CONTENTS

SECTION 8 MAST

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 gives the general information of the machine and explains the safety hints for maintenance.

SECTION 2 REMOVAL & INSTALLATION OF UNIT

This section explains the procedures and techniques of removal and installation of each component.

SECTION 3 POWER TRAIN SYSTEM

This section explains the structure of the transmission as well as control valve and drive axle.

SECTION 4 BRAKE SYSTEM

This section explains the brake piping, each component and operation.

SECTION 5 STEERING SYSTEM

This section explains the structure of the steering unit, priority valve, trail axle as well as steering circuit and operation.

SECTION 6 HYDRAULIC SYSTEM

This section explains the structure of the gear pump, main control valve as well as work equipment circuit, each component and operation.

SECTION 7 ELECTRICAL SYSTEM

This section explains the electrical circuit and each component.

It serves not only to give an understanding electrical system, but also serves as reference material for troubleshooting.

SECTION 8 MAST

This section explains the structure of mast, carriage, backrest and forks.

The specifications contained in this service manual are subject to change at any time and without any advance notice. Contact your HYUNDAI distributor for the latest information.

2. HOW TO READ THE SERVICE MANUAL

Distribution and updating

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

Filing method

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

Revised edition mark (①②③···)

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

Revisions

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

Symbols

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

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

3. CONVERSION TABLE

Method of using the Conversion Table

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

Example

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

   Convert 55 mm into inches.

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

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

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

2. Convert 550 mm into inches.

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

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

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

Millimeters to inches

ⓑ

1 mm = 0.03937 in

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

Millimeters to inches

1 mm = 0.03937in

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

Kilogram to Pound

1 kg = 2.2046lb

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

Liter to U.S. Gallon

1 ℓ = 0.2642 U.S.Gal

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

Liter to U.K. Gallon

1 ℓ = 0.21997 U.K.Gal

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

kgf · m to lbf · ft

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

bar 1	kgf/cm² 1.02	psi 14.504	MPa 0.1
88	90	1280	9
90	91	1300	9
92	94	1340	9
98	100	1420	10
110	112	1600	11
118	120	1710	12
120	122	1740	12
122	124	1770	12
127	129	1840	13
130	133	1890	13
132	135	1920	13
135	138	1960	14
140	143	2030	14
145	148	2100	14
147	150	2130	15
150	153	2180	15
157	160	2280	16
160	163	2320	16
162	165	2350	16
165	168	2390	16
167	170	2420	17
170	174	2470	17
172	176	2500	17
175	179	2540	18
177	181	2570	18
180	183	2610	18
185	188	2680	18
187	191	2710	19
190	194	2760	19
195	199	2830	20
197	200	2850	20
207	211	3000	21
210	214	3050	21
217	221	3150	22
220	224	3190	22
234	239	3400	23
414	422	6000	41

kgf/cm2 to lbf/in2

1 kgf / cm2 = 14.2233 lbf / in2

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

TEMPERATURE

Fahrenheit-Centigrade Conversion.

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

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

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

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

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

SECTION 1 GENERAL

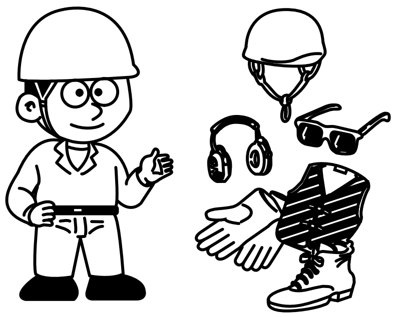
GROUP 1 SAFETY HINTS

Careless performing of the easy work may cause injuries.
Take care to always perform work safely, at least observing the following.

· Oil is a dangerous substance. Never handle oil, grease or oily clothes in places where there is any fire of flame.
  As preparation in case of fire, always know the location and directions for use of fire extinguishers and other fire fighting equipment.

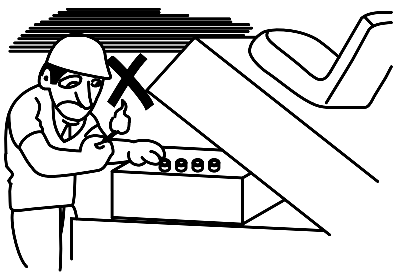
D50ASF01

· Wear well-fitting helmet, safety shoes and working clothes. When drilling, grinding or hammering, always wear protective goggles.
  Always do up safety clothes properly so that they do not catch on protruding parts of machines. Do not wear oily clothes.
  When checking, always release battery plug.



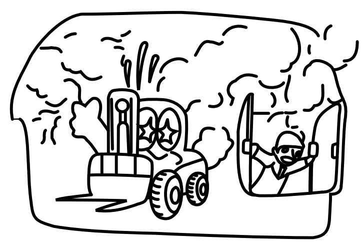
D50ASF02

· Flames should never be used instead of lamps. Never use a naked flame to check leaks or the level of oil or electrolyte.



D50ASF03

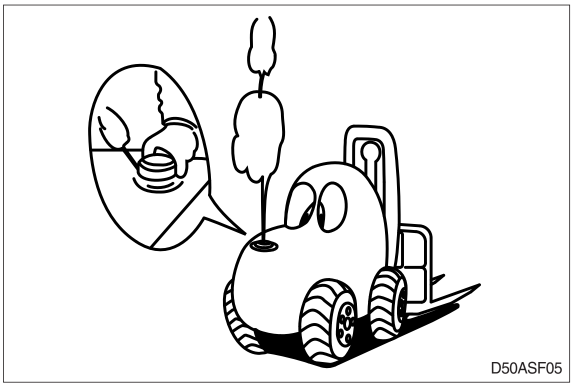
· Exhaust gas is dangerous. Provide adequate ventilation when working a closed space.



D50ASF04

⚠ Be particularly careful when removing the radiator cap and the hydraulic oil tank filler cap, if this is done immediately after using the machine, there is a danger that boiled oil may spurt out.

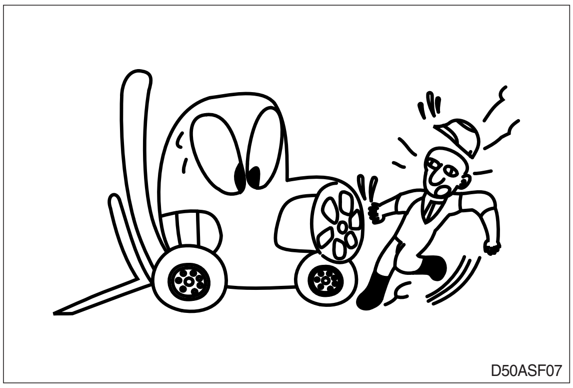
· The procedure for releasing the hydraulic pressure is as follows : lower the fork to the ground, and stop the engine (Motor), move the control levers to each position two or three times.



· When working on top of the machine, be careful not to lose your balance and fall.

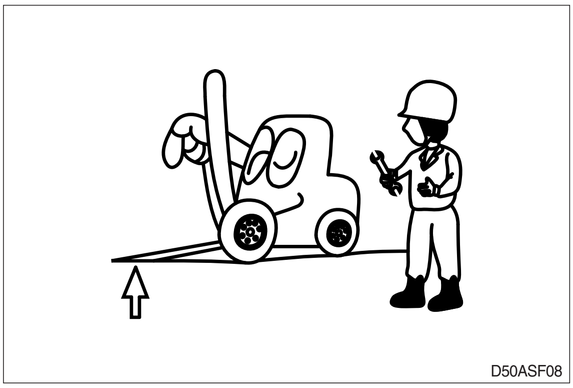
· Hand a caution sign in the operator's compartment (For example **Do not start** or **Maintenance in progress**).
  This will prevent anyone from starting or moving the machine by mistake.

⚠ It is extremely dangerous to try to check the fan belt tension while he engine is running.

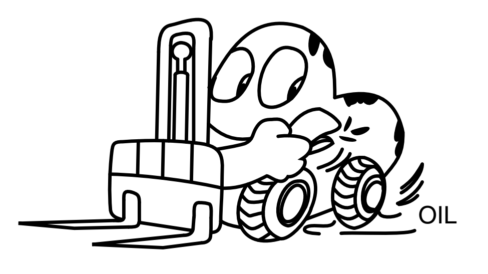


When inspecting the engine is running parts, or near such parts, always stop the engine first.
Before checking or servicing accumulator or piping, depress brake pedal repeatedLy to release pressure.

· Park the machine on firm, flat ground.
  Lower the fork to the ground and stop the engine.
  Return each lever to **NEUTRAL** and apply the brake lock.



· Immediately remove any oil or grease on the floor of the operator's compartment, or on the handrail. It is very dangerous if someone slips while on the machine.

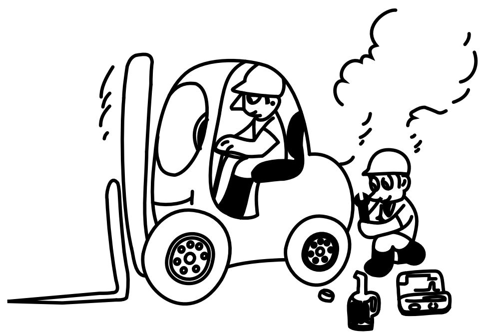


D50ASF09

· When working with others, choose a group leader and work according to his instructions. Do not perform any maintenance beyond the agreed work.

D50ASF10

· Unless you have special instructions to the contrary, maintenance should always be carried out with the engine stopped. If maintenance is carried out with the engine running, there must be two men present : one sitting in the operator's seat and the other one performing the maintenance. In such a case, never touch any moving part.


D50ASF11

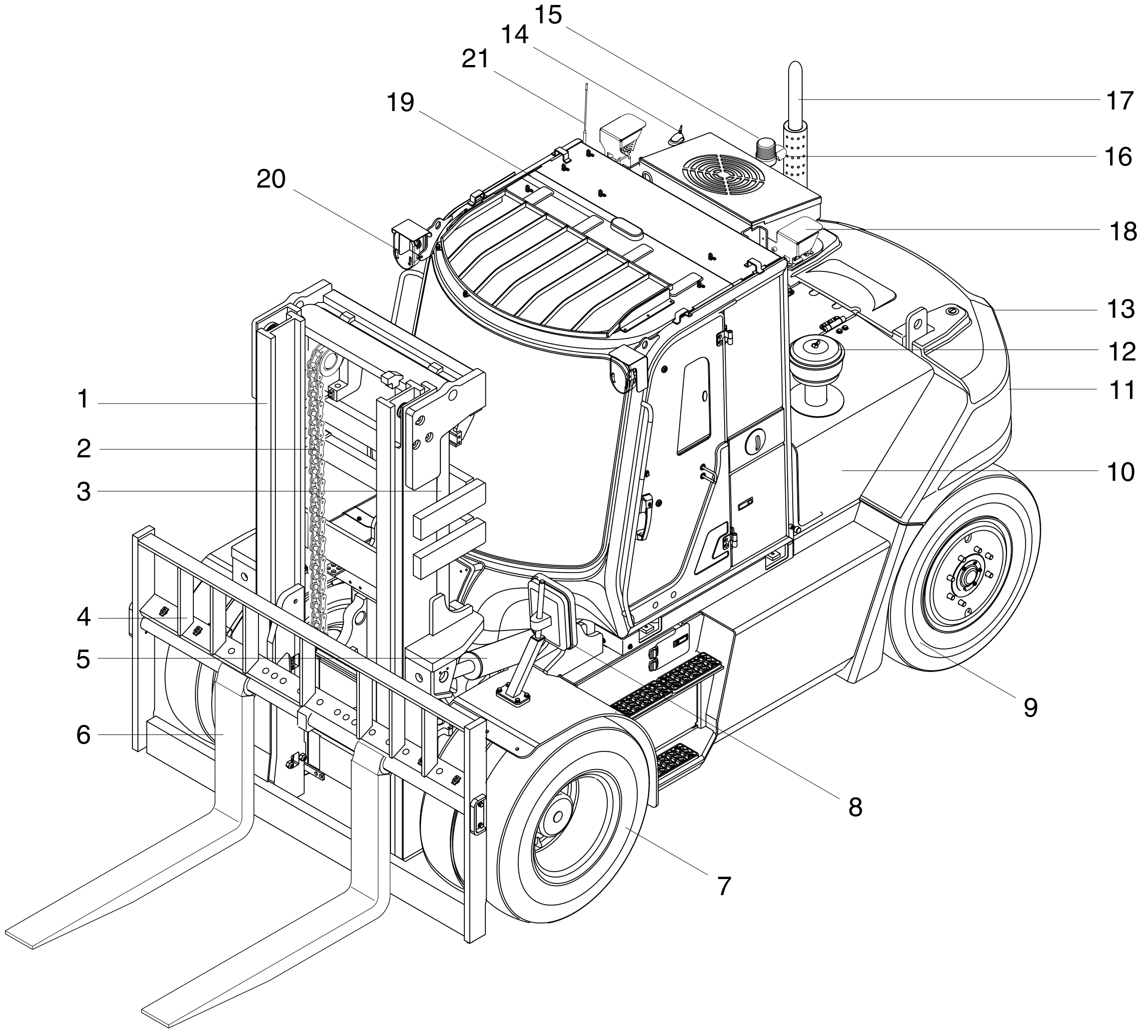
· Always remember that the hydraulic oil circuit is under pressure. When feeding or draining the oil or carrying out inspection and maintenance, release the pressure first.

· Thoroughly clean the machine. In particular, be careful to clean the filler caps, grease fittings and the area around the dipsticks. Be careful not to let any dirt or dust into the system.
· Always use HYUNDAI Forklift genuine parts for replacement.
· Always use the grades of grease and oil recommended by HYUNDAI Forklift.
Choose the viscosity specified for the ambient temperature.
· Always use pure oil or grease, and be sure to use clean containers.
· When checking or changing the oil, do it in a place free of dust, and prevent any dirt from getting into the oil.
· Before draining the oil, warm it up to a temperature of 30 to 40°C.
· After replacing oil, filter element or strainer, bleed the air from circuit.
· When the strainer is located in the oil filler, the strainer must not be removed while adding oil.
· When changing the oil filter, check the drained oil and filter for any signs of excessive metal particles or other foreign materials.
· When removing parts containing O-ring, gaskets or seals, clean the mounting surface and replace with new sealing parts.
· After injecting grease, always wipe off the oil grease that was forced out.
· Do not handle electrical equipment while wearing wet places, as this can cause electric shock.
· During maintenance do not allow any unauthorized person to stand near the machine.
· Be sure you fully understand the contents of the operation. It is important to prepare necessary tools and parts and to keep the operating area clean.
· When checking an open gear case there is a risk of dropping things in. Before removing the covers to inspect such cases, empty everything from your pockets. Be particularly careful to remove wrenches and nuts.
· Way to use dipstick
Push the dipstick fully into the guide, and then pull out.

Carrying out other difficult maintenance work carelessly can cause unexpected accidents. If you consider the maintenance is too difficult, always request the HYUNDAI Forklift distributor to carry out it.

GROUP 2 SPECIFICATIONS

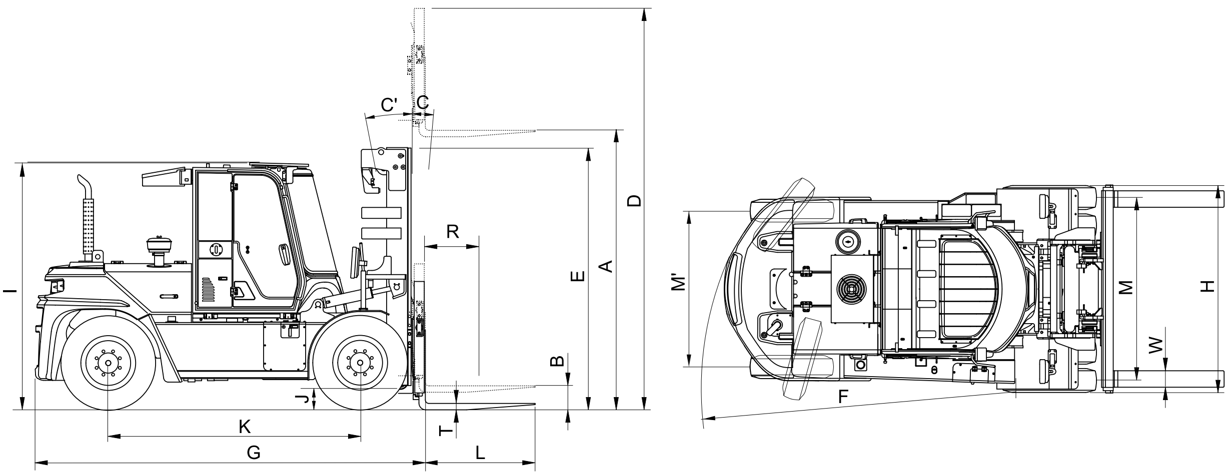
1. MAJOR COMPONENTS



100D9V3CD10

1	Mast	8	Rear view mirror	15	Beacon lamp (option)
2	Lift chain	9	Rear wheel	16	Camera (option)
3	Lift cylinder	10	Body wing cover	17	Silencer
4	Carriage and backrest	11	Rear combination lamp	18	Rear work lamp
5	Tilt cylinder	12	Preclenaer	19	Cabin
6	Fork	13	Counterweight	20	Head and turn signal lamp
7	Front wheel	14	Mobile antenna	21	Antenna

2. SPECIFICATIONS



100D9V8SP01

Model			Unit	100D-9V
Capacity			kg (lb)	10000 (22000)
Load center		R	mm (in)	600 (24")
Weight(Unloaded)			kg (lb)	13125 (28936)
Fork	Lifting height	A	mm (ft·in)	3025 (9' 11")
	Free lift	B	mm (in)	150 (5.9)
	Lifting speed (Unload/Load)		mm/sec (ft/min)	500/440 (98.4/86.6)
	Lowering speed (Unload/Load)			500/500 (98.4/98.4)
	L×W×T	L,W,T	mm (in)	1200×180×75(47.2×7×3)
	Carriage width	N	mm (in)	2265 (89.2)
Mast	Tilt angle (forward/backward)	C/C’	degree	15/10
	Max. height	D	mm (ft·in)	4360 (14' 4")
	Min. height	E	mm (ft·in)	2850 (9' 4")
Body	Travel speed (Unload)		km/h (mph)	32.7 (20.3)
	Gradeability (Load)		%	34
	Min. turning radius (Outside)	F	mm (ft·in)	3965 (13' 0")
ETC	System set pressure		bar (psi)	226 (3271)
Overall length		G	mm (ft·in)	4265 (14' 0")
Overall width		H	mm (ft·in)	2265 (7' 5")
Cabin height		I	mm (ft·in)	2680 (8' 10")
Ground clearance		J	mm (in)	250 (9.8)
Wheel base		K	mm (ft·in)	2750 (9' 0")
Wheel tread front/rear		M/M'	mm (ft·in)	1693/1700 (5' 7"/5' 7")

3. SPECIFICATION FOR MAJOR COMPONENTS

1) ENGINE

Item	Unit	Specification
Model	–	Cummins F3.8
Type	–	Vertical, 4 cycle DI, EU Stage V diesel engine
Cooling Method	–	Water cooling
Number of cylinders and arrangement	–	4 cylinders, In-line
Firing order	–	1-3-4-2
Combustion chamber type	–	Direct injection
Cylinder bore X stroke	mm (in)	102×115 (4.0×4.5)
Piston displacement	cc (cu in)	3726 (227.4)
Compression ratio	–	17.2 : 1
Rated gross horse power	ps/rpm	122.4/2200
Maximum torque at rpm	kgf·m/rpm	51/1500
Engine oil quantity	ℓ (U.S. gal)	12 (3.17)
Dry weight	kg (lb)	360 (794)
High idling speed	rpm	2450
Low idling speed	rpm	850
Rated fuel consumption	g/kWh	217
Starting motor	V-kW	24-4.8
Alternator	V-A	28-70
Battery	V-AH	24-80

2) MAIN PUMP

Item	Unit	Specification	
Type	–	Axial piston variable pump	Gear fixed pump
Model	–	Casspa MVP	Casspa PLP
Displacement	cc/rev (in^3/rev)	67 (4.1)	9.17 (0.56)
Maximum operating pressure	bar (psi)	280 (4060)	250 (3625)
Rated speed (Max/Min)	rpm	2700/600	
Weight	kgf (lbf)	31.6 (69.7)	

3) MAIN CONTROL VALVE (MCV)

Item	Unit	Specification
Type	–	Mono block (3spool), Semi-Mono block (4 / 5spool)
Model	–	Buchholz NG16
Opearating method	-	Hydraulic pilot
Maximum flow rated (lift/lower, tilt)	lpm (U.S. gpm)	170 (45), 60 (16)
Lift/tilt relief valve set pressure (DV1)	bar (psi)	210 (3050)
Attachment oil flow rated (aux1/2/3)	lpm (U.S. gpm)	110 / 110 / 110 (29 / 29 / 29)
Attachment relief valve pressure (DV2)	bar (psi)	140 ~ 190 (2030 ~ 2760)
Built-in accessories valve	-	· Manual fork lowering valve (Emergency function) · Adj. max. fork lowering speed, Lower breake valve · Overcenter valve (tilt A2), Priority valve (steering)
Weight	kgf (lbf)	3 spool : 28 (61.7), 4 spool : 36 (79.4), 5 spool : 43 (94.8)

4) STEERING UNIT

Item	Unit	Specification
		100D-9V
Type	–	Load sensing
Model	–	VSP 200 LSH
Capacity	cc/rev (in^3/rev)	200 (12.2)
Steering relief valve set pressure	bar (psi)	160 ~ 165 (2320 ~ 2390)
Weight	kgf (lbf)	5.5 (12)

5) CYLINDER

Index			Unit	Specification
				100D-9V
Main lift	V300	Tube bore diameter × Rod diameter × Stroke	mm (in)	85×60×1475 (3.34×2.36×58.1)
Main lift	TS450			85×60×1463 (3.34×2.36×57.6)
Free lift				95×70×767 (3.74×2.76×30.2)
Tilt (15/10 degree)				115×60×307 (4.53×2.36×12.09)
Steering				85×55×149.5 (3.35×2.16×5.89)
Weight	Lift	V300	kgf (lbf)	68.1 (150)
	Tilt	15/10 degree		48 (106)

6) POWER TRAIN DEVICE

Item			Specification		
			100D-9V		
Torque converter	Type		3 Element, 1 stage, 2 phases		
	Stall ratio		2.395 : 1		
Transmission	Model		ZF 3WG94		
	Type		Full auto, power shift		
	Gear shift (F/R)		3/3		
	Adjustment		Electrical single lever type		
	Overhaul ratio	FR	1 : 4.714	2 : 2.341	3 : 0.974
		RR	1 : 4.711	2 : 2.340	3 : 0.974
Axle	Type		Front-wheel drive type, fixed location		
	Gear ratio		12.86		
	Gear		Ring & pinion gear type		
Wheels	Q'ty (FR/RR)		Double : 4/2		
	Front (drive)		9.00-20-14 PR		
	Rear (steer)		9.00-20-14 PR		
Brakes	Travel		Front wheel, wet disc brake		
	Parking		Calliper disc, SHAR (Spring Actuate Hydraulic Release) type		
Steering	Type		Full hydraulic, power steering		
	Steering angle		75.87° to both right and left angle, respectively		

4. TIGHTENING TORQUE FOR MAJOR COMPONENTS

NO	Item		Size	kgf · m	lbf · ft
1	Engine	Engine mounting bolt	M12×1.25	12.3±3.0	89±21.7
2		Engine bracket mounting nut	M10×1.5	6.9±1.4	50±10.1
3		Radiator mounting bolt, nut	M10×1.5	6.9±1.4	50±10.1
4	Hydraulic system	Hydraulic pump mounting bolt	M16×2.0	19±2	138±14.5
5		MCV mounting bolt	M 8×1.25	2.5±0.5	18±3.6
6		Steering unit mounting bolt	M10×1.5	4±0.5	29±3.6
7		Tilt cylinder; rod-end bolt, nut	M20×2.5	58±6	420±43.4
8		Tilt cylinder pin; mounting bolt	M10×1.5	6.9±1.4	50±10.1
9	Power train system	Transmission mounting bolt, nut	M16×2.0	60.5±5.5	438±39.8
10		Torque converter mounting bolt	M10×1.5	6.9±1.4	50±10
11		Drive axle mounting bolt, nut	M27×3.0	150±15	1085±109
12		Propeller shaft (to axle and TM)	3/8-24 UNF	7.0±0.7	50.6±5.1
13		Steering axle mounting bolt, nut	M18×2.5	41.3±6.2	299±44.8
14		Front and rear wheel mounting nut	M22×1.5	62.0±9.3	448±67.3
15	Others	Counterweight mounting bolt	M30×3.5	100±15	723±108
16		Operator's seat mounting nut	M 8×1.25	2.5±0.5	18.1±3.6
17		Cabin mounting bolt	M12×1.75	12.8±3.0	92.6±21.7
18		Mast mounting bolt	M20×2.5	57.9±8.7	419±63

5. TORQUE CHART

Use following table for unspecified torque.

1) BOLT AND NUT

(1) Coarse thread

Bolt size	8.8T		10.9T		12.9T	
	kgf · m	lbf · ft	kgf · m	lbf · ft	kgf · m	lbf · ft
M 6×1.0	0.8 ~ 1.2	5.8 ~ 8.6	1.2 ~ 1.8	8.7 ~ 13.0	1.5 ~ 2.1	10.9 ~ 15.1
M 8×1.25	2.0 ~ 3.0	14.5 ~ 21.6	2.8 ~ 4.2	20.3 ~ 30.4	3.4 ~ 5.0	24.6 ~ 36.1
M10×1.5	4.0 ~ 6.0	29.0 ~ 43.3	5.6 ~ 8.4	40.5 ~ 60.8	6.8 ~ 10.0	49.2 ~ 72.3
M12×1.75	6.8 ~ 10.2	50.0 ~ 73.7	9.6 ~ 14.4	69.5 ~ 104	12.3 ~ 16.5	89.0 ~ 119
M14×2.0	10.9 ~ 16.3	78.9 ~ 117	16.3 ~ 21.9	118 ~ 158	19.5 ~ 26.3	141 ~ 190
M16×2.0	17.9 ~ 24.1	130 ~ 174	25.1 ~ 33.9	182 ~ 245	30.2 ~ 40.8	141 ~ 295
M18×2.5	24.8 ~ 33.4	180 ~ 241	34.8 ~ 47.0	252 ~ 340	41.8 ~ 56.4	302 ~ 407
M20×2.5	34.9 ~ 47.1	253 ~ 340	49.1 ~ 66.3	355 ~ 479	58.9 ~ 79.5	426 ~ 575
M22×2.5	46.8 ~ 63.2	339 ~ 457	65.8 ~ 88.8	476 ~ 642	78.9 ~ 106	570 ~ 766
M24×3.0	60.2 ~ 81.4	436 ~ 588	84.6 ~ 114	612 ~ 824	102 ~ 137	738 ~ 991
M30×3.5	120 ~161	868 ~ 1164	168 ~ 227	1216 ~ 1641	202 ~ 272	1461 ~ 1967

(2) Fine thread

Bolt size	8.8T		10.9T		12.9T	
	kgf · m	lbf · ft	kgf · m	lbf · ft	kgf · m	lbf · ft
M 8×1.0	2.1 ~ 3.1	15.2 ~ 22.4	3.0 ~ 4.4	21.7 ~ 31.8	3.6 ~ 5.4	26.1 ~ 39.0
M10×1.25	4.2 ~ 6.2	30.4 ~ 44.9	5.9 ~ 8.7	42.7 ~ 62.9	7.0 ~ 10.4	50.1 ~ 75.2
M12×1.25	7.3 ~ 10.9	52.8 ~ 78.8	10.3 ~ 15.3	74.5 ~ 110	13.1 ~ 17.7	94.8 ~ 128
M14×1.5	12.4 ~ 16.6	89.7 ~ 120	17.4 ~ 23.4	126 ~ 169	20.8 ~ 28.0	151 ~ 202
M16×1.5	18.7 ~ 25.3	136 ~ 182	26.3 ~ 35.5	191 ~ 256	31.6 ~ 42.6	229 ~ 308
M18×1.5	27.1 ~ 36.5	196 ~ 264	38.0 ~ 51.4	275 ~ 371	45.7 ~ 61.7	331 ~ 446
M20×1.5	37.7 ~ 50.9	273 ~ 368	53.1 ~ 71.7	384 ~ 518	63.6 ~ 86.0	460 ~ 622
M22×1.5	51.2 ~ 69.2	370 ~ 500	72.0 ~ 97.2	521 ~ 703	86.4 ~ 116	625 ~ 839
M24×2.0	64.1 ~ 86.5	464 ~ 625	90.1 ~ 121	652 ~ 875	108 ~ 146	782 ~ 1056
M30×2.0	129 ~ 174	933 ~ 1258	181 ~ 245	1310 ~ 1772	217 ~ 294	1570 ~ 2126

2) PIPE AND HOSE (FLARE TYPE)

Hose size	Thread (PF)	Hex. across flat (mm)	Tightening torque	
			kgf·m	lbf·ft
1/4"	1/4	19	4	28.9
3/8"	3/8	22	5	36.2
1/2"	1/2	27	9.5	68.7
3/4"	3/4	36	18	130.2
1"	1	41	21	151.9
1-1/4"	1-1/14	50	35	253.2

3) PIPE AND HOSE (ORFS TYPE)

Hose size	Thread (UN/UNF/UNS)	Hex. across flat (mm)	Tightening torque	
			kgf·m	lbf·ft
1/4"	9/16-18	19	3	21.7
3/8"	11/16-16	22	5	36.2
1/2"	13/16-16	24	7	50.6
5/8"	1-14	30	12	86.8
3/4"	1-3/16-12	36	18	130.2
1"	1-7/16-12	41	23	166.4
1-1/4"	1-11/16-12	50	28	202.5
1-1/2"	2-12	58	32	231.1

4) FITTING (O-RING SEAL TYPE)

Hose size	Thread (UN/UNF)	Hex. across flat (mm)	Tightening torque	
			kgf·m	lbf·ft
1/4"	7/16-20	17	2	14.5
3/8"	9/16-18	19	3	21.7
1/2"	3/4-16	22	4	28.9
		24	6	43.4
5/8"	7/8-14	27	10	72.3
		30	12	86.8
3/4"	1-1/16-12	32	15	108.5
		36	18	130.2
1"	1-5/16-12	41	23	166.4
1-1/4"	1-5/8-12	50	28	202.5
1-1/2"	1-7/8-12	55	32	231.5

5) BAND CLAMP

Tag No.	Hose size (mm)	Band width (mm)	Tightening torque	
			kgf·m	lbf·ft
S20-15	8 ~ 14	9	0.3	2.17
S20-17	11 ~ 17			
S20-22	13 ~ 20		0.35	2.53
S20-25	15 ~ 24			
S20-28	19 ~ 28			
S20-32	22 ~ 32	12		
S20-40	26 ~ 38	9	0.42	3.04
S20-45	32 ~ 44			

6) BAND CLAMP (IDEAL, FLEX GEAR TYPE)

Tag No.	Hose size (mm)	Band width (mm)	Tightening torque	
			kgf·m	lbf·ft
41-212	32 ~ 54	15.9	1.1	8.0
41-262	45 ~ 67			
41-312	57 ~ 79			
41-362	40 ~ 92			
41-412	83 ~ 105			
41-462	95 ~ 117			
41-512	108 ~ 130			

6. WRENCH AND SPANEER CHART

No.	Wrench & Spanner			Thread			PIPE AND HOSE	
	inch		mm	UNF/UN	M	PF/G	ORFS (UNF/UN)	FLARE (PF)
1	-	0.050	1.3	-	-	-	-	-
2	-	0.059	1.5	-	-	-	-	-
3	1/16	0.063	1.6	-	-	-	-	-
4	5/64	0.078	2	-	-	-	-	-
5	3/32	0.094	2.4	-	-	-	-	-
6	-	0.098	2.5	-	-	-	-	-
7	7/64	0.109	2.8	-	-	-	-	-
8	-	0.118	3	-	-	-	-	-
9	1/8	0.125	3.2	-	-	-	-	-
10	9/64	0.141	3.5	-	-	-	-	-
11	5/32	0.156	4	-	-	-	-	-
12	-	0.177	4.5	-	-	-	-	-
13	3/16	0.188	4.8	-	-	-	-	-
14	-	0.197	5	-	-	-	-	-
15	13/64	0.203	5.2	-	-	-	-	-
16	7/32	0.219	5.5	-	-	-	-	-
17	15/64	0.234	6	-	-	-	-	-
18	1/4	0.250	6.4	-	-	-	-	-
19	17/64	0.266	6.8	-	-	-	-	-
20	9/32	0.281	7	-	-	-	-	-
21	5/16	0.313	8	-	-	-	-	-
22	11/32	0.344	8.7	-	-	-	-	-
23	-	0.354	9	-	-	-	-	-
24	3/8	0.375	9.5	-	-	-	-	-
25	-	0.394	10	-	-	-	-	-
26	-	-	11	-	-	-	-	-
27	7/16	0.438	11.1	-	-	-	-	-
28	15/32	0.469	12	-	-	-	-	-
29	1/2	0.500	12.7	-	-	-	-	-
30	-	-	13	-	-	-	-	-
31	17/32	0.53	13.5	-	-	-	-	-
32	-	0.55	14	7/16-20	-	-	-	-
33	9/16	0.56	14.3	-	-	-	-	-
34	19/32	0.59	15	-	-	-	-	-
35	5/8	0.63	15.9	-	-	-	-	-
36	-	-	16	-	-	-	-	-
37	21/32	0.66	16.7	-	-	-	-	-

No.	Wrench & Spanner			Thread			PIPE AND HOSE	
	inch		mm	UNF/UN	M	PF/G	ORFS (UNF/UN)	FLARE (PF)
38	-	-	17	-	M12	-	-	-
39	11/16	0.69	17.5	-	-	-	-	-
40	-	-	18	-	-	-	-	-
41	3/4	0.75	19	9/16-18	M14	G1/4	9/16-18	PF1/4
42	25/32	0.78	19.8	-	-	-	-	-
43	-	-	20	-	-	-	-	-
44	13/16	0.81	20.6	-	-	-	-	-
45	-	-	21	-	-	-	-	-
46	-	-	22	-	M16	G3/8	11/16-16	PF3/8
47	7/8	0.88	22.2	-	-	-	-	-
48	29/32	0.91	23	-	-	-	-	-
49	15/16	0.94	23.8	-	-	-	-	-
50	-	-	24	3/4-16	M18	-	13/16-16	-
51	31/32	0.97	26.4	-	-	-	-	-
52	-	-	25	-	-	-	-	-
53	1	1.00	25.4	-	-	-	-	-
54	-	-	26	-	-	-	-	-
55	1 1/16	1.06	27	7/8-14	M22	G1/2	-	PF1/2
56	-	-	28	-	-	-	-	-
57	1 1/8	1.13	28.6	-	-	-	-	-
58	-	-	29	-	-	-	-	-
59	-	-	30	-	-	-	1-14	-
60	1 3/16	1.19	30.2	-	-	-	-	-
61	-	-	31	-	-	-	-	-
62	1 1/4	1.25	31.8	-	-	-	-	-
63	-	-	32	1-1/16-12	M24	G3/4	-	-
64	-	-	33	-	-	-	-	-
65	1 5/16	1.31	33.3	-	-	-	-	-
66	-	-	34	-	-	-	-	-
67	1 3/8	1.38	35	-	-	-	-	-
68	-	-	36	1-3/16-12	M27	G3/4	1-3/16-12	PF3/4
69	1 7/16	1.44	37	-	-	-	-	-
70	1 1/2	1.50	38	-	-	-	-	-
71	-	-	39	-	-	-	-	-
72	1 9/16	1.56	39.7	-	-	-	-	-
73	-	-	40	-	-	-	-	-
74	-	-	41	1-5/16-12	M33	G1	1-7/16-12	PF1
75	1 5/8	1.63	41.3	-	-	-	-	-

No.	Wrench & Spanner			Thread			PIPE AND HOSE	
	inch		mm	UNF/UN	M	PF/G	ORFS (UNF/UN)	FLARE (PF)
76	1 11/16	1.69	43	-	-	-	-	-
77	1 3/4	1.75	44	-	-	-	-	-
78	1 13/16	1.81	46	-	-	-	-	-
79	1 7/8	1.88	47.6	-	-	-	-	-
80	-	-	48	-	-	-	1-11/16-12	-
81	1 15/16	1.94	49.2	-	-	-	-	-
82	-	-	50	1-5/8-12	-	G1-1/4	-	PF1-1/4
83	2	2.00	50.8	-	-	-	-	-
84	-	-	51	-	-	-	-	-
85	2 1/8	2.13	54	-	-	-	-	-
86	-	-	55	1-7-8-12	-	G1-1/2	-	PF1-1/2
87	-	-	57	-	-	-	2-12	-
88	2 1/4	2.25	57.2	-	-	-	-	-
89	-	-	60	-	-	-	-	-

7. RECOMMENDED LUBRICANTS

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	12 (3.17)	★SAE 5W-40 SAE 10W SAE 10W-30 SAE 5W-30 SAE 15W-40 SAE 30
Torque converter transmission	Transmission oil	20 (5.3)	Huyndai oilbank xteer THF 75W-80
Axle	Gear oil	13 (3.43)	SAE 80W-90
Brake	Cooling oil	22 (5.8)	Huyndai oilbank xteer THF 75W-80
Hydraulic oil tank	Hydraulic oil	125 (33)	★ISO VG 15 ISO VG 32 ISO VG 46 ISO VG 68
Cabin tilt hand pump	Hydraulic oil	0.7 (0.2)	
Fuel tank	Diesel fuel★1	171.5 (45.3)	★ASTM D975 NO.1 ASTM D975 NO.2
Fitting (Grease nipple)	Grease	-	★NLGI NO.1 NLGI NO.2
Radiator	Antifreeze : Water	14.2 (3.75)	Ethylene glycol base permanent type (50:50) ★Ethylene glycol base permanent type (60 : 40)
DEF/AdBlue® tank	Mixture of urea and deionized water	43 (11.4)	ISO 22241 (High-purity urea + deionized water (32.5:67.5))

NOTES :
- Engine oil should be API service class CK-4.
- Change the type of engine oil according to the ambient temperature.
- When using oil of different brands from the previous one, be sure to drain all the previous oil before adding the new engine oil.

★1 : Ultra low sulfur diesel
- sulfur content ≤ 15 ppm

★ : Cold region
Russia, CIS, Mongolia

GROUP 3 PERIODIC REPLACEMENT

For operation safety, never fail to perform periodic maintenance or make periodic replacement of the consumable parts listed in the following.
These parts may deteriorate in time and are susceptible to wear. It is difficult to estimate the degree of wear at time of periodic maintenance; therefore, even if no apparent wear is found, always replace with new parts within the prescribed period of replacement (Or earlier if trouble is found).
Note that periodic replacement has nothing to do with guarantee service.

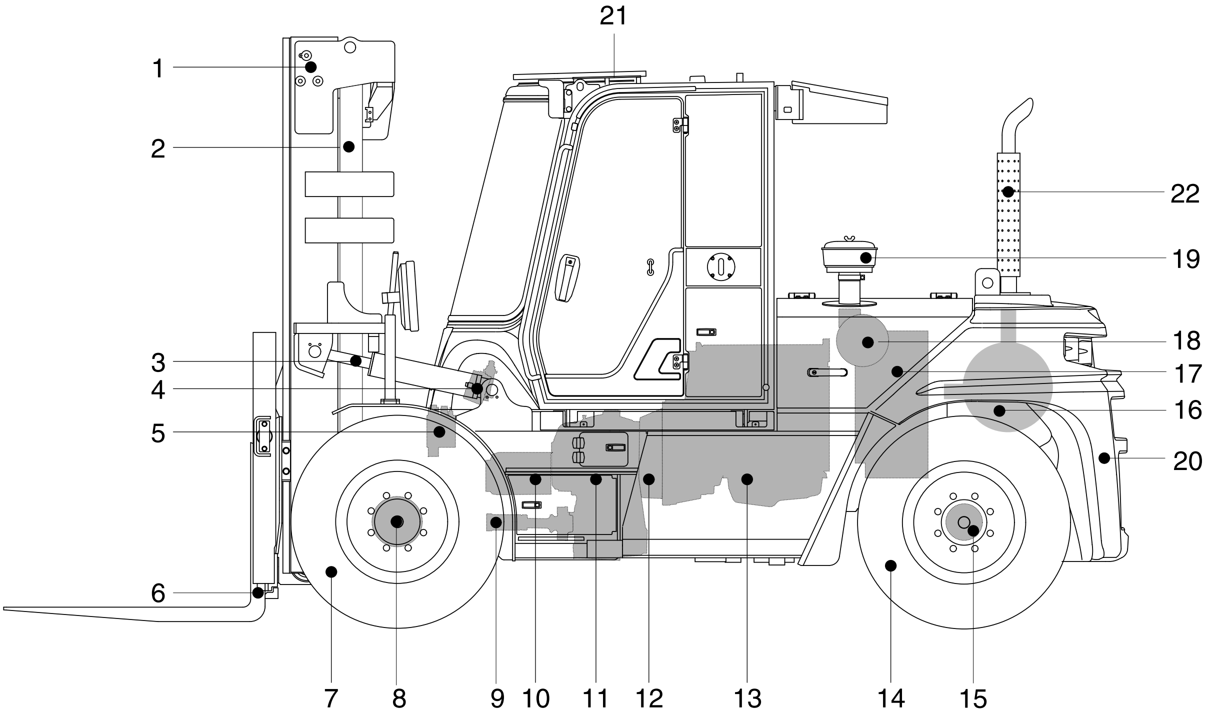
No.	Periodical replacement of safety parts	Interval
1	Lift cylinder hose	Every 1 year (harsh operation) Every 2 years (normal operation)
2	Tilt cylinder hose	
3	Side shift cylinder hose	
4	Brake hose	
5	Hydraulic pump hose	Every 2 years
6	Power steering hose	
7	Coolant hose and clamps	
8	Fuel hose	Every 2 years (harsh operation) Every 4 years (normal operation)
9	Packing, seal, and O-ring of steering cylinder	
10	Lift chain	
11	Hydraulic pump seal kit	Every 3 years
12	Pressure sensor	Every 5 years
13	Mast accmulator (piston type)	Every 10 years

※ Replace the O-ring and gasket at the same time when replacing the hose.
※ Replace clamp at the same time if the hose clamp is cracked when checking and replacing hose.
※ Normal operation
- Eight hour material handling, mostly in buildings or in clean, open air on clean paved surfaces.

※ Harsh operation
- All harsh working environment
- Long term heavy load operation
- High and low temperature working environment
- Sudden change in temperature
- Dusty or sandy working environment
- Highly corrosive chemical working environment
- Damp working environment

SECTION 2 REMOVAL & INSTALLATION OF UNIT

GROUP 1 STRUCTURE



1	Mast	9	Propeller shaft	17	Radiator
2	Lift cylinder	10	Hydraulic pump	18	Air cleaner
3	Tilt cylinder	11	Transmission	19	Precleaner
4	Steering unit	12	Torque converter	20	Counterweight
5	Main control valve	13	Engine	21	Cabin
6	Fork	14	Rear wheel	22	Silencer
7	Front wheel	15	Steering axle		
8	Drive axle	16	Aftertreatment		

GROUP 2 REMOVAL AND INSTALLATION OF UNIT

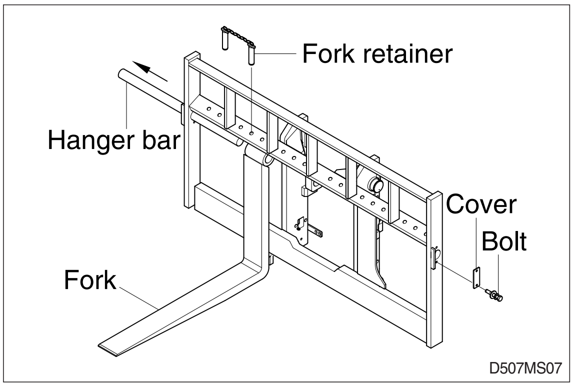
Remove and install following units as explained in the flow chart.

1. MAST

1) REMOVAL

Fork — Carriage — Piping — Mast

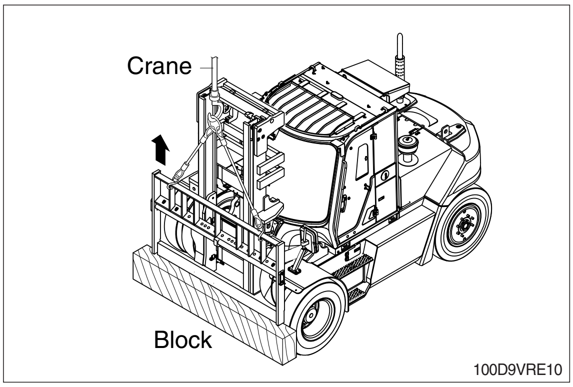
(1) SHAFT TYPE FORKS



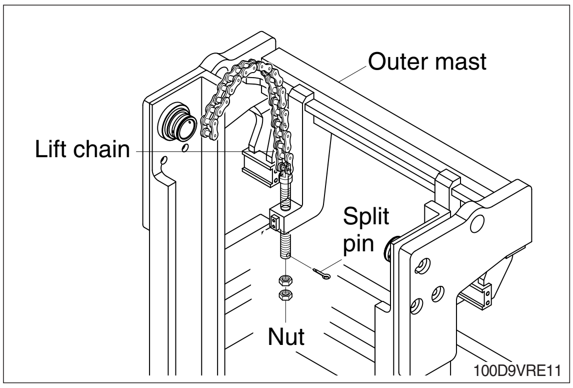
① Lower the fork carriage until the forks are approximately 25 mm (1 in) from the floor.
② Release fork retainer and remove cover.
③ Slide one hanger bar at a time out of carriage assembly.
④ Remove only one fork at a time.
※ On larger forks it may be necessary to use a block of wood.

(2) CARRIAGE

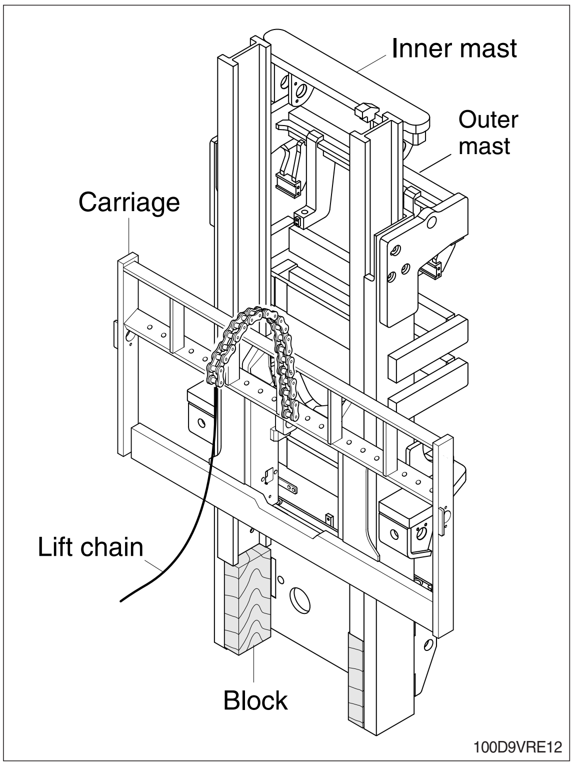
① With the mast vertical, raise the carriage high enough to place blocks under the load forks. This is done to create slack in the load chains when the carriage is lowered. Lower the carriage all the way down to the floor. Make sure the carriage is level, this will prevent any binding when the mast is raised.



② While supporting lift chains, remove the split pin and nuts from the chain anchor bolts of stationary upright.



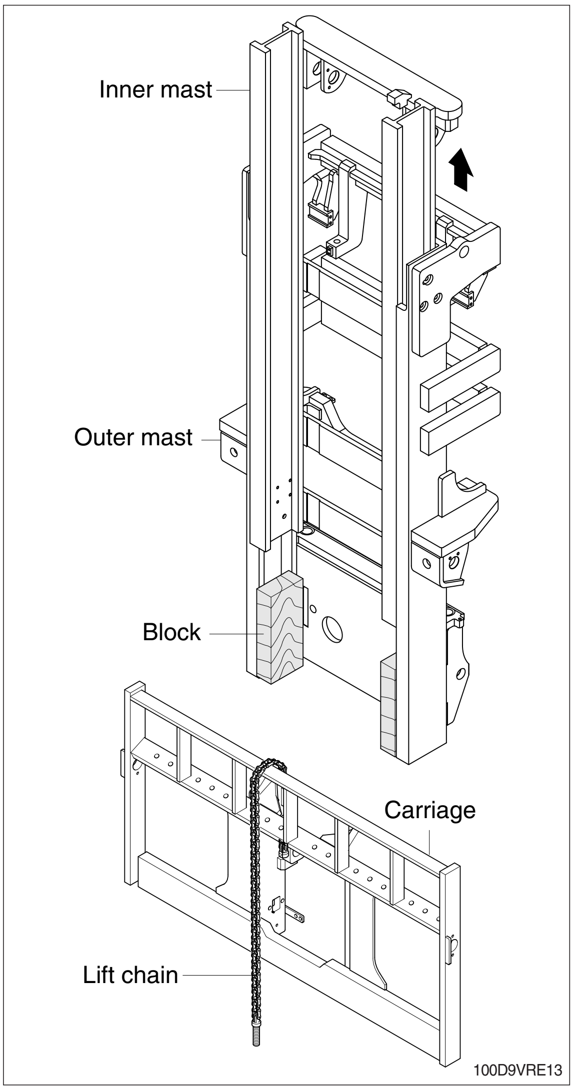
③ Pull the chains out of the sheaves and drape them over the front of the carriage.



④ Slowly raise inner mast upright until mast clears top of fork carriage. Move carriage to work area and lower the mast.

⚠ **Make sure that carriage remains on floor and does not bind while mast is being raised.**

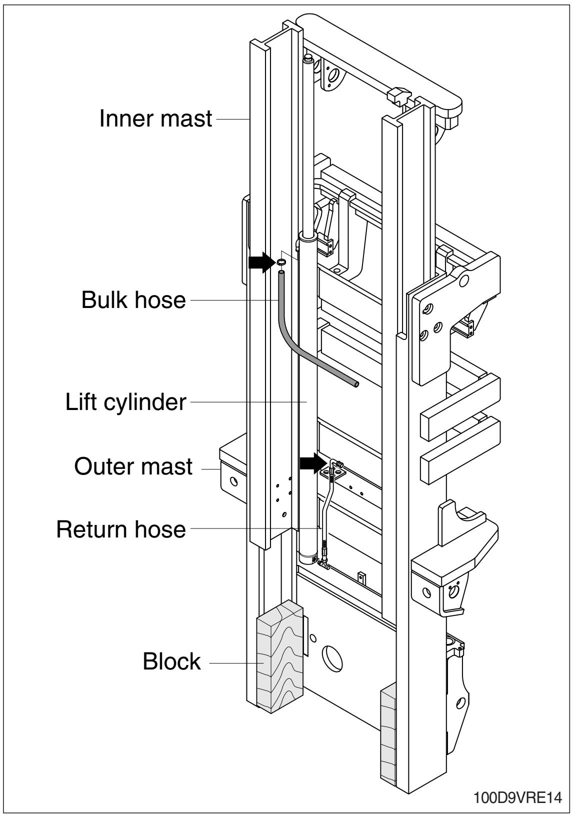
※ Inspect all parts for wear or damage. Replace all worn or damaged parts.



(5) PIPING

① Remove the bulk hoses and clamps attached to the cylinder.
② Remove the return hose from the down control valve.

※ Put blind plugs in the piping immediately after removing hoses.
This prevents the hydraulic oil from flowing out and also prevents dust and dirt from getting in.

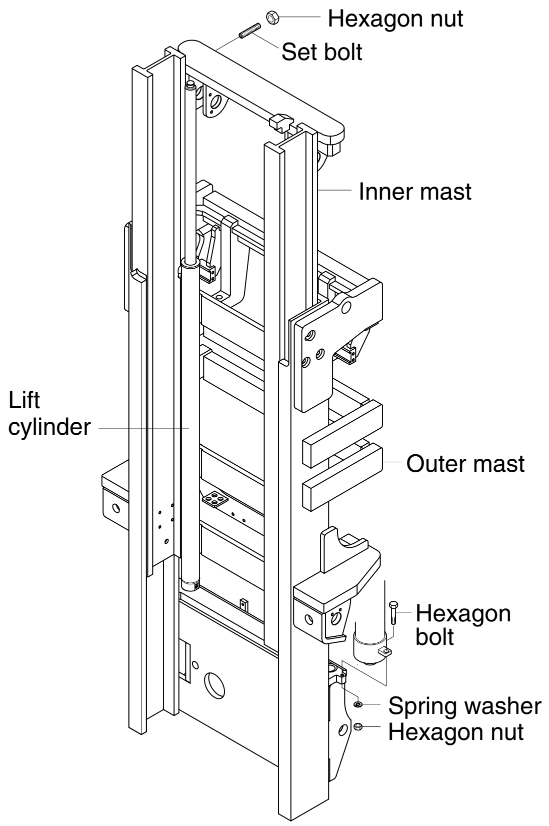


(6) LIFT CYLINDER

① Loosen and remove hexagon nuts and set bolts securing lift cylinders to inner mast.
② Bind the lift cylinder with overhead hoist rope and pull up so that the rope has no slack or binding.

▲ **Make sure the lift cylinder be tightened firmly for safety.**

③ Loosen and remove hexagon bolts, spring washers and nuts securing lift cylinders to outer mast.
④ Using an overhead hoist, slowly raise the inner mast high enough to clear lift cylinder.
⑤ Using an overhead hoist, draw out lift cylinder carefully and put down on the work floor.



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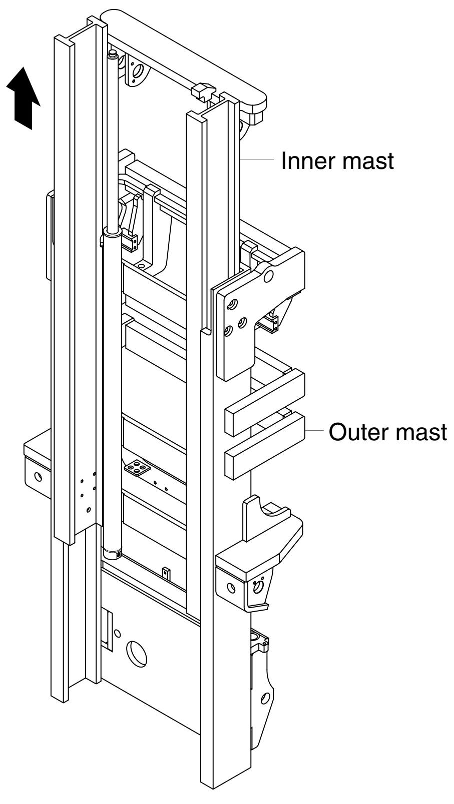
(7) INNER MAST

① Using an overhead hoist, raise the inner mast straight and carefully draw out of outer mast section.

▲ **Be careful the mast not to swing or fall.**



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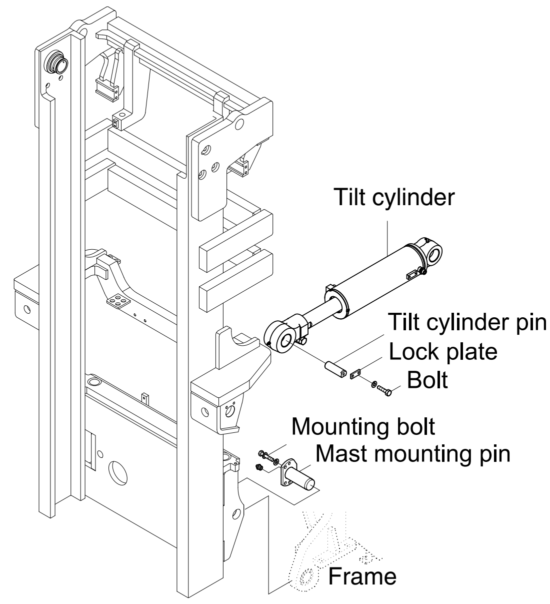
(8) TILT CYLINDER PIN

Loosen the bolt and remove the lock plate and tilt cylinder pin.

(9) MAST MOUNTING PIN

① Attach a crane to the stay at the top of the outer mast, and raise it.
② Loosen the mounting bolts and remove the mast mounting pins from frame, then slowly raise outer mast.

※ This operation is carried out under the truck, so use a pit, or if there is no pit, jack up the machine and loosen with an impact wrench.



2) INSTALLATION

After assembling mast components totally without piping connections, install mast assembly to the equipment.

※ Installation procedure for each of mast component is the reverse of the removal procedure.

(1) MAST MOUNTING PIN

① Check the mast mounting pins for wear, then install pins into the mast support bracket and drive axle.

② Jack up the machine so that the front is raised and then using an overhead hoist assemble outer mast to drive axle unit.

③ Tighten mounting socket bolts to drive axle unit.

· Tightening torque : 49.2~66.6 kgf · m (356~481 lbf · ft)

(2) TILT CYLINDER PIN

Hold the mast with a crane, operate the tilt control lever and align the holes, then knock the pin and lock plate by the bolts.

· Tightening torque : 15.8 kgf·m (114 lbf·ft)

(3) LIFT CYLINDER INSTALLATION AND ADJUSTMENT

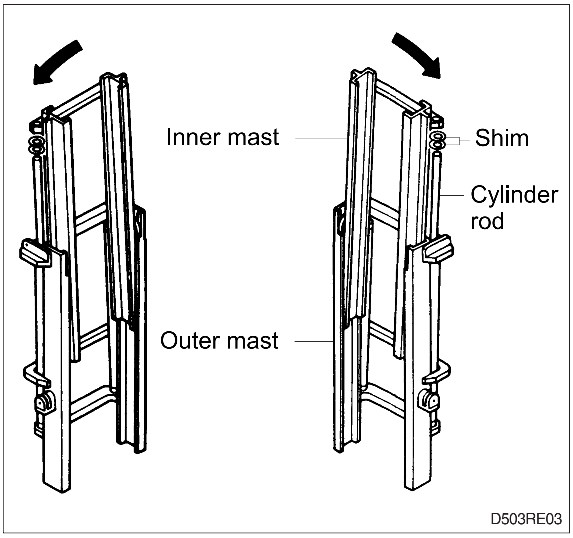
① Assemble the lift cylinder inside the outer mast, then tighten the stopper bolt. If the cylinder assembly has been replaced, adjust as follows so that the left and right cylinders are synchronized at the maximum lifting height.

② Assemble the cylinder rod to the inner mast, and check the left-to-right play of the mast at the maximum lifting height.

※ If play is to LEFT, install adjustment shim to LEFT cylinder.

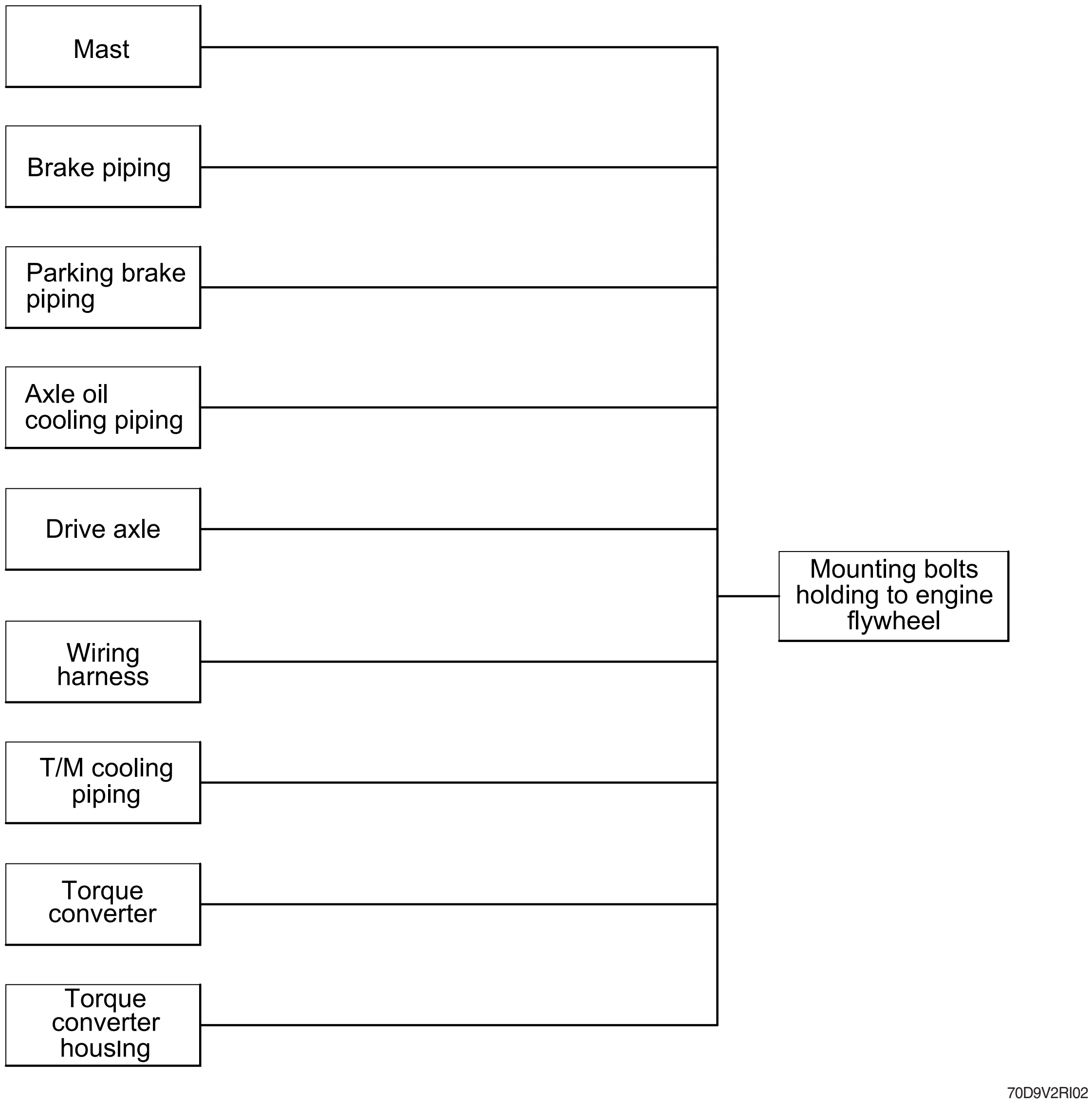
※ If play is to RIGHT, install adjustment shim to RIGHT cylinder.

· Shim thickness : 1.0 mm (0.04 in)



2. POWER TRAIN ASSEMBLY

1) REMOVAL



(1) Mast

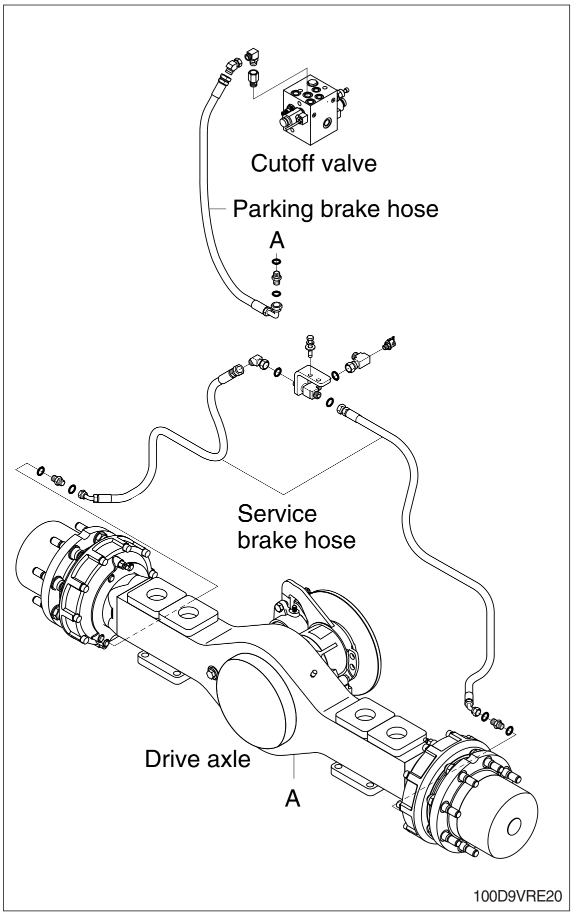
Refer to section on mast (Page 2-2)

(2) Service brake piping

Disconnect the brake hydraulic hoses from the drive axle.

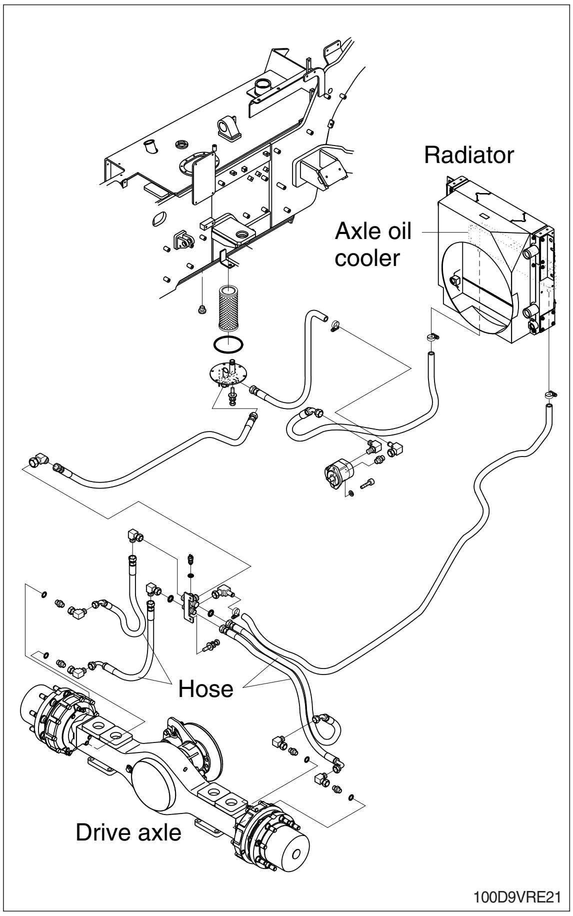
(3) Parking brake piping

Disconnect parking brake hydraulic hoses from the drive axle.



(4) Axle oil cooling piping

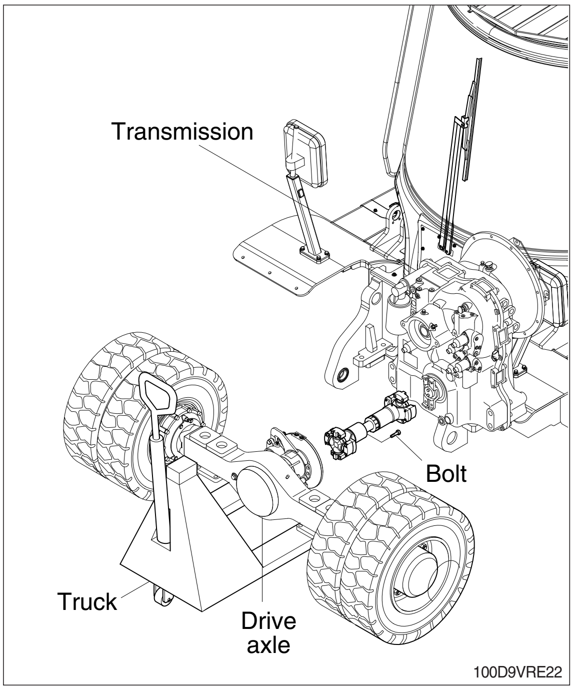
Disconnect the brake cooling hoses from the drive axle.



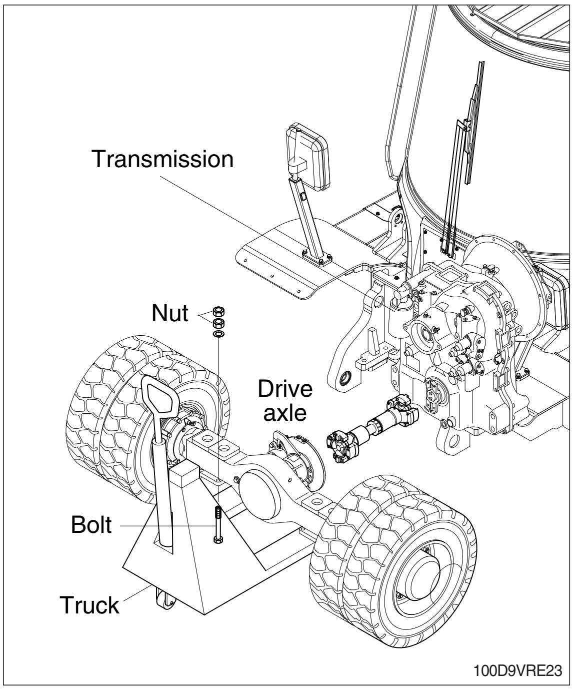
(5) Drive axle

※ Before removing the drive axle unit, drain all of the oil from the axle.

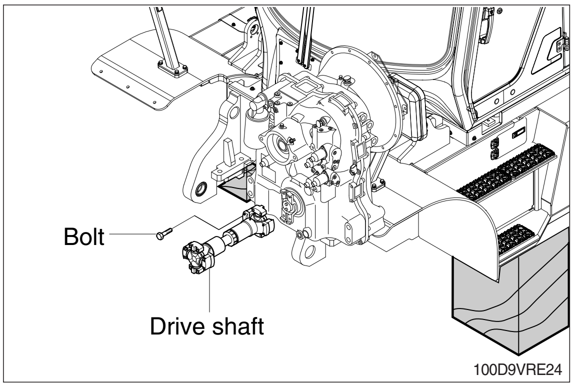
① Attach a crane to the tilt cylinder notches on the dashboard and raise the truck.
② Loosen hexagonal bolts connecting drive axle to drive shaft.
③ Put the block under the front axle and support under the drive axle with a truck.



④ Remove drive axle mounting bolts from the frame and then slowly pull out the truck with drive axle to the front.



⑤ Remove drive shaft from the transmission by loosening the mounting bolts.



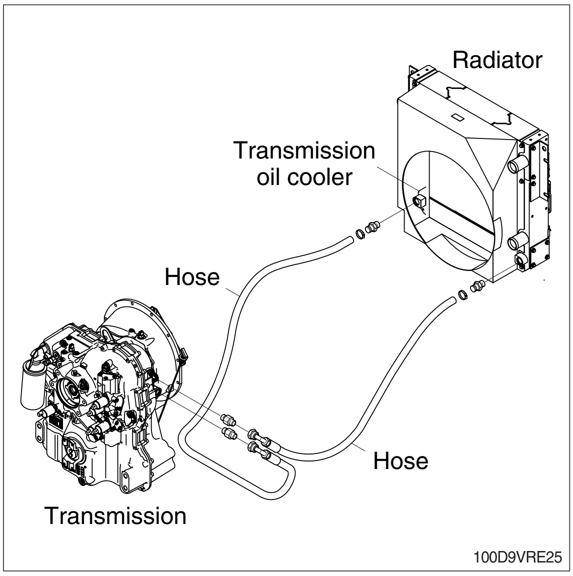
(6) Inching linkage

Remove the inching sensor cable.

(7) Transmission cooling piping

Disconnect cooling hose and connector from the transmission.

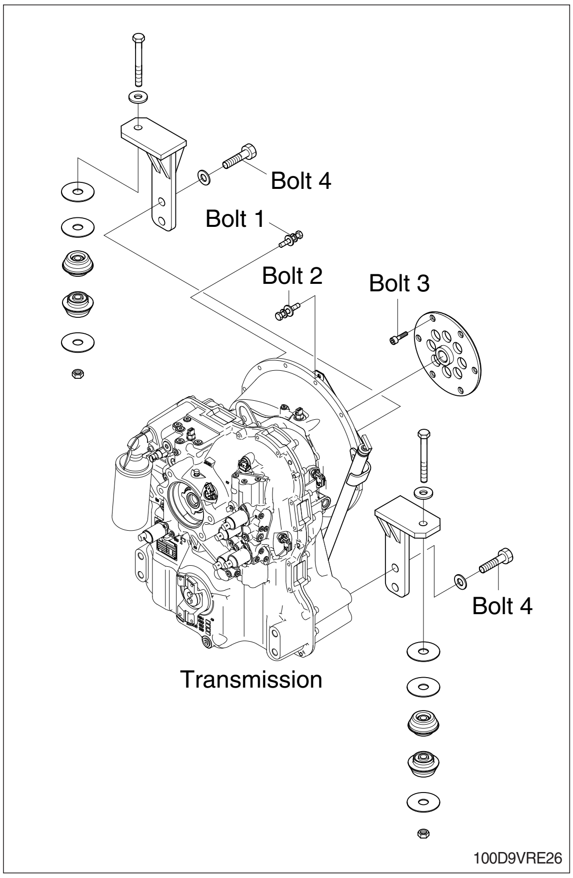
※ Make sure that the coolant be drained from the hose.



(8) Transmission assembly

① Remove the transmission assembly by loosening the bolts (1, 2, 3) mounted on the engine flywheel housing and the bolts (4) mounted on the bracket.

② Using a moving truck slowly, pull out transmission assembly to the front.



2) INSTALLATION

Installation is the reverse order to removal, but be careful of the following points.

(1) Tightening torque of the mounting bolts for the transmission.

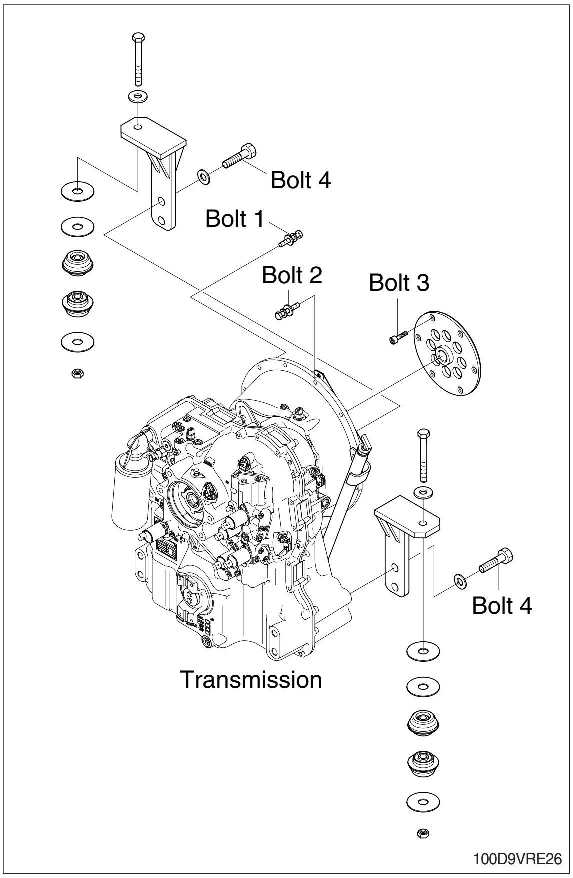
· Bolt 1 : 5.5~8.3 kgf · m (39.8~60.0 lbf · ft)

· Bolt 2 : 5.5~8.3 kgf · m (39.8~60.0 lbf · ft)

· Bolt 3 : 5.5~8.3 kgf · m (39.8~60.0 lbf · ft)

· Bolt 4 : 90~110 kgf · m (651~796 lbf · ft)

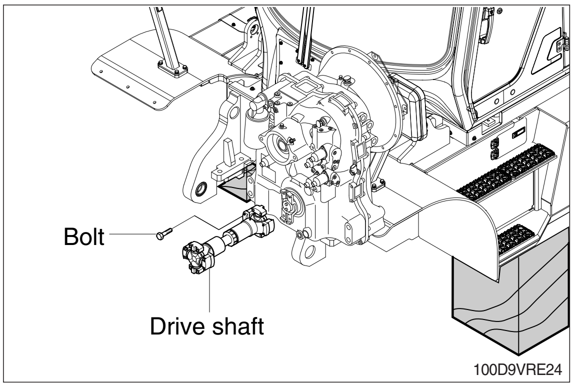
※ Apply loctite #277 on the thread before tightening.



(2) Tightening torque of mounting bolt for the drive shaft.

· 6.3~7.7 kgf · m (45.6~55.7 lbf · ft)

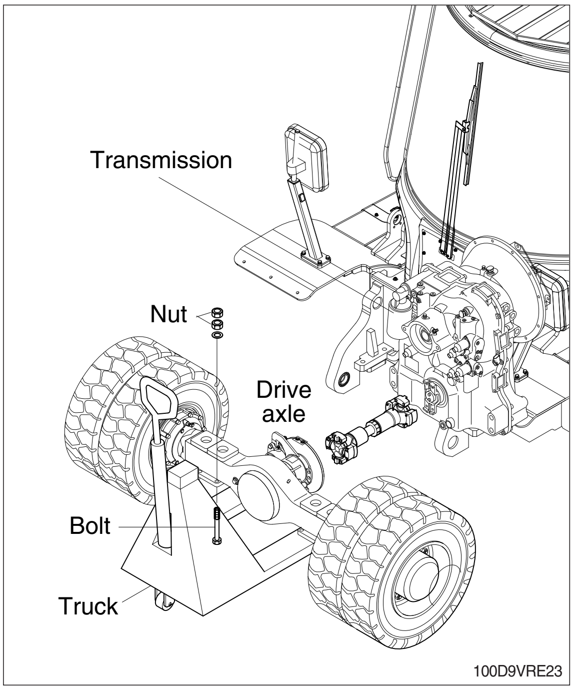
※ Apply loctite #277 on the thread before tightening.



(3) Tightening torque of mounting bolt for the drive axle.

· 90~110 kgf · m (651~796 lbf · ft)

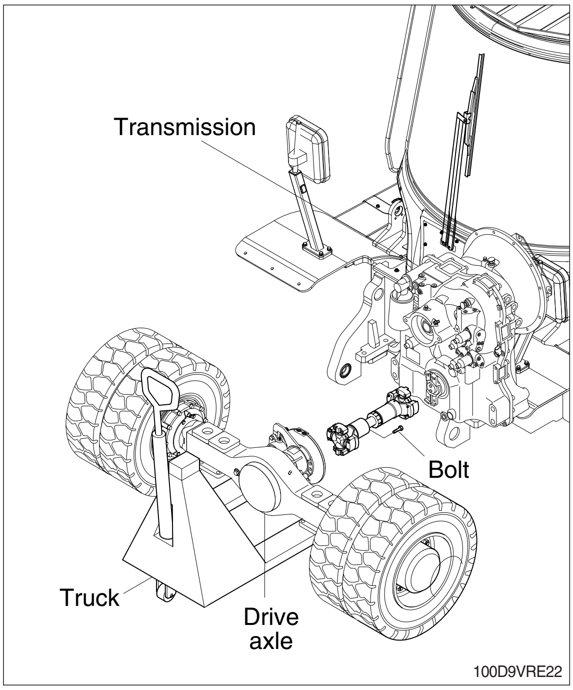
※ **Apply loctite #277 on the thread before tightening.**



(4) Tightening torque of mounting bolt for drive shaft.

· 6.3~7.7 kgf · m (45.6~55.6 lbf · ft)

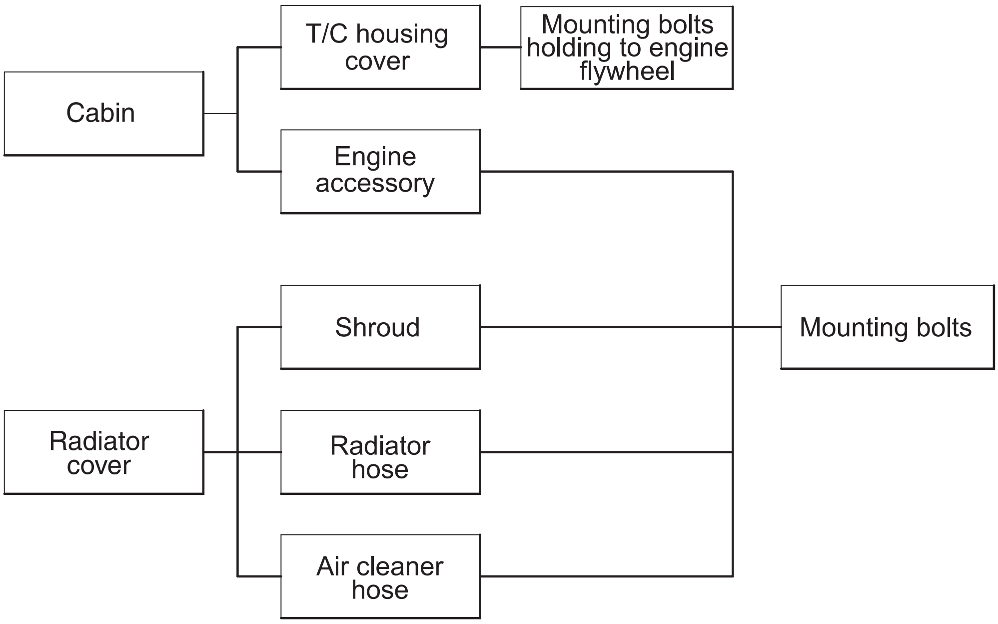
※ **Apply loctite #277 on the thread before tightening.**



3. ENGINE

Remove the torque converter, transmission and front axle inside the frame, then remove the engine assembly.

1) REMOVAL



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(1) Engine hood

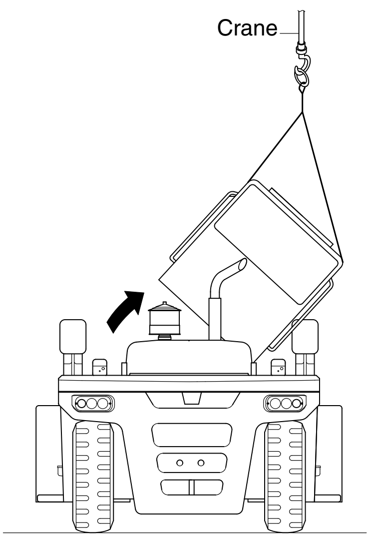
① Cabin

- First, tilt the cabin

※ **Refer to the operator's manual page 7-16.**

- After remove the wiring for rear combination lamp, work lamp, head lamp and flasher lamp on the stay of the cabin and then raise it with a crane
- Finally remove cabin for removal tilt option cylnder and latch assy.

② Center cover and door assy (LH, RH)
Remove the Center cover and door assy (LH, RH) by loosening the mounting bolts.



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(2) Lossen the bolts mounted on the engine flywheel housing. For details, see page 2-11.

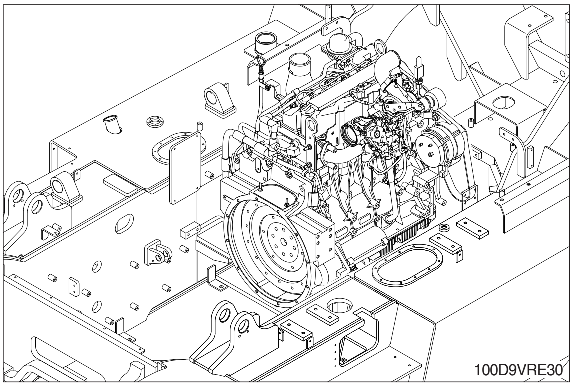
(3) Engine accessory

Remove all wiring harnesses, cables and hoses around the engine, dashboard and frame.

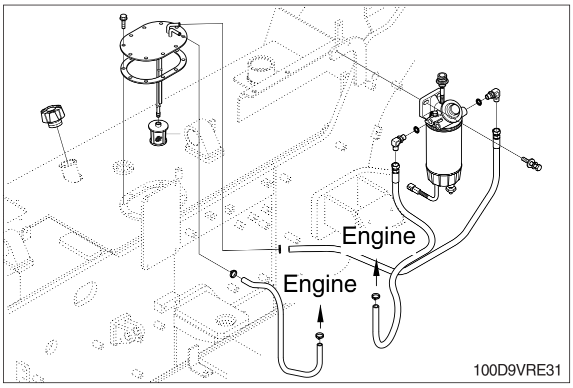
① Wiring harness to alternator and starter.

② Wiring harness for oil pressure and engine water temperature gauges.

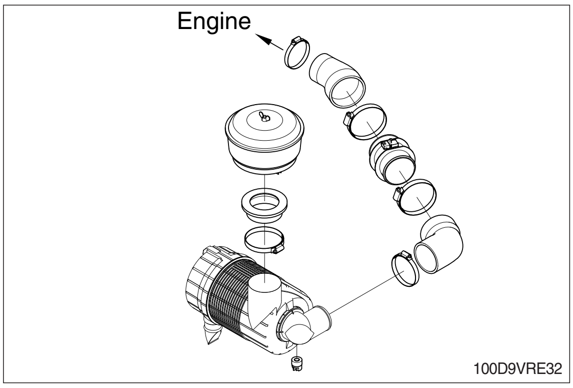
③ Cables for meters, buttons and accelerator pedal.



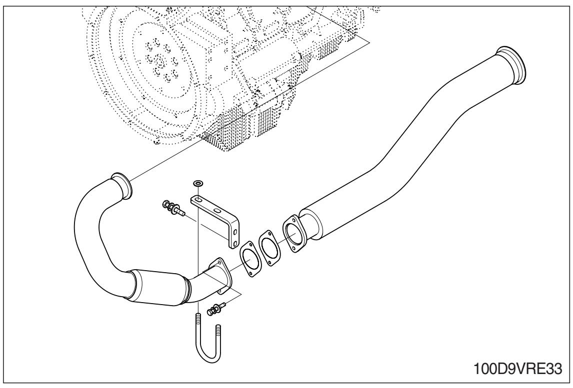
④ Hoses to fuel tank.



⑤ Hose to the air cleaner.

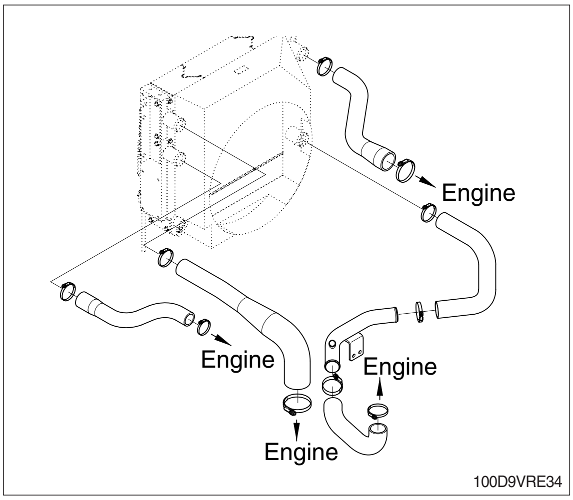


⑥ Exhaust pipe.



(4) Radiator hose

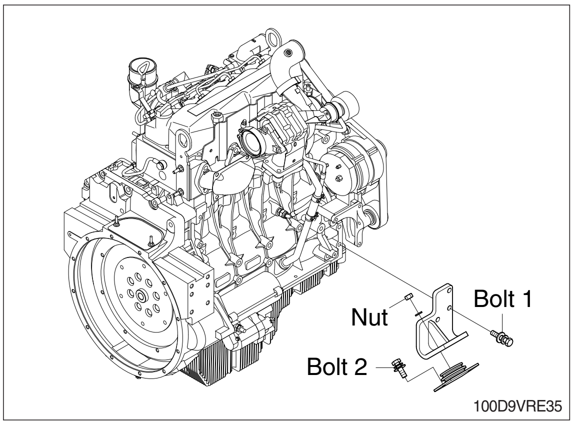
Open the drain valve of the radiator and drain the cooling water, then remove the radiator hose.



(5) Mounting bolt

Attach a crane to the engine hook and raise, then remove mounting bolts and nuts. Raise the engine slightly, slide towards the radiator, then lift up.

※ **When sliding the engine, be careful of the collision engine and radiator.**



2) INSTALLATION

Installation is the reverse order of removal, but be careful of the following points.

(1) Tighten the engine mounting bolts and nuts.

(2) Tighten the engine mounting bracket bolts.

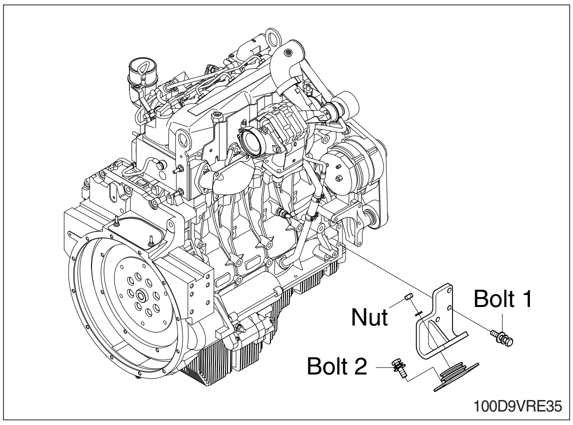
※ **Do not remove the bolts unless necessary. Loctite is coated over the threads of bolt. So, once the bolts were removed, coat them with loctite (#243) when installing.**

※ **Before installing the bolts, loctite in the holes should be removed by a tap.**

(3) Tightening torque of mounting bolt installing to torque converter housing.

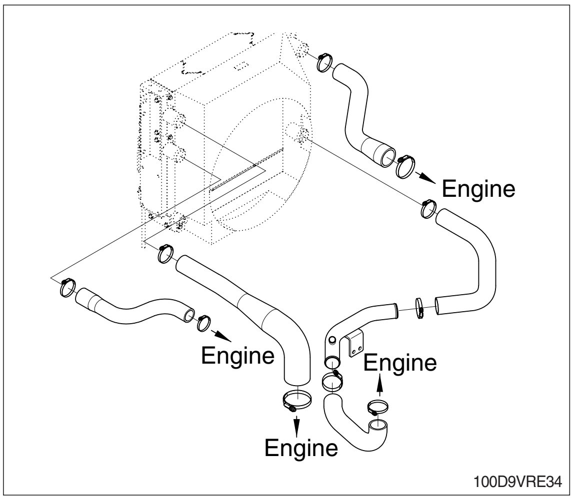
· Bolt 1 : 12.3±3.0 kgf · m (89±21.7 lbf · ft)
· Bolt 2 : 5.5~8.3 kgf · m (39.8~60.0 lbf · ft)
· Nut : 5.5~8.3 kgf · m (39.8~60.0 lbf · ft)

※ **Apply loctite #243 on the thread before tightening.**



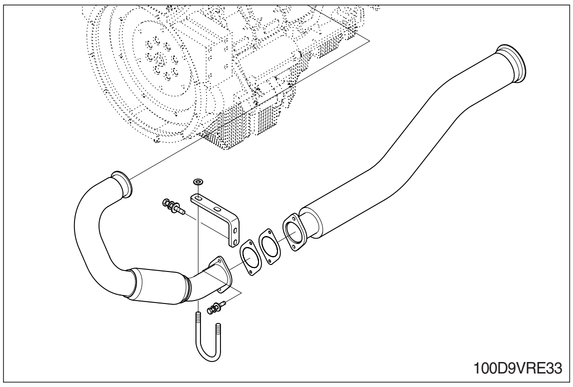
(4) Radiator hoses

Insert the radiator hoses securely and fit the clamps.



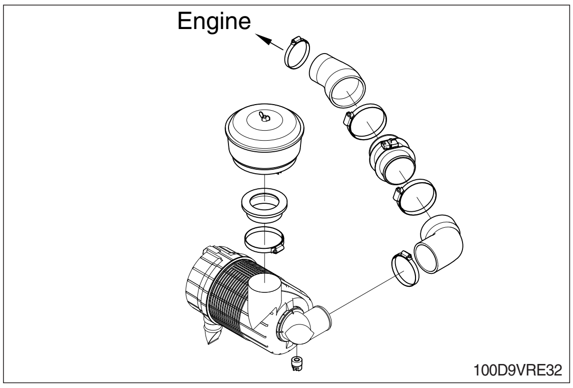
(5) Exhaust pipe

Insert the exhaust pipe to the engine securely and fit a clamp.



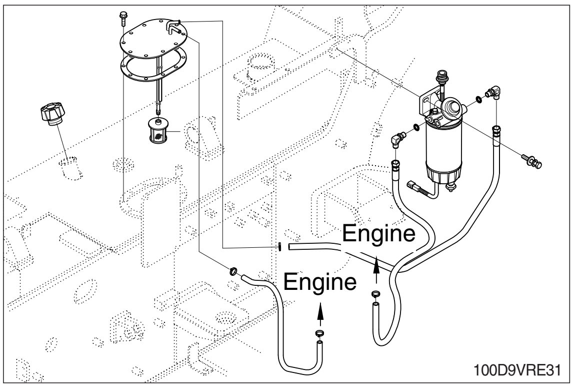
(6) Air cleaner hose

Insert the air cleaner hose securely and fit a clamp.



(7) Fuel hoses

Insert the fuel hoses securely and fit the clamps.



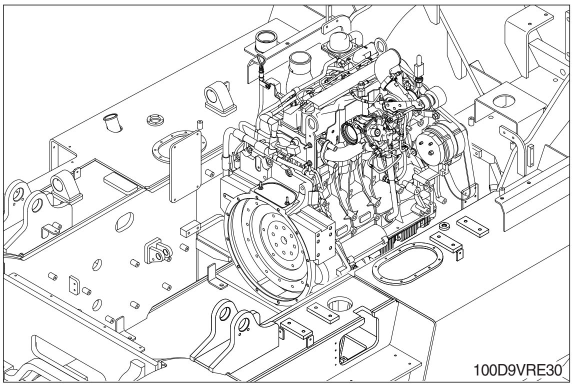
(8) Engine accessory

Install all wiring harnesses, cables and hoses around the engine, dashboard and frame.

① Wiring harness to alternator and starter.

② Wiring harness for oil pressure and engine water temperature gauges.

③ Cables for meters, buttons and accelerator pedal.

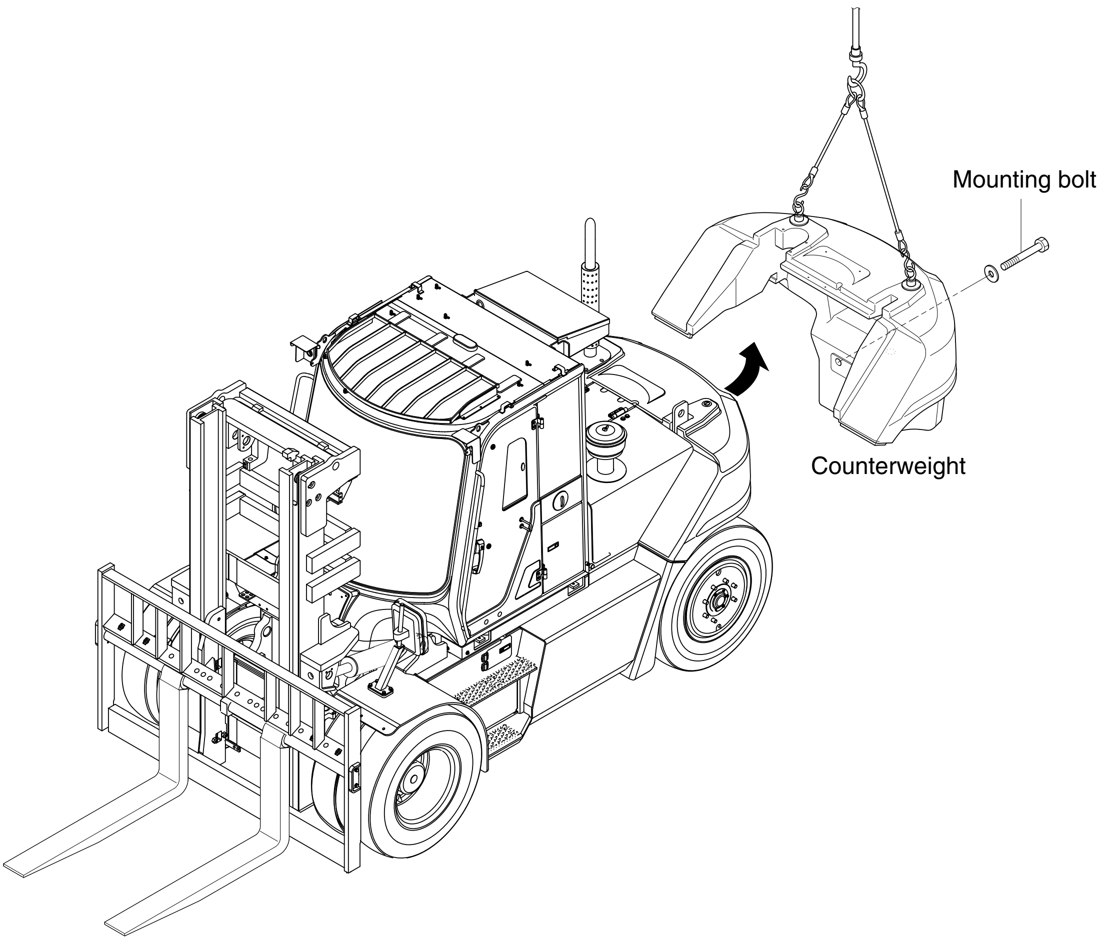


4. STEERING AXLE

1) REMOVAL

Counterweight — Rear wheel — Hose and pipe — Mounting bolt

D503RE35



100D9VRE40

(1) Counterweight

Hold the counterweight with hoist bars, and raise it with a crane.
Remove the mounting bolts, raise slightly and move it slowly to rear side.

· Weight of counterweight (standard) : 4220 ㎏ (9300 ㏌)
· Tightening torque : 100±15 kgf·m (723±108 lbf·ft)

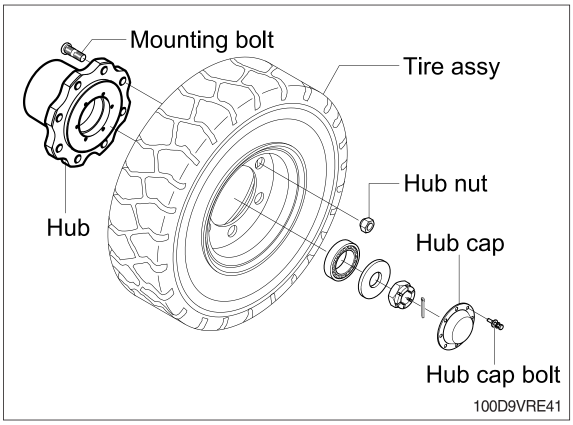
※ **Apply loctite #277 on the thread before tightening the bolts.**

(2) Rear wheel

Remove mounting bolt and hub nut with socket wrench and then carefully take out the tire assembly.

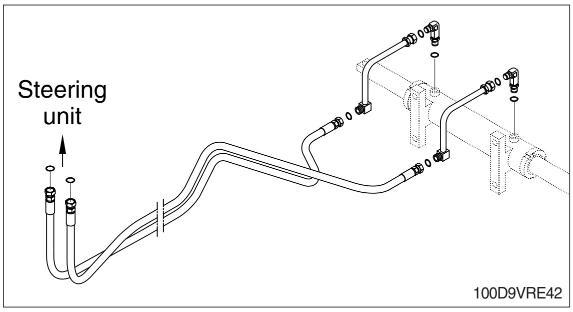
· Tightening torque
- Hub nut
  66.3±5 kgf·m (480±36.2 lbf·ft)
- Hub cap bolt
  2.5±0.5 kgf·m (18.0±3.6 lbf·ft)

※ Keep gas tight by applying liquid gasket #1215 on the contact surface of the hub cap before assembling the hub cap.



(3) Hose and piping

① Disconnect the hoses from the steering axle and then drain out oil.
② Disconnect the pipes from the axle support.

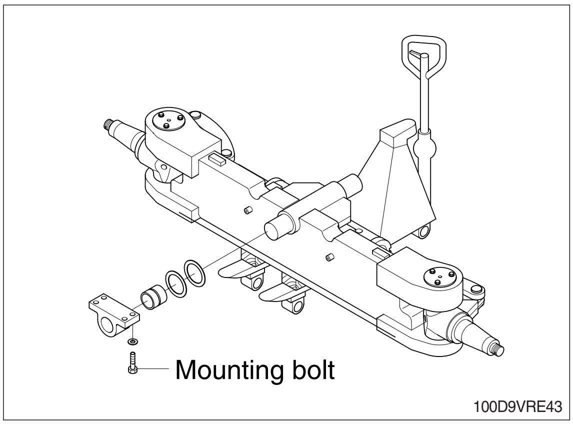


(4) Mounting bolt

Put a block under the steering axle, support on a truck, an raise the frame with a crane. Remove the mounting bolts installing to the frame, and pull out to the rear.
There are shims between the support and steering axle to prevent play.

· Mounting bolt tightening torque
  49.2~66.6 kgf·m (356~482 lbf·ft)

※ Apply loctite #277 on the thread before tightening.



GROUP 3 MAINTENANCE FOR HOSE

1) MAINTENANCE

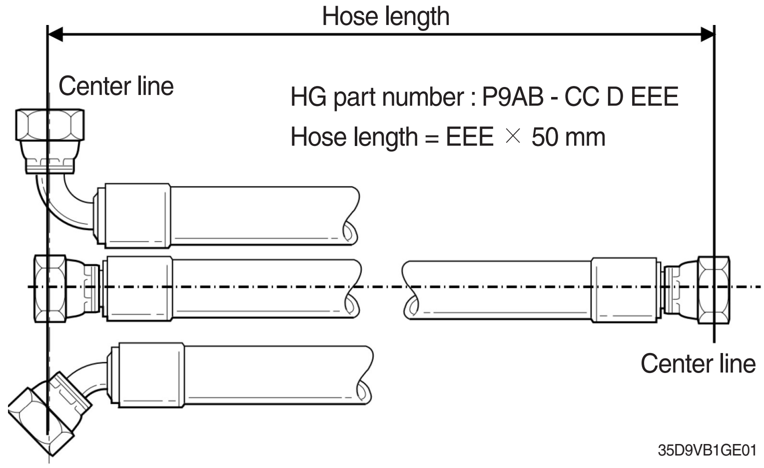
The function and service life of hydraulic components depend to a great extent on how clean the hydraulic oil is. Therefore, it is very important to prevent dirt from entering the hydraulic system. Some simple advice to keep the hydraulic system clean:

- · Always clean the area around parts before starting work. If possible, it is better to wash the the truck.
- · Plug hose connections immediately after disconnecting. If possible, use correct plugs for the connection type. If plugs are missing, use clean plastic bags and cable ties or tape to seal the connection.
- · Never reutse oil that has been drained from the truck.
- · If possible, filter the oil before pouring it into the truck, oil barrels often contain impurities.

2) HOSE LENGTH

Connected hoses have HG part number, but if they have no information the hoses are measured as follows:

- · The hose length is measured on a laid-out hose between the sealing surfaces.
- · On angled connections, measure from the sealing surface's center line according to the figure.



3) CAUTION FOR REPLACEMENT

When replacing hoses for maximum service life and functionality, the following must be observed:

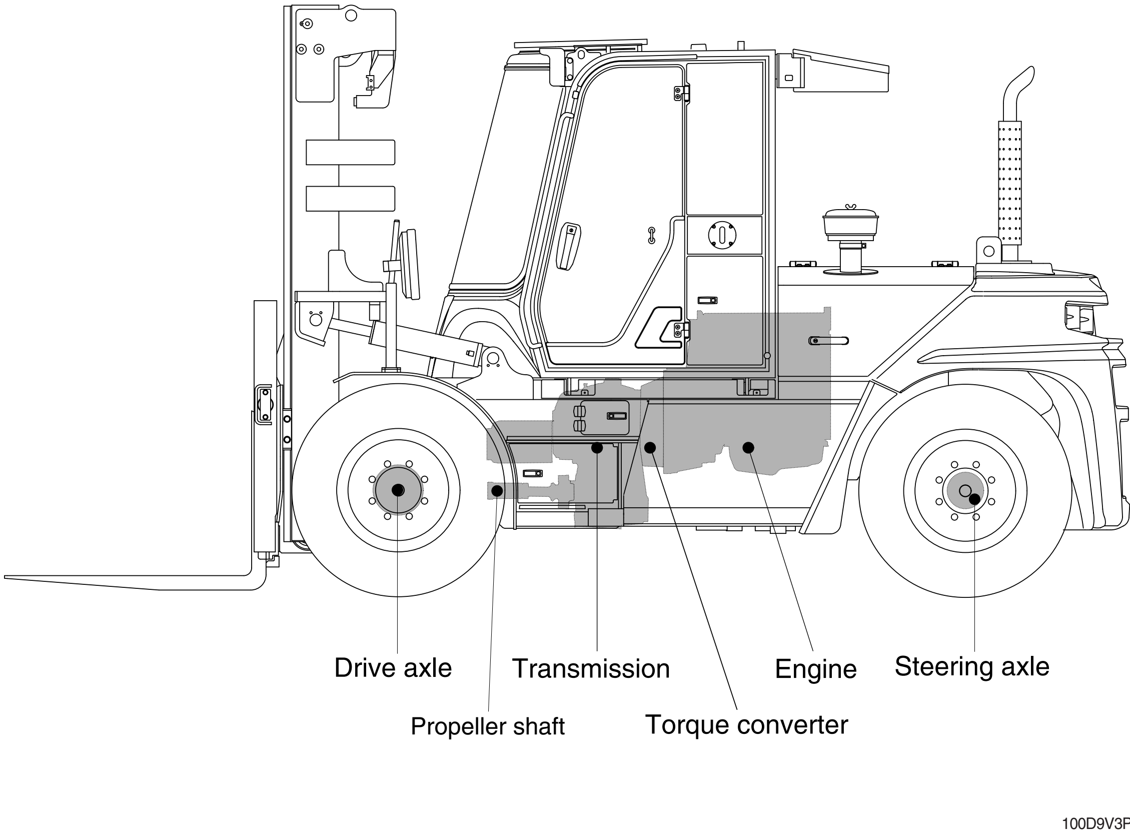
- · To avoid stress when connecting, a straight hose length must be secured after connection.
- · Do not kink the hose. 7% twist reduces the service life by 90%.
- · Do not use hoses that are too short. It may cause leakage or damage.
- · Use the correct coupling to minimize the number of bends.
- · Avoid sharp bending.
- · When storing, keep the inside of the hose clean. When installing, keep the plug in place for as long as possible.

SECTION 3 POWER TRAIN SYSTEM

SECTION 3 POWER TRAIN SYSTEM

GROUP 1 STRUCTURE AND OPERATION

1. STRUCTURE

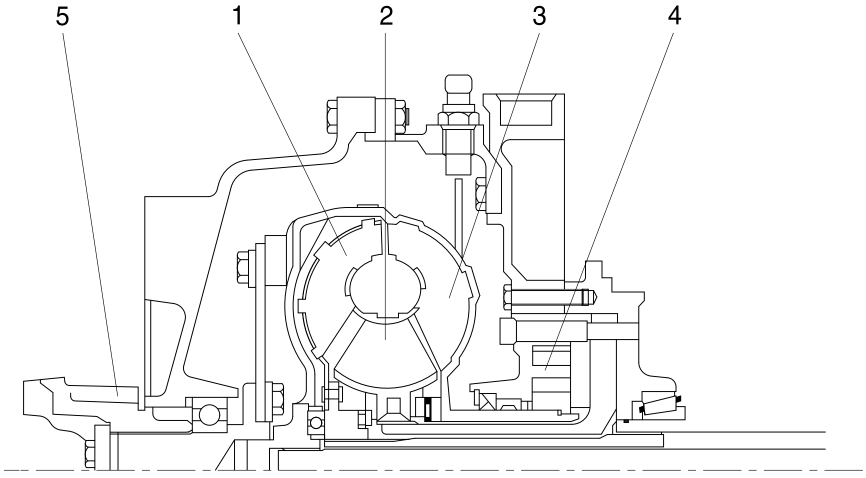


The power train consists of the following components :

· Torque converter
· Transmission
· Drive shaft
· Drive axle

Engine power is transmitted to the transmission through the torque converter.
The transmission is a hydraulically engaged three speed forward, three speed reverse power shift type transmission.
The transmission outputs through the universal joints of the drive shaft to drive axle assembly.
The power transmitted to front axle drives front wheels.

2. TORQUE CONVERTER



D503TM01

1	Turbine	3	Pump	5	Input shaft
2	Stator	4	Transmission pump		

The converter is working according to the Trilok-system, i.e. it assumes at high turbine speed the characteristics, and with it the favorable efficiency of a fluid clutch.
The converter will be defined according to the engine power so that the most favorable operating conditions for each installation case are given.

The Torque converter is composed of 3 main components :
Pump wheel - turbine wheel - stator (Reaction member)

These 3 impeller wheels are arranged in such a ring-shape system that the fluid is streaming through the circuit components in the indicated order.

Pressure oil is constantly streaming out of the transmission pump through the converter. In this way, the converter can fulfill its task to multiply the torque of the engine, and at the same time, the heat created in the converter is dissipated through the escaping oil.
The oil, escaping out of the pump wheel, enters the turbine wheel and is there inversed in the direction of flow.

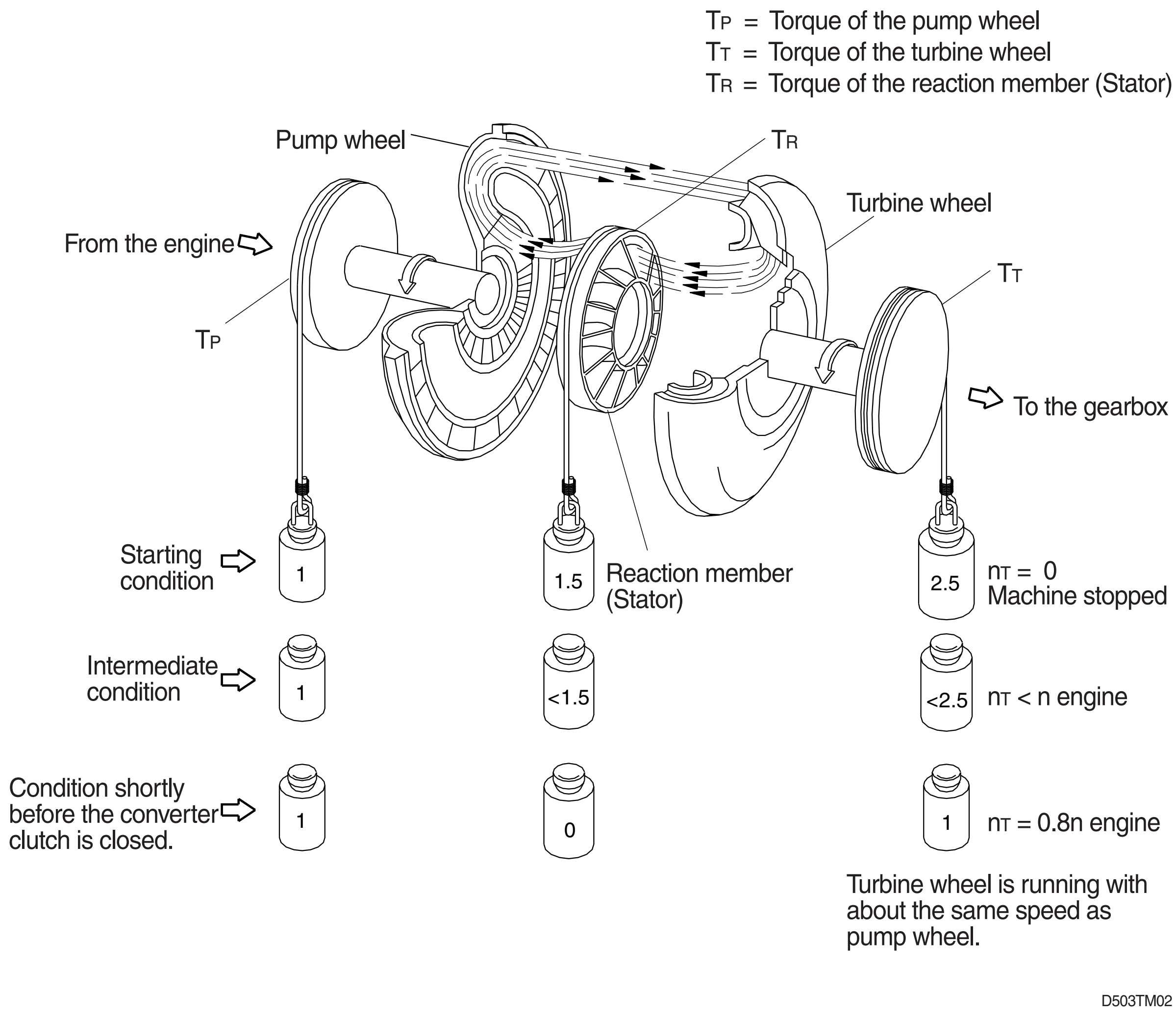
According to the rate of inversion, the turbine wheel and with it also the output shaft, receive a more or less high reaction moment. The stator (Reaction member), following the turbine, has the task to inverse again the oil which is escaping out of the turbine and to delivery it under the suitable discharge direction to the pump wheel.
Due to the inversion, the stator receives a reaction moment.
The relation turbine moment/pump moment is called torque conversion. This is the higher the greater the speed difference of pump wheel and turbine wheel will be.

Therefore, the maximum conversion is created at standing turbine wheel.
With increasing output speed, the torque conversion is decreasing. The adoption of the output speed to a certain required output moment is infinitely variable and automatically achieved by the torque converter.

If the turbine speed is reaching about 80% of the pump speed, the conversion becomes 1.0 i.e. the turbine moment becomes equal to that of the pump moment.
From this point on, the converter is working similar to a fluid clutch.

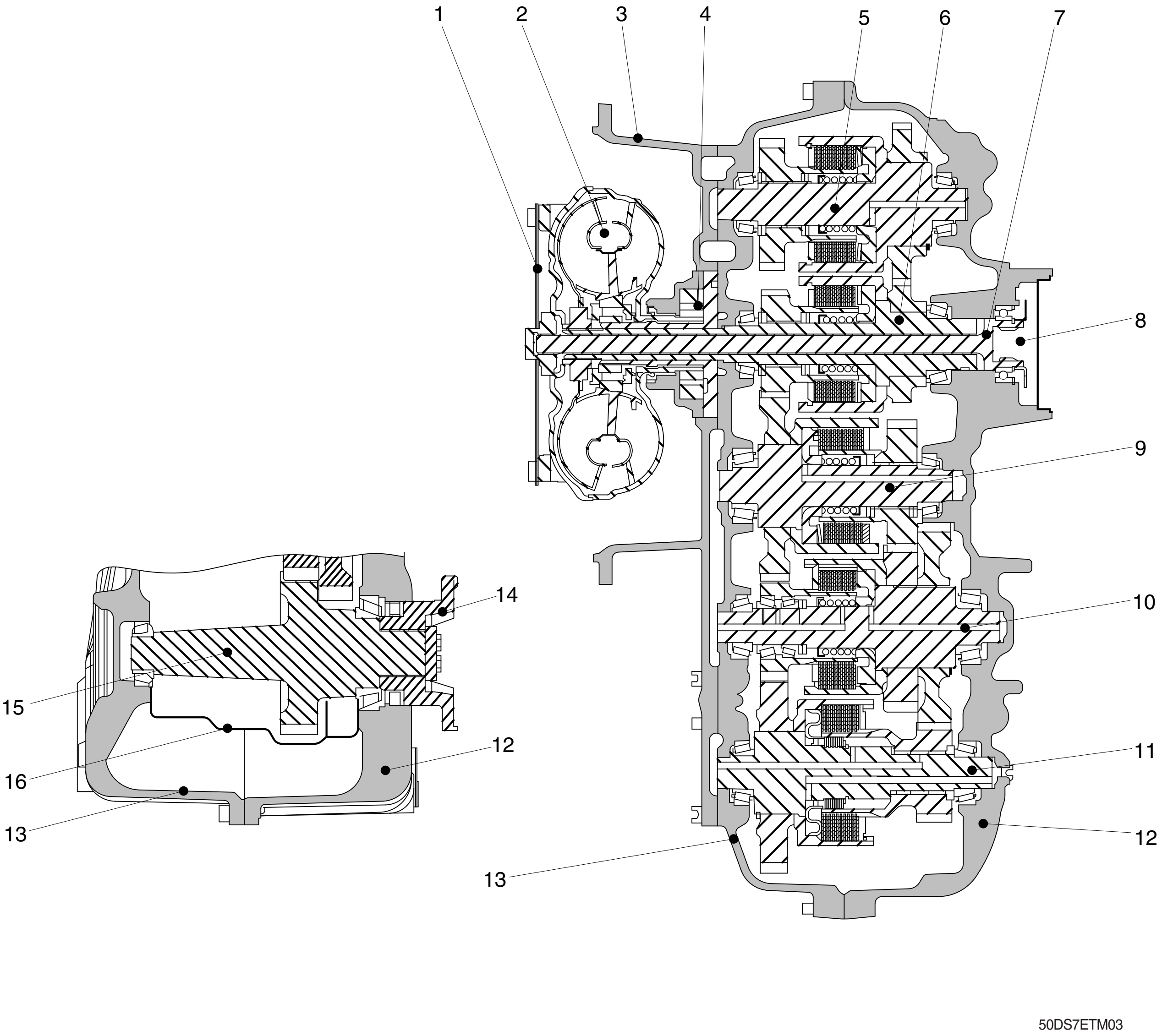
A stator freewheel serves to improve the efficiency in the upper driving range, it is backing up in the conversion range the moment upon the housing, and is released in the coupling range.
In this way, the stator can rotate freely.

Function of a hydrodynamic torque converter (Schematic view)



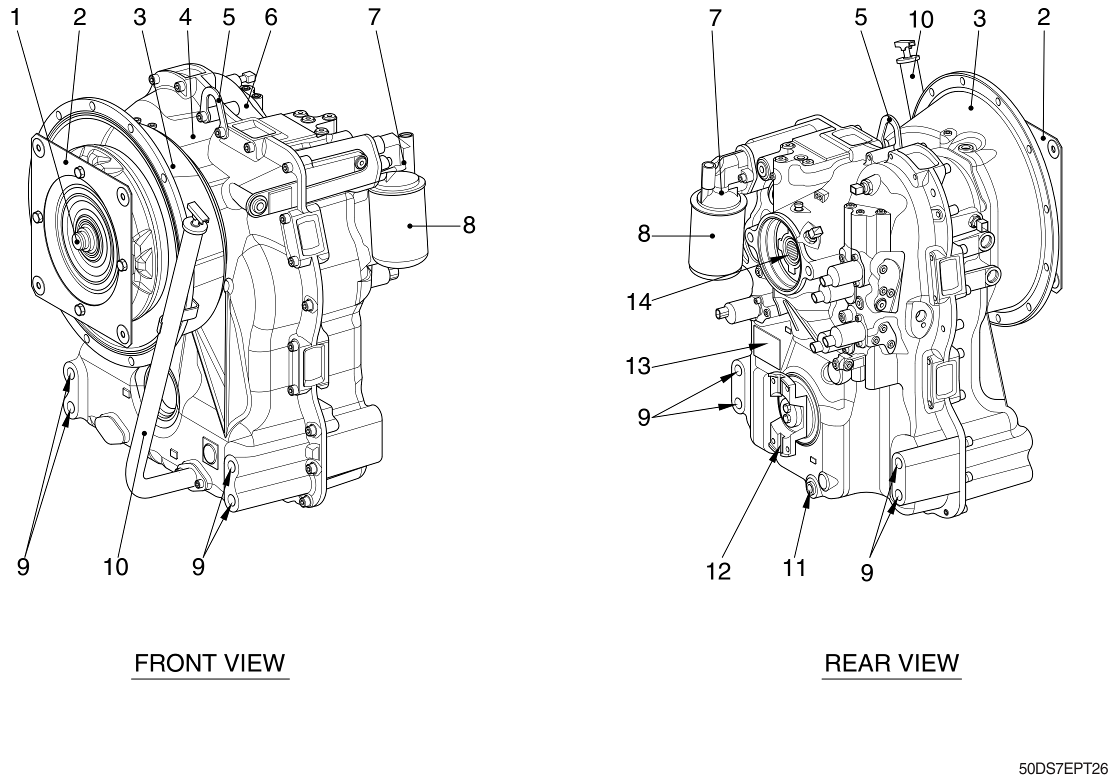
3. TRANSMISSION

1) LAYOUT



1	Flex plate for direct mount	7	Central shaft/input shaft PTO	12	Transmission housing - rear part
2	Converter	8	Connection, PTO ; coaxial, engine-dependent	13	Transmission housing - front part
3	Converter bell housing			14	Output flange
4	Transmission pump	9	Clutch shaft (KD)	15	Output shaft
5	Clutch shaft (KV)	10	Clutch shaft (KE)	16	Screen sheet
6	Input shaft/clutch shaft (KR)	11	Clutch shaft (KC)		

2) INSTALLATION VIEW



1	Converter	8	Filter
2	Direct mount via flex plate	9	Transmission mounting holes
3	Converter bell housing	10	Oil filter tube with oil dipstick
4	Transmission housing-front part	11	Oil drain plug
5	Transport bracket	12	Output flange
6	Transmission housing-rear part	13	Identification plate
7	Filter head	14	Connection PTO ; coaxial, engine-dependent

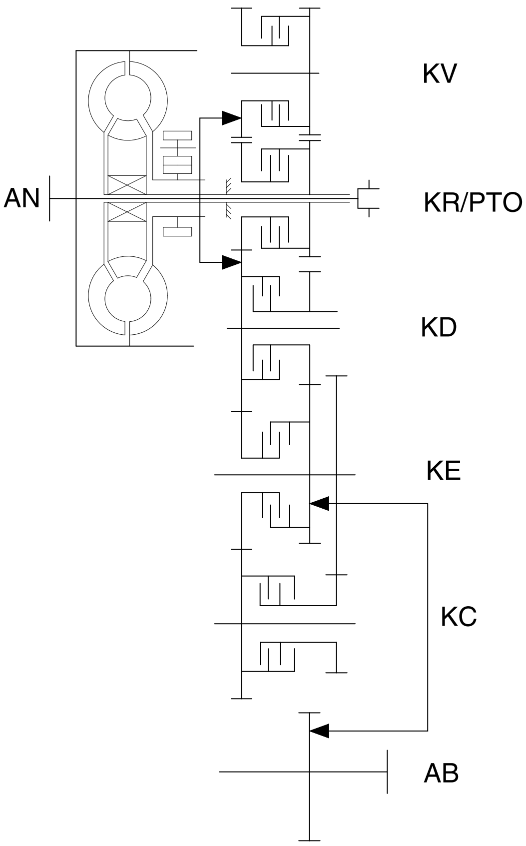
3) OPERATION OF TRANSMISSION

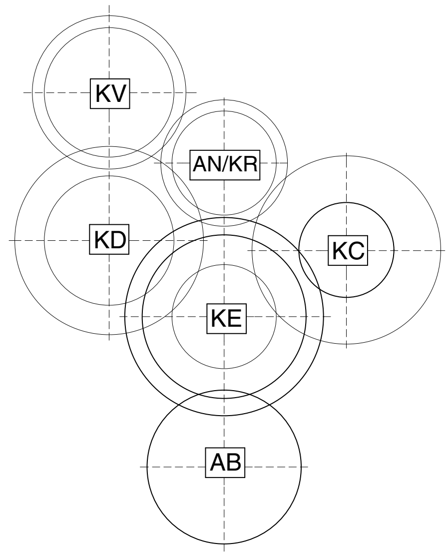
(1) Gearbox diagram

The multi-speed reversing transmission in countershaft design is power shiftable by hydraulically actuated multi-disk clutches.

All gears are constantly meshing and carried on antifriction bearings.
The gear wheels, bearings and clutches are cooled and lubricated with oil.
The 3-speed reversing transmission is equipped with 5 multi-disk clutches.
At the shifting, the actual plate pack is compressed by a piston, movable in axial direction, which is pressurized by pressure oil.

A compression spring takes over the pushing bask of the piston, thus the release of the plate pack. As to the layout of the transmission as well as the specifications of the closed clutches in the single speeds.





Legend:

AN = Input
KV = Clutch forward
KR = Clutch reverse
KC = Clutch 1st speed
KD = Clutch 2nd speed
KE = Clutch 3rd speed
PTO = Power take-off
AB = Output

Diagram Clutches

Driving direction	Speed	Clutch
Forward	1	KV/KC
	2	KV/KD
	3	KV/KE
Reverse	1	KR/KC
	2	KR/KD
	3	KR/KE

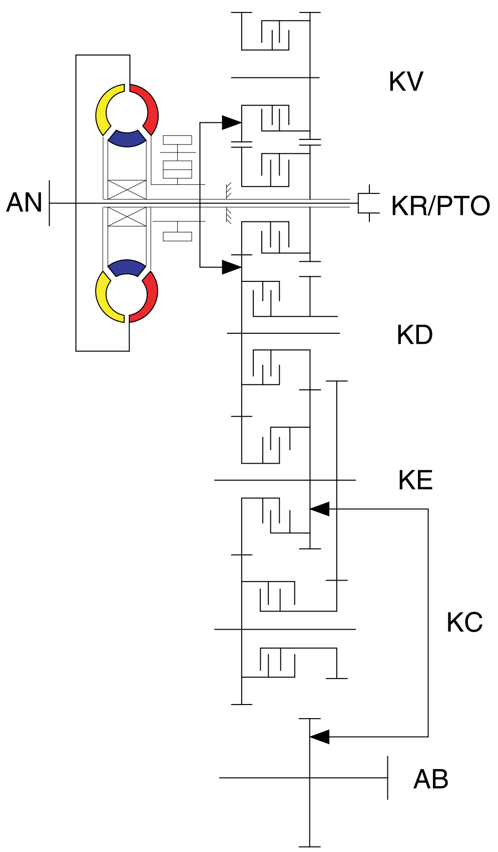
50DS7EPT32

(2) Forward

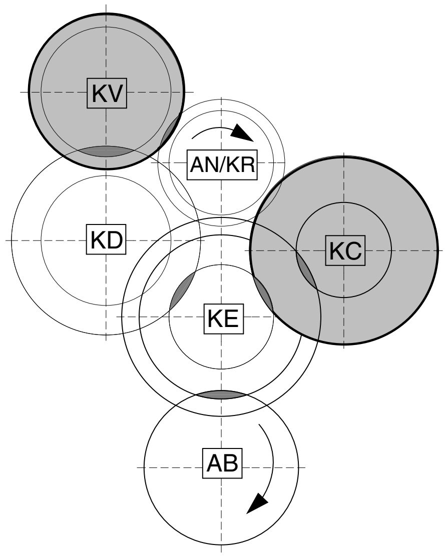
In forward, forward clutch and 1st, 2nd, 3rd clutch are engaged.

Forward clutch and 1st, 2nd, 3rd clutch are actuated by the hydraulic pressure applied to the clutch piston.

Transmission diagram



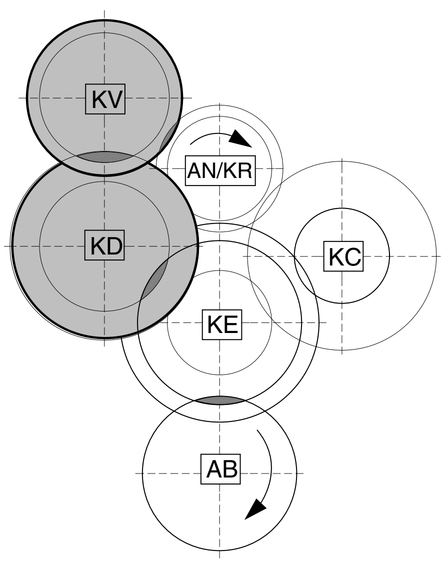
1st gear forward



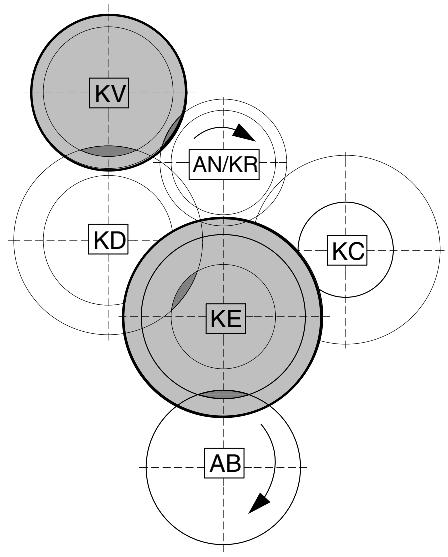
Legend:

AN = Input
KV = Clutch forward
KR = Clutch reverse
KC = Clutch 1st speed
KD = Clutch 2nd speed
KE = Clutch 3rd speed
PTO = Power take-off
AB = Output

2nd gear forward



3rd gear forward



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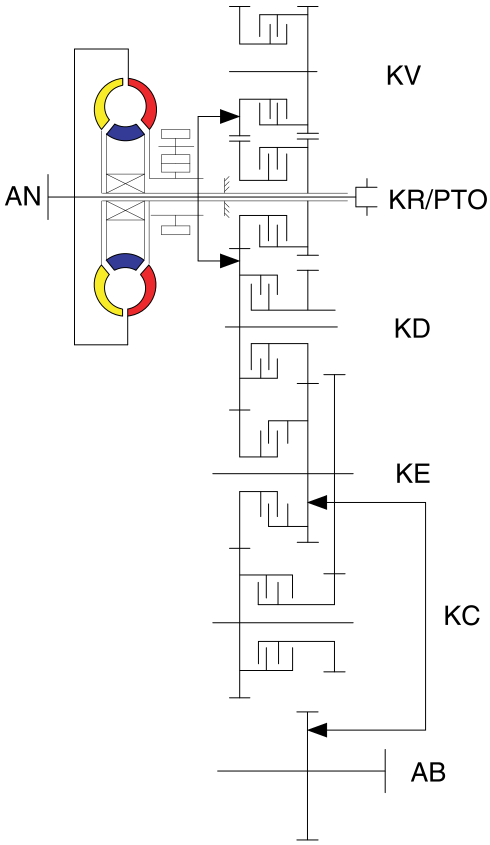
(3) Reverse

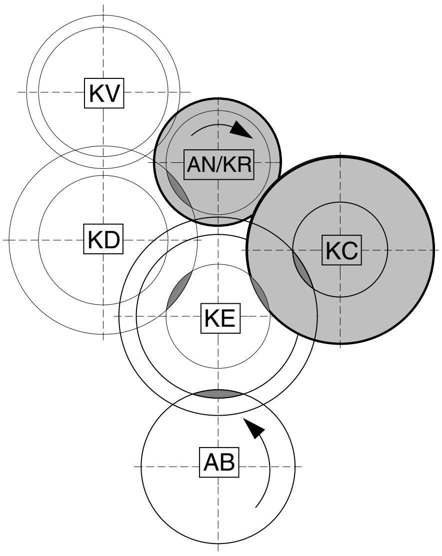
In reserve, reserve clutch and 1st, 2nd, 3rd clutch are engaged.

Reverse clutch and 1st, 2nd, 3rd are actuated by the hydraulic pressure applied to the clutch piston.

Transmission diagram



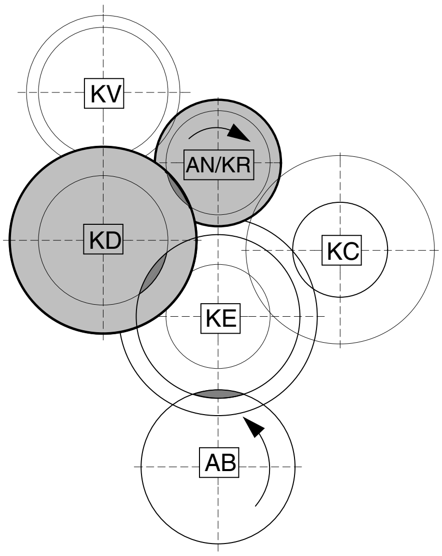
1st gear reverse



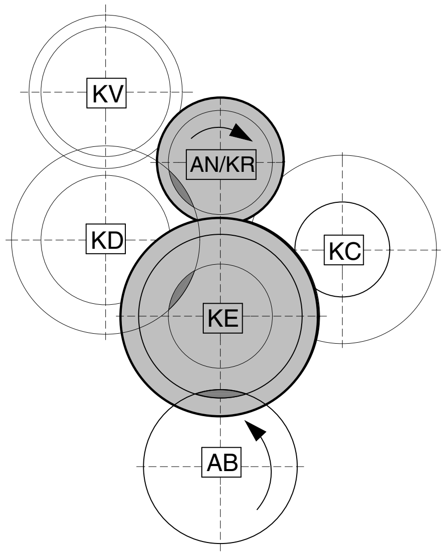
Legend:

AN = Input
KV = Clutch forward
KR = Clutch reverse
KC = Clutch 1st speed
KD = Clutch 2nd speed
KE = Clutch 3rd speed
PTO = Power take-off
AB = Output

2nd gear reverse



3rd gear reverse



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4) TRANSMISSION CONTROL

Transmission control see measuring points and oil circuit diagram see page 3-10.
The transmission pump which is necessary for the oil supply of the converter and for the transmission control is located within the transmission on the engine-dependent input shaft.
The pump feed rate is Q=45 ℓ /min, at n_{engine}=1500 min^{-1}
This pump is sucking the oil out of the oil sump via the coarse filter, and delivers it to the main pressure valve via the fine filter.

The 5 clutches of the transmission are controlled via the 5 proportional valves Y1 to Y5.

The direct proportional control with separate pressure modulation for each clutch controls the pressures towards the clutches which are involved in the gear change.
This allows a hydraulic overlapping of the clutches to be engaged and disengaged.
The pressure modulation to the respective clutch is controlled by cup springs and proportional valves in the package.

This creates spontaneous shifting without tractive effort interruption.

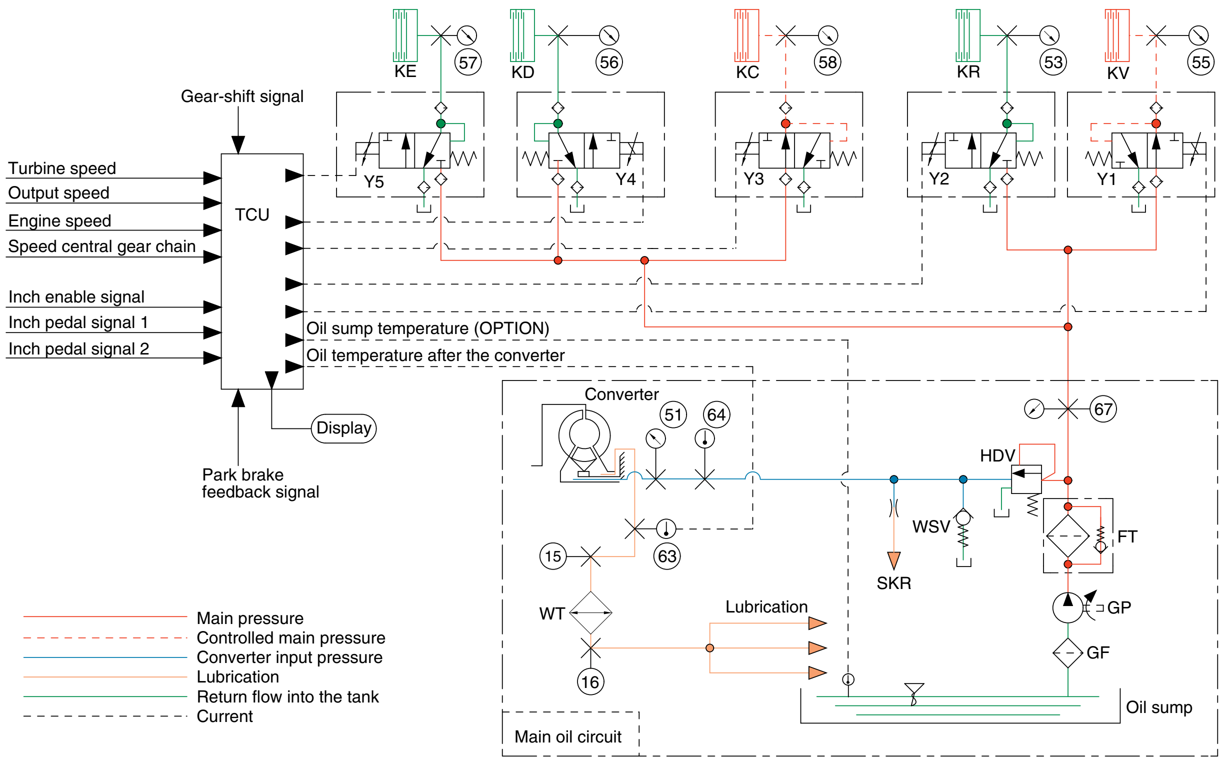
The following criteria are considered during the shifting operation:

- RPM of engine, turbine, gear chain and output
- Transmission temperature
- Shifting mode (upshifting, downshifting, reverse shifting and gear engagement out of neutral)
- Load condition (full and partial load, drive, coast, including consideration of load reversals during shifting)
- Electronic inching

The main pressure valve limits the max, control pressure to 16+3 bar and release the main stream towards the converter-and lubrication circuit.

The converter inlet incorporates a converter safety valve which protects the converter from high internal pressure (opening pressure 11+2 bar).
Within the converter, the oil serves for transmitting the power according to the well-known hydrodynamic principle (see Chapter torque converter page 3-2)
To avoid cavitation, the converter must always be completely filled with oil.

· Hydraulic circuit



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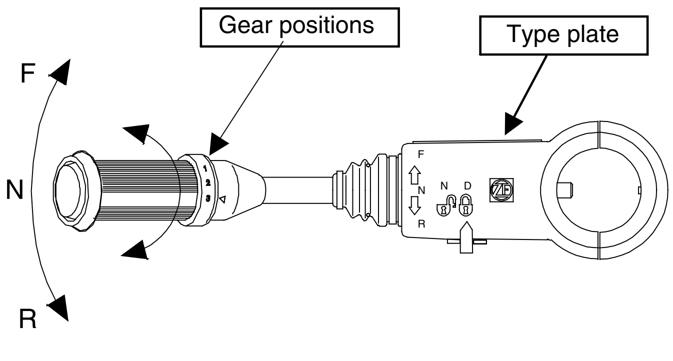
Driving direction	Gear	Proportional valve under current						Engaged clutches	
		Y1	Y2	Y3	Y4	Y5	N		
Forward	1	●		●				KV	KC
	2	●			●			KV	KD
	3	●				●		KV	KE
Reverse	1		●	●				KR	KC
	2		●		●			KR	KD
	3		●			●		KR	KE
Engaged clutch		KV	KR	KC	KD	KE			
Curr. No. of meas. points		55	53	58	56	57			

GF Coarse filter
GP Transmission pump
FT Filter
HVD Main pressure valve, 16+3 bar
WSV Converter safety valve, 11+2 bar
SKR Lubrication of KR clutch
WT Heat exchanger
Y1 Proportional valve, clutch KV
Y2 Proportional valve, clutch KR
Y3 Proportional valve, clutch KC
Y4 Proportional valve, clutch KD
Y5 Proportional valve, clutch KE
KV KV clutch, forward
KR KR clutch, reverse
KC KC clutch, 1st gear
KD KD clutch, 2nd gear
KE KE clutch, 3rd gear
TCU Transmission control unit

5) GEAR SELECTOR (DW-3)

The gear selector is designed for the mounting on the steering column left side. By a rotative motion, the positions(speeds) 1 to 3 are selected by tilting the lever, the driving direction (Forward (F) - Neutral (N) - Reverse (R)).

