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

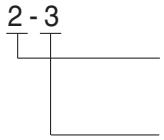
Distribution and updating

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



Item number (2. Structure and Function)

Consecutive page number for each item.

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

10 - 4
10 - 4 - 1
10 - 4 - 2] Added pages
10 - 5

Revised edition mark (①②③…)

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

Revisions

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

Symbols

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

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

3. CONVERSION TABLE

Method of using the Conversion Table

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

Example

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

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

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

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

2. Convert 550 mm into inches.

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

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

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

Millimeters to inches

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/cm² to lbf/in²

1kgf / cm² = 14.2233lbf / in²

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

TEMPERATURE

Fahrenheit-Centigrade Conversion.

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

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

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

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

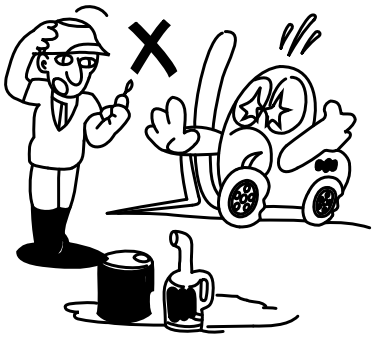
˚C		˚F	˚C		˚F	˚C		˚F	˚C		˚F
-40.4	-40	-40.0	-11.7	11	51.8	7.8	46	114.8	27.2	81	117.8
-37.2	-35	-31.0	-11.1	12	53.6	8.3	47	116.6	27.8	82	179.6
-34.4	-30	-22.0	-10.6	13	55.4	8.9	48	118.4	28.3	83	181.4
-31.7	-25	-13.0	-10.0	14	57.2	9.4	49	120.2	28.9	84	183.2
-28.9	-20	-4.0	-9.4	15	59.0	10.0	50	122.0	29.4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

SECTION 1 GENERAL

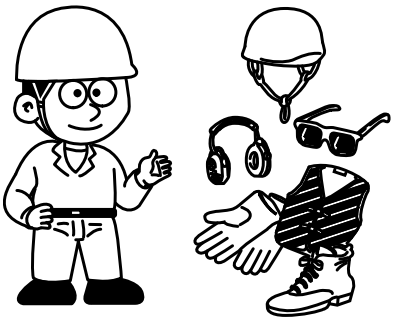
GROUP 1 SAFETY HINTS

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

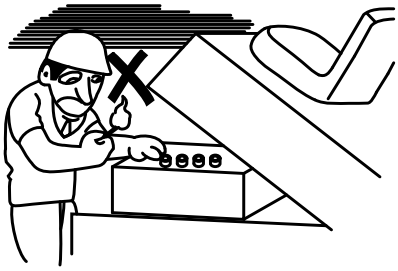
- Oil is a dangerous substance. Never handle oil, grease or oily clothes in places where there is any fire of flame.
  As preparation in case of fire, always know the location and directions for use of fire extinguishers and other fire fighting equipment.


D35ASF01

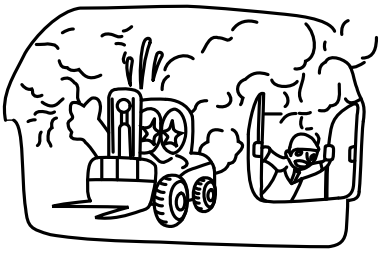
- Wear well-fitting helmet, safety shoes and working clothes. When drilling, grinding or hammering, always wear protective goggles.
  Always do up safety clothes properly so that they do not catch on protruding parts of machines. Do not wear oily clothes.
  When checking, always release battery plug.


D35ASF02

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

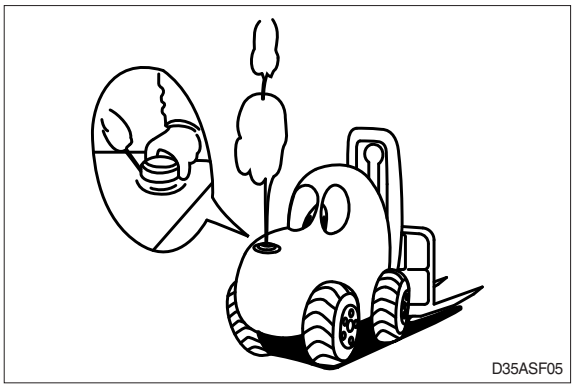

D35ASF03

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

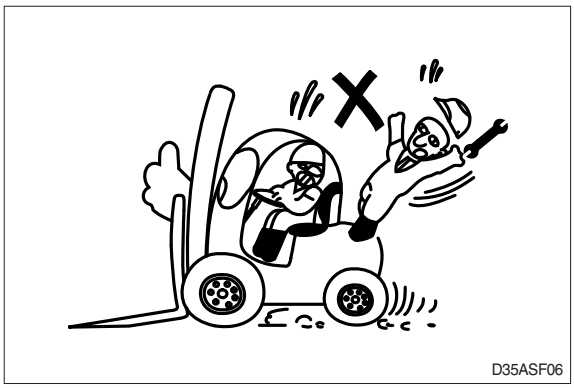

D35ASF04

⚠ 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.

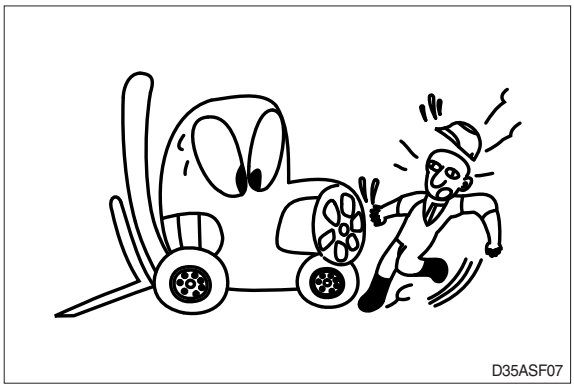

D35ASF05

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


D35ASF06

· 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.

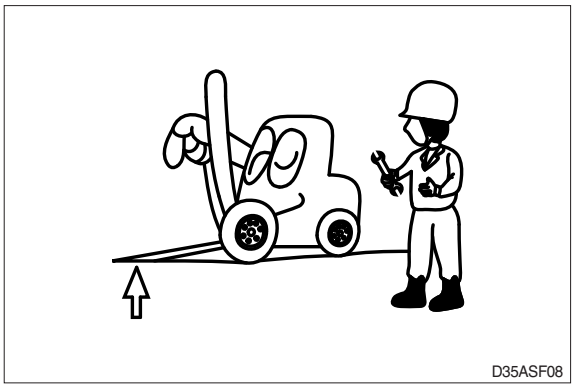
⚠ It is extremely dangerous to try to check the fan belt tension while he engine is running.


D35ASF07

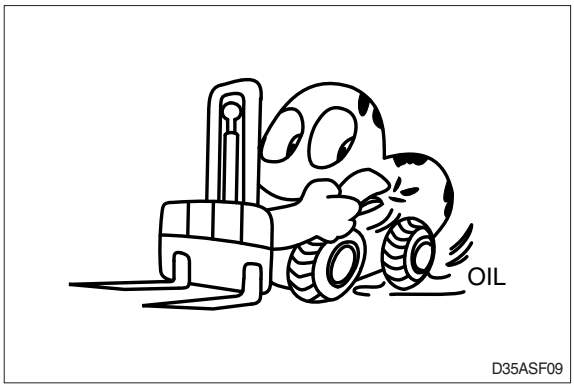
When inspecting the engine is running parts, or near such parts, always stop the engine first.

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

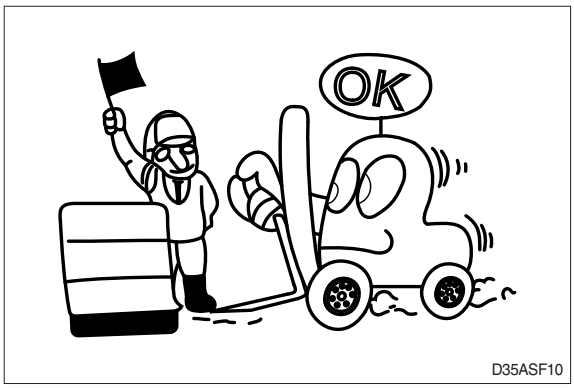
· Park the machine on firm, flat ground.
Lower the fork to the ground and stop the engine.
Return each lever to **NEUTRAL** and apply the brake lock.


D35ASF08

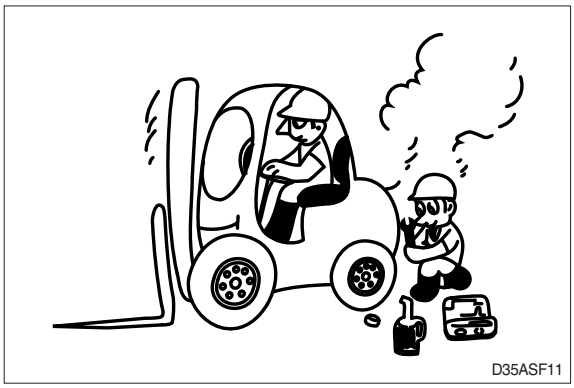
· Immediately remove any oil or grease on the floor of the operator's compartment, or on the handrail. It is very dangerous if someone slips while on the machine.



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



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



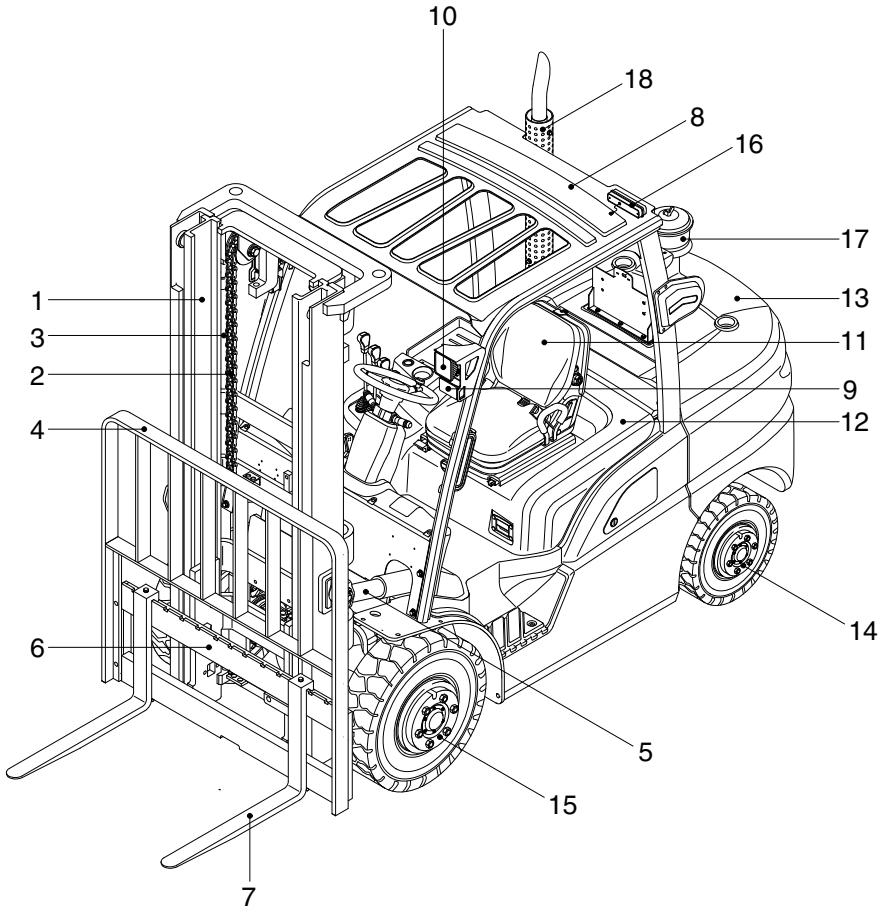
· Unless you have special instructions to the contrary, maintenance should always be carried out with the engine stopped. If maintenance is carried out with the engine running, there must be two men present : one sitting in the operator's seat and the other one performing the maintenance. In such a case,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

- Thoroughly clean the 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

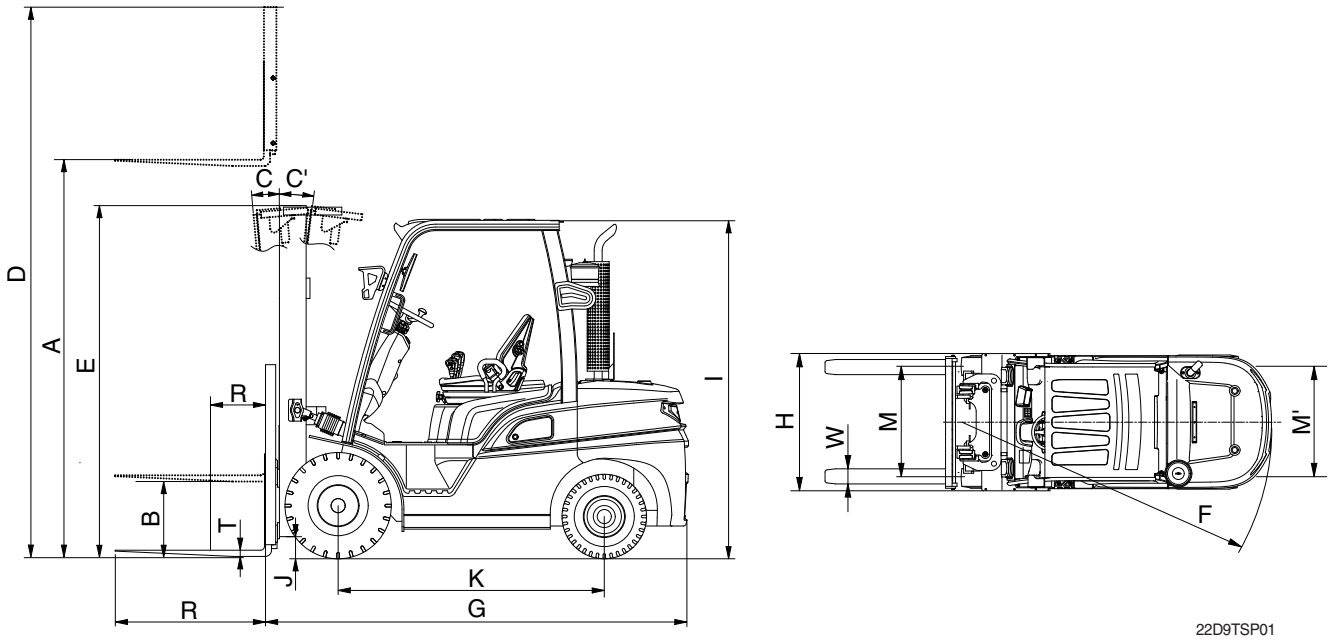
1. GENERAL LOCATIONS



22D9TOM54

1	Mast	7	Forks	13	Counterweight
2	Lift chain	8	Overhead guard	14	Rear wheel
3	Lift cylinder	9	Turn signal lamp	15	Front wheel
4	Backrest	10	Head lamp	16	Rear combination lamp
5	Tilt cylinder	11	Operator's seat	17	Pre-cleaner
6	Lift bracket	12	Bonnet	18	Silencer

2. SPECIFICATIONS



Model			Unit	22D-9S	25D-9S	30D-9S	33D-9S
Capacity			kg (lb)	2200 (4400)	2500 (5000)	3000 (6000)	3300 (6500)
Load center		R	mm (in)	500 (24")	←	←	←
Weight (Unloaded)			kg (lb)	3625 (7990)	3935 (8680)	4604 (10150)	4658 (10270)
Fork	Lifting height	A	mm (ft·in)	3305 (10' 10")	←	←	←
	Free lift	B	mm (in)	155 (6.1")	←	←	←
	Lifting speed (Unload/Load)		mm/sec	520/500	520/490	500/460	500/470
	Lowering speed (Unload/Load)		mm/sec	450/500	←	←	←
	L × W × T	L,W,T	mm (in)	1050×100×45 (41.3×3.9×1.8)	←	1050×122×45 (41.3×4.8×1.8)	←
Mast	Tilt angle (forward/backward)	C/C'	degree	6/10	←	←	←
	Max height	D	mm (ft·in)	4485 (14' 9")	←	←	←
	Min height	E	mm (ft·in)	2175 (7' 2")	←	2190 (7' 2")	2260 (7' 5")
Body	Travel speed (Unload)		km/h	18.4	←	19.8	←
	Gradeability (Load)		%	47.2	42	32.4	29.9
	Min turning radius (Outside)	F	mm (ft·in)	2286 (7' 6")	2342 (7' 8")	2413 (7' 11")	2463 (8' 1")
ETC	Operating pressure		kgf/cm²	200	←	←	←
	Hydraulic oil tank		ℓ (usgal)	36	←	38	←
	Fuel tank		ℓ (usgal)	60	←	←	←
Overall length		G	mm (ft·in)	2577 (8' 5")	2607 (8' 7")	2676 (8' 9")	2732 (9' 0")
Overall width		H	mm (ft·in)	1160 (3' 10")	←	1230 (4' 0")	1228 (4' 0")
Overhead guard height		I	mm (ft·in)	2160 (7' 1")	←	2180 (7' 2")	←
Ground clearance		J	mm (in)	130 (3.1")	←	145 (5.7")	←
Wheel base		K	mm (ft·in)	1650 (5' 5")	←	1700 (5' 7")	←
Wheel tread front/rear		M/M'	mm (ft·in)	999/980 (3' 3"/3' 3")	←	1005/980 (3' 6"/3' 3")	←

3. SPECIFICATION FOR MAJOR COMPONENTS

1) ENGINE

Item	Unit	Specification
Model	-	KUBOTA V3600
Type	-	Vertical, water-cooled, 4-cycle diesel
Cooling Method	-	Water cooling
Number of cylinders and arrangement	-	4 cylinders, in-line
Firing order	-	1-3-4-2
Combustion type	-	Spherical type (E-TVCS)
Cylinder bore X stroke	mm (in)	98×120 (3.9×4.7)
Piston displacement	cc (cu in)	3620 (221)
Compression ratio	-	22.6
Rated gross horse power	ps/rpm	65.4/2300
Maximum gross torque at rpm	kgf · m/rpm	22.5/1700
Engine oil quantity	ℓ (U.S.gal)	13.2 (3.5)
Dry weight	kg (lb)	272 (600)
High idling speed	rpm	2570
Low idling speed	rpm	900±50
Rated fuel consumption	g/ps.hr	173
Starting motor	V-kW	12-3
Alternator	V-A	14-45
Battery	V-AH	12-100
Fan belt deflection	mm (in)	10~12 (0.39~0.47)

2) MAIN PUMP

Item	Unit	Specification
Type	-	Fixed displacement gear pump
Capacity	cc/rev	32
Maximum operating pressure	bar	250
Rated speed (Max/Min)	rpm	2700/500

3) MAIN CONTROL VALVE

Item	Unit	Specification
Type	-	Sectional
Operating method	-	Mechanical
Main relief valve pressure	kg/cm^2	200/165
Flow capacity	lpm	80

4) POWER TRAIN DEVICES

Item			Specification
Torque converter	Model		KAPEC 280 DB
	Type		3 Element, 1 stage, 2 phase
	Stall ratio		2.90
Transmission	Type		Power shift
	Gear shift(FWD/REV)		1/1
	Control		Solenoid ON/OFF type
	Overhaul ratio	FWD	1.143
		REV	1.143
Axle	Type		Front-wheel drive type, fixed location
	Gear ratio		14.2 : 1
	Gear		Spiral bevel gear type
Wheels	Q'ty (FR/RR)		Single : 2/2, Double : 4/2
	Front (drive)	2.2/2.5	Single : 7.00-12-14 PR (STD), 8.15-15-14 PR (OPT)
			Double : 6.00-15-10 PR
		3.0/3.3	Single : 8.5-15-14 PR
			Double : 6.00-15-10 PR
	Rear (steer)	2.2~3.3	Single : 6.50-10-14 PR
			Double : 6.50-10-12 PR
Brakes	Travel		Front wheel, wet disk brake
	Parking		Wet disk (negative brake)
Steering	Type		Full hydraulic, power steering
	Steering angle		78.9˚ to both right and left angle, respectively

4. TIGHTENING TORQUE FOR MAJOR COMPONENTS

No.	Items		Size	kgf · m	lbf · ft
1	Engine	Engine mounting bolt (bracket-frame)	M12×1.75	12.8±3	92.6±21
2		Engine mounting bolt (engine-bracket)	M12×1.25	9.7±1.9	70±13
3		Radiator mounting bolt, nut	M 8×1.25	2.5±0.5	18±3.6
4		Torque converter mounting bolt (8EA)	M10×1.25	7.4±1.5	53.5±10
5	Hydraulic system	MCV mounting bolt	M10×1.5	4±0.5	29±3.6
6		Steering unit mounting bolt	M10×1.5	4±0.5	29±3.6
7		Pump mounting bolt	M10×1.5	5.3±0.5	38.3±3.6
8	Power train system	Transmission mounting bolt, nut	M16×2.0	7.5	54
9		Drive axle mounting bolt, nut	M20×1.5	65±3	470±21
10		Steering axle mounting bolt	M20×2.5	58±8.5	420±61
11		Front wheel mounting nut	M20×1.5	40±10	289±72
12		Rear wheel mounting nut	M16×1.5	18±2	130±14
13	Others	Counterweight mounting bolt	M30×3.5	199±30	1439±217
14		Operator's seat mounting nut	M 8×1.25	2.5±0.5	18.1±3.6
15		Head guard mounting bolt, nut	M12×1.75	12.3±1.2	89.0±8.7

5. TORQUE CHART

Use following table for unspecified torque.

1) BOLT AND NUT

(1) Coarse thread

Bolt size	8T		10T	
	kg · m	lb · ft	kg · m	lb · 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	2.73 ~ 4.12	19.5 ~ 29.8
M10 × 1.5	4.0 ~ 6.0	28.9 ~ 43.4	5.5 ~ 8.3	39.8 ~ 60
M12 × 1.75	7.4 ~ 11.2	53.5 ~ 79.5	9.8 ~ 15.8	71 ~ 114
M14 × 2.0	12.2 ~ 16.6	88.2 ~ 120	16.7 ~ 22.5	121 ~ 167
M16 × 2.0	18.6 ~ 25.2	135 ~ 182	25.2 ~ 34.2	182 ~ 247
M18 × 2.5	25.8 ~ 35.0	187 ~ 253	35.1 ~ 47.5	254 ~ 343
M20 × 2.5	36.2 ~ 49.0	262 ~ 354	49.2 ~ 66.6	356 ~ 482
M22 × 2.5	48.3 ~ 63.3	350 ~ 457	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 ~ 1655
M36 × 4.0	174 ~ 236	1261 ~ 1703	250 ~ 310	1808 ~ 2242

(2) Fine thread

Bolt size	8T		10T	
	kg · m	lb · ft	kg · m	lb · ft
M 8 × 1.0	2.17 ~ 3.37	15.7 ~ 24.3	3.04 ~ 4.44	22.0 ~ 32.0
M10 × 1.25	4.46 ~ 6.66	32.3 ~ 48.2	5.93 ~ 8.93	42.9 ~ 64.6
M12 × 1.25	7.78 ~ 11.58	76.3 ~ 83.7	10.6 ~ 16.0	76.6 ~ 115
M14 × 1.5	13.3 ~ 18.1	96.2 ~ 130	17.9 ~ 24.1	130 ~ 174
M16 × 1.5	19.9 ~ 26.9	144 ~ 194	26.6 ~ 36.0	193 ~ 260
M18 × 1.5	28.6 ~ 43.6	207 ~ 315	38.4 ~ 52.0	278 ~ 376
M20 × 1.5	40.0 ~ 54.0	289 ~ 390	53.4 ~ 72.2	386 ~ 522
M22 × 1.5	52.7 ~ 71.3	381 ~ 515	70.7 ~ 95.7	512 ~ 692
M24 × 2.0	67.9 ~ 91.9	491 ~ 664	90.9 ~ 123	658 ~ 890
M30 × 2.0	137 ~ 185	990 ~ 1338	182 ~ 248	1314 ~ 1795
M36 × 3.0	192 ~ 260	1389 ~ 1879	262 ~ 354	1893 ~ 2561

2) PIPE AND HOSE (FLARE type)

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

3) PIPE AND HOSE (ORFS type)

Thread size	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	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) -50 (-58) -30 (-22) -20 (-4) -10 (14) 0 (32) 10 (50) 20 (68) 30 (86) 40 (104)
Engine oil pan	Engine oil	13.2 (3.5)	★SAE 5W-40 SAE 30 SAE 10W SAE 10W-30 SAE 15W-40
Torque converter transmission	Transmission oil	10 (2.6)	ATF DEXRON III
Axle	Gear oil	5 (1.3)	Shell DONAX TD
Hydraulic tank	Hydraulic oil	40 (10.6)	★ISO VG 15 ISO VG 46 ISO VG 68
Fuel tank	Diesel fuel★1	60 (15.9)	★ASTM D975 NO.1 ASTM D975 NO.2
Fitting (Grease nipple)	Grease	-	★NLGI NO.1 NLGI NO.2
Brake reservoir tank	Brake oil	0.5 (0.13)	★AZOLLA ZS10 (ISO VG10) AZOLLA ZS32 (Hydraulic oil, ISO VG32)
Radiator	Antifreeze : Soft water★2	9.4 (2.48)	Ethylene glycol base permanent type (50:50) ★Ethylene glycol base permanent type (60 : 40)

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.

★ : Cold region
Russia, CIS, Mongolia

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

★2 : Soft water
City water or distilled water

GROUP 3 PERIODIC REPLACEMENT

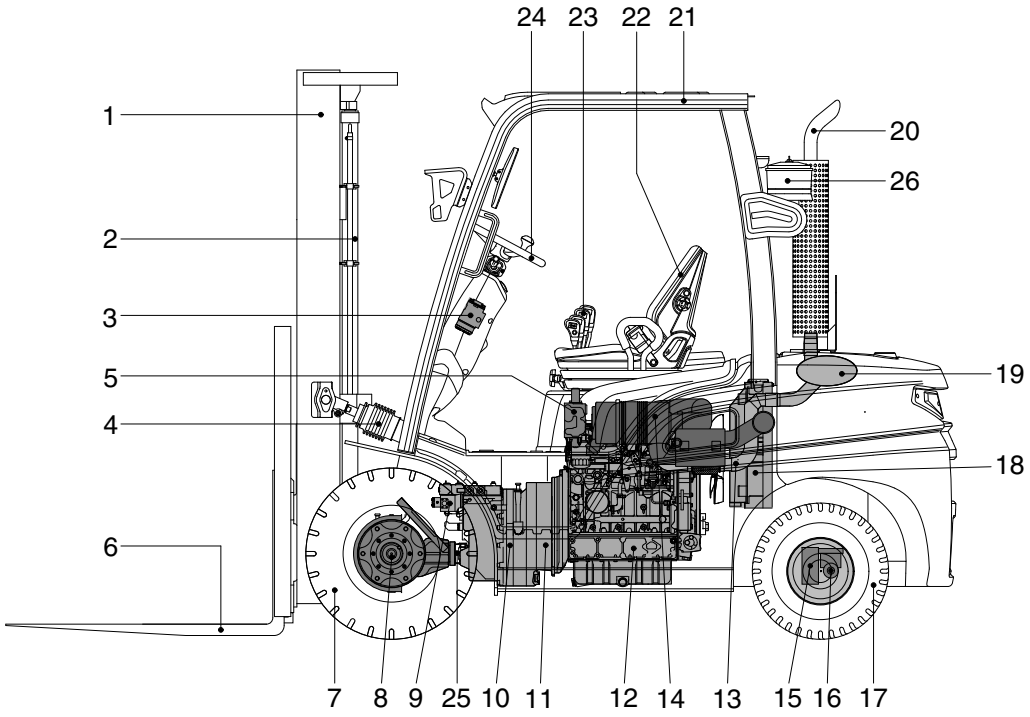
For operation safety, never fail to perform periodic maintenance or make periodic replacement of the consumable parts listed in the following.
These parts may deteriorate in time and are susceptible to wear. It is difficult to estimate the degree of wear at time of periodic maintenance; therefore, even 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	Packing, seal and O-ring of steering cylinder	Every 2 to 4 years
8	Lift chain	Every 2 to 4 years
9	Lift, tilt, side shift cylinder hose	Every 1 or 2 years
10	Hydraulic pump hose	Every 2 years

SECTION 2 REMOVAL & INSTALLATION OF UNIT

SECTION 2 REMOVAL & INSTALLATION OF UNIT

GROUP 1 MAJOR COMPONENTS



22D9SOM21

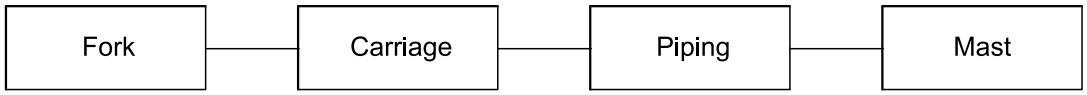
1	Mast	10	Transmission	19	Muffler
2	Lift cylinder	11	Torque converter	20	Silencer
3	Steering unit	12	Engine	21	Overhead guard
4	Tilt cylinder	13	Exhaust pipe	22	Seat
5	Control valve	14	Air cleaner	23	Control lever
6	Fork	15	Steering axle	24	Steering wheel
7	Front wheel	16	Steering cylinder	25	Drive shaft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

GROUP 2 REMOVAL AND INSTALLATION OF UNIT

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

1. MAST

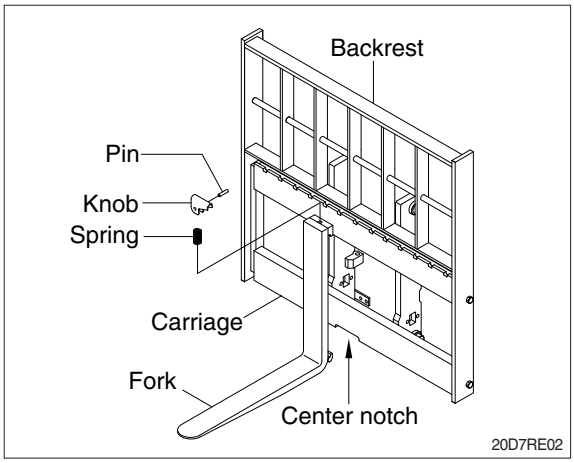
1) REMOVAL



L15C3RE001

(1) Forks

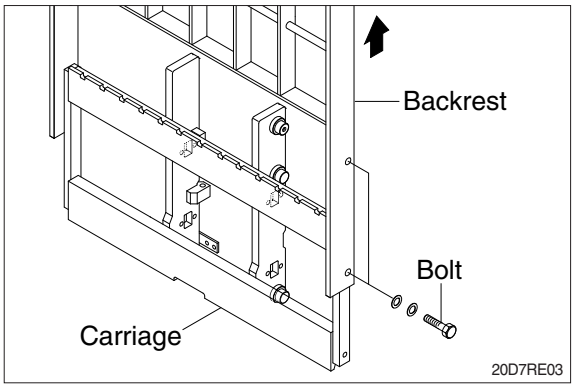
① Lower the fork carriage until the forks are approximately 25 mm (1 in) from the floor.
② Turn knob up and slide one fork at a time toward the center of the carriage where a notch has been cut in the bottom plate for easy removal.
③ Remove only one fork at a time.
※ On larger forks it may be necessary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



20D7RE02

(2) Backrest (If necessary)

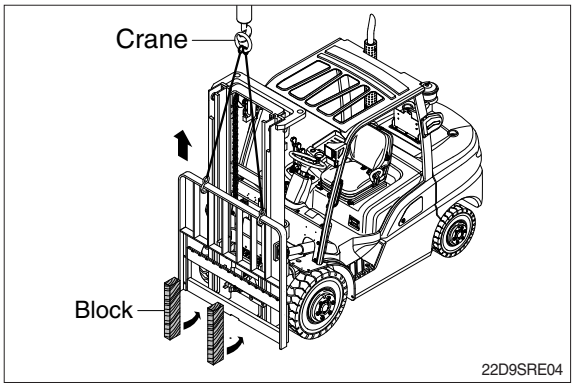
① Remove bolts securing backrest to fork carriage. Lift backrest straight up and remove it from carriage.



20D7RE03

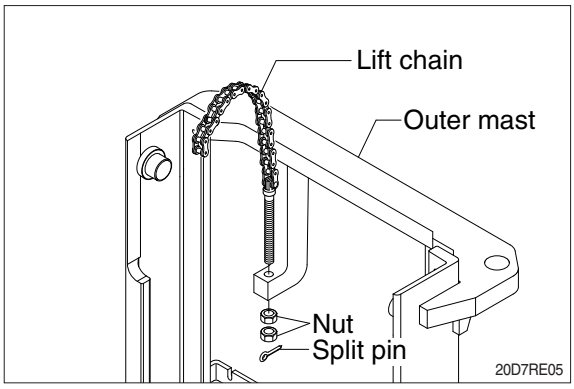
(3) Carriage

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.

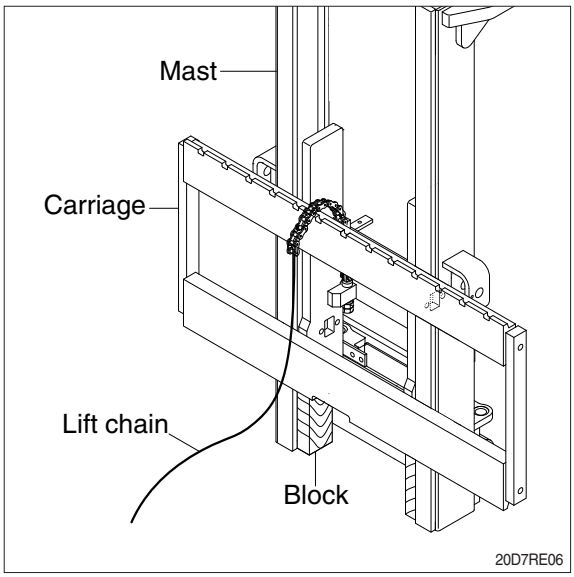


22D9SRE04

② While supporting lift chains, remove nuts and split pin from the anchor bolt.



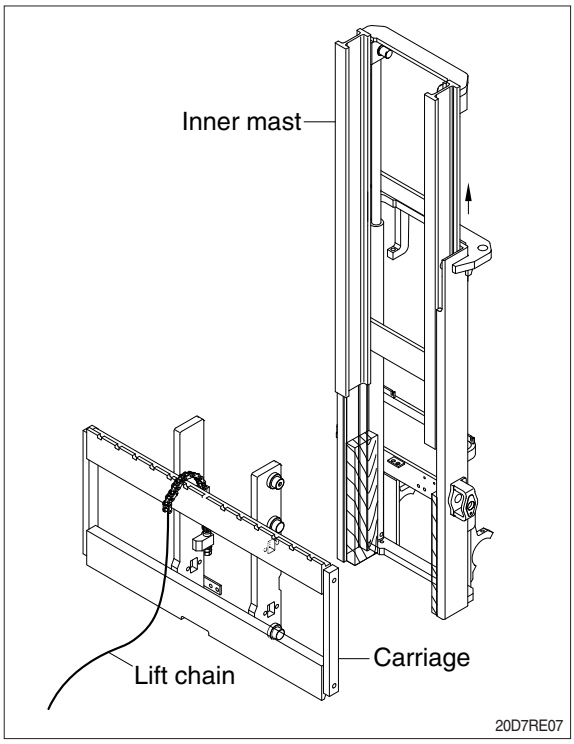
③ Pull the chains out of the sheaves and drape them over the front of the carriage.



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

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

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

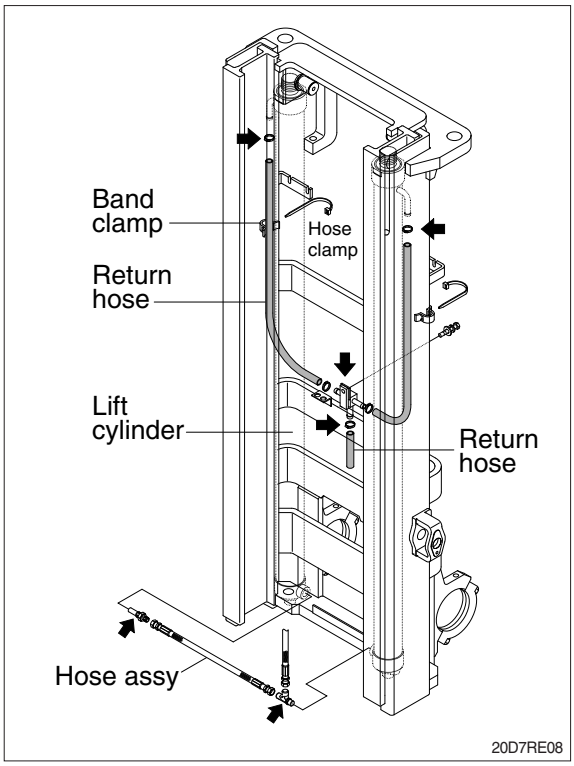


(4) Piping

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

② Remove hose assembly, valve and tee from the lift cylinder.

