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 truck 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, steering 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

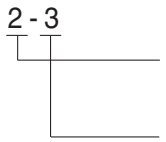
Distribution and updating

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



   Item number (2. Removal & installation of unit)
   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.

   7 - 4
   7 - 4 - 1
   7 - 4 - 2] Added pages
   7 - 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

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.

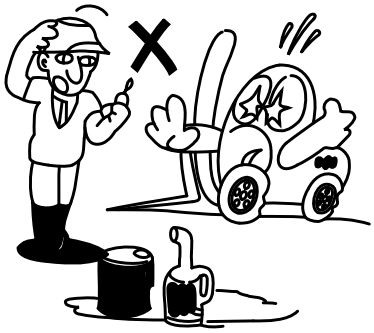
˚C		˚F	˚C		˚F	˚C		˚F	˚C		˚F
-40.4	-40	-40.0	-11.7	11	51.8	7.8	46	114.8	27.2	81	117.8
-37.2	-35	-31.0	-11.1	12	53.6	8.3	47	116.6	27.8	82	179.6
-34.4	-30	-22.0	-10.6	13	55.4	8.9	48	118.4	28.3	83	181.4
-31.7	-25	-13.0	-10.0	14	57.2	9.4	49	120.2	28.9	84	183.2
-28.9	-20	-4.0	-9.4	15	59.0	10.0	50	122.0	29.4	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

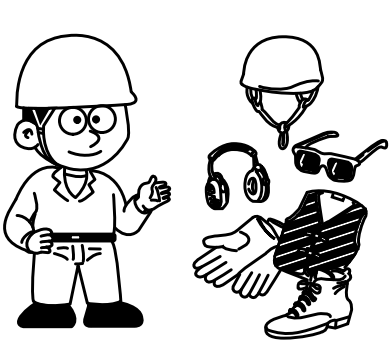
GROUP 1 SAFETY HINTS

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

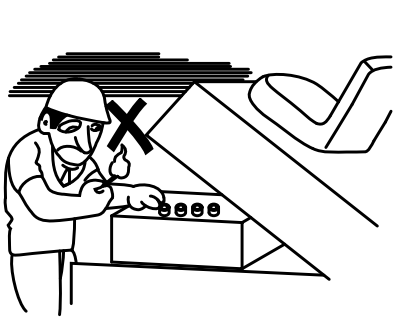
- Oil is a dangerous substance. Never handle oil, grease or oily clothes in places where there is any fire of flame.
  As preparation in case of fire, always know the location and directions for use of fire extinguishers and other fire fighting equipment.


D50ASF01

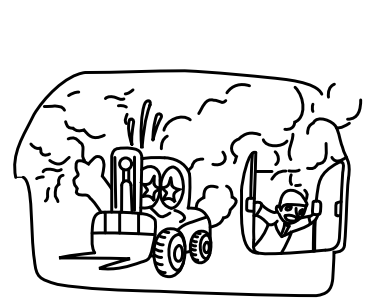
- Wear well-fitting helmet, safety shoes and working clothes. When drilling, grinding or hammering, always wear protective goggles.
  Always do up safety clothes properly so that they do not catch on protruding parts of truck.
  Do not wear oily clothes.
  When checking, always release battery plug.


D50ASF02

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

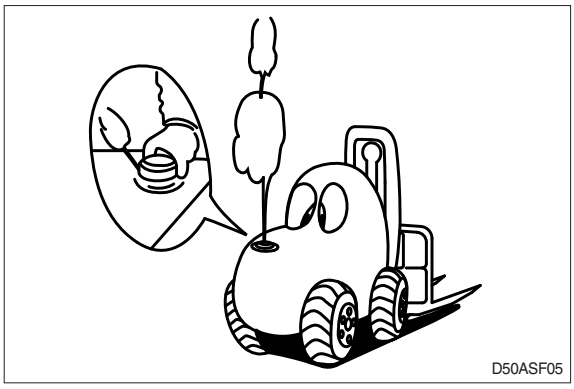

D50ASF03

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

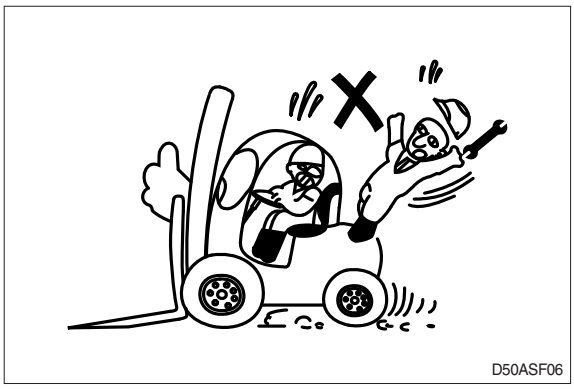

D50ASF04

⚠ Be particularly careful when removing the radiator cap and the hydraulic oil tank filler cap, if this is done immediately after using the truck, 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, move the control levers to each position two or three times.

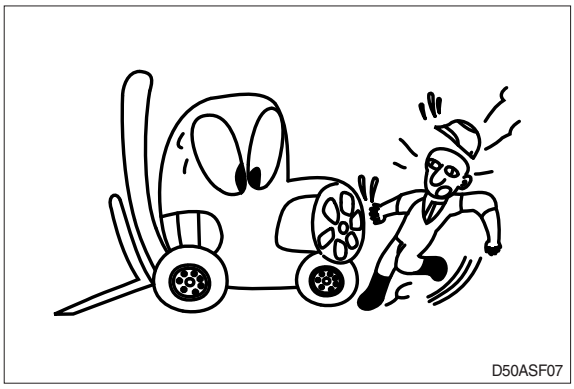

D50ASF05

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


D50ASF06

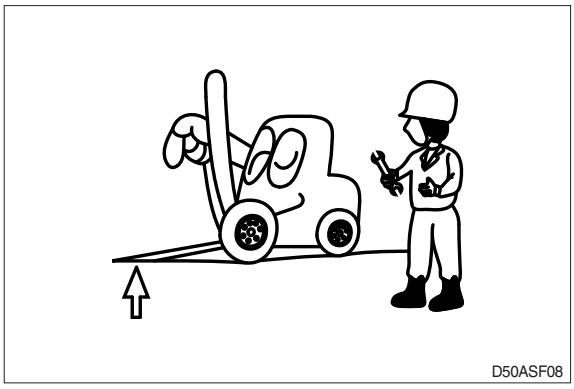
· Hand a caution sign in the operator's compartment (For example **Do not start** or **Maintenance in progress**).
This will prevent anyone from starting or moving the truck by mistake.

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

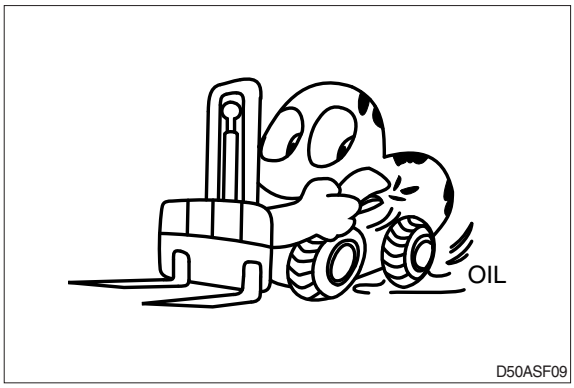

D50ASF07

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.

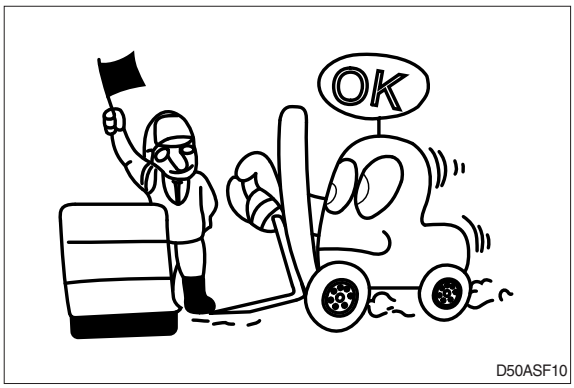
· Park the truck on firm, flat ground.
Lower the fork to the ground and stop the engine.
Return each lever to **NEUTRAL** and apply the brake lock.


D50ASF08

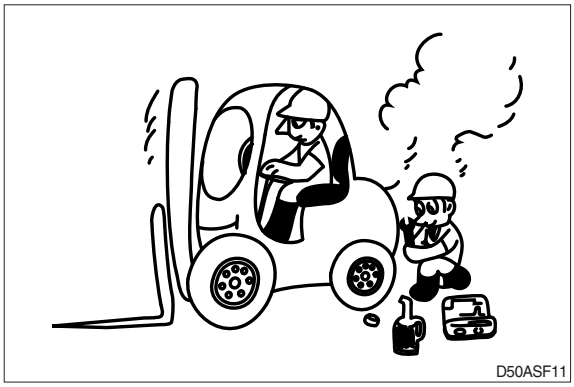
· Immediately remove any oil or grease on the floor of the operator's compartment, or on the handrail. It is very dangerous if someone slips while on the truck.



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



· 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.



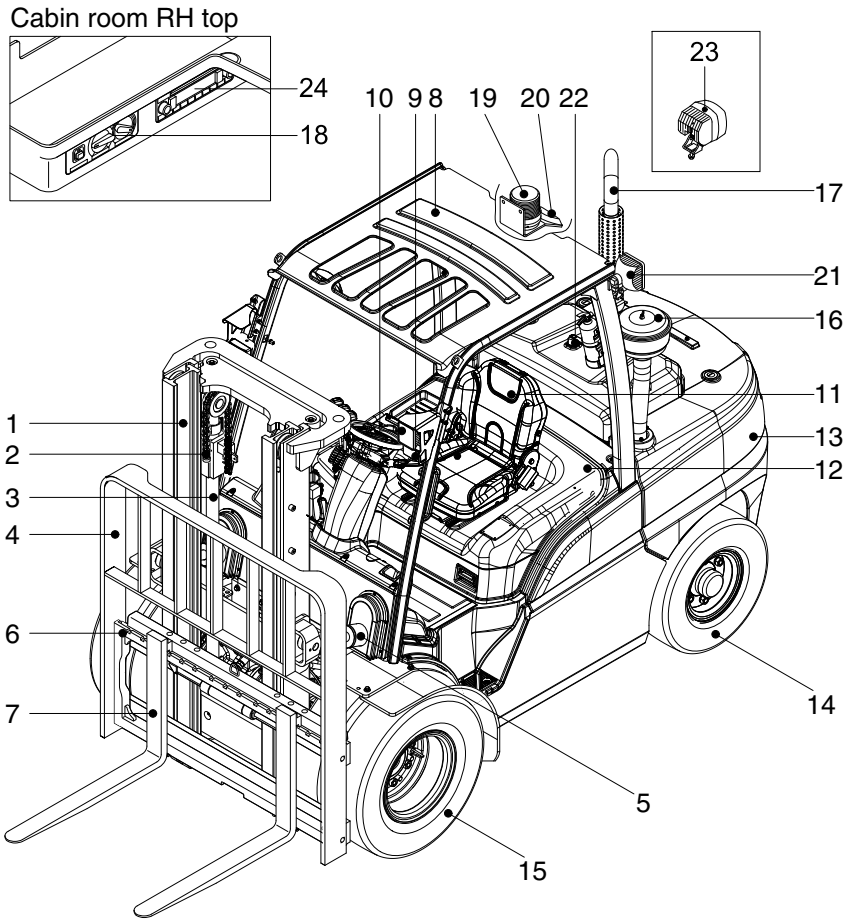
· Unless you have special instructions to the contrary, maintenance should always be carried out with the engine stopped. If maintenance is carried out with the engine running, there must be two men present : one sitting in the operator's seat and the other one performing the maintenance. In such a case,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

- Thoroughly clean the truck. 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 truck.
- 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

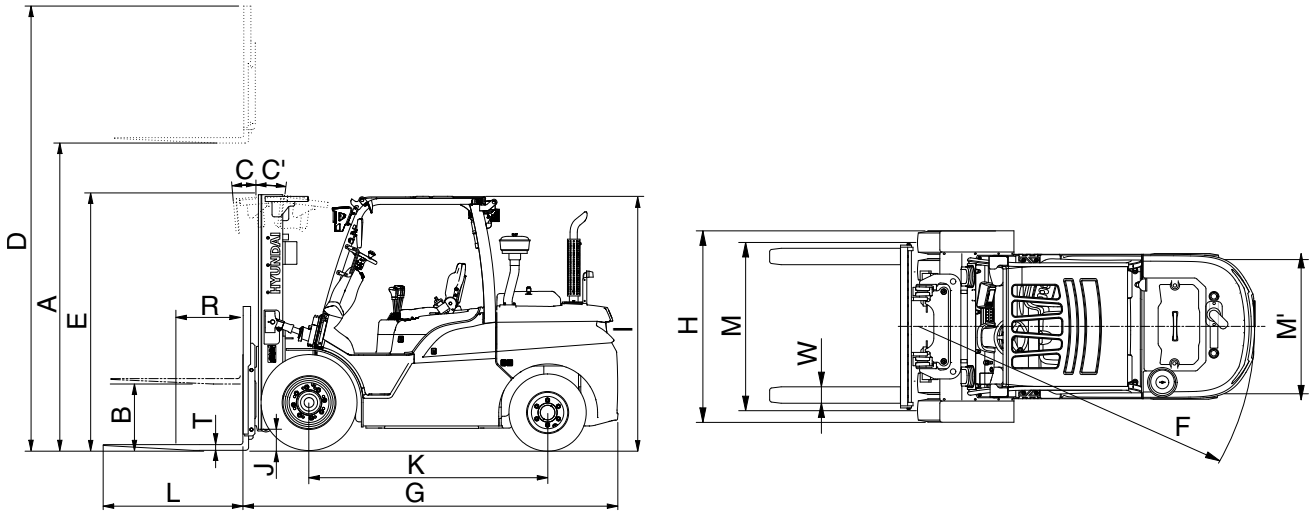


35D9VB3KY01

1	Mast	9	Turn signal lamp	17	Silencer
2	Lift chain	10	Head lamp	18	Aircon & heater (opt)
3	Lift cylinder	11	Operator's seat	19	Beacon lamp (opt)
4	Backrest	12	Bonnet	20	Camera (opt)
5	Tilt cylinder	13	Counterweight	21	Rear work lamp (opt)
6	Lift bracket	14	Rear wheel	22	Rear handle with horn (opt)
7	Forks	15	Front wheel	23	Blue spot (opt)
8	Overhead guard	16	Precleaner	24	Radio & USB player (opt)

2. SPECIFICATIONS

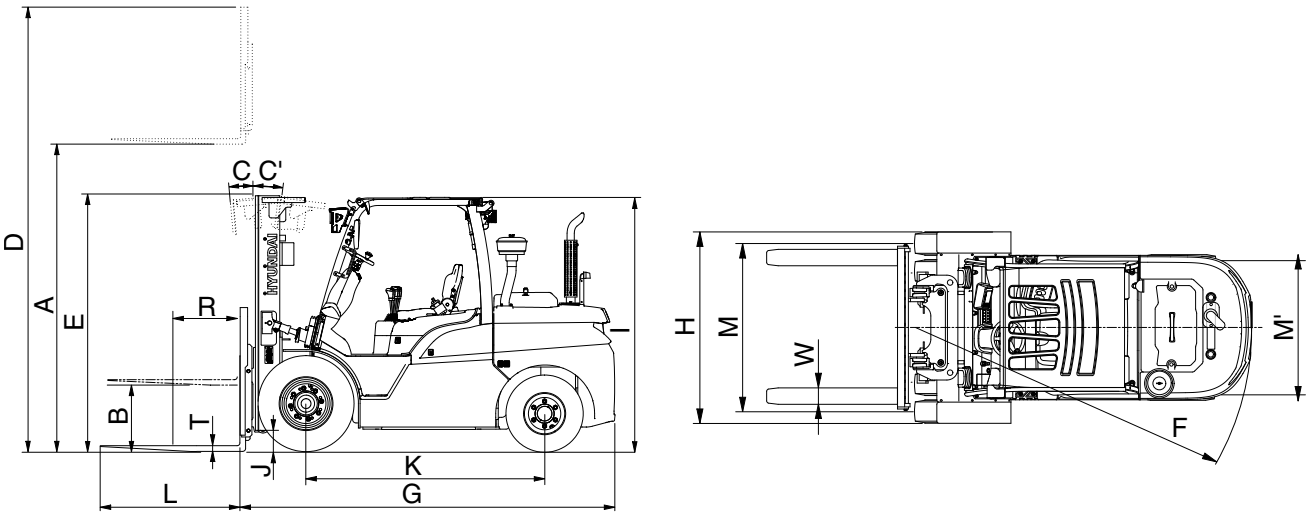
1) 35/40/45D-9VB, 50DN-9VB



35D9VB8SP01

Model			Unit	35D-9VB	40D-9VB	45D-9VB	50DN-9VB
Capacity			kg (lb)	3500 (8000)	4000 (9000)	4500 (10000)	5000 (11000)
Load center		R	mm (in)	600 (24")	←	←	←
Weight (Unloaded)			kg (lb)	5851 (12899)	6405 (14121)	6860 (15124)	7264 (16014)
Fork	Lifting height	A	mm (ft·in)	3020 (9' 11")	←	←	2930 (9' 7")
	Free lift	B	mm (in)	120 (4.7")	←	←	←
	Lifting speed (Unload/Load)		mm/sec (ft/min)	540/520 (106/102)	540/510 (106/100)	←	460/410 (91/81)
	Lowering speed (Unload/Load)		mm/sec (ft/min)	550/550 (109/108)	←	←	500/550 99/109
	L×W×T	L,W,T	mm (in)	1070×122×50 (42×4.8×2)	1070×150×50 (42×5.9×2)	1220×150×50 (48×5.9×2)	1200×150×60 (47×5.9×2.4)
Mast	Tilt angle (forward/backward)	C/C'	degree	8/10	←	←	←
	Max height	D	mm (ft·in)	4234 (13' 11")	←	←	4147 (13' 7")
	Min height	E	mm (ft·in)	2235 (7' 4")	2220 (7' 3")	←	←
Body	Travel speed (Unload/Load)		km/h (mph)	29.2/26.8 (18.2/16.6)	28.4/26.5 (17.6/16.4)	28.2/26.1 (17.5/16.6)	28.1/25.8 (17.5/16.0)
	Max gradeability (Unload/Load)		%	25.1/44.5	24.1/39.2	23.4/35.4	22.3/32.6
	Min turning radius (Outside)	F	mm (ft·in)	2895 (9' 6")	2944 (9' 8")	3038 (10')	3081 (10' 1")
ETC	System set pressure		bar (psi)	210 (3050)	←	←	←
Length to face of forks		G	mm (ft·in)	3149 (10' 4")	3204 (10' 6")	3284 (10' 9")	3347 (11')
Overall width		H	mm (ft·in)	1370 (4' 6")	1746 (5' 9")	←	←
Overhead guard height		I	mm (ft·in)	2230 (7' 4")	2220 (7' 3")	←	←
Ground clearance		J	mm (in)	170 (6.7")	155 (6.1")	←	←
Wheel base		K	mm (ft·in)	2030 (6' 8")	←	2100 (6' 11")	←
Wheel tread front/rear		M/M'	mm (ft·in)	1132/1140 (3' 9"/3' 9")	1282/1140 (4' 2"/3' 9")	←	←
Max drawbar pull (Unload/Load)			kg (lb)	4223/4017 (9311/8856)	4218/4121 (9300/9086)	4221/4113 (9306/9068)	4226/4104 (9317/9048)

2) 40/45D-9VC, 50DN-9VC



35D9VB8SP01

Model			Unit	40D-9VC	45D-9VC	50D-9VC
Capacity			kg (lb)	4000 (9000)	4500 (10000)	4990 (11000)
Load center		R	mm (in)	500 (20")	←	←
Weight (Unloaded)			kg (lb)	5851 (12899)	6405 (14121)	6860 (15124)
Fork	Lifting height	A	mm (ft·in)	3020 (9' 11")	←	←
	Free lift	B	mm (in)	120 (4.7")	←	←
	Lifting speed (Unload/Load)		mm/sec (ft/min)	540/520 (106/102)	540/510 (106/100)	←
	Lowering speed (Unload/Load)		mm/sec (ft/min)	550/550 (109/108)	←	←
	L×W×T	L,W,T	mm (in)	1070×122×50 (42×4.8×2)	1070×150×50 (42×5.9×2)	1220×150×50 (48×5.9×2)
Mast	Tilt angle (forward/backward)	C/C'	degree	8/10	←	←
	Max height	D	mm (ft·in)	4234 (13' 11")	←	←
	Min height	E	mm (ft·in)	2235 (7' 4")	2220 (7' 3")	←
Body	Travel speed (Unload/Load)		km/h (mph)	29.2/26.8 (18.2/16.6)	28.4/26.5 (17.6/16.4)	28.2/26.1 (17.5/16.6)
	Max gradeability (Unload/Load)		%	25.1/44.5	24.1/39.2	23.4/35.4
	Min turning radius (Outside)	F	mm (ft·in)	2895 (9' 6")	2944 (9' 8")	3038 (10')
ETC	System set pressure		bar (psi)	210 (3050)	←	←
Length to face of forks		G	mm (ft·in)	3149 (10' 4")	3204 (10' 6")	3284 (10' 9")
Overall width		H	mm (ft·in)	1370 (4' 6")	1746 (5' 9")	←
Overhead guard height		I	mm (ft·in)	2230 (7' 4")	2220 (7' 3")	←
Ground clearance		J	mm (in)	170 (6.7")	155 (6.1")	←
Wheel base		K	mm (ft·in)	2030 (6' 8")	←	2100 (6' 11")
Wheel tread front/rear		M/M'	mm (ft·in)	1132/1140 (3' 9"/3' 9")	1282/1140 (4' 2"/3' 9")	←
Max drawbar pull (Unload/Load)			kg (lb)	4223/4017 (9311/8856	4218/4121 (9300/9086)	4221/4113 (9306/9068)

3. SPECIFICATION FOR MAJOR COMPONENTS

1) ENGINE

Item	Unit	Specification
Model	–	HMC D4CC
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)	95×102 (3.74×4.02)
Piston displacement	cc (cu in)	2891 (176.4)
Compression ratio	–	15.8 :1
Rated gross horse power	hp/rpm	73.2/2200
Maximum torque at rpm	kgf · m/rpm	34.5/1500
Engine oil quantity	ℓ (U.S.gal)	9.1 (2.4)
Dry weight	kg (lb)	266 (586)
High idling speed	rpm	2450
Low idling speed	rpm	850
Rated fuel consumption	g/kWh	207
Starting motor	V-kW	12-2.0
Alternator	V-A	13.5-130
Battery	V-AH	12-100
Fan belt deflection	mm (in)	10~12 (0.40~0.47)
CO_2	g/kWh	594.2

※ This CO_2 measurement results from testing over a fixed test cycle under laboratory conditions a(n) (parent) engine representative of the engine type (engine family) and shall not imply or express any guarantee of the performance of a particular engine.

2) MAIN PUMP

Item	Unit	Specification
Type	–	Axial piston variable pump
Capacity	cc/rev (in^3/rev)	45 (2.75)
Maximum operating pressure	bar (psi)	280 (4060)
Eninge idling speed (High/Low)	rpm	2450/850
Weight	kgf (lbf)	15 (33)

3) MAIN CONTROL VALVE

Item	Unit	Specification
Type	–	Mono-block (3spool / 4spool / 5spool)
Operating method	–	Manual (hand lever)
Maximum flow rated (Lift/Tilt)	lpm (US. gpm)	110/40 (29/11)
Main relief valve set pressure (DV1)	bar (psi)	210 (3050)
Attachment oil flow rated (Aux1/2/3)	lpm (US. gpm)	60/60/60 (16/16/16)
Attachment relief valve pressure (DV2)	bar (psi)	140~180 (2030~2610)
Weight	kfg (lbf)	3spool : 11 (24) / 4spool : 13 (29) / 5spool : 15

4) FINGERTIP CONTROL VALVE (ECV, option)

Item	Unit	Specification
Type	–	Mono-block (4spool)
Operating method	–	Electro-Hydraulic control
Maximum flow rated (Lift/Tilt)	lpm (US. gpm)	110/40 (29/11)
Main relief valve set pressure (DV1)	bar (psi)	210 (3050)
Attachment oil flow rated (Aux1/2)	lpm (US. gpm)	45/45 (12/12)
Attachment relief valve pressure (DV2)	bar (psi)	140~180 (2030~2610)
Weight	kgf (lbf)	4spool : 14 (31)

5) STEERING UNIT

Item	Unit	Specification
Type	–	Load sensing, Non-load reaction
Capacity	cc/rev (in^3/rev)	125 (7.63)
Steering relief valve set pressure	bar (psi)	135 (1960)
Weight	kgf (lbf)	5.5 (12)

6) PRIORITY VALVE

Item	Unit	Specification
Type	–	Load sensing, Dynamic signal
Rated input flow	lpm (US.gpm)	150 (40)
Max. inlet and EF Pressure	bar (psi)	310 (4500)
Max. CF Pressure	bar (psi)	276 (4000)
Weight	kgf (lbf)	6 (13)

7) POWER TRAIN DEVICES

Item			Specification
Torque converter	Model		AEROSPACE
	Type		3 Element, 1 stage, 2 phase
	Stall ratio		2.21 : 1
Transmission	Type		Power shift
	Gear shift(FWD/REV)		2/1
	Control		Electrical single lever type
	Overhaul ratio	FWD	1st : 2.667 2nd : 1.024
		REV	1.838
Axle	Type		Front-wheel drive type, fixed location
	Gear ratio		11.692
Wheels	Q'ty(FR/RR)		Single : 2/2, Double : 4/2
	Front(drive)	Single	8.25-15-14 PR
		Double	7.50-16-12 PR
	Rear(steer)		7.00-12-14 PR
Brakes	Travel		Front wheel, wet disk brake
	Parking		SAHR (Spring Actuate Hydraulic Release) type
Steering	Type		Full hydraulic, power steering
	Steering angle		74.8˚ to both right and left angle, respectively
	Relief valve presssure		135 bar (1960 psi)

4. TIGHTENING TORQUE FOR MAJOR COMPONENTS

NO	Item		Size	kgf · m	lbf · ft
1	Engine	Engine mounting bolt	M10×1.25	7.4±1.4	53.7±10.7
2		Engine bracket mounting nut	M10×1.5	6.9±1.4	49.9±10.1
3		Radiator mounting bolt, nut	M10×1.5	6.9±1.4	49.9±10.1
4	Hydraulic system	Hydraulic pump mounting bolt	M14×1.5	7.0±0.5	51±3.6
5		MCV mounting bolt, nut	M12×1.75	12.8±3.0	92.6±21.7
6		PF valve mounting bolt	M 8×1.25	2.5±0.5	18.1±3.6
7		Steering unit mounting bolt	M10×1.5	4.0±0.5	28.9±3.6
8		Priority valve mounting bolt, nut	M 8×1.25	2.5±0.5	18.1±3.6
9		Tilt cylinder; rod-end bolt, nut	M14×2.0	15±1.5	147±14
10		Tilt cylinder pin; mounting bolt	M10×1.5	4.0±1.5	28.9±3.6
11	Power train system	Transmission mounting bolt, nut	M16×2.0	7.5±1.5	54.2±10.8
12		Torque converter mounting bolt	M10×1.5	6.9±1.4	50±10
13		Drive axle mounting bolt, nut	M24×2.0	62.5±9.5	452±68.7
14		Drive shaft mounting bolt	3/8-24 UNF	7.0±0.7	50.6±5.1
15		Steering axle mounting bolt, nut	M14×2.0	19.6±2.9	142±21
16		Front wheel mounting nut	M22×1.5	62.0±9.3	448±67.3
17		Rear wheel mounting nut	M22×1.5	62.0±9.3	448±67.3
18	Others	Counterweight mounting bolt	M30×3.5	100±15	723±108
19		Operator's seat mounting nut	M 8×1.25	2.5±0.5	18.1±3.6
20		Head guard mounting bolt	M12×1.75	12.8±3.0	92.6±21.7
21		Cabin mounting bolt	M12×1.75	12.8±3.0	92.6±21.7

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	-	-	-	-	-

6. 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	9.1 (2.4)	★SAE 5W-40 SAE 10W SAE 10W-30 SAE 5W-30 SAE 15W-40 SAE 30
Torque converter transmission	Transmission oil	17 (4.5) 18.5 (4.9) (35D-9V: #3~ 40D-9VB: #10~ 45D-9VB:#12~ 50DN-9VB:#39~)	ATF DEXRON III
Axle	Gear oil	13 (3.4)	SHELL DONAX TD or HUYNDAI OILBANK XTEER THF 75W-80
Hydraulic tank	Hydraulic oil	76 (20)	★ISO VG 15 ISO VG 32 ISO VG 46 ISO VG 68
Fuel tank	Diesel fuel★1	3.5/4.0 ton : 134 (35) 4.5/5.0 ton : 139 (47)	★ASTM D975 NO.1 ASTM D975 NO.2
Fitting (Grease nipple)	Grease	-	★NLGI NO.1 NLGI NO.2
Radiator	Antifreeze : Water	12.5 (3.3)	Ethylene glycol base permanent type (50:50) ★Ethylene glycol base permanent type (60 : 40)

NOTES :

- Engine oil should be ACEA classification C2/C3.
- 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	Master cylinder and wheel cylinder caps dust seals	Every 1 years
2	Lift cylinder hose	Every 1 years (harsh operation) Every 2 years (normal operation)
3	Tilt cylinder hose	
4	Side shift cylinder hose	
5	Brake hose or tube	
6	Hydraulic pump hose	Every 2 years
7	Power steering hose	
8	Coolant hose and clamps	
9	Fuel hose	Every 2 years (harsh operation) Every 4 years (normal operation)
10	Packing, seal, and O-ring of steering cylinder	
11	Lift chain	
12	Hydraulic pump seal kit	Every 3 years
13	Pressure sensor	Every 5 years
14	Mast accmulator (piston type)	Every 10 years

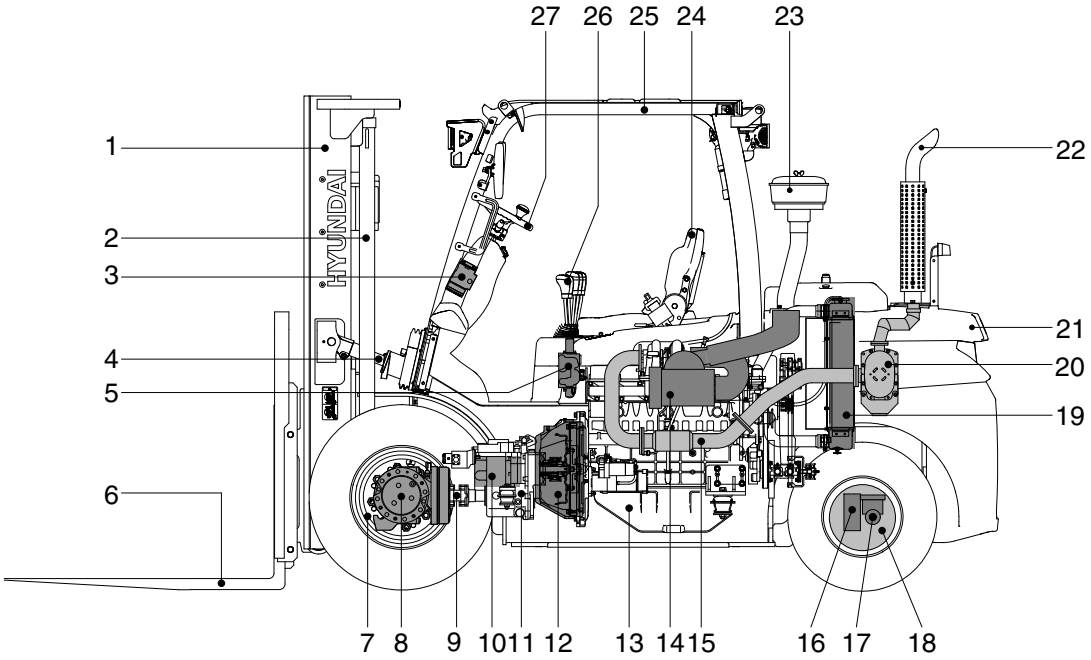
※ **Replace the O-ring and gasket at the same time when replacing the hose.**
※ **Replace clamp at the same time if the hose clamp is cracked when checking and replacing hose.**
※ **Normal operation**
- **Eight hour material handling, mostly in buildings or in clean, open air on clean paved surfaces.**

※ **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

SECTION 2 REMOVAL & INSTALLATION OF UNIT

GROUP 1 MAJOR COMPONENTS



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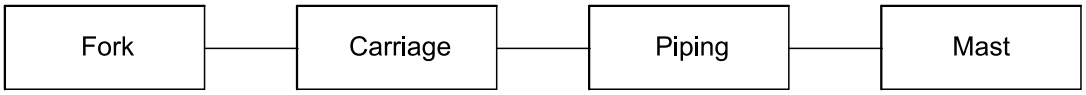
1	Mast	10	Hydraulic pump	19	Radiator
2	Lift cylinder	11	Transmission	20	Aftertreatment device
3	Steering unit	12	Torque converter	21	Counterweight
4	Tilt cylinder	13	Engine	22	Silencer
5	Control valve	14	Air cleaner	23	Precleaner
6	Fork	15	Exhaust pipe	24	Seat
7	Front wheel	16	Steering axle	25	Overhead guard
8	Drive axle	17	Steering cylinder	26	Control lever
9	Drive shaft	18	Rear wheel	27	Steering wheel

GROUP 2 REMOVAL AND INSTALLATION OF UNIT

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

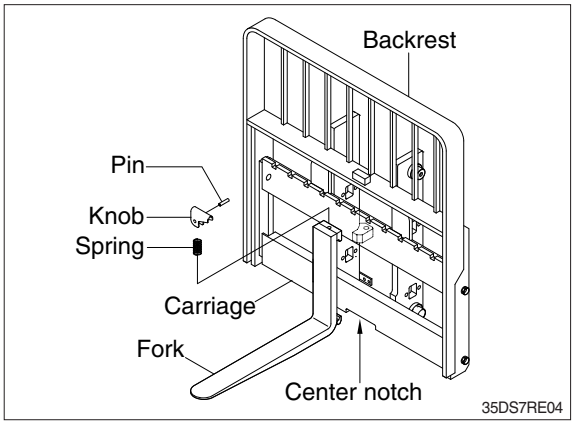
1. MAST

1) REMOVAL



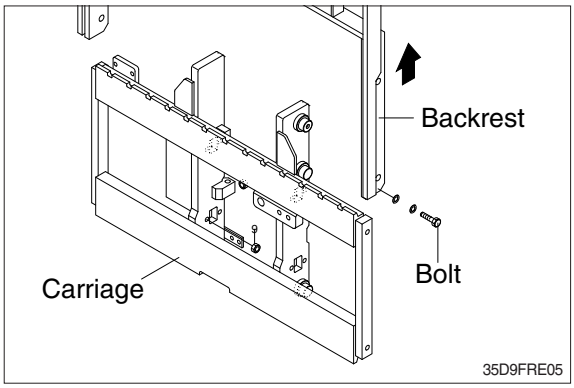
(1) Forks

① Lower the fork carriage until the forks are approximately 25 mm (1 in) from the floor.
② Turn knob up and slide one fork at a time toward the center of the carriage where a notch has been cut in the bottom plate for easy removal.
③ Remove only one fork at a time.
※ On larger forks it may be necessary to use a block of wood.



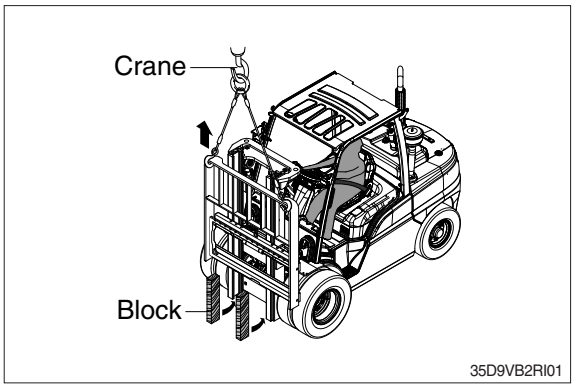
(2) Backrest (If necessary)

① Remove bolts securing backrest to fork carriage. Lift backrest straight up and remove it from carriage.

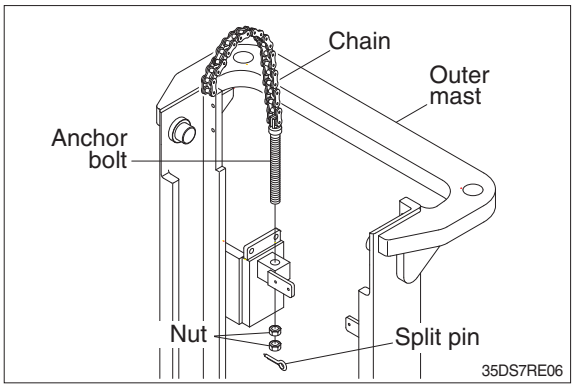


(3) Carriage

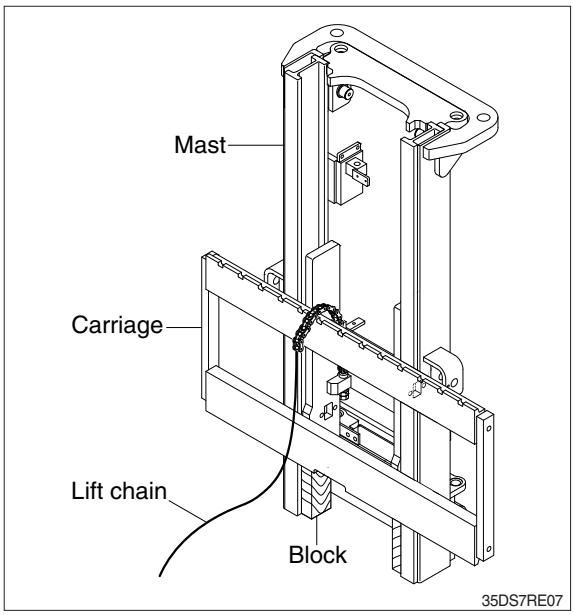
① With the mast vertical, raise the carriage high enough to place blocks under the carriage. This is done to create slack in the load chains when the carriage is lowered. Lower the carriage all the way down to the floor. Make sure the carriage is level, this will prevent any binding when the mast is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



② While supporting lift chains, remove the split pin and nuts from the anchor bolt. Slide out chain anchor bolt from the chain anchors of stationary upright.



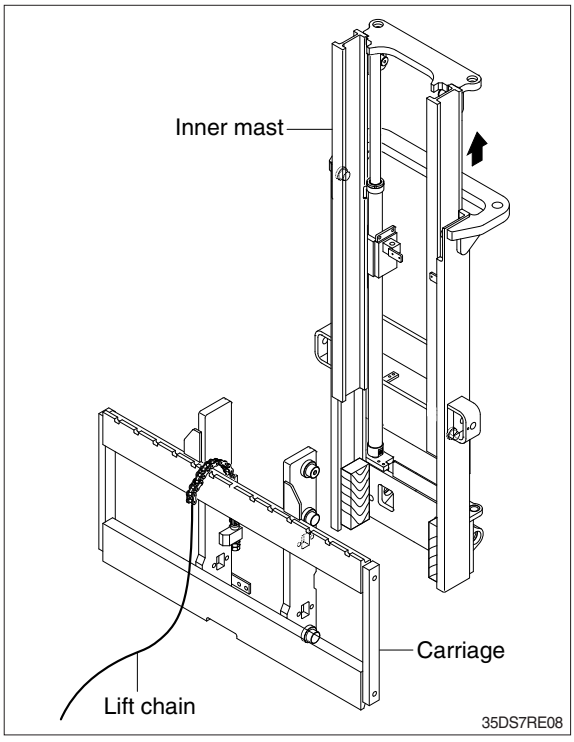
③ Pull the chains out of the sheaves and drape them over the front of the carriage.



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

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

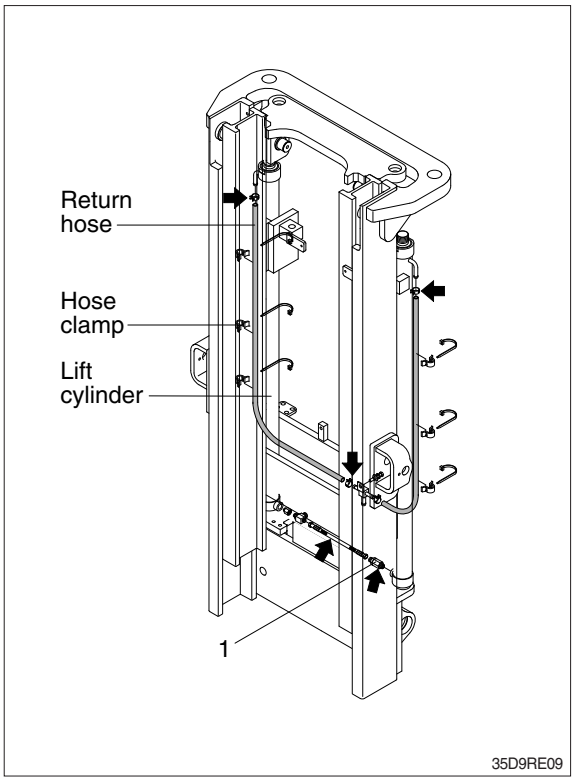
※ Inspect all parts for wear or damage. Replace all worn or damaged parts.



(4) Piping

① Remove the return hoses and clamps attached to the lift cylinder.
② Remove the return hoses from the tee.
③ Remove hose assembly, tee and down safety valve (1).

※ 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.

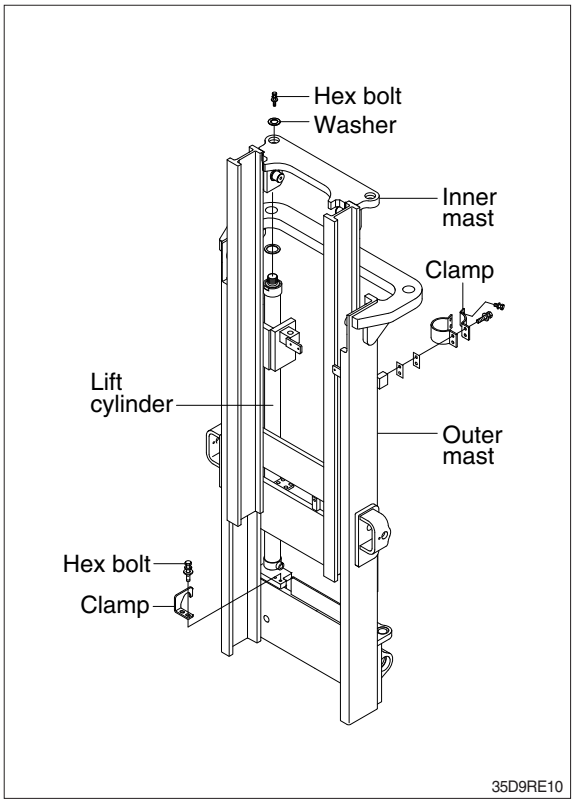


(5) Lift cylinder

① Loosen and remove hexagon bolts and washers 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.

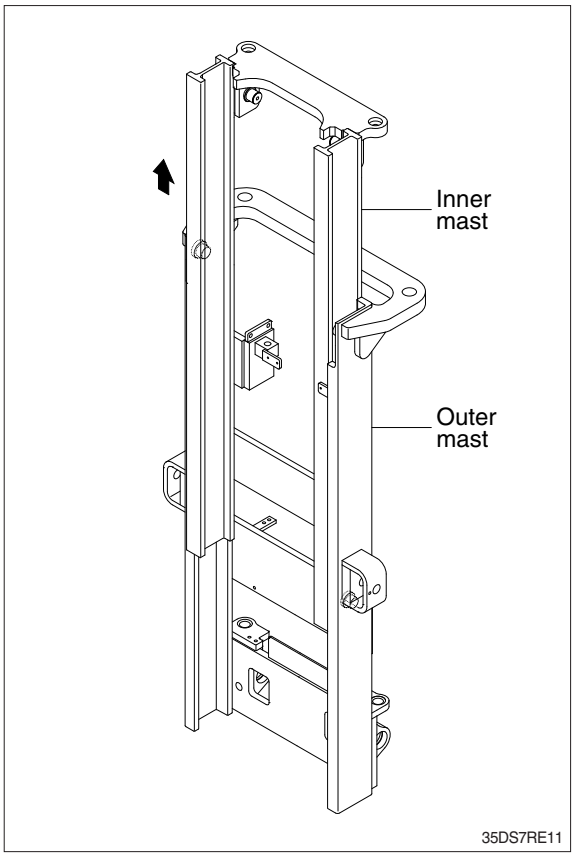
③ Loosen and remove hexagon bolts and clamp securing lift cylinders to outer mast.
④ Using an overhead hoist, slowly raise the inner mast high enough to clear lift cylinder.
⑤ Using an overhead hoist, draw out lift cylinder carefully and put down on the work floor.



(6) 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.



(7) Tilt cylinder pin

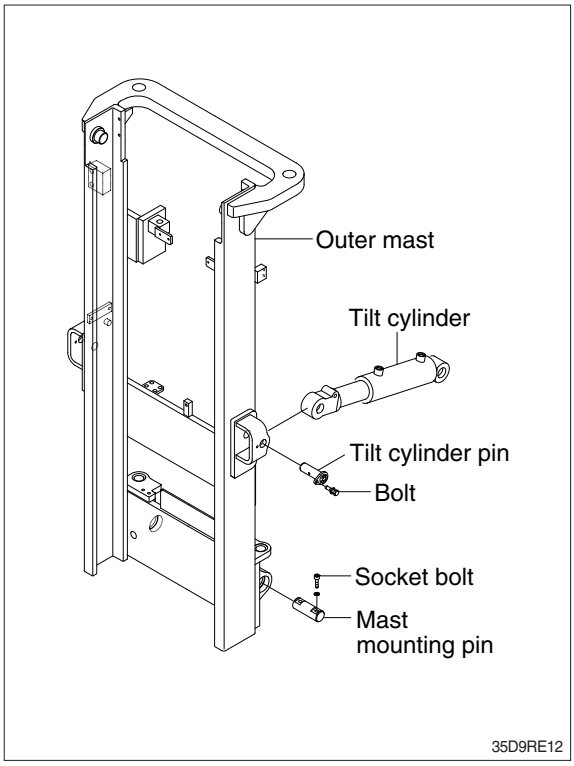
Loosen the bolt and remove the tilt cylinder pin.

(8) Mast mounting pin

① Attach a crane to the stay at the top of the outer mast, and raise enough to sustain jacked up truck.

② Loosen the mounting socket bolts and remove the mast mounting pins.
Then slowly raise the outer mast.

※ This operation is carried out under the truck, so use a pit, or if there is no pit, jack up the truck 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.

② Jack up the truck so that the front is raised and then using an overhead hoist assemble outer mast to frame.

③ Tighten mounting socket bolts to frame.

· Tightening torque : 35.1~47.5 kgf·m (254~344 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.

(3) Lift cylinder installation and adjustment

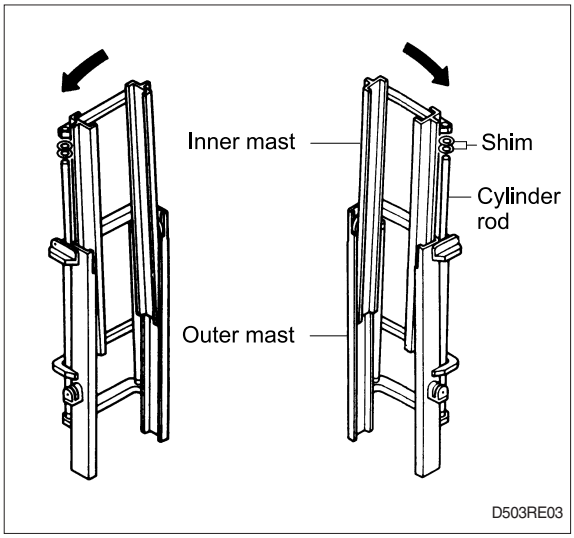
① Assemble the lift cylinder inside the outer mast, then tighten the stopper bolt. If the cylinder assembly has been replaced, adjust as follows so that the left and right cylinders are synchronized at the maximum lifting height.

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.**

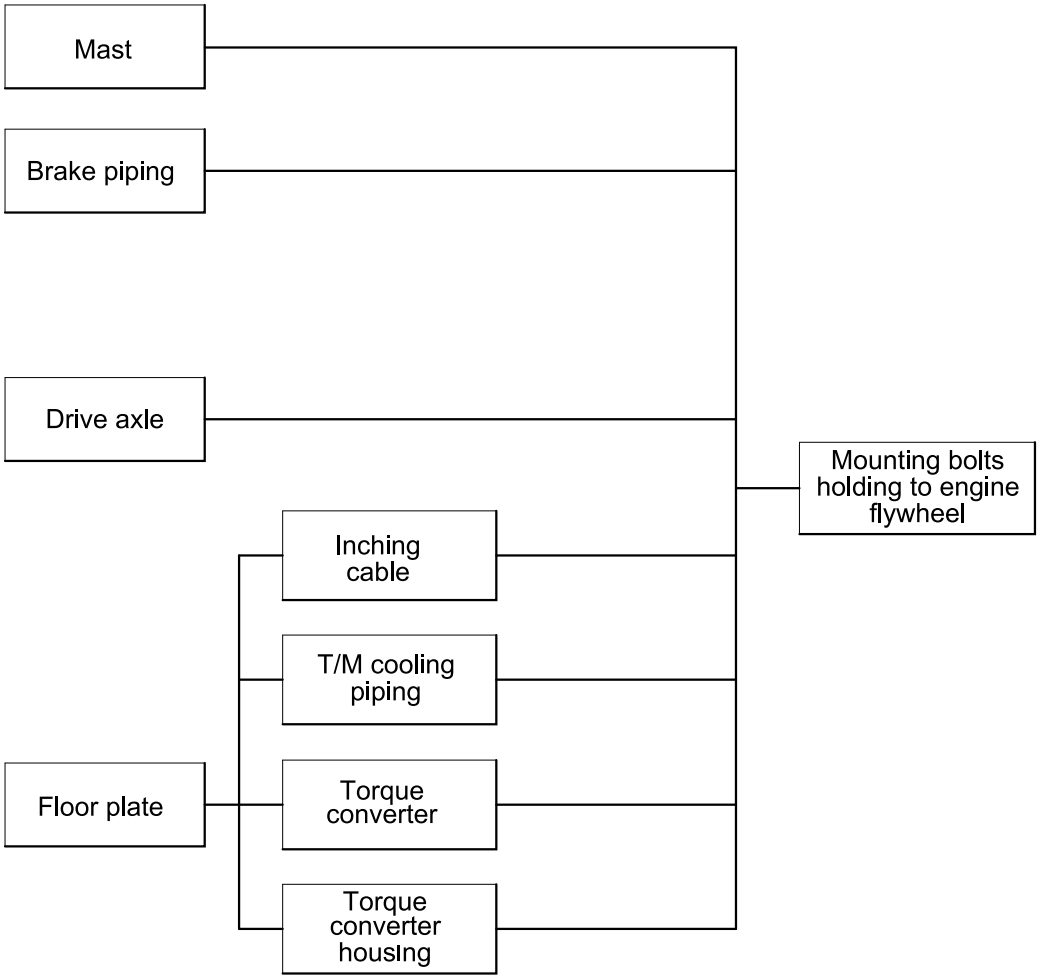
※ **If play is to RIGHT, install adjustment shim to RIGHT cylinder.**

· **Shim thickness : 1.0 mm (0.04 in)**



2. POWER TRAIN ASSEMBLY

1) REMOVAL



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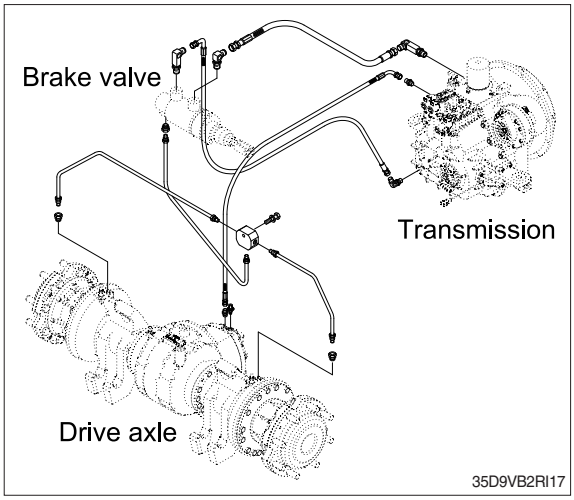
(1) Mast

Refer to section on mast (Page 2-2)

(2) Brake piping

Disconnect the brake piping from the brake housing of drive axle.



(3) Drive axle

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

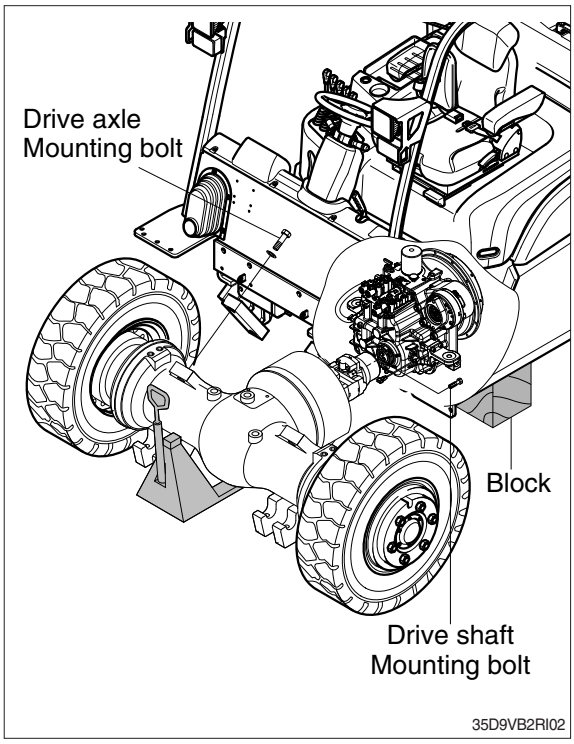
① Loosen hexagonal bolts connecting drive axle to the drive shaft.

※ **If there is a pit, use the pit for safety.**

② Jack up the truck and then put the block under the frame.

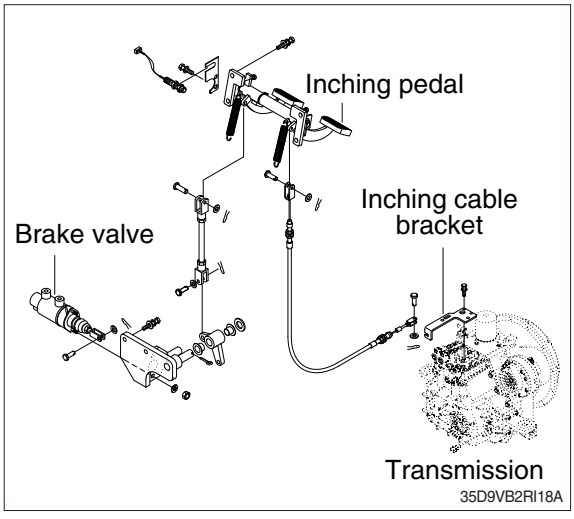
③ Prepare the truck under the drive axle unit to support it.

④ Remove mounting bolts fixing the axle to the frame and then carefully draw the truck out of the vehicle with the drive axle unit.



(4) Inching linkage

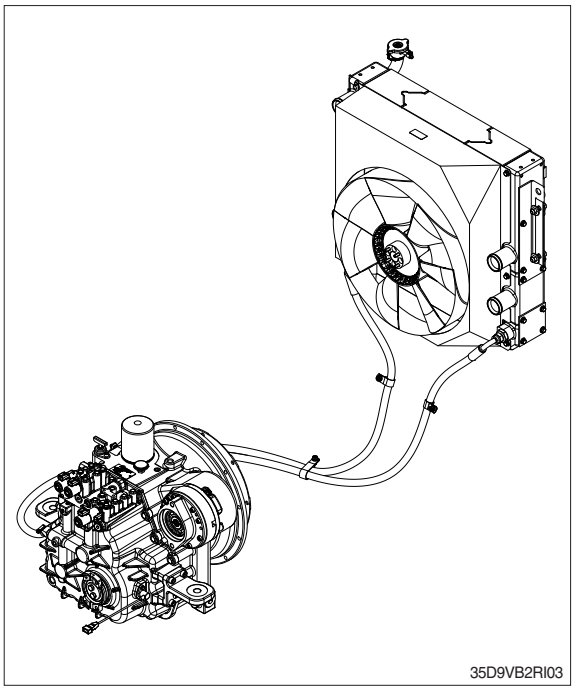
Remove the bolt fixing the inching cable bracket to T/M control valve.



(5) Transmission cooling piping

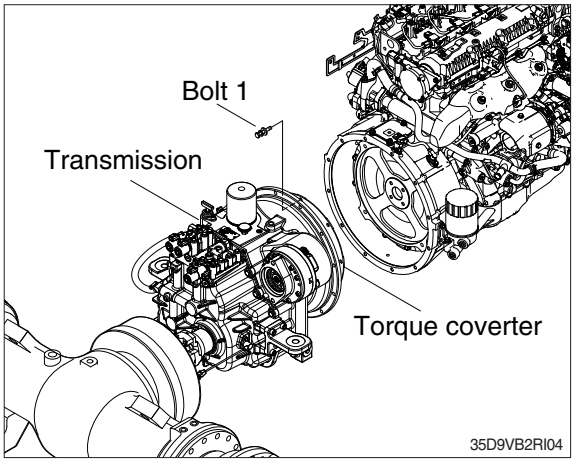
① Loosen the hose clamp and disconnect the cooling hose from the transmission.

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



(6) Torque converter

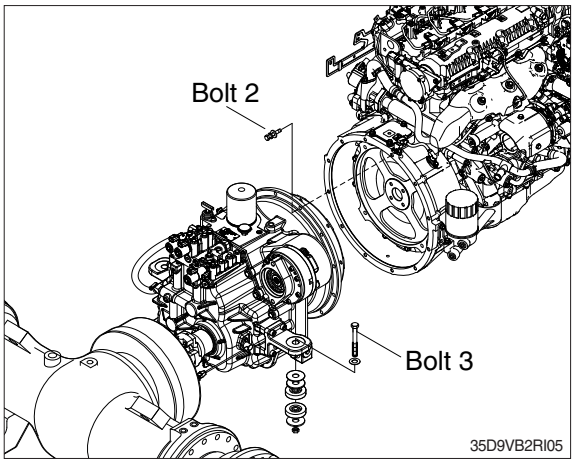
① Remove the cover on top face of the engine flywheel housing then remove the 8 mounting bolts 1 installed on the engine flywheel. To rotate the flywheel, remove 1 mounting bolt, then insert a turning tool in the mounting hole. One man must turn the engine fan by hand while the other turns the flywheel.



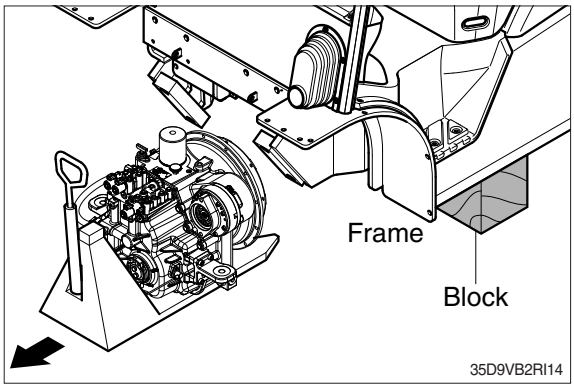
(7) Mounting bolts holding to flywheel housing

① Loosen the mounting bolts 2 to disconnect the transmission assembly from the engine flywheel.

② Loosen the mounting bolts 3 to disconnect the transmission assembly from the main frame.



③ Using a moving truck slowly pull out transmission assembly to the front.



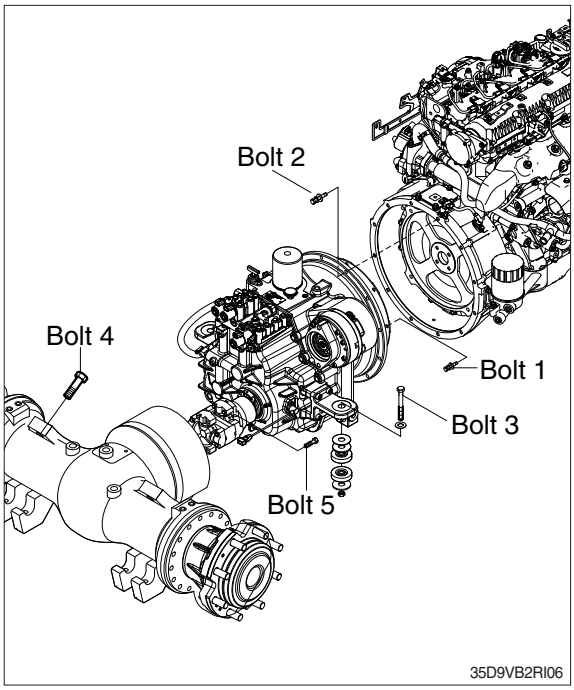
2) INSTALLATION

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

(2) Tightening torque

- 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 : 7.5 kgf·m (54.3 lbf·ft)
- Bolt 4 : 53~72 kgf·m (383~521 lbf·ft)
- Bolt 5 : 6.3~7.7 kgf·m (45.6~55.7 lbf·ft)

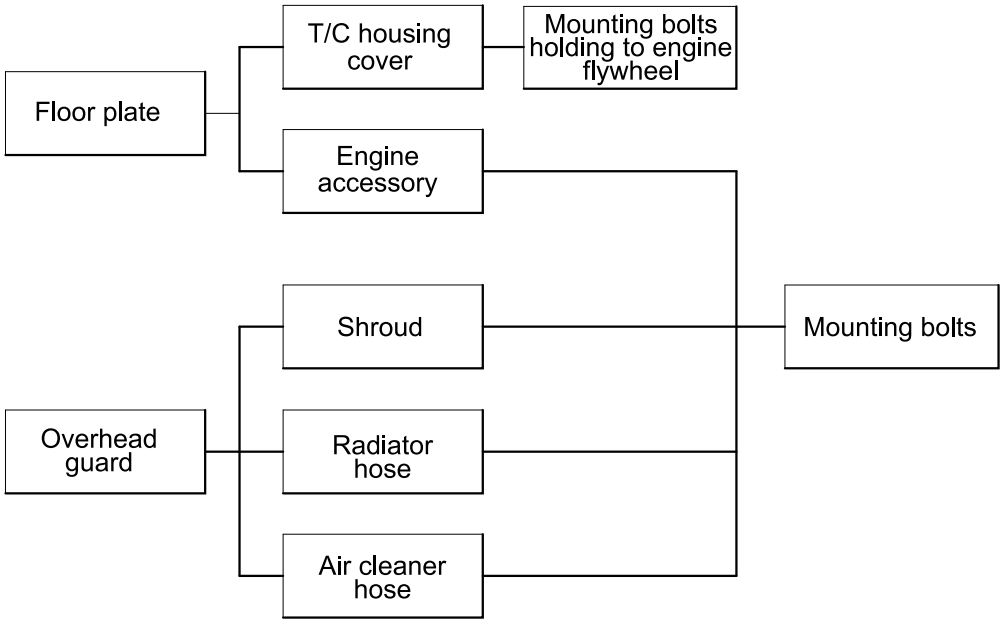
※ Apply loctite #243 on the thread of the bolt 4,5 before tightening.



3. ENGINE

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

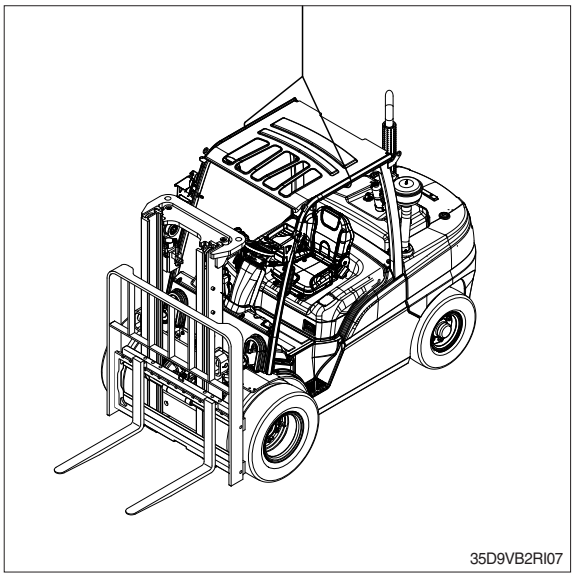
1) REMOVAL



D503RE25

(1) Overhead guard

Remove the wiring for rear combination lamp, working lamp, head lamp and flasher lamp on the stay of the overhead guard and then raise it. Then remove the bonnet with seat.



35D9VB2RI07

(2) Remove the torque converter housing cover, mounting bolts installed to flywheel housing.
For details, see page 2-9.

(3) Engine accessory

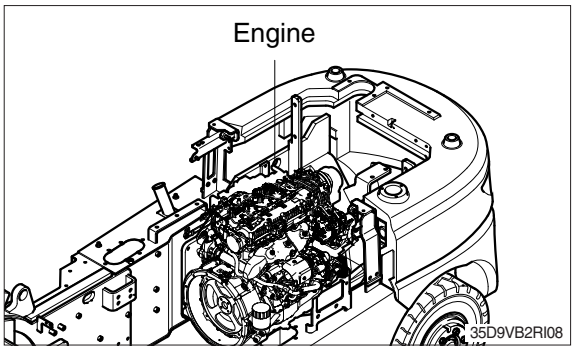
Remove all wiring harnesses, cables and hoses around the engine, dashboard and frame.

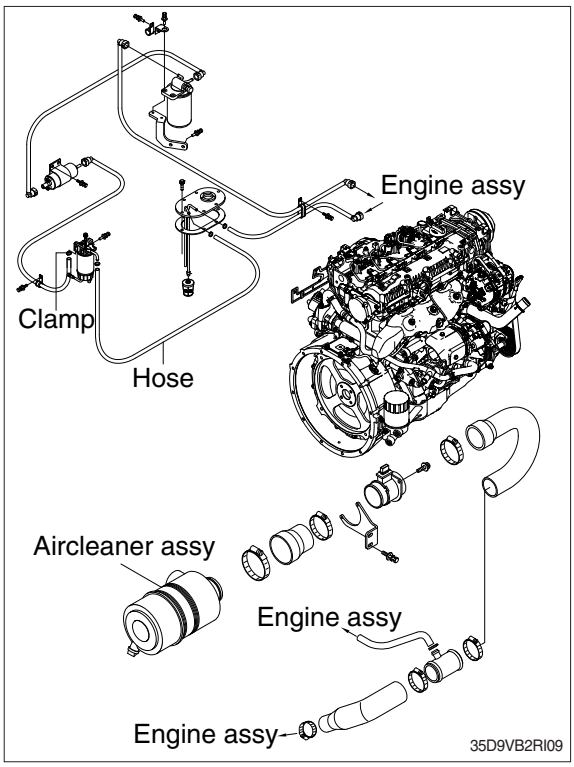
① Wiring harness to alternator and starter.

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

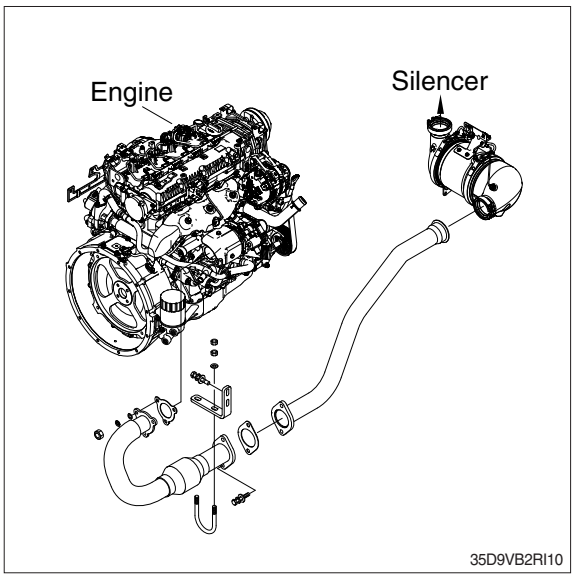
③ Cables for meters, buttons and accelerator pedal.

④ Hoses to fuel tank and air cleaner.
Loosen the clamps and disconnect the hoses from the engine.



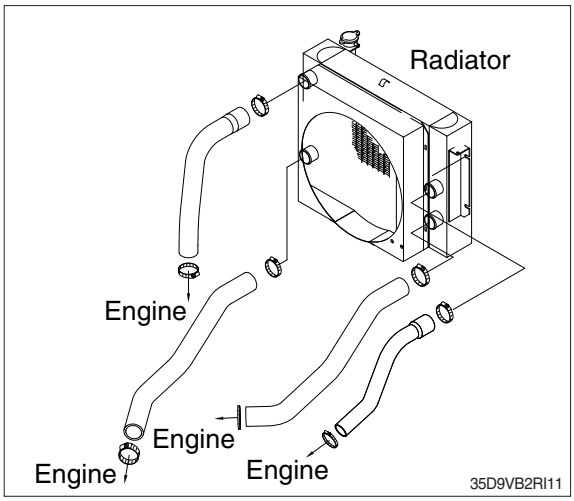


⑤ Exhaust pipe.
Loosen the nuts and disconnect the pipe from the engine.



(4) Radiator hose

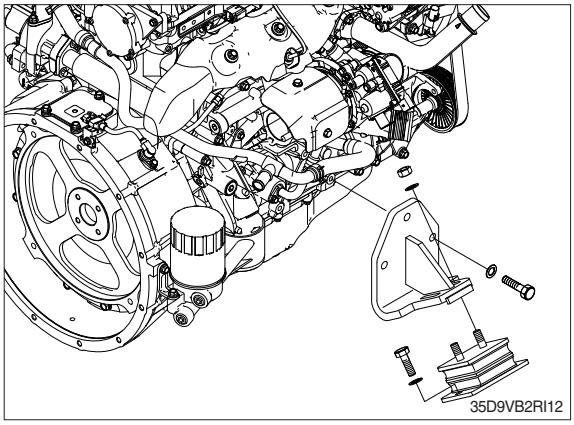
Open the drain valve of the radiator and drain the cooling water, then remove the radiator hose.



(5) Mounting bolt

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

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



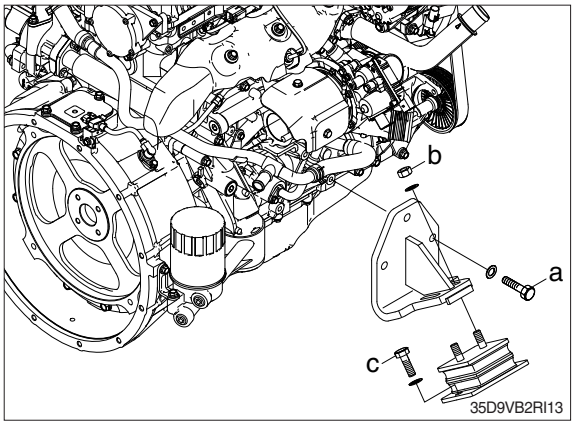
2) INSTALLATION

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

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

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

※ **Before installing the bolts and nuts, loctite #243 in the holes should be removed by a tap.**

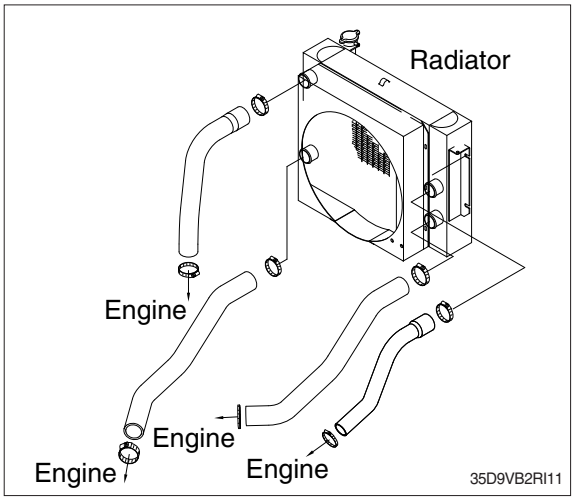


(1) Tighten the engine mounting bolts (a).
- Tighten torque : 5.9~8.9 kgf·m (42.7~64.4 lbf·ft)

(2) Tighten the engine mounting bracket nuts (b) and the frame mounting resillient bolts (c).
- Tighten torque : 5.5~8.3 kgf·m (39.8~60.1 lbf·ft)

(3) Radiator hoses

Insert the radiator hoses securely and fit the clamps.

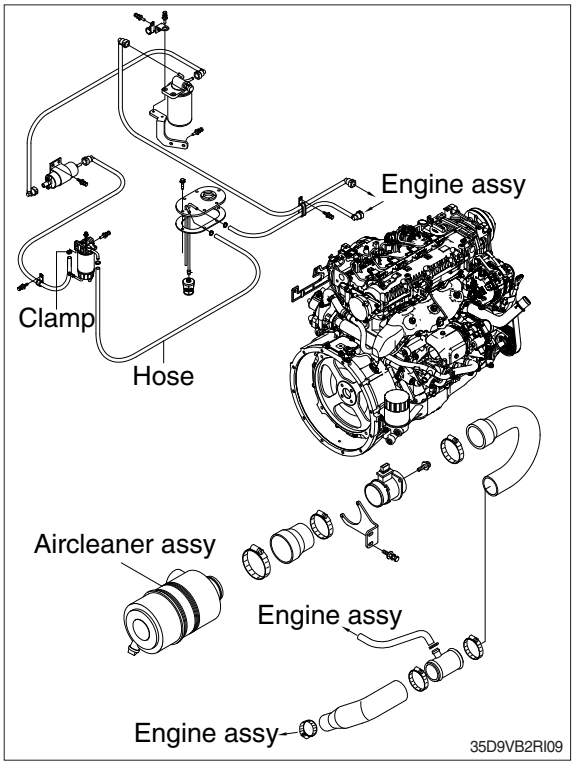


(4) Fuel hoses

Insert the fuel hoses securely and fit a clamp.

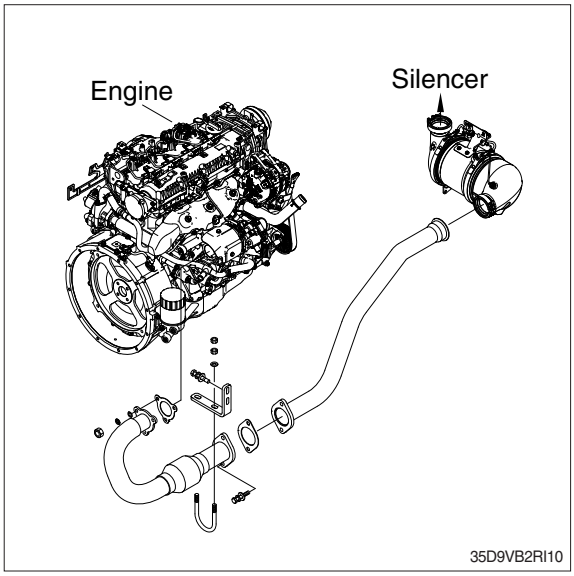
(5) Air cleaner hose

Insert the air cleaner hose securely and fit a clamp.



(6) Exhaust pipe

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

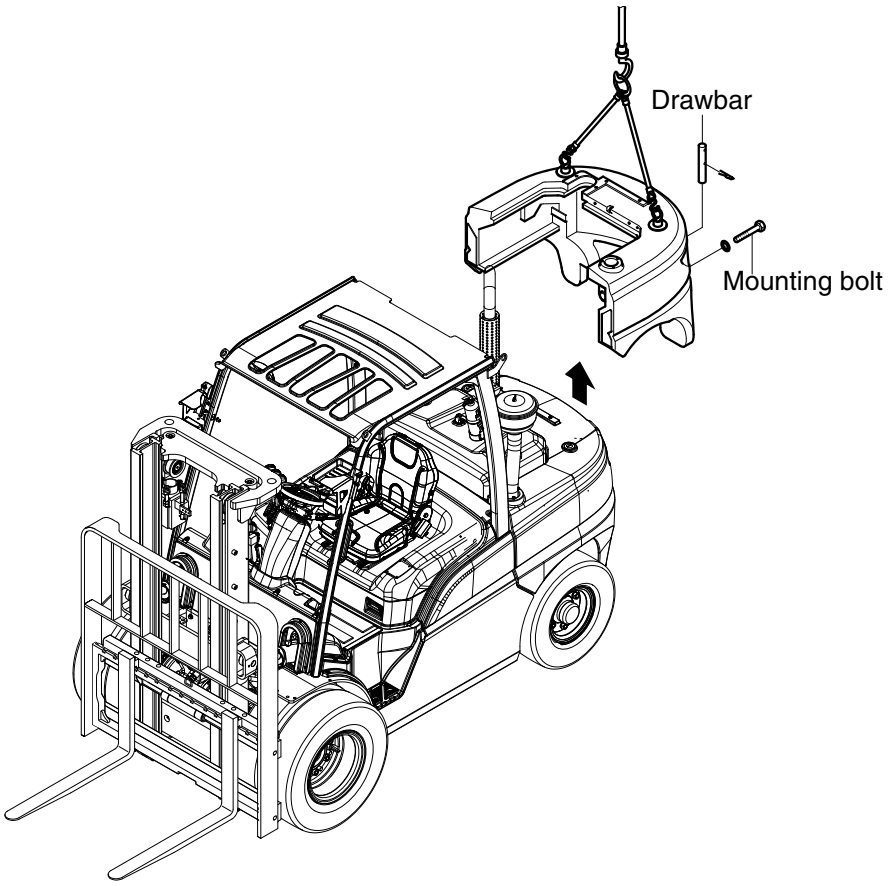


5. STEERING AXLE

1) REMOVAL

Counterweight — Rear wheel — Hose and pipe — Mounting bolt

(1) Counterweight



35D9VB2RI15

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)

35D-9VB, 40D-VC	1821 kg (4015 lb)	45D-9VB, 50DN-9VC	2544 kg (5609 lb)
40D-9VB, 45D-VC	2187 kg (4822 lb)	50DN-9VB	2866 kg (6318 lb)

· Tightening torque : 100±15 kgf·m (723±108 lbf·ft)

(2) Rear wheel

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

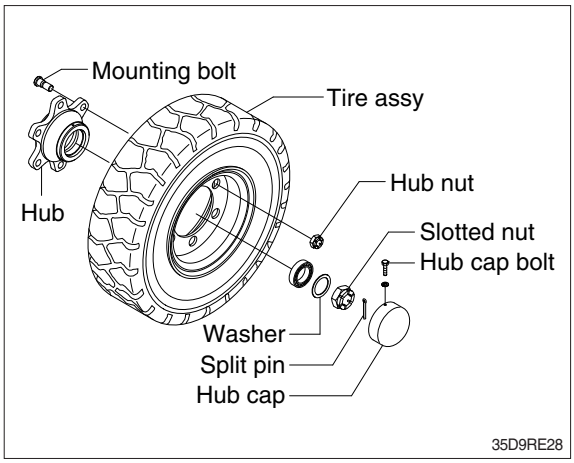
· Tightening torque

- Hub nut

  61.2±9.3 kgf·m (442±67.3 lbf·ft)

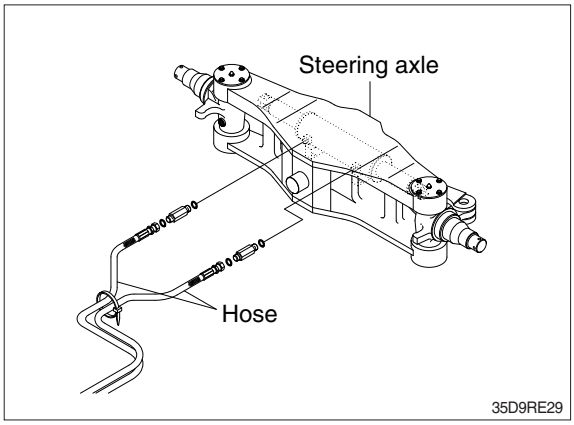
- Hub cap bolt

  1.15±0.15 kgf·m (8.3±1.1 lbf·ft)



(3) Hose

Disconnect the hoses from the steering axle.



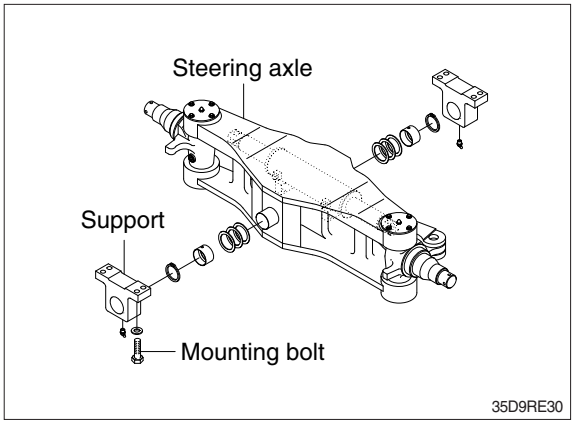
(4) Mounting bolt

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

19.6±2.9 kgf·m (142±21.0 lbf·ft)



※ Apply loctite #277 on the thread before tightening.

※ Tighten the slotted nut to the torque 20 kgf·m and loosen it to adjust the preload (0.3~0.4 kgf·m) and fit the split pin.

GROUP 3 MAINTENANCE FOR HOSE

1) MAINTENANCE

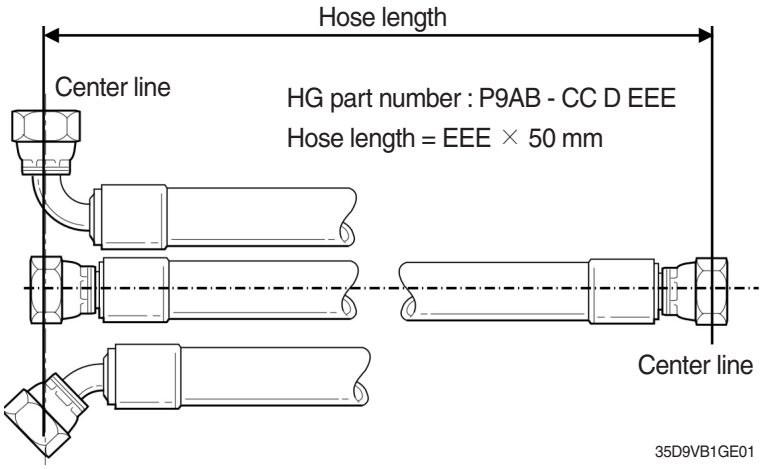
The function and service life of hydraulic components depend to a great extent on how clean the hydraulic oil is. Therefore, it is very important to prevent dirt from entering the hydraulic system. Some simple advice to keep the hydraulic system clean:

- 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 reuse 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.

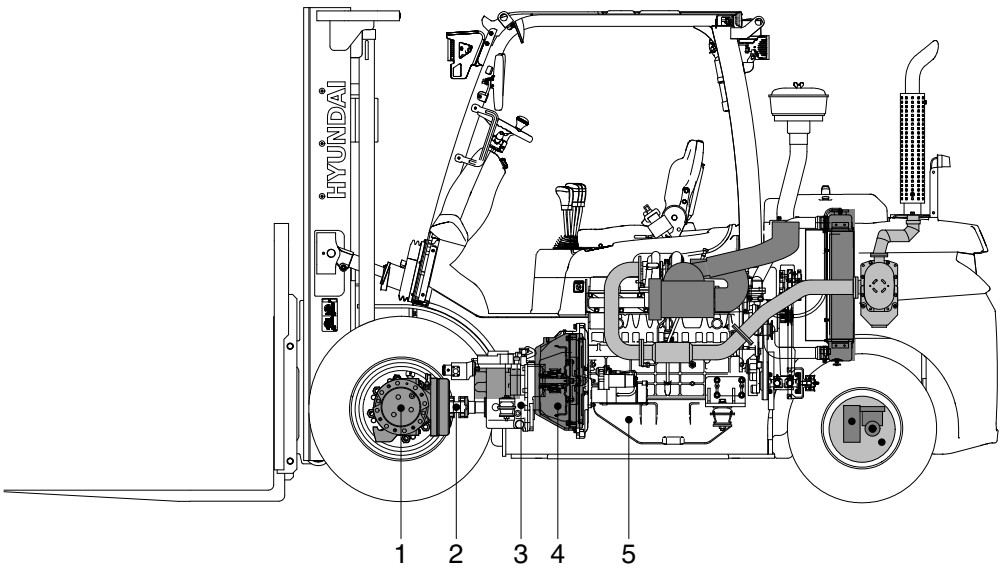
SECTION 3 POWER TRAIN SYSTEM

SECTION 3 POWER TRAIN SYSTEM

GROUP 1 STRUCTURE AND OPERATION

1. POWER TRAIN COMPONENT OVERVIEW

1) STRUCTURE



35D9VB3PS01

1	Drive axle	3	Transmission	5	Engine
2	Drive shaft	4	Torque converter		

2) OPERATION

Power train system consists of engine (5), torque converter (4), transmission (3), drive shaft (2), drive axle (1).

Engine power is transmitted to the transmission (3) through the torque converter (4).

Transmission (3) which operates as a type of regularly and continuously engaged counter shaft shifting by 1 stage both forward and reverse consists of 4 hydraulic clutch packs.

Clutch piston is released by tension of spring.

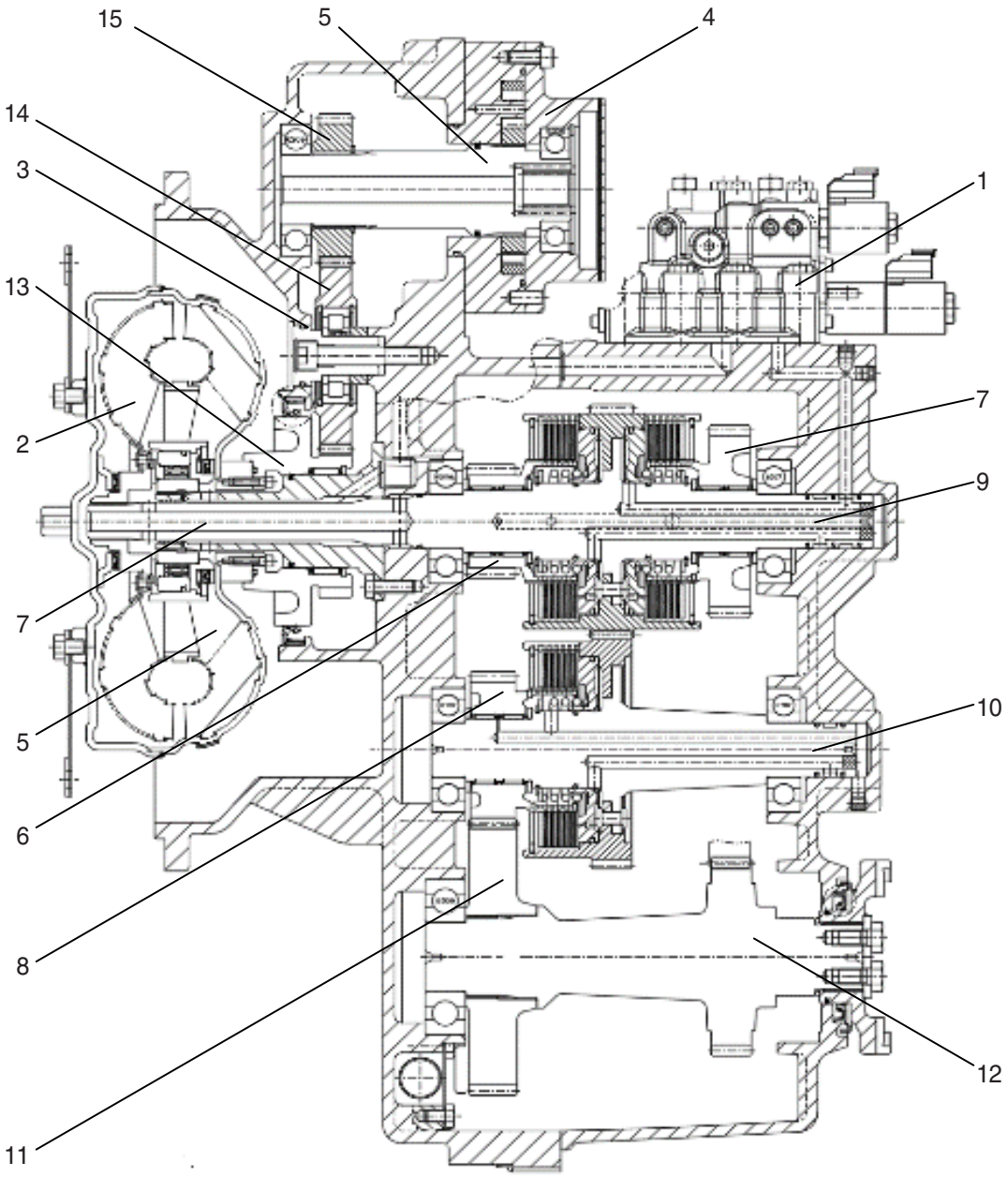
The power is transmitted to spiral gear and bevel gear set of differential through the output gear and then goes to the drive wheel via drive axle.

3) SPECIFICATION

Item			Specification
Torque converter	Model		AEROSPACE
	Type		3 Element, 1 stage, 2 phase
	Stall ratio		2.21 : 1
Transmission	Type		Power shift
	Gear shift(FWD/REV)		2/1
	Control		Electrical single lever type
	Overhaul ratio	FWD	1st : 2.667 2nd : 1.024
		REV	1.838
Drive axle	Type		Front-wheel drive type, fixed location
	Gear		Spiral bevel gear type
Brakes	Travel		Front wheel, wet disk brake
	Parking		SAHR (Spring Actuate Hydraulic Release) type

2. TRANSMISSION

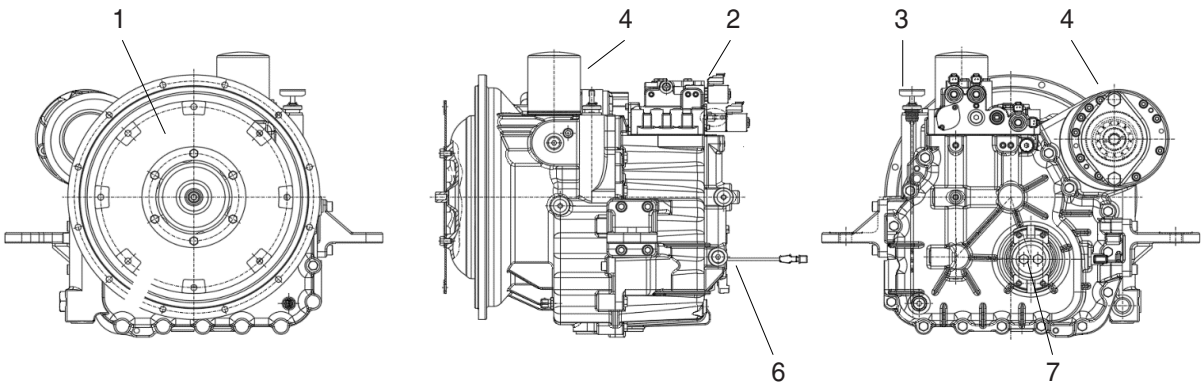
1) STRUCTURE



35D9VB3PS02

1	Control valve	6	Forward 1st clutch gear	11	Output gear
2	Torque converter	7	Forward 2nd clutch gear	12	Output shaft
3	PTO shaft	8	Reverse clutch gear	13	PTO input gear
4	Oil pump	9	Forward clutch pack	14	PTO idle gear
5	PTO pump shaft	10	Reverse clutch pack	15	PTO output gear

2) INSTALLATION VIEW



35D9VB3PS03

1	Torque converter	3	Oil level pipe and dipstick	5	Flange yoke
2	Control valve	4	Oil filter	6	Speed sensor

3) OPERATION

(1) Torque converter

① Converter equipment

The torque converter is an automatic fluid drive. It transmits engine torque by means of hydraulic force. The torque converter leads and the power which is delivered rotated the charging pump. Oil is drawn form the transmission reservoir by the charging pump. The pump delivers its entire output to a full-flow oil filter for cleaning. From the oil filter, the oil supply is sent to the control valve.

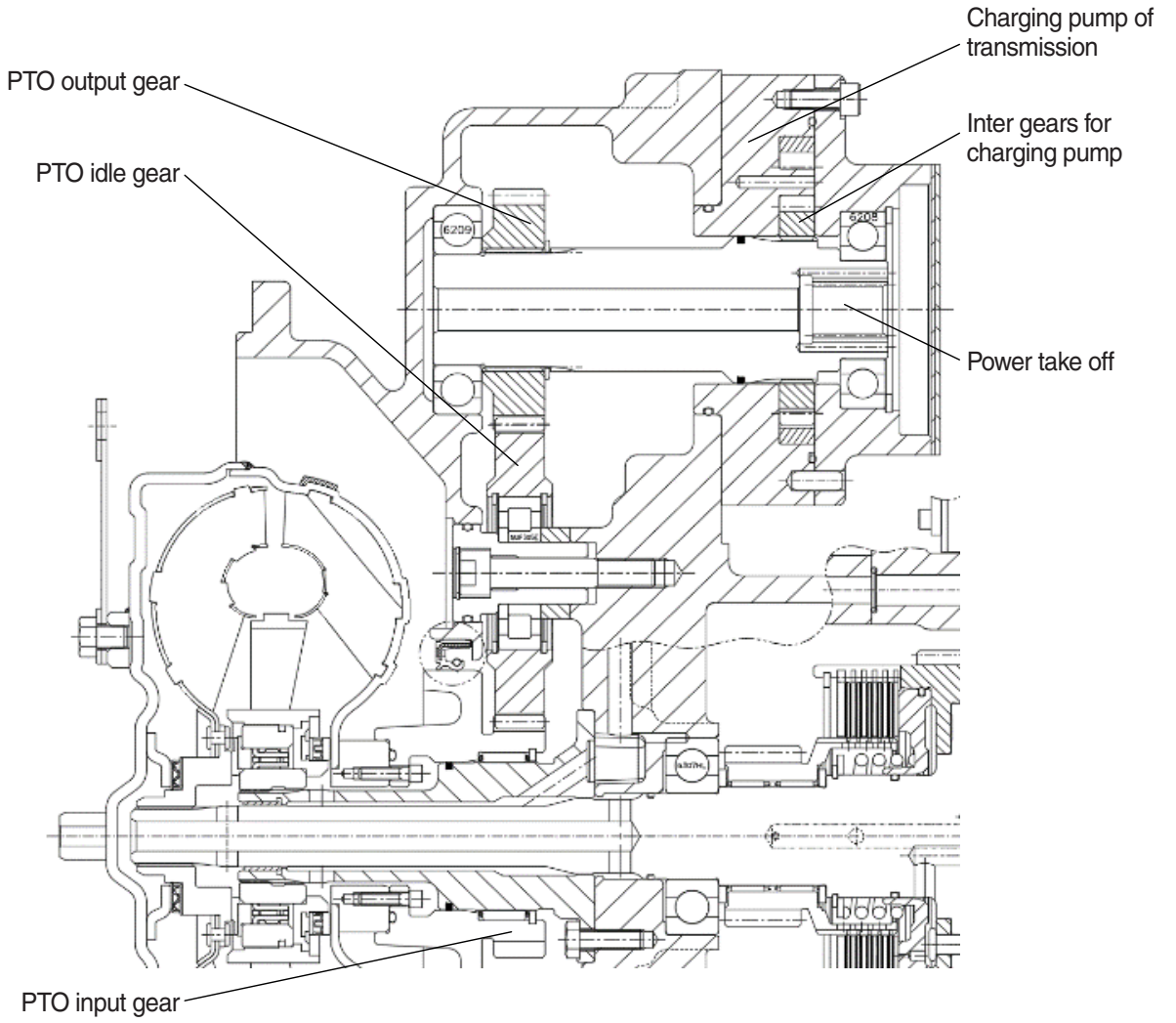
The main pressure regulator valve provides pressure for clutch pack, directs oil to the solenoid valve. Moving the solenoid valve allows oil to charge the selected (forward or reverse) clutch line and to engage that clutch.

