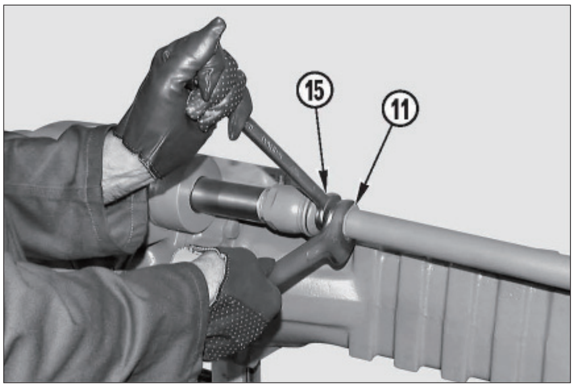
· Torque wrench setting for nuts : 42~52 Nm.



14W98FA135

(15) CONVERGENCY ADJUSTMENT ON ALTERNATOR VERSIONS

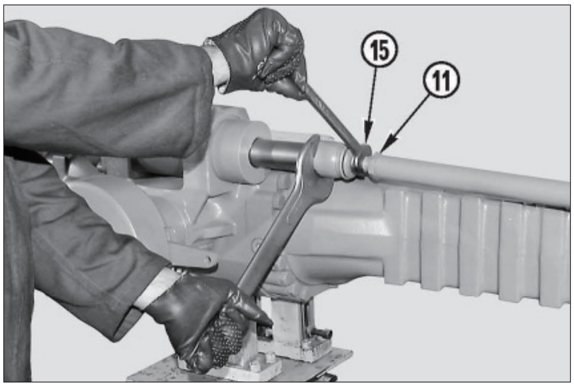
① Unloose the nuts (11) and screw them onto the ball-and-socket joints (15).



14W98FA136

② Hold the articulations still and rotate the ball-and-socket joints (15). Once the convergency has been adjusted, lock the nuts (11).

· Torque wrench setting for nuts : 298-328 Nm

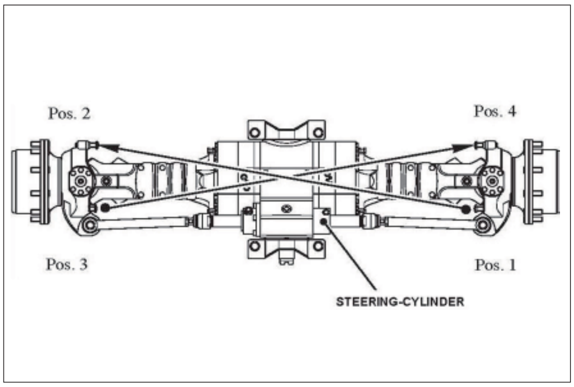


14W98FA137

(16) ADJUSTMENT THE STEERING ANGLE

※ Form the same operations on both sides see diagram.

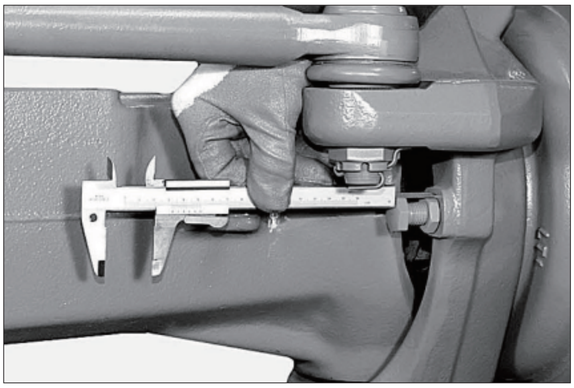
① Loosen the nut of one of the adjusting screw on cylinder side.



14W98FA138

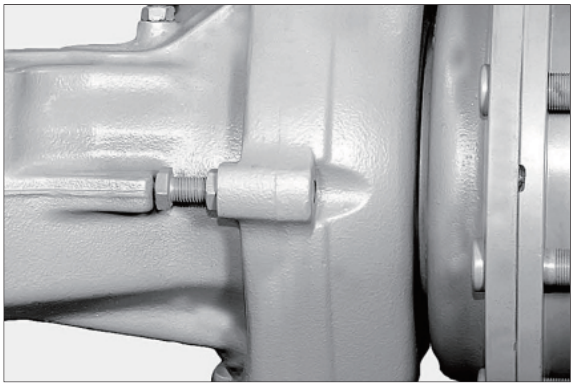
② Adjust the jutting portion of the screw according to data shown in the table.
Lock into the position with nut tightening to max 148 Nm.

Steering angle	43°	45°	35°	55°	40°	40°
Distance (mm)	58.5	53.5	51.6	23.8	36.6	38.2



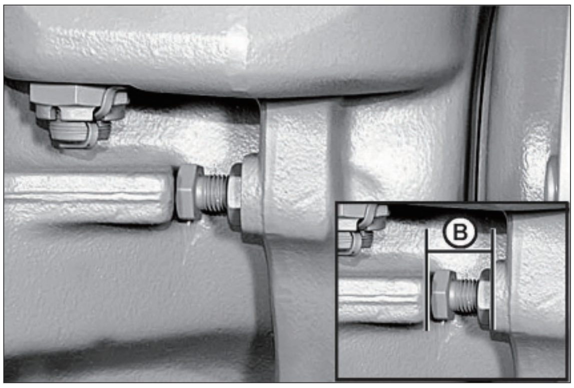
14W98FA139

③ Perform one full steering operation until the adjusted screw leans against the arm stop.



14W98FA140

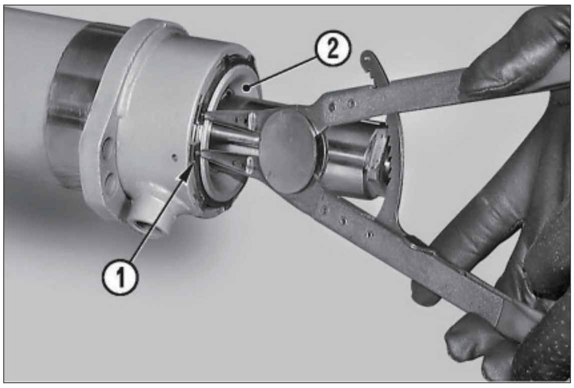
④ Adjust the jutting portion.



14W98FA141

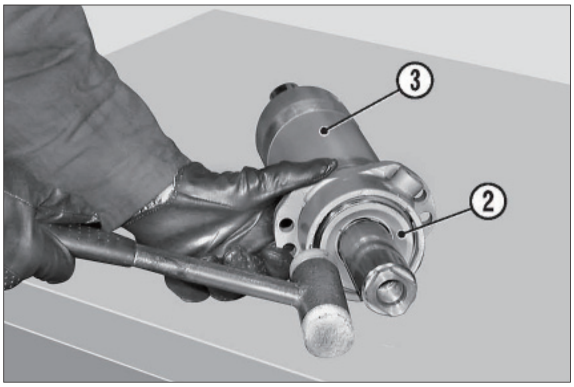
3) DISASSEMBLE THE STEERING CYLINDER

(1) Remove the snap ring (1) from the cylinder head (2).



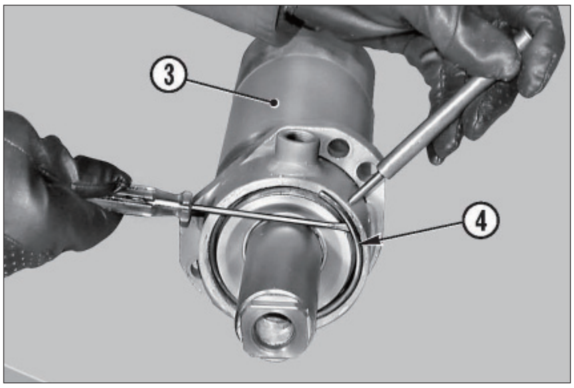
14W98FA142

(2) With the help of a plastic hammer, push the head (2) inside the cylinder (3).
※ The head should line up with the edge of the cylinder.



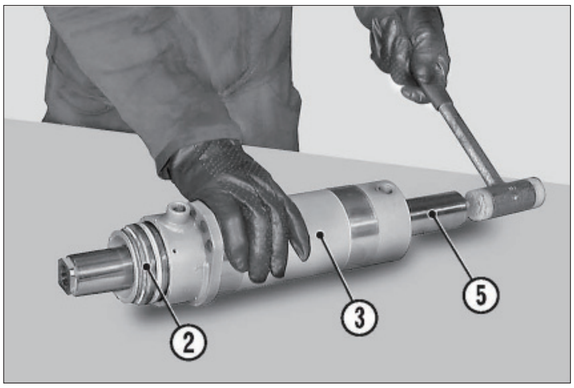
14W98FA143

(3) With the help of a dirty, apply pressure to the stop ring (4) that is placed inside the cylinder (3) and extract the ring using a screwdriver.



14W98FA144

(4) Hammer the piston (5) in the rear head (2) using a plastic hammer.
Continue hammering until the head (2) is ejected from the cylinder (3).



14W98FA145

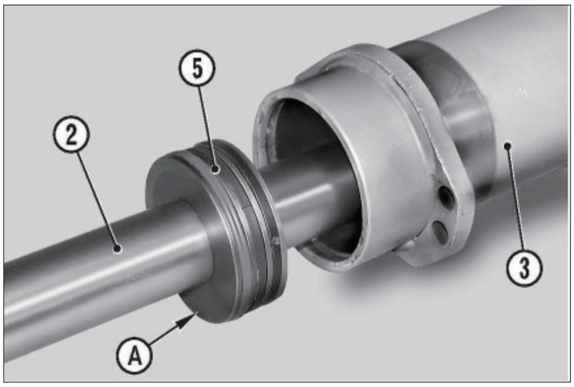
(5) Disassemble the cylinder unit (3) by extracting first the head (2), then the piston (5).

※ Note down the assembly side of the piston (5). The bevelled part "A" of the piston is oriented towards the head (2).

(6) Remove all seals, anti-extrusion rings and scraper rings from head (2), cylinder (3) and piston (5).

※ All seals must be replaced every time the unit is disassembled.

※ Particular attention must be paid not to damage the seals of both seals and piston side.

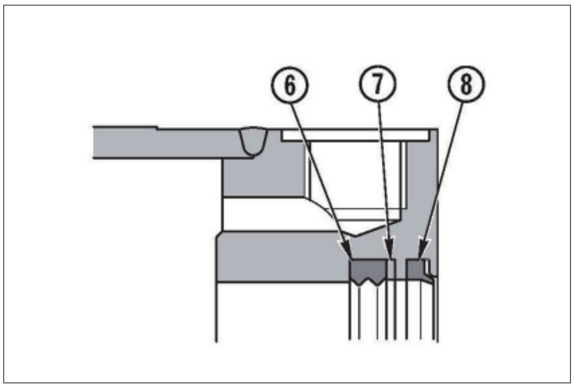


14W98FA146

4) ASSEMBLE THE STEERING CYLINDER

(1) After applying grease, install the sealing ring (6) of the shaft, the anti-extrusion ring (7) and the scraper ring (8) inside the cylinder (3).

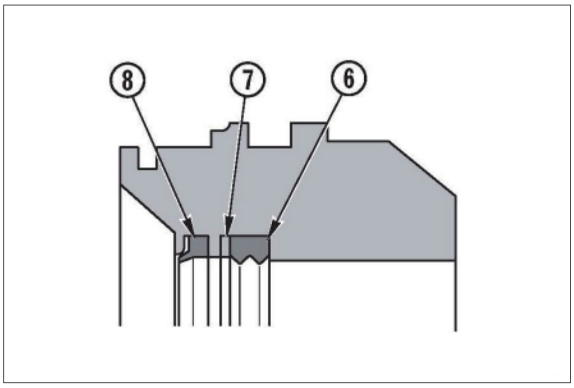
※ Thoroughly check that position of the anti-extrusion ring (7) is correct.



14W98FA148

(2) After applying grease, install the sealing ring (6) of the shaft, the anti-extrusion ring (7) and the scraper ring (8) in the head (2).

※ Thoroughly check that positioning of the anti-extrusion (7) ring is correct.

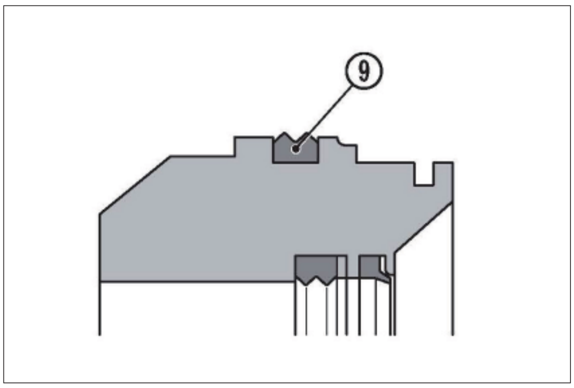


14W98FA149

(3) Fit the seal (9) onto the outside of the head (2).

※ In order to facilitate assembly, apply grease to the outer surface of the piston.

※ Do not roll the seal (9) up.

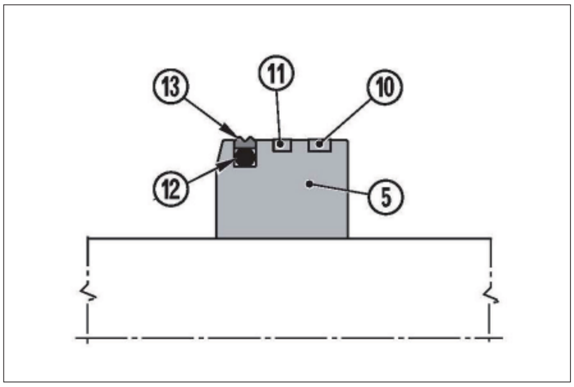


14W98FA150

(4) Prepare the piston (5) by fitting it with the guide ring (10), the magnetic ring (11), the O-ring (12) and the seal (13).

※ In order to facilitate assembly, apply grease.

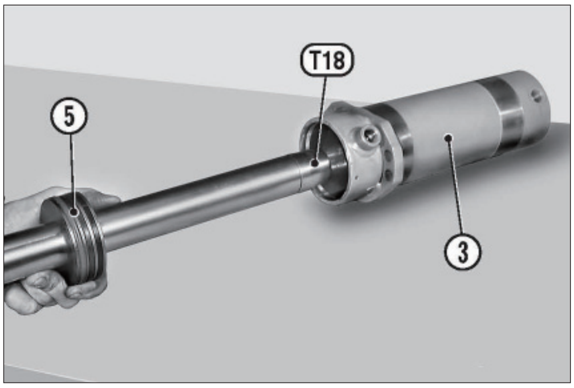
※ If a centering sensor is not fitted, then the magnetic ring (11) should be replaced by another guide ring (10).



14W98FA151

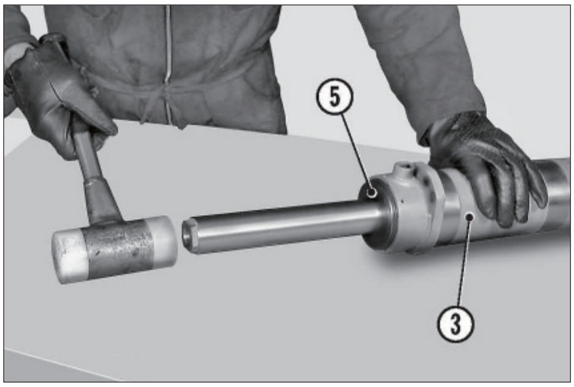
(5) Apply tool T18 to the shaft on the opposite side of the head (2) and center it on the cylinder (3) so that of fits into the piston (5).

※ Apply a little grease to seals and cylinder.



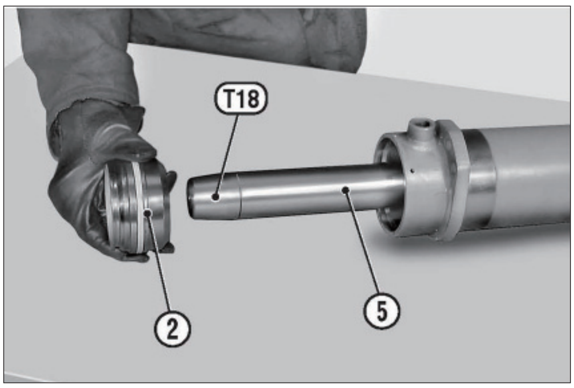
14W98FA152

(6) Push the piston (5) into the cylinder for 100 mm using a plastic hammer.



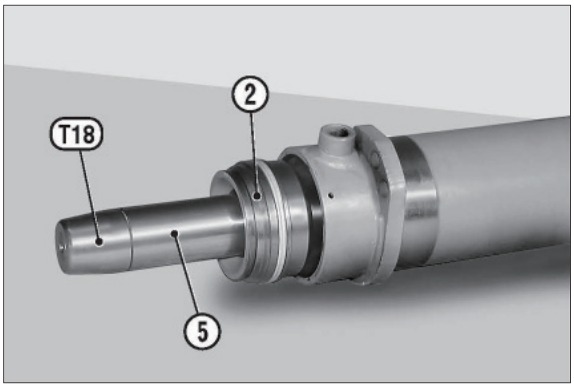
14W98FA153

(7) Remove tool T18 and apply of to the opposite side of the piston (5).



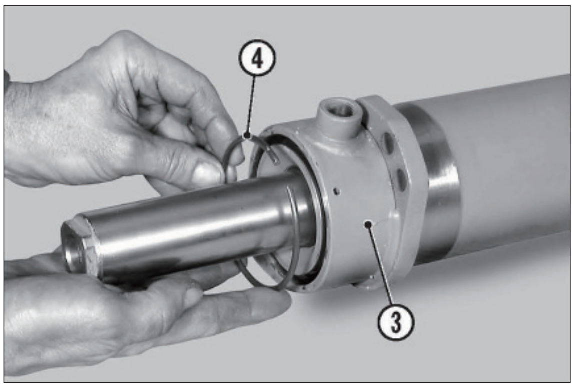
14W98FA154

(8) Apply grease to head (2) seals, fit the head onto the piston and push it into the cylinder (3) using a plastic hammer.
※ Insert the head as to line up with edge of the cylinder.



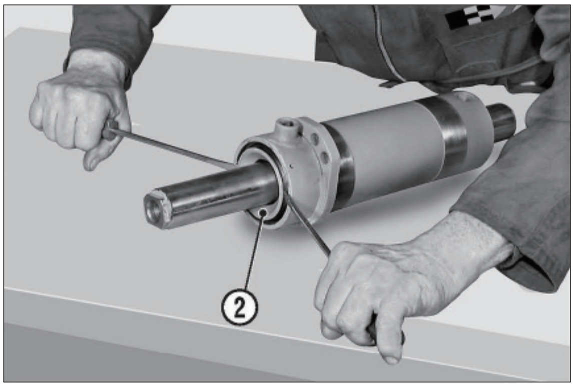
14W98FA155

(9) Insert the stop ring (4) ensuring that it fits into the seat of the cylinder (3).



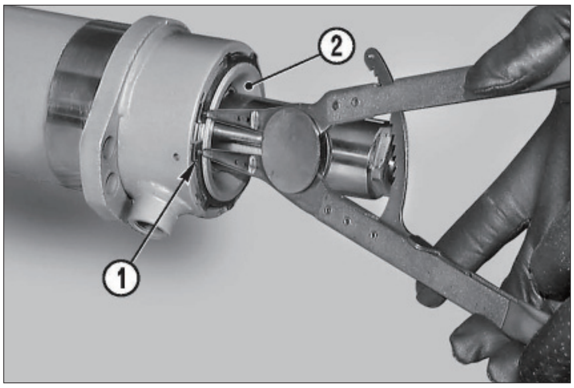
14W98FA156

(10) Apply pressure to the head using two screwdrivers or levers until the head is fastened onto the stop ring (4).



14W98FA157

(11) Fit the snap ring (1) on the head (2). Make sure that the snap ring (1) is securely fastened in its seat.
※ If necessary, force it into its seat using a drift and a hammer.

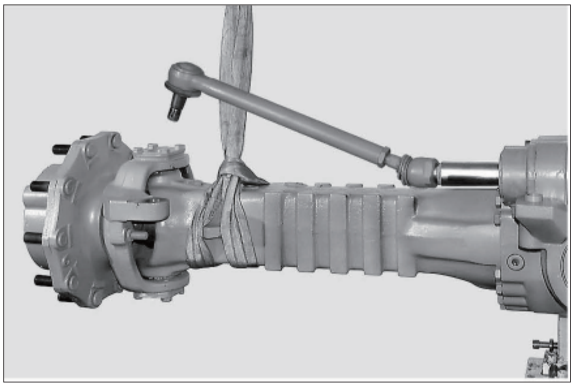


14W98FA158

10. THE BEVEL PINION

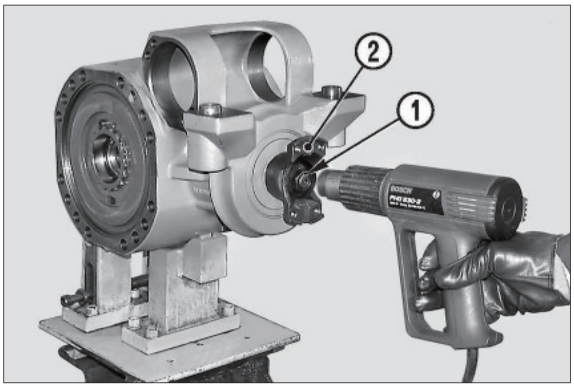
1) REMOVE THE BEVEL PINION

(1) Remove the complete arms and the differential unit.
For details, see "CHECKING WEAR AND REPLACING THE BRAKING DISKS" and "REMOVING THE DIFFERENTIAL UNIT".



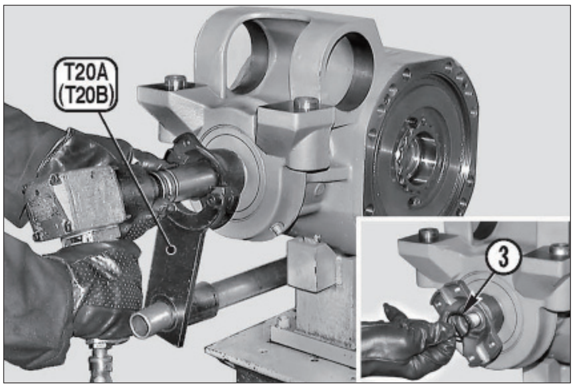
14W98FA159

(2) If disassembly is awkward, heat the check nut (1) of the flange (2) at 80°C.



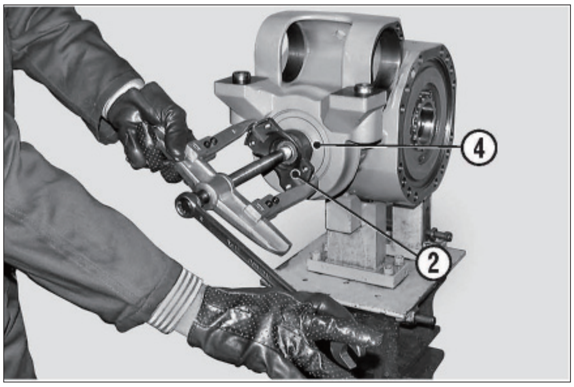
14W98FA160

(3) Position tool T20A (or T20B), so as to avoid pinion rotation. Unloose and remove the nut (1) ; also remove the O-ring (3).



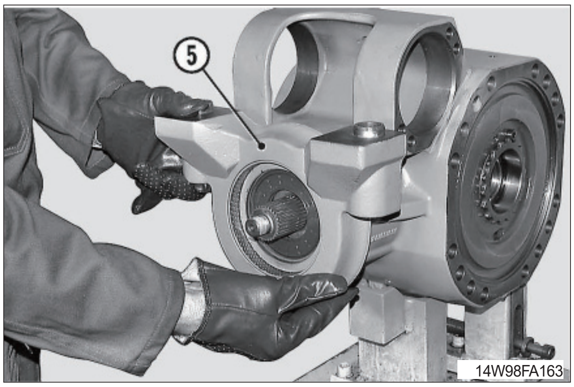
14W98FA161

(4) Remove the flange (2) complete with guard (4) by means of a puller.



14W98FA162

(5) Remove the swinging support (5).

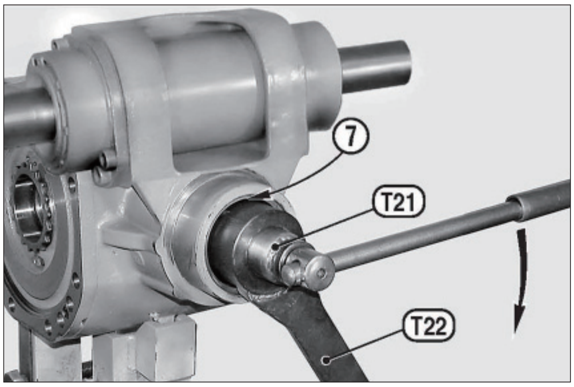


(6) Remove the sealing ring (6).

14W98FA164

(7) Position wrench T22 onto the ring nut (7) and apply bar hold T21 to the pinion (8). Stop wrench T22 and rotate the pinion so as to release and remove the ring nut (7)

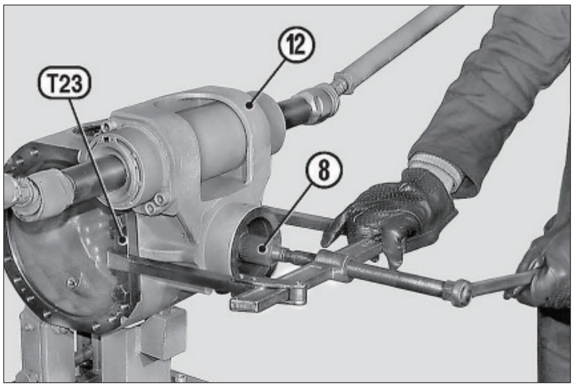
※ If disassembly proves awkward, weld the ring nut at approx 80°C.



14W98FA165

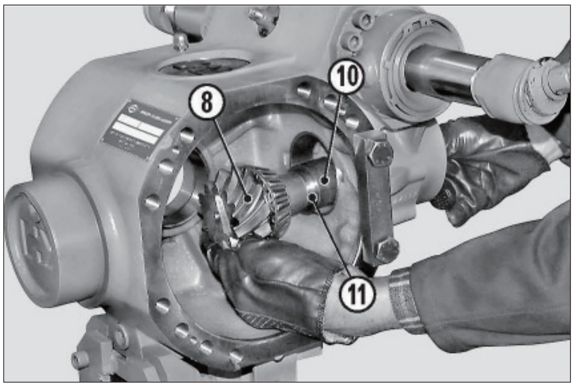
(8) Apply blocks T23 and, with the help of a puller, extract the pinion (8) complete with the internal bearing (9), the distance piece (10) and shims (11).

※ The thrust blocks of the bearing remain in the central body (12).



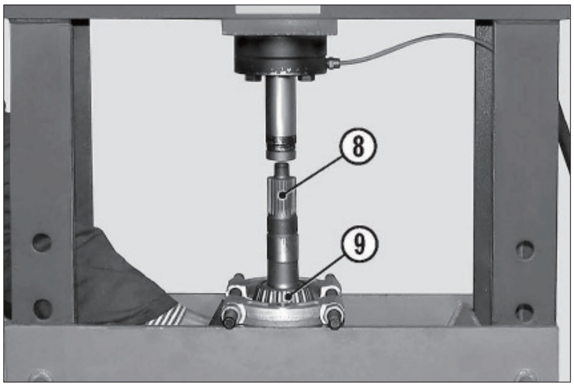
14W98FA166

(9) Remove the pinion (8), shims (11) and distance piece (10).



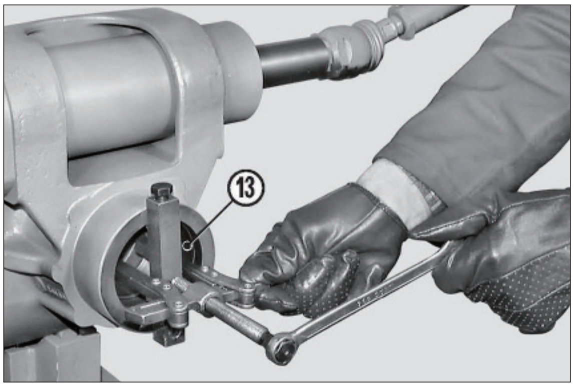
14W98FA167

(10) Using a puller and a press, remove the inner bearing (9) from the pinion (8).



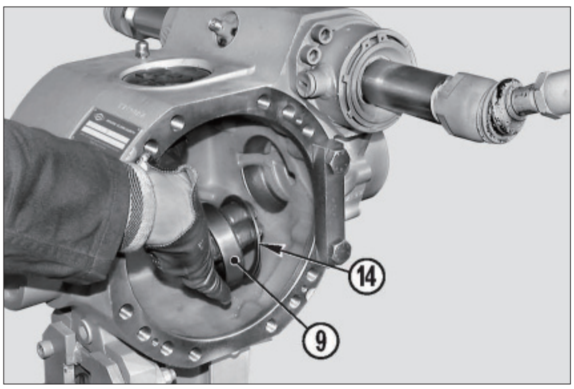
14W98FA168

(11) Remove the thrust block of the external bearing (13).



14W98FA169

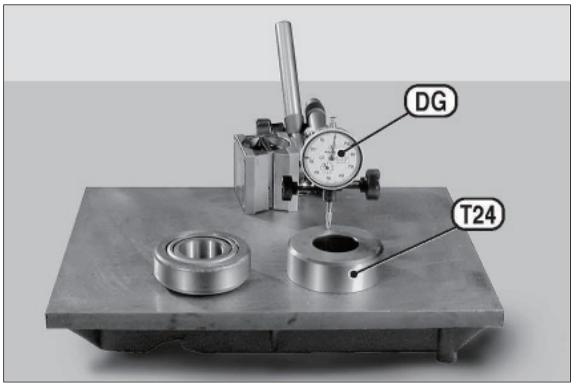
(12) Insert a drift in the appropriate holes and remove the thrust block of the internal bearing (9) as well as the shim washers (14).



14W98FA170

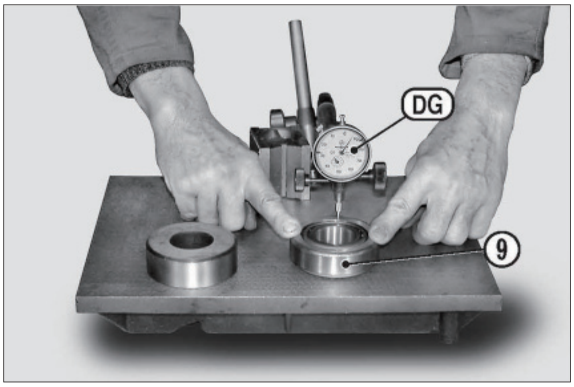
2) INSTALL AND ADJUST THE BEVEL PINION

(1) Using a surface plate, reset a centesimal comparator "DG" and place it on the measurement ring T24 (with a thickness of 30.2 mm).
Preset the comparator to approx 2 mm.



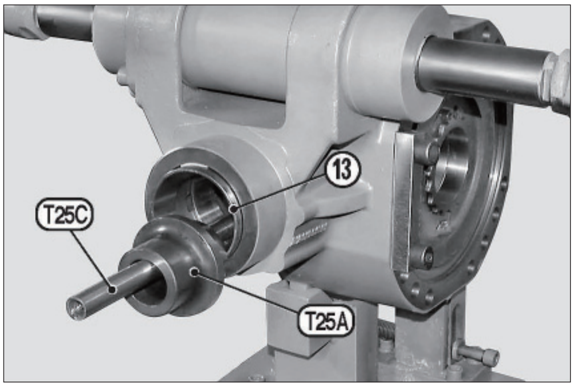
14W98FA171

(2) Bring the internal bearing (9), complete with its thrust block, under the comparator "DG".
Determine overall thickness "D" of the bearing checking the discrepancy between this size and the size of the measurement ring.
※ Press the thrust block in the center and take several measurements while rotating the thrust block.



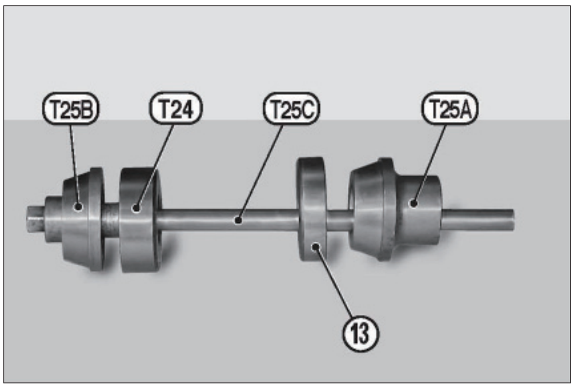
14W98FA172

(3) Partially insert the thrust block of the external bearing (13).



14W98FA173

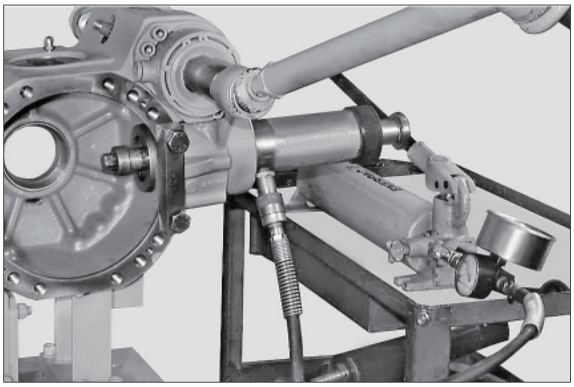
(4) Install tension rod T25C, measurement ring T24 and front guide tool T25A on the thrust block of the external bearing (13).



14W98FA174

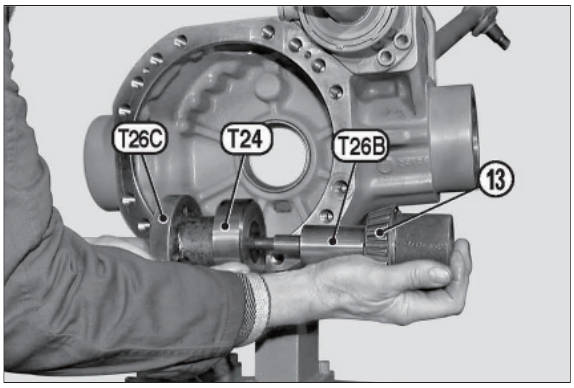
(5) Connect the tension rod to the press and move the thrust block of the external bearing (13) into its seat.
Disconnect the press and remove the tension rod.

※ Before starting the next stage, make sure that the thrust block has been completely inserted into its seat.



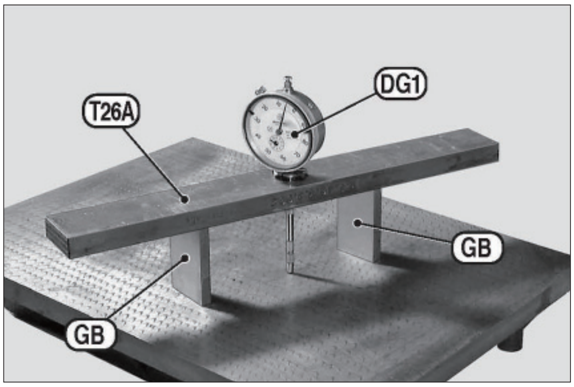
14W98FA175

(6) Insert tool T26B complete with external bearing (13), measurement ring T24 and gauged ring nut T26C.
Manually tighten.



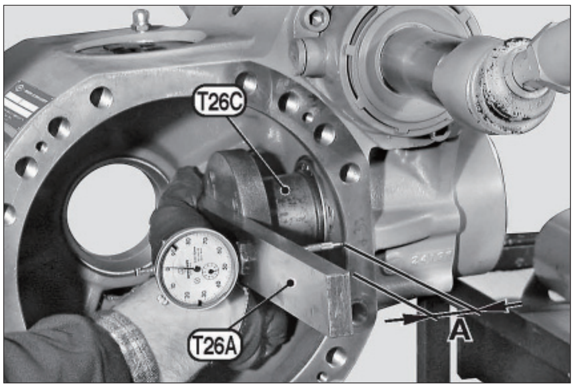
14W98FA176

(7) Fit a centesimal comparator "DG1" with long stem into bar T26A ; when the bar rests on two size-blocks "GB" of 57 mm , rest the comparator.
Preset the comparator to approx. 2 mm and reset.



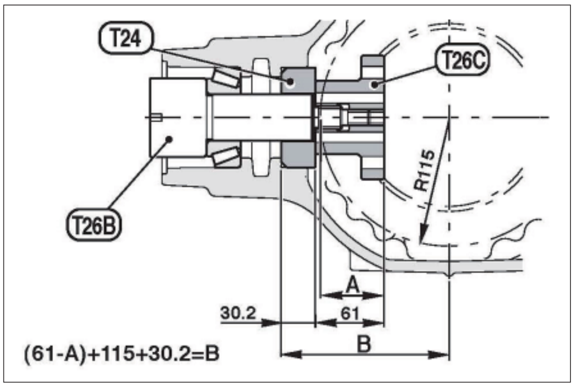
14W98FA177

(8) Lay bar T26A on gauge nut T26C and take the size "A" at about 57 mm corresponding to the maximum diameter of arms centering.



14W98FA178

(9) Calculate size "B" which will be the first useful value for calculating the size of the shims (14) that are to be inserted under the thrust block of the internal bearing (9).

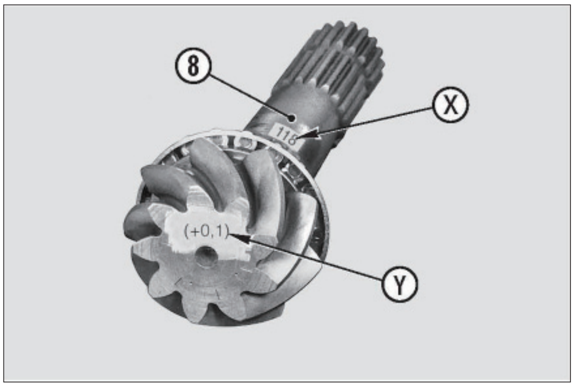


14W98FA179

(10) Check the nominal size (X) marked on the pinion and add or subtract the indicated variation (Y) so as to obtain size "Z".

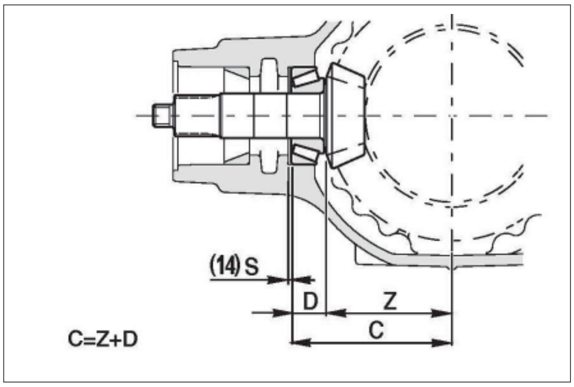
e.g. : Z =118 + 0.1 = 118.1

Z = 118 - 0.2 = 117.8



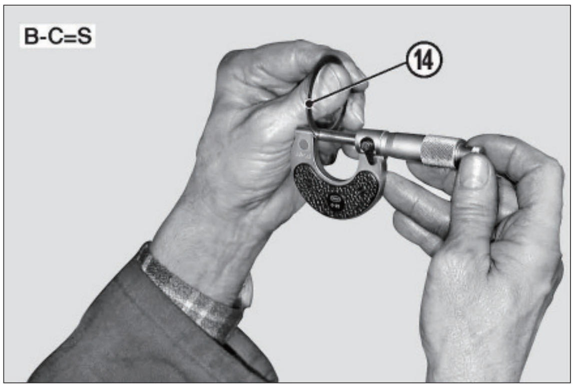
14W98FA180

(11) Calculate size "C" which represents the second value for calculating the size of the shims "S" that are to be placed under the thrust block of the internal bearing (9).



14W98FA181

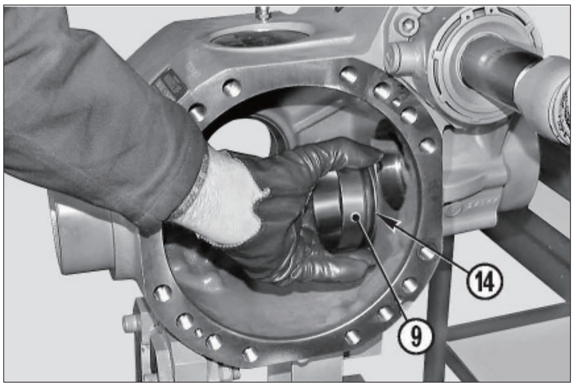
(12) Calculate the difference between sizes "B" and "C" so as to obtain the size "S" of the shim (14) that will go under the thrust block of the internal bearing (9).



14W98FA182

(13) Insert shim "S" (14) and the thrust block of the internal bearing (9) in the central body.

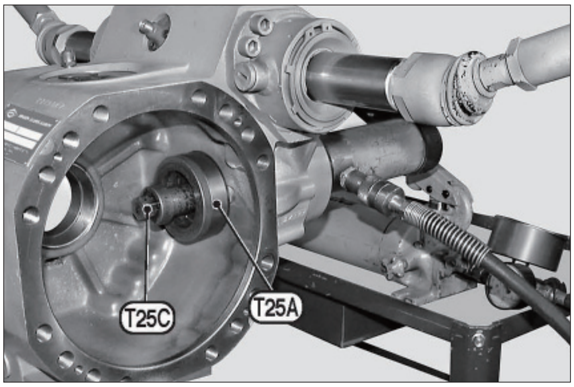
※ To hold shim "S" (14) in position, apply grease.



14W98FA183

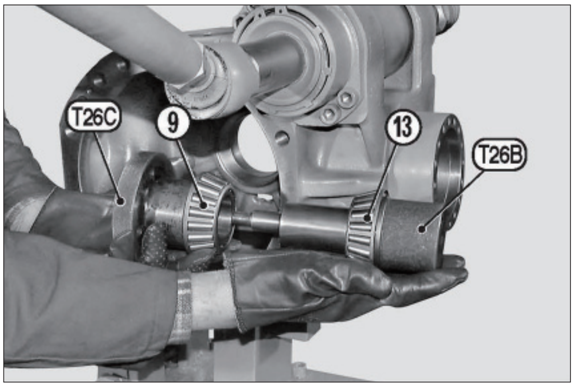
(14) Position tool T25A and tension rod T25C. Connect the tension rod to the press, fasten the thrust block and then remove the tools.

※ Before going on the next stage, make sure that the thrust block has been completely inserted.



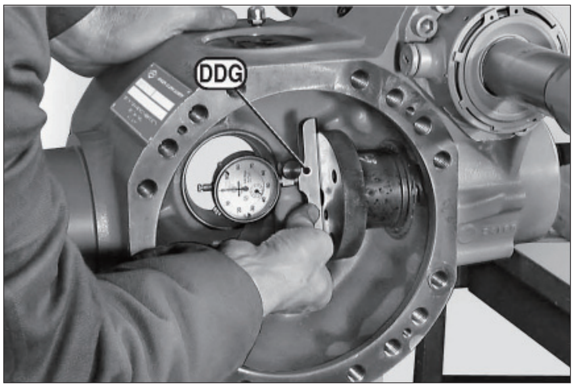
14W98FA184

(15) Position tools T26C and T26B complete with tapered bearing (9) and (13) ; manually tighten until a rolling torque has been obtained.



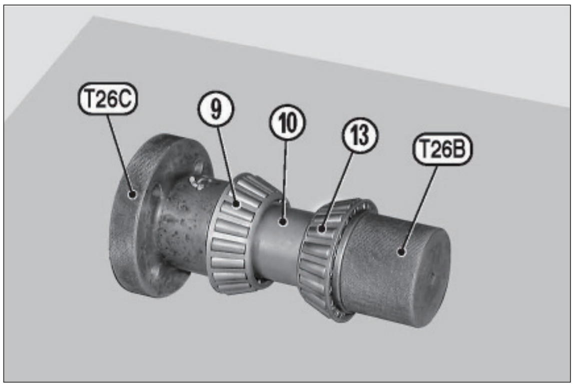
14W98FA185

(16) Insert the stem of a depth comparator "DDG" in either side hole of tool T26C ; reset the comparator with a presetting of approx. 3 mm.



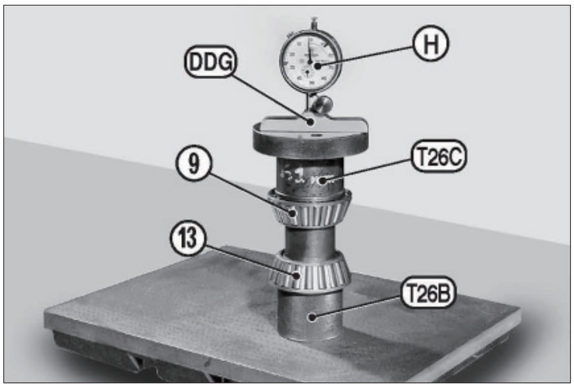
14W98FA186

(17) Remove the comparator and release tools and bearing from the central body. Re-install all and insert the distance piece (10) between bearings (9) and (13) ; manually tighten until a rolling torque has been obtained.



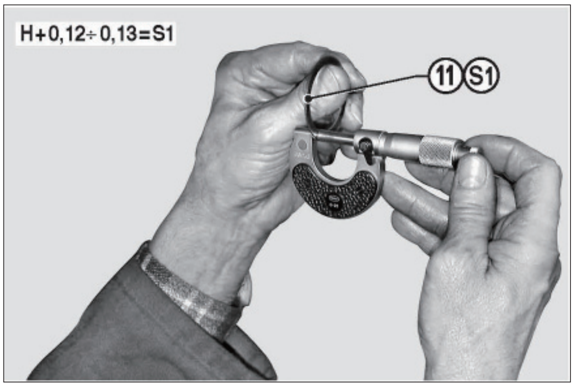
14W98FA187

(18) Insert the stem of a depth comparator "DDG" into tool T26B-T26C and measure variation "H" in relation to the zero setting performed back at point d.



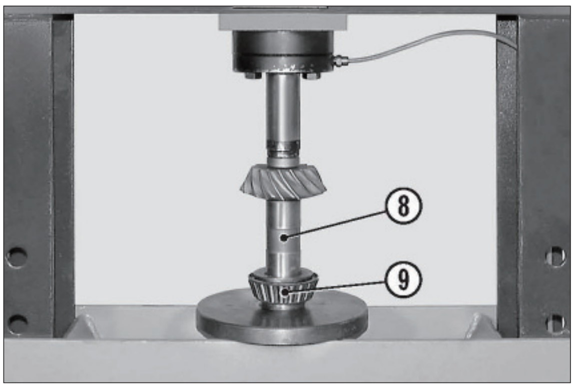
14W98FA188

(19) The variation is to be added to a set value of 0.12-0.13 mm., so as to obtain the size of shim "S1" (11) which will be inserted between the external bearing (13) and the distance piece (10) and subsequently, to determine the preload for the bearings.



14W98FA189

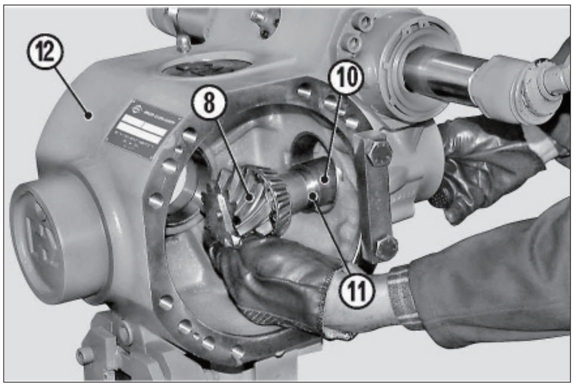
(20) Position the internal bearing (9) and the pinion (8) under a press ; force the bearing onto the pinion.



14W98FA190

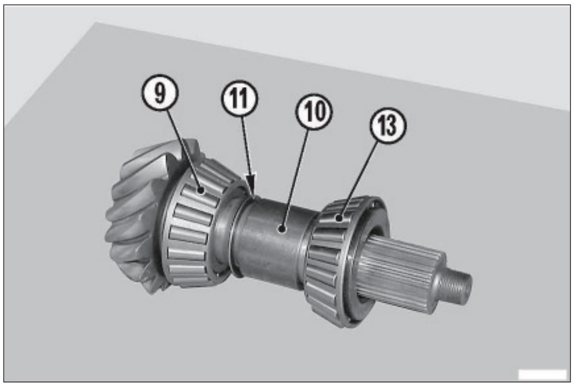
(21) Fit the pinion (8), shim "S1" (11) and distance piece (10) in the main body (12).

※ The finer shim must be placed in between the thicker ones.



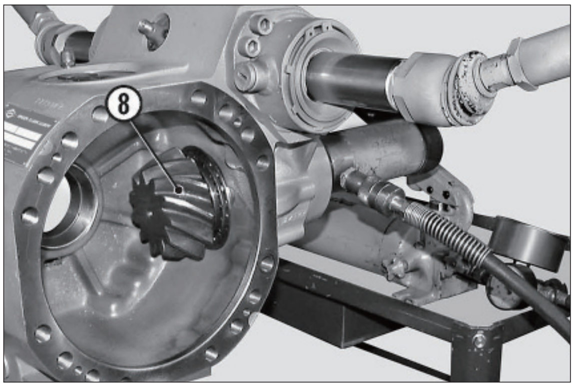
14W98FA191

(22) Insert the external bearing (13) in the central body in order to complete the pack arranged as in the figure.



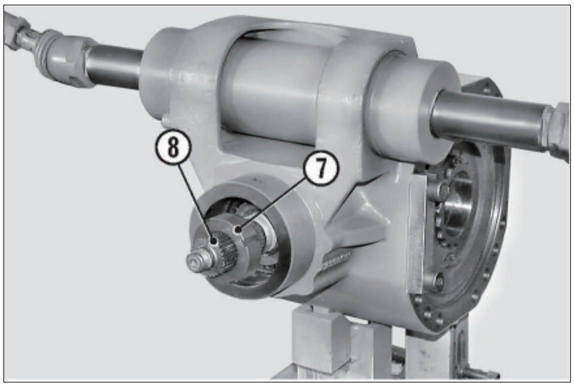
14W98FA192

(23) Connect the pinion (8) to the tie rod T28A and T28B ; connect the tie rod T28C (see special tools) to the press and block.



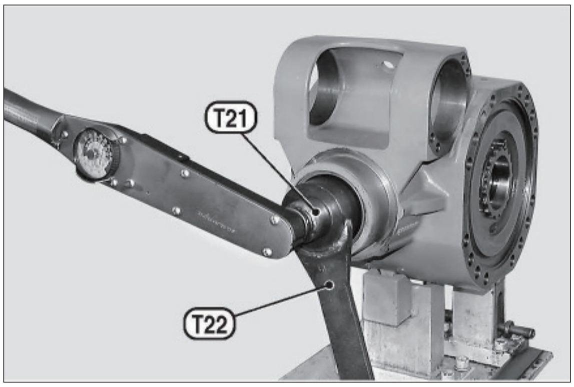
14W98FA193

(24) Apply loctite 242 to the thread of the ring nut (7) and screw the nut onto the pinion (8).



14W98FA194

(25) Apply special wrench T22 to the ring nut (7) and bar-hold T21 to the pinion (8).
Lock the wrench T22 and rotate the pinion using a dynamometric wrench, up to a minimum required torque setting of 500 Nm.



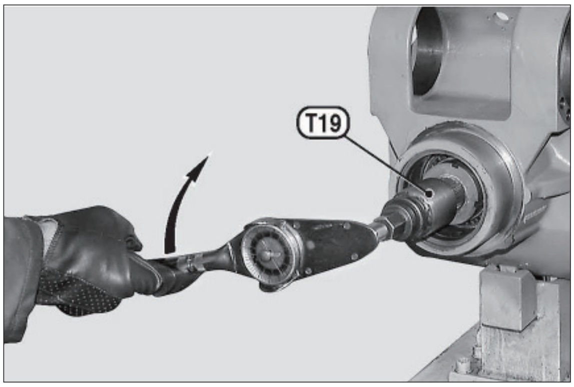
14W98FA195

(26) Apply onto the pinion (8) the bar-hold and with the help of a torque meter, check the torque of the pinion (8).
Torque : 120-170Ncm

※ If torque exceed the maximum value, then the size of shim "S1" (11) between the bearing (13) and the distance piece (10) needs to be increased.

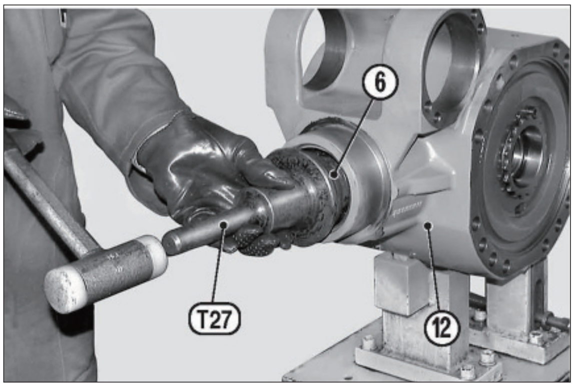
※ If torque does not reach the set value, increase the torque setting of the ring nut (7) in differential stages to obtain a maximum value of 570 Nm.
If torque does not reach the minimum value, then the size of shim "S1" (11) needs to be reduced.

※ When calculating the increase or decrease in size of shim "S1", bear in mind that a variation of shim (11) of 0.01 mm corresponds to a variation of 60 Ncm in the torque of the pinion (8).



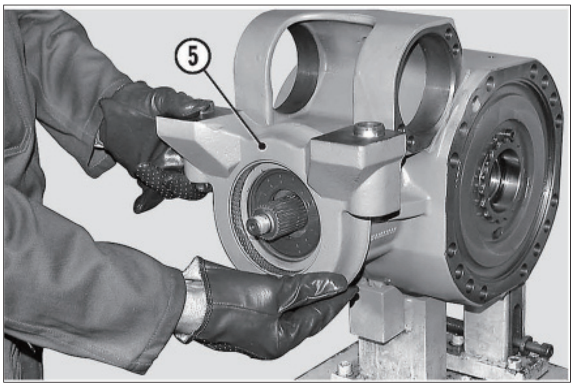
14W98FA196

(27) Lubricate the outer surface of the new sealing ring (6) and fit it onto the central body (12) using tool T27.



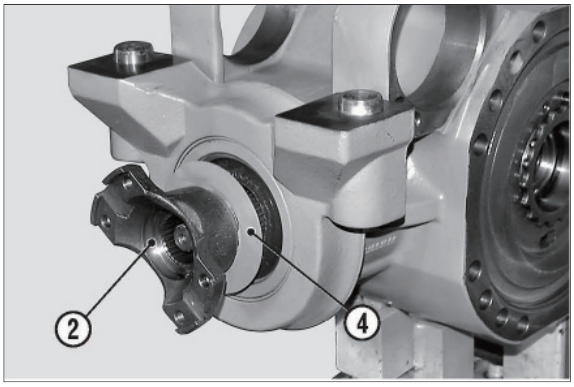
14W98FA197

(28) Install the swing support (5).
※ Check that it is properly oriented.



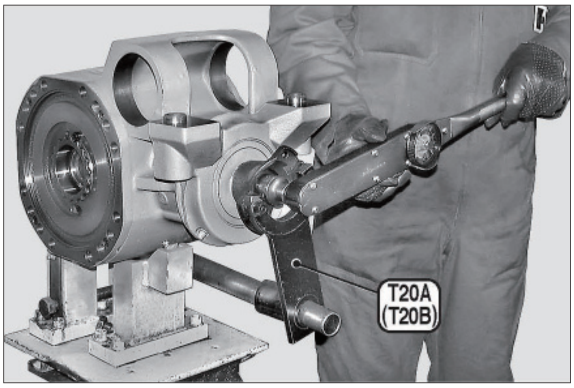
14W98FA198

(29) Fit the flange (2) complete with the guard (4) and fasten it.
For keying the flange (2), use a plastic hammer if necessary.
※ Make sure that the guard (4) is securely fastened onto the flange and that it is not deformed.



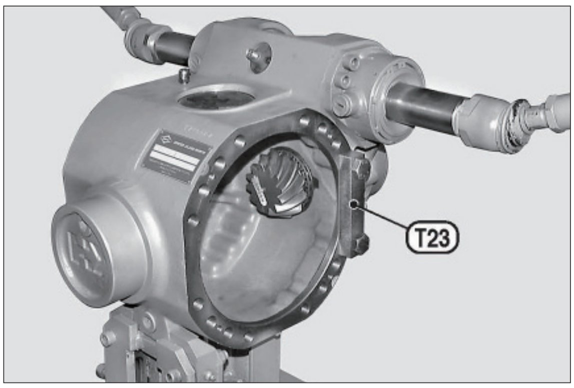
14W98FA199

(30) Apply loctite 242 to the threaded part of the pinion (8).
Position tool T20A (or T20B) and fasten it in order to avoid rotation.
Insert O-ring (3) and the nut (1) and tighten it using a dynamometric wrench.
· Torque wrench setting : 280-310 Nm



14W98FA200

(31) Remove blocks T23 (used for extracting the pinion) and re-install the arms.
For details, see "CHECKING WEAR AND REPLACING THE BRAKING DISKS."

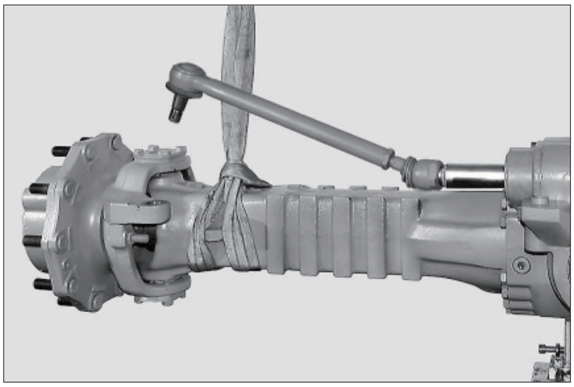


14W98FA201

11. THE DIFFERENTIAL UNIT

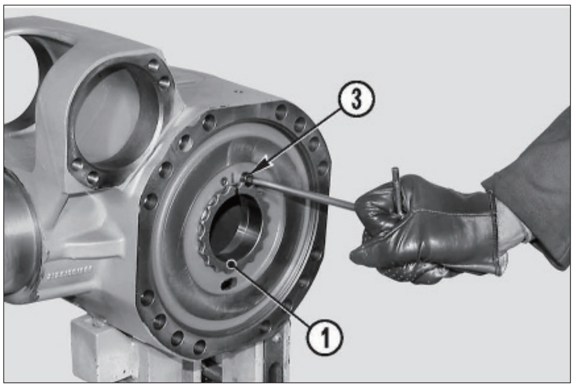
1) REMOVE AND DISASSEMBLE THE DIFFERENTIAL UNIT

(1) Remove the complete arms.
For details, see "CHECKING WEAR AND REPLACING THE BRAKING DISKS".



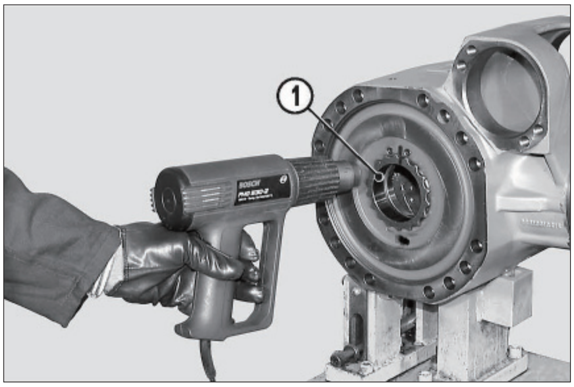
14W98FA202

(2) Make the position of the ring nuts (1).
Remove the screws (3) from the ring nuts (1).