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



(5) Lift cylinder

① Loosen hexagonal bolts and remove washers securing the lift cylinders to inner mast.

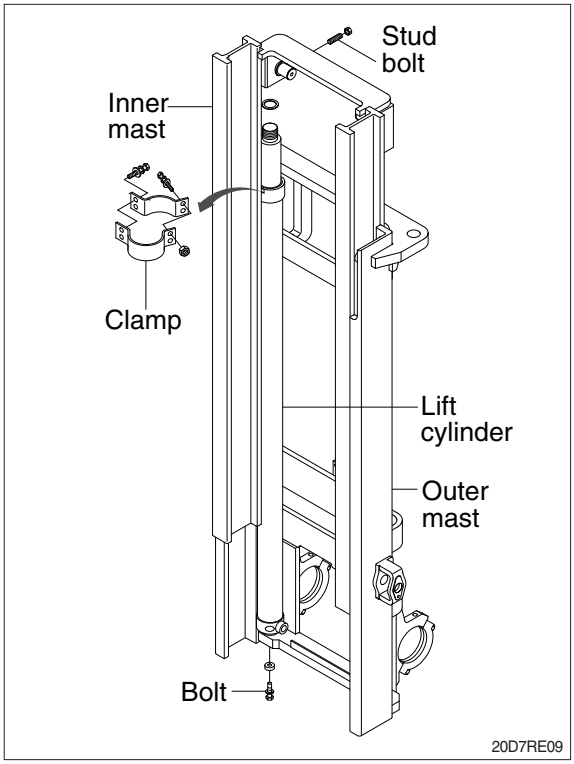
② Bind the lift cylinder with overhead hoist rope and pull up so that the rope has no slack or binding.

⚠ Make sure that the lift cylinder be tightened firmly for safety.

③ Loosen and remove hexagon nuts and clamp securing cylinder to outer mast.

④ Using an overhead hoist, slowly raise the inner mast high enough to clear lift cylinder.

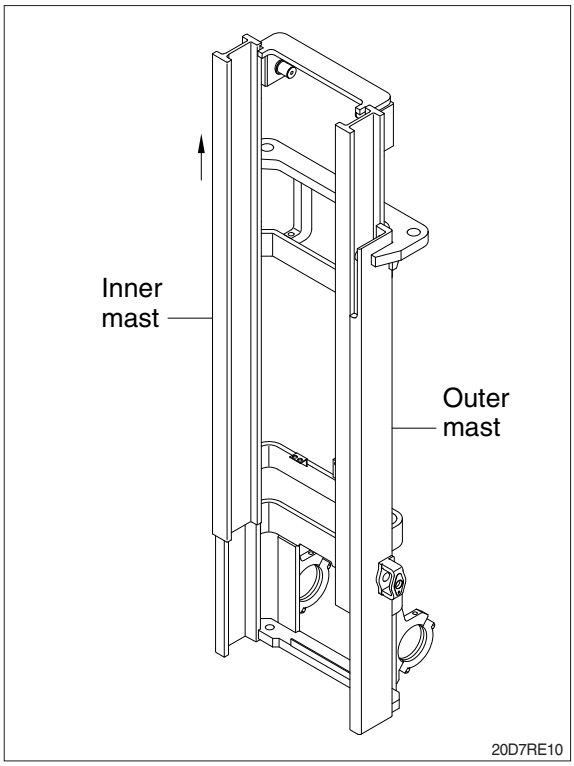
⑤ Using an overhead hoist, draw out lift cylinder carefully and put down on the work floor.



(6) Inner mast

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

⚠ Be careful the mast not to swing or fall.



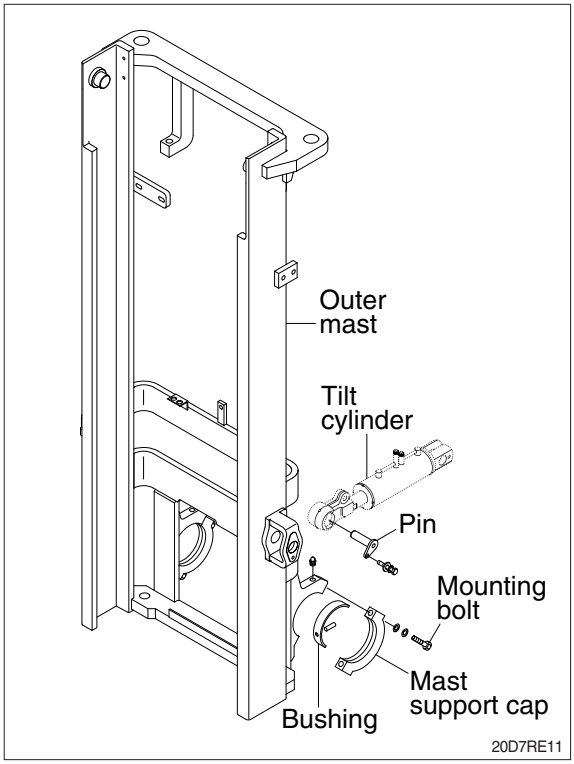
(7) Tilt cylinder pin

(8) Mast support cap

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

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

② Remove the mounting bolts from the cap then slowly raise the outer mast.



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 cap

① Check the mast support cap and spring pin for wear.

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 bolts to mast support cap. Apply lubrication oil GTP 600 or 1000 PASTE.

· Tightening torque : 24.5±2.5 kgf · m (177±18 lbf · ft)

(2) Tilt cylinder pin

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

(3) Lift cylinder installation and adjustment

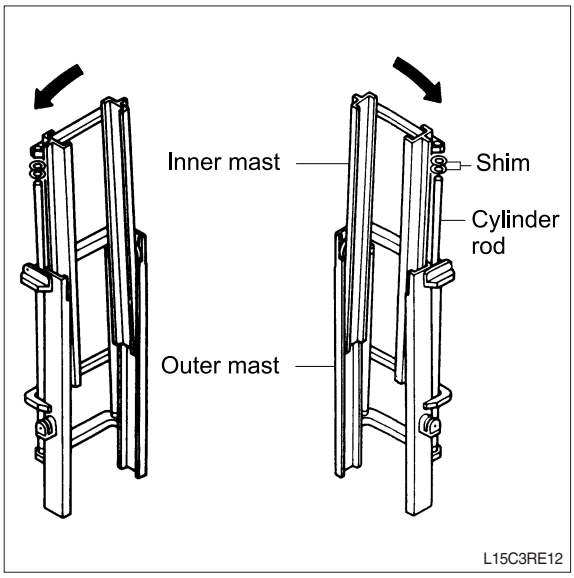
① Assemble the lift cylinder inside the outer mast, then tighten the stopper bolt. If the cylinder assembly has been replaced, adjust as follows so that the left and right cylinders are synchronized at the maximum lifting height.

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

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

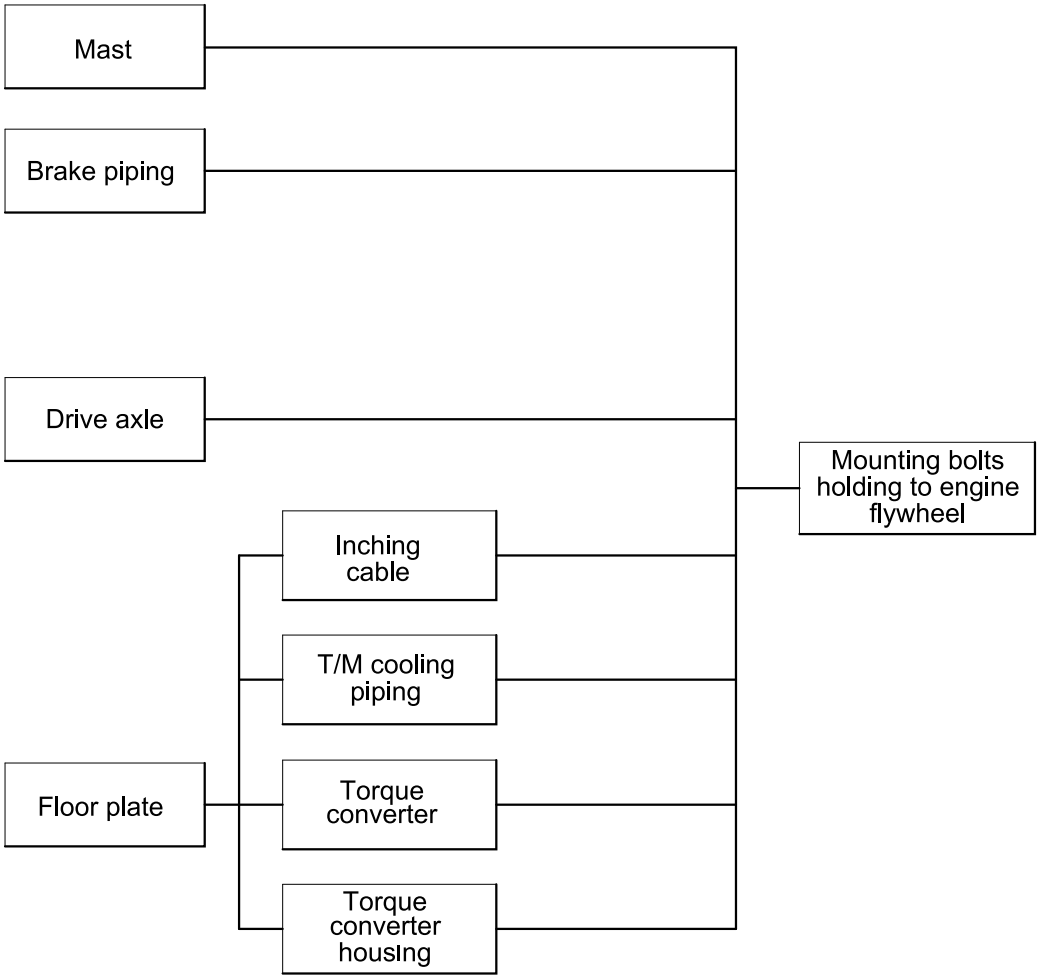
※ If play is to RIGHT, install adjustment shim to RIGHT cylinder.

· Shim thickness : 1.0 mm (0.04 in)



2. POWER TRAIN ASSEMBLY

1) REMOVAL



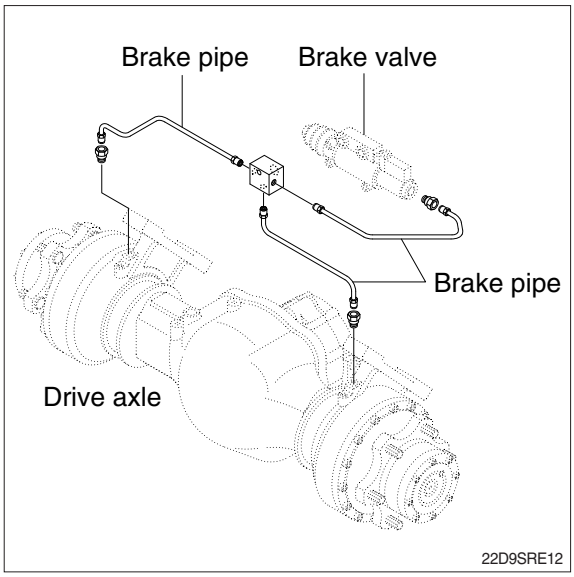
D503RE04

(1) Mast

Refer to section on mast (Page 2-2)

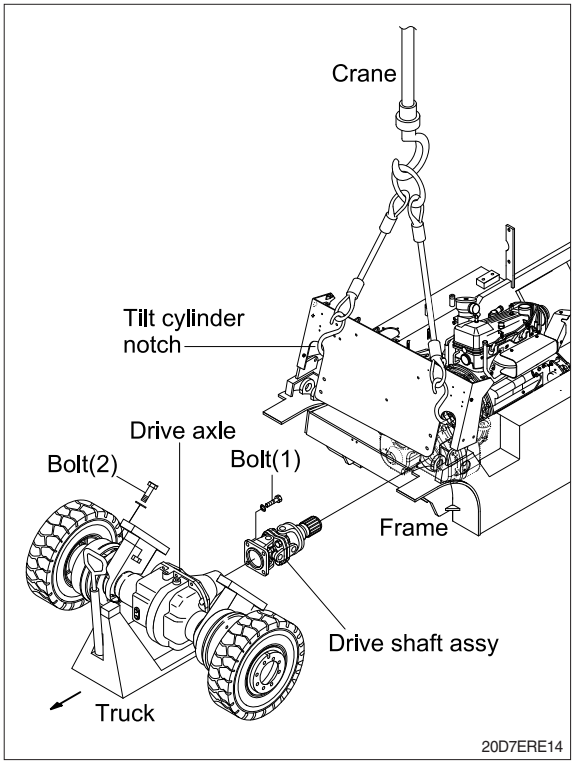
(2) Brake piping

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



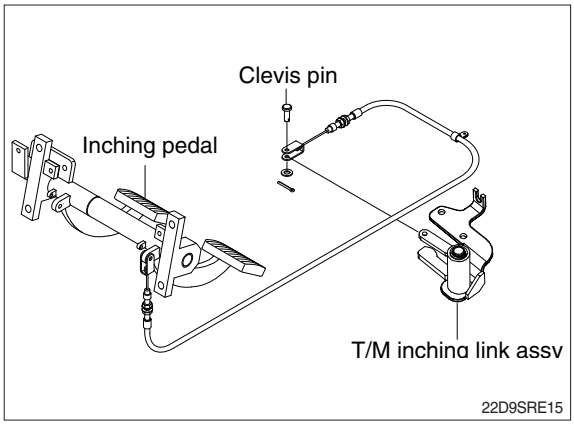
(3) Drive axle

① Attach a crane to the tilt cylinder notches on the dashboard and raise the machine.
② Loosen hexagonal bolts (1) connection drive axle to the transmission.
③ Put the block under the drive axle and support under the drive axle with a truck.
④ Remove drive axle mount bolts (2) from the frame and then slowly pull out the truck with drive axle to the front.
⑤ Remove drive shaft assy from transmission.



(4) Inching linkage

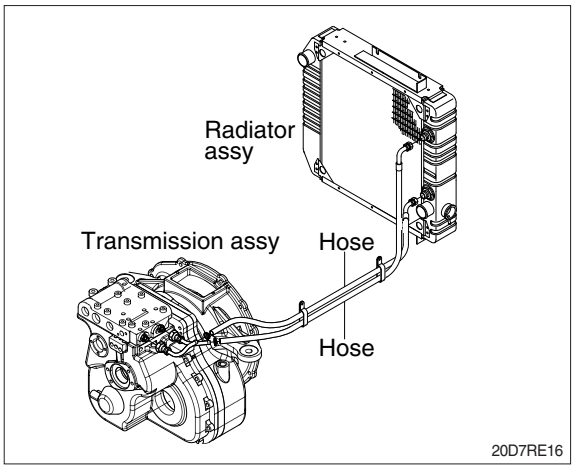
Remove the clevis pin from the transmission control valve.



(5) Transmission cooling piping

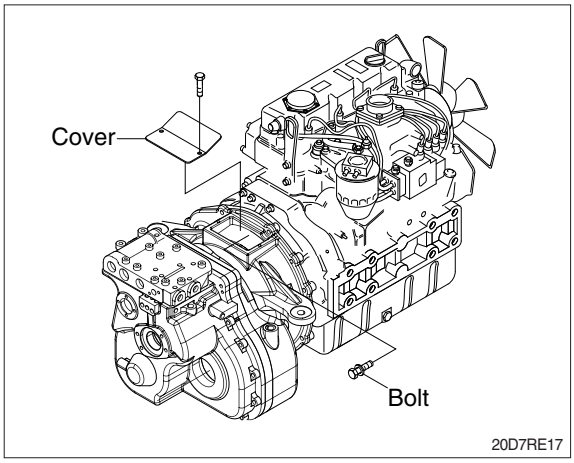
① Disconnect cooling hose from the transmission.

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



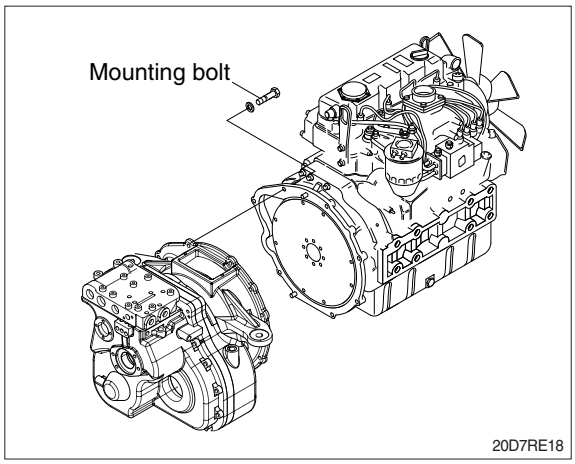
(6) Torque converter

① Remove the cover on top face of the torque converter housing then remove the 8 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.

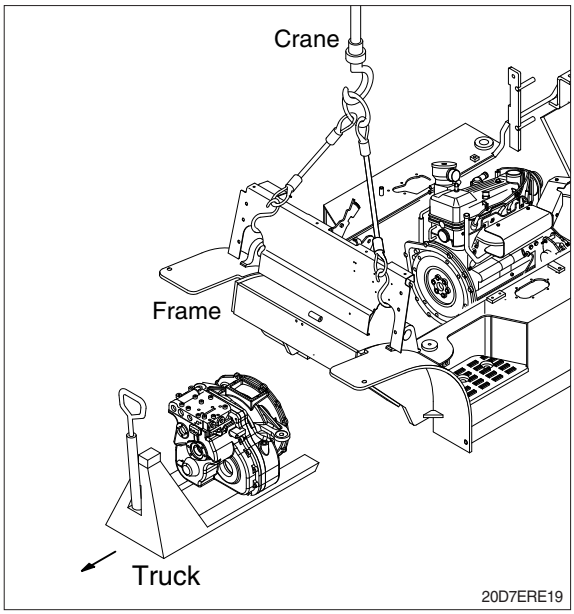


(7) Mounting bolts holding to flywheel housing

① Remove transmission assembly from the engine flywheel housing by loosening the 8 mounting bolts.



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

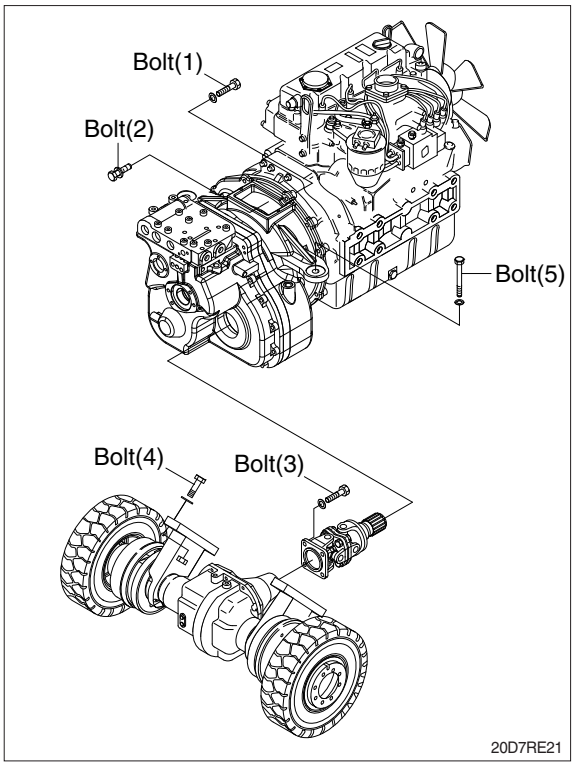


2) INSTALLATION

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

(2) Tightening torque

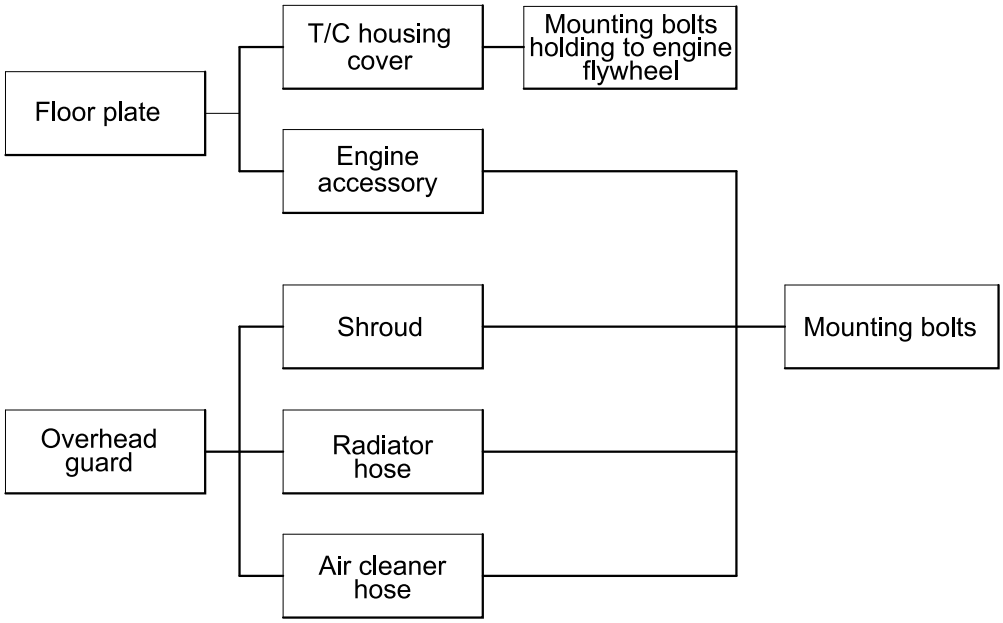
- Bolt (1):5.9~8.9 kgf · m (42.7~64.4 lbf · ft)
- Bolt (2):2.7~4.1 kgf · m (19.5~29.7 lbf · ft)
- Bolt (3):5.9~8.9 kgf · m (42.7~64.4 lbf · ft)
- Bolt (4):62~68 kgf · m (448~492 lbf · ft)
- Bolt (5):7.5 kgf · m (54.2 lbf · ft)



3. ENGINE

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

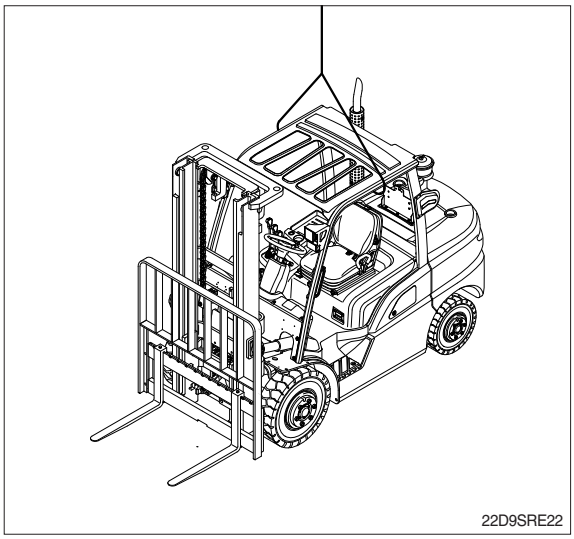
1) REMOVAL



D503RE25

(1) Overhead guard

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

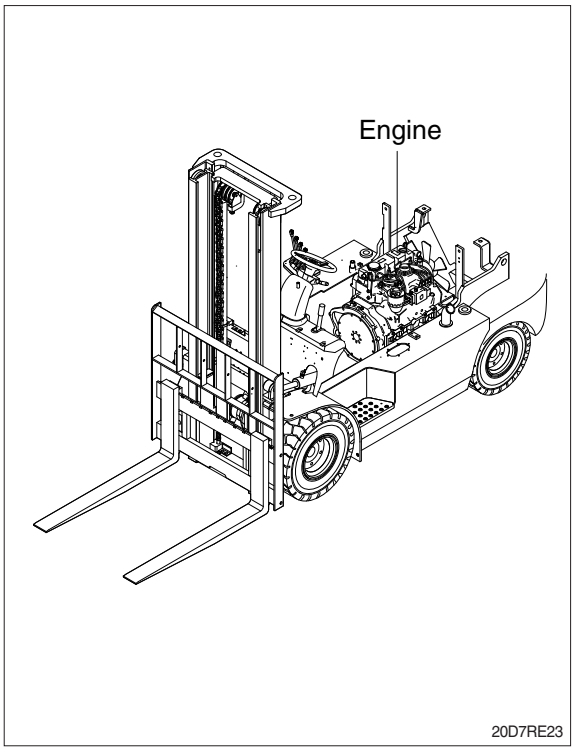


22D9SRE22

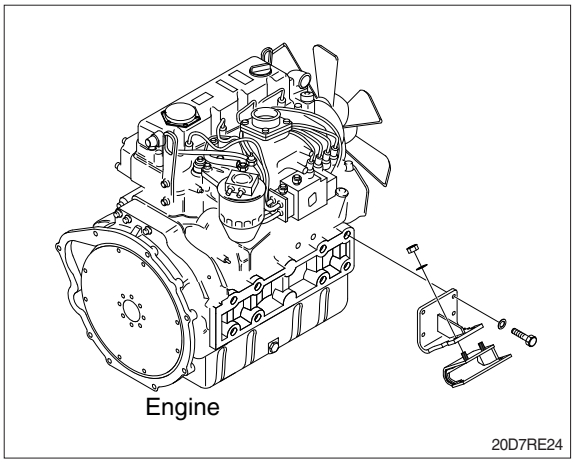
(2) Remove the torque converter housing cover, mounting bolts installed to flywheel housing.
For details, see page 2-9.

(3) Engine accessory
Remove all wiring harnesses, cables and hoses around the engine, dashboard and frame.
① Wiring harness to alternator and starter.
② Wiring harness for oil pressure and engine water temperature gauges.
③ Cables for meters, buttons and accelerator pedal.
④ Hoses to fuel tank and air cleaner.
⑤ Exhaust pipe.

(4) Radiator hose
Open the drain valve of the radiator and drain the cooling water, then remove the radiator hose.



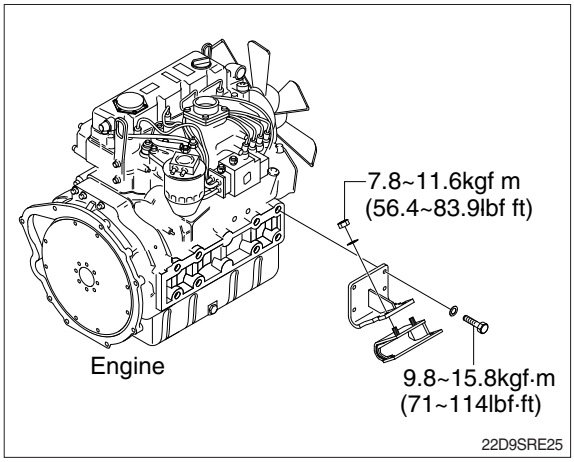
(5) Mounting bolt
Attach a crane to the engine hook and raise, then remove mounting bolts. Raise the engine slightly, slide towards the radiator, then lift up.
※ When sliding the engine, be careful of the collision engine and radiator.



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

(1) Tighten the engine mounting bolts and nuts.

(2) Tighten the engine mounting bracket bolts.
※ Do not remove the bolts unless necessary. Loctite is coated over the threads of bolt. So, once the bolts were removed, coat them with loctite (#243) when installing.
※ Before installing the bolts, loctite in the holes should be removed by a tap.



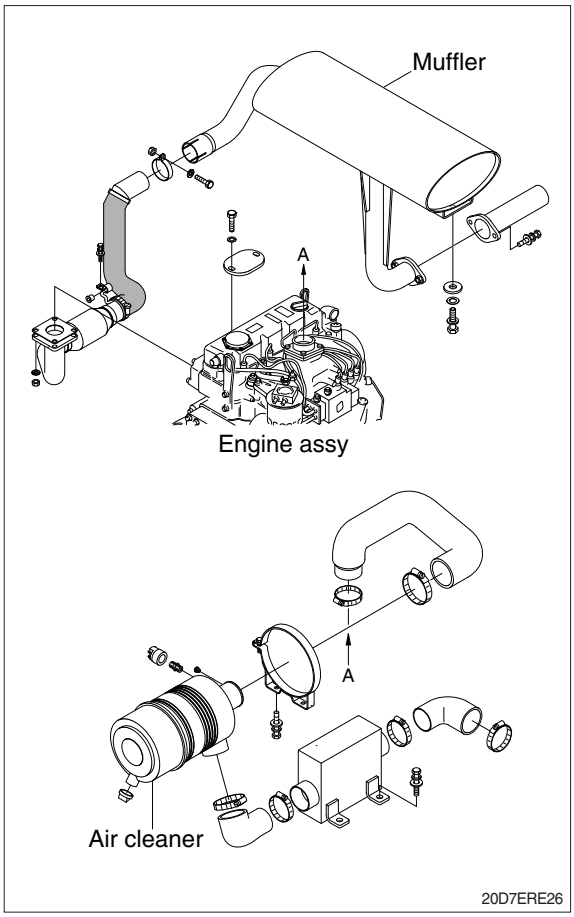
(3) Tightening torque of mounting bolt installing to torque converter housing.
- 5.9~8.9 kgf · m (43~64 lbf · ft)

(4) Radiator hoses
- Distance to insert hose : 35 mm (1.4 in)

(5) Air cleaner hose

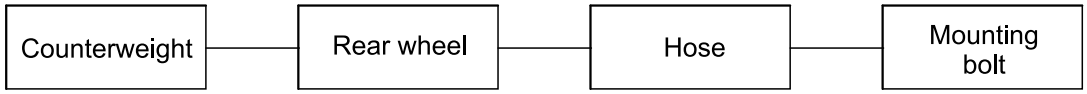
① Insert the air cleaner hose securely and fit a clamp.

② Distance to insert hose
- Air cleaner hose : 35 mm (1.4 in)
- Engine end : 35 mm (1.4 in)

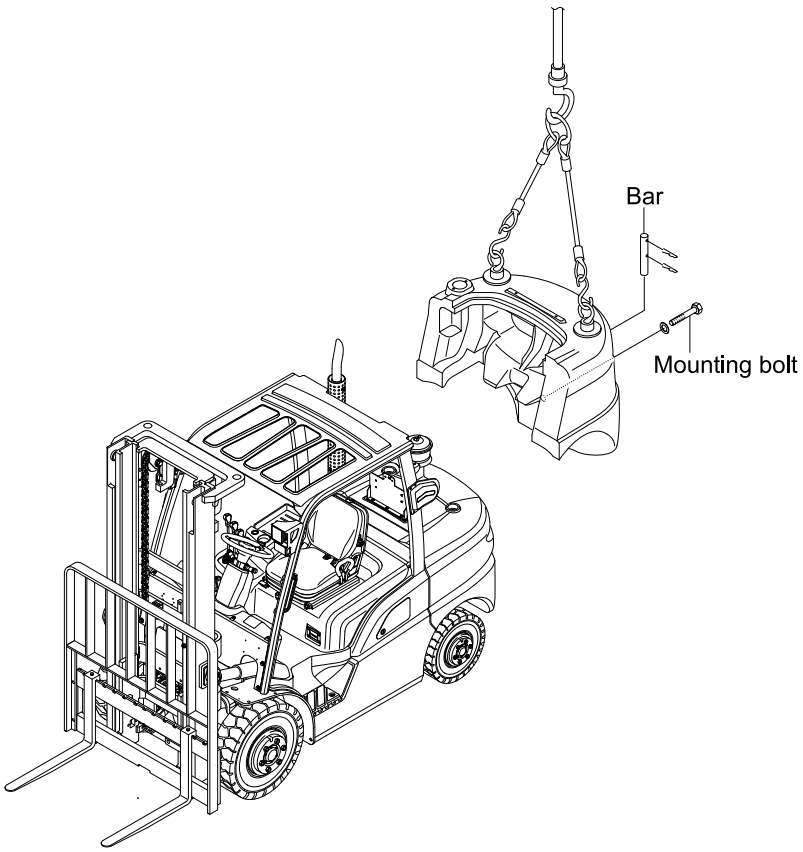


4. STEERING AXLE

1) REMOVAL



D503RE35



22D9SRE27

(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)

22D-9S : 1,060 kg (2,337 lb)

25D-9S : 1,370 kg (3,020 lb)

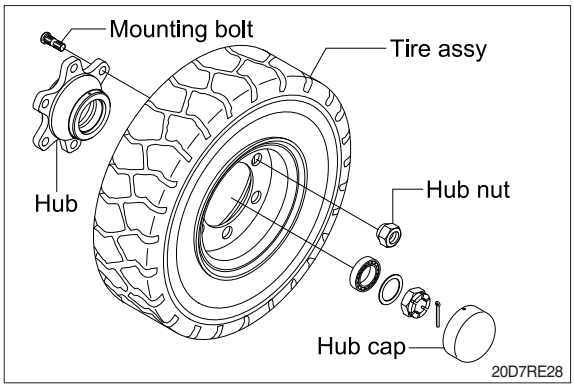
30D-9S : 1,688 kg (3,721 lb)

33D-9S : 1,925 kg (4,244 lb)

⚠ When rasing the counterweight, only must use appropriate lifting appliances which should be had sufficient capacity for lifting of the counterweight.

(2) Rear wheel

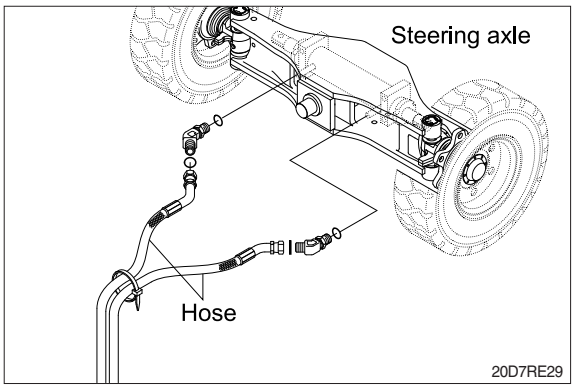
Remove mounting bolt and hub nut with socket wrench and then carefully take out the tire assembly.



(3) Hose

Drain hydraulic oil in the hoses and cylinders before removing them.

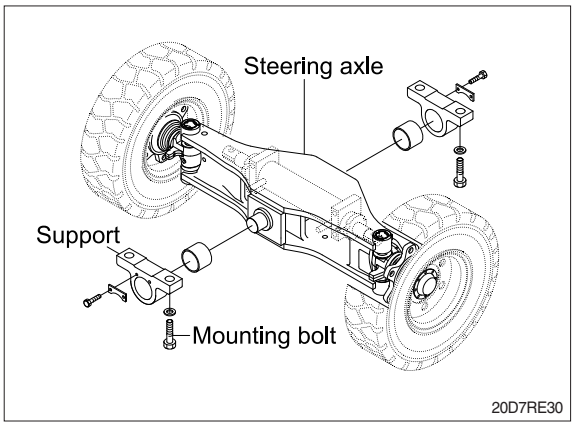
Remove the fitting and then disconnect the hoses.



(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.