For the protection from unintended start off, a neutral interlock is installed :
Position "N" - Controller lever blocked in this position
Position "D" - Driving



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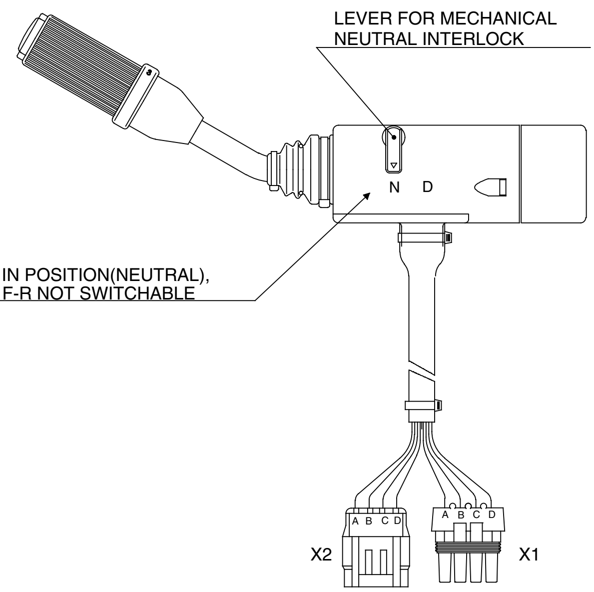
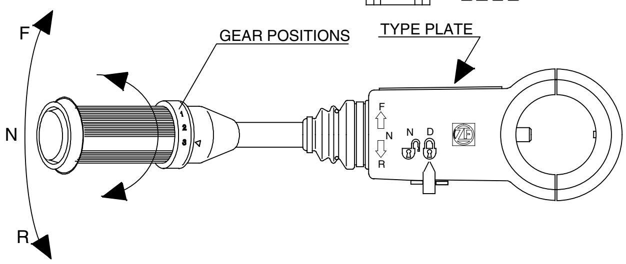
Gear selector (DW-3)



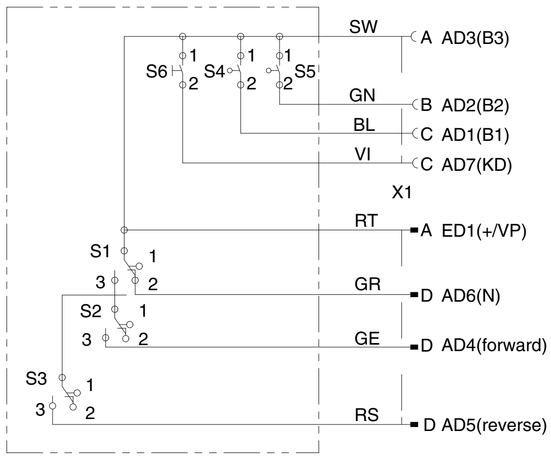
CODING GEAR SELECTOR

SPEED		OUTPUT									KD
		FORWARD			REVERSE			NEUTRAL			
		1	2	3	1	2	3	1	2	3	
AD1	B1	●			●			●			
AD2	B2			●			●			●	
AD3	B3	●	●	●	●	●	●	●	●	●	
AD4	V	●	●	●							
AD5	R				●	●	●				
AD6	AS							●	●	●	
AD7											●

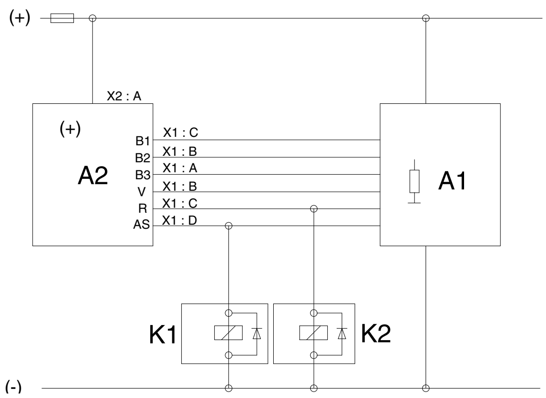


F = Forward
N = Neutral
R = Reverse
D = Mechanical neutral interlock
1 = 1st speed
2 = 2nd speed
3 = 3rd speed

CIRCUIT DIAGRAM SELECTOR



CIRCUIT DIAGRAM SELECTOR



K1 = Relay starter interlock
K2 = Relay reverse lights
A1 = TCU(Transmission Control Unit)
A2 = Gear selector

50DS7EPT38

6) TRANSMISSION ERROR DISPLAY

(1) Function

The display can be used with the gear selector. It indicates speed and driving direction as well as the activated inching.

When driving in the automatic mode, a bar indicator gives additionally also information about the selected driving range; The automatic range is symbolized by arrows above and below the bar indicator. In case of possible errors in the system, a wrench appears on the display, combined with indication of the error number. Also sporadically occurring errors can be indicated.

Transmission message display

70D9V3PS82

(2) Display during operation

Symbol	Meaning	Remarks
F, N, R 1, 2, 3	Actual gear and direction Central side shows actual gear Right side shows actual direction	
NN (Central and right side)	Not neutral, waiting for neutral after power up or a severe fault	To engage a gear, first move shift selector to neutral position and again to F to R position
1 bar	Manual mode Ist gear	
2 bar	Manual mode 2nd gear	
3 bar	Manual mode 3nd gear	
3 bars and 2 arrows	Automatic mode	a, b, c, d, f
✳✳	Transmission neutral	Cold start phase
Bars flashing	Downshift mode active	
Spanner flashing	At least on fault active	Select neutral to get fault code displayed
WT	Warning torque converter temperature	Changes between actual gear/direction while driving, in neutral only displayed if no fault is detected (spanner)
WS	Warning sump temperature	Changes between actual gear/direction while driving, in neutral only displayed if no fault is detected (spanner)
WE	Warning high engine speed	Changes between actual gear/direction while driving, in neutral only displayed if no fault is detected (spanner)
PN	Direction F or R selected while parking brake engaged	Transmission in neutral until parking brake is released. ※Machine starts to move after release of parking brake.
F or R flashing	Direction F or R selected while turbine speed is to high	※ Gear will engage when turbine speed drops

(3) Display during AEB-Mode

Symbol	Meaning	Remarks
PL	AEB-Starter is plugged at the diagnostic plug	
ST	AEB-Starter-button is pressed	
KA.....KE KV, KR	Calibrating clutch KC..KE, KV or KR resp.	KC, KD for 2 gear transmission KC, KD, KE for 3 gear transmission
_and Kx	Wait for start, initialization of clutch Kx, x : C, D, E, V, R	
≡and Kx	Fast fill time determination of clutch Kx	
=and Kx	Compensating pressure determination of clutch Kx	
OK	Calibration for all clutches finished	Transmission stays in neutral, you have to restart the TCU (ignition off/on) after removing AEB-Starter
STOP	AEB canceled (activation stopped)	Transmission stays in neutral, you have to restart the TCU (ignition off/on)
STOP and Kx	AEB stopped, clutch Kx can't be calibrated	Transmission stays in neutral, you have to restart the TCU (ignition off/on)
Spanner and Kx	Kx couldn't be calibrated, AEB finished	Transmission stays in neutral, you have to restart the TCU (ignition off/on)
△ E	Engine speed too low → raise engine speed	
▽ E	Engine speed too high → lower engine speed	
△ T	Transmission oil temperature too low → heat up transmission	
▽ T	Transmission oil temperature too high → cool down transmission	
FT	Transmission temperature not in defined range during calibration	Transmission stays in neutral, you have to restart the TCU (ignition off/on)
FB	Operating mode not NORMAL or transmission temperature sensor defective or storing of Calibrated values to EEPROM-has failed.	Transmission stays in neutral, you have to restart the TCU (ignition off/on)
FO	Outputspeed_not_zero	Transmission stays in neutral, you have to restart the TCU (ignition off/on)
FN	Shift lever not in Neutral position	Transmission stays in neutral, you have to restart the TCU (ignition off/on)
FP	Parkbrake_not_applied	Transmission stays in neutral, you have to restart the TCU (ignition off/on)
STOP	AEB-Starter was used incorrect or is defective. Wrong device or wrong cable used.	Transmission stays in neutral, you have to restart the TCU (ignition off/on)

(4) Definition of the error codes

① Introduction

The error codes consists of two hexadecimal numbers.

The first number shows the type of signal, the second number shows signal and the type of the error.

② Description of error codes

First No.	Meaning of number
1 hex	Digital input signals
2 hex	Analog input signals
3 hex	Speed signals
4 hex	Speed signals
7 hex	Analog current output signals
8 hex	Analog current output signals
9 hex	Digital output signals
A hex	Digital output signals
B hex	Clutch errors
D hex	Power supply
E hex	High speed signals
F hex	General errors

③ List of error codes

Number	Meaning of error code
11 hex	Logical error at gear range signal
12 hex	Logical error at direction select signal
21 hex	Short circuit to battery voltage at clutch cutoff input
22 hex	Short circuit to ground or open circuit at clutch cutoff input
25 hex	Short circuit to battery voltage or open circuit at temperature sensor input
26 hex	Short circuit to ground at temperature sensor input
31 hex	Short circuit to battery voltage at engine speed input
32 hex	Short circuit to ground or open circuit at engine speed input
33 hex	Logical error at engine speed input
34 hex	Short circuit to battery voltage at turbine speed input
35 hex	Short circuit to ground or open circuit at turbine speed input
36 hex	Logical error at turbine speed input
37 hex	Short circuit to battery voltage at internal speed input
38 hex	Short circuit to ground or open circuit at internal speed input
39 hex	Logical error at internal speed input

Number	Meaning of error code
3A hex	Short circuit to battery voltage or open circuit at output speed input
3B hex	Short circuit to ground or open circuit at output speed input
3C hex	Logical error at output speed input
71 hex	Short circuit to battery voltage at clutch KC
72 hex	Short circuit to ground at clutch KC
73 hex	Open circuit at clutch KC
74 hex	Short circuit to battery voltage at clutch KD
75 hex	Short circuit to ground at clutch KD
76 hex	Open circuit at clutch KD
77 hex	Short circuit to battery voltage at clutch KE
78 hex	Short circuit to ground at clutch KE
79 hex	Open circuit at clutch KE
84 hex	Short circuit to battery voltage at clutch KV
85 hex	Short circuit to ground at clutch KV
86 hex	Open circuit at clutch KV
87 hex	Short circuit to battery voltage at clutch KR
88 hex	Short circuit to ground at clutch KR
89 hex	Open circuit at clutch KR
91 hex	Short circuit to ground at relay reverse warning alarm
92 hex	Short circuit to battery voltage at relay reverse warning alarm
93 hex	Open circuit at relay reverse warning alarm
94 hex	Short circuit to ground at relay starter interlock
95 hex	Short circuit to battery voltage at relay starter interlock
96 hex	Open circuit at relay starter interlock
97 hex	Short circuit to ground at park brake solenoid
98 hex	Short circuit to battery voltage at park brake solenoid
99 hex	Open circuit at park brake solenoid

Number	Meaning of error code
B1 hex	Slippage at clutch KC
B2 hex	Slippage at clutch KD
B3 hex	Slippage at clutch KE
B5 hex	Slippage at clutch KV
B6 hex	Slippage at clutch KR
D1 hex	Short circuit to battery voltage at power supply for sensors
D2 hex	Short circuit to ground at power supply for sensors
D3 hex	Low voltage at battery
D4 hex	High voltage at battery
D5 hex	Error at valve power supply 1
D6 hex	Error at valve power supply 2
E5 hex	Communication failure on devicenet
F1 hex	General EEPROM fault
F2 hex	Configuration lost
F3 hex	Application error

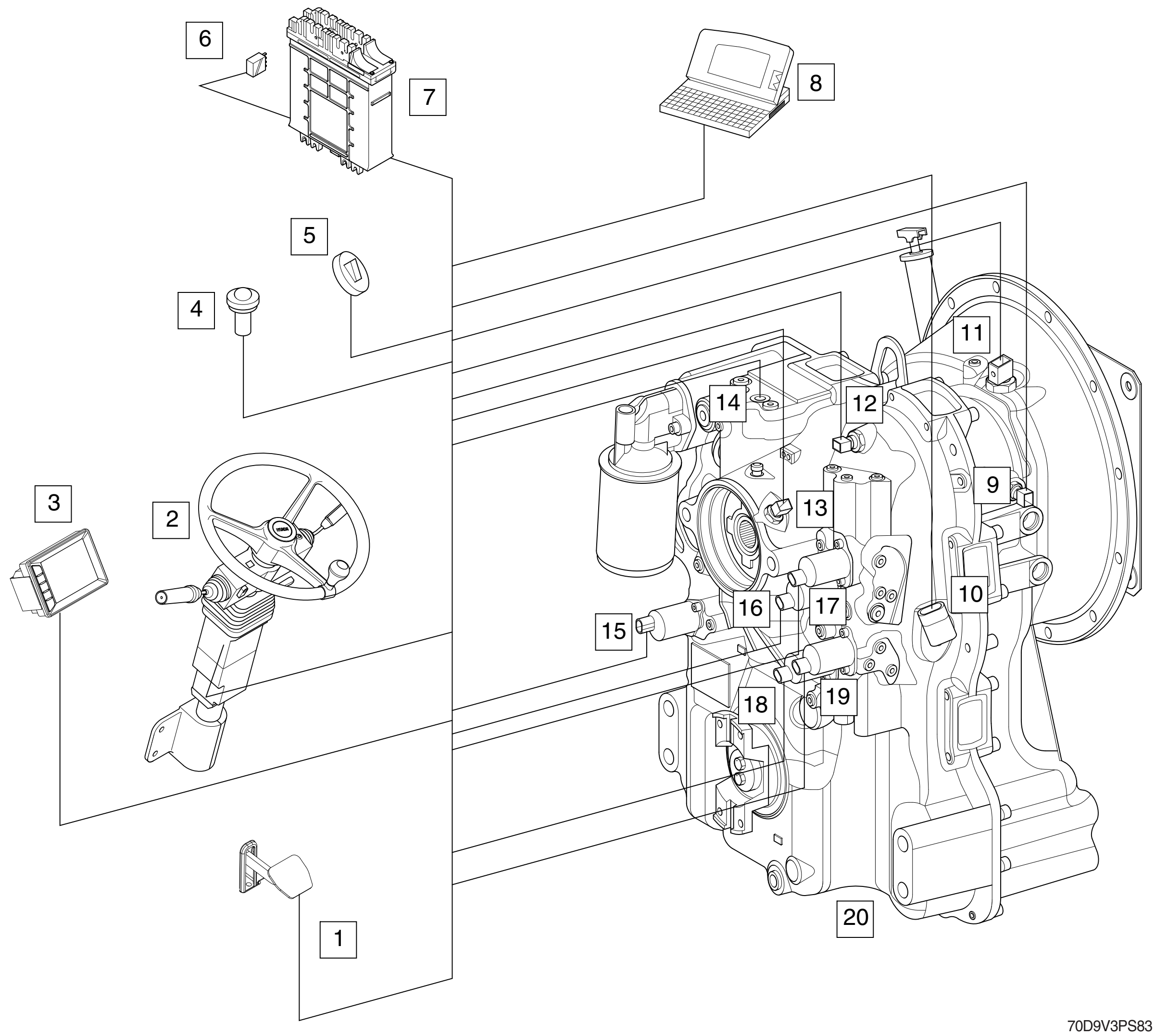
6) ELECTRONIC CONTROL FOR POWER TRANSMISSION

(1) Description of the basic functions

The powershift transmission 3 WG-94 EC of series WG-90 is equipped with the electronic transmission control EST-65 specially developed for this purpose.

The system process the driver command according to the following criteria:

· Gear determination depending on driving speed and load condition.
· If required, protection against operating errors is possible via electronic protection (programming)
· Protection against overspeeding (on the basis of engine and turbine speed)
· Pressure cut-off possible (vehicle-specific, only after coordination with ZF)
· Switch-over possibility for automatic / manual operation
· Downshifting functions possible
· Electronic inching



1	Inching pedal	11	Temperature measuring point after the converter (No. 63)
2	Gear selector	12	Inductive sensor - turbine speed
3	Display	13	Inductive sensor - engine speed
4	Optical warning	14	Temperature measuring point for the converter (No. 64)
5	Switch for driving program Manual/Automatic	15	Proportional valve Y3 - KC clutch
6	CAN connection	16	Proportional valve Y2 - KR clutch
7	TCU	17	Proportional valve Y1 - KV clutch
8	Diagnostic Laptop with ZF diagnostic system Testman/Pro	18	Proportional valve Y5 - KE clutch
9	Inductive sensor - speed of central gear chain	19	Proportional valve Y4 - KD clutch
10	Speed sensor - output	20	Ergopower transmission 3 WG-94 EC

(2) Inching device

This function is especially suitable for lift trucks. Without modifying the engine speed, it allows a continuously variable reduction of the driving speed to such a level that operation at a very low speed is possible. In this way, the driver can move the vehicle to a certain position with high accuracy.
At the same time, a large part of the engine power is available for driving the hydraulic lifting system, due to the high engine speed.

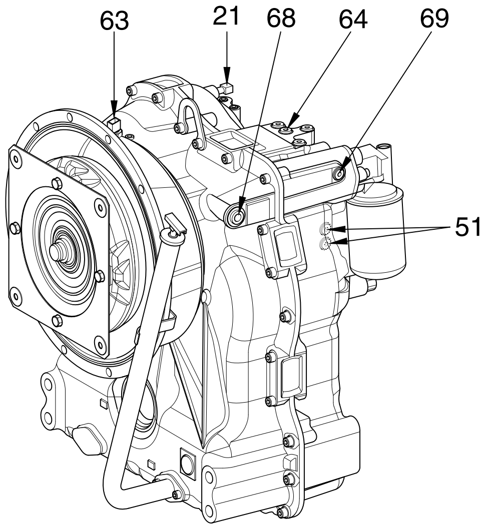
The electrical inching is operated via a separate inching pedal fitted with an angle-of-rotation sensor.
By means of the proportional valve technology, the TCU controls the pressure in the driving direction clutch in such a way that the driving speed is adjusted in accordance with the position of the inching angle-of-rotation sensor. Clutch overloading is prevented by the electronic protection.

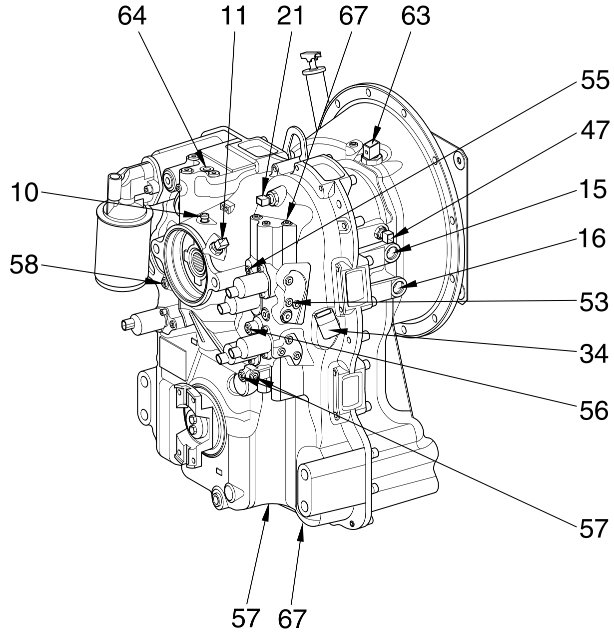
※ After each readjustment of the inching linkage, the IPK (Inch Pedal Calibration-Inch Sensor Calibration) must be carried out.
During the inching calibration mode, the position of the inching pedal in neutral position and at full actuation is determined by the calibration process and stored in theTCU.

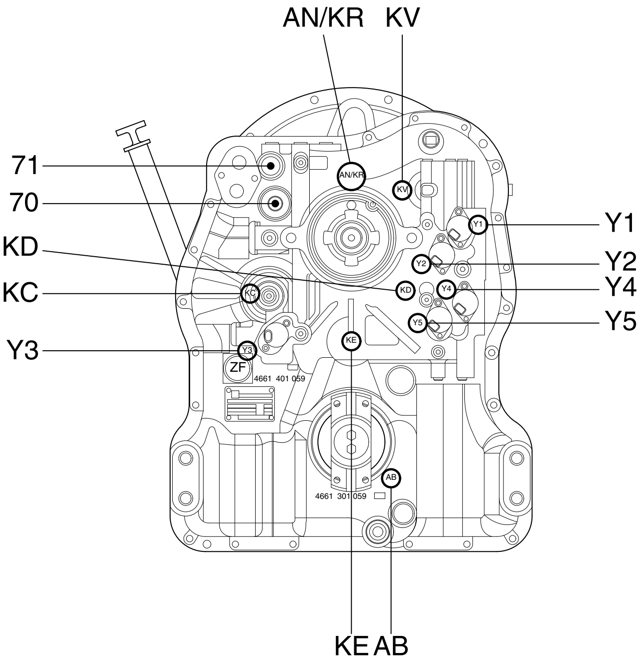
※ The inching function does not become active until successful completion of AEB and IPK start.

4. TRANSMISSION MEASURING POINTS AND CONNECTIONS

The measurement have to be carried out with hot transmission (about 80~95°C)







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1) MEASURING POINTS FOR PRESSURE OIL AND TEMPERATURE

Port	Description			Size
51	Before the converter - opening pressure		11 + 2 bar	M10×1
53	Reverse clutch	KR	16 + 3 bar	M10×1
55	Forward clutch	KV	16 + 3 bar	M10×1
56	Clutch	KD	16 + 3 bar	M10×1
57	Clutch	KE	16 + 3 bar	M10×1
58	Clutch	KC	16 + 3 bar	M10×1
63	Temperature after the converter 100°C ; short-term 120°C			M14×1.5
64	Temperature sensor			M12×1.5
67	System pressure		16 + 3 bar	M10×1

2) VALVES AND CONNECTIONS

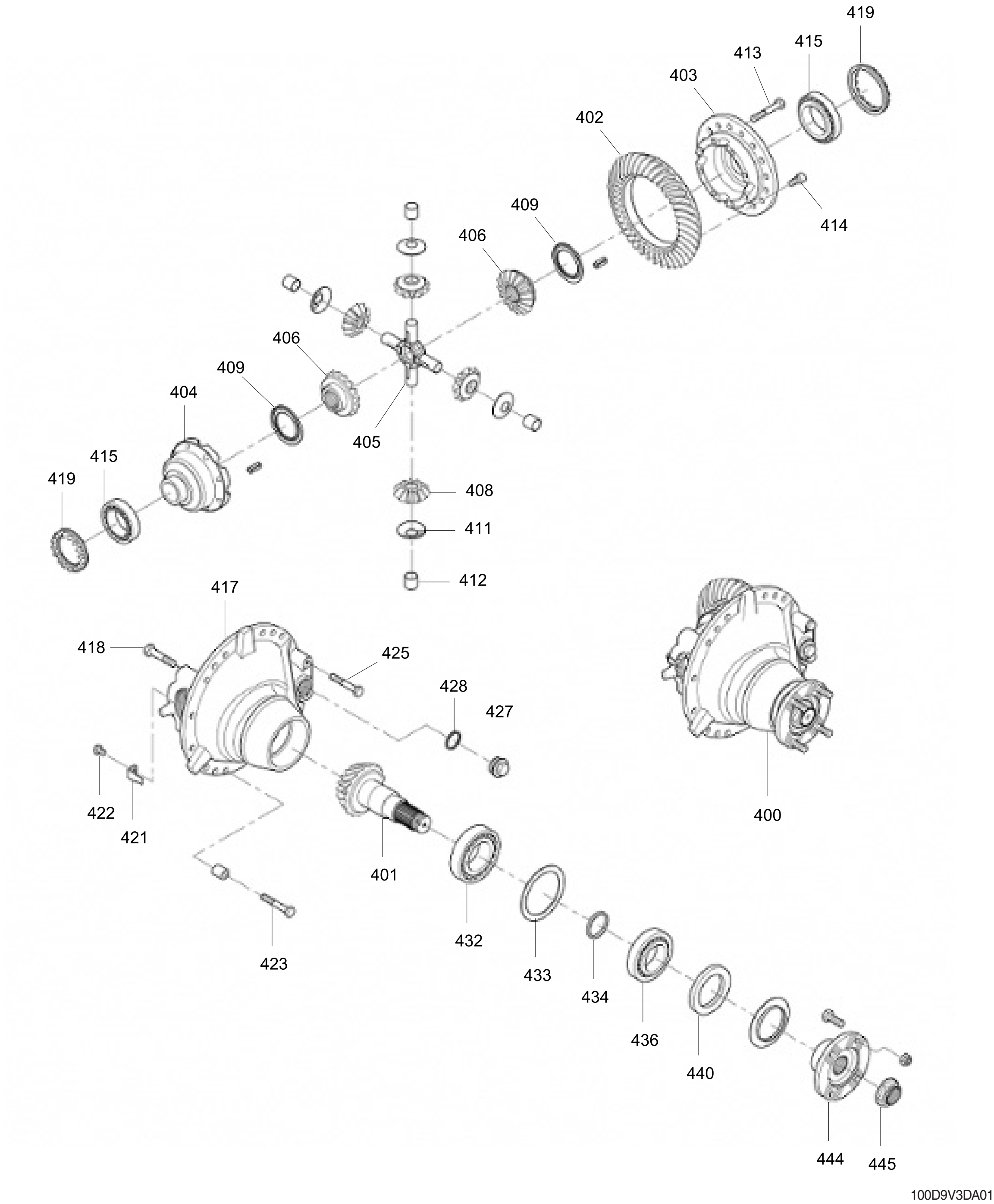
Port	Description	Size
10	Breather	M10×1
15	Connection towards heat exchange	7/8" 14 UNF
16	Connection from heat exchanger	7/8" 14 UNF
68	Connection after fine filter	9/6-18 UNF-2B
69	Connection before fine filter	7/8" 14 UN 2A
70	Converter safety valve (WSV)	
71	Main pressure valve (HDV)	

3) INDUCTIVE TRANSMITTERS AND SPEED SENSOR

Port	Description		Size
11	Inductive transmitter	n Engine	M18×1.5
21	Inductive transmitter	n Turbine	M18×1.5
34	Speed sensor	n Output	-
47	Inductive transmitter	n Central gear train	M18×1.5

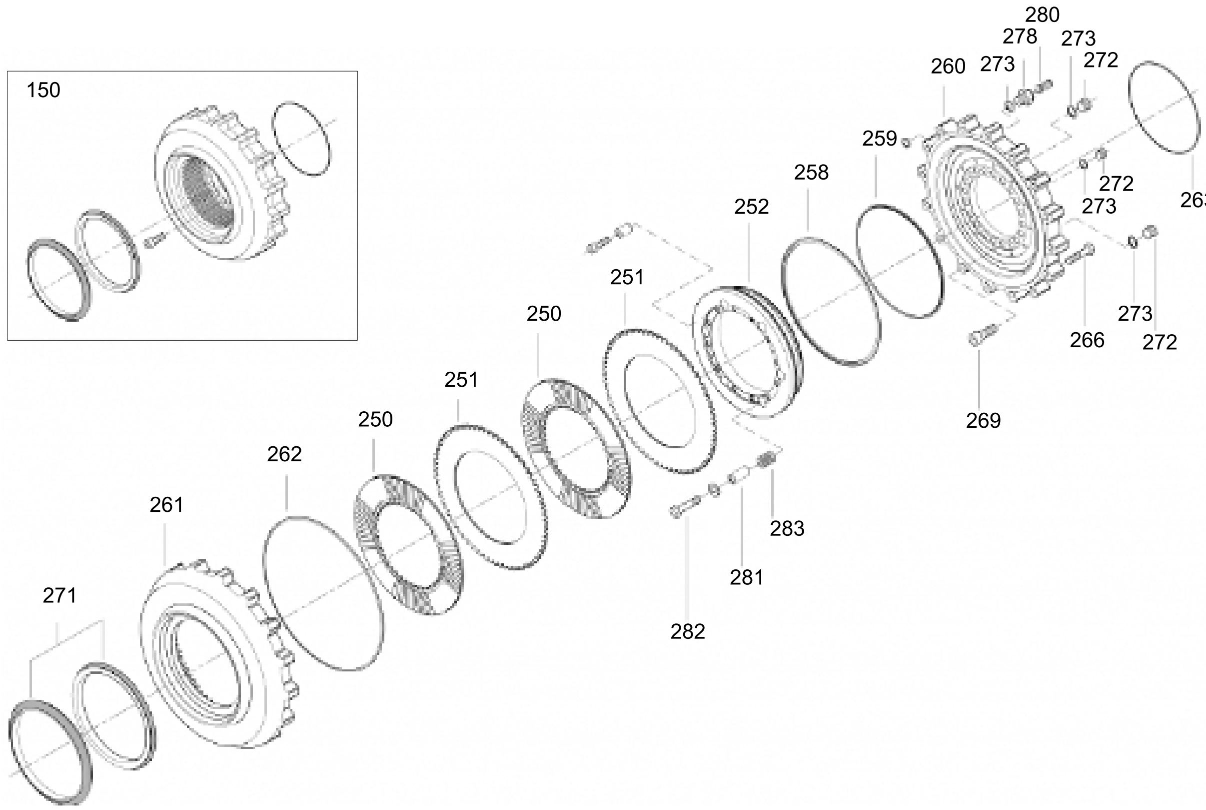
6. DRIVE AXLE (KESSLER)

1) STRUCTURE (1/6)



400	Differential & carrier assy	412	Bearing bushing	425	Hexagon screw
401	Drive pinion	413	Hexagon socket screw	427	Screw plug
402	Ring gear	414	Hexagon screw	428	Sealing ring
403	Differential housing	415	Tapered roller bearing	432	Tapered roller bearing
404	Differential housing	417	Differential carrier	433	Disk
405	Differential spider	418	Hexagon screw	434	Ring
406	Differential side gear	419	Setting ring	436	Tapered roller bearing
408	Differential pinion	421	Lock plate	440	Radial seal ring
409	Disk	422	Hexagon screw	444	Drive flange
411	Disk	423	Hexagon screw	445	Adjusting nut

2) STRUCTURE (2/6)



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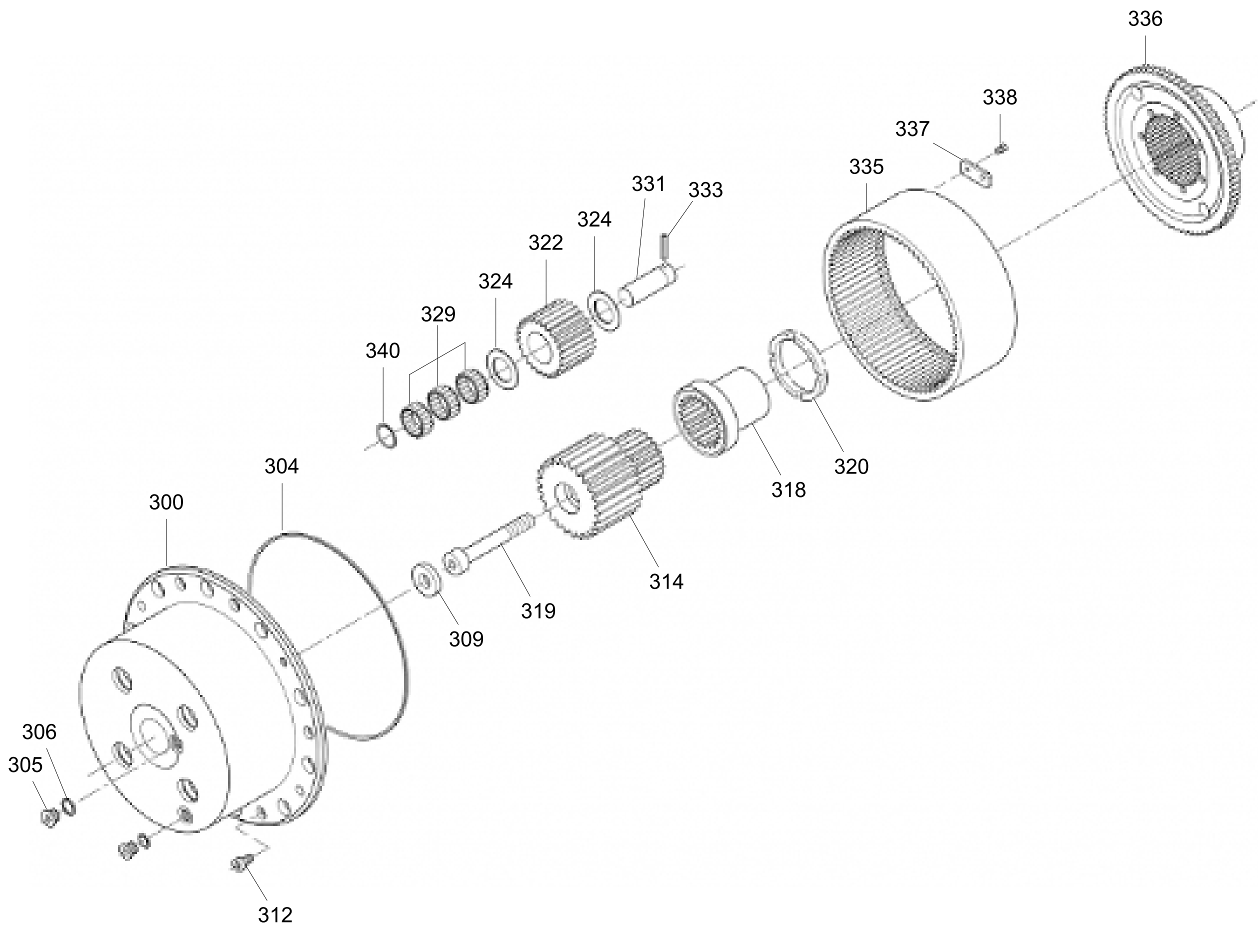
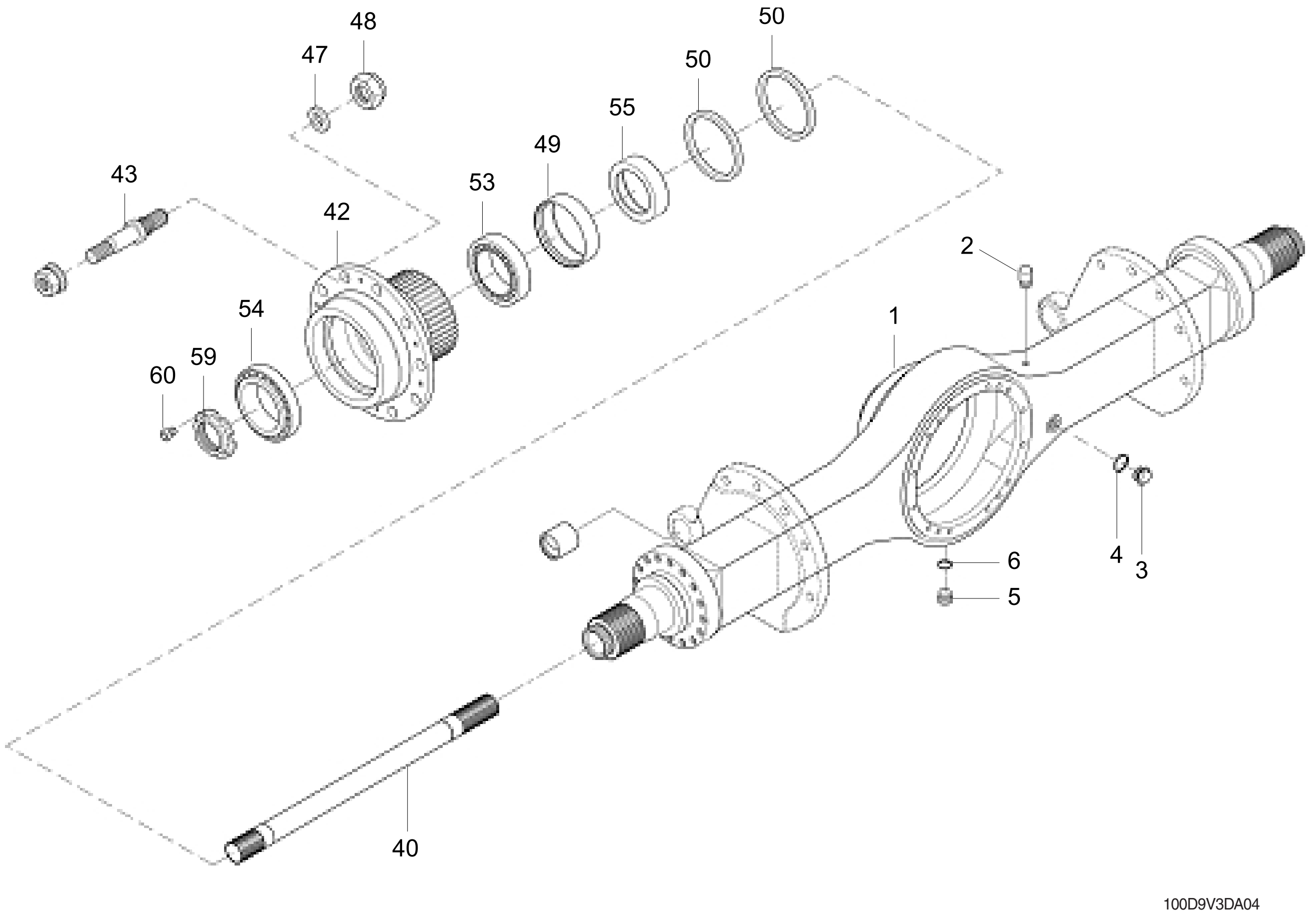
150	Brake assy	261	Housing	273	Sealing ring
250	Friction disc	262	O-ring	278	Bleeding socket
251	Steel disc	263	O-ring	280	Bleeder valve
252	Clutch piston	266	Hexagon socket screw	281	Pipe
258	Gasket	269	Hex sockets crew	282	Hexagon screw with flange
259	Gasket	271	Face seal	283	Compression spring
260	Brake carrier	272	Screw plug		

3) STRUCTURE (3/6)



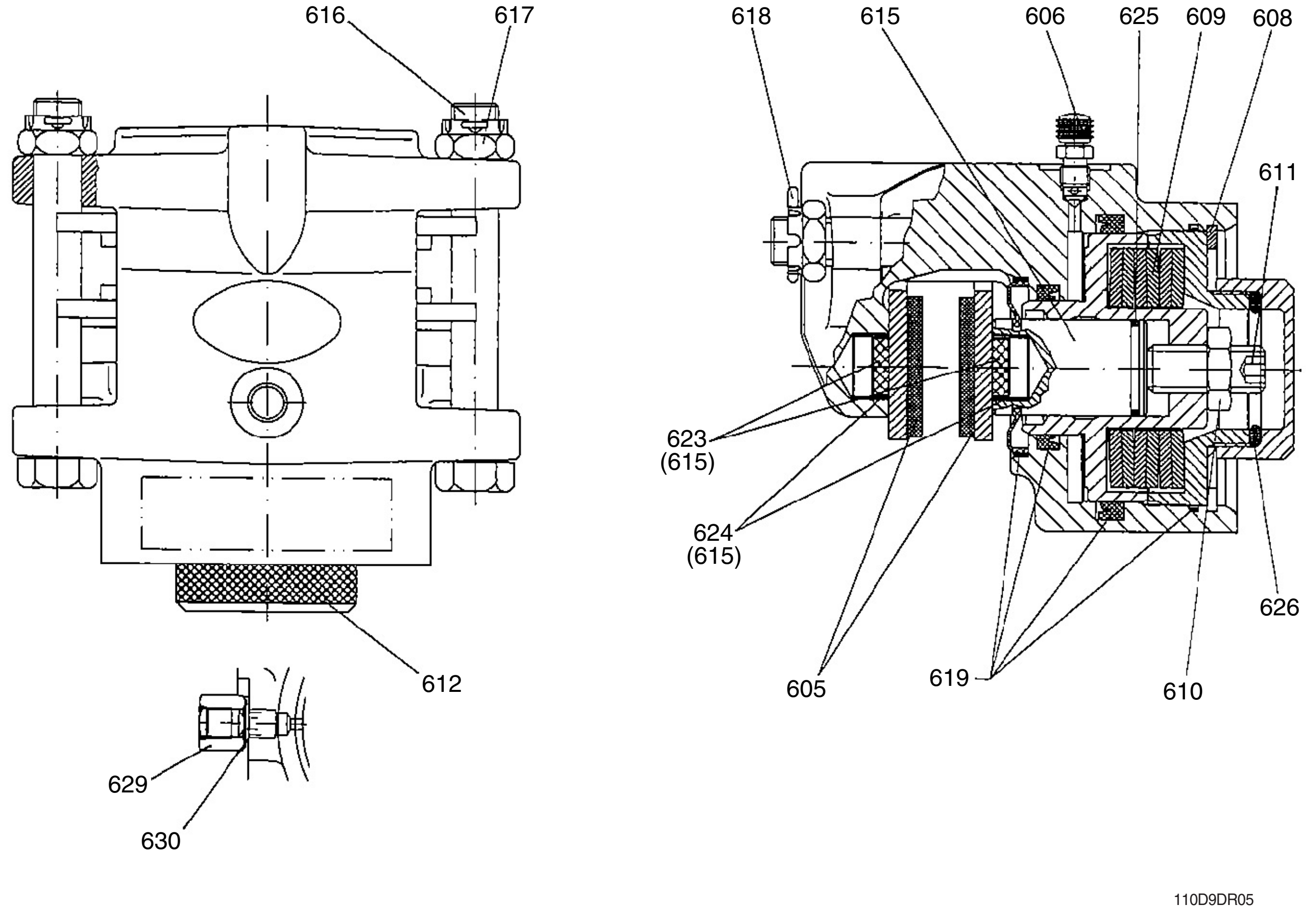
300	Planetary housing	318	Sleeve	333	Locking pin
304	O-ring	319	Screw	335	Ring gear
305	Screw plug	320	Thrust ring	336	Ring gear carrier
306	Sealing ring	322	Planetary gear	337	Retainer
309	Thrust washer	324	Thrust washer	338	Hexagon socket screw
312	Hexagon socket screw	329	Needle bearing	340	O-ring
314	Sun gear	331	Planetary pin		

4) STRUCTURE (4/6)



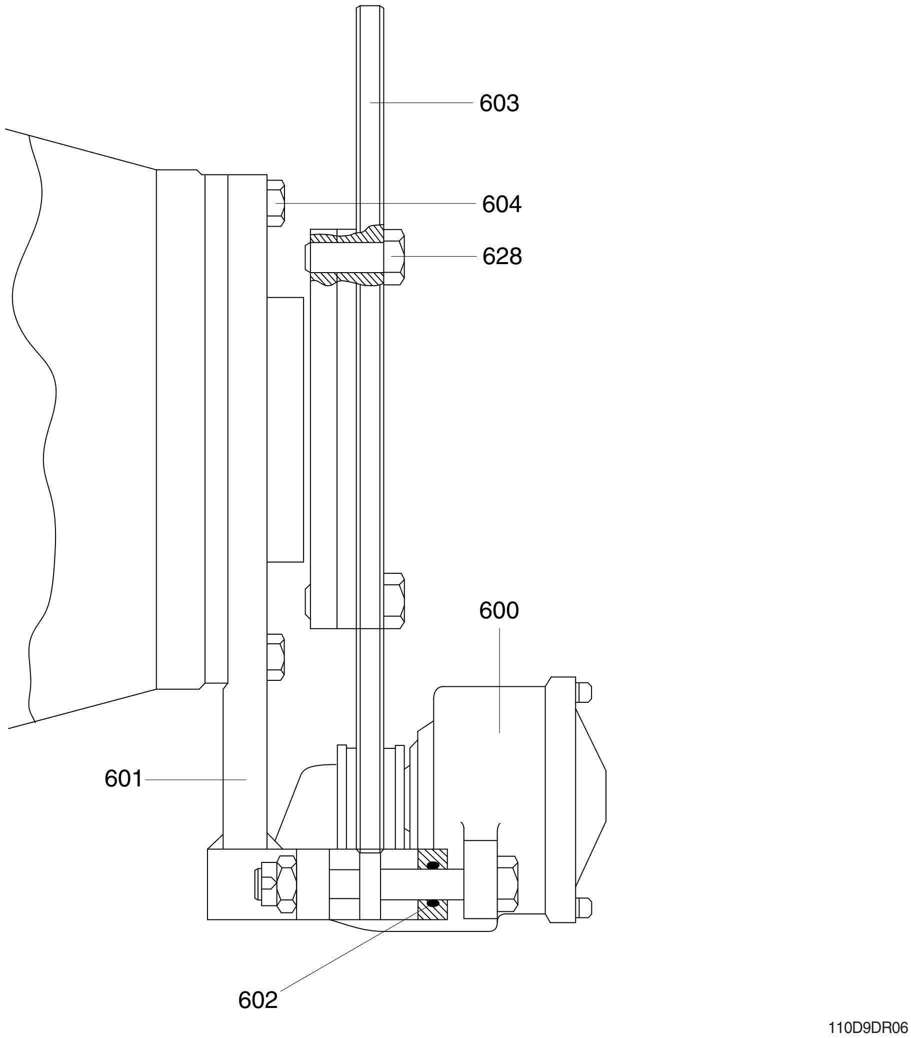
1	Axle housing	40	Axle shaft	50	Radial seal ring
2	Breather	42	Wheel hub	53	Taper roller bearing
3	Plug	43	Wheel stud	54	Taper roller bearing
4	Seal	47	Disk	55	Spacer ring
5	Screw plug	48	Hex nut	59	Nut
6	Seal	49	Bushing	60	Socket screw

5) STRUCTURE (5/6)



605	Lining set	612	Cap	623	Magetic
606	Bleeder valve	615	Pressure bolt	624	Tolerance ring
608	Circlip	616	Hex screw	625	O-ring
609	Dished plate spring	617	Castle nut	626	O-ring
610	Hex nut	618	Split pin	629	Socket screw
611	Set screw	619	Gasket	630	Sealing ring

6) STRUCTURE (6/6)



600	Parking brake	602	O-ring	604	Hex screw
601	Brake carrier	603	Disc plate	628	Hex screw

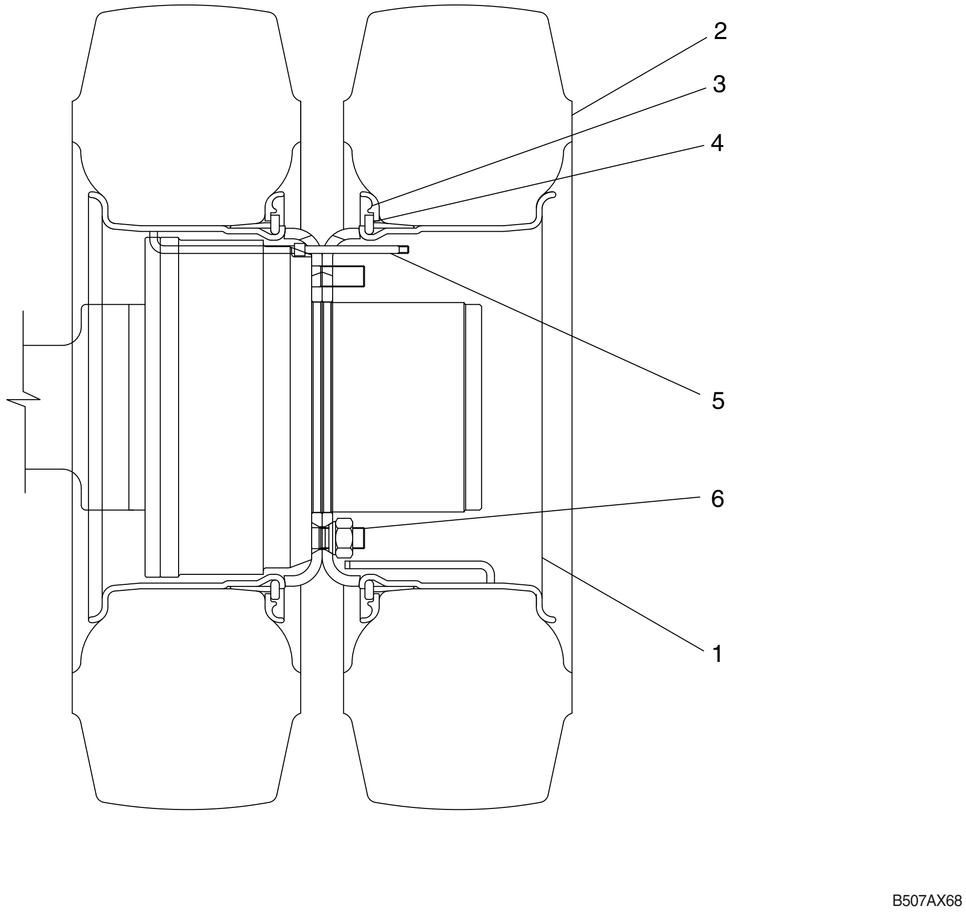
7) OPERATION

Both sides of the housing are supported by the frame and the center is mounted on the transmission case through propeller shaft.

The mast is installed on the front of the drive axle housing. The final deceleration and differential device built in the housing guarantee accurate rotation and smooth operation.

The power from the transmission in transferred through the hypoid pinion, hypoid gear, differential case, the pinion of the differential device and the side gear to the drive axle shaft by the side gear spline and to the hub and wheel mounted on the shaft by high tension bolts.

6. TIRE AND WHEEL



1	Wheel rim	3	Lock ring	5	Valve assembly
2	Tire	4	Side ring	6	Wheel nut

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

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

GROUP 2 OPERATION AND MAINTENANCE

1. OPERATION

1) DRIVING PREPARATION AND MAINTENANCE

Prior to the commissioning of the transmission, take care that the prescribed oil grade will be filled in with the correct quantity. At the initial filling of the transmission has to be considered that the oil cooler, the pressure filters as well as the pipes must get filled with oil.

According to these cavities, the quantity of oil to be filled in, is greater than at the later oil fillings in the course of the usual maintenance service.

※ Because the converter and the oil cooler, installed in the vehicle, as well as the pipes can empty at standstill into the transmission, the **oil level check must be carried out at engine idling speed and operation temperature of the transmission.**

⚠ **At the oil level check, the vehicle has to be secured against rolling by blocks, articulated vehicles additionally against unintended turning-in.**

2) DRIVING AND SHIFTING

(1) Neutral position

Neutral position will be selected via the gear selector.

After the ignition is switched on, the electronics remains in the waiting state. By the position NEUTRAL of the gear selector, the TCU becomes ready for operation.

A gear can be engaged.

(2) Starting

The starting of the engine has always to be carried out in the NEUTRAL POSITION of the gear selector.

For safety reasons it is to recommend to brake the vehicle securely in position with the parking brake prior to start the engine.

After the starting of the engine and the preselection of the driving direction and the gear, the vehicle can be set in motion by acceleration.

At the start off, the converter takes over the function of a master clutch.

On a level road it is possible to start off also in higher gears.

- **Upshifting under load.**

  Upshifting under load will be then realized if the vehicle can continue to accelerate by it.

- **Downshifting under load.**

Downshifting under load will be then realized if more traction force is needed.

- **Upshifting in overrunning condition.**
  In the overrunning mode, the upshifting will be suppressed by accelerator pedal idling position, if the speed of the vehicle on a downgrade should not be further increased.
- **Downshifting in overrunning condition.**
  Downshifting in overrunning mode will be then carried out if the vehicle should be related.

If the vehicle will be stopped and is standing with running engine and engaged transmission, the engine cannot be stalled. On a level and horizontal roadway it is possible that the vehicle begins to crawl, because the engine is creating at idling speed a slight drag torque via the converter.
It is convenient to brake the vehicle at very stop securely in position with the parking brake. At longer stops, the controller has to be shifted to the NEUTRAL POSITION.

At the start off, the parking brake has to be released. We know from experience that at a converter transmission it might not immediately be noted to have forgotten this quite normal operating step because a converter, due to its high ratio, can easily overcome the braking torque of the parking brake.
Temperature increases in the converter oil as well as overheated brakes will be the consequences to be find out later.
Neutral position of the selector switch at higher vehicle speed(above stepping speed) is not admissible.
Either a suitable gear is to be shifted immediately, or vehicle must be stopped at once.

3) COLD START

At an oil temperature in the shifting circuit <-12 °C, the transmission must be warmed-up for some minutes.
This must be carried out in neutral with an increased engine speed (about 1500 min^{-1}).
Until this oil temperature is reached, the electronics remains in neutral, and the symbol of the cold start phase will be indicated on the display.

Indication on the display: **

After the indication on the display is extinguished, the full driving program can be utilized out of "NEUTRAL".

4) OIL TEMPERATURE

The oil temperature in the transmission sump is in the electrohydraulic control unit.

The service temperature in the sump of 60~90 °C must not be exceeded.
By overstepping results by 105 °C notice "WS" on the display.

At a trouble-free unit and an adequate driving mode, a higher temperature will not occur.
The notice "WS" results at the display, the vehicle has to be stopped and controlled for external oil loss and the engine must run with a speed of 1200~1500 min^{-1} at NEUTRAL POSITION of the transmission.

Now, the temperature must drop quickly(in about 2~3 minutes) to normal values. If this is not the case, there is a trouble pending, which must be eliminated prior to continue working.

The monitoring of the oil temperature(behind the converter) is additionally on the temperature gauge which is located on the dashboard.

Operating temperature behind the converter at least 65 °C and 100 °C in continuous operation, a short-time increase up to max. 120 °C is permitted.

The temperature is measured on the measuring point "63" (see schedule of measuring points-3-22)

2. MAINTENANCE

1) TRANSMISSION

(1) Oil level check

⚠ **At the oil level check, the vehicle has to be secured against rolling with blocks.**

The oil level check must be carried out as follows :

- Oil level check (weekly)
- At horizontally standing vehicle
- Transmission in neutral position "N"
- In the cold start phase, the engine must be running about 2-3 minutes at idling speed, and the marking on the oil dipstick must then be lying above the cold start mark "COLD"
- At operating temperature of the transmission (about 80~90 °C)
- At engine idling speed
- Loosen oil dipstick by counterclock rotation, remove and clean it
- Insert oil dipstick slowly into the oil level tube until contact is obtained, and pull it out again.
- On the oil dipstick, the oil level must be lying in the zone "HOT"
- Insert the oil dipstick again, and tighten it by clockwise rotation

If the oil level has dropped in operating temperature condition below the "HOT" zone, it is absolutely necessary to replenish oil.
An oil level above the "HOT" marking, is leading to a too high oil temperature.

(2) Oil change and filter replacement intervals

※ First oil change after 100 operating hours in service.
Every further oil change after 1000 operating hours in service, however at least once a year.
At every oil change, the fine filter has to be replaced.

① Oil change and oil filling capacity

The oil change has to be carried out as follows. At operating temperature of the transmission, horizontally standing vehicle open the oil drain plug and drain the used oil.

- Clean oil drain plug with magnetic insert and surface on the housing and install again along with O-ring.
- Fill in oil (about 24 liters).

(Sump capacity, external oil capacities e. g. in the heat exchanger, in the lines etc. are depended on the vehicle).
The indicated value is a guide value.

※ It is imperative to pay attention to absolute cleanliness of oil and filter.
Binding is in any case the making on the oil dipstick.

- Start the engine-idling speed
- Transmission in neutral position "N"
- Top up oil up to the marking "COLD"
- Brake the vehicle securely in position and warm up the transmission
- Shift all controller positions through
- Check the oil level once more and top up oil once more if necessary
- On the oil dipstick, the oil level must be lying in the zone "HOT"
- Insert the oil dipstick again and tighten it by clockwise rotation

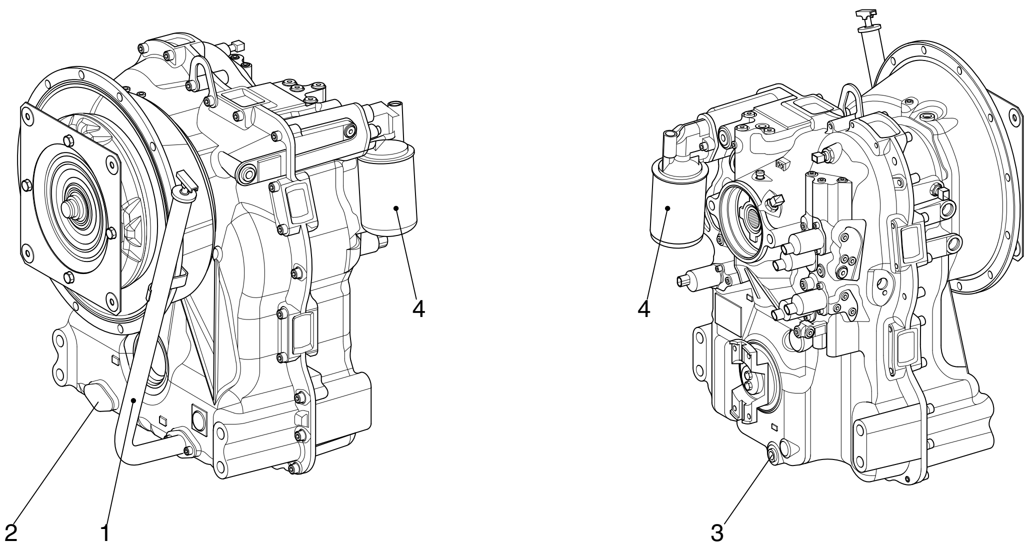
※ At the initial filling of the transmission has to be considered that the heat exchanger, the pressure filter as well as the pipes must get filled with oil.
According to these cavities, the oil capacity to be filled in is greater than at the later oil fillings in the course of the usual maintenance service.

② Filter replacement

At the replacement of the filter in the main oil steam, pay attention that no dirt or oil sludge can penetrate into the circuit.
At the mounting of the filter, any exertion of force has to be avoided.

※ Treat the filter carefully at the installation, the transport and the storage.
Damaged filters must no more be installed.
The mounting of the filter must be carried out as follows:

- Cover the gasket with a small amount of oil.
- Screw the filter in until contact with the sealing surface is obtained and tighten it now by hand about 1/3 to 1/2 turn.



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Legend:

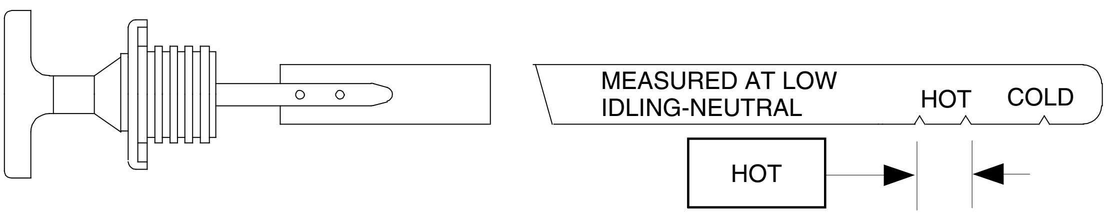
1 = Oil filler tube with oil dipstick

2 = Mounting provision for oil filler tube with oil dipstick (option)

3 = Oil drag plug 7/8" 14 UNF 2B

4 = Fine filter

Oil dipstick



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2) DRIVE AXLE

(1) Important remarks

① For safety reasons, the operator should verify and service at regular intervals all of the bolted assemblies and all of the important safety locks such as :

- Wheel nuts
- Nuts of axle mounting bolts
- Bolts on the steering components and the brake system parts : if the screws are tightable, the loctite contact breaks loose and remounting is necessary.
- Corrosion on the carrier elements (such as the axle spindle) is not acceptable for operational safety reasons.
- Verify seals, oil levels and lubrication at regular intervals.

② Brakes

- Inspect brake lining and brake drum/brake disk regularly as well as wear of brake system parts.
- Inspect the free movement of brake system rode.
- In case of signs of excessive heating, consult a brake specialist or the manufacturer.

(2) Oil change

During changing the oil, always follow the stated measures

① Place vehicle in horizontal position and jack it up if possible so that complete draining of oil is possible and clean oil can be filled to the correct level.

② Make sure that oil has cooled down before draining it.

③ Always replace gaskets of the screw plugs with new gaskets. The gaskets are mostly copper rings.

④ Pay attention to the specific notes.

⑤ The precise position of the lube point can deviate from the illustration. The relevant lube point can be found on the KESSLER product on hand.

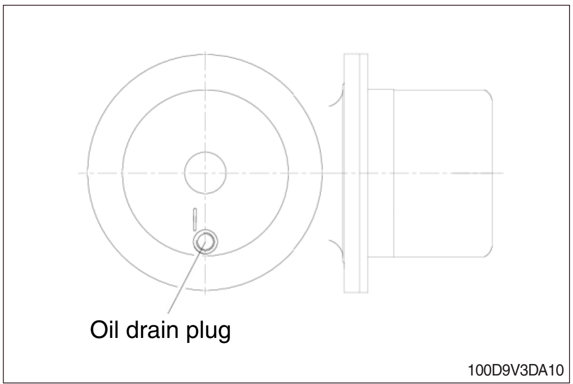
⑥ Pay attention to the given activity sequence.

(3) Drain oil

※ Differential and carrier assembly, axle housing and hub assembly have a total oil space. Oil drain has to take place at the complete axle.

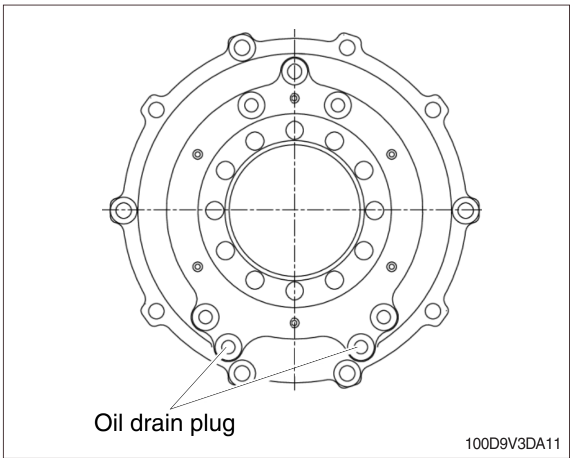
※ Wet multiple disk brake
Drain the extra oil.

① Hub assembly



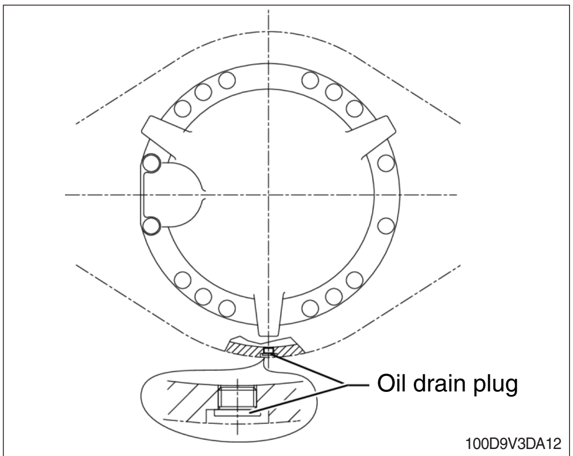
a. Clean drainage point and oil drain plug.
b. Rotate the hub assembly until the oil drain plug is at the bottom position (6 o'clock position).
c. Open the oil drain plug and allow oil to drain.
  - Collect the oil in a suitable container.
  - Dispose of the oil in an environmentally friendly manner.
d. Clean bore hole and oil drain plug.
e. Screw oil drain plug back in.

② Wet multiple disk brake



a. Clean drainage point and oil drain plug.
b. Open the oil drain plug and allow oil to drain.
  - Collect the oil in a suitable container.
  - Dispose of the oil in an environmentally friendly manner.
c. Clean borehole and oil drain plug.
d. Screw oil drain plug back in.

③ Differential and carrier assembly/axle housing:



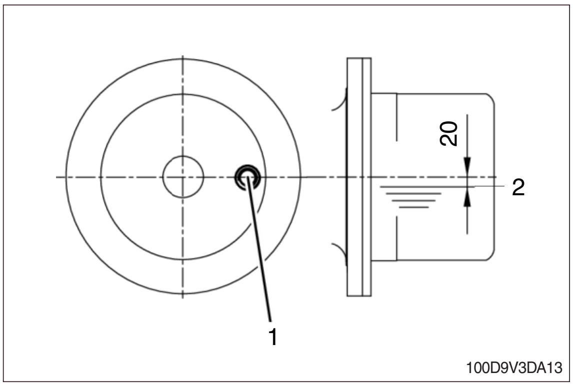
a. Clean drainage point and oil drain plug.
b. Open the oil drain plug and allow oil to drain.
  - Collect the oil in a suitable container.
  - Dispose of the oil in an environmentally friendly manner.
c. Clean borehole and oil drain plug.
d. Screw oil drain plug back in.

(4) Oil filling and filling level

※ Differential and carrier assembly, axle housing and hub assembly have a total oil space.

- All oil drain plugs have to be closed before filling with oil.
- The whole axle is filled with oil from the differential and carrier assembly, axle housing and hub assembly and together.
- The oil level is specified at the respective component (differential and carrier assembly / axle housing and hub assembly).

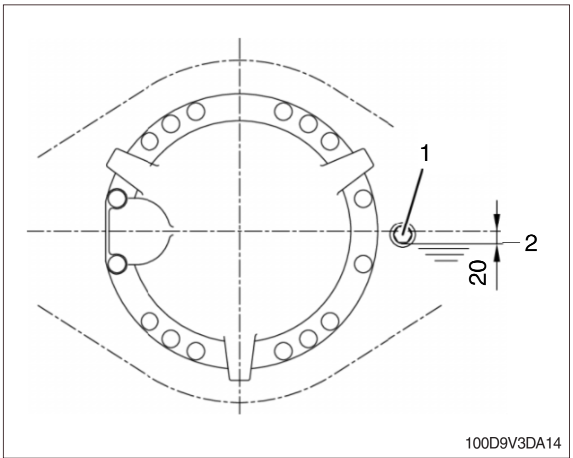
① Hub assembly



1 Oil filling and level check point
2. Oil level

a. Clean filling point and oil filling plug.
b. Turn hub assembly into position.
  - The oil drain plug has to be at the bottom.
c. Open the oil filling plug.
d. Fill hub assembly with clean oil until the oil level reaches the filling bore (= inspection bore).
  - Overflow check
  - Oil in accordance with the specified lubricants.
e. After a few minutes, check the oil level again at the filling bores.
  - Keep filling the hub assembly with oil until the oil level remains constant.
f. Clean bore hole and oil filling plug.
g. Screw oil filling plug back in.

② Differential and carrier assembly/axle housing



1 Oil filling and level check point
2. Oil level

a. Clean filling point and oil filling plug.
b. Open oil filling plug.
c. Fill axle and differential and carrier assembly with clean oil until the oil level reaches the filling bore (= inspection bore).
  - Overflow check
  - Oil in accordance with the specified lubricants.
d. After a few minutes, check the oil level again at the filling bores.
  - Keep filling the axle until the oil level remains constant.
e. Clean borehole and oil filling plug.
f. Screw oil filling plug back in.

3. TROUBLESHOOTING

1) TRANSMISSION

(1) GENERAL INSPECTION WHILE DRIVING

No	Problem	Cause
1	Failure at the specific gear stage	1. Low oil pressure or no pressure. 1) No oil, low level or high oil viscosity. 2) Loose inching control valve connection, incorrect adjustment or damage. 3) Inching valve spool sticked or open. 4) Oil pump damage or defect. 5) T/C pump gear side bolt breakage or gear not meshing with pump. 6) Main regulator valve sticked or open. 7) Oil circuit clogged or strainer contaminated. 8) T/M inside leakage. Control valve gasket damage. - Clutch shaft metal sealing wear or damage. - Clutch piston seal damage or wear. 9) Control valve gasket wear cause oil leakage. 2. Abnormal connection of outer line of cooler. 3. Mechanical defect inside the T/M
2	Gear shift failure	1. Low oil pressure. 2. Main regulator valve does not move. 3. Malfunctioning of solenoid or relative electric components.
3	T/M overheating	1. Clogged cooling line. 2. Oil level is too high or too low. 3. Low pump pressure, pump wear or defect. 4. Partial clutch wear or slip 5. Air mixed with oil, air leakage at the pump input port. 6. Insufficient oil flow through the T/C. 7. Overload on the machine. 8. Too excessive inching operation. 9. Too excessive stall operation of T/C. 10. Cooler bypass valve stick or open. Oil flow insufficient through oil cooler.

No	Problem	Cause
4	Slow clutch meshing or failure	1. Low oil pressure. 2. Low converter oil pressure. 3. Air mixed with oil 1) Air mixed through the pump input port. 2) Low oil level 4. Abnormal adjustment of inching valve linkage.
5	Reverse gear shift failure	1. Excessive wear of disk and plate at reverse clutch. 2. Oil leakage from seal. 3. Reverse clutch components defect. 1) Metal sealing wear or defect. 2) Clutch piston seal wear or defect. 3) Another components damaged. 4. Malfunction of solenoid or related electric parts.
6	Forward gear shift failure	1. Excessive wear of disk and plate at forward clutch. 2. Oil leakage from seal. 3. Forward clutch components defect. 1) Metal sealing wear or defect. 2) Clutch piston seal wear or defect. 3) Another components damaged. 4. Malfunction of solenoid or related electric parts.
7	Low stall speed	1. Incorrect engine performance. 2. Torque converter stator failure.
8	High stall speed at all of gear stage	1. Low oil level. 2. Air mixed with oil. 3. Clutch slip. 4. T/C malfunctioning.
9	High stall speed at partial direction or speed	1. Clutch line leakage. 2. Clutch defect.
10	Slow clutch meshing and rough gear shift	1. Incorrect adjustment of inching valve. 2. Inching valve not closed or clogged orifice. 3. Low main pressure. 4. Low pressure of direction clutch. 5. Oil leakage. 6. Valve spool spring weakened or damaged.
11	Abnormal movement to the specified direction at neutral	1. Clutch defect, clutch disk and plate damaged. 2. Valve spool defect or spool sticked.

(2) ABNORMAL NOISE CHECK LIST

No	Problem	Cause
1	Noise only at neutral	1. Gear or bearing wear inside the pump. 2. Torque converter stator wear. 3. Low oil level. 4. Gear parts of engine and T/M pump's misalignment with that of converter housing and pump.
2	Pump noise	1. Loud noise irregularly repeats if there's contaminants in the T/M hydraulic components. 2. Regular noise means pump defect.
3	T/M noise	1. Converter housing and pump gear misalignment with engine or T/M 2. T/M components wear or damage. 1) Gear damage. 2) Clutch plate and disk slip noise. 3) Thrust washer defect. 4) Another components wear or damage.
4	Control valve noise	1. Air mixed into hydraulic system. 1) Air leakage from the pump input port. 2. Clogged oil passage. 3. Abnormal spool movement.

(3) PRESSURE TEST CHECK LIST

No	Problem	Cause
1	FR/RR clutch low pressure	Incorrect adjustment of inching valve linkage
		Inching spool sticked and open.
		Clutch and piston oil leakage.
		Regulator spring defect.
		Low oil pressure.
		Incorrect connection of cooler external line.
2	High clutch and main pressure	Pressure regulation valve does not move smoothly.
		Clogged hydraulic line.
3	Low clutch pressure	Oil leakage due to incorrect assembly of clutch piston seal.
		Damage or wear of clutch piston seal and shaft seal.
		Valve contact surface not flat or gasket damage.
4	Low main pressure	Low oil quantity
		Pressure regulation valve does not move smoothly.
		Pump wear
		Internal leakage
		Low oil pressure
5	High converter pressure	Main regulation valve sticked and open, oil overflow to converter.
		Clogged internal passage of converter assembly.
		Clogged oil line.
6	Low converter pressure	Clogged main regulator valve.
7	Low converter output pressure, cooler input pressure.	Low oil pressure
		Cooler bypass valve sticked and open.
8	High converter output pressure, cooler input pressure	Clogged or restricted cooler line.

(4) Transmission fault codes

Fault code (Hex)	Meaning of the fault code possible reason for fault detection	Reaction of the TCU	Possible steps to repair
11	**Logical error at gear range signal** TCU detected a wrong signal combination for the gear range · Cable from shift lever to TCU is broken · Cable is defective and is contacted to battery voltage or vehicle ground · Shift lever is defective	TCU shifts transmission to neutral OP-mode : Transmission shutdown	· Check the cables from TCU to shift lever · Check signal combinations of shift lever positions for gear range ※ Failure cannot be detected in systems with DW2/DW3 shift lever. Fault is taken back if TCU detects a valid signal for the position
12	**Logical error at direction select signal** TCU detected a wrong signal combination for the direction · Cable from shift lever to TCU is broken · Cable is defective and is contacted to battery voltage or vehicle ground · Shift lever is defective	TCU shifts transmission to neutral OP-Mode : Transmission shutdown	· Check the cables from TCU to shift lever · Check signal combinations of shift lever positions F-N-R ※ Fault is taken back if TCU detects a valid signal for the direction at the shift leve
15	**Logical error at direction select signal 2. shift lever** · Cable form shift lever 2 to TCU is broken · Cable is defective and is contacted to battery voltage or vehicle ground · Shift lever is defective	TCU shifts transmission to neutral if selector activ OP-Mode : Transmission shutdown if selector activ	· Check the cables from TCU to shift lever 2 · Check signal combinations of shift lever positions F-N-R
25	**S.C. to battery voltage or O.C. at transmission sump temperature sensor input** The measured voltage is too high: · Cable is defective and is contacted to battery voltage · Cable has no connection to TCU · Temperature sensor has an internal defect · Connector pin is contacted to battery voltage or is broken	No reaction, TCU use default temperature OP mode : Normal	· Check the cable from TCU to the sensor · Check the connectors · Check the temperature sensor
26	**S.C. to ground at transmission sump temperature sensor input** The measured voltage is too low: · Cable is defective and is contacted to vehicle ground · Temperature sensor has an internal defect · Connector pin is contacted to vehicle ground	No reaction, TCU uses default temperature OP mode : Normal	· Check the cable from TCU to the sensor · Check the connectors · Check the temperature sensor

Fault code (Hex)	Meaning of the fault code possible reason for fault detection	Reaction of the TCU	Possible steps to repair
27	**S.C. to battery voltage or O.C. at retarder/torque converter temperature sensor input** The measured voltage is too high: · Cable is defective and is contacted to battery voltage · Cable has no connection to TCU · Temperature sensor has an internal defect · Connector pin is contacted to battery voltage or is broken	No reaction, TCU uses default temperature OP mode : Normal	· Check the cable from TCU to the sensor · Check the connectors · Check the temperature sensor
28	**S.C. to ground at retarder/torque converter temperature sensor input** The measured voltage is too low: · Cable is defective and is contacted to vehicle ground · Temperature sensor has an internal defect · Connector pin is contacted to vehicle ground	No reaction, TCU uses default temperature OP mode : Normal	· Check the cable from TCU to the sensor · Check the connectors · Check the temperature sensor
2B	**Inch sensor-signal mismatch the measured voltage from CCO and CCO2 signal don't match :** · Cable is defective · Sensor has an internal defect	During inching mode : TCU shifts to neutral While not inching : no change OP-Mode : normal	· Check the cable from TCU to the sensor · Check the connectors · Check the sensor
31	**S.C. to battery voltage or O.C. at engine speed input** TCU measures a voltage higher than 7.00V at speed input pin · Cable is defective and is contacted to battery voltage · Cable has no connection to TCU · Speed sensor has an internal defect · Connector pin is contacted to battery voltage or has no contact	OP mode : Substitute clutch control	· Check the cable from TCU to the sensor · Check the connectors · Check the speed sensor
32	**S.C. to ground at engine speed input** TCU measures a voltage less than 0.45V at speed input pin · Cable/connector is defective and is contacted to vehicle ground · Speed sensor has an internal defect	OP mode : Substitute clutch control	· Check the cable from TCU to the sensor · Check the connectors · Check the speed sensor

Fault code (Hex)	Meaning of the fault code possible reason for fault detection	Reaction of the TCU	Possible steps to repair
33	**Logical error at engine speed input** TCU measures a engine speed over a threshold and the next moment the measured speed is zero · Cable/connector is defective and has bad contact · Speed sensor has an internal defect · Sensor gap has the wrong size	OP mode : Substitute clutch control	· Check the cable from TCU to the sensor · Check the connectors · Check the speed sensor · Check the sensor gap ※ This fault is reset after power up of TCU
34	**S.C. to battery voltage or O.C. at turbine speed input** TCU measures a voltage higher than 7.00V at speed input pin · Cable is defective and is contacted to vehicle battery voltage · Cable has no connection to TCU · Speed sensor has an internal defect · Connector pin is contacted to battery voltage or has no contact	OP mode : Substitute clutch control If a failure is existing at output speed, TCU shifts to neutral OP mode : Limp home	· Check the cable from TCU to the sensor · Check the connectors · Check the speed sensor
35	**S.C. to ground at turbine speed input** TCU measures a voltage less than 0.45V at speed input pin · Cable/connector is defective and is contacted to vehicle ground · Speed sensor has an internal defect	OP mode : Substitute clutch control If a failure is existing at output speed, TCU shifts to neutral OP mode : Limp home	· Check the cable from TCU to the sensor · Check the connectors · Check the speed sensor ※ This fault is reset after power up of TC
36	**Logical error at turbine speed input** TCU measures a turbine speed over a threshold and at the next moment the measured speed is zero · Cable/connector is defective and has bad contact · Speed sensor has an internal defect · Sensor gap has the wrong size	OP mode : Substitute clutch control If a failure is existing at output speed, TCU shifts to neutral OP mode : Limp home	· Check the cable from TCU to the sensor · Check the connectors · Check the speed sensor · Check the sensor gap
37	**S.C. to battery voltage or O.C. at internal speed input** TCU measures a voltage higher than 7.00V at speed input pin · Cable is defective and is contacted to vehicle battery voltage · Cable has no connection to TCU · Speed sensor has an internal defect · Connector pin is contacted to battery voltage or has no contact	OP mode : Substitute clutch control	· Check the cable from TCU to the sensor · Check the connectors · Check the speed sensor
38	**S.C. to ground at internal speed input** TCU measures a voltage less than 0.45V at speed input pin · Cable/connector is defective and is contacted to vehicle ground · Speed sensor has an internal defect	OP mode : Substitute clutch control	· Check the cable from TCU to the sensor · Check the connectors · Check the speed sensor

Fault code (Hex)	Meaning of the fault code possible reason for fault detection	Reaction of the TCU	Possible steps to repair
39	**Logical error at internal speed input** TCU measures a internal speed over a threshold and at the next moment the measured speed is zero · Cable/connector is defective and has bad contact · Speed sensor has an internal defect · Sensor gap has the wrong size	OP mode : Substitute clutch control	· Check the cable from TCU to the sensor · Check the connectors · Check the speed sensor · Check the sensor gap ※ This fault is reset after power up of TCU
3A	**S.C. to battery voltage or O.C. at output speed input** TCU measures a voltage higher than 12.5V at speed input pin · Cable is defective and is contacted to battery voltage · Cable has no connection to TCU · Speed sensor has an internal defect · Connector pin is contacted to battery voltage or has no contact	Special mode for gear selection OP mode : Substitute clutch control If a failure is existing at turbine speed, TCU shifts to neutral OP mode : lamp home	· Check the cable from TCU to the sensor · Check the connectors · Check the speed sensor
3B	**S.C. to ground at output speed input** TCU measures a voltage less than 1.00V at speed input pin · Cable/connector is defective and is contacted to vehicle ground · Speed sensor has an internal defect	Special mode for gear selection OP mode : Substitute clutch control If a failure is existing at turbine speed, TCU shifts to neutral OP mode : lamp home	· Check the cable from TCU to the sensor · Check the connectors · Check the speed sensor
3C	**Logical error at output speed input** TCU measures a turbine speed over a threshold and at the next moment the measured speed is zero · Cable/connector is defective and has bad contact · Speed sensor has an internal defect · Sensor gap has the wrong size	Special mode for gear selection OP mode : Substitute clutch control If a failure is existing at turbine speed, TCU shifts to neutral OP mode : lamp home	· Check the cable from TCU to the sensor · Check the connectors · Check the speed sensor · Check the sensor gap ※ This fault is reset after power up of TCU
3E	**Output speed zero doesn't fit to other speed signals** If transmission is not neutral and the shifting has finished, TCU measures output speed zero and turbine speed or internal speed not equal to zero. · Speed sensor has an internal defect · Sensor gap has the wrong size	Special mode for gear selection OP mode : Substitute clutch control If a failure is existing at turbine speed, TCU shifts to neutral OP mode : lamp home	· Check the sensor signal of output speed sensor · Check the sensor gap of output speed sensor · Check the cable from TCU to the sensor ※ This fault is reset after power up of TCU

Fault code (Hex)	Meaning of the fault code possible reason for fault detection	Reaction of the TCU	Possible steps to repair
54	**Vehicle1 timeout** Time of CAN-message Vehicle1 from display computer · Interference on CAN-Bus · CAN wire/connector is broken · CAN wire/connector is defective and has contact to vehicle ground or battery voltage	TCU shifts to neutral NN(because of shifting lever)	· Check vehicle controller · Check wire of CAN-Bus · Check cable to vehicle controller
57	**EEC1 timeout** Timeout of CAN-message EEC1 from EEC controller · Interference on CAN-Bus · CAN wire/connector is broken · CAN wire/connector is defective and has contact to vehicle ground or battery voltage	OP mode : Substitute clutch control	· Check EEC controller · Check wire of CAN-Bus · Check cable to EEC controller
71	**S.C. to battery voltage at clutch KC** The measured resistance value of the valve is out of limit, the voltage at KC valve is too high · Cable/connector is defective and has contact to battery voltage · Regulator has an internal defect	TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown	· Check the cable from TCU to the gearbox · Check the connectors from TCU to the gearbox · Check the regulator resistance* · Check internal wire harness of the gearbox * See page 3-55
72	**S.C. to ground at clutch KC** The measured resistance value of the valve is out of limit, the voltage at KC valve is too low · Cable/connector is defective and has contact to vehicle ground · Cable/connector is defective and has contact to another regulator output of the TCU · Regulator has an internal defect	TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown	· Check the cable from TCU to the gearbox · Check the connectors from gearbox to TCU · Check the regulator resistance* · Check internal wire harness of the gearbox * See page 3-55
73	**O.C. at clutch KC** The measured resistance value of the valve is out of limit · Cable/connector is defective and has no contact to TCU · Regulator has an internal defect	TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown	· Check the cable from TCU to the gearbox · Check the connectors from gearbox to TCU · Check the regulator resistance* · Check internal wire harness of the gearbox * See page 3-55
74	**S.C. to battery voltage at clutch KD** The measured resistance value of the valve is out of limit, the voltage at KD valve is too high · Cable/connector is defective and has contact to battery voltage · Regulator has an internal defect	TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown	· Check the cable from TCU to the gearbox · Check the connectors from gearbox to TCU · Check the regulator resistance* · Check internal wire harness of the gearbox * See page 3-55

Fault code (Hex)	Meaning of the fault code possible reason for fault detection	Reaction of the TCU	Possible steps to repair
75	S.C. to ground at clutch KD The measured resistance value of the valve is out of limit, the voltage at KD valve is too low · Cable/connector is defective and has contact to vehicle ground · Cable/connector is defective and has contact to another regulator output of the TCU · Regulator has an internal defect	TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown	· Check the cable from TCU to the gearbox · Check the connectors from gearbox to TCU · Check the regulator resistance* · Check internal wire harness of the gearbox * See page 3-55
76	O.C. at clutch KD The measured resistance value of the valve is out of limit · Cable/connector is defective and has no contact to TCU · Regulator has an internal defect	TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown	· Check the cable from TCU to the gearbox · Check the connectors from gearbox to TCU · Check the regulator resistance* · Check internal wire harness of the gearbox * See page 3-55
77	S.C. to battery voltage at clutch KE The measured resistance value of the valve is out of limit, the voltage at KE valve is too high · Cable/connector is defective and has contact to battery voltage · Regulator has an internal defect	TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown	· Check the cable from TCU to the gearbox · Check the connectors from gearbox to TCU · Check the regulator resistance* · Check internal wire harness of the gearbox * See page 3-55
78	S.C. to ground at clutch KE The measured resistance value of the valve is out of limit, the voltage at KE valve is too low · Cable/connector is defective and has contact to vehicle ground · Cable/connector is defective and has contact to another regulator output of the TCU · Regulator has an internal defect	TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown	· Check the cable from TCU to the gearbox · Check the connectors from gearbox to TCU · Check the regulator resistance* · Check internal wire harness of the gearbox * See page 3-55
79	O.C. at clutch KE The measured resistance value of the valve is out of limit · Cable/connector is defective and has no contact to TCU · Regulator has an internal defect	TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown	· Check the cable from TCU to the gearbox · Check the connectors from gearbox to TCU · Check the regulator resistance* · Check internal wire harness of the gearbox * See page 3-55

Fault code (Hex)	Meaning of the fault code possible reason for fault detection	Reaction of the TCU	Possible steps to repair
84	**S.C. to battery voltage at clutch KV** The measured resistance value of the valve is out of limit, the voltage at KV valve is too high · Cable/connector is defective and has contact to battery voltage · Regulator has an internal defect	TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown	· Check the cable from TCU to the gearbox · Check the connectors from gearbox to TCU · Check the regulator resistance* · Check internal wire harness of the gearbox * See page 3-55
85	**S.C. to ground at clutch KV** The measured resistance value of the valve is out of limit, the voltage at KV valve is too low · Cable/connector is defective and has contact to vehicle ground · Cable/connector is defective and has contact to another regulator output of the TCU · Regulator has an internal defect	TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown	· Check the cable from TCU to the gearbox · Check the connectors from gearbox to TCU · Check the regulator resistance* · Check internal wire harness of the gearbox * See page 3-55
86	**O.C. at clutch KV** The measured resistance value of the valve is out of limit · Cable/connector is defective and has no contact to TCU · Regulator has an internal defect	TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown	· Check the cable from TCU to the gearbox · Check the connectors from gearbox to TCU · Check the regulator resistance* · Check internal wire harness of the gearbox * See page 3-55
87	**S.C. to battery voltage at clutch KR** The measured resistance value of the valve is out of limit, the voltage at KR valve is too high · Cable/connector is defective and has contact to battery voltage · Regulator has an internal defect	TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown	· Check the cable from TCU to the gearbox · Check the connectors from gearbox to TCU · Check the regulator resistance* · Check internal wire harness of the gearbox * See page 3-55
88	**S.C. to ground at clutch KR** The measured resistance value of the valve is out of limit, the voltage at KR valve is too low · Cable/connector is defective and has contact to vehicle ground · Cable/connector is defective and has contact to another regulator output of the TCU · Regulator has an internal defect	TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown	· Check the cable from TCU to the gearbox · Check the connectors from gearbox to TCU · Check the regulator resistance* · Check internal wire harness of the gearbox * See page 3-55

Fault code (Hex)	Meaning of the fault code possible reason for fault detection	Reaction of the TCU	Possible steps to repair
89	**O.C. at clutch KR** The measured resistance value of the valve is out of limit · Cable/connector is defective and has no contact to TCU · Regulator has an internal defect	TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown	· Check the cable from TCU to the gearbox · Check the connectors from gearbox to TCU · Check the regulator resistance* · Check internal wire harness of the gearbox * See page 3-55
B1	**Slippage at clutch KC** TCU calculates a differential speed at closed clutch KC. If this calculated value is out of range, TCU interprets this as slipping clutch · Low pressure at clutch KC · Low main pressure · Wrong signal at internal speed sensor · Wrong signal at output speed sensor · Wrong size of the sensor gap · Clutch is defective	TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown	· Check pressure at clutch KC · Check main pressure in the system · Check sensor gap at internal speed sensor · Check sensor gap at output speed sensor · Check signal at internal speed sensor · Check signal at output speed sensor Replace clutch ·
B2	**Slippage at clutch KD** TCU calculates a differential speed at closed clutch KD. If this calculated value is out of range, TCU interprets this as slipping clutch · Low pressure at clutch KD · Low main pressure · Wrong signal at internal speed sensor · Wrong signal at output speed sensor · Wrong size of the sensor gap · Clutch is defective	TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown	· Check pressure at clutch KD · Check main pressure in the system · Check sensor gap at internal speed sensor · Check sensor gap at output speed sensor · Check signal at internal speed sensor · Check signal at output speed sensor Replace clutc ·
B3	**Slippage at clutch KE / KB** TCU calculates a differential speed at closed clutch KE / KB. If this calculated value is out of range, TCU interprets this as slipping clutch · Low pressure at clutch KE / KB · Low main pressure · Wrong signal at internal speed sensor · Wrong signal at output speed sensor · Wrong size of the sensor gap · Clutch is defective	TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown	· Check pressure at clutch KE · Check main pressure in the system · Check sensor gap at internal speed sensor · Check sensor gap at output speed sensor · Check signal at internal speed sensor · Check signal at output speed sensor Replace clutch ·

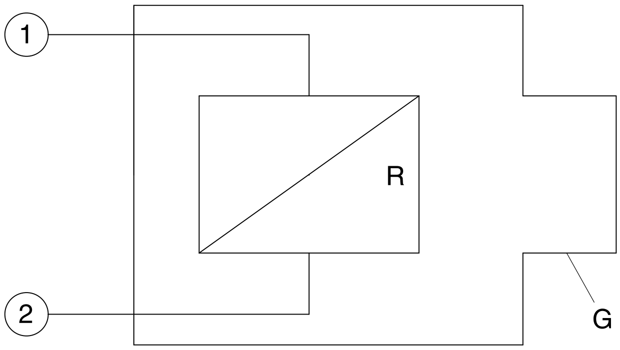
Fault code (Hex)	Meaning of the fault code possible reason for fault detection	Reaction of the TCU	Possible steps to repair
B5	**Slippage at clutch KV** TCU calculates a differential speed at closed clutch KV. If this calculated value is out of range, TCU interprets this as slipping clutch · Low pressure at clutch KV · Low main pressure · Wrong signal at internal speed sensor · Wrong signal at turbine speed sensor · Wrong size of the sensor gap · Clutch is defective	TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown	· Check pressure at clutch KV · Check main pressure in the system · Check sensor gap at internal speed sensor · Check sensor gap at turbine speed sensor · Check signal at internal speed sensor · Check signal at turbine speed sensor · Replace clutch
B6	**Slippage at clutch KR** TCU calculates a differential speed at closed clutch KR. If this calculated value is out of range, TCU interprets this as slipping clutch · Low pressure at clutch KR · Low main pressure · Wrong signal at internal speed sensor · Wrong signal at turbine speed sensor · Wrong size of the sensor gap · Clutch is defective	TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown	· Check pressure at clutch KR · Check main pressure in the system · Check sensor gap at internal speed sensor · Check sensor gap at turbine speed sensor · Check signal at internal speed sensor · Check signal at turbine speed sensor · Replace clutch
B7	**Overtemp sump** TCU measured a temperature in the oil sump that is over the allowed threshold.	No reaction OP mode : Normal	· Cool down machine · Check oil level · Check temperature sensor
B8	**Overtemp converter** TCU measured a temperature in the retarder oil that is over the allowed threshold	No reaction OP mode : Normal	· Cool down machine · Check oil level · Check temperature sensor
B9	**Overspend engine**	Retarder applies OP mode : Normal	
BC	**Overtemp converter** TCU measured a transmission output speed above the define threshold	No reaction OP mode : Normal	
C0	**Engine torque or engine power overload** TCU calculates an engine torque or engine power above the defined thresholds	OP mode : Normal	
C1	**Transmission output torque overload** TCU calculates an transmission output torque above the defined threshold	OP mode : Normal	
C2	**Transmission input torque overload** TCU calculates an transmission output torque above the defined threshold	programmable : No reaction or shift to neutral OP mode : Normal	

Fault code (Hex)	Meaning of the fault code possible reason for fault detection	Reaction of the TCU	Possible steps to repair
C3	**Overtemp converter output** TCU measured a oil temperature at the converter output that is the allowed threshold	No reaction OP mode : Normal	· Cool down machine · Check oil level · Check temperature sensor
D1	**S.C. to battery voltage at power supply for sensors** TCU measures more than 6V at the pin AU1 (5V sensor supply)	See fault codes No.21 to 2C	· Check cables and connectors to sensors, which are supplied from AU1 · Check the power supply at the pin AU1(Should be appx. 5V) · Fault codes No.21 to No.2C may be reaction of this fault
D2	**S.C. to ground at power supply for sensors** TCU measures less than 4V at the pin AU1 (5V sensor supply)	See fault codes No.21 to 2C	· Check cables and connectors to sensors, which are supplied from AU1 · Check the power supply at the pin AU1(Should be appx. 5V) · Fault codes No.21 to No.2C may be reaction of this fault
D3	**Low voltage at battery** Measured voltage at power supply is lower than 18V(24V device)	Shift to neutral OP mode : TCU shutdown	· Check power supply battery · Check cables from batteries to TCU · Check connectors from batteries to TCU
D4	**High voltage at battery** Measured voltage at power supply is higher than 32.5V(24V device)	Shift to neutral OP mode : TCU shutdown	· Check power supply battery · Check cables from batteries to TCU · Check connectors from batteries to TCU
D5	**Error at valve power supply VPS1** TCU switched on VPS1 and measured VPS1 is off or TCU switched off VPS1 and measured VPS1 is still on · Cable or connectors are defect and are contacted to battery voltage · Cable or connectors are defect and are contacted to vehicle ground · Permanent power supply KL30 missing · TCU has an internal defect	Shift to neutral OP mode : TCU shutdown	· Check fuse · Check cables from gearbox to TCU · Check connectors from gearbox to TCU · Replace TCU
D6	**Error at valve power supply VPS2** TCU switched on VPS2 and measured VPS2 is off or TCU switched off VPS2 and measured VPS2 is still on · Cable or connectors are defect and are contacted to battery voltage · Cable or connectors are defect and are contacted to vehicle ground · Permanent power supply KL30 missing · TCU has an internal defect	Shift to neutral OP mode : TCU shutdown	· Check fuse · Check cables from gearbox to TCU · Check connectors from gearbox to TCU · Replace TCU

Fault code (Hex)	Meaning of the fault code possible reason for fault detection	Reaction of the TCU	Possible steps to repair
E3	**S.C. to battery voltage at display output** TCU sends data to the display and measures always a high voltage level on the connector · Cable or connectors are defective and are contacted to battery voltage · Display has an internal defect	No reaction OP mode : Normal	· Check the cable from TCU to the display · Check the connectors at the display · Change display
E4	**S.C. to ground at display output** TCU sends data to the display and measures always a high voltage level on the connector · Cable or connectors are defective and are contacted to battery voltage	No reaction OP mode : Normal	· Check the cable from TCU to the display · Check the connectors at the display · Change display
F1	**General EEPROM fault** TCU can't read non volatile memory · TCU is defective	No reaction OP mode : Normal	· Replace TCU ※ Often shown together with fault code F2
F2	**Configuration lost** TCU has lost the correct configuration and can't control the transmission · Interference during saving data on non volatile memory · TCU is brand new or from another vehicle	Transmission stay neutral OP mode : TCU shutdown	· Reprogram the correct configurat-ion for the vehicle (e.g. with cluster controller,...)
F3	**Application error** Something of this application is wrong	Transmission stay neutral OP mode : TCU shutdown	· Replace TCU ※ This fault occurs only if an test engineer did something wrong in the application of the vehicle
F5	**Clutch failure** AEB was not able to adjust clutch filling parameters · One of the AEB-Values is out of limit	Transmission stay neutral OP mode : TCU shutdown	· Check clutch ※ TCU shows also the affected clutch on the display
F6	**Clutch adjustment data lost or Inch pedal calibration data lost** TCU was not able to read correct clutch adjustment parameters · Interference during saving data on non volatile memory · TCU is brand new	No reaction, Default values : 0 for AEB Offsets used OP mode : Normal	· Execute AEB

(5) Measuring of resistance at actuator/sensor and cable

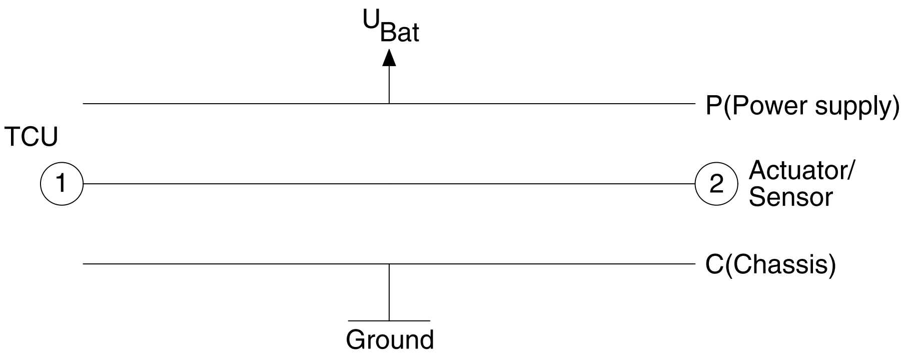
① Actuator



76043PT19

Open circuit	$R_{12} = R_{1G} = R_{2G} = \infty$
Short cut to ground	$R_{12} = R$; $R_{1G} = 0$, $R_{2G} = R$ or $R_{1G} = R$, $R_{2G} = 0$
(For S.C. to ground, G is connected to vehicle ground)	
Short cut to battery	$R_{12} = R$; $R_{1G} = 0$, $R_{2G} = R$ or $R_{1G} = R$, $R_{2G} = 0$
(For S.C. to battery, G is connected to battery voltage)	

② Cable



76043PT20

Open circuit	$R_{12} = R_{1P} = R_{1C} = R_{2P} = R_{2C} = \infty$
Short cut to ground	$R_{12} = 0$; $R_{1C} = R_{2C} = 0$, $R_{1P} = R_{2P} = \infty$
Short cut to battery	$R_{12} = 0$; $R_{1C} = R_{2C} = 0$, $R_{1P} = R_{2P} = 0$

2) DRIVE AXLE

(1) Noise and vibration

Locating fault and cause		Measures
Drive axle	Shortage of oil	Check oil level or refill lubricating oil.
	Inappropriate oil	Replace the oil.
	Damaged wheel bearing	Replace the wheel bearing.
	Damaged ring gear and pinion shaft	Replace the ring gear and pinion shaft.
	Loosened or worn bearing of pinion shaft	Disassemble, check or replace the bearing.
Differencial	Loosened bolt for assembling ring gear	Disassemble, check and reassemble the ring gear.
	Damaged ring gear	Replace the ring gear.
	Loosened or worn differencial bearing	Disassemble, check, reassemble or replace the differencial bearing.
	Damaged bevel gear bearing	Replace the bevel gear bearing.
	Worn or damaged diff pinion and side gear.	Replace the diff pinion and side gear.
	Worn or damaged thrust washer.	Replace the thrust washer.
	Excessive backlash of diff pinion and side gear.	Replace the diff pinion and side gear.
Brake	Incorrect axle fluid and/or friction material used	Use only meritor specified or approved materials.
		Drain and flush fluid from axle. Replace with approved fluid.
		Replace all friction discs. Throughly clean or replace stationary discs.

(2) Oil leakage

Locating fault and cause			Measures
External leakage	Excess supply of oil		Check oil level. set of oil amount.
	Inappropriate oil		Replace the oil.
	Blocking air breather		Cleaning, replace the air breather
	Damaged hub oil seal		Replace the hub oil seal.
	Worn or damaged bevel pinion shaft oil seal		Replace the oil seal.
	Loosened bleeder screw		Tighten bleeder screw.
	Losened brake inlet fitting and plugs		Tighten brake inlet fitting.
	Damaged brake inlet fitting, plug and o-ring		Replace the brake inlet fitting, plug and o-ring.
Brake	Internal leak : Fluid bypasses seals into axle and fills axle with fluid and blows out breather or empties brake fluid reservoir.	Worn or damaged piston seal	Replace the piston seals.
		Melted or extruded piston seals	Correct cause of overheating and replace seals.
		Corrosion, pitting, wear or other damage, marks scratches to piston and/or brake housing bore in area of seal/sealing lips	Clean, smooth, rework or replace affected parts.
	External leak	Loosened bleeder screw	Tighten bleeder screw to 2 ~ 2.7 kgf·m (14.5 ~ 19.6 lbf·ft).
		Loosened inlet fitting or plugs	Tighten inlet fitting to 3.4 ~ 4.8 kgf·m (24.7 ~ 34.8 lbf·ft).
		Damaged inlet fitting or plugs or damaged seats	Replace inlet fitting or plug and o-ring if used.

(3) Service brake

① Brake overheats.

Locating fault and cause		Measures
Overheating due to excessive duty cycle	Inadequate coolant flow or heat exchange	Install brake cooling system if not already installed on truck.
		Re-analyze and re-size brake cooling system if necessary.
Inadequate coolant flow	Low pump output, blocked filter or coolant lines	Check pump output at different operating modes. Replace filter and check lines.
Low or no coolant	Improper fill or leaks	Check for proper fill level.
	leaking face seal	Replace or reinstall face seal assembly.
	Loosened or damaged plugs.	Tighten drain, fill or forced cooling plug. Replace if damaged.
	Deteriorated or inadequate sealant used at joint.	Disassemble, clean, re-seal and re-assemble bake housing joint.
Brake drags	More than 0.14 MPa pressure applies when brakes released.	Repair hydraulic system so pressure is less than 0.14 MPa when brakes released and while machine is operating in any mode.
	Damaged piston return spring assy	Repair or replace for piston return spring assy.
	Piston not returning	Check piston seals and seal separator.
	Wrong cooling and/or actuation fluid used.	Check piston seals and seal separator for swelling or damaged. Replace as necessary. Purge system and use correct fluid.
	Tighten or damaged splines (ex. friction disc-to-hub driver)	Repair or replace parts.

② Brake does not apply.

Locating fault and cause		Measures
Low or no pressure to brake	Empty fluid reservoir	Fill reservoir to correct level with specified fluid.
	Damaged hydraulic system	Repair hydraulic system.
	Leaked of brake actuation fluid	Refer to "brake leaks actuation fluid" in this manual.
	Parking brake not adjust properly	Adjust parking brake swtich as described in assy of this manual.

③ Brake does not release.

Locating fault and cause		Measures
Truck does not move.	Damaged hydraulic system	Repair hydraulic system.
Brakes dragging	More than 0.14 MPa pressure applied when brakes released.	Repair hydraulic system so pressure is less than 0.14 MPa when brakes released and while machine is operating in any mode.
	Damaged piston return spring assy	Repair or replace piston return spring assy.
	Piston not returning.	Check piston seals for swelling or damage. Replace as necesary.
	Wrong cooling and/or actuation fluid used	Check piston seals for swelling or damage. Purge system and use specified fluid.
	Parking brake not adjusted prorerly	Adjust parking brakeing lever as described in assy of this manual.

④ Braking performance

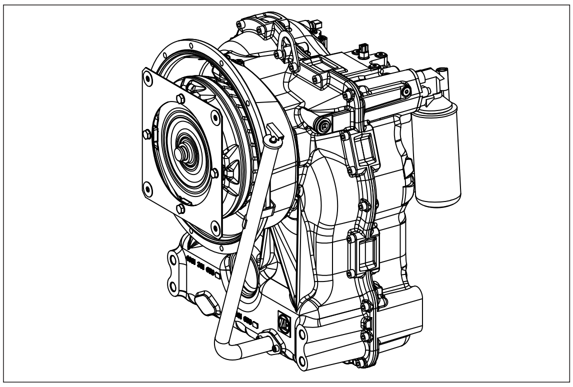
Locating fault and cause		Measures
Noticeable change or decrease in stopping performance.	Inadequate actuation fluid supply to brakes	Replenish fluid in brake system. Check for leakge and correct cause.
	Inadequate pressure to apply brakes	Check brkaes apply system. Check for leakage in brake system or brakes, and correct cause.
	Worn or damaged discs	Inspect and replace discs if necssary.
		※ **As disc wear occurs, make sure brake system can supply adequate fluid to fully apply brakes.**
	Overheated seals and/or discs	Inspect and replace discs and seals if necessary.
Brake does not fully apply.	Dirty or contaminated cooling fluid.	Drain and flush cooling fluid from brakes and entire brake system. Replace with approved fluid. In some case, it may necessary to replace discs. Clean or replace filter.
Brake does not fully apply.	Empty fluid reservoir.	Fill reservoir to correct level with specified fluid.
	Damaged hydraulic system	Repair hydraulic system
	Leakage of brake actuation fluid.	Refer to "brake leaks actuation fluid" in this manual.
Brake fell spongy/soft	Brakes or brake system not proerly bled.	Bleed brakes and brake system.

GROUP 3 DISASSEMBLY AND ASSEMBLY

1. TRANSMISSION DISASSEMBLY

1) DISASSEMBLY

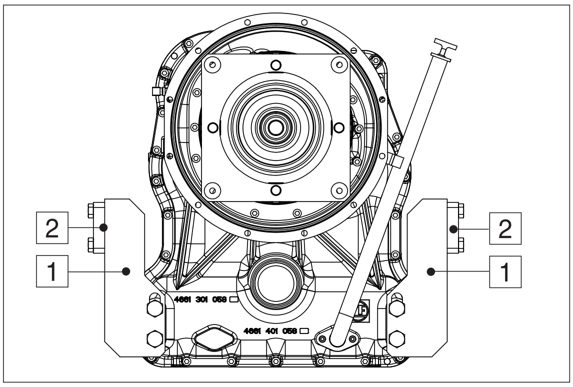
Transmission 3 WG-94 EC



50DS7ETM11

① Attach transmission to the assembly truck by means of clamping angles (1) and holding fixtures (2).

(S) Assembly truck	5870 350 000
(S) Holding fixtures	5870 350 063
(S) Clamping angles	5870 350 124



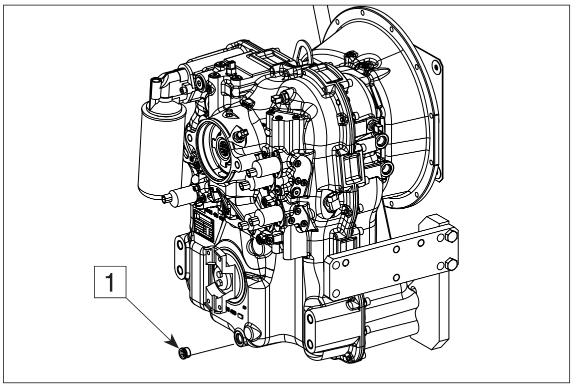
50DS7ETM12

(1) Removal of the filter

※ Drain oil prior to starting disassembly.

① Remove screw plug (1).

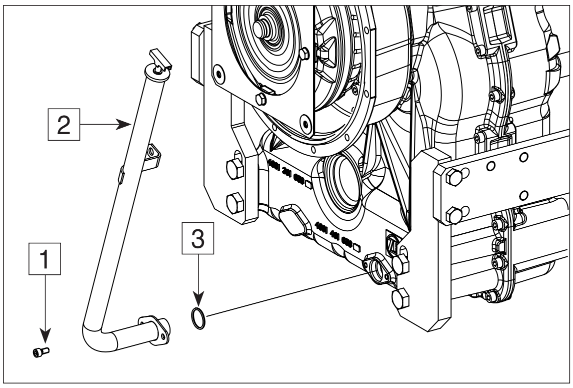
⚠ Disposal of oil according to legal requirements.



50DS7ETM13

② Loosen the cylindrical screws (1) and remove the oil filler tube with the oil dipstick (2).

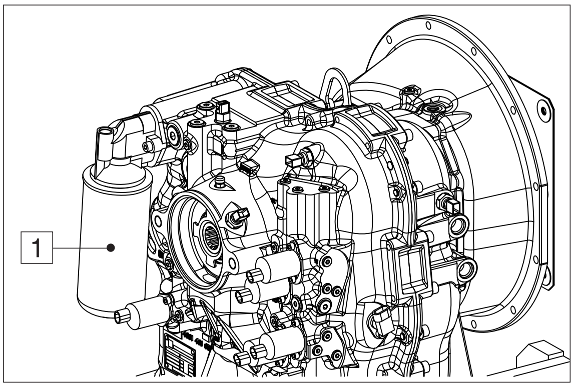
※ Remove the O-ring (3) from the oil filler tube.



50DS7ETM14

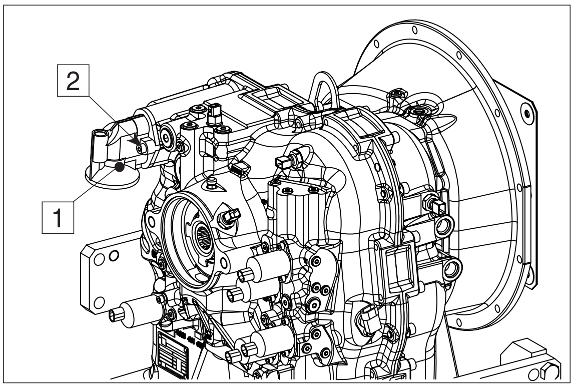
③ Separate the fine filter (1) from the filter head by means of belt wrench.

(S) Belt wrench 5870 105 005



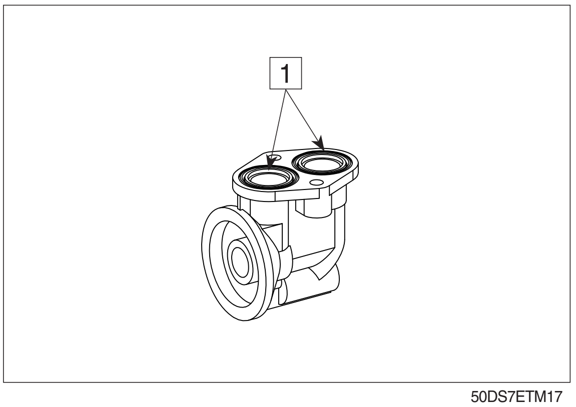
50DS7ETM15

④ Loosen the cylindrical screws (2) and separate the filter head (1) from the transmission housing.



50DS7ETM16

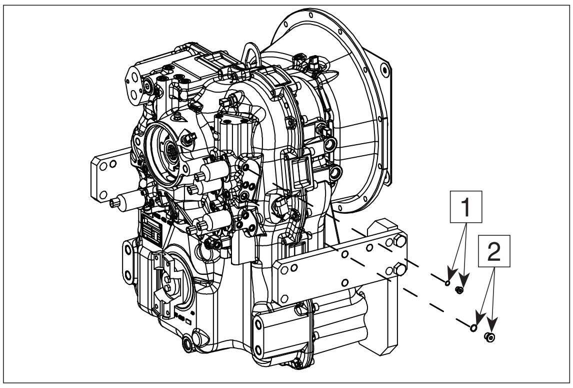
⑤ Remove both O-rings (1) out of the annular groove of the filter head.



50DS7ETM17

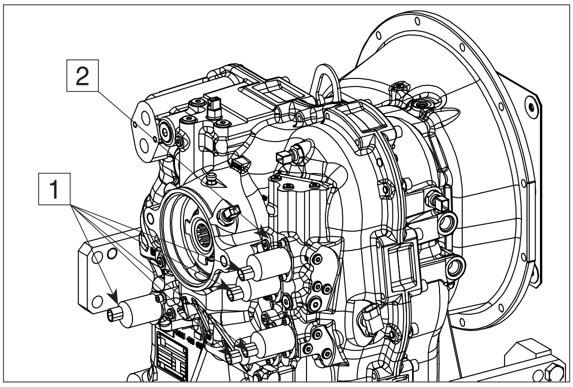
2) DISASSEMBLY PRESSURE CONTROLLER (PROPORTIONAL VALVES), INDUCTIVE SENSOR, SPEED SENSOR (HALL SENSOR), TEMPERATURE SENSOR, BREATHER AND SCREW PLUGS

① Remove all screw plugs with O-ring (1 and 2).



50DS7ETM18

② Loosen cylindrical screws (1) and remove pressure controller (proportional valves, 2).

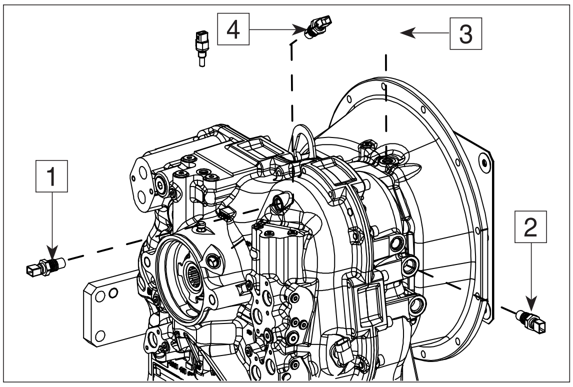


50DS7ETM19

③ Remove positioned parts.

1 = Inductive sensor-n turbine
2 = Inductive sensor-n central gear chain
3 = Temperature sensor, measuring point "63" after converter
4 = Inductive sensor

※ Remove O-rings.

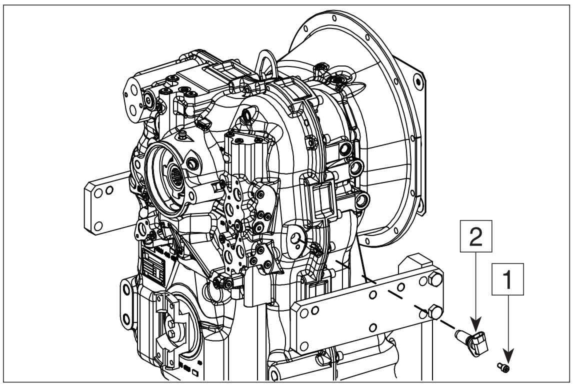


50DS7ETM20

④ Loosen cylindrical screw (1) and remove speed sensor (2).

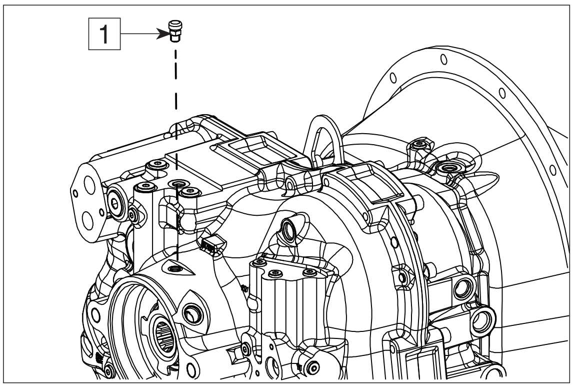
2 = Speed sensor-n output (Hall sensor)

※ Remove O-rings.



50DS7ETM21

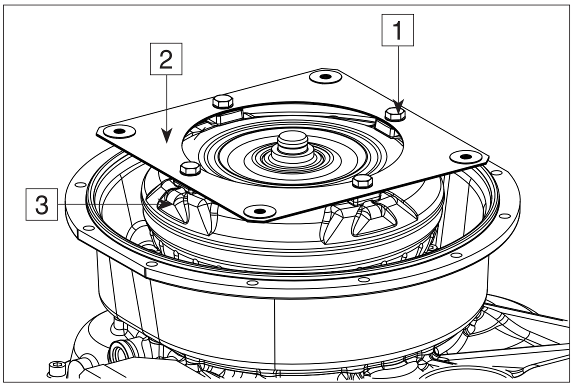
⑤ Remove breather (1).



50DS7ETM22

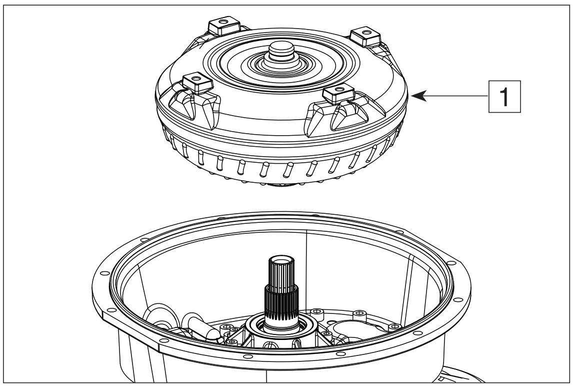
3) DISASSEMBLY CONVERTER AND CENTRAL SHAFT (PTO SHAFT)

① Loosen cylindrical screws (1) and separate the flexplate (2) from the converter (3).



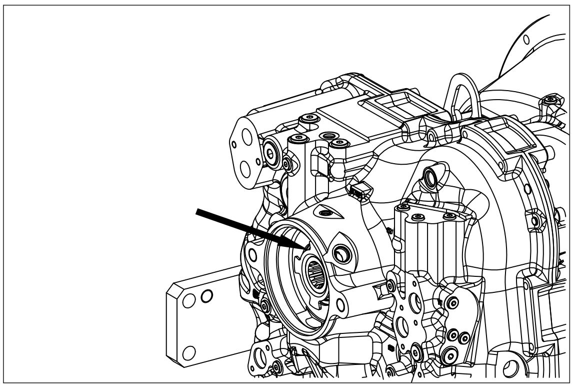
50DS7ETM23

② Pull off converter (1) by hand.



50DS7ETM24

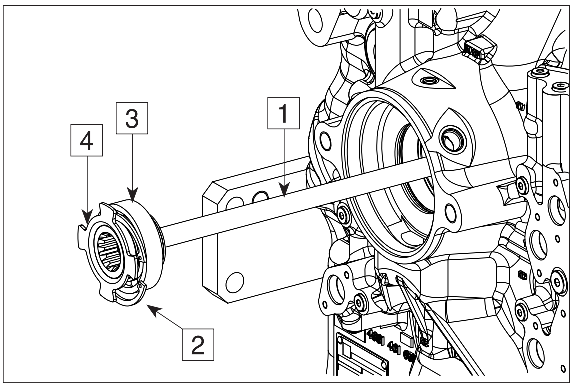
③ Disengage the retaining ring (see arrow).



50DS7ETM25

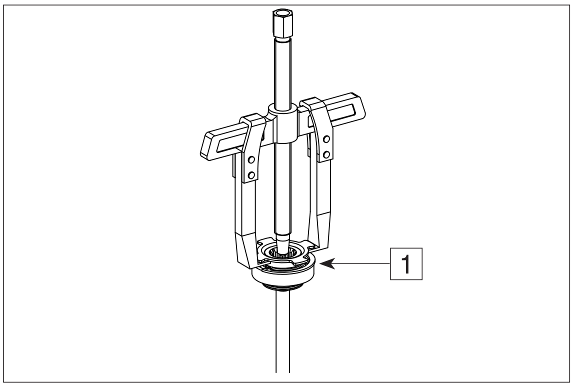
④ Pull the central shaft assy out of the housing hole.

1 = Central shaft
2 = Retaining ring
3 = Ball bearing
4 = Toothed disk



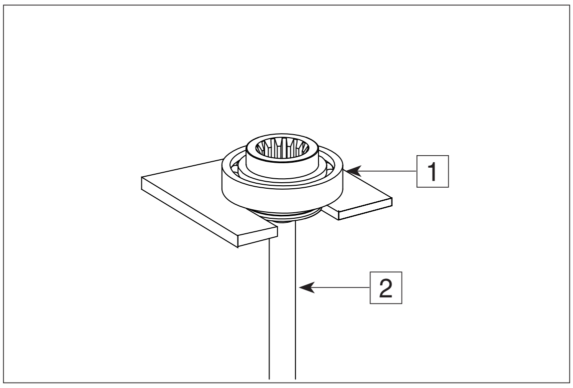
50DS7ETM26

⑤ Pull the toothed disk (1) from the central shaft.



50DS7ETM27

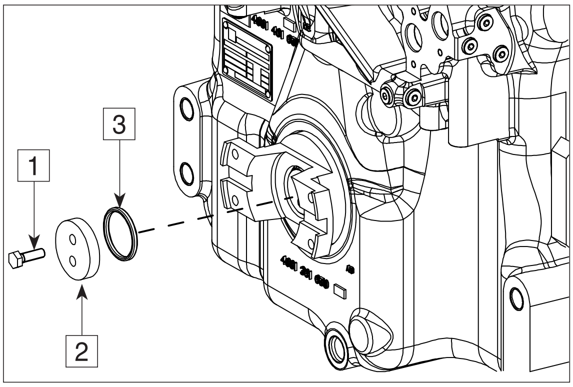
⑥ Press the ball bearing (1) from the central shaft (2).



50DS7ETM28

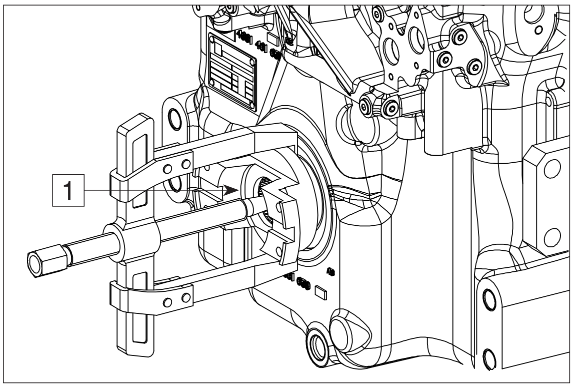
4) DISASSEMBLY OF OUTPUT FLANGE

① Loosen the hexagon screws (1) and remove disk and O-ring (2 and 3).



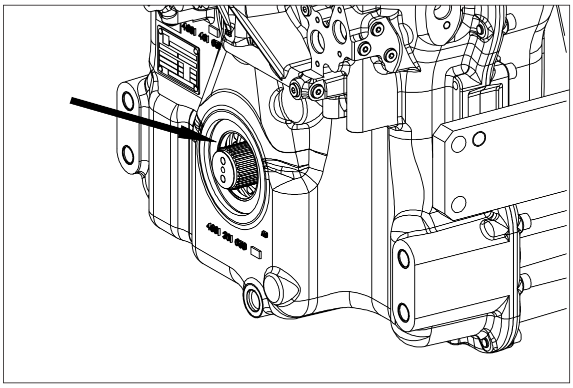
50DS7ETM29

② Pull output flange (1) off the output shaft by means of two-armed puller.



50DS7ETM30

③ Remove shaft seal (see arrow) from the housing hole by means of assembly lever.



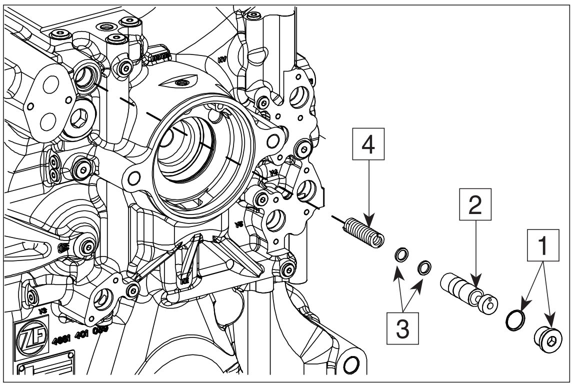
50DS7ETM31

5) DISASSEMBLY OF MAIN PRESSURE VALVE AND CONVERTER SAFETY VALVE

① Loosen screw plug (1) and remove main pressure valve (control pressure valve):

Main pressure valve consists of:

1 = Screw plug with O-ring
2 = Piston
3 = Spacer rings
4 = Compression spring

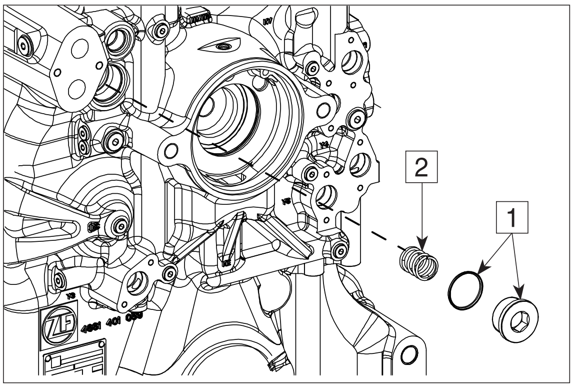


50DS7ETM32

② Loosen screw plug (1) and remove converter safety valve.

Converter safety valve consists of :

1 = Screw plug with O-ring
2 = Pressure valves
- = Valve assy is installed in the housing-not visible-(functional check of valve see below ③).

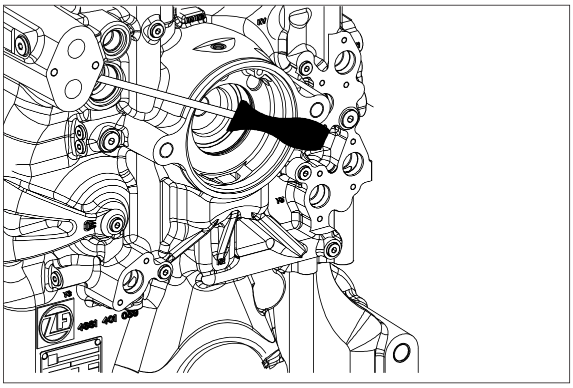


50DS7ETM33

③ Functional check of valve.

※ Use a screwdriver to check the movability of the ball in the valve.

If the valve is o.k., it does not need to be removed.

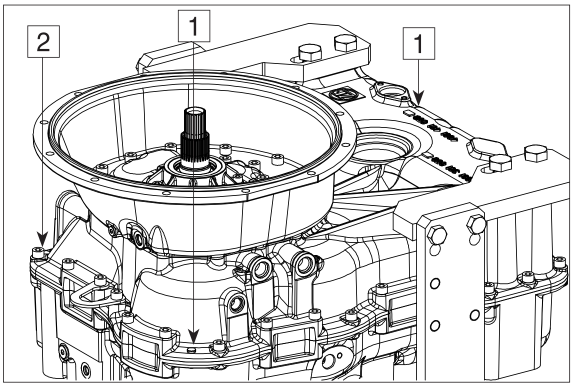

50DS7ETM34

6) REMOVAL OF CLUTCHES AND DISASSEMBLY OF OIL PRESSURE PUMP

① Force out cylindrical pins (1).

② Loosen bolted connection (2) of housing front and rear part.

▲ Make sure to leave 2 cylindrical screws crosswise in the bolted connection (2). Transmission rear part is not fixed to the clamping angle and could get loose when turning.

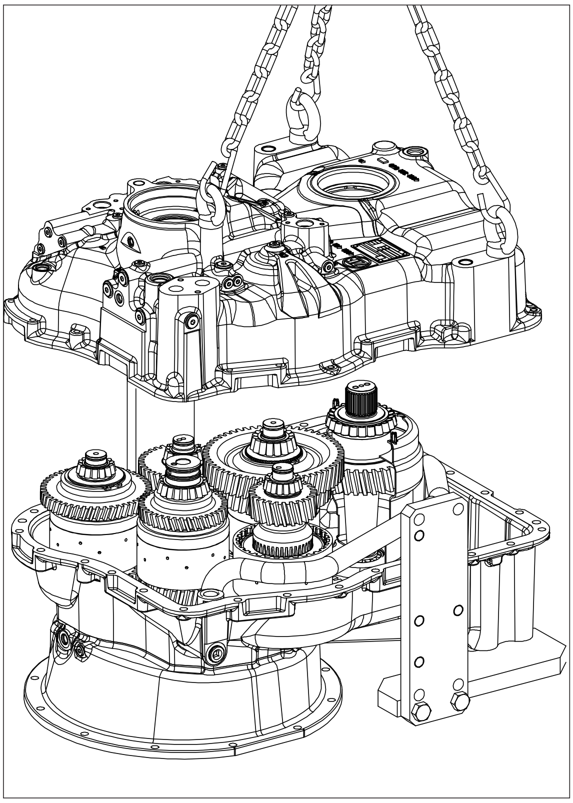


50DS7ETM35

③ Rotate transmission housing 180°, loosen the last 2 cylindrical screws from the bolted connection housing front and rear part and separate housing rear part by means of lifting device.

※ Support by means of assembly lever.

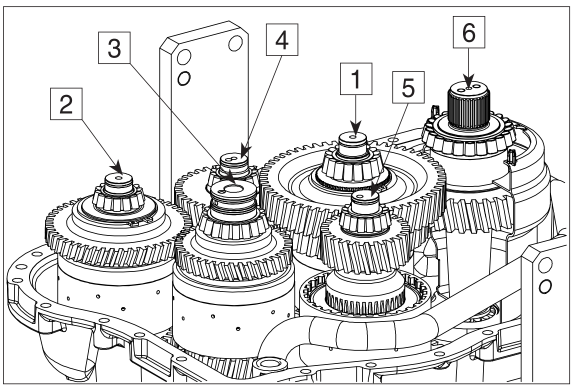
(S) Assembly lever 5870 345 036



50DS7ETM36

④ Lift the clutches out of the housing in the following sequence:

1 = Clutch KE (Clutch-3rd gear)
2 = Clutch KV (Clutch-forward)
3 = Clutch KR (Clutch-reverse and input)
4 = Clutch KD (Clutch-2nd gear)
5 = Clutch KC (Clutch-1st gear)
6 = Output with screen sheet

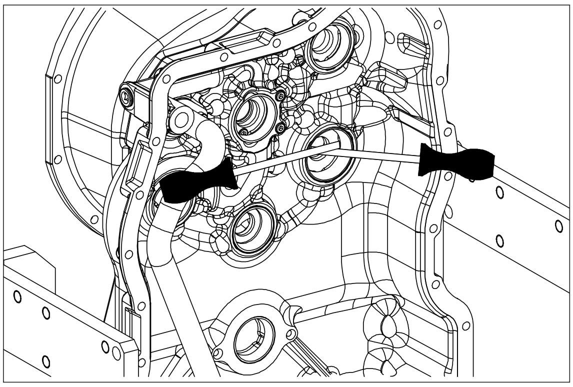


50DS7ETM37

⑤ Use assembly lever to remove all bearing outer rings from the housing front part.

※ If, contrary to the ZF recommendation, the tapered roller bearings of clutches and output are not replaced, it is imperative to ensure the previous pairing (bearing outer ring/bearing inner ring).

※ Bearing outer ring and bearing inner ring must be marked.



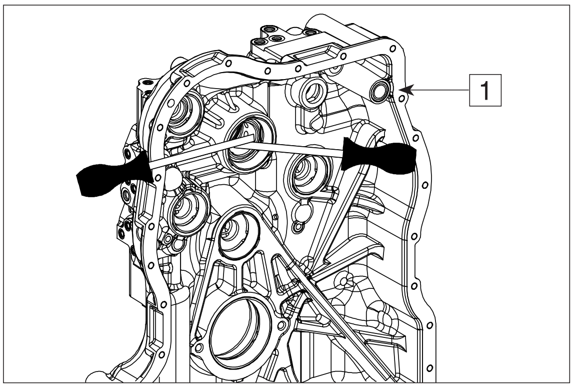
50DS7ETM38

⑥ Use assembly lever to remove all bearing outer rings from the housing rear part.

※ If, contrary to the ZF recommendation, the tapered roller bearings of clutches and output are not replaced, it is imperative to ensure the previous pairing (bearing outer ring/bearing inner ring).

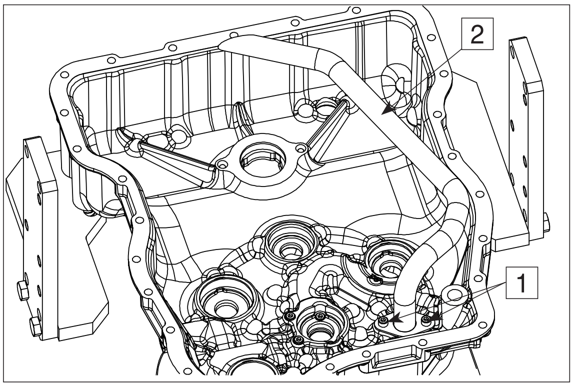
※ Bearing outer ring and bearing inner ring must be marked.

⑦ Remove O-ring (1).



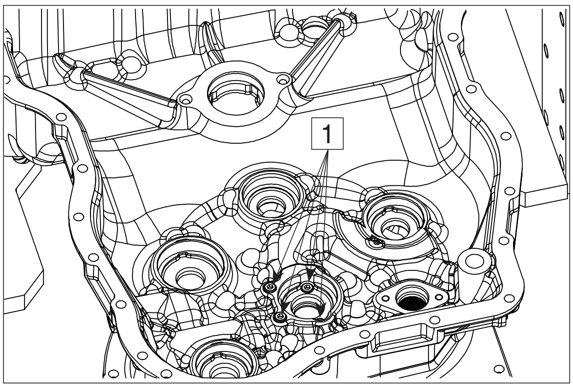
50DS7ETM39

⑧ Loosen cylindrical screws (1) and remove suction tube (2).



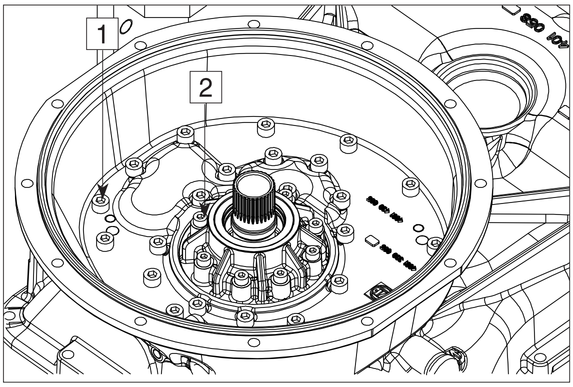
50DS7ETM40

⑨ Loosen cylindrical screws (1).



50DS7ETM41

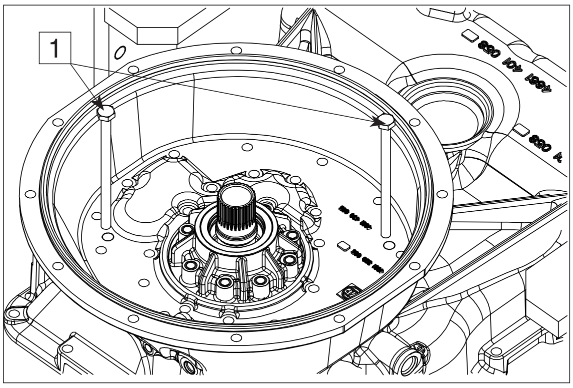
⑩ Loosen bolted connection between converter bellhousing/transmission housing (1) and pressure oil pump/ transmission housing (2).



50DS7ETM42

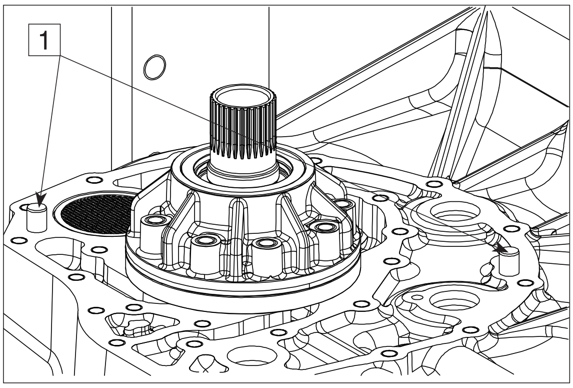
⑪ Press converter bellhousing off the housing equally by means of hexagon screws M10 (1).

※ Difficult disassembly due to fixing by cylindrical pins.



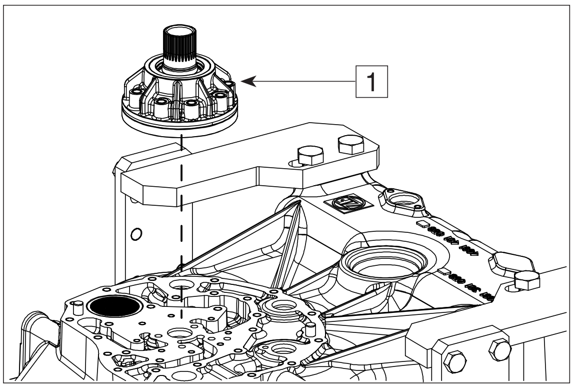
50DS7ETM43

⑫ If required, remove both cylindrical pins (1).



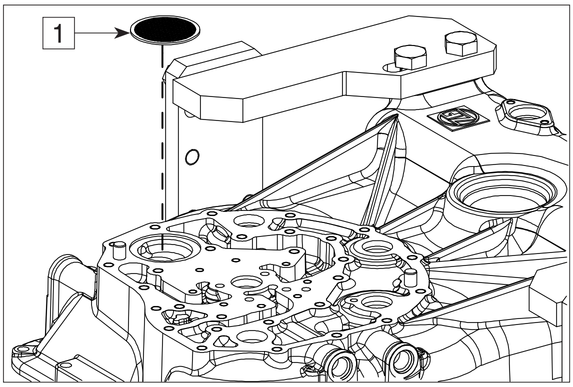
50DS7ETM44

⑬ Remove oil pressure pump (1).



50DS7ETM45

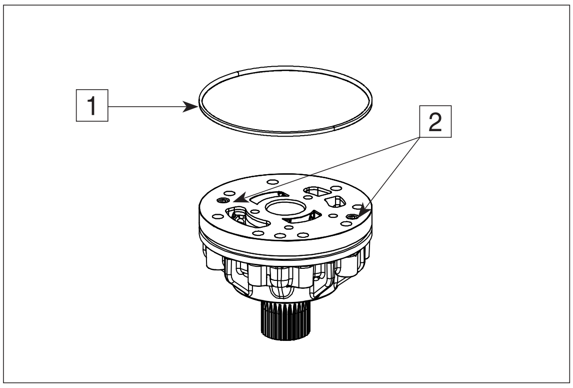
⑭ Remove filter (1).



50DS7ETM46

⑮ Remove O-ring (1).

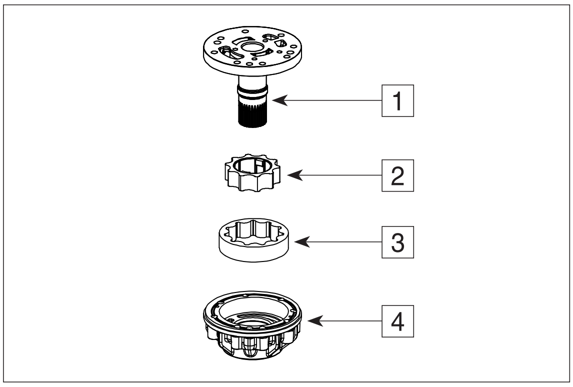
⑯ Loosen cylindrical screws (2).



50DS7ETM47

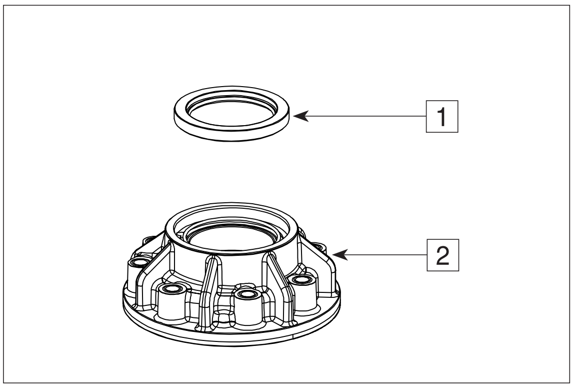
※ Check oil pressure pump :
In case of wear marks in the pump housing, stator hollow shaft or on the inner and outer rotor, the complete oil pressure pump is to be replaced.

