CONTENTS

SECTION 8 MAST

1. STRUCTURE

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

SECTION 1 GENERAL
This section gives the general information of the machine and explains the safety hints for maintenance.

SECTION 2 REMOVAL & INSTALLATION OF UNIT
This section explains the procedures and techniques of removal and installation of each component.

SECTION 3 POWER TRAIN SYSTEM
This section explains the structure of the transmission as well as control valve and drive axle.

SECTION 4 BRAKE SYSTEM
This section explains the brake piping, each component and operation.

SECTION 5 STEERING SYSTEM
This section explains the structure of the steering unit, priority valve, trail axle as well as steering circuit and operation.

SECTION 6 HYDRAULIC SYSTEM
This section explains the structure of the gear pump, main control valve as well as work equipment circuit, each component and operation.

SECTION 7 ELECTRICAL SYSTEM
This section explains the electrical circuit and each component.
It serves not only to give an understanding electrical system, but also serves as reference material for troubleshooting.

SECTION 8 MAST
This section explains the structure of mast, carriage, backrest and forks.

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

2. HOW TO READ THE SERVICE MANUAL

Distribution and updating

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

Filing method

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

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

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

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

Revised edition mark(①②③…)

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

Revisions

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

Symbols

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

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

3. CONVERSION TABLE

Method of using the Conversion Table

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

Example

1. Method of using the Conversion Table to convert from millimeters to inches
   Convert 55mm into inches.

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

   (2) Locate the number 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, 55mm = 2.165 inches.

2. Convert 550mm into inches.

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

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

   (3) The original value(550mm) 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 550mm = 21.65 inches.

Millimeters to inches

1mm = 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

1mm = 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

1kg = 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

1kgf · m = 7.233lbf · ft

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

kgf/cm^2 to lbf/in^2

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

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

TEMPERATURE

Fahrenheit-Centigrade Conversion.

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

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

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

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

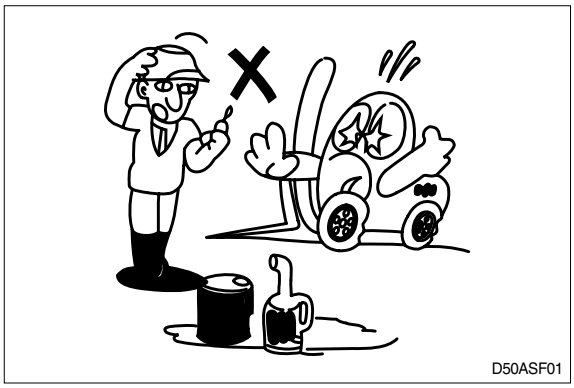
°C		°F	°C		°F	°C		°F	°C		°F
-40.4	-40	-40.0	-11.7	11	51.8	7.8	46	114.8	27.2	81	117.8
-37.2	-35	-31.0	-11.1	12	53.6	8.3	47	116.6	27.8	82	179.6
-34.4	-30	-22.0	-10.6	13	55.4	8.9	48	118.4	28.3	83	181.4
-31.7	-25	-13.0	-10.0	14	57.2	9.4	49	120.2	28.9	84	183.2
-28.9	-20	-4.0	-9.4	15	59.0	10.0	50	122.0	29.4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

SECTION 1 GENERAL

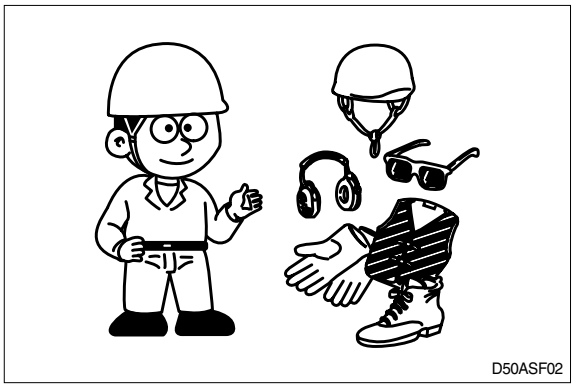
GROUP 1 SAFETY HINTS

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

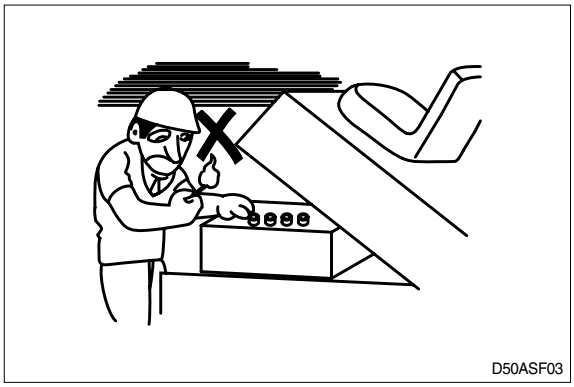
- Oil is a dangerous substance. Never handle oil, grease or oily clothes in places where there is any fire of flame.
  As preparation in case of fire, always know the location and directions for use of fire extinguishers and other fire fighting equipment.


D50ASF01

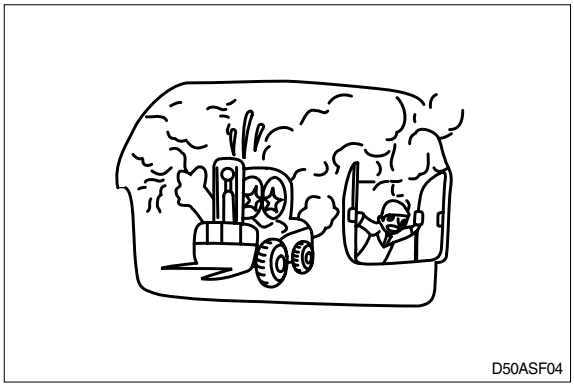
- Wear well-fitting helmet, safety shoes and working clothes. When drilling, grinding or hammering, always wear protective goggles.
  Always do up safety clothes properly so that they do not catch on protruding parts of machines. Do not wear oily clothes.
  When checking, always release battery plug.


D50ASF02

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

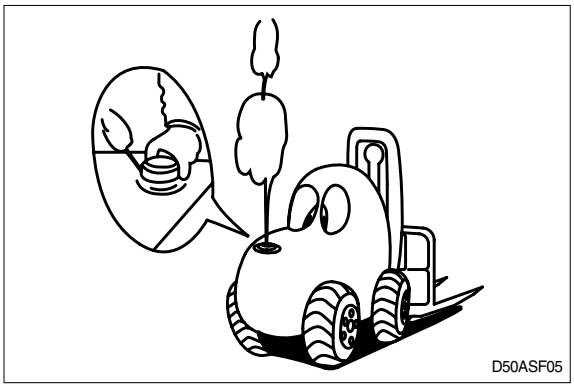

D50ASF03

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

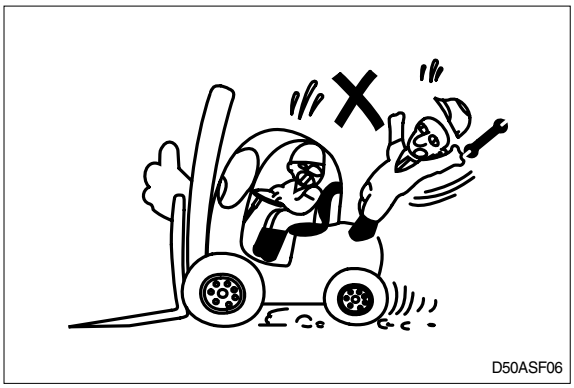

D50ASF04

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

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

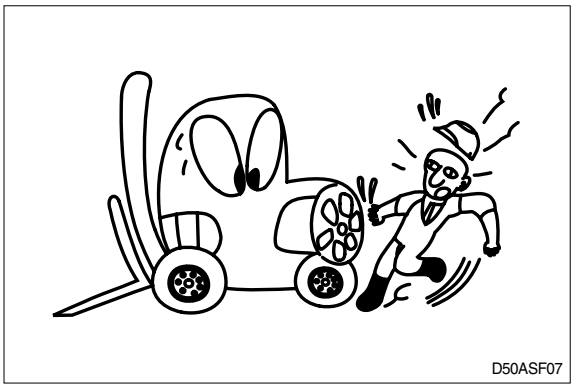

D50ASF05

· When working on top of the machine, 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 machine by mistake.

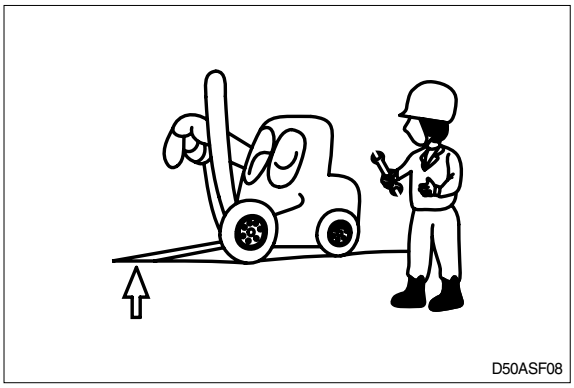
⚠ It is extremely dangerous to try to check the fan belt tension while he engine is running.


D50ASF07

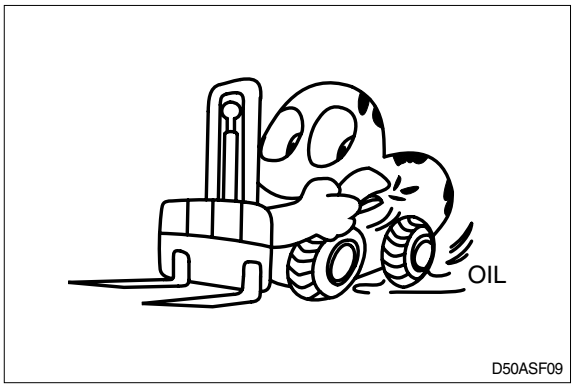
When inspecting the engine is running parts, or near such parts, always stop the engine first.

Before checking or servicing accumulator or piping, depress brake pedal repeatedly to release pressure.

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

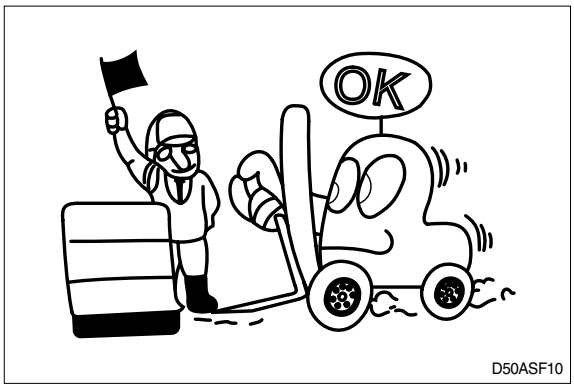

D50ASF08

- 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 machine.



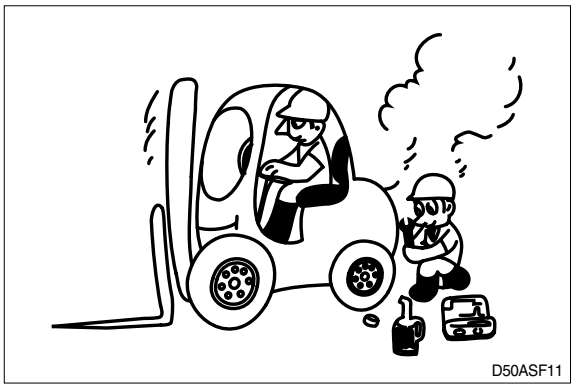
D50ASF09

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



D50ASF10

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


D50ASF11

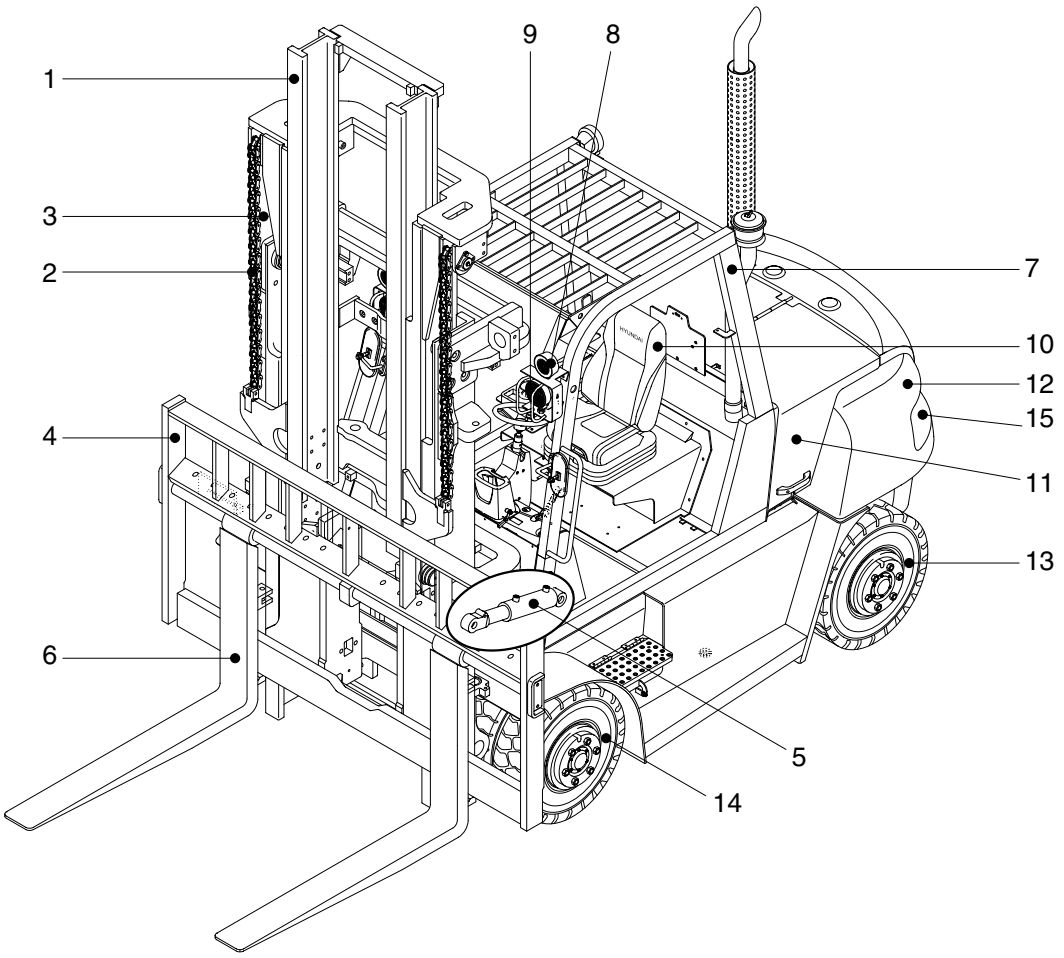
- Always remember that the hydraulic oil circuit is under pressure. When feeding or draining the oil or carrying out inspection and maintenance, release the pressure first.

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

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

GROUP 2 SPECIFICATIONS

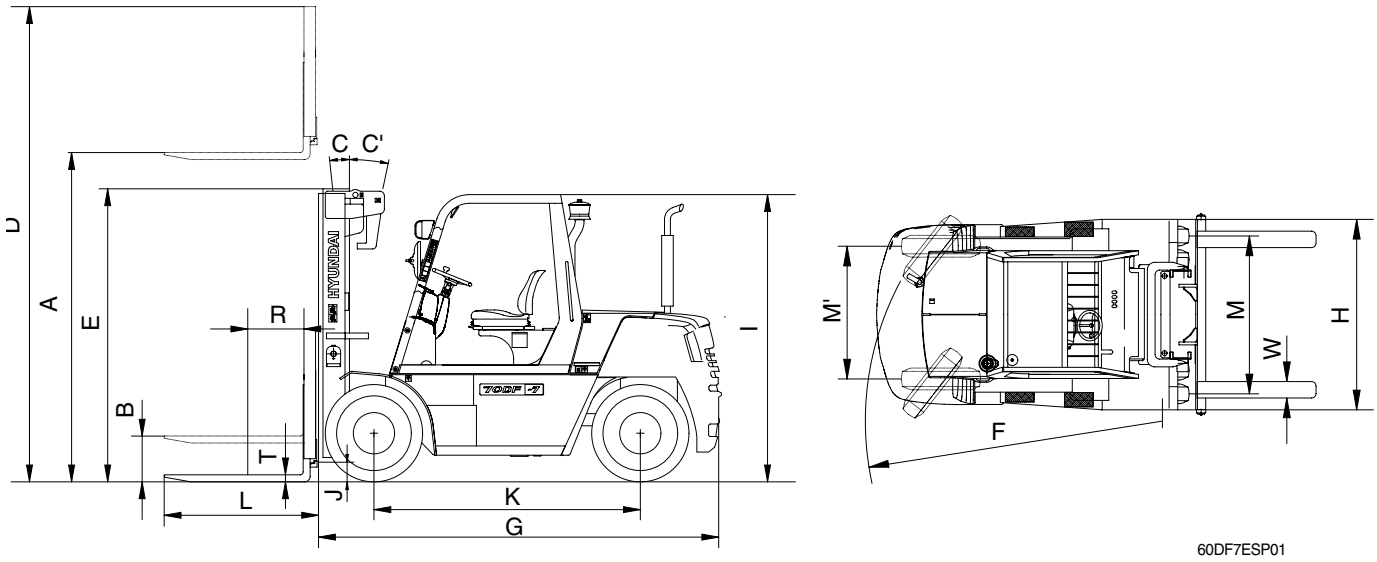
1. MAJOR COMPONENTS



60DF7OM54

1	Mast	6	Forks	11	Bonnet
2	Lift chain	7	Overhead guard	12	Counterweight
3	Lift cylinder	8	Turn signal lamp	13	Rear wheel
4	Backrest	9	Head lamp	14	Front wheel
5	Tilt cylinder	10	Operator's seat	15	Rear combination lamp

2. SPECIFICATIONS



60DF7ESP01

Model			Unit	50DF-7	60DF-7	70DF-7
Capacity			kg	5000	6000	7000
Load center		R	mm	600	←	←
Weight(Unloaded)			kg	8382	9245	9871
Fork	Lifting height	A	mm	3030	←	←
	Free lift	B	mm	140	←	←
	Lifting speed(Unload/Load)		mm/sec	460/440	460/430	460/420
	Lowering speed(Unload/Load)		mm/sec	450/500	←	←
	L × W × T	L,W,T	mm	1200 × 150 × 60	1200 × 180 × 65	←
Mast	Tilt angle(forward/backward)	C/C'	degree	15/10	←	←
	Max height	D	mm	4275	←	←
	Min height	E	mm	2515	←	←
Body	Travel speed(Unload)		km/h	22.8	22.7	22.8
	Gradeability		degree(%)	24.6(45.8)	23.3(43.1)	21.1(38.5)
	Min turning radius(Outside)	F	mm	3349	3396	3442
ETC	Operating pressure		kgf/cm²	185	←	←
	Hydraulic oil tank		ℓ	100	←	←
	Fuel tank		ℓ	150	←	←
Overall length		G	mm	4700	4765	4860
Overall width		H	mm	2068	←	←
Overhead guard height		I	mm	2523	←	←
Ground clearance		J	mm	195	←	←
Wheel base		K	mm	2300	←	←
Wheel tread front/rear		M, M'	mm	1578/1602	←	←

3. SPECIFICATION FOR MAJOR COMPONENTS

1) 50DF/60DF/70DF-7

(1) ENGINE

Item	Unit	Specification
Model	-	HYUNDAI D4DD
Type	-	4 cycle turbocharged diesel type
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)	104 × 115(4.1 × 4.5)
Piston displacement	cc(cu in)	3907(238)
Compression ratio	-	17.5 : 1
Rated gross horse power	ps/rpm	100/2300
Maximum gross torque at rpm	kgf · m/rpm	38/1600
Engine oil quantity	ℓ (U.S.gal)	8.5(2.2)
Dry weight	kg(lb)	350(772)
High idling speed	rpm	2510±20
Low idling speed	rpm	800±50
Rated fuel consumption	g/ps.hr	140.2(at 1700rpm)
Starting motor	V-kW	24-5
Alternator	V-A	24-50
Battery	V-AH	24-75
Fan belt deflection	mm(in)	10~15(0.39~0.59)

(2) MAIN PUMP

Item	Unit	Specification
Type	-	Fixed displacement gear pump
Capacity	cc/rev	36+33+8
Maximum operating pressure	bar	250
Rated speed (Max/Min)	rpm	3000/600

(3) MAIN CONTROL VALVE

Item	Unit	Specification
Type	-	Sectional
Operating method	-	Mechanical
Main relief valve pressure	bar	185/150
Flow capacity	lpm	163

(4) POWER TRAIN DEVICES

Item			Specification
Torque converter	Type		3 Element, 1 stage, 2 phase
	Stall ratio		2.526
Transmission	Type		Full auto, Power shift
	Gear shift(FWD/REV)		2/2
	Control		Electrical single lever type
	Overhaul ratio	FWD	1st : 4.97 2nd : 1.55
		REV	1st : 4.97 2nd : 1.55
Axle	Type		Front-wheel drive type, fixed location
	Gear ratio		10.545
Wheels	Q'ty(FR/RR)		Double : 4/2
	Front(drive)		8.25-15-14 PR
	Rear(steer)		8.25-15-14 PR
Brakes	Travel		Front wheel, Duo-servo/dry, wet disk brake/wet
	Parking		Toggle, internal expanding mechanical type
Steering	Type		Full hydraulic, power steering
	Steering angle		75.87° to both right and left angle, respectively

4. TIGHTENING TORQUE FOR MAJOR COMPONENTS

NO	Item		Size	kgf · m	lbf · ft
1	Engine	Engine mounting bolt, nut	M16×2.0	7.5	54
2		Radiator mounting bolt, nut	M10×1.5	6.9±1.4	50±10
3	Hydraulic system	MCV mounting bolt, nut	M12×1.75	12.8±3.0	93±22
4		Steering unit mounting bolt	M10×1.5	6.9±1.4	50±10
5	Power train system	Transmission mounting bolt, nut	M16×2.0	7.5	54
6		Torque converter mounting bolt	M10×1.5	6.9±1.4	50±10
7		Drive axle mounting bolt, nut	M24×3.0	100±15	723±108
8		Steering axle mounting bolt, nut	M18×2.5	41.3±6.2	300±45
9		Front wheel mounting nut	M22×1.5	61.2	443
10		Rear wheel mounting nut	M22×1.5	61.2	443
11	Others	Counterweight mounting bolt	M30×3.5	105±15	760±108
12		Operator's seat mounting nut	M 8×1.25	2.5±0.5	18.1±3.6
13		Head guard mounting bolt	M12×1.75	12.8±3.0	93±22

5. TORQUE CHART

Use following table for unspecified torque.

1) BOLT AND NUT

(1) Coarse thread

Bolt size	8T		10T	
	kgf · m	lbf · ft	kgf · m	lbf · ft
M 6 × 1.0	0.85 ~ 1.25	6.15 ~ 9.04	1.14 ~ 1.74	8.2 ~ 12.6
M 8 × 1.25	2.0 ~ 3.0	14.5 ~ 21.7	2.7 ~ 4.1	19.5 ~ 29.7
M10 × 1.5	4.0 ~ 6.0	28.9 ~ 43.4	5.5 ~ 8.3	39.8 ~ 60.0
M12 × 1.75	7.4 ~ 11.2	53.5 ~ 81.0	9.8 ~ 15.8	70.9 ~ 114
M14 × 2.0	12.2 ~ 16.6	88.2 ~ 120	16.7 ~ 22.5	121 ~ 163
M16 × 2.0	18.6 ~ 25.2	135 ~ 182	25.2 ~ 34.2	182 ~ 247
M18 × 2.0	25.8 ~ 35.0	187 ~ 253	35.1 ~ 47.5	254 ~ 344
M20 × 2.5	36.2 ~ 49.0	262 ~ 354	49.2 ~ 66.6	356 ~ 482
M22 × 2.5	48.3 ~ 63.3	349 ~ 458	65.8 ~ 98.0	476 ~ 709
M24 × 3.0	62.5 ~ 84.5	452 ~ 611	85.0 ~ 115	615 ~ 832
M30 × 3.0	124 ~ 168	898 ~ 1214	169 ~ 229	1223 ~ 1656
M36 × 4.0	174 ~ 236	1261 ~ 1704	250 ~ 310	1808 ~ 2242

(2) Fine thread

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

2) PIPE AND HOSE(FLARE TYPE)

Thread size(PF)	Width across flat(mm)	kgf · m	lbf · ft
1/4"	19	4	28.9
3/8"	22	5	36.2
1/2"	27	9.5	68.7
3/4"	36	18	130
1"	41	21	152
1-1/4"	50	35	253

3) PIPE AND HOSE(ORFS TYPE)

Thread size(UNF)	Width across flat(mm)	kgf · m	lbf · ft
9/16-18	19	4	28.9
11/16-16	22	5	36.2
13/16-16	27	9.5	68.7
1-3/16-12	36	18	130
1-7/16-12	41	21	152
1-11/16-12	50	35	253

4) FITTING

Thread size(PF)	Width across flat(mm)	kgf · m	lbf · ft
1/4"	19	4	28.9
3/8"	22	5	36.2
1/2"	27	9.5	68.7
3/4"	36	18	130
1"	41	21	152
1-1/4"	50	35	253

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) -20 (-4) -10 (14) 0 (32) 10 (50) 20 (68) 30 (86) 40 (104)
Engine oil pan	Engine oil	HMC : 8.5 (2.2)	SAE 30 SAE 10W SAE 10W-30 SAE 15W-40
Torque converter transmission	T/M oil	13(3.4)	ATF DEXRON III
Axle	Gear oil	12.5 (3.3)	SAE 80W-90/API GL-5(DRY), MOBILFLUID 424(WET)
Hydraulic tank	Hydraulic oil	100 (26.4)	ISO VG32 ISO VG46 ISO VG68
Fuel tank	Diesel fuel	150 (39.6)	ASTM D975 No.1 ASTM D975 No.2
Fitting (Grease nipple)	Grease	-	NLGI No.1 NLGI No.2
Brake reservoir tank	Hyd oil	-	DOT 3(DRY), AZOLLA ZS10(Hydraulic oil ISO VG10 : WET)
Radiator	Antifreeze:Water 50:50	17 (4.5)	Ethylene glycol base permanent type

NOTES :

① SAE numbers given to engine oil should be selected according to ambient temperature.

② For engine oil used in engine oil pan, use SAE 10W oil when the temperature at the time of engine start up is below 0°C, even if the ambient temperature in daytime is expected to rise to 10°C or more.

③ If any engine oil of API service class CF is used instead of class CH4 engine oil, the frequency of oil change must be doubled.

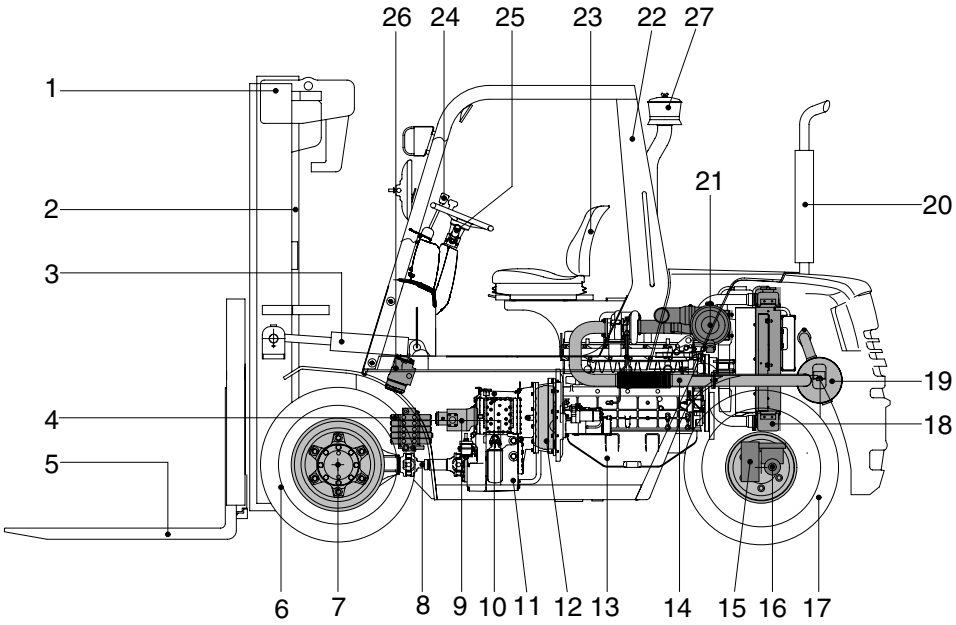
GROUP 3 PERIODIC REPLACEMENT

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.	Description	Period of replacement
1	Master cylinder and wheel cylinder caps, dust seals	Every 1 year
2	Brake hose or tube	Every 1 or 2 years
3	Brake reservoir tank and tube	Every 2 to 4 years
4	Power steering hose	Every 2 years
5	Stop lamp switch(Oil pressure type)	Every 2 years
6	Fuel hose	Every 2 to 4 years
7	Rubber parts of power steering	Every 2 to 4 years
8	Lift chain	Every 2 to 4 years
9	Hose of load handling	Every 1 or 2 years

SECTION 2 REMOVAL & INSTALLATION OF UNIT

GROUP 1 STRUCTURE



60DF7OM21

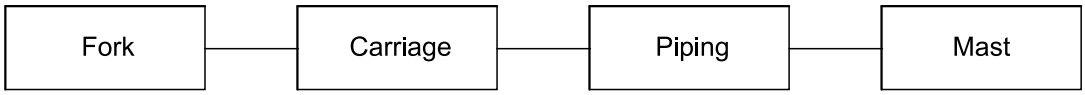
1	Mast	10	Priority valve	19	Muffler
2	Lift cylinder	11	Transmission	20	Silencer
3	Tilt cylinder	12	Torque converter	21	Air cleaner
4	Control valve	13	Engine	22	Overhead guard
5	Fork	14	Exhaust pipe	23	Seat
6	Front wheel	15	Steering axle	24	Steering wheel
7	Drive axle	16	Steering cylinder	25	Control lever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

GROUP 2 REMOVAL AND INSTALLATION OF UNIT

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

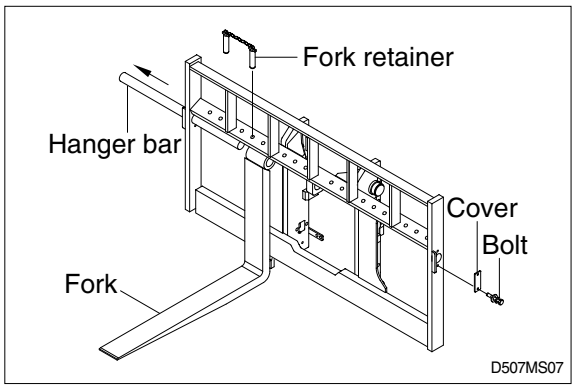
1. MAST

1) REMOVAL



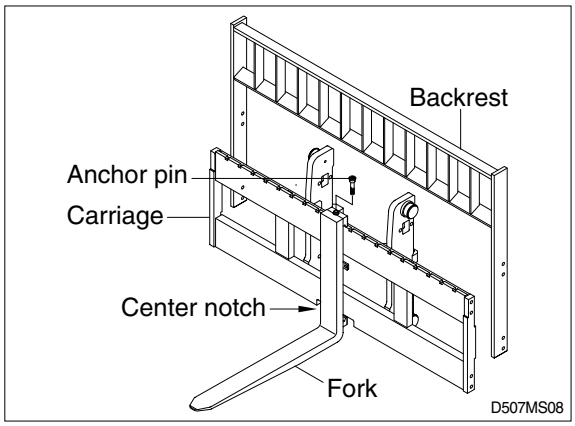
(1) SHAFT TYPE FORKS

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



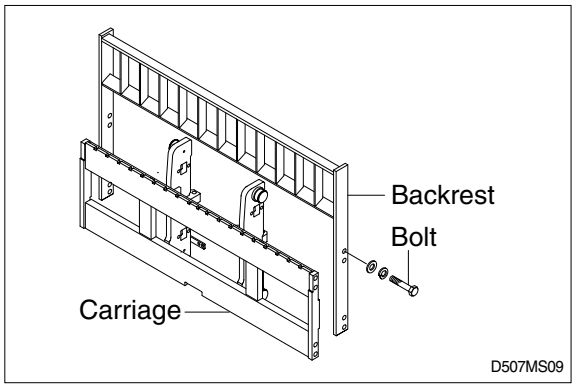
(2) HOOK ON TYPE FORKS(OPTION)

① Lower the fork carriage until the forks are approximately 25㎜(1in) from the floor.
② Release fork anchor pins 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 fork removal.
③ Remove only one fork at a time.
※ On larger forks it may be necessary to use a block of wood.



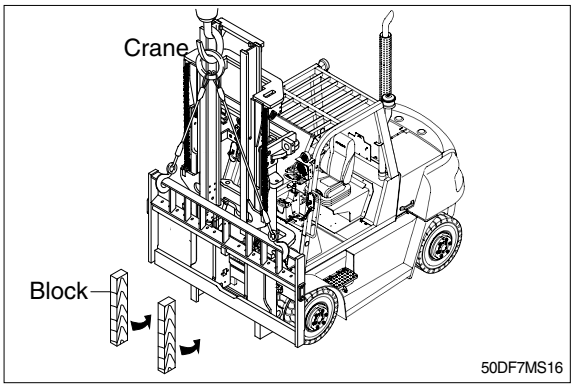
(3) BACKREST(HOOK ON TYPE)

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

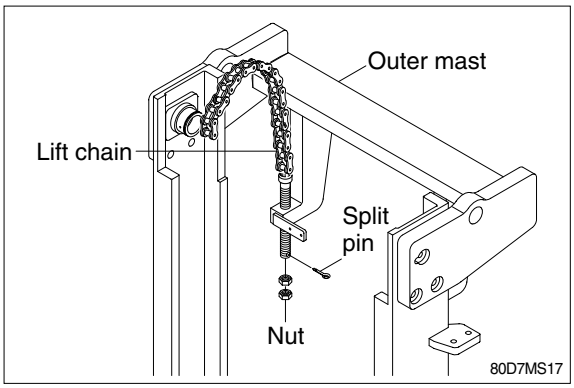


(4) CARRIAGE

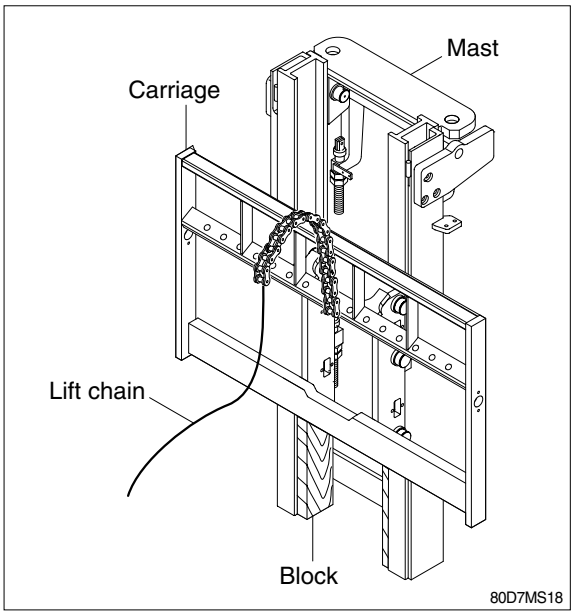
① With the mast vertical, raise the carriage high enough to place blocks under the load forks. This is done to create slack in the load chains when the carriage is lowered. Lower the carriage all the way down to the floor. Make sure the carriage is level, this will prevent any binding when the mast is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



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



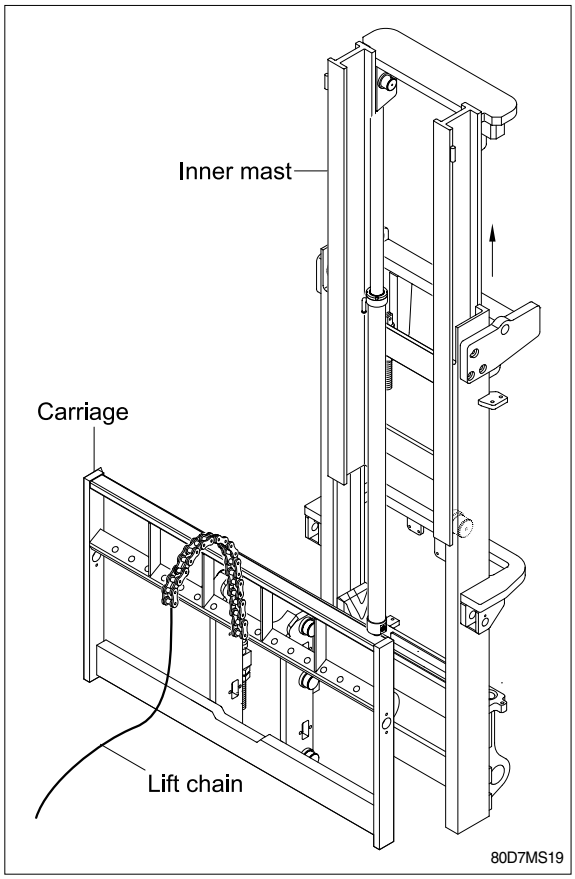
③ Pull the chains out of the sheaves and drape them over the front of the carriage.



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

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

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

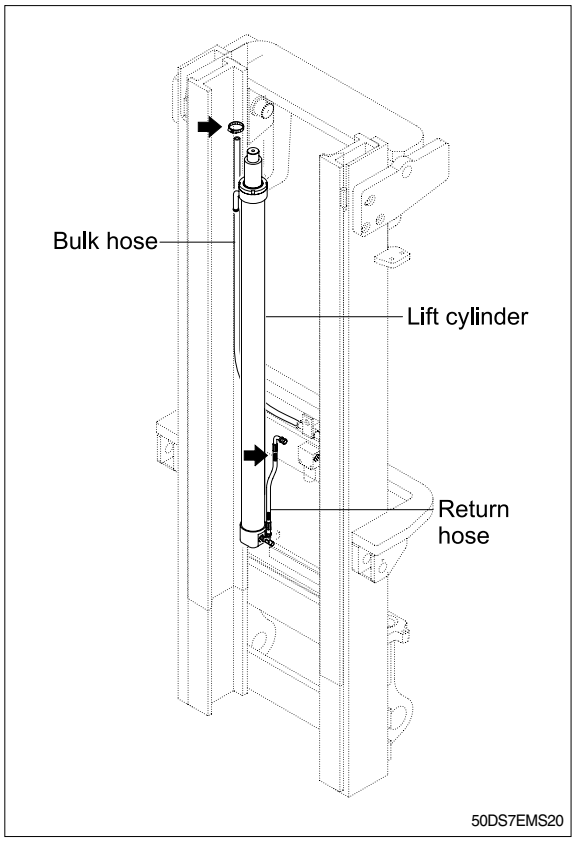


(5) PIPING

① Remove the bulk hoses and clamps attached to the cylinder.

② Remove the return hose from the down control valve.

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

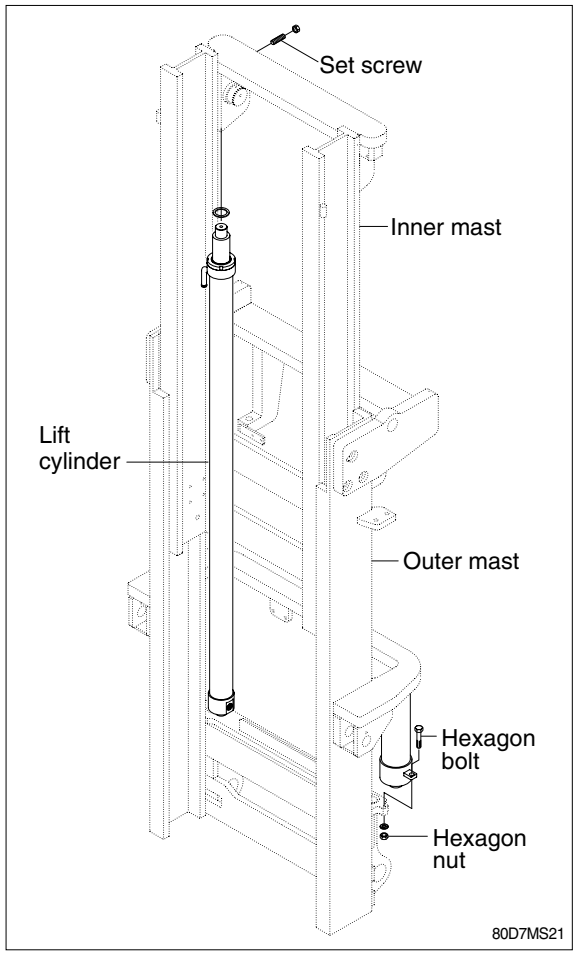


(6) LIFT CYLINDER

① Loosen and remove hexagon 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.

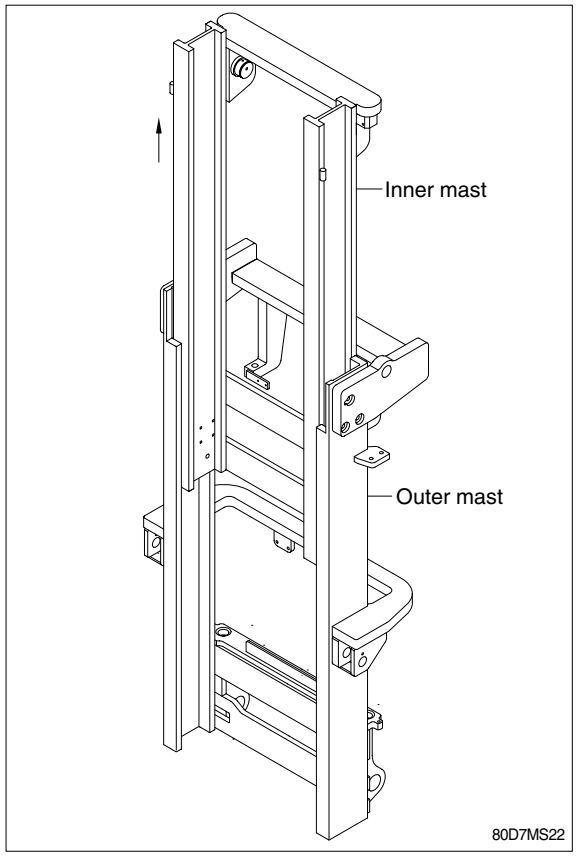
③ Loosen and remove hexagon bolts and nuts securing lift cylinders to outer mast.
④ Using an overhead hoist, slowly raise the inner mast high enough to clear lift cylinder.
⑤ Using an overhead hoist, draw out lift cylinder carefully and put down on the work floor.



(7) INNER MAST

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

⚠ Be careful the mast not to swing or fall.

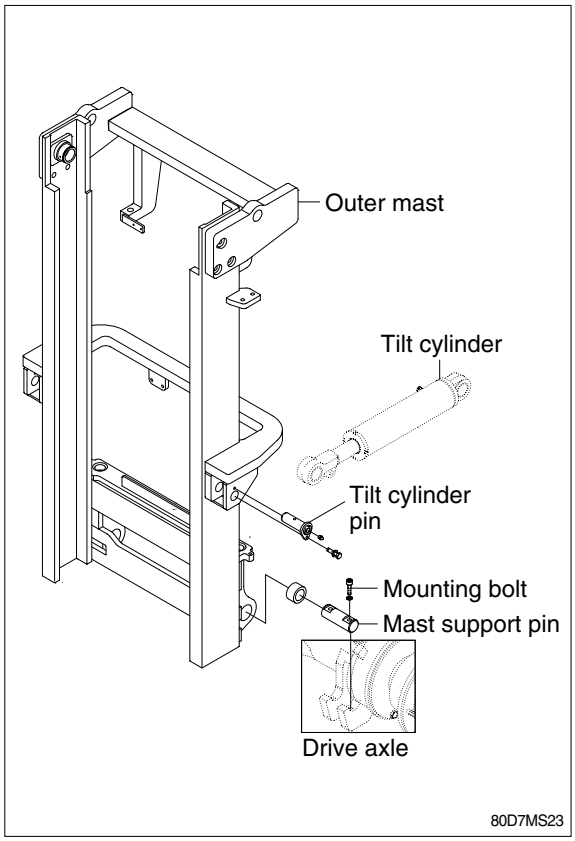


(8) TILT CYLINDER PIN

(9) MAST SUPPORT PIN

Attach a crane to the stay at the top of the outer mast, and raise it.
Remove the mounting bolts and pins from drive axle, then slowly raise outer mast.

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



2) INSTALLATION

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

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

(1) MAST SUPPORT PIN

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

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

③ Tighten mounting socket bolts to drive axle unit.

· Tightening torque : 49.2~66.6kgf · m(355~481lbf · 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

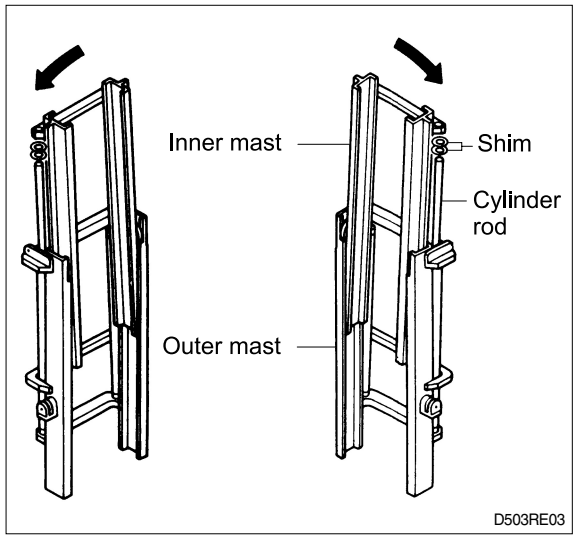
① Assemble the lift cylinder inside the outer mast, then tighten the stopper bolt. If the cylinder assembly has been replaced, adjust as follows so that the left and right cylinders are synchronized at the maximum lifting height.

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.

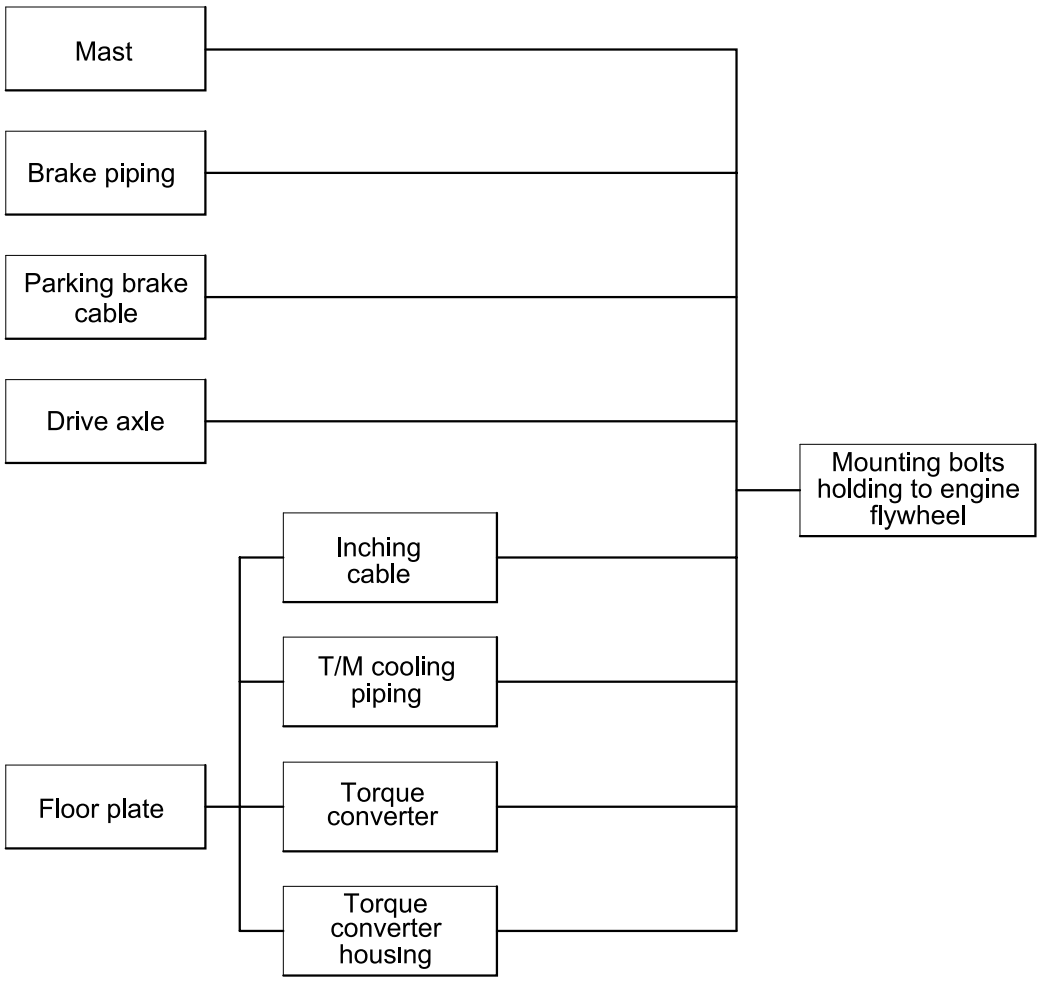
※ If play is to RIGHT, install adjustment shim to RIGHT cylinder.

· Shim thickness : 1.0mm(0.04in)



2. POWER TRAIN ASSEMBLY

1) REMOVAL

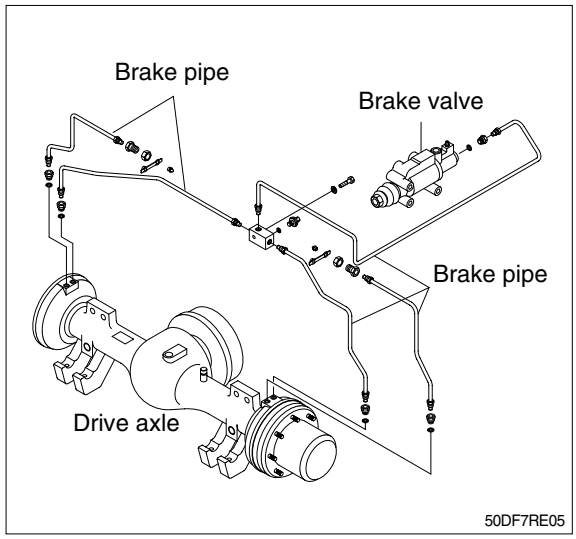


(1) Mast

Refer to section on mast(Page 2-2)

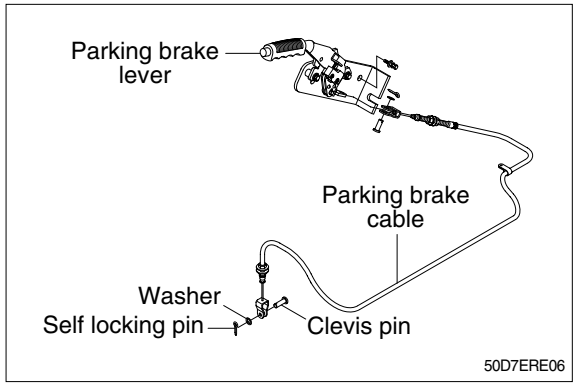
(2) Brake piping

Disconnect the brake piping from the wheel cylinder end.



(3) Parking brake cable

Disconnect parking brake cable from the wheel brake assembly.



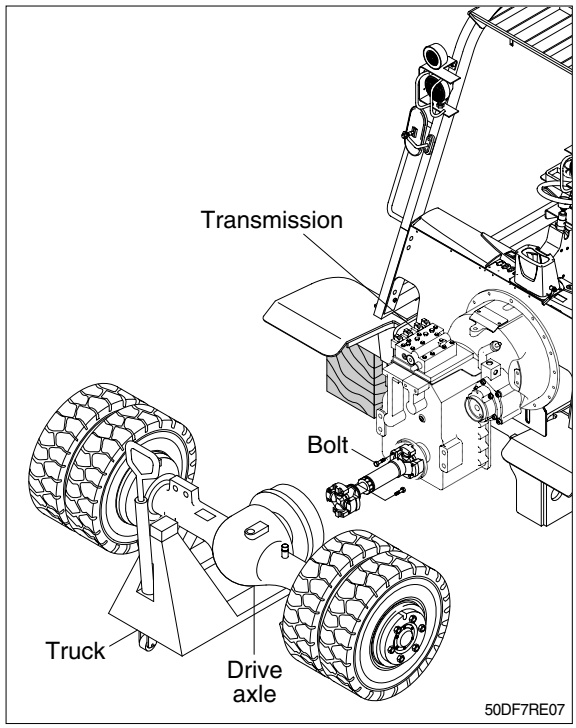
(4) Drive axle

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

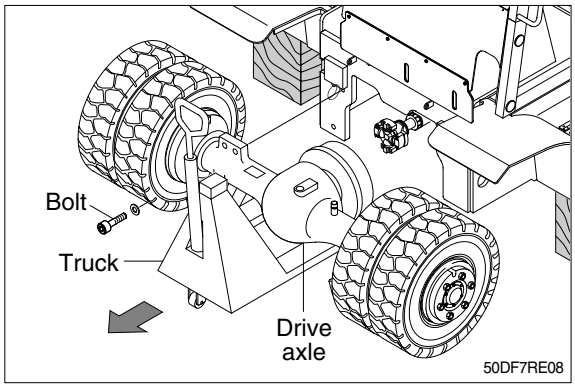
① Attach a crane to the tilt cylinder notches on the dashboard and raise the machine.

② Loosen hexagonal bolts connecting drive axle to propeller shaft.

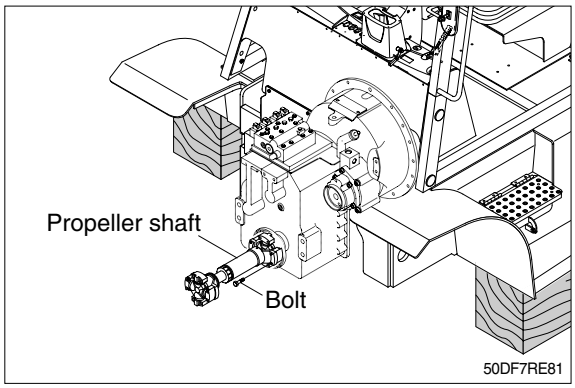
③ Put the block under the front axle and support under the drive axle with a truck.



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

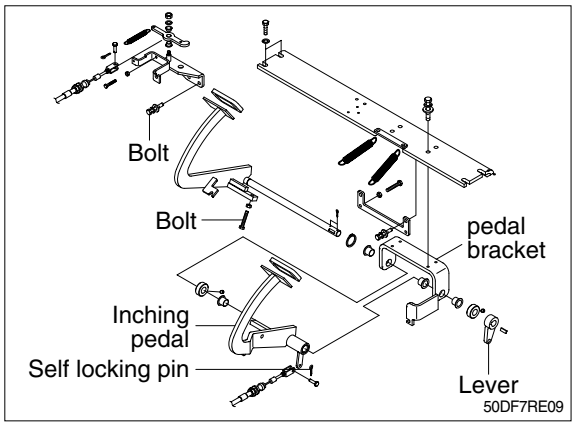


⑤ Remove propeller shaft from the transmission by loosening the mounting bolts.



(5) Inching linkage

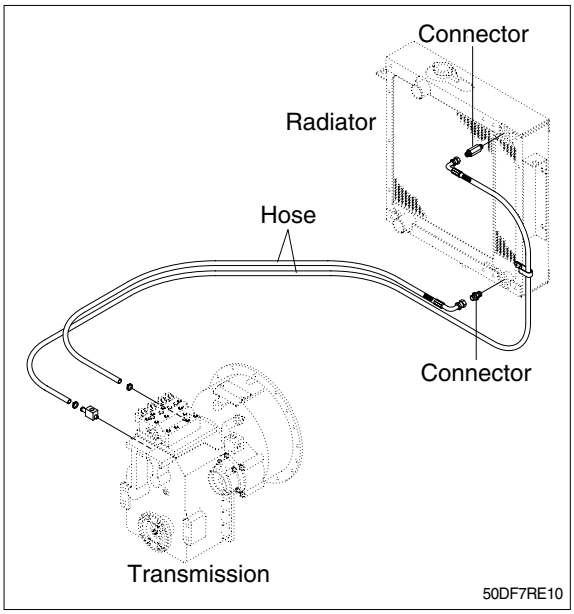
Remove the clevis pins and self locking pin.



(6) Transmission cooling piping

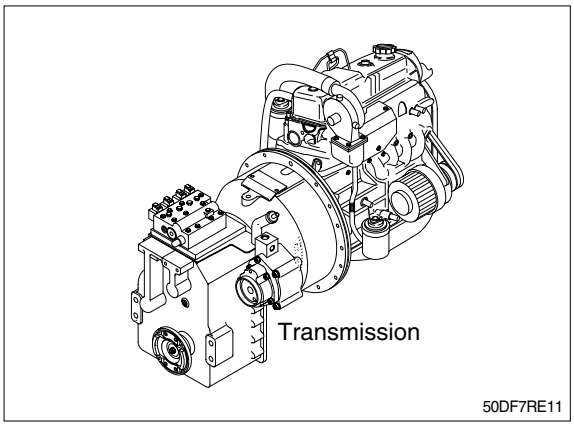
① Disconnect cooling hose and connector from the transmission.

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



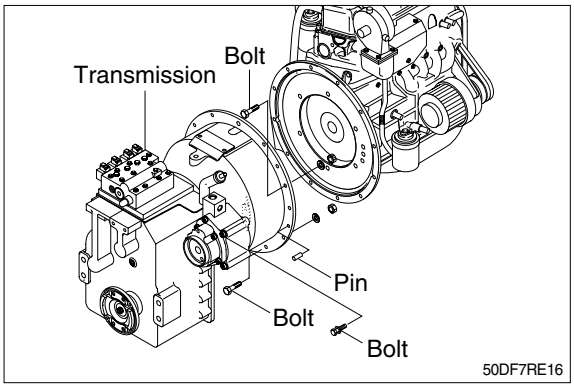
(7) Torque converter

① Remove the cover on bottom face of the torque converter housing then remove the 4 mounting bolts 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.

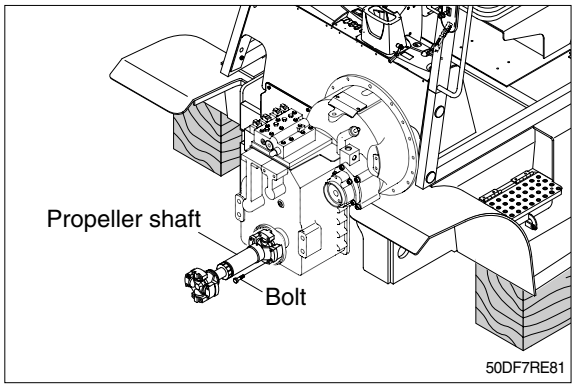


(8) Mounting bolts holding to flywheel housing

① Remove the transmission assembly from the torque converter housing by loosening the mounting bolts.
Remove torque converter housing from the engine flywheel by loosening the mounting bolts and pins.



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

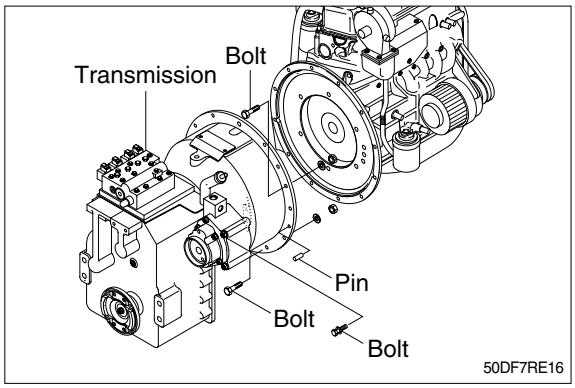


2) INSTALLATION

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

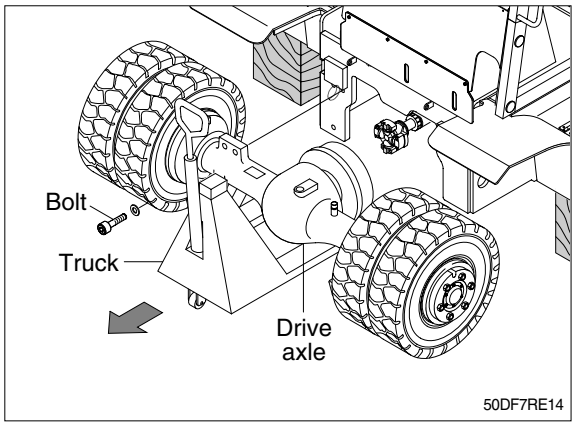
(1) Tightening torque of mounting bolt for torque converter housing.

· 5.8~8.3kgf · m (42.0~60.0lbf · ft)

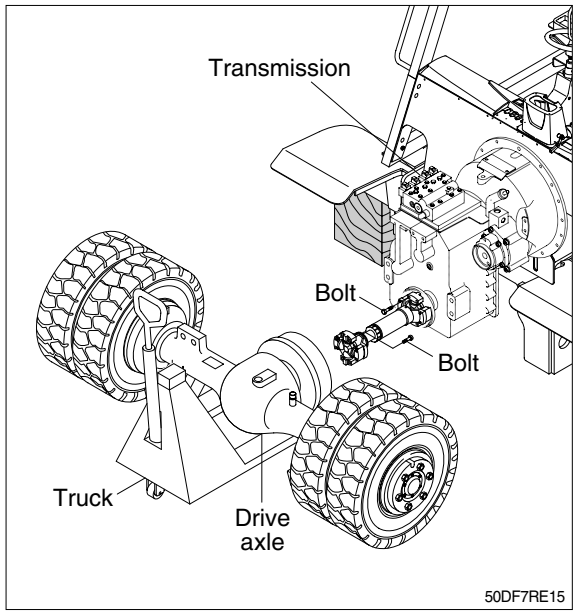


(2) Tightening torque of mounting bolt for drive axle.

· 85~115kgf · m (615~832lbf · ft)



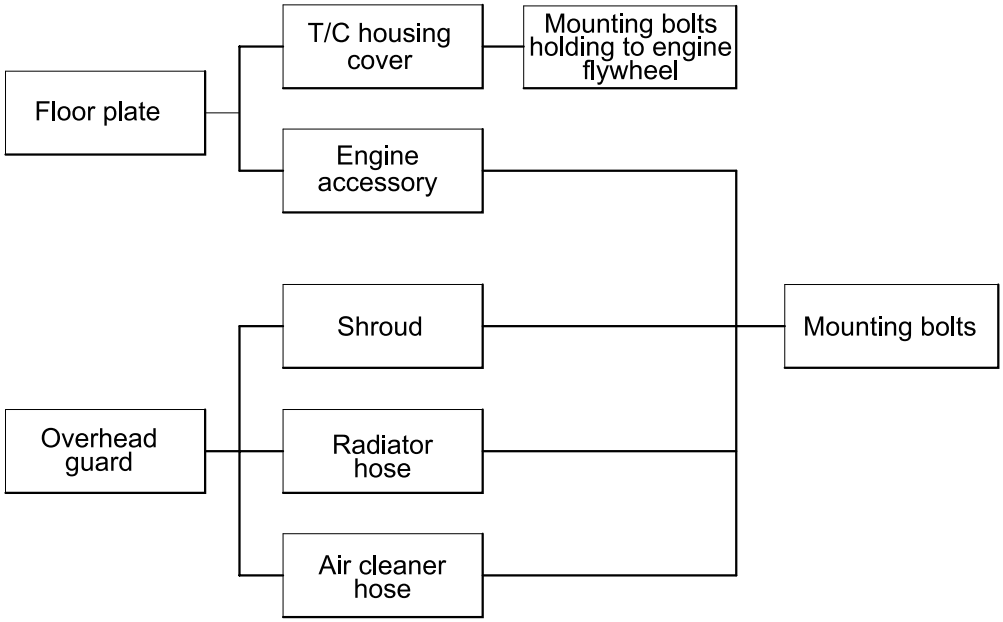
(3) Tightening torque of mounting bolt for transmission and propeller shaft.
 · 6.3~7.7kgf · m (45.6~55.6lbf · ft)



3. ENGINE

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

1) REMOVAL



D503RE25

(1) Remove the torque converter housing cover and mounting bolts installed to flywheel housing.
For details, see page 2-12.

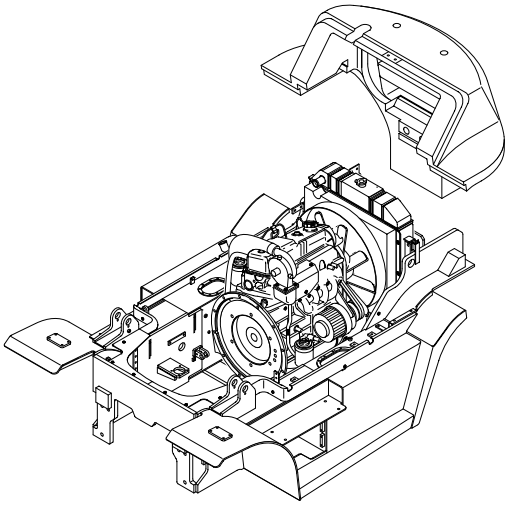
(2) Engine accessory

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.
⑤ Exhaust pipe.

(3) Radiator hose

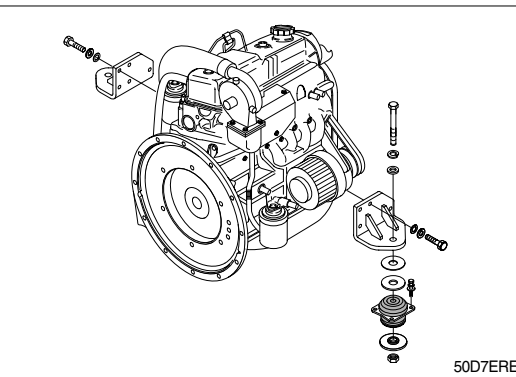
Open the drain valve of the radiator and drain the cooling water, then remove the radiator hose.


50D7ERE18

(4) 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.


50D7ERE19

2) INSTALLATION

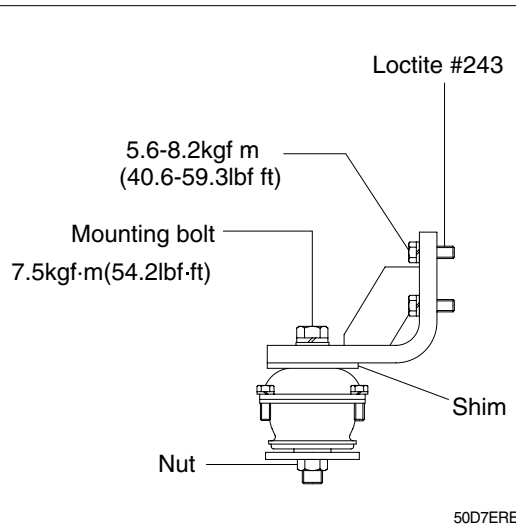
Installation is the reverse order of removal, but be careful of the following points.

(1) Tighten the engine mounting bolts and nuts.

(2) Tighten the engine mounting bracket bolts.

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

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



50D7ERE20

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

· 5.5~8.3kgf · m(39.8~60.0lbf · ft)

(4) Radiator hoses

· Distance to insert hose : 50mm(1.96in)

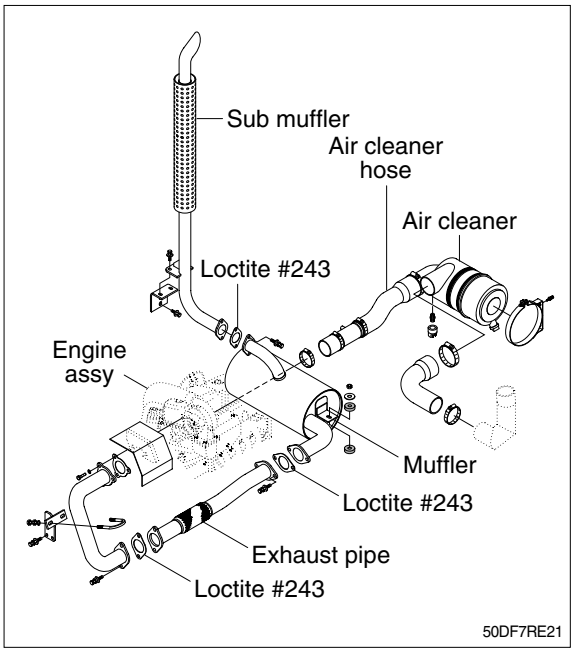
(5) Air cleaner hose

Insert the air cleaner hose securely and fit a clamp.