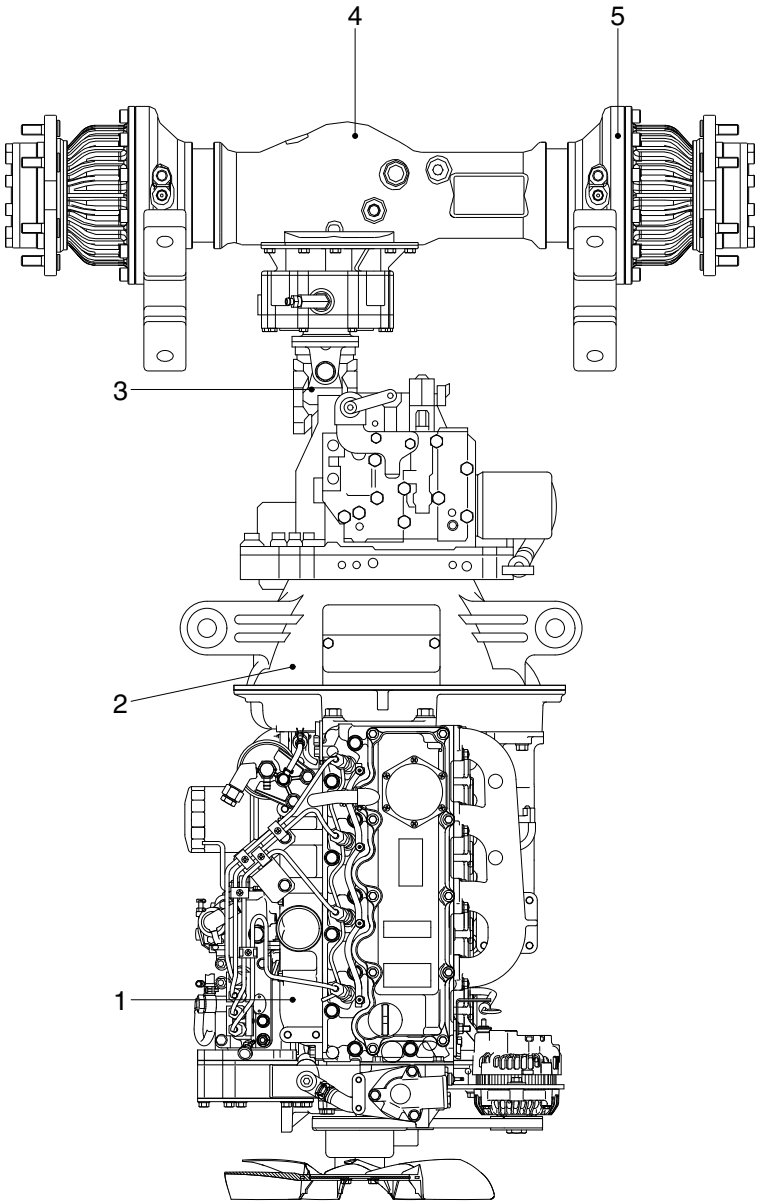
SECTION 3 POWER TRAIN SYSTEM

SECTION 3 POWER TRAIN SYSTEM

GROUP 1 STRUCTURE AND OPERATION

1. POWER TRAIN DIAGRAM

1) STRUCTURE



22D9SPT26

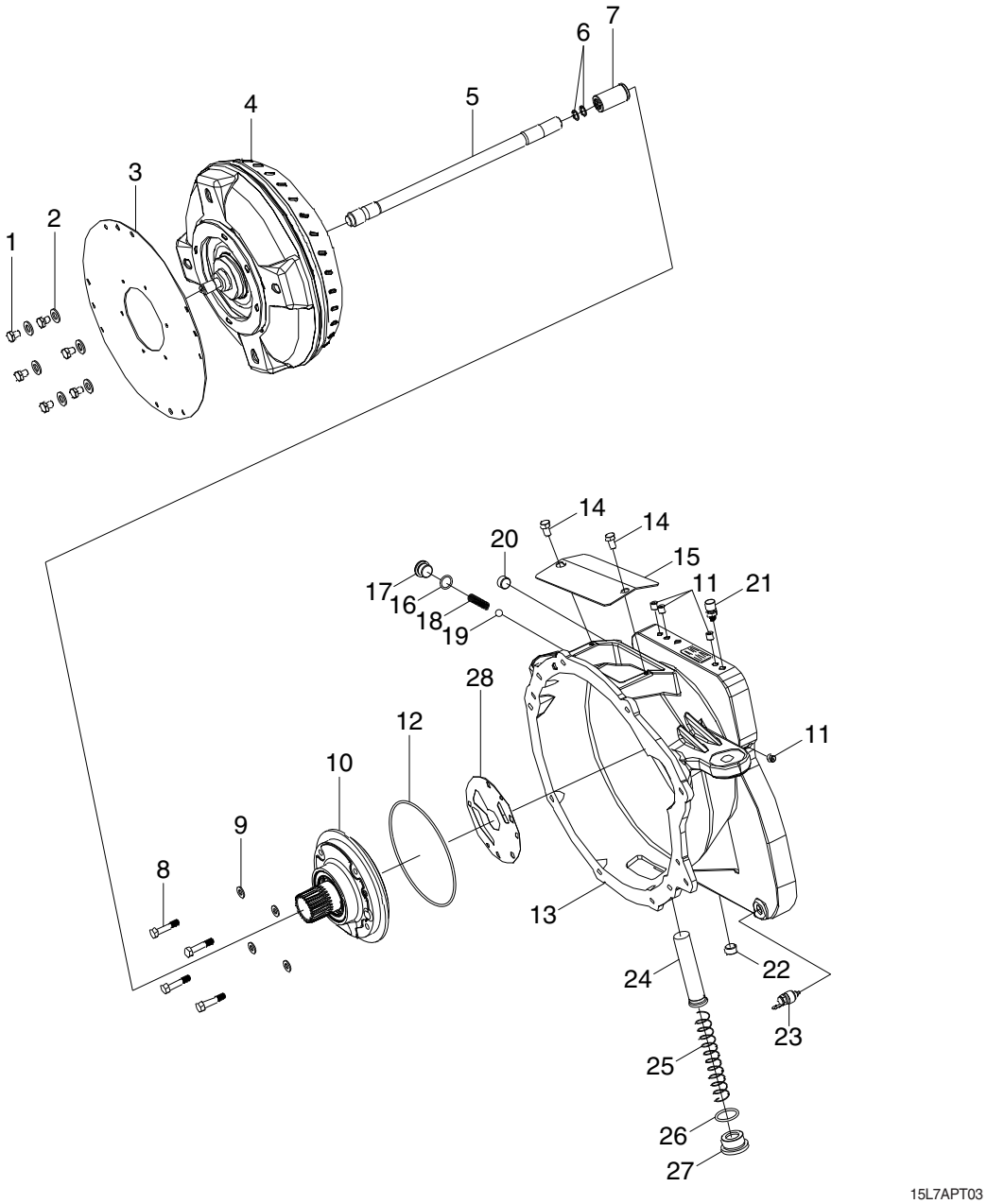
1	Engine	3	Drive shaft	5	Brake
2	Transmission	4	Drive axle		

2) SPECIFICATION

Item			Specification
Torque converter	Model		KAPEC 280 DB
	Type		3 Element, 1 stage, 2 phase
	Stall ratio		2.90
Transmission	Type		Power shift
	Gear shift (FWD/REV)		1/1
	Control		Solenoid ON/OFF type
	Overhaul ratio	FWD	1.143
		REV	1.143
Axle	Type		Front-wheel drive type, fixed location
	Gear ratio		14.2 : 1
	Gear		Spiral bevel gear type
Wheels	Q'ty (FR/RR)		Single : 2/2, Double : 4/2
Brakes	Travel		Front wheel, wet disk brake
	Parking		Wet disk (negative brake)
Steering	Type		Full hydraulic, power steering
	Steering angle		78.9˚ to both right and left angle, respectively

2. TORQUE CONVERTER

1) STRUCTURE



1	Hexagon bolt	11	Plug	21	Air breather
2	Plain washer	12	O-ring	22	Magnetic plug
3	Flexible plate	13	Torque converter housing	23	Temperature sensor
4	Torque converter assembly	14	Hexagon bolt	24	Inner oil strainer
5	Shaft	15	Torque converter cover	25	Oil strainer spring
6	Snap ring	16	O-ring	26	O-ring
7	Gear	17	Plug	27	Oil strainer plug
8	Hexagon bolt	18	Spring	28	Gasket
9	Copper washer	19	Ball		
10	Charging pump assembly	20	Plug		

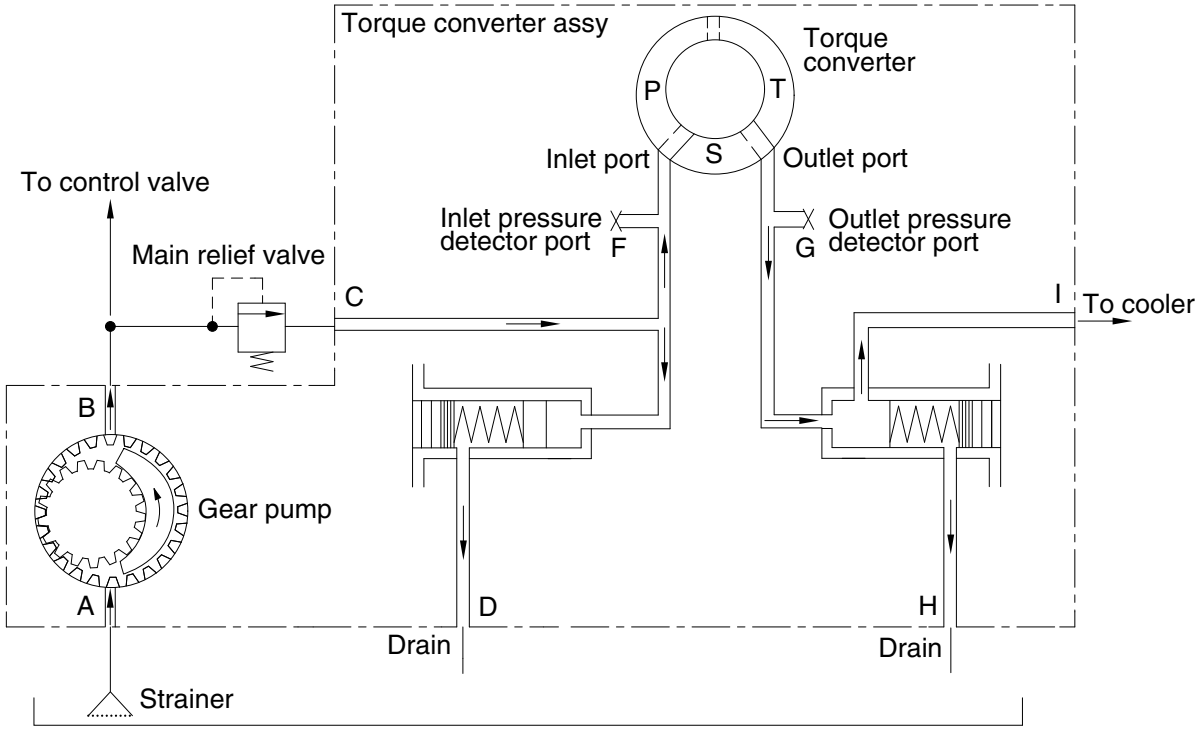
2) OPERATION

The torque converter is connected with a flywheel by a flexible plate, engine output is delivered from the flywheel to the flexible plate.

The exterior of the torque converter is protected by the torque converter housing.

The torque converter housing forms the oil path for the oil pump, it includes the oil strainer filtering sucked oil through this oil path and the oil level gauge measuring oil level of the transmission inside.

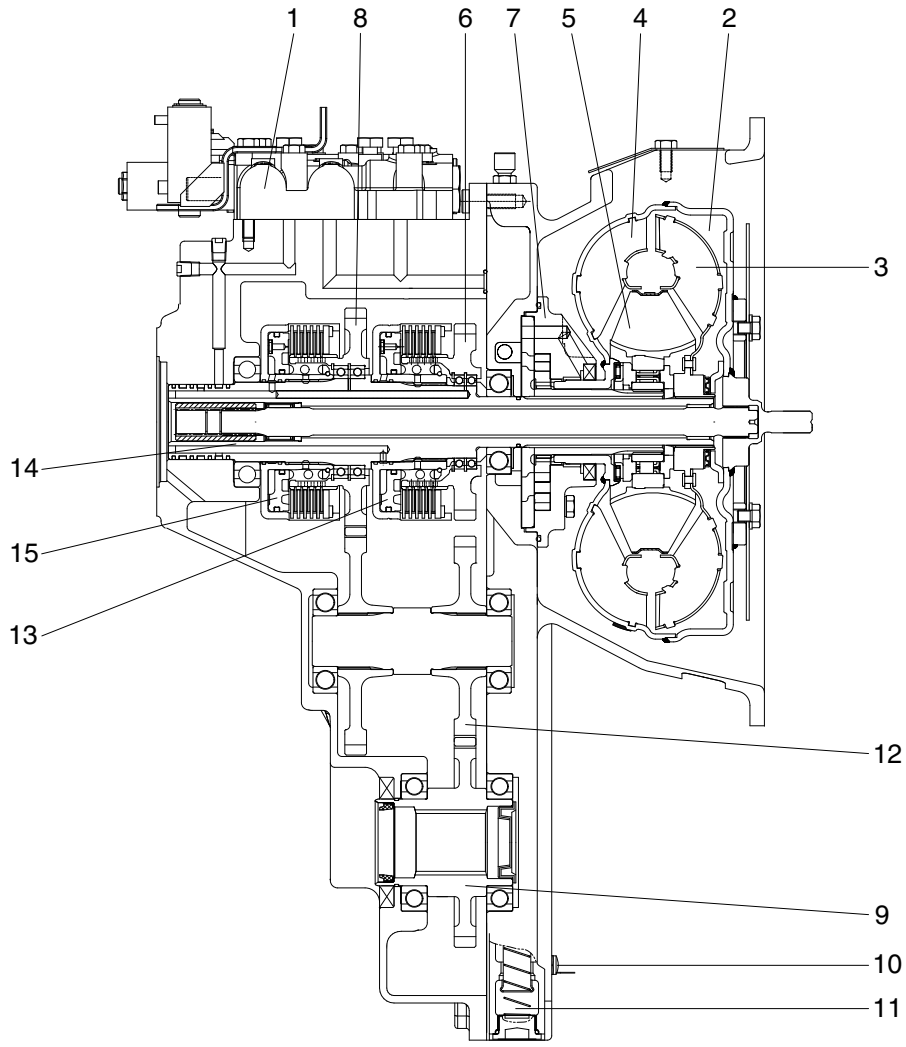
3) TORQUE CONVERTER HYDRAULIC CIRCUIT



20D7PT04

3. TRANSMISSION

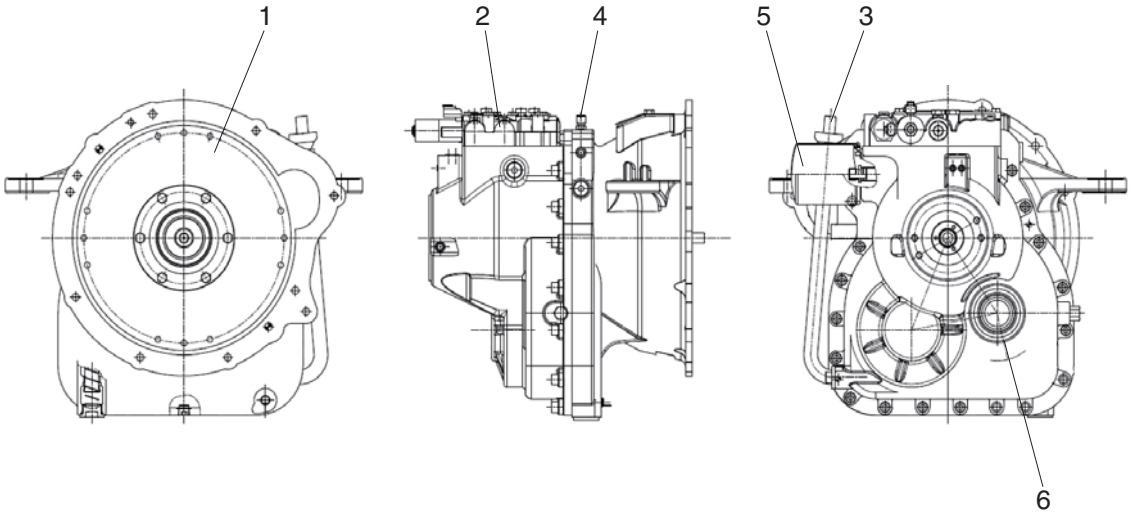
1) STRUCTURE



15L7APT28

1	Control valve	9	Output gear
2	Torque converter	10	Temperature sensor
3	Turbine wheel	11	Oil strainer
4	Impeller wheel	12	Idle gear
5	Stator wheel	13	Forward clutch pack
6	Forward clutch gear	14	Input shaft
7	Oil pump	15	Reverse clutch pack
8	Reverse clutch gear		

2) INSTALLATION VIEW



22D9TPT05

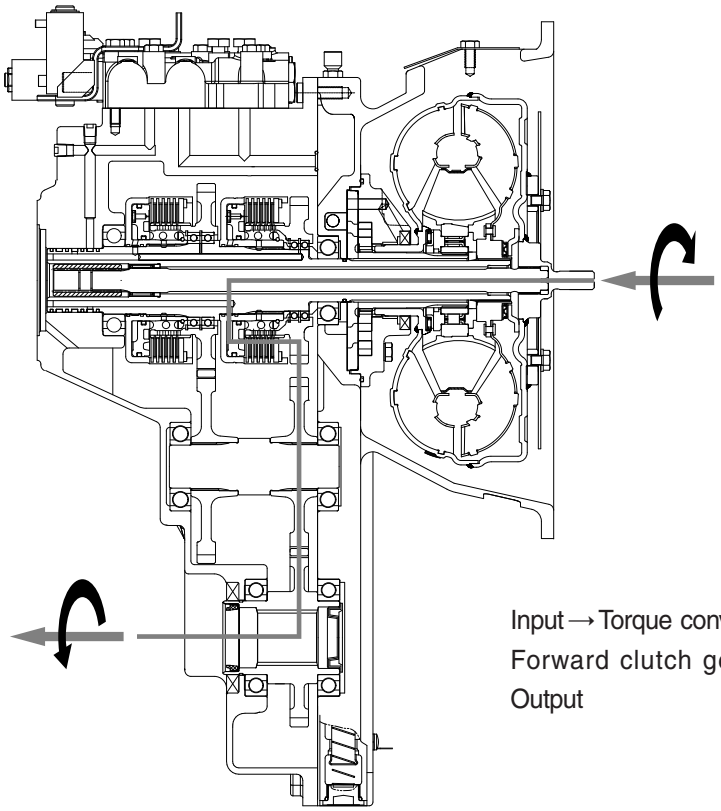
1 Torque converter
2 Control valve
3 Oil level pipe and dipstick
4 Air breather
5 Transmission oil filter
6 Transmission output (Universal joint link part)

3) OPERATION

The torque converter is an automatic fluid drive.
It transmits engine torque by means of hydraulic force.
The torque converter leads and the power which is delivered rotated the charging pump.
Oil is drawn from the transmission reservoir by the charging pump.
The pump delivers its entire output to a full-flow oil filter for cleaning.
From the oil filter, the oil supply is sent to the control valve.
The main pressure regulator valve provides pressure for clutch pack, directs oil to the solenoid valve.
Moving the solenoid valve allows oil to charge the selected (forward or reverse) clutch line and to engage that clutch.
The remaining oil appropriating clutch pressure flows into the torque converter.
A converter pressure regulator valve in the converter-in line limits the oil pressure there.
The oil pressure input to the torque converter is adjusted 4~7 kgf/cm^2 (57~100 psi).
The oil pressure output from the torque converter is adjusted below 2~4.5 kgf/cm^2 (28.4~64 psi).
The torque converter is continuously filled with oil during operation.
Rotation of the converter impeller imparts energy to the oil which, in turn, drives the turbines.
The oil then flows between the stator vanes which redirect it to the impeller.
At this time, torque is increased.
The oil from the torque converter enters the cooler.
The cooler is a heat exchanger in which the oil flows through air cooled passages.
After refrigerated, it is in charge of clutch lubrication through the lubrication oil path of the clutch shaft. A lubrication valve between the cooler and lubrication system returns all excess oil to the transmission reservoir.

4) OPERATING MODES

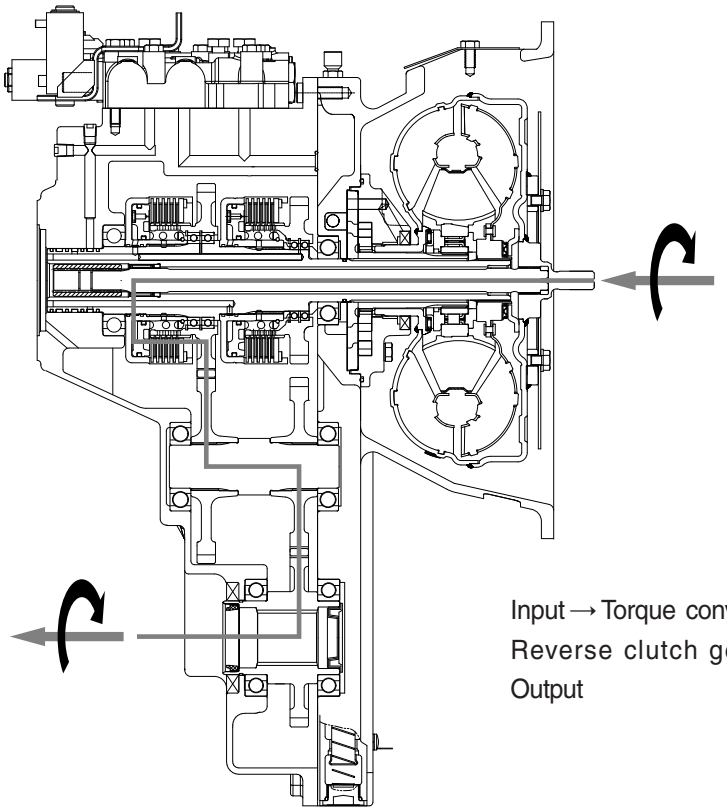
(1) Forward



Input → Torque converter → Clutch shaft → Forward clutch gear → Output gear → Output

15L7APT29

(2) Reverse

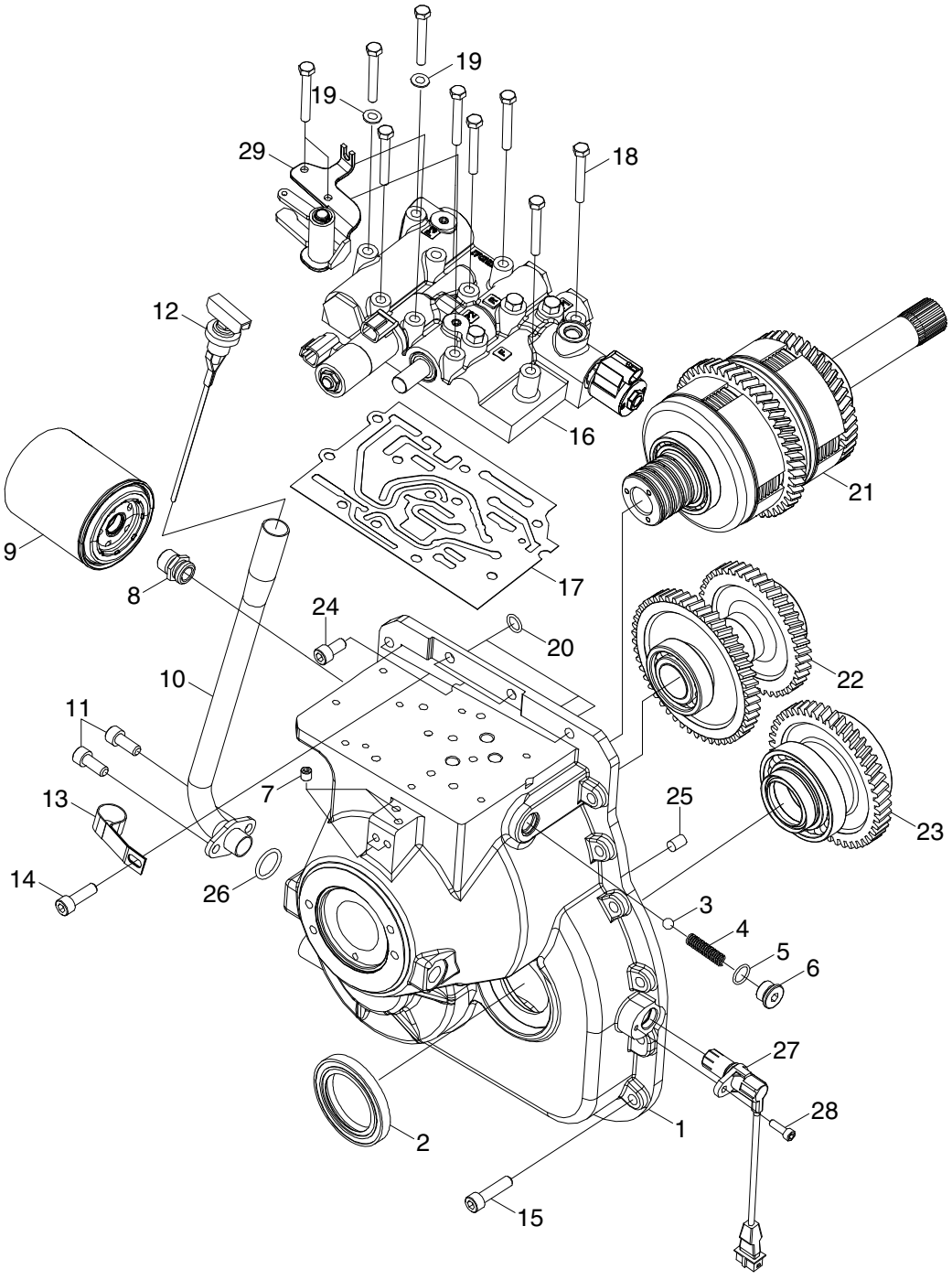


Input → Torque converter → Clutch shaft → Reverse clutch gear → Output gear → Output

15L7APT30

5) TRANSMISSION CASE AND CONTROL VALVE

(1) Structure



22D9TPT07

1	Transmission case	11	Socket bolt	21	Cylinder gear
2	Oil seal	12	Oil gauge	22	Idle gear
3	Ball	13	Clamp	23	Output gear
4	Spring	14	Socket bolt	24	Socket bolt
5	O-ring	15	Flange bolt	25	Dowel pin
6	Plug	16	Control valve	26	O-ring
7	Plug	17	Gasket	27	Speed sensor
8	Bolt	18	Hexagon bolt	28	Socket bolt
9	Transmission oil filter	19	Plain washer	29	Inching link assy
10	Dipstick pipe	20	O-ring		

(2) Operation

The transmission case includes the function of a control valve, an oil filter and a parking brake.

The oil filter is charge of filtering sucked oil by an oil pump before transmitting sucked oil to a control valve and a torque converter.

Oil transmitted through an oil filter delivers oil pressure to the piston of the forward and reverse clutch through the solenoid valve.

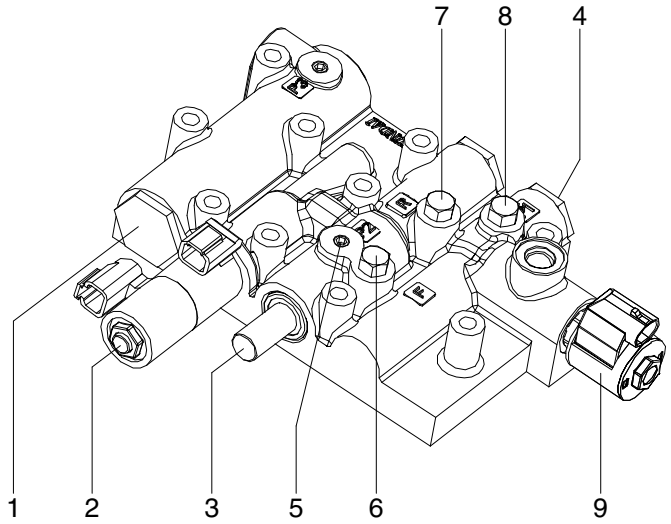
At this time, the solenoid valve is in charge of the important function of transmitting oil pressure for forward and reverse through an electric signal by the forward and reverse selection lever of the truck.

Oil pressure chosen for forward or reverse by the solenoid valve is transmitted to the forward clutch through the formed oil path between transmission case or the reverse clutch through the pipe of transmission outside.

Parking brake works by the band brake installed on parking drum which is linked to the output shaft of the forward clutch.

6) CONTROL VALVE

(1) Operation



22D9TPT08

1 Modulation
2 Solenoid valve
3 Inching spool
4 Main relief valve
5 Inching valve pressure check port
6 Forward clutch pressure check port
7 Reverse clutch pressure check port
8 Main pressure check port
9 Parking solenoid valve

The control valve consists of the main relief valve, solenoid valve, modulation valve and inching valve.

The discharged oil from the gear pump enters main relief valve of the control valve and its pressure is adjusted 10.8~14.9 kgf/cm^2 (154~212 psi).

The oil adjusted pressure by the main relief valve is decided on the direction of forward or reverse by the solenoid valve.

The decided oil is delivered the power transferred from the torque converter to drive axle through the oil path between torque converter housing and transmission case.

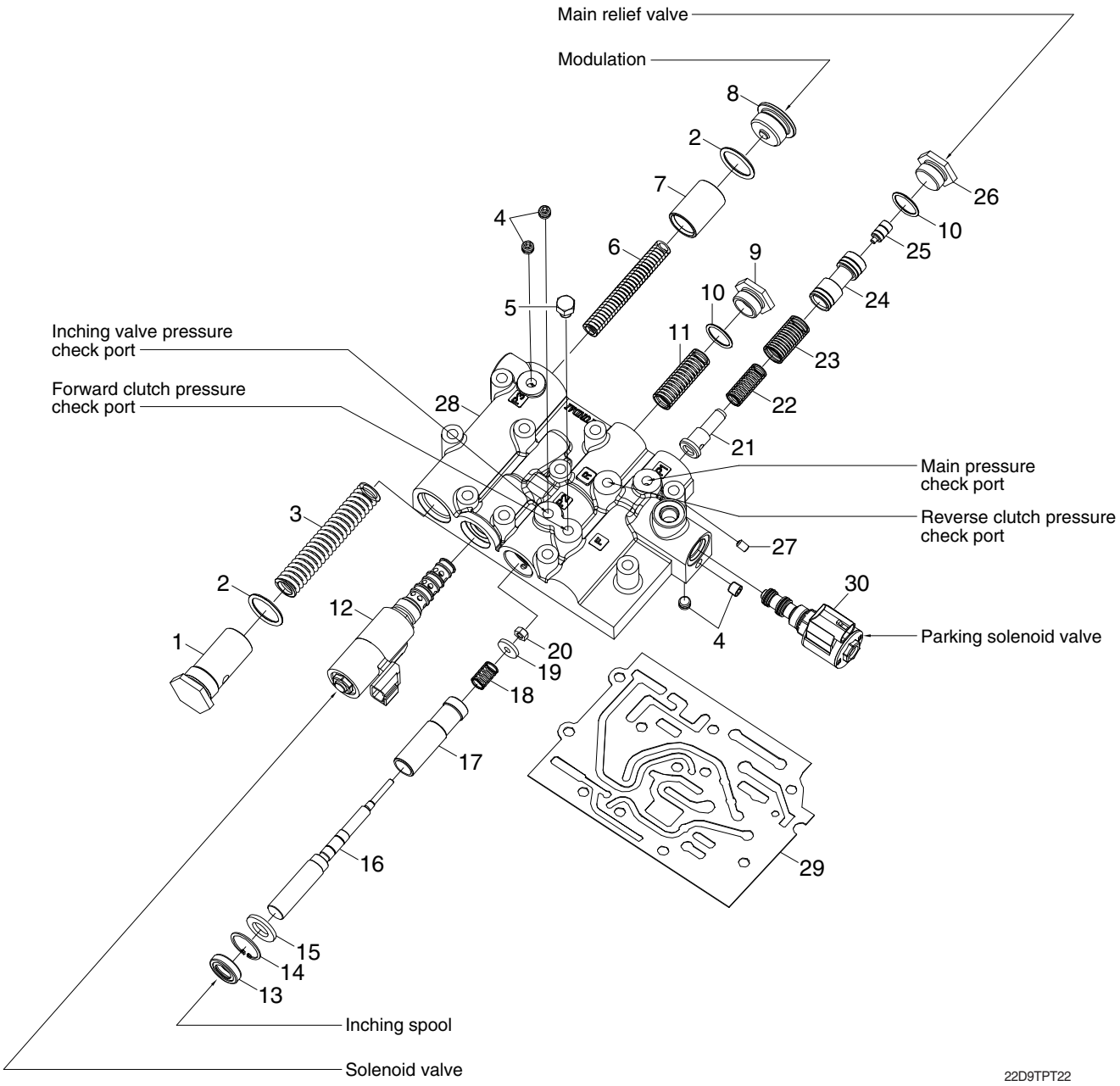
The modulation valve provide a soft plugging when changing gears.

The modulation valve to absorb the small shocks of rapid pressure build up and quick release during gear changes.

When full pressure builds up, the modulation valve shuts the modulation off and allows it to empty, so it is ready to function again during gear change.

The inching valve permits the clutch to partially disengage, so that engine rpm can be increased for lifting while travel speed remains low.

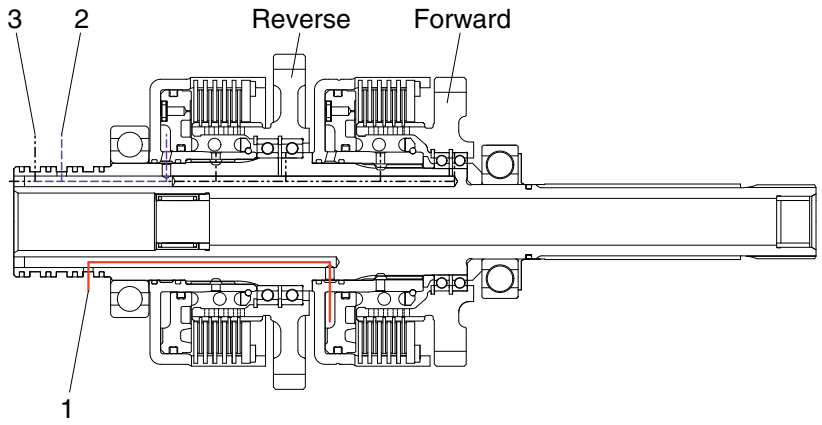
(2) Structure



1	Guide plug	11	Spring	21	Stopper
2	O-ring	12	Solenoid valve	22	Spring
3	Spring	13	Oil eal	23	Spring
4	Socket plug	14	Snap ring	24	Valve
5	Plug	15	Plate	25	Piston
6	Spring	16	Spool	26	Plug
7	Piston	17	Valve	27	Screw
8	Socket plug	18	Spring	28	Body
9	Plug	19	Stopper	29	Gasket
10	O-ring	20	Nut	30	Solenoid valve

7) CLUTCH

(1) Operation

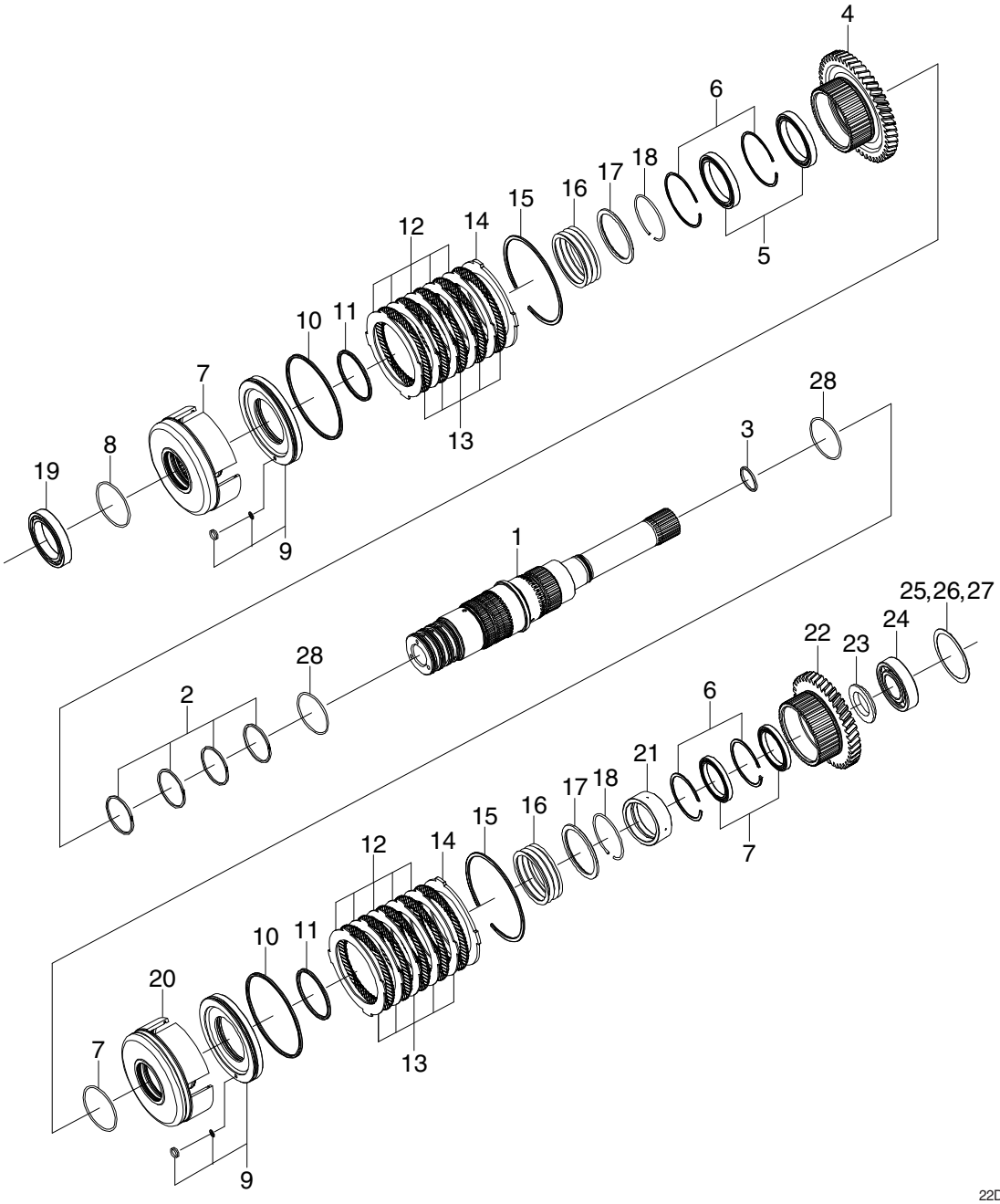


15L7APT31

1 Forward clutch plugging pressure delivery line (———)
2 Reverse clutch plugging pressure delivery line (- - - - - -)
3 Clutch pack lubrication line (---—---—---)

When (forward/reverse) mode is selected through the solenoid valve of control valve, the flux flowed by the oil pump flows into forward (reverse) clutch pack in 10.5~14.9 kgf/cm^2 (149~212 psi) of pressure through the oil path of transmission inside.
This oil make plugging of clutch pack by giving pressure at the piston of clutch pack.
At this time, the clutch shaft is always revolving while connected with the turbine of torque converter.
According to be plugging, the clutch gear is connected and revolved with drum.
This power is delivered with linking output gear in touch with clutch gear.