1 = Stator hollow shaft
2 = Inner rotor
3 = Outer rotor
4 = Pump housing



50DS7ETM48

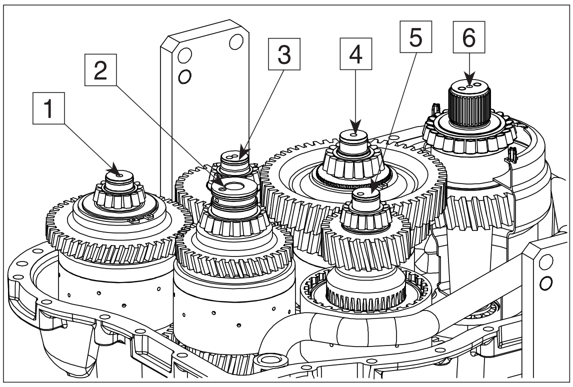
⑰ Remove shaft seal (1) from the pump housing (2).



50DS7ETM49

7) DISASSEMBLY CLUTCHES :

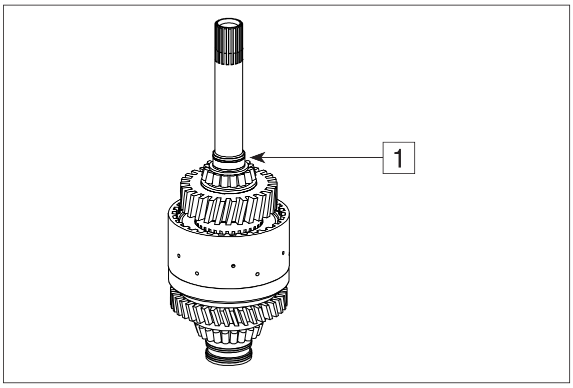
1 = Clutch KV(Clutch-forward)
2 = Clutch KR(Clutch-reverse and input)
3 = Clutch KD(Clutch-2nd gear)
4 = Clutch KE(Clutch-3rd gear)
5 = Clutch KC(Clutch-1st gear)
6 = Output



50DS7ETM50

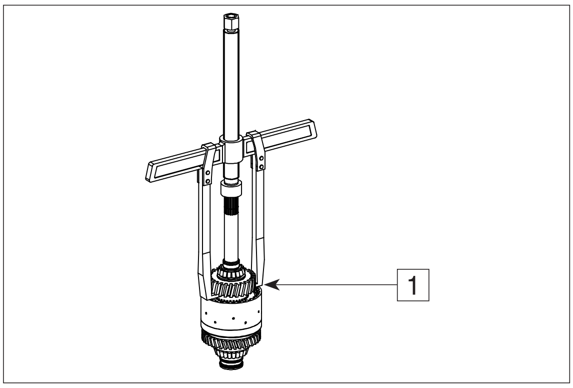
(1) Clutch KR/input

① Disengage rectangular ring (1).



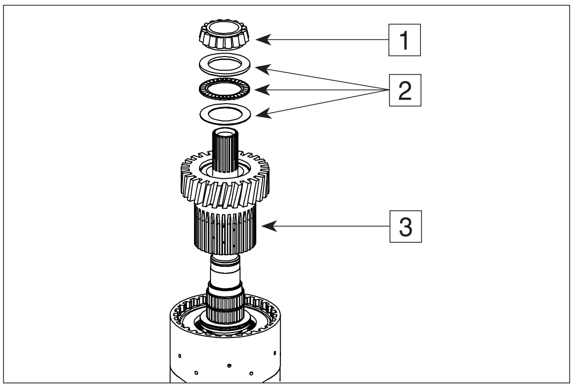
50DS7ETM51

② Pull off bearing inner ring with inner disk carrier (1).



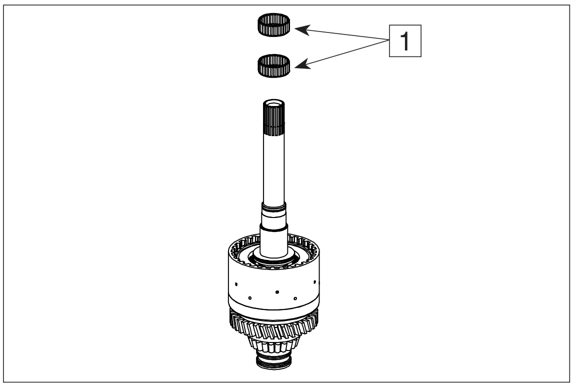
50DS7ETM52

③ Remove bearing inner ring (1), axial bearing assy (2) and inner disk carrier (3).



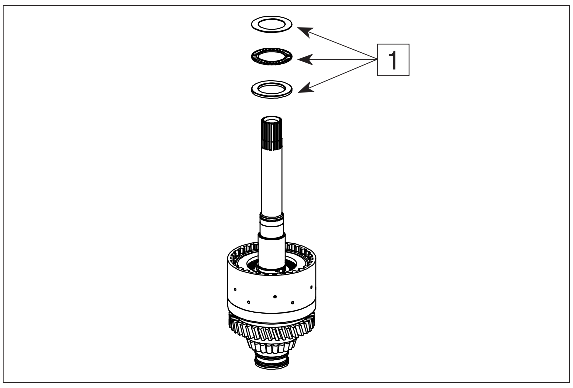
50DS7ETM53

④ Remove needle cage (1).



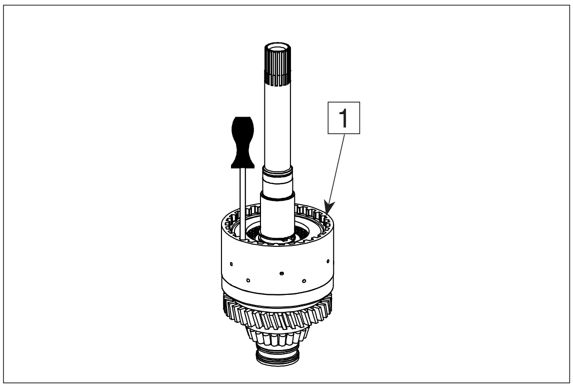
50DS7ETM54

⑤ Remove axial bearing assy (1).



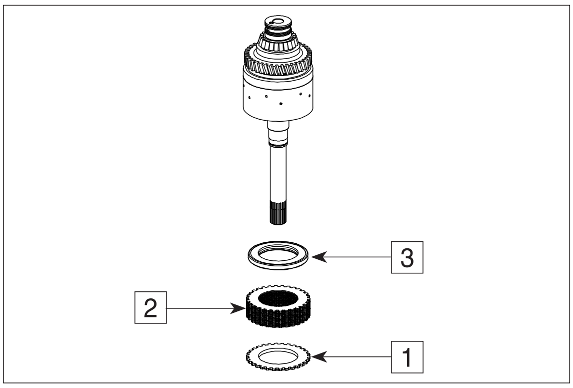
50DS7ETM55

⑥ Disengage snap ring (1).



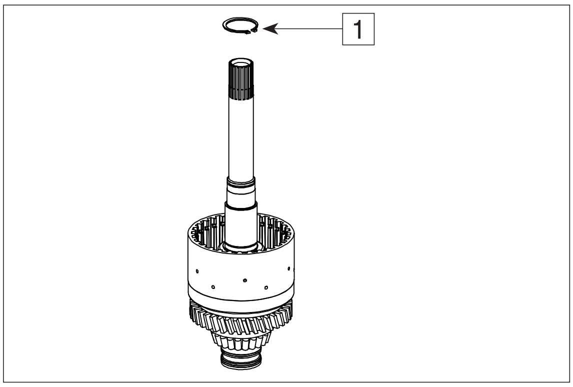
50DS7ETM56

⑦ Remove end plate (1), disk package (2) and plate with cup springs (3) from the disk carrier.



50DS7ETM57

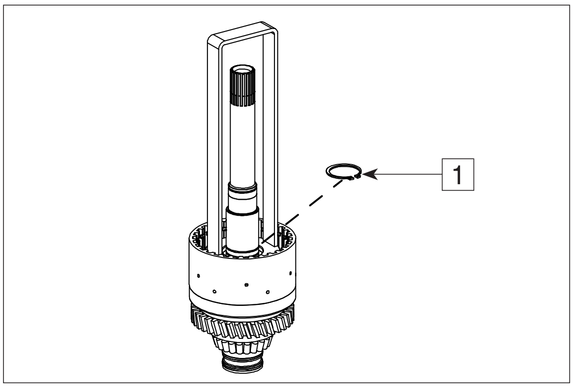
⑧ Remove retaining ring-contact position of axial bearing (1).



50DS7ETM58

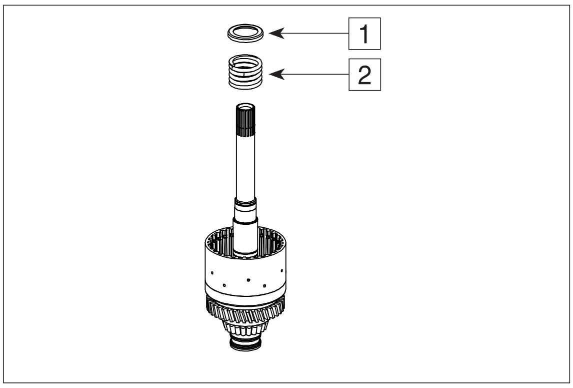
⑨ Preload compression spring and disengage retaining ring (1).

(S) Assembly aid 5870 345 114



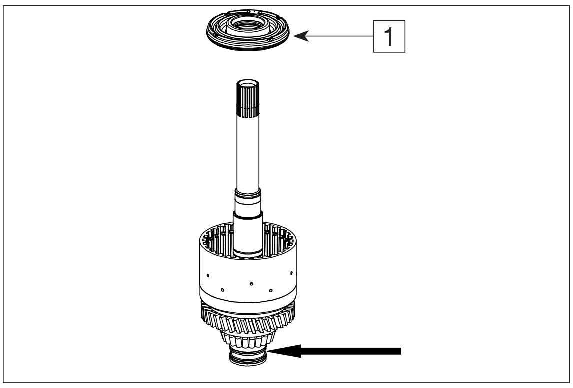
50DS7ETM59

⑩ Remove cup spring (1) and compression spring (2).



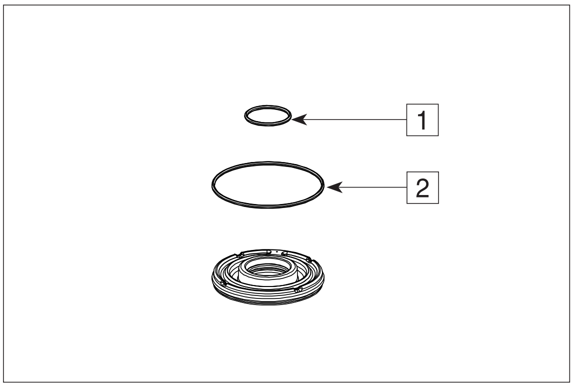
50DS7ETM60

⑪ By means of compressed air (see arrow), press piston (1) off the shaft/disk carrier (see arrow) and remove it.



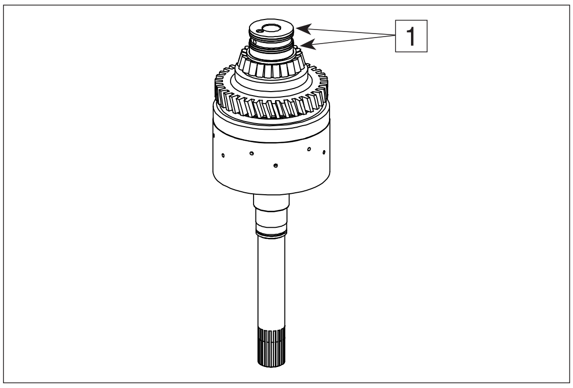
50DS7ETM61

⑫ Remove both O-rings (1 and 2).



50DS7ETM62

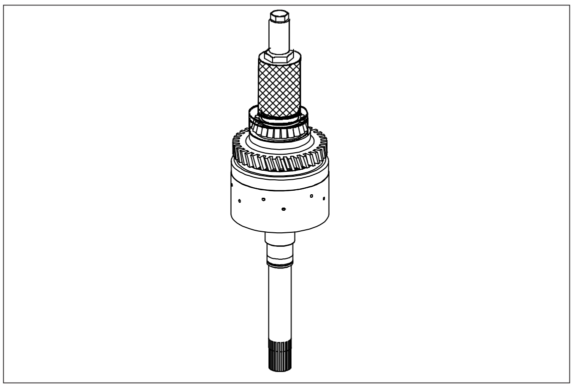
⑬ Disengage rectangular rings (1).



50DS7ETM63

⑭ Pull tapered roller bearing (inner ring) off the shaft.

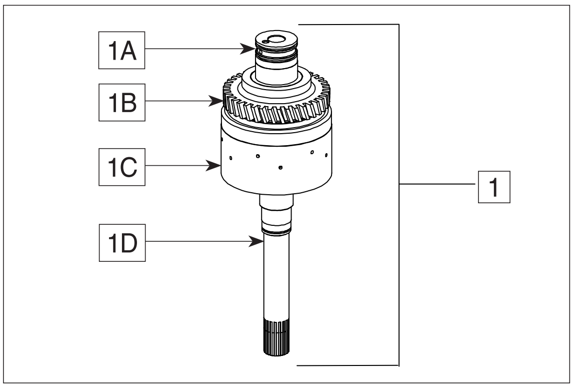
(S) Grab sleeve	5873 001 026
(S) Basic tool	5873 001 000



50DS7ETM64

※ The clutch (1) cannot be disassembled. It is supplied by the spare parts service only as a complete assy which consists of :

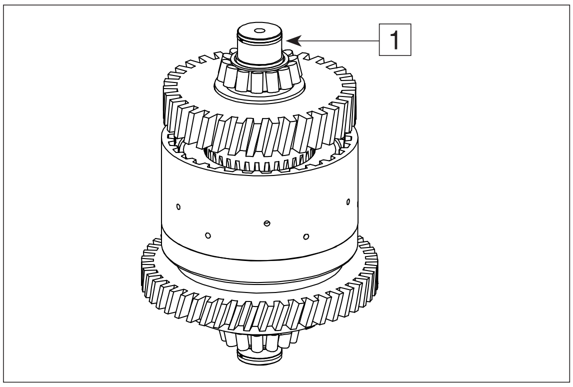
1A = Ball
1B = Helical gear
1C = Disk carrier
1D = Input shaft



50DS7ETM65

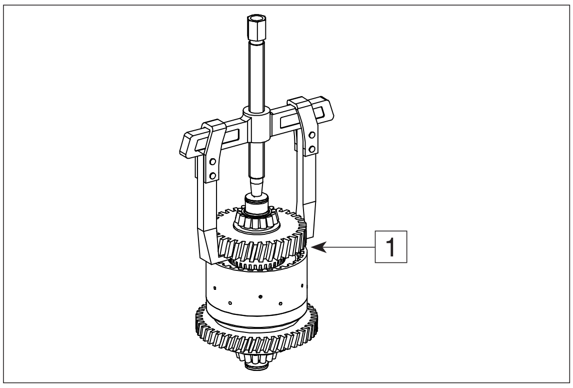
(2) Clutch KV

① Snap out rectangular ring (1).



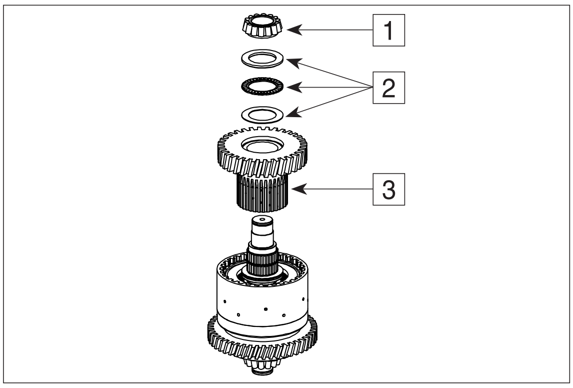
50DS7ETM66

② Pull off bearing inner ring with inner disk carrier (1).



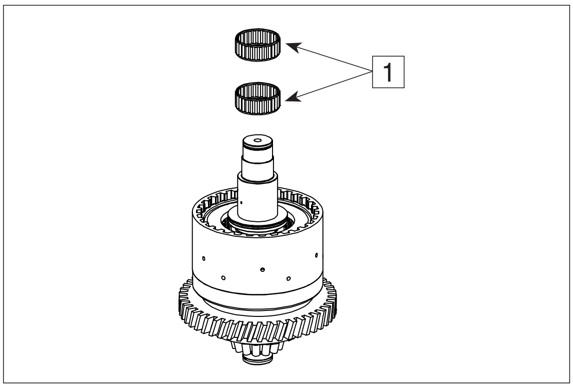
50DS7ETM67

③ Remove bearing inner ring (1), axial bearing assy (2) and inner disk carrier (3).



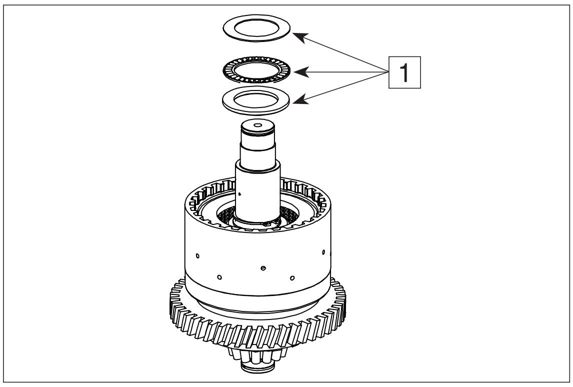
50DS7ETM68

④ Remove needle cage (1).



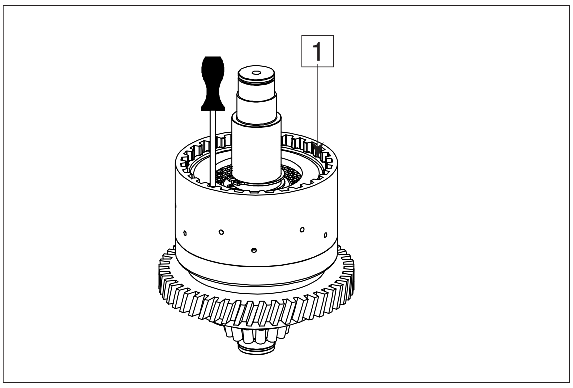
50DS7ETM69

⑤ Remove axial bearing assy (1).



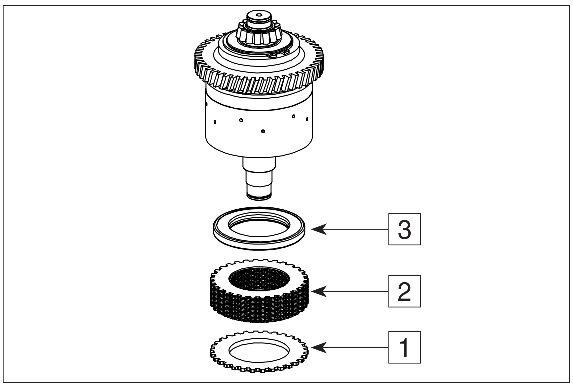
50DS7ETM70

⑥ Remove snap ring (1).



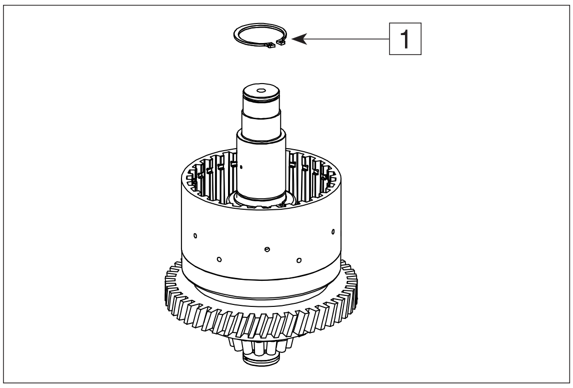
50DS7ETM71

⑦ Remove end plate (1), disk package (2) and plate (3) from the disk carrier.



50DS7ETM72

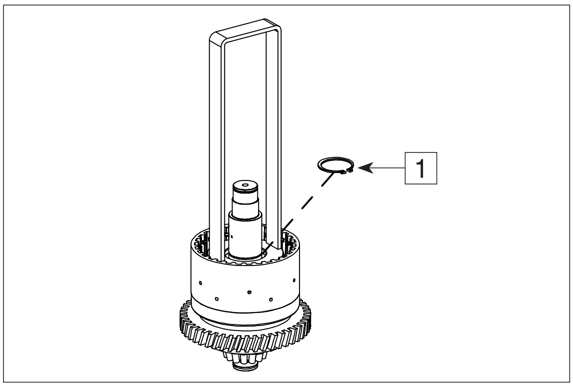
⑧ Remove retaining ring-contact position of axial bearing (1).



50DS7ETM73

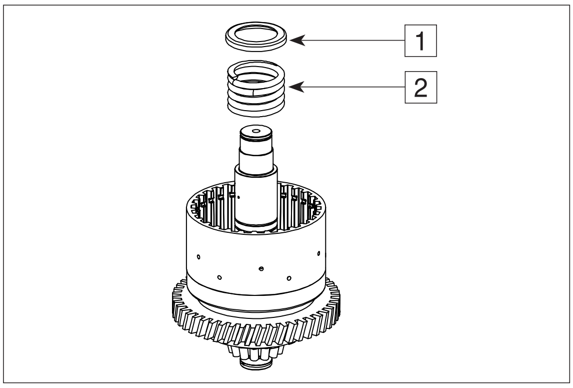
⑨ Preload compression spring and remove retaining ring (1).

(S) Assembly aid 5870 345 114



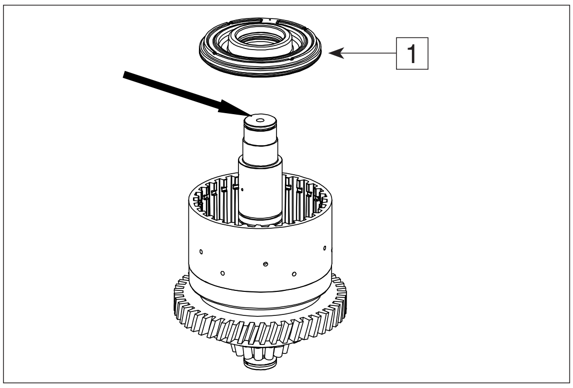
50DS7ETM74

⑩ Remove cup spring (1) and compression spring (2).



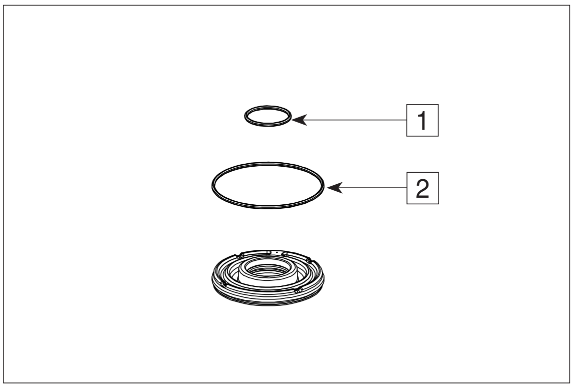
50DS7ETM75

⑪ By means of compressed air (see arrow), press piston (1) off the shaft/disk carrier and remove it.



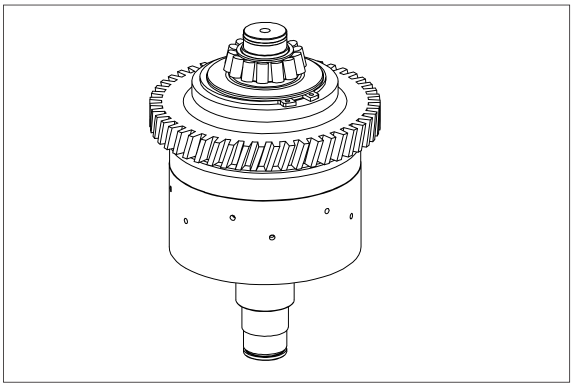
50DS7ETM76

⑫ Remove both O-rings (1 and 2).



50DS7ETM62

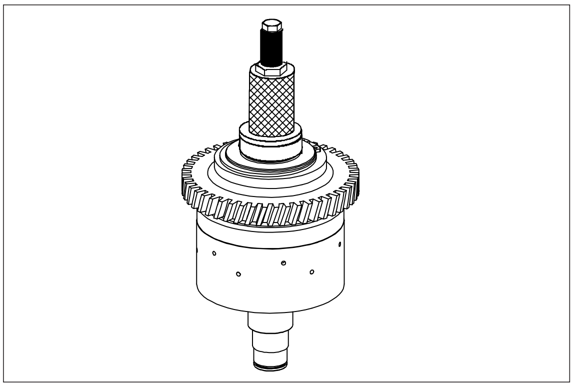
⑬ Snap out rectangular ring (1).



50DS7ETM78

⑭ Pull tapered roller bearing (inner ring) off the shaft.

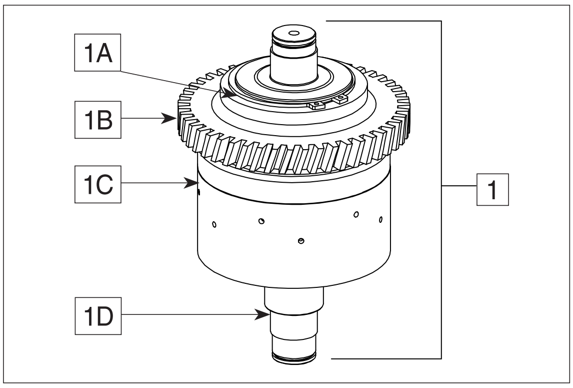
(S) Grab sleeve	5873 000 029
(S) Basic tool	5873 000 000



50DS7ETM79

※ The clutch (1) cannot be disassembled. It is supplied by the spare parts service only as a complete assy which consists of :

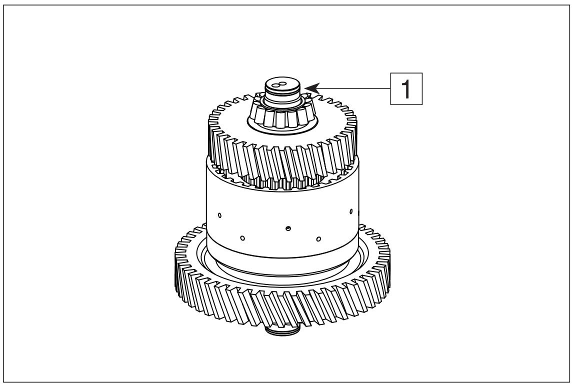
1A = Retaining ring
1B = Helical gear
1C = Disk carrier
1D = Shaft



50DS7ETM80

(3) Clutch KD

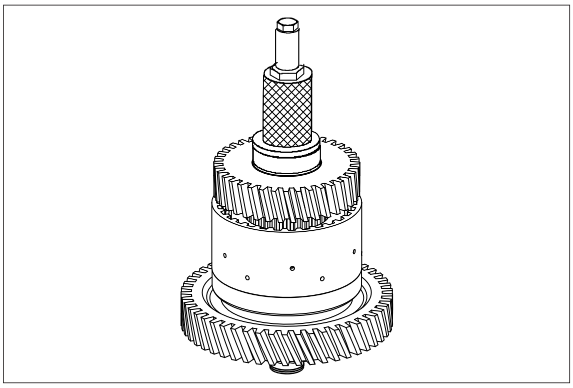
① Snap out rectangular ring (1).



50DS7ETM81

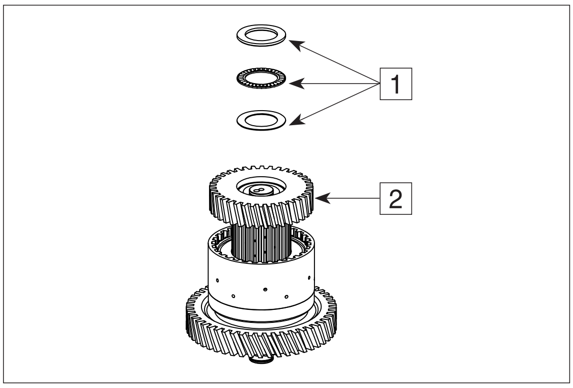
② Pull tapered roller bearing (inner ring) off the shaft.

(S) Grab sleeve	5873 000 029
(S) Basic tool	5873 000 000



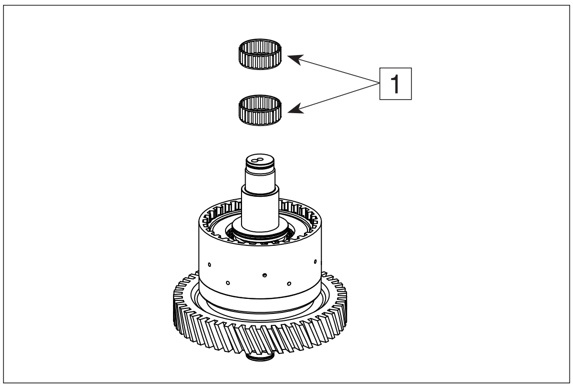
50DS7ETM82

③ Remove axial bearing assy (1) and inner disk carrier.



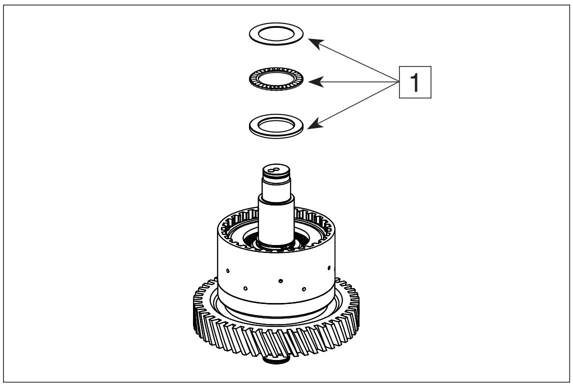
50DS7ETM83

④ Remove needle cage (1).



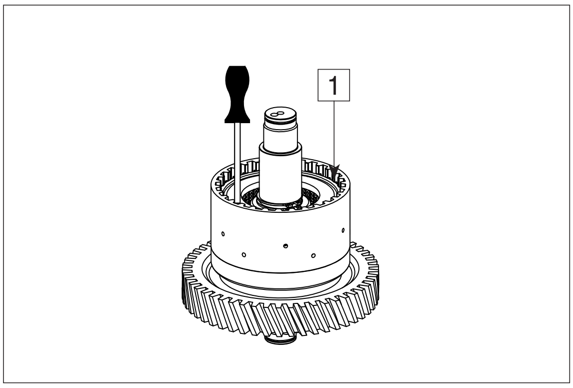
50DS7ETM84

⑤ Remove axial bearing assy (1).



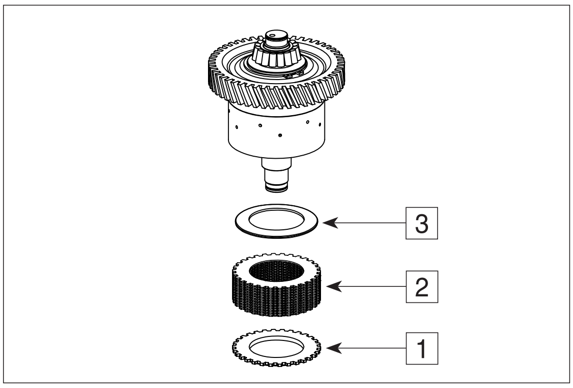
50DS7ETM85

⑥ Remove snap ring (1).



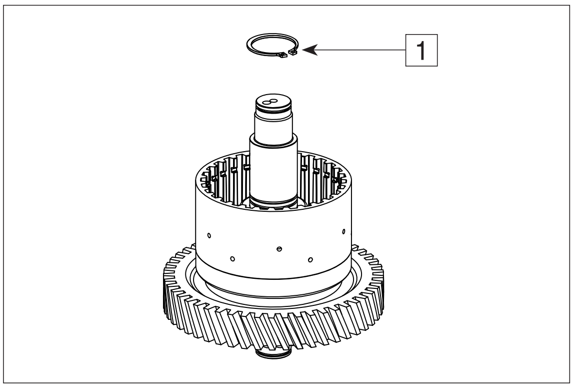
50DS7ETM86

⑦ Remove end plate (1), disk package (2) and cup spring (3) from the disk carrier.



50DS7ETM87

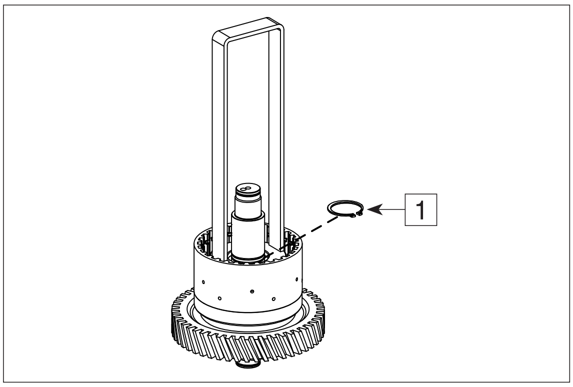
⑧ Remove retaining ring-contact position of axial bearing (1).



50DS7ETM88

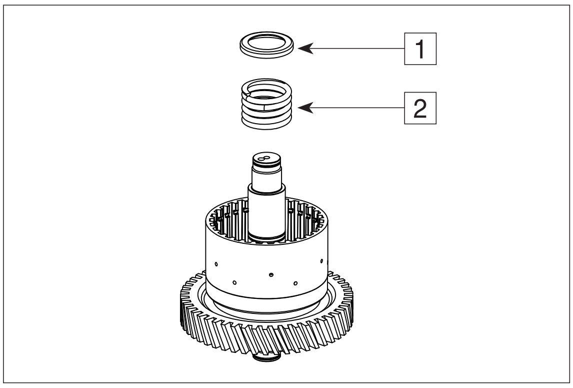
⑨ Preload compression spring and remove snap ring (1).

(S) Assembly aid 5870 345 114



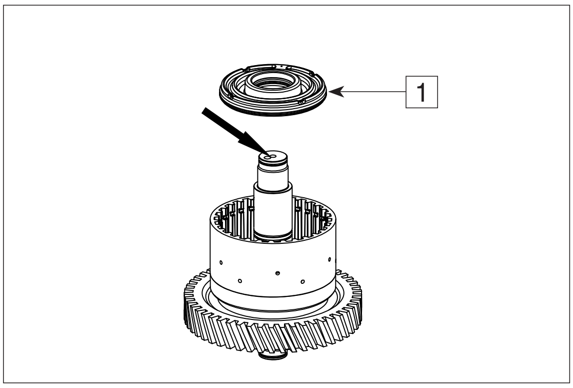
50DS7ETM89

⑩ Remove spring cup (1) and compression spring (2).



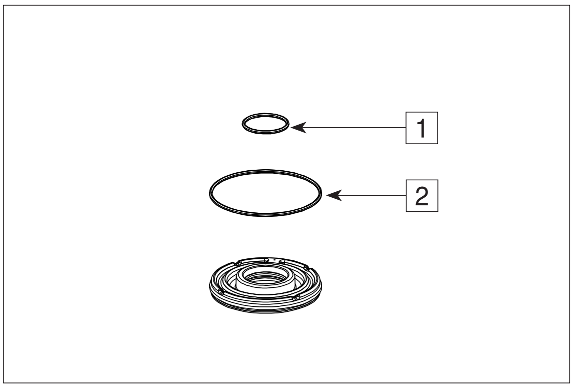
50DS7ETM90

⑪ By means of compressed air (see arrow), press piston (1) off the shaft/disk carrier and remove it.



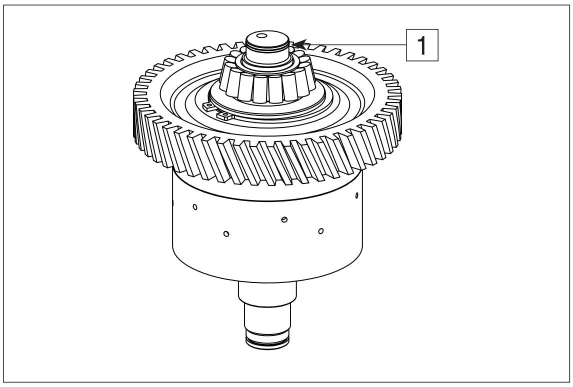
50DS7ETM91

⑫ Remove both O-rings (1 and 2).



50DS7ETM62

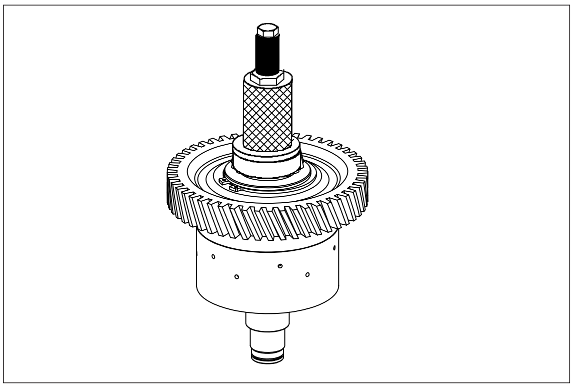
⑬ Snap out rectangular ring (1).



50DS7ETM93

⑭ Pull tapered roller bearing (inner ring) off the shaft.

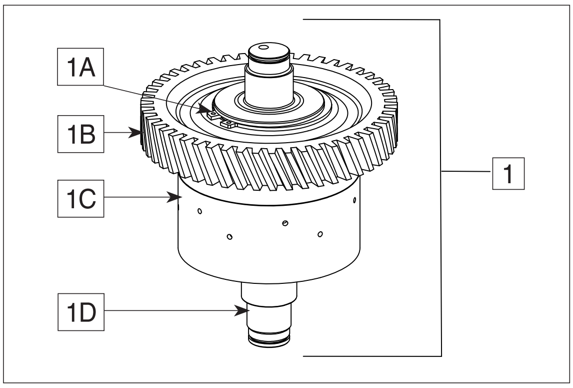
(S) Rapid grip	5873 011 011
(S) Extractor set	5870 026 100



50DS7ETM94

※ The clutch (1) cannot be disassembled. It is supplied by the spare parts service only as a complete assy which consists of :

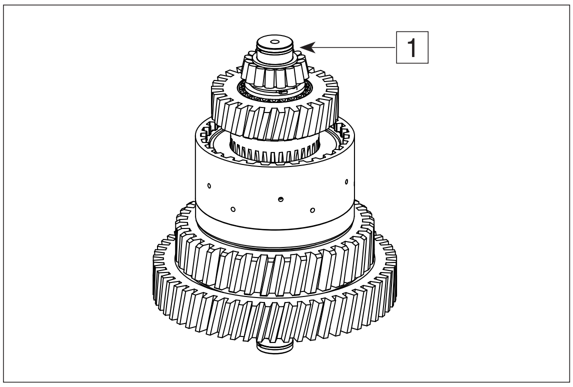
1A = Retaining ring
1B = Helical gear
1C = Disk carrier
1D = Shaft



50DS7ETM95

(4) Clutch KE

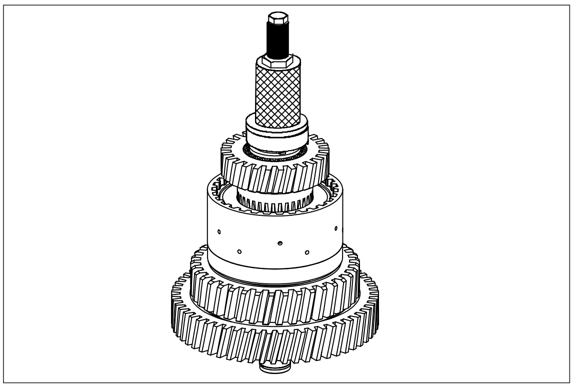
① Snap out rectangular ring (1).



50DS7ETM96

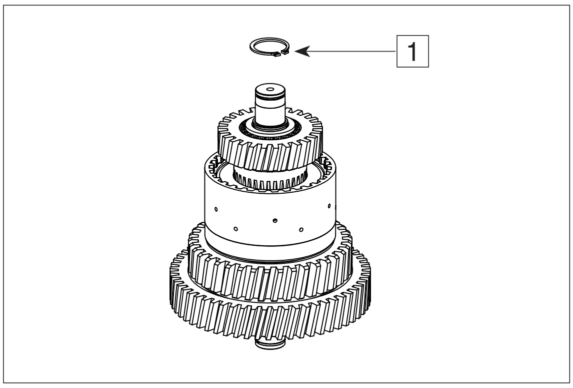
② Pull tapered roller bearing (inner ring) off the shaft.

(S) Grab sleeve	5873 000 029
(S) Basic tool	5873 001 000



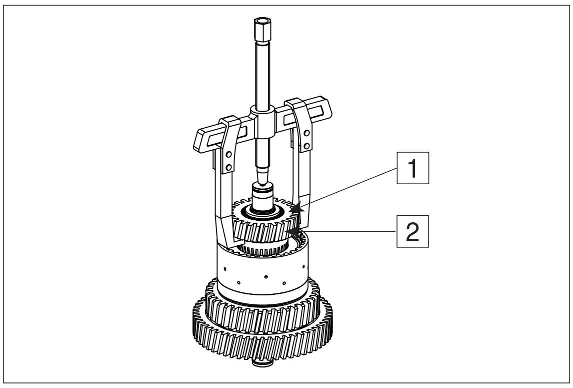
50DS7ETM97

③ Remove retaining ring (1).



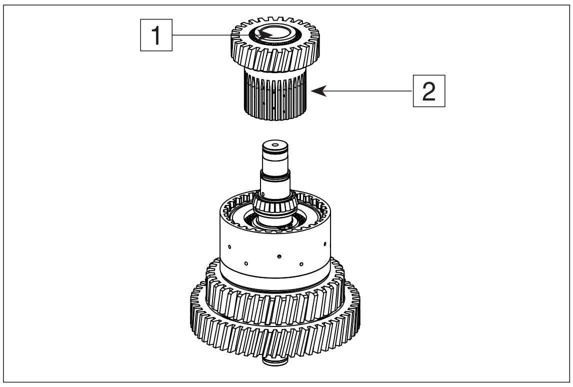
50DS7ETM98

④ Remove bearing inner ring (1) and inner disk carrier (2).



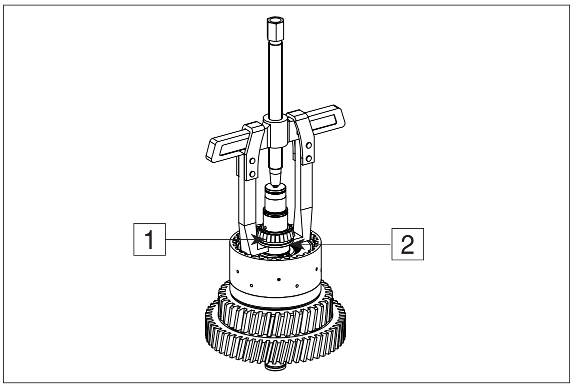
50DS7ETM99

⑤ Remove tapered roller bearing (1) and inner disk carrier (2).



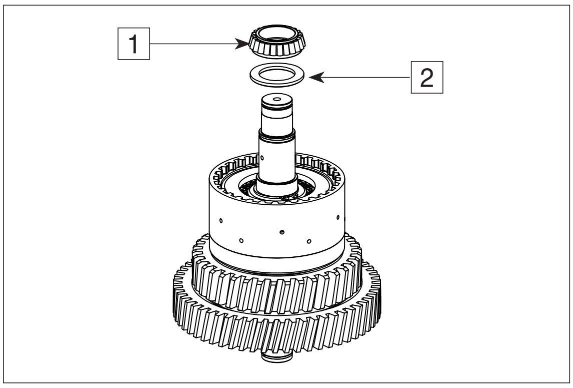
50DS7ETM100

⑥ Pull off bearing inner ring (1) and running disk (2).



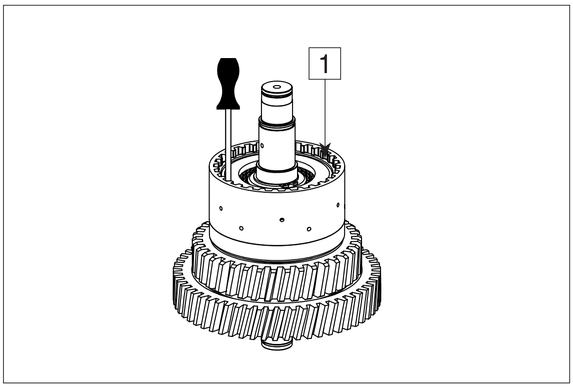
50DS7ETM101

⑦ Remove bearing inner ring (1) and running disk (2).



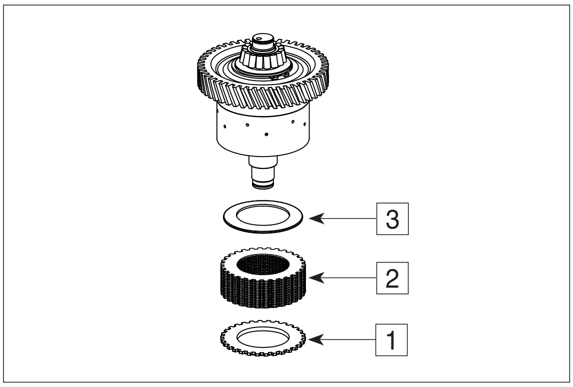
50DS7ETM102

⑧ Disengage snap ring (1).



50DS7ETM103

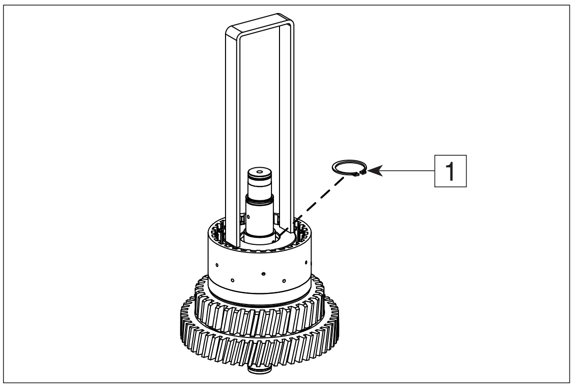
⑨ Remove end plate (1), disk package (2) and cup spring (3) from the disk carrier.



50DS7ETM104

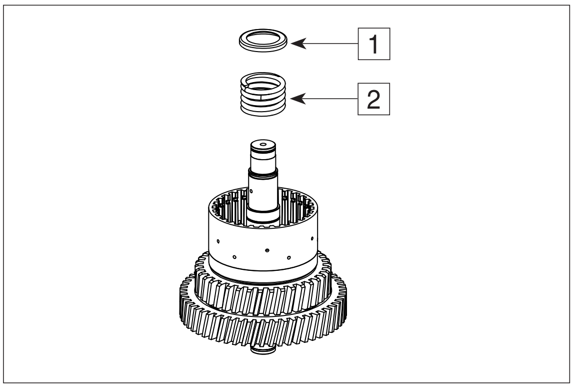
⑩ Preload compression spring and remove snap ring (1).

(S) Assembly aid 5870 345 114



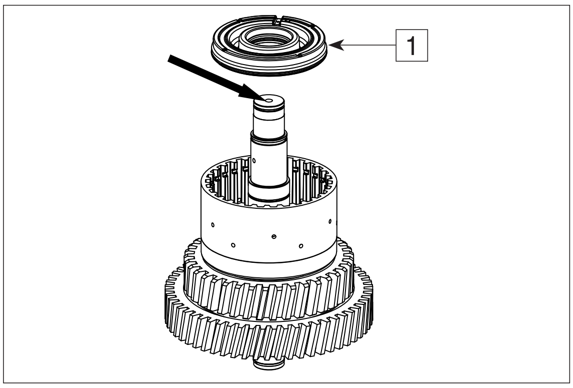
50DS7ETM105

⑪ Remove spring cup (1) and compression spring (2).



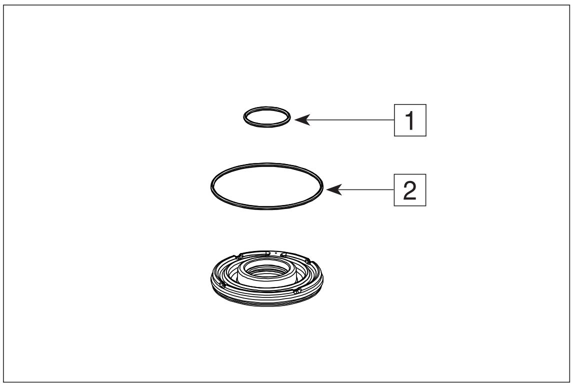
50DS7ETM106

⑫ By means of compressed air (see arrow), press piston (1) off the shaft/disk carrier and remove it.



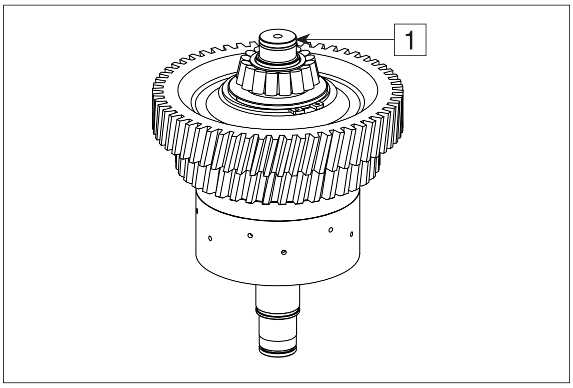
50DS7ETM107

⑬ Remove both O-rings (1 and 2).



50DS7ETM62

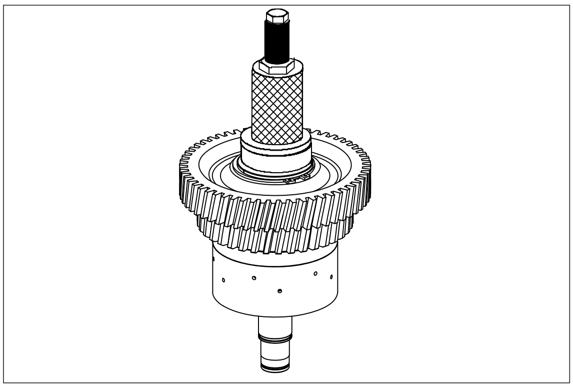
⑭ Snap out rectangular ring (1).



50DS7ETM109

⑮ Pull tapered roller bearing (inner ring) off the shaft.

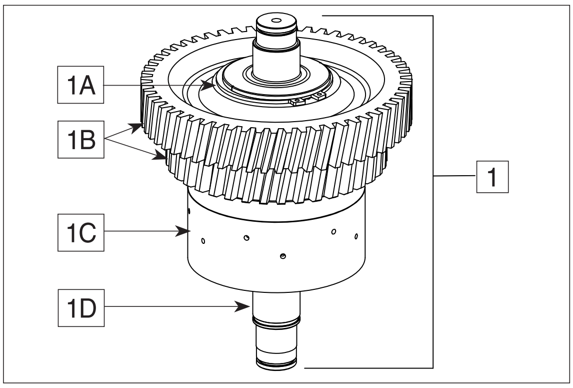
(S) Rapid grip	5873 011 011
(S) Basic tool	5873 001 000



50DS7ETM110

※ The clutch (1) cannot be disassembled. It is supplied by the spare parts service only as a complete assy which consists of :

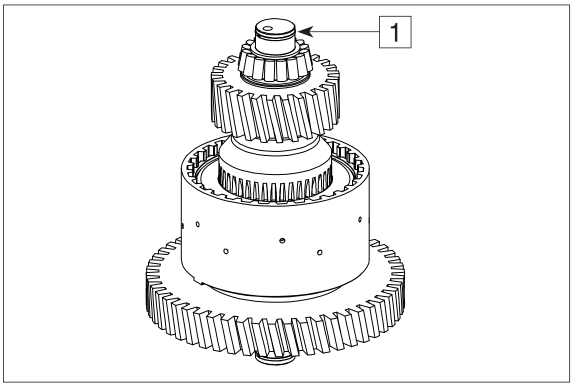
1A = Retaining ring
1B = Helical gears
1C = Disk carrier
1D = Shaft



50DS7ETM111

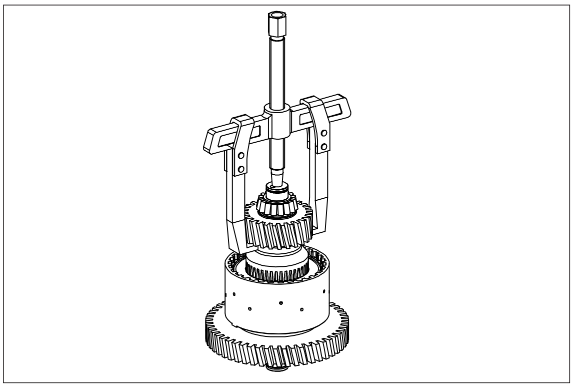
(5) Clutch KC

① Snap out rectangular ring (1).



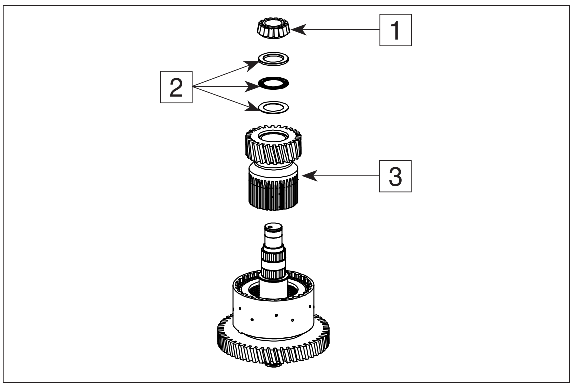
50DS7ETM112

② Pull off bearing inner ring with inner disk carrier (1).



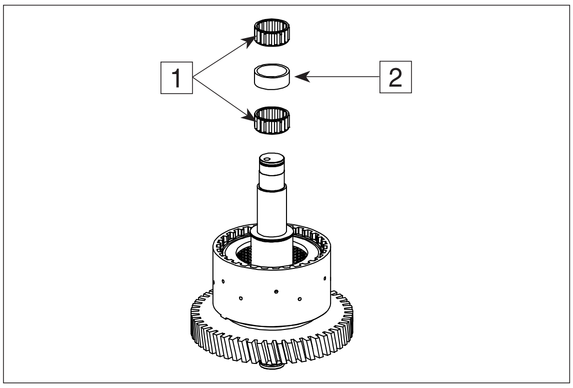
50DS7ETM113

③ Remove bearing inner ring (1), axial bearing assy (2) and inner disk carrier (3).



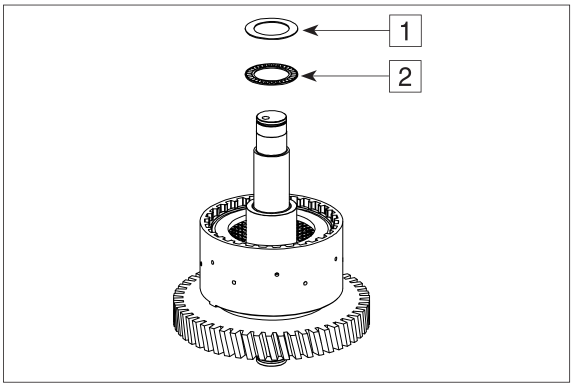
50DS7ETM114

④ Remove needle cage (1) and bush (2).



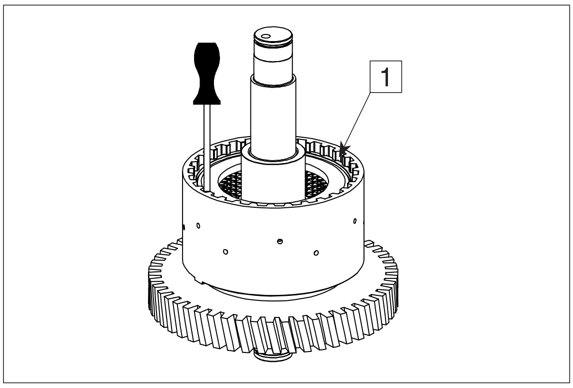
50DS7ETM115

⑤ Remove axial disk (1) and axial needle cage (2).



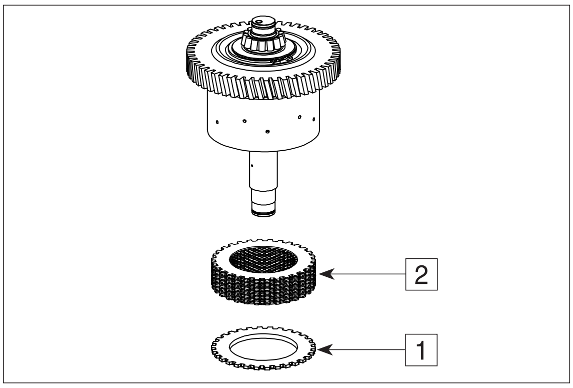
50DS7ETM116

⑥ Disengage snap ring (1).



50DS7ETM117

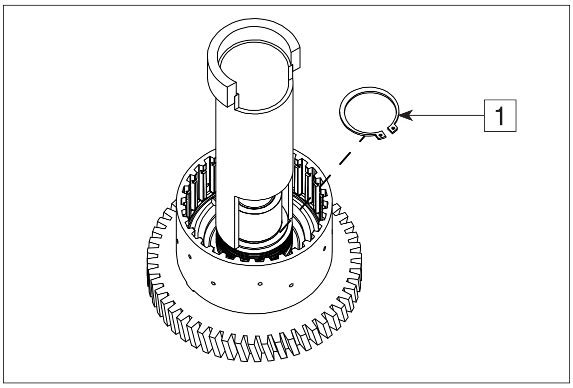
⑦ Remove end plate (1) and disk package (2) from the disk carrier.



50DS7ETM118

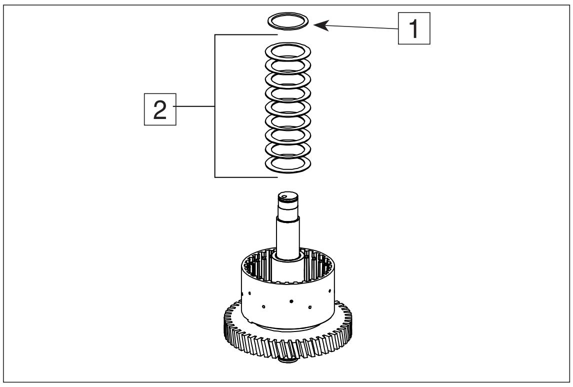
⑧ Preload compression springs and remove snap ring (1).

(S) Assembly aid 5870 506 128



50DS7ETM119

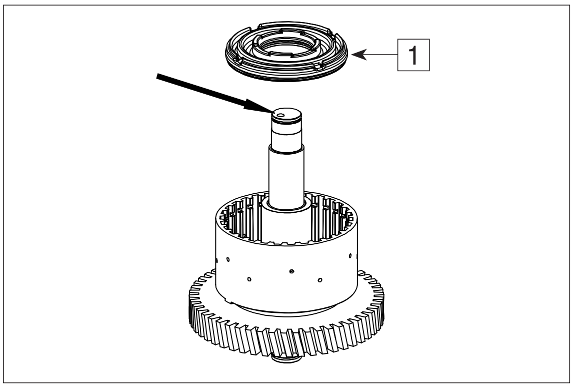
⑨ Remove disk (1) and cup springs (2).



50DS7ETM120

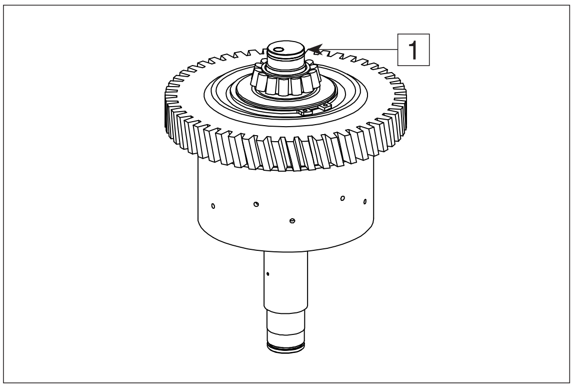
⑩ By means of compressed air (see arrow), press piston (1) off the shaft/disk carrier and remove it.

Remove both O-rings.



50DS7ETM121

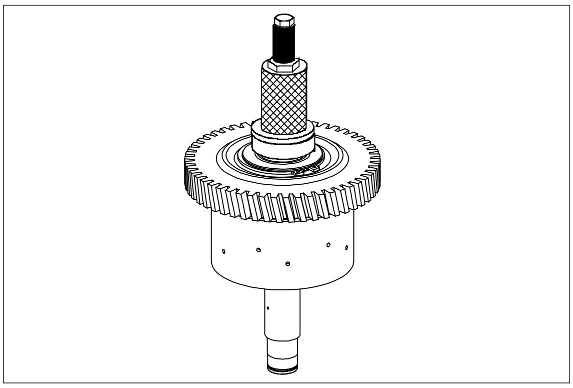
⑪ Snap out rectangular ring (1).



50DS7ETM122

⑫ Pull tapered roller bearing (inner ring) off the shaft.

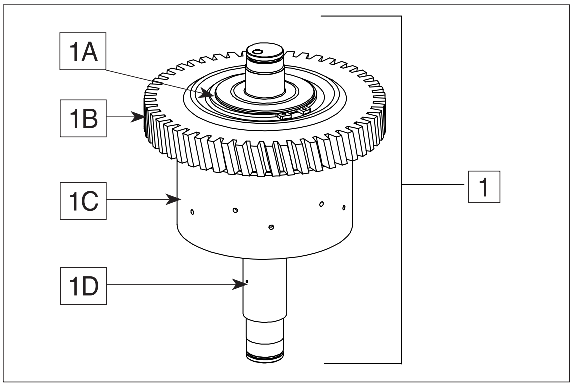
(S) Grab sleeve	5873 002 029
(S) Basic tool	5873 000 001



50DS7ETM123

※ The clutch (1) cannot be disassembled. It is supplied by the spare parts service only as a complete assy which consists of:

1A = Retaining ring
1B = Helical gear
1C = Disk carrier
1D = Shaft

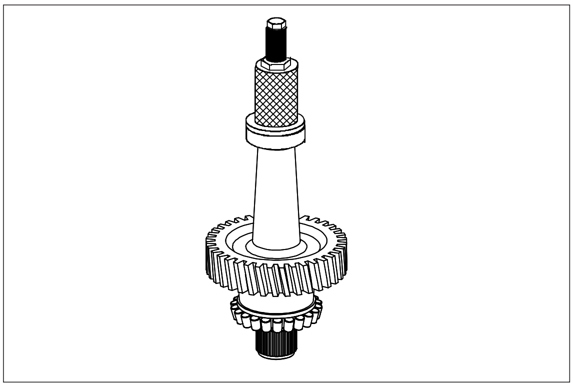


50DS7ETM124

(6) Output shaft

① Pull the bearing inner ring off the output shaft.

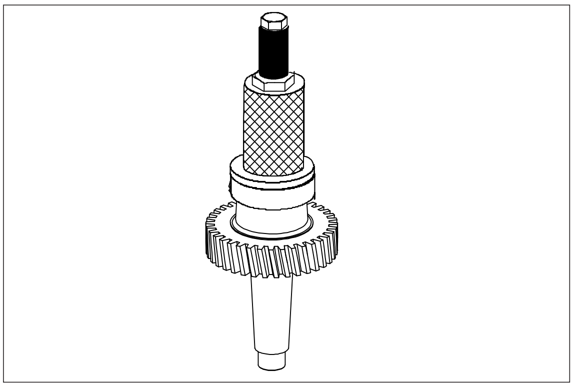
(S) Grab sleeve	5873 000 029
(S) Basic tool	5873 000 001



50DS7ETM125

② Rotate output shaft 180°and pull off bearing inner ring.

(S) Grab sleeve	5873 002 035
or	
(S) Rapid grip	5873 012 011
(S) Basic tool	5873 002 000



50DS7ETM126

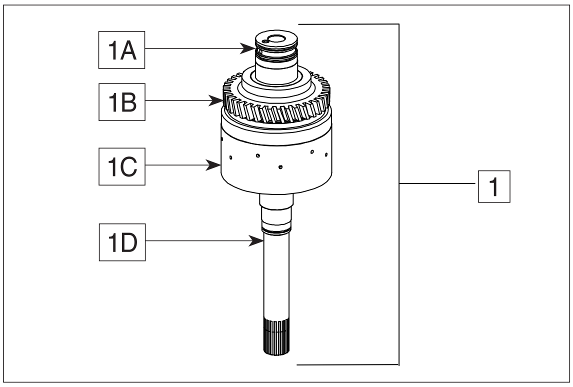
2. TRANSMISSION ASSEMBLY

1) REASSEMBLY OF CLUTCHES :

(1) Clutch KR/input

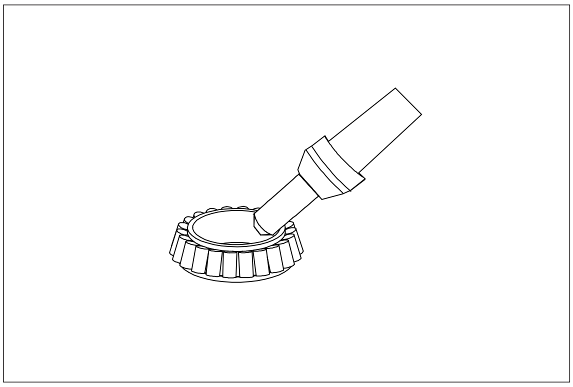
※ The clutch (1) is supplied by the spare parts service only as a complete assy which consists of:

1A = Ball
1B = Helical gear
1C = Disk carrier
1D = Input shaft



50DS7ETM65

① Heat up bearing inner ring (approx. 120°C).

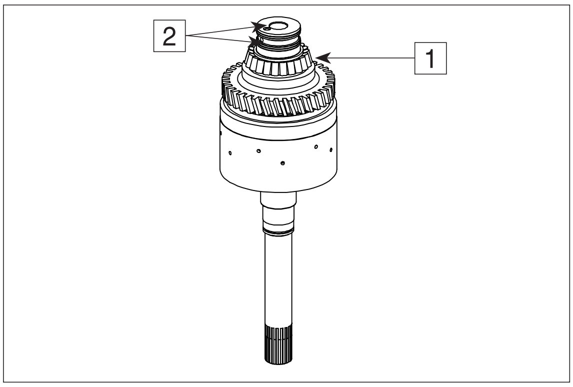

50DS7ETM128

② Mount bearing inner ring (1) until contact is obtained.

Fit rectangular rings 50×2.5 (2).

⚠ Wear protective gloves.

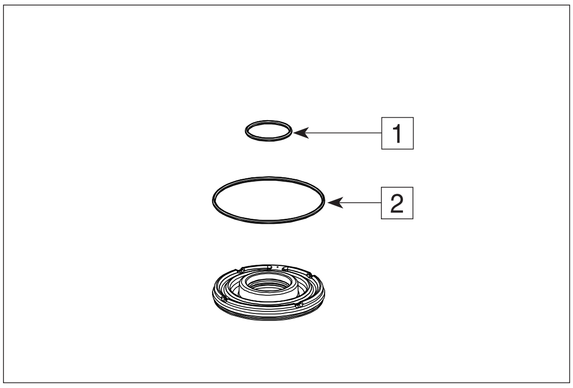
※ Adjust bearing inner ring after cooling-down.



50DS7ETM129

③ Insert both O-rings (1 and 2) into the piston grooves and oil them.

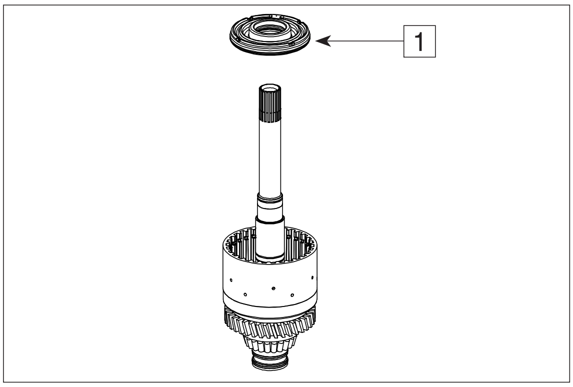
1 = 40×3
2 = 104.5×3



50DS7ETM62

④ Insert piston (1) into the disk carrier.

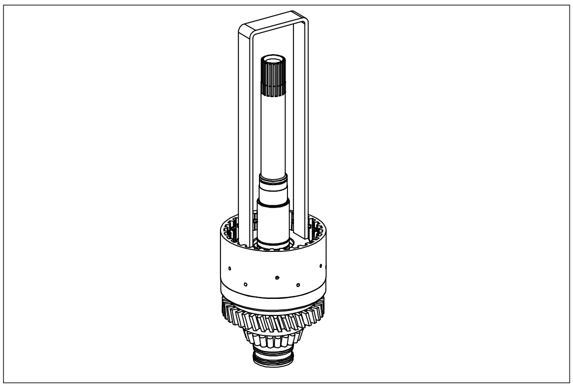
※ Pay attention to the installation position, see Figure.



50DS7ETM131

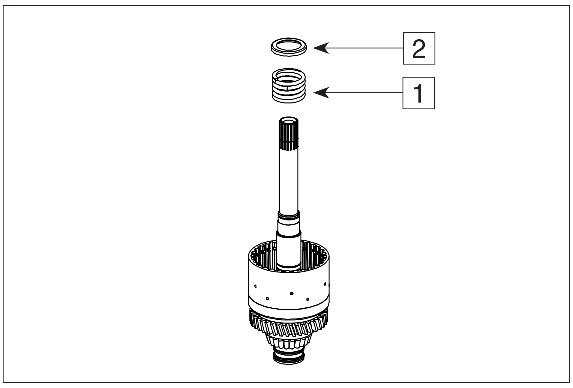
⑤ Use a hand-operated press to place piston into the disk carrier by means of the assembly aid.

(S) Assembly aid 5870 345 114



50DS7ETM132

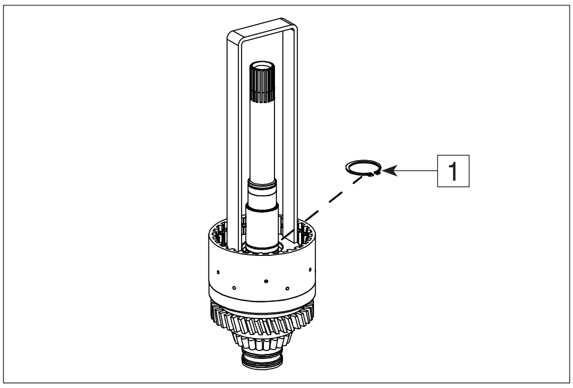
⑥ Mount compression spring (1) and cup spring (2).



50DS7ETM60

⑦ By means of the assembly aid, preload compression spring under a hand-operated press until the retaining ring 40×1.75 (1) can be snapped in.

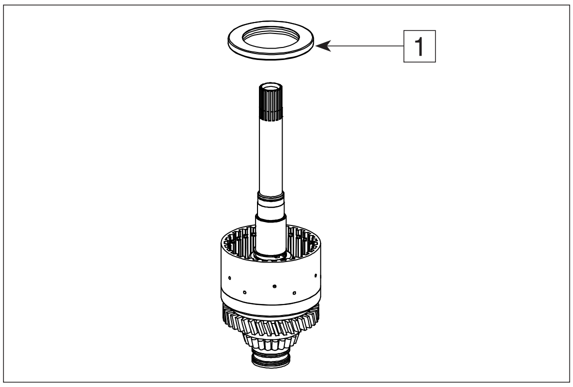
(S) Assembly aid 5870 345 114



50DS7ETM59

⑧ Mount plate assy with cup springs (1), with the open side showing towards the piston (see arrow).

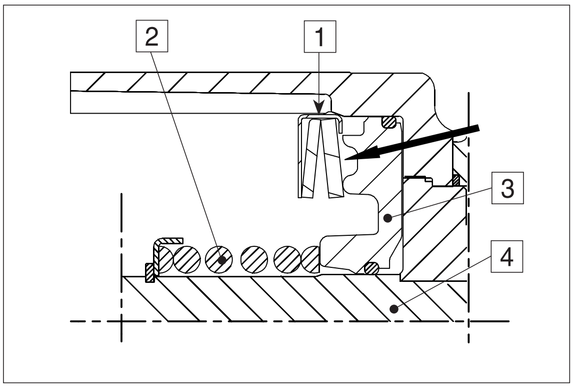
※ Installation position plate-see below figure.



50DS7ETM135

⑨ Fit plate (1) according to sketch (see arrow).

1 = Plate with cup springs
2 = Compression spring with spring cup and retaining ring
3 = Piston with O−rings
4 = Clutch assy

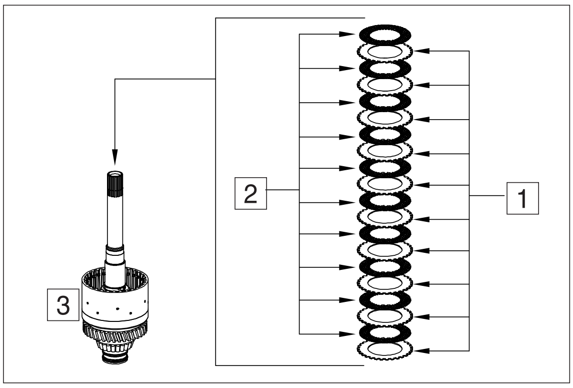


50DS7ETM136

⑩ Install outer and inner disks alternately into the disk carrier (3) as shown in figure.

Starting with an outer disk and ending with an inner disk.

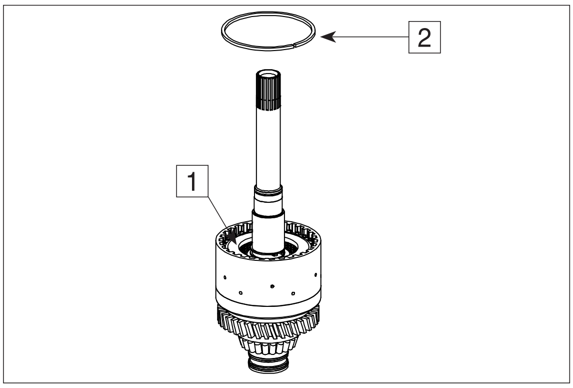
1 = Outer disks (10 pcs)
2 = Inner disks (10 pcs)
3 = Clutch assy



50DS7ETM137

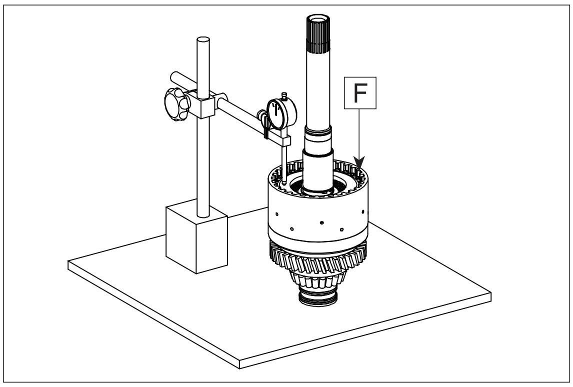
⑪ Mount end plate (1) with the flat side showing towards the disk package and fix it by means of snap ring (2) (e.g. thickness=2.5 mm/recommended value).

※ Pay attention to the installation position of the end plate.



50DS7ETM138

⑫ Equally press on end plate with F (approx. 100N = 10㎏) and set dial indicator to "zero".

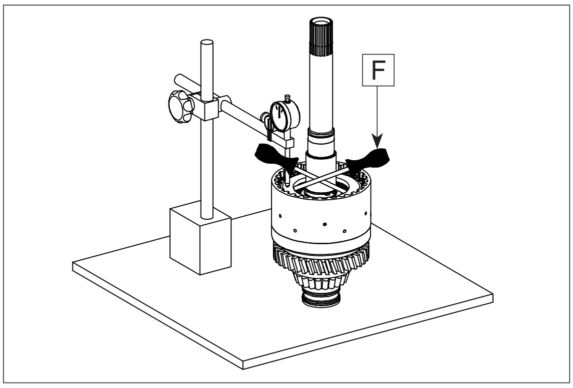


50DS7ETM139

⑬ Then press end plate against the snap ring (upwards) and read the disk clearance.

※ Disk clearance : 2.2 to 2.6 ㎜

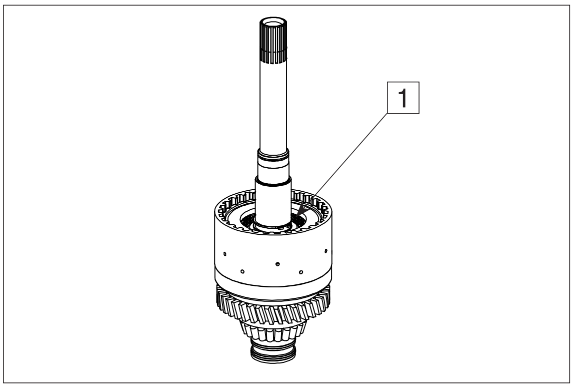
※ In case of deviations, the disk clearance must be corrected with an appropriate snap ring (optional thickness = 2.0 ...... 3.5 ㎜/available in steps of 0.25 ㎜).



50DS7ETM140

⑭ Snap retaining ring 40×1.75 (1) into the groove.

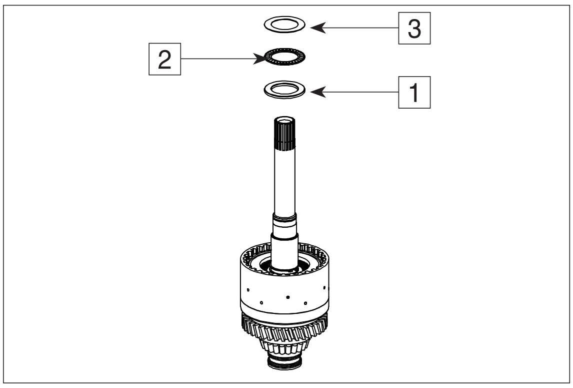
※ Contact for axial bearing - see below figure.



50DS7ETM141

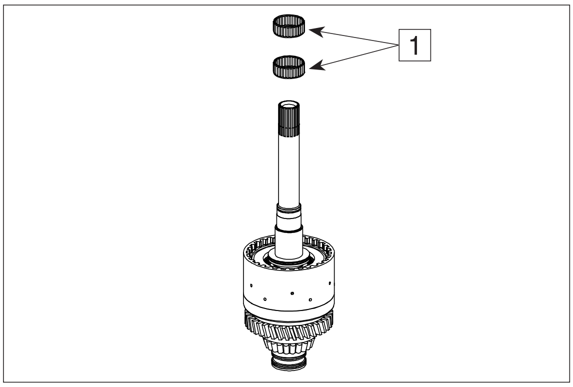
⑮ Mount running disk 40×60×3.5 (1), axial needle cage 40×60×3 (2) and axial washer 40×60×1 (3) and oil them.

※ Fit running disk (1), with the chamfer showing towards the retaining ring.



50DS7ETM142

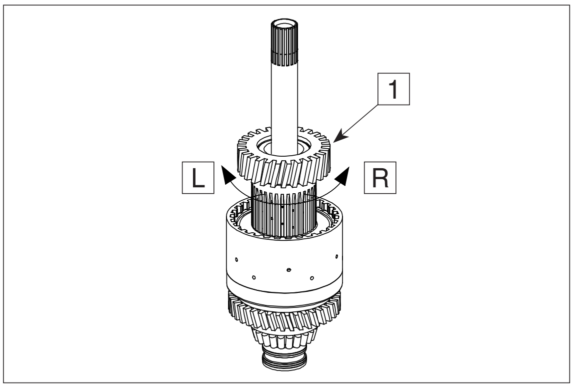
⑯ Mount needle cage 40×45×17 (1) and oil it.



50DS7ETM143

⑰ Mount inner disk carrier until contact is obtained.

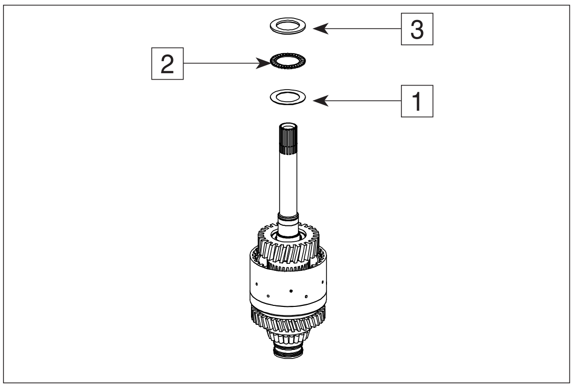
Install inner disks by short ccw/cw rotations of the inner disk carrier (1).



50DS7ETM144

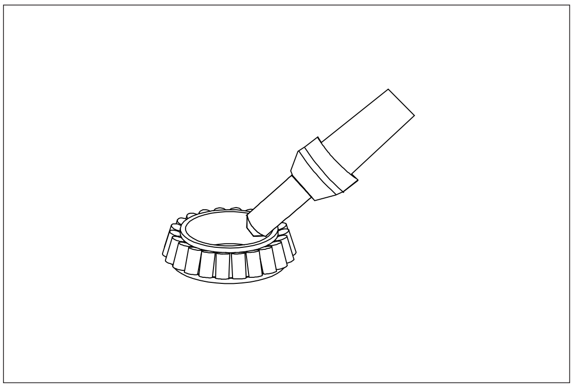
⑱ Mount axial washer 40×60×1 (1), axial needle cage 40×60×3 (2) and running disk (3) 40×60×3.5 and oil them.

※ Fit running disk (3), with the chamfer showing towards the tapered roller bearing.



50DS7ETM145

⑲ Heat up bearing inner ring (approx. 120°C).



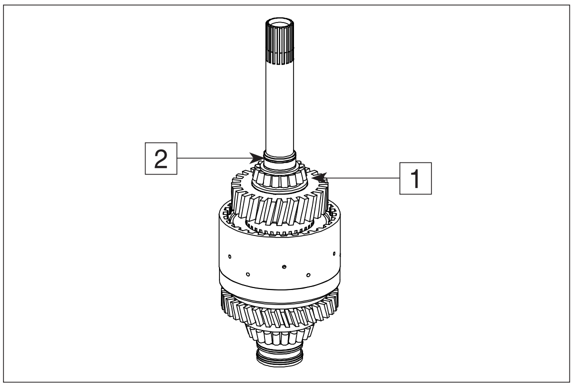
50DS7ETM128

⑳ Mount bearing inner ring (1) until contact is obtained.

Fit rectangular ring 30×2 (2).

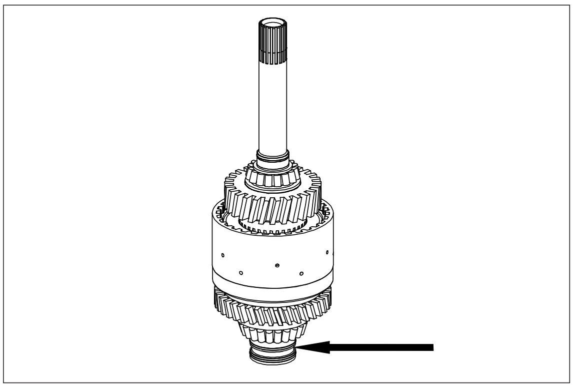
⚠ Wear protective gloves.

※ Adjust bearing inner ring after cooling-down.



50DS7ETM147

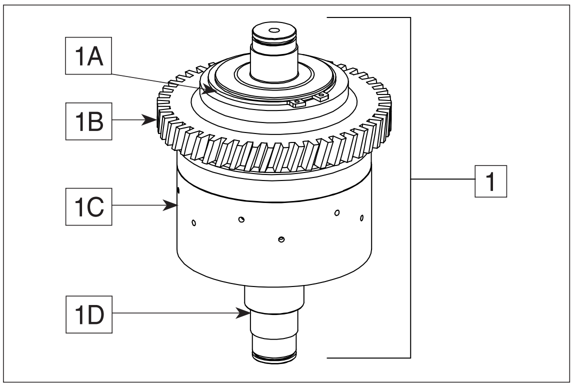
※ Check closing and opening of the clutch by means of compressed air at the hole (see arrow).
Closing and opening of the clutch must be clearly audible.


50DS7ETM148

(2) Clutch KV

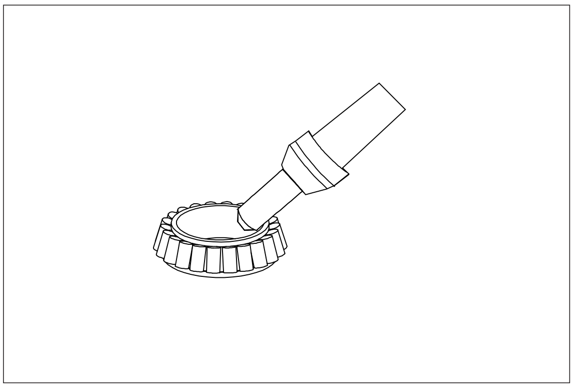
The clutch (1) is supplied by the spare parts service only as a complete assy which consists of :

1A = Retaining ring
1B = Helical gear
1C = Disk carrier
1D = Shaft



50DS7ETM149

① Heat up bearing inner ring (approx. 120°C).



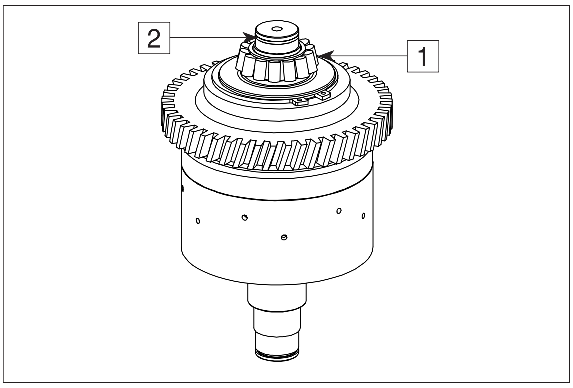
50DS7ETM128

② Mount bearing inner ring (1) until contact is obtained.

Fit rectangular rings 30×2 (2).

⚠ Wear protective gloves.

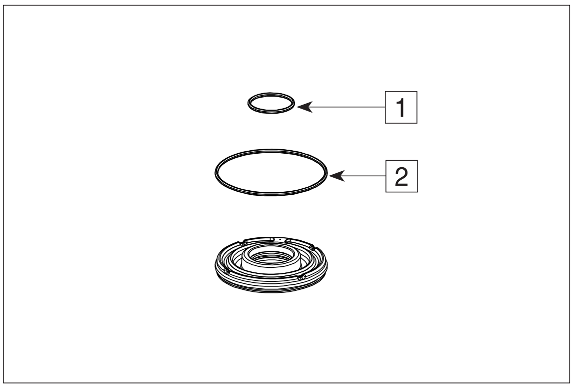
※ Adjust bearing inner ring after cooling-down.



50DS7ETM151

③ Insert both O-rings (1 and 2) into the piston grooves and oil them.

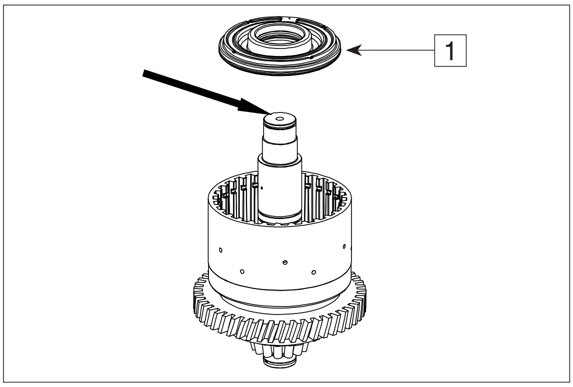
1 = 40×3
2 = 104.5×3



50DS7ETM62

④ Insert piston (1) into the disk carrier.

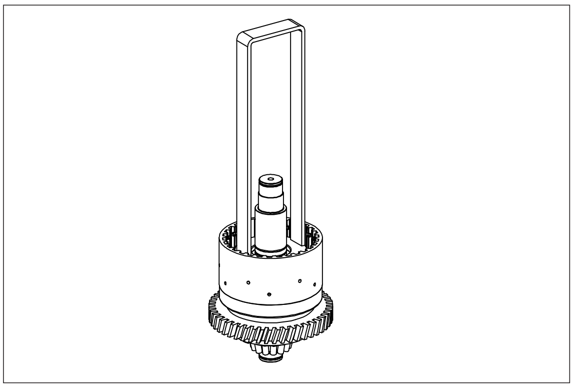
※ Pay attention to the installation position, see figure.



50DS7ETM76

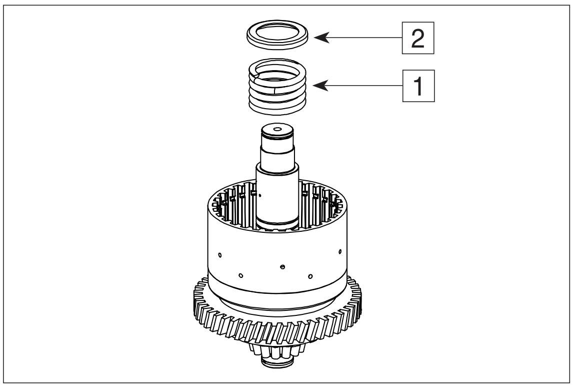
⑤ Use a hand-operated press to place piston into the disk carrier by means of the assembly aid.

(S) Assembly aid 5870 345 114



50DS7ETM154

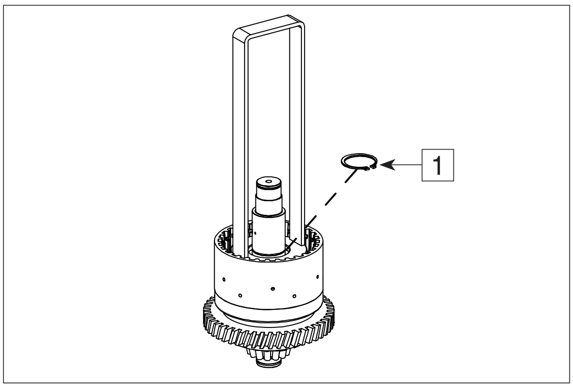
⑥ Mount compression spring (1) and spring cup (2).



50DS7ETM75

⑦ By means of the assembly aid, preload compression spring under a hand-operated press until the retaining ring 40×1.75 (1) can be snapped in.

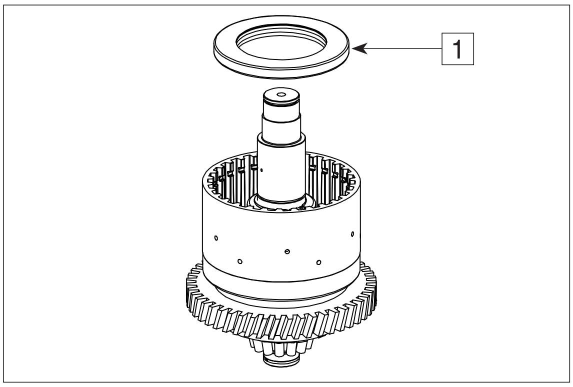
(S) Assembly aid 5870 345 114



50DS7ETM74

⑧ Mount plate assy with cup springs (1), with the open side showing towards the piston (see arrow).

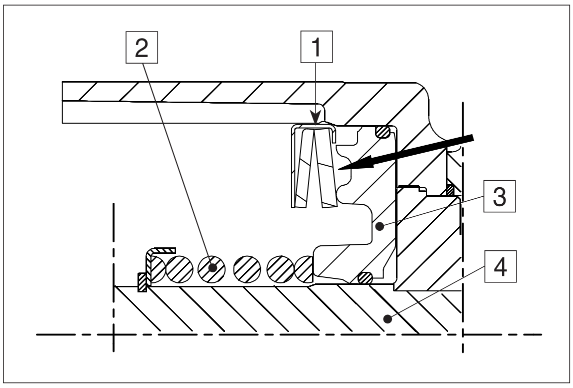
※ Installation position plate-see below figure.



50DS7ETM157

⑨ Fit plate (1) according to sketch (see arrow).

1 = Plate with cup springs
2 = Compression spring with cup spring and retaining ring
3 = Piston with O-rings
4 = Clutch assy

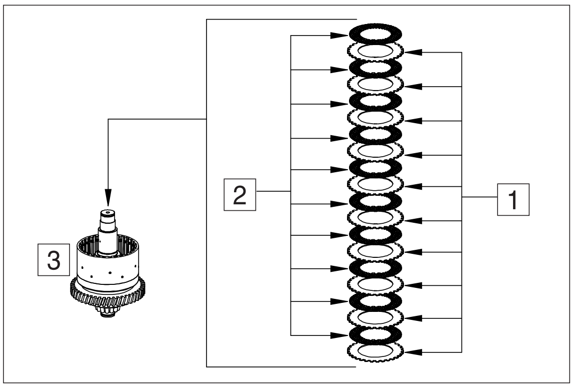


50DS7ETM158

⑩ Install outer and inner disks alternately into the disk carrier (3) as shown in figure.

Starting with an outer disk and ending with an inner disk.

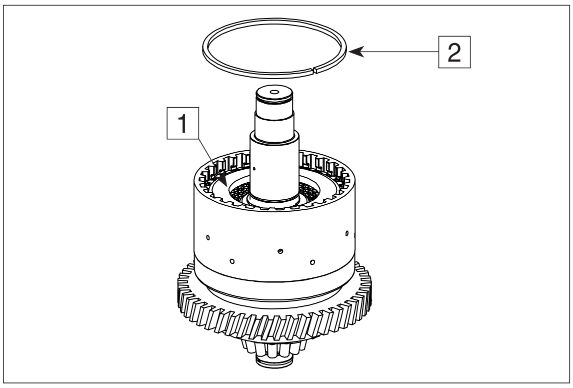
1 = Outer disks (10 pcs)
2 = Inner disks (10 pcs)
3 = Clutch assy



50DS7ETM159

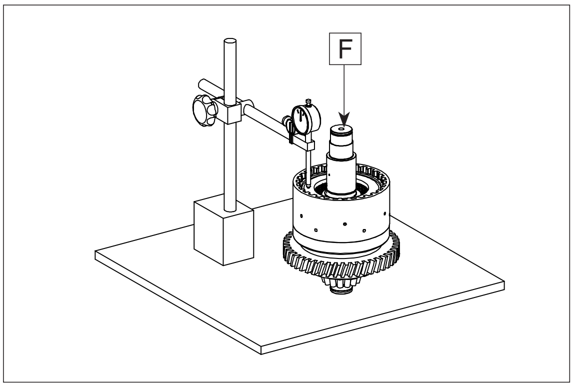
⑪ Mount end plate (1) with the flat side showing towards the disk package and fix it by means of snap ring (2) (e.g. thickness=2.5 mm/recommended value).

※ Pay attention to the installation position of the end plate.



50DS7ETM160

⑫ Equally press on end plate with F (approx. 100N = 10㎏) and set dial indicator to "zero".

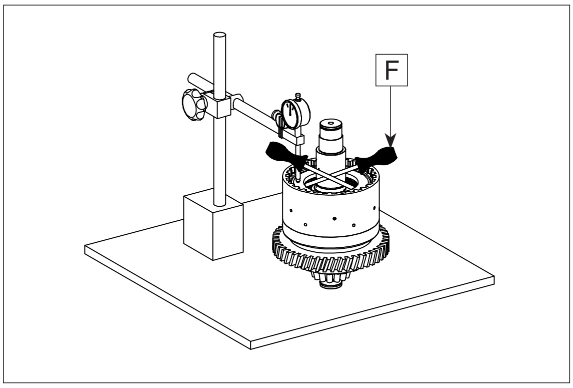


50DS7ETM161

⑬ Then press end plate against the snap ring (upwards) and read the disk clearance.

※ Disk clearance : 2.2 to 2.6 ㎜

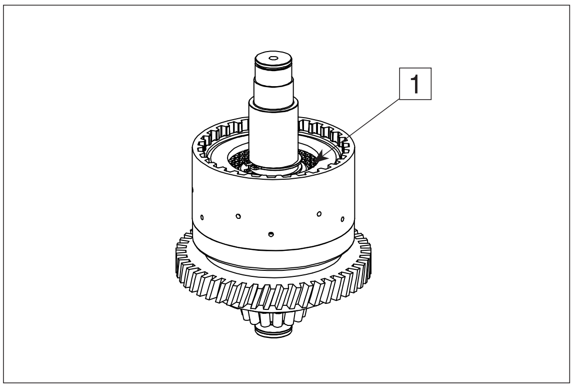
※ In case of deviations, the disk clearance must be corrected with an appropriate snap ring(optional thickness = 2.0~3.5 ㎜/available in steps of 0.25 ㎜).



50DS7ETM162

⑭ Snap retaining ring 40×1.75 (1) into the groove.

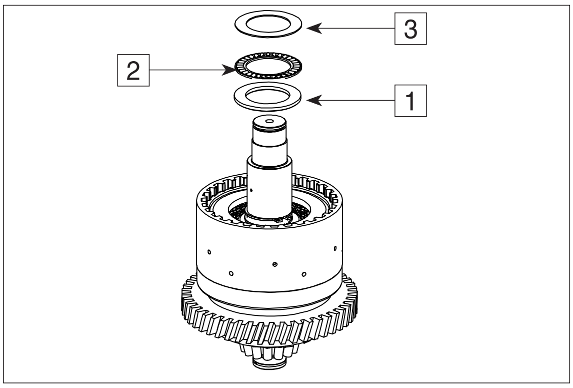
※ Contact for axial bearing-see below figure.



50DS7ETM163

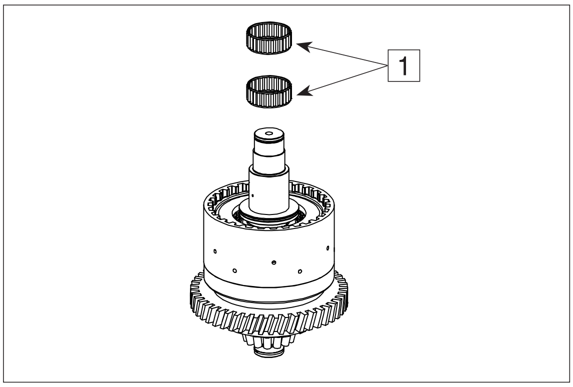
⑮ Mount running disk 40×60×3.5 (1), axial needle cage 40×60×3 (2) and axial washer 40×60×1 (3) and oil them.

※ Fit running disk (1), with the chamfer showing towards the retaining ring.



50DS7ETM164

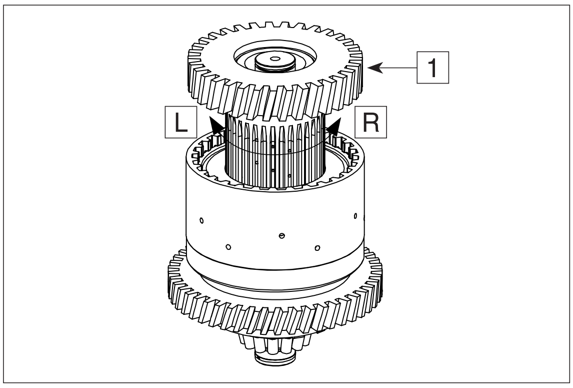
⑯ Mount needle cage 40×45×17 (1) and oil it.



50DS7ETM69

⑰ Mount inner disk carrier until contact is obtained.

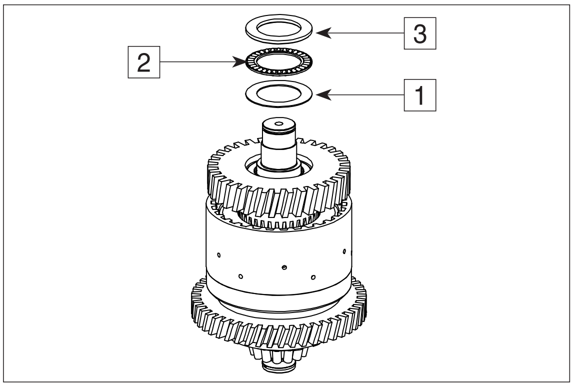
Install inner disks by short ccw/cw rotations of the inner disk carrier (1).



50DS7ETM166

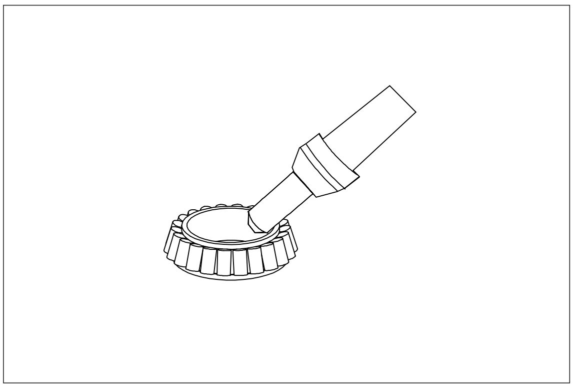
⑱ Mount axial washer 40×60×1 (1), axial needle cage 40×60×3 (2) and running disk (3) 40×60×3.5 and oil them.

※ Fit running disk (3), with the chamfer showing towards the tapered roller bearing.



50DS7ETM167

⑲ Heat up bearing inner ring (approx. 120°C).



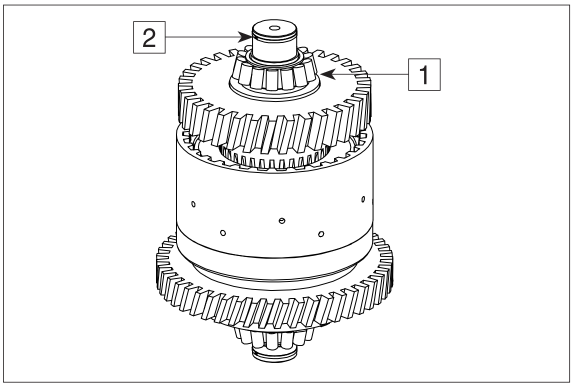
50DS7ETM128

⑳ Mount bearing inner ring (1) until contact is obtained.

Fit rectangular ring 30×2 (2).

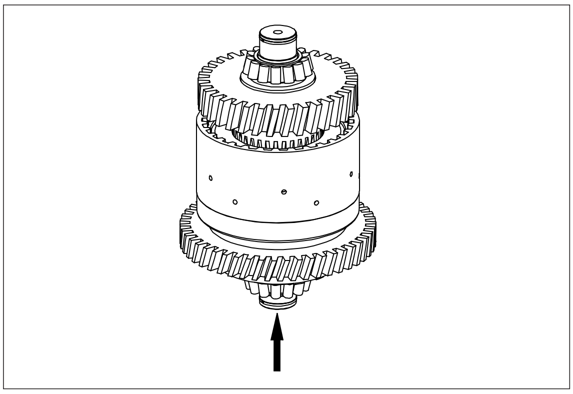
⚠ Wear protective gloves.

※ Adjust bearing inner ring after cooling-down.



50DS7ETM169

※ Check closing and opening of the clutch by means of compressed air at the hole (see arrow).
Closing and opening of the clutch must be clearly audible.

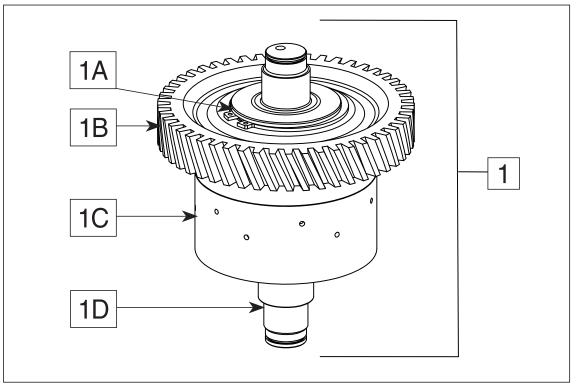


50DS7ETM170

(3) Clutch KD

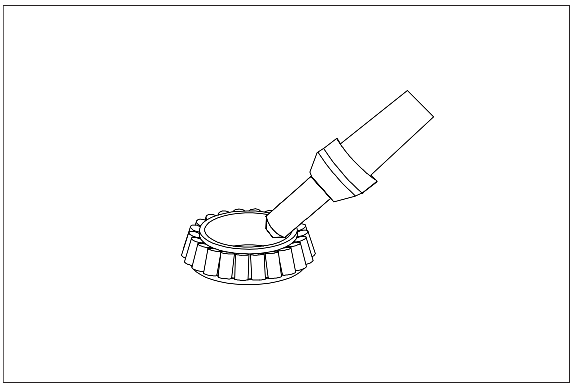
※ The clutch (1) is supplied by the spare parts service only as a complete assy which consists of :

1A = Retaining ring
1B = Helical gear
1C = Disk carrier
1D = Shaft



50DS7ETM95

① Heat up bearing inner ring(approx. 120°C).

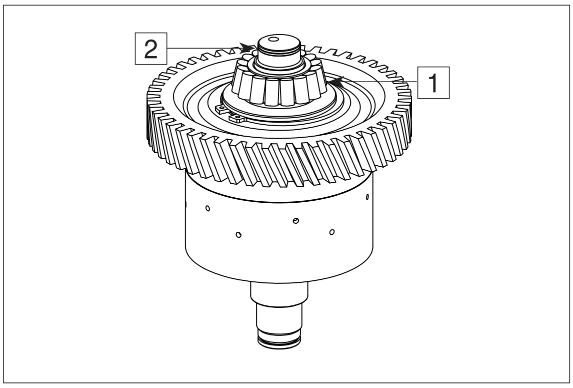

50DS7ETM128

② Mount bearing inner ring (1) until contact is obtained.

Fit rectangular rings 30×2 (2).

⚠ Wear protective gloves.

※ Adjust bearing inner ring after cooling-down.

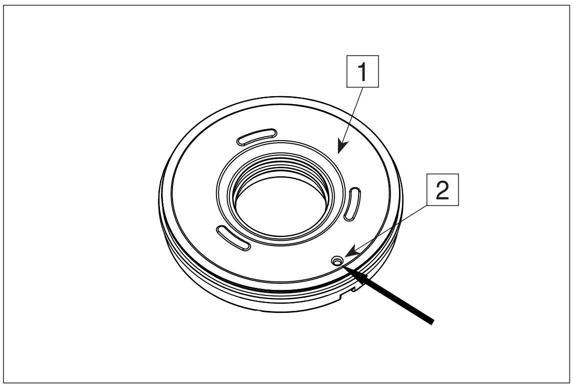


50DS7ETM171

③ Piston (1) with drain valve.

※ Check function of the drain valve (2). There must be no jamming of the ball(see arrow).

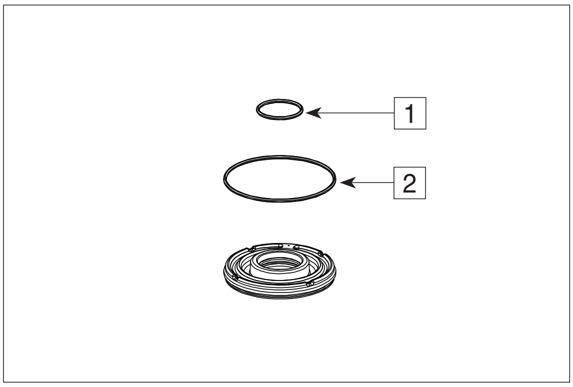
※ The piston (1) is supplied by the spare parts service only as a complete assy.



50DS7ETM172

④ Insert both O-rings (1 and 2) into the piston grooves and oil them.

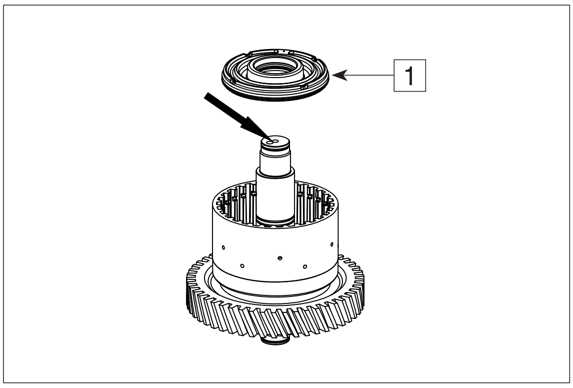
1 = 40×3
2 = 104.5×3



50DS7ETM62

⑤ Insert piston (1) into the disk carrier.

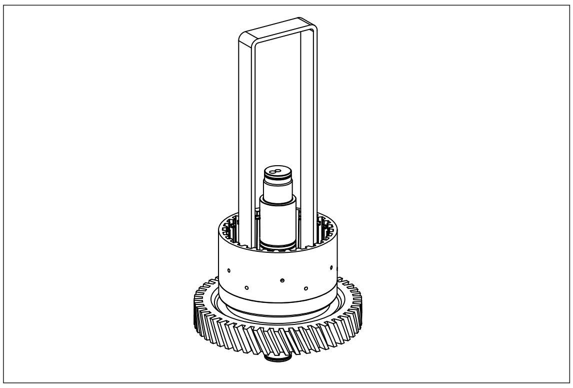
※ Pay attention to the installation position, see figure.



50DS7ETM91

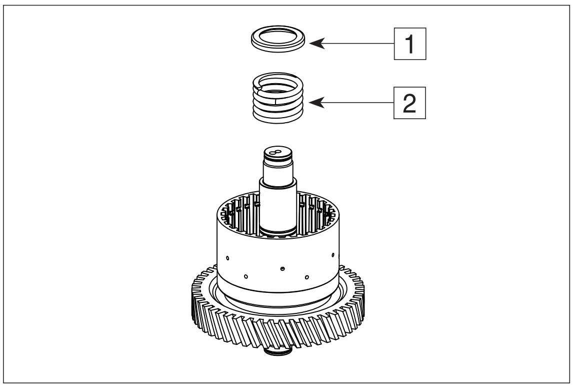
⑥ Use a hand-operated press to place piston into the disk carrier by means of the assembly aid.

(S) Assembly aid 5870 345 114



50DS7ETM173

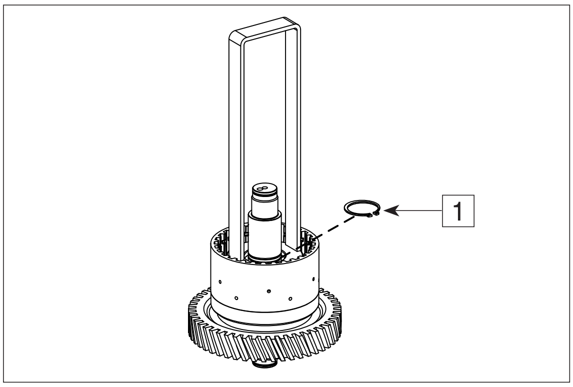
⑦ Mount compression spring (1) and spring cup (2).



50DS7ETM90

⑧ By means of the assembly aid, preload compression spring under a hand-operated press until the retaining ring 40×1.75 (1) can be snapped in.

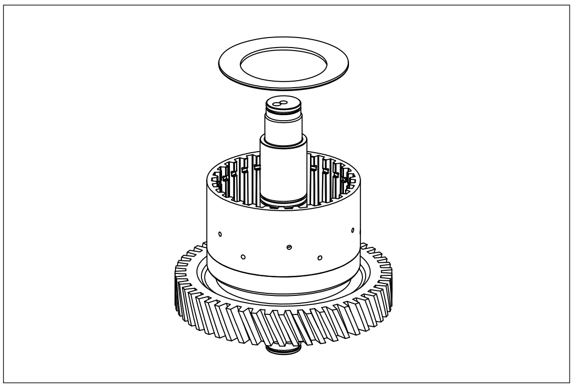
(S) Assembly aid 5870 345 114



50DS7ETM89

⑨ Cup spring (1) into the disk carrier.

※ Pay attention to the installation position, see next page TM177.

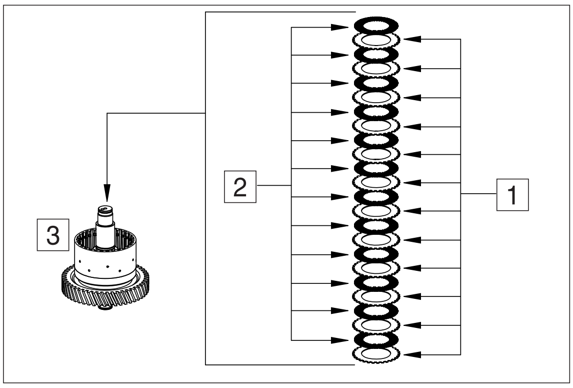


50DS7ETM174

⑩ Install outer and inner disks alternately into the disk carrier (3) as shown in figure.

Starting with an outer disk and ending with an inner disk.

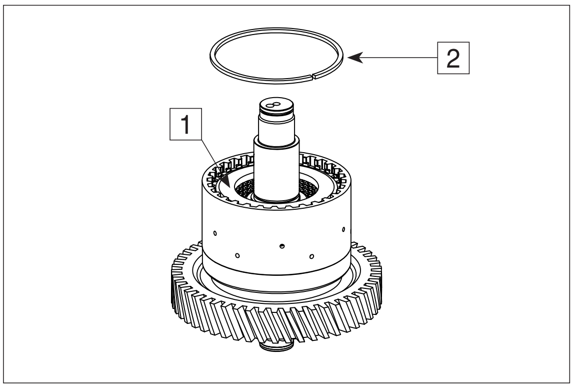
1 = Outer disks (12 pcs)
2 = Inner disks (12 pcs)
3 = Clutch assy



50DS7ETM175

⑪ Mount end plate (1) with the flat side showing towards the disk package and fix it by means of snap ring (2) (e.g. thickness = 2.5 mm/recommended value).

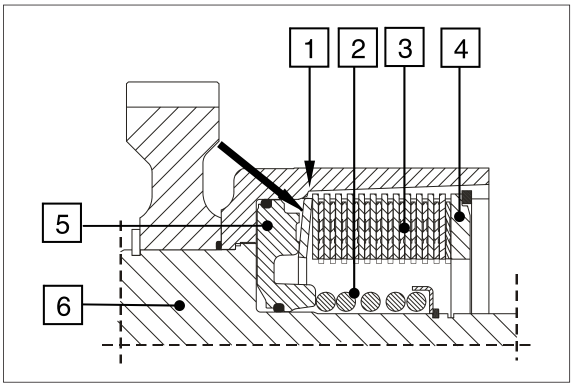
※ Pay attention to the installation position of the end plate, see next page TM177.



50DS7ETM176

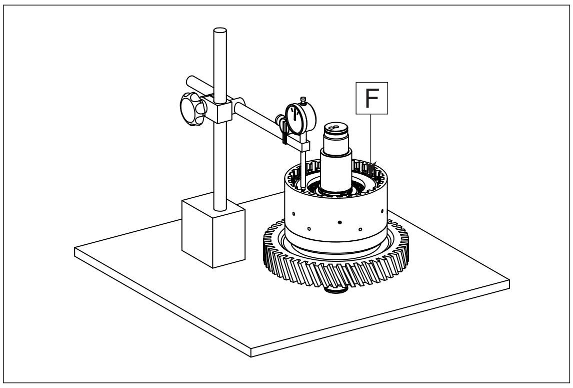
⑫ Cap spring (1) according to sketch (see arrow).

1 = Cup spring
2 = Compression spring with spring cup and retaining ring
3 = Inner clutch- and outer clutch disc
4 = End shim
5 = Piston with O-rings
6 = Clutch assy.



50DS7ETM177

⑬ Equally press on end plate with F (approx. 100N = 10kg) and set dial indicator to "zero".

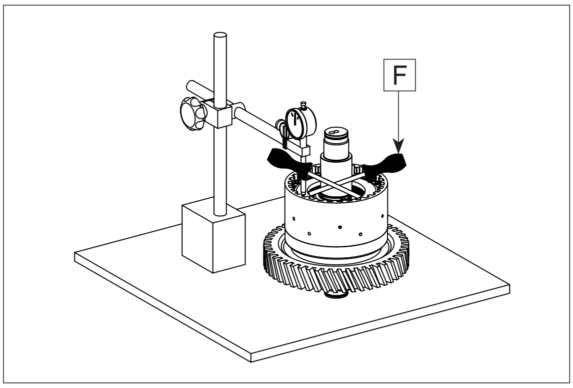


50DS7ETM178

⑭ Then press end plate against the snap ring (upwards) and read the disk clearance.

※ Disk clearance : 2.6 to 3.1 mm.

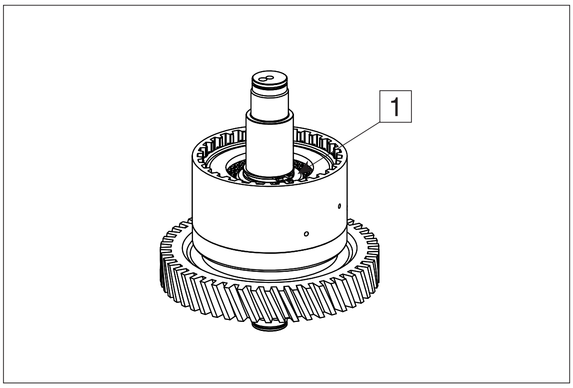
※ In case of deviations, the disk clearance must be corrected with an appropriate snap ring(optional thickness = 2.0~3.5 mm/available in steps of 0.25 mm).



50DS7ETM179

⑮ Snap retaining ring 40×1.75 (1) into the groove.

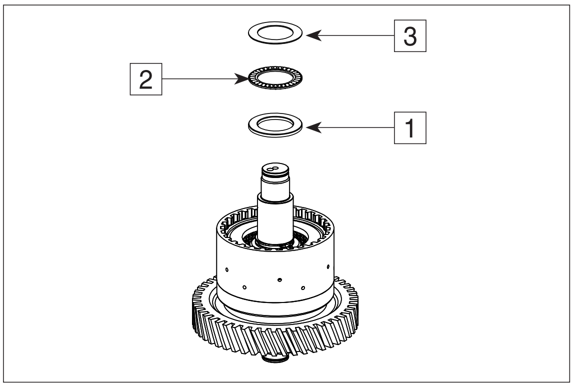
※ Contact for axial bearing - see next page TM181.



50DS7ETM180

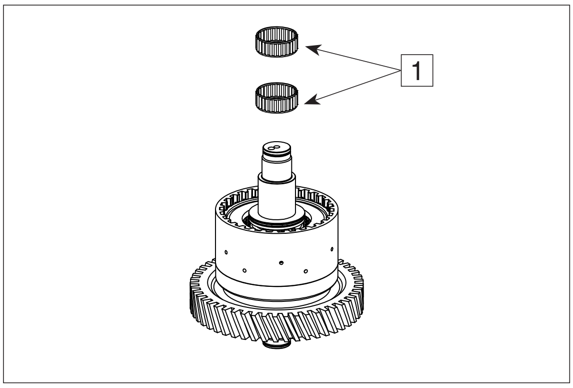
⑯ Mount running disk 40×60×3.5 (1), axial needle cage 40×60×3 (2) and axial washer 40×60×1 (3) and oil them.

※ Fit running disk (1), with the chamfer showing towards the retaining ring.



50DS7ETM181

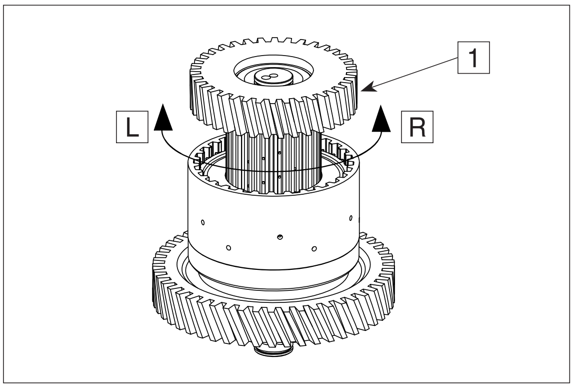
⑰ Mount needle cage 40×45×17 (1) and oil it.



50DS7ETM84

⑱ Mount inner disk carrier until contact is obtained.

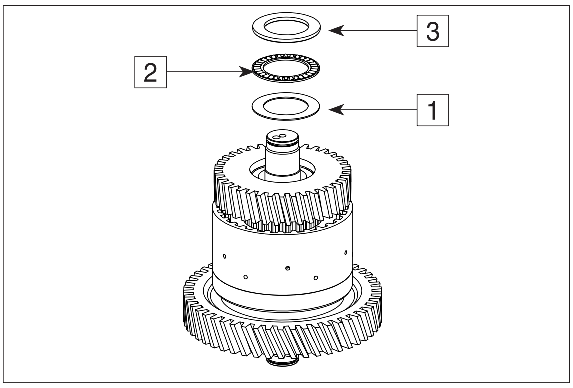
Install inner disks by short ccw/cw rotations of the inner disk carrier (1).



50DS7ETM182

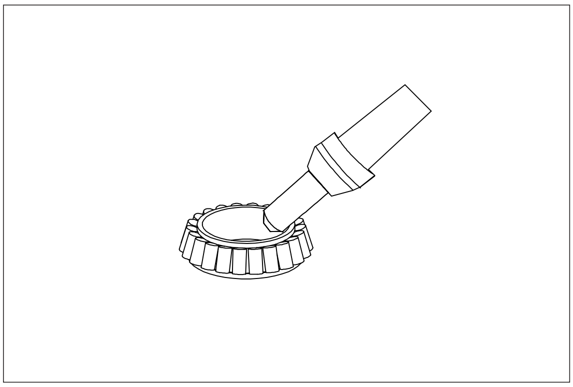
⑲ Mount axial washer 40×60×1 (1), axial needle cage 40×60×3 (2) and running disk (3) 40×60×3.5 and oil them.

※ Fit running disk (3), with the chamfer showing towards the tapered roller bearing.



50DS7ETM183

⑳ Heat up bearing inner ring (approx. 120°C).



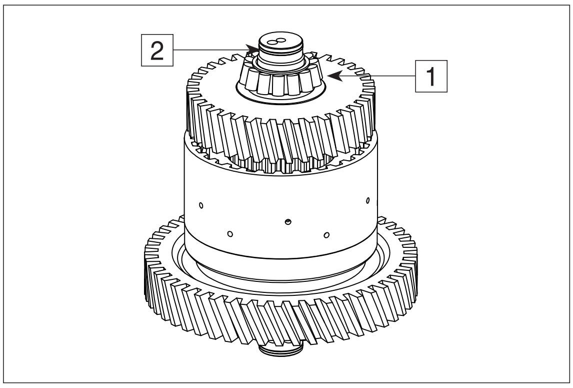
50DS7ETM128

㉑ Mount bearing inner ring (1) until contact is obtained.

Fit rectangular ring 30×2 (2).

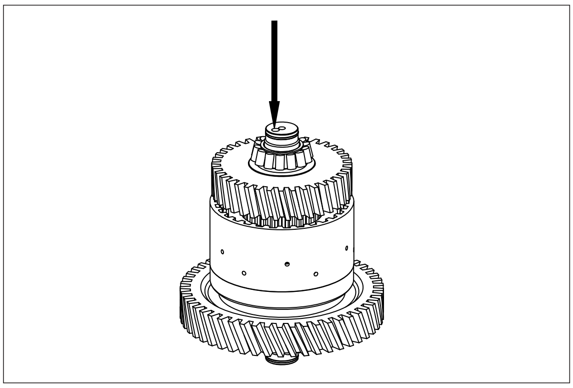
⚠ Wear protective gloves.

※ Adjust bearing inner ring after cooling-down.



50DS7ETM184

※ Check closing and opening of the clutch by means of compressed air at the hole (see arrow).
Closing and opening of the clutch must be clearly audible.

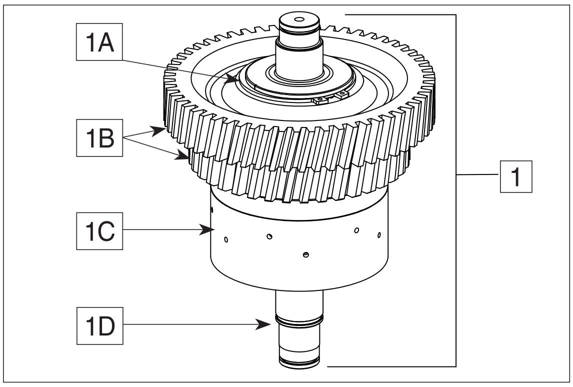


50DS7ETM185

(4) Clutch KE

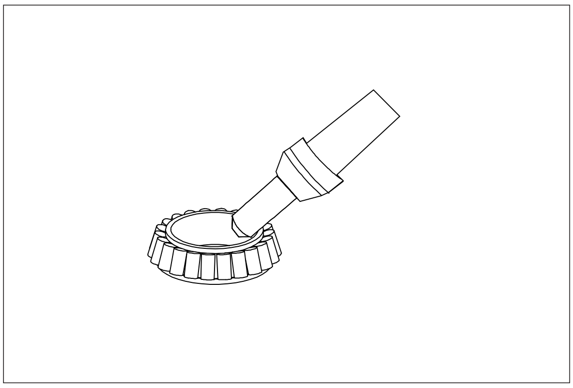
※ The clutch (1) is supplied by the spare parts service only as a complete assy which consists of :

1A = Retaining ring
1B = Helical gear
1C = Disk carrier
1D = Shaft



50DS7ETM111

① Heat up bearing inner ring (approx. 120°C).



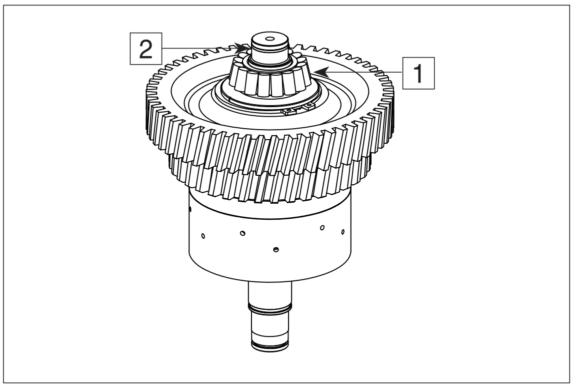
50DS7ETM128

② Mount bearing inner ring (1) until contact is obtained.

Fit rectangular ring 30×2 (2).

▲ Wear protective gloves.

※ Adjust bearing inner ring after cooling-down.

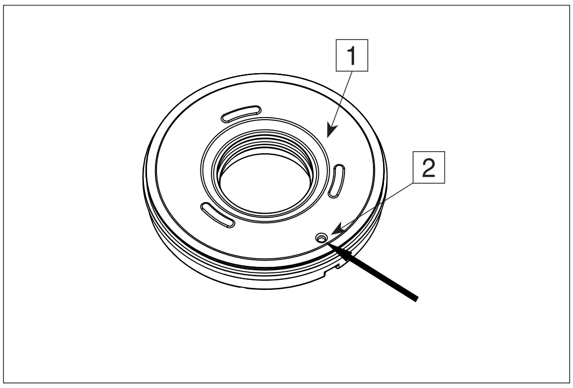


50DS7ETM186

③ Piston (1) with drain valve.

※ Check function of the drain valve (2). There must be no jamming of the ball (see arrow).

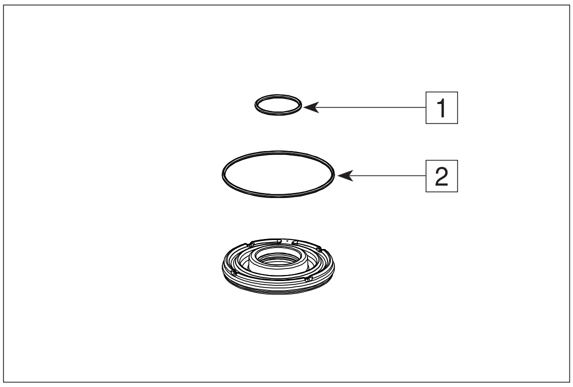
※ The piston (1) is supplied by the spare parts service only as a complete assy.



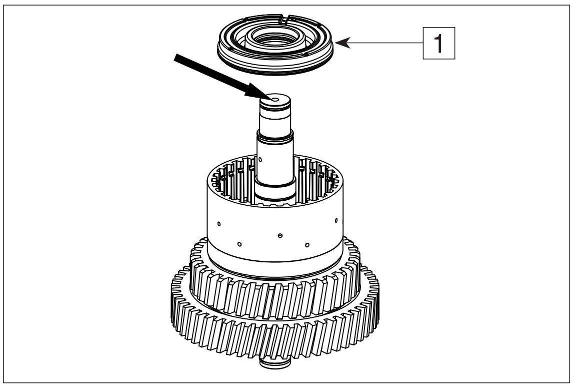
50DS7ETM187

④ Insert both O-rings (1 and 2) into the piston grooves and oil them.

1 = 40×3
2 = 104.5×3



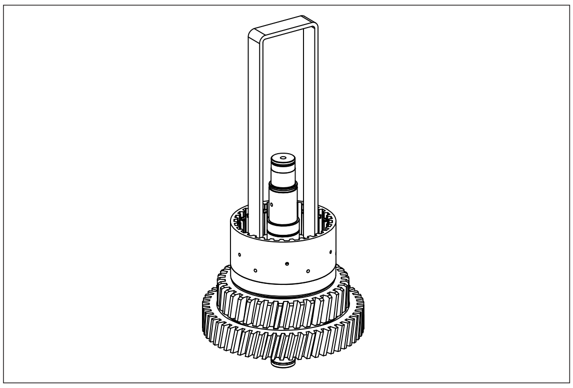
50DS7ETM62



50DS7ETM107

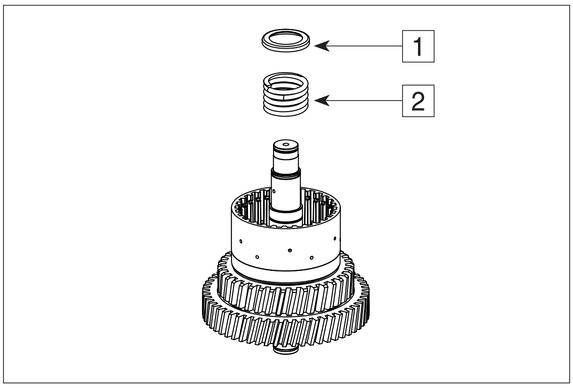
⑤ Use a hand-operated press to place piston into the disk carrier by means of the assembly aid.

(S) Assembly aid 5870 345 114



50DS7ETM188

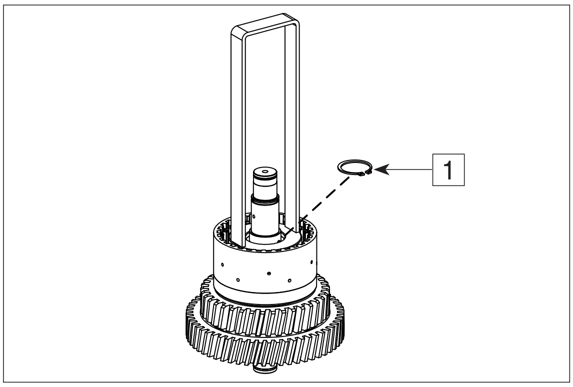
⑥ Mount compression spring (1) and spring cup (2).



50DS7ETM106

⑦ By means of the assembly aid, preload compression spring under a hand-operated press until the retaining ring 40×1.75 (1) can be snapped in.

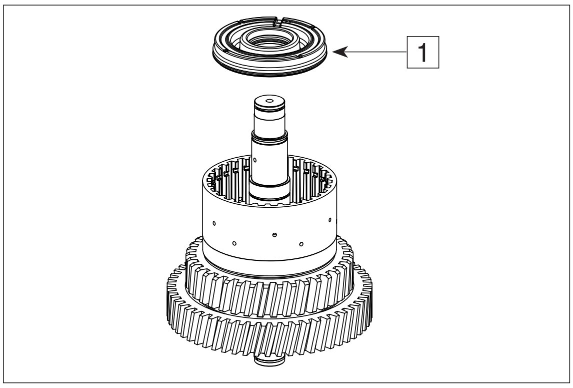
(S) Assembly aid 5870 345 114



50DS7ETM105

⑧ Cup spring (1) into the disk carrier.

※ Pay attention to the installation position, see next page TM192.

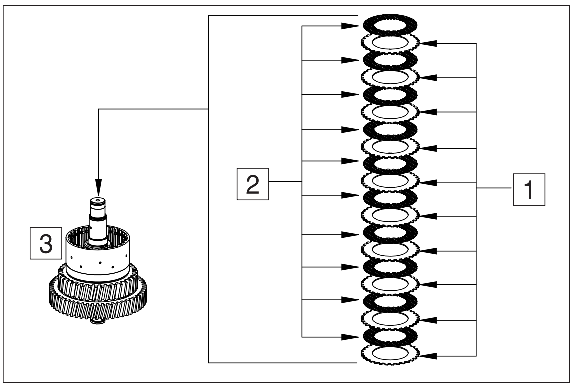


50DS7ETM189

⑨ Install outer and inner disks alternately into the disk carrier (3) as shown in figure.

Starting with an outer disk and ending with an inner disk.

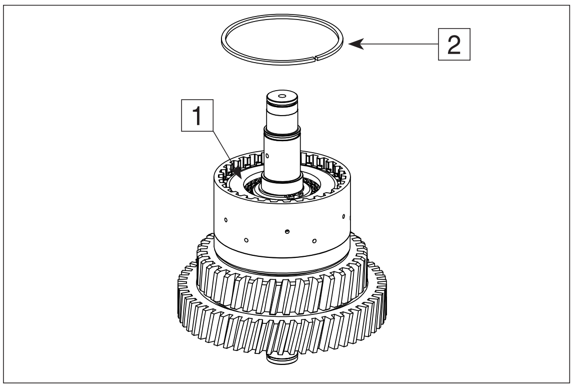
1 = Outer disks (10 pcs)
2 = Inner disks (10 pcs)
3 = Clutch assy



50DS7ETM190

⑩ Mount end plate (1) with the flat side showing towards the disk package and fix it by means of snap ring (2) (e.g. thickness=2.5 mm/recommended value).

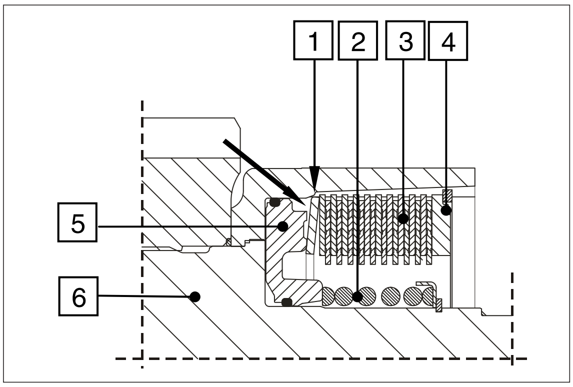
※ Pay attention to the installation position of the end plate, see next page TM192.



50DS7ETM191

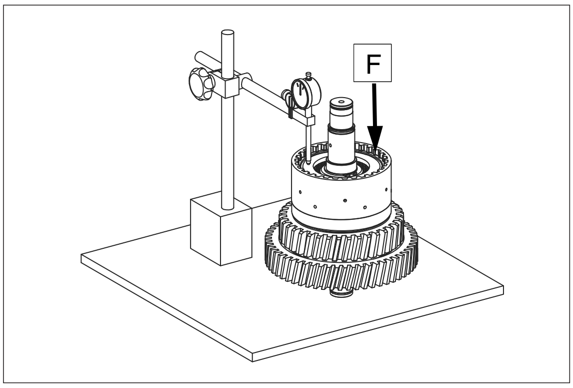
⑪ Cap spring (1) according to sketch(see arrow).

1 = Cup spring
2 = Compression spring with spring cup and retaining ring
3 = Inner clutch-and outer clutch disc
4 = End shim
5 = Piston with O-rings
6 = Clutch assy



50DS7ETM192

⑫ Equally press on end plate with F (approx. 100 N = 10kg) and set dial indicator to "zero".

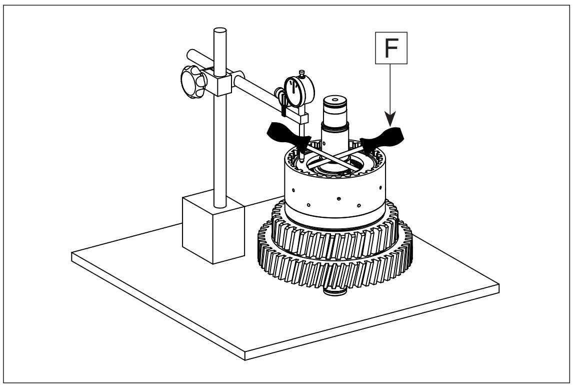


50DS7ETM193

⑬ Then press end plate against the snap ring (upwards) and read the disk clearance.

※ Disk clearance : 2.2 to 2.6 mm.

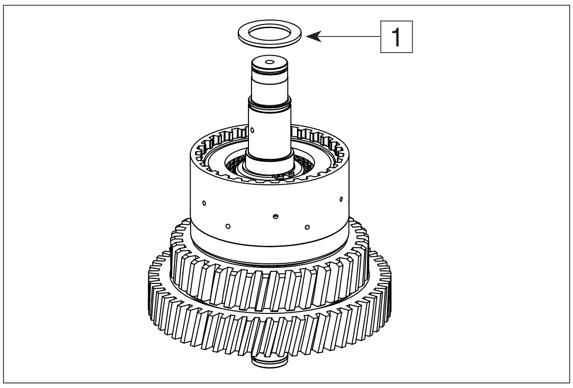
※ In case of deviations, the disk clearance must be corrected with an appropriate snap ring(optional thickness=2.0~3.5 mm/available in steps of 0.25 mm).



50DS7ETM194

⑭ Mount running disk 35×52×3.5 (1).

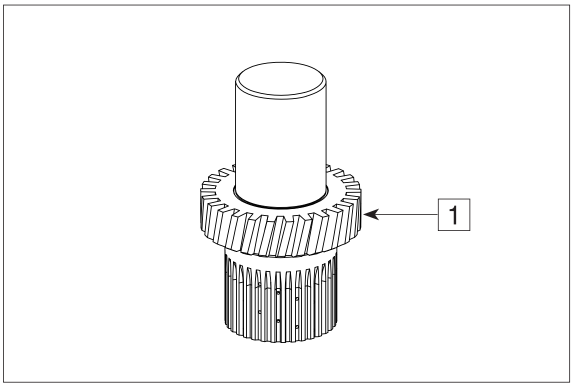
※ Fit running disk (1), with the chamfer showing towards the retaining ring.



50DS7ETM195

⑮ Press in both bearing outer rings into the inner disk carrier (1) until contact is obtained.

Then mount the bearing inner rings.



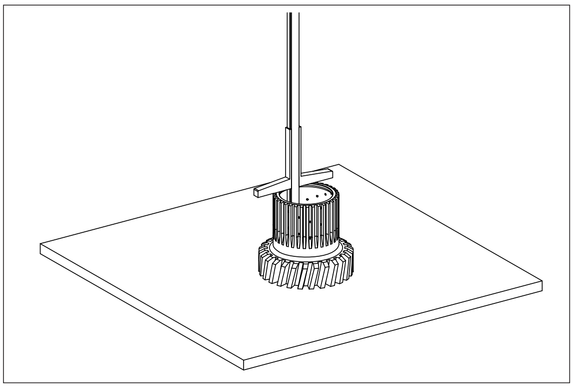
50DS7ETM196

※ Setting of axial play of the inner disk carrier bearing ±0.05 ㎜ (see TM197 to TM202) :

⑯ Determine dimension "X2" of the inner disk carrier → see below figure.