Distance to insert hose

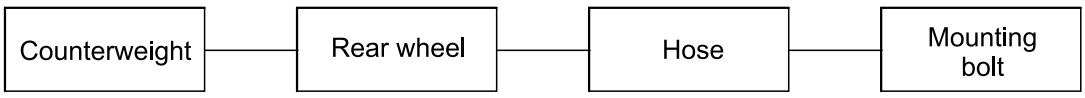
· Air cleaner hose : 55mm(2.17in)

· Engine end(HMC) : 45mm(1.77in)



4. STEERING AXLE

1) REMOVAL



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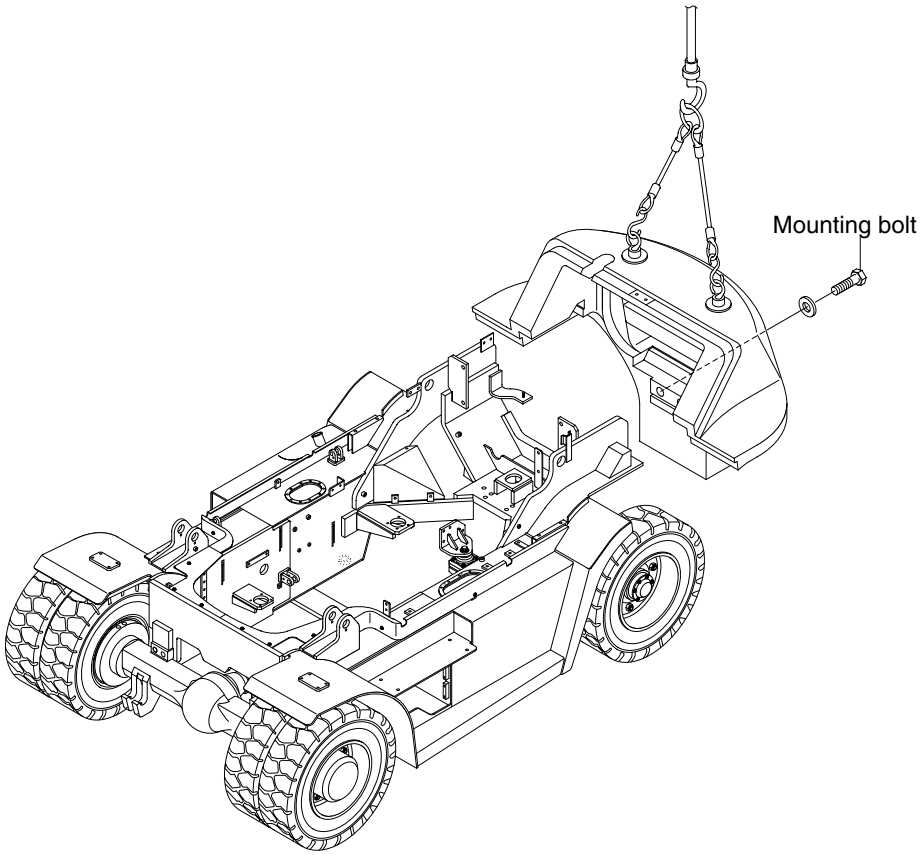


50D7ERE30

(1) Counterweight

Hold the counterweight with hoist bars, and raise it with a crane.

Remove the mounting bolts, raise slightly and move it slowly to rear side.

· Weight of counterweight(standard)

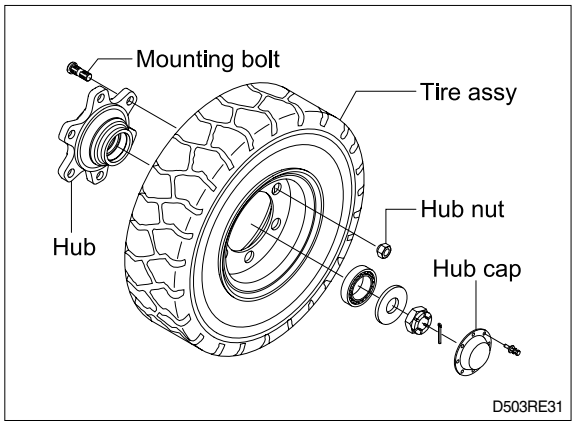
50DF-7 : 2,120kg(4,675lb)

60DF-7 : 2,680kg(5,910lb)

70DF-7 : 3,250kg(7,165lb)

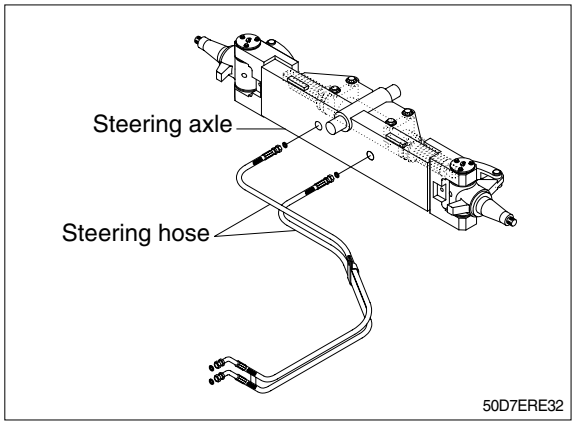
(2) Rear wheel

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



(3) Hose

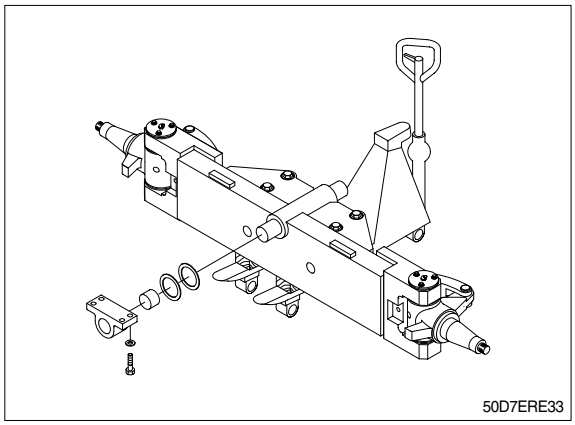
Disconnect the hoses from steering axle and then drain out oil.



(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.

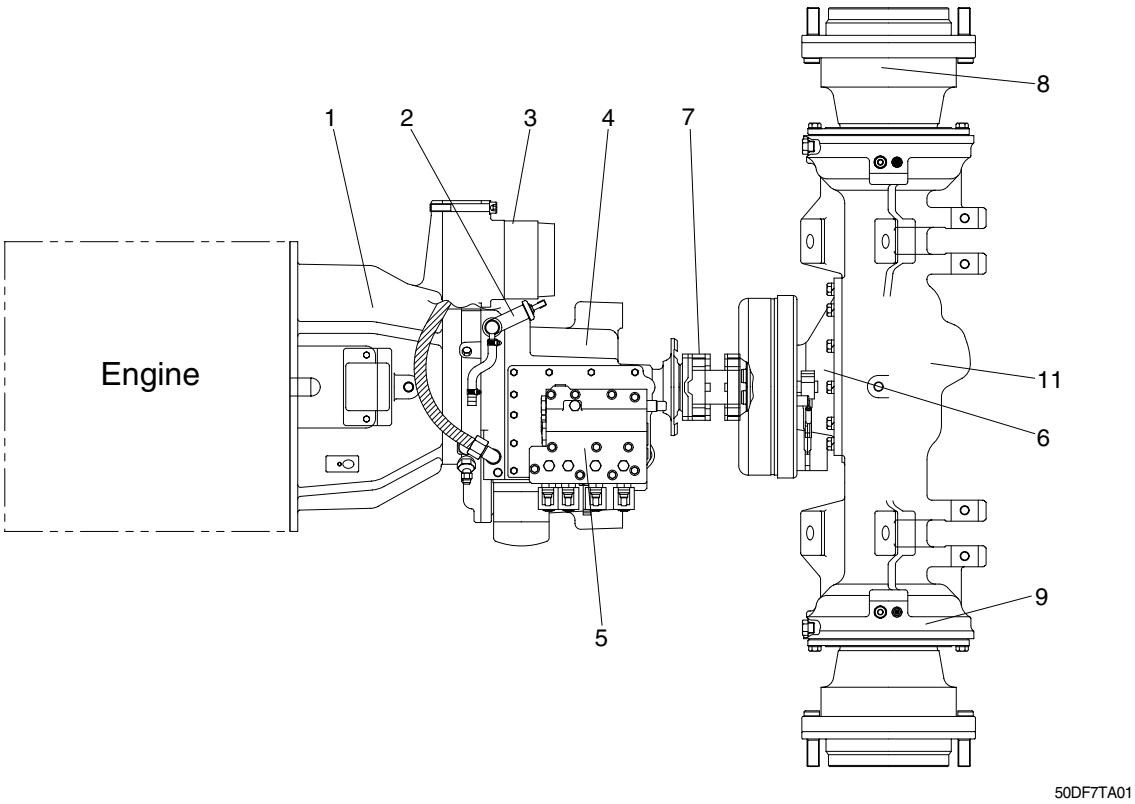


SECTION 3 POWER TRAIN SYSTEM

GROUP 1 STRUCTURE AND OPERATION

1. POWER TRAIN COMPONENT OVERVIEW

1) STRUCTURE



1	Torque converter	5	T/M control valve	8	Drive wheel
2	T/M oil level gauge	6	Differential	9	Disk brake
3	Transmission	7	Drive shaft	11	Drive axle
4	T/M oil pump				

2) OPERATION

Power train system consists of engine , torque converter(1) , transmission(3) , drive shaft(7) , drive axle(11) and drive wheel(8).

Engine power is transmitted to the transmission(3) through the torque converter(1).

Transmission(3) which operates as a type of regularly and continuously engaged counter shaft shifting by 2 stage both forward and reverse consists of 4 hydraulic clutch packs.

Clutch piston is released by tension of spring.

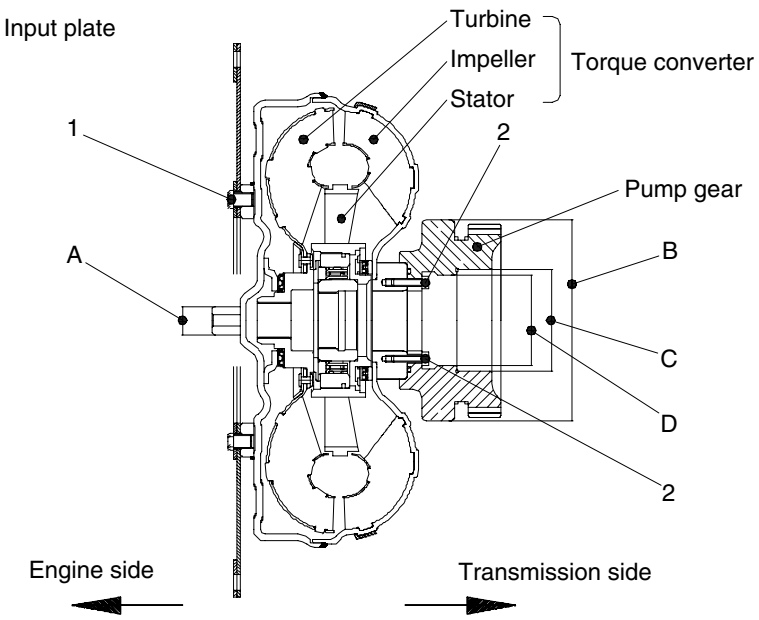
The power is transmitted to spiral gear and bevel gear set of differential through the output gear and then goes to the drive wheel via drive axle.

3) SPECIFICATION

Item			Unit	Specification
Torque converter	Type		-	3 elements 2 phase 1 stage
	Power transmit		-	Torque converter
Transmission	Type/Gear shift		-	POWER SHIFT / F2 : R2
	Gear ratio	FR/RR 1 stage	-	4.97
		FR/RR 2 stage	-	1.55
	P.T.O system		-	Included
	T/M oil		-	DEXRON 3
	Oil quantity		ℓ	13
T/M valve	Type		-	Electric
Charging pump	Displacement		cc/rev	20.6
Drive axle	Gear ratio	Differential	-	2.636
		Planetary	-	4
		Total	-	10.545
	Axle oil		-	MOBILFLUID 424
	Oil quantity		ℓ	12.5
Brake	Service brake		-	Wet disk brake
	Brake oil		-	AZOLA-ZS10
	Parking brake		-	Ratchet drum brake
Differential	Gear type		-	Spiral bevel gear
	Differential type		-	4 pinions

2. TORQUE CONVERTER

1) STRUCTURE



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No	Item	Specification
1	Torque converter input plate	4.5±0.3kg · m (32.5±2.2lbf · ft)
2	Torque converter pump gear	2.0±0.3kg · m (14.5±2.2lbf · ft)
A	Pilot boss outer diameter	19.009 ~ 19.030mm(0.748 ~ 0.749in)
B	Oil seal outer diameter	134.9 ~ 135.0mm(5.311 ~ 5.315in)
C	Needle bearing outer diameter	68.000 ~ 68.019mm(2.677 ~ 2.678in)
D	Seal ring inner diameter	60.333 ~ 60.363mm(2.375 ~ 2.376in)

2) OPERATION

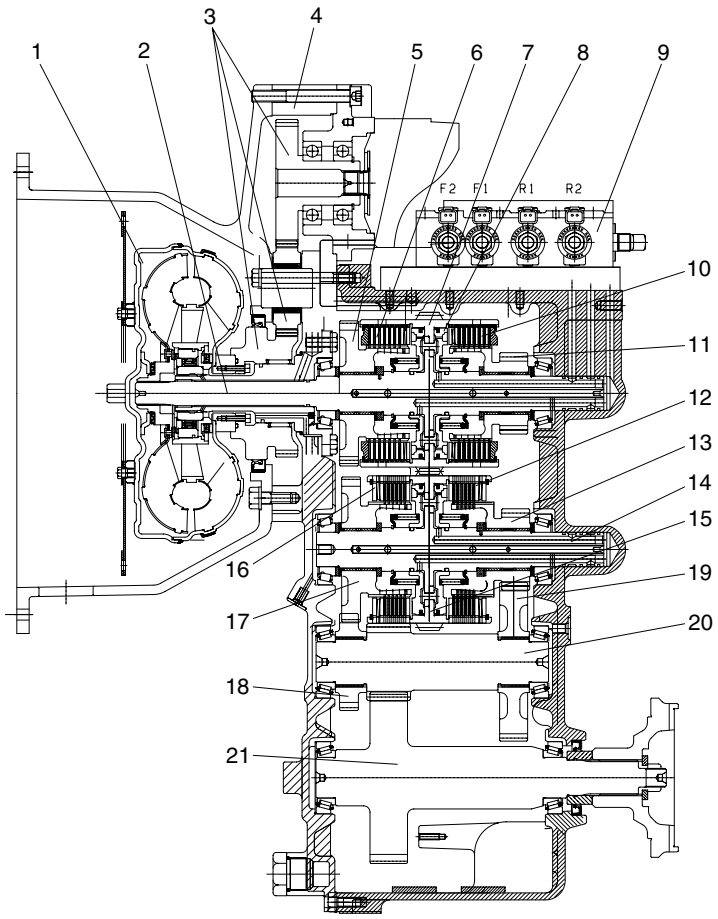
The torque converter hydraulically connects the engine to the transmission. There is no direct mechanical connection between the engine and the transmission. When the machine works against a load, the torque converter can mulitply the torque from the engine and send a higher torque to the transmission. The oil for the operation of the torque converter comes from the transmission oil pump. The oil flows through a small passage in stator support around the shaft of the stator support and into the converter. Outlet oil from the converter flows through the transmission oil cooler and into the lubrication system.

The touque converter has four main parts : housing, impeller (pump), turbine and stator. The housing is connected to the engine flywheel through flex plate. Impeller and housing are connected and turn with the engine flywheel at engine speed. Turbine turns the transmission input shaft. Stator is installed stationary on stator support. Impeller, which turns with housing at engine speed, directs the oil toward the outside of the impeller and against the blades of turbine. When the oil hits the turbine blades, it causes turbine and the input shaft to turn. This sends touque to the transmission. Oil returns through the stator vanes to the impeller. The stator vanes direct the oil back to the impeller that causes a torque increase.

When the speed of turbine is the same as the speed of impeller stator clutch permits the stator to turn freely with engine rotation but it locks (holds), to prevent opposite rotation to engine rotation. The free rotation of the stator helps also to decrease the sudden or fast movement of the oil which can cause cavitation (air bubbles) in the hydraulic system. When the turbine speed is less than the speed of impeller, stator holds in place. Torque is multiplied only when the stator is held in place.

3. TRANSMISSION

1) STRUCTURE



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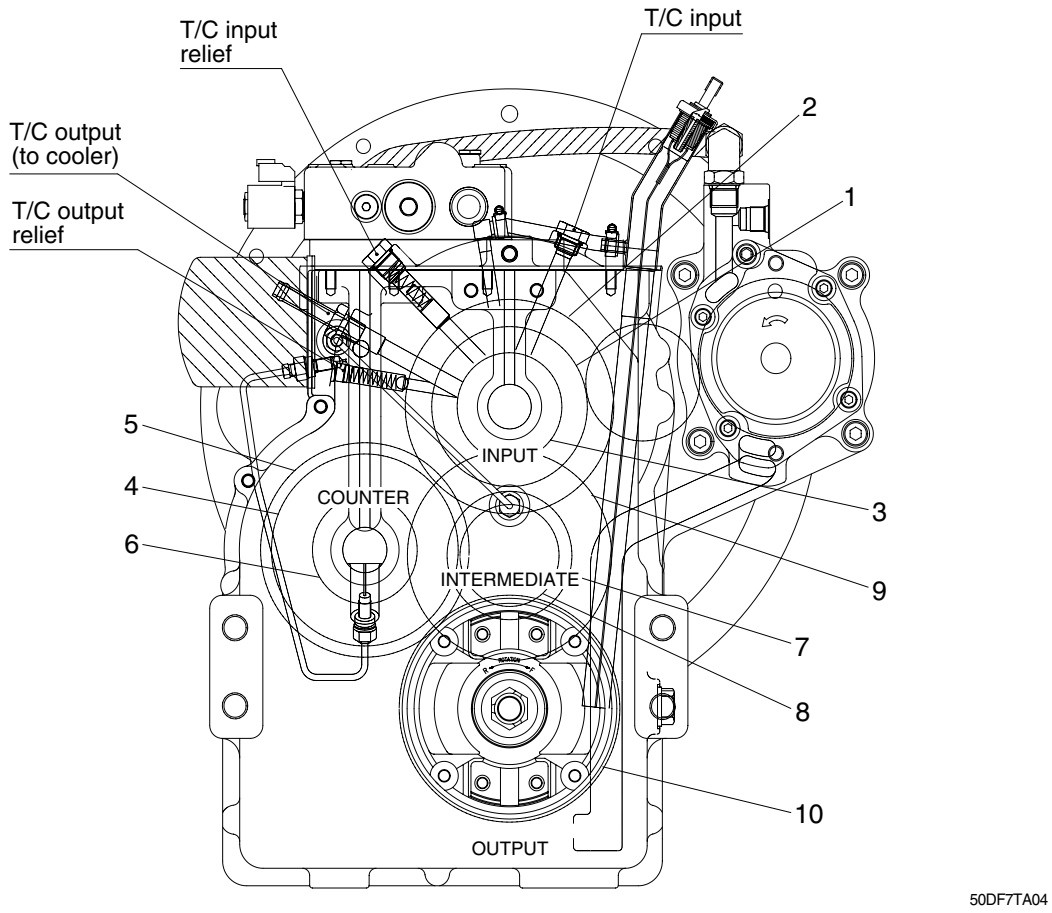
1	Torque converter	8	Clutch piston	15	Clutch drum (RR)
2	Input shaft	9	Valve assembly	16	Clutch (RR, 2 stage)
3	3 P.T.O gears	10	Clutch (FR, 1 stage)	17	Gear (RR, 2 stage)
4	Pump assembly	11	Gear (FR, 1 stage)	18	Gear (Output, 2 stage)
5	Gear (FR, 2 stage)	12	Gear (RR, 1 stage)	19	Gear (Output, 1 stage)
6	Clutch (FR, 2 stage)	13	Clutch (RR, 1 stage)	20	Intermediate shaft
7	Clutch drum(FR)	14	Counter shaft	21	Output shaft

2) OPERATION

The basic components of the power train are : engine, torque converter, power shift transmission, drive axle and drive wheels. Power from the engine flywheel goes from the torque converter to the input shaft of the transmission. The power shift transmission is a constant mesh countershaft type and has four hydraulically operated clutches that are spring released. The transmission has two speeds in forward and two speeds in reverse. In other words, The transmission is a constant mesh power shift transmission and gives two forward and two reverse speeds. The transmission has four cluthces that are engaged hydraulically and released by spring force. The direction and speed are changed electrically.

⚠ Damage can be caused to the transmission if the truck is moved with the engine not running. There will be no lubrication to the transmission components.

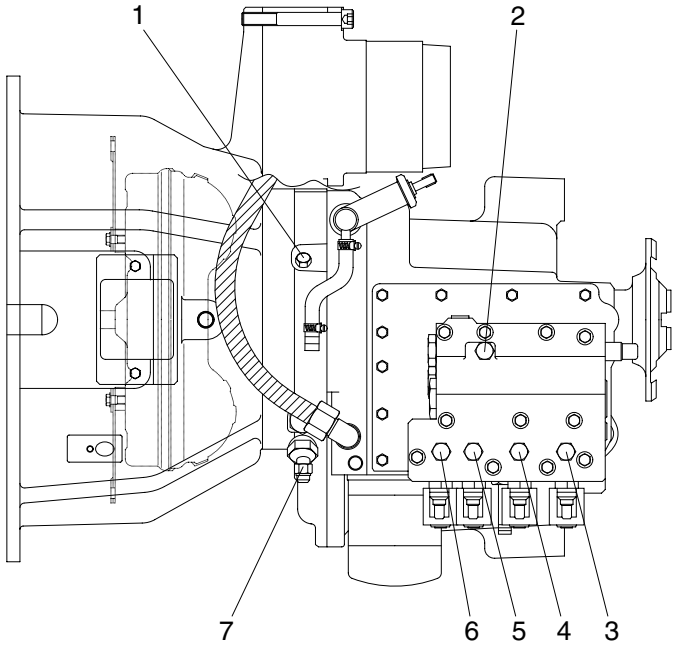
3) TRANSMISSION GEAR ARRAY



1	Cylinder clutch (FR)	4	Cylinder clutch(RR)	7	Gear(Output, 1st stage)
2	Gear(FR, 2nd stage)	5	Gear(RR, 2nd stage)	9	Gear(Output, 2nd stage)
3	Gear(FR, 1st stage)	6	Gear(RR, 1st stage)	10	Output gear

※ Selection of either forward or reverse gear makes all of the parts inside the T/M operate.

4) TRANSMISSION INPUT PORT



50DF7TA05

1 T/C input port pressure
2 Main line pressure
3 RR 2nd stage pressure
4 RR 1st stage pressure
5 FR 1st stage pressure
6 FR 2nd stage pressure
7 T/C output port pressure

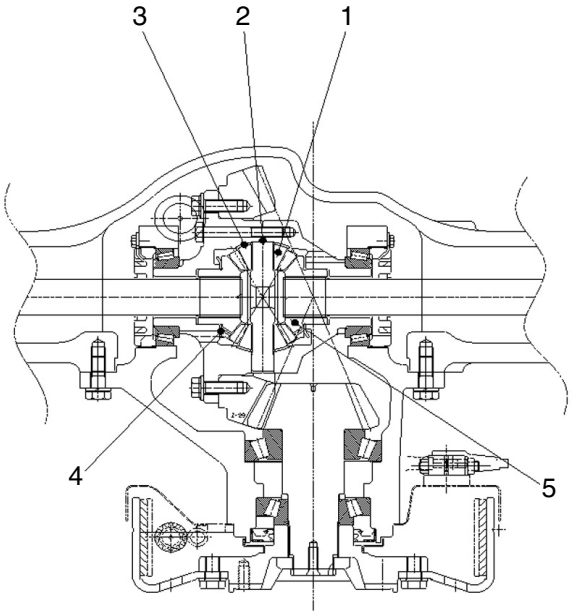
· **Transmission pressure(50±10°C)**

Engine rpm	Unit	Main line (Neutral)	T/Converter (Neutral)	FR 1,2 stage clutch	RR 1,2 stage clutch
Idle	kgf/cm² (psi)	10.0~13.2 (142.2~187.7)	-	10.0~13.2 (142.2~187.7)	10.0~13.2 (142.2~187.7)
800~1200	kgf/cm² (psi)	10.0~13.5 (142.2~192.0)	-	10.0~13.5 (142.2~192.0)	10.0~13.5 (142.2~192.0)
1800~2400	kgf/cm² (psi)	10.0~15.5 (142.2~220.5)	-	10.0~15.5 (142.2~220.5)	10.0~15.5 (142.2~220.5)
2500	kgf/cm² (psi)	-	4.2~7.2 (59.7~102.4)	-	-

※ Reference : Clutch pressure will be dropped 0.5kgf/cm² in case of main pressure.

4. DIFFERENTIAL CARRIER ASSEMBLY

1) STRUCTURE



50D7EAX02

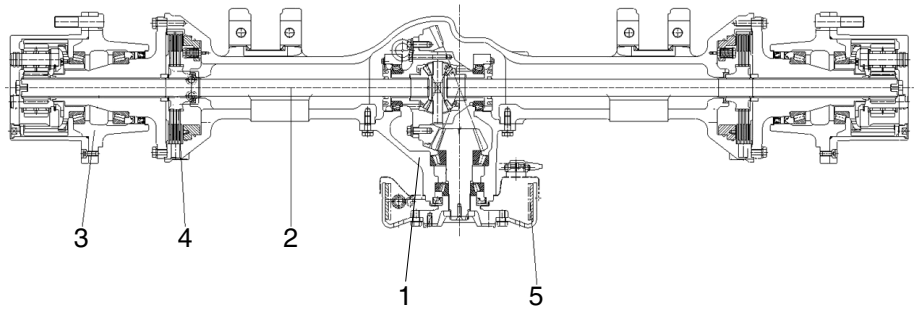
No	Item	Unit	Specification
1	Differential pinion gear inner diameter	mm(in)	20.000 - 20.021(0.787~0.788)
2	Spider outer diameter	mm(in)	19.959 - 19.980(0.786~0.787)
3	Pinion gear washer	mm(in)	1.92 - 2.08(0.076~0.082)
4	Side gear washer	mm(in)	1.95 - 2.05(0.077~0.081)
5	Side gear	-	-

2) OPERATION

Differential transmits the power from the transmission to drive wheel.
When the vehicle is running one side wheel rotates slower than the other side wheel.
Differential is composed of 4 pinions(1), 2 side gears(5) and 1 spider(2).
The spider is meshed vertically between 4 pinions(1) and 2 side gear(5), so the engagement become a right angle.

5. DRIVE AXLE

1) STRUCTURE



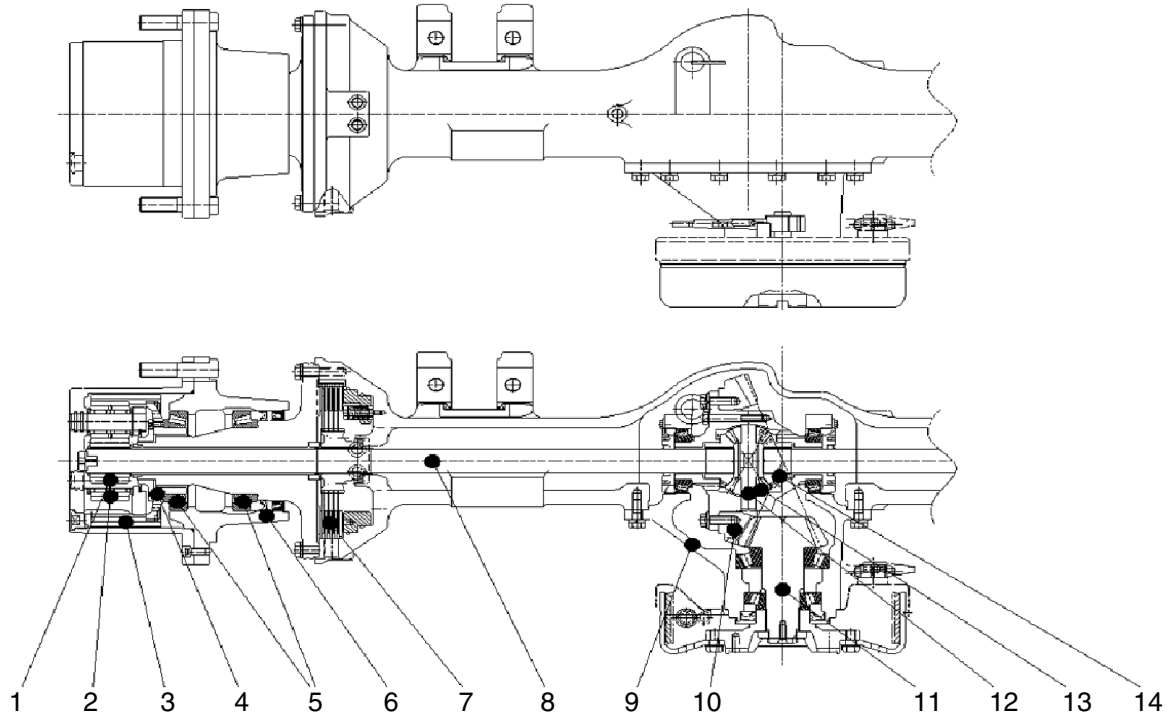
50D7EAX01

1	Differential carrier ass'y	3	Drive wheel	5	Parking brake
2	Drive shaft	4	Disc brake		

OPERATION

The drive axle is composed of differential carrier assy (1), drive shaft (2), and drive wheel (3).
The power is transmitted from the engine fly wheel to the transmission.
The power of transmission is transmitted to the spiral bevel gear through the output gear of the transmission.
Then the power of differential is transmitted to the wheel through the drive shaft.

2) DRIVE AXLE



50D7EAX03

1	Sun gear	6	Hub assy	11	Pinion shaft
2	Planetary gear	7	Disk brake	12	Spider
3	Inner gear	8	Drive shaft	13	Differential pinion gear
4	Inner gear carrier	9	Differential carrier assy	14	Differential side gear
5	Tapered bearing	10	Ring gear		

OPERATION

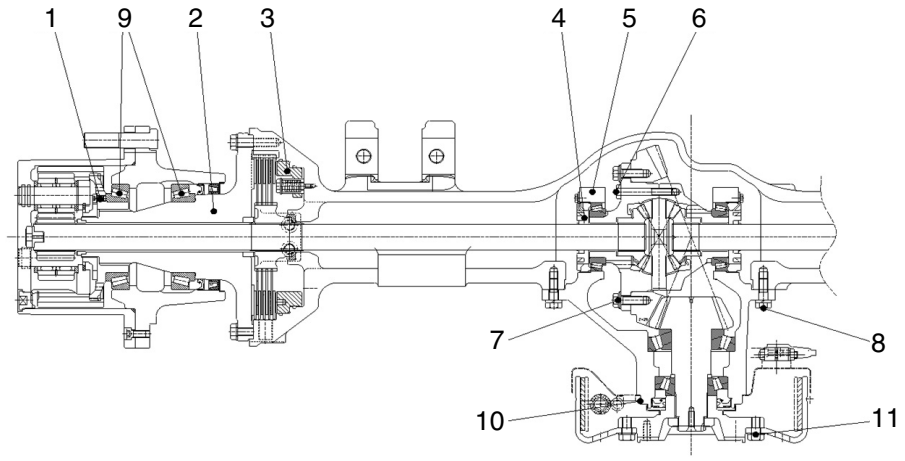
Drive axle which consists of differential carrier assembly (9), drive shaft (8) and hub assembly (6) transmits the drive force from transmission to the wheels.

Pinion shaft (11) is connected to transmission output through universal joint.

The power of transmission is transmitted to differential which consists of pinion shaft (11) and ring gear (10) and the differential rotates the drive shaft (8).

Side gear (14) and drive shaft (8) are connected with spline and the drive shaft (8) connect to planetary gear (2), inner hub (6) and finally drive wheels.

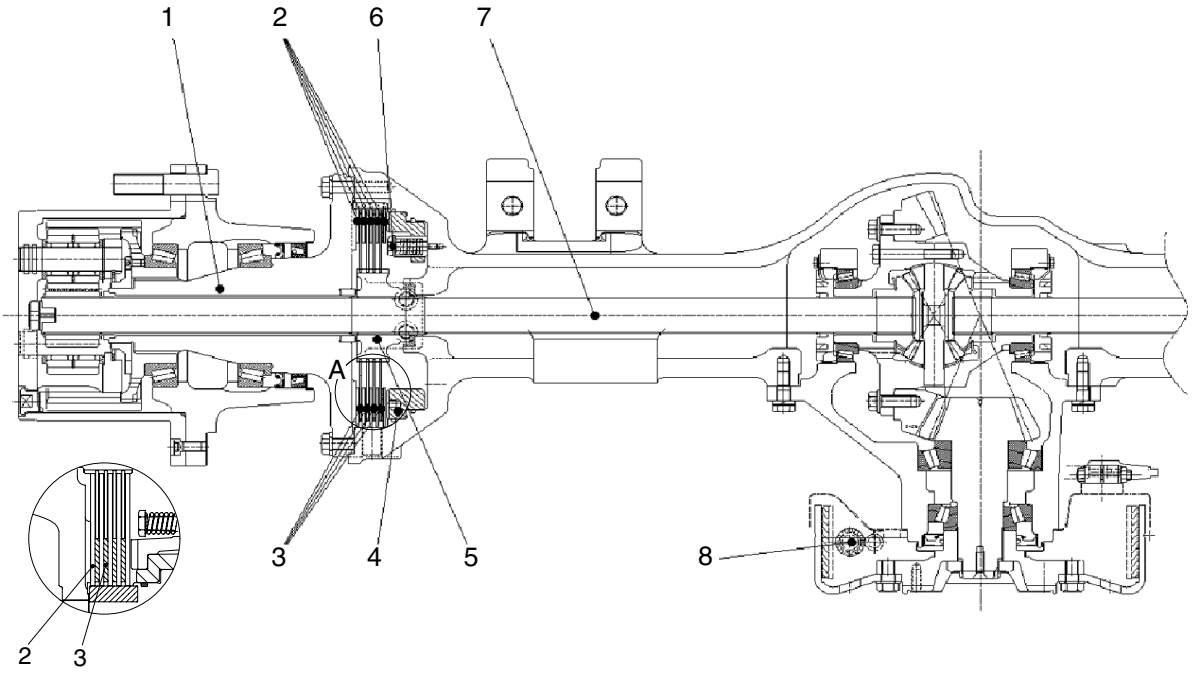
3) DRIVE AXLE TIGHTENING TORQUE



50D7EAX04

No	Item	Specification
1	Inner carrier	2.2±0.3kgf · m (15.9±2.2lbf · ft)
2	Spindle	12±0.5kgf · m (86.8±3.6lbf · ft)
3	Service piston	1.5±0.1kgf · m (10.8±0.7lbf · ft)
4	Adjuster nut	1.0±0.2kgf · m (7.2±1.4lbf · ft)
5	Differential cap	16±0.5kgf · m (116±3.6lbf · ft)
6	Differential case	6.0±0.5kgf · m (43.4±3.6lbf · ft)
7	Ring gear	13.5±0.5kgf · m (97.6±3.6lbf · ft)
8	Differential carrier assembly	18.0±0.5kgf · m (130±3.6lbf · ft)
9	Wheel hub rolling resistant	3.0±0.3kgf · m (21.7±2.2lbf · ft)
10	Parking brake	20.0±0.9kgf · m (144.7±6.5lbf · ft)
11	Brake drum	12.0±0.5kgf · m (86.8±3.6lbf · ft)

4) DISK BRAKE



50D7EAX05

1	Spindle	4	Service piston	7	Drive shaft
2	Steel plate	5	Service collar	8	Parking brake
3	Disk plate	6	Service piston adjust bolt		

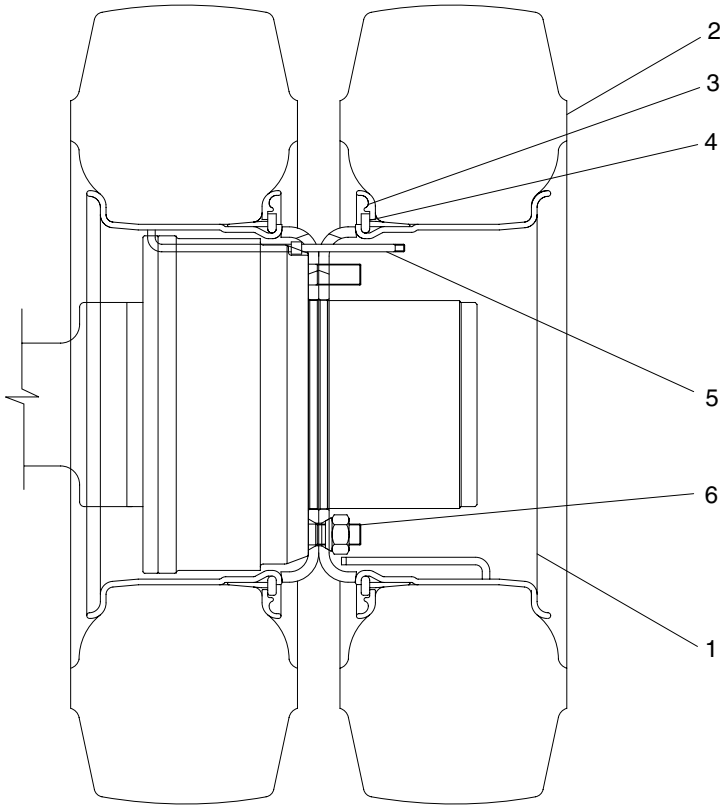
OPERATION

Sealed up structure of hydraulic multi-disk brake system secures good brake performance even in the high humid or dusty area.

Because it is possible to use the brake semi-permanently, there is no need to maintain its lining as drum type brake do. Also with self-adjust of friction plate clearance, it's easy to prevent the brake performance drop due to friction material wear.

Major components are 3 disk plates (3), 4 steel plates (2), service piston (4) and 4 piston adjust bolts (5). Braking take places when the discs and plates are pressed each other which make rotation resistance to the collar (6) and the drive shaft (7).

7. TIRE AND WHEEL



B507AX68

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

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

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

GROUP 2 INSPECTION AND TROUBLESHOOTING

1. INSPECTION

To check the problems of transmission, operate the machine and test its performance.
Check and record the abnormal noise and if the machine doesn't operate perfectly, refer to problem and possible cause in the troubleshooting table.

1) VISUAL CHECK

(1) Start engine and check T/M oil level at the neutral gear shift.
(2) Check any kind of damage or leakage on the oil piping, hose, connection, etc.
(3) Operate the Forward/Reverse lever to both of directions.
(4) Check the contamination in the strainer and filter inside the transmission.
① If rubbed paper particles detected, check clutch defects.
② If metal particles detected inside the filter, check metallic friction inside the T/M or mechanical faults.
③ If rubber particles detected, check seal or hose defects.
④ If Aluminum particles detected, check converter or control valve damage.
(5) If metal or rubber particles found, clean all of the T/M hydraulic parts.
(6) Replace damaged parts with the new one.

2) DRIVE CHECK

Fill T/M oil to the proper level before starting the machine.
Improper oil level can cause the damages on the components.

(1) After starting engine, step on the brake pedal and then operate the Forward/Reverse lever to both of directions.
(2) If the machine moves to each of directions, it will operates normally but check noise and cause and then note them.
In case of abnormal operation, refer to troubleshooting table.

2. TROUBLESHOOTING

1) TRANSMISSION

(1) Check list during operation list

No	Condition	Possible causes	Correction
1	Transmission does not operate in any speed or does not engage(slips) in all speeds	(1) Low oil pressure or no oil pressure caused by : a. Low oil, no oil, or thick oil. b. Inching control valve linkage loose, broken or adjustment is not correct. c. Inching valve spool stuck(held) open. d. Failure of the oil pump or a defect in the oil pump. e. Converter drive tangs worn off or not engaged into pump or broken bolt. f. Main regulator valve stuck open. g. Restriction in the oil flow circuit such as dirty oil screen.	(1) Check to oil level. a. Check to mix another oil. b. Check to tightening bolt or changing a control valve ass'y. c. Changing a spool of the control valve ass'y or check it. d. Changing the oil pump or have to check. e. Check to tightening torque of bolt from Torque Converter Gear. f. Check to Control Valve Ass'y. g. Check to suction filter due to a clogged from a mixed foreign materal.
2	Transmission does not shift	(1) Low oil pressure. (2) Main regulator valve will not move(stuck). (3) Solenoids or related electric components are out of order.	(1) Check to oil level. (2) Check Control Valve Ass'y. (3) Check to Solenoids Valve or related electric components.
3	Transmission gets hot.	(1) Restriction in cooling circuit. (2) Oil level too high or too low. (3) Low pump pressure -worn or damaged pump. (4) Converter one way clutch worn and slipping. (5) Air mixed in the oil. Air leaks on the intake side of the pump. (6) Low oil flow through converter. (7) Wrong application for vehicle (loads are too heavy for the lift truck). (8) Too much inching operation (slipping the clutch plates and discs). (9) Too much stalling of torque converter. (10) Cooler bypass valve stuck(held) open, full oil flow does not go through oil cooler.	(1) Check to Restriction in cooling circuit of transmission. (2) Check to oil level or replacement. (5) Check to transmission inside cover. (6) A plugged(restriction) oil flow passage. (7) Check to reliable work place under circumstance. (8) Check to Control Valve Ass'y. (9) Check to Torque Converter Ass'y or replacement.

No	Condition	Possible causes	Correction
4	Clutch engagement is slow or loss of power during engagement.	(1) Low oil pressure. (2) Low converter pressure. (3) Air mixed in the oil. a. Air leaks on suction side of pump. b. Low oil level also causes aeration. (4) Inching valve linkage adjustment is not correct.	(1) Check to oil level. (2) Check touque converter assy. (3) Check to transmission inside cover. a. Air mixed in the oil air on the intake side of the pump. b. Thin oil level.
5	Transmission operates in forward speeds only.	(1) Discs and plates have too much wear in forward direction clutches. (2) Leakage at the seals. a. Forward clutch components have damage. b. Leakage caused by worn or broken seal around metal sealing rings. c. Leakage caused by worn or (3) broken seal around clutch piston. Failure of other components. (4) Solenoids or related electric components are out of order.	(1) Check to disc and plate in clutch assy. (2) Replace to seal. (3) Replace to relate with other component. (4) Check to solenoids valve in control valve.
6	Transmission operates in reverse speeds only.	(1) Discs and plates have too much wear in forward direction clutches. (2) Leakage at the seals. a. Foward clutch components have damage. b. Leakage caused by worn or broken seal around metal sealing rings. c. Leakage caused by worn or (3) broken seal around clutch piston. Failure of other components. (4) Solenoids or related electric components are out of order.	(1) Check to disc and plate in clutch assy. (2) Replace to seal. (3) Replace to relate with other component. (4) Check to solenolds valve in control valve.
7	Low stall speed.	(1) Engine performance is not correct. (2) The one-way clutch of the torque converter does not hold.	(1) Check to engine component. (2) Check to torque converter or replacement.
8	High stall speed in all transmission speeds and directions.	(1) Low oil level. (2) Air in the oil. (3) Clutches slip(clutch plates slide in relation to one another). (4) Torque converter failure.	(1) Check to oil level. (2) Check to mix another oil. (3) Check to inner disc and plate. (4) Replace to torque converter.

No	Condition	Possible causes	Correction
9	High stall speed in one speed or one direction.	(1) There is a leak in that clutch circuit. (2) There is a failure if the clutch in that speed or direction.	(1) Check to clutch assy and then replace to relate with other comonent. (2) Replace the clutch assy.
10	Clutch engagement is slow and makes rough shifts.	(1) Inching valve adjustment is not correct. (2) Inching valve is not completely closed or orifice has dirt(plugged). (3) Low main pressure. (4) Low directional clutch pressure. (5) Internal oil leaks. (6) Valve spool springs are weak or have damage.	(1) Adjust to inching valve (2) Check to orifice has dirt(plugged) and then remove to foregin materal. (3) Check to the oil flow circuit in the transmission. (4) Check to oil flow circuit of clutch. (5) Replace to a leak component. (6) Replace to spring.
11	Vehicle operates in one direction and creeps in that direction in NEUTRAL. Engine stalls when shifted to the other direction.	(1) Failure of clutch in the direction the lift truck moves. Clutch discs or plates are warped(damaged) or held together because of too much heat. (2) Failure of the valve spool in the direction the lift truck moves. The spool stuck(held) in the engaged position possibly caused by metal burrs(particles) or dirt.	(1) Raplace have to relate with other component. (2) Replace have to relate with other component.

(2) Check list from operation noises

No	Condition	Possible causes	Correction
1	Noise in NEUTRAL only.	(1) Worn bushing in pump assembly. (2) Worn one-way clutch in torque converter. (3) Oil level low. (4) Converter housing or converter tangs not in alignment with engine or transmission pump.	(1) Changing is related with other componrent of charging. (2) Charging to torque converter assy. (3) Check to oil level. (4) Should be alignment with engine or transmission pump.
2	Pump noise not normal.	(1) A loud sound at short time periods gives an indication that foreign material is in the transmission hydraulic system. (2) A constant loud noise is an indication of pump failure.	(1) Charging to the oil pump. (2) Charging to the oil pump.
3	Noise in the transmission that is not normal.	(1) Converter housing or converter tangs not in alignment with engine or transmission pump. (2) Transmission components have wear or damage. a. Damaged gears. b. Worn teeth or clutch plates and/or clutch discs and slipping clutch plates and discs noise. c. Failure of the thrust washers. e. Other component parts have wear or damage.	(1) Should be alignment with engine or transmission pump. (2) Transmission components have wear or damage. a. Charging to gear. b. Charging to plate and disc. c. Charging to thrust washer. e. Charging to other component.
4	Noise in the control valve.	(1) Air in the hydraulic system. a. Air leakage on suction side of the pump or low oil level that causes aeration. (2) Restrictions in oil passage. (3) Valve spools movement has restriction.	(1) Charging to control valve assy. (2) Charging to control valve assy. (3) Charging to control valve assy.

(3) Check list from pressure test

No	Condition	Possible causes	Correction
1	Low pressure to FORWARD and REVERSE clutches.	(1) Inching valve linkage adjustment is not correct. (2) Inching valve spool held(stuck) open. (3) Clutch piston seals cause leakages. (4) A defective regulator valve spring. (5) Low oil pressure, see probable cause for low oil pressure. (6) Cooler external lines are not connected correctly.	(1) Adjust to inching valve. (2) Change to inching spool. (3) Change to clutch and piston seal. (4) Change to the spring of the Regulator. (5) Check to oil flow circuit of the transmission. (6) Check to the cooler external lines.
2	Clutch pressure and main pressure are high.	(1) Pressure regulator valve is not free to move(stuck). (2) A restriction in the hydraulic circuit.	(1) Check to adjusting pressure valve. (2) Check to the hydraulic circuit.
3	Pressure to one clutch is low.	(1) Clutch piston seal alignment is not correct, oil leaks through. (2) Seal rings on shaft or clutch piston seals are broken or worn. (3) Control valve surface not flat or gasket has damage.	(1) Change to clutch piston seal. (2) Change to shaft sealing and clutch piston seal. (3) Change to the control valve gasket.
4	Low main line pressure.	(1) Low oil level. (2) Main regulator valve movement is restricted. (3) Transmission pump is worn. (4) Inner oil leakage. (5) Low oil pressure.	
5	High converter pressure.	(1) Main regulator valve stuck open so most of the flow goes to the converter. (2) A restriction inside the converter assembly. (3) A plugged(restriction) oil flow passage.	(1) Checjk to adjusting main valve. (2) Change to torque converter assy. (3) Check to the oil flow hole of the transmisson.
6	Low converter pressure.	(1) Main regulator valve movement is restricted (plugged).	(1) Check to main regulator valve or change.
7	Converter outlet pressure or cooler inlet pressure is low.	(1) Low oil pressure. Cooler bypass valve stuck open.	(1) Check to the oil level. Cooler bypass valve stuck open.
8	Converter outlet pressure or cooler inlet pressure too high.	(1) Restriction(plugging) in oil cooler lines or a plugged oil cooler.	(1) Check to the oil cooler lines

2) DRIVE AXLE

No	Condition	Possible causes	Correction
1	Constant noise in differential.	(1) Oil is not enough(Replace interval : 50 hrs first, then every 500hrs).	· Refueling lubricating oil
		(2) Wrong kind of oil.	· Exchange lubricating oil
		(3) Wheel bearings out of adjustment or have a defect.	· Exchange bearing
		(4) Drive gear and pinion not in adjustment for correct tooth contact.	· Re-assemble
		(5) Teeth of drive gear and pinion have been damage or worn.	· Exchange dameged gear
		(6) Gear backlash is too much or too little.	· Exchange differential gear set
		(7) Loose or worn on pinion bearings.	· Exchange bearing
		(8) Loose or worn on side bearing.	· Exchange bearing
2	Noise at different intervals.	(1) Ring gear does not run even.	
		a. Bolts on drive gear are not tightened correctly.	· Tighten bolts
		b. Drive gear has a defect (warped)	· Exchange dameged drive gear set
		(2) Loose or broken differential bearings.	· Exchange bearing
3	Noise on turns only.	(1) Differential pinion gears are tight on the spider.	· Exchange differential pinion gear or spider
		(2) Side gears are tight in differential case.	· Exchange differential side gear
		(3) Differential pinion or side gears have a defect.	· Exchange differential gear set
		(4) Thrust washers worn or have a damage.	· Exchange differential washer
		(5) Too much clearance(backlash) between side gears and pinions.	· Exchange differential gear set
4	Leakage of the oil.	(1) Leakage through axle hub carrier	
		a. Too much oi	· Adjust oil level
		b. Wrong kind of oil.	· Exchange lubricating oil
		c. Much restriction on air eather.	· Exchange air breather
		(2) Leakage around pinion shaft.	
		a. Too much oil.	· Adjust oil level
		b. Wrong kind of oil.	· Exchange lubricating oil
		c. Much restriction on air eather.	· Exchange air breather
		d. Oil seal worn or not installed correctly.	· Exchange oil seal

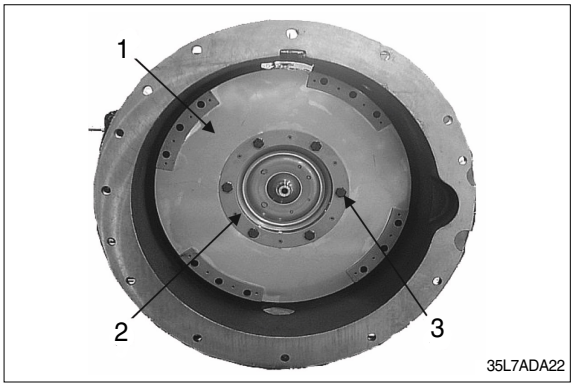
No	Condition	Possible causes	Correction
5	Drive wheels do not rotate	(1) Broken axle shaft. a. Loose wheel bearings. b. Axle shaft too short. c. Loose flange studs or nuts. (2) Drive gear teeth have been damaged. (3) Side gear on differential damaged. (4) Differential pinion shaft or spider broken	 · Re-assemble wheel bearings. · Replace drive shaft · Tighten studs or nuts · Exchange damaged drive gear set · Exchange damaged gear · Exchange damaged gear

GROUP 3 DISASSEMBLY AND ASSEMBLY

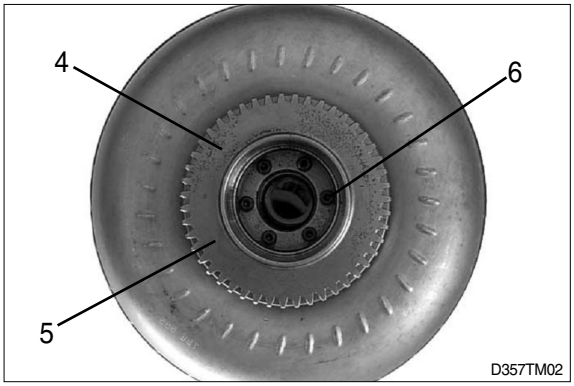
1. DISASSEMBLY OF TRANSMISSION

1) Pull torque converter(1) straight forward and remove from the converter housing.

Remove six bolts(3) and flexible plate(1), plate(2) from the torque converter.

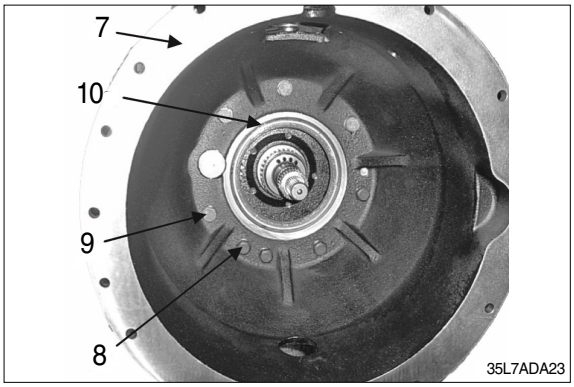


2) Remove six socket bolts (3) and then gear P.T.O input from the the torque converter.

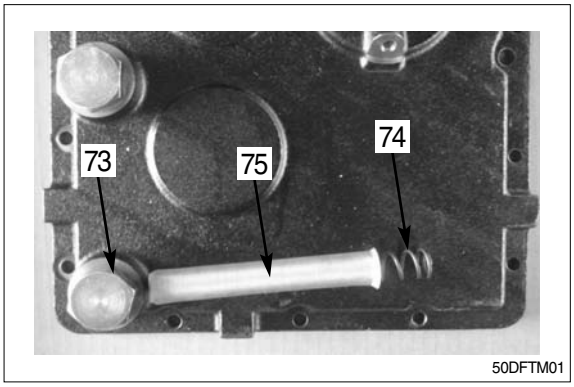


3) Remove four bolts (9) and bolts(8), washes, oil seal(10) from the housing converter(7).

※ Use loctite 277 to apply to the thread of a screw(8,9).



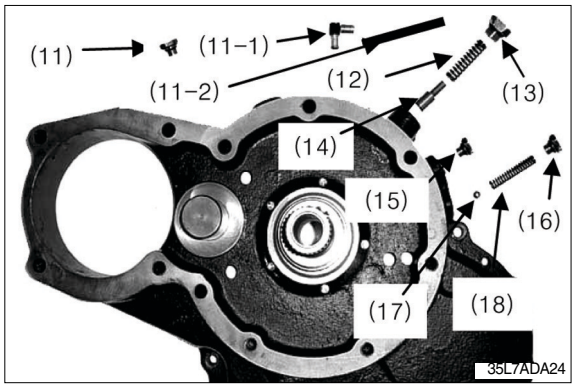
4) Remove transmission oil from transmission case then remove plug(73), spring(74), screen suction(75).



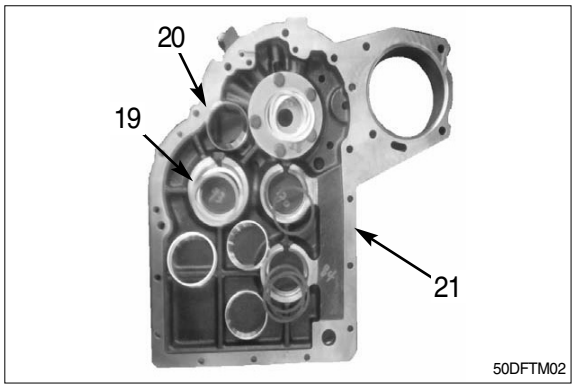
5) Remove plug (16) and O-ring, spring (18) and ball (17) from the bearing plate.

6) Remove plug (13) and spring (12), Valve(14).

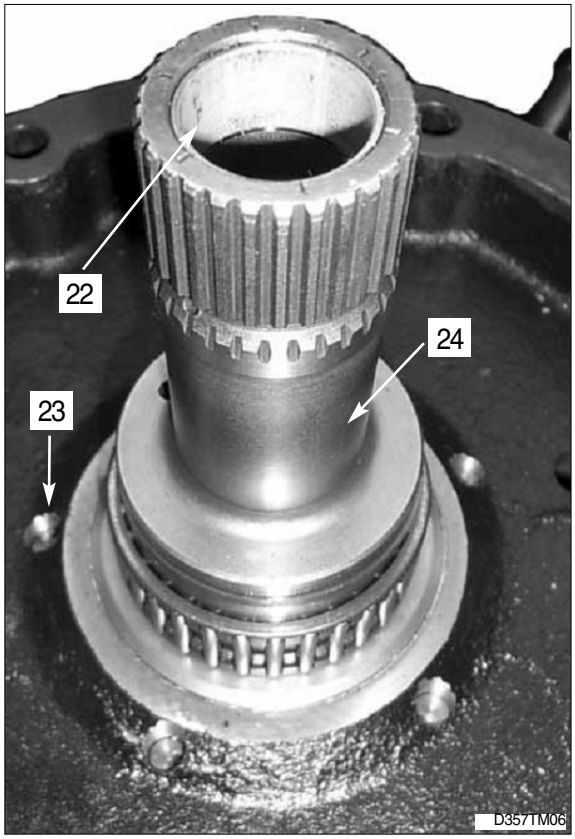
7) Remove plug (11).



※ Bearing cups and their shims will be in cover or on the shafts in transmission case. Put identification on each of bearing cups and shims as to their location on transmission cover or shaft in transmission case.



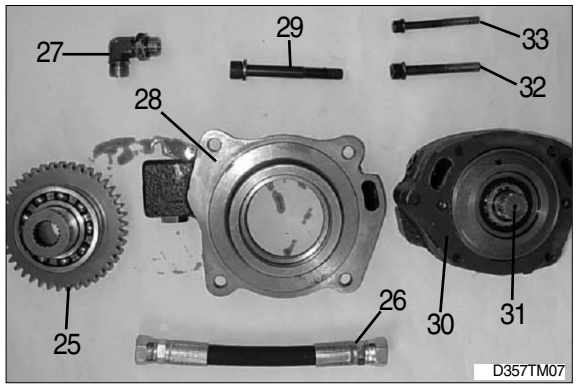
8) Remove fasten five bolts(23) from fixed stator hub(24) and bearing plate. In this time, Use the plastic hammer.



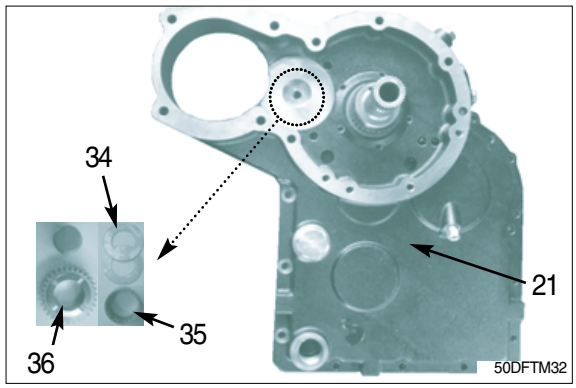
9) Remove four socket bolts (29), flange pump (28) from bearing plate (21).

Remove a bolt.soc(32) and four socket bolt (33) from flange pump.

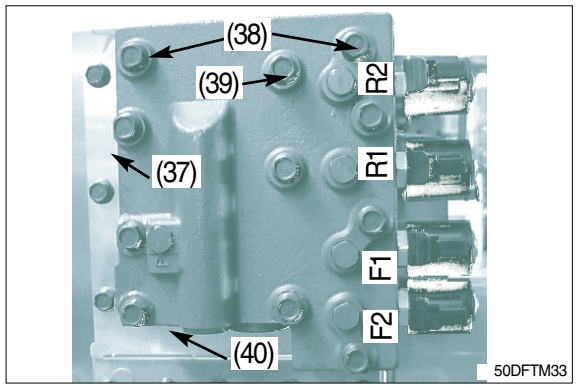
Remove charging pump(31) and pump gasket(30), then seperate to gear-P.T.O output(25) and ball bearing, 90° elbow(27).



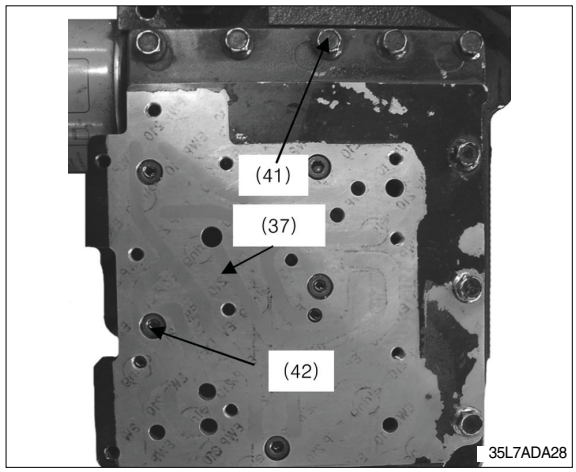
10) Separate to two thrust washers(34), needle bearing(35), gear- P.T.O Idle(36) from front cover.



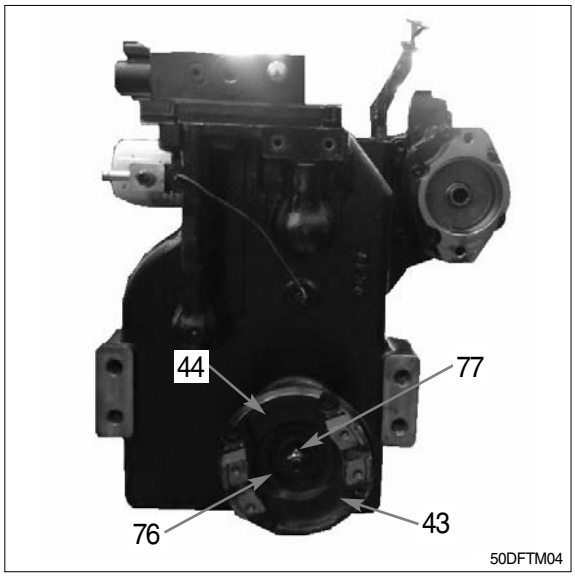
11) Remove two bolts(38), nine bolts(39), valve gasket(40), valve plate(37).



12) Remove eight bolts(41), five socket bolt(42), then separate valve plate(37) from transmission case.



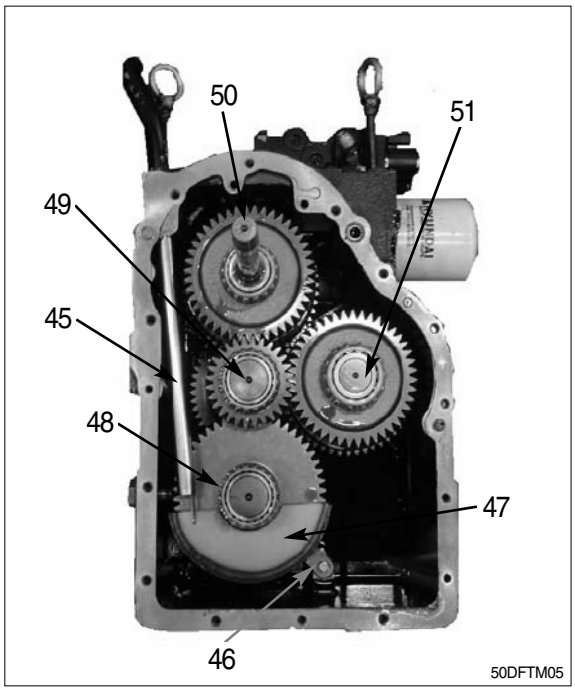
13) Remove nut(43), yoke(44), washer(76), cork(79) from transmission assy.



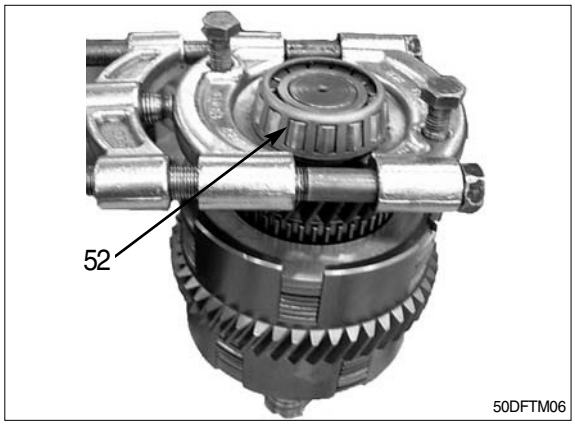
14) Use plastic hammer when removing tube(45) from transmission case.

15) Untighten bolt(46), oil collector(47) then remove output shaft assembly(48) from transmission case.

16) Remove input shaft assembly(50), counter shaft assembly(51), intermediate shaft assembly(49) from transmission case.

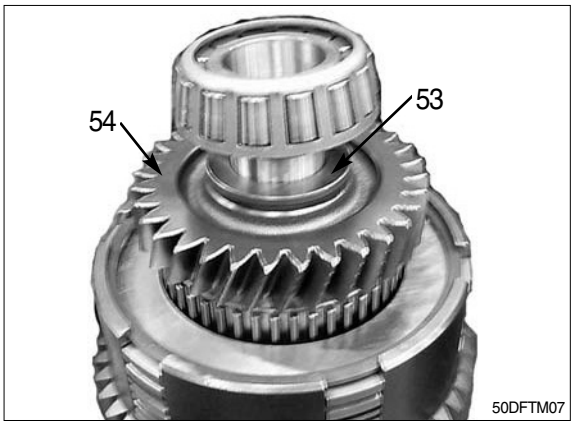


17) For high speed forward clutch assembly, remove bearing cone (52) with gear pulley tools.



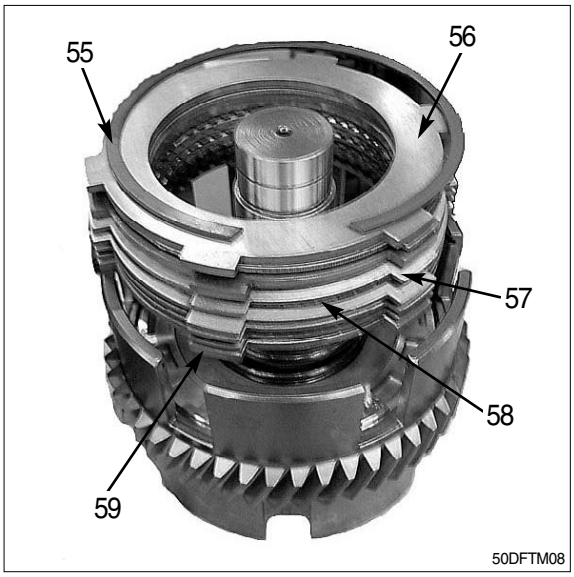
18)Remove two thrust washes (53) and gear (54).

19)Remove needle bearings and thrust washer from the forward shaft of high speed clutch side.



20)Use a tool and remove snap ring(55) from the cylinder.

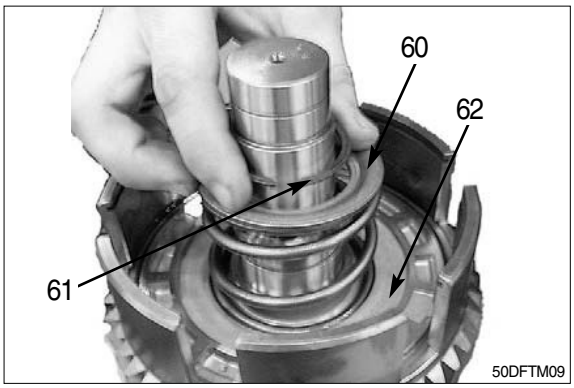
21)Remove a five clutch discs and three 4T clutch plates(56), six 2T clutch plates(57), one bending plate(59) from the cylinder.



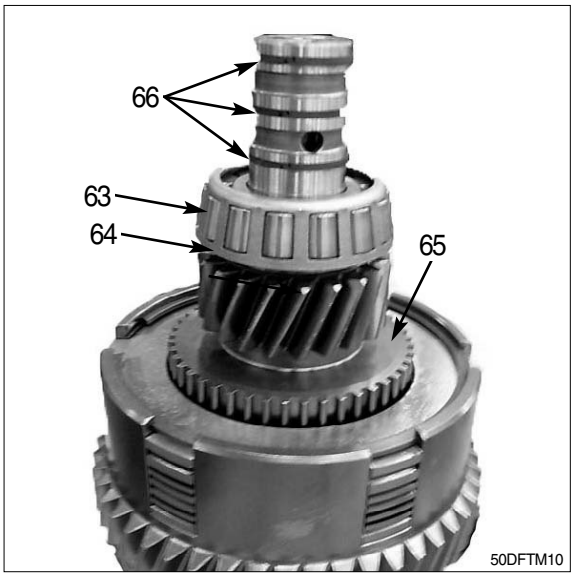
22)Push down on the retainer(60) by a jig and remove snap ring(61) with a screwdriver. Slowly release the tension on the spring assembly.

23)Remove retainer(60) and spring assembly from cylinder.

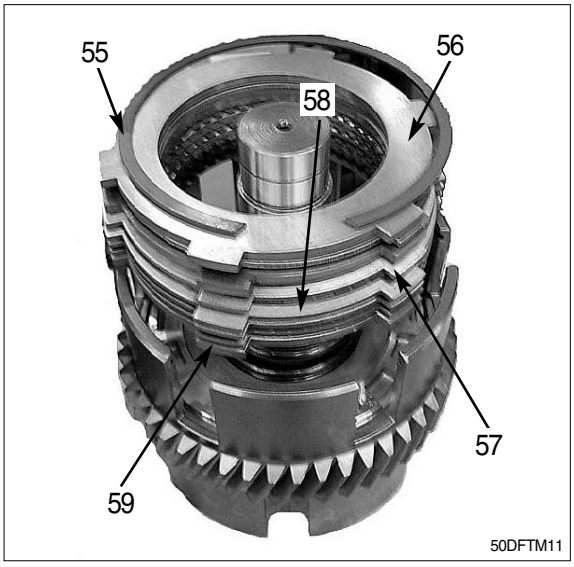
24)Remove piston(62) by using compressed air, then remove O-ring from the shaft.



25) For low speed forward clutch assembly, remove seal rings (66) from shaft.
Remove bearing (63), thrust washer (64), gear (65), needle bearing, spacer and sealing (66).



26) Remove snap ring (55), then remove a seven clutch discs (58) and three 4T clutch plates (56) and six 2T clutch plates (57), one bending plate (59) from the cylinder.