The remaining oil appropriating clutch pressure flows into the torque converter, A converter pressure regulator valve in the converter-in line limits the oil pressure there. {The oil pressure input to the torque converter is adjusted 3~7 kgf/cm² (42.7~64 psi).} {The oil pressure output from the torque converter is adjusted below 1~4 kgf/cm² (14.2~64 psi).} The toeque converter is continuously filled with oil during operation, Rotation of the converter impeller imparts energy to the oil which, is turn, drives the turbines. The oil then flows between the stator vanse which redirect it to the impeller. At thist time, torque is increased.

The oil from the torque converter enters the cooler, The cooler is a heat exchanger in which the oil flows through air cooled passages. Ater refrigerated, it is in charge of clutch lubrication through the lubrication oil pach of the clutch shaft. A lubrication valve between the cooler and lubrication system returns all excess oil to the transmission reservoir.

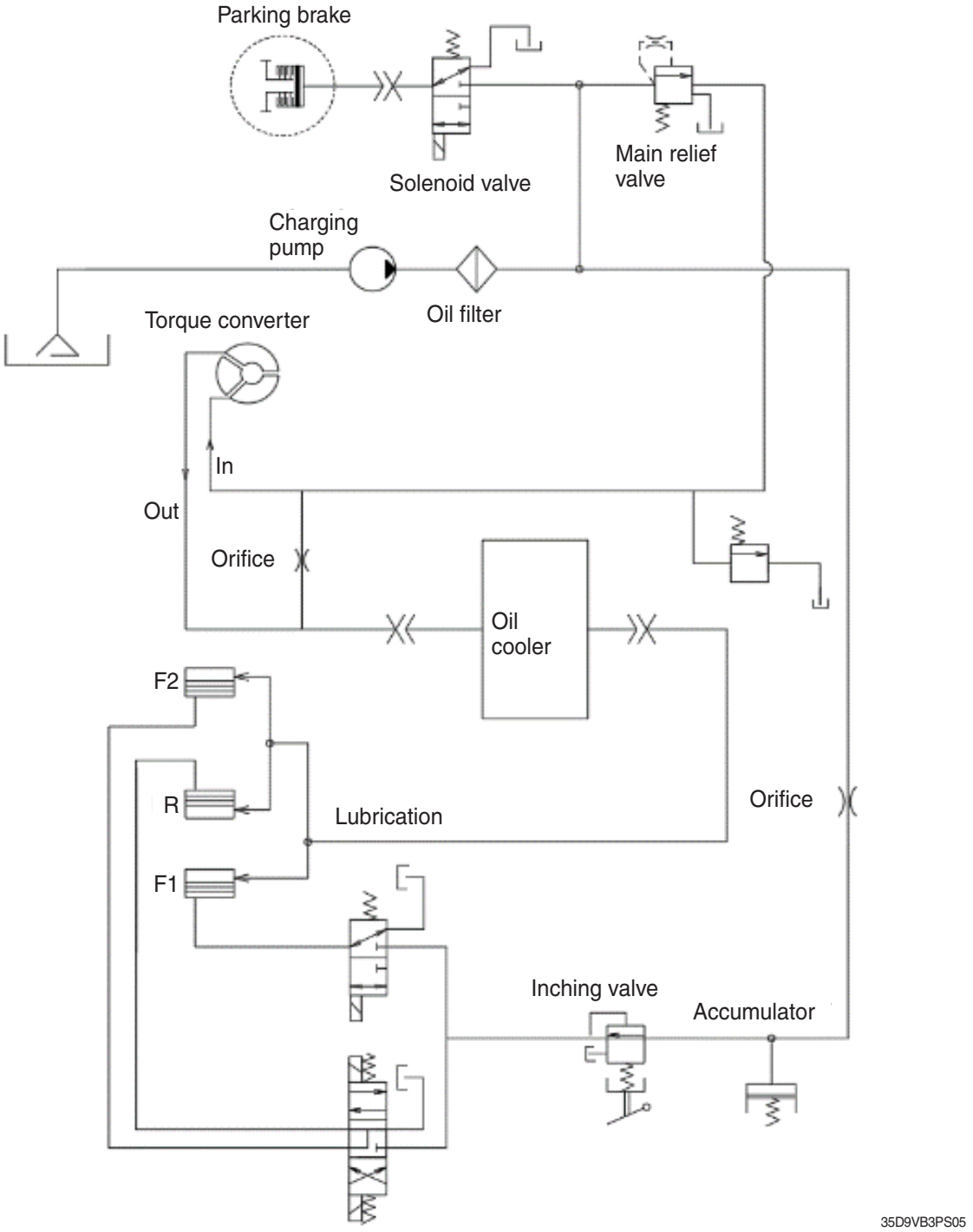
② Pump drive device

There is pump device beside torque converter as below picture which is for charging pump of transmission and power take off (PTO).



35D9VB3PS04

4) HYDRAULIC CIRCUIT



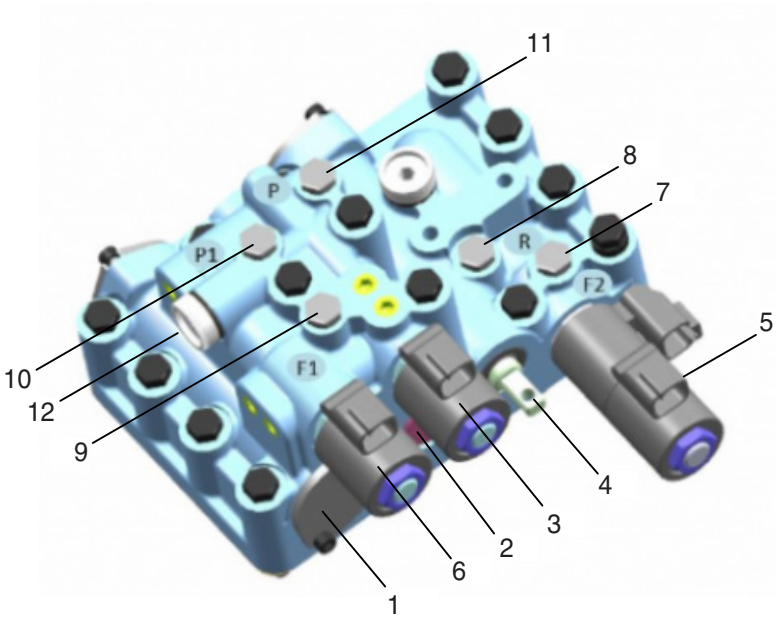
(1) The oil that is pumped up through the strainer from the oil pump of transmission by charging pump of transmission. And this oil is sent to Torque converter through the relief valve for the main pressure of hydraulic clutches.

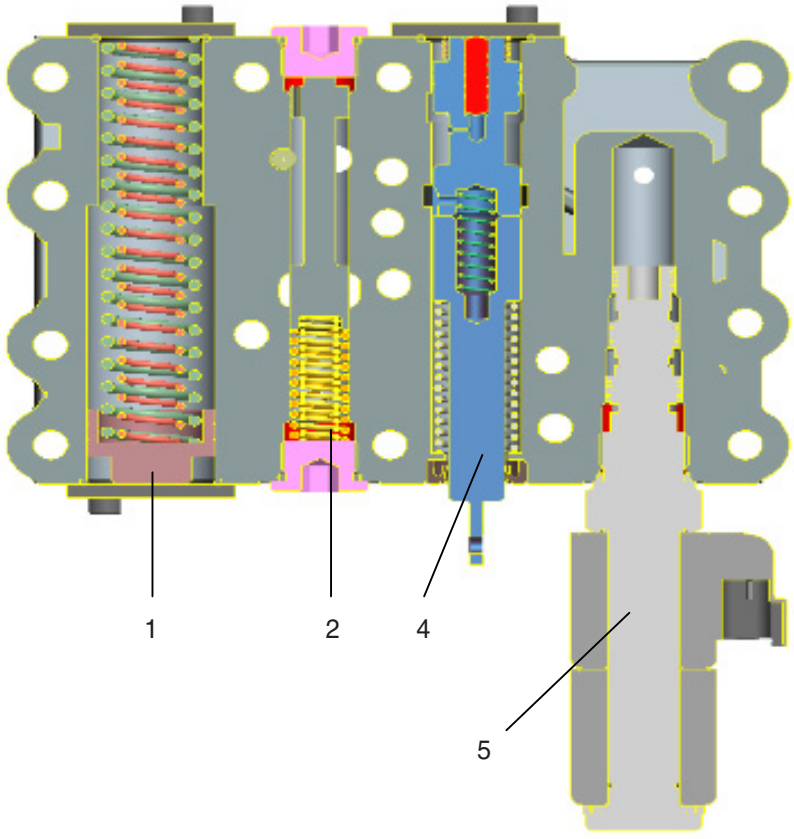
(2) The oil that is sent to torque converter flows between the turbine shaft and Inner race of free wheel, and flows into the circuit of converter through the space between stator wheel and turbine wheel.

(3) The oil which is drained from torque converter is cooled by the external cooler of the vehicle. And this cooled oil lubricates and cools each parts of Transmission like bearings, clutches and so on.

5) CONTORL VALVE

(1) Structure





35D9VB3PS06

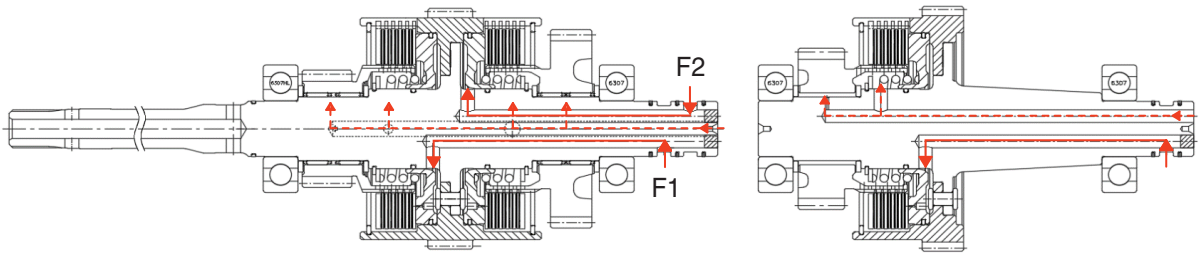
1	Modulation	7	For. 2 clutch pressure check port
2	Main relief	8	Rev. clutch pressure check port
3	Parking solenoid valve	9	For. 1 clutch pressure check port
4	Inching spool	10	Parking pressure check port
5	For 2, rev. solenoid valve	11	Main pressure check port
6	For 1. solenoid valve	12	Outlet port for releasing parking brake

(2) Assembly

Control valve assembly contains main relief valve for regulating pressure of hydraulic clutch assembly, inching valve for adjusting clutch pressure, accumulator valve for rising up clutch pressure smoothly, solenoid valves for selecting direction (F1, F2 & R) and controlling parking brake.

Structure	Operation
Main relief valve	This valve regulates the clutch pressure stably.
Inching valve	This valve adjusts the pressure of clutch through the controlling Inching pedal.
Accumlator valve	This valve adjusts the pressure of clutch for smooth start when the operator wants to move and change the direction.
Solenoid valve for direction (F&R)	These valve control the oil flow for moving forward 1, 2 & reverse through voltage signal which is given by direction selector.
Solenoid valve for parking	This valve control the oil flow for applying and releasing parking brake.

6) CLUTCH



Forward 1, 2 clutch　　Reverse clutch

——— : Pressure line

--------- : Lubrication line

35D9VB3PS07

(1) Summary

① This transmission consists of the forward and reverse shift equipments which is the wet multipic disc type of hydraulic clutch.

② There are 7 discs per each clutch which is made by carbon paper.

(2) Clutch shifting

① The explain of shift is represented in case of the shift "N (neutral) → F or R" in the vehicle.

② F & R solenoid valve become "ON" by voltage signal which is given by gear selector on the vehicle.

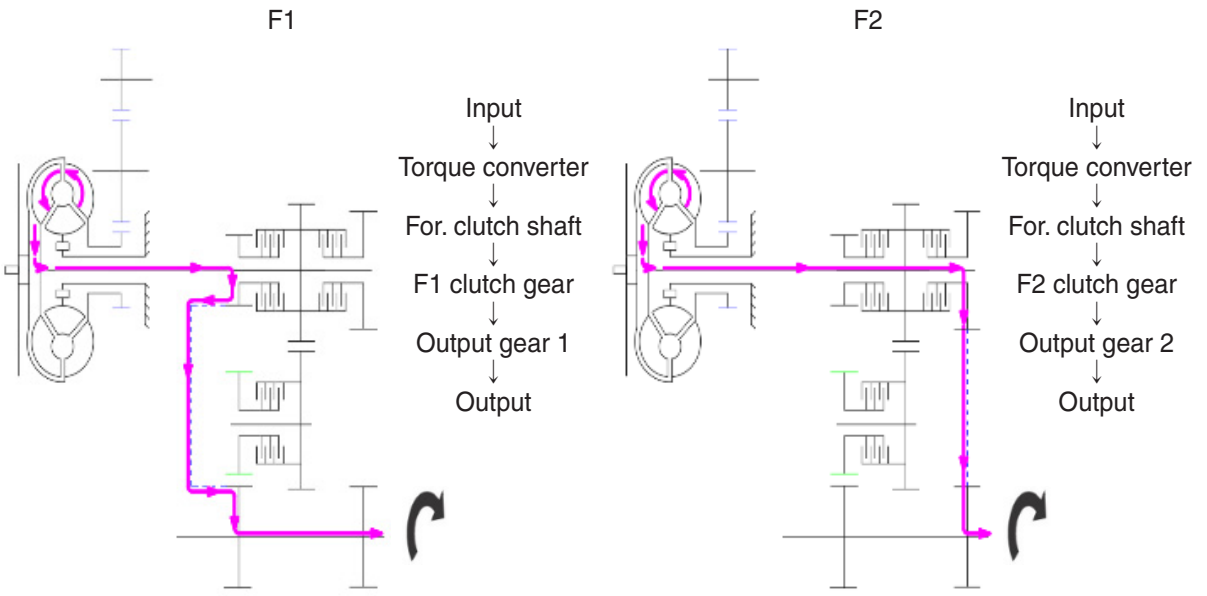
③ The hydraulic oil that is charged in accumulator valve discharges to the clutch port, and the port is filled.

④ After the filling of the port concludes, the oil that comes through the orifice "A" presses the piston of the accumulator slowly. And the clutch is engaged by the prescribed characteristic of pressure up, and the shock in clutch engagement is relieved.

⑤ When the clutch engagement concludes and the hydraulic oil becomes regular pressure.
⑥ The hydraulic oil in the piston room presses the piston, and make the steel plates and the friction plates stick strongly against the force of the return spring.
⑦ Therefore the torque that is transmitted to the clutch shaft assembly transmits to the reduction gears.

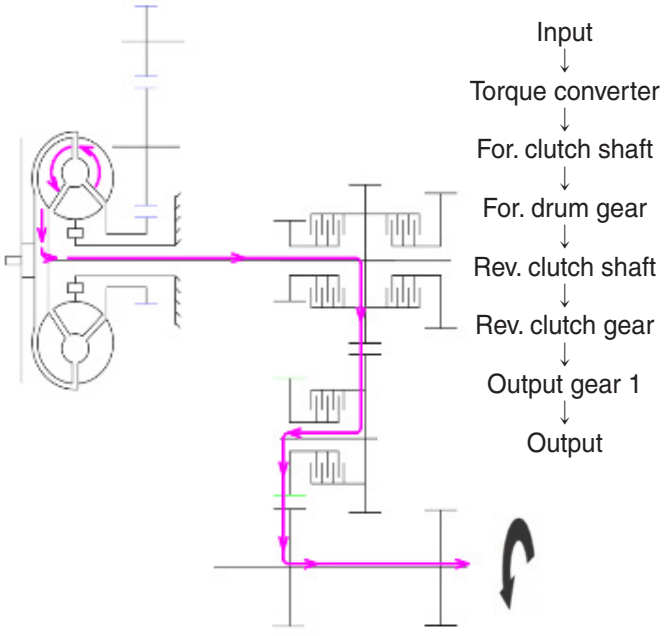
7) POWER FLOW

(1) Forward 1, 2



35D9VB3PS08

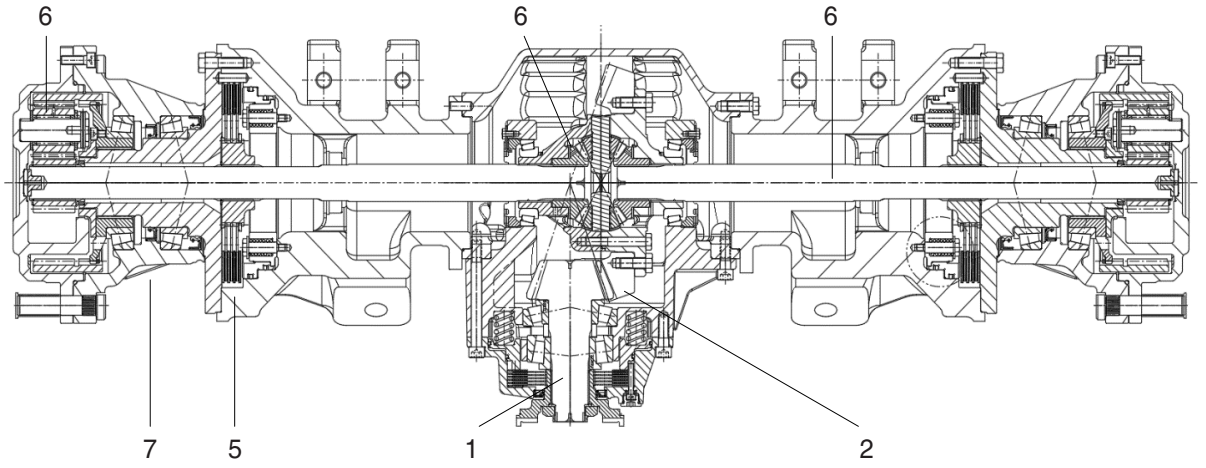
(2) Reverse



35D9VB3PS09

3. DRIVE AXLE

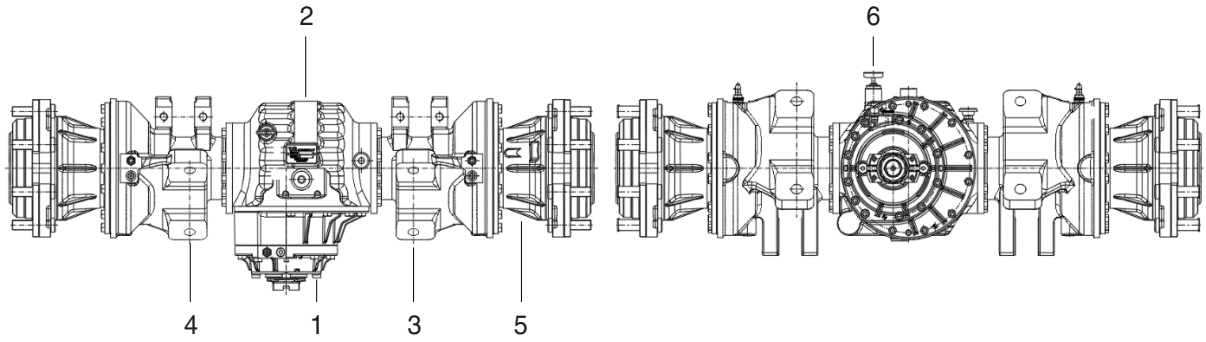
1) STRUCTURE



35D9VB3PS10

1	Pinion shaft	4	Axle shaft	7	Hub
2	Ring gear	5	Traveling brake		
3	Differential device	6	Hub reduction		

2) INSTALLATION VIEW

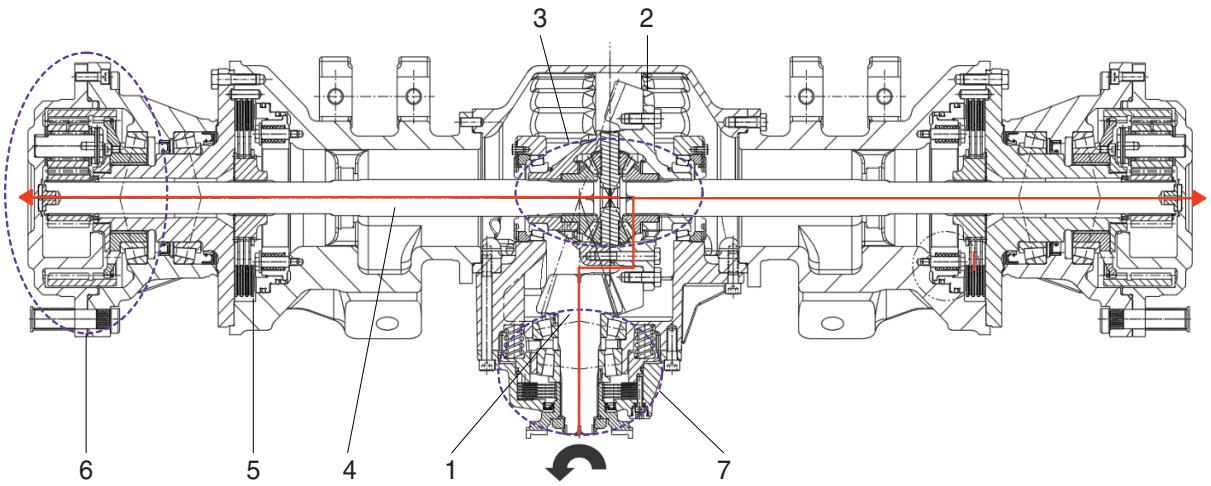


35D9VB3PS11

1	Input carrier sub assembly	3	Beam RH	5	Hub
2	Axle housing	4	Beam LH	6	Oil level gauge

3) OPERATION

The drive axle is connected with the transmission output gear by drive shaft assembly. The power transferred by the drive shaft assembly is connected to the pinion shaft of drive axle, the pinion shaft delivers the power to the differential device through the ring gear. The differential device deliver the power to hub reduction through axle shaft.

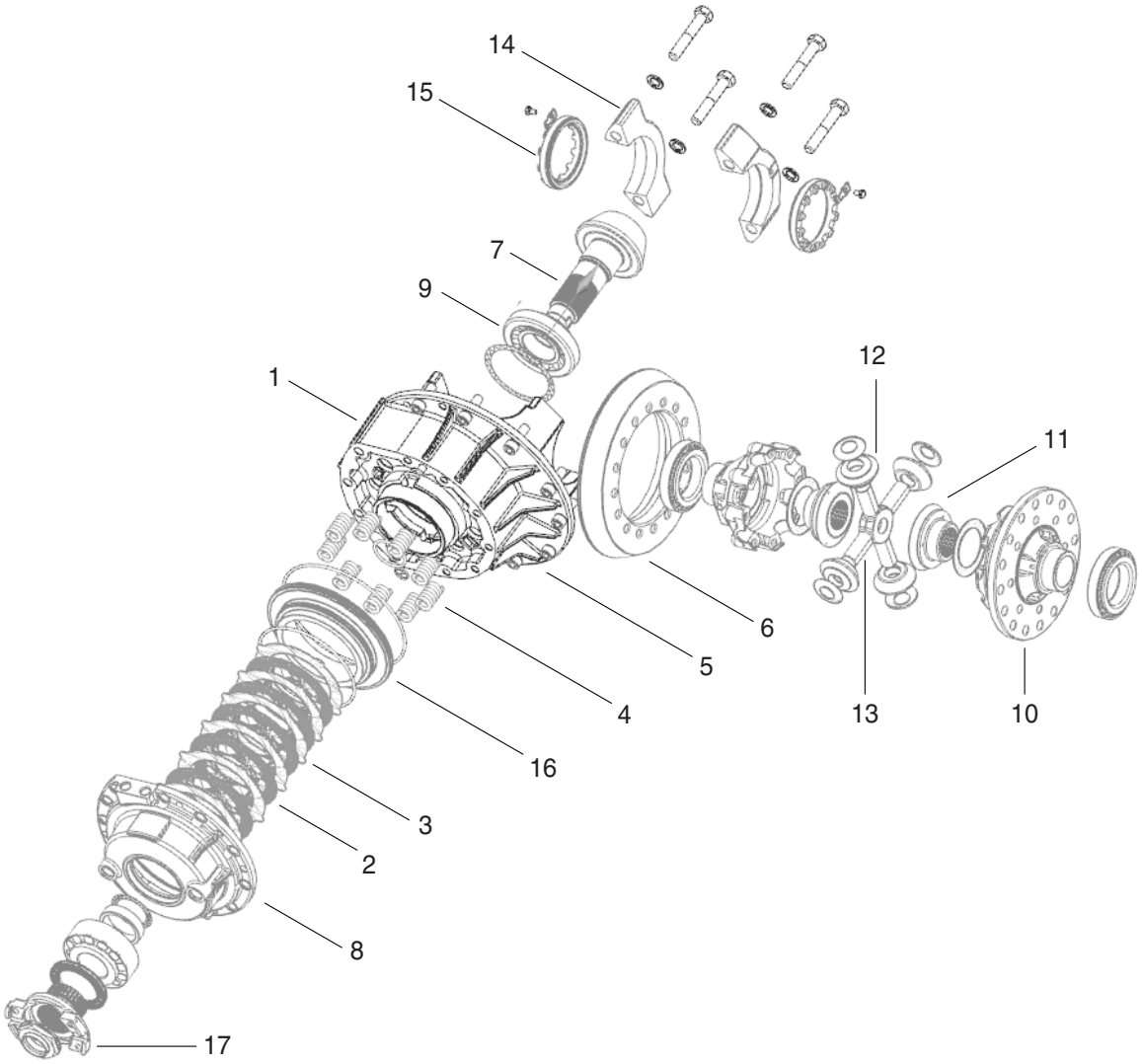


35D9VB3PS12

1	Pinion shaft	4	Axle shaft	7	Parking brake device
2	Ring gear	5	Service brake		
3	Differential device	6	Hub reduction		

4) Input carrier sub assembly

(1) Structure



35D9VB3PS13

1	Pin-parallel	7	Pinion shaft	13	Spider
2	Clutch disk	8	Parking cover	14	Carrier cap
3	Opposing plate	9	T/R bearing	15	Adjust screw
4	Return spring	10	Diff. case	16	Parking brake piston
5	Input case	11	Diff. side gear	17	Flange yoke
6	Ring gear	12	Diff. pinion gear		

(2) Performance property

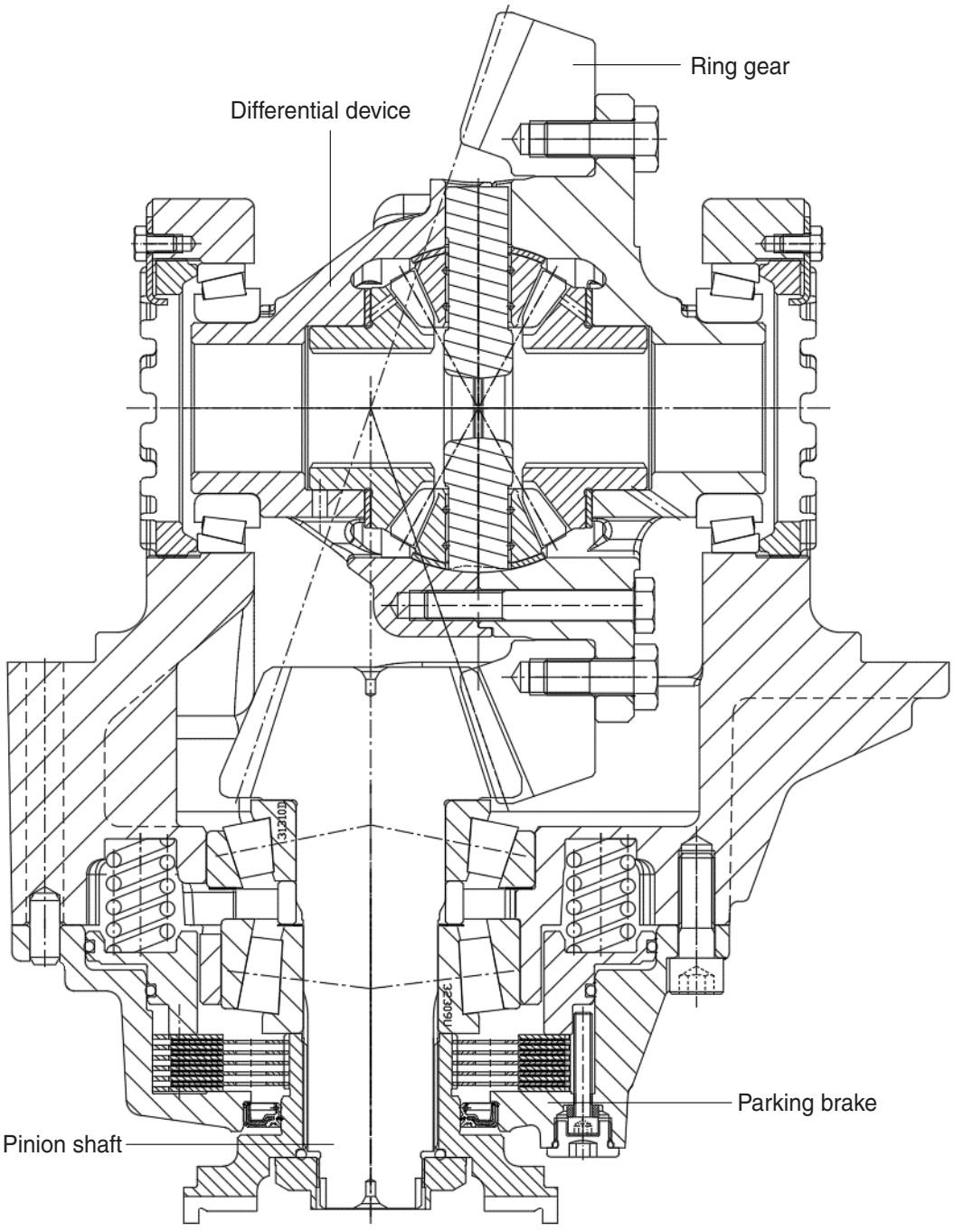
Input carrier sub assembly includes differential device and parking brake.

The pinion shaft is supported by the taper roller bearing in the carrier case and the bolt at the end of pinion shaft and transfers the power which is delivered from the drive shaft assembly to the ring gear assembled from bolts at a differential device.

This power makes the differential device run.

Since the differential device is connected with an axle shaft and a spindle, the power transferred to differential device is delivered to final drive through the axle shaft.

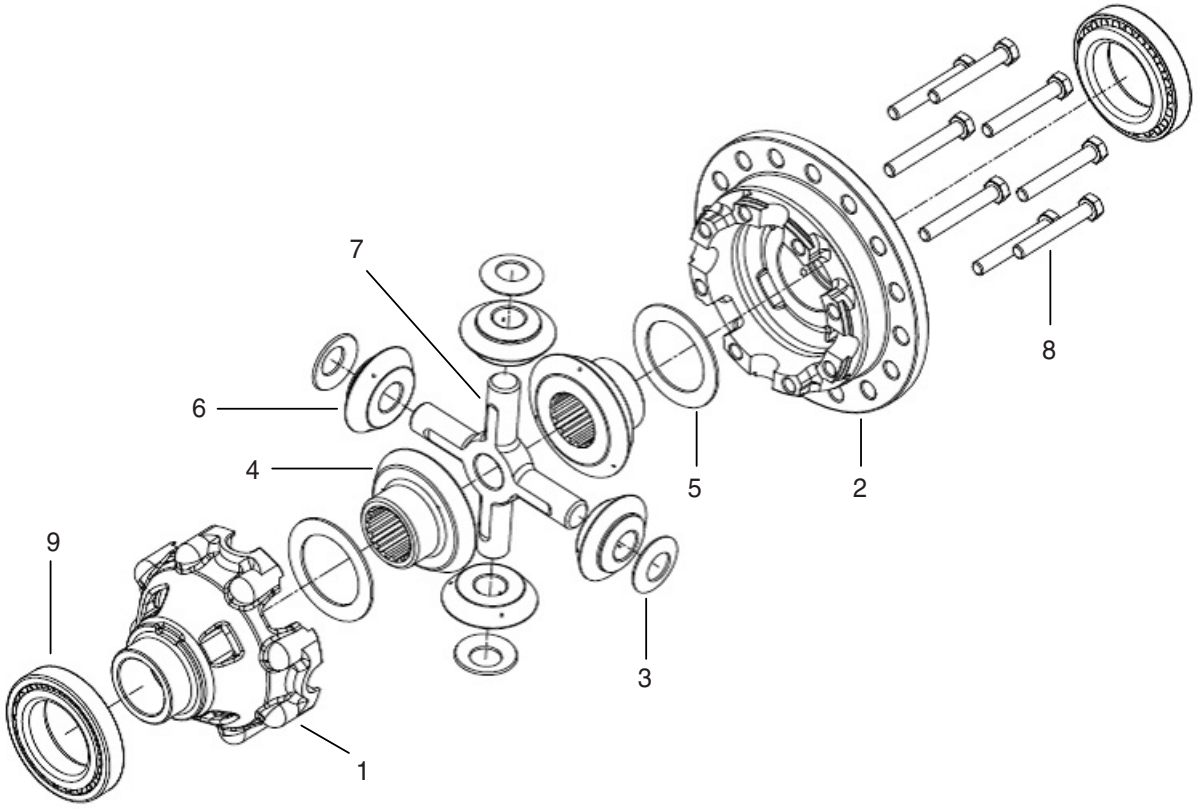
Parking brake, like as traveling brake system is consists of several friction plate functions braking by sticking to each friction plate when pull parking had hand lever.



35D9VB3PS14

4) Differential sub assembly

(1) Structure



35D9VB3PS15

1	Diff case RH	4	Diff side gear	13	Spider
2	Diff case LH	5	Thrust washer	14	Hex bolt
3	Thrust washer	6	Diff pinion gear	15	T/R bearing

(2) Performance property

Since the ring gear is linked with the right of the differential case and the bolt, the power transferred to the ring gear makes the differential device revolve.

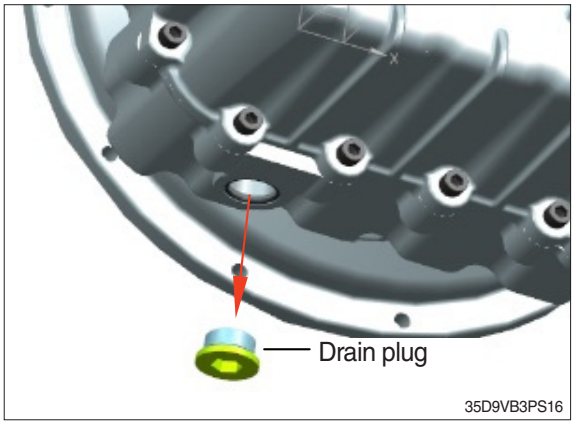
And also, the differential case are connected with the left and right of the axle shaft and the spline respectively, it delivers the power to the final drive.

If the load concerning in the left and right of the final drive is different, the shock is transferred to the drive axle, the differential gear in the differential device runs, the power transferred to the differential device adjusts the delivering rate to the left and right axle shaft. Consequently, it guarantees for safety of drivers.

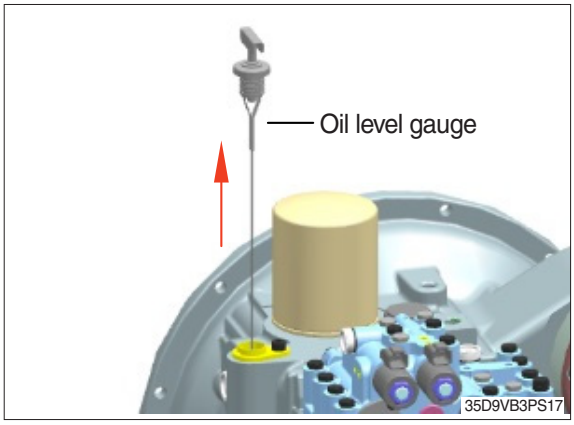
1. DISASSEMBLY OF TRANSMISSION

1) DISASSEMBLY OF TRANSMISSION

(1) Discharge transmission oil. Disaasemble drain plug of T/C housing.

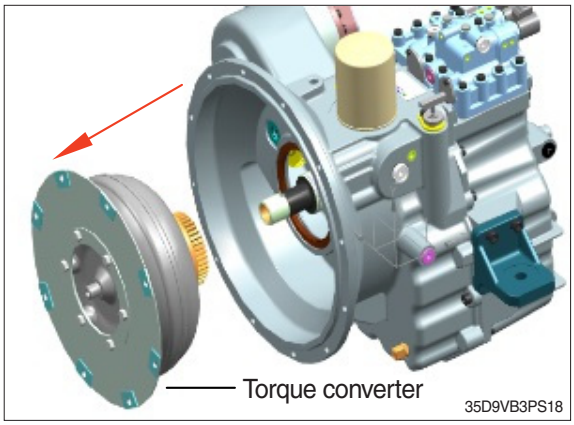


(2) Disassemble oil level gauge. Check oil residue in T/M.

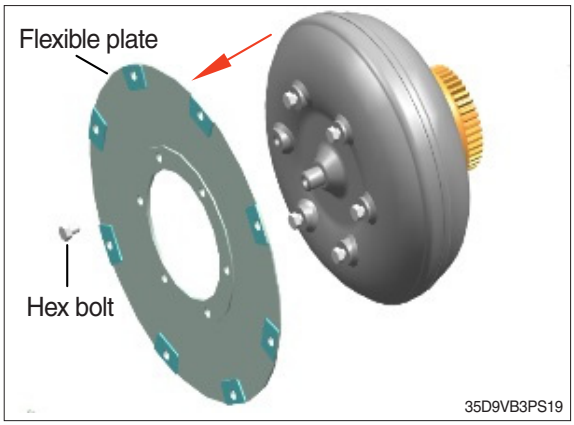


(3) Disassemble T/C part.

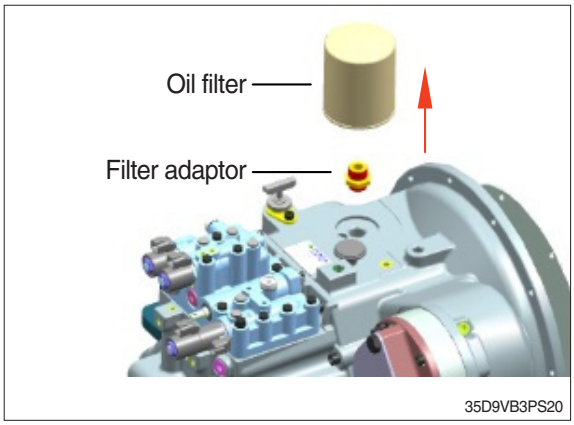
① Disassemble T/C sub assembly.



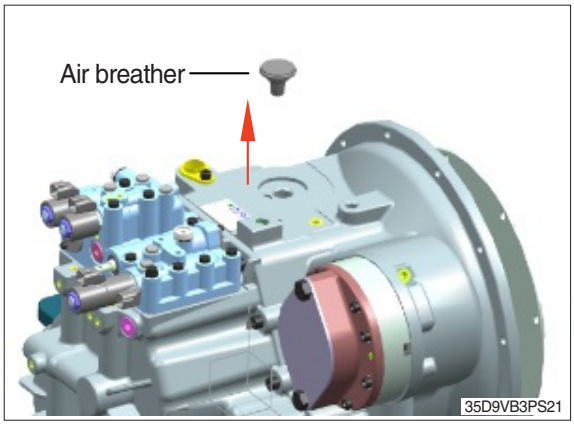
② Disassemble hex bolt and flexible plate.



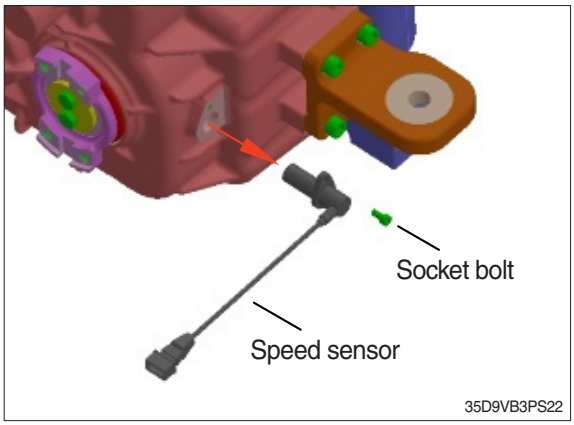
(4) Disassemble oil filter and filter adaptor.



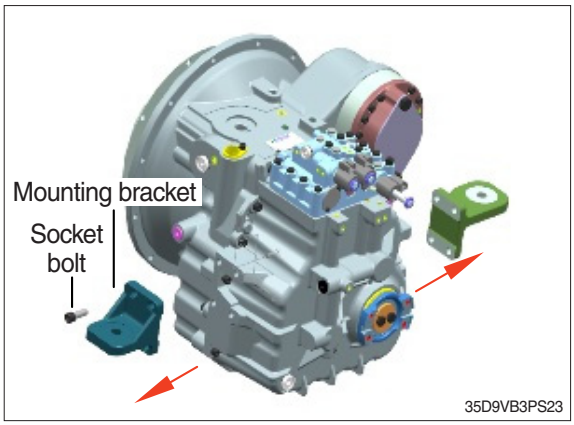
(5) Disassemble air breather.



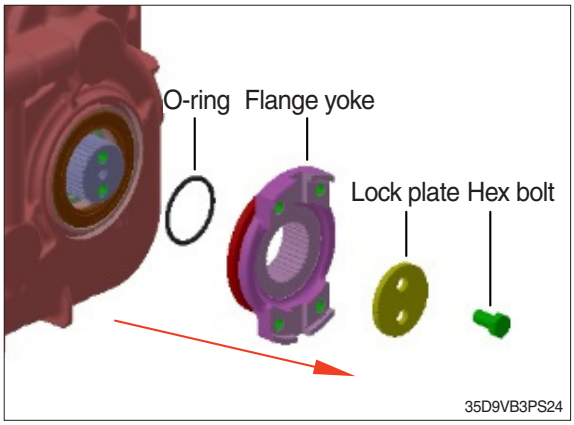
(6) Disassemble socket bolt and speed sensor.



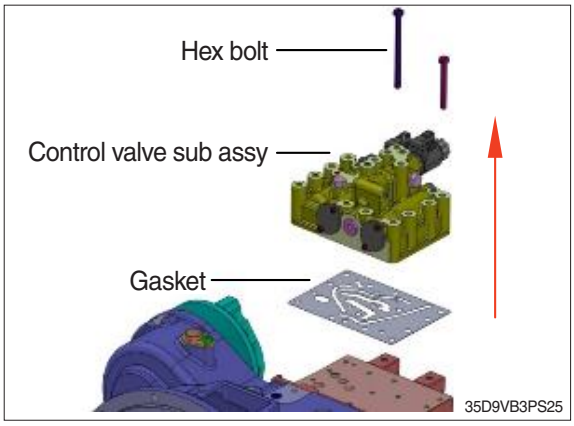
(7) Disassemble socket bolt and mounting bracket.



(8) Disassemble hex bolt, lock plate, flange yoke and o-ring.

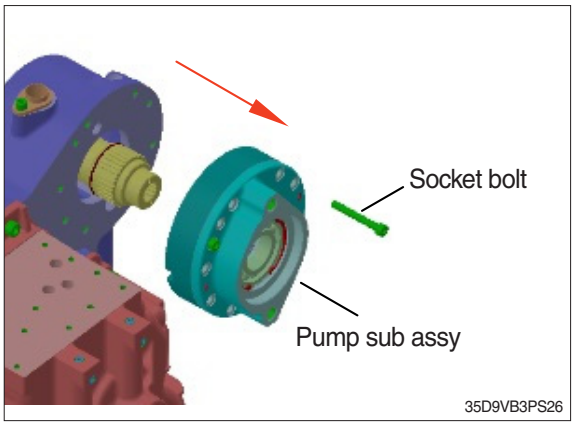


(9) Disassemble hex bolt, control valve sub assy and gasket.

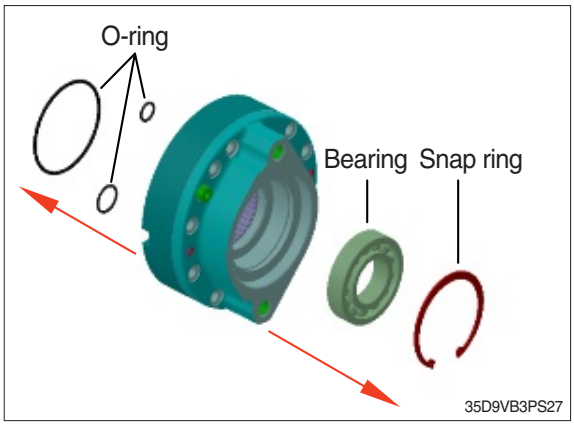


(10) Disassemble oil pump sub part.

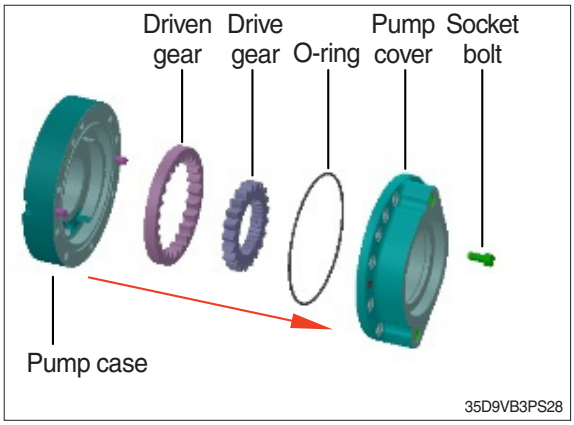
① Disassemble socket bolt and pump sub assy.



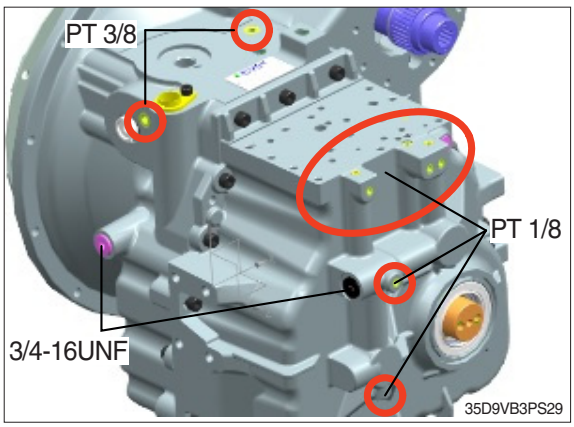
② Disassemble snap ring, ball bearing and o-ring (3 EA).



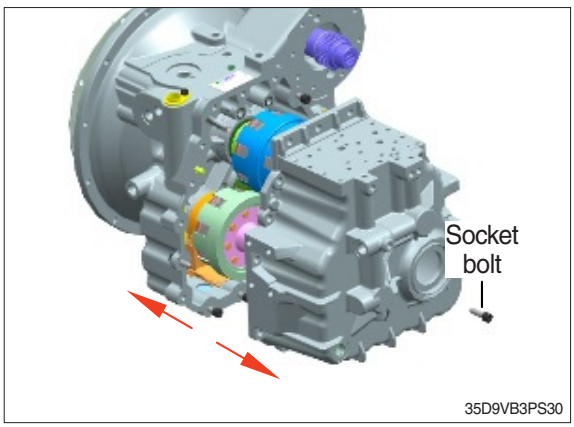
③ Disassemble socket bolt, o-ring, drive gear and driven gear of pump case.



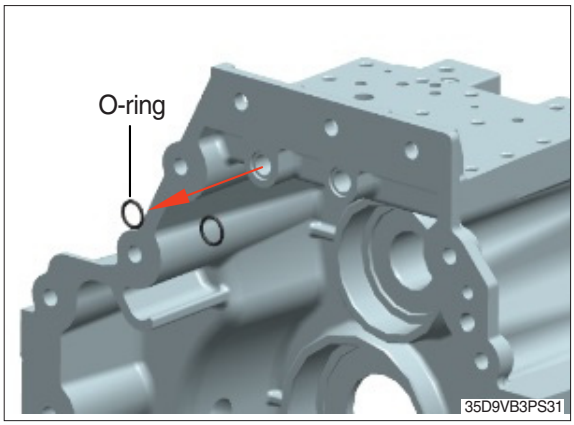
(11) Disassemble plug.



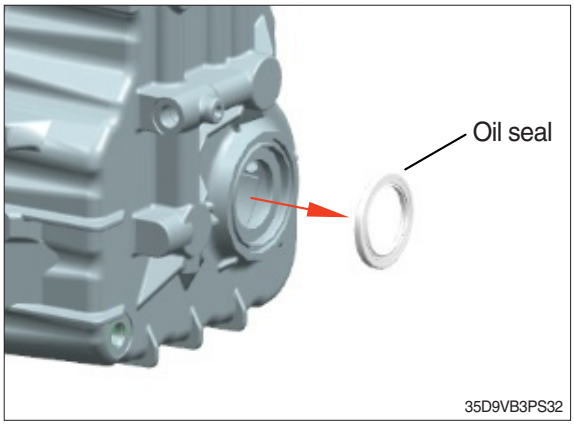
(12) Disassemble socket bolt and T/M case of T/C housing.



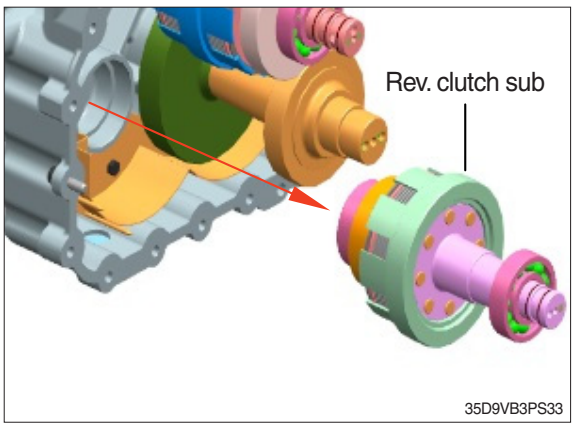
(13) Disassemble o-ring.



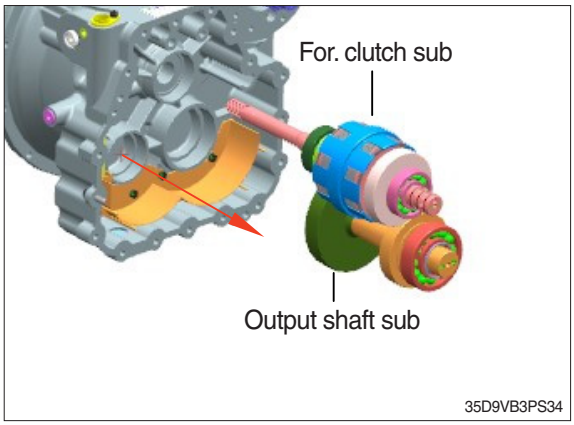
(14) Disassemble oil seal.



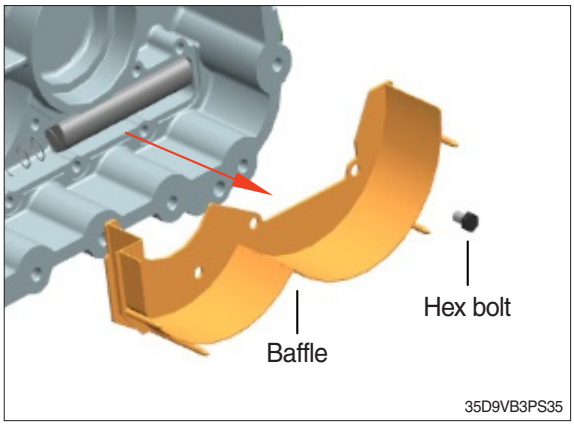
(15) Disassemble rev. clutch sub assy.



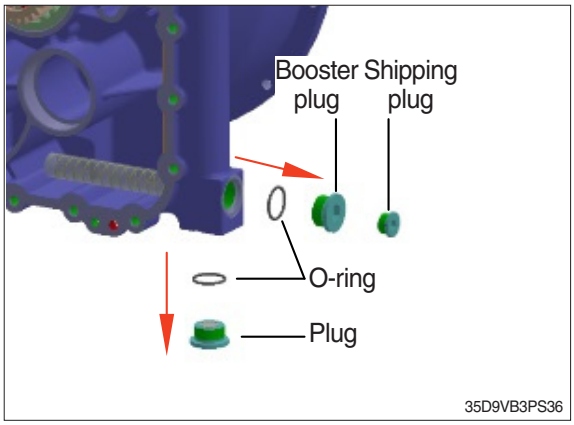
(16) Disassemble rev. clutch sub assy and output shaft sub assy.



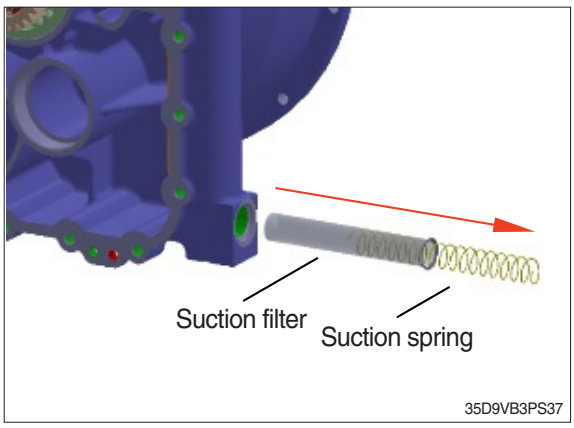
(17) Disassemble baffle and hex bolt.



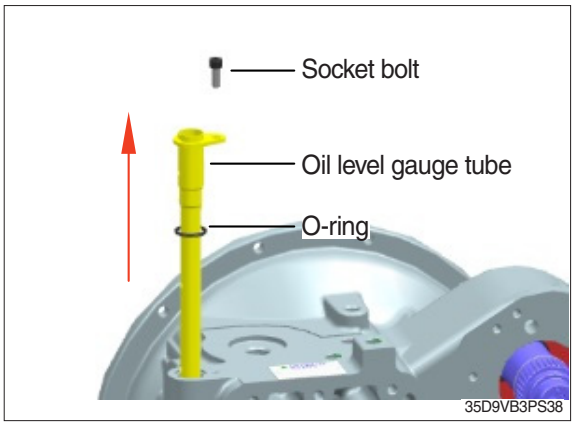
(18) Disassemble plug and o-ring.



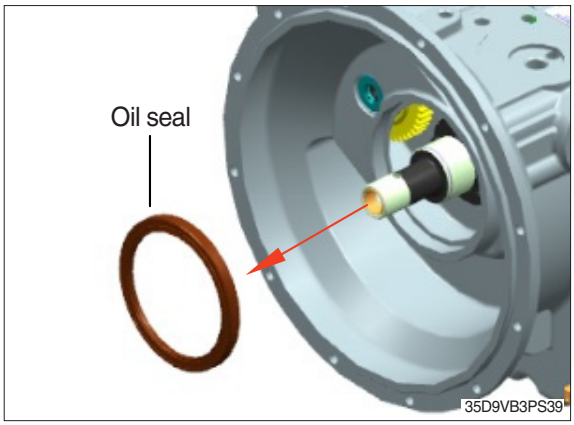
(19) Disassemble suction filter and spring.



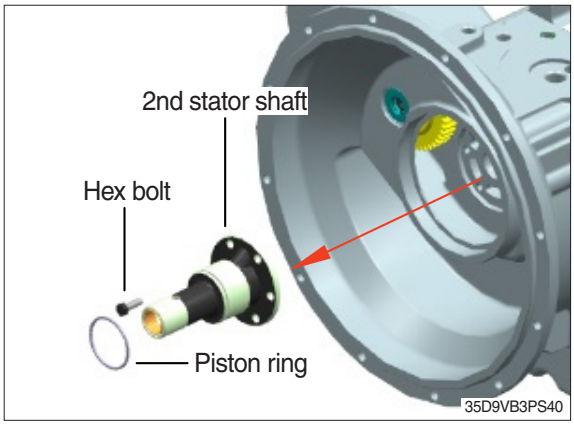
(20) Disassemble socket bolt, oil level gauge and o-ring.



(21) Disassemble oil seal.

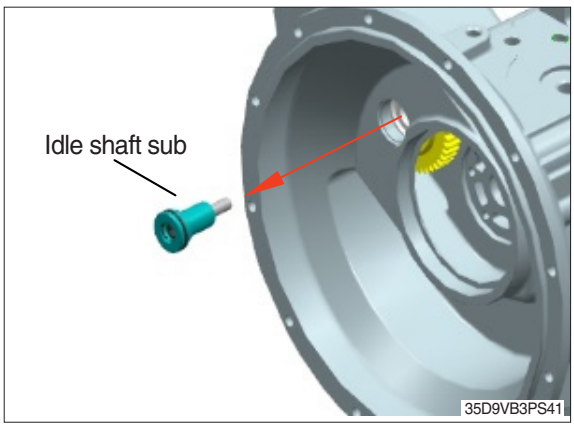


(22) Disassemble hex bolt, 2nd stator shaft and piston ring.

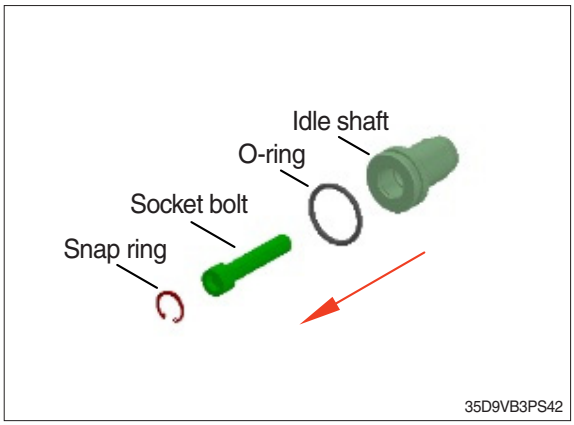


(23) Disassemble idle gear part.

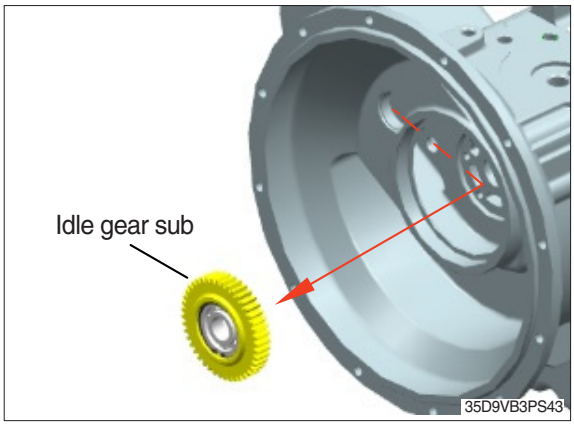
① Disassemble idle shaft sub.



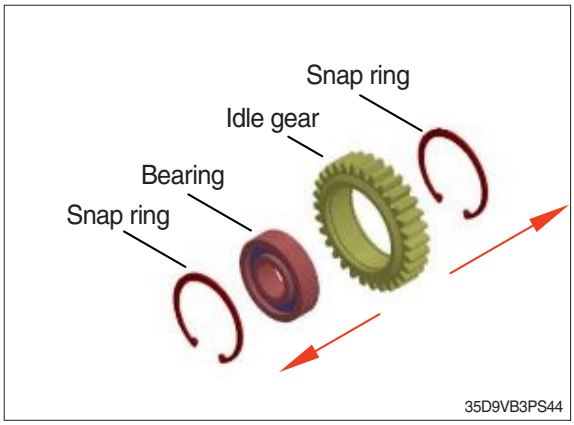
② Disassemble o-ring, snap ring of idle shaft and socket bolt.



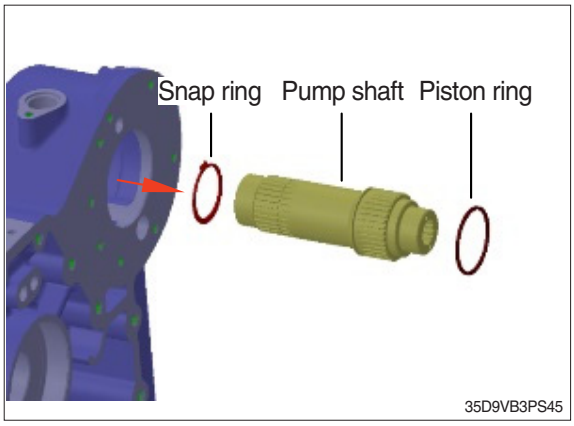
③ Disassemble idle gear sub.



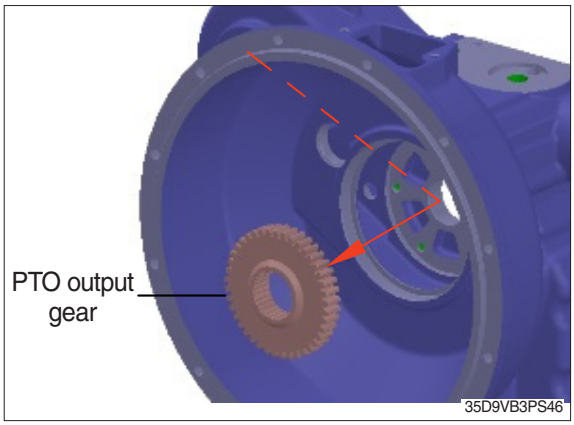
④ Disassemble snap ring of idle gear and bearing.



(24) Disassemble pump shaft and snap ring of pump shaft.

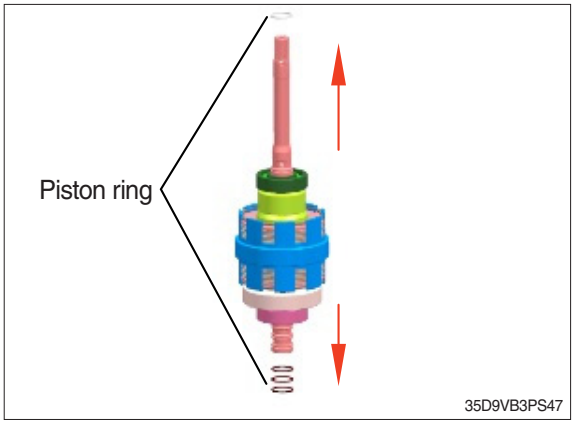


(25) Disassemble PTO output gear.

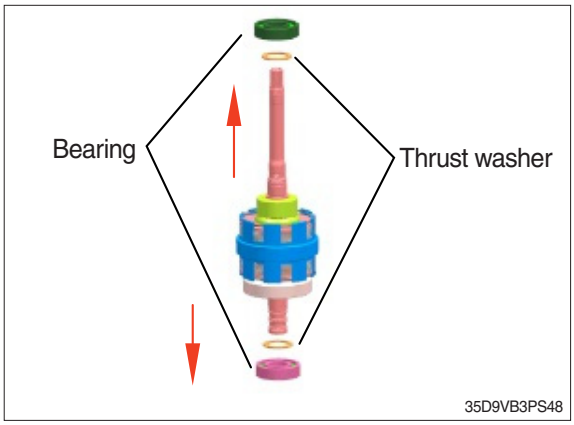


2) DISASSEMBLY OF CLUTCH SUB ASSEMBLY

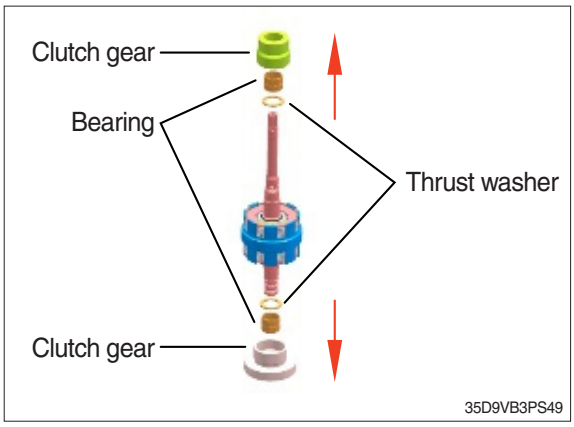
(1) Disassemble piston ring.



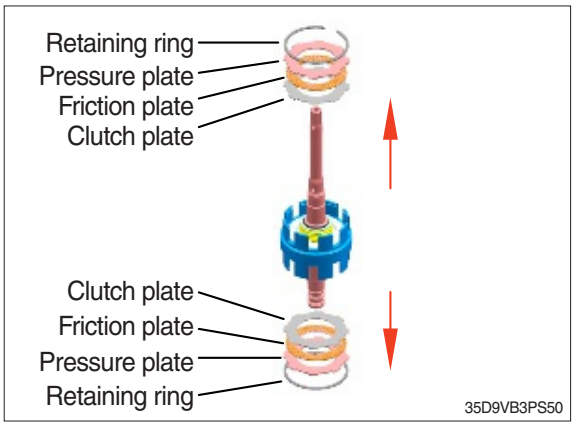
(2) Disassemble bearing and thrust washer.



(3) Disassemble clutch gear, bearing and thrust washer.

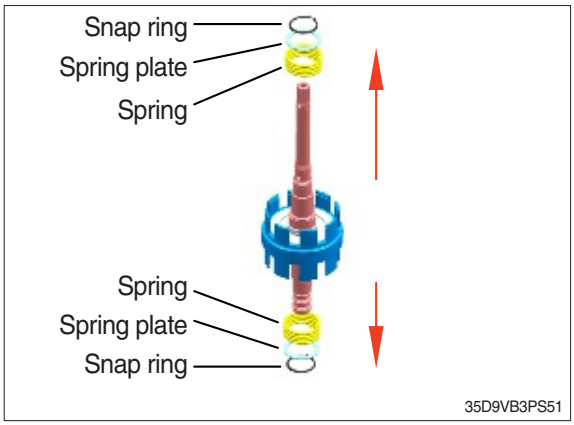


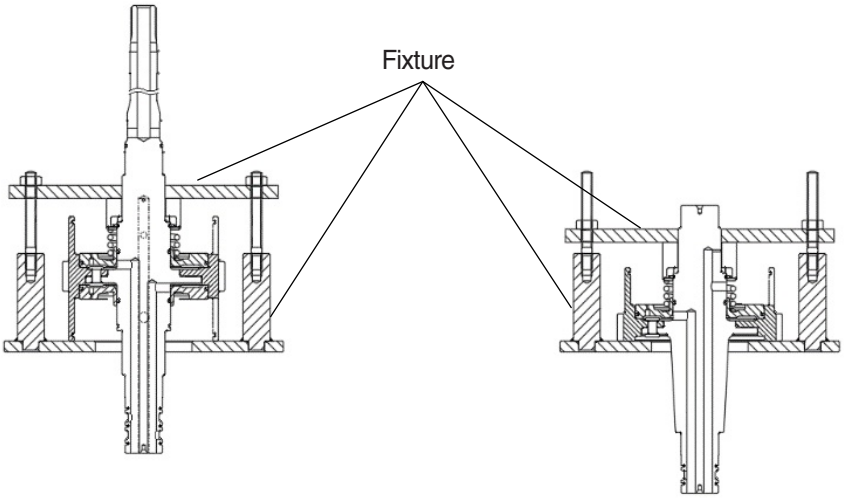
(4) Disassemble retaining reing, plate and friction plate.



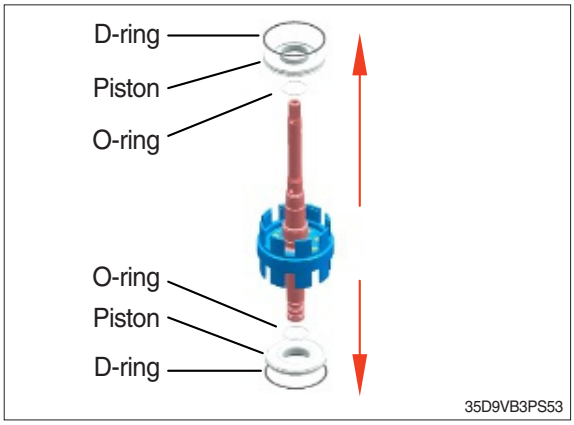
(5) Disassemble snap ring, spring plate and spring.

△ **If you take out snap ring, spring should be shocked in damage. And, you should fix the spring and take out it.**





(6) Disassemble piston sub, o-ring and d-ring of piston.

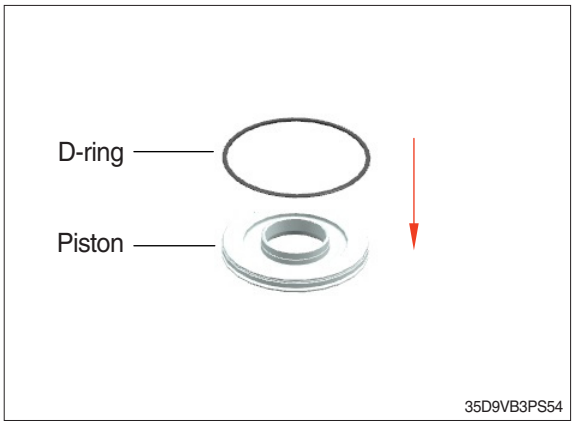


2. ASSEMBLY OF TRANSMISSION

1) ASSEMBLY OF CLUTCH SUB ASSEMBLY

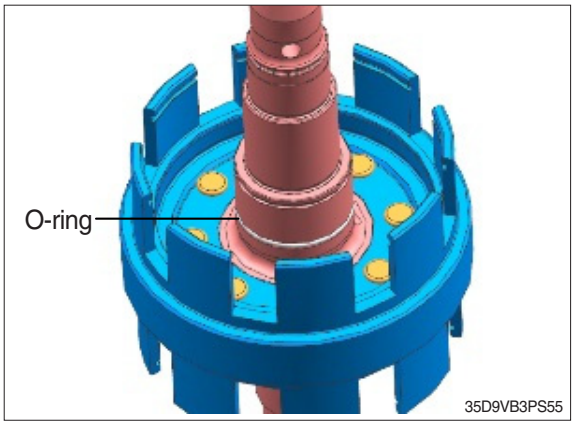
(1) Assemble d-ring.

※ **Cover T/M oil on d-ring.**

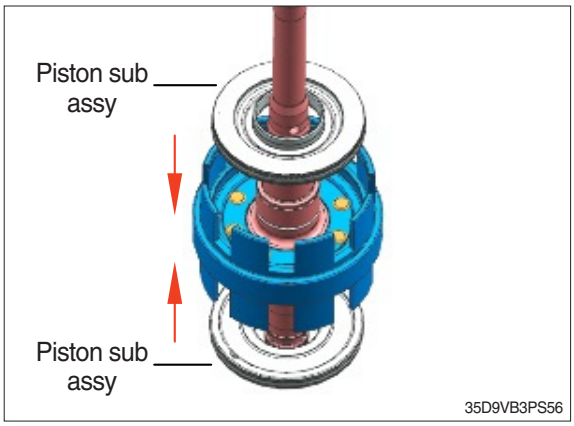


(2) Assemble piston ring on groove face of piston ring to clutch shaft.

※ **Cover T/M oil on o-ring.**

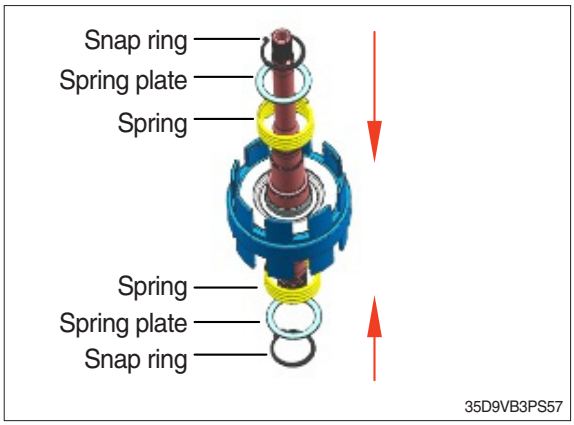


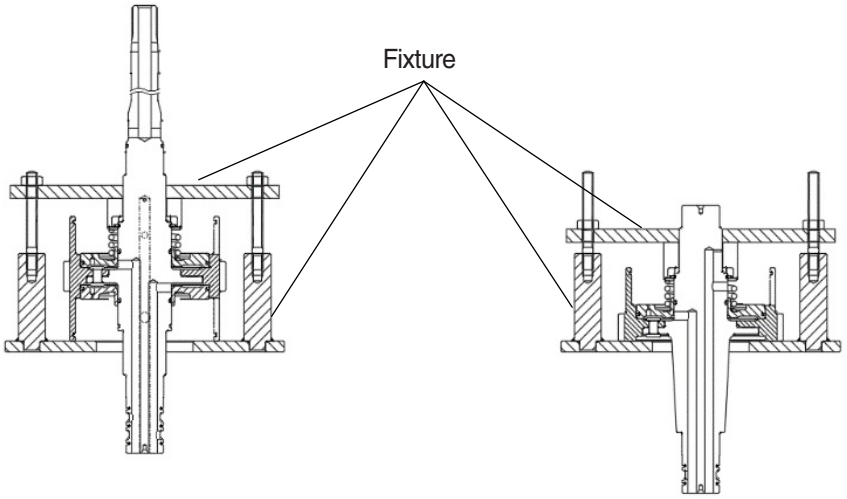
(3) Assemble piston sub assy.



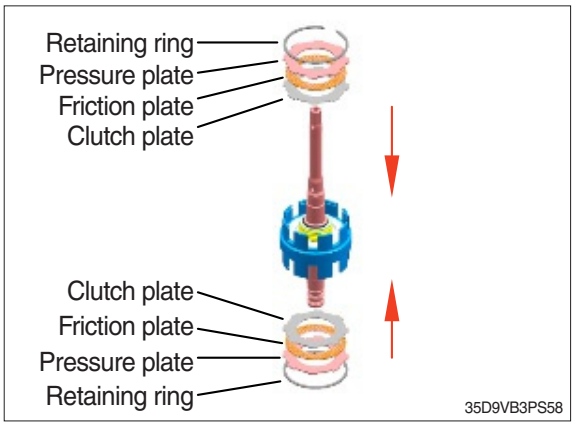
(4) Assemble spring, spring plate and snap ring.

△ **If you take out snap ring, spring should be shocked in damage. And, you should fix the spring and take out it.**



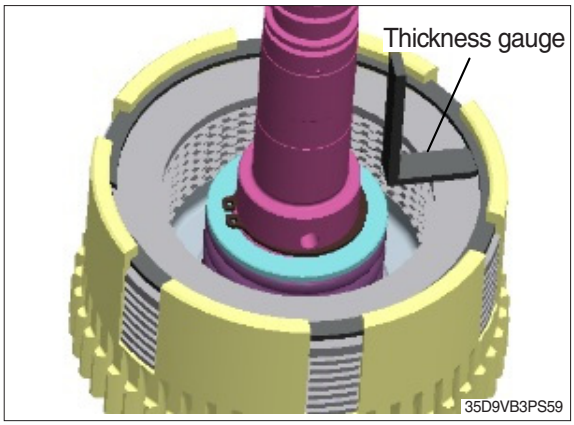


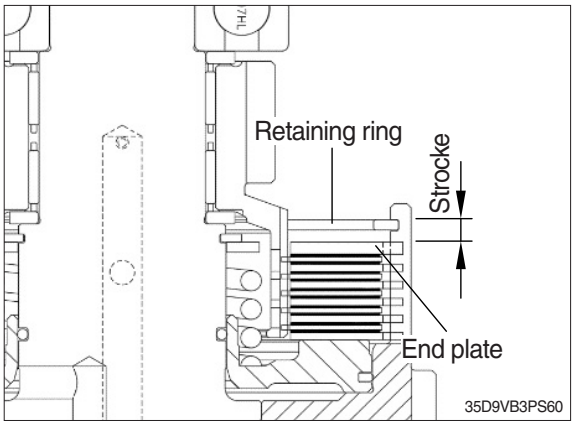
(5) Put in clutch plate, friction plate, pressure plate and retaining ring.



(6) Calculate the distance between end plate and retaining ring.

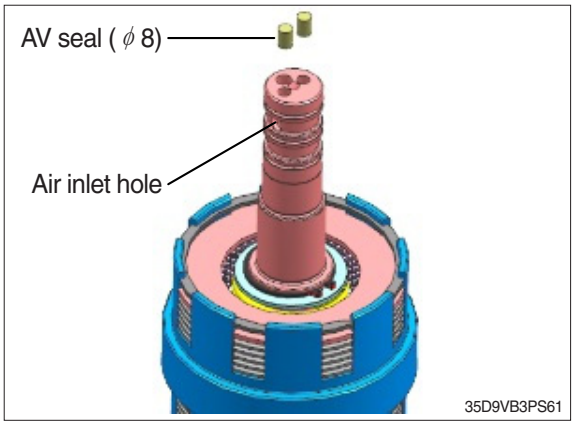
※ **Use thickness gauge.**
Stroke : 2.7 ~ 3.1 mm (0.11 ~ 0.12 in)



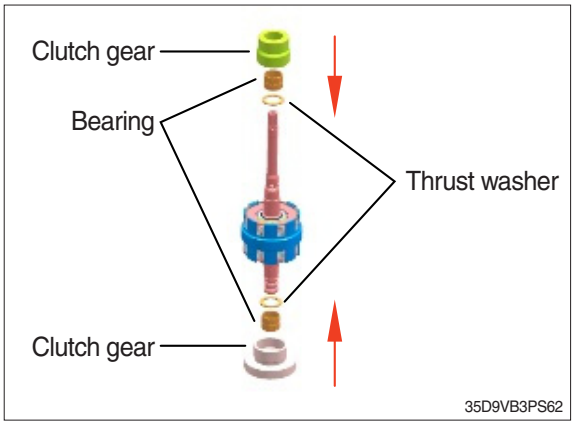


(7) Assemble AV seal.

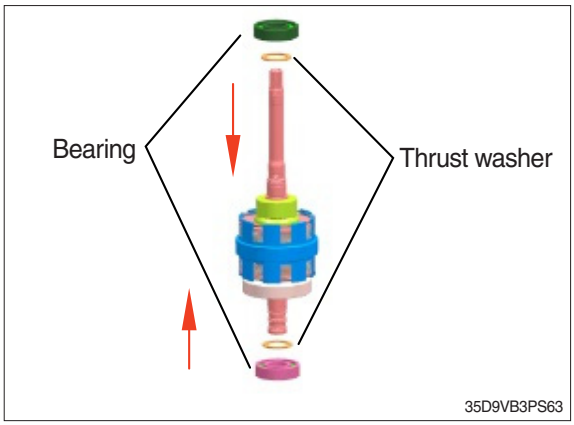
※ **Check smooth operation of piston.**
Air inject : 1.0 ~ 3.0 bar (14.5 ~ 43.5 psi)



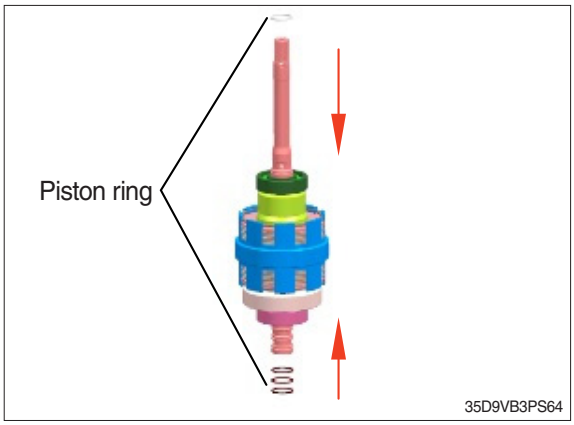
(8) Assemble clutch gear, bearing and thrust washer.



(9) Assemble thrust washer and bearing.

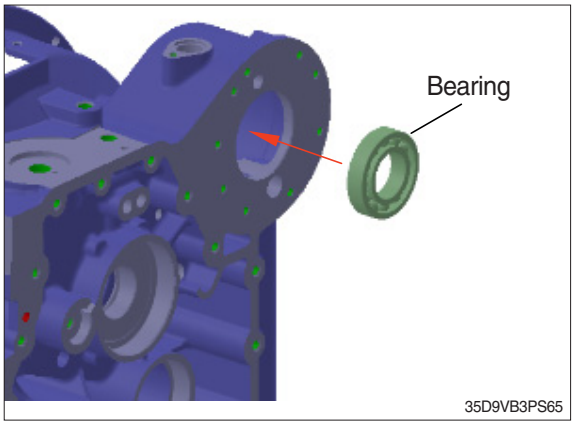


(10) Assemble piston ring.

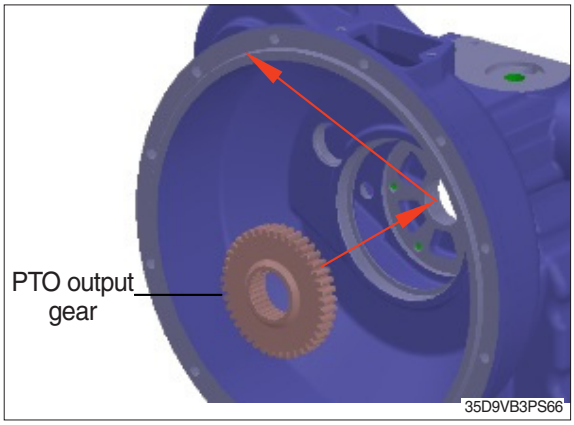


2) ASSEMBLY OF TRANSMISSION

(1) Assemble ball bearing.



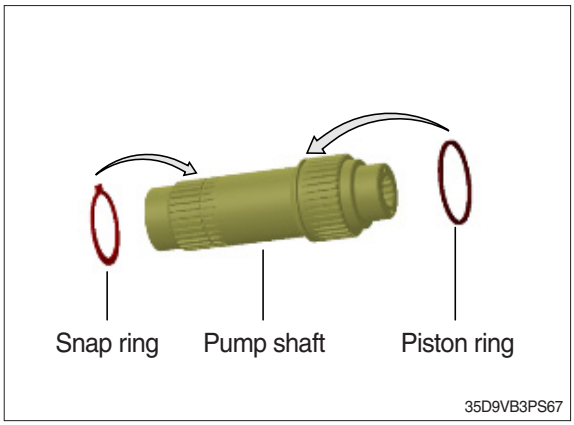
(2) Assemble clutch gear, bearing and thrust washer.



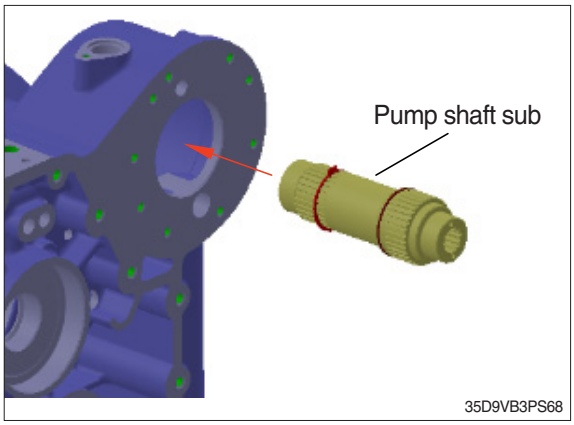
(3) Assemble pump shaft sub part.

① Assemble snap ring and piston ring on pump shaft.

※ **Cover grease on piston ring.**

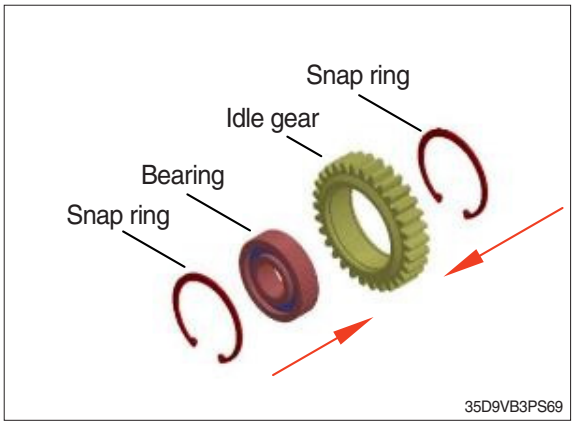


② Assemble pump shaft sub.

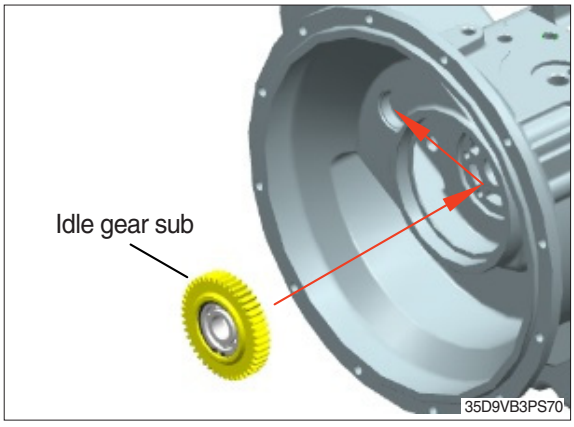


(4) Assemble idle gear sub part.

① Assemble bearing and snap ring on idle gear.

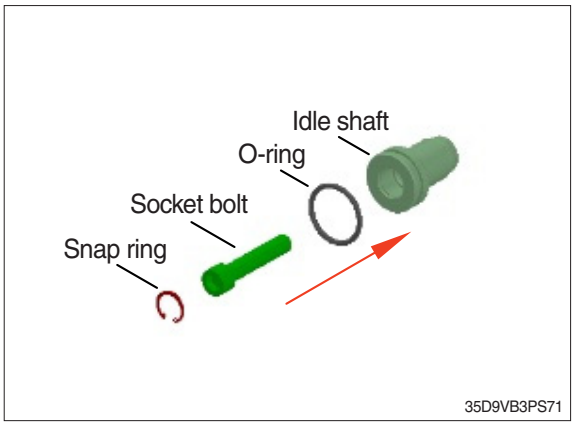


② Assemble idle gear sub through center hole of T/C housing.



③ Assemble socket bolt, snap ring on idle shaft and o-ring.

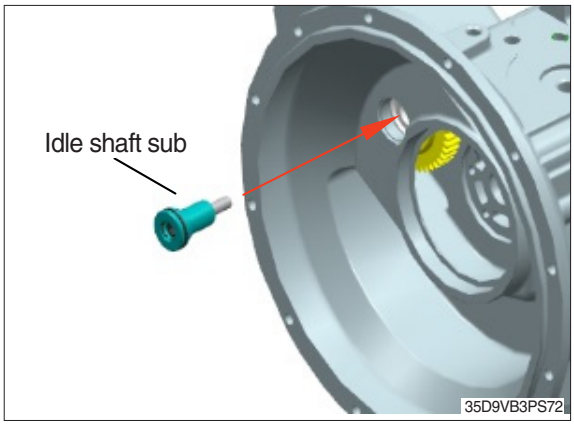
※ **Cover grease on o-ring.**



④ Assemble idle shaft sub.

· Tightening torque : 10.2 ~ 11.2 kgf·m
(73.8 ~ 81.0 lbf·ft)

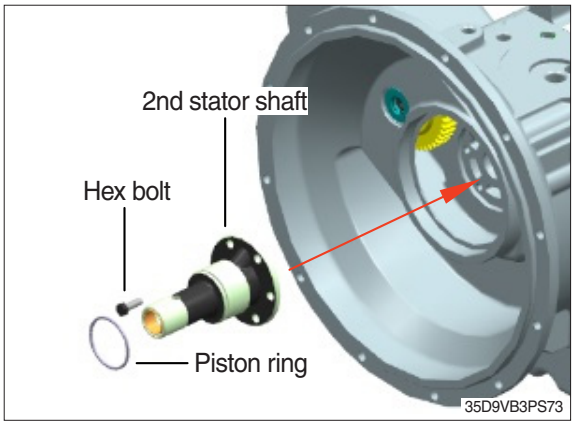
※ **Cover loctite #277 on the screw side of bolt.**



(5) Assemble piston ring on 2nd stator shaft. And assemble 2nd stator shaft, hex bolt and washer on T/C housing.

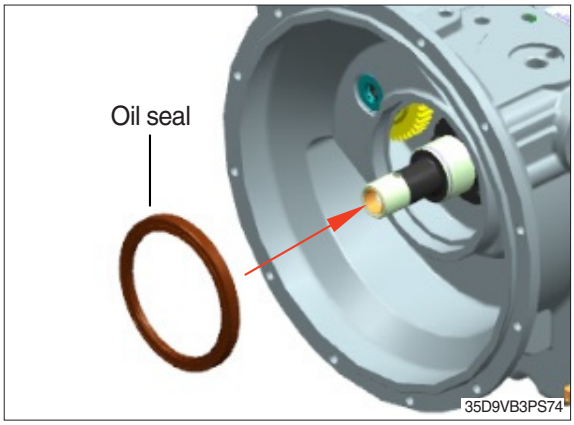
· Tightening torque : 3.1 ~ 3.5 kgf·m
(22.4 ~ 25.3 lbf·ft)

※ **Cover loctite #277 on the screw side of bolt and grease on piston ring.**



(6) Assemble oil seal.

※ **Cover loctite #592 on the side of oil seal.**

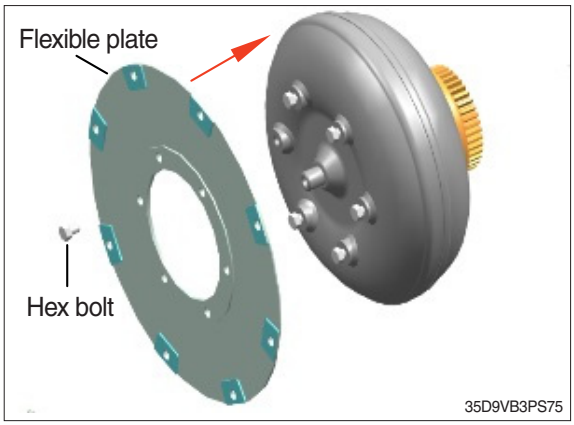


(7) Assemble T/C part.

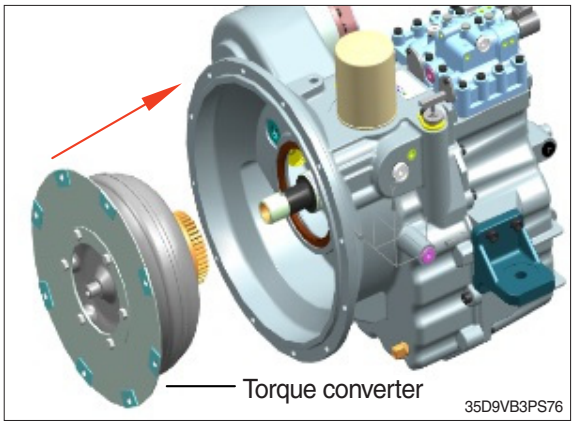
① Assemble flexible plate and hex bolt on torque converter.

· Tightening torque : 4.1 ~ 4.9 kgf·m
(29.7 ~ 35.5 lbf·ft)

※ **Cover loctite #277 on the screw side of bolt.**



② Assemble torque converter sub.



(8) Assemble oil level gague and tube part.

① Assemble o-ring on oil level gauge tube.

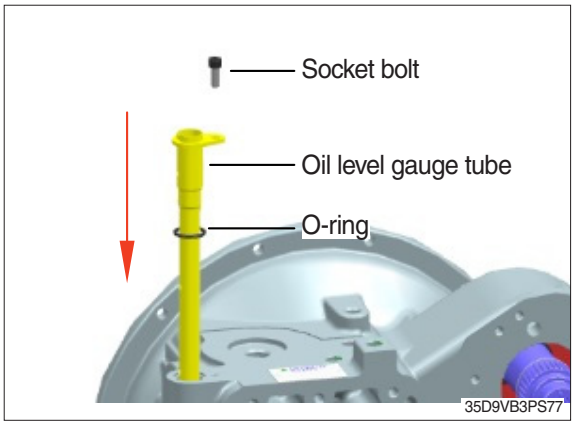
※ **Cover grease on o-ring.**

② Assemble oil level gaguge tube and bolt.

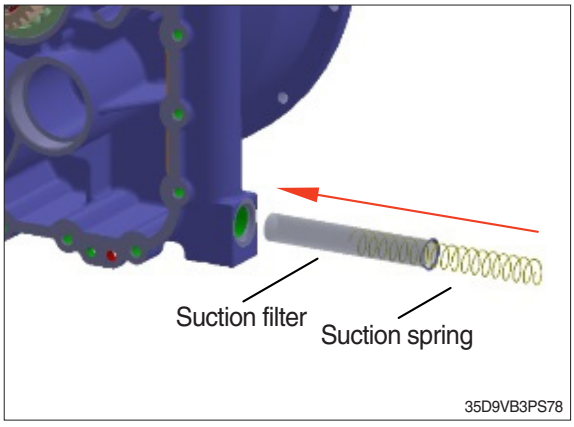
· Tightening torque : 3.1 ~ 3.5 kgf·m
(22.4 ~ 25.3 lbf·ft)

※ **Cover loctite #277 on the screw side of bolt.**

③ Assemble oil level gaguge.