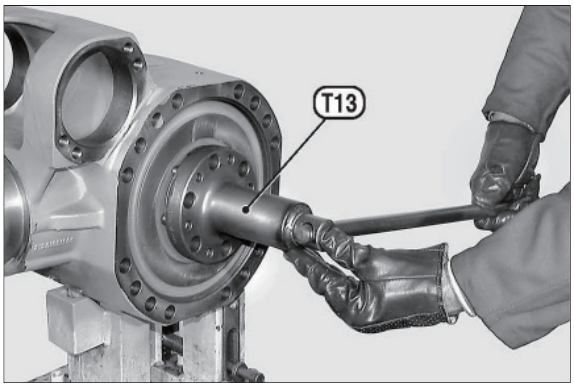
14W98FA203

(3) Uniformly heat the ring nuts (1) up to a temperature of 80°C.



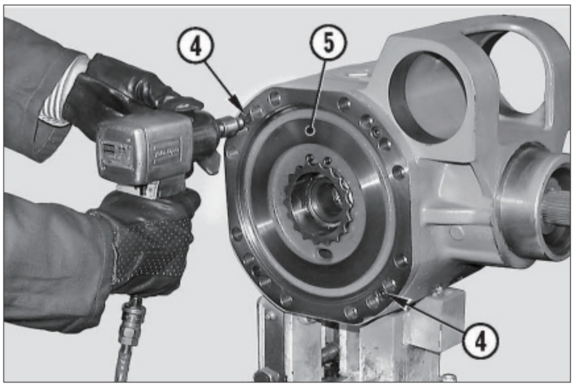
14W98FA204

(4) Apply tool T13 and remove the ring nuts.
※ Accurately clean the threaded portions on ring nuts of body and cover.



14W98FA205

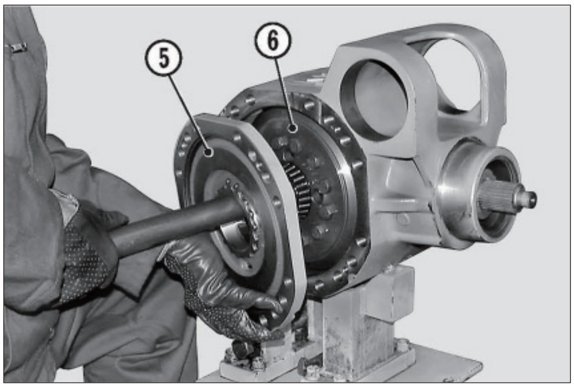
(5) Remove the fittin screws (4) from the middle cover (5).



14W98FA206

(6) Insert a screw-driver in the opposing slots then force and remove the middle cover (5) and the complete differential unit (6).

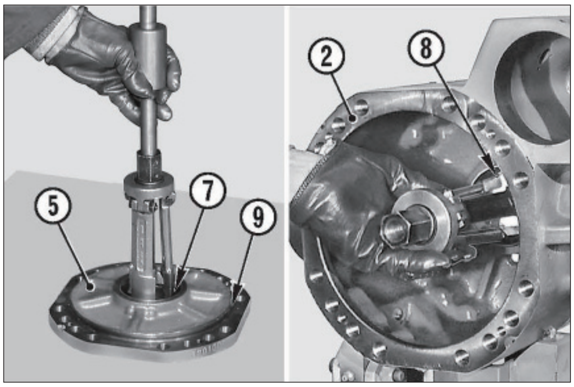
※ Support the pieces using a rod.



14W98FA207

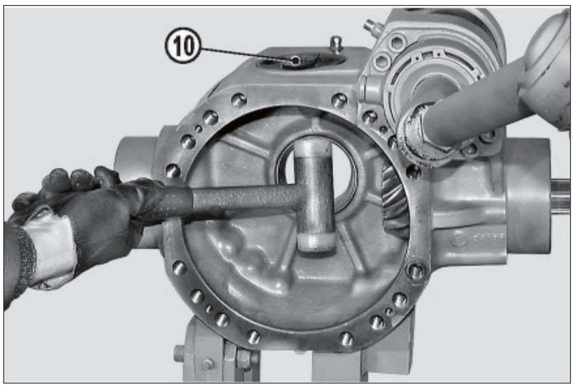
(7) If the bearing need replacing, extract the external thrust blocks of the bearing (7) and (8) from middle cover (5) and central body (2).

※ Accurately check the O-ring (9).



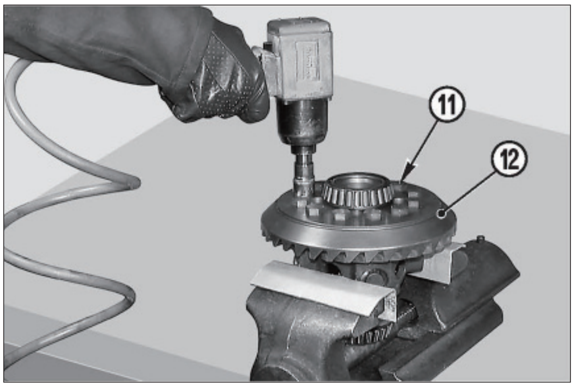
14W98FA208

(8) Remove the top plug (10).



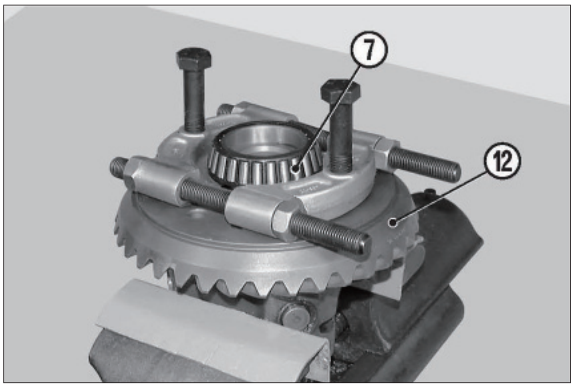
14W98FA209

(9) Remove the screw (11) from the crown (12).



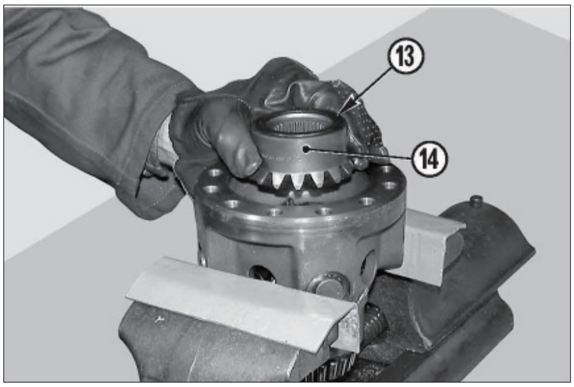
14W98FA210

(10) If the bearing need replacing, extract the bearing (7) and remove the crown (12).



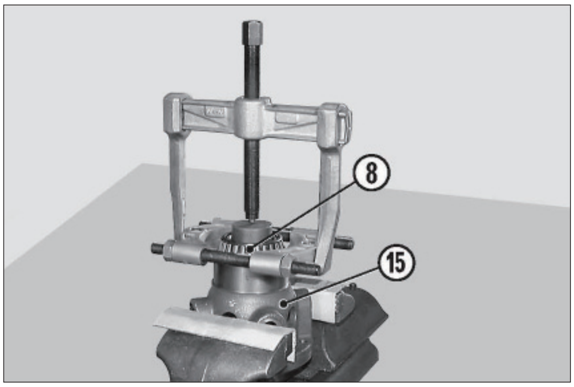
14W98FA211

(11) Remove the shim washer (13) and the planetary gear (14).



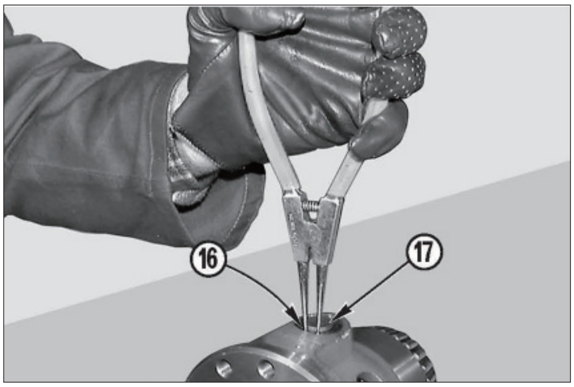
14W98FA212

(12) If the bearing need replacing, extract the bearing (8) from the differential carrier (15).



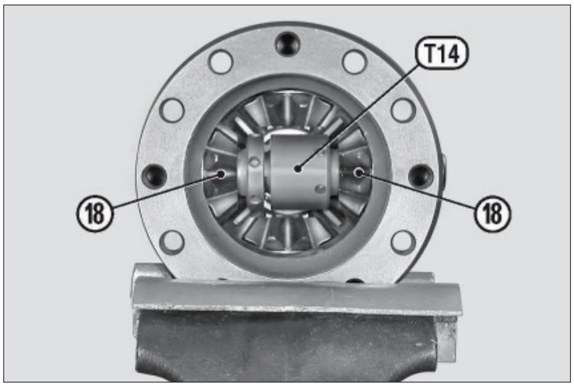
14W98FA213

(13) Remove the snap rings (16) from the two pins (17) of the planet wheel gears (18).



14W98FA214

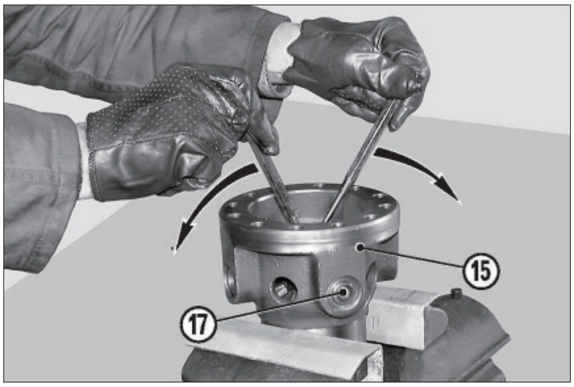
(14) Insert tool T14 between the planet wheel gears (18).



14W98FA215

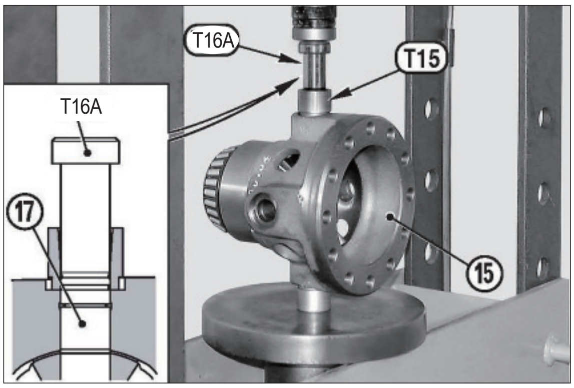
(15) Force tool T14 in-between the planet wheel gears (18) using two pin-drivers.

※ Make sure that tool T14 is perfectly lined up with the pins (17) when locked.



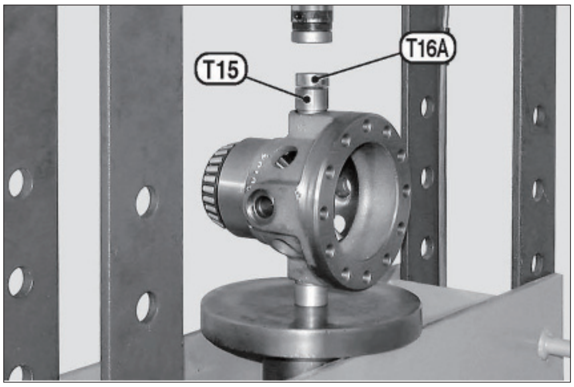
14W98FA216

(16) Place the differential carrier (15) under a press, position bush T15 and insert gudgeon T16A. Press T16A pin to limit position.



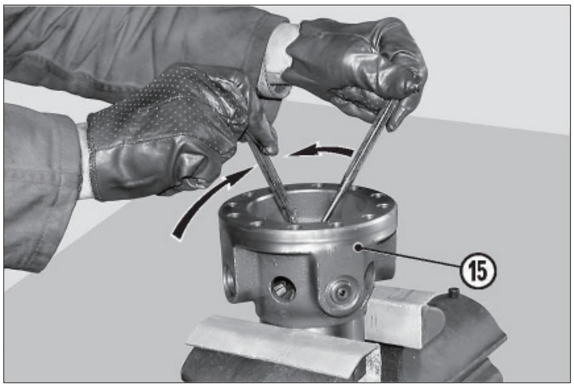
14W98FA217

(17) Remove gudgeon T16A and bush T15.
※ In this condition the tool T14 contains pin (17)



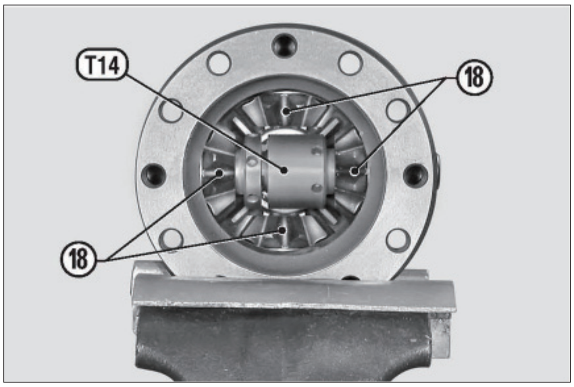
14W98FA218

(18) Remove tool T14 together with the pin (17) of the planet wheel.



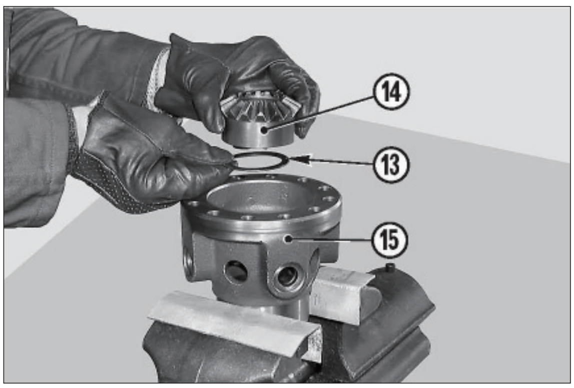
14W98FA219

(19) Leave the released planetary gear in position and again lock tool T14.
Repeat the operations for the extraction of the 2nd planet wheel (17).
Repeat the operations for all other pins.



14W98FA220

(20) Remove tool T14 and remove the last two planet wheel gears (18), the 2nd differential unit gear (14) and the relative shim washer (13) from the differential carrier.

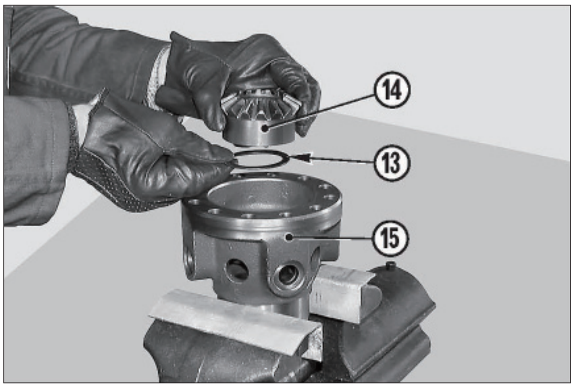


14W98FA221

2) ASSEMBLE AND INSTALL THE DIFFERENTIAL UNIT

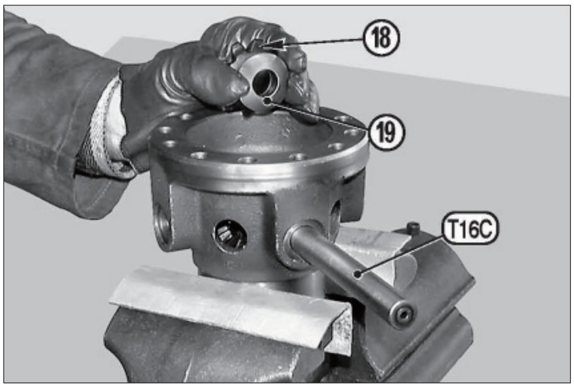
· ASSEMBLING

(1) Insert the shim washer (13) and the planetary gear (14) in the differential carrier (15).



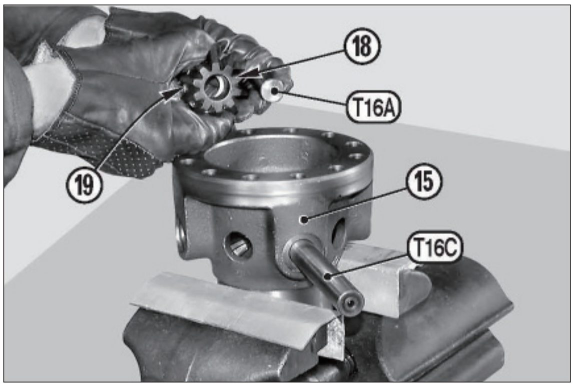
14W98FA222

(2) Position the shim washer (19) and the first planet wheel gear (18).
Hold them in position using bar T16C.



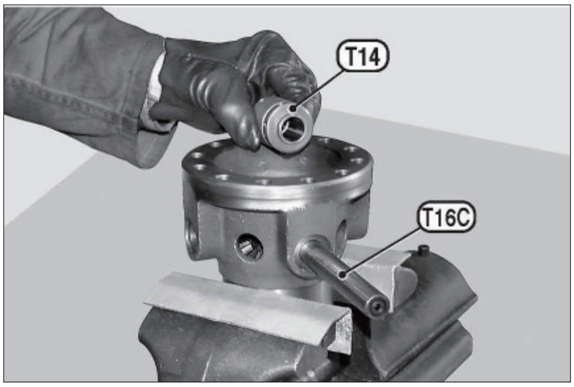
14W98FA223

(3) With the help of gudgeon T16A, position the second planet wheel gear (18) and the relative shim, washer (19).



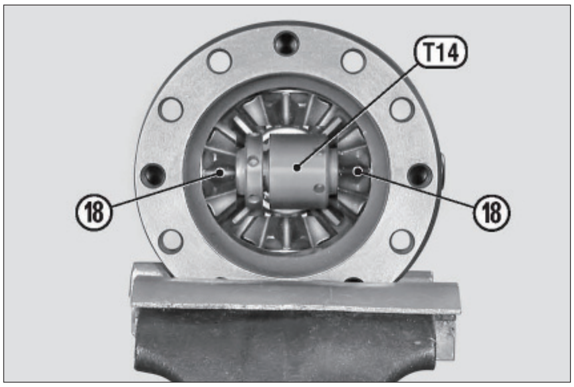
14W98FA224

(4) Insert tool T14 between the two planetary gears (18). Line up the entire unit by pushing bar T16C all the way down until gudgeon T16A is ejected.



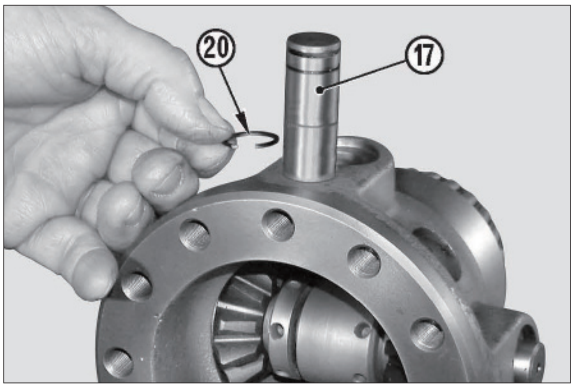
14W98FA225

(5) Lock tool T14 behind the planet wheel gears (18). After locking, remove bar T16C.



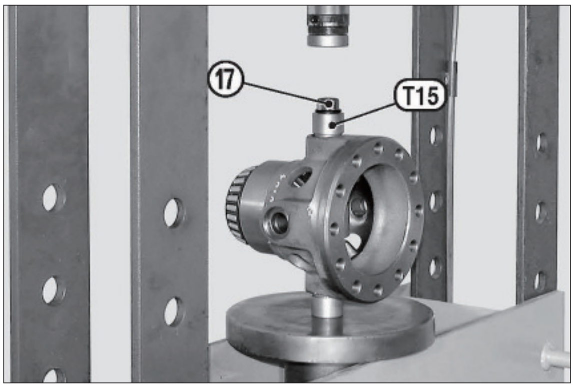
14W98FA226

(6) Fit the snap rings (20) onto the pins (17).



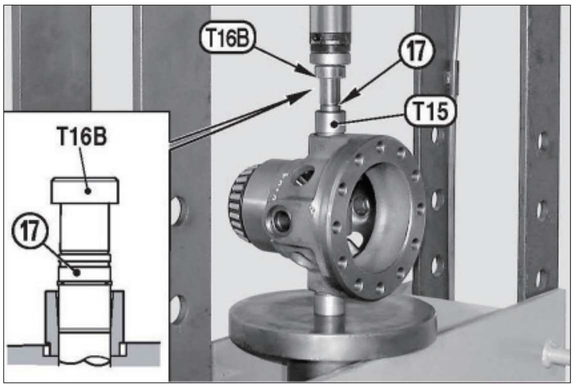
14W98FA227

(7) Place the differential carrier (15) under the press, position bush T15 and insert the planet wheel pin (17).



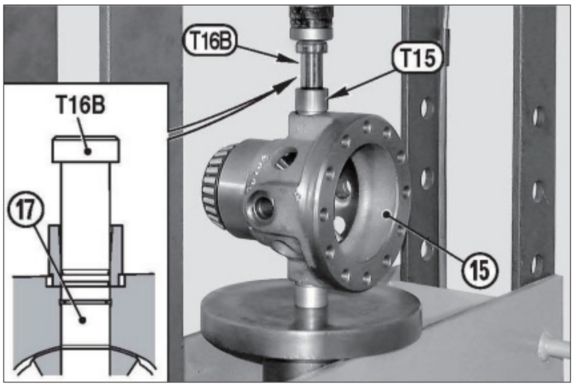
14W98FA228

(8) Put gudgeon T16B on top if the planet wheel pin (17).



14W98FA229

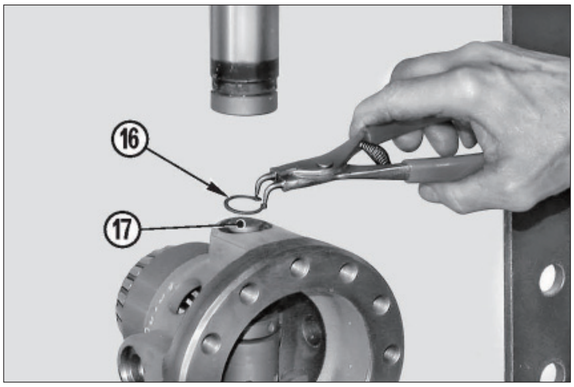
(9) Press T16B pin all the way down.



14W98FA230

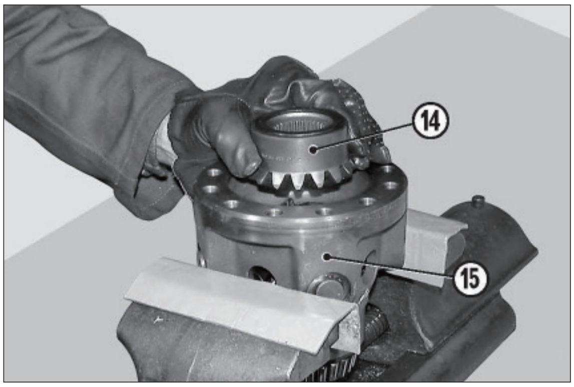
(10) Remove gudgeon T16B, bush T15 and fit the snap ring (16) on the pin (17).

※ Make sure that the snap ring centers the seat and that it sets on the surface of the differential carrier.
Repeat the operations on the other planet wheel pin or planet wheel axle.



14W98FA231

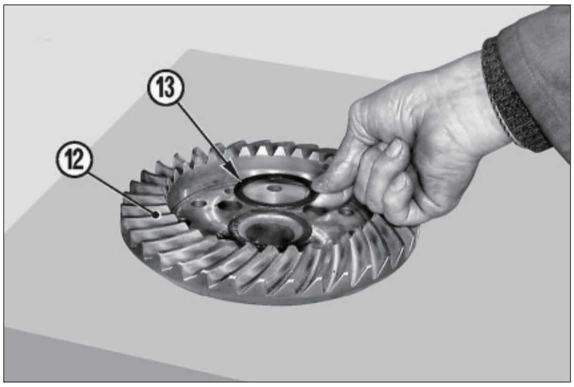
(11) Position the second planetary gear (14) in the differential carrier (15).



14W98FA232

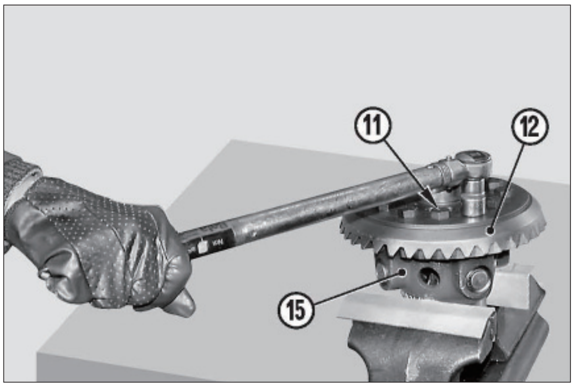
(12) Position the shim washer (13) on the crown (12).

※ In order to hold the shim washer (13) in position, apply grease to it.



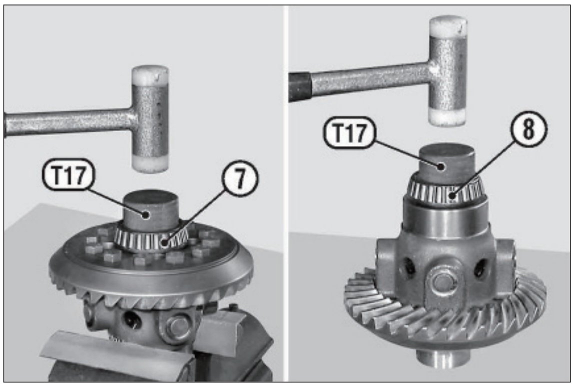
14W98FA233

(13) Position the crown (12) in the differential carrier (15) and lock it with screws (11) applied with loctite 242.
Torque wrench setting for screws : 128-142 Nm
※ Secure the screws using the cross-tightening method.



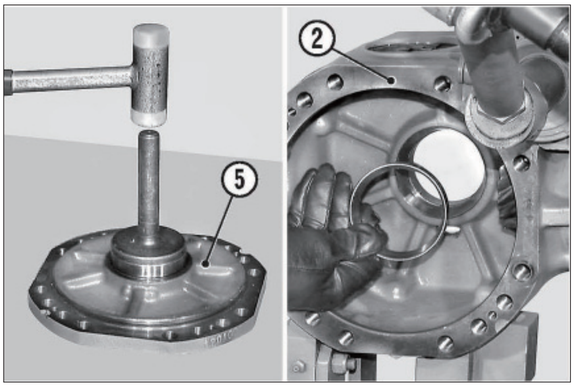
14W98FA234

(14) Install the bearings (7) and (8) using tool T17.



14W98FA235

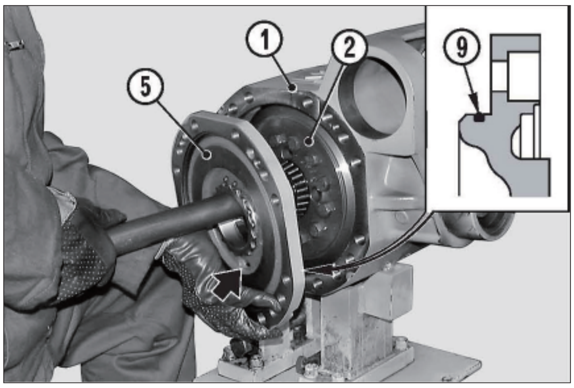
(15) If the bearings are replaced, insert the external thrust blocks in the middle cover (5) and in the central body (2).



14W98FA236

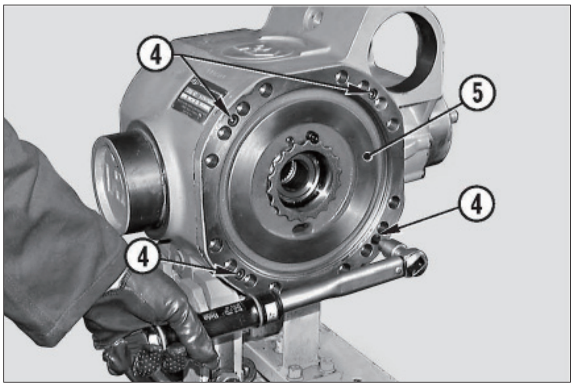
· INSTALLING

(16) Position the differential unit (6) in the central body (2) with the help of a bar and fit the middle cover (5).
※ Thoroughly check the state of the O-ring (9) and make sure that the cover is fitted with the oil discharge in the lower position.



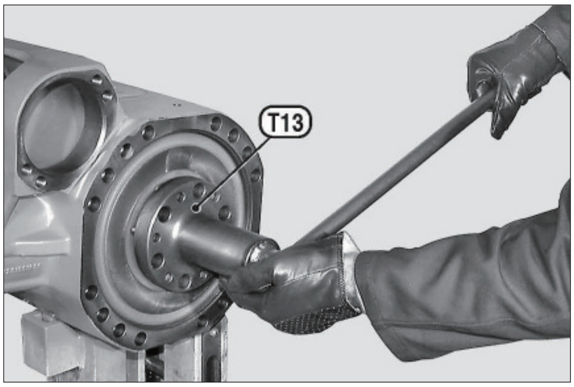
14W98FA237

(17) Lock the middle cover (5) with screws (4).
  · Torque wrench setting for screw :
  23.8 - 26.2 Nm



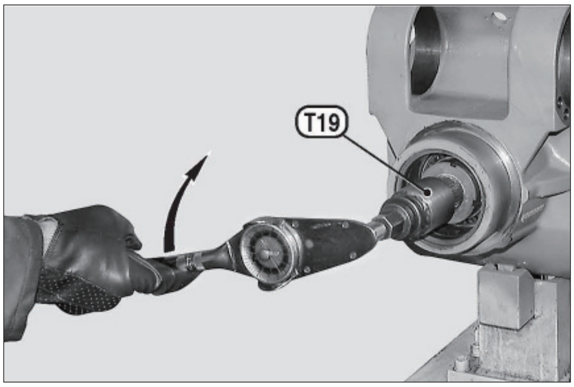
14W98FA238

(18) Tighten ring nuts on the crown side until clearance between pinion and crown is zero, then lock the crown ; go back 1/4～1/2 turn.
※ It the ring nuts (1) are removed, spread them with loctite 242.



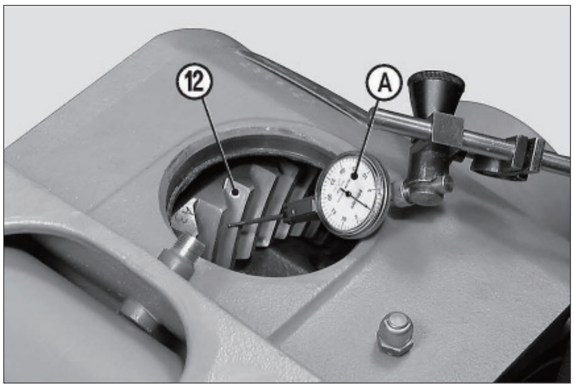
14W98FA239

(19) Pre-set the bearing by means of the ring nut situated on the opposite side of the crown, so as to increase pinion torque up to 140～210 Ncm.
※ If bearings are not new, check the static torque ; if bearing are new, check the continuous torque.



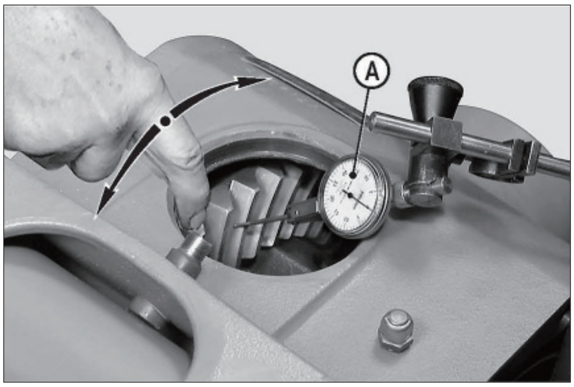
14W98FA240

(20) Introduce a comparator with rotary key "A" through the top plug hole (10).
Position the comparator on the center of one of the teeth of the crown (12), pre-set it to 1 mm and reset it.



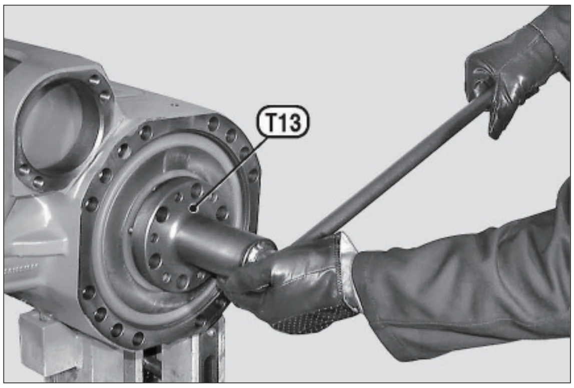
14W98FA241

(21) Manually move the crown (12) in both directions in order to check the existing backlash between the pinion and the crown.



14W98FA242

(22) Adjust the backlash between the pinion and the crown by unloosing one of the ring nuts (1) and tightening the opposite to compensate.
Normal backlash : see table.



14W98FA243

※ Differential between MIN and MAX clearance for whole circumference should not exceed 0.09 mm.

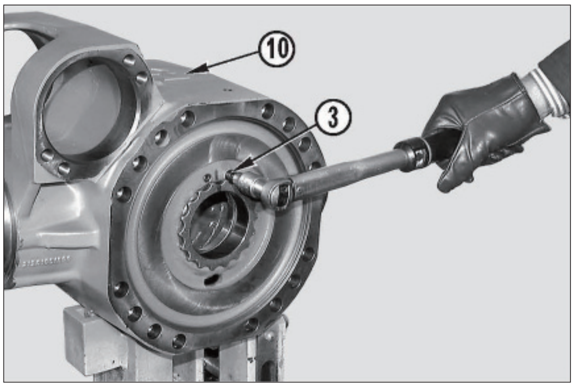
TABLE

Ratio	Clearance	
	Min.	Max.
9:34	0.18	0.23
9:35	0.13	0.18
11:31	0.20	0.28
11:35	0.13	0.18
12:35	0.13	0.18
12:41	0.15	0.20
14:32	0.18	0.23
14:36	0.15	0.20
14:41	0.15	0.20
15:32	0.18	0.23
15:47	0.13	0.18

(23) Apply loctite 242 to the screws (3), fit them into one of the two holes and tighten.

· Torque wrench setting : 23.8 - 26.2 Nm

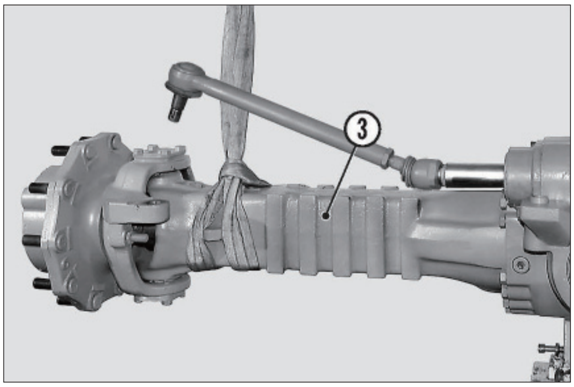
Fit the top plug (10) after applying repositionable jointing compound for seals to the rims.



14W98FA244

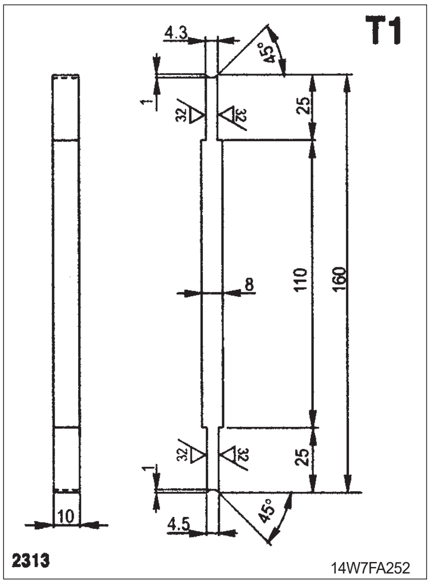
(24) Re-install the complete arms.

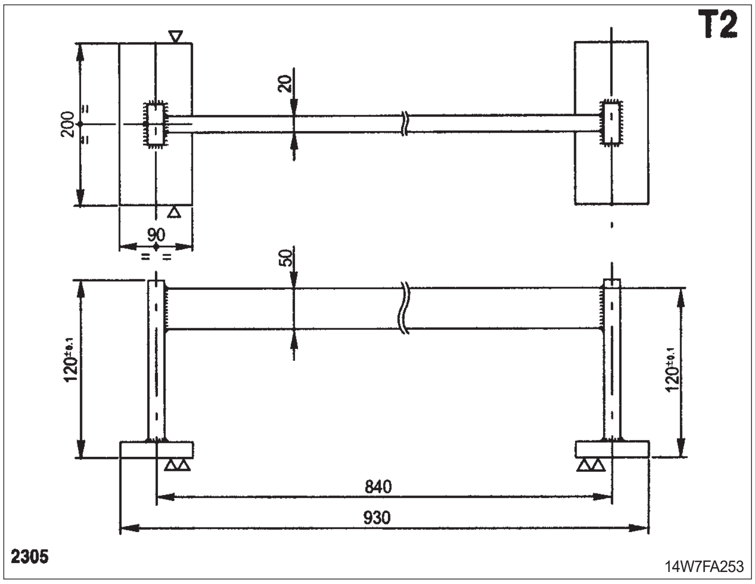
For details, see "CHECKING WEAR AND REPLACING THE BRAKING DISKS".

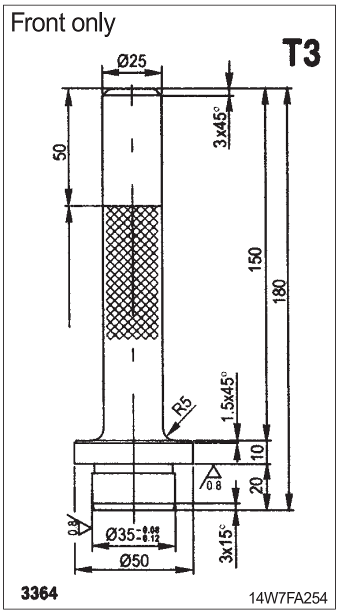


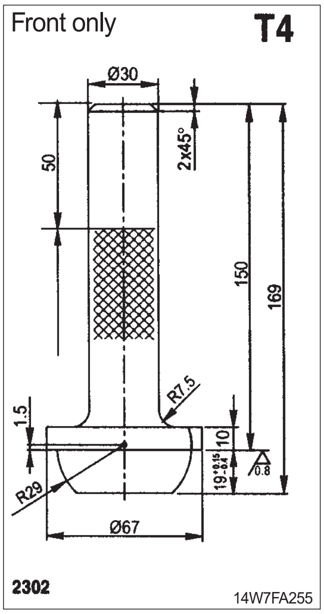
14W98FA245

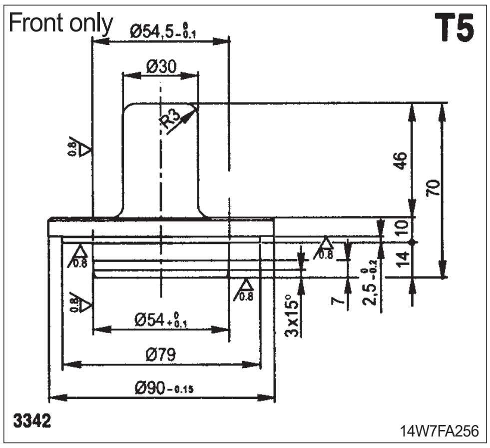
12. SPECIAL TOOLS

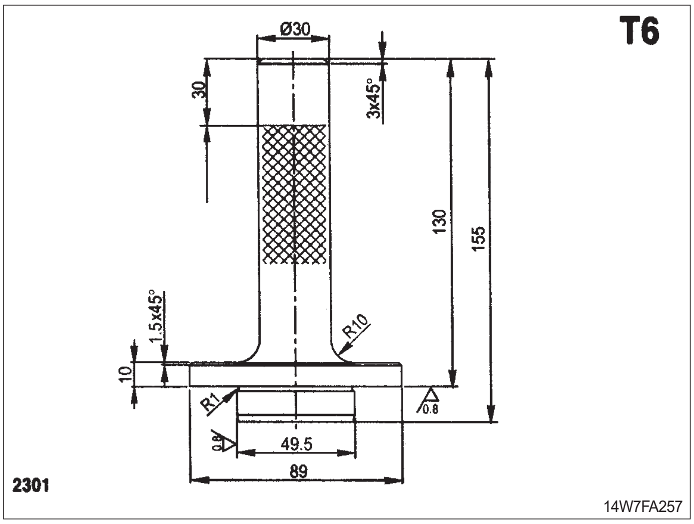


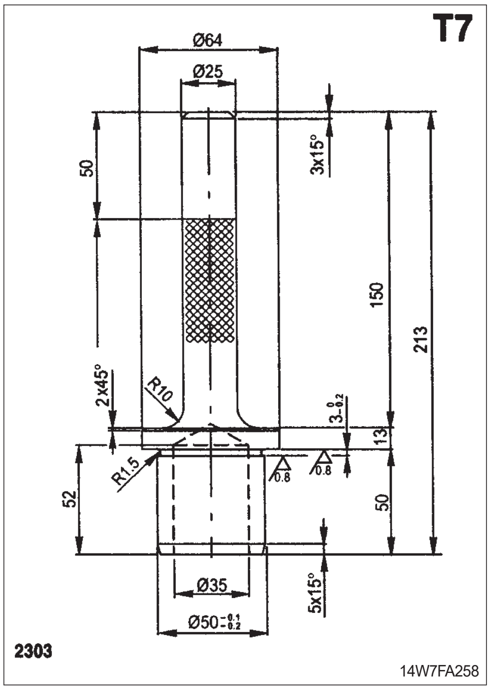


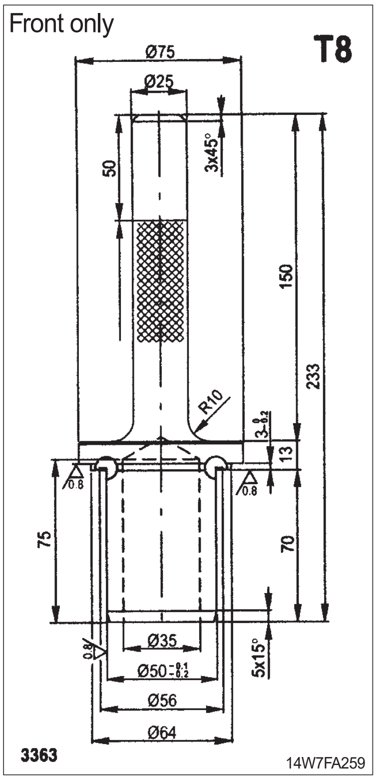











Front only
T8
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3x45°
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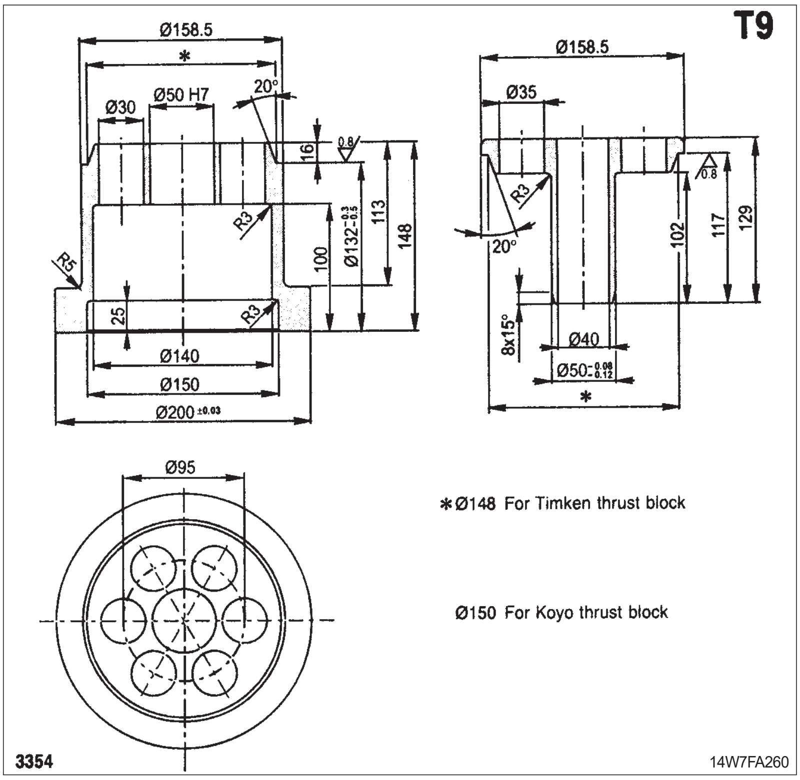
T9
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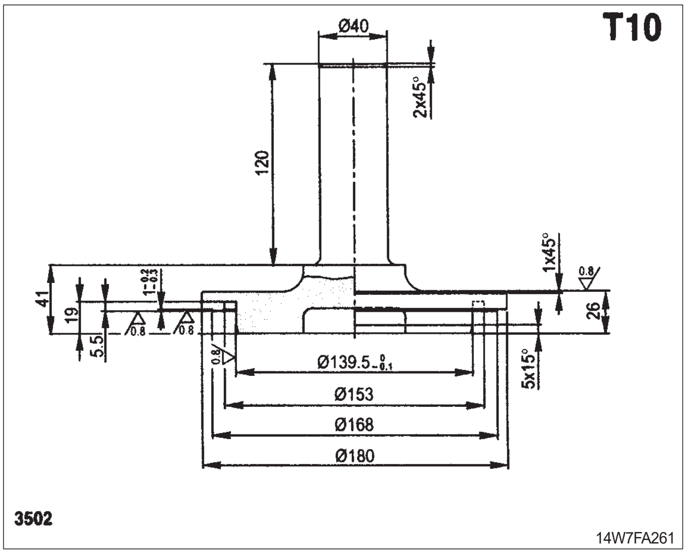
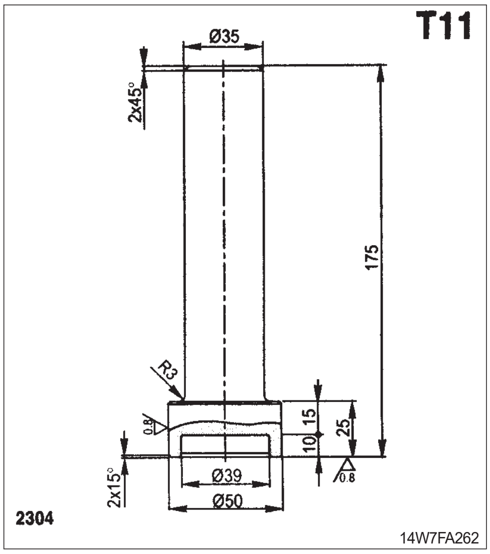
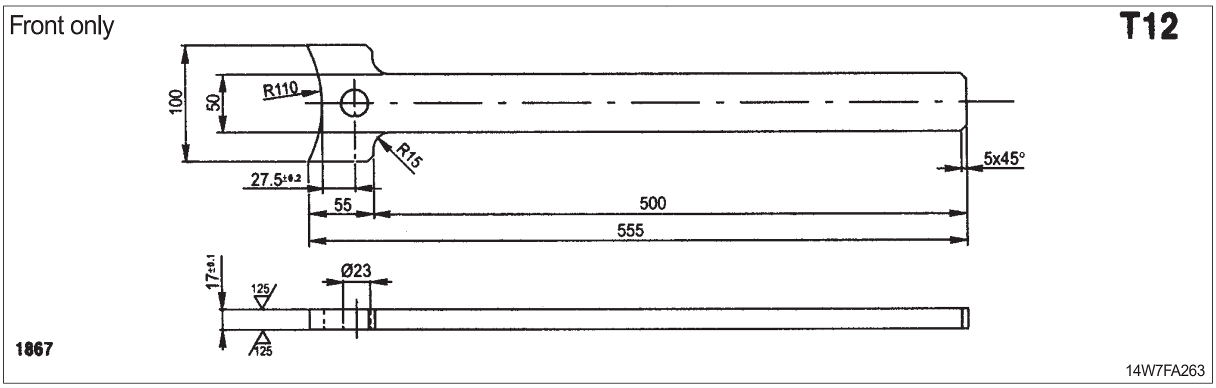
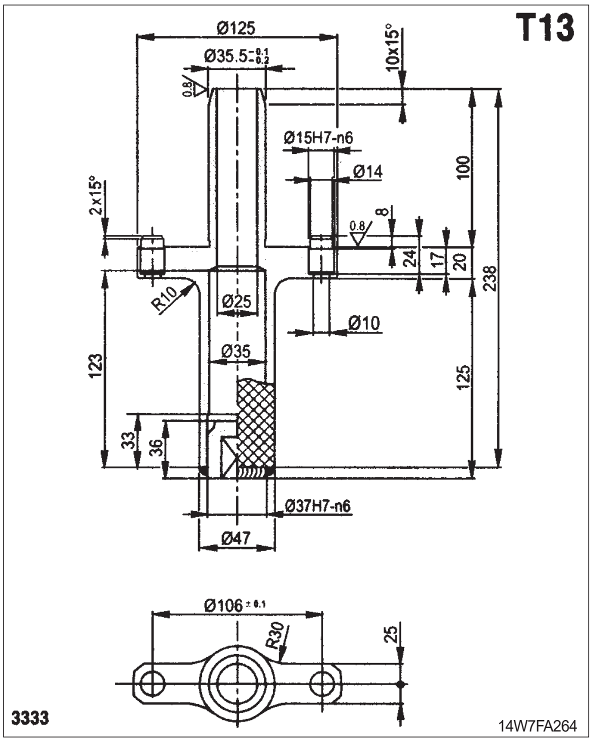
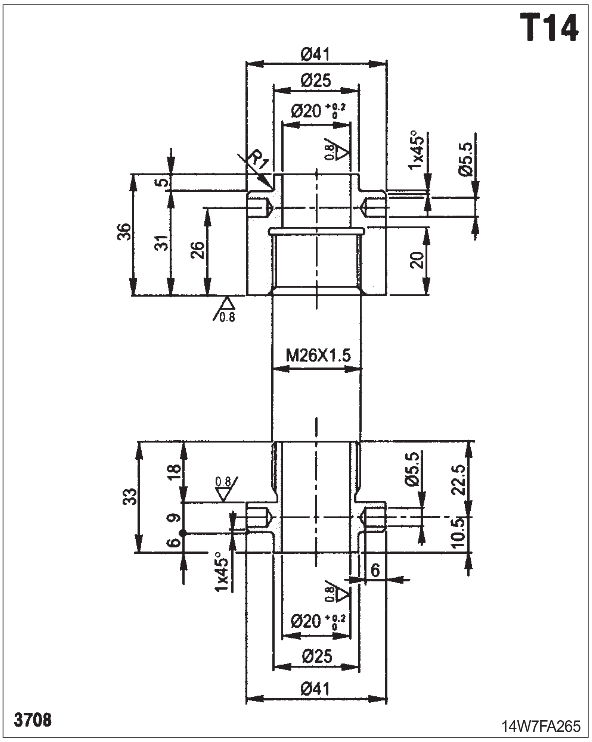
Ø35
R3
20°
0.8
102
117
129
8x15°
Ø40
*
Ø95
*Ø148 For Timken thrust block
Ø150 For Koyo thrust block
3354
14W7FA260

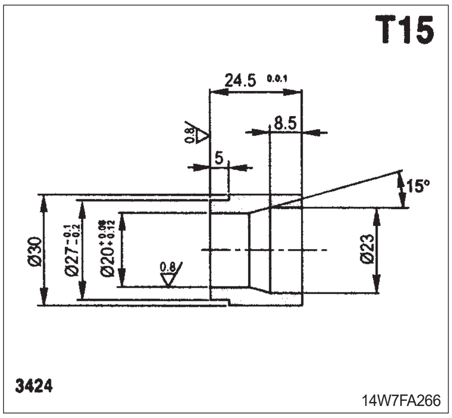

T10
Ø40
2x45°
120
1x45°
0.8
41
19
5.5
26
5x15°
Ø153
Ø168
Ø180
3502
14W7FA261

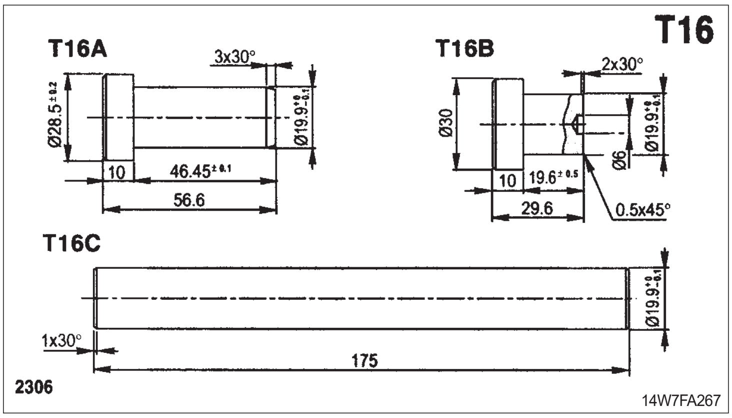

T11
Ø35
2x45°
175
R3
0.8
15
25
10
2x15°
Ø39
Ø50
2304
14W7FA262

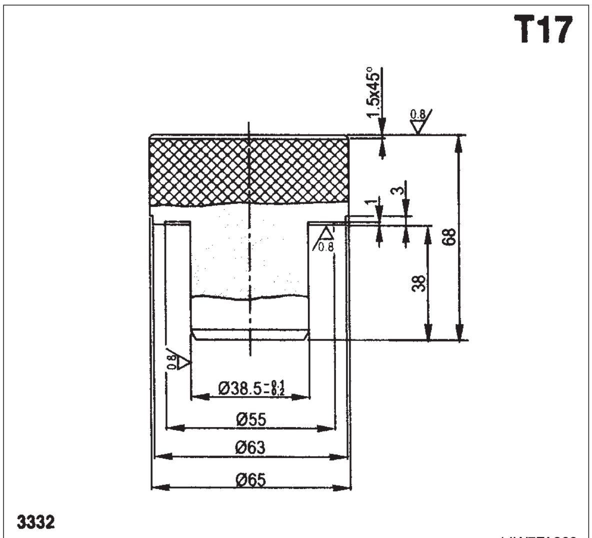

Front only
T12
100
50
R110
R15
5x45°
27.5±0.2
55
500
555
Ø23
125
1867
14W7FA263

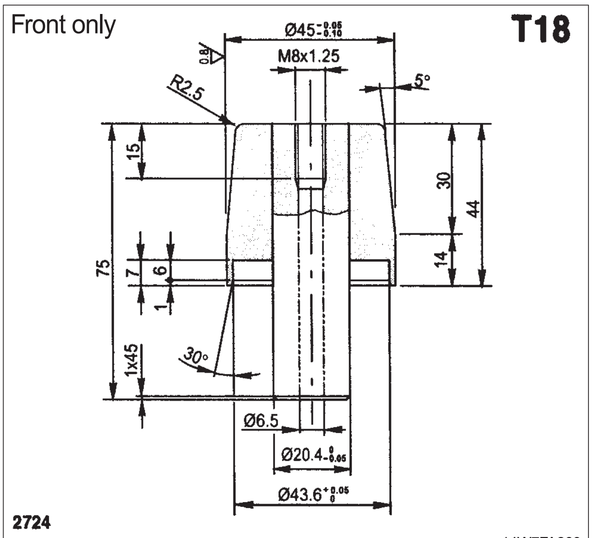

T13
Ø125
Ø35.5
10x15°
Ø15H7-n6
Ø14
2x15°
100
8
24
17
20
238
R10
Ø25
Ø10
Ø35
123
125
33
36
Ø37H7-n6
Ø47
Ø106
R30
25
3333
14W7FA264


T14
Ø41
Ø25
Ø20
R1
1x45°
Ø5.5
36
5
31
26
20
0.8
M26X1.5
33
18
9
6
22.5
10.5
1x45°
6
Ø20
Ø25
Ø41
3708
14W7FA265

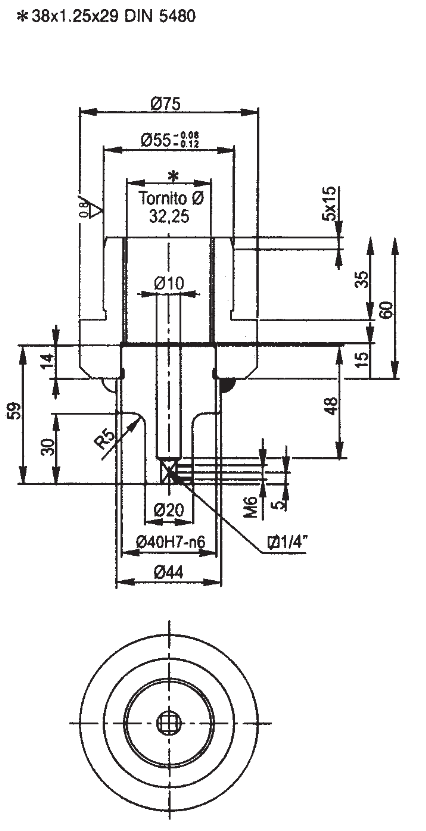

T15
24.5
8.5
5
15°
Ø30
Ø27
Ø20
Ø23
3424
14W7FA266


T16
T16A
3x30°
Ø28.5
Ø19.9
10
46.45
56.6
T16B
2x30°
Ø30
Ø19.9
Ø6
10
19.6
29.6
0.5x45°
T16C
Ø19.9
1x30°
175
2306
14W7FA267


T17
1.5x45°
1
3
68
38
Ø38.5
Ø55
Ø63
Ø65
3332
14W7FA268


Front only
T18
Ø45
M8x1.25
R2.5
5°
15
30
44
75
7
6
1
14
1x45
30°
Ø6.5
Ø20.4
Ø43.6
2724
14W7FA269