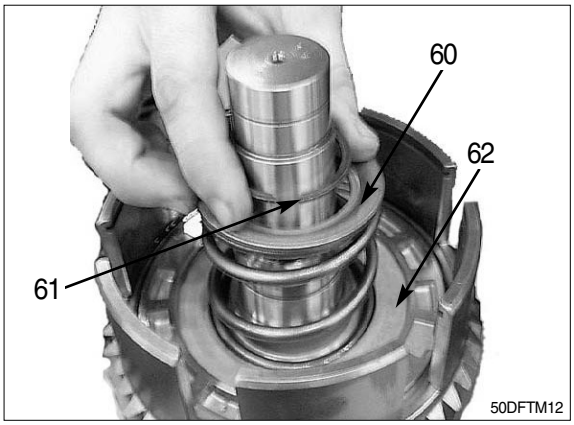


27) Remove two thrust washes and pin.

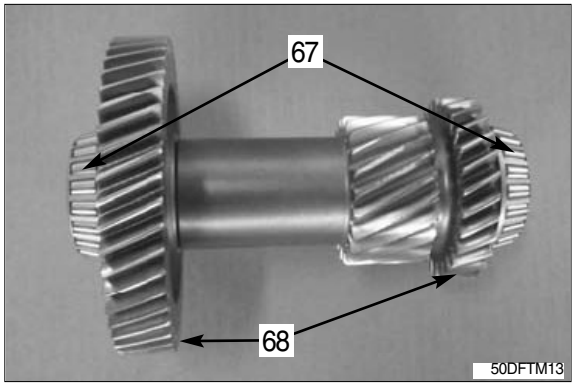
28) Push down on the retainer (60) by a jig and remove snap ring (61).
Slowly release the tension on the spring assembly, then remove retainer and spring assembly.

29) Remove piston (62) by using compressed air, then remove O-ring from the shaft.

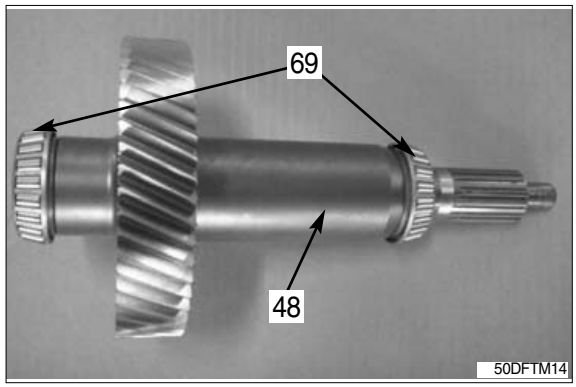
※ Disassembling procedure of input shaft assembly is the same as counter shaft assembly.



30)Remove bearing(67) and gear(68).

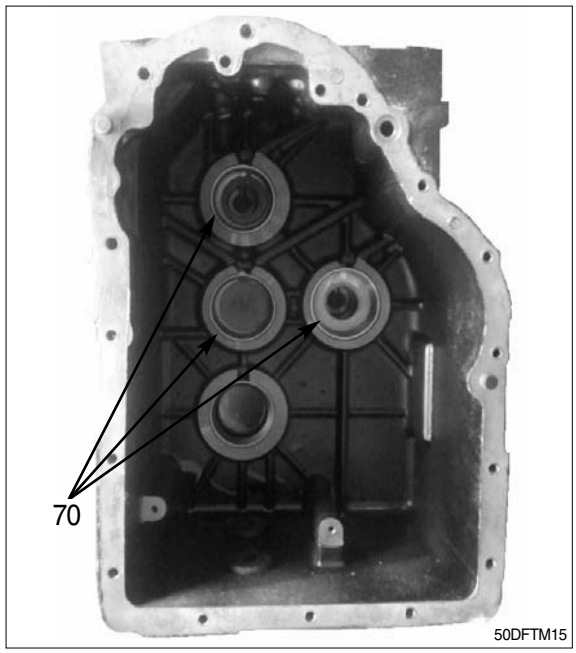


31)Remove bearing(69) from output shaft assembly(48).

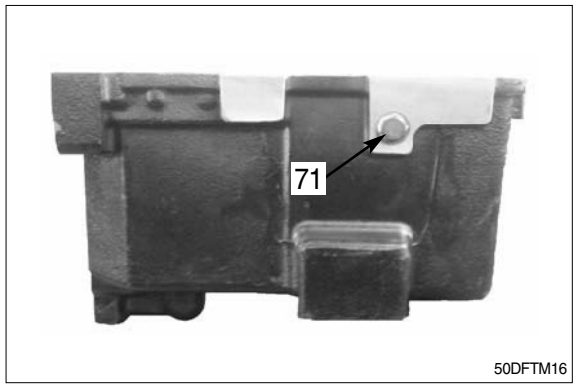


32)Remove bearing cups (70) from the transmission case.

※ Put identification on bearing cups to use at assembly.



33)Remove speed sensor(71) from the transmission case.



34)Remove oil seal(72) from the transmission case.

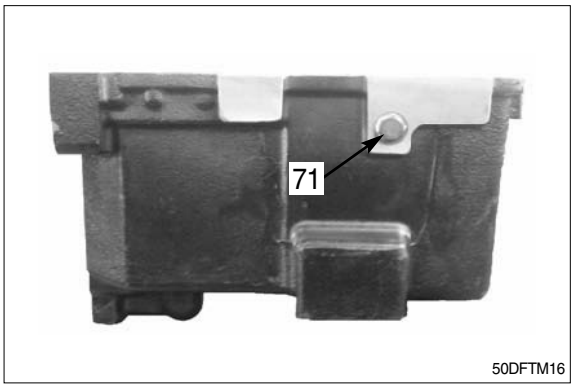
2. ASSEMBLY OF TRANSMISSION

1) Thoroughly clean all the parts of the transmission.
   Put clean transmission oil on all of the inner parts.

2) Put lip type oil seal (72) in position on the case with the spring loaded lip of the inside seal toward the inside of the transmission case.

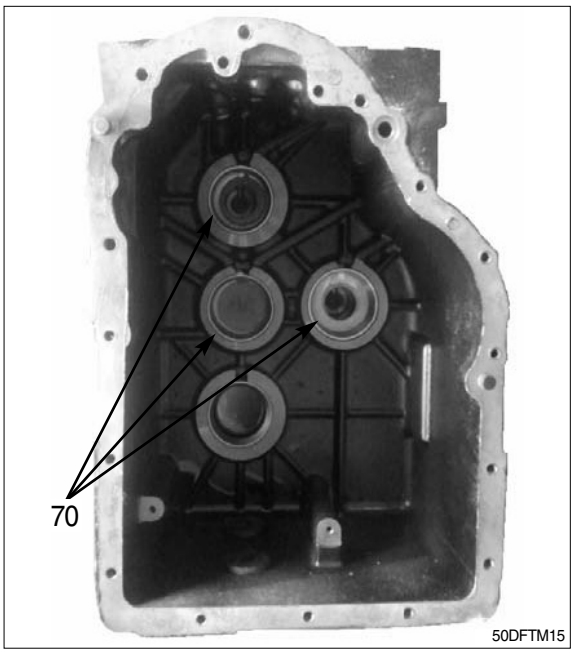
※ Use loctite 591 to apply to the outer diameter of a oil seal (72).

3) Install speed sensor(71) to transmission case.

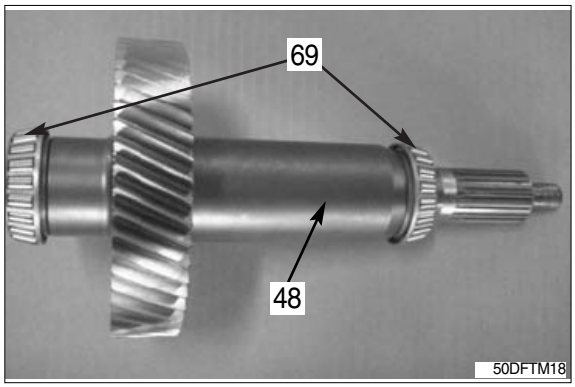


4) Install bearing cups (70) in position on the transmission case.

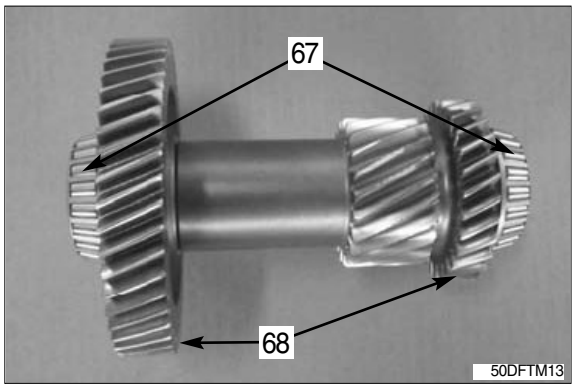
※ Put identification on bearing cups to use at assembly.



5) Install bearing(69) to output shaft assembly(48).



6) Install bearing(67) and gear(68) to intermediate shaft assembly.



7) Install seal ring on the piston(62).
Put clean transmission oil on the seal ring.

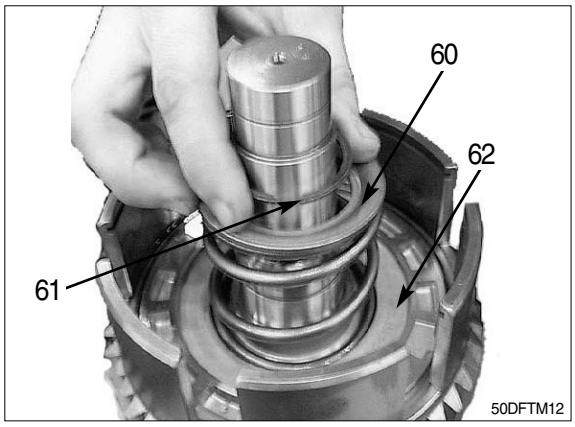
8) Install piston with seal ring in cylinder.

9) Put spring assembly and retainer(60) in position in the cylinder.

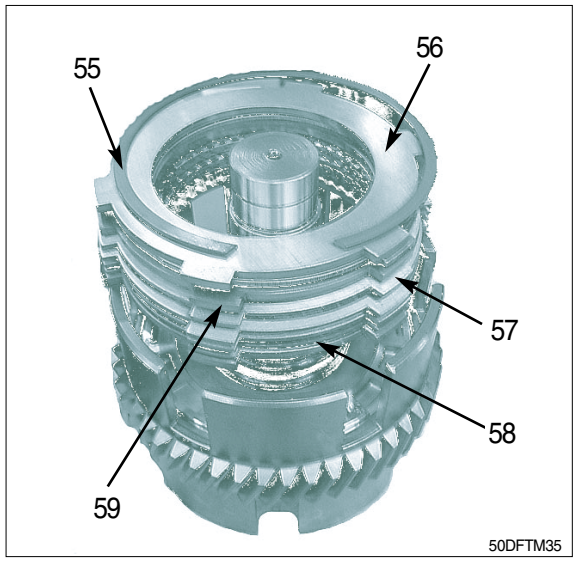
10) Put the shaft assembly in a press. Push down on the retainer and install snap ring (61) with a screwdriver.

11) Install pin and two thrust washes in the counter shaft of low speed clutch side.

※ Be extra careful during installation of the piston.
Broken seal rings can be the result.

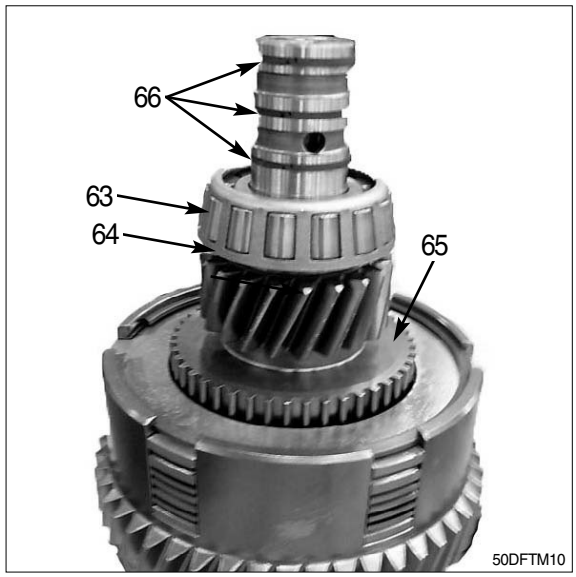


12) Put clean transmission oil on each side of the clutch plates and clutch discs. Install six 2T clutch plates(57), three 4T clutch plates(56), seven clutch discs(58) and one bending plate(59) in the cylinder with the following procedure.
   (1) Install a clutch plate first, that has guide shape on its outside diameter.
   (2) Next, install a clutch disc that has teeth on its inside diameter.
   (3) Follow steps (1) and (2) again until all of four the 2T clutch plates and discs are installed in the cylinder.
   (4) Install a 4T clutch plate, then install a bending plate. In following procedure, bending plate shape will be downward.
   (5) Finaly, install a 4T cluch plate.



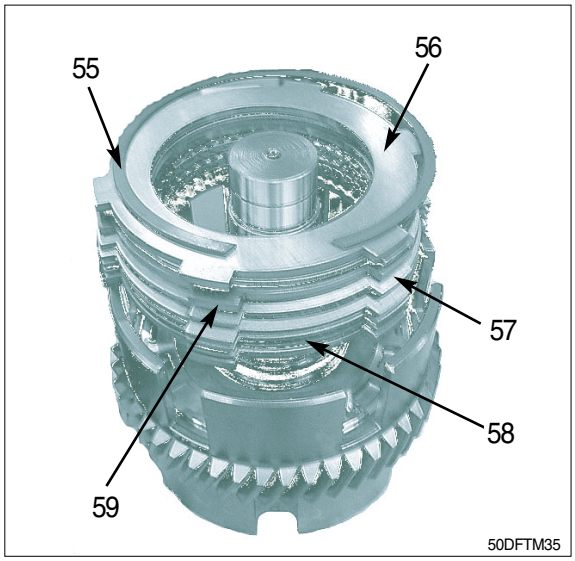
13) Use a tool and install snap ring(55) that check all of them in position in the cylinder.
※ Be carefully, do not damage to the seal rings on the counter shaft.

14) Install needle bearing, spacer, needle bearing gear(65), thrust washer(64) and bearing(63) and seal ring(66).



15) For the other side of the counter shaft assembly, follow the procedure in steps 5 through 8.

16) Put clean transmission oil on each side of the clutch plates and clutch discs. Install four 2T clutch plates, three 4T clutch plates, five clutch discs and one bending plate in the cylinder with the following procedure.
 (1) First, install a 4T cluch plate (56).
 (2) Install a 4T clutch plate, then install a bending plate (59). In following procedure, bending plate shape will be downward.
 (3) Follow steps (1) and (2) again until all of four the 2T clutch plates (57) and discs (58) are installed in the cylinder.
 (4) Next, install a clutch disc that has teeth on its inside diameter.
 (5) Finally, Install a clutch plate first, that has guide shape on its outside diameter.

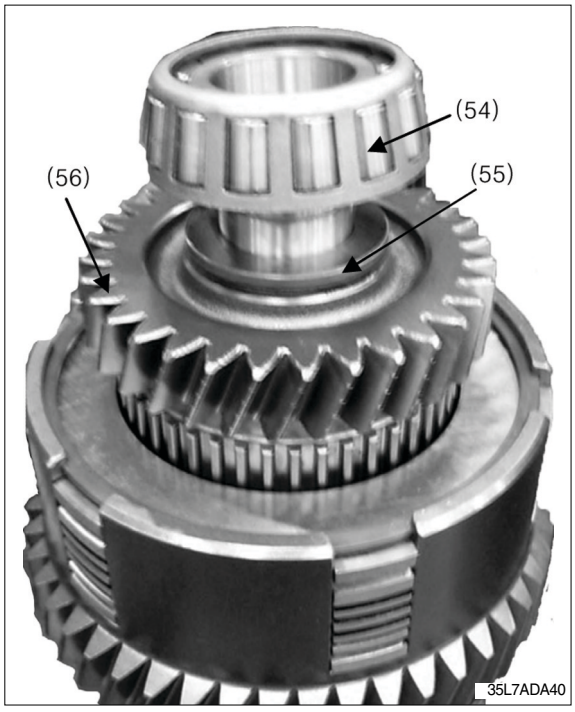


17) Use a screwdriver and install snap ring (55) that check all of them in position in the cylinder.

18) Install three seal rings on the shaft.
※ Be careful not to cause damage to the seal rings.

19) Install thrust washer and needle bearings on the counter shaft of high speed clutch side.

20) Install gear (56), thrust washes (55) and bearing cone (54) with tool.
※ Do not use force to install the gear.
Move the gear backward and forward while the gear is pushed into the clutch assembly until the teeth on the clutch discs are in alignment with the splines on the gear.

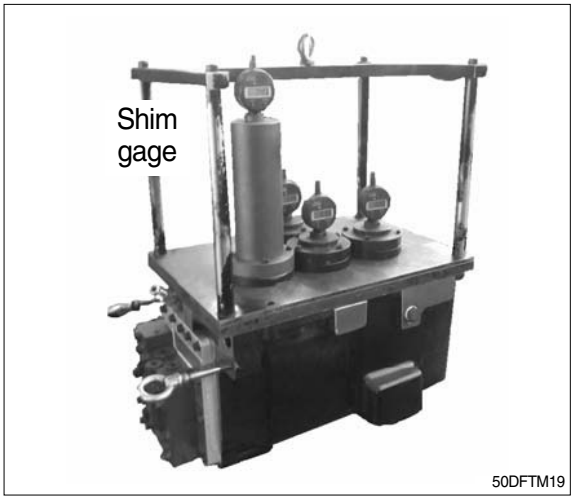


21) When new parts are used, required shim thickness should be calculated as follows .

(1) Assemble shaft assembly (including taper bearing cone and cup).

(2) Insert shaft assembly into transmission case.

※ Use depth gage and block gage because the height of bearing cup is higher than surface of transmission case.



· Method of the shaft shim measure

: Measure the dimension "depth" from surface of bearing plate to bottom of bore where bearing cup is installed.

Item	Shim thickness
Input shaft	**Y-X**-0.01
Counter shaft	**Y-X**-0.05
Output shaft	**Y-X**-0.05

(3) Select shims to have 0 to 0.05mm (0 to 0.002 inch) of axial tightness.

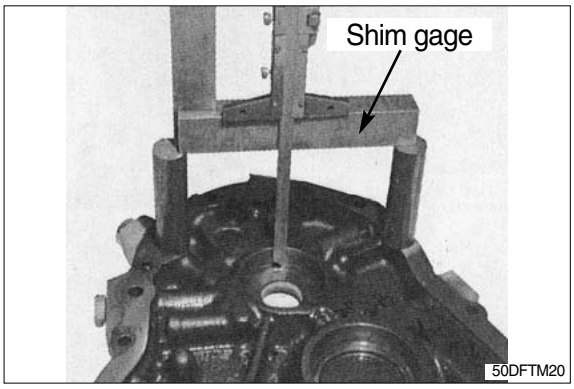
(4) Assemble transmission case, cover and gasket.

(5) Set up transmission assembly vertically.

(6) If you reshim input shaft or counter shaft, turn transmission input shaft by hand. It should be turned smoothly. If you reshim output shaft, turn output shaft by hand. It should be turned smoothly.

(7) If the input shaft or output shaft does not turn smoothly, remove shims about 0.025 - 0.05mm.

※ Be extra careful during installation of the cover. Do not tilt the cover during installation, damage to the seal rings on the input shaft can be result.



22) Assemble input shaft assembly with the same procedure as counter shaft assembly.

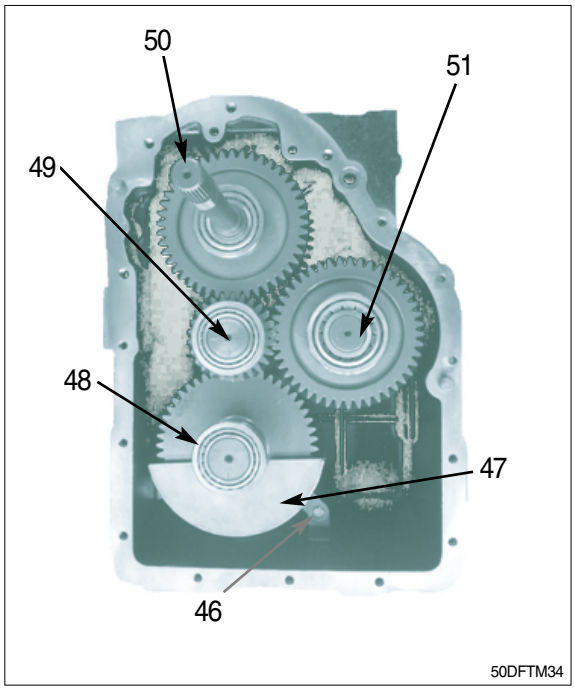
23) Install the gear assembly into transmission case.

24) Carefully put the counter shaft assembly (51) in position in the transmission case.

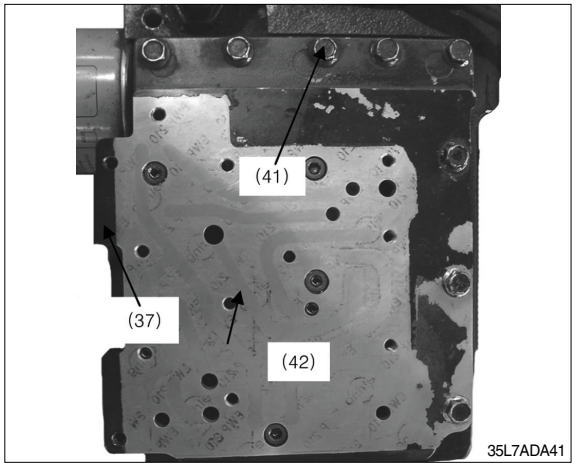
25) Carefully put the input shaft assembly (50) in position in the transmission case.
Install output shaft assembly (48) into output gear assembly.
Turn the gear until the teeth are in alignment with gears of another shaft assembly.

26) Install carefully intermediate shaft assemly(49) and put between the input shaft assembly(50) and counter shaft assembly(51).

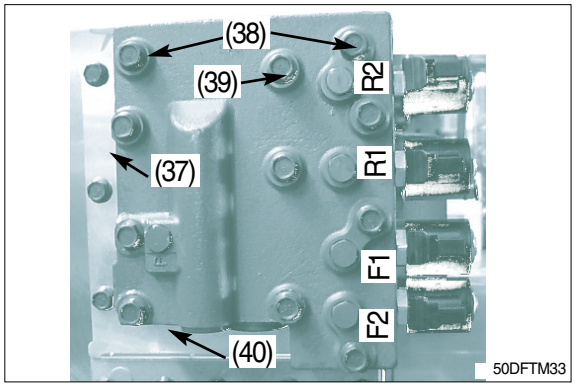
27) Install bolt(46) fighten on the cover(47).



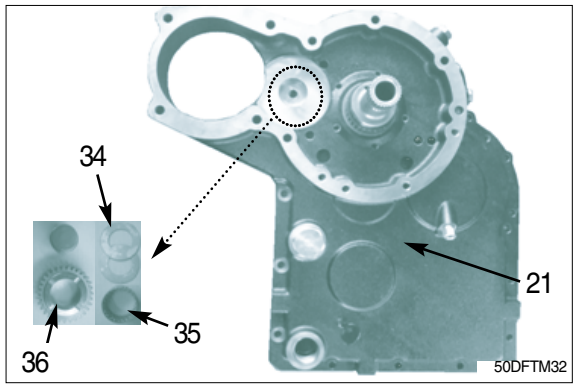
28) First, apply to Loctite 5172 on the transmission case then, fixed.
Install valve plate (37) by using a eight bolts (41) and an five socket bolt (42).



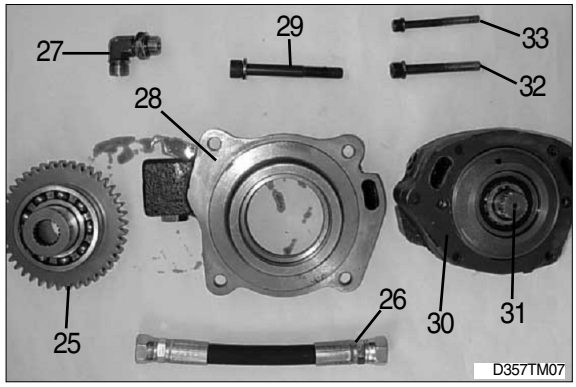
29) Install sticks to gasket on the transmisson case and then tighten bolt(38), nine bolt(39) on the control valve.



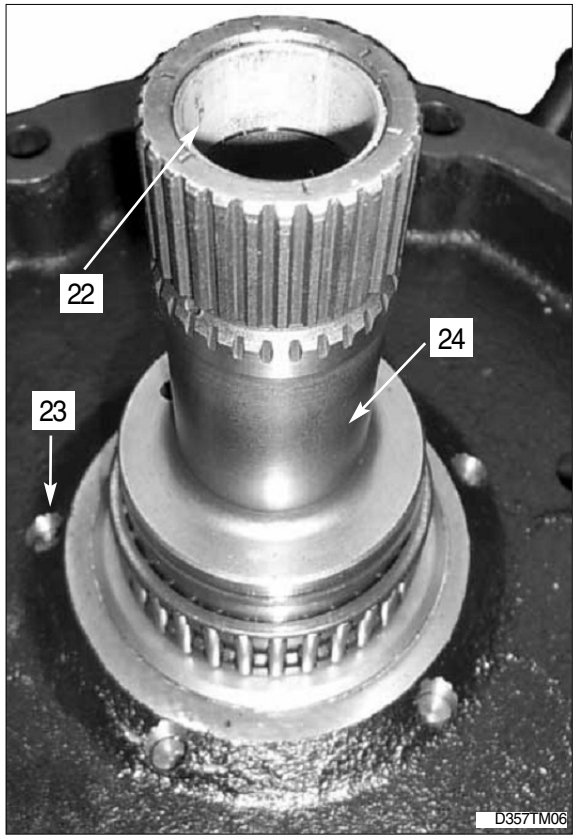
30) Install a two thrust washer(34), a needle bearing(35), gear-P.T.O idle(36) in the bearing plate(21).



31) Install a gear-P.T.O output(25), two ball bearings on the flange pump(28) by using the jig then, install four bolts(29) on the bearing plate.
Then, charging pump(31) and gasket(30) on the flange pump by install a bolt(32) and four bolts(33). Install a 90 degree elbow(27), rubber hose(26).



32) Install the stator hub assembly (24) due to bearing plate assy (21).
- Install bush(22), piston ring, bolt(23) which assembling by each six's.
Then install bearing plate



33) Install plug (11) and O-ring, elbow (11-1) rubber hose (11-2) in the bearing plate.

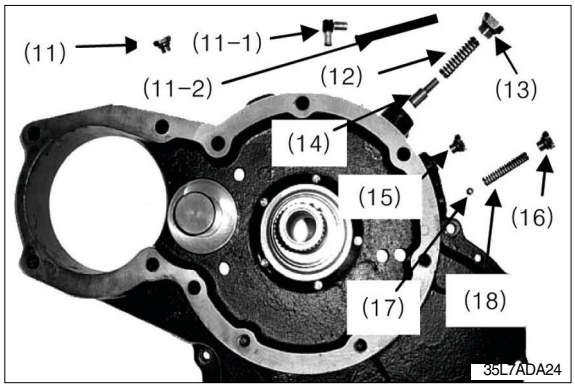
34) Install valve (14), spring (12), plug (13) and O-ring in the bearing plate.

35) Install plug (15) in the bearing plate.

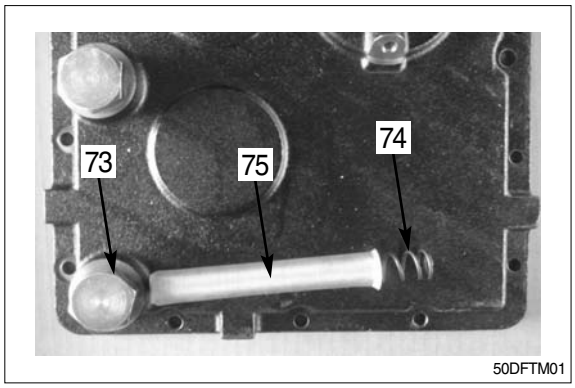
36) Install ball (17), spring (18), plug (16) and O-ring in the bearing plate.

37) Put bearing cups and their shims in the bearing plate.

※ Bearing cups and their shims should be put into their location on transmission cover so as to fit on their shafts in transmission case.

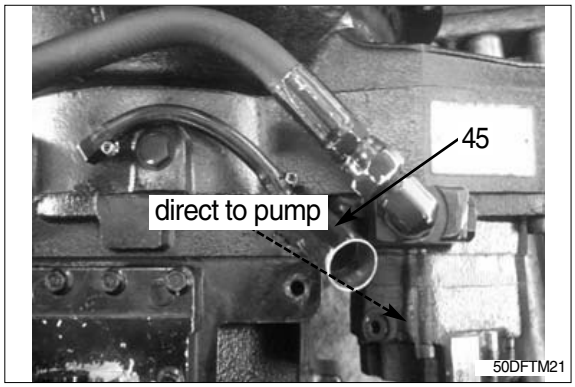


38) Insert spring(74), oil screen(75) in a hole then install plug(73).

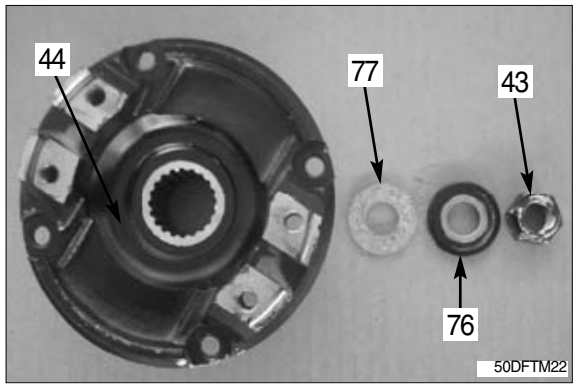


39) Use a plastic hammer when install tube(45) to transmission case.

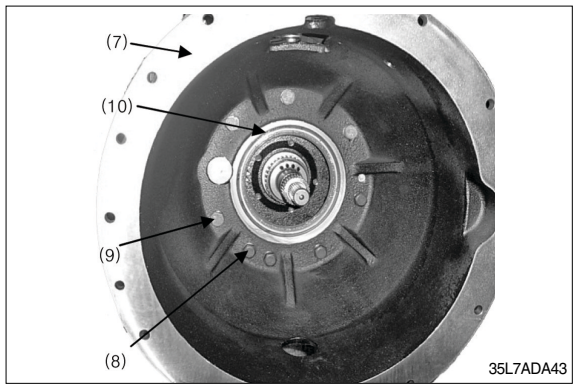
※ Tube direction to charging pump outside.



40) Install yoke(44), washer(76), cork(77), nut(43) in a output shaft assembly.

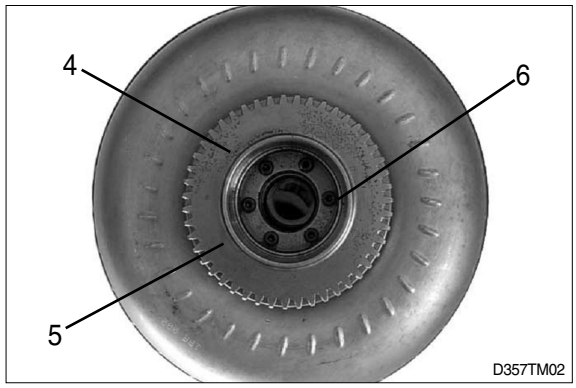


41) Install torque converter housing in position. Install four bolts (9) and washes, oil seal (10), four bolts (8) that hold torque converter housing to the transmission.



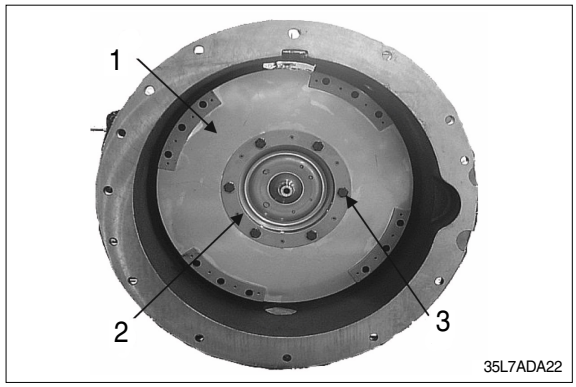
42) Install gear P.T.O input(5) to torque converter, then tighten six socket bolts(6) in postion.

※ Use loctite 277 to apply to the thread of a screw(6).



43) Install torque converter in postion. Install flexible plate (1) with six bolts (3) and plate (2).

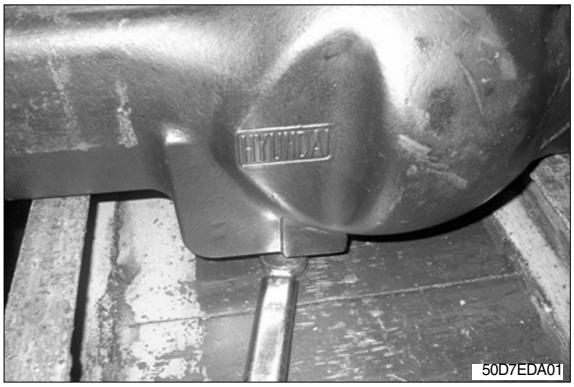
Then, Install torque converter housing in position.



3. DISASSEMBLY OF DRIVE AXLE

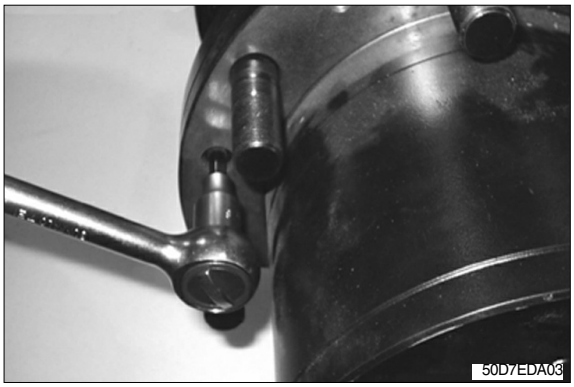
1) REMOVAL AND DISASSEMBLY OF WHEEL HUB

(1) Loosen drain plug with a torque wrench(1) in axle housing and drain oil.

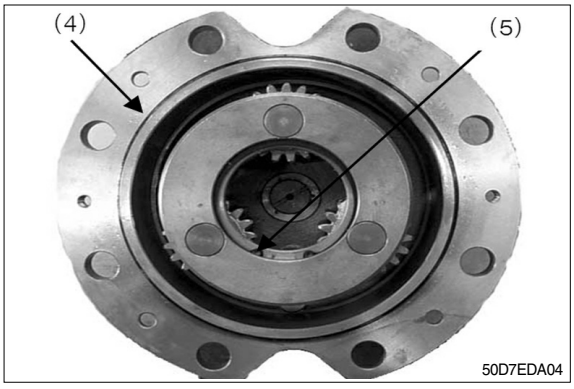


(2) Loosen oil drain plug in planetary housing and drain oil.

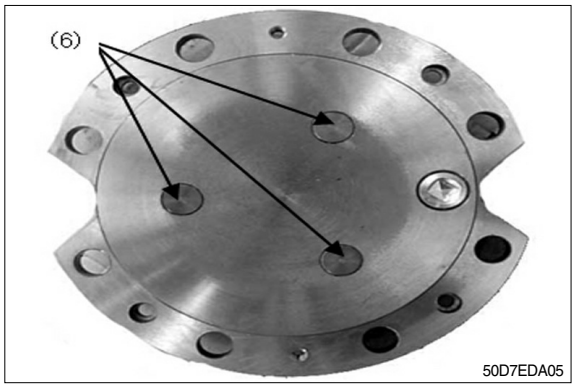
(3) Loosen 4 socket head bolts and remove the planetary carrier.



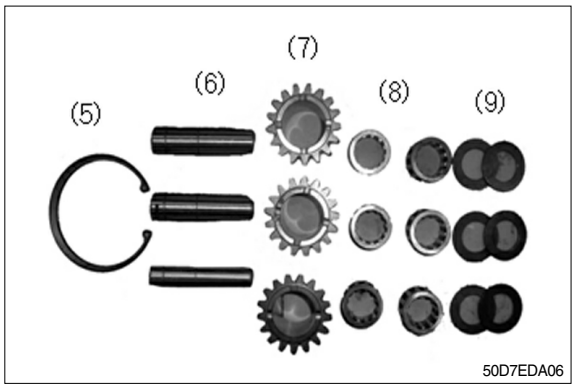
(4) Remove O-ring (4) and snap ring (5) from the housing of planetary.



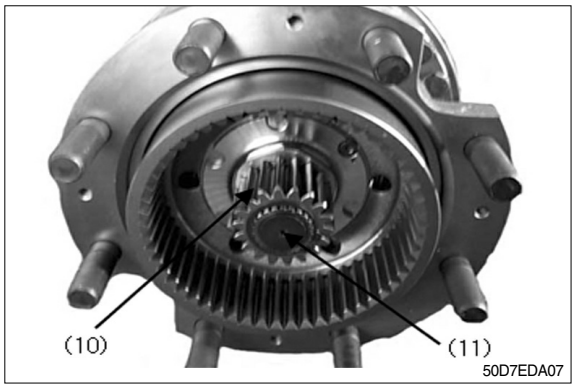
(5) Remove 3 pins(6) with a plastic hammer.



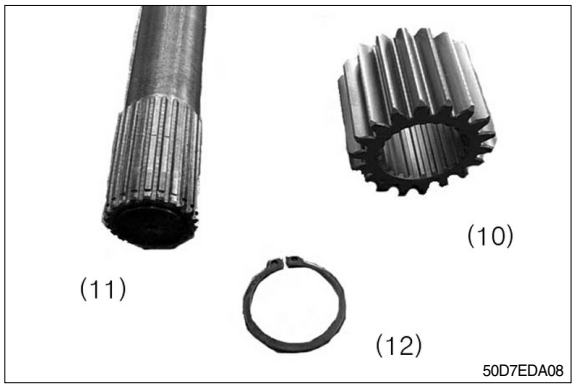
(6) Remove needle bearing(8), planet gear(7) and thrust washer(9).



(7) Remove sun gear(10) and drive shaft(11).

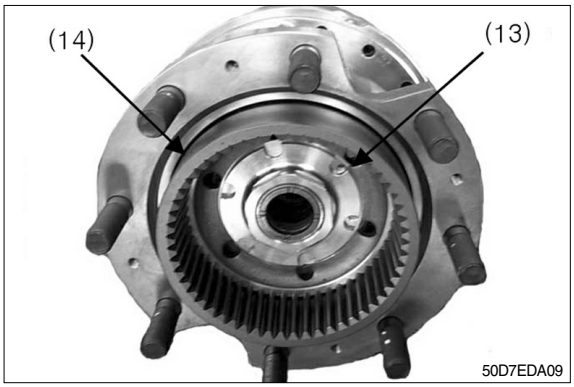


(8) Remove snap ring(12) and then remove sun gear(10) from the shaft(11).

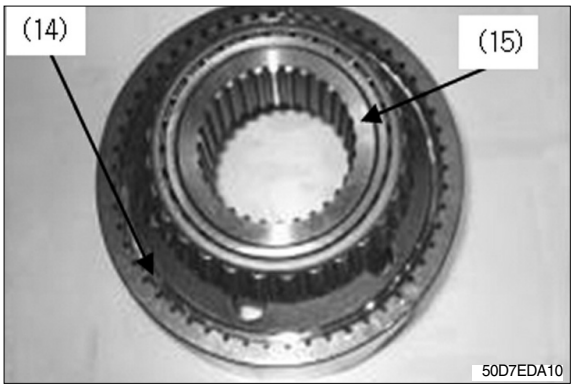


(9) After removing bolt(13), remove ring gear(14) and torque plate assembly(14) from the spindle.

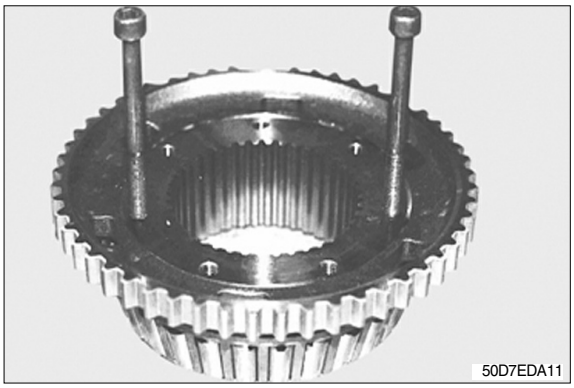
※ **Must measure the rolling resistance of tapered roller bearing.**



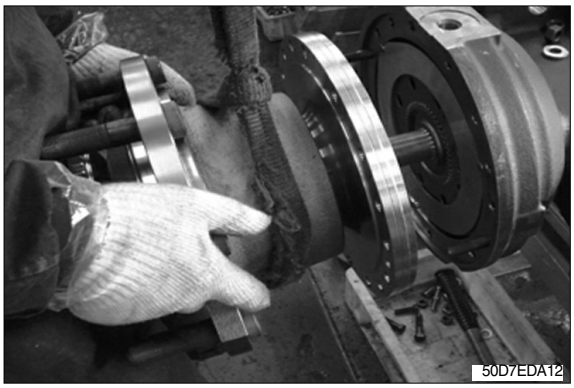
(10) Remove C-ring (14) from the ring gear and pull the spindle (15) out of the ring gear.



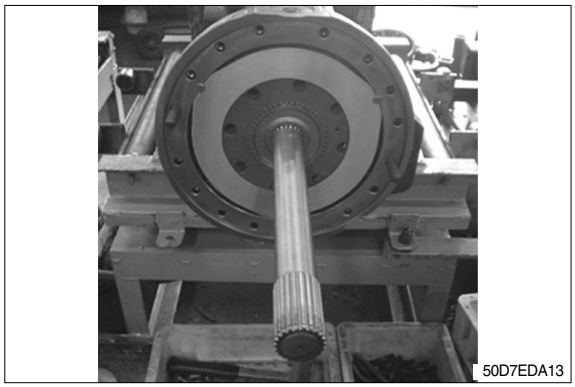
(11) Pull out bearing inner race on flange using 2 × M8 bolts.

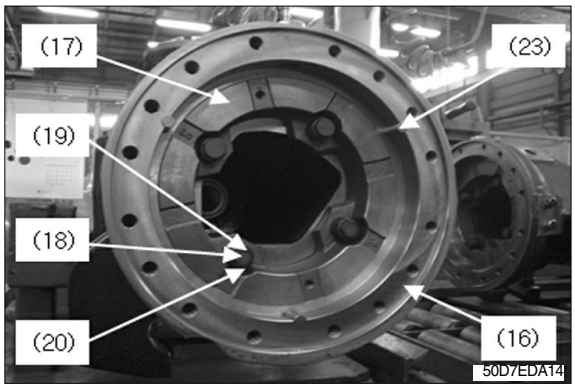


(12) Remove wheel hub from the axle housing after loosen 14 bolt and 2 nut.



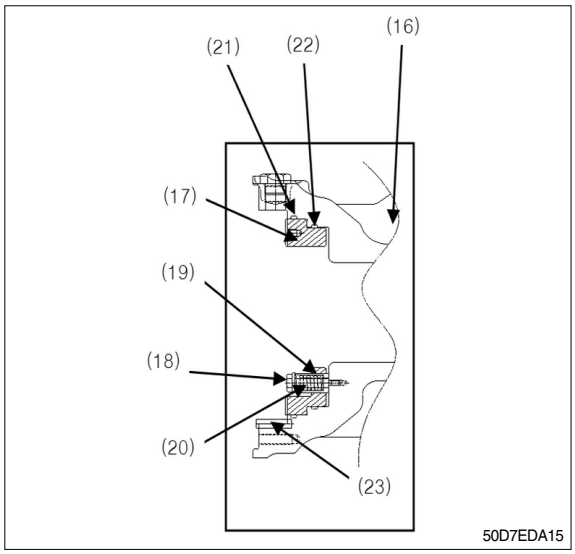
(13) Disassemble drive shaft and disc & plate assembly.





(14) After loosing 4 bolt-self adjust (18), disassemble spring-self adjust (20) form bushing-self adjust (19).
Then disassemble piston (17) from axle housing (16).
After checking 3 pins (23), then finally remove square ring (21, 22).

※ **Do not reuse damaged square ring.**

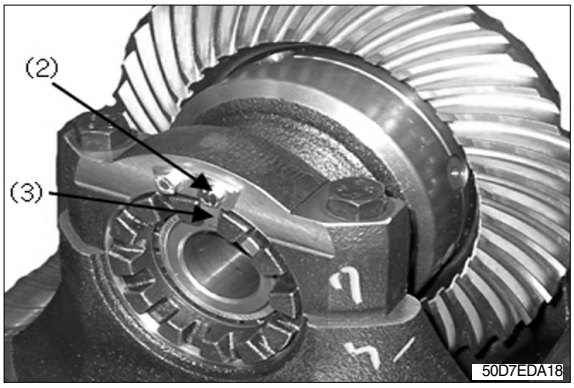


(15) Remove bearing cup from the wheel hub by using jig and hammer. Shaft seal may be damaged.

2) DISASSEMBLY OF THE DIFFERENTIAL CARRIER ASSEMBLY

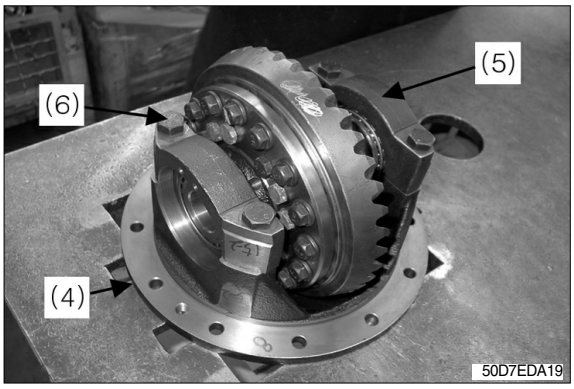
(1) Loosen 12 bolts(1) and then remove carrier from the housing by using a lifting machine.

(2) For the reassembly, check rolling resistance and record it. After loosen 2 bolts(2) and then remove backing plate (3).



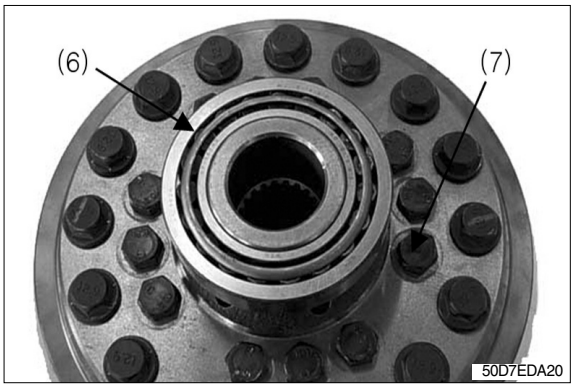
(3) Before removing differential assembly from carrier(4), check the location of cap(5) and mark it for reassembly.

(4) Remove 4 hexagon bolts(6) and cap(5).

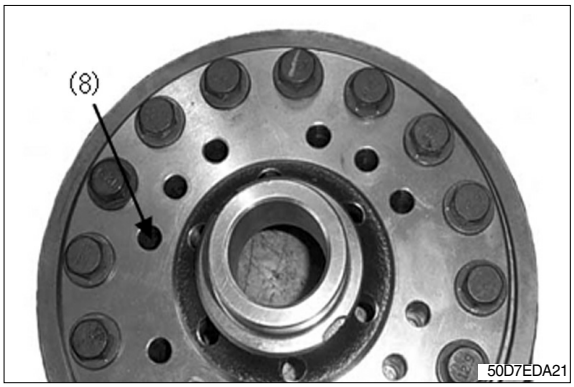


(5) Remove differential assembly from the carrier.

(6) Disassemble bearing(6) from the differential housing and remove 12 bolts (7).

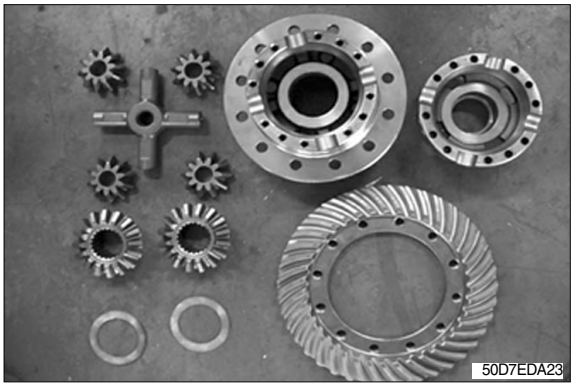


(7) After removing 12 mounting bolts(8) from the housing and then disassemble the ring gear.



(8) Check the mark on the housing and separate the housing from the differential.
If there is no mark, be sure to mark on the housing.
When reassembling, it must be placed at the same position as before.

(8) Remove thrust washer, side gears, pinion gears and spider and then place them on the clean place.



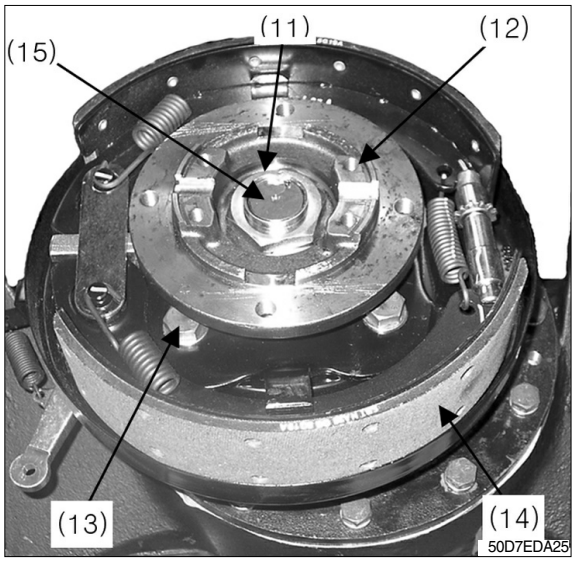
(10) Loosen 4 bolts (10) and then remove the drum from the parking brake.

(11)After removing lock nut(11) and then remove the yoke(12).

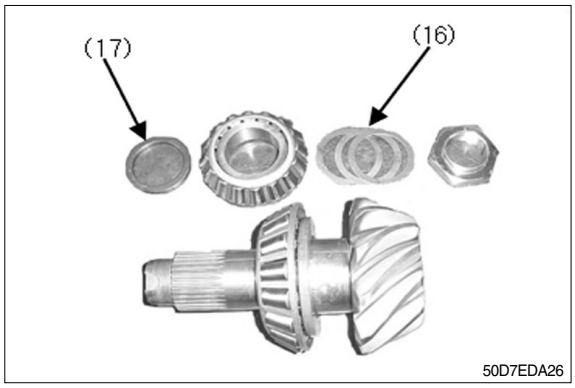
(12)Loosen 4 bolts (13) and then remove parking brake (14) from the carrier housing.

(13)Remove the drive bevel pinion shaft (15) carefully busing a plastic hammer.

※ **Be careful not to damage bevel pinion shaft.**

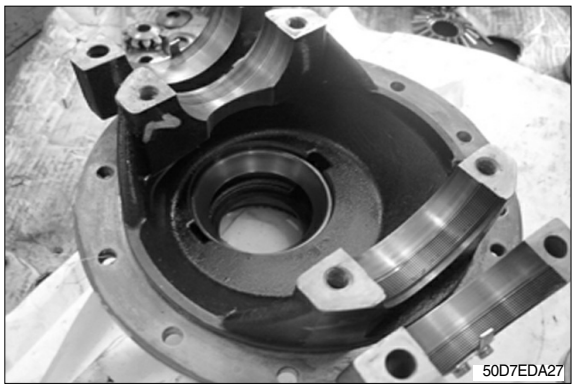


(12)Remove shim(16) and spacer(17) from pinion shaft.
Using a bearing puller, disassemble inner race of taper roller bearing from the pinion shaft.

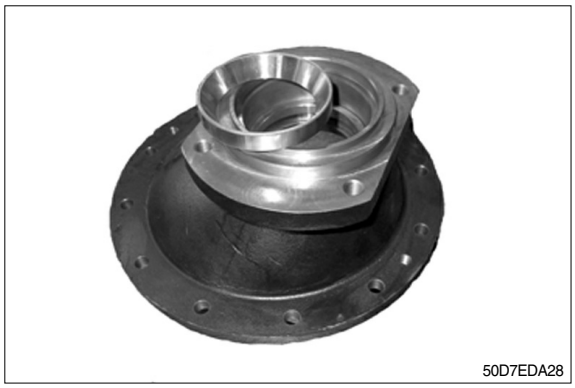


(13)Remove outer race of taper roller bearing and shim from the housing by using a jig and hammer.

※ **Do not reuse damaged shims.**



(14)Remove outer race of taper roller bearing on the opposite side.



4. REASSEMBLY OF DRIVE AXLE

Clean every parts with cleaner and then remove remained loctite.

※ **Be careful not to spill cleaner on your body.**
Avoid drinking cleaner or breathing its fumes.
Wear protective clothing, glasses and gloves.
If spilled on the skin, flush your skin with water immediately.
If swallowed, get medical attention immediately.

- Check wear, damage or crack for all the parts and replace if needed.
- If the teeth of gear are damaged, replace it as a set.
- Replace damaged tapered roller bearing.
- Do not reuse deformed shims or worn thrust washers.
- Polish the surface on which seal contacted if needed.

1) ADJUSTMENT OF BEVEL PINION SHAFT

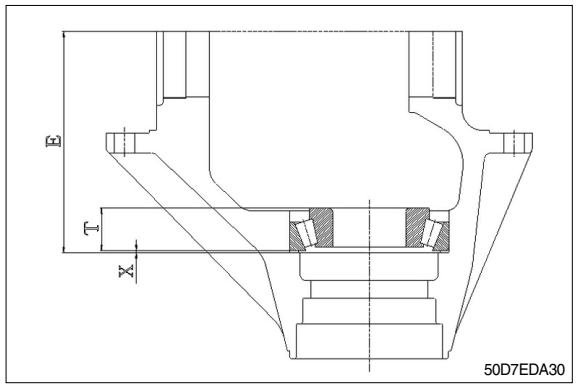
Adjusting shims of bevel pinion shaft.

(1) Adjust shim thickness for the bevel pinion shaft with following method.
① Measure "**E**" distance on the housing.
② By the equation "**X** = **E** - **B** - **T** ± **C** + **0.25** ", define the shim thickness(1).

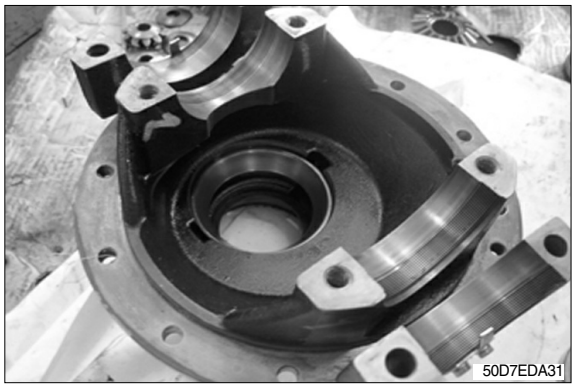
B : Mounting dimension of bevel pinion shaft , 131.10mm (5.2 in)
T : Height of bearing.
C : Dimension of carved seal on the pinion. If there's no carved seal **C**=0.

EX) : From the housing
"**E**" = 162.85mm (6.4in)
B is factory dimension
"**B**" = 131.10mm (5.2in)
Front the bearing
"**T**" = 31.75mm (1.5in)
Carved seal on the pinion
"**C**"= 0.05mm (0.002in)
Shim thickness :
"**X**" = 162.85 -131.10 - 31.75 + 0.05
= 0.45mm (0.022in)

※ **If teeth are damaged, replace it as a set (bevel gear and shaft).**
Do not reuse damaged shims and bearings.



(2) Using different kinds of shims, adjust shim thickness as measured by previous equation. Place shims at the bearing place.
Using a jig, assemble drive bearing so that the outer race contact with the bearing place.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(3) Heat inner race of bearing to max 100°C and then assemble it to the pinion shaft.
Also inner race should contact with bearing place.


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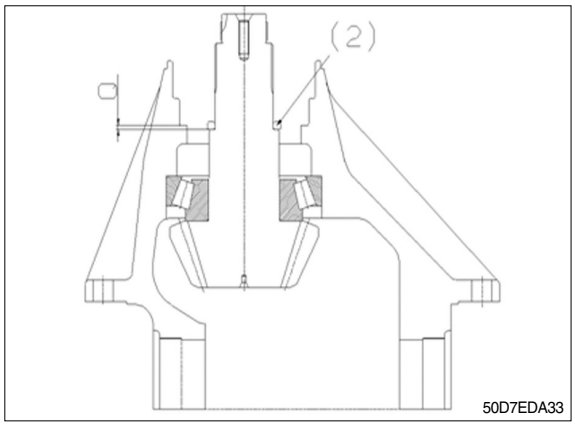
· **Measuring play of bevel pinion shaft end**
Measure shim thickness by following method.
Dimension "**Q**" : Distance from bearing outer race surface to spacer surface.
Dimension "**S**" : Distance from bearing outer race surface to inner race surface.
From the below equation, define required shim thickness **Z**.

" **Z** = **S** + **Q** "

EX) : From the bearing
S = 2.25mm (0.09in)
From the housing
Q = 3.15mm (0.12in)
Needed shim thickness **Z** :

Z = 2.25 + 3.15 = 5.40mm (0.21in)



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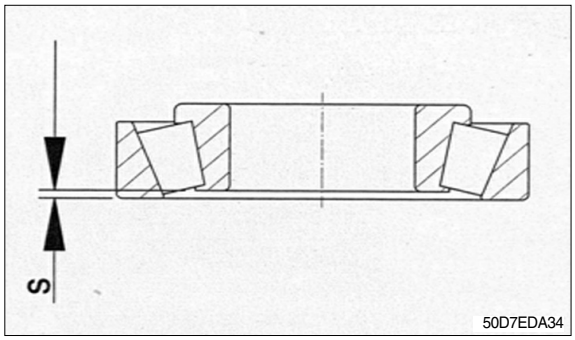
Unit : mm(in)

P	Q	Z
2.25(0.089)	3.15(0.124)	5.40(0.213)
2.30(0.091)	3.15(0.124)	5.45(0.215)
2.35(0.093)	3.15(0.124)	5.50(0.217)
2.40(0.094)	3.15(0.124)	5.55(0.219)
2.45(0.096)	3.15(0.124)	5.60(0.220)



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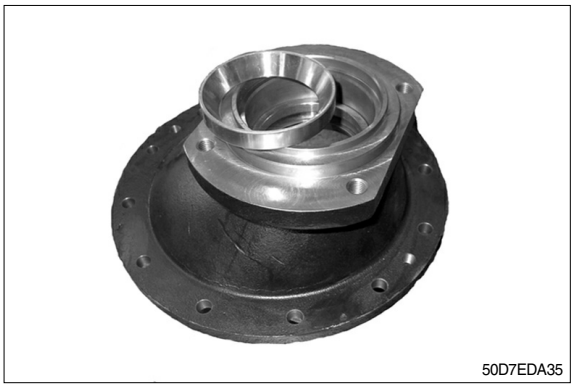
2) ADJUSTMENT OF PINION SHAFT

(1) Assemble bearing cup.
Assemble spacer to the pinion shaft and then install measured shims onto the spacer.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(2) Insert pinion shaft into the carrier.
Assemble bearing cone and lock nut.
Apply grease on the outer bearing.

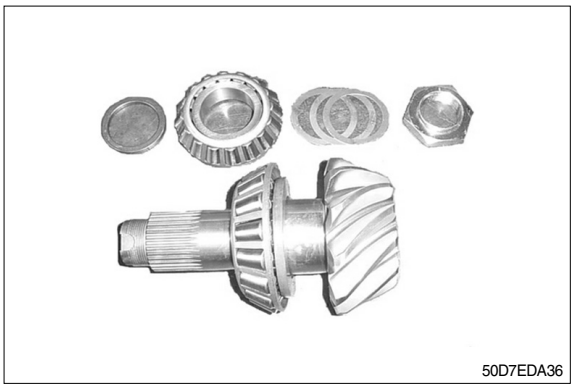
Apply loctite #271 or #277 on the thread of pinion and then tighten lock nut.

· Tightening torque : 45~51kgf · m
(325~369lbf · ft).

Measure rolling resistance of pinion shaft.

· Rolling resistance : 0.20~0.41kgf · m
(1.4~2.9lbf · ft).

Coke lock nut into the pinion shaft slot.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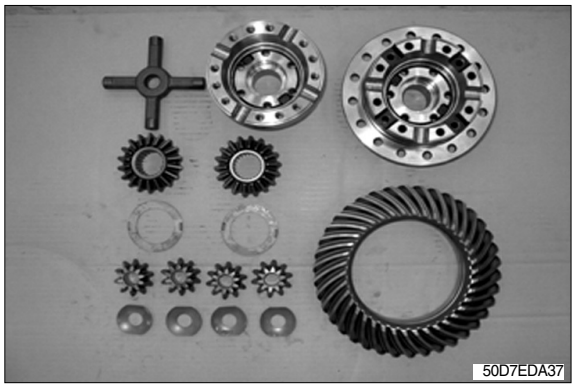
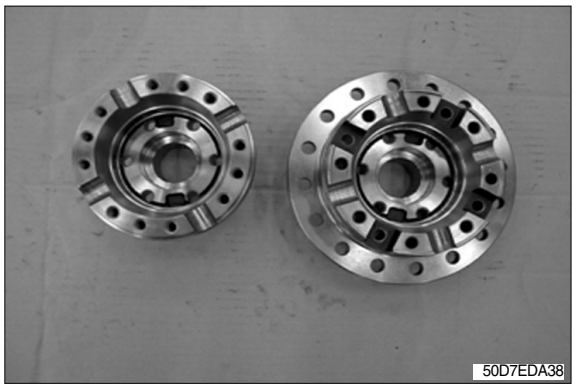
3) ASSEMBLY OF DIFFERENTIAL ASSEMBLY

(1) Assemble thrust washer, side gear and spider with gears and then install them to the differential housing.
Apply grease on the bevel gear and thrust washer.



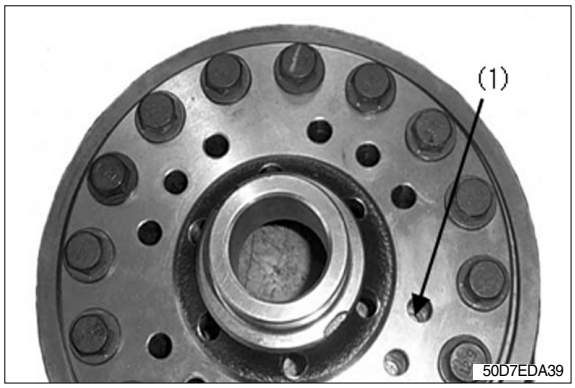
(2) Assemble differential housing.

※ **Check marks on the housing.**
Match two marks at the same position.



(3) Tighten 12 bolts(1) to the differential housing.
Apply loctite #271 or #277 on the thread of bolt.

· Tightening torque : 5.0~7.5kgf · m
(36~54lbf · ft)

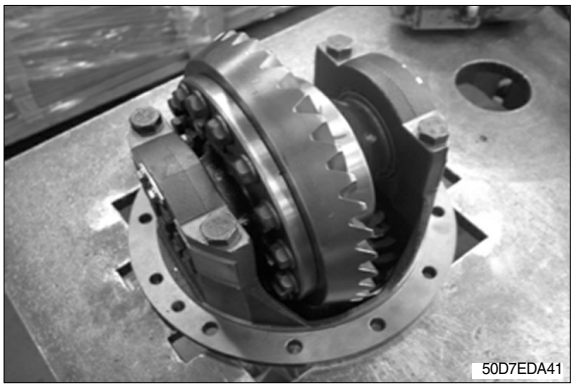


(4) Assemble ring gear by tightening 12 bolts(2).
Apply loctite #271 or #277 on the thread of bolt.

· Tightening torque : 12.5~14.5kgf · m
(90~105lbf · ft)

(5) Install differential assembly into the carrier. Place the bearing cup and screw into the housing. At this moment, using a screw adjust rotation backlash.
Install the dial gauge on the gear tooth and measure the backlash while rotating bevel gear.

· Rotation backlash : 0.18~0.23mm (0.007~0.009in)



(6) Assemble bearing cap.

※ **Fix bearing cap with hexagon bolt.**

· Tightening torque : 15.0~17.0kgf · m (108~123lbf · ft)

Measure rolling resistance of tapered roller bearing.
The following table shows the relation between preload(P) of bevel pinion shaft and rolling resistance(Z).
(calculated at adjustment of pinion shaft ②).

Unit : kgf · m (lbf · ft)

P	Z
0.20(1.45)	0.30~0.36(2.17~2.60)
0.25(1.81)	0.35~0.41(2.53~2.97)
0.30(2.17)	0.40~0.46(2.89~3.33)
0.35(2.53)	0.45~0.49(3.25~3.54)

(7) Confirm that the screw contacts to the bearing.

(8) After complete assembly of bearing, measure rotation backlash once more and readjust with a screw if needed.

(9) Apply loctite #271 to the thread of bearing cap bolt and then assemble it with tightening torque of 15.0~17.0kgf · m(108~123lbf · ft).

(10) Assemble plate with hexagon bolts. Apply loctite #271 or #277 to the tapped side of bolt and then assemble it with tightening torque of 0.80~1.20 kgf · m(5.8~8.7lbf · ft).

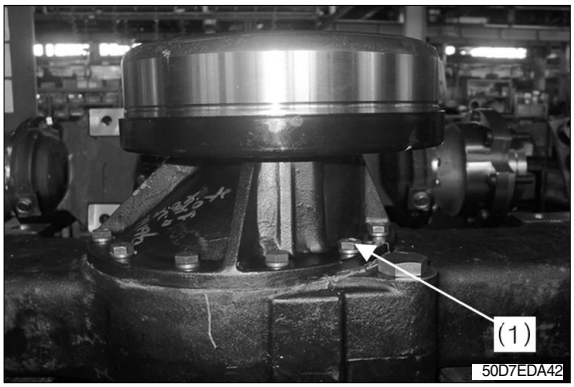
※ **Assemble opposite side with the same methods.**

(11) Apply marking liquid on 3~4 teeth of the ring gear and then rotate pinion gear to check gear contact. Check out the contacted shape.

4) ASSEMBLING CARRIER

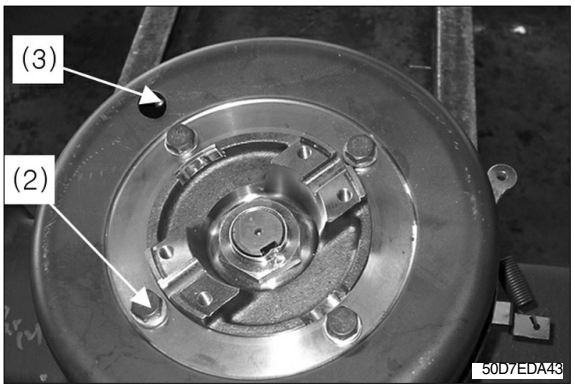
(1) Assemble carrier assembly into the axle housing.

(2) Fix the carrier assembly with hexagon bolt (1). Apply loctite #271 or #277 to thread of bolt and then assemble it with tightening torque of 11~13kgf · m(79.6~94.0lbf · ft).



(3) Assemble brake drum to yoke with tighting 4 bolts (2).
Apply loctite #271 or #277 to thread of bolt and then assemble it with tightening torque of 11~13kgf · m(79.6~94.0lbf · ft).

(4) Close hole (3) with rubber plug.



5) ADJUSTMENT OF PARKING BRAKE

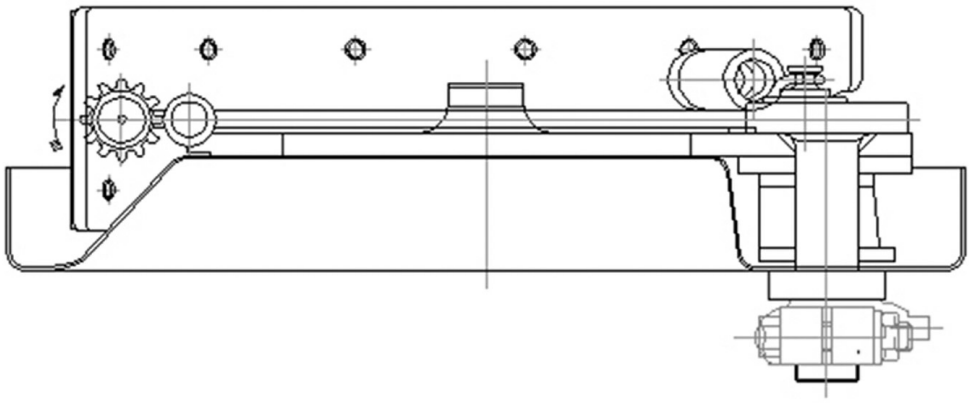
(1) The following procedures should be applied for brake shoe adjustment.

① Open rubber plug on (2).

② Adjuster should be turned according to arrow direction until occurring drum drug.

③ Adjuster should be turned opposite direction of the arrow sign by four click.
At that case, lining clearance is 0.1~0.25 mm.

④ Check drum drag after operating lever several times.
(Repeat from begining if drag is occured)



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6) ASSEMBLING WHEEL HUB ASS'Y

(1) Insert bearing into wheel hub.

※ Apply grease or oil to shaft seal and then assemble it with proper direction (outer side of wheel hub).


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(2) Install wheel hub assembly to the spindle completely.