Calculation example :

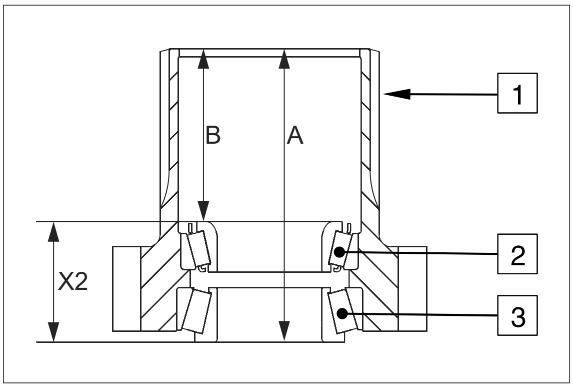
Dimension A ---------------------------	97.00 mm
Dimension B -----------------------	- 57.00 mm
Dimension X2 ----------------------	= 40.00 mm



50DS7ETM197

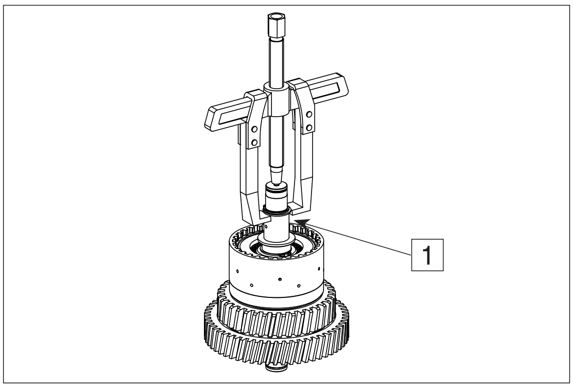
⑰ Legend :

1 = Inner disk carrier
2 = Tapered roller bearing 59×35×16
3 = Tapered roller bearing 62×35×18



50DS7ETM198

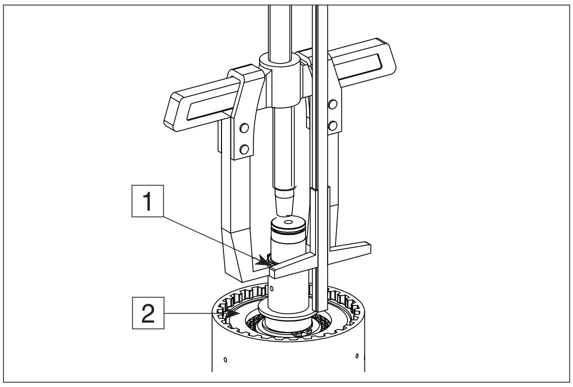
⑱ Mount the retaining ring e.g. 35×2.0 (1) and bring it into contact position by means of a two-armed puller.



50DS7ETM199

⑲ Determine dimension "X1" from retaining ring (1) to running disk (2).
→ see below figure.

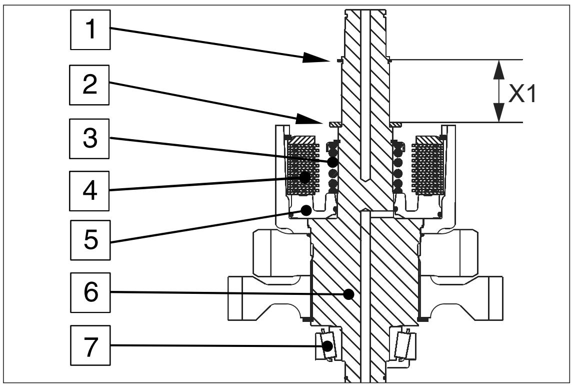
Dimension X1 = 42.1 mm



50DS7ETM200

⑳ Legend :

1 = Retaining ring 35×2.0
2 = Running disk 35×52×3.5
3 = Compression spring with cup spring and retaining ring
4 = Disk package with end plate and snap ring
5 = Piston with O-rings
6 = Clutch assy
7 = Tapered roller bearing



50DS7ETM201

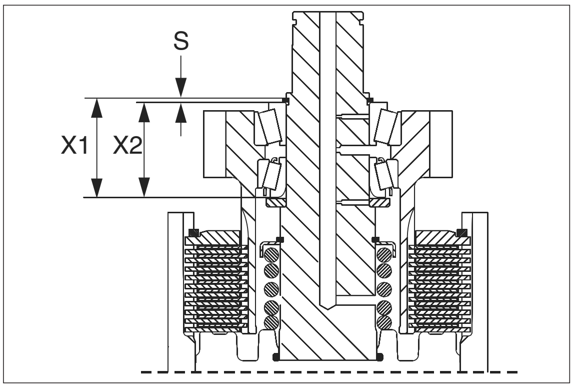
㉑ **Axial play of inner disk carrier bearing ±0.05**

Calculation example :

Dimension X1 -----------------------	42.10 mm
Dimension X2 -----------------------	- 40.00 mm
Dimension S (retaining ring) ---	= 2.10 mm

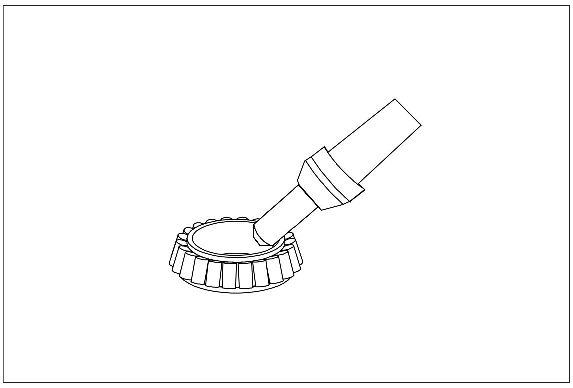
※ Determined retaining ring S = 2.10 mm

※ Axial play must be set with the retaining ring(optional thickness = 1.8~2.7 mm/ available in steps of 0.10 mm).



50DS7ETM202

㉒ Heat up bearing inner ring (approx. 120°C).

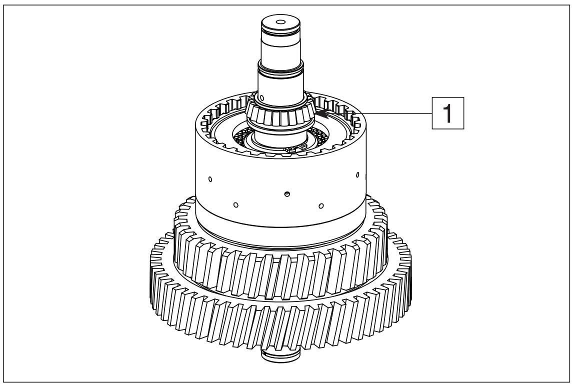

50DS7ETM128

㉓ Mount bearing inner ring (1) until contact is obtained.

※ Different bearing sizes → see page 3-124 TM198.

⚠ Wear protective gloves.

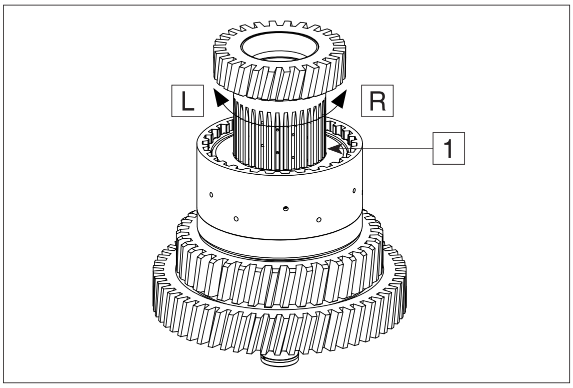
※ Adjust bearing inner ring after cooling-down.



50DS7ETM203

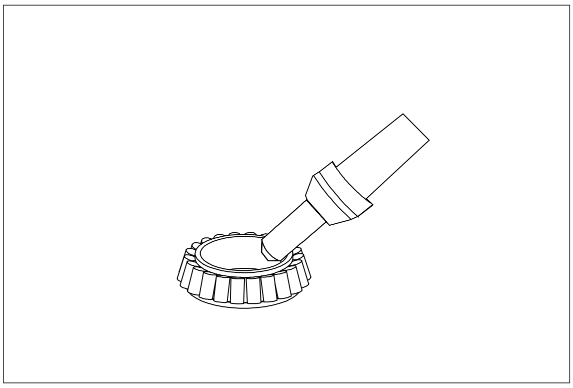
㉔ Mount inner disk carrier until contact is obtained.

Install inner disks by short ccw/cw rotations of the inner disk carrier (1).



50DS7ETM204

㉕ Heat up bearing inner ring (approx. 120°C).



50DS7ETM128

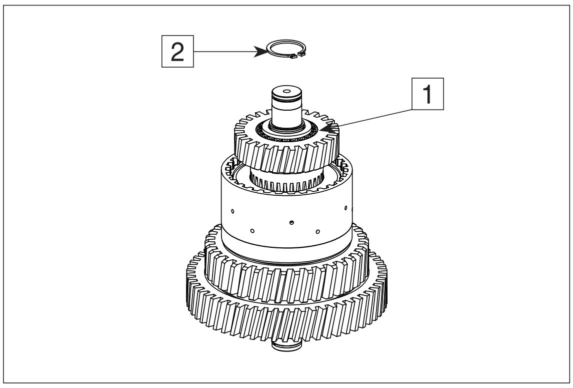
㉖ Mount bearing inner ring (1) until contact is obtained.

⚠ Wear protective gloves.

※ Adjust bearing inner ring after cooling-down.

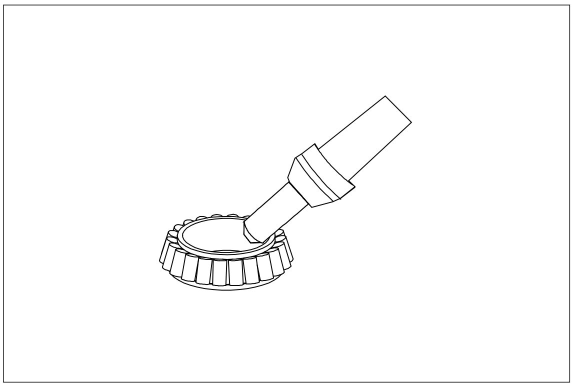
Snap in retaining ring 35×2.1 (2).

※ Pay attention to an exact contact of the retaining ring in the groove.



50DS7ETM205

㉗ Heat up bearing inner ring (approx. 120°C).

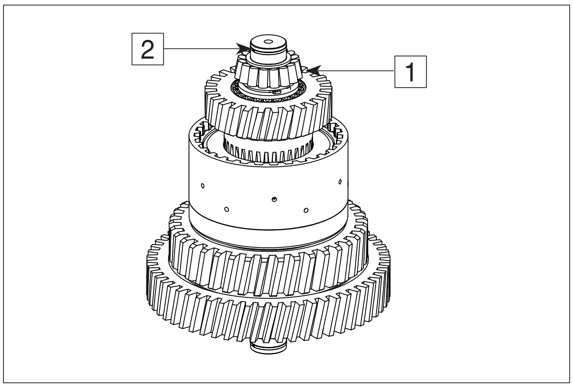


50DS7ETM128

㉘ Mount bearing inner ring (1) until contact is obtained.
Fit rectangular ring 30×2 (2).

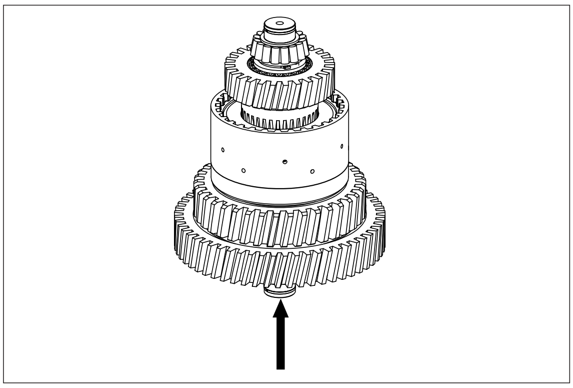
⚠ Wear protective gloves.

※ Adjust bearing inner ring after cooling-down.



50DS7ETM206

※ Check closing and opening of the clutch by means of compressed air at the hole (see arrow).
Closing and opening of the clutch must be clearly audible.

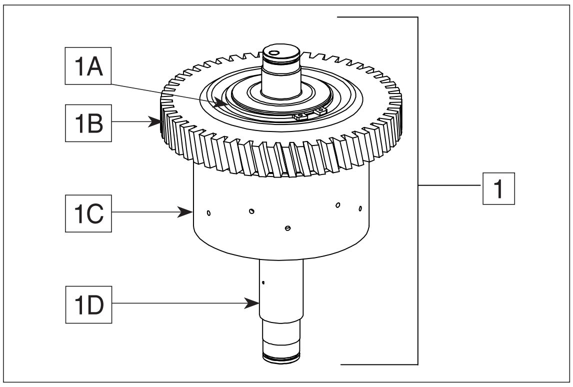


50DS7ETM207

(5) Clutch KC

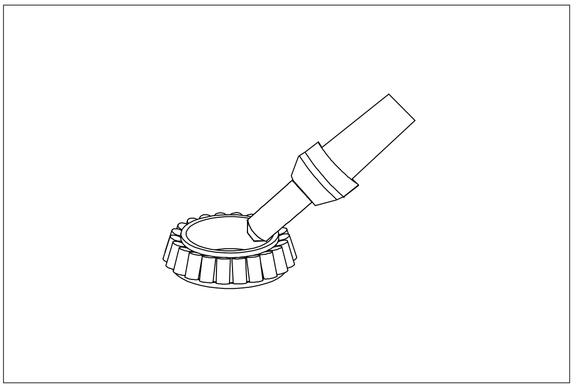
※ The clutch (1) cannot be disassembled. It is supplied by the spare parts service only as a complete assy which consists of :

1A = Retaining ring
1B = Helical gear
1C = Disk carrier
1D = Shaft



50DS7ETM124

① Heat up bearing inner ring (approx. 120°C).



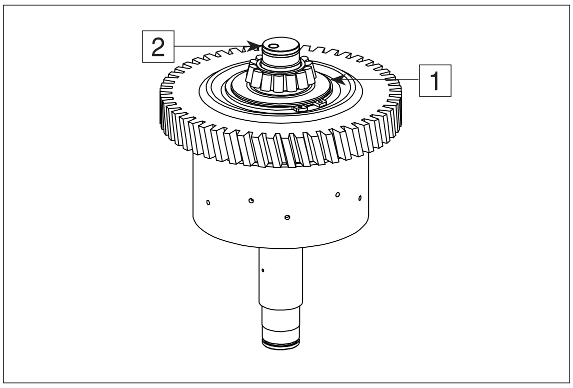
50DS7ETM128

② Mount bearing inner ring (1) until contact is obtained.

Fit rectangular rings 30×2 (2).

⚠ Wear protective gloves.

※ Adjust bearing inner ring after cooling-down.



50DS7ETM208

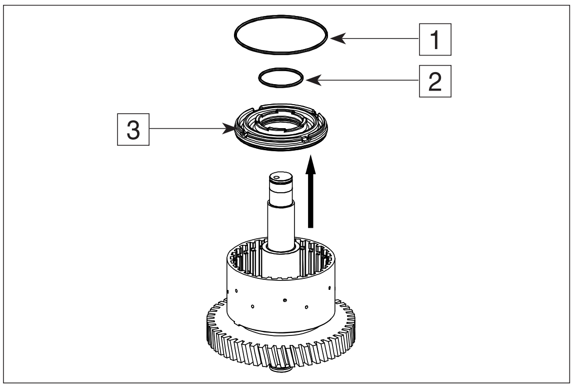
③ Insert both O-rings (1 and 2) into the piston (3) grooves and oil them.

1 = 115×3
2 = 52×3

Insert piston (3) into the disk carrier.

※ Pay attention to the installation position, see next page TM211.

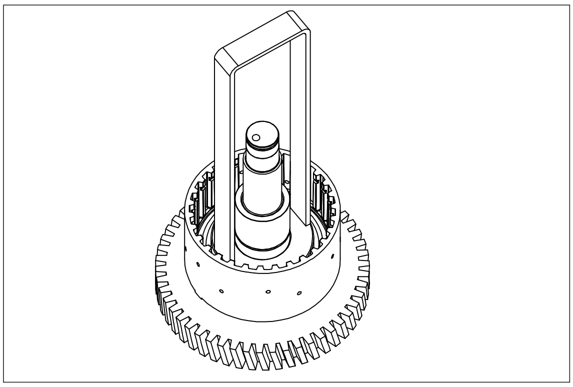
※ Check function of the drain valve (see arrow) - There must be no jamming of the ball.



50DS7ETM209

④ Use a hand-operated press to place piston into the disk carrier by means of the assembly aid.

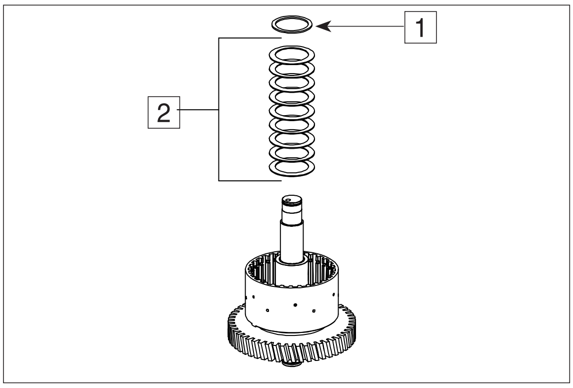
(S) Assembly aid 5870 345 114



50DS7ETM210

⑤ Mount cup spring package (1) and disk (2).

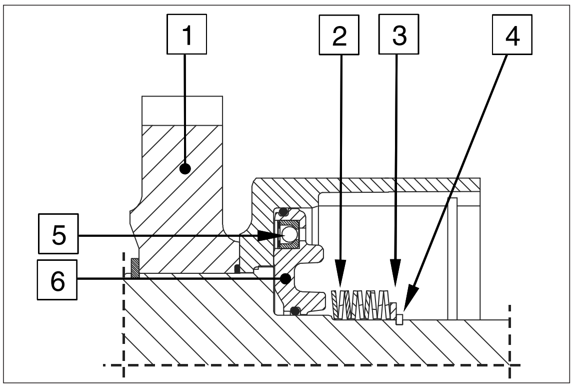
※ Installation position of the cup springs, see below figure.



50DS7ETM120

⑥ Install cup springs according to the sketch.

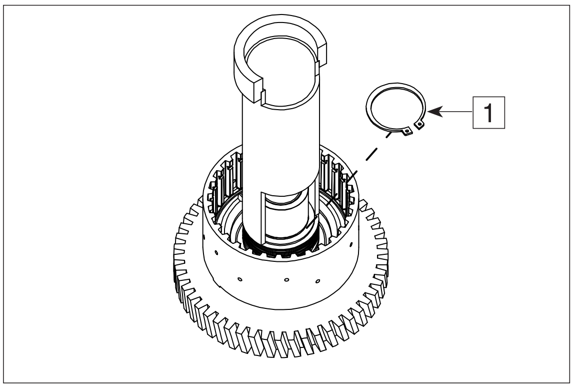
1 = Clutch
2 = Cup springs (9 pcs)
3 = Disk
4 = Retaining ring (50×2)
5 = Drain valve (piston)
6 = Piston with O-Rings



50DS7ETM211

⑦ By means of the assembly aid, preload cup springs under a handoperated press until the retaining ring 50×2 (1) can be snapped in.

(S) Assembly aid 5870 506 128

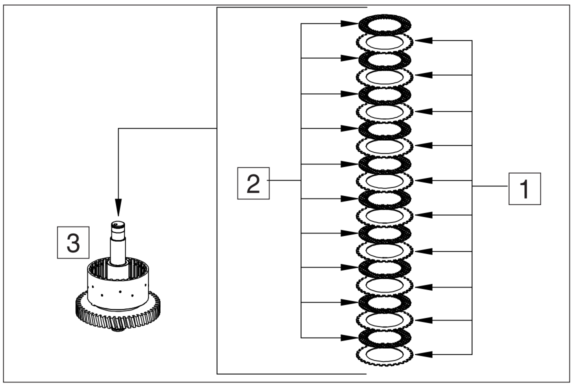


50DS7ETM119

⑧ Install outer and inner disks alternately into the disk carrier (3) as shown in figure.

Starting with an outer disk and ending with an inner disk.

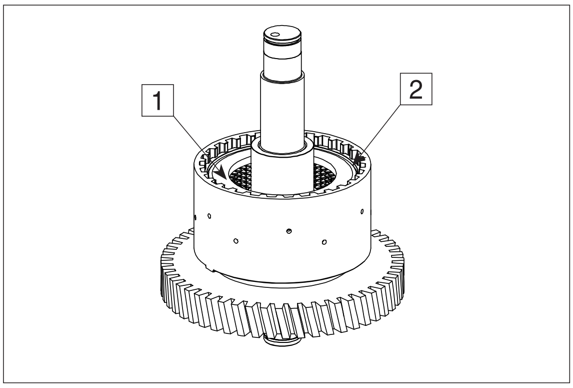
1 = Outer disks (10 pcs)
2 = Inner disks (10 pcs)
3 = Clutch assy



50DS7ETM212

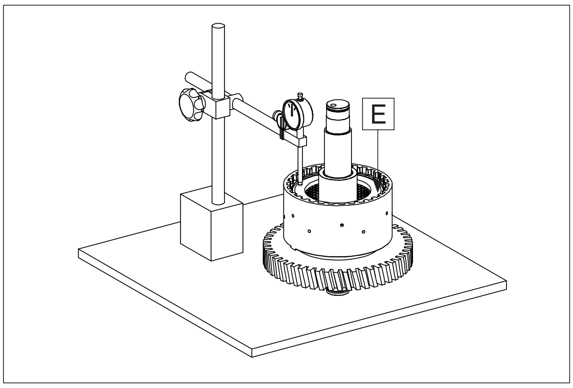
⑨ Mount end plate (1) with the flat side showing towards the disk package and fix it by means of snap ring (2) (e.g. thickness=2.5 mm/recommended value).

※ Pay attention to the installation position of the end plate.



50DS7ETM213

⑩ Equally press on end plate with F (approx. 18 N to 20 N = 1.8 to 2.0 kg) and set dial indicator to "zero".

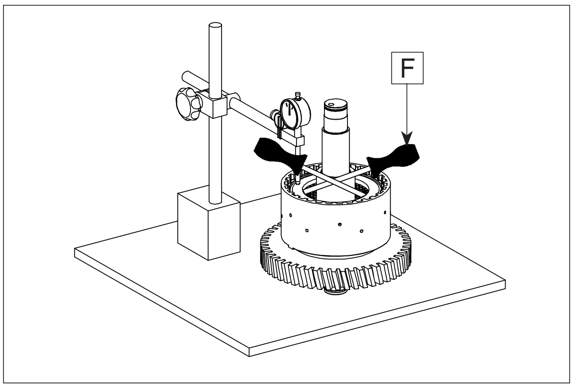


50DS7ETM214

⑪ Then press end plate against the snap ring (upwards) and read the disk clearance.

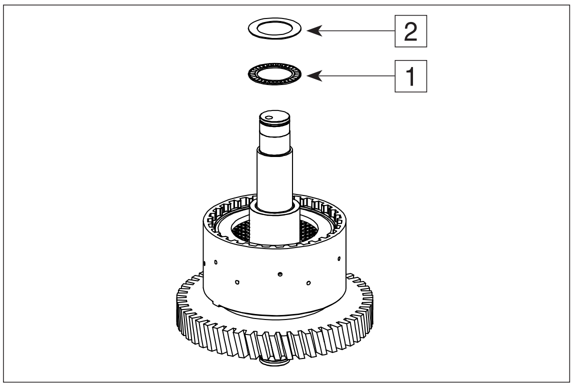
※ Disk clearance : 2.0 to 3.0 mm.

※ In case of deviations, the disk clearance must be corrected with an appropriate snap ring (optional thickness s=2.0~4.0 mm/available in steps 0.25 mm).



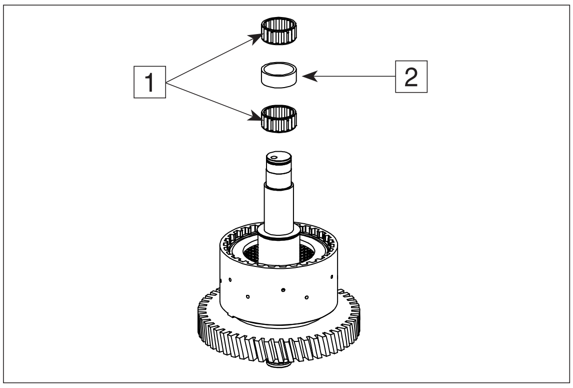
50DS7ETM215

⑫ Mount axial needle cage 35×52×2 (1) and axial disk 35×52×1 (1) and oil them.



50DS7ETM116

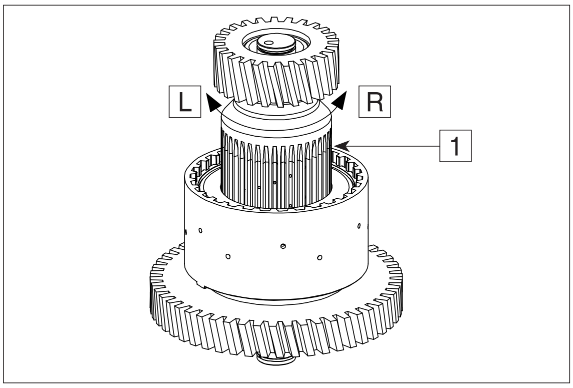
⑬ Mount needle cage 35×42×18 (1) and bush (2) and oil it.



50DS7ETM115

⑭ Mount inner disk carrier until contact is obtained.

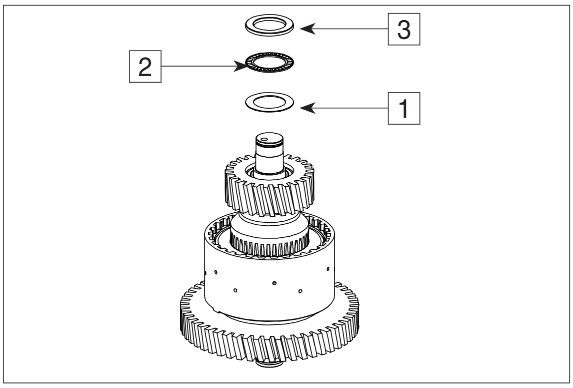
Install inner disks by short ccw/cw rotations of the inner disk carrier (1).



50DS7ETM216

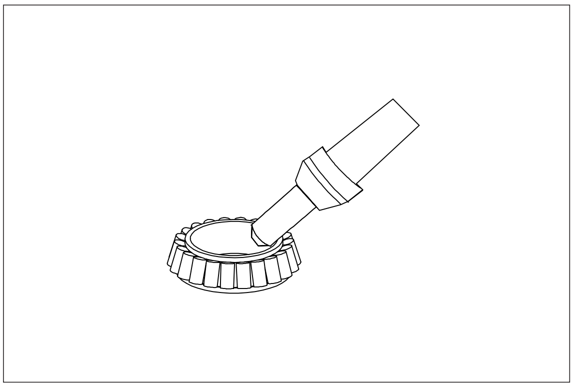
⑮ Mount axial washer 35×60×1 (1), axial needle cage 40×60×3 (2) and running disk (3) 40×60×3.5 and oil them.

※ Fit running disk (3), with the chamfer showing towards the tapered roller bearing.



50DS7ETM217

⑯ Heat up bearing inner ring (approx. 120°C).



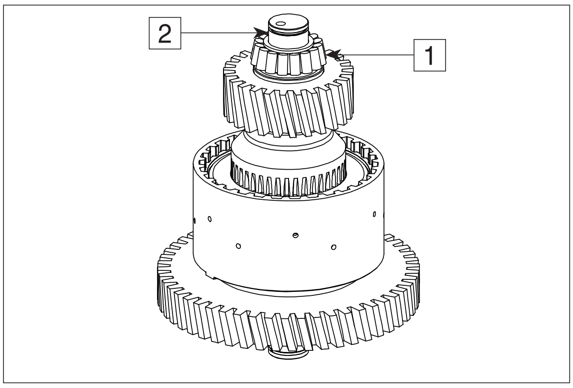
50DS7ETM128

⑰ Mount bearing inner ring (1) until contact is obtained.

Fit rectangular ring 30×2 (2).

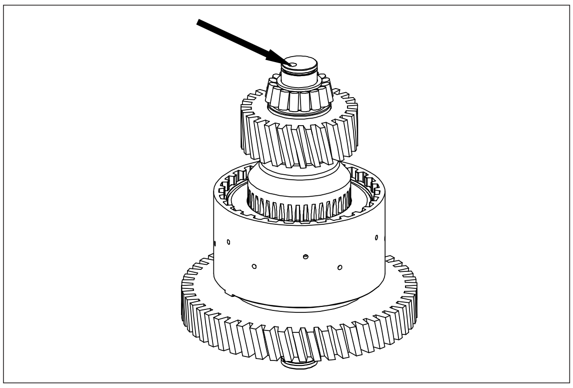
⚠ Wear protective gloves.

※ Adjust bearing inner ring after cooling-down.



50DS7ETM218

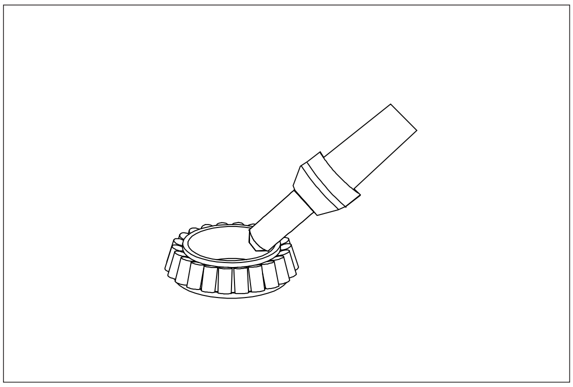
※ Check closing and opening of the clutch by means of compressed air at the hole (see arrow).
Closing and opening of the clutch must be clearly audible.



50DS7ETM219

(6) Output

① Heat up bearing inner ring (approx. 120˚C).

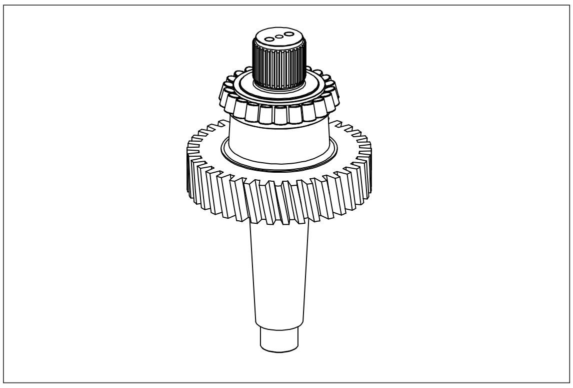


50DS7ETM128

② Mount bearing inner ring (1) until contact is obtained.

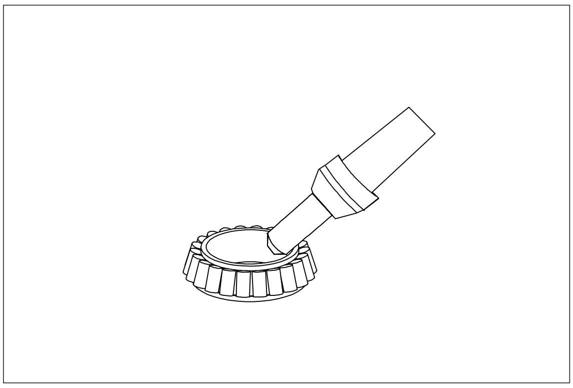
⚠ Wear protective gloves.

※ Adjust bearing inner ring after cooling-down.



50DS7ETM220

③ Heat up bearing inner ring (approx. 120˚C).

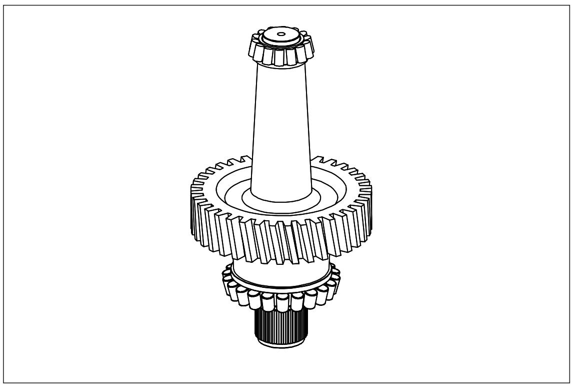


50DS7ETM128

④ Mount bearing inner ring (1) until contact is obtained.

⚠ Wear protective gloves.

※ Adjust bearing inner ring after cooling-down.



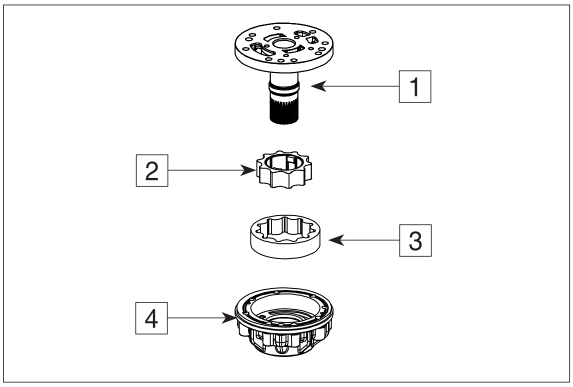
50DS7ETM221

2) REASSEMBLY OF OIL PRESSURE PUMP AND REINSTALLATION OF CLUTCHES

(1) Reassembly of oil pressure pump

※ In case of wear marks in the pump housing, stator hollow shaft, inner rotor, outer rotor and on the sliding bearing, the pump assy must be replaced.

1 = Stator hollow shaft
2 = Inner rotor
3 = Outer rotor
4 = Pump housing with sliding bearing

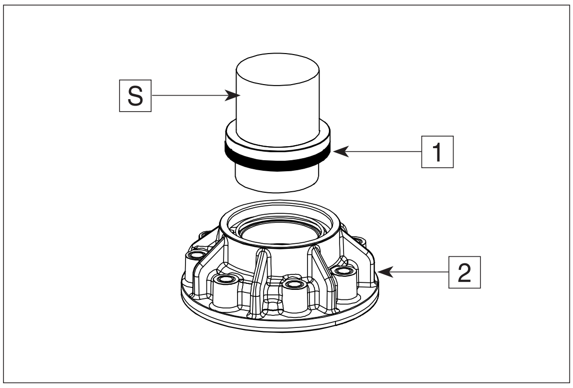


50DS7ETM48

① With the sealing lip showing downwards, carefully insert the shaft seal 55×75×8 (1) into the pump housing (2) until contact is obtained.

※ Apply sealing agent (Loctite no. 574) to the outer diameter.

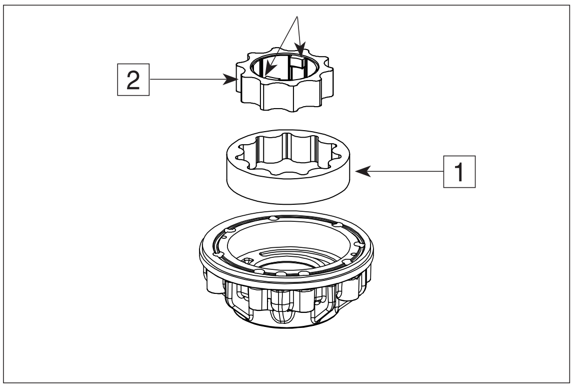
(S) Driver tool 5870 048 219



50DS7ETM222

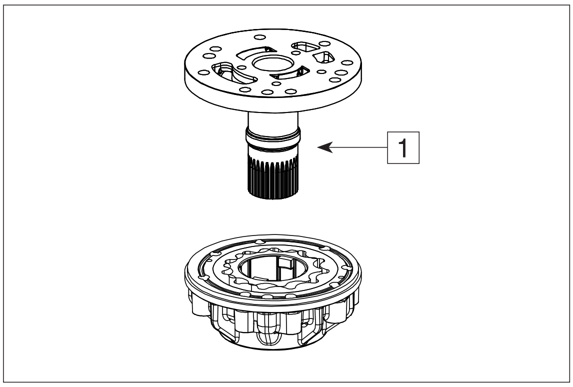
② Mount outer rotor (1) and inner rotor (2).

※ The driver pins of the inner rotor (see arrows) are to be fitted in upward direction.



50DS7ETM223

③ Fit stator hollow shaft (1).

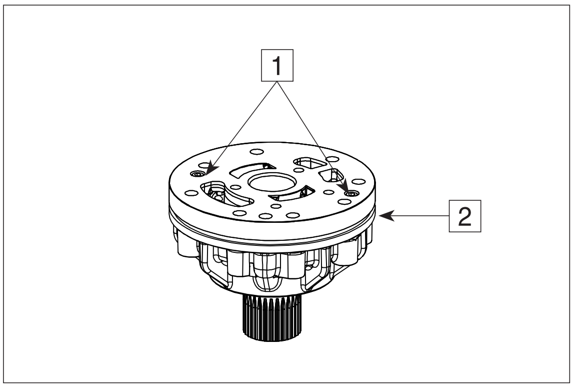


50DS7ETM224

④ Fix stator hollow shaft radially with two cylindrical screws (1).

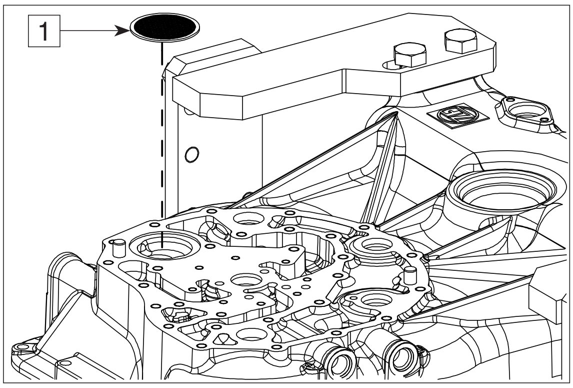
※ Do not tighten the cylindrical screws - just turn them in until contact is obtained and then turn them back by approx. 1/2 rotation.

Place O-ring (2) 135×3 into the annular groove and grease it.



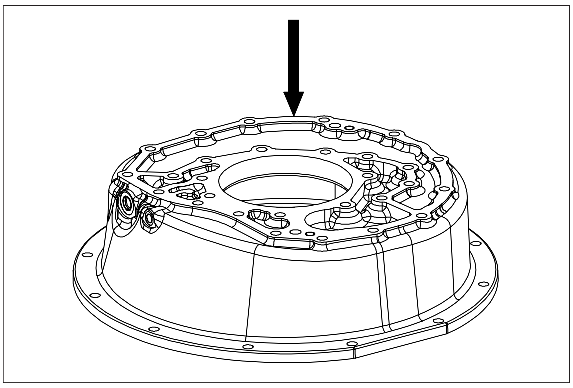
50DS7ETM225

⑤ Insert filter (1).



50DS7ETM226

⑥ Wet mounting face bell housing with Loctite (type no. 574).

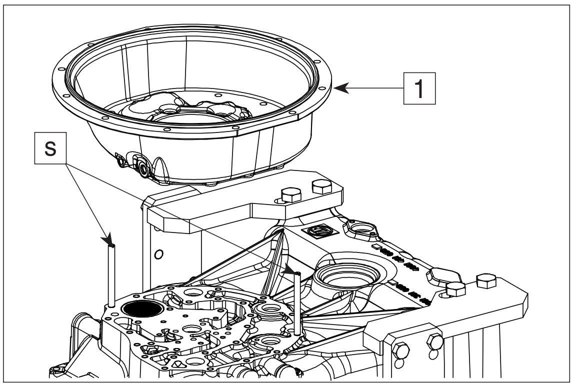


50DS7ETM227

⑦ Fit two adjusting screws (S) and position converter bellhousing (1) equally until contact is obtained.

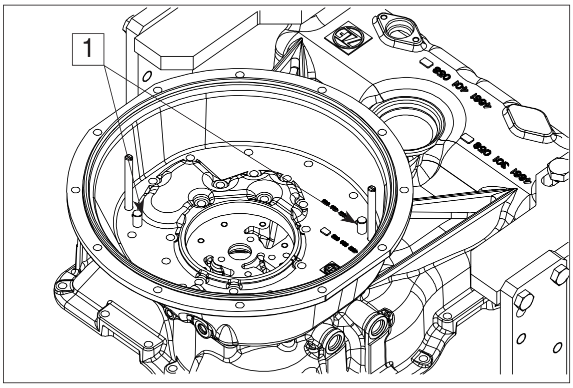
※ Pay attention to the hole pattern.

(S) Adjusting screws (M10) 5870 204 007



50DS7ETM228

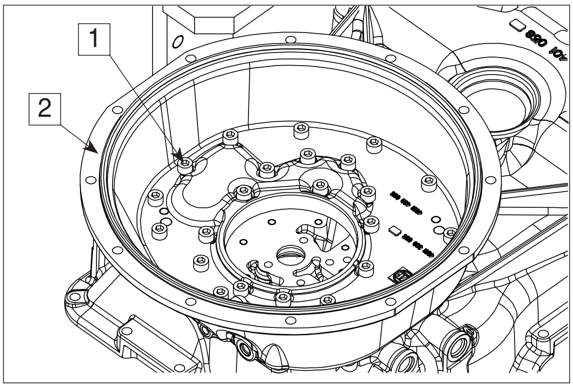
⑧ Force the cylindrical pins 12×24 (1) into the holes (blind holes) until contact is obtained.



50DS7ETM229

⑨ Fix converter bell housing (1) with cylindrical screws M10×30 (2).

Tightening torque (M10/8.8×30) .... M_A = 46 Nm

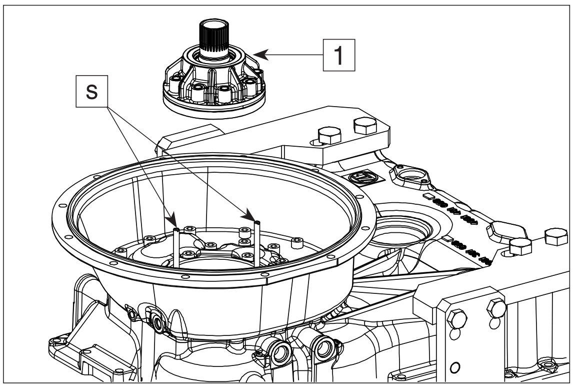


50DS7ETM230

⑩ Fit two adjusting screws (S) and mount preassembled pump (1).

※ Pay attention to the hole pattern.

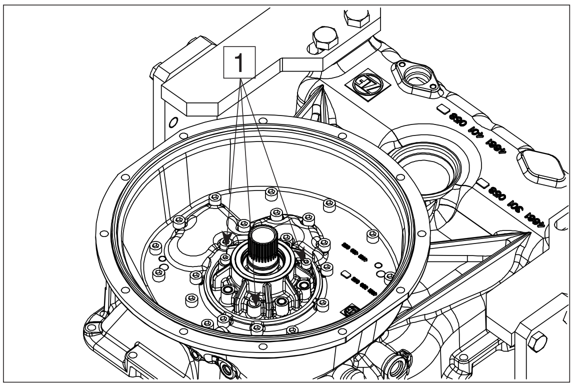
(S) Adjusting screws (M8) 5870 204 011



50DS7ETM231

⑪ Position transmission pump with 3 cylindrical screws (1) M8×60 (3×120° offset position) equally until contact is obtained.

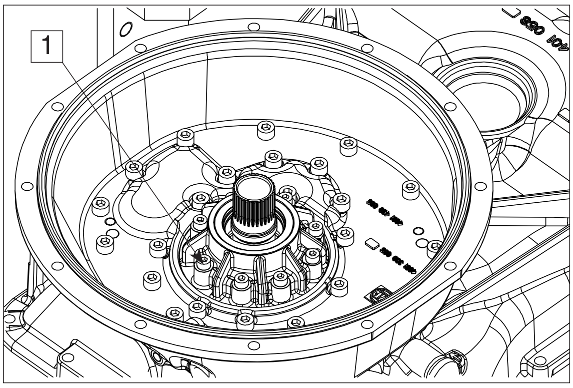
※ Do not damage (shear off) the O-ring.



50DS7ETM232

⑫ Fix transmission pump with cylindrical screws M8×60 (1).

Tightening torque (M8/8.8×60) ·· M_A = 23 Nm



50DS7ETM233

⑬ Fix pump with cylindrical screws (1 and 2).
1 = M8×16
2 = M8×35

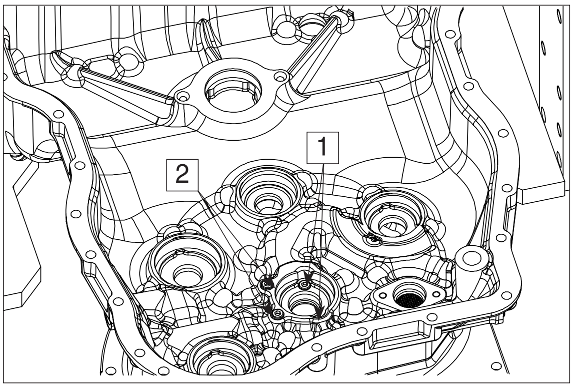
Tightening torque M8/8.8×16 ---- M_A = 23 Nm
Tightening torque M8/8.8×35 ---- M_A = 23 Nm

※ New cylindrical screws are to be fitted on a general basis.

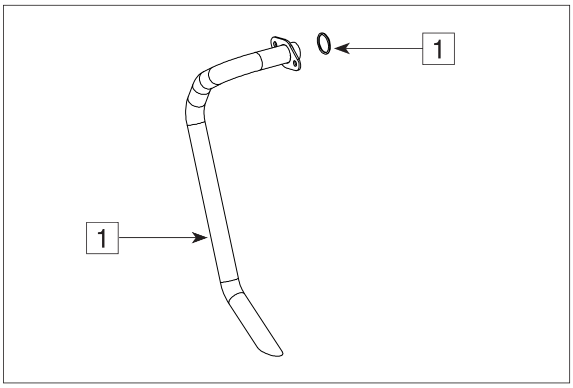
※ These cylindrical screws are already provided with adhesive (microcapsule).

The microcapsule bursts when the screw is turned in, wets screw and nut thread and hardens.

Mount O-ring 30×3 (1) onto the suction tube (2) and grease it.



50DS7ETM234



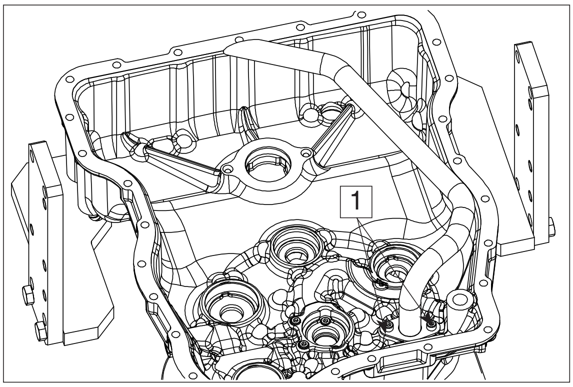
50DS7ETM235

⑭ Fix suction tube (1) with cylindrical screws M8×16 (2).

Tightening torque M8/8.8×16 ---- M_A = 23 Nm

※ When reusing the cylindrical screws, they must be secured with Loctite no. 243.

※ New cylindrical screws are already provided with adhesive (microcapsule). The microcapsule bursts when the screw is turned in, wets screw and nut thread and hardens.

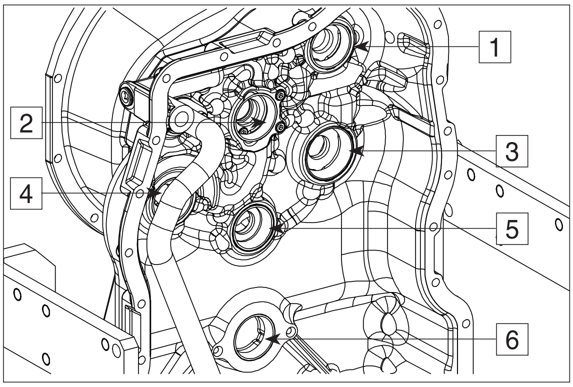


50DS7ETM236

⑮ Insert all bearing outer rings into the bearing holes of both housing parts (see figure TM236 and TM237).

1 = KV clutch - forward
2 = KR clutch - reverse and input
3 = KD clutch - 2nd gear
4 = KC clutch - 1st gear
5 = KE clutch - 3rd gear
6 = Output

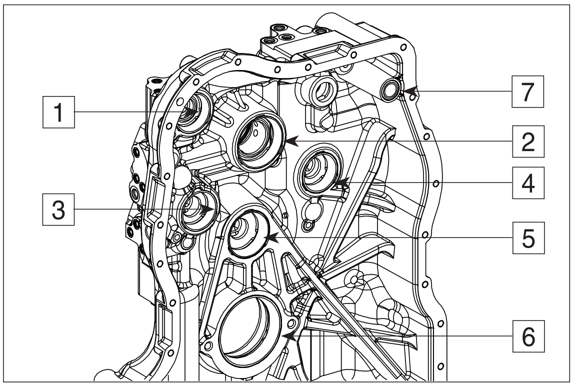
※ Place bearing outer rings into the bearing holes using assembly grease.



50DS7ETM237

※ If, contrary to the ZF recommendation, the tapered roller bearings of clutches and input are not replaced, it is imperative to ensure the previous pairing (bearing inner ring/bearing outer ring) - see page 3-68 TM40 and TM41.

⑯ Insert O-ring 24×2.5 (7) into the hole and grease it.

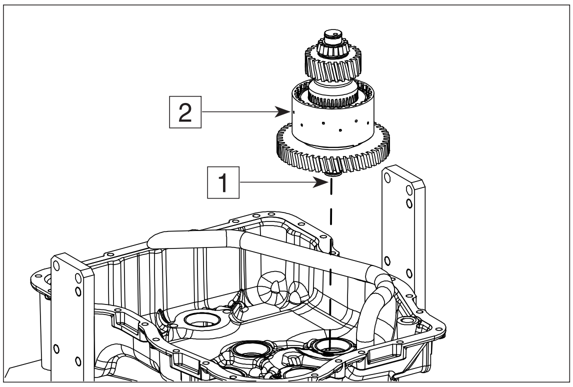


50DS7ETM238

(2) Reinstallation of clutches

① Align and grease rectangular ring 30×2 (1).

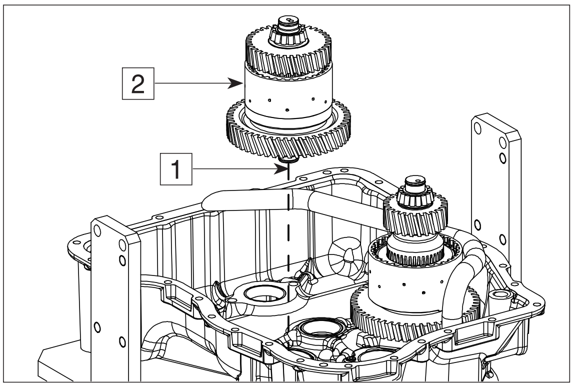
Position clutch KC (2).



50DS7ETM239

② Align and grease rectangular ring 30×2 (1).

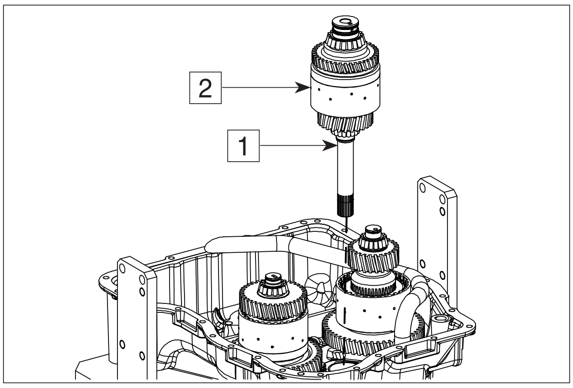
Position clutch KD (2).



50DS7ETM240

③ Align and grease rectangular rings 50×2.5 (1).

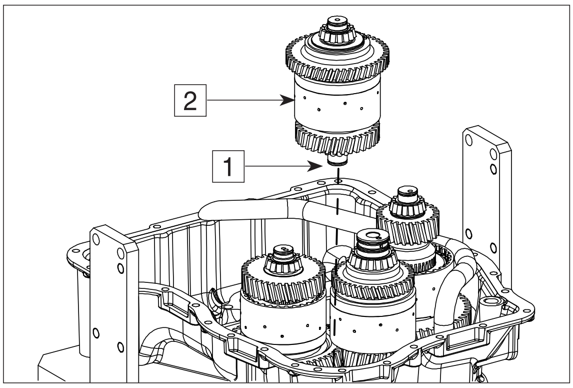
Position clutch KR- input (2).



50DS7ETM241

④ Align and grease rectangular ring 30×2 (1).

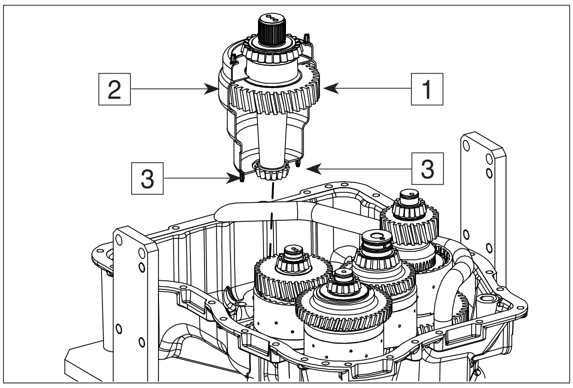
Position clutch KV (2).



50DS7ETM242

⑤ Position output shaft (1) together with screen sheet (2).

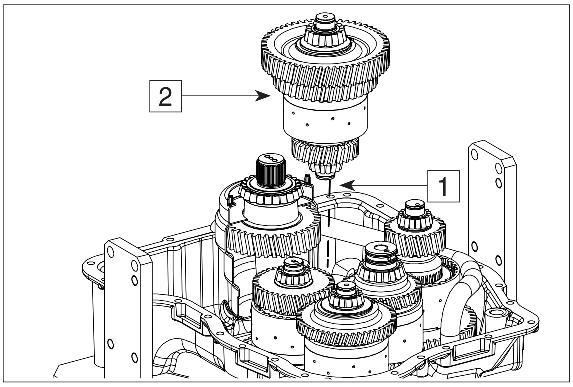
※ Bolts (3) of screen sheet must be fixed into the pilot holes.



50DS7ETM243

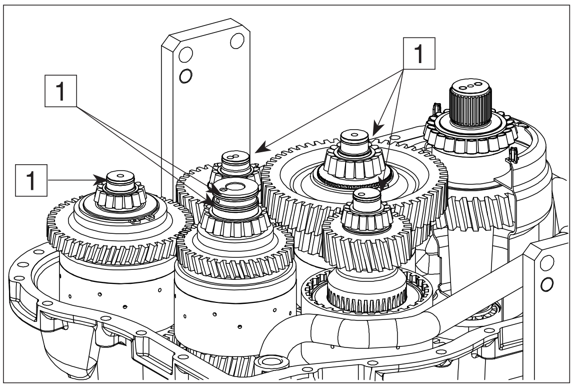
⑥ Align and grease rectangular ring 30×2 (1).

Position clutch KE (2).



50DS7ETM244

⑦ Align and grease rectangular rings (1).

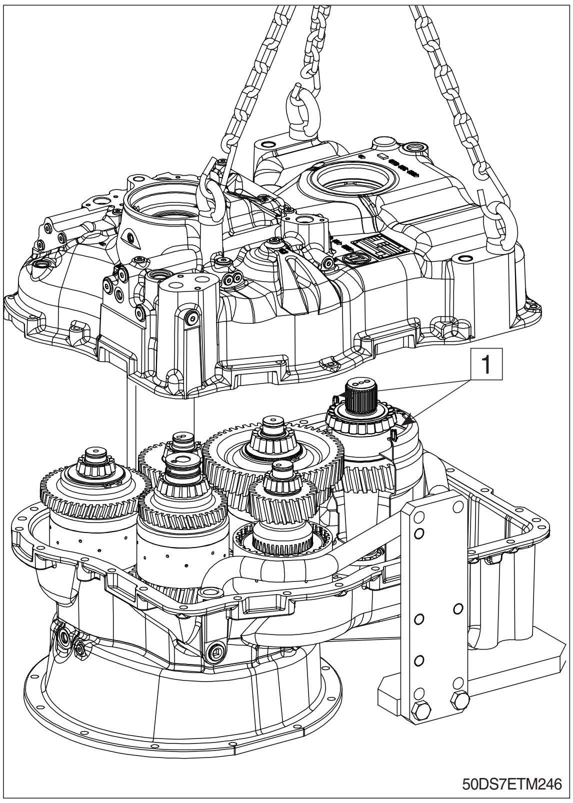


50DS7ETM245

⑧ Use the lifting device to carefully bring the transmission housing rear part into contact position.

※ Bolts (1) of screen sheet must be fixed into the pilot holes.

※ Wet mounting face with Loctite (type no. 574).



50DS7ETM246

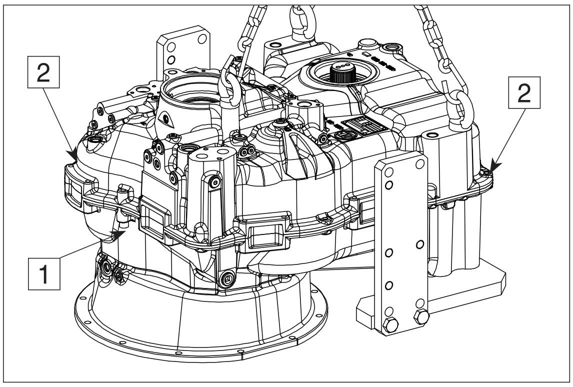
⑨ Hand-tighten the transmission housings crosswise with 2 cylindrical screws (1).

Fit cylindrical pins 12×24 (2) centrically to the mounting face.

Tighten the transmission housing front and rear part crosswise with 4 cylindrical screws M10 (1).

Tightening torque ------------- M_A = 46 Nm

⚠ Transmission rear part is not fixed to the holding fixture and could get loose after turning.
Secure the connection with cylindrical screws.



50DS7ETM247

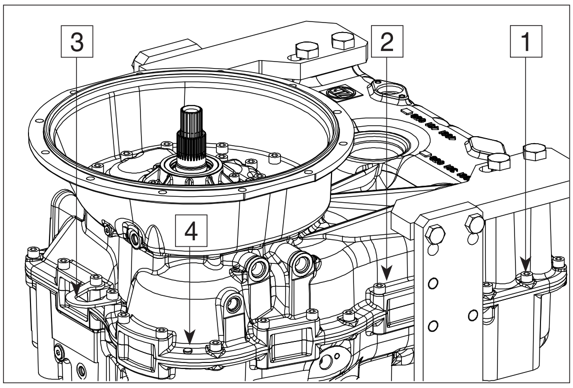
⑩ Fix transmission housing front and rear part by means of cylindrical screws (1 and 2).

Fit bracket (3).

Cylindrical screws (1) M10×30 (11EA)
Cylindrical screws (1) M10×50 (17EA)

Tightening torque (M10/8.8×30) ····· M_A = 46 Nm
Tightening torque (M10/8.8×50) ···· M_A = 46 Nm

4 = cylindrical pin 12×24



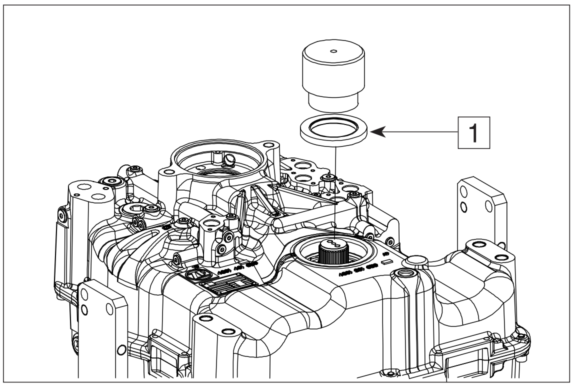
50DS7ETM248

3) REASSEMBLY OF OUTPUT FLANGE

① Use driver tool to fit the shaft seal 70×100 ×10 (1) until contact position, with the sealing lip showing towards the oil sump.

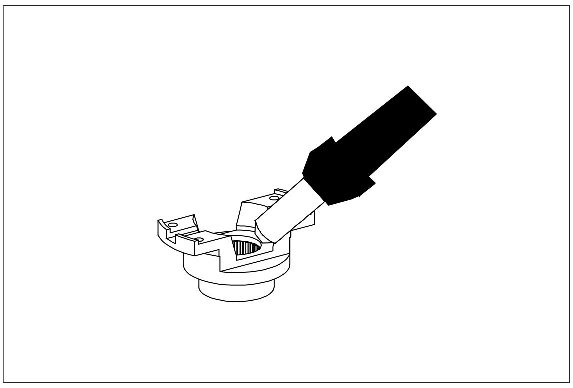
(S) Driver tool 5870 048 057

※ Fill space between sealing lip and dust lip with grease.
※ Wet outer diameter with spirit.



50DS7ETM249

② Heat up output flange(approx. 120°C).

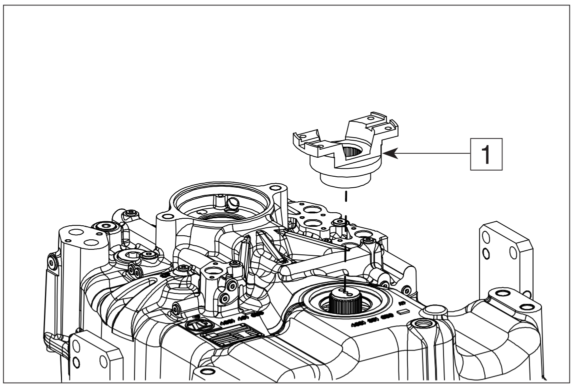


50DS7ETM250

③ Mount output flange (1) until contact is obtained.

⚠ Wear protective gloves.

※ Adjust output flange after cooling down.

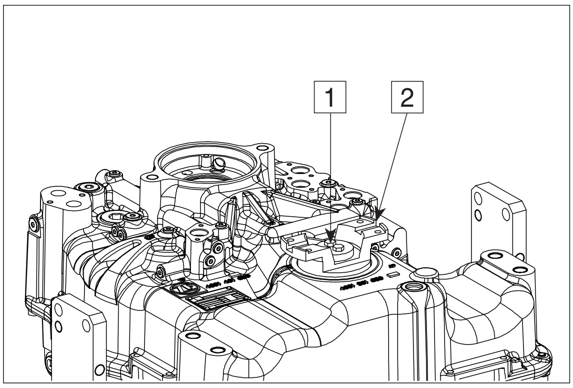


50DS7ETM251

④ Insert O-ring 38×4 into the space between output flange and shaft.

Fix output flange by means of washer (1) and hexagon screws 10×25 (2).

Tightening torque (M8/10.9×25) ···· M_A = 34 Nm



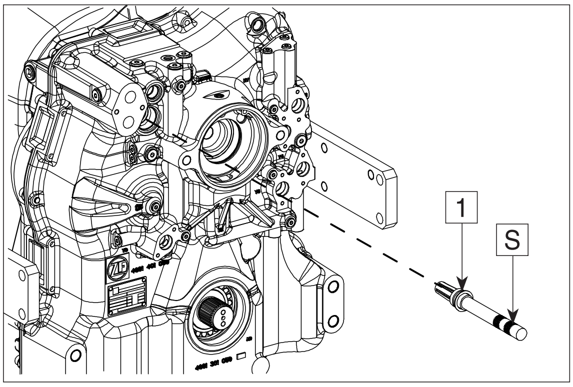
50DS7ETM252

4) REASSEMBLY OF CONVERTER SAFETY VALVE AND MAIN PRESSURE VALVE

(1) Reassembly of converter safety valve

① Insert valve(1) with drift(S) into the housing until contact is obtained.

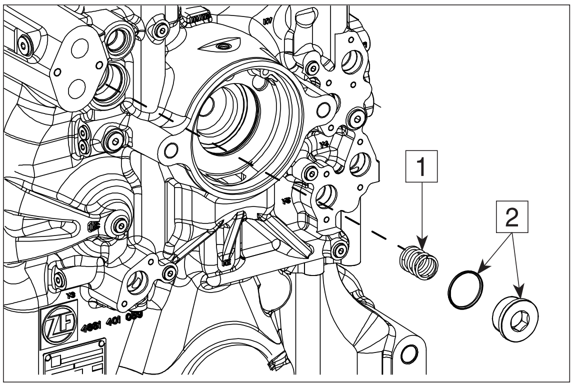
(S) Drift 5870 705 012



50DS7ETM253

② Place compression spring (1) into the transmission hole and fit screw plug M38×1.5 (2) with O-ring 35×2 (3).

Tightening torque ·················· M_A = 46 Nm



50DS7ETM33

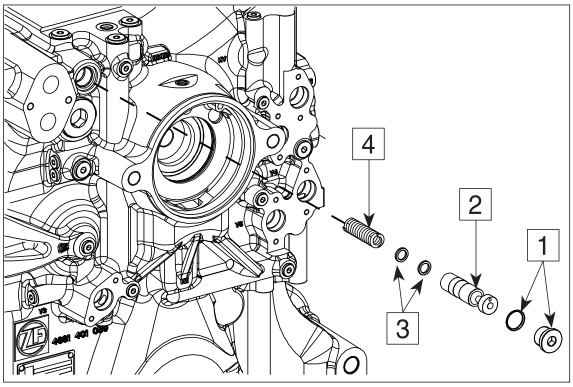
(2) Reassembly of main pressure valve (control pressure valve)

① Main pressure valve consists of :

1 = Screw plug M22×1.5 with O-ring 19×2
2 = Piston
3 = Spacer ring (2 pcs)
Recommended value 5 mm
4 = Compression spring

※ The main pressure 16+3 bar is determined by means of the spacer rings.
Gradation of available spacer rings see parts manual.

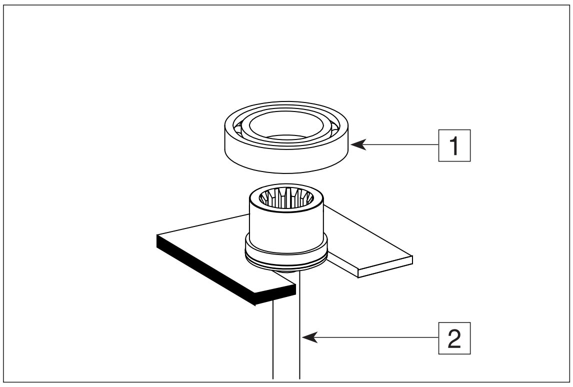
Tightening torque ·················· M_A = 60 Nm



50DS7ETM32

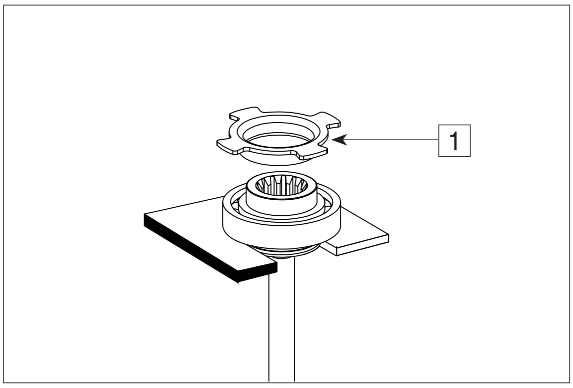
5) REASSEMBLY OF CENTRAL SHAFT (PTO) AND CONVERTER

① Press tapered bearing (1) onto the central shaft (2) until contact is obtained.



50DS7ETM254

② Press the toothed disk (1) onto the pump shaft until contact is obtained.



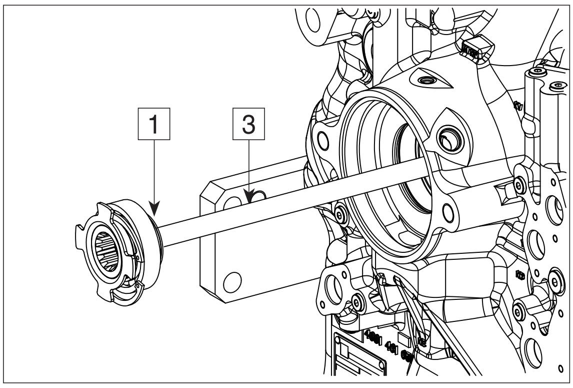
50DS7ETM255

③ Mount rectangular ring 50×2.5 (1).

Grease and centrically align rectangular ring.

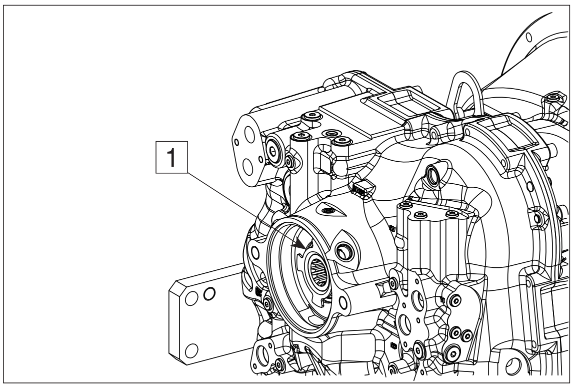
Mount retaining ring 75×2.5 (2).

Mount central shaft (3) until contact is obtained.



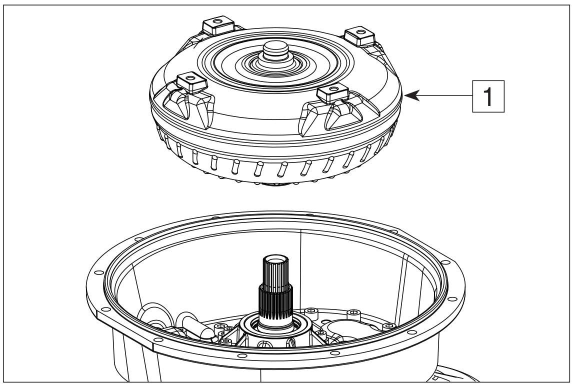
50DS7ETM256

④ Fix central shaft with retaining ring 75×2.5 (1).



50DS7ETM257

⑤ Mount converter (1) until contact is obtained.



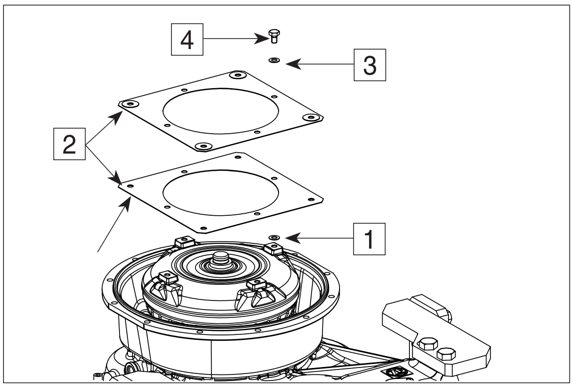
50DS7ETM24

⑥ Position 1 washer/each/thickness= 1.0mm (4EA) (1) onto the flexplate mounting webs (4EA).

Place flexplates (2).

※ Pay attention to the installation position. Spot-welded reinforcing disks of the flexplate to be arranged towards the outside-see arrows.

Mount washer (3) to the hexagon screw M10×16 (4) and fix the flexplates.



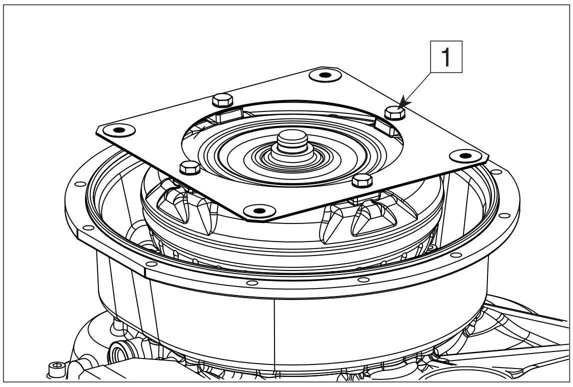
50DS7ETM258

⑦ Tighten hexagon screws M10×16 (1).

Tightening torque (M10/8.8×16) ···· M_A = 46 Nm

※ When reusing the hexagon screws they must be secured with Loctite 243.

※ New hexagon screws are already provided with adhesive (microcapsule). The microcapsule bursts when the screw is turned in, wets screw and nut thread and hardens.

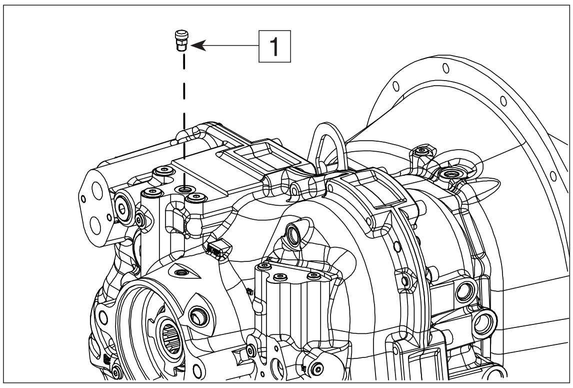


50DS7ETM259

⚠ Fix converter axially.
Risk of injury.

6) REASSEMBLY OF PRESSURE CONTROLLER (PROPORTIONAL VALVES), INDUCTIVE SENSOR, SPEED SENSOR (HALL SENSOR), TEMPERATURE SENSOR, BREATHER AND SCREW PLUGS

① Mount breather (1).



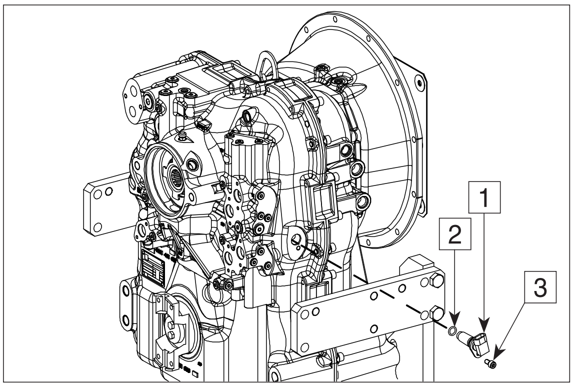
50DS7ETM260

② Mount output Hall sensor- (1) onto the speed sensor, install O-ring 15.5×2.6 (2) and fix it with cylindrical screws M8×16 (3).

Tightening torque (M8/8.8x16) ······· M_A = 23 Nm

※ When reusing the cylindrical screw, it must be secured with Loctite no. 243.

※ New cylindrical screw is already provided with adhesive (microcapsule). The microcapsule bursts when the screw is turned in, wets screw and nut thread and hardens.



50DS7ETM261

③ Fit positioned parts.

1 = Inductive sensor with O-ring 15×2 - n turbine

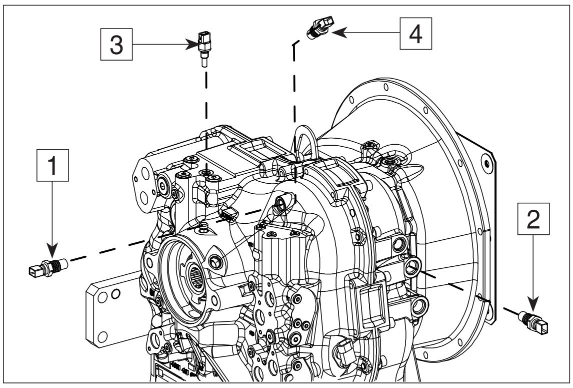
2 = Inductive sensor with O-ring 15×2 - n central gear chain

3 = Inductive sensor with O-ring 15×2 - n engine

Tightening torque ·················· M_A = 30 Nm

4 = Temperature sensor with O-ring 11×2 Measuring point "63" after the converter

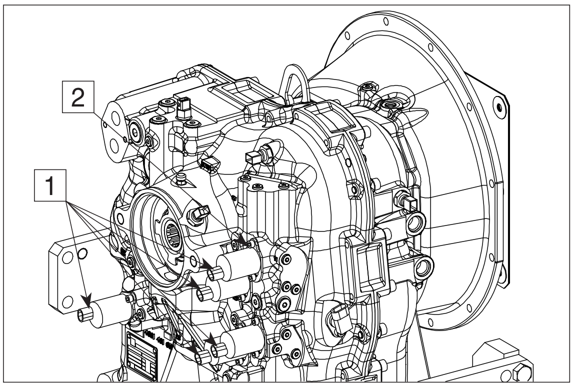
Tightening torque ·················· M_A = 25 Nm



50DS7ETM262

④ Fix pressure controller-proportional valves-(1) with the cylindrical screws M6×12 (2).

Tightening torque (M6/8.8×12) ····· M_A = 9.5 Nm



50DS7ETM263

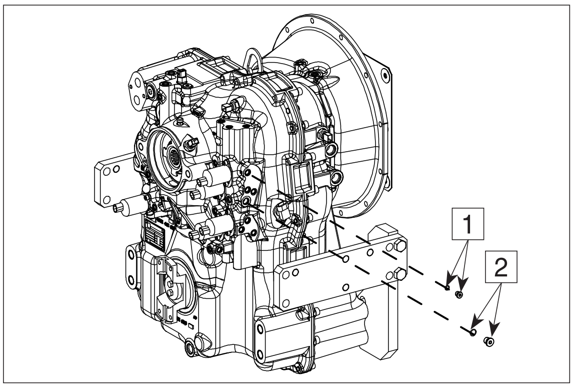
⑤ Mount all screw plugs (1 and 2) with O−rings.

1 = Screw plug M10x1 with O-ring 8×1.5 (24EA)

Tightening torque (M10×1) ········· M_A = 6 Nm

2 = Screw plug 9/16-18 UNF with O-ring 11.9×2 (7EA)

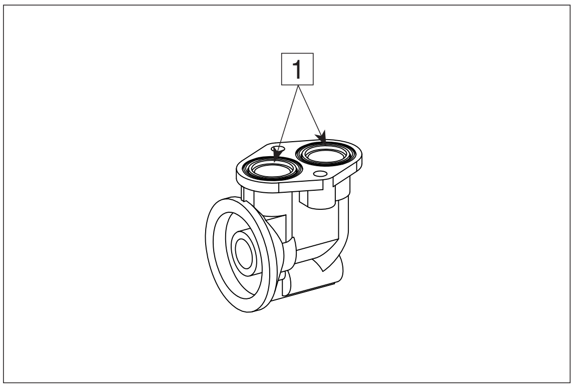
Tightening torque (9/16-18 UNF) ·· M_A = 15 Nm



50DS7ETM264

7) REASSEMBLY OF FILTER, CLOSING COMPONENTS, OIL FILLER TUBE WITH OIL DIPSTICK AND OIL DRAIN PLUG

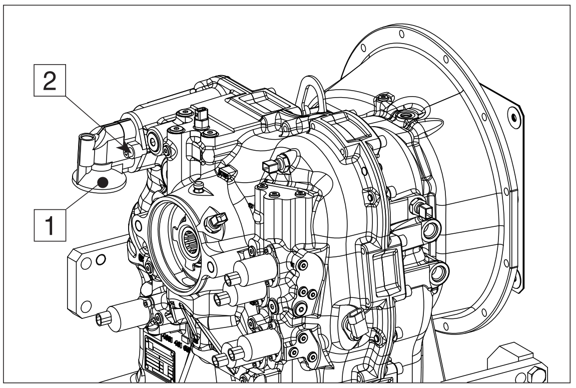
① Place O-rings 34.2×3 (1) into the holes and grease them.



50DS7ETM265

② Attach filter head (1) with cylindrical screws M8×30 (2).

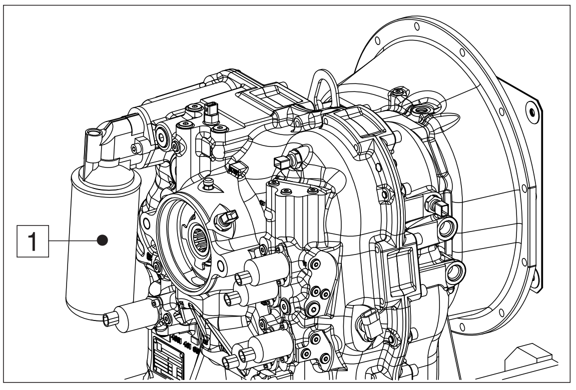
Tightening torque (M8/8.8×30) ······ M_A = 23 Nm



50DS7ETM266

※ The fine filter (1) has to be fitted as follows :

- Slightly oil the seal
- Turn in the filter until contact with the sealing surface is obtained, and then tighten it by hand with approx. 1/3 to 1/2 rotation.

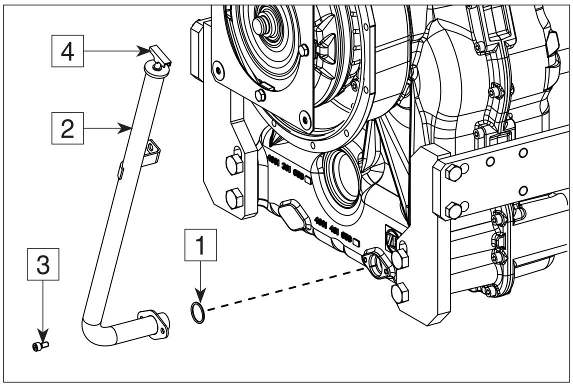


50DS7ETM267

③ Install O-ring 30×3 (1) onto the oil suction tube (2), grease it and fix it with cylindrical screws M8×16 (3) to the transmission housing.

Mount oil dipstick (4).

Tightening torque (M8/8.8×16) ····· M_A = 23 Nm

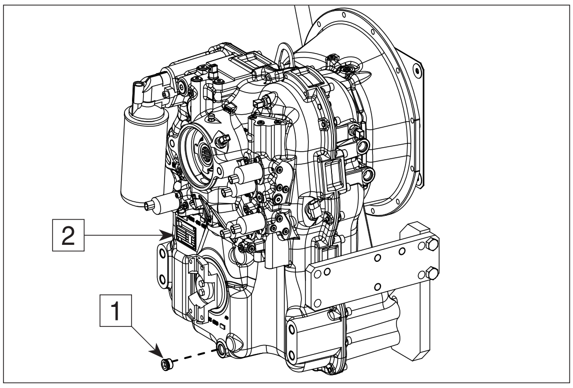


50DS7ETM268

④ Fit oil drain plug 7/8-14 UN 2A (1).

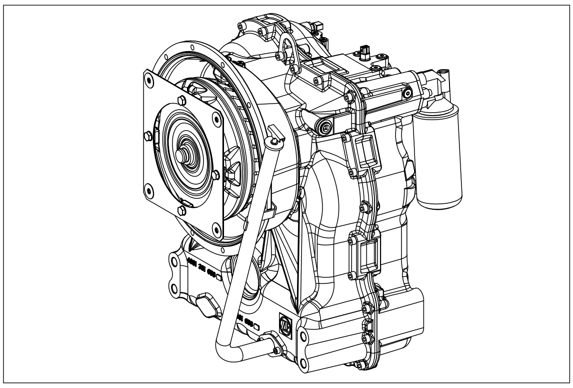
Tightening torque (7/8-14 UN 2A) ··· M_A = 30 Nm

Fix identification plate (2) by means of grooved pins 3×5.



50DS7ETM269

※ Before putting the transmission into operation, fill it with oil according to Operator's Manual.



50DS7ETM270

3. DRIVE AXLE DISASSEMBLY (KESSLER)

1) GENERAL INSTRUCTIONS FOR CORRECT ASSEMBLY AND DISASSEMBLY

(1) Disassembly and assembly are to be accomplished only by trained personnel.

(2) The assembly can be made reverse to the respective disassembly instruction.

(3) Drain oil before removing, check for presence of metal particles.

(4) Mark the parts to each other before dismantle.

(5) Never use a hard object to separate tightly fitted assemblies. To remove bearings, drive flanges and similar parts, use the proper pullers.

(6) It is recommended that the special tools.

(7) Do not place parts on a dirty surface.

(8) Systematically replace used seals, O-rings and, if necessary, bearings on disassembly.

(9) Clean parts before reassembly.

(10) Replace or clean corroded parts.

(11) The cages of bearings rotating in oil are to be coated with oil at reassembly.

(12) Seal ring treads on flanges, shafts etc. must be preserved with SAE80W-90/API GL-5 before mounting.

(13) Oil seal rings and particularly the anti-dust lip seals must be filled with grease.

(14) The universal joint shafts and the axle shafts must not be force mounted (They must slide).

(15) At mounting of radial seal rings pay attention that there is suffice overlap to the housing bores. Pay attention for a plain alignment of the radial seal ring. The seal lips always must not be contacted with Loctite.

(16) The bolted or keyed assemblies safeties are to be checked according to instructions ; in case of doubt, consult Hyundai dealer.

(17) Refill the oil after assembly.

(18) Repair weldment is only allowed after consultation with Hyundai.

2) USING OF LOCTITE AND OPERATING SUPPLIES

Kind	Type	Color	Application
Loctite	243	Blue	Lightly locked screws
	262	Red	Middle locked screws
	270	Green	Highly locked screws
	270	Green	Increased coefficient of friction in contact surfaces
	510	Orange	Surface gasket
	572	White	Special gasket
	638	Light-green	Glueing with big width of slit
Epple	33	Grey	Surface gasket
Dirko	-	Grey	Elastic gasket

3) REMARKS FOR WORKING UP LOCTITE AND OPERATING SUPPLIES

(1) Threads and surfaces have to be cleaned and free from color, oil and grease before applying loctite.

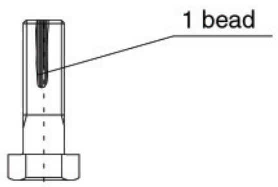
(2) Loctite will harden under following conditions :
① Exclusion of air
② Metal contact
③ Increased temperature

(3) Pre-assembly and control tightening has to be made in a short time (5 to 10 min).

(4) The time between glueing and mounting of the parts should be shorter than 1hour.
Exception : Parts made from nonferrous metal have to be glued within one minute.

(5) Assembled parts must remain unloaded for at least 24 hours.

(6) Loctite quantity :
- At screws :



100D7XL80

- At contact surfaces : Pay attention for a sufficient loctite application.

4) TIGHTENING TORQUE

Unit : N·m

(1) Standard metric threads

Metric standard thread						
Thread	Screw	Nut	Screw	Nut	Screw	Nut
	8.8	8	10.9	10	12.9	12
M4	3.0		4.4		5.1	
M5	5.9		8.7		10	
M6	10		15		18	
M8	25		36		43	
M10	49		72		84	
M12	85		125		145	
M14	135		200		235	
M16	210		310		365	
M8	300		430		500	
M20	425		610		710	
M22	580		830		970	
M24	730		1050		1220	
M27	1100		1550		1800	
M30	1450		2100		2450	

(2) Metric fine threads

Unit : N·m

Metric fine thread						
Thread	Screw	Nut	Screw	Nut	Screw	Nut
	8.8	8	10.9	10	12.9	12
M 8×1	27		39		46	
M10×1	55		81		95	
M10×1.25	52		76		90	
M12×1.25	93		135		160	
M12×1.5	89		130		155	
M14×1.5	145		215		255	
M16×1.5	225		330		390	
M18×1.5	340		485		570	
M20×1.5	475		680		790	
M22×1.5	650		920		1050	
Brake caliper dowel screws (Greased)						
M20×1.5	400 + 100					
M27×2	900 + 100					
Nut for steering stop = 300 Nm						

Regard reduced tightening torque for galvanized bolts and nuts.

(3) Tightening torques of wheel nuts

Dimensions	Phosphor blackened
M20×1.5	470 Nm
M22×1.5	650 Nm

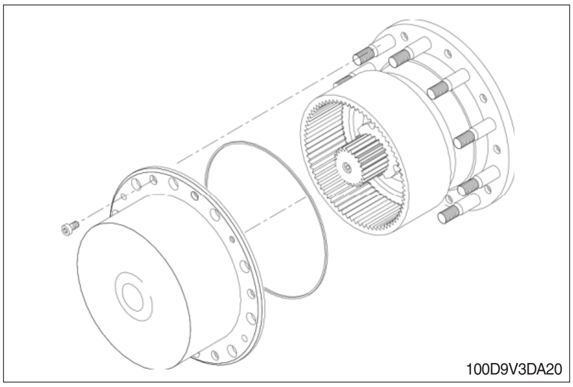
5) DISASSEMBLY OF DRIVE AXLE

(1) Disassembly of planetary gear

① Drain the oil.
   See "Oil change" on page 3-37.

② Loosen and remove mounting bolts.

③ Carefully pull off planetary pot/lid.

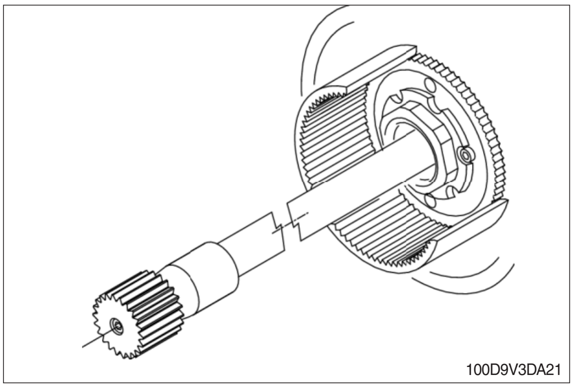


100D9V3DA20

(2) Disassembly of sun gear and axle shaft

※ Observe the length of the axle shaft!
Mount the dismantled axle shaft again onto the same position on the axle.

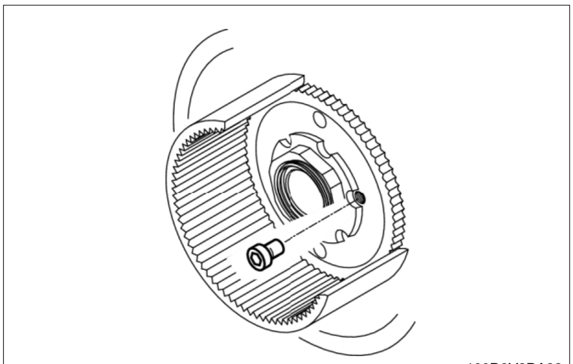
① Pull the sun gear together with the axle shaft of the axle spindle
   - Sun gear and axle shaft are screwed together.



100D9V3DA21

(3) Loosening the wheel bearing adjustment nut

① Loosen the securing screw of the wheel bearing adjustment nut, clean it and deposit safely.



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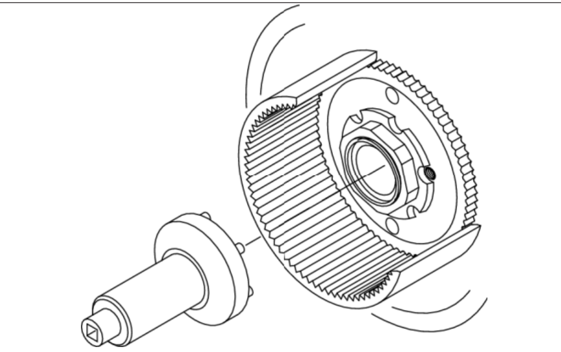
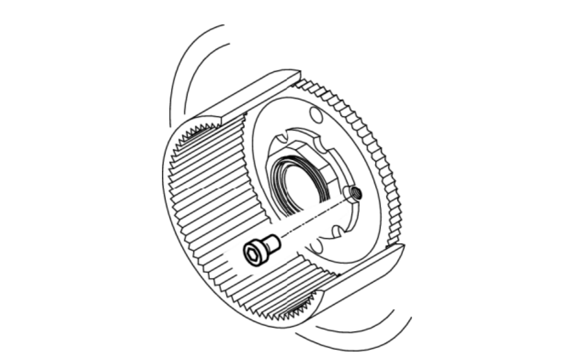
(4) Checking/Retightening the wheel bearing adjustment nut

① Put the customer service tool on the wheel bearing adjustment nut and tighten to the specified tightening torque.
- Customer service tool : Wrench for wheel bearing adjustment nut (see above)
- Tightening torque for used bearings : 300 Nm
- Rotate the wheel hub several times while tightening.
- If it is not possible to secure at this position, the wheel bearing adjustment nut needs to be turned forward to the next possible position for securing.


100D9V3DA23

(5) Wheel bearing adjustment nut

① Secure the wheel bearing adjustment nut with a screw.
- Hexagon socket screw
- Screw securing : Loctite 270
- Tightening torque : 36 Nm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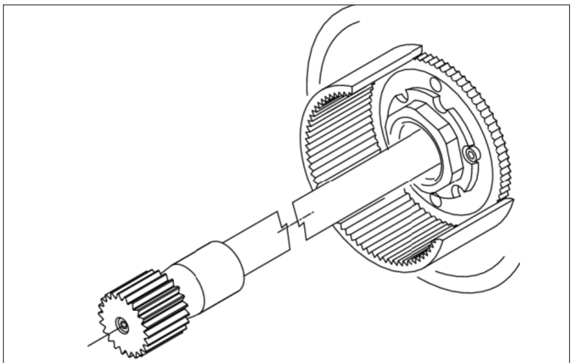
(6) Axle shaft and sun gear

① Push the axle shaft screwed together with the sun gear into the axle spindle to the stop.
- It must be possible to easily slide the axle shaft (by hand) in the inner profile of the differential.

② Rotate the hub assembly until one of the oil compensating holes of the ring gear carrier is at the bottom position!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(7) Planetary gear

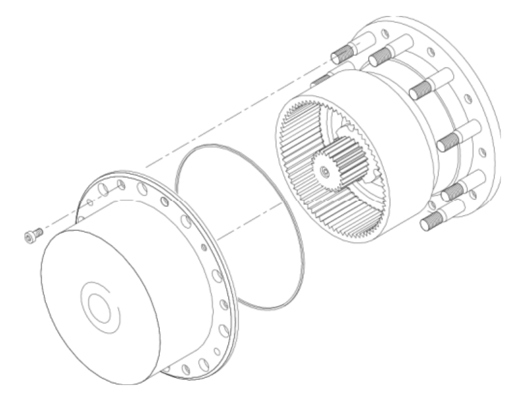
① Insert O-ring into groove of the planetary housing.
   - Sealing of the contact surface between planetary housing and wheel hub
   - Multi-purpose grease prevents the O-ring from falling out during assembly.

② Align planetary housing so that it aligns with the corresponding boreholes in the wheel hub.
   - The oil drain plug has to be at the bottom.

③ Slide the prepared planetary unit over the wheel bolts.

④ Bolt the planetary unit to the wheel hub.
   - Loctite #262
   - Tightening torque

⑤ Top up with oil.



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SECTION 4 BRAKE SYSTEM

GROUP 1 STRUCTURE AND FUNCTION

1. OUTLINE

※ The brakes are operated by a pressure compensated, closed center hydraulic system.
Flow is supplied by a fixed displacement, gear type brake pump.

1) SERVICE BRAKE SYSTEM

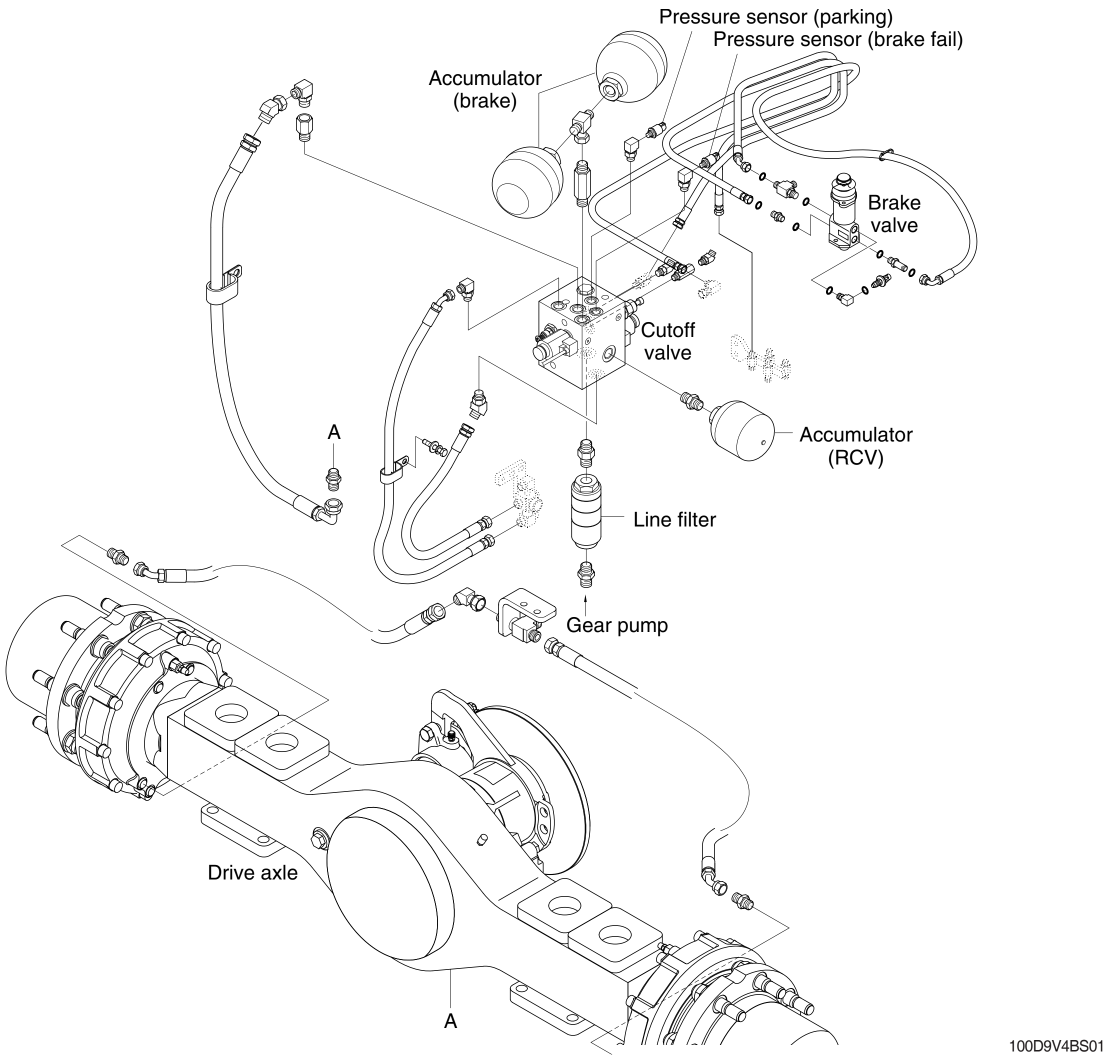
The fixed displacement brake pump supplies flow to the cut-off valve for service brake circuit. It flows to two accumulator. The accumulator has a gas precharge and an inlet check valve to maintain a pressurized volume of oil for reserve brake applications. Oil through the accumulator flows to the brake valves. The brake valve is a closed center design, single circuit operated by a pedal. The brake system contains the following components:

- · Gear pump
- · Cut-off valve, Line filter, Accumlators, Prssure sensor
- · Brake valve, Prssure switch
- · Line filter

2) PARKING BRAKE SYSTEM

In the parking brake system, turn parking brake switch ON, the parking brake solenoid valve in the cut off solenoid valve is de-energized and the valve open the drain port.

At the same time, the hydraulic oil in the parking brake return to the tank through the solenoid valve. When the piston is returned by the force of the spring, the parking brake is applied.



3) FULL POWER HYDRAULIC BRAKE SYSTEM

ADVANTAGES - The full power hydraulic brake system has several advantages over traditional brake actuation systems. These systems are capable of supplying fluid to a range of very small and large volume service brakes with actuation that is faster than air brake systems. Figure represents a time comparison between a typical air/hydraulic and full power hydraulic brake actuation system.

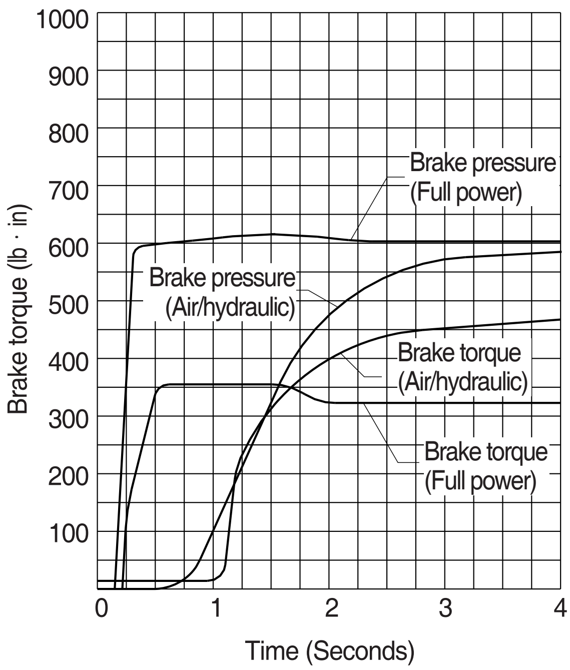
Full power systems can supply significantly higher brake pressures with relatively low reactive pedal forces. The reactive pedal force felt by the operator will be proportional to the brake line pressure being generated. This is referred to as brake pressure modulation.

Another key design feature of full power systems is the ability to control maximum brake line pressure. In addition, because these systems operate with hydraulic oil, filtration can be utilized to provide long component life and low maintenance operation.

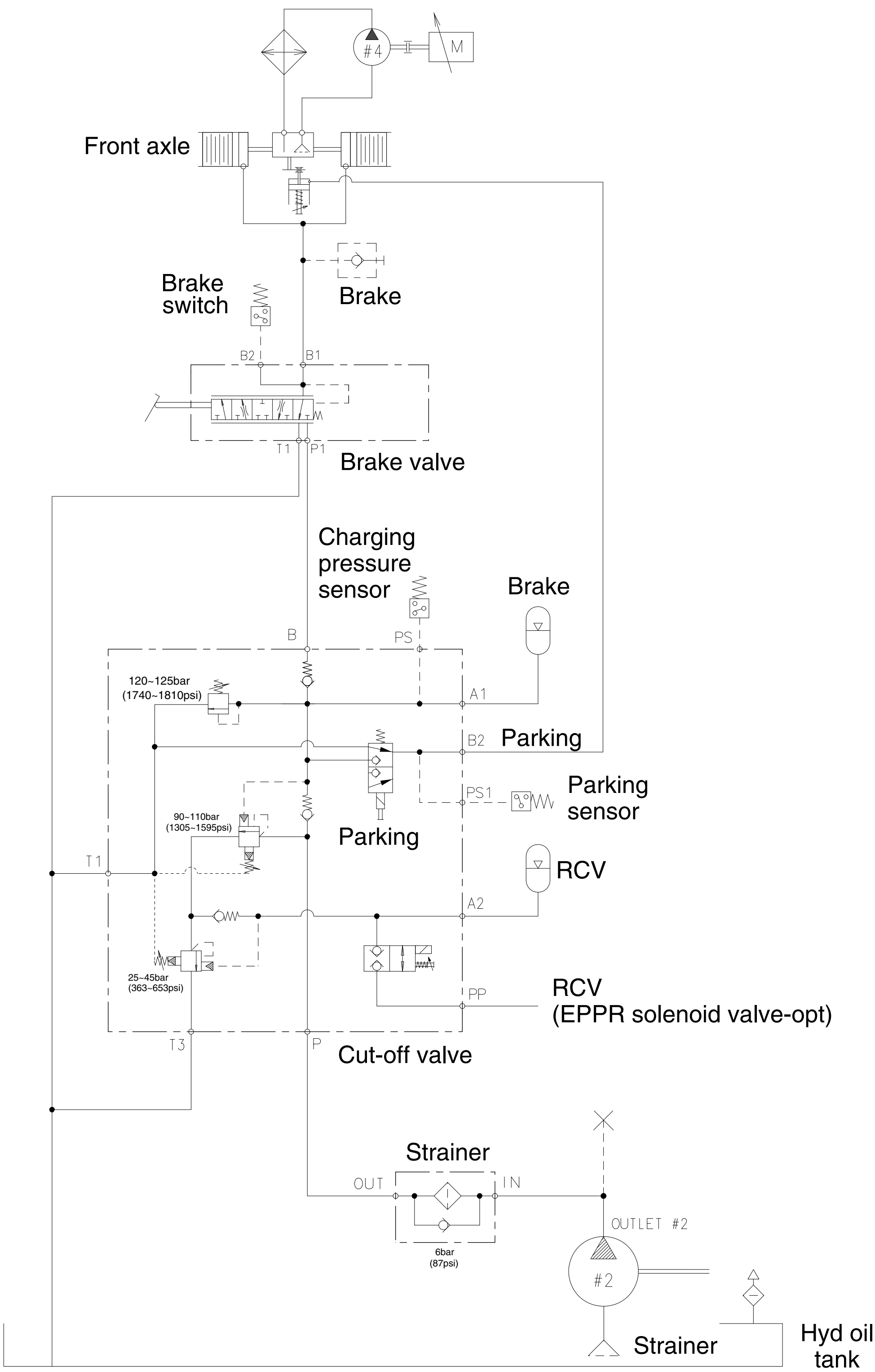
Because these systems are closed center, by using a properly sized accumulator, emergency power-off braking that is identical to power-on braking can be achieved. These systems can be either dedicated, where the brake system pump supplies only the demands of the brake system or non-dedicated, where the pump supplies the demands of the brake system as well as some secondary down stream hydraulic devise.

Another important note is that all seals within these system must be compatible with the fluid medium being used.

Response time
Full power brake actuation VS
Air/Hydraulic brake actuation



2. HYDRAULIC CIRCUIT



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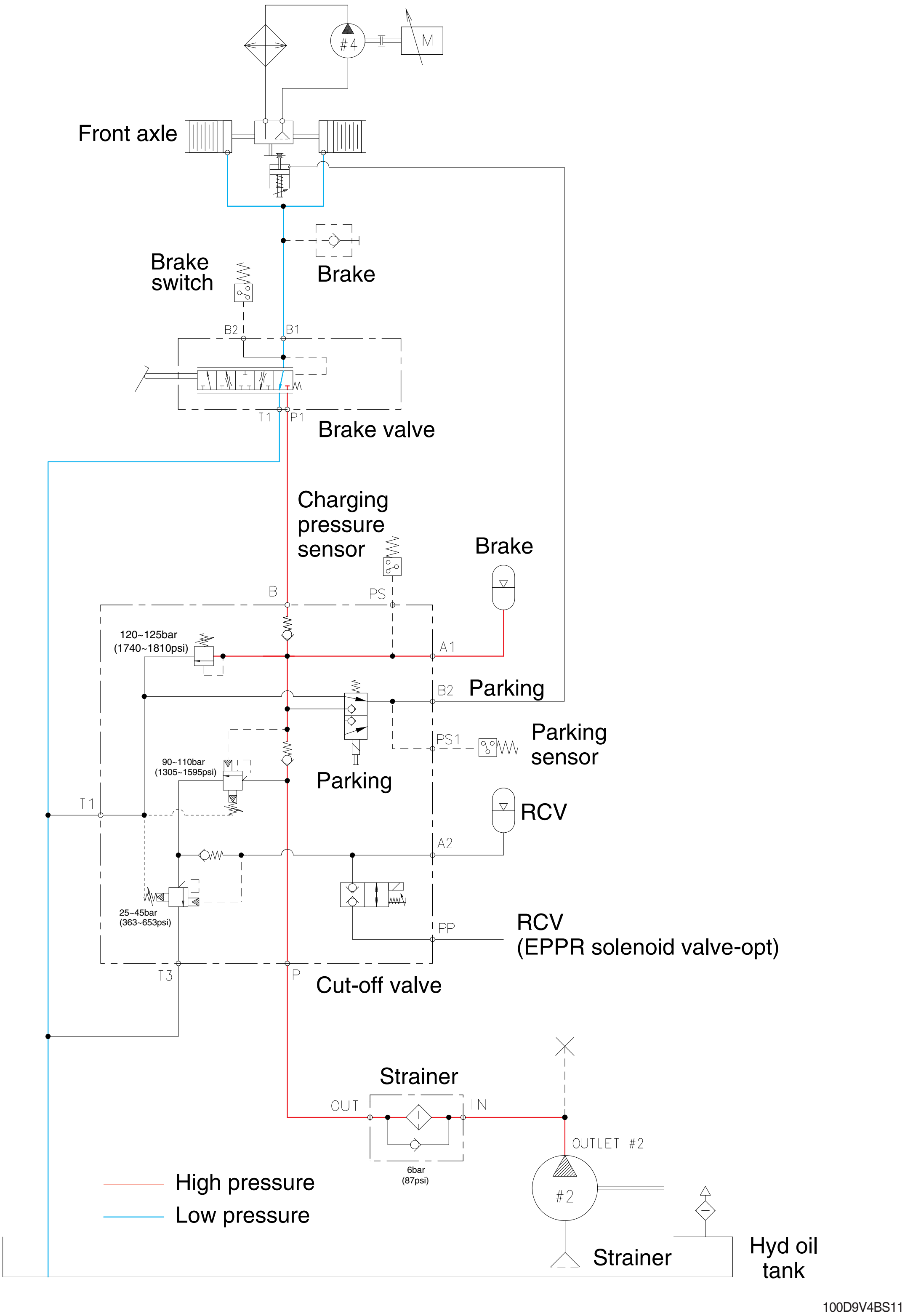
1) SERVICE BRAKE RELEASED

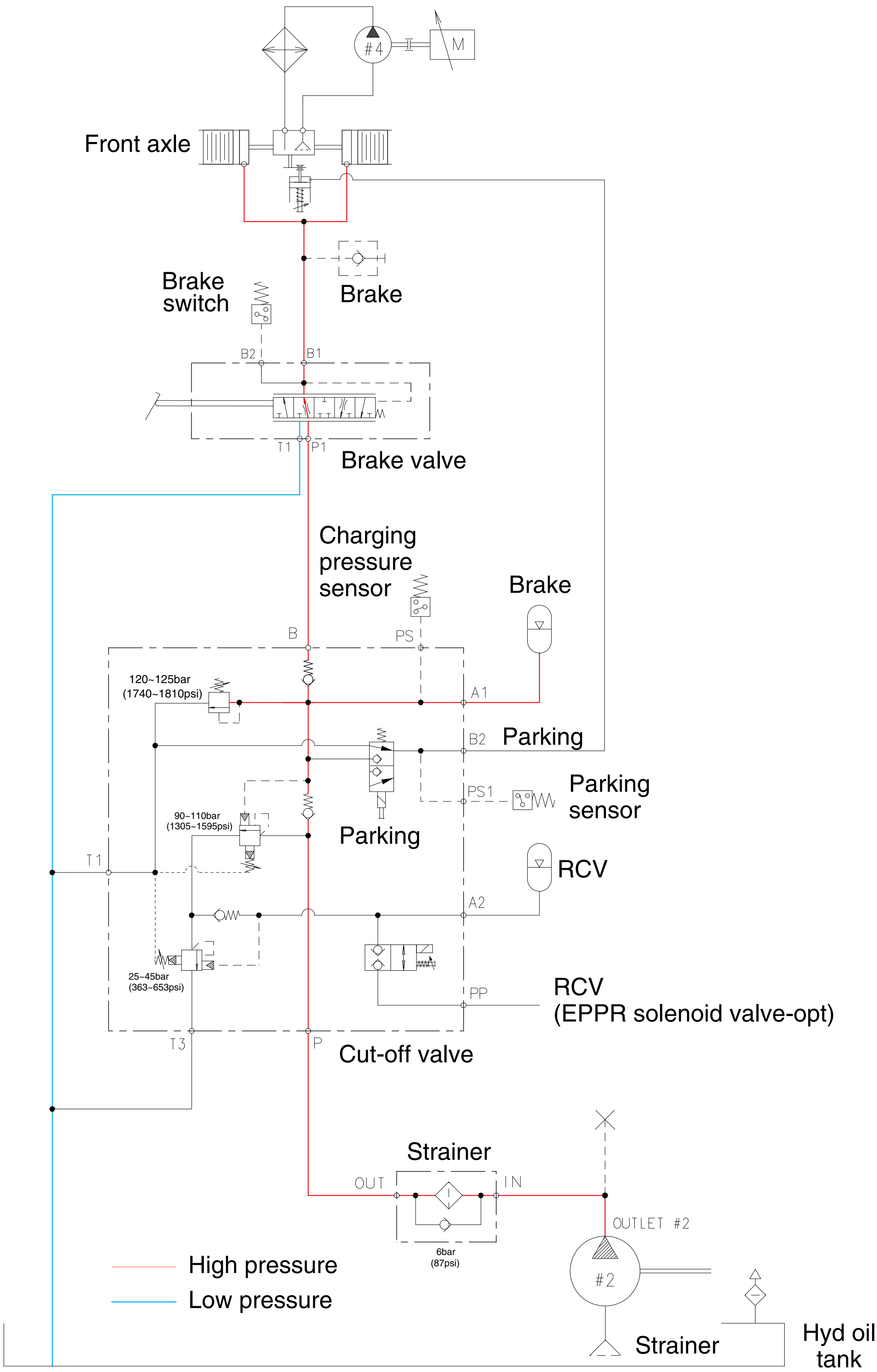


When the pedal of brake valve is released, the operating force is eliminated by the force of the spring, and the spool is returned.

When the spool removes up, the drain port is opened and the hydraulic oil in the piston of front axle return to the hydraulic oil tank.

Therefore, the service brake is kept released.

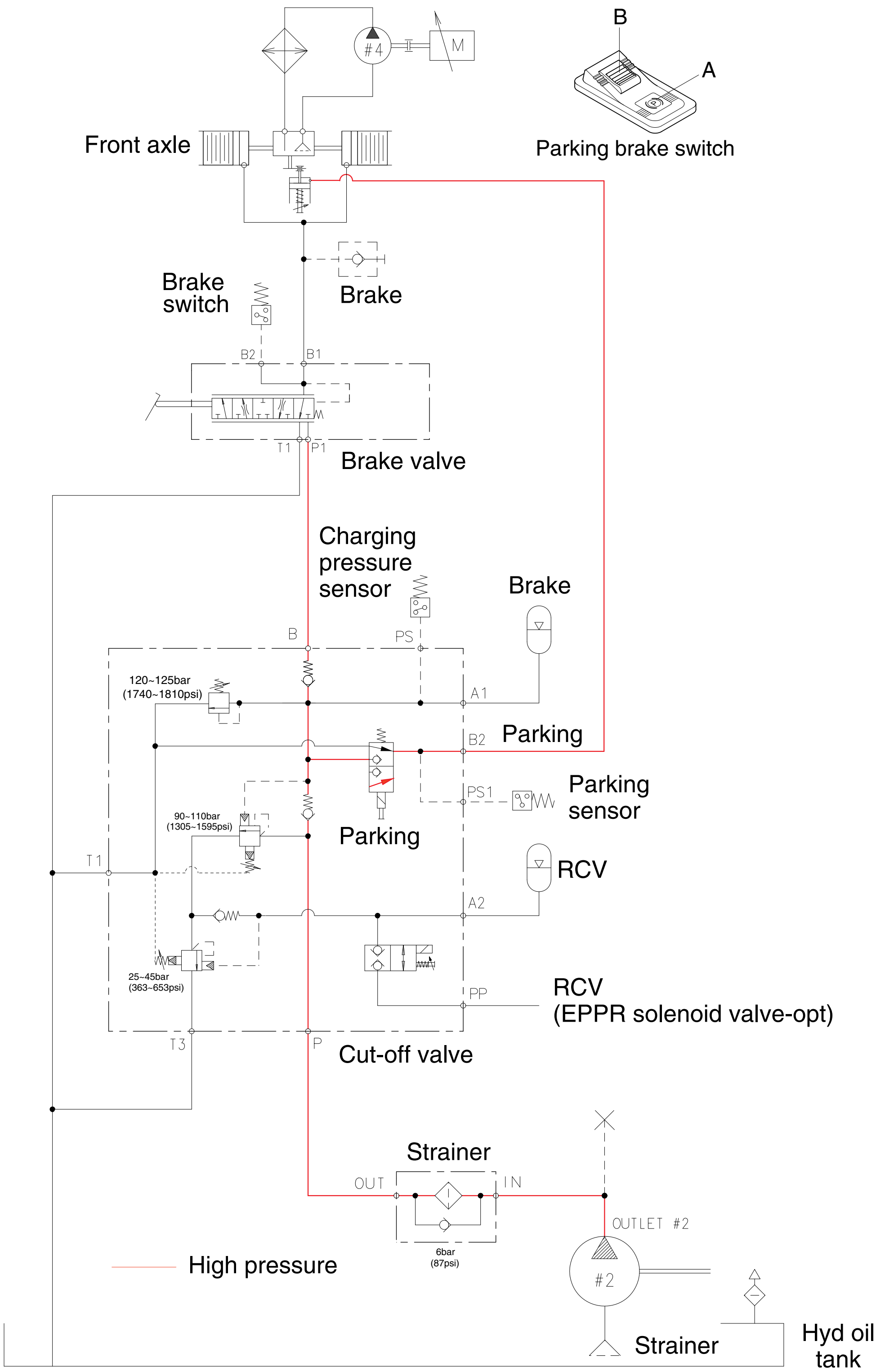
2) SERVICE BRAKE OPERATED



100D9V4BS12

When the pedal of brake valve is depressed, the operating force overcomes the force of the spring, and is transmitted to the spool. When the spool moves down, the inlet port is opened, and at the same time the hydraulic oil controlled the pressure level by the cut-off valve enters the piston in the front axle. Therefore, the service brake is applied.

3) PARKING BRAKE RELEASED

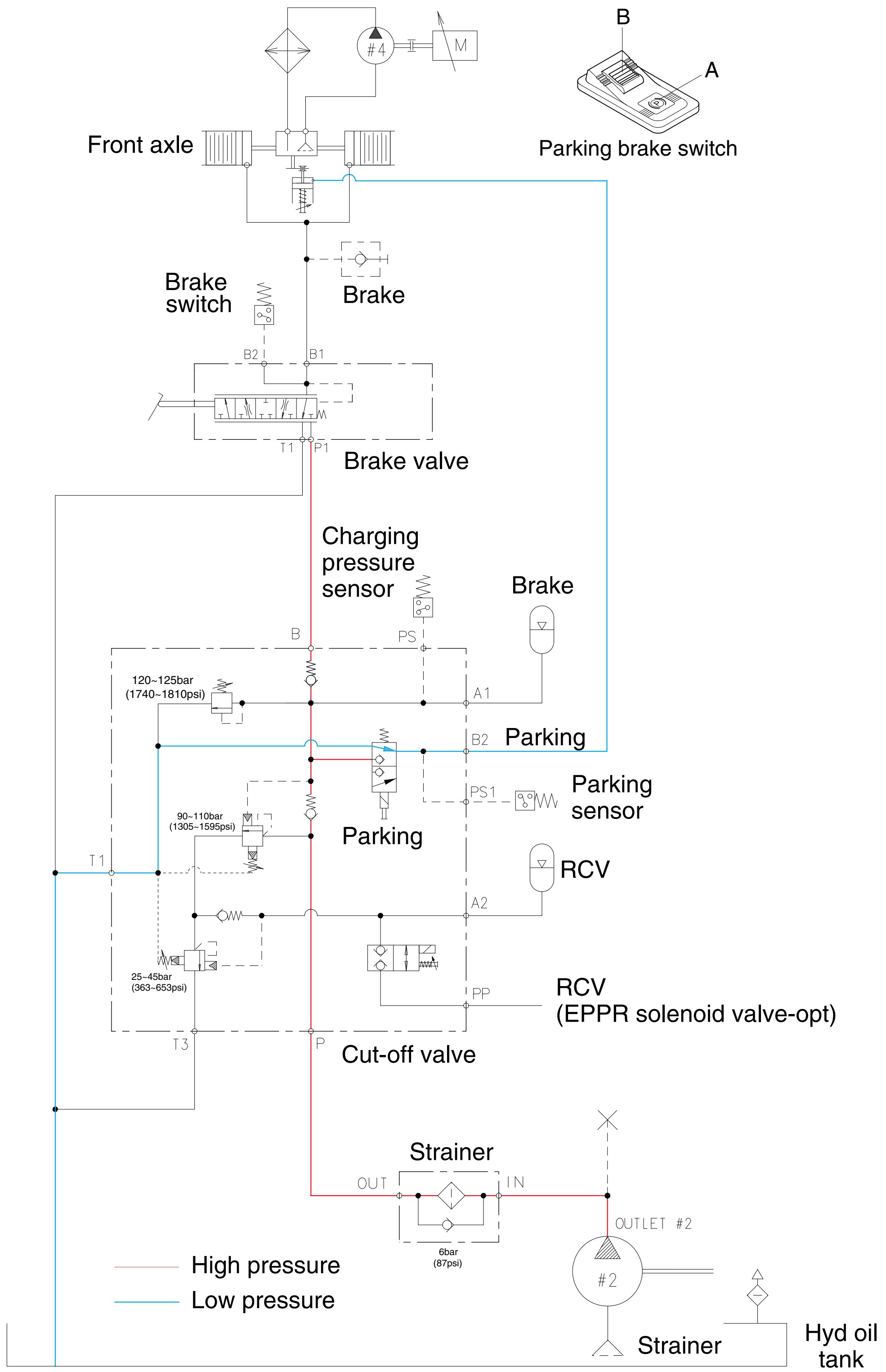


100D9V4BS13

When the parking brake switch is pressed B position, the parking brake solenoid valve is energized and the hydraulic oil controlled the pressure level by the cut-off valve enters the parking brake. It overcomes the force of the spring and pushes the parking brake piston. This releases the parking brake.

Therefore, the hydraulic oil pressure is applied to the parking brake piston through the solenoid valve and the parking brake is kept released.

4) PARKING BRAKE OPERATED



100D9V4BS14

When the parking brake switch is pressed A position, the parking brake solenoid valve is de-energized and the valve open the drain port.

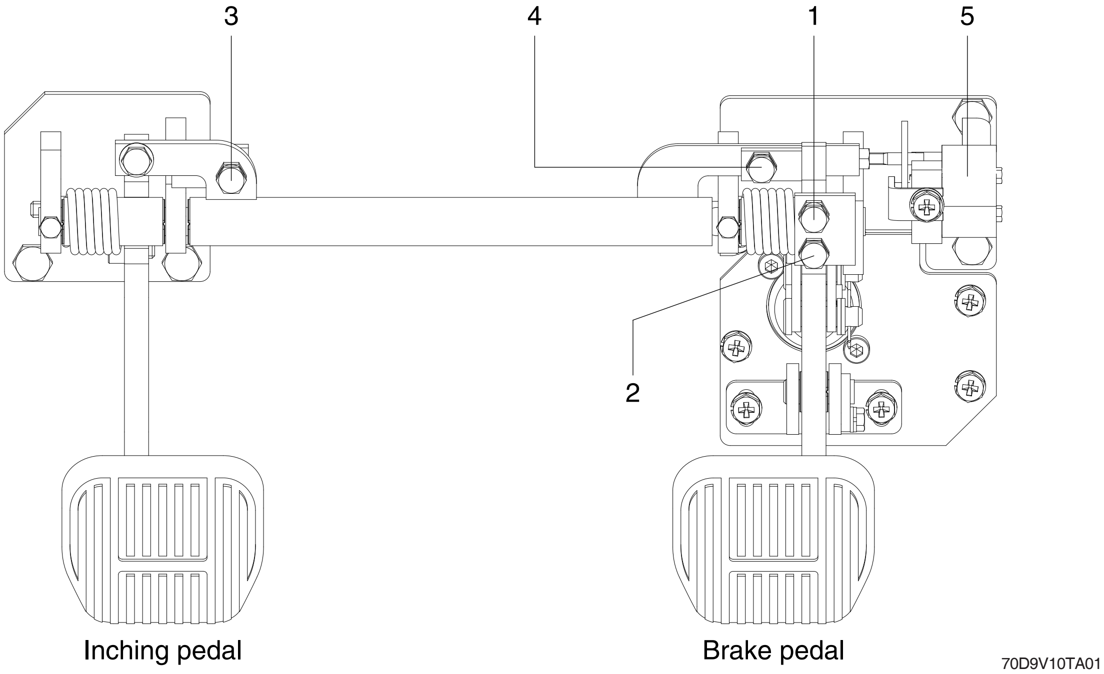
At the same time, the hydraulic oil in the parking brake return to the hydraulic oil tank through the solenoid valve. When the piston is returned by the force of the spring, the parking brake is applied.

5) DO AEB WORK

※ Please refer to page 7-91.

3. INCHING PEDAL AND LINKAGE

The brake pedal serves to actuate the hydraulic brakes on the front axle. At the beginning of the pedal stroke, the inching spool of the transmission control valve is actuated to shift the hydraulic clutch to neutral and turn off the driving force. By treading the pedal further, the brake is applied.



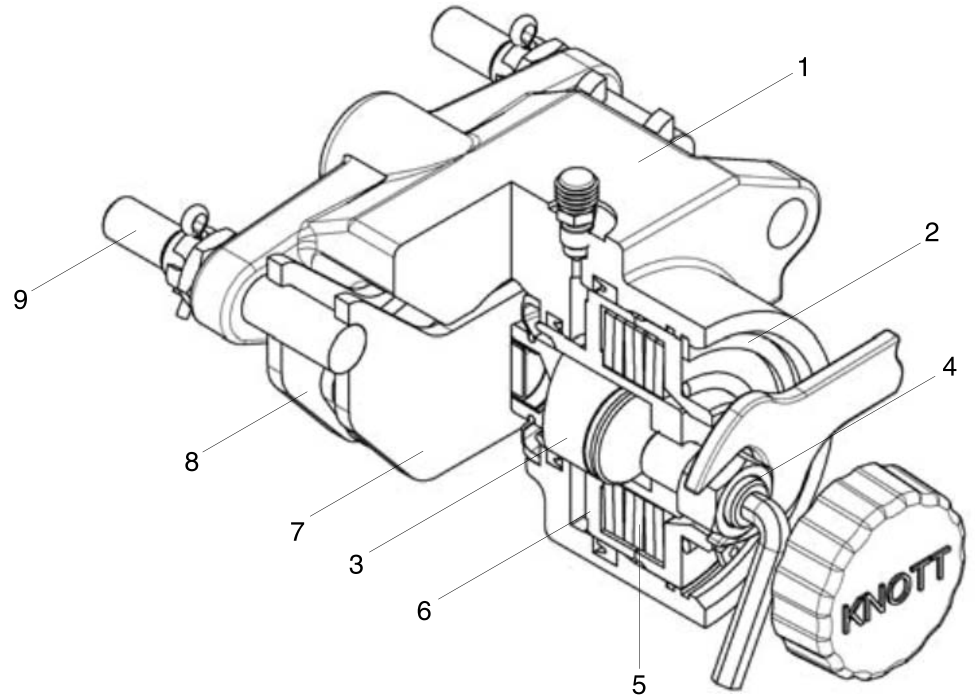
1	Brake stopper bolt	3	Inching stopper bolt	5	Inching sensor
2	Brake storke limit bolt	4	Brake & inching pedal interlock bolt		

1) INITIALIZING THE INCHING SENSOR

Refer to the page of the cluster setting.

4. PARKING BRAKE SYSTEM (KESSLER)

1) STRUCTURE



100D7BS111

1	Housing	4	Adjust screw	7	Lining pad
2	Pressure ring	5	Bank of cup springs	8	Lining pad
3	Thrust bolt	6	Piston	9	Gliding bolt

2) OPERATION

The two identical brake pads and slide freely on the guide bolt, which is fastened in the housing. The guide bolts are guided in an additional brake anchor plate which in turn is screwed onto the vehicle, i.e. its axle.

On actuation, the brake generates a clamping force at the brake lining pads, which cause a tangential force/braking moment to be generated at the brake disk, the extent of which depends on the coefficients of friction generated by the linings.

The clamping force is generated by the bank of cup springs, during which the piston is moved together with the adjusting screw, the thrust bolt and the brake pad towards the brake disk.

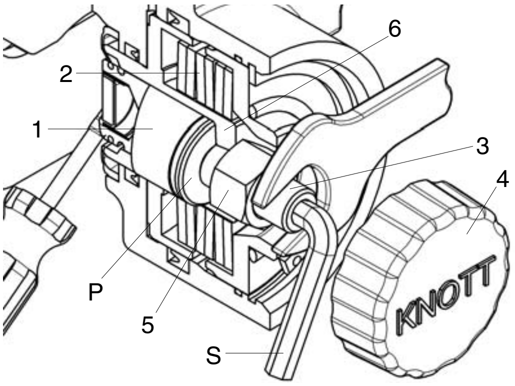
When the brake pad comes into contact with the brake disk, the reaction force shifts the housing onto the guide bolts until the brake pad is also pressed against the brake disk.

The brake is released by complete pre-tensioning of the bank of cup springs. Du-ring this process, through application of the necessary release pressure after overcoming the cup spring force, the piston must move back until it comes to rest against the pressure ring.

The clamping force diminishes with wear of the brake lining and brake disk. The brake must be adjusted at the latest at the times indicated by the adjusting specification followings.

3) MOUNTING AND BASIC SETTING REGULATIONS

Basic brake setting is required after mounting new brake lining plates or brake disks, as well as during all repair stages and in the event of insufficient braking performance.



100D7BS112

1	Thrust bolt	4	Screw cap	P	Even surface
2	Bank of cup springs	5	Lock nut	S	Socket wrench
3	Adjusting screw	6	Piston		

※ **All mounting and basic setting work must be carried out on the brake when cold.**

(1) Mounting the brake

① Stand the vehicle on an even surface and secure against rolling away.

② Release the screw cap.

③ Release the lock nut (size 24 or 30) and turn the adjusting screw anticlockwise using a size 8 or 10 socket wrench until the pressure bolt comes to rest against the even surface of the piston. In this status, the brake can be mounted onto the brake disk and fastened.

④ Mount the pressure connection again.
Apply the necessary release pressure to the brake until the bank of cup springs is completely pre-tensioned. Following carry out the following page basic setting regulation.

(2) BASIC SETTING REGULATION

① Turn the adjusting screw manually clockwise until both brake pads make contact with the brake disk. Then it is not longer possible to turn the adjusting screw without exerting a major amount of force.

② Turn the adjusting screw anticlockwise in order to set the following rated clearances.

Model	Adjusting screw	Clearance (mm)		Turns
100D-9V	FSG 90	Min.	0.5	1/4
		Clearance	1.0	1/2
		Max.	1.5	3/4
	FSG 110 M20 (SW 10)	Min.	1.0	2/5
		Clearance	2.0	4/5
		Max.	3.0	1 1/5

③ Hold the adjusting screw in position with a hexagonal socket wrench and lock with lock nut. (50+5 Mm)

④ Mount the screw cap and tighten as far as possible manually.

⑤ Mount the pressure connection in accordance with the instructions of the axle.

※ For bleeding the piston chamber use the socket spanner size 13 for the bleeding valve.

(3) ADJUSTING REGULATIONS

During this adjusting process, the parking brake must be released, i.e. the bank of cup springs must be completely pre-tensioned.

① Stand the vehicle on an even surface and secure against rolling away.

② Release the parking brake by using the required release pressure.

③ Release the screw cap and unscrew.

④ Release the lock nut (size 24 or 30) and turn the adjusting screw with socket wrench size 8 or 10 manually clockwise until the two brake pads make contact with the brake disk.

⑤ Turn the adjusting screw anti-clockwise and set the clearance specified in the above table.

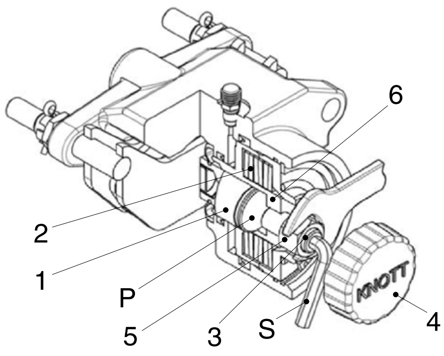
⑥ Hold the adjusting screw in position with the hexagonal socket wrench and lock with the lock nut. (50+5 Mm)

⑦ Mount the screw cap and tighten as far as possible manually.

※ Actuate the brake valve several times and check the braking efficiency of the parking brake on a slope.

4) EMERGENCY RELEASE OF THE PARKING BRAKE

After the failure of the pressure release the parking brake by using following manual procedure.



100D7BS117

1	Thrust bolt	4	Screw cap	P	Even surface
2	Bank of cup springs	5	Lock nut	S	Socket wrench
3	Adjusting screw	6	Piston		

(1) The vehicle has to be secured against rolling away.

(2) Release the screw cap and unscrew

(3) Release the lock nut (size 24 or 30) and turn the adjusting screw with socket wrench size 8 or 10 manually counter-clockwise until the brake disc is free.

⚠ **For the emergency release is an actuation torque of 40 Nm respectively 70 Nm required.**

(4) Mount the lock nut and the screw cap and tighten both as far as possible manually. (protection against dirt)

⚠ **Now, the vehicle do not have any brake function. The vehicle must be secured against moving away with proper means. Before putting the vehicle into operation again, the brake has to be adjusted again. Refer to previous page. "Assembly and basic setting regulations".**

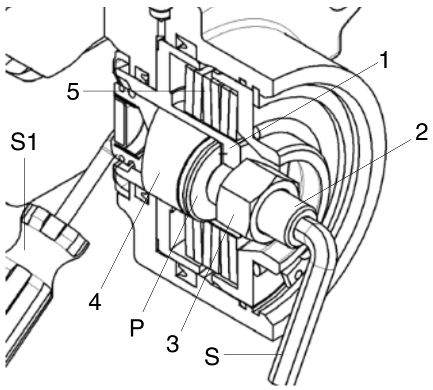
5) MAINTENANCE AND REPAIR WORK

(1) Maintenance and exchange of brake pads

The brake pads themselves are maintenance free. All that is required here is a check for damaged parts, as well as inspection to ensure that the brake disk remains easy running.

The thickness of the brake lining must be subjected to a visual inspection at regular intervals, which depend on vehicle usage, but every six months at the latest. In the event of a minimal residual lining thickness, these intervals must be reduced accordingly in order to avoid major damage to the brake or disk.

- FSG 90
  Min. residual thickness 1.0 mm per lining pad (6 mm carrier plate thickness).
- FSG 100
  Min. residual thickness 2.0 mm per lining pad (8 mm carrier plate thickness).

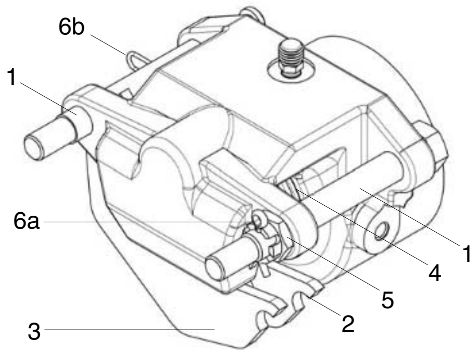


180D7EBS113

1	Piston	5	Bank of cup spring
2	Adjusting screw	S	Socket wrench
3	Lock nut	S1	Screwdriver
4	Thrust bolt	P	Inside of the piston

※ Only original spare lining plates may be used. If any other spare parts are used, no warranty claims will be accepted either for the brakes or their functional characteristics.

① Stand the vehicle on an even surface and secure against rolling away.
② Release the parking brake by applying the required release pressure.
③ Release the screw cap and unscrew.
④ Release the lock nut (size 24 or 30) and turn the adjusting screw with socket wrench size 8 or 10 manually clockwise until it lies flush with the inside of the piston.
⑤ Press back the thrust bolt using a suitable screwdriver until it has contact with the piston.



1	Guide bolt	5	Castellated nut
2	Lining pad	6a	Safety splint
3	Lining pad	6b	Safety clip
4	Permanent magnet		

⑥ Depending on the free space available, release one of the two guide bolts, removing the safety splint, unscrewing the castellated nut and pulling the guide bolt out of the brake anchor plate. Now, the brake lining pads can be removed tangentially to the brake disk.

※ In the event of minimal clearance, i.e. it is not possible for space reasons to exchange the brake lining plate in accordance with these instructions, the brake must be removed completely. To do this, pull both guide bolts out of the brake anchor plate.

⚠ Check the pressure hose. If the pressure hose is to short, it must be unscrewed to remove the brake. Before the pressure hose can be released the brake must be emergency released.

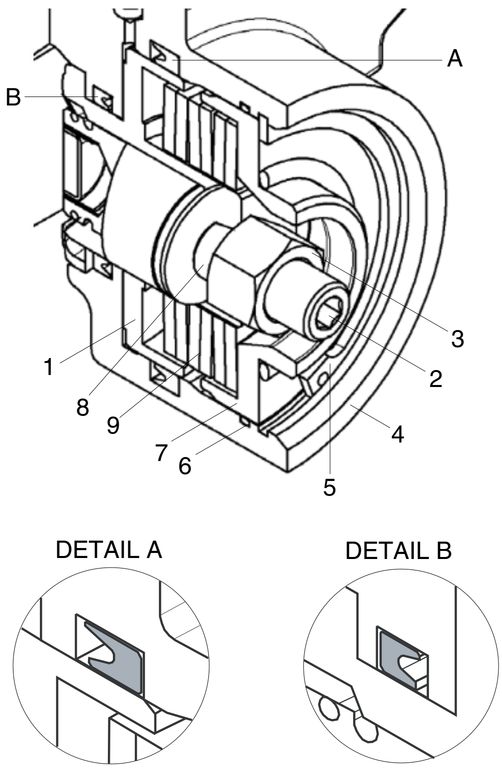
⑦ Exchange the brake pads and insert the guide bolts into the brake anchor plate. If you have removed the complete brake you have to amount the brake on both guide bolt again, now.

⑧ Check both permanent magnets if they still have sufficient magnetic force to hold the brake lining plates. Should this not be the case, the permanent magnets must also be changed by using a suitable screw driver.

⑨ Secure the guide bolt with the castellated nut and the safety splint respective safety clip.

⚠ After mounting new brake lining plates or their repair, the brake must be correctly set in accordance with the instructions "Adjusting regulations".

(2) Changing the seal



1	Piston	5	Circlip	9	Bank of cup spring
2	Adjusting screw	6	Seal	A	Detail of the seal
3	Lock nut	7	Guide bolt	B	Detail of the seal
4	Housing	8	Thrust bolt		

※ Faulty seals must be exchanged in accordance with the instructions below.

① Stand the vehicle on an even surface and secure against rolling away.
② Release the parking brake by applying the necessary release pressure.
③ Release the screw cap and unscrew.
④ Release the lock nut (size 24 or 30) and turn the adjusting screw with socket wrench size 8 or 10 manually counter clockwise until the adjuster screw is flush with the inner side of the piston.
⑤ Push back the thrust bolt until it has contact with the piston. Following actuate the hand brake valve (No pressure must be in the piston chamber). The bank of cup springs is now completely depressurized.
⑥ Unscrew the pressure hose and remove the brake.
⑦ Release the circlip and remove the pressure ring of the housing.
⑧ Release the bank of cup spings and the piston.

⚠ Pay attention to the mounting direction of the seal rings, otherwise leaks can occur.

⚠ Use for mounting the new seal rings a suitable mounting needle with rounded edge.
Be careful.

⑨ Change all seals and mount the parts of the brake in other way round order. By mounting the piston, the sliding and sealing surfaces must be greased lightly using lubricating grease to DIN 51825. The dust protection cap is fitted with a vulcanized-in steel ring which is used to press it through the locating hole. For exchanging, "lever out" the ring using a suitable tool. The new dust protection cap must be pressed in with the aid of a suitable mounting ring and screw clamps or a lever press.