(2) Structure



22D9TPT11

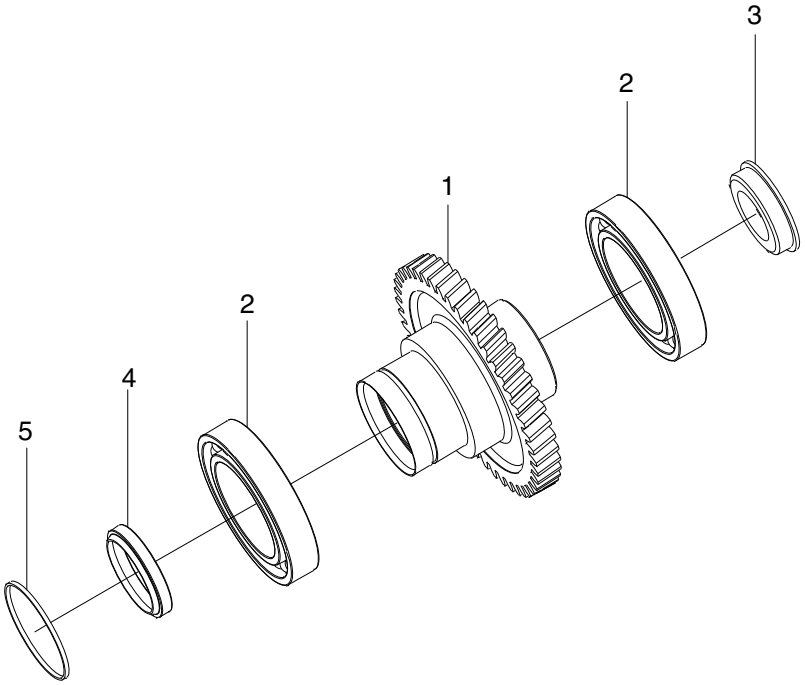
1	Shaft	11	Quad ring	21	Spacer
2	Peek seal	12	Plate	22	Forward clutch gear
3	Small seal ring	13	Friction plate	23	Spacer
4	Reverse clutch gear	14	Plate	24	Ball bearing
5	Ball bearing	15	Snap ring	25	Clutch shim (0.1 t)
6	Snap ring	16	Spring	26	Clutch shim (0.15 t)
7	Clutch drum	17	Back plate	27	Clutch shim (0.2 t)
8	O-ring	18	Wire ring	28	O-ring
9	Piston	19	Ball bearing		
10	Quad ring	20	Clutch drum		

8) OUTPUT GEAR

(1) Operation

The output gear is engaging the forward clutch gear and reverse clutch gear together.
If a driver selects forward, the forward clutch gets plugging, the forward clutch gear revolves and the power of forward clutch gear is delivered to output gear.
If a driver selects reverse, the reverse clutch gets plugging, the reverse clutch gear revolves and the power of reverse clutch gear is delivered to output gear.

(2) Structure

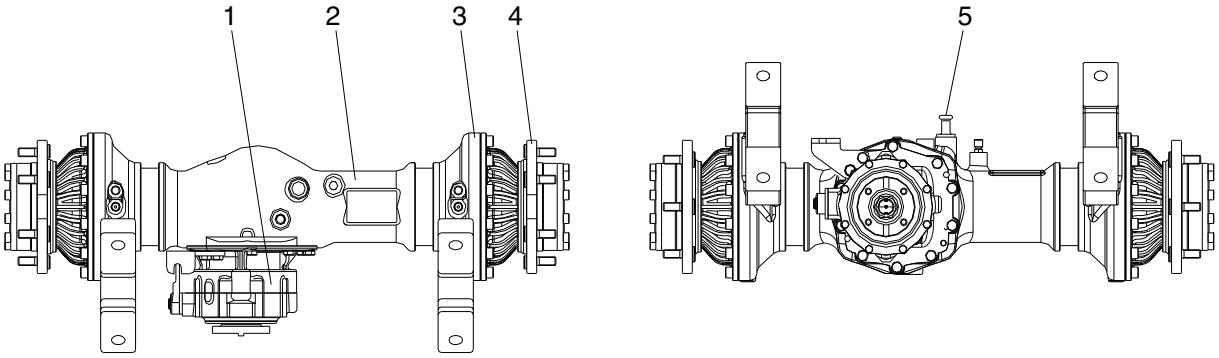


15L7APT14

1 Output gear
2 Ball bearing
3 Cover
4 Oil seal
5 Seal ring

4. DRIVE AXLE

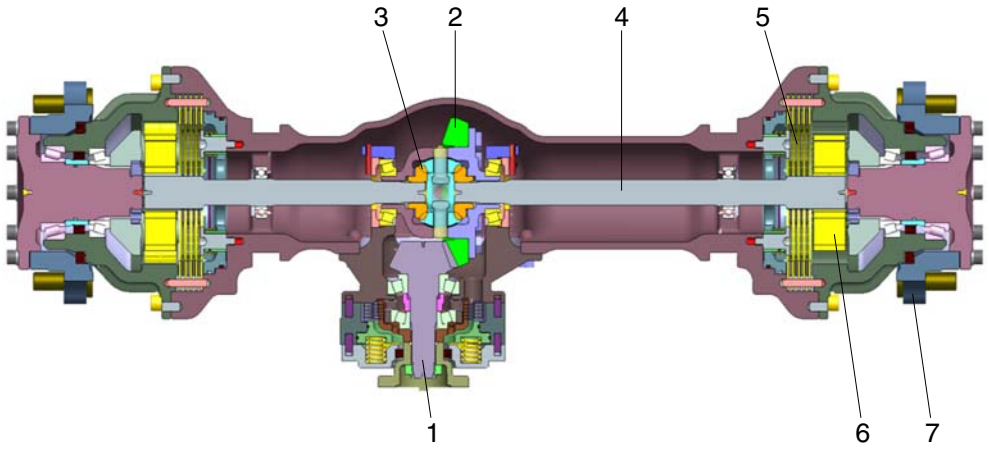
1) INSTALLATION VIEW



15L7APT15

1	Carrier assembly	3	Traveling brake	5	Oil level gage
2	Drive axle housing	4	Hub		

2) STRUCTURE



22D9TPT16

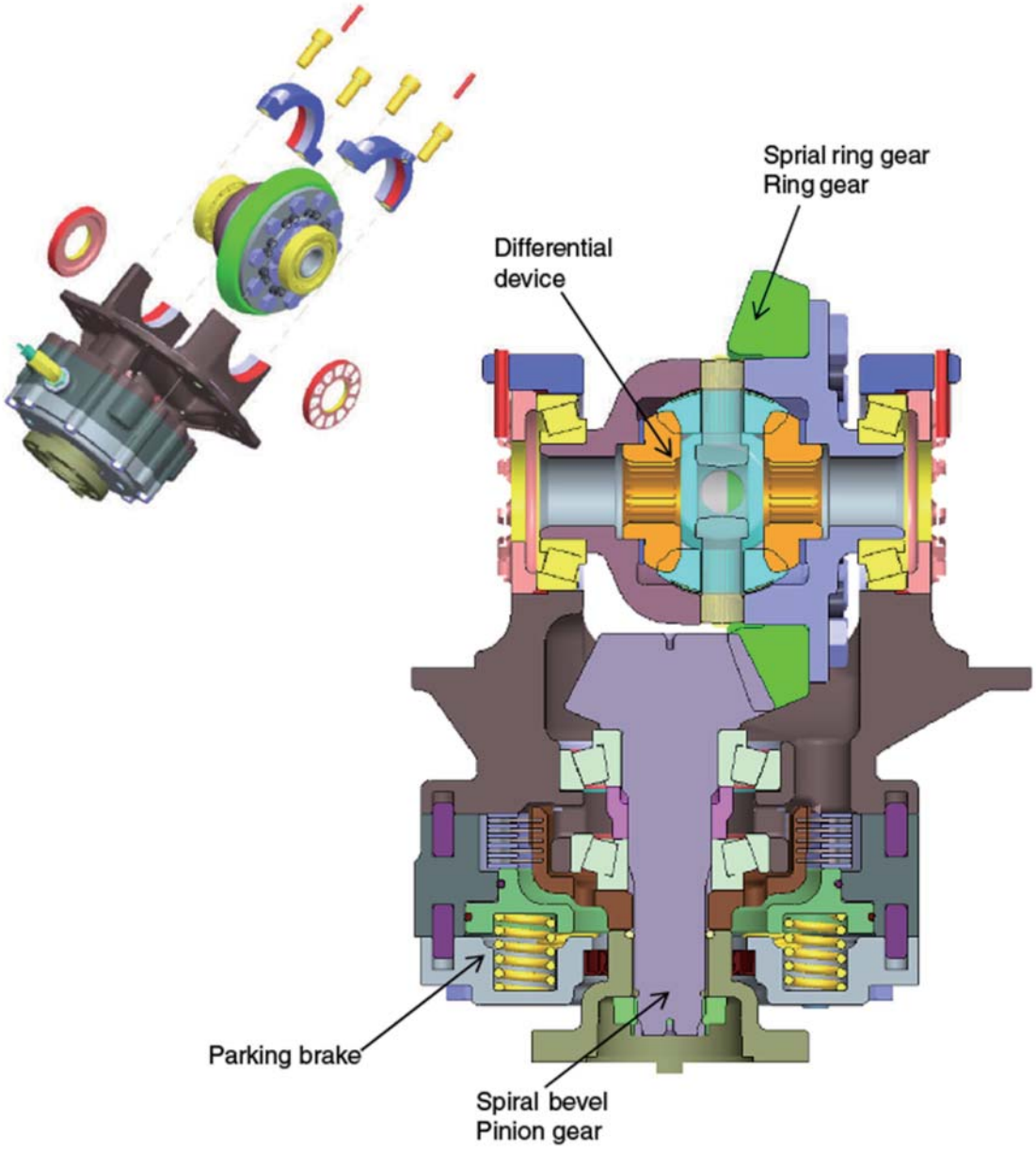
1	Pinion shaft	4	Axle shaft	7	Wheel hub
2	Ring gear	5	Traveling brake		
3	Differential device	6	Hub reduction		

The drive axle is connected with the transmission output gear and universal joint.
The power transferred by the universal joint is connected to the pinion shaft of drive axle, the pinion shaft delivers the power to the differential device through the ring gear.
The power transferred to the differential gear is delivered to final drive through the axle shaft in reduced at the hub reduction.

3) CARRIER ASSEMBLY

(1) Operation

Carrier sub assembly include spiral bevel gear for transfer the power of transmission to axle.
Also, including differential device for separate power of transmission to left/right axle shaft and parking brake.



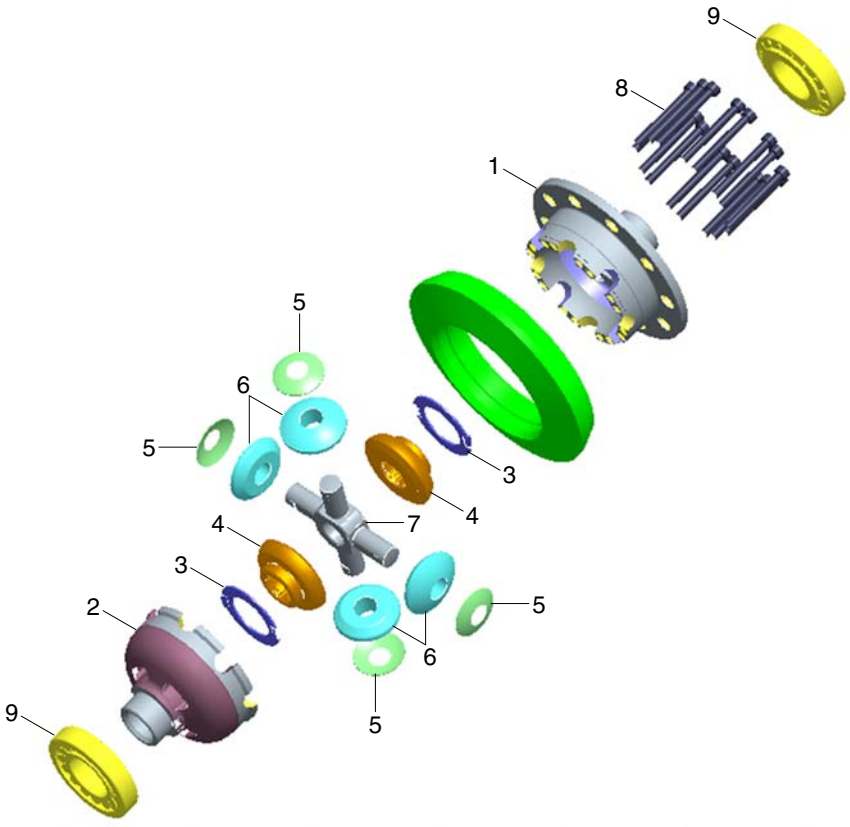
22D9TPT21A

4) DIFFERENTIAL DEVICE

(1) Operation

Since the ring gear is linked with the right of the differential case and the bolt, the power transferred to the ring gear makes the differential device revolve.
And also, the left and right of the differential case are connected with the left and right of the axle shaft and the spline respectively, it delivers the power to the final drive.
If the load concerning in the left and right of the final drive is different, the shock is transferred to the drive axle, the differential gear in the differential device runs, the power transferred to the differential device adjusts the delivering rate to the left and right axle shaft.
Consequently, it guarantees for safety of drivers.

(2) Structure



22D9TPT19

1	Differential case (RH)	4	Side gear	7	Differential spider
2	Differential case (LH)	5	Thrust washer	8	Socket bolt
3	Thrust washer	6	Pinion gear	9	Taper roller bearing

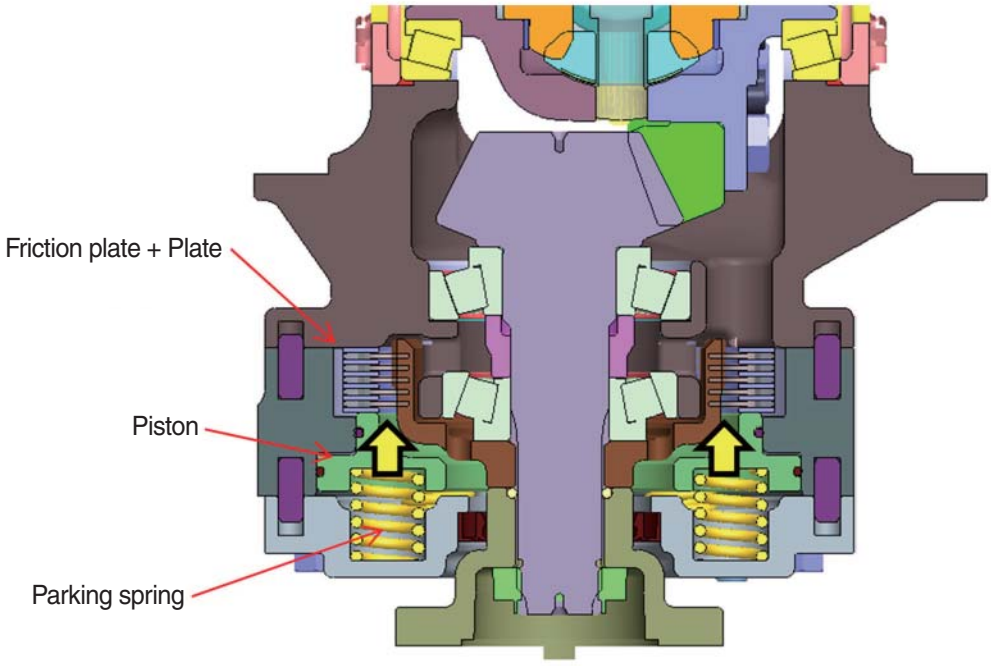
5) PARKING BRAKE (NEGATIVE BREAKE)

(1) Operation

In case of key OFF at truck, active parking brake from parking spring push parking piston, and then piston pressured friction plate. It has force distribution.

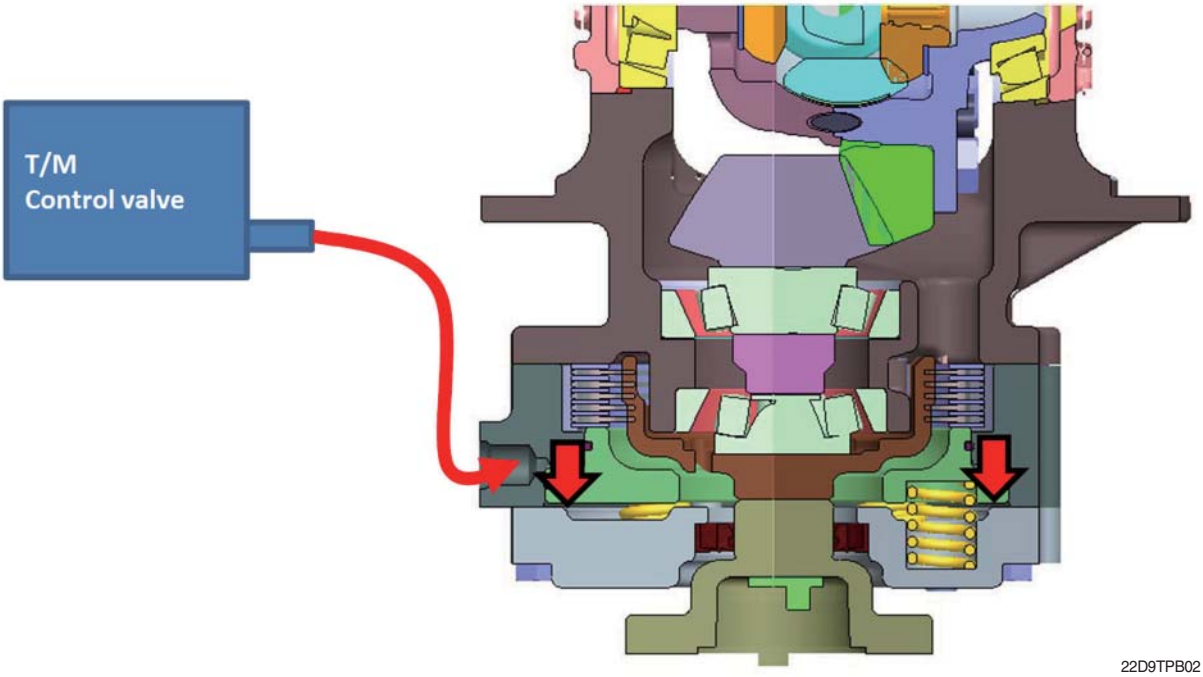
In case of key ON at truck, the main pressure at control valve on transmission main pressure supply to parking brake port, and then released pressure at piston and friction plate finally the parking brake is released.

Status of KEY OFF (Active parking brake)



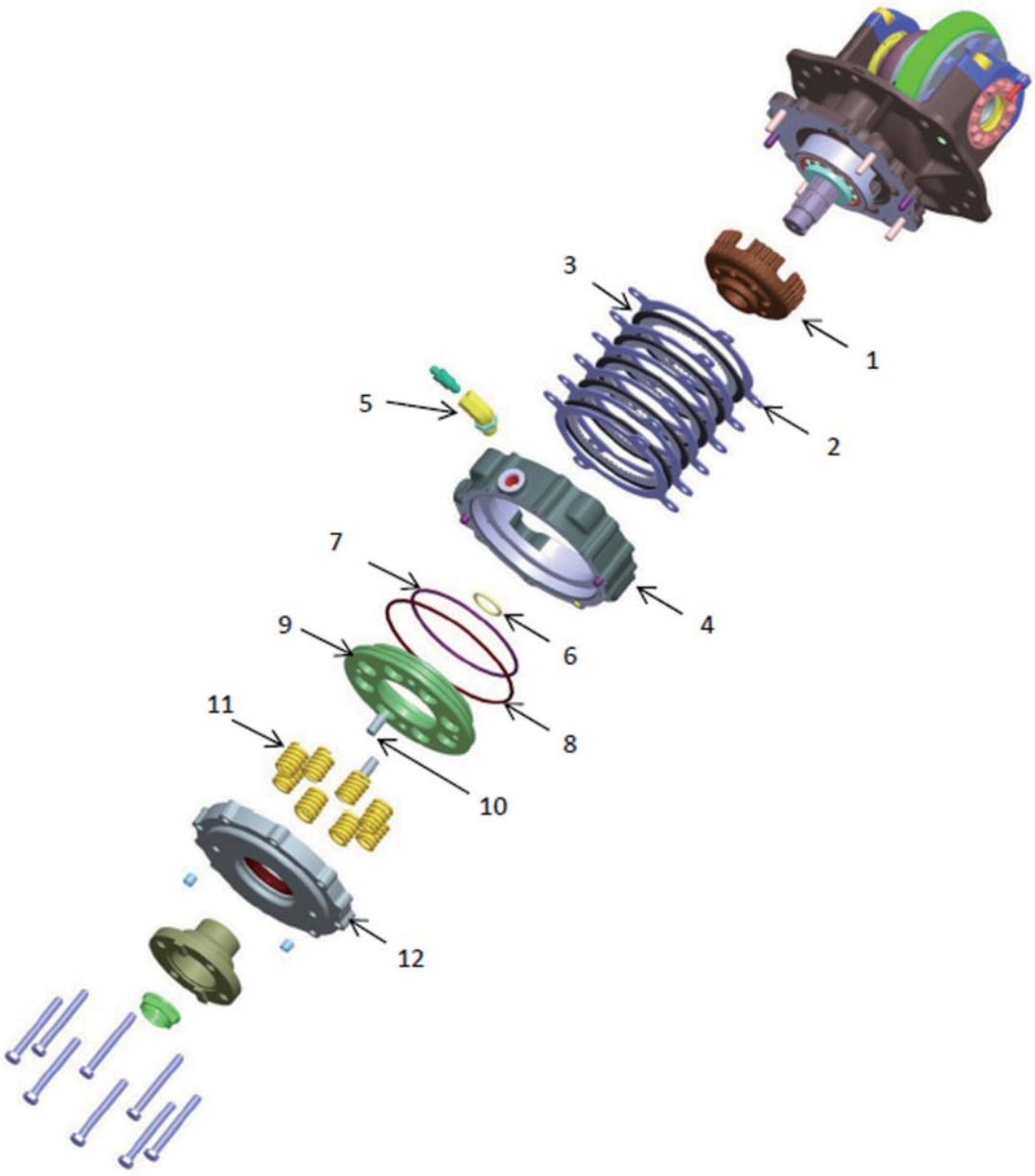
22D9TPB01

Staus of KEY ON (Release parking brake)



22D9TPB02

(2) Structure



22D9TPB03

1	Parking spline	5	Elbow 45	9	Brake piston
2	Plate	6	O-ring	10	Guide pin
3	Friction plate	7	Quad ring - S	11	Parking spline
4	Piston housing	8	Quad ring - L	12	Parking cover

GROUP 2 TROUBLESHOOTING

1. TRANSMISSION

Trouble symptom	Probable cause	Remedy
1. Output does not go up		
1) Torque converter		
- Torque converter oil	· The oil is in short supply.	· Replenish oil.
	· The oil that is not regulated is used.	· Change the oil to regular oil.
	· The air has mixed into oil.	· Tighten each joint coupling and the pipe further.
	· The oil filter is clogging.	· Wash the oil filter or change it.
- Main body of torque converter	· The stator free wheel is broken.	· Change the stall revolution then if the revolution is extremely low, change the free wheel inner race, free wheel cam and roller.
	· The stator free wheel is sticking.	· Check the rise of the temperature of oil at no load. Change the free wheel inner race, free wheel cam and roller when the temperature of oil rises abnormally.
	· The wheel with blades is broken or it is touching other components.	· Check whether the aluminum powder and the like has mixed into torque converter oil. Change the wheel with blades if the aluminum powder and the like has mixed in.
2) Transmission		
- Charging pump	· The pump does not operates normally.	· Change the pump.
	· The oil is in short supply.	· Replenish oil.
- Torque converter oil	· The oil that is not regulated is used.	· Change the oil to regular oil.
	· The air bubble occurs because the torque converter pressure decrease.	· Check and adjust the torque converter pressure.
	· The water has mixed into oil.	· Check the cooler, and change all oil.
- Valve assy	· The clutch oil pressure has de-creased, because the spring is setting or break.	· Change the spring.
	· The valve does not move with the valve opens.	· Repair or change the valve.
	· The orifice is clogging.	· Wash the orifice.
- Clutch	· The seal ring of the clutch piston are damaged.	· Change the seal ring.
	· The clutch plate slips because the clutch oil pressure decrease.	· Measure the clutch pressure.
	· The clutch plate is worn out or damaged.	· Change the clutch plate.
	· The clutch piston down not operate normally.	· Repair or change the clutch piston.

Trouble symptom	Probable cause	Remedy
2. Power is not transmitted		
1) Torque converter	· The flexible plate is broken.	· Change the flexible plate.
	· The oil is in short supply.	· Replenish oil.
	· The shaft and spline are worn.	· Change the shaft and the spline.
	· The gear is broken.	· Change the gear.
	· The charging pump does not operate normally.	· Change the charging pump.
2) Transmission		
- Hydraulic converter oil	· The oil is in short supply.	· Replenish oil.
- Clutch part	· The clutch plate is worn and broken.	· Change the clutch plate.
	· The clutch plate is sticking.	· Change the clutch plate.
	· The clutch shaft spline is worn.	· Change clutch shaft.
	· The clutch pressure has decreased because the seal of the clutch piston do not operate normally.	· Change the clutch.
- Output gear	· The gear is broken.	· Change the gear.
- Solenoid valve	· The solenoid lines are broken.	· Change the solenoid.
	· Spool does not operate normally.	· Repair or change the solenoid valve.
- Valve assy	· The clutch pressure has decreased because the spring is setting or brake.	· Change the spring.
	· The valve does not move with the valve opens.	· Repair or change the valve.
	· The orifice is clogging.	· Wash the orifice.
3) Electric circuit	· The switches or the relays are broken.	· Refer to the electric circuit figure and repair the broken points.
	· Wiring has come off and they are broken.	· Refer to the electric circuit figure and repair the broken points.
3. Oil temperature rise abnormally		
1) Torque converter		
- Torque converter oil	· Amount of oil is not appropriate.	· Check the oil level.
	· The oil that is not regulated is used.	· Change the oil to regular oil.
	· The air has mixed into oil.	· Tighten each joint coupling and the pipe further.
	· The water has mixed into oil.	· Check the cooler and change the all oil.
- Flows resistance	· The oil cooler is sticking.	· Wash the oil cooler or change them.
2) Transmission		
- Torque converter oil	· The clutch plate is sticking.	· Change the clutch plate.
	· The clutch piston does not operate normally.	· Repair the clutch piston or change them.
	· The pressure of clutch has decreased.	· Check the clutch pressure.
	· The bearing are worn or sticking.	· Change the bearing.

Trouble symptom	Probable cause	Remedy
4. Clutch or converter oil pressure is too high		
1) Torque converter	· Viscosity of oil is too high (at cold time).	· Warm up the torque converter if the temperature of torque converter oil is below outside air temperature.
	· The oil that is not regulated is used.	· Change the oil to regular oil.
2) Transmission		
- Valve assy	· The value does not operate normally because the valve has damage and the valve catch rubbishy in valve.	· Repair the valve assy and change them.
5. Clutch or converter oil pressure is too low		
1) Torque converter	· The oil is in short supply.	· Replenish oil.
	· The oil that isn't regulated is used.	· Change the oil to regular oil.
	· The charging pump is worn and broken.	· Change the charging pump.
	· The oil seal ring or O-ring is worn.	· Change the oil seal ring or the O-ring.
2) Transmission		
- Valve assy	· The spring is setting and broken.	· Change the spring.
	· The valve does not move with the valve opens.	· Repair the valves or change it.
	· The orifice is clogging.	· Wash the orifice.
- Clutch	· The seal ring of the clutch piston are damaged.	· Change the clutch piston.
6. Noises occurs		
1) Transmission	· The clutch is sticking and dragging.	· Change the clutch.
	· The bearings are sticking are worn.	· Change the bearing.
	· The gear is broken.	· Change the gear.
	· The spline is worn.	· Change the spline.
	· The bolt is loosen or broken.	· Tighten the bolt or change it.

2. DRIVE AXLE

Trouble symptom	Probable cause	Remedy
1. Noise & vibration, abnormal fever		
1) Axle	· Lubricating oil shortage · Using different lubricating oil	· Check oil level and refill lubricating oil · Change lubricating oil
2) Spiral bevel gear	· Failure on match of spiral bevel gear · Damage or fitting of spiral bevel gear · Release pinion shaft taper-roller bearing (spacing) · Damage of pinion shaft taper-roller bearing · Release bolt of ring gear · Damage of differential case · Damage of differential spider	· After disassembly and adjust (adjust match pattern of gear) · After disassembly and replace the part · After disassembly and adjust freeload or replace bearing · After disassembly and adjust freeload or replace bearing · Paste loctite #277, Check tighten torque 710~760 kgf-cm · After disassembly and replace the part · After disassembly and replace the part
3) Differential	· Damage of diff sub taper-roller bearing · Release diff sub taper-roller bearing (spacing) · Fitting of diff pinion or side gear · Too much backlash at diff pinion and side gear · Wear or damage of thrust washer	· After disassembly and replace the part · After disassembly and rearrange adjust bearing · After disassembly and replace the part · After disassembly and adjust or replace bearing · After disassembly and replace the part
4) Axle shaft	· Damage of axle shaft (break or bending) · Damage of gear at axle shaft	· After disassembly and replace the part · After disassembly and replace the part
5) Planetary gear (Wheel hub)	· Damage of needle bearing · Damage of taper-roller bearing · Release taper-roller bearing on wheel shaft · Fitting of planetary gear · Fitting of ring gear	· After disassembly and replace bearing · After disassembly and replace bearing · After disassembly and adjust freeload or replace bearing · After disassembly and replace the part · After disassembly and replace the part
6) Brake	· Incorrect axle fluid and/or friction material used · Incorrect volume of oil · Particle (moisture) throughout the oil · Wear of friction plate	· Use only specified or approved materials · Drain and flush fluid from axle. Replace with approved fluid · Exchange oil · Exchange the friction plate

Trouble symptom	Probable cause		Remedy
2. Oil leakage			
1) Leakage	Leakage of assembly side	· Release of bolt	· After disassembly and paste loctite, check the torque
		· Damage of assembly side	· After disassembly and replace the part
		· Damage or loose gasket (liquid)	· Change the gasket
	Leakage of hub	· Damage of oil seal	· After disassembly and replace the part
		· Damage of O-ring	· After disassembly and replace the part
	Leakage of inlet	· Damage of oil seal	· After disassembly and replace the part
		· Damage of O-ring	· After disassembly and replace the part
	Leakage of air breather	· Excess oil volume	· Check oil level, set correct oil volume
		· Damage of air breather	· Wash or replace the air breather
		· Use non-standard oil	· Change standard oil
	· Defect of material		· After disassembly and replace the part
	· Release of air breather		· Check the tighten torque 150~200 kgf-cm
	· Release of input fitting or plug		· Check the tighten torque 380~420 kgf-cm
	· Damage of input fitting or plug		· After disassembly and replace the part
2) Internal leakage	Leakage of service brake ↓ (Loss of brake reserve tank oil)	· Damage of brake seal	· Change piston seal
		· Wrong assemble brake seal	· After disassembly and replace the part
		· Detect of slide on seal (Axle housing, pistion)	· Replace related part
		· Mix particle of slide on seal	· Wash slide part or replace piston seal
		· Defect of material (or oil line)	· After disassemble and replace part
	Leakage of parking brake ↓ TM oil transfer axle ↓ Leakage of air breather	· Damage of parking brake seal	· After disassembly and replace the part
		· Wrong assemble parking brake seal	· After disassembly and replace the part
		· Detect of slide on seal (Axle housing, pistion)	· Replace related part
		· Mix particle of slide on seal	· Wash slide part or replace piston seal
		· Defect of material (or oil line)	· After disassembly and replace the part

※ When leakage of parking brake, transmission oil move to axle. It need to exchange the oil.

Trouble symptom	Probable cause	Remedy
3. Axle does not revolution		
1) Spiral bevel gear	· Damage of spiral bevel gear	· After disassembly and replace the part
	· Release pinion shaft taper-roller bearing (spacing)	· After disassembly and adjust freeload or replace part
	· Damage of pinion shaft taper-roller bearing	· After disassembly and replace the part
	· Release bolt of ring gear	· After disassembly and replace the part
2) Differential	· Damage of differential pinion and side gear	· After disassembly and replace the part
	· Damage of differential spider	· After disassembly and replace the part
	· Damage of pinion shaft and ring gear	· After disassembly and replace the part
	· Wear or damage of thrust washer	· After disassembly and replace the part
3) Axle shaft	· Damage of axle shaft (break or bending)	· After disassembly and replace the part
	· Damage of gear at axle shaft	· After disassembly and replace the part
4) Planetary gear (wheel hub)	· Damage of planetary needle bearing	· After disassembly and replace the bearing
	· Damage of wheel shaft taper-roller bearing	· After disassembly and replace the bearing
	· Release of wheel shaft taper-roller bearing (spacing)	· After disassembly and rearrange adjust bearing
	· Release lock-nut	· After disassembly and rearrange adjust part
	· Fitting of planetary gear	· After disassembly and replace the part
	· Fitting of ring gear	· After disassembly and replace the part
	· Release lock-nut	· After disassembly and replace the part
	· Release bolt of hub sub	· Paste loctite #277, check tighten torque 1170~1310 kgf-cm
	· Damage or release of bolt and nut on hub	· After disassembly and replace the part
5) Brake	· Failure of service brake piston	· After disassembly and rearrange adjust part
	· Leakage of parking brake	· After disassembly and rearrange adjust part
	· Damage of friction plate and plate	· After disassembly and rearrange adjust part

※ Wash or check the outfit of shaft, gear, bearing
※ Wash or check the outfit of seal
※ Make clean internal housing
※ Exchange of oil

Trouble symptom	Probable cause		Remedy
4. Brake does not apply			
1) Inoperation of brake	Travel brake	· Non-inject or lack of brake oil	· Check oil level, set correct oil volume
		· Damage of brake seal	· Replace piston seal
		· Wrong assemble brake seal	· After disassembly and adjust or replace part
		· Detect of slide on seal (axle housing, pistion)	· Replace related part
		· Mix particle of slide on seal	· Wash slide part or replace piston seal
		· Damage of friction plate and plate	· After disassembly and adjust or replace part
		· Defect of material (or oil line)	· After disassembly and replace the part
	Parking brake	· Damage of parking spring	· After disassembly and replace the part
		· Wrong assembly of parkgin spring	· After disassembly and adjust or replace part
		· Damage of friction plate and plate	· After disassembly and adjust or replace part
2) Impossible release of brake	Travel brake	· Failure of return at service brake piston	· After disassembly and adjust or replace part
		· Damage of friction plate and plate	· After disassembly and adjust or replace part
	Leakage of parking brake	· Damage of brake seal	· After disassembly and replace the part
		· Wrong assemble brake seal	· After disassembly and adjust or replace part
		· Detect of slide on seal (axle housing, pistion)	· Replace related part
		· Mix particle of slide on seal	· Wash slide part or replace piston seal
		· Defect of material (or oil line)	· After disassembly and replace the part
3) Deterioration of brake	· Inadequate actuation fluid supply to brake		· Supply standard oil, replace seal of brake system
	· Inadequate pressure to apply brakes		· Check or replace of brake seal and brake oil line
	· Worn or damaged discs		· After disassembly and adjust or replace part
	· Air enter into brake system		· Remove air by air breather
	· Deform parking spring		· After disassembly and replace the part

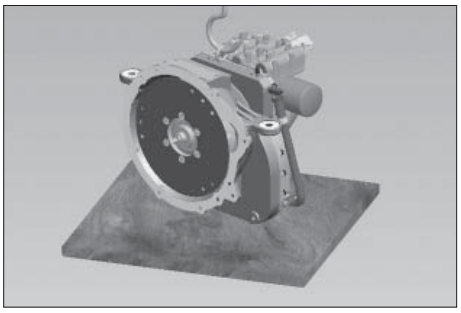
GROUP 3 DISASSEMBLY AND ASSEMBLY

1. DISASSEMBLY OF TRANSMISSION

1) DISASSEMBLING OF TRANSMISSION ASSY

(1) Drain the transmission oil.
Remove the drain plug at T/C housing.