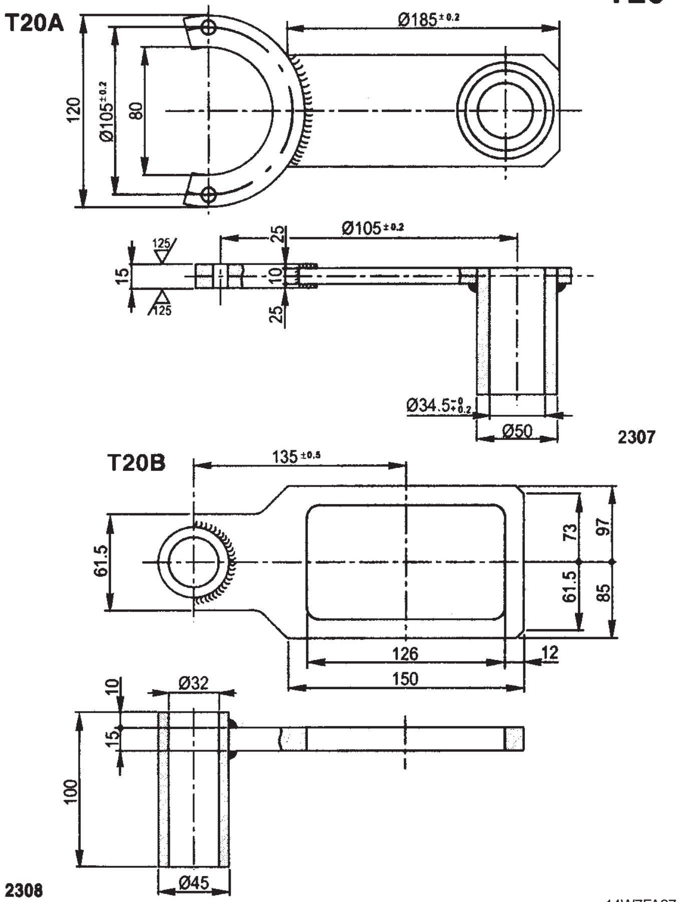
T19



3317/4

14W7FA270

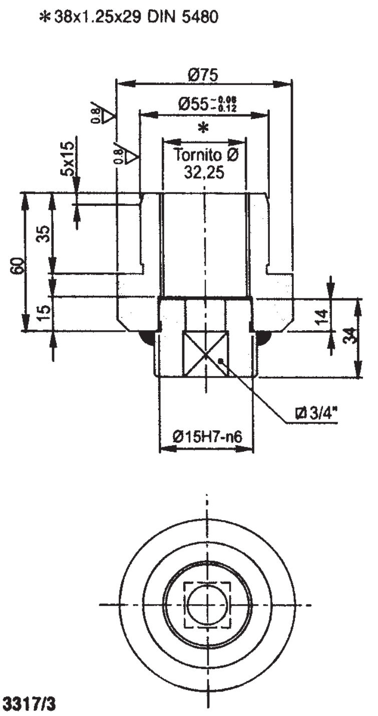
T20



2308

14W7FA271

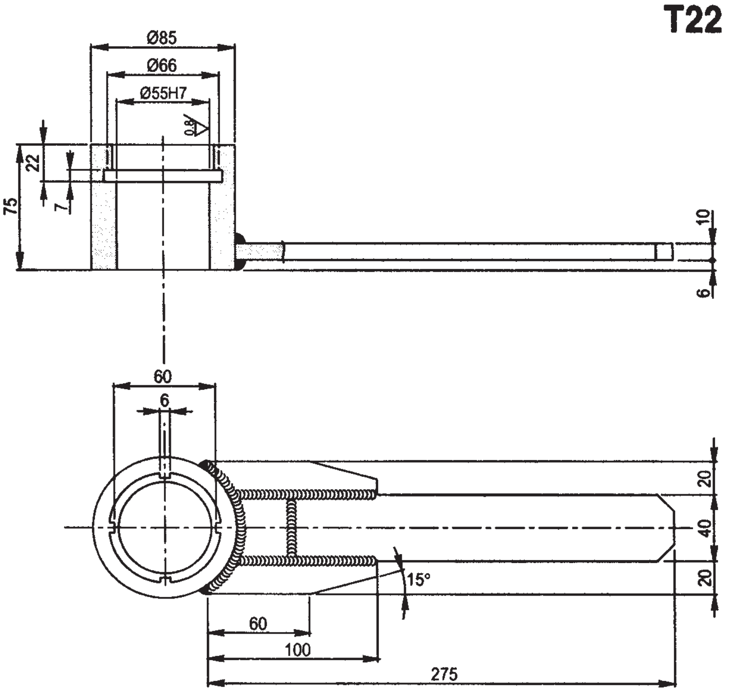
T21



3317/3

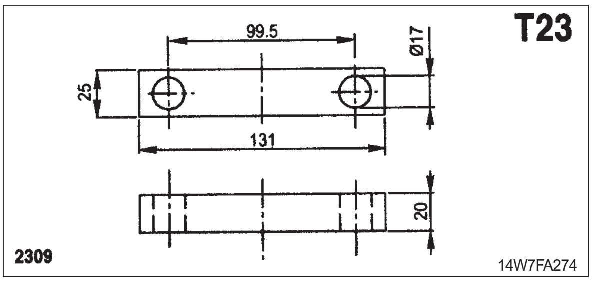
14W7FA272

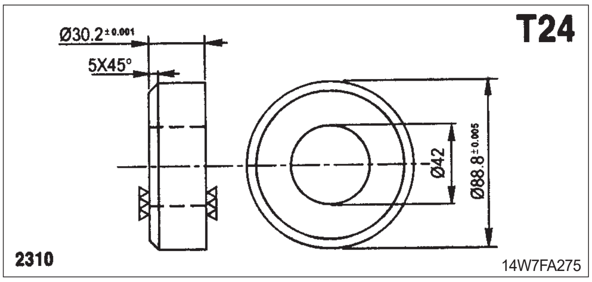
T22

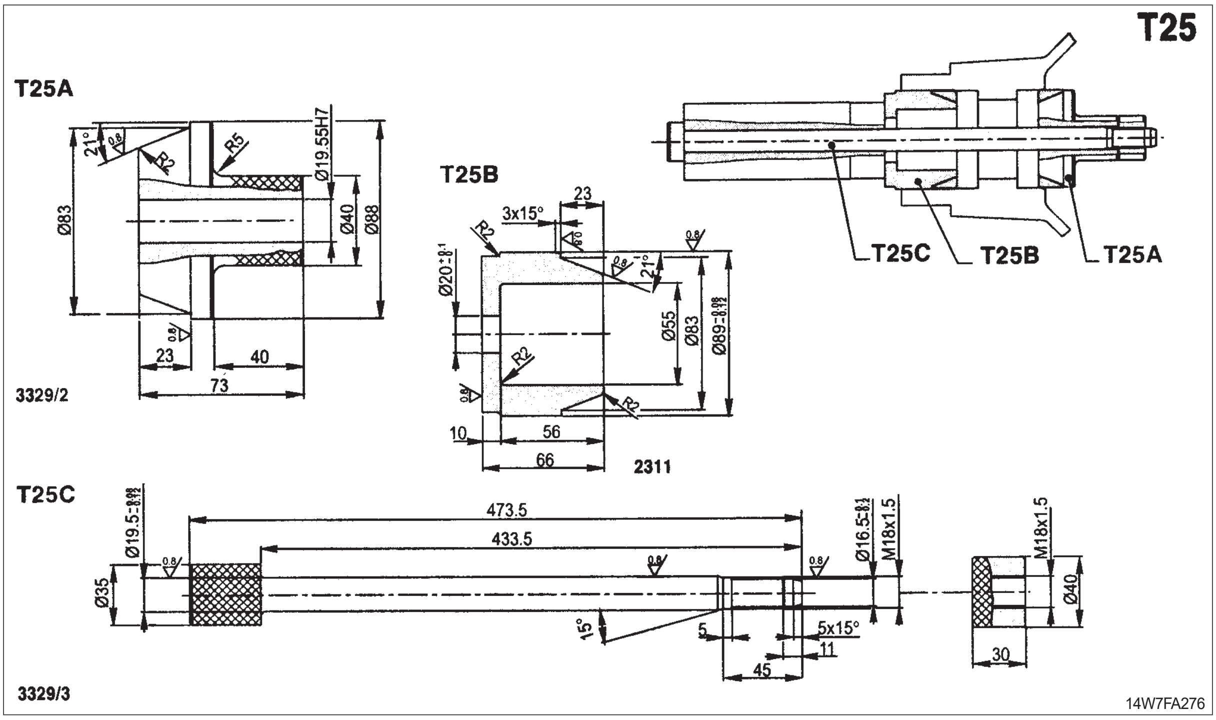


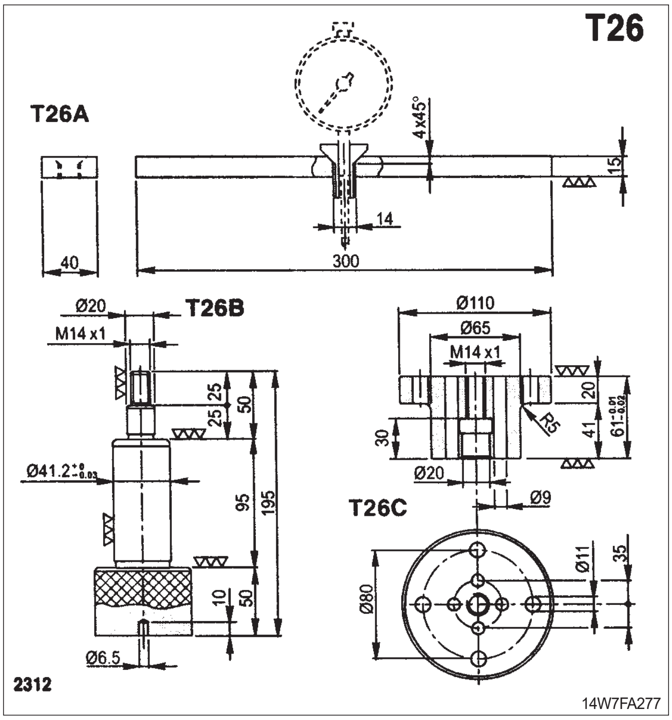
3317/A

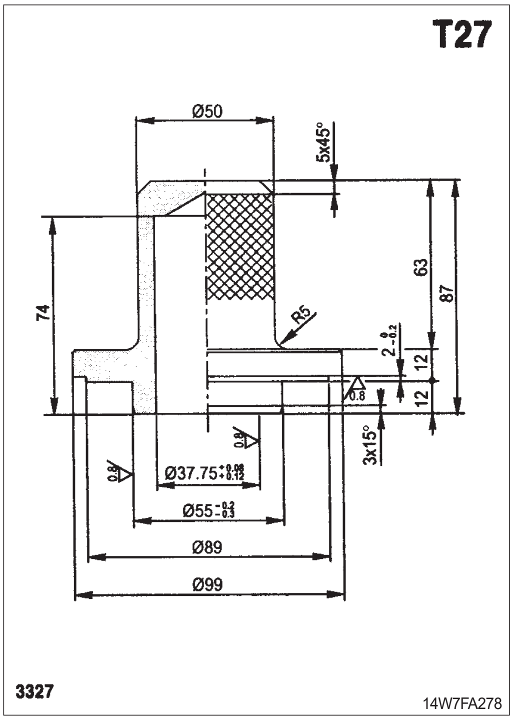
14W7FA273

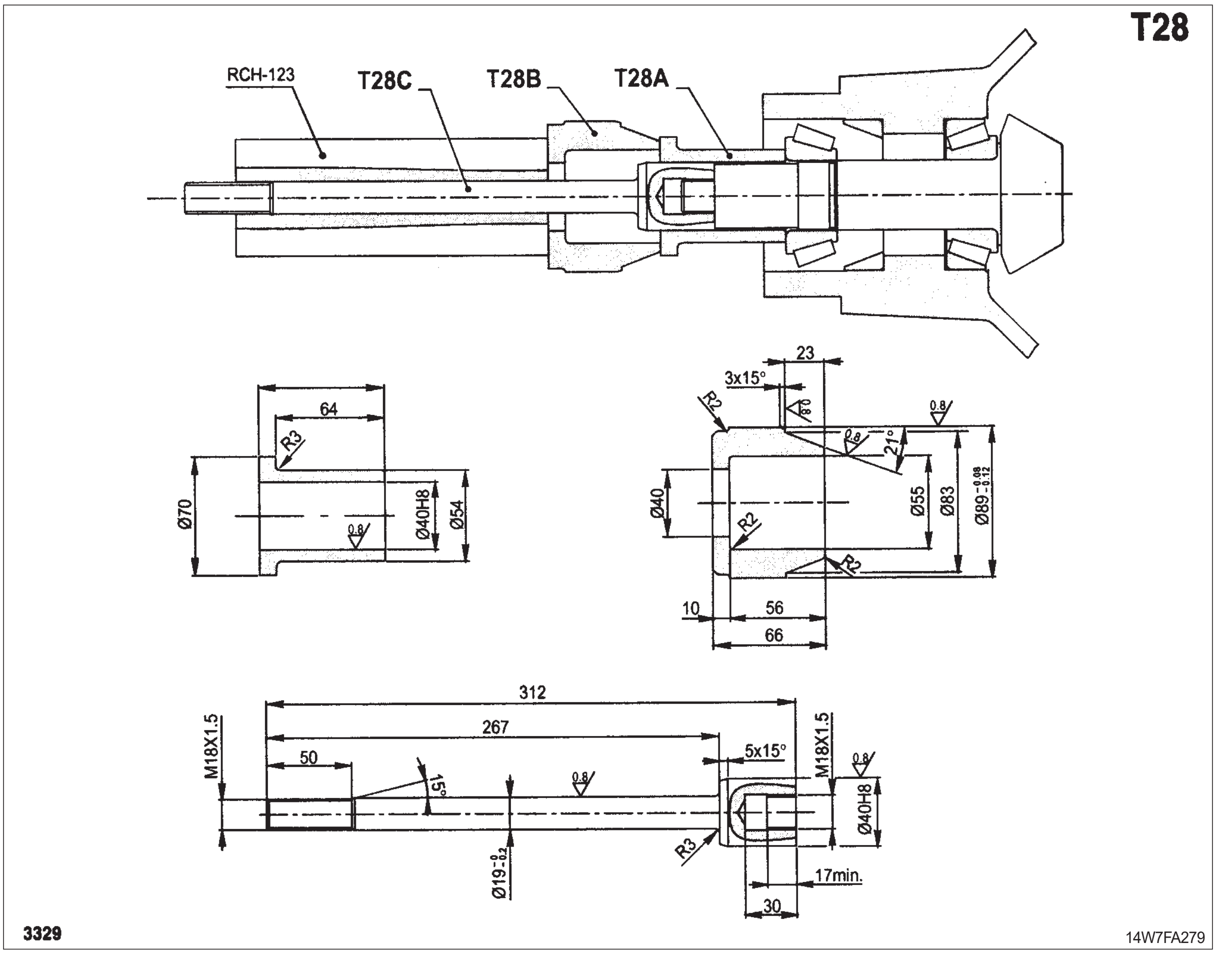

T23
99.5
Ø17
25
131
20
2309
14W7FA274

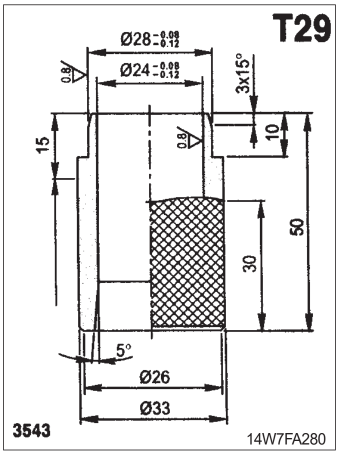

T24
Ø30.2 ±0.001
5X45°
Ø42
Ø88.8 ±0.005
2310
14W7FA275

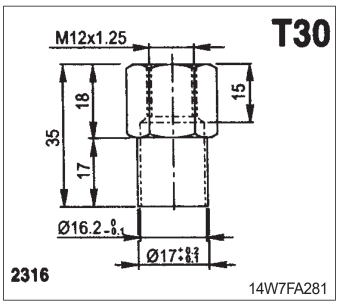

T25
T25A
21°
R3
R5
Ø19.55H7
Ø83
Ø40
Ø88
23
40
73
3329/2
T25B
23
3x15°
R2
21°
Ø20
Ø55
Ø83
R2
R3
10
56
66
2311
T25C
T25B
T25A
T25C
473.5
433.5
Ø19.5
Ø35
Ø16.5
M18x1.5
15°
5
5x15°
11
45
M18x1.5
Ø40
30
3329/3
14W7FA276

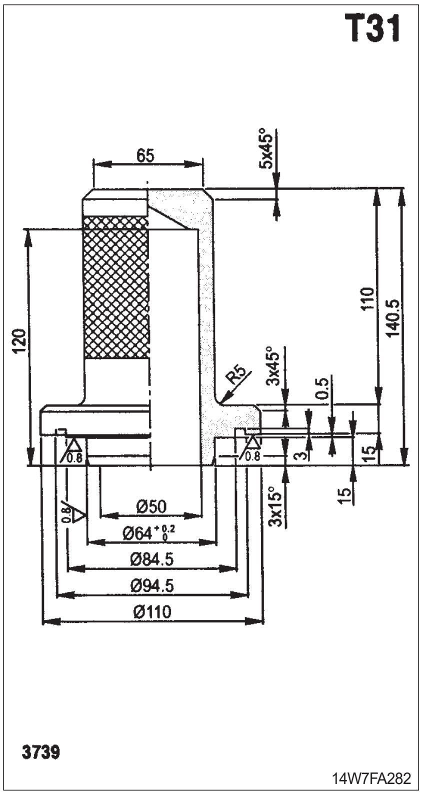

T26
T26A
4x45°
15
14
40
300
Ø20
T26B
M14 x1
25
25
50
Ø41.2
95
195
10
50
Ø6.5
Ø110
Ø65
M14 x1
20
30
R5
41
Ø20
Ø9
T26C
Ø80
Ø11
35
2312
14W7FA277

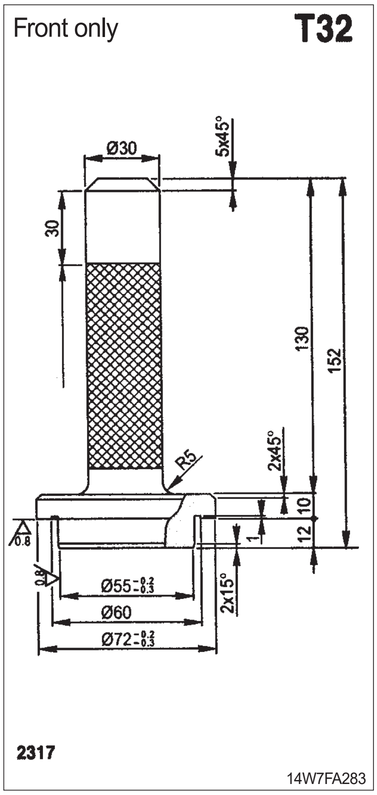

T27
Ø50
5x45°
74
63
87
R5
12
12
3x15°
Ø37.75
Ø55
Ø89
Ø99
3327
14W7FA278


T28
RCH-123
T28C
T28B
T28A
64
R3
Ø70
Ø40H8
Ø54
0.8
23
3x15°
R2
0.8
21°
Ø40
R2
Ø55
Ø83
Ø89
R3
10
56
66
312
267
50
5x15°
M18X1.5
15°
M18X1.5
Ø40H8
R3
Ø19
17min.
30
3329
14W7FA279


T29
Ø28
Ø24
3x15°
15
10
50
30
5°
Ø26
Ø33
3543
14W7FA280


T30
M12x1.25
18
15
35
17
Ø16.2
Ø17
2316
14W7FA281


T31
65
5x45°
120
110
140.5
R5
3x45°
0.5
15
3
15
3x15°
Ø50
Ø64
Ø84.5
Ø94.5
Ø110
3739
14W7FA282


Front only
T32
Ø30
5x45°
30
130
152
R5
2x45°
10
12
1
Ø55
Ø60
2x15°
Ø72
2317
14W7FA283

B. FRONT AXLE (#0074 and up)

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)

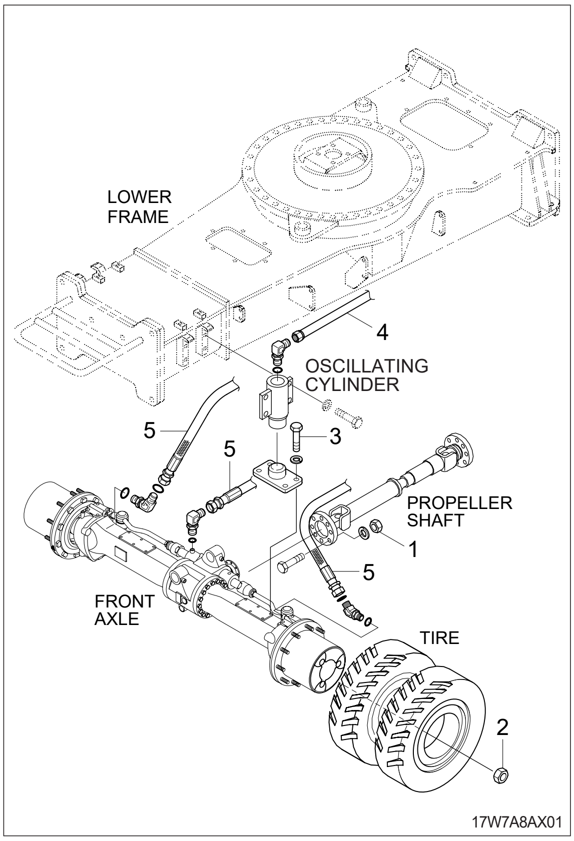
2) Wheel nut (2, M22)
   · Tightening torque : 60^{+0}_{-5} kgf · m
   (433^{+0}_{-36} lbf · ft)

3) Oscillating cylinder supporting mounting bolt (3, M16)
   · Tightening torque : 12.3±2.5 kgf · m
   (88.9±18.1 lbf · ft)

4) Pipe assy (4)

5) Hose assy (5)

6) Front axle weight : 540 kg (1190 lb)



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.

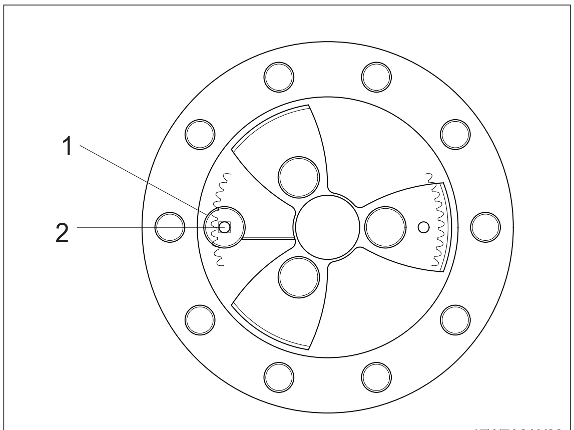
3) LUBRICANT SPECIFICATIONS

(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



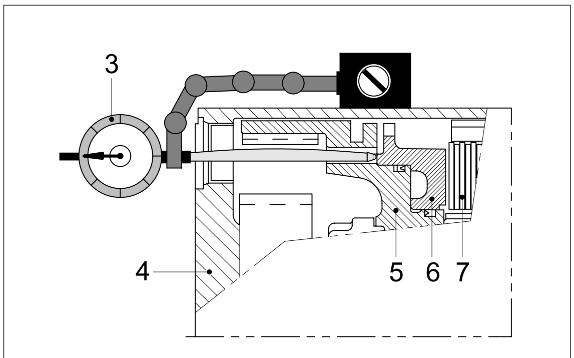
17W7A8AX03

(1) The measurement of wear on the multi-disc brake only gives limited information on the total state of the plate pack without disassembling the output.
Make measurement of lining wear at least once per year, in particular, however, in case of a different braking behaviour, like :
- Braking noises
- Reduced braking power
- Different deceleration
- Different brake oil level
- Different braking pressure

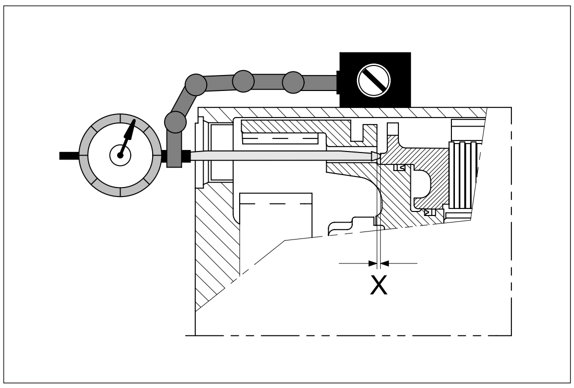
※ To avoid injury when opening the oil drain/oil filler plug (1), due to a possible pressure build-up in the planetary carrier bring drain hole to topmost position (12 o'clock) and carefully unscrew oil drain and filler plug (1).

(2) Then turn output until oil filler / oil drain hole (2) is on 9 o'clock position.

1 = Oil filler-/oil drain hole
2 = Gauge hole (ø =10 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



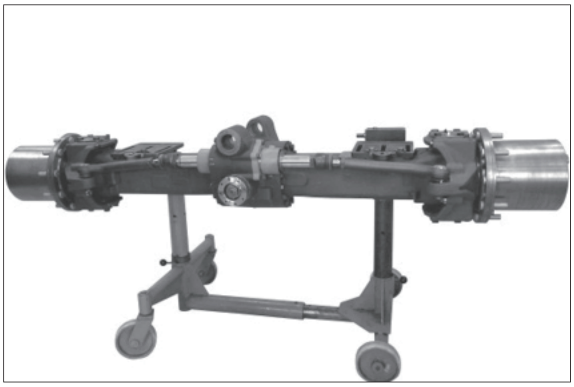
17W7A8AX05

3. DISASSEMBLY

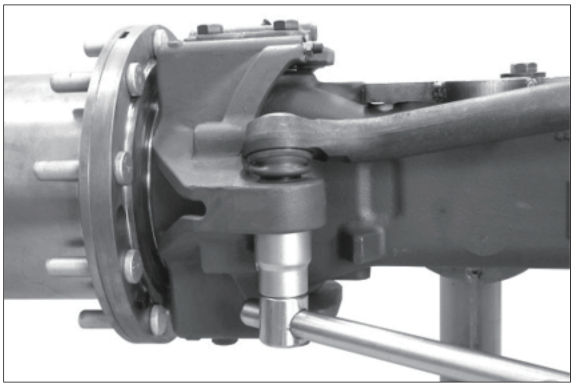
1) STEERING

(1) Fix the axle to the assembly truck.

(S) Assembly truck 5870 350 000
(S) Support 5870 350 106

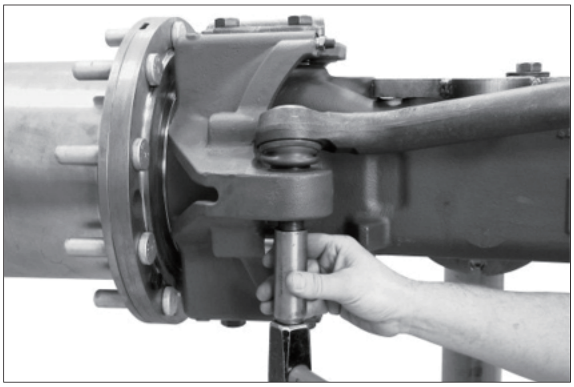

17W98FA001

(2) Loosen locknut.


17W98FA002

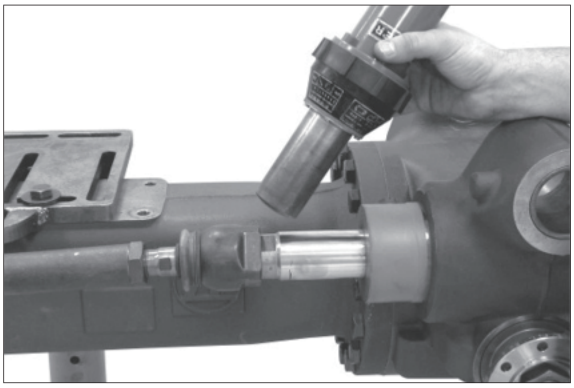
(3) Force out tie rod from bevel seat.

※ Use suitable mandrel (brass or aluminum).


17W98FA003

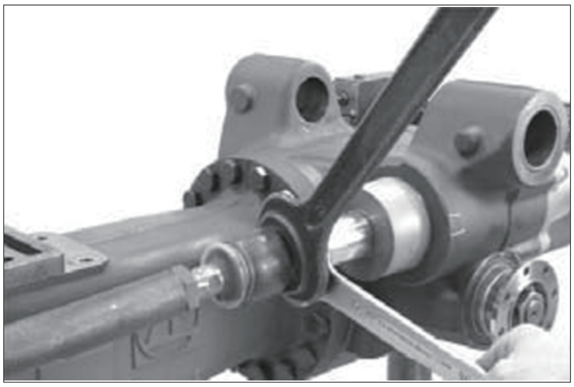
(4) Warm up piston rod by means of hot air blower.

※ Axial joint is installed with Loctite no. 243.


17W98FA004

(5) Separate both tie rods from piston rod.

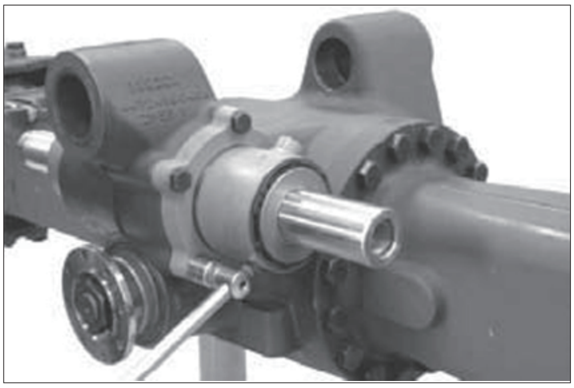
※ If work is just to be done on piston rod, guide or sealing elements, no disassembly of the steering cylinder assy is required.



17W98FA005

(6) Loosen hexagon screws.

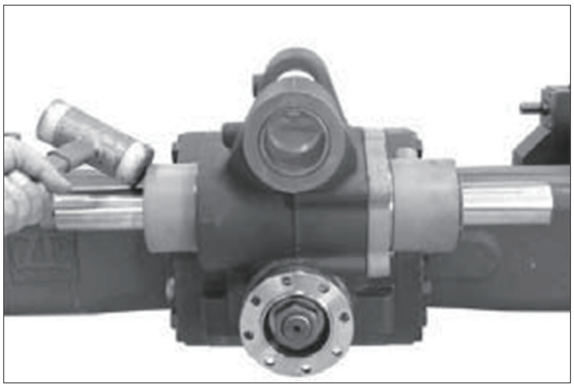
※ Mark radial installation position of steering cylinder to axle housing – assembly aid.



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

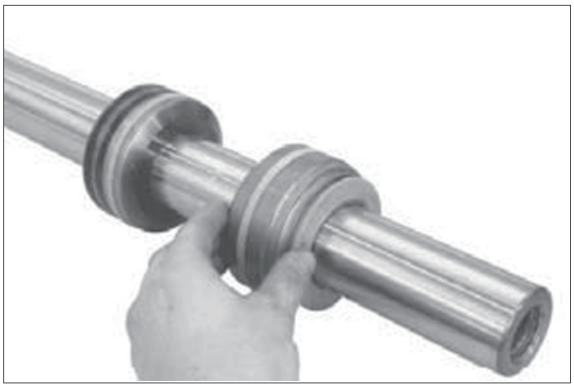
(11) Unsnap retaining ring.

Then drive out piston rod together with brake head from cylinder tube.

17W98FA011

(12) Pull off brake head from the piston rod.

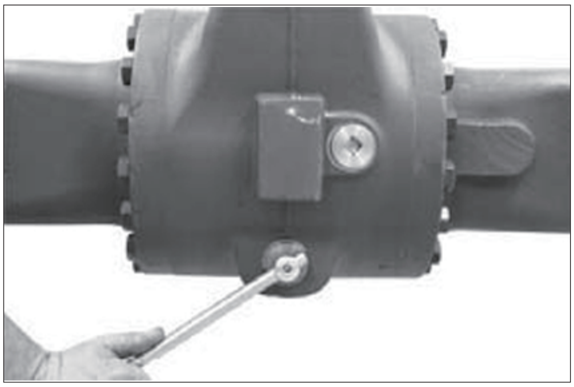
Then remove all sealing elements from piston rod, brake head and cylinder tube.



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.

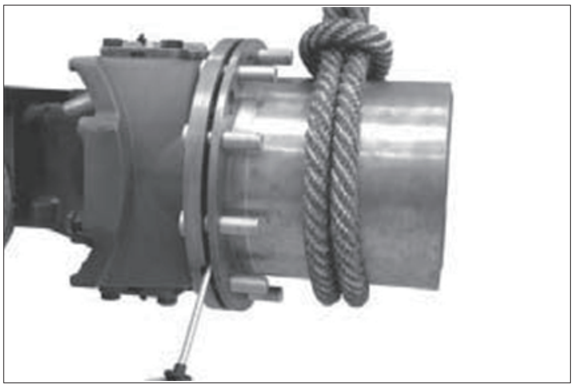
※ To avoid injury due to a possible pressure build-up in the oil system of the planetary carrier, bring oil filler and control plug to 12 o’clock position and carefully unscrew. Then bring drain hole to 6 o’clock position and drain oil.

※ Use suitable collecting basin environmental protection.

17W98FA014

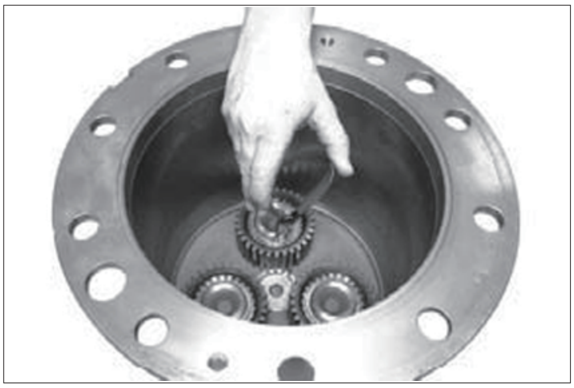
(3) Planetary carrier

Loosen both hexagon screws and separate planetary carrier from hub.



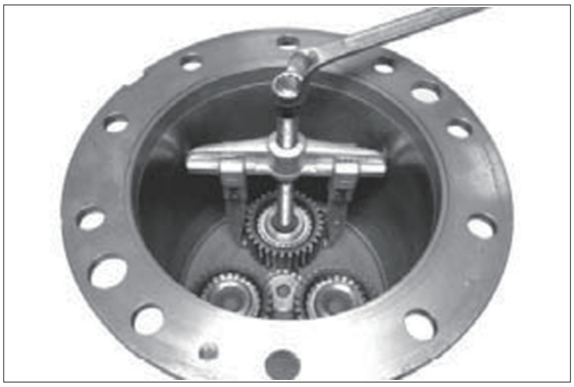
17W98FA015

(4) Unsnap retaining ring.



17W98FA016

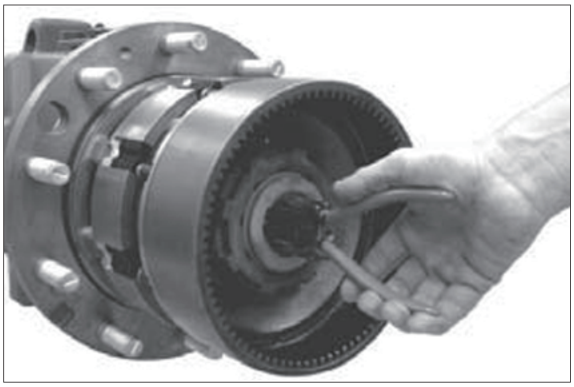
(5) Pull off planetary gear together with cylindrical roller bearing.



17W98FA017

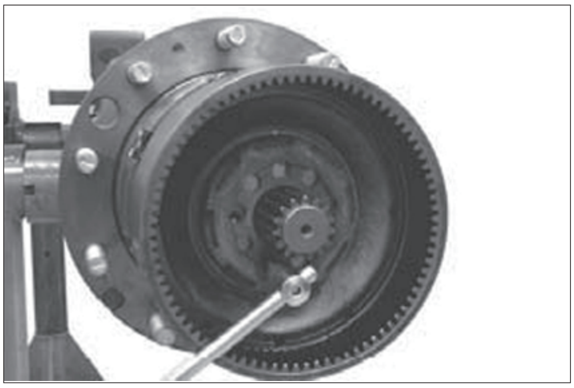
(6) Brake

Unsnap retaining ring and remove both thrust washers.



17W98FA018

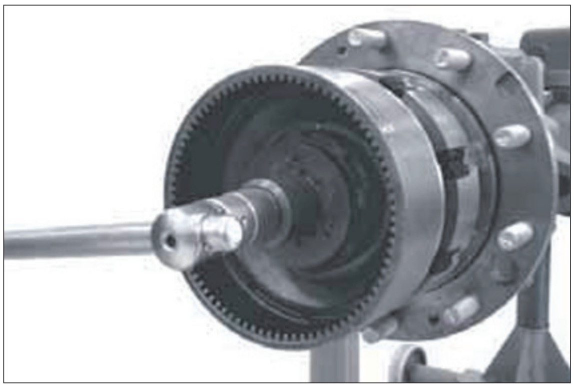
(7) Loosen cylindrical screw (slotted nut fixing).



17W98FA019

(8) Loosen slotted nut.

(S) Socket wrench 5870 656 097

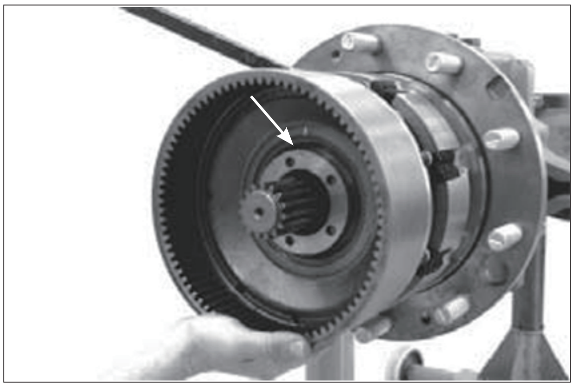


17W98FA020

(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

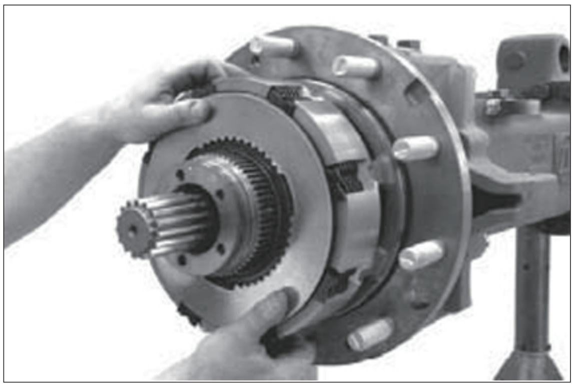
(11) Press off piston from ring gear.

17W98FA023

(12) Remove sealing elements from the annular grooves (see arrows) of the ring gear.

17W98FA024

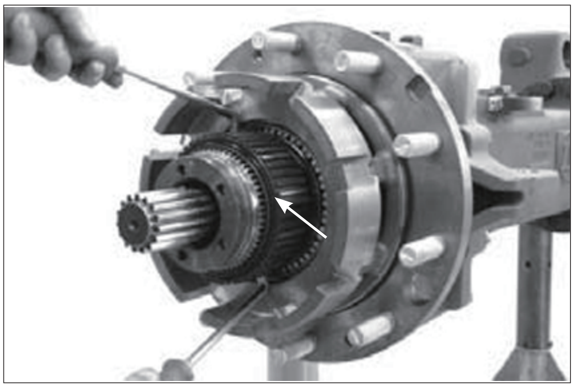
(13) Remove disk package.



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

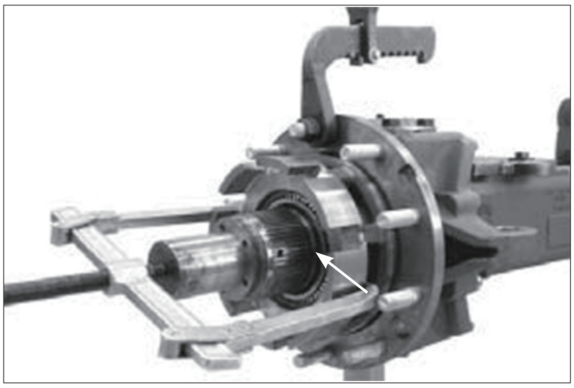
Remove O-ring (see arrow).

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.

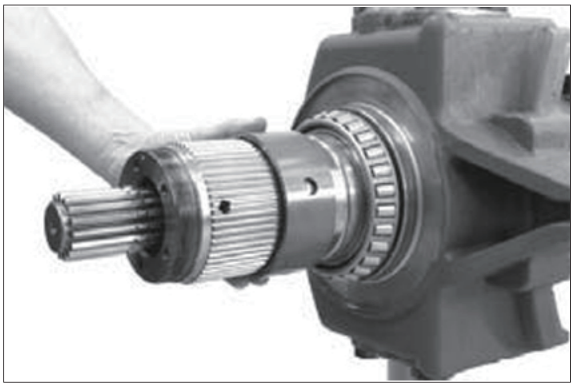


17W98FA027

(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

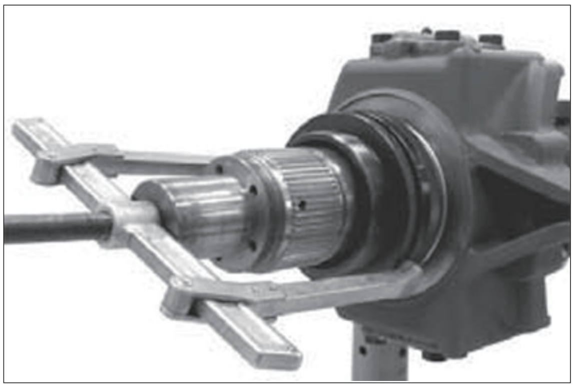
(17) Remove spacer bushing.



17W98FA029

(18) Pull tapered roller bearing from joint housing.

(S) Grab sleeve 5873 013 015
(S) Pressure piece 5870 100 067



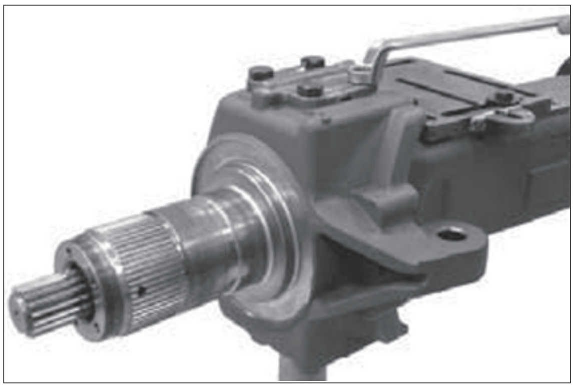
17W98FA030

(19) **Knuckle housing**

Loosen threaded joint and remove upper bearing pin.

※ Pay attention to releasing O-ring.

※ Remove lower bearing pin only after securing the knuckle housing (see figure FA032).

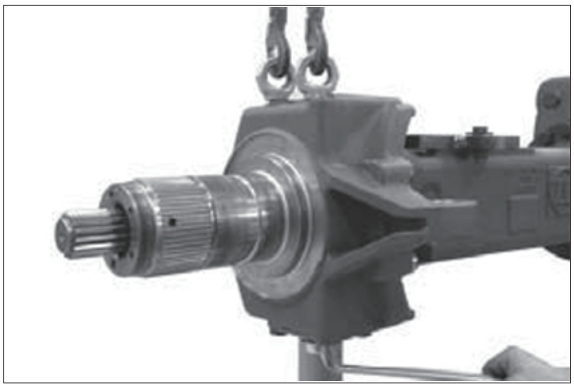


17W98FA031

(20) Secure knuckle housing by means of lifting tackle.

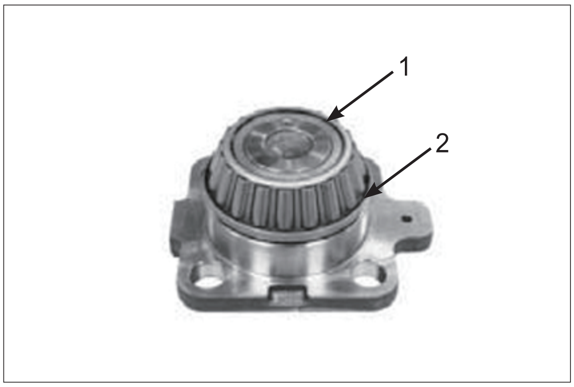
Then loosen threaded joint and remove lower bearing pin.

(S) Eyebolts (M 16) 0636 804 001



17W98FA032

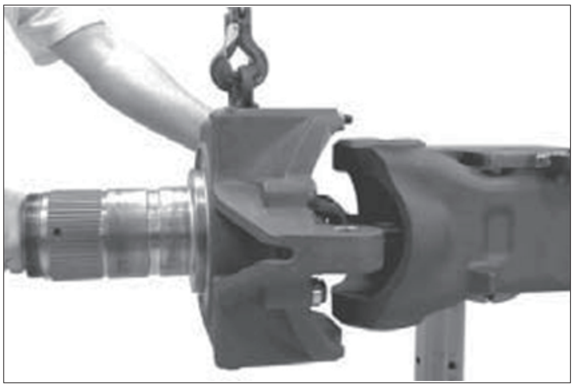
(21) Use lever to remove tapered roller bearing (1) from bearing pin, remove releasing sealing cap (2) and the O-ring lying behind.



17W98FA033

(22) Separate knuckle housing with double u-joint shaft from the axle housing.

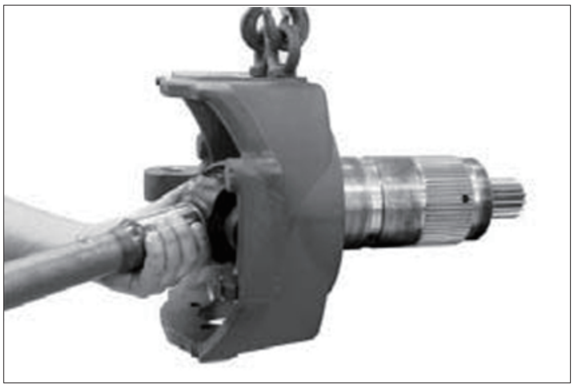
※ Pay attention to shaft seal ring in the axle housing risk of damage.



17W98FA034

(23) Pull out double u-joint shaft from knuckle housing.

※ Pay attention to shaft seal ring in the knuckle housing risk of damage.



17W98FA035

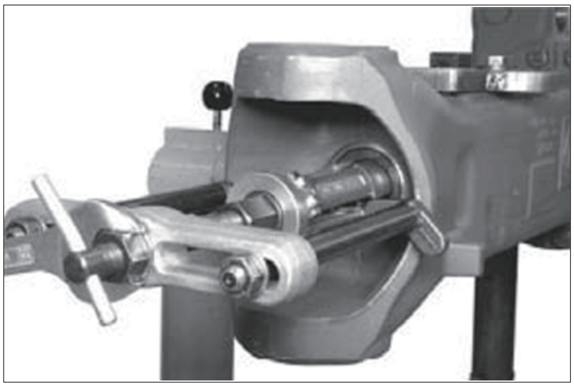
(24) Pull out shaft seal ring and afterwards the bushing behind from the axle housing.

(S) Internal extractor	5870 300 007
(S) Counter support	5870 300 020

17W98FA036

(25) Pull out shaft seal ring and afterwards the bushing behind from the axle housing.

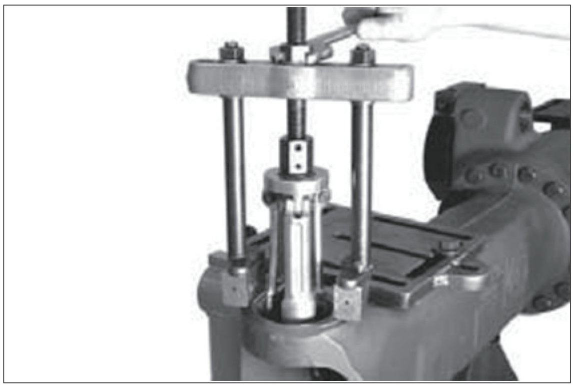
(S) Internal extractor 5870 300 007
(S) Counter support 5870 300 020



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

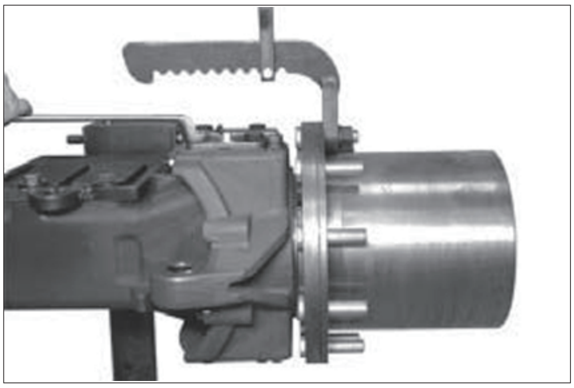
(27) Output assy

※ 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).

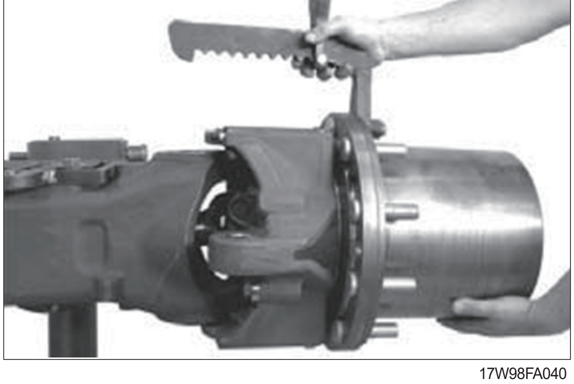
(S) Lifting bracket 5870 281 043

Then loosen threaded joints of both bearing pins.



17W98FA039

(28) Remove both bearing pins and separate the output assy from the axle housing.

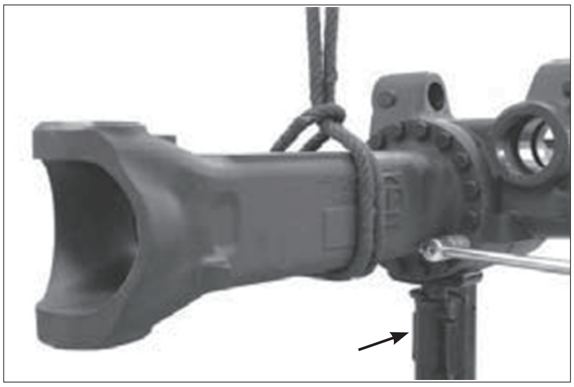


17W98FA040

3) INPUT

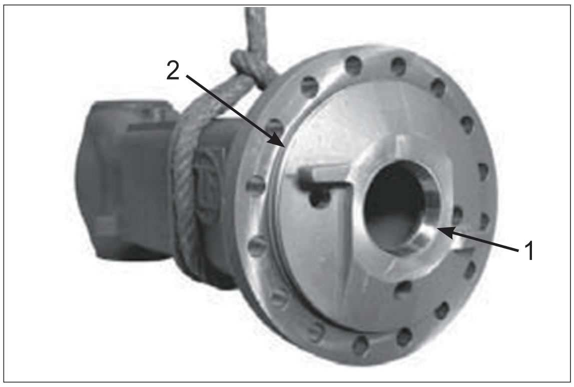
(1) Support axle to axle drive housing (see arrow).
Then secure axle housing (crown wheel side) by means of lifting tackle and loosen threaded joint.
Then separate axle housing from axle drive housing.

※ 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).

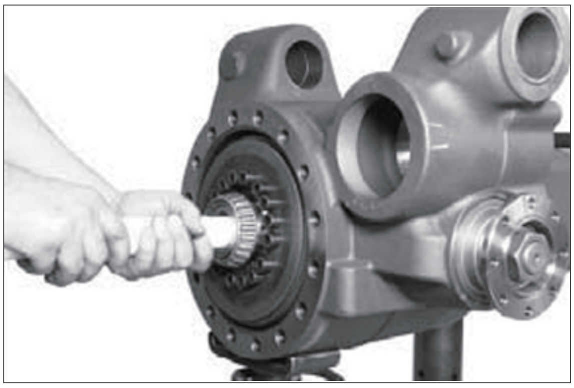
(S) Striker 5870 650 004



17W98FA042

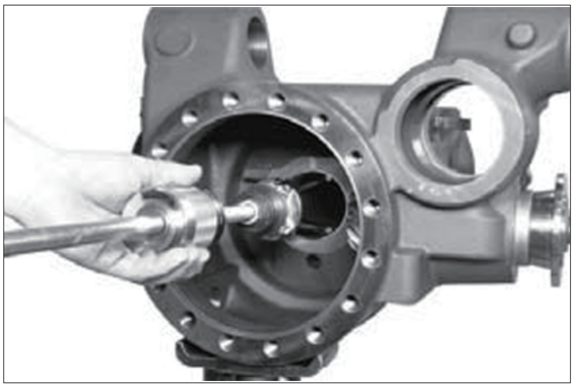
(3) Lift differential out of the axle drive housing.

※ 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.

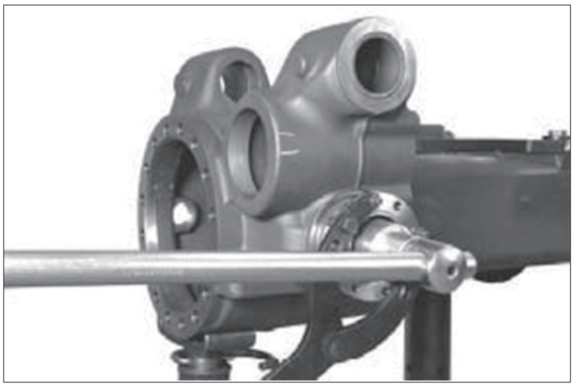
(S) Striker 5870 650 004


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.

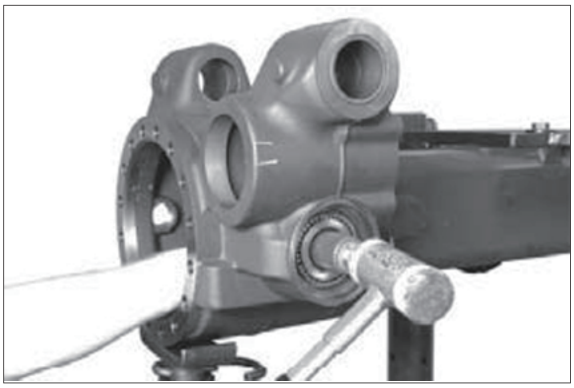

17W98FA046

(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.

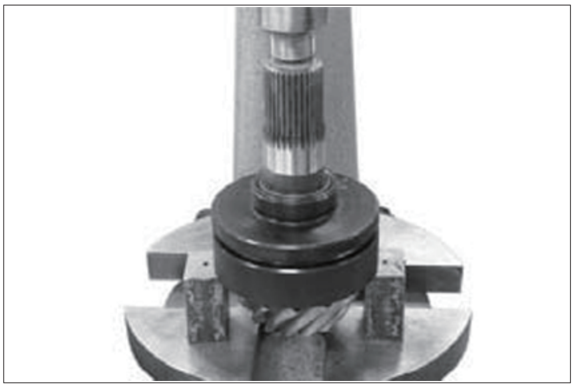

17W98FA048

(9) Remove spacer ring.

17W98FA049

(10) Press roller bearing from input pinion.

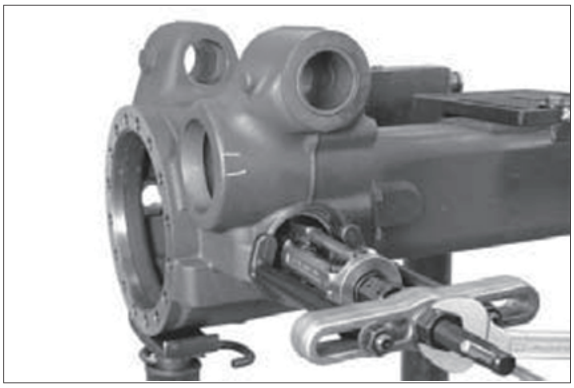
(S) Grab sleeve 5873 001 037



17W98FA050

(11) Pull off outer bearing outer ring from bearing hole.

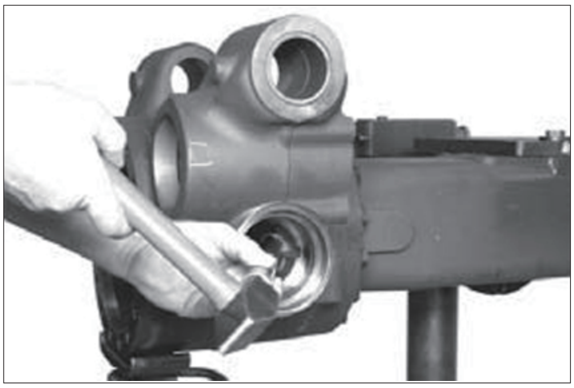
(S) Internal extractor 5870 300 019
(S) Counter support 5870 300 020



17W98FA051

(12) Force out bearing outer ring from the inner bearing hole pay attention to the shim behind.

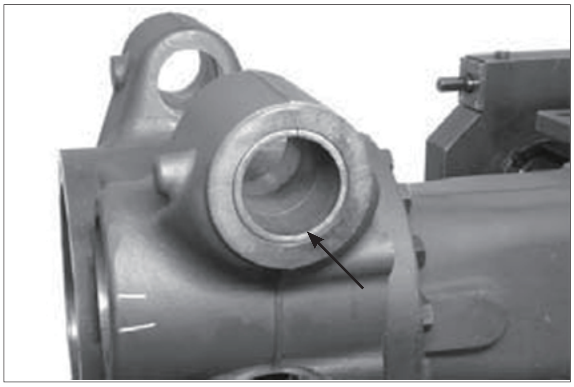
※ Mark shim (with regard to position/bearing allocation) assembly aid.



17W98FA052

(13) If necessary, provide bushings with a separating slot (see arrow) and remove from holes.

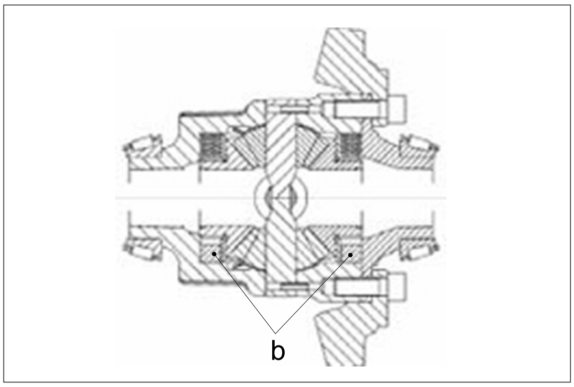
※ Bushings are destroyed by this.



17W98FA053

4) DIFFERENTIAL

(1) Differential
b = Constant spacers



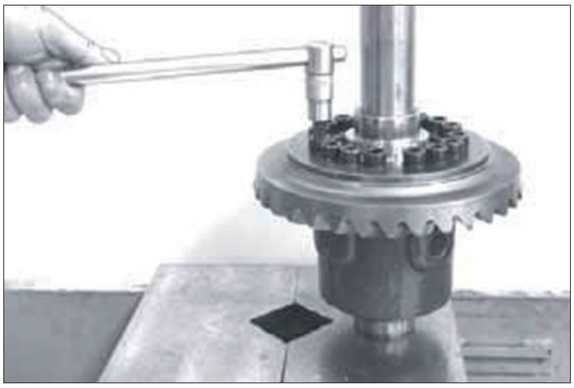
17W98FA054

(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

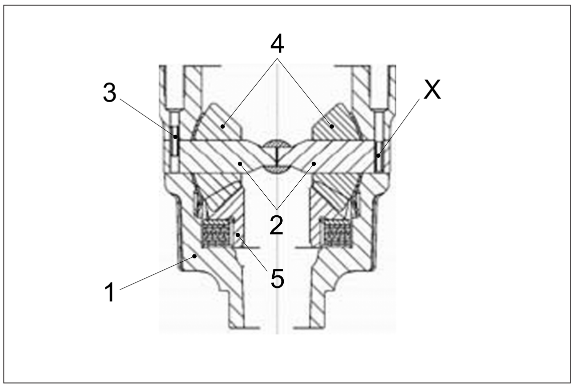
(5) Remove single parts.
Remove axle bevel gear together with thrust washer and constant spacer from the differential carrier.