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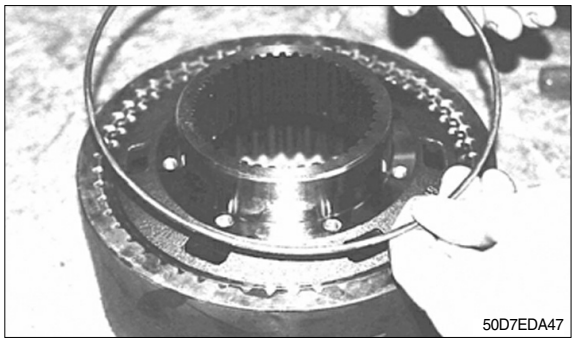
(3) Insert the spindle into ring gear and secure with circlip.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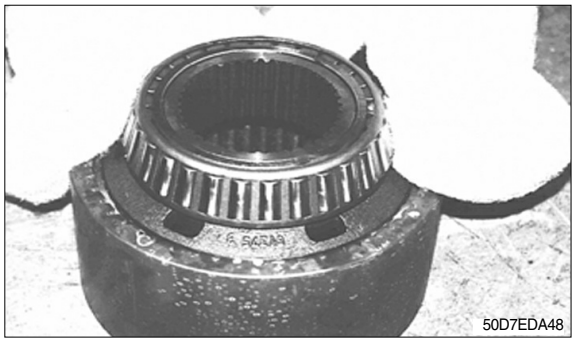
(4) Place heated tapered roller bearing inner race into the spindle until contact take places. Install it on the wheel hub after cooling down.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(5) Install the torque plate to fix the spindle.
Apply loctite #5127 to axle housing surface which contact to the spindle.


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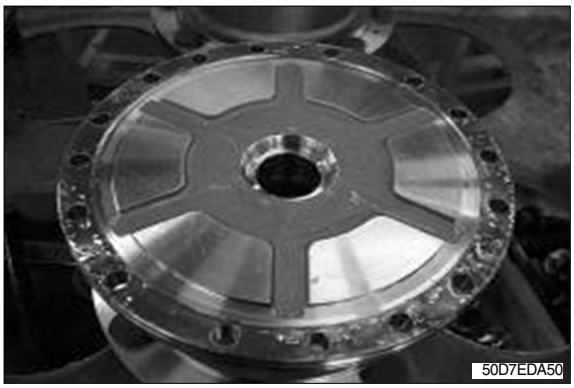
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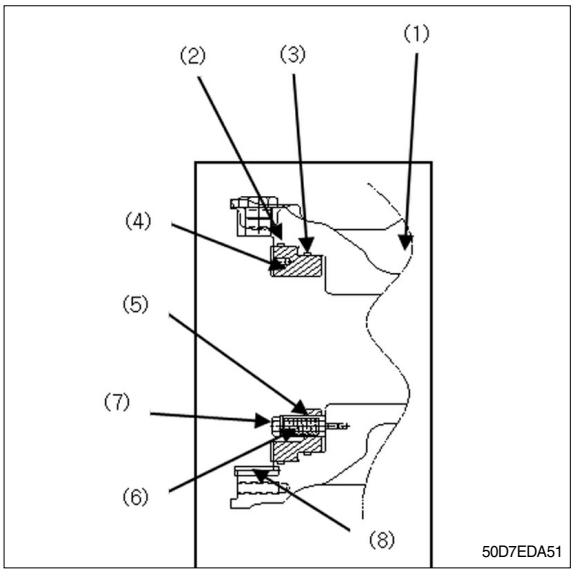
(6) Assemble square ring(2), (3) to the axle housing(1) then apply the oil (Mobilfluid #424). Assemble bushing(5) to piston (2) and then assemble piston (2) to axle housing after applying oil sufficiently and then assemble the spring (6) to the bushing (5).
Also, apply loctite #271 to 4 bolts(7) then assemble them with tightening torque 14~16kgf · m(101.3~115.7lbf · ft).
Assemble 3 brake pins(8) to axle housing.

※ **Check the status of square ring and replace if damaged.**



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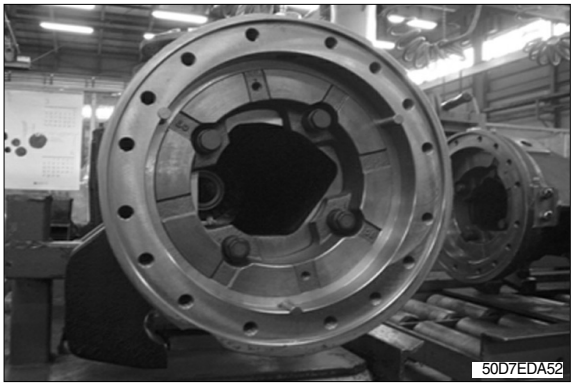
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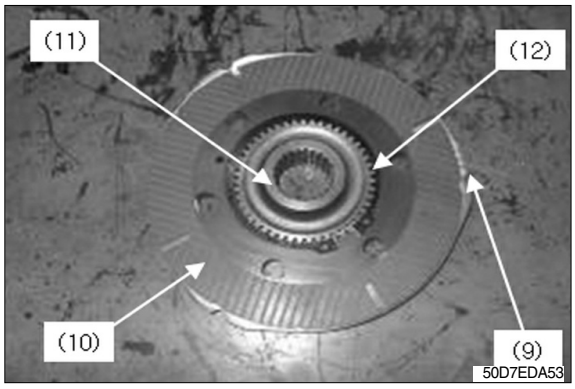
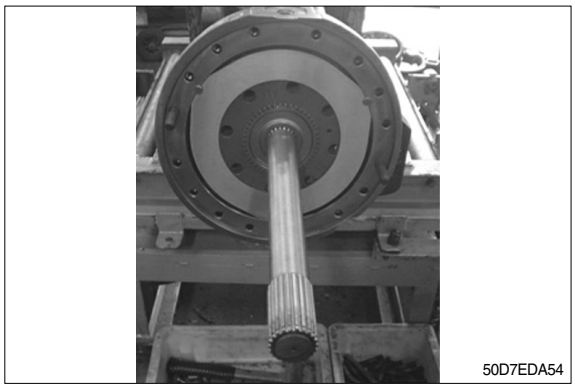
Assembling plate and inspection

① Assemble 5 plates(9) and 4 disks(10) with spline collar(11) and then lock with snap ring (12).
- Disc must be assembled after the oil immersion during 12 hours. (Mobilfluid #424)

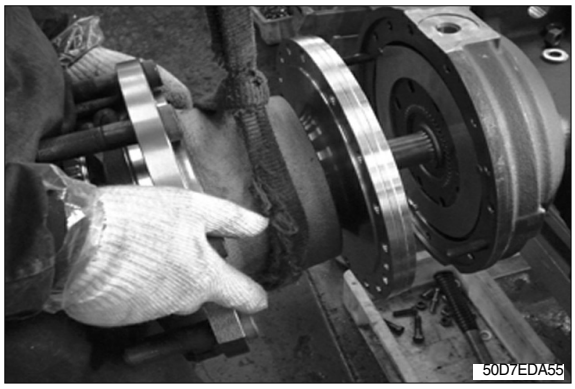
② Install assembled spline collar to the axle housing with the drive shaft.
- Before assembling, clean all of the parts completely and remove burrs.

③ After assembling, confirm that the clearance between the outer plate and the axle housing surface is 2.1~2.6㎜ (0.08~0.10in).

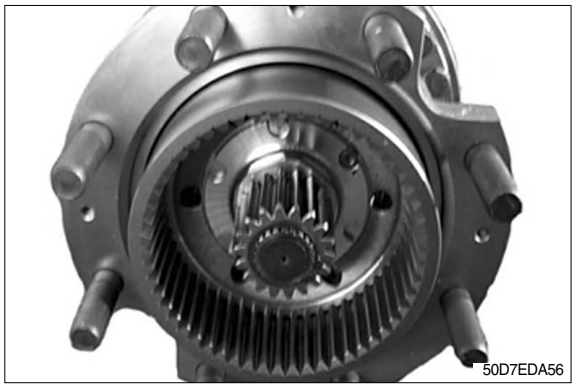




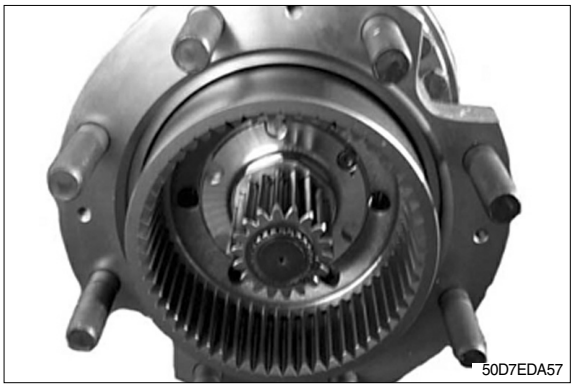
(7) Push pre-assembled wheel hub to the axle housing until contact take places.



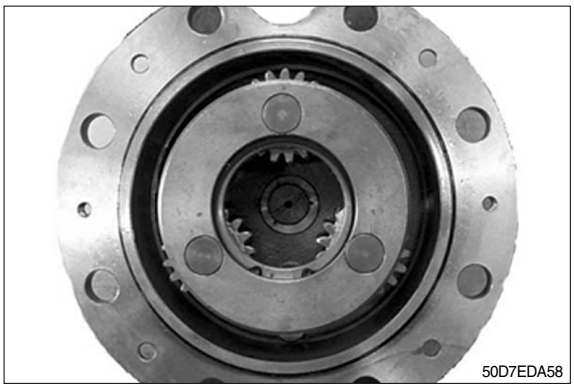
(8) Tighten the torque plate until the wheel hub assembly has the same rolling resistance as before.
Apply loctite #271 or #277 to thread of bolt (13) and then assemble it with tightening torque of 18~22㎏f · m(130.2~159.1lbf · ft).



(9) After assemble sun gear to axle shaft and fix it with a snap ring.
Apply grease on the shaft where bushing contacts.
Apply grease on teeth of the planetary gear.


50D7EDA57

(10) Assemble internal components of planetary carrier with the reverse order of disassembly.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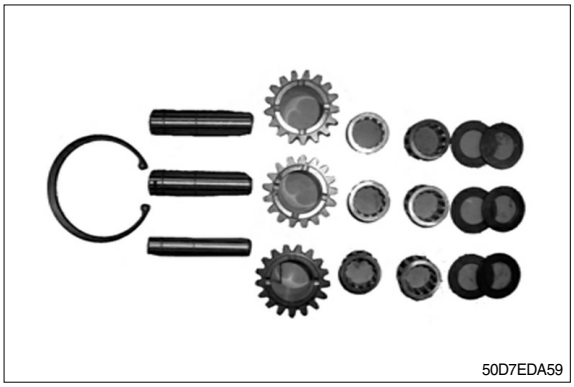
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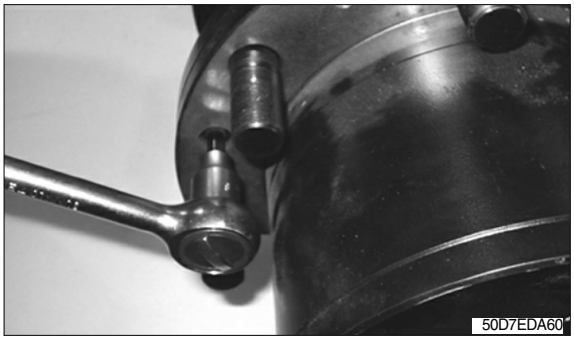
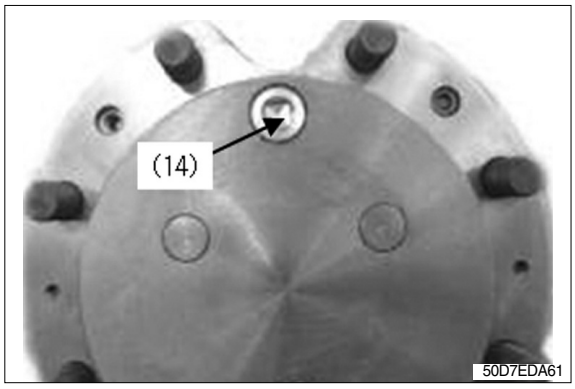
(11) Install planetary carrier assembly to wheel hub and tighten bolt (2).
· Tightening torque : 25~40kgf · m
(180.9~289.3lbf · ft).


50D7EDA60

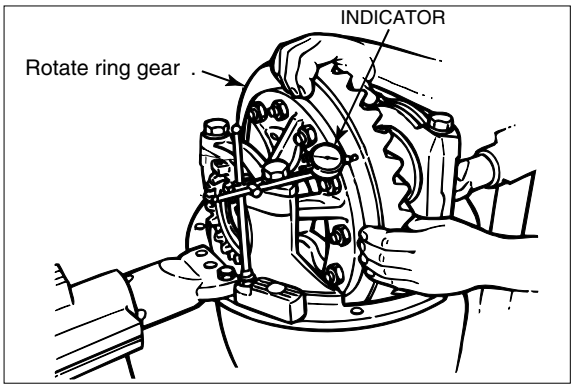
(12)Assemble wheel hub and tighten plug(14).

· Tightening torque : 35~60kgf · m
(253.2~434.0lbf · ft).



1. CHECKING THE RING GEAR BACKFACE RUNOUT

Runout specification : 0.20㎜(0.008-inch) maximum



D507AX53

1) Attach a dial indicator on the mounting flange of the carrier.
2) Adjust the dial indicator so that the plunger or pointer is against the back surface of the ring gear.
3) Set the dial indicator to zero(0).
4) Rotate the ring gear and read the dial indicator. The runout must not exceed 0.20㎜(0.008inch).

   If runout exceeds specification, remove the differential and ring gear assembly from the carrier. Refer to "Disassembling the differential carrier assembly".
5) Check the differential parts, including the carrier, for problems that may cause the ring gear runout to exceed specifications. Repair or replace parts.
6) Re-install the differential and ring gear into the carrier. Refer to "Assembling the differential case".
7) Repeat the preload adjustment of the differential bearings.

2. ADJUSTING THE GEARSET BACKLASH

Backlash specification : 0.13~0.18mm
(0.005-0.007inch)

If the old gearset is installed, adjust the backlash to the setting that was measured before the carrier was disassembled.

If a new gearset is installed, adjust the backlash to the correct specification for new gear sets.

1) Attach a dial indicator on the mounting flange of the carrier.

2) Adjust the dial indicator so that the plunger or pointer is against the tooth surface, near the heel end of the gear tooth. Set the indicator dial to zero(0).

3) Hold the drive pinion in position.

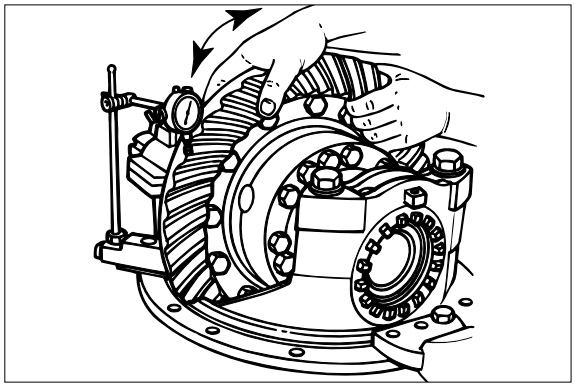
4) Read the dial indicator, while rotating the ring gear a small amount in both directions, against the drive pinion teeth.

※ When you adjust backlash, move the ring gear ONLY. DO NOT move the drive pinion.

5) If the backlash reading is within specification, continue checking tooth contact patterns.
Otherwise, adjust backlash. Refer to step 6), and check, following steps 1)-4).

※ Backlash is increased by moving the ring gear away from the drive pinion. Backlash is decreased by moving the ring gear toward the drive pinion.

6) Loosen one bearing adjusting ring one notch, then tighten the opposite ring the same amount.



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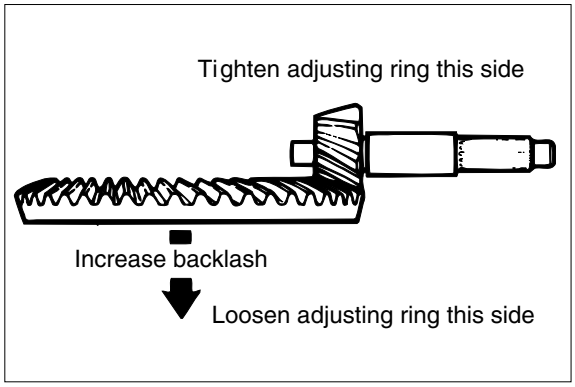

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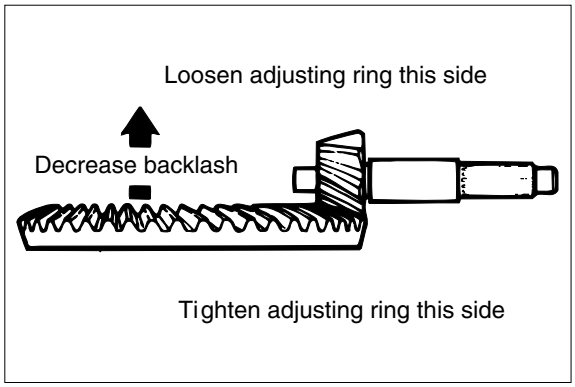
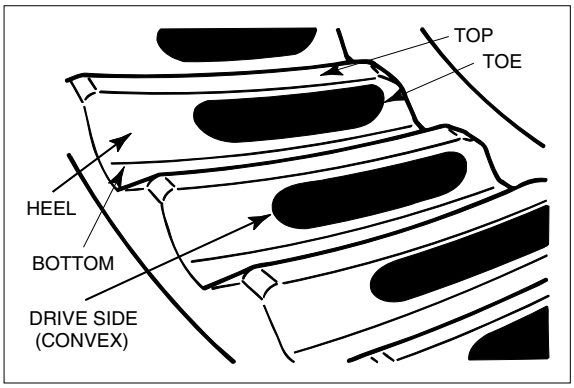


D507AX56

3. ADJUSTING TOOTH CONTACT PATTERN OF THE GEARSET

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

1) Apply marking compound to approximately 12 teeth of the ring gear.



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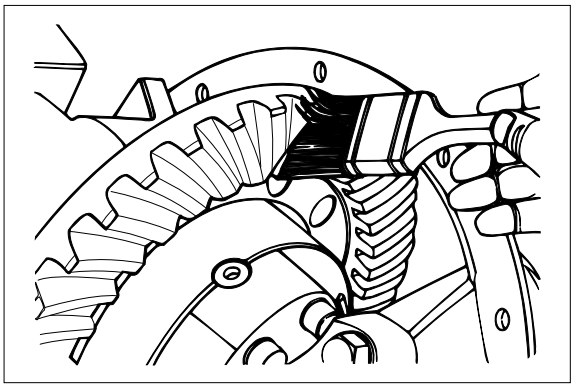


D507AX58

2) Rotate ring gear forward and backward so that the 12 marked teeth go past the drive pinion six times to get a good contact pattern.

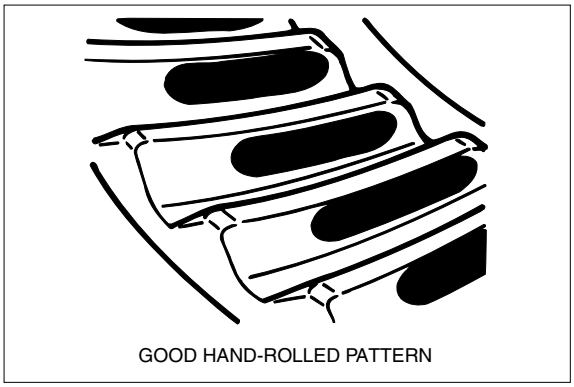
3) Compare the contact patterns.

In new gearsets, a good contact pattern is toward the toe of the tooth, and centered between the top and bottom of the tooth.

In used gearsets, a good contact pattern fills approximately the full length of the tooth. The top of the pattern is near the top of the tooth. The location should match the wear pattern on the tooth.

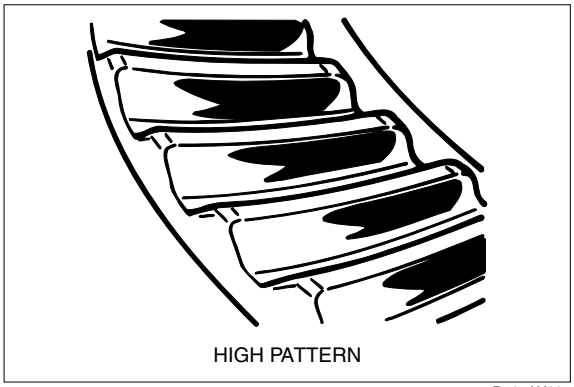
If the contact patterns require adjustment along the width of tooth(top/bottom), follow steps 4)-5).

If the contact patterns requires adjustment along the length of tooth(toe/heel), follow step 6)-7).



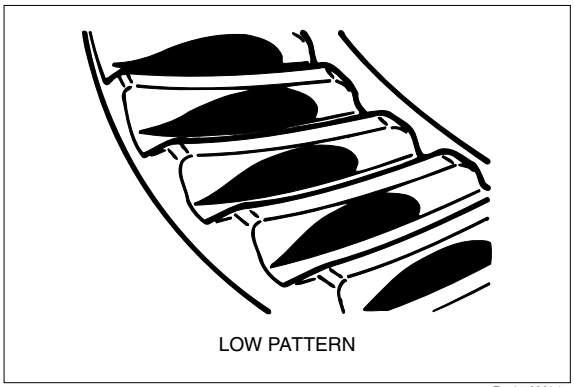
GOOD HAND-ROLLED PATTERN

D507AX59



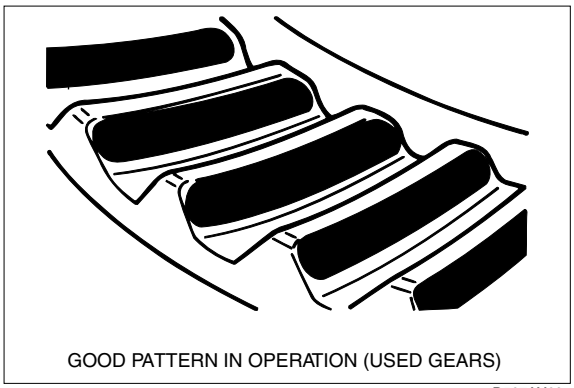
HIGH PATTERN

D507AX60



LOW PATTERN

D507AX61

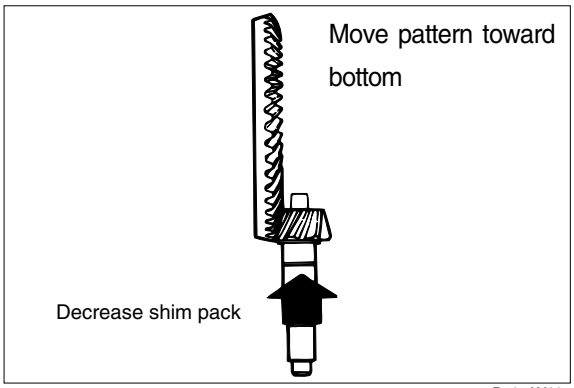


GOOD PATTERN IN OPERATION (USED GEARS)

D507AX62

4) **High pattern :** A high contact pattern indicates that the pinion was installed too shallow into the carrier.

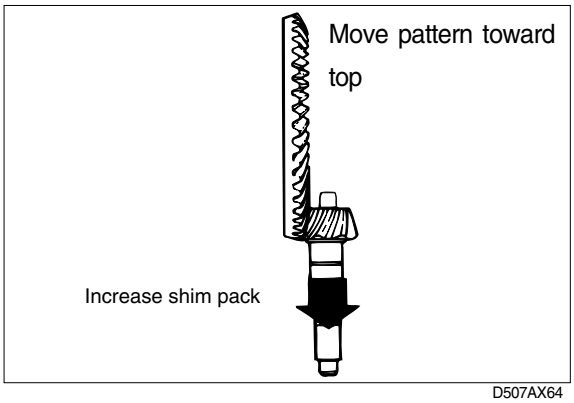
To correct, move the pinion toward the ring gear by decreasing the shim pack between pinion spigot and inner bearing cone. Refer to "Assembling the pinion bearing cage".



D507AX63

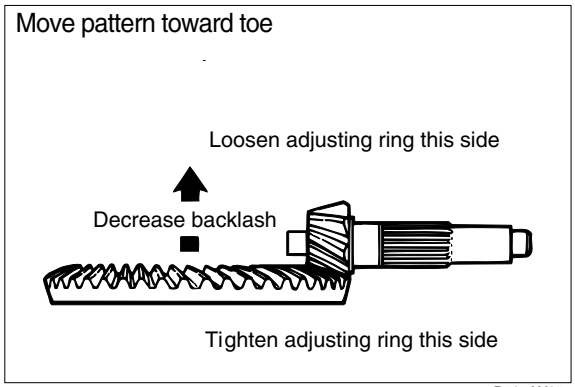
5) **Low pattern :** A low contact pattern indicates that the pinion was installed too deep into the carrier.

To correct, move the pinion away from the ring gear by increasing the shim pack between pinion spigot and inner bearing cone. Refer to "Assembling the pinion bearing cage".



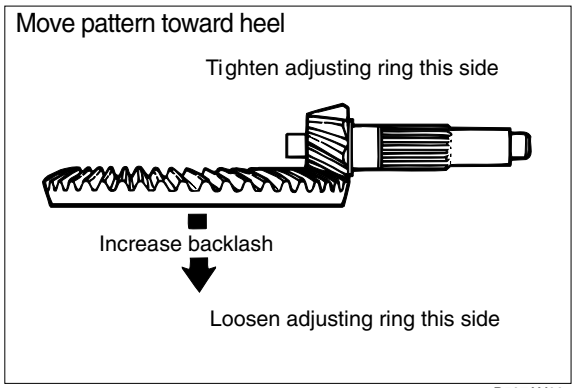
D507AX64

6) **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".



D507AX65

7) **Toe pattern :** Increase the gearset backlash(within specified range) to move contact pattern toward heel and away from toe.
Refer to "Adjusting the gearset backlash".



D507AX66

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 hand brake system.

In the foot brake system, oil pressure is generated in the master cylinder by treading on the brake pedal. This pressure causes the wheel cylinder pistons to extend, expanding the brake shoes and pressing them against the brake drums to attain braking force.

In the hand (parking) brake system, the brake shoes are expanded by operating the brake lever. Force from the lever is transmitted to the brake shoes through the hand brake cables and a lever arm in each disk brake assembly.

2. SPECIFICATION

1) DISK BRAKE

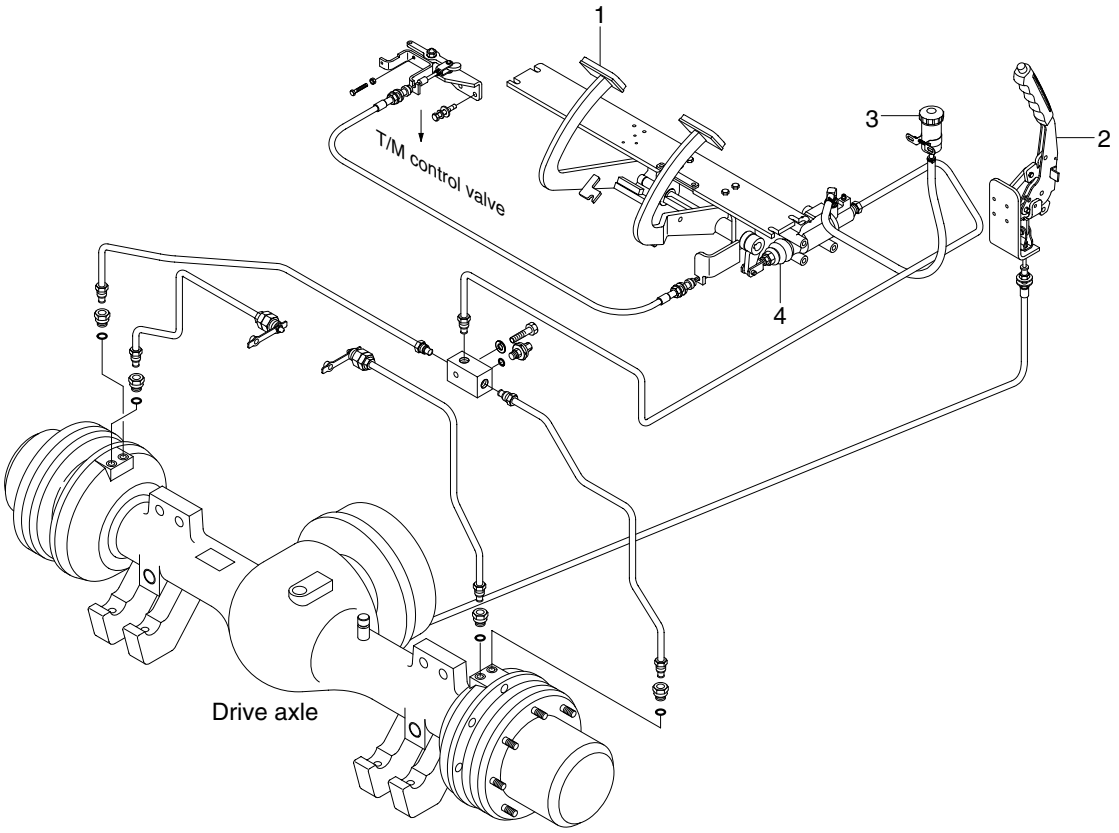
Item		Specification
Type		Wet disk brake
Brake valve step/bore piston diameter		40mm (1.6in) / 30mm (1.2in)
Pedal adjustment	Pedal height	155~163mm (6.10~6.41in)
	Play	2~3mm (0.08~0.11in)
Brake oil		Azola ZS10 (SAE 10W hydraulic oil)

2) PARKING BRAKE

Item	Specification
Type	Ratchet, internal expanding mechanical type
Parking lever stroke	82mm(3.2in)
Parking cable stroke	28mm(1.1in)

3. BRAKE PEDAL AND PIPING

1) STRUCTURE

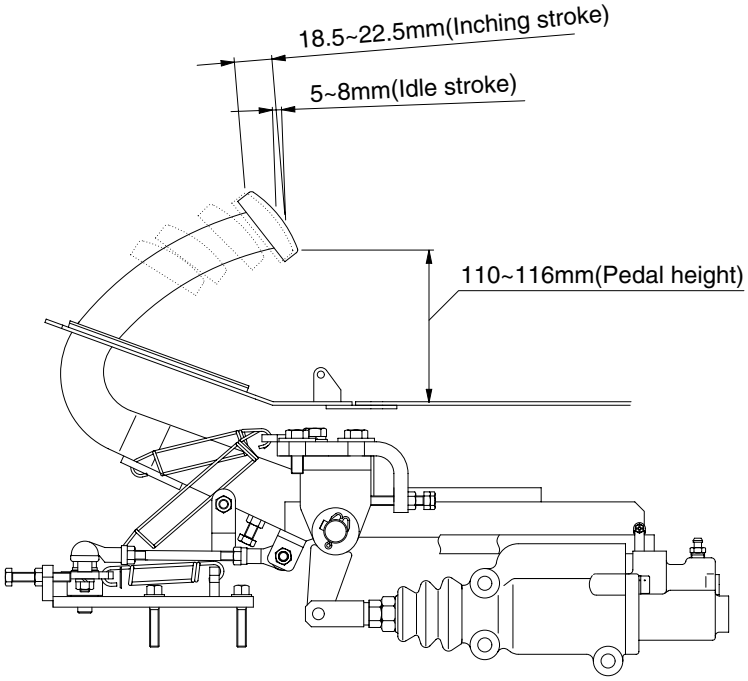


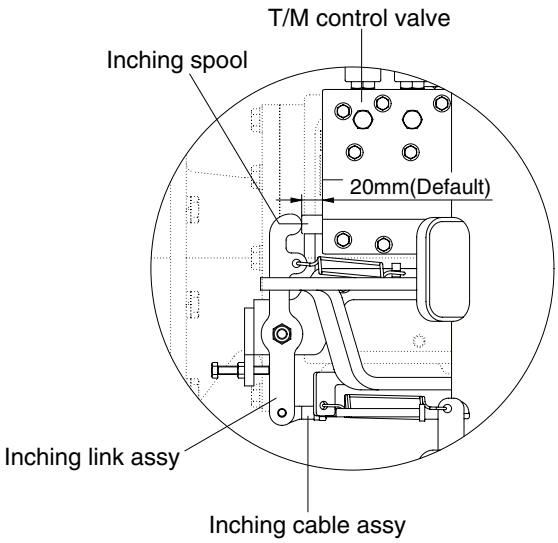
50DF7BS03

1	Brake pedal & bracket assembly	3	Reservoir tank assembly
2	Parking lever assembly	4	Brake valve

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.

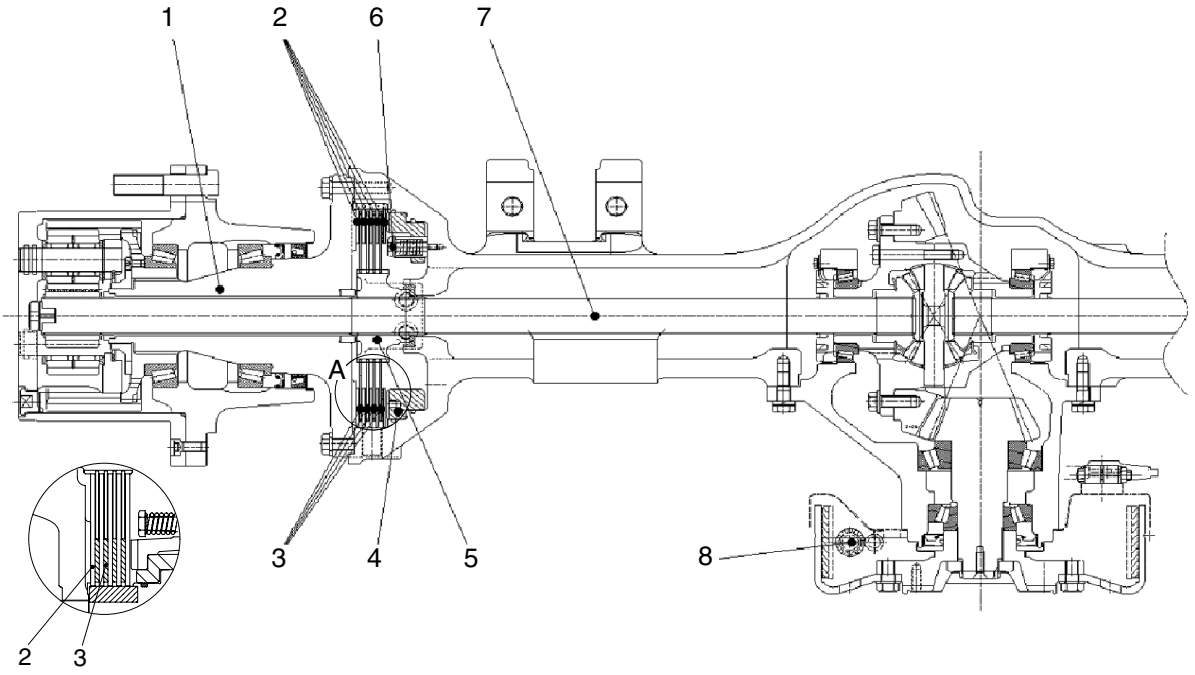




50DF7BS04

5. DISK BRAKE

1) STRUCTURE



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1	Spindle	4	Service piston	7	Drive shaft
2	Steel plate	5	Spline collar	8	Parking brake
3	Disk plate	6	Service piston adjust bolt		

OPERATION

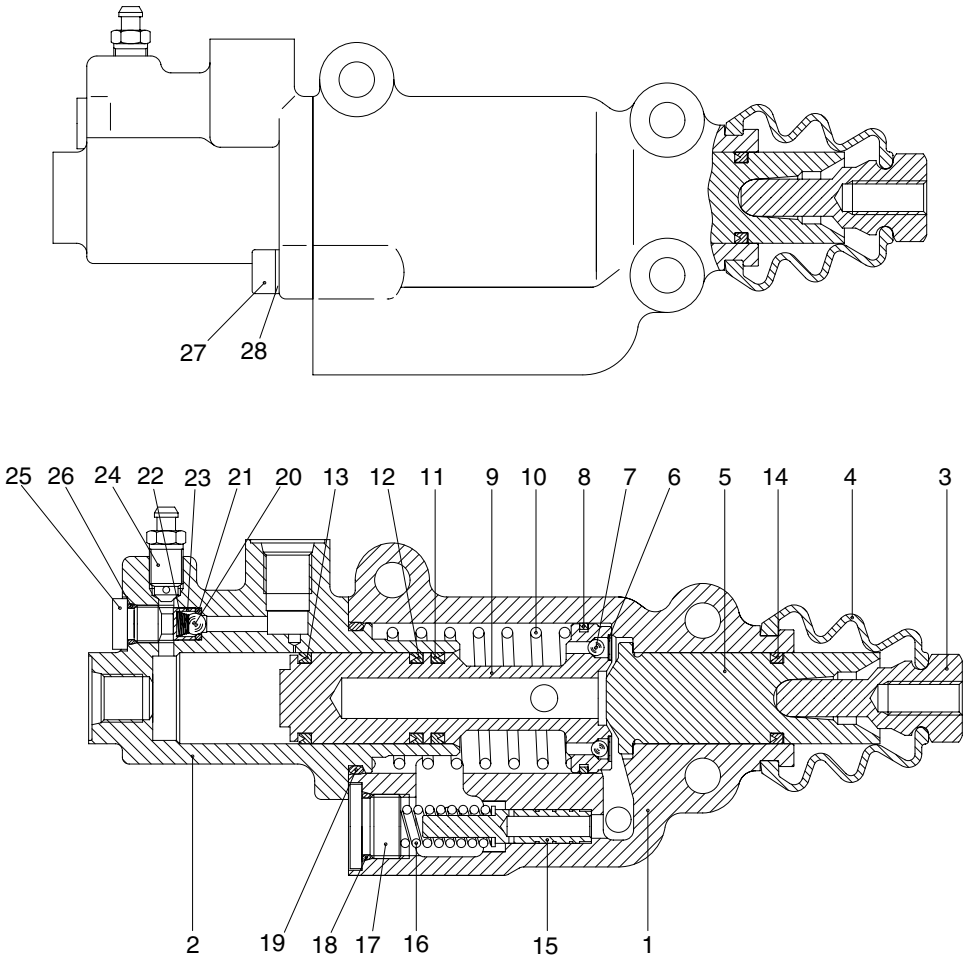
Sealed up structure of hydraulic multi-disk brake system secures good brake performance even in the high humid or dusty area.

Because it is possible to use the brake semi-permanently, there is no need to maintain its lining as drum type brake do. Also with self-adjust of friction plate clearance, it's easy to prevent the brake performance drop due to friction material wear.

Major components are 4 disk plates(3), 5 steel plates(2), service piston(4) and 4 piston adjust bolts (6). Braking take places when the discs and plates are pressed each other which make rotation resistance to the collar (5) and the drive shaft (7).

6. BRAKE VALVE

1) STRUCTURE

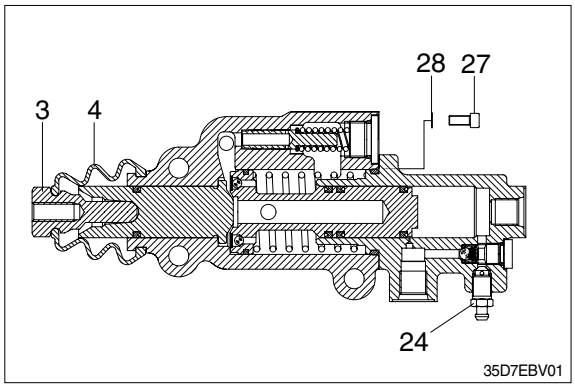


35D7EBV00

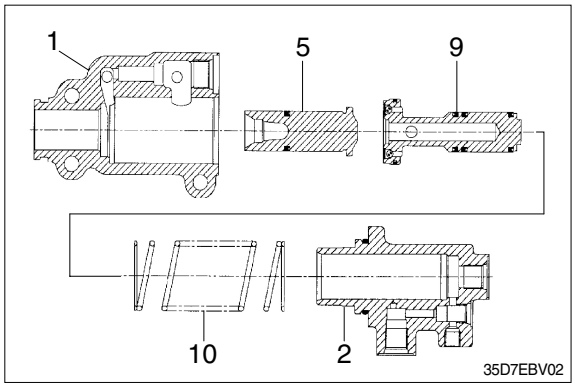
1	Front housing	11	U-cup seal	21	O-ring
2	Rear housing	12	U-cup seal	22	Spring
3	Push rod	13	U-cup seal	23	Gauge
4	Bellows	14	U-cup seal	24	Air bent
5	Master piston	15	Relief piston	25	Plug
6	Lock washer	16	Relief spring	26	O-ring
7	Piston ball	17	Relief plug	27	Bolt
8	Piston ring	18	O-ring	28	Spring washer
9	Servo piston	19	O-ring		
10	Servo spring	20	Ball		

2) DISASSEMBLY

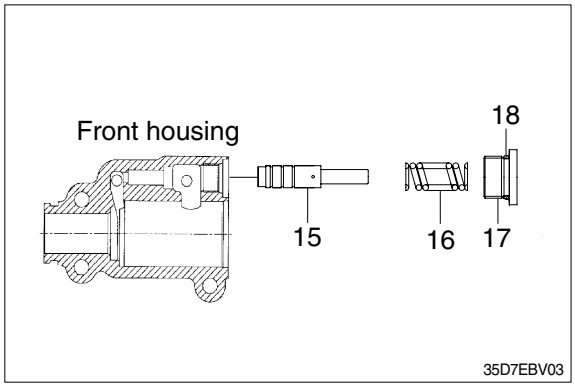
(1) Remove push rod (3), bellows (4), air vent (24), bolt (27) and washer (28).



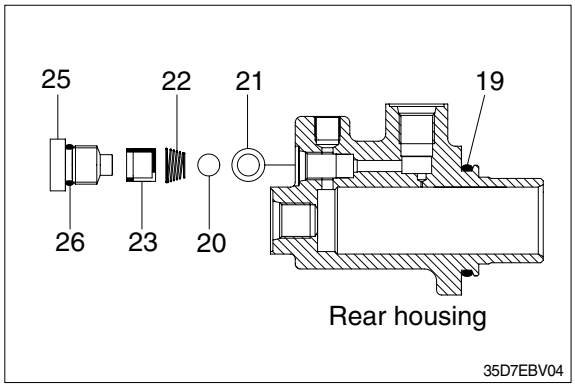
(2) Remove front housing (1), rear housing (2), servo spring (10), servo piston (9) and master piston (5).



(3) Remove relief plug (17) with O-ring (18), relief spring (16) and relief piston (15).



(4) Remove O-ring (19), check plug (25) with O-ring (26), cage (23), check spring (22), check ball (20) and O-ring (21).



3) INSPECTION AND ASSEMBLY

(1) Clean all parts thoroughly and lubricate the parts either with mineral or with hydraulic oil, according to their use destination.

(2) All single parts are to be checked for damage and replaced, if required.

(3) Assembly is in opposite order to disassembly.

(4) Seal kit : XKAU-00176

⚠ Use only brake fluid (Azola ZS10) into the compensation reservoirs.

GROUP 2 OPERATIONAL CHECKS AND TROUBLESHOOTING

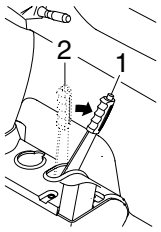
1. OPERATIONAL CHECKS

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) Operating force of parking lever is 35 - 40 kgf · m(253 - 290lbf · ft).
(2) Check that parking brake can hold machine in position when loaded on 20% slope. If there is no slope available, travel at low speed and check braking effect of parking brake.



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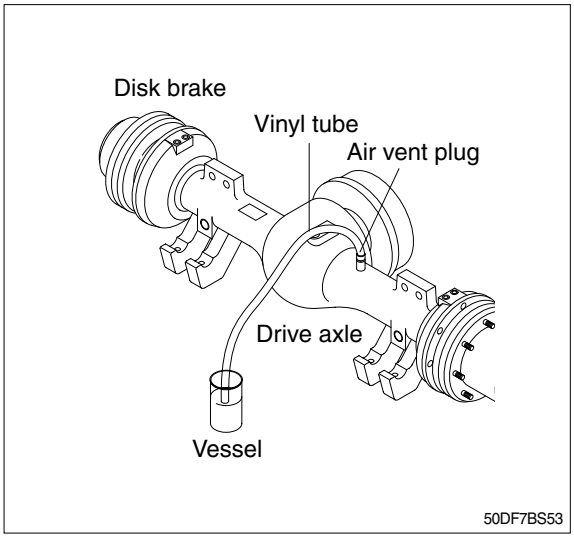
2. TROUBLESHOOTING

Problem	cause	Remedy
Insufficient braking force	· Hydraulic system leaks oil. · Hydraulic system leaks air. · Disk worn. · Brake valve malfunctioning. · Hydraulic system clogged.	· Repair and add oil. · Bleed air. · Replace. · Repair or replace. · Clean.
Brake acting unevenly. (Machine is turned to one side during braking.)	· Tires unequally inflated. · Brake out of adjustment. · Disk surface roughened. · Wheel bearing out of adjustment. · Hydraulic system clogged.	· Adjust tire pressure. · Adjust. · Repair by polishing or replace. · Adjust or replace. · Clean.
Brake trailing.	· Pedal has no play. · Piston cup faulty. · Brake valve return port clogged. · Hydraulic system clogged. · Wheel bearing out of adjustment.	· Adjust. · Replace. · Clean. · Clean. · Adjust or replace.
Brake chirps	· Brake trailing. · Piston fails to return. · Disk worn. · Disk surface roughened.	· See above. Brake trailing. · Replace. · Replace. · Repair by polishing or replace.
Brake squeaks	· Disk surface roughened. · Disk worn. · Excessively large friction between disk plate.	· Repair by polishing or replace. · Replace. · Clean and apply brake grease.
Large pedal stroke	· Brake out of adjustment. · Hydraulic line sucking air. · Oil leaks from hydraulic line, or lack of oil. · Disk worn.	· Adjust. · Bleed air. · Check and repair or add oil. · Replace.
Pedal dragging.	· Twisted push rod caused by improperly fitted brake valve. · Brake valve seal faulty.	· Adjust. · Replace.

GROUP 3 TESTS AND ADJUSTMENTS

1. AIR BLEEDING OF BRAKE SYSTEM

1) Air bleeding should be performed by two persons :
   One rides on truck for depressing and releasing brake pedal : the other person is on the ground and removes cap from air vent plug on wheel cylinder.
2) Block the front wheel securely and apply parking brake.
3) Start the engine.
4) Attach a vinyl tube to air vent plug and immerse other end of tube into a vessel filled with hydraulic oil.
5) Loosen air vent plug by turning it 3/4 with a wrench. Depress brake pedal to drain oil mixed with air bubbles from plug hole.
6) Depress brake pedal until no air bubbles come out of air vent plug hole.
7) After completion of air bleeding, securely tighten air vent plug. Install cap on plug.
8) Same way for the opposite side.



2. ADJUSTMENT OF PEDAL

1) BRAKE PEDAL

(1) Pedal height from cross plate

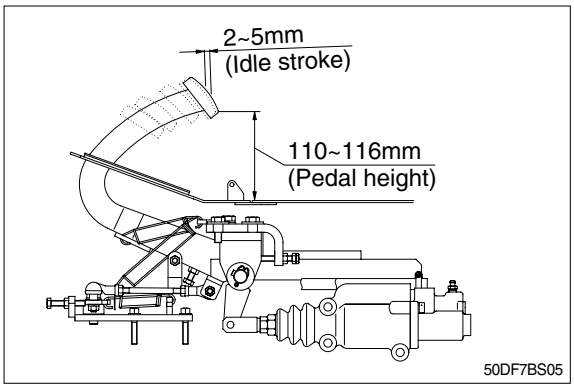
Adjust with stopper bolt.

· Pedal height : 110~116mm(4.3~4.5in)

(2) Idle stroke

Adjust with rod of brake valve

· Play : 2~5mm(0.08~0.20in)



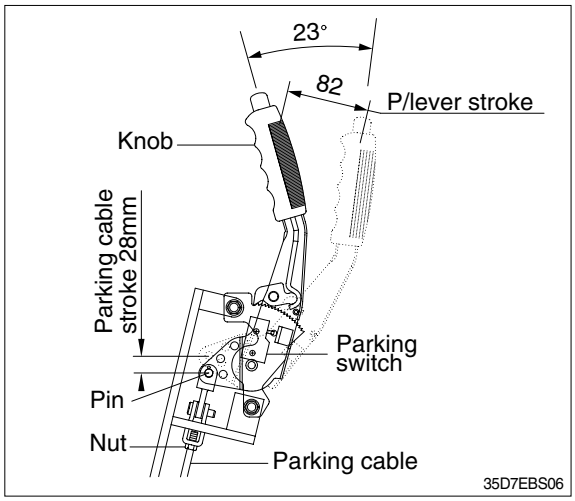
(3) Micro switch for parking brake (if equipped)

① After assembling parking brake and parking cable, put the parking brake lever released.

② Loosen the nut for parking brake plate to play up and down.

③ Move up the plate so that the stopper can be contacted with the pin and then reassemble nut.

· Micro switch stroke when parking brake is applied : 2~3㎜(0.08 ~ 0.1in)



2) INCHING PEDAL

(1) Pedal height from cross plate

Adjust with stopper bolt.

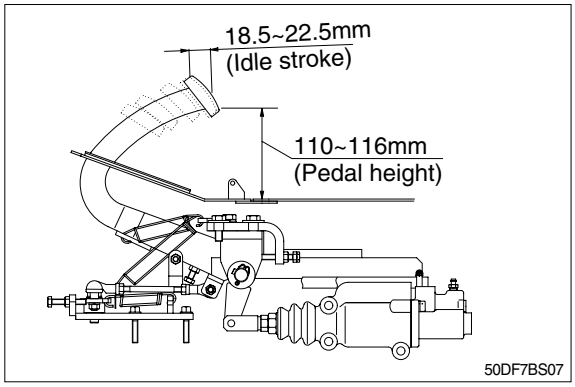
· Pedal height : 110~116㎜(4.3~4.5in)

(2) Adjust bolt so that brake pedal interconnects with inching pedal at inching pedal stroke 18.5±22.5㎜(0.72±0.88in).

(3) Idle stroke

Adjust with cable.

· Play : 2~3㎜(0.08~0.12in).

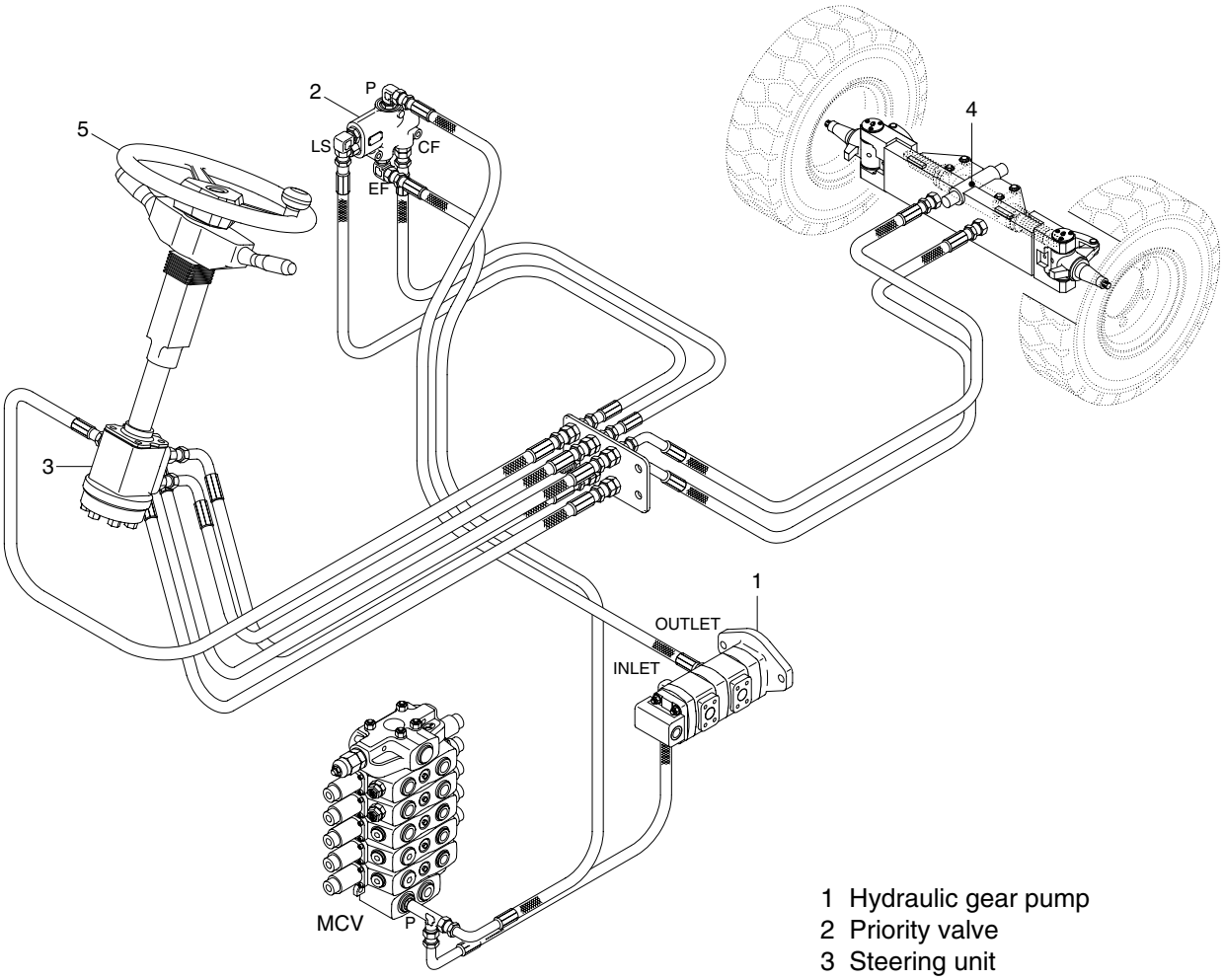


SECTION 5 STEERING SYSTEM

SECTION 5 STEERING SYSTEM

GROUP 1 STRUCTURE AND FUNCTION

1. OUTLINE

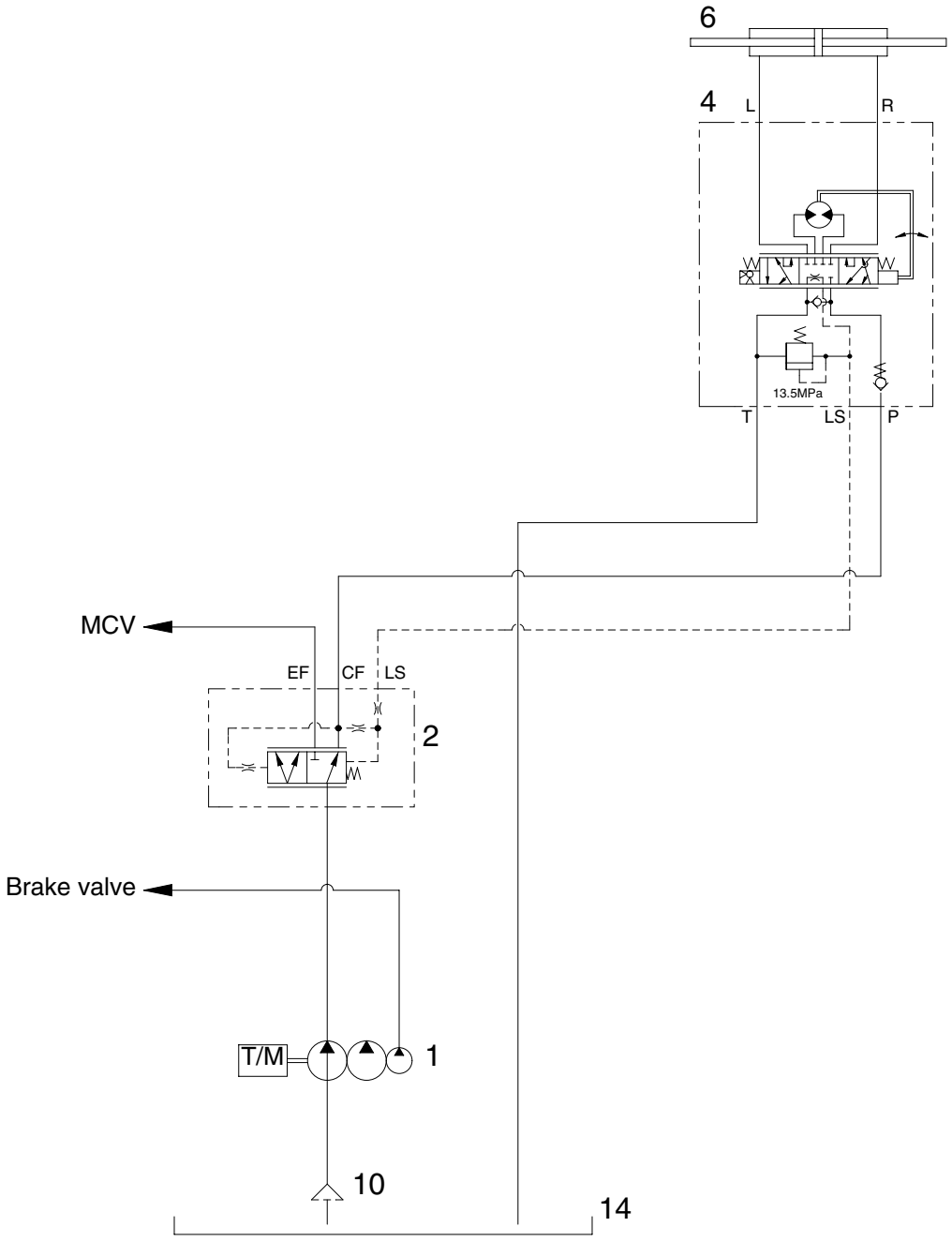


1 Hydraulic gear pump
2 Priority valve
3 Steering unit
4 Steering cylinder
5 Steering wheel

50D7ESE00

The steering system for this machine is composed of steering wheel assembly, steering unit, steering cylinder, trail axle and piping. The steering force given to the steering wheel enters the steering unit through the steering column. The required oil flow is sensed by the function of the control section of the unit, and pressurized oil delivered from the hydraulic pump is fed to the steering cylinder. The force produced by the steering cylinder moves the knuckle of steering tires through the intermediate link.
The axle body is unit structure having steering knuckles installed to its both ends by means of kingpins. Hub and wheel are mounted through bearing to spindle of knuckle.

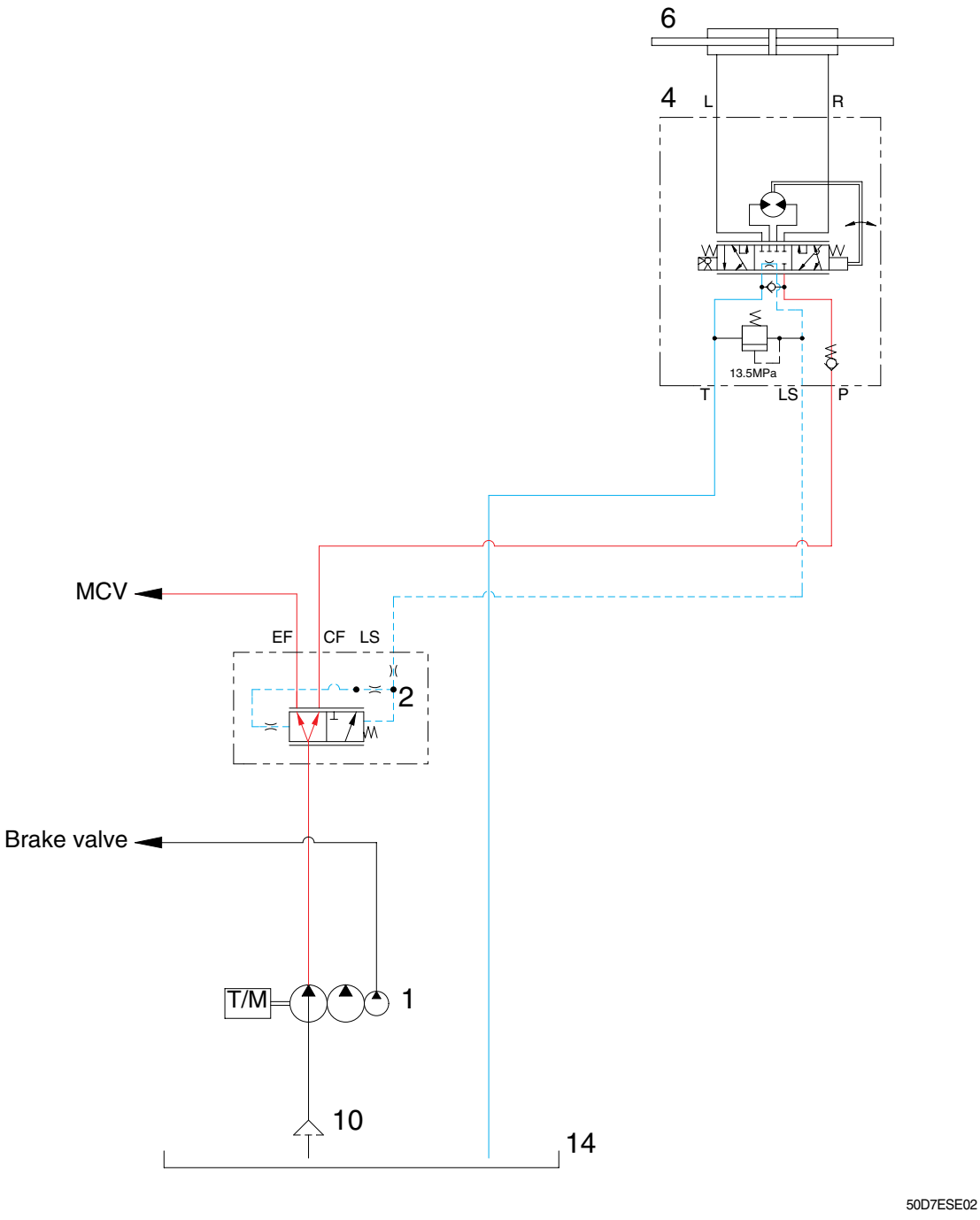
2. HYDRAULIC CIRCUIT



50D7ESE01

1	Hydraulic gear pump	6	Steering cylinder
2	Priority valve	10	Suction filter
4	Steering unit	14	Hydraulic tank

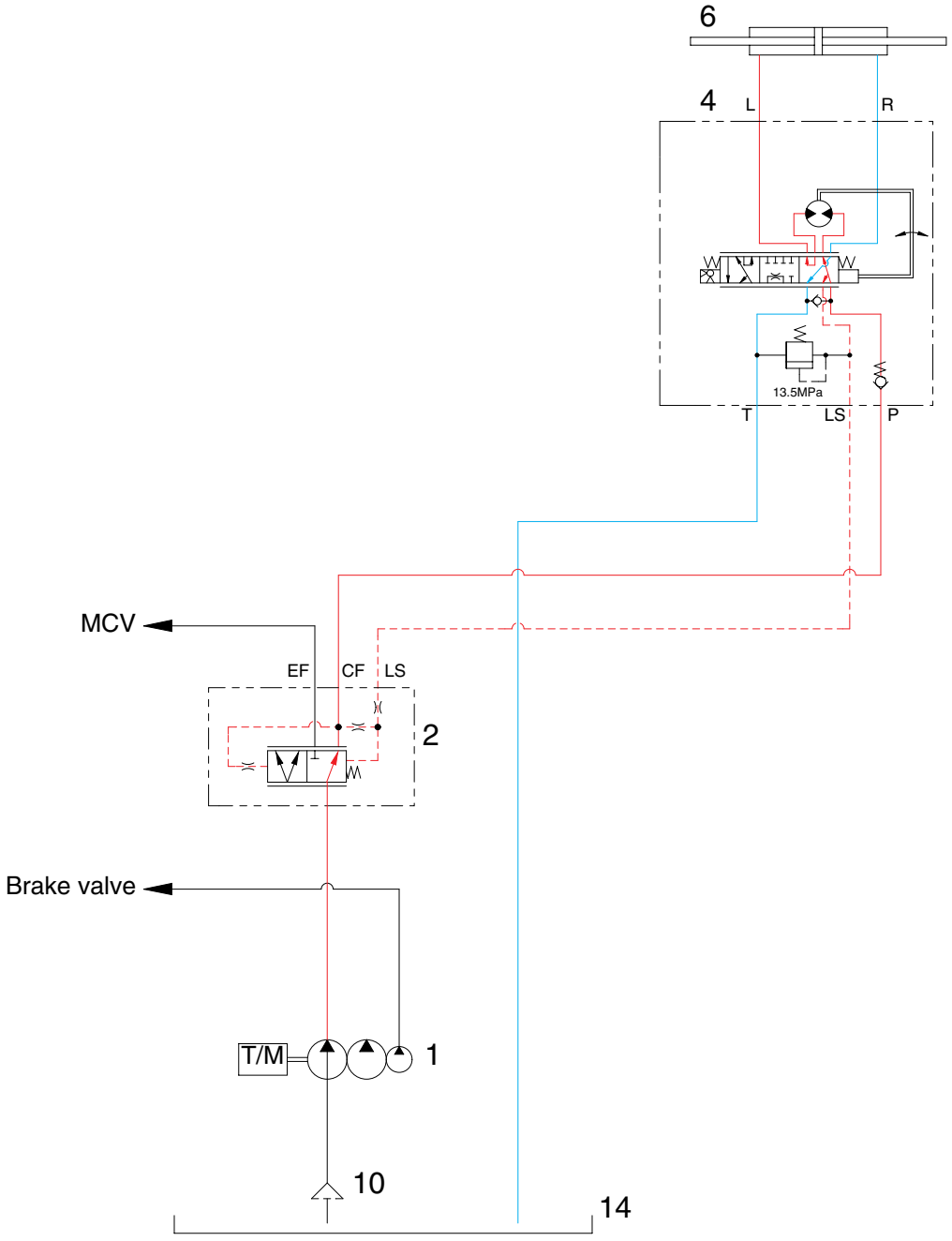
1) NEUTRAL



50D7ESE02

The steering wheel is not being operated, so control spool(G) does not move.
The oil from hydraulic gear pump(1) enters the port P of priority valve(3) and the inlet pressure oil moves the spool(D) to the left.
Oil flow into LS port to the hydraulic tank(14), so the pump flow is routed to the main control valve through the EF port.

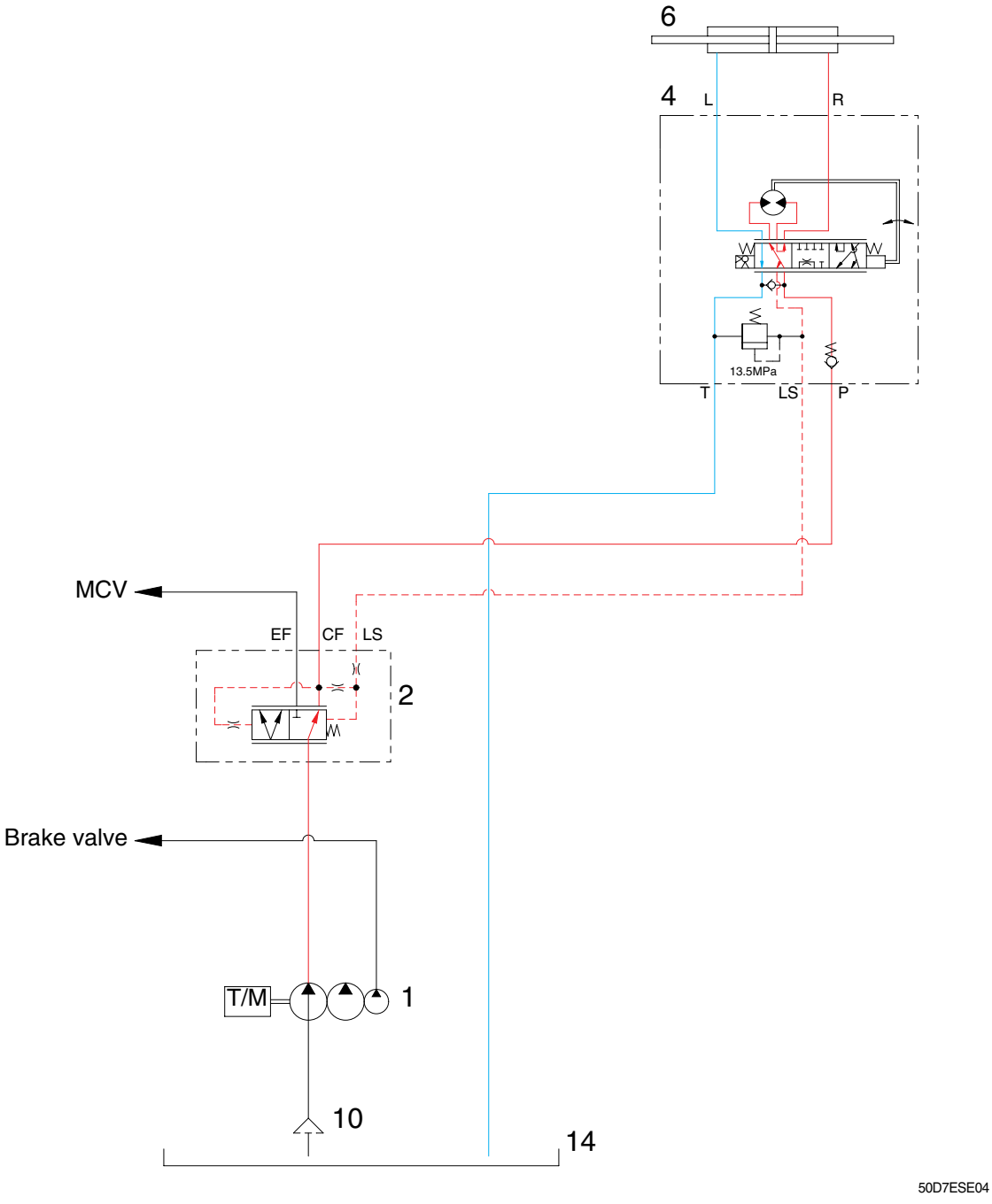
2) LEFT TURN



50D7ESE03

When the steering wheel is turned to the left, the spool(G) within the steering unit(4) connected with steering column turns in left hand direction.
At this time, the oil discharged from the pump flows into the spool(G) the steering unit through the spool(D) of priority valve and flows the gerotor(H).
Oil flow from the gerotor flows back into the spool(G) where it is directed out the left work port(L).
Oil returned from cylinder returns to hydraulic tank(14).
When the above operation is completed, the machine turns to the left.