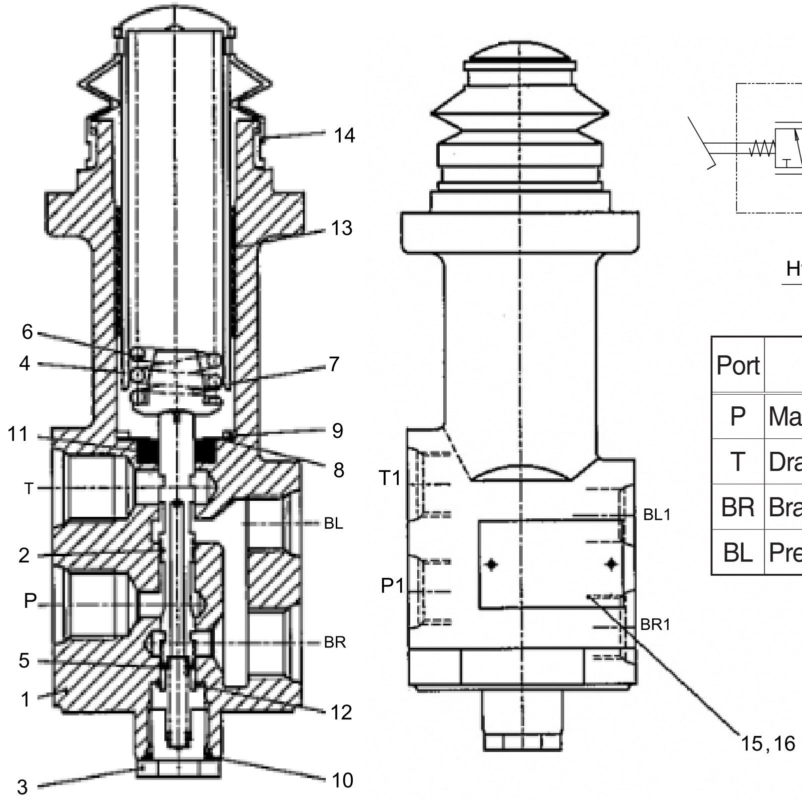
(2) General

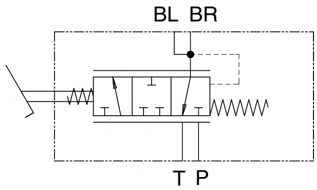
Any discovered defects or damage to parts not listed here must naturally be repaired or replaced using original parts.

For any other information not contained in these instructions or for more detailed instructions, please contact Hyundai dealer.

5. BRAKE VALVE

1) STRUCTURE





Hydraulic circuit

Port	Port name	Port size
P	Main pressure port	PF 3/8
T	Drain port	PF 3/8
BR	Brake cylinder port	PF 3/8
BL	Pressure switch port	PF 1/4

160D9VBS07

1	Valve body	7	Spring retainer	13	DU bushing
2	Spool	8	Plain washer	14	Rubber cover
3	Plug	9	Snap ring	15	Name plate
4	Brake holder	10	O-ring	16	Drive screw
5	Lower spring	11	Oil seal		
6	Main spring	12	Snap ring		

(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

A connection is established between ports (BR) and ports (T) so that the wheel brakes ports (BR) are pressureless via the returns ports (T).

(3) Partial braking

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

The main spring (6) beneath pedal plate (12) 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 spool (2) is mechanically actuated via main spring (6). As spool (2) move downward, they will first close returns (T) via the control edges, thus establishing a connection between accumulator ports (P) and ports (BR) for the wheel brake cylinders. The foot force applied now determines the output braking pressure. The control spool (2) is held in the control position by the force applied (Spring assembly above the spool).
After output of the braking pressure, spool (2) is in a partial braking position, causing ports (P) and ports (T) to close and holding the pressure in ports (BR).

(4) Full braking position

When pedal is fully actuated, end position of the brakes is reached and a connection established between accumulator ports (P) and brake cylinder ports (BR). Returns (T) are closed at this point.

When the braking process is ended, a connection is once again established between brake cylinder ports (BR) and return ports (T), closing accumulator ports (P).

(5) Installation requirements

Return lines (T) must be connected directly to the tank.
The connecting lines must be installed is such a way as to permit proper bleeding.

(6) Maintenance of the brake valve

No special maintenance beyond the legal requirements is necessary.

When using high-pressure cleaners on the machine, please make sure that the water jet is not aimed directly at the brake valve (To prevent damaging the bellows).

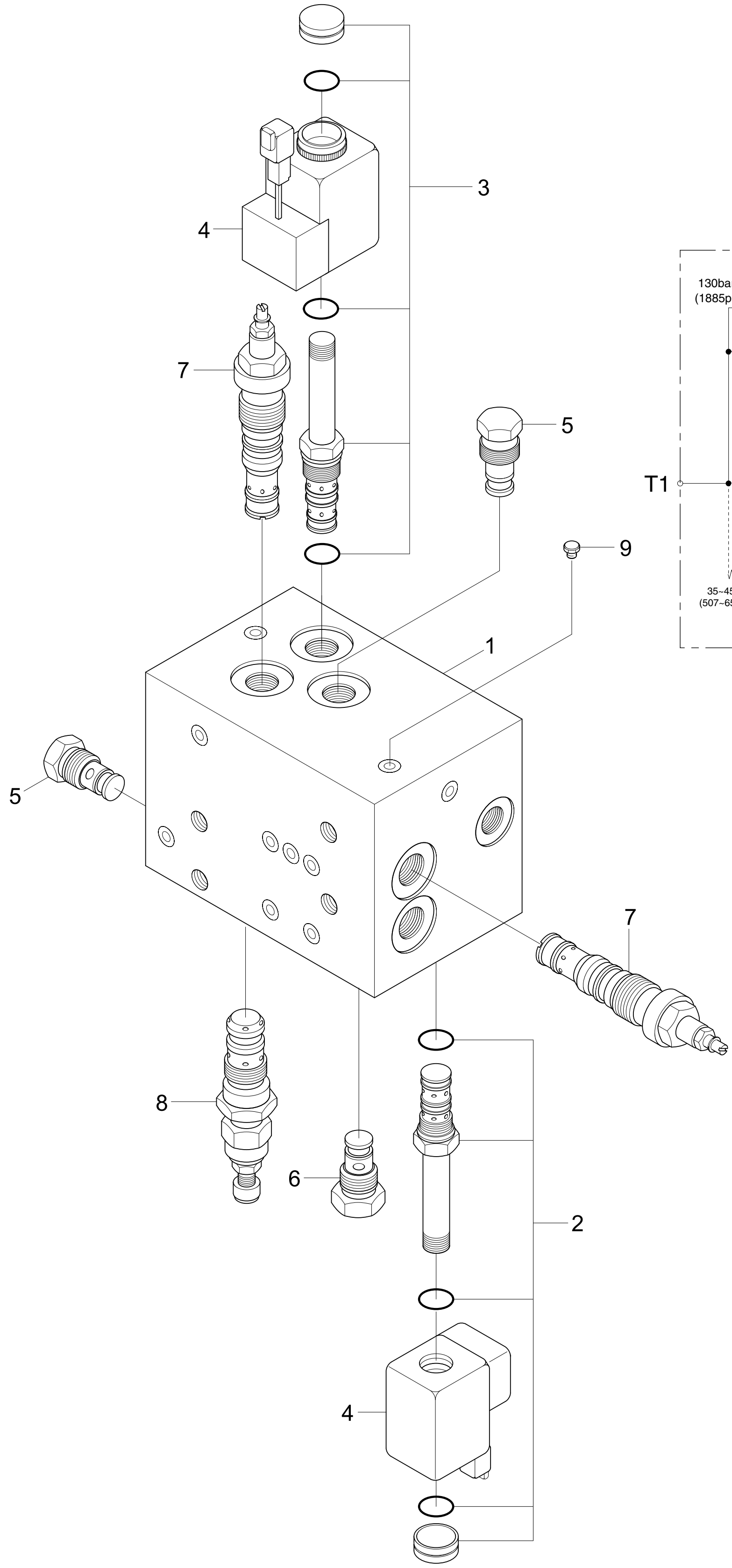
△ For safety reasons the whole of the brake valve must be replaced if parts other than those listed above are damaged.

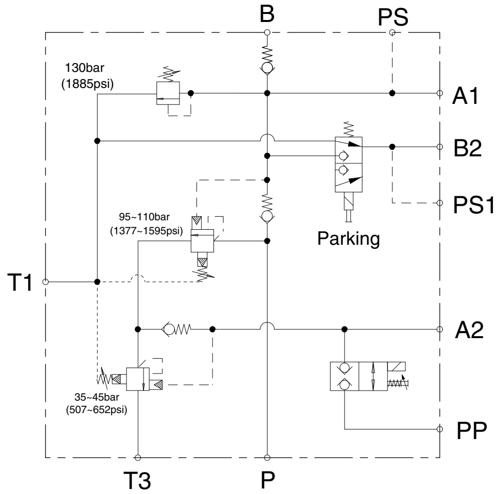
(7) Repair work

△ When working on the braking system, always make sure that there is absolutely no pressure in the system. Even when the engine is switched off there will be some residual pressure in the system.
When doing repair work, make sure your environment is very clean.
Immediately close all open ports on the components and on pipes using plugs.

6. CUT-OFF VALVE

1) STRUCTURE





Hydraulic circuit

1 Block
2 Solenoid valve
3 Solenoid valve
4 Coil
5 Check valve
6 Check valve
7 Cutoff valve
8 Relief valve
9 Plug

100D9V4CV01

2) TIGHTENING TORQUE

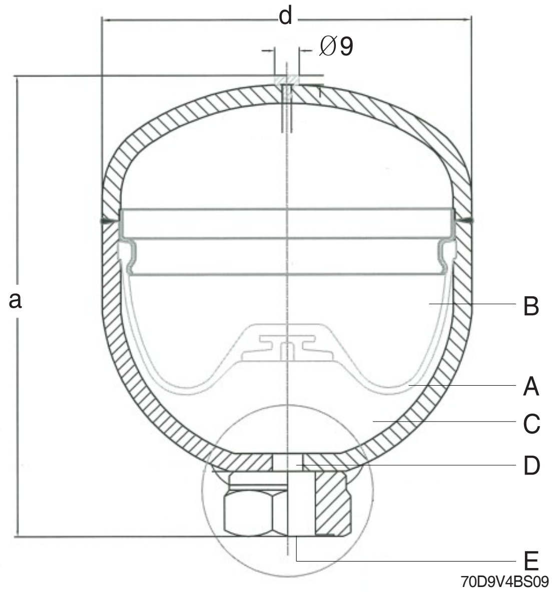
Item	Name	Hex size	Tightening torque
2	Solenoid valve	27 mm	45 Nm
3	Solenoid valve	27 mm	45 Nm
5	Check valve	22 mm	40 Nm
6	Check valve	22 mm	40 Nm
7	Cutoff valve	27 mm	50 Nm
8	Relief valve	27 mm	50 Nm

2) OPERATION

When the pump works, the oil under the pressure flows into P port.
The oil in P port is stored in the accumulator on A1 port.
As the pressure on P line rises to 90 bar, the cut off valve (7) starts cut-offing and the oil in the P port is unloaded. The pressure on P line goes down 80 bar by the minute leakage from valve and other factors.
At this pressure, the cut-off valve starts cutting.
This process is repeated in the regular period of 30~40 seconds.

7. BRAKE ACCUMULATOR

1) STRUCTURE



Item	Brake (2 EA)	RCV (1 EA)
Diameter (d)	122 mm	90 mm
Mounting height (a)	145 mm	120 mm
Nominal volume	0.75 ℓ	0.35 ℓ
Priming pressure	50 bar	15 bar
Operating medium	Oil	Oil
Operating pressure	Max. 210 bar	Max. 170 bar
Thread	M18×1.5	PF 1/2
Priming gas	Nitrogen	Nitrogen

A Fluid portion
B Gas portion
C Diaphragm
D Valve disk
E Flat port

2) OPERATION

(1) Purpose

Fluids are practically incompressible and are thus incapable of accumulating pressure energy. In hydropneumatic accumulators, the compressibility of a gas is utilized to accumulate fluid. The compressible medium used in the accumulators is nitrogen.

In braking systems, the purpose of the accumulators is to store the energy supplied by the hydraulic pump. They are also used as an energy reserve when the pump is not working, as a compensator for any losses through leakage, and as oscillation dampers.

(2) Operation

The accumulator consists of a fluid portion (A) and a gas portion (B) with a diaphragm (C) as a gas-tight dividing element. The fluid portion (A) is connected to the hydraulic circuit, causing the diaphragm accumulator to be filled and the gas volume to be compressed as the pressure rises.

When the pressure falls, the compressed gas volume will expand, thus displacing the accumulated pressure fluid into the circuit.

The diaphragm bottom contains a valve disk (D) which, if the diaphragm accumulator is completely empty, closes the hydraulic outlet, thus preventing damage to the diaphragm.

(3) Installation requirements

The accumulators can be fitted in the hydraulic circuit, directly on a component or in blocks on suitable consoles.

They should be fitted in as cool a location as possible.

Installation can be in any position.

(4) Maintenance of the accumulator

No special maintenance beyond the legal requirements is necessary.

The accumulator should be checked annually. It should be replaced if the initial gas pressure has fallen by more than 30% (Please refer to **Performance testing and checking of the accumulator**).

(5) Disposal of the accumulator

Before the accumulator is scrapped, its gas filling pressure must be reduced. For this purpose, drill a hole through gas chamber (B) using a drill approx. 3 mm in diameter. The gas chamber is located on the side opposite the threaded port above the welding seam around the center of the accumulator.

※ Wear safety goggles when doing this job.

(6) Performance testing and checking of the accumulator

The accumulator is gradually pressurized via the test pump; until the initial gas pressure is reached, the hydraulic pressure in the accumulator will rise abruptly. This is apparent from gauge M. If the initial gas pressure is more than 30% below the prescribed value, the accumulator needs to be replaced. If the measuring process needs to be repeated, wait for intervals of 3 minutes between the individual tests. Any accumulator whose initial gas pressure is insufficient must be scrapped following the instructions under Disposal of the accumulator.

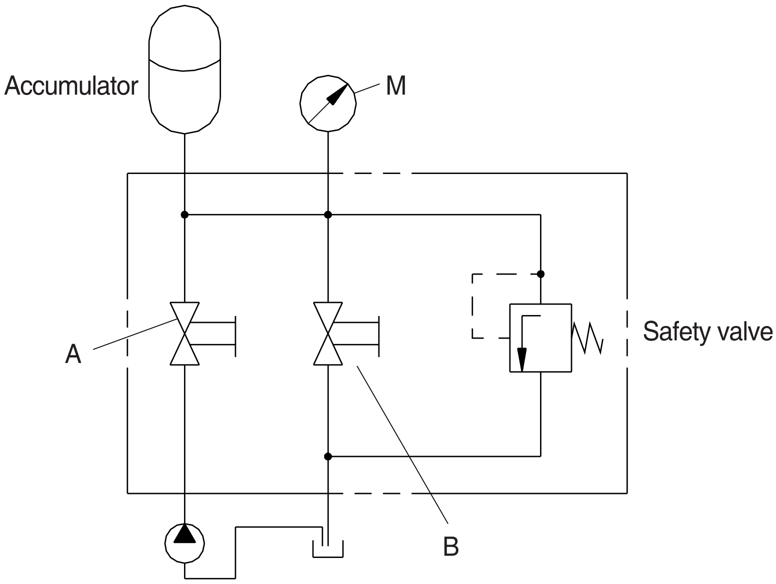
The amount of initial gas pressure can also be checked from the vehicle. Start the vehicle's engine. The pump will now supply oil to the accumulators. Until the initial gas pressure is reached, the hydraulic pressure in the accumulator will rise abruptly. This is apparent from the gauge in the cab. If the initial gas pressure is more than 30% below the prescribed value, that initial pressure lies outside the permissible range for at least one of the accumulators fitted in the vehicle. This accumulator can be traced only by using the method described above, i.e. all accumulators have to be individually tested. The accumulator whose initial gas pressure is insufficient must be replaced and scrapped following the instruction under Disposal of the accumulator.

(7) Repair work

△ When working on the braking system, always make sure that there is absolutely no pressure in the system. Even when the engine in switched off there will be some residual pressure in the system.

※ When doing repair work, make sure your environment is very clean.
Immediately close all open ports on the components and on pipes using plugs.

△ For safety reasons the accumulators need to be replaced as a whole if damaged.

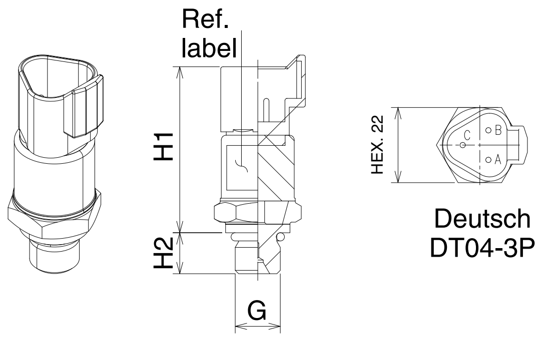


(770-3ATM) 4-23

8. PRESSURE SENSOR AND SWITCH

1) PRESSURE SENSOR

(1) Structure



· Tightening torque : 2.5 ~ 3.0 kgf·m
(18 ~ 21.7 lbf·ft)

Pin map	Function
A	+ Supply
B	- Supply
C	Output

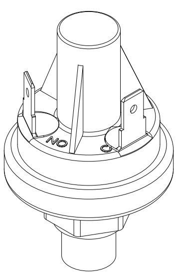
70D9V4BS10

Item	Medium	Thread (G)	H1 (mm)	H2 (mm)	Measuring range (bar)	Cut-off actuating pressure	Voltage (V)	Electircal connections
Charging pressure sensor (PS or PSS)	Oil	9/16-18 UNF	49	12	0 ~ 350	90 ~ 95 bar (1.52 ~ 1.58 V)	Max. 30	CD-3
Parking pressure sensor (PS1 or PSP)	Oil	9/16-18 UNF	49	12	0 ~ 350	90 ~ 95 bar (1.52 ~ 1.58 V)	Max. 30	CD-26

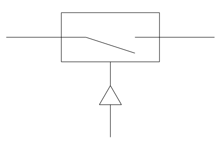
※ O-ring (S611-012001) : 11.89 × 1.98 (AS568-906, NBR Hs90)

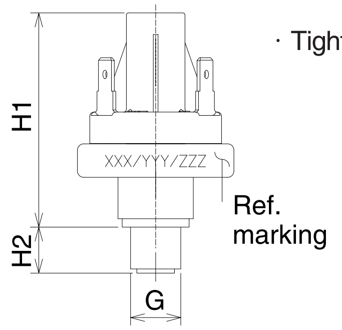
2) PRESSURE SWITCH

(1) Structure

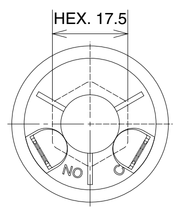


Normally open





· Tightening torque : 2.5 ~ 3.0 kgf·m
(18 ~ 21.7 lbf·ft)



70D9V4BS11

Item	Type	Medium	Thread (G)	H1 (mm)	H2 (mm)	Measuring range (bar)	Actuating pressure	Supply voltage	Electrical connections
Brake lamp pressure switch (B2 or BL)	Normally open	Oil	1/2-20 UNF	49	11	1 ~ 10	5 ± 1 bar (0.56 V)	Max. 45 V	Slip on CD-4

※ O-ring (S611-011001) : 10.52 × 1.82 (AS568-905, NBR Hs90)

2) OPERATION

(1) Purpose

The pressure switches are used to visually or audibly warn the driver of the pressure within the system.

(2) Make contact / circuit closer

The pressure switch can be fitted in the braking system or directly on one of its components.

The system pressure acts on an absorption area within the switch, making an electrical contact as the pressure on that area is increased. The resulting current is used to activate a warning facility, for instance.

(3) Break contact / circuit breaker

The pressure switch can be fitted in the braking system or directly on one of its components.

The system pressure acts on a absorption area within the switch, breaking an electrical contact as the pressure on that area is increased. The current is now broken, e.g. to deactivate a warning facility.

(4) Installation requirements

No special measures need to be taken.

(5) Maintenance of the pressure switch

No special maintenance beyond the legal requirements is necessary.

When using high-pressure cleaners on the vehicle, please make sure that the water jet is not directed at the pressure switch(Corrosion of contacts).

(6) Repair work

△ **When working on the braking system, always make sure that there is absolutely no pressure in the system. Even when the engine is switched off there will be some residual pressure in the system.**

※ When doing repair work, make sure your environment is very clean.
Immediately close all open ports on the components and on pipes using plugs.

※ For safety reasons the pressure switch needs to be replaced as a whole if damaged.

GROUP 2 OPERATIONAL CHECKS AND TROUBLESHOOTING

1. OPERATIONAL CHECKS

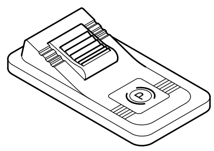
1) BRAKE PIPING

(1) Check pipes, hoses and joints for damage, oil leakage or interference.

(2) Operate brake pedal and check operating force when pedal in depressed. Check also change in operating force, and change in position of pedal when pedal is kept depressed.

2) PARKING BRAKE

(1) Check that parking brake can hold machine in position when loaded on 20% slope. If there is no slope available, travel at low speed and check braking effect of parking brake.



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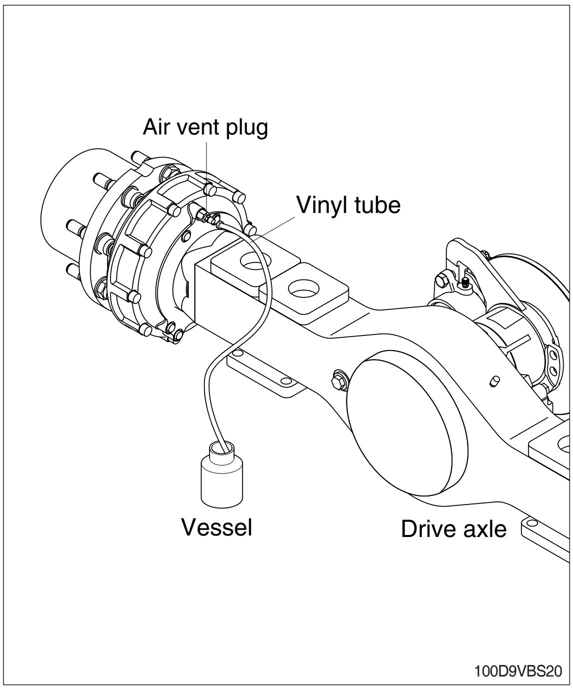
2. TROUBLESHOOTING

Problem	Cause	Remedy
Insufficient braking force	· Hydraulic system leaks oil. · Hydraulic system leaks air. · Disk worn. · Brake valve malfunctioning. · Hydraulic system clogged.	· Repair and add oil. · Bleed air. · Replace. · Repair or replace. · Clean.
Brake acting unevenly. (Machine is turned to one side during braking.)	· Tires unequally inflated. · Brake out of adjustment. · Disk surface roughened. · Wheel bearing out of adjustment. · Hydraulic system clogged.	· Adjust tire pressure. · Adjust. · Repair by polishing or replace. · Adjust or replace. · Clean.
Brake trailing.	· Pedal has no play. · Piston cup faulty. · Brake valve return port clogged. · Hydraulic system clogged. · Wheel bearing out of adjustment.	· Adjust. · Replace. · Clean. · Clean. · Adjust or replace.
Brake chirps	· Brake trailing. · Piston fails to return. · Disk worn. · Disk surface roughened.	· See above. Brake trailing. · Replace. · Replace. · Repair by polishing or replace.
Brake squeaks	· Disk surface roughened. · Disk worn. · Excessively large friction between disk plate.	· Repair by polishing or replace. · Replace. · Clean and apply brake grease.
Large pedal stroke	· Brake out of adjustment. · Hydraulic line sucking air. · Oil leaks from hydraulic line, or lack of oil. · Disk worn.	· Adjust. · Bleed air. · Check and repair or add oil. · Replace.
Pedal dragging.	· Twisted push rod caused by improperly fitted brake valve. · Brake valve seal faulty.	· Adjust. · Replace.

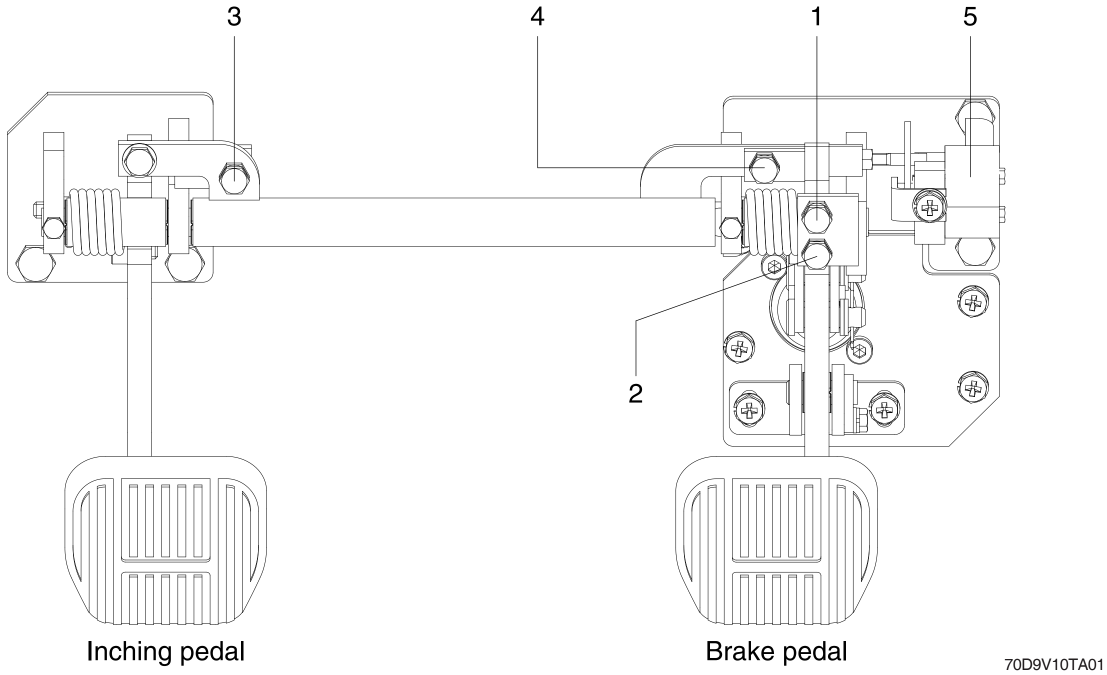
GROUP 3 TESTS AND ADJUSTMENTS

1. AIR BLEEDING OF BRAKE SYSTEM

1) Air bleeding should be performed by two persons :
   One rides on truck for depressing and releasing brake pedal : the other person is on the ground and removes cap from air vent plug on wheel cylinder.
2) Block the front wheel securely and apply parking brake.
3) Start the engine.
4) Attach a vinyl tube to air vent plug and immerse other end of tube into a vessel filled with hydraulic oil.
5) Loosen air vent plug by turning it 3/4 with a wrench. Depress brake pedal to drain oil mixed with air bubbles from plug hole.
6) Depress brake pedal until no air bubbles come out of air vent plug hole.
7) After completion of air bleeding, securely tighten air vent plug. Install cap on plug.
8) Same way for the opposite side.



2. ADJUSTMENT OF PEDALS



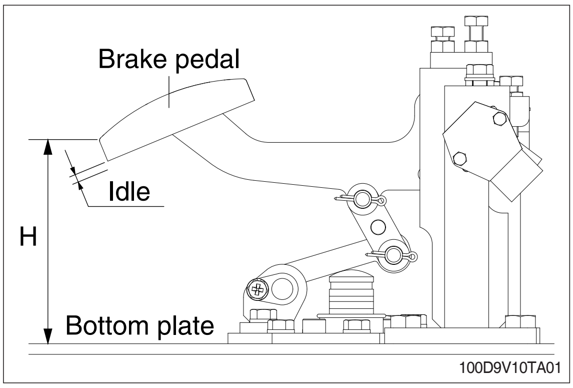
1	Brake stopper bolt	3	Inching stopper bolt	5	Inching sensor
2	Brake storke limit bolt	4	Brake&inching pedal interlock bolt		

1) Brake pedal

· Adjust the brake stopper bolt (1) so that pedal height is "H".

Unit : mm

H	IDLE
149±1	0



2) Inching pedal

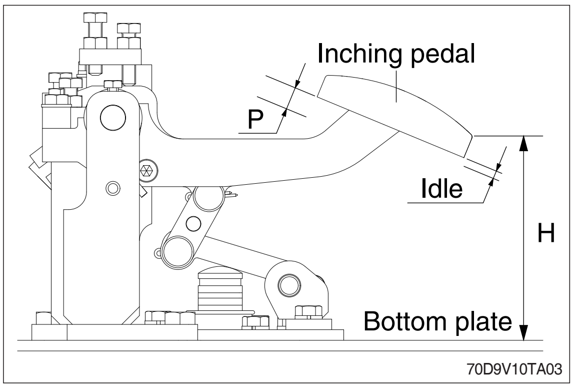
· Adjust inching stopper bolt (3) so that pedal height is "H".

· Adjust rod of inching cable so that inching pedal play is idle stroke when pedal height is "H".

· Adjust the brake and inching pedal interlock bolt (4) so that brake pedal interconnects with inching pedal at inching pedal stroke "P".

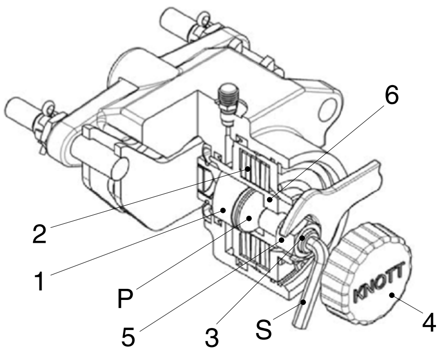
Unit : mm

H	P	IDLE
149±1	10	3



3. EMERGENCY RELEASE OF THE PARKING BRAKE

After the failure of the pressure release the parking brake by using following manual procedure.



100D7BS117

1	Thrust bolt	4	Screw cap	P	Even surface
2	Bank of cup springs	5	Lock nut	S	Socket wrench
3	Adjusting screw	6	Piston		

1) The vehicle has to be secured against rolling away.
2) Release the screw cap and unscrew
3) Release the lock nut (size 24 or 30) and turn the adjusting screw with socket wrench size 8 or 10 manually counter-clockwise until the brake disc is free.

⚠ **For the emergency release is an actuation torque of 40 Nm respectively 70 Nm required.**

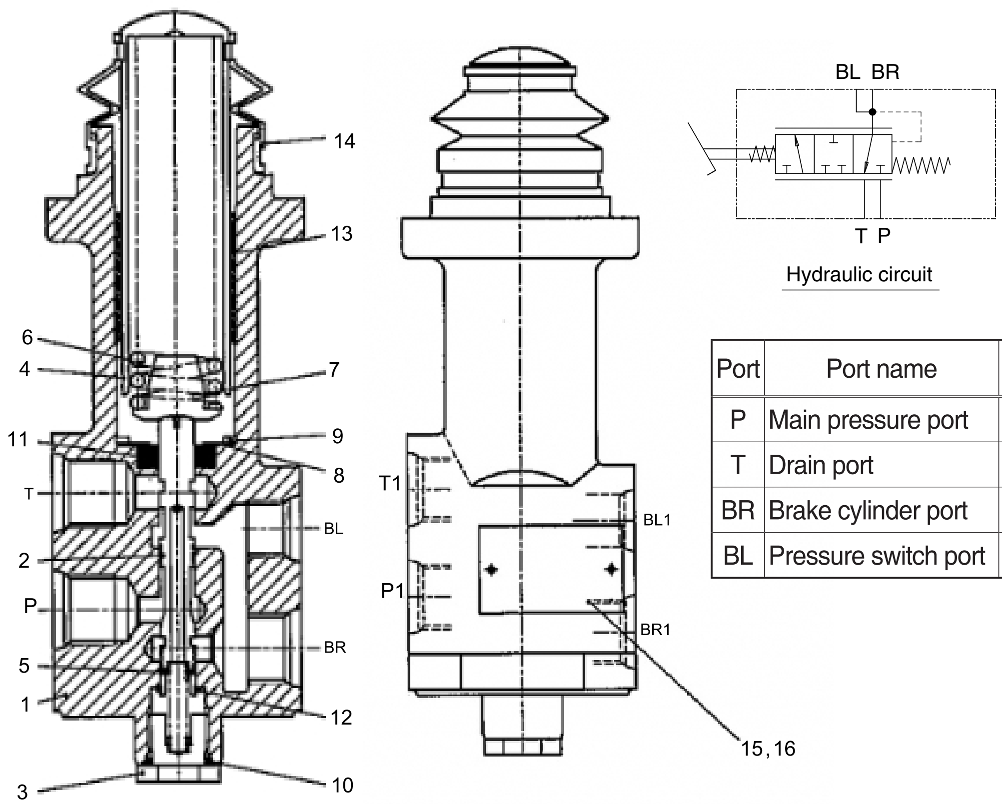
4) Mount the lock nut and the screw cap and tighten both as far as possible manually. (protection against dirt)

⚠ **Now, the vehicle do not have any brake function. The vehicle must be secured against moving away with proper means. Before putting the vehicle into operation again, the brake has to be adjusted again. Refer to previous page. "Assembly and basic setting regulations".**

GROUP 4 DISASSEMBLY AND ASSEMBLY

1. BRAKE VALVE

1) STRUCTURE



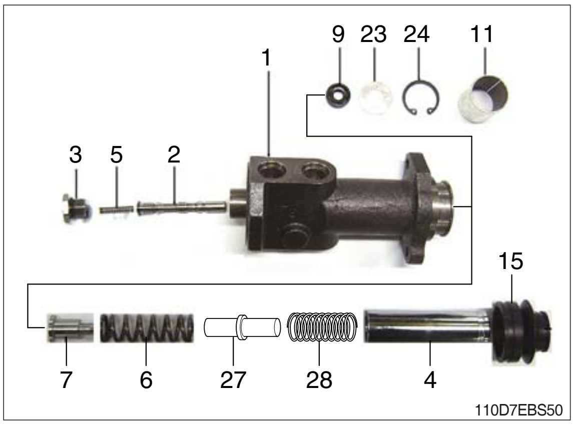
Port	Port name	Port size
P	Main pressure port	PF 3/8
T	Drain port	PF 3/8
BR	Brake cylinder port	PF 3/8
BL	Pressure switch port	PF 1/4

160D9VBS07

1	Valve body	7	Spring retainer	13	DU bushing
2	Spool	8	Plain washer	14	Rubber cover
3	Plug	9	Snap ring	15	Name plate
4	Brake holder	10	O-ring	16	Drive screw
5	Lower spring	11	Oil seal		
6	Main spring	12	Snap ring		

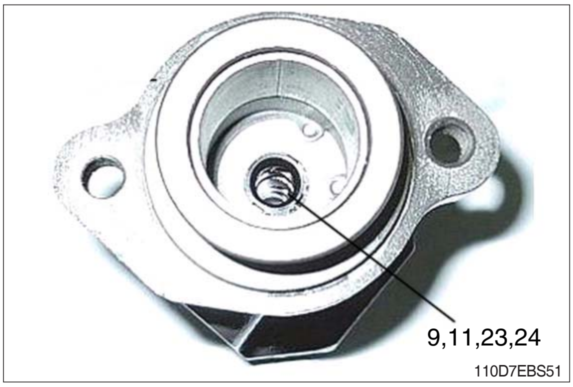
2) REASSEMBLY

(1) Body assembly



1	Body
2	Spool
3	Plug
4	Holder
5	Spring
6	Main spring 1
7	Spring retainer 1
9	Oil seal
11	DU bushing
15	Rubber cover
23	Plain washer
24	Snap ring
27	Spring retainer 2
28	Main spring 2

① Install oil seal (9), plain washer (23), snap ring (24), DU bushing (11).
- Tool : Jig for dry bearing, snap ring plier.



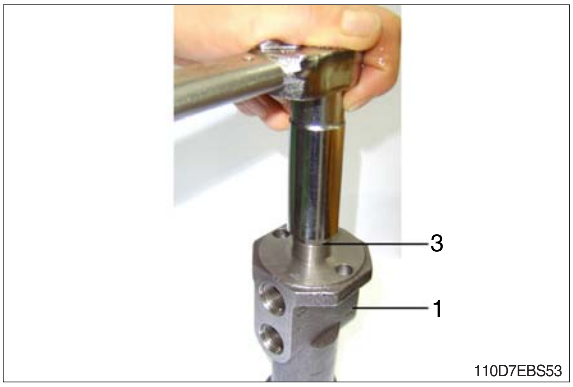
② Install spool (2) into body (1).

③ Tighten plug (3)

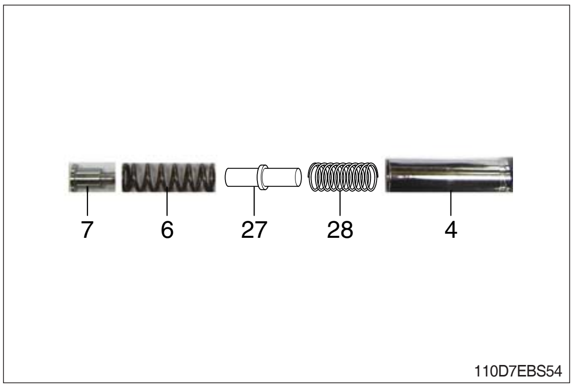
- Tool : 19 ㎜ spanner
- Tightening torque : 14.0~16.5 ㎏f · m

※ Press-in the DU bushing (11) with a exclusive jig.

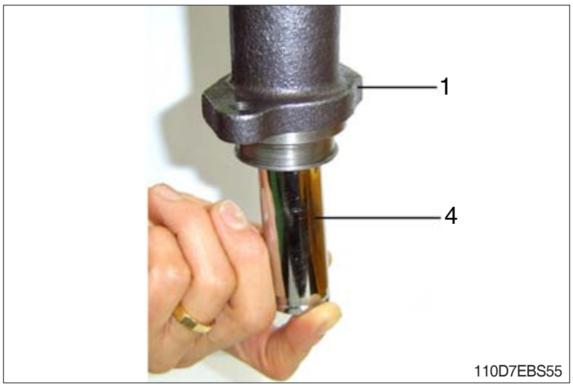
※ Be careful of dust and scrap after washing the parts.



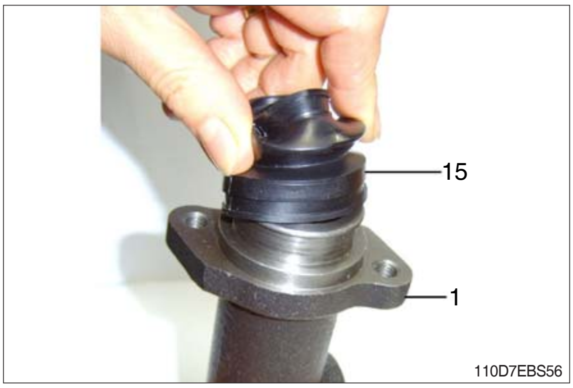
④ Spring retainer (7, 27), main spring (6, 28) and holder (4).



⑤ Holder (4) → Body (1)



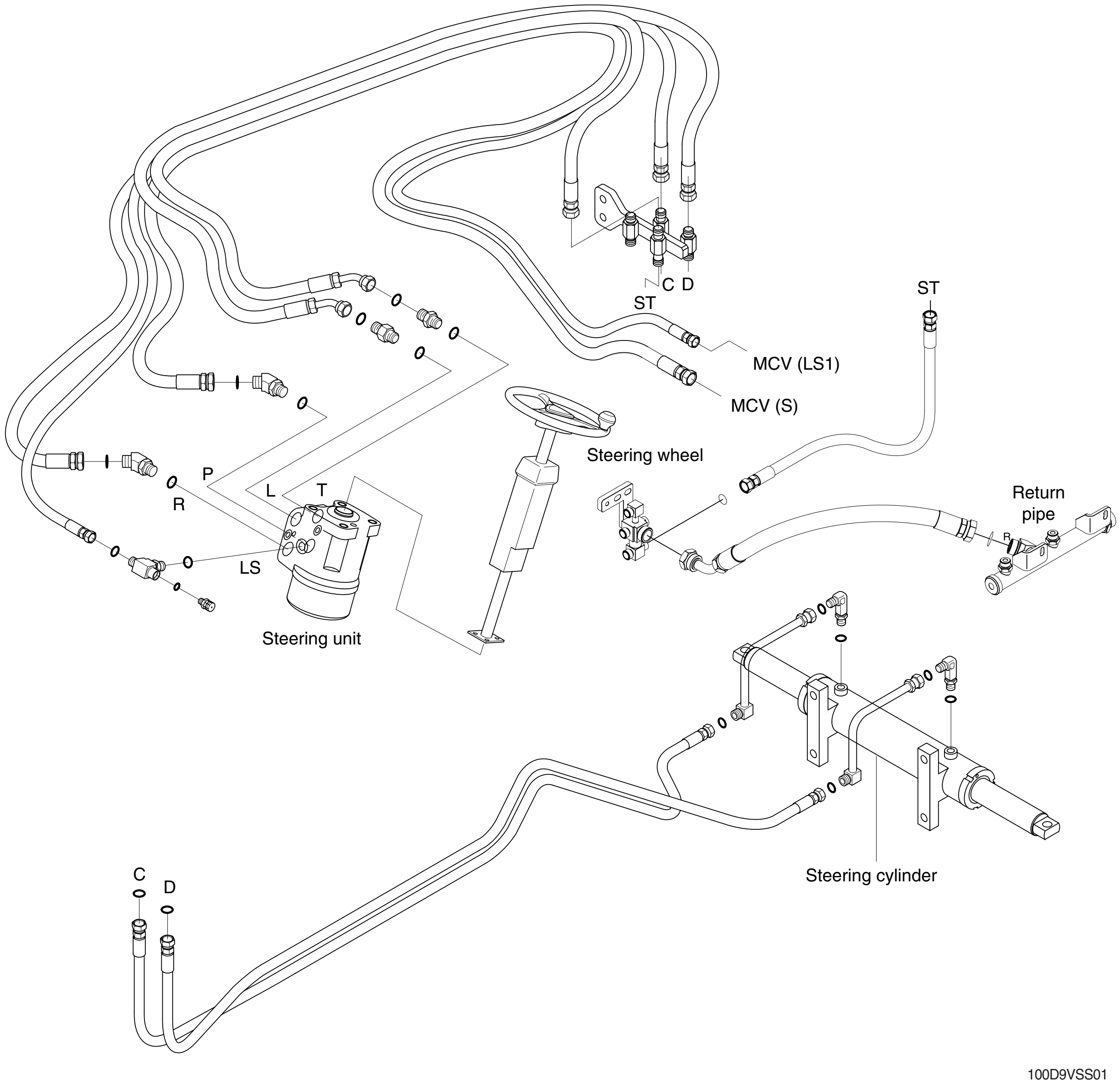
⑥ Rubber cover (15)



SECTION 5 STEERING SYSTEM

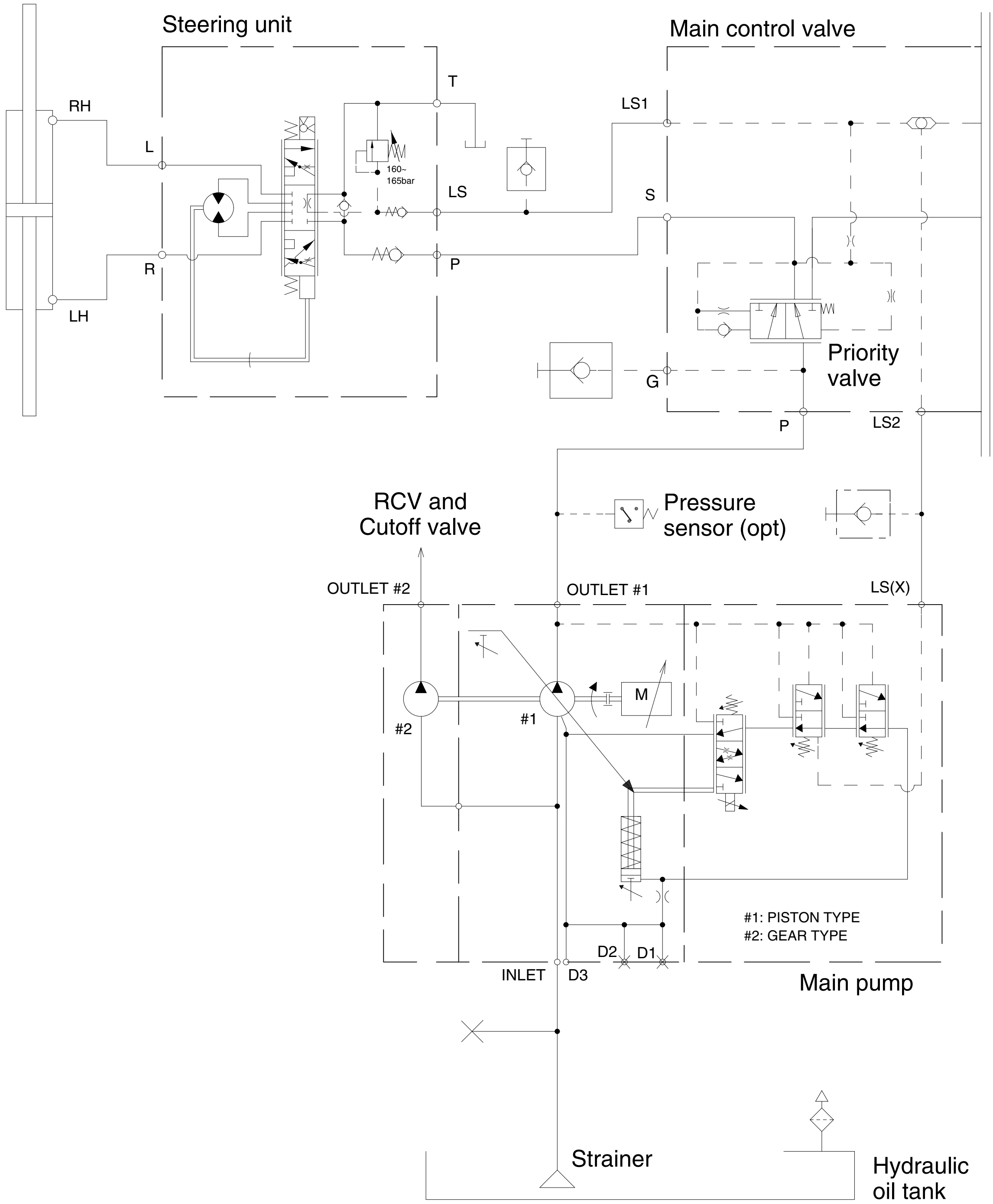
GROUP 1 STRUCTURE AND FUNCTION

1. OUTLINE



The steering system for this truck is composed of main pump, steering wheel assembly, steering unit, priority valve (built in MCV), steering cylinders, steering axle and piping. The steering axle supports the forklift weight with the rear axle, contains a cylinder and controls the position of the rear tires. The steering axle body is unit structure having steering knuckles installed to its both ends by means of king pins. Hub and wheel are mounted through bearing to spindle of knuckle. When the steering wheel is turned, the rotation torque is transmitted to the steering unit, and the hydraulic oil in the steering unit is transmitted to the steering axle hydraulic cylinder through the hose, so that the forklift moves left and right. The force produced by the steering cylinders moves the knuckle of rear tires through the intermediate link. Refer to the illustration for the location of the steering system components.

2. HYDRAULIC CIRCUIT



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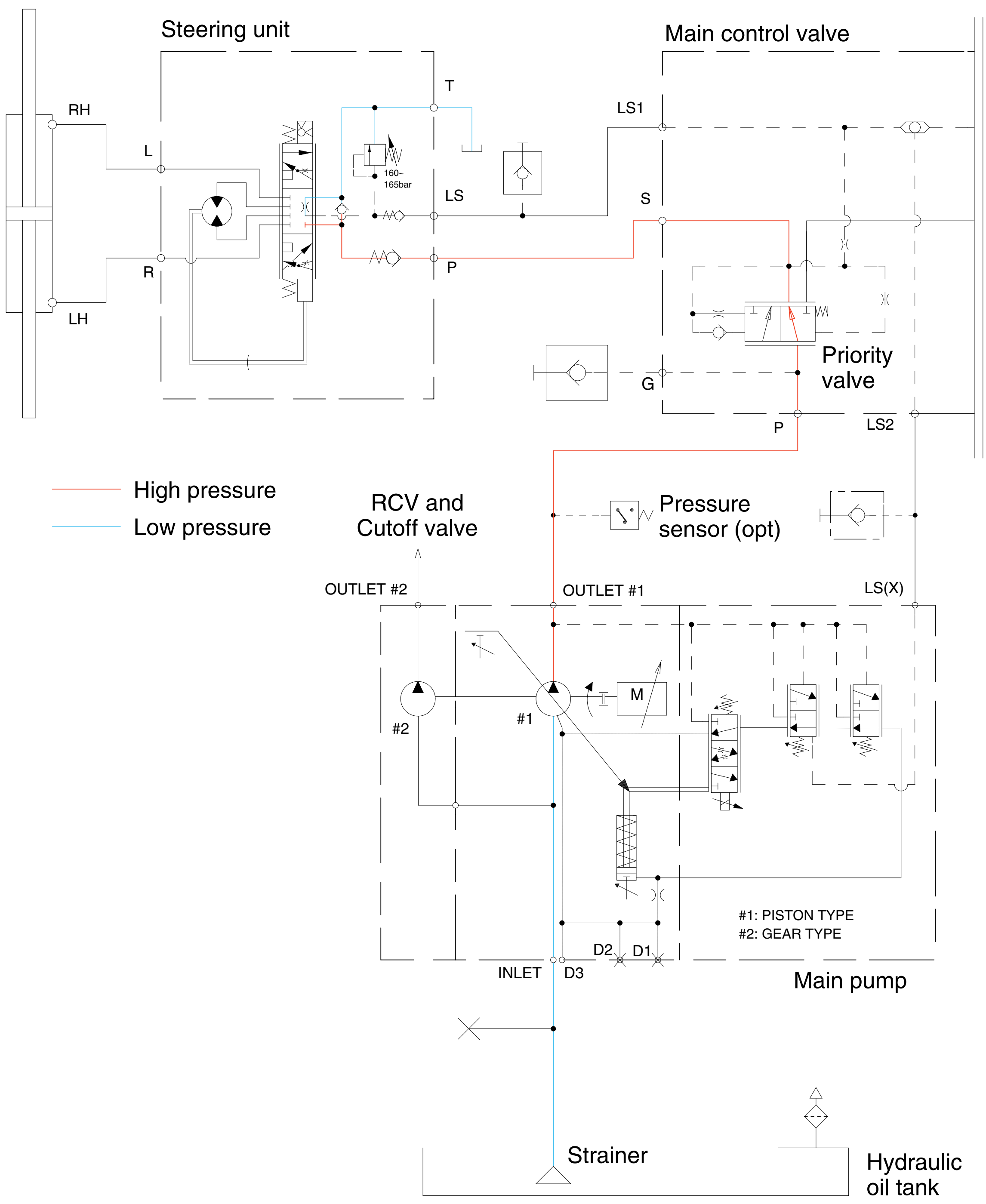
The hydraulic oil discharged from the pump flows to the priority valve built in the main control valve. When the driver operates the steering wheel, the steering unit is supplied with pressure oil preferentially by the priority valve operation circuit. The oil passages in the steering unit are changed over to direct the hydraulic pressure from the priority valve to the steering cylinder, which extends or contracts depending on the hydraulic pressure, thereby steering the truck. The excess flow of the pump generated at this time flows to the priority valve and the tank through the priority valve EF flow path.

1) NEUTRAL



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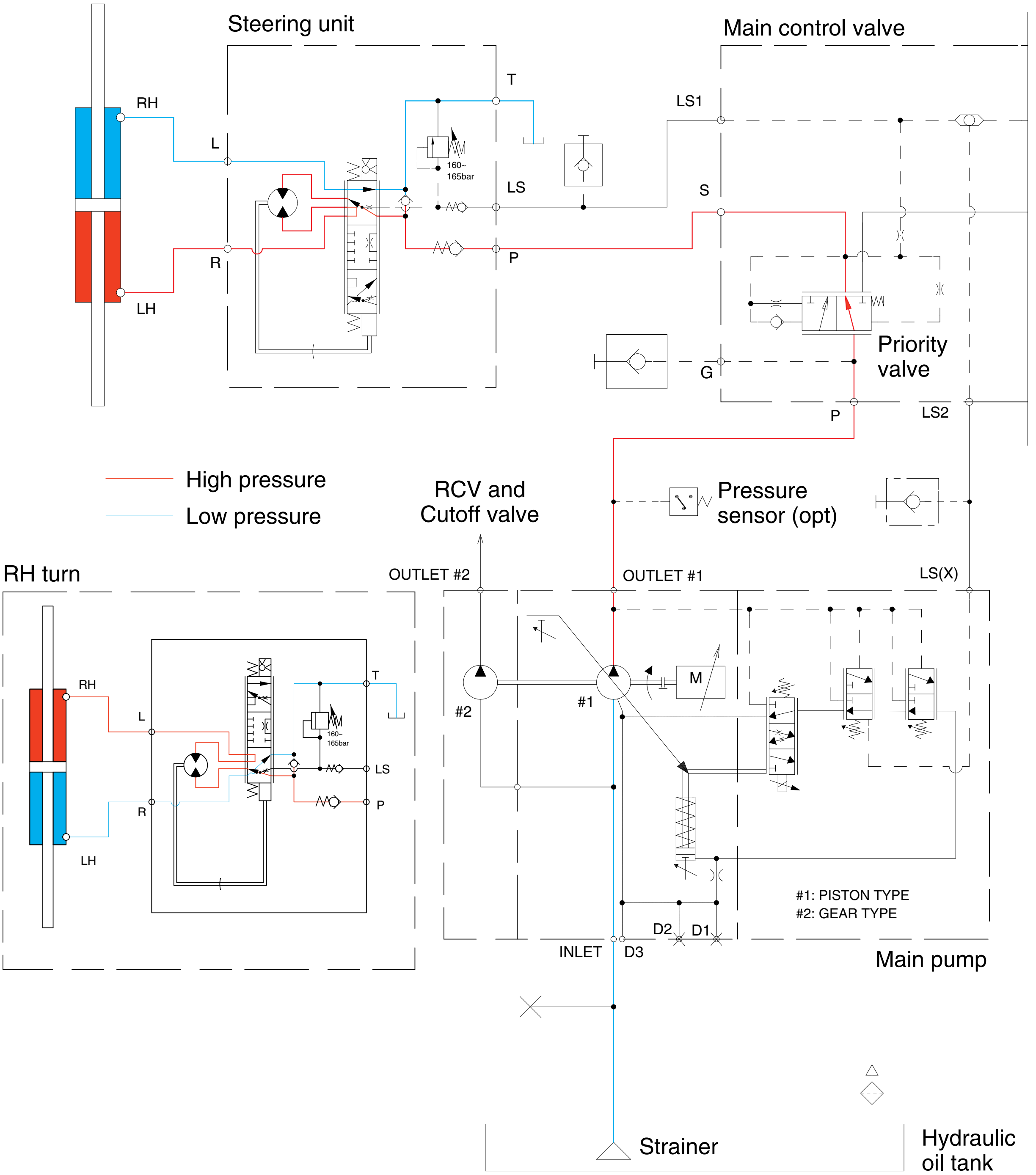
When the engine is running and the steering wheel is not being turned, the steering unit spool and sleeve set are aligned (neutral position). Oil flow through the valve is blocked from entering the left or right steering ports.The pressure on the pilot side of the priority valve spool controls the spool to move in the opposite direction (spring direction). This movement causes the pump discharge flow to flow to the priority valve. In this neutral position, a small amount of oil is constantly bled through the dynamic orifice. The oil then flows into the LS hose piping and returns to the tank through the steering unit spool and sleeve set. This dynamic flow prevents initial hard spot when steering is turned rapidly or abruptly.

2) LEFT OR RIGHT TURN

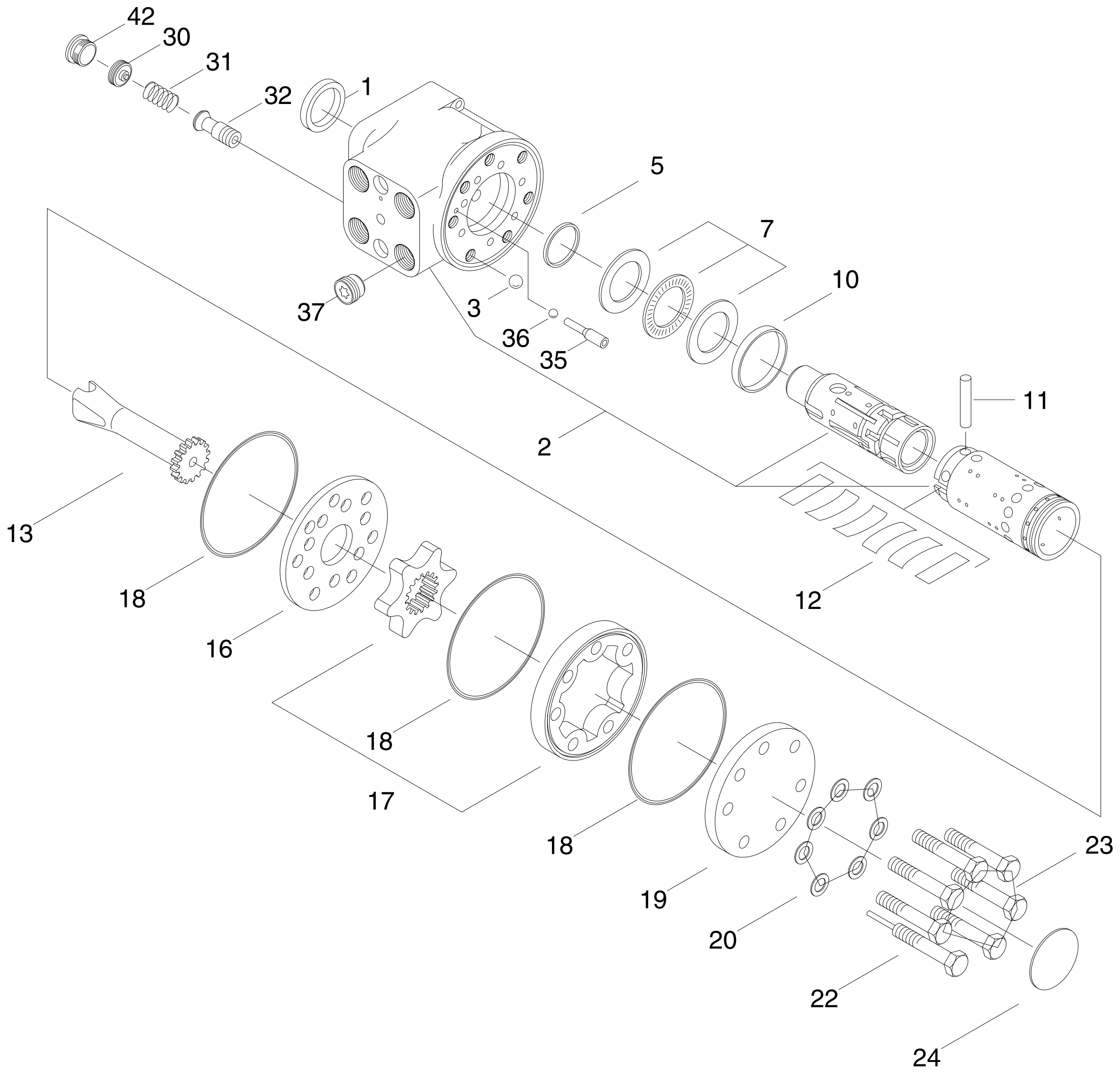


100D9V5SS12

When the engine is running and the steering wheel is being turned, the steering unit spool and sleeve set rotates. The passage opens to allow oil to flow into the internal gerotor gear of the steering unit. The oil flow causes the gerotor pump to rotate. Oil flows back into the steering valve spool and sleeve set and out to the left or right steering ports depending on the direction of steering wheel rotation. At the same time, the LS circuit blocks the return to the hydraulic tank and is connected to the S port to sense the pressure required to turn the steering wheel. As the required pressure increases or decreases in the LS circuit, the priority valve spool moves to meet the flow and pressure required to rotate the tire. When the steering cylinder reaches the end of the stroke, a relief valve in the steering circuit releases LS pressure into the hydraulic tank.

3. STEERING UNIT

1) STRUCTURE

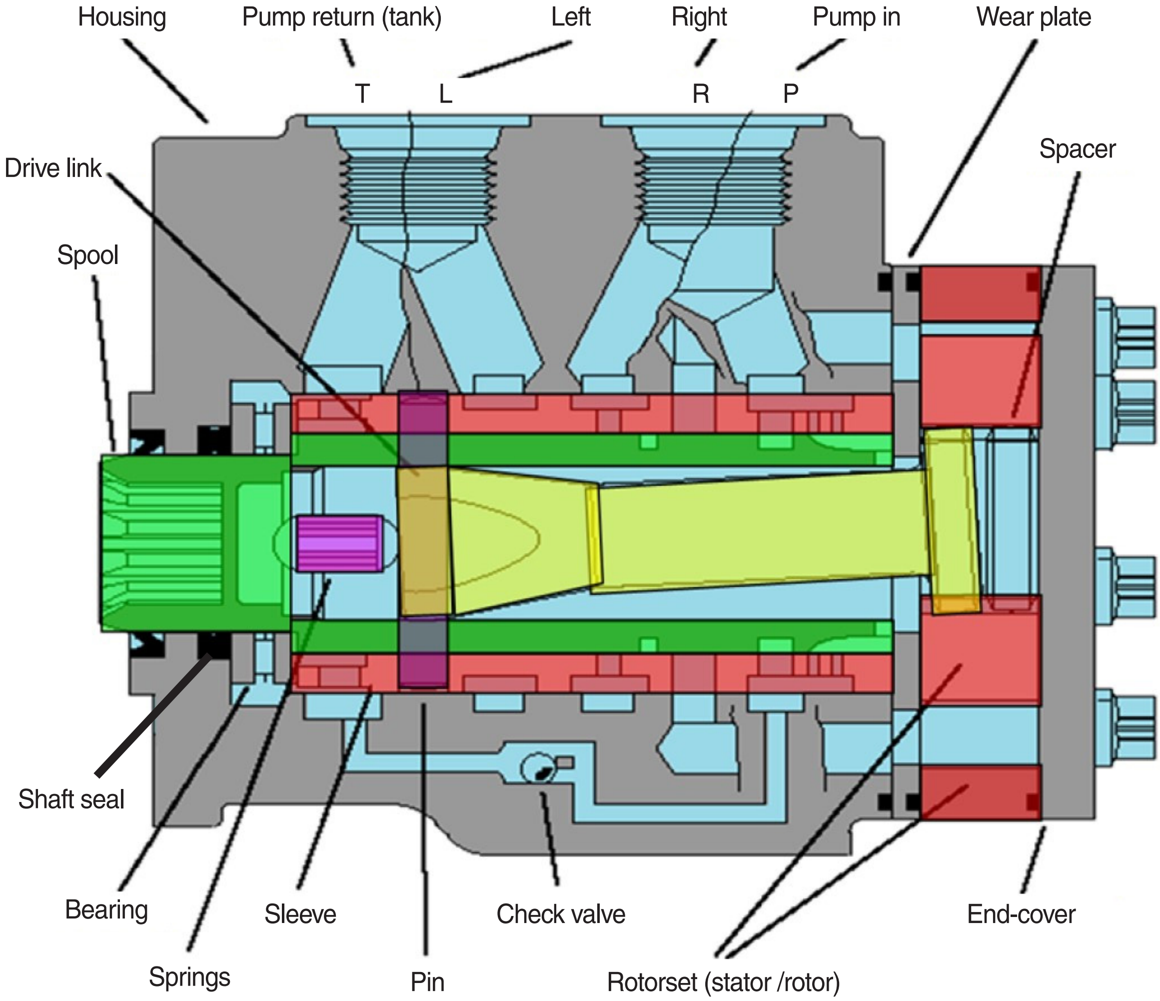


70D9V5SS06

1	Dust seal ring	13	Cardan shaft	24	Model / Code label
2	Housing and spool/sleeve	16	Distributor plate	30	Adjusting screw
3	Ball	17	Gearwheel set	31	Spring
5	Shaft seal	18	O-ring	32	Piston
7	Bearing assembly	19	End over	35	Ball
10	Ring	20	Washer	36	Ball
11	Cross pin	22	Pin bolt screw	37	Check valve
12	Set of springs	23	Screw	42	Plug

※ Seal kit (EA) : 1 (1), 5 (1), 18 (3), 20 (7)

2) OPERATION

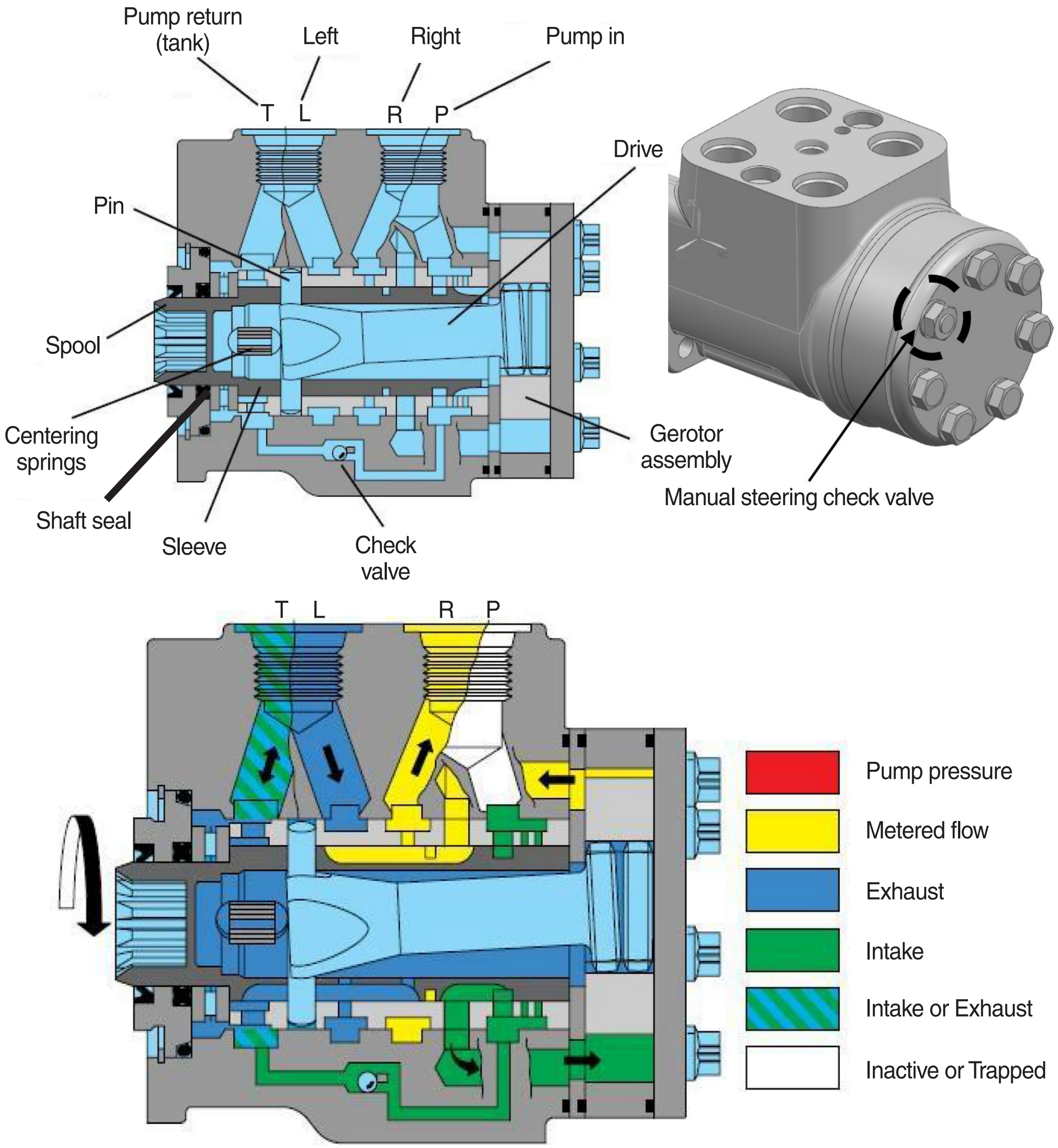


35D9VB5SS76

The steering unit is a closed center circuit and consists of a rotary valve (spool + sleeve set) and a metering gear set. With a LS (load sensing) dynamic circuit, even when the viscosity of the oil is low in winter, it operates smoothly without jamming the steering wheel and reduces the impact of the steering wheel due to rapid rotation or kickback of the tire. The LS circuit in the valve is used to control the operation of the priority valve spool. Steering relief valve oil flows through an internal flow path to the tank return line. The relief valve is set lower than the AUX relief valve set pressure in the MCV.

· Manual steering check valve : converts unit to hand operated pump for limited manual steering.
· Inlet check valve (P port) : Prevents oil from returning through the steering unit when pressure on the cylinder side is greater than pressure on the inlet side to prevent steering wheel kick.
· LS relief valve : Limits maximum pressure in the steering circuit.

3) MANUAL STEERING (EMERGENCY)



35D9VBSS77

When the engine is not running and the steering wheel is being turned, the priority divider valve spool is pushed against the end stop by spring force. In this position, oil flow opens to the spool and sleeve set. As the steering wheel turns, a vacuum is created in the supply line between the priority valve and the steering unit spool and sleeve set. As the spool and sleeve set rotates, a passage opens to allow oil to flow to the inner gerotor gear set of the steering unit. Oil trapped in the steering port passes through the manual steering check valve and feeds through the gerotor gear to the opposite side of the steering cylinder, enabling manual steering.

4) RELIEF VALVE PRESSURE TEST AND ADJUSTMENT

(1) Test specification

· Enine speed : low idle rpm

· Oil temperature : 50 ± 5 ℃ (122 ± 9 ˚F)

· Steering relief set pressure : 135 ~ 140 bar (1958 ~ 2031 psi)

(2) Pressure test and adjustment

① Operate hydraulic system until the oil temperature is within test specification. See hydraulic warmup procedure.

② Lower the fork to the ground, stop the engine, and apply the parking brake switch.

③ Connect pressure gauge to "LS" pressure check port of the steering unit as shown the illustration.

④ Operate engine at test specifications.

⑤ Turn the steering wheel all the way to a stop and hold it there.

⑥ Check pressure gauge reading. Compare the readings and specifications.

⑦ Loosen the relief valve plug. Turn the adjusting screw to adjust the pressure.

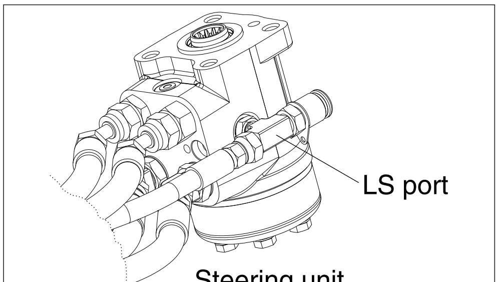
· Tightening torque : 6.6 ± 0.5 kgf·m (47.9 ± 3.7 lbf·ft)

· If pressure is lower than specification, turn relief valve adjusting screw clockwise.

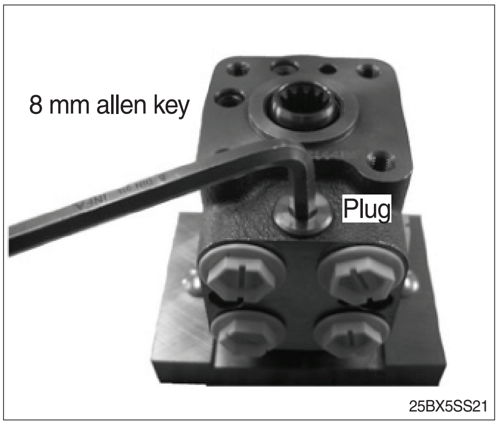
· If the pressure is higher than the specification, turn the adjusting screw counterclockwise.

⑧ Repeat Step ⑥, ⑦. If pressure is to specifications, remove test equipment.

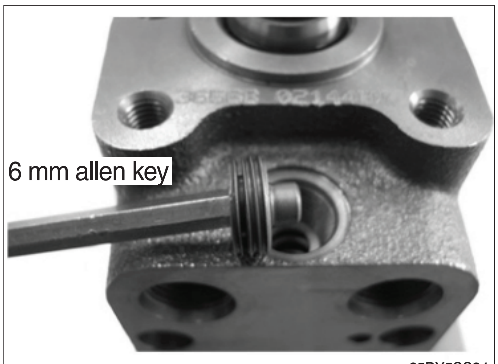
△ **Do not permit dirt or other contaminants to enter the hydraulic system. Disconnected hoses, tubes, open valves, cylinder fittings, and ports should be protected with clean caps or plugs.**



70D9V5SS78



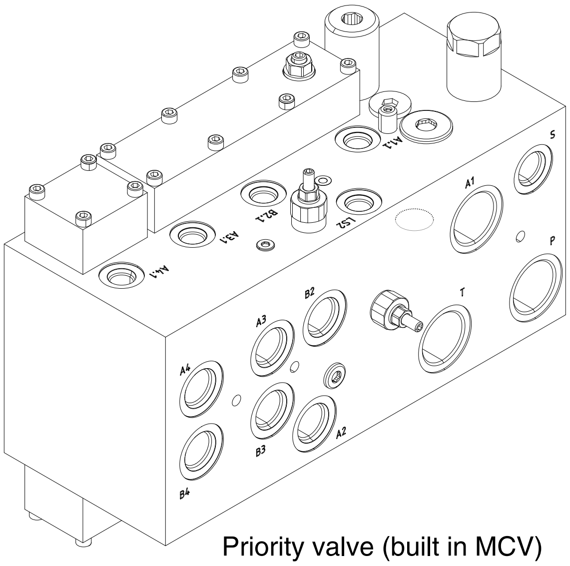
25BX5SS21



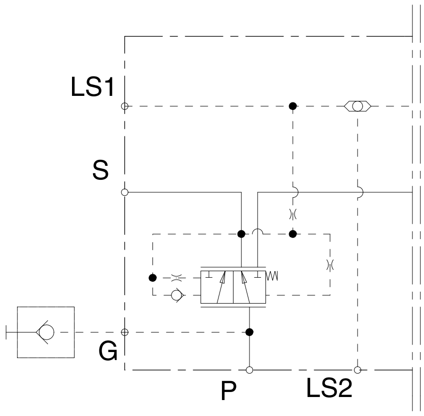
25BX5SS34

4. PRIORITY VAVLVE

1) STRUCTURE



Priority valve (built in MCV)



Hydraulic circuit

70D9V5SS07

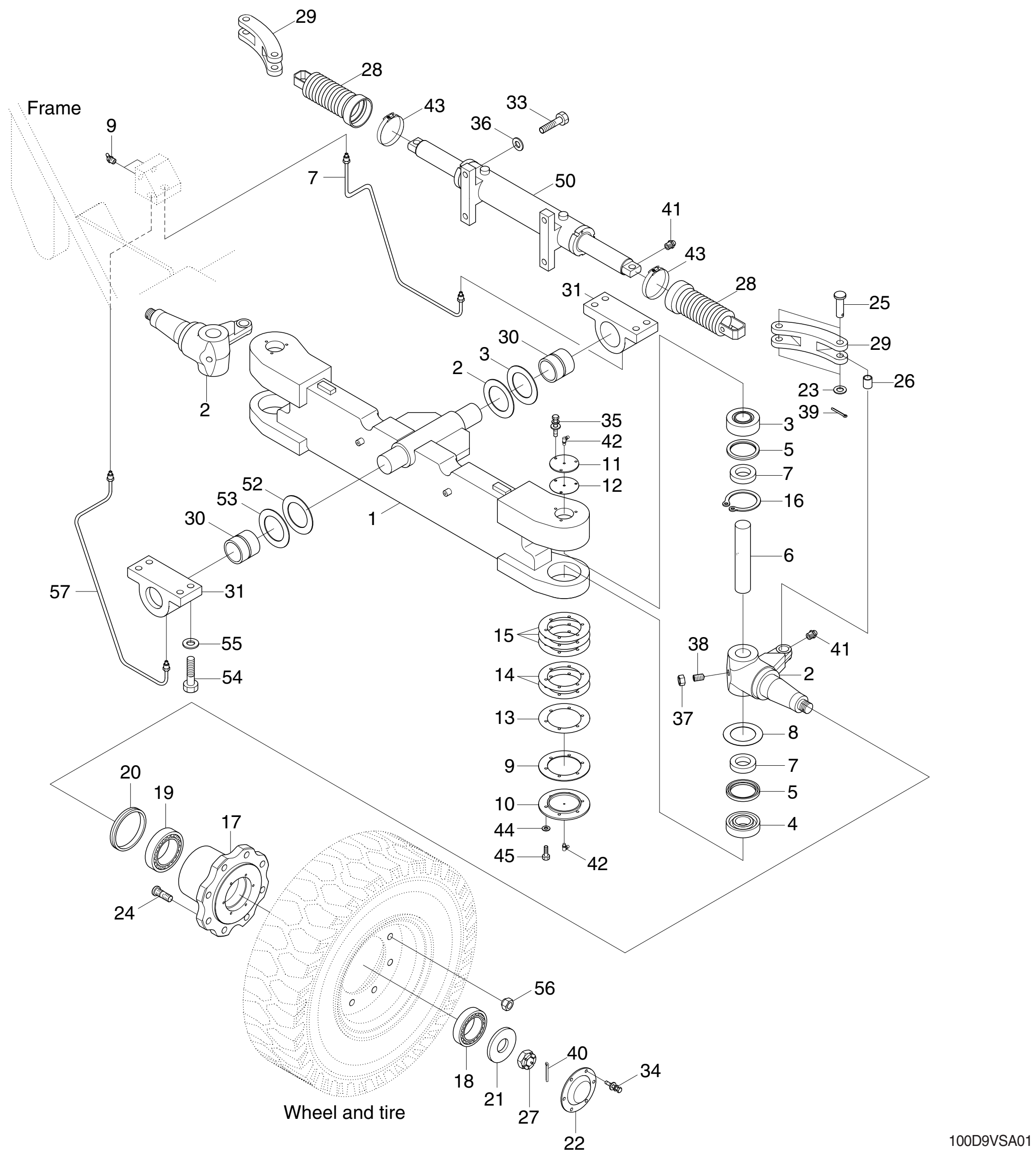
2) OPERATION

The oil from the hydraulic pump flows to the priority valve.
The priority valve supplies a flow of oil to the steering system and lift, tilt system.
The steering flow is controlled by the steering unit to operate the steering cylinder.
The remainder of the oil flow from the pump flows to the main control valve.

5. STEERING AXLE

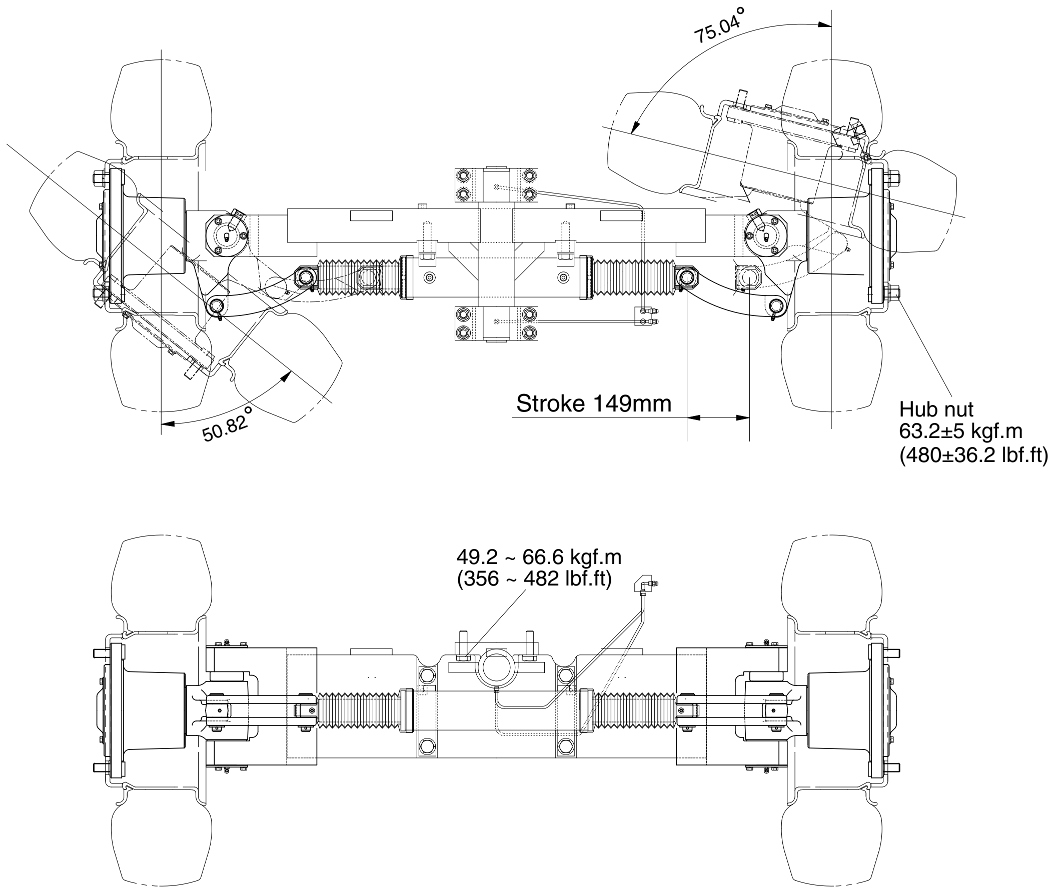
1) STRUCTURE

※ Do not remove the stopper bolt unless necessary.



1	Steering axle	15	Shim	28	Boot	42	Grease nipple
2	Axle knuckle	16	Retainer ring	29	Steering link	43	Hose clamp
3	Taper roller bearing	17	Axle hub	30	Pin bushing	44	Plain washer
4	Taper roller bearing	18	Taper roller bearing	31	Support	45	Hex bolt
5	Oil seal	19	Taper roller bearing	33	Hex bolt	50	Steering cylinder
6	King pin	20	Oil seal	34	W/washer bolt	52	Thrust washer
7	Spacer	21	Washer	35	W/washer bolt	53	Thrust washer
8	Spacer	22	Hub cap	36	Harden washer	54	Hex bolt
9	Gasket	23	Special washer	37	Hex nut	55	Harden washer
10	Cover	24	Wheel bolt	38	Set bolt	56	Wheel nut
11	Cover	25	Link pin	39	Split pin	57	Grease pipe
12	Gasket	26	Pin bushing	40	Split pin	58	Grease pipe
13	Shim	27	Slot nut	41	Grease nipple	59	Grease nipple
14	Shim						

2) TIGHTENING TORQUE AND SPECIFICATION

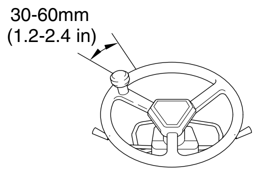


100D9VSA02

Type	Unit	Center pin support single shaft
Structure of knuckle	-	Elliott type
Toe-in	degree	0
Camber	degree	0
Caster	degree	0
King pin angle	degree	0
Max steering angle of wheels(Inside/Outside)	degree	75.04/50.82
Tread	mm (in)	1700 (66.9)

GROUP 2 OPERATIONAL CHECKS AND TROUBLESHOOTING

1. OPERATIONAL CHECKS

Check item	Checking procedure
Steering wheel 	· Set rear wheels facing straight forward, then turn steering wheel to left and right. Measure range of steering wheel movement before rear wheel starts to move. Range should be 30~60 mm at rin of steering wheel. If play is too large, adjust at gear box. Test steering wheel play with engine at idling.
Knuckle	· Check knuckle visually or use crack detection method. If the knuckle is bent, the tire wear is uneven, so check tire wear.
Steering axle	· Put camber gauge in contact with hub and measure camber. If camber is not within 0±0.5° ; rear axle is bent. · Ask assistant to drive machine at minimum turning radius. · Fit bar and a piece of chalk at outside edge of counterweight to mark line of turning radius. · If minimum turning radius is not within±100 mm (±4 in)of specified value, adjust turning angle stopper bolt. Min turning radius (Outside) 100D-9V: 3965 (13' 0")
Hydraulic pressure of power steering	Remove plug from the LS port of the steering unit and install oil pressure gauge. Turn steering wheel fully and check oil pressure. ※ Oil pressure : 160 ~ 165 bar (2320 ~ 2390 psi)

2. TROUBLESHOOTING

1) STEERING UNIT

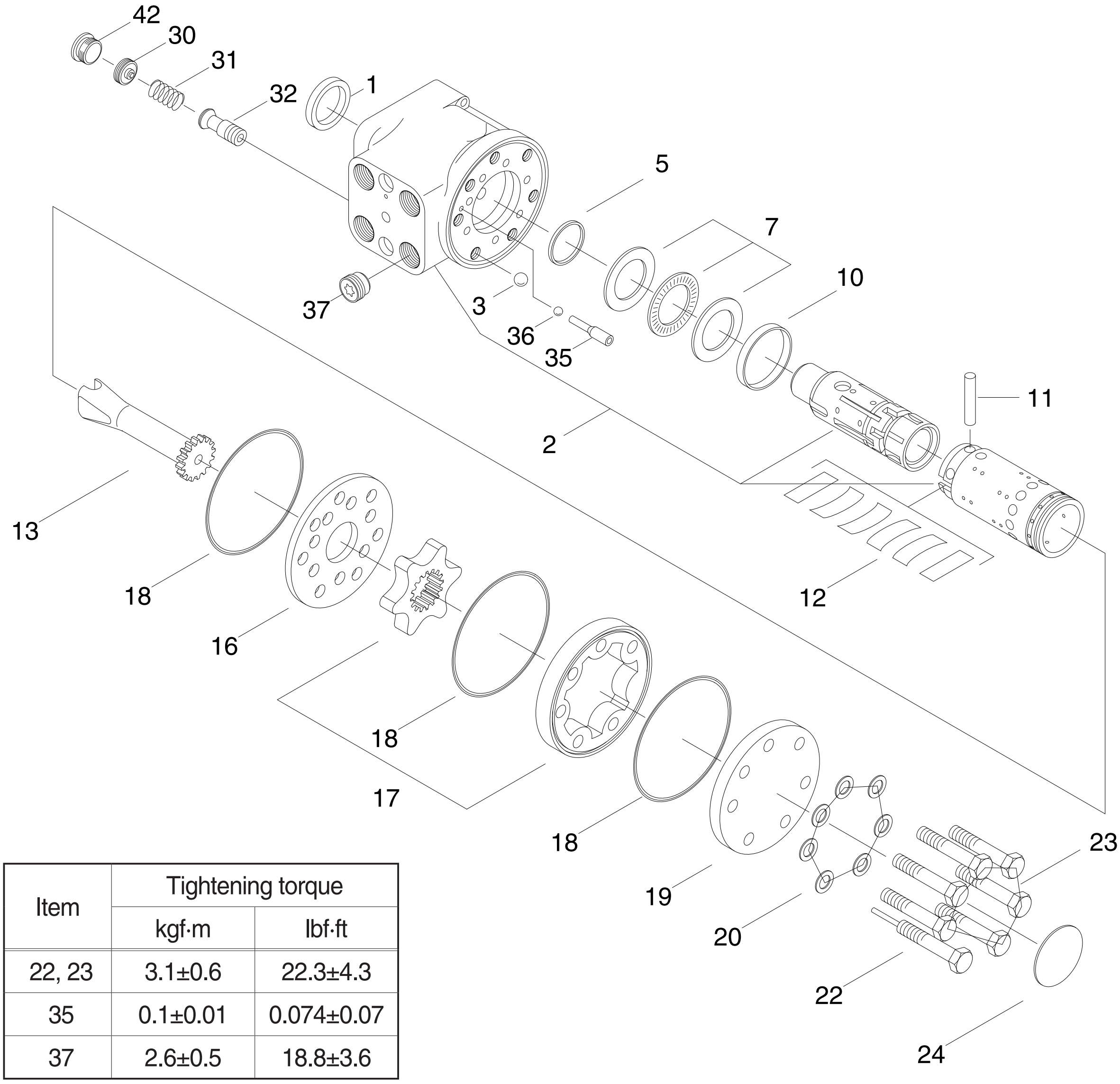
Problem	Cause	Remedy
The steering wheel cannot be rotated.	· The steering unit column shaft is installed incorrectly or damaged. · The oil pressure does not rise. · The relief valve is faulty or not closed. · LS line (Hose) incorrectly connected. · The piping is damaged.	· Inspect and correct or replace. · Inspect and adjust the relief set pressure. · Inspect and correct. · Inspect and correct. · Replace.
The steering wheel is heavy.	· The tire inflating pressure is low. · The oil pressure does not rise. · The high and low pressure hoses are connected reversely. · The power steering cylinder rod is bent or the piston is sticking.	· Adjust the inflating pressure. · Inspect and adjust the relief set pressure. · Inspect and correct. · Inspect and correct or replace.

Problem	Cause	Remedy
The oil pressure does not rise.	· The high and low pressure hoses are connected reversely. · The relief valve is faulty or not closed. · The oil pump function is degraded or the oil volume is insufficient. · The power steering cylinder piston packing is damaged.	· Inspect and correct. · Inspect and correct. · Inspect and correct or replace. · Replace.
The steering wheel does not return properly.	· The tire inflating pressure is low. · The steering unit spool does not move smoothly. · The steering knuckle sliding motion is improper.	· Adjust the inflating pressure. · Correct or replace the steering unit · Add the lubricant or correct.
The steering wheel does not return (lateness) to the neutral position when released.	· The steering unit spool does not move smoothly. · The steering unit column shaft is damaged. · The centering spring is damaged. · The piping is blocked (crushed or clogged).	· Correct or replace the steering unit. · Replace the steering unit · Replace. · Inspect and correct or replace.
The play is excessive and the vehicle wobbles.	· Oil moves in the steering unit. · The steering unit spool is not moving correctly. · Air is sucked from the piping. · The steering unit column shaft is defective.	· Replace the steering unit. · Correct or replace the steering unit. · Inspect and correct or replace. · Inspect and correct or replace.
The tires are steered opposite to the steering wheel operated direction.	· The cylinder piping is connected reversely.	· Inspect and correct.
The steering wheel in the idling state is heavy.	· Oil moves in the steering unit. · The relief valve is not functioning correctly. · Air is sucked from the piping. · The piping is blocked (crushed or clogged). · The end cap set screw is tightened to an excessive torque.	· Replace the steering unit. · Inspect and correct. · Inspect and correct or replace. · Inspect and correct or replace. · Tighten uniformly to the specified torque.
Abnormal noise is generated.	· The relief valve is defective. · Air is sucked from the piping. · The piping is blocked (crushed or clogged).	· Correct, inspect the pressure, and adjust. · Inspect and correct or replace. · Inspect and correct or replace.

GROUP 3 DISASSEMBLY AND ASSEMBLY

1. STEERING UNIT

1) STRUCTURE



Item	Tightening torque	
	kgf·m	lbf·ft
22, 23	3.1±0.6	22.3±4.3
35	0.1±0.01	0.074±0.07
37	2.6±0.5	18.8±3.6

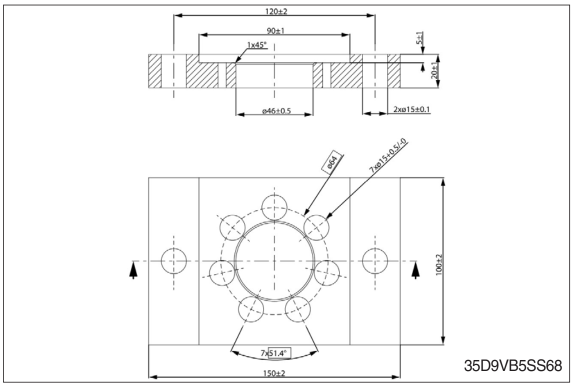
70D9V5SS06

1 Dust seal ring
2 Housing and spool/sleeve
3 Ball
5 Shaft seal
7 Bearing assembly
10 Ring
11 Cross pin
12 Set of springs
13 Cardan shaft
16 Distributor plate
17 Gearwheel set
18 O-ring
19 End over
20 Washer
22 Pin bolt screw
23 Screw
24 Model / Code label
30 Adjusting screw
31 Spring
32 Piston
35 Ball stop
36 Ball
37 Check valve
42 Plug

※ Seal kit (EA) : 1 (1), 5 (1), 18 (3), 20 (7)

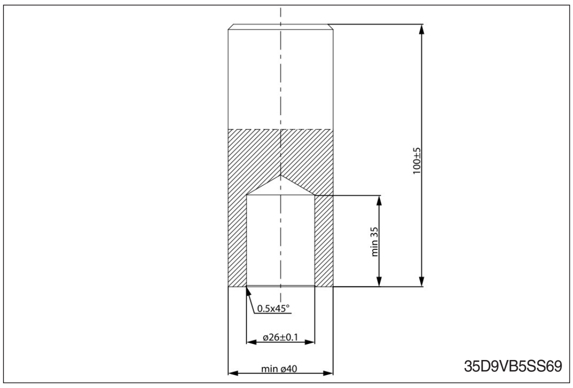
2) TOOLS

(1) Holding tool for the entire steering unit.
Material: Appropriate metal or hard plastic.



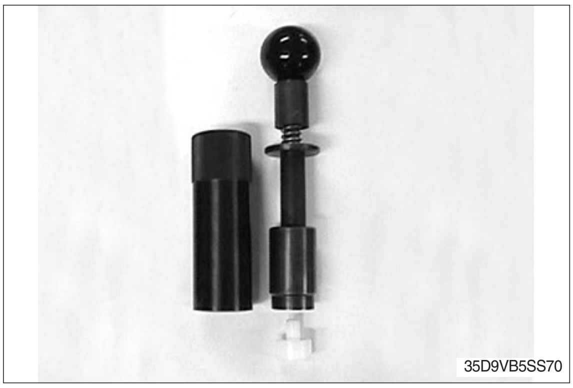
35D9VB5SS68

(2) Assembly tool for dust seal.
Material: Free cutting steel.

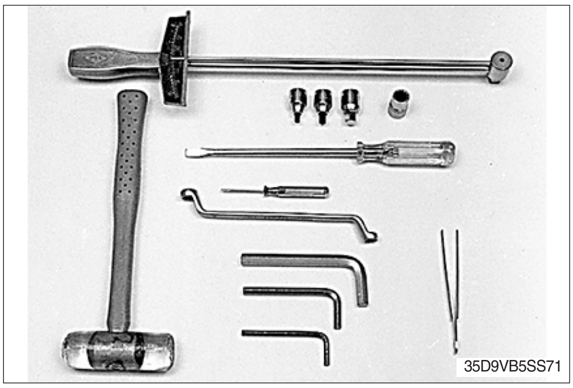


35D9VB5SS69

(3) Assembly tool for shaft seal, O-ring/Roto Glyd type:
Code number: 11092408.

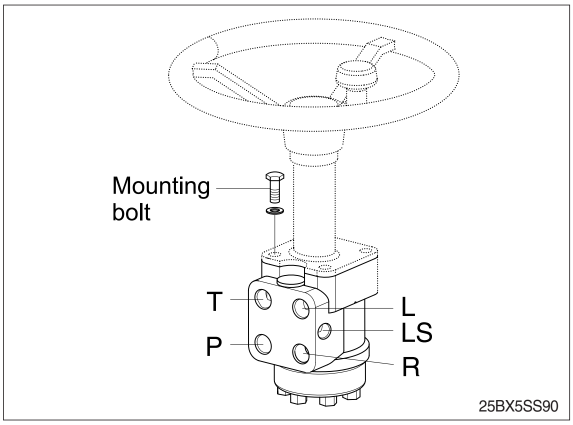

35D9VB5SS70

(4) Torque wrench
- · 13 mm socket spanner
- · 2 mm, 7/64 inch (2.75 mm) allen key
- · Torx Bit size T50
- · 12 mm screwdriver
- · 2 mm screwdriver
- · 13 mm ring spanner
- · Plastic hammer
- · Tweezers


35D9VB5SS71

3) TIGHTENING TORQUE

L : Left port
R : Right port
T : Tank port
P : Pump port
LS : Load sensing port



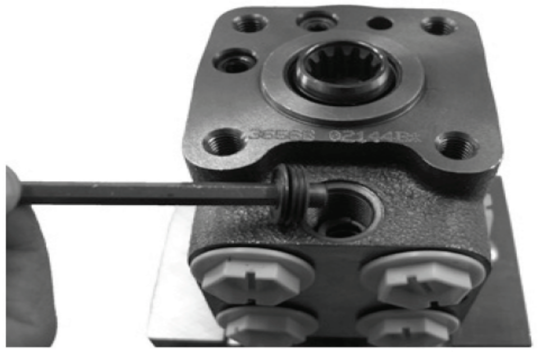
Port	Port size	Tightening torque	
		kgf·m	lbf·ft
L, P, R, T	3/4-16 UNF	6	43.4
LS	7/16-20 UNF	2	14.5
Mounting bolt	M10×1.5×85 mm	4	28.9

4) DISASSEMBLY

(1) Screw out the plug (42) for relief valve using an 8 mm allen key. Sealing washer is crimped on the plug.

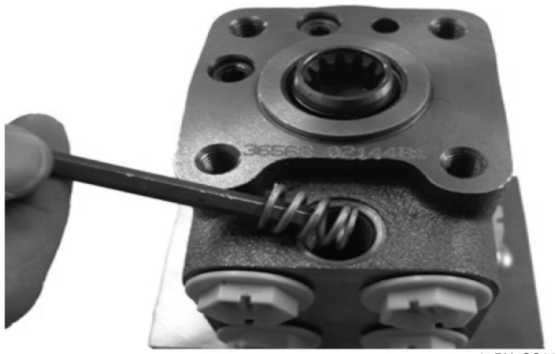
25BX5SS21

(2) Screw out the adjusting screw (30) using a 6 mm allen key.



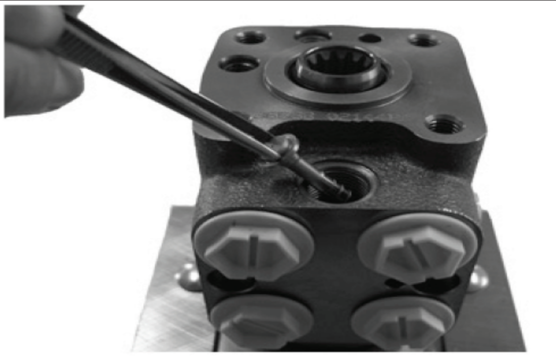
25BX5SS22

(3) Remove the spring for relief valve (31).



25BX5SS23

(4) Remove the piston for relief valve (32).



25BX5SS25

(5) Replace the unit in the holding tool on steering column end.
Remove the screws (22 and 23) with washers (20) using a 13 mm ring spanner or top wrench.


35D9VB5SS09

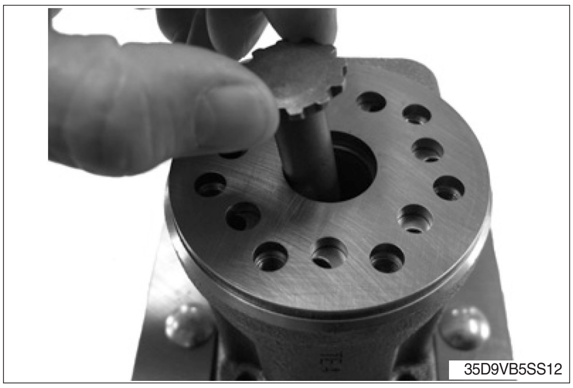
(6) Remove the end cover (19), sideways.


35D9VB5SS10

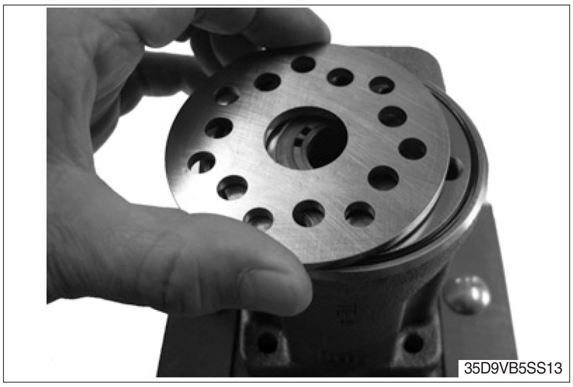
(7) Lift the gearwheel set (17) off the unit. Remove the two o-rings (18).


35D9VB5SS11

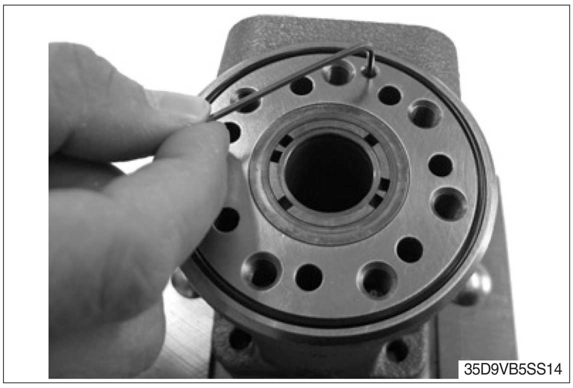
(8) Remove the cardan shaft (13).


35D9VB5SS12

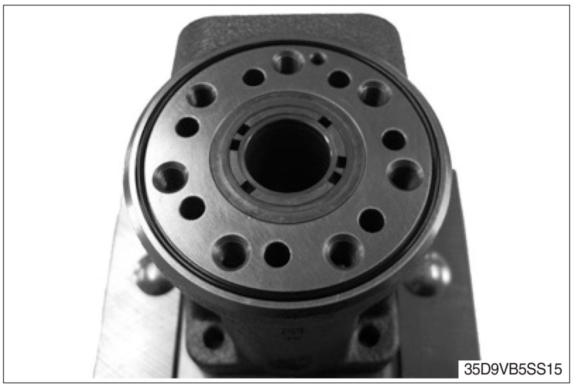
(9) Remove the distributor plate (16).



(10) Screw out the ball stop (35) using a 2 mm allen key.

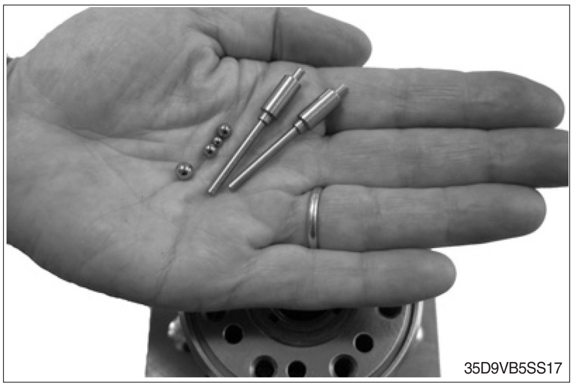


(11) Remove the o-ring (18) from housing.



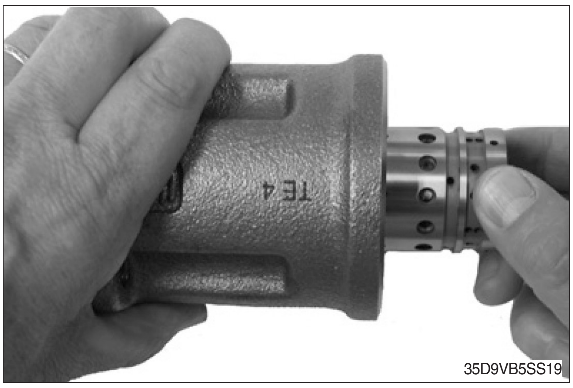
(12) Remove the check valve (37) using a torx bit size T50.

(13 Shake out the check valve ball (3), suction valve pins (34), balls (33 and 36).


35D9VB5SS17

(14) Place the housing with the ports facing down on the work bench. Ensure that the cross pin (11) in the spool and sleeve set (2) is in the horizontal position. The pin (11) can be observed through the open end of the spool. Press the spool (2) inwards (from the housing mounting face end) and the sleeve (2), ring (7) and bearing assembly (6) will be pushed out of the housing together.


35D9VB5SS18


35D9VB5SS19

(15) Take the bearing races and needle bearing (7) from the spool and sleeve set (2). The outer bearing (7) race can sometimes "stick" in the housing, therefore check that it has come out.


35D9VB5SS20

(16) Press out the cross pin (11).

35D9VB5SS21

(17) Remove the ring (10).

35D9VB5SS22

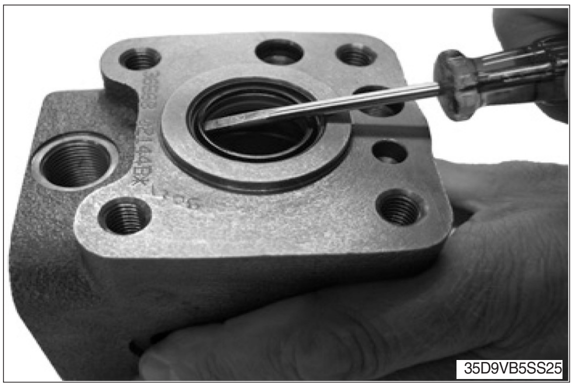
(18) Carefully press the spool out of the sleeve.

35D9VB5SS23

(19) Press the neutral position springs (12) out of the slot of the spool.

35D9VB5SS24

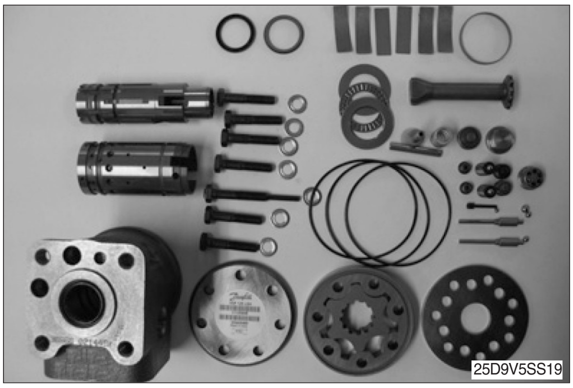
(20) Remove dust seal (1) and shaft seal (Roto Glyd) (5) carefully with a screw driver or similar tool.


35D9VB5SS25

(21) The steering unit is now completely dismantled.

※ Clean all parts carefully in shellsol K or similar cleaner fluid.

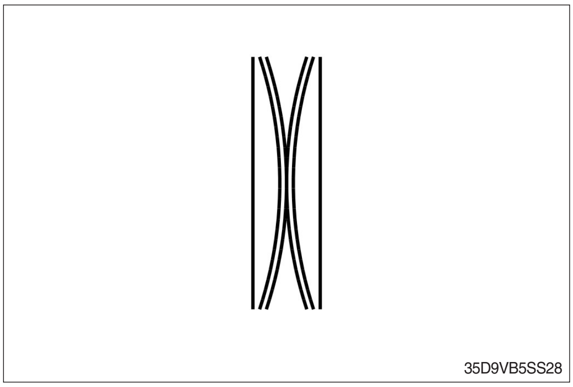
※ Inspection and replacement Replace all seals and washers. Check all parts carefully and make any replacements as is necessary.


25D9V5SS19

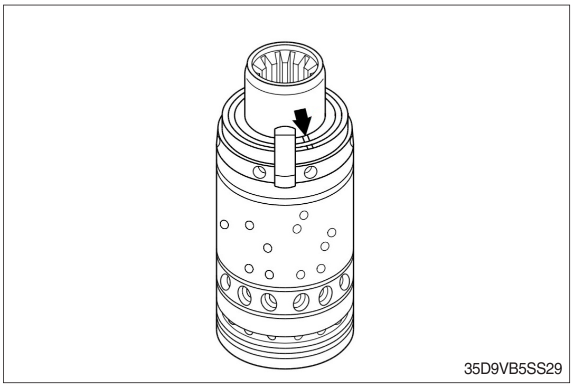
5) ASSEMBLY

(1) Place the two flat neutral position springs in the slot. Place the curved springs between the flat ones and press them into place.

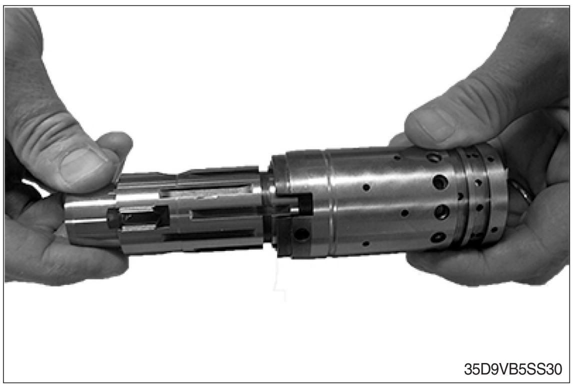
(2) Configuration of spring set (12). There can be different numbers of curved springs depending on configuration of spring set. There can be 2, 4 or 6 curved springs.



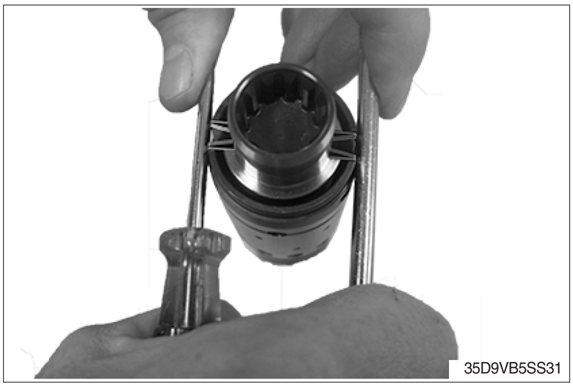
(3) Some spool and sleeve sets for steering unit must be positioned correctly relatively to each other. Small marks are present on both spool and sleeve close to one of the slots for the spring set. Most spool and sleeve sets for steering unit have no marks, so those can be positioned relatively to each other in any of the 2 positions possible.



(4) Guide the spool into the sleeve (2). Make sure the centering springs (12) are placed into the slot.



(5) Line up the spring set (12).

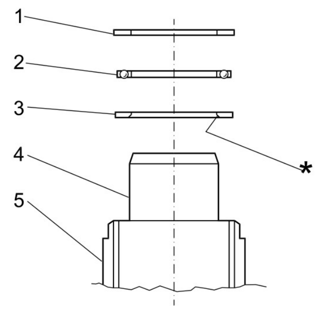


(6) Guide the ring (10) down over the sleeve. The ring should be able to move free of the springs.

(7) Fit the cross pin (11) into the spool/sleeve.

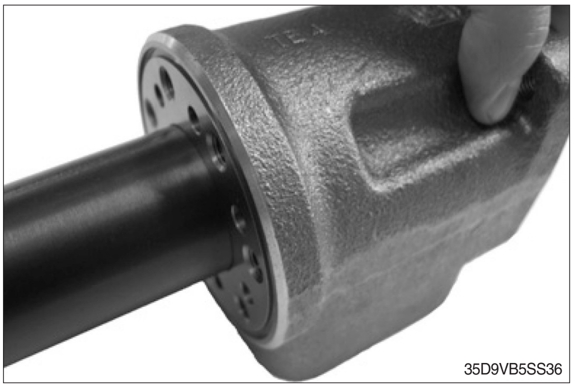
(8) Fit bearing races and needle bearing (7) as shown on the drawing below.

(9) Assembly pattern for standard bearing 1 Outer bearing race → 2 Needlebearing → 3 Inner bearing race → 4 Spool → 5 Sleeve.
The inside chamfer on the inner bearing race must face the chest of the inner spool.

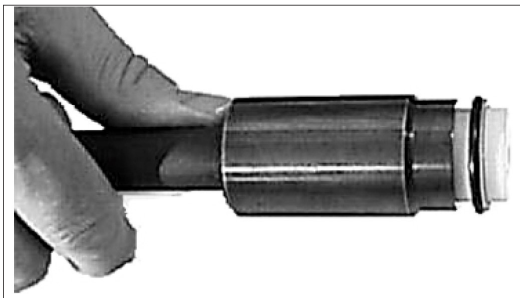


35D9VB5SS35

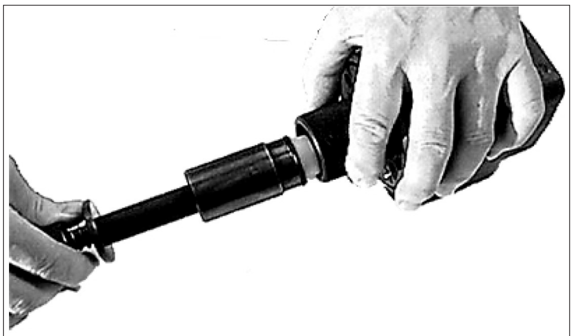
(11) Place the steering unit housing with the port face down on the work bench. Guide the outer part of the assembly tool for shaft seal into the bore for the spool/ sleeve set (2).


35D9VB5SS36

(10) Grease the shaft seal (Roto Glyd, 5) with hydraulic oil and place them on the tool. Ensure that the Roto Glyd seal is placed on the insertion tool as per the photograph.


35D9VB5SS37

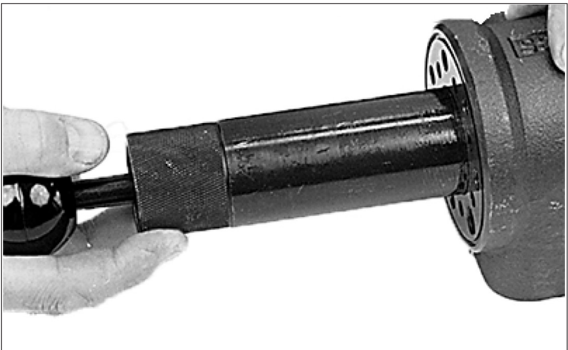
(13) Hold the outer part of the assembly tool in the bottom of the steering unit housing and guide the inner part of the tool right to the bottom.


35D9VB5SS38

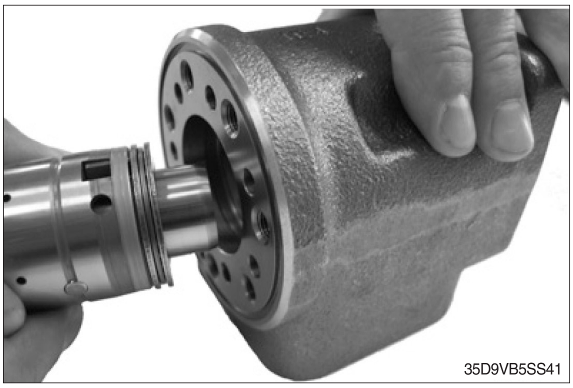
(14) Press and turn the shaft seal (5) into position in the housing.


35D9VB5SS39

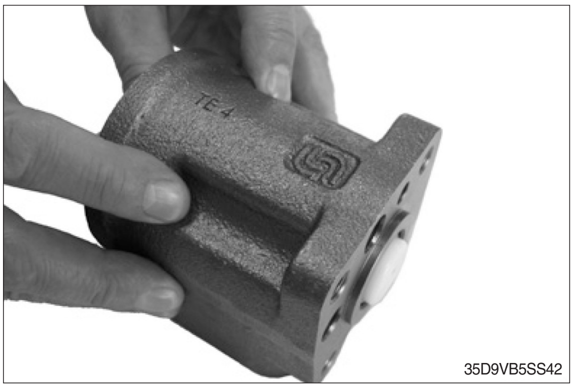
(15) Draw the inner and outer parts of the assembly tool out of the steering unit bore, leaving the guide from the inner part in the bore.


35D9VB5SS40

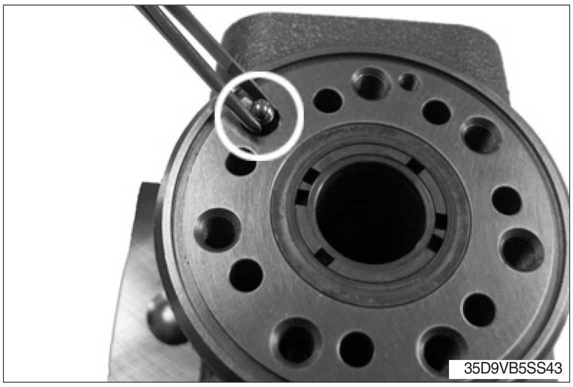
(16) With a light turning movement, guide the spool and sleeve into the bore.
Fit the spool set holding the cross pin (11) horizontal.


35D9VB5SS41

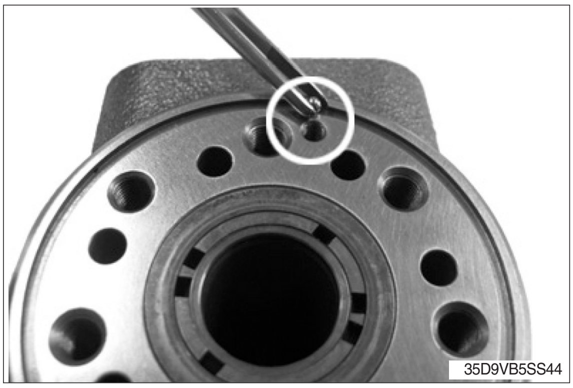
(17) The spool set will push out the assembly tool guide. The shaft seal (5) are now installed.


35D9VB5SS42

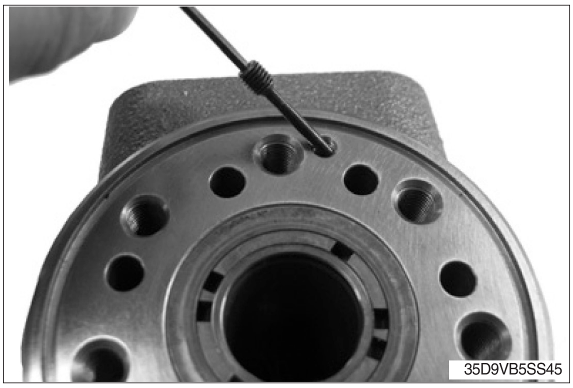
(18) Place the steering unit housing on the holding tool on the steering column end. Put the check valve ball (3) into the hole indicated by the circle.



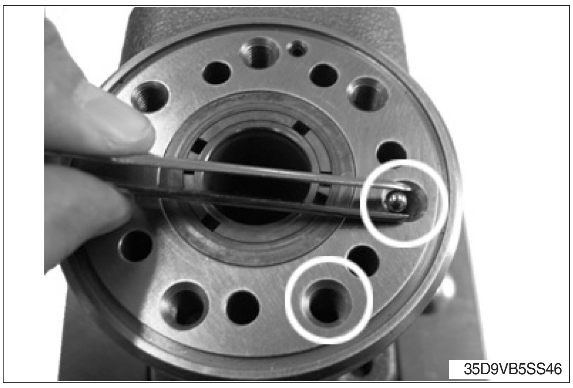
(19) Place the ball for LS check valve (36) into the hole indicated by the circle.



(20) Screw the ball stop (35) into the LS check valve bore using a 2 mm allen key.
  · Tightening torque : 0.1±0.01 kgf·m
  (0.72±0.072 lbf·ft)



(21) Place a ball (33) in the two bolt holes indicated by the circles.



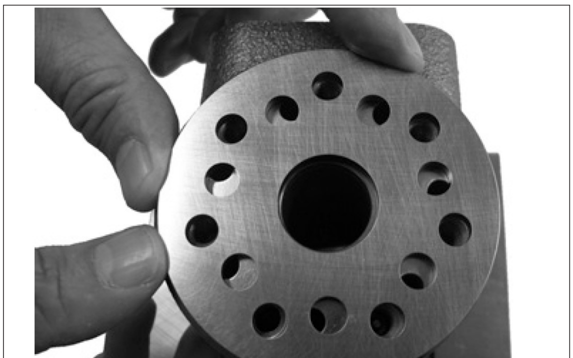
(22) Place the pins (34) in the same two bolt holes.

35D9VB5SS47

(23) Insert the O-ring (18) in the grove on the housing.

35D9VB5SS48

(24) Place the distributor plate (16) so that the channel holes match the thread holes in the housing.

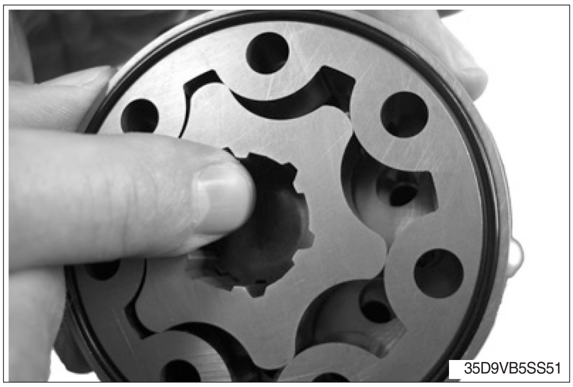


35D9VB5SS49

(25) Guide the cardan shaft (13) down into the bore so that the slot is parallel with the connection flange ports and lines up with the cross pin (11).

35D9VB5SS50

(26) Place the 2 o-rings (18) in the two groves in the gear rim. Fit the gearwheel and rim (17) on the cardan shaft (13).
Place the gear wheel side with all the deeper splines facing downwards. Only this side will fit on the cardan shaft due to all gear sets used in steering unit have timing securing: splines of gear wheel and cardan shaft can only be assembled with correct timing. Line up the gear rim holes to match the thread holes of the housing.



35D9VB5SS51

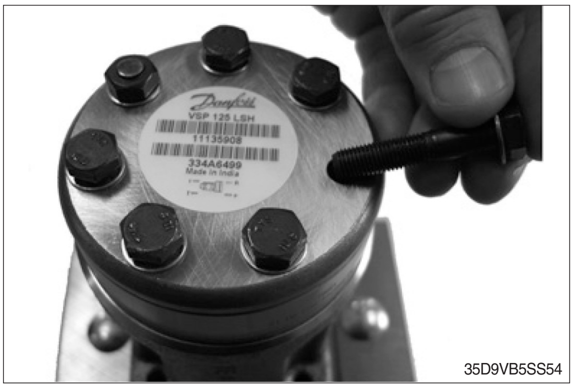
(27) Place the end cover (19) in position. Ensure that the bar codes and writing are parallel with port face.

35D9VB5SS52

(28) Fit the pin bolt screw (22) with washer (20) and place it in the hole shown.

35D9VB5SS53

(29) Fit the six screws (23) with new washers (20) and insert them. Use a 13 mm top wrench. Cross-tighten all the screws (22 and 23) with a torque
· Tightening torque : 3.1±0.6 kgf·m
(22.4±4.3 lbf·ft)

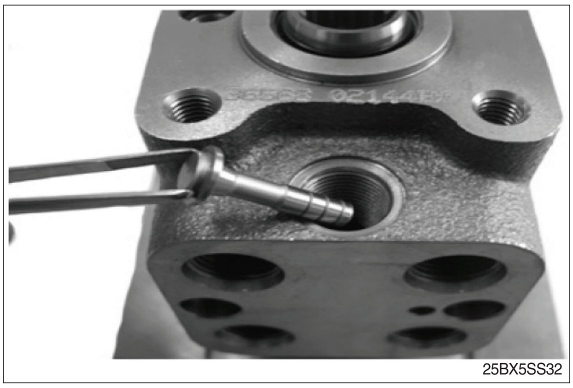


35D9VB5SS54

(30) Screw in the check valve (37) into the P-port using a Torx Bit size T50.
· Tightening torque : 2.6±0.5 kgf·m
(18.8±3.6 lbf·ft)


35D9VB5SS55

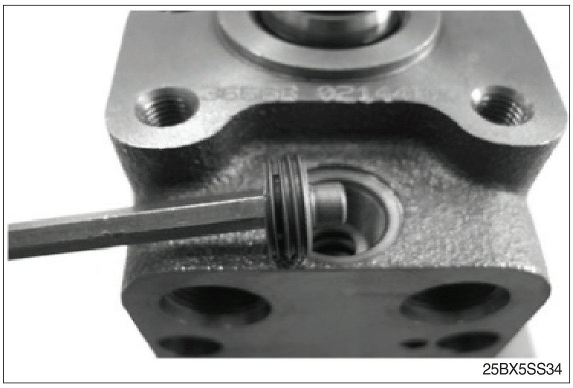
(31) Replace the unit in the holding tool on gear set end. Install the piston (32) to housing.


25BX5SS32

(32) Install the spring (31) on top of the piston (32).

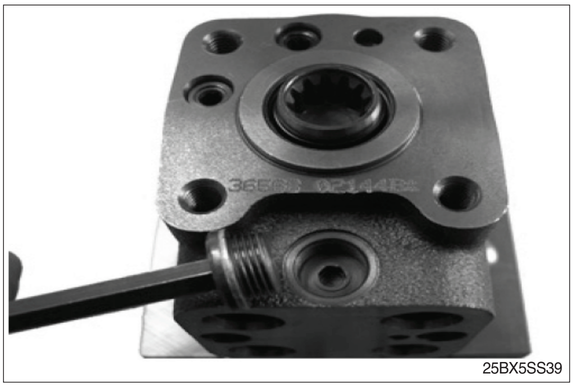

25BX5SS33

(33) Screw in the adjustment screw (30) using a 6 mm allen key. Make the pressure setting on a test panel according to valve setting specification.

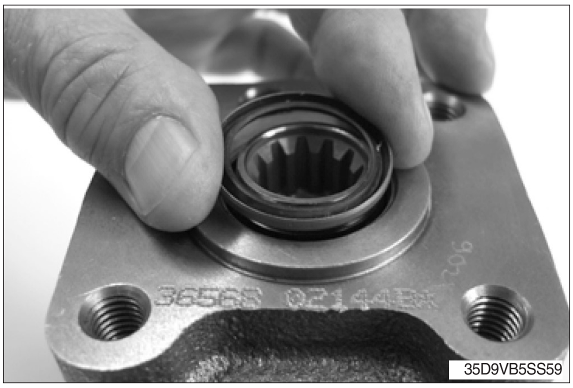

25BX5SS34

(34) Screw in the plug (42) using a 8 mm allen key.

· Tightening torque : 6.6±0.5 kgf·m (47.7±3.6 lbf·ft)


25BX5SS39

(35) Place the dust seal ring (1) in the housing.


35D9VB5SS59

(36) Fit the dust seal ring in the housing using special tool for dust seal assembly and a plastic hammer.

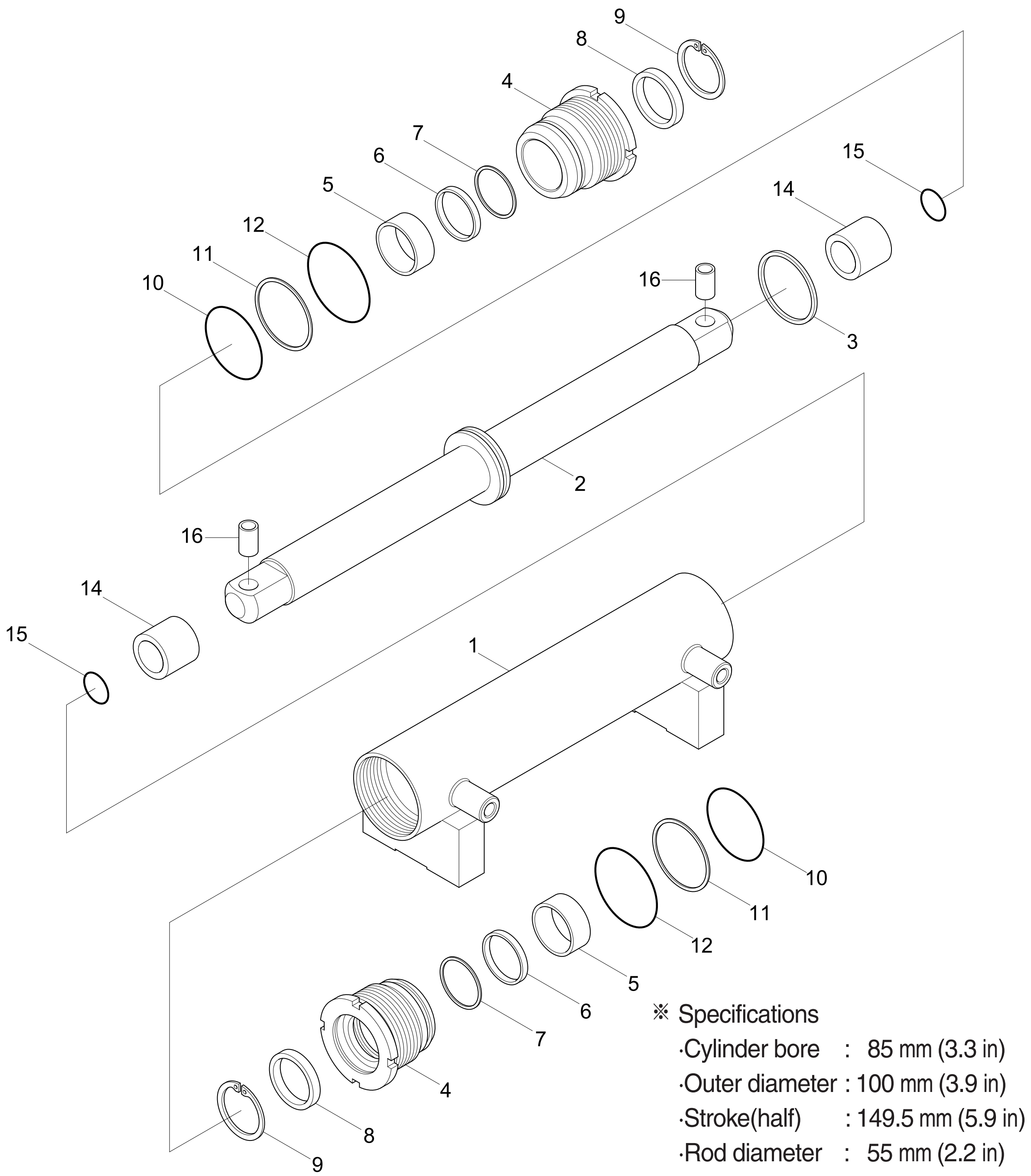

35D9VB5SS60

(37) Screw in the plastic plugs into the connection ports to keep the ports clean during storage and transportation.


25BX5SS40

2. STEERING CYLINDER

1) STRUCTURE



※ Specifications

- ·Cylinder bore : 85 mm (3.3 in)
- ·Outer diameter : 100 mm (3.9 in)
- ·Stroke(half) : 149.5 mm (5.9 in)
- ·Rod diameter : 55 mm (2.2 in)

35FQ-09001

1	Tube assy	7	Back up ring	13	Lock washer
2	Rod assy	8	Dust wiper	14	Spacer
3	Piston seal	9	Snap ring	15	O-ring
4	Gland	10	O-ring	16	Pin bushing
5	DU bushing	11	Back up ring		
6	Rod seal	12	O-ring		

※ Seal kit : 3, 6, 7, 8, 10, 11, 12, 15

2) DISASSEMBLY

※ Before disassembling steering cylinder, release oil in the cylinder first.

(1) Put wooden blocks against the cylinder tube, then hold in & vice.

(2) Remove the cover by hook a wrench in the notch of cylinder head and turn counter-clockwise.

(3) Remove the cylinder rod and piston from the tube.

(4) Check wear condition of the sealing parts (O-ring, oil seal, dust seal, U-packing, bush). If there are some damage, replace with new parts.

3) CHECK AND INSPECTION

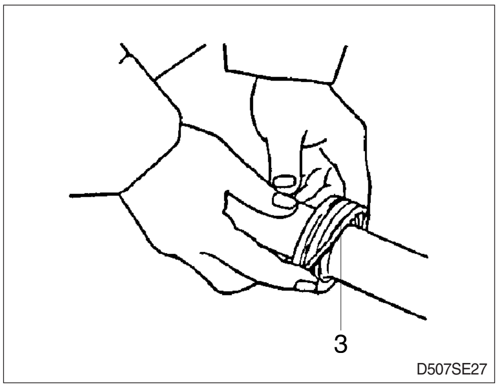
mm (in)

Check item	Criteria		Remedy
	Standard size	Repair limit	
Clearance between piston & cylinder tube	0.05~0.25 (0.002~0.01)	0.4 (0.02)	Replace piston seal
Clearance between cylinder rod & bushing	0.05~0.18 (0.002~0.007)	0.3 (0.01)	Replace bushing
Seals, O-ring	Damage		Replace
Cylinder rod	Dents		Replace
Cylinder tube	Biting		Replace

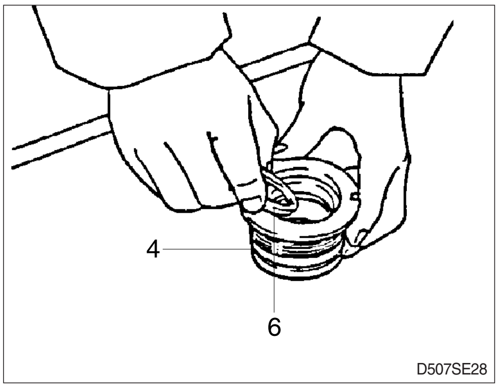
4) ASSEMBLY

(1) Install a new piston seal (3) around the groove on the piston.

※ Be careful not to scratch the seal too much during installation or it could not be seated properly.

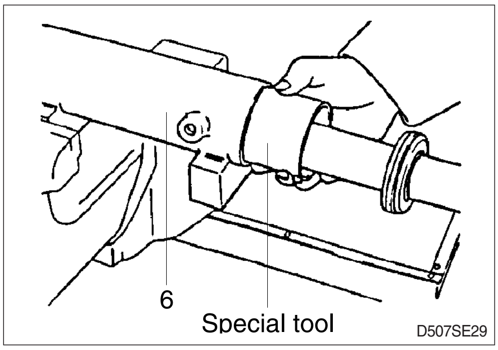


(2) Install the rod seal (6) to the position in the gland(4) applying a slight coat with grease prior to install.

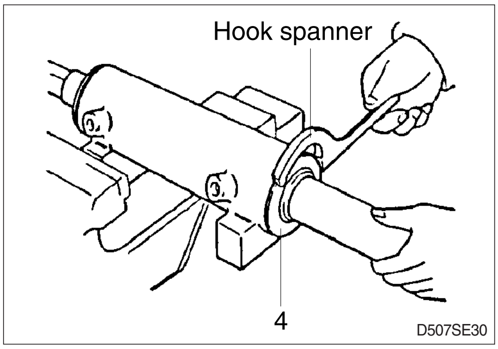


(3) Install the dust wiper (8) to the gland (4) using a special installing tool. Coat the dust wiper with grease slightly before installing.

(4) Using a special tool, install gland assembly into the cylinder tube (1).

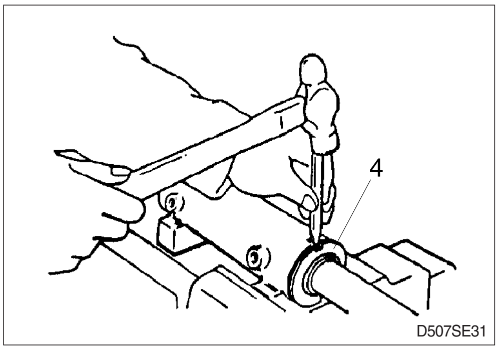


(5) Using a hook spanner, install the gland (4) assembly, and tighten it with torque 60±6 kgf·m (434±43 lbf·ft).



(6) After the gland (4) assembly was installed to the cylinder tube (1), calk at the tube end into the groove on the gland to prevent screw loosening.

※ If it is needed to calk again, never calk on the same place.



(7) Move the piston rod back and forth several times for the full distance of its stroke. This helps to seat the ring and seals before applying full hydraulic pressure to the cylinder.

(8) Install cylinder into trail axle.

(9) While idling the engine with the rear wheels off the ground, operate the steering wheel left and right alternately.

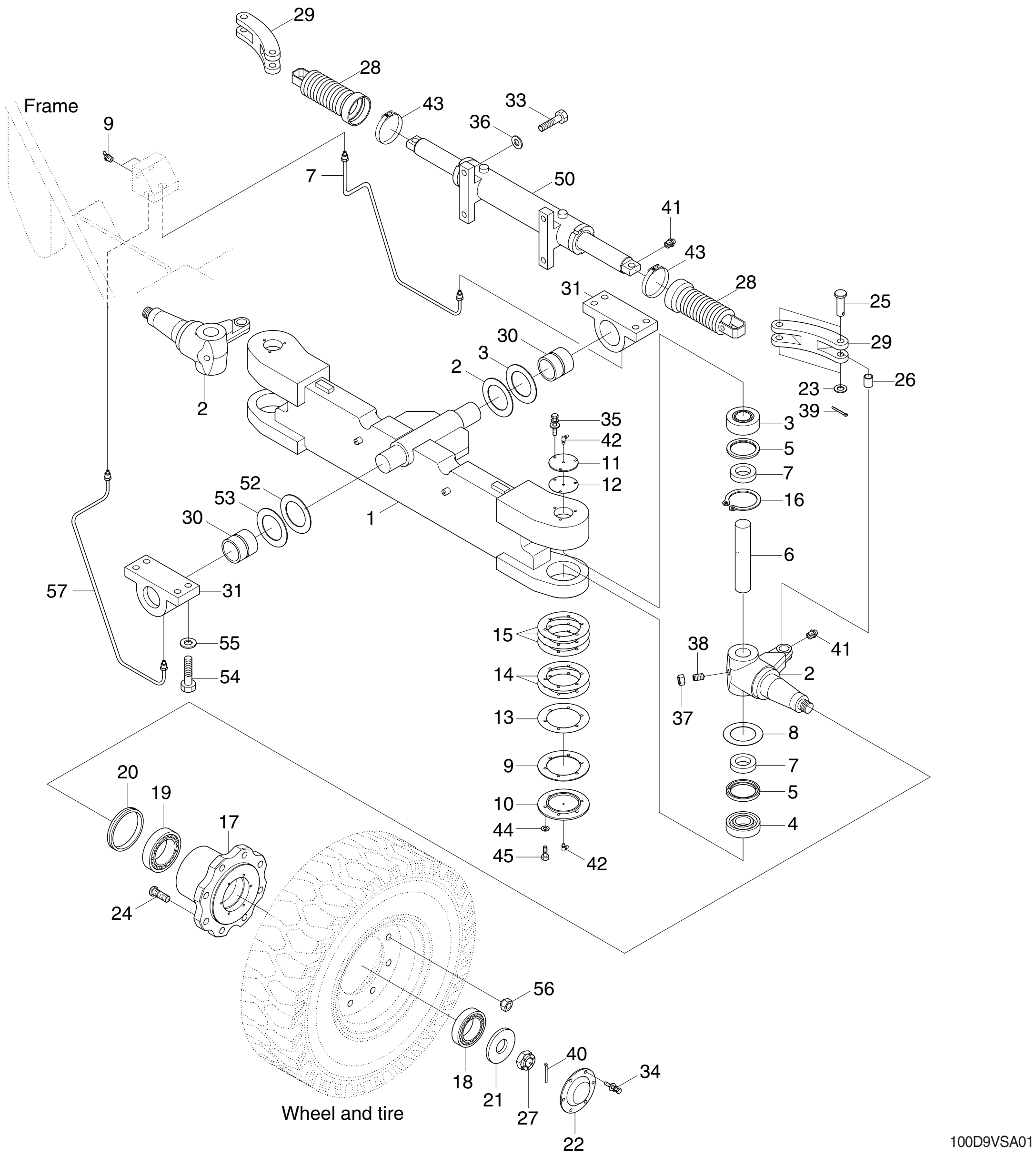
※ Then, repeat the above operation at gradually increasing engine rpm. This releases air from the system and completes preparation for operation.