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

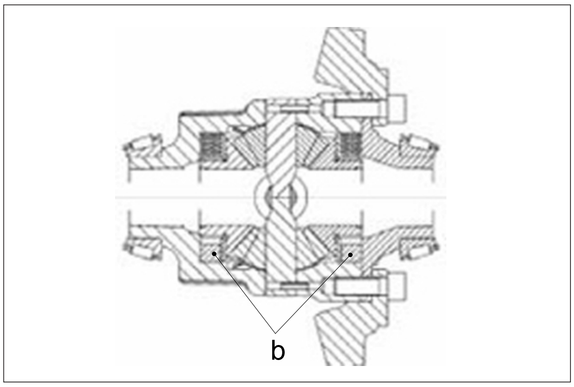
(9) Remove all single parts.

17W98FA062

4. REASSEMBLY

1) DIFFERENTIAL

(1) b = Constant spacers

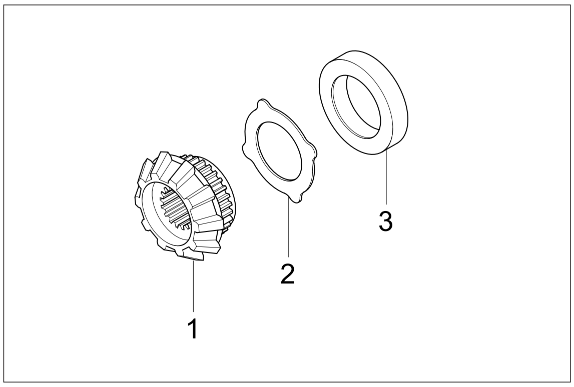


17W98FA054

(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).

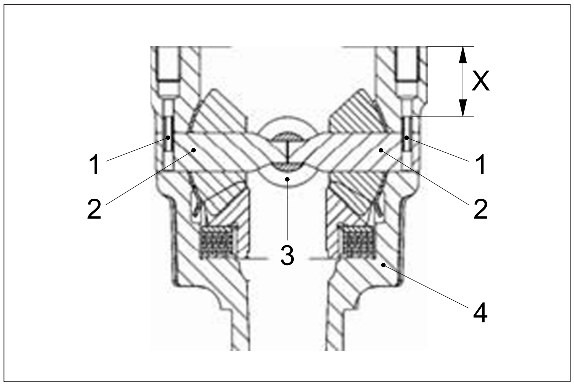
17W98FA068

(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.

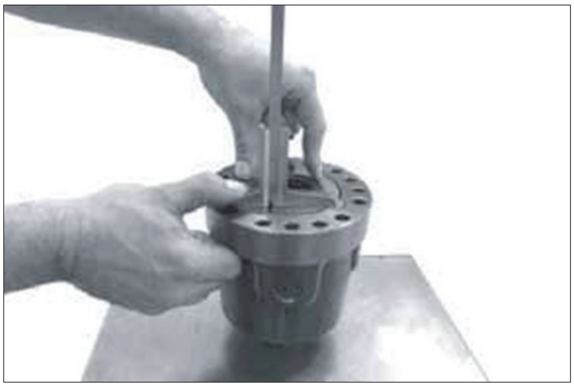
17W98FA071

(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.

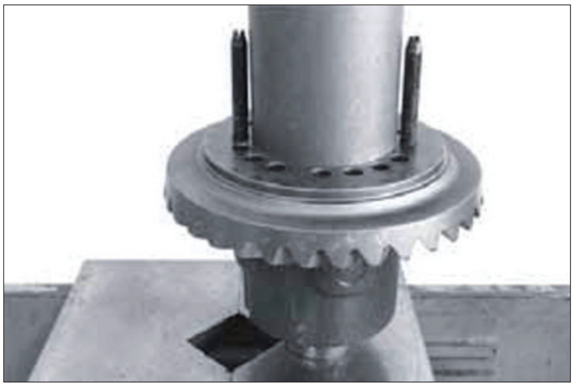
Then oil and reassemble all single parts.


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.

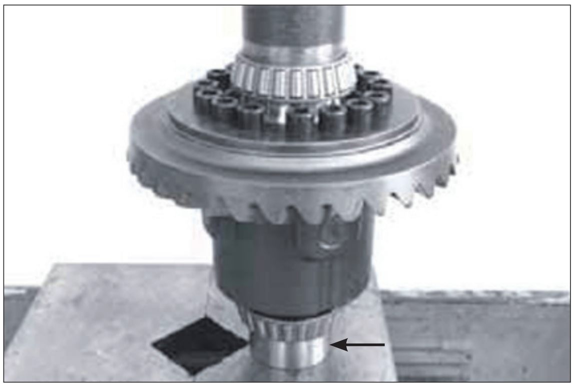

17W98FA074

(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

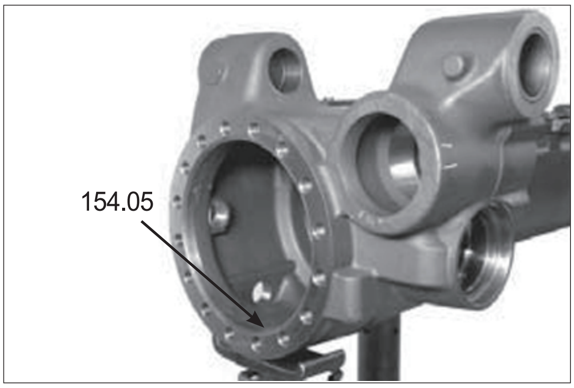
(1) Input pinion

※ 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



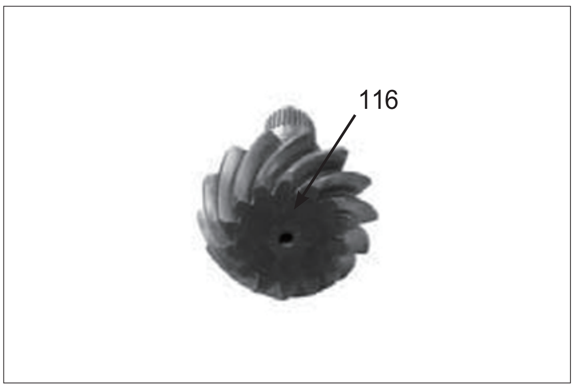
17W98FA077

(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



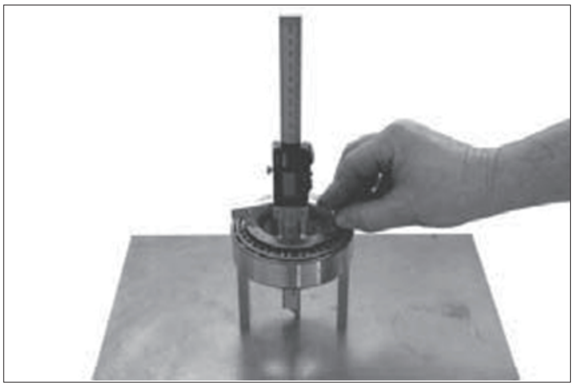
17W98FA078

(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

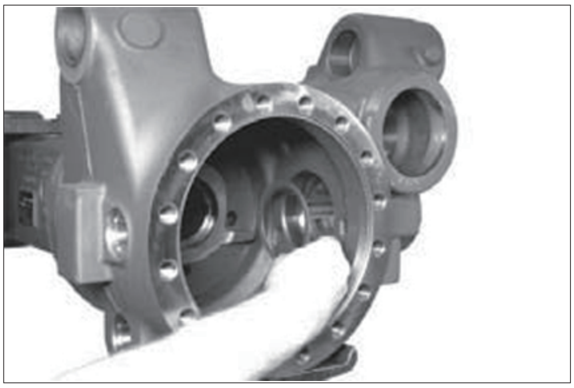


17W98FA079

(5) Calculation example "B" :

Dimension I . . . . 154.05 mm
Dimension X . . . . - 152.50 mm
Difference = shim s = 1.55 mm

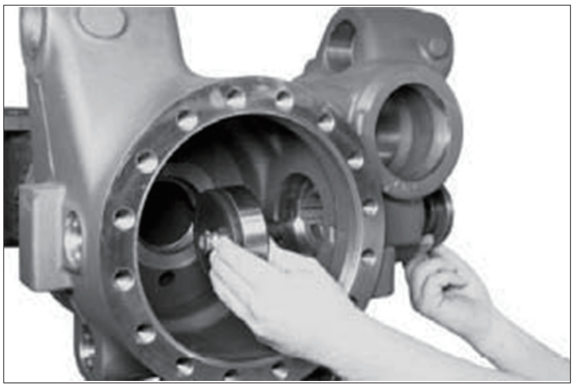
Insert the determined shim (e.g. s = 1.55 mm) into the inner bearing hole.



17W98FA080

(6) Undercool bearing outer ring (see arrow) and bring into contact position in the bearing hole by using the assembly fixture (S).

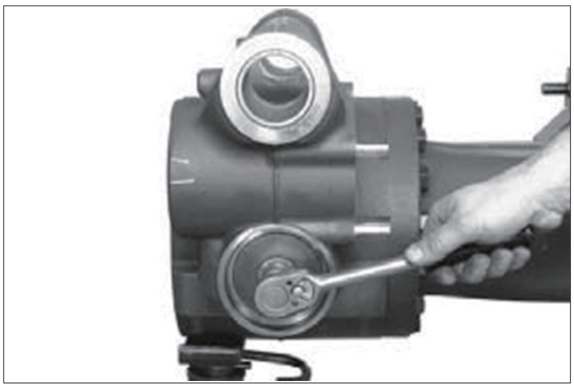
(S) Assembly fixture	5870 345 049
(S) Pressure ring	5870 345 056



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

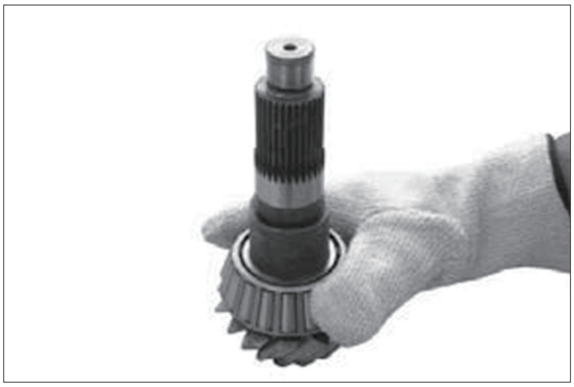


17W98FA082

(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.



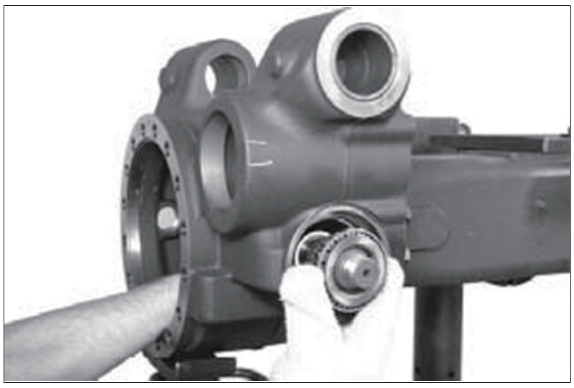
17W98FA083

(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

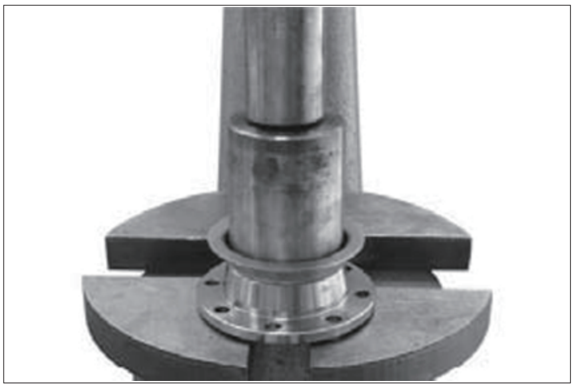
(10) Insert the preassembled input pinion into the axle housing and mount the heated roller bearing until contact is obtained.



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.



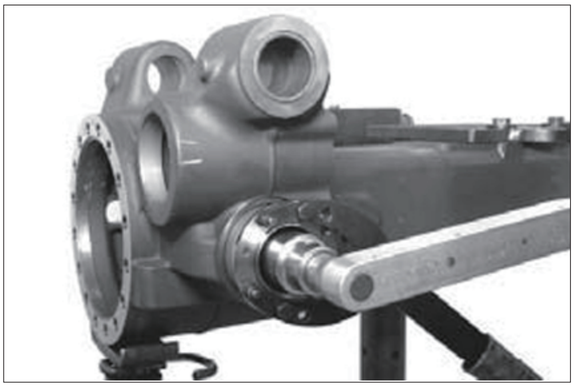
17W98FA086

(12) Mount input flange, fix with disk and hexagon nut.

Tightening torque (M30x1,5) . . . . MA = 600 Nm

(S) Clamping fork 5870 240 025

※ During the tightening process rotate the input pinion several times in both directions.

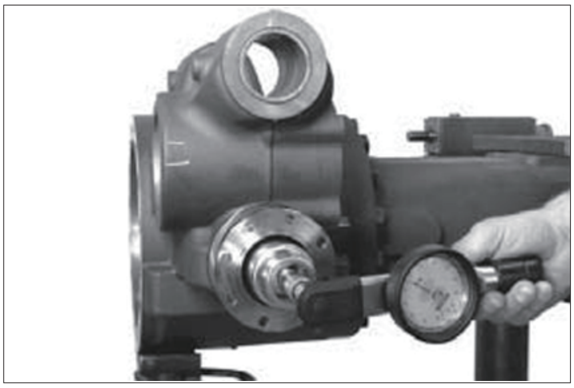


17W98FA087

(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.

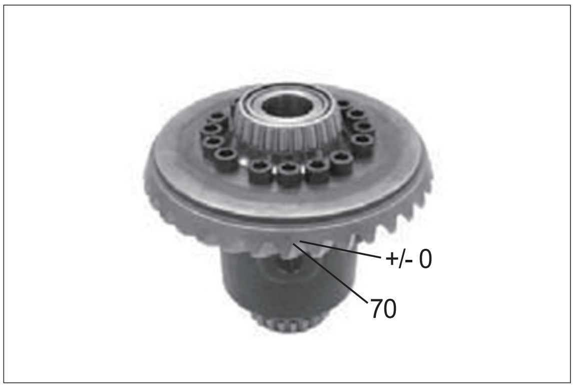


17W98FA088

(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.

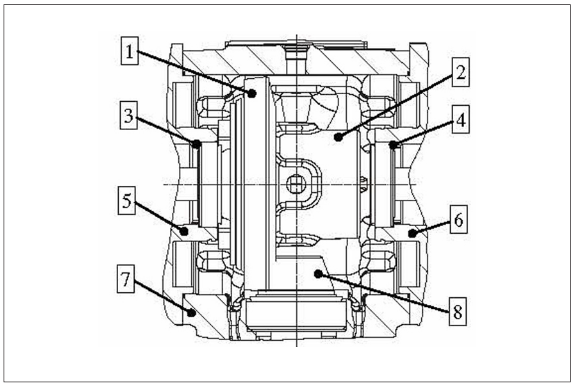
※ Test dimension "70" is stamped into the crown wheel rear. Without + or deviation specification, this corresponds to test dimension / Actual value "70" in the table below.
According to this value the necessary shims are allocated in the table next page.



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)

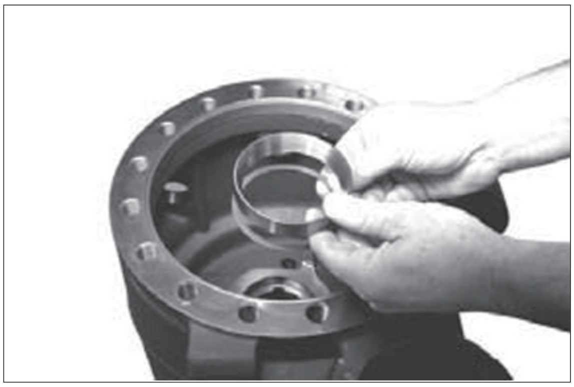
5 = Axle housing 6 = Axle housing

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

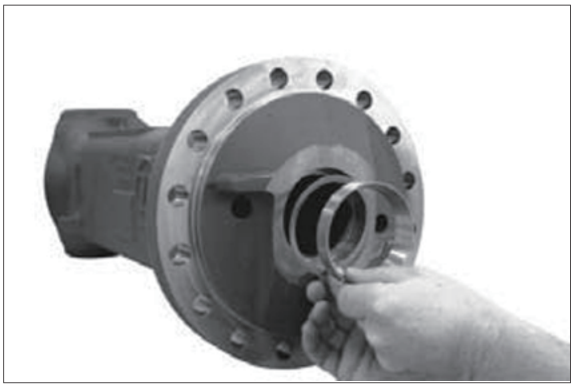
(16) Insert the determined shim (e.g. s = 1.15 mm) and the bearing outer ring into the hole of the axle housing on the differential carrier side.

※ 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.

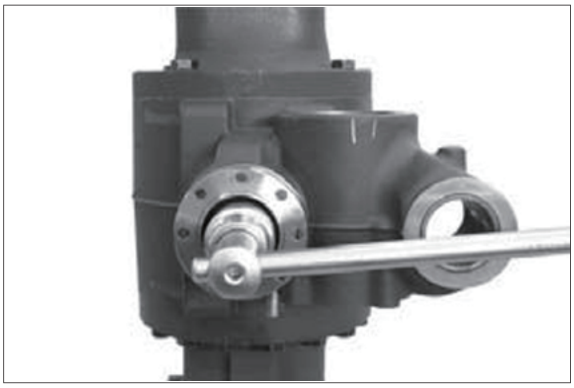
Tightening torque (M18/10.9) .... MA = 390 Nm

※ Preliminarily fix axle housing without O-ring.

17W98FA095

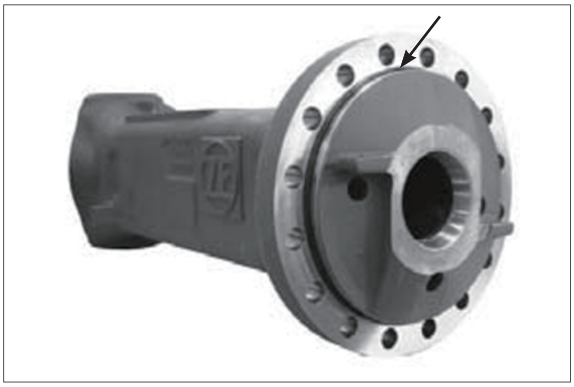
(21) Roll the crown wheel by rotation on the input flange several times in both directions over the input pinion.
Then remove axle housing again and lift differential out of the axle drive housing.
Compare the obtained contact pattern with contact pattern example page 0/4 and 0/5.

※ 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 (M18/10.9) .... MA = 390 Nm

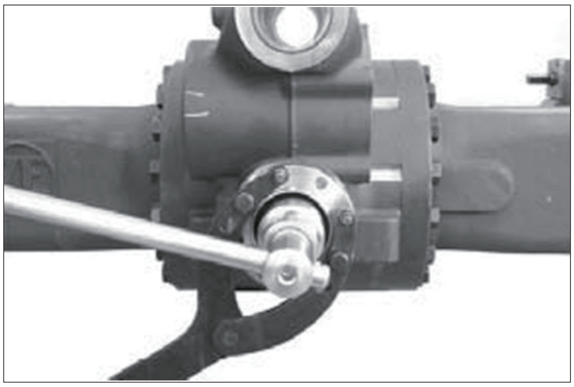
Then bring axle into horizontal position and reassemble the second clamping angle (S) (see also figure FA001).

17W98FA098

(24) **Mount shaft seal ring (input flange)**

Loosen hexagon nut and pull the input flange from the input pinion.

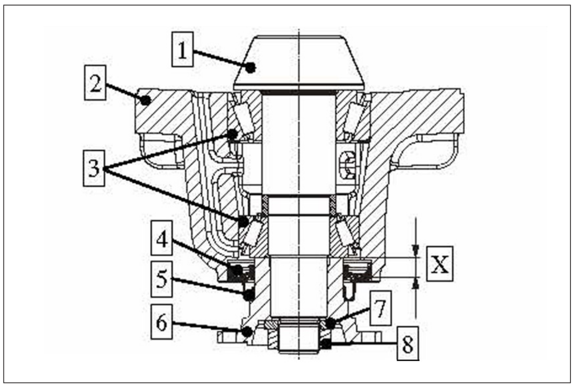
(S) Clamping fork 5870 240 025



17W98FA099

(25) Comment on sketch:

1 = Input pinion
2 = Axle drive housing
3 = Tapered roller bearing
4 = Shaft seal ring
5 = Screen sheet
6 = Input flange
7 = Disk
8 = Hexagon nut
X = Installation dimension → 13.5 +0, 2 mm



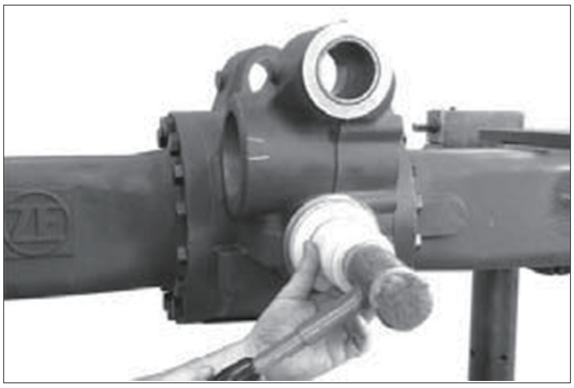
17W98FA100

(26) Mount shaft seal ring with the seal lip showing to the oil chamber.

(S) Driver tool 5870 048 286

※ Use of the specified driver tool (S) ensures the exact installation position of the shaft seal ring.

※ Just before fitting, wet contact face shaft seal ring/axle drive housing with lubricant. Apply grease on seal and dust lip of the shaft seal ring.



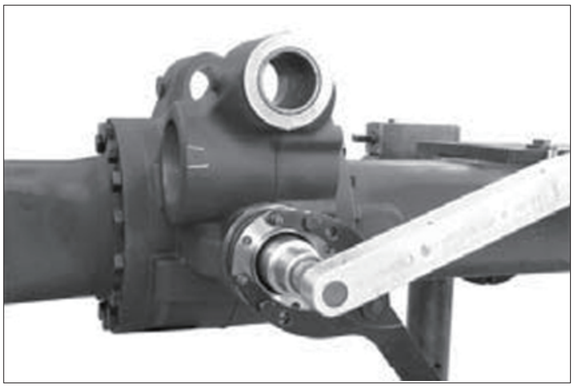
17W98FA101

(27) Mount input flange, finally tighten with disk and hexagon nut.

Tightening torque (M30x1.5) .... MA = 600 Nm

(S) Clamping fork 5870 240 025

※ Wet thread of the hexagon nut with Loctite no. 262.



17W98FA102

3) OUTPUT

(1) Preassembly axle housing

Insert bushing into hole of axle housing considering installation dimension “B” and installation position "Y" (see also sketch FA104 and FA106).

(S) Driver tool 5870 055 081
(S) Handle 5870 260 002

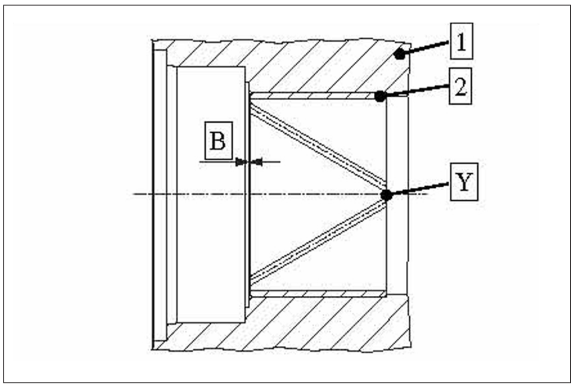
17W98FA103

(2) Comment on sketch:

1 = Axle housing
2 = Bushing
B = Installation dimension 1.0±0.3 mm
Y = Installation position / lubrication groove outlet of bushing (top view)

※ Lubrication groove outlet (V-point) must be mounted in 6 o’clock position (bottom) and showing to the oil chamber side.

※ Use of the specified driver tool (S) ensures the exact installation depth of the bushing.



17W98FA104

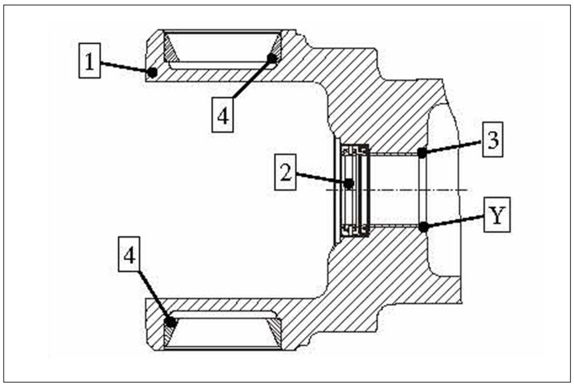
(3) Flush-mount seal ring with the seal lip showing to the oil chamber (see sketch FA106) into the axle housing hole.

(S) Driver tool 5870 055 081
(S) Handle 5870 260 002

※ Use of the specified driver tool (S) ensures the exact installation position of the shaft seal ring.

17W98FA105

※ Just before fitting wet the contact face shaft seal ring/axle drive housing with lubricant.
Apply grease on seal and dust lip of the shaft seal ring.

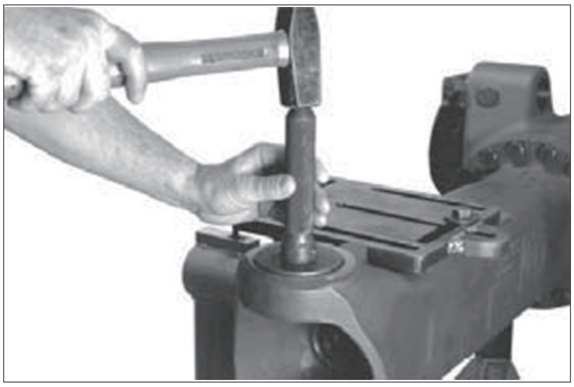


17W98FA106

(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)

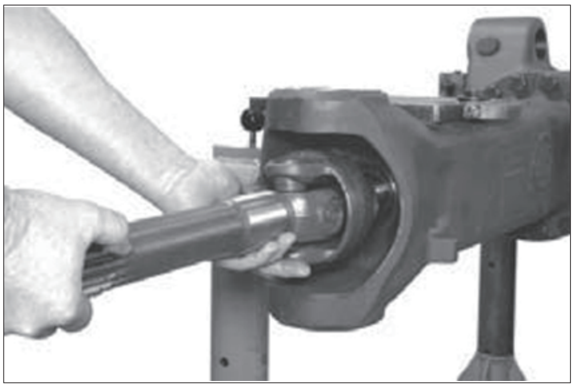
(5) Insert both bearing outer rings into the pivot bearing holes of the axle housing.

(S) Driver tool	5870 058 058
(S) Handle	5870 260 002


17W98FA107

(6) Install the u-joint shaft by inserting the u-joint shaft into the axle bevel gear teeth.

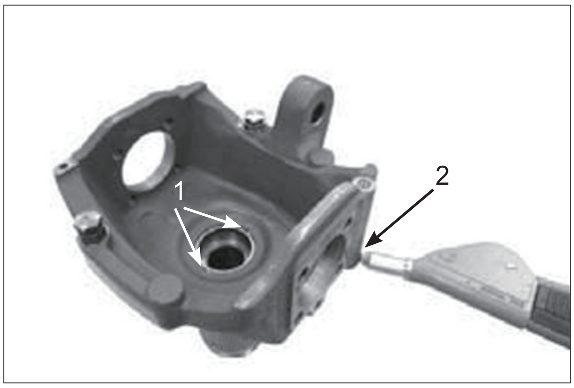
※ Pay attention to shaft seal ring in the axle housing risk of damage.


17W98FA108

(7) **Knuckle housing** (pivot bearing-SET-RIGHT)
Seal machining openings of oil supply holes – position 1 and 2 with plugs.

(S) Lever riveting tongs 5870 320 016

※ Operation is only required when using a new knuckle housing.



17W98FA109

(8) Insert bushing into the hole of the knuckle housing considering the installation dimension "B" and installation position "Y" (see also sketch FA111 and FA113).

(S) Driver tool	5870 055 081
(S) Handle	5870 260 002

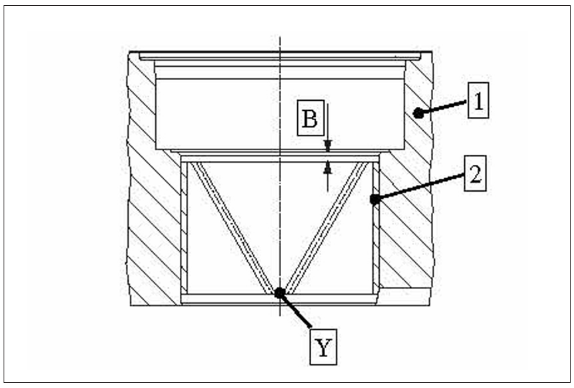
17W98FA110

(9) Comment on sketch:

1 = Knuckle housing
2 = Bushing
B = Installation dimension . . . 1.0±0.2 mm
Y = Installation position / lubrication groove outlet of the bushing

※ Lubrication groove outlet (V-point) must be mounted in 6 o'clock position (bottom) and showing to the oil chamber side (referred to the axle fitted into the vehicle).

※ Use of the specified driver tool (S) ensures the exact installation depth of the bushing.



17W98FA111

(10) Insert shaft seal ring into the hole of the knuckle housing with the seal lip showing to the oil chamber – considering the installation dimension "W" (see also sketch below).

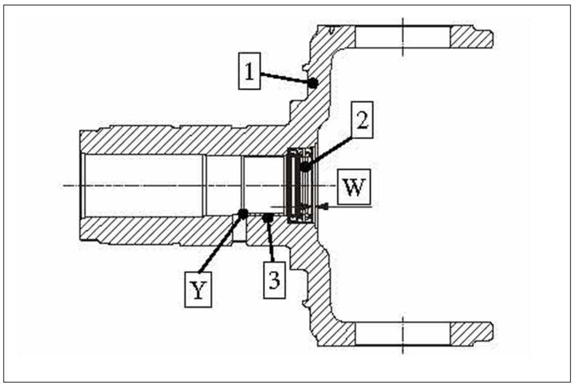
(S) Driver tool	5870 055 081
(S) Handle	5870 260 002

※ Use of the specified driver tool (S) ensures the exact installation position of the shaft seal ring.

17W98FA112

(11) Comment on sketch:
1 = Knuckle housing
2 = Shaft seal ring
3 = Bushing
W = Installation dimension – shaft seal ring .... 2.0±0.2 mm
Y = Lubrication groove outlet (V-point) must be mounted in 6 o'clock position and showing to the oil chamber side (referred to the axle fitted into the vehicle)

※ 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.



17W98FA113

(12) Grease O-ring (see arrow) and insert it into the groove of the bearing pin.


17W98FA114

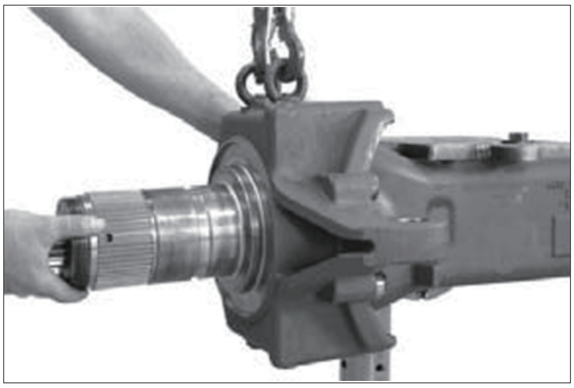
(13) Place sealing cap (see arrow) and mount the tapered roller bearing until contact position is obtained.


17W98FA115

(14) Locate pre-assembled knuckle housing on axle housing and carefully mount u-joint shaft.

(S) Eyebolts (M 16)   0636 804 001

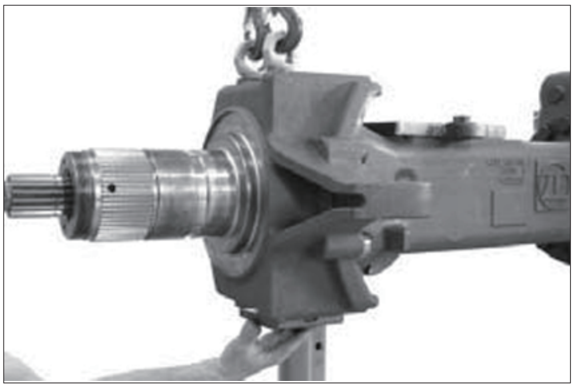
※ Pay attention to shaft seal ring in the knuckle housing risk of danger.



17W98FA116

(15) Insert the pre-assembled lower bearing pin and preliminarily fix with hexagon screws.

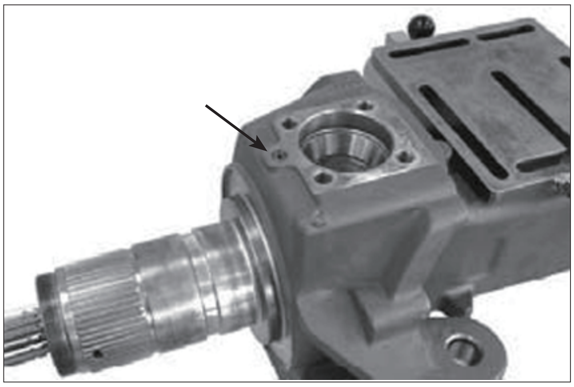
※ Pay attention to installation position mount bearing pin with lubrication nipple showing to axle centre.



17W98FA117

(16) Insert O-ring (see arrow) or O-rings into countersink of the knuckle housing.

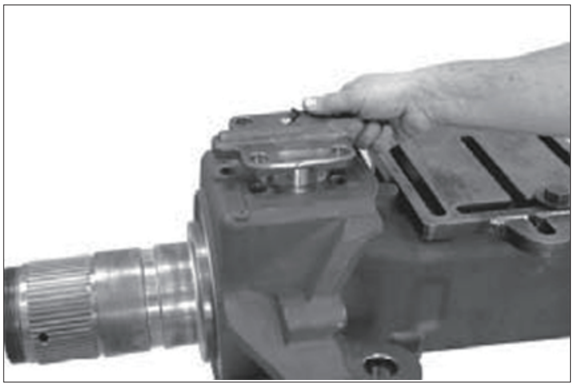
1 ps for version with breather valve in the knuckle housing
2 pcs for version with breather valve in the bearing pin



17W98FA118

(17) Insert pre-assembled upper bearing pin.

※ Observe installation position mount bearing pin with oil supply holes showing to axle centre.

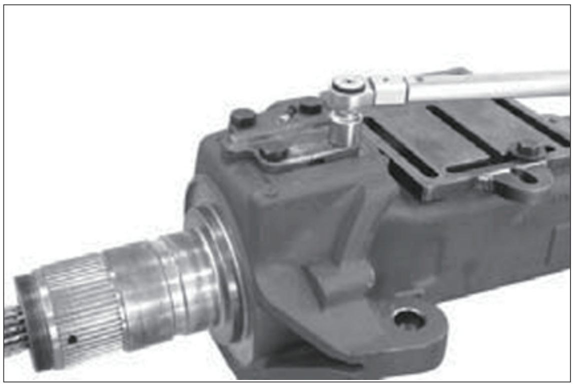


17W98FA119

(18) Fix both bearing pins definitely.

※ Tightening torque (M 16 / 10.9T) . .. .
. . . . MA = 280 Nm

※ Use of new locking screw is imperative.



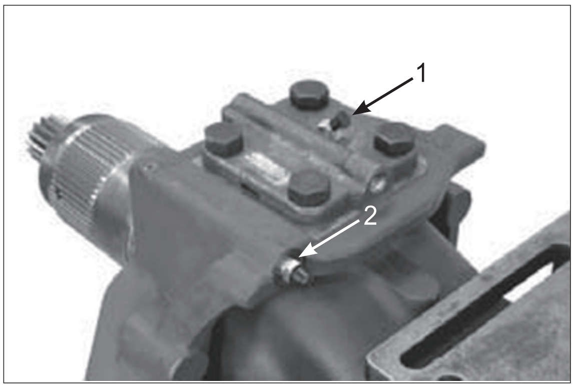
17W98FA120

(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 × 1.0) . . . .
. . . . 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 = 20Nm



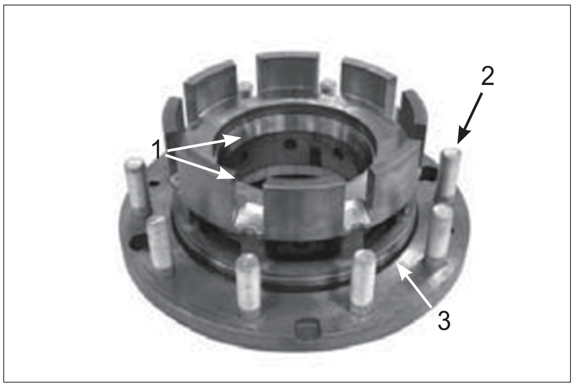
17W98FA121

4) HUB (Hub bearing-SET-RIGHT)

(1) Insert both bearing outer rings (1) of the hub bearing until contact position is obtained.

Press wheel bolts (2) into the hub until contact position is obtained.

Oil O-ring (3) and locate in annular groove of hub.



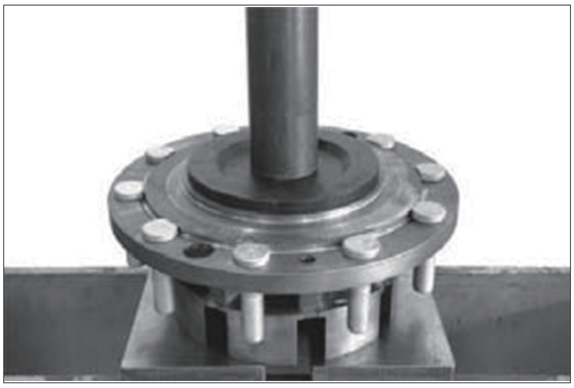
17W98FA122

(2) Press shaft seal ring with the marking "OUT SIDE" showing outside (upwards) into the hub.

(S) Driver tool 5870 051 035

※ Use of the specified driver tool (S) ensures the exact installation position of the shaft seal ring.

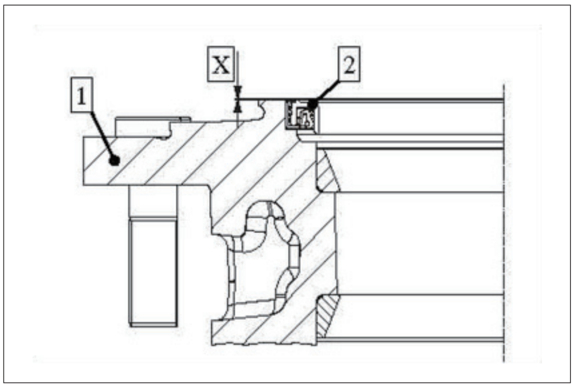
※ Just before fitting, wet contact face shaft seal ring/hub with lubricant.



17W98FA123

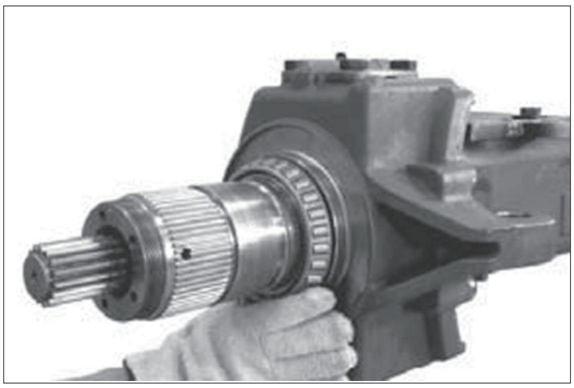
(3) Comment on sketch:

1 = Hub
2 = Shaft seal ring
X = Installation dimension – Shaft seal ring
.... 0.0~0.3 mm



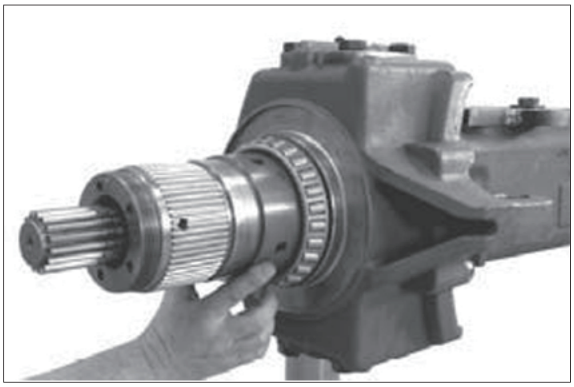
17W98FA124

(4) Heat the tapered roller bearing and mount until contact position with the knuckle housing is obtained.



17W98FA125

(5) Insert spacer bushing.



17W98FA126

(6) Install preassembled hub until contact is obtained and fix with heated tapered roller bearing.

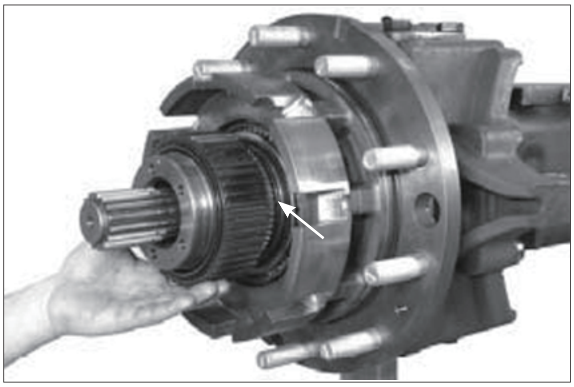
(S) Lifting bracket 5870 281 043

※ Just before fitting wet the seal lips of the shaft seal ring with lubricant.

17W98FA127

(7) Oil O-ring and insert it into the annular groove (see arrow) of the knuckle housing.

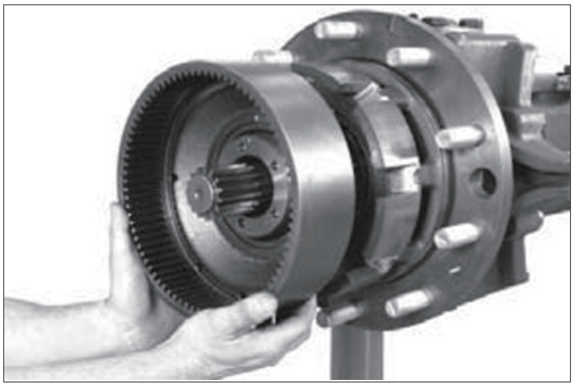
Then install disk carrier.



17W98FA128

(8) Bring disk carrier and hub bearing into contact position (figure FA129 and FA130)

Install ring gear (without sealing elements).



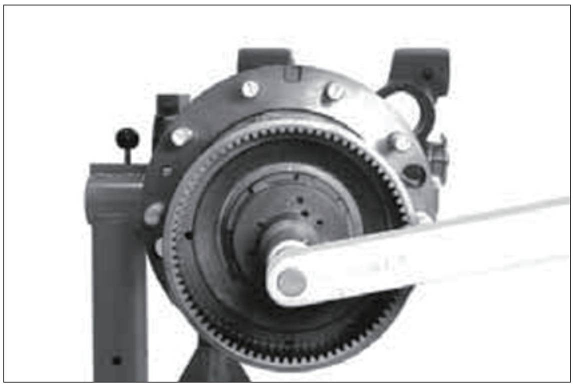
17W98FA129

(9) Bring hub bearing into contact position for this purpose tighten slotted nut with a tightening torque of max. 1400 Nm.

(S) Socket wrench 5870 656 097

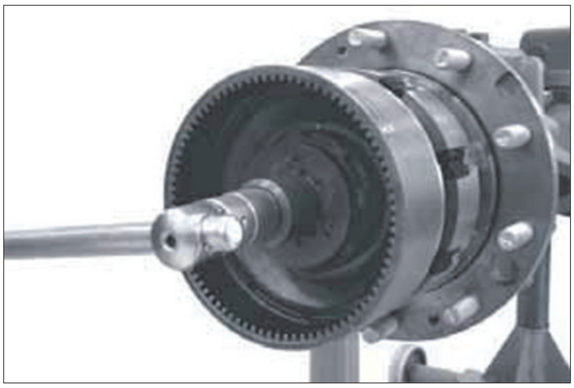
※ While tightening the slotted nut rotate hub in both directions several times roller setting.

※ Apply lubricant to thread knuckle housing / slotted nut.



17W98FA130

(10) Loosen slotted nut again and remove ring gear.



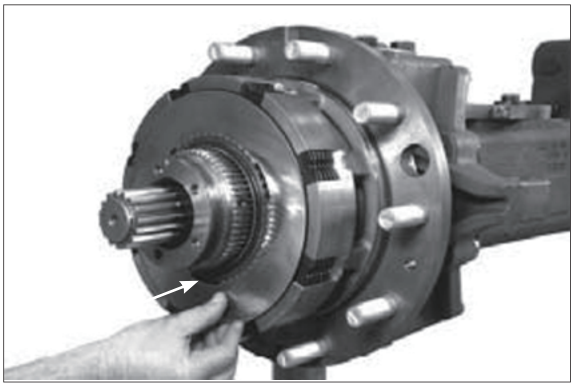
17W98FA131

5) DISK BRAKE

(1) Install disk package alternately starting with an outer disk.

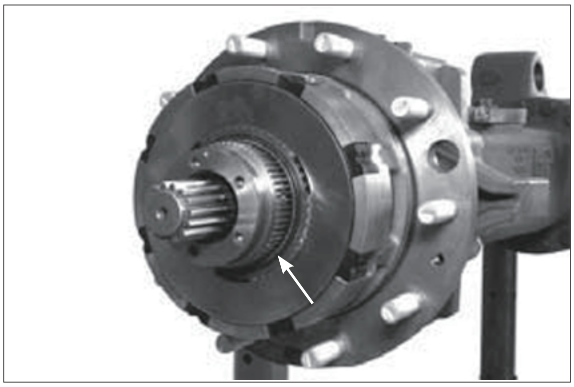
※ Take the actually required disk fitting / arrangement from the corresponding spare parts list.

※ Bring inner clutch disks in a position where one of the tooth recesses (see arrow) is in 6 o'clock position with axle being installed in the vehicle.



17W98FA132

(2) Oil O-ring and locate in annular groove of disk carrier.



17W98FA133

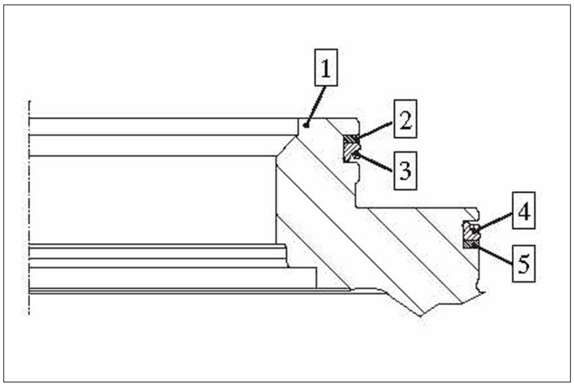
(3) Oil U- and support rings and insert them into the annular grooves of the ring gear.

※ Observe installation position, see sketch below.

17W98FA134

(4) Comment on sketch:

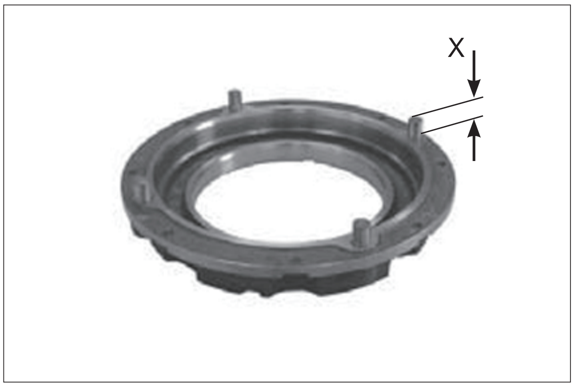
1 = Ring gear
2 = Support ring
3 = U-ring
4 = U-ring
5 = Support ring



17W98FA135

(5) Mount cylindrical pins into piston, considering installation dimension "X".

X = Installation dimension ..... 18.00 mm



17W98FA136

(6) Install piston on ring gear.

17W98FA137

(7) Fix piston with "new" hexagon screws (1), spring sleeves (2) and compression springs (3 and 4).

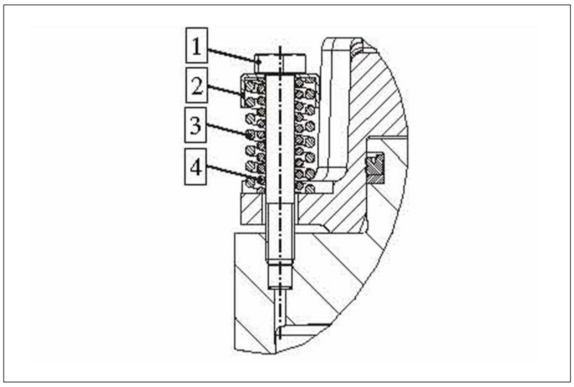
Tightening torque (M 6/8.8) .... MA = 8 Nm

※ Use hexagon screws just once.

17W98FA138

(8) Comment on sketch:

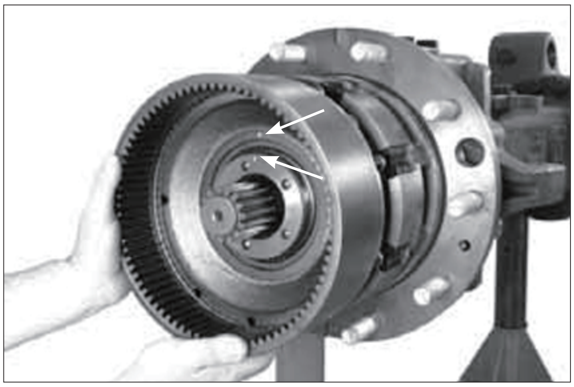
1 = Hexagon screw (special version)
2 = Spring sleeve
3 = Compression spring
4 = Compression spring



17W98FA139

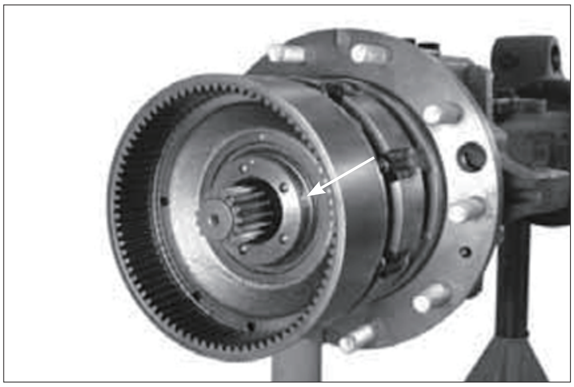
(9) Mount preassembled ring gear considering the installation position (markings O in 12 o'clock position - see arrows).

※ Ensure exact toothing position of oil supply holes knuckle housing / ring gear (pressure oil supply to brake piston).



17W98FA140

(10) Oil O-ring and insert in recess (see arrow).



17W98FA141

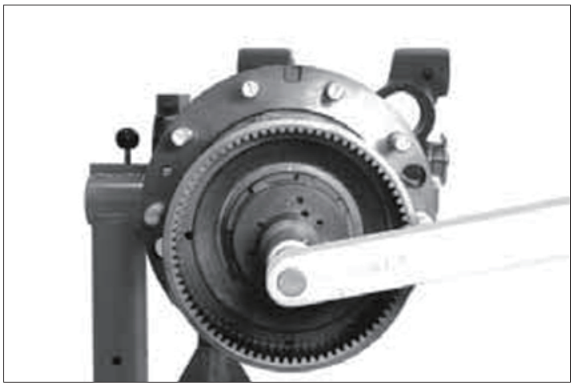
(11) Fix ring gear with slotted nut.

Tightening torque:
(M 85x 1.5). . . . . MA = 1400 + 200 Nm

(S) Socket wrench 5870 656 097

※ First tighten slotted nut with 1400 Nm, then retighten slotted nut until a fixing hole overlaps a threaded hole in the knuckle housing.
While tightening the slotted nut rotate hub in both directions several times roller setting.

※ Wet thread knuckle housing / slotted nut with lubricant.



17W98FA142

(12) Make leakage test of multi-disk brake
Mount threaded coupling (S) and connect HP pump.

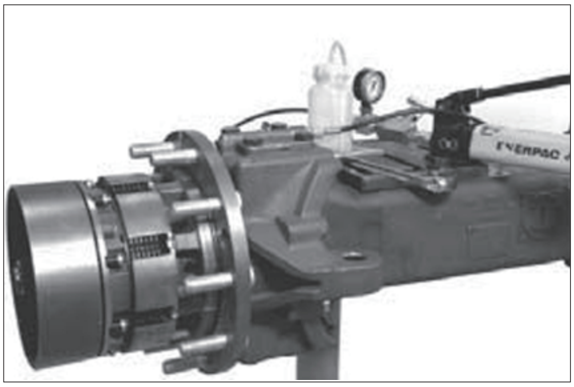
(S) HP pump 5870 287 007
(S) Threaded coupling (M14x1.5) 5870 950 102
(S) Breather bottle 5870 286 072

※ Breathe brake completely before starting the test.

Test media :
Motor oils SAE-10W

High-pressure test:
Build up test pressure p = 100 bar and close locking valve of HP pump.
A pressure drop by max. 3 bar is permissible during a 5-minute test duration.

Low pressure test:
Reduce test pressure p = 5 bar and close locking valve.
No pressure drop is allowed during a 5-minute testing duration.



17W98FA143

(13) **Adjust and check piston stroke**

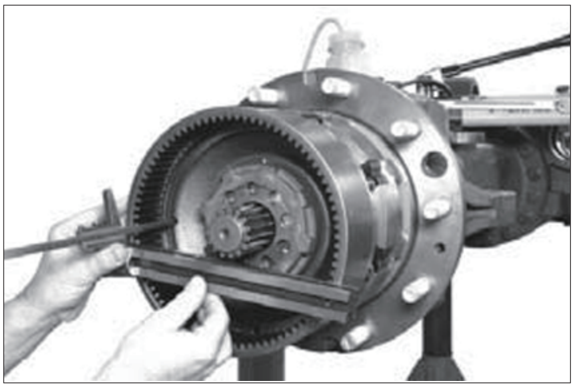
Piston stroke / disk clearance = 0.7 ..... 1.3 mm

Build up braking pressure (100 bar) and close locking valve of the HP pump.

Determine dimension "A", from face of the ring gear (1) through measuring hole (see also sketch FA145) to the face of the piston (3).

Dimension "A" e.g. . . . . 83.10 mm

※ Breathe brake completely before starting the measuring operation.

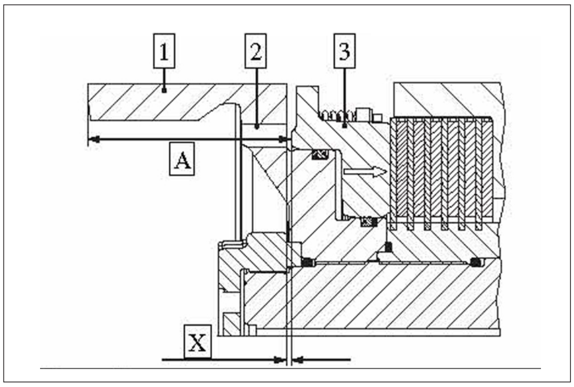


17W98FA144

(14) Then open locking valve of the HP pump and release pressure from brake (reset piston through compression springs).

Determine dimension "B", from the face of the ring gear (1) through the measuring hole (see also sketch FA146) to the face of the piston (3).

Dimension "B" e.g. . . . . 82.10 mm



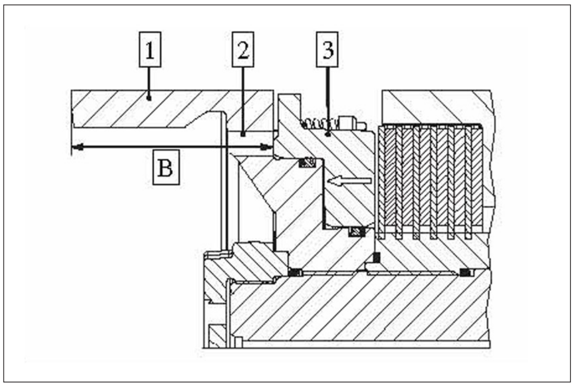
17W98FA145

(15) CALCULATION EXAMPLE:

Dimension "A" e.g. . . . . 83.10 mm
Dimension "B" e.g. . . . . - 82.10 mm
Difference = Piston stroke = 1.00 mm

※ If the required piston stroke (0.7 ... 1.3 mm) is not achieved, correct it with the corresponding inner clutch disk (s) – refer to corresponding spare parts list.

Then remove HP pump (S), breather bottle (S) and threaded coupling (S).



17W98FA146

Comment on sketch 43 and 44:
1 = Ring gear
2 = Measuring hole
3 = Piston
X = Piston stroke / disk clearance

(S) Straightedge 5870 200 022

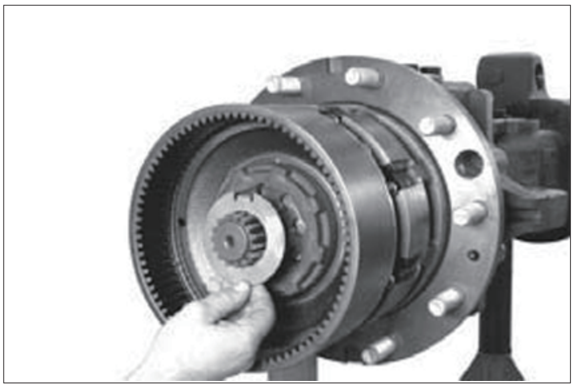
(16) Secure slotted nut with cylindrical screw (please also refer to figure FA142)

Tightening torque (M 10/8.8) . . . . MA = 32 Nm

17W98FA147

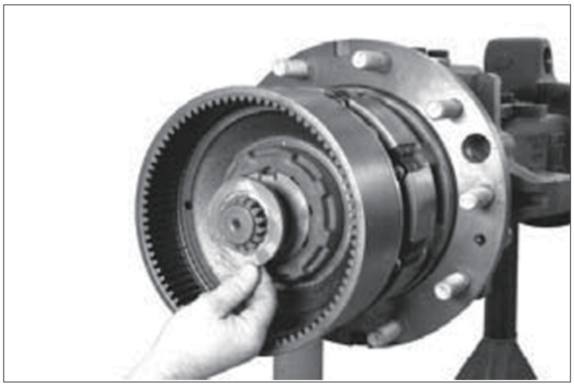
(17) Insert thrust washer.

※ Observe installation position ensure that both lugs of the thrust washer are engaged each in a spare fixing hole of the slotted nut.



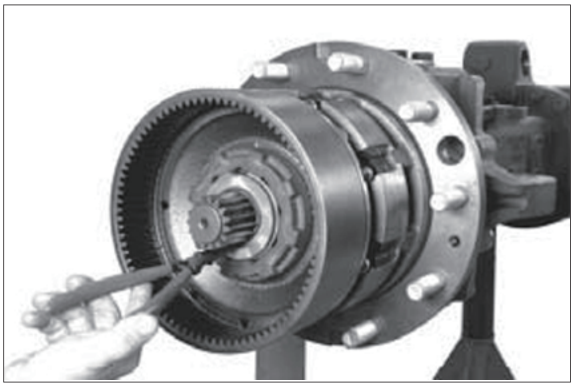
17W98FA148

(18) Mount thrust washer with shoulder showing to the retaining ring (outwards).