(2) Lay the wood plate (or plastic plate) on the workshop's table (bottom).
And put the T/M assy on the wood plate (or plastic plate) : For an (dis) assembly at the time of damage prevent.

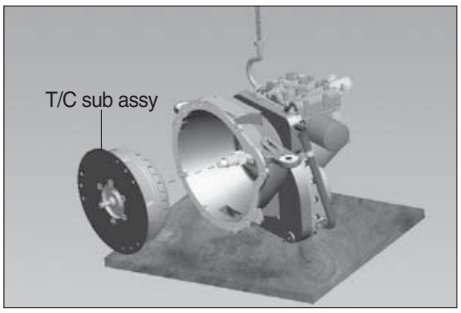


15L7ATM001

⚠ To avoid serious personal injury and possible damage to components, be very careful when using lifting devices during removal and disassembly procedures.

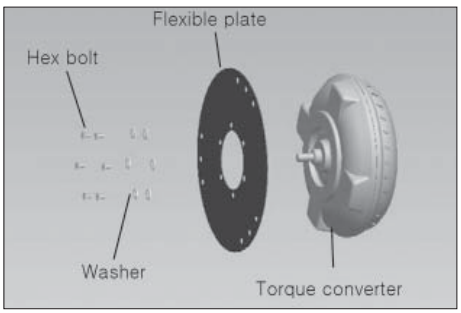
(3) Removal torque converter part.

① Remove the torque converter sub assy.



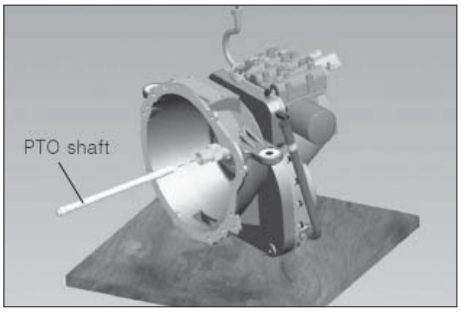
15L7ATM002

② Remove the hexagon bolt , washer, flexible plate.



15L7ATM003

(4) Remove the PTO shaft.



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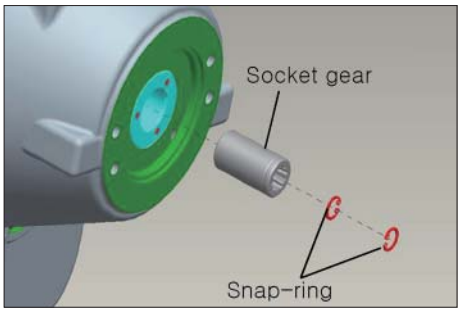
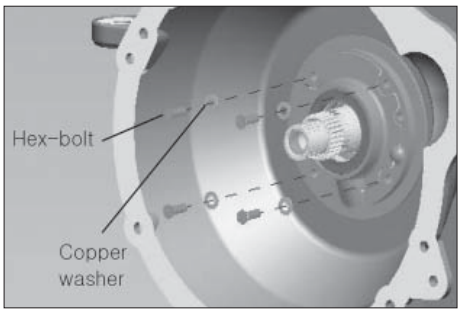
(5) Remove the socket gear.
Next remove the snap-ring at socket gear.



22D9TTM005

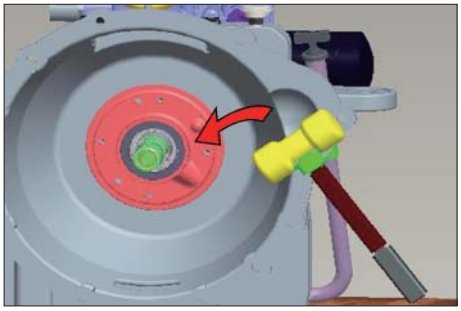
(6) Removal the oil pump sub assy.

① Remove the hexagon bolt (M8 × 1.25P × 38L), and then remove the copper washer.

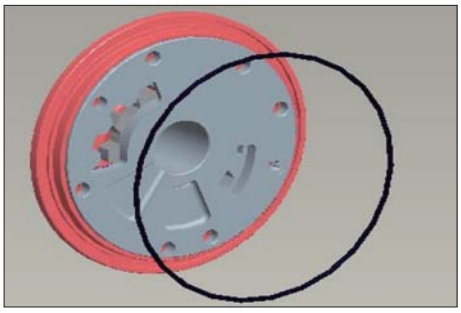


15L7ATM006

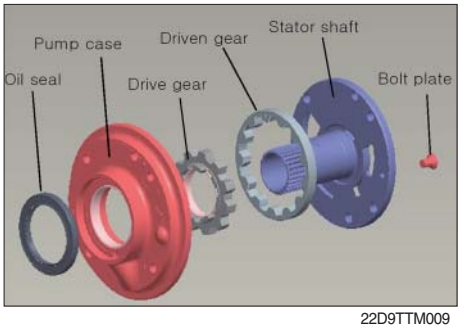
※ Use a plastic mallet to decomposition.


22D9TTM007

② Remove the O-ring at pump sub assy.


22D9TTM008

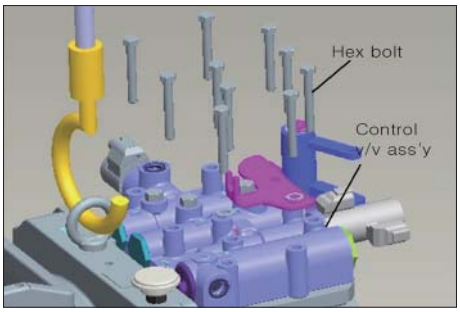
③ Remove the oil seal, pump case, drive gear, driven gear, stator shaft and bolt plate.



22D9TTM009

(7) Removal the control valve sub assy.

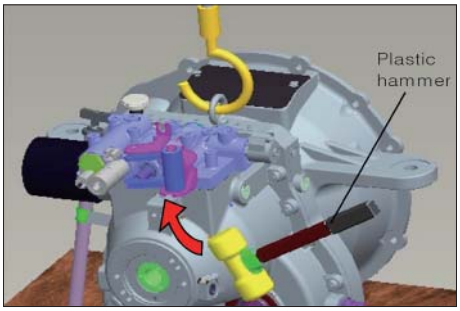
① Remove the hexagon bolt (M8 × 1.25P × 60L).



22D9TTM010

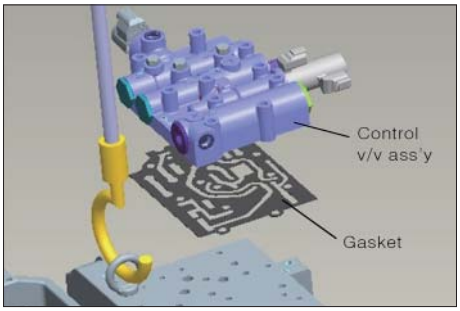
② Remove the part slowly with hit the end side softly.

※ Using a plastic hammer .
Do not hit steel parts with a steel hammer.
Pieces of a part can break off and cause serious personal injury.



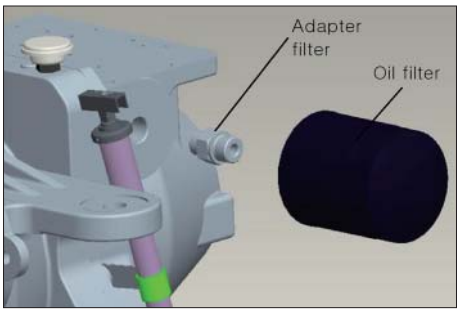
22D9TTM011

③ Remove the control valve assy, and then remove the gasket.



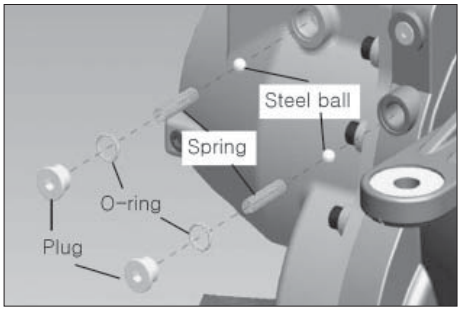
22D9TTM012

(8) Remove the oil filter, and then remove the filter adapter.



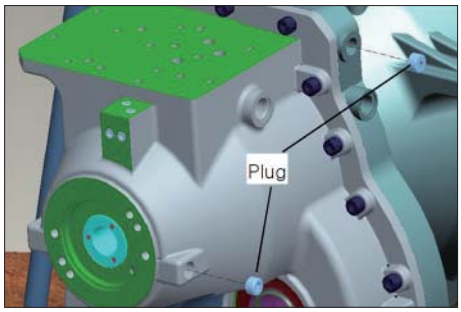
22D9TTM013

(9) Remove the (T/C in relief, cooler relief) plug, and then remove the spring, steel ball.
Next remove the O-ring at relief plug.



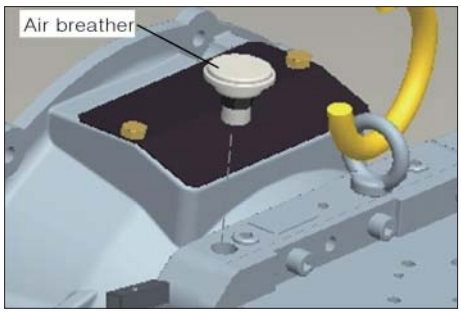
15L7ATM014

(10) Remove the cooler (in/out) plug.(M16)



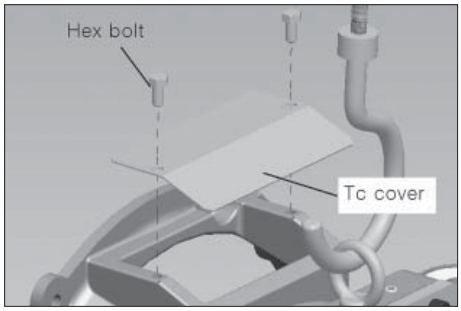
22D9TTM015

(11) Remove the air breather.



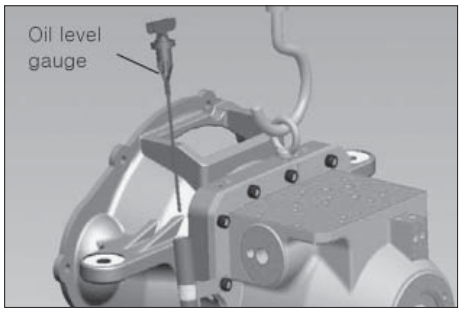
22D9TTM016

(12) Remove the hexagon bolt, and then remove the T/C cover.



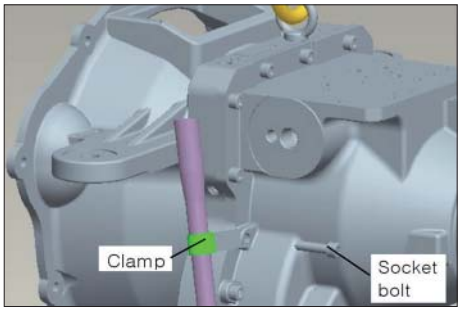
15L7ATM017

(13) Remove the oil level gauge.



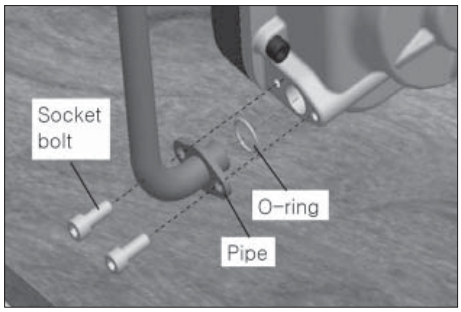
15L7ATM018

(14) Remove the socket bolt, and then remove the clamp.



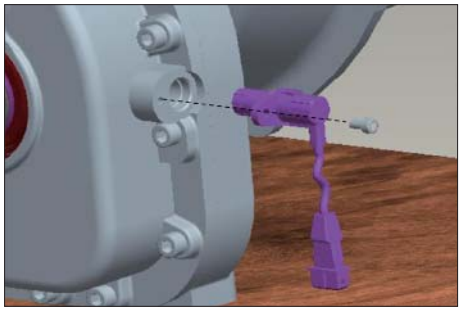
22D9TTM019

(15) Remove the socket bolt, and then remove the pipe.
Next remove the O-ring at the pipe.

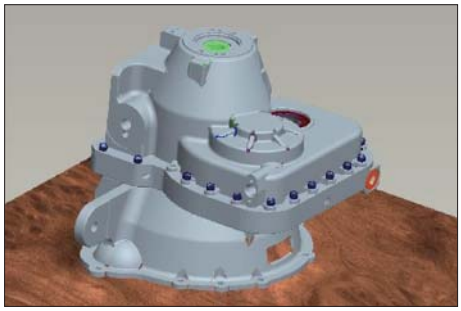


15L7ATM020

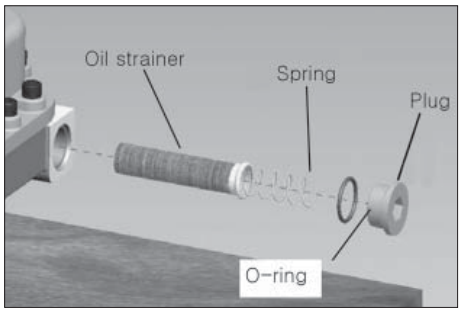
(16) Remove the socket bolt, and then remove the speed sensor.


22D9TTM021

(17) Lay the T/M assy without damage to the T/C housing.(engine mounting surface)

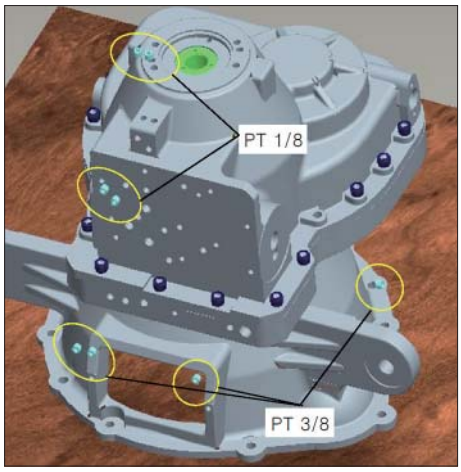

22D9TTM022

(18) Remove the plug, and then remove the spring, oil strainer.
Next remove the O-ring at the plug.



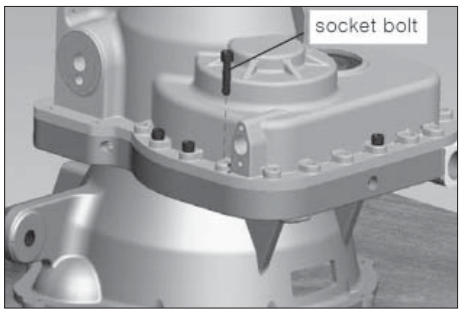
15L7ATM023

(19) Remove the plug.(PT 1/8 × 4EA, PT3/8 × 4EA)

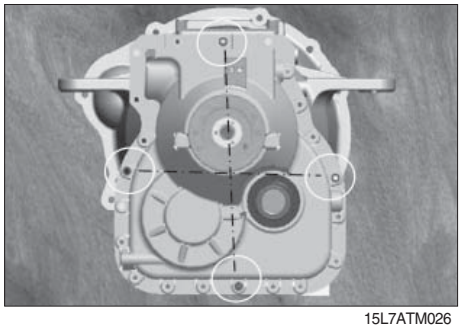


22D9TTM024

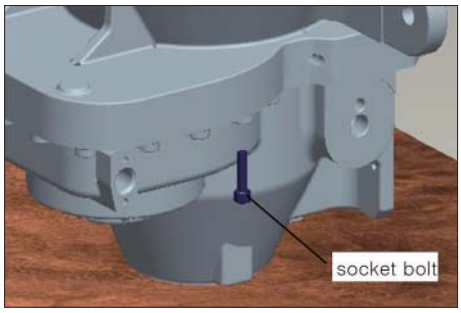
(20) Remove the socket bolt (T/M case + T/C housing fastening bolt) 4 socket bolt exclusions.



15L7ATM025


15L7ATM026

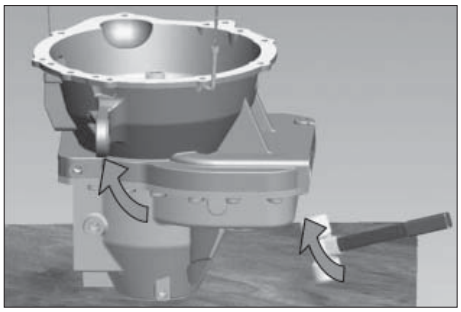
(21) To turn over T/M assy without damage to the T/M case. (main pump mounting surface)
Next remove the 4 socket bolt.



22D9TTM027

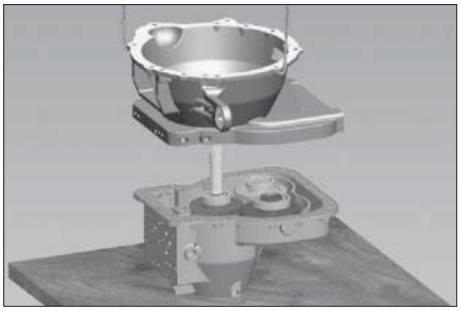
(22) Remove the part slowly with hit the end side softly.

※ Using a plastic hammer.



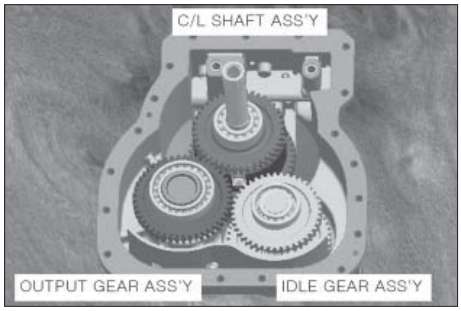
15L7ATM028

(23) Remove the T/C housing.



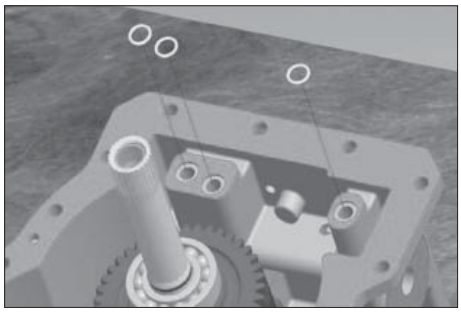
15L7ATM029

(24) Gear assemblies arrangements.



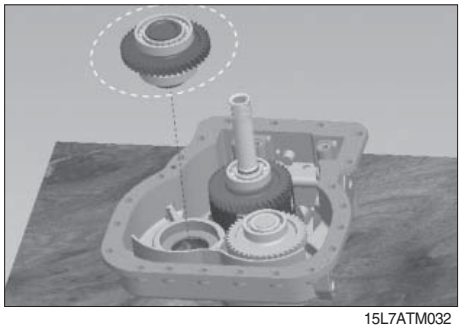
15L7ATM030

(25) Remove the O-ring.



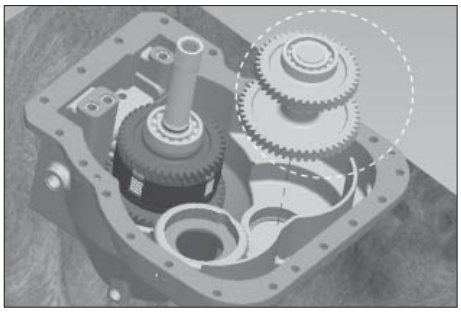
15L7ATM031

(26) Remove the output gear assy.



15L7ATM032

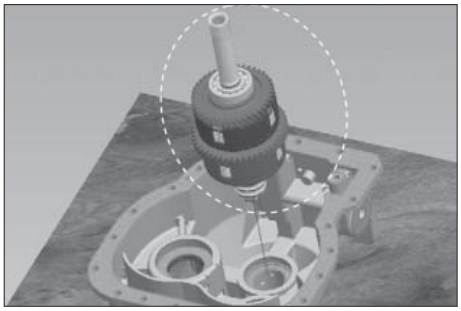
(27) Remove the idle gear assy.



15L7ATM033

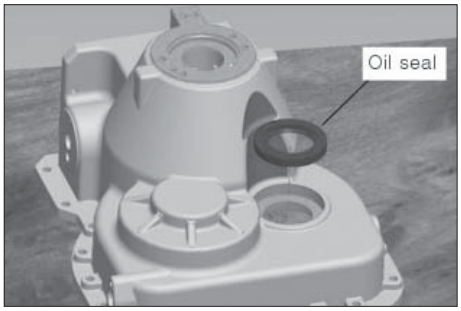
(28) Remove the clutch gear assy.

※ Store each gear assembly in separate box.



15L7ATM034

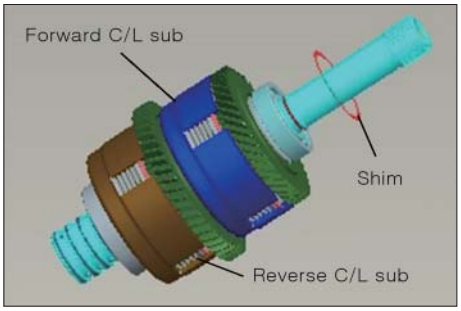
(29) Remove the oil seal.



15L7ATM035

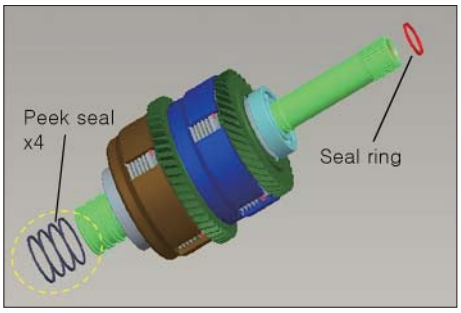
2) DISASSEMBLING OF GEAR ASSEMBLIES

(1) Disassembling clutch gear assy.



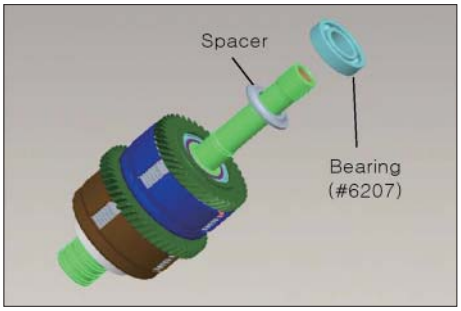
22D9TTM036

① Remove the peek seal and seal ring.



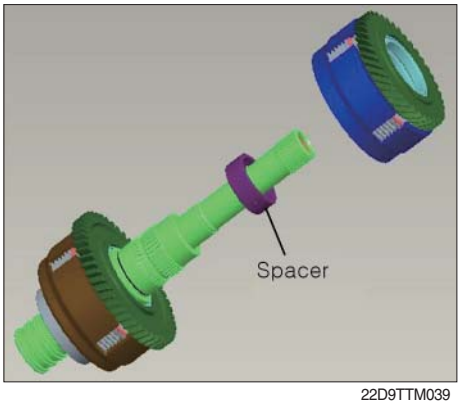
22D9TTM037

② Pull out the bearing (#6207) and spacer from the shaft.



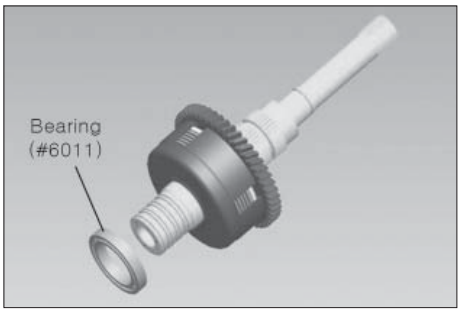
22D9TTM038

③ Pull out the forward clutch sub assy and space.



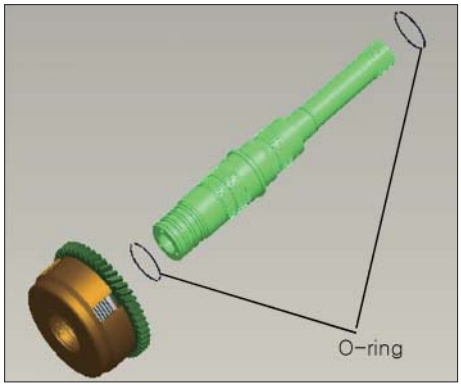
22D9TTM039

④ Pull out the bearing (#6911) from the shaft.



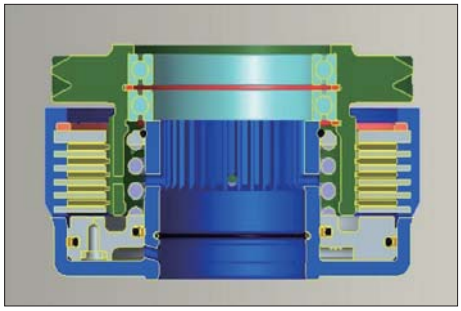
22D9TTM040

⑤ Pull out the reverse clutch sub assy and remove the O-ring.

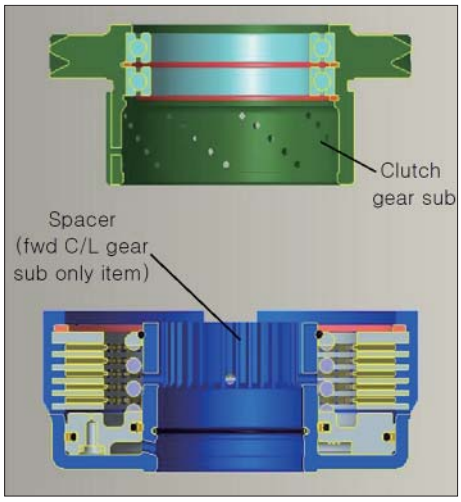


22D9TTM041

⑥ Forward clutch sub assy.

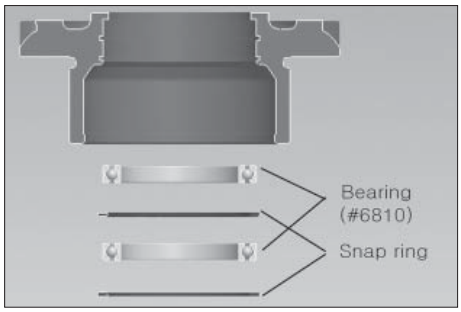

22D9TTM042

⑦ Remove the forward clutch gear sub, and then remove the spacer.



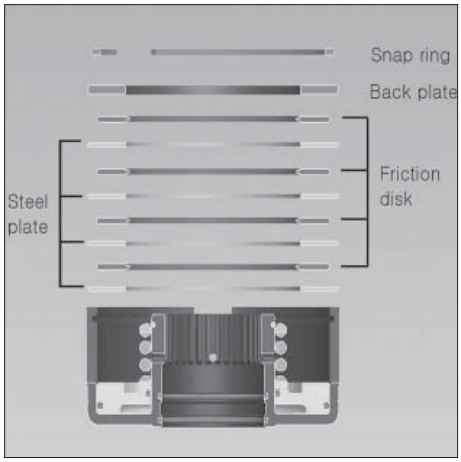
22D9TTM043

⑧ Remove the snap ring, and then remove the bearing.



15L7ATM044

⑨ Remove the snap ring, and then remove the back plate, friction disk, and steel plate.

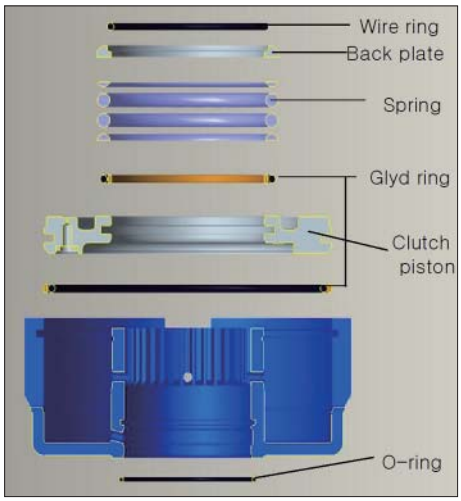


15L7ATM045

⑩ Remove the wire ring, and then remove the back plate and spring.

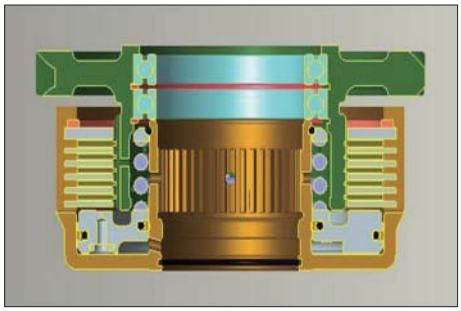
⚠ When you remove the wire-ring, it might be shot out by impact of spring. Certainly fixing the spring, will have to remove.

⑪ Pull out the clutch piston, and then remove the O-ring.
Next remove the glyd ring at the clutch piston.

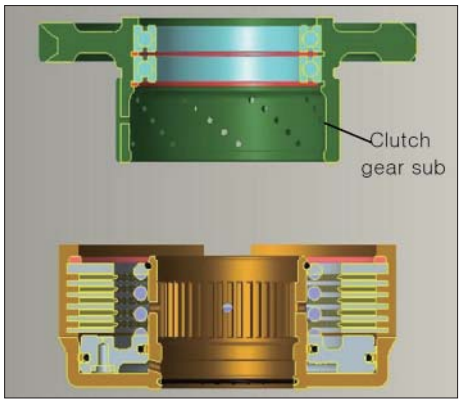


22D9TTM046

⑫ Reverse clutch sub assy.

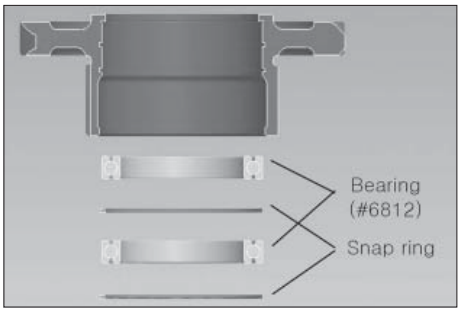

22D9TTM047

⑬ Remove the reverse clutch gear sub.



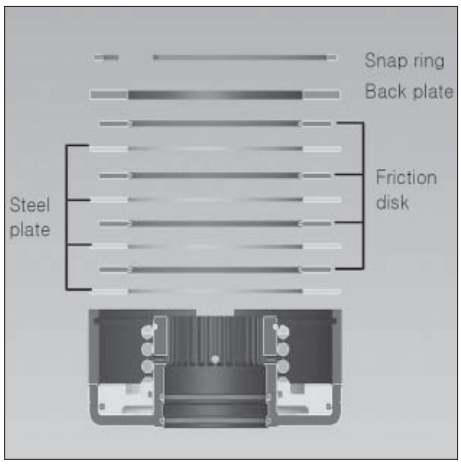
22D9TTM048

⑭ Remove the snap ring, and then remove the bearing.



15L7ATM049

⑮ Remove the snap ring, and then remove the back plate, friction disk, and steel plate.

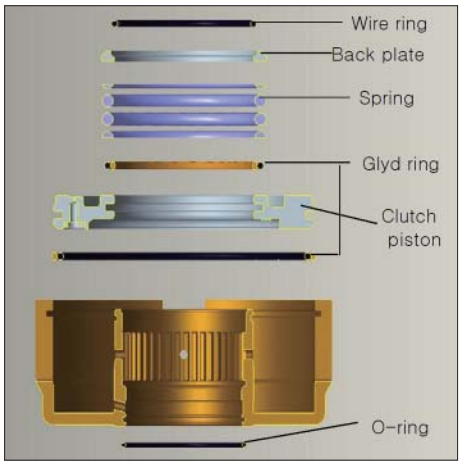


15L7ATM050

⑯ Remove the wire ring, and then remove the back plate and spring.

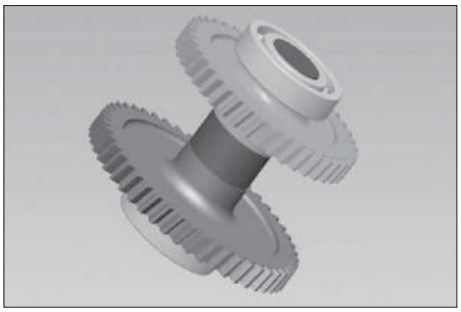
⚠ When you remove the wire-ring, it might be shot out by impact of spring.
Certainly fixing the spring, will have to remove.

⑰ Pull out the clutch piston, and then remove the O-ring.
Next remove the glyd ring at the clutch piston.



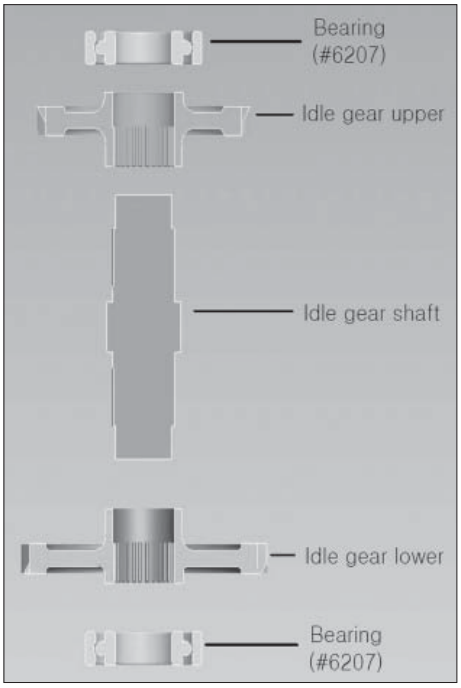
22D9TTM051

(2) Disassembling of Idle gear assy.



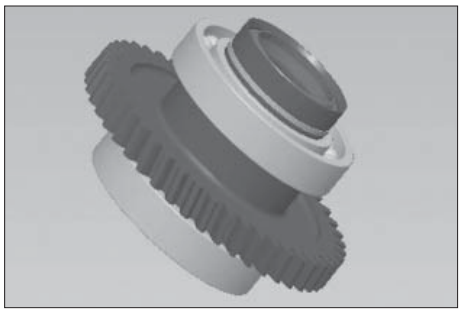
15L7ATM052

① Pull out the bearing, and then remove the idle gear upper (lower).



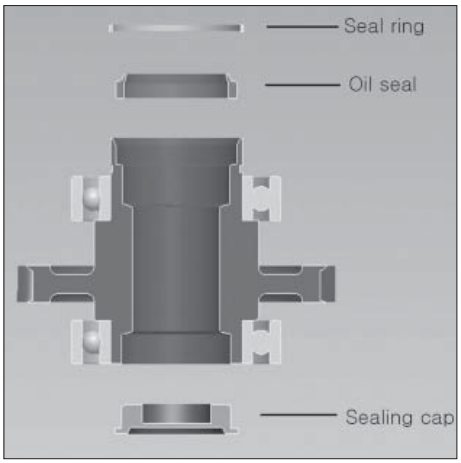
15L7ATM053

(3) Disassembling of output gear assy.



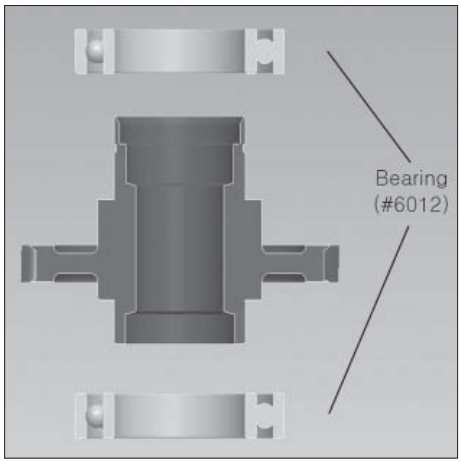
15L7ATM054

① Remove the seal ring, oil seal and sealing cap.



15L7ATM055

② Pull out the bearing.



15L7ATM056

2. ASSEMBLY OF TRANSMISSION

1) ASSEMBLING OF GEAR ASSEMBLIES

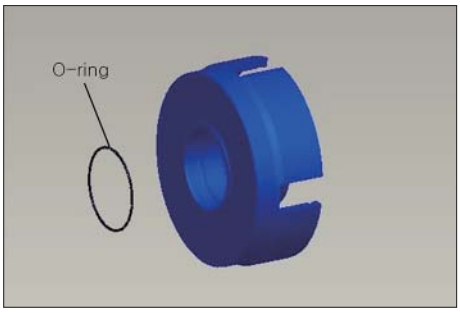
※ Assemble the part with reverse the aforementioned disassemble procedure.

· Assembling of clutch gear assembly.

(1) Forward clutch drum sub assembly.

① In drum internal groove O-ring assembly.

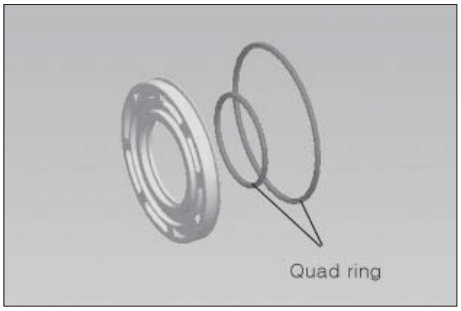
※ Spread grease on seal ring.