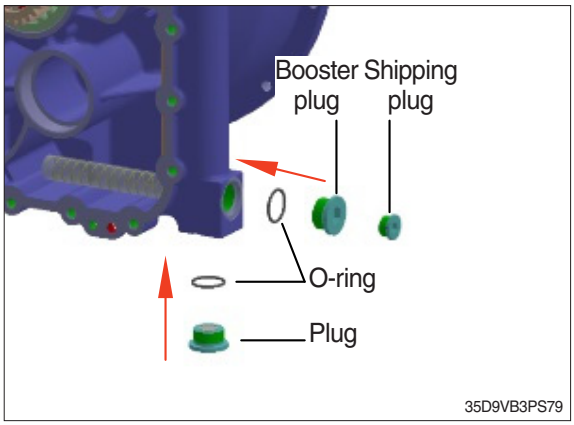


(9) Assemble suction filter and spring.



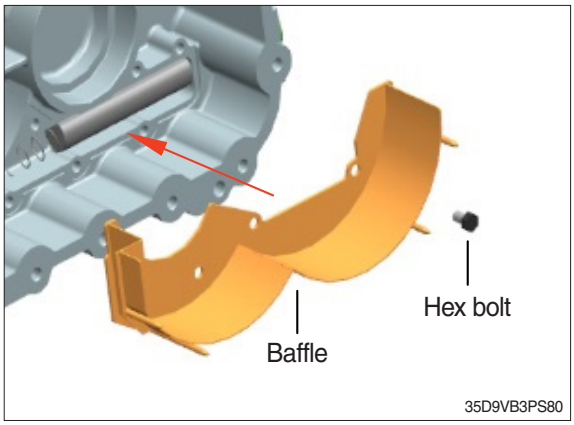
(10) Assemble O-ring, plug, booster plug, o-ring and shipping plug.
· Tightening torque : 4.1 ~ 4.9 kgf·m
(29.7 ~ 35.5 lbf·ft)

※ **Cover grease on o-ring.**

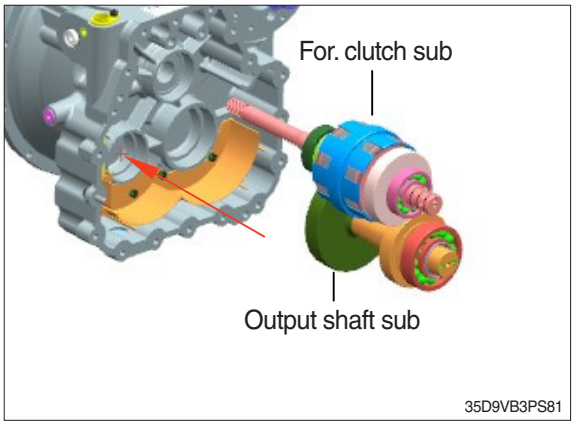


(11) Assemble baffle plate and hex bolt.
· Tightening torque : 3.1 ~ 3.5 kgf·m
(22.4 ~ 25.3 lbf·ft)

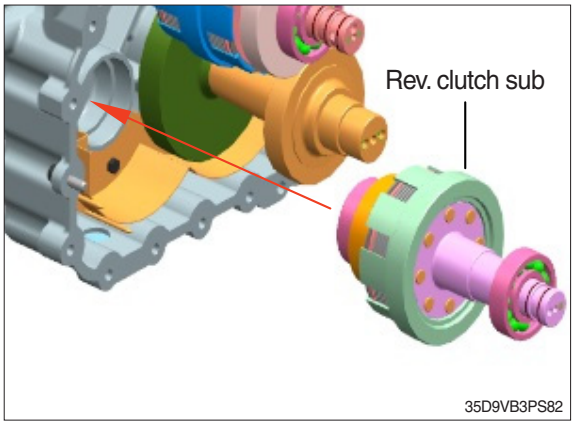
※ **Cover loctite #277 on the screw side of bolt.**



(12) Assemble for. clutch sub and output shaft sub.

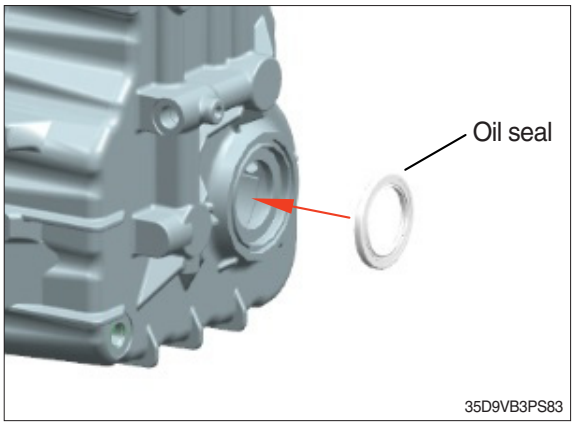


(13) Assemble rev. clutch sub.



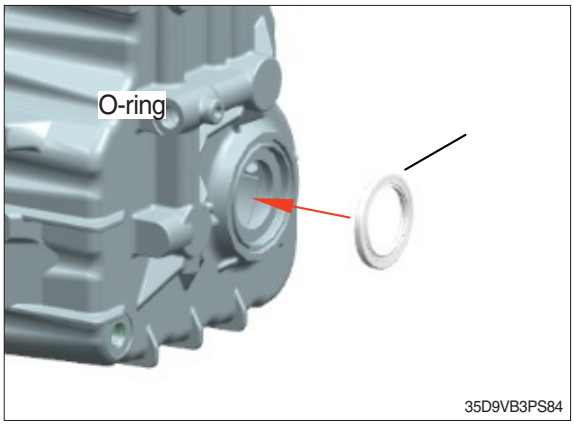
(14) Assemble oil seal.

※ **Cover loctite #592 on the side oil seal.**

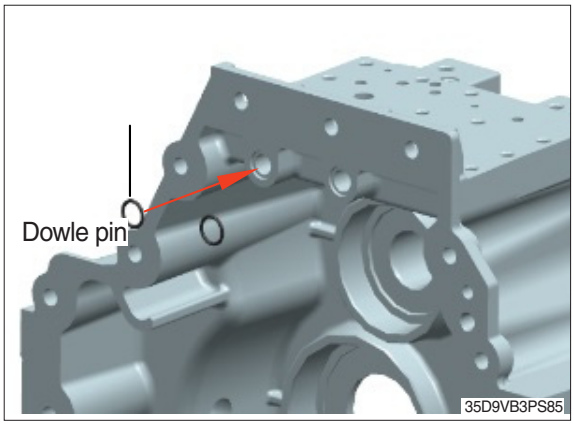


(15) Assemble o-ring.

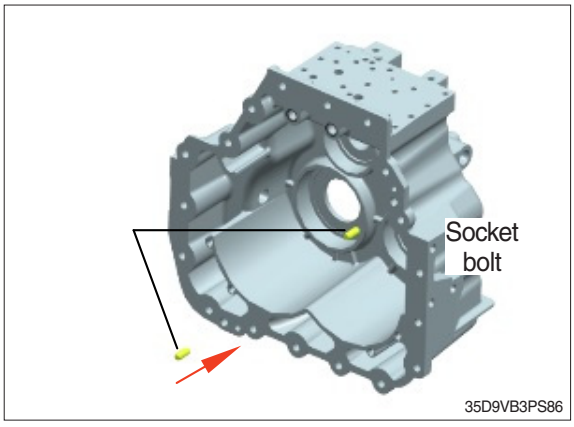
※ **Cover grease on o-ring.**



(16) Assemble dowel pin (2 EA).



(17) Assemble T/M case sub on T/C housing sub.

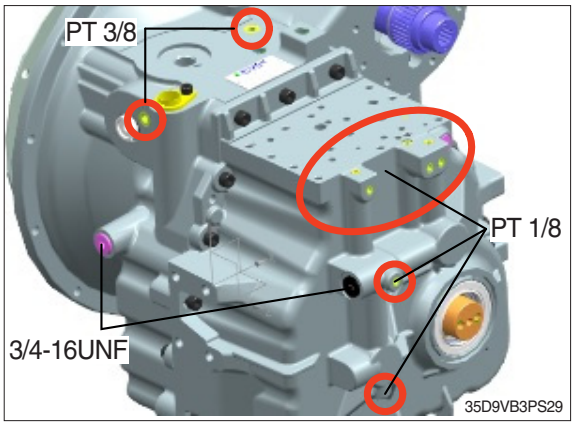


(18) Assemble plug.

· Tightening torque : 4.1 ~ 4.9 kgf·m
(29.7 ~ 35.5 lbf·ft)

· Tightening torque : 1.0 ~ 1.4 kgf·m
(7.2 ~ 10.1 lbf·ft)

※ **Cover loctite #577 on the screw side of plug.**

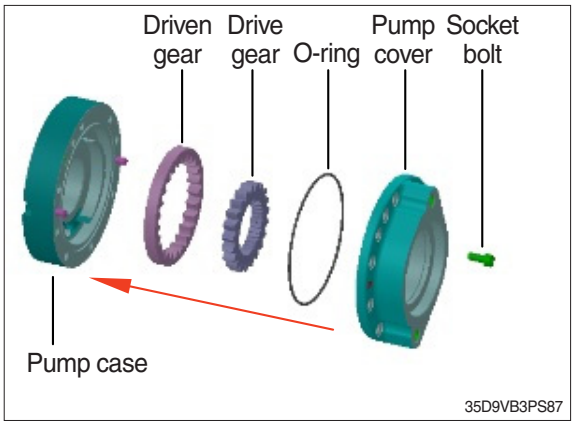


(19) Assemble oil pump sub part.

① Assemble driven gear, drive gear and o-ring on pump case. And assemble pump cover and socket bolt.

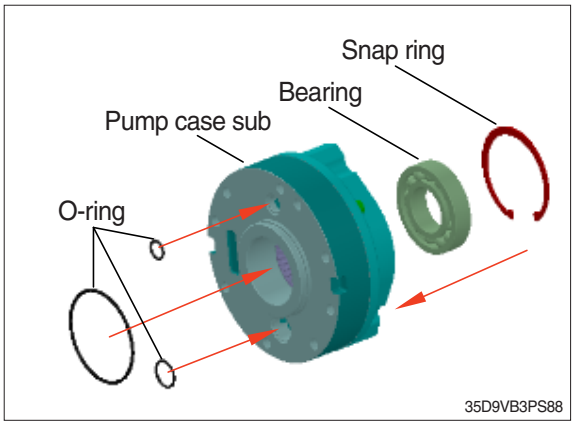
· Tightening torque : 3.1 ~ 3.5 kgf·m
(22.4 ~ 25.3 lbf·ft)

※ **Cover grease on o-ring and loctite #277 on the screw side of bolt.**



② Assemble o-ring (3 EA) on pump case sub. Overturn assemble bearing and snap ring.

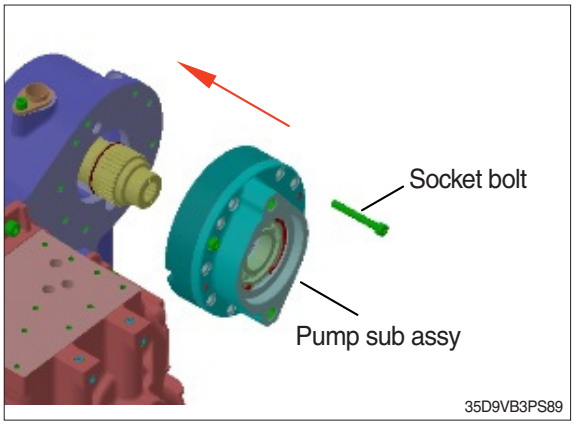
※ **Cover grease on o-ring.**



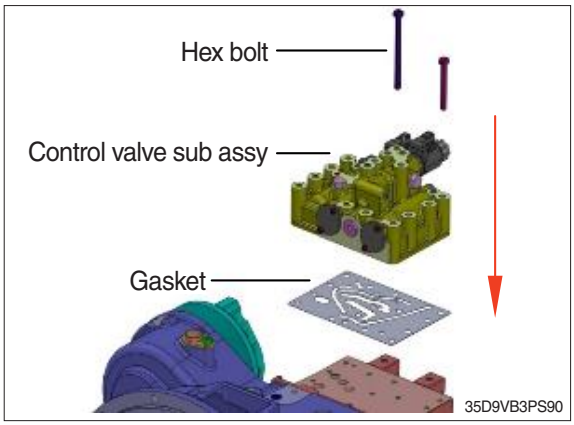
③ Assemble pump case sub and socket bolt.

· Tightening torque : 3.1 ~ 3.5 kgf·m
(22.4 ~ 25.3 lbf·ft)

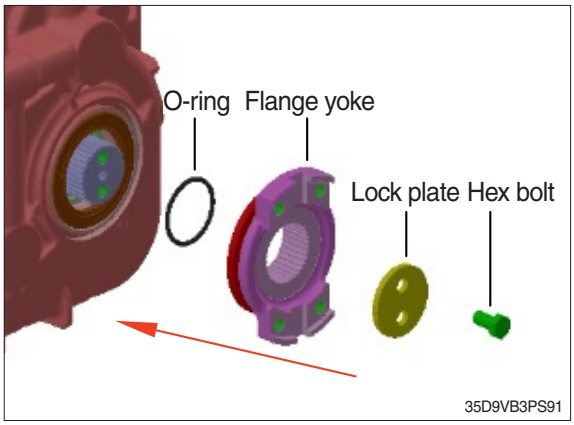
※ **Cover loctite #277 on the screw side of bolt.**



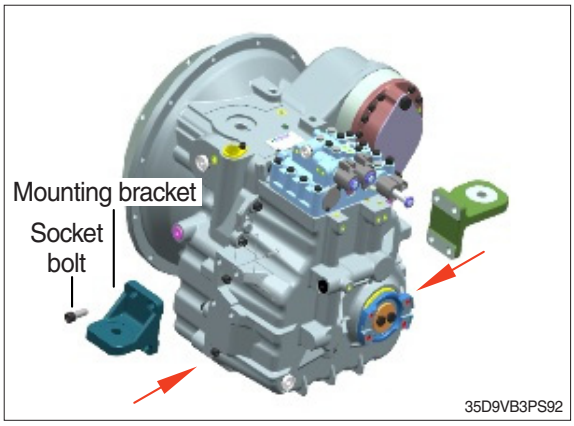
(20) Assemble gasket, valve sub and hex bolt.
· Tightening torque : 3.1 ~ 3.5 kgf·m
(22.4 ~ 25.3 lbf·ft)
※ **Cover loctite #277 on the screw side of plug.**



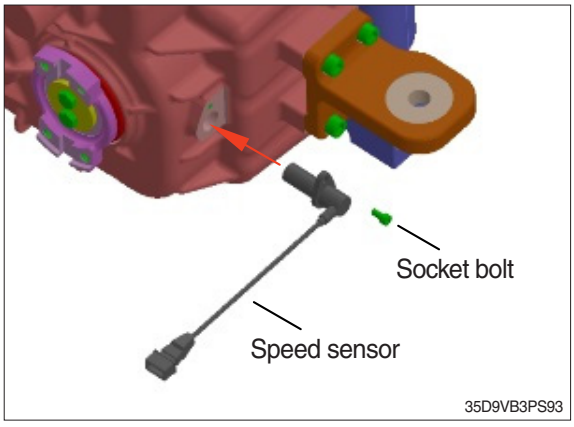
(21) Assemble o-ring, flange yoke, lock plate and hex bolt.
· Tightening torque : 6.1 ~ 6.6 kgf·m
(44.1 ~ 47.8 lbf·ft)
※ **Cover loctite #277 on the screw side of bolt.**



(22) Assemble mounting bracket and socket bolt.
· Tightening torque : 11.7 ~ 13.1 kgf·m
(84.7 ~ 94.8 lbf·ft)
※ **Cover loctite #277 on the screw side of bolt.**



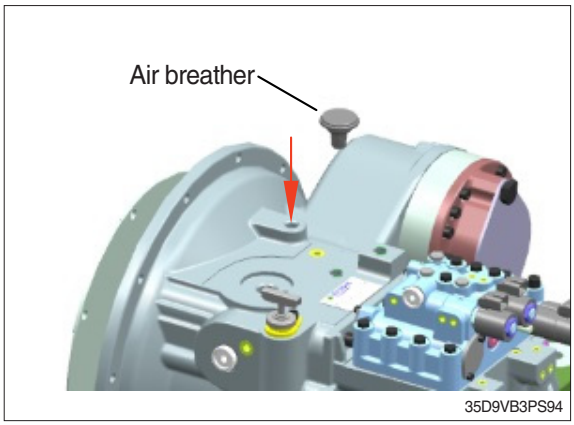
(23) Assemble speed sensor and socket bolt.
· Tightening torque : 0.92 ~ 1.1 kgf·m
(6.7 ~ 8.0 lbf·ft)
※ **Cover loctite #277 on the screw side of bolt.**



(24) Assemble air breather

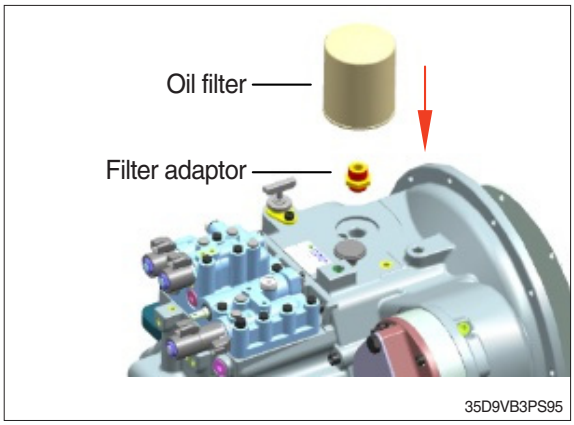
· Tightening torque : 1.0 ~ 1.4 kgf·m
(7.2 ~ 10.1 lbf·ft)

※ **Cover loctite #577 on the screw side of plug.**

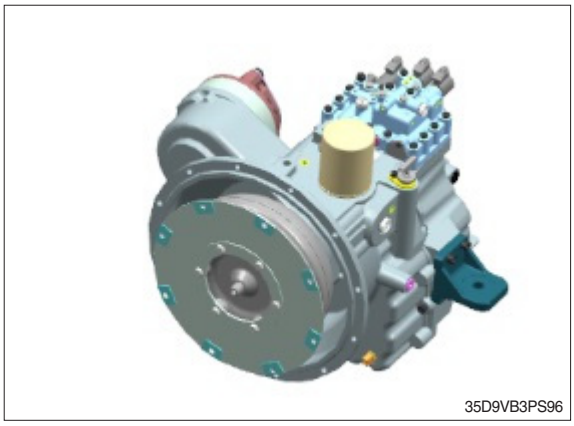


(25) Assemble filter adaptor and oil filter.

· Tightening torque : 13.3 ~ 14.7 kgf·m
(96.2 ~ 106 lbf·ft)



(26) Complete transmission assembly.

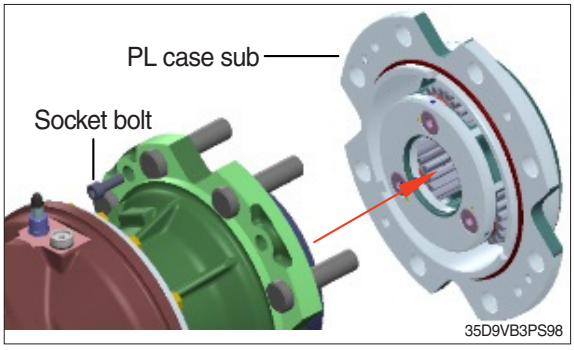


3. DISASSEMBLY OF DRIVE AXLE

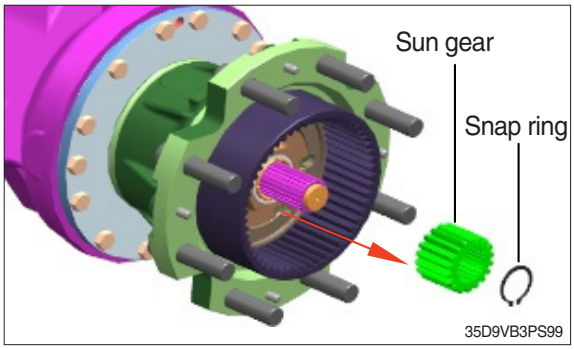
1) DISASSEMBLY OF HUB

(1) Disaasemble drive axle assy.

(2) Disassemble the socket bolt and PL case sub assy.

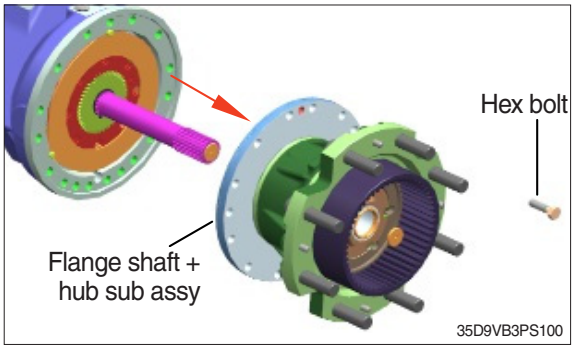


(3) Disassemble snap ring and sun gear at the end of axle.

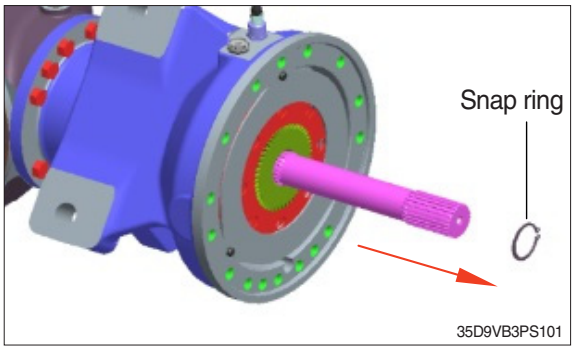


(4) Disassemble hex bolt of flange shaft and hub + flange shaft sub assy.

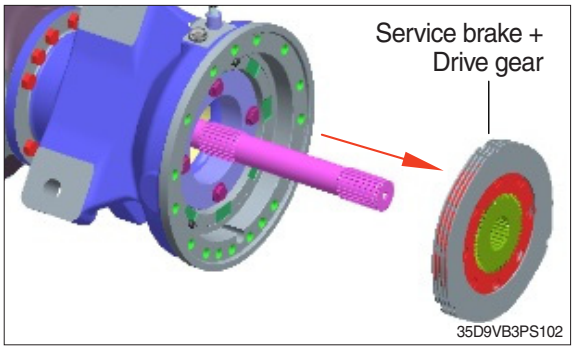
△ **When you disassemble hub sub assembly, the hub sub assembly will be prevention of falling from lift system. Falling of hub sub assembly will make engineers harm and product damage. You must be careful.**



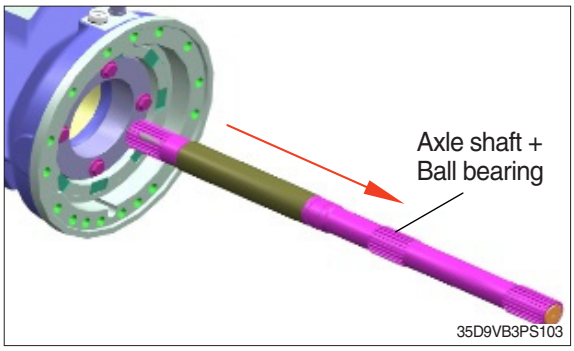
(5) Disassemble snap ring.



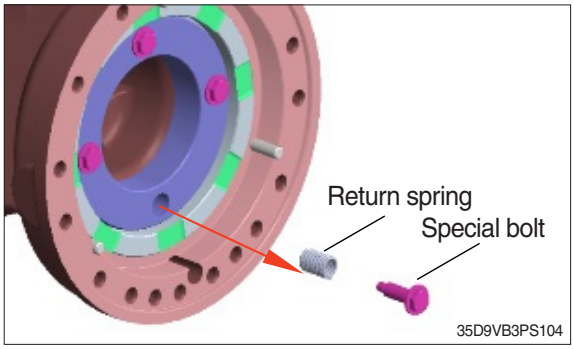
(6) Disassemble service brake + drive gear.



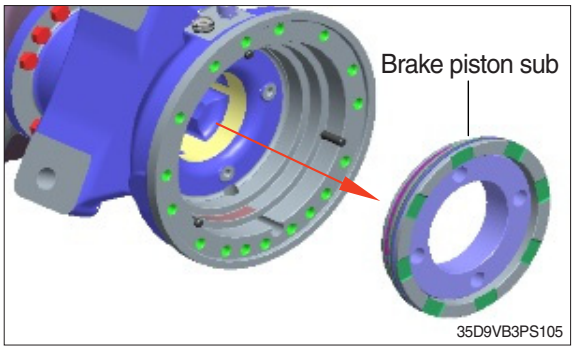
(7) Pick out axle shaft and the opposite side of axle shaft as same way.



(8) Disassemble special bolt & return spring.

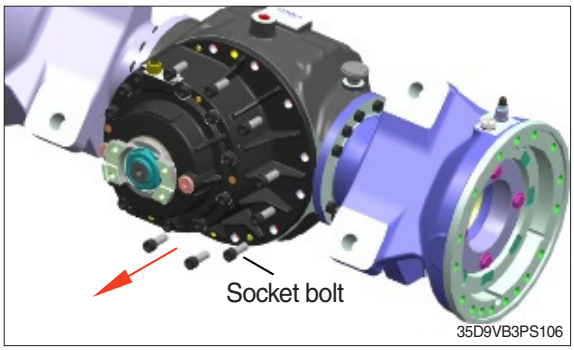


(9) Disassemble brake piston sub assy.

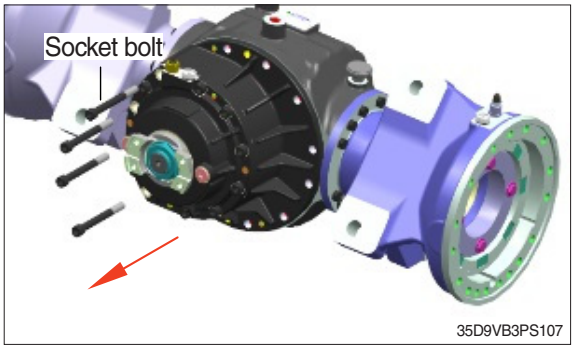


2) DISASSEMBLY OF CARRIER SUB ASSY

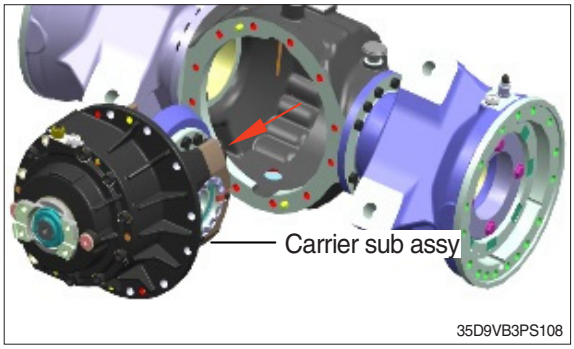
(1) Disassemble socket bolt.



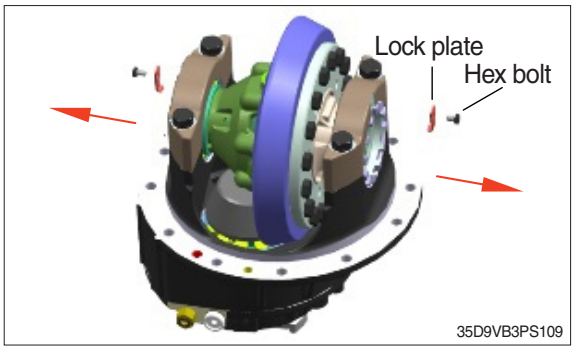
(2) Disassemble socket bolt (4 EA).



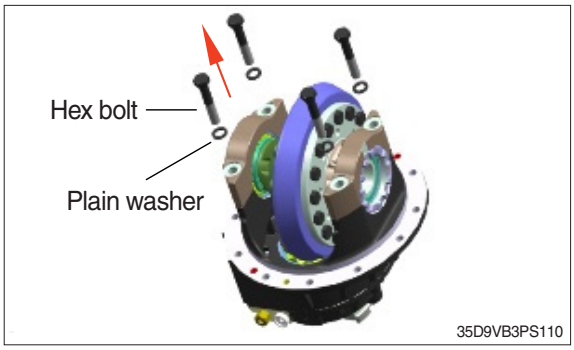
(3) Disassemble carrier sub assy.



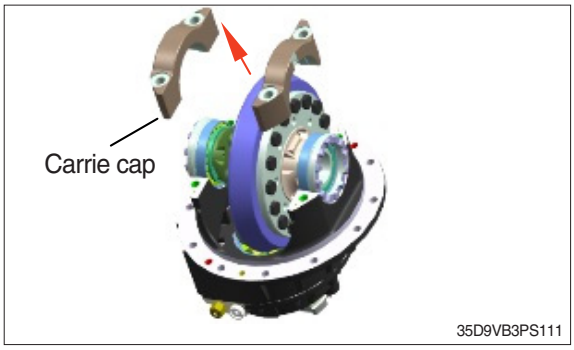
(4) Disassemble hex bolt and lock plate from carrier sub assembly.



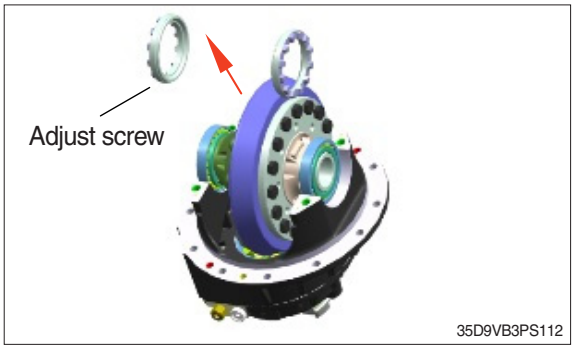
(5) Disassemble hex bolt and plain washer.



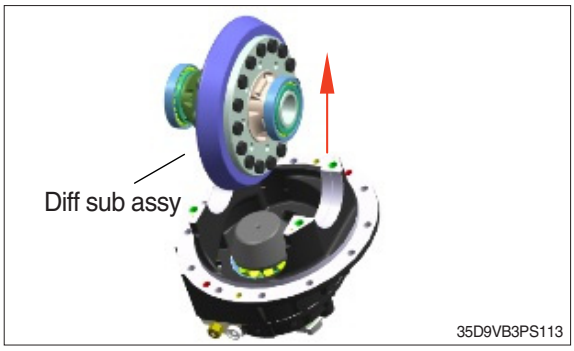
(6) Disassemble carrier cap.



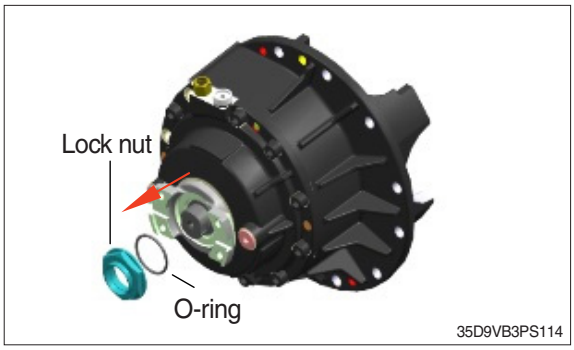
(7) Disassemble adjust screw.



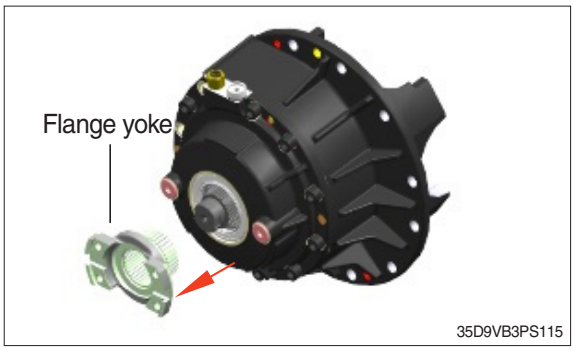
(8) Disassemble differential sub assy from carrier sub assy.



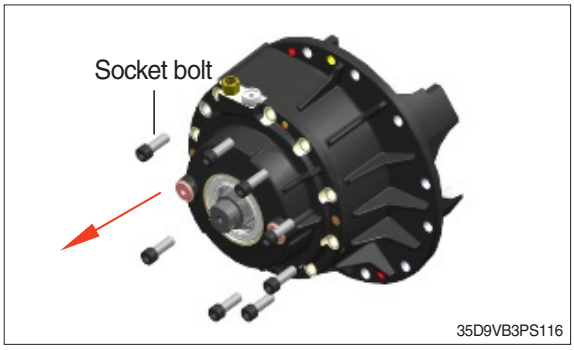
(9) Disassemble lock nut and o-ring from carrier sub assy.



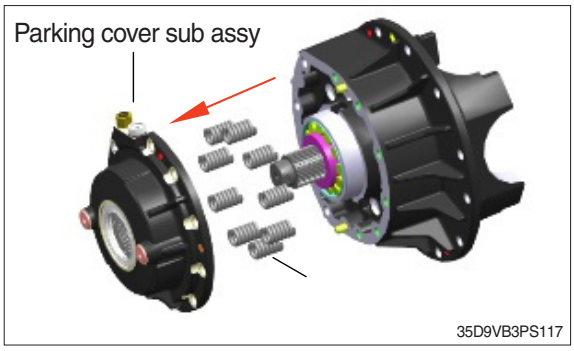
(10) Disassemble flange yoke.



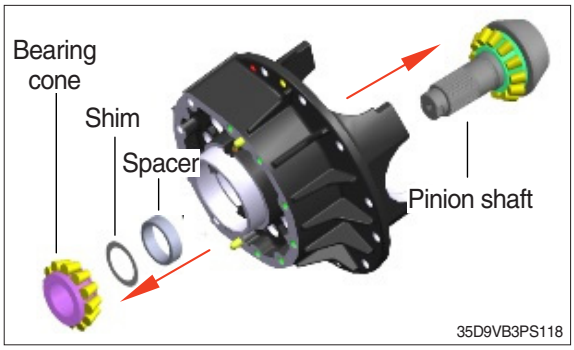
(11) Disassemble socket bolt.



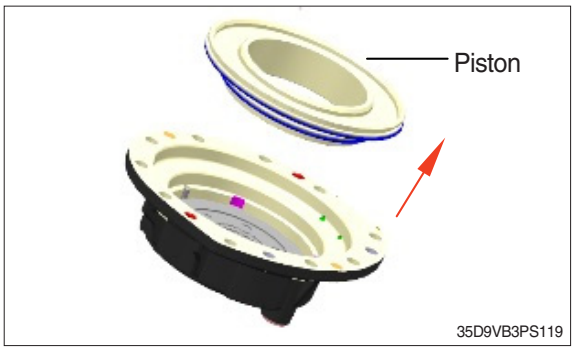
(12) Disassemble parking cover sub assy and return spring.



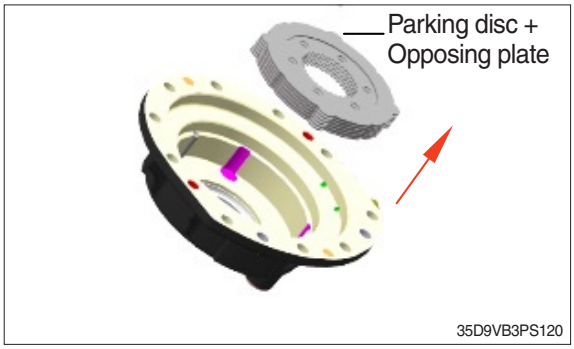
(13) Disassemble pinion shaft, spacer, bearing cone, and shim.



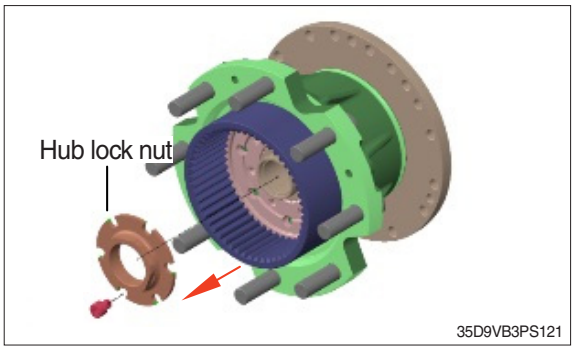
(14) Disassemble piston.



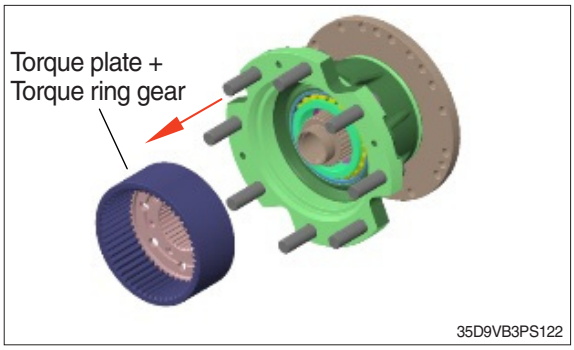
(15) Disassemble parking disk and opposing plate.



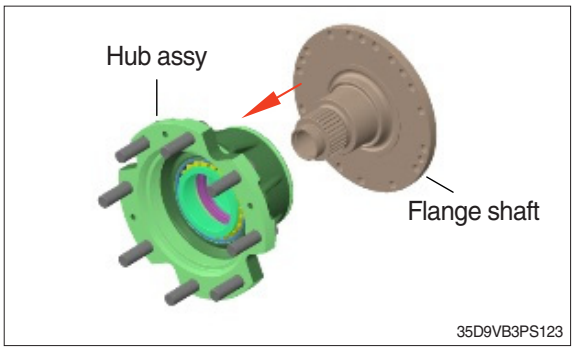
(16) Disassemble socket bolt and hub lock nut.



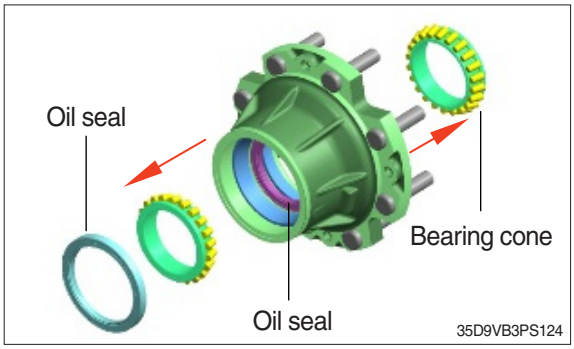
(17) Disassemble torque plate and torque ring gear.



(18) Disassemble flange shaft from hub assy.

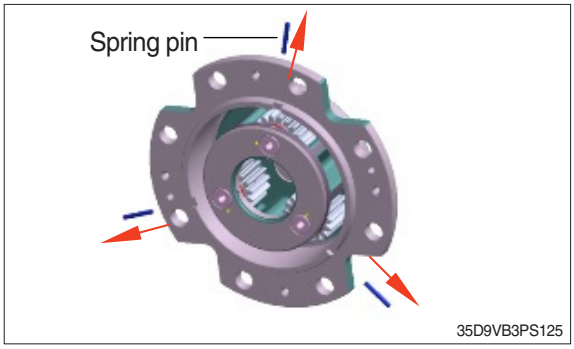


(19) Disassemble bearing cone and oil seal from.

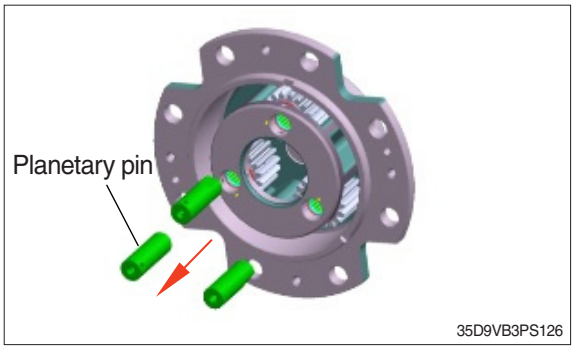


3) DISASSEMBLY OF PLANETARY CASE

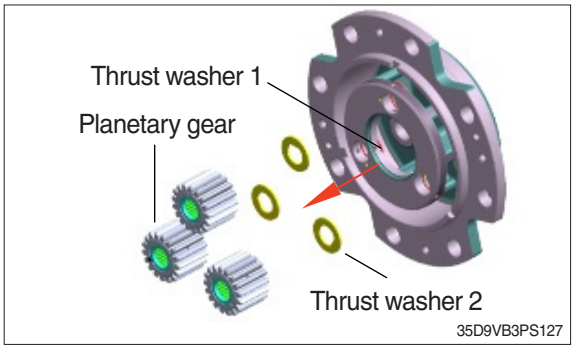
(1) Disassemble spring pin from planetary case assy.



(2) Disassemble planetary pin.



(3) Disassemble needle roller with planetary gear and then, disassemble thrust washer.

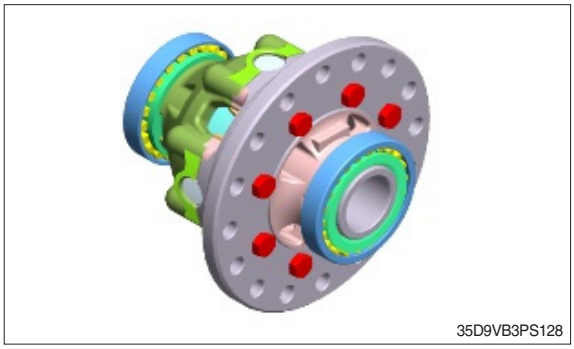


4. ASSEMBLY OF DRIVE AXLE

1) ASSEMBLY OF CARRIER SUB ASSY

(1) Assembly of differential device

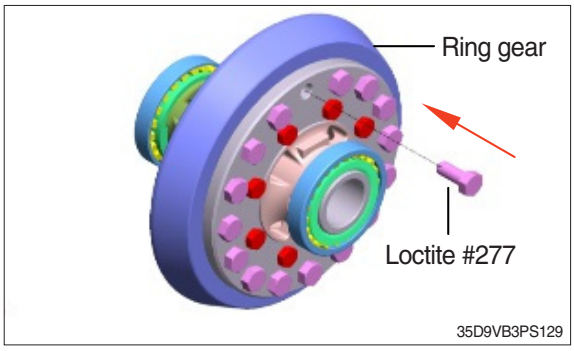
① Make preparation for diffdrential assy.



② Assemble ring gear by bolt.

· Tightening torque : 10.2 ~ 11.2 kgf·m
(73.8 ~ 81.0 lbf·ft)

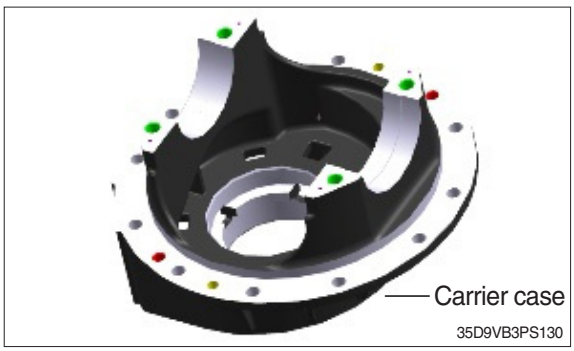
※ Cover loctite #277 on the screw side of bolt.



(2) Control of shim and pinion shaft assy

① Fix carrier case to jig.

※ Before install gearset to carrier, you must recognize information. You always have tested the mark at gear set which each pair of gear suits it. The mark of gearset supposed to look like the illustration.

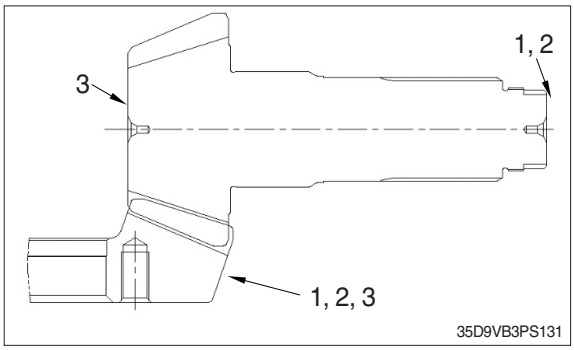


a. Part number

a) Example of gearset part number
· Conventional ring gear, C11D00280
· Conventional pinion gear, C11D00291

b) The place of Pinion shaft : At the end of Shaft

c) The place of Ring gear : Front face or outer diameter



b. Tooth combination number

a) Exampleof tooth combination number : 13-38 (13-38 gearset is maning of 13-tooth drive pinion and 38-tooth ring gear.

b) The place of pinion shaft : at the end of shaft

c) The place of ring gear : front face or outer diameter

c. Pinion cone variation number

(The pinion cone variation number is disused in match checking the gearset. The number is using in carrier for adjusting the depth of pinion.)

a) For example - pinion cone variation nubmers : +2 (+0.01 mm), -1 (0.02 mm)

b) The place of gearset : end of pinion shaft head or outer diameter of ring gear

② The thickness of the shim is determined by a gauge and a measuring device.
(Final clearance of the carrier case : A)
(Correction value of the pinion shaft : B)
(Bearing width measurement : C)

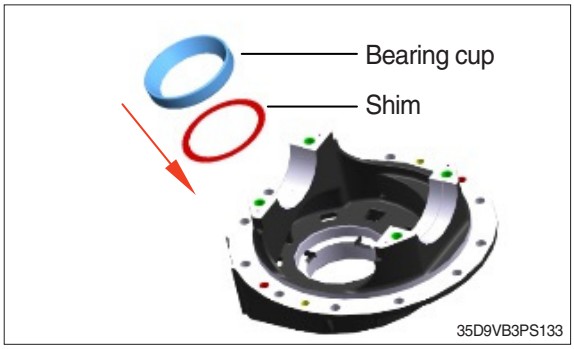
· Thickness of shim

X = "Actual measurement value" - "M.D value" - C
(Actual measurement value = 160.95+A)
(M.D value = 131.2+B)

ex) A= 0.15, B= -0.05, C= 29.25
X= (160.95+0.15)-(131.2+(-0.05)-29.25=0.7
→ Thickness of shim : 0.7 t

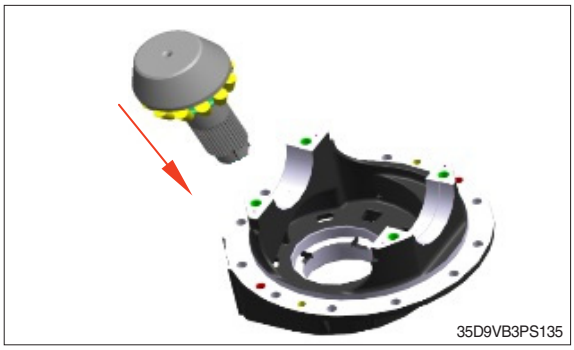
③ Assemble shim and press the bearing cup.

· Sort of shim : 0.1, 0.15, 0.3 mm
(0.004, 0.006, 0.012 in)

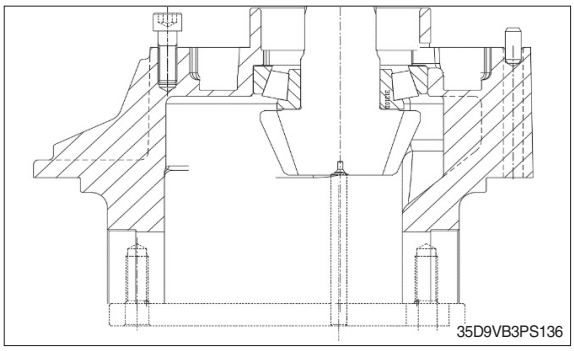


④ Press bearing cone on pinion shaft.

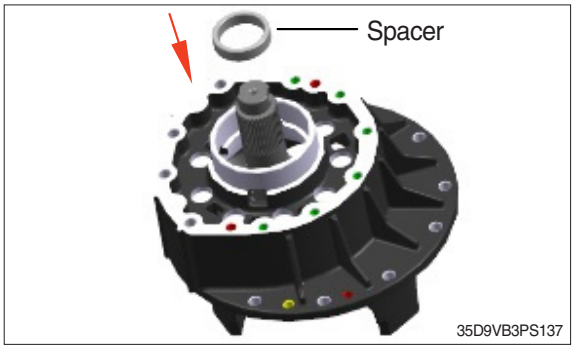
⑤ Assemble carrier case on pinion shaft.



⑥ Turn carrier case a one-eighty (180˚) and fix it on jig.



⑦ Turn carrier case a one-eighty (180˚) and fix it on jig.



⑧ The thickness of the shim is determine by a gauge and a measuring device.

· Thickness of shim

X = ("E"+"measurement value")-("F"-measurement value) +0.15

"E" : The gap between BRG. cup and cone (the left illustration)

"F" : The gap between carrier and spacer (the right illustration)

"0.15" : Correction value.

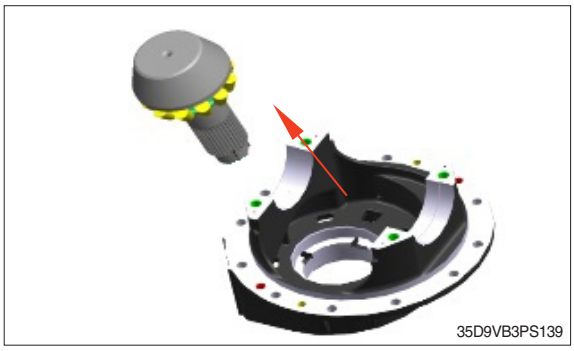
ex) "E"=0.25, measurement value : 0.1

"F"=1.85, measurement value : 0.1

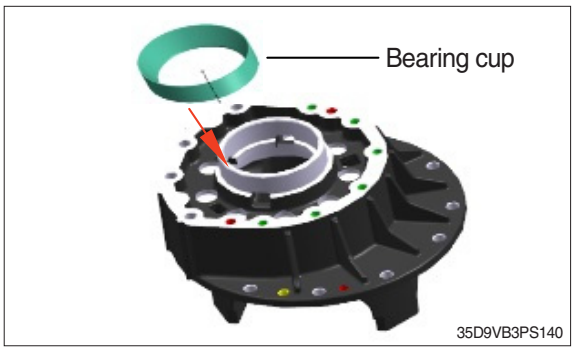
X =(2.25+0.1)-(1.85-0.1)+0.15=0.75

→ Thickness of shim : 0.75 t

⑨ Disassemble pinion shaft from carrier case.

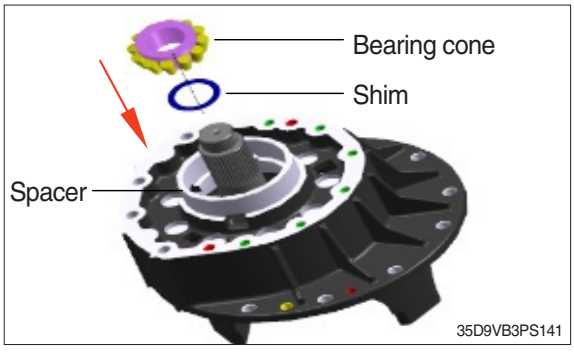


⑩ Assemble bearing cup.

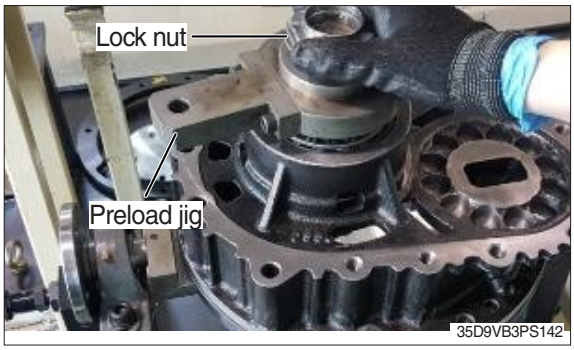


⑪ Reassemble pinion shaft and assemble shim & master bearing.

· Sort of shim : 0.1 , 0.15 , 0.3 mm (0.004, 0.006, 0.012 in)



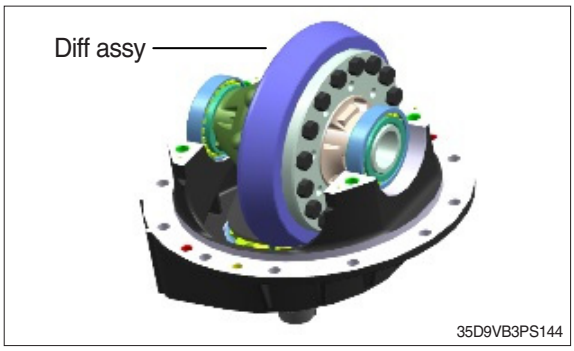
⑫ Assemble preload measurement jig and lock nut.



⑬ Measure the preload in the clockwise direction. After completion of measurement, disassemble the lock nut and jig.

(3) Control of gearset backlash

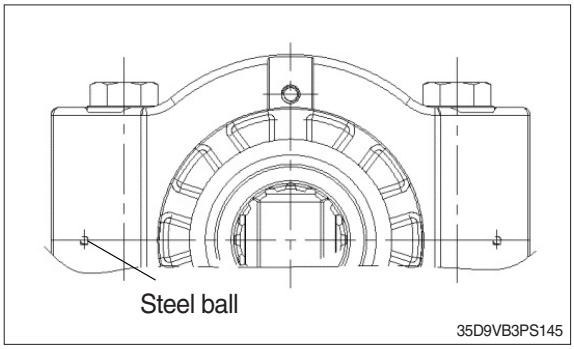
① Assemble differencial assembly on carrier case.



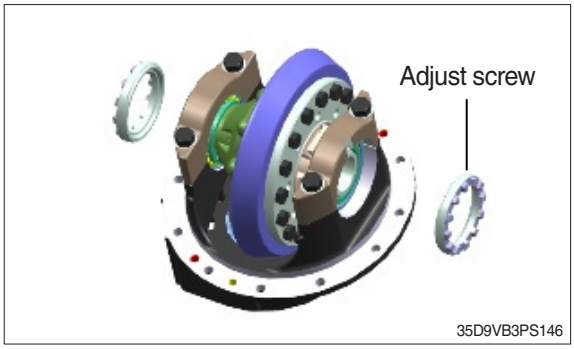
② Assemble washer and hex bolt on carrier cap.

· Tightening torque : 15.8 ~ 18.4 kgf·m
(114 ~ 133 lbf·ft)

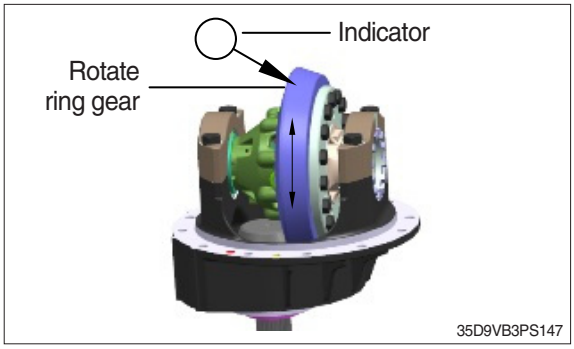
※ Cover loctite #277 on the screw side of bolt.



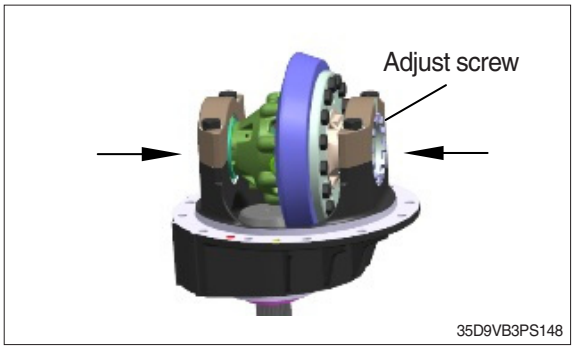
③ Assemble adjust screw on carrier case.



④ Measure backlash as turn ring gear slowly.



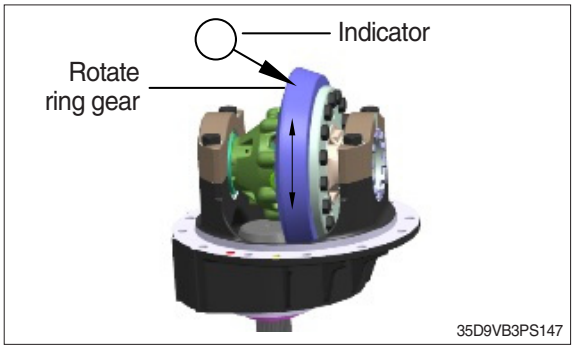
⑤ Lock adjust screw.



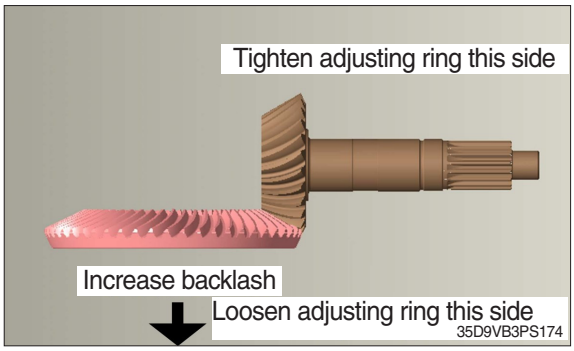
⑥ Remeasure Backlash.

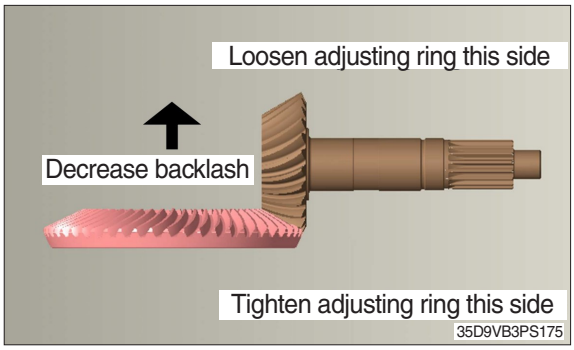
· Backlash of pinion and ring gear : 0.18 ~ 0.23 mm
(0.007 ~ 0.009 in)

※ If it is wrong backlash, you can adjust value as moving each step. If ring gear takes from pinion shaft far, the value of backlash will be increased. If ring gear takes from pinion shaft close, the value of backlash will be decreased.



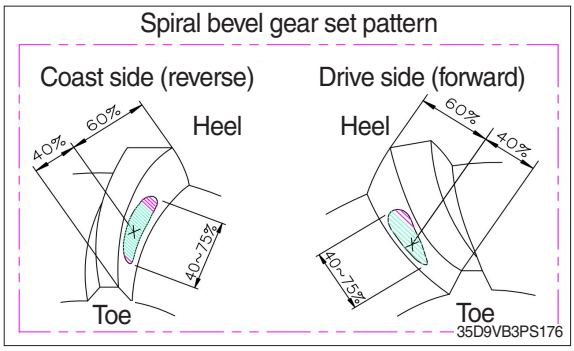
⑦ If ring loosen same with one bolt screw side, you should ring tighten it. And if ring tighten it, you should loosen the adjusting ring.



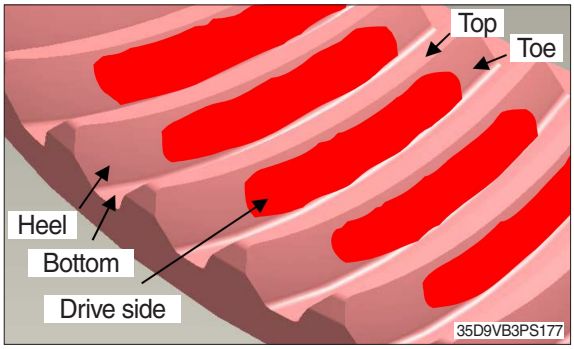


(4) Measurement of tooth contact pattern

※ After assemble, adjust pattern of the gear and pinion shaft figure. If pattern is not adjusted, take a measure as measuring backlash again and then reassemble.

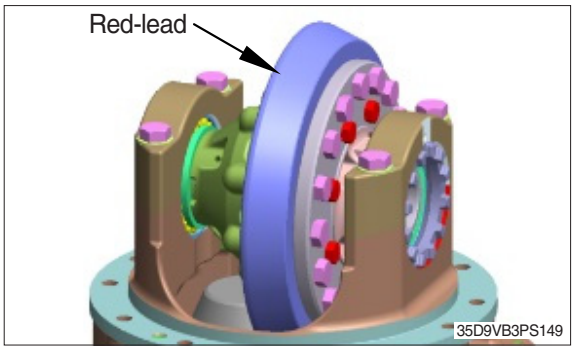


※ Always check tooth contact pattern on the driving side of gear teeth.



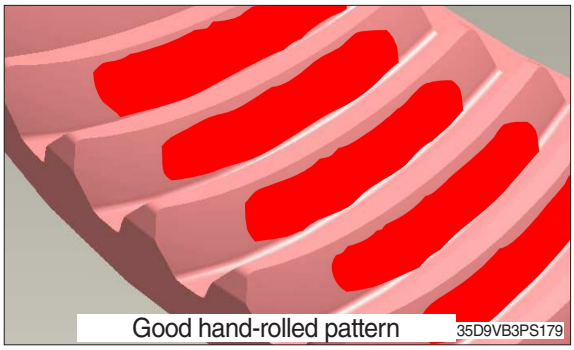
① Marking red-lead on 6 tooth surface of ring gear.

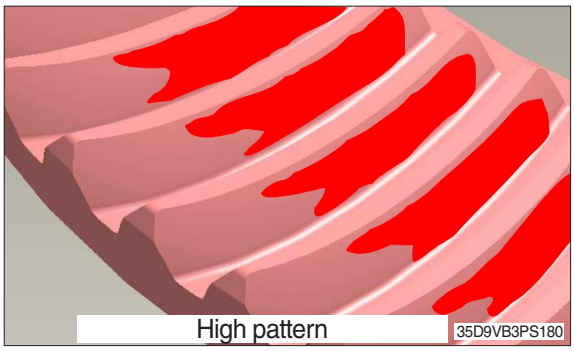
② Rotate ring gear forward and backward so that the 6 marked teeth go past the drive pinion six time to get a good contact pattern.

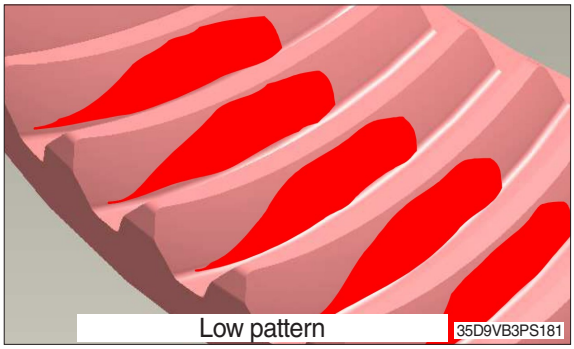


③ Compare the contact pattern with illustrations.

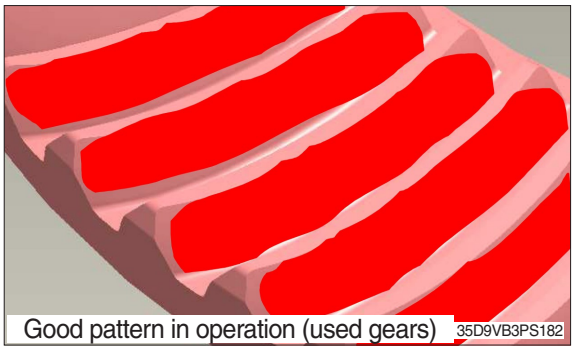
※ **The good contact pattern of gearset is appeared what the length of tooth has had.**







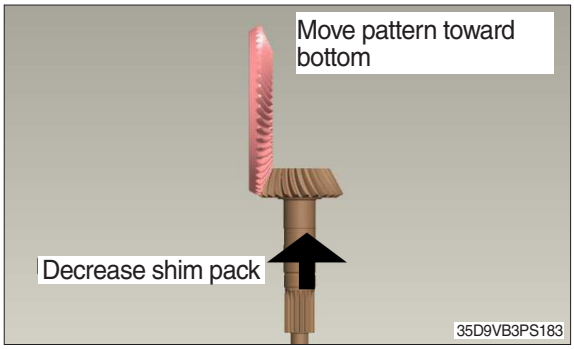
※ **The good contact pattern of used gearset is appeared what the length of tooth has had as wear pattern.**



④ **If you need control contact pattern to adjust THK of tooth (top/bottom), you should obey steps a-b.**
If you need control contact pattern to adjust THK of tooth (toe/heel), you should obey steps c-d.

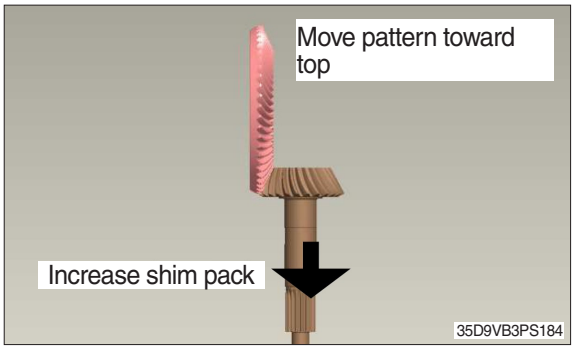
a. High pattern

If A high contact pattern appear it which pinion was installed shallowly in carrier.
To modify, move the pinion toward the ring gear by decreasing the shim pack between pinion spigot and inner bearing cone.



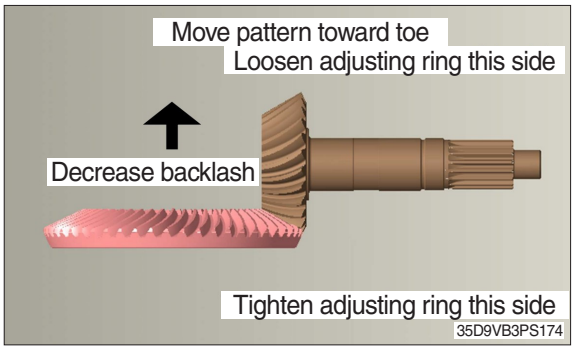
b. Lower pattern

If A low contact pattern appear it which pinion was installed deeply in carrier.
To modify, move the pinion away from the ring gear by increasing the shim pack between pinion spigot and inner bearing cone.



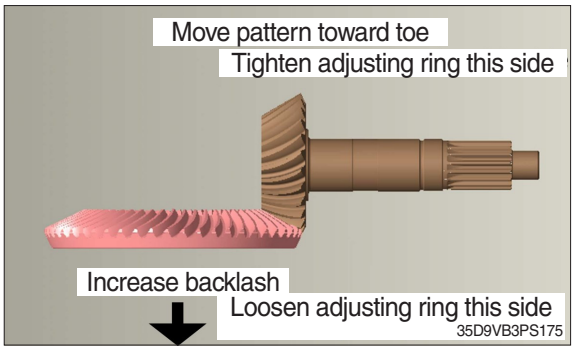
c. Heel pattern

Decrease the gearset backlash (within specified range) to move contact pattern toward toe and away from heel. Refer to "Adjusting the gearset backlash".



d. Toe pattern

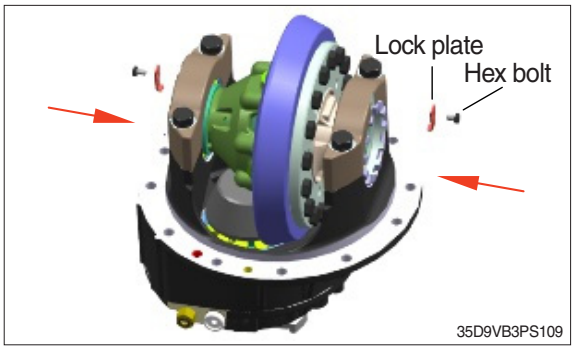
Increase the gearset backlash (within specified range) to move contact pattern toward heel and away from toe. Refer to "Adjusting the gearset back lash".



④ Assemble lock plate and hex bolt.

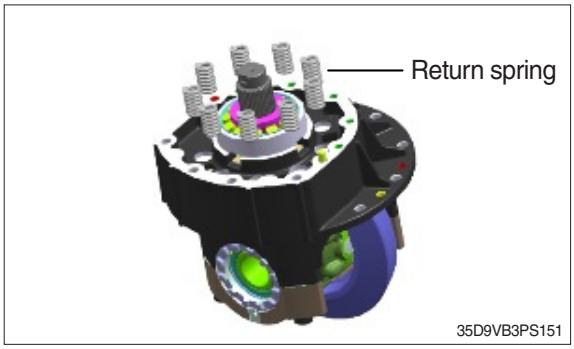
· Tightening torque : 0.92 ~ 1.2 kgf·m (6.7 ~ 8.7 lbf·ft)

※ Cover loctite #277 on the screw side of bolt.



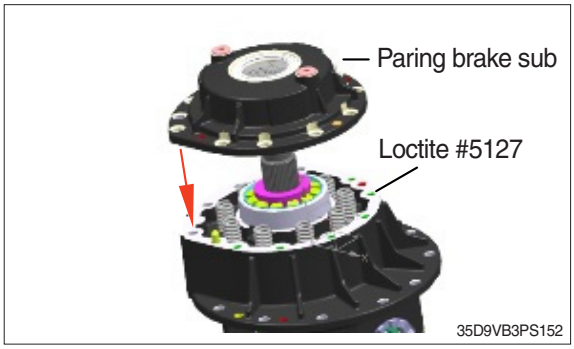
(5) Assembly of parking sub

① Assemble return spring.



② Assemble parking brake sub on carrier case.

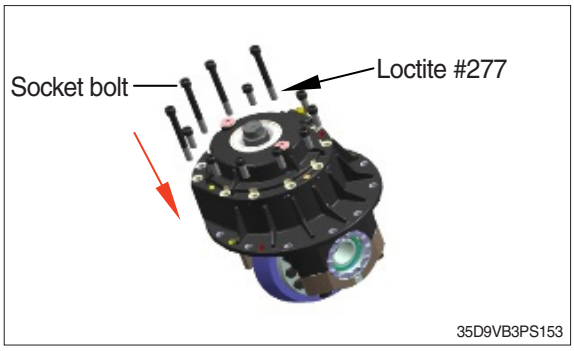
※ Cover loctite #5127 on carrier case.



③ Assemble socket bolt.

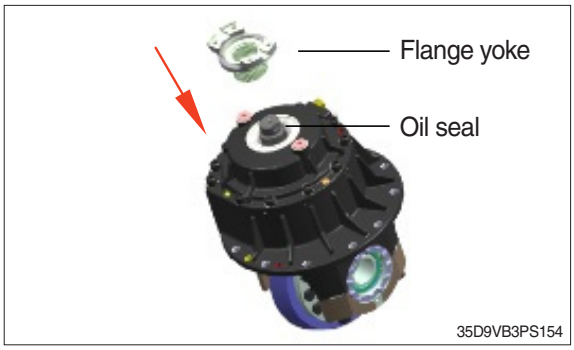
· Tightening torque : 10.2 ~ 11.2 kgf·m
(73.8 ~ 81.0 lbf·ft)

※ Cover loctite #277 on the screw side of bolt.



④ Assemble flange yoke.

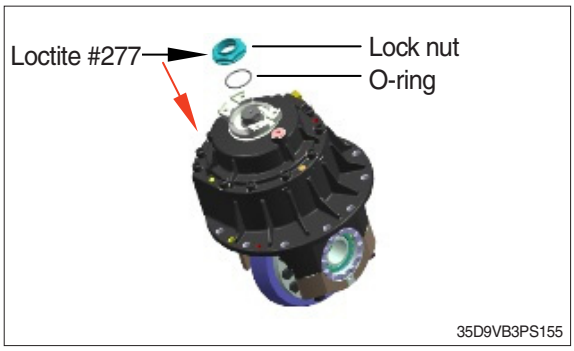
※ Cover grease on seal rip.



⑤ Assemble o-ring and lock nut.

· Tightening torque : 44.9 ~ 50.0 kgf·m
(324 ~ 361 lbf·ft)

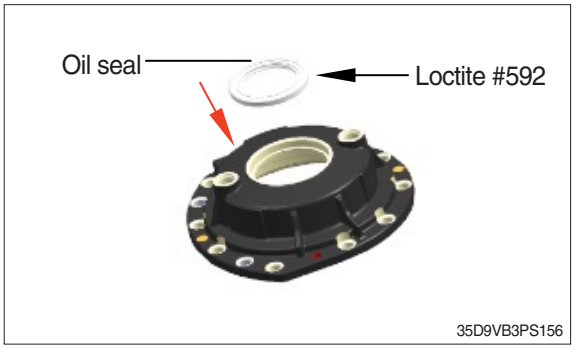
※ Cover grease on o-ring and loctite #277 on lock nut.



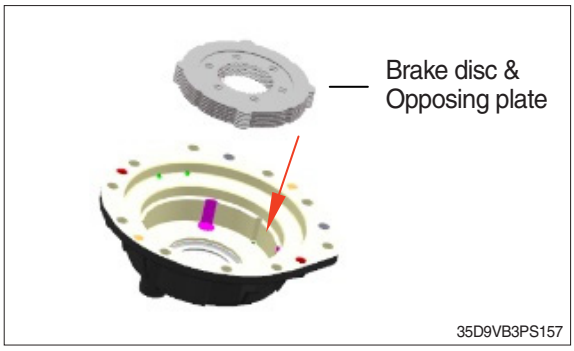
(6) Assembly of parking cover

① Assemble oil seal on parking cover.

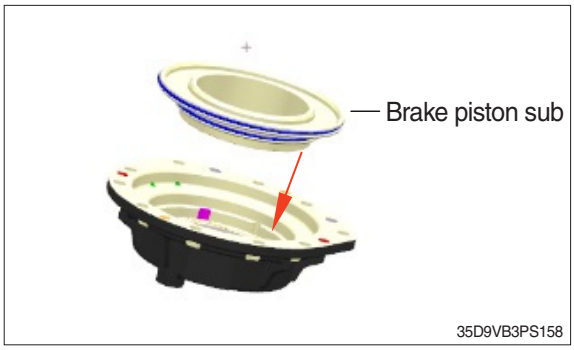
※ Cover loctite #592 on outer diameter of oil seal and grease on internal diameter.



② Assemble brake disk and opposing plate.
- Brake disk : 6EA
- Opposing plate : 6EA



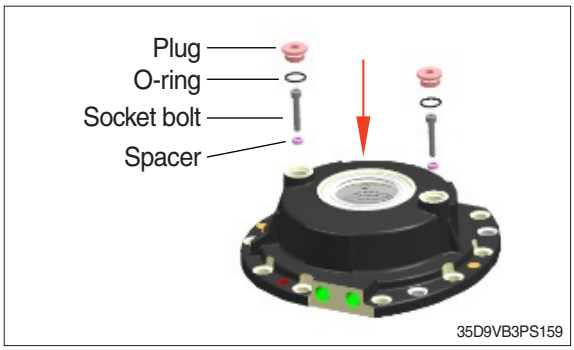
③ Assemble brake piston sub.
※ **Cover grease on o-ring.**



④ Assemble spacer and socket bolt.
- Tightening torque : 0.8 ~ 1.1 kgf·m
  (5.9 ~ 8.1 lbf·ft)

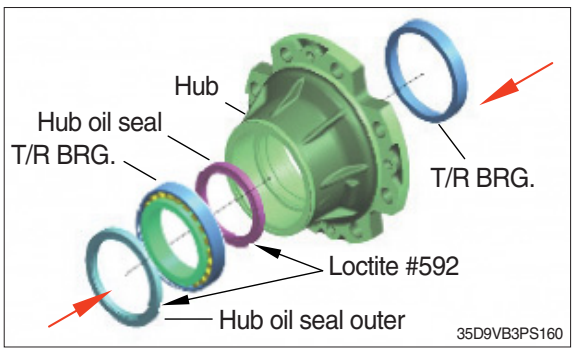
⑤ Assemble o-ring and plug.
- Tightening torque : 4.2 ~ 4.9 kgf·m
  (30.2 ~ 35.3 lbf·ft)

※ **Cover grease on o-ring.**



2) ASSEMBLY OF HUB SUB

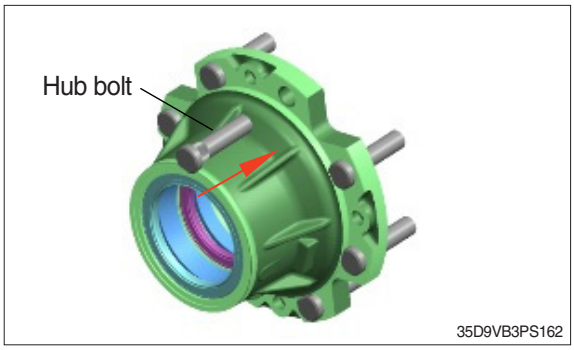
(1) Press hub oil seal. Assemble bearing cup (2 EA) on each left and right hub.



(2) Press hub outer oil seal.

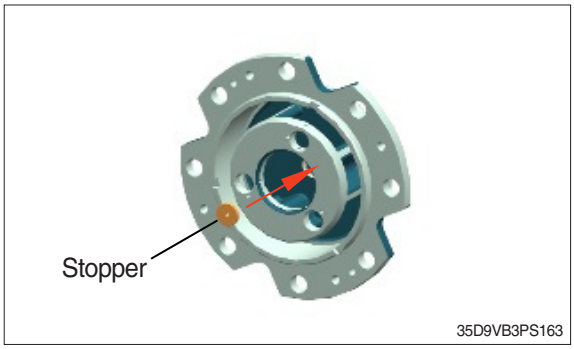
※ **Cover grease at inside hub. (grease : Shell Retinax 0434 - 45 ~ 80cc spread)**

(3) Press hub bolt into hub.

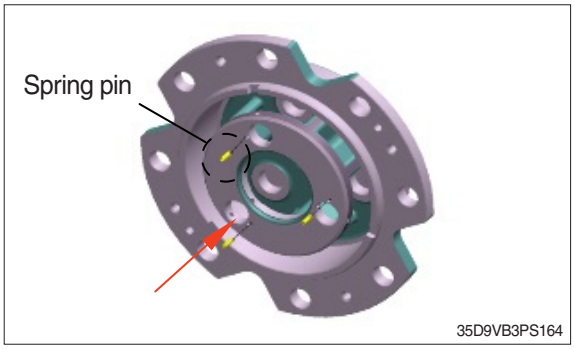


3) ASSEMBLY OF PLANETARY CASE

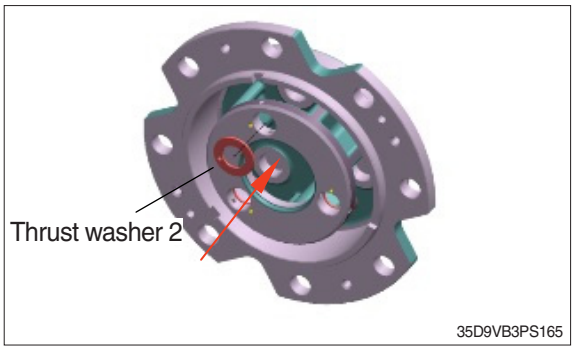
(1) Assemble stopper.



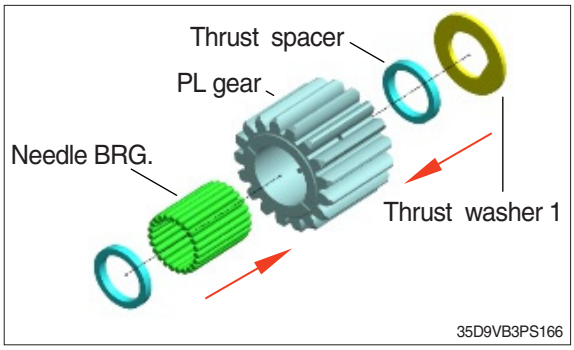
(2) Assemble spring pin (3 EA).



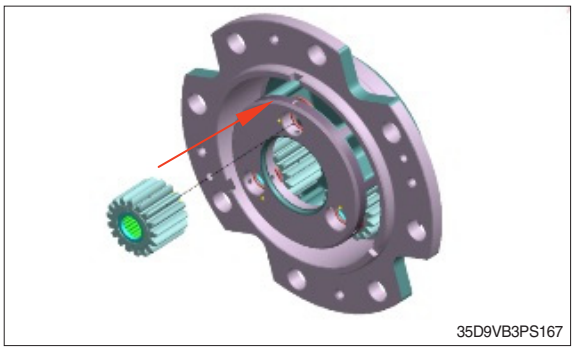
(3) Assemble thrust wahser 2 (3EA).



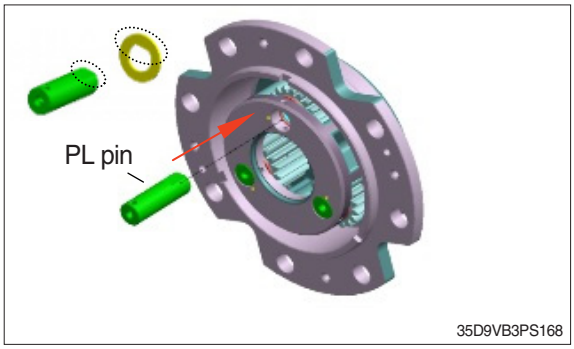
(4) Needle bearing → thrust spacer → thrust washer 1. Assemble planetary gear (3 EA) as above in order.
· Needle bearing 69 EA (1 Gear)



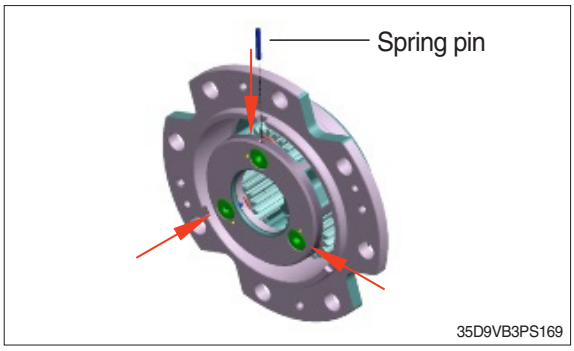
(5) Assemble planetary gear (3 EA).



(6) Assemble planetary pin (3 EA).

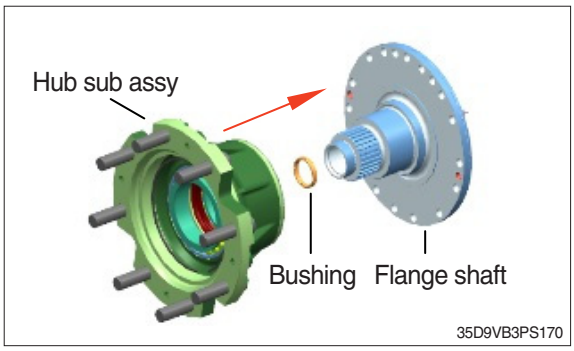


(7) Assemble spring pin (3 EA).

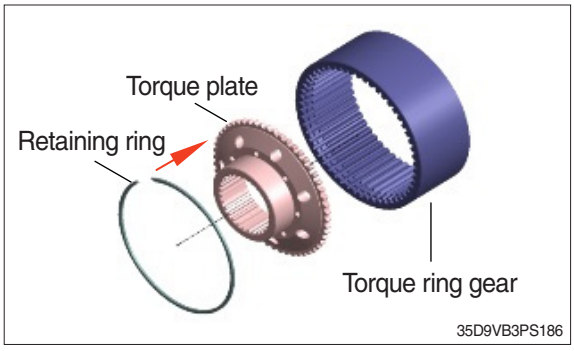


4) ASSEMBLY OF FLANGE SHAFT AND HUB SUB ASSY

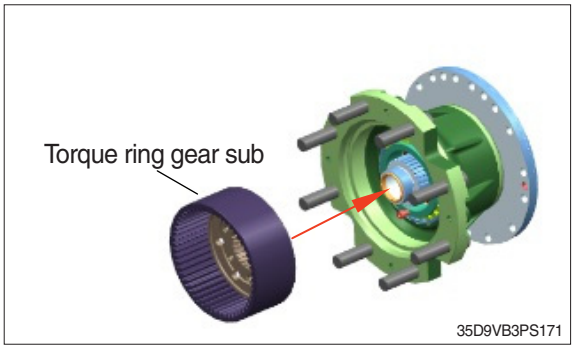
(1) Assemble hub sub assy on flange shaft.



(2) Assemble torque plate and retaining ring on torque ring gear.

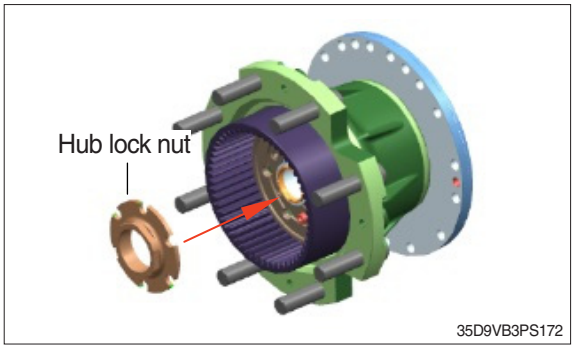


(3) Assemble torque ring gear sub.



(4) Tighten the hub lock nut as much as possible and turn it 2 or 3 times to the left and right. After loosening the nut, tighten the torque.

· Tightening torque : 25 ~ 30 kgf·m
(180 ~ 217 lbf·ft)



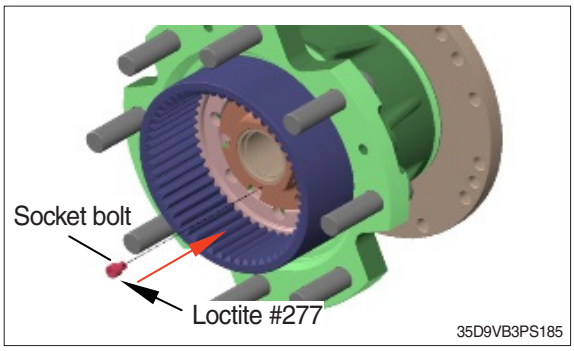
(5) Measure the preload after torque tightening. If the results are different, repeat step (4). If the hub bearing preload is different, the shaft may be damaged. You should check the preload to prevent serious accidents.

· Hub preload : 150 ~ 300 kg·cm
(10.8 ~ 21.7 lb·ft)

(6) Assemble socket bolt.

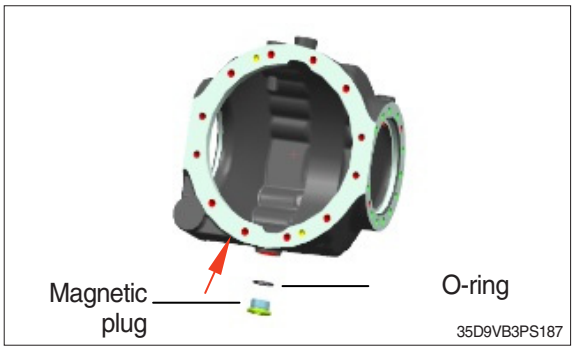
· Tightening torque : 1.8 ~ 2.4 kgf·m
(13.0 ~ 17.4 lbf·ft)

※ **Cover loctite #277 on the screw side of bolt.**



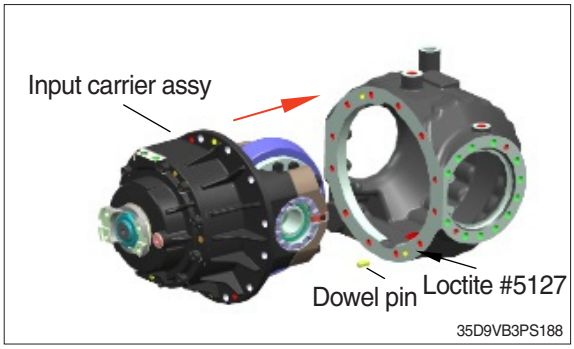
5) ASSEMBLY OF DRIVE AXLE

(1) Assemble oil level gauge and drain plug (magnetic).



(2) Assemble dowel pin on axle housing and carrier assy.

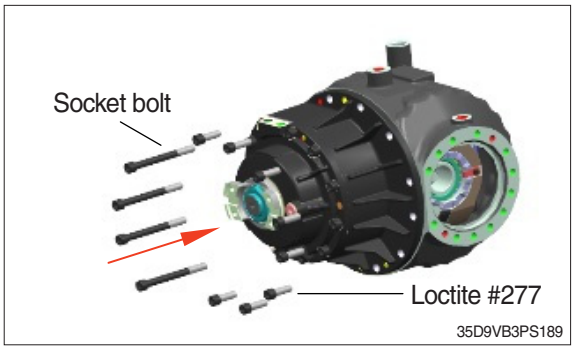
※ **Cover loctite #5127 on axle housing.**



(3) Assemble socket bolt.

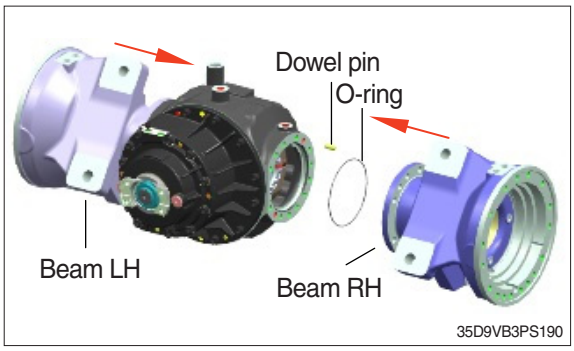
· Tightening torque : 10.2 ~ 11.2 kgf·m
(73.3 ~ 80.6 lbf·ft)

※ **Cover loctite #277 on the screw side of bolt.**



(4) Assemble dowel pin on axle housing, o-ring and beam LH, RH.

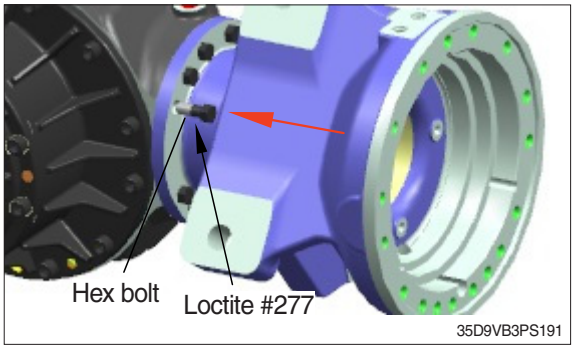
※ **Cover grease on O-ring.**



(5) Assemble hex bolt.

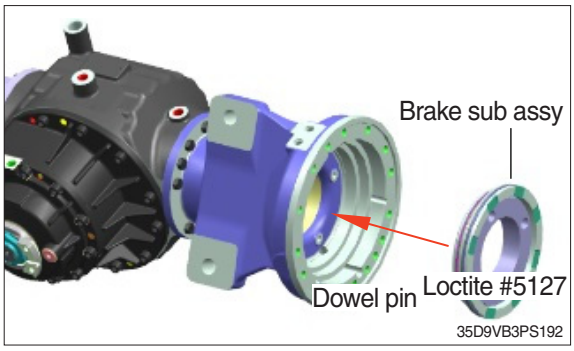
· Tightening torque : 10.2 ~ 11.2 kgf·m
(73.3 ~ 80.6 lbf·ft)

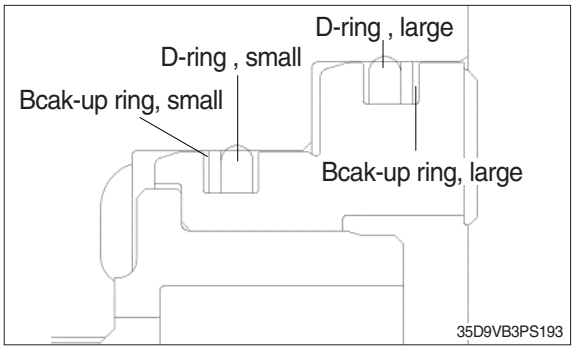
※ **Cover loctite #277 on the screw side of bolt.**



(6) Assemble brake sub assy.

※ **Cover grease on D-ring.**

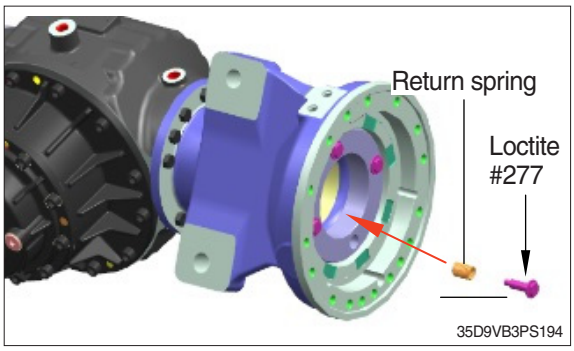




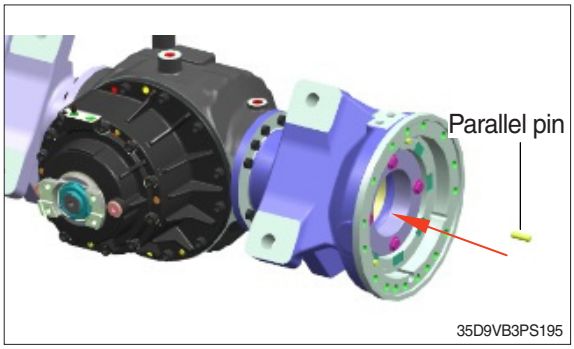
(7) Assemble return spring and special bolt.

· Tightening torque : 3.1 ~ 3.6 kgf·m
(22.1 ~ 25.8 lbf·ft)

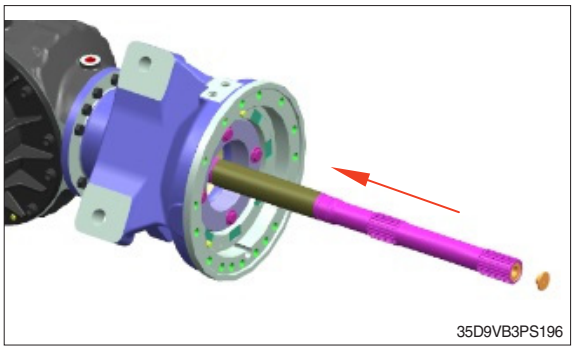
※ **Cover loctite #277 on the screw side of bolt.**



(8) Assemble parallel pin on beam.

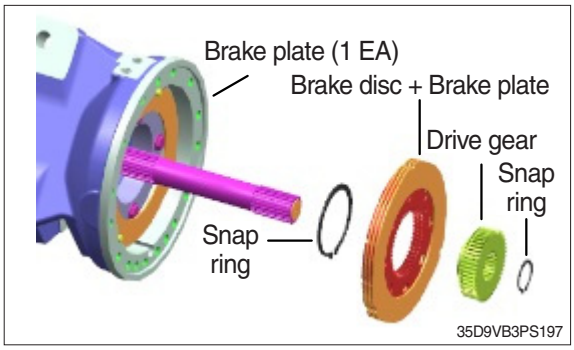


(9) Assemble axle shaft and bushing.



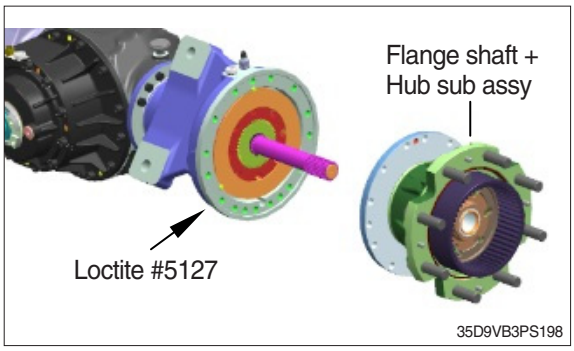
(10) Assemble snap ring, brake disc and plate on drive gear.
- Brake disc : 3 EA
- Brake plate : 3 EA

Assemble brake plate (1 EA) on beam and drive gear sub and snap ring on drive axle assy.