17W98FA149

(19) Fix thrust washers by using a retaining ring.



17W98FA150

6) PLANETARY CARRIER

(1) Press thrust washer into the planetary carrier until contact position is obtained.

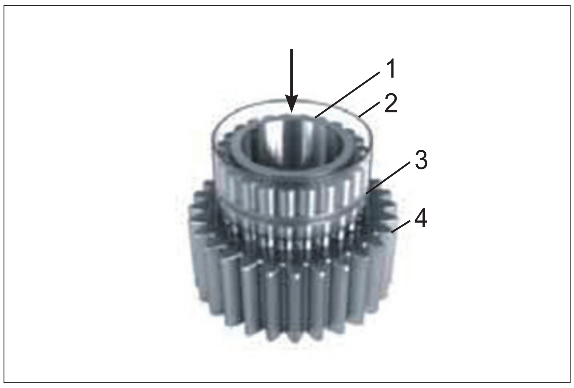
(S) Driver tool 5870 048 245

17W98FA151

(2) Insert the cylindrical roller bearing into the planetary gear for this purpose press the cylindrical roller bearing through the packaging sleeve until the snap ring engages into the annular groove of the planetary gear.

※ Use packaging sleeve to facilitate assembly.

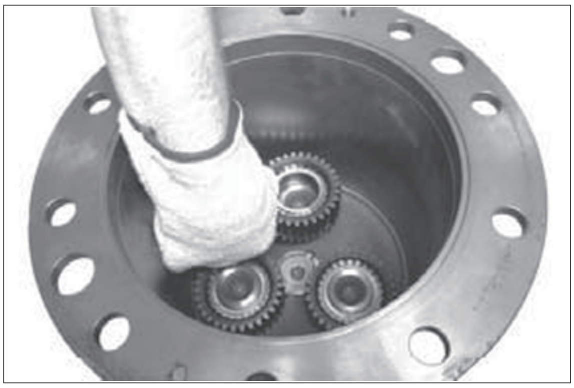
1 = Cylindrical roller bearing
2 = Packaging sleeve
3 = Snap ring
4 = Planetary gear



17W98FA152

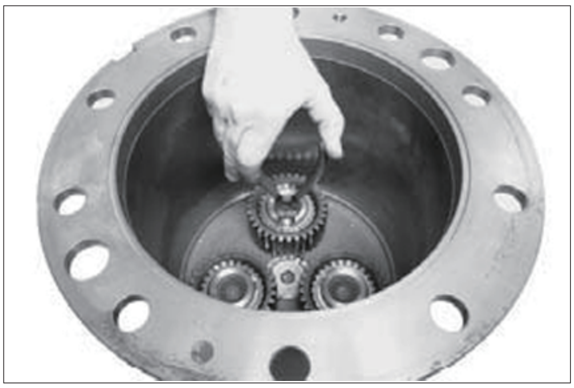
(3) Warm up bearing inner ring and install pre-assembled planetary gear until contact is obtained.

※ Mount bearing inner ring with large radius, showing to the planetary carrier (downwards).



17W98FA153

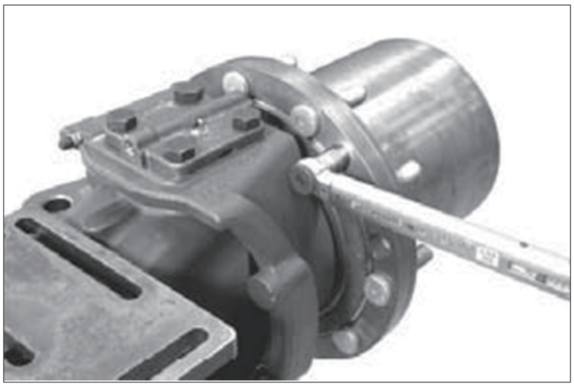
(4) Fix planetary gear by means of retaining ring.



17W98FA154

(5) Install preassembled planetary carrier and fix with hexagon screws.

Tightening torque (M12/8.8) . . . . MA = 55 Nm



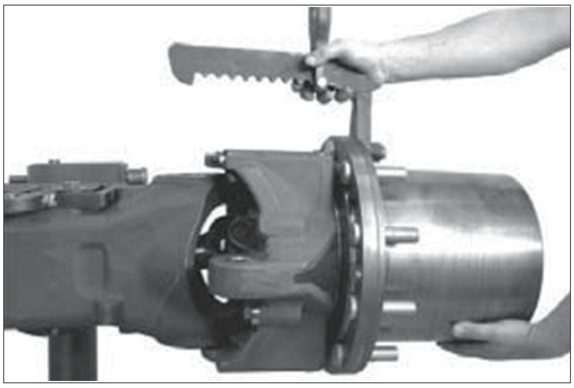
17W98FA155

(6) Output assy

Locate output assy on the axle by means of the lifting bracket (S) by installing the u-joint shaft in the axle bevel gear toothing.

(S) Lifting bracket 5870 281 043

※ Pay attention to shaft seal ring in the axle housing risk of damage.

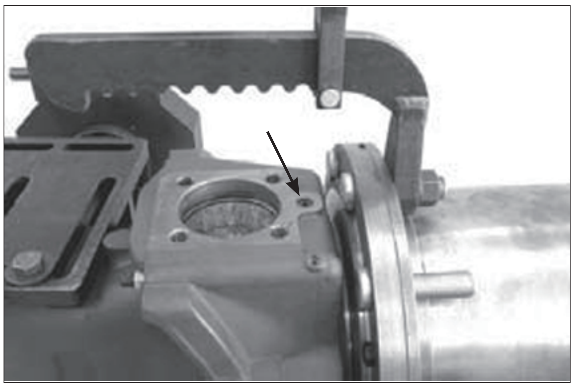


17W98FA156

(7) Insert O-ring (see arrow) or O-rings into the countersink (s) of the knuckle housing.

1 pc for version with breather valve in knuckle housing.

2 pcs. for version with breather valve in bearing pin.



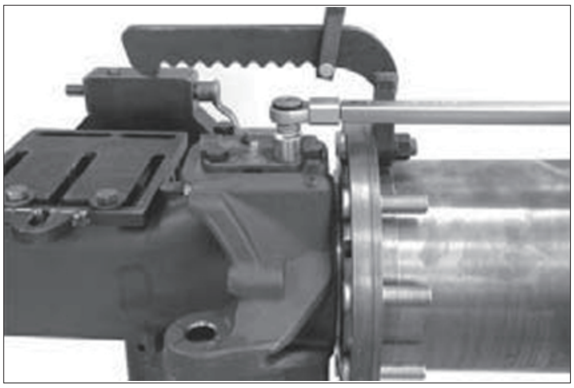
17W98FA157

(8) Mount both bearing pins and fix with hexagon screws or locking screws.

Tightening torque (M16/10.9T) . . . . MA = 280 Nm

※ Observe installation position, mount upper bearing pin with oil supply holes showing to axle centre.

※ Use of new locking screw is imperative.



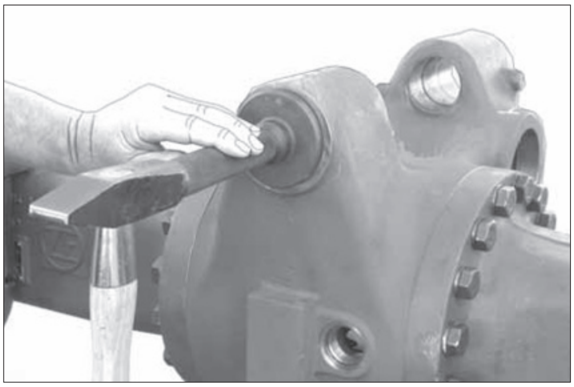
17W98FA158

(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.

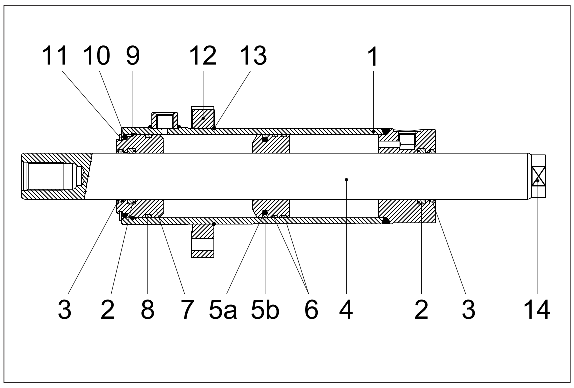


17W98FA159

7) STEERING

(1) Comment on sketch:

1 = Steering cylinder
2 = Grooved ring
3 = Scraper
4 = Piston rod
5a = O-ring 〉Piston sealing
5b = Form seal ring
6 = Guide ring
7 = Brake head
8 = Dual ring
9 = Retaining ring
10 = O-Ring (only for version "with" O-ring)
11 = Retaining ring
12 = Flange
13 = Retaining ring
14 = Wrench point of attack (piston rod)



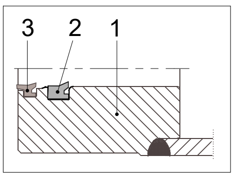
17W98FA160

(2) Preassemble steering

Mount U-ring (2) and scraper (3) in the steering cylinder (1).

※ Observe installation position – see detailed sketch.

Detailed sketch:

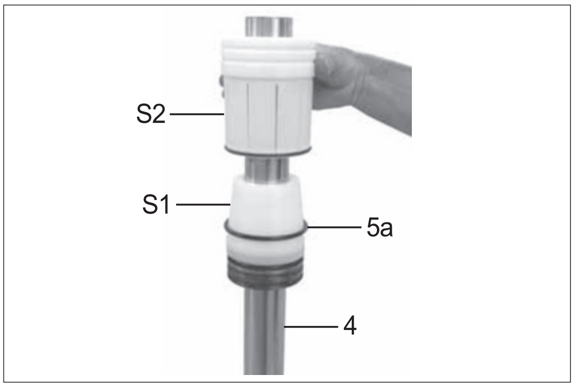


17W98FA161

(3) Position inner installer (S1) on piston rod (4).

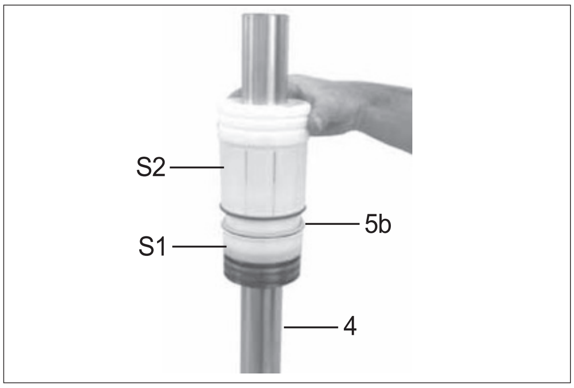
Mount O-ring (5a) and press with inner installer (S2) into annular groove (arrow) of the piston (4).

(S) Inner installer (S1) 5870 651 086
(S) Inner installer (S2) 5870 651 087



17W98FA162

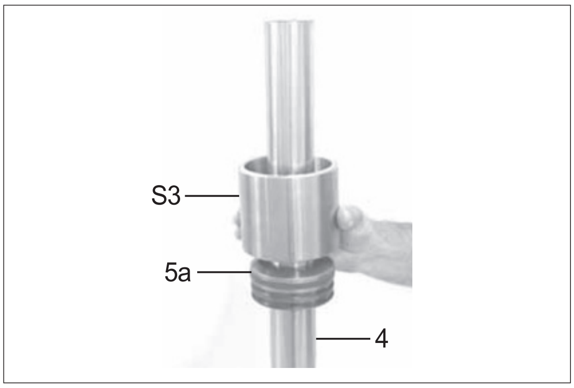
(4) Install form seal ring (5b) and press with inner installer (S2) into the annular groove of the piston (4).



17W98FA163

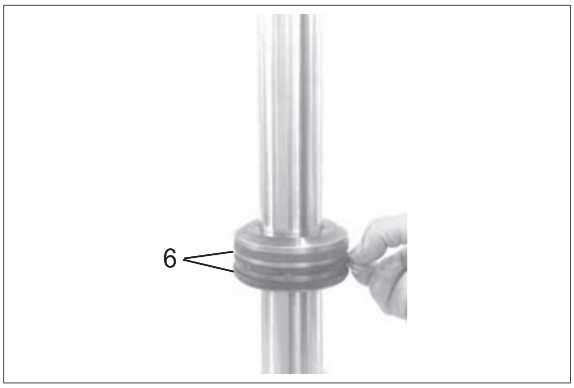
(5) Calibrate form seal ring (5b) with calibration bush (S3).

(S) Calibration bush (S3) 5870 651 090



17W98FA164

(6) Place both guide rings (6) into the annular grooves of the piston rod.

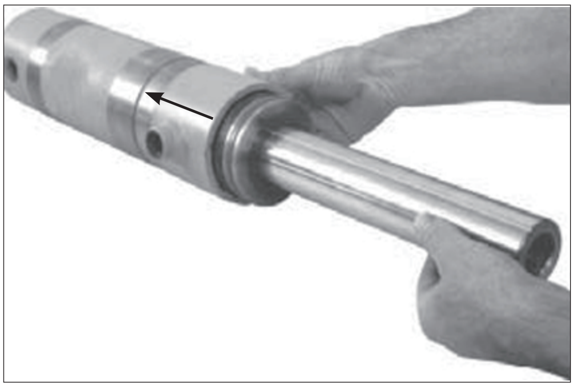


17W98FA165

(7) Insert preassembled piston rod into the steering cylinder.

※ Slightly oil all sealing elements before installing the piston rod.

※ Observe installation position, insert piston rod with wrench point of attack (14, see also sketch FA160) showing in direction of arrow.

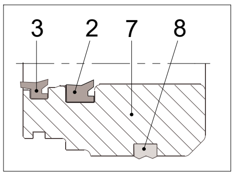


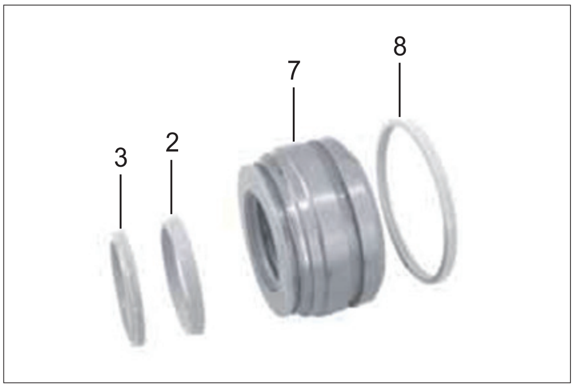
17W98FA166

(8) Insert U-ring (2), scraper (3) and dual ring (8) into the grooves of the brake head (7).

※ Observe installation position in this connection refer to detailed sketch.

Detailed sketch:





17W98FA167

(9) Push preassembled brake head into the steering cylinder so that the retaining ring (see figure FA169) can be mounted.

※ Slightly oil all sealing elements before inserting the brake head.

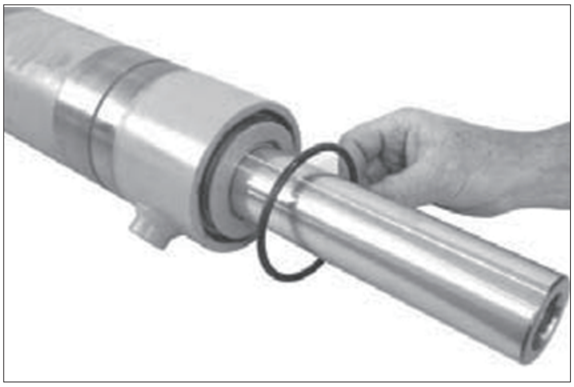
17W98FA168

(10) Engage retaining ring (9) into the groove of the cylinder tube.

17W98FA169

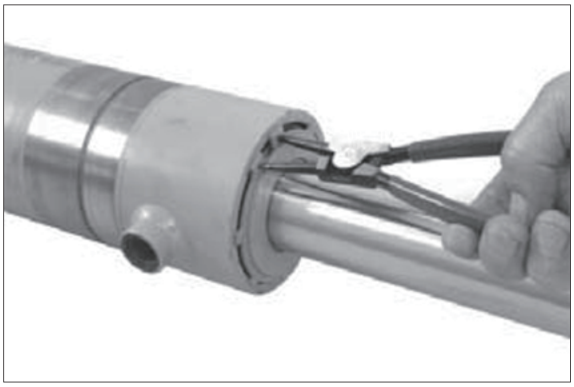
(11) Position the inserted brake head (7) on the snap ring (9) until contact is obtained (arrow).

Only for version with O-ring (see corresponding spare parts list) : Oil O-ring (10) and place into the recess.



17W98FA170

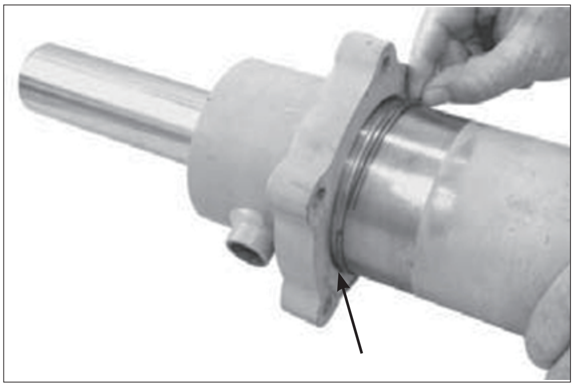
(12) Fix brake head (7) with retaining ring (11).



17W98FA171

(13) Install flange (12) and engage retaining ring (13).

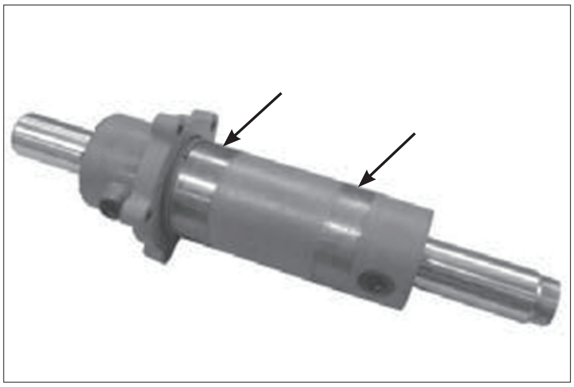
※ Observe installation position of flange mount flange with chamfer (see arrow) showing to the snap ring.



17W98FA172

(14) Mount steering

Apply anti-corrosive agent (Weicon Anti-Seize) on contact faces (cylinder tube / axle housing, see arrow).



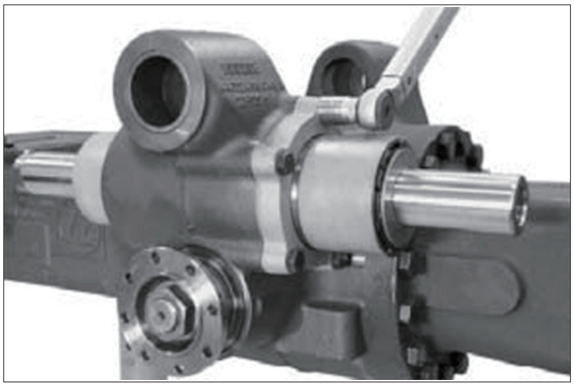
17W98FA173

(15) Insert preassembled steering cylinder into axle housing and fix with hexagon screws.

Tightening torque (M 12/8.8) . . . . MA = 79 Nm

※ The radial installation position of the steering cylinder (position of the hydr. connections) is customer specific see also disassembly instructions figure FA018.

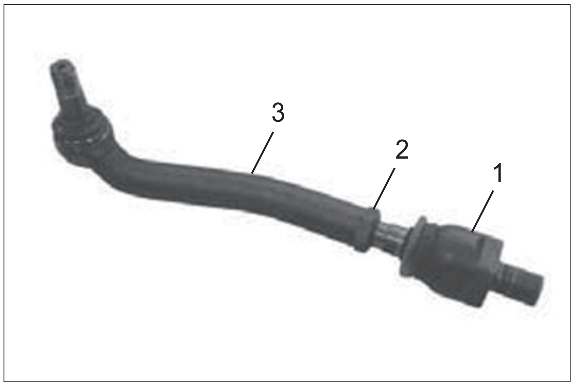
※ Wet the thread of the hexagon screws with Loctite no. 243.



17W98FA174

(16) Bolt hexagon nut (2) and ball joint (3) to axial joint (1).

※ Do not tighten hexagon nut before setting the track.



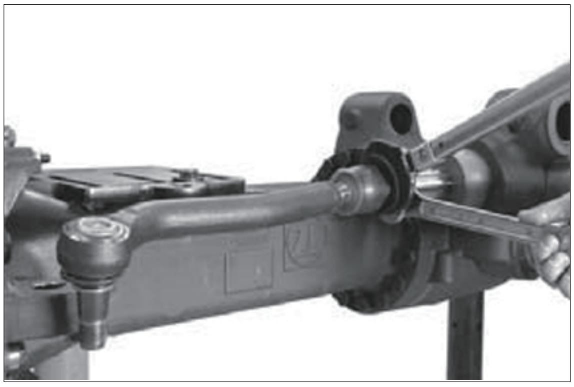
17W98FA175

(17) Fix both tie rods to piston rod (with offset showing to the axle housing).

Tightening torque (M30 × 1.5) . . . . MA = 450 Nm

(S) Socket wrench (SW 55)   5870 656 100

※ Wet thread of the axial joint with Loctite no. 243.

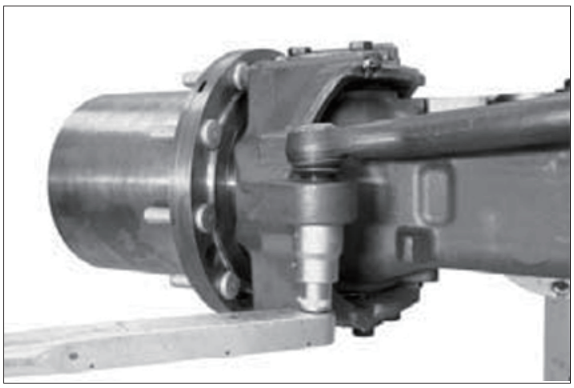


17W98FA176

(18) Install tie rod into knuckle housing and fix with "new" locking nut.

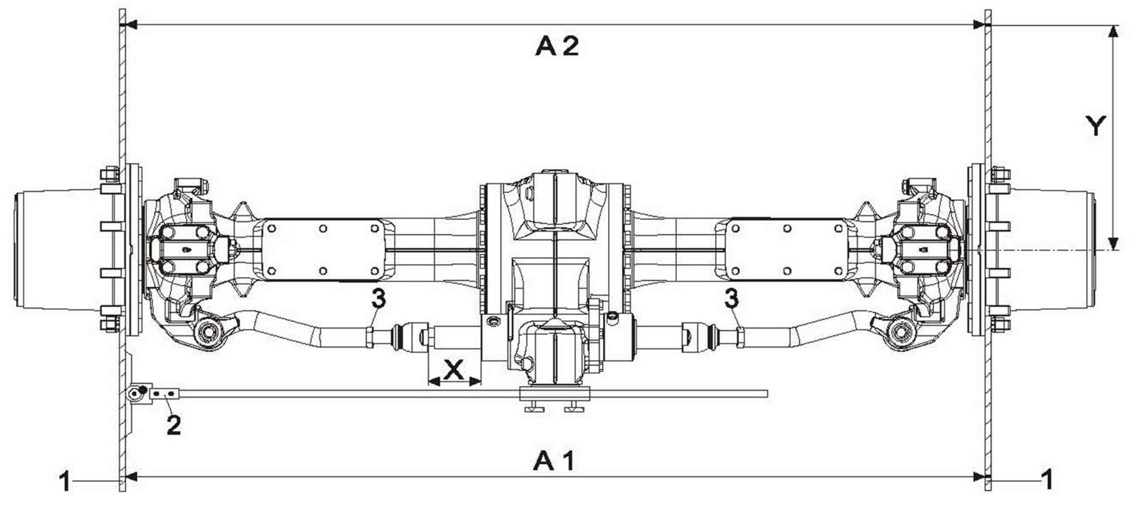
Tightening torque (M 27 × 1.5) . . . . MA = 600 Nm

※ Use locking screws just once.



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 flangeBasic track setting

(20) Basic track setting

Bring piston rod in central position.
Dimension X = 119 mm (measured from front face/steering cylinder to contact face/axial joint).

※ Do not change axial position of piston rod any more during track setting.

Mount straightedge (1) in horizontal and central axis position.
Fix measuring device (2) to yoke.
Loosen hexagon nut (3) and set length of tie rod (axial joint) until the measuring device (2) indicates 0° (corresponds to a track setting of zero mm).

※ For a toe-in and toe-out setting, which might be required, stick to the vehicle manufacturer's specification.

※ Make setting on both output sides.

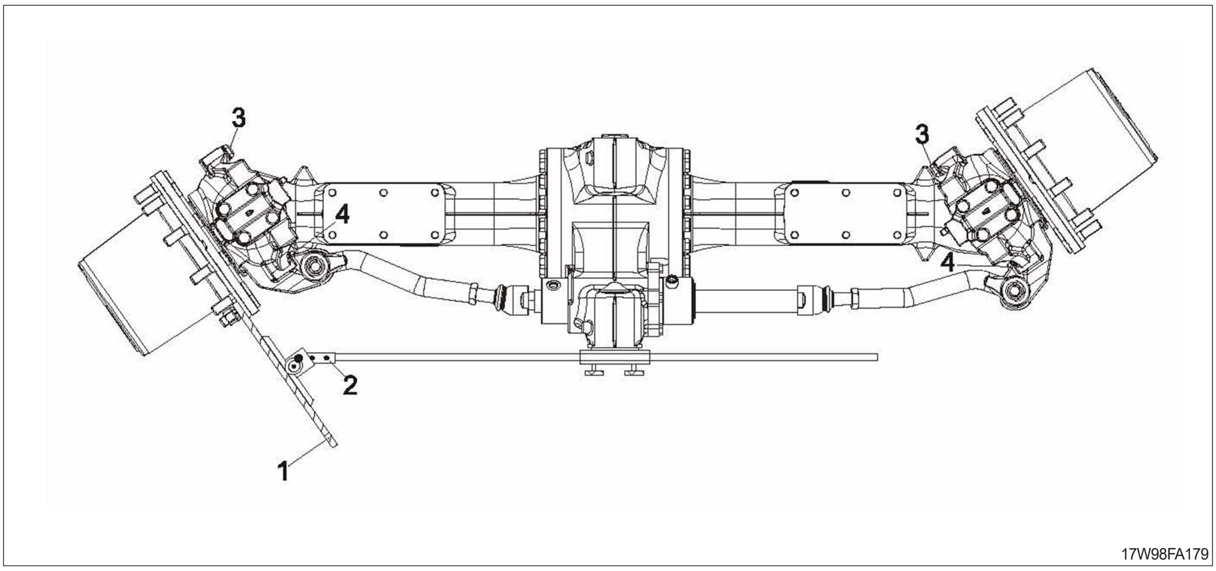
Check track setting (0°):
Determine dimension A1.
Rotate both outputs by 180° – dimension A2 must equal dimension A1.
Dimension "Y" = distance between rim center and rim flange.

Then fix both tie rods (axial joint) by means of hexagon nut (3).

Tightening torque (M28 × 1.5) . . . . MA = 390 - 410 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

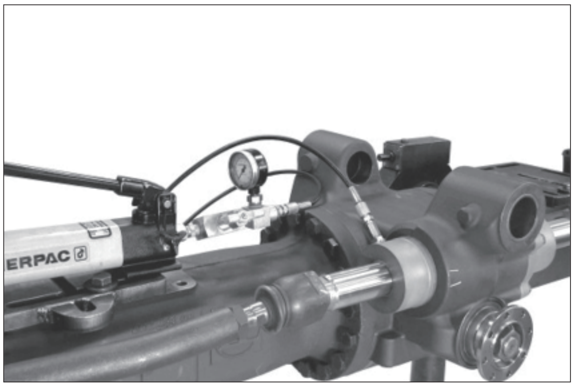
Test pressure p = Build up 200 bar (bleed pressure chamber).

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

C. REAR AXLE (#0074 and up)

1. REMOVAL REAR AXLE

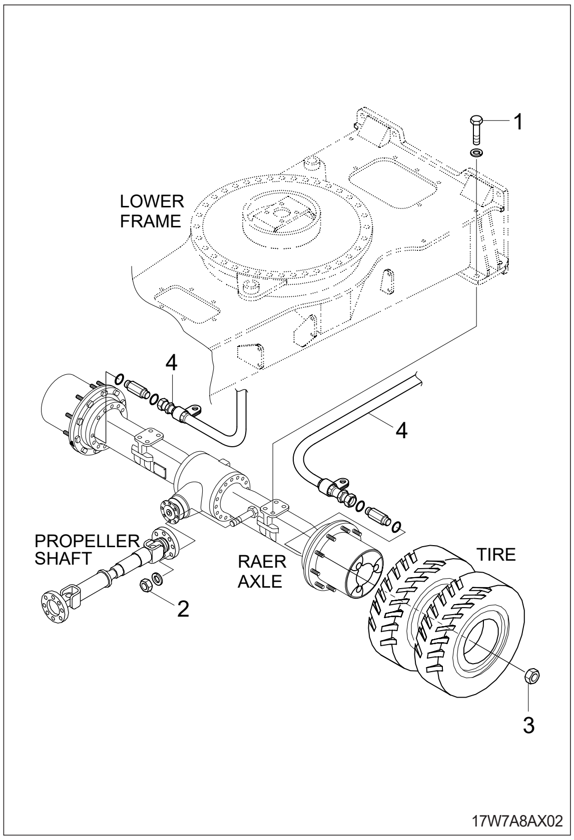
1) Rear axle mounting nut (1, M20)
   · Tightening torque : 58±6.3 kgf · m
   (419±45.5 lbf · ft)

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 : 450 kg (992 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

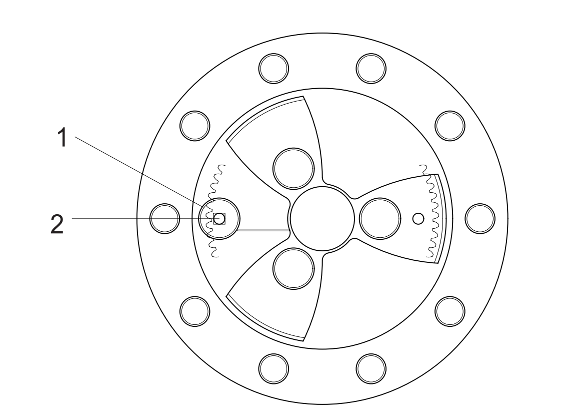
(1) Gear oils with limited - slip additives.

(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

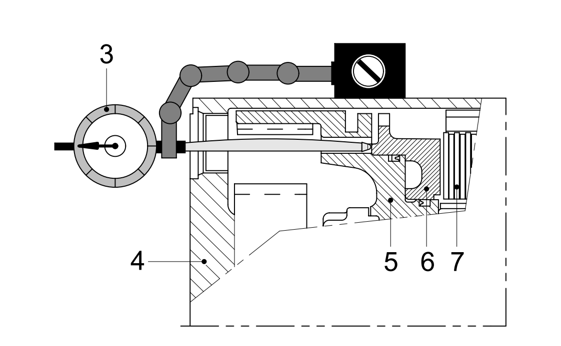


17W7A8AX03

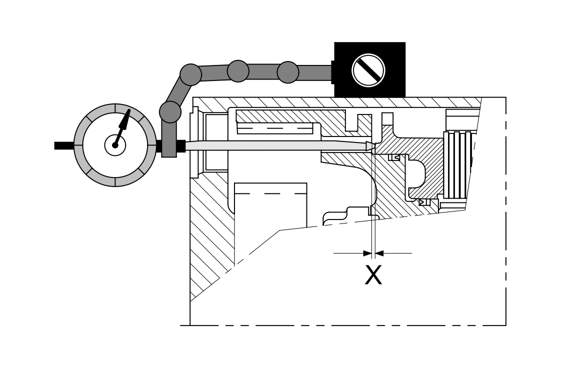
※ To avoid injury when opening the oil drain/oil filler plug (1), due to a possible pressure build-up in the planetary carrier bring drain hole to topmost position (12 o'clock) and carefully unscrew oil drain and filler plug (1).

(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

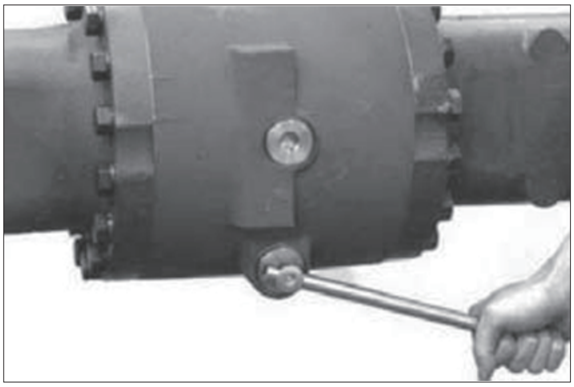
1) OUTPUT

(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.

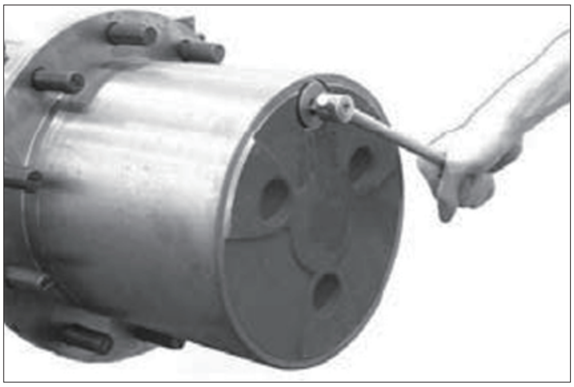


17W98RA002

(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.

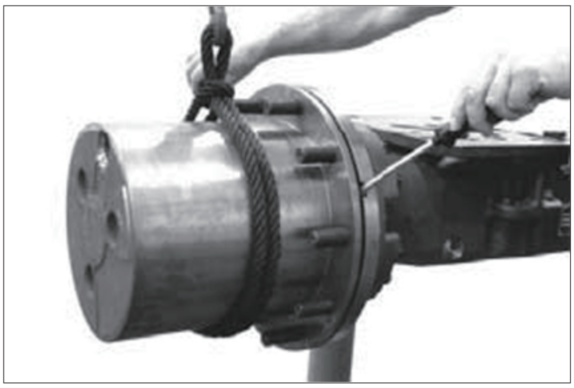
※ Use suitable oil reservoir environmental protection.



17W98RA003

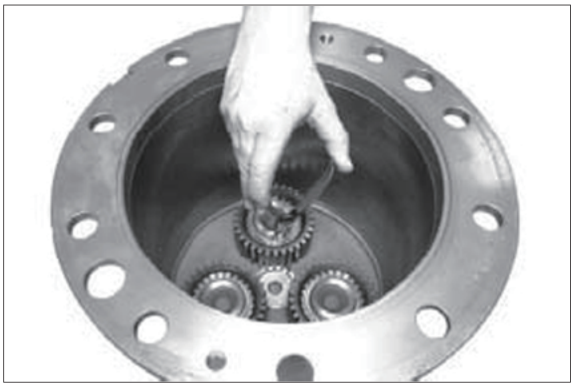
(4) Planetary carrier

Loosen both hexagon screws and separate planetary carrier from the hub.



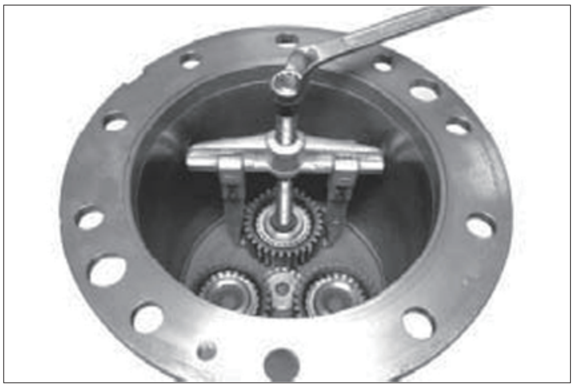
17W98RA004

(5) Snap out retaining ring.



17W98RA005

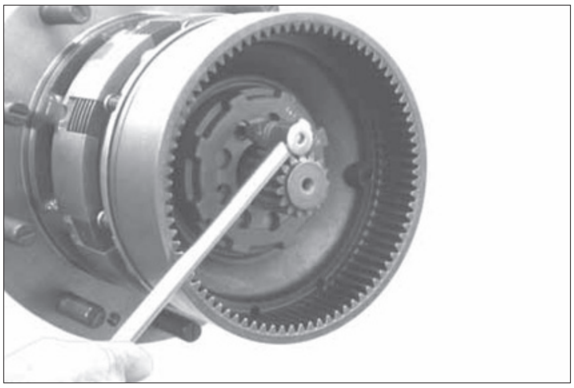
(6) Pull off planetary gear together with cylindrical roller bearing.



17W98RA006

(7) Brake

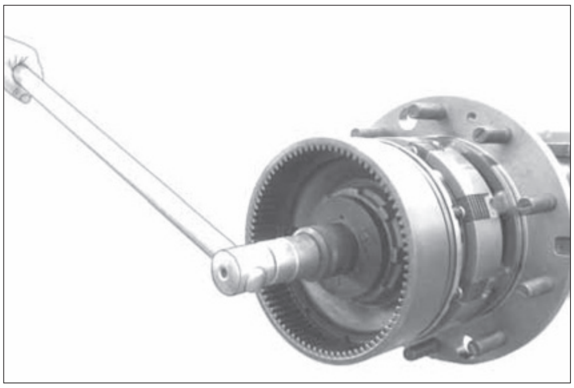
Loosen cylindrical screw (slotted nut fixing).



17W98RA007

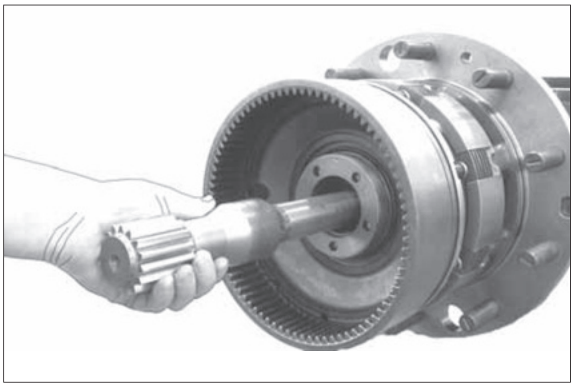
(8) Loosen slotted nut.

(S) Socket wrench 5870 656 097



17W98RA008

(9) Pull sun gear together with stub shaft out of the axle housing.

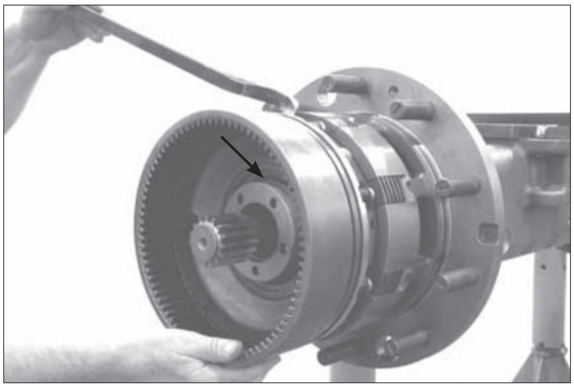


17W98RA009

(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

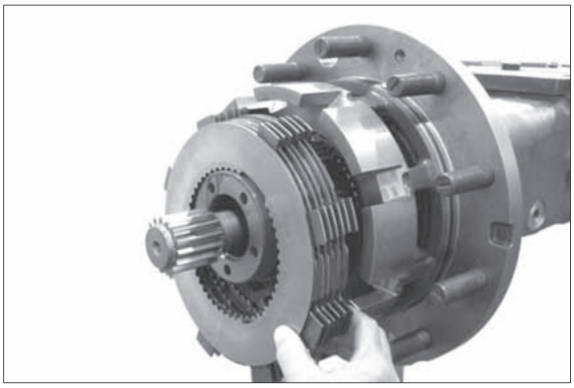
(12) Press piston off the ring gear.

17W98RA012

(13) Remove sealing elements from the annular grooves (see arrows) of the ring gear.

17W98RA013

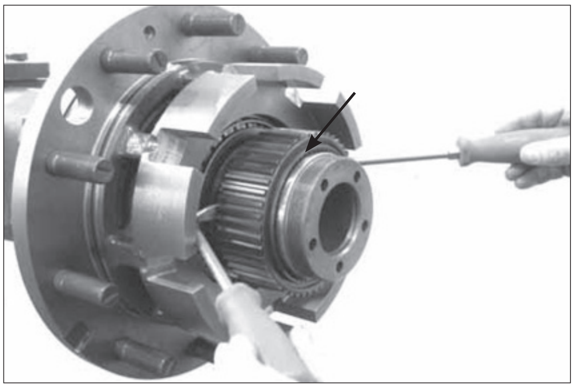
(14) Remove disk package.



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

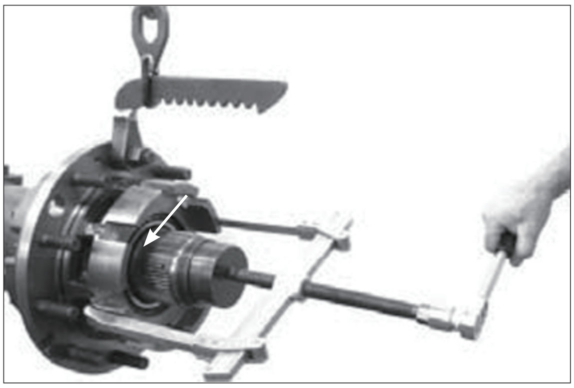
(15) Hub

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.

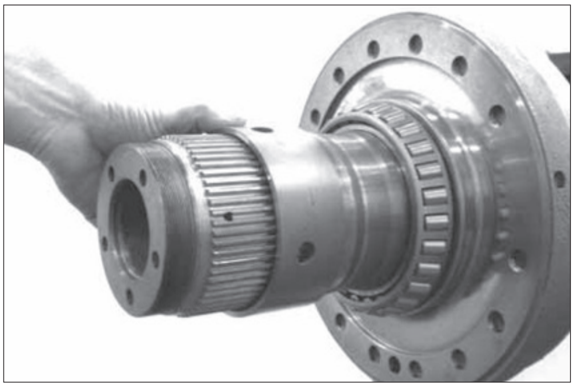


17W98RA016

(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

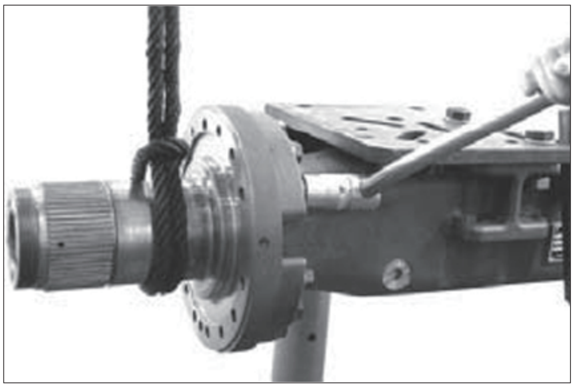
(19) Pull tapered roller bearing off the hub.

(S) Grab sleeve	5873 013 015
(S) Pressure piece	5870 100 063

17W98RA019

(20) Secure hub carrier with lifting tackle, loosen threaded joint and separate hub carrier from the axle housing.

Then remove single parts such as screw neck, breather valve and O-ring from the hub carrier.



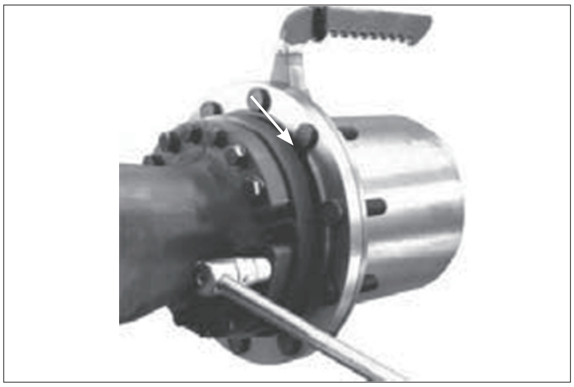
17W98RA020

(21) Output assy

※ If work is to be done on the differential or pinion, you may remove the output as a complete unit (operations figure RA021 and RA022).

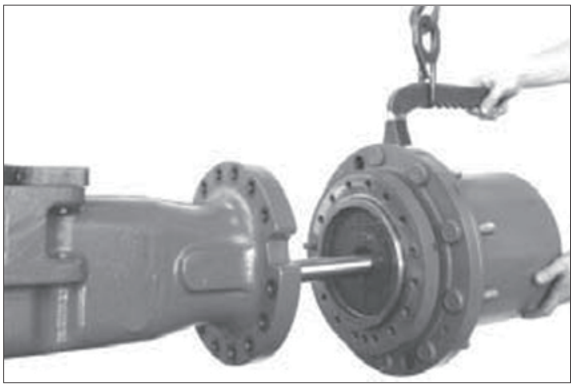
Secure output by means of lifting tackle (S) and loosen threaded joint.

(S) Lifting bracket 5870 281 043



17W98RA021

(22) Separate output assy from the axle housing and pull out stub shaft.



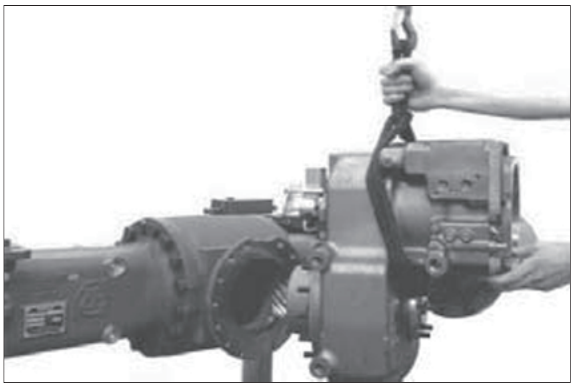
17W98RA022

2) INTPUT

(1) Secure transmission with lifting tackle and loosen threaded joint (transmission/axle drive housing).

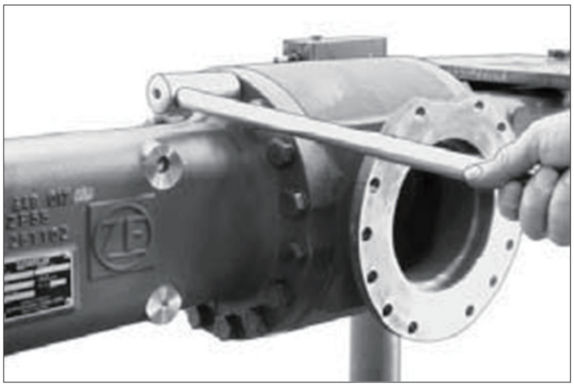
17W98RA023

(2) Separate transmission from the axle.



17W98RA024

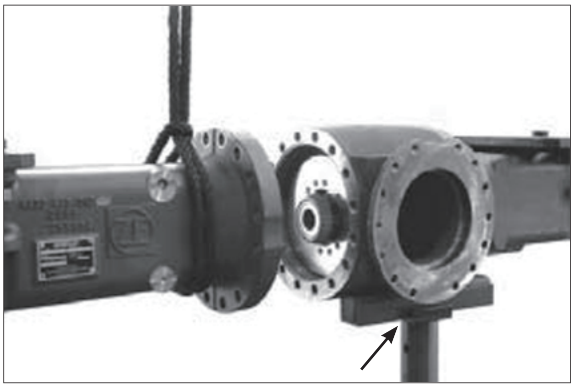
(3) Secure axle housing (on crown wheel side) by means of lifting tackle and loosen threaded joint.


17W98RA025

(4) Support axle at the axle drive housing (see arrow).

Then separate axle housing from the axle drive housing.

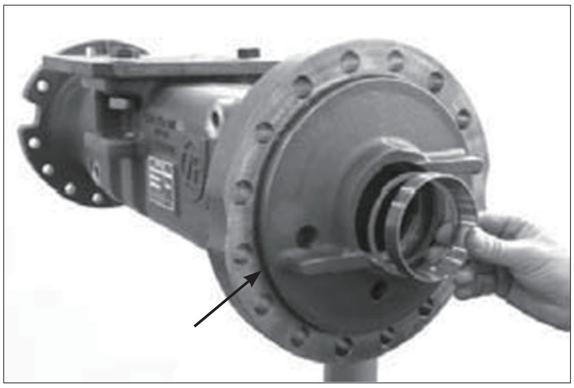
※ Pay attention that the differential does not drop.


17W98RA026

(5) Pull bearing outer ring out of the bearing hole and remove the releasing shim.

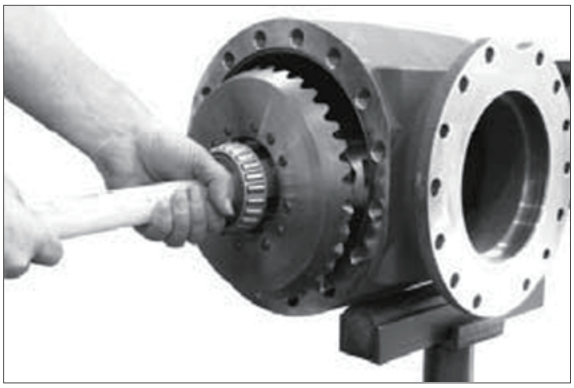
Then remove O-ring (see arrow).

(S) Striker 5870 650 004


17W98RA027

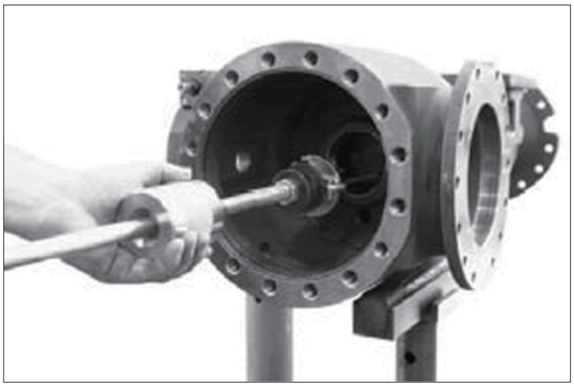
(6) Lift differential out of the axle drive housing.

※ Disassembly of the differential see description on page 8-241 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

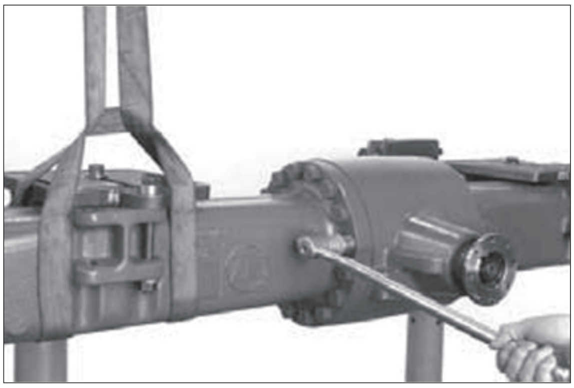


17W98RA029

(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.

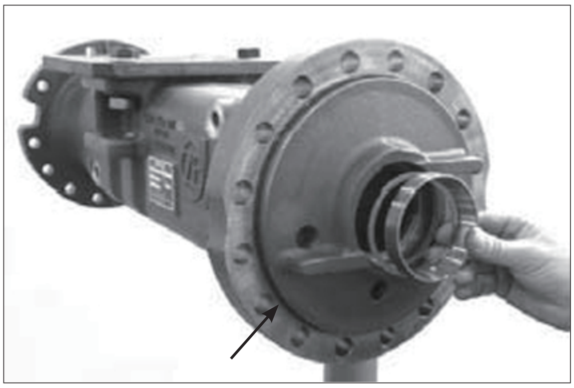


17W98RA030

(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

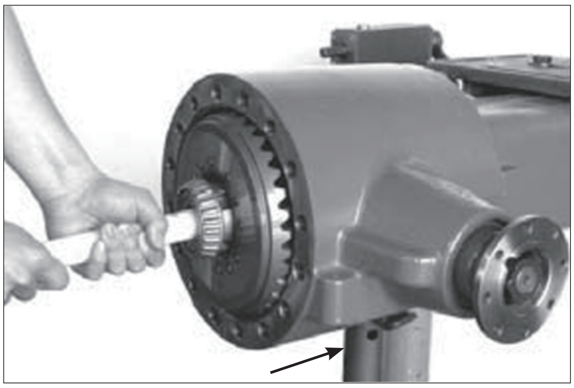


17W98RA031

(10) Support axle at the axle drive housing (see arrow).

Then lift differential out of the axle drive housing.

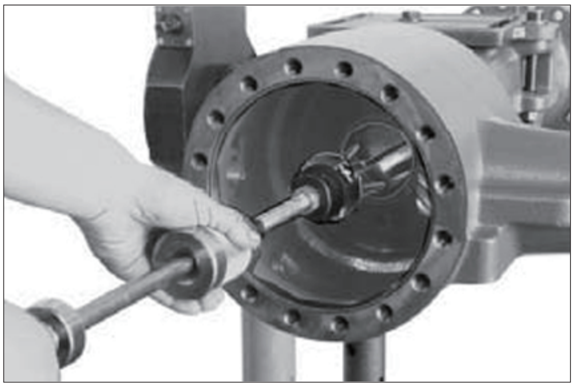
※ Disassembly of the differential see description on page 8-241 and following.



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



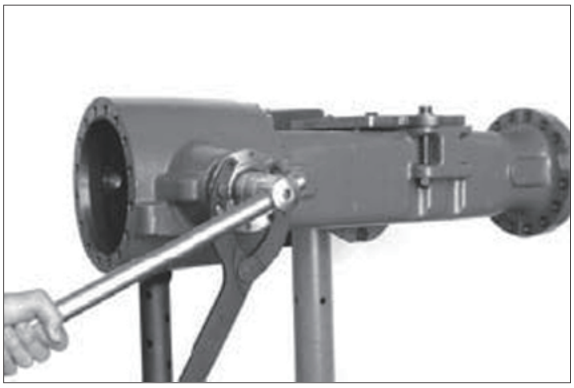
17W98RA033

(12) Heat up hexagon nut with hot-air blower.

Then loosen hexagon nut and remove the releasing washer.

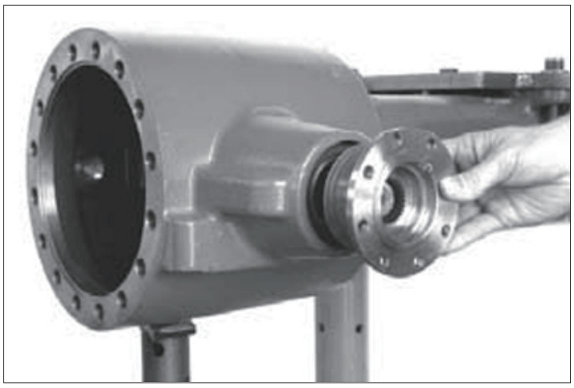
(S) Clamping fork 5870 240 025

※ Hexagon nut is secured with Loctite no. 262.



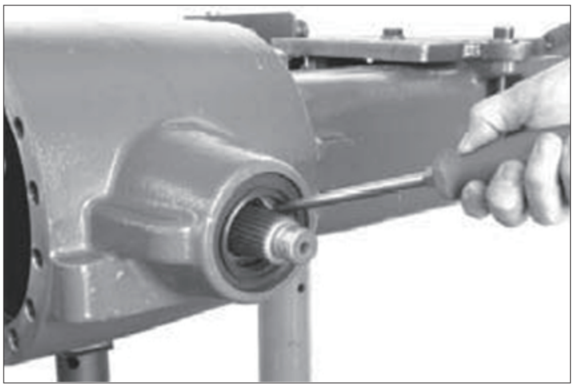
17W98RA034

(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.

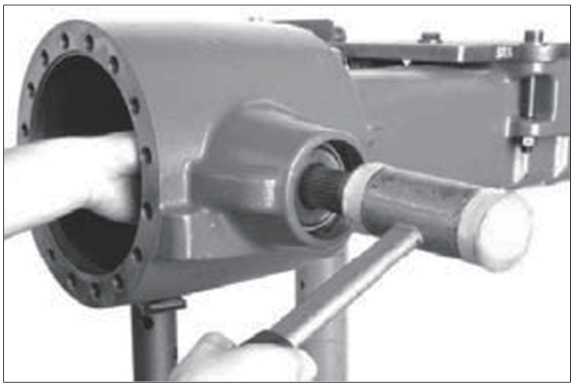


17W98RA036

(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.



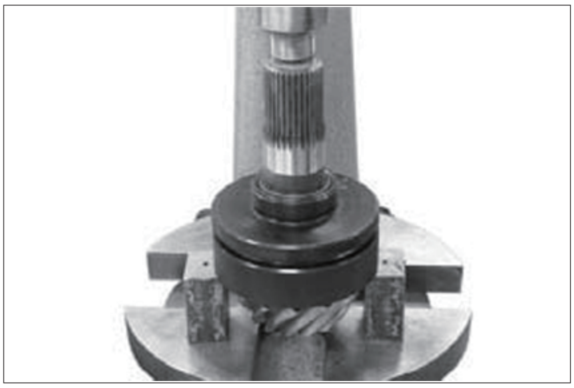
17W98RA037

(16) Remove spacer ring.

17W98RA038

(17) Press roller bearing off the input pinion.

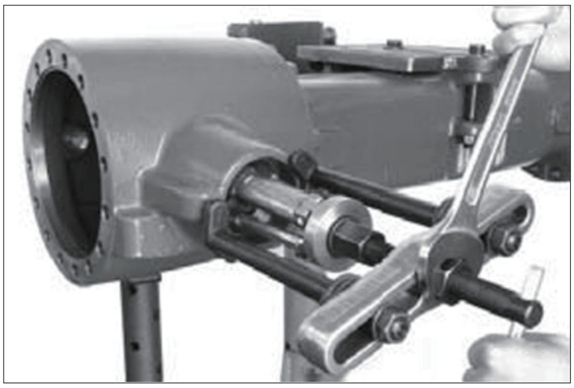
(S) Grab sleeve 5873 001 037



17W98RA039

(18) Pull external bearing outer ring out of the bearing hole.

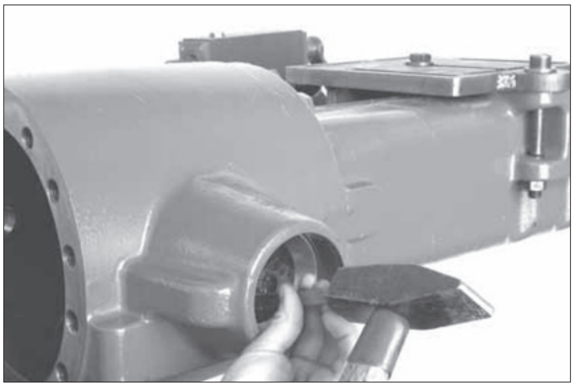
(S) Internal extractor 5870 300 019
(S) Counter support 5870 300 020



17W98RA040

(19) Force bearing outer ring off the inner bearing hole pay attention to the shim behind.

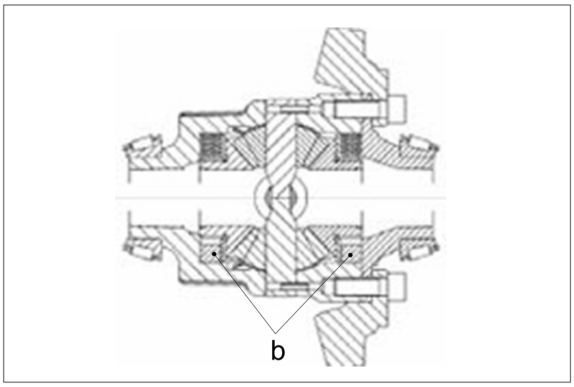
※ Mark shim regarding position/bearing allocation reassembly aid.