22D9TTM057

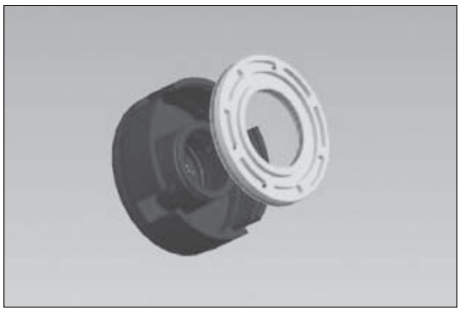
② In piston groove glyd ring assembly.

※ Spread grease on glyd ring.



15L7ATM058

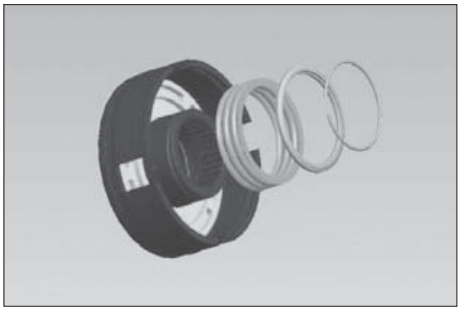
③ Assemble piston at the drum.



15L7ATM059

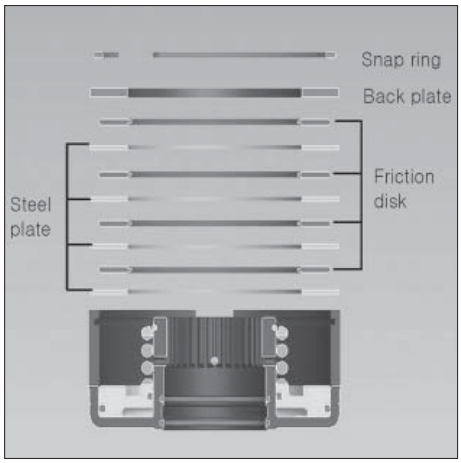
④ Assemble return spring, plate back and wire ring at the drum sub.

⚠ When you assemble the wire ring, it might be shot out by impact of spring.
Certainly fixing the spring, will have to assemble.



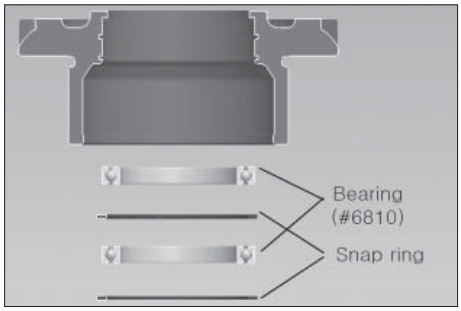
15L7ATM060

⑤ First insert steel plate, and then insert friction disk alternately.
Next insert the back plate, and then assemble the snap ring.



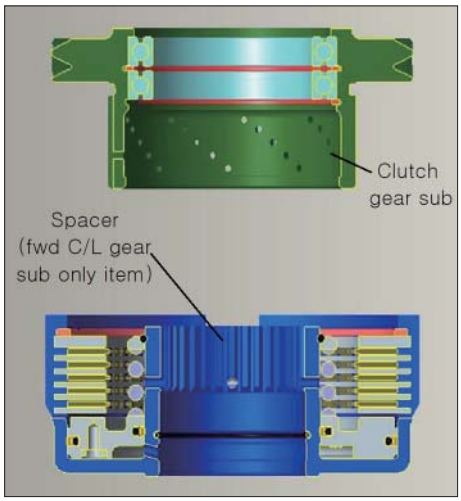
15L7ATM061

⑥ Assemble the bearing, and then assemble the snap ring alternately.



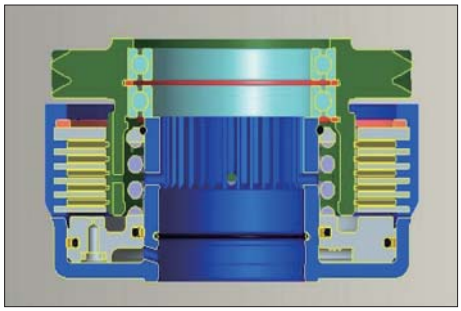
15L7ATM062

⑦ Arrange serration of the friction disk, and then assemble the spacer, clutch gear sub.



22D9TTM063

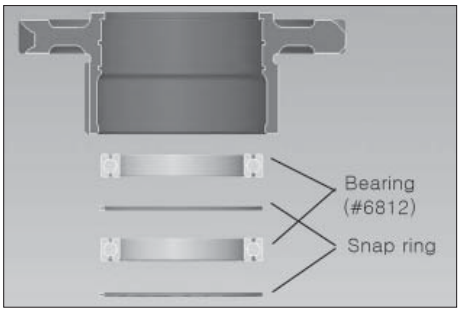
⑧ Forward clutch drum sub assembly.


22D9TTM064

(2) Reverse clutch drum sub assembly.

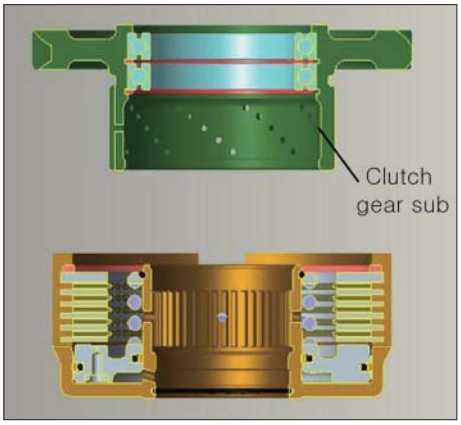
① Do work as the same way like forward clutch drum sub assembly procedure 1) ① ~ ⑤.

② Assemble the bearing, and then assemble the snap ring alternately.



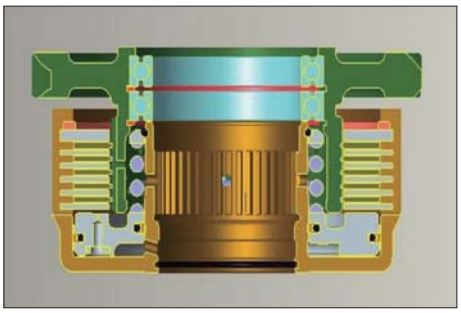
15L7ATM065

③ Arrange serration of the friction disk, and then assemble the clutch gear sub.



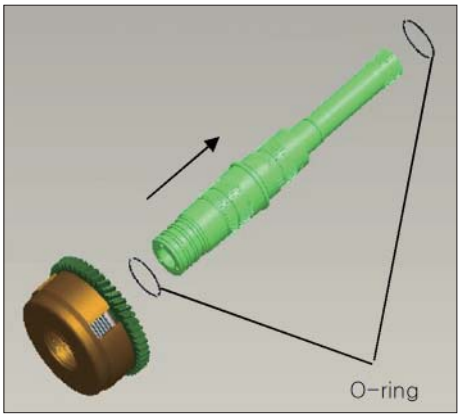
22D9TTM066

④ Reverse clutch drum sub assembly.


22D9TTM067

(3) Clutch gear assembly

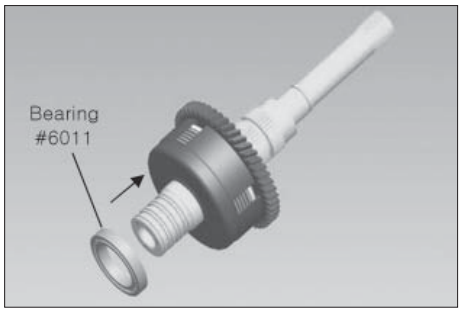
① Assemble the reverse clutch drum sub assy and O-ring at the shaft sub assy.



22D9TTM068

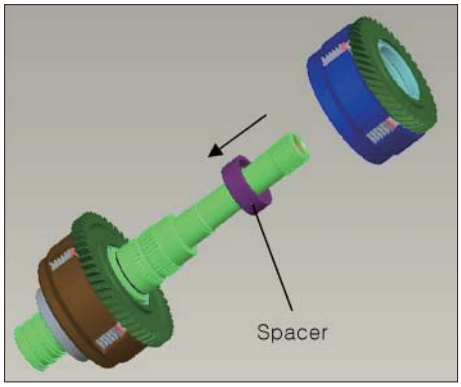
② Assemble the bearing.
- Used method of heating bearing.

※ All bearings should never be heated above 120°C.



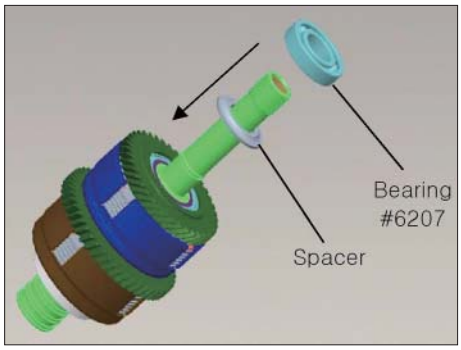
15L7ATM069

③ Assemble the forward clutch drum sub assy and space at the shaft sub assy.



22D9TTM070

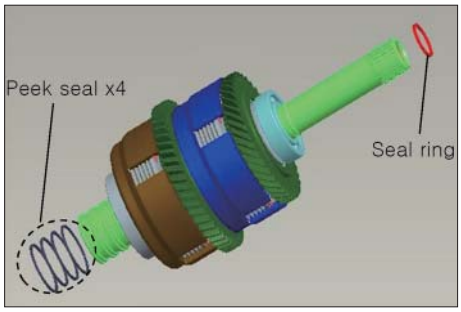
④ Assemble the spacer and bearing.
- Used method of heating bearing.



22D9TTM071

⑤ Assemble the peek seal and seal ring.

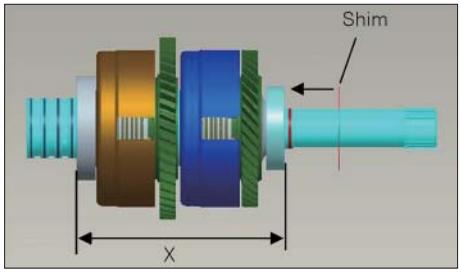
※ Spread grease on peek seal and seal ring.



22D9TTM072

⑥ Clutch gear assy. (assemble the shim)

※ Bearing distance (191.5) - X = The amount of shim
(It will manage bearing distance $191.5^{0}_{-0.1}$)

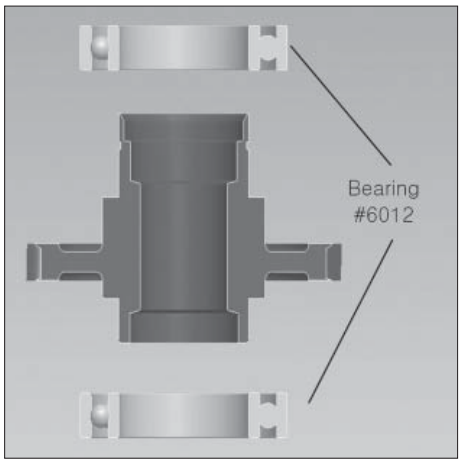


22D9TTM073

Assembling of output gear assembly.

① Assemble the bearing.
- Used method of heating bearing

※ All bearings should never be heated above 120°C



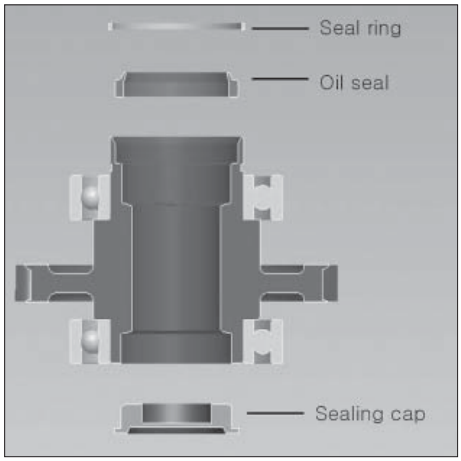
15L7ATM074

② Assemble the oil seal, seal ring and sealing cap.

※ Spread loctite #609 on the out wheel of oil seal, spread grease on inside wheel of oil seal.

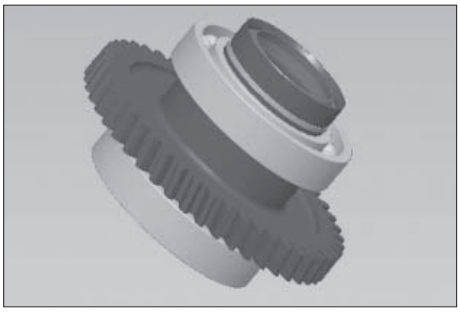
※ Spread grease on seal ring.

※ Spread loctite #592 on the out wheel of sealing cap.



15L7ATM075

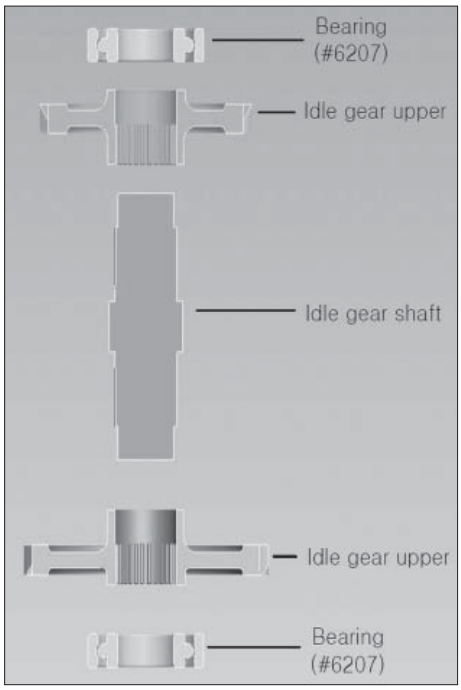
③ Output gear assy.


15L7ATM076

Assembling of idle gear assembly.

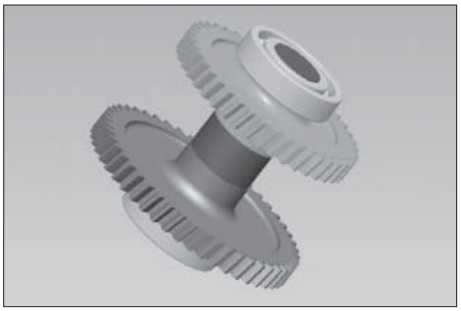
① Press the idle gear upper and idle gear lower at the idle gear shaft, and then assemble the bearing.
- Used method of heating bearing

※ All bearings should never be heated above 120°C



15L7ATM077

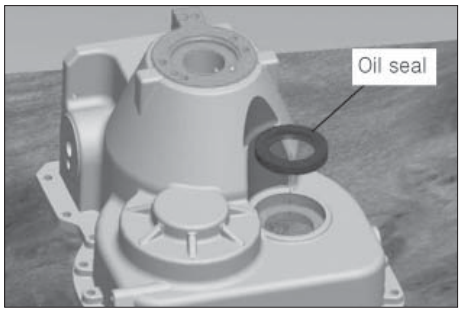
② Idle gear assy.


15L7ATM078

2) ASSEMBLING OF TRANSMISSION ASSY

(1) Press the oil seal.

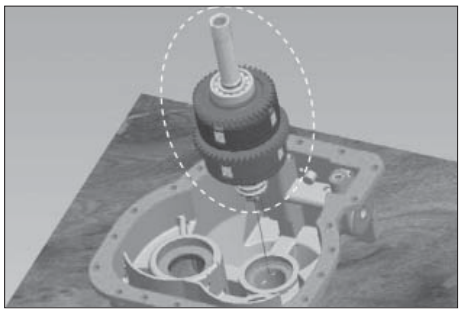
※ Spread loctite #592 on the out wheel of oil seal, spread grease on inside wheel of oil seal.



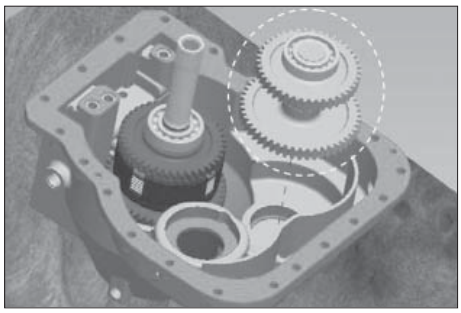
15L7ATM079

(2) Assemble the clutch gear assy.

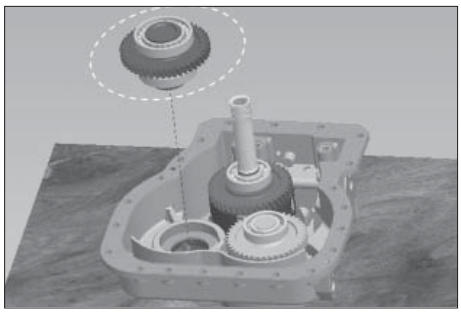
※ When you insert the shaft after install the seal ring in the shaft, please insert the shaft with turning it into the shaft side and hole side of shaft for prevent the damage of shaft.


15L7ATM080

(3) Assemble the idle gear assy.

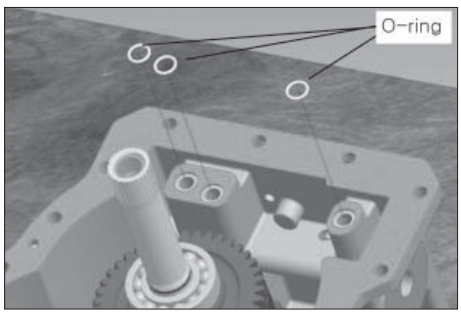

15L7ATM081

(4) Assemble the output gear assy.


15L7ATM082

(5) Assemble the O-rings.

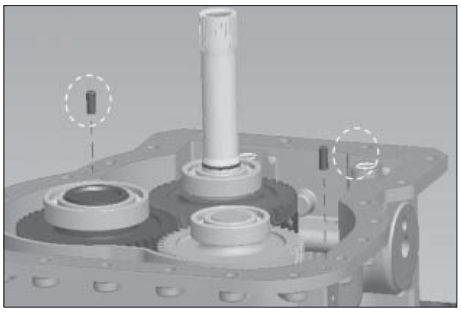
※ Spread grease on O-ring.



15L7ATM083

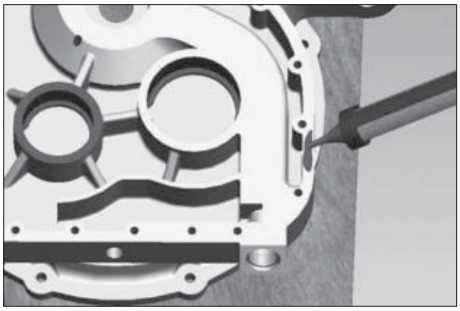
(6) Press the lock-pins.

※ After the assembling, please check whether you can turn the input (output) gear lightly by your hand.



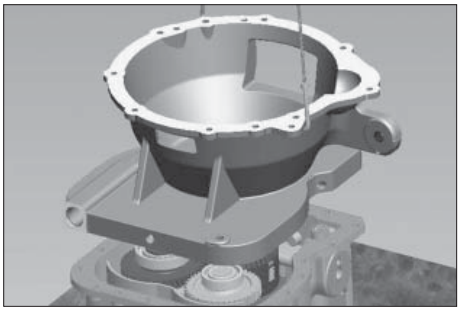
15L7ATM084

(7) Spread loctite #5127 on T/C housing space.



15L7ATM085

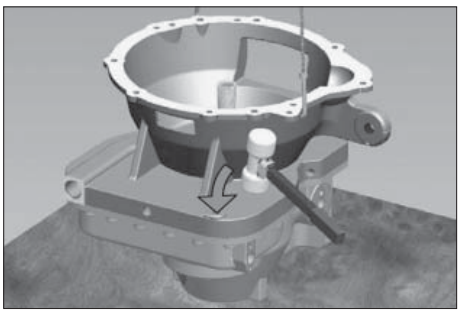
(8) Assemble the T/C housing.



15L7ATM086

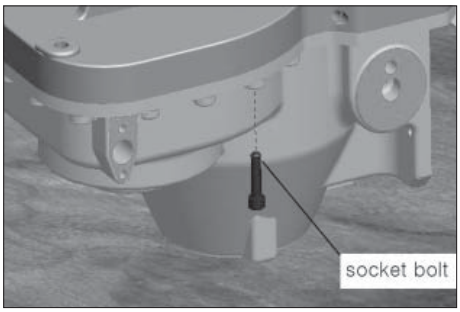
(9) Assemble the part slowly with hit the end side softly.

※ Using a plastic hammer.



15L7ATM087

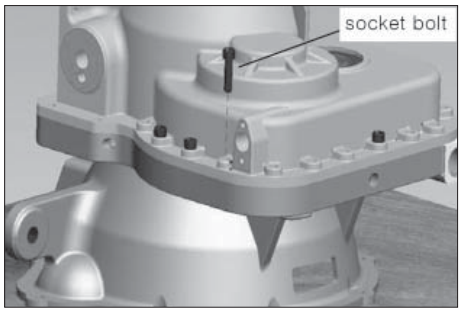
(10) Assemble the socket bolts.
(T/M case + T/C housing softly fastening)



15L7ATM088

(11) Turn over T/M assy without damage to the T/C housing.(engine mounting surface)
Next assemble the socket bolts.
- Socket bolt (M10 × 1.5p × 40 mm) × 16EA
- Tightening torque : 6.5~7.0 kgf · m (47~50.5 lbf · ft)

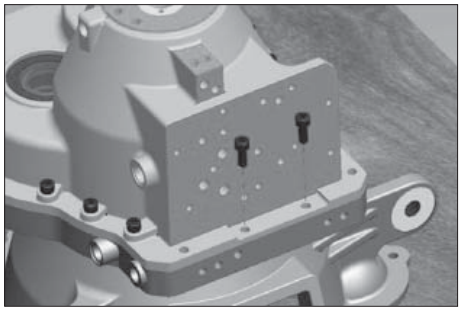
※ Spread loctite #277 on socket bolt.



15L7ATM089

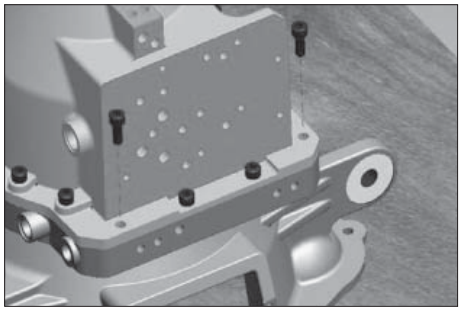
(12) Assemble the socket bolts.
- Socket bolt (M10 × 1.5p × 25mm) × 2EA
- Tightening torque : 6.5~7.0 kgf · m (47~50.5 lbf · ft)

※ Spread loctite #277 on socket bolt.


15L7ATM090

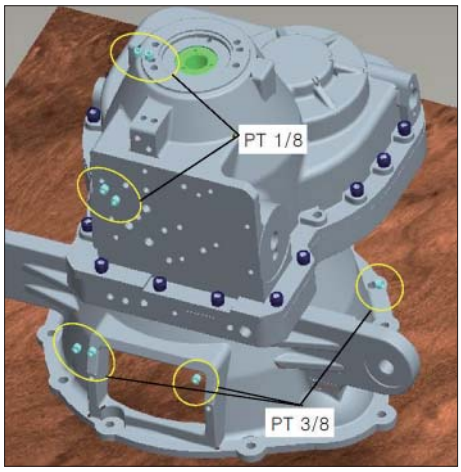
(13) Assemble the socket bolts.
- Socket bolt (M10 × 1.5p × 30 mm) × 2EA
- Tightening torque : 6.5~7.0 kgf · m (47~50.5 lbf · ft)

※ Spread loctite #277 on socket bolt.


15L7ATM091

(14) Assemble the plugs(PT 1/8, PT 3/8) × 4EA
- PT 1/8 Tightening torque : 1.0~1.5 kgf · m (7.0~11 lbf · ft)
- PT 3/8 Tightening torque : 3.0~4.5 kgf · m (21.5~29.0 lbf · ft)

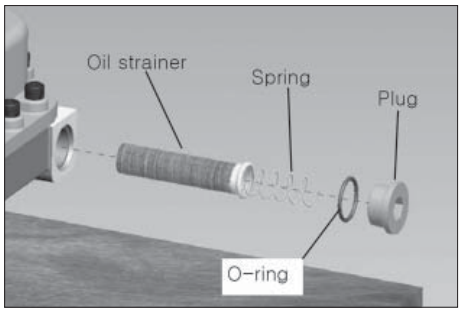
※ Spread loctite #577 on plug.



22D9TTM092

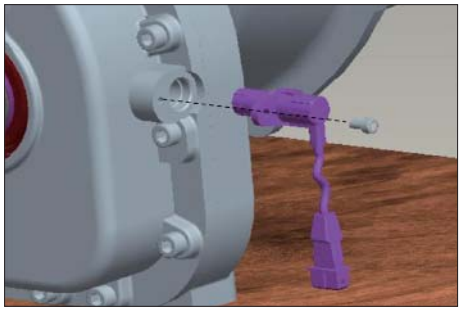
(15) Assemble the O-ring at the plug.
Insert the oil strainer, spring ,and then assemble O-ring+plug assy.
· Plug tightening torque : 8~10 kgf · m (58~72 lbf · ft)

※ Spread grease on O-ring.



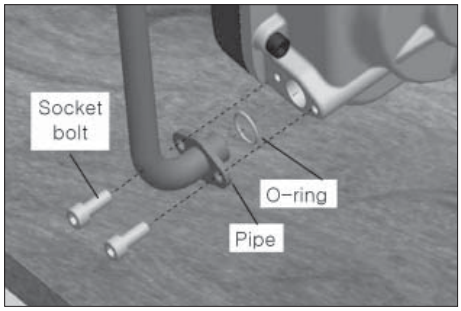
15L7ATM093

(16) Assemble the speed sensor, next assemble the socket bolts.
· Tightening torque : 0.5~0.8 kgf · m (3.5~5.5 lbf · ft)


22D9TTM094

(17) Assemble the O-ring at the pipe, and then assemble the pipe+O-ring assy.
Next assemble the socket bolts.
· Socket bolt (M8 × 1.5p × 15 mm) × 2EA
· Tightening torque : 3.2~3.6 kgf · m (23~26 lbf · ft)

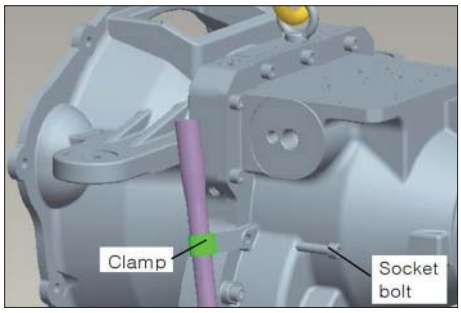
※ Spread grease on O-ring.
※ Spread loctite #277 on socket bolt.



15L7ATM095

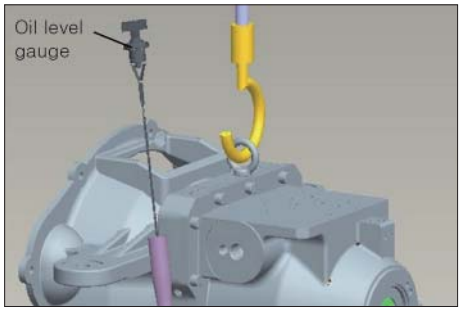
(18) Assemble the clamp at the pipe, and then assemble the socket bolt.
· Socket bolt (M10 × 1.5p × 30 mm)
· Tightening torque : 5.5~6.5 kgf · m (40~47 lbf · ft)

※ Spread loctite #277 on socket bolt.



22D9TTM096

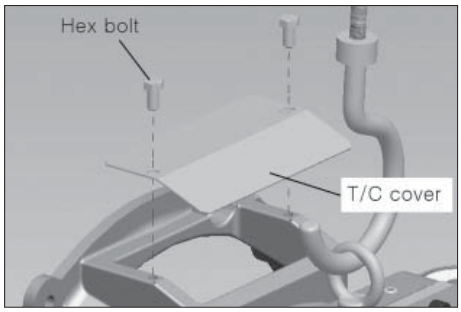
(19) Assemble the oil level gauge at the pipe.



22D9TTM097

(20) Assemble the T/C cover and hexagon bolts.
- Hexagon bolt (M8 × 1.25p × 16 mm) × 2EA
- Tightening torque : 3.2~3.6 kgf · m (23~26 lbf · ft)

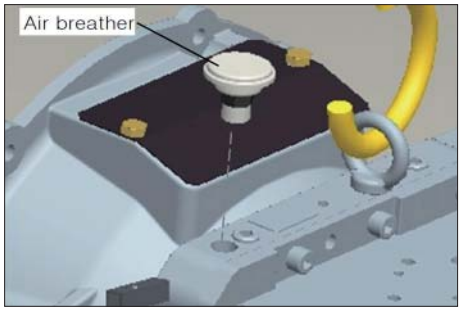
※ Spread loctite #277 on socket bolt.



15L7ATM098

(21) Assemble the air breather.
- Tightening torque : 3.0~4.0 kgf · m (21.5~29 lbf · ft)

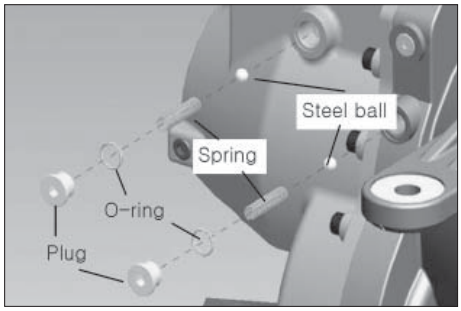
※ Spread loctite #577 on air breather.



22D9TTM099

(22) Assemble the O-ring at the plug, and then insert steel ball, spring.
Next assemble O-ring+plug assy.
- Plug(3/4-16 UNF) × 2EA
  - Tightening torque : 3.5~4.5 kgf · m (25~33 lbf · ft)

※ Spread loctite #577 on plug.
※ Spread grease on O-ring.

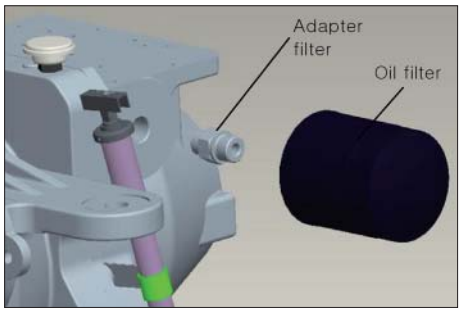


15L7ATM100

(23) Assemble the adapter filter, and then assemble the oil filter.
- Adapter filter
  - Tightening torque : 3.5~4.5 kgf · m (25~32 lbf · ft)

※ Spread loctite #277 on adapter filter.

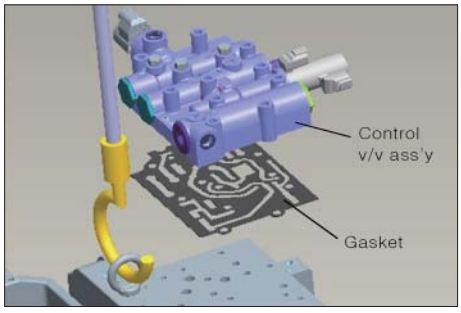
- Oil filter
  - Tightening torque : 2.2~2.5 kgf · m (16~18 lbf · ft)



22D9TTM101

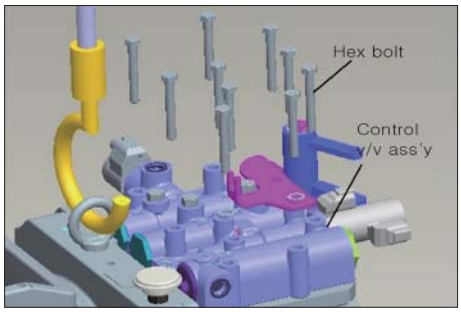
(24) Install the gasket, and then install the control valve assy.

※ Spread grease on gasket.



22D9TTM102

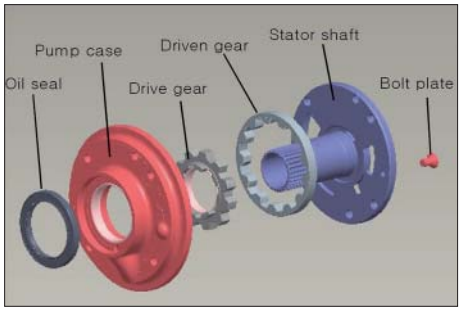
(25) Assemble the hex bolt.
- Hexagon bolt (M8 × 1.25p × 60 mm) × 10EA
- Tightening torque : 3.2~3.6 kgf · m (23~26 lbf · ft)



22D9TTM103

(26) Assemble the drive gear, driven gear and stator shaft at the pump case and assemble the bolt plate and then oil seal.
- Bolt plate
- Tightening torque : 3.0~4.0 kgf · m (21~29 lbf · ft)

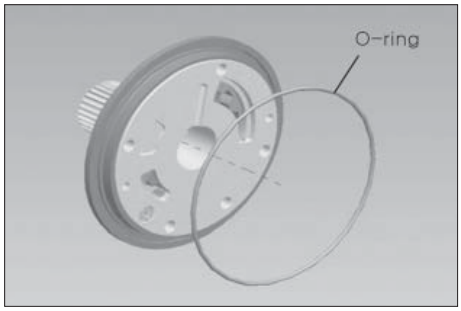
※ Spread Loctite #592 on the out wheel of oil seal, spread grease on inside wheel of oil seal.



22D9TTM104

(27) Assemble the o-ring at the charging pump assy.

※ Spread grease on O-ring.

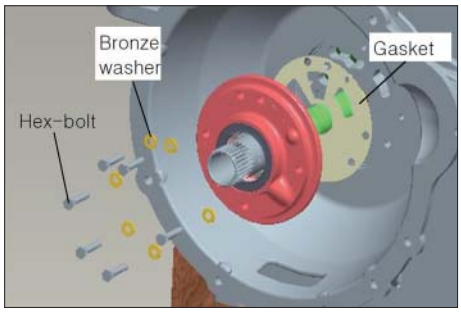


15L7ATM104

(28) Install the gasket at the T/C housing, and then install the charging pump assy.
Next assemble the hexagon bolt and bronze washer.

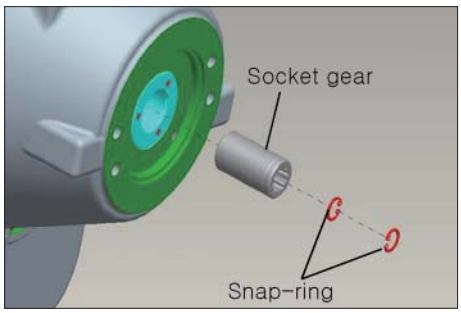
※ Spread grease on gasket.
- Hexagon bolt (M8 × 1.25p × 38L) × 6EA
- Tightening torque : 3.2~3.6 kgf · m (23~26 lbf · ft)

※ Spread loctite #242 on hexagon bolt.



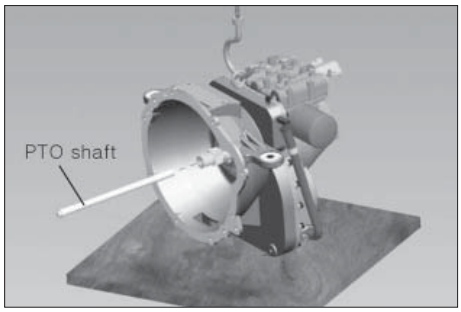
22D9TTM105

(29) Assemble the snap ring at the socket gear, and then insert the socket gear sub assy at the cylinder gear assy.



22D9TTM106

(30) Insert the PTO shaft.

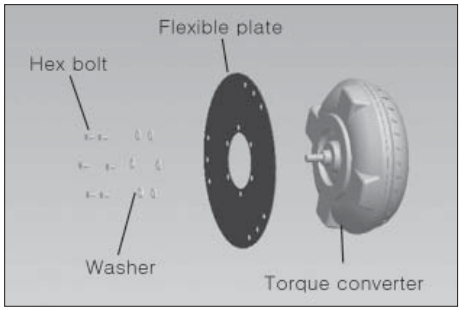


15L7ATM107

(31) Install the flexible plate at the torque converter, and then install the hexagon bolt and washer.

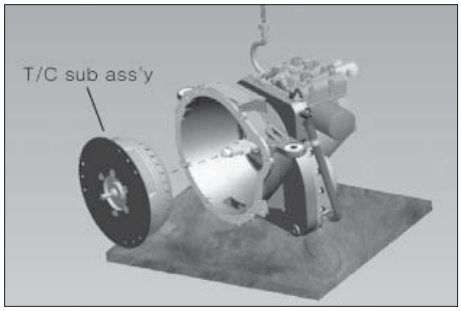
- Hexagon bolt (3/8-24UNF-2B) ×6EA
- Tightening torque : 3.0~3.5 kgf · m
  (21.6~25.3 lbf · ft)

※ Spread loctite #277 on hexagon bolt



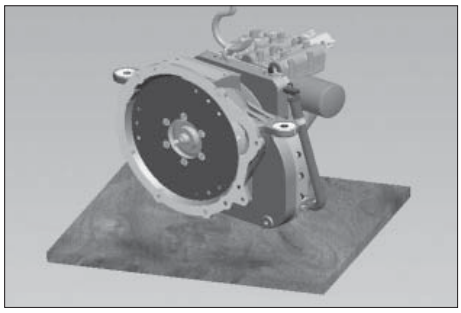
15L7ATM108

(32) Insert the T/C sub assy at the T/M sub assy.