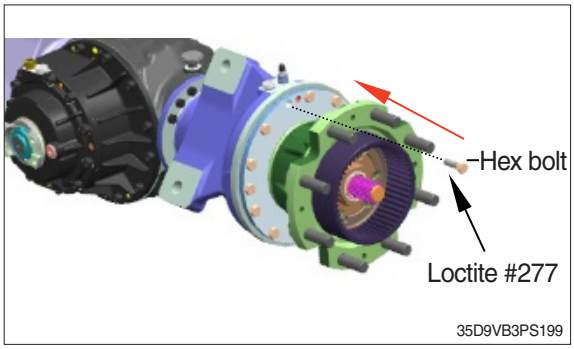
(11) Assemble flange shaft + hub sub assy.

※ **Cover loctite #5127 on beam.**

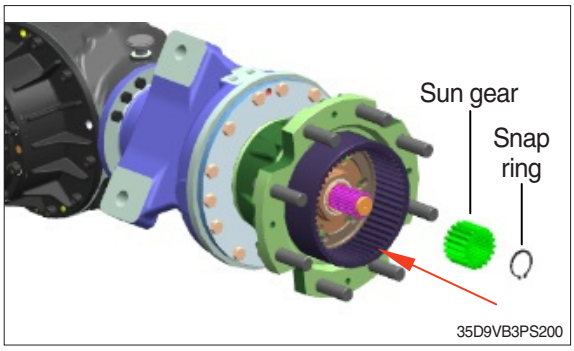


(12) Assemble hex bolt.
- Tightening torque : 10.2 ~ 11.2 kgf·m (73.3 ~ 80.6 lbf·ft)

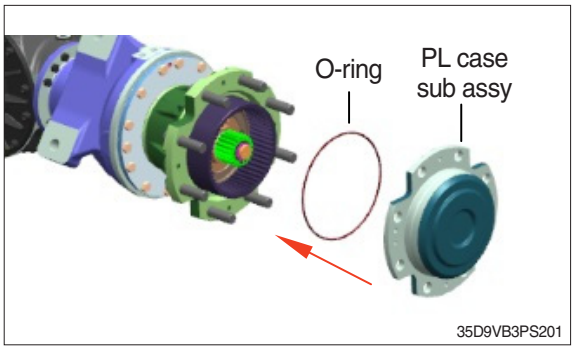
※ **Cover loctite #277 on the screw side of bolt.**



(13) Assemble snap ring and sun gear.



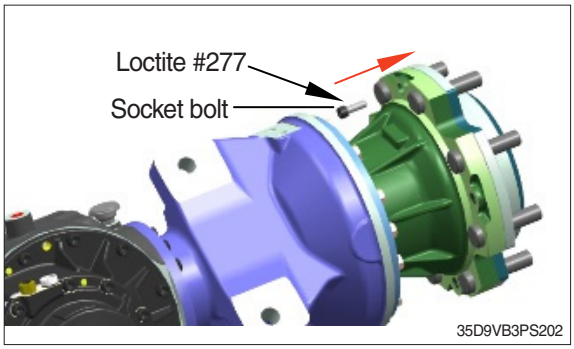
(14) Assemble o-ring and PL case sub assy.



(15) Assemble socket bolt.

· Tightening torque : 6.1 ~ 6.6 kgf·m
(44.0 ~ 47.6 lbf·ft)

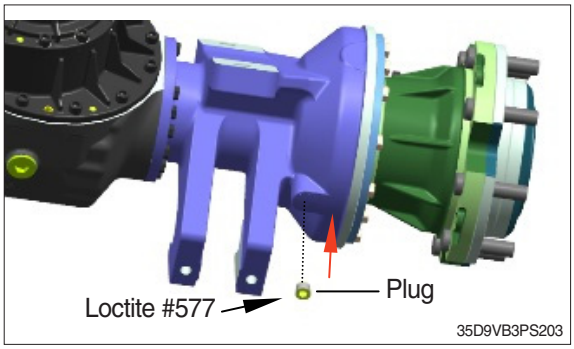
※ **Cover loctite #277 on the screw side of bolt.**



(16) Assemble plug.

· Tightening torque : 4.0 ~ 5.0 kgf·m
(29.1 ~ 36.3 lbf·ft)

※ **Cover loctite #577 on the screw side of plug.**



(17) Assemble o-ring → bleeder fitting → bleeder → bleeder cap.

· Fitting tightening torque : 3.8 ~ 4.2 kgf·m (27.2 ~ 30.2 lbf·ft)

· Bleeder tightening torque : 1.6 ~ 2.0 kgf·m (11.4 ~ 14.4 lbf·ft)

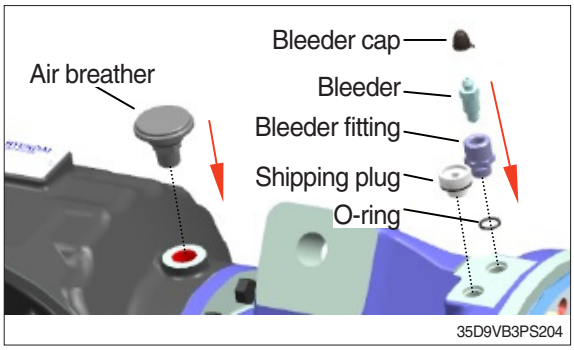
※ **Spread grease on o-ring.**

Asssemble air breather on axle housing.

· Tightening torque : 0.5 ~ 0.6 kgf·m (3.7 ~ 4.3 lbf·ft)

※ **Cover loctite #577 on the screw side.**

Assemble shipping plug.



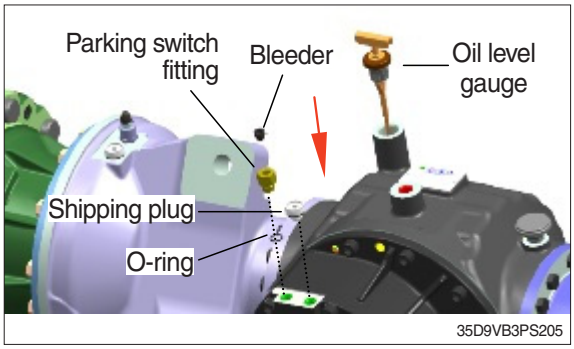
(18) Assemble o-ring→ parking switch fitting → Bleeder cap.

· Fitting tightening torque : 3.8 ~ 4.2 kgf·m (27.2 ~ 30.2 lbf·ft)

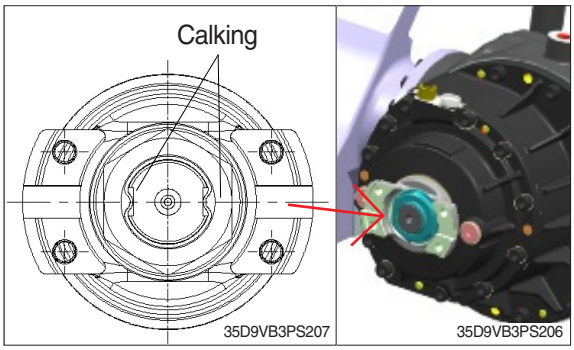
· Bleeder tightening torque : 1.0 ~ 1.2 kgf·m (7.2 ~ 8.6 lbf·ft)

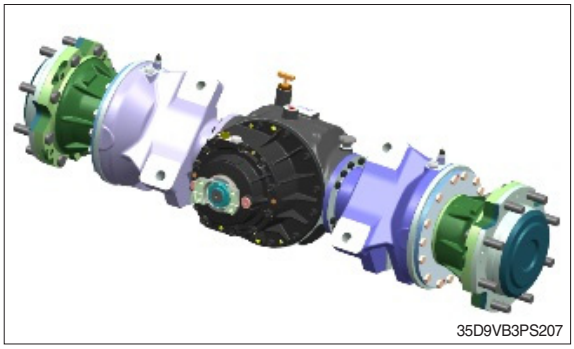
※ **Spread grease on o-ring.**

Assemble shipping plug and oil level gauge.



(19) Caulking of lock nut (2 EA) on carrier assy.





GROUP 3 MAINTENANCE AND TROUBLESHOOTING

1. MAINTENANCE

1) TRANSMISSION

(1) Recommend oils

The property that needs for auto transmission oil.

- · It has suitable viscosity at the height temperature.
- · It has suitable fluidity at the low temperature.
- · It has excellent oxidation stability.
- · It has property which remove bubble, and property of lubricant.
- · Therefore please be sure to use following the oil when you supply or change oil. In addition, please use the same oil that you supplied already.

① Oil volume is approximately 8 ℓ (2.1 U.S. gal, without torque converter).

② Suggested oil : ATF (Auto Transmission oil, Dexron type)

(2) Point of exchange oil

① Pulling out oil

a. Please take off the drain plug where under of the transmission, and then discharge the old oil.

b. Please take off the hose join part, and then discharge the old oil that remained in the oil cooler and in the hose.

※ Period of exchange oil filter : initial time 100 hour, and then every 1000 hour

② Oil supply

a. Please stop the engine (ok), then refuel the oil into transmission until 「HOT」 level of oil level gauge.

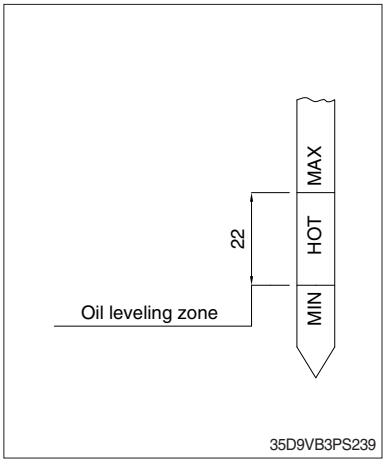
b. Please change lever "neutrality" position. Then please turn on the engine and keep low idle speed.

c. The oil reaches the hydraulic torque converter, cooler and pipe and so on, after start up the engine. Then oil level sink down.

d. Please drive the engine about 5 minutes at low idle speed, then refuel the oil gradually the oil level settle in regular position (between 「MAX」 and 「MIN」 position).

※ Please refuel the oil carefully, without get rubbish or water and so on in the oil.
Lack of oil or excess of oil becomes cause of breakdown. So please be careful.

※ Check the oil level, when the oil temperature is 50℃ ~ 60℃.
Amount of all oil : about 14 ℓ (3.7 U.S. gal)



(3) Period of overaul

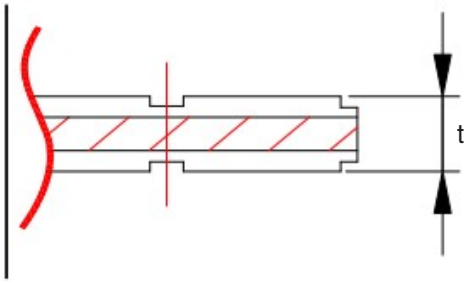
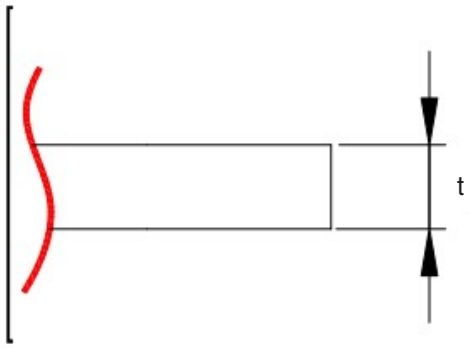
① As for the overhaul, we recommend either every 5 years or 7000 hours coming early to be done as a limit.

② Please change the oil seal, rubber such as o-ring, and gasket, copper gasket, if it has damaged.

③ Please check the part by your eyes which you disassembled whether they have the crack, the scar, abnormal wear and corrosion etc. If the parts have such abnormal condition, please change or repair.

④ Seal ring, snap ring, friction disc, plate → Change the part that exceeds the wear limits.

⑤ Bearing, bush → Check the bearing to see if it rotates freely. If in doubt about the wear or lack of lubrication, replace this bearing.

	Item in the F&R clutch	Standard	Limit
Friction disk		2.4	2.1
Plate		1.8	1.6
Back plate		3	2.8

(4) Period of exchanging parts

time / Item name	At the first overhaul	At the overhaul after the second times
Oil seal	Please change all parts.	Please change all parts at every overhaul.
O-ring		
Gasket		
Copper gasket		
Oil seal ring	Please check the each part.	Please change all parts at 2nd and 4th time.
Seal ring race plane		Please change the part that exceeds the wear limit.
Friction disk		
Stator free wheel part		Please change the part that exceeds the wear limit. Please change the abnormal leaf spring.
Sliding surfaces of oil seal		Please change the part that exceeds the wear limit.
Sliding seciton of clutch piston		
Inside diameter or bush		
Each bearing		
Spring		

(5) Standard of exchanging parts

Classfication	Contents	Object parts	Item name
A	The part that you should change the part to new one whenever overhauling and for check cleaning.	Gasket, Rubber	Gasket, O-ring, Copper gasket, Oil seal
B	The part that wear of the part is extreme comparatively, so the change time is high frequency.	Seal ring, Clutch plate	Oil seal ring, Snap ring, Friction plate&steel plate in clutch
C	The part that you do not have to change every overhauling but it is abnormally when overhauling you have to change the part.	Bearings, Race side of seal ring	Bearing, Bush, Part of free wheel, Seal race
D	The part that you usually do not have to change to new part but when if it its abnormally you have to chage.	Gear, Shaft	Each gear, Clutch shaft, Turbine shaft, Flange

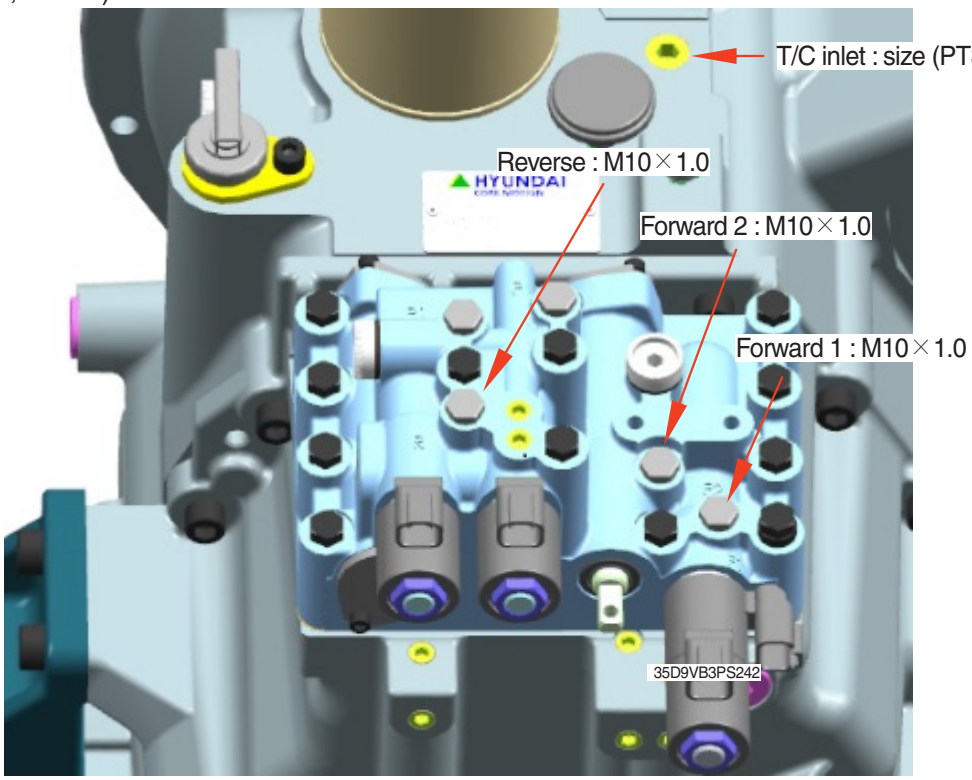
(6) Test

① Operation check

- Please change the change lever to 「N」 position and hold this position, then please change the engine speed from low idle to high idle, and check the below condition.
- The abnormal sound dose not occur.
- The abnormal oscillation dose not occur.
- The oil is not leaking.
- Overheating, a strong odor of overheated oil is a major trouble sign.

② Oil pressure measurement

- If you measure each part pressure, remove the plug and then install the pressure gauge. (PT 3/8, PT 1/8)



a. Please warming up the engine until the torque converter oil temperature becomes about 50~60˚C.

b. Please measure the oil pressure of every required part as below under the low & high idle speed of engine.

c. When if you measure the individual pressure of clutch and pressure of lubricating. Please install the pressure gauge on the hole which take out the pressure then check the pressure while up the crane.

- Measure the oil pressure of clutch and T/C inlet at the 800 ~ 2400 rpm.

Description	Standard (MPa)	
	800 rpm	2400 rpm
Main relief	1.5 ± 0.2	1.5 ± 0.2
Forward	1.5 ± 0.2	1.5 ± 0.2
Reverse		
T/C inlet	0.1 ~ 0.4	0.3 ~ 0.7

③ Stall torque output test

· Please pay attention to the truck starts suddenly, because the torque converter generates largest torque.

※ When the torque converter is stall condition, heat generate suddenly inside of the torque converter. So do not drive the engine when you drive over 30 seconds and the torque converter oil temperature is over 90℃.

a. Please use the parking brake and service brake securely.

b. Please set the lever to F or R.

c. Please step on the accelerator pedal until limit position, then check the engine speed when the engine speed become constant.

d. Standard of engine maximum speed in stall condition is around 1,800~2,000 rpm. (depends on the standard performance of engine and torque converter)

2) DRIVE AXLE

(1) General information

Drive axles generate small metal wear particles during operating, especially hard particles are allowed to circulate in the lubricant, along with external moisture. In these case the internal components can be more faster damaged and the brake can be made a noise.

(2) Magnets and magnetic drain plugs

The axle has magnetic drain plugs which has minimum 0.5 kg of capacity for picking-up low carbon steel. This drain plug must be checked if there are metal particles at every oil change interval.

(3) Breather

Breathers release the air pressure inside and help to minimize the condensation of oil.

※ Please clean the plug if it has particles on the surface. Cover the breather when steam cleaning the housing. If the breather is not covered, water can enter the housing and contaminate the oil.

(4) Oil level

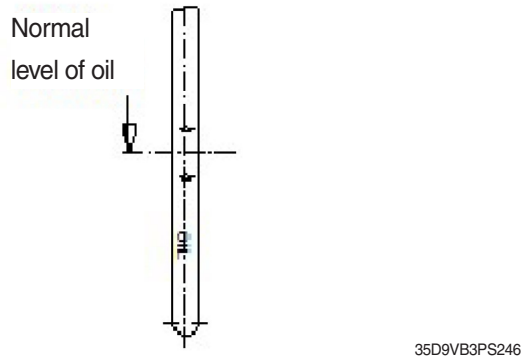
① Check and adjust oil

⚠ To prevent serious eye injury, please always wear the glass for safe when you perform the truck maintenance or service.

The part for oil filling and drain plugs are located in the axle housing.

a. Park the truck on flat ground.

b. Pull out oil level gauge from axle, then check the height of oil.



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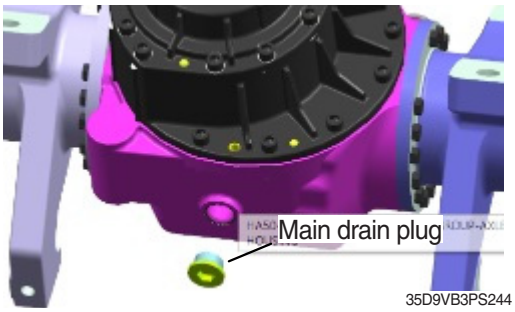
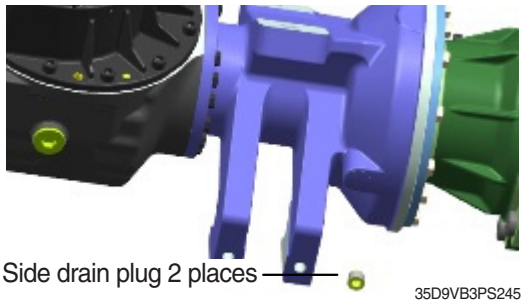
c. If the height of oil of level gauge is higher than the upper limit, drain the oil outby after loosening main drain plug which is described the below figure, if the height of oil is lower than the lowest limit, replenish up to normal level.





② Oil change

⚠ Park the truck on flat ground. Block the wheels to prevent the truck moving during maintenance. Do not work under the truck supported only jacks for safe. Because Jacks can slip and fall over.

a. Make sure the vehicle is on level surface.

b. Raise lift of vehicle and drain oil by loosening main drain plug and 2 places of side plug.

c. After drain all oil, clean the magnetic plug.

d. Fill oil with checking the height of level with level gauge.

③ Oil volume and available of list

a. Oil volume is approximately 13 ℓ (3.4 U.S. gal)

b. Available oil list

Manufacture name	Brand name
Mobil corporation	Mobil fluid 424
Sheel oil corporation	Shell spriax S4 TXM

(5) Period of overhul

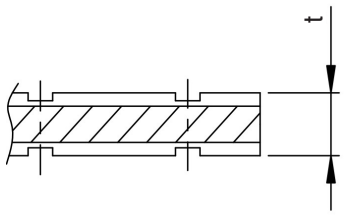
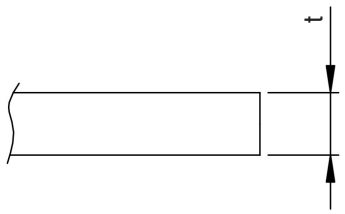
① Period of drive axle assy overhaul : Every 5 year or 7,000 hours.

② The Axle oil needs to be replaced per every 1,000 hours, to prevent brake noise.

③ O-ring, oil seal, rubber, gasket : Change all parts at every overhaul.

※ Check internal leakage of brake system (Brake seal) : Every 2,000 hours, replace as necessary.

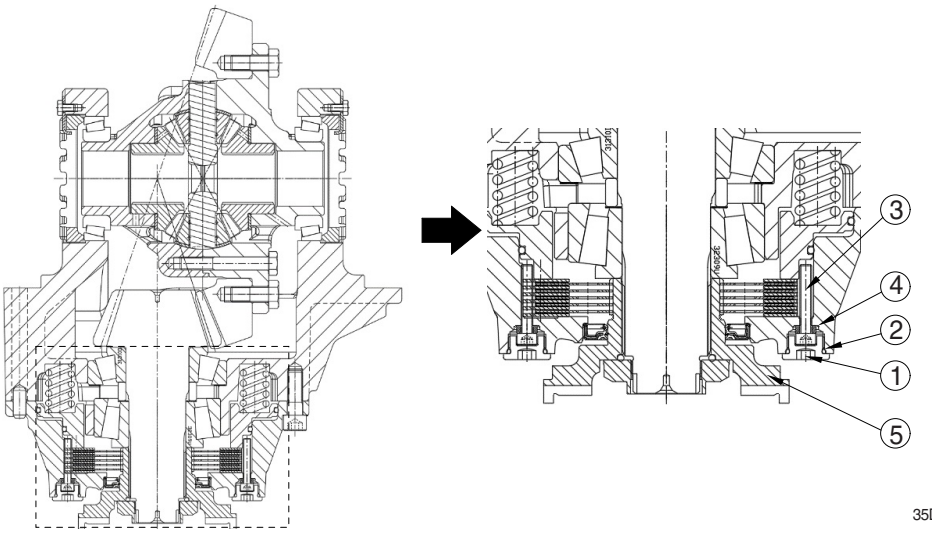
④ Snap ring, disc, opposing plate : Change the part that exceeds the wear limits.

Item		Part no.	Standard	Limit
Disc		C11D00760 (Service brake)	t=4	t=3.4
		C11D00571 (Parking brake)	t=2.0	t=1.7
Opposing plate		C11D00750 (Service brake)	t=2.5	t=2.3
		C11D00581 (Parking brake)	t=1.4	t=1.2

⑤ Bearing, spring : Check the release bearing the see if it rotates freely. If it has doubt for the wear or lack of lubrication, replace this bearing.

⑥ Gear, shaft : If it is abnormal you have to change.

(6) Emergency release operation method F50 parking



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① Emergency release operation method

a. Part ①, ② (plug and o-ring) disassembly.
b. Part ③ (socket bolt) and part ④ (parking spacer) disassembly.
c. Reassemble ③ (socket bolt) and tighten until part ③ (socket bolt) stops.
d. Operation check of part ⑤ : release completed when rotating part ⑤ (flange yoke).

② Restoration after emergency release

a. Disassemble part ③ (socket bolt) and assemble part ④ (parking spacer).
b. Tighten until part ③ (socket bolt) stops.
c. Assemble part ①, ② (plug and o-ring).
d. Operation check of part ⑤ : completed when part ⑤ (flange yoke) is not rotating.

2. TROUBLESHOOTING

1) TRANSMISSION

(1) Output does not go up

Locating fault and cause			Measures
Engine	The engine speed is abnormal.		When the gear is neutral position and torque converter is stall state, please measure the engine speed. Then if the engine speed does not become proper speed, please adjust the engine or repair it. (Please refer to page of stall test.)
Torque converter	Torque converter oil	The oil is in short supply.	Please replenish oil.
		The oil that is not regulated is used.	Please change the oil to regular oil.
		The air has mixed into oil.	Please tighten each joint coupling and the pipe further.
		The air bubble occurs because the torque converter pressure decrease.	Please check and adjust the torque converter pressure.
		The water has mixed into oil.	Please check the cooler, and change all oil.
		The oil filter is clogging.	Please wash the oil filter of change it.
	Main body of torque converter	The stator free wheel is broken.	Please change the stall revolution then if the revolution is extremely low, please change torque convertor.
		The stator free wheel is sticking.	Please check the rise of the temperature of oil at no load. And please change torque convertor when the temperature of oil rises abnormally.
		The wheel with blades is broken or it is touching other components.	Please check whether the aluminum powder and the like has mixed into torque converter oil. Please change torque convertor.
	Charging pump	The pump dose not operates normally.	Please change the pump.
Transmission	Control valve assy	The clutch oil pressure has decreased because the spring is settling or break.	Please change the spring.
		The valve does not move with the valve opens.	Please repair or change the valve.
		The orifice is clogging.	Please wash the orifice.

(2) Power is not transmitted

Locating fault and cause			Measures
Torque converter	The input plate wheel is broken.		Please change the input plate.
	The oil is in short supply.		Please replenish oil.
	The shaft and spline are worn.		Please change the shaft and the spline.
	The gear is broken.		Please change the gear.
	The charging pump does not operate normally.		Please change the charging pump.
Transmission	Torque converter oil	The oil is in short supply.	Please replenish oil.
	Clutch assembly	The clutch plate is worn and broken.	Please change the clutch plate.
		The clutch plate is sticking.	Please change the clutch plate.
		The clutch shaft spline is worn.	Please change the clutch shaft spline.
		The clutch pressure has decreased because the shaft end of the clutch and the oil seal ring of the clutch piston do not operate normally.	Please change the clutch assembly.
	Output shaft	The shaft spline is worn.	Please change the part which has worned spline.
		The gear is broken.	Please change the gear.
	Solenoid valve	The solenoid valve is broken.	Please change the solenoid.
		Spool does not operate normally.	Please change the solenoid valve.

(3) Oil temperature rises abnormally

Locating fault and cause			Measures
Torque converter	Main body of torque converter	The device of stator free wheel is broken.	Please check the stall speed, and then if the speed is out of regular valve, please change the stator assembly to new part.
		The wheel with blades are touching each other.	If the foreign material (the aluminum powder and the like) has entered in torque converter oil, please change the wheel with blades to new one.
		The bearings are worn or sticking.	Please repair the bearings or change them.
	Torque converter oil	Amount of oil is not appropriate.	Please check the oil level.
		The oil that is not regulated is used.	Please change the oil to regular oil.
		The air has mixed into oil.	Please tighten each joint coupling and the pipe further.
		The water has mixed into oil.	Please check the cooler and change the all oil.
	The piping resistance is large	The hose is bending, or it is broken.	Please repair the hose or change it.
		The oil cooler is sticking.	Please wash the oil cooler or change them.

Locating fault and cause			Measures
Transmission	The clutch is dragging	The clutch plate is sticking.	Please change the clutch plate.
		The clutch piston does not operate normally.	Please repair the clutch piston or change it.
		The pressure of clutch has decreased.	Please check the clutch pressure.
	The bearings are worn or sticking.		Please change the bearings.

(4) Clutch or converter oil pressure is too high

Locating fault and cause			Measures
Torque converter	Hose of outlet side is bending, and the hose is broken and the oil cooler is clogging.		Please repair or change the hose and oil filter, cooler
	Viscosity of oil is too high. (At cold time)		Please warm up the torque converter if the temperature of torque converter oil is below outside air temperature.
	The oil that is not regulated is used.		Please change the oil to regular oil.
Transmission	Control valve assembly	The valve does not operate normally because spring is broken or spools are sticked in the valve.	Please repair the valve assembly or change to new one.

(5) Clutch or converter oil pressure is too low

Locating fault and cause			Measures
Transmission	The oil is in short supply.		Please replenish oil.
	The oil that is not regulated is used.		Please change the oil to regular oil.
	The charging pump is worn and broken.		Please change the charging pump.
	The oil seal ring or o-ring is worn or damaged.		Please change the oil seal ring or the o-ring.
	The filter is clogging.		Please wash the oil filter or change it.
	control valve assembly	The spring is settling, and broken.	Please change the spring.
		The valve does not move with the valve opens.	Please repair the valves or change it.
		The restriction is clogging.	Please wash the restriction.
	The filter is clogging.	The end of the shaft and the seal ring of the clutch piston are damaged.	Please change the clutch piston.

(6) Noise occurs

Locating fault and cause		Measures
Torque converter	The input plate is broken.	Please change the input plate.
	The bearing is broken or bearings are worn.	Please change the bearing.
	The gear is broken.	Please change the gear.
	The wheel with blades are touching each other.	Please change the wheel with blades.
	The bolt and rivet are loosen or broken.	Please repair the bolt and rivet or change it.
	The spline is worn.	Please change the part which has worned spline.
	The pump does not operate normally.	Please change the pump.
Transmission	The clutch is sticking and dragging.	Please change the clutch.
	The bearings are sticking and worn.	Please change the bearing.
	The gear is broken.	Please change the gear.
	The spline is worn.	Please change the spline.
	The bolt is loosen or broken.	Please repair the bolt or change it.

(7) Shinfting is impossible

Locating fault and cause		Measures
Transmission	The clutch plate is sticking.	Please change the clutch plate.
	The solenoid valve does not operate normally.	Please repair the solenoid valve or change it.
	The gear is broken.	Please change the gear.

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.

Locating fault and cause		Measures
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.

SECTION 4 BRAKE SYSTEM

SECTION 4 BRAKE SYSTEM

GROUP 1 STRUCTURE AND FUNCTION

1. OUTLINE

There are two brake systems, the foot brake system and the parking brake system.

The foot brake adopts the brake system of oil type at drive axle.

Oil pressure is generated in maximum 60 kgf/cm^2 through oil input path of the left and right drive axle housing, this pressure allows the piston brake to advance and compresses a friction plate and a plate.

So when the transportation travels, it is possible to brake.

The parking brake works by the switch installed on steering column.

2. SPECIFICATION

1) SERVICE BRAKE

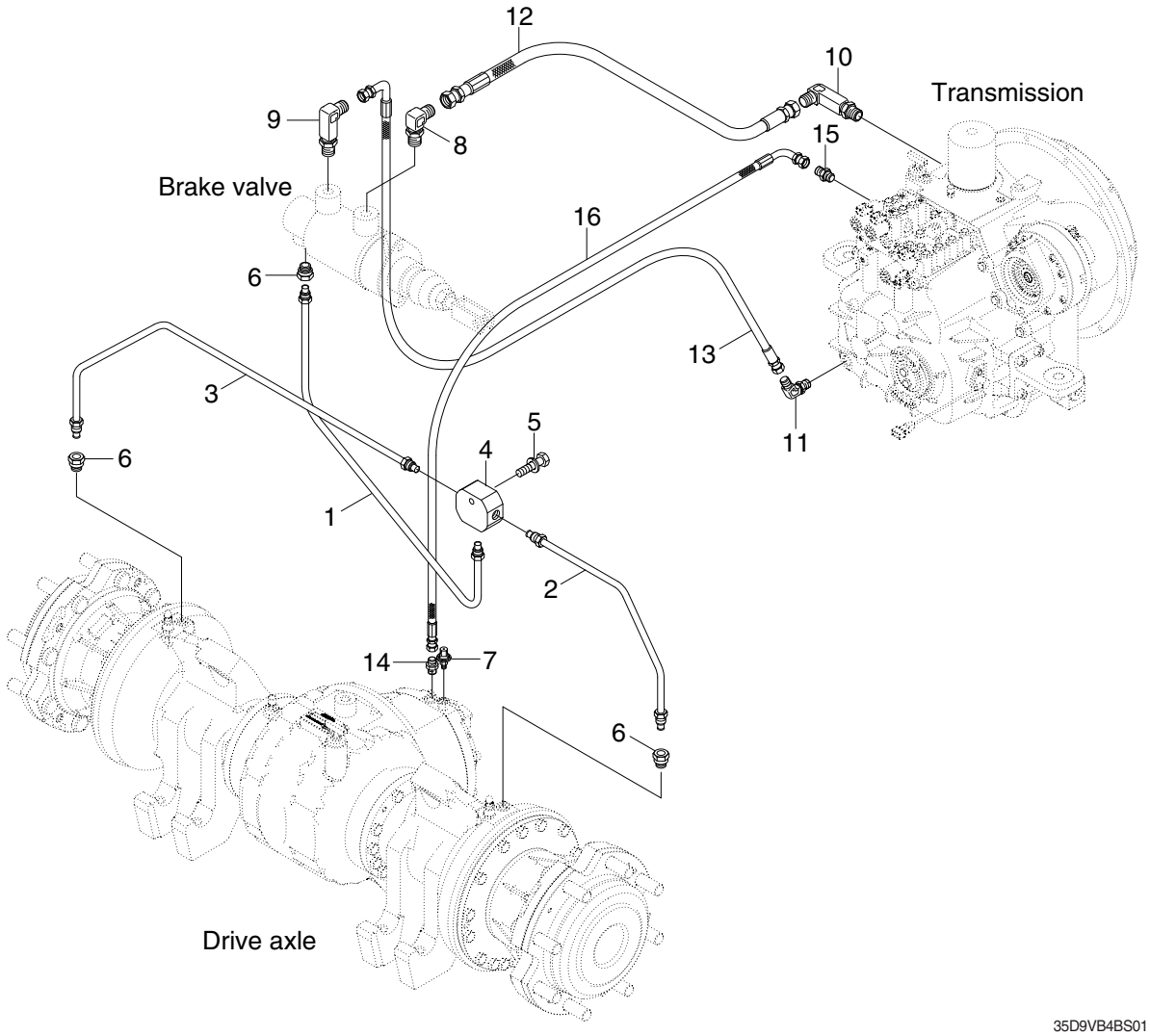
Item		Specification
Type		Wet disk brake
Pedal adjustment	Pedal height	135±4 mm (5.3±0.16 in)
	Play	0

2) PARKING BRAKE

Item	Specification
Type	SAHR (Spring Actuate Hydraulic Release)
Switch location	Steering column
Disc location	Drive axle carrier sub assy

3. BRAKE PIPING

1) STRUCTURE

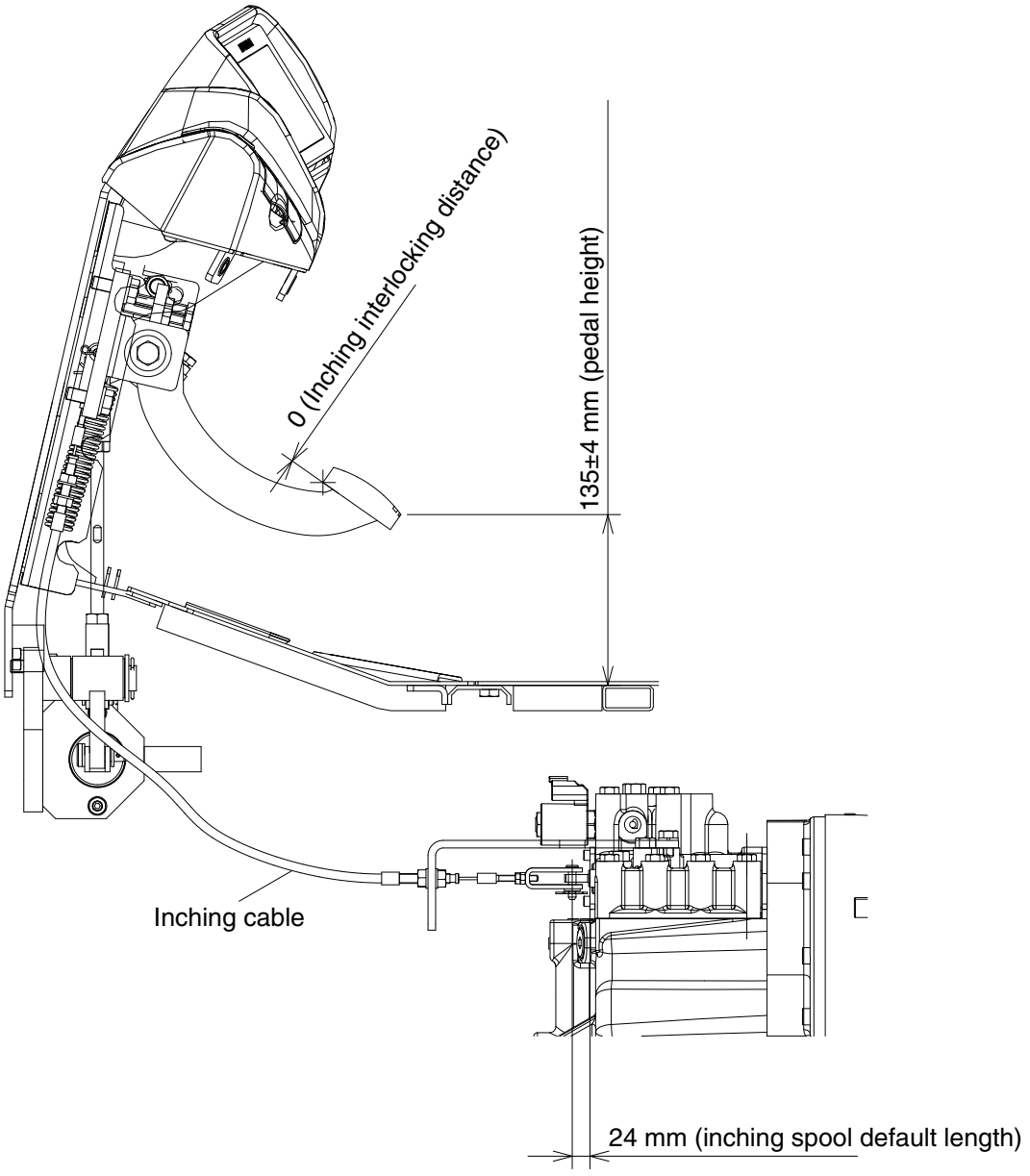


35D9VB4BS01

1	Pipe assy	7	Sensor-pressure	13	Hose assy-Orfs&Thd
2	Pipe assy-LH	8	Elbow-90	14	Connector
3	Pipe assy-RH	9	Elbow-90	15	Connector
4	Block-3way	10	Elbow-90	16	Hose assy-Orfs&Thd
5	Bolt-hex	11	Elbow-45		
6	Fitting	12	Hose assy-Orfs&Thd		

4. INCHING PEDAL AND LINKAGE

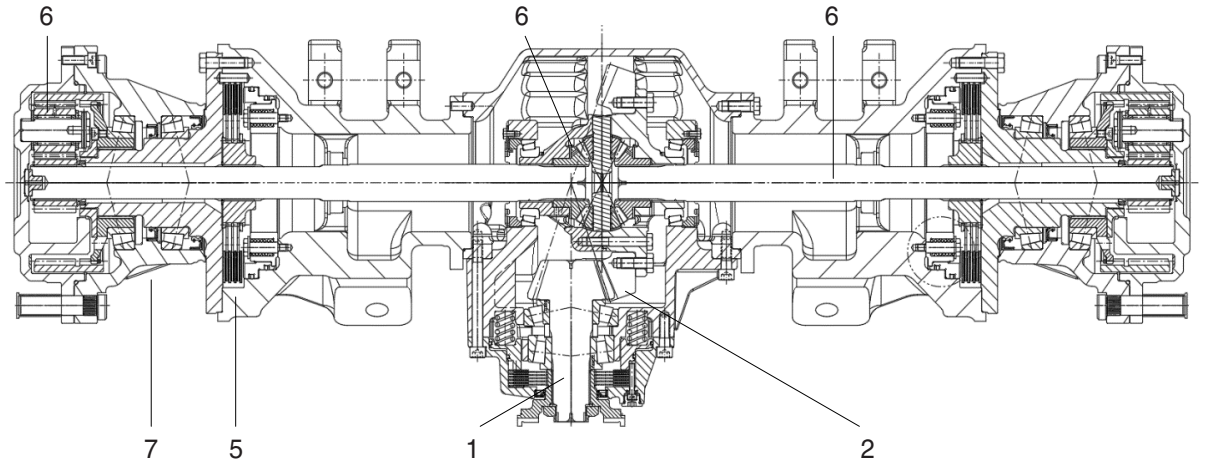
The brake pedal serves to actuate the hydraulic brakes on the front axle. At the beginning of the pedal stroke, the inching spool of the transmission control valve is actuated to shift the hydraulic clutch to neutral and turn off the driving force. By treading the pedal further, the brake is applied.



35D9VB4BS02

5. WET DISK BRAKE

1) STRUCTURE

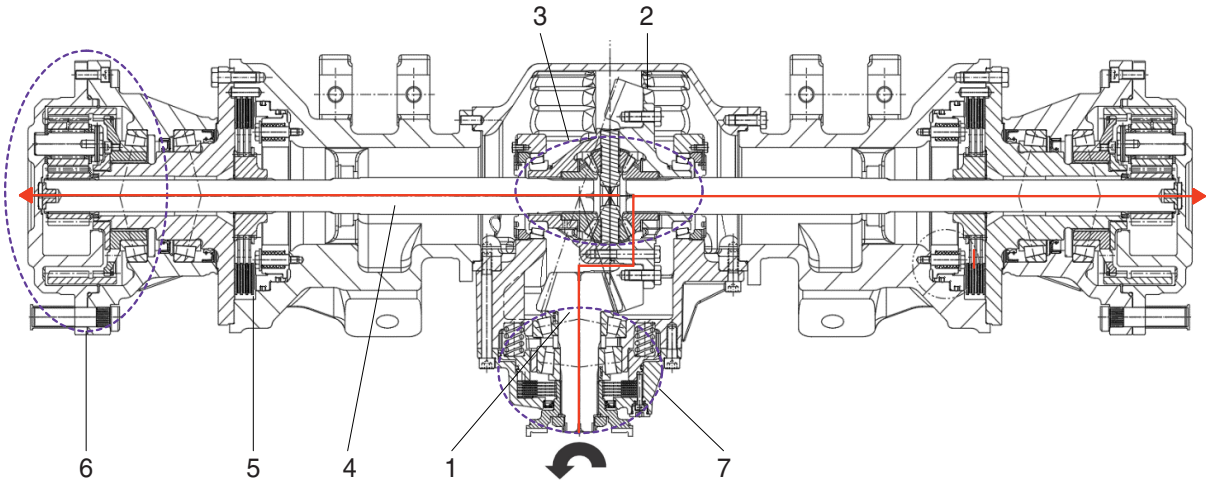


35D9VB3PS10

1	Pinion shaft	4	Axle shaft	7	Hub
2	Ring gear	5	Traveling brake		
3	Differential device	6	Hub reduction		

2) OPERATION

The drive axle is connected with the transmission output gear by drive shaft assembly. The power transferred by the drive shaft assembly is connected to the pinion shaft of drive axle, the pinion shaft delivers the power to the differential device through the ring gear. The differential device deliver the power to hub reduction through axle shaft.



35D9VB3PS12

1	Pinion shaft	4	Axle shaft	7	Parking brake device
2	Ring gear	5	Service brake		
3	Differential device	6	Hub reduction		

GROUP 2 OPERATIONAL CHECKS AND TROUBLESHOOTING

1. OPERATIONAL CHECKS

1) BRAKE PIPING

(1) Check pipes, hoses and joints for damage, oil leakage or interference.

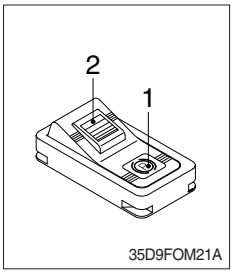
(2) Operate brake pedal and check operating force when pedal in depressed. Check also change in operating force, and change in position of pedal when pedal is kept depressed.

2) PARKING BRAKE

(1) Position 1
Parking brake is applied and front wheel is locked.

(2) Position 2
Parking brake is released.

※ **Before moving the truck be sure the parking brake is released.**



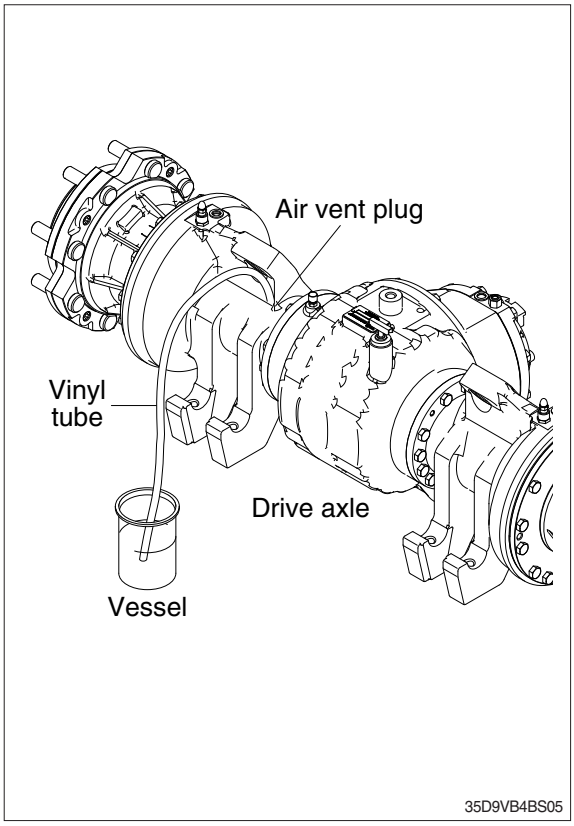
35D9FOM21A

2. TROUBLESHOOTING

The truck use transmission hydraulic system as a hydraulic system mentioned below

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 T/M oil. · Bleed air. · Replace. · Repair or replace. · Clean.
Brake acting unevenly. (truck 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 T/M oil. · Replace.
Pedal dragging.	· Twisted push rod caused by improperly fitted brake valve. · Brake valve seal faulty.	· Adjust. · Replace.

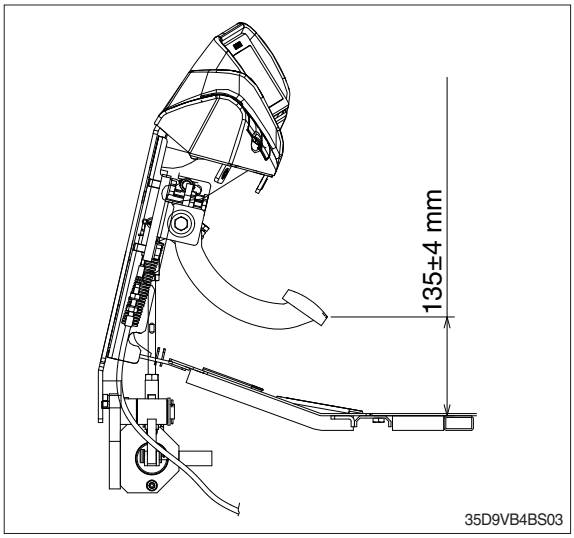
1. AIR BLEEDING OF BRAKE SYSTEM



※ Check transmission oil level and fill if insufficient.

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.

2. ADJUSTMENT OF PEDAL



1) BRAKE PEDAL
   Pedal height from floor plate
   Adjust with stopper bolt.
   · Pedal height : 135 ± 4 mm (5.3 ± 0.16 in)

2) INCHING PEDAL

(1) Pedal height from floor plate

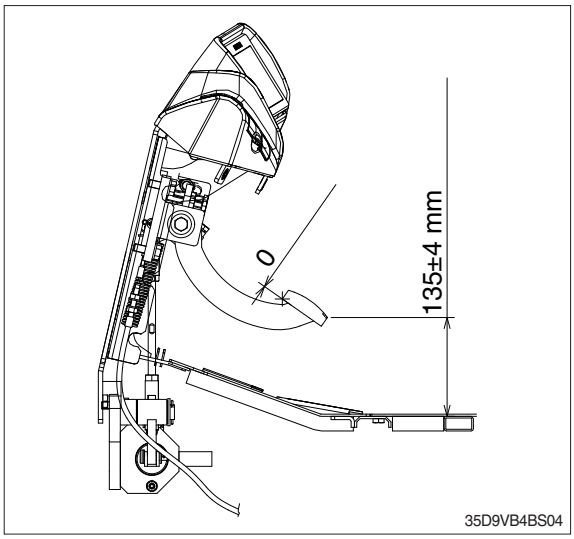
Adjust with stopper bolt.

· Pedal height : 135 ± 4 ㎜ (5.3 ± 0.16 in)

(2) Inching interlocking distance

Adjust with interlocking bolt

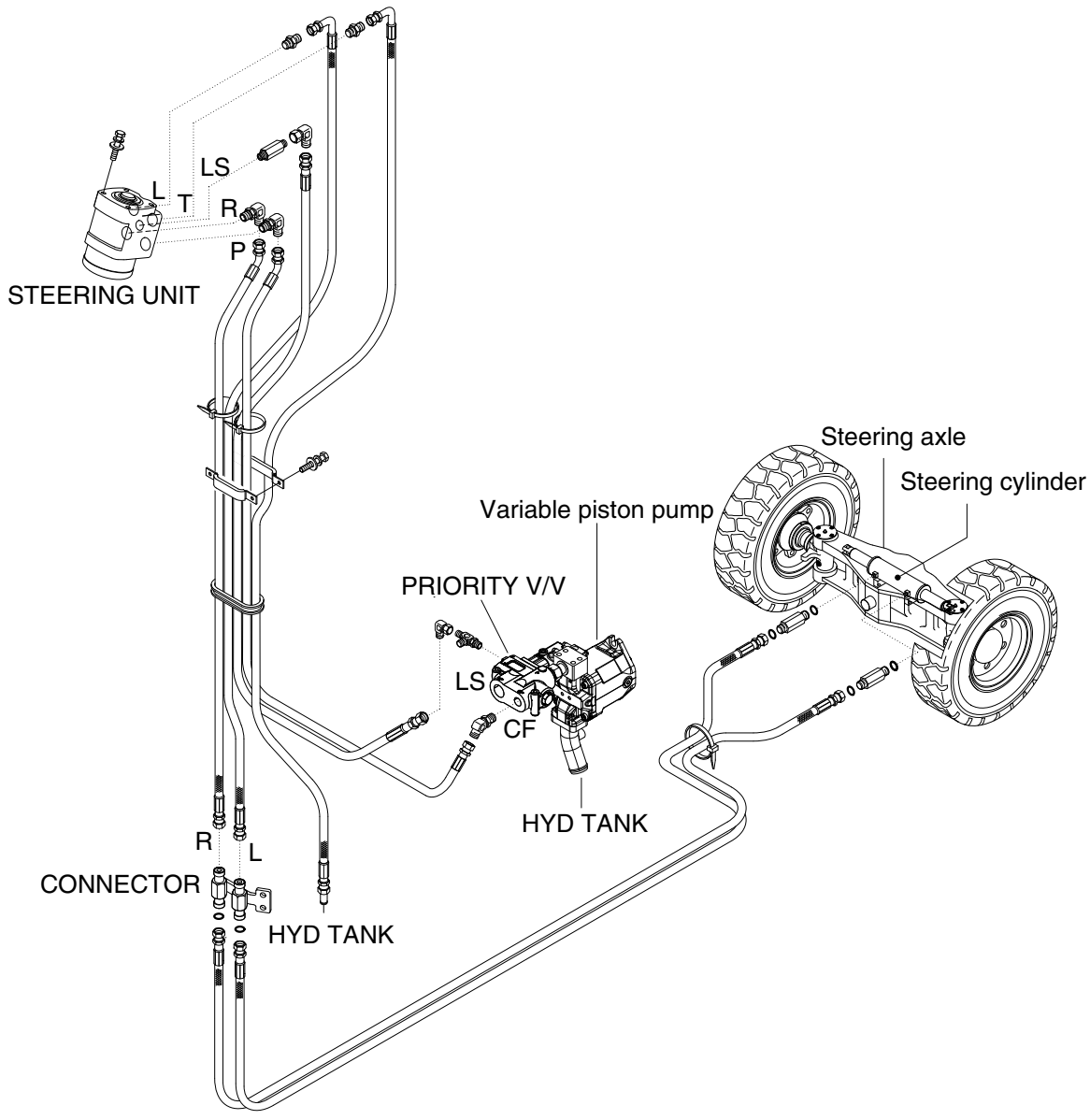
· Distance : 0



SECTION 5 STEERING SYSTEM

GROUP 1 STRUCTURE AND FUNCTION

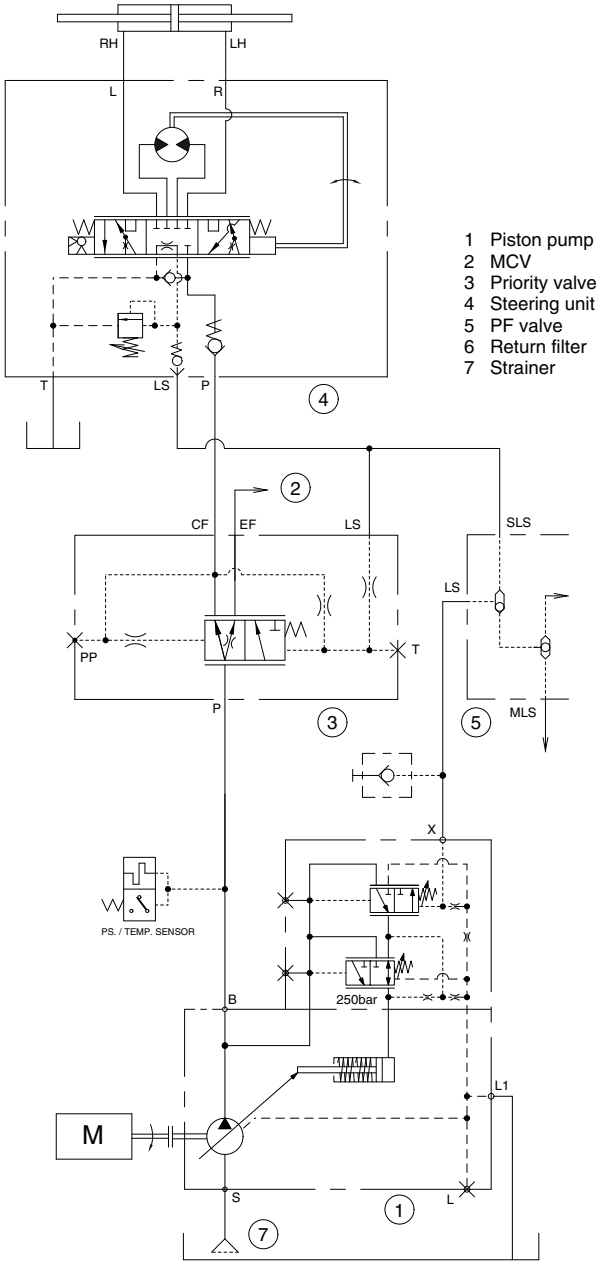
1. OUTLINE



35D9VB5SS72

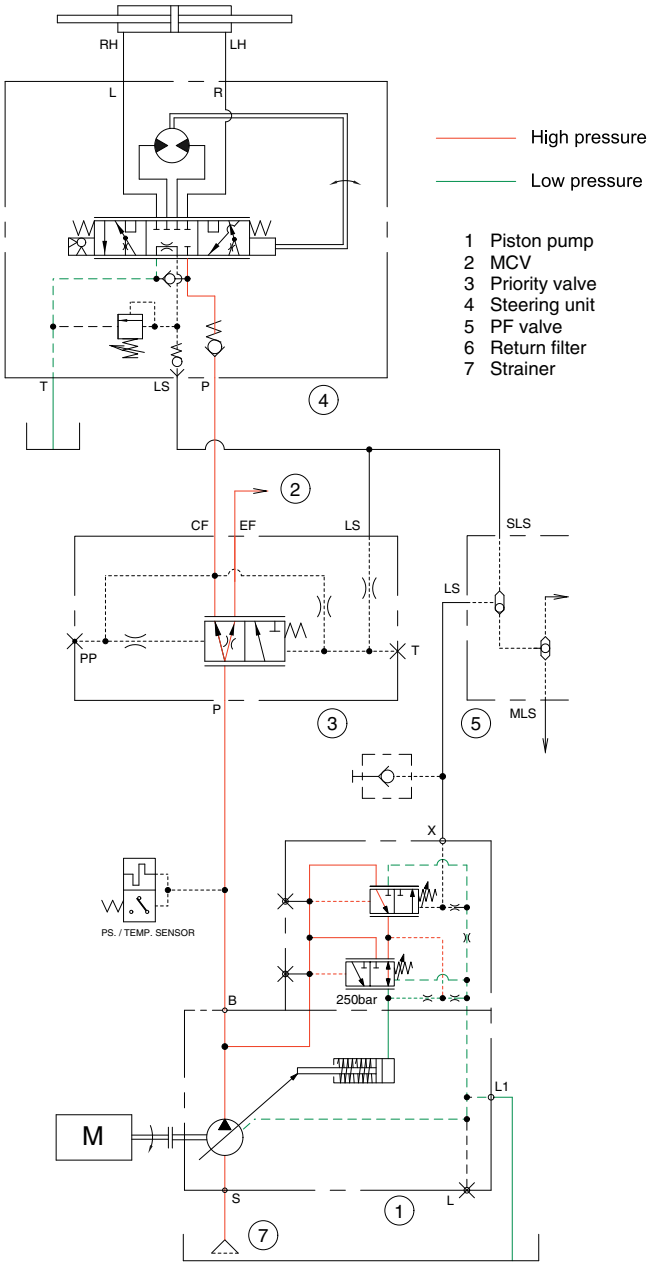
The steering system for this truck is composed of main pump, steering wheel assembly, steering unit, priority valve, steering cylinders, steering axle and piping. The steering axle supports the forklift weight with the rear axle, contains a cylinder and controls the position of the rear tires. The steering 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



The hydraulic oil discharged from the variable displacement pump (1) flows to the priority valve (2). When the driver operates the steering wheel, the steering unit (3) 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 MCV and the tank through the priority valve EF flow path.

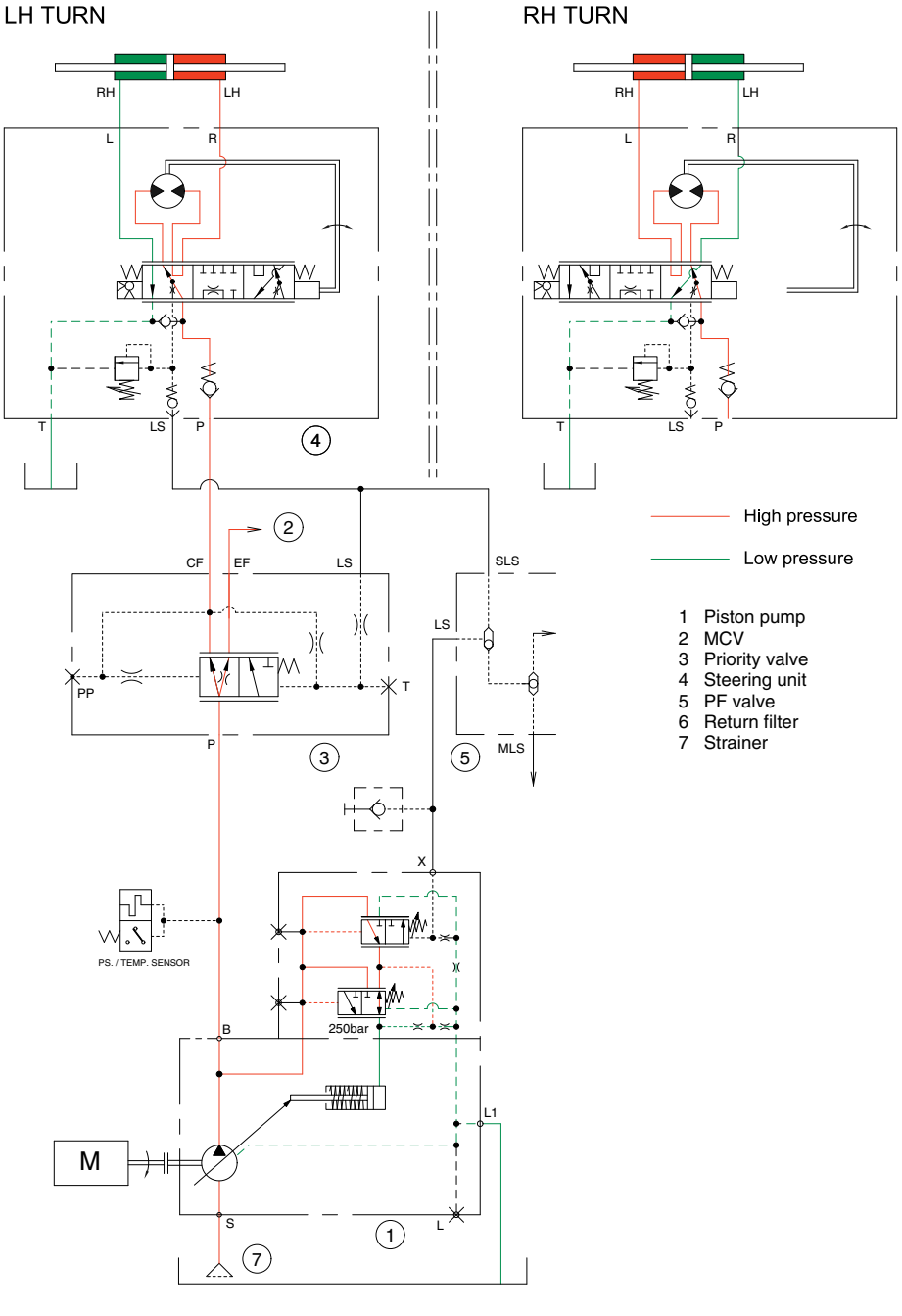
1) NEUTRAL



35D9VB5SS73

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 (PP) 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 MCV through the EF passage. 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

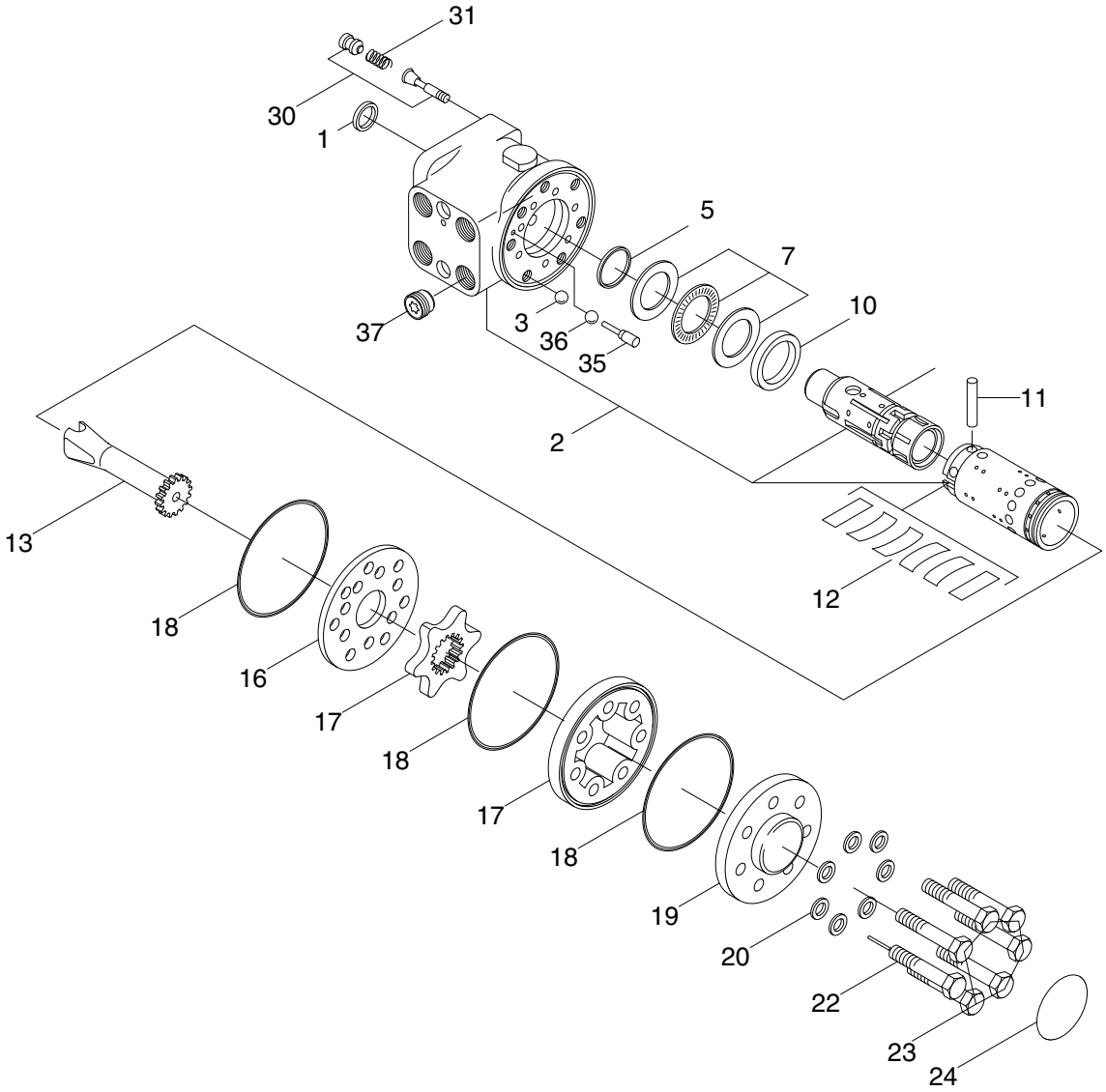


35D9VBSS75

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 CF 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. The priority valve spool moves and directs the pump flow through the EF passage to the MCV.

3. STEERING UNIT

1) STRUCTURE

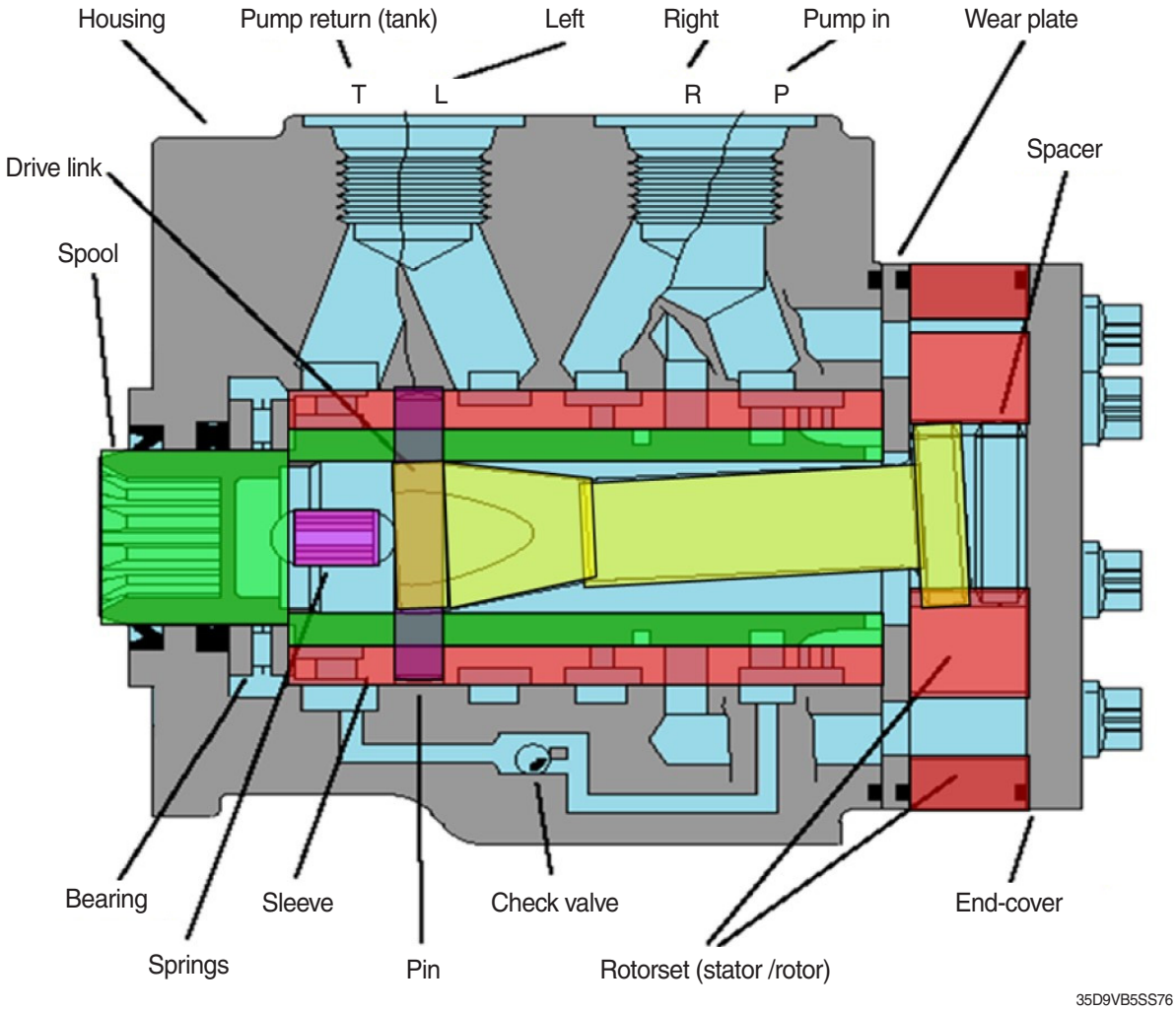


35D9VB5SS74

1	Dust seal ring	13	Cardan shaft	24	Model / Code label
2	Housing and spool/sleeve	16	Distributor plate	30	Relief valve
3	Ball	17	Gearwheel set	31	Spring for relief valve
5	Shaft seal	18	O-ring	35	Ball stop threaded for LS Check
7	Bearing assy	19	End cover	36	Ball ∅3 for is check
10	Ring	20	Washer	37	Check valve
11	Cross pin	22	Pin bolt screw		
12	Set of springs	23	Screw		

※ Seal kit : 1, 5, 18, 20

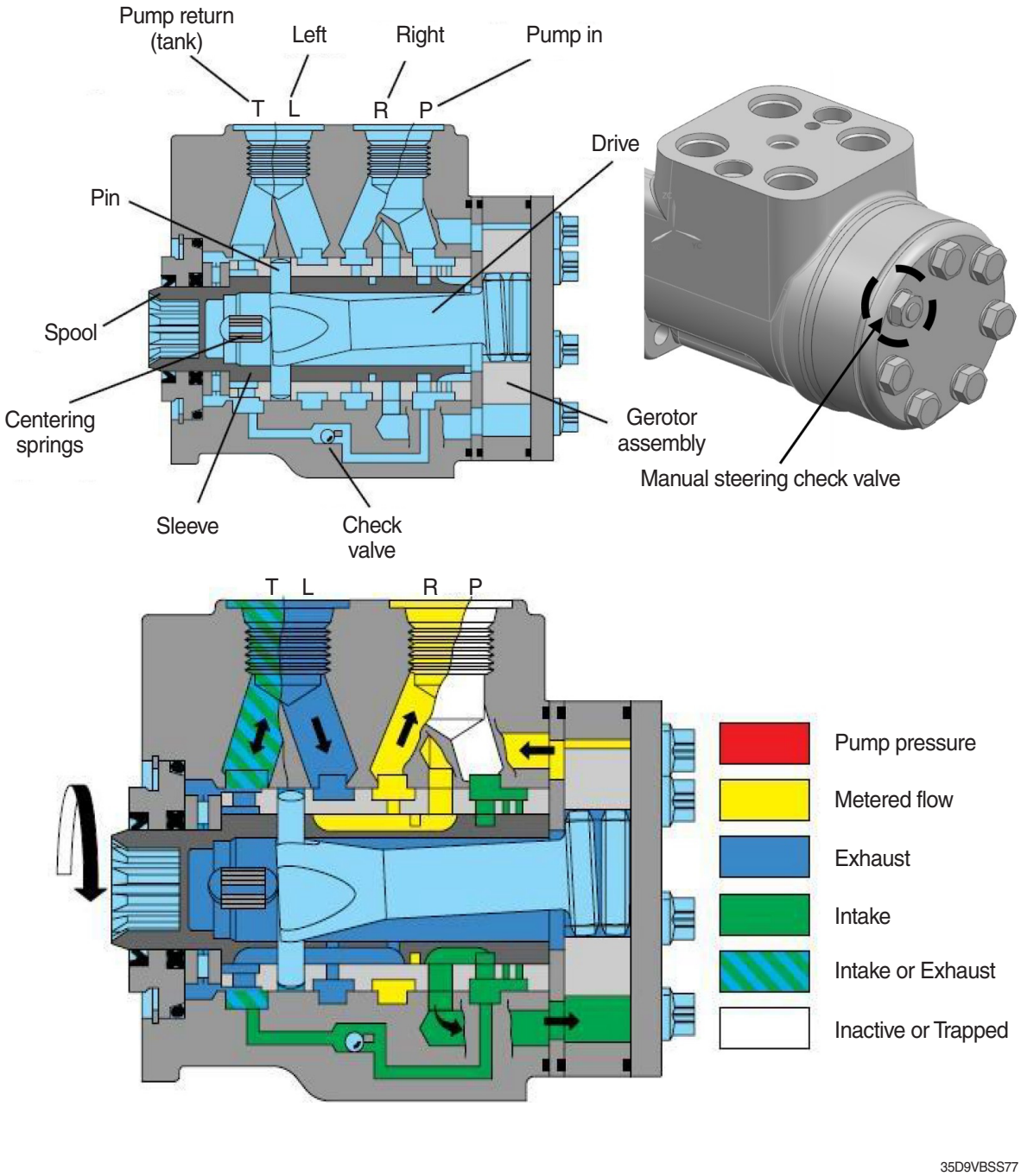
2) OPERATION



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 and the EF port closes. 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 ℉)
- 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 Loose the steering unit mounting bolts for removal front column covers and the floor panel.

- Tightening torque : 4 ± 0.5 kgf·m (28.9 ± 3.6 lbf·ft)

④ Connect pressure gauge to "X" pressure check port of variable pump as shown the illustration.

⑤ Operate engine at test specifications.

⑥ Turn the steering wheel all the way to a stop and hold it there.

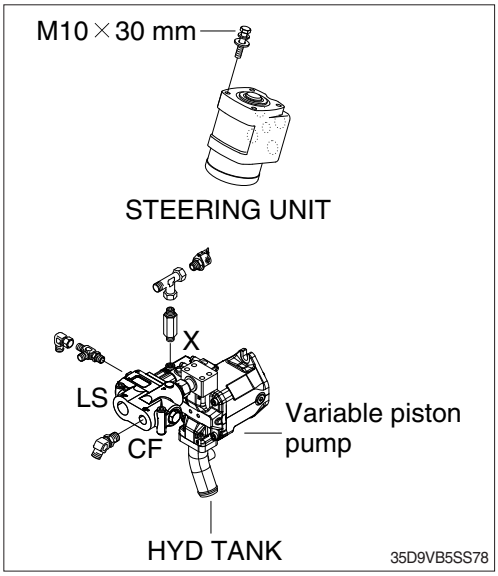
⑦ Check pressure gauge reading. Compare the readings and specifications.

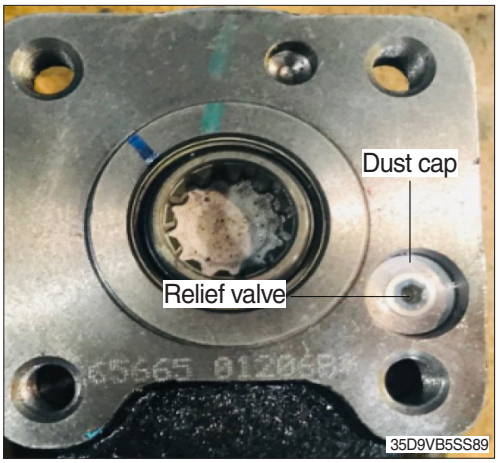
⑧ Remove the steering unit. Remove the dust cap and loosen the relief valve plug and turn the adjusting screw to adjust the pressure.

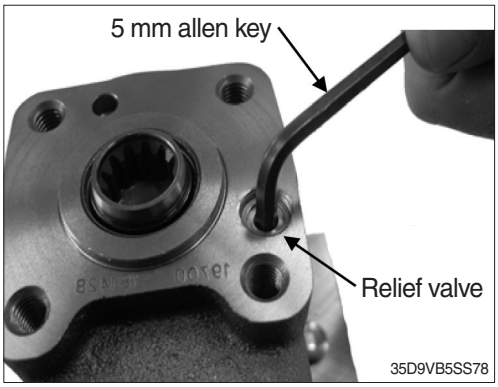
- Tightening torque : 0.6 ± 0.1 kgf·m (4.4 ± 0.7 lbf·ft)
- If pressure is lower than specification, turn relief valve adjusting screw clockwise.
- If the pressure is higher than the specification, turn the adjusting screw counterclockwise.

⑨ Repeat Step ⑦, ⑧. 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.**







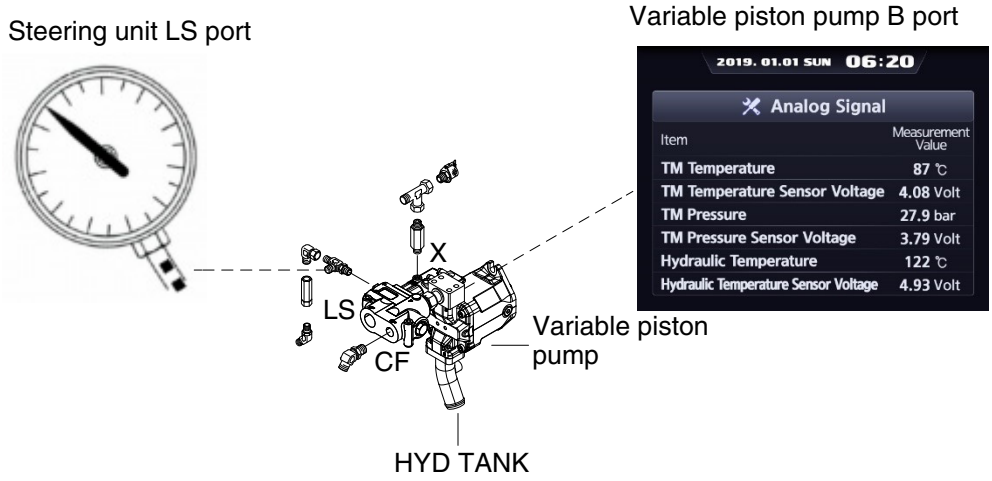
5) LS PRESSURE TEST OR STEERING SYSTEM

This test checks if LS (Load-Sense) pressure is correct to operate the priority valve spool functions of the steering system. The margin pressure is required to control priority valve spool movement, which controls priority oil to steering and excess flow (EF) to the MCV. The margin pressure is the pump pressure (B) minus the LS pressure (X).

(1) Test specification

- Enine speed : low idle rpm
- Oil temperature : 50 ± 5 ℃ (122 ± 9 ℉)
- Margin pressure : 22 ± 1 bar (320 ± 14.5 psi)

(2) Pressure test



35D9VB5SS88

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 Remove floor panel.
④ Connect pressure gauge to LS port of steering unit as shown the illustration. For pump B pressure check port you can check it in the analog signal value item in the cluster menu.
⑤ Operate engine at test specifications.
⑥ Measure the pump B port pressure and then check the margin pressure by measuring the steering unit LS port pressure.
- Margin pressure (Pump B - Steering unit LS) : 22 ± 1 bar (320 ± 14.5 psi)

⑦ If the LS pressure is out of specifications, remove the priority valve LS plug. Inspect and clean LS orifices.
⑧ If pressure is to specifications, remove test equipment.

※ Cluster menu : Maintenance → Password enter → Signal status → Analog signal

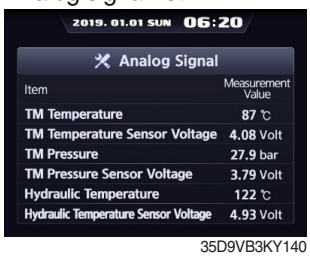
Siganl status

35D9VB3KY138

Analog signal

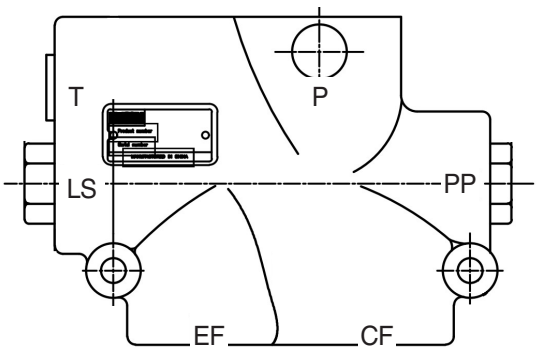
35D9VB3KY139

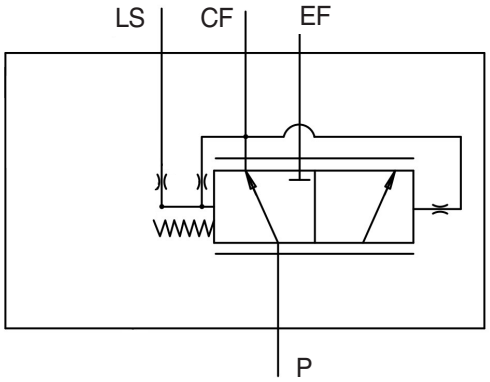
Analog signal list

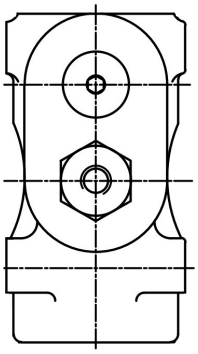


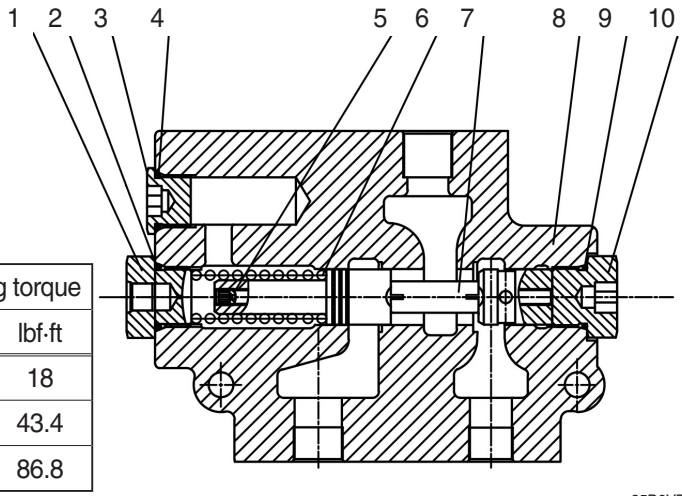
35D9VB3KY140

4. PRIORITY VALVE









Port	Port size	Tightening torque	
		kgf·m	lbf·ft
LS	7/16-20UNF	2.5	18
CF	3/4-16 UNF	6	43.4
P, EF	1-1/16-12 UN	12	86.8

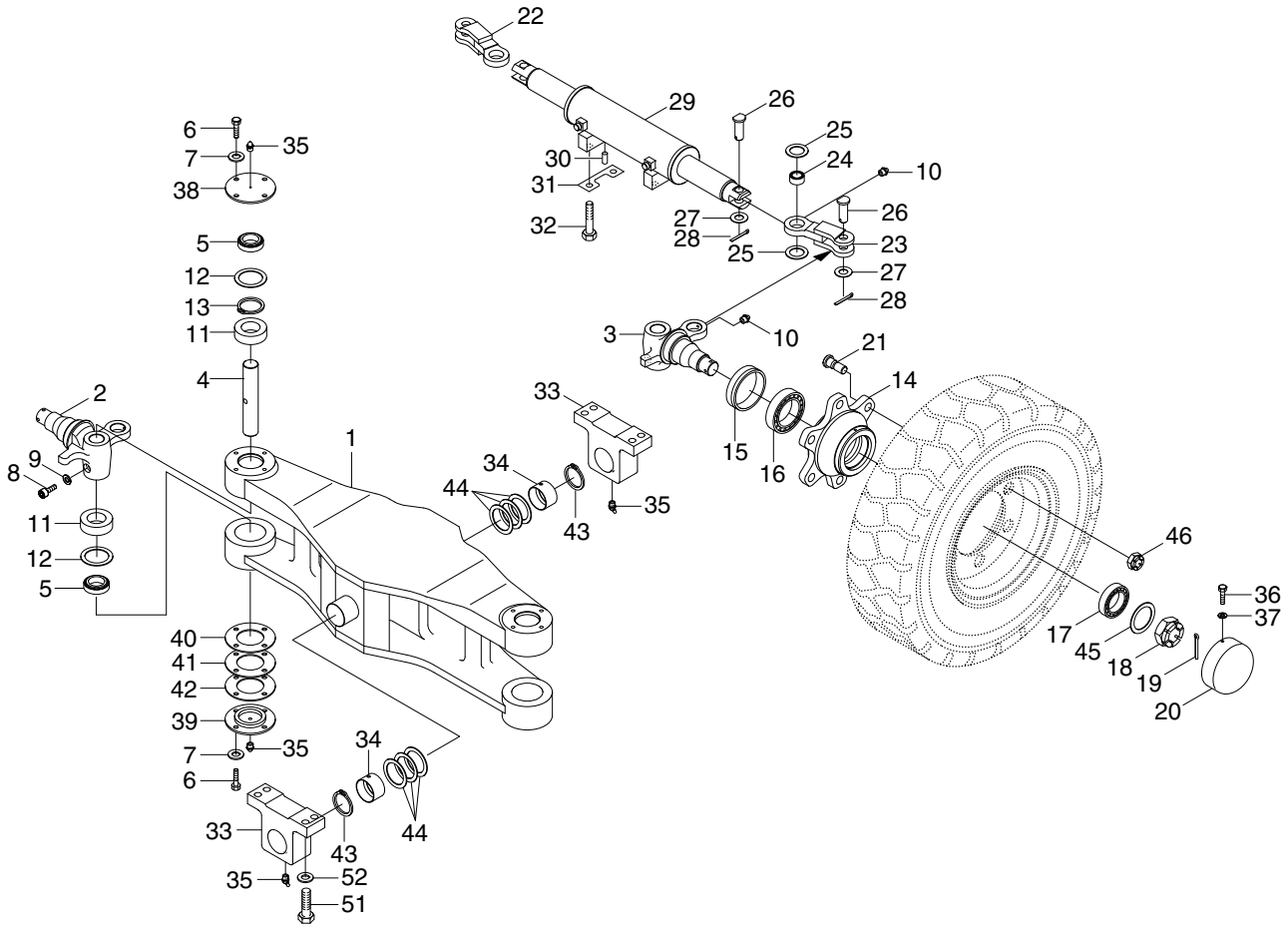
35D9VB5SS79

1	Plug	5	Throttle	9	O-ring
2	O-ring	6	Spring compression	10	Plug
3	Plug	7	Spool		
4	O-ring	8	Housing		

The priority valve is located on the top of the pump and is influenced by the LS signal from the steering unit to ensure that the steering circuit receives sufficient feed. This valve always keeps the steering force and speed constant against changes in the pump discharge flow rate, and gives priority to hydraulic oil to the steering circuit.

5. STEERING AXLE

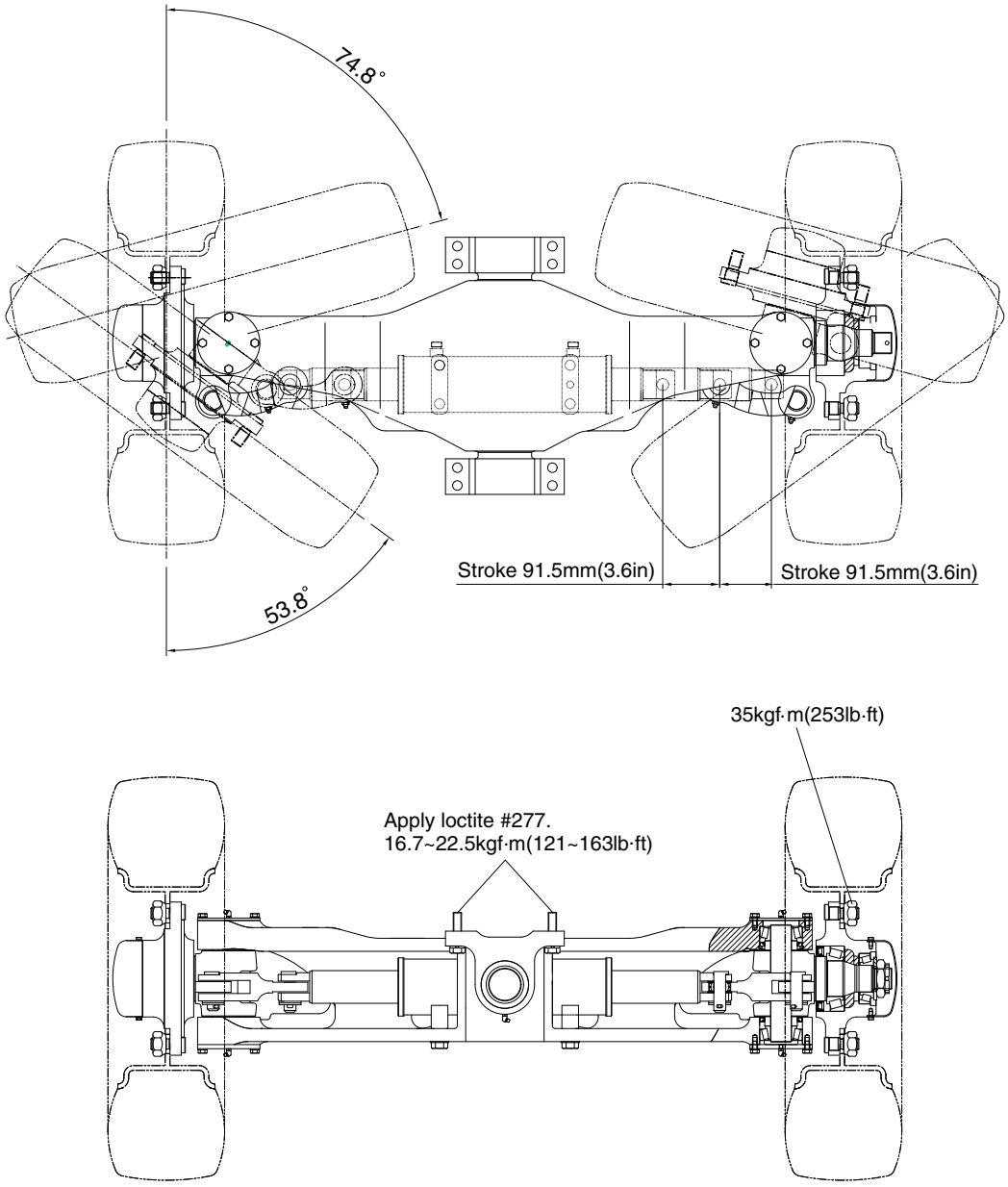
1) STRUCTURE



35D9SSE06

1	Axle center	13	Retaining ring	25	Thrust washer	37	Spring washer
2	Knuckle-RH	14	Hub	26	Clevis pin	38	Upper cover
3	Knuckle-LH	15	Oil seal	27	Plain washer	39	Lower cover
4	King pin	16	Taper roller bearing	28	Split pin	40	Shim (0.1t)
5	Taper roller bearing	17	Taper roller bearing	29	Steering cylinder	41	Shim (0.15t)
6	Hexagon bolt	18	Slotted nut	30	Pin	42	Shim (0.3t)
7	Spring washer	19	Split pin	31	Lock plate	43	Retaining ring
8	Special bolt	20	Hub cap	32	Hexagon bolt	44	Shim (0.5t)
9	Spring washer	21	Serration bolt	33	Support	45	Plain washer
10	Grease nipple	22	Link-RH	34	Bushing	46	Hub nut
11	Collar	23	Link-LH	35	Grease nipple	51	Hexagon bolt
12	Oil seal	24	SPH plain bearing	36	Hexagon bolt	52	Spring washer

2) GREASING AND SPECIFICATION

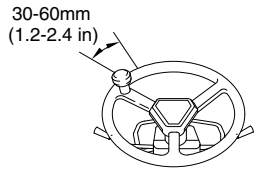


35DS7SE07

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	74.8/53.8
Tread	mm (ft·in)	1140 (3' 9")

GROUP 2 OPERATIONAL CHECKS AND TROUBLESHOOTING

1. OPERATIONAL CHECKS

<table>
<tr><th>Check item</th><th>Checking procedure</th></tr>
<tr><td>Steering wheel
 
</td><td>· 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.</td></tr>
<tr><td>Knuckle</td><td>· Check knuckle visually or use crack detection method. If the knuckle is bent, the tire wear is uneven, so check tire wear.</td></tr>
<tr><td>Steering axle</td><td>· 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 truck 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)
<table>
<tr><td>35D-9VB, 40D-VC</td><td>2895 mm (114 in)</td><td>45D-9VB, 50DN-9VC</td><td>3038 mm (120 in)</td></tr>
<tr><td>40D-9VB, 45D-VC</td><td>2944 mm (116 in)</td><td>50DN-9VB</td><td>3081 mm (121 in)</td></tr>
</table></td></tr>
<tr><td>Hydraulic pressure of power steering</td><td>Remove screw coupling from X port of pump and install oil pressure gauge.
Turn steering wheel fully and check oil pressure.
※ Oil pressure : 135 bar (1960 psi)</td></tr>
</table>

2. TROUBLESHOOTING

1) STEERING UNIT

Problem	cause	Remedy
Steering wheel drags.	· Low oil pressure. · Bearing faulty. · Spring spool faulty. · Reaction plunger faulty. · Ball-and-screw assembly faulty. · Sector shaft adjusting screw excessively tight. · Gears poorly meshing. · Flow divider coil spring fatigued.	· Check lockout. Repair. · Clean or replace. · Clean or replace. · Replace. · Clean or replace. · Adjust. · Check and correct meshing. · Replace.
Steering wheel fails to return smoothly.	· Bearing faulty. · Reaction plunger faulty. · Ball-and-screw assy faulty · Gears poorly meshing.	· Clean or replace. · Replace. · Clean or replace. · Check and correct meshing.