17W98RA041

3) DIFFERENTIAL

(1) b = Constant spacers



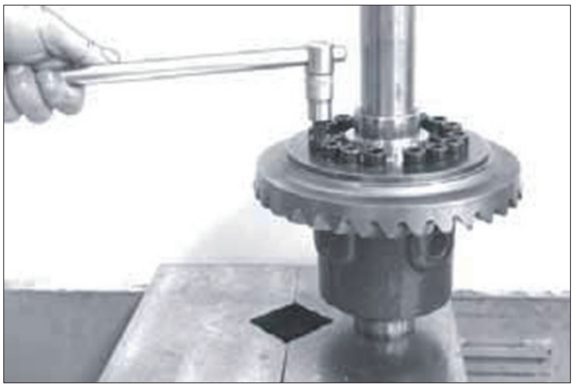
17W98RA042

(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.

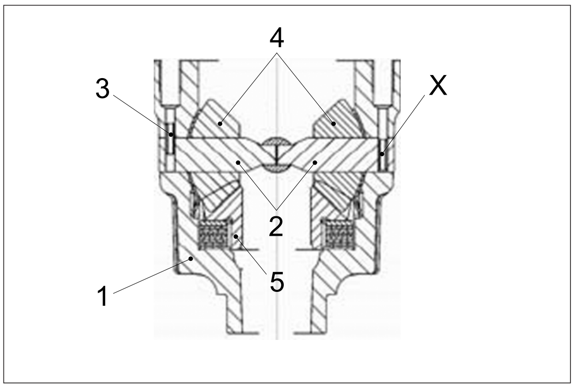
17W98RA046

(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

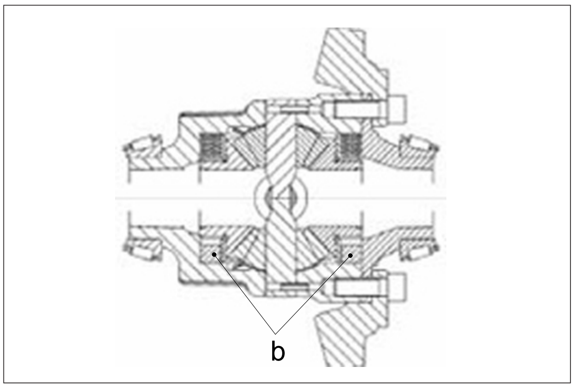
(9) Remove all single parts.

17W98RA050

4. REASSEMBLY

1) DIFFERENTIAL

(1) b = Constant spacers

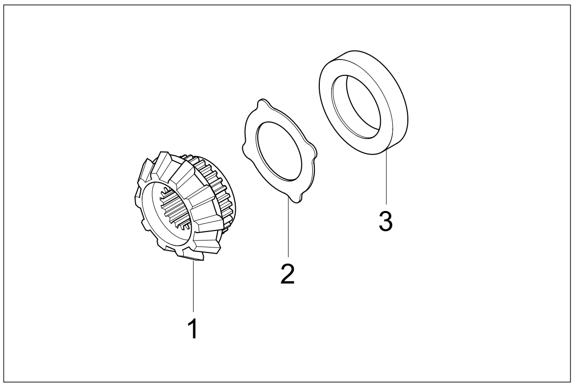


17W98RA042

(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

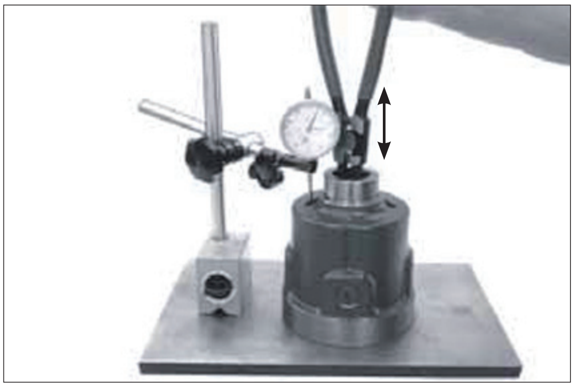
(5) Check axial play of the axle bevel gear 0.0 … 0.15 mm.

※ 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).



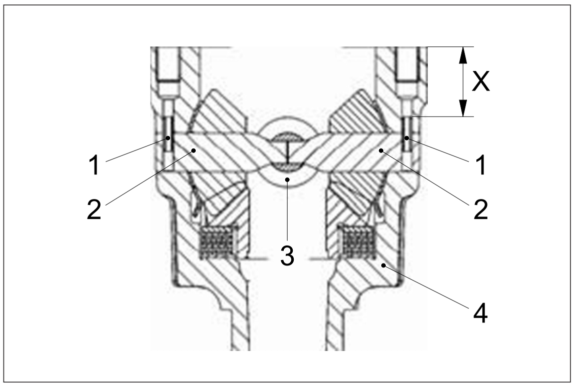
17W98RA056

(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±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.

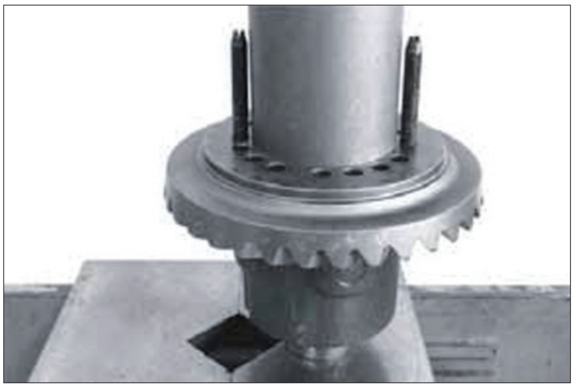
17W98RA060

(10) Mount two adjusting screws (S) and insert cover.

(S) Adjusting screws (M12 $\times$ 1.5)
5870 204 027

17W98RA061

(11) Press crown wheel onto the cover / differential carrier until contact position is obtained.



17W98RA062

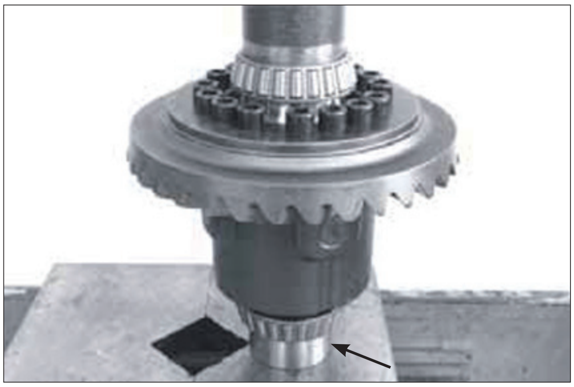
(12) Fix differential with press and tighten crown wheel with cylindrical screws.

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.

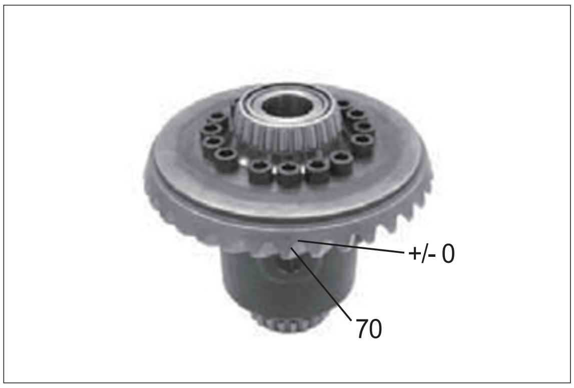


17W98RA064

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)

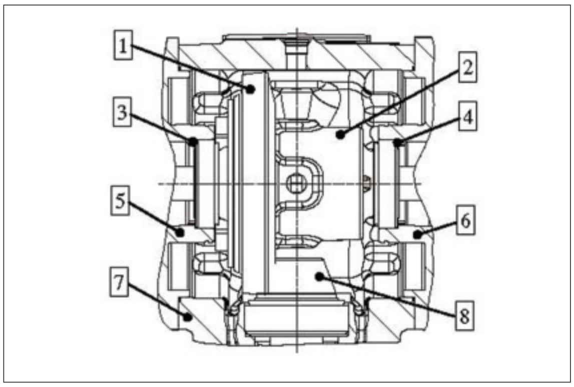


17W98RA065

(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

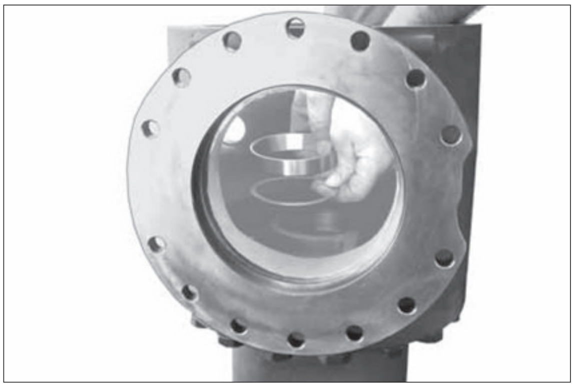
· Legend to sketch:

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 (M18/10.9) . . . . MA = 390 Nm

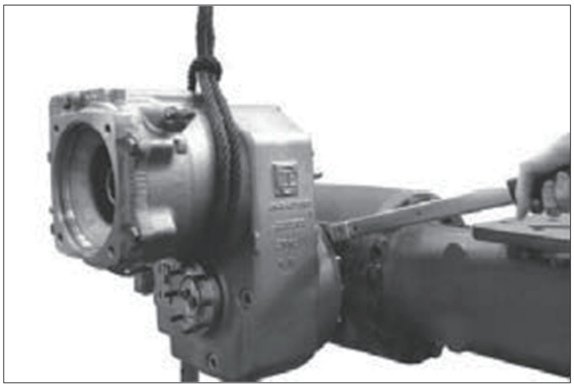
※ Preliminarily fix axle housing without O-ring.

17W98RA071

(8) Rotate axle by 90° and support it.

Use lifting tackle to bring HL transmission into contact position with the axle housing and fix it.

Tightening torque . . . . MA = 79 Nm



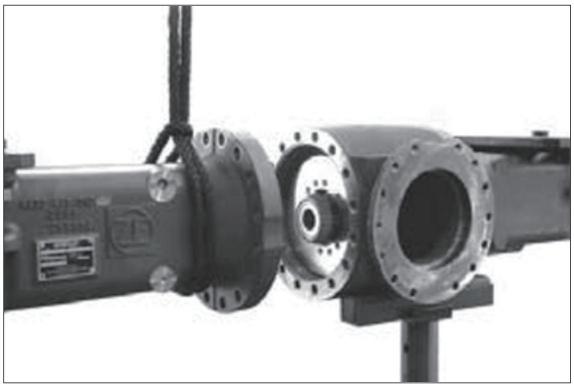
17W98RA072

(9) By rotating the input flange, roll crown wheel over the input pinion in both directions several times.

Then remove transmission and axle housing and lift differential out of the axle drive housing.

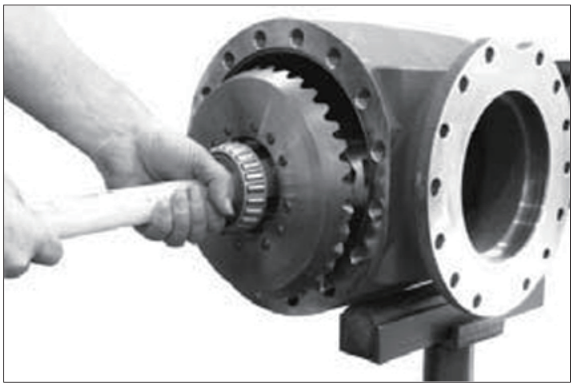
Compare the obtained contact pattern.

※ In case of a contact pattern deviation, check the pinion shimming of the transmission.



17W98RA073

(10) After contact pattern check, place differential into the axle drive housing.



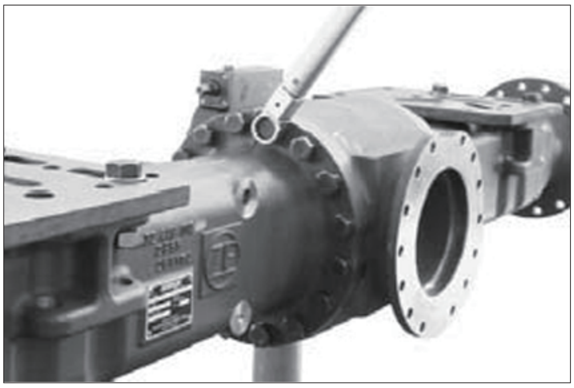
17W98RA074

(11) Grease O-ring (see arrow) and mount it to axle housing.

17W98RA075

(12) Use lifting tackle to mount the axle housing and finally tighten it with hexagon screws.

Tightening torque (M18/10.9) . . . . MA = 390 Nm



17W98RA076

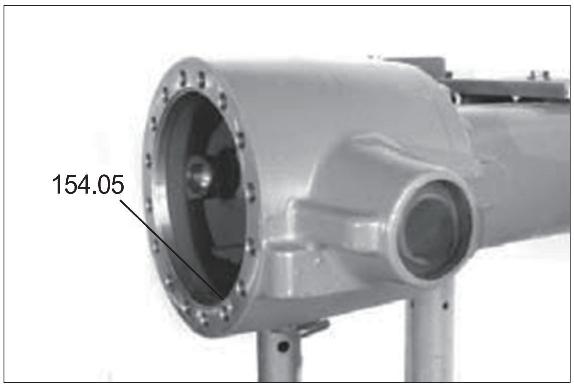
3) INPUT PINION

The following measuring operations must be carried out with utmost accuracy. Inaccurate measurements lead to an incorrect contact pattern and require an additional disassembly and reassembly of the input pinion.

(1) **Determination of shim thickness to obtain a correct contact pattern**

Read dimension I from the axle drive housing.

Dim. I e.g. 154.05 mm



17W98RA077

(2) Read dimension II (pinion dimension).

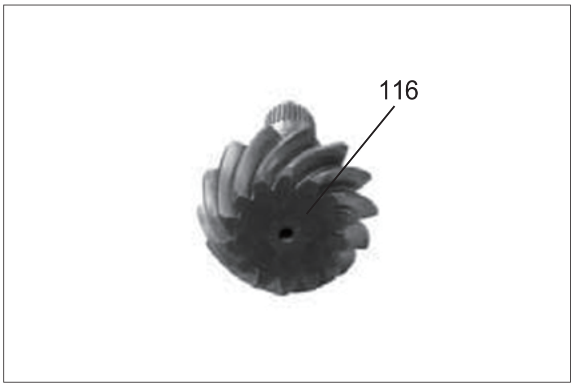
Dim. II e.g. 116.00 mm

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

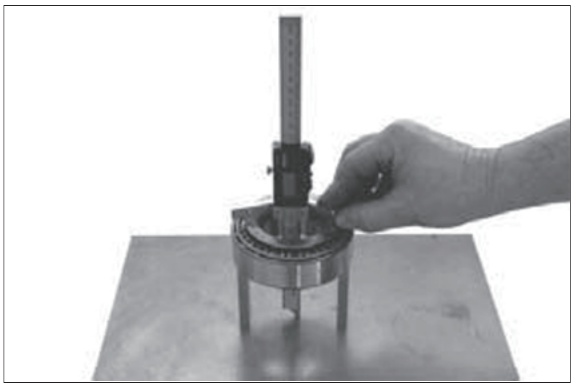
(3) Determine dimension III (bearing width).

※ 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

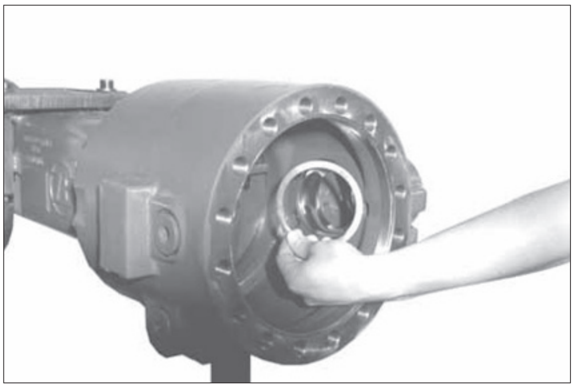


17W98RA079

(4) Calculation example :

Dimension I . . . . 154.05 mm
Dimension X . . . . - 152.50 mm
Difference = shim s = 1.55 mm

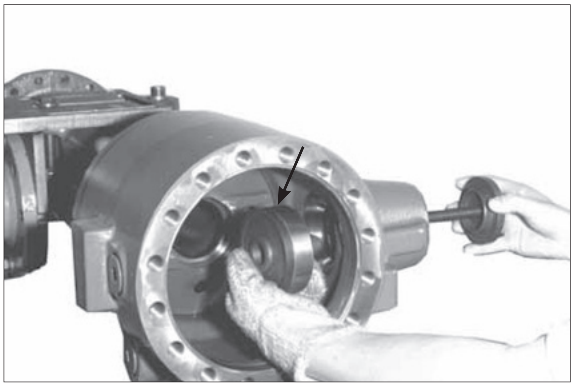
Place the determined shim (e.g. thickness = 1.55 mm) into the inner bearing hole.



17W98RA080

(5) Undercool bearing outer ring (see arrow) and bring it into contact position in the bearing hole by using the assembly fixture (S).

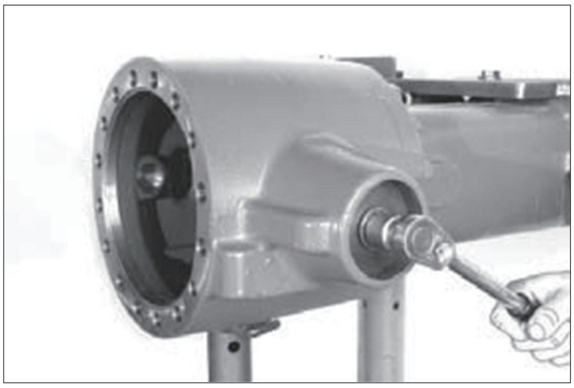
(S) Assembly fixture	5870 345 049
(S) Pressure ring	5870 345 056



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

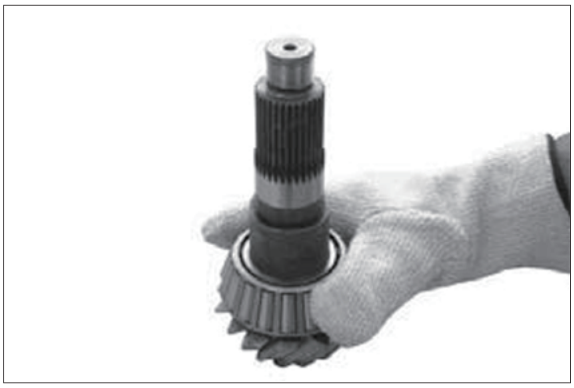


17W98RA082

(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.



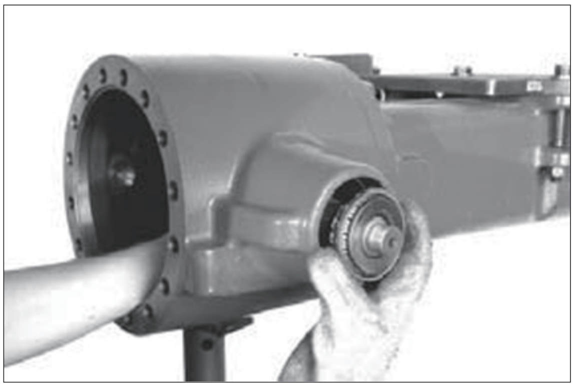
17W98RA083

(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

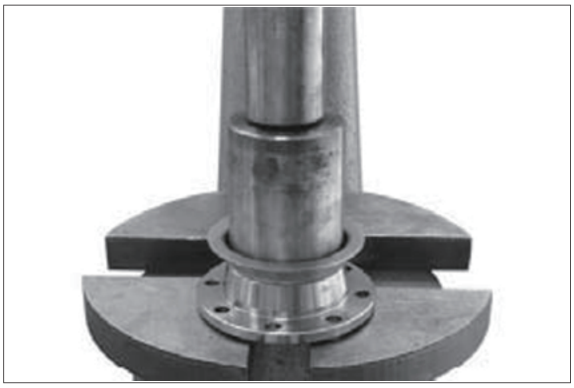
(9) Place the preassembled input pinion into the axle housing and mount the heated roller baring until contact is obtained.



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.



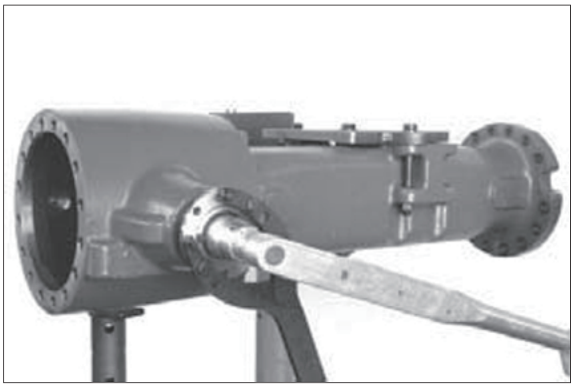
17W98RA086

(11) Mount input flange and fix it with washer and hexagon nut.

Tightening torque (M30x1.5) . . . .
MA = 600 Nm

(S) Clamping fork 5870 240 025

※ While tightening, rotate the input pinion in both directions several times.



17W98RA087

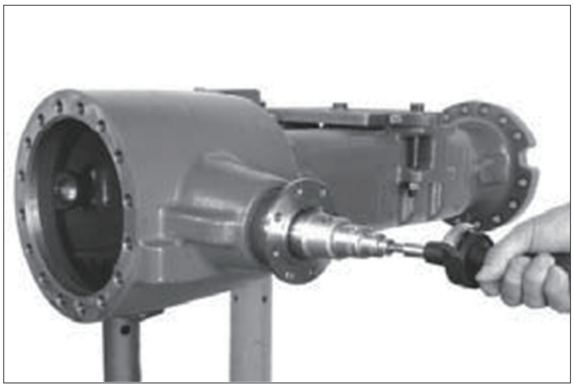
(12) Check rolling torque (1.0 ... 3.0 Nm without shaft seal ring).

※ 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.

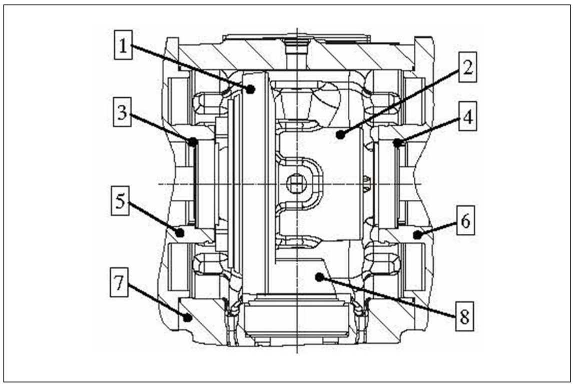
※ The test dimension "70" is stamped into the crown wheel rear side. If no + or deviation is indicated, this value corresponds with the test dimension/ actual value "70" in the table below. According to this value, the required shims are allocated in the table below.

※ 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

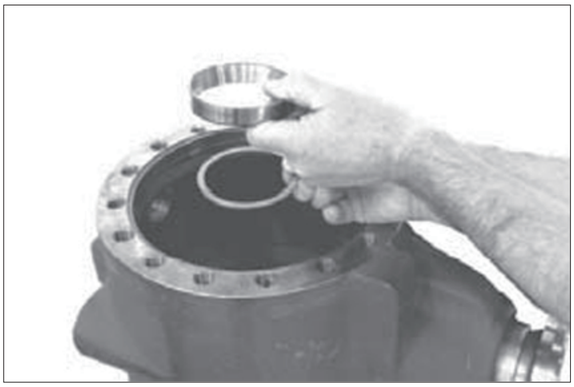


17W98RA090

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.

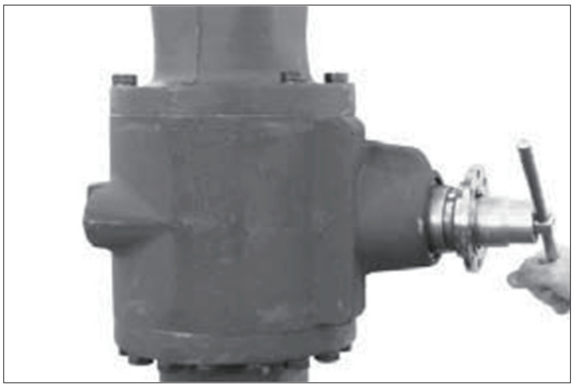
Tightening torque (M18/10.9) .... MA = 390 Nm

※ Preliminarily fix axle housing without O-ring.

17W98RA095

(20) By rotating the input flange, roll crown wheel over the input pinion in both directions several times.
Then remove axle housing and lift differential out of the axle drive housing.
Compare the obtained contact pattern with contact pattern.

※ In case of a contact pattern deviation it is imperative to correct the measuring error which was made when determining the shim (figure RA080).



17W98RA096

(21) After contact pattern check, place differential into the axle drive housing.

Grease O-ring (see arrow) and mount it to the axle housing.

17W98RA097

(22) Use lifting tackle to mount the axle housing and finally fix it with hexagon screws.

Tightening torque (M18/10.9) .... MA = 390 Nm

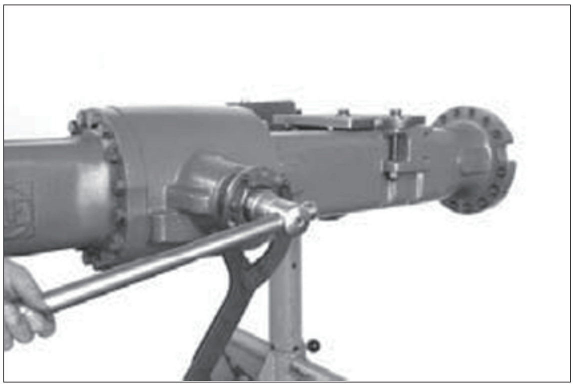
Then bring axle into horizontal position and reassemble the second supporting bracket (S) (see also figure RA001).

17W98RA098

(23) **Fitting of shaft seal ring** (input flange)

Loosen hexagon nut and pull input flange off the input pinion.

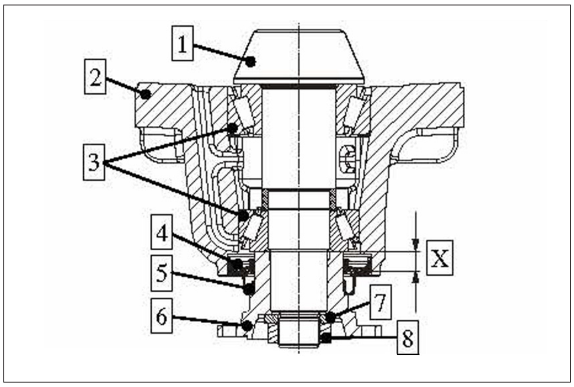
(S) Clamping fork 5870 240 025



17W98RA099

(24) Legend to sketch:

1 = Input pinion
2 = Axle drive housing
3 = Tapered roller bearing
4 = Shaft seal ring
5 = Screen sheet
6 = Input flange
7 = Washer
8 = Hexagon nut
X = Installation dimension→13.5 +0. 2 mm



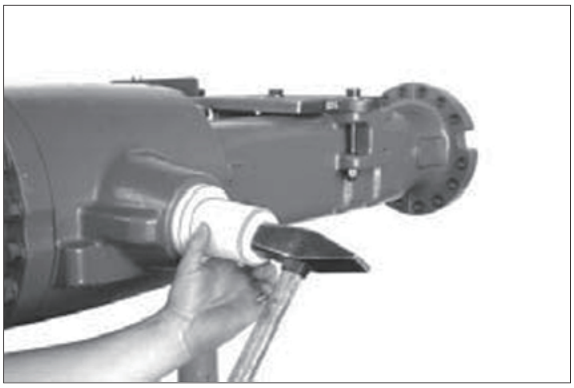
17W98RA100

(25) Mount shaft seal ring with the sealing lip facing the oil chamber.

(S) Driver tool 5870 048 286

※ Use of the specified driver tool (S) ensures the exact installation position of the shaft seal ring.

※ Just before fitting, apply lubricant to the contact face of shaft seal ring/axle drive housing.
Apply grease to seal and dust lip of the shaft seal ring.



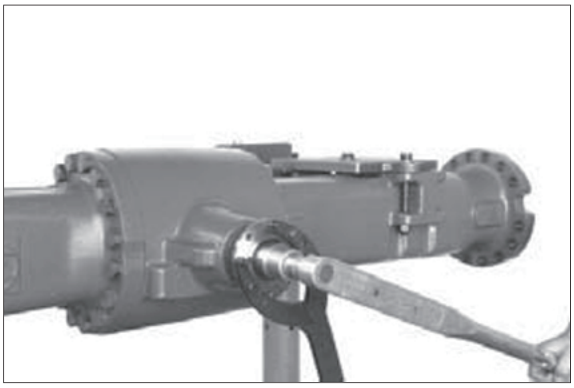
17W98RA101

(26) Mount input flange and finally fix it with washer and hexagon nut.

Tightening torque (M30x1.5) . . . .
. . . . MA = 600 Nm

(S) Clamping fork 5870 240 025

※ Wet thread of hexagon nut with Loctite no. 262.



17W98RA102

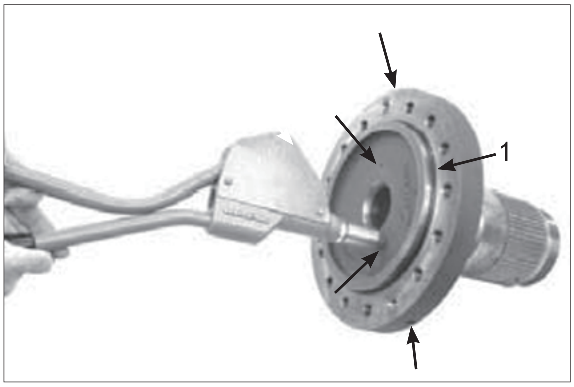
4) OUTTPUT

(1) Hub carrier

Grease O-ring (1) and mount it to hub carrier.

The following operation is only required when fitting a new hub carrier :
Seal machining openings (arrows) of oil supply holes with plugs.

(S) Lever riveting tongs 5870 320 016

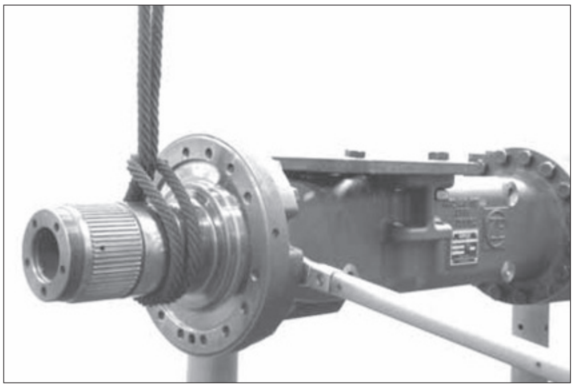


17W98RA103

(2) Mount preassembled hub carrier to the axle housing, considering the installation position, and fix it with hexagon screws.

Tightening torque (M 16/10.9) . . . . MA = 280 Nm

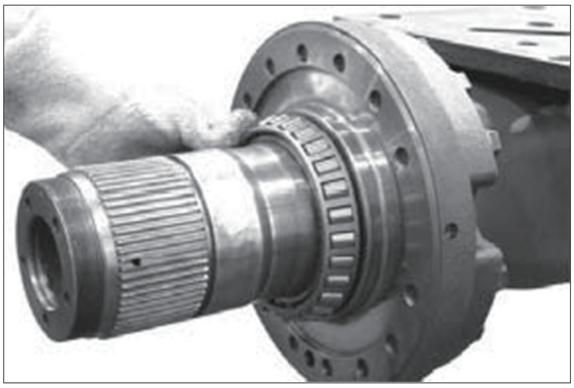
※ Ensure radial installation position. Stamped circle (see arrow) must be in uppermost (12 o'clock) position.



17W98RA104

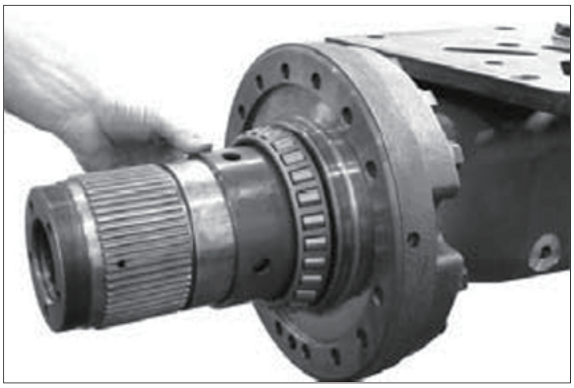
(3) Hub (Hub bearing SET-RIGHT)

Heat up tapered roller bearing and mount it to hub carrier until contact is obtained.



17W98RA105

(4) Mount spacer bushing.

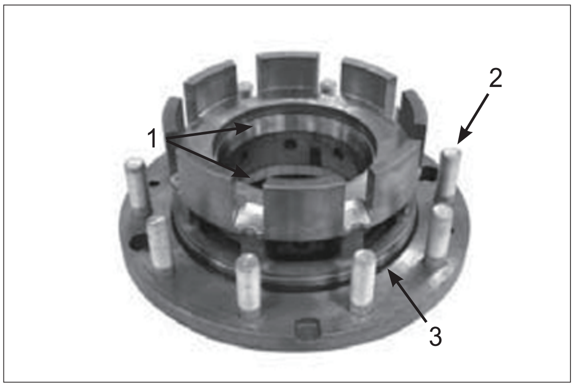


17W98RA106

(5) Insert both bearing outer rings (1) of the hub bearing until contact position is obtained.

Press wheel bolts (2) into the hub until contact position is obtained.

Grease O-ring (3) and place it into the annular groove of the hub.



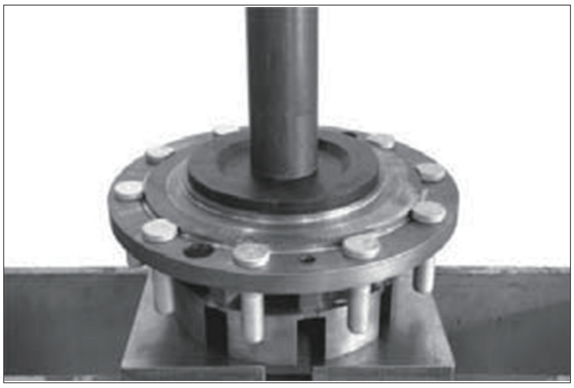
17W98RA107

(6) Press shaft seal ring into the hub, with the marking "OUT SIDE" showing outwards (facing up):

(S) Driver tool 5870 051 035

※ Use of the specified driver tool (S) ensures the exact installation position of the shaft seal ring.

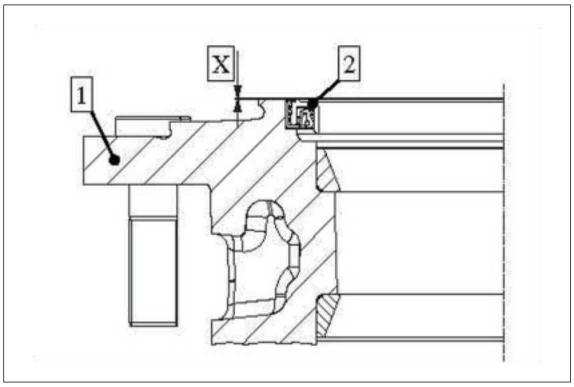
※ Wet outer diameter of the shaft seal ring with Loctite no. 574.



17W98RA108

(7) Legend to sketch:

1 = Hub
2 = Shaft seal ring
X = Installation dimension – shaft seal ring
.... 0.0~0.3 mm

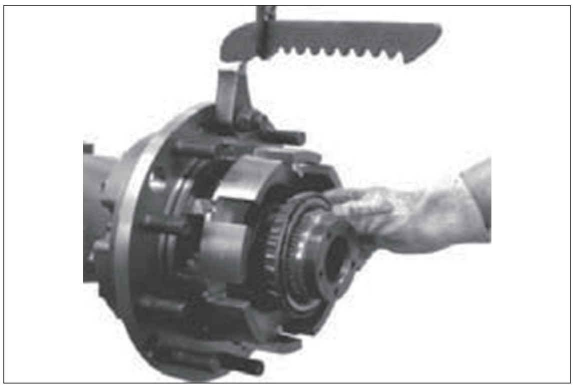


17W98RA109

(8) Mount preassembled hub until contact is obtained and fix it with heated tapered roller bearing.

(S) Lifting bracket 5870 281 043

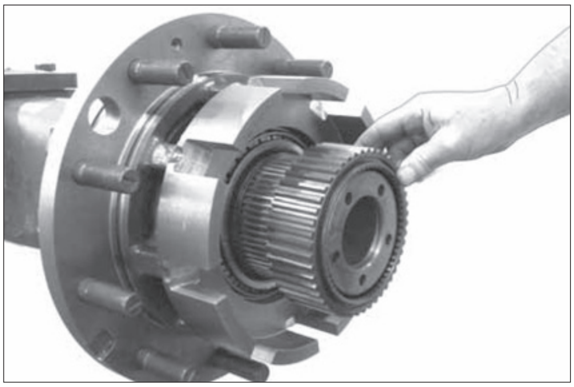
※ Just before fitting, wet sealing lips of shaft seal ring with lubricant.



17W98RA110

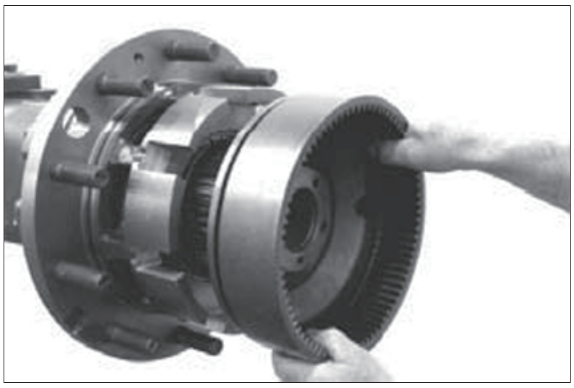
(9) Oil O-ring and insert it into the annular groove (see arrow) of the hub carrier.

Then mount disk carrier.



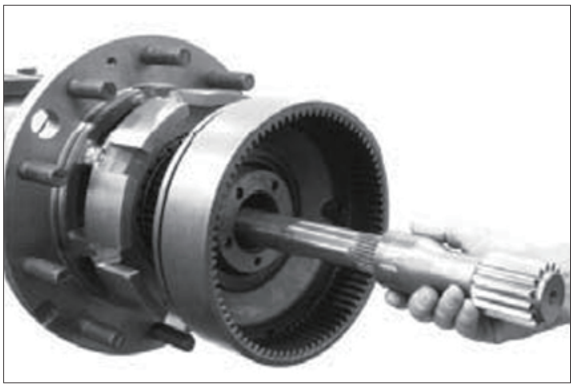
17W98RA111

(10) Bring disk carrier and hub bearing into contact position (figure No. RA112 … RA115) :
Mount ring gear (without sealing elements).



17W98RA112

(11) Insert stub shaft and sun gear shaft for supporting the socket wrench (see following figure).



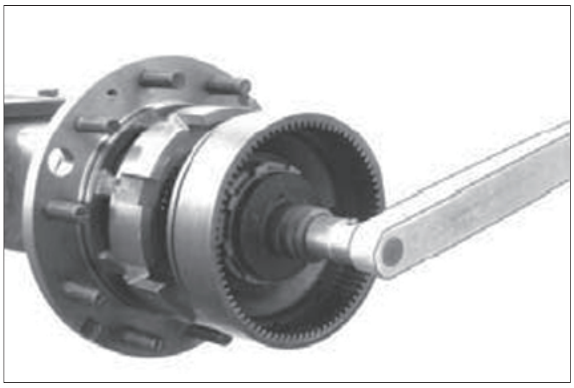
17W98RA113

(12) Bring hub bearing into contact position for this purpose tighten slotted nut with a tightening torque of 1400 Nm max.

(S) Socket wrench 5870 656 097

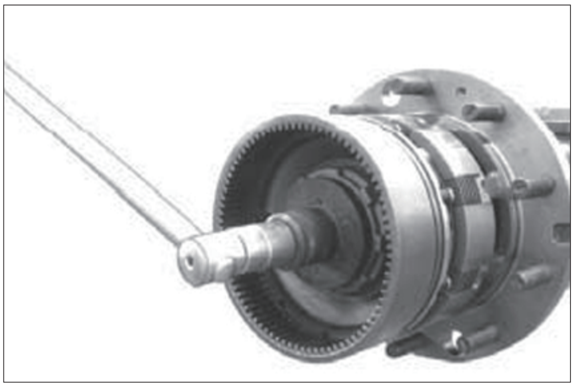
※ While tightening the slotted nut rotate hub in both directions several times roller setting.

※ Apply lubricant to thread of knuckle housing/slotted nut.



17W98RA114

(13) Loosen slotted nut and remove ring gear.



17W98RA115

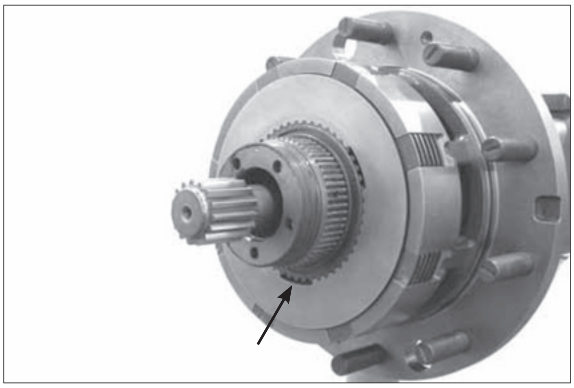
(14) **Multi-disk brake**

Mount outer and inner disks of the disk package alternately, starting with an outer disk.

※ For the actually required disk fitting/arrangement please refer to the corresponding spare parts list.

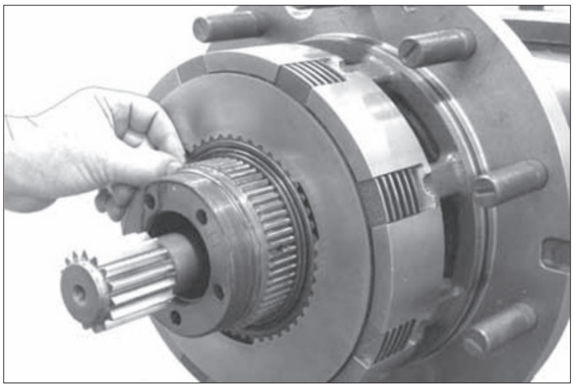
17W98RA116

(15) Bring inner clutch disks into a position where one of the tooth recesses is in 6 o'clock position after installation of the axle into the vehicle.



17W98RA117

(16) Oil O-ring and place it into the annular groove of the disk carrier.



17W98RA118

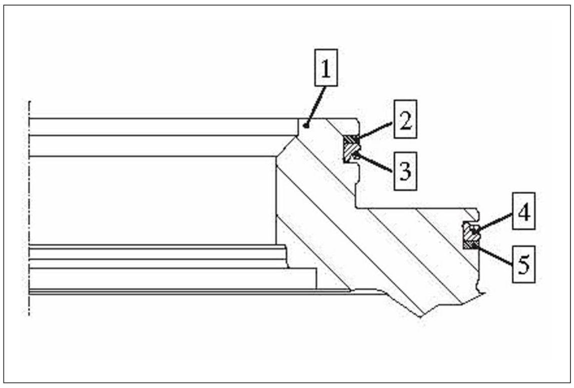
(17) Oil grooved and back-up rings and insert them into the annular grooves of the ring gear.

※ Observe installation position, see sketch below.

17W98RA119

(18) Legend to sketch:

1 = Ring gear
2 = Back-up ring
3 = Grooved ring
4 = Grooved ring
5 = Back-up ring



17W98RA120

(19) Fit cylindrical pins into the piston, considering the installation dimension "X".

X = Installation dimension . . . . . .18.00 mm

17W98RA121

(20) Mount piston onto ring gear.

17W98RA122

(21) Fix piston with "new" hexagon screws (1), spring sleeves (2) and compression springs (3 and 4).

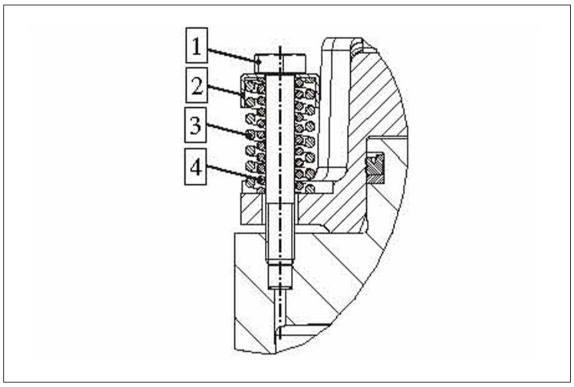
Tightening torque (M 6/8.8) .... MA = 8 Nm

※ Use hexagon screws just once.

17W98RA123

(22) Legend to sketch:

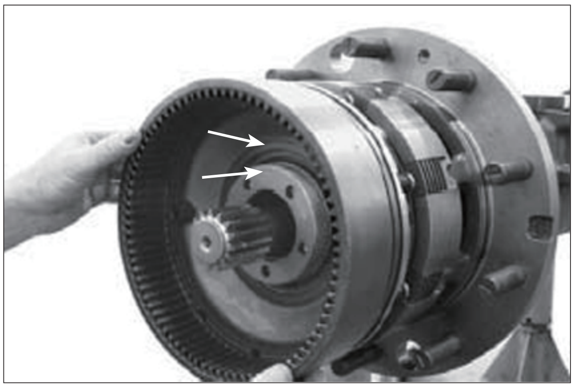
1 = Hexagon screw (special version)
2 = Spring sleeve
3 = Compression spring
4 = Compression spring



17W98RA124

(23) Mount preassembled ring gear, considering the installation position (markings O in 12 o'clock position – see arrows).

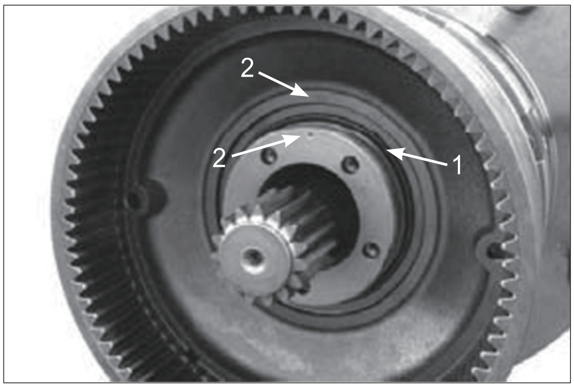
※ Ensure exact toothing position of oil supply holes – hub carrier/ring gear (pressure oil supply to brake piston).



17W98RA125

(24) Oil O-ring and insert it into the recess (see arrow 1).

※ Arrows (2) show once more the markings O and the installation position of hub carrier and ring gear.



17W98RA126

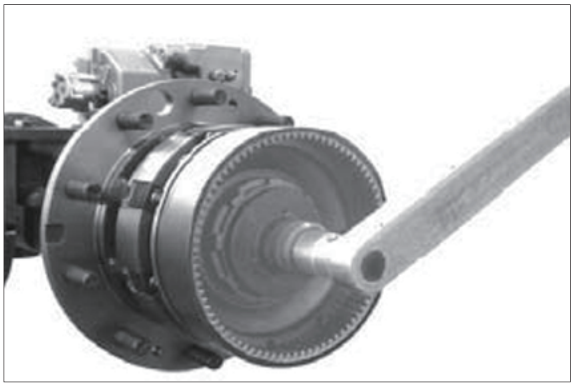
(25) Fix ring gear with slotted nut.

Tightening torque (M85 × 1.5) . . . . MA = 1400 + 200 Nm

(S) Socket wrench 5870 656 097

※ Pretighten slotted nut with 1400 Nm, then continue tightening the slotted nut until a fixing hole overlaps a threaded hole in the knuckle housing.
While tightening the slotted nut rotate hub in both directions several times – roller setting.

※ Apply lubricant to thread of knuckle housing / slotted nut.



17W98RA127

(26) Leakage test of multi-disk brake

Fit breather (arrow) and threaded coupling (S), then connect HP pump.

(S) HP pump 5870 287 007
(S) Threaded coupling (M14 × 1.5) 5870 950 102
(S) Breather bottle 5870 286 072

※ Breathe brake completely before starting the test.

Test media :
Motor oils SAE-10W

High-pressure test:
Build up test pressure p = 100 bar and close shut-off valve of HP pump.
A maximum pressure drop of 3 bar is permissible during a 5-minute test.

Low-pressure test:
Reduce test pressure to p = 5 bar and close shut-off valve.
No pressure drop is allowed during a 5-minute test.

17W98RA128

(27) Adjustment and check of piston stroke

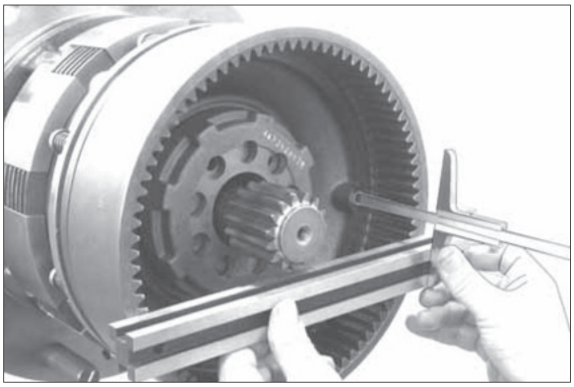
Piston stroke / disk clearance =
0.7 ... 1.3 mm

Build up brake pressure (100 bar) and close shut-off valve of HP pump.

Determine dimension "A", from face of the ring gear (1) through the measuring hole (see also sketch 43) to the face of the piston (3).

Dim. "A" e.g. . . . . 83.10 mm

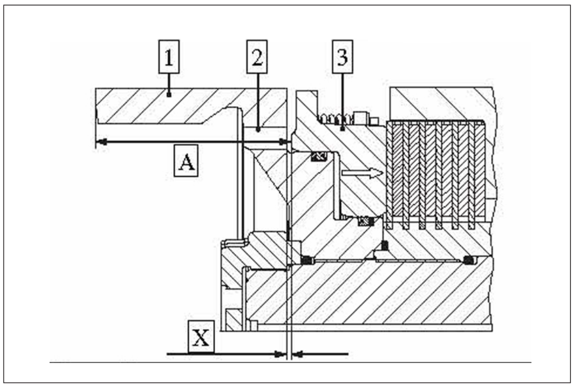
※ Breathe brake completely before starting the measuring operation.


17W98RA129

(28) Then open shut-off valve of HP pump and release pressure from brake (piston return via compression springs).

Determine dimension "B", from the face of the ring gear (1) through the measuring hole (see also sketch RA131) to the face of the piston (3).

Dimension "B" e.g . . . . 82.10 mm



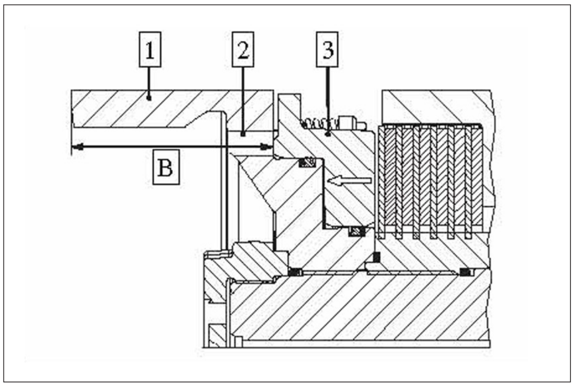
17W98RA130

(29) Calculation example :

Dimension „A“ e.g. . . . . 83.10 mm
Dimension „B“ e.g. . . . . - 82.10 mm
Difference = piston stroke = 1.00 mm

※ If the required piston stroke (0.7 ... 1.3 mm) is not achieved, correct it with (a) corresponding inner clutch disk(s) – see respective spare parts list.

Then remove HP pump (S), breather bottle (S) and threaded coupling (S).



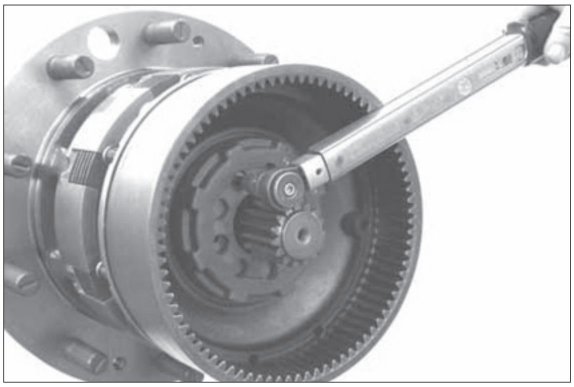
17W98RA131

Legend to sketches RA130 and RA131:
1 = Ring gear
2 = Measuring hole
3 = Piston
X = Piston stroke/disk clearance

(S) Straightedge 5870 200 022

(30) Secure slotted nut with cylindrical screw (see also figure RA127).

Tightening torque (M 10/8.8) . . . . MA = 32 Nm



17W98RA132

(31) Planetary carrier

Press thrust washer into the planetary carrier until contact is obtained.

(S) Driver tool 5870 048 245

17W98RA133

(32) Insert the cylindrical roller bearing into the planetary gear – for this purpose press the cylindrical roller bearing through the packaging sleeve until the snap ring engages into the annular groove of the planetary gear.

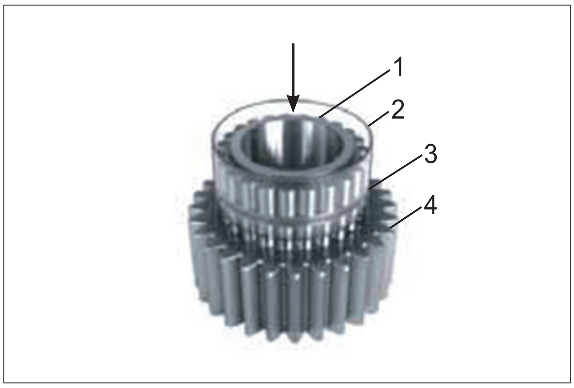
※ Use packaging sleeve to facilitate assembly.

1 = Cylindrical roller bearing

2 = Packaging sleeve

3 = Snap ring

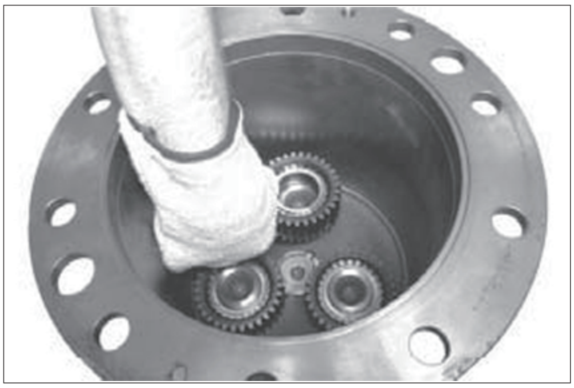
4 = Planetary gear



17W98RA134

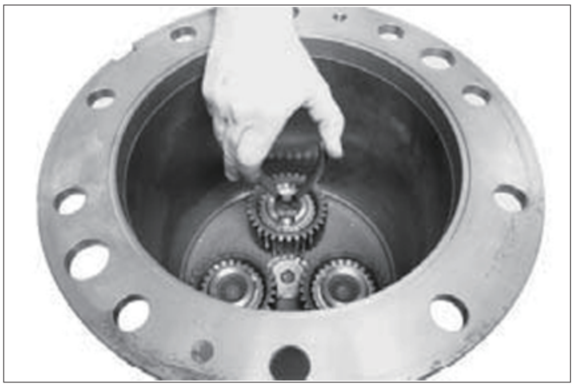
(33) Heat up bearing inner ring and mount preassembled planetary gear until contact is obtained.

※ Mount bearing inner ring with the large radius facing the planetary carrier (downwards).



17W98RA135

(34) Fix planetary gear by means of retaining ring.



17W98RA136

(35) Mount preassembled planetary carrier and fix it with hexagon screws.

Tightening torque (M12/8.8) . . . . MA = 55 Nm

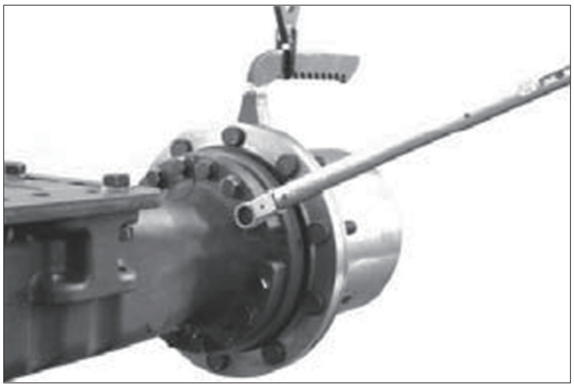
17W98RA137

(36) Output assy

Use lifting tackle (S) to locate the output assy at the axle, mount stub shaft into the teeth of the axle bevel gear and fix output assy with hexagon screws.

Tightening torque (M 16/10.9) . . . . 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 10 RCV LEVER

1. REMOVAL AND INSTALL

1) REMOVAL

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

(2) Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

(3) Loosen the breather slowly to release the pressure inside the hydraulic tank.

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

13031GE18

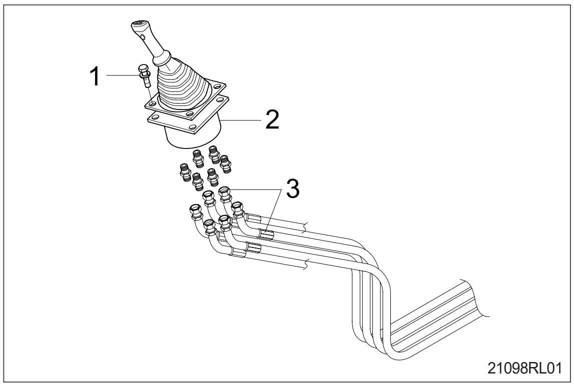
(4) Loosen the socket bolt (1).