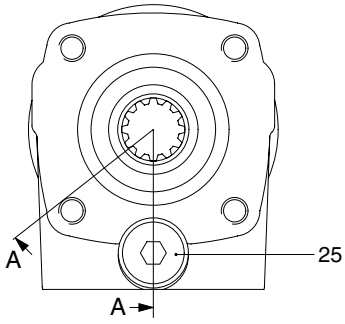
3) RIGHT TURN

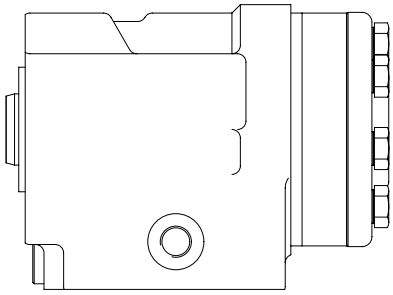


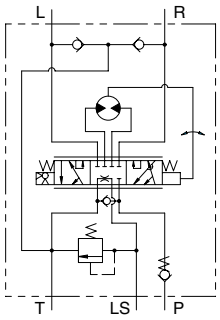
When the steering wheel is turned to the right, the spool(G) within the steering unit(4) connected with steering column turns in right hand direction.
At this time, the oil discharged from the pump flows into the spool(G) the steering unit through the spool(D) of priority valve and flows the gerotor(H).
Oil flow from the gerotor flows back into the spool(G) where it is directed out the right work port(R).
Oil returned from cylinder returns to hydraulic tank(14).
When the above operation is completed, the machine turns to the right.

3. STEERING UNIT

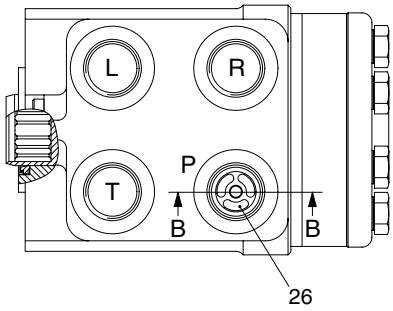
1) STRUCTURE

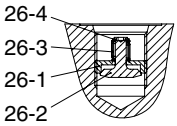




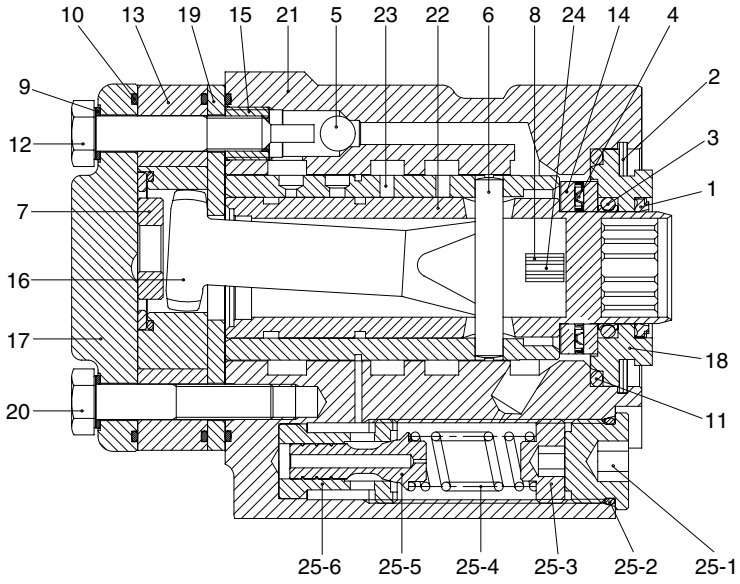


Hydraulic circuit





SECTION B-B



SECTION A - A

D507SE32

1	Dust seal	10	O-ring	19	Plate	25-3	Spring seat
2	Retaining ring	11	O-ring	20	Cap screw	25-4	Spring
3	Cap seal	12	Rolled screw	21	Housing	25-5	Spool
4	Thrust bearing	13	Gerotor set	22	Spool	25-6	Bushing
5	Ball	14	Bearing race	23	Sleeve	26	Check valve
6	Pin	15	Bore screw	24	Plate spring	26-1	Guide
7	Spacer	16	Drive shaft	25	Relief valve	26-2	Shim
8	Center spring	17	End cap	25-1	Plug	26-3	Spring
9	Washer	18	Bushing	25-2	O-ring	26-4	Washer

2) OPERATION

The steering unit is composed of the control valve(rotary valve) and the metering device. The control valve controls the flow of oil from the pump in the interior of the unit depending on the condition of the steering wheel. The metering device is a kind of hydraulic motor composed of a stator and a rotor. It meters the required oil volume, feeds the metered oil to the power cylinder and detects cylinder's motion value, that is, cylinder's motion rate.

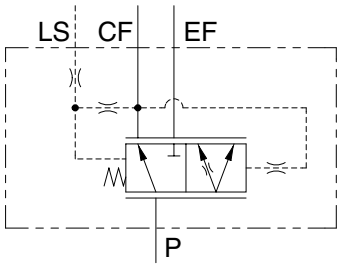
When the steering wheel is turned, the spool turns, the oil path is switched and the oil is fed into the metering device. As a result, the rotor is caused to run by oil pressure, and the sleeve is caused to run through the drive shaft and cross pin. Therefore, when the spool is turned, the spool turns by the same value in such a manner that it follows the motion of the spool. Steering motion can be accomplished when this operation is performed in a continuous state.

⚠ If the hoses of the steering system are incorrectly connected, the steering wheel can turn very rapidly when the engine is started. Keep clear of the steering wheel when starting the engine.

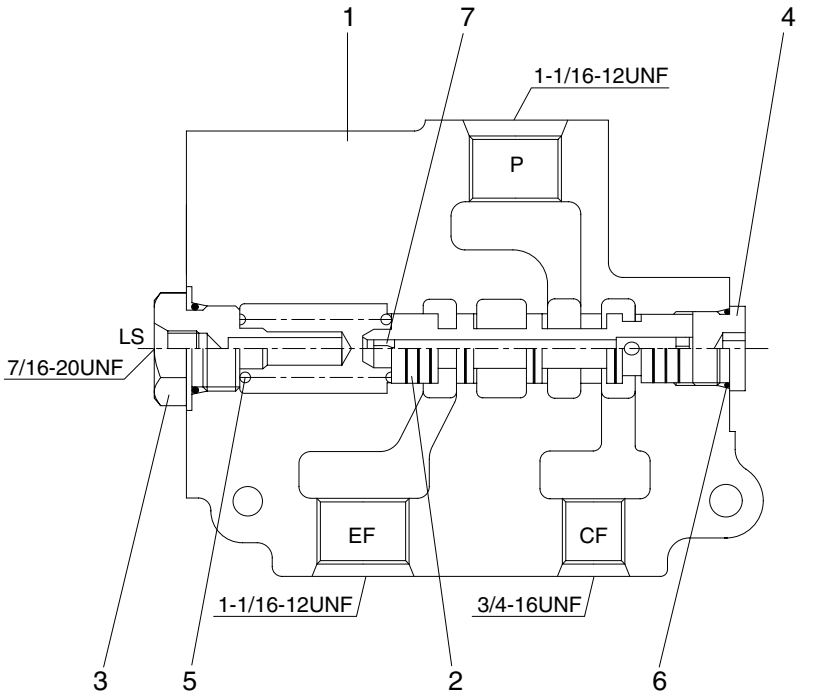
The centering spring for the spool and sleeve is provided to cause the valve to return to the neutral position. It is therefore possible to obtain a constant steering feeling, which is transmitted to the hands of the driver. Return to the center position occurs when the steering wheel is released.

4. PRIORITY VALVE

1) STRUCTURE



HYDRAULIC CIRCUIT



50DS7ESE06

1	Body	4	End plug	7	Orifice
2	Spool	5	Spring		
3	Spring plug	6	O-ring		

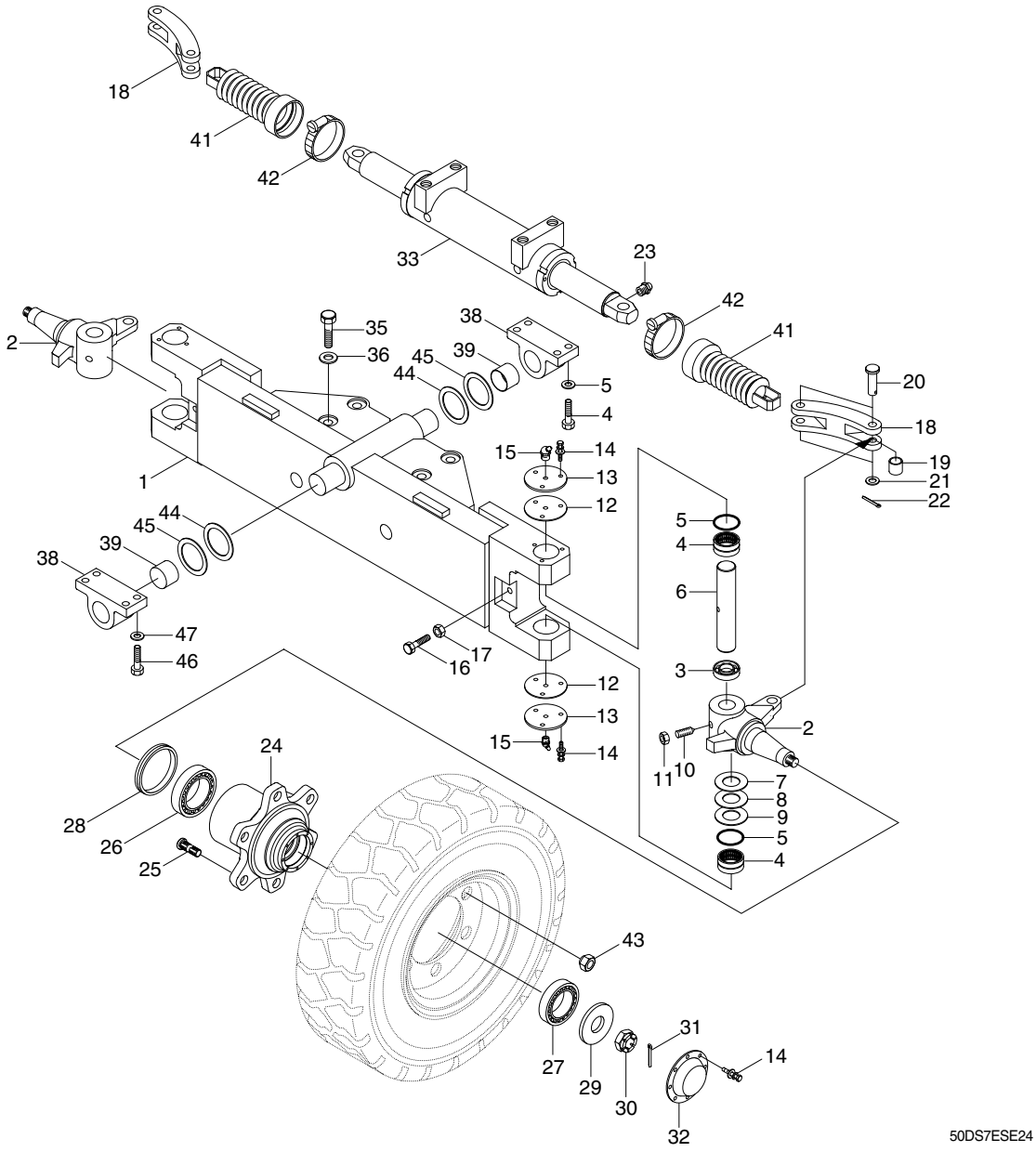
2) OPERATION

The oil from the hydraulic gear pump flows to the priority valve.
The priority valve supplies a flow of oil to the steering system and lift, tilt system.
The steering flow is controlled by the steering unit to operate the steering cylinder.
The remainder of the oil flow from the pump flows to the main control valve.

5. STEERING AXLE

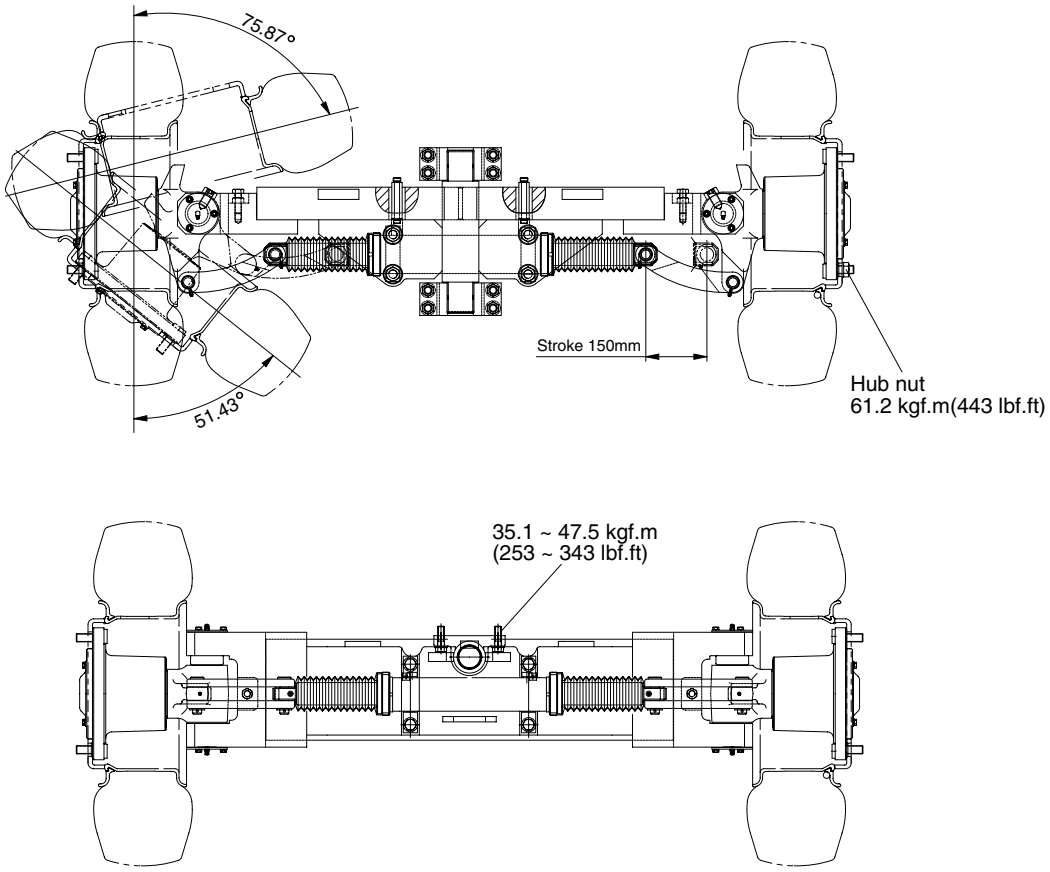
1) STRUCTURE

※ Do not remove the stopper bolt unless necessary.



1	Steering axle	12	Gasket	23	Grease nipple	35	Cover
2	Knuckle	13	Cover	24	Hub	36	Hexagon bolt
3	Thrust bearing	14	Bolt w/washer	25	Hub bolt	38	Support
4	Needle bearing	15	Grease nipple	26	Taper roller bearing	39	Bushing
5	Oil seal	16	Hexagon bolt	27	Taper roller bearing	41	Steer cylinder boot
6	King pin	17	Hexagon nut	28	Oil seal	42	Clamp
7	Thrust washer	18	Link	29	Special washer	43	Hub nut
8	Shim washer	19	Inner race bushing	30	Lock nut	44	Shim(1.0t)
9	Shim washer	20	Link pin	31	Split pin	45	Shim(0.5t)
10	Set screw	21	Special washer	32	Hub cap	46	Hexagon bolt
11	Hexagon nut	22	Split pin	33	Steering cylinder	47	Hardened washer

2) TIGHTENING TORQUE AND SPECIFICATION

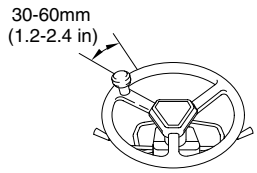


50DS7ESE07

Type	Unit	Center pin support single shaft
Structure of knuckle	-	Elliott type
Toe-in	degree	0
Camber	degree	0
Caster	degree	0
King pin angle	degree	0
Max steering angle of wheels(Inside/Outside)	degree	75.87/ 51.43
Tread	mm(in)	1604(63.1)

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 30~60mm 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 machine at minimum turning radius.
· Fit bar and a piece of chalk at outside edge of counterweight to mark line of turning radius.
· If minimum turning radius is not within±100mm (±4in)of specified value, adjust turning angle stopper bolt.
Min turning radius(Outside)
<table>
<tr><td>50DF-7</td><td>3349mm(132in)</td></tr>
<tr><td>60DF-7</td><td>3396mm(134in)</td></tr>
<tr><td>70DF-7</td><td>3442mm(136in)</td></tr>
</table></td></tr>
<tr><td>Hydraulic pressure of power steering</td><td>Remove plug from outlet port of flow divider and install oil pressure gauge.
Turn steering wheel fully and check oil pressure.
※ Oil pressure : 135 ~ 140 kgf/cm² (132 ~ 137bar)</td></tr>
</table>

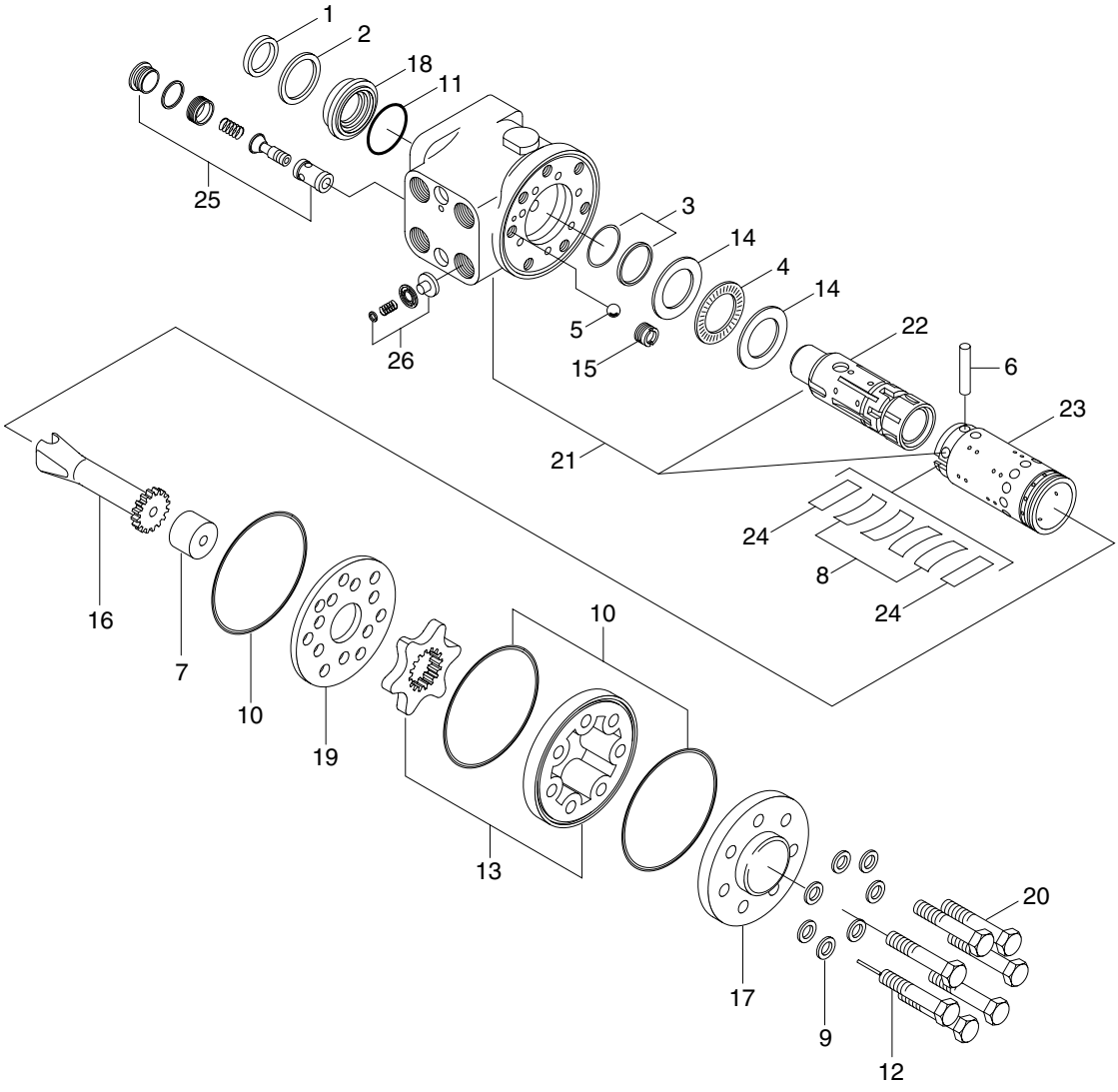
2. TROUBLESHOOTING

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

1. STEERING UNIT

1) STRUCTURE

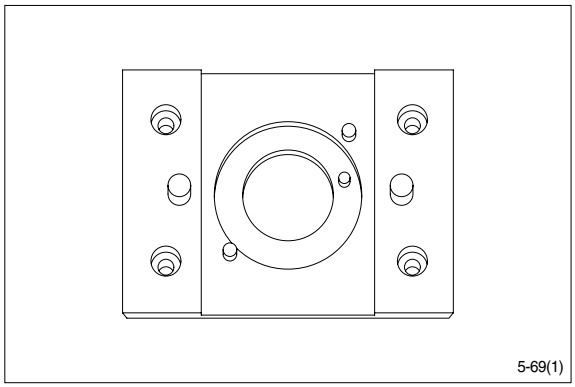


50DS7ESE05

1	Dust seal	10	O-ring	19	Plate
2	Retaining ring	11	O-ring	20	Cap screw
3	Cap seal	12	Rolled screw	21	Housing
4	Thrust bearing	13	Gerotor set	22	Spool
5	Ball	14	Bearing race	23	Sleeve
6	Pin	15	Bore screw	24	Plate spring
7	Spacer	16	Drive shaft	25	Relief valve
8	Center spring	17	End cap	26	Check valve
9	Washer	18	Bushing		

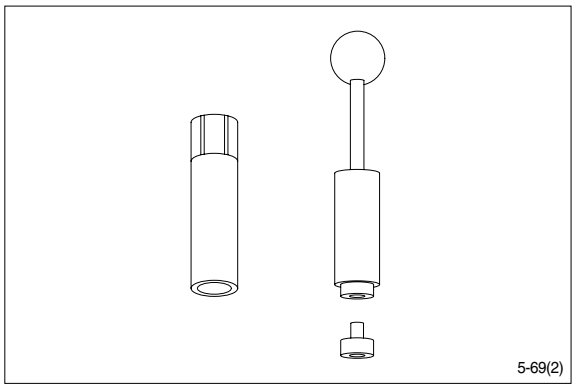
2) TOOLS

(1) Holding tool.



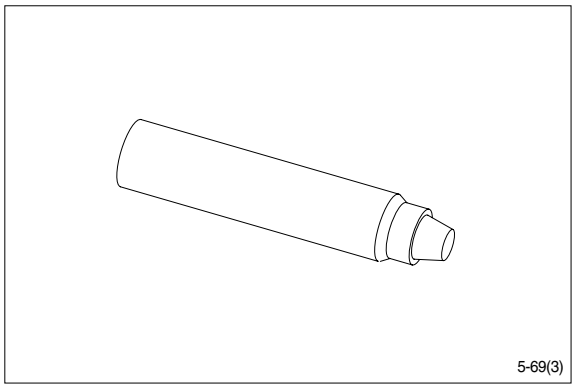
5-69(1)

(2) Assembly tool for O-ring and kin-ring.



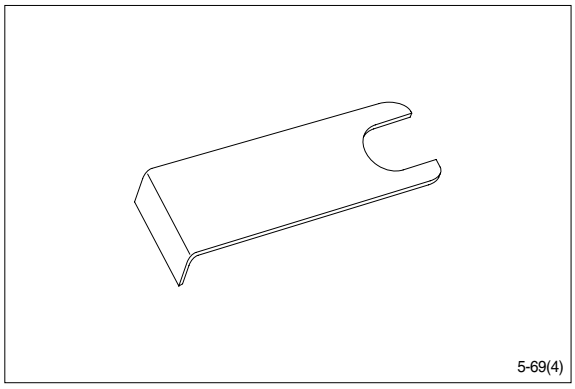
5-69(2)

(3) Assembly tool for lip seal.



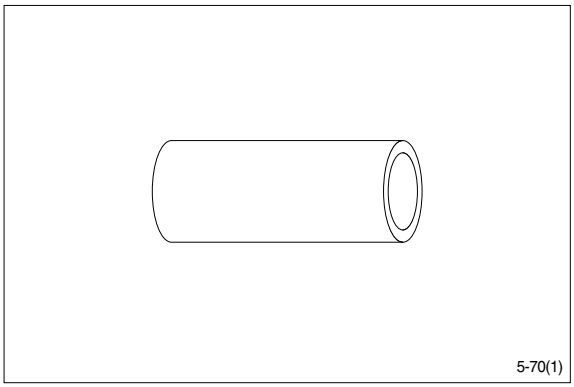
5-69(3)

(4) Assembly tool for cardan shaft.

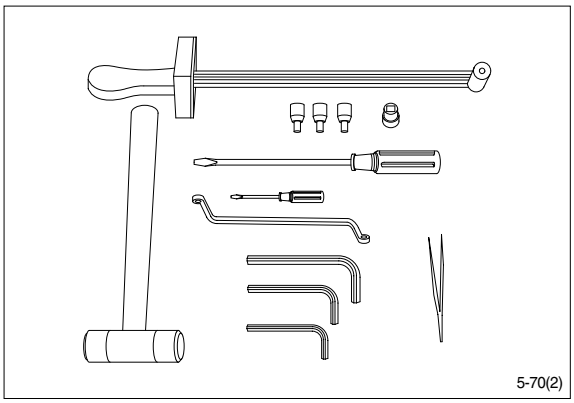


5-69(4)

(5) Assembly tool for dust seal.

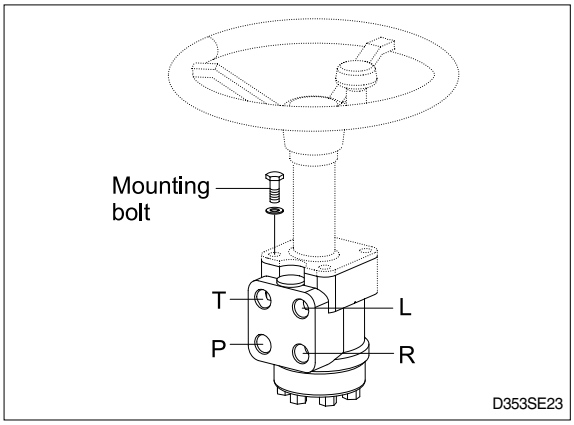


(6) Torque wrench 0~7.1kgf · m
(0~54.4lbf · ft)
13mm socket spanner
6, 8mm and 12mm hexagon sockets
12mm screwdriver
2mm screwdriver
13mm ring spanner
6, 8 and 12mm hexagon socket spanners
Plastic hammer
Tweezers



3) TIGHTENING TORQUE

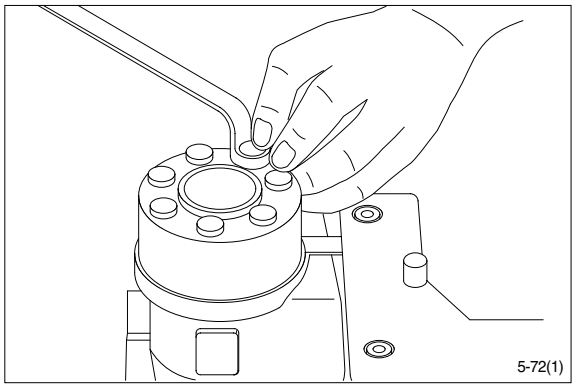
L : Left port
R : Right port
T : Tank
P : Pump



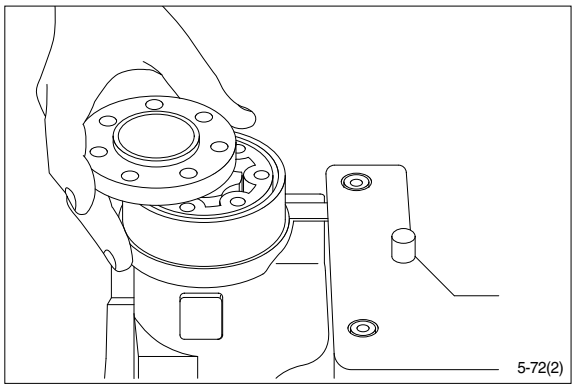
Port	Size	Torque [kgf · m(lbf · ft)]
L	3/4 - 16UNF	6.1±0.6 (44±4.3)
R	3/4 - 16UNF	6.1±0.6 (44±4.3)
T	3/4 - 16UNF	6.1±0.6 (44±4.3)
P	3/4 - 16UNF	6.1±0.6 (44±4.3)
Mounting bolt	M10×1.5	4.0 ±0.5 (29±3.6)

4) DISASSEMBLY

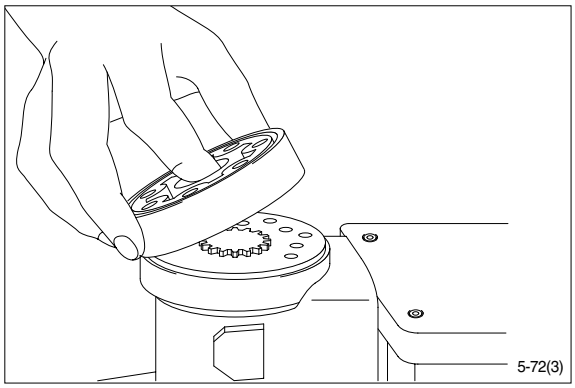
(1) Disassemble steering column from steering unit and place the steering unit in the holding tool.
Screw out the screws in the end cover(6-off plus one special screw).


5-72(1)

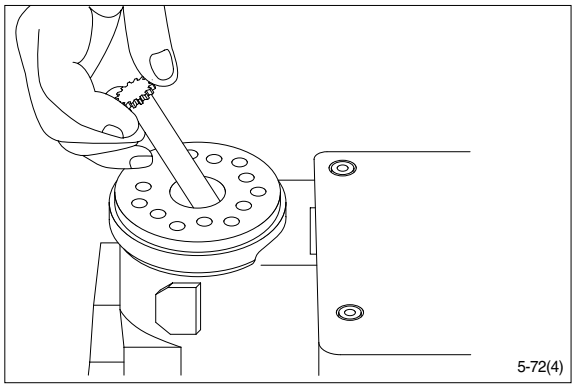
(2) Remove the end cover, sideways.


5-72(2)

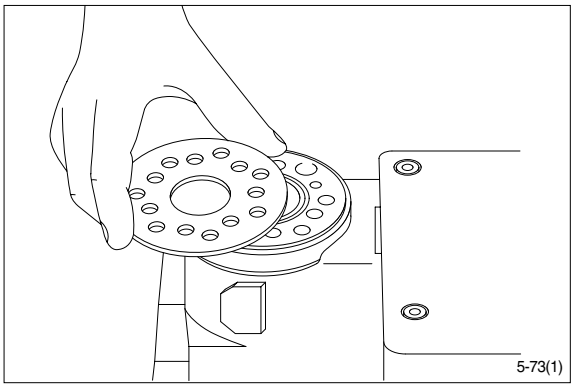
(3) Lift the gearwheel set(With spacer if fitted) off the unit.
Take out the two O-rings.


5-72(3)

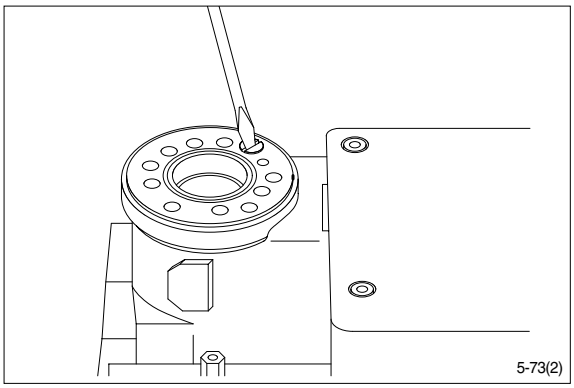
(4) Remove cardan shaft.


5-72(4)

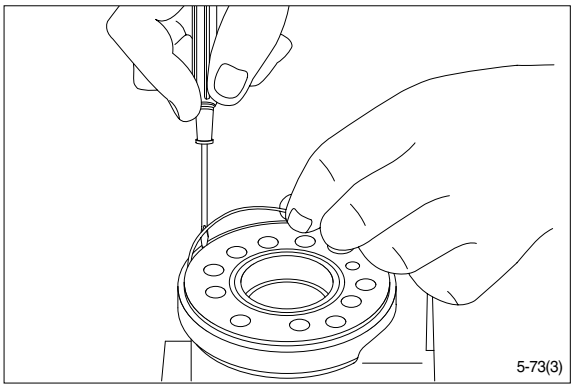
(5) Remove distributor plate.



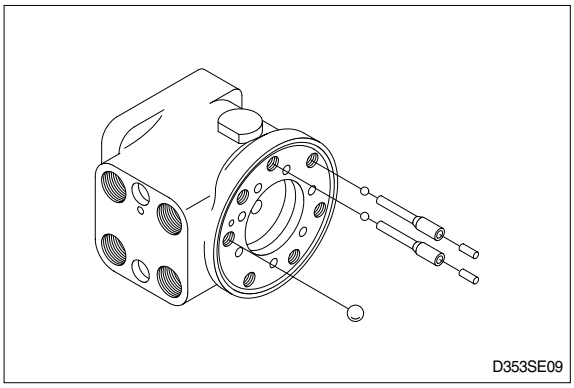
(6) Screw out the threaded bush over the check valve.



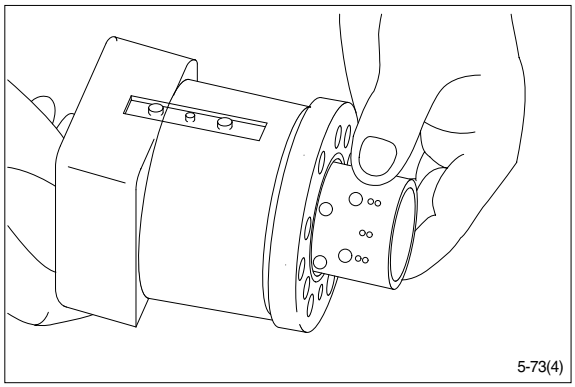
(7) Remove O-ring.



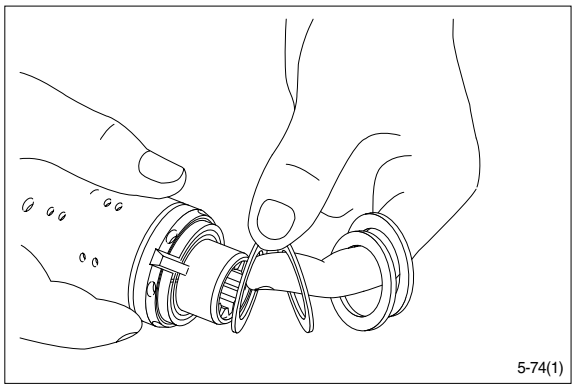
(8) Shake out the check valve ball and suction valve pins and balls.



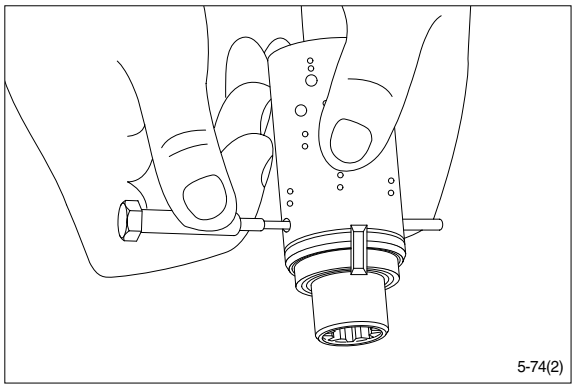
(9) Take care to keep the cross pin in the sleeve and spool horizontal. The pin can be seen through the open end of the spool. Press the spool inwards and the sleeve, ring, bearing races and thrust bearing will be pushed out of the housing together.


5-73(4)

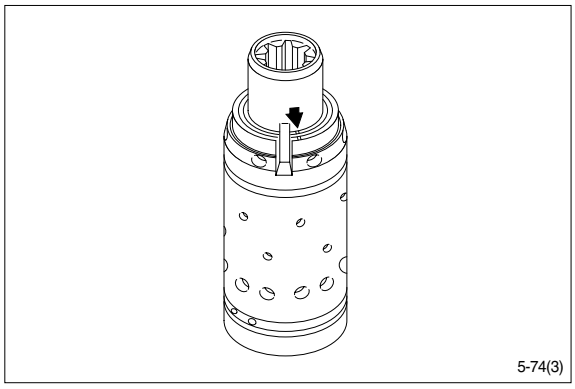
(10) Take ring, bearing races and thrust bearing from sleeve and spool. The outer (Thin) bearing race can sometimes "stick" in the housing, therefore check that it has come out.


5-74(1)

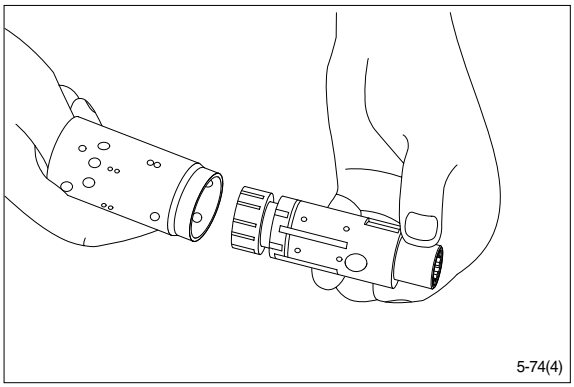
(11) Press out the cross pin. Use the special screw from the end cover.


5-74(2)

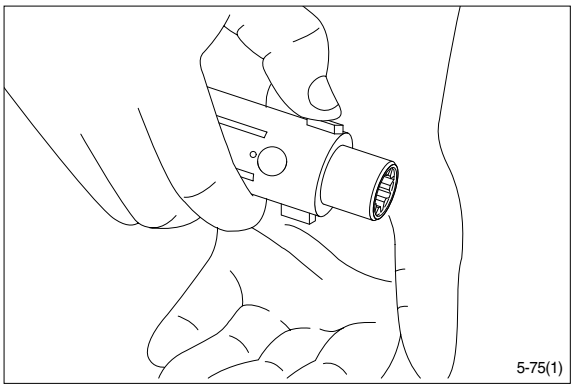
※ A small mark has been made with a pumice stone on both spool and sleeve close to one of the slots for the neutral position springs(See drawing).
If the mark is not visible, remember to leave a mark of your own on sleeve and spool before the neutral position springs are disassembled.


5-74(3)

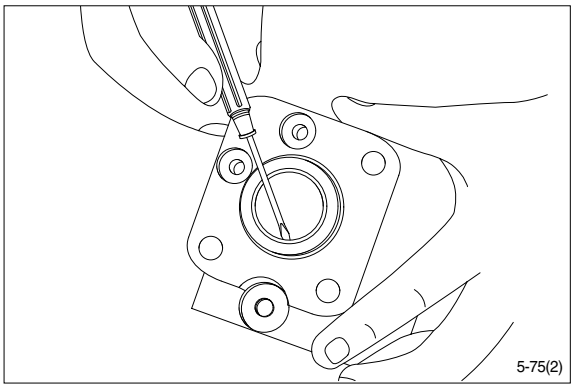
(12) Carefully press the spool out of the sleeve.



(13) Press the neutral position springs out of their slots in the spool.

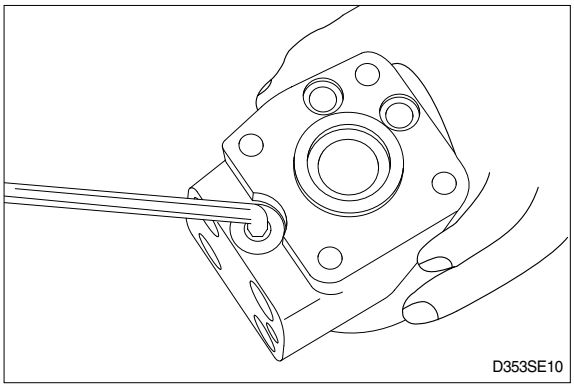


(14) Remove dust seal and O-ring.

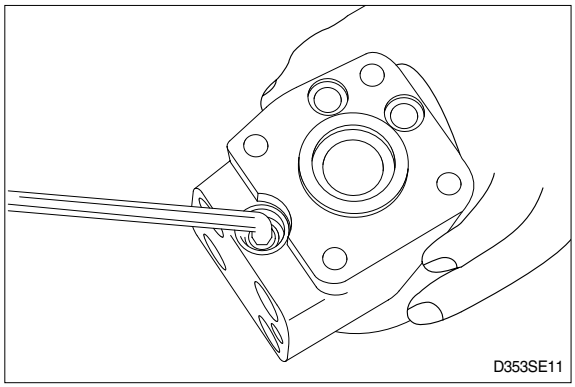


Disassembling the pressure relief valve

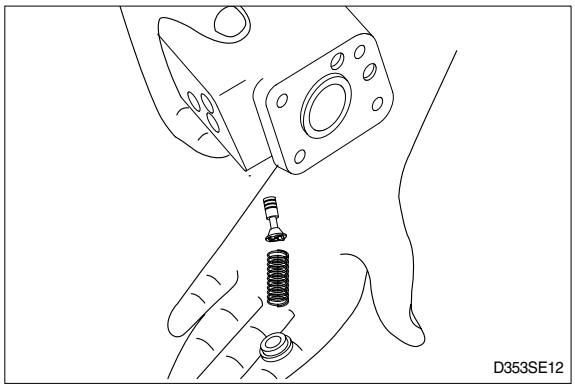
(15) Screw out the plug using an 8㎜ hexagon socket spanner.
Remove seal washers.



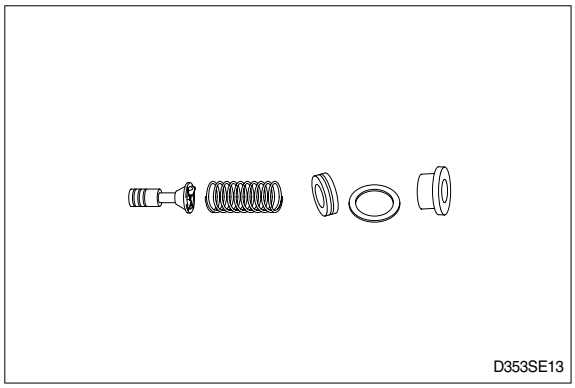
(16) Unscrew the setting screw using an 8mm hexagon socket spanner.



(17) Shake out spring and piston. The valve seat is bonded into the housing and cannot be removed.



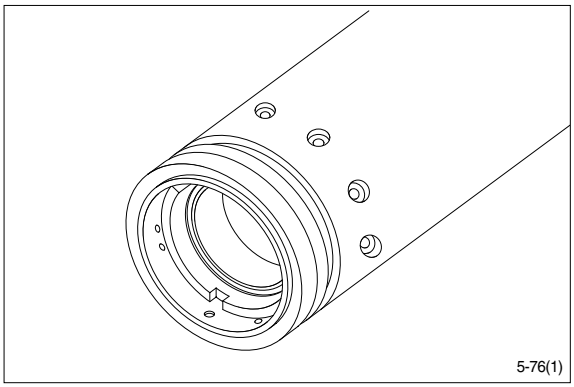
(18) The pressure relief valve is now disassembled.



5) ASSEMBLY

(1) Assemble spool and sleeve.

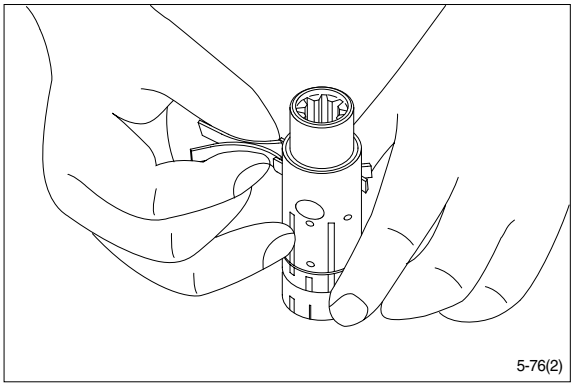
※ When assembling spool and sleeve only one of two possible ways of positioning the spring slots is correct. There are three slots in the spool and three holes in the sleeve in the end of the spool / sleeve opposite to the end with spring slots. Place the slots and holes opposite each other so that parts of the holes in the sleeve are visible through the slots in the spool.



5-76(1)

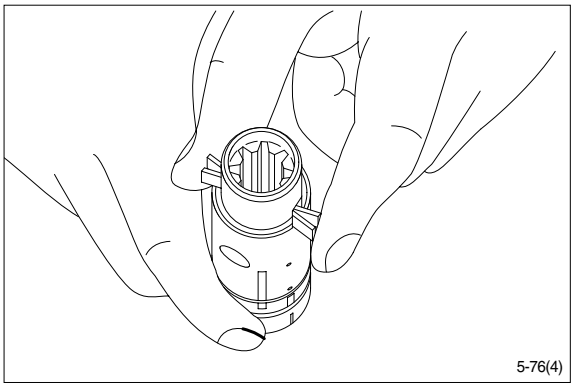
(2) Place the two flat neutral position springs in the slot.

Place the curved springs between the flat ones and press them into place (see assembly pattern).



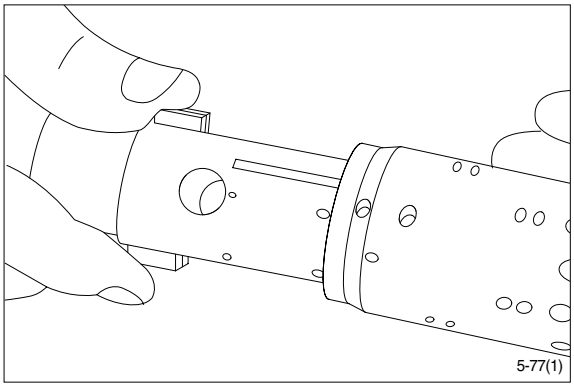
5-76(2)

(3) Line up the spring set.



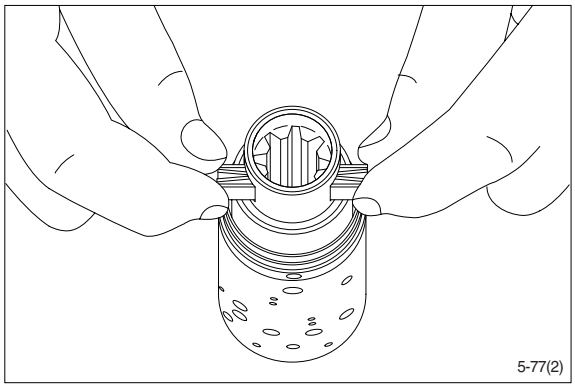
5-76(4)

(4) Guide the spool into the sleeve. Make sure that spool and sleeve are placed correctly in relation to each other.

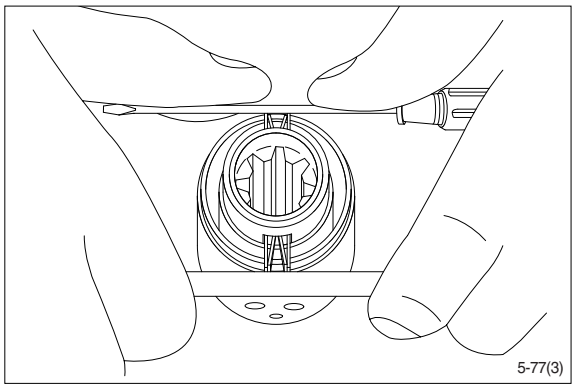


5-77(1)

(5) Press the springs together and push the neutral position springs into place in the sleeve.

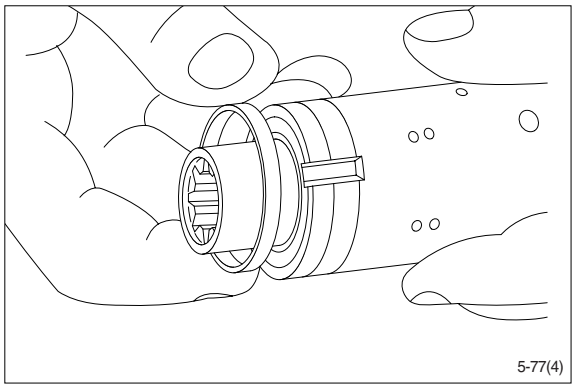

5-77(2)

(6) Line up the springs and center them.

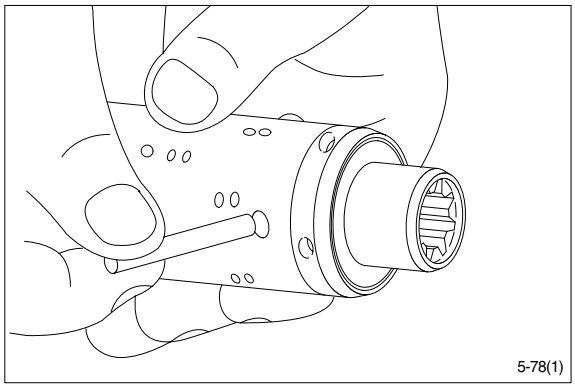

5-77(3)

(7) Guide the ring down over the sleeve.

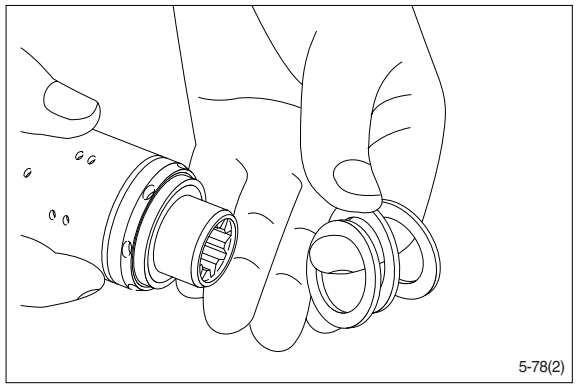
※ The ring should be able to rotate free of the springs.


5-77(4)

(8) Fit the cross pin into the spool / sleeve.

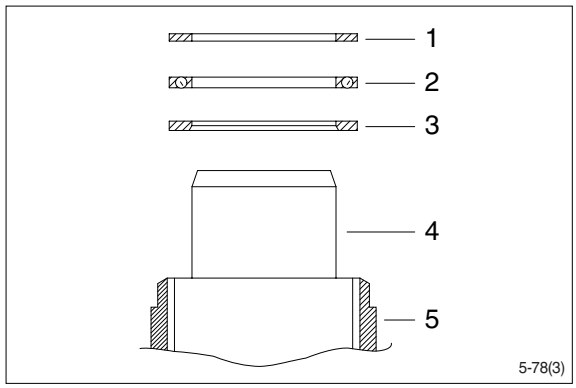

5-78(1)

(9) Fit bearing races and needle bearing as shown on below drawing.



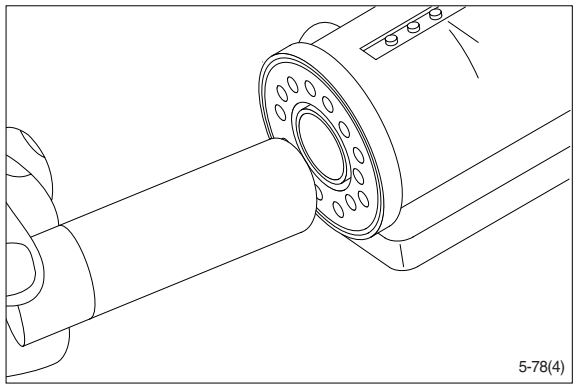
※ **Assembly pattern for standard bearings**

1 Outer bearing race
2 Thrust bearing
3 Inner bearing race
4 Spool
5 Sleeve

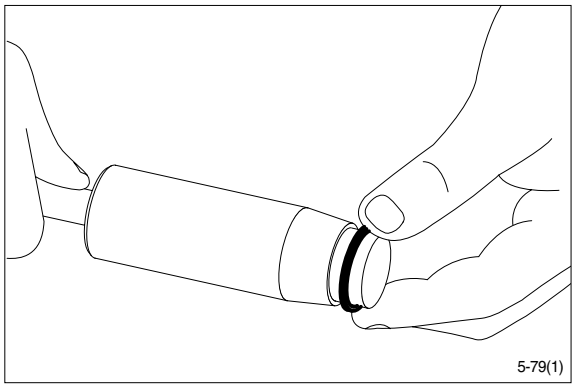


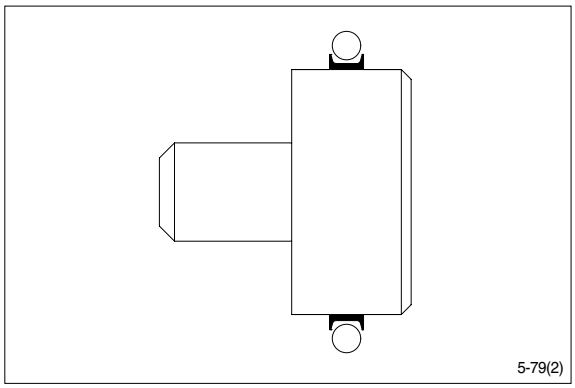
Installation instruction for O-ring

(10) Turn the steering unit until the bore is horizontal. Guide the outer part of the assembly tool into the bore for the spool / sleeve.

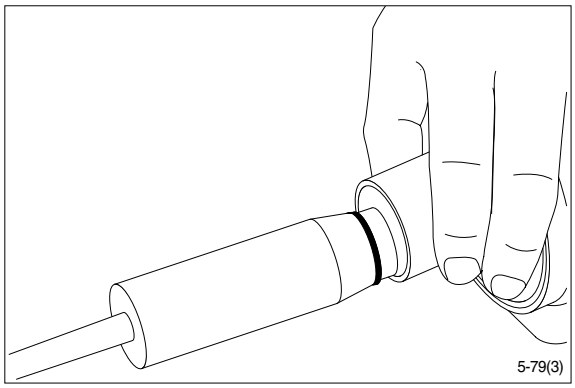


(11) Grease O-ring with hydraulic oil and place them on the tool.

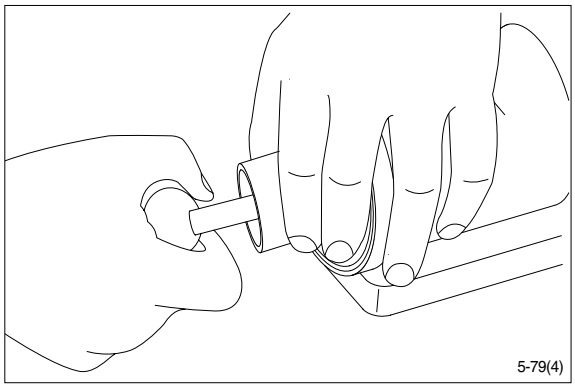

5-79(1)


5-79(2)

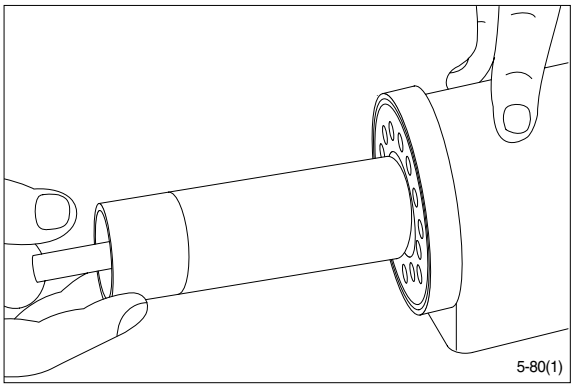
(12) Hold the outer part of the assembly tool in the bottom of the steering unit housing and guide the inner part of the tool right to the bottom.


5-79(3)

(13) Press and turn the O-ring into position in the housing.

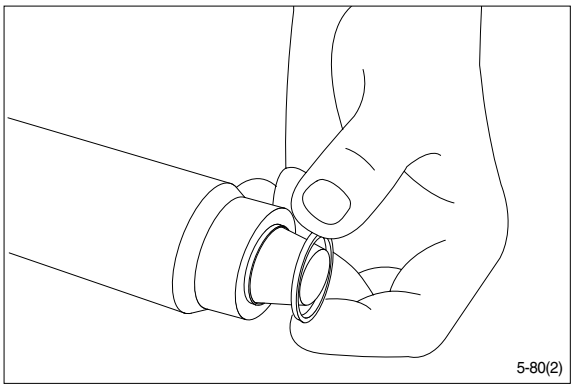

5-79(4)

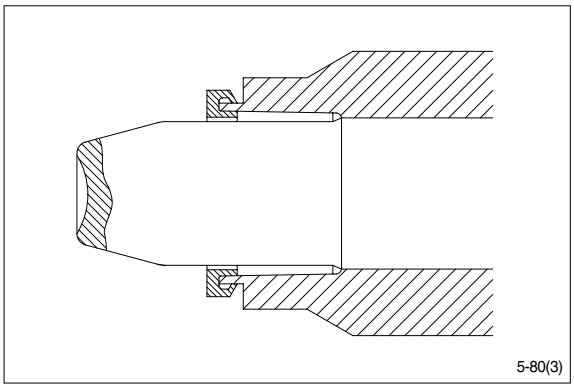
(14) Draw the inner and outer parts of the assembly tool out of the steering unit bore, leaving the guide from the inner part in the bore.



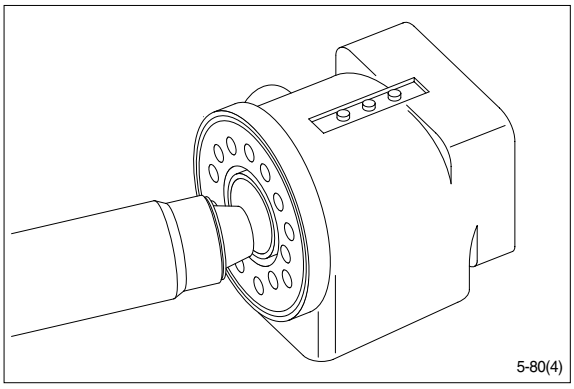
Installation instructions for lip seal

(15) Lubricate the lip seal with hydraulic oil and place it on the assembly tool.

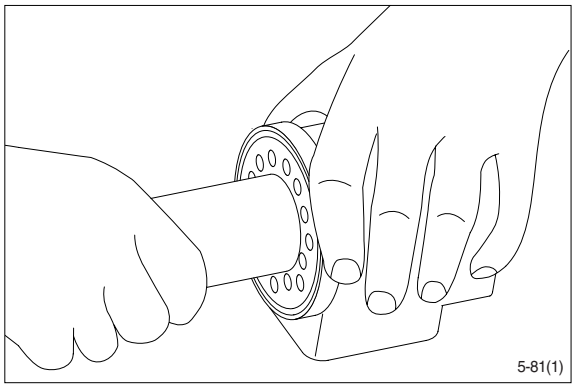




(16) Guide the assembly tool right to the bottom.

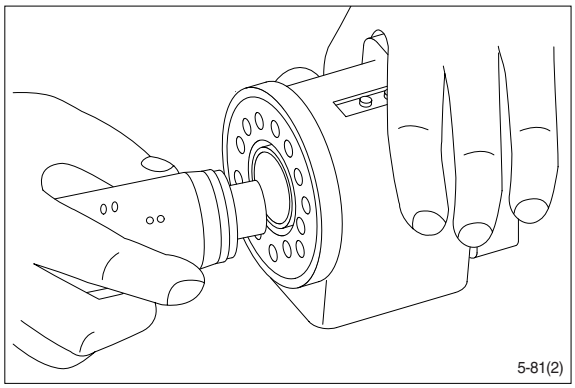


(17) Press and turn the lip seal into place in the housing.

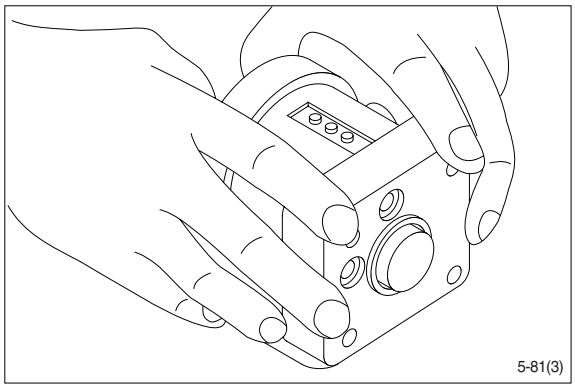


(18) With a light turning movement, guide the spool and sleeve into the bore.

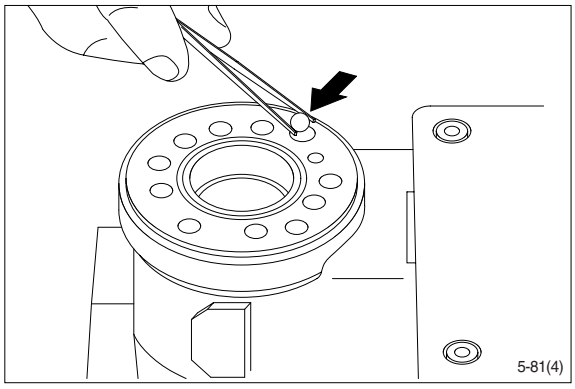
※ Fit the spool set holding the cross pin horizontal.



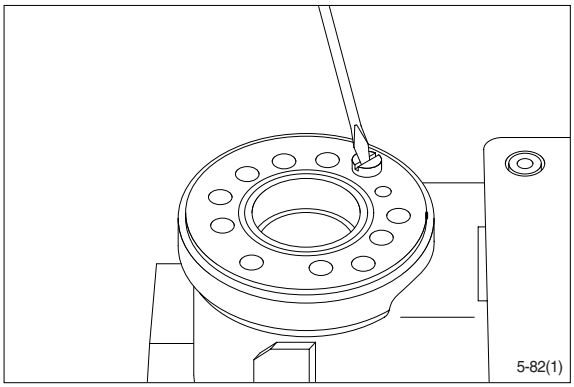
(19) The spool set will push out the assembly tool guide. The O-ring are now in position.



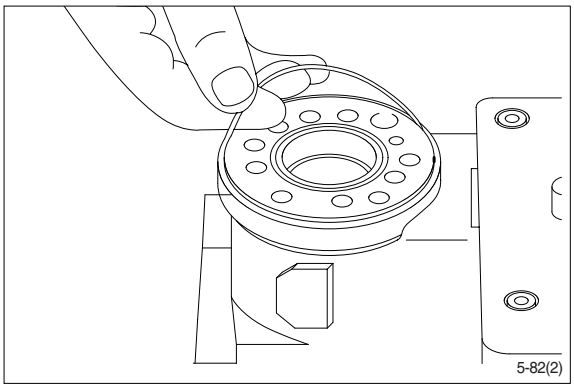
(20) Turn the steering unit until the bore is vertical again. Put the check valve ball into the hole indicated by the arrow.



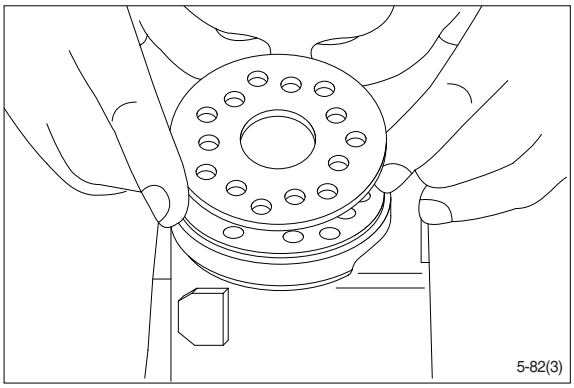
(21) Screw the threaded bush lightly into the check valve bore. The top of the bush must lie just below the surface of the housing.



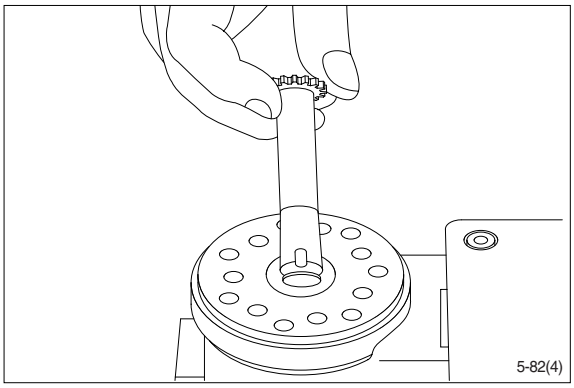
(22) Grease the O-ring with mineral oil approx. viscosity 500 cSt at 20℃.



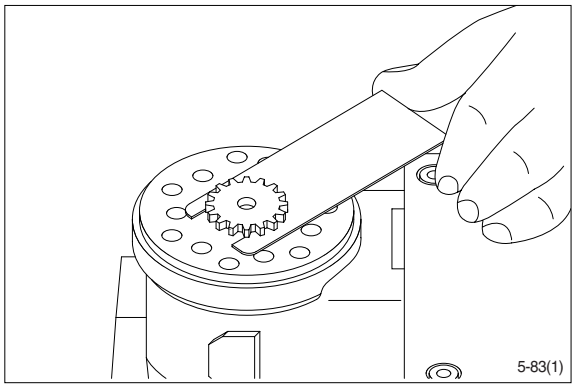
(23) Place the distributor plate so that the channel holes match the holes in the housing.



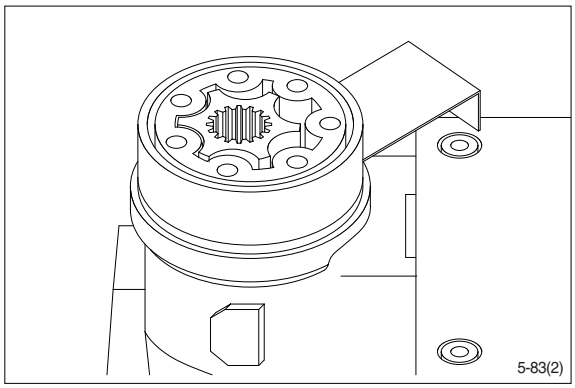
(24) Guide the cardan shaft down into the bore so that the slot is parallel with the connection flange.



(25) Place the cardan shaft as shown - so that it is held in position by the mounting fork.



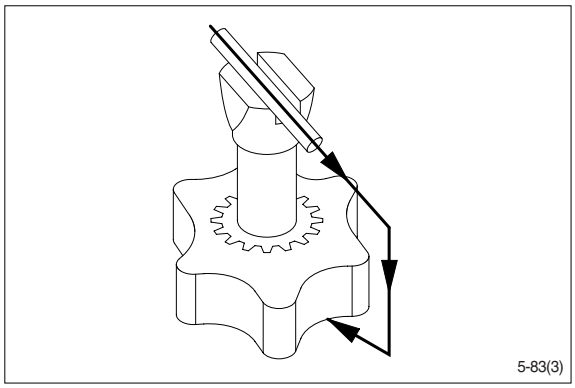
(26) Grease the two O-rings with mineral oil approx. viscosity 500 cSt at 20°C and place them in the two grooves in the gear rim. Fit the gearwheel and rim on the cardan shaft.



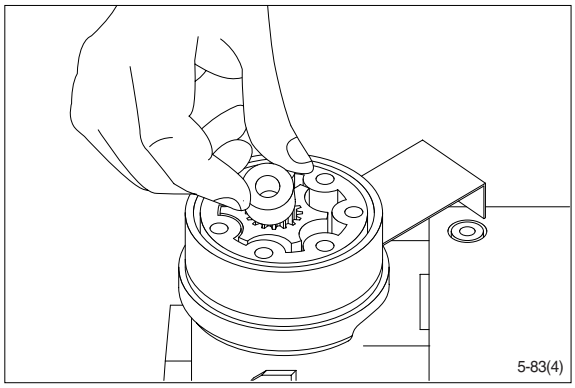
(27) Important

Fit the gearwheel(Rotor) and cardan shaft so that a tooth base in the rotor is positioned in relation to the shaft slot as shown.