Problem	cause	Remedy
Steering wheel turns unsteadily. Steering system makes abnormal sound or vibration.	· Lockout loosening. · Metal spring deteriorated. · Gear backlash out of adjustment. · Lockout loosening. · Air in oil circuit.	· Retighten. · Replace. · Adjust. · Retighten. · Bleed air.
Abnormal sound heard when steering wheel is turned fully	Valve · Faulty. (Valve fails to open.) Piping · Pipe (from pump to power steering cylinder) dented or clogged.	· Adjust valve set pressure and check for specified oil pressure. · Repair or replace.
Piping makes abnormal sounds.	Oil pump · Lack of oil. · Oil inlet pipe sucks air. · Insufficient air bleeding.	· Add oil. · Repair. · Bleed air completely.
Valve or valve unit makes abnormal sounds.	Oil pump · Oil inlet pipe sucks air. Valve · Faulty. (Unbalance oil pressure) Piping · Pipe (from pump to power steering) dented or clogged. · Insufficient air bleeding.	· Repair or replace. · Adjust valve set pressure and check specified oil pressure. · Repair or replace. · Bleed air completely.
Insufficient or variable oil flow.	· Flow control valve orifice clogged.	· Clean
Insufficient or variable discharge pressure.	Piping · Pipe (from tank to pipe) dented or clogged.	· Repair or replace.
Steering cylinder head leakage (Piston rod)	· Packing foreign material. · Piston rod damage. · Rod seal damage and distortion. · Chrome gilding damage.	· Replace · Grind surface with oil stone. · Replace · Grind
Steering cylinder head thread (A little bit leak is no problem)	· O-ring damage.	· Replace
Welding leakage	· Cylinder tube damage.	· Tube replace.
Rod	· Tube inside damage. · Piston seal damage and distortion	· Grind surface with oil store. · Replace
Piston rod bushing inner diameter excessive gap	· Bushing wear.	· Replace

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.
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.

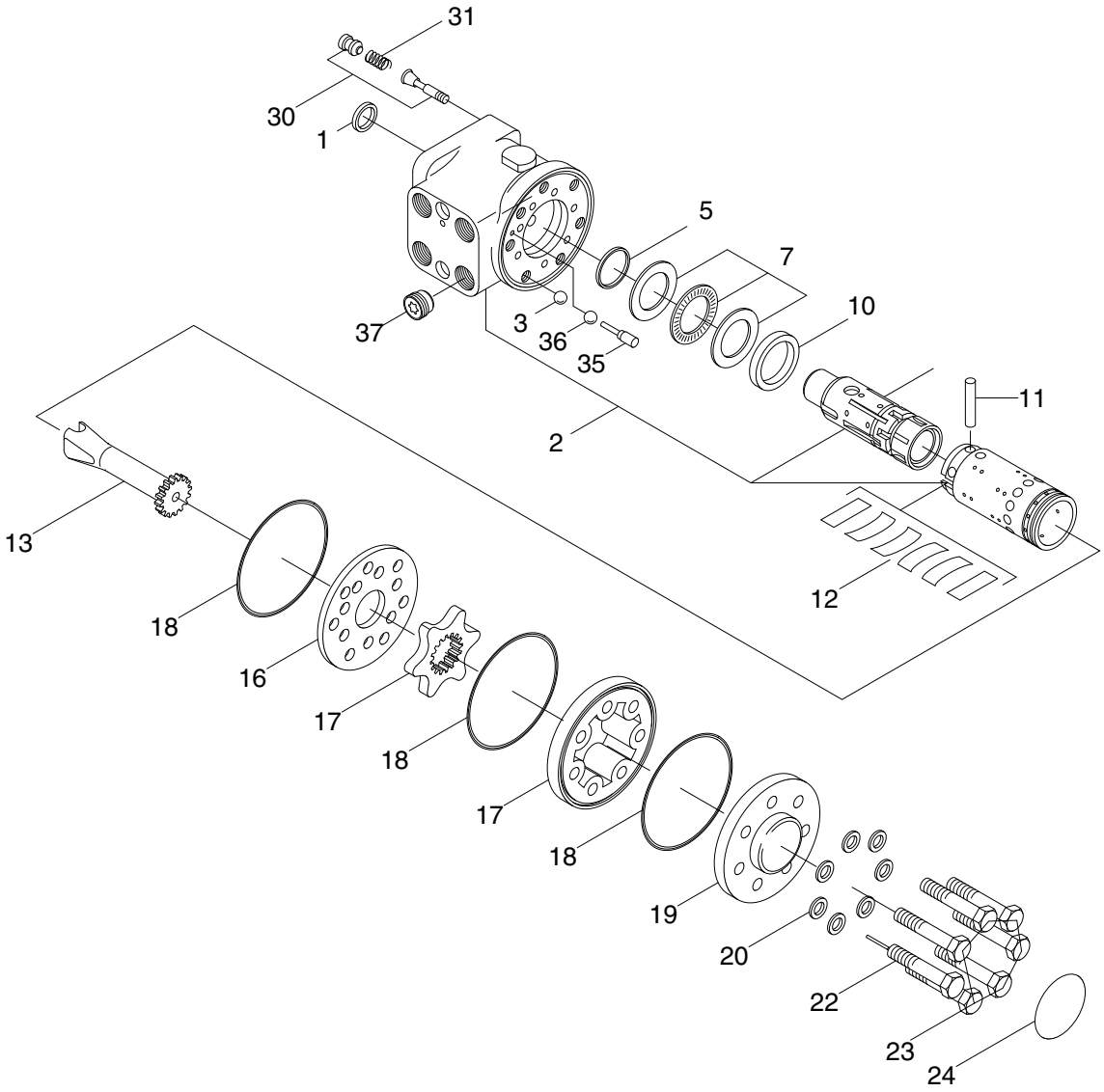
Problem	Cause	Remedy
The steering wheel in the idling state is heavy.	· Oil moves in the steering unit. · The relief valve is not functioning correctly. · Air is sucked from the piping. · The piping is blocked (crushed or clogged). · The end cap set screw is tightened to an excessive torque.	· Replace 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.

2) PRIORITY VALVE

Problem	Check point	Remedy
Springs scratche, wear or fall.	· Those of having critical scratches or wear and those of below the repair limit must be replaced with a new one.	· Replace.
Spools scratche or wear on sliding surface.	· Extremely small scratches must be removed with sandpaper. · Those of having critical scratches or wear must be replaced with a new one.	· Replace.
O-ring	· Those of having scratches on the seal or having critical wear must be replaced with a new one.	· Replace.

1. STEERING UNIT

1) STRUCTURE



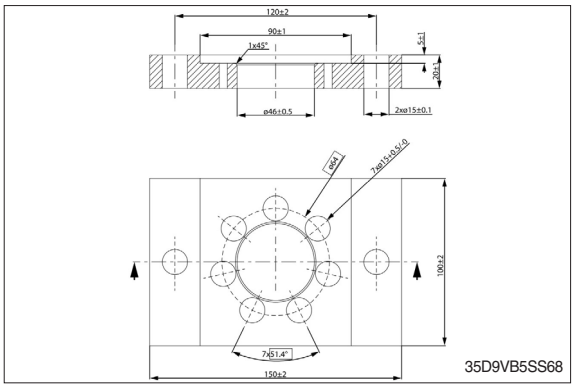
35D9VB5SS74

1	Dust seal ring	13	Cardan shaft	24	Model / Code label
2	Housing and spool/sleeve	16	Distributor plate	30	Relief valve
3	Ball	17	Gearwheel set	31	Spring for relief valve
5	Shaft seal	18	O-ring	35	Ball stop threaded for LS Check
7	Bearing assy	19	End over	36	Ball ∅3 for is check
10	Ring	20	Washer	37	Check valve
11	Cross pin	22	Pin bolt screw		
12	Set of springs	23	Screw		

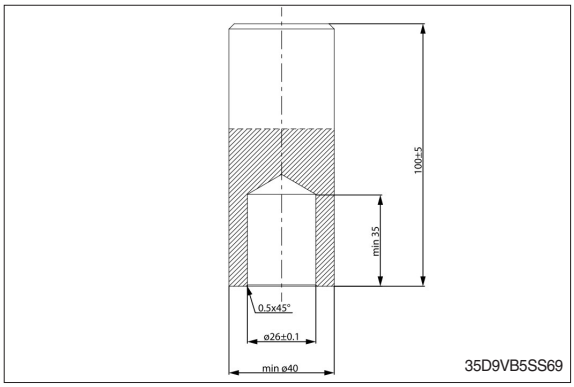
※ Seal kit : 1, 5, 18, 20

2) TOOLS

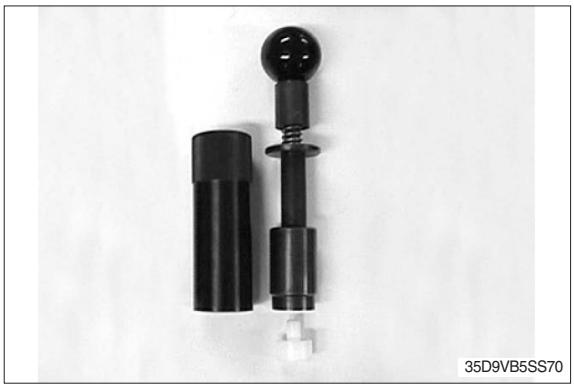
(1) Holding tool for the entire steering unit.
Material: Appropriate metal or hard plastic.



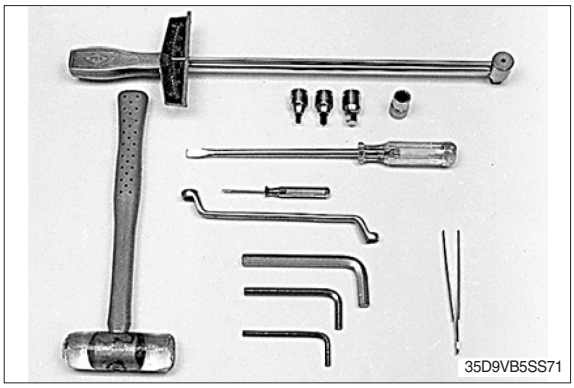
(2) Assembly tool for dust seal.
Material: Free cutting steel.



(3) Assembly tool for shaft seal, O-ring/Roto Glyd type:
Code number: 11092408.

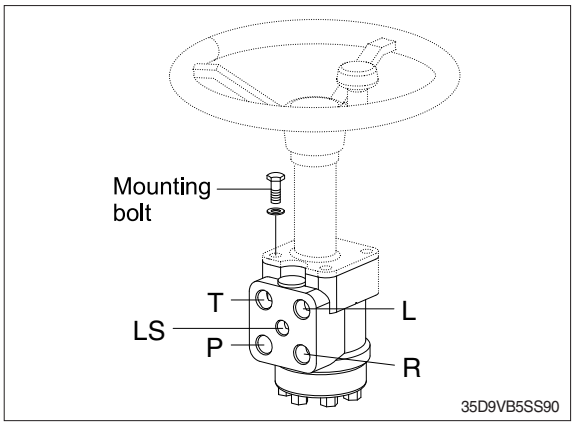


(4) Torque wrench 0 ~ 70 N·m.
- 13 mm socket spanner
- 2 ~ 2.75 – 5 ~ 6 and 8 mm Allen key
- Torx Bit size T50
- 12 mm screwdriver
- 2 mm screwdriver
- 13 mm ring spanner
- Plastic hammer
- Tweezers



3) TIGHTENING TORQUE

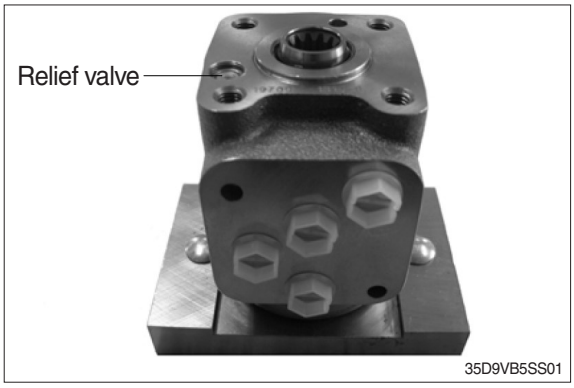
L : Left port
R : Right port
T : Tank port
P : Pump port
LS : Load sensing port



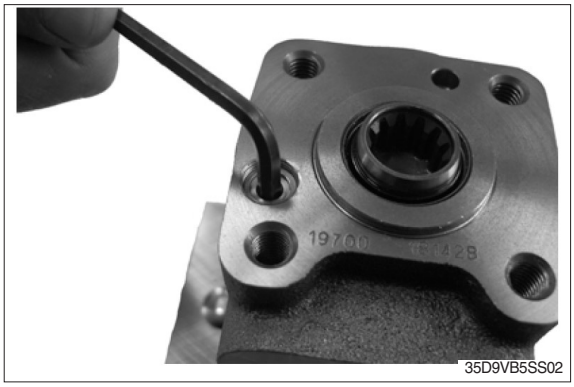
Port	Port size	Tightening torque	
		kgf·m	lbf·ft
L, R, T, P	7/16-20UNF	6	43.4
LS	3/4-16 UNF	2.5	18.4
Mounting bolt	M10	4	28.9

4) DISASSEMBLY

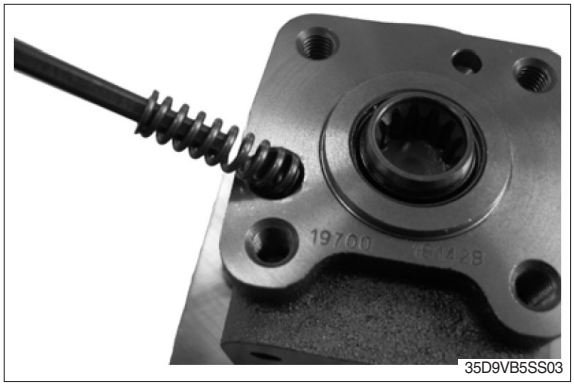
(1) Place the unit in the holding tool on gear set end. Remove the dust cap on the relief valve.



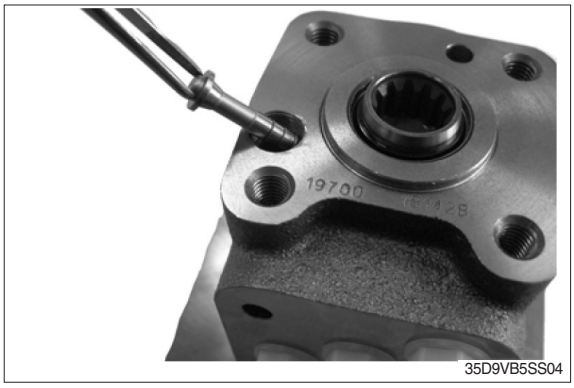
(2) Screw out the adjusting screw for relief valve (30) using a 5 mm Allen key.



(3) Remove the spring for relief valve (31).



(4) Remove the piston for relief valve.

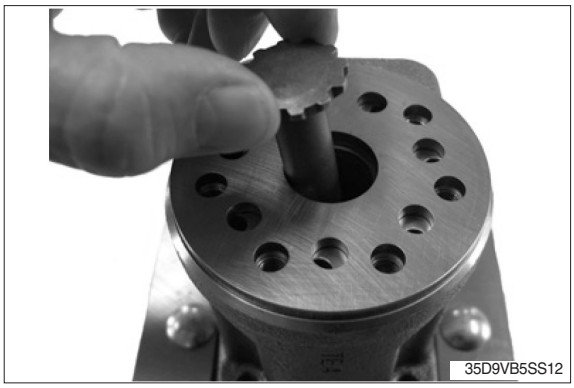


(5) Replace the unit in the holding tool on steering column end.
Remove the screws (22 and 23) with washers (20) using a 13 mm ring spanner or top wrench.

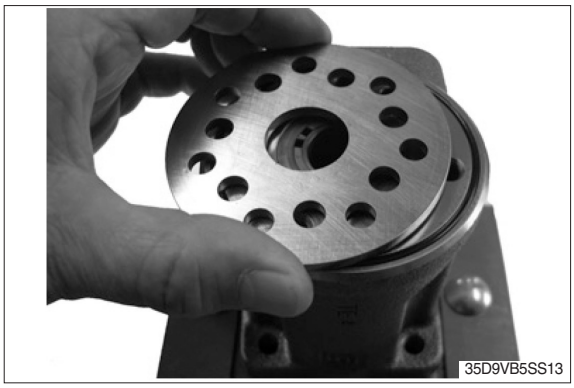
(6) Remove the end cover (19), sideways.

(7) Lift the gearwheel set (17) off the unit. Remove the two O-rings (18).

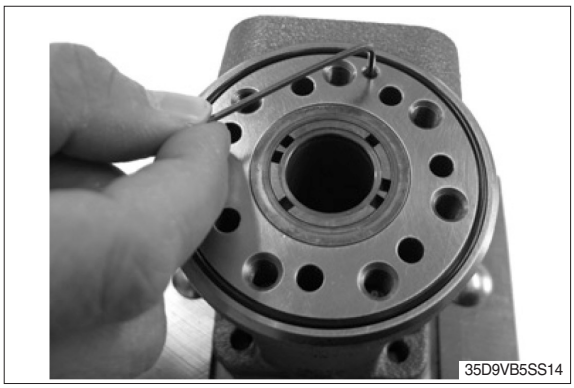
(8) Remove the cardan shaft (13).



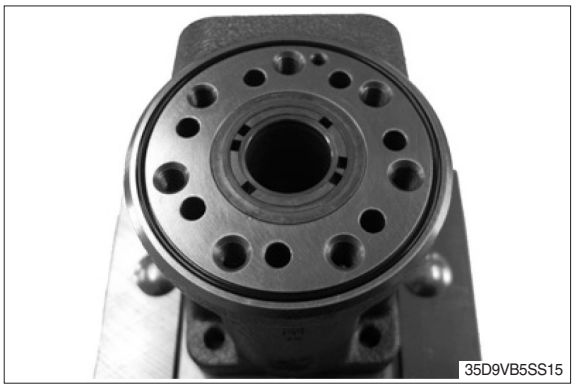
(9) Remove the distributor plate (16).



(10) Screw out the ball stop (35) using a 2 mm Allen key.

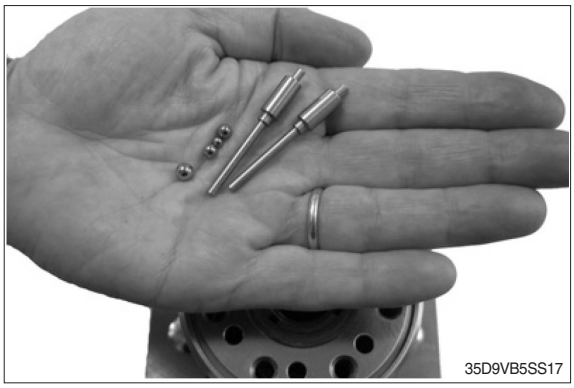


(11) Remove the O-ring (18) from housing.

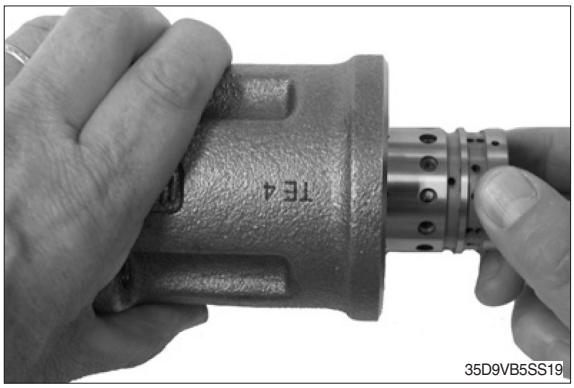


(12) Remove the check valve (37) using a torx bit size T50.

(13 Shake out the check valve ball (3), suction valve pins (34), balls (33 and 36).



(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.

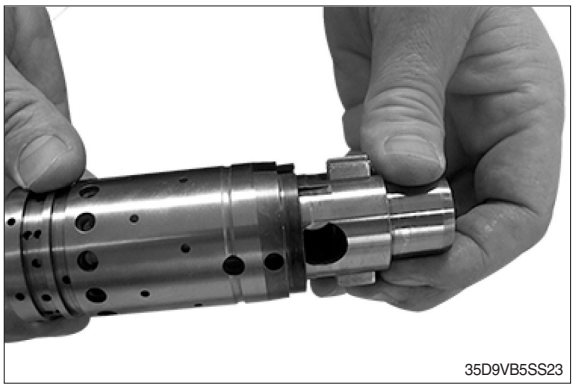


(15) Take the bearing races and needle bearing (7) from the spool and sleeve set (2). The outer bearing (7) race can sometimes “stick” in the housing, therefore check that it has come out.

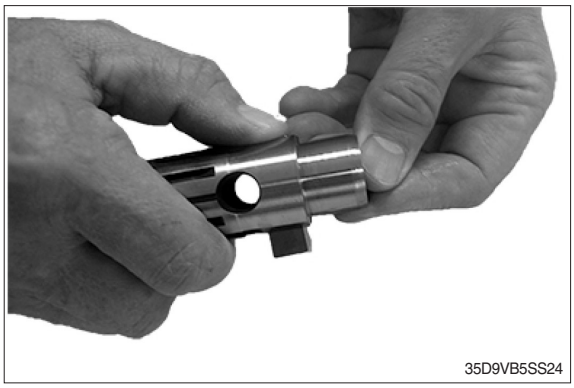
(16) Press out the cross pin (11).

(17) Remove the ring (10).

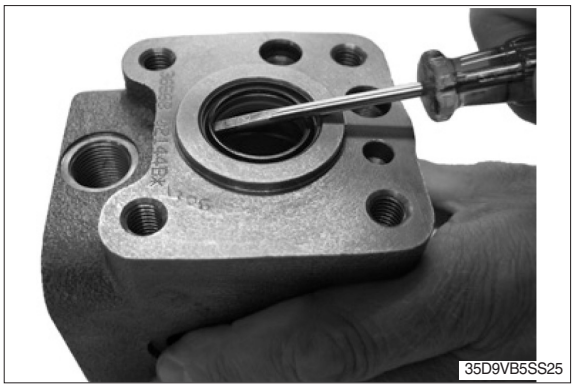
(18) Carefully press the spool out of the sleeve.



(19) Press the neutral position springs (12) out of the slot of the spool.



(20) Remove dust seal (1) and shaft seal (Roto Glyd) (5) carefully with a screw driver or similar tool.



(21) The steering unit is now completely dismantled.

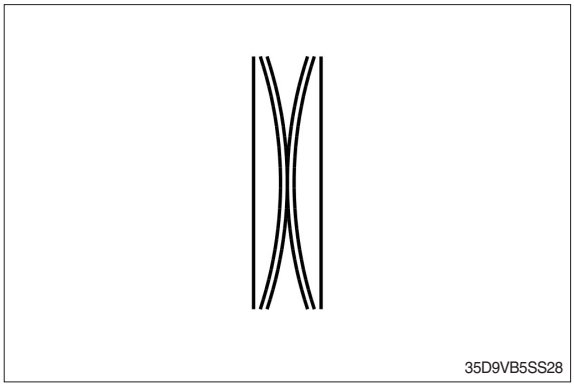
※ **Clean all parts carefully in shellsol K or similar cleaner fluid.**

※ **Inspection and replacement Replace all seals and washers. Check all parts carefully and make any replacements as is necessary.**

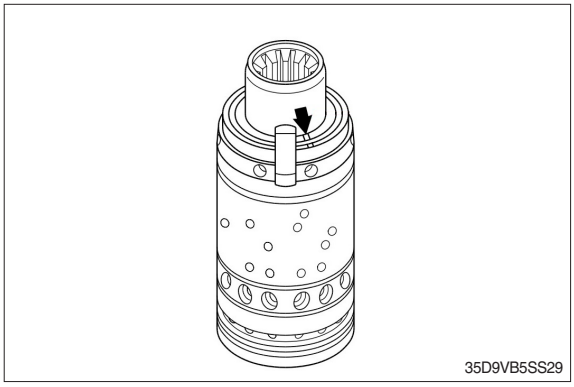
5) ASSEMBLY

(1) Place the two flat neutral position springs in the slot. Place the curved springs between the flat ones and press them into place.

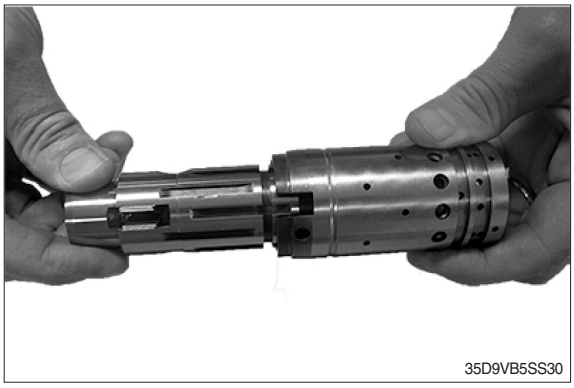
(2) Configuration of spring set (12). There can be different numbers of curved springs depending on configuration of spring set. There can be 2, 4 or 6 curved springs.



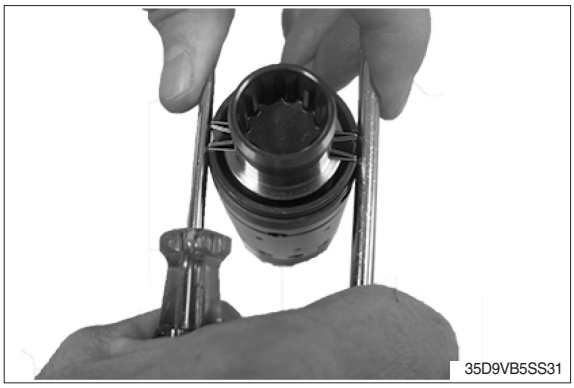
(3) Some spool and sleeve sets for steering unit must be positioned correctly relatively to each other. Small marks are present on both spool and sleeve close to one of the slots for the spring set. Most spool and sleeve sets for steering unit have no marks, so those can be positioned relatively to each 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).

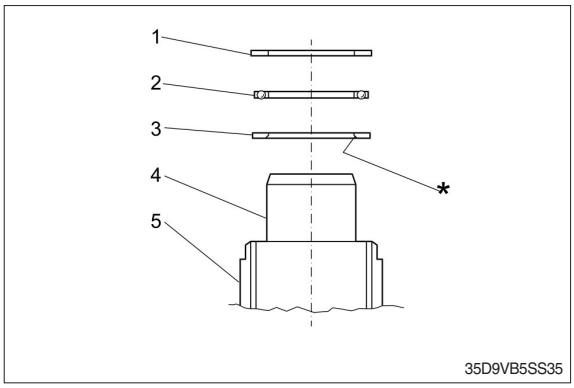


(6) Guide the ring (10) down over the sleeve. The ring should be able to move free of the springs.

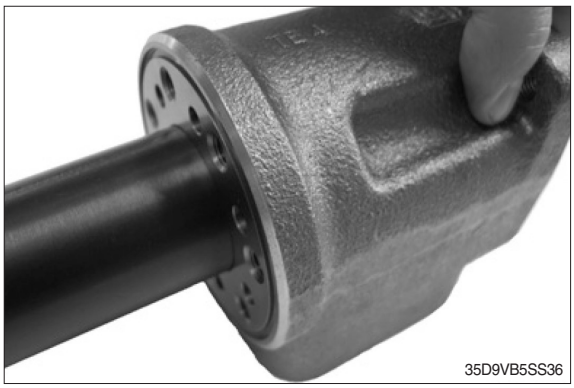
(7) Fit the cross pin (11) into the spool/sleeve.

(8) Fit bearing races and needle bearing (7) as shown on the drawing below.

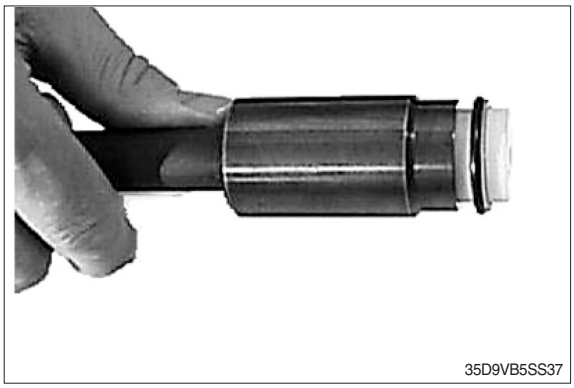
(9) Assembly pattern for standard bearing 1 Outer bearing race → 2 Needlebearing → 3 Inner bearing race → 4 Spool → 5 Sleeve.
The inside chamfer on the inner bearing race must face the chest of the inner spool.



(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).

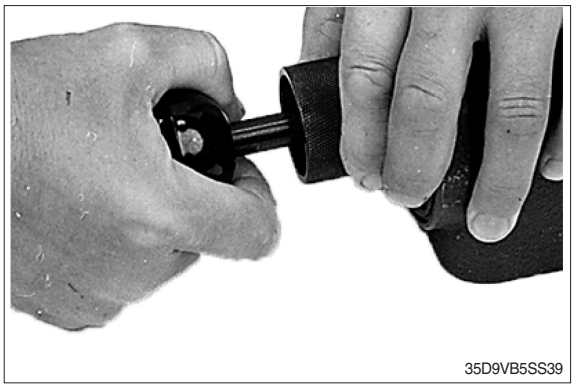


(10) Grease the shaft seal (Roto Glyd, 5) with hydraulic oil and place them on the tool. Ensure that the Roto Glyd seal is placed on the insertion tool as per the photograph.

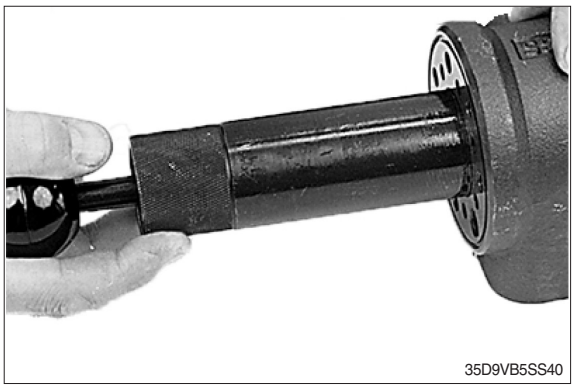


(13) Hold the outer part of the assembly tool in the bottom of the steering unit housing and guide the inner part of the tool right to the bottom.

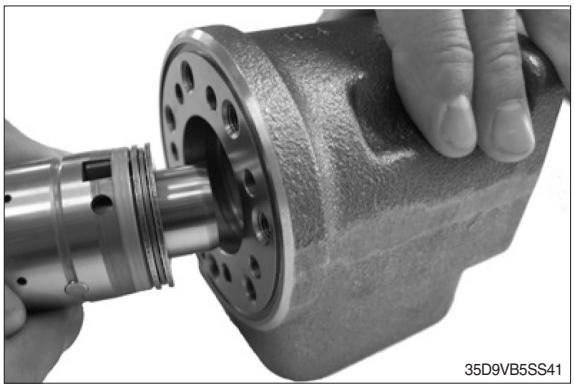
(14) Press and turn the shaft seal (5) into position in the housing.



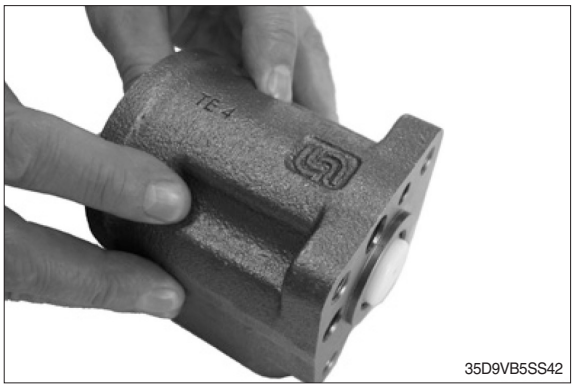
(15) Draw the inner and outer parts of the assembly tool out of the steering unit bore, leaving the guide from the inner part in the bore.



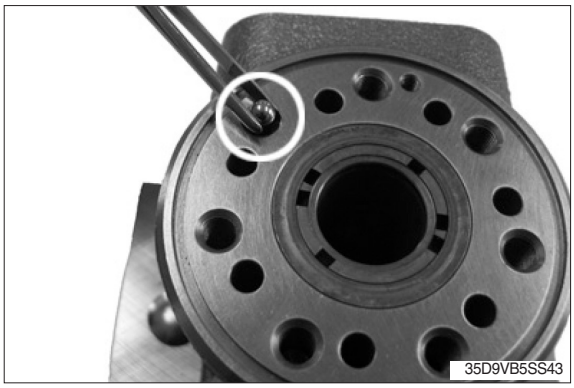
(16) With a light turning movement, guide the spool and sleeve into the bore.
Fit the spool set holding the cross pin (11) horizontal.



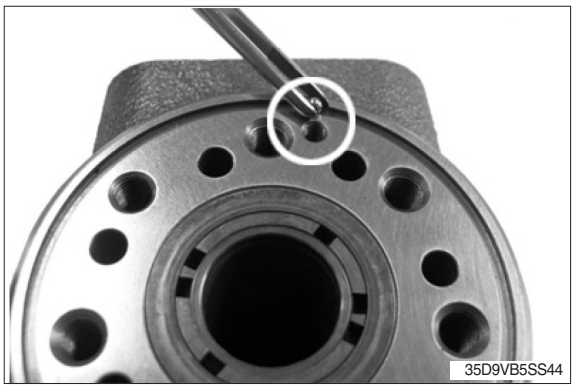
(17) The spool set will push out the assembly tool guide. The shaft seal (5) are now installed.



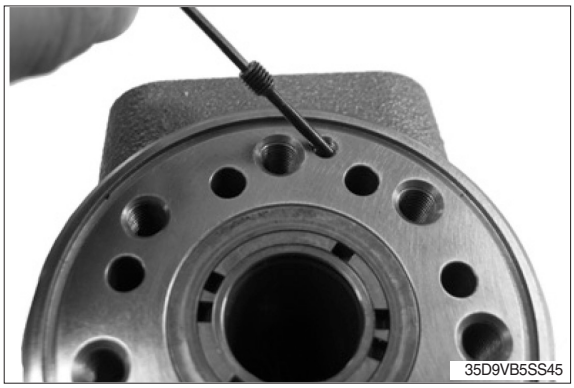
(18) Place the steering unit housing on the holding tool on the steering column end. Put the check valve ball (3) into the hole indicated by the circle.



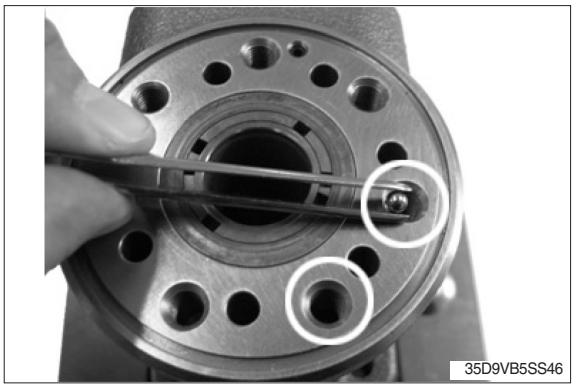
(19) Place the ball for LS check valve (36) into the hole indicated by the circle.



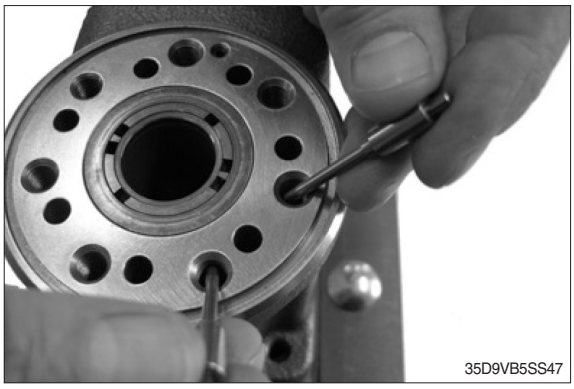
(20) Screw the ball stop (35) into the LS check valve bore using a 2 mm Allen key.
· Tightening torque : 0.1±0.01 kgf·m
(0.72±0.072 lbf·ft)



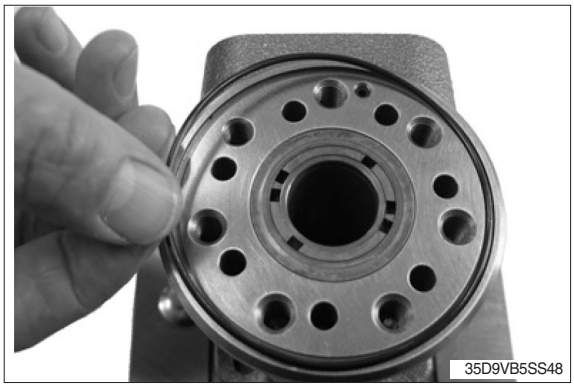
(21) Place a ball (33) in the two bolt holes indicated by the circles.



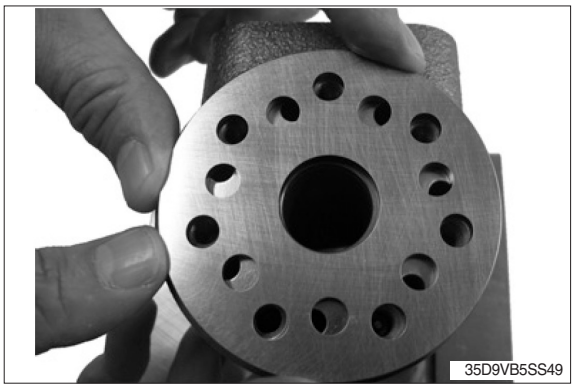
(22) Place the pins (34) in the same two bolt holes.



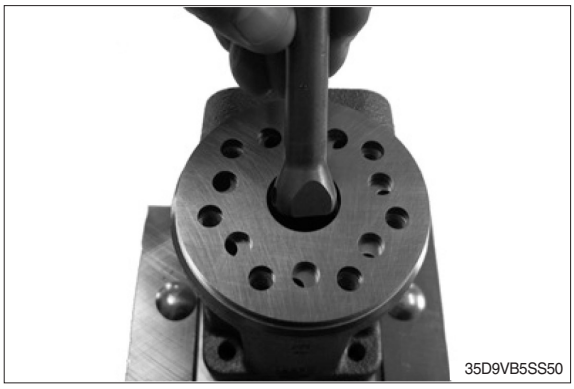
(23) Insert the O-ring (18) in the grove on the housing.



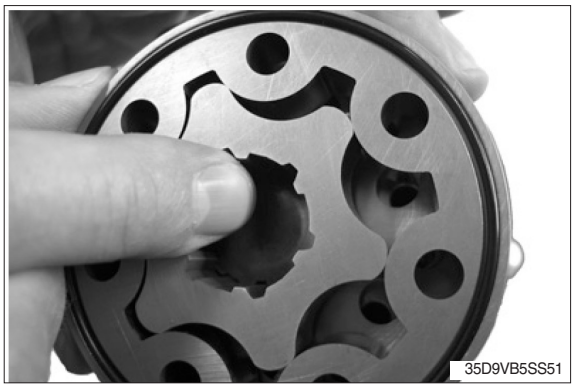
(24) Place the distributor plate (16) so that the channel holes match the thread holes in the housing.



(25) Guide the cardan shaft (13) down into the bore so that the slot is parallel with the connection flange ports and lines up with the cross pin (11).



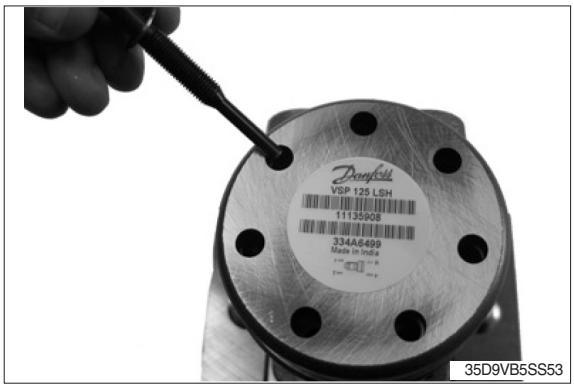
(26) Place the 2 O-rings (18) in the two groves in the gear rim. Fit the gearwheel and rim (17) on the cardan shaft (13).
Place the gear wheel side with all the deeper splines facing downwards. Only this side will fit on the cardan shaft due to all gear sets used in steering unit have timing securing: 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.

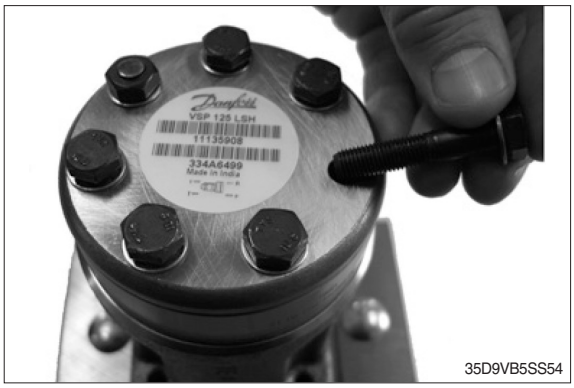
35D9VB5SS52

(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

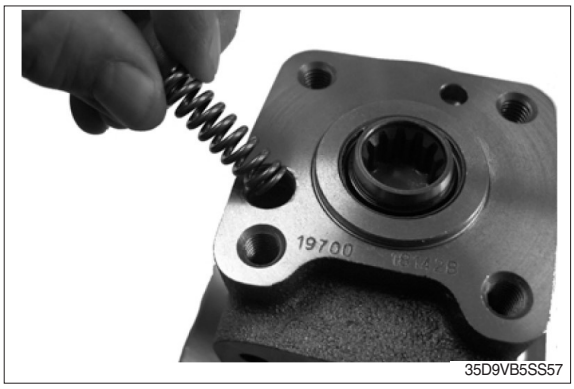
(30) Screw in the check valve (37) into the P-port using a Torx Bit size T50.
· Tightening torque : 2.6±0.5 kgf·m
(18.8±3.6 lbf·ft)


35D9VB5SS55

(31) Replace the unit in the holding tool on gear set end.
Install the piston (30) to housing.

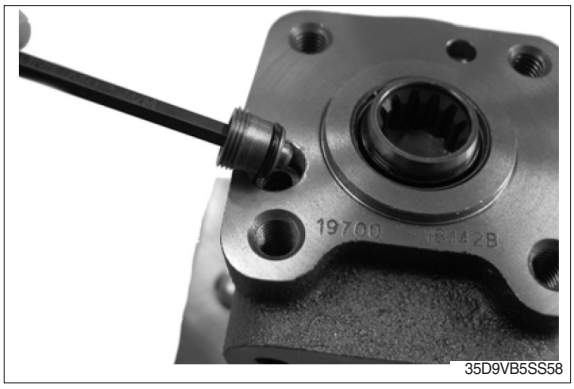
35D9VB5SS56

(32) Install the spring (31) on top of the piston.



35D9VB5SS57

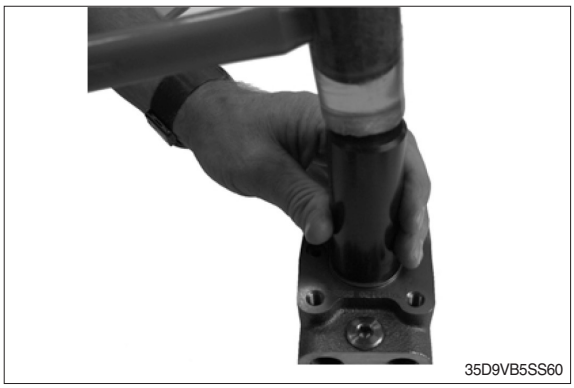
(33) Place o-ring on adjusting screw (30). Screw in the adjustment screw (30) using a 5 mm Allen key. Make the pressure setting on a test panel according to valve setting specification.



35D9VB5SS58

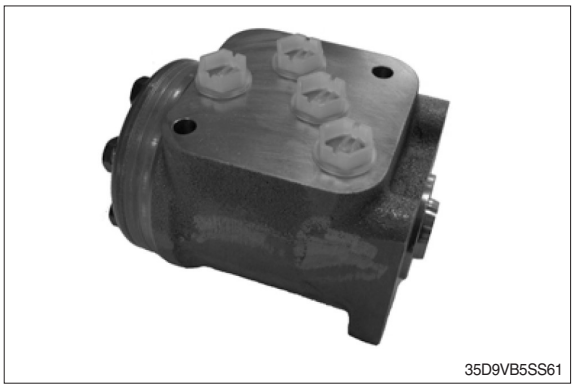
(34) Place the dust seal ring (1) in the housing.

(35) Fit the dust seal ring in the housing using special tool for dust seal assembly and a plastic hammer.



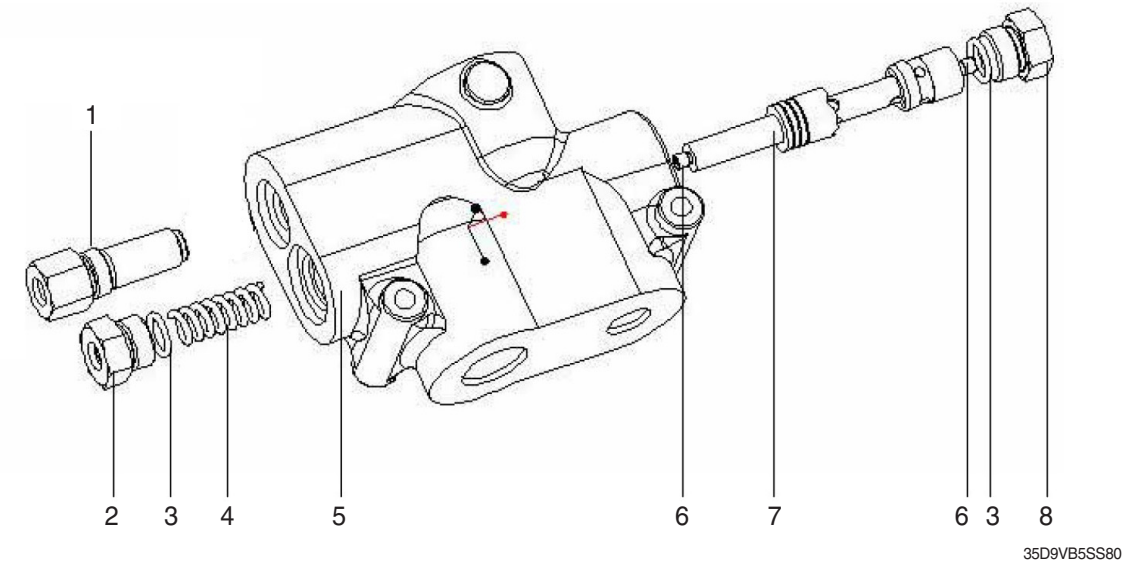
(36) After finalizing the entire assembly, screw in the plastic plugs into the connection ports to keep the ports clean during storage and transportation.

※ **Refer to the relief valve and LS port pressure test and adjustment.**



2. PRIORITY VALVE

1) STRUCTURE



1	Plug	4	Spring compression	7	Spool
2	Plug	5	Housing	8	Plug
3	O-ring	6	Throttle		

2) DISASSEMBLY

※ Check that the priority valve has not been damaged during transportation.

※ Clean the working area before operation.

※ If needed, components must be replaced exclusively by serviceman.

(1) Clamp the unit in vice. Loosen the plug (using 27 mm wrench) and screw out. Be careful of the spring.

(2) Take out the spring vertically.

(3) Unscrew the plug in the opposite side using the 27mm wrench.

(4) Press out the spool by hand.

※ **It is strongly recommended that relief valve cartridge not be adjusted by customer. If necessary, it must be done by Eaton representative. Approximately 800psi per revolution of the adjusting screw.**

(5) Clean all metal parts in clean solvent. Blow dry with air. Do not wipe dry with cloth or paper towel because lint or other matter can get into the hydraulic system and cause damage.

3) ASSEMBLY

※ Before assembly, lubricate all parts with normal hydraulic oil.

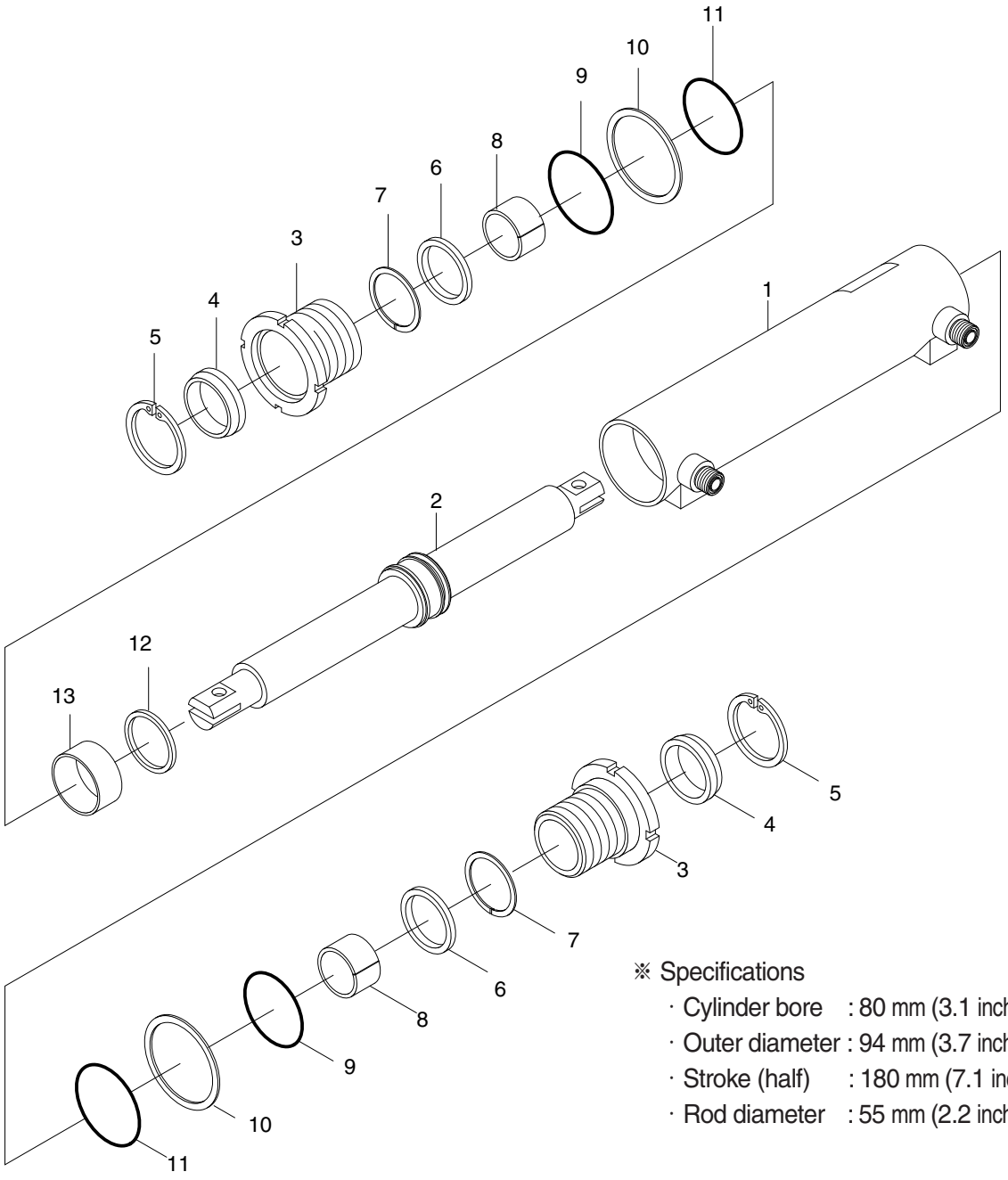
(1) Position the valve horizontally and insert the spool into its bore. Pay attention to spool direction and ensure spool moves smoothly.

(2) Insert the spring into the bore.

(3) Screw in the two plugs and tighten.
· Tightening torque : 4.1 ~ 6.1 kgf·m
(29.7 ~ 44.1 lbf·ft)

3. STEERING CYLINDER

1) STRUCTURE



※ Specifications
- Cylinder bore : 80 mm (3.1 inch)
- Outer diameter : 94 mm (3.7 inch)
- Stroke (half) : 180 mm (7.1 inch)
- Rod diameter : 55 mm (2.2 inch)

35D9VB5SS91

1	Tube	6	Rod seal	11	O-ring
2	Rod piston	7	Backup ring	12	Piston seal
3	Gland	8	Dry bearing	13	Wear ring
4	Dust wiper	9	O-ring		
5	Retainer	10	Backup ring		

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

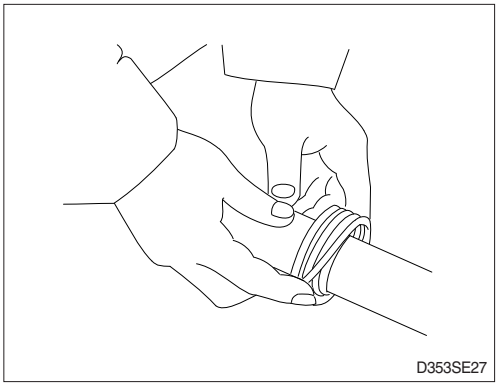
mm (in)

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

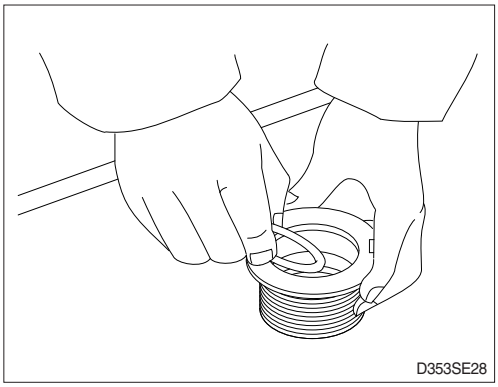
4) ASSEMBLY

(1) Install a new piston seal around the groove on the piston.

※ Be careful not to scratch the seal too much during installation or it could not be seated properly.

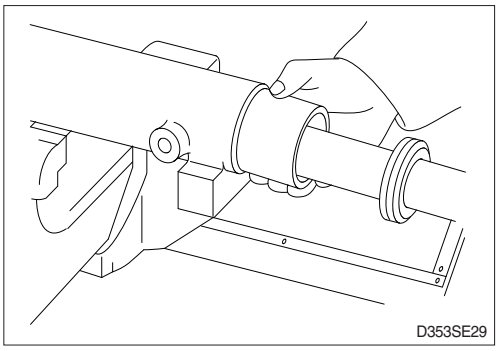

D353SE27

(2) Install the rod seal to the position in the gland applying a slight coat with grease prior to install.

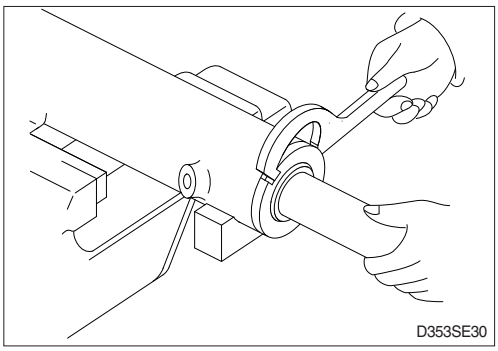

D353SE28

(3) Install the dust wiper to the gland 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.

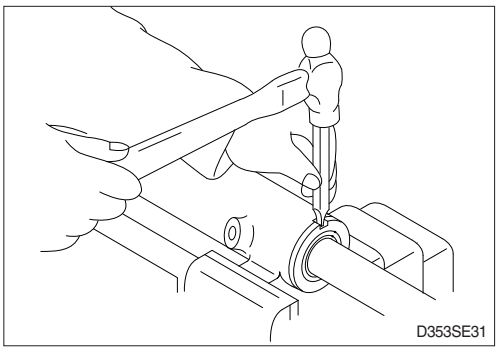

D353SE29

(5) Using a hook spanner, install the gland assembly, and tighten it with torque 60±6 kgf·m (434±43 lbf·ft).


D353SE30

(6) After the gland assembly was installed to the cylinder tube, 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.


D353SE31

(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.

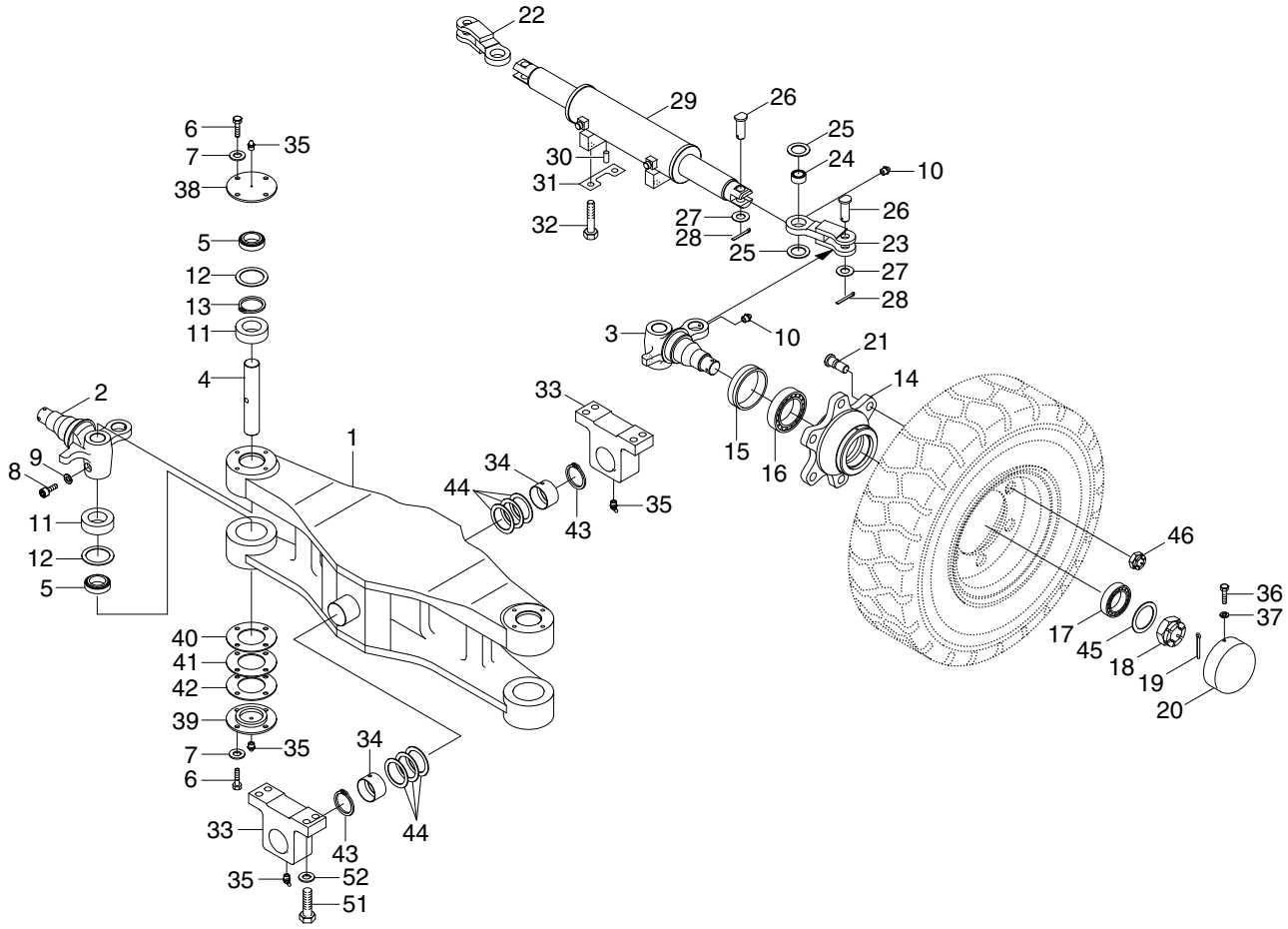
(9) While idling the engine with the rear wheels off the ground, operate the steering wheel left and right alternately.

※ 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

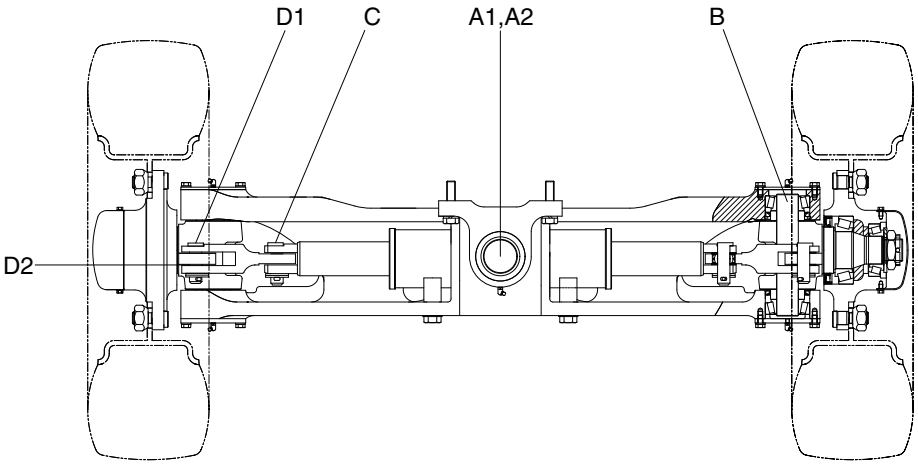
1) STRUCTURE



35D9SE06

1	Axle center	13	Retaining ring	25	Thrust washer	37	Spring washer
2	Knuckle-RH	14	Hub	26	Clevis pin	38	Upper cover
3	Knuckle-LH	15	Oil seal	27	Plain washer	39	Lower cover
4	King pin	16	Taper roller bearing	28	Split pin	40	Shim (0.1t)
5	Taper roller bearing	17	Taper roller bearing	29	Steering cylinder	41	Shim (0.15t)
6	Hexagon bolt	18	Slotted nut	30	Pin	42	Shim (0.3t)
7	Spring washer	19	Split pin	31	Lock plate	43	Retaining ring
8	Special bolt	20	Hub cap	32	Hexagon bolt	44	Shim (0.5t)
9	Spring washer	21	Serration bolt	33	Support	45	Plain washer
10	Grease nipple	22	Link-RH	34	Bushing	46	Hub nut
11	Collar	23	Link-LH	35	Grease nipple	51	Hexagon bolt
12	Oil seal	24	SPH plain bearing	36	Hexagon bolt	52	Spring washer

2) CHECK AND INSPECTION



35DS7SE08

unit : mm (in)

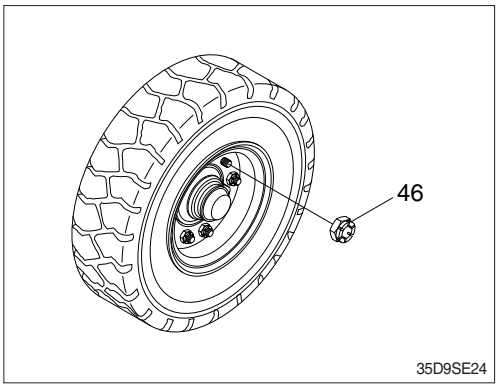
No.	Check item			Criteria		Remedy
				Standard size	Repair limit	
A	Shaft	A1	OD of shaft	55 (2.2)	54.5 (2.1)	Replace
		A2	ID of bushing	55 (2.2)	55.5 (2.2)	
B	OD of king pin			35 (1.4)	34.5 (1.4)	
C	OD of steering cylinder pin			20 (0.8)	19.5 (0.8)	
D	Knuckle	D1	OD of pin	20 (0.8)	19.5 (0.8)	
		D2	Vertical play	-	-	Adjust with shims

· 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 counter weight part of the truck.

(1) Loosen the hub nut (46) and take off the steering wheel tire.



(2) Remove hub cap (20).

(3) Pull out split pin (19) and remove slotted nut (18) and washer (45).

(4) Using the puller, take off the hub (14) together with the taper roller bearing (16, 17).

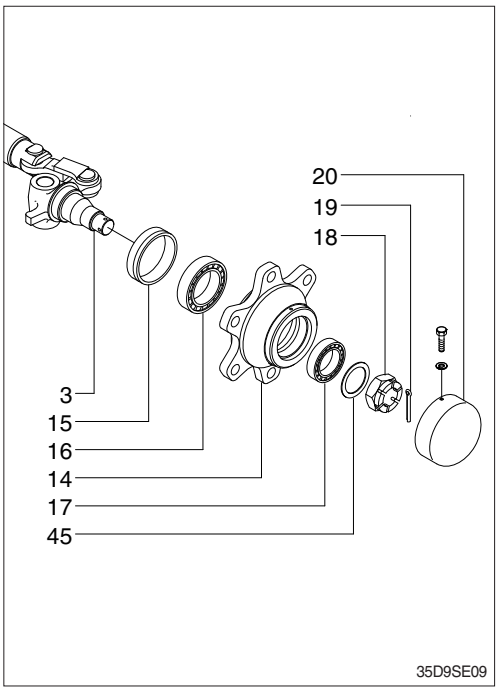
※ Be very careful because just before the hub comes off, taper roller bearing will fall out.

(5) After hub (14) is removed take off the inner race of the taper roller bearing (16, 17).

(6) Pull out oil seal (15).

※ 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.



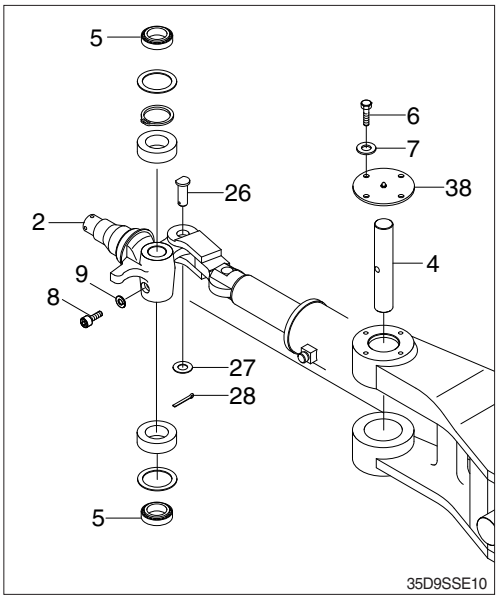
(8) Loosen special bolt (8) and spring washer (9).

(9) Remove hexagon bolt (6) and upper cover (38).

(10) Push out the king pin (4) without damaging the knuckle arm (2).

(11) If defect is observed in taper roller bearing (5), pull it out by using extractor.

(12) Remove spilt pin (28), plain washer (27) and clevis pin (26).



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 special bolt (8) and washer (9) of king pin (4).

(2) There is a notch in the middle of the king pin (4), make sure that this notch is on the special bolt side.

(3) Do not hammer to drive in taper roller bearing (5) because it will break.
Always use drive-in tool.
Be sure that the fixed ring of the bearing is placed in position facing the knuckle (3).

(4) Hub

① Mount oil seal (15) and inner race of taper roller bearing (16) on the knuckle. The bearing should be well greased before assembling.

② Install the outer race of the taper roller bearing (17) in the wheel center and assemble to the knuckle.

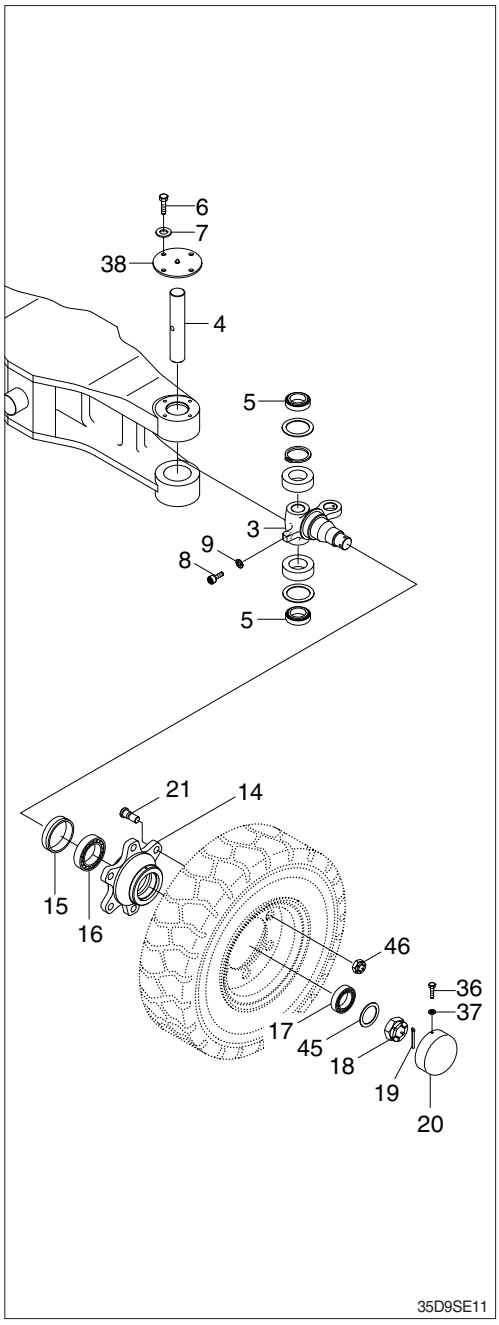
③ Put the plain washer (45) in place, tighten the slotted nut (18) and lock with split pin (19). In locking with split pin, locate the hole for the split pin by turning the nut back 1/6 of a turn. Adjust the preload of bearing.

④ Mount the hub cap (20) and tighten with bolt (36).

※ Apply loctite #609 on the contact surface of the hub cap (20).

※ Apply loctite #277 on the thread of the bolt (36).

※ Bearing should be well greased before assembling.



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 or ECV), 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 OR ECV

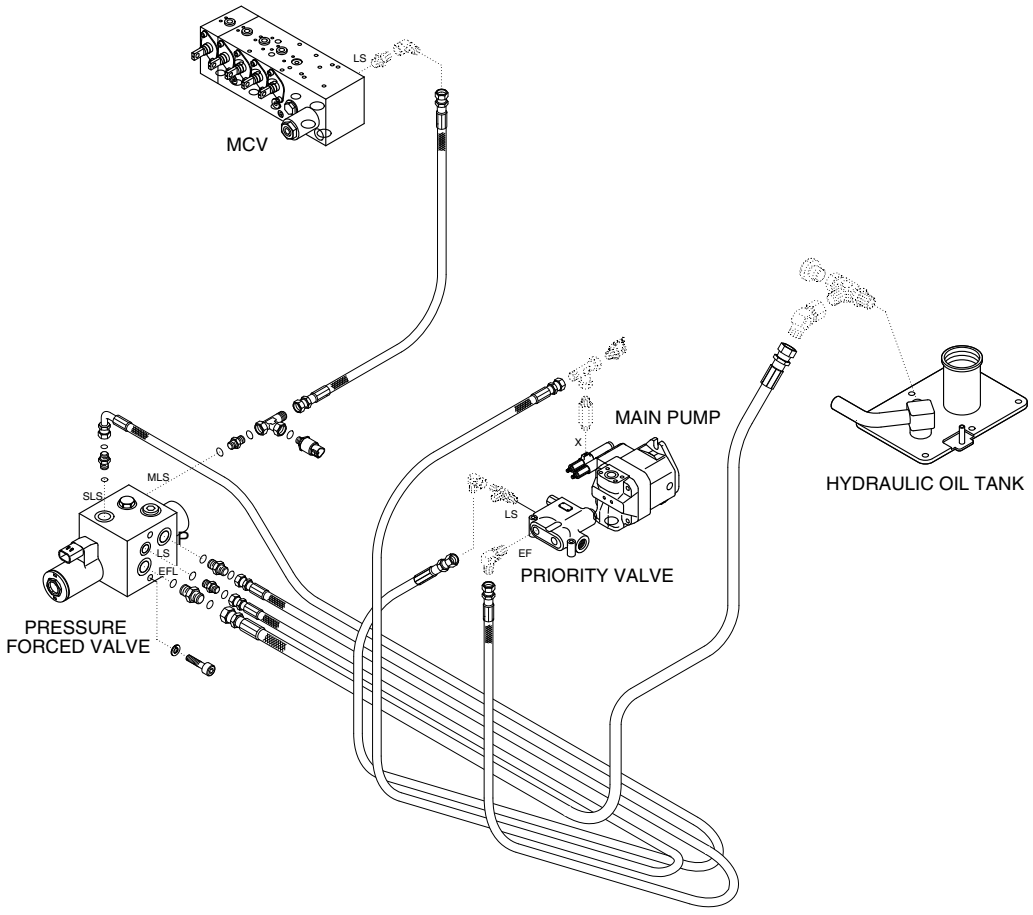
· Lift function, Tilt function, Auxiliary function (Sideshift etc.), Fingertip controller (ECV)

3) HYDRAULIC OIL TANK

· Return filter, Suction Strainer, Air breather, Drain plug-magnetic

4) PRESSURE FORCED VALVE

· Built-in Shuttle valve



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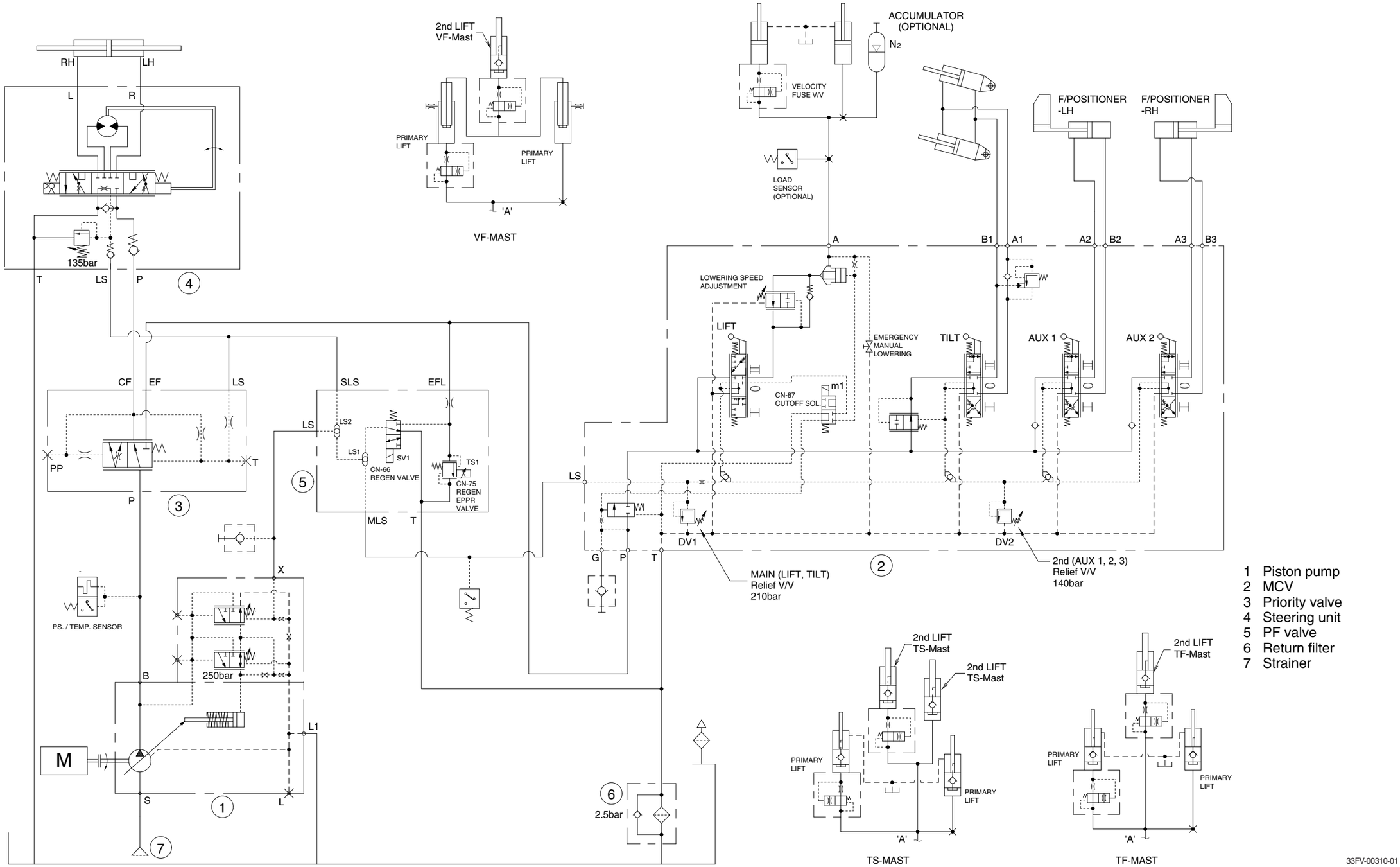
2. HYDRAULIC CIRCUIT

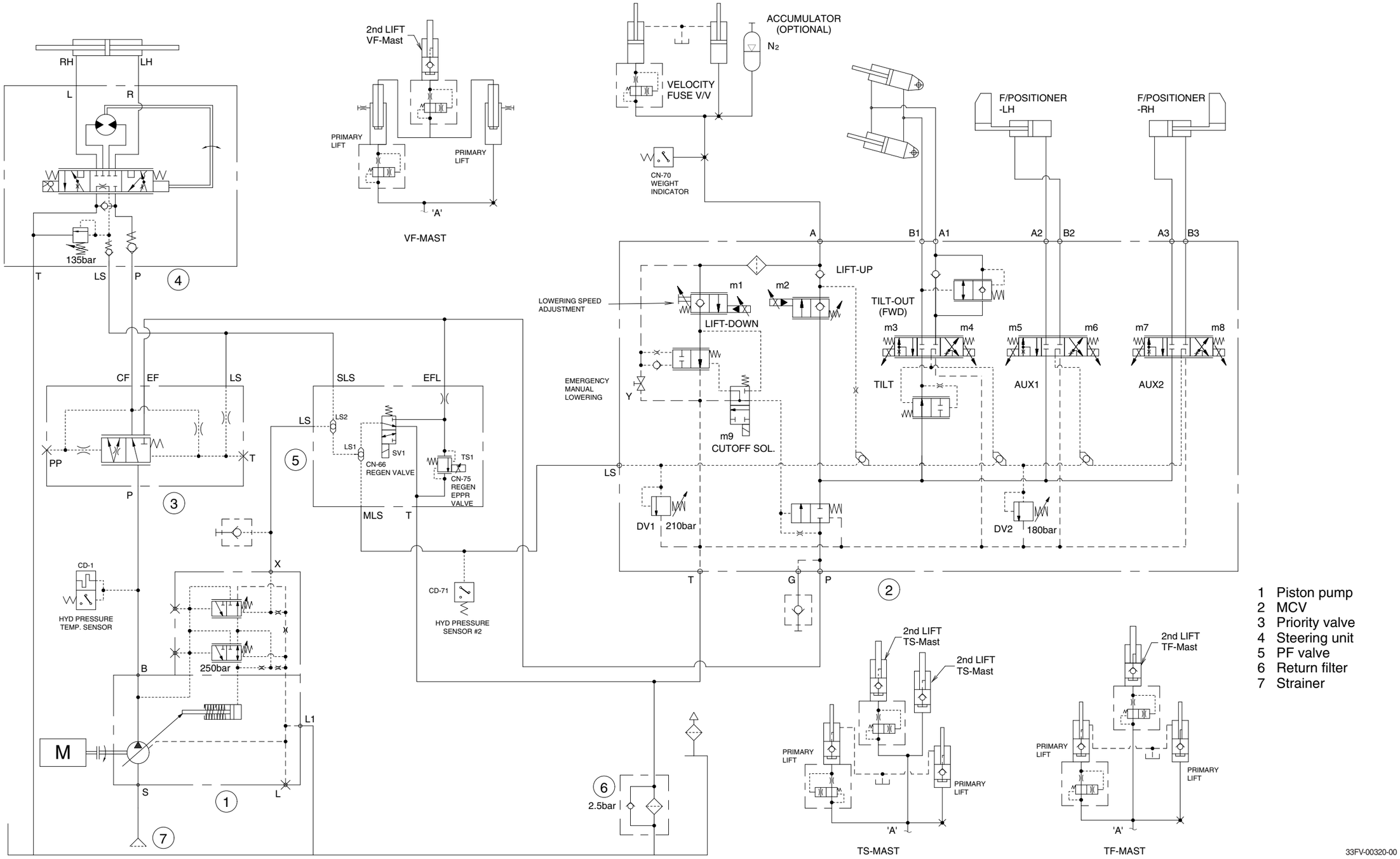
1) MANUAL



1 Piston pump
2 MCV
3 Priority valve
4 Steering unit
5 PF valve
6 Return filter
7 Strainer

33FV-00310-01

2) FINGERTIP (OPTIONAL)

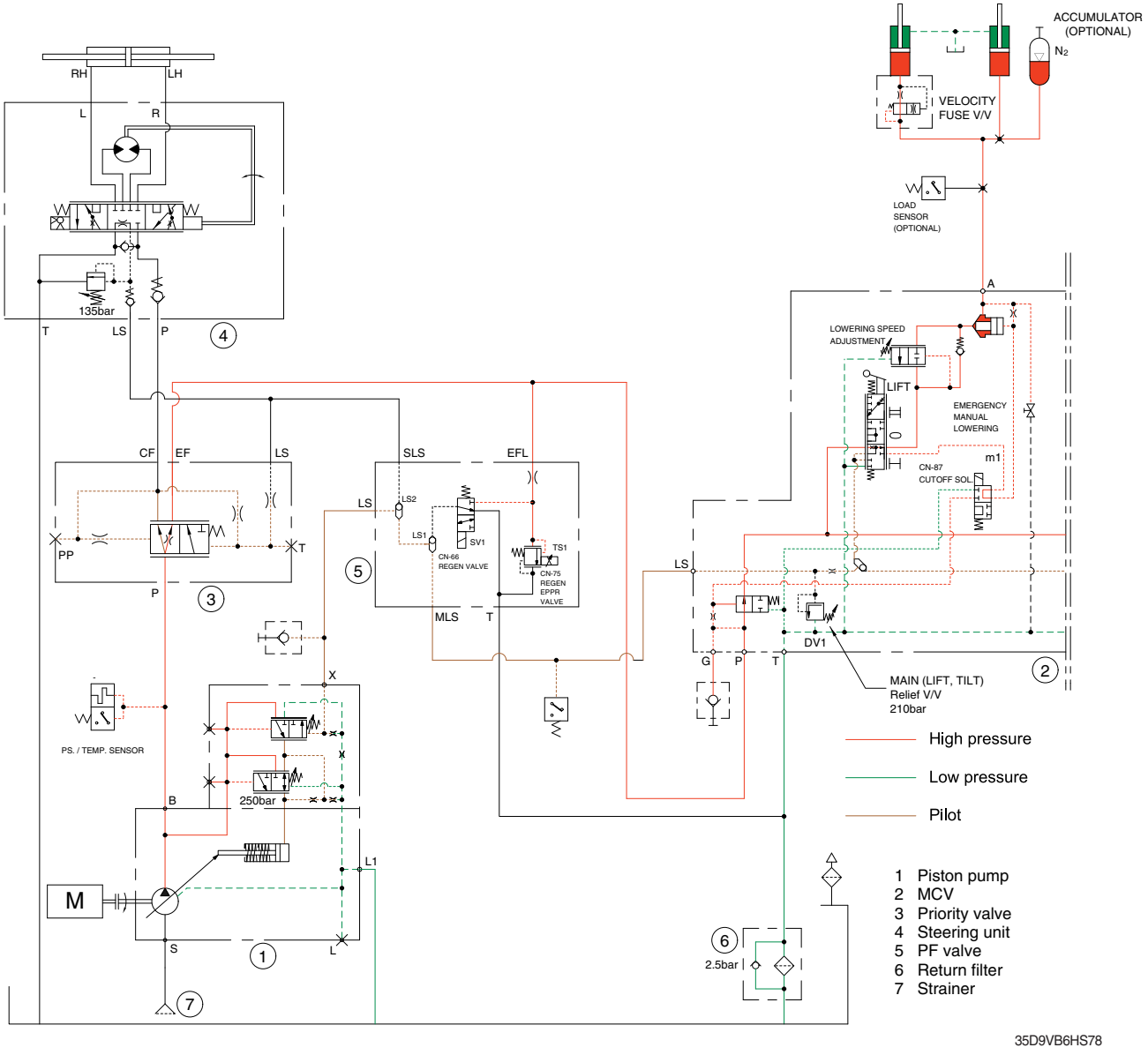


1 Piston pump
2 MCV
3 Priority valve
4 Steering unit
5 PF valve
6 Return filter
7 Strainer

33FV-00320-00

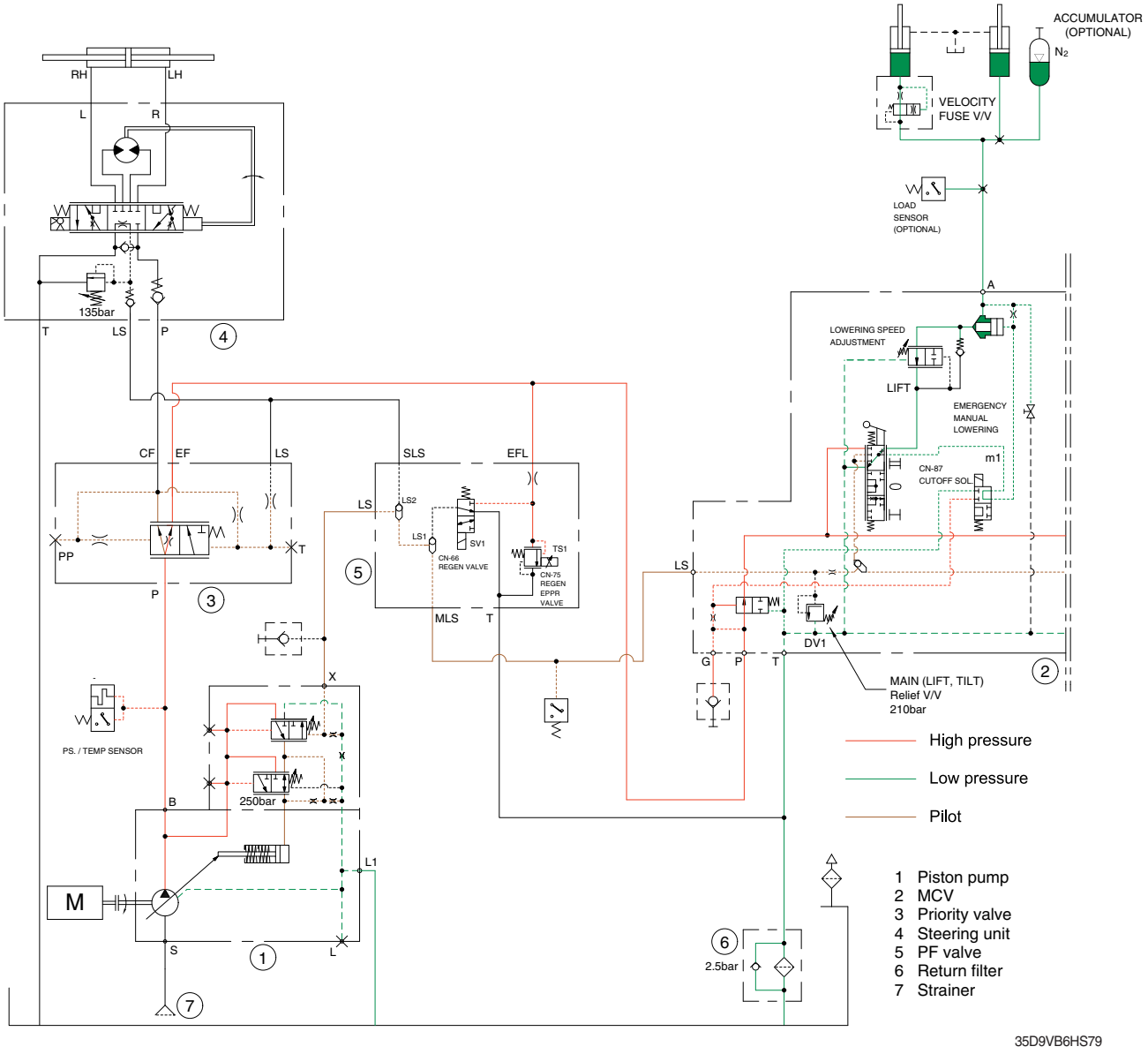
3. WORK EQUIPMENT HYDRAULIC CIRCUIT

1) WHEN THE LIFT CONTROL LEVER IS IN THE LIFT POSITION



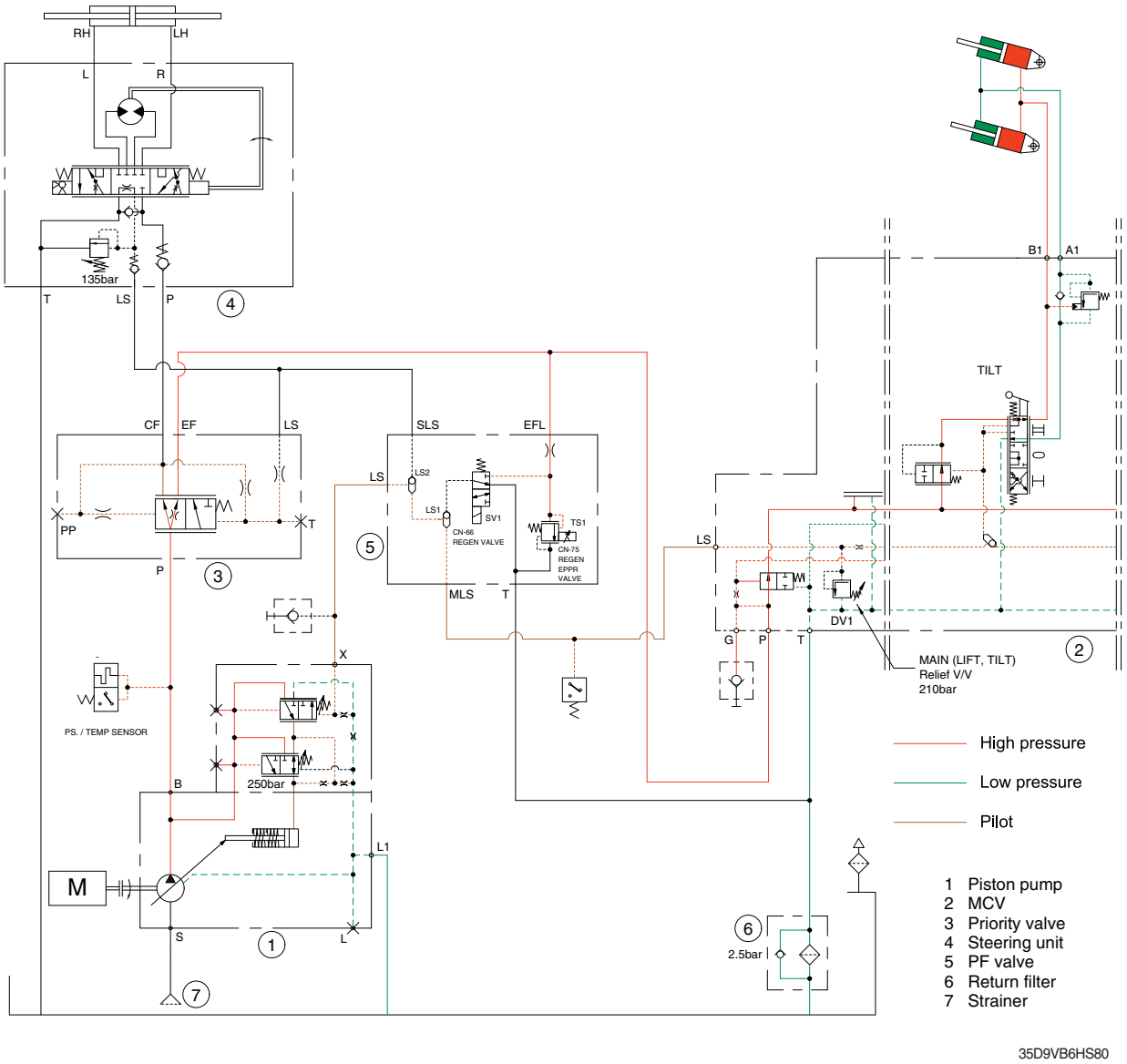
When the lift control lever is pulled back, the spool in the first block is moves to lift position.
The oil from the piston pump (1) flows into main control valve (2) through the priority valve (3). Then goes to the large chamber of lift cylinder by pushing the load check valve of the spool and lift 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.

2) WHEN THE LIFT CONTROL LEVER IS IN THE LOWER POSITION



When the lift control is pushed forward, the 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.

3) WHEN THE TILT CONTROL LEVER IS IN THE FORWARD POSITION



35D9VB6HS80

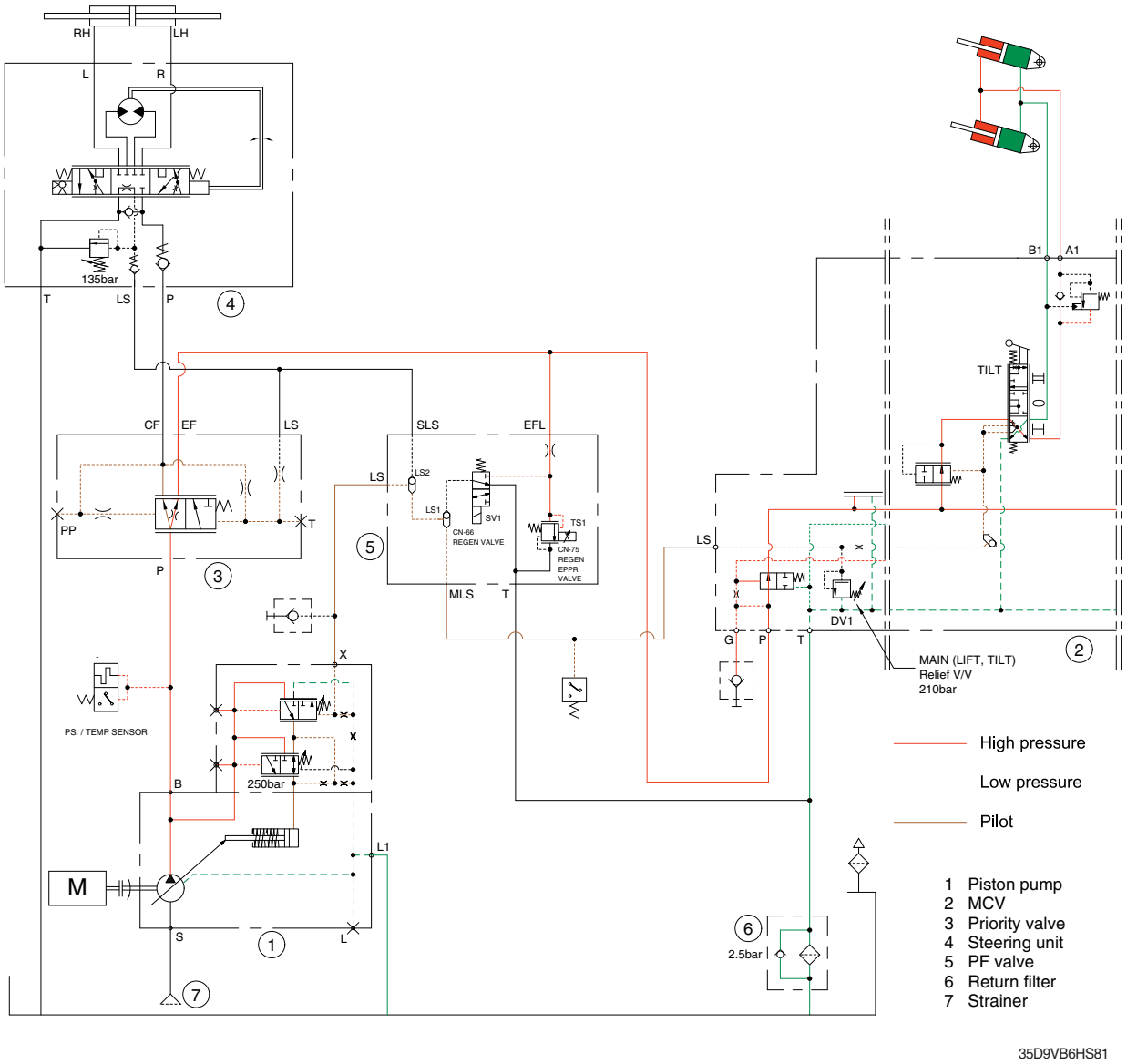
When the tilt control lever is pushed forward, the spool in the second block is moved to tilt forward position.