(10) Stop the engine, lower the floating rear wheels, and check pump joints for oil leaks and looseness and retighten, them as required.

4. STEERING AXLE

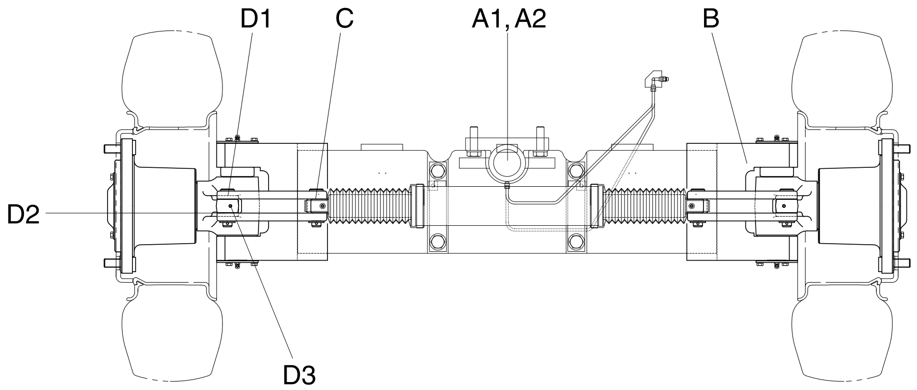
1) STRUCTURE

※ Do not remove the stopper bolt unless necessary.



1	Steering axle	15	Shim	28	Boot	42	Grease nipple
2	Axle knuckle	16	Retainer ring	29	Steering link	43	Hose clamp
3	Taper roller bearing	17	Axle hub	30	Pin bushing	44	Plain washer
4	Taper roller bearing	18	Taper roller bearing	31	Support	45	Hex bolt
5	Oil seal	19	Taper roller bearing	33	Hex bolt	50	Steering cylinder
6	King pin	20	Oil seal	34	W/washer bolt	52	Thrust washer
7	Spacer	21	Washer	35	W/washer bolt	53	Thrust washer
8	Spacer	22	Hub cap	36	Harden washer	54	Hex bolt
9	Gasket	23	Special washer	37	Hex nut	55	Harden washer
10	Cover	24	Wheel bolt	38	Set bolt	56	Wheel nut
11	Cover	25	Link pin	39	Split pin	57	Grease pipe
12	Gasket	26	Pin bushing	40	Split pin	58	Grease pipe
13	Shim	27	Slot nut	41	Grease nipple	59	Grease nipple
14	Shim						

2) CHECK AND INSPECTION



50D9SE25

unit : mm (in)

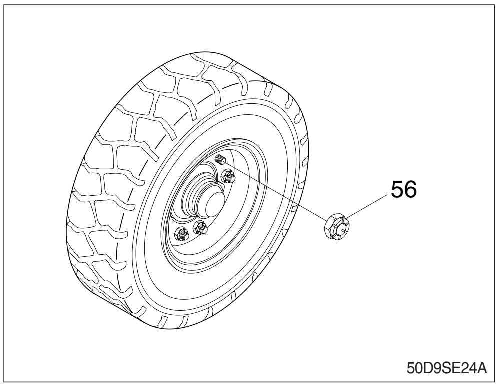
No.	Check item			Criteria		Remedy
				Standard size	Repair limit	
A	Shaft	A1	OD of shaft	60 (2.4)	59.5 (2.3)	Replace
		A2	ID of bushing	60 (2.4)	59.5 (2.3)	
B	OD of king pin			50 (2.0)	49.8 (2.0)	
C	OD of steering cylinder pin			22 (0.9)	21.9 (0.9)	
D	Knuckle	D1	OD of pin	22 (0.9)	21.9 (0.9)	
		D2	Vertical play	-	0.2 (0.008)	Adjust shim
		D3	ID of bushing	22 (0.9)	22.5 (0.9)	Replace

·OD : Outer diameter
·ID : Inner diameter

3) DISASSEMBLY

※ Servicing work on the knuckle part can be carried out without removing the axle assy from chassis. The work can be done by jacking up the balance weight part of the truck.

(1) Loosen the hub nut (56) and take off the steering wheel tire.



50D9SE24A

(2) Remove hub cap (22).

(3) Pull out split pin (40) and remove slotted nut (27), washer (21).

(4) Using the puller, take off the hub (17) together with the taper roller bearing (18, 19).

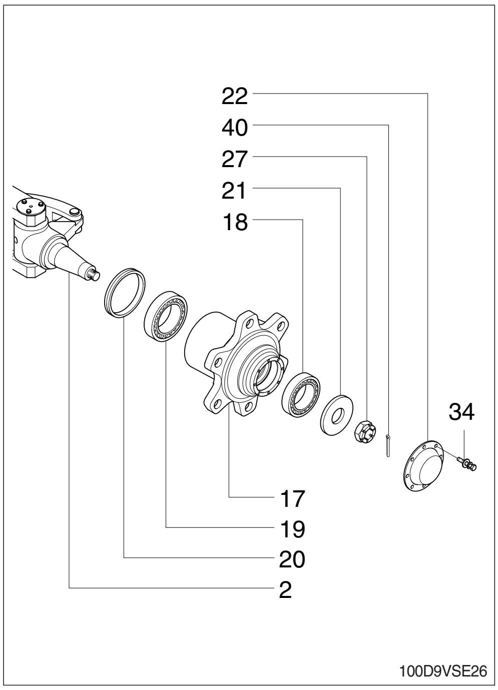
※ Be very careful because just before the hub comes off, tapered roller bearing will fall out.

(5) After hub (17) is removed take off the inner race of taper roller bearing (16, 19).

(6) Pull out oil seal (20).

※ Don't use same oil seal twice.

(7) Repeat the same procedure for the other side. Moreover, when disassembling is completed, part the slotted nut in the knuckle to protect the threaded portion.



100D9VSE26

(8) Loosen set bolt (38) and nut (37).

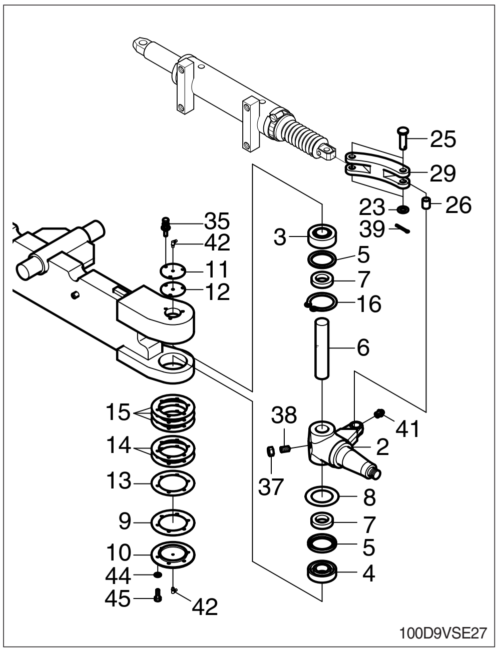
(9) Loosen with washer bolt (35) and remove cover (11), gasket (12). Remove grease nipple (42).

(10) Push out the king pin (6) without damaging the knuckle arm (2).

(11) At the same time the king pin is removed, pull out the oil seal (5).

(12) If defect is observed in taper roller bearing (4), pull it out by using extractor.

(13) Remove spilt pin (39), special washer (23) and link pin (25).



100D9VSE27

4) ASSEMBLY

※ In reassembling, have all parts washed, grease applied to lubricating parts, and all expendable items such as oil seal and spring washers replaced by new ones.

Perform the disassembly in reverse order.

(1) Tighten the set bolt (38) of king pin (6).

(2) There is a notch in the middle of the king pin (6), make sure that this notch is on the set screw side.

(3) Do not hammer to drive in taper roller bearing (4) because it will break.
Always use drive-in tool. In assembling the taper roller bearing (3), be sure that the fixed ring of the bearing is placed in position facing the knuckle (2).

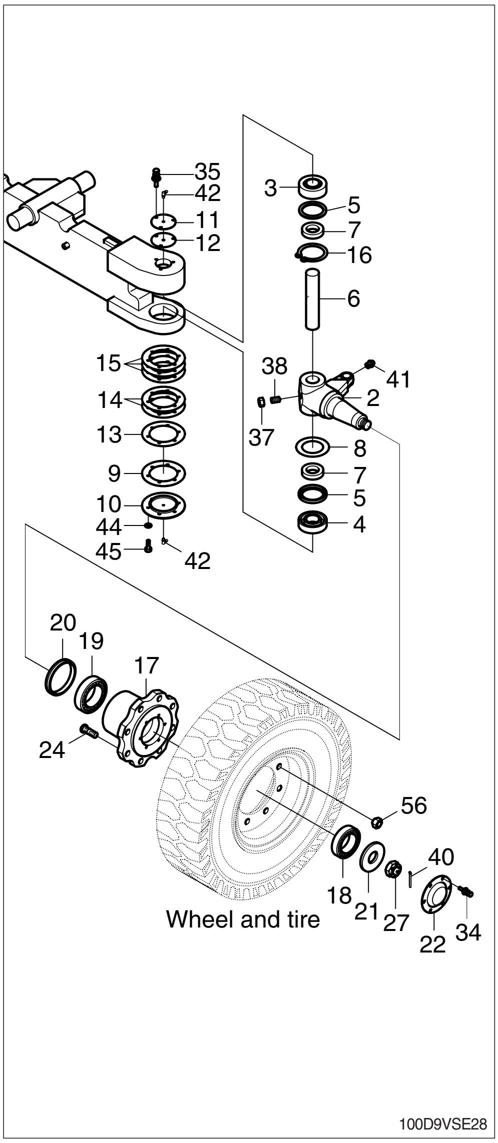
(4) Hub

※ Mount oil seal (20) and inner race of taper roller bearing (19) on the knuckle. The bearing should be well greased before assembling.

※ Install the outer race of the bearing (18) in the wheel center and assemble to the knuckle.

※ Put washer (21) in place, tighten with nut (27) and locked with split pin (40). In locking with split pin, locate the hole for the split pin by turning the nut back 1/6 of a turn. Adjust the preload of bearing.

※ Mount the hub cap (22).
Bearing should be well greased before assembling.



SECTION 6 HYDRAULIC SYSTEM

SECTION 6 HYDRAULIC SYSTEM

GROUP 1 STRUCTURE AND FUNCTION

1. HYDRAULIC SYSTEM OUTLINE

The hydraulic system consists of a variable displacement pump, a control valve (MCV), lift cylinders and tilt cylinders. Refer to below followings. The oil is supplied from the tank at the left side of the frame. The hydraulic return filter is installed inside in the hydraulic tank. For the high-pressure piping, the o-ring fitting method (ORFS) that provides high sealing performance is employed to improve hydraulic system serviceability.

1) VARIABLE DISPLACEMENT PUMP

· Lift cylinder ,Tilt cylinder, Steering cylinder, Auxiliary function cylinder

2) MCV

· Built in priority valve and shuttle valve, Lift function, Tilt function, Auxiliary function (Sideshift etc.), RCV, Fingertip (EPPR valve, Controller)

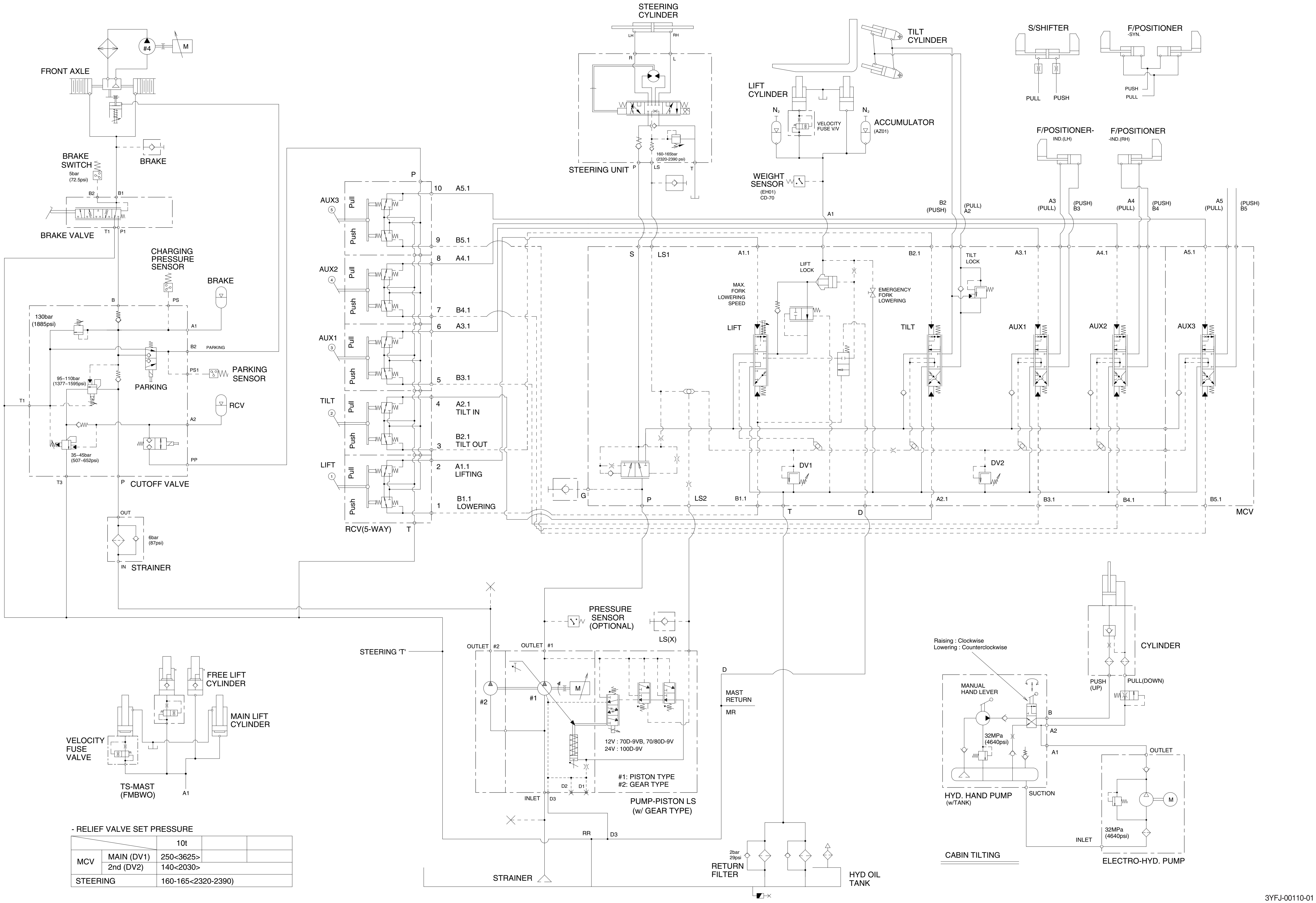
3) RCV, FINGERTIP (EPPR VALVE, CONTROLLER-OPTION)

4) HYDRAULIC OIL TANK

· Return filter, Suction strainer, Air breather, Drain plug-magnetic

2. HYDRAULIC CIRCUIT

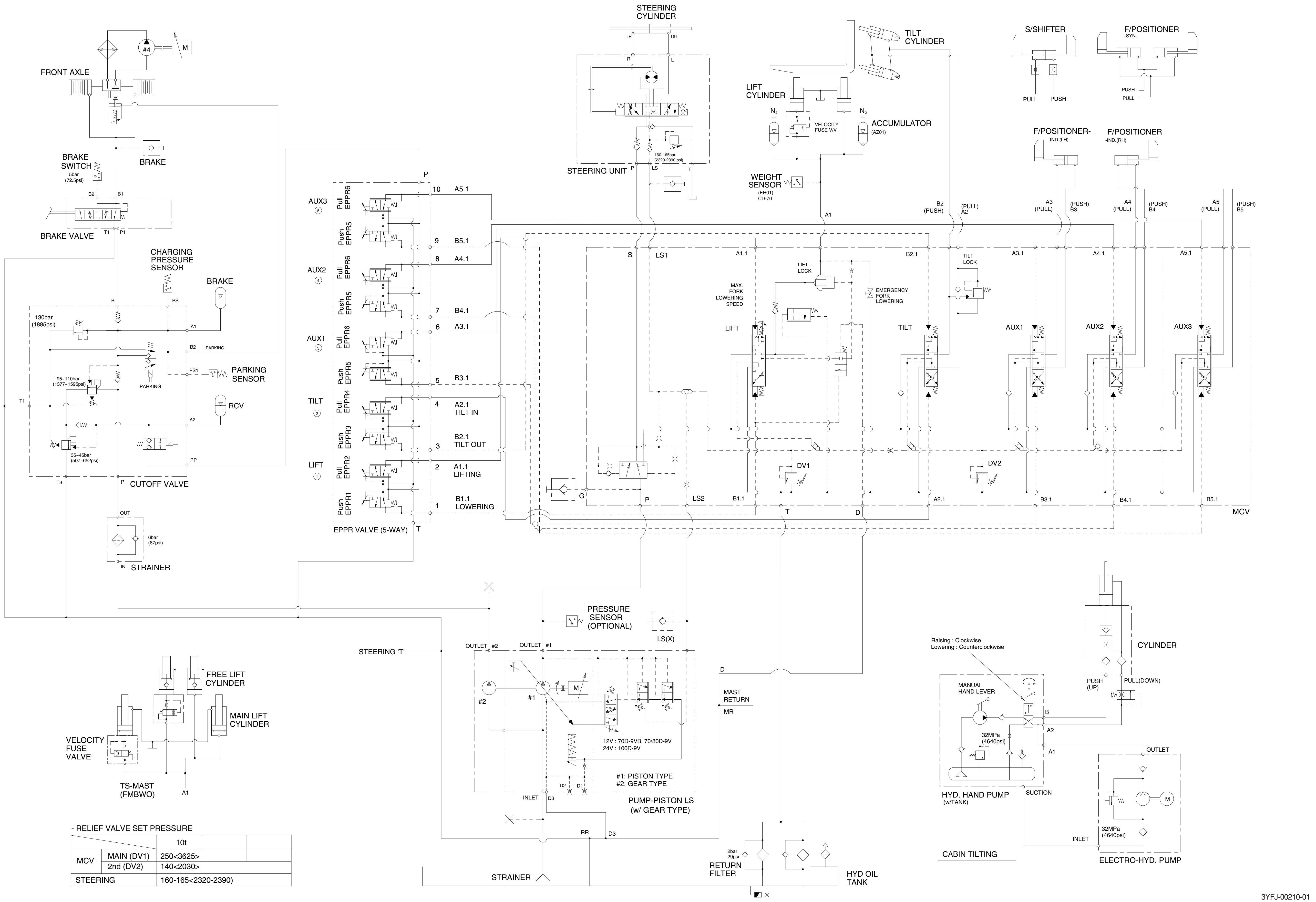
1) RCV TYPE



- RELIEF VALVE SET PRESSURE

		10t		
MCV	MAIN (DV1)	250<3625>		
	2nd (DV2)	140<2030>		
STEERING		160-165<2320-2390)		

2) FINGERTIP TYPE (OPTION)



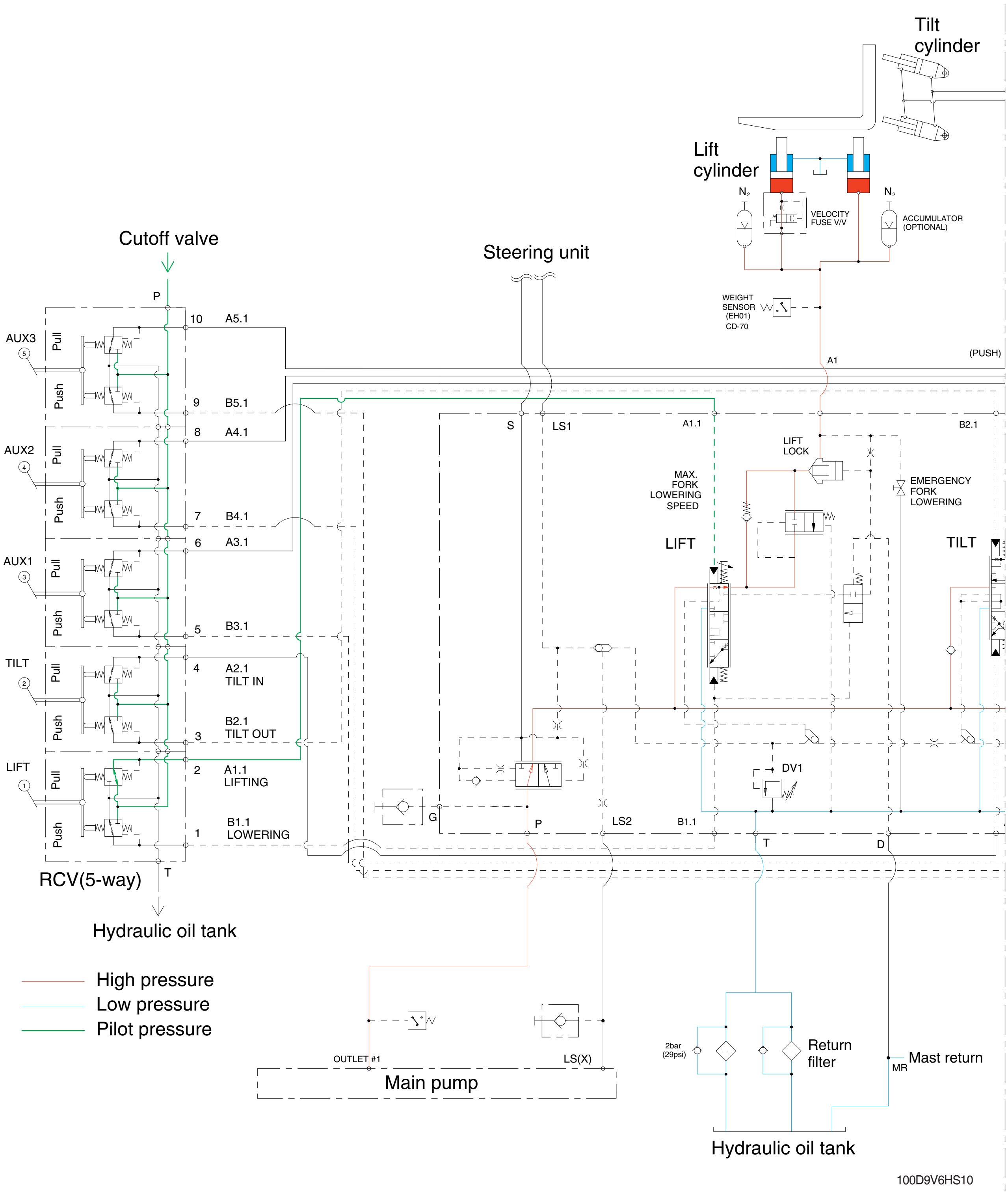
- RELIEF VALVE SET PRESSURE

		10t		
MCV	MAIN (DV1)	250<3625>		
	2nd (DV2)	140<2030>		
STEERING		160-165<2320-2390>		

3. WORK EQUIPMENT HYDRAULIC CIRCUIT

※ The operating explain is based on the remote control lever type.

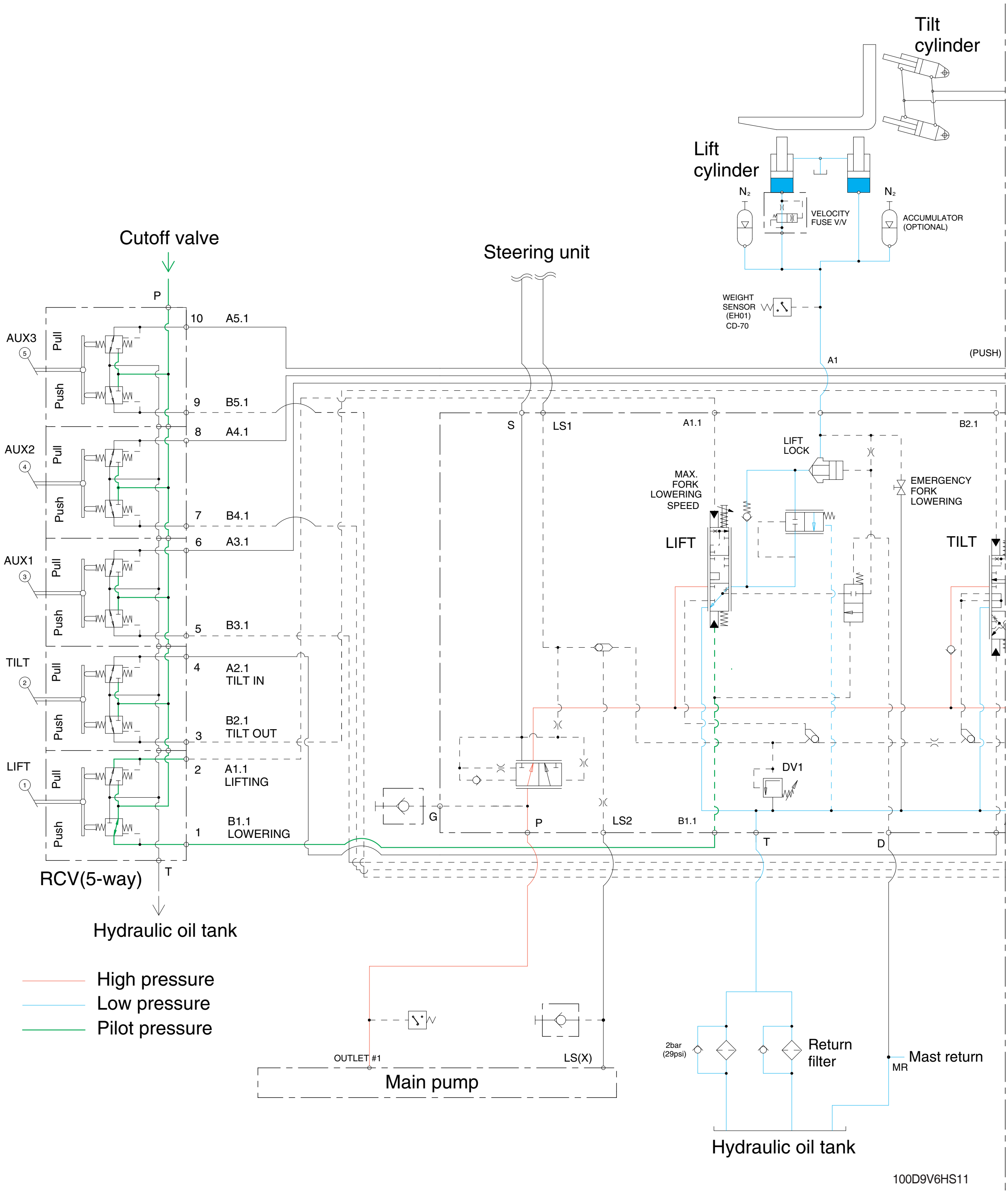
1) WHEN THE LIFT CONTROL LEVER IS IN THE LIFT POSITION



When the lift control lever is pulled back, the lift spool in the first block is moves to lift position. The oil from the main pump flows into the lift spool of main control valve through the priority valve. Then goes to the large chamber of lift cylinder by pushing the load check valve of the spool and lift lock valve. The oil from the small chamber of lift cylinder returns to hydraulic oil tank at the same time. When this happens, the forks go up.

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

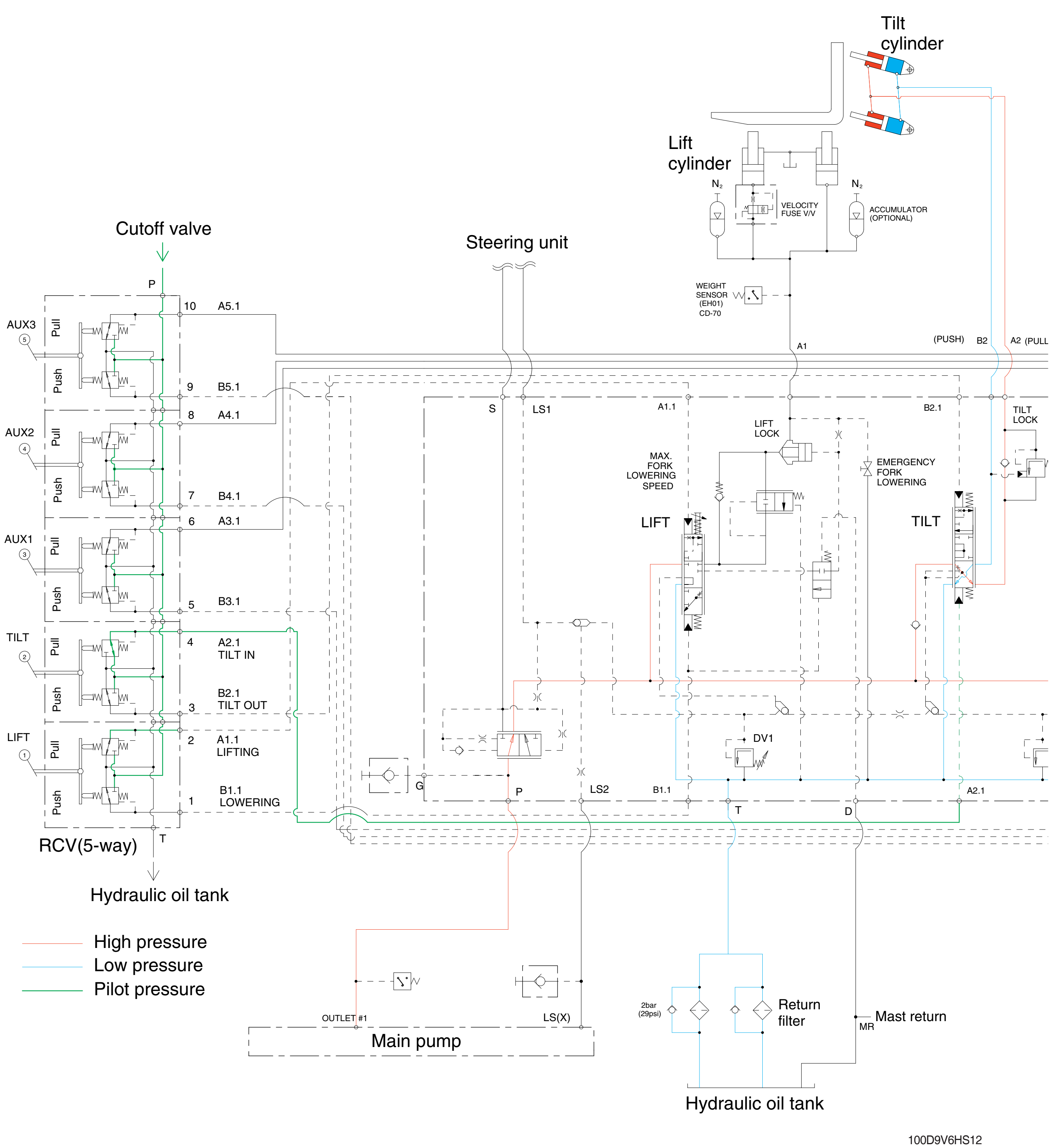
2) WHEN THE LIFT CONTROL LEVER IS IN THE LOWER POSITION



When the lift control is pushed forward, the lilt spool in the first block is moved to lower position. The work port and the small chamber and the large chamber are connected to the return passage, so the forks will be lowered due to its own weight.

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

3) WHEN THE TILT CONTROL LEVER IS IN THE BACKWARD POSITION



When the tilt control lever is pulled back, the tilt spool in the second block is moved to tilt backward position.

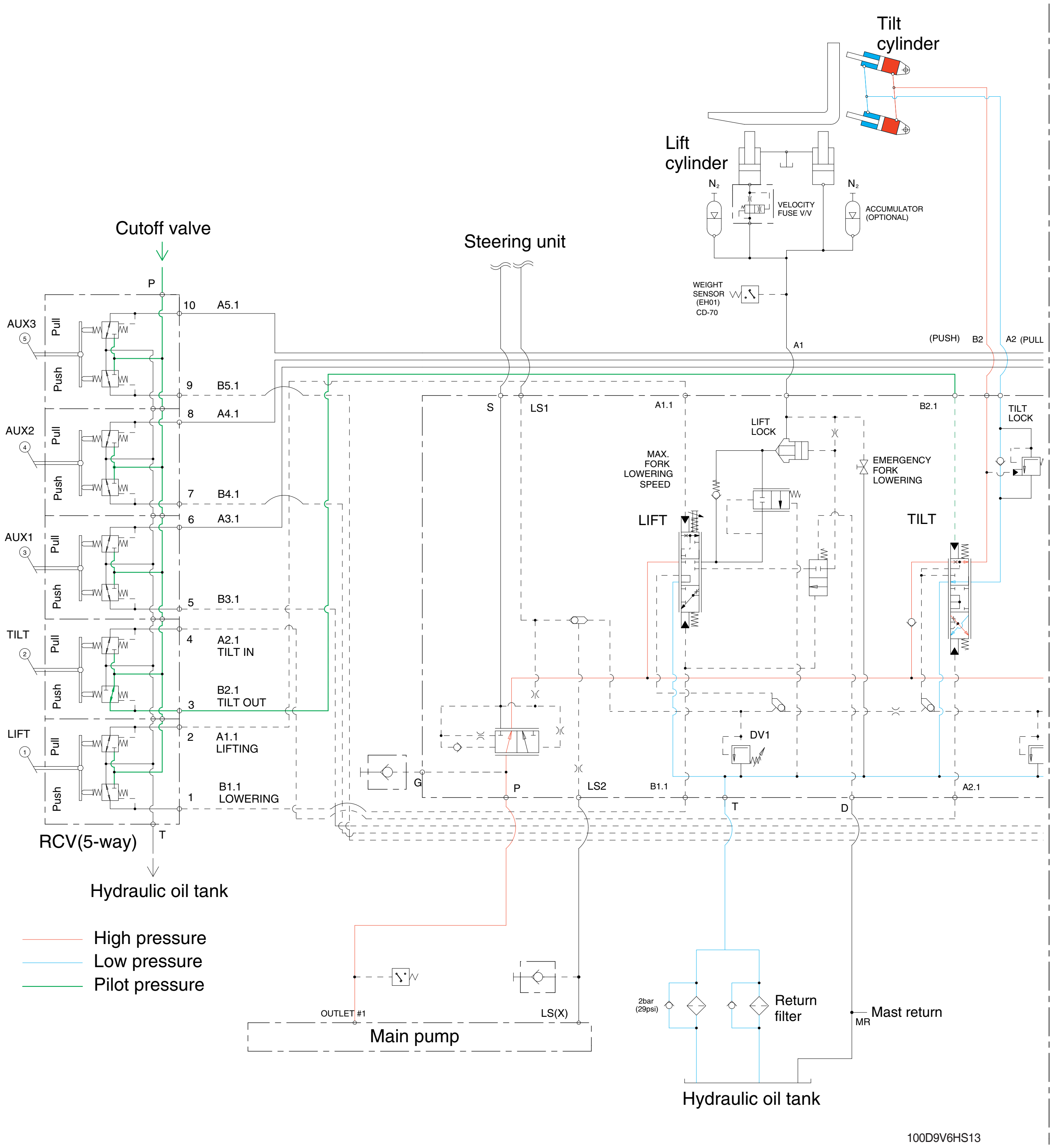
The oil from the main pump flows into the tilt spool of main control valve through the priority valve. Then goes to the small chamber of tilt cylinder by pushing the load check valve of the spool and tilt lock valve.

The oil at the large chamber of tilt cylinder returns to hydraulic oil tank through the hydraulic oil cooler and return filter at the same time.

When this happens, the mast tilt backward.

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

4) WHEN THE TILT CONTROL LEVER IS IN THE FORWARD POSITION



When the tilt control lever is pushed forward, the tilt spool in the second block is moved to tilt forward position.

The oil from the main pump flows into the tilt spool of main control valve through the priority valve.

Then goes to the large chamber of tilt cylinder by pushing the load check valve of the spool and tilt lock valve.

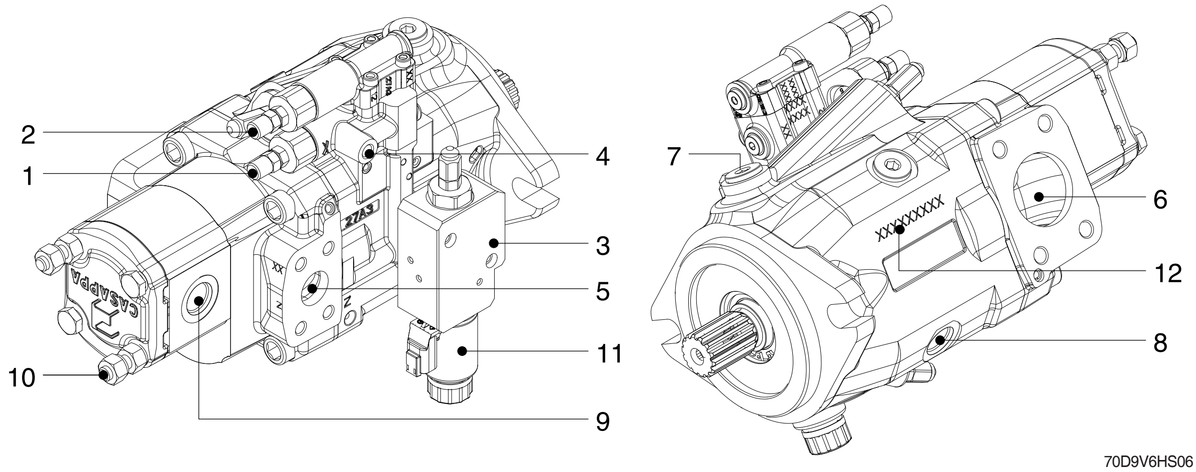
The oil at the small chamber of tilt cylinder returns to hydraulic oil tank through the hydraulic oil cooler and return filter at the same time.

When this happens, the mast tilt forward.

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

4. MAIN PUMP

1) STRUCTURE



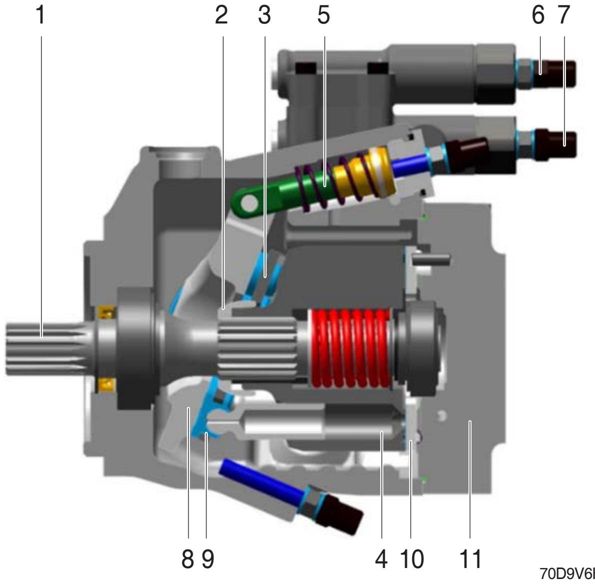
70D9V6HS06

1 Flow compensator
2 Pressure compensator
3 DEC valve
4 Load sense (LS) port X
5 Pressure port (out) B
6 Suction port (in) S
7 Drain port D1 (not used)
8 Drain port D3
9 Pressure port (Outlet)
10 Stud bolt and nut
11 24V coil
12 Label

Index	Function	Port	Thread (quantity)	Tightening torque	
				kgf·m	lbf·ft
Piston pump	Suction	IN (S)	M12 (4 EA)	3.1	22.4
	Dischrage	OUT (B)	M10 (4 EA)	3.1	22.4
	LS	X	BSPP PF 1/8	1.5	10.9
	Drain	D1	7/8-14UNF	3.1	22.4
	Plug and nut (M8)	Limiter (Displacement, pressure)		1.5	10.9
		Flow regulator		1.5	10.9
		DEC Valve		1.5	10.9
	Mount bolt	DEC Valve	M6 (2 EA)	1.5	10.9
		Flow regulator, pressure limiter	M6×60 (4 EA)	1.5	10.9
		Cover	M14×45 (4 EA)	13.2	95.5
	Coil valve DEC	-	-	0.6	4.4
Gear pump	Dischrage	Outlet	7/8-14UNF	7.2	52
	Mount bolt	Stud bolt	M10×120 (2 EA)	4.6	33.3
		Rear cover	M10×85 (2 EA)	4.6	33.3

2) OPERATION

(1) General



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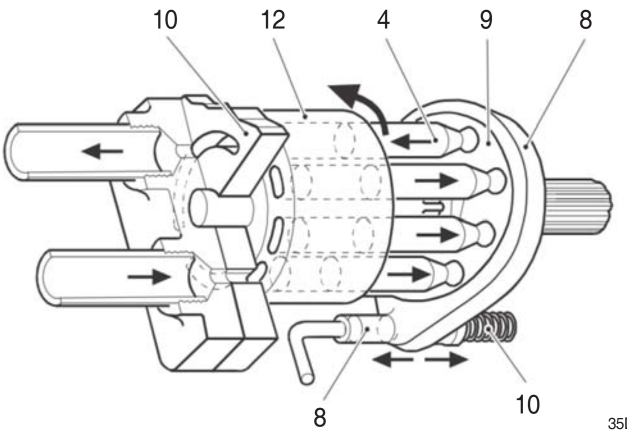


35D9VB6HS62

1 Drive shaft
2 Sleeve (retaining ball)
3 Slider
4 Piston
5 Regualting piston
6 Pressure compensator
(adusting screw, max. Pressure)
7 Flow compensator
(adjusting screw, stand-by pressure)
8 Swash plate
9 Regualting plate
10 Valve plate (distributor plate)
11 Connection plate
12 Cyclinder rotor
13 Return spring

These pumps are the variable axial piston pump type and are controlled with load signals from the flow demand for each respective function. They pump oil with 9 pistons (4) that are located in a cylindrical cylinder block (cylinder rotor). The pistons (4) are tubular sleeves with a ball-shaped top. There are T-shaped sliders (3) on the piston top. The sliders are fixed in the swash plate (8).

The swash plate secures the piston tops so that the pistons run straight in the cylinder bores. The swash plate is forced against the regulating plate by a ball-shaped sleeve (2) on the pump shaft. The cylinder rotor (12), pistons (4), sliders (3) and swash plate (8) rotate with the pump shaft.

The sliders (3) slide against the regulating plate (9). On the other side of the cylinder rotor, there is a valve plate (10) which controls oil to and from the cylinder rotor. The regulating plate (9) angles in relation to the pump's shaft with a regulating piston (5) to change the pump's capacity. A return spring (13) acts against the regulating piston (5).

The pressure regulator (6) limits max. pressure and min. pressure (stand-by pressure).

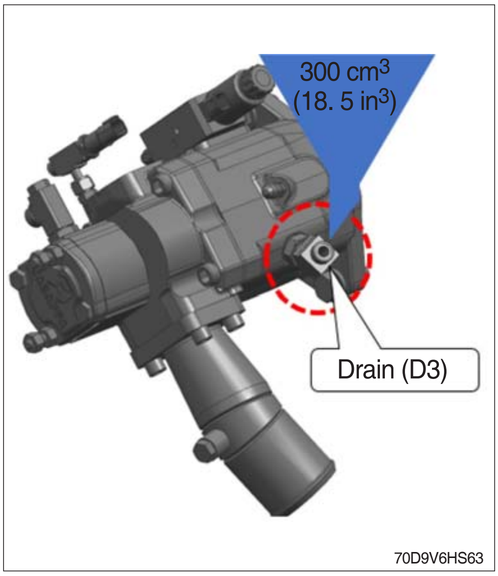
When the shaft turns, the cylinder rotor (12) will rotate. The angle of the regulating plate (9) results in the pistons being pulled in and out of the cylinder rotor by the sliders. The pistons' (4) stroke is changed by changing the angle of the yoke.

When the pistons are pulled out of the cylinder rotor (12), the cylinder and the space in the piston are filled with oil (suction phase). The oil is sucked through the outlets in the valve plate (1).

When the pistons are pressed in, the oil is forced out at the bottom, through the valve plate (10). A small amount of oil is forced through the piston head and lubricates the slider and yoke. The yoke does not rotate, which means that the pistons always suck and respectively force oil in a certain part of the revolution. This makes it possible to simplify the design of the valve plate, and valves can be avoided.

The regulating piston, which controls the angle of the yoke and thus the pump performance, is affected by load signals from the hydraulic system's valves. The pump also has its own supply which means that the pump always pumps a small amount, a so-called "stand-by pressure".

※ Axial piston variable pumps may not be started until they are filled with oil. A pump of this construction relies on the oil it is pumping to provide lubrication for its moving parts. Never lubricate the sliding parts in the pump casing and do not operate the pump in a dry state. It will be damaged immediately. Fill the pump case to the highest case drain or vent port. Use clean filtered fluid.



3) CHECKS AND ADJUSTMENTS

(1) Margin pressure check

The margin pressure is the difference between the pressure at the B-Port and X-Port. If the margin pressure is not within the range shown in the below table, the flow of hydraulic oil out of the variable displacement pump will be either too low or too high.

⚠ **Do not operate the hydraulic functions while checking the margin pressure. Serious injury to personnel and damage to the lift truck can result if hydraulic functions are operated.**

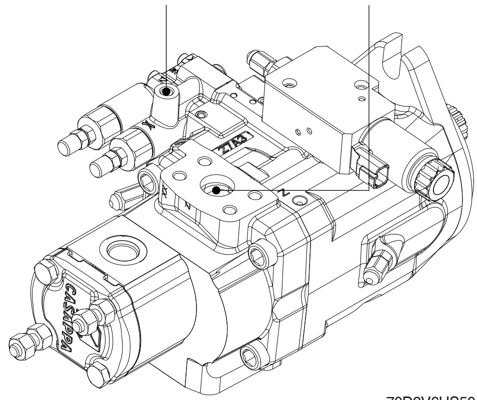
① Install pressure gauges on port B and port X respectively. See the illustration for location.

② Start the engine and keep the forklift at idle for 5 minutes.

③ Check the pressure on the gauge compared to that listed in the under table.

④ If the margin pressure is not within the range specified in the below table, go to "The flow compensator adjustment section".

Gague B-X	bar	psi
	25 ± 1	363 ± 14.5



70D9V6HS50

(2) Flow compensator adjustment

① Insert an hexagonal wrench (3 mm) into flow compensator adjustment screw. Hold hexagonal wrench in flow compensator screw and turn locknut (13 mm) counterclockwise all the way.

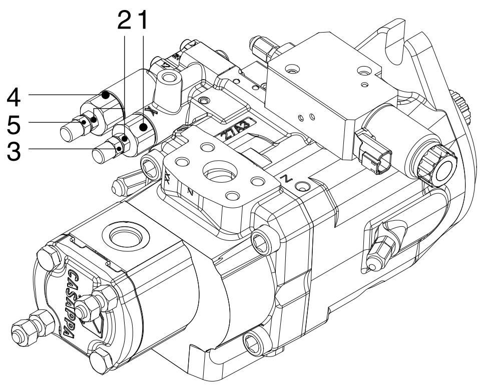
② Turn the flow compensator adjustment screw to adjust the B port pressure.

· Clockwise to increase the B port pressure by 16 bar (232 psi) per turn.

· Counterclockwise to decrease the B Port pressure by 16 bar (232 psi) per turn.

③ Check the margin pressure as described in the margin pressure checks. If margin pressure is not correct, perform Step 1 and Step 2 until correct margin pressure is reached.

④ Tighten the locknut to 1.5 kgf·m (10.9 lbf·ft).



1 Flow compensator
2 Lock nut (13 mm hex.)
3 Flow compensator adjustment screw (3 mm SW)
4 Pressure compensator
5 Pressure compensator adjustment screw (3 mm SW)

70D9V6HS60

(3) Pressure compensator adjustment

① Mark or measure the screw locations of the flow and pressure compensators.

※ **Be sure to count and note the number of turns on the lock nut.**

Pressure compensator	bar	psi
	250	3625

② Using an hexagonal wrench (3 mm), hold the flow compensator adjustment screw and turn the lock nut (13 mm) counterclockwise all the way.

③ Turn the flow compensator adjustment screw clockwise until it stops.

· Clockwise to increase the B port pressure by 52 bar (754 psi) per turn.

· Counterclockwise to decrease the B Port pressure by 52 bar (75 psi) per turn.

④ Start forklift truck engine and let it idle. Do not operate the hydraulic functions. Measure the pressure at the B port of the pump. If pressure does not match what is shown in the above table, adjust the pressure compensator as follows.

a. Turn pressure compensator adjustment screw clockwise to increase pressure by 52 bar (754 psi) per turn.

b. Turn pressure compensator adjustment screw counter clockwise to decrease pressure by 52 bar (754 psi) per turn.

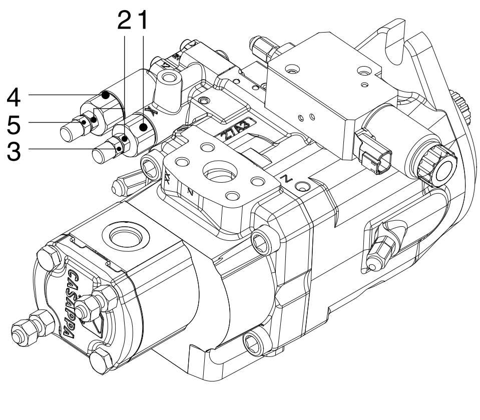
c. Put the pressure compensator adjustment screw back to its original position by turning the adjustment screw counter clockwise by the number of turns noted earlier.

d. Tighten locknut on pressure compensator adjustment screw to 1.5 kgf·m (10.9 lbf·ft).

e. Put the flow compensator adjustment screw back to its original position by turning the adjustment screw counter clockwise by the number of turns noted earlier.

f. Check the margin pressures as described in the margin pressure checks.

g. If margin pressure is correct, tighten the flow compensator lock nut to 1.5 kgf·m (10.9 lbf·ft). If margin pressure is not correct, adjust margin pressure as outlined in the margin pressure checks.



1 Flow compensator

2 Locknut (13 mm hex.)

3 Flow compensator adjustment screw (3 mm SW)

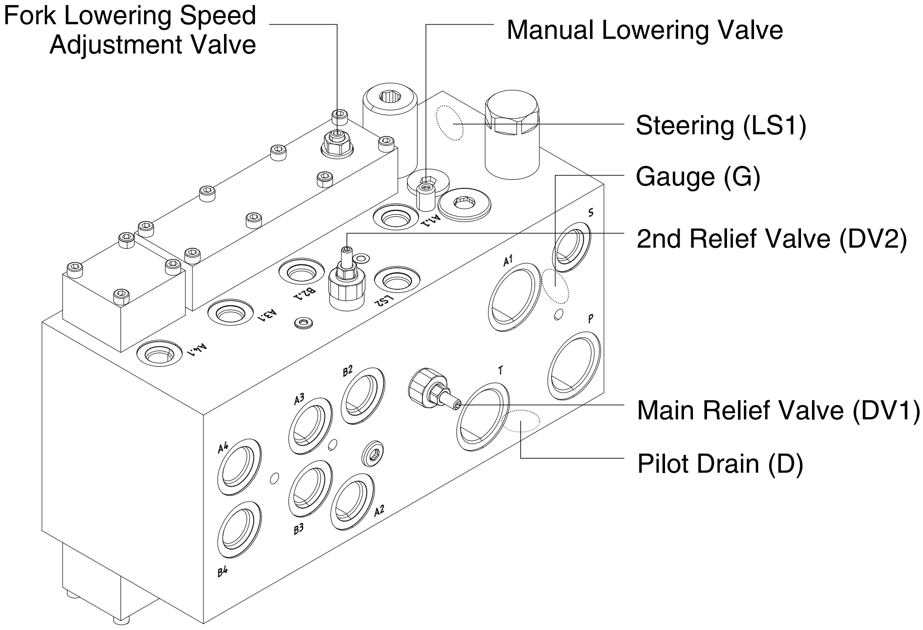
4 Pressure compensator

5 Pressure compensator adjustment screw (3 mm SW)

70D9V6HS60

5. MAIN CONTROL VALVE

1) STRUCTURE (4 SPOOL)



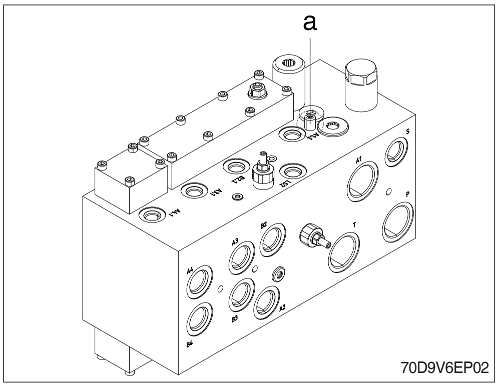
70D9V6HS07A

Port	Port name	Port size	Tightening torque	
			kgf·m	lbf·ft
A1	Lift / Lower	BSPP PF 1	19.0	177
A2, B2	Tilt rod / head	7/8-14 UNF	9.5	51.6
A-, B-	Aux 1, Aux 2			
P	Inlet	BSPP PF 1	19.0	177
T	Outlet			
a-.-, b-.-	RCV Lever	9/16-18 UNF	3.0	22.4
G / LS2 / D / LS1, S	Gauge / Pilot / Drain / Steering			
-	Main relief valve (DV1)	-	0.27	1.95
	2nd relief valve (DV2)			
	Manual lowering valve			
	Fork lowering speed ajdustment valve	M8		

2) FUNCTION

(1) Emergency fork lowering

In case that the mast can not be lowered due to a problem in the controller, activate the emergency lowering valve on the MCV assembly by rotating the valve (a).



⚠ Manual override features are intended for emergency use, not for continuous-duty operation.

① Rasing the cabin.

② Use the L-wrench (3 mm) to slowly undo the screw for the emergency lowering feature in an anti-clockwise direction until lowering begins.

※ Do not undo the screw more than 1.5 turns.

※ If lowering still does not begin, there is a mechanical block. Do not under any circumstances continue to unscrew the emergency lowering feature.

③ After lowering is complete, the screw must be screwed back in again

※ Screw locking is essential to prevent fork lifting (or lowering) slow (or malfunction) due to valve opening.

※ Do not exceed a tightening torque of maximum 0.25 ~ 0.3 kgf·m (1.8 ~ 2.2 lbf·ft).

⚠ When operating the emergency lowering valve in order to lower the mast inevitably, always make certain that any person should not stand or pass under the mast, the fork and platform so as to avoid from unexpected accident such as severe personal injury or death.

(2) Cutoff solenoid for hydraulic blocking

This device is a mast interlock that prevents the hydraulic functions of the RCV from being activated unless the driver is seated. In addition, it is a key lowering interlock device that prevents the fork from descending even when the ignition key is turned off. This safety function is defined in ISO 3691-1 and should not be arbitrarily disabled in the RCV.

(3) Relief valve

① Main relief valve (DV1)

The main relief valve limits the maximum pressure for the lift and tilt functions. If the lift or tilt function is operated simultaneously with the auxiliary function, the maximum pressure of the lift or tilt function is limited by the 2nd relief valve pressure setting. Typically the main relief valve would not require any field adjustment. If adjustment is necessary, refer to next page for main relief valve test and adjustment.

② 2nd relief valve (DV2)

The secondary relief valve limits the maximum pressure of the auxiliary function and is set lower than the main relief valve. Secondary relief valves may require pressure adjustment depending on the type of attachment.

※ If pressure adjustment is required, it is recommended to adjust within 90% of the main relief valve set pressure (e.g. 210 × 0.9=190 bar). If the main relief valve is too close to the set pressure, a problem of inter-circuit interference may occur. Refer next page for relief valve test and adjustment for adjustment instructions. As for the auxiliary function, up to 2 fingertip control methods and up to 3 manual control methods are provided as options.

3) RELIEF VALVE PRESSURE TEST AND ADJUSTMENT

(1) Test specification

· Engine speed : high idle rpm
· Oil temperature : 50 ± 5 ℃ (122 ± 9 °F)
· MCV relief set pressure
  - Main : 210 ± 3 bar (3045 ± 43 psi)
  - 2nd : 140 ± 3 bar (2030 ± 43 psi)
· Tools : spanner 10 mm, hex. wrench 3 mm

⚠ In general, the main relief valve (DV1) should not be adjusted for boosting applications in the field. Increasing the main relief valve pressure above the specified set pressure can damage the equipment.

⚠ Inspect the relief valve in a safe and clean environment.

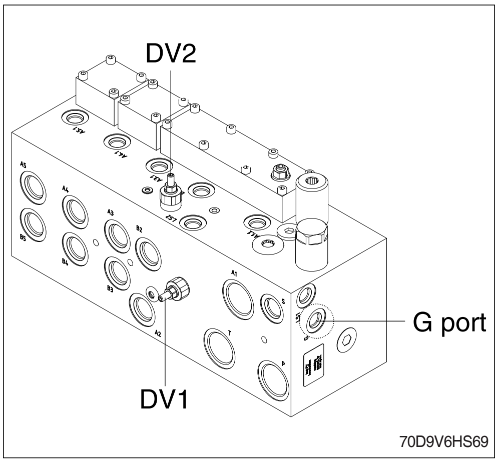
⚠ Make sure that there is no other person around the equipment during operation and testing.

⚠ Even after turning off the engine, hydraulic oil may remain in the hydraulic system. To prevent personal injury, lower the fork completely down to the ground. (The mast chain has to be released loosely so that the fork is completely lowered.)

⚠ Before disassembling, tightening, removing, or adjusting piping components (hoses, fittings, plugs, etc.), be sure to turn off the engine. Completely remove the pressure inside the circuit by moving the MCV control lever two or three times in the forward and backward direction. Also opening the hydraulic tank cap and remove the pressure. (If the hydraulic tank breather filter is clogged, the pressure in the tank may remain.)

▲ Hot hydraulic oil can cause serious burns to skin. Do not touch hydraulic components or oil during test. Make sure hydraulic oil has cooled to safe temperature before installing or removing test equipment.

▲ Hydraulic oil under pressure can be injected into skin. Lower forks to ground and relieve all circuit pressure before removing test plugs from valve.



① Operate hydraulic system until the oil temperature is within test specification. See Hydraulic WarmUp Procedure.

② Lower the fork to the ground, stop the engine, and apply the parking brake switch.

③ Rasing the cabin.

④ Connect a pressure gauge to the "G" pressure check port on the MCV.

⑤ Operate engine at test specifications.

⑥ Pull the lift lever to raise the fork all the way and hold it.

⑦ Check pressure gauge reading. Compare the readings and specifications.

⑧ Loosen the MCV relief valve locknut (10 mm) and turn the adjusting (3 mm) screw to adjust the pressure.

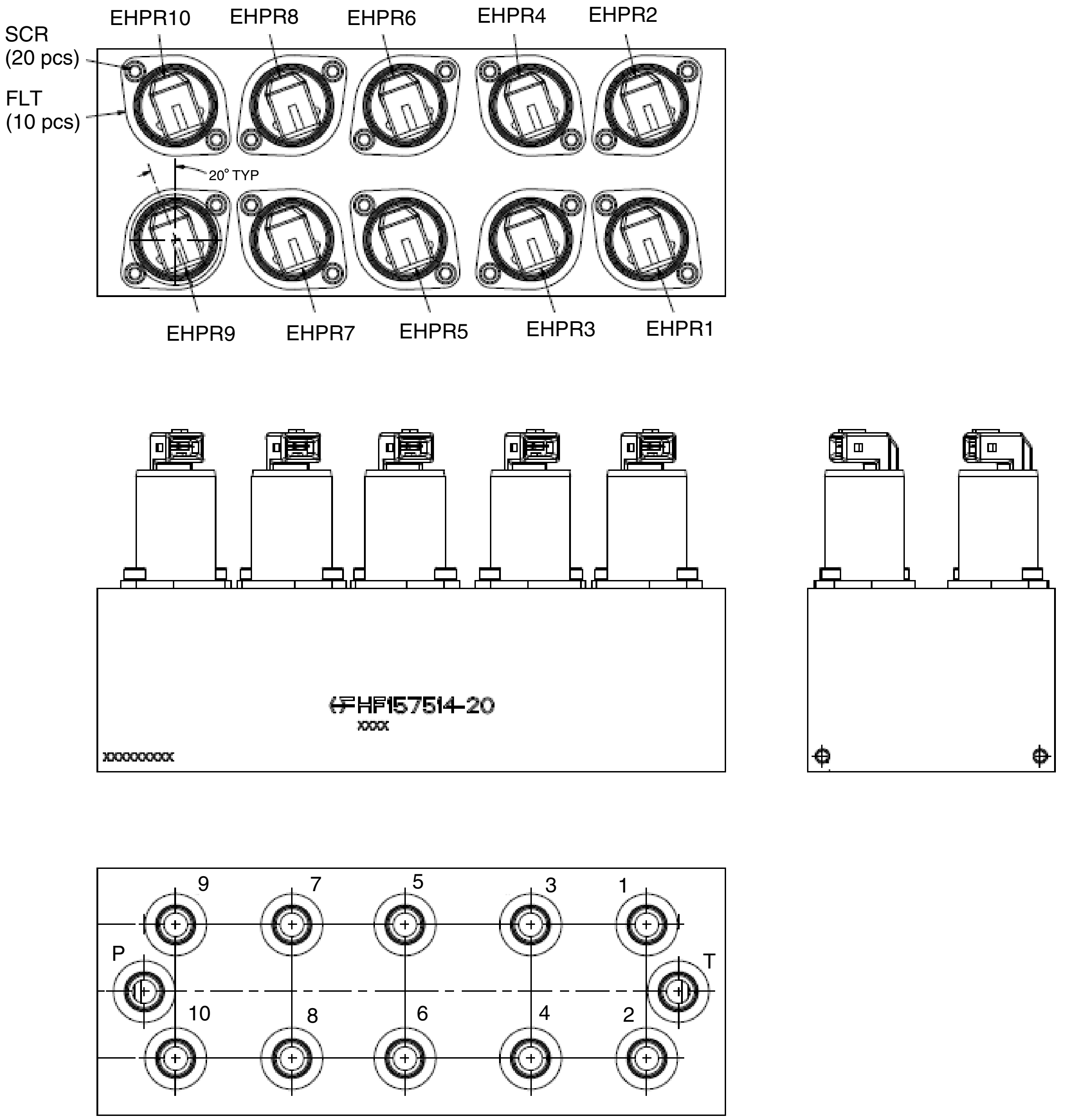
- Tightening torque : 0.25 kgf·m (1.81 lbf·ft)
- If pressure is lower than specification, turn relief valve adjusting screw clockwise.
- If the pressure is higher than the specification, turn the adjusting screw counterclockwise.

▲ The MCV relief valve adjustment screw is very sensitive. Operate in 1/4 turn increments to avoid system overpressure.

⑨ Repeat step ⑦, ⑧. If pressure is to specifications, remove test equipment.

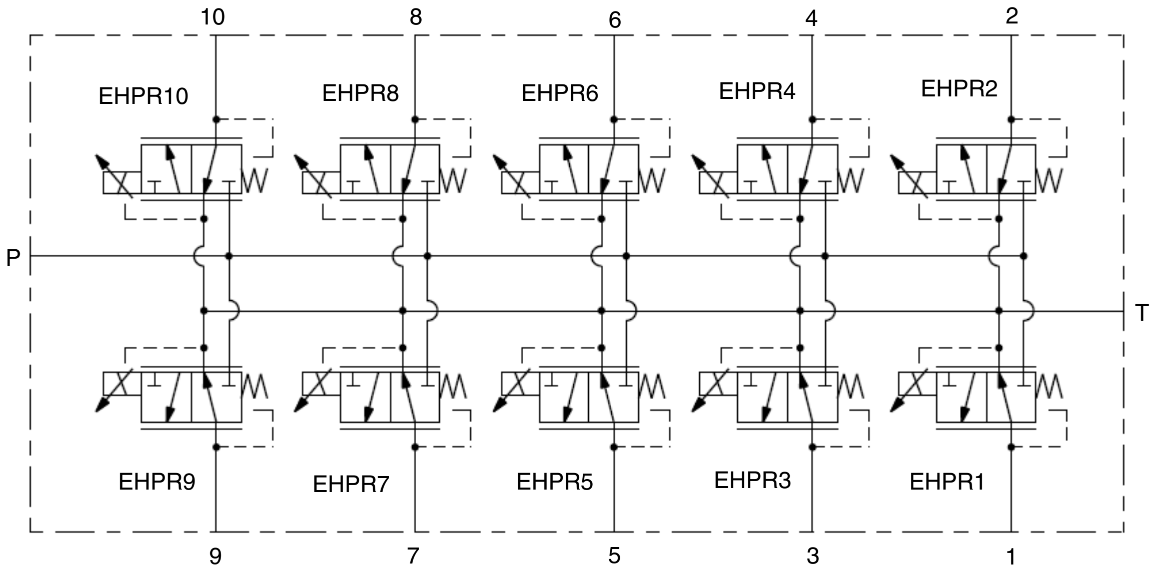
6. EPPR VALVE (option)

1) STRUCTURE (4 OR 5 SPOOL)



100D9V6EV01

Hydraulic circuit



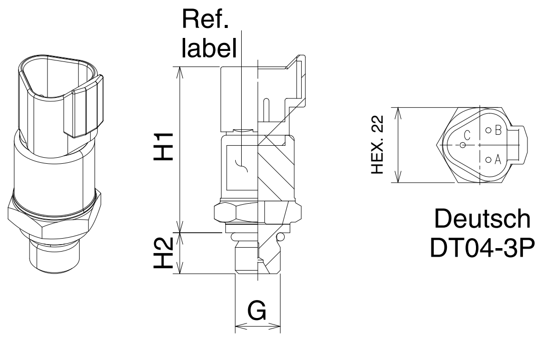
100D9V6EV02

Port	Port name	Port size	Hex. (mm)	Tightening torque	
				kgf·m	lbf·ft
1, 2	Lift / Lower	9/16-18 UNF	19	3.0	22.4
3, 4	Tilt rod / head				
5, 6 / 7, 8 / 9, 10	Aux 1, Aux 2				
P	Inlet				
T	Outlet				
-	EPPR valve	M5×0.8×12 mm	SW 4	0.31~0.41	2.2~3.0

7. PRESSURE SENSORS

1) LOAD PRESSURE SENSOR

(1) Structure



· Tightening torque : 2.5 ~ 3.0 kgf·m (18 ~ 21.7 lbf·ft)

Pin map	Function
A	+ Supply
B	- Supply
C	Output

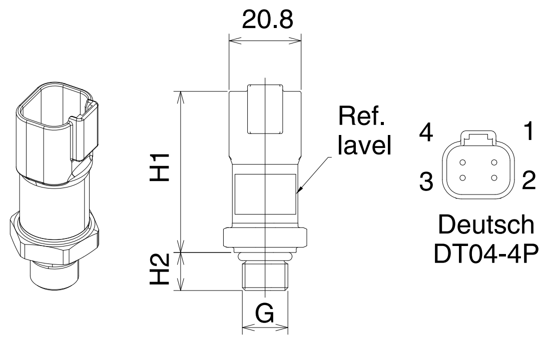
70D9V4BS10

Item	Medium	Thread (G)	H1 (mm)	H2 (mm)	Measuring range (bar)	Voltage (V)	Electircal connections
Fork load pressure sensor	Oil	9/16-18 UNF	49	12	0 ~ 350	5 ± 0.5	CD-70

※ O-ring (S611-012001) : 11.89×1.98 (AS568-906, NBR Hs90)

2) PUMP PRESSURE SENSOR

(1) Structure



· Tightening torque : 2.5 ~ 3.0 kgf·m (18 ~ 21.7 lbf·ft)

Pin map	Function
1	+ Supply
2	- Supply
3	-
4	Output

70D9V6HS15

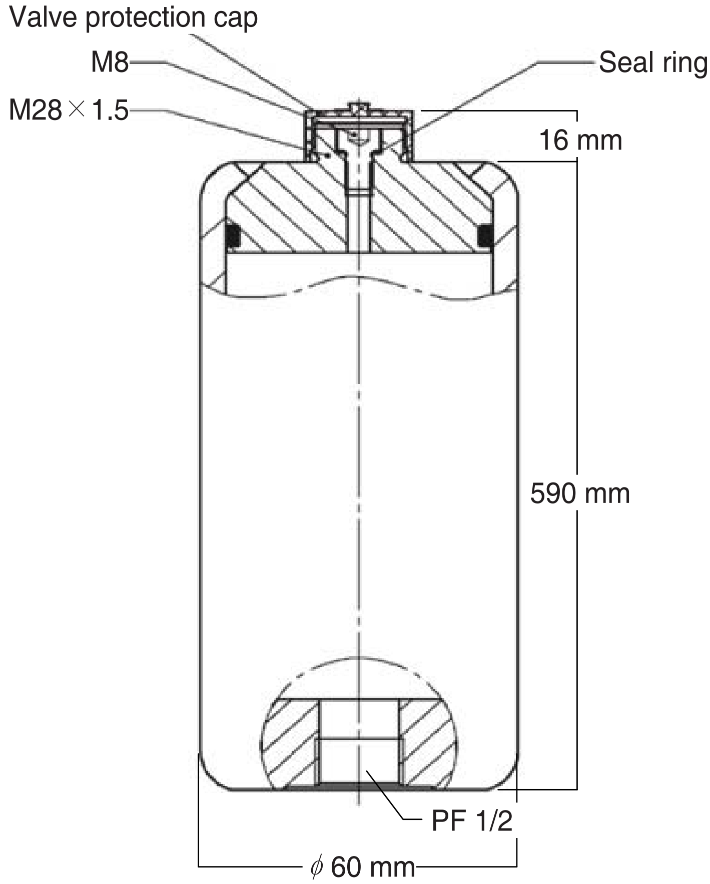
Item	Medium	Thread (G)	H1 (mm)	H2 (mm)	Measuring range (bar)	Pressure output signal (V)	Voltage (V)	Electircal connections
Pump pressure sensor (LS)	Oil	9/16-18 UNF	49	12	0 ~ 250	1 ~ 5	Max. 30	CD-5

※ O-ring (S611-012001) : 11.89×1.98 (AS568-906, NBR Hs90)

8. MAST ACCUMULATOR

1) STRUCTURE

· Tightening torque : 2 kgf·m (14.7 lbf·ft)



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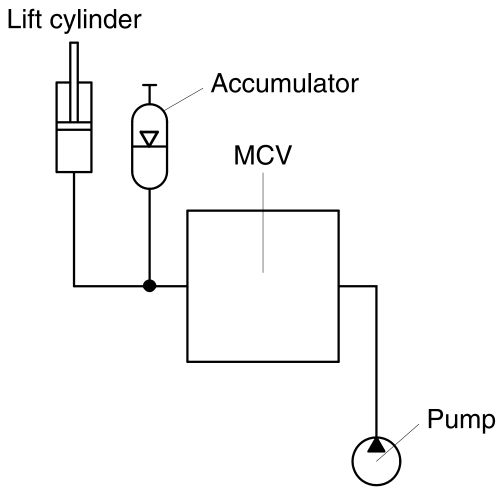


35D9VB6HS59

Parts No.	Normal volume	Pre-charging pressure at 20 ℃ (68 °F)	Gas	Weight
35FV-05000	0.5 ℓ (0.13 U.S. gal)	25 bar (363 psi)	Nitrogen gas N_2	4. 8 kg (10.6 lb)

※ **Max. working pressure : 280 bar (4000 psi), shell, rod material : carbon steel**

※ **Permitted operating temperature : -20 ~ +80 ℃ (-4 ~ +176 °F), seal material : NBR/PUR**

The mast accumulator is installed in the hydraulic line of the lift cylinder to absorb fork vibration and reduce hydraulic pulsation, which acts as a shock absorber to reduce vibration that may occur when climbing slopes or driving on rough road surfaces. This helps to prevent damage to fragile items such as glass or ceramics (porcelain) by ensuring the stability of the truck. In addition, when applied to hydraulic attachments (e.g. paper roll clamps, carton clamps, etc.), it can be configured and utilized to help reduce damage to the load through "prevent slipping of loads".

※ **The accumulator works effectively under light and heavy loads. The higher the load, the smaller the absorption effect.**

※ **Compared with the case without the accumulator, this device can repeat overrun and underrun for a certain period of time when the fork stops. The phenomenon is slightly different depending on the load conditions, so please understand its characteristics before operation.**

2) PRE-CHARGE PRESSURE

The accumulator is supplied pre-charged with nitrogen gas. The pre-fill pressure provided is indicated on the label of the accumulator shell or engraved on the surface of the top shell of the accumulator. A gas valve connection terminal is provided on the top of the accumulator to adjust the filling pressure (depending on the load or workplace conditions) as needed.

· First, it can be adjusted in the range of 6 ~ 50 bar (87 ~ 725 psi), and more can be adjusted.
· Based on temperature of 20 ℃ (68 °F), charging is prohibited under high temperature conditions.

3) MAINTENANCE

⚠ **Under no circumstances should the piston accumulator be welded, soldered or mechanically repaired.**

(1) Normal checks

The basic maintenance instructions for the piston type mast accumulator are as follows. To maintain trouble-free operation, it is recommended to perform the following maintenance procedures regularly.

· Check that the connection is tihgt and there are no oil or gas leaks.
· Check the fastening parts.
· Accumulator pre-charge pressure test

(2) Checking for oil leakage into the gas side

Hydraulic oil in the accumulator may leak to the gas side through the piston seal. Check this in the following way. In this case, there is oil leakage on the gas side, so replace the accumulator.

· If a higher filling pressure than the previous test is found.
· When oil or oil mist comes out when loosening the M8 screw with a 6 mm hex. wrench.

※ **If there is oil leakage inside the accumulator, it is recommended not to repair it and replace the parts.**

· The supplied HYDAC SK280 piston accumulator is a non-repairable sealed product.
· It is an economical product with excellent durability and non-repairable structure, optimizing size and weight to reduce costs.

(3) Pre-charge pressure testing and frequency

※ **Check the charging pressure of the accumulator after completely draining the hydraulic oil from the lift cylinder line. If the cylinder line is not fully evacuated, the gas filling pressure may look different. Also, when disconnecting the accumulator connection piping, the pressure oil in the cylinder line must be discharged first.**

It t is recommended to check the filling pressure as follows.

· Initial 250 hour or 6 weeks
· Once 2000 hours or every year.

If there is no significant gas loss during the initial inspection, check 2000 hours.

※ **if the truck continues to run in harsh workplace (or high operating temperature) conditions, it should be tested more often.**

4) GAS RELEASE AND CHARGING

(1) Release

① Loosen the plastic cap and loosen the M8 screw tightly locked to the gas valve connection on the top of the accumulator with a 6 mm hex. wrench and lock it again.

② Connect FPU to the accumulator gas vlave.

※ **Release valve (D) be sure to connect while locked.**

③ Open the accumulator valve (counterclockwise) with the spindle of the FPU and check the gas.

④ Open the release valve of FPU slowly (counterclockwise) and blow out nitrogen gas until the set pressure is confirmed. Pressure is measured at room temperature around 20 ℃ (68 °F).

⑤ When the set pressure is reached, close the release valve (clockwise) and close the accumulator valve with the spindle.

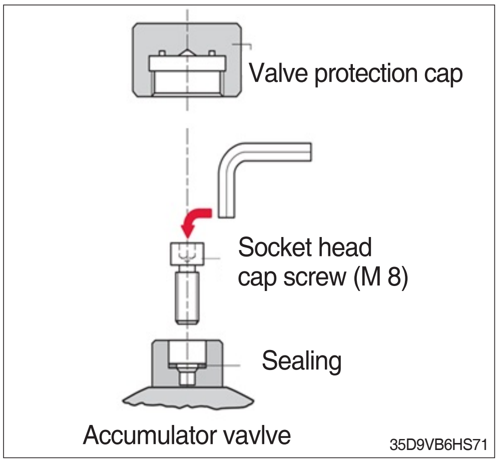
⑥ Wait 5-10 minutes for the filled nitrogen gas pressure to stabilize, then recheck the set pressure and adjust if necessary.

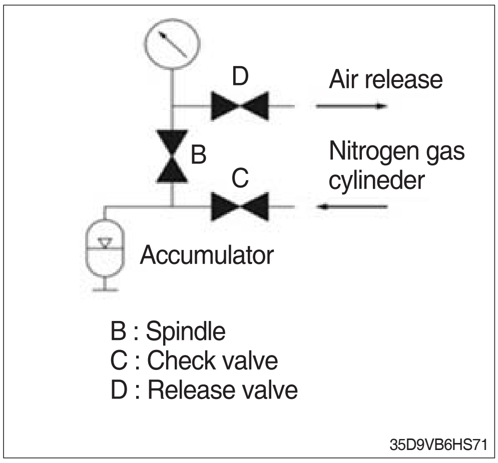
⑦ Open the release valve and blow out gas in the FPU.

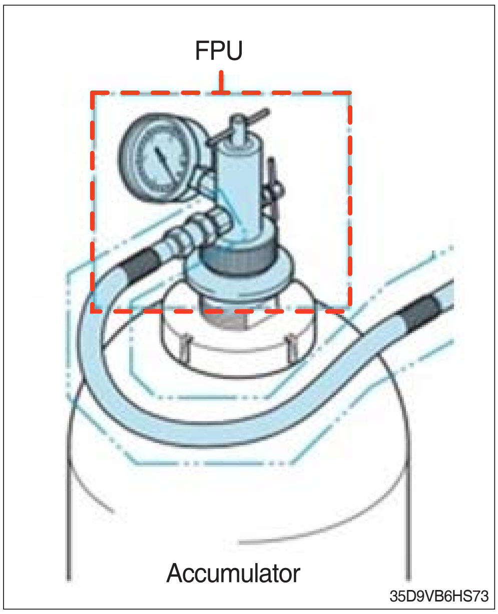
※ **If there is gas in the charging hose and FPU, it cannot be separated, and it is very dangerous if it is forcibly separated. Be sure to separate the charging hose and after blowing out the gas inside the FPU.**

⑧ Separate the FPU from the accumulator.

⑨ Tighten the M8 screw on the top of the accumulator to 2.0 kgf·m (15 lbf·ft) and tighten the plastic cap by hand.







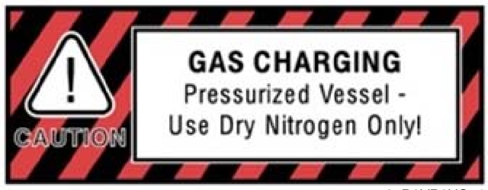
(2) Charging

※ The filling kit operation method was prepared based on HYDAC product standards.

※ Accumulator gas pressure adjustment and charging kit must be purchased separately.

※ To recharge nitrogen gas, it is convenient to use the HYDAC FPU-1 unit.

⚠ Must be filled with clean nitrogen gas only. Never use oxygen or air. Explosion hazard. Basically, nitrogen must use a minimum class 4.0. (99,99 %, filtering < 3 μm)



35D9VB6HS74

① Connect the charging hose to the nitrogen gas cylinder and FPU. Be sure to connect the release valve while it is closed. The release valve has a structure that lengthens when locked and decreases when released.

② Loosen the plastic cap and loosen the M8 screw tightly locked to the gas valve connection on the top of the accumulator with a 6 mm hex. wrench and lightly lock it again.

③ Connect FPU to the accumulator.

④ Using the spindle of FPU, open the M8 screw on the top of the accumulator. (counterclock-wise)

⑤ Slowly open the valve of the nitrogen gas cylinder and check the pressure of the gas injected into the accumulator.

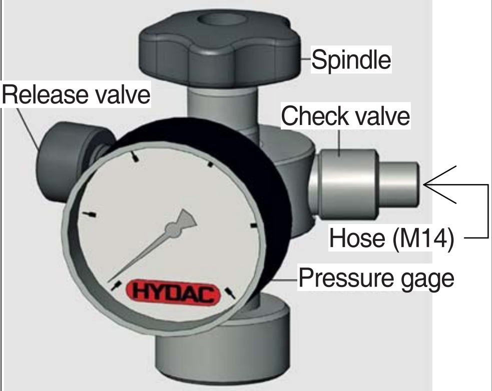
⑥ When filling is complete, close the gas valve of the accumulator using the valve of the nitrogen gas cylinder and the spindle of the FPU.

※ When adding nitrogen to the accumulator filled with nitrogen gas, wait 5-10 minutes for the temperature and pressure of the gas mixture to stabilize, then check the pressure again and adjust if necessary.

⑦ Open the release valve of FPU to remove nitrogen from the charging hose and FPU.

⑧ Using the spindle of FPU, open the accumulator valve, check the gauge, and adjust the release valve to blow out the accumulator nitrogen to the desired pressure.

⑨ When the desired pressure is reached, close the release valve of the FPU and close the gas valve of the accumulator using the spindle.



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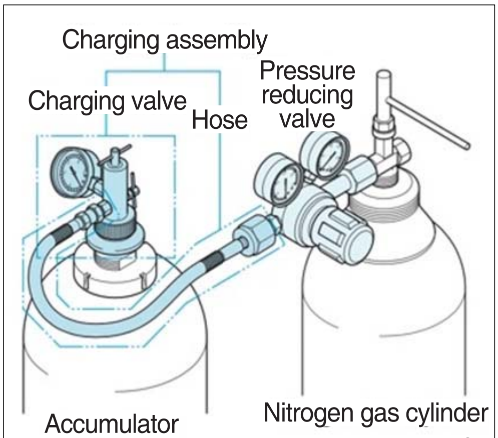


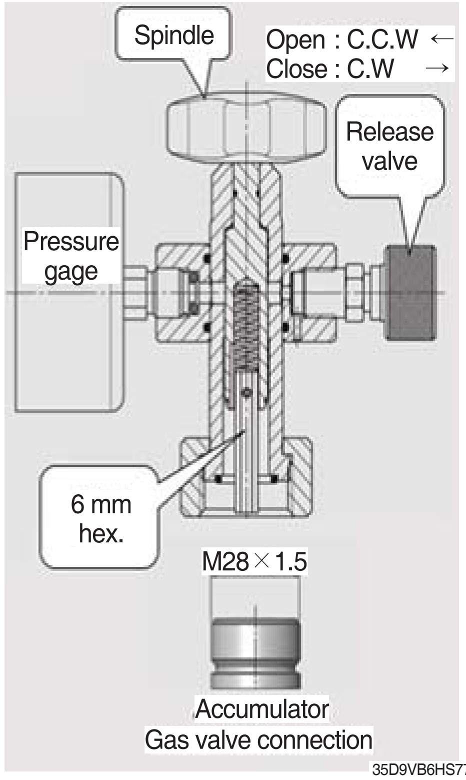
35D9VB6HS76

⑩ Open the release valve and blow out nitrogen gas in the FPU.

※ **If there is gas in the charging hose and FPU, it cannot be separated, and it is very dangerous if it is forcibly separated. Be sure to separate the charging hose and after blowing out the gas inside the FPU.**

⑪ Remove the FPU from the accumulator.

⑫ Tighten the M8 screw on the top of the accumulator to 2.0 kgf·m (15 lbf·ft) and tighten the plastic cap by hand.



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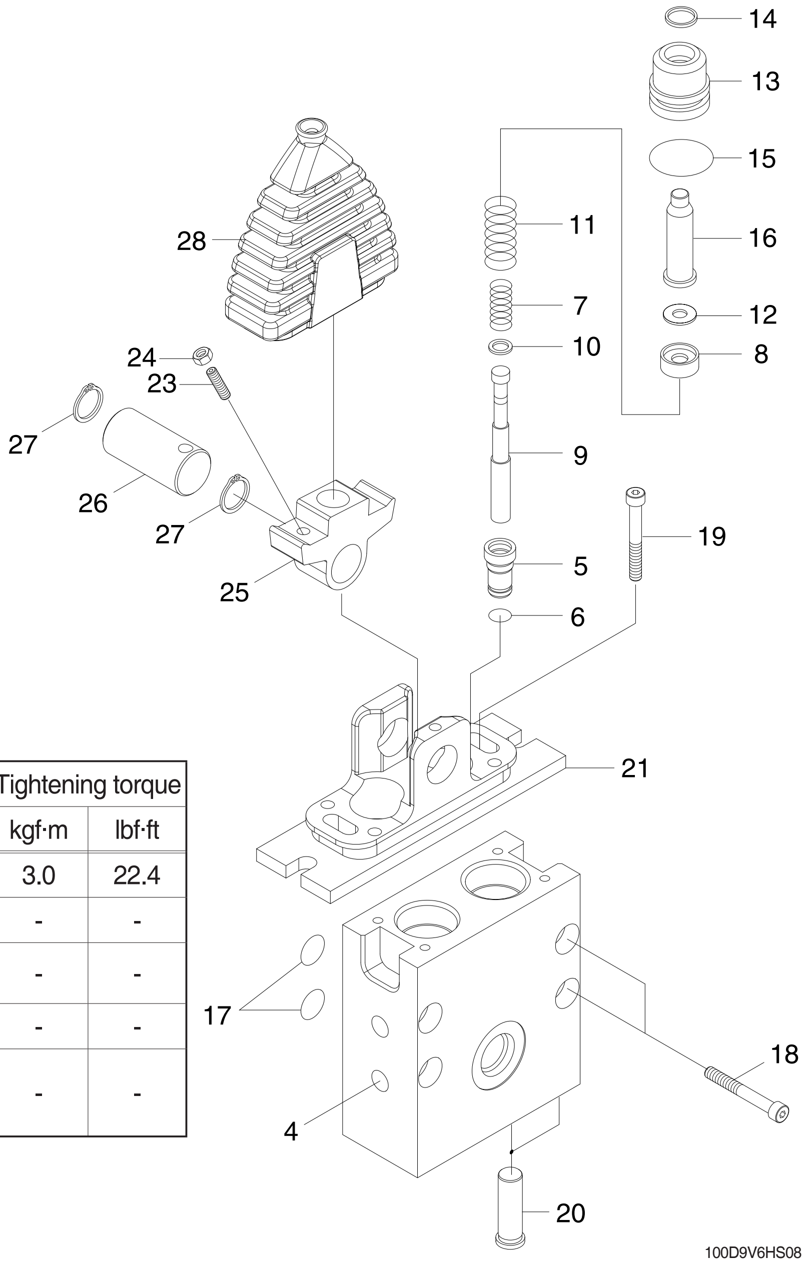
9. REMOTE CONTROL VALVE

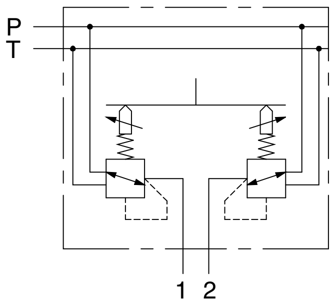
1) STRUCTURE



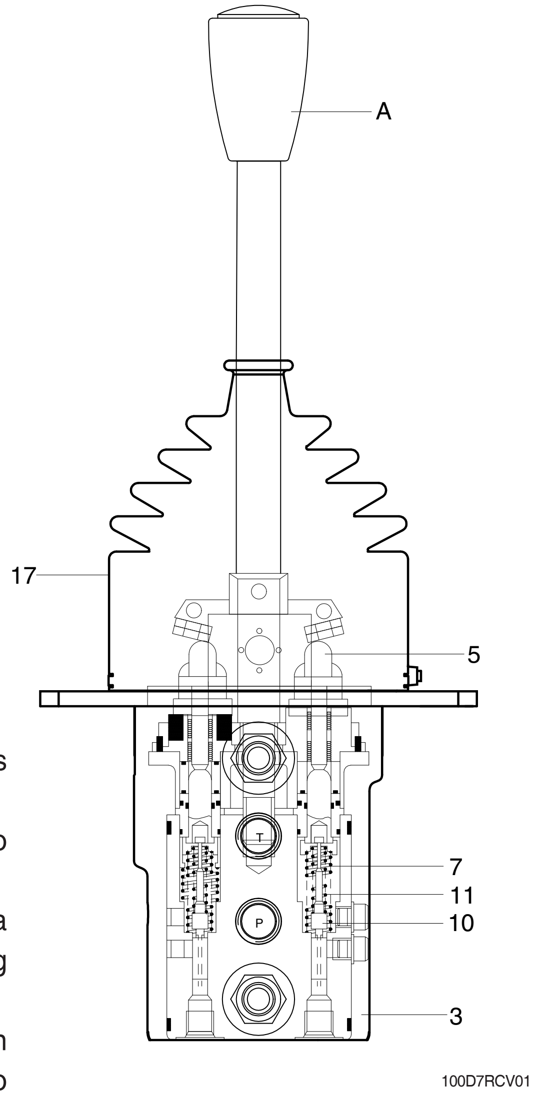
Port name	Port thread	Hex. (mm)	Tightening torque	
			kgf·m	lbf·ft
All port	9/16-18UNF	19	3.0	22.4
Bolt - tie 3SP	M6 × 40L (8 EA)		-	-
Bolt - tie 4SP	M6 × 40L (4 EA) M6 × 75L (4 EA)	SW 5	-	-
Bolt - tie 5SP	M6 × 75L (8 EA)		-	-
Bolt cover	M4 × 20L (12 EA) M4 × 20L (16 EA) M4 × 20L (20 EA)	-	-	-

1	Body	12	Stopper	21	Cover
4	Plug	13	Plug	23	Bolt
5	Plug	14	Oil seal	24	Nut
6	O-ring	15	O-ring	25	Guide
7	Spring	16	Push rod	26	Pin
8	Spring seat	17	O-ring	27	Spring pin
9	Spool	18	Bolt	28	Boot
10	Spool	19	Bolt		
11	Shim	20	Cap		

2) OPERATION



HYDRAULIC CIRCUIT



(1) Hydraulic functional principle

Pilot devices with end position locks operate as direct operated pressure reducing valves.

They basically comprise of control lever (A), two pressure reducing valves, body (3) and locks.

Each pressure reducing valve comprises of a plunger kit (5), a metering spring (7) and a spring (11).

At rest, control lever(A) is held in its neutral position by return springs (11). Ports (1, 2) are connected to tank port T.

When control lever (A) is deflected, plunger kit (5) is pressed against return spring (11) and metering spring (7).

Metering spring (7) initially moves docking rod (10) downwards and closes the connection between the relevant port and tank port T. At the same time the relevant port is connected to port P. The control phase starts as soon as docking rod (10) finds its balance between the force from metering spring (7) and the force, which results from the hydraulic pressure in the relevant port (ports 1, 2).

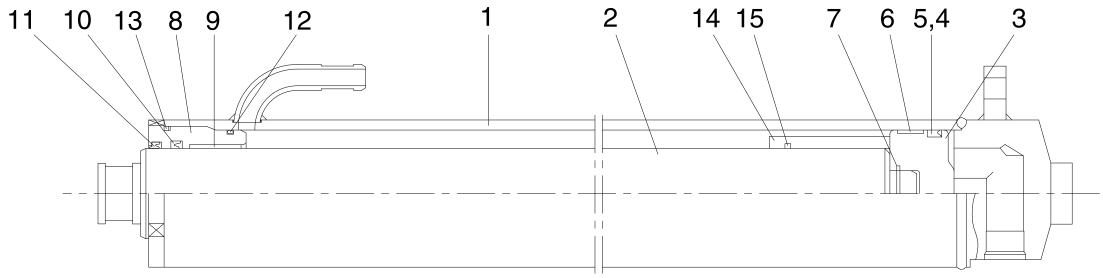
Due to the interaction between docking rod (10) and metering spring (7) the pressure in the relevant port is proportional to the stroke of plunger (5) and hence to the position of control lever (A).

This pressure control which is dependent on the position of the control lever and the characteristics of the control spring permits the proportional hydraulic control of the main directional valves and high response valves for hydraulic pumps.

A rubber bellows (17) protects the mechanical components in the housing from contamination.

10. LIFT CYLINDER

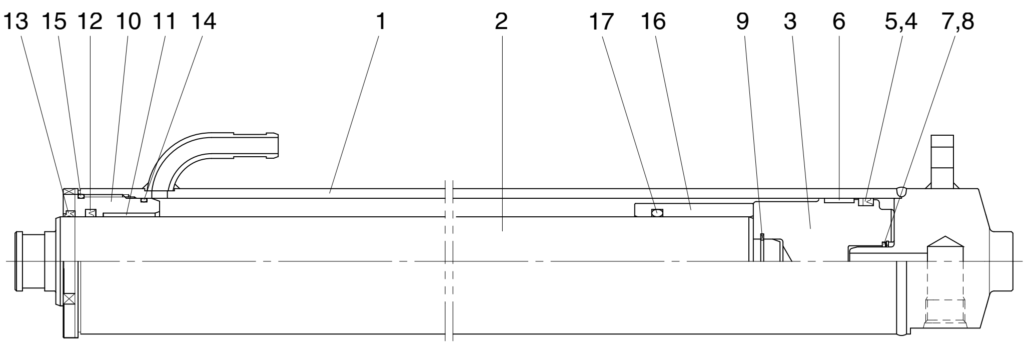
1) V MAST



3YFJ-07020

1	Tube assy	6	Wear ring	11	Dust wiper
2	Rod	7	Cushion seal	12	O-ring
3	Piston	8	Gland	13	O-ring
4	Piston seal	9	Du bushing	14	Spacer
5	Back up ring	10	Rod seal	15	O-ring

2) TS MAST

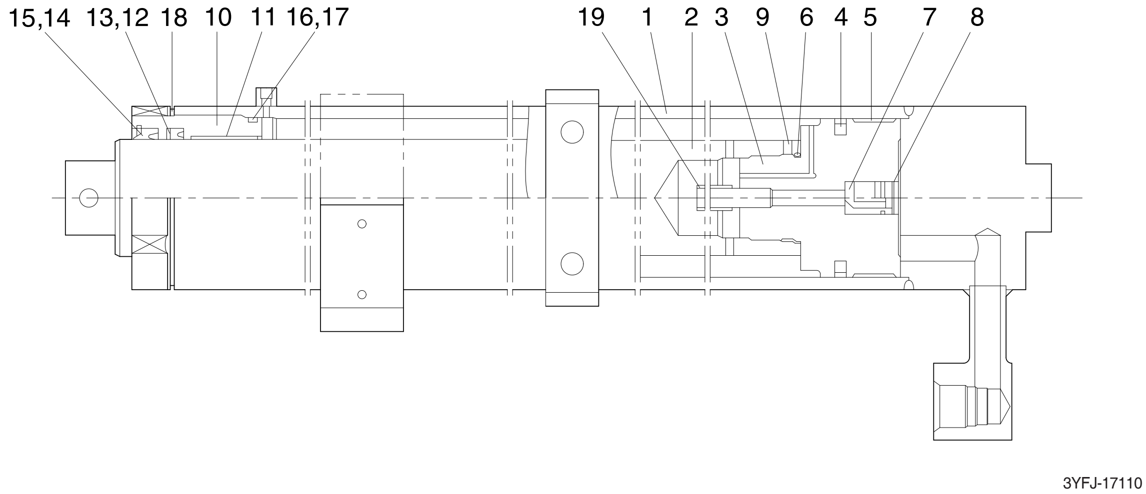


3YFJ-07210

1	Tube assy	7	Cushion seal	13	Dust wiper
2	Rod	8	Retaining ring	14	O-ring
3	Piston	9	Retaining ring	15	O-ring
4	Piston seal	10	Gland	16	Spacer
5	Back up ring	11	Du bushing	17	O-ring
6	Wear ring	12	Rod seal		

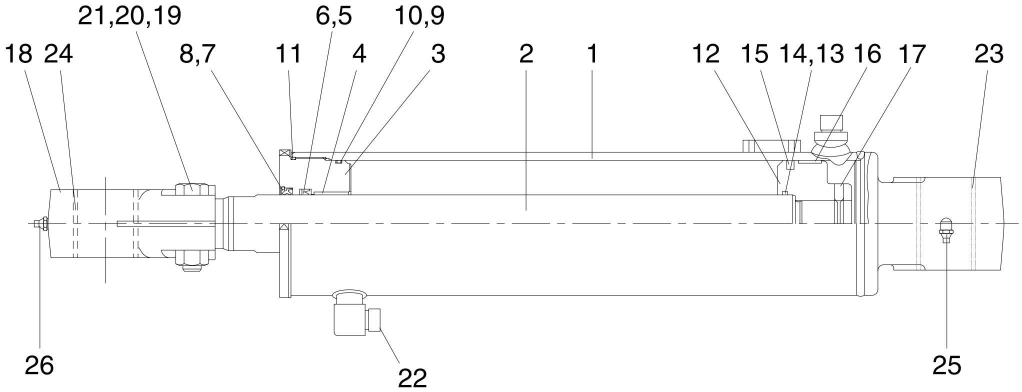
11. FREE LIFT CYLINDER

1) TS MAST



1	Tube assy	8	Retaining ring	15	Retaining ring
2	Rod	9	Set screw	16	O-ring
3	Piston	10	Rod cover	17	Backup ring
4	Piston seal	11	Rod bushing	18	O-ring
5	Wear ring	12	U-packing	19	Pipe
6	O-ring	13	Backup ring		
7	Check valve	14	Dust wiper		

12. TILT CYLINDER



1	Tube assy	10	Back up ring	19	Hex bolt
2	Rod	11	O-ring	20	Hex nut
3	Rod cover	12	Piston	21	Spring washer
4	Pin bushing	13	O-ring	22	O-ring
5	U-packing	14	Back up ring	23	Rod bushing
6	Back up ring	15	Piston seal	24	Rod bushing
7	Wiper ring	16	Wear ring	25	Grease nipple
8	Stop ring	17	Set screw	26	Grease nipple
9	O-ring	18	Eye		

GROUP 2 OPERATIONAL CHECKS AND TROUBLESHOOTING

1. OPERATIONAL CHECKS

1) CHECK ITEM

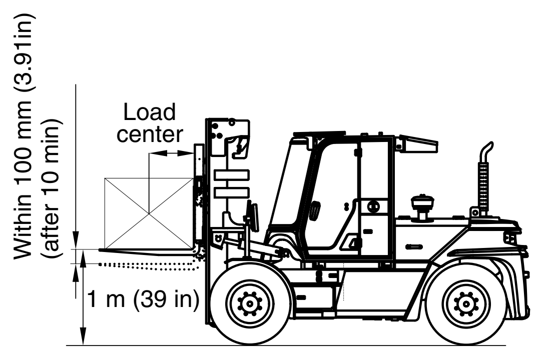
(1) Check visually for deformation, cracks or damage of rod.

(2) Set mast vertical and raise 1 m (39 inch) from ground. Wait for 10 minutes and measure hydraulic drift (amount forks move down and amount mast tilts forward).

· Check condition
- Hydraulic oil : 45±5 ℃ (113±41 °F)
- Rated capacity load
- Mast substantially vertical
- Key OFF, operator non-existence

· Hydraulic drift
- Down (Downward movement of forks)
  : Within 100 mm (3.9 in)
- Forward (Extension of tilt cylinder)
  : Within 5°

(3) If the hydraulic drift is more than the specified value, replace the control valve or cylinder packing.



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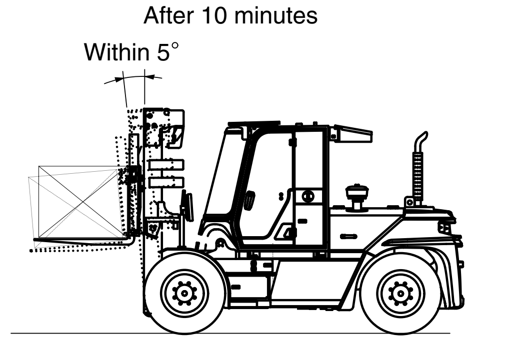

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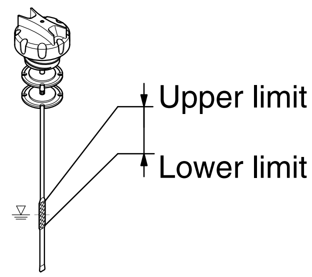
2) HYDRAULIC OIL

(1) Using dipstick, measure oil level, and oil if necessary.

(2) When changing hydraulic oil, clean suction strainer (screwed into outlet port pipe) and return filter (screwed into inlet pipe).



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3) CONTROL VALVE

(1) Raise forks to maximum height and measure oil pressure. Check the oil pressure.

Model	Unit	Pressure
100D-9V	bar (psi)	210 ± 3 (3050 ± 43)

2. TROUBLESHOOTING

1) SYSTEM

Problem	Cause	Remedy
Large fork lowering speed	· Seal inside control valve defective. · Oil leaks from joint or hose. · Seal inside cylinder defective.	· Replace spool or valve body. · Replace. · Replace packing.
Large spontaneous tilt of mast	· Tilting backward : Check valve defective. · Tilting forward : tilt lock valve defective. · Oil leaks from joint or hose. · Seal inside cylinder defective.	· Clean or replace. · Clean or replace. · Replace. · Replace seal.
Slow fork lifting or slow mast tilting	· Lack of hydraulic oil. · Hydraulic oil mixed with air. · Oil leaks from joint or hose. · Excessive restriction of oil flow on pump suction side. · Relief valve fails to keep specified pressure. · Poor sealing inside cylinder. · High hydraulic oil viscosity. · Mast fails to move smoothly. · Oil leaks from lift control valve spool. · Oil leaks from tilt control valve spool.	· Add oil. · Bleed air. · Replace. · Clean filter. · Adjust relief valve. · Replace packing. · Change to SAE10W, class CD engine oil. · Adjust roll to rail clearance. · Replace spool or valve body. · Replace spool or valve body.
Hydraulic system makes abnormal sounds	· Excessive restriction of oil flow pump suction side. · Gear or bearing in hydraulic pump defective.	· Clean filter. · Replace gear or bearing.
Control valve lever is locked	· Foreign matter jammed between spool and valve body. · Valve body defective.	· Clean. · Tighten body mounting bolts uniformly.
High oil temperature	· Lack of hydraulic oil. · High oil viscosity. · Oil filter clogged.	· Add oil. · Change to SAE10W, class CD engine oil. · Clean filter.
Actuator (cylinder or motor) works slowly or does not operate.	· Shortage of oil in oil tank. · Decrease of relief valve pressure. · Spool got stuck. · Shortage of oil flow to the valve.	· Check the oil level in the oil tank. · Install pressure gauge on the circuit, and check the pressure with it by handling the lever. · Check that manual lever moves smoothly. Check that lever stroke is enough. · Check that oil flow of the pump is within specified rate.

Problem	Cause	Remedy
High oil temperature	· Lack of hydraulic oil. · High oil viscosity. · Oil filter clogged.	· Add oil. · Change to SAE10W, class CD engine oil. · Clean filter.
Cylinder lowers considerably under normal circumstance.	· Internal leakage of cylinder happens frequently. · Excessive leakage from spool of the valve. · Spool got stuck. · Leakage in a part of the circuit.	· Fit the stop valve on the pipe between valve and cylinder, observe the internal leakage of cylinder. · Check the oil viscosity is not too low. · Check that manual lever moves smoothly. · Check the circuit. Observe leakage from pipes.
Pressure does not increase sufficiently.	· Defect of relief valve. · Leakage in a part of the circuit.	· Check the relief valve. · Check the circuit. Observe leakage from pipes.
Temperature rising of the hydraulic oil.	· Working with higher pressure than rated pressure. · Low viscosity of oil. · Leakage from a part of the circuit. · Oil leakage in the pump. · Insufficient suction of the pump.	· Check the flow pressure. · Check the sort of oil and viscosity. · Check if the circuit is relieved at all times. · Check if the temperature of pump surface higher 30˚C than oil temperature. · Check the oil tank volume. Check if the suction strainer is blocked.
Steering force is heavy.	· Defect of steering relief valve.	· Check the steering relief valve.

2) MAIN PUMP

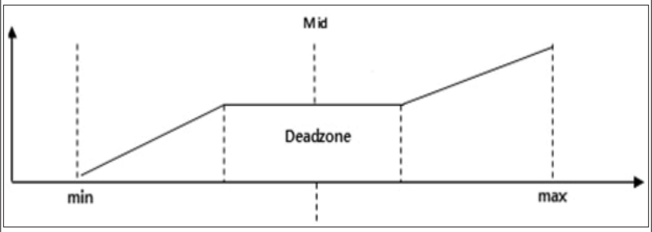
Problem	Cause	Remedy
Unusual noises No or insufficient flow	· Insufficient air bleeding of the hydraulic system.	· Fill the axial piston pump, suction line for the hydraulic pump and the oil tank. · Completely air bleed the pump and hydraulic system. · Inspect and correct or replace. - Installation position
	· Insufficient suction conditions - Viscosity of the hydraulic fluid too high - Suction pressure too low - Impermissible filter in the suction line - Foreign particles in the suction line	· Optimize inlet conditions. - Use suitable hydraulic fluid. - Fill the suction line with hydraulic fluid. - Remove foreign particles from the suction line.
	· Improper mounting of the axial piston pump	· Inspect and correct the mounting of the pump. - Observe tightening torques.
	· Improper mounting of assembled parts (hydraulic lines)	· Mount assembled parts according to the information provided.
	· Pump control valve vibration	· Optimize the adjustment of the axial piston pump and the pressure limitation in the hydraulic system.
	· Mechanical damage to the main pump (e.g. bearing damage)	· Inspect and correct or replace.
No or insufficient flow	· Faulty mechanical drive (e.g. defective coupling & spline) · Hydraulic fluid not in optimal viscosity range	· Inspect and correct or replace. · Check temperature range and use suitable hydraulic fluid.
No or insufficient pressure	· Insufficient pilot pressure or control pressure · Output actuator defective (e.g. hydraulic cylinder)	· Check pilot pressure or control pressure. Inspect and correct. · Inspect and correct.
Pressure Flow fluctuations Instabilities	· Malfunction of the control device of the axial piston pump · Wear or mechanical damage to the axial piston pump · Unstable control signal	· Inspect and correct. · Inspect and correct or replace. · Inspect and correct.
Increased, unusual vibration	· Bearings worn	· Inspect and correct or replace.
Excessively high temperature of hydraulic fluid and housing	· Wrong setting or malfunction in the pressure relief and pressure control valves e.g.) - high pressure relief valve - pressure cut-off - pressure controller · Axial piston pump worn	· Optimize the adjustment of the pressure limitation and pressure control valves of the axial piston pump and the pressure safeguarding in the hydraulic system. · Inspect and correct. · Inspect and correct or replace.

3) CYLINDER

Problem	Cause	Remedy
Oil leaks out from rod cover through rod	· Foreign matters on packing. · Unallowable score on rod. · Unusual distortion of dust seal. · Chrome plating is striped.	· Replace packing. · Smooth rod surface with an oil stone. · Replace dust seal. · Replace rod.
Oil leaks out from cylinder rod cover thread	· O-ring damaged.	· Replace O-ring.
Rod spontaneously retract	· Scores on inner surface of tube. · Unallowable score on the inner suface of tube. · Foreign matters in piston seal.	· Smooth rod surface with an oil stone. · Replace cylinder tube. · Replace piston seal.
Wear (clearance between cylinder tube and wear ring)	· Excessive clearance between cylinder tube and wear ring.	· Replace wear ring.
Abnormal noise is produced during tilting operation	· Insufficient lubrication of anchor pin or worn bushing and pin. · Bent tilt cylinder rod.	· Lubricate or replace. · Replace.

4) FINGERTIP (OPTION)

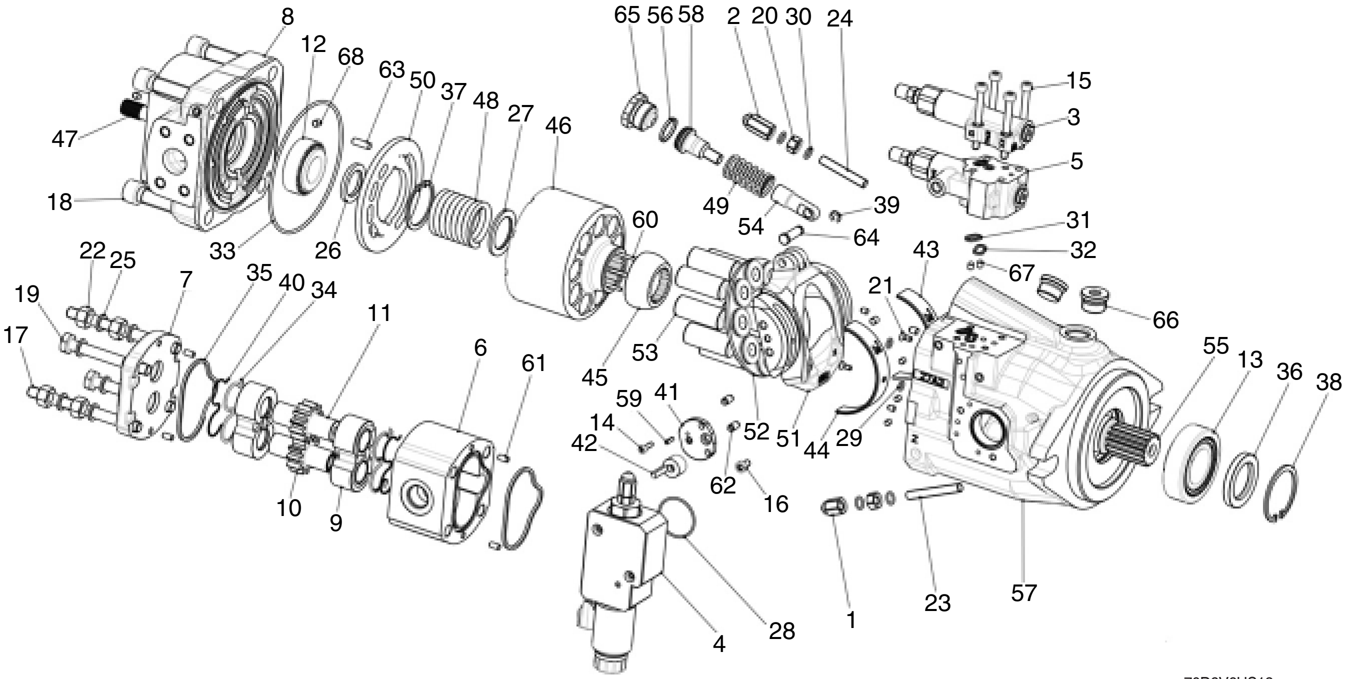
(1) DTC Error code and Trouble shooting

Category	DTC Error Code	Action
Lever setting error	· Lift Lever Setting Error · Tilt Lever Setting Error · Aux1 Lever Setting Error · Aux2 Lever Setting Error  * VCU : Valve Control Unit (HAWE "CANIO14+") **DTC : Diagnostic Trouble Code	Check Lever Setting Value is correct like below values, and retry lever setting correctly. Min = 0.3~0.7 Mid = 2.3~2.7 Max = 4.3~4.7 (Voltage) If the Lever Value doesn't change from "0", Check fingertip levers. It might parts failure or Electric wire failure.
Valve open error	· Lift up (down) Valve 0 (1) Open · Tilt in (out) Valve 2 (3) Open · Aux1 in (out) Valve 4 (5) Open · Aux2 in (out) Valve 6 (7) Open	Check Valve Electric wire open circuit.
Valve short error	· Lift up (down) Valve 0 (1) Short · Tilt in (out) Valve 2 (3) Short · Aux1 in (out) Valve 4 (5) Short · Aux2 in (out) Valve 6 (7) Short	Check Valve Electric wire short circuit.
Valve VCC missing error	· Lift up (down) Valve 0 (1) VCC missing · Tilt in (out) Valve 2 (3) VCC missing · Aux1 in (out) Valve 4 (5) VCC missing · Aux2 in (out) Valve 6 (7) VCC missing	Check VCU VCC(Supply Voltage). About 24V must be supplied for A1, A8, B5 Pin.

GROUP 3 DISASSEMBLY AND ASSEMBLY

1. MAIN PUMP

1) STRUCTURE



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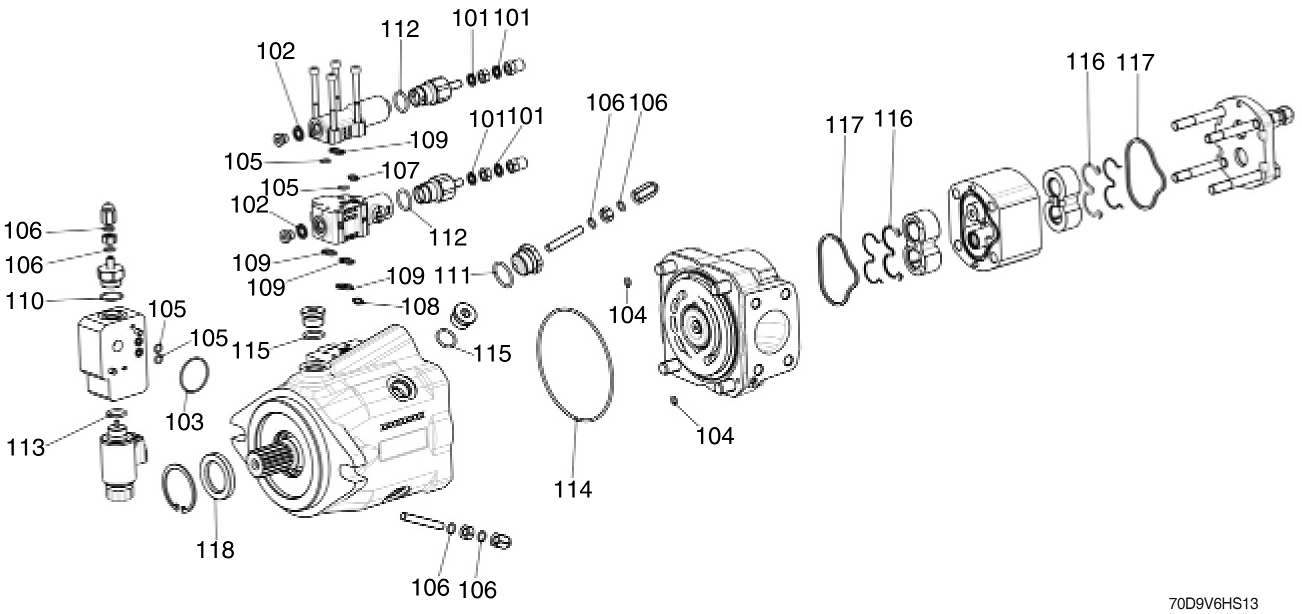
1	Lock nut	24	Screw (M8×50)	47	Hub
2	Lock nut	25	Washer	48	Piston spring
3	Flow compensator	26	Washer	49	Spring
4	Displacement regulator	27	Washer	50	Valve plate
5	Flow compensator	28	O-Ring	51	Swash plate
6	Housing	29	O-Ring	52	Piston guide plate
7	Rear Cover	30	Seal	53	Piston
8	Cover	31	Seal	54	Connection shaft
9	Thrust plate	32	Seal	55	Version shaft
10	Drive gear	33	O-Ring	56	Segment
11	Drive gear	34	Seal	57	Pump body
12	Roller bearing	35	Seal	58	Piston
13	Roller bearing	36	Shaft seal	59	Dowel pin
14	Screw (M4×14)	37	Ring	60	Dowel pin
15	Screw (M6×60)	38	Snap ring	61	Dowel pin
16	Screw (M6×10)	39	Ring	62	Dowel pin
17	Stud bolt (M10×120)	40	Seal plate	63	Dowel pin
18	Screw (M14×45)	41	Drive Support	64	Dowel pin
19	Screw	42	Drive regulator	65	Plug
20	Nut (M8)	43	Swash plate	66	Plug
21	Screw (M4×10)	44	Swash plate	67	Plug
22	Nut	45	Ring spline	68	Plug
23	Screw (M8×60)	46	Cylinder block		

· Seal kit (101~118)



101	Washer	107	O-Ring	113	O-Ring
102	Washer	108	Seal	114	O-Ring
103	O-Ring	109	Seal	115	O-Ring
104	O-Ring	110	O-Ring	116	Seal
105	O-Ring	111	O-Ring	117	Seal
106	Seal	112	O-Ring	118	Shaft seal

2) GENERAL INSTRUCTION

(1) Purpose

The following document shows all replacement steps for all seals, belonging to the pump. When you see a leakage, you must follow the replacement instruction only for the components involved in the leak. This explain the most common replacements, that concern shaft seal, compensators seals and internal pump seals (piston and gear).

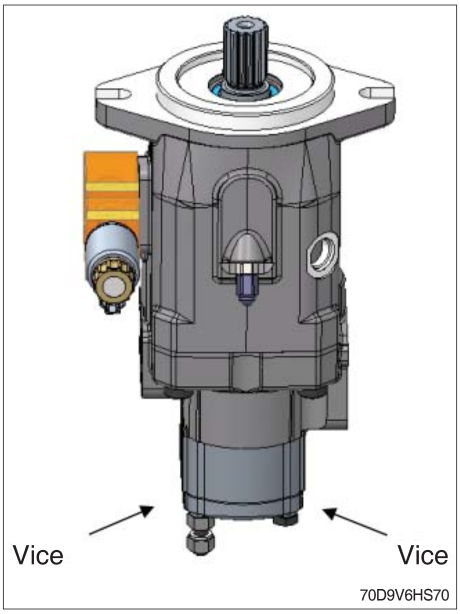
(2) Suggestion

① Check the parts have not been damaged during the shipment.
② Work in a clean area.
③ Clean with solvent (except the seals) and dry air all components before assembling.
④ Pay attention not to damage the machined surfaces.
⑤ The components need to be fitted in place without forcing them. If too much force is required, it is due to a bad clearances issues.
⑥ When hand pressure is not enough, use only mallet and never hammer.
⑦ Respect the tightening torque for bolts.
⑧ Pay attention when you see a warning sign.

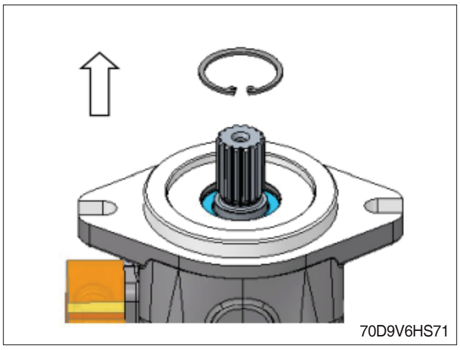
3) SHAFT SEAL REPLACEMENT

(1) Put the pump in vertical, with the shaft facing up.

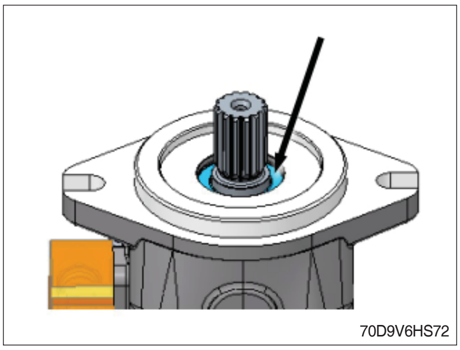
⚠ You need to find something suitable for the cover geometry, in order to put the pump in vertical position.



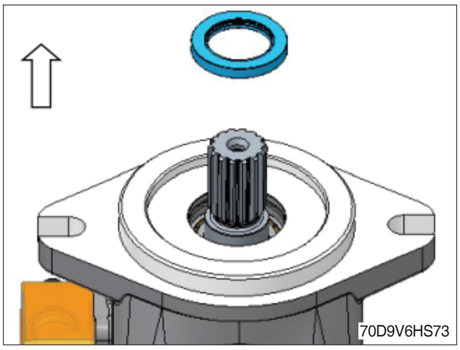
(2) Remove the snap ring.



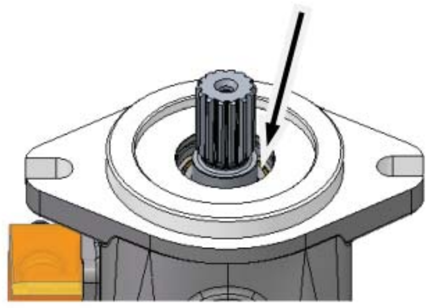
(3) Realize a small hole (or more small holes) in the shaft seal.



(4) Use an artisanal tool or a screwdriver, in order to deform the shaft seal and remove it. Holes made before can help to enter between shaft seal lip and the shaft, with the tool or the screwdriver.



(5) Clean the surface with compressed air.


70D9V6HS74

(6) Put a thin layer of clean grease on the contact surface.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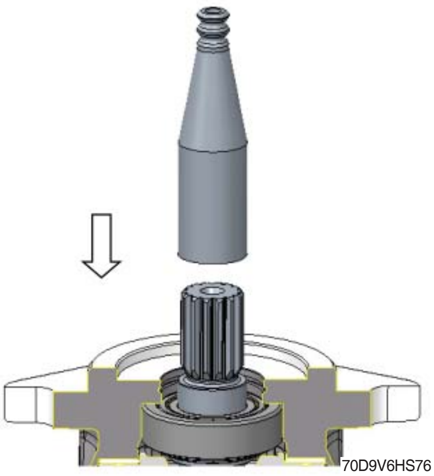
(7) Protect the shaft seal using a proper protection for the shaft end.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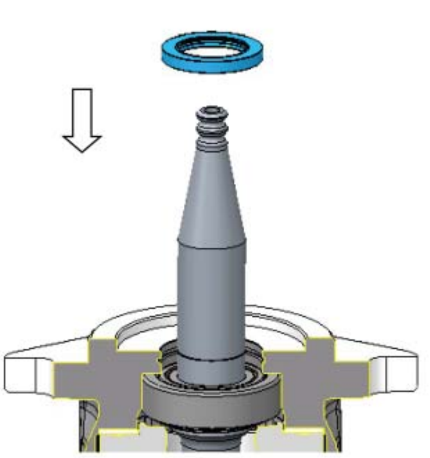
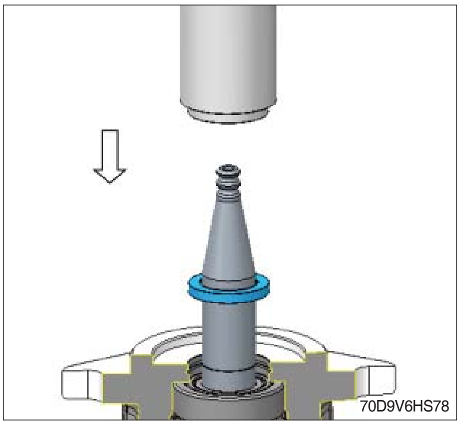
(8) Do not damage the shaft seal lip while assembling the seal on the shaft. Pay attention both to the shaft end and to the little gap in the diameter between the shaft end and the seat of the shaft seal.


70D9V6HS77

(7) Use a proper tool to push the shaft seal close to its seat. The shaft seal must be kept always perpendicular to the shat to not damage the seal lip.



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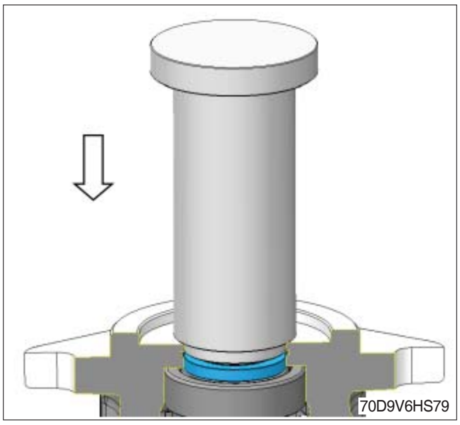
(8) Be careful not to push the shaft seal inside the case. It is sufficient to push it in order to have enough space for the snap ring to be placed near its seat.



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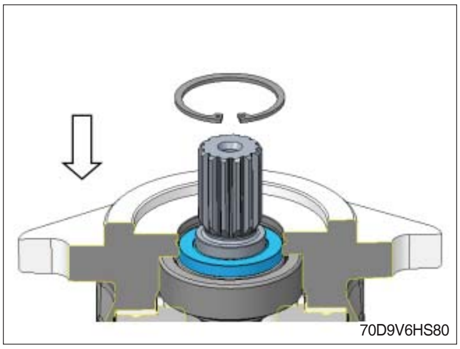
(9) Insert the snap ring.



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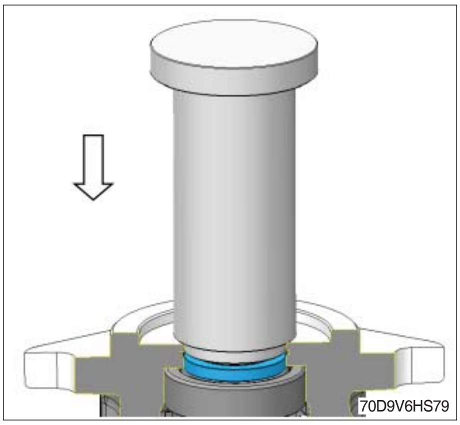
(10) Use a proper tool to push the snap ring in its seat. The shaft seal is going to be pushed by the snap ring in the correct position.



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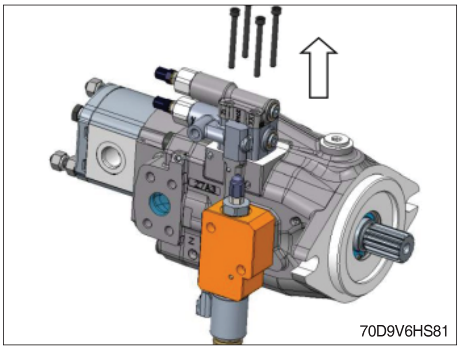
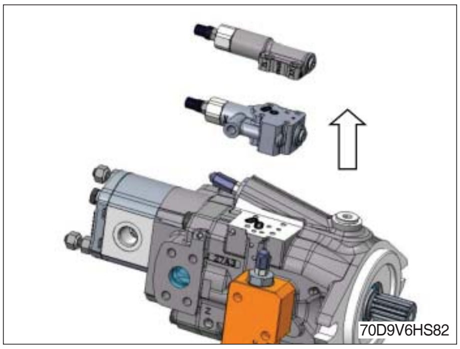
4) COMPENSATOR SEALS REPLACEMENT

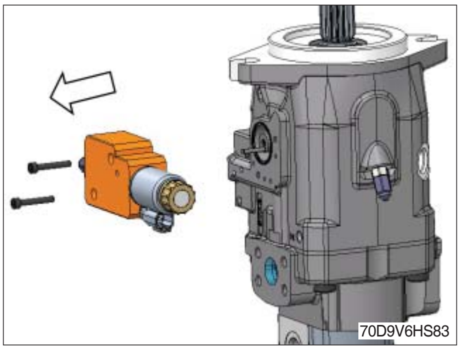
(1) Remove the screws of the compensators.



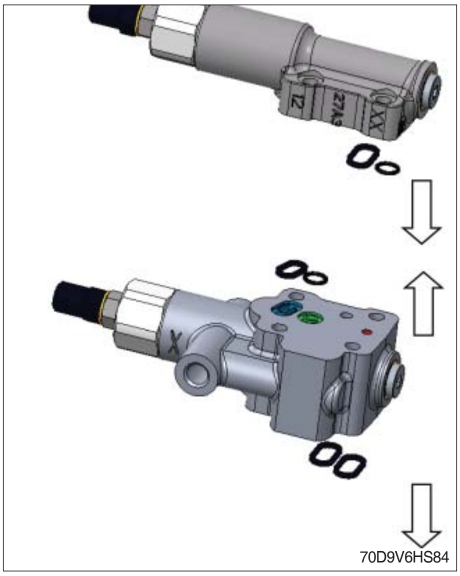
(2) Remove the pressure and the flow compensators.



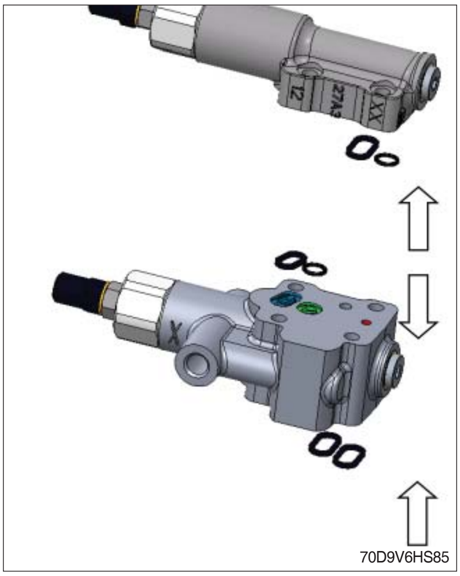
(3) Remove the DEC (Displacement Electronic Control).



(4) Remove the O-ring seals.



(5) Insert the new O-ring seals.



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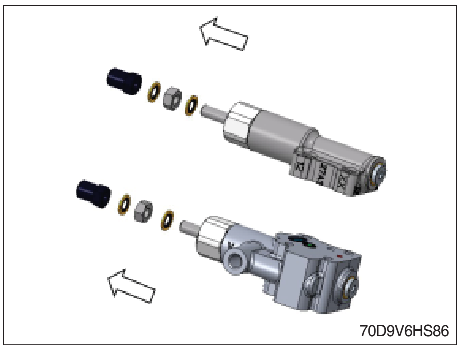
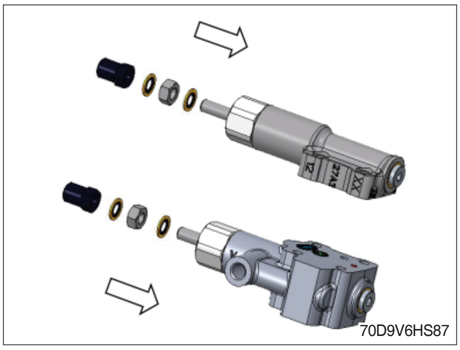
(6) Remove nut and washer.


70D9V6HS86

(7) Insert new washers. Tightening torque of nut and plug.
· Tightening torque : 1.5 kgf·m (10.9 lbf·ft)

⚠ Keep attention to do not touch the limiter screws or you will change the calibration of pressure and flow compensators.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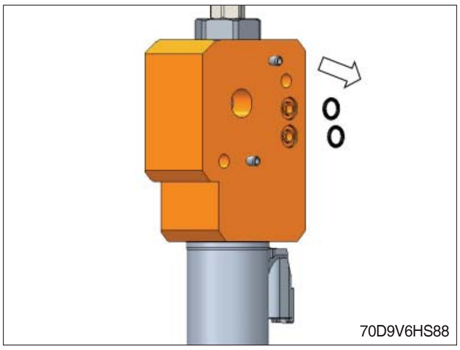
(8) Remove the O-ring seals.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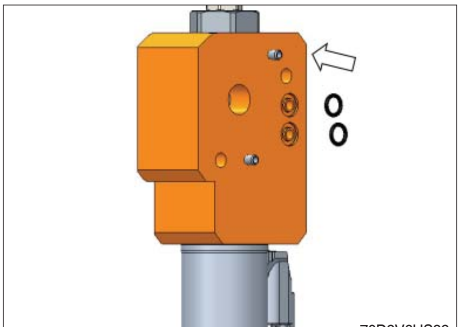
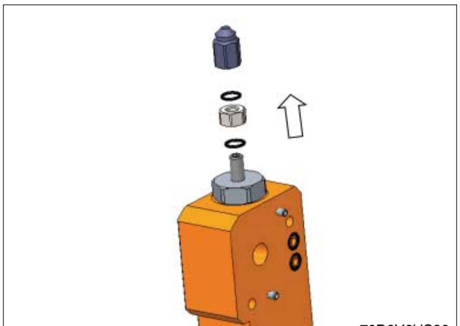
(9) Insert the new O-ring seals.


70D9V6HS89

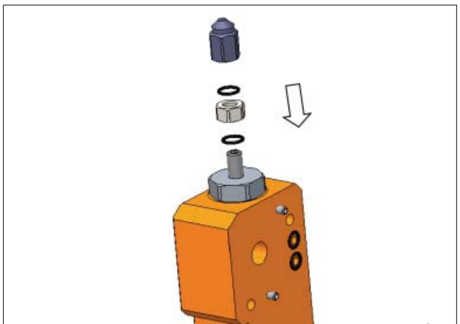
(10) Remove plug, nut and the O-ring seals.


70D9V6HS90

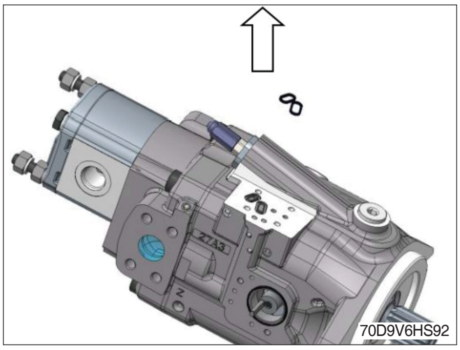
(11) Insert the new O-ring seals. Tightening torque of nut and plug.

· Tightening torque : 1.5 kgf·m (10.9 lbf·ft)

⚠ **Keep attention to do not touch the limiter screws or you will change the calibration.**


70D9V6HS91

(12) Remove the O-ring seals on the compensator plane.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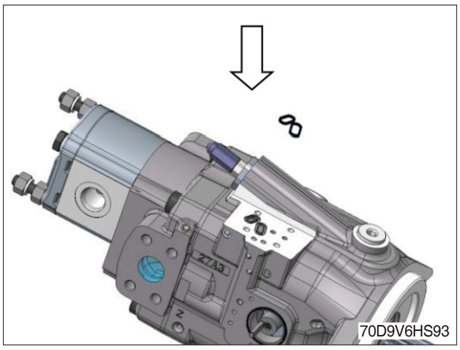
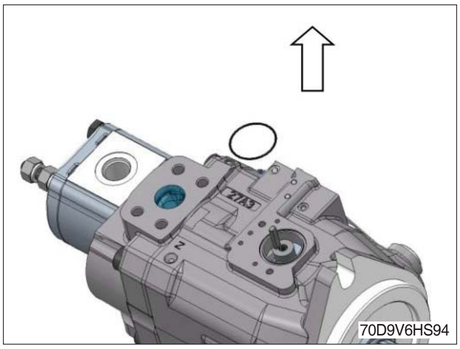
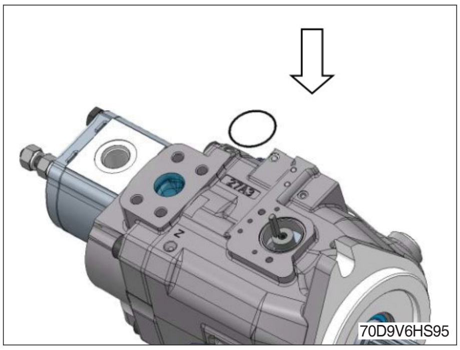
(13) Insert the new O-ring seals on the compensator plane.



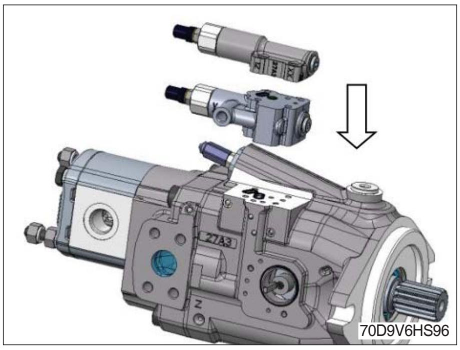
(14) Remove the O.ring seals on DEC (Displacement Electronic Control) plane.



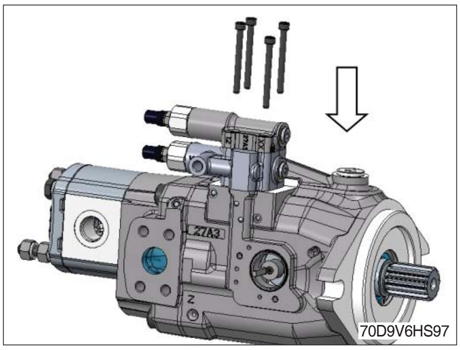
(15) Insert the new O-ring seals on DEC (Displacement Electronic Control) plane.



(16) Reassemble the flow and the pressure regulators.

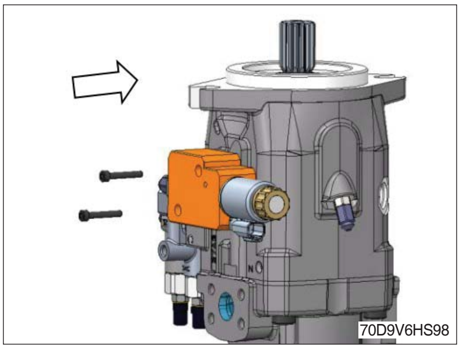


(17) Tighten the bolts with a torque wrench.
· Tightening torque : 1.5 kgf·m (10.9 lbf·ft)



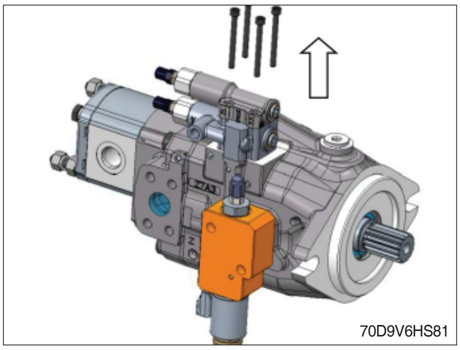
(18) Reassemble the DEC (Displacement Electronic Control). Tighten the bolts with a torque wrench.
· Tightening torque : 1.5 kgf·m (10.9 lbf·ft)

⚠ Keep attention, in order to reassemble the torque limit in the right way, you need to spin the limiter, using the eccentric as reference, pushing it against the body pump.

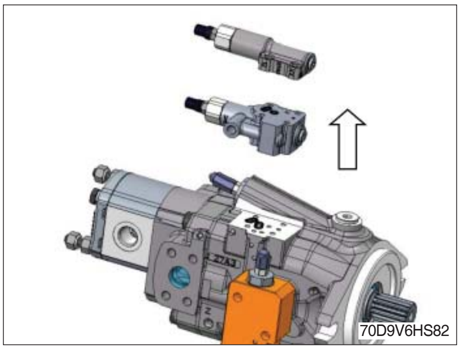


5) PISTON PUMP SEALS REPLACEMENT

(1) Remove the screws of the compensators.

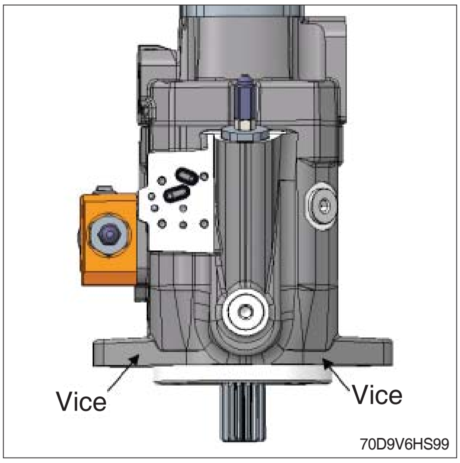


(2) Remove the pressure and the flow compensators.

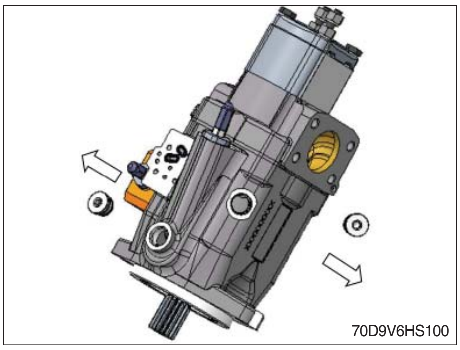


⚠ Use some aluminum protection on the vice to not damage the machined surfaces. Put the pump in vertical position. Grab the pump by the pilot.