(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

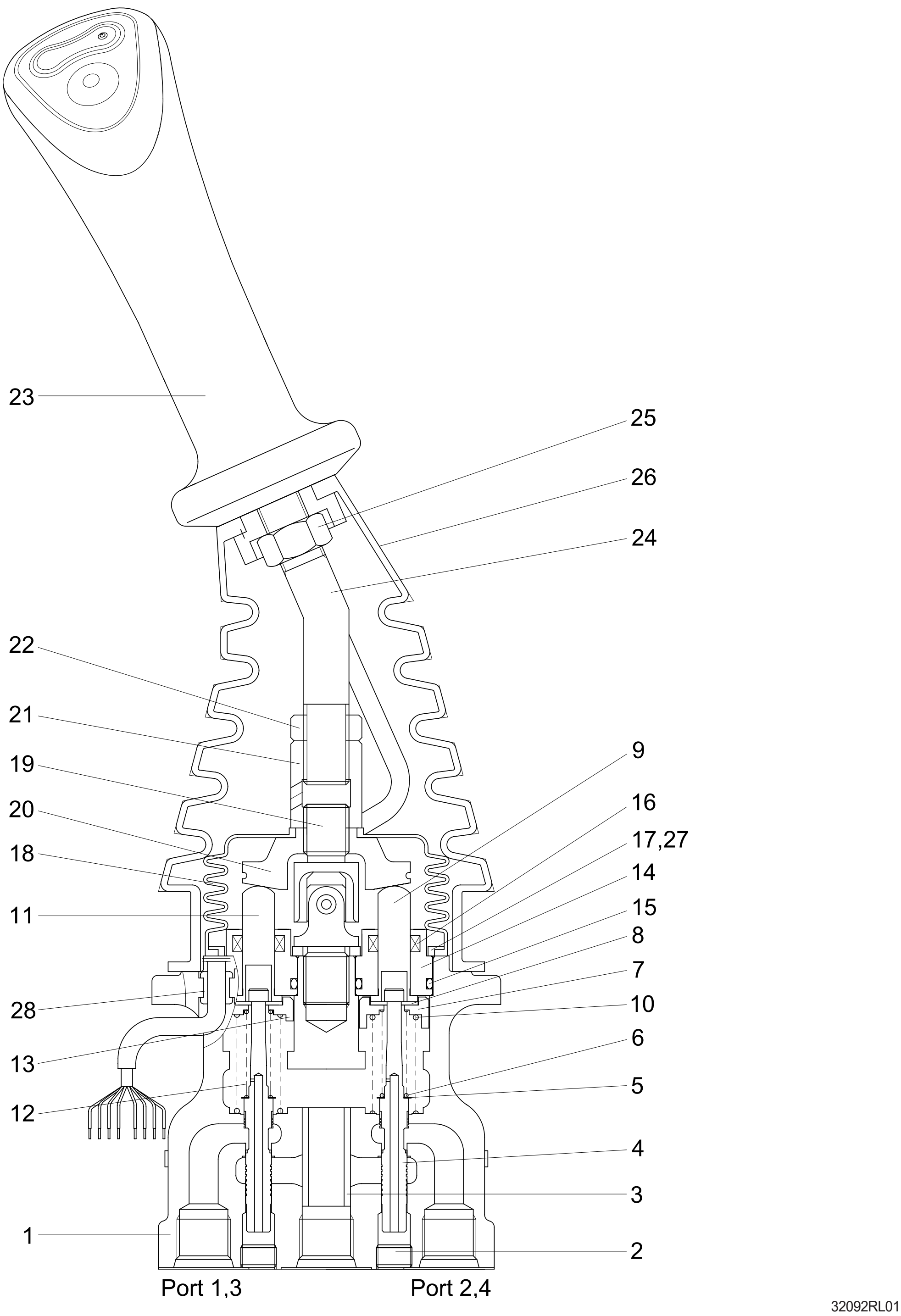
2) INSTALL

(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

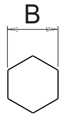
1) STRUCTURE



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

2) TOOLS AND TIGHTENING TORQUE

(1) Tools

Tool name	Remark	
Allen wrench	6	 B
Spanner	22	
	27	
(+) Driver	Length 150	
(-) Driver	Width 4~5	
Torque wrench	Capable of tightening with the specified torques	

(2) Tightening torque

Part name	Item	Size	Torque	
			kgf · m	lbf · ft
Plug	2	PT 1/8	3.0	21.7
Joint	19	M14	3.5	25.3
Swash plate	20	M14	5.0±0.35	36.2±2.5
Adjusting nut	21	M14	5.0±0.35	36.2±2.5
Lock nut	22	M14	5.0±0.35	36.2±2.5

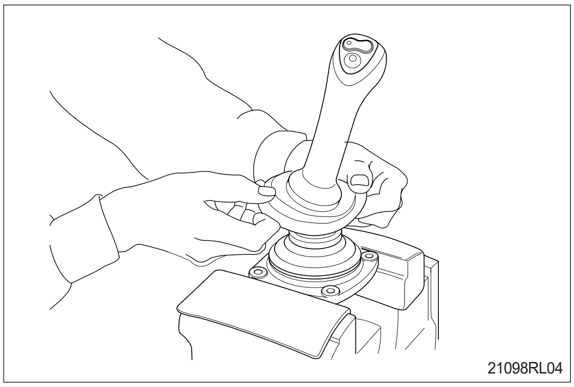
3) DISASSEMBLY

(1) Clean pilot valve with kerosene.

※ Put blind plugs into all ports

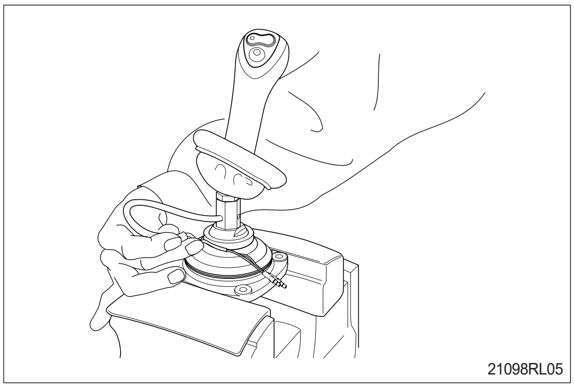
(2) Fix pilot valve in a vise with copper (or lead) sheets.

(3) Remove end of boot (26) from case (1) and take it out upwards.



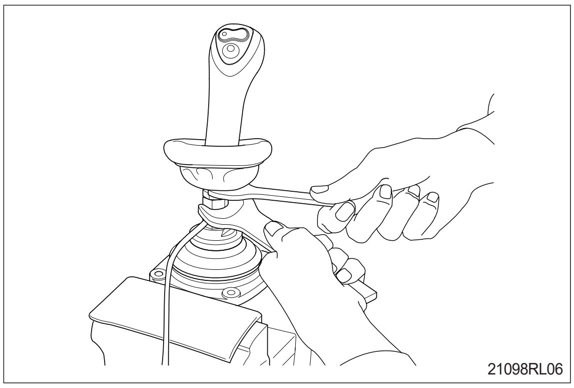
21098RL04

※ For valve with switch, remove cord also through hole of casing.



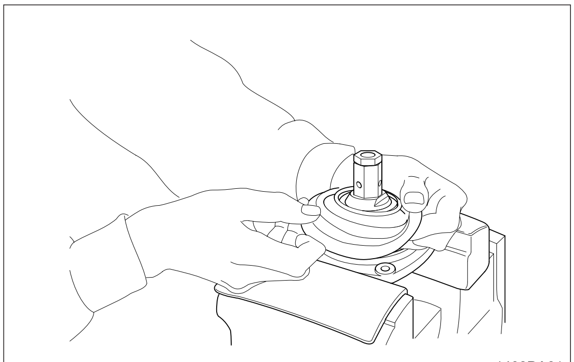
21098RL05

(4) Loosen lock nut (22) and adjusting nut (21) with spanners on them respectively, and take out handle section as one body.



21098RL06

(5) Remove the boot (18).



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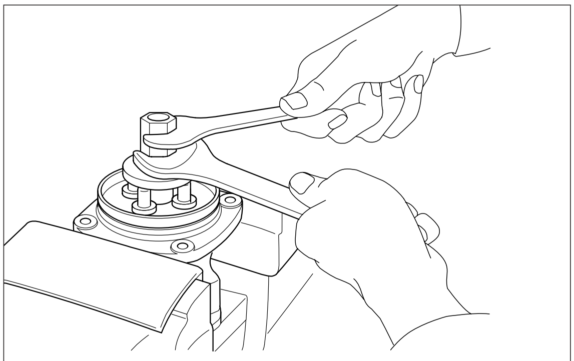
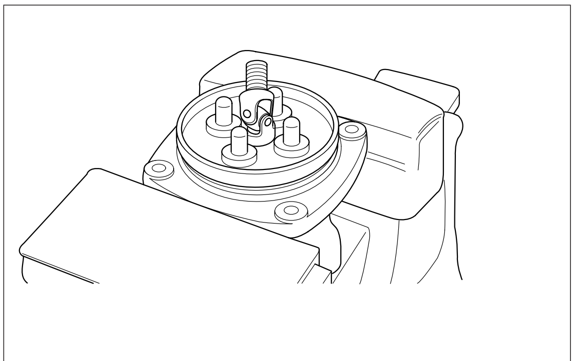
(6) Loosen adjusting nut (21) and swash plate (20) with spanners on them respectively, and remove them.



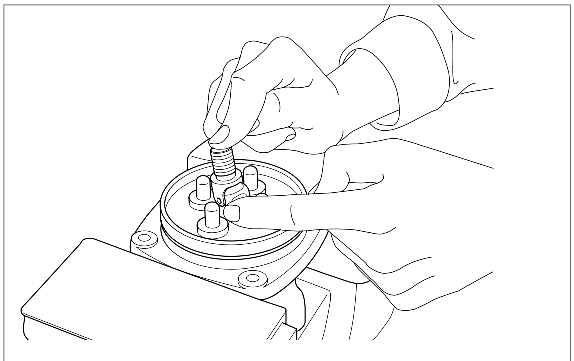
36078RL01



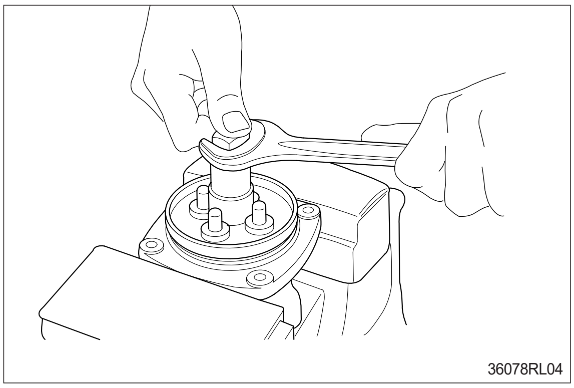
36078RL02

(7) Turn joint anticlockwise to loosen it, utilizing jig (Special tool).

※ When return spring (10) is strong in force, plate (17), plug (14) and push rod (11) will come up on loosening joint.
Pay attention to this.

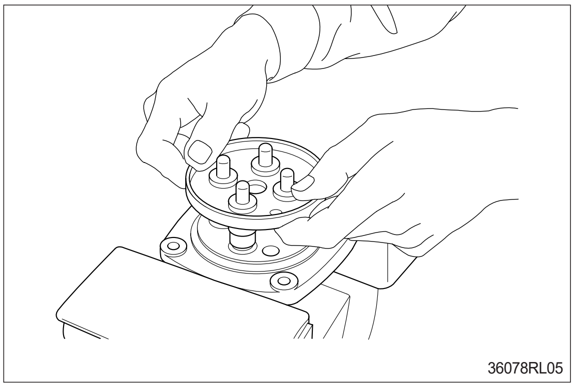


36078RL03



36078RL04

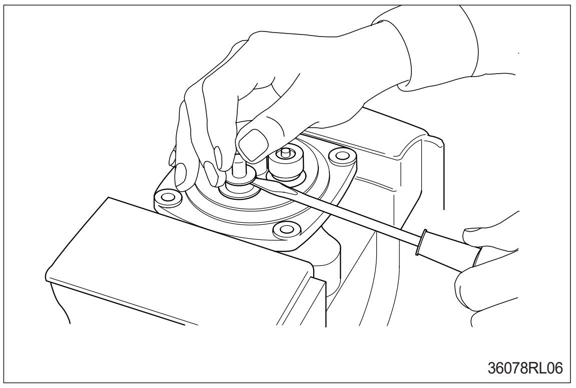
(8) Remove plate (17).



(9) When return spring (10) is weak in force, plug (14) stays in casing because of sliding resistance of O-ring.

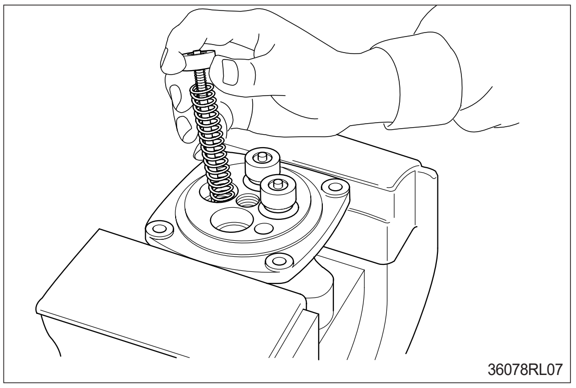
※ Take it out with minus screwdriver.
Take it out, utilizing external periphery groove of plug and paying attention not to damage it by partial loading.

※ During taking out, plug may jump up due to return spring (10) force.
Pay attention to this.

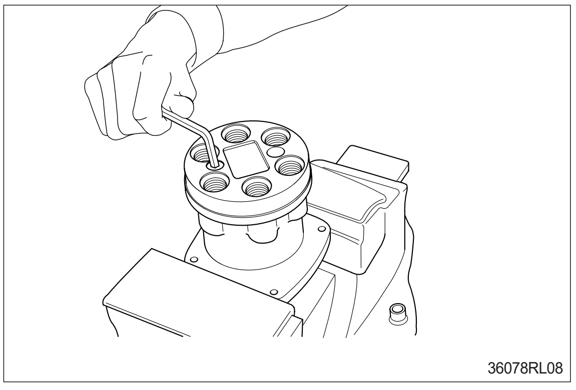


(10) Remove reducing valve subassembly and return spring (10) out of casing.

※ Record relative position of reducing valve subassembly and return springs.



(11) Loosen hexagon socket head plug(2) with hexagon socket screw key.

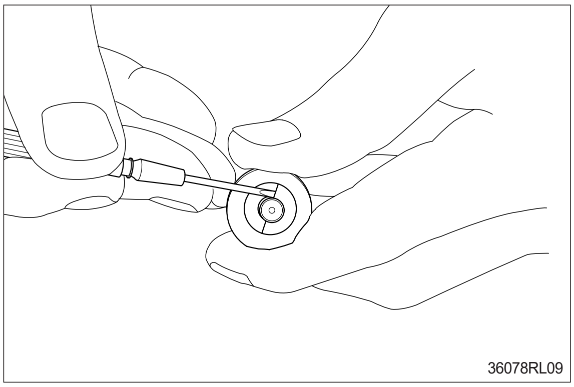


(12) For disassembling reducing valve section, stand it vertically with spool (4) bottom placed on flat workbench. Push down spring seat (7) and remove two pieces of semicircular stopper (8) with tip of small minus screwdriver.

※ Pay attention not to damage spool surface.

※ Record original position of spring seat (7).

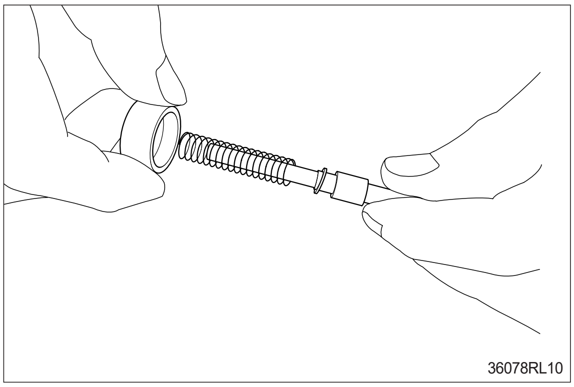
※ Do not push down spring seat more than 6㎜.



36078RL09

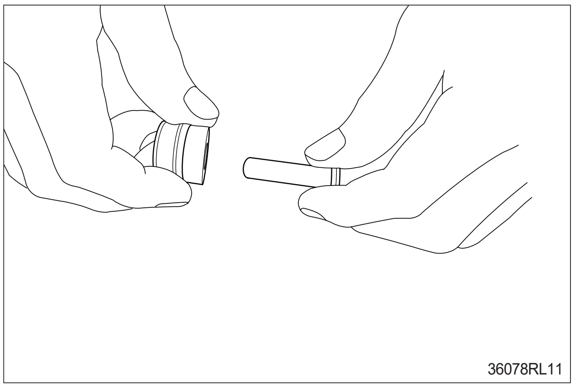
(13) Separate spool (4), spring seat (7), spring (6) and shim (5) individually.

※ Until being assembled, they should be handled as one subassembly group.



36078RL10

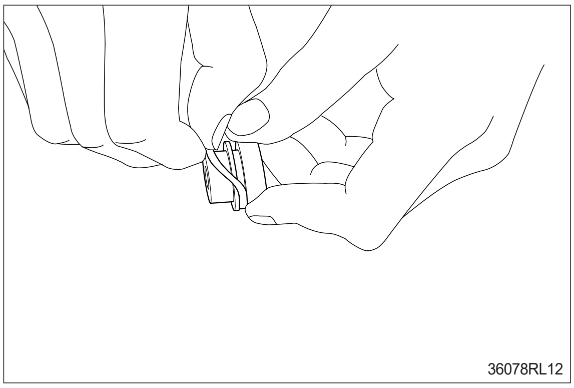
(14) Take push rod (11) out of plug (14).



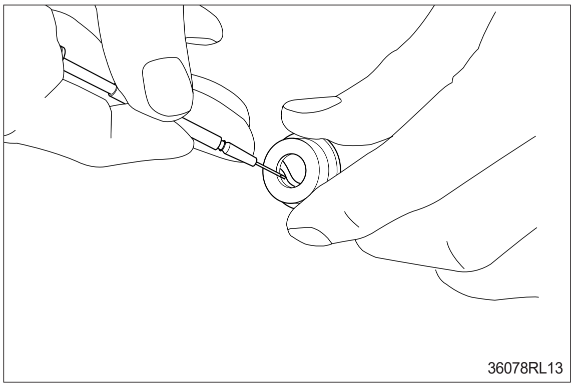
36078RL11

(15) Remove O-ring (15) and seal (16) from plug (14).

Use small minus screwdriver or so on to remove this seal.

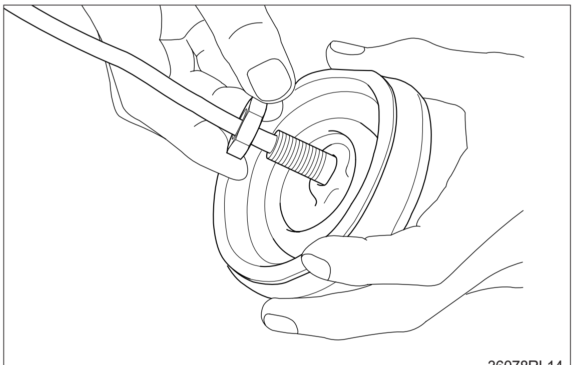


36078RL12

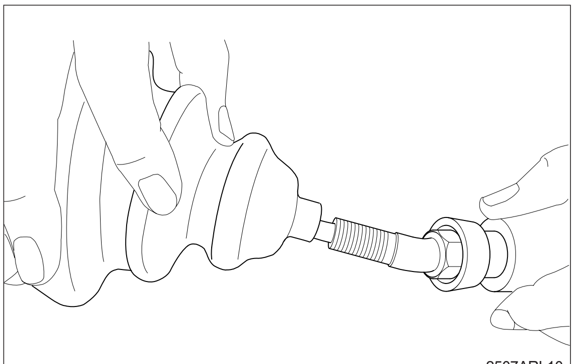


36078RL13

(16) Remove lock nut (22) and then boot (26).



36078RL14



2507ARL10

(16) Cleaning of parts

① Put all parts in rough cleaning vessel filled with kerosene and clean them (rough cleaning).

※ If dirty part is cleaned with kerosene just after putting it in vessel, it may be damaged. Leave it in kerosene for a while to loosen dust and dirty oil.

※ If this kerosene is polluted, parts will be damaged and functions of reassembled valve will be degraded.
Therefore, control cleanliness of kerosene fully.

② Put parts in final cleaning vessel filled with kerosene, turning it slowly to clean them even to their insides (finish cleaning).

※ Do not dry parts with compressed air, since they will be damaged and/or rusted by dust and moisture in air.

(17) Rust prevention of parts

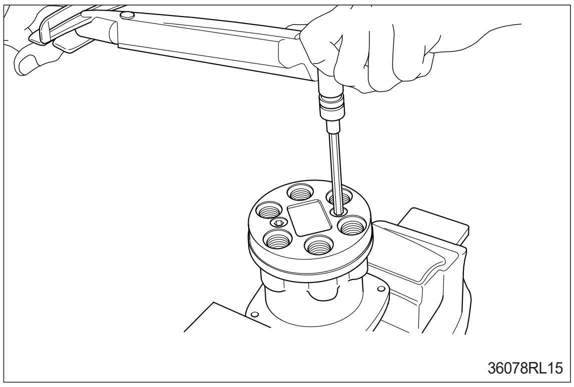
Apply rust-preventives to all parts.

※ If left as they after being cleaned, they will be rusted and will not display their functions fully after being reassembled.

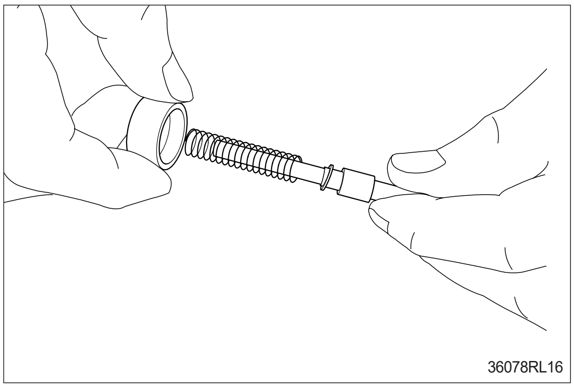
4) ASSEMBLY

(1) Tighten hexagon socket head plug (2) to the specified torque.

※ Tighten two bolts alternately and slowly.

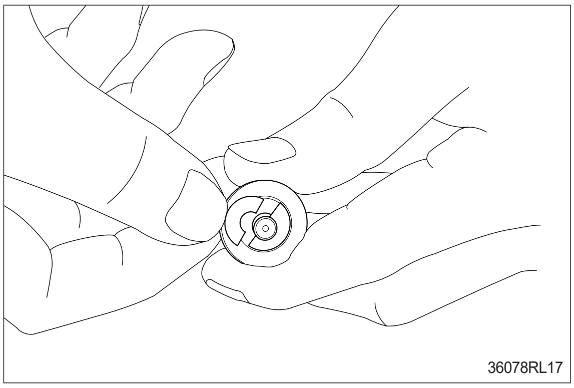


(2) Put shim (5), springs (6) and spring seat (7) onto spool (4) in this order.



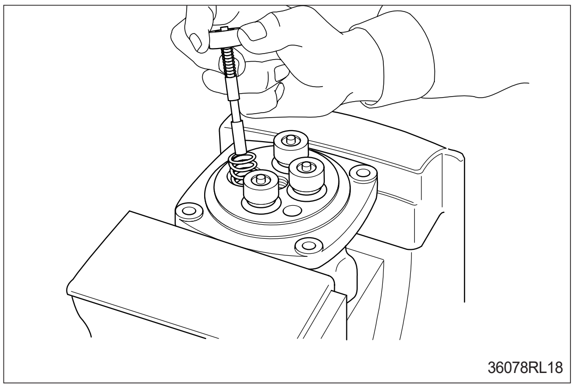
(3) Stand spool vertically with its bottom placed on flat workbench, and with spring seat pushed down, put two pieces of semicircular stopper (8) on spring seat without piling them on.

※ Assemble stopper (8) so that its sharp edge side will be caught by head of spool. Do not push down spring seat more than 6mm.

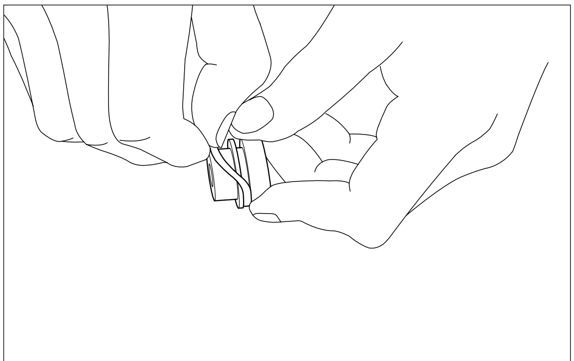


(4) Assemble spring (10) into casing (1). Assemble reducing valve subassembly into casing.

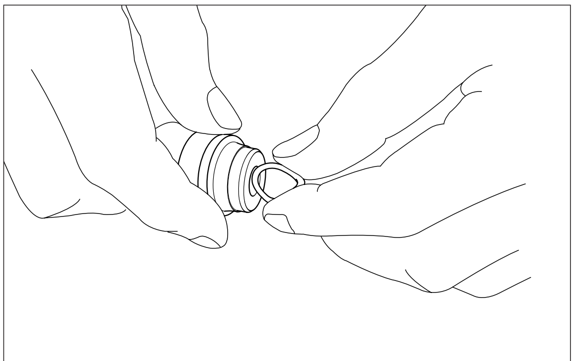
※ Assemble them to their original positions.



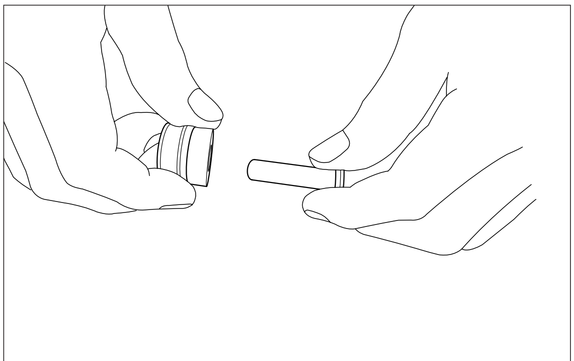
(5) Assemble O-ring (15) onto plug (14).


36078RL19

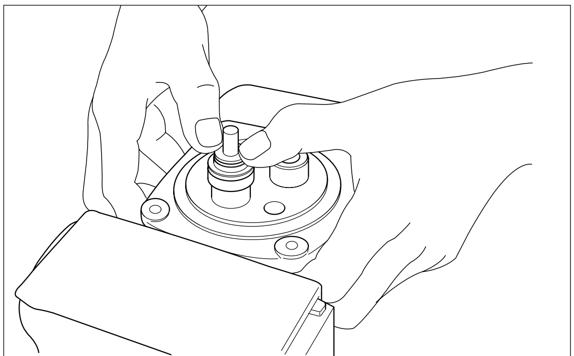
(6) Assemble seal (16) to plug (14).
※ Assemble seal in such lip direction as shown below.


36078RL20

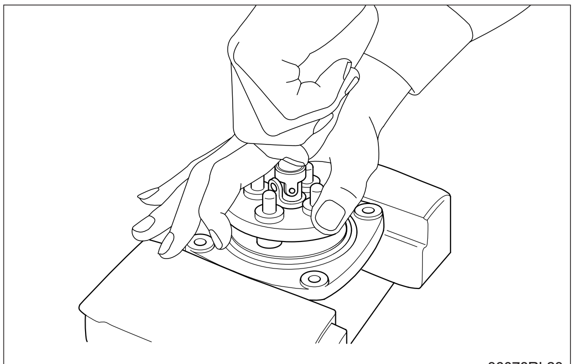
(7) Assemble push rod (11) to plug (14).
※ Apply working oil on push-rod surface.


36078RL21

(8) Assemble plug subassembly to casing.
※ When return spring is weak in force, subassembly stops due to resistance of O-ring.


36078RL22

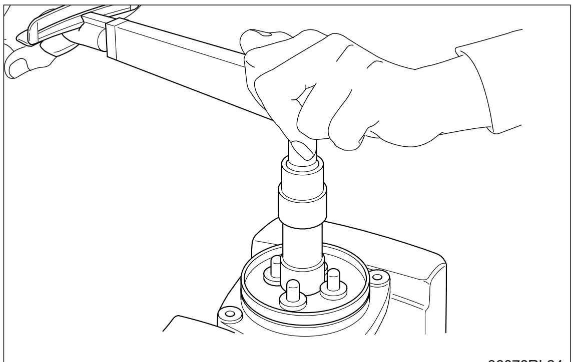
(9) When return spring is strong in force, assemble 4 sets at the same time, utilizing plate (17), and tighten joint (19) temporarily.



36078RL23

(10) Fit plate (17).

(11) Tighten joint (19) with the specified torque to casing, utilizing jig.

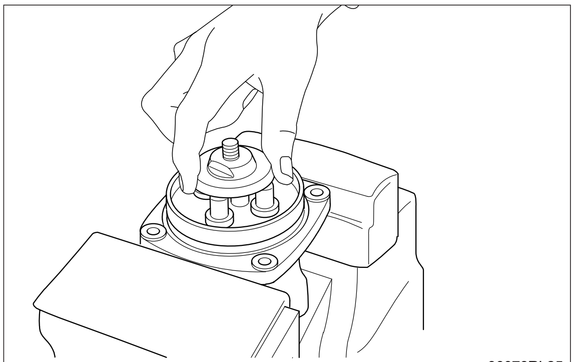


36078RL24

(12) Assemble swash plate (20) to joint (19).

※ Screw it to position that it contacts with 4 push rods evenly.

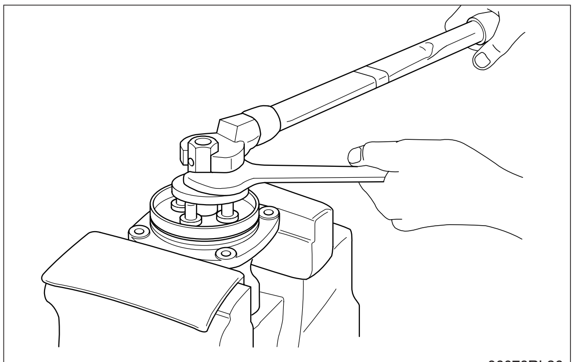
※ Do not screw it over.



36078RL25

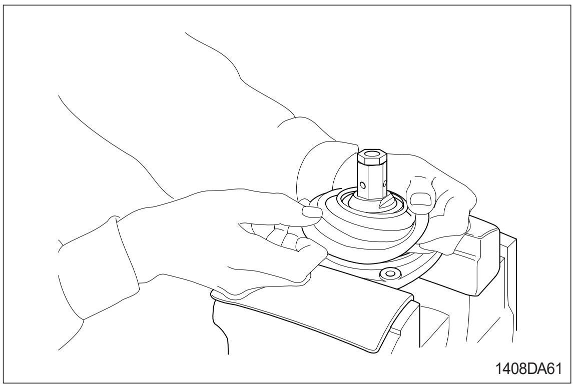
(13) Assemble adjusting nut (21), apply spanner to width across flat of plate (20) to fix it, and tighten adjusting nut to the specified torque.

※ During tightening, do not change position of disk.

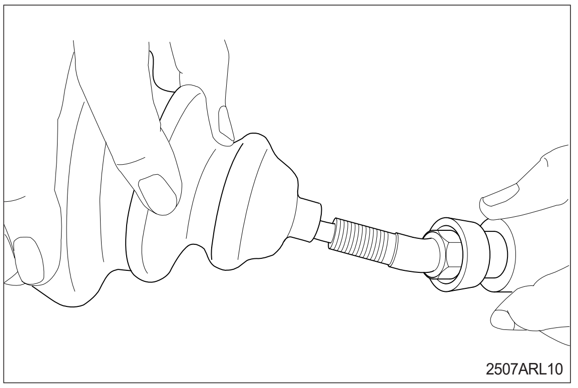


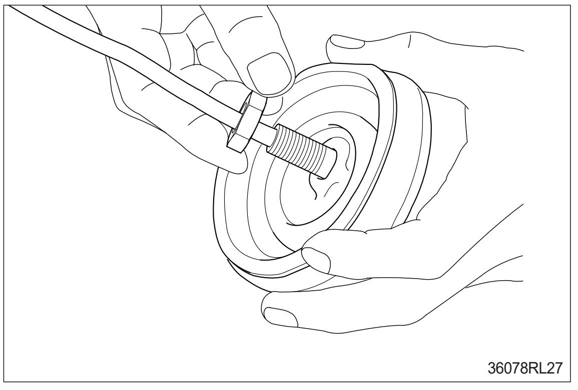
36078RL26

(14) Fit boot (18) to plate.

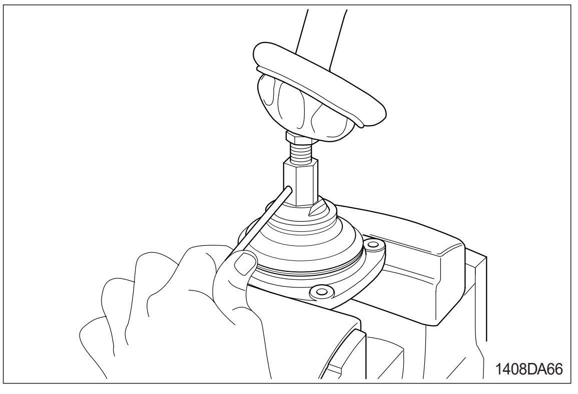


(15) Fit boot (26) and lock nut (22), and handle subassembly is assembled completely.



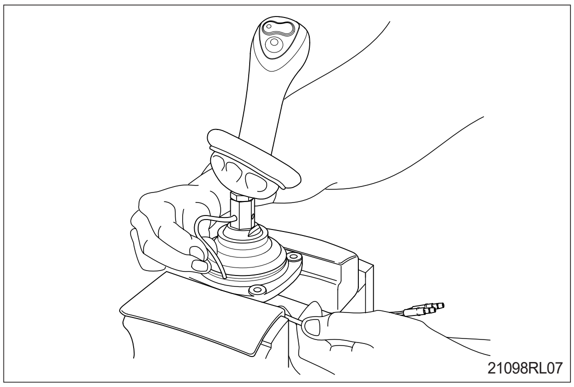


(16) Pull out cord and tube through adjusting nut hole provided in direction 60° to 120° from casing hole.



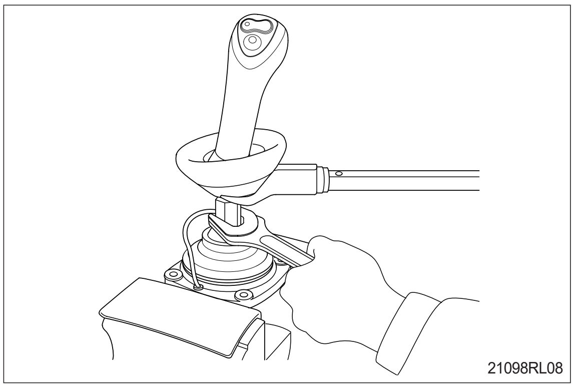
(17) Assemble bushing (28) to plate and pass cord and tube through it.

※ Provide margin necessary to operation.



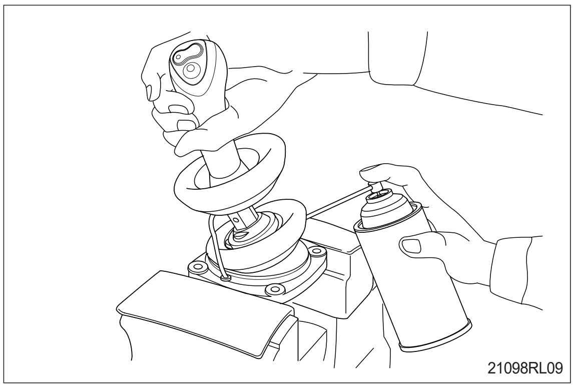
21098RL07

(18) Determine handle direction, tighten lock nut (22) to specified torque to fix handle.



21098RL08

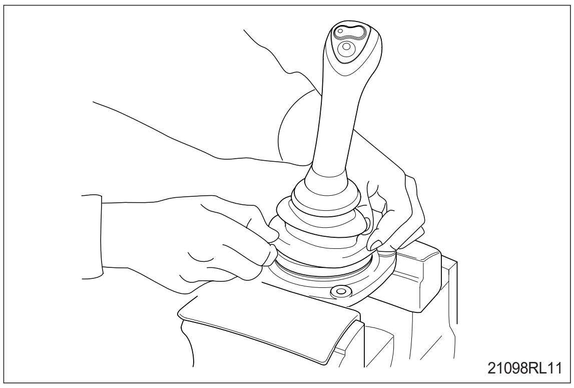
(19) Apply grease to rotating section of joint and contacting faces of disk and push rod.



21098RL09

(20) Assemble lower end of bellows to casing.

(21) Inject volatile rust-preventives through all ports and then put blind plugs in ports.



21098RL11

GROUP 11 TURNING JOINT

1. REMOVAL AND INSTALL

1) REMOVAL

13031GE18

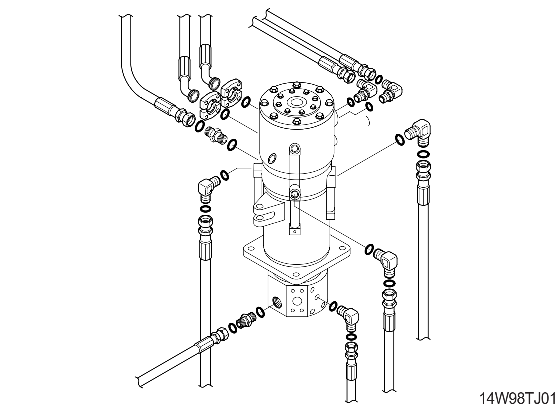
(1) Lower the work equipment to the ground and stop the engine.

(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.



14W98TJ01

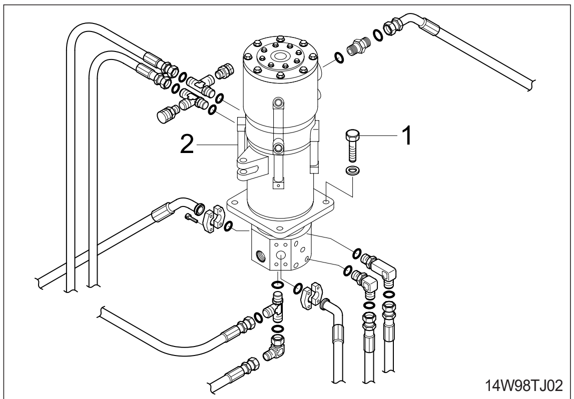
(4) Disconnect all hoses.

(5) Sling the turning joint assembly (1) and remove the mounting bolt (2).

- Weight : 120 kg (265 lb)
- Tightening torque : 12.3 ± 1.3 kgf · m (89 ± 9.4 lbf · ft)

(6) Remove the turning joint (1) assembly.

※ When removing the turning joint, check that all the hoses have been disconnected.



14W98TJ02

2) INSTALL

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

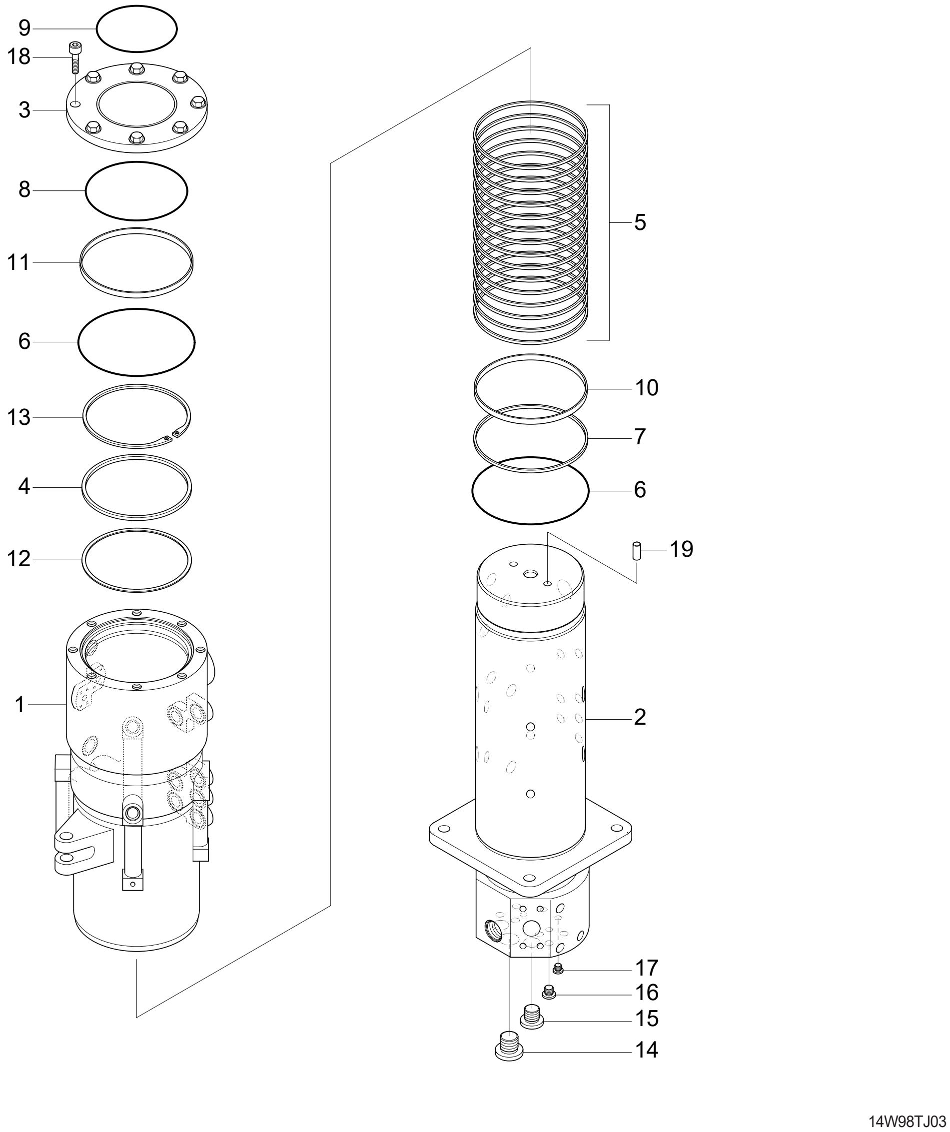
※ Take care of turning joint direction.

※ 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

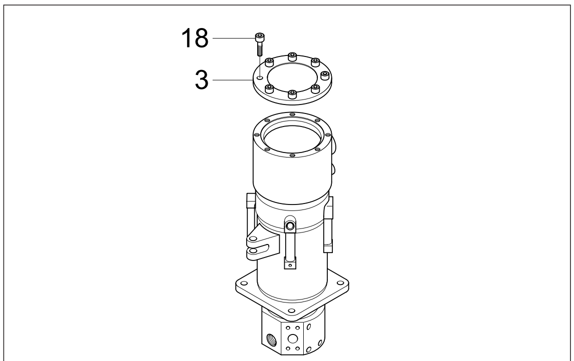


1	Hub	8	O-ring	15	Plug
2	Shaft	9	O-ring	16	Plug
3	Cover	10	Wear ring	17	Plug
4	Spacer	11	Wear ring	18	Socket bolt
5	Slipper seal	12	Shim	19	Spring pin
6	O-ring	13	Retainer ring		
7	O-ring	14	Plug		

2) DISASSEMBLY

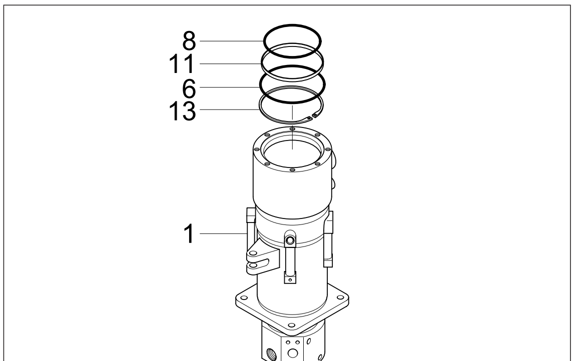
※ Before the disassembly, clean the turning joint.

(1) Loosen the socket bolt (18) and remove cover (3).



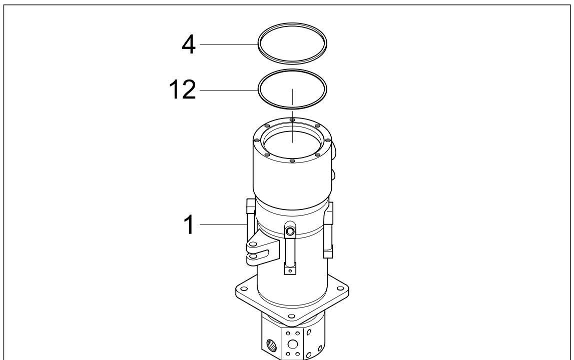
14W98TJ04

(2) Remove O-ring (8), wear ring (11), O-ring (6) and retainer ring (13) from hub (1).



14W98TJ05

(3) Remove spacer (4) and shim (12) from hub (1).

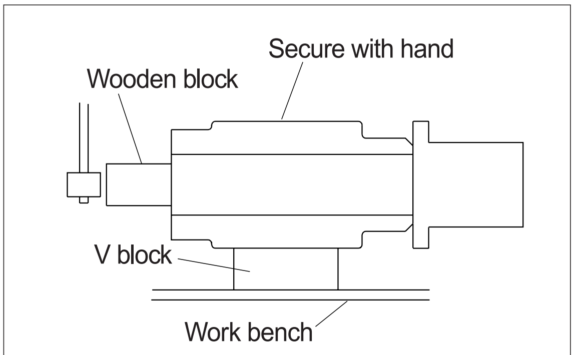


14W98TJ06

(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.

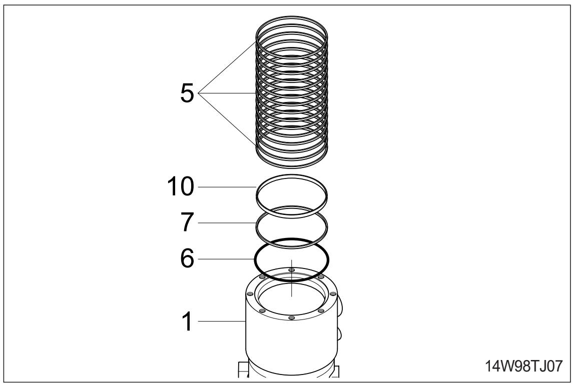
※ Take care not to damage the shaft (2) when remove hub (1) or rest it sideway.

※ Put a fitting mark on hub (1) and shaft (2).



8-141(3)

(5) Remove seventeen slipper seal (5), O-ring (6, 7) and wear ring (10) from hub (1).



3) ASSEMBLY

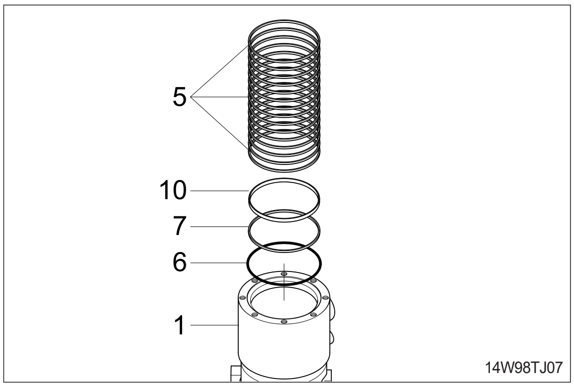
※ Clean all parts.

※ As a general rule, replace oil seals and O-ring.

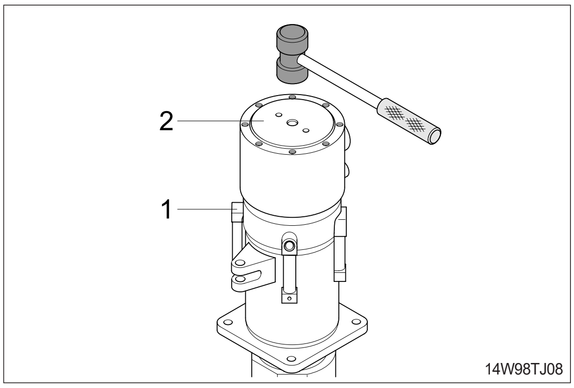
※ Coat the sliding surfaces of all parts with engine oil or grease before installing.

(1) Fit O-ring (7), seventeen slipper seal (5), and wear ring (10).

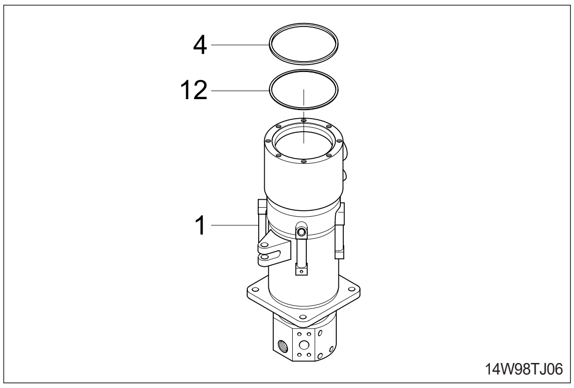
(2) Fit O-ring (6) to shaft (2).



(3) Set shaft (2) on block, tap hub (1) with a plastic hammer to install.

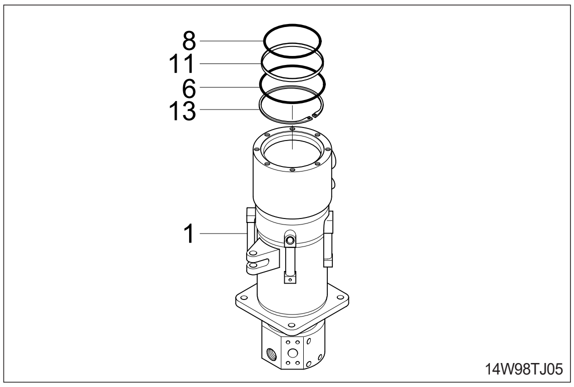


(4) Fit shim (12), and spacer (4) to hub (1) of turning joint upside.



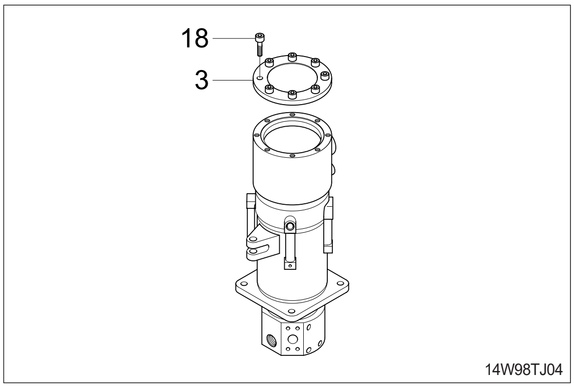
(5) Fit retainer ring (13), O-ring (6) and wear ring (11) to shaft (2).

(6) Fit O-ring (8) 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 12 BOOM, ARM, BUCKET, DOZER AND OUTRIGGER CYLINDERS

1. REMOVAL AND INSTALL

1) BUCKET CYLINDER

(1) Removal

※ Expand the arm and bucket fully, lower the work equipment to the ground and stop the engine.

※ Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

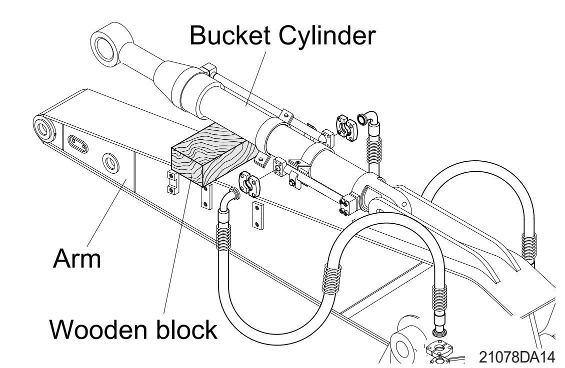
※ Loosen the breather slowly to release the pressure inside the hydraulic tank.

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

※ Fit blind plugs in the hoses after disconnecting them, to prevent dirt or dust from entering.

13031GE18

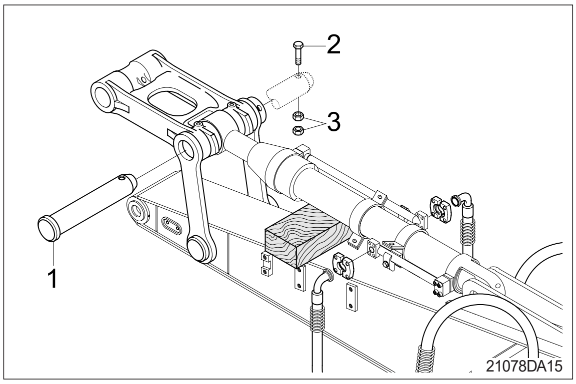
① Set block between bucket cylinder and arm.



21078DA14

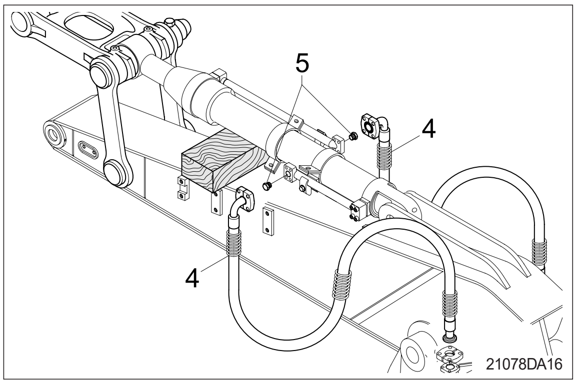
② Remove bolt (2), nut (3) and pull out pin (1).

※ 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.

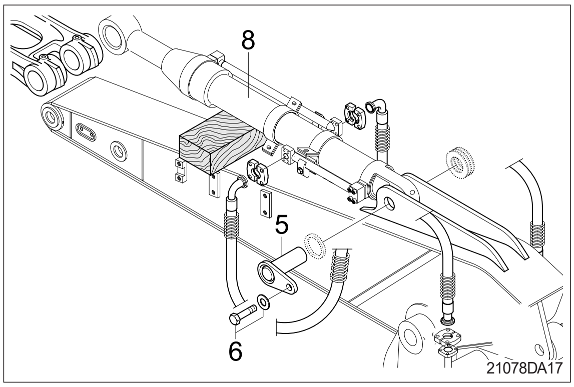


21078DA16

④ Sling bucket cylinder assembly (8) and remove bolt (6) then pull out pin (5).

⑤ Remove bucket cylinder assembly (8).

・Weight : 100 ㎏ (220 ㏈)



(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.

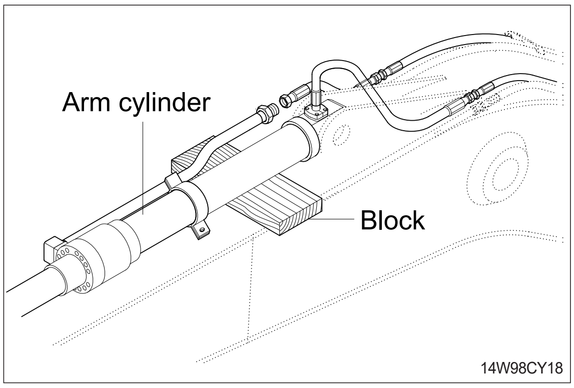
※ Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

※ 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.

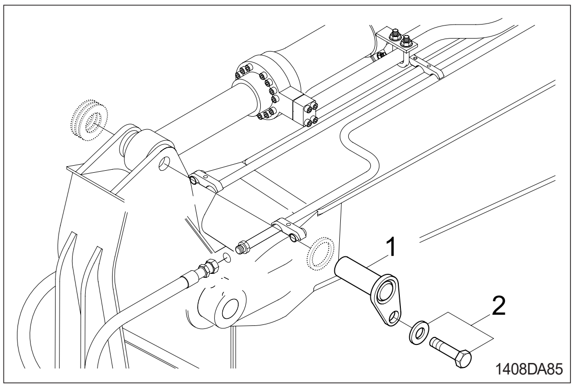

13031GE18



14W98CY18

② Remove bolt (2) and pull out pin (1).

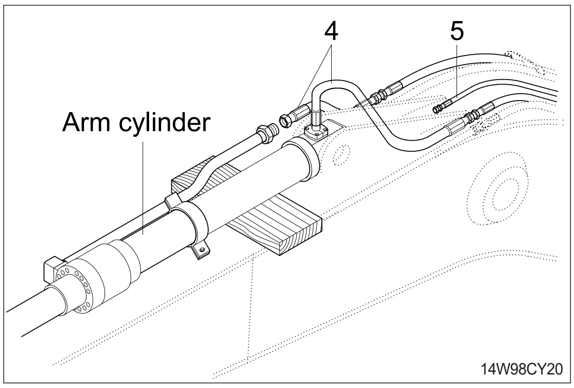
※ Tie the rod with wire to prevent it from coming out.



1408DA85

③ Disconnect arm cylinder hoses (4) and put plugs on cylinder pipe.

④ Disconnect greasing pipings (5).

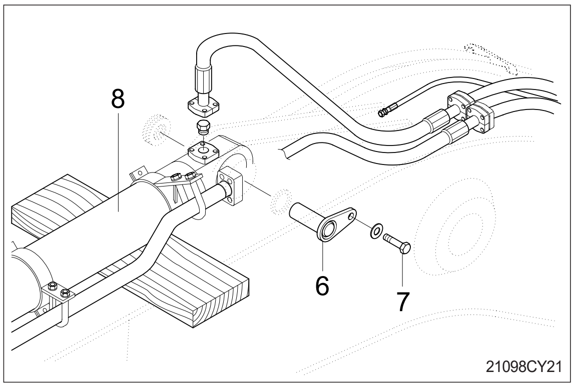


14W98CY20

⑤ Sling arm cylinder assembly(8) and remove bolt (7) then pull out pin (6).

⑥ Remove arm cylinder assembly (8).

· Weight : 160 ㎏ (350 ℔)



(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.

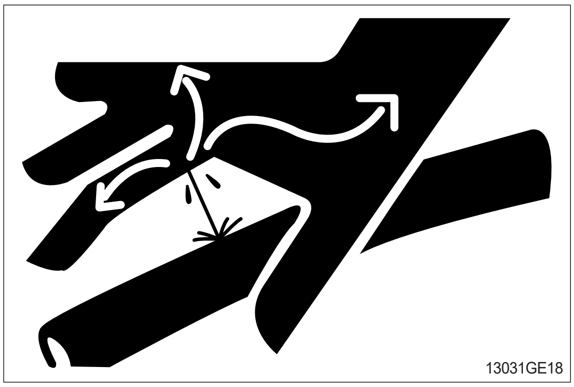
※ Confirm the hydraulic oil level and check the hydraulic oil leak or not.

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.


13031GE18

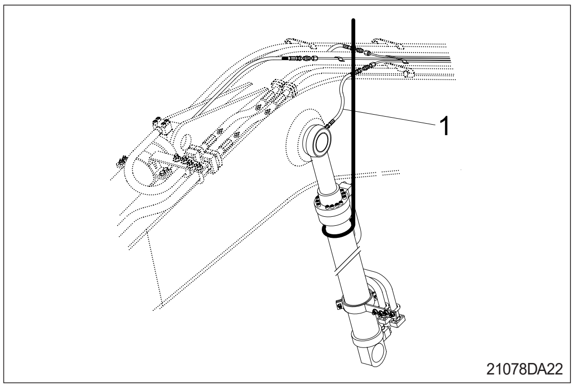
※ Loosen the breather slowly to release the pressure inside the hydraulic tank.

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

※ Fit blind plugs in the hoses after disconnecting them, to prevent dirt or dust from entering.

① Disconnect greasing hoses (1).

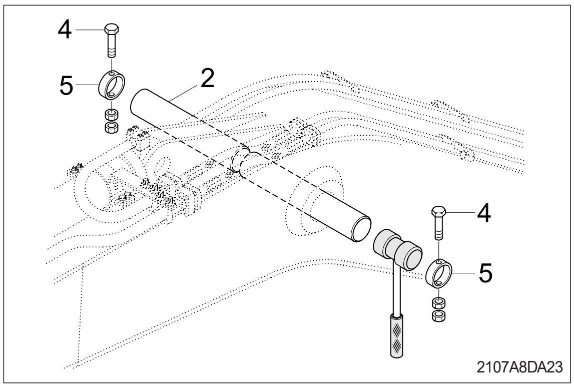
② Sling boom cylinder assembly.



21078DA22

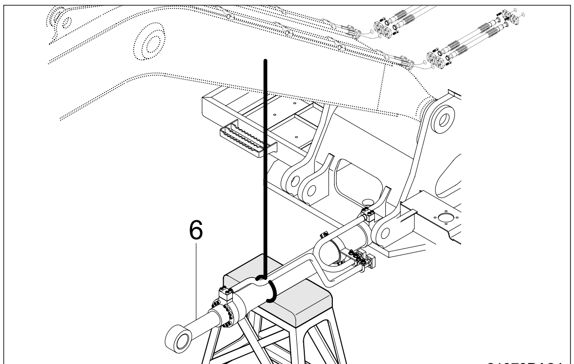
③ Remove bolt (4), stopper (5) and pull out pin (2).