The oil from the piston pump (1) flows into main control valve (2) through the priority valve (3). Then goes to the large chamber of tilt cylinder by pushing the load check valve of the spool and lift 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.

4) WHEN THE TILT CONTROL LEVER IS IN THE BACKWARD POSITION



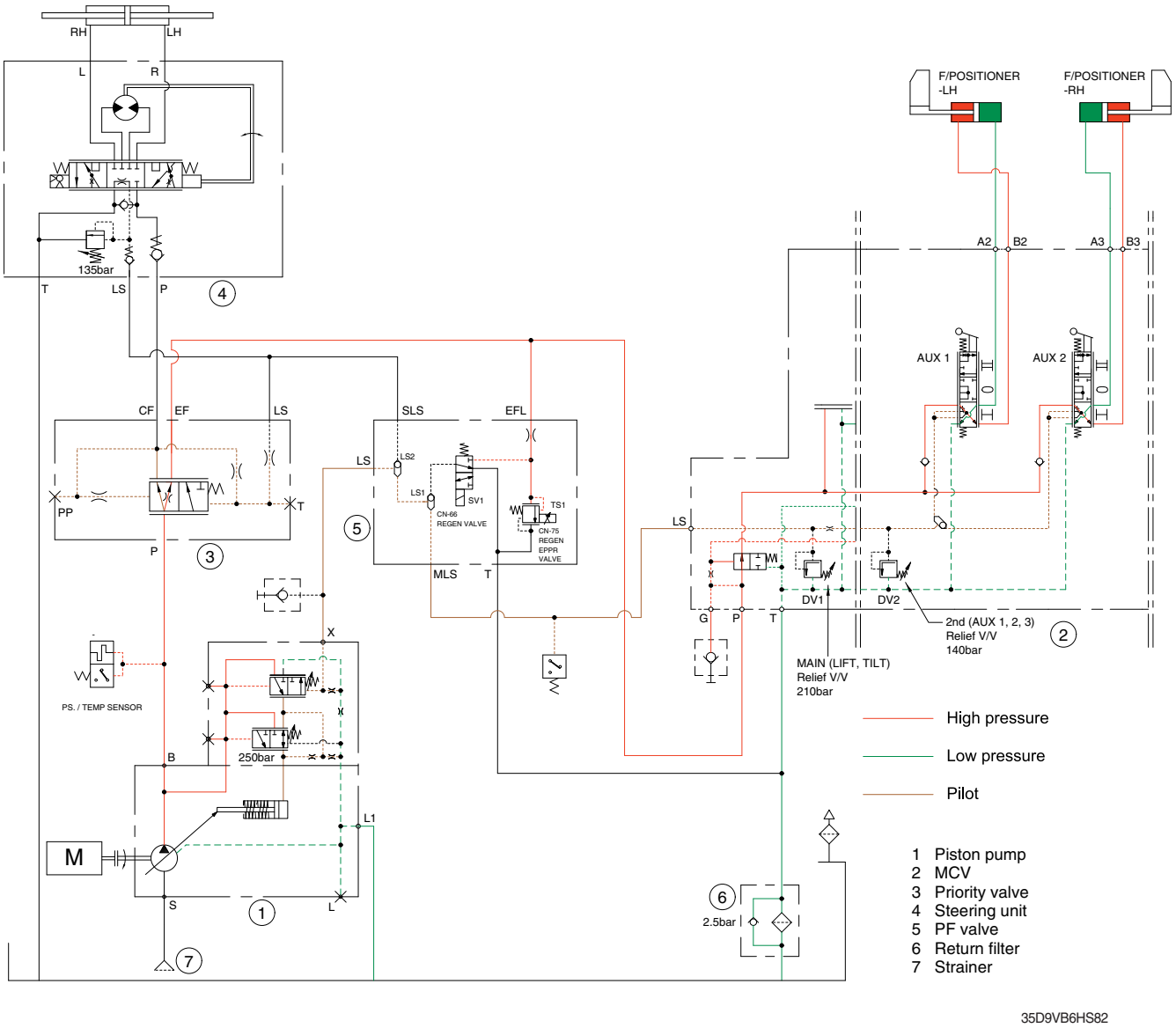
When the tilt control lever is pulled back, the spool in the second block is moved to tilt backward position.

The oil from the piston pump (1) flows into main control valve (2) through the priority valve (3). Then goes to the small chamber of tilt cylinder by pushing the load check valve of the spool and lift 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.

5) WHEN THE FORK POSITIONER LEVER IS IN THE SPREAD-OUT POSITION (OPTION)



35D9VB6HS82

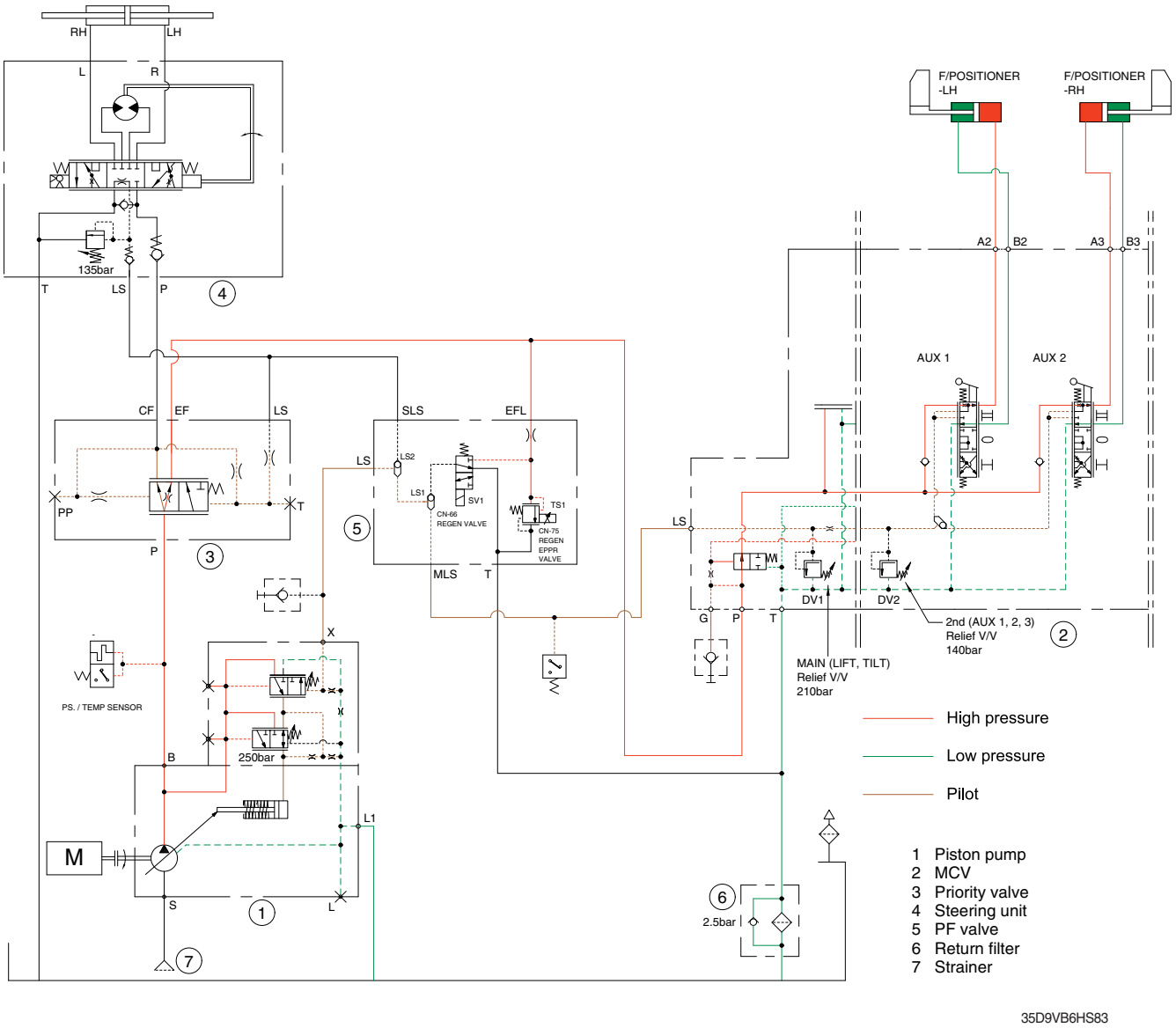
When the fork positioner lever is pulled backward, the spool in the third, fourth block is moved to fork positioner spread out position.

The oil from the piston pump (1) flows into main control valve (2) through the priority valve (3). Then goes to the large chamber of fork positioner cylinder by pushing the load check valve of the spool and lift lock valve.

The oil at the small chamber of fork positioner cylinder returns to hydraulic oil tank through the hydraulic oil cooler and return filter at the same time.

When this happens, the forks are spread out.

6) WHEN THE FORK POSITIONER LEVER IS IN THE CLOSE POSITION (OPTION)



35D9VB6HS83

When the fork positioner lever is pushed forward, the spool in the third, fourth block is moved to fork positioner spread out position.

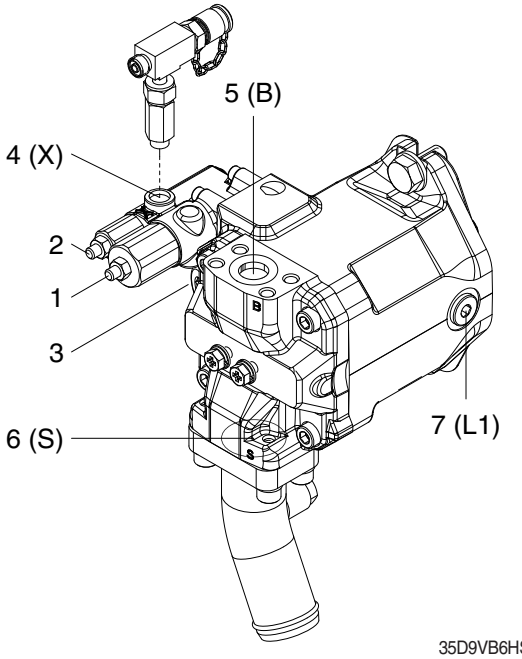
The oil from the piston pump (1) flows into main control valve (2) through the priority valve (3). Then goes to the small chamber of fork positioner cylinder by pushing the load check valve of the spool and lift lock valve.

The oil at the large chamber of fork positioner cylinder returns to hydraulic oil tank through the hydraulic oil cooler and return filter at the same time.

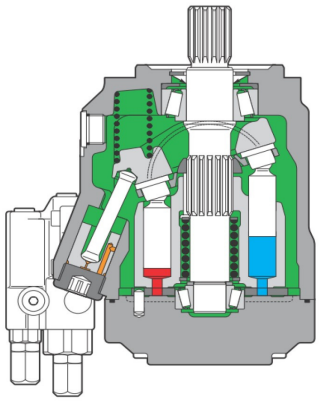
When this happens, the forks are close.

4. MAIN PUMP

1) STRUCTURE



35D9VB6HS01



Pump cross section

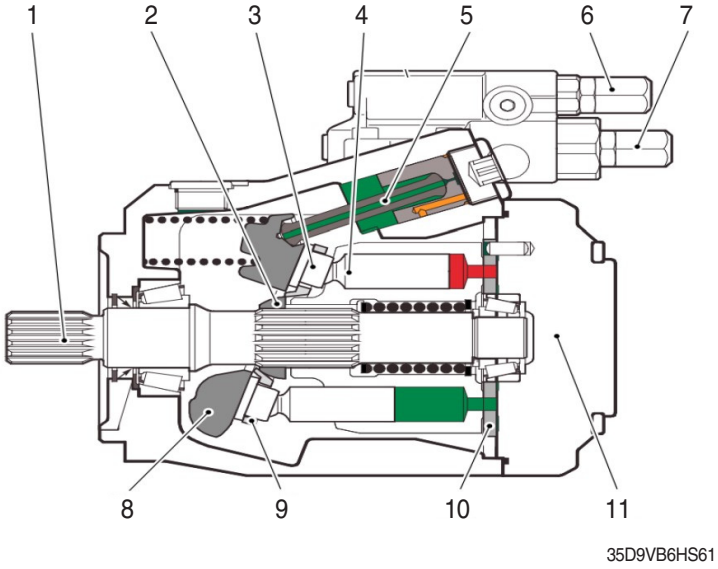
35D9VB6HS58

Port	Port size	Tightening torque	
		kgf·m	lbf·ft
B	3/4"	3.5	25.3
L1	7/8-14 UNF	7.3	53.1
S	1-1/4"	5	36.2
X	7/16-20 UNF	1.5	11.1

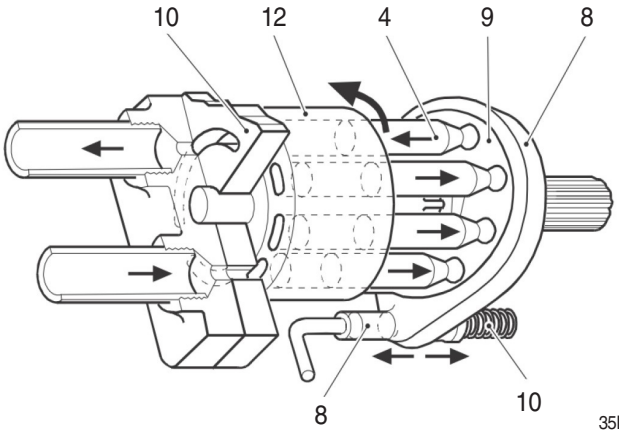
1 Flow compensator
2 Pressure compensator
3 Pump regualtor valve
4 Load Sense (LS) port X
5 Pressure port B
6 Suction port S
7 Drain port L1

2) OPERATION

(1) General



35D9VB6HS61



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 palte (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 (7) limits max. pressure and min. pressure (stand-by pressure).

The pressure regulator (7) limits max. pressure and min. pressure (stand-by pressure).

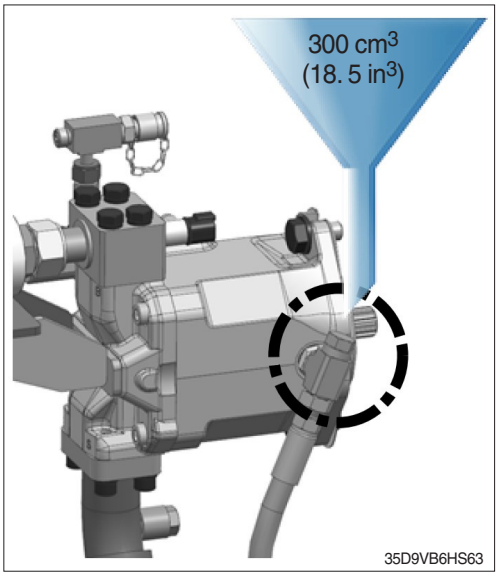
When the shaft turns, the cylinder rotor (12) will rotate. The angle of the regulating plate (9) results in the pistons being pulled in and out of the cylinder rotor by the sliders. The pistons' (4) stroke is changed by changing the angle of the yoke.

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).

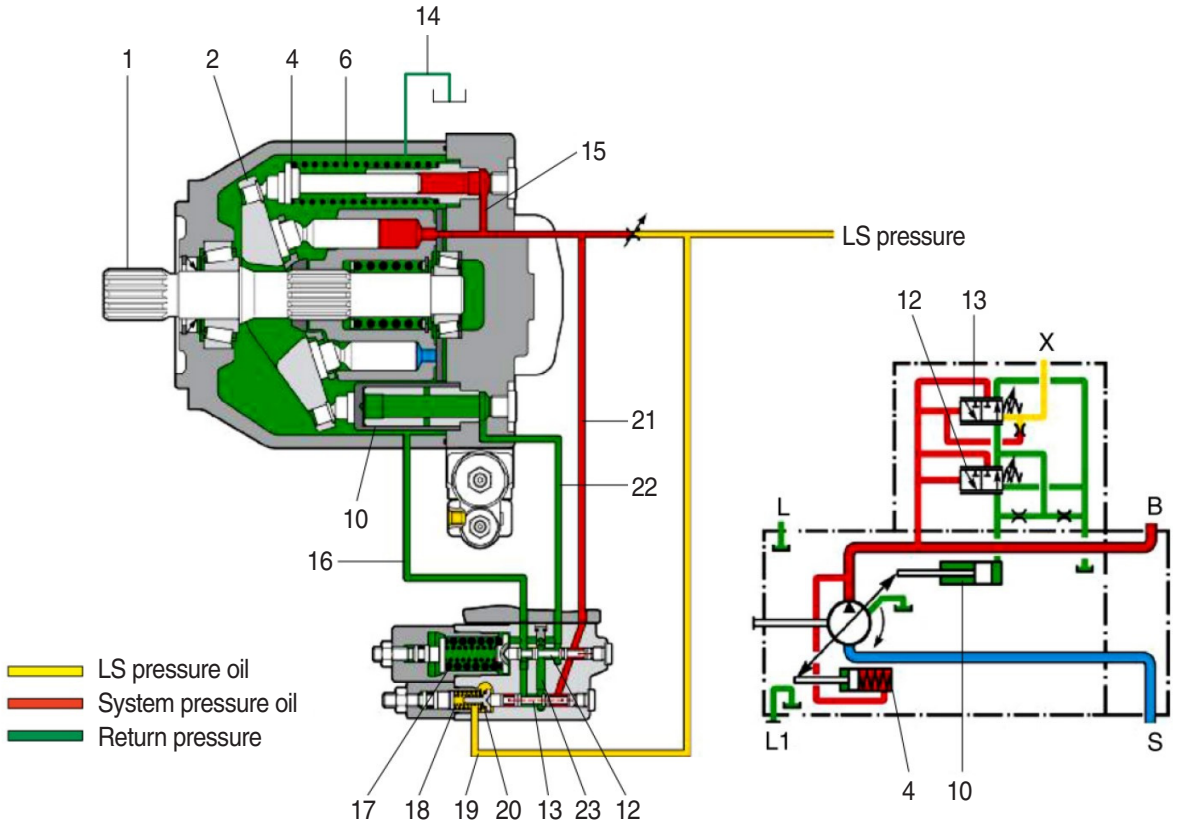
When the pistons are pressed in, the oil is forced out at the bottom, through the valve plate (10). A small amount of oil is forced through the piston head and lubricates the slider and yoke. The yoke does not rotate, which means that the pistons always suck and respectively force oil in a certain part 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.**



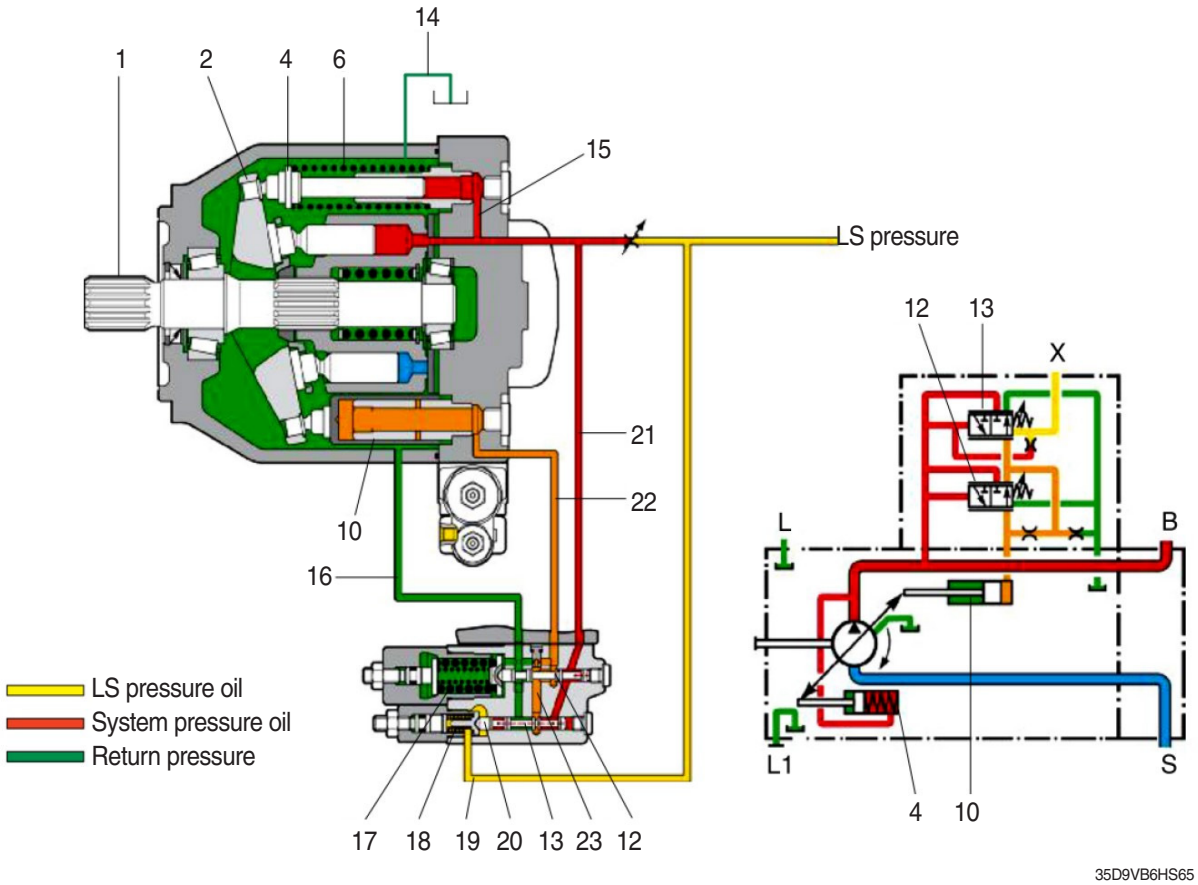
(2) Upstroking



1	Drive shaft	13	Flow compensator spool	19	LS line from pump
2	Swash plate	14	Case drain	20	Cavity
3	Counter piston	15	Passage	21	Passage
6	Counter spring	16	Passage	22	Passage
10	Control piston	17	Spring	23	Cavity
12	Pressure compensator spool	18	Spring		

Upstroking of the pump occurs as flow demand from attachment (MCV) and steering system. The increased flow demand causes a LS pressure in LS line (19). The LS pressure in LS line (19) combines with the force of spring (18) in cavity (20). The force of spring (18) causes pump pressure to be higher than the LS pressure (19). If the combination of LS pressure and of spring force is greater than the pump discharge pressure, this difference pressure causes spool (13) to move right. As spool (13) moves right, the spool (13) blocks the flow of supply oil to control piston (10). Pump swash plate (2) is controlled by pressure and flow as much as hydraulic system requests. When the oil flow to control piston (10) is blocked, the pilot oil in passage (22) drains to passage (23). The oil then flows past pressure compensator spool (12) and through passage (16) into the housing and via the drain line (14) to tank. Supply oil flows through passage (15) to counter piston (4). The oil acts against counter piston (4). The oil combines with the force of counter spring (6). This causes swash plate (2) to upstroke. This also causes the pump flow to increase. As flow requirements are satisfied, the pump output pressure increase. The pressure increases until the pressure in passage (15) moves flow compensator spool (13) up to be satisfied with system requirement for pressure and flow.

(3) Destroking

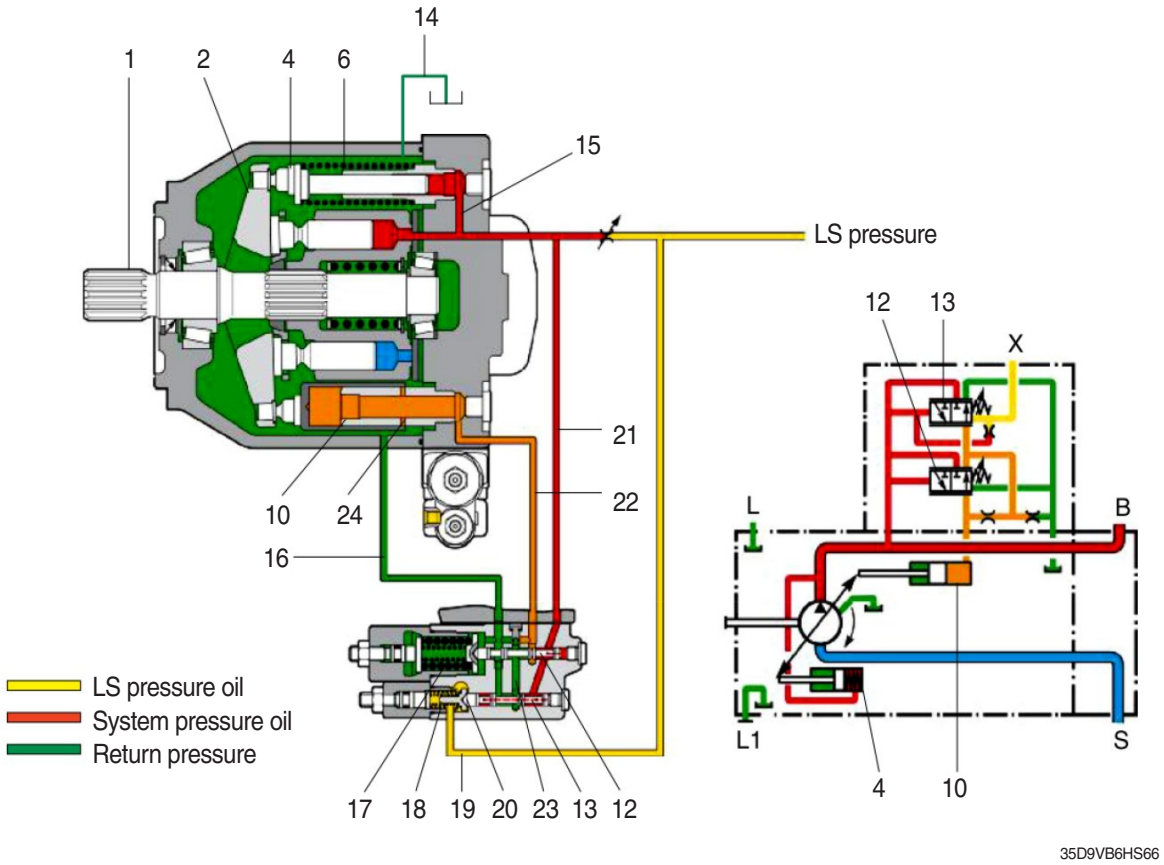


1	Drive shaft	13	Flow compensator spool	19	LS line from pump
2	Swash plate	14	Case drain	20	Cavity
3	Counter piston	15	Passage	21	Passage
6	Counter spring	16	Passage	22	Passage
10	Control piston	17	Spring	23	Cavity
12	Pressure compensator spool	18	Spring		

The decreased flow demand causes a LS pressure in line (19). The LS pressure in line (19) combines with the force of spring (18) in cavity (20). This combination of LS pressure and of spring force is less than the pump pressure in passage (21). This causes flow compensator spool (13) to move left. Pump oil now flows through passage (15). The oil then flows past flow compensator spool (13), through passage (22), and then to control piston (10). The pump pressure behind control piston (10) is now greater than the combined force of counter piston(4) and of counter spring (6). The angle of swash plate (2) decreases. This decreases the pump output and the system pressure. When the lower flow requirements are met, flow compensator spool (13) moves right up to the balanced position. Swash plate (2) maintains an angle that is sufficient to provide the lower required pressure. If the operator does not turn the steering wheel and does not move MCV, then the pump will return to low pressure standby.

· Control piston → Changes pump displacement; influenced by controller.
· Counter piston → Helps to change pump displacement but no possible to control this piston.

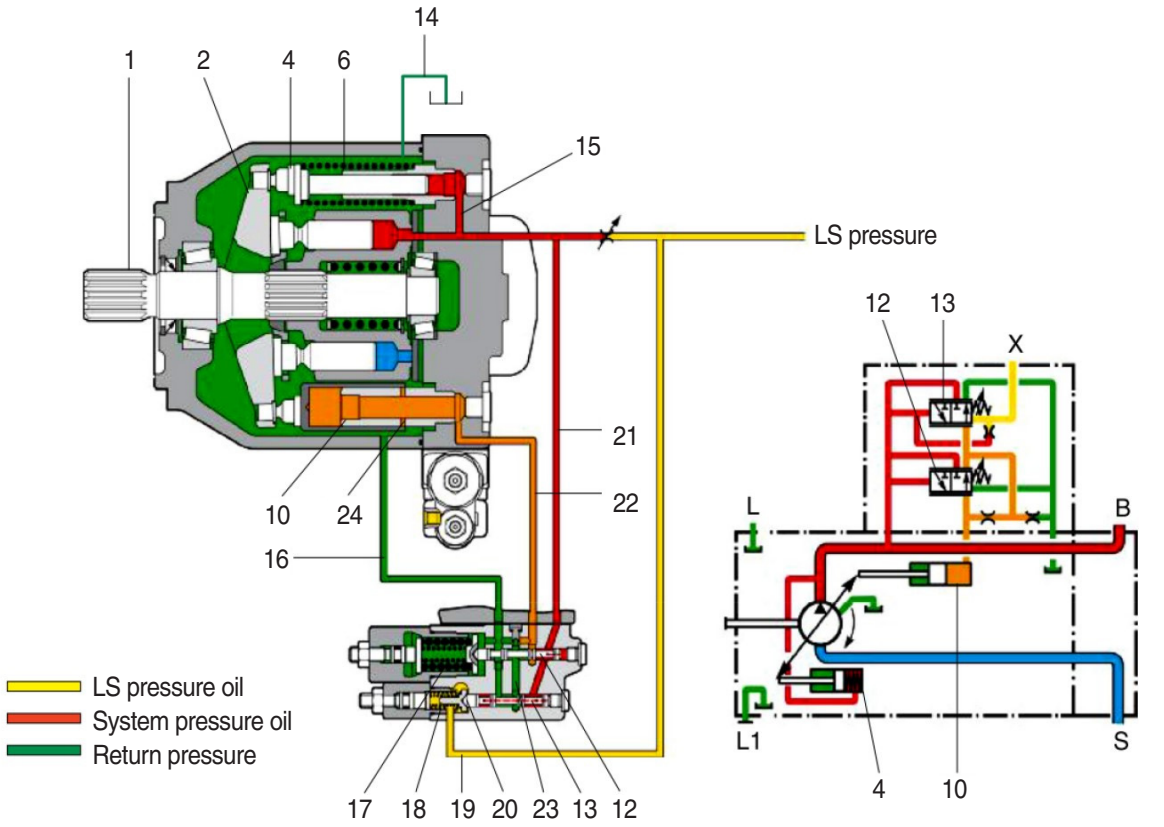
(4) Low pressure standby



1	Drive shaft	13	Flow compensator spool	19	LS line from pump
2	Swash plate	14	Case drain	20	Cavity
3	Counter piston	15	Passage	21	Passage
6	Counter spring	16	Passage	22	Passage
10	Control piston	17	Spring	23	Cavity
12	Pressure compensator spool	18	Spring		

Low pressure standby constitutes the following condition a running engine and inactive steering and attachment. There are no flow demands on the pump or pressure demands on the pump. Therefore, there is no LS pressure in line (19). Before you start the engine, counter spring (6) holds swash plate (2) at the maximum angle. As the pump begins to turn, oil begins to flow and pressure increases in the system. because of close centered steering unit and close centered hydraulic system. As this pressure increase, the pressure pushes flow compensator spool(13) against spring(18). This causes flow compensator spool (13) to move left. This opens passage (23) in order to allow pressure oil to flow to control piston (10). The oil acts against control piston (10) in order to overcome the force of counter spring (6). The oil causes control piston (10) to move to the left. When control piston (10) moves to the left, the piston moves swash plate (2) toward the minimum angle. Control piston (10) continues to move to the left until cross-drilled hole (24) allows the oil to drain to the case. Cross-drilled hole (24) limits the maximum travel of control piston (10) to the left. The pump supplies a sufficient amount of flow that compensates for system leakage. The pump also supplies a sufficient of flow that compensates for leakage to the pump case. The leakage to the pump case is a result of the cross-drilled hole. The pump maintains low pressure stand-by.Low pressure stand-by pressure should not exceed 30 bar (435 psi). Low pressure standby will vary in the same pump as the system leakage or the pump leakage increases. The pump will upstroke slightly in order to compensate for the increasing leakage. Control piston (10) will cover more of the cross-drilled hole.

(5) High pressure standby



1	Drive shaft	13	Flow compensator spool	19	LS line from pump
2	Swash plate	14	Case drain	20	Cavity
3	Counter piston	15	Passage	21	Passage
6	Counter spring	16	Passage	22	Passage
10	Control piston	17	Spring	23	Cavity
12	Pressure compensator spool	18	Spring		

When the hydraulic system stalls under load or when the cylinders reach the end of the stroke, the main system pressure increases. But LS pressure (19) is regulated by LS relief valve on steering system and MCV system. The pressure difference between discharged pump and LS pressure equal to spring (18). It means no flow is necessary. Therefore, discharged pressure push flow compensator spool (13) left. Supply oil now flows past flow compensator spool (13) and through passage (23). The oil flows past flow compensator spool (13) and into passage (22). The oil then flows to control piston (10). Pump swash plate (2) will be minimum displacement if the operator does not turn the steering wheel and MCV, then the pump will return to low pressure standby.

3) CHECKS AND ADJUSTMENTS

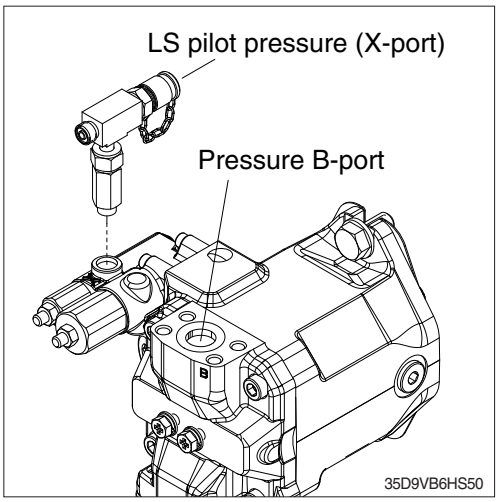
(1) Margin pressure check

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".

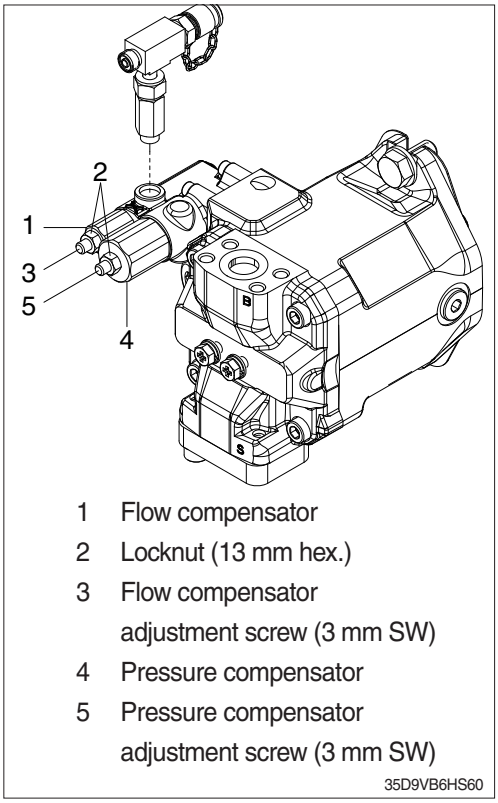
Gague B- X	bar	psi
	22 ± 1	320 ± 14.5



(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 2.2 kgf·m (15.9 lbf·ft).



(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 ± 3	3625 ± 43

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.

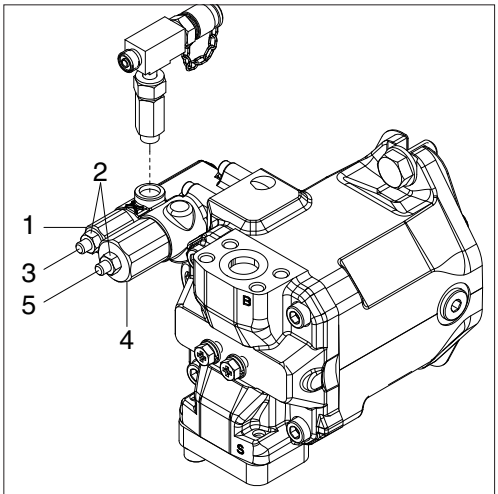
c. Put the pressure compensator adjustment screw back to its original position by turning the adjustment screw counter clockwise by the number of turns noted earlier.

d. Tighten locknut on pressure compensator adjustment screw to 2.2 kgf·m (15.9 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 2.2 kgf·m (15.9 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)

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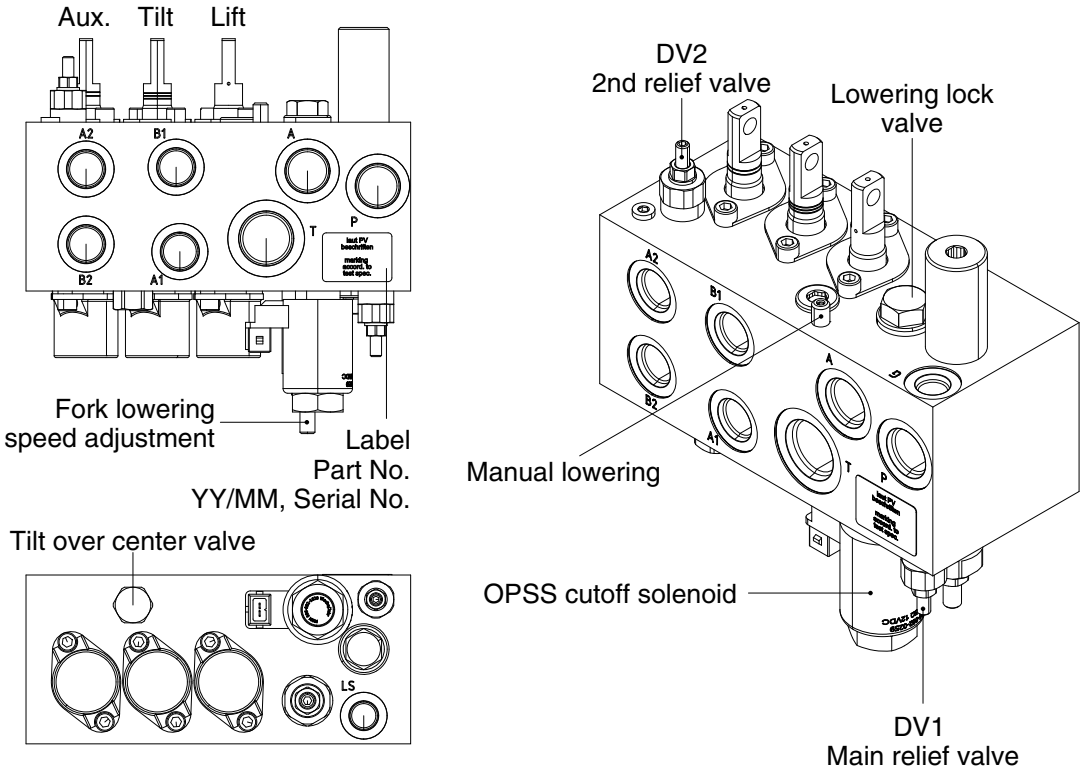
5. MAIN CONTROL VALVE

1) STRUCTURE

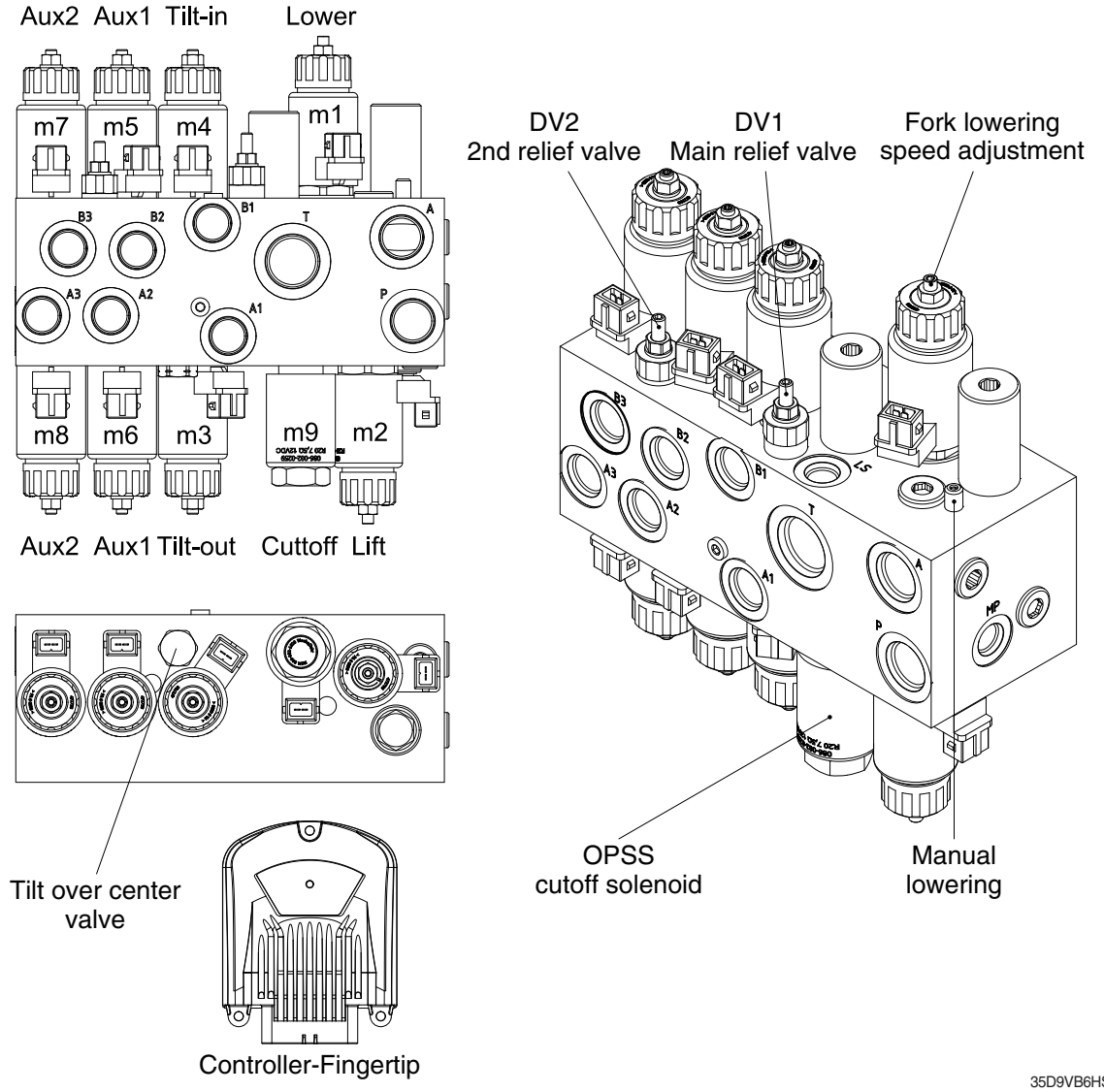
(1) 3 spool



35D9VB6HS53

Port	Port name	Port size	Tightening torque	
			kgf·m	lbf·ft
A	Lift / Lower	1-1/16-12 UN	12	86.8
A1, B1	Tilt rod / head	3/4-16 UNF	5	36.2
A-, B-	Aux 1, Aux 2, Aux 3	3/4-16 UNF	5	36.2
P	Inlet	7/8-14 UNF	7	50.6
T	Outlet	1 1/16-12 UN	12	86.8
G, LS	Gauge, Pilot	9/16-18UNF	4	28.9

(2) Fingertip MCV (option)



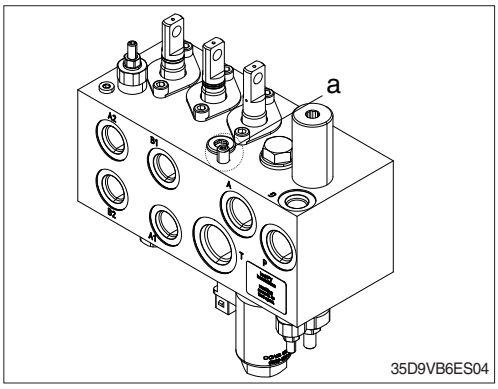
35D9VB6HS54

Port	Port name	Port size	Tightening torque	
			kgf·m	lbf·ft
A	Lift / Lower	1-1/16-12 UN	12	86.8
A1, B1	Tilt rod / head	3/4-16 UNF	5	36.2
A-, B-	Aux 1, Aux 2	3/4-16 UNF	5	36.2
P	Inlet	7/8-14 UNF	7	50.6
T	Outlet	1 1/16-12 UN	12	86.8
G, LS	Gauge, Pilot	9/16-18UNF	4	28.9

2) FUNCTION

(1) Emergency fork lowering

In case that the mast can't be lowered due to a problem in the controller, activate the emergency lowering valve on the MCV assy by rotating the valve (a).



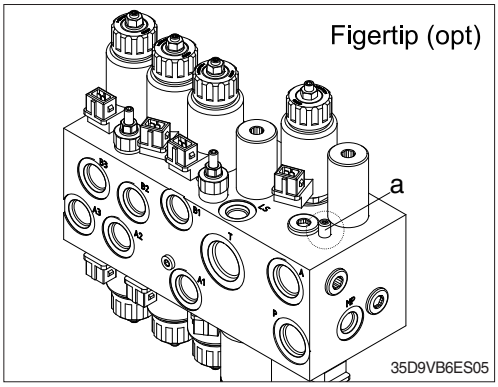
⚠ Manual override features are intended for emergency use, not for continuous-duty operation.

① Open the bonnet.

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

※ **Do not exceed a tightening torque of maximum 0.25 kgf·m (1.81 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 MCV 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 MCV.

(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 ℉)
- 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.)

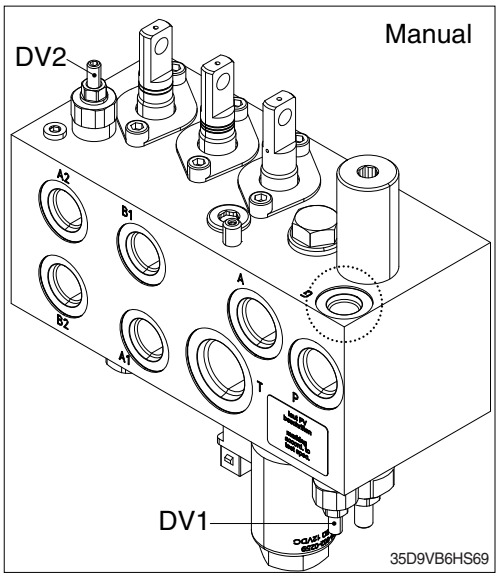
⚠ **Hot hydraulic oil can cause serious burns to skin. Do not touch hydraulic components or oil during test. Make sure hydraulic oil has cooled to safe temperature before installing or removing test equipment.**

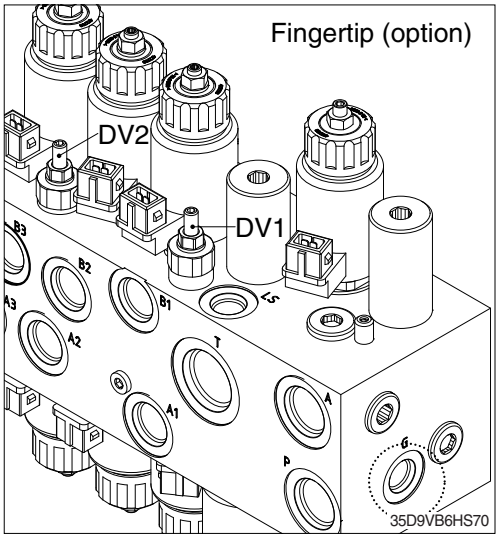
⚠ **Hydraulic oil under pressure can be injected into skin. Lower forks to ground and relieve all circuit pressure before removing test plugs from valve.**

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 Open the bonnet.
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.

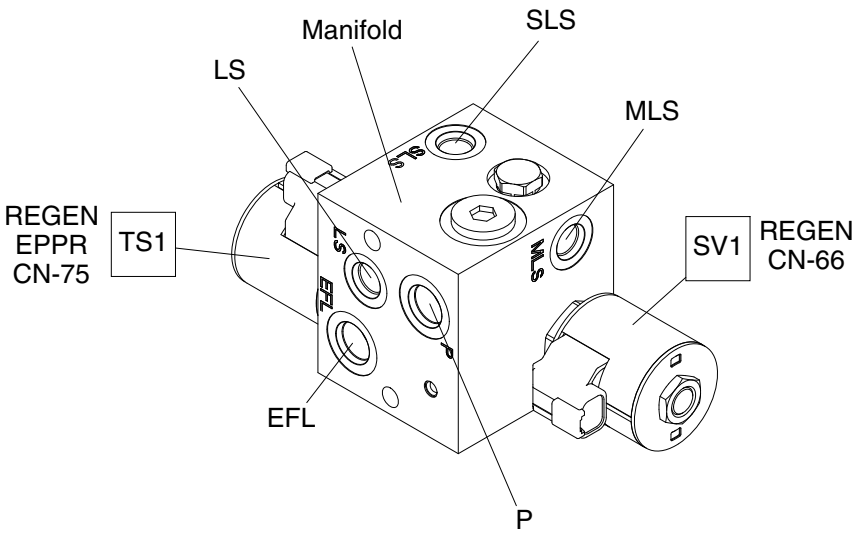
⚠ **The MCV relief valve adjustment screw is very sensitive. Operate in 1/4 turn increments to avoid system overpressure.**

⑨ Repeat step ⑦, ⑧. If pressure is to specifications, remove test equipment.





6. PRESSURE FORCED VALVE



35D9VB6HS86

Port	Port size	Component	Related issues	Remarks
LS	G 1/4	Pump 'X'	Pump, Load sensing	-
EFL	G 3/8	Hyd oil tank 'TT'	Back pressure	-
P	G 3/8	Priority valve 'EF'	Load sensing	-
SLS	G 1/4	MCV LS or ECV LS	Load sensing	-
MLS	G 1/4	*HO P sensor #2	Working device operation	MCV or ECV
	-	*HO T/P sensor #1	Working device operation	PUMP, CD-71
SV1	-	Regen valve; ON/OFF	Working device operation	CN-66
TS1	-	Regen valve; EPPR	Noise/Vibration, DPF state	CN-75

* HO T/P SENSOR : Hydraulic oil, Temperature & Pressure sensor

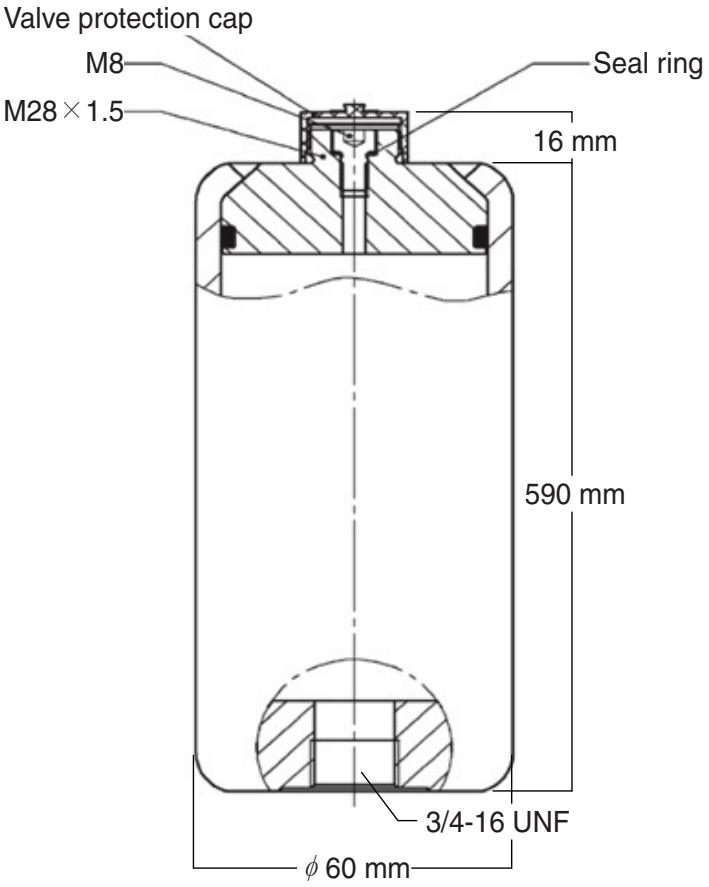
It is a DPF Aiding hydraulic system that helps the engine aftertreatment system. It is possible to work with the working device during automatic regeneration. However, there is a difference between the working device and the running operation when the automatic reproduction rice production is simultaneous, and the forced reproduction (stopping reproduction) is required when the automatic reproduction is not completed.

This valve follows the RMCU control method according to the DPF Aiding Level condition. Noise is generated because pressure is created to remove DPF during the control process.

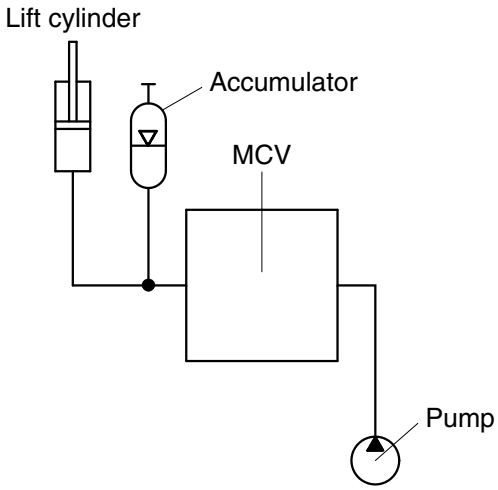
The control method includes operating temperature conditions for preventing an abnormal rise in oil temperature.

7. MAST ACCUMULATOR

1) STRUCTURE



35D9VB6HS52



35D9VB6HS59

Parts No.	Normal volume	Pre-charging pressure at 20 ℃ (68 ℉)	Gas	Weight
31HK-70060	1 ℓ (0.26 U.S. gal)	10 bar (145 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 ℉), 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 ℉), 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 (counter-clockwise) and blow out nitrogen gas until the set pressure is confirmed. Pressure is measured at room temperature around 20 ℃ (68 ℉).

⑤ When the set pressure is reached, close the release valve (clockwise) and close the accumulator valve with the spindle.

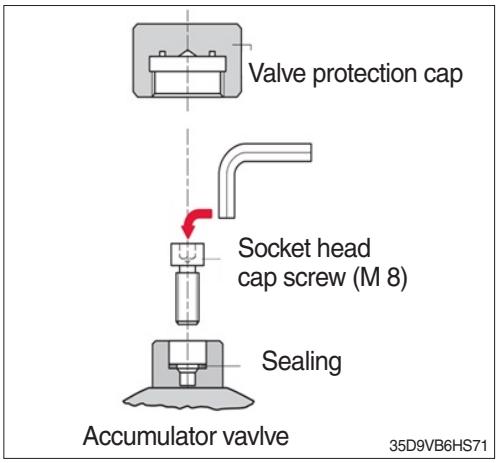
⑥ Wait 5-10 minutes for the filled nitrogen gas pressure to stabilize, then recheck the set pressure and adjust if necessary.

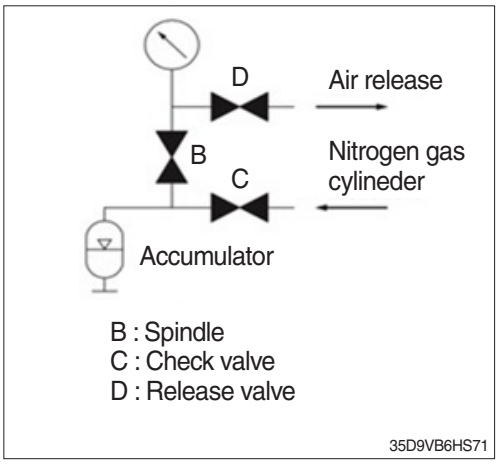
⑦ Open the release valve and blow out gas in the FPU.

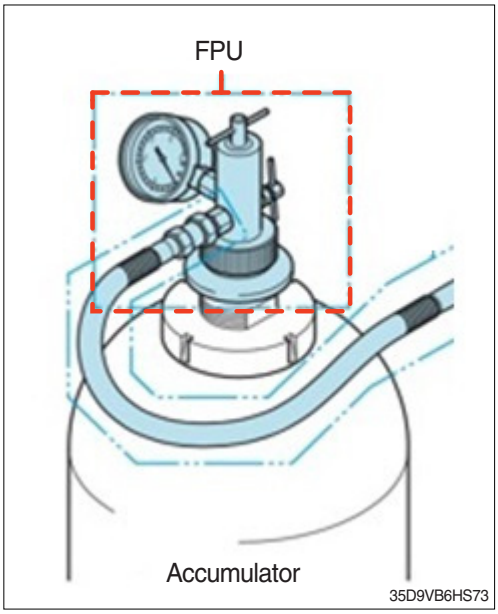
※ **If there is gas in the charging hose and FPU, it cannot be separated, and it is very dangerous if it is forcibly separated. Be sure to separate the charging hose and after blowing out the gas inside the FPU.**

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)**

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. (counterclockwise)

⑤ Slowly open the valve of the nitrogen gas cylinder and check the pressure of the gas injected into the accumulator.

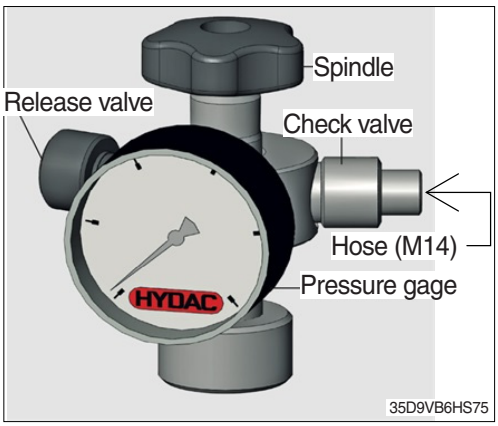
⑥ When filling is complete, close the gas valve of the accumulator using the valve of the nitrogen gas cylinder and the spindle of the FPU.

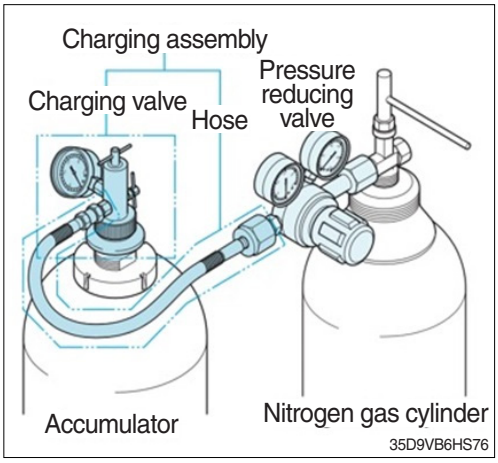
※ **When adding nitrogen to the accumulator filled with nitrogen gas, wait 5-10 minutes for the temperature and pressure of the gas mixture to stabilize, then check the pressure again and adjust if necessary.**

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.



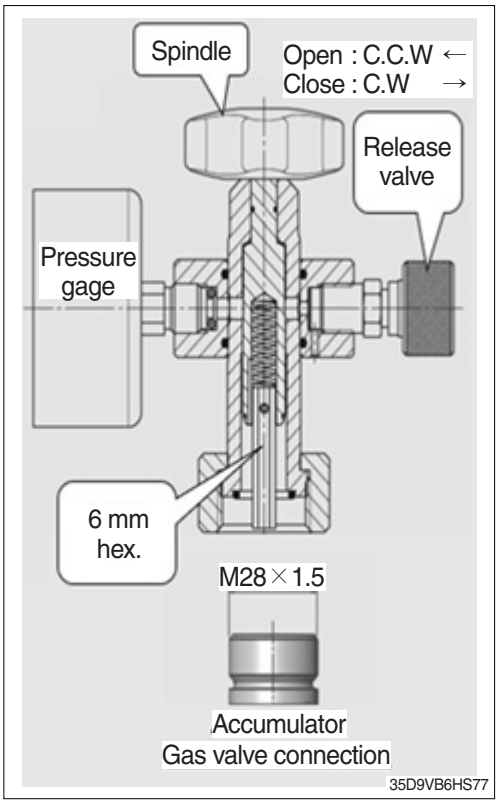


⑩ Open the release valve and blow out nitrogen gas in the FPU.

※ **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.**

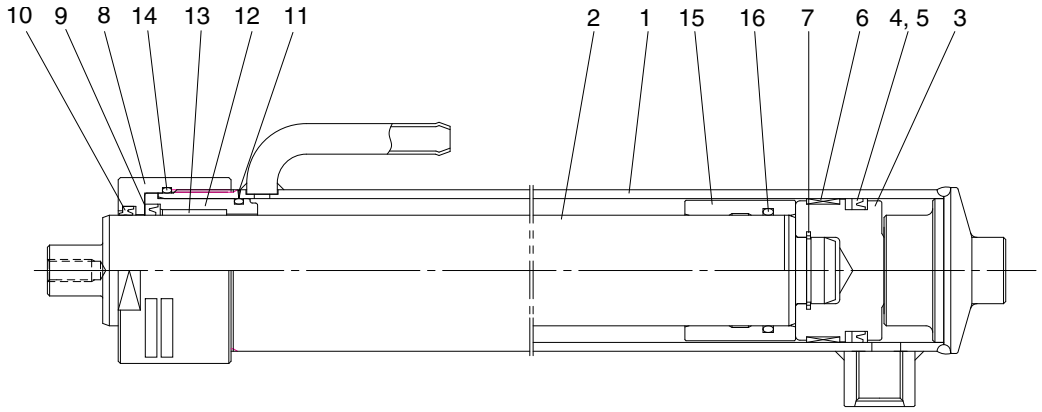
⑪ Remove the FPU from the accumulator.

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.



8. LIFT CYLINDER

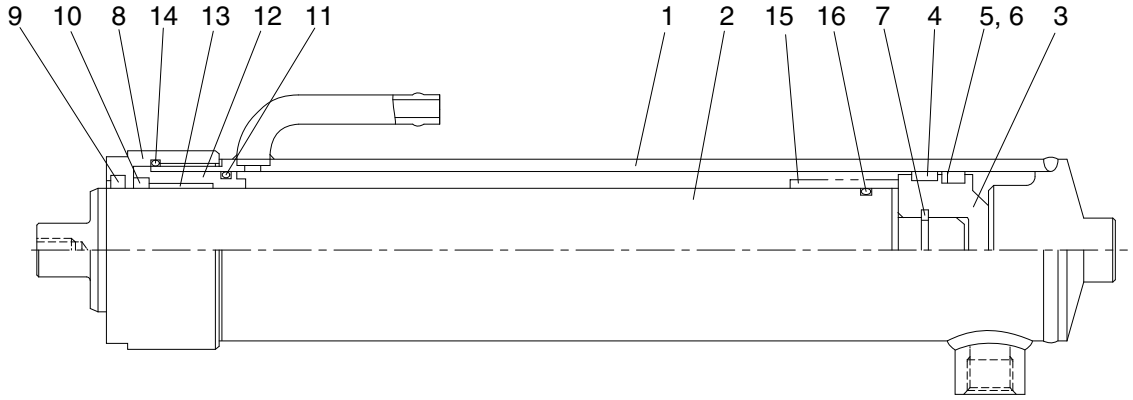
1) V MAST (35/40/45D-9VB, 40/45D-9VC, 50DN-9VC)



35D9FHS125

1	Tube assy	7	Retaining ring	13	Rod busing
2	Rod	8	Rod cover	14	O-ring
3	Piston	9	U-packing	15	Spacer
4	U-packing	10	Dust wiper	16	O-ring
5	Back up ring	11	O-ring		
6	Wear ring	12	Guide		

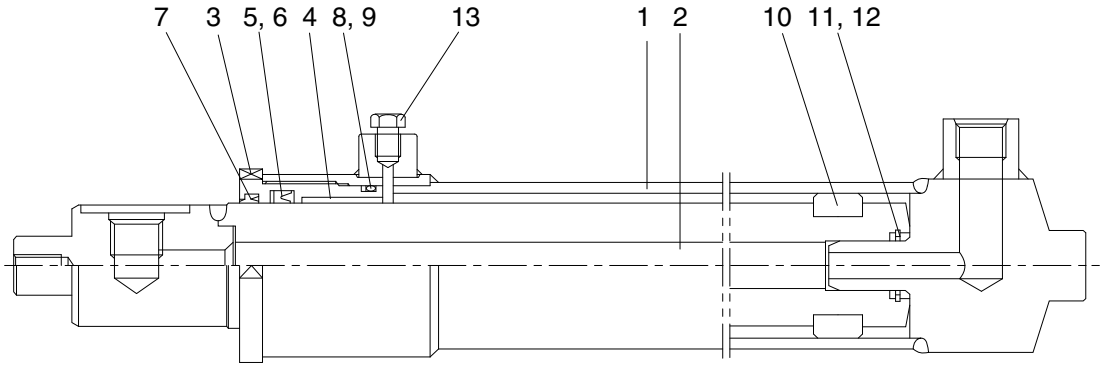
2) V MAST (50DN-9VB)



35D9FHS126

1	Tube assy	7	Stop ring	13	DU busing
2	Rod	8	Rod cover	14	O-ring
3	Piston	9	Dust wiper	15	Spacer
4	Wear ring	10	U-packing	16	O-ring
5	U-packing	11	O-ring		
6	Back up ring	12	Stopper		

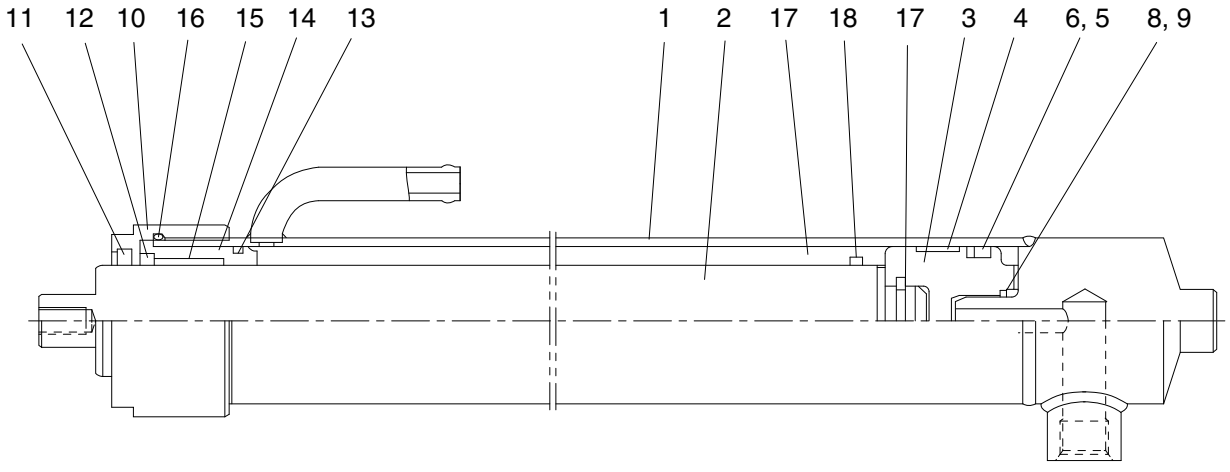
3) VF MAST



35D9FHS127

1	Tube assembly	6	Back up ring	11	Cushion seal
2	Rod assy	7	Dust wiper	12	Retaining ring
3	Rod cover	8	O-ring	13	Bleeder
4	Rod bushing	9	Back up ring		
5	U-packing	10	Piston ring		

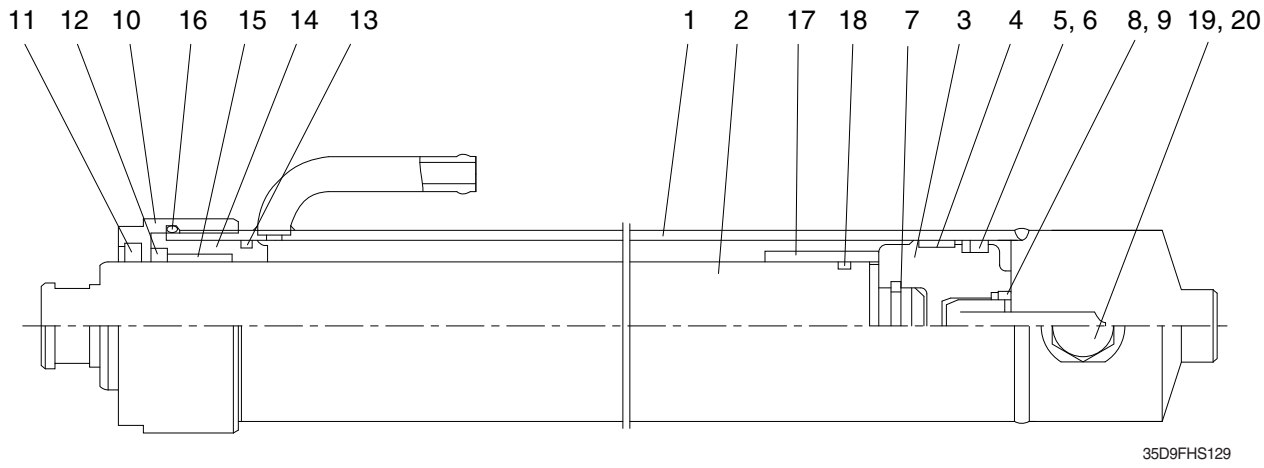
4) TF MAST (35/40/45D-9VB, 40/45D-9VC, 50DN-9VC)



35D9FHS128

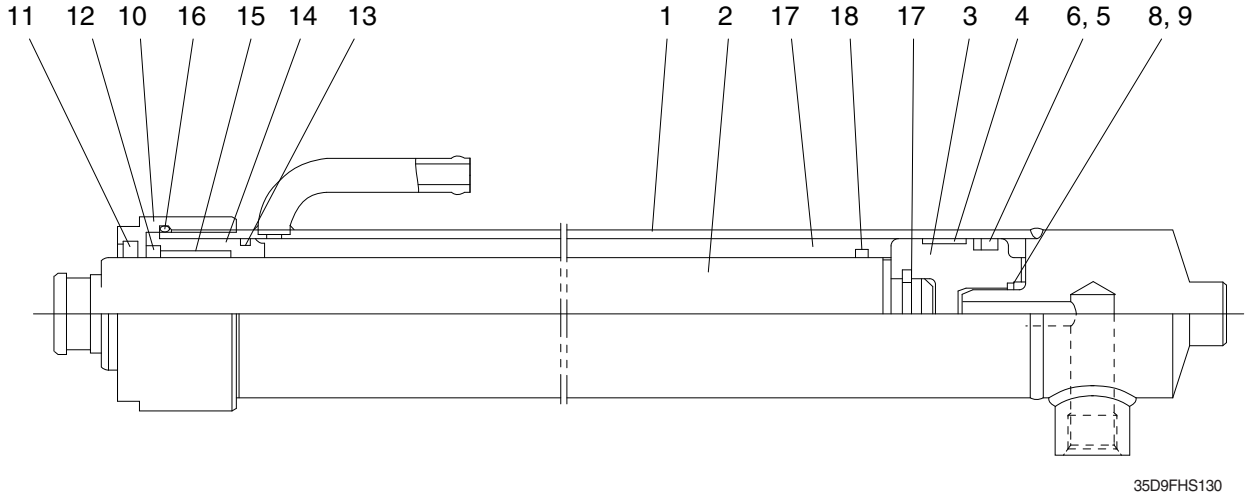
1	Tube assembly	7	Stop ring	13	O-ring
2	Rod	8	Cushion seal	14	Stopper
3	Piston	9	Retaining ring	15	Rod bushing
4	Wear ring	10	Rod cover	16	O-ring
5	U-packing	11	Dust wiper	17	Spacer
6	Back up ring	12	U-packing	18	O-ring

5) TF AND TS-MAST (50DN-9VB)



1	Tube assembly	8	Cushion seal	15	Rod bushing
2	Rod	9	Retaining ring	16	O-ring
3	Piston	10	Rod cover	17	Spacer
4	Wear ring	11	Dust wiper	18	O-ring
5	U-packing	12	U-packing	19	Plug
6	Back up ring	13	O-ring	20	O-ring
7	Stop ring	14	Stopper		

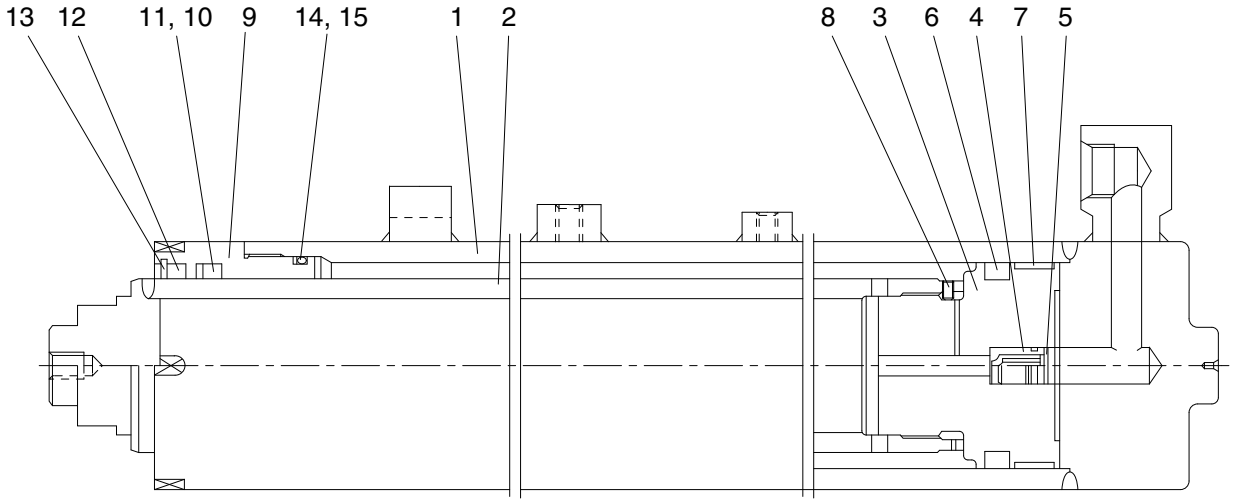
6) TS MAST (35/40/45D-9VB, 40/45D-9VC, 50DN-9VC)



1	Tube assembly	7	Stop ring	13	O-ring
2	Rod	8	Cushion seal	14	Stopper
3	Piston	9	Retaining ring	15	Rod bushing
4	Wear ring	10	Rod cover	16	O-ring
5	U-packing	11	Dust wiper	17	Spacer
6	Back up ring	12	U-packing	18	O-ring

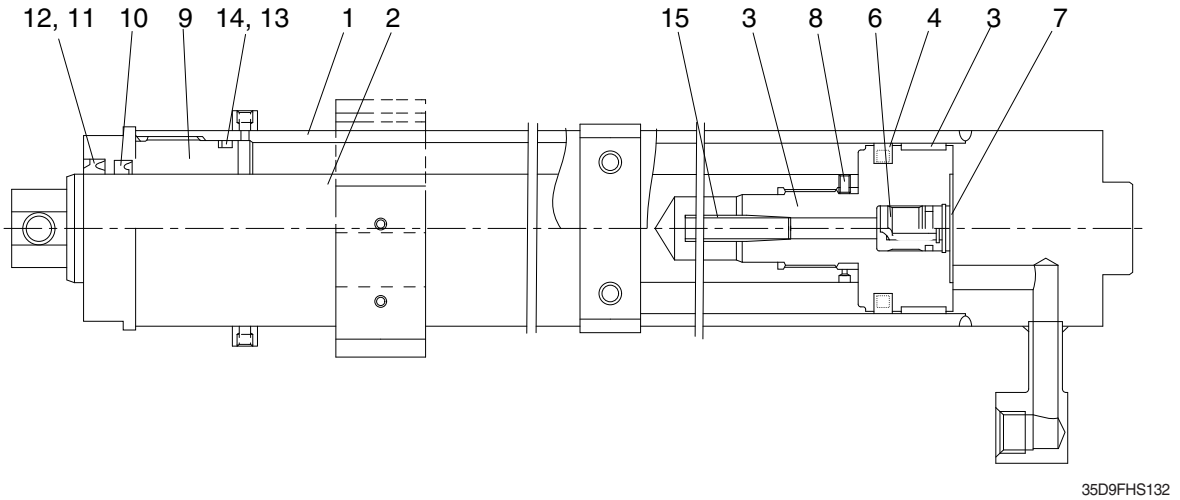
9. FREE LIFT CYLINDER

1) VF AND TF MAST (35/40/45D-9VB, 40/45D-9VC, 50DN-9VC)



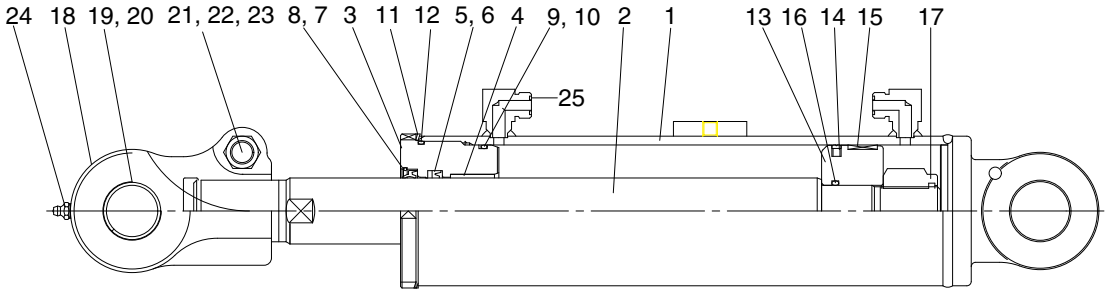
1	Tube assembly	6	Piston seal	11	Back up ring
2	Rod assembly	7	Wear ring	12	Dust wiper
3	Piston	8	Set screw	13	Retaining ring
4	Check valve	9	Rod cover	14	O-ring
5	Retaining ring	10	U-packing	15	Back up ring

2) TS MAST



1	Tube assembly	6	Check valve	11	Dust wiper
2	Rod	7	Retaining ring	12	Retaining ring
3	Piston	8	Set screw	13	O-ring
4	Piston seal	9	Rod cover	14	Back up ring
5	Wear ring	10	U-packing	15	Pipe

10. TILT CYLINDER



35D9FHS133

1	Tube assy	10	Back up ring	19	Spherical bearing
2	Rod	11	Lock washer	20	Retaining ring
3	Rod cover	12	O-ring	21	Hexagon bolt
4	Rod bushing	13	Piston	22	Hexagon nut
5	U-packing	14	Piston seal	23	Spring washer
6	Back up ring	15	Wear ring	24	Grease nipple
7	Dust wiper	16	O-ring	25	O-ring
8	Stop ring	17	Nylon nut		
9	O-ring	18	Rod eye		

GROUP 2 OPERATIONAL CHECKS AND TROUBLESHOOTING

1. OPERATIONAL CHECKS

1) CHECK ITEM

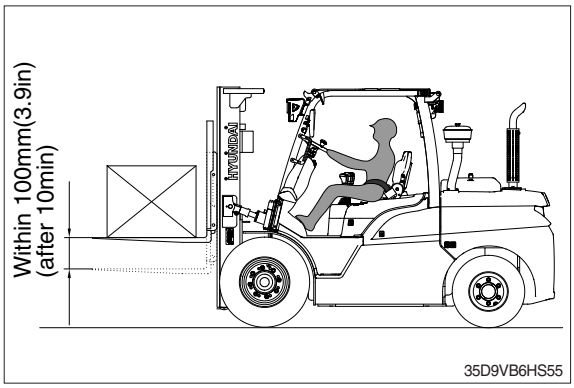
(1) Check visually for deformation, cracks or damage of rod.

(2) Load maximum load, set mast vertical and raise 1m from ground. Wait for 10 minutes and measure hydraulic drift (amount forks move down and amount mast tilts forward).

· **Hydraulic drift**

- Down (Downward movement of forks)
  : Within 100 mm (3.9 in)
- Forward (Extension of tilt cylinder)
  : Within 5 °

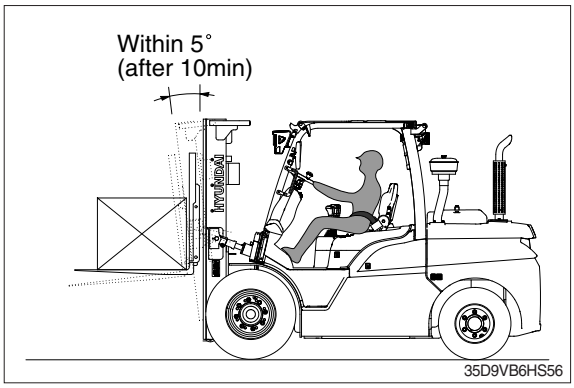
If the hydraulic drift is more than the specified value, replace the control valve or cylinder packing.



(3) Check that clearance between tilt cylinder bushing and mounting pin is within standard range.

mm (in)

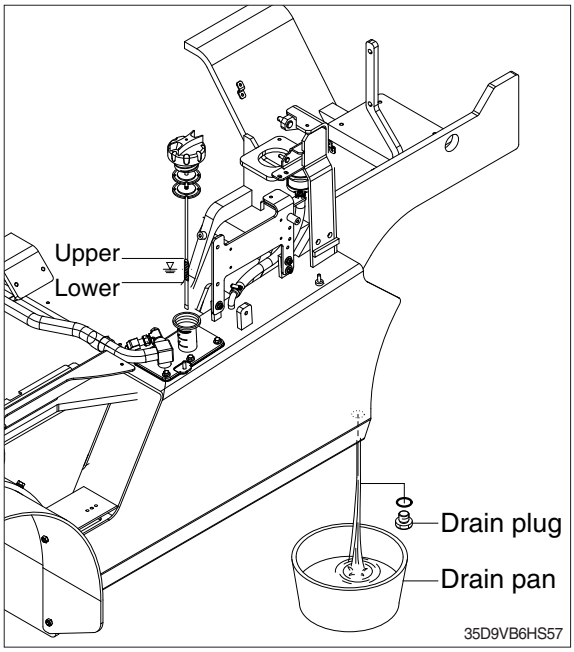
Standard	Under 0.6 (0.02)



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).



3) CONTROL VALVE

(1) Raise forks to maximum height and measure oil pressure.
Check that oil pressure is 210 bar.
(3050 psi)

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 CF 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 CF engine oil. · Clean filter.

Problem	Cause	Remedy
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.
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) LIFT CYLINDER

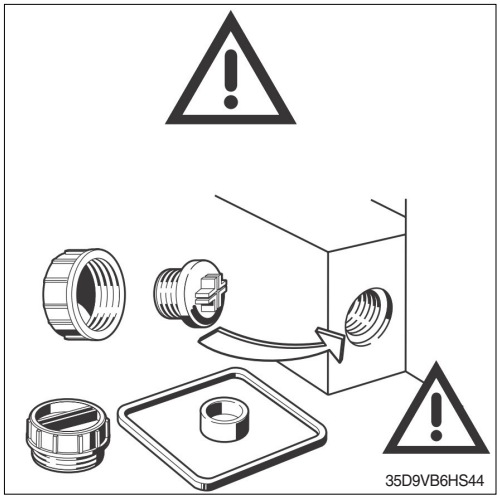
Problem	Cause	Remedy
Oil leaks out from rod cover through rod	· Foreign matters on packing. · Unallowable score on rod. · Unusual distortion of dust seal. · Chrome plating is striped.	· Replace packing. · Smooth rod surface with an oil stone. · Replace dust seal. · Replace rod.
Oil leaks out from cylinder 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.

1. MAIN PUMP

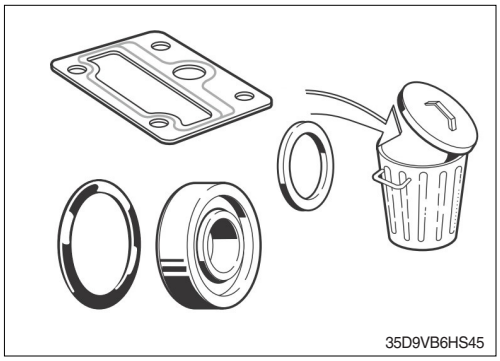
1) DISASSEMBLY AND ASSEMBLY

(1) General precautions

· Observe the following notes when repairing hydraulic components. Close all ports of the hydraulic component.

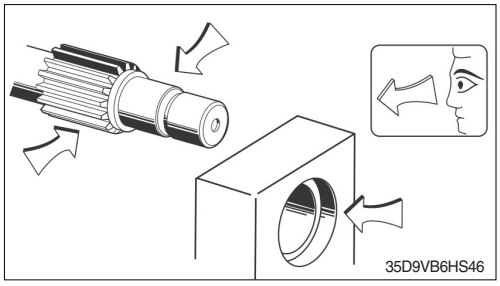


· Replace all seals. Use only original spare parts.

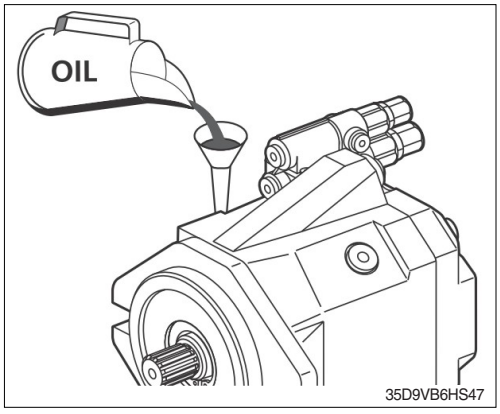


· Check all seal and sliding surfaces for wear.

△ **Rework of sealing area (ex. abrasive paper) can damage the surface.**

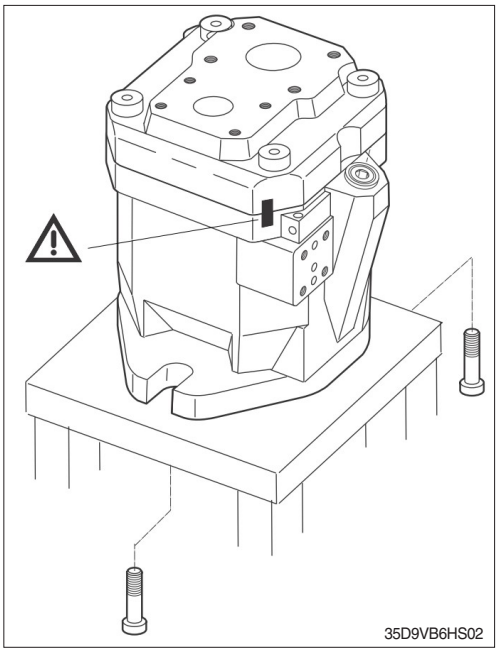


· Fill the hydraulic units with the recommended hydraulic fluid before commissioning.

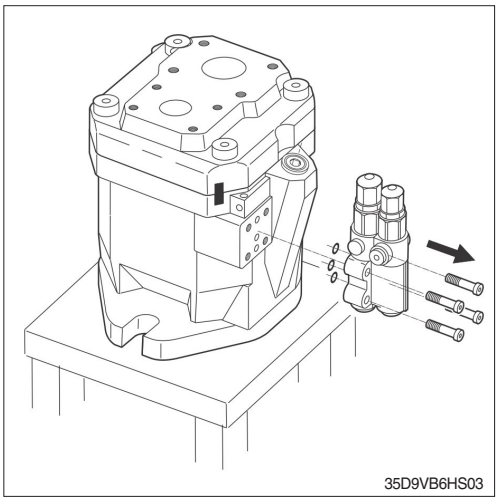


(2) Disassembly

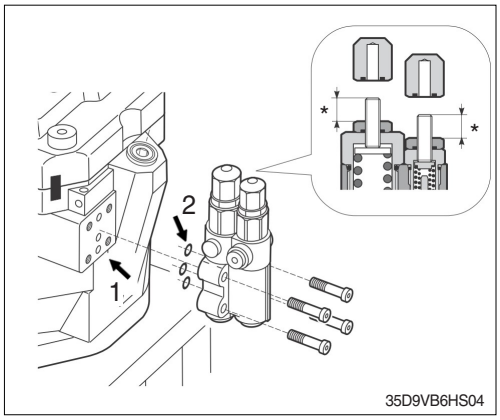
① Mark the location of the connection plate on the housing of pump.

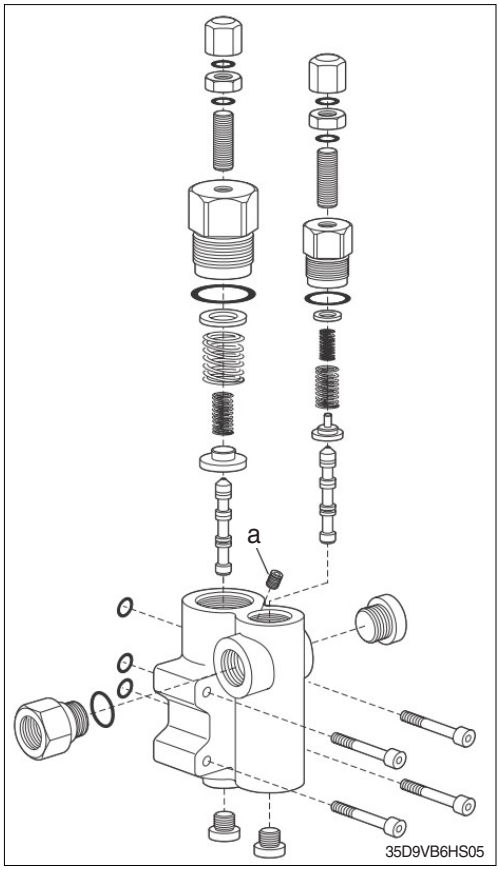


② Remove the control valve.

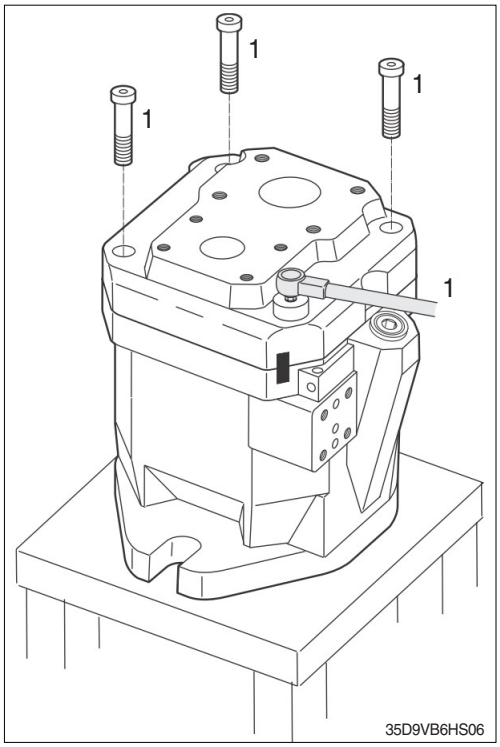


③ Remove the control valve, measure dimension (*) and note down. Check sealing surface (1). Check O-rings (2).
a : Orifice



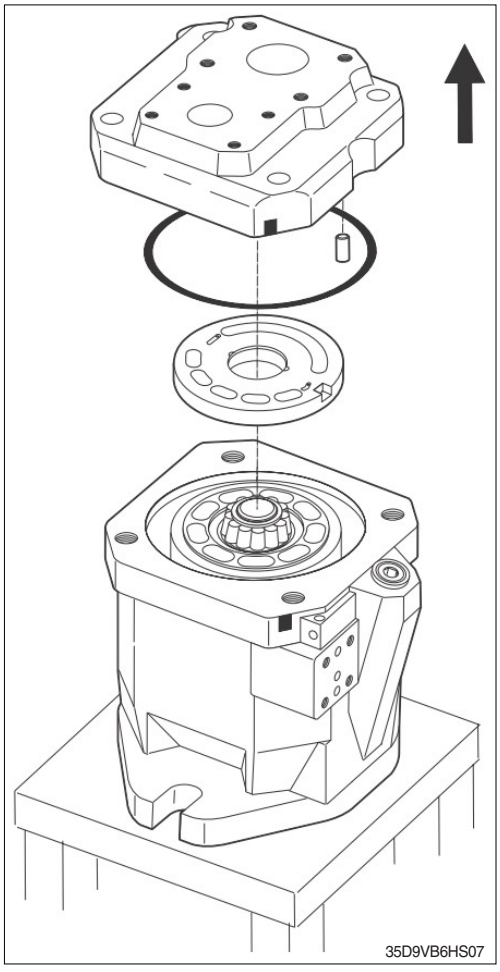


④ Remove the socket screws (1).