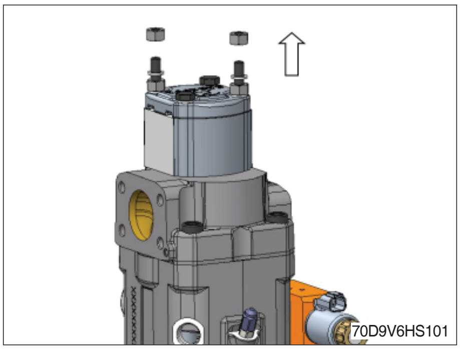
(3) Loosen the screws.



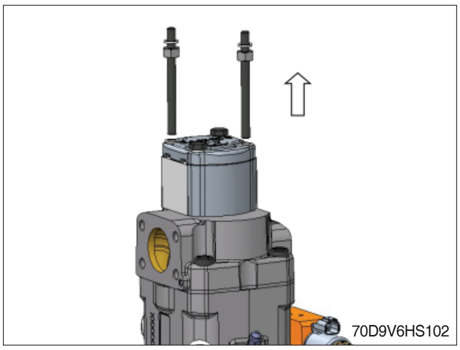
(4) Remove the drain plugs.



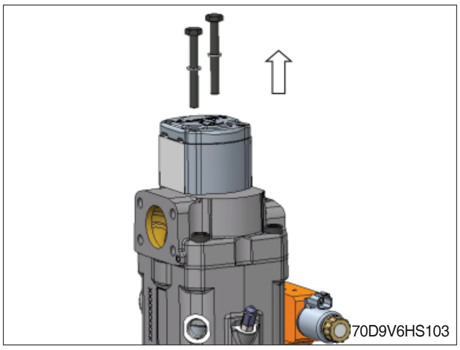
(5) Remove the nut from stud bolt from gear pump section.



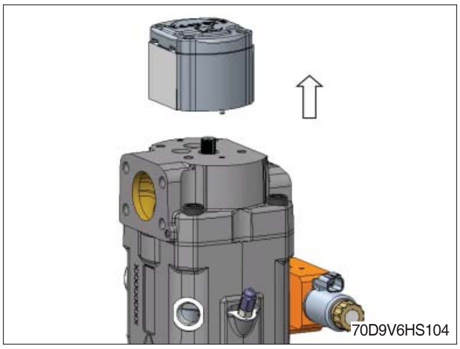
(6) Remove the nut, washers and stud bolt from gear pump section.



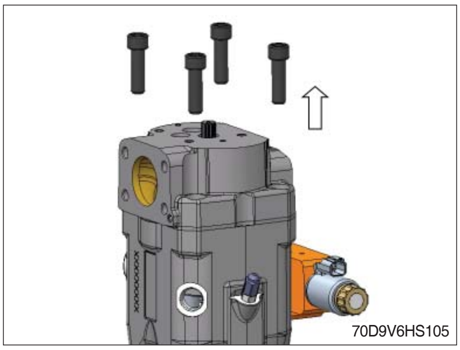
(7) Remove the screws and washers from gear pump section.


70D9V6HS103

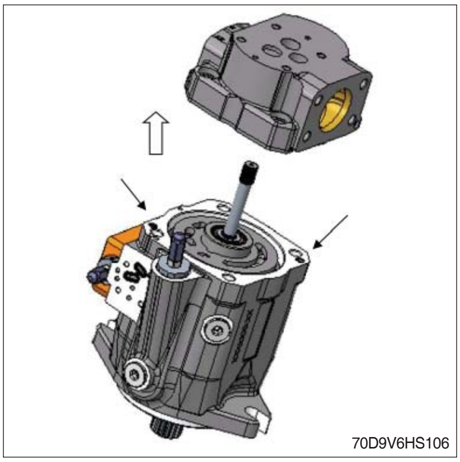
(8) Remove the gear pump section.


70D9V6HS104

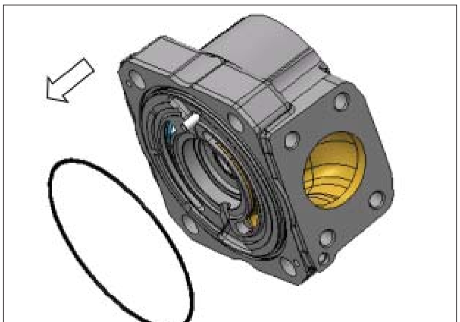
(9) Remove the screws from the cover.


70D9V6HS105

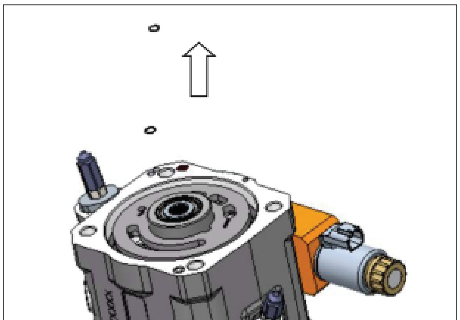
(10) Remove gently the cover slipping the fingers between it and the case in order to keep the valve plate that could be attached to the cover.
In this view and following ones, the bearing is represented as a single piece, but actually the outer ring will remain fixed to the cover because of the interference between parts. The mobile part of the bearing is the only one that will remain on shaft.
Attention to the little O-ring near the screws holes indicated with the black arrows.
Remove also the hub.


70D9V6HS106

(11) Remove the seals from the cover.

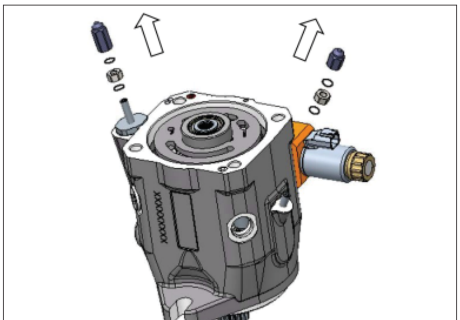

70D9V6HS107

(12) Remove the O-rings from the body.

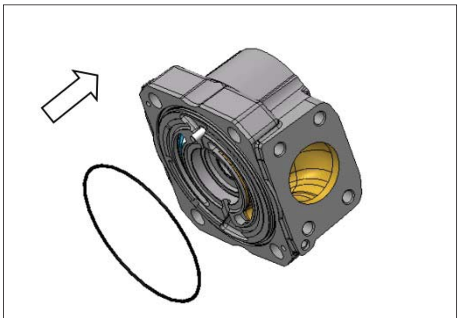

70D9V6HS108

(13) Remove plugs from the max and min displacement limiter and their seals.

⚠ Keep attention to don't touch the limiter screws or you will change the max or min displacement of your pump.

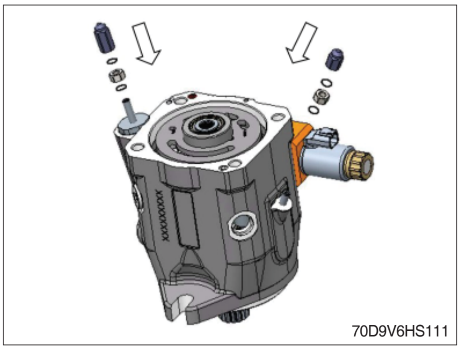

70D9V6HS109

(14) Insert the new static seals.

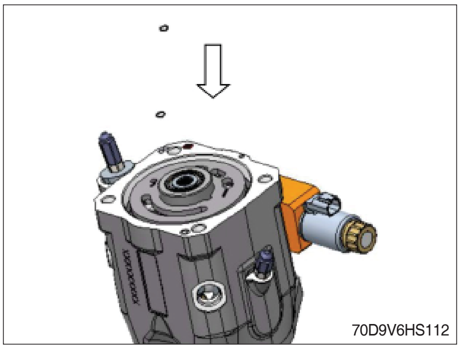

70D9V6HS110

(15) Insert the new O-rings and reassemble the max and min displacement limiters. Tighten the plug M8 and the nut M8.

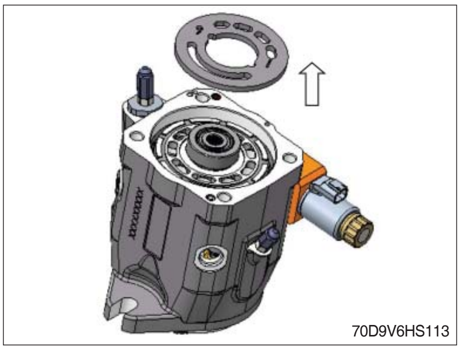
· Tightening torque : 1.5 kgf·m (10.9 lbf·ft)



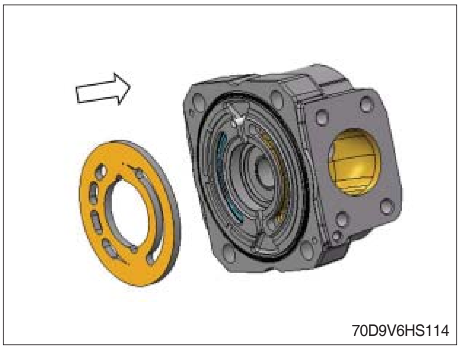
(16) Insert the new O-rings.



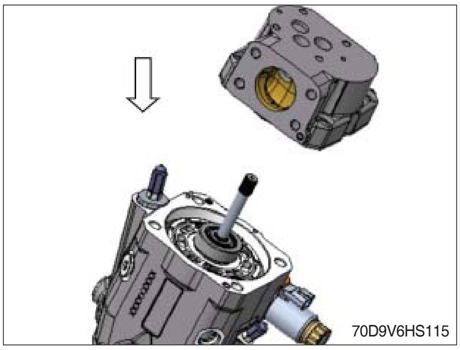
(17) Remove the valve plate.



(18) Use grease in order to attach valve plate to the cover, following the pin.

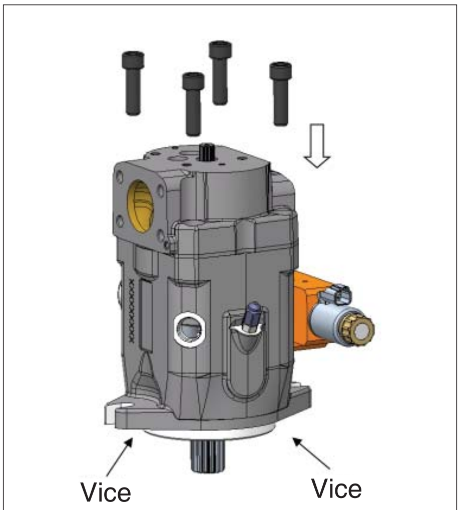


(19) Reassemble the hub and the cover.


70D9V6HS115

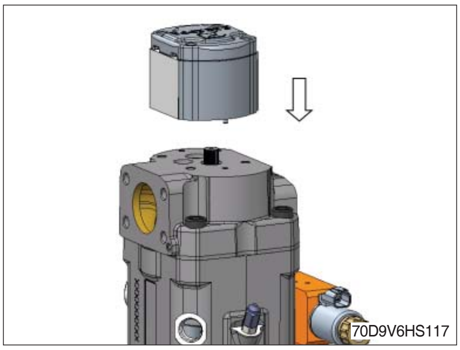
⚠ Put the pump in the vice. Use some aluminum protection on the vice to not damage the machined surfaces. Put the pump in vertical position. Grab the pump by the pilot.

(20) Tighten the bolts with a torque wrench.
 · Tightening torque : 13.2 kgf·m (95.5 lbf·ft)

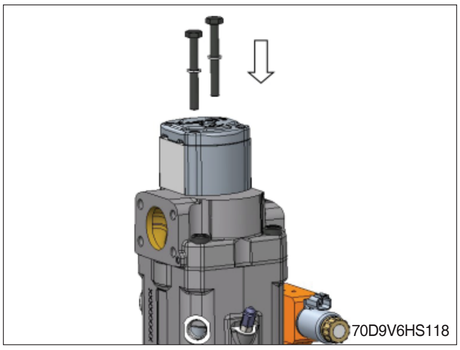


70D9V6HS116

(21) Reassemble the gear pump section.

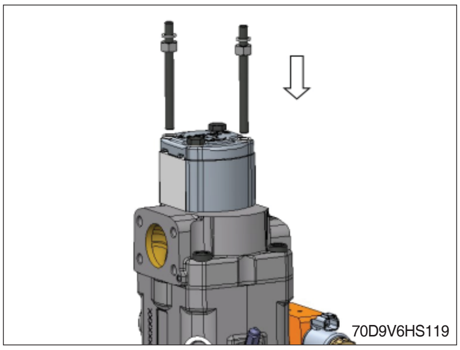

70D9V6HS117

(22) Tighten the screws with a torque wrench.
 · Tightening torque : 4.6 kgf·m (33.3 lbf·ft)

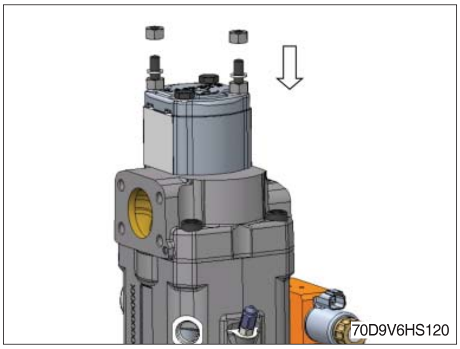

70D9V6HS118

(23) Reassemble the nut, washers and stud bolt.

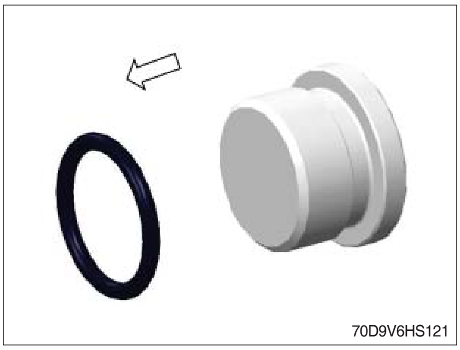
· Tightening torque : 4.6 kgf·m (33.3 lbf·ft)



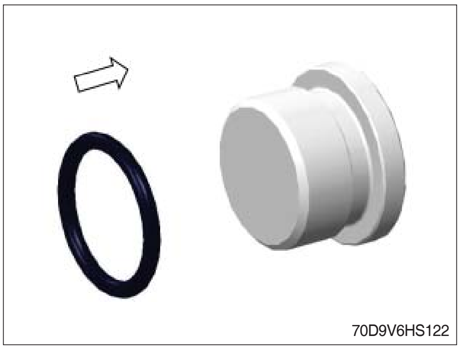
(24) Reassemble the nut from stud bolt.



(25) Remove the O-ring from the drain plugs.

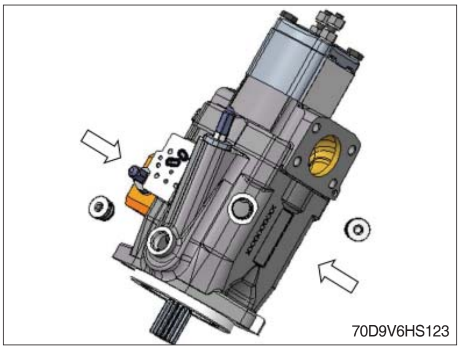


(26) Insert the new O-ring.

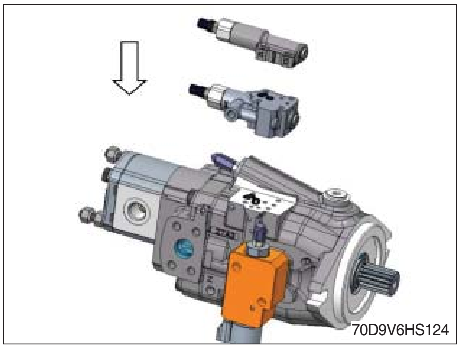


(27) Insert the plug in the body.

· Tightening torque : 3.1 kgf·m (22.4 lbf·ft)

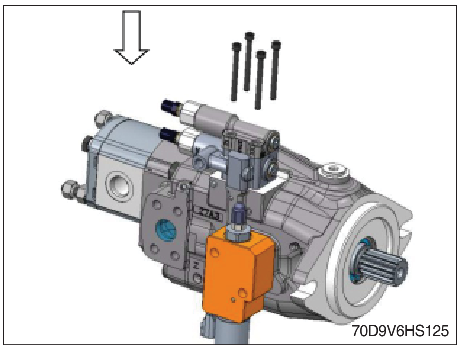


(28) Reassemble the flow and the pressure regulators.



(29) Tighten the bolts with a torque wrench.

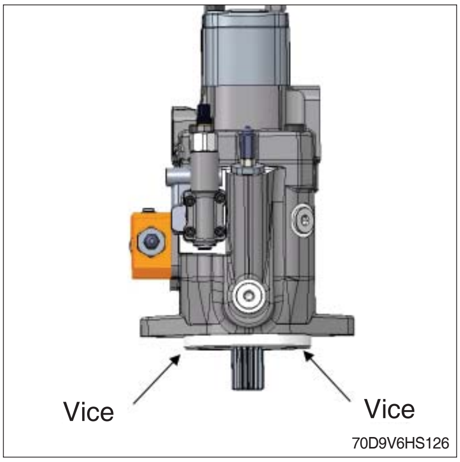
· Tightening torque : 1.5 kgf·m (10.9 lbf·ft)



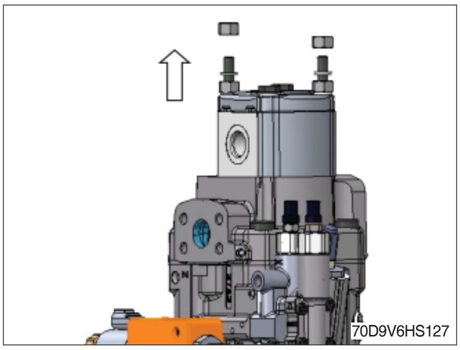
6) GEAR PUMP SEALS REPLACEMENT

⚠ Use some aluminum protection on the vice to not damage the machined surfaces. Put the pump in vertical position. Grab the pump by the pilot.

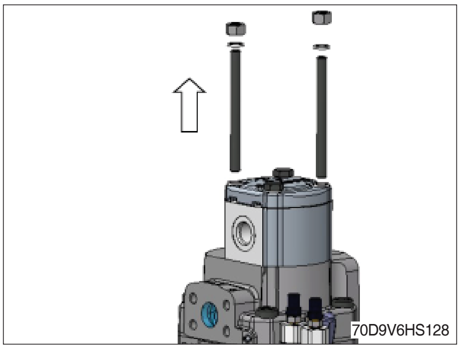
1) Loosen the screws.



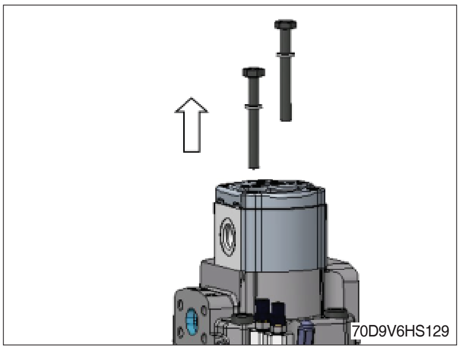
(6) Remove the nut from stud bolt from gear pump section.



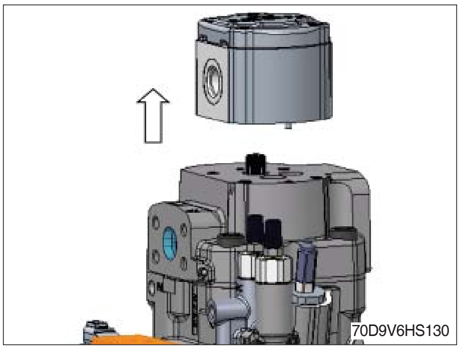
(7) Remove the nut, washers and stud bolt from gear pump section.



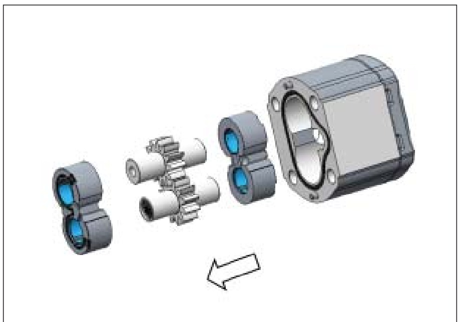
(8) Remove the screws and washers from gear pump section.



(8) Remove the gear pump section.

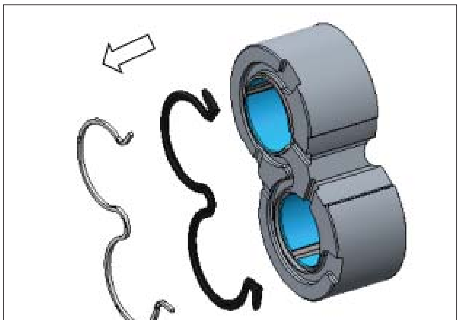


(9) Remove thrust plates and gears from the housing.



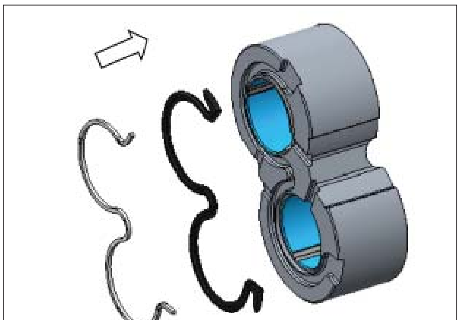
70D9V6HS131

(10) Remove seal and anti-extrusion seal.



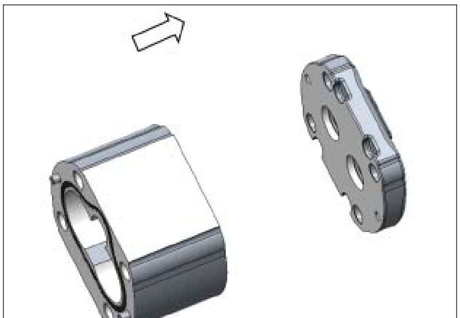
70D9V6HS132

(11) Insert new seal and anti-extrusion seal.



70D9V6HS133

(12) Remove rear cover.

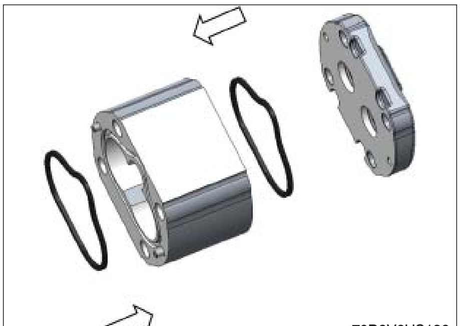


70D9V6HS134

(13) Remove seal of the housing.

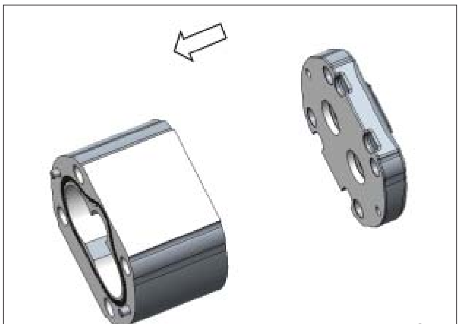
70D9V6HS135

(14) Insert new seal of the housing.



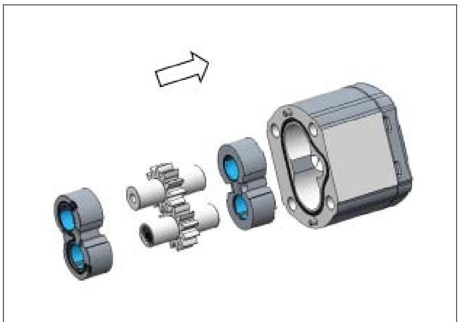
70D9V6HS136

(15) Reassemble rear cover.



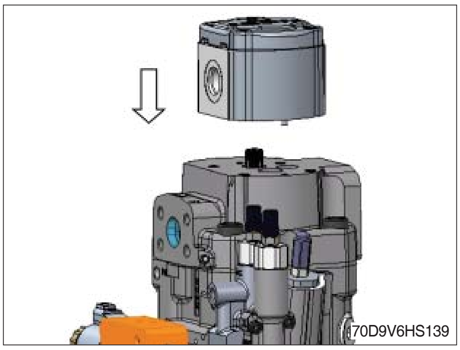
70D9V6HS137

(16) Reassemble thrust plates and gears.



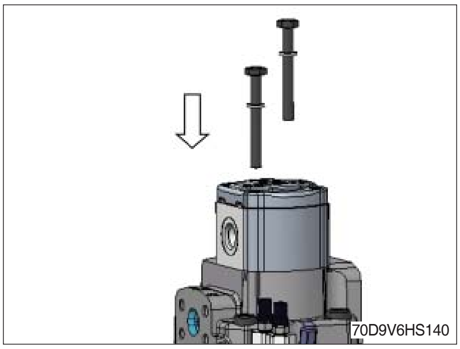
70D9V6HS138

(17) Reassemble the gear pump section.



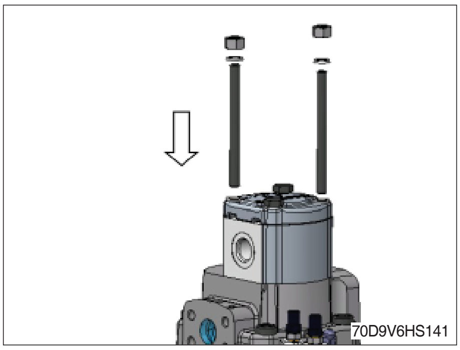
(18) Reassemble the screws and washers from gear pump section. Tighten the screws with a torque wrench.

· Tightening torque : 4.6 kgf·m (33.3 lbf·ft)

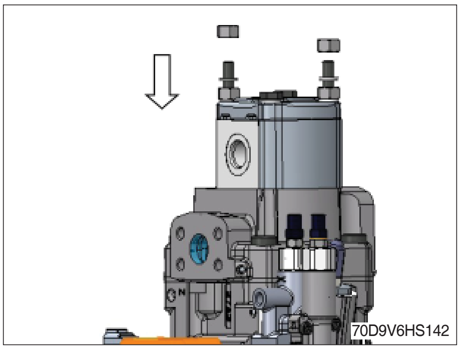


(19) Reassemble the nut, washers and stud bolt from gear pump section.

· Tightening torque : 4.6 kgf·m (33.3 lbf·ft)



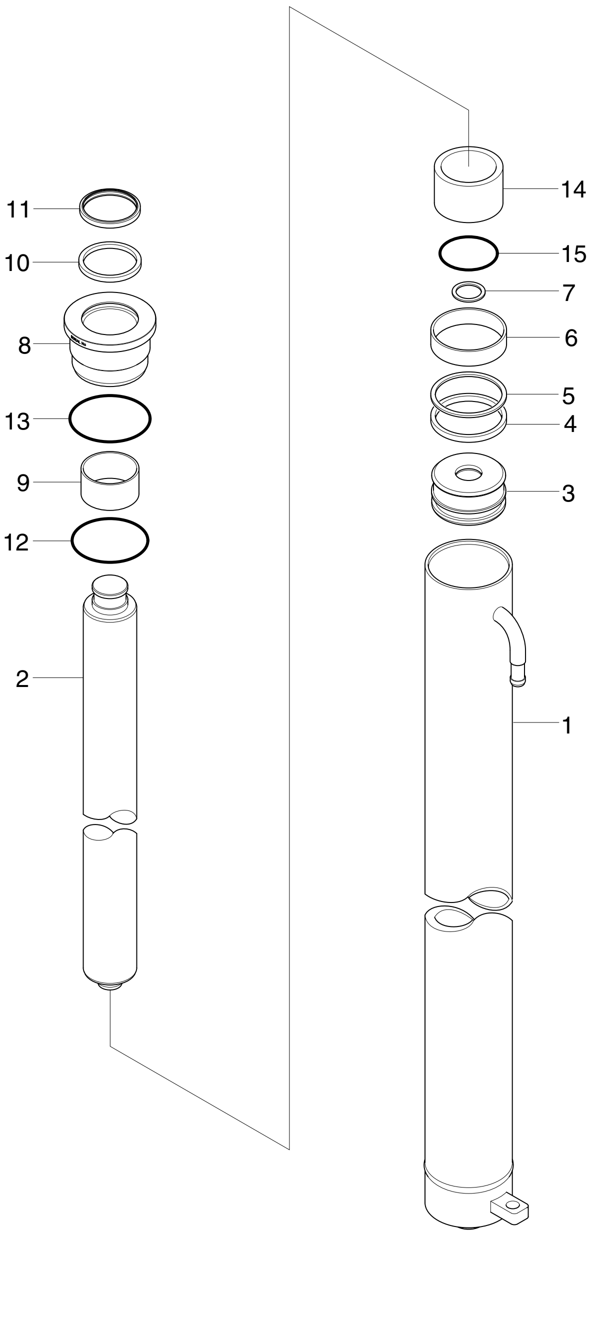
(20) Reassemble the nut from stud bolt from gear pump section.



3. LIFT CYLINDER

1) STRUCTURE

(1) V-mast



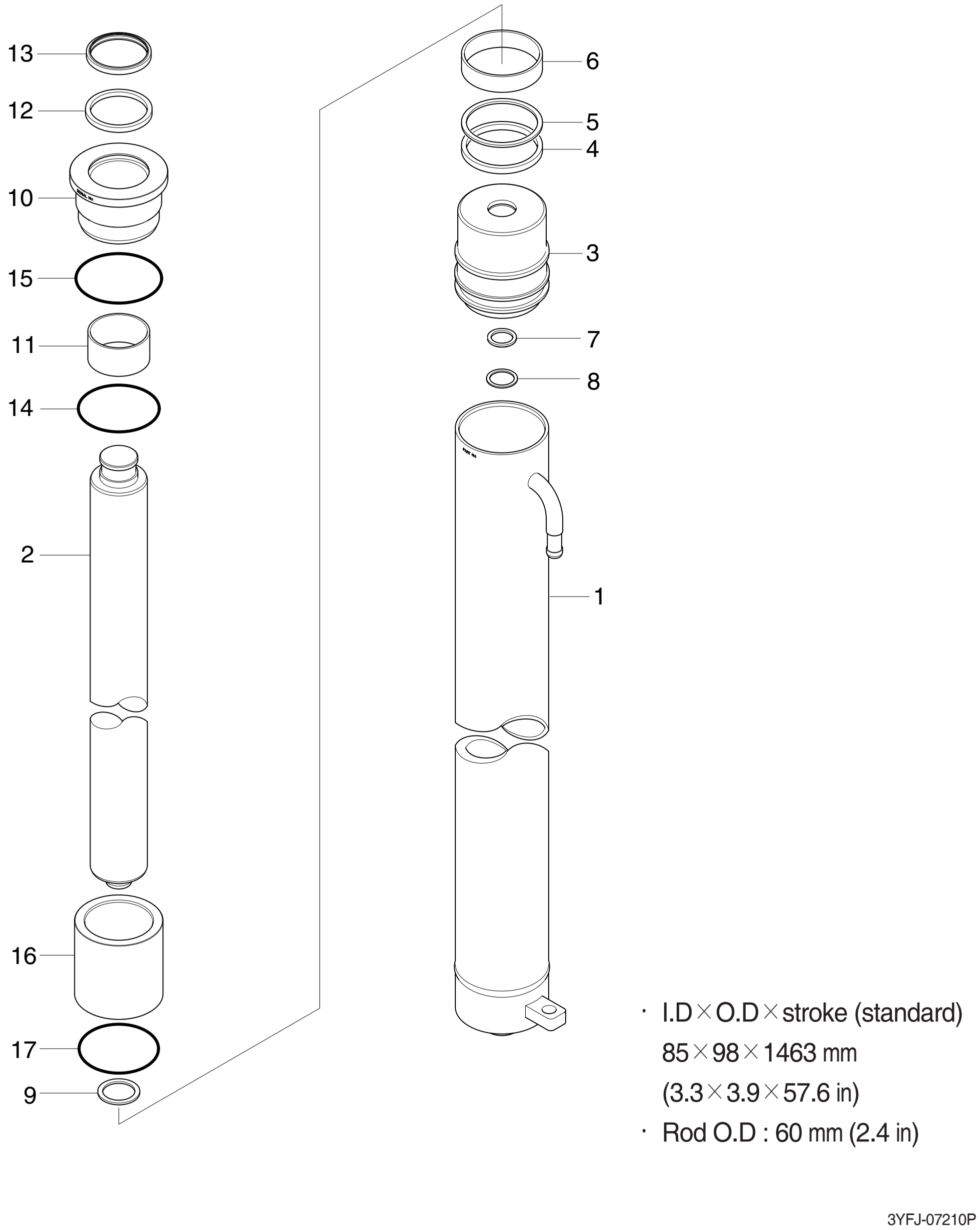
· I.D × O.D × stroke (standard)
85 × 98 × 1475 mm
(3.3 × 3.9 × 58.1 in)

· Rod O.D : 60 mm (2.4 in)

3YFJ-07020P

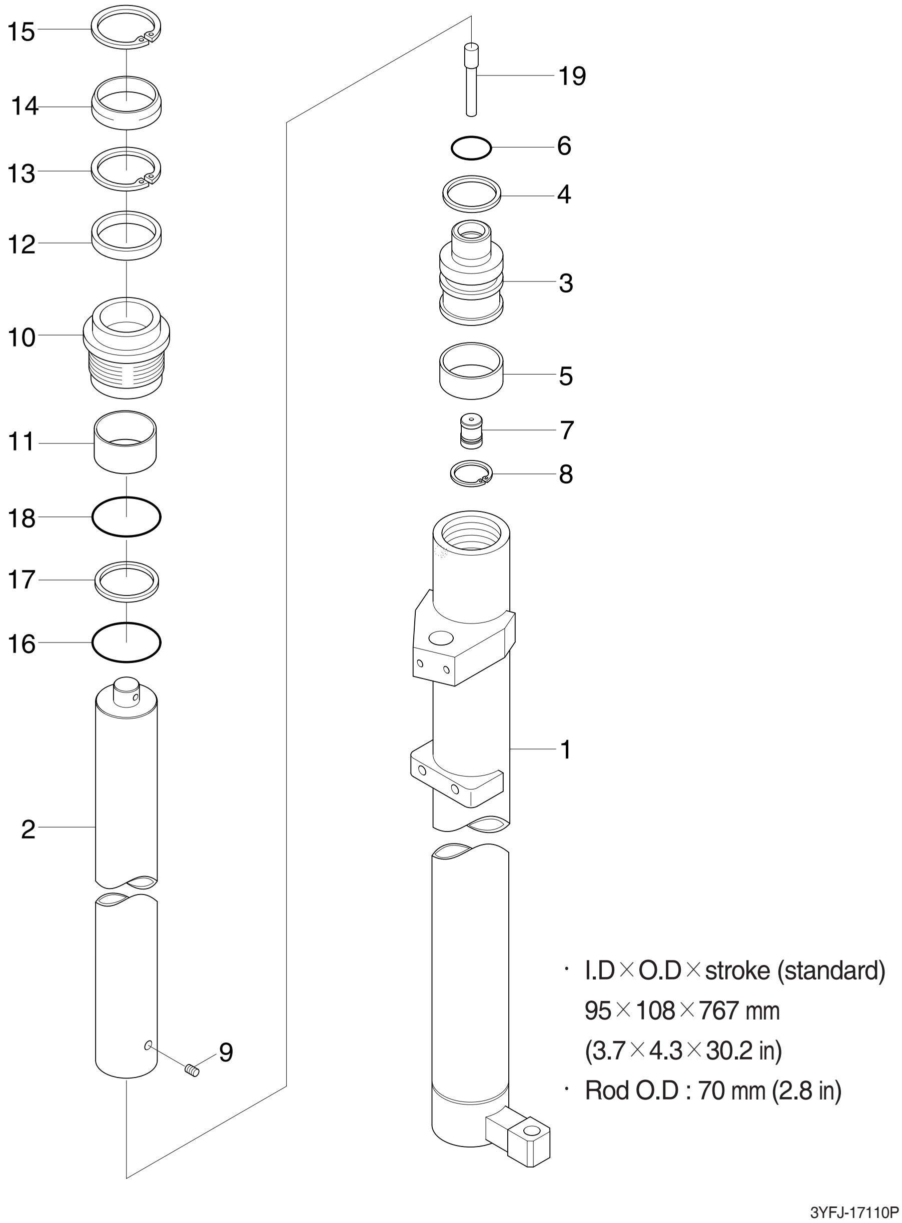
1	Tube assy	6	Wear ring	11	Wiper ring
2	Rod	7	Stop ring	12	O-ring
3	Piston	8	Rod cover	13	O-ring
4	U-packing	9	Rod bushing	14	Spacer
5	Back up ring	10	U-packing	15	O-ring

(2) TS-mast



1	Tube assy	7	Cushion ring	13	Wiper ring
2	Rod	8	Retainer ring	14	O-ring
3	Piston	9	Stop ring	15	O-ring
4	U-packing	10	Rod cover	16	Spacer
5	Back up ring	11	Rod bushing	17	O-ring
6	Wear ring	12	U-packing		

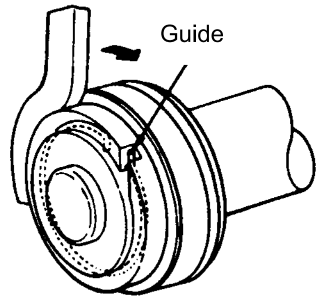
(3) **Free lift** (TS-mast)



1	Tube assy	8	Retaining ring	15	Retaining ring
2	Rod	9	Set screw	16	O-ring
3	Piston	10	Rod cover	17	Backup ring
4	Piston seal	11	Rod bushing	18	O-ring
5	Wear ring	12	U-packing	19	Pipe
6	O-ring	13	Backup ring		
7	Check valve	14	Dust wiper		

2) DISASSEMBLY

(1) Hold the cylinder tube in a vice, loosen the cylinder head and remove it.
Remove the spacer from the cylinder tube and knock out the bushing. Hook a wrench in the hole in the retainer at the piston end and turn. Lever up the edge of the guide, then turn the guide in again and the guide can be removed.



D503HS20

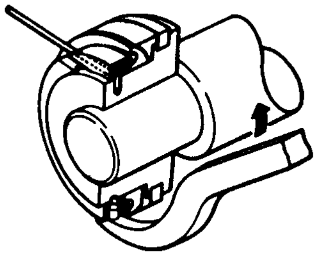
3) CHECK AND INSPECTION

mm (in)

Check item	Standard size	Repair limit	Remedy
Clearance between cylinder rod & bushing	0.05~0.25 (0.002~0.01)	0.4 (0.0015)	Replace bushing
Clearance between piston ring & tube	0.05~0.35 (0.002~0.013)	0.5 (0.02)	Replace piston ring

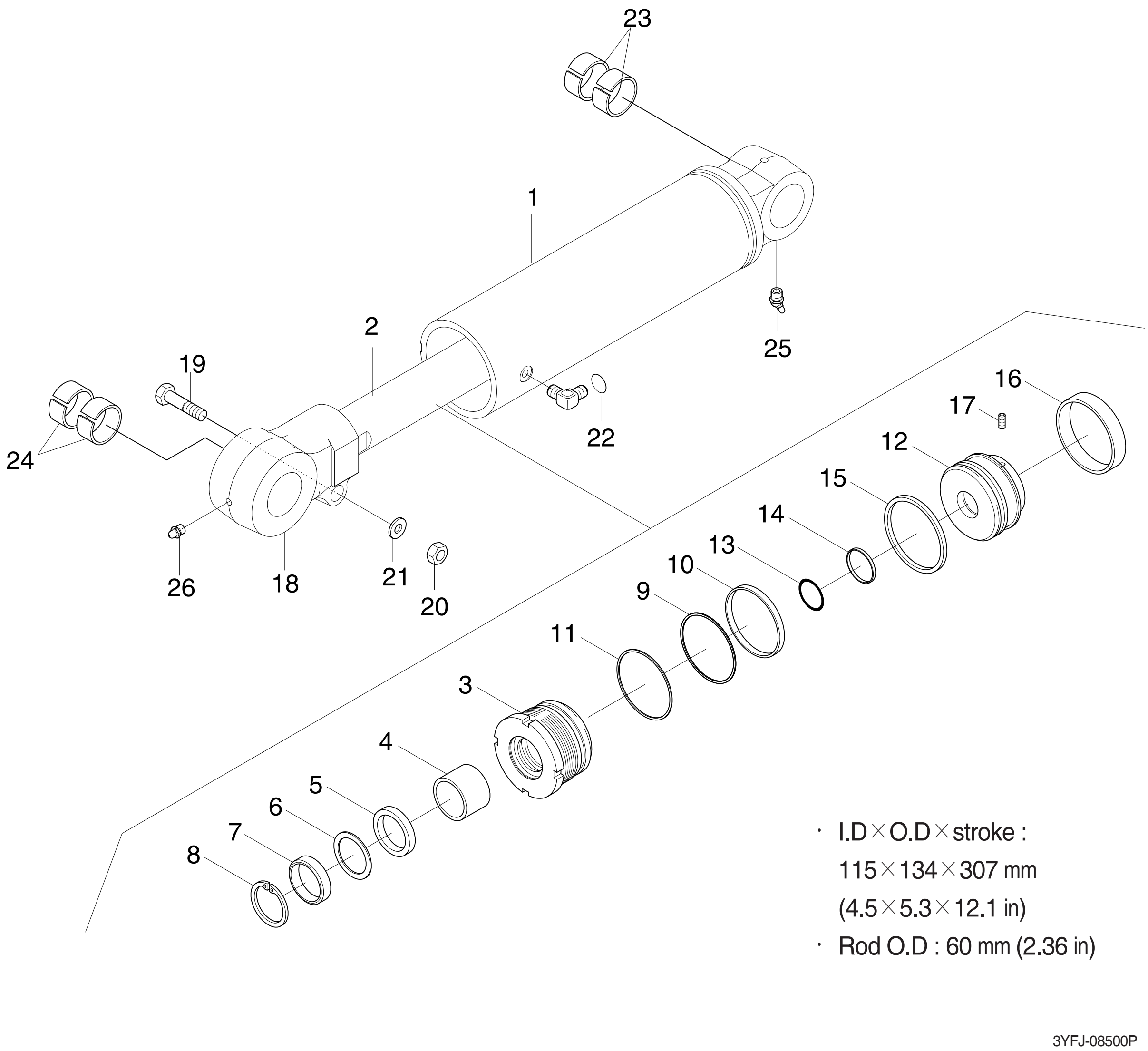
4) ASSEMBLY

(1) Soak the piston ring in hydraulic oil at a temperature of 40 to 50˚C, expand the inside diameter and assemble on the piston. Install a piston seal.
Bend the edge of the guide and rotate it to install the guide completely.


D503HS21

4. TILT CYLINDER

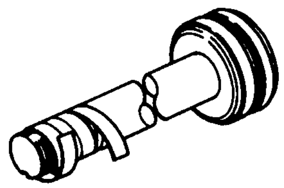
1) STRUCTURE



1	Tube assy	10	Back up ring	19	Hex bolt
2	Rod	11	O-ring	20	Hex nut
3	Rod cover	12	Piston	21	Spring washer
4	Pin bushing	13	O-ring	22	O-ring
5	U-packing	14	Back up ring	23	Pin bushing
6	Back up ring	15	Piston seal	24	Pin bushing
7	Wiper ring	16	Wear ring	25	Grease nipple
8	Stop ring	17	Set screw	26	Grease nipple
9	O-ring	18	Eye		

2) DISASSEMBLY

(1) Hold the parallel parts of the cylinder tube bottom in a vice and mark the rod head end to show how much it is screwed in, then remove the rod head. Next, hook a wrench into the notch at the cylinder head and remove the cylinder head from cylinder tube.
When doing this, wind tape round the threaded part of the rod and be careful not to damage the dust seal and rod seal inside cylinder head.



D503HS23

3) CHECK AND INSPECTION

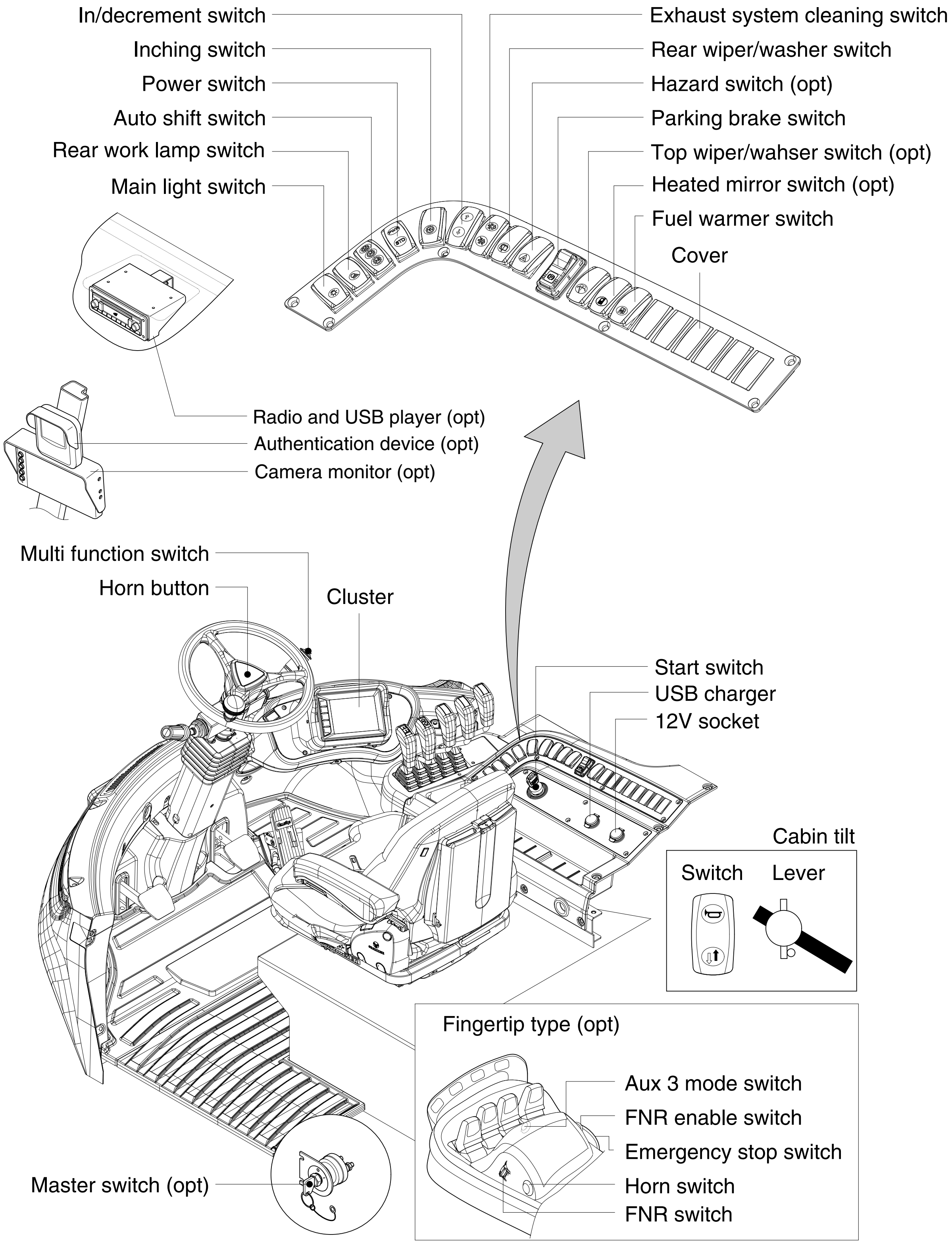
mm (in)

Check item	Standard size	Repair limit	Remedy
Clearance between cylinder rod & bushing	0.072~0.288 (0.003~0.011)	0.5 (0.020)	Replace bushing
Clearance between rod head bushing & pin	0.10~0.35 (0.004~0.014)	0.6 (0.024)	Replace bushing

SECTION 7 ELECTRICAL SYSTEM

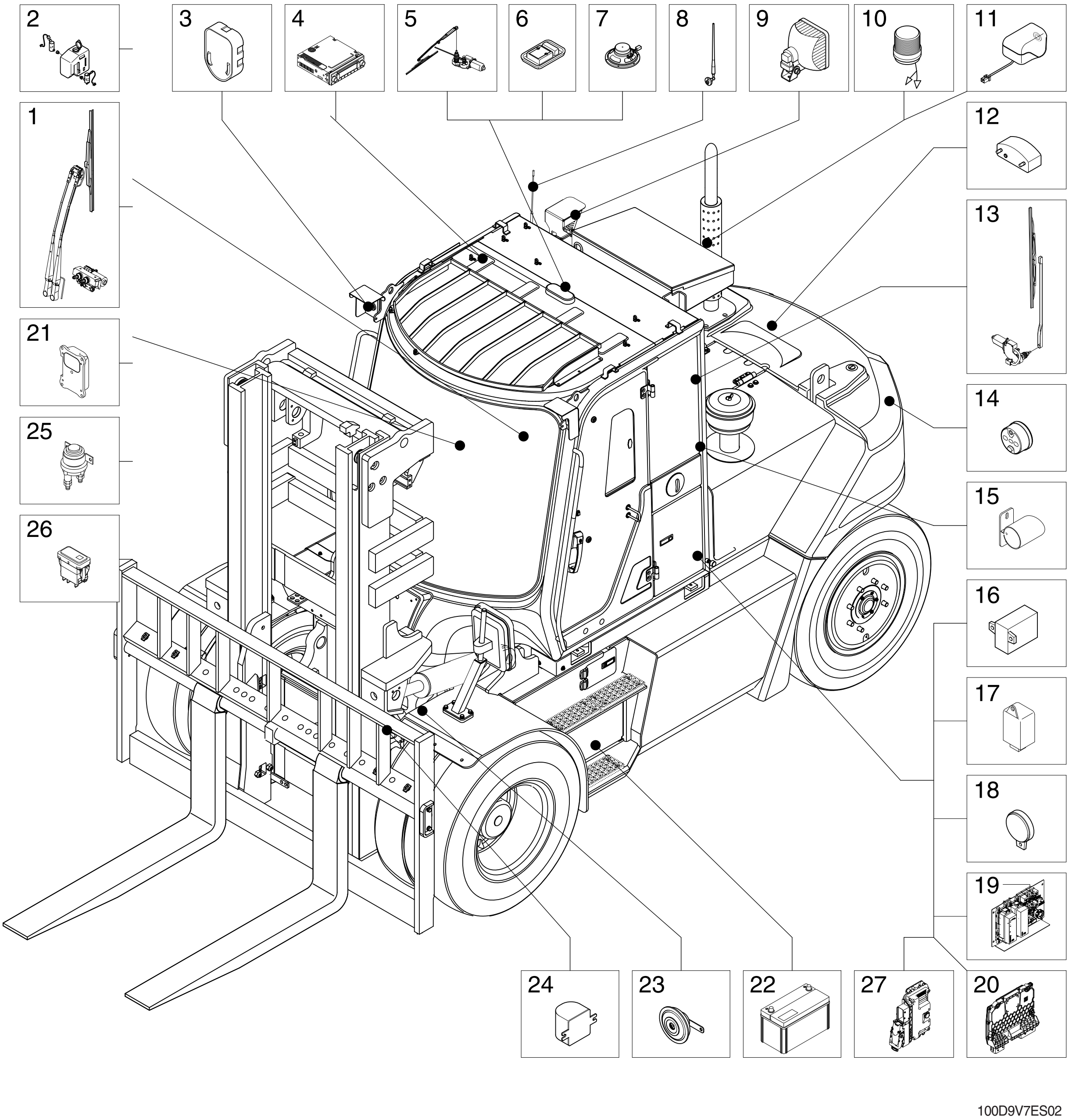
GROUP 1 COMPONENT LOCATION

1. LOCATION 1



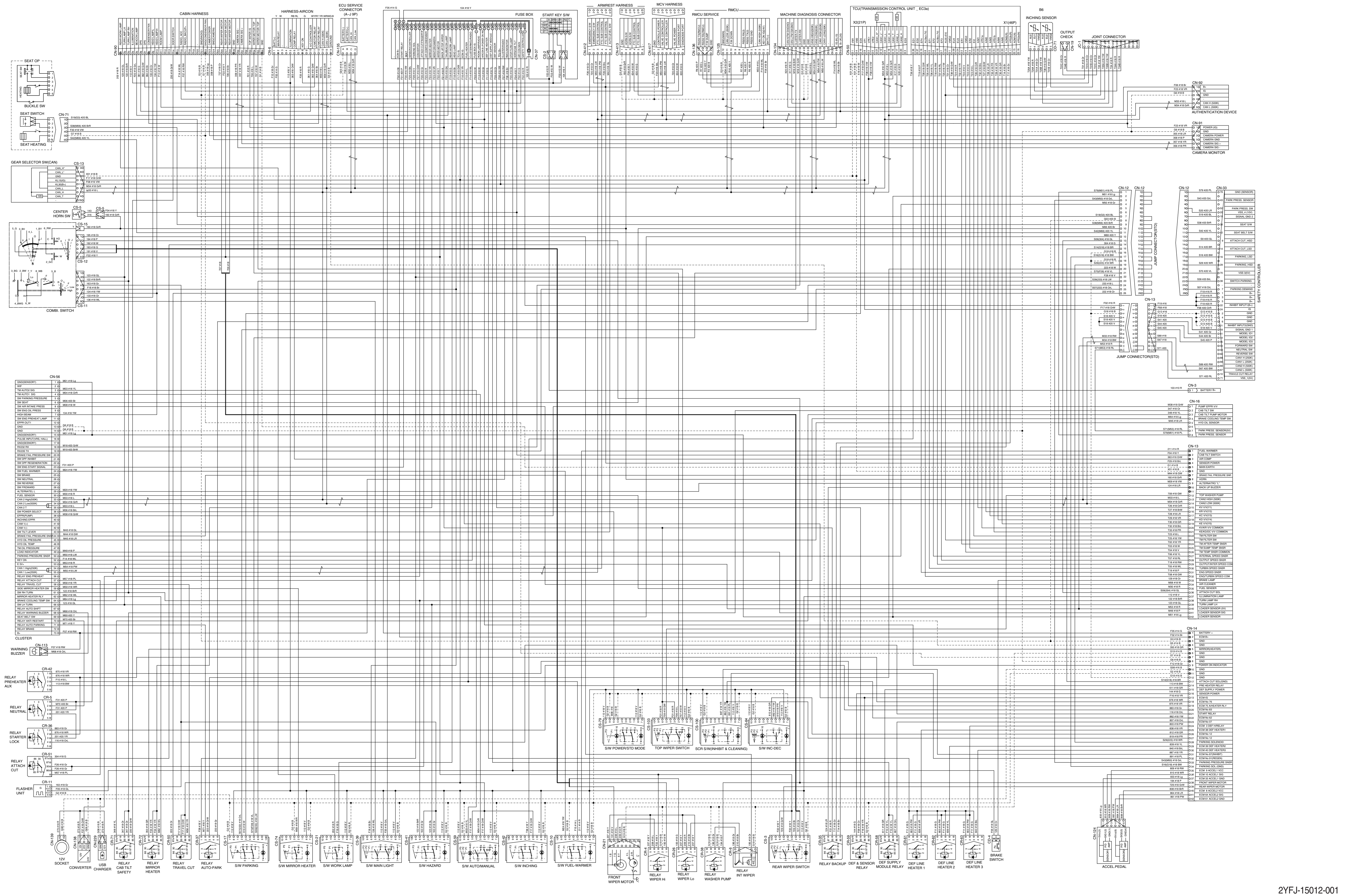
100D9V7ES01

2. LOCATION 2



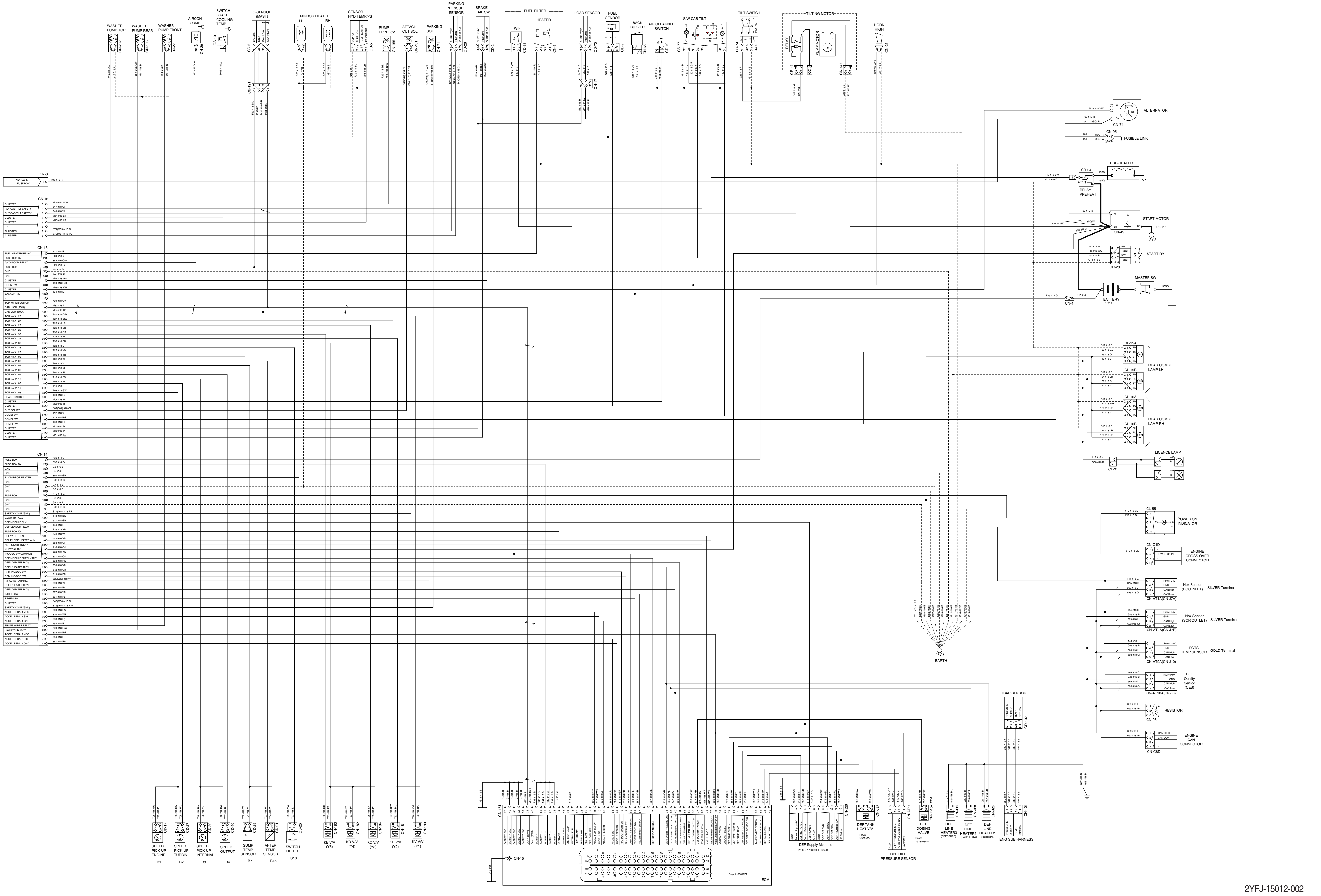
1	Wiper assembly	10	Beacon lamp	19	ECU
2	Washer reservoir tank	11	Camera (opt)	20	TCU
3	Head and turn signal lamp	12	License lamp (opt)	21	RMCU (opt)
4	Radio and USB player	13	Rear wiper assembly	22	Battery
5	Top wiper assembly (opt)	14	Rear combination lamp	23	Horn
6	Room lamp switch	15	Back buzzer	24	Angle sensor (opt)
7	Speaker	16	Wiper relay	25	Start relay
8	Mobile antenna	17	Flasher unit	26	Power ON indicator
9	Work lamp	18	Warning buzzer	27	Safety controller

· ELECTRICAL CIRCUIT (1/3, CABIN TYPE, -#0006)

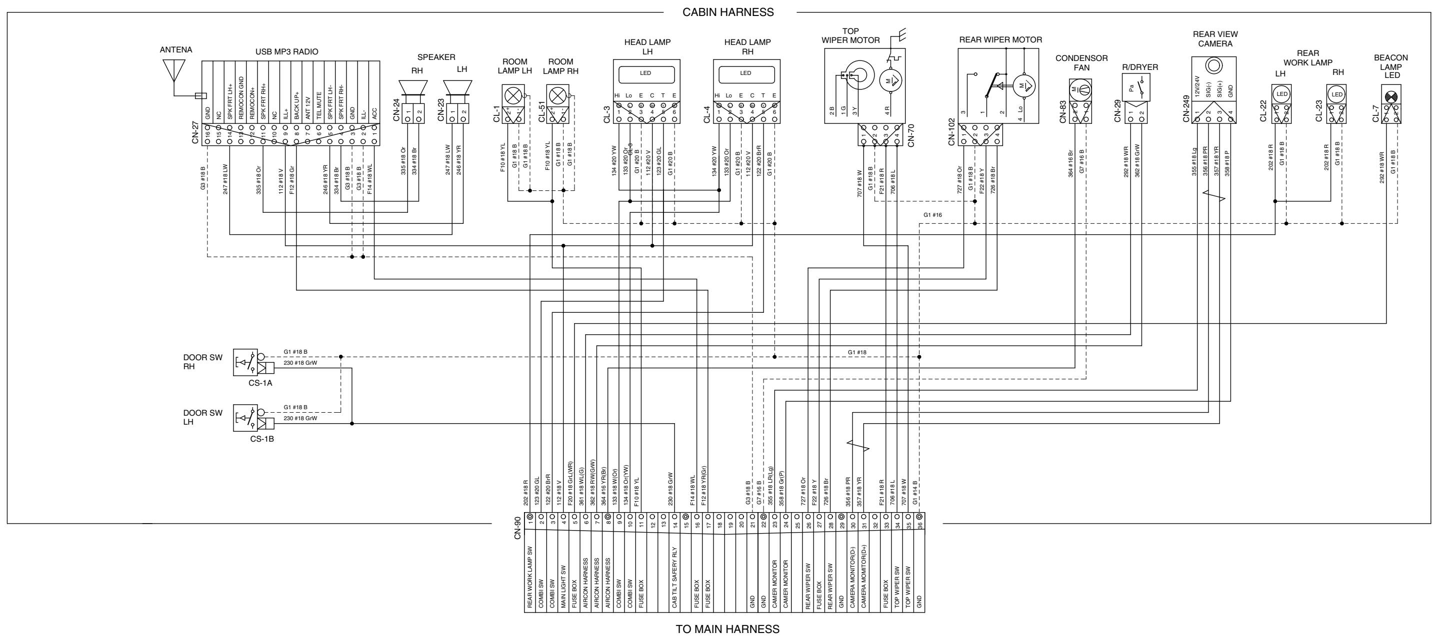


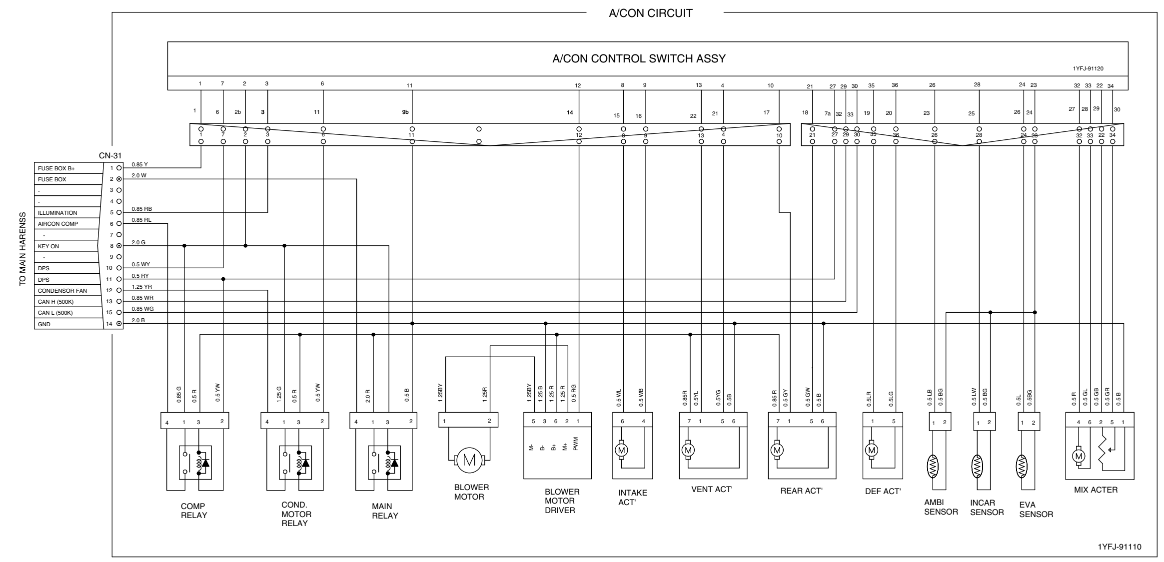
2YFJ-15012-001

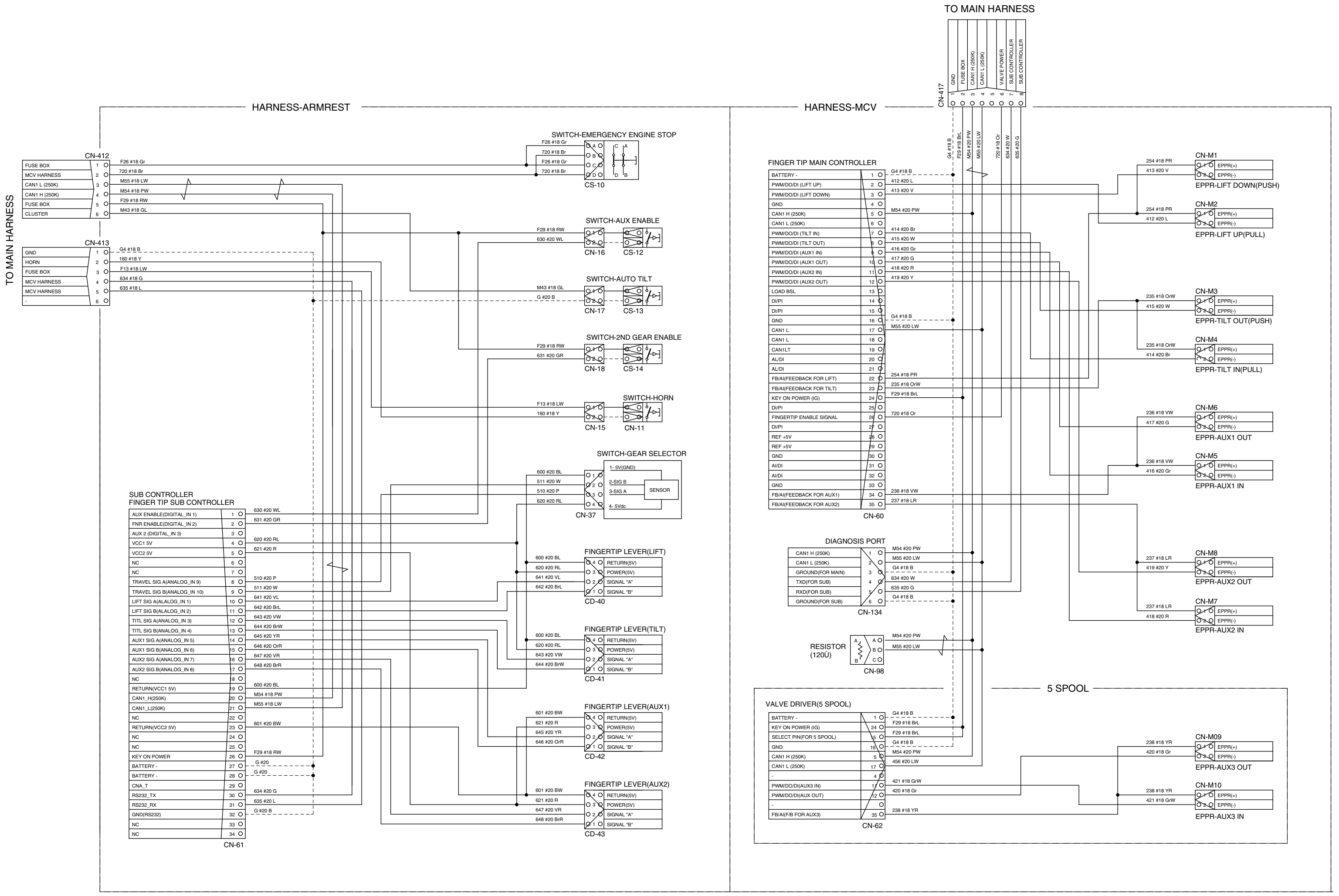
· ELECTRICAL CIRCUIT (2/3, -#0006)

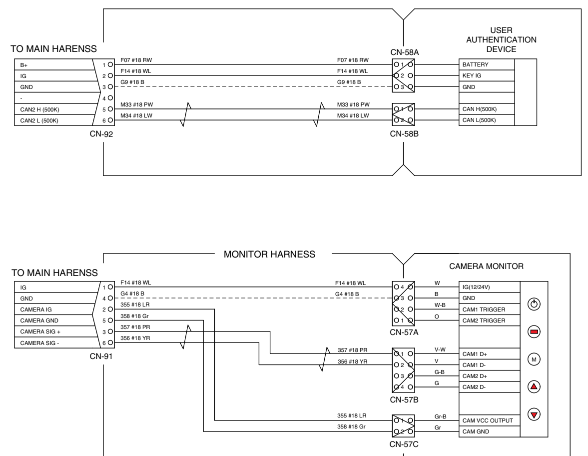


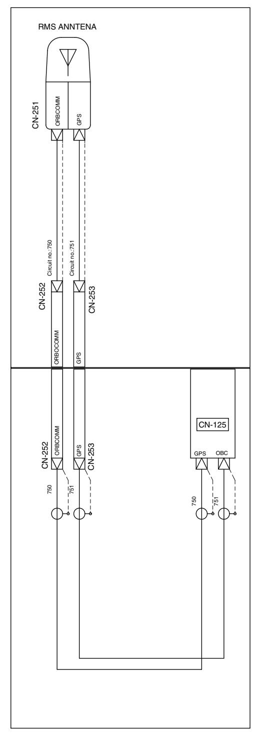
· ELECTRICAL CIRCUIT (3/3, -#0006)





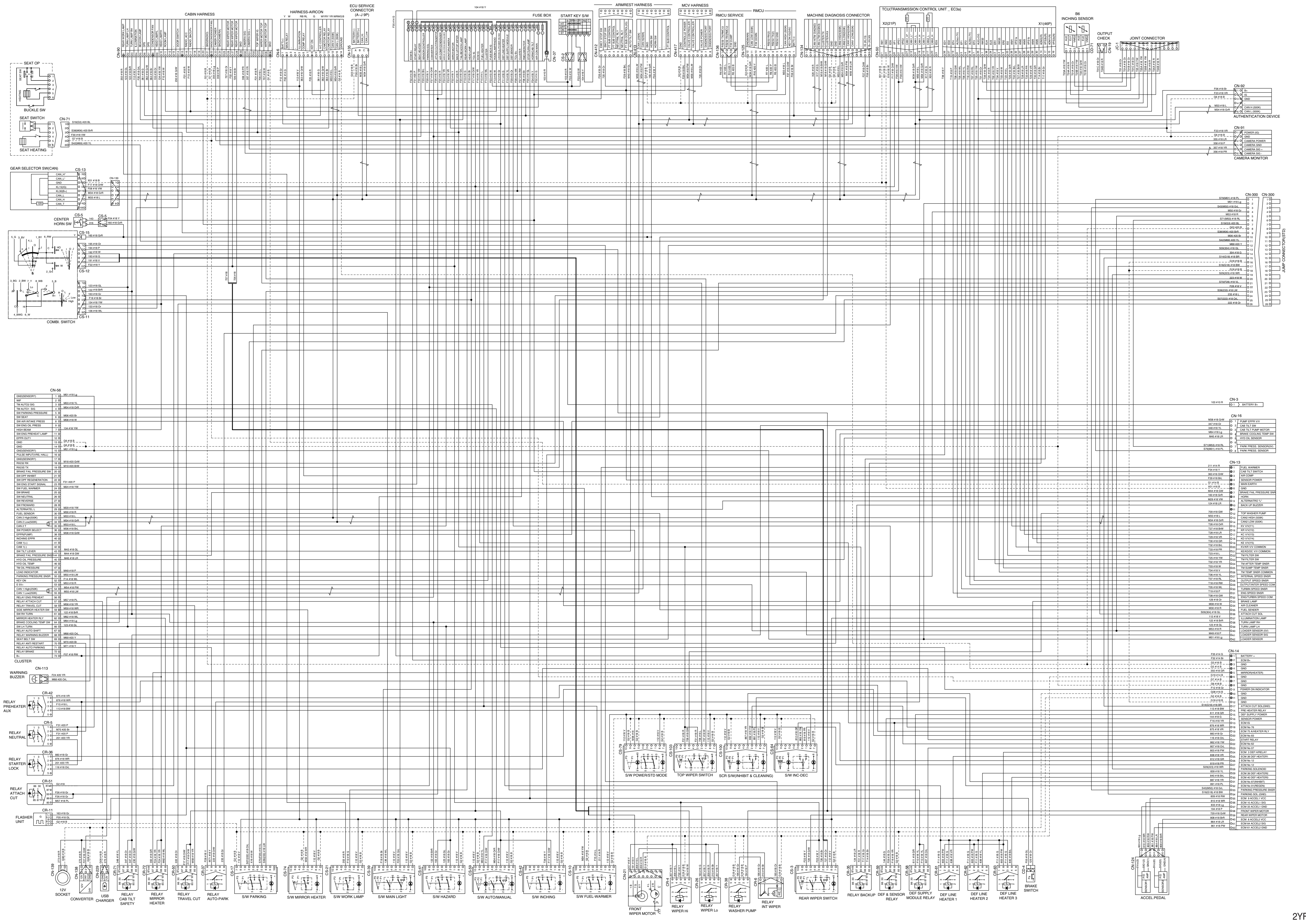






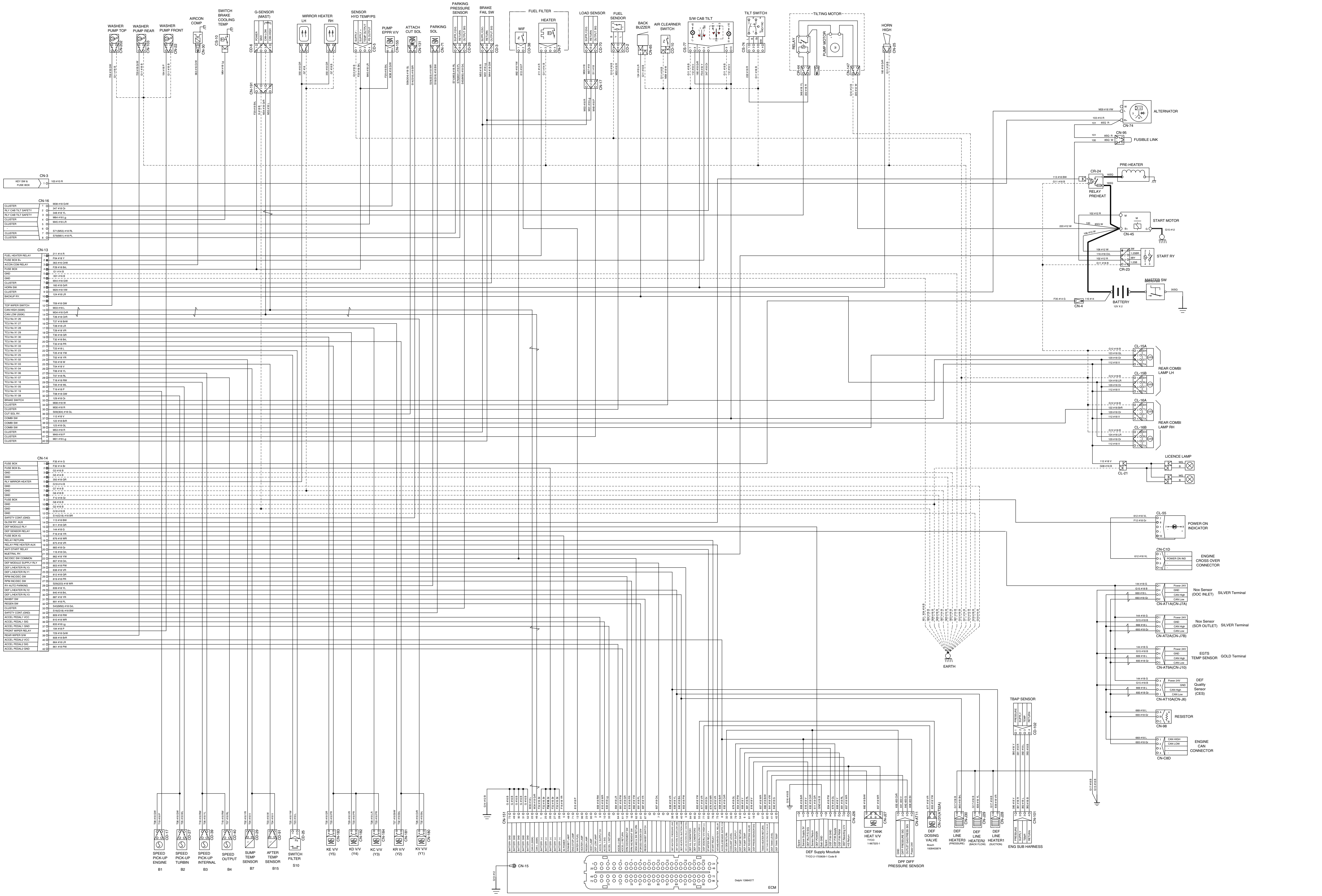
2YFJ-15012-003

· ELECTRICAL CIRCUIT (1/3, CABIN TYPE, #0007~0036)



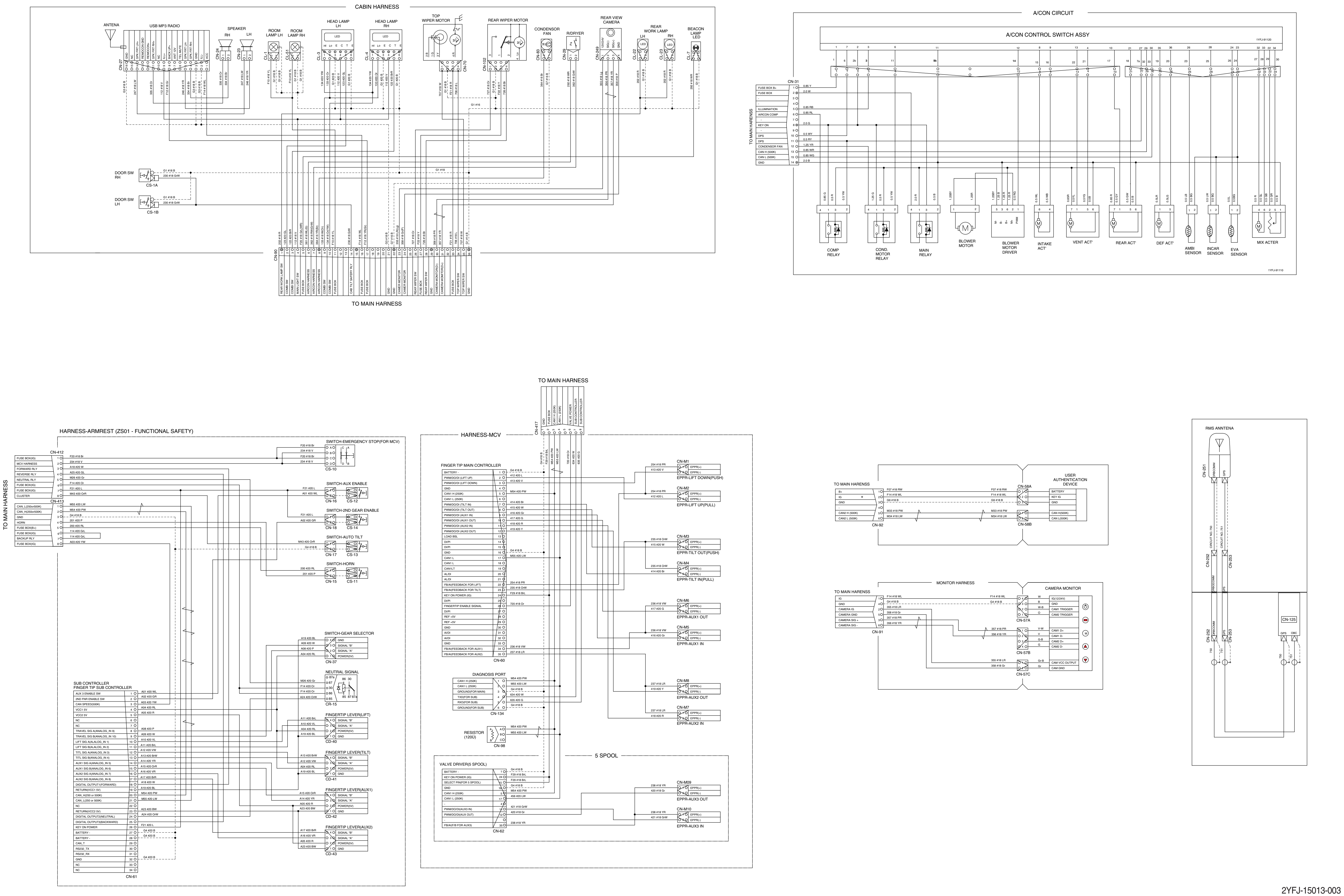
2YFJ-15013-001

· ELECTRICAL CIRCUIT (2/3, #0007~0036)



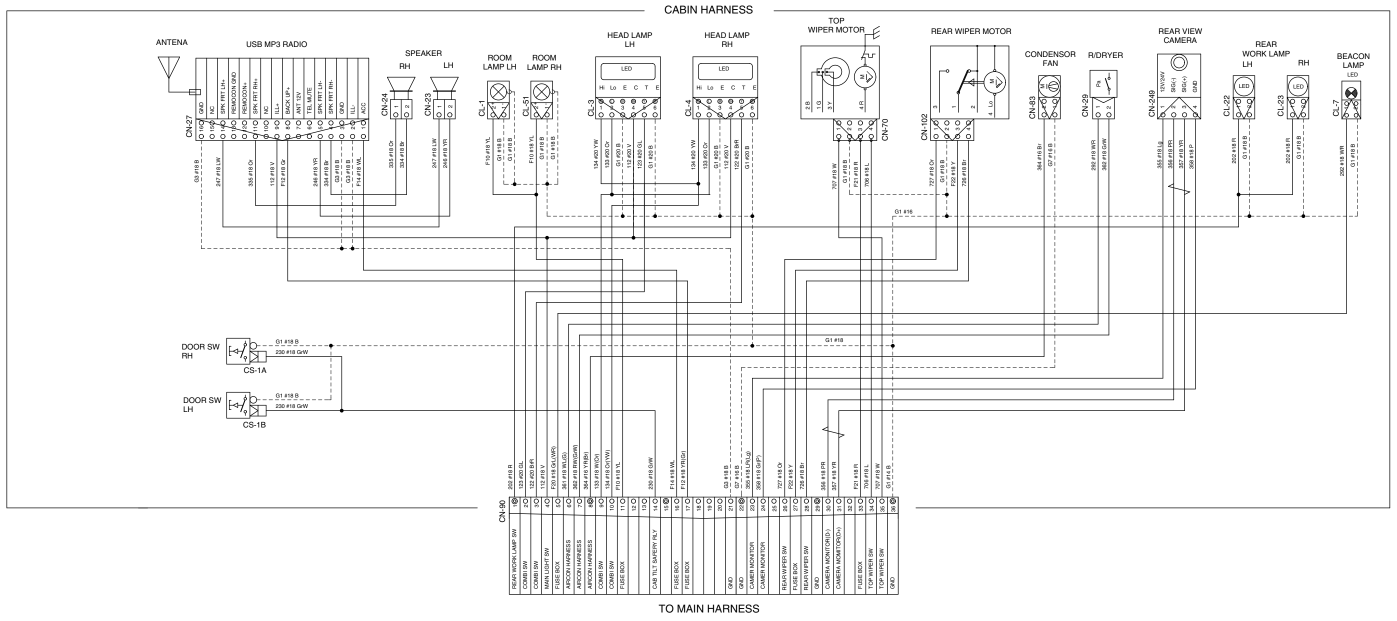
2YFJ-15013-002

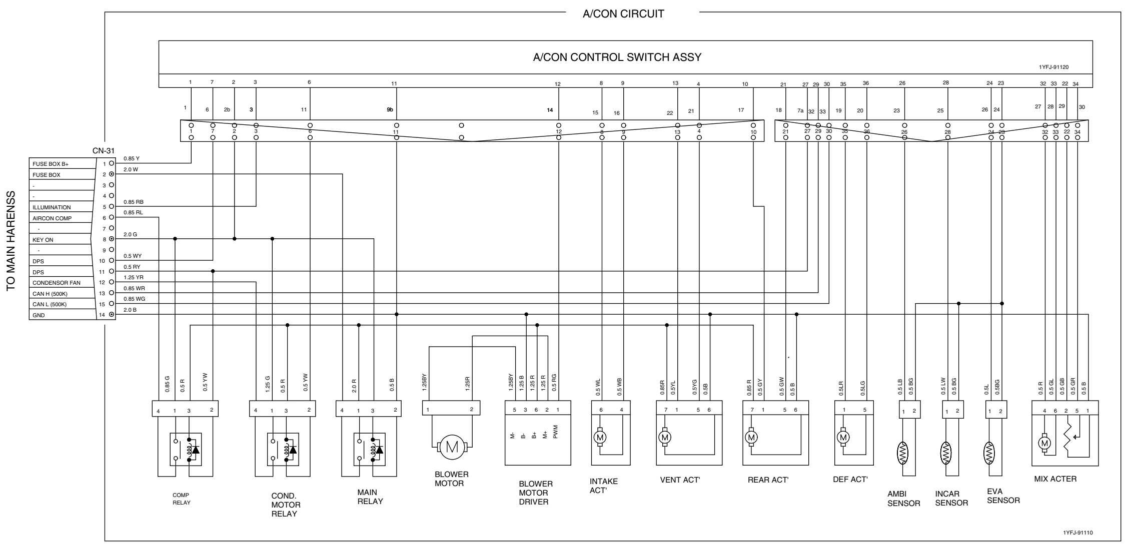
· ELECTRICAL CIRCUIT (3/3, #0007~0036, OLD)

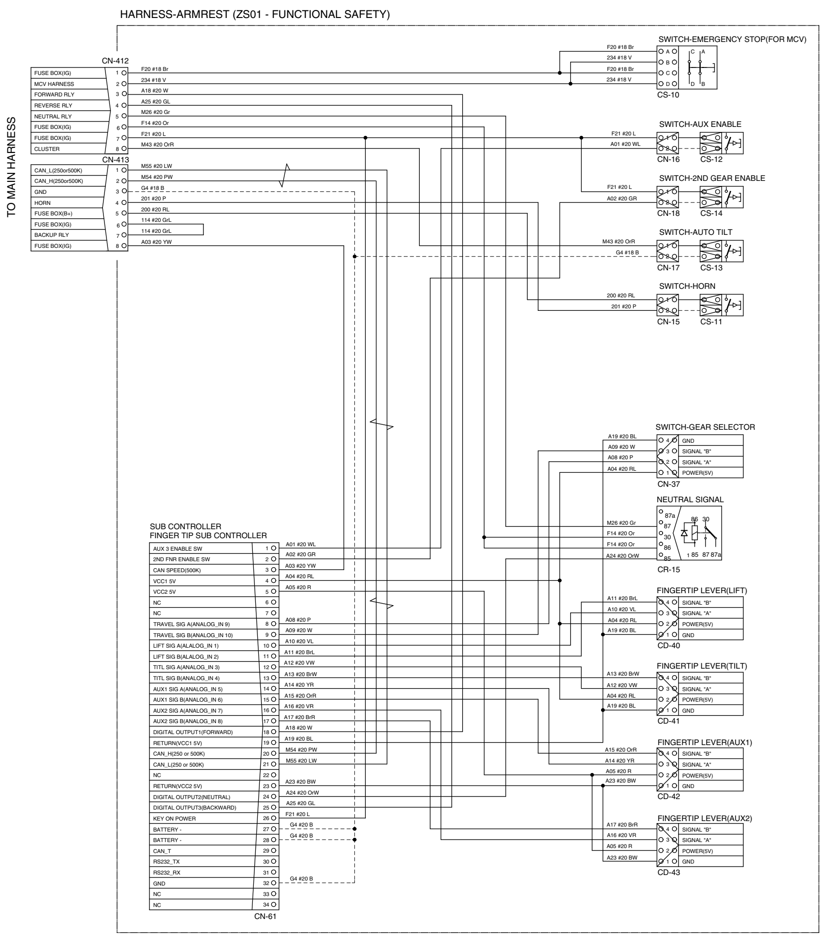


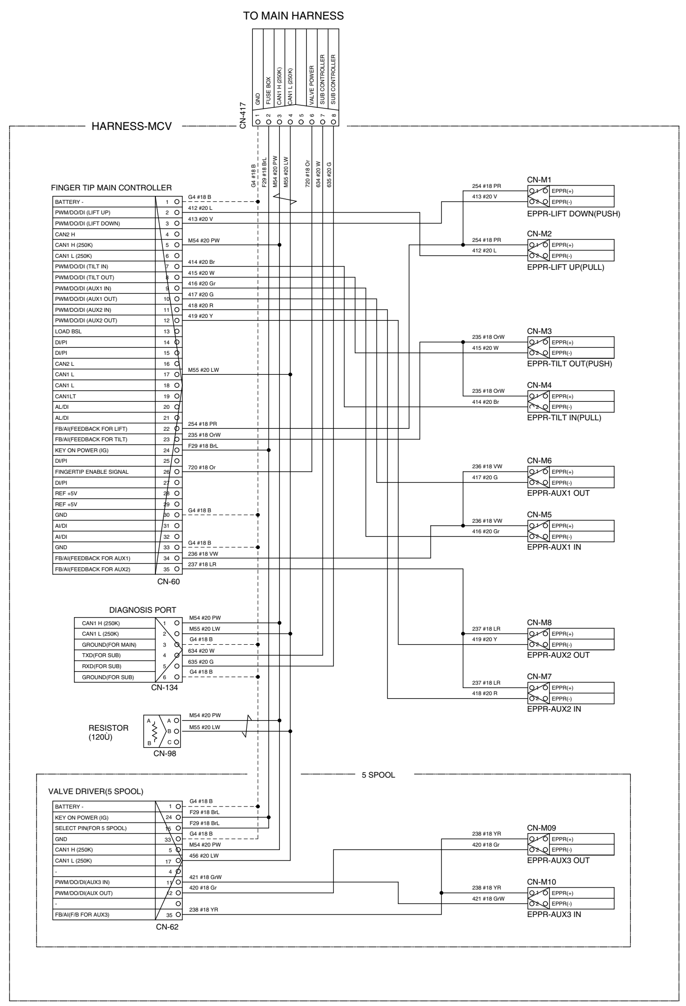
2YFJ-15013-003

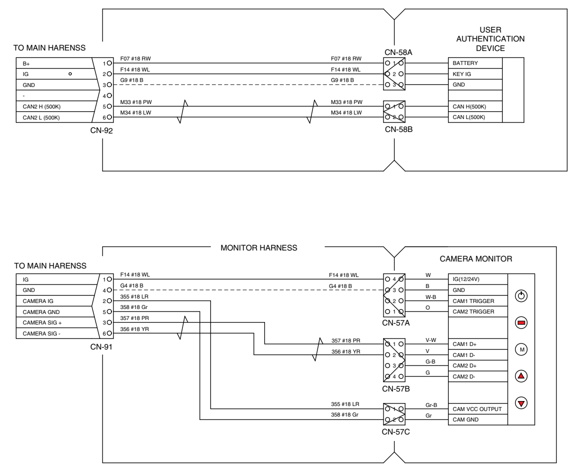
· ELECTRICAL CIRCUIT (3/3, #0007~0036, NEW)

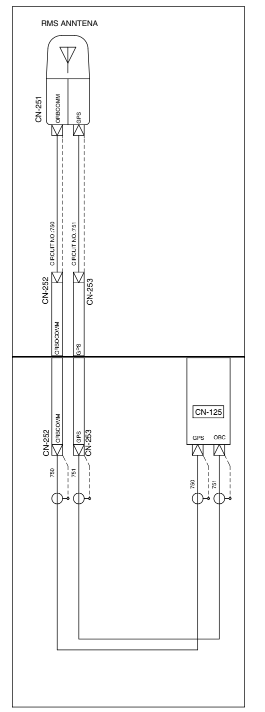






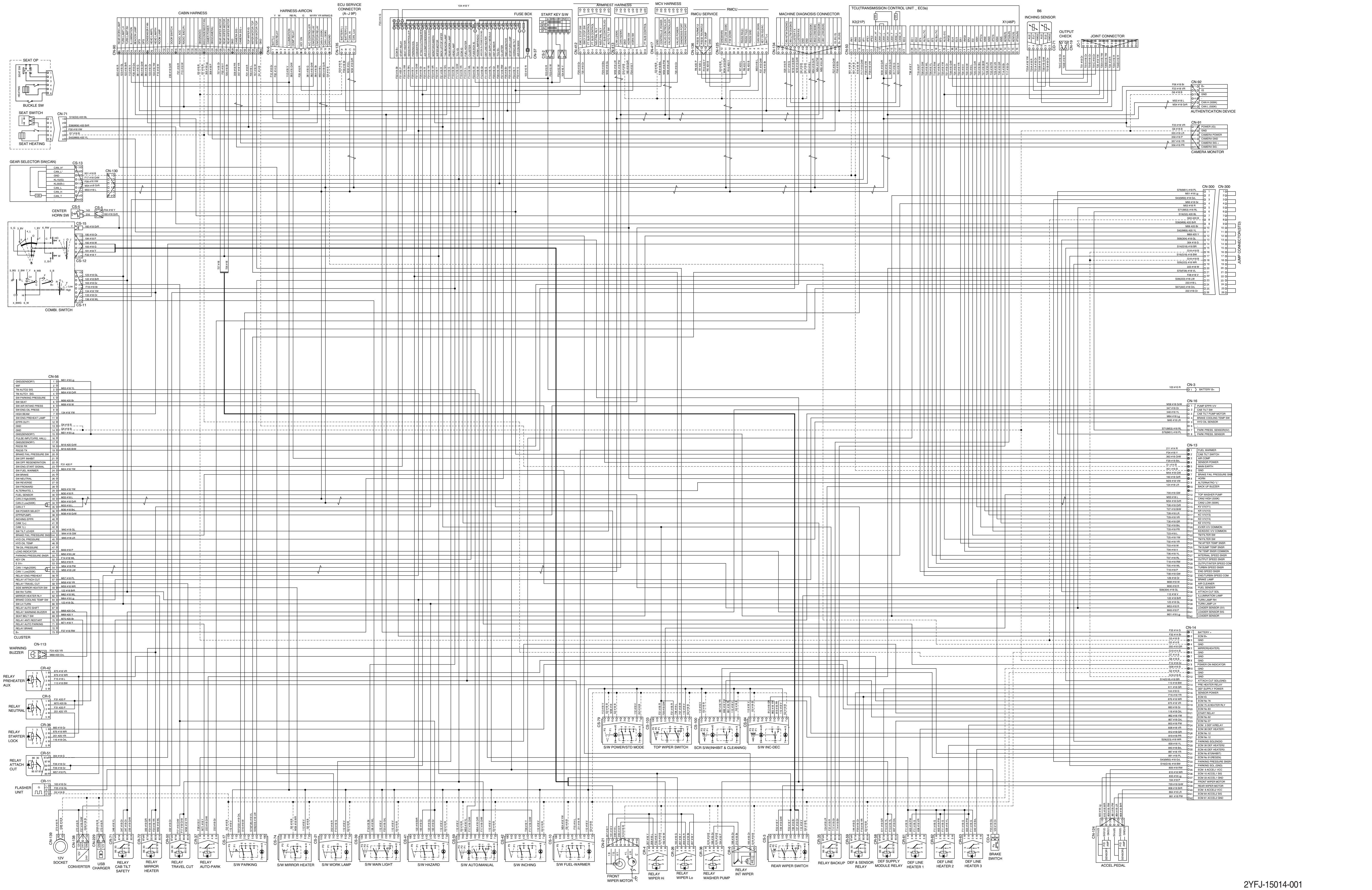






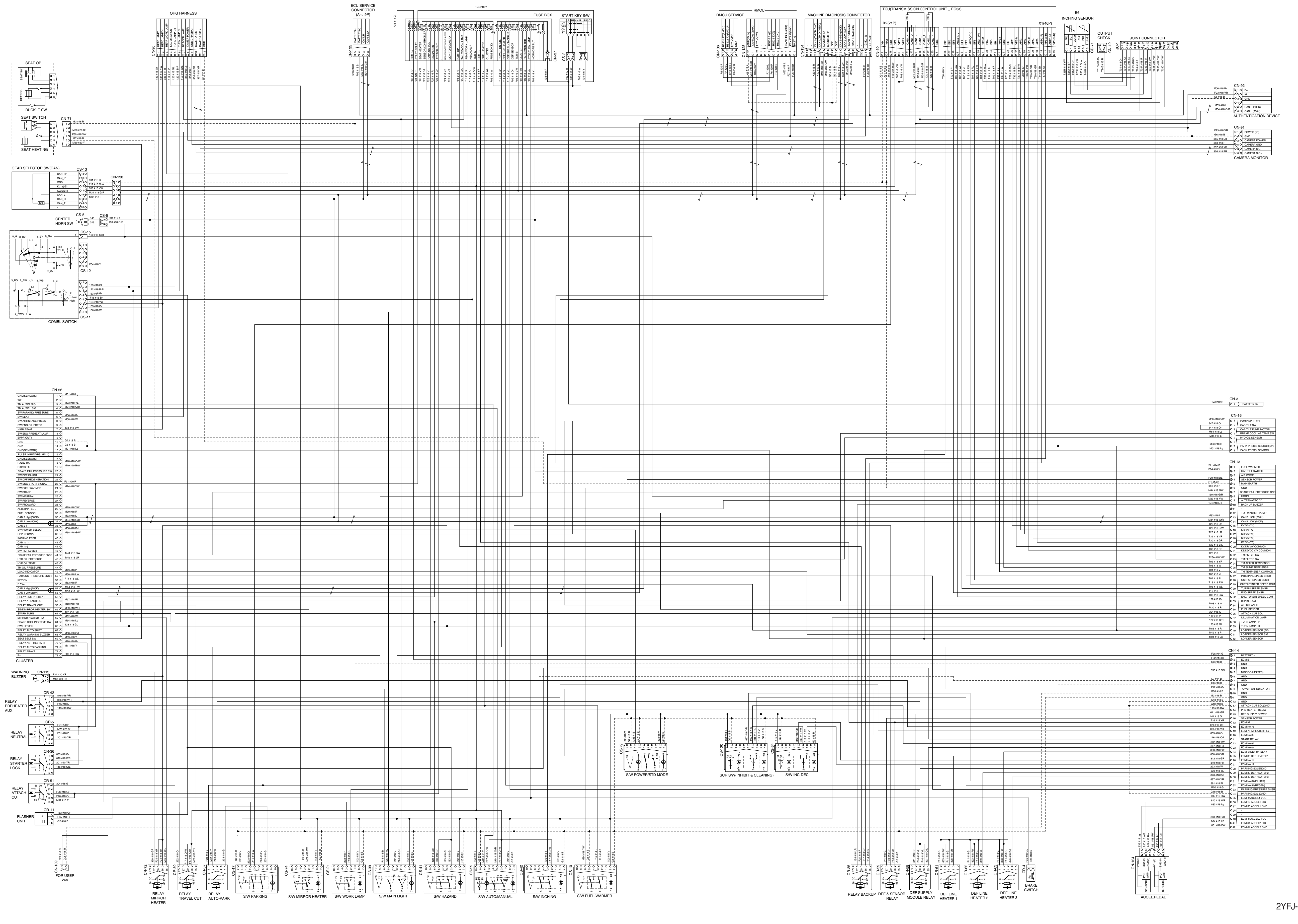
2YFJ-15013-013

· ELECTRICAL CIRCUIT (1/4, CABIN TYPE, #0037-)



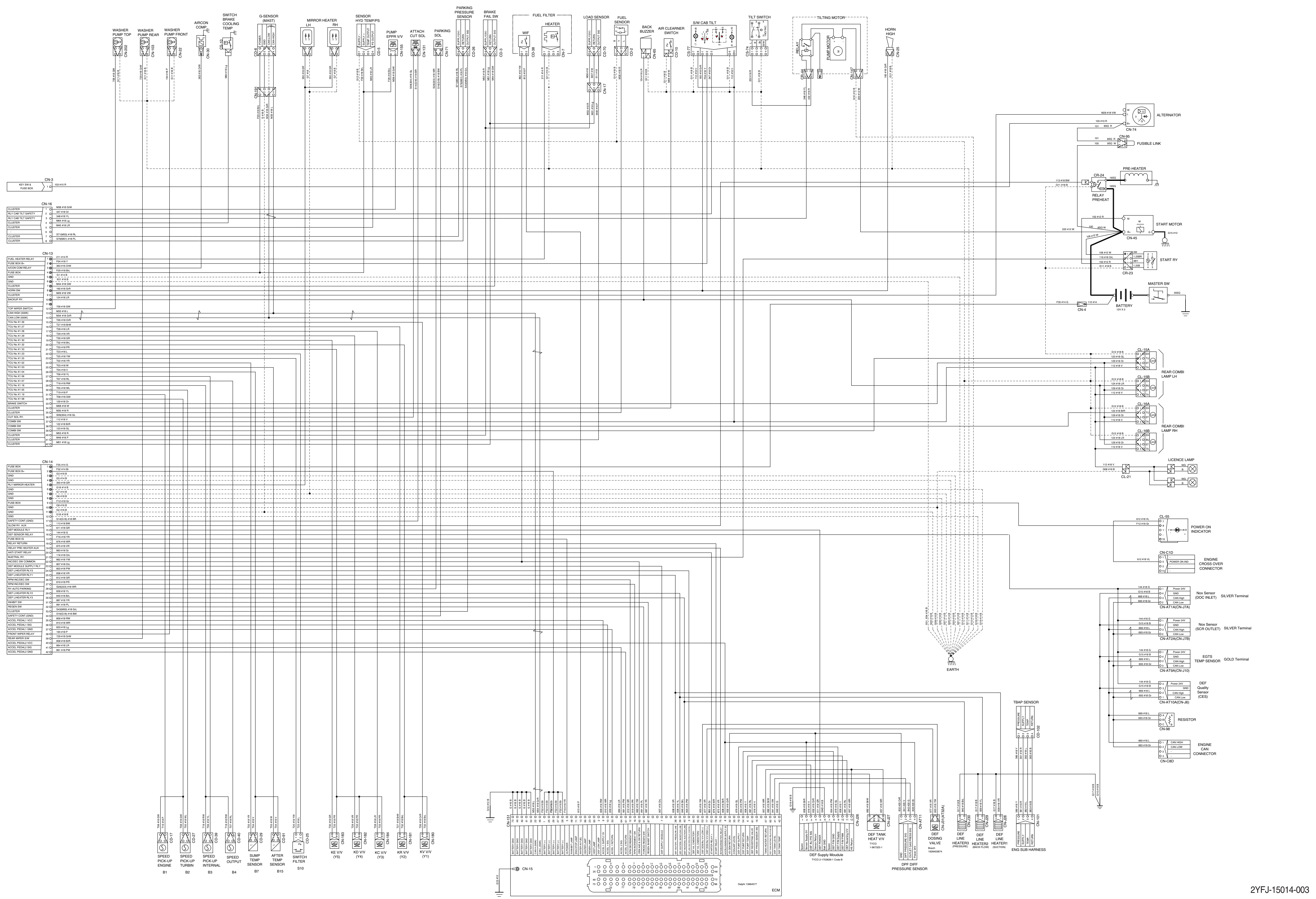
2YFJ-15014-001

· ELECTRICAL CIRCUIT (2/4, CANOPY TYPE, #0037-)



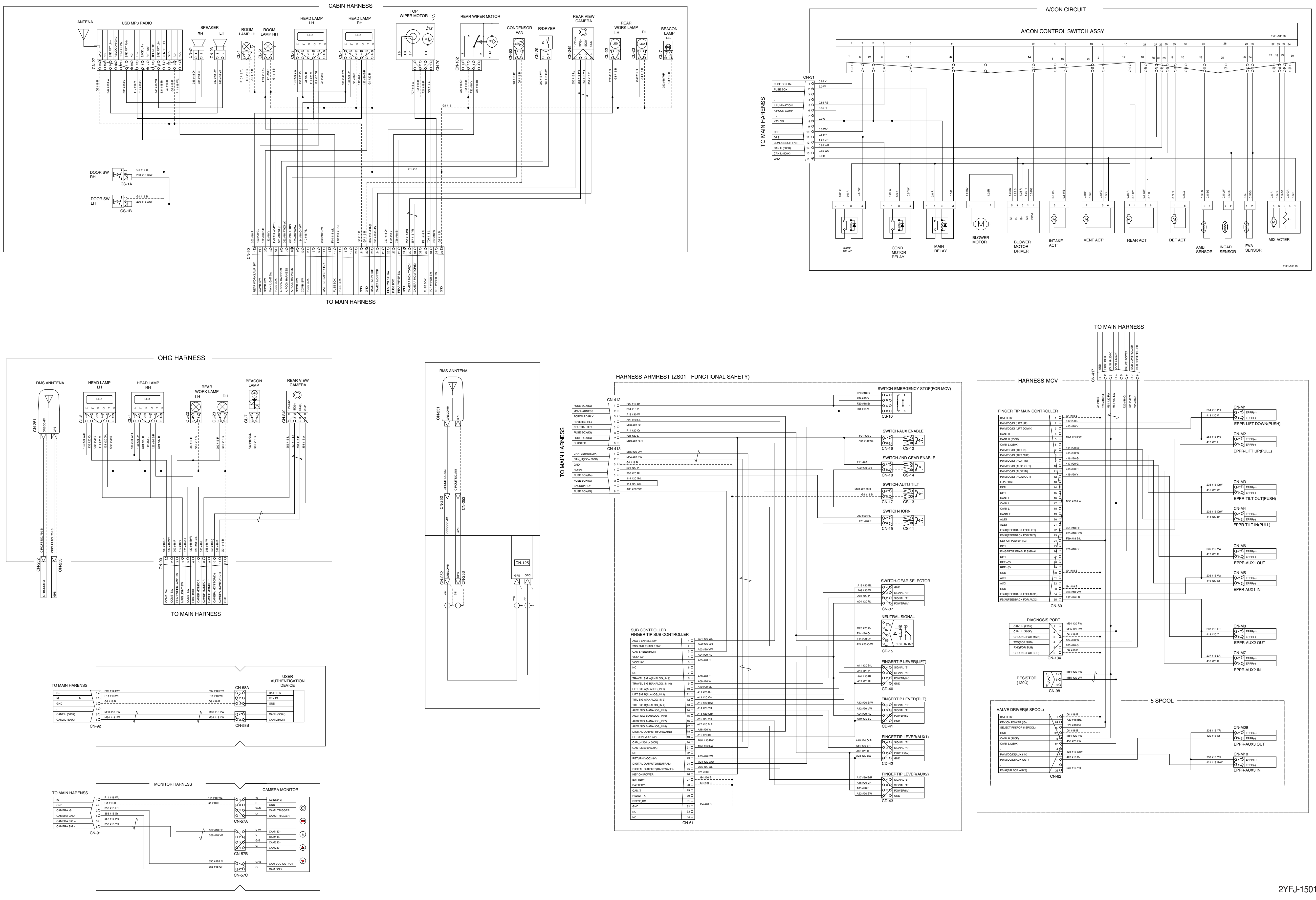
2YFJ-15014-002

· ELECTRICAL CIRCUIT (3/4, #0037-)



2YFJ-15014-003

· ELECTRICAL CIRCUIT (4/4, #0037-)



2YFJ-15014-004

1. POWER CIRCUIT

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

1) OPERATING FLOW

- Battery(+)
  - → I/conn [CN-4] → I/conn [CN-14 (1)] → Fuse box [CN-37 (No.35 → 32]
    - → I/conn [CN-14 (2)] → ECM [CN-151 (1, 25, 26, 27, 28)]
  - → Start motor [CN-45 (B+)]
    - → Tilting motor [CN-147]
    - → Start Relay [CR-23 (1)]
    - → Preheat relay [CR-24]
    - → Fusible link [CN-95] → Alternator [CN-74 (B+)]
      - → I/conn [CN-3]

- → Start key switch [CS-2 (1)]
- → Fuse box [No.2] → Aircon harness [CN-6 (2)]
- → Fuse box [No.4]
  - → C/horn switch [CS-5 (1)]
  - → Horn switch [CS-12 (6)]
  - → I/conn [CN-413 (5)] → Horn switch [CN-15 (1)]
  - → I/conn [CN-13 (2)] → Cabin tilt switch [CS-77 (2)]
- → Fuse box [No.5] → Flasher unit [CR-11 (B)] → Brake switch [CD-4]
- → Fuse box [No.6]
  - → RMCU [CN-125 (1)]
  - → Authentication device [CN-92 (1)]
  - → Machine diagnosis connector [CN-134 (16)]
  - → ECU Service connector [CN-135 (B)]
- → Fuse box [No.7] → Cluster [CN-56 (73)]
- → Fuse box [No.8]
  - → I/conn [CN-130 (2)] → Gear selector switch [CS-13 (11)]
  - → TCU [CN-50 (2, 5)]
- → Fuse box [No.9] → DEF & sensor relay [CR-59 (30)]
- → Fuse box [No.10] → DEF supply module relay [CR-58 (30, 86)]
- → Fuse box [No.11]
  - → DEF line 1 relay [CR-61 (1, 3)]
  - → DEF line 2 relay [CR-62 (1, 3)]
  - → DEF line 3 relay [CR-63 (1, 3)]
- → Fuse box [No.12]
  - → I/conn [CN-90 (17)] → Radio and USB player [CN-27 (8)]
  - → Aircon harness [CN-6 (1)]
  - → I/conn [CN-14 (9)] → Power on indicator [CL-55 (8)]
- → Fuse box [No.13] → I/conn [CN-90 (11)]
  - → Room lamp RH/LH [CL-1 (2), CL-51 (2)]

※ I/conn : Intermediate connector

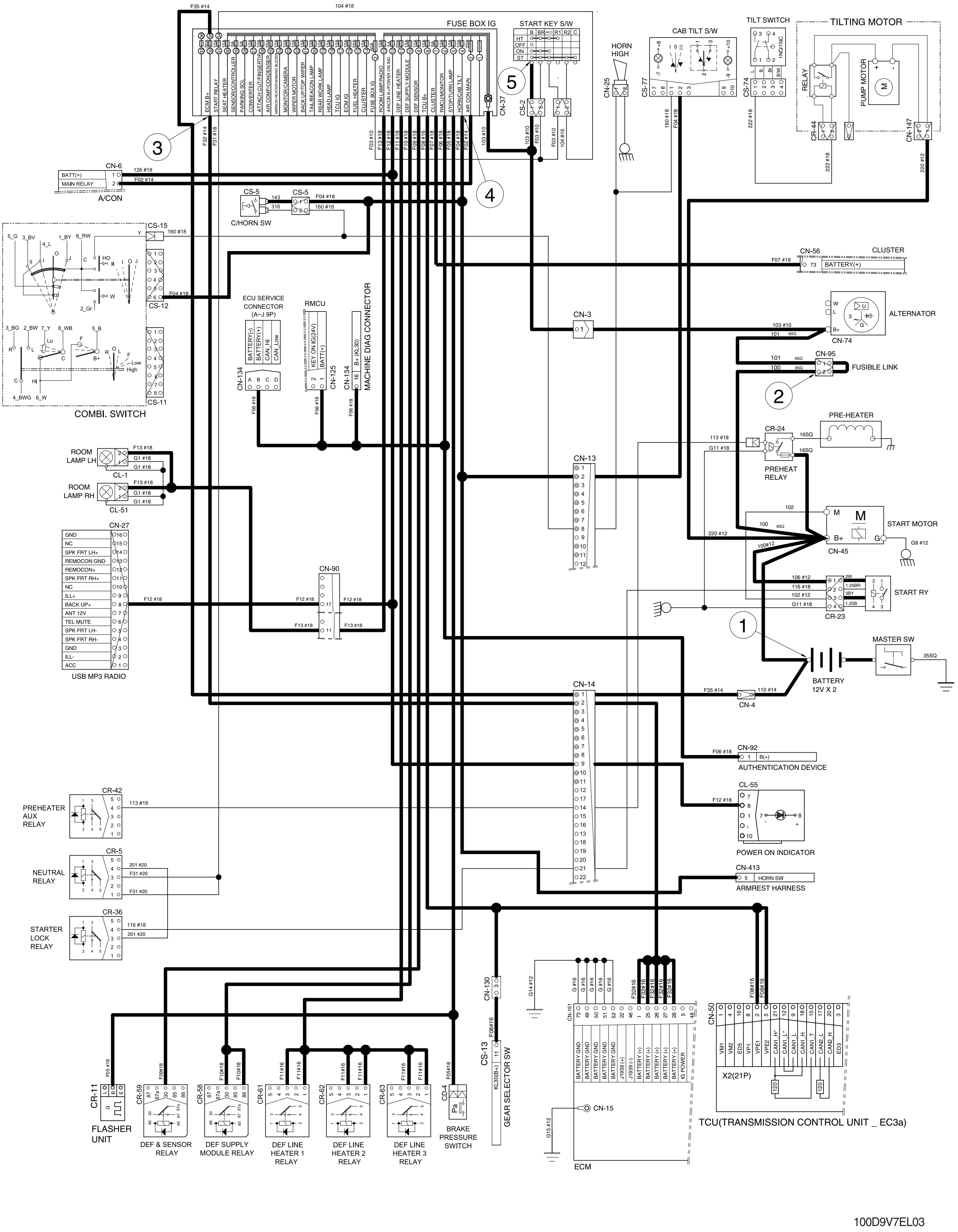
2) CHECK POINT

Engine	Key switch	Check point	Voltage
OFF	OFF	① - GND (Battery (+)) ② - GND (Fusible link) ③ - GND (Fuse No.33) ⑤ - GND (Start key)	24V

※ GND : Ground

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

POWER CIRCUIT



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

2. STARTING CIRCUIT

1) OPERATING FLOW

Battery (+) terminal → Start motor [CN-45 (B+)]

→ Fusible link [CN-95] → Alternator [CN-74 (B+)] → I/conn [CN-3 (1)] → Start switch [CS-2 (1)]

→ Start relay [CR-23 (1)]

→ Heater relay [CR-24]

The engine can be started only when the gear selector lever is in neutral position.
The operator should be seated when starting.

(1) When start switch is in ON position

Start switch ON [CS-2 (2, 1)] → Fuse box [CN-37 (3)]
→ Power is supplied with the electric component

(2) When start key switch is START position

Start switch START [CS-2 (2)] → Fuse box [No. 34→31] → Neutral relay [CR-5 (3)→(4)]
→ Start lock relay [CR-36 (3)→(4)] → I/conn [CN-14 (21)] → Start relay [CR-23 (2)→(4)]
→ Start motor [CN-45 (M)] → Start motor operating

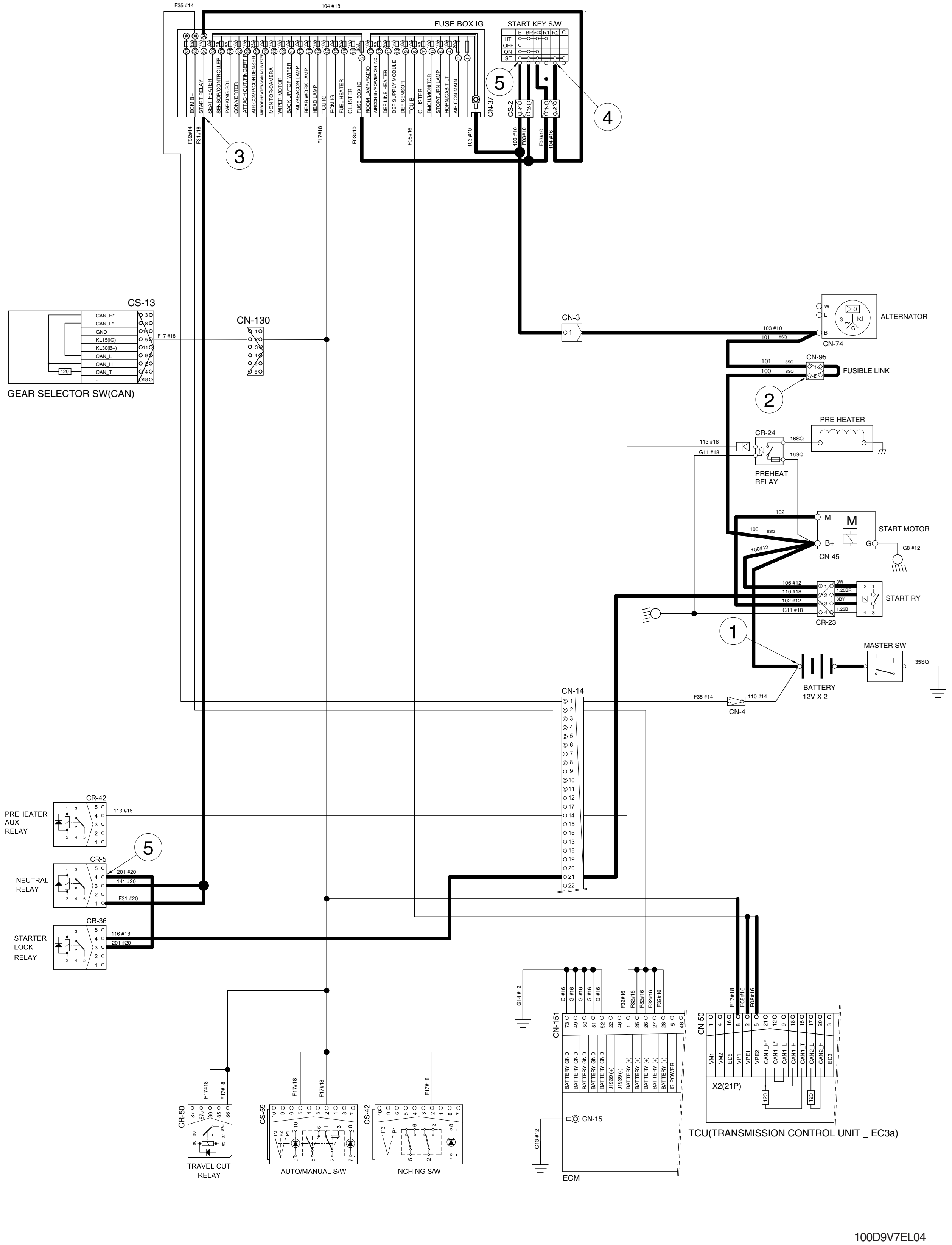
2) CHECK POINT

Engine	Start switch	Check point	Voltage
Running	ON	① - GND (Battery B+) ② - GND (Fusible link) ③ - GND (Fuse box No.31) ④ - GND (Start switch) ⑤ - GND (Neutral relay)	24V

※ GND : Ground

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

STARTING CIRCUIT



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

3. CHARGING CIRCUIT

When the starter is activated and the engine is started, the operator release the start switch to the ON position. Charging current generated by operating the alternator flows into the battery.
The current also flows from the alternator to each electrical component through the fusible link (CN-95) and the fuse box.

1) OPERATING FLOW

(1) Warning flow

Alternator [CN-74 (L)] → I/conn [CN-13 (9)] → Cluster alternator level [CN-56 (29)]

(2) Charging flow

Alternator [CN-74 (B+)] → Fusible link [CN-95] → Starter [CN-45 (B+)] → Battery (+) terminal charging
→ I/conn [CN-3] → Start switch [CS-2 (1)] → Fuse box [No. 14~30]
→ Fuse box [No. 4~13]

2) CHECK POINT

Engine	Start switch	Check point	Voltage
ON	ON	① - GND (Battery voltage) ② - GND (Alternator B+ terminal) ③ - GND (Alternator L terminal) ④ - GND (Start switch) ⑤ - GND (Cluster)	24V

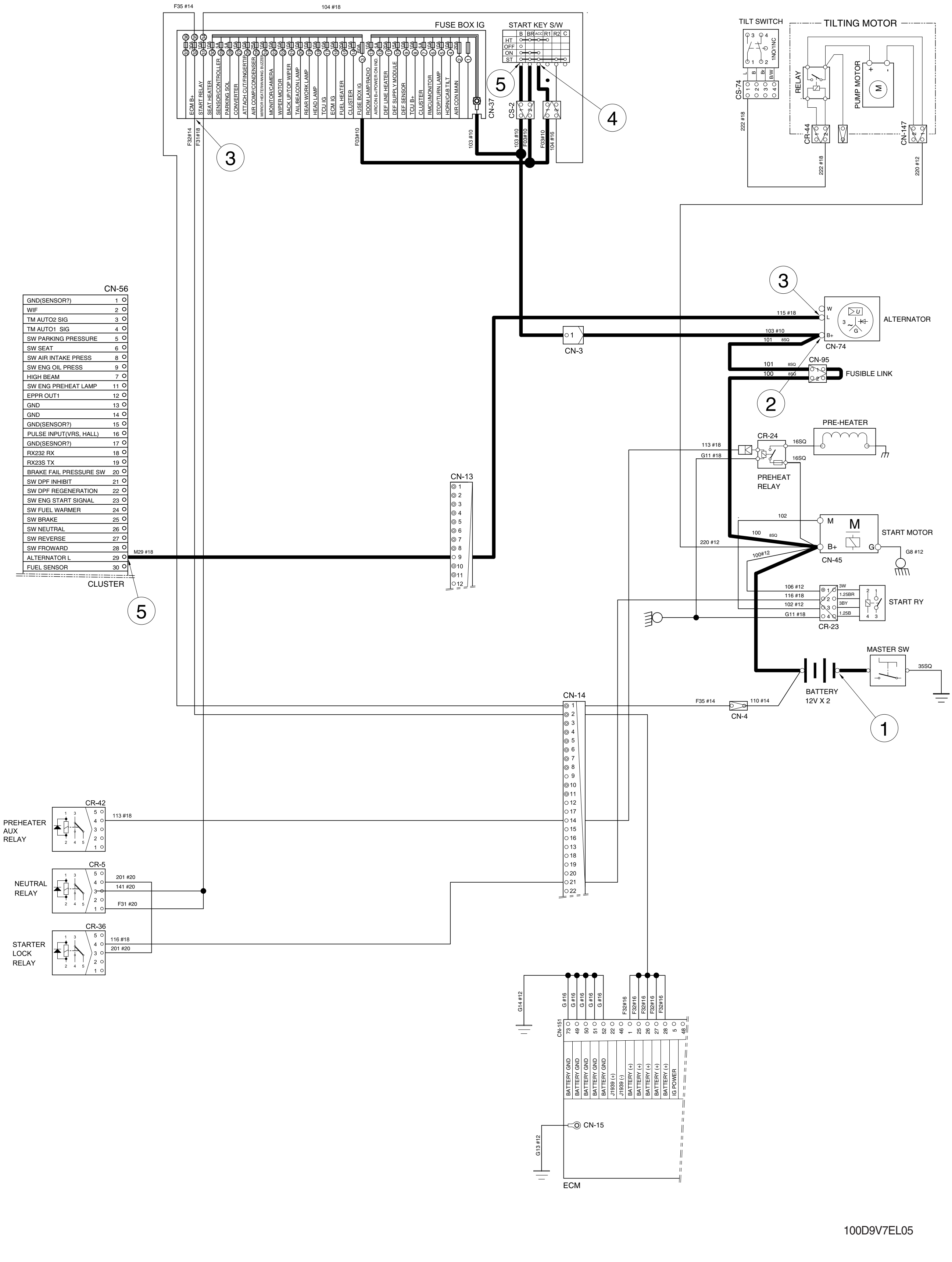
※ GND : Ground

※ Cautions

1. When using an arc welder, always disconnect the ground lead from the battery to prevent alternator or battery damage.
2. Attach the welding ground clamp as close to the weld area as possible to prevent welding current from damaging the bearings of the alternator.
3. Do not disconnect the battery when the engine is running. The voltage surge can damage the diode and resistors in the electrical system.
4. Do not disconnect an electric wire before the engine is stopped and the switches are OFF.

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

CHARGING CIRCUIT



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

4. PREHEATING CIRCUIT

Combustion chamber glow plugs are used in order to give satisfactory starting of low ambient temperatures.

1) OPERATING FLOW

Battery (+) terminal → Start motor [CN-45 (B+)] → Preheat relay [CR-24]

When you turn the start switch to the ON position, the preheat relay makes the preheater operated and the engine warm up lamp of the cluster turned ON.

Start switch ON [CS-2 (2)]
→ Fuse box [No.15] → Fuel heater switch [CS-10 (3)→(2)] → I/conn [CN-13 (1)]
→ Fuel heater [CN-7 (1)] → Fuel heater operating
→ ECM [CN-151 (75)] → I/conn [CN-14 (19)] → Preheater aux relay [CR-42 (1)→(4)]
→ I/conn [CN-14 (14)] → Preheater relay [CR-24] → Preheater operating

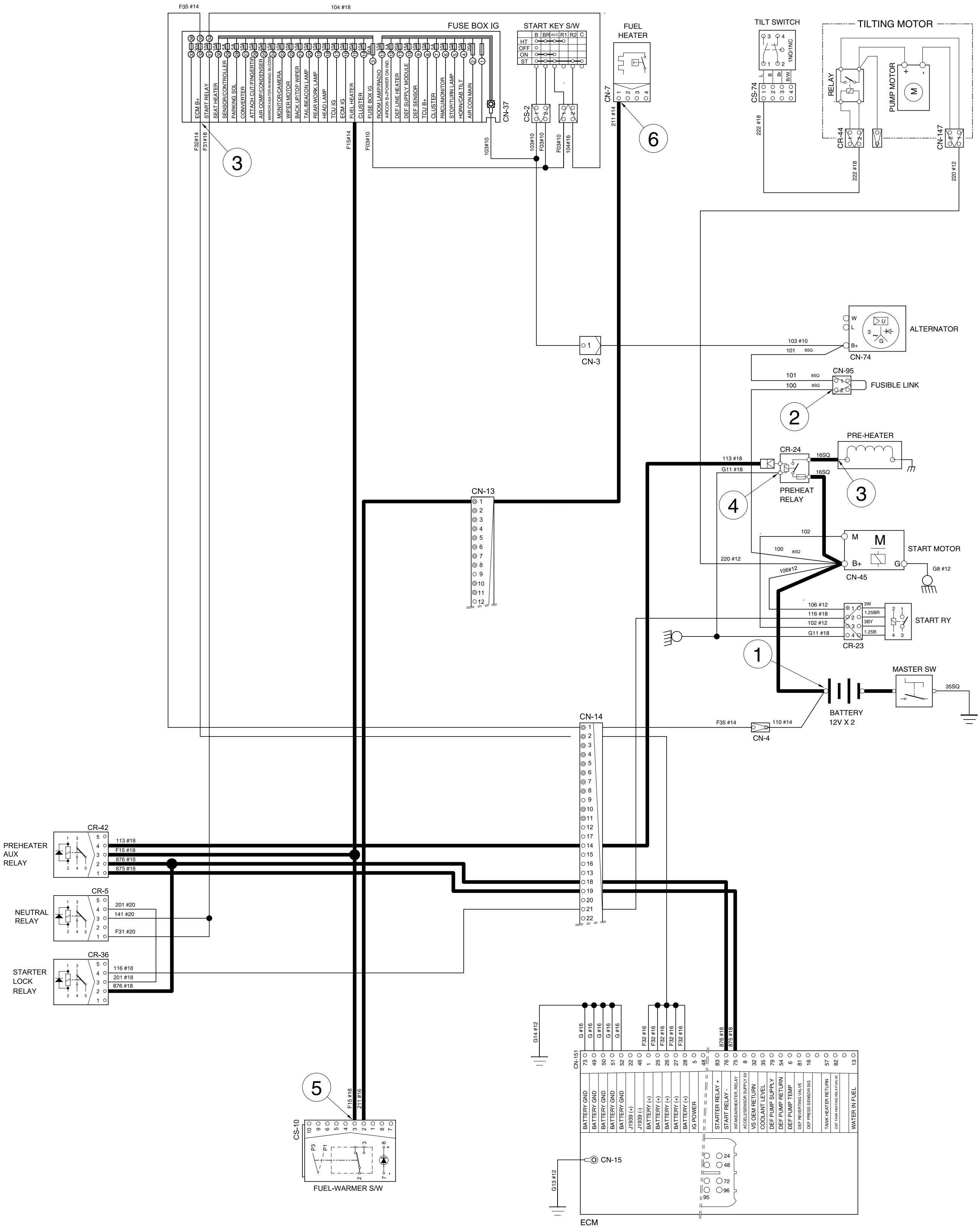
2) CHECK POINT

Engine	Start switch	Check point	Voltage
Stop	ON	① - GND (Battery B+) ② - GND (Fusible link) ③ - GND (Preheater) ④ - GND (preheat relay) ⑤ - GND (Fuel warmer switch) ⑥ - GND (Fuel heater)	24V

※ GND : Ground

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

PREHEATING CIRCUIT



100D9V7EL07

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

5. HEAD LIGHT AND REAR WORK LIGHT CIRCUIT

1) OPERATING FLOW

(1) Head light

Fuse box (No.18) → Main light switch [CS-39 (6)] → Switch ON, 2nd step [CS-39 (5)]
→ Multi function switch [CS-11 (8)]
→ Multi function switch MIDDLE [CS-11 (7)] → I/conn [CN-90 (9)]
→ LH Head light low beam ON [CL-3 (2)]
→ RH Head light low beam ON [CL-4 (2)]
→ Multi function switch DOWN [CS-11 (6)]
→ Cluster high beam pilot lamp ON [CN-56 (13)]
→ I/conn [CN-90 (10)] → LH Head light high beam ON [CL-3 (1)]
→ RH Head light high beam ON [CL-4 (1)]

(2) Rear work light

Fuse box (No.19) → Rear work light switch [CS-21 (2)] → Switch ON [CS-21 (3)]
→ I/conn [CN-90 (1)] → LH rear work light ON [CL-22 (1)]
→ RH rear work light ON [CL-23 (1)]

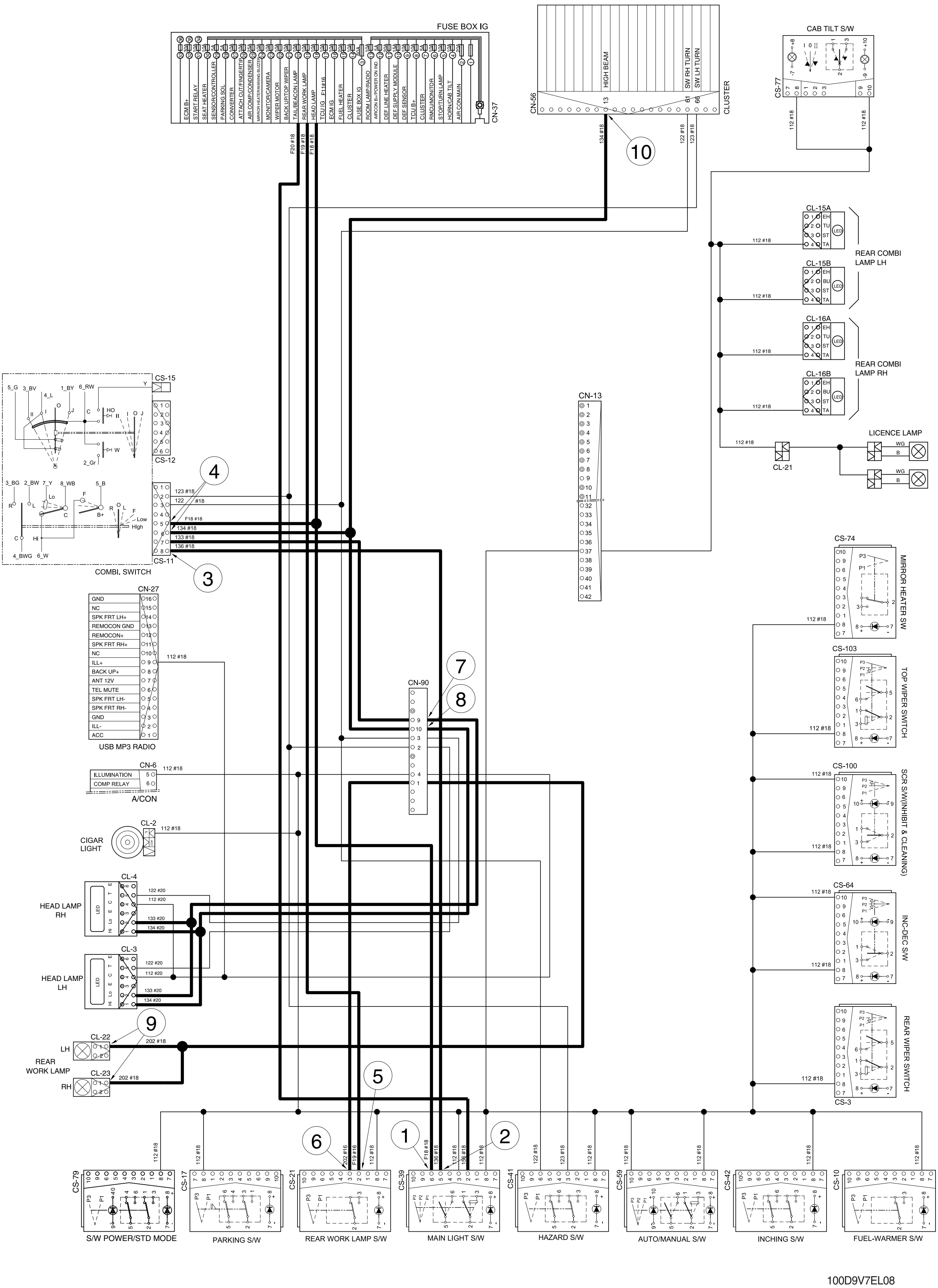
2) CHECK POINT

Engine	Start switch	Check point	Voltage
OFF	ON	① - GND (Main light switch input) ② - GND (Main light switch output) ③ - GND (Multifunction switch input) ④ - GND (Multifunction switch output) ⑤ - GND (Rear work light switch input) ⑥ - GND (Rear work light switch output) ⑦ - GND (Low beam) ⑧ - GND (High beam) ⑨ - GND (Rear work light) ⑩ - GND (Cluster high beam pilot lamp input)	20~25V

※ GND : Ground

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

HEAD LIGHT AND REAR WORK LIGHT CIRCUIT



100D9V7EL08

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

6. WIPER AND WASHER CIRCUIT

1) OPERATING FLOW

Fuse box [No.22] → Front wiper motor [CN-21 (8)]
→ Wiper relay Hi [CR-4 (3)]
→ Wiper relay Lo [CR-26 (1)]
→ Multi function switch [CS-12 (6)]
→ Rear wiper & washer switch [CS-3 (3, 6)]
→ I/conn [CN-90 (27)] → Rear wiper motor [CN-102 (3)]

Fuse box [No.21] → Top wiper & washer switch [CS-103 (3, 6)]
→ I/conn [CN-90 (33)] → Top wiper motor [CN-70 (3)]

(1) Front washer switch ON

① Washer switch ON [CS-12 (6)→(2)] → I/conn [CN-14 (38)] → Front washer pump [CN-22 (2)]
→ Washer pump relay [CR-38 (1)→(3)] → Int wiper relay [CR-6 (1)→(2)]
→ Wiper Lo relay [CR-26 (2)→(3)] → Front wiper motor [CN-21 (2)]
→ Wiper motor operating (low)

(2) Front wiper switch ON

① INT position
Washer switch ON [CS-12 (6)→(1)] → Int wiper relay [CR-6 (3)→(2)] → Wiper Lo relay [CR-26 (2)→(3)]
Front wiper motor [CN-21 (2)] → Front wiper motor intermittently operating

② Lo position
Wiper switch ON [CS-12 (6)→(4)] → Wiper Lo relay [CR-26 (5)→(2)] →
Front wiper motor [CN-21 (2)] → Front wiper motor operating (low)

③ Hi position
Wiper switch ON [CS-12 (6)→(3)] → Wiper Hi relay [CR-4 (1)→(4)] →
Front wiper motor [CN-21 (4)] → Front wiper motor operating (high)

(3) Auto-parking (when switch OFF)

Switch OFF [CS-12 (3)] → Wiper relay Lo [CR-26 (5)→(3)] → Front wiper motor [CN-21 (2)] →
Wiper motor stop

(4) Rear wiper and washer switch

① **Wiper switch ON** (1st step)
Wiper switch ON [CS-3 (3)→(2)] → I/conn [CN-90 (36)] → Rear wiper motor [CN-102 (4)] →
Rear wiper motor operating

② **Washer switch ON** (2nd step)
Washer switch ON [CS-3 (6)→(5)] → I/conn [CN-14 (39)] → Rear washer tank [CN-103 (2)] →
Washer operating
Wiper switch ON [CS-3 (3)→(2)] → I/conn [CN-90 (36)] → Rear wiper motor [CN-102 (4)] →
Rear wiper motor operating

(5) Top wiper and washer switch

① **Wiper switch ON** (1st step)
Wiper switch ON [CS-103 (3)→(2)] → I/conn [CN-90 (34)] → Top wiper motor [CN-70 (4)] →
Top wiper motor operating

② **Washer switch ON** (2nd step)
Washer switch ON [CS-103 (6)→(5)] → I/conn [CN-13 (12)] → Top washer tank [CN-202 (2)] →
Washer operating
Wiper switch ON [CS-103 (3)→(2)] → I/conn [CN-90 (34)] → Top wiper motor [CN-70 (4)] →
Top wiper motor operating

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

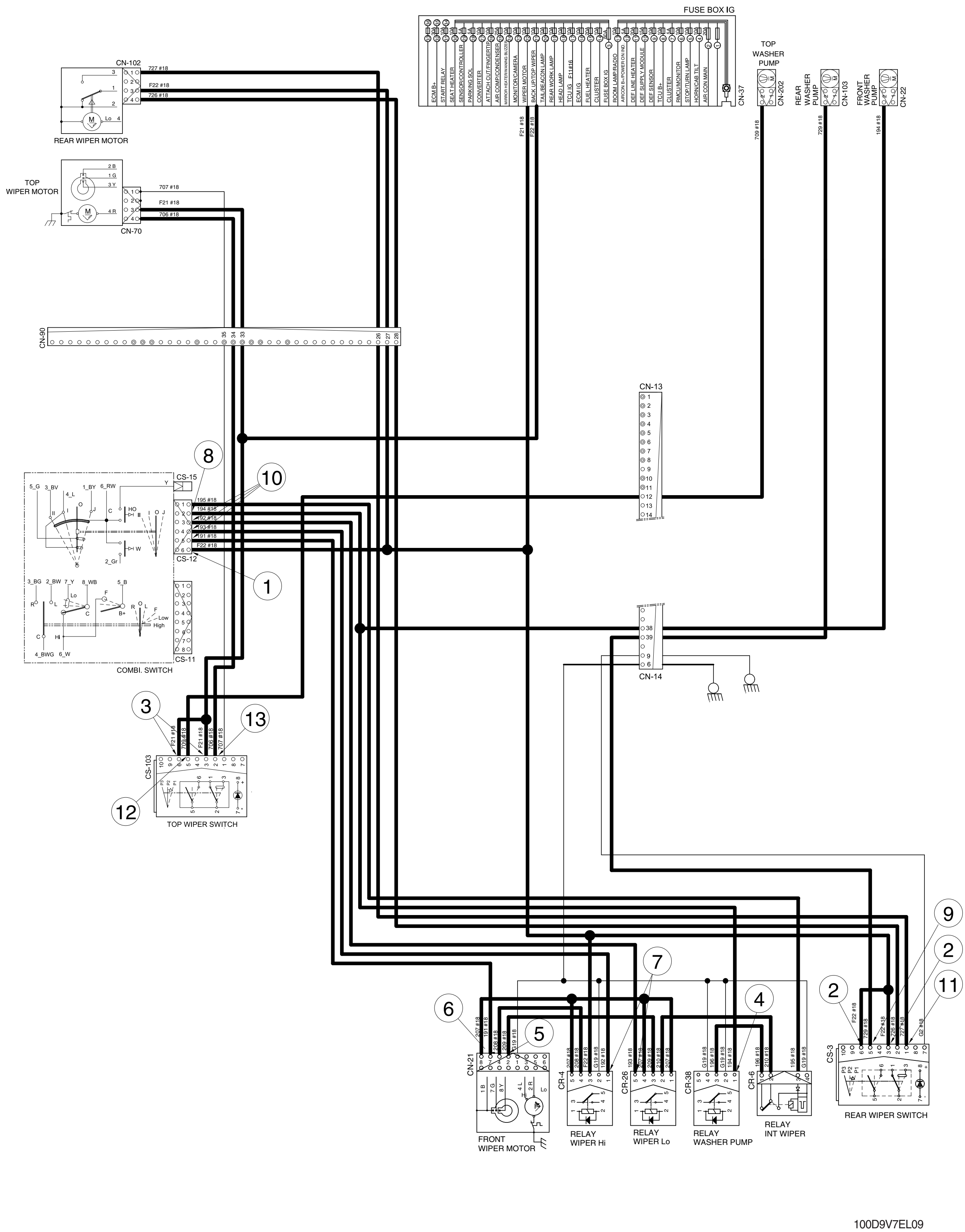
2) CHECK POINT

Engine	Start switch	Check point	Voltage
Stop	ON	① - GND (Front wiper switch power input) ② - GND (Rear wiper switch power input) ③ - GND (Top wiper switch power input) ④ - GND (Washer pump relay power input) ⑤ - GND (Front wiper motor Lo power input) ⑥ - GND (Front wiper motor High power input) ⑦ - GND (Wiper relay power input) ⑧ - GND (Front washer power output) ⑨ - GND (Rear washer power output) ⑩ - GND (Front wiper motor power output) ⑪ - GND (Rear wiper motor power output) ⑫ - GND (Top washer power output) ⑬ - GND (Top wiper motor power output)	20~25V

※ GND : Ground

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

WIPER AND WASHER CIRCUIT



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

GROUP 3 CLUSTER

1) STRUCTURE

Like following figure, cluster is consisted of LCD and buttons. LCD will indicate the operation and abnormal status of truck to the driver in order to use and maintenance. Also, LCD allows to set and indicate the various modes, monitoring, and gadgets.