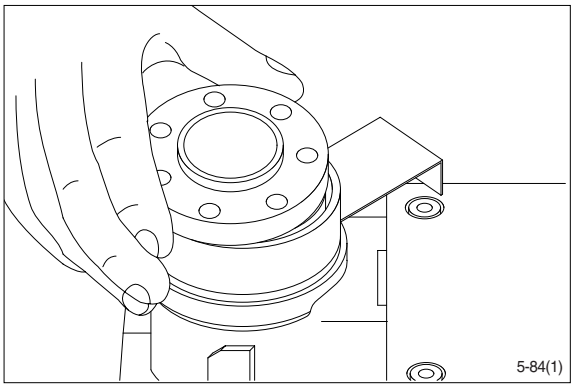
Turn the gear rim so that the seven through holes match the holes in the housing.



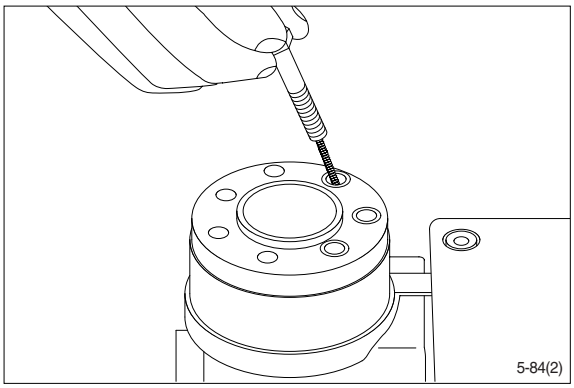
(28) Fit the spacer, if any.



(29) Place the end cover in position.

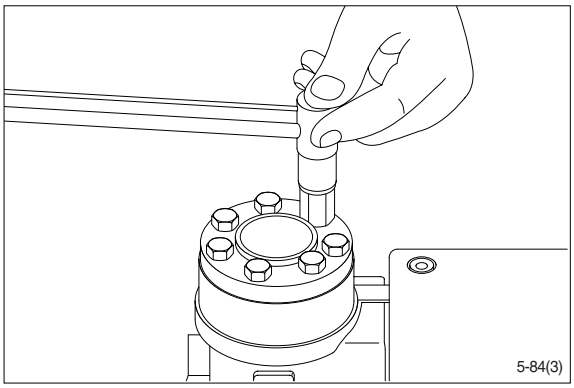

5-84(1)

(30) Fit the special screw with washer and place it in the hole shown.

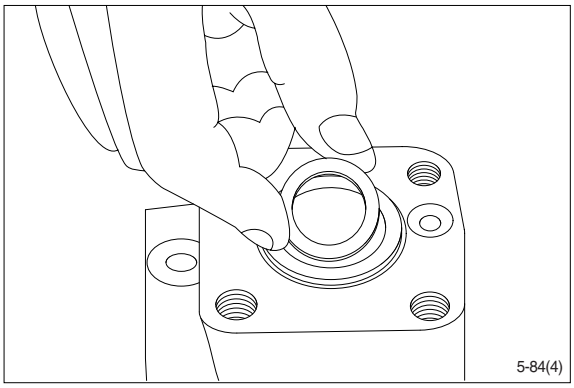

5-84(2)

(31) Fit the six screws with washers and insert them. Cross-tighten all the screws and the rolled pin.

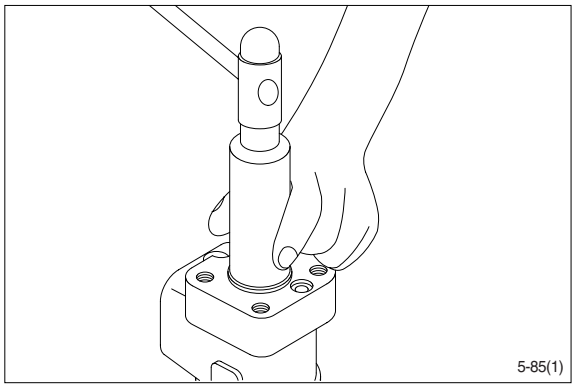
· Tightening torque : 4.0 ± 0.5kgf · m
(28.9 ± 3.6lbf · ft)


5-84(3)

(32) Place the dust seal ring in the housing.

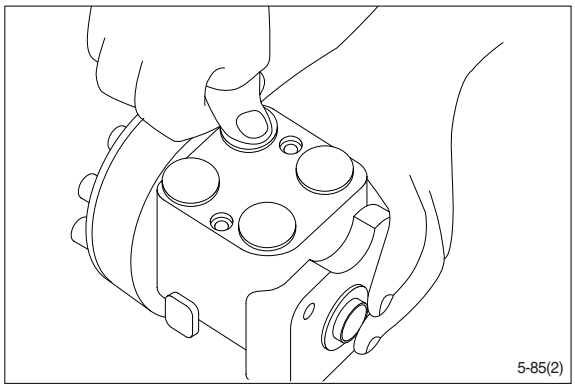

5-84(4)

(33) Fit the dust seal ring in the housing.


5-85(1)

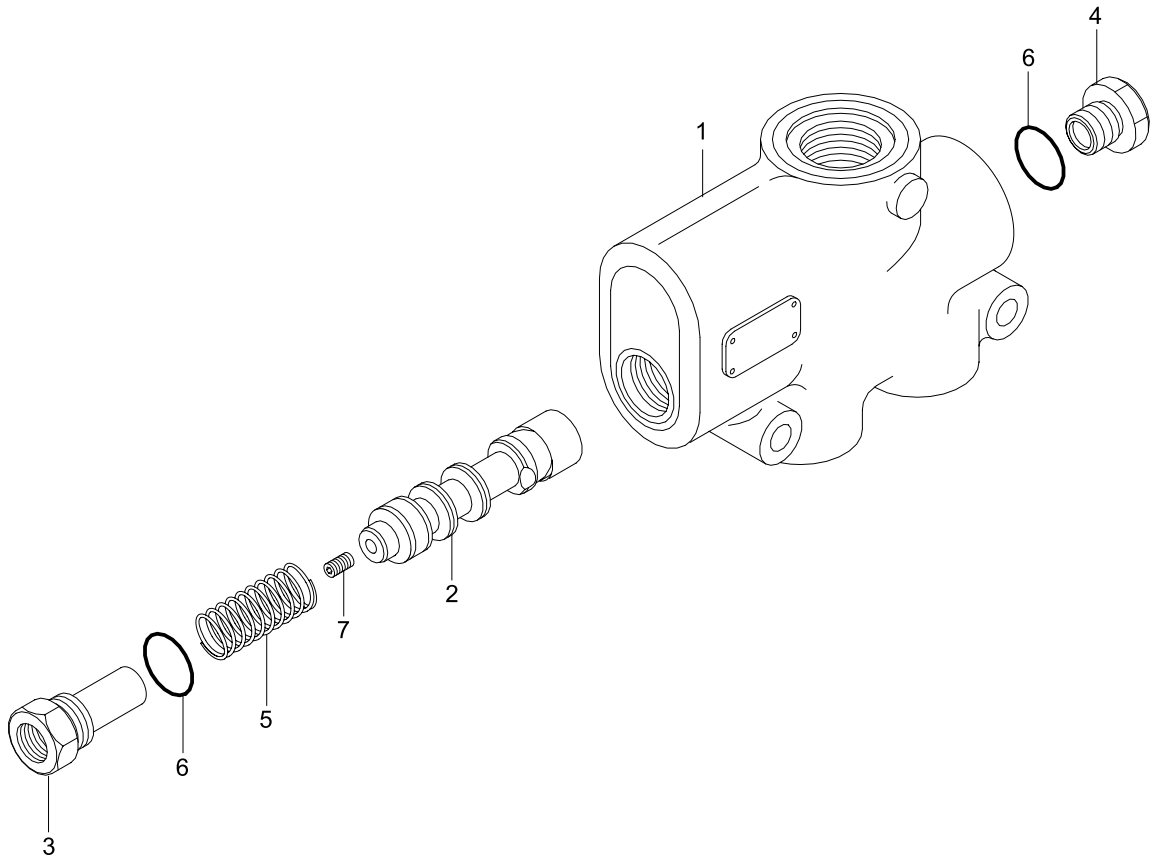
(34) Press the plastic plugs into the connection ports.

※ Do not use a hammer!


5-85(2)

2. PRIORITY VALVE

1) STRUCTURE



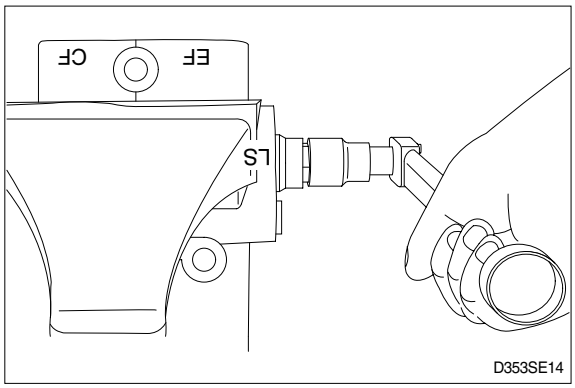
50DS7ESE08

1	Body	4	End plug	7	Orifice
2	Spool	5	Spring		
3	Spring plug	6	O-ring		

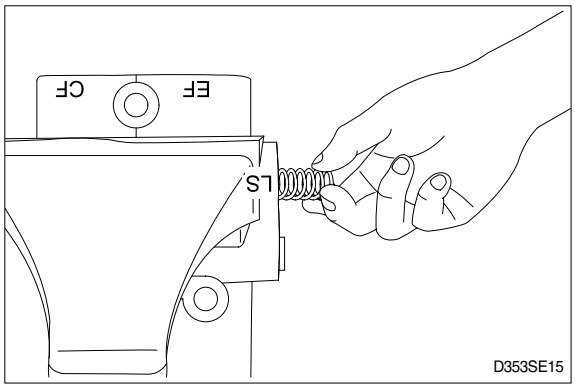
2) DISASSEMBLY

※ Cleanliness is the primary means of assuring satisfactory the priority valve life.
Select clean place.
Before removing the piping, clean the surrounding area of valve ports.

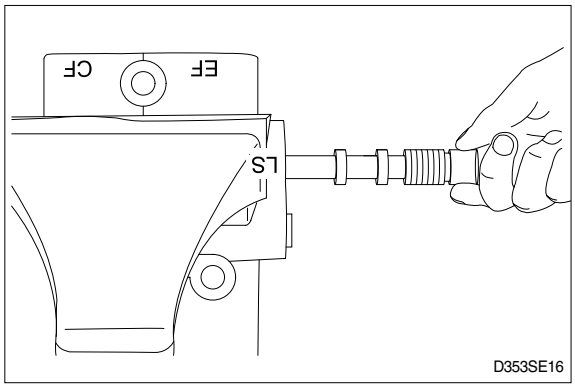
(1) Fix the body(1) in a vise with copper or lead sheets.
Do not over tighten jaws.
(2) Loosen plug(3) for LS port.



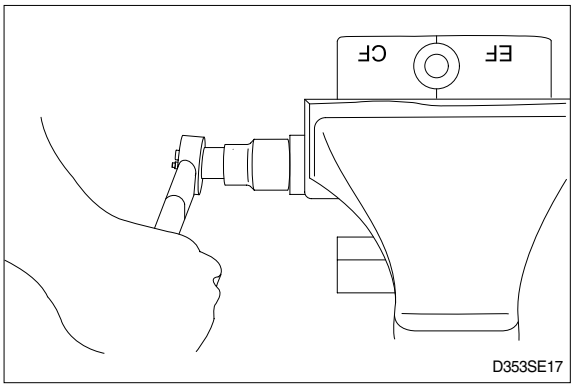
(3) Remove spring(5).



(4) Remove spool assy(2).
※ Can't remove the orifice(7) from spool(2), because the orifices were locked at the spool.



(5) Remove plug(4) and separate O-ring(6) and plug(3, 4) individually.

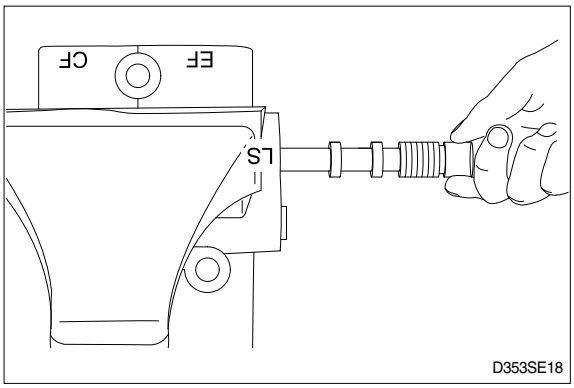


3) ASSEMBLY

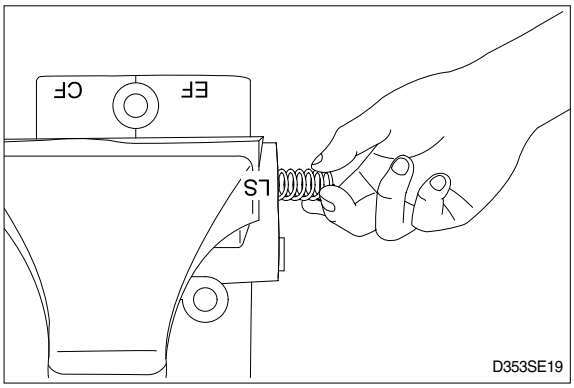
※ Clean all metal parts in clean solvent and blow dry with air and correct any damage, burrs and rust.
※ Do not wipe dry with cloth or paper towel.
※ Replace seals such as O-ring with new ones as a rule and coat with grease.

(1) Fix the body(1) in a vise.
(2) Insert the spool(2).

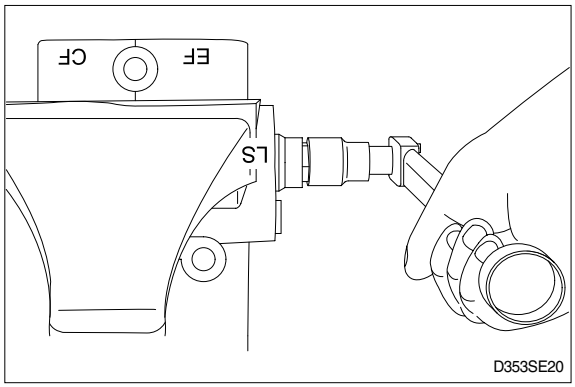
※ Secure the spool(2) remain in their correct direction.
※ Secure the spool(2) to move smoothly by finger.



(3) Insert the spring(5) into the body(1).

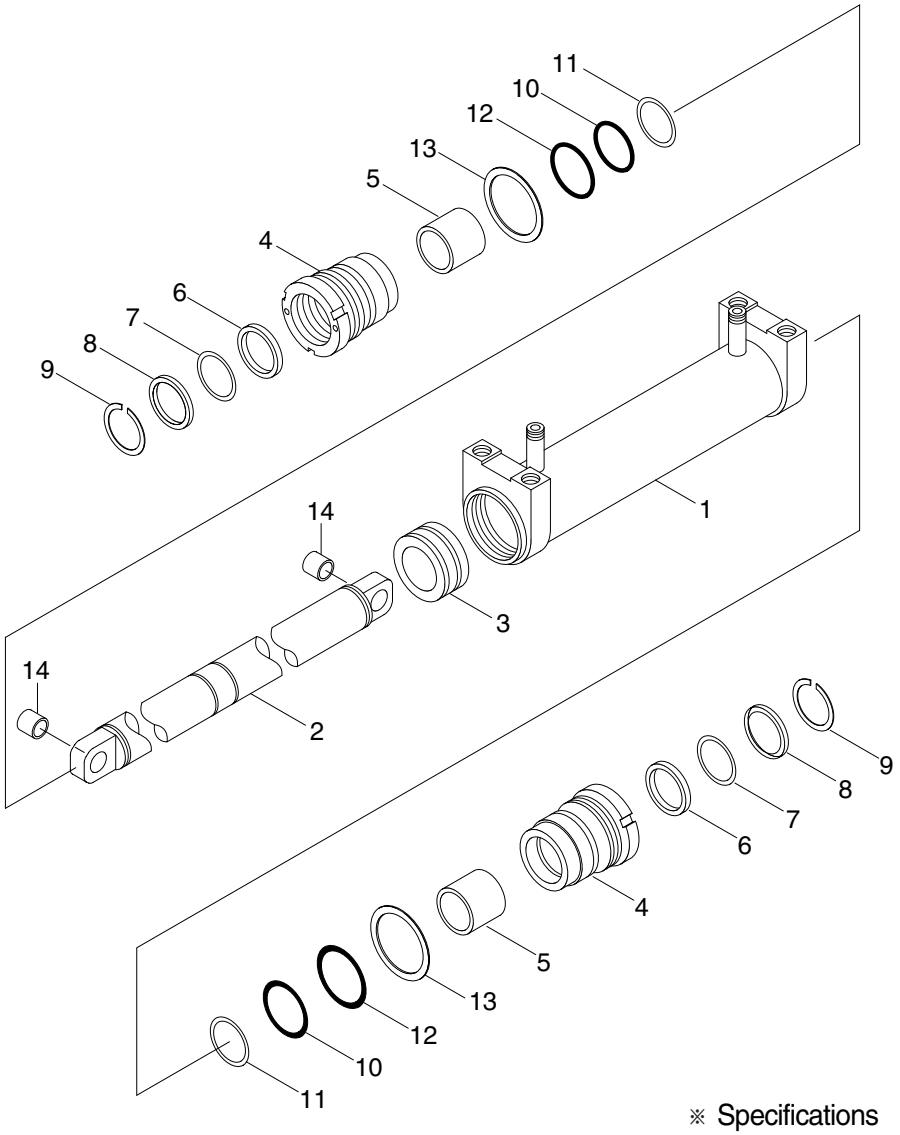


(4) Install the O-ring(6) onto plug(3, 4) and install the plug(3, 4) into the body(1).
· Tighten torque : 4.5kgf · m(32.5lbf · ft)



3. STEERING CYLINDER

1) STRUCTURE



※ Specifications
- Cylinder bore : 80mm
- Outer diameter : 94mm
- Stroke(half) : 150mm
- Rod diameter : 55mm

D507SE21

1	Tube assy	6	Rod seal	11	Back up ring
2	Rod	7	Back up ring	12	O-ring
3	Piston seal	8	Dust wiper	13	Lock washer
4	Gland	9	Snap ring	14	Pin bushing
5	Bushing	10	O-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

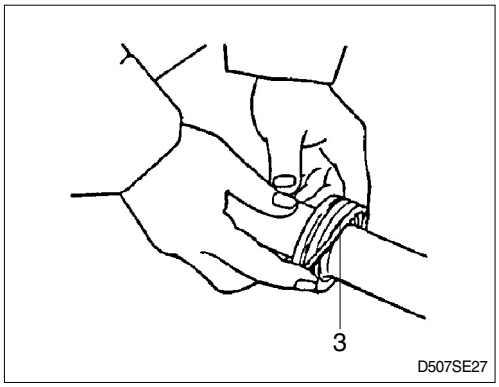
mm(in)

Check item	Criteria		Remarks
	Standard size	Repair limit	
Clearance between piston & cylinder tube	0.05~0.25 (0.002~0.01)	0.4 (0.02)	Replace piston seal
Clearance between cylinder rod & bushing	0.05~0.18 (0.002~0.007)	0.3 (0.01)	Replace bushing
Seals, O-ring	Damage		Replace
Cylinder rod	Dents		Replace
Cylinder tube	Biting		Replace

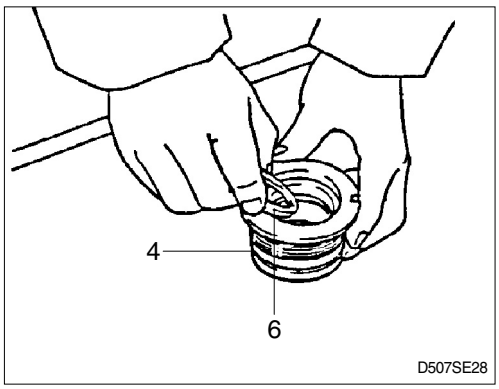
4) ASSEMBLY

(1) Install a new piston seal(3) around the groove on the piston.

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

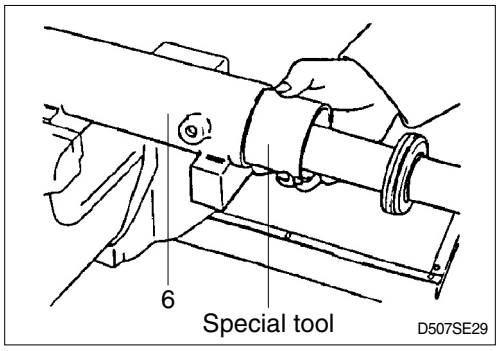


(2) Install the rod seal(6) to the position in the gland(4) applying a slight coat with grease prior to install.

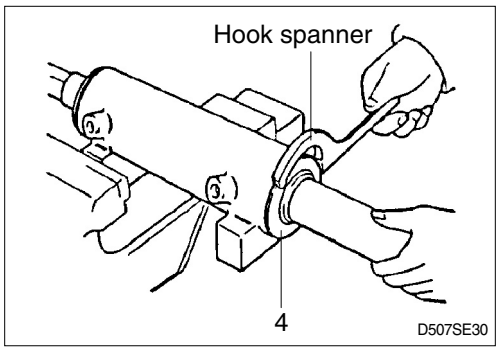


(3) Install the dust wiper(8) to the gland(4) using a special installing tool. Coat the dust wiper with grease slightly before installing.

(4) Using a special tool, install gland assembly into the cylinder tube(1).

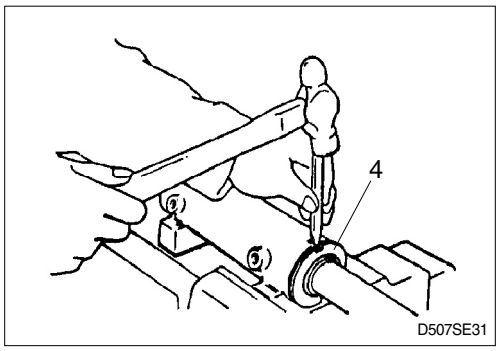


(5) Using a hook spanner, install the gland(4) assembly, and tighten it with torque 60±6kgf · m (434±43lbf · ft).



(6) After the gland(4) assembly was installed to the cylinder tube(1), calk at the tube end into the groove on the gland to prevent screw loosening.

※ If it is needed to calk again, never calk on the same place.



(7) Move the piston rod back and forth several times for the full distance of its stroke. This helps to seat the ring and seals before applying full hydraulic pressure to the cylinder.

(8) Install cylinder into trail axle.

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

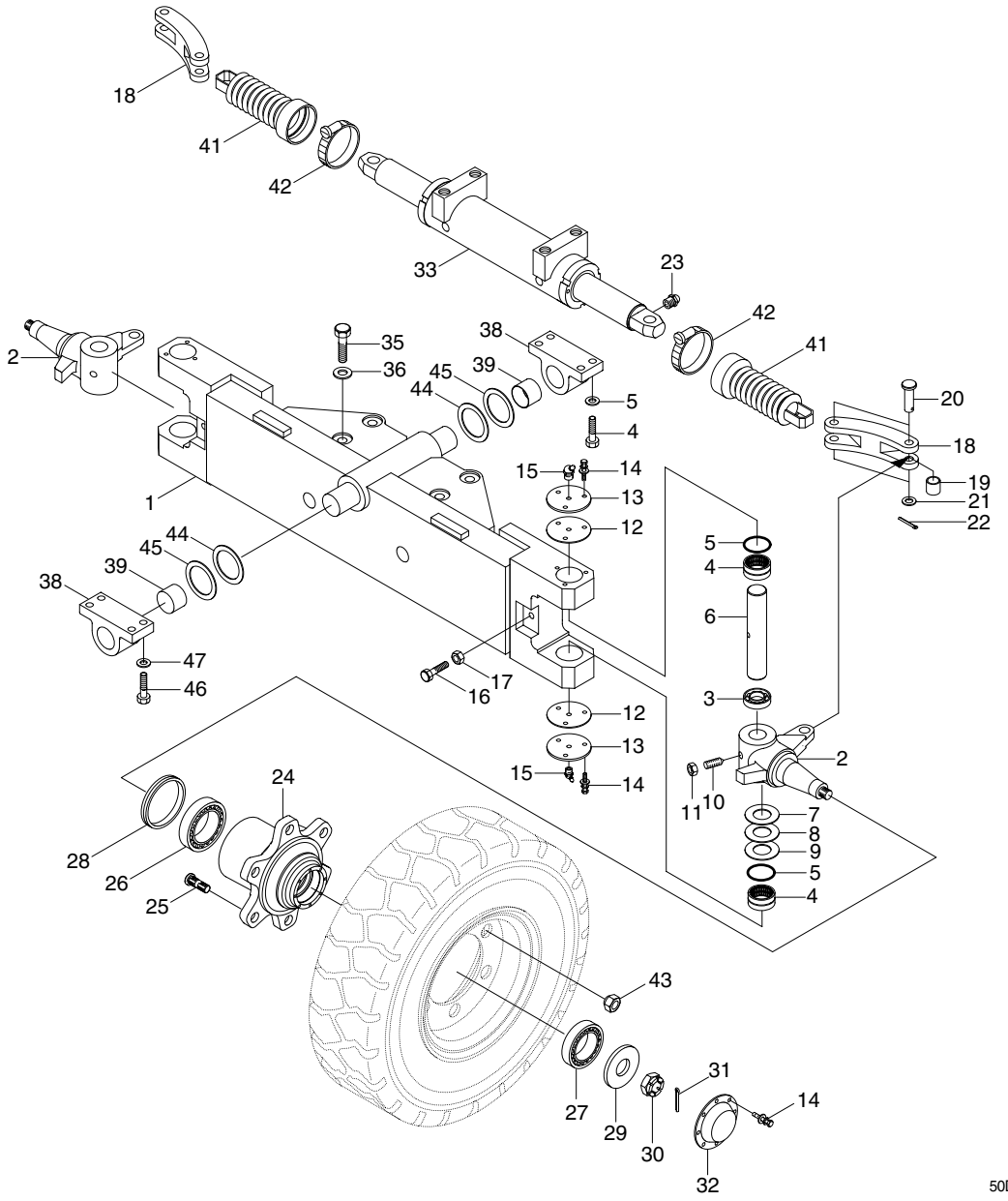
※ Then, repeat the above operation at gradually increasing engine rpm. This releases air from the system and completes preparation for operation.

(10) Stop the engine, lower the floating rear wheels, and check pump joints for oil leaks and looseness and retighten, them as required.

4. STEERING AXLE

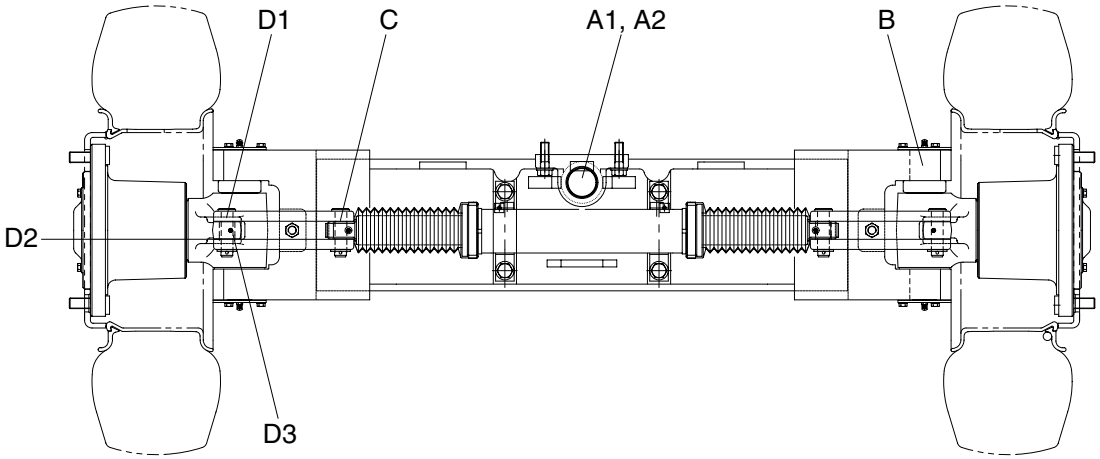
1) STRUCTURE

※ Do not remove the stopper bolt unless necessary.



1	Steering axle	12	Gasket	23	Grease nipple	35	Cover
2	Knuckle	13	Cover	24	Hub	36	Hexagon bolt
3	Thrust bearing	14	Bolt w/washer	25	Hub bolt	38	Support
4	Needle bearing	15	Grease nipple	26	Taper roller bearing	39	Bushing
5	Oil seal	16	Hexagon bolt	27	Taper roller bearing	41	Steer cylinder boot
6	King pin	17	Hexagon nut	28	Oil seal	42	Clamp
7	Thrust washer	18	Link	29	Special washer	43	Hub nut
8	Shim washer	19	Inner race bushing	30	Lock nut	44	Shim(1.0t)
9	Shim washer	20	Link pin	31	Split pin	45	Shim(0.5t)
10	Set screw	21	Special washer	32	Hub cap	46	Hexagon bolt
11	Hexagon nut	22	Split pin	33	Steering cylinder	47	Hardened washer

2) CHECK AND INSPECTION



50DS7ESE25

unit : mm(in)

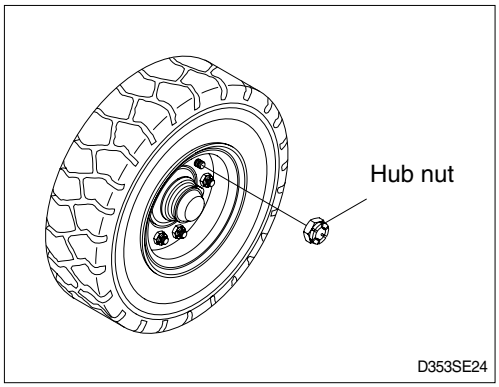
No.	Check item			Criteria		Remarks
				Standard size	Repair limit	
A	Shaft	A1	OD of shaft	60(2.4)	59.5(2.3)	Replace
		A2	ID of bushing	60(2.4)	59.5(2.3)	
B	OD of king pin			50(2.0)	49.8(2.0)	
C	OD of steering cylinder pin			22(0.9)	21.9(0.9)	
D	Knuckle	D1	OD of pin	22(0.9)	21.9(0.9)	
		D2	Vertical play	-	0.2(0.008)	Adjust shim
		D3	ID of bushing	22(0.9)	22.5(0.9)	Replace

· OD : Outer diameter
· ID : Inner diameter

3) DISASSEMBLY

※ Servicing work on the knuckle part can be carried out without removing the axle assy from chassis. The work can be done by jacking up the balance weight part of the truck.

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



(2) Remove Hub cap.

(3) Pull out split pin and remove lock nut, washer.

(4) Using the puller, take off the hub together with the roller bearing.

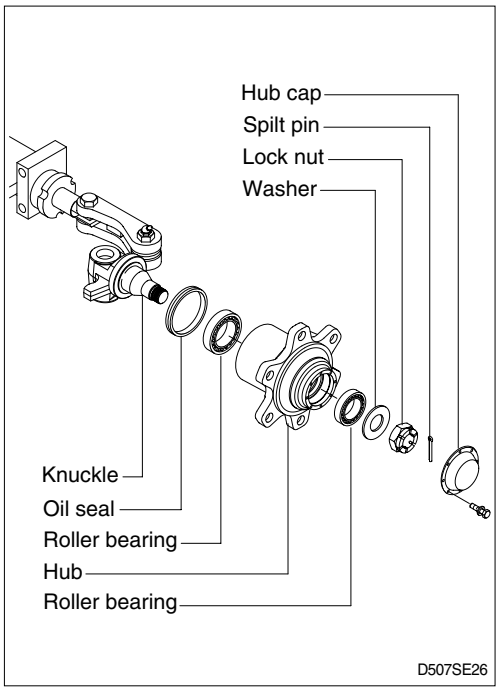
※ Be very careful because just before the hub comes off, tapered roller bearing will fall out.

(5) After hub is removed take off the inner race of roller bearing.

(6) Pull out oil seal.

※ Don't use same oil seal twice.

(7) Repeat the same procedure for the other side. Moreover, when disassembling is completed, part the lock nut in the knuckle to protect the threaded portion.



(8) Loosen set screw(10) and nut(11).

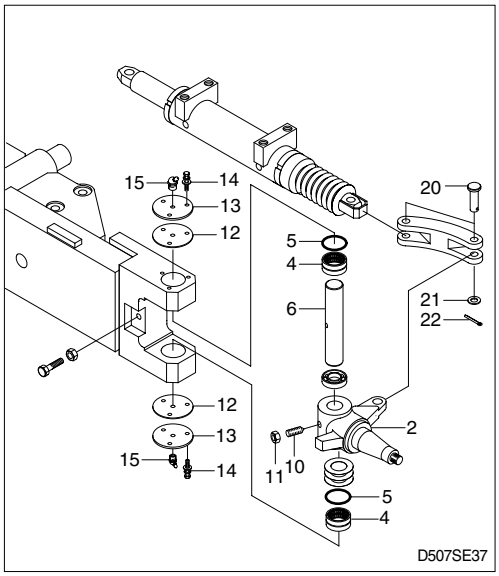
(9) Loosen with washer bolt(14) and remove cover (13), gasket(12). Remove grease nipple(15).

(10) Push out the king pin(6) without damaging the knuckle arm(2).

(11) At the same time the king pin is removed, pull out the oil seal(5).

(12) If defect is observed in needle bearing(4), pull it out by using extractor.

(13) Remove spilt pin(22), special washer(21) and link pin(20).



4) ASSEMBLY

※ In reassembling, have all parts washed, grease applied to lubricating parts, and all expendable items such as oil seal and spring washers replaced by new ones.

Perform the disassembly in reverse order.

(1) Tighten the set screw(10) of king pin(6).

(2) There is a notch in the middle of the king pin(6), make sure that this notch is on the set screw side.

(3) Do not hammer to drive in needle bearing(4) because it will break.
Always use drive-in tool. In assembling the thrust bearing(3), be sure that the fixed ring of the bearing is placed in position facing the knuckle(2).

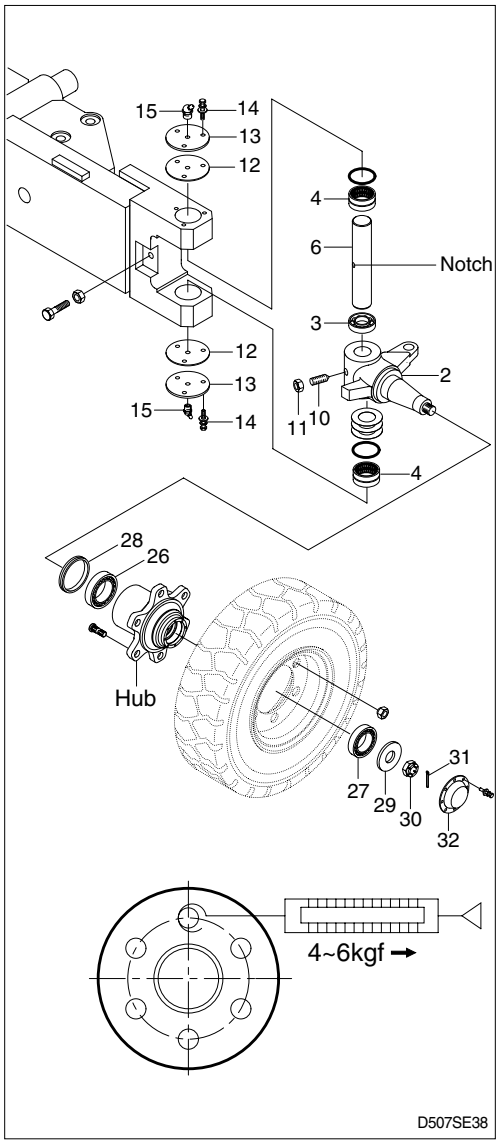
(4) Hub

① Mount oil seal(28) and inner race of tapered roller bearing(26) on the knuckle. The bearing should be well greased before assembling.

② Install the outer race of the bearing(27) in the wheel center and assemble to the knuckle.

③ Put washer(29) in place, tighten with nut(31) and locked with split pin(30). 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(32).
Bearing should be well greased before assembling.

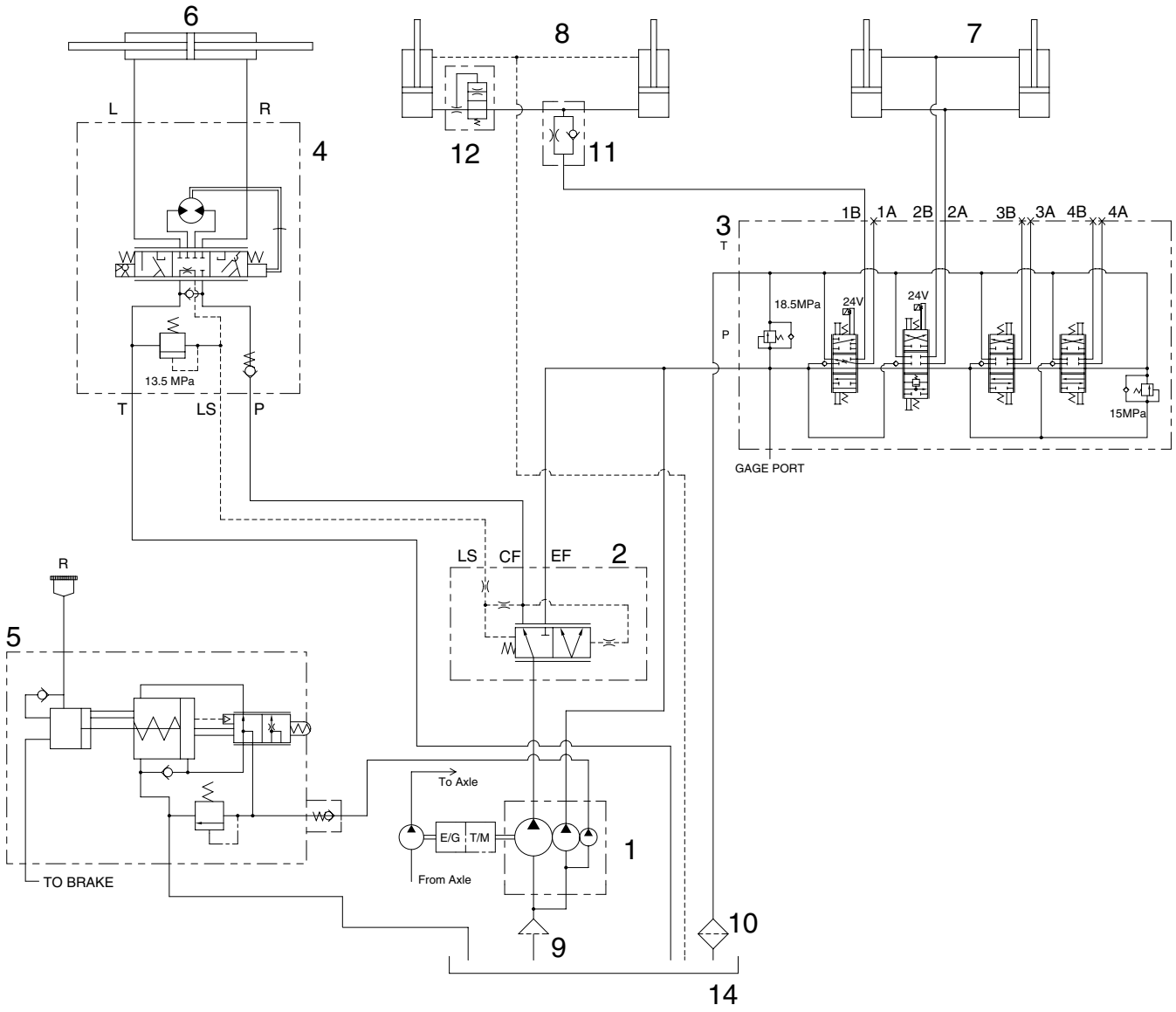


SECTION 6 HYDRAULIC SYSTEM

SECTION 6 HYDRAULIC SYSTEM

GROUP 1 STRUCTURE AND FUNCTION

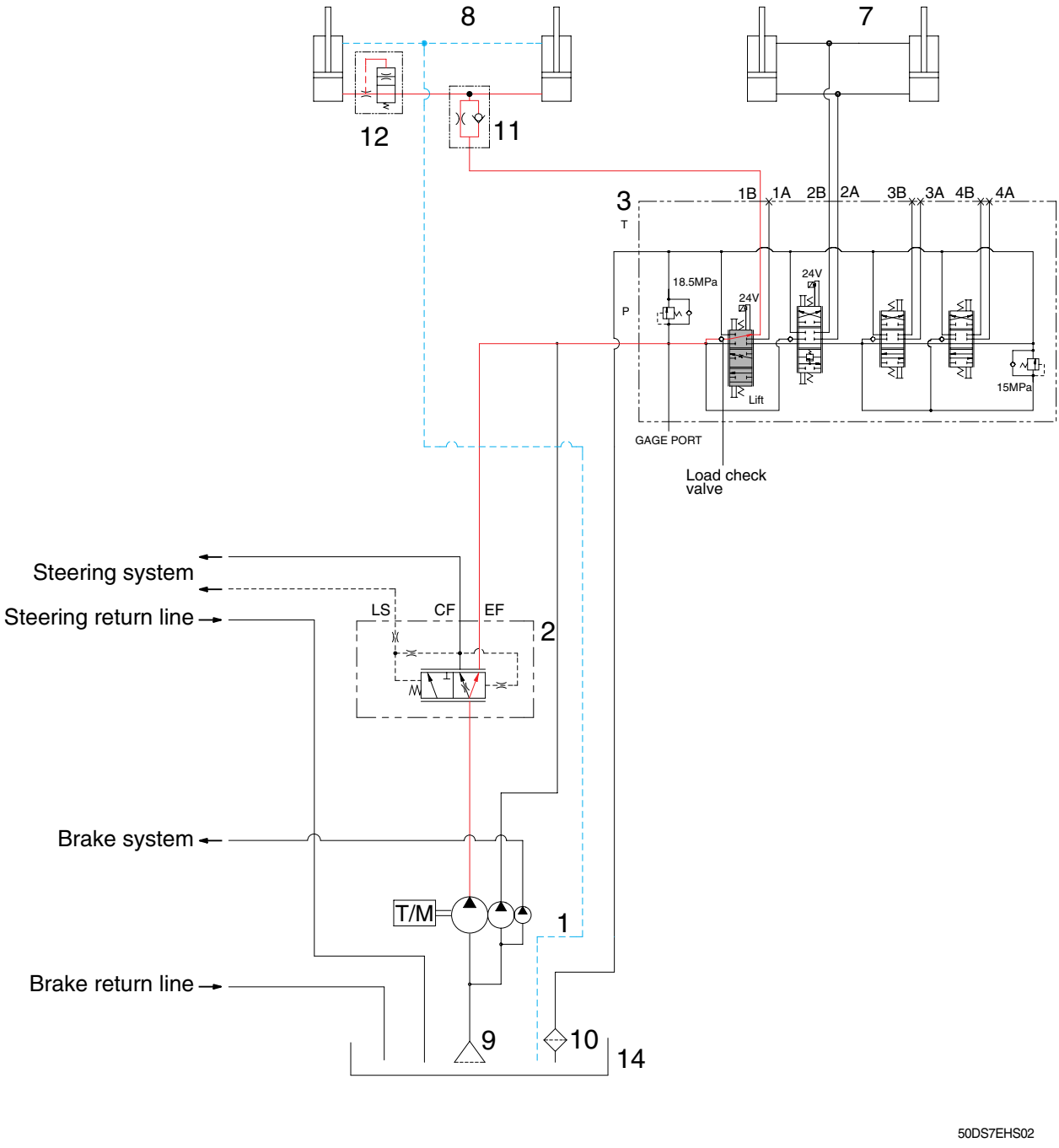
1. HYDRAULIC CIRCUIT



50DF7HS01

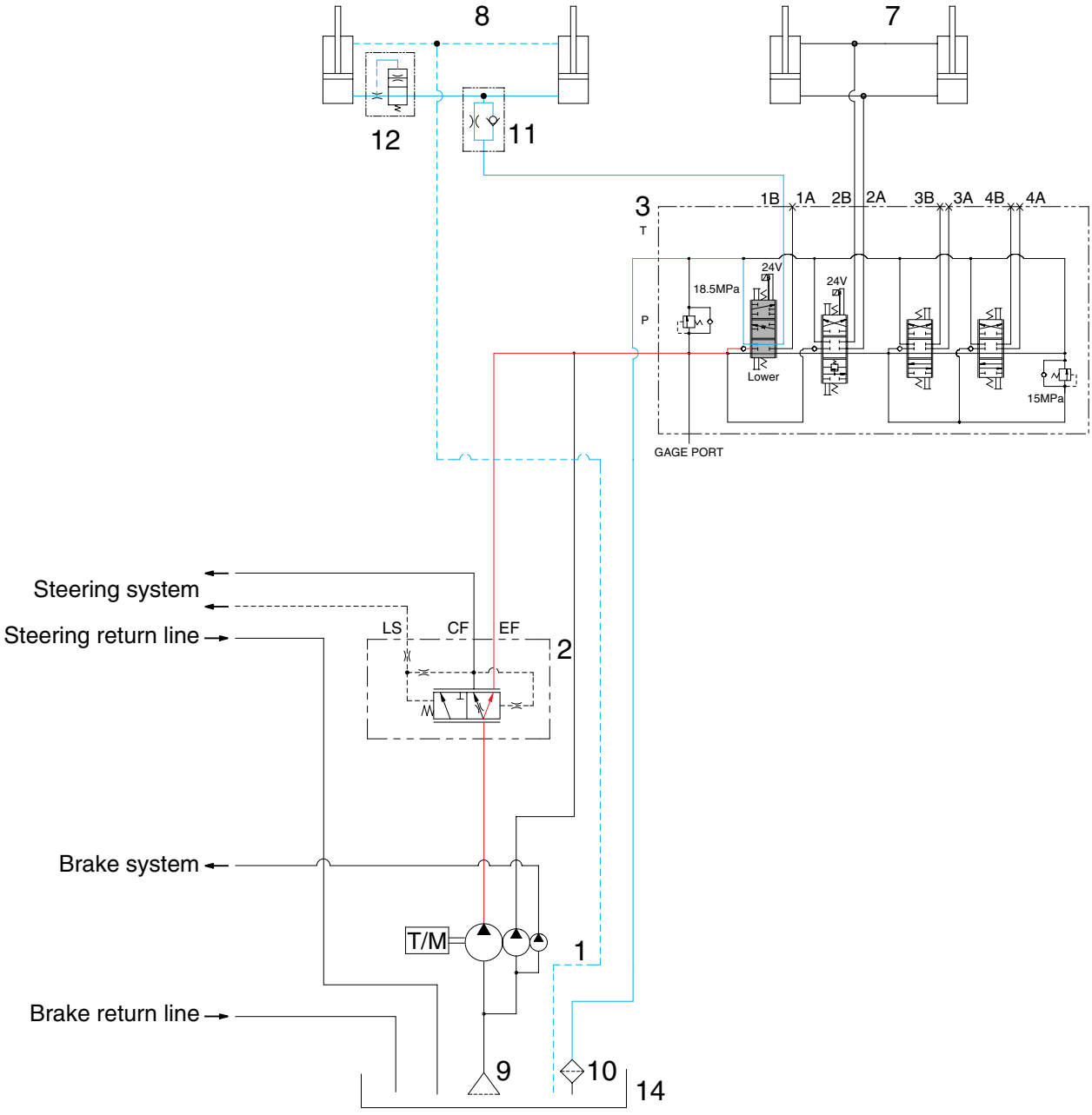
1	Hydraulic gear pump	8	Lift cylinder
2	Priority valve	9	Suction filter
3	Main control valve	10	Return filter
4	Steering unit	11	Down control valve
5	Brake valve	12	Down safety valve
6	Steering cylinder	14	Hydraulic tank
7	Tilt cylinder		

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



When the lift control lever is pulled back, the spool on the first block is moves to lift position.
The oil from hydraulic gear pump(1) flows into main control valve(3) and then goes to the large chamber of lift cylinder(8) by pushing the load check valve of the spool.
The oil from the small chamber of lift cylinder(8) returns to hydraulic oil tank(14) at the same time.
When this happens, the forks go up.

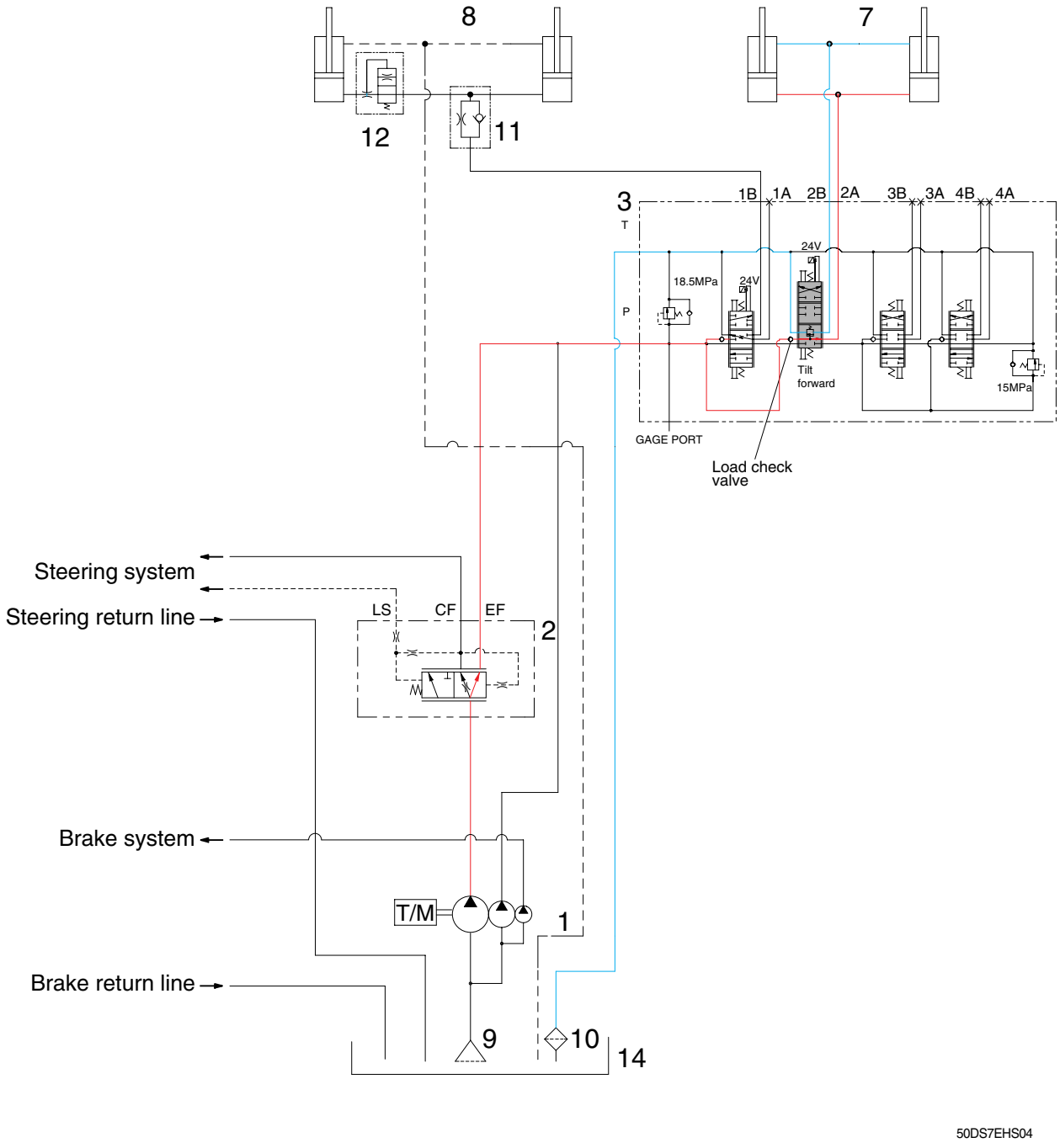
2) WHEN THE LIFT CONTROL LEVER IS IN THE LOWER POSITION



50DS7EHS03

When the lift control is pushed forward, the spool on the first block is moved to lower position.
The work port(1B) and the small chamber and the large chamber are connected to the return passage, so the lift will be lowered due to its own weight.

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



50DS7EHS04

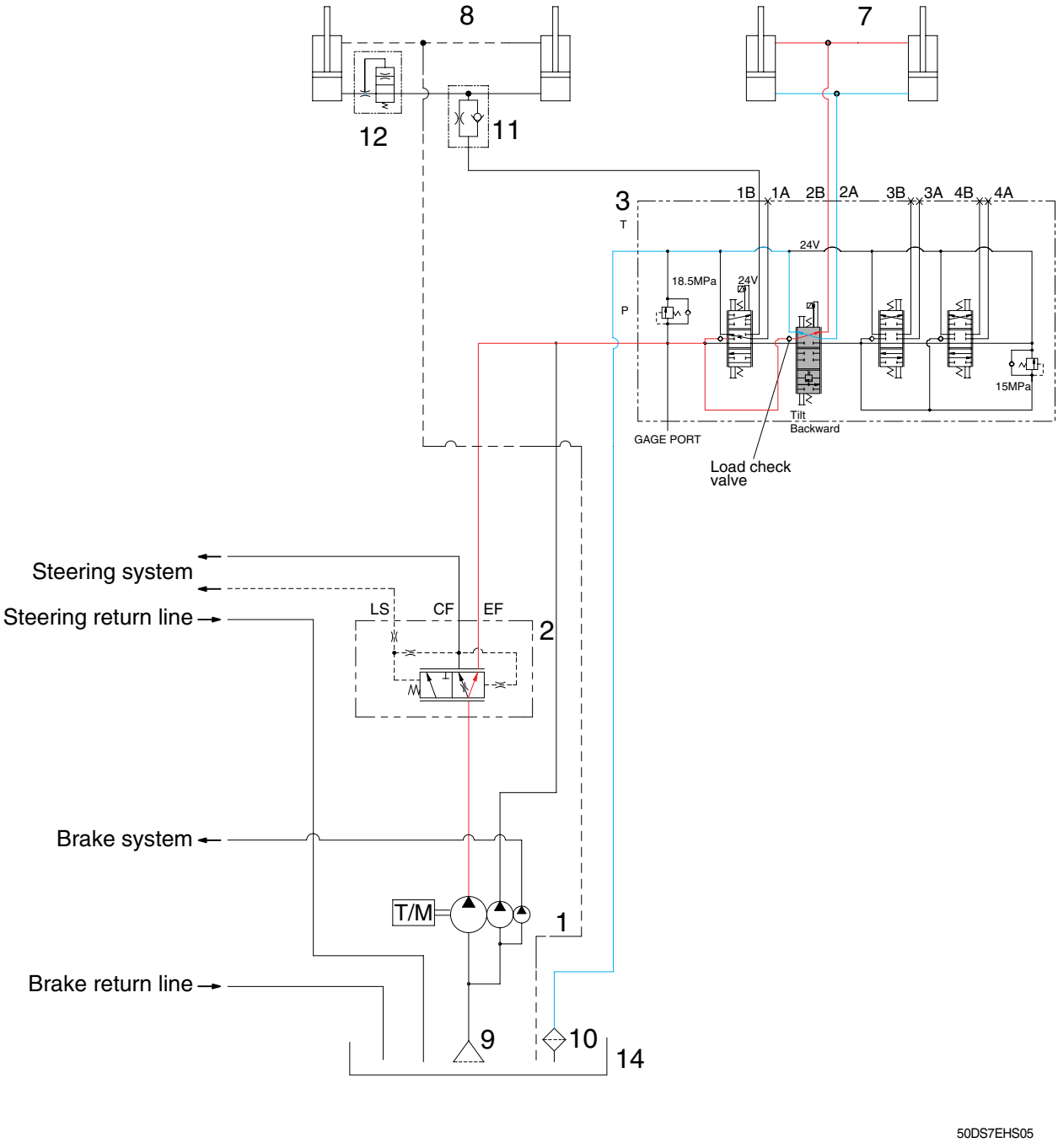
When the tilt control lever is pushed forward, the spool on the second block is moved to tilt forward position.

The oil from hydraulic gear pump(1) flows into main control valve(3) and then goes to the large chamber of tilt cylinder(7) by pushing the load check valve of the spool.

The oil at the small chamber of tilt cylinder(7) returns to hydraulic tank(14) at the same time.

When this happens, the mast tilt forward.

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



50DS7EHS05

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

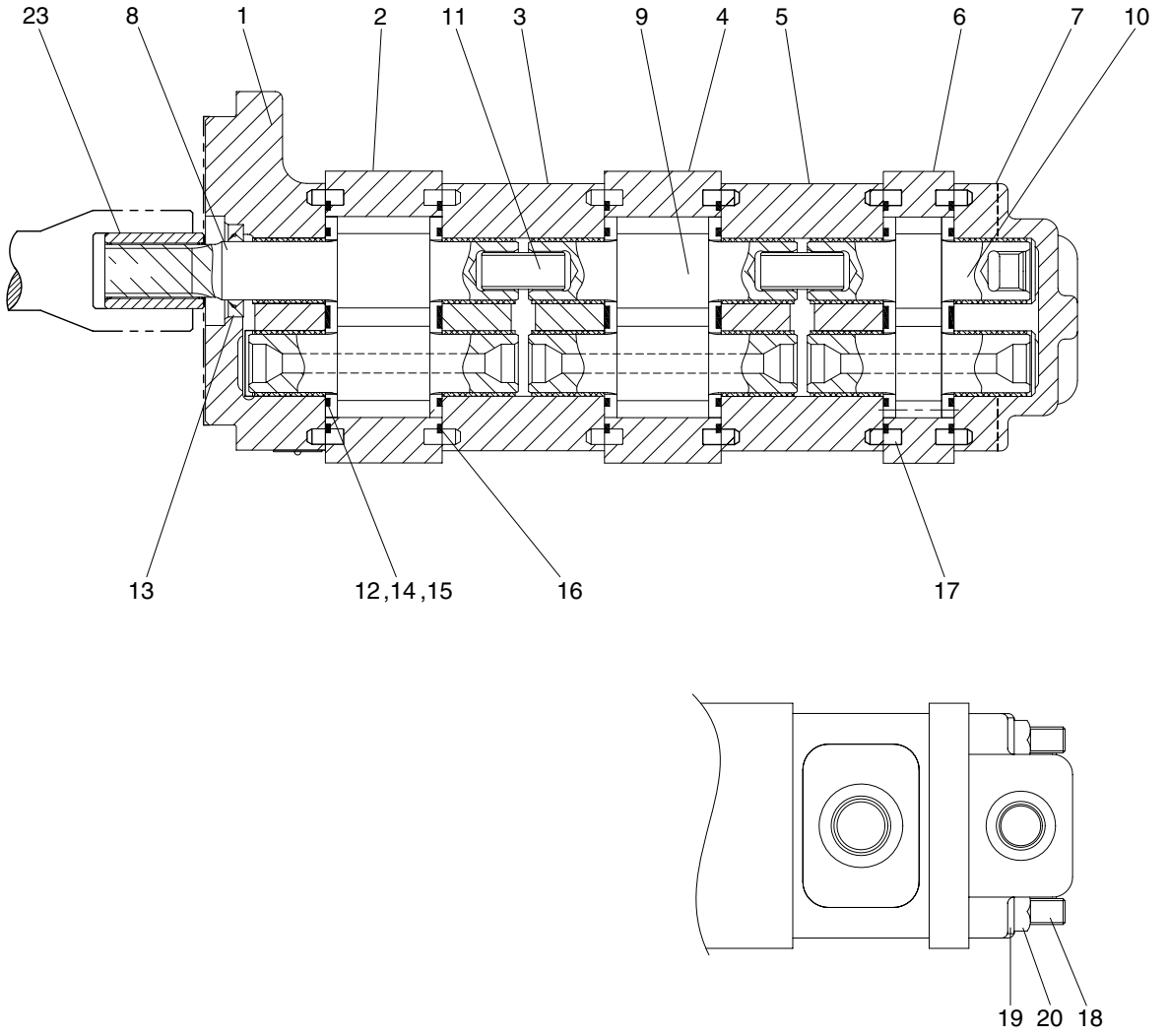
The oil from hydraulic gear pump(1) flows into main control valve(3) and then goes to the small chamber of tilt cylinder(7) by pushing the load check valve of spool.

The oil at the large chamber of tilt cylinder(7) returns to hydraulic tank(14) at the same time.

When this happens, the mast tilt backward.

2. HYDRAULIC GEAR PUMP

1) STRUCTURE

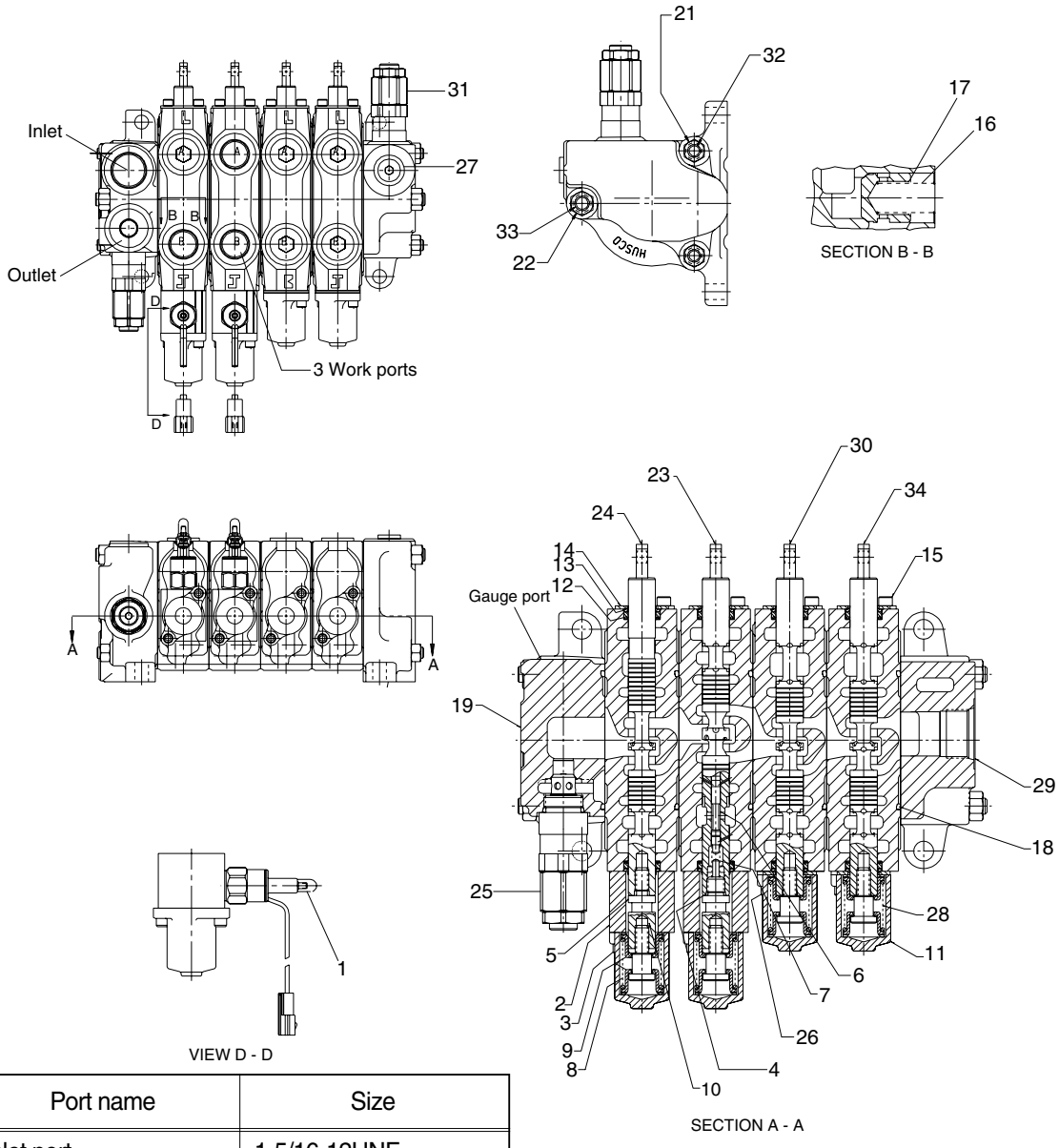


50D7EHS06

1	Cover	8	Shaft gear	15	Seal
2	Gear housing	9	Drive gear	16	Seal
3	Carrier	10	Gear set	17	Dowel pin
4	Gear housing	11	Shaft	18	Stud bolt
5	Carrier	12	Thrust plate	19	Washer
6	Gear housing	13	Seal	20	Hex-nut
7	Cover	14	Seal	23	Shaft

3. MAIN CONTROL VALVE

1) STRUCTURE(4 Spool)



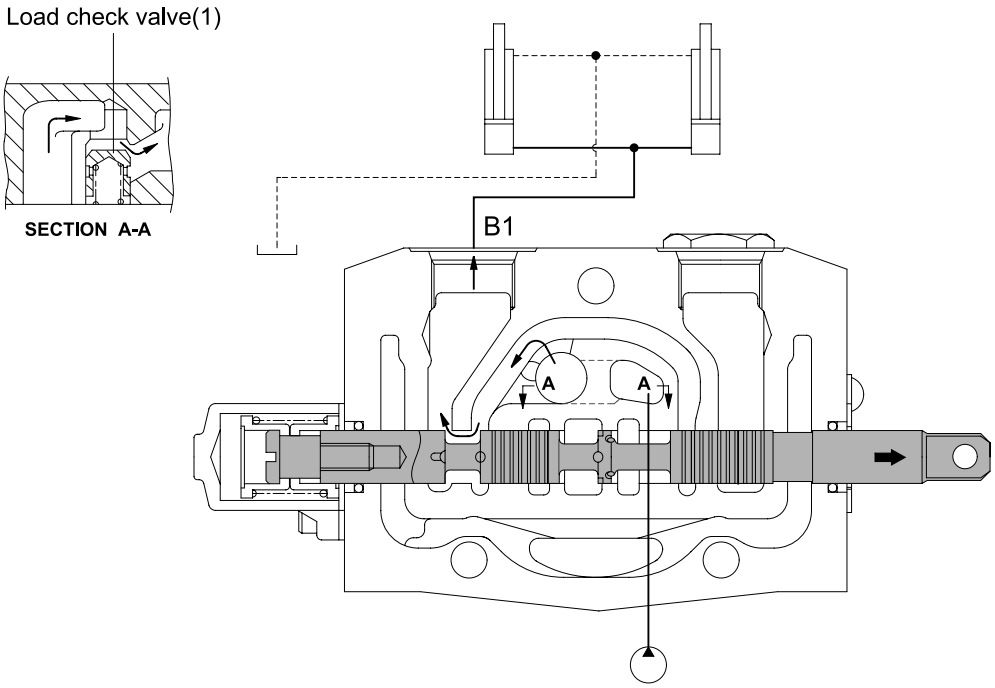
Port name	Size
Inlet port	1-5/16-12UNF
Outlet port	1-5/16-12UNF
Gauge port	PF1/4
Work port	1-1/16-12UNF

50DS7EHS07

1	Solenoid valve	13	Wiper	25	Main relief valve
2	Cap	14	Plate	26	Cap
3	Cap	15	Screw	27	Plug
4	Spool end	16	Spring	28	Spring
5	Spool end	17	Poppet	29	Outlet section assy
6	Piston	18	O-ring	30	Spool section assy(Aux)
7	Spring	19	Inlet section assy	31	Relief valve assy
8	Seal plate	20	Plug	32	Tie rod
9	Spring seat	21	Nut	33	Tie rod
10	Spool end	22	Nut	34	Spool section assy(Aux)
11	Cap	23	Spool section assy(Tilt)		
12	Seal	24	Spool section assy(Lift)		

2) LIFT SECTION OPERATION

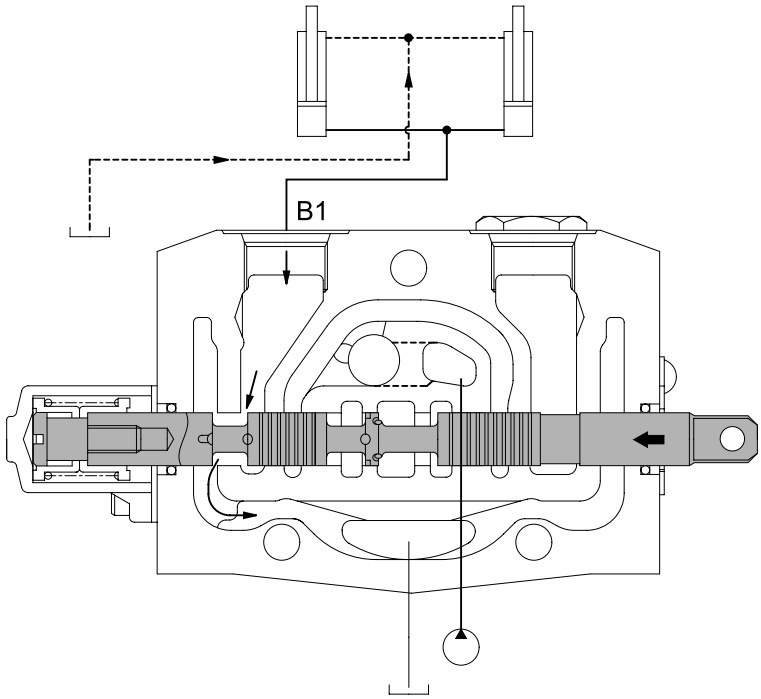
(1) Lift position



D353HS08

When the lift control lever is pulled back, the spool moves to the right and the neutral passage is closed.
The oil supplied from the pump pushes up the load check valve(1) and flow into lift cylinder port(B1).
The pump pressure reaches proportionally the load of cylinder and fine control finished by shut off of the neutral passage.
The return oil from cylinder flows into the tank.