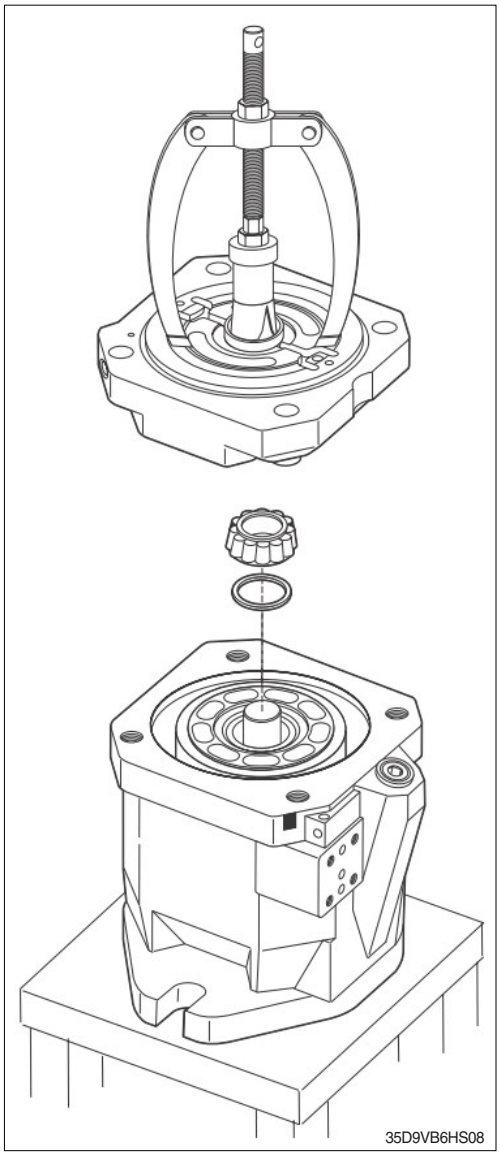
⑤ Remove connection plate.

⚠ **Control plate can drop down - keep tight while removing connection plate.**

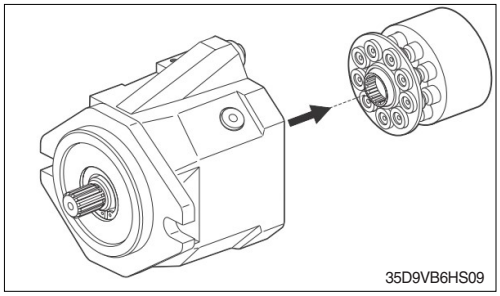


⑥ Pull bearing of the connection plate out using a bearing puller and remove bearing and shim.

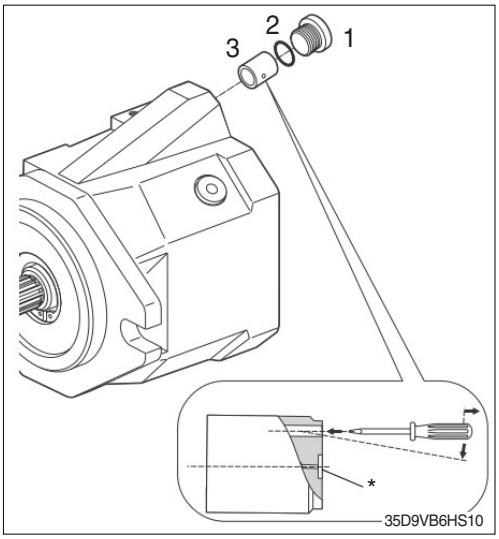
△ **Do not damage the sealing surface.**



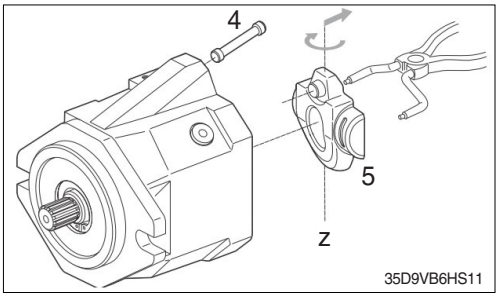
⑦ Remove the rotary group in a horizontal position.



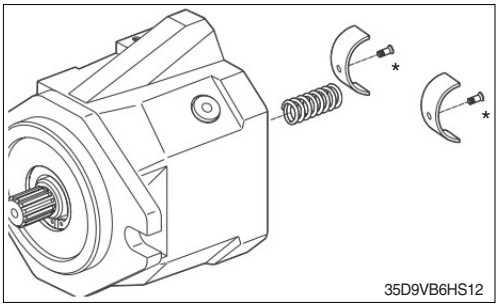
⑧ Remove plug (1) with seal (2). Pull out control piston (3) (flat surface*) with tool.



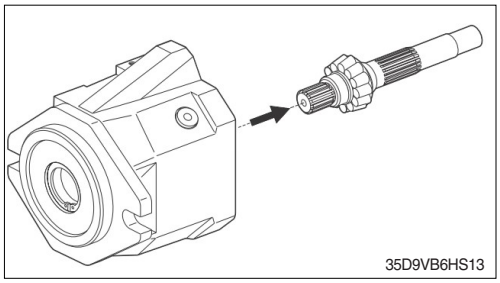
⑨ Remove piston rod and swash plate. Turn swash plate (5) inside of the housing slightly along Z-axis with tool. Remove piston rod (4) and swash plate (5).



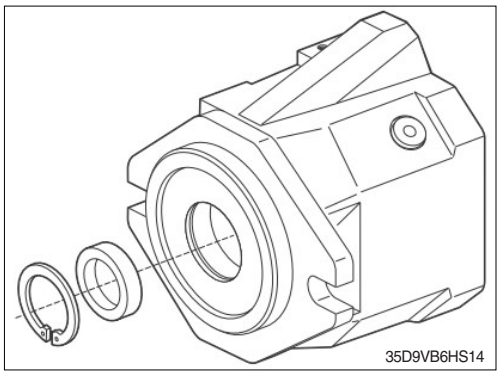
⑩ Remove bearing shells and bearing.



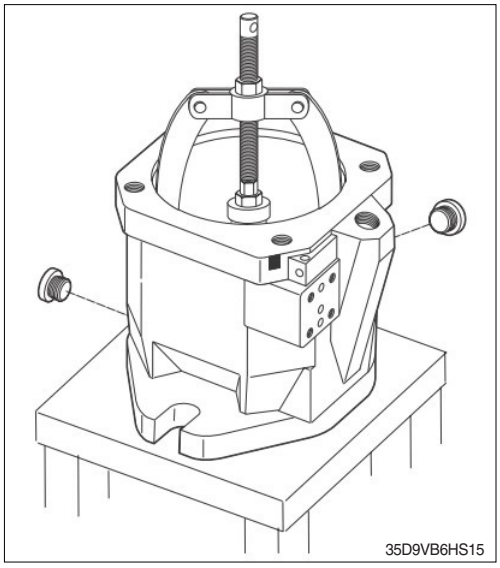
⑪ Remove drive shaft with bearing.



⑫ Remove circlip and shaft seal.

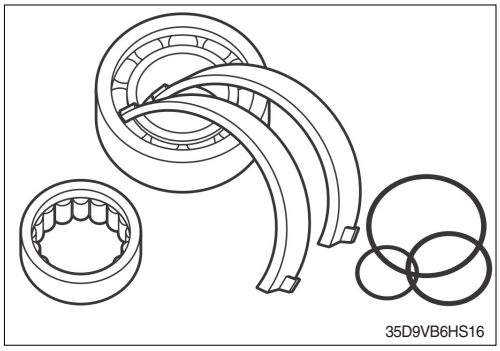


⑬ Pull out outer race of tapered bearing out of housing press seat. Use bearing puller. Remove all plugs and stop ring.

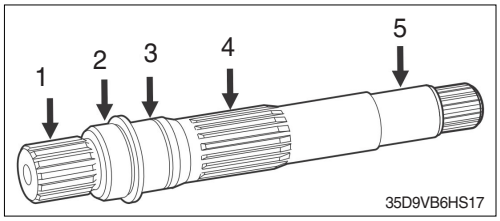


(3) Inspection notes

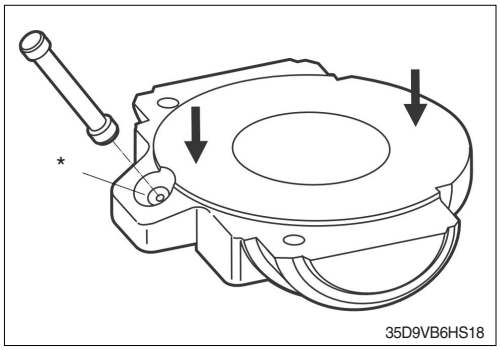
· Renew all bearings and seals.



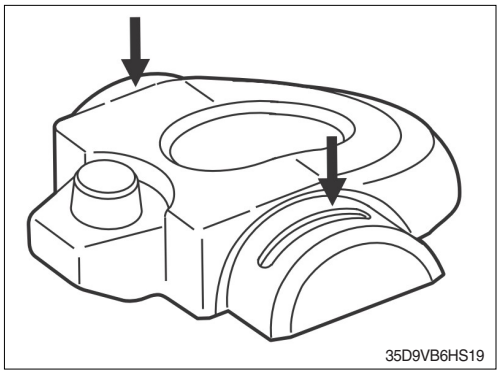
· Check :
(1) Wear on slines, fretting
(2) Drive shaft seal wear grooves
(3) Bearing seat
(4) Splines for cylinder drive
(5) Bearing seat



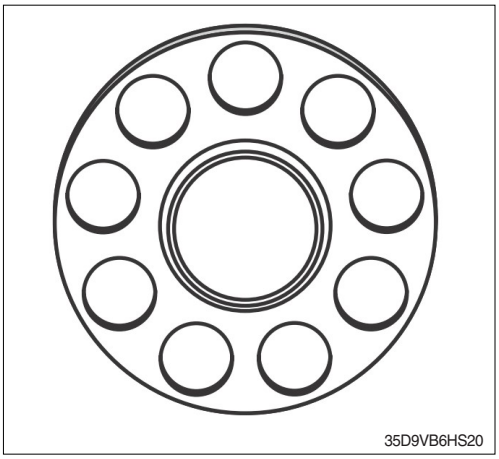
· Check sliding surface free of grooves. Check for freedom of piston rod movement



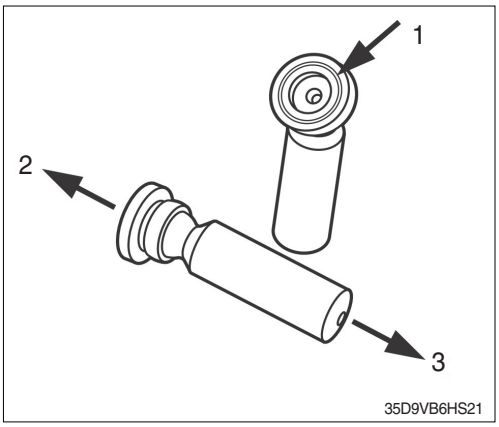
· Bearing surfaces



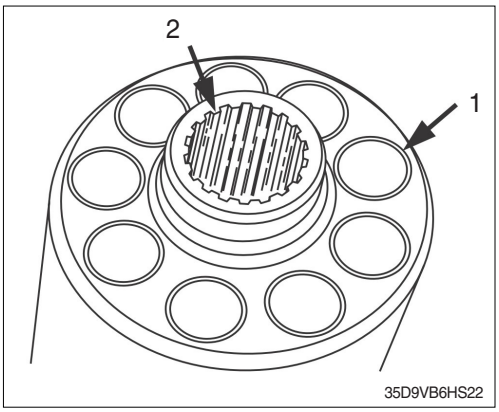
· Check that the retaining plate is free of grooves and that there is no wear in the slipper pad area.



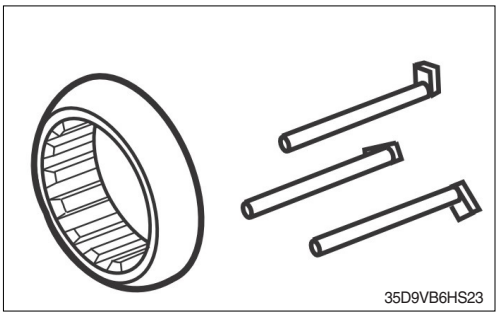
· Check to see that there are no scratches or metal deposits on the sliding surface (1), and that there is no axial play (2). (pistons must only be replaced as a set)



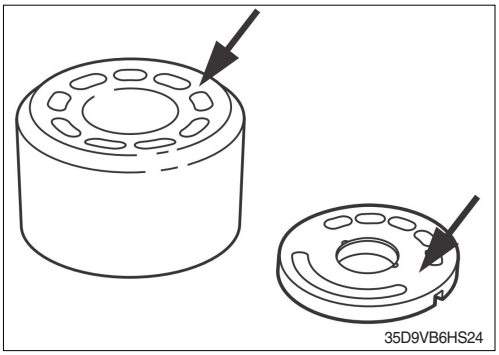
· Check cylinder bores (1), splines (2).



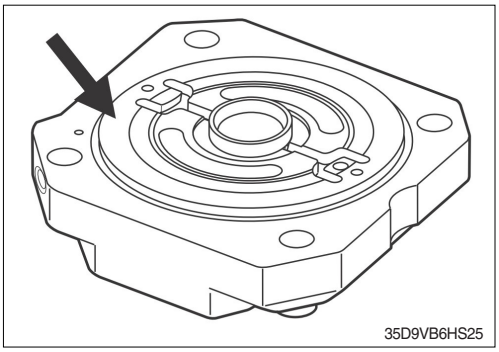
· Free of grooves, no signs of wear.



· Check cylinder sliding surface free of grooves, no wear, no embedded foreign particles. That there are no scratches on the control plate. (Only replace them as a set)

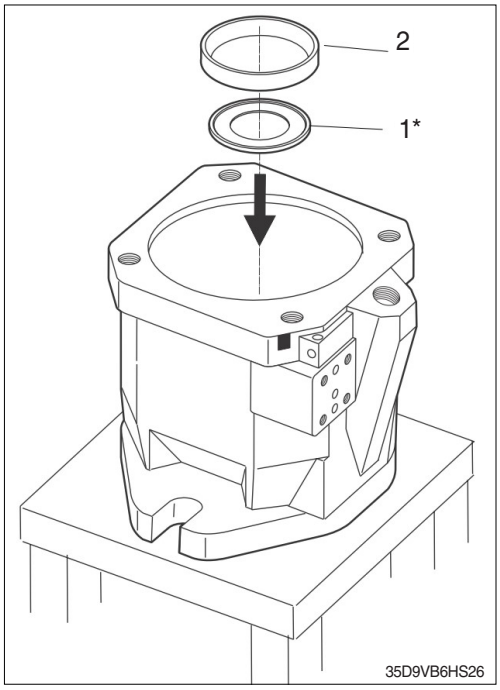


· Check mounting surface - control plate undamaged



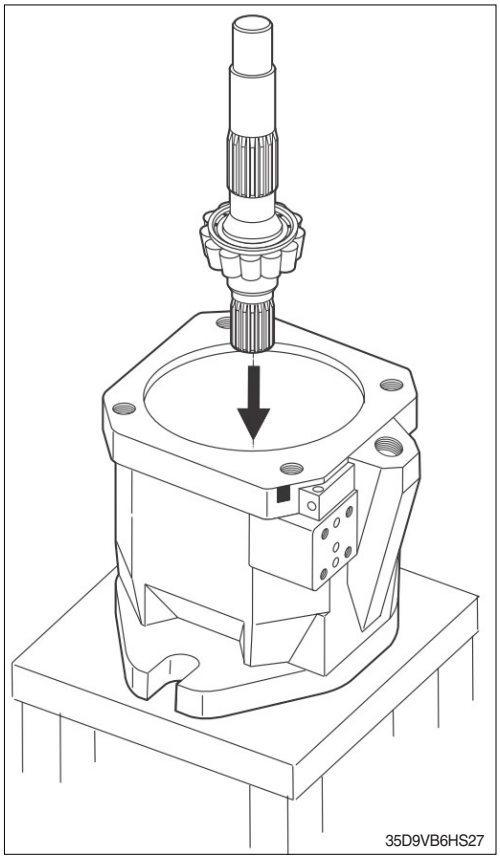
(4) ASSEMBLY

① Assemble stop ring. Press-in distance ring with tool.

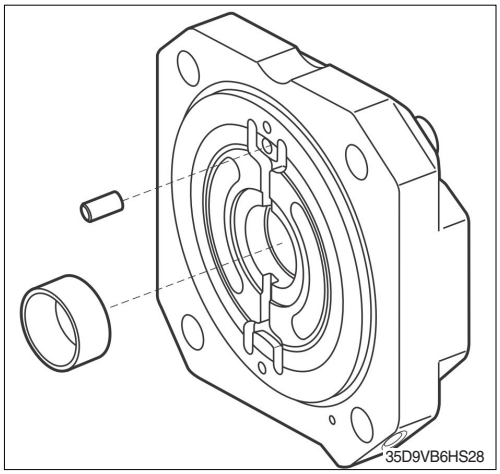


② Assemble shaft in correct position.

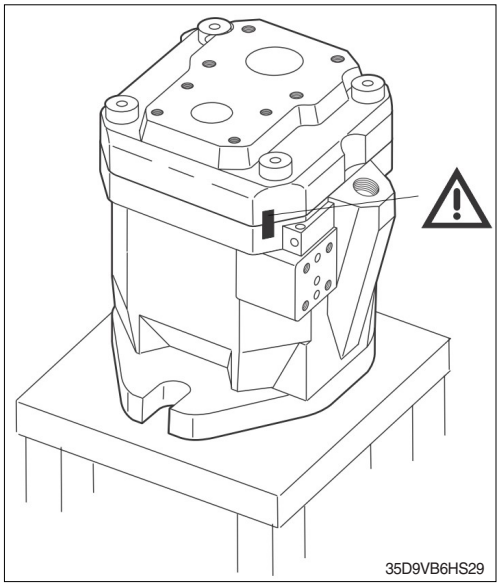
⚠ **Do not cut shaft seal.**



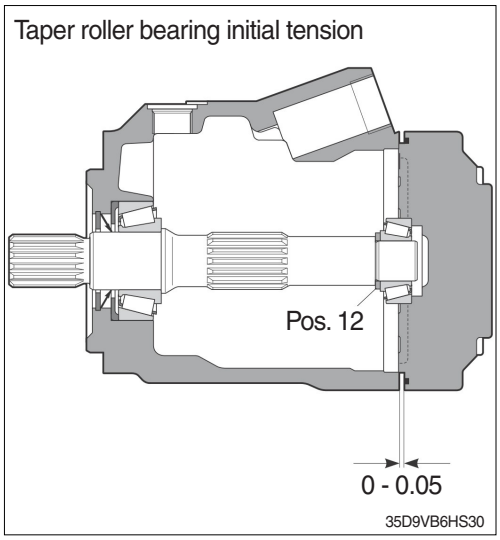
③ Press-in outer racer of rear bearing into connection plate.



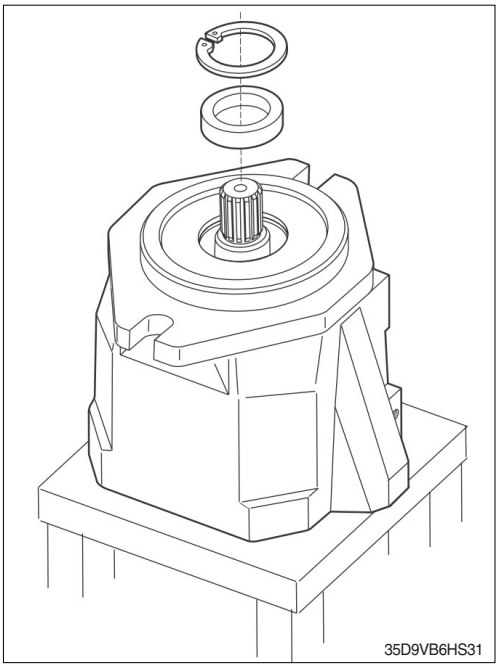
④ Assemble connection plate to pump acc. sign. Pull 4 socket screws tight.
Adjustment of taper roller bearing set see below. Disassemble connection plate.



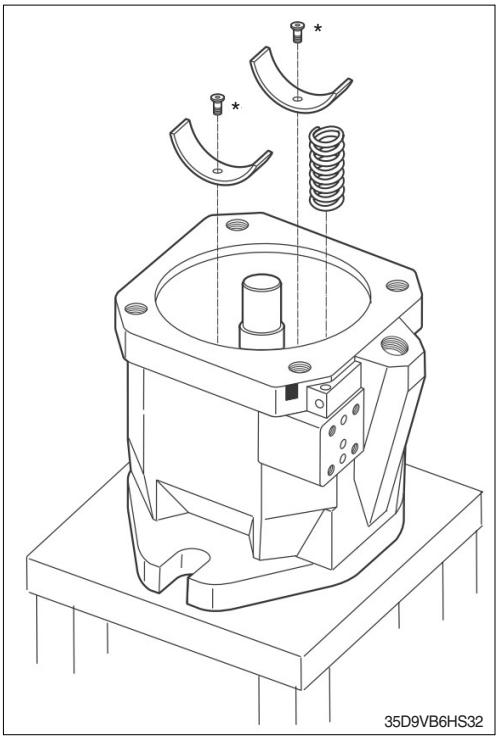
· Adjustment of taper roller bearing
Cast iron housing must have initial tension of the bearings: 0 ~ 0.05 mm, grind Pos. 12 if necessary.



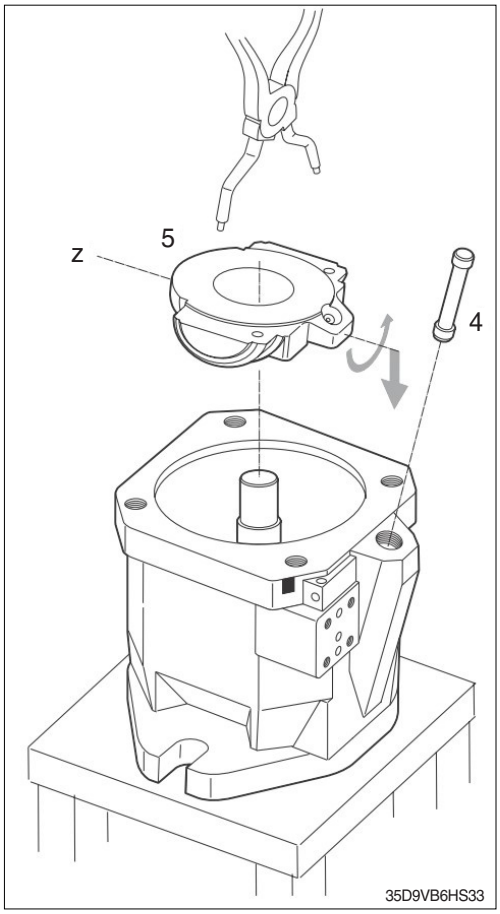
⑤ Assembly instruction shaft seal.



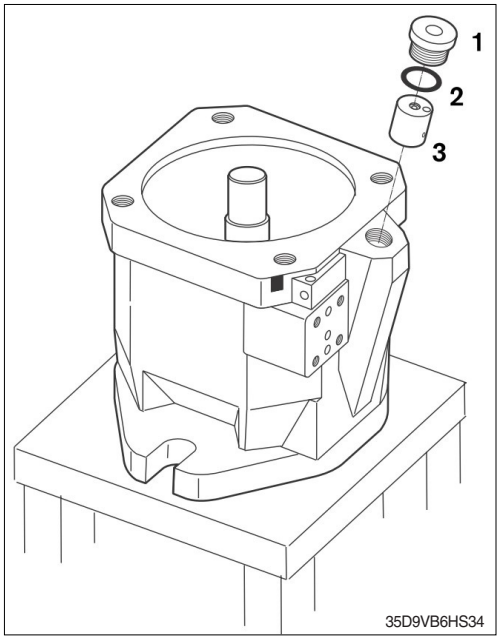
⑥ Fit in bearing shells and spring. Fix with grease.



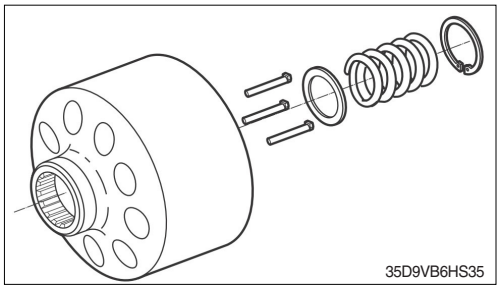
⑦ Assemble swash plate (5) and piston rod (4) into pump. Spring guide pin in correct position. Check correct position of the spring.



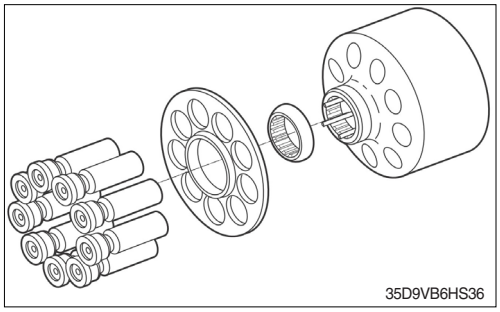
⑧ Assemble piston rod (4), control piston (3), seal (2), and plug (1).
Pull plug tight.
Size 28, 45, 60
M_A = 19.4 + 2.04 kfg·m (140 + 14.8 lbf·ft)
Size 85
M_A = 32.7 + 2.04 kgf·m (237 + 14.8 lbf·ft)
Secure with Loctite 242.



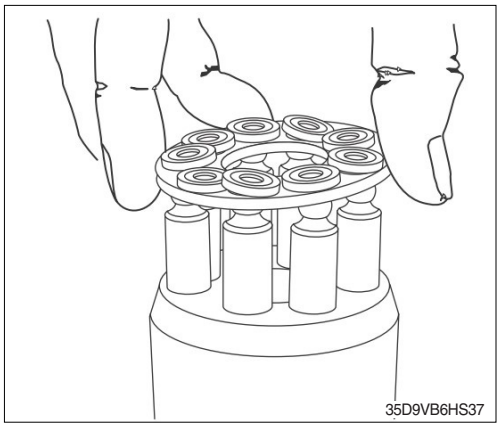
⑨ Fit pressure pins using an assembly aid.



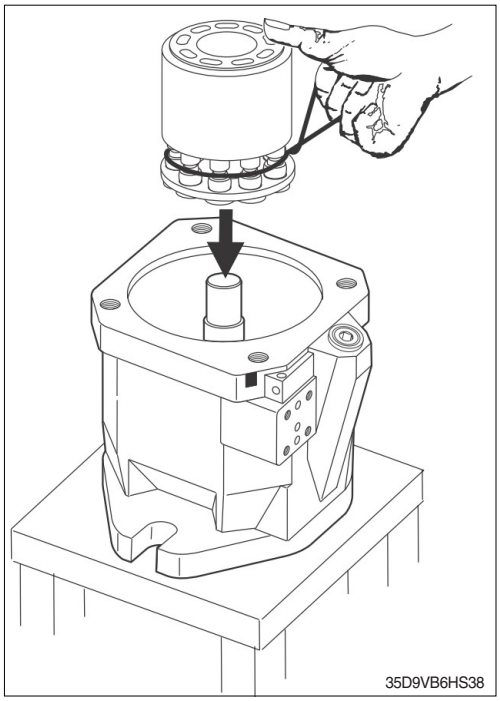
⑩ Pre-tension the spring using a suitable device.



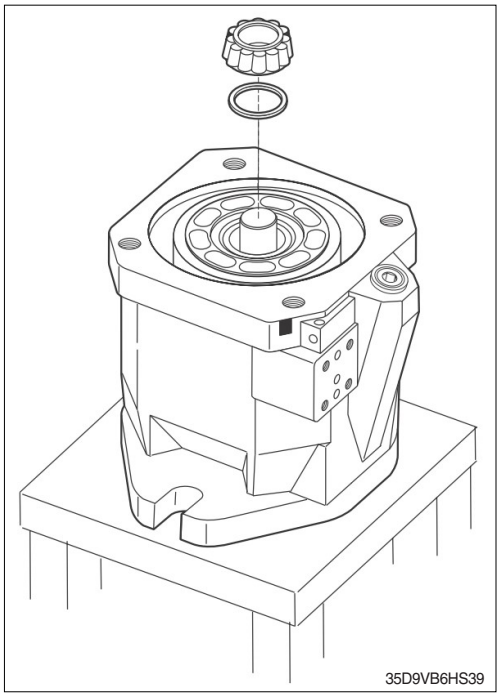
⑪ Assemble piston with retaining plate. (Oil piston and slipper pad)



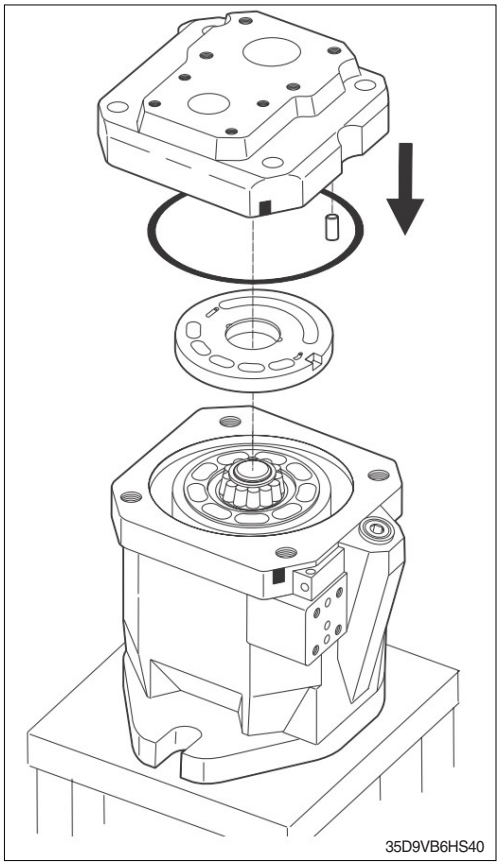
⑫ Fit rotary group. Hold the pistons by usning an O-ring.



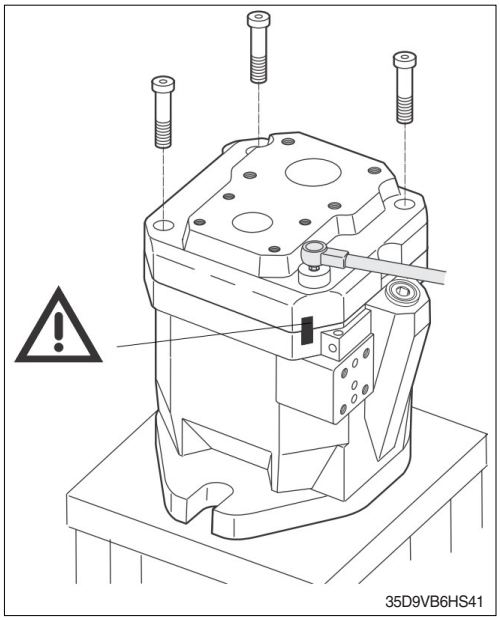
⑬ Assemble bearing and adjustment shim to shaft.



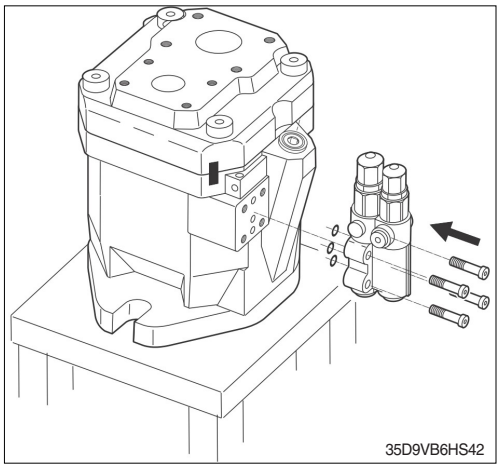
⑭ Fit O-ring and control plate. Fix with grease. Check correct position to pin.



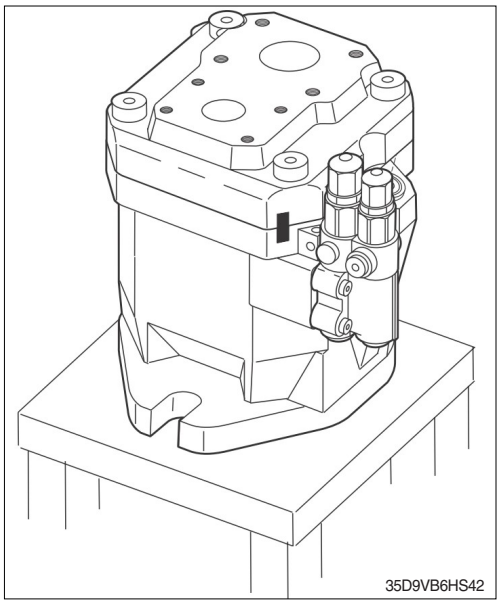
⑮ Assemble connection plate. Check the correct position to housing. Sign! Pull screws tight acc.



⑯ Assemble control valve. Valve adjustment

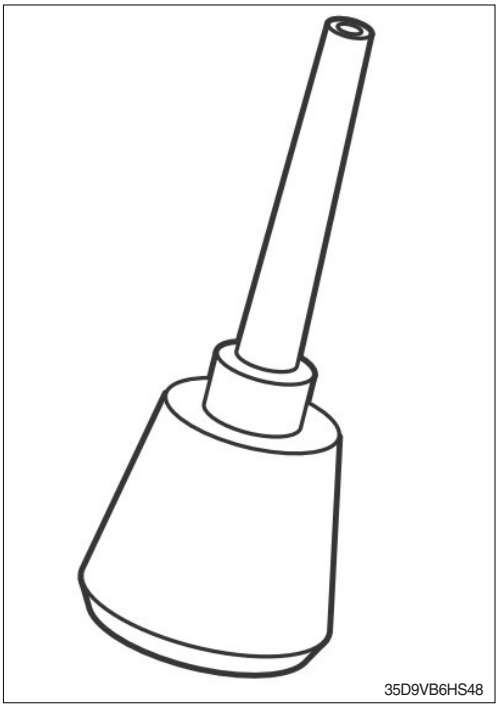


⑰ Final pump assembly. Double check of the housing signs.

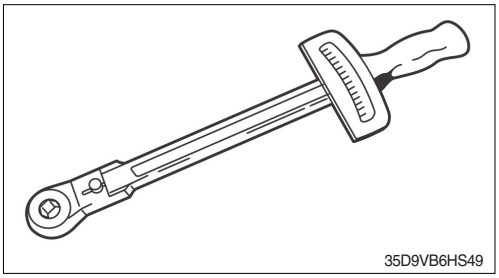


(5) TOOLS TIGHTENING TORQUES

· Loctite types used:
For all break-off plugs : No. 601
For all other parts : No. 242



· Bolt tensile strength grade : 8.8, 10.9, 12.9



		M4	M5	M6	M8	M10	M12	M14	M16	M18	M20	M24	M30
M_A kgf·m (lbf·ft)	0.9 (6.5)	0.2 (1.7)	0.5 (3.7)	0.9 (6.3)	2.1 (15.5)	4.2 (30.3)	7.3 (53.1)	11.7 (84.9)	18.0 (130)	24.5 (177)	35.7 (258)	61.2 (443)	125 (900)
	1.1 (8.0)	0.3 (2.4)	0.7 (5.3)	1.2 (8.9)	3.0 (21.4)	5.9 (42.8)	10.2 (73.8)	16.8 (122)	25.5 (185)	35.7 (258)	50.0 (362)	85.7 (620)	170 (1233)
	1.3 (9.5)	0.4 (3.0)	0.9 (6.3)	1.5 (10.7)	3.6 (25.8)	7.1 (51.7)	12.3 (89.3)	19.9 (144)	30.6 (221)	41.8 (303)	60.2 (436)	101.0 (731)	204 (1476)

※ M_A [kgf·m (lbf·ft)] = max. tightening torque (lubricated screws μ = 0.125)

(6) ASSEMBLY TIGHTENING TORQUES

· Plugs with internal hexagon, O-ring and UNF-, UN- threads to SAE J 514

Thread	Tightening torque M_A	
	kgf·m	lbf·ft
7/16-20 UNF	1.5	11.1
9/16-18 UNF	2.6	18.5
3/4-16 UNF	7.3	53.1

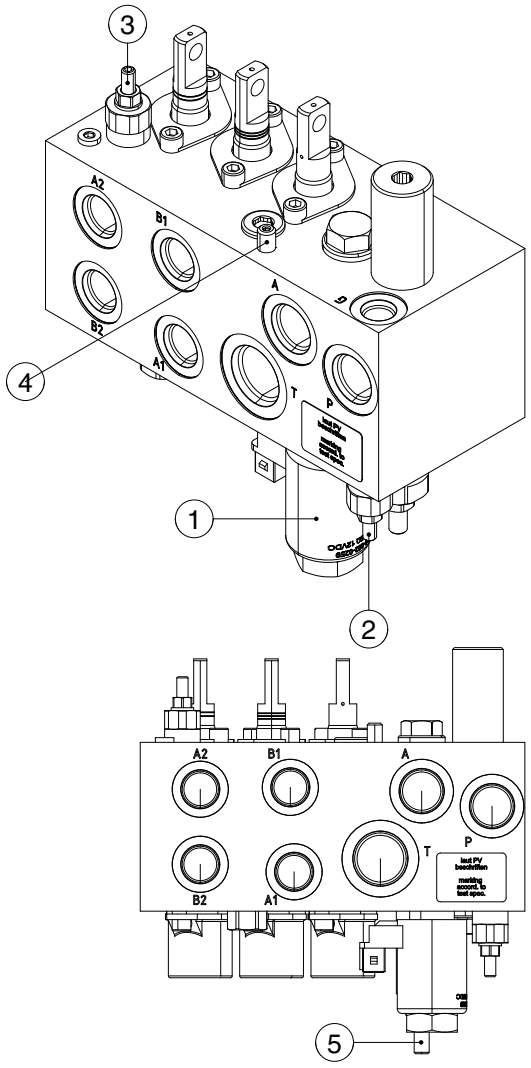
· Bolts

Thread	8.8T		10.9T		12.9T	
	Tightening torque M_A					
	kgf·m	lbf·ft	kgf·m	lbf·ft	kgf·m	lbf·ft
M4	0.3	2.3	0.5	3.3	0.5	3.9
M5	0.6	4.5	0.9	6.6	1.1	7.7
M6	1.1	7.7	1.6	11.4	1.8	13.3
M8	2.6	18.5	3.8	27.3	4.4	31.7
M10	5.2	37.6	7.7	55.4	8.9	64.2

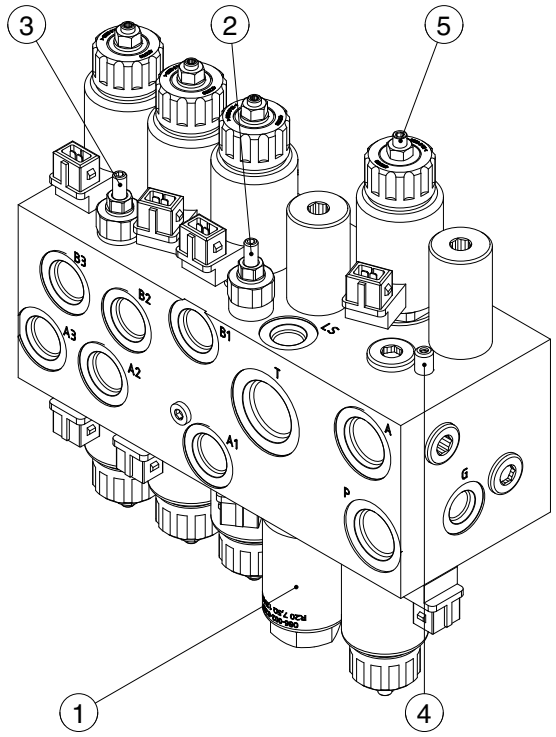
2. MAIN CONTROL VALVE

1) STRUCTURE

Manual



Fingertip (option)



35D9VB6HS51

1 OPSS cutoff solenoid
2 Main relief valve (DV1)
3 2nd reilief valve (DV2)
4 Manual lowering
5 Fork lowering speed adjustment

2) DISASSEMBLY AND ASSEMBLY

(1) Cutoff solenoid

① Park the forklift safely and full lower the forkcarriage.

② Operate the lever in the engine off (key ON) state to discharge the pressure oil in the MCV.

③ Open the bonnet. Loosen nut of the cutoff solenoid and remove coil from the check valve.

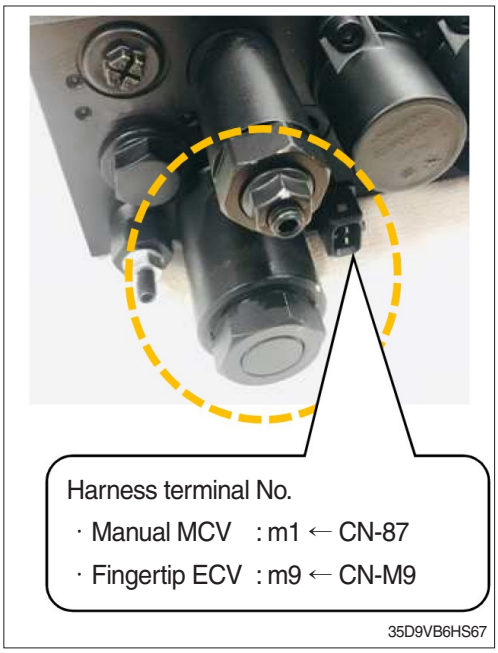
④ Clean the check valve and valve block so that opened valve block cannot become contaminated.

⑤ Loosen the check valve with spanner 17 mm (0.7 in). Apply a light coat of hydraulic oil to the o-rings of the new check valve and insert a new check valve and screw in tightly.

· Tightening torque : 4 kgf·m (28.9 lbf·ft)

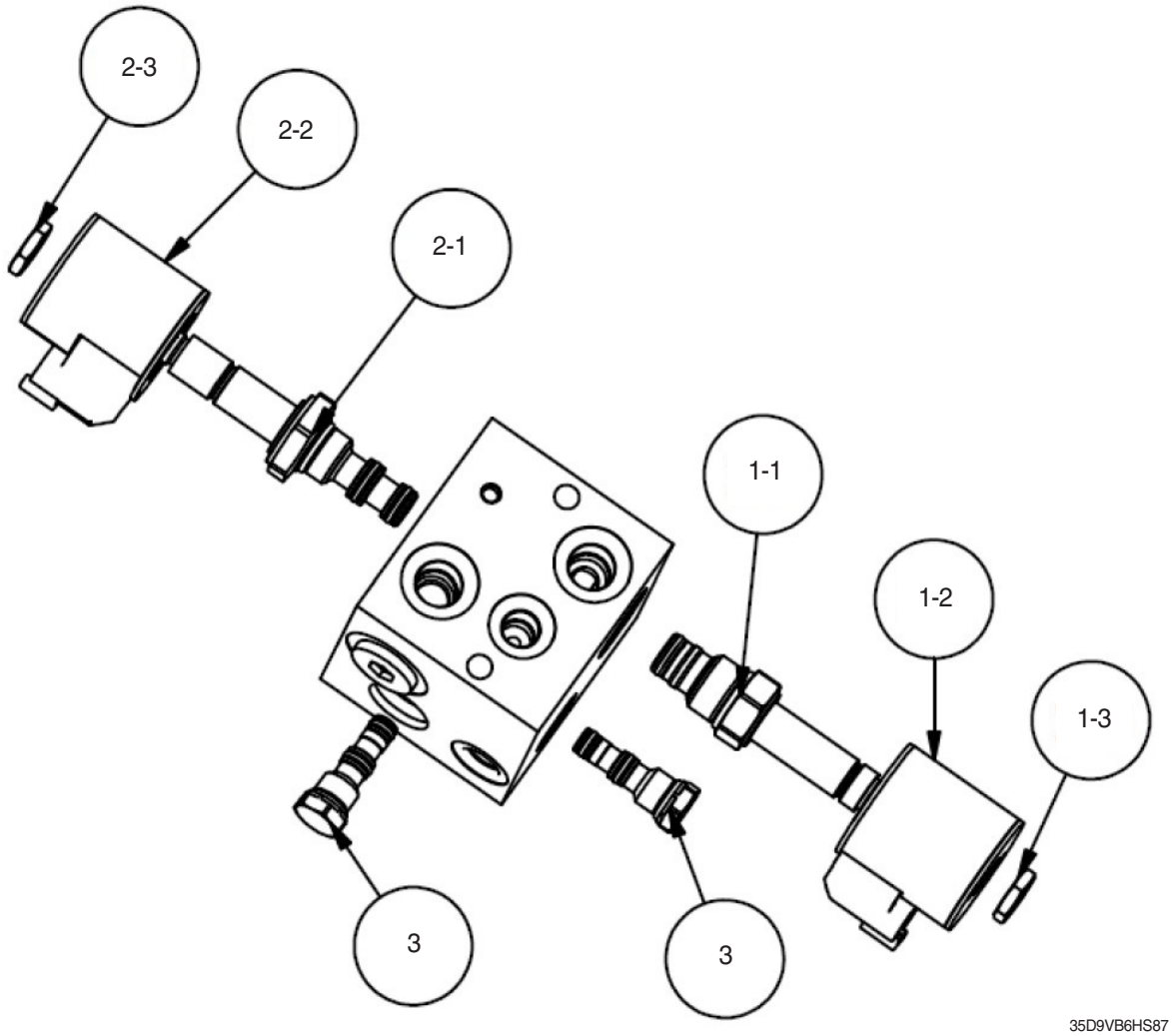
⑥ Refit the solenoid coil according to the direction and tighten with the o-ring side of the nut facing the coil.

· Tightening torque : 0.7 kgf·m (5.1 lbf·ft)



3. PRESSURE FORCED VALVE

1) STRUCTURE



No.	Item	Tightening torque		Remarks
		kgf·m	lbf·ft	
1-1	TS1	3.5	25	Proportional valve
1-2	CL1	-	-	Coil
1-3	Nut	0.8	6	25.4 mm (1 inch) hex head
2-1	SV1	2.8	20	ON/OFF Solenoid valve
2-2	CL1	-	-	Coil
2-3	Nut	0.8	6	19mm (3/4 inch) hex head
3	LS1, 2	2.8	20	3way shuttle valve

2) DISASSEMBLY

(1) TS1

Clean the valve installation surface. Disassemble Nut with 25.4 mm (1 inch) size spanner. Take out electronic coil. Disassemble valve with 25.4 mm (1 inch) spanner

(2) SV1

Clean the valve installation surface. Disassemble Nut with 19.1 mm (3/4 inch) size spanner. Take out electronic coil. Disassemble valve with 17.5 mm (11/16 inch) spanner

(3) LS

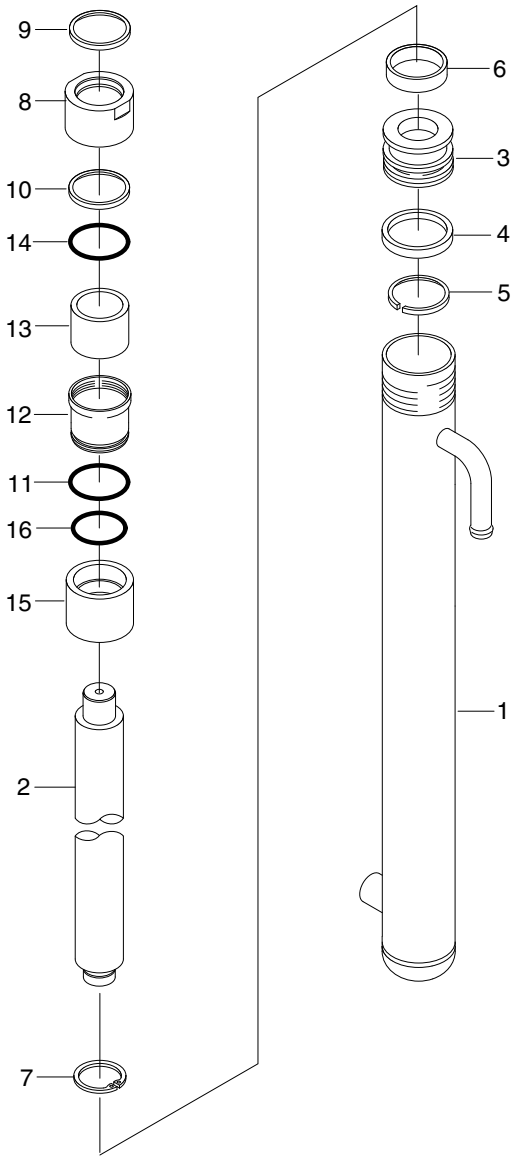
Clean the valve installation surface. Disassemble with 25.4 mm (1 inch) size spanner.

3) ASSEMBLY

Assemble is a reverse order of disassemble and should be performed by trained technician with calibrated torque wrench otherwise the manifold performance will be out of specification.

4. LIFT CYLINDER

1) STRUCTURE



D357HS19

1	Tube assy	7	Retaining ring	13	Rod busing
2	Rod	8	Rod cover	14	O-ring
3	Piston	9	U-packing	15	Spacer
4	U-packing	10	Dust wiper	16	O-ring
5	Back up ring	11	O-ring		
6	Wear ring	12	Guide		

※ Parts list is based on the 35/40/45D-9VB, 40/45D-9VC, 50DN-9VC.

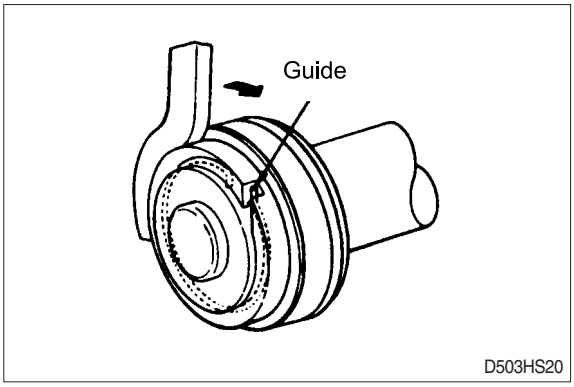
· Specification (standard)

Unit : mm (inch)

Model	I.D	O.D	Stroke	Rod O.D
35/40/45D-9VB, 40/45D-9VC 50DN-9VC (V300)	65 (2.6)	73 (2.9)	1485 (58.5)	50 (2.0)
50DN-9VB (V290)	70 (2.8)	82 (3.2)	1435 (56.5)	55 (2.2)

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.



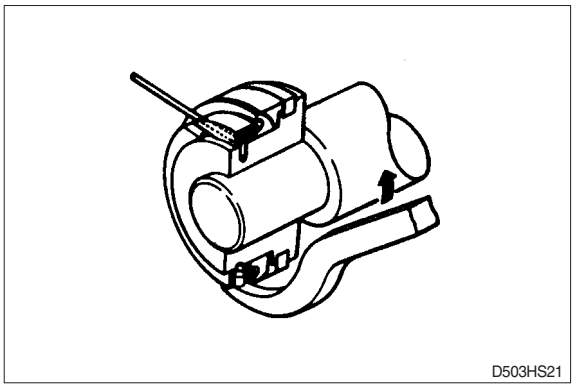
3) CHECK AND INSPECTION

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

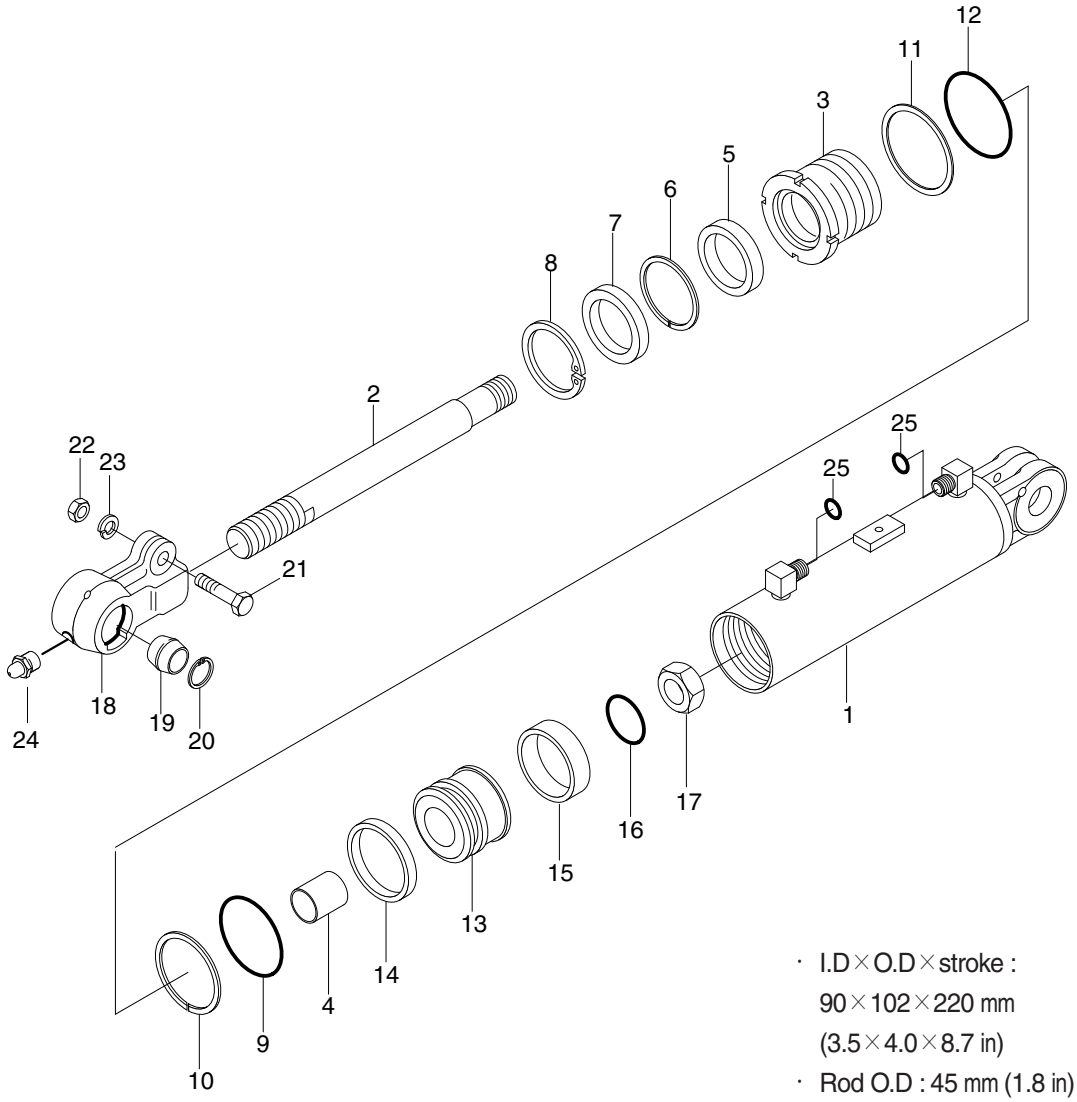
4) ASSEMBLY

(1) Soak the piston ring in hydraulic oil at a temperature of 40 to 50℃, 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.



5. TILT CYLINDER

1) STRUCTURE



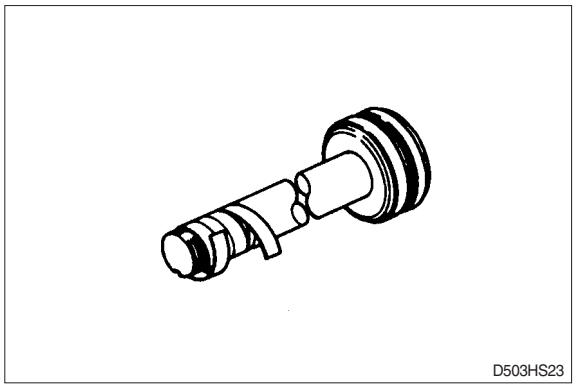
· I.D × O.D × stroke :
90 × 102 × 220 mm
(3.5 × 4.0 × 8.7 in)
· Rod O.D : 45 mm (1.8 in)

35D9FHS16

1	Tube assy	10	Back up ring	19	Spherical bearing
2	Rod	11	Lock washer	20	Retaining ring
3	Rod cover	12	O-ring	21	Hexagon bolt
4	Rod bushing	13	Piston	22	Hexagon nut
5	U-packing	14	Piston seal	23	Spring washer
6	Back up ring	15	Wear ring	24	Grease nipple
7	Dust wiper	16	O-ring	25	O-ring
8	Stop ring	17	Nylon nut		
9	O-ring	18	Rod 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.



3) CHECK AND INSPECTION

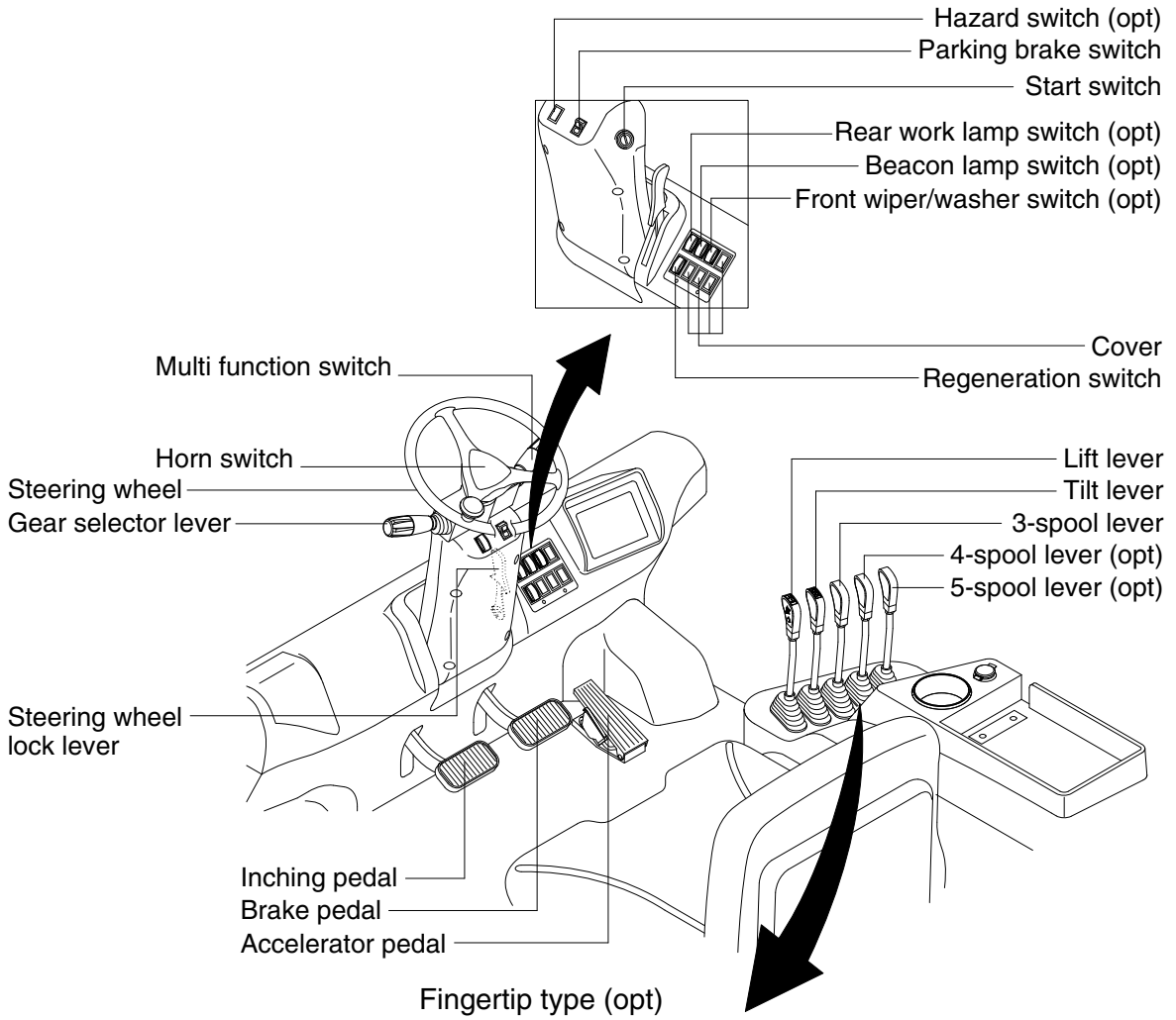
mm (in)

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

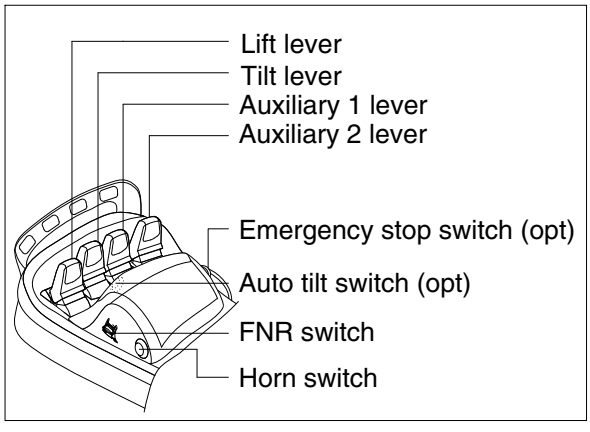
SECTION 7 ELECTRICAL SYSTEM

GROUP 1 COMPONENT LOCATION

1. LOCATION 1



Fingertip type (opt)



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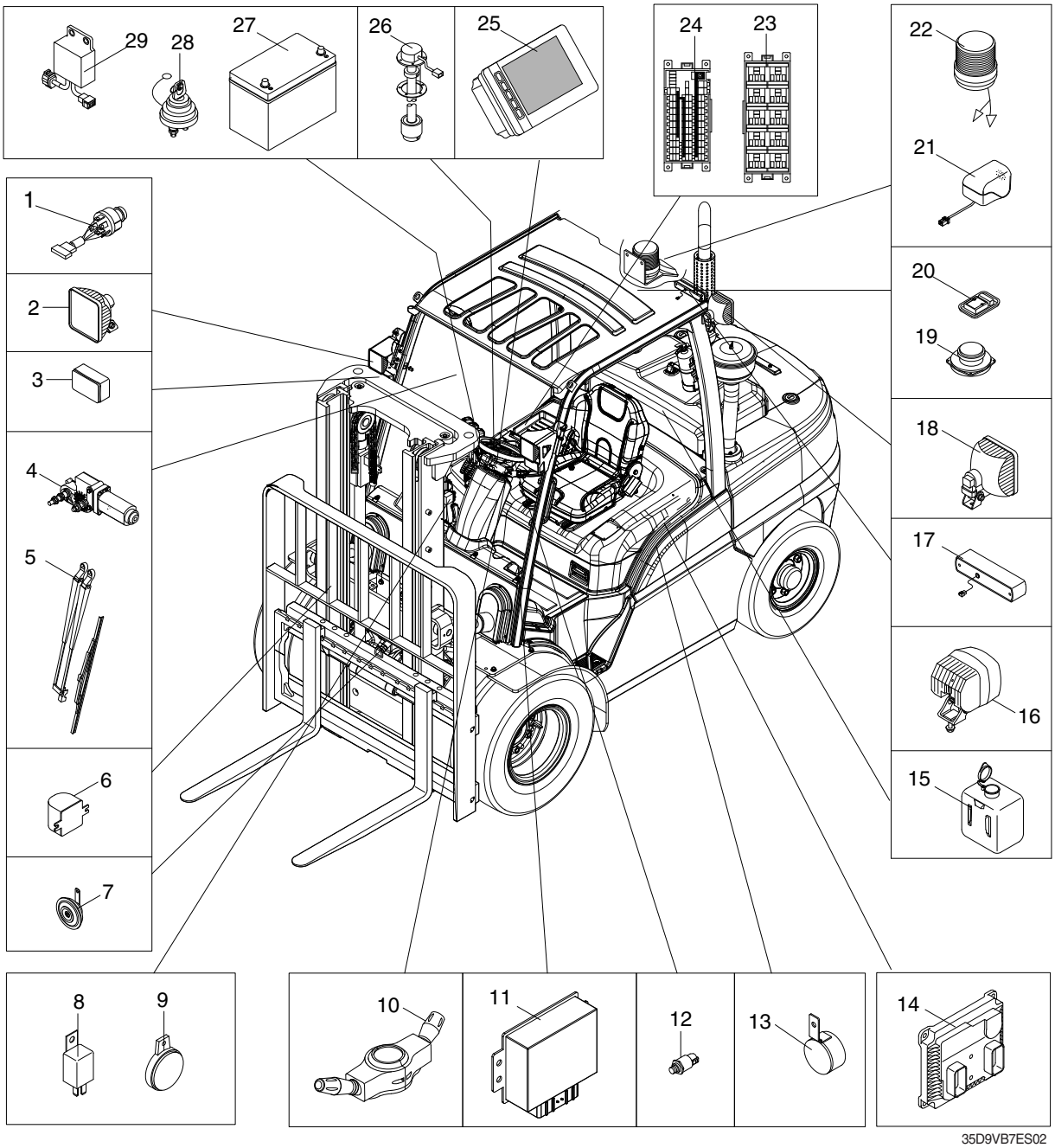
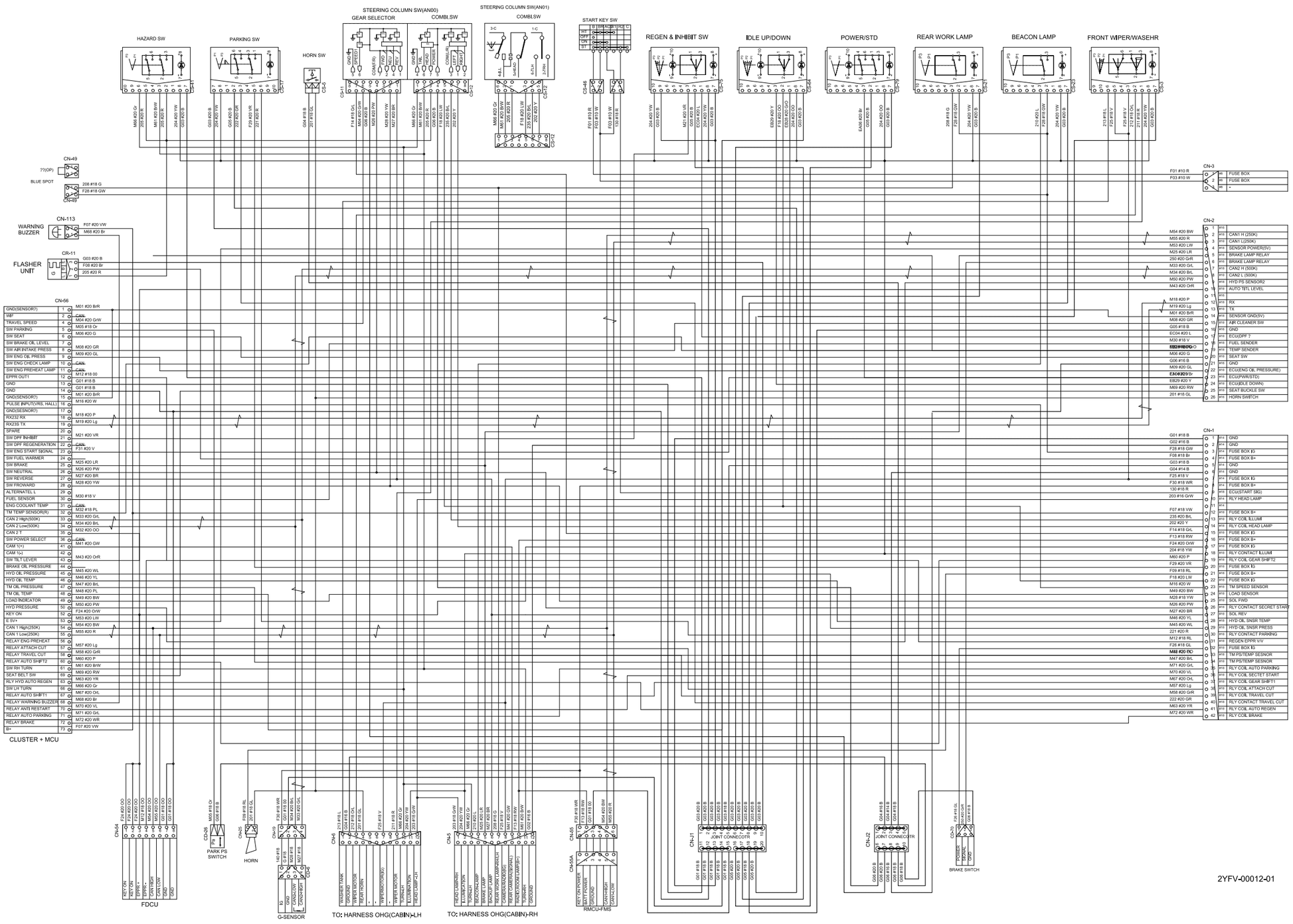
2. LOCATION 2



1	Start switch	11	FDCU	21	Camera (opt)
2	Front work lamp	12	Load sensor (opt)	22	Beacon lamp (opt)
3	Front turn lamp	13	Back buzzer	23	Relay box
4	Wiper motor (opt)	14	Engine control module	24	Fuse box
5	Wiper arm and blade (opt)	15	Washer tank (opt)	25	Cluster CI
6	G-sensor (opt)	16	Blue spot (opt)	26	Fuel sender
7	Horn	17	Rear combination lamp	27	Battery
8	Flusher unit	18	Rear work lamp (opt)	28	Master switch (opt)
9	Intermittent buzzer	19	Speaker (opt)	29	FNR controller (opt)
10	Multifunction switch	20	Room lamp (opt)		

GROUP 2 ELECTRICAL CIRCUIT

· ELECTRICAL CIRCUIT (1/4, DASHBOARD)



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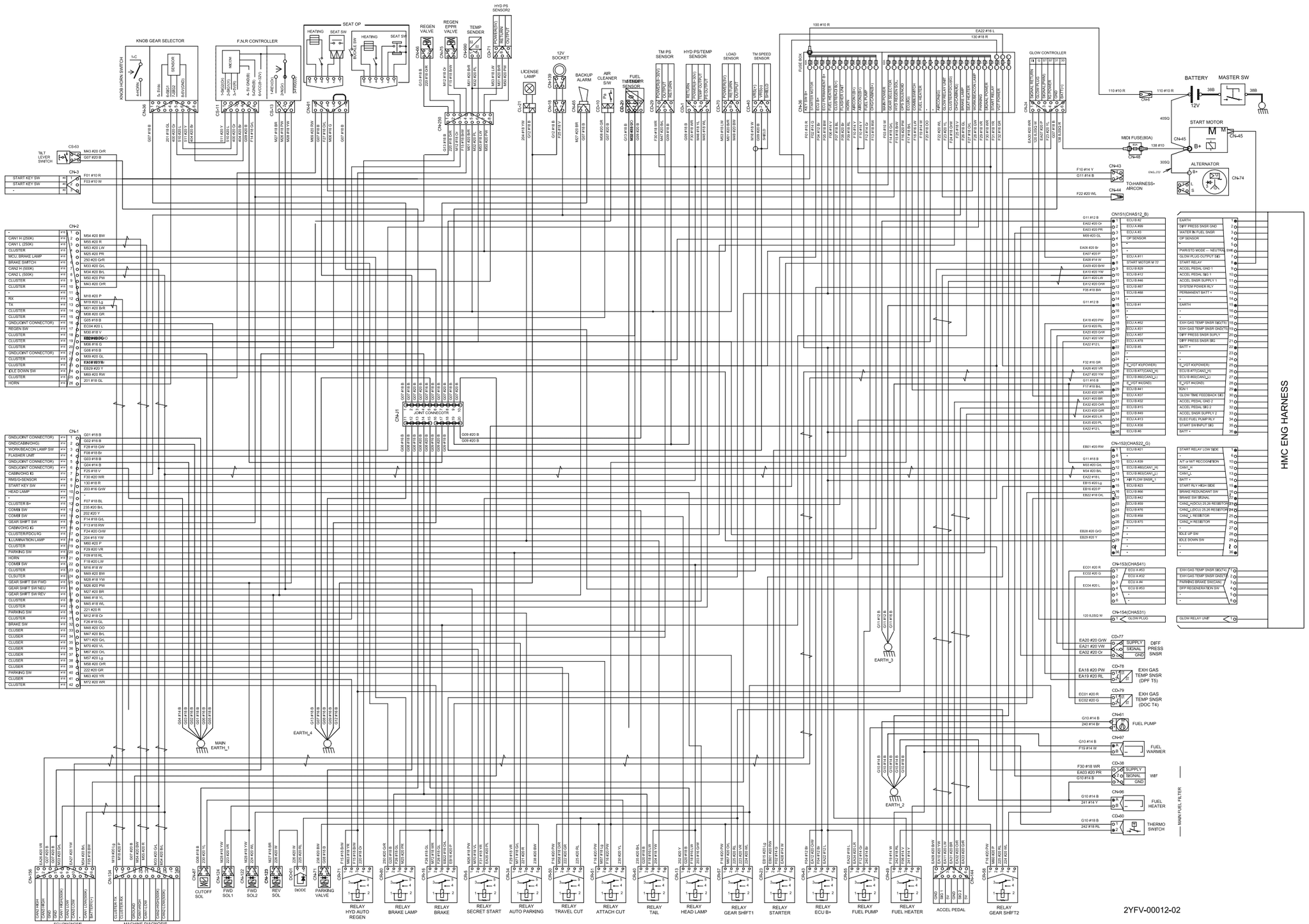
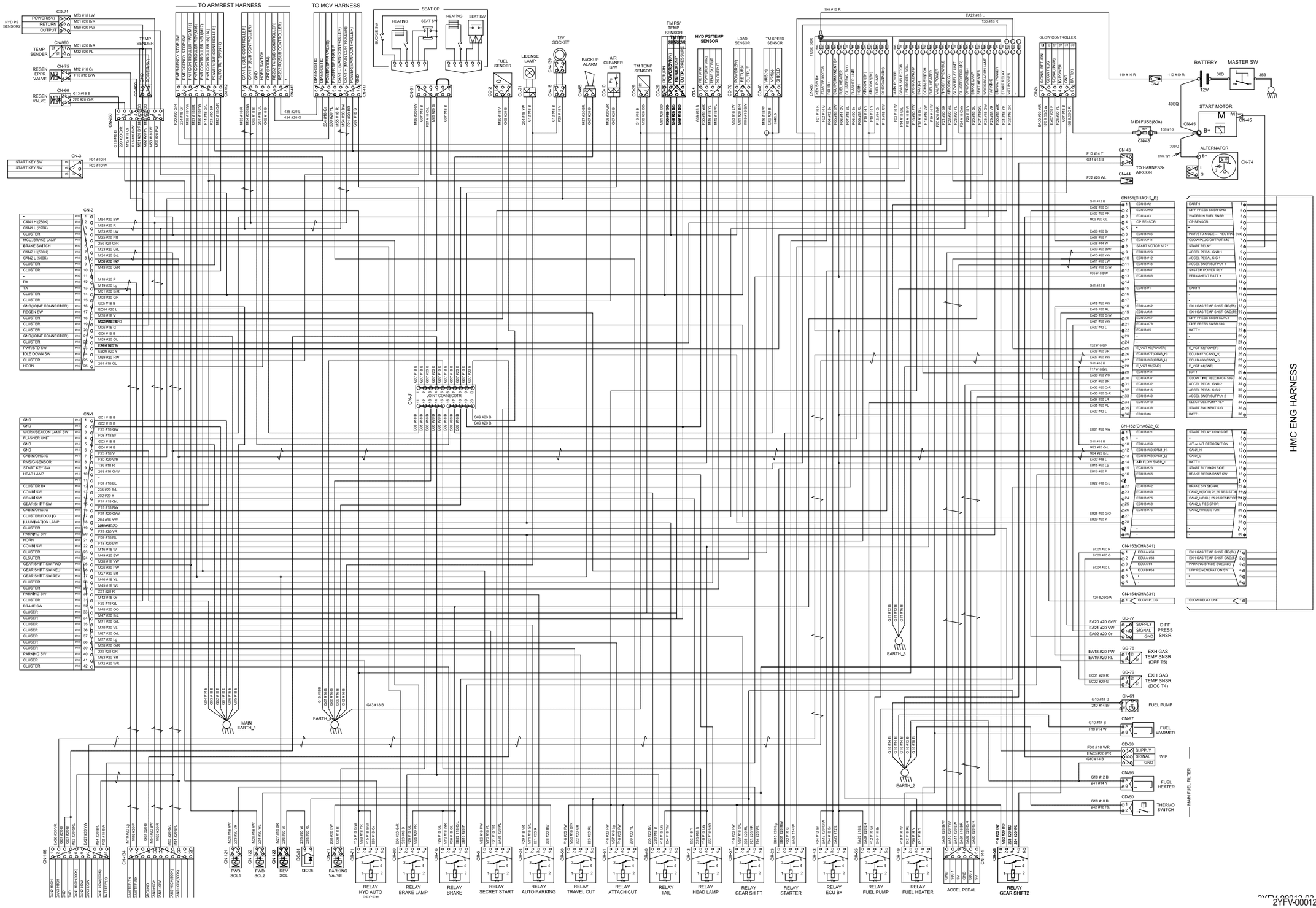
· ELECTRICAL CIRCUIT (2/4, FRAME)

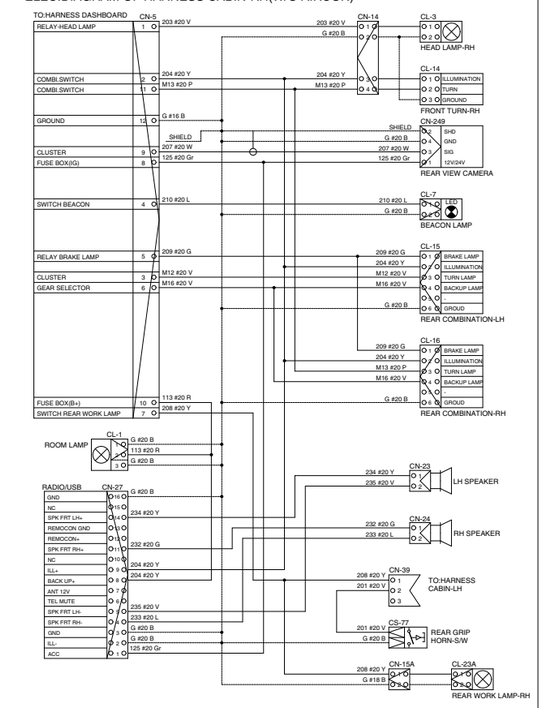


· ELECTRICAL CIRCUIT (3/4, FRAME-FINGERITP)

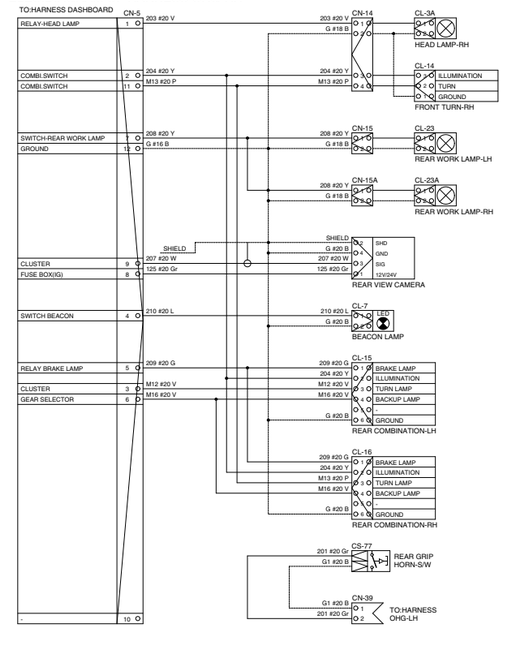


· ELECTRICAL CIRCUIT (4/4, CABIN, OHG, MCV, ARMREST)

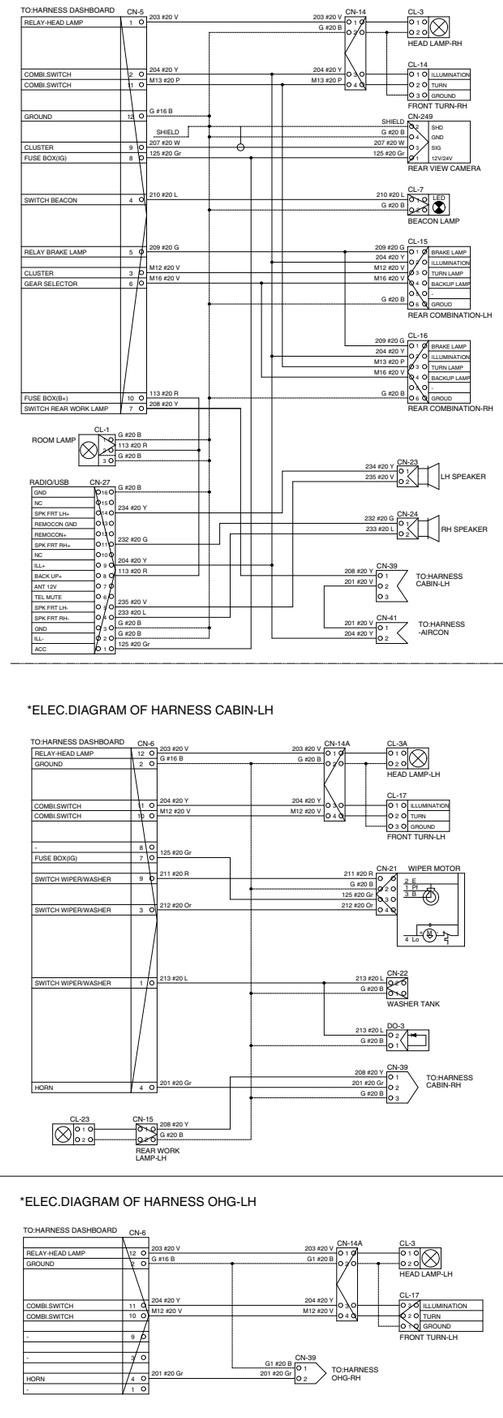
*ELEC.DIAGRAM OF HARNESS CABIN-RH(W/O AIRCON)



*ELEC.DIAGRAM OF HARNESS OHG-RH



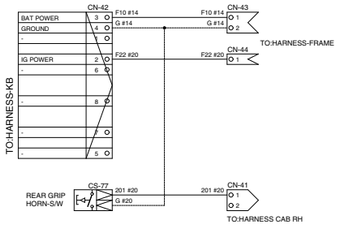
*ELEC.DIAGRAM OF HARNESS CABIN-RH(WITH AIRCON)



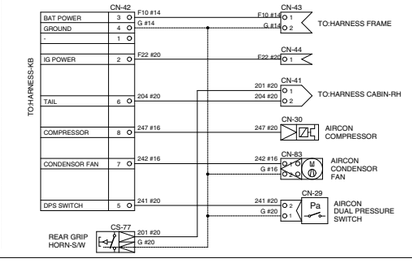
*ELEC.DIAGRAM OF HARNESS CABIN-LH

*ELEC.DIAGRAM OF HARNESS OHG-LH

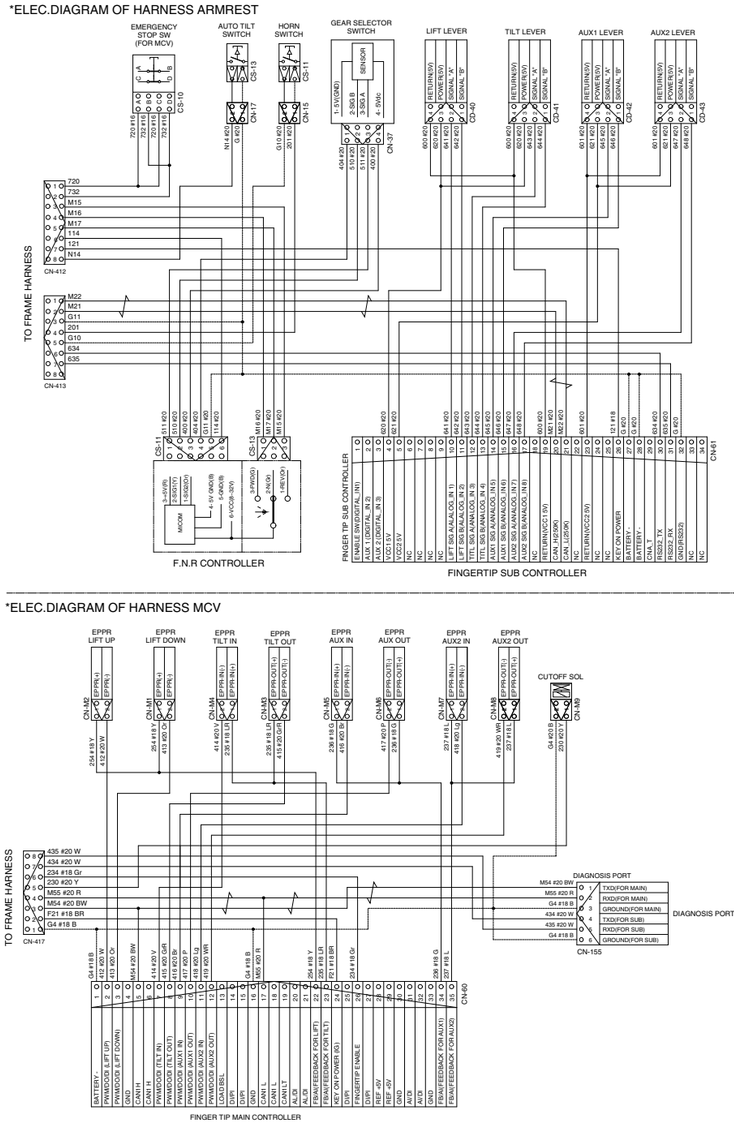
*ELEC.DIAGRAM OF HARNESS-HEATER (HEATER ONLY)



*ELEC.DIAGRAM OF HARNESS-AIRCON(AIRCON+HEATER)



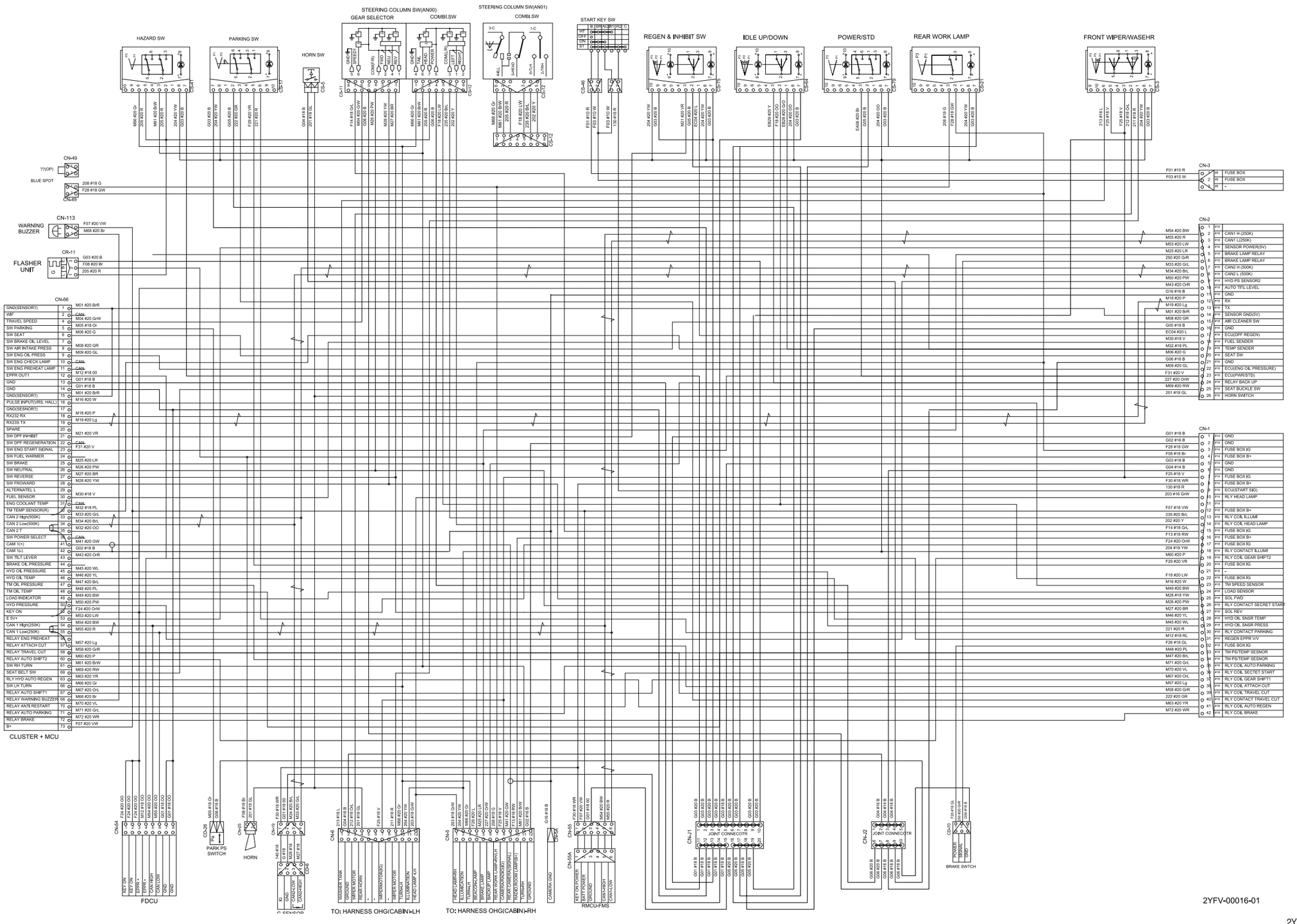
*ELEC.DIAGRAM OF HARNESS ARMREST



*ELEC.DIAGRAM OF HARNESS MCV

GROUP 2 ELECTRICAL CIRCUIT

· ELECTRICAL CIRCUIT (1/4, DASHBOARD)



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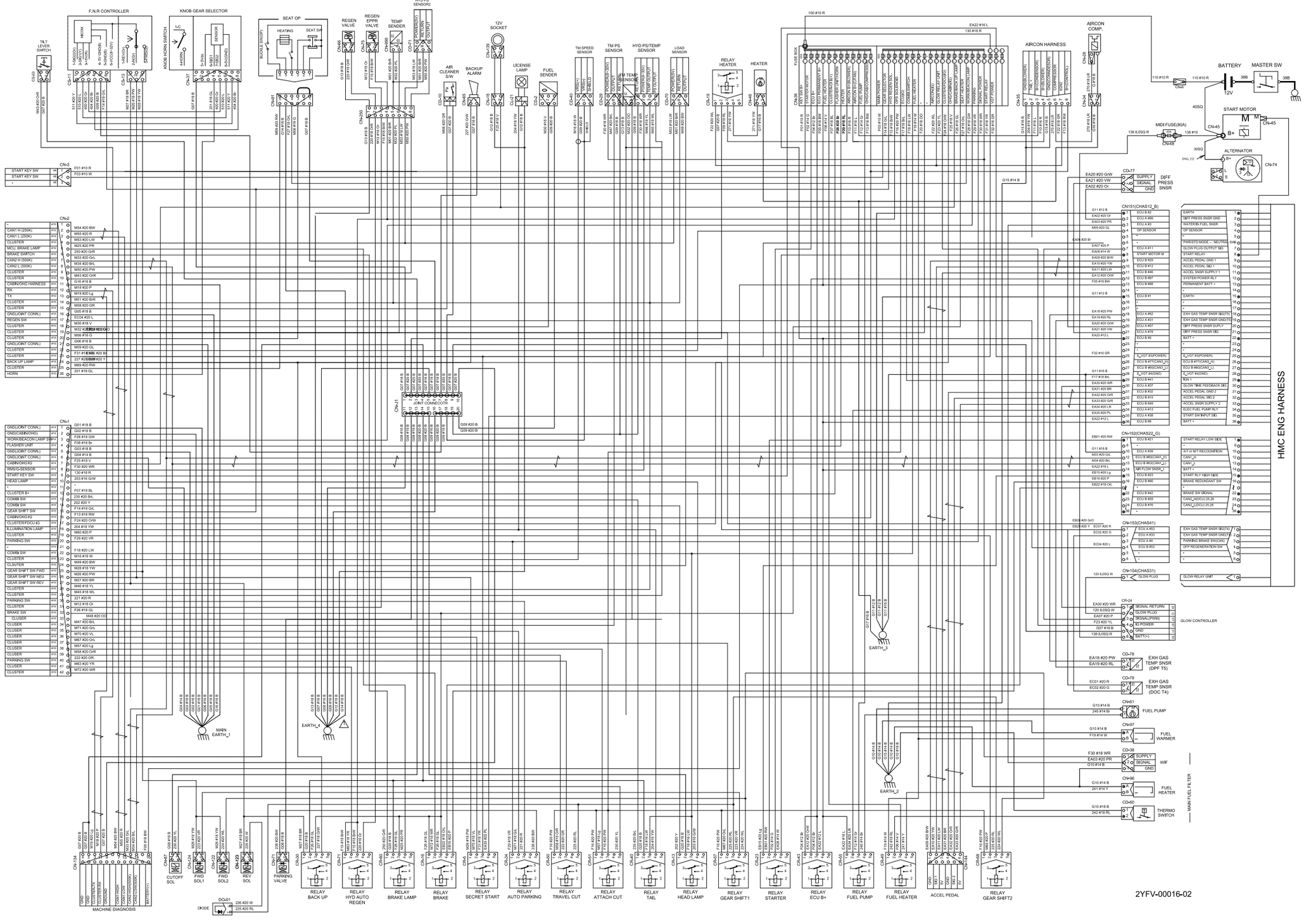
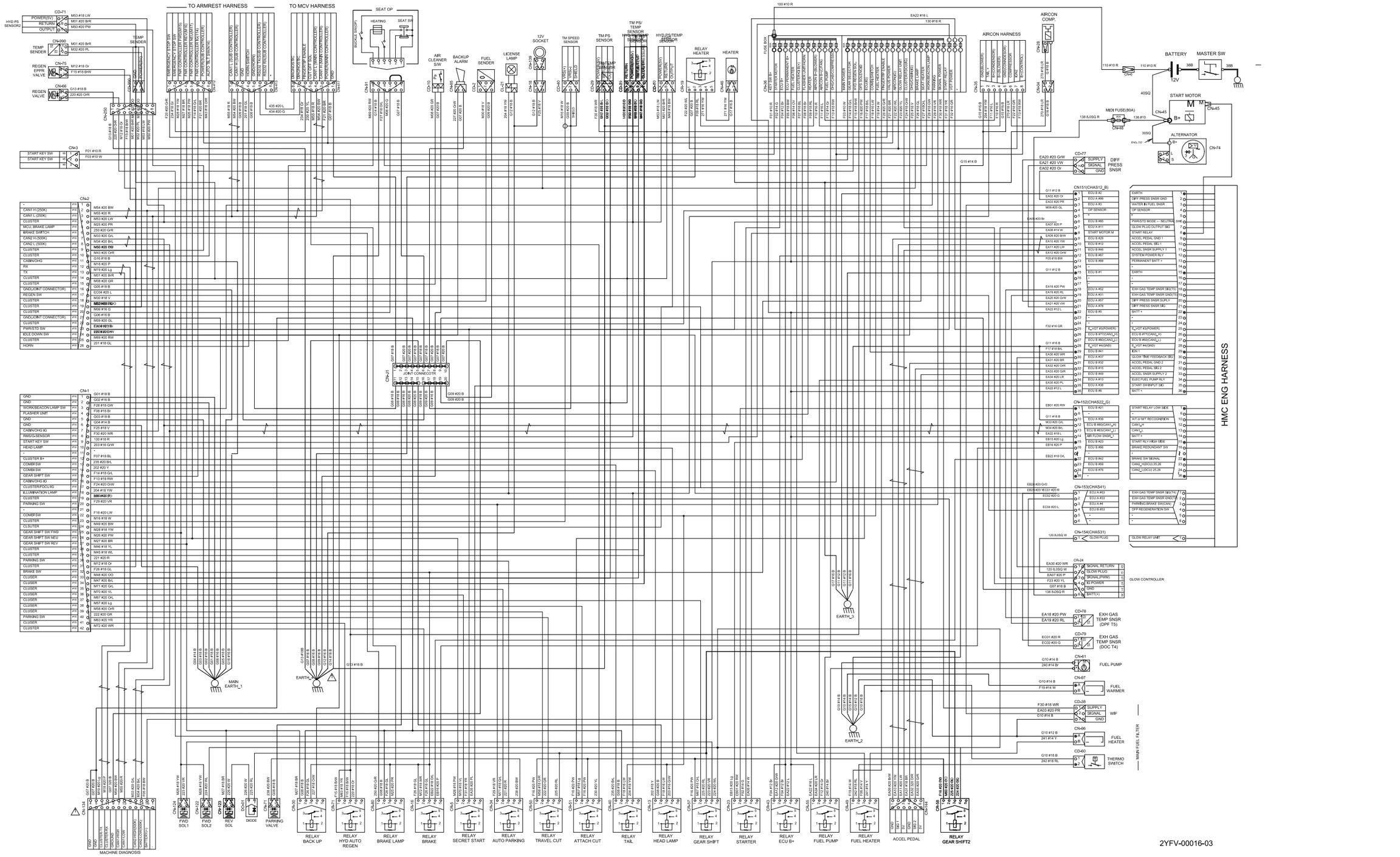
· ELECTRICAL CIRCUIT (2/4, FRAME)

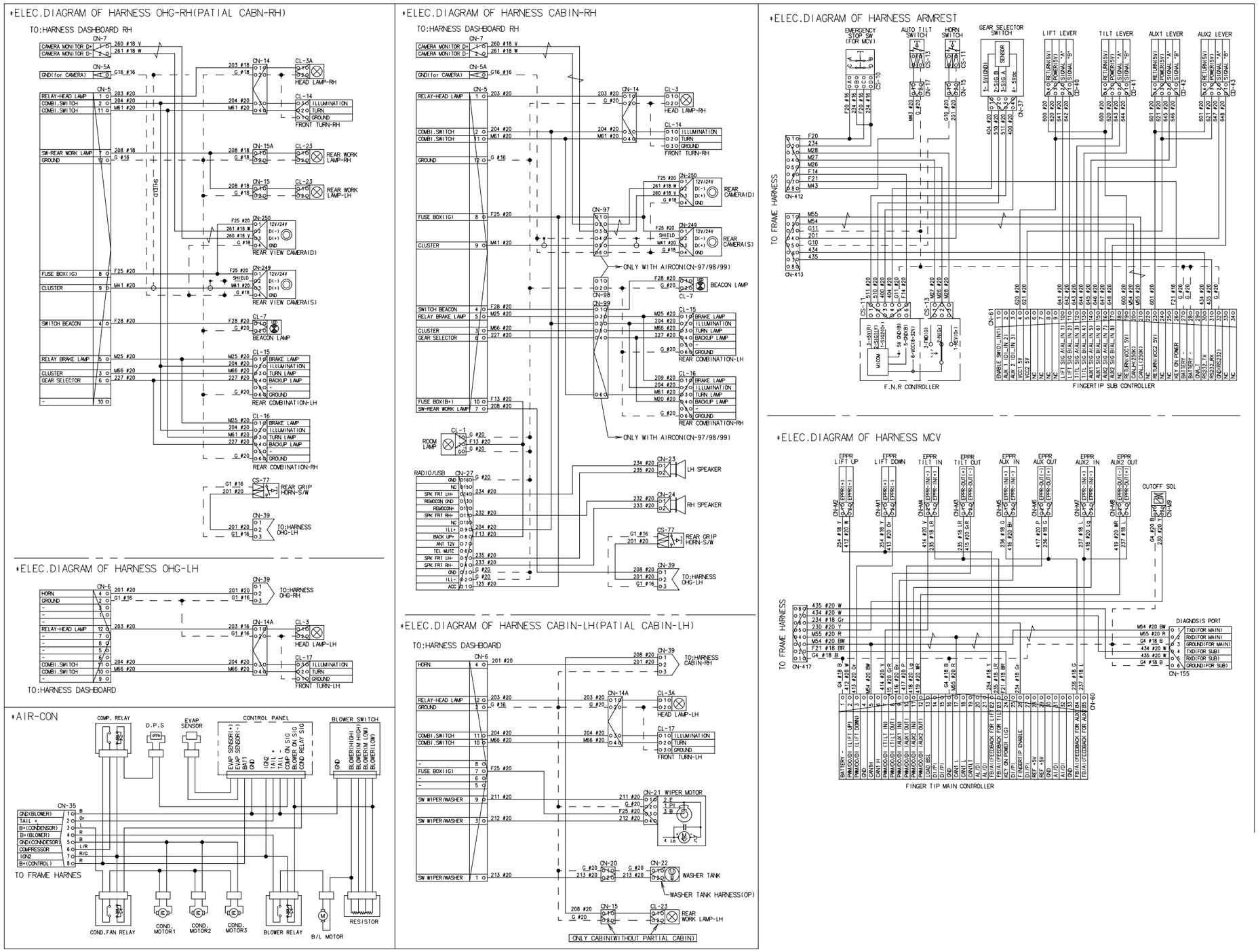


· ELECTRICAL CIRCUIT (3/4, FRAME-FINGERITP)



2YFV-00016-00 3OF4

· ELECTRICAL CIRCUIT (4/4, CABIN, OHG, AIRCON, HEATER)



1. POWER CIRCUIT

The negative terminal of the battery is grounded to the truck chassis.
When the start switch is in the off position, the current flows from the positive battery terminal.