※ The cluster installed on this truck does not entirely guarantee the condition of the truck. Daily inspection should be performed according to the operating manual chapter 7. PLANNED MAINTERNACNE AND LUBRICATION.

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

70D9V3KY29

2) GAUGE

(1) Operation screen

Operating screen will be displayed if turn on the start switch.

70D9V3KY30A

1	Speed meter	3	Coolant temperature gauge	5	Transmission oil temperature gauge
2	Fuel gauge	4	DEF gauge	6	Clock

(2) Speed meter

100D9V3KY30

· It indicates the speed of truck and calibrated in miles per hour (mph) or kilometer per hour (km/h).

※ **Speed unit can be set in the speed unit menu of display set up at page 7-67.**

(3) Fuel gauge

70D9V3KY31

· Fuel gauge displays the approximate amount of fuel remaining in the fuel tank.

· It shall be obtained fuel as soon as warning lamp lights on.

(4) Coolant temperature gauge

70D9V3KY32

· It indicates the temperature of the engine coolant.

- White zone : 40 ~ 120 ℃ (104 ~ 248 ˚F)
- Red zone : Over 120 ℃ (248 ˚F)
- Warning lamp on : Over 115 ℃ (239 ˚F)

· If the gauge display in the red zone, or warning lamp comes on, please stop the engine and inspect the coolant system.

(5) DEF (Diesel Exhaust Fluid) gauge

70D9V3KY33

· This gauge indicates the level of DEF.
· Fill the DEF when the level is low.

(6) Transmission oil temperature gauge

70D9V3KY34

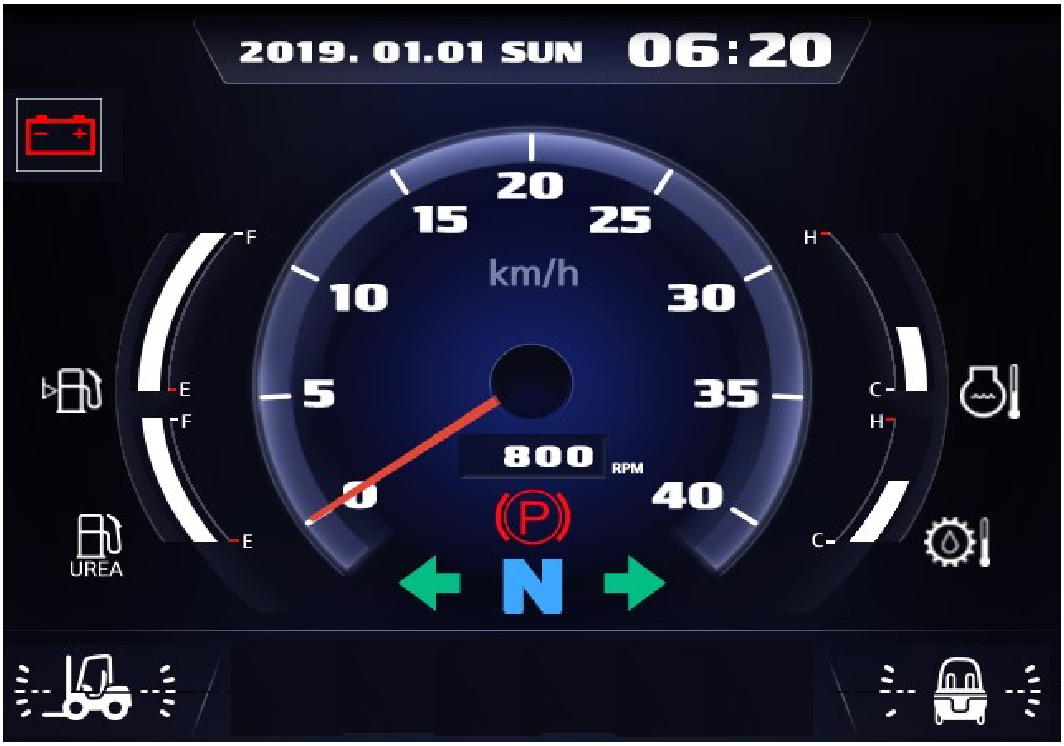
· This range indicates the temperature of transmission oil.
  - White range : 40 ~ 109 ℃ (104 ~ 228 ˚F)
  - Amber range : 110 ℃ (230 ˚F) or higher
· - Red range : 120 ℃ (248 ˚F) or higher
  Keep idling engine at low speed until the indicator is in the operating range.
· If the indicator is in the red range, it means the transmission is overheated. Be careful that the indicator does not move into the red range.

(7) Clock

35D9VB3KY07

· It displays current time.
· The time can be adjusted at display Set Up > Time Set Up menu.

3) WARNING LAMPS

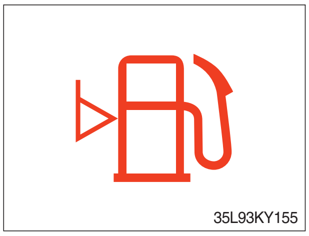


70D9V3KY35

※ Warning and indicator lamp will display only items that were set as ON, and all warning and indicator except fuel level warning and coolant temperature warning will be displayed in order from the left of screen. And directional indicator lamp will display at the center.

No.	Warning lamp		No.	Warning lamp	
1		Fuel Level warning lamp	12		HEST warning lamp
2		Coolant temperature warning lamp	13		Clutch protection warning lamp
3		Engine oil pressure warning lamp	14		Communication error warning lamp
4		Air cleaner warning lamp	15	UREA	DEF low warning lamp
5		Water in fuel warning lamp	16		Brake fail warning lamp
6	CHECK	Engine check warning lamp	17		Seat belt reminder lamp
7		Engine stop warning lamp	18	F F	Fingertip warning lamp
8		Battery charge warning lamp	19		Transmission warning lamp
9		Transmission oil temperature warning lamp	20		FSCU Communication error warning lamp
10		Exhaust system cleaning warning lamp	21		FSCU warning lamp
11		Exhaust system cleaning inhibit warning lamp	-	-	-

(1) Fuel level warning lamp

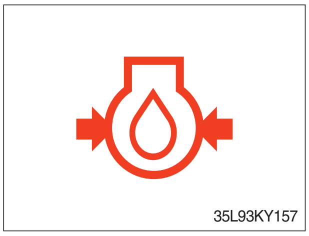


· Warning lamp will be displayed if fuel level is low.
· Please refuel immediately if the lamp is ON.

(2) Coolant temperature warning lamp

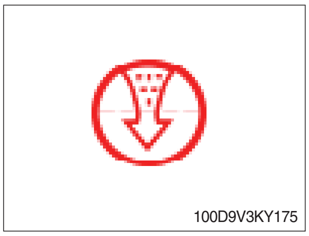
· Coolant temperature warning will be lit up when temperature is over 115 ℃ (239 °F).
· If the warning lamp is on continuously, please inspect the coolant system.

(3) Engine oil pressure warning lamp



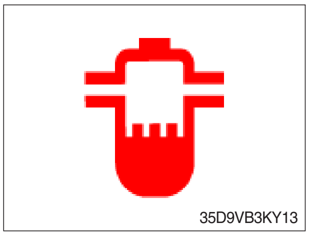
· This warning lamp will be lit up when engine oil pressure is low.
· Stop the engine immediately if the warning lamp is lit up. Please check the engine oil.

(4) Air cleaner warning lamp



· This warning lamp is lit when air cleaner element is clogged up.
· Please clean up or replace the element.

(5) Water in fuel warning lamp



· Light up when water in fuel.
· Stop the engine and please drain the water of the fuel filter.

(6) Engine check warning lamp

35D9VB3KY14

- When the engine is ON, it blinks for about 3 seconds. If the warning light remains on after 3 seconds, there is something wrong with the engine control, fuel supply and so on.
- Check the failure code of cluster.

※ Some engine controls may not start if there is a problem.

※ Continued operation with the engine warning lamp ON or flashing can damage the exhaust control system, which affects operating performance and fuel consumption. You may also be subject to sanctions related to emission regulations, so be sure to check.

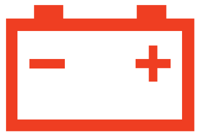
(7) Engine stop warning lamp

35D9VB3KY15

- If the lamp lights on, stop the engine immediately and check the engine.

※ Please contact your Hyundai service center or local dealer.

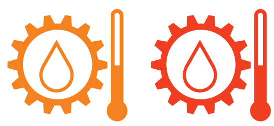
(8) Battery charge warning lamp



35L93KY159

- This warning lamp is lit when battery charging voltage is low.
- Please inspect the battery charging circuit if the warning lamp is lit.

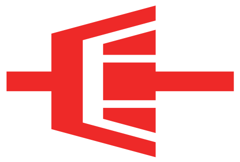
(9) Transmission oil temperature warning lamp



70D9V3KY191

- Transmission oil temperature warning is consisted of two indications.
  - 110 ℃ (230 ˚F) or higher : Amber is light up
  - 120 ℃ (248 ˚F) or higher : Red is flashing
- When the red lamp lights up during operation, stop the engine and check the truck.

(10) Clutch protection warning lamp



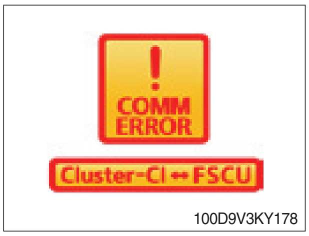
35D9VB3KY19

- Warning lamp will be displayed if transmission oil pressure is not enough or while inching operation.
- Please check the transmission when the lamp is displayed without inching operation. If not, the brake performance can be decreased until the problem is resolved.

(11) Communication error warning lamp

· This warning lamp will be lit up if the communication between cluster-CI and ECU is fail.
· Please check the communication line if the warning lamp is lit up.

(12) FSCU Communication error warning lamp (option)



· This warning lamp will be lit up if the communication between MCU and FSCU is fail.
· Please check the communication line between MCU and FSCU if the warning lamp is lit up.

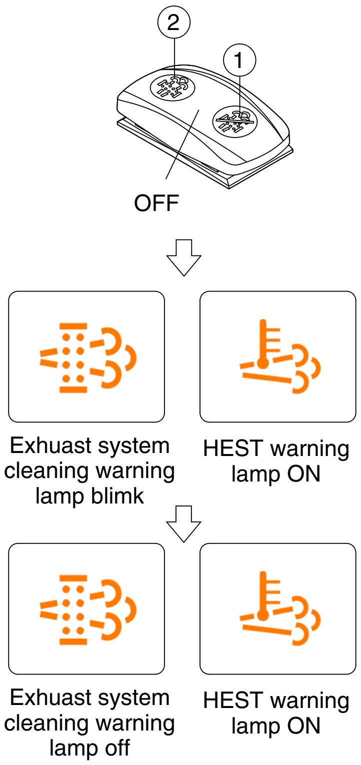
(13) Exhaust system cleaning warning lamp

50D93CD52

· This warning lamp lights ON or flashes when exhaust system cleaning is needed as seen in the table below

Warning lamp				Remark
Exhaust warning lamp	DEF low lamp	Engine check lamp	Engine stop lamp	
				
On	-	-	-	1. Changing to a more challenging duty cycle. 2. Performing a manual (stationary) exhaust system cleaning.
On	-	On	-	1. The aftertreatment exhaust system needs to be cleaned immediately. 2. Engine power will be reduced automatically if action is not taken.
-	-	-	On	1. These lamps will be on when a manual (stationary) exhaust system cleaning is not performed 2. Stop the engine immediatary 3. Please contact your hyundai service center or local dealer
Flash	-	-	-	The status of a manual (stationary) exhaust system cleaning when the exhaust system cleaning switch has been activated.
-	On	-	-	DEF level initial warning DEF level 10% (engine error code 3497)
-	Flash	-	-	DEF level critical warning DEF level 5% (engine error code 3498)
-	Flash	On	-	DEF level first derate warning DEF level 2.5% (engine error code 1673, 25% derate)
-	Flash	On	-	DEF level secondary derate warning DEF level 0% (error code 3547, 3714, 50% derate, 30 min)
-	Flash	On	On	DEF level final derate warning Engine error code 3712 Contact Hyundai Service conter or dealer

※ Manual exhaust system cleaning



160D9VCD143

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

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

· Stop and park the truck.

· Push the switch to position ② to initiate the manual exhaust system cleaning.

※ Refer to the operator manual page 3-44 for the exhaust system cleaning swtich operation.

※ The engine speed may increase during exhaust system cleaning and it will take approximately 20~60 minutes depending on condition.

· The exhaust system cleaning warning lamp will flash and HEST warning lamp will light on during the exhaust system cleaning is operation.

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

(14) Exhaust system cleaning inhibit warning lamp


50D93CD30

· This warning lamp lights ON when the exhaust system cleaning switch is pushed inhibit position, therefore automatic and manual exhaust system cleaning can not occur. It should inhibited, before caused fire due to the exhaust gas in high temperature.

※ Refer to the operator manual page 3-44 for the exhaust system cleaning switch.

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


50D9CL003

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

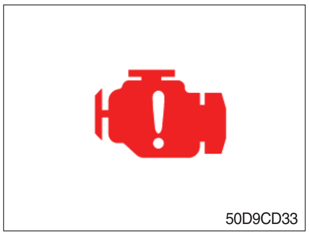
· The lamp will also illuminate during a manual exhaust system cleaning.

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

⚠ When this lamp is illuminated, the exhaust gas temperature could reach 800 ˚C [1500 ˚F], which is hot enough to ignite or melt common materials, and to burn people.

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

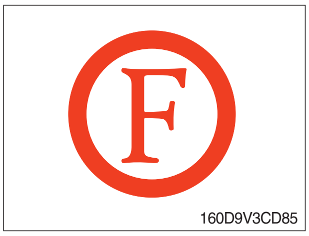
(16) Engine stop warning lamp



· When this warning lamp lights ON, stop the engine immediately and and check the DEF level and related parts of the engine.

※ Please contact your Hyundai service center or local dealer.

(17) Fingertip red warning lamp



· This lamp lights ON when the forklift truck is in a condition that is serious enough to stop it.

· If the warning light is lit while driving, stop the engine and check the forklift.

(18) Fingertip amber warning lamp

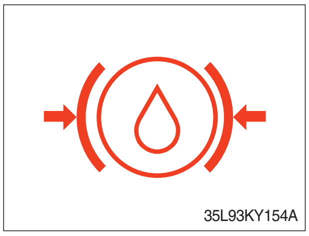
· This lamp lights ON when there is a problem with the forklift truck system, but the vehicle does not need to be stopped immediately.

(19) DEF (Diesel Exhaust Fluid) low warning lamp

· This warning lamp indicates, when illuminated or flashing, that the diesel exhaust fluid level is low.

※ Add the diesel exhaust fluid into DEF tank.

(20) Brake fail warning lamp

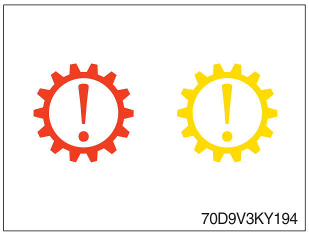


· The lamp lights ON when the oil pressure of service brake drops below the nomal range.

· When the lamp is ON, stop the engine and check for its cause.

※ Do not operate untill andy problems are corrected.

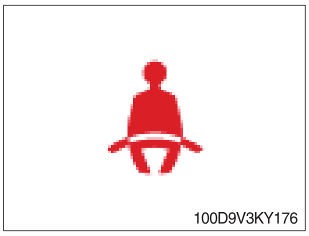
(21) Transmission warning lamp



· If the lamp lights on, check the transmission.

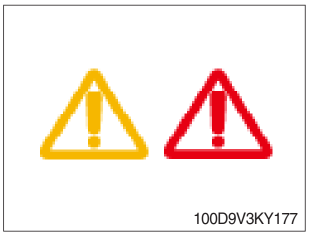
· If the red warning light is lit while driving, stop the engine and check the forklift.

(22) Seat belt reminder lamp



· This lamp will be blinked 5 times, after key on.
· If not wearing a seat belt, this reminder lamp will be displayed (option). (If driving over 4 km/h, it will be activated with buzzer)
※ If reminder lamp still displayed after wearing seat belt, Please check the seat belt wiring.

(23) FSCU warning lamp (option)



· If this warning light is lighted, check the failure code of FSCU. (with activating buzzer)
※ If the red warning light is lit while driving, stop the engine and check the forklift.

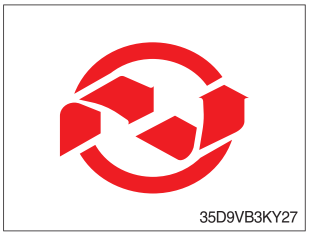
4) INDICATOR LAMPS

70D9V3KY36

※ Warning and indicator lamps will display only items that were set as ON, and all warning and indicator except turning indicator lamp and driving indicator lamp will be displayed in order from the left of screen.

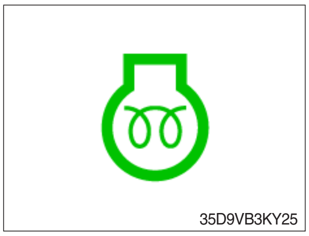
No.	Indicator lamp		No.	Indicator lamp	
1		Consumables management indicator lamp	8	N	Driving indicator lamp
2		Engine warning up indicator lamp	9	F F1 F2 F3	Driving indicator lamp
3		Fuel warmer indicator lamp	10	R R1 R2 R3	Driving indicator lamp
4	(P)	Parking brake indicator lamp	11	SIDE	Side mirror heated pilot lamp (option)
5	TILT LOCK	Tilt lock indicator lamp (if installed)	12		DrivingHigh beam indicator lamp
6	OP SS	OPSS indicator lamp	13	M A A1 A2	Shift mode indicator lamp
7		Driving turn lamp	14		Inching switch on indicator lamp

(1) Consumables management indicator lamp



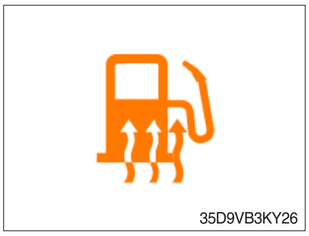
· Light up if consumables which must be replaced are exist.
· The indicator lamp will light up only 3 minutes since start switch ON, and then light OFF.
· Please check the consumables management list in maintenance menu.

(2) Engine warm-up indicator lamp



· The truck senses the engine coolant temperature and warms-up engine when needed.
· When it is happening, the indicator lamp is ON.

(3) Fuel warmer indicator lamp



· Light up when fuel warmer is operating. (Controlled by ECU)

(4) Parking brake indicator lamp

· Light up when parking brake is ON.

(5) Tilt lock indicator lamp (if installed)

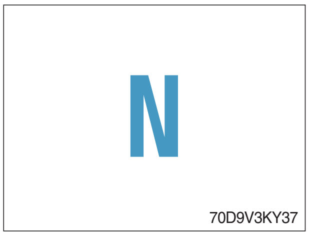
· The Indicator lamp will be lit up if the tilt lock switch (option) is entered.
· Tilt action will be limited if this Indicator lamp is lit up and the mast is located at 90 degrees.

(6) OPSS indicator lamp

· Light up if driver leave seat during operation.
· Truck driving and/or mast control will be blocked if lamp is lit up.
※ Please refer to page the operator manual 0-12 for details.

(7) Driving indicator lamp

① Neutral



· This indicator lamp will be lit up when gear selector lever is located in neutral.

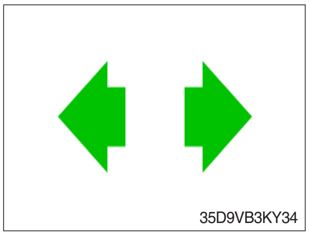
② Forward

· This indicator lamp will be lit up if the forward gear is selected.

③ Reverse

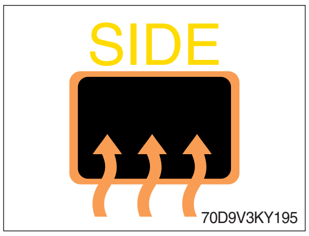
· This indicator lamp will be lit up if the reverse gear is selected.

(8) Driving turn lamp



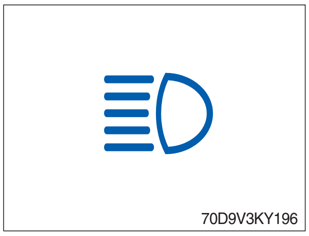
· This indicator lamp will flash if turns on the right or left turn signal.

(9) Side mirror heated indicator lamp (option)



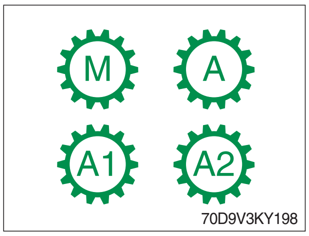
① When the heated mirror is operating, the lamp lights ON.

(10) High beam indicator lamp



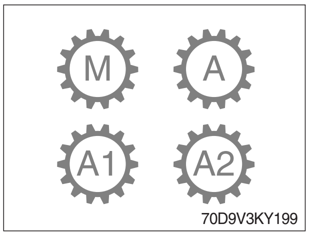
· This indicator is displayed when the vehicle's high beam is on.

(11) Shift mode indicator lamp 1



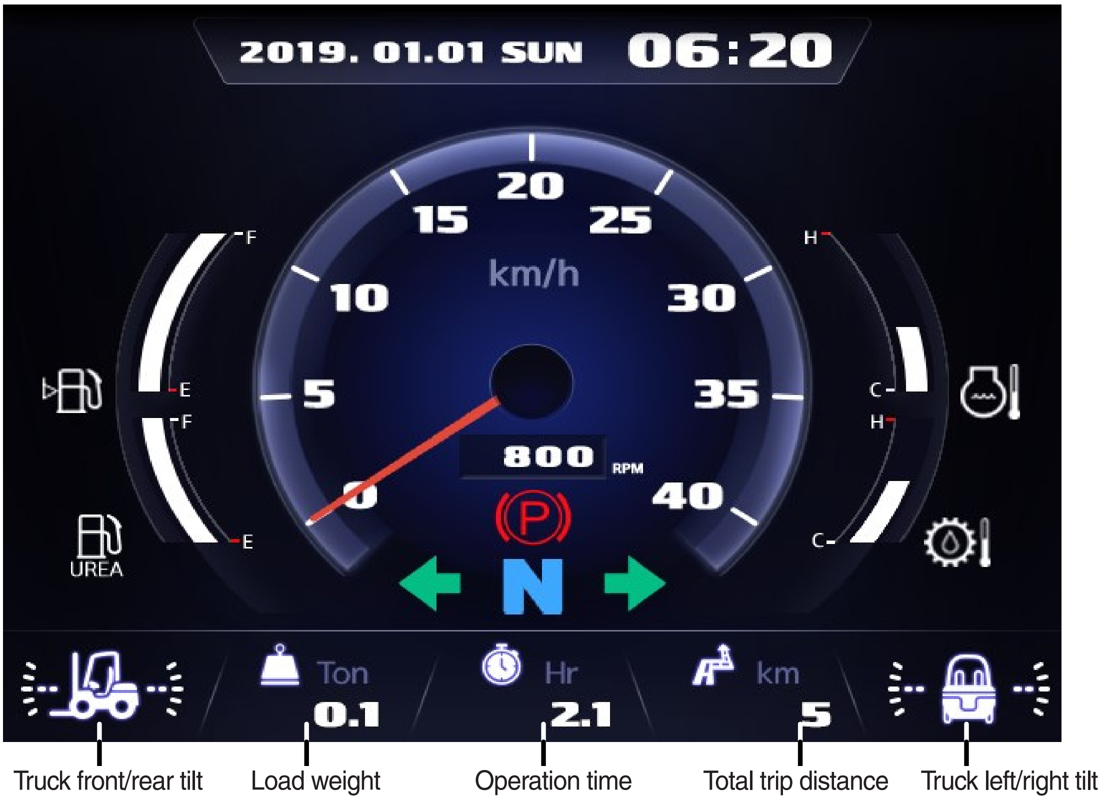
· This indicator shows the current vehicle's shift mode, A1 and A2 are indicated on vehicles with 2nd gear or higher.

(12) Shift mode indicator lamp 2



· This indicator shows the shift mode when activating the 2nd FNR, A1 and A2 are indicated on vehicles with 2nd gear or higher.

5) INFORMATION DISPLAY



70D9V3KY40

(1) Mast front/rear tilt


70D9V3KY41

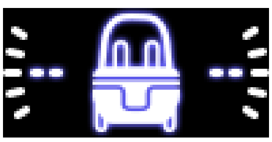
· Display the real time tilt of mast.

(2) Truck front/rear tilt


35D9VB3KY36

· Display the front and rear tilt of truck in real time.
· The red warning symbol turned on condition.
  - Stop : Tilt angle is higher than 2.3˚
  - Driving : Tilt angle is higher than 10.2˚

(3) Truck left/right tilt

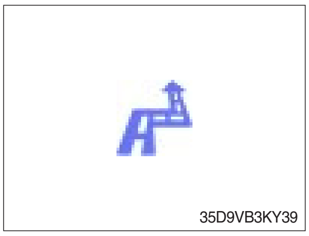

35D9VB3KY37

· Display the left and right tilt of truck in real time.
· The red warning symbol turned on condition.
  - Stop : Tilt angle is higher than 3.4˚
  - Driving : Tilt angle is higher than 28.0˚

(4) **Load weight** (option)

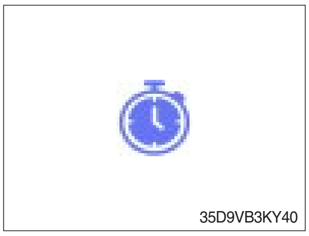
· Display the load weight.
· Screen will display blurry if the weight sensor has not been mounted.

(5) **Total trip distance**



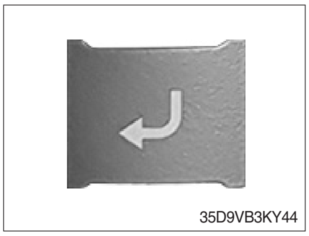
· Display total trip distance of the truck.
· Unit of distance is kilometer.

(6) **Operation time**



· Display the used time of the truck.

(7) **Explanation of warning lamp and indicator lamp**



· When warning lamp or indicator lamp comes on, please press the enter button to check detailed explanation.
· During pressing the enter button, it keeps the screen to be shown explanation for warning lamp or indicator.

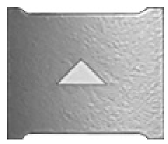
6) BUTTONS

(1) Camera

35D9VB3KY41

· This switch displays rear camera images. (if the camera is mounted)

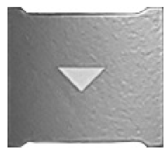
(2) UP/Left



35D9VB3KY42

· This switch is used to move upward or leftward in menu or increase the value.

(3) Down/Right



35D9VB3KY43

· This switch is used to move downward or rightward in menu or decrease the value.

(4) Enter (select)

35D9VB3KY44

· This switch is used to enter into the menu or to select.

(5) Cancel (ESC)

35D9VB3KY45

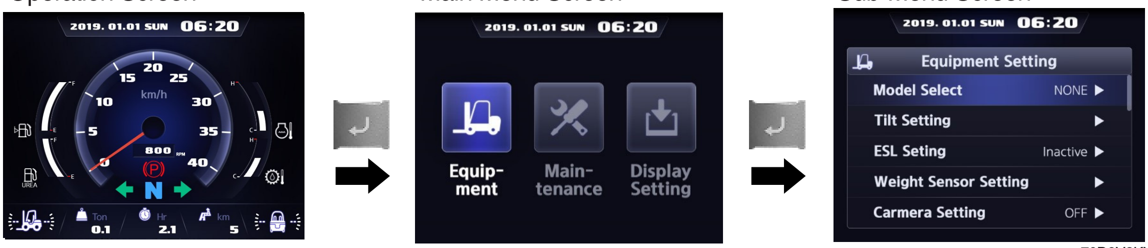
· This switch is used to cancel or move to upper menu.

7) MAIN MENU

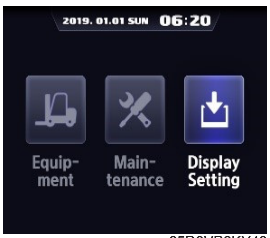
(1) Structure

Menus consist of main menu and sub-menu.

Operation Screen　　　Main Menu Screen　　　Sub-Menu Screen



70D9V3KY42

No.	Main menu screen	Sub menu	Explanation
1	 35D9VB3KY47	· Model select · Tilt setting · ESL setting · Weight sensor setting (option) · Camera setting (if installed) · Fingertips setting (option) · CSC setting (if installed) · Auto shift setting (if installed) · DCSR setting (if installed) · HAC setting (if installed) · Vehicle Max speed limit · Zero start setting (if installed) · Clutch protection beep (if installed) · ZF TCU calibration · Seat belt interlock (option) · Cluster-CI info	· Diesel, LPG · Truck tilt initialize · ESL setting, Engine start limit, Delay time · Enter the cylinder cross section area, Adjust load weight, Weight display setup · Reverse gear interworking · DCSR on, Cut-off driving speed, Restore driving speed · Maximum speed limitation · Cluster-CI information
2	 35D9VB3KY48	· Failure history · Consumables management · I/O inforamation	· Engine, Transmission failure history · Change oil and filter replacement cycle · Analog, Digital signal
3	 35D9VB3KY49	· LCD brightness adjustment · User setting · A/S phone No. · Password change · Consumables management	· Automatic, Manual · Time, Unit, Language · Change A/S contact · Engine starting password connect · Maintenance parts management

(2) Equipment menu

① Model Select (a required setting)

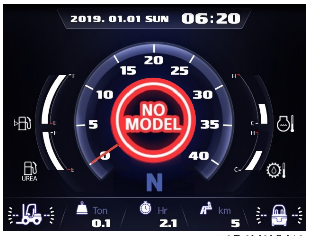
Check under the start switch ON status. Selection will be canceled if press the cancel button.

※ This is a required setting. Some functions may not be worked properly if you do not select the model.

※ If you want to move back to previous page, please enter ESC button in any stage.

※ It shall be selected right model to prevent malfunction of truck.

1. NO MODEL



70D9V3KY43

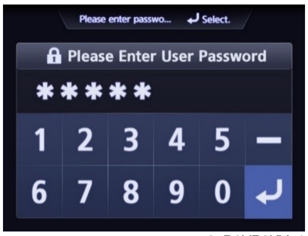
Select the your model.

2. Equipment

35D9VB3KY47

Enter to Equipment.

3. Password



35D9VB3KY51

Enter the password.
Default password is “00000”.
Password length must be 5~10 digits.

4. Model select

70D9V3KY54

Choose Model Select and enter.

5. Diesel or LPG

35D9VB3KY53

Please select the fuel type.

6. Truck weight

70D9V3KY44

Please select the truck weight level.

7. Truck model

70D9V3KY45

Please select the exact model name.

8. Confirm

70D9V3KY46

Confirm the model which you select.

9. Completion

70D9V3KY47

Model selection is completed.

10. Check

70D9V3KY48

Check the status which is not shown 'NO MODEL' in main display.

② Tilt Setting

a. Setting (Check under the start switch ON status.)

※ The tilt sensor has already been initialized when deliver the truck from factory.

※ Tilt reset if the tilt sensor figure or truck tilt is not horizontal in the flatland.

⚠ You must set tilt in the flatland since this is a horizontal set up.

※ If tilt sensor for mast is mounted (option), locates the mast vertically.

※ Mast maximum angle depends on the truck.

· Truck that has not applied the mast angle sensor

· Truck that has applied the mast angle sensor (option)

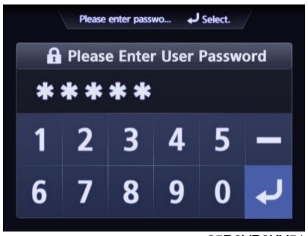
70D9V3KY49

1. Equipment

35D9VB3KY47

Enter to Equipment.

2. Password



35D9VB3KY51

Enter the password.

3. Tilt setting

70D9V3KY50

Choose Tilt Setting and enter.

4. Instruction

70D9V3KY51

Follow the instruction showing in the screen.

5. Completion

70D9V3KY52

Setting has been completed.

b. Check functions

a) Check the real time operation by changing angles of truck tilt and mast tilt.

b) Auto-leveling (if installed)

(a) Tilt mast forward or backward.

(b) Start tilting mast toward its vertical position, pushing the auto tilt leveling switch.

(c) Check if the mast stops traveling when it becomes vertical to ground.

c) Forward or backward truck tilt warning (red)

· Stop : ±2.3° (1.5 ~ 5 tons)

· Driving : ±10.2° (1.5 ~ 5 tons)

d) Left or right truck tilt warning (red)

· Stop : ±3.4˚ (1.5 ~ 5.0 tons)

· Driving

Truck weight	Warning angles (red)
1.5 ~ 2.0 tons	±20.3˚
2.2 ~ 3.3 tons	±20.8˚
3.5 ~ 4.5 tons	±24.2˚
5.0 tons ~	±28.0˚

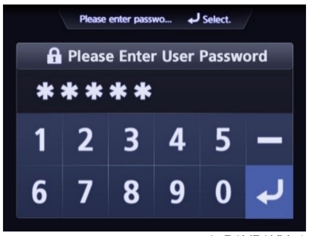
③ ESL (Engine Start Limit) Setting : Default is 'Inactive'

1. Equipment

35D9VB3KY47

Enter to Equipment.

2. Password



35D9VB3KY51

Enter the password.

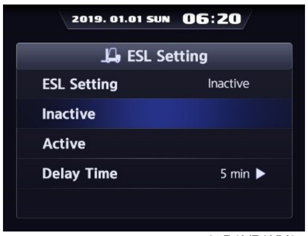
3. ELS Setting

70D9V3KY55

Choose ESL setting and enter.

a. Setting

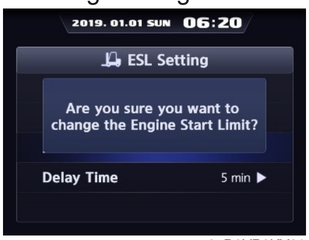
1. Inactive



35D9VB3KY85

Choose Inactive.

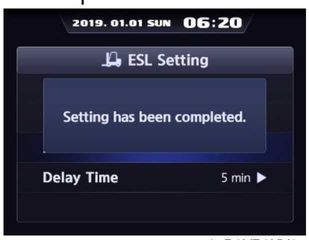
2. Change setting



35D9VB3KY86

If you want to change setting, press enter button.

3. Completion

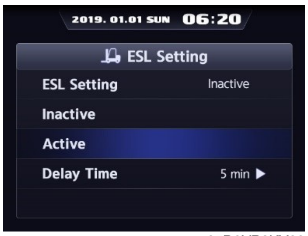


35D9VB3KY87

Setting has been completed.

b. Active

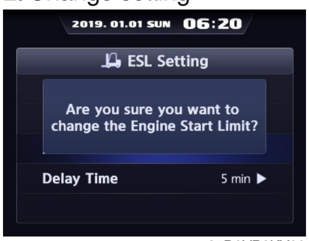
1. Active



35D9VB3KY88

Choose Active.

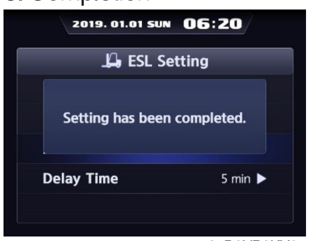
2. Change setting



35D9VB3KY89

If you want to change setting, press enter button.

3. Completion



35D9VB3KY87

Setting has been completed.

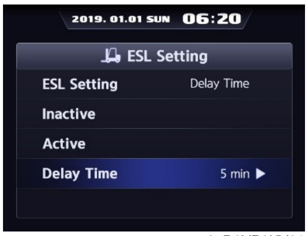
b. Check functions

(a) Set the mode as active and start switch OFF.
(b) Upon start switch ON, the password screen pops up and starting is prohibited until the right. password has been offered. (But, driver still can start the vehicle if starts within 10 seconds from start switch OFF)
(c) Set the mode as 5 min of delay time and start switch OFF.
(d) check if vehicle can start within 5 min and start switch OFF.
(e) check if vehicle requests password after 5 min.
※ Start switch ON screen (When startup control mode is ON)

35D9VB3KY90

c. Delay time

1. Delay time



35D9VB3KY91

Choose delay time.

2. Select value

35D9VB3KY92

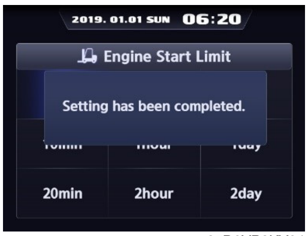
Select value you want to apply.

3. Change setting

35D9VB3KY93

If you are sure to change ESL, press enter.

4. Completion



35D9VB3KY94

Setting has been completed.

④ Weight Sensor Setting (option)

Check under the start switch ON status. There are three settings (unload, load, reset) for weight sensor.

※ The weight sensor has already been set when deliver the truck from factory.

a. Setting Cylinder Cross-Section

※ Cylinder cross-section value

unit : cm^2

Model	Mast type	V-mast	TS-mast
100D-9V	V300~500	113.49	141.76
	TS450~500		
	V550~600	141.76	190.07
	TS550~750		

· Truck that has not applied the weight sensor

· Truck that has applied the weight sensor (option)

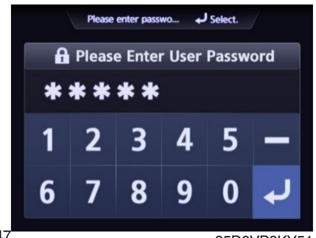
70D9V3KY53

1. Equipment

35D9VB3KY47

Enter to Equipment.

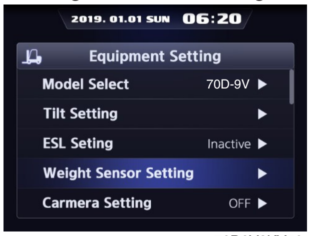
2. Password



35D9VB3KY51

Enter the password.

3. Weight Sensor Setting



70D9V3KY56

Choose Weight Sensor Setting and enter.

4. Cylinder Cross-Section

70D9V3KY57

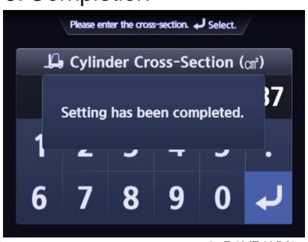
Choose Cylinder Cross-Section. If cylinder cross-section is already set up, setting value is shown in initial screen.

5. Value

35D9VB3KY66

Enter cylinder cross-section value using up or down buttons.

6. Completion



35D9VB3KY67

Setting has been completed.

7. Check

70D9V3KY58

Check the value whether it is right.

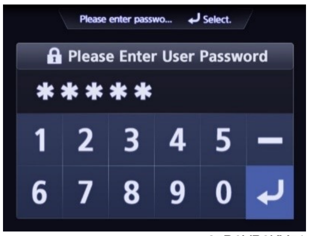
b. Unloaded status adjustment

1. Equipment

35D9VB3KY47

Enter to Equipment menu

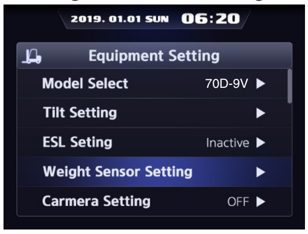
2. Password



35D9VB3KY51

Enter the password

3. Weight Sensor Setting



70D9V3KY56

Choose Weight Sensor Setting

4. Load Weight Adjustment

70D9V3KY59

Choose Load Weight Adjustment and enter.

5. Unloaded Status Adjustment

70D9V3KY60

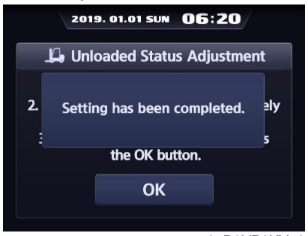
Choose Unloaded Status Adjustment and enter.

6. Instruction

35D9VB3KY71

Follow the instruction showing in the screen. After finish setting and press enter button

7. Completion



35D9VB3KY72

Setting has been completed.

c. Loaded status adjustment

※ Must be prepared to lift up by locating the load on the fork before enter the weight.

※ MCU (Main Control Unit) recognizes the weight automatically by detecting the pressure change.

※ Must be performed within 30 seconds of the lift task. If it is not completed within 30 seconds, this process will be canceled automatically.

※ Accurate weight value is not recognized if other pressure changes that are occurred besides salvage work.

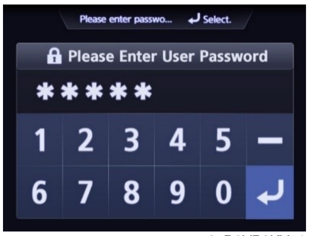
※ Perform again, if the measurement malfunction is occurred.

1. Equipment

35D9VB3KY47

Enter to Equipment menu

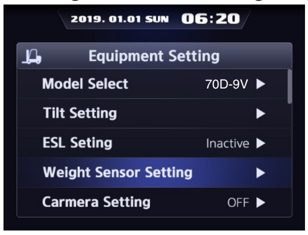
2. Password



35D9VB3KY51

Enter the password

3. Weight Sensor Setting



70D9V3KY56

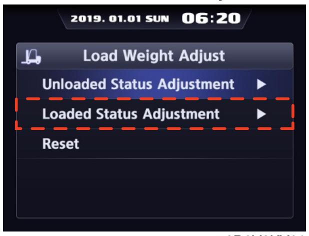
Choose Weight Sensor Setting

4. Load Weight Adjustment

70D9V3KY59

Choose Load Weight Adjustment and enter.

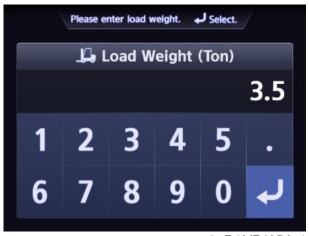
5. Loaded Status Adjustment



70D9V3KY61

Choose Load Weight Adjustment and enter.

6. Value



35D9VB3KY74

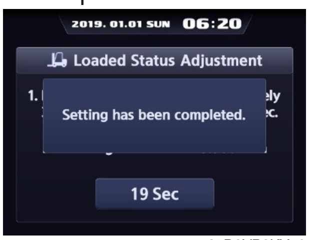
Enter load weight using up or down buttons.

7. Instruction

35D9VB3KY75

Follow the instruction showing in the screen. After finish setting and press enter button. Please proceed the operation within 30 seconds.

8. Completion



35D9VB3KY76

Setting has been completed.

d. Reset

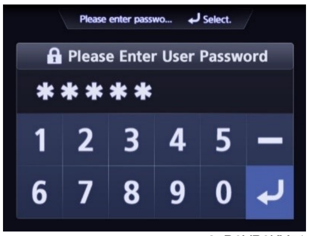
Initialize the all values of 'Unloaded and Loaded Status Adjustment' that were entered previously. (Cylinder cross-sectional area is not initialized.)

1. Equipment

35D9VB3KY47

Enter to Equipment menu

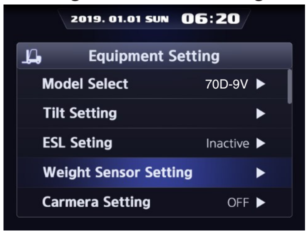
2. Password



35D9VB3KY51

Enter the password

3. Weight Sensor Setting



70D9V3KY56

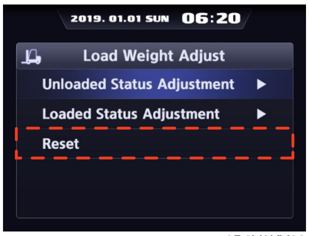
Choose Weight Sensor Setting

4. Load Weight Adjustment

70D9V3KY59

Choose Load Weight Adjustment and enter.

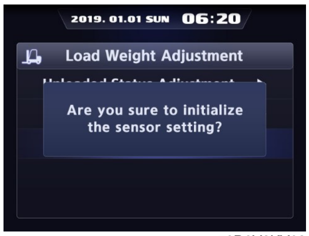
5. Reset



70D9V3KY62

Enter to Reset.

6. Check



70D9V3KY63

Press the enter button.

7. Completion

70D9V3KY64

Reset has been completed.

e. Weight Display Setting

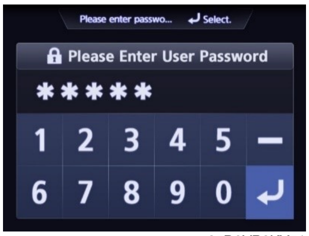
Enable to adjust the digit-number fo weight of main screen.

1. Equipment

35D9VB3KY47

Enter to Equipment menu

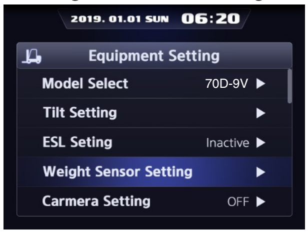
2. Password



35D9VB3KY51

Enter the password

3. Weight Sensor Setting



70D9V3KY56

Choose Weight Sensor Setting

4. Weight Display Setting

70D9V3KY65

Choose weight sensor setting and enter.

5. Unit

35D9VB3KY81

Choose unit what you want to use.

6. Completion

35D9VB3KY80

Setting has been completed.

· 100 kg unit

70D9V3KY66

· 10 kg unit

70D9V3KY67

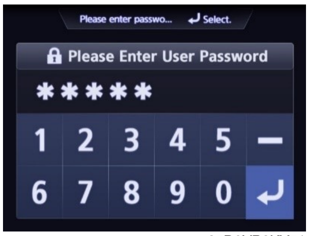
f. Overload Alarm

1. Equipment

35D9VB3KY47

Enter to Equipment menu

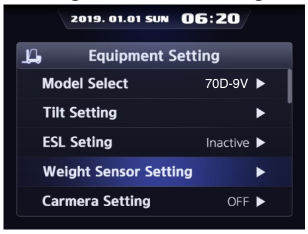
2. Password



35D9VB3KY51

Enter the password

3. Weight Sensor Setting



70D9V3KY56

Choose Weight Sensor Setting

4. Overload alarm

70D9V3KY68

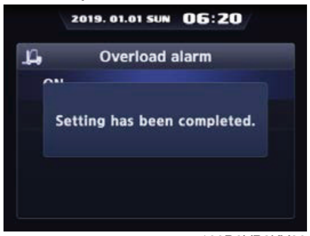
Enter to Overload alarm.

5. Select

35D9VB3KY81

Select ON or OFF.

6. Completion



100D9VB3KY80

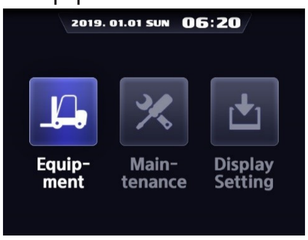
Setting has been completed.

⑤ Camera Setting (if installed)

· Device setup → Camera setup

· After set the reverse gear interoperation as ON, the screen will be changed from main screen to camera mode if put gear into reverse, and if the gear is changed, screen will be back to the main screen.

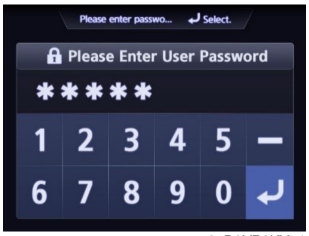
1. Equipment



35D9VB3KY47

Enter to Equipment.

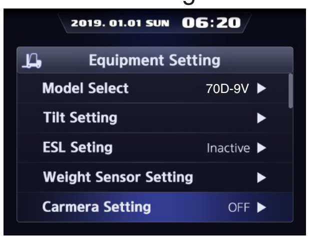
2. Password



35D9VB3KY51

Enter the password

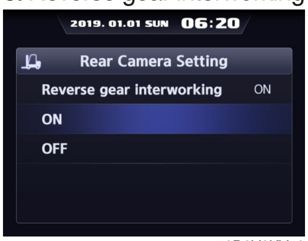
2. Camera Setting



70D9V3KY69

Choose Camera Setting and enter.

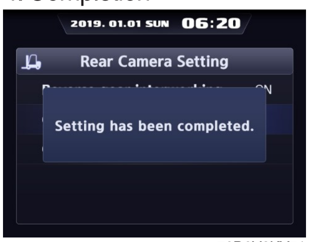
3. Reverse gear interworking



70D9V3KY70

Select ON or OFF.

4. Completion



70D9V3KY71

Setting has been completed.

35D9VB3KY98

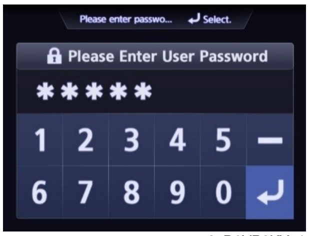
⑥ FingerTips Setting (option)

1. Equipment

35D9VB3KY47

Enter to Equipment.

2. Password



35D9VB3KY51

Enter the password

3. FingerTips Setting

70D9V3KY72

Choose FingerTips Setting and enter.

a. Lever Position Setting

1. Lever Position Setting

70D9V3KY73

Choose Lever Position Setting and Enter

2. Setting

70D9V3KY74

Set minimum and maximum value.

b. Lever Dead Zone Setting

1. Lever Dead Zone Setting

70D9V3KY75

Choose Lever Dead Zone Setting and enter.

2. Setting

70D9V3KY76

Set lever dead zone range.

c. Valve setting

3-3. Valve Setting

70D9V3KY77

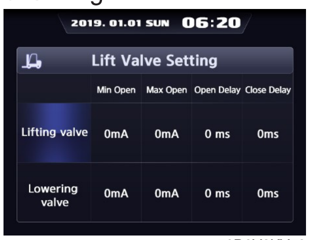
Choose Valve Setting and enter.

4. Lift Section Valve

70D9V3KY78

In the Valve Setting, you can set the lift, tilt, AUX1, or AUX2 section valves

5. Setting.



70D9V3KY79

For each valve value, you can adjust the current value and time on the above screen

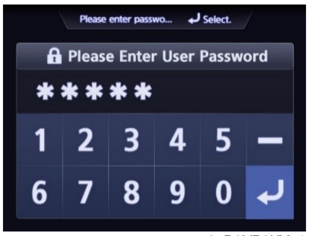
⑦ CSC (Curve Speed Control) Setting (if installed)

1. Equipment

35D9VB3KY47

Enter to Equipment.

2. Password



35D9VB3KY51

Enter the password

3. CSC Setting

70D9V3KY80

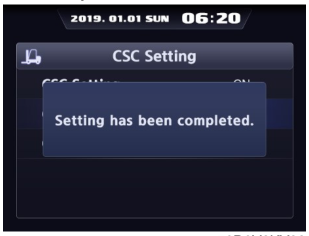
Choose CSC setting and enter.

4. Select

70D9V3KY81

Select ON or OFF.

5. Completion



70D9V3KY82

Setting has been completed.

⑧ Auto Shift Setting (if installed)

Enable to turn the function ON or OFF or change the shift speed.

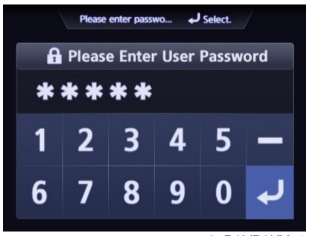
a. Mode Select

1. Equipment

35D9VB3KY47

Enter to Equipment.

2. Password



35D9VB3KY51

Enter the password

3. Auto Shift Setting

70D9V3KY83

Choose Auto Shift setting and enter.

4. Mode Select

70D9V3KY84

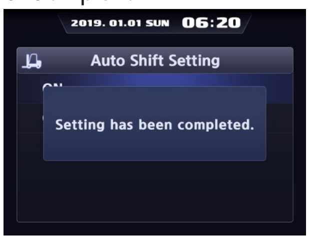
Choose Mode Select.

5. Select

70D9V3KY85

Select ON or OFF.

6. Completion



70D9V3KY86

Setting has been completed.

b. Speed Setting

· In case of 1st gear → 2nd gear, it is possible to set up to 7 ~ 10 km/h.

· In case of 2nd gear → 1st gear, it is possible to set up to 4 ~ 5 km/h.

※ Depending on the model, the function can be turned on/off only by an external switch.

3-2. Speed Setting

70D9V3KY87

Choose Speed Setting and enter.

4. Adjustment

70D9V3KY88

Change the speed value after selecting the shift point that needs to be changed

⑨ DCSR (Direction Change Shock Relief) setting (if installed)

· Set the mode ON. Below is how this feature functions.

· If you are driving at over the block drive speed and then change gear from forward to reverse (or reverse to forward), the gear stays as neutral until the truck reaches the restore drive speed.

· The truck changes direction and starts to travel.

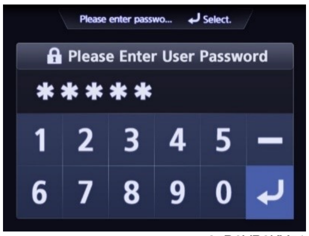
※ Restore drive speed can not be set over the block drive speed.

1. Equipment

35D9VB3KY47

Enter to Equipment.

2. Password



35D9VB3KY51

Enter the password

3. DCSR Setting

70D9V3KY89

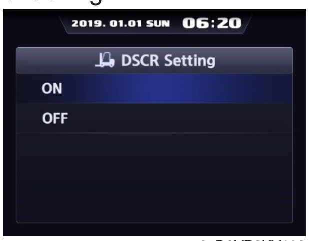
Choose DCSR setting and enter.

4. Mode Select

35D9VB3KY108

Select Mode Select.

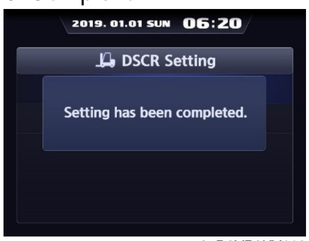
5. Setting



35D9VB3KY109

Select ON or OFF.

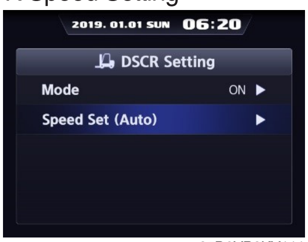
6. Completion



35D9VB3KY110

Setting has been completed.

7. Speed Setting



35D9VB3KY111

If you want to change speed setting, enter Speed Setting.

8. Drive Speed

35D9VB3KY112

Change speed.

⑩ HAC (Hill Assist Control) Setting (if installed)

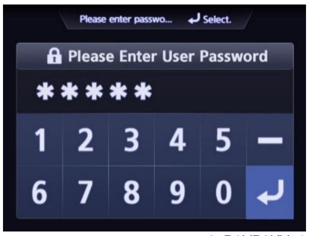
If you are trying to drive in stop status on the hill, the truck does not move backward when the HAC setting is ON.

1. Equipment

35D9VB3KY47

Enter to Equipment.

2. Password



35D9VB3KY51

Enter the password

3. HAC Setting

70D9V3KY90

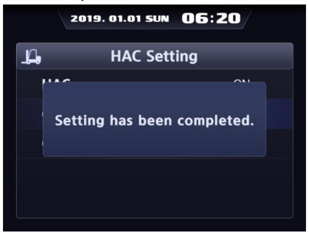
Choose DCSR setting and enter.

4. Select

70D9V3KY91

Select ON or OFF.

5. Completion



70D9V3KY92

Setting has been completed.

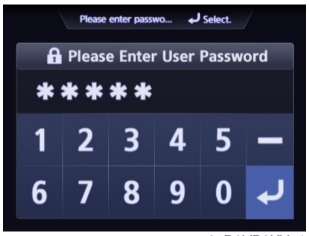
⑪ Vehicle Max Speed Limit

1. Equipment

35D9VB3KY47

Enter to Equipment.

2. Password



35D9VB3KY51

Enter the password

3. Vehicle Max Speed Limit

70D9V3KY93

Choose Vehicle Max Speed Limit and enter.

4. Mode

70D9V3KY94

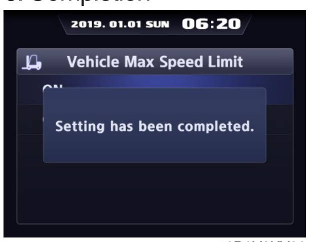
Enter to Mode.

5. Select

70D9V3KY95

Select ON or OFF.

6. Completion



70D9V3KY96

Setting has been completed.

· Limit speed : 10 km/h

70D9V3KY97

The truck does not exceed the limit speed.

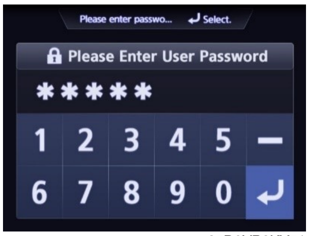
⑫ Zero Start Setting (if installed)

1. Equipment

35D9VB3KY47

Enter to Equipment.

2. Password



35D9VB3KY51

Enter the password

3. Zero Start Setting

70D9V3KY98

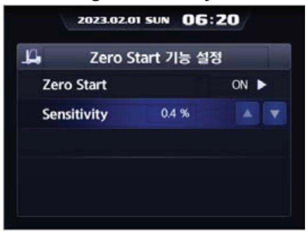
Choose Zero Start Setting and enter.

4. Select Sensitivity

100D9V3KY99

Select Sensitivity and pressthe enter.

5. Setting Sensitivity



100D9V3KY10

Change value using up/down button and press the enter

※ Default Sensitivity is 0.4% and it can be changed to maximum 4.8%

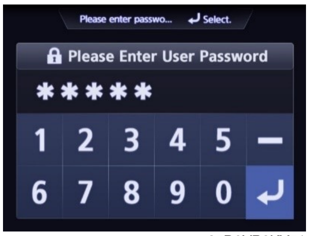
⑬ Clutch Protection Beep (if installed)

1. Equipment

35D9VB3KY47

Enter to Equipment.

2. Password



35D9VB3KY51

Enter the password

3. Clutch Protection Beep

70D9V3KY101

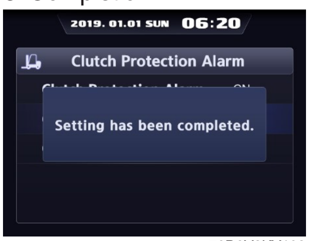
Choose Clutch Protection Beep and enter.

4. Select

70D9V3KY102

Select ON or OFF.

5. Completion



70D9V3KY103

Setting has been completed.

⑭ ZF TCU Calibration

Enable to calibrate the inching and clutch of the transmission.

※ Depending on the model, the initial conditions for calibration may be different or the procedure may be automatically skipped.

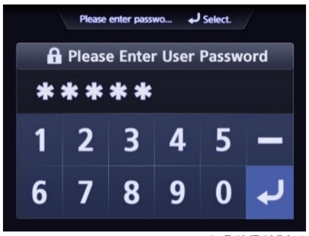
a. Inching Calibration

1. Equipment

35D9VB3KY47

Enter to Equipment.

2. Password



35D9VB3KY51

Enter the password

3. ZF TCU Calibration

70D9V3KY127

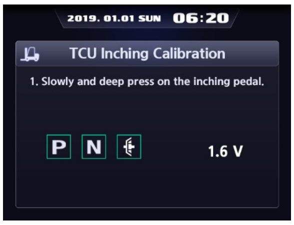
Choose ZF TCU Calibration and enter.

4. Prepare for Calibration

70D9V3KY128

Before starting calibration, turn on the parking switch, the gear neutral, and the inching switch off.

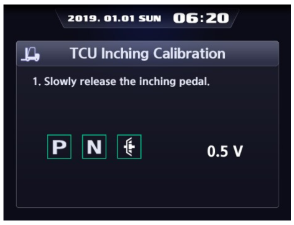
5. Calibration 1



70D9V3KY129

Fully press the inching pedal.

6. Calibration 2



70D9V3KY130

Take your foot off the inching pedal.

7. Calibration 3

70D9V3KY131

Confirm the completion of calibration and press the ESC button or OK button to exit to the menu

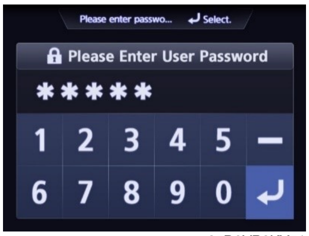
b. Clutch Calibration

2-1. ZF TCU Calibration

70D9V3KY127

Choose ZF TCU Calibration and enter.

2. Password



35D9VB3KY51

Enter the password

3. ZF TCU Calibration

70D9V3KY127

Choose ZF TCU Calibration and enter.

4. Prepare for Calibration

70D9V3KY185A

Before starting calibration, must be satisfied with 5 conditions.

※ Conditions

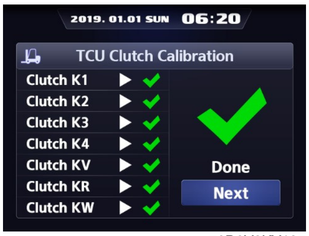
1) Engine RPM 800 to 1100
2) T/M temperature 60℃ to 90℃
3) Truck speed 0 km/h (stop)
4) Gear neutral
5) Parking swtich ON

5. Calibration 1

70D9V3KY186

Wait untill the next button is ON.

6. Calibration 1



70D9V3KY187

Enter the next button.

7. Calibration 2

70D9V3KY188

Confirm the completion of calibration and press the ESC button or OK button to exit to the menu

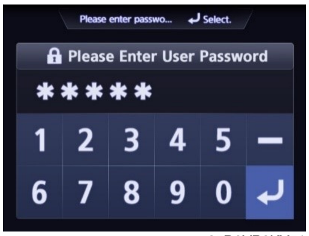
⑮ Seat Belt Interlock (option)

1. Equipment

35D9VB3KY47

Enter to Equipment.

2. Password



35D9VB3KY51

Enter the password (applied master password)

3. Seat Belt Interlock

70D9V3KY132

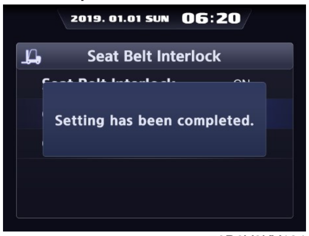
Choose Seat Belt Interlock and enter.

4. Select

70D9V3KY133

Select ON or OFF.

5. Completion



70D9V3KY134

Setting has been completed.

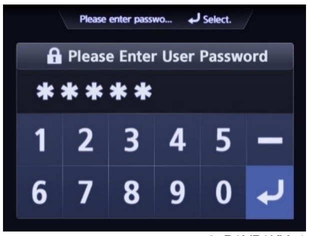
⑯ Cluster-CI

1. Equipment

35D9VB3KY47

Enter to Equipment.

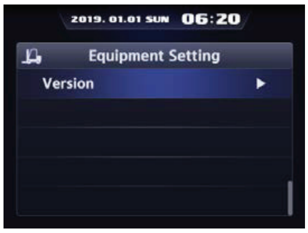
2. Password



35D9VB3KY51

Enter the password

3. Version



100D9V3KY136

Choose Version and enter.

4. Cluster-CI

70D9V3KY137

Choose Cluster-CI and enter.

5. Check Version

70D9V3KY138

(2) Maintenance

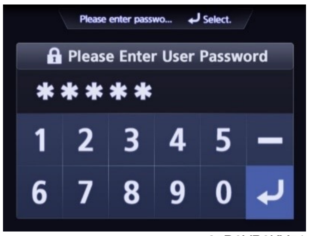
① Failure History

1. Maintenance

35D9VB3KY48

Enter to Maintenance.

2. Password



35D9VB3KY51

Enter the password

3. Failure History

70D9V3KY138

Choose Failure History and enter.

4. Engine or Transmission

70D9V3KY139

Choose what needs to check.

5. History

70D9V3KY140

6. Failure List

70D9V3KY141

② Consumables Management

- If the consumables replacement cycle has been passed, alarm will be displayed as ON.
- Press the 'Consumables replacement' if replaced the consumables.
- Information about recent replacement (maximum 9) will be displayed.
- If you want to change the cycle, please press the 'Change' button.

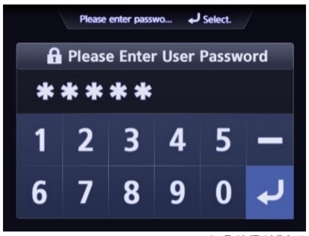
※ Refer to the operating manual page 7-12 about periodic replacement parts.

1. Maintenance

35D9VB3KY48

Enter to Maintenance.

2. Password



35D9VB3KY51

Enter the password

3. Consumables Mangement

70D9V3KY142

Choose Consumables Mangement and enter.

4. Select Replacement Item

70D9V3KY143

Select the replaced item.

5. Replacement History

70D9V3KY144

Select Replacement History.

6. Check.

70D9V3KY145

Check history.

7. Replacement

70D9V3KY146

Select Replacement.

8. Confirm

70D9V3KY147

Press enter button.

9. Change

70D9V3KY148

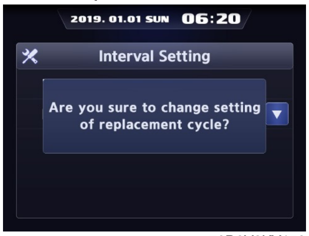
Select Change.

10. Setting Cycle

70D9V3KY149

Change properly the interval.

11. Completion



70D9V3KY150

Setting has been completed.

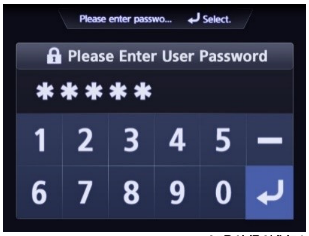
③ I/O Information

1. Maintenance

35D9VB3KY48

Enter to Maintenance.

2. Password



35D9VB3KY51

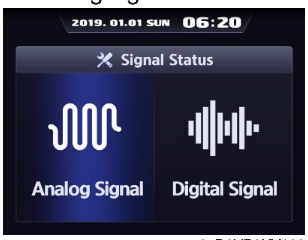
Enter the password

3. I/O Information

70D9V3KY151

Choose I/O Information and enter.

4. Analog signal



35D9VB3KY139

Enter to Analog Signal.

5. Analog signal list

70D9V3KY152

Check the analog signal list.

6. Digital signal

35D9VB3KY141

Enter to Digital Signal

7. Digital signal list

70D9V3KY153

Check the digital signal list.

(3) Display setting

① LCD Brightness Adjustment

- LCD brightness has two options. (Automatic and Manual modes)
- Manual mode always keeps the selected brightness.
- Brightness : Daytime 100%, Nighttime 50%
- Daytime/Nighttime time zone : 06 ~ 18

1. Display Setting

35D9VB3KY49

Enter to Display Setting.

2. LCD Brightness Adjustment

70D9V3KY154

Choose LCD Brightness Adjustment and enter.

3. LCD brightness

70D9V3KY155

Select Manual or Automatic.

4. LCD Brightness (Day/Night)

70D9V3KY156

Set day and night brightness in the manual mode.

5. LCD Brightness

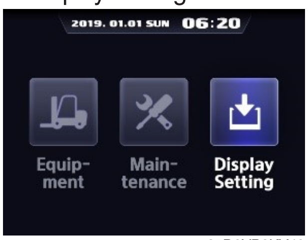
35D9VB3KY148

Set LCD brightness in the manual mode.

② User Setting

Enable to set time, unit, and language.

1. Display Setting



35D9VB3KY49

Enter to Display Setting.

2. User Setting

35D9VB3KY149

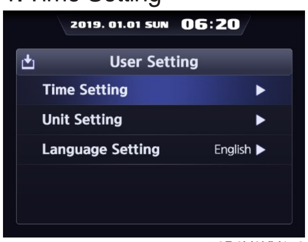
Choose User Setting and enter.

70D9V3KY158

Select Time Setting.

a. Time Setting

1. Time Setting



70D9V3KY158

Select Time Setting.

2. Setting

35D9VB3KY150

Set time.

b. Unit Setting

1. Unit Setting

70D9V3KY159

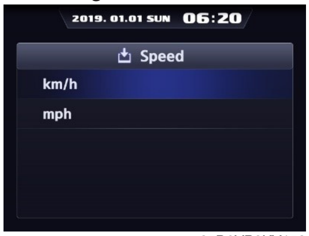
Select Unit Setting.

2. Unit Setting Litst

35D9VB3KY152

Enable to set the unit of speed, weight, temperature and pressure.

3. Setting



35D9VB3KY153

Set unit.

c. Language Setting

1. Language Setting

70D9V3KY160

Select Language Setting.

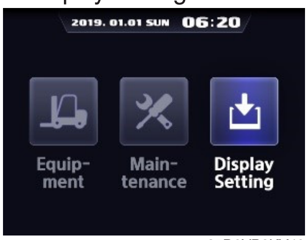
2. Setting

70D9V3KY161

Choose a language.

③ A/S Phone No.

1. Display Setting



35D9VB3KY49

Enter to Display Setting.

2. A/S Phone No.

70D9V3KY162

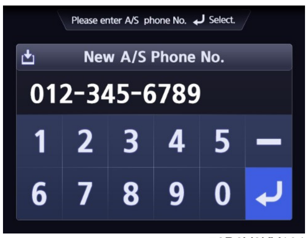
Choose A/S Phone No. and enter.

3. Change

70D9V3KY163

Select phone number if you want to change.

4. New A/S Phone No.



70D9V3KY164

Enter new phone number using up or down buttons and press the enter button.

5. Finish

70D9V3KY165

Contact will be displayed as the modified number.

④ Password Change.

- This function is to allow to change password from default password to user defined password.
- Password length must be 5~10 digits.

※ Since, if you forget the password, you must request the A/S, do not forget the password.

1. Display Setting

35D9VB3KY49

Enter to Display Setting.

2. Password Change

70D9V3KY166

Choose Password Change and enter.

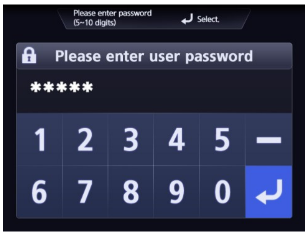
3. User Password Change

70D9V3KY167

Select User Password Change.

a. User Password Change

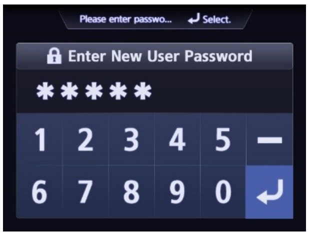
1. Current User Password



70D9V3KY168

Enter the current user passwrd.

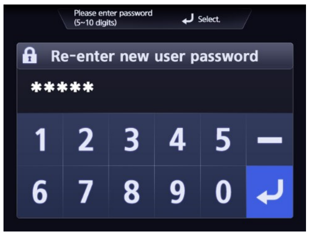
2. New User Password



35D9VB3KY144

Enter a new user password.

3. Re-enter

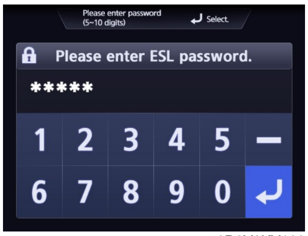


70D9V3KY169

Enter a new user password again.

b. ESL Password Change

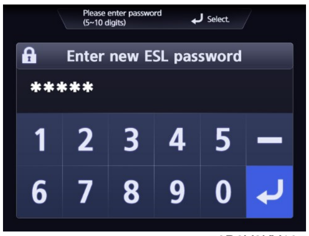
1. Current User Password



70D9V3KY166

Enter the current user password.

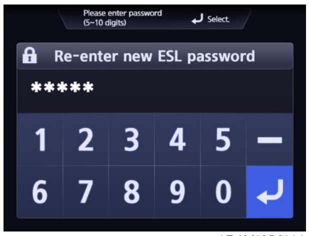
2. New User Password



70D9V3KY167

Enter a new user password.

3. Re-enter



70D9V3KY168

Enter a new user password again.

⑤ Consumables Management

1. Display Setting

35D9VB3KY49

Enter to Display Setting.

2. Conusmables Management

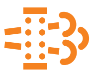
70D9V3KY174

Choose Consumables Man-
agement and enter.

3. List

70D9V3KY143

8) CAUSES AND CORRECTION OF CLUSTER WARNING LAMP

No.	Warning lamp types	Symbol	Warning and indicator lamp	Causes and correction
1	Engine oil pressure warning		Engine oil pressure warning lamp	Engine oil pressure is low. Please fill the engine oil
2	Engine warm-up indicator		Engine warm-up indicator lamp	Warm-up will be started.
3	Air cleaner warning		Air cleaner warning lamp	Replace the air cleaner filter.
4	Water in fuel warning		Water in fuel warning lamp	Please drain the water of the fuel filter.
5	Engine check warning		Engine check warning lamp	Check the failure code of cluster.
6	Engine stop warning		Engine stop warning lamp	Check the failure code of cluster.
7	Exhaust system cleaning warning		Exhaust system cleaning warning lamp	Exhaust system cleaning is required
8	Exhaust system cleaning inhibit warning		Exhaust system cleaning inhibit warning lamp	Exhaust system cleaning is inhibited
9	HEST warning		HEST warning lamp	High exhaust system temperature will be started.
10	Fuel warmer indicator		Fuel warmer indicator lamp	Warming up the fuel.
11	Transmission oil temperature warning		Transmission oil temperature warning lamp	T/M oil is over temperature condition. 110 ℃ (230 ˚F) or higher : Amber 120 ℃ (248 ˚F) or higher : Red
12	Parking brake indicator		Parking brake indicator lamp	Parking brake is the operational status.

No.	Warning lamp types	Symbol	Warning and indicator lamp	Causes and correction
13	Battery charging warning		Battery charging warning lamp	Battery is not being charged. Please check alternator and wiring.
14	Tilt lock indicator (if installed)	TILT LOCK	Tilt lock indicator lamp	Auto-leveling is the operational status.
15	OPSS indicator	OP SS	OPSS indicator lamp	OPSS is working : Driving, lifting, and tilting is locked or the truck is parked status.
16	Fuel level warning		Fuel level warning lamp	Fuel level is low. Please fill the fuel.
17	Coolant temperature warning		Engine coolant temperature warning lamp	Engine coolant is over temperature condition.
18	Clutch protection warning		Clutch protection warming lamp	Clutch protection warning operation
19	Consumables replacement indicator		Consumables replacement indicator lamp	Consumables replacement cycle has been passed.
20	LH Turn indicator		LH Turning indicator lamp	-
21	RH Turn indicator		RH Turning indicator lamp	-
22	Forward gear	F F1 F2 F3	Forward gear, 1 gear, 2 gear, and 3 gear indicator lamp	-
23	Reverse gear	R R1 R2 R3	Reverse gear, 1 gear, 2 gear, and 3 gear indicator lamp	-
24	Communication error warning (ECU)	COMM ERROR Cluster-CI ↔ ECU	Communication error warning lamp	Communication between cluster-CI and ECU has been failed. Check communication line.
25	Communication error warning (FSCU)	COMM ERROR Cluster-CI ↔ TCU	Communication error warning lamp	Communication between cluster-CI and FSCU has been failed. Check communication line.
26	DEF low warning	UREA	DEF low warning lamp	DEF levle is low. Please fill the DEF.
27	Brake fail warning		Brake fail warning lamp	Stop the engine and check for its cause.
28	Side mirror heated indicator	SIDE	Side mirror heated pilot lamp	Side mirror heated operation
29	Seat belt reminder		Seat belt reminder lamp	Please wear seat belt

GROUP 4 COMPONENT SPECIFICATION

No	Part name	Qty	Specification
1	Battery	2	24 V×80 AH RC : 190 min CCA : 850 A
2	LED work lamp	2	12~24 V, 20~27 W
3	License lamp (opt)	1	24 V, 5 W
4	LED rear combination lamp	2	24 V, LED (turn signal, tail, stop)
5	LED head and turn lamp	2	24 V, 26 W (high and low), 18 W (low) 24 V, 2.4 W (turn)
6	Room lamp	1	24 V, 10 W
7	LED beacon lamp (opt)	1	12~24 V, Max. 0.96 A
8	Radio and USB player	1	12~32 V, 20 W×2
9	Cluster	1	12 V / 24 V
10	Rear view camera	1	6~32 V, 1.4 W
11	12V socket	1	12 V, 10 A
12	Relay (5P)	7	24 V, 20 A
13	Flasher unit	1	24 V, 85±10 C/M, (23 W+23 W)×2+3 W×2
14	Back buzzer	1	24 V, 90±5 dB, 60±10 C/M, 300 mA
15	Warning buzzer	1	24 V, 85±5 dB, 120±20 C/M, 50 mA
16	Horn	1	24 V, 100~115 dB, 3.5A
17	Intermittent wiper relay	1	9~16 V, 2.5 A (rated), operating time : 4.5±1 sec
18	Fuel level sender	1	Float indicator: Empty / 7/14 / Full Resistance (Ω): EC / 350 / 50 Tolerance (Ω): ±(R×1.5 %+1 Ω)
19	Start switch	1	24 V, 60 A
20	Parking brake switch	1	24 V, 20 A
21	Main light switch	1	24 V, 15 A
22	Auto shift switch	1	24 V, 20 A
23	Power switch	1	24 V, 20 A
24	Inhching switch	1	24 V, 20 A
25	In/decrement switch	1	24 V, 20 A
26	Rear wiper and washer switch	1	24 V, 20 A
27	Exhaust system cleaning switch	1	24 V, 20 A
28	Rear work lamp switch (opt)	1	24 V, 20 A
29	Hazard switch (opt)	1	24 V, 20 A
30	Top wiper/washer switch (opt)	1	24 V, 20 A
31	Multi function switch	1	24 V, 2 A
32	Gear selector switch	1	24 V, 3.5 A
33	Master switch (opt)	1	6~36 V, 180 A
34	Cabin tilt switch	1	24 V, 20 A

GROUP 5 CONNECTOR DESTINATION

Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CN-3	KET	1	I/conn (frame-main harness)	-	MG650943-5
CN-4	AMP/KET	3	I/conn (frame-main harness)	MG642292	MG652290
CN-6	AMP	15	Aircon harness	2-85262-1	-
CN-7	-	4	Fuel heater	-	-
CN-12	AMP	26	I/conn (main-satety harness)	1897009-2	1897013-2
CN-13	AMP	42	I/conn (main-frame harness)	936421	936429
CN-13	KET	12	I/conn (main-satety harness)	MG610346	MG640348
CN-14	AMP	42	I/conn (frame-main harness)	936421	936429
CN-15	RINGTERM	-	ECM earth	-	-
CN-16	KET	8	I/conn (frame-main harness)	MG610339	-
CN-17	AMP	3	I/conn (frame harness-load sensor)	174357-2	174359-2
CN-19	KET	2	Outpu check	MG610320	MG642552
CN-21	DEUTSCH	8	Front wiper	DT06-8S	-
CN-23	-	2	Speaker (LH)	MG610070	-
CN-24	-	2	Speaker (RH)	MG610070	-
CN-25	MOLEX	2	Horn	35825-0211	-
CN-27	-	16	Radio and USB player	PK145-16017	-
CN-29	-	2	Receiver dryer	MG640795	-
CN-30	KUM	1	Aircon compressor	PB625-01027	-
CN-31	AMP	15	I/conn (main-aircon harness)	2-85262-1	-
CN-37	QPL	-	Fuse box main assy	21HN-55010	-
CN-37	-	4	Fingertip-gear selector	-	-
CN-45	HCE	1	Start motor (B+)	S820-308000	-
CN-50A	AMP	46	TCU	1-2112231-1	-
CN-50B	AMP	21	TCU	1-1534127-1	-
CN-56	MOLEX	73	Cluster CI	34566-0103	-
CN-57A	MOLEX	4	Monitor power	-	52213-0417
CN-57B	MOLEX	4	Monitor sig	-	52266-0417
CN-57C	MOLEX	2	Monitor trigger	-	52266-0211
CN-58A	DAEDONG	3	User authenfication power	110-3PR	-
CN-58B	DAEDONG	2	User authenfication CAN	110-2PR	-
CN-65	KET	1	Backup buzzer	ST730018-3	ST750036-2
CN-70	-	4	Top wiper motor	180900	-
CN-71	KET	2	Pakring solenoid	MG610320	-
CN-71	DEUTSCH	6	Seat switch	DT06-6S	21HN-52080
CN-83	-	2	Condenser fan	PB625-02027	-
CN-90	AMP	36	I/conn (main-cabin harness)	1743059-2	1743062-2
CN-91	AMP	6	I/conn (main-monitor harness)	174262-2	174264-2

Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CN-92	AMP	6	I/conn (monitor-main harness)	174262-2	174264-2
CN-98	DEUTSCH	3	Resistor	DT06-3S-EP06	DT04-3S-EP10
CN-102	-	4	Rear wiper motor	180900	-
CN-113	KET	2	Warning buzzer	MG610320	-
CN-125	-	1	ORBCOMM	-	TNC-C-58
CN-125	DEUTSCH/-	12/1	I/conn (cabin harness-RMCU)	DT06-12S	TNJ-C-58
CN-125	-	1	I/conn (cabin harness-GPS)	-	SMA-C-316R/V
CN-130	AMP	6	I/conn (Main-gear selector harness)	174262-2	174264-2
CN-131	KET	2	Attach cut solenoid	MG610320	-
CN-134	MOLEX	16	Diagnosis	51115-1601	-
CN-135	DEUTSCH	9	ECU service	HD10-9-1939P	-
CN-136	AMP	4	RMCU service	174257-2	-
CN-138	KET	3	Converter	MG610045	-
CN-139	KET	2	Socket (12 V)	MG610043	-
CN-144	AMP	6	Accel pedal	174262-2	-
CN-147	KET	2	Cabin tilt relay switch	MG640188-4	-
CN-151	AMP	96	Engine	-	-
CN-155	DEUTSCH	2	Pump EPPR valve	DT06-2S	DT04-2P
CN-180	AMP	2	KV solenoid	12162198	-
CN-181	AMP	2	KR solenoid	12162198	-
CN-182	AMP	2	KD solenoid	12162198	-
CN-183	AMP	2	KE solenoid	12162198	-
CN-184	AMP	2	KC solenoid	12162198	-
CN-191	AMP	4	I/conn (frame harness-G sensor)	174257-2	174259-2
CN-202	KET	2	Washer pump-top	MG640605	-
CN-202	KET	2	Washer pump-rear	MG640605	-
CN-229	AMP	2	USB charger	172684-2	-
CN-249	-	4	Rear view camera	174257-2	174259-2
CN-251	-	1	RMS antenna (ORBCOMM)	FME J1505-58	-
CN-251	-	1	RMS antenna (GPS)	-	FME P1505-316
CN-252	-	1	RMS antenna (ORBCOMM)	TNJ-C-58	TNC-C-58
CN-253	-	1	RMS antenna (GPS)	SMJ-C-316R/V	SMA-C-316R/V
CN-412	AMP	6	I/conn (armrest-main harness)	174262-2	174264-2
CN-413	AMP	6	I/conn (main-armrest harness)	174262-2	174264-2
CN-417	AMP	8	I/conn (main-MCV finger tip harness)	174982-2	174984-2
CN-930	KET	20	HVAC ext harness	MG614119	-
CN-935	KET	16	HVAC ext harness	MG614120	-
CN-940	AMP	13	HVAC ext harness	-	172508-1
CN-945	AMP	17	HVAC ext harness	-	172509-1

Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
· Switch					
CS-2	KET	2	Start switch	MG610281	MG620282
CS-3	CARLING	10	Rear wiper switch	21HN-56300	-
CS-5	KET	2	Center horn	-	MG640322
CS-5A	KET	2	Center horn	MG610320	-
CS-5B	KET	1	Center horn	-	S820-105000
CS-10	CARLING	10	Fuel warmer switch	21HN-56300	-
CS-11	KET	8	Multi function switch	MG610339	-
CS-12	KET	6	Multi function switch	MG610335	-
CS-13	DEUTSCH	18	Gear selector switch	DT16-18SA-K004	-
CS-15	KET	1	Multi function switch	ST730018-3	-
CS-17	CARLING	10	Parking brake switch	21HN-56300	-
CS-21	CARLING	10	Work lamp switch	21HN-56300	-
CS-39	CARLING	10	Main light switch	21HN-56300	-
CS-41	CARLING	10	Hazard switch	21HN-56300	-
CS-42	CARLING	10	Inching switch	21HN-56300	-
CS-59	CARLING	10	Auto shift switch	21HN-56300	-
CS-64	CARLING	10	In/decrement switch	21HN-56300	-
CS-74	DEUTSCH	4	Tilt switch	-	DT04-4P
CS-74	CARLING	10	Mirror heater switch	21HN-56300	-
CS-77	CARLING	10	Cabin tilt switch	21HN-56300	-
CS-79	CARLING	10	Power/standard switch	21HN-56300	-
CS-100	CARLING	10	Regen & inhibit switch	21HN-56300	-
CS-103	CARLING	10	Top wiper/washer switch	21HN-56300	-
· Lamp					
CL-1	-	2	Room lamp (LH)	MG610392	-
CL-3	-	6	Head lamp (LH)	HP285-06021	-
CL-4	-	6	Head lamp (RH)	HP285-06021	-
CL-7	-	2	Beacon lamp	DT06-2S	DT04-2P
CL-15A	AMP	4	Turn/Stop/Tail lamp (black)	184050-1	-
Cl-15B	AMP	4	Backup/Stop/Tail lamp (gray)	184050-2	-
CL-16A	AMP	4	Turn/Stop/Tail lamp (black)	184050-1	-
Cl-16B	AMP	4	Backup/Stop/Tail lamp (gray)	184050-2	-
CL-21	KET	1	License lamp	ST730018-3	ST750036-2
CL-22	-	2	Rear work lamp (LH)	DT06-2S	-
CL-23	-	2	Rear work lamp (RH)	DT06-2S	-
CL-51	-	2	Room lamp (RH)	MG610392	-
· Relay					
CR-6	KET	4	INT wiper relay	MG610047	-
CR-11	TYCO	3	Flsher unit relay	21LM-01600	-

Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CR-15	-	5	Neutral signal relay	-	-
CR-24	FCI	6	Glow controller relay	F162210	-
CR-34	HELLA	5	Travel cut relay	8JA003526-001	-
CR-35	HELLA	5	Back up relay	8JA003526-001	-
CR-44	AMP	2	Cabin tilt relay coil relay	174352-2	-
CR-51	HELLA	5	Attach cut relay	8JA003526-001	-
CR-58	HELLA	5	DPF supply module relay	8JA003526-001	-
CR-59	HELLA	5	DPF sensor relay	8JA003526-001	-
CR-71	HELLA	5	Cab tilt safety relay	8JA003526-001	-
CR-72	HELLA	5	Mirror heater relay	8JA003526-001	-
· Sensor and pressure switch					
CD-2	KET	3	Fuel sender	MG610045	-
CD-3	DEUTSCH	3	Brake fail pressure switch	DT06-3S	-
CD-4	AMP	1	Brake switch	171809-2	-
CD-5	DEUTSCH	4	Hydraulic pressure and temperature sensor	DT06-4S	-
CD-6	DEUTSCH	4	G-sensor	DT06-4S	-
CD-10	KET	1	Air cleaner switch	ST730057-2	-
CD-17	AMP	2	Speed pickup-engine	1-1418483-1	-
CD-25	AMP	2	Filter switch	282080-1	-
CD-26	DEUTSCH	3	Parking switch (PS1)	DT06-3S	-
CD-27	AMP	2	Speed pickup-turbine	1-1418483-1	-
CD-29	AMP	2	Sump temperature sensor	963040-3	-
CD-38	AMP	3	Water in fuel sensor	-	936292-2
CD-39	AMP	2	Speed pickup-internal	1-1418483-1	-
CD-40	AMP	2	Speed output	1-1418483-1	-
CD-40	DEUTSCH	4	Fingertip-Lift	-	-
CD-41	DEUTSCH	4	Fingertip-Tilt	-	-
CD-42	DEUTSCH	4	Fingertip-Aux 1	-	-
CD-43	DEUTSCH	4	Fingertip-Aux 2	-	-
CD-60	AMP	2	Thermo switch	282080-1	-
CD-70	DEUTSCH	3	Load sensor	DT06-3S	-
CD-71	DELPHI	6	Inching sensor	12110293	-
CD-91	AMP	2	After temperature sensor	963040-3	-
CD-102	DEUTSCH	4	TBAP sensor	-	-
JC-1	KET	14	Joint connector	MG610754	-
JC-1	AMP	36	Joint connector	-	1743062-2
· MCV (fingertip, option)					
CN-60	AMP	35	Valve controller unit	776164-1	-
CN-61	-	35	Sub controller	-	-
CN-98	DEUTSCH/QPL	3	Resistor	DT06-3S-EP06	DT04-3P

Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CN-155	KET	6	Diagnosis connector	MG610335	MG642554
CN-M1	DEUTSCH	2	Lift down	963040-3	-
CN-M2	DEUTSCH	2	Lift up	963040-3	-
CN-M3	DEUTSCH	2	Tilt out	963040-3	-
CN-M4	DEUTSCH	2	Tilt in	963040-3	-
CN-M5	DEUTSCH	2	Aux 1 in	963040-3	-
CN-M6	DEUTSCH	2	Aux 1 out	963040-3	-
CN-M7	DEUTSCH	2	Aux 2 in	963040-3	-
CN-M8	DEUTSCH	2	Aux 2 out	963040-3	-

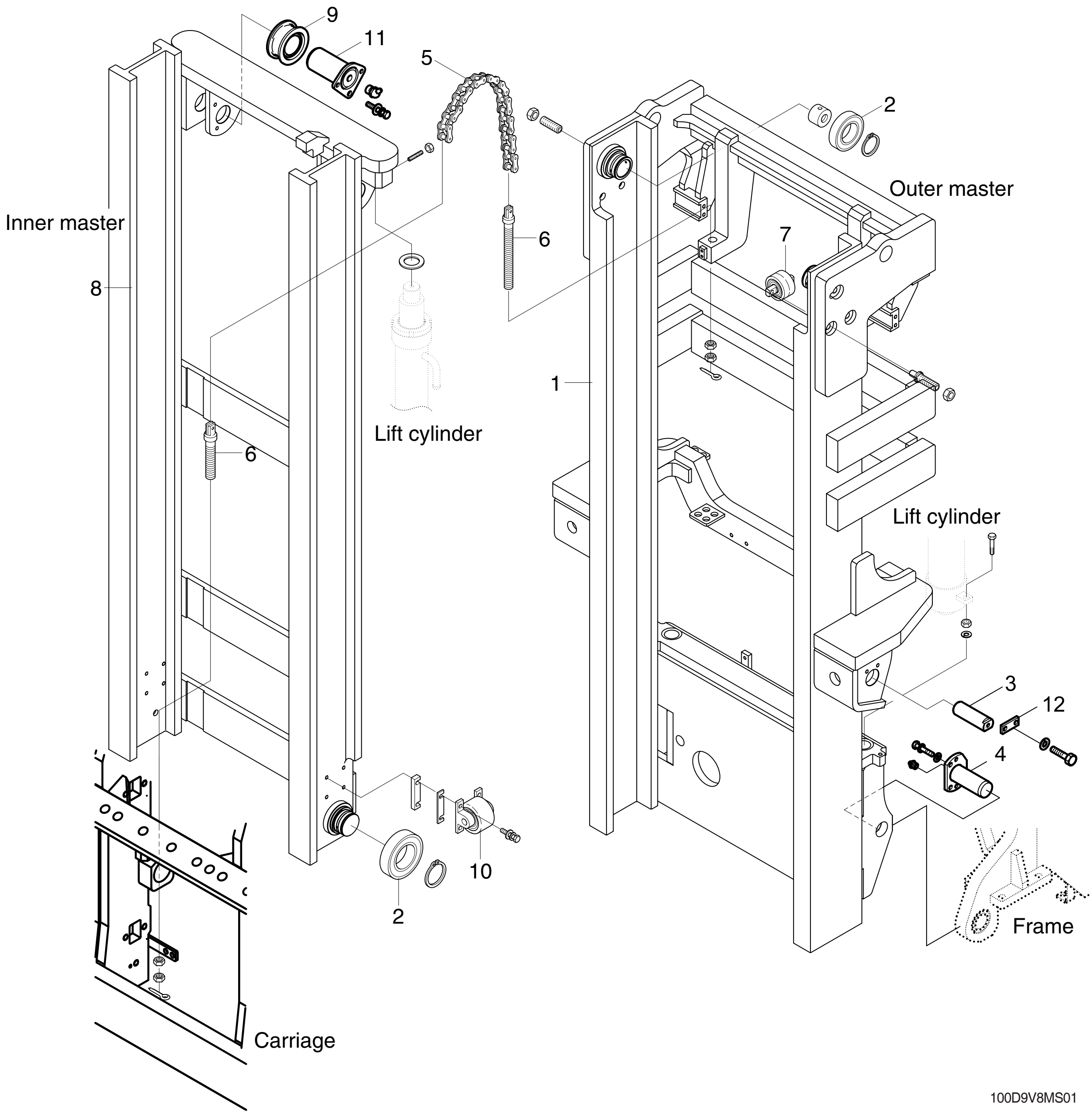
GROUP 6 TROUBLESHOOTING

Trouble symptom	Probable cause	Remedy
Lamps dimming even at maximum engine speed.	· Faulty wiring.	· Check for loose terminal and disconnected wire.
Lamps flicker during engine operation.	· Improper belt tension.	· Adjust belt tension.
Charge lamp does not light during normal engine operation.	· Charge lamp defective. · Faulty wiring.	· Replace. · Check and repair.
Alternator makes abnormal sounds.	· Alternator defective.	· Replace.
Starting motor fails to run.	· Faulty wiring. · Insufficient battery voltage.	· Check and repair. · Recharge battery.
Starting motor pinion repeats going in and out.	· Insufficient battery voltage.	· Recharge battery.
Excessively low starting motor speed.	· Insufficient battery voltage. · Starting motor defective.	· Recharge battery. · Replace
Starting motor comes to a stop before engine starts up.	· Faulty wiring. · Insufficient battery voltage.	· Recharge battery. · Replace
Heater signal does not become red.	· Faulty wiring. · Glow plug damaged.	· Check and repair. · Replace
Engine oil pressure caution lamp does not light when enigne is stopped (with starting switch left in "ON" position).	· Caution lamp defective. · Caution lamp switch defective.	· Replace · Replace

SECTION 8 MAST

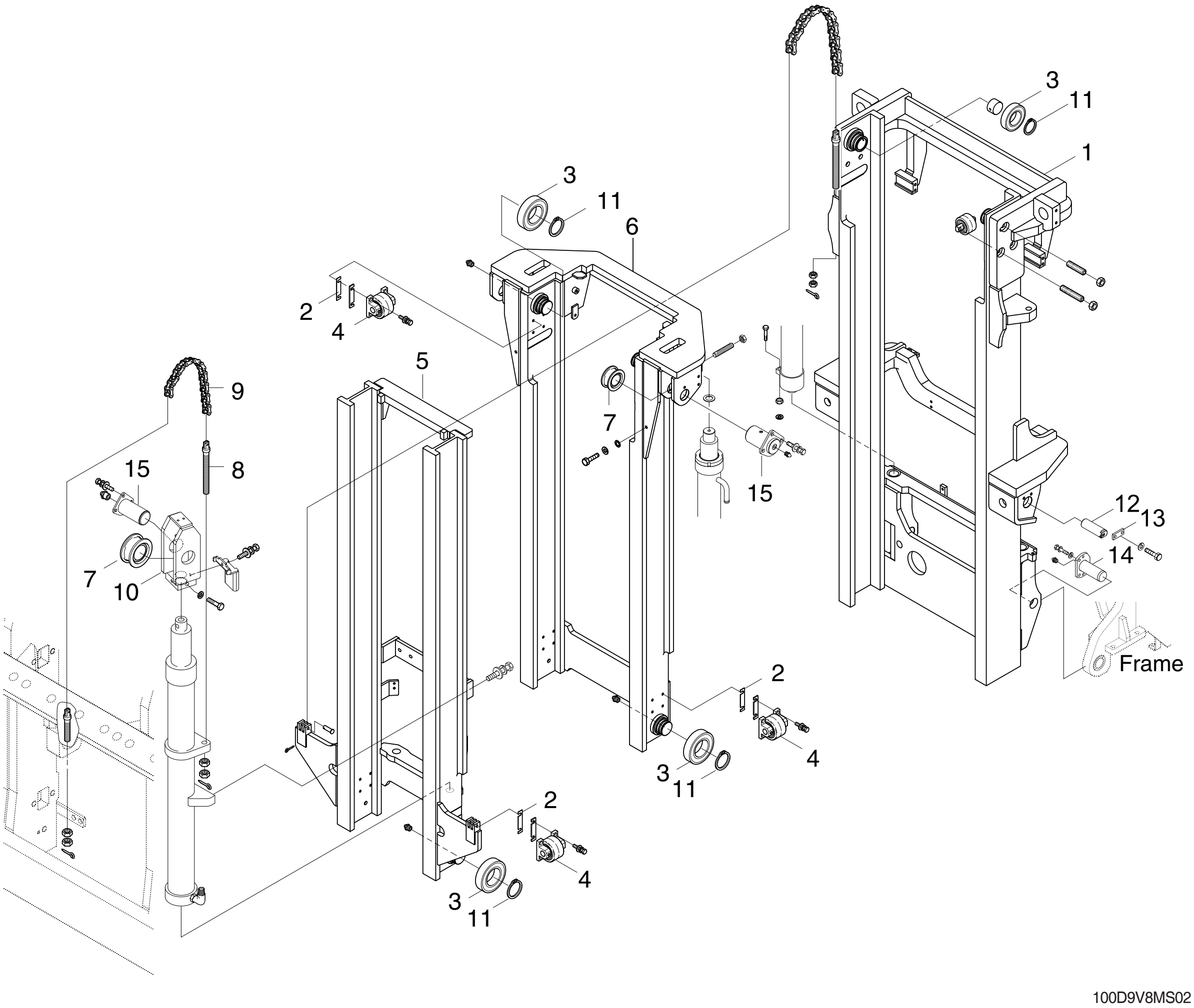
GROUP 1 STRUCTURE

1. 2 STAGE MAST (V MAST)



1	Outer mast	5	Lift chain	9	Chain sheave bearing
2	Roller bearing	6	Anchor bolt	10	Side roller bearing
3	Tilt cylinder pin	7	Side roller bearing	11	Joint pin
4	Mast mounting pin	8	Inner mast	12	Lock plate

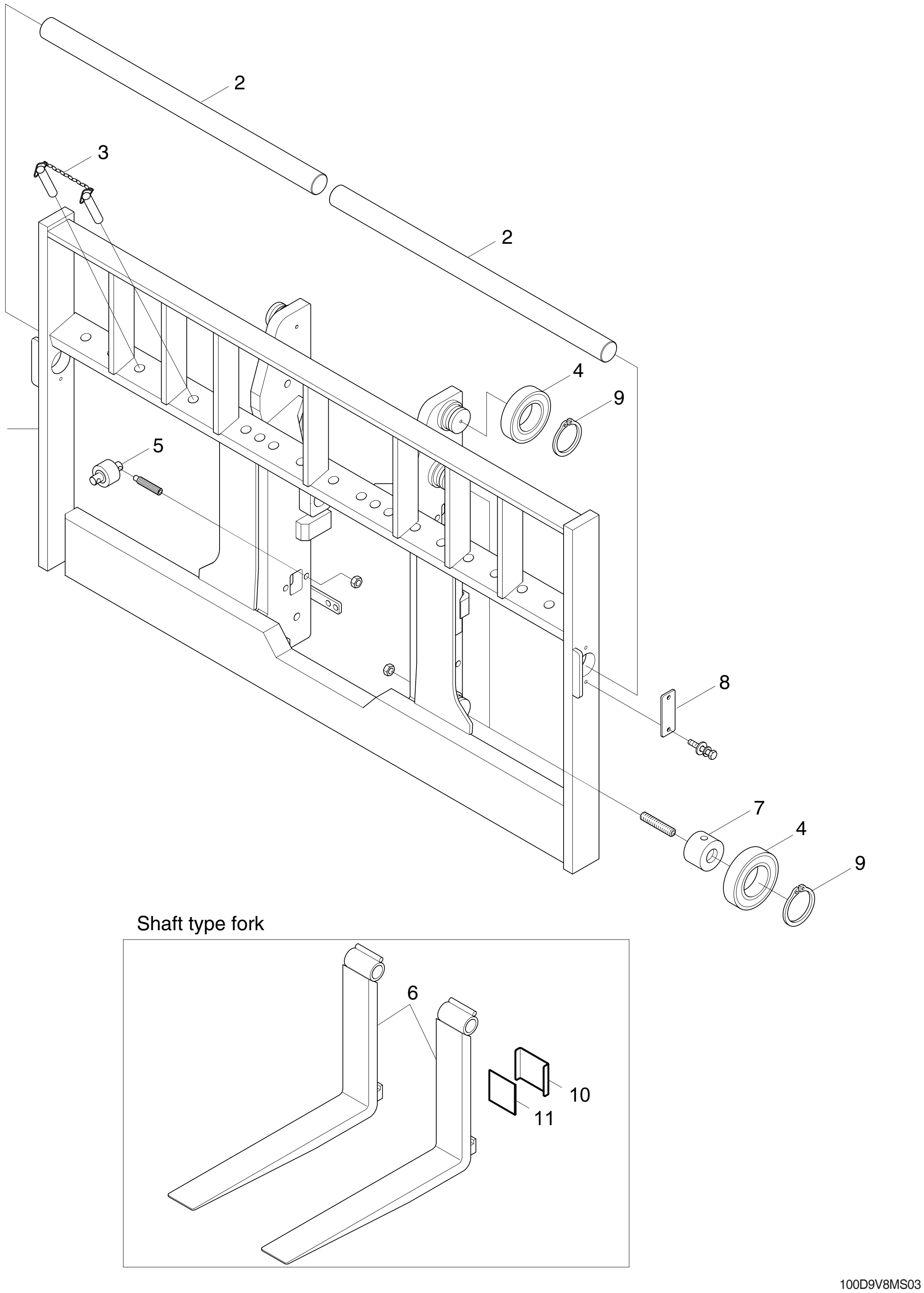
2. 3 STAGE MAST (TS MAST)



1	Outer mast	6	Middle mast	11	Retainer ring
2	Shim	7	Sheave	12	Tilt cylinder pin
3	Load roller bearing	8	Anchor bolt	13	Lock plate
4	Side roller bearing	9	Chain	14	Master mounting pin
5	Inner mast	10	Sheave bracket	15	Joint pin

3. CARRIAGE, BACKREST AND FORK

1) SHAFT TYPE



1	Carriage & backrest	5	Side roller	9	Retainer ring
2	Hanger bar	6	Fork	10	Spacer
3	Fork retaining	7	Wear plug	11	Spacer
4	Roller	8	Cover		

GROUP 2 OPERATIONAL CHECKS AND TROUBLESHOOTING

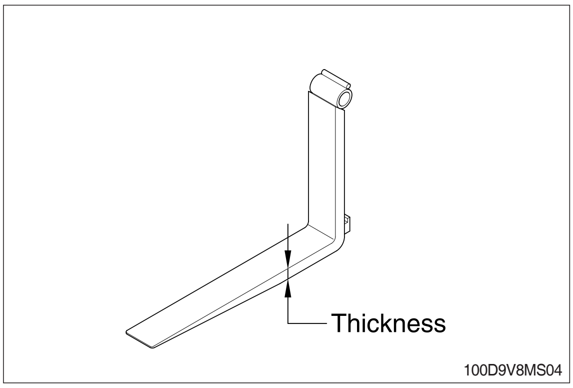
1. OPERATIONAL CHECKS

1) FORKS

(1) Measure thickness of root of forks and check that it is more than specified value.
EX : ℓ =1200 mm (47 in)

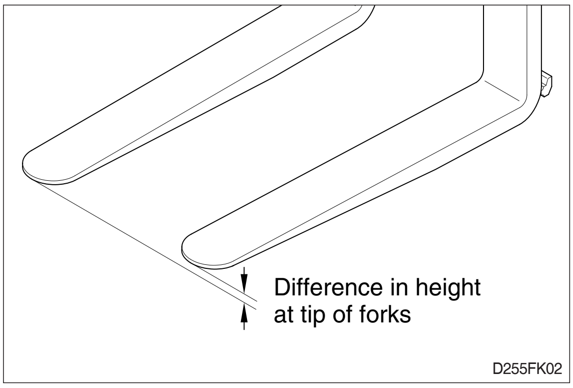
mm (in)

STD Fork assy	Applicable model	Standard	Limit
69FJ-71010G	100D-9V	75 (3.0)	68 (2.7)



2) Set forks in middle and measure out of parallel and difference in height at the top of forks.

Model	Fork length	Height difference
100D-9V	equal or below 1500	3 mm
	above 1500	4 mm



3) Most force is concentrated at root of fork and at hook, so use crack detection method to check cracks.

2. MAST

1) Check for cracks at mast stay, tilt cylinder bracket, guide bar, fork carriage and roller shaft weld. Check visually or use crack detection method. Repair any abnormality.
2) Set mast vertical, raise forks about 10cm from ground and check front-to-rear clearance and left-to-right clearance between inner mast and fork carriage, and between outer mast and inner mast. Use these figures to judge if there is any play at roller or rail.
   · Front-to-rear clearance : Within 2.0 mm (0.08 in)
   · Left-to-right clearance : Within 2.5 mm (0.10 in)
3) Check that there is an oil groove in bushing at mast support.
4) Set mast vertical, raise forks about 10 cm from ground, and push center of lift chain with finger to check for difference in tension.
   If there is any difference in tension, adjust chain stopper bolt.
5) Check visually for abnormalities at thread of chain anchor bolt, and at contact surface between chain wheel and chain.
   Rotate chain wheel by hand and check for any play of bearing.

2. TROUBLESHOOTING

1) MAST

Problem	Cause	Remedy
Forks fail to lower.	· Deformed mast or carriage.	· Disassemble, repair or replace.
Fork fails to elevate	· Faulty hydraulic equipment. · Deformed mast assembly.	· See troubleshooting hydraulic pump and cylinders in section 6, hydraulic system. · Disassemble mast and replace damaged parts or replace complete mast assembly.
Slow lifting speed and insufficient handling capacity.	· Faulty hydraulic equipment. · Deformed mast assembly.	· See troubleshooting hydraulic pump and cylinders in section 6, hydraulic system. · Disassemble mast and replace damaged parts or replace complete mast assembly.
Mast fails to lift smoothly.	· Deformed masts or carriage. · Faulty hydraulic equipment. · Damaged load and side rollers. · Unequal chain tension between LH & RH sides. · LH & RH mast inclination angles are unequal. (Mast assembly is twisted when tilted)	· Disassembly, repair or replace. · See Troubleshooting Hydraulic Cylinders, pump and control valve in section 6, hydraulic system. · Replace. · Adjust chains. · Adjust tilt cylinder rods.
Abnormal noise is produced when mast is lifted and lowered.	· Broken load roller bearings. · Broken side roller bearings. · Deformed masts. · Bent lift cylinder rod. · Deformed carriage. · Broken sheave bearing.	· Replace. · Replace. · Disassemble, repair or replace. · Replace. · Replace. · Replace.
Abnormal noise is produced during tilting operation.	· Insufficient lubrication of anchor pin, or worn bushing and pin. · Bent tilt cylinder rod.	· Lubricate or replace. · Replace.

2) FORKS

<table>
<tr><th>Problem</th><th>Cause</th><th>Remedy</th></tr>
<tr><td>Abrasion</td><td>Long-time operations causes the fork to wear and reduces the thickness of the fork.
Inspection for thickness is needed.
· Wear limit : Must be 90% of fork thickness</td><td>If the measured value is below the wear limit, replace fork.</td></tr>
<tr><td>Distortion</td><td>Forks are bent out of shape by a number of reasons such as overloading, glancing blows against walls and objects, and picking up load unevenly.
· Difference in fork tip height<table><tr><th>Fork length (mm)</th><th>Height difference (mm)</th></tr><tr><td>equal or below 1500</td><td>3</td></tr><tr><td>above 1500</td><td>4</td></tr></table></td><td>If the measured value exceeds the allowance, replace fork.</td></tr>
<tr><td>Fatigue</td><td>Fatigue failure may result from the fatigue crack even though the stress to fork is below the static strength of the fork. Therefore, a daily inspection should be done.
· Crack on the fork heel.
· Crack on the fork weldments.</td><td>Repair fork by expert.
In case of excessive distortion, replace fork.</td></tr>
</table>

GROUP 3 ADJUSTMENT

1. MAST LOAD ROLLER

1) INNER/OUTER MAST ROLLER CLEARANCE ADJUSTMENT

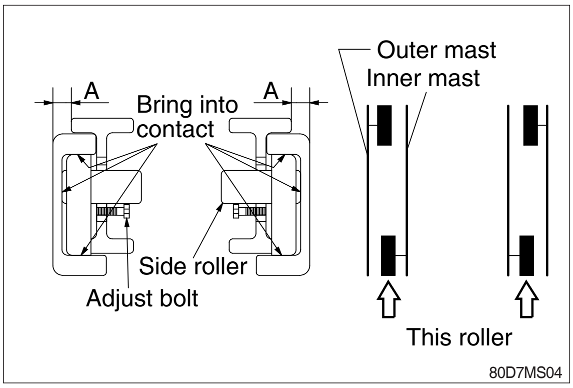
(1) Measure the clearance with the mast overlap at near 480 mm (19 in).

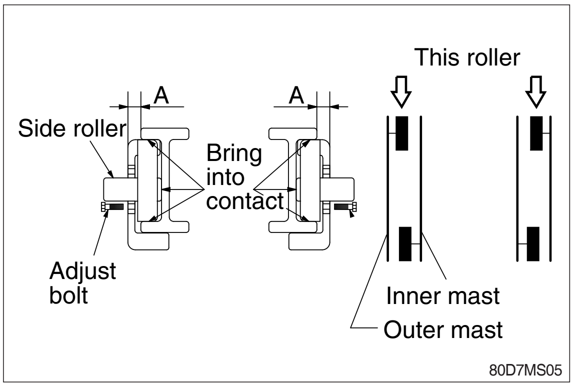
(2) Shift the inner mast to one side to bring the side roller into contact with the outer mast, and adjust the clearance between the end of inner beam and the outside of outer mast position on the opposite side to the following value by adjust bolt.

· Reference clearance A = 43.1 mm

(3) Distribute the clearance A equally to the left and right.

(4) After the adjustment, check that the inner mast moves smoothly in the outer mast.





2) CARRIAGE LOAD ROLLER

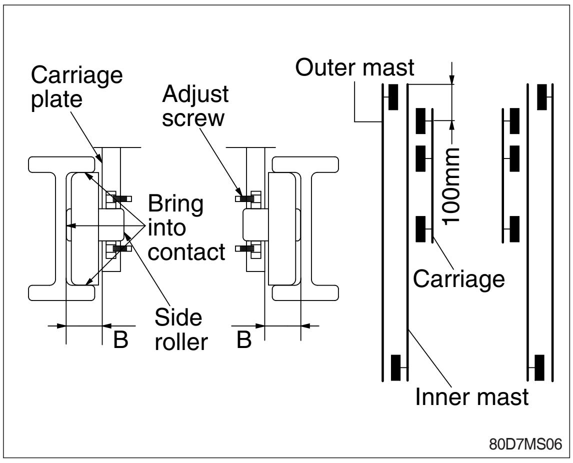
(1) Measure the clearance when the center of the carriage upper roller is 100 mm from the top of the inner mast.

(2) Measure the clearance at upper, middle and lower rollers after loosen the adjust screws from the side rollers. Shift the carriage to one side to bring the side roller into contact with the inner mast, and measure the clearance between inner face of the inner mast and carriage plate at the closest position on the opposite side to the following value by adjust screw.

· Reference clearance B = 56.9 mm

(3) **Distribute the clearance B equally to the left and right.**

(4) After the adjustment, the carriage should move smoothly along the overall mast length.

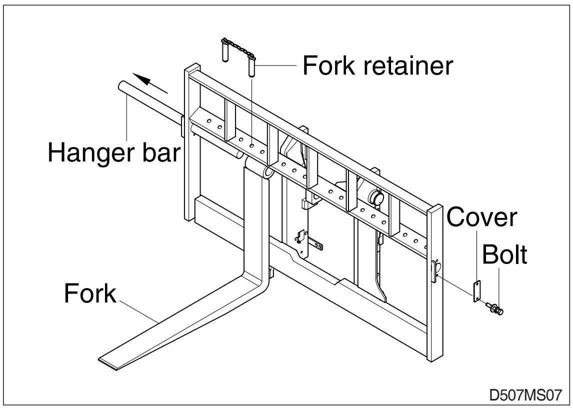


GROUP 4 REMOVAL AND INSTALLATION

1. FORKS

1) SHAFT TYPE

(1) Lower the fork carriage until the forks are approximately 25 mm (1 in) from the floor.
(2) Release fork retainer and remove cover.
(3) Slide one hanger bar at a time out of carriage assembly.
(4) Remove only one fork at a time.
※ On larger forks it may be necessary to use a block of wood.
(5) Reverse the above procedure to install load forks.



3. CARRIAGE ASSEMBLY

1) CARRIAGE

(1) With the mast vertical, raise the carriage high enough to place blocks under the load forks. This is done to create slack in the load chains when the carriage is lowered. Lower the carriage all the way down to the floor. Make sure the carriage is level, this will prevent any binding when the mast is raised.
(2) While supporting lift chains, remove the split pin and slide out chain anchor pins from the chain anchors of stationary upright.
(3) Pull the chains out of the sheaves and drape them over the front of the carriage.
(4) Slowly raise inner mast upright until mast clears top of fork carriage. Move carriage to work area and lower mast.

※ Make sure carriage remains on floor and does not bind while mast is being raised.

(5) Inspect all parts for wear or damage. Replace all worn or damaged parts.
(6) Reverse the above steps to reinstall.

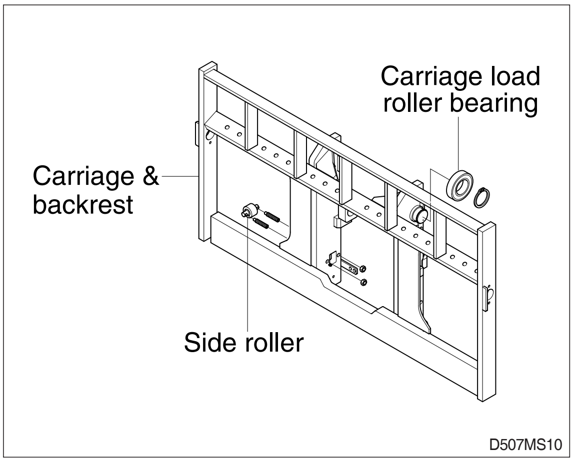
※ Replace the split pin of chain anchor with new one.

2) SIDE ROLLER

(1) Remove carriage as outlined in the carriage removal paragraph.
(2) Loosen and remove nuts, adjust screws and side rollers from carriage side plate.
(3) Thoroughly clean, inspect and replace all worn or damaged parts.
(4) Reverse the above procedure to assembly.

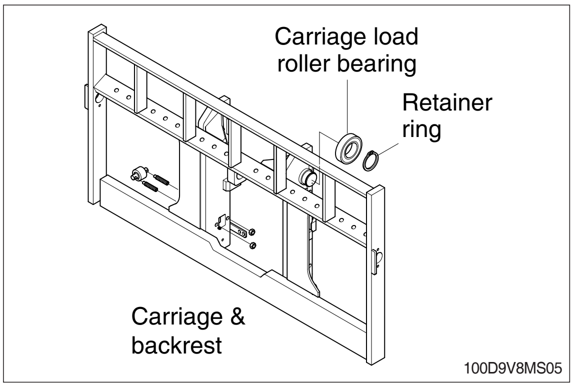
※ Adjustment

- Once carriage is properly installed, loosen nuts and adjust screws, (if not already done) allowing carriage to be centered in the inner mast.
- Adjust side roller by tightening screw until side roller just makes contact with mast. Back off approximately 1/10 turn on screw and tighten nut to lock screw in place.
- Run carriage up and down along the inner mast to be sure the carriage has free movement and does not stick. Also, make sure chains are properly adjusted. Refer to chain adjustment paragraph. Make adjustment when necessary and recheck operation of carriage.



3) CARRIAGE LOAD ROLLER BEARING

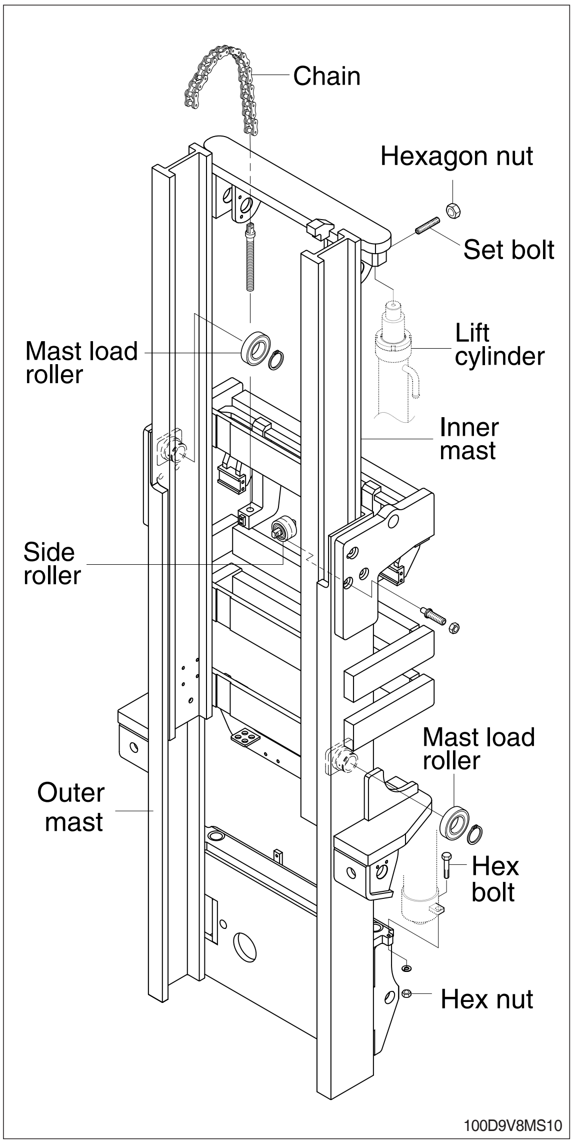
(1) Remove carriage as outlined in the carriage removal paragraph.
(2) Using the plier, remove retaining rings from load roller bearing bracket.
(3) Using a plier, remove load roller bearings from load roller bearing bracket.
(4) Reverse the above procedure to assemble. Refer to MAST ROLLER ADJUSTMENT paragraph.



4. MAST LOAD ROLLER

1) 2 STAGE MAST (V MAST)

(1) Remove the carriage assembly and move them to one side.
(2) Loosen and remove hexagon nuts and set bolts securing lift cylinders to inner mast.
(3) Loosen and remove hexagon bolts and nuts securing lift cylinders to outer mast.
(4) Attach chains or sling to the inner mast section at top crossmember. Using an overhead hoist, slowly raise the inner mast high enough to clear lift cylinder.
(5) After lowering the lift cylinder rods, and disconnecting lift cylinder hose, tilt the lift cylinders (LH and RH) with ropes to the outer mast.
(6) Using the overhead hoist, lower inner mast until top and bottom rollers are exposed.
(7) Using a plier, remove load rollers from load roller bracket. Remove side rollers.
(8) Thoroughly clean, inspect and replace all worn or damaged parts.
(9) Reverse the above procedure to assemble.
Refer to MAST ROLLER ADJUSTMENT paragraph.
(10) After completing all necessary steps for load rollers removal, use an overhead hoist to remove sling or chain around upper crossmember of the inner mast section.
Lift inner mast upright straight up and out of outer mast section.
(11) Replace and reverse above procedure to install.
(12) Make all necessary measurements and adjustments.



3) 3 STAGE MAST(TS MAST)

(1) Remove the carriage assembly and move it to one side.

(2) Loosen and remove hexagon bolt securing bottom cylinder from outer mast.

(3) Loosen and remove set bolts and nuts securing lift cylinders to middle mast.

(4) Attach chains or sling to the inner and middle mast section at top crossmember. Using an overhead hoist, slowly raise the uprights high enough to clear lift cylinder.

(5) After lowering the lift cylinder rods, and disconnecting lift cylinder hose, tilt the lift cylinders LH and RH and tie them with ropes to the outer mast.

(6) Using the overhead hoist raise inner and middle masts. Place 4inch block of wood under the free lift cylinder bracket of the inner mast then lower mast sections (this will create slack in the chains).

(7) Remove retaining rings securing chain sheaves to sheave support brackets while supporting chains, remove chain sheaves and let chains hang free.

The upper outer and lower middle mast rollers and back up liners are now exposed.

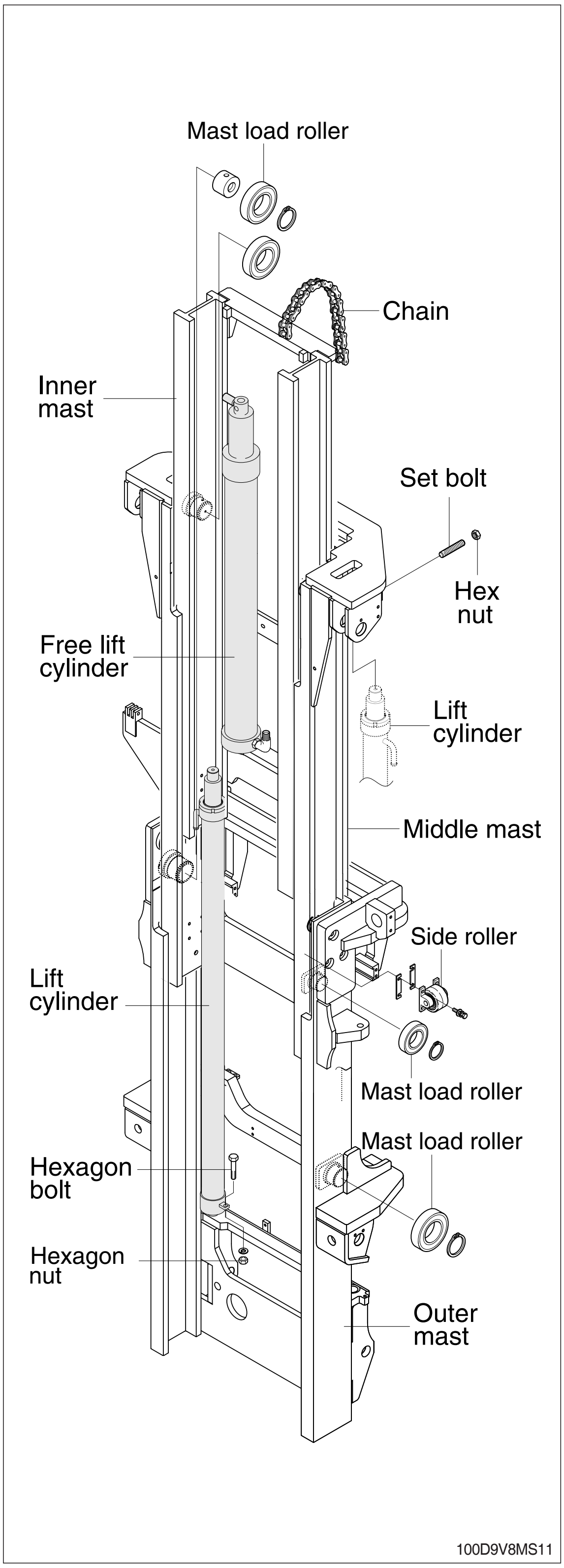
(8) Using a plier, remove load rollers from load bracket. Remove side rollers from mast.

(9) Attach chains or sling to the middle mast section at top crossmember. Using an overhead hoist, slowly raise the middle mast until top and bottom rollers are exposed.

(10) Using a plier, remove load rollers from roller bracket.

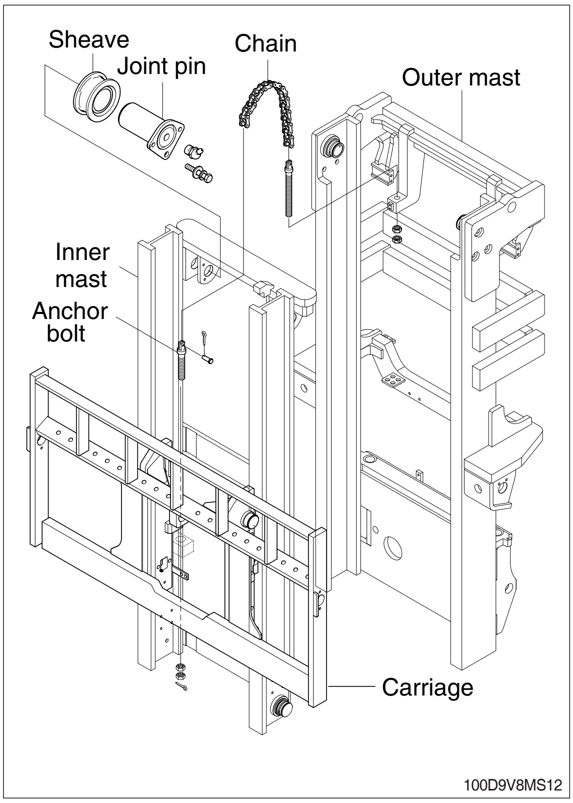
(11) Thoroughly clean, inspect and replace all worn or damaged parts.

(12) Reverse the above procedure to assemble. Refer to MAST LOAD ROLLER ADJ-USTMENT Paragraph.



5. CHAIN

1) CHAIN SHEAVE



(1) Place a sling around carriage and attach to an overhead hoist. Lift carriage high enough so that the tension on the chain over sheaves is relieved after the carriage is blocked. Position wooden blocks under the carriage and lower it.

(2) Remove the split pin securing the chain anchor pins and discard. While supporting the chains, remove the chain anchor pins and drape the chain over the carriage.

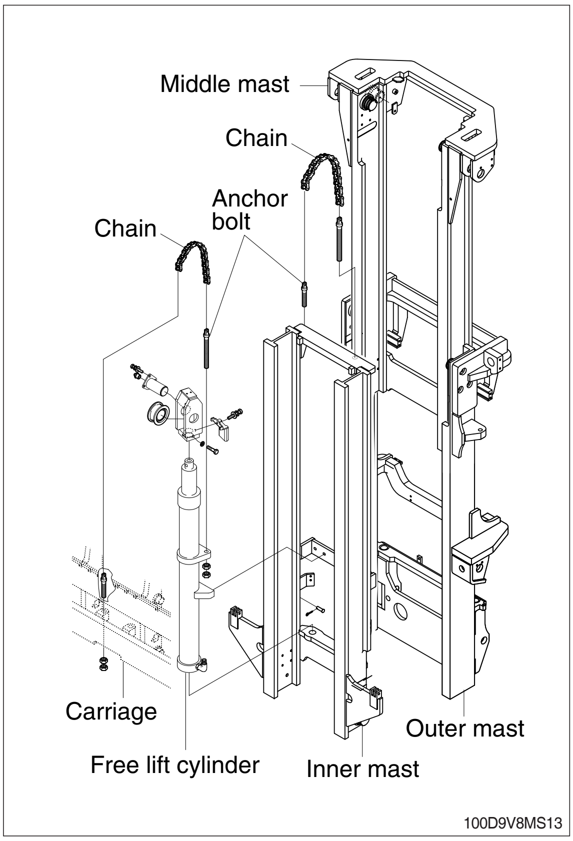
(3) Remove retaining ring securing sheaves to sheave support. Remove sheaves with bearings.

(4) Remove bearing retaining ring from sheave and press bearings from sheaves.

(5) Thoroughly clean, inspect and replace all worn or damaged parts.

(6) Reverse the above to assemble and install. Use new split pins in chain anchor pins.

2) REAR CHAIN SHEAVE (TS mast)



(1) Raise and securely block carriage and inner mast section.

(2) Remove the split pin securing the chain anchor pins and discard.

(3) Remove chains.

(4) Remove retaining ring securing chain sheaves to sheave support. Pry off sheaves with bearings.

(5) Remove bearing retaining ring from sheave and press bearings from sheaves.

(6) Thoroughly clean, inspect and replace all worn or damaged parts.

(7) Reverse the above procedure to assemble and install. Use new split pins in chain anchor pins.

3) SHEAVE SUPPORT (TS mast)

(1) Remove the carriage assembly and move to one side.
(2) After removing bolt to securing sheave support assembly to free lift cylinder.
Attach a sling to the sheave support assembly. Using an overhead hoist, lift support assembly straight up and off of free lift cylinder. Move assembly to work area.
(3) Remove retaining ring securing sheave to sheave support.
(4) Remove bearing retaining ring from sheave and press bearings from sheaves.
(5) Thoroughly clean, inspect and replace all worn or damaged parts.
(6) Reverse the above procedure to install.

4) REAR CHAIN (TS mast)

(1) Remove the carriage assembly and move to one side. Refer to carriage removal and installation.
(2) Raise and securely block truck approximately 6 inches from the floor.
(3) Using a sling or chain around inner mast section attached to an overhead hoist, slowly raise inner mast until there is enough slack in the chains to remove them. Block inner mast section.
(4) Remove split pins and chain anchor pins securing chains to chain anchor(part of inner mast).
(5) While supporting the chains, remove split and chain anchor pins securing chains to chain anchors attached to outer mast section.
(6) Remove chains.
(7) Reverse the above to assemble and install. Use new split pins in chain anchor pins. Refer to this section for Load chain lubrication and adjustment.

5) CARRIAGE CHAIN

(1) Place a sling around carriage front plate and attach to an overhead hoist. Lift and secure carriage high enough so that split and chain anchor pins on carriage can be easily be removed. Remove chain anchor pins from carriage and drape chains out over carriage.
(2) Place a wooden block under the carriage and lower the carriage on the block.
(3) While supporting the chains, remove split pins and chain anchor pins from chain anchors.
(4) Remove chains and wash them with solvent. Refer to this section for Load chain inspection and maintenance.
(5) Reverse the above procedure to assemble and install. Use new split pins in chain anchor pins.
Refer to this section for Load chain lubrication and adjustment.

6) LOAD CHAIN INSPECTION AND MAINTENANCE

After every 200 hours of truck operation, lift chains should be inspected and lubricated inspect for the following chain conditions :

(1) Wear

As the chain flexes on and off the sheaves, the joints very gradually wear. The stretch a chain develops in service is due to material being worn off pin outer diameter and pitch hole inner diameter on the inside plate.

Chain wear can be measured using a wear scale or steel tape. When chains have elongated 2%, they should be discarded. When checking chain wear, be sure to measure a segment of chain that operates over a sheave. Do not repair chains by cutting out the worn section and splicing in a new piece. If part of the chain is worn, replace all the chains on the truck.

(2) Rust and corrosion

Chains used on lift trucks are highly stressed precision components. It is very important that the "as-manufactured" ultimate strength and fatigue strength be maintained throughout the chain service life. Corrosion will cause a major reduction in the load-carrying capacity of lift chain or roller chain because corrosion causes side plate cracking.

(3) Cracked plate

The most common cause of plate cracking is fatigue failure. Fatigue is a phenomenon that affects most metals and many plastics. After many repeated heavy loads, the plates may crack and the chains will eventually break. Fatigue cracks are almost always found through the pitch holes perpendicular to the pitch line. Contrast this failure mode to the random failures caused by stress-corrosion cracking. If cracks are present, replace all the chain on the truck. Noise in the chain indicates that the plate is on the verge of cracking and will be failed before long.

(4) Tight joints

All joints in lift chain should flex freely. Tight joints resist flexure, increase internal friction, thus increasing chain tension required to lift a given load. Increased tension accelerates wear and fatigue problems.

Tight joints in lift chains can be caused by :

· Bent pins or plates.
· Rusty joints.
· Peened plate edges.

Oil rusty chains and replace chains with bent or peened components.

(5) Protruding or turned pins

Heavily loaded chains operating with lube generate tremendous friction between pins and plates. In extreme cases, the frictional torque in the joint can actually turn pins in the press-fit outside plates. If chain is allowed to operate in this condition, the pins slowly work out of the chain causing chain failure. Turned pins can be quickly spotted because the flats on the V heads are no longer in line. Chains with turned or protruding pins should be replaced immediately. Do not attempt to repair the chain by driving pins back into the chain.

(6) Chain side wear

A wear pattern on pin heads and outside plates indicates misalignment. This condition damages chain and sheaves as well as increasing internal friction in the chain system.

(7) Chain anchors and sheaves

An inspection of the chain system includes a close examination of chain anchors and sheaves. Check chain anchors for wear, breakage and misalignment. Anchors with worn or broken fingers should be replaced. Anchors should be adjusted to eliminate twisting or other misalignment in the chain. When chain is misaligned, load is not distributed uniformly between the plates. Prolonged operation will result in premature fatigue failure. Sheaves with badly worn flanges and outside diameter should be replaced. Heavy flange wear indicates chain misalignment.

(8) Chain wear scale

The chain can be checked for wear or stretching with the use of a chain wear scale. Stretching of a chain is due to the elongation of the pitch holes and wearing of the pin O.D. The greatest amount of stretching occurs at the areas of the chain that flex over the sheaves most frequently. Check the chain at this point with a scale. The wear scale has instructions printed on the sides for use in determining chain stretch and are as follows :

· Determine pitch length of chain using 6 inch scale on one side of wear scale.
· If pitch is 1/2 (12.7 mm), 3/4 (19.05 mm), 1 (25.4 mm), 1-1/2 (38.1 mm), 2 (50.8 mm), use side A of scale.
· If pitch is 5/8 (15.875 mm), 1-1/4 (31.75 mm) or 2 (50.8 mm), use side B.
· Align point A or B to center of a pin and note position of the opposite A or B point.
· If other point also lines up with a pin, the chain is worn and should be replaced.

If any of the above conditions exists (cracked plates, turned pins, stretching etc), the chains should be replaced in pairs as a complete assembly. Order chains by part number to insure the correct chain length, pitch and material specifications.

7) LOAD CHAIN LUBRICATION AND ADJUSTMENT

(1) Lubrication

The most important consideration in field maintenance of lift chains is lubrication. Hard working, heavily loaded chains cannot be expected to give satisfactory wear life without scheduled periodic re-lubrication. Like all bearing surfaces, the precision manufactured, hardened steel, joint-wearing surfaces require a film of oil between mating parts to prevent rapid wear. Oil must penetrate the chain joint to prevent wear. Applying oil to external surfaces will prevent rust, but oil must flow into the live bearing surfaces for maximum wear life. Frequency of re-lube will vary with operating conditions and environment, the best estimate of lube period is 200 hours. Trucks parked outdoors or trucks in extremely severe service, may require more frequent re-lube to maintain an oil film on all chain surface.

· Wipe off the old oil with a clean cloth and blow out the remaining dirt with compressed air.

⚠ Wear eye protection.

· With a clean brush, apply EP-140 extreme pressure lubricant or heavy motor oil(40W).

(2) Replacement

Replace chains as a pair. It will be virtually impossible to maintain uniform loading between the strands if a new chain is put into service opposite an old chain. The joints in the old chain will be greater than that on the new chain, greatly complicating the problem of maintaining equal chain tension. The new chain will wear more slowly causing it to bear the major portion of the load resulting in premature wear and fatigue failure. Don’t steam clean or decrease new chains.

The manufacturer’s grease is effective in reducing wear and corrosion. If the original factory lube is dried out or wiped off, soak the new chain in heavy engine oil for at 1/2 hour prior to installing on truck. After the old chains have been stripped from the mast, very carefully inspect chain anchors and sheaves. Broken, cracked or worn anchor must be replaced using the new anchor pin and split pin. Do not paint newly replaced chain after it has been installed.

(3) Adjustment

Chain adjustments are important for the following reasons :

· Equal loading of chain.
· Proper sequencing of mast.
· Prevent over-stretching of chains.
· Prevent chains from jumping off sheaves if they are too loose.

(4) Adjustment procedure

· With mast in its fully collapsed and vertical position, lower the fork to the floor.
· Adjust the chain length by loosening or tightening nut on the chain anchor.

After making adjustment on the mast, be sure to tighten the nut.