15L7ATM109

(33) Transmission assy.

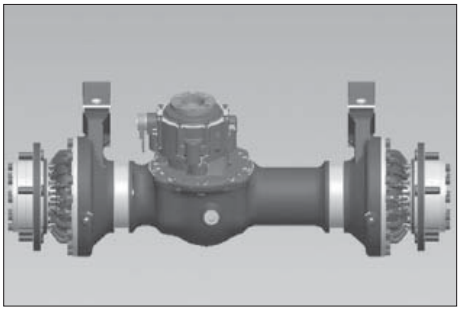


15L7ATM110

3. DISASSEMBLY OF DRIVE AXLE

1) DISASSEMBLY

(1) Disassembling of drive axle assy.

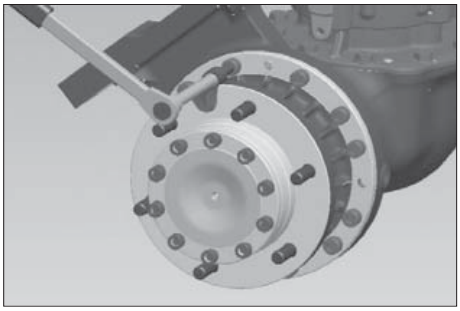


15L7ADA001

(2) Remove bolts of hub sub assembly.

⚠ **To avoid serious personal injury and possible damage to components, be very careful when using lifting devices during removal and disassembly procedures.**

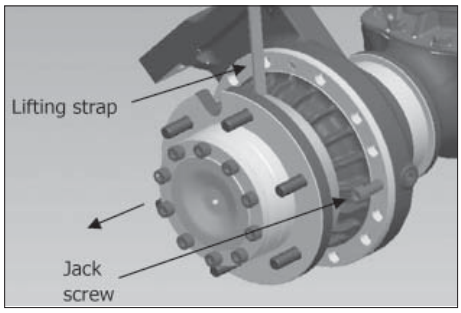
- Inspect to make sure that neither lifting strap is damaged.
- Do not subject lifting straps to any shock or drop loading.



15L7ADA002

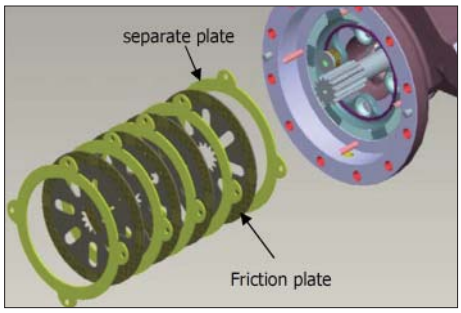
(3) After support hub sub assembly by lifting device, make hub sub assembly separate at the same intervals by tightening two jack screw.

⚠ **Use care when you remove the hub assembly to prevent the hub assembly from falling off of the lifting device. Do not drop the hub assembly. Damage to the hub assembly and serious personal injury can result.**



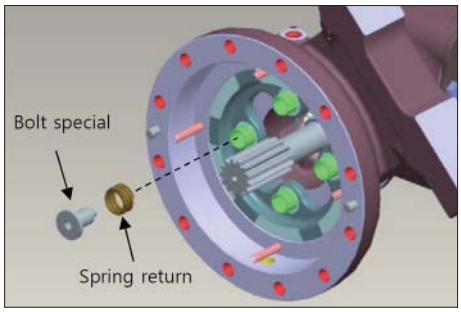
15L7ADA003

(4) Disassemble in order of separate plate → friction plate.



22D9TDA004

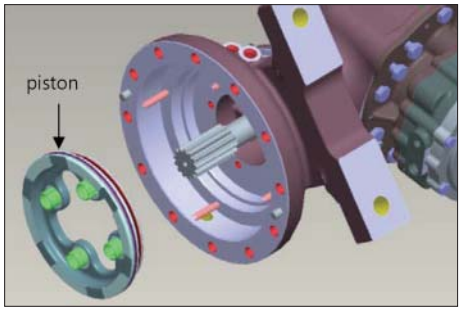
(5) Disassemble in order of special bolt → return spring.



22D9TDA006

(6) Remove the brake pistion.

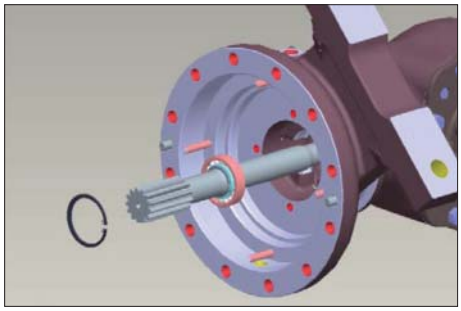
※ Caution of the quad ring damage.



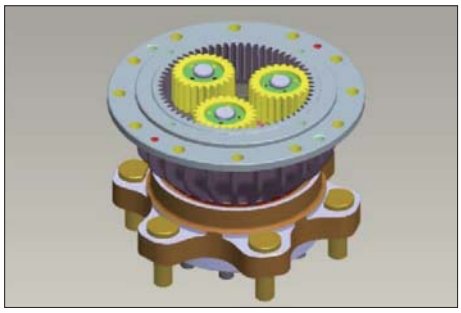
22D9TDA007

(7) After remove retaining ring, pull out left axle shaft. (Do work as the same way like right axle shaft)

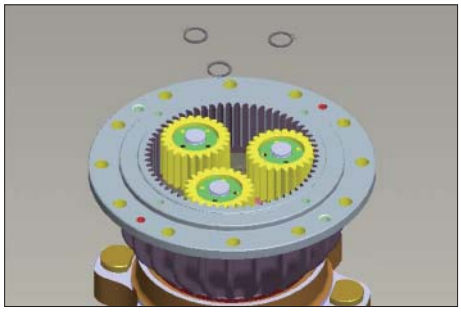
⚠ Use a brass, leather or rubber mallet for assembly and disassembly procedures. Do not hit steel parts with a steel hammer. Pieces of a part can break off and cause serious personal injury.


22D9TDA008

(8) Disassembling of hub sub assy.

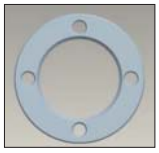

22D9TDA009

(9) Remove all snap rings.


22D9TDA010

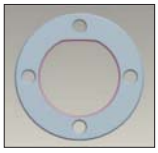
(10) Remove all each parts in order of thrust washer → planet gear → needle bearing → thrust washer.

※ Check to be sure that the needle roller quantity. (19 EA/1 gear)



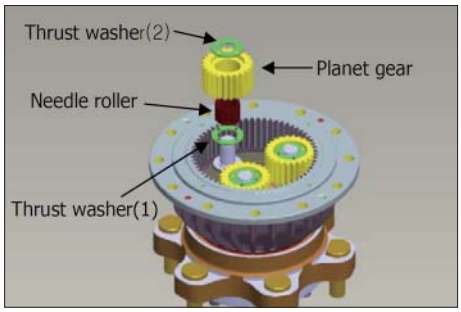
22D9TDA011-1

Thrust washer (1)



22D9TDA011-2

Thrust washer (2)



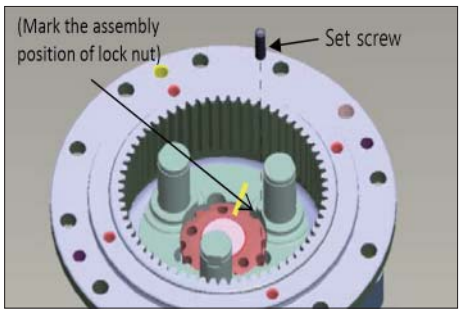
22D9TDA011

(11) Disassemble the set screw.

When hard to disassemble by loctite, heating the set screw on 1 min by heating device. And then try to disassemble.

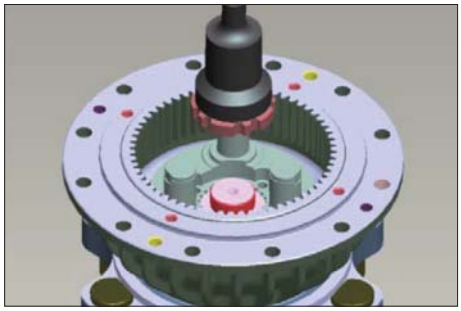
Mark the position, before disassemble.

When the bearings, wheel shaft, housing is not replaced, use the replaced shim.



22D9TDA011A

(12) Loose lock nut by using jig.

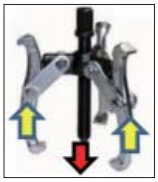


22D9TDA012

(13) Extract planet carrier.

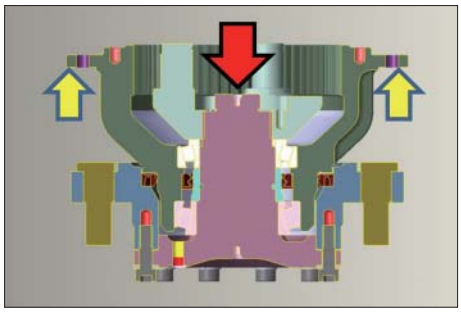
Disassemble hub sub.

※ Extract using a gear puller.



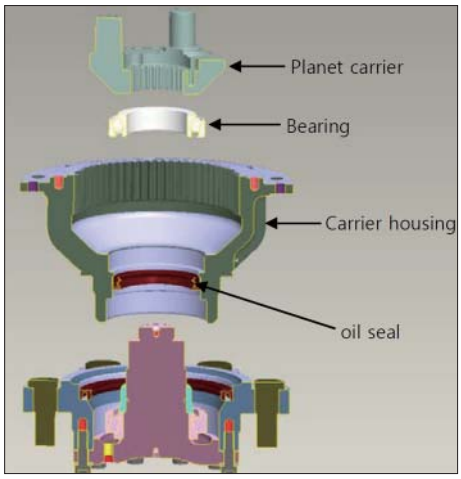
22D9TDA013-1

Gear puller



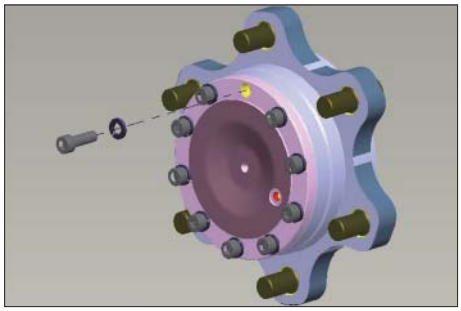
22D9TDA013

(14) Extract carrier housing with bearing.

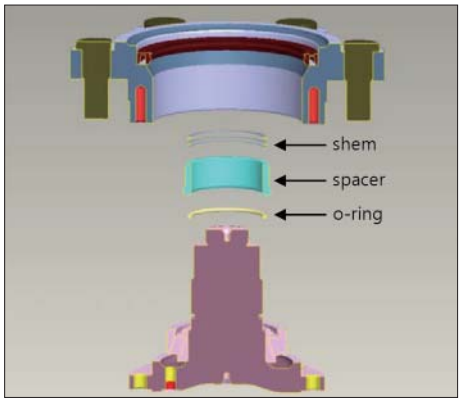


22D9TDA014

(15) Remove bolts and spring wahser.

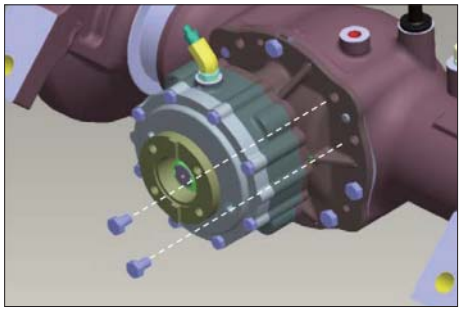

22D9TDA015

(16) Remove flange hub, shim, spacer and O-ring.
If you do not replace the bearing or spacer, disassemble and reassemble the shim to accept.



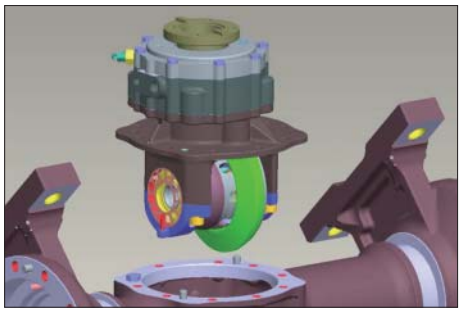
22D9TDA016

(17) Extract the fixing bolt of carrier assembly.


22D9TDA017

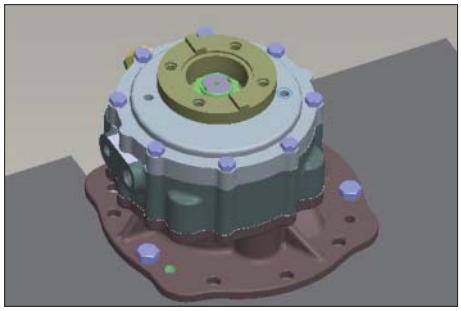
(18) Extract carrier assembly.

※ Using lifting device.



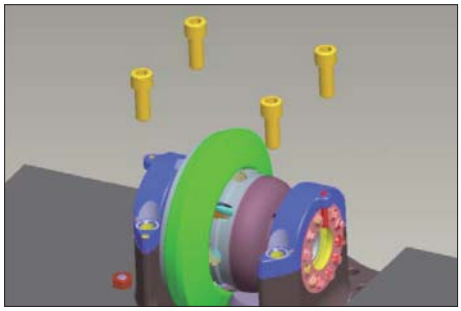
22D9TDA018

(19) Fix carrier assembly to a jig.



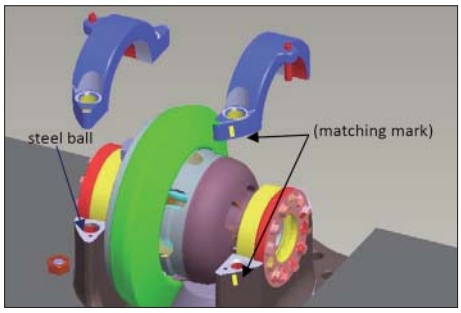
22D9TDA019

(20) Remove carrier cap bolt.



22D9TDA020

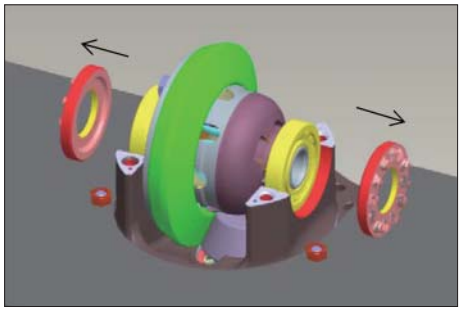
(21) Extract the carrier cap (apply marking a match).



22D9TDA021

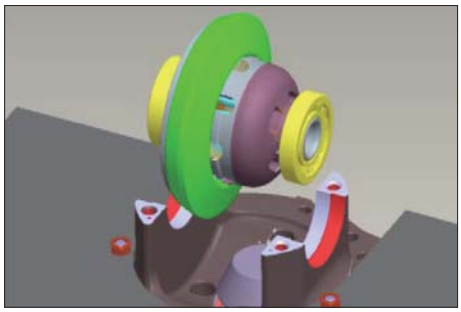
(22) Remove adjusting ring of both sides bearing cup.

※ Using dedicated fixtures and brass drift punch.



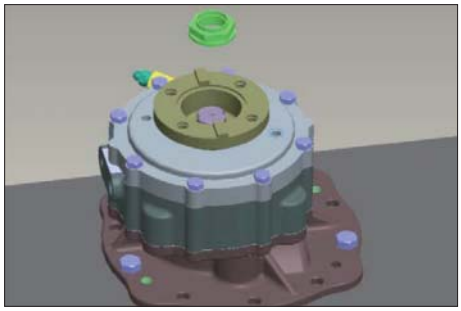
22D9TDA022

(23) Extract differential assembly.



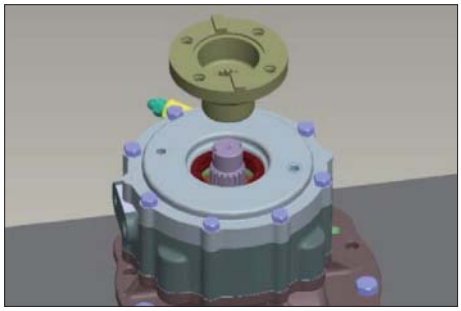
22D9TDA023

(24) After turn over carrier assy and fix it, remove nut.



22D9TDA024

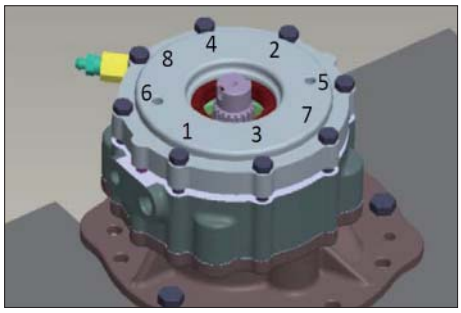
(25) Remove U-joint flange.



22D9TDA025

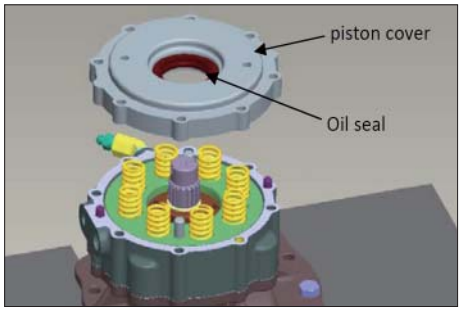
(26) Remove carrier case cover bolts.

※ Disassemble slowly and follow the No. in regular.
It prevent to jump out the cover by inner spring



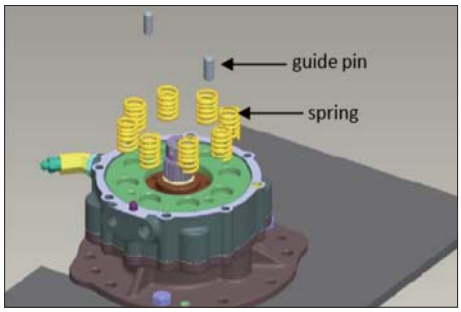
22D9TDA026

(27) Extract carrier case cover assembly.



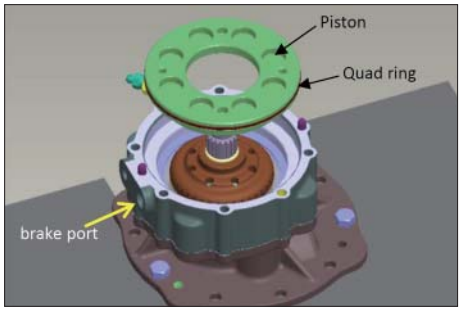
22D9TDA027

(28) Remove spring and guide pin.



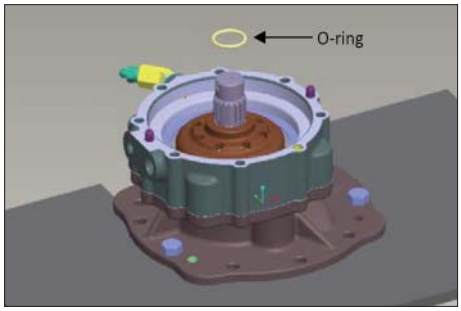
22D9TDA028

(29) Disassemble the piston.
When disassembling, apply oil or air pressure at brake port.
Caution of damage on quad ring



22D9TDA029

(30) Remove the O-ring



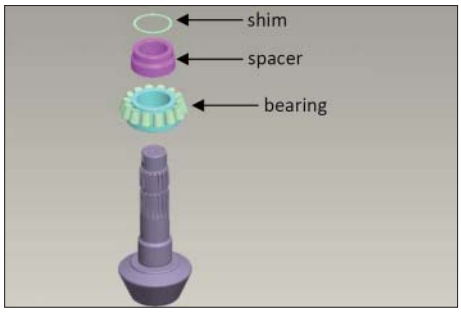
22D9TDA030

(31) Disassemble the pinion shaft.
Hit the pinion shaft by rubber hammer.

※ To avoid personal injury and possible damage to component.
Be very carefully to disassemble.

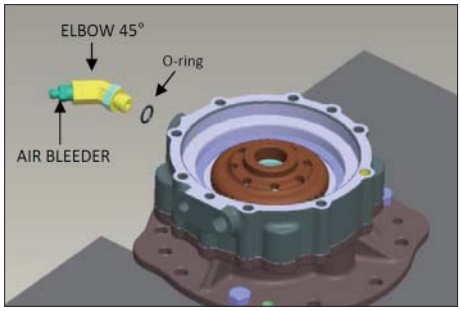

22D9TDA031

(32) Disassemble shim, spacer, and bearing.
If do not replace the spacer and bearing, it use original shim.



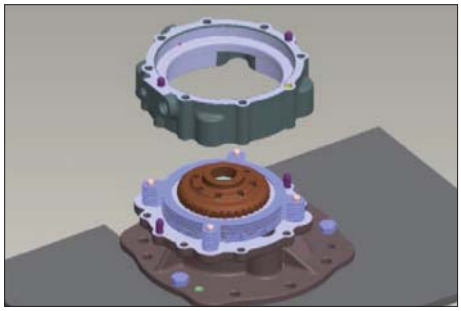
22D9TDA032

(33) Remove the O-ring.

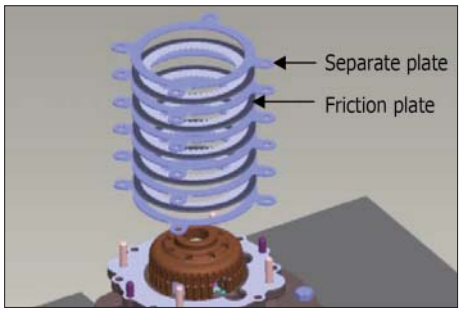


22D9TDA033

(34) Extract piston housing.

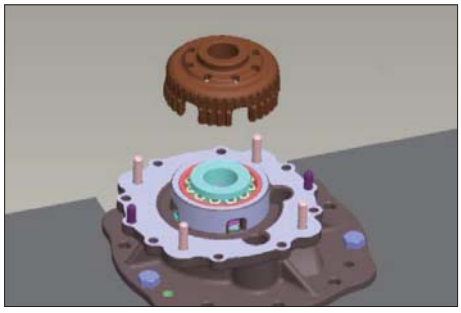

22D9TDA034

(35) Remove parking friction plate and separate plate.

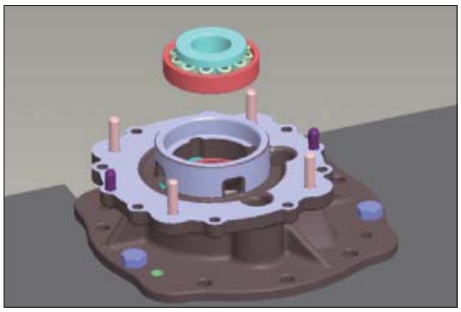


22D9TDA035

(36) Remove spline parking.

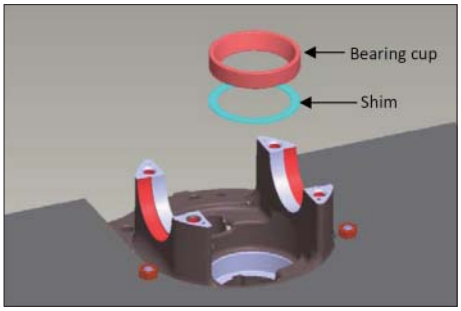

22D9TDA036

(37) Remove bearing cup and shim.



22D9TDA037

(38) Bearing cup and shim parts.



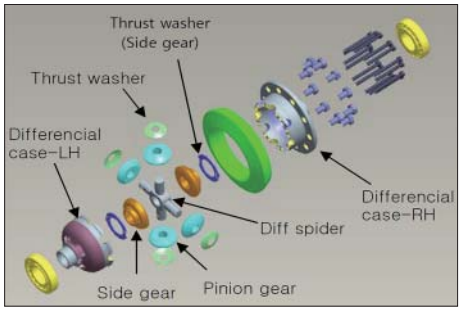
22D9TDA038

2) ASSEMBLY

(1) Carrier sub assembly

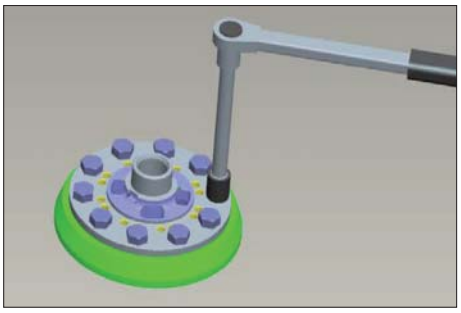
Differential device assembly

① Prepare parts for assembly of differential.



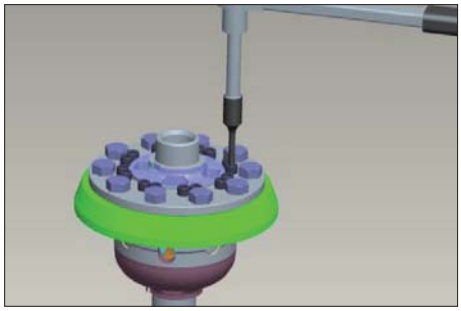
22D9TDA138

② Fix differential case RH and spiral ring gear with bolt.
After paste loctite #277 on spiral of bolt.
Confirm torque : 7.1~7.6 kgf · m



22D9TDA139

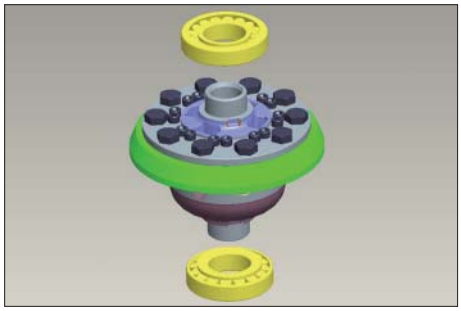
③ Assemble the carrier sub of a sequential development.
Differential case RH and LH with bolt
After paste loctite #277 on spiral of bolt.
Confirm torque : 1.6~1.7 kgf · m



22D9TDA140

④ Assemble bearing.
Heating pressurize bearing cone.

※ Control the heating temperature 100°C or less.

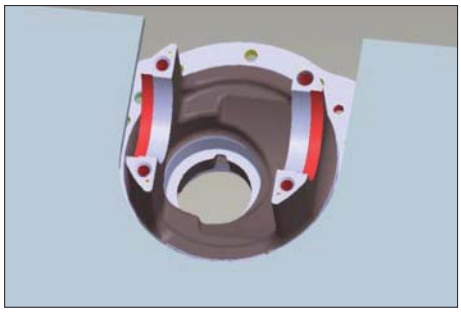


22D9TDA141

Adjusting shim and pinion shaft assembly

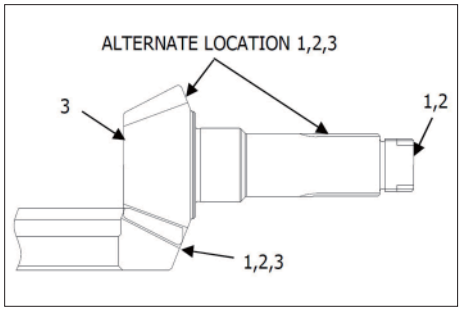
① Fix carrier case to the jig.

※ Read the following information before installing new gear set in the carrier. Always inspect the gear set for correct marks to make sure the gears are a matched set.



22D9TDA036A

The locations of the gear set marks are shown in right figure.



22D9TDA037

· Part number

a. Examples of gear set part numbers
- Conventional ring gear, 21DA-20041
- Conventional pinion shaft, 21DA-20051

※ Part No. : Refer to parts manual.

b. Location on pinion shaft : Shaft end

c. Location on ring gear : Front face or outer diameter

· Tooth combination number

a. Example of a tooth combination number : 13-32
(An 13-32 gear set has an 13-tooth drive pinion and a 32-tooth ring gear)

b. Location on pinion shaft : Shaft end

c. Location on ring gear : Front face or outer diameter

· Pinion cone variation number
(The pinion cone variation number is not used when checking for a matched gear set. The number is used when you adjust the depth of the pinion in the carrier.)

a. Examples - Pinion cone variation numbers
· +2 : +0.02 mm
· -1 : -0.01 mm

b. Location on gear set
End of pinion shaft head or outer diameter of ring gear

c. Decide thickness of shim by gauge and measuring apparatus (Standard gap between bearing and carrier case step : A)
(Mounting distance (MD) of pinion shaft : B)

※ Thickness of shim

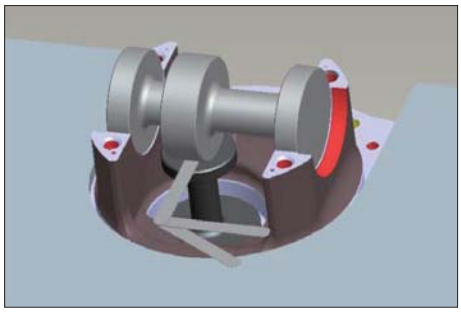
· X = A - B + Carrier case bearing step depth

ex1) A=0.35, B=-0.1, Bearing step depth= +0.1

X=0.35 + 0.1 + 0.1 = 0.55 mm

ex2) A=0.35, B=+0.1, Bearing step depth= -0.1

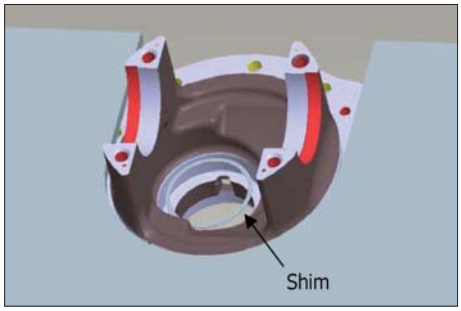
X=0.35 - 0.1 - 0.1 = 0.15 mm



22D9TDA038A

② Assemble shim and bearing cup.

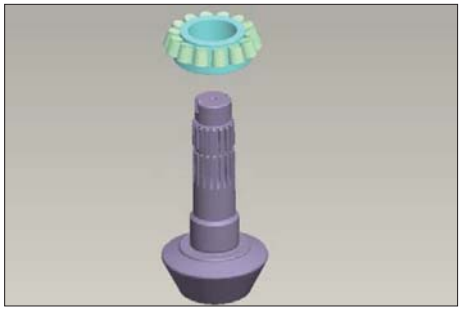
※ Using dedicated fixtures.



22D9TDA039

③ Put with heating bearing cone on pinion shaft.

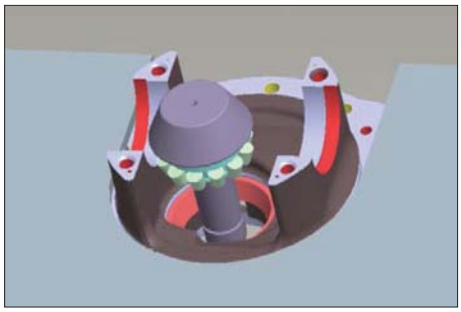
※ The heating temperature below 100°C or less administration.



22D9TDA041

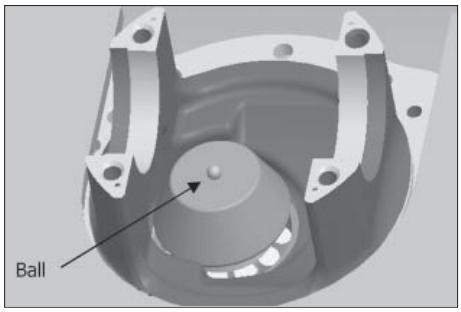
④ Put into pinion shaft.

※ Applied oil or grease on the bearing roller area.



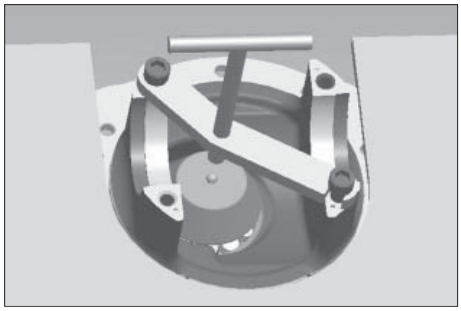
22D9TDA042

⑤ Set a ball.



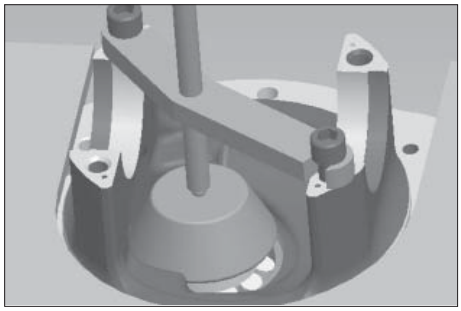
15L7ADA043

⑥ Equip jig for fixing.



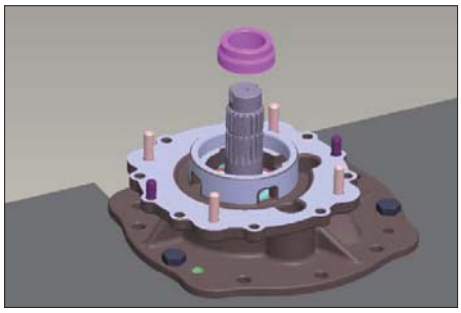
15L7ADA044

⑦ Fasten the ball.



15L7ADA045

⑧ Put into spacer.



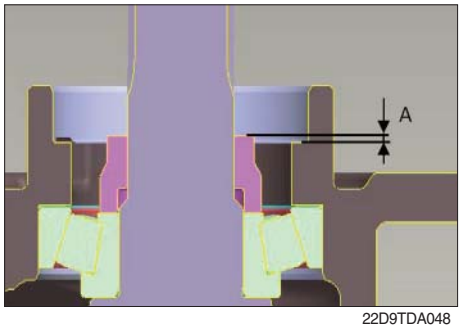
22D9TDA047

⑨ Decide thickness of shim by depth gauge (thickness : A)

· If there is no set work-related replacement parts required. Re-use the existing parts.

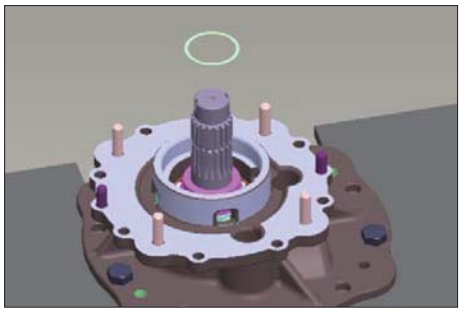
Thickness of shim = A - (0.03 ~ 0.06)

A : short distance between the bearing assembly and spacer



22D9TDA048

⑩ Assemble shim.

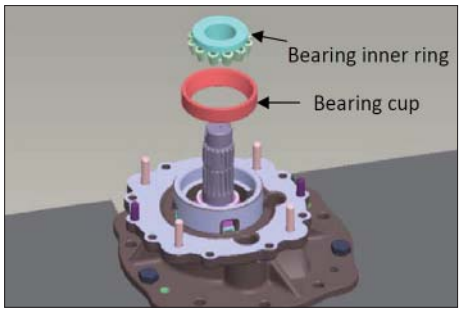


22D9TDA052

⑪ Assemble bearing.

※ Bearing cup is assembled using a dedicated jig.

※ Put heated bearing inner ring, and control heating temperature 100°C or less.



22D9TDA053

Assemble of parking sub assembly

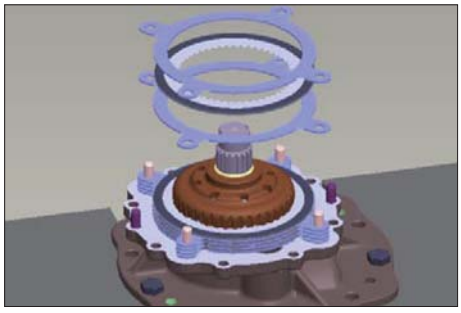
① Assemble spline parking.

22D9TDA054

② Assemble O-ring

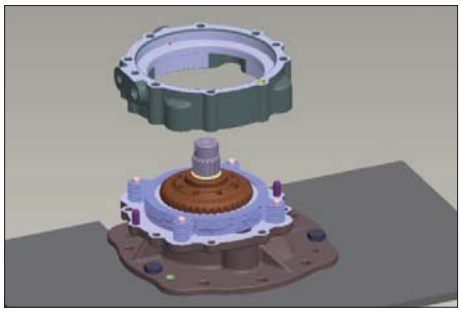
22D9TDA055

③ Assemble in order of separate plate (plate → friction plate).