1) OPERATING FLOW

Battery (+)

- Start motor [CN-45 (B+)] → Midi fuse [CN-48] → Glow controller [CR-24]
- Fuse box [CN-36]
  - Fuse box [No.9] → I/conn [CN-1 (21)] → Horn [CN-25 (1)]
  - Fuse box [No.8] → I/conn [CN-1 (4)] → Flasher unit [CR-11 (2)]
  - Fuse box [No.7] → I/conn [CN-1 (12)] → Warning buzzer [CN-113 (2)]
  - Fuse box [No.7] → I/conn [CN-1 (12)] → Cluster [CN-56 (73)]
  - Fuse box [No.19] → Fuel warmer relay [CR-49 (1)]
  - Fuse box [No.9] → ECU (B+) relay [CR-43 (1, 3)]
  - Fuse box [No.10] → To air conditioner harness
  - Fuse box [No.11] → To air conditioner harness
  - Fuse box [No.13] → I/conn [CN-1 (16)] → RMCU [CN-55 (2)]

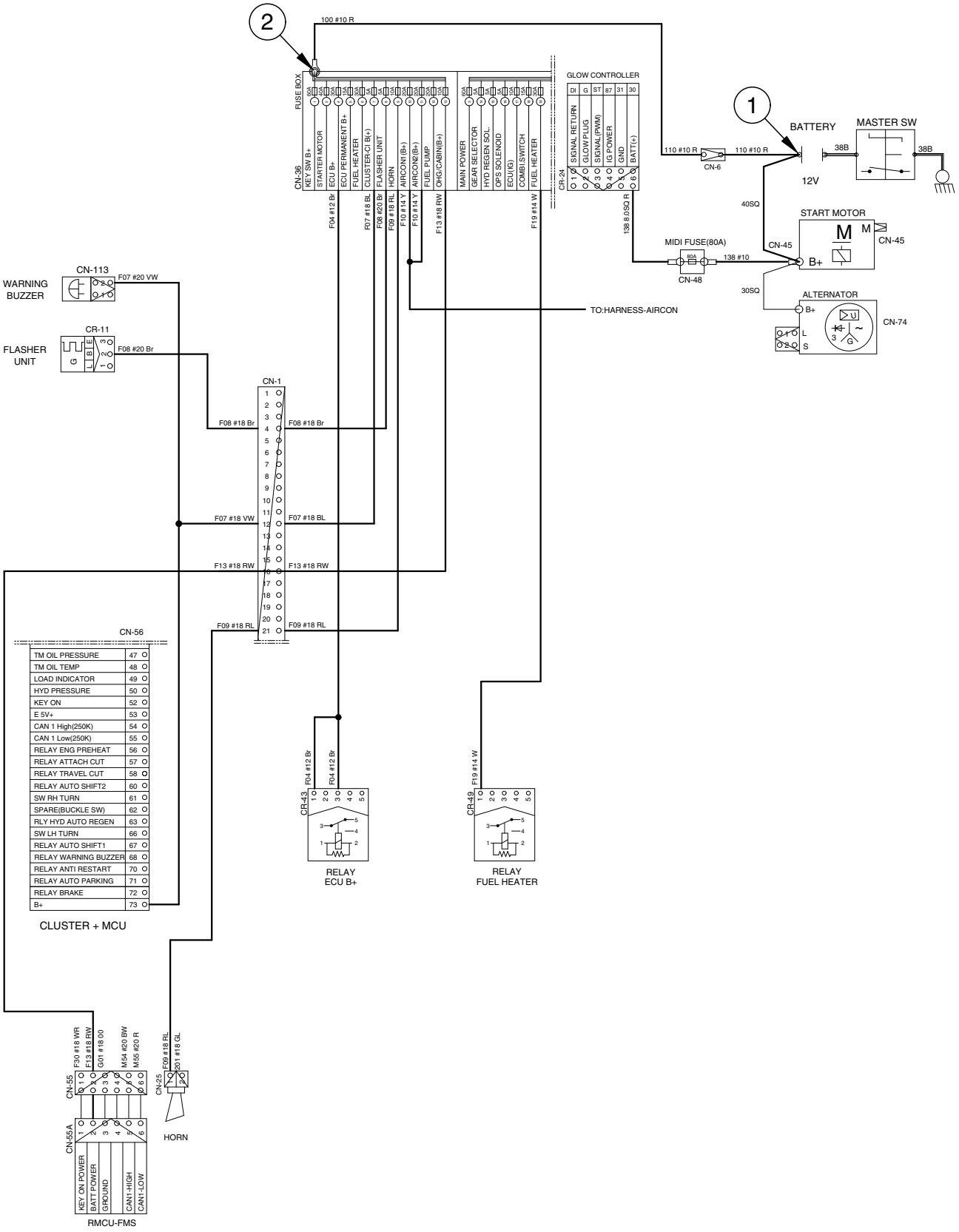
2) CHECK POINT

Engine	Start switch	Check point	Voltage
STOP	OFF	① - GND (Battery (+)) ② - GND (Fuse B+)	12V

※ 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+)]

※ The engine can be started only when the gear selector lever is in neutral position.

(1) When start switch is in ON position

Start switch ON [CS-46 (2)] → I/conn [CN-3 (2)] → Fuse box [CN-36 (No.3)]
→ Power is supply with the electric components.

(2) When start switch is START position

Start switch START [CS-46 (2)] → I/conn [CN-1 (9)] → Fuse box [CN-36 (No.34 → 31)]
→ Secret relay [CR-5 (3 → 4)] → Engine harness [CN-151 (35)] → Start motor operating

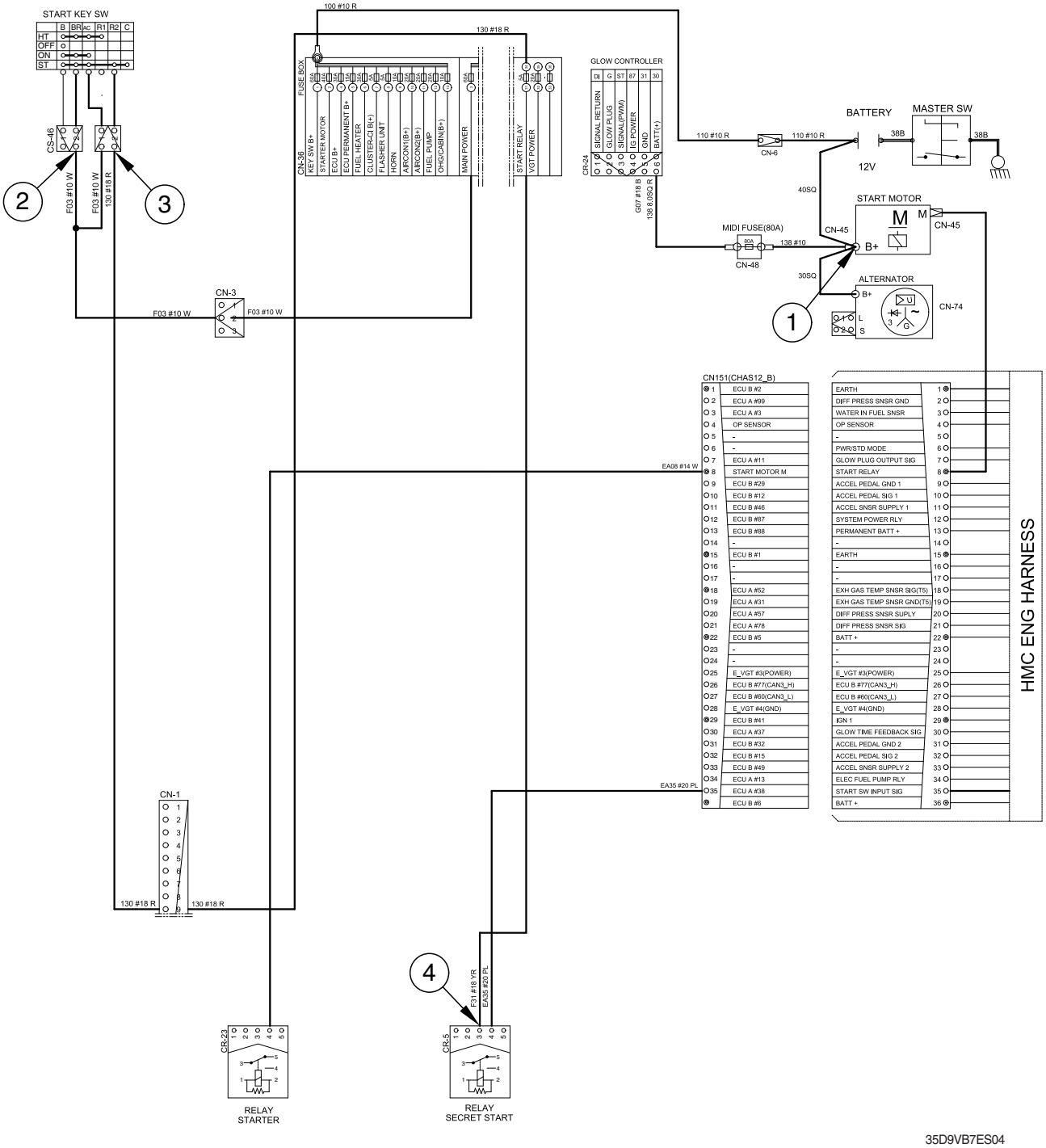
2) CHECK POINT

Engine	Start switch	Check point	Voltage
Running	ON	① - GND (Battery B+) ② - GND (Start key switch) ③ - GND (Start key switch) ④ - GND (Secret start relay)	12V

※ 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 alternator flows into the battery.
The current also flows from alternator to each electrical component through the fuse box.

1) OPERATING FLOW

(1) Warning flow
Cluster charging warning lamp (via CAN interface)

(2) Charging flow
Alternator (B+) → Start motor [CN-45 (B+)] → Battery (+) terminal → Charging

2) CHECK POINT

Engine	Start switch	Check point	Voltage
Running	ON	① - GND (Alternator B+) ② - GND (Battery voltage)	12V

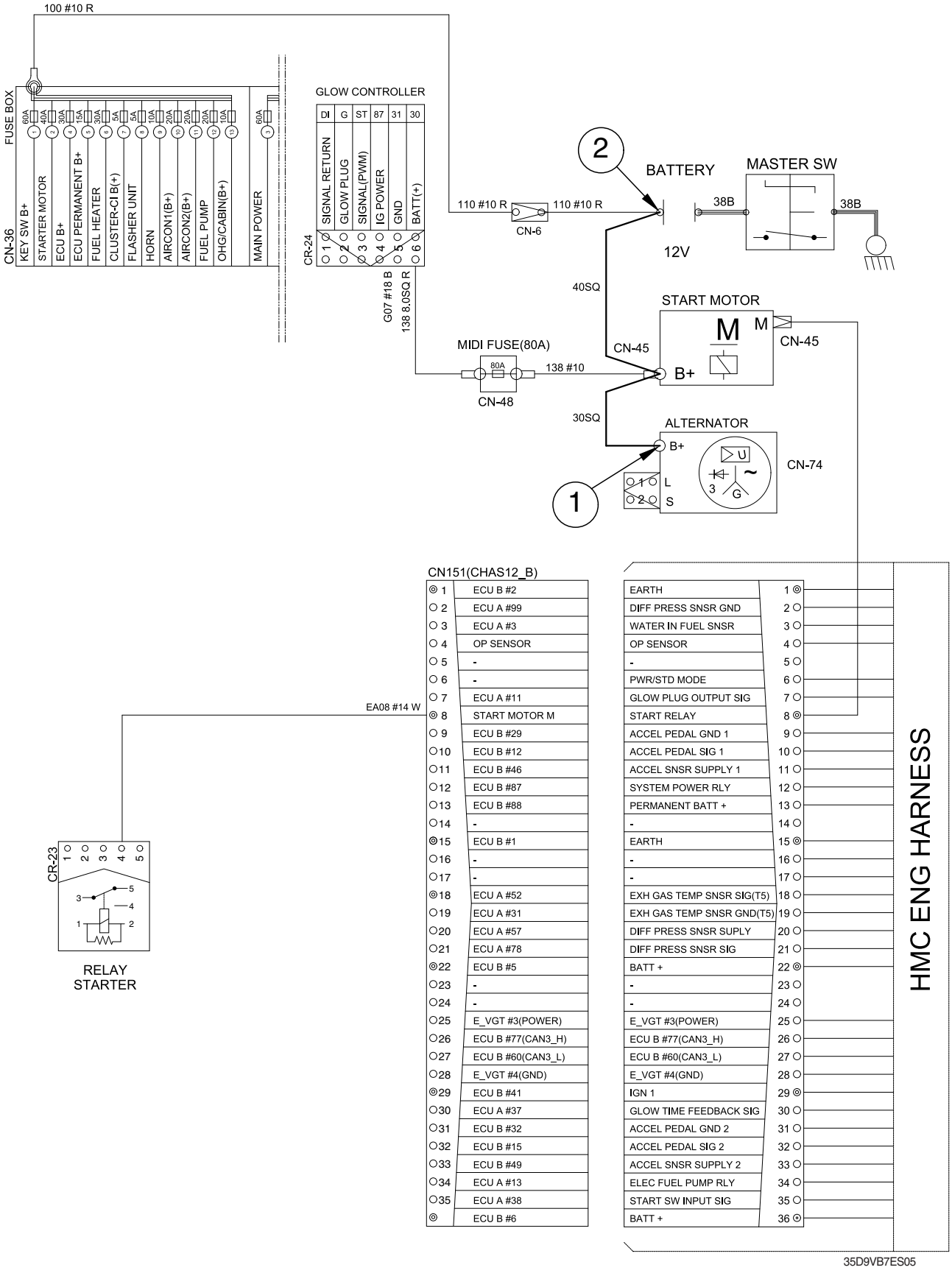
※ GND : Ground

※ 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. PREHEATER AND FUEL WARMER CIRCUIT

Combustion chamber air heater are used in order to give satisfactory starting of low ambient temperatures.

1) OPERATING FLOW

(1) Preheater

Battery (+) terminal → Start motor [CN-45 (B+)] → Midi fuse [CN-48]
→ Glow controller [CR-24]

※ When you turn the start switch to the ON position, the air heater relay makes the air heater operated and the air heater pilot lamp of the cluster turned ON.

(2) Fuel heater

Thermo switch [CD-60(2)] → Fuel warmer relay [CR-49 (2)]
Fuse box [CN-36, No.6] → Fuel warmer relay [CR-49, (3 → 4)] → Fuel warmer [CN-96 (B)]
→ Fuel warmer operating

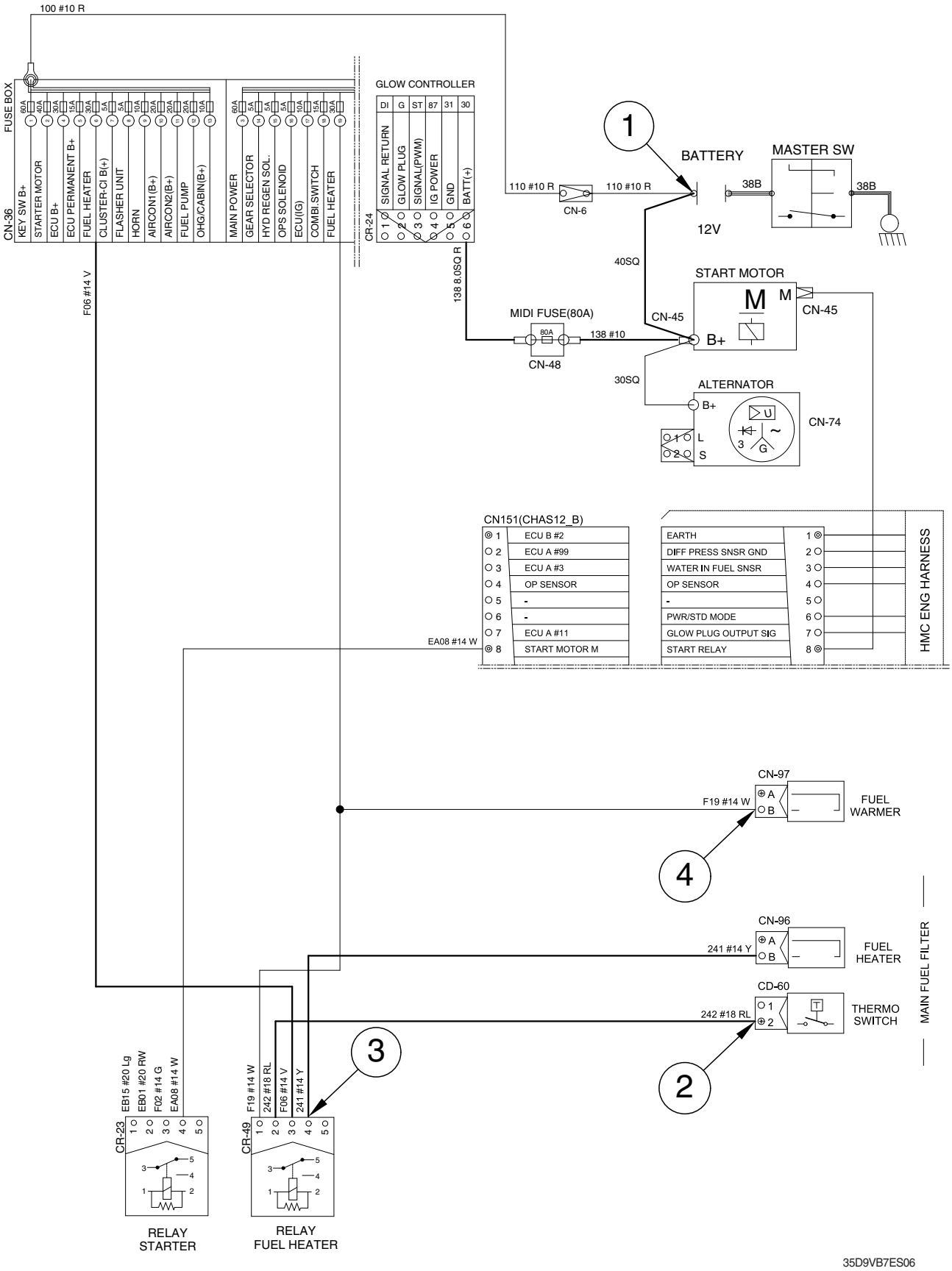
2) CHECK POINT

Engine	Key switch	Check point	Voltage
Stop	ON	① - GND (Battery B+) ② - GND (Thermo switch) ③ - GND (Fuel heater relay) ④ - GND (Fuel heater)	12V

※ GND : Ground

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

PREHEATER AND FUEL WARMER CIRCUIT



※ 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 [CS-36, No.18] → Multi function switch [CS-12 (5)]

- Multi function switch ON [CS-12 (7)] → I/conn [CN-1 (14)] → Head lamp relay [CR-13 (1→4)]
  - → I/conn [CN-1 (10)]
    - I/conn [CN-6 (12)] → LH Head lamp ON [CN-14A (1)]
    - I/conn [CN-5 (1)] → RH Head lamp ON [CN-14 (1)]
- Multi function switch ON [CS-12 (6)] → I/conn [CN-1 (13)] → Tail lamp relay [CR-40 (1→4)]
  - Switch pilot lamp ON
  - License lamp ON

(2) Rear work light

Fuse box [CN-36, No.28)] → I/conn [CN-1 (3)] → Rear work light switch [CS-21 (2)]
→ Switch ON [CS-21 (3)] → I/conn [CN-5 (7)]

- LH rear work light ON [CN-15 (1)]
- RH rear work light ON [CN-15A (1)]

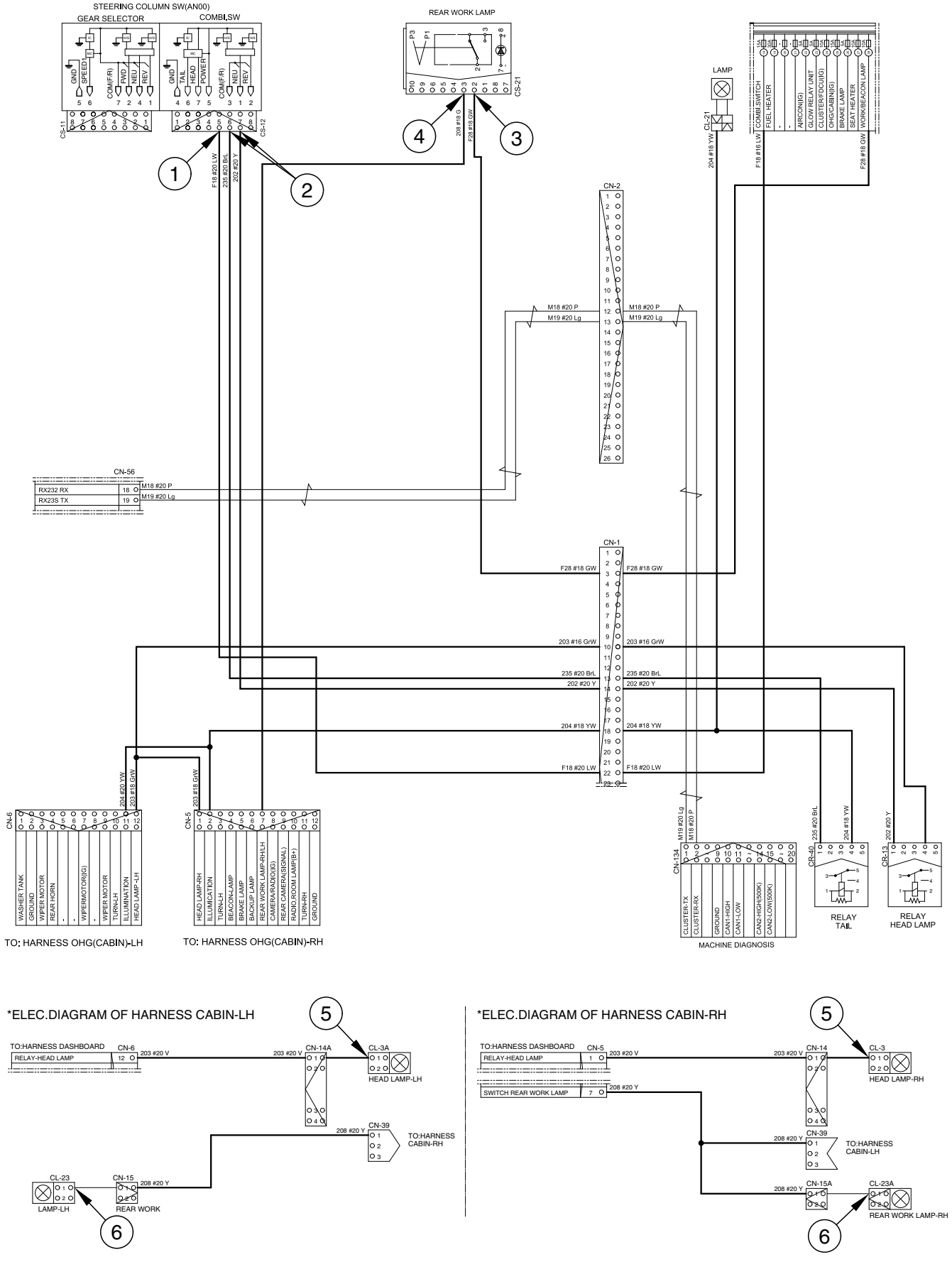
2) CHECK POINT

Engine	Start switch	Check point	Voltage
OFF	ON	① - GND (Multifunction switch input) ② - GND (Multifunction switch output) ③ - GND (Rear work light switch input) ④ - GND (Rear work light switch output) ⑤ - GND (High light) ⑥ - GND (Rear work light)	10~12.5V

※ GND : Ground

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

HEAD LIGHT AND REAR WORK LIGHT CIRCUIT



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

6. FRONT WIPER AND WASHER CIRCUIT

1) OPERATING FLOW

Fuse box [CN-36 (No.25)] → I/conn [CN-1 (7)] → Front wiper & washer switch [CS-3 (3, 5)]
I/conn [CN-6 (7)] → Wiper motor [CN-21 (3)]

(1) Front wiper & washer switch ON (1st step)

Front wiper & washer switch [CS-3 (2)] → I/conn [CN-6 (3)] → Front wiper motor [CN-21 (4)]
→ Front wiper motor operating

(2) Front wiper & washer switch ON (2nd step)

Front wiper & washer switch ON [CS-3 (2)] → I/conn [CN-6 (3)]
→ Front wiper motor [CN-21 (3)] → Front wiper motor operating
Front wiper & washer switch [CS-3 (6)] → I/conn [CN-6 (1)]
→ Front washer tank [CN-22 (2)] → Front washer pump operating

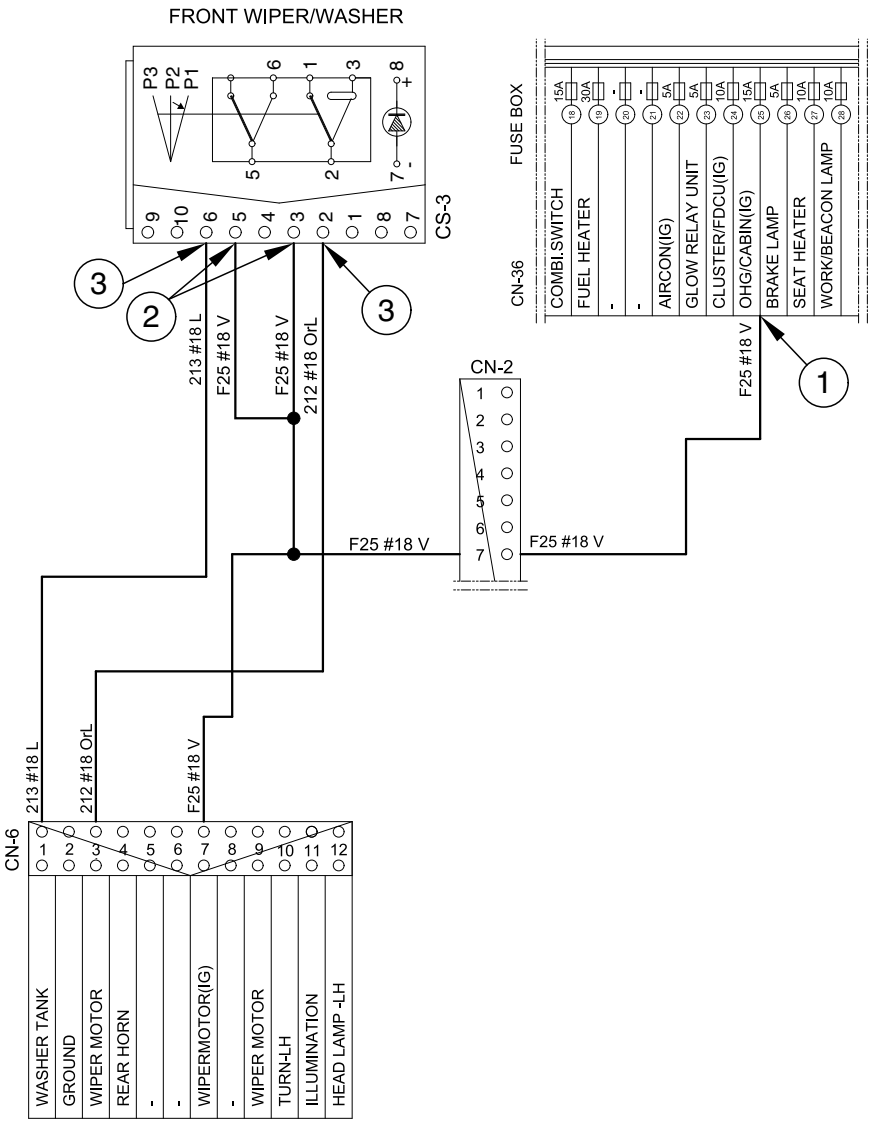
2) CHECK POINT

Engine	Start switch	Check point	Voltage
Stop	ON	① - GND (Fuse box No. 25) ② - GND (Front wiper & washer switch power input) ③ - GND (Front wiper & washer switch output) ④ - GND (Front wiper motor power input) ⑤ - GND (Front washer pump power input)	10~12.5V

※ GND : Ground

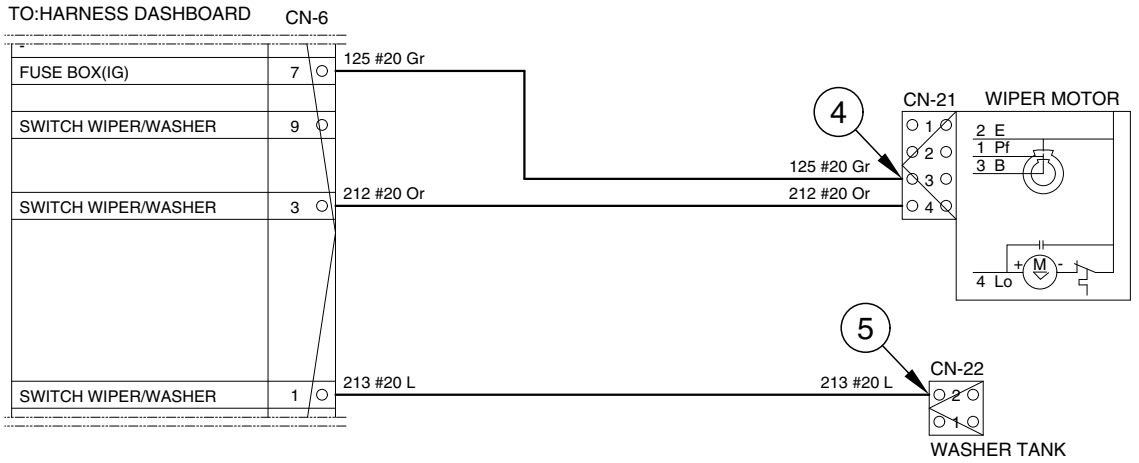
※ The circuit diagram may differ from the equipment, so please check before a repair.

FRONT WIPER AND WASHER CIRCUIT



TO: HARNESS OHG(CABIN)-LH

*ELEC.DIAGRAM OF HARNESS OHG(CABIN)-LH



35D9VB7ES08

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

GROUP 3 COMPONENT SPECIFICATION

<table>
<tr><th>No</th><th>Part name</th><th>Qty</th><th>Specification</th></tr>
<tr><td>1</td><td>Battery</td><td>1</td><td>12V×100 AH
RC : 190 min
CCA : 850 A</td></tr>
<tr><td>2</td><td>Work lamp</td><td>1</td><td>12V, 55W</td></tr>
<tr><td>3</td><td>Work lamp (LED, opt)</td><td>1</td><td>12V, 22W</td></tr>
<tr><td>4</td><td>License lamp (opt)</td><td>1</td><td>12V, 10W</td></tr>
<tr><td>5</td><td>Rear combination lamp (LED)</td><td>2</td><td>12V, 1.6/0.2W (Stop/Tail)
12V, 1.1W (Turn)
12V, 1.1W (Back Up)</td></tr>
<tr><td>6</td><td>Flasher lamp</td><td>2</td><td>12V, 0.5/2.2W (posit/turn signal)</td></tr>
<tr><td>7</td><td>Beacon lamp (LED/opt)</td><td>1</td><td>12V, max. 0.800A</td></tr>
<tr><td>8</td><td>Camera (opt)</td><td>1</td><td>12V, 1.32W</td></tr>
<tr><td>9</td><td>Flasher unit relay (3P)</td><td>1</td><td>12V, 20A</td></tr>
<tr><td>10</td><td>Relay (5P)</td><td>10</td><td>12V, 20A</td></tr>
<tr><td>11</td><td>Flasher Unit</td><td>1</td><td>12V, 85±10 CM, (23W + 23W)×2 + 3W×2</td></tr>
<tr><td>12</td><td>Back buzzer</td><td>1</td><td>12V, 90±5 dB, 60±10 C/M</td></tr>
<tr><td>13</td><td>Horn</td><td>1</td><td>12V, MAX 3.5A, 105 ~ 120 dB</td></tr>
<tr><td>14</td><td>Cluster-CI</td><td>1</td><td>12V, 15W</td></tr>
<tr><td>15</td><td>G-sensor (Mast angle) (opt)</td><td>1</td><td>12V, 5W</td></tr>
<tr><td>16</td><td>Fuel level sender</td><td>1</td><td>
<table>
<tr><td>Float indicator</td><td>E</td><td>4/8</td><td>F</td></tr>
<tr><td>Resistance (Ω)</td><td>700</td><td>350</td><td>50</td></tr>
<tr><td rowspan="2">Tolerance (Ω)</td><td>−0%</td><td rowspan="2">+5%</td><td>+0%</td></tr>
<tr><td>+5%</td><td>−5%</td></tr>
</table>
</td></tr>
<tr><td>17</td><td>Master switch (opt)</td><td>1</td><td>12V, 180A</td></tr>
<tr><td>18</td><td>Gear selector switch</td><td>1</td><td>12V, 3.5A</td></tr>
<tr><td>19</td><td>Combination switch</td><td>1</td><td>Direction : 12V, 3.5A
Multi-function switch : 12V, 2A</td></tr>
<tr><td>20</td><td>Rear worklamp switch (opt)</td><td>1</td><td>12V, 15A</td></tr>
<tr><td>21</td><td>Hazard switch (opt)</td><td>1</td><td>12V, 15A</td></tr>
<tr><td>22</td><td>Fuel warmer switch</td><td>1</td><td>12V, 15A</td></tr>
<tr><td>23</td><td>Beacon lamp switch (opt)</td><td>1</td><td>12V, 15A</td></tr>
<tr><td>24</td><td>Wiper/washer switch (opt)</td><td>1</td><td>12V, 15A</td></tr>
<tr><td>25</td><td>Accelerator pedal</td><td>1</td><td>12V, input voltage 5Vdc, current 16~20mA</td></tr>
<tr><td>26</td><td>Parking switch</td><td>1</td><td>12V, 15A</td></tr>
<tr><td>27</td><td>OPSS buzzer</td><td>1</td><td>12V, 50mA max, 80~90dB</td></tr>
<tr><td>28</td><td>Socket assy (opt)</td><td>1</td><td>12V, 10A</td></tr>
<tr><td>29</td><td>Blue spot (LED, opt)</td><td>1</td><td>12V, 8W</td></tr>
</table>

GROUP 4 CONNECTOR DESTINATION

1. FRAME HARNESS

Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CN-1	AMP	42	Dashboard Harness	936614-2	0-936429-2
CN-2	AMP	26	Dashboard Harness	1897009-2	936784-2
CN-3	KET	3	Dashboard Harness	MG631984	MG652290-5
CN-18	AMP	2	Socket (12V) Harness	174352-2	368121-1
CN-36	QPL	-	Fuse Box Main Ass'y	21HN-55010	-
CN-37	KET	8	Knob Gear Selector	-	MG640341
CN-43	KET	2	Aircon Harness	-	MG652934-5
CN-44	KET	1	Aircon Harness	-	MG640280
CN-45	HCE	-	Start Motor	-	-
CN-48	LITTLE FUSE	-	MIDI FUSE HOLDER	-	-
CN-61	HCE	-	Fuel Pump	-	-
CN-65	KET	2	Backup Alarm	-	MG640322
CN-71	DEUTSCH	2	Parking Valve	DT06-2S	
CN-87	AMP	3	Cutoff Sol	963040-3	-
CN-91	DEUTSCH	6	Seat Switch	DT06-6S	-
CN-96	DELPHI	2	Fuel Heater	10737780	-
CN-97	DELPHI	2	Fuel Warmer	15300027	-
CN-122	DEUTSCH	2	FWD SOL 2	DT06-2S	-
CN-123	DEUTSCH	2	REV SOL	DT06-2S	-
CN-124	DEUTSCH	2	FWD SOL 1	DT06-2S	-
CN-134	KET	20	Machine Diagnosis	MG652863	MG632867
CN-144	AMP	6	Accel Pedal	174262-2	-
CN-151	AMP	36	HMC E/G Harness	-	1743062-2
CN-152	AMP	36	HMC E/G Harness	-	1743062-3
CN-153	KUM	6	HMC E/G Harness	PB625-06027	-
CN-154	KET	1	HMC E/G Harness	MG613801-5	-
CN-156	MOLEX	16	ECU Diagnosis	51115-1601	68154-0021
CN-250	KET	8	EXT Harness	MG633061	MG640341
CN-J1	KET	20	Joint Connector #1	MG655633	-
· Relay					
CR-24	FCI	6	Glow Controller	-	F162210
· Switch					
CS-11	AMP	3	F.N.R Controller A	-	174357-2
CS-13	AMP	6	F.N.R Controller B	174264-2	-
CS-53	KET	2	Tilt Lever Switch	MG610320	-

Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
· Lamp					
CL-21	KET	1	License Lamp	ST730018-3	ST750036-3
· Sensor, sender					
CD-1	DEUTSCH	4	Hyd PS/Temp Sensor	DT06-4S	-
CD-2	KET	3	Feul Sender	MG610327	-
CD-10	KET	1	Air-Cleaner Switch	ST730057-2	-
CD-29	DEUTSCH	3	TM PS/TEMP Sensor	DT06-3S	-
CD-38	AMP	3	WIF	-	936292-2
CD-40	AMP	3	TM Speed Sensor	963040-3	-
CD-60	AMP	2	Thermo Switch	282080-1	-
CD-70	DEUTSCH	3	Load Sensor	DT06-3S	
CD-77	KET	3	Diff Pressure Sensor	MG64453-5	-
CD-78	DELPHI	2	Exhaust Gas Temp Sensor (DPF T5)	33401218	-
CD-79	DELPHI	2	Exhaust Gas Temp Sensor (DOC T4)	33401219	-
· Diode					
DO-01	AMP	2	Diode	174352-2	-

2. FRAME HARNESS (FIGERTIP, OPTION)

Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CN-1	AMP	42	Dashboard Harness	936614-2	0-936429-2
CN-2	AMP	26	Dashboard Harness	1897009-2	936784-2
CN-3	KET	3	Dashboard Harness	MG631984	MG652290-5
CN-18	AMP	2	Socket (12V) Harness	174352-2	368121-1
CN-36	QPL	-	Fuse Box Main Ass'y	21HN-55010	-
CN-43	KET	2	Aircon Harness	-	MG652934-5
CN-44	KET	1	Aircon Harness	-	MG640280
CN-45	HCE	-	Start Motor	-	-
CN-48	LITTLE FUSE	-	MIDI FUSE HOLDER	-	-
CN-61	HCE	-	Fuel Pump	-	-
CN-65	KET	2	Backup Alarm	-	MG640322
CN-71	DEUTSCH	2	Parking Valve	DT06-2S	
CN-91	DEUTSCH	6	Seat Switch	DT06-6S	-
CN-96	DELPHI	2	Fuel Heater	10737780	-
CN-97	DELPHI	2	Fuel Warmer	15300027	-
CN-122	DEUTSCH	2	FWD SOL 2	DT06-2S	-
CN-123	DEUTSCH	2	REV SOL	DT06-2S	-

Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CN-124	DEUTSCH	2	FWD SOL 1	DT06-2S	-
CN-134	KET	20	Machine Diagnosis	MG652863	MG632867
CN-144	AMP	6	Accel Pedal	174262-2	-
CN-151	AMP	36	HMC E/G Harness	-	1743062-2
CN-152	AMP	36	HMC E/G Harness	-	1743062-3
CN-153	KUM	6	HMC E/G Harness	PB625-06027	-
CN-154	KET	1	HMC E/G Harness	MG613801-5	-
CN-156	MOLEX	16	ECU Diagnosis	51115-1601	68154-0021
CN-250	KET	8	EXT Harness	MG633061	MG640341
CN-412	AMP	8	Armrest Harness	-	174984-2
CN-413	AMP	8	Armrest Harness	174982-2	-
CN-417	KET	8	MCV Harness	MG610339	-
CN-J1	KET	20	Joint Connector #1	MG655633	-
· Relay					
CR-24	FCI	6	Glow Controller	-	F162210
· Lamp					
CL-21	KET	1	License Lamp	ST730018-3	ST750036-3
· Sensor, sender					
CD-1	DEUTSCH	4	Hyd PS/Temp Sensor	DT06-4S	-
CD-2	KET	3	Feul Sender	MG610327	-
CD-10	KET	1	Air-Cleaner Switch	ST730057-2	-
CD-29	DEUTSCH	3	TM PS/TEMP Sensor	DT06-3S	-
CD-38	AMP	3	WIF	-	936292-2
CD-40	AMP	3	TM Speed Sensor	963040-3	-
CD-60	AMP	2	Thermo Switch	282080-1	-
CD-70	DEUTSCH	3	Load Sensor	DT06-3S	
CD-77	KET	3	Diff Pressure Sensor	MG64453-5	-
CD-78	DELPHI	2	Exhaust Gas Temp Sensor (DPF T5)	33401218	-
CD-79	DELPHI	2	Exhaust Gas Temp Sensor (DOC T4)	33401219	-
· Diode					
DO-01	AMP	2	Diode	174352-2	-

3. DASHBOARD HARNESS

Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CN-1	AMP	42	Frame Harness	0-936421-2	0-936615-2
CN-2	AMP	26	Frame Harness	-	1897013-2
CN-3	KET	3	Frame Harness	MG642292-5	-

Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CN-1	AMP	42	Frame Harness	0-936421-2	0-936615-2
CN-2	AMP	26	Frame Harness	-	1897013-2
CN-3	KET	3	Frame Harness	MG642292-5	-
CN-5	KET	12	OHG (Cabin)-RH Harness	MG630418	MG640348
CN-6	KET	12	OHG (Cabin)-LH Harness	MG630418	MG640348
CN-19	AMP	4	G Sensor Harness	174257-2	368121-1
CN-25	MOLEX	2	Horn	35825-0211	-
CN-49	AMP	2	Blue Spot	174352-2	-
CN-54	AMP	32	FDCU	344111-1	-
CN-55	DEUTSCH	6	FMS Harness	DT06-6S	-
CN-56	MOLEX	73	Cluster CI	34566-0103	-
CN-113	KET	2	Warining Buzzer	MG610320	-
CN-J1	KET	20	Joint Connector #1	MG655633	-
CN-J2	KET	20	Joint Connector #2	MG621725-5	-
· Releay					
CR-11	DAEDONG	3	Flasher Unit	312 GIHUNG 3P	-
· Switch					
CS-3	CALRING (VC2-01)	10	Wiper Switch	21HN-56300	-
CS-5	HCE	-	Horn Switch	-	-
CS-11	AMP	8	Gear Selector	174982-2	-
CS-12	AMP	8	Combi Switch	-	174984-2
CS-17	CALRING (VC2-01)	10	Parking Switch (Rocker)	21HN-56300	-
CS-21	CALRING (VC2-01)	10	Reat Work Lamp Switch	21HN-56300	-
CS-23	CALRING (VC2-01)	10	Becon Lamp Switch	21HN-56300	-
CS-41	CALRING (VC2-01)	10	Hazard Switch	21HN-56300	-
CS-46	KET	2	Start Key	MG610281	-
	KET	2		-	MG620282
CS-75	CLRING (VC2-01)	10	Rgen Switch	21HN-56300	-
· Pressure switch					
CD-26	AMP	1	Parking PS Switch	171809-2	-
CD-70	AMP	3	Brake Switch	174357-2	-

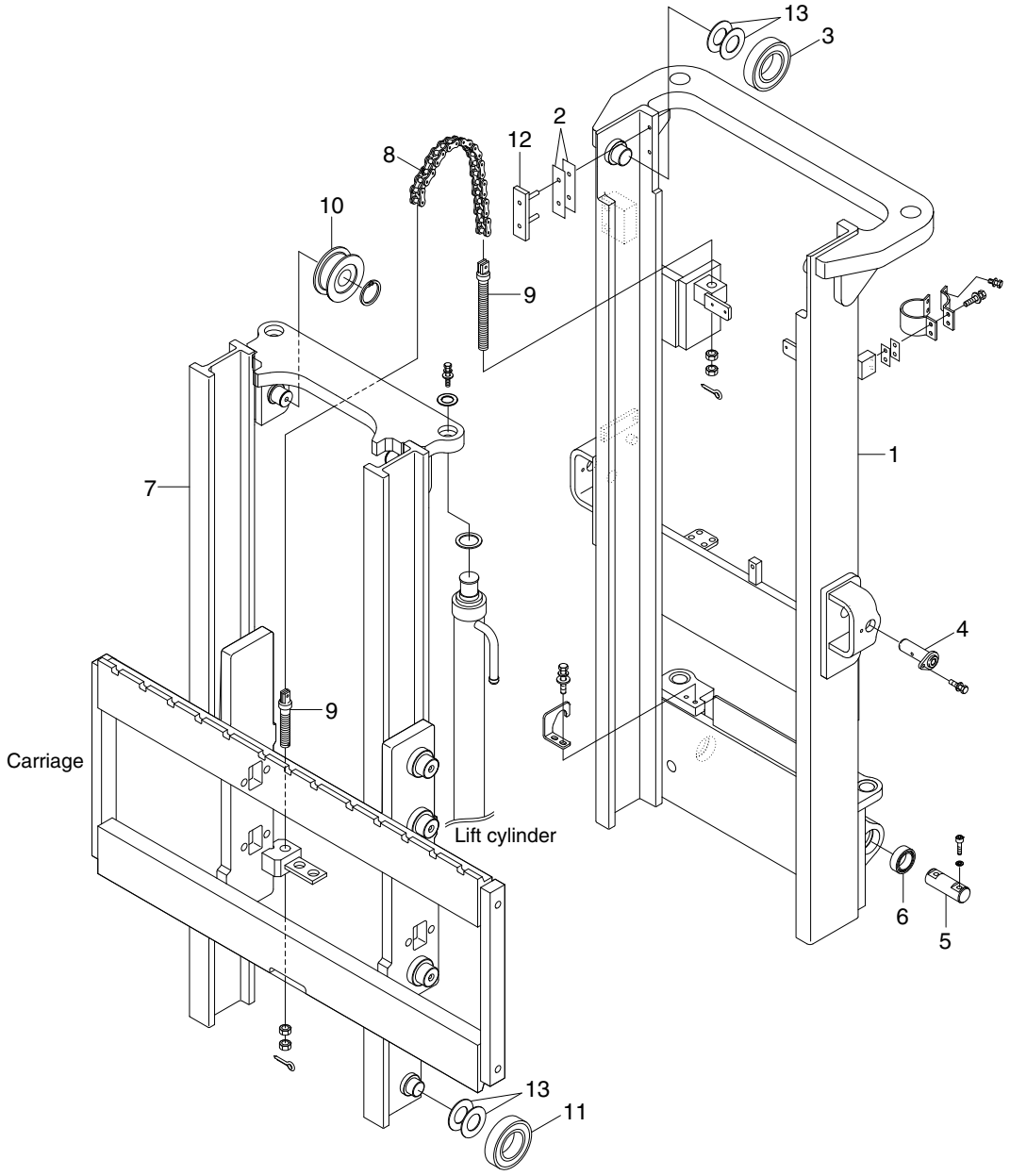
GROUP 5 TROUBLESHOOTING

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.	· Check and repair. · Recharge battery.
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

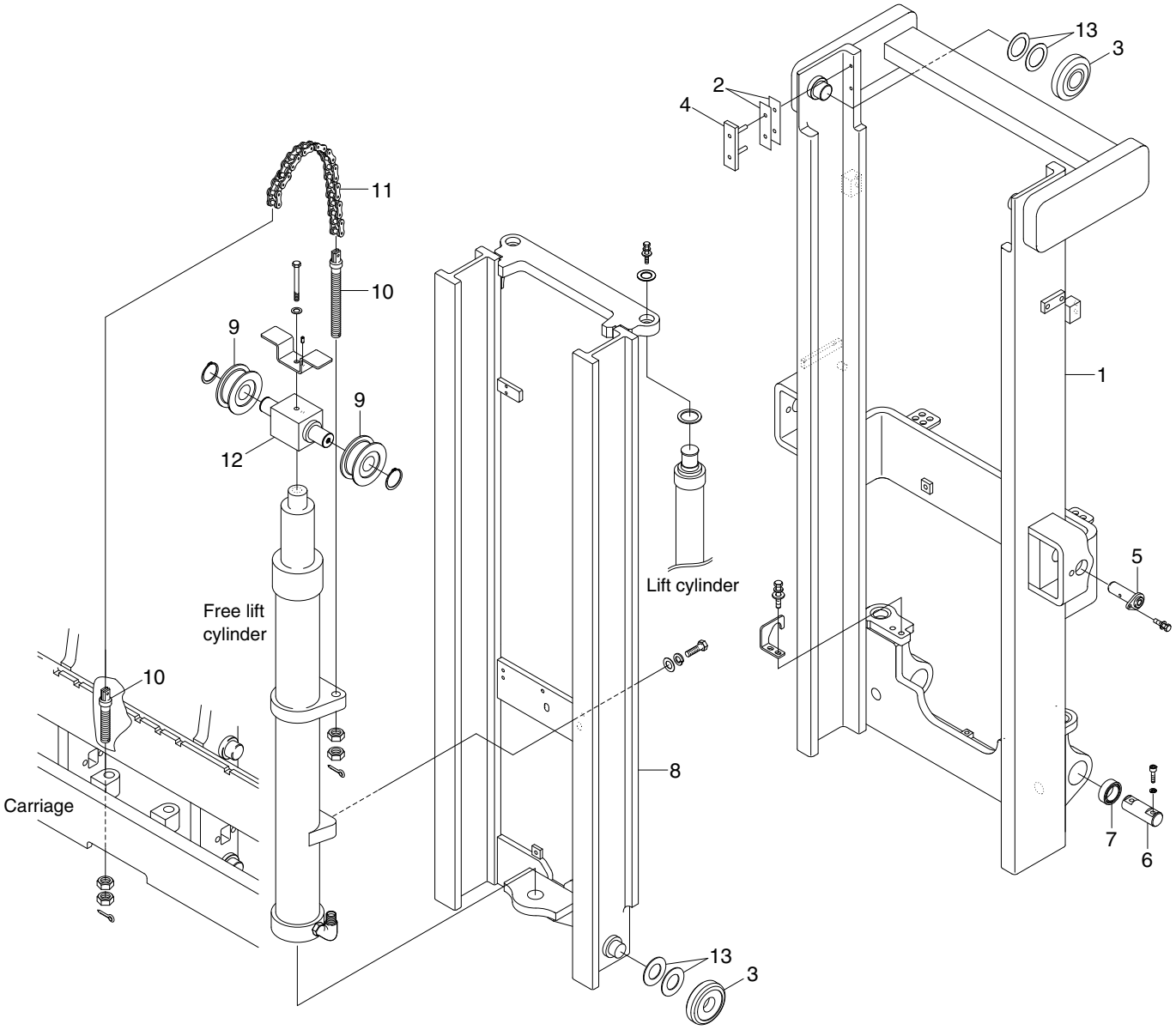
1. 2 STAGE MAST (V MAST)



35D9MS01

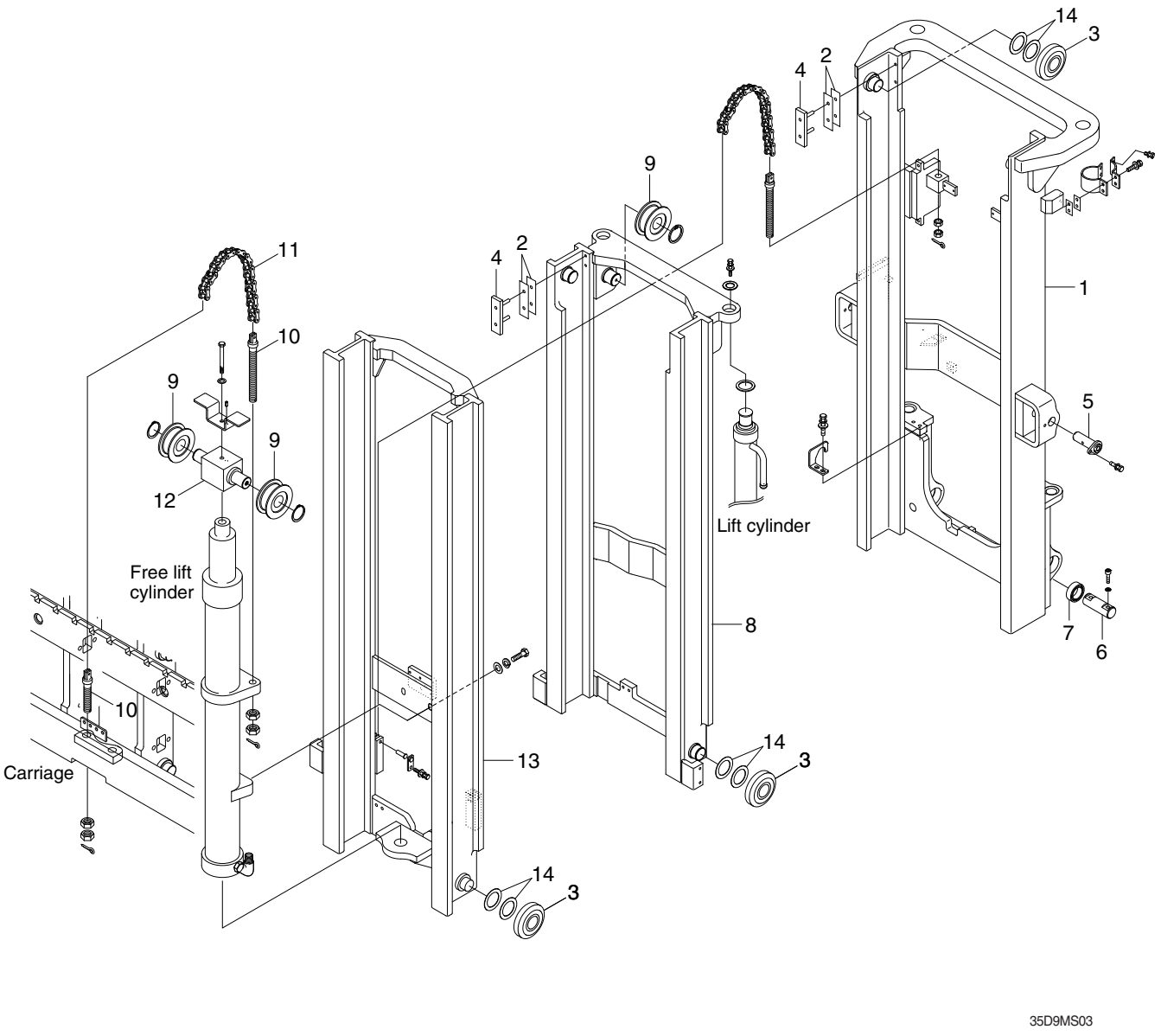
1	Outer mast	6	Bearing	11	Roller bearing
2	Shim (0.5, 1.0t)	7	Inner mast	12	Back up liner
3	Roller bearing	8	Lift chain	13	Shim (0.5, 1.0t)
4	Tilt cylinder pin	9	Anchor bolt		
5	Mast mounting pin	10	Chain sheave bearing		

2. 2 STAGE MAST(VF MAST)



1	Outer mast	6	Mast mounting pin	11	Chain
2	Shim (0.5, 1.0t)	7	Bearing	12	Sheave bracket
3	Roller bearing	8	Inner mast	13	Shim (0.5, 1.0t)
4	Backup liner	9	Chain sheave bearing		
5	Tilt cylinder pin	10	Anchor bolt		

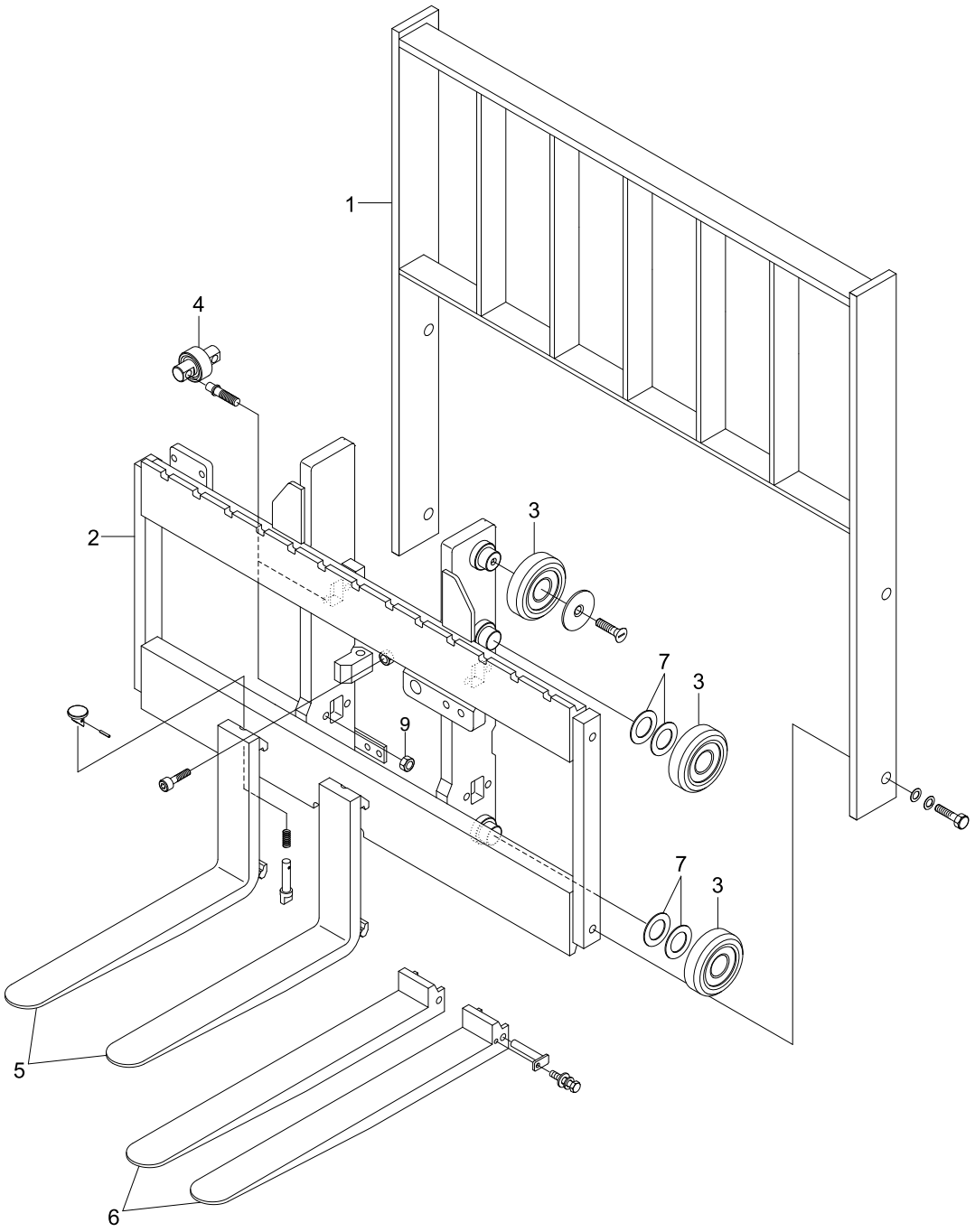
3. 3 STAGE MAST(TF MAST)



35D9MS03

1	Outer mast	6	Mast mounting pin	11	Chain
2	Shim (0.5, 1.0t)	7	Bearing	12	Sheave bracket
3	Roller bearing	8	Middle mast	13	Inner mast
4	Backup liner	9	Chain sheave bearing	14	Shim (0.5, 1.0t)
5	Tilt cylinder pin	10	Anchor bolt		

3. CARRIAGE, BACKREST AND FORK



35D9MS04

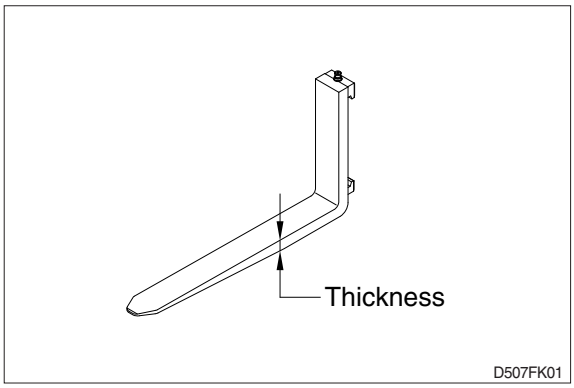
1	Backrest	5	Fork
2	Carriage	6	Extension fork
3	Roller	7	Shim (0.5, 1.0t)
4	Side roller		

GROUP 2 OPERATIONAL CHECKS AND TROUBLESHOOTING

1. OPERATIONAL CHECKS

1) FORKS

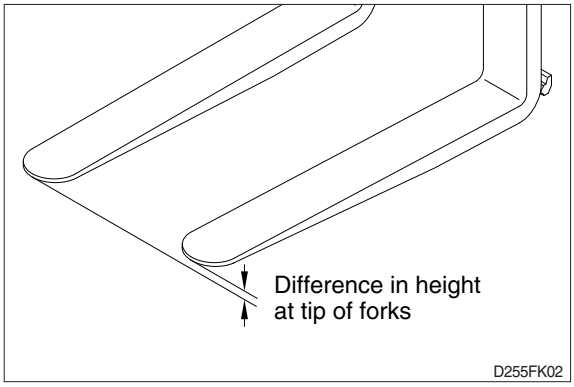
(1) Measure thickness of root of forks and check that it is more than specified value.
EX : ℓ =1200 mm (47 in)



mm (in)

STD Fork assy	Applicable model	Standard	Limit
S173896-02	35D-9VB 40D-9VC	50 (2.0)	45 (1.7)
F13710020	40D-9VB 45D-9VC	50 (2.0)	45 (1.7)
F13710020	45D-9VB 50DN-9VC	50 (2.0)	45 (1.7)
F14710011	50DN-9VB	60 (2.4)	54 (2.1)

2) Set forks in middle and measure out of parallel and difference in height at the top of forks.



Fork length	Height difference
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</th><th>Height difference</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 (V, VF MAST)

1) INNER/OUTER MAST ROLLER CLEARANCE ADJUSTMENT

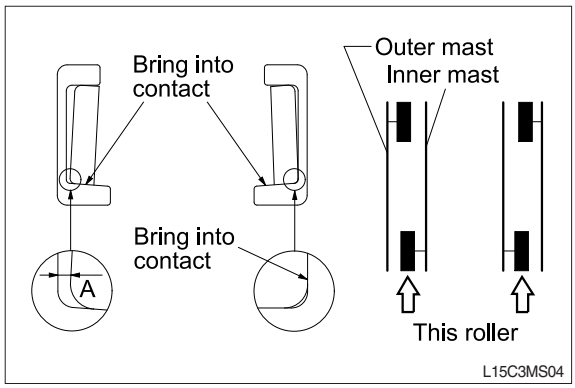
(1) Measure the clearance with the mast overlap at near 480 mm.

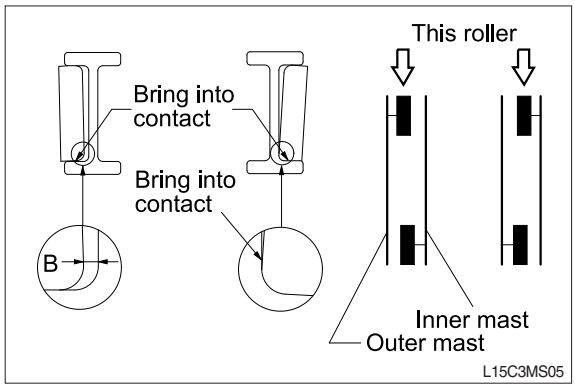
(2) Shift the inner mast to one side to bring the roller into contact with the outer mast, and adjust the clearance between the roller side face and mast at the closest position on the opposite side to the following value by inserting the inner/outer mast roller shim.

- Standard clearance A, B = 0~0.6 mm
- Shim thickness 0.5, 1.0 mm

(3) Distribute the shim thickness equally to the left and right roller. Refer to Mast load roller and back up liner, removal and Installation.

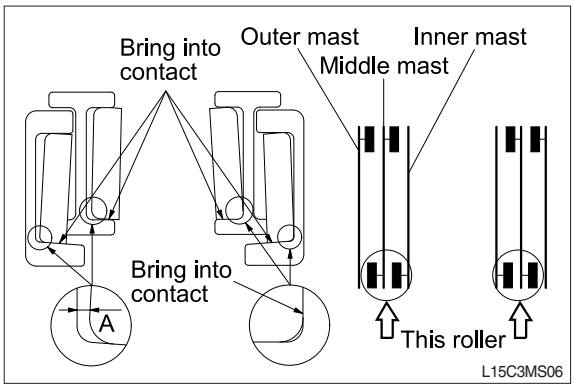
(4) After the adjustment, check that the inner mast moves smoothly in the outer mast.





2. MAST LOAD ROLLER (TF MAST)

1) INNER AND MIDDLE MAST ROLLER CLEARANCE ADJUSTMENT



(1) Measure the clearance with the mast overlap at near 480 mm.

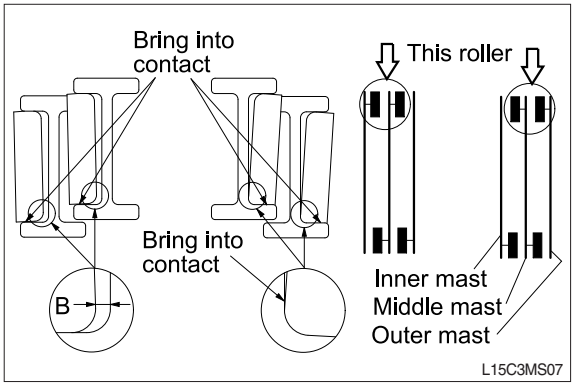
(2) Shift the inner mast to one side to bring the roller into contact with the outer mast and the middle mast, and adjust the clearance between the roller side face and mast at the closest position on the opposite side to the following value by inserting the inner and middle mast roller shim, respectively.

- Standard clearance A = 0~0.6 mm
- Shim thickness 0.5, 1.0 mm

(3) Distribute the shim thickness equally to the left and right roller. Refer to Mast load roller and back up liner, removal and Installation.

(4) After the adjustment, check that the inner mast moves smoothly in the middle mast, and the middle mast moves smoothly in the outer mast.

2) OUTER AND MIDDLE MAST UPPER ROLLER CLEARANCE ADJUSTMENT.



(1) Measure the clearance with the mast overlap at near 480 mm.

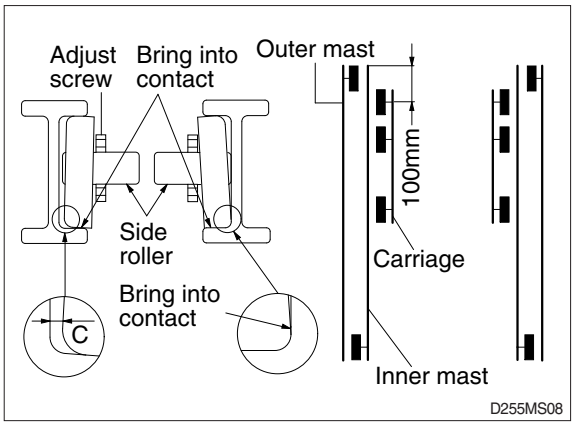
(2) Shift the inner mast to one side to bring the roller into contact with the outer mast and the middle mast, and adjust the clearance between the roller side face and mast at the closest position on the opposite side to the following value by inserting the outer and middle mast roller shim, respectively.

- Standard clearance B = 0~0.6 mm
- Shim thickness 0.5, 1.0 mm

(3) Distribute the shim thickness equally to the left and right roller. Refer to Mast load roller and back up liner, removal and Installation.

(4) After the adjustment, check that the inner mast moves smoothly in the middle mast, and the middle mast moves smoothly in the outer mast.

3) 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.

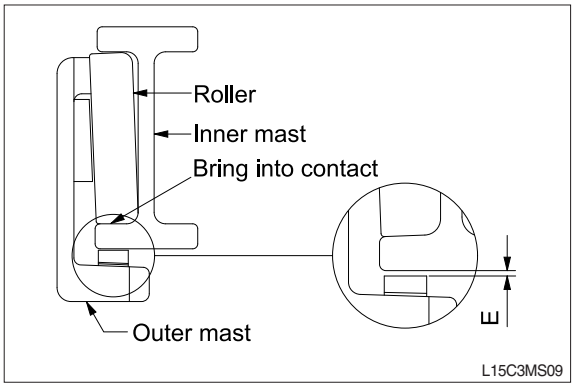
(2) Measure the clearance at upper, middle and lower rollers after loosen the adjust screws from the side rollers. Shift the carriage to one side to bring the roller into contact with the inner mast, and measure the clearance between the roller side face and mast at the closest position on the opposite side to the following value by inserting the carriage roller shim.

- Standard clearance C = 0~0.6 mm
- Shim thickness 0.5, 1.0 mm

(3) Distribute the shim thickness equally to the left and right roller. Refer to Carriage assembly.

(4) After the adjustment, the carriage should move smoothly along the overall mast length.

4) MAST BACK UP LINER



(1) Measure the clearance with the middle mast at the bottom position.

(2) With the middle mast in contact with the outer mast roller, adjust the clearance between the mast back up liner and middle mast to the following value by inserting the back up liner shim.

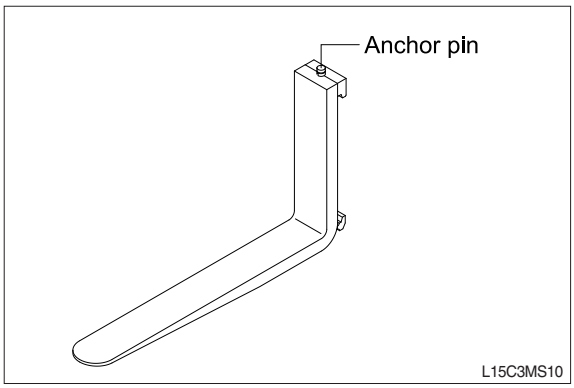
- Standard clearance E = 0.2 ~ 0.6 mm
- Shim thickness 0.5, 1.0 mm

(3) After the adjustment, the mast should move smoothly.

GROUP 4 REMOVAL AND INSTALLATION

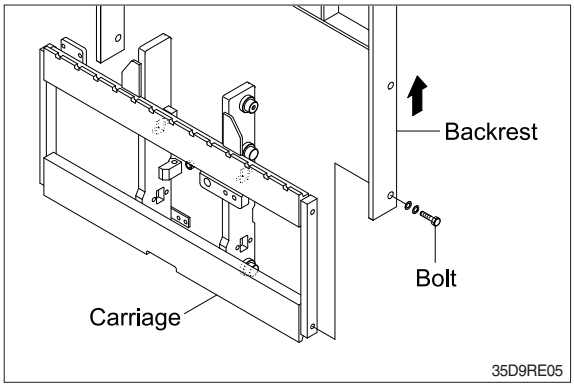
1. FORKS

1) Lower the fork carriage until the forks are approximately 25 mm (1 in) from the floor.
2) Release fork anchor pins and slide forks, one by one, toward the center of the carriage where a notch has been cut in the bottom plate for easy fork removal.
3) Remove the fork one by one. On larger forks it may be necessary to use a block of wood.
4) Reverse the above procedure to install load forks.



2. BACKREST

1) Remove bolts securing backrest to fork carriage. Lift backrest straight up and remove from carriage.
2) Position backrest on carriage and lower in place. Install and tighten bolts.



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 elevating upright until mast clears top of fork carriage. Move carriage to work area and lower mast.

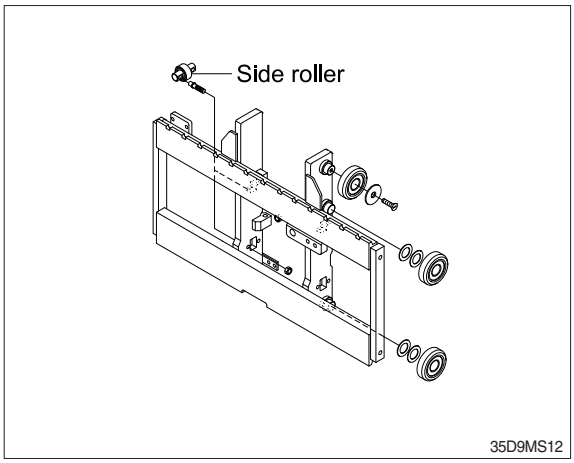
⚠ Make sure carriage remains on floor and does not bind while mast is being raised.

(5) Inspect all parts for wear or damage. Replace all worn or damaged pars.
(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 assembly and removal paragraph.
(2) Loosen and remove nuts, adjust screws and side rollers from carriage side pate.
(3) Thoroughly clean, inspect and replace all worn or damaged parts.
(4) Reverse the above procedure to assembly.

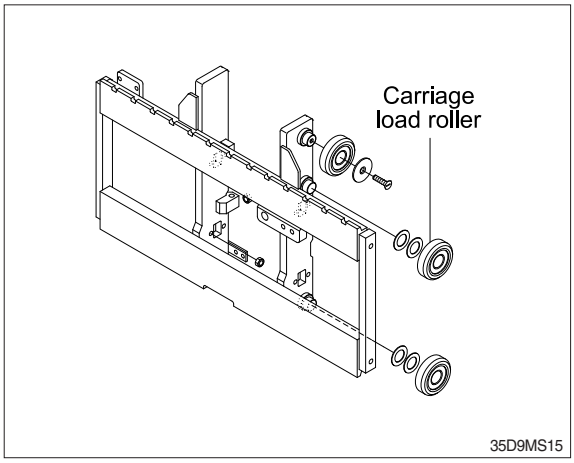


※ Adjustment

- 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 for 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

(1) Remove carriage as outlined in the carriage assembly removal paragraph.
(2) Loosen and remove flat head bolts and plain washers from top load roller bracket.
(3) Using a pryer, remove load rollers from load roller bracket.
(4) Reverse the above procedure to assemble. Refer to MAST ROLLER ADJUSTMENT paragraph.



4) MAST LOAD ROLLER AND BACK UP LINER

(1) 2 stage mast (V mast)

① Remove the carriage assembly and move them to one side.

② Loosen and remove hexagon bolts and clamps securing lift cylinders to outer mast.

③ Loosen and remove hexagon bolts and washers securing lift cylinders to inner 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.

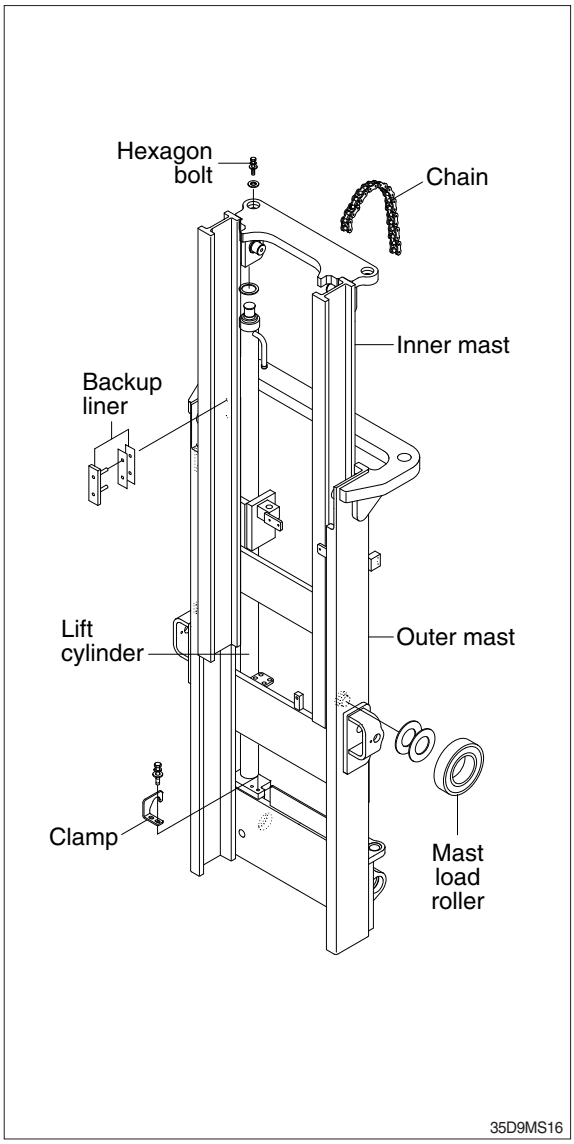
⑤ After lowering the lift cylinder rods, and disconnecting lift cylinder hose, tilt the lift cylinders LH and RH and them with ropes to the outer mast.

⑥ Using the overhead hoist, lower inner mast until top and bottom rollers and back up liners are exposed.

⑦ Using a pryer, remove load rollers from load roller bracket. Remove back up liners and shims.

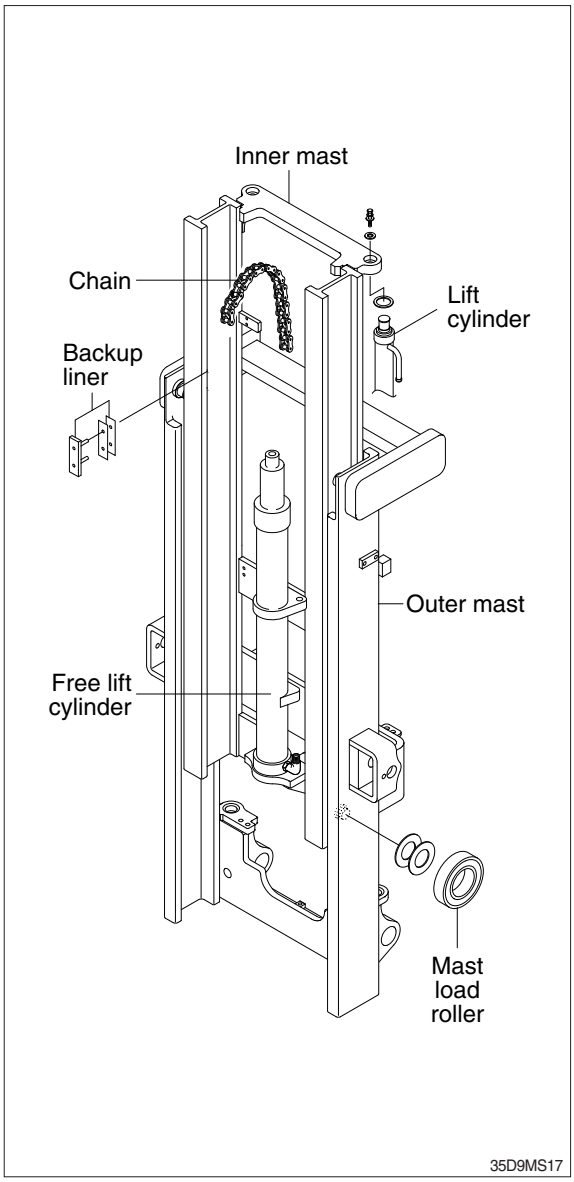
⑧ Thoroughly clean, inspect and replace all worn or damaged parts.

⑨ Reverse the above procedure to assemble. Refer to MAST LOAD ROLLER ADJUSTMENT paragraph.



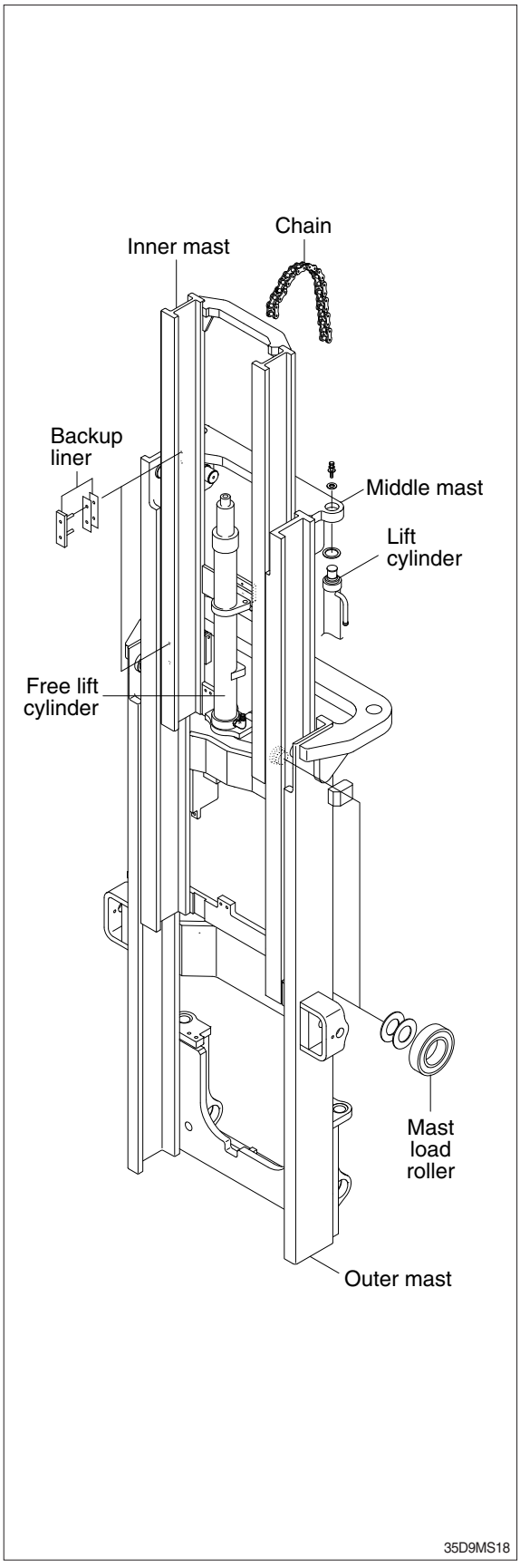
(2) 2 stage mast (VF mast)

① Remove free lift chain connected between carriage and free lift cylinder.
② Remove the carriage assembly and move them to one side.
③ Loosen and remove hexagon bolts and washers securing lift cylinders to inner mast.
④ Loosen and remove hexagon bolts and nuts securing lift cylinders to inner mast.
⑤ 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.
⑥ After lowering the lift cylinder rods, and disconnecting lift cylinder hose, tilt the lift cylinders LH and RH and them with ropes to the outer mast.
⑦ Using the overhead hoist, lower inner mast until top and bottom rollers and back up liners are exposed.
⑧ Using a pryer, remove load rollers from load roller bracket. Remove back up liners and shims.
⑨ Thoroughly clean, inspect and replace all worn or damaged parts.
⑩ Reverse the above procedure to assemble. Refer to MAST LOAD ROLLER ADJUSTMENT paragraph.



(3) 3 stage mast (TF mast)

① Remove the carriage assembly and move to one side.
② Loosen and remove hexagon bolt securing bottom cylinder from outer mast.
③ Loosen and remove bolts and special washers 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 4 inch 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 support 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 pryer, remove load rollers from load bracket. Remove back up liners and shims.
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 player, remove load rollers from load 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 ADJUSTMENT paragraph.



5) ELEVATING MAST

(1) Inner mast (V, VF mast)

① After completing all necessary steps for load rollers and back up liner removal use an overhead hoist and sling or chain around upper crossmember of the inner mast section.
② Lift inner mast upright straight up and out of outer mast section.
③ Replace and reverse above procedure to install. Make all necessary measurements and adjustments.

(2) Inner and middle mast (TF mast)

① After completing all necessary steps for load rollers and back up liner removal. Remove rear chains and sheave support if not already done.
② Disconnect free lift cylinder hose. Drain hose into a suitable pan or container and cap hose.
③ While supporting free lift cylinder assembly, remove bolts and washers securing cylinder to mast crossmember.
④ Place a sling around free lift cylinder and attach to an overhead hoist. Slowly raise and move cylinder to one side.
⑤ Attach chains or sling to the inner mast section at top crossmember. Using an overhead hoist slowly raise the upright straight up and out of middle mast section.
⑥ Attach chains or sling to the middle mast section at top crossmember. Using an overhead hoist slowly raise the upright straight up and out of outer mast section.
⑦ Replace upright and reverse above procedure to install. Make all necessary measurements and adjustments.

6) CHAIN

(1) Chain sheave (V, VF mast)

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.

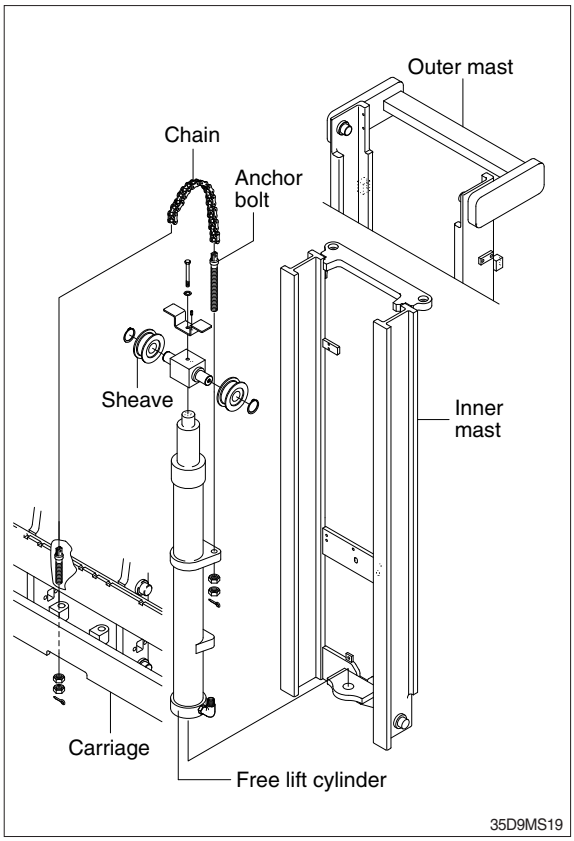
② Remove the split pin securing the chain anchor pins and discard. While supporting the chains, remove the chain anchor pins and drape the chains over the carriage.

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 (TF mast)

① Raise and securely block carriage and inner mast section.

② Remove the split pin securing the chain anchor pins and discard. While supporting the chains, remove the chain anchor pins from outer mast section.

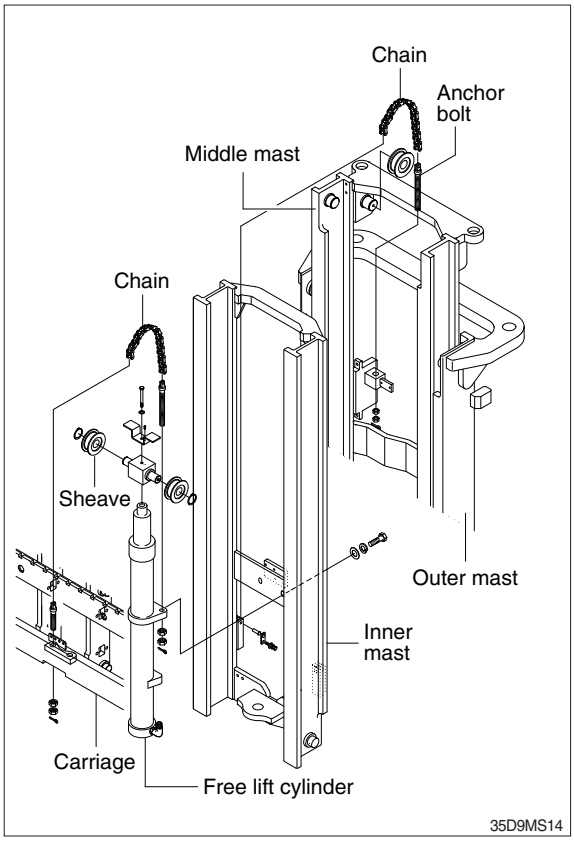
③ Remove chains.

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) Chain wheel bearing support (TF mast)

① Remove the carriage assembly and move to one side.
② After removing bolt to securing chain wheel bearing support assembly to free lift cylinder.
After a sling to the chain wheel bearing 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 chain wheel bearing to chain wheel bearing support.
④ Remove bearing retaining ring from chain wheel bearing and press bearings from chain wheel bearings.
⑤ Thoroughly clean, inspect and replace all worn or damaged parts.
⑥ Reverse the above procedure to install.

(4) Rear chain (TF 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 chain wheel bearings, the joints very gradually wear. The stretch a chain developes 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 our 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 penomenon that affects most metals and many plastics. After many repeated heavy loads, the plates may crack and the chains will evenually 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 chain wheel bearings

An inspection of the chain system includes a close examination of chain anchors and chain wheel bearings. 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. Chain wheel bearings 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 ㎜), 3/4 (19.05 ㎜), 1 (25.4 ㎜), 1-1/2 (38.1 ㎜), 2 (50.8 ㎜), use side A of scale.
- If pitch is 5/8 (15.875 ㎜), 1-1/4 (31.75 ㎜) or 2 (50.8 ㎜), 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 chain wheel bearing. 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.