(2) Lower position

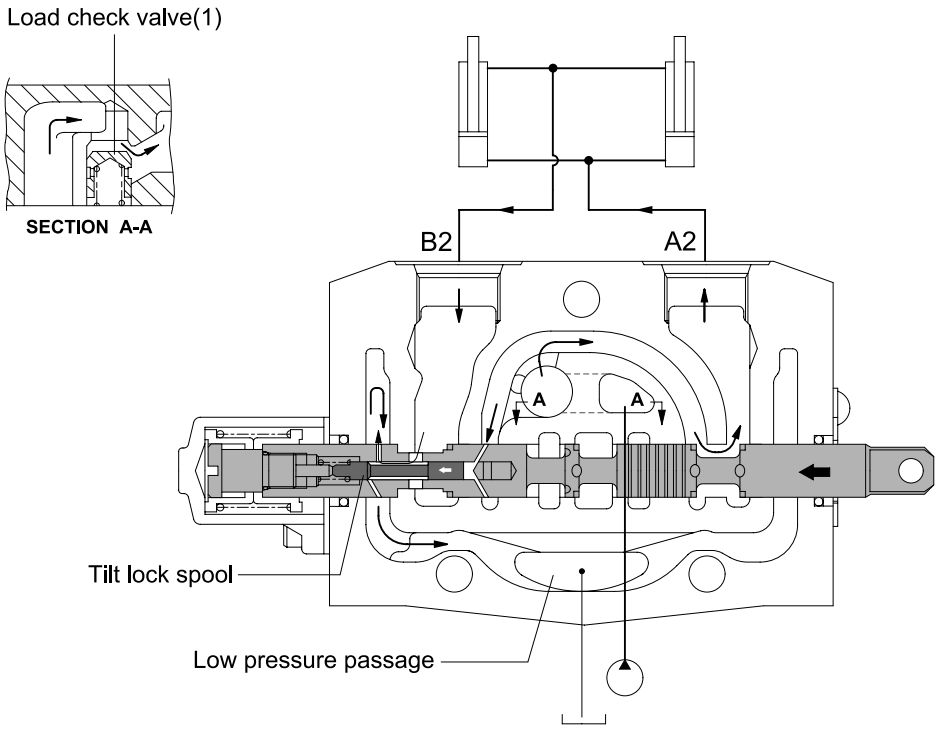


D353HS09

When the lift control lever is pushed forward, the spool moves to the left and the neutral passage is closed.
The spool moves to the lift lower position, opening up the neutral passage to tank and (B1)→T.
In lift lower position the fork drops due to its own weight.

3) TILT SECTION OPERATION

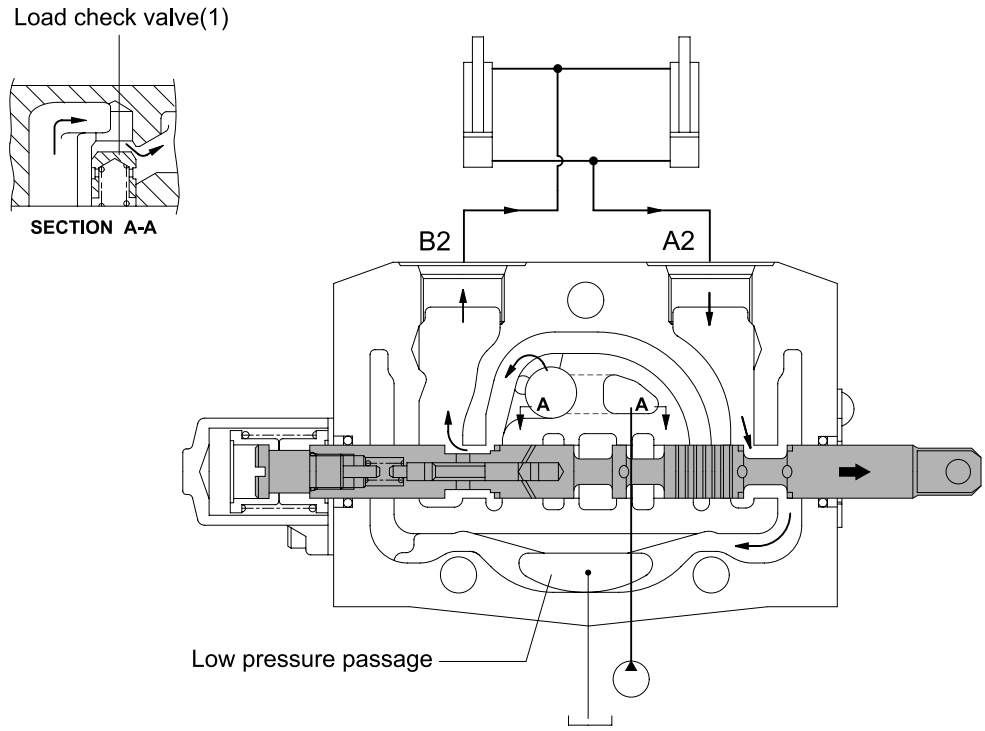
(1) Tilt forward position



D353HS10

When the tilt control lever is pushed forward, the spool moves to the left and the neutral passage is closed.
The oil supplied from the pump pushes up the load check valve(1) and flow into tilt cylinder port(A2).
The pump pressure reaches proportionally the load of cylinders and fine control finished by closing the neutral passage.
The return oil from cylinder port(B2) flows into the tank through the hole of the tilt lock spool.

(2) Tilt backward position



D353HS11

When the tilt control lever is pulled back, the spool moves to the right and the neutral passage is closed.

The oil supplied from the pump pushes up the load check valve(1) and flows into tilt cylinder port(B2). The pump pressure reaches proportionally the load of cylinder and fine control finished by shut off of the neutral passage.

The return oil from cylinder port(A2) flows into the tank via the low pressure passage.

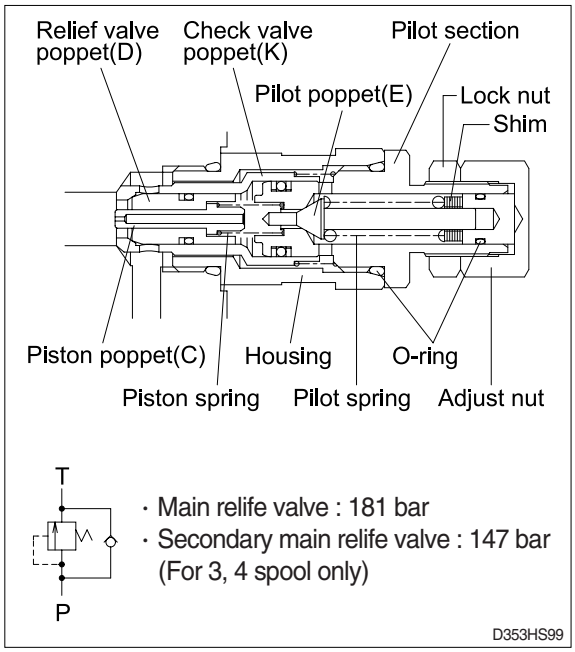
4) MAIN RELIEF VALVE

(1) Pressure setting

A good pressure gauge must be installed in the line which is in communication with the work port relief. A load must be applied in a manner to reach the set pressure of the relief unit.

Procedure

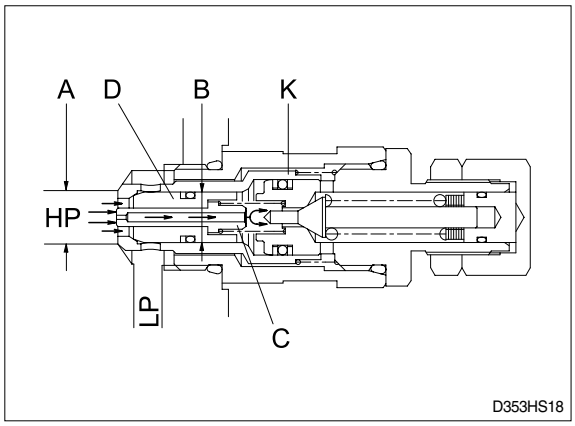
① Loosen lock nut.
② Set adjusting nut to desired pressure setting.
③ If desired pressure setting cannot be achieved, add or remove shims as required.
④ Tighten lock nut.
⑤ Retest in similar manner as above.



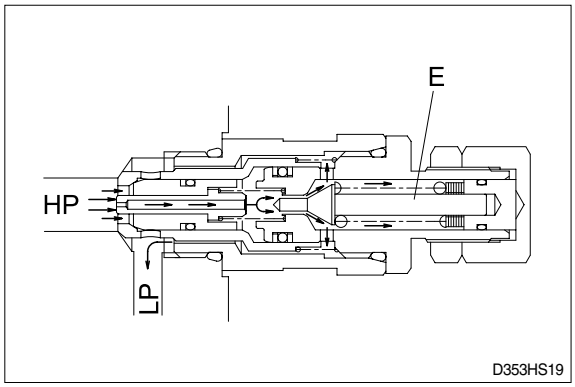
(2) Function

① As work port relief

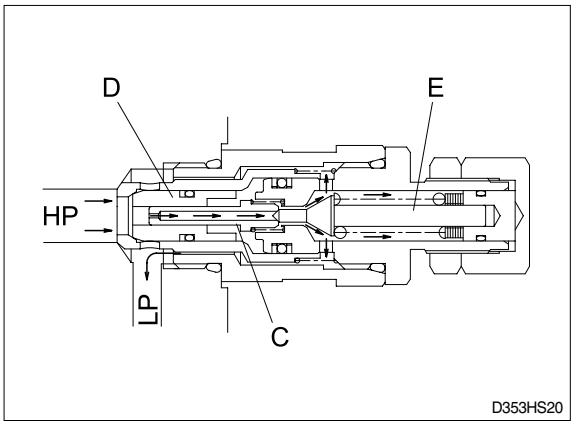
The relief valve is in communication between the high pressure port HP and low pressure LP. Oil is admitted through the hole in poppet C and because of the differential area between diameters A and B relief valve poppet D and check valve poppet K are tightly seated as shown.



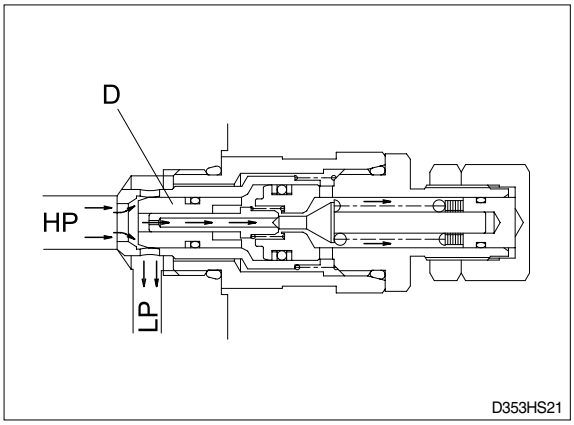
The oil pressure in the high pressure port HP has reached the setting of the pilot poppet spring force and unseats the pilot poppet E and oil flows around the poppet through the cross drilled holes and to the low pressure area LP.



The loss of oil behind poppet C, effected by the opening of pilot poppet E, causes poppet C to move back and seat against pilot puppet E. This shuts off the oil flow to the area behind relief valve poppet D, and causes a low pressure area internally.

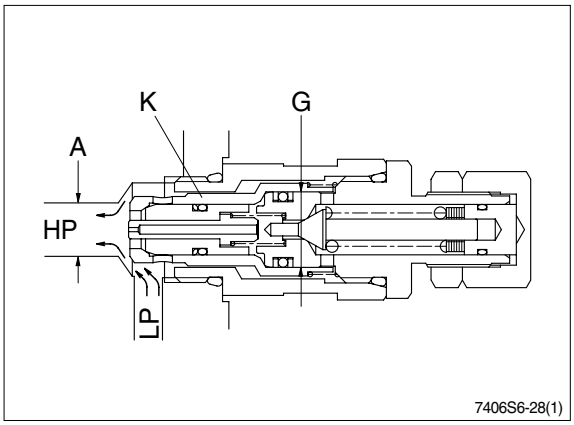


The imbalance of pressure on the inside as compared to that of the high pressure port HP, forces the relief valve poppet D to open and relieve the oil directly to the low pressure chamber LP in the valve.

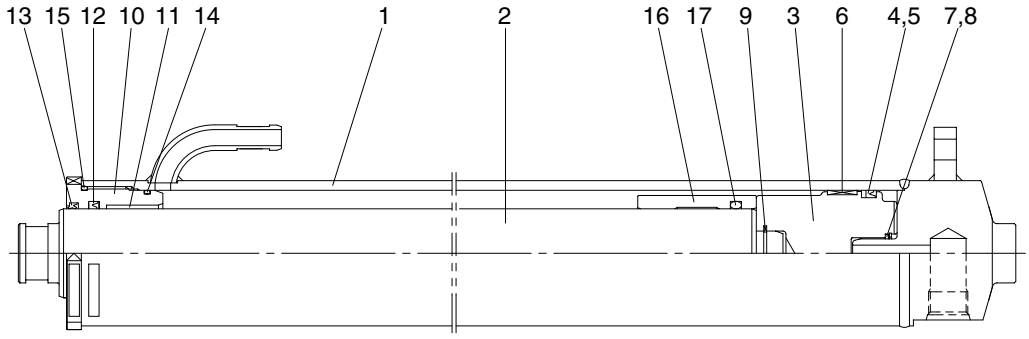


② **As anti void**

The anti-void unit supplies oil to the high pressure port HP when cavitation has occurred. A lower pressure exists in the port HP compared to the low pressure chamber LP. The difference between the effective area of diameter A and G causes imbalance of the check valve poppet K which unseats, thus allowing oil from the low pressure chamber LP to enter the port HP and fill the void.



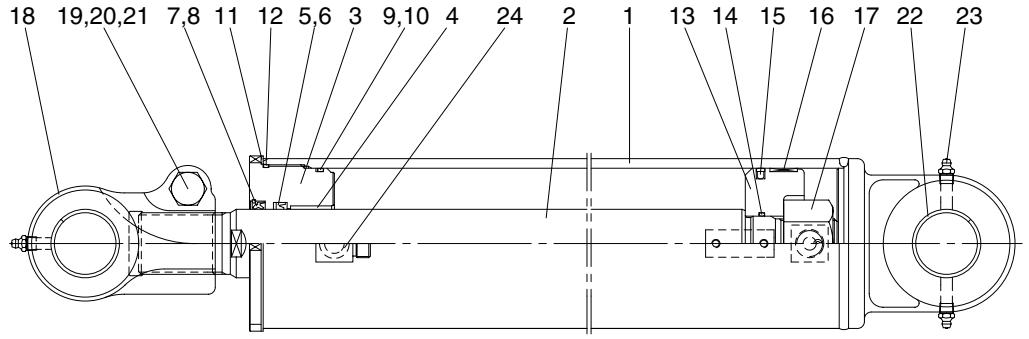
4. LIFT CYLINDER



D507HS12

1	Tube assy	7	Cushion seal	13	Dust wiper
2	Rod	8	Retaining ring	14	O-ring
3	Piston	9	Retaining ring	15	O-ring
4	Piston seal	10	Gland	16	Spacer
5	Back up ring	11	Du bushing	17	O-ring
6	Wear ring	12	Rod seal		

5. TILT CYLINDER



D507HS13

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

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**

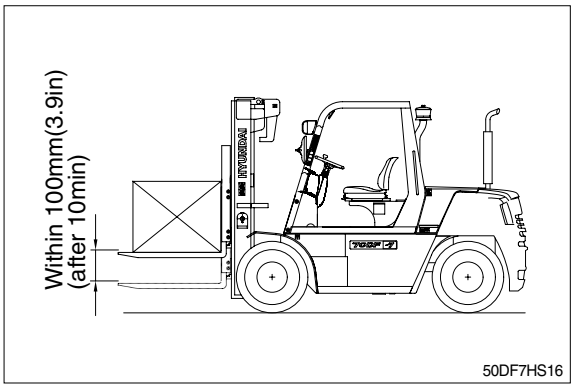
- Down(Downward movement of forks)
  : Within 100mm(3.9in)
- Forward(Extension of tilt cylinder)
  : Within 5°

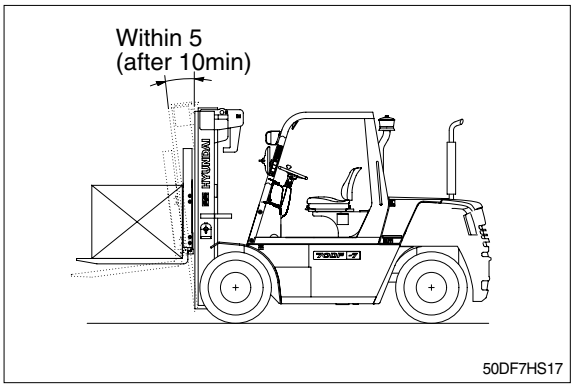
If the hydraulic drift is more than the specified value, replace the control valve or cylinder packing.

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

mm (in)

Standard	Under 0.6 (0.02)

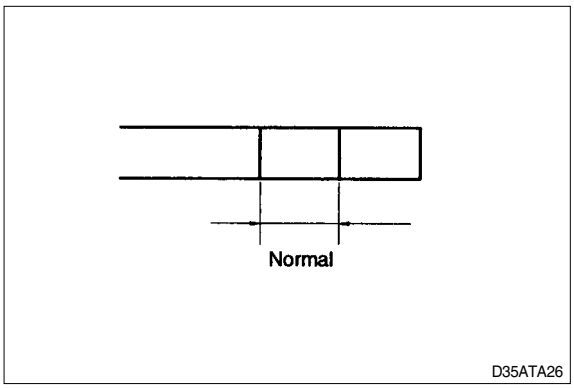




2) HYDRAULIC OIL

(1) Using dipstick, measure oil level, and oil if necessary.

(2) When changing hydraulic oil, clean suction strainer(screwed into outlet port pipe) and line filter(screwed into inlet pipe).



3) CONTROL VALVE

(1) Raise forks to maximum height and measure oil pressure.
Check that oil pressure is 185kgf/cm^2.
(2683psi)

2. TROUBLESHOOTING

1) SYSTEM

Problem	cause	Remedy
Large fork lowering speed.	· Seal inside control valve defective. · Oil leaks from joint or hose. · Seal inside cylinder defective.	· Replace spool or valve body. · Replace. · Replace packing.
Large spontaneous tilt of mast.	· Tilting backward : Check valve defective. · Tilting forward : tilt lock valve defective. · Oil leaks from joint or hose. · Seal inside cylinder defective.	· Clean or replace. · Clean or replace. · Replace. · Replace seal.
Slow fork lifting or slow mast tilting.	· Lack of hydraulic oil. · Hydraulic oil mixed with air. · Oil leaks from joint or hose. · Excessive restriction of oil flow on pump suction side. · Relief valve fails to keep specified pressure. · Poor sealing inside cylinder. · High hydraulic oil viscosity. · Mast fails to move smoothly. · Oil leaks from lift control valve spool. · Oil leaks from tilt control valve spool.	· Add oil. · Bleed air. · Replace. · Clean filter. · Adjust relief valve. · Replace packing. · Change to SAE10W, class CD engine oil. · Adjust roll to rail clearance. · Replace spool or valve body. · Replace spool or valve body.
Hydraulic system makes abnormal sounds.	· Excessive restriction of oil flow pump suction side. · Gear or bearing in hydraulic pump defective.	· Clean filter. · Replace gear or bearing.
Control valve lever is locked	· Foreign matter jammed between spool and valve body. · Valve body defective.	· Clean. · Tighten body mounting bolts uniformly.
High oil temperature.	· Lack of hydraulic oil. · High oil viscosity. · Oil filter clogged.	· Add oil. · Change to SAE10W, class CD engine oil. · Clean filter.

2) HYDRAULIC GEAR PUMP

Problem	Cause	Remedy
Pump does not develop full pressure.	· System relief valve set too low or leaking. · Oil viscosity too low. · Pump is worn out.	· Check system relief valve for proper setting. · Change to proper viscosity oil. · Repair or replace pump.
Pump will not pump oil.	· Reservoir low or empty. · Suction strainer clogged.	· Fill reservoir to proper level. · Clean suction strainer.
Noisy pump caused by cavitation.	· Oil too thick. · Oil filter plugged. · Suction line plugged or too small.	· Change to proper viscosity. · Clean filters. · Clean line and check for proper size.
Oil heating.	· Oil supply low. · Contaminated oil. · Setting of relief valve too high or too low. · Oil viscosity too low.	· Fill reservoir to proper level. · Drain reservoir and refill with clean oil. · Set to correct pressure. · Drain reservoir and fill with proper viscosity.
Foaming oil.	· Low oil level. · Air leaking into suction line. · Wrong kind of oil.	· Fill reservoir to proper level. · Tighten fittings, check condition of line. · Drain reservoir, fill with non-foaming oil.
Shaft seal leakage.	· Worn shaft seal. · Worn shaft in seal area.	· Replace shaft seal. · Replace drive shaft and seal.

3) MAIN RELIEF VALVE

Problem	Cause	Remedy
Can't get pressure	· Poppet D, E or K stuck open or contamination under seat.	· Check for foreign matter between poppets D, E or K and their mating parts. Parts must slide freely.
Erratic pressure	· Pilot poppet seat damaged. · Poppet C sticking in D.	· Replace the relief valve. · Clean and remove surface marks for free movement.
Pressure setting not correct	· Normal wear. Lock nut & adjust screw loose.	· See *How to set pressure on work main relief.
Leaks	· Damaged seats. · Worn O-rings. · Parts sticking due to contamination.	· Replace the relief valve. · Install seal and spring kit. · Disassemble and clean.

★ A good pressure gauge must be installed in the line which is in communication with the main relief. A load must be applied in a manner to reach the set pressure of the main relief unit.
Then, follow these steps:

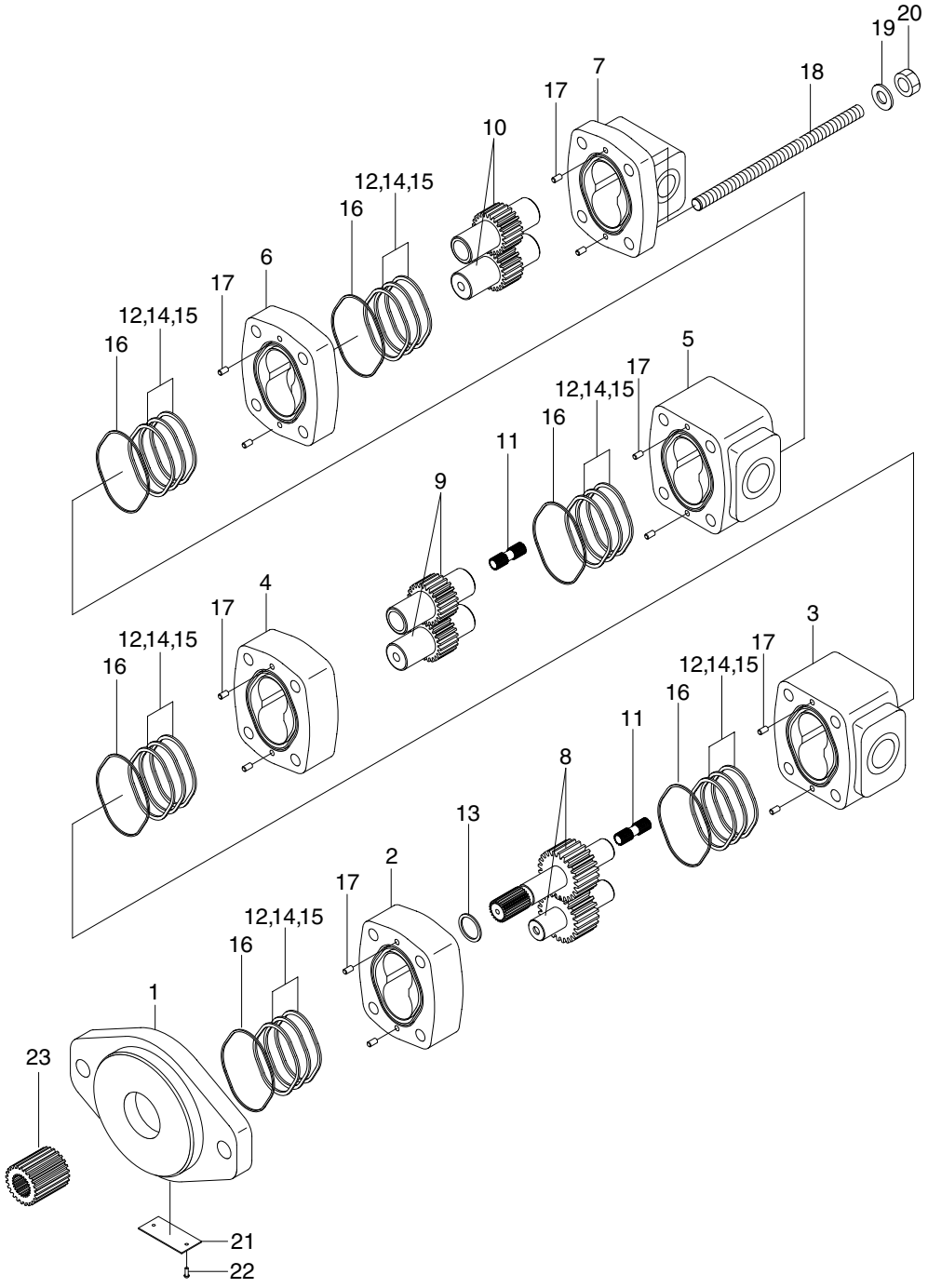
- Loosen lock nut.
- Set adjusting nut to desired pressure setting.
- If desired pressure setting cannot be achieved, add or remove shims as required.
- Tighten lock nut.
- Retest in similar manner as above.

4) LIFT CYLINDER

Problem	Cause	Remedy
Oil leaks out from gland 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 gland 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) STRUCTURE



50D7EHS23

1	Cover	8	Gear	15	Seal
2	Gear housing	9	Gear	16	Seal
3	Carrier	10	Gear set	17	Dowel-pin
4	Gear housing	11	Shaft	18	Stud bolt
5	Carrier	12	Thrust plate	19	Washer
6	Gear housing	13	Seal	20	Hex-nut
7	Cover	14	Seal	23	Shaft

2) GENERAL INSTRUCTION

(1) Cleanliness

① Cleanliness is the primary means of assuring satisfactory hydraulic pump life.
Components such as flanges and covers are best cleaned in soap and hot water, then air dried. Gears should be washed in solvent, air dried, and oiled immediately.

⚠ Certain cleaning solvents are flammable. Do not allow sources of ignition in the area when using cleaning solvents.

② Protect all exposed surfaces and open cavities from damage and foreign material.

※ Gear journals and gear faces are super finished. Take care not to touch these surfaces after oil and solvent.

(2) Lubrication of moving parts

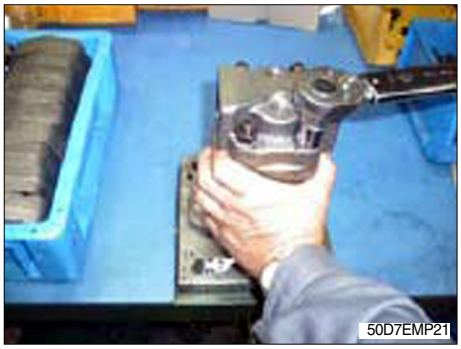
During assembly, all running surfaces(Bearing and wear plate) must be lightly lubricated with a clean oil or aerosol lubricant.

(3) Tools required for assembly

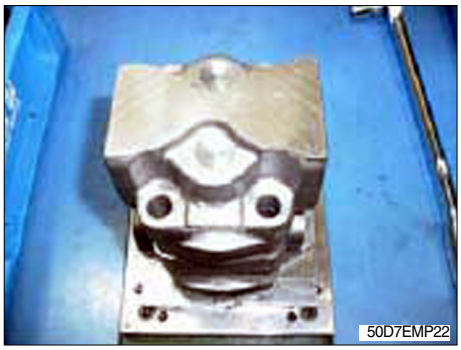
① Socket set(1/2″ drive)
② Internal snap ring pliers
③ Shaft seal sleeve or clear tape
④ Torque wrench(200lbf · ft capacity)
⑤ Plastic hammer
⑥ Torque wrench box end adapters

3) DISASSEMBLY

(1) Loosen and remove the nuts and washers from cover.



(2) Remove cover and dowel pin stud bolts from cover.



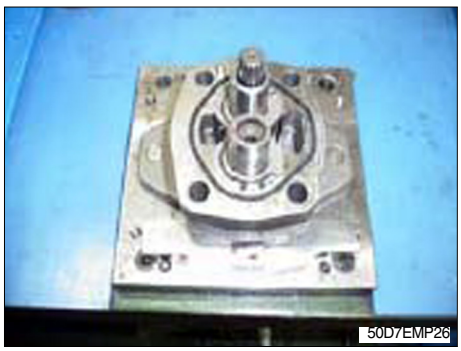
(3) Remove connection shaft, drive gear and driven gear set from gear housing.

※ When removing the gear housing, keep it as straight as possible during removal so that it can not happen scratch or damage to inner surface by touching gear teeth.

(4) Remove gear housing from carrier.
Remove thrust plate from gear housing.

(5) Remove bearing carrier from gear housing.

(6) Remove connecting shaft from gear set.
Remove thrust plate from gear housing.



(7) After taking out connecting shaft, remove gear housing, drive gear and driven gear set from cover.

※ When removing the gear housing, keep it as straight as possible so that it can not happen scratch or damage to inner surface by touching gear teeth.
Inspect scoring or excessive wear of shaft and gear teeth for both drive gear and driven gear set.

(8) Remove lip seal from the cover.

※ When remove the lip seal from the cover, take care not to give any scratch or damage on the surface of shaft hole or seal bore.

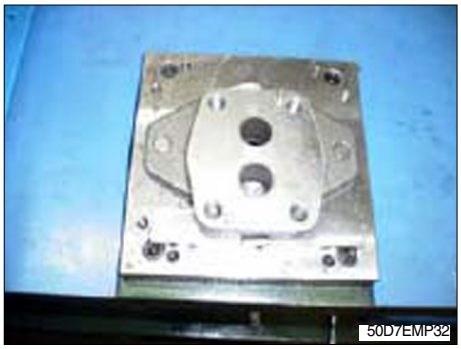
4) ASSEMBLY

(1) Throughly clean seal bore, press the shaft seal in to the seal bore of the cover.

※ Uniform pressure must be used to prevent misalignment or damage to the seal.

(2) Assemble shaft to the cover.

※ Throughly clean mounting surface of the gear housing for the seals.



(3) Assemble gear housing and thrust plate to the cover.

(4) Assemble gear set and thrust plate, shaft.

※ Throughly clean mounting surface of square seal and insert the seal in the gear housing, thrust plate.

(5) Assemble gear housing to carrier using dowel pin.

(6) Assemble gear housing and gear set.

(7) Assemble carrier to gear housing using dowel pins.
Assemble gear housing to carrier using dowel pins.

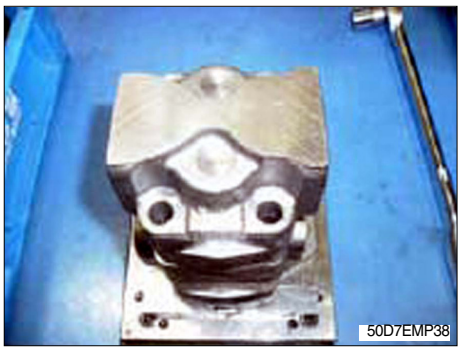
※ Throughly clean mounting surface of seals, and then insert seals and thrust plate.

※ Take care not to happen any damage of the seals.

(8) Assemble last drive gear and driven gear set to the drive gear and driven gear set using connecting shaft.
Assemble cover to gear housing using dowel pin.

※ Throughly clean mounting surface of seals and then insert the seals and thrust plate.

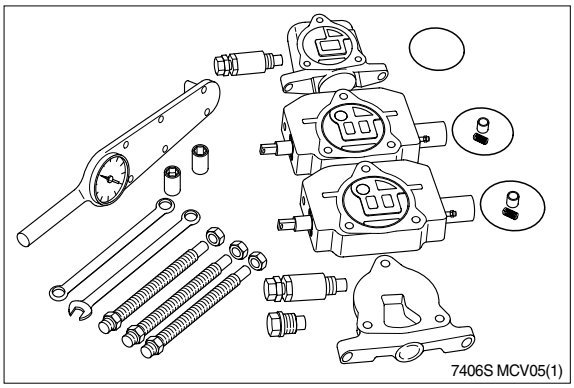
※ Take care not to happen any damage of the seals.



(9) Assemble stud bolts, washers and fasten nuts.
· Tightening torque for nut : 15 kg · m

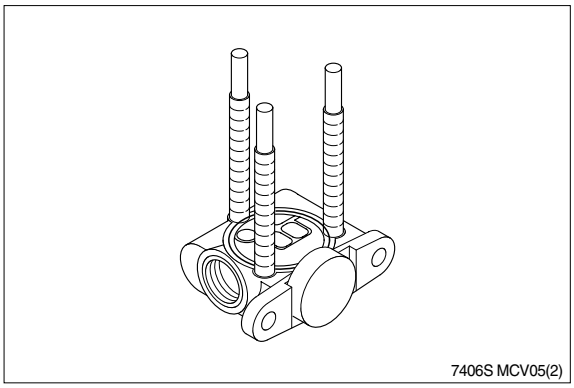
2. MAIN CONTROL VALVE

1) Lay out valve components on a clean, flat working surface. The inlet assembly will include an O-ring, and the spool section(s) include an O-ring, a load check poppet and a load check spring. Tools required for basic valve assembly include 3/4 and 11/16 open or box end wrenches and a torque wrench with thin wall sockets.



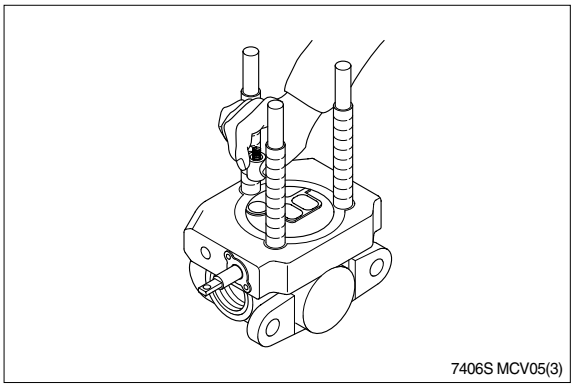
7406S MCV05(1)

2) Assemble tie rod nuts to one end of each tie rod with one or two threads showing. Insert tie rods through tie rod holes of inlet (Large tie rod at top). Lay inlet on end with tie rods up, place O-ring into position.



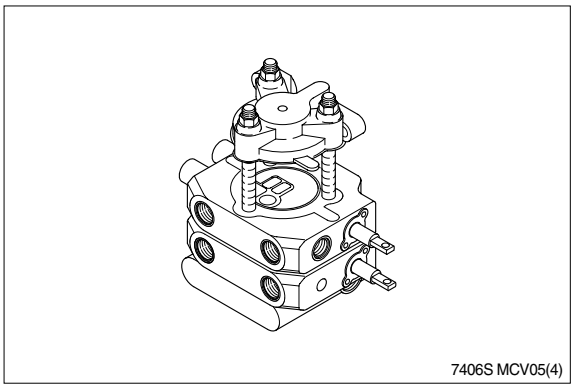
7406S MCV05(2)

3) Place first spool section(O-ring side up) on inlet section, position O-ring and insert load check poppet(Nose down) and spring (Behind poppet) into load check cavity as shown. Repeat this procedure for each spool section ; The load check springs are compressed by the following sections during assembly.



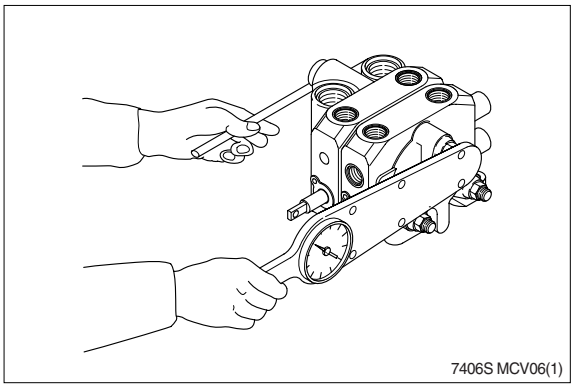
7406S MCV05(3)

4) Position end section on last spool section as shown and hand tighten tie rod nuts. The end section on picture is a "turn around" section without ports. Universal outlet /power beyond section and power beyond and closed center sections are also used as end sections. These end sections do not have O-ring grooves.



7406S MCV05(4)

5) Position valve assembly with the mounting pads of the end sections on a flat surface. To obtain proper alignment of end sections relative to the spool sections apply downward pressure to the end sections ; Snug tie rod nuts to about 10lbf · ft.
Final torque the two 11/16 nuts to 48± 5lbf · ft ; Final torque the 3/4 nut to 74± 8lbf · ft. Check for proper spool movement.

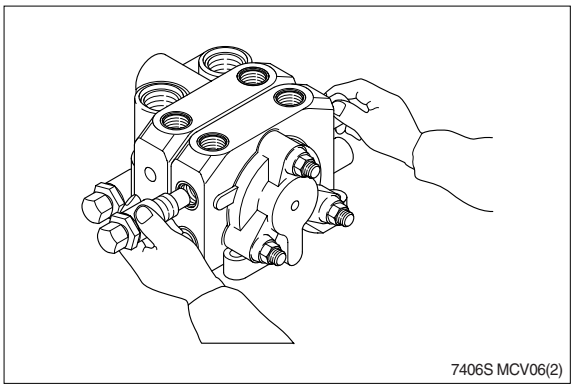

7406S MCV06(1)

6) Install auxiliary valves and plugs and torque to proper specifications.

※ **General assembly notes**:

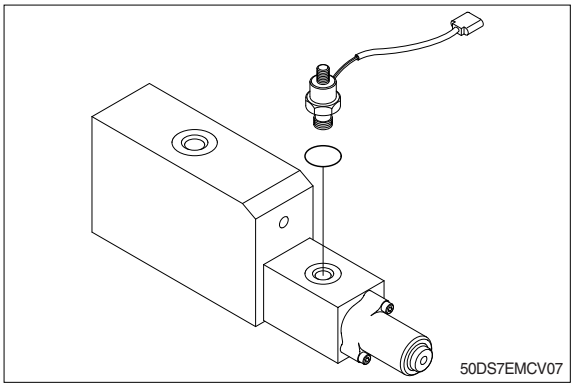
A. Lever assemblies can be installed on section before or after complete valve assembly.

B. The load check and spring may be omitter from assembly in certain circuit conditions(i.e., motor spools).


7406S MCV06(2)

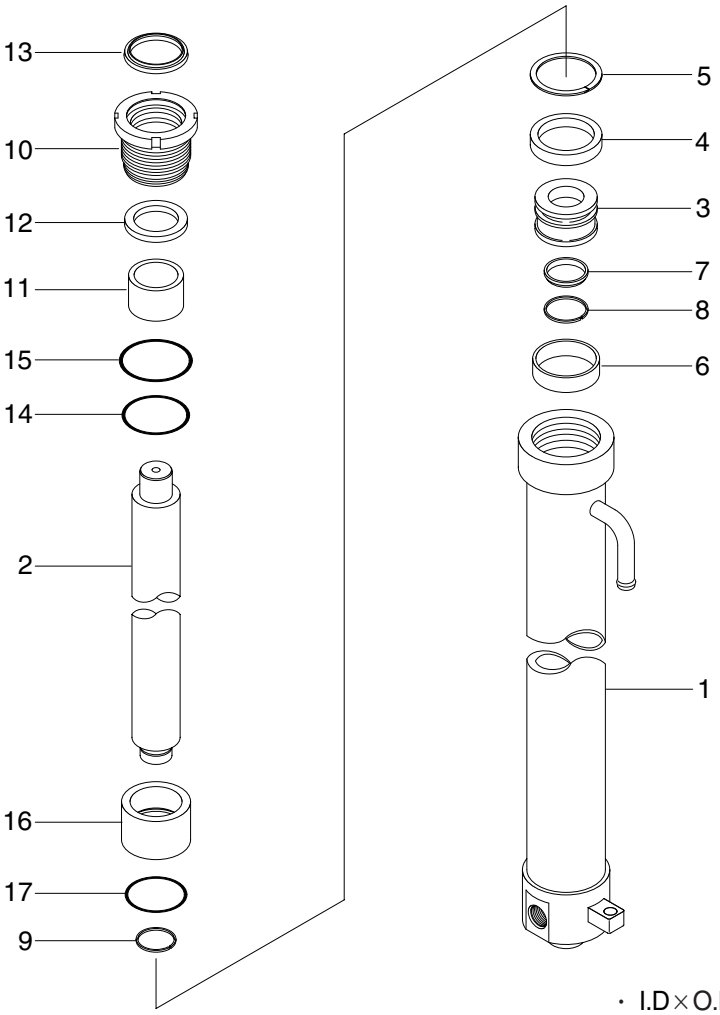
7) Install solenoid valve and O-ring torque to proper specification.

※ Solenoid valve torque : 10±1lbf · ft


50DS7EMCV07

3. LIFT CYLINDER

1) STRUCTURE



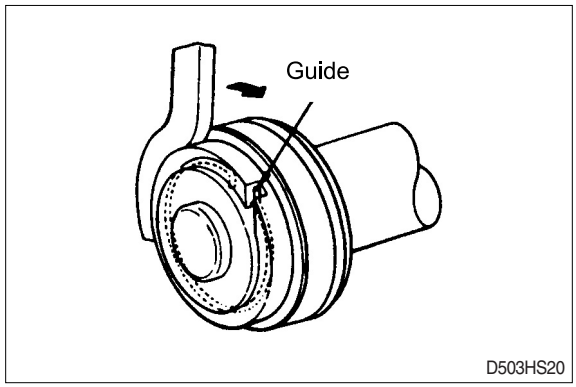
- I.D × O.D × stroke(standard)
  85 × 98 × 1335mm
  (3.3 × 3.9 × 52.6in)
- Rod O.D : 60mm(2.4in)

D507HS19

1	Tube assy	10	Gland
2	Rod	11	Du bushing
3	Piston	12	Rod seal
4	Piston seal	13	Dust wiper
5	Back up ring	14	O-ring
6	Wear ring	15	O-ring
7	Cushion seal	16	Spacer
8	Retainning ring	17	O-ring
9	Retainning ring		

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.



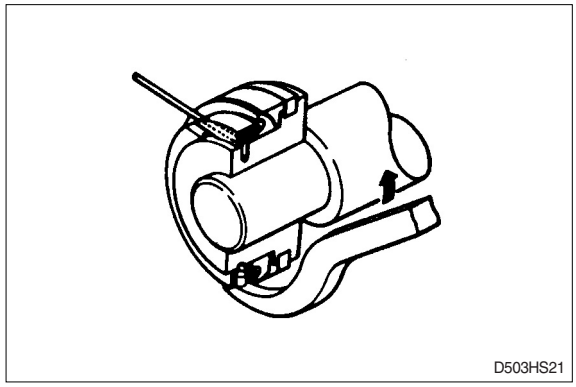
2) CHECK AND INSPECTION

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

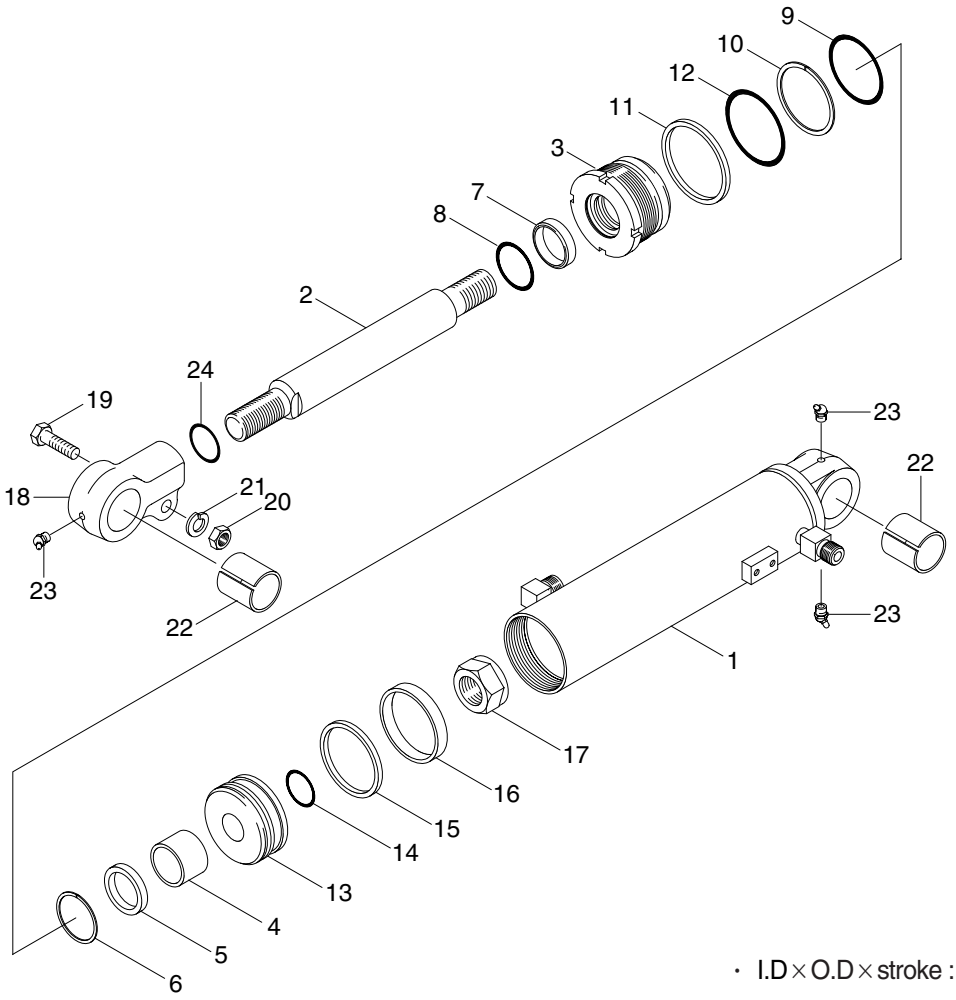
3) ASSEMBLY

(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.



4. TILT CYLINDER

1) STRUCTURE



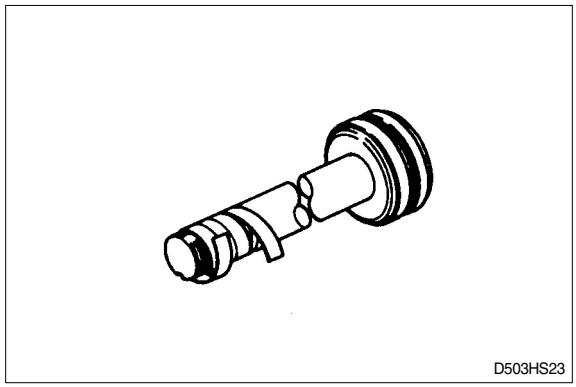
- I.D × O.D × stroke : 110 × 124 × 338mm (4.3 × 4.9 × 13.3in)
- Rod O.D : 50mm(2.0in)

D507HS22

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

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.



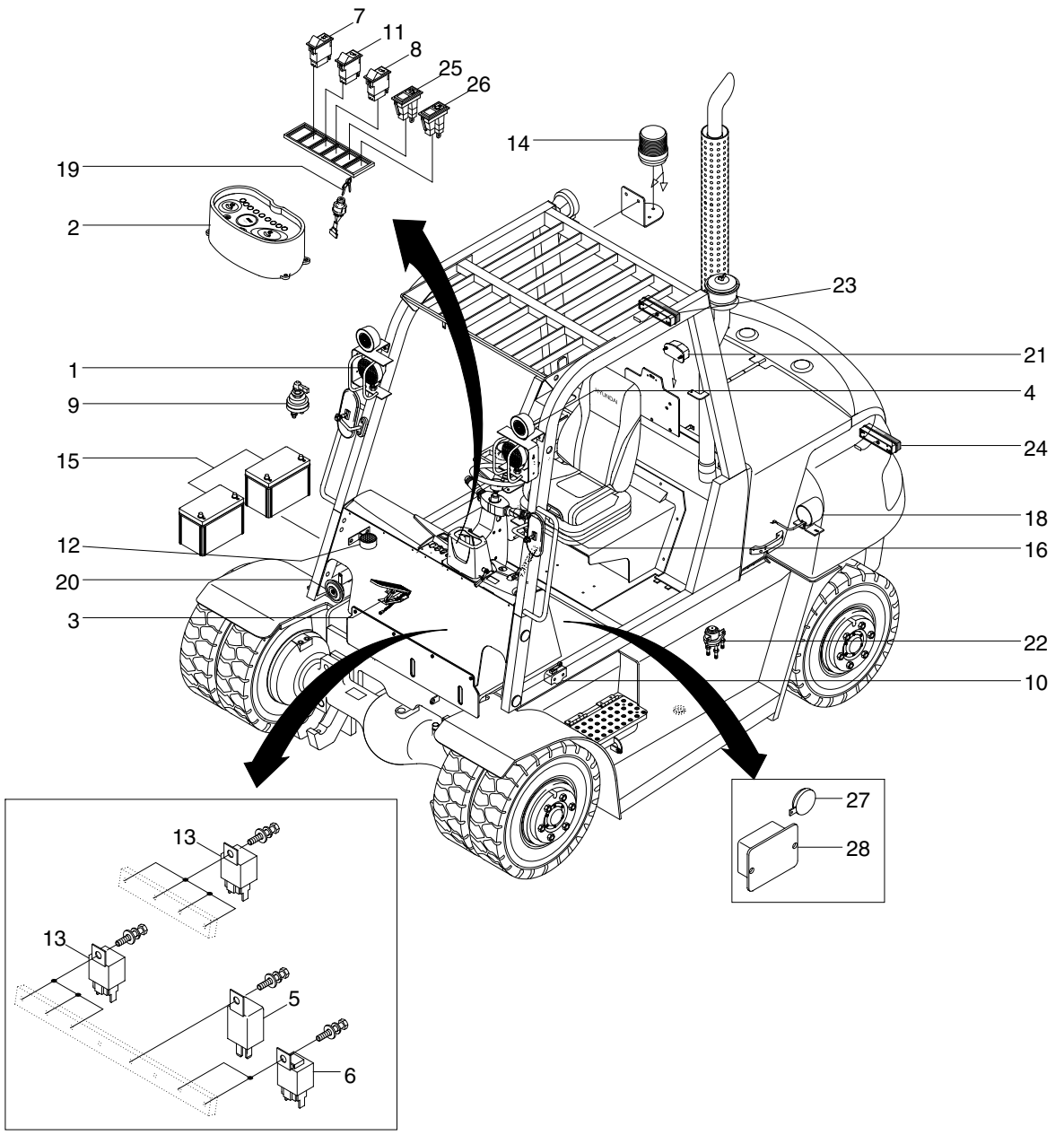
3) CHECK AND INSPECTION

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



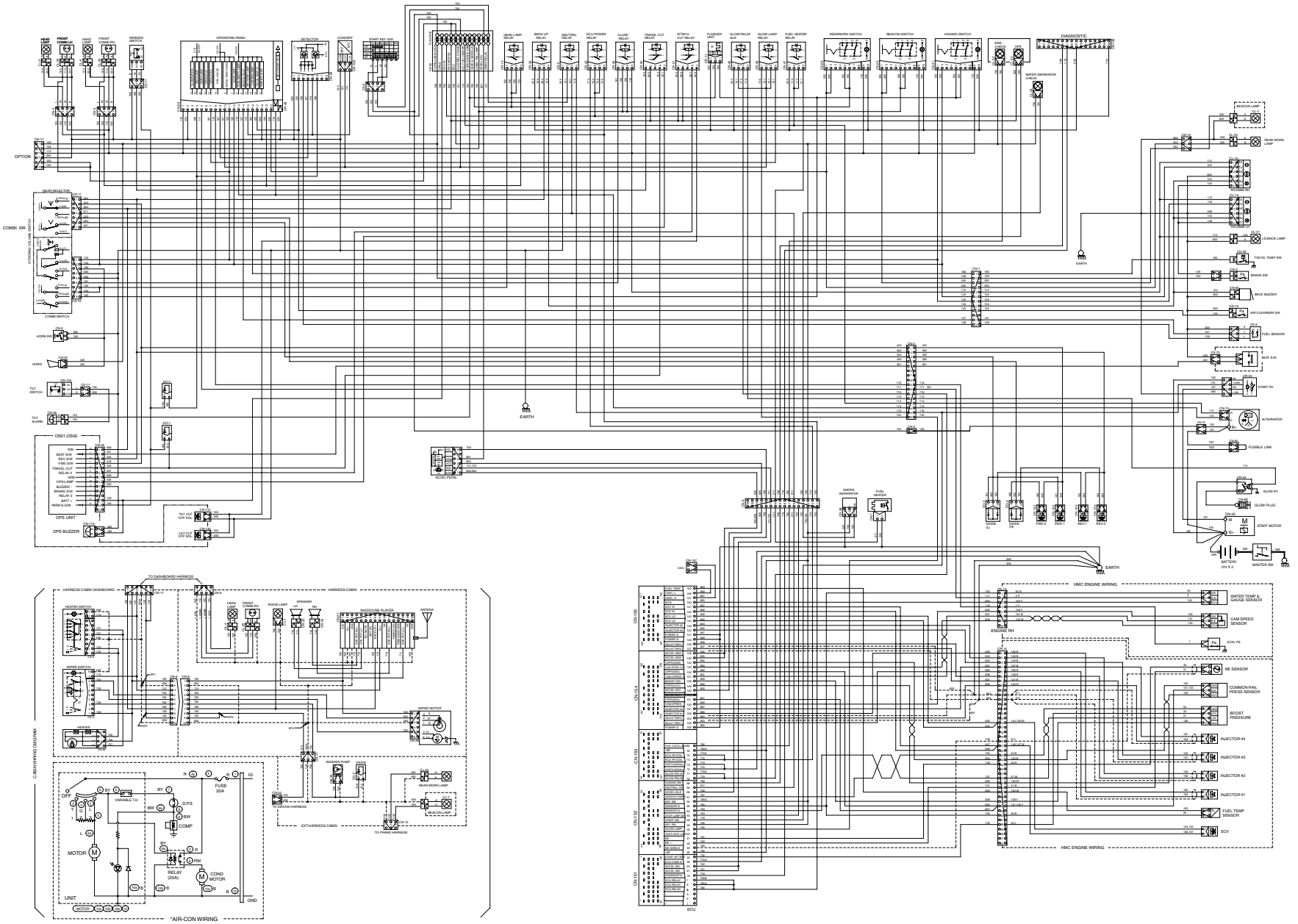
50DF7EL00

1	Work lamp	11	Hazard switch	21	License lamp
2	Operating panel	12	Alarm	22	Start relay
3	Elec accelerator pedal	13	Relay 4P	23	RH combination lamp
4	Flasher lamp	14	Beacon lamp	24	LH combination lamp
5	Flasher unit	15	Battery	25	Engine check warning lamp
6	Relay 5P	16	Gear selector	26	Water separator lamp
7	Beacon switch	17	Combination switch	27	Buzzer
8	Work lamp switch	18	Backup alarm	28	Opss unit
9	Master switch	19	Start switch		
10	Micro switch	20	High horn		

MEMORANDUM

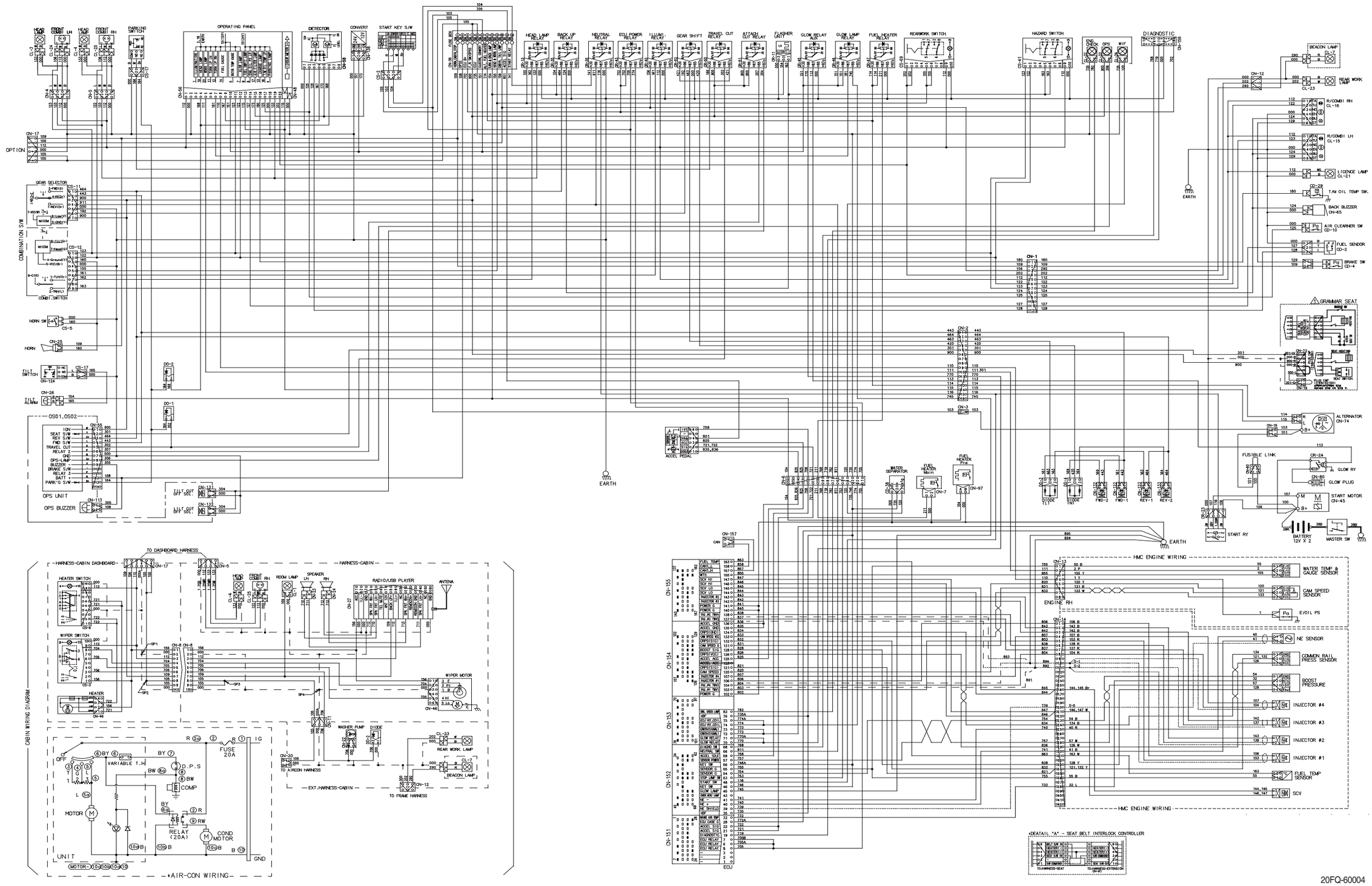

Robex
HYUNDAI HEAVY INDUSTRIES CO., LTD.
CONSTRUCTION EQUIPMENT DIV.

GROUP 2 ELECTRICAL CIRCUIT



50DF7EL01

ELECTRICAL CIRCUIT (70DF : #1296~)



MEMORANDUM


Robex
HYUNDAI HEAVY INDUSTRIES CO., LTD.
CONSTRUCTION EQUIPMENT DIV.

1. POWER CIRCUIT

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

1) OPERATING FLOW

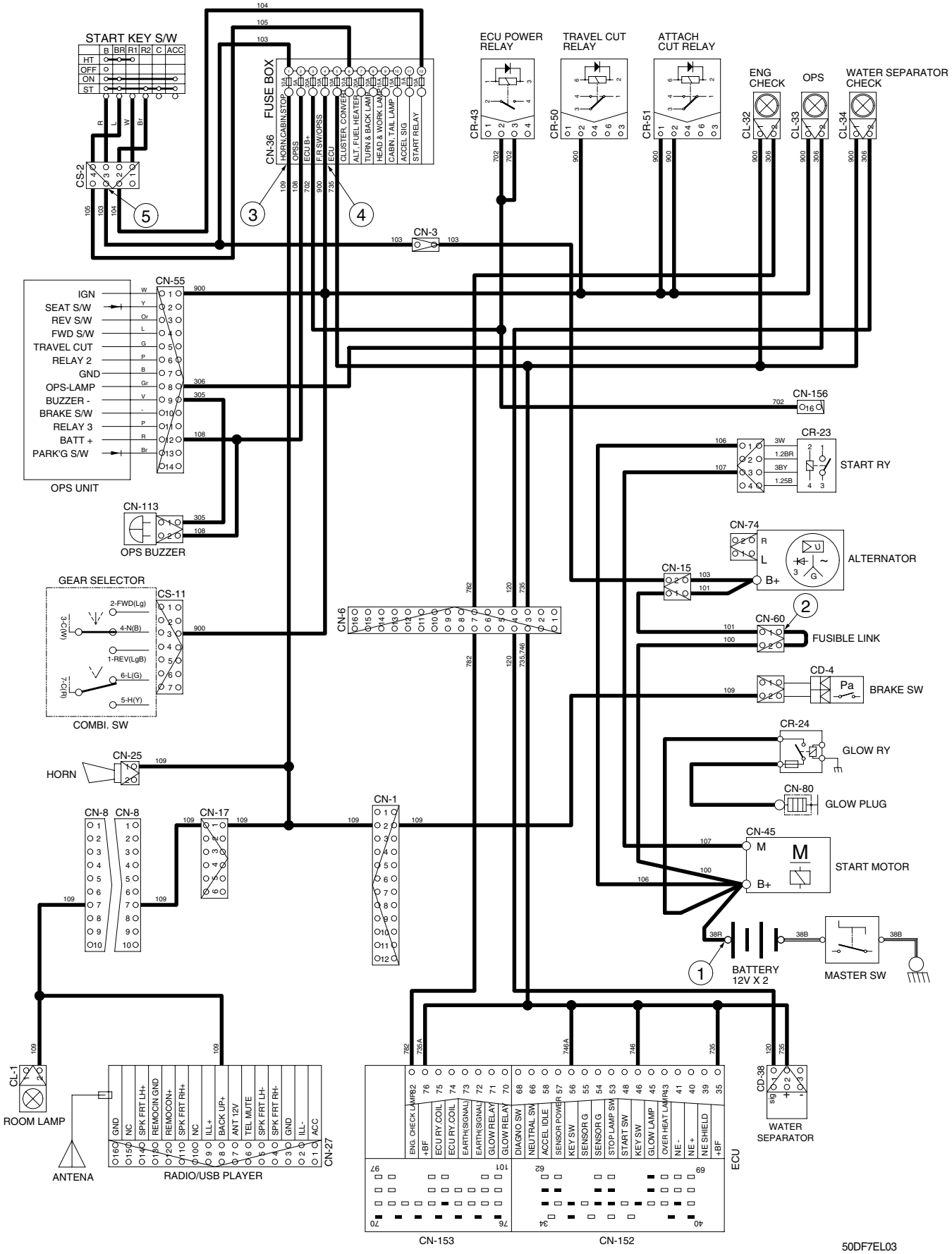
- Battery(+) → Start motor[CN-45(B+)]
  - Glow relay[CR-24] → Glow plug[CN-80]
  - Start relay[CR-23]
  - Fusible link[CN-60] → Alternator[CN-74(B+)] → [CN-15(2)] → [CN-3]
  - Fuse box[CN-36(1)]
    - Horn[CN-25(1)]
    - I /conn[CN-1(2)] → Brake s/w[CD-4]
    - I/conn[CN-17(1)] → I/conn[CN-8(7)]
      - Radio/USB player[CN-27]
      - Room lamp[CL-1]
  - Fuse box[CN-36(2)]
    - OPS unit[CN-55(2)]
    - OPS buzzer[CN-133(2)]
  - Fuse box[CN-36(3)]
    - ECU power relay[CR-43(2,3)]
    - Diagnostic[CN-156(16)]
  - Fuse box[CN-36(4)]
    - Travel cut relay[CR-50(2)]
    - Attach cut relay[CR-51(1,2)]
    - OPS[CN-55(1)]
    - Gear selector[CS-11(3)]
  - Fuse box[CN-36(5)]
    - Water separator check[CL-34(1)]
    - Engine check[CL-32(1)]
    - I/conn[CN-6(3)] → ECU[CN-152(35, 46, 56), CN-153(76)]

2) CHECK POINT

Engine	Key switch	Check point	Voltage
OFF	OFF	① - GND (Battery(+)) ② - GND (Fusible link) ③ - GND (Fuse No.1) ④ - GND (Fuse No.4) ⑤ - GND (Start key)	24V

※ GND : Ground

POWER CIRCUIT



50DF7EL03

2. STARTING CIRCUIT

1) OPERATING FLOW

Battery(+) terminal
→ Start motor[CN-45(B+)] ┬→ Fusible link[CN-60] → I/conn[CN-15(1)] → Alternator[CN74(B+)]
└→ Start relay[CR-23]
┬→ I/conn[CN-2(15)] → Neutral relay[CR-5(4)-(2)] → Fuse box B[CN-36(12)]
→ Start switch[CS-2(2)]
└→ ECU[CN-152(48)]

※ **The engine can be started only when the gearshift is in neutral position.**
The operator should be seated when starting.

(1) **When start key switch is in ON position**
Start switch ON [CS-2(4)] → Fuse box[CN36(6)→(4)] ┬→ Gear selector switch[CS-11(3)]
└→ OPS unit[CN-55(1)]

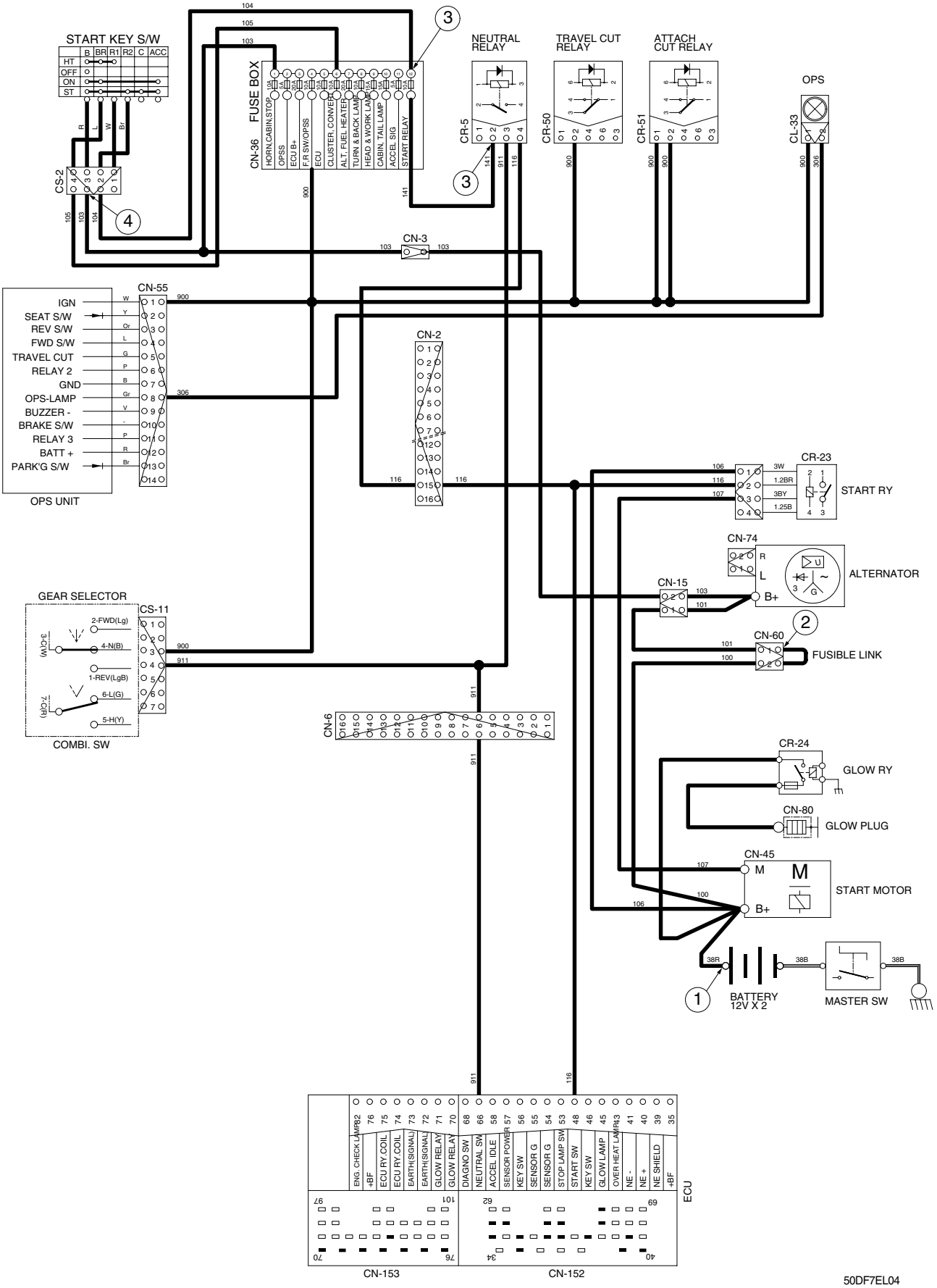
(2) **When start key switch is START position**
Start switch START[CS-2(2)] → Fuse box[No. 12] → Neutral relay[CR-5(2)→(4)]
→ I/conn[CN-2(15)] ┬→ Start relay[CR-23(1)]
└→ ECU[CN-152(48)]

2) CHECK POINT

Engine	Key switch	Check point	Voltage
Running	ON	① - GND (Battery B+) ② - GND (Fusible link) ③ - GND (Fuse box B No.1, 12) ④ - GND (Start key) ⑤ - GND (Neutral relay)	24V

※ GND : Ground

STARTING CIRCUIT



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 fusible link(CN-60) and the fuse box.