※ Tie the rod with wire to prevent it from coming out.



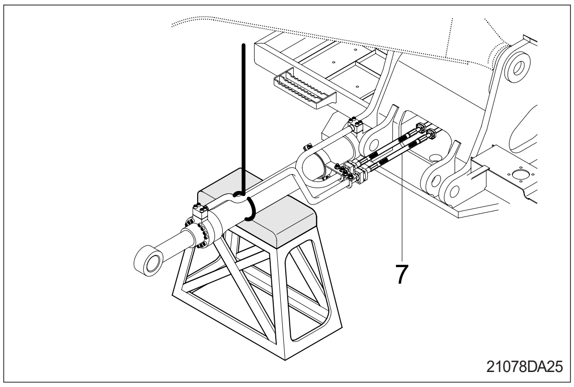
2107A8DA23

④ Lower the boom cylinder assembly (6) on a stand.



21078DA24

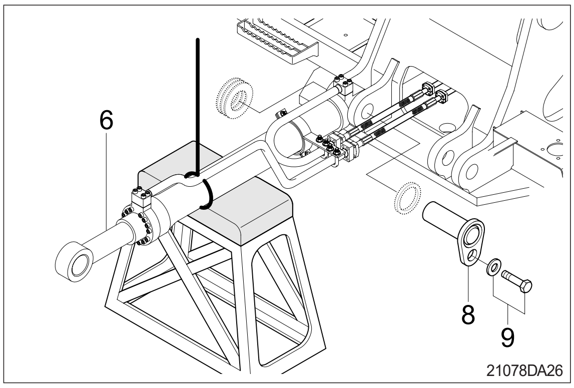
⑤ Disconnect boom cylinder hoses (7) and put plugs on cylinder pipe.



⑥ Remove bolt (9) and pull out pin (8).

⑦ Remove boom cylinder assembly (6).

· Weight : 130 ㎏ (285 ㏈)



(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.

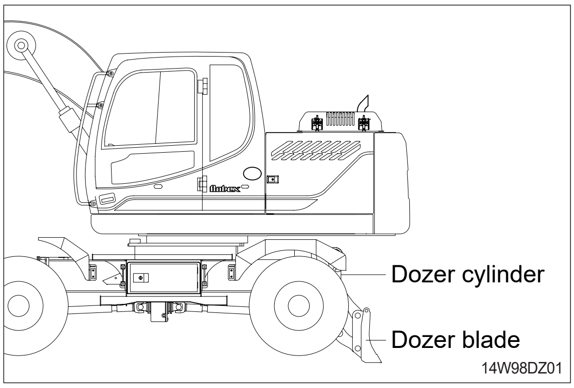
※ Loosen the breather slowly to release the pressure inside the hydraulic tank.

⚠ 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.

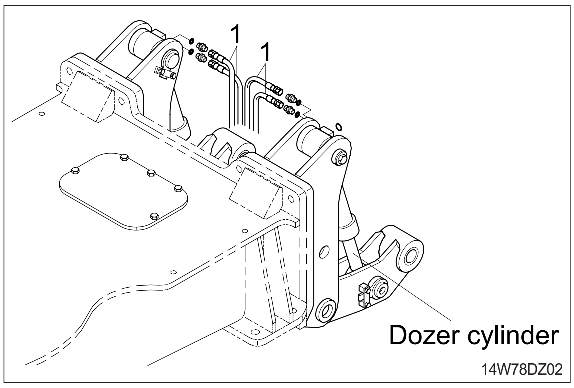
① Lower the dozer blade to the ground.


13031GE18



14W98DZ01

② Disconnect dozer cylinder hoses (1), and put plugs on cylinder pipe.

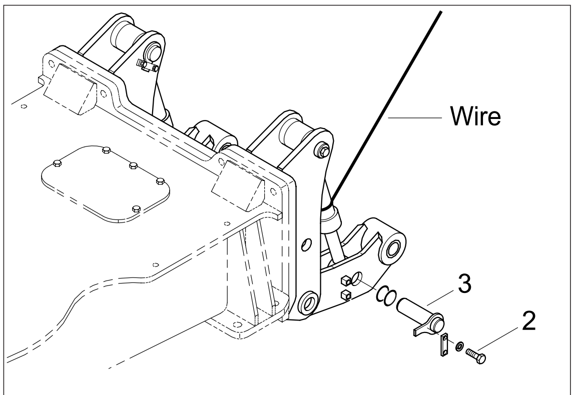


14W78DZ02

③ Sling dozer cylinder assembly.

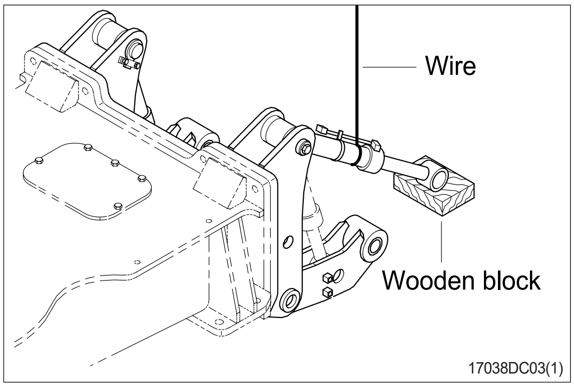
④ Remove bolt (2) and pull out pin (3).

※ Tie the rod with wire to prevent it from coming out.



17038DC02(3)

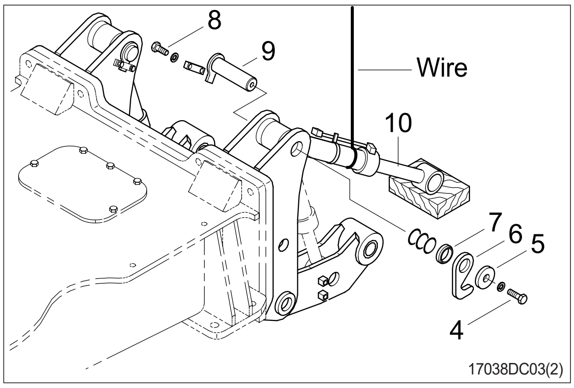
⑤ Lower the dozer cylinder rod side on a wooden block.



⑥ Loosen the bolt (4) and remove lock washer (5), hook plate (6), and spacer (7). Remove bolt (8) and pull out pin (9).

⑦ Remove the dozer cylinder assy (10).

⑧ · Weight : 55 ㎏ (120 ℔)



(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.**

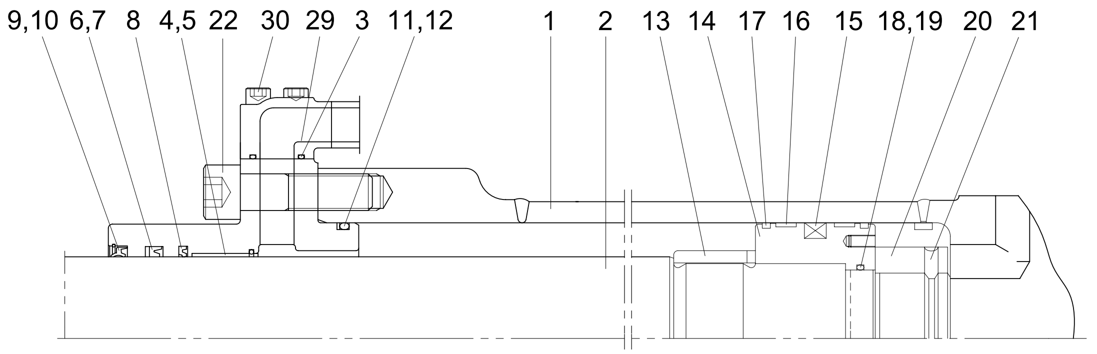
※ Bleed the air from the dozer cylinder.

※ Confirm the hydraulic oil level and check the hydraulic oil leak or not.

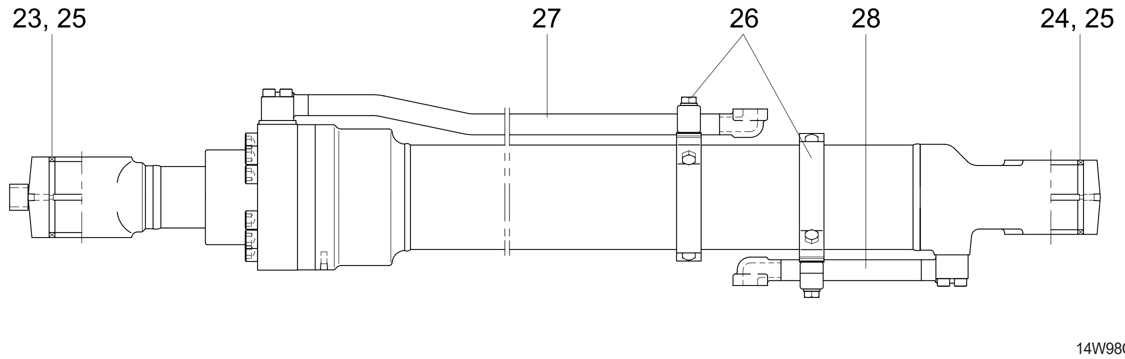
2. DISASSEMBLY AND ASSEMBLY

1) STRUCTURE

(1) Bucket cylinder

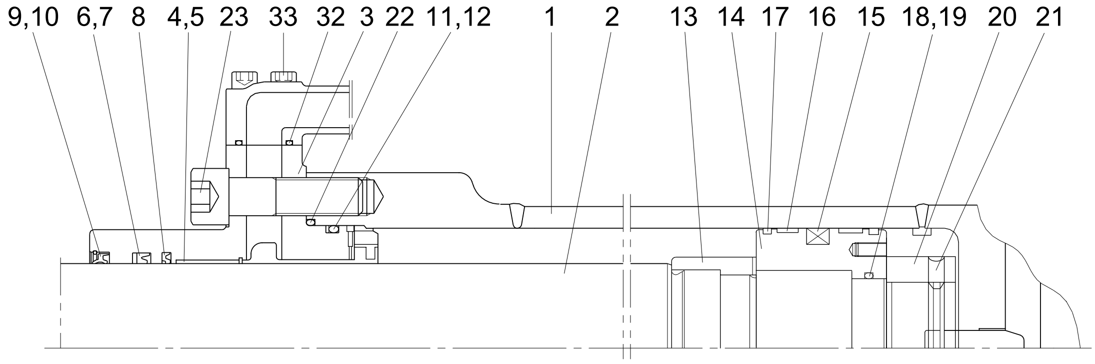


Internal detail

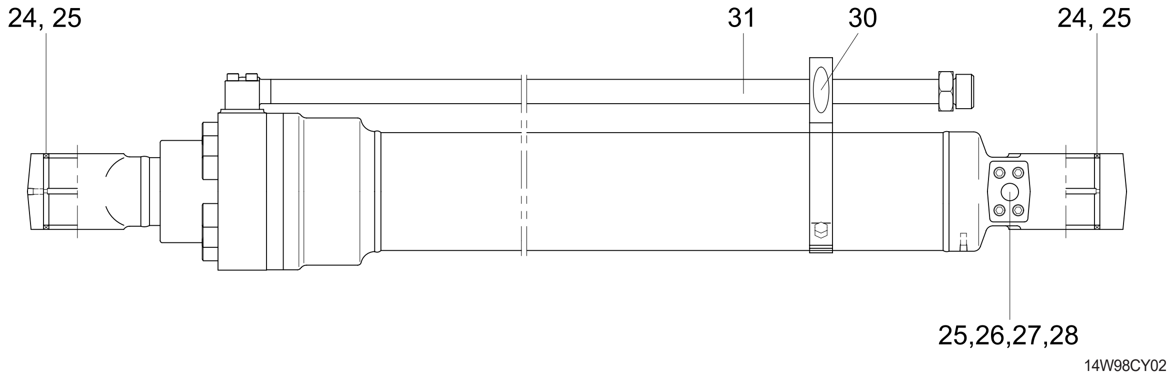


1	Tube assembly	11	O-ring	21	Hexagon socket set screw
2	Rod assembly	12	Back up ring	22	Hexagon socket head bolt
3	Gland	13	Cushion ring	23	Pin bushing
4	DD2 bushing	14	Piston	24	Pin bushing
5	Snap ring	15	Piston seal	25	Dust seal
6	Rod seal	16	Wear ring	26	Band assembly
7	Back up ring	17	Dust ring	27	Pipe assembly-R
8	Buffer ring	18	O-ring	28	Pipe assembly-B
9	Dust wiper	19	Back up ring	29	O-ring
10	Snap ring	20	Lock nut	30	Hexagon socket head bolt

(2) Arm cylinder

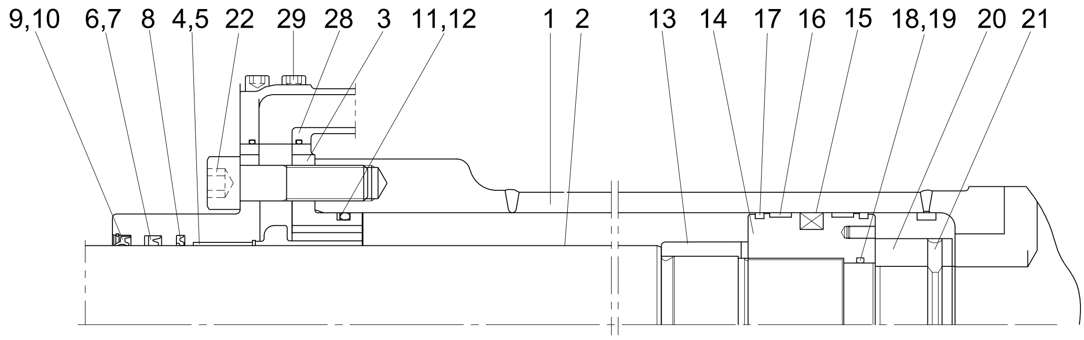


Internal detail

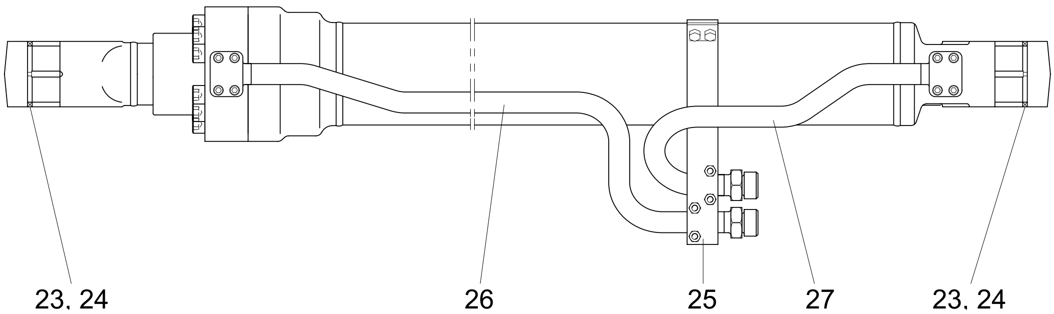


1	Tube assembly	12	Back up ring	23	Hexagon socket head bolt
2	Rod assembly	13	Cushion ring	24	Pin bushing
3	Gland	14	Piston	25	Dust seal
4	DD2 bushing	15	Piston seal	26	Check valve
5	Snap ring	16	Wear ring	27	Coil spring
6	Rod seal	17	Dust ring	28	O-ring
7	Back up ring	18	O-ring	29	Plug
8	Buffer ring	19	Back up ring	30	Band assembly
9	Dust wiper	20	Lock nut	31	Pipe assembly-R
10	Snap ring	21	Hexagon socket set screw	32	O-ring
11	O-ring	22	O-ring	33	Hexagon socket head bolt

(3) Boom cylinder



Internal detail

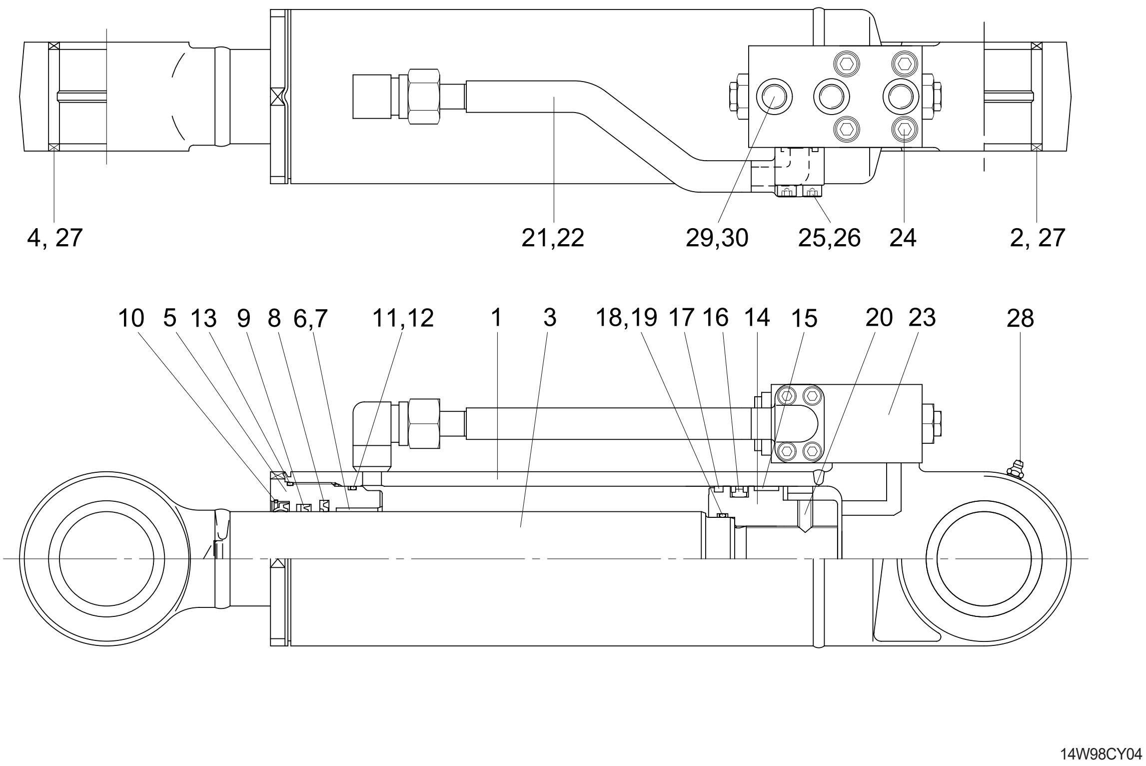


14W98CY03

1	Tube assembly	11	O-ring	21	Hexagon socket set screw
2	Rod assembly	12	Back up ring	22	Hexagon socket head bolt
3	Gland	13	Cushion ring	23	Pin bushing
4	DD2 bushing	14	Piston	24	Dust seal
5	Snap ring	15	Piston seal	25	Band assembly
6	Rod seal	16	Wear ring	26	Pipe assembly-R
7	Back up ring	17	Dust ring	27	Pipe assembly-B
8	Buffer ring	18	O-ring	28	O-ring
9	Dust wiper	19	Back up ring	29	Hexagon socket head bolt
10	Snap ring	20	Lock nut		

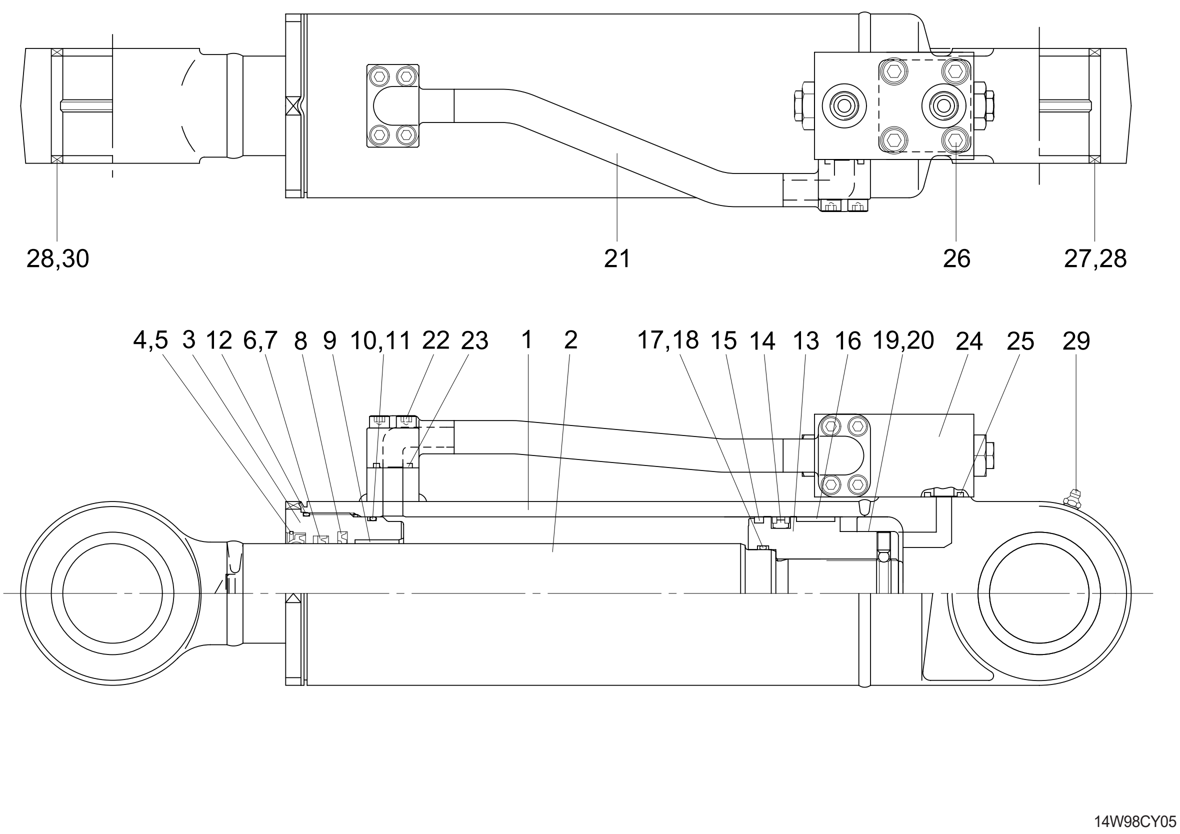
(4) Dozer cylinder

① Rear dozer cylinder



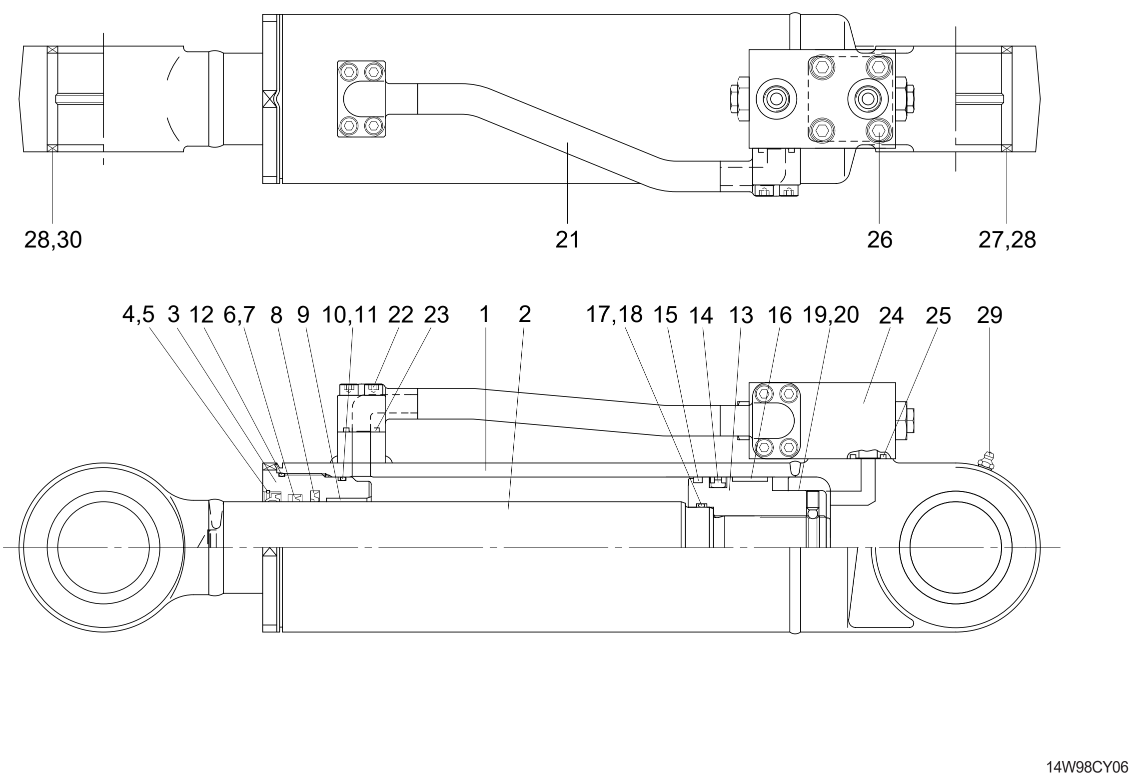
1	Tube assembly	12	Back up ring	22	O-ring
2	Pin bushing	13	O-ring	23	Check valve assembly
3	Rod assembly	14	Piston	24	Hexagon socket head bolt
4	Pin bushing	15	Wear ring	25	Hexagon socket head bolt
5	Rod cover	16	Piston seal	26	Spring washer
6	Rod bushing	17	Dust ring	27	Wiper pin
7	Retaining ring	18	O-ring	28	Grease nipple
8	Buffer ring	19	Back up ring	29	Plug
10	Dust wiper	20	Set screw	30	O-ring
11	O-ring	21	Pipe assembly		

② Front dozer cylinder



1	Tube assembly	11	Back up ring	21	Pipe assembly
2	Rod assembly	12	O-ring	22	Hexagon socket head bolt
3	Gland	13	Piston	23	O-ring
4	Dust wiper	14	Piston seal	24	Check valve assembly
5	Retainer ring	15	Dust ring	25	O-ring
6	Rod seal	16	Wear ring	26	Hexagon socket head bolt
7	Back up ring	17	O-ring	27	Pin bushing
8	Buffer ring	18	Back up ring	28	Dust seal
9	DD2 bushing	19	Steel ball	29	Grease nipple
10	O-ring	20	Set screw	30	Pin bushing

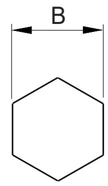
(5) Outrigger cylinder



1	Tube assembly	11	Back up ring	21	Pipe assembly
2	Rod assembly	12	O-ring	22	Hexagon socket head bolt
3	Gland	13	Piston	23	O-ring
4	Dust wiper	14	Piston seal	24	Check valve assembly
5	Retainer ring	15	Dust ring	25	O-ring
6	Rod seal	16	Wear ring	26	Hexagon socket head bolt
7	Back up ring	17	O-ring	27	Pin bushing
8	Buffer ring	18	Back up ring	28	Pin bushing
9	Du bushing	19	Steel ball	29	Dust seal
10	O-ring	20	Set screw		

2) TOOLS AND TIGHTENING TORQUE

(1) Tools

Tool name	Remark	
Allen wrench	6	
	8	
	14	
	17	
Spanner	7	
	8	
(-) Driver	Small and large sizes	
Torque wrench	Capable of tightening with the specified torques	

(2) Tightening torque

Part name		Item	Size	Torque	
				kgf · m	lbf · ft
Socket head bolt	Bucket cylinder	22	M14	15±2.0	108±14.5
	Boom cylinder		M14	15±2.0	108±14.5
	Arm cylinder	23	M16	23±2.0	166±14.5
	Dozer cylinder	25	M8	2.7±0.3	19.5±2.2
	Outrigger cylinder	22			
	Dozer cylinder	24	M10	5.4±0.5	39.1±3.6
	Outrigger cylinder	26			
Pipe mounting socket head bolt	Bucket	30	M10	5.4±0.5	39.1±3.6
	Boom	29	M8	2.7±0.3	19.6±2.2
	Arm	33	M10	5.4±0.5	39.1±3.6
Lock nut	Bucket cylinder	20	M45	100±10.0	723±72.3
	Boom cylinder		M50		
	Arm cylinder		M55		
Piston	Bucket cylinder	14	-	150±15.0	1085±109
	Boom cylinder				
	Arm cylinder				
	Dozer cylinder - Rear				
	Dozer cylinder - Front	13			
	Outrigger cylinder			140±14.0	1012±101

3) DISASSEMBLY

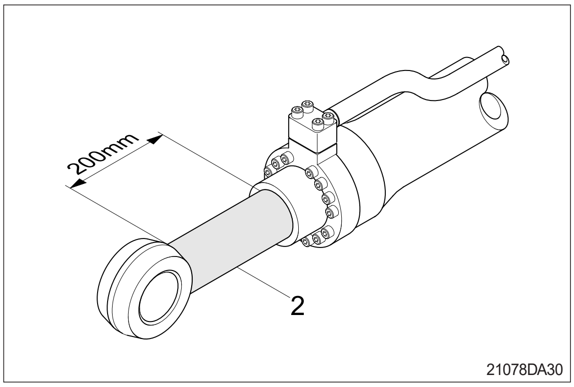
(1) Remove cylinder head and piston rod

※ Procedures are based on the bucket cylinder.

① Hold the clevis section of the tube in a vise.

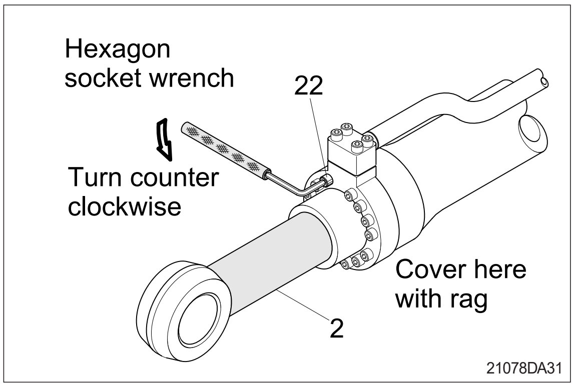
※ Use mouth pieces so as not to damage the machined surface of the cylinder tube. Do not make use of the outside piping as a locking means.

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.



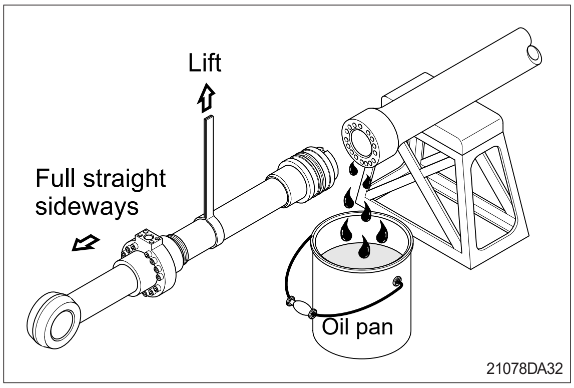
③ Loosen and remove socket bolts (22) of the gland in sequence.

※ Cover the extracted rod assembly (2) with rag to prevent it from being accidentally damaged during operation.



④ Draw out cylinder head and rod assembly together from tube assembly (1).

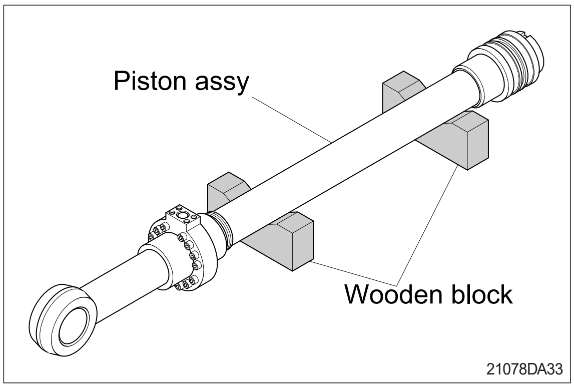
※ Since the rod assembly is heavy in this case, lift the tip of the rod assembly (2) with a crane or some means and draw it out. However, when rod assembly (2) has been drawn out to approximately two thirds of its length, lift it in its center to draw it completely.



Note that the plated surface of rod assembly (2) is to be lifted. For this reason, do not use a wire sling and others that may damage it, but use a strong cloth belt or a rope.

⑤ Place the removed rod assembly on a wooden V-block that is set level.

※ Cover a V-block with soft rag.

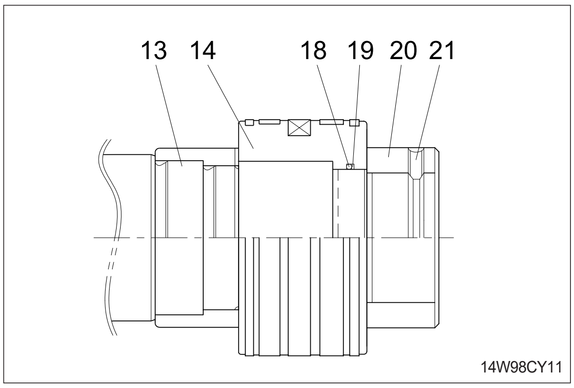


(2) Remove piston and cylinder head

① Remove set screw (21).

※ 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).

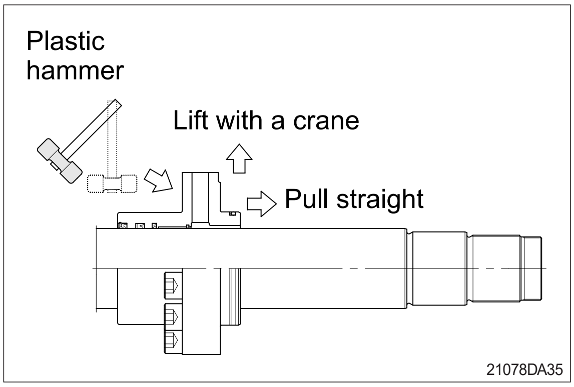


③ Remove the cylinder head assembly from rod assembly (2).

※ 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).

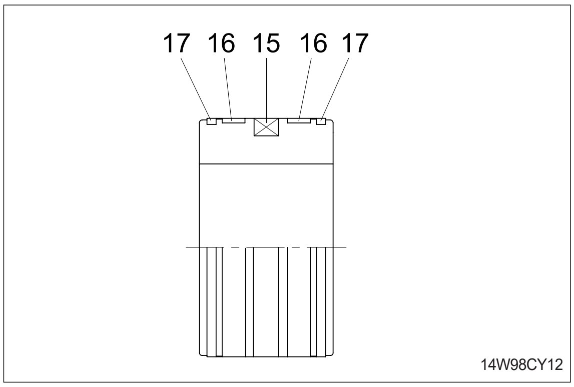


(3) Disassemble the piston assembly

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).

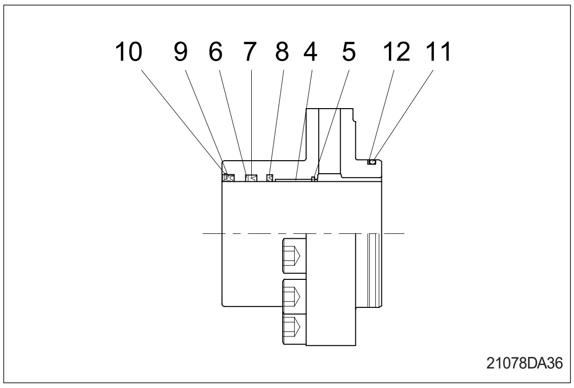
② Remove snap ring (10), dust wiper (9).

③ Remove back up ring (7), rod seal (6) and buffer ring (8).

※ Exercise care in this operation not to damage the grooves.

※ Do not remove seal and ring, if does not damaged.

※ Do not remove bushing (4).

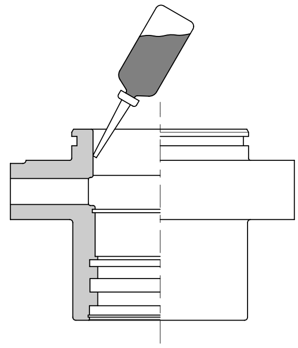


3) ASSEMBLY

(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.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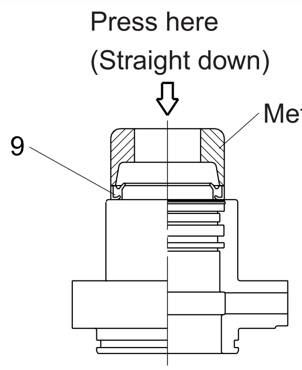
② Coat dust wiper (9) with grease and fit dust wiper (9) to the bottom of the hole of dust seal.
At this time, press a pad metal to the metal ring of dust seal.

③ Fit snap ring (10) to the stop face.

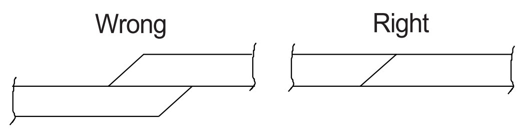


8-157(2)

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.

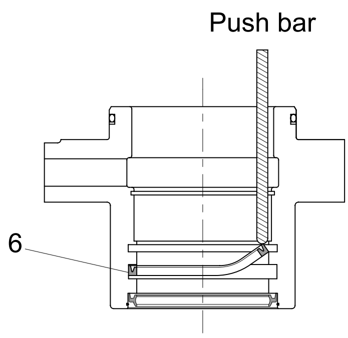
※ Insert the backup ring until one side of it is inserted into groove.



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.



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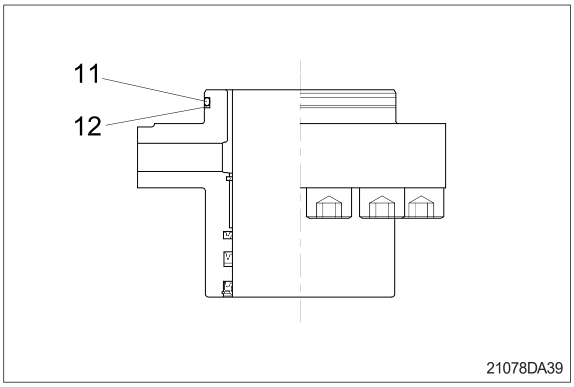
⑤ Fit back up ring (12) to gland (3).

※ Put the backup ring in the warm water of 30~50°C.

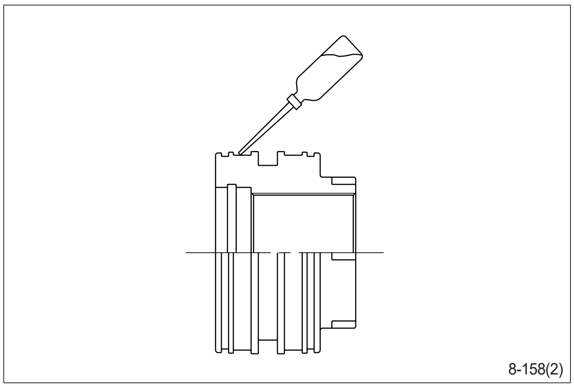
⑥ Fit O-ring (11) to gland (3).



(2) Assemble piston assembly

※ Check for scratches or rough surfaces. If found smooth with an oil stone.

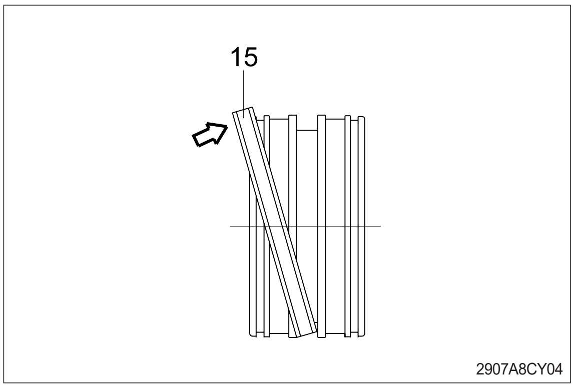
① Coat the outer face of piston (14) with hydraulic oil.



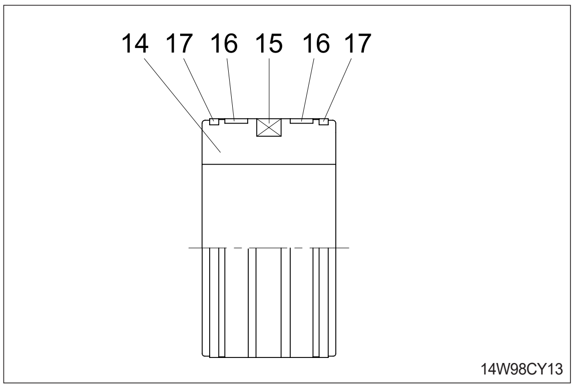
② Fit piston seal (15) to piston.

※ Put the piston seal in the warm water of 60~100°C for more than 5 minutes.

※ After assembling the piston seal, press its outer diameter to fit in.

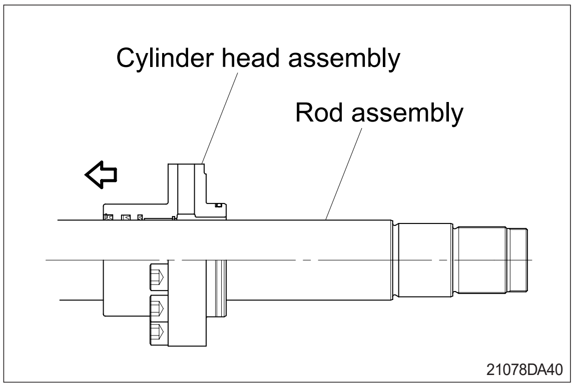


③ Fit wear ring (16) and dust ring (17) to piston (14).

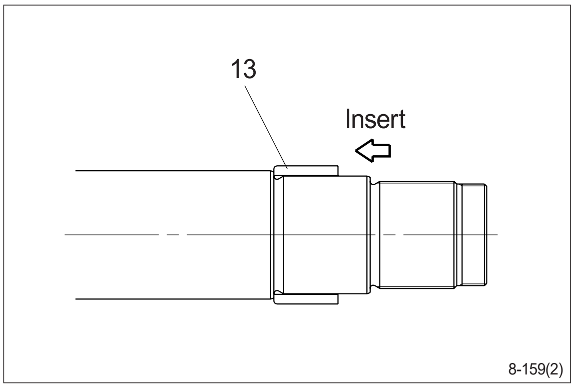


(3) Install piston and cylinder head

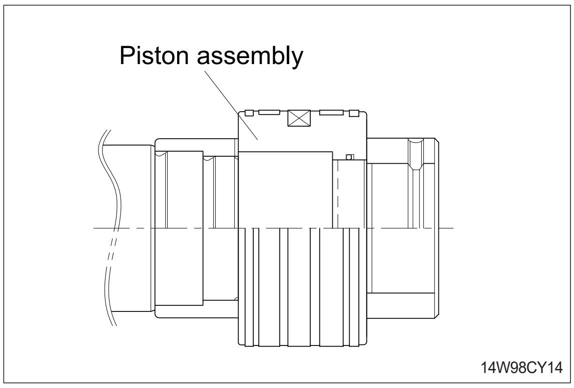
① Fix the rod assembly to the work bench.
② Apply hydraulic oil to the outer surface of rod assembly (2), the inner surface of piston and cylinder head.
③ Insert cylinder head assembly to rod assembly.



④ Insert cushion ring (13) to rod assembly.
※ Note that cushion ring (13) has a direction in which it should be fitted.

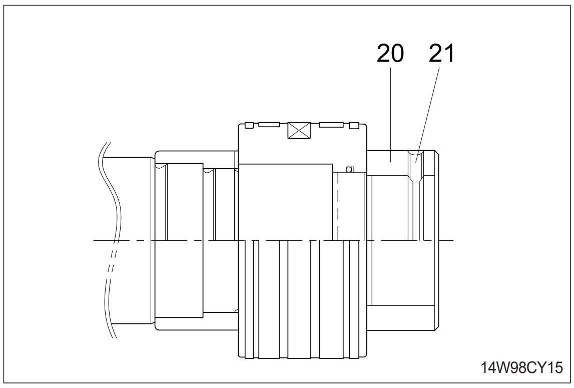


⑤ Fit piston assembly to rod assembly.
· Tightening torque : 150±15 kgf · m
(1085±108 lbf · ft)



⑥ Fit lock nut (20) and tighten the screw (21).
· Tightening torque :

Item		kgf · m	lbf · ft
20	Bucket	100±10	723±72.3
	Boom		
	Arm		
21		2.7±0.3	19.6±2.2



(3) Overall assemble

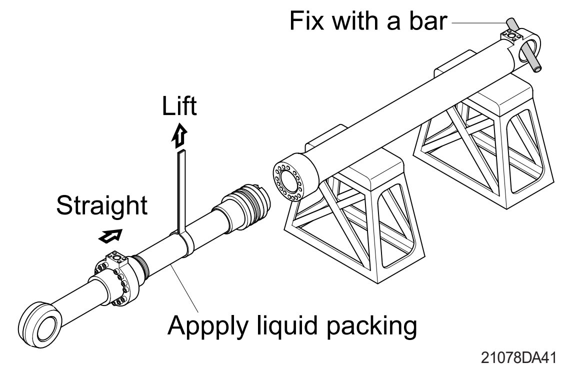
① Place a V-block on a rigid work bench. Mount the tube assembly (1) on it and fix the assembly by passing a bar through the clevis pin hole to lock the assembly.

② Insert the rod assembly in to the tube assembly, while lifting and moving the rod assembly with a crane.

※ Be careful not to damage piston seal by thread of tube assembly.

③ Match the bolt holes in the cylinder head flange to the tapped holes in the tube assembly and tighten socket bolts to a specified torque.

※ Refer to the table of tightening torque.



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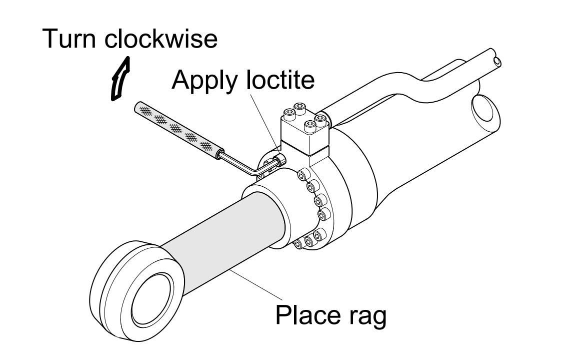

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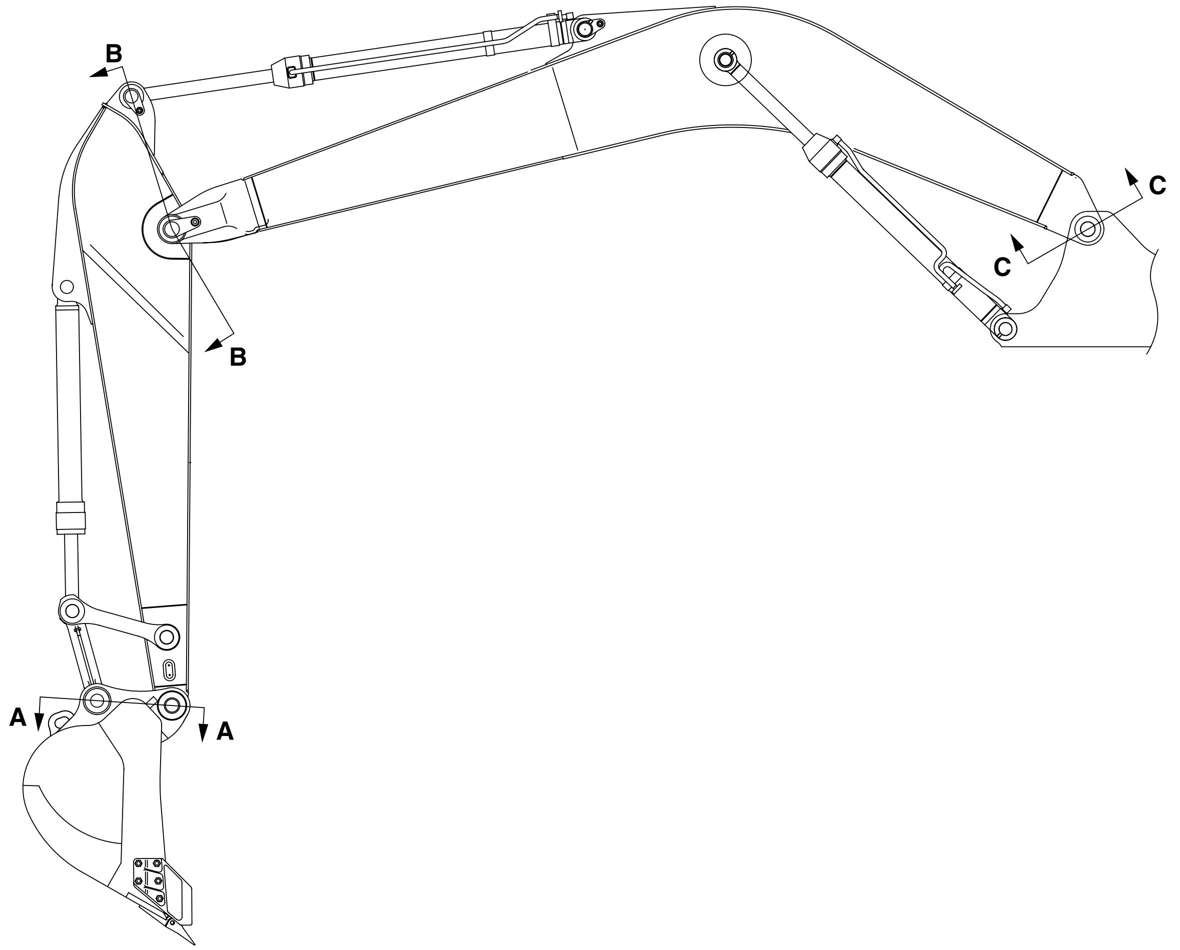
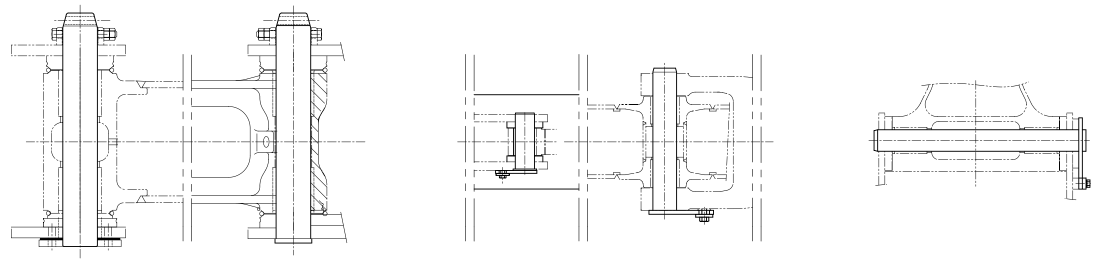
GROUP 13 WORK EQUIPMENT

1. STRUCTURE





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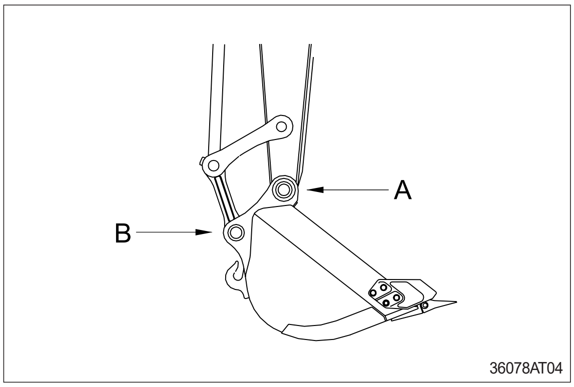
2. REMOVAL AND INSTALL

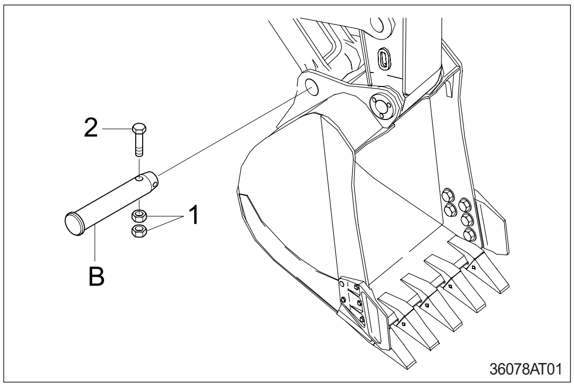
1) BUCKET ASSEMBLY

(1) Removal

① Lower the work equipment completely to ground with back of bucket facing down.

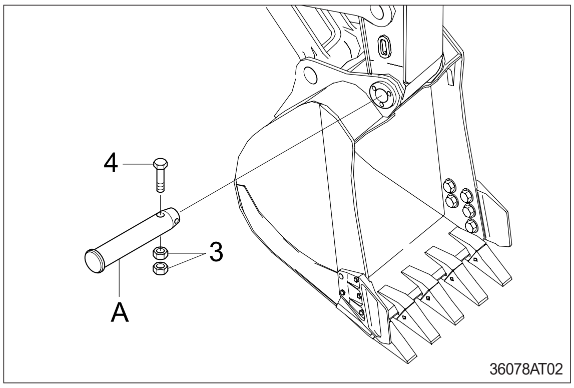


② Remove nut (1), bolt (2) and draw out the pin (B).



③ Remove nut (3), bolt (4) and draw out the pin (A) then remove the bucket assembly.

· Weight : 480 ㎏ (1060 ㏈)

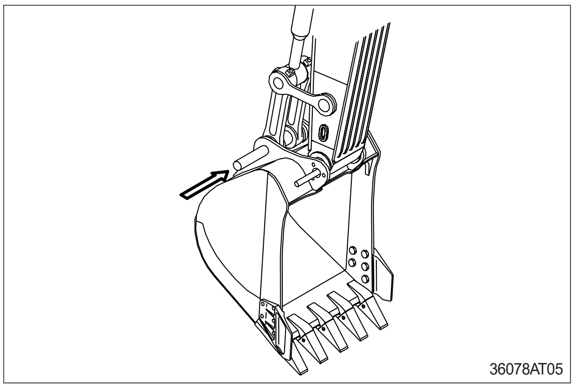


(2) Install

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.



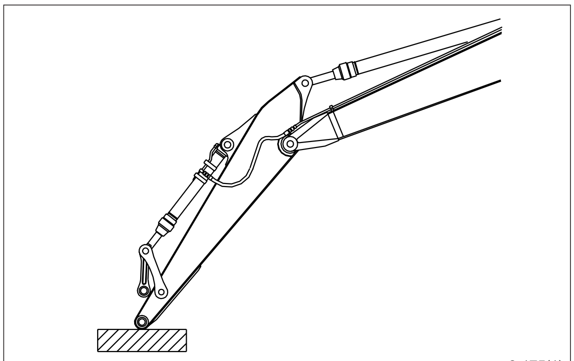
2) ARM ASSEMBLY

(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.


8-175(1)

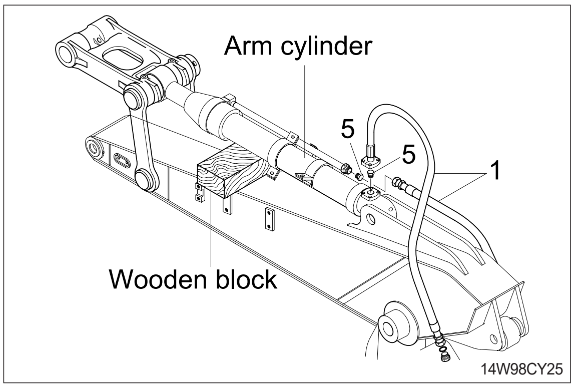
② Disconnect bucket cylinder hose (1).

⚠ **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.



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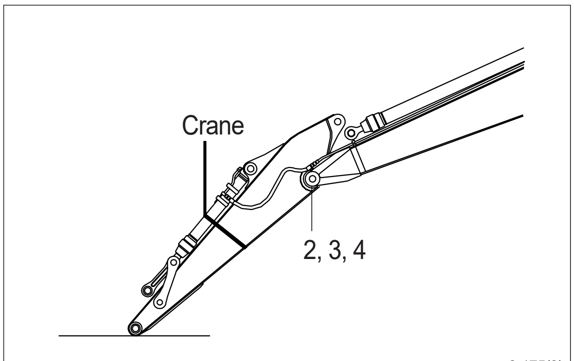
⑤ Remove bolt (2), plate (3) and pull out the pin (4) then remove the arm assembly.

※ · Weight : 385 ㎏ (850 ㏜)
When lifting the arm assembly, always lift the center of gravity.



8-175(3)

(2) Install

① Carry out installation in the reverse order to removal.

⚠ **When lifting the arm assembly, always lift the center of gravity.**

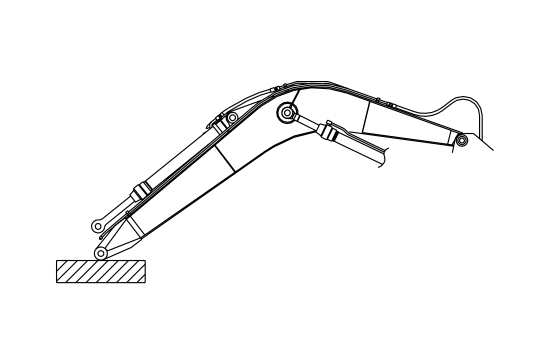
※ Bleed the air from the cylinder.

3) BOOM CYLINDER

(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.



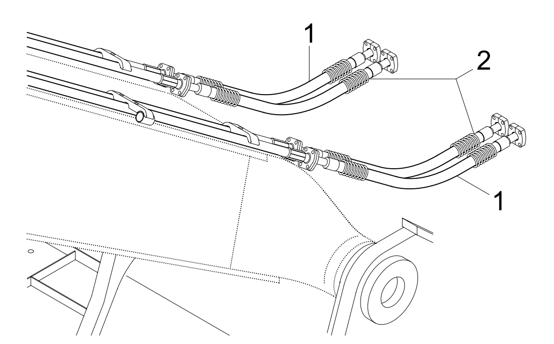
8-176(1)

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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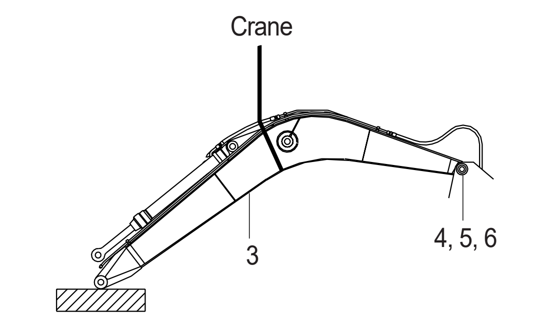
⑥ Remove bolt (4), plate (5) and pull out the pin (6) then remove boom assembly.
・Weight :760 ㎏ (1675 ㏍)

※ When lifting the boom assembly always lift the center of gravity.



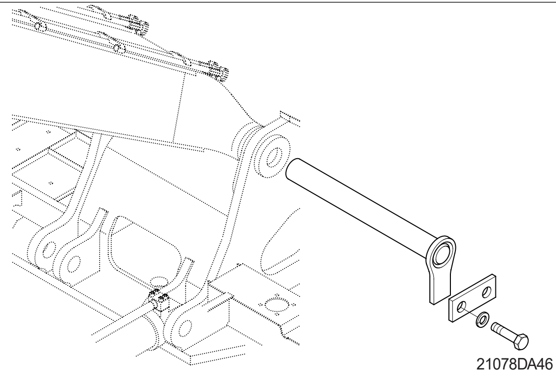
8-176(3)

(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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