1) OPERATING FLOW

(1) Warning flow

Alternator[CN-74(L)] → I/conn[CN-2(14)] → Cluster charging lamp ON[CN-56(13)]
I/conn[CN-2(14)] → Hour meter[CN-48]

(2) Charging flow

Alternator[CN-74(B+)] → I/conn[CN-15(1)] → Fusible link[CN-60] → Starter[CN-45(B+)]
I/conn[CN-15(1)] → Battery(+) terminal charging
Alternator[CN-74(B+)] → I/conn[CN-15(2)] → I/conn[CN-3] → Fuse box[CN-36(1)]
I/conn[CN-3] → I/conn[CS-2(3)] → Start key switch

2) CHECK POINT

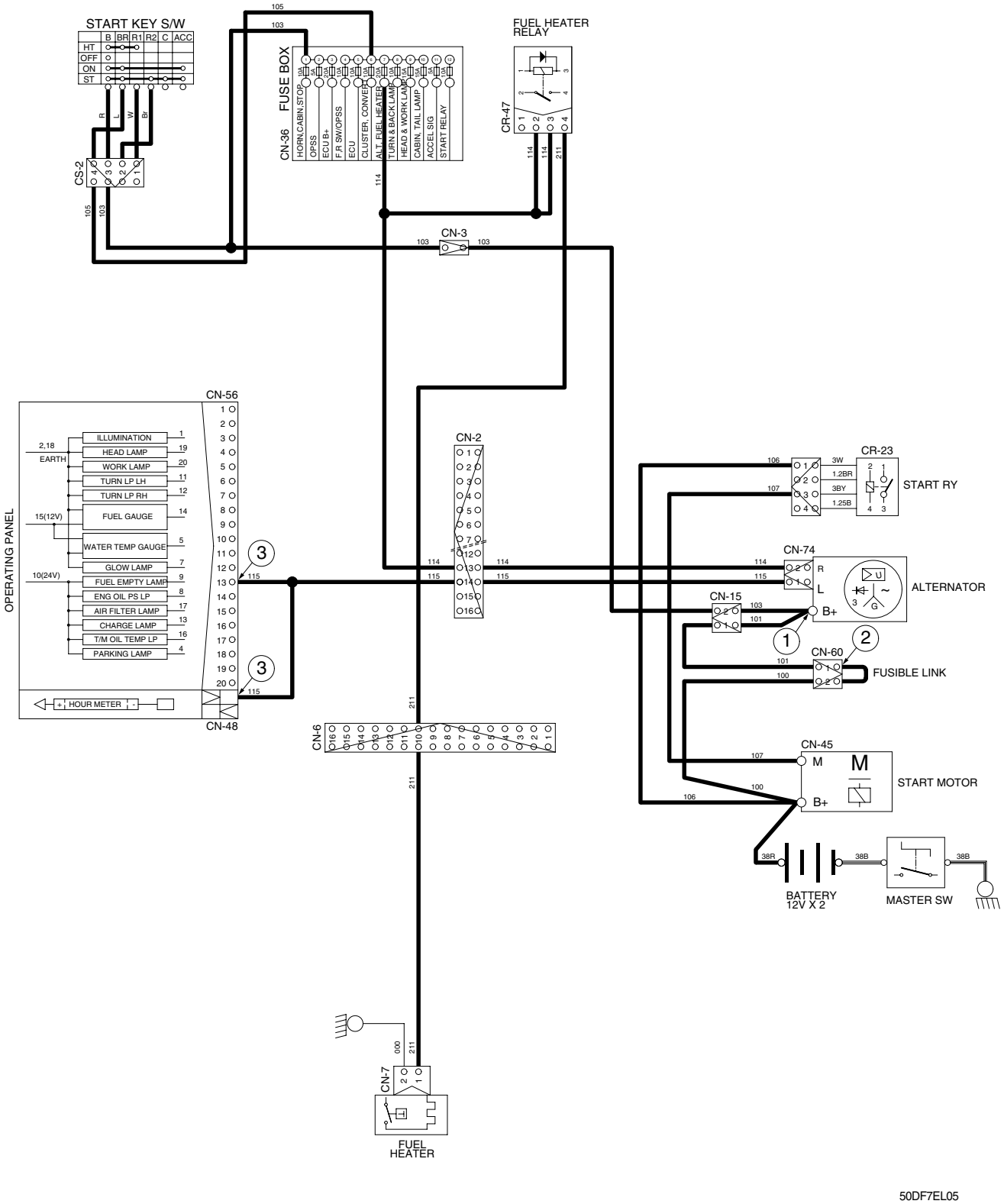
Engine	Key switch	Check point	Voltage
ON	ON	① - GND (Alternator B+) ② - GND (Start switch) ③ - GND (Cluster)	24V

※ GND : Ground

※ **Cautions**

1. When using an arc welder, always disconnect the ground lead from the battery to prevent alternator or battery damage.
2. Attach the welding ground clamp as close to the weld area as possible to prevent welding current from damaging the bearings of the alternator.
3. Do not disconnect the battery when the engine is running. The voltage surge can damage the diode and resistors in the electrical system.
4. Do not disconnect an electric wire before the engine is stopped and the switches are OFF.

CHARGING CIRCUIT



50DF7EL05

4. PREHEATING CIRCUIT

Combustion chamber glow plugs are used in order to give satisfactory starting of low ambient temperatures.

1) OPERATING FLOW

Battery(+) terminal → Start moter[CN-45(B+)]
- → Fusible link[CN-60] → I/conn[CN-15(1)] → Alternator [CN-74(B+)]
  - → I/conn[CN-15(2)] → I/conn[CN-3]
    - → Fuse box[CN-36(1)]
    - → I/conn[CS-2(3)] → Start switch(B)
- → Glow relay[CR-24] → Glow plug[CN-80]

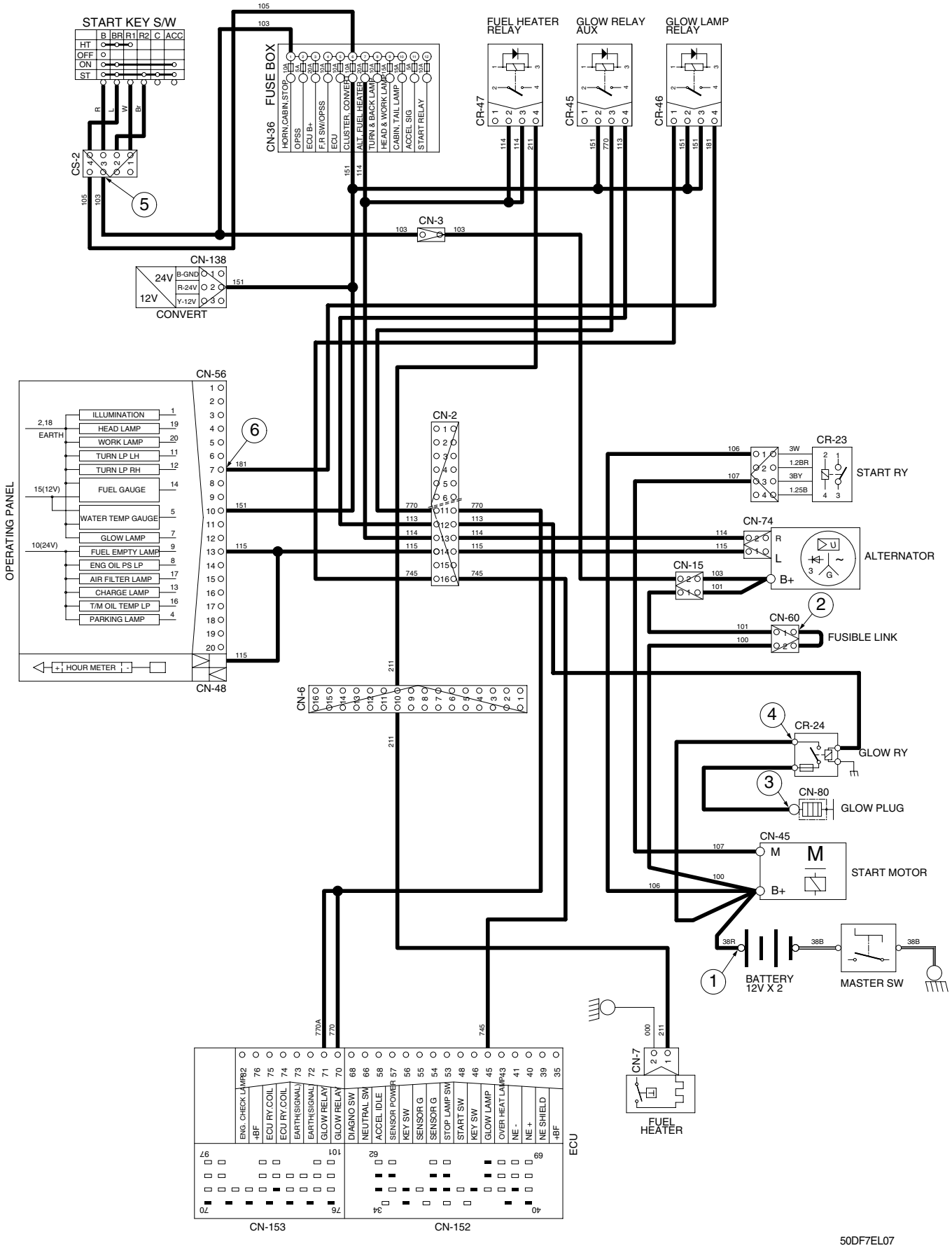
※ When you turn the start switch to the ON position, the glow relay makes the glow plugs operated and the glow lamp of the cluster turned ON.

Start switch ON [CS-2(4)]
- → Fuse box [CN-36(No.6 → 7] → Fuel heater relay [CR-47(3), (2)→(4)] → I/conn[CN-6(10)]
  - → Fuel heater [CN-7(1)]
- → Fuse box [CN-36(6)]
  - → Glow aux relay[CR-45(2)→(4)] → I/conn[CN-2(12)]
    - → Glow relay[CR-24] → Glow plug[CN-80]
  - → Glow lamp relay[CR-46(3),(2)→(4)] → Glow lamp[CN-56(7)]

2) CHECK POINT

Engine	Key switch	Check point	Voltage
Stop	HEAT	① - GND (Battery B+) ② - GND (Fusible link) ③ - GND (Glow plug) ④ - GND (Glow relay) ⑤ - GND (Start switch) ⑥ - GND (Glow lamp)	24V

PREHEATING CIRCUIT



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>2</td><td>12V×72AH
RC : 130min
CCA : 630A</td></tr>
<tr><td>2</td><td>Working lamp</td><td>1</td><td>24V, 70W</td></tr>
<tr><td>3</td><td>License lamp</td><td>1</td><td>24V, 3W x 2</td></tr>
<tr><td>4</td><td>Rear Combination lamp</td><td>2</td><td>24V, 21/5W (Stop/Tail)
24V, 21W (Turn)
24V, 21W (Back Up)</td></tr>
<tr><td>5</td><td>Head lamp</td><td>2</td><td>24V, 70W</td></tr>
<tr><td>6</td><td>Flasher lamp</td><td>2</td><td>24V, 25/10W</td></tr>
<tr><td>7</td><td>Glow relay</td><td>1</td><td>24V, 300A</td></tr>
<tr><td>8</td><td>Relay (4P)</td><td>4</td><td>24V, 20A</td></tr>
<tr><td>9</td><td>Relay (5P)</td><td>3</td><td>24V, 6A</td></tr>
<tr><td>10</td><td>Flasher Unit</td><td>1</td><td>85±10CM(at 25.6V, 20±5℃), (21W + 21W) x 2 + 3W x 2</td></tr>
<tr><td>11</td><td>Back buzzer</td><td>1</td><td>24V, 90±5dB, 60±10C/M</td></tr>
<tr><td>12</td><td>Horn</td><td>1</td><td>24V, 1.5A, 100 ~ 115 dB(at 26V, 2m)</td></tr>
<tr><td>13</td><td>Fuel level sender</td><td>1</td><td>
<table>
<tr><td>Float indicate</td><td>E</td><td>1/2</td><td>F</td></tr>
<tr><td>Resistance(Ω)</td><td>105</td><td>32.5</td><td>5</td></tr>
<tr><td rowspan="2">Tolerance(Ω)</td><td>+0
−5</td><td rowspan="2">±2.5</td><td>+0.5
−0</td></tr>
</table>
</td></tr>
<tr><td>14</td><td>Master Switch</td><td>1</td><td>24V, 180A</td></tr>
<tr><td>15</td><td>Combination Switch</td><td>1</td><td>Direction 4.5A, Tail 5A
Head 6A, Horn 4A</td></tr>
<tr><td>16</td><td>Brake Switch</td><td>1</td><td>24V, 50W</td></tr>
<tr><td>17</td><td>Working Lamp Switch</td><td>1</td><td>24V, 8A</td></tr>
<tr><td>18</td><td>Hazard Switch</td><td>1</td><td>24V, 8A</td></tr>
<tr><td>19</td><td>Beacon Inching</td><td>1</td><td>24V, 8A</td></tr>
<tr><td>20</td><td>Auto manual Switch</td><td>1</td><td>24V, 8A</td></tr>
<tr><td>21</td><td>Start switch</td><td>1</td><td>24V, 30A</td></tr>
<tr><td>22</td><td>Fusible link</td><td>1</td><td>24V, 45A</td></tr>
<tr><td>23</td><td>Start relay</td><td>1</td><td>24V, 300A</td></tr>
<tr><td>24</td><td>Seat switch</td><td>1</td><td>24V, 8A</td></tr>
<tr><td>25</td><td>Tilt switch</td><td>1</td><td>24V, 8A</td></tr>
<tr><td>26</td><td>Warning buzzer</td><td>1</td><td>24V, 50mA, 80~90dB</td></tr>
</table>

GROUP 4 CONNECTOR DESTINATION

Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CN-1	AMP	12	I/conn(Console harness-frame harness)	S816-012002	171663-2
CN-2	AMP	16	To Dashboard harness	368047-1	368050-1
CN-3	KET	1	To Dashboard harness	MG640944-5	MG650943-5
CN-4	KET	4	To LH Support harness	S810-004201	-
CN-5	KET	4	Harness -Dashboard	MG610339	-
CN-6	AMP	16	To Dashboard harnes	368047-1	368050-1
CN-7	BOSCH	2	Fuel heater	1-928-402-404	-
CN-8	KET	10	Harness-Cabin dashboard	MG610056	-
CN-9	AMP	4	TCU service tool	174257-2	174259-2
CN-10	AMP	8	I/conn(Console harness-T/M harness)	S816-008002	S816-108002
CN-11	KET	3	Cabin harness	S810-003201	S810-103201
CN-12	KET	3	Rear support harness	S810-103201	-
CN-13	NMWP	8	HMC engine harness	PB625-08027	-
CN-14	AMP	42	HMC engine harness	936421	-
CN-15	SMITOMO	2	Alternator (B+)	6189-0172	-
CN-17	KET	6	Option	MG640515-4	-
CN-19	KET	2	Output check	MG640515-4	MG610320
CN-20	KET	4	Aircon harness	MG641744-5	-
CN-21	AMP	6	Wiper motor	936257-2	-
CN-22	KET	2	Washer tank	MG640605	-
CN-23	KET	2	LH Speaker	MG610070	-
CN-24	KET	2	RH Speaker	MG610070	-
CN-25	KET	2	Horn	35825-0211	-
CN-26	KET	1	Tilt alarm	S822-014000	-
CN-27	KLM	16	Radio/USB player	PK145-16017	-
CN-36	AMP	1	Fuse box	F12890010	-
CN-45	RING TERM	2	Start motor	S820-308000	-
CN-46	KET	2	Wiper motor	MG610392	-
CN-48	KET	1	Hour meter	S822-014000	
CN-50	AMP	68	Transmission control unit	963598-1	-
CN-51	AMP	6	Diagnostic	926682-3	-
CN-55	KET	14	OPS unit	S814-014100	-
CN-56	MOLEX	20	Cluster	35109-2010	-
CN-57	AMP	20	Cluster	175967-2	-
CN-58	KET	8	Detector	S810-008201	-
CN-60	KET	2	Fusible link	S813-130201	-
CN-65	KET	1	Back buzzer	S822-014000	S822-114000

Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CN-74	KET	2	Alternator	MG640188-4	-
CN-80	RING TERM	1	Glow plug	S820-204000	-
CN-97	DELPHI	2	Pre filter fuel warmer	15300027	-
CN-98	KET	2	Resistor	DT06-3S-EP06	-
CN-113	KET	2	OPSS buzzer	S814-002000	-
CN-122	DEUTSCH	2	Forward solenoid 1	DT06-2S	
CN-123	DEUTSCH	2	Reverse solenoid 1	DT06-2S	
CN-124	AMP	6	Accel. pedal	S816-006002	-
CN-131	AMP	2	Cut off solenoid 1(tilt)	S816-002002	
CN-132	AMP	2	Cut off solenoid 1(lift)	S816-002002	
CN-132	DEUTSCH	2	Forward solenoid 2	DT06-2S	
CN-133	DEUTSCH	2	Reverse solenoid 2	DT06-2S	
CN-138	KET	3	Regulator	S810-003201	-
CN-144	AMP	6	Accelerator pedal	S816-006002	-
CN-147	KET	2	Cabin tilting lamp	MG640188-4	-
CN-151	AMP	34	ECU	1123337-1	-
CN-152	AMP	35	ECU	1123338-1	-
CN-153	AMP	32	ECU	1123339-1	-
CN-154	AMP	35	ECU	1123340-1	-
CN-155	AMP	31	ECU	1123341-1	-
CN-156	MOLEX	16	ECU diagonostic	51115-1601	-
CN-157	KET	2	CAN	MG651026(L)	-
CN-169	DEUTSCH	4	RS232C	DT06-4S-EP06	DT04-4P-E005
Switch					
CS-2	KET	4	Start switch	S810-004201	-
CS-5	KET	2	Horn switch	368050-1	-
CS-11	AMP	7	Gear selector switch	S811-007002	-
CS-12	AMP	9	Combination switch	S811-009002	-
CS-17	KET	3	Parking switch	S810-003201	-
CS-23	SWF	10	Beacon lamp switch	593757	-
CS-41	SWF	10	Hazard switch	593757	-
CS-42	SWF	10	Inching switch	593757	-
CS-59	SWF	10	Auto manual switch	593757	-
CS-69	SWF	10	Rear work switch	593757	-
CS-72	KET	2	Tilt switch	S814-002000	-
CS-73	KET	2	Seat switch	S810-002201	-
CS-77	SWF	12	Cabin tilting switch	593757	-

Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
Lamp					
CL-1	KET	2	Room lamp	MG610392	-
CL-15	KET	6	Combination lamp-LH	S814-006100	-
CL-16	KET	6	Combination lamp-RH	S814-006100	-
CL-21	KET	1	License lamp	S822-014000	S822-114000
CL-32	SWF	2	Engine check lamp	913328	-
CL-33	SWF	2	OPSS lamp	913328	-
CL-34	SWF	2	Water separator check lamp	913328	-
Relay					
CR-5	KET	5	Neutral relay	MG640927	-
CR-11	KET	3	Flasher unit relay	S810-003702	-
CR-13	KET	5	Head lamp relay	MG640927	-
CR-23	AMP	4	Start relay	S810-004202	-
CR-24	KET	1	Glow relay	S822-014000	-
CR-34	KET	6	Parking relay	S810-006202	-
CR-35	KET	5	Back up relay	MG640927	-
CR-40	KET	5	Illumination relay	MG640927	-
CR-43	KET	5	ECU power relay	MG640927	-
CR-44	AMP	2	Cabin tilting relay	17435202	-
CR-45	KET	5	Glow aux relay	MG640927	-
CR-46	KET	5	Glow lamp relay	MG640927	-
CR-47	KET	4	Fuel heater relay	S810-004201	-
CR-49	KET	5	Fuel heater relay	MG640927	-
CR-50	KET	5	Tilt cut-off relay	MG640927	-
CR-51	KET	5	Attach cut relay	MG640927	-

Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
Sensor and pressure switch					
CD-2	KET	3	Fuel sendor	S810-003201	-
CD-3	DEUTSCH	2	Brake fail pressure	-	DT04-2P-E005
CD-4	AMP	1	Stop lamp switch	S819-010122	-
CD-10	KET	1	Air cleaner switch	ST730057-2	-
CD-27	AMP	2	Turbin speed input	963040-3	-
CD-38	YAZAKI	3	Water separator	7283-7031-10	-
CD-71	AMP	6	Inching sensor	1-967616-1	-
CD-72	AMP	2	Gear train speed sensor	963040-3	-
CD-73	AMP	3	Output speed sensor	282087	-
CD-74	AMP	2	Engine speed sensor	963040-3	-
CD-80	PACKARD	2	KV Solenoid	12162197	-
CD-81	PACKARD	2	KR Solenoid	12162197	-
CD-82	PACKARD	2	KD Solenoid	12162197	-
CD-83	PACKARD	2	KE Solenoid	12162197	-
CD-84	PACKARD	2	KC Solenoid	12162197	-
CD-90	AMP	2	Temp sensor	963040-3	-
DO-01	-	2	Diode	21EA-50550	-
DO-02	-	2	Diode	21EA-50550	-
DO-03	-	3	Diode	F15890030	-
DO-04	-	3	Diode	F15890030	-

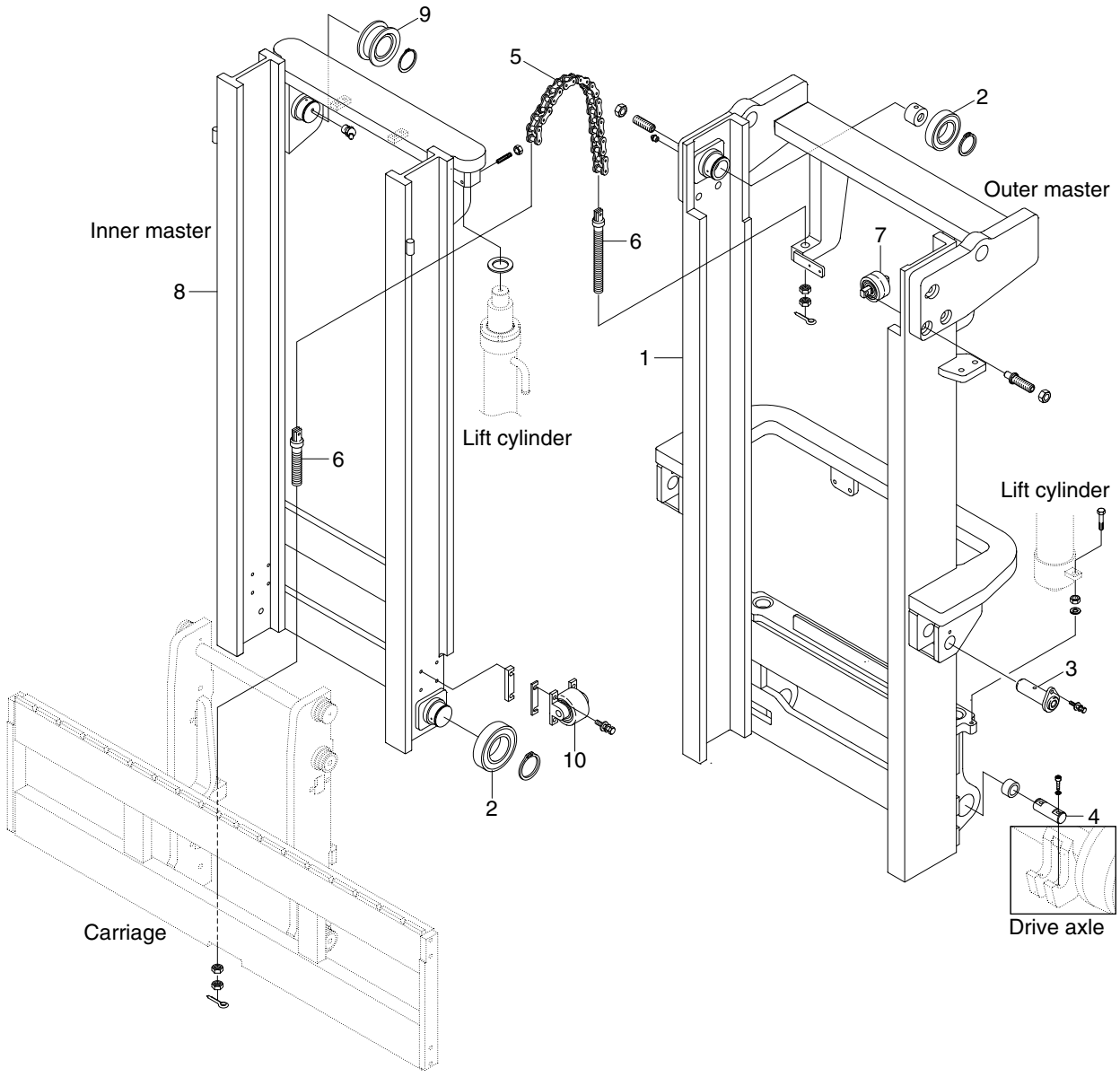
GROUP 5 TROUBLESHOOTING

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 engine is stopped (with starting switch left in"ON" position).	· Caution lamp defective. · Caution lamp switch defective.	· Replace · Replace

SECTION 8 MAST

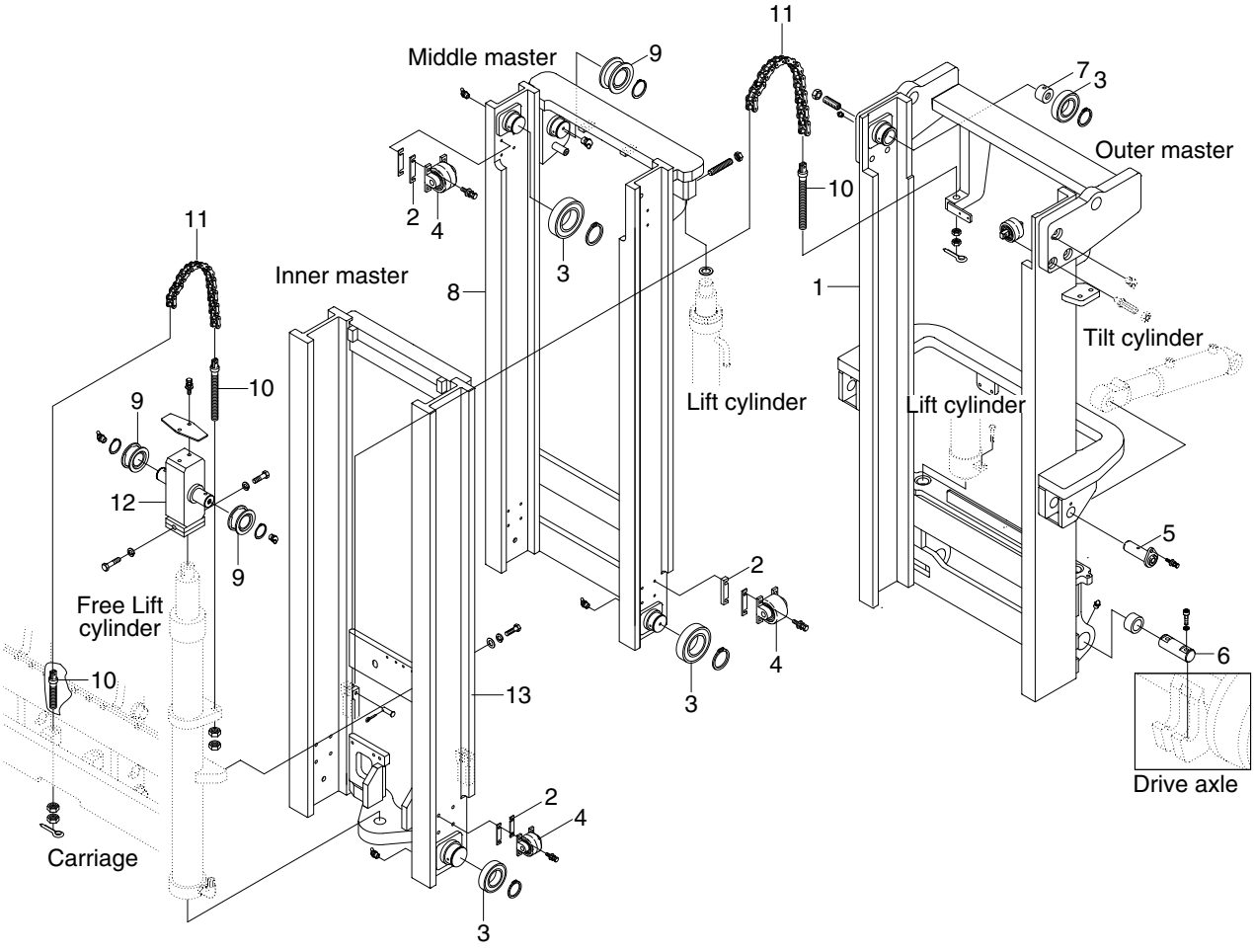
GROUP 1 STRUCTURE

1. 2 STAGE MAST(V MAST)



1	Outer mast	5	Lift chain	9	Chain sheave bearing
2	Roller bearing	6	Anchor bolt	10	Side roller bearing
3	Tilt cylinder pin	7	Side roller bearing		
4	Mast mounting pin	8	Inner mast		

2. 3 STAGE MAST(TF MAST)

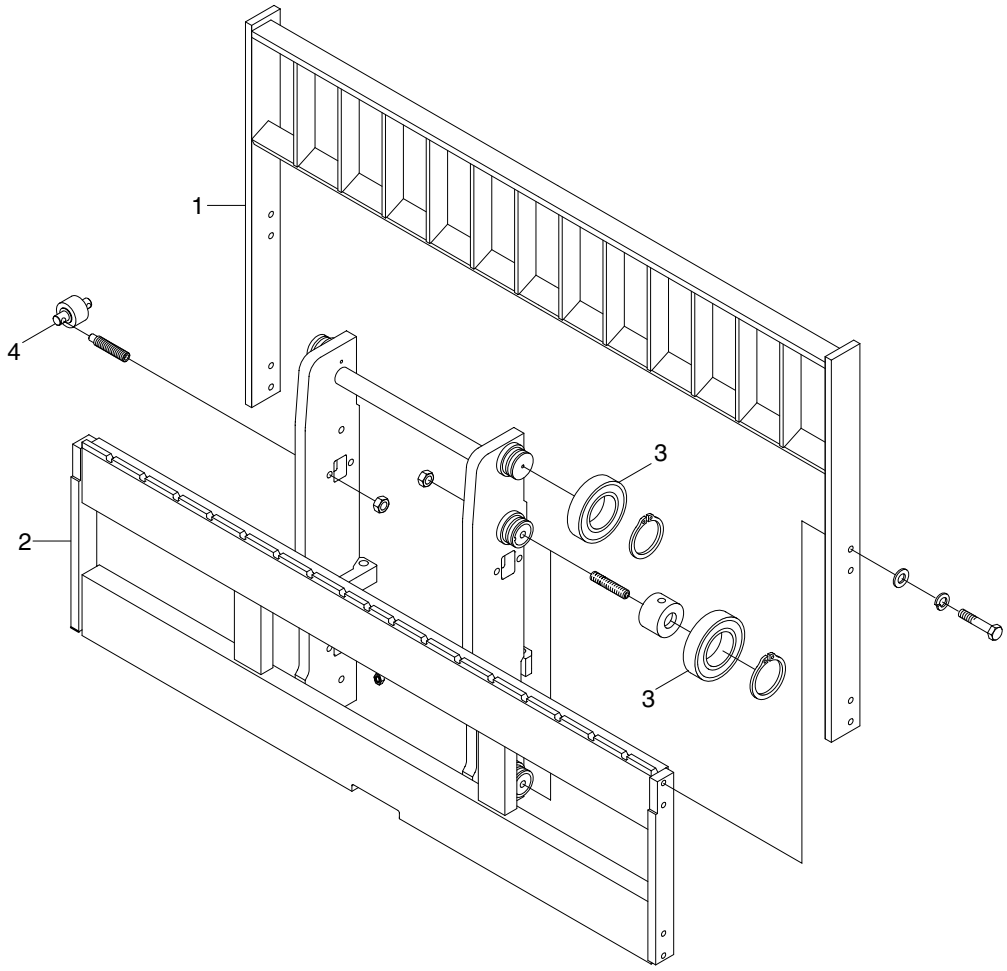


50D7EMS011

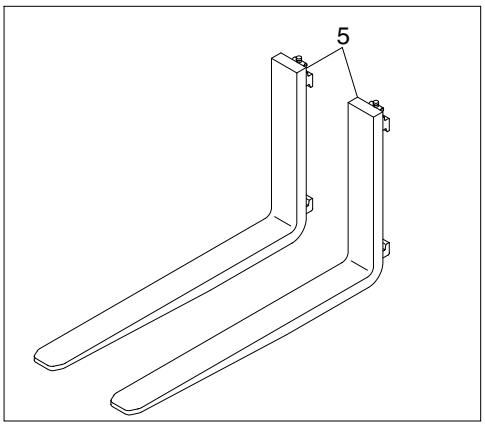
1	Outer mast	6	Mast mounting pin	11	Chain
2	Shim	7	Wear plug	12	Sheave bracket
3	Roller bearing	8	Middle mast	13	Inner mast
4	Side roller bearing	9	Sheave		
5	Tilt cylinder pin	10	Anchor bolt		

3. CARRIAGE, BACKREST AND FORK

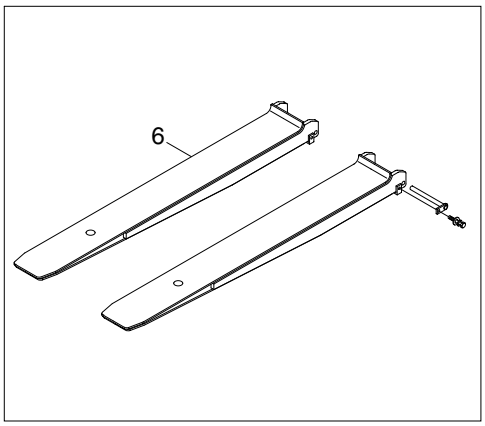
1) HOOK ON TYPE(STD)



Hook on type fork



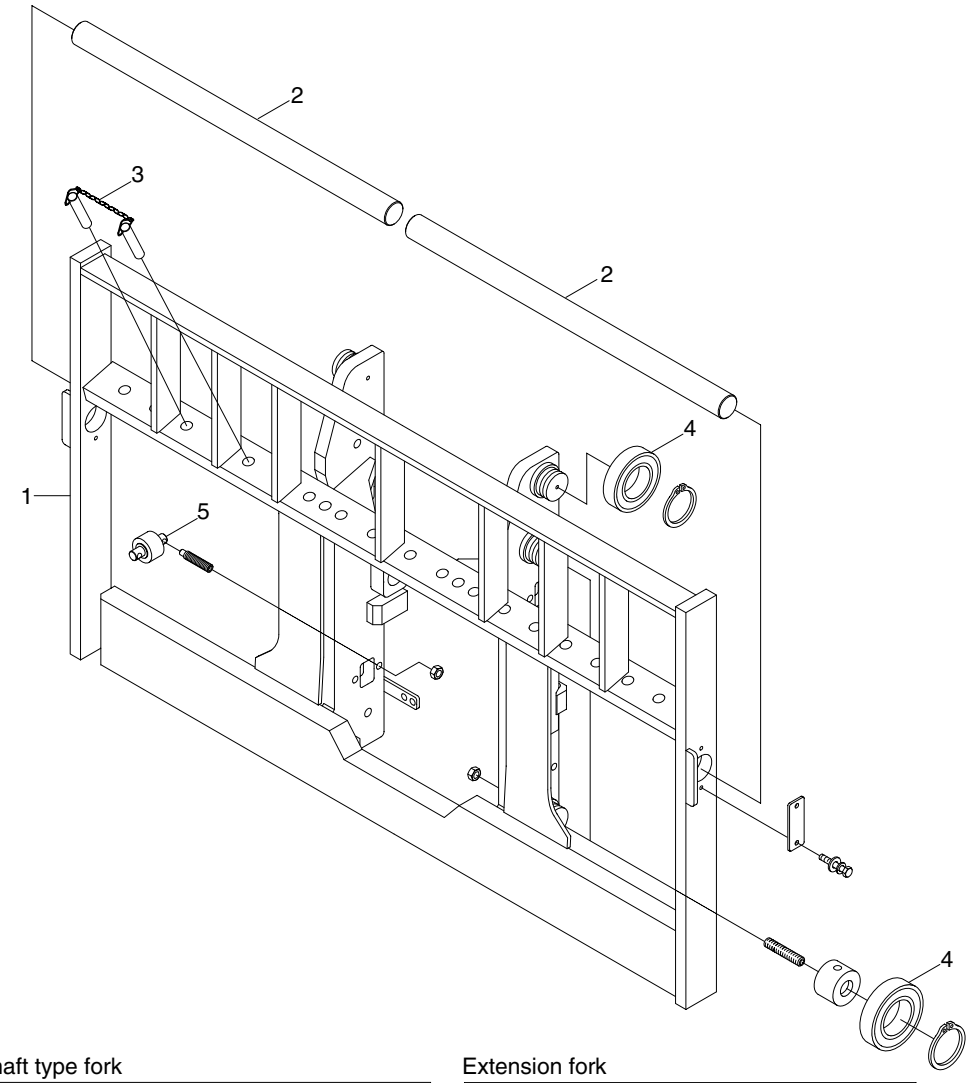
Extension fork



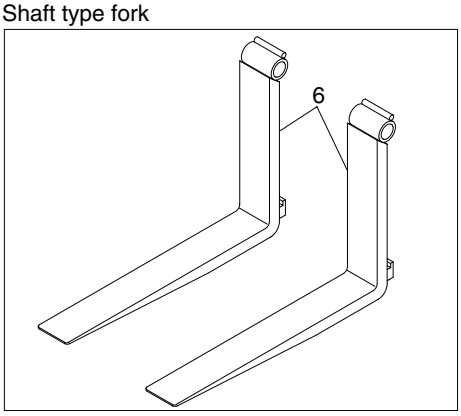
50DS7EMS03

1	Backrest	4	Side roller
2	Carriage	5	Fork
3	Roller	6	Extension fork

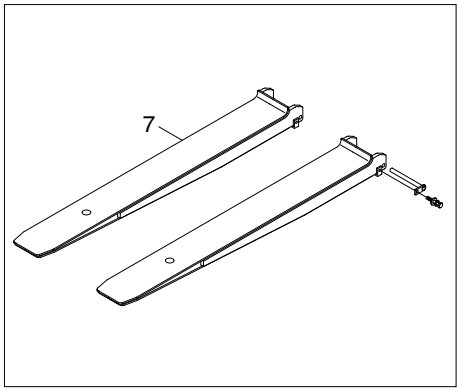
2) SHAFT TYPE(OPTION)



Shaft type fork



Extension fork



80D7MS02

1 Carriage & backrest
2 Hanger bar
3 Fork retaining
4 Roller
5 Side roller
6 Fork
7 Extension fork

GROUP 2 OPERATIONAL CHECKS AND TROUBLESHOOTING

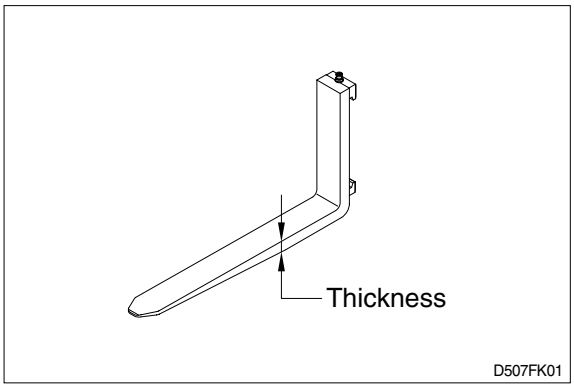
1. OPERATIONAL CHECKS

1) FORKS

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

mm(in)

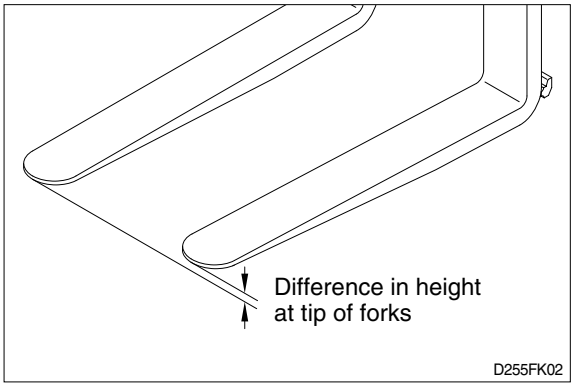
STD Fork assy	Applicable model	Standard	Limit
F14710011	50DF-7	60(2.4)	54(2.1)
F14710111	60DF-7	65(2.6)	59(2.3)
F14710111	70DF-7	65(2.6)	59(2.3)



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

mm(in)

Model	Fork length	Height difference
50DF-7 60DF-7 70DF-7	equal or below 1500	3
	above 1500	6



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 2.0mm(0.08in)
   - Left-to-right clearance : Within 2.5mm (0.10in)
3) Check that there is an oil groove in bushing at mast support.
4) Set mast vertical, raise forks about 10cm 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.	· See troubleshooting hydraulic pump and cylinders in section 6, hydraulic system.
	· Deformed mast assembly.	· Disassemble mast and replace damaged parts or replace complete mast assembly.
Slow lifting speed and insufficient handling capacity.	· Faulty hydraulic equipment.	· See troubleshooting hydraulic pump and Cylinders in section 6, hydraulic system.
	· Deformed mast assembly.	· Disassemble mast and replace damaged parts or replace complete mast assembly.
Mast fails to lift smoothly.	· Deformed masts or carriage.	· Disassembly, repair or replace.
	· Faulty hydraulic equipment.	· See Troubleshooting Hydraulic Cylinders pump and control valve in section 6, hydraulic system.
	· Damaged load and side rollers.	· Replace.
	· Unequal chain tension between LH & RH sides.	· Adjust chains.
	· LH & RH mast inclination angles are unequal. (Mast assembly is twisted when tilted)	· Adjust tilt cylinder rods.
Abnormal noise is produced when mast is lifted and lowered.	· Broken load roller bearings.	· Replace.
	· Broken side roller bearings.	· Replace.
	· Deformed masts.	· Disassemble, repair or replace.
	· Bent lift cylinder rod.	· Replace.
	· Deformed carriage.	· Replace.
	· Broken sheave bearing.	· Replace.
Abnormal noise is produced during tilting operation.	· Insufficient lubrication of anchor pin, or worn bushing and pin.	· Lubricate or replace.
	· Bent tilt cylinder rod.	· Replace.

2) FORKS

<table>
<tr><th>Problem</th><th>cause</th><th>Remedy</th></tr>
<tr><td>Abrasion</td><td>Long-time operations causes the fork to wear and reduces the thickness of the fork.
Inspection for thickness is needed.
· Wear limit : Must be 90% of fork thickness</td><td>If the measured value is below the wear limit, replace fork.</td></tr>
<tr><td>Distortion</td><td>Forks are bent out of shape by a number of reasons such as overloading, glancing blows against walls and objects, and picking up load unevenly.
· Difference in fork tip height
<table><tr><th>Fork length (mm)</th><th>Height difference(mm)</th></tr><tr><td>equal or below 1500</td><td>3</td></tr><tr><td>above 1500</td><td>6</td></tr></table></td><td>If the measured value exceeds the allowance, replace fork.</td></tr>
<tr><td>Fatigue</td><td>Fatigue failure may result from the fatigue crack even though the stress to fork is below the static strength of the fork. Therefore, a daily inspection should be done.
· Crack on the fork heel.
· Crack on the fork weldments.</td><td>Repair fork by expert.
In case of excessive distortion, replace fork.</td></tr>
</table>

GROUP 3 ADJUSTMENT

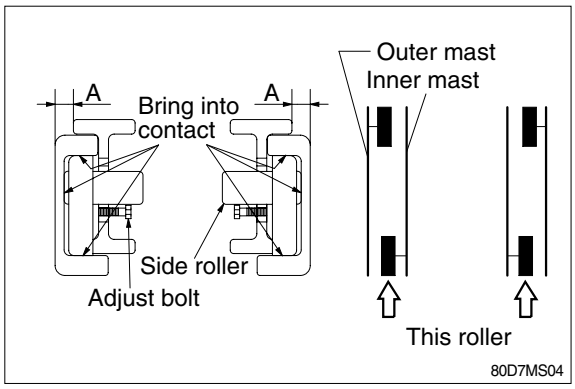
1. MAST LOAD ROLLER

1) INNER/OUTER MAST ROLLER CLEARANCE ADJUSTMENT

(1) Measure the clearance with the mast overlap at near 480mm(19in).

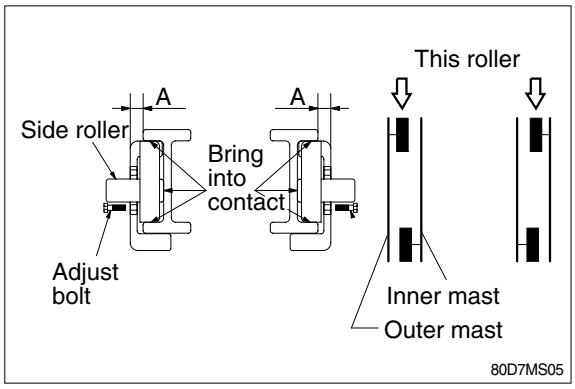
(2) Shift the inner mast to one side to bring the side roller into contact with the outer mast, and adjust the clearance between the end of inner beam and the outside of outer mast position on the opposite side to the following value by adjust bolt.

· Reference clearance A = 43.1mm



(3) Distribute the clearance A equally to the left and right.

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



2) CARRIAGE LOAD ROLLER

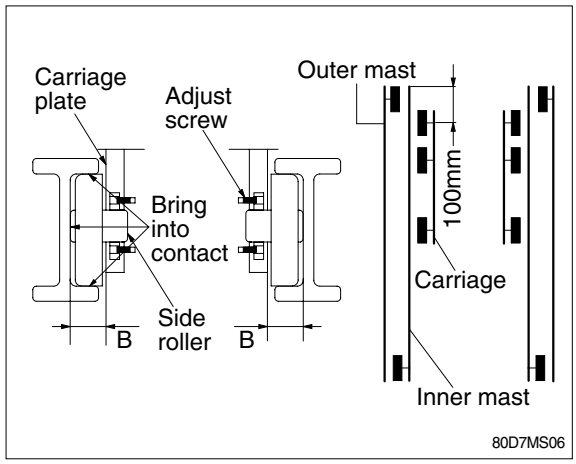
(1) Measure the clearance when the center of the carriage upper roller is 100㎜ from the top of the inner mast.

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

· Reference clearance B = 56.9㎜

(3) Distribute the clearance B equally to the left and right.

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

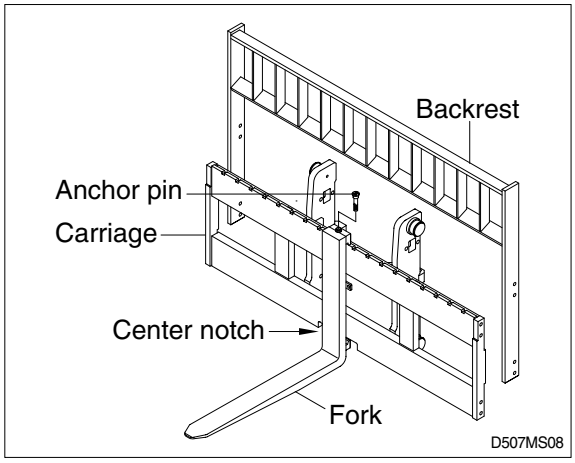


GROUP 4 REMOVAL AND INSTALLATION

1. FORKS

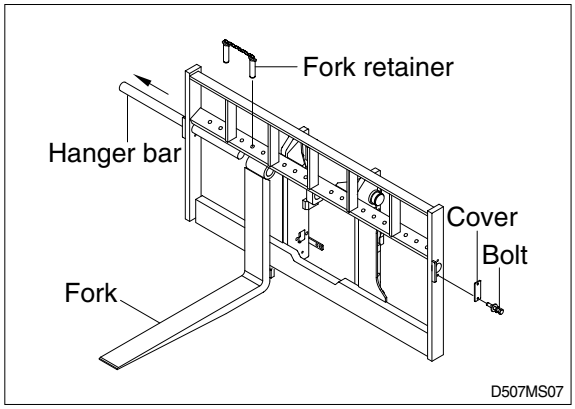
1) HOOK ON TYPE

(1) Lower the fork carriage until the forks are approximately 25mm(1in) from the floor.
(2) Release fork anchor pins 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 fork removal.
(3) Remove only one fork at a time.
※ On larger forks it may be necessary to use a block of wood.
(4) Reverse the above procedure to install load forks.



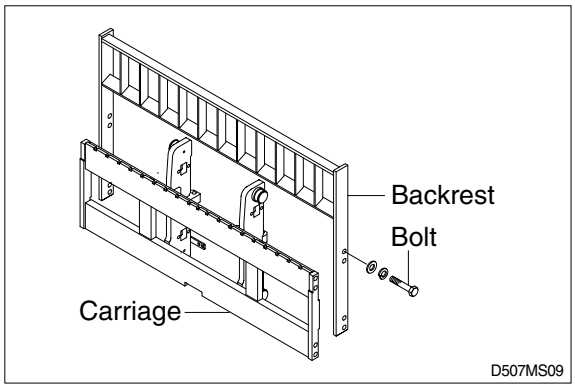
2) SHAFT TYPE(Option)

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



2. BACKREST(Hook on type)

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

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

(5) Inspect all parts for wear or damage. Replace all worn or damaged parts.

(6) Reverse the above steps to reinstall.

※ Replace the split pin of chain anchor with new one.

2) SIDE ROLLER

(1) Remove carriage as outlined in the carriage removal paragraph.

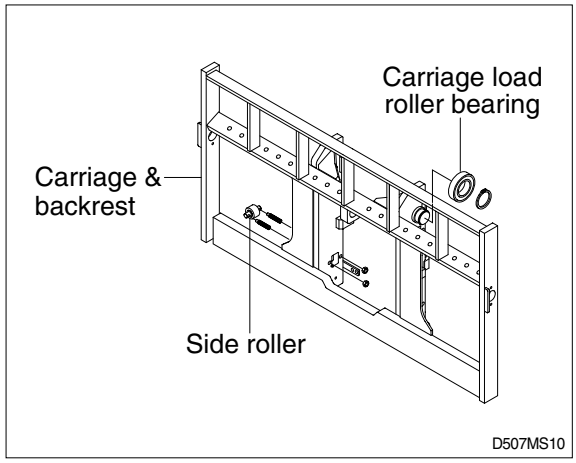
(2) Loosen and remove nuts, adjust screws and side rollers from carriage side plate.

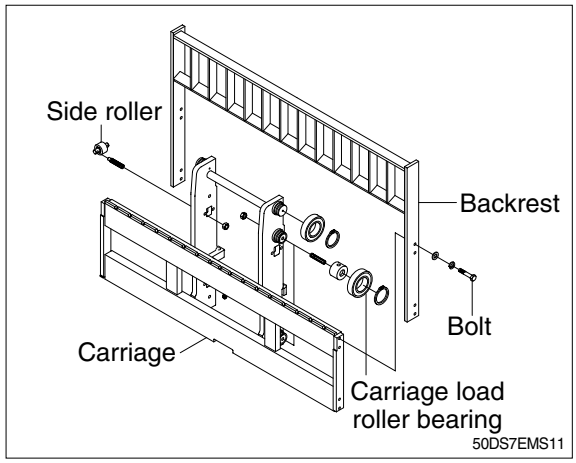
(3) Thoroughly clean, inspect and replace all worn or damaged parts.

(4) Reverse the above procedure to assembly.

※ **Adjustment**

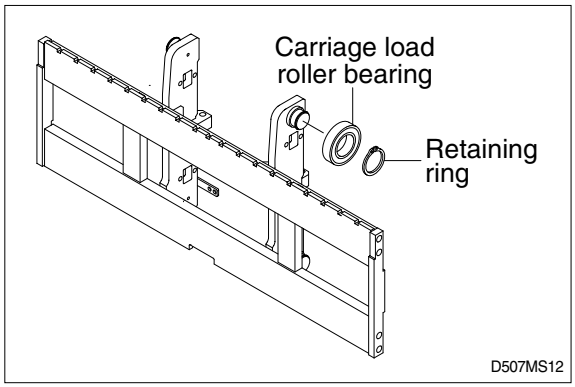
- Once carriage is properly installed, loosen nuts and adjust screws, (if not already done) allowing carriage to be centered in the inner mast.
- Adjust side roller by tightening screw until side roller just makes contact with mast. Back off approximately 1/10 turn on screw and tighten nut to lock screw in place.
- Run carriage up and down along the inner mast to be sure the carriage has free movement and does not stick. Also, make sure chains are properly adjusted. Refer to chain adjustment paragraph. Make adjustment when necessary and recheck operation of carriage.





3) CARRIAGE LOAD ROLLER BEARING

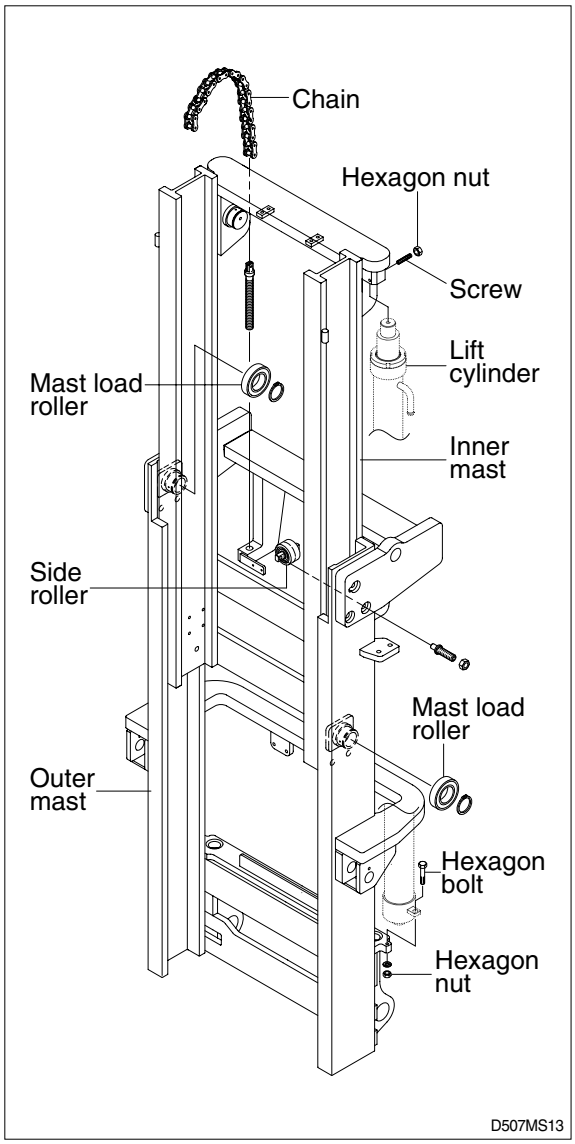
(1) Remove carriage as outlined in the carriage removal paragraph.
(2) Using the plier, remove retaining rings from load roller bearing bracket.
(3) Using a plier, remove load roller bearings from load roller bearing bracket.
(4) Reverse the above procedure to assemble. Refer to MAST ROLLER ADJUSTMENT paragraph.



4. MAST LOAD ROLLER

1) 2 STAGE MAST(V MAST)

(1) Remove the carriage assembly and move them to one side.
(2) Loosen and remove hexagon nuts and screws securing lift cylinders to inner mast.
(3) Loosen and remove hexagon bolts and nuts securing lift cylinders to outer mast.
(4) Attach chains or sling to the inner mast section at top crossmember. Using an overhead hoist, slowly raise the inner mast high enough to clear lift cylinder.
(5) After lowering the lift cylinder rods, and disconnecting lift cylinder hose, tilt the lift cylinders(LH and RH) with ropes to the outer mast.
(6) Using the overhead hoist, lower inner mast until top and bottom rollers are exposed.
(7) Using a plier, remove load rollers from load roller bracket. Remove side rollers.
(8) Thoroughly clean, inspect and replace all worn or damaged parts.
(9) Reverse the above procedure to assemble. Refer to MAST ROLLER ADJUSTMENT paragraph.
(10) After completing all necessary steps for load rollers removal, use an overhead hoist to remove sling or chain around upper crossmember of the inner mast section. Lift inner mast upright straight up and out of outer mast section.
(11) Replace and reverse above procedure to install.
(12) Make all necessary measurements and adjustments.



2) 3 STAGE MAST(TF MAST)

(1) Remove the carriage assembly and move it to one side.

(2) Loosen and remove hexagon bolt securing bottom cylinder from outer mast.

(3) Loosen and remove set screws and nuts securing lift cylinders to middle mast.

(4) Attach chains or sling to the inner and middle mast section at top crossmember. Using an overhead hoist, slowly raise the uprights high enough to clear lift cylinder.

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

(6) Using the overhead hoist raise inner and middle masts. Place 4inch block of wood under the free lift cylinder bracket of the inner mast then lower mast sections(this will create slack in the chains).

(7) Remove retaining rings securing chain sheaves to sheave support brackets while supporting chains, remove chain sheaves and let chains hang free.
The upper outer and lower middle mast rollers and back up liners are now exposed.

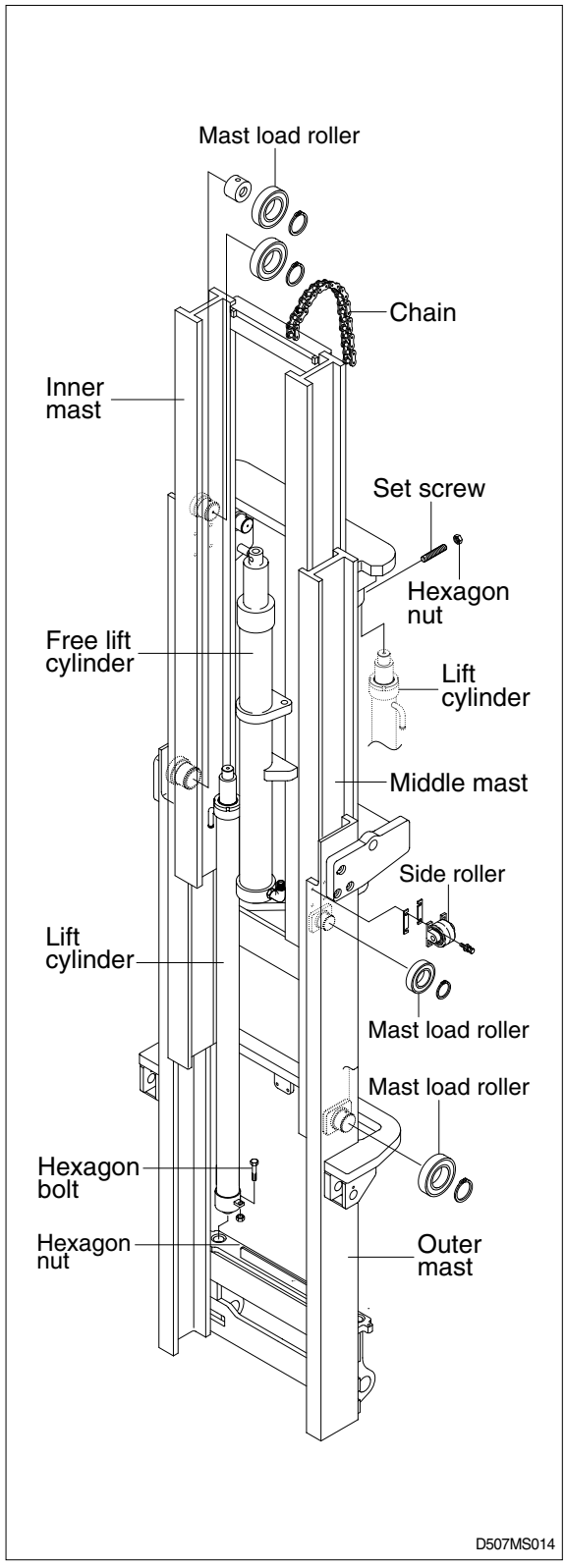
(8) Using a plier, remove load rollers from load bracket. Remove side rollers from mast.

(9) Attach chains or sling to the middle mast section at top crossmember. Using an overhead hoist, slowly raise the middle mast until top and bottom rollers are exposed.

(10) Using a plier, remove load rollers from roller bracket.

(11) Thoroughly clean, inspect and replace all worn or damaged parts.

(12) Reverse the above procedure to assemble. Refer to MAST LOAD ROLLER ADJUSTMENT Paragraph.



5. CHAIN

1) CHAIN SHEAVE

(1) Place a sling around carriage and attach to an overhead hoist. Lift carriage high enough so that the tension on the chain over sheaves is relieved after the carriage is blocked. Position wooden blocks under the carriage and lower it.

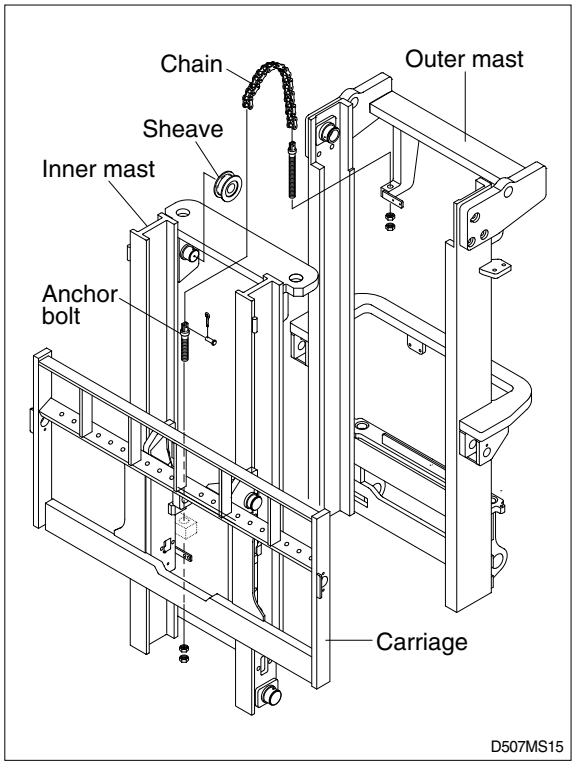
(2) Remove the split pin securing the chain anchor pins and discard. While supporting the chains, remove the chain anchor pins and drape the chain over the carriage.

(3) Remove retaining ring securing sheaves to sheave support. Remove sheaves with bearings.

(4) Remove bearing retaining ring from sheave and press bearings from sheaves.

(5) Thoroughly clean, inspect and replace all worn or damaged parts.

(6) Reverse the above to assemble and install. Use new split pins in chain anchor pins.



2) Rear chain sheave(TF mast)

(1) Raise and securely block carriage and inner mast section.

(2) Remove the split pin securing the chain anchor pins and discard.

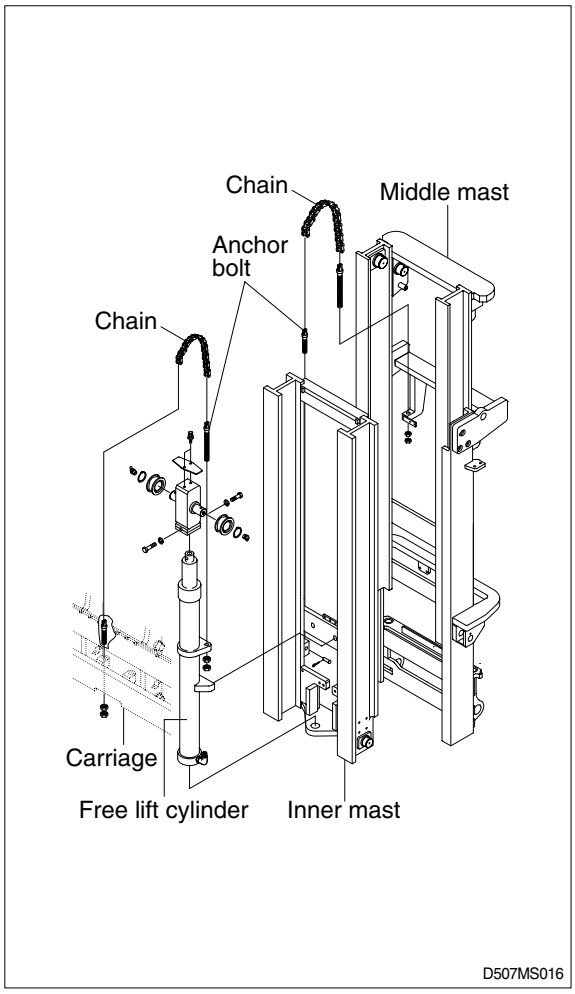
(3) Remove chains.

(4) Remove retaining ring securing chain sheaves to sheave support. Pry off sheaves with bearings.

(5) Remove bearing retaining ring from sheave and press bearings from sheaves.

(6) Thoroughly clean, inspect and replace all worn or damaged parts.

(7) Reverse the above procedure to assemble and install. Use new split pins in chain anchor pins.



3) Sheave support(TF mast)

(1) Remove the carriage assembly and move to one side.
(2) After removing bolt to securing sheave support assembly to free lift cylinder.
Attach a sling to the sheave support assembly. Using an overhead hoist, lift support assembly straight up and off of free lift cylinder. Move assembly to work area.
(3) Remove retaining ring securing sheave to sheave support.
(4) Remove bearing retaining ring from sheave and press bearings from sheaves.
(5) Thoroughly clean, inspect and replace all worn or damaged parts.
(6) Reverse the above procedure to install.

4) Rear chain(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 sheaves, the joints very gradually wear. The stretch a chain develops in service is due to material being worn off pin outer diameter and pitch hole inner diameter on the inside plate.
Chain wear can be measured using a wear scale or steel tape. When chains have elongated 2%, they should be discarded. When checking chain wear, be sure to measure a segment of chain that operates over a sheave. Do not repair chains by cutting out the worn section and splicing in a new piece. If part of the chain is worn, replace all the chains on the truck.

(2) Rust and corrosion

Chains used on lift trucks are highly stressed precision components. It is very important that the "as-manufactured" ultimate strength and fatigue strength be maintained throughout the chain service life. Corrosion will cause a major reduction in the load-carrying capacity of lift chain or roller chain because corrosion causes side plate cracking.

(3) Cracked plate

The most common cause of plate cracking is fatigue failure. Fatigue is a phenomenon that affects most metals and many plastics. After many repeated heavy loads, the plates may crack and the chains will eventually break. Fatigue cracks are almost always found through the pitch holes perpendicular to the pitch line. Contrast this failure mode to the random failures caused by stress-corrosion cracking. If cracks are present, replace all the chain on the truck. Noise in the chain indicates that the plate is on the verge of cracking and will be failed before long.

(4) Tight joints

All joints in lift chain should flex freely. Tight joints resist flexure, increase internal friction, thus increasing chain tension required to lift a given load. Increased tension accelerates wear and fatigue problems.

Tight joints in lift chains can be caused by :

- Bent pins or plates.
- Rusty joints.
- Peened plate edges.

Oil rusty chains and replace chains with bent or peened components.

(5) Protruding or turned pins

Heavily loaded chains operating with lube generate tremendous friction between pins and plates. In extreme cases, the frictional torque in the joint can actually turn pins in the press-fit outside plates. If chain is allowed to operate in this condition, the pins slowly work out of the chain causing chain failure. Turned pins can be quickly spotted because the flats on the V heads are no longer in line. Chains with turned or protruding pins should be replaced immediately. Do not attempt to repair the chain by driving pins back into the chain.

(6) Chain side wear

A wear pattern on pin heads and outside plates indicates misalignment. This condition damages chain and sheaves as well as increasing internal friction in the chain system.

(7) Chain anchors and sheaves

An inspection of the chain system includes a close examination of chain anchors and sheaves. Check chain anchors for wear, breakage and misalignment. Anchors with worn or broken fingers should be replaced. Anchors should be adjusted to eliminate twisting or other misalignment in the chain. When chain is misaligned, load is not distributed uniformly between the plates. Prolonged operation will result in premature fatigue failure. Sheaves with badly worn flanges and outside diameter should be replaced. Heavy flange wear indicates chain misalignment.

(8) Chain wear scale

The chain can be checked for wear or stretching with the use of a chain wear scale. Stretching of a chain is due to the elongation of the pitch holes and wearing of the pin O.D. The greatest amount of stretching occurs at the areas of the chain that flex over the sheaves most frequently. Check the chain at this point with a scale. The wear scale has instructions printed on the sides for use in determining chain stretch and are as follows :

- Determine pitch length of chain using 6 inch scale on one side of wear scale.
- If pitch is 1/2(12.7㎜), 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 sheaves. Broken, cracked or worn anchor must be replaced using the new anchor pin and split pin. Do not paint newly replaced chain after it has been installed.

(3) Adjustment

Chain adjustments are important for the following reasons :

- Equal loading of chain.
- Proper sequencing of mast.
- Prevent over-stretching of chains.
- Prevent chains from jumping off sheaves if they are too loose.

(4) Adjustment procedure

- With mast in its fully collapsed and vertical position, lower the fork to the floor.
- Adjust the chain length by loosening or tightening nut on the chain anchor.
  After making adjustment on the mast, be sure to tighten the nut.