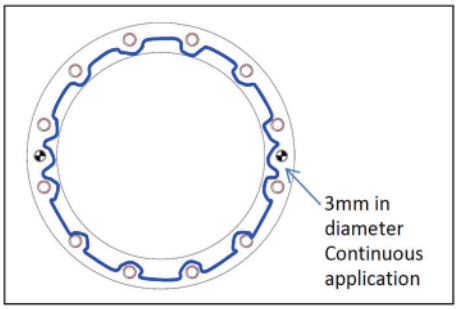
22D9TDA056

④ Assemble the piston housing. (paste loctite #5127)



22D9TDA057

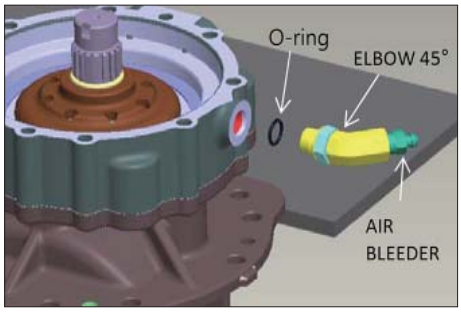
※ Example of paste loctite.



22D9TDA057A

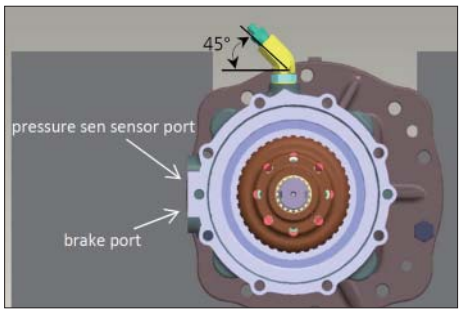
⑤ Assemble O-ring, air bleeder and elbow 45°.
(when assemble O-ring, paste oil or greace).

- Tightening torque of elbow 45° : 3.8~4.2 kgf·m
- Tightening torque of air bleeder : 1.5~2.0 kgf·cm



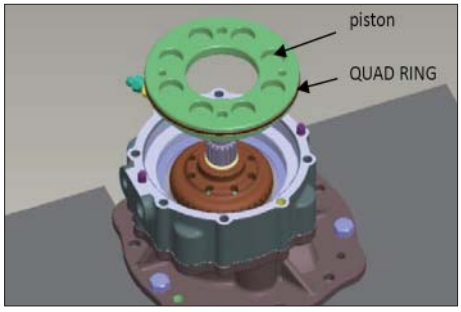
22D9TDA058

※ Attention of direction on assembly.



22D9TDA058A

⑥ Assemble piston.
Check twist of quad ring.
Paste oil or greace on surrounding of quad ring.

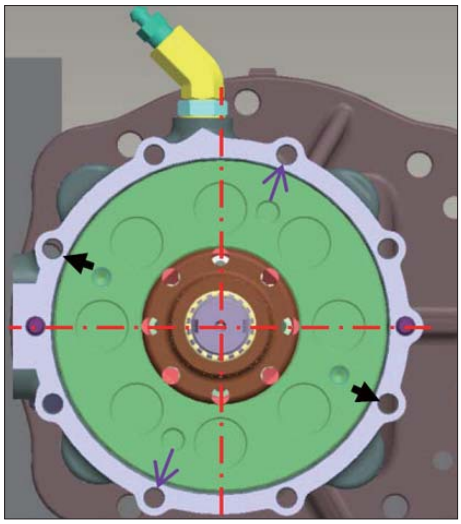


22D9TDA059

※ Assemldy direction

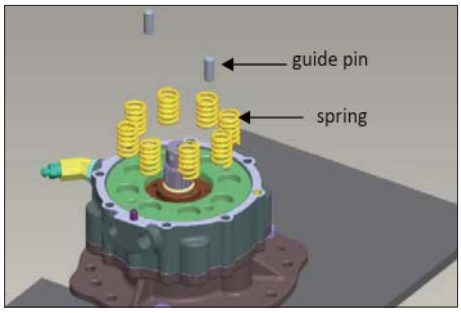
◀— : Top of parking release

◀— : Assembly of guide pin



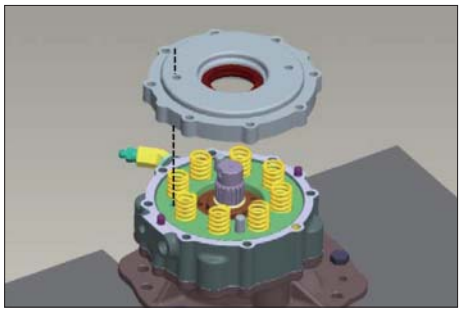
22D9TDA059A

⑦ Guide pin + spring assembly.



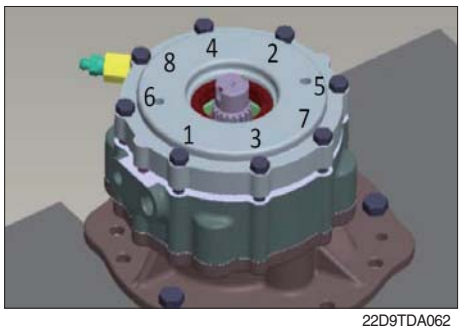
22D9TDA060

⑧ Parking cover + oil seal assembly.
(Match the parking position tap and cover hole)



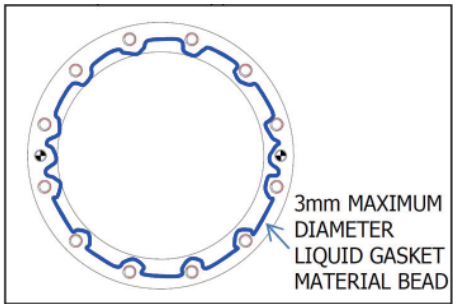
22D9TDA061

⑨ Assemble bolt.
Paste loctite #5127 on side assembling.
Paste loctite #277 on bolt, tightening torque 3~4 kgf · m.



22D9TDA062

※ Follow the direction at the cover assembly symmetry, for proper seating of the spring.



22D9TDA062A

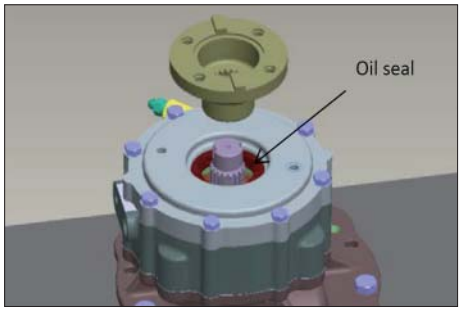
⑩ Check the performance of parking brake.

※ The following procedure describes how to test brake oil leakage, return state of piston.

a. Remove residual air in brake line.
b. Actuate the piston at least five times with 10 bar.
   Check the performance of brake.
c. Preset 10 bar at piston, blank the oil line. If it has variation of pressure under 2 bar in 3 min, It is normal condition.
d. When oil leakage, disassemble parking cover, check brake oil leakage and solve the problem from inspection.

※ Major inspection part
- Check damage of wet movement.
- Check damage of brake seal.
- Check incorrect assembly at brake seal.

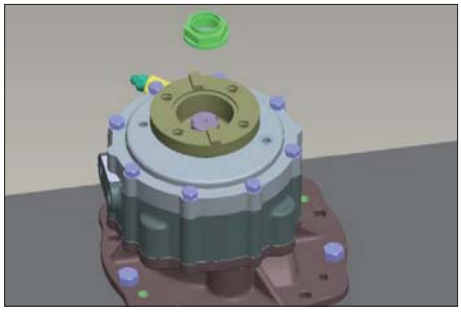
⑪ Assemble flange U-joint.
Oil or grease before assemble oil seal inner ring part application.



22D9TDA063

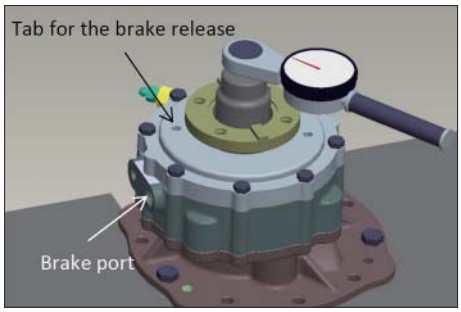
⑫ Fasten nut.
Assemble paste loctite #242.
Confirm torque : 26~29.5 kgf · m

※ Preload : 10~19 kgf · cm


22D9TDA064

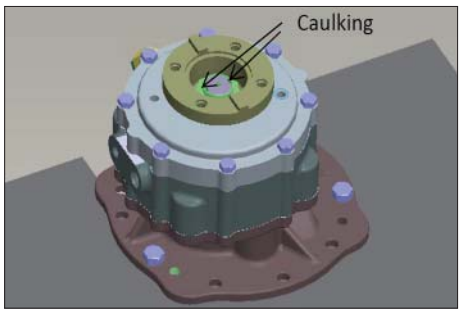
⑬ Preload measurement. (Spec : 10~19 kgf · ㎝)
If preload is over the spec, follow the procedure. (refer to ⑨, ⑩ page 3-66, 3-67)
Adjust the thickness of shim.

※ Always remember that the hydraulic oil circuit is under pressure.
When carring out inspection and maintenance, release the pressure first. (Using release bolt)

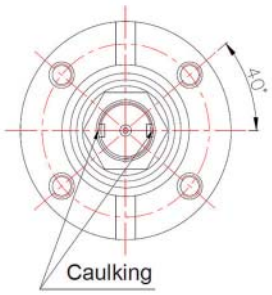


22D9TDA065

⑭ Caulking. (2 EA)
Brass drift punch used.

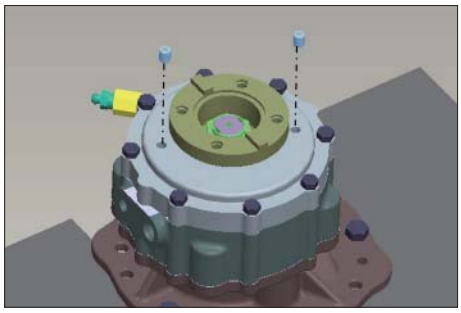


22D9TDA066



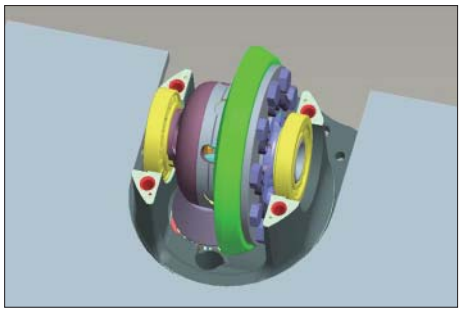
22D9TDA066A

⑮ Assemble plug.
Applied, Loctite 577 tightening torque 1.0~1.5 kgf·m


22D9TDA067

Adjusting the gear set backlash

① Assemble differential sub in carrier case.

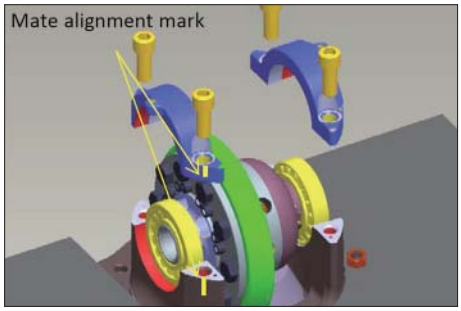


22D9TDA076

② Sub-assembly differential carrier case de suffren.
Threaded steel ball assembly for positioning.

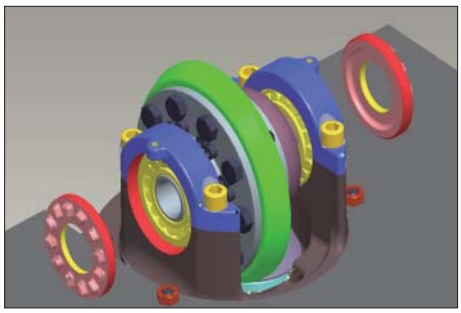
22D9TDA077

③ Fit carrier cap with steel ball.
Bolt : paste loctite #277
Confirm torque : 11.7~13.1 kgf · m



22D9TDA078

④ Fasten bearing adjust ring.
Lightly tighten bearing only about to be in close contact.

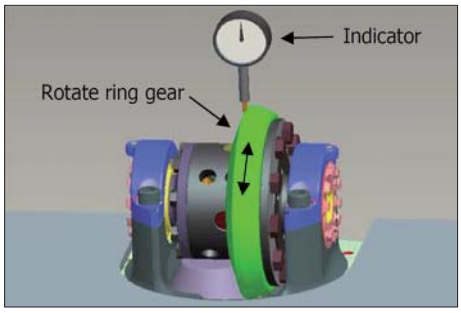


22D9TDA079

⑤ Measure again backlash.

※ Backlash of pinion and ring gear : 0.15~0.20 mm

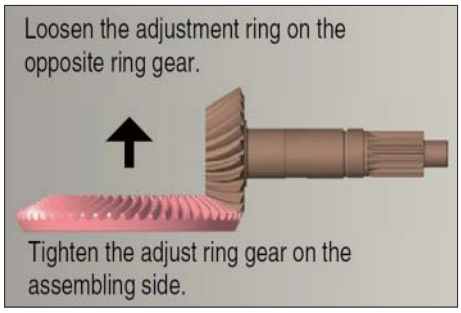
※ If backlash is wrong, carry out adjusting work. Adjust the left/right of ring bearing adjust by one and one clip.



22D9TDA080

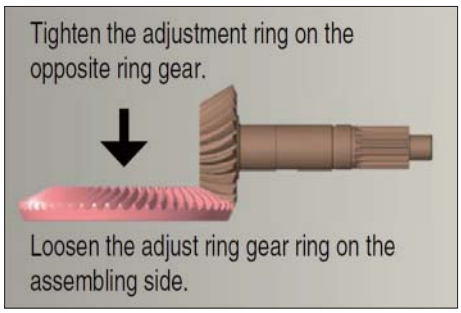
※ When the ring gear away from the pinion shaft will increase the backlash.

Backlash reduction methods



22D9TDA082

How to increase backlash

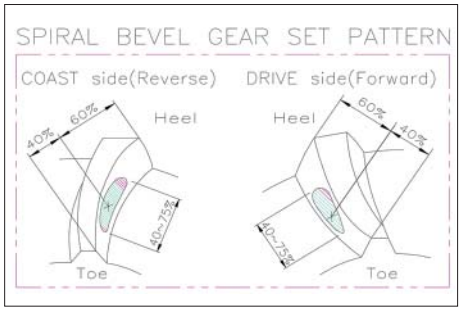


22D9TDA081

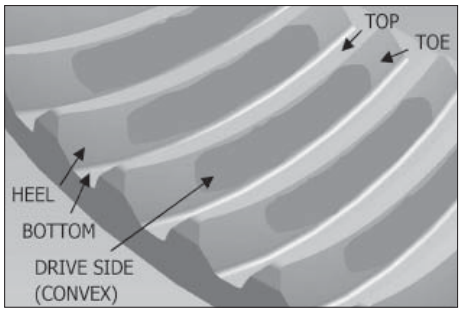
Adjusting tooth contact pattern of the gear set

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

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

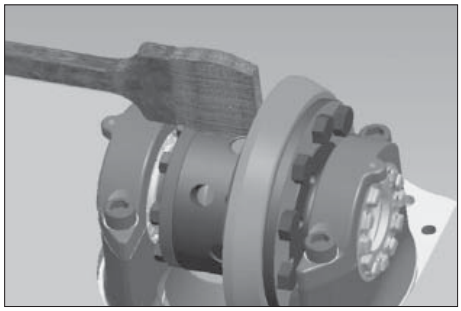


22D9TDA083



15L7ADA084

① Apply marking compound to approximately 5~6 teeth of the ring gear.

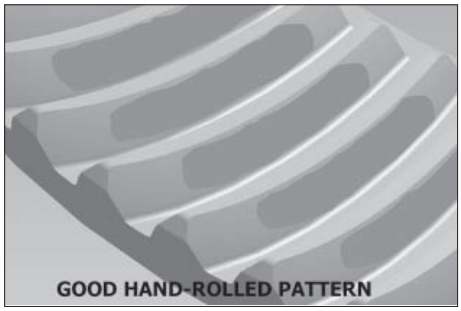


15L7ADA085

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

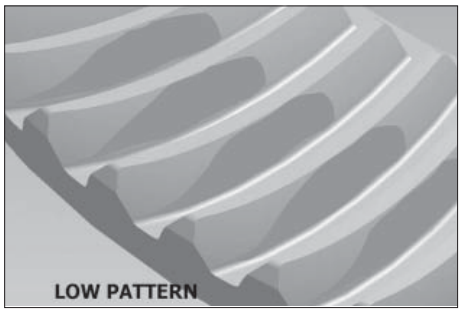
③ Compare the contact patterns.

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



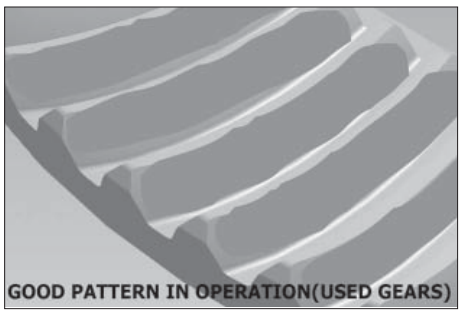
15L7ADA086

15L7ADA087



15L7ADA088

※ In used gear sets, 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.

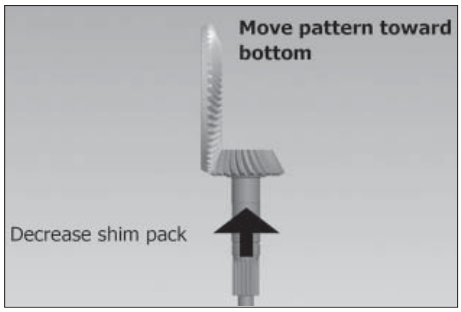


15L7ADA089

④ If the contact patterns require adjustment along the width of tooth (top/bottom), follow steps ⓐ-ⓑ.
If the contact patterns require adjustment along the length of tooth (toe/heel), follow steps ⓒ-ⓓ.

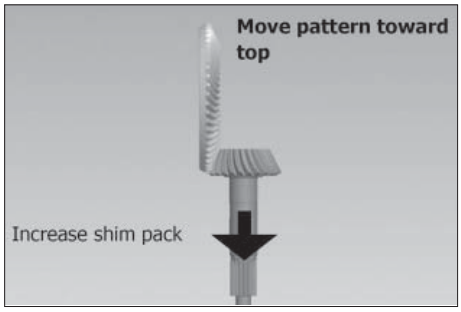
ⓐ High pattern : A high contact pattern indicates that the pinion was installed too shallow into the carrier. Figure DA087.

To correct, move the pinion toward the ring gear by decreasing the shim pack between pinion spigot and inner bearing cone.
Figure DA090.



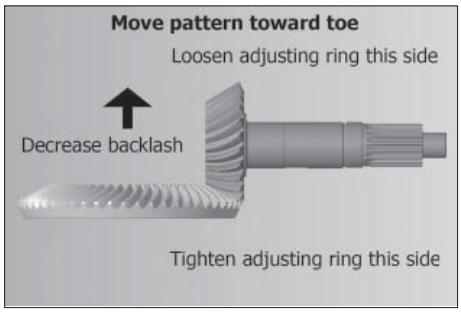
15L7ADA090

ⓑ Low pattern : A high contact pattern indicates that the pinion was installed too deep into that the pinion was installed too deep into the carrier. Figure DA088.
To correct, move the pinion away from the ring gear by increasing the shim pack between pinion spigot and inner bearing cone.
Figure DA091.



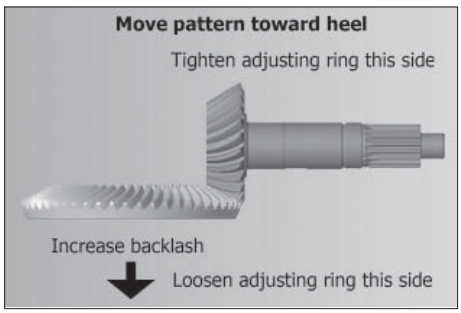
15L7ADA091

ⓒ Heel pattern : Decrease the gear set backlash (within specified range) to move contact pattern toward toe and away from heel. Refer to page 3-72 "Adjusting the gear set backlash".
Figure DA092.



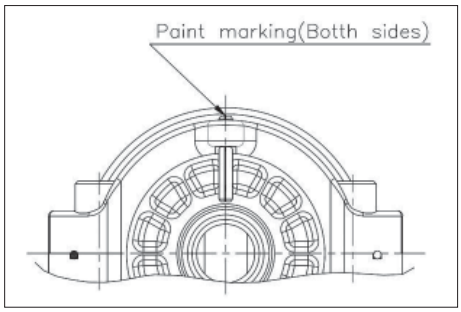
15L7ADA092

ⓓ Toe pattern : Increase the gearset backlash (within specified range) to move contact pattern toward heel and away from toe.
Refer to the pate 3-72 "Adjusting the gear set backlash". Figure DA093.



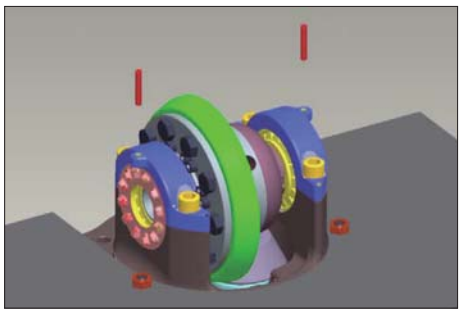
15L7ADA093

⑤ Fix spring pin with ring bearing adjust.
And assemble them.



15L7ADA094

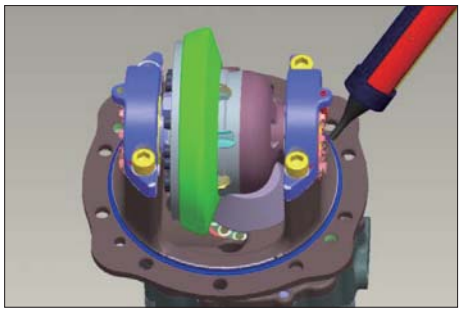
⑥ After completion of the pattern adjustment, the spring pin assembly.
Adjust the bearing ring to be fixed.


22D9TDA096


15L7ADA095

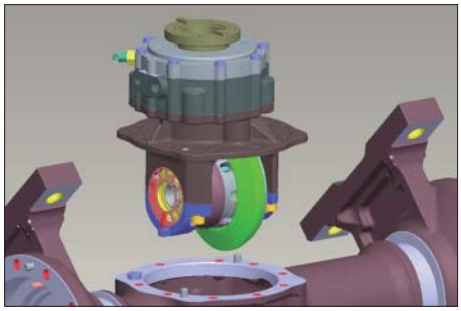
(2) Assemble of carrier assembly

① Paste sealant on axle housing.
(Loctite #5127)



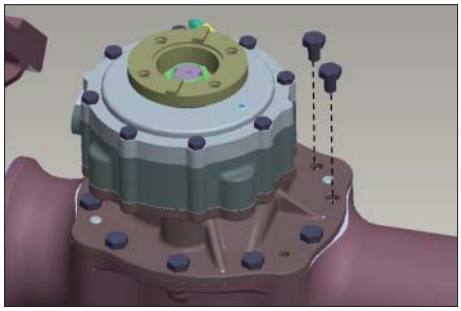
22D9TDA097

② Assemble carrier assembly on axle housing.



22D9TDA098

③ Fasten bolt.
Assemble bolt after spread loctite #277.
Confirm torque : 6.1~6.5 kgf · m

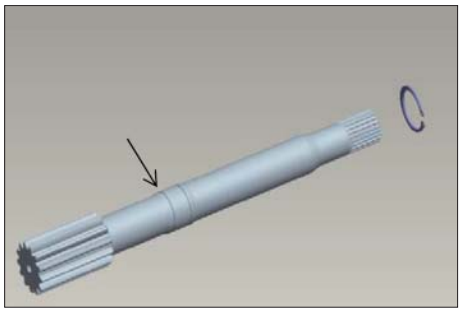


22D9TDA099

(3) Traveling brake system assembly

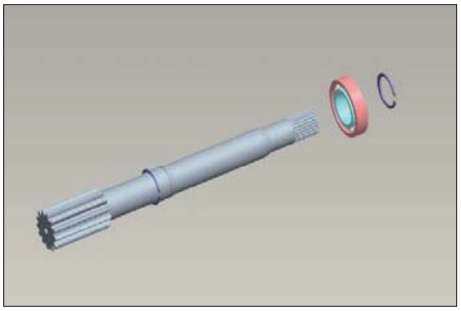
Axle shaft assembly

① Insert snap ring on the axle shaft.



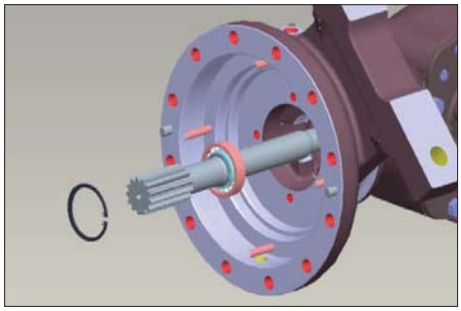
22D9TDA100

② After put the ball bearing, fix it with snap ring.



22D9TDA101

③ After put axle shaft into axle housing fix with snap ring.

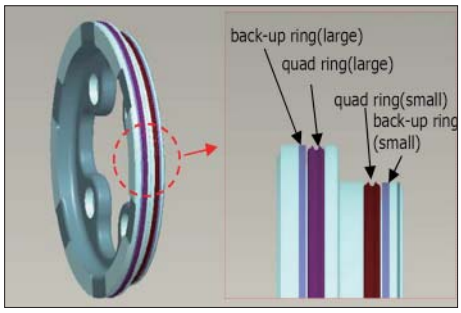


22D9TDA102

Brake piston assembly

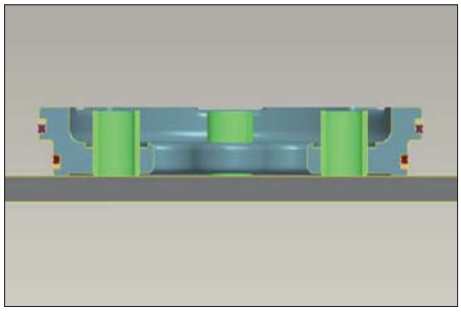
① Assemble ring (Quad ring + Back up ring) at piston brake.

※ When assembling seal pay attend to chopping.
※ Before assemble ring coating oil or grease.
※ Careful assembly direction of Quad ring + Back up ring



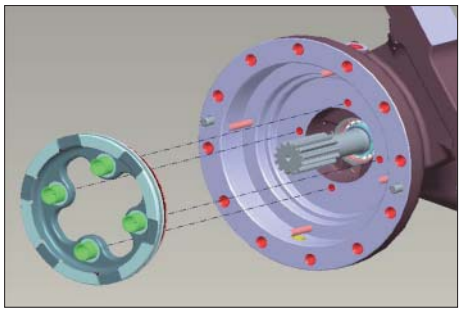
22D9TDA103

② Assemble sleeve at piston.
Same with sleeve and piston surface on floor.



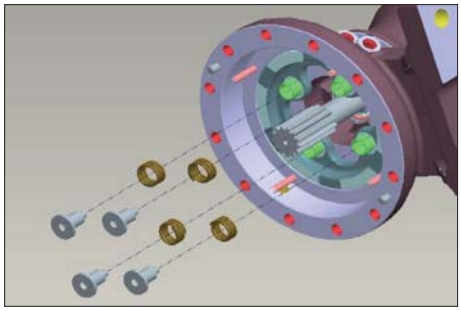
22D9TDA104

③ Assemble the piston.
Match assembly tap of special bolt and position of sleeve.
Before assemble Quad ring coating oil or grease.



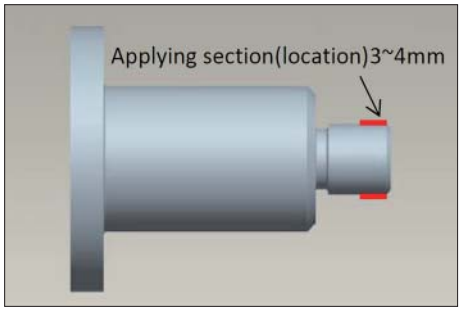
22D9TDA105

④ Assemble return spring and special bolt.
Paste loctite #277.
· Tighten torque :1.8~2.0 kgf · m



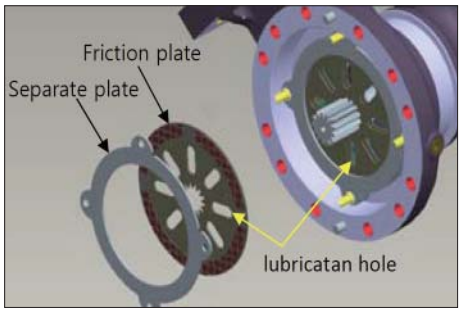
22D9TDA106

※ Example) Paste loctite on speical bolt.
If paste loctite too much on sleeve & special bolt, piston has malfunctioned by jam.



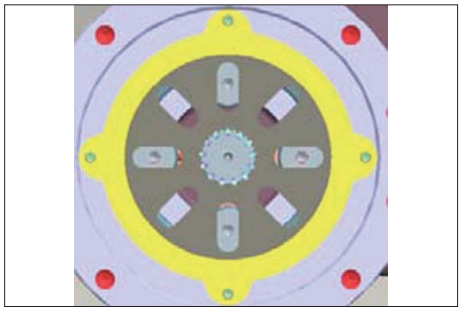
22D9TDA106A

⑤ Assemble in order of separate plate → Friction plate.
But assemble separate plate first and lastly.
Separate plate : 5EA
Friction plate : 4EA
Assemble plate to according to the hole on plate.



22D9TDA107

※ Do not cover the hole each others.

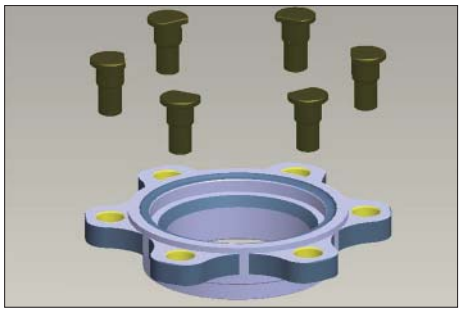


22D9TDA107A

(4) Hub assembly

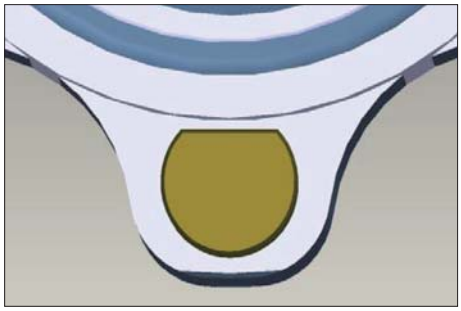
Hub sub assembly

① Assemble hub bolt. (Use jig and press)



22D9TDA110

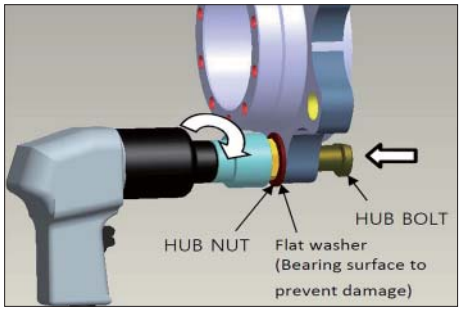
※ Assemble direction example.
Careful assemble with head of bolt and hub flange.



22D9TDA110A

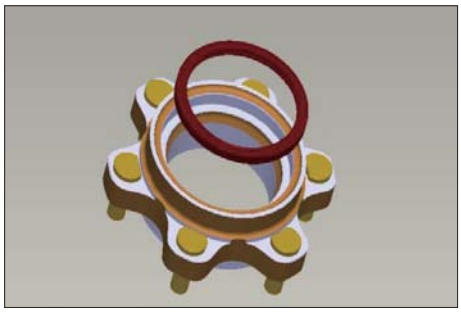
If you do not press or dedicated fixtures.
Assemble the hub nuts, hub bolt assembly can be tightened.

To prevent damage to the bearing surface between the hub and the hub nut.
Bore ø20, ø40~ ø50 diameter flat washer insert.



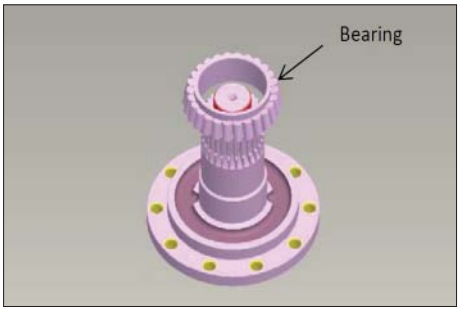
22D9TDA110B

② Pressurize oil seal with loctite #592.
Spread grease inside of oil seal.



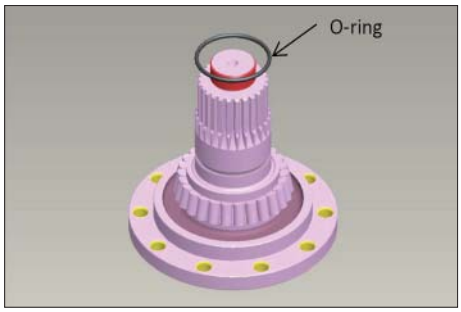
22D9TDA111

③ Put with heating bearing cone on wheel shaft.
Assemble after paste axle oil on roll of bearing cone.



22D9TDA112

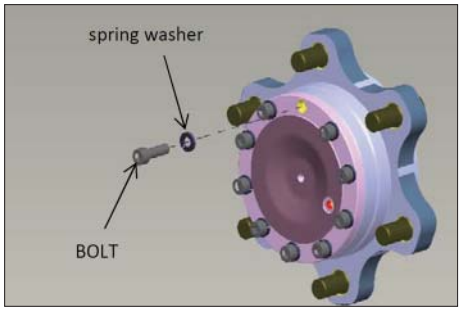
④ Assemble O-ring coated grease at wheel shaft.



22D9TDA113

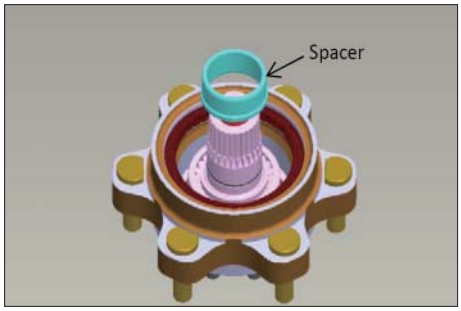
⑤ Assemble flange hub and wheel shaft.

※ Paste loctite #5127
Confirm torque : 6.0~7.0 kgf · m
Bolt : Spread loctite #277



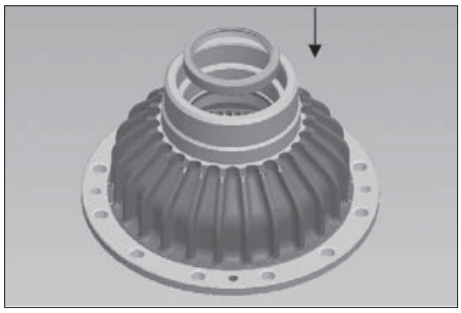
22D9TDA114

⑥ Fix spacer.

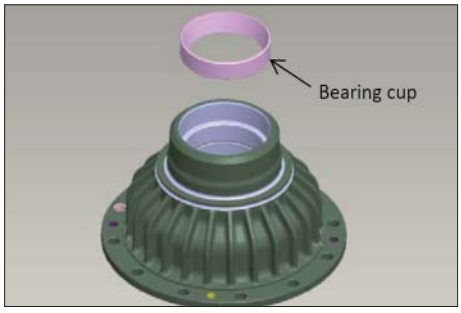


22D9TDA115

⑦ Assemble oil seal at carrier housing.
Oil seal with loctite #592.

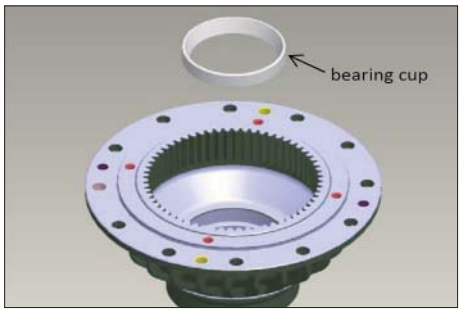

15L7ADA116

⑧ Assemble bearing cup at carrier housing.



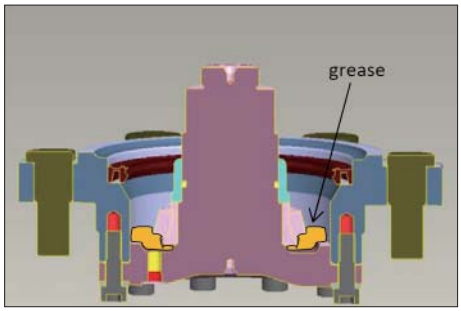
22D9TDA117

⑨ Assemble bearing cup at upper side of carrier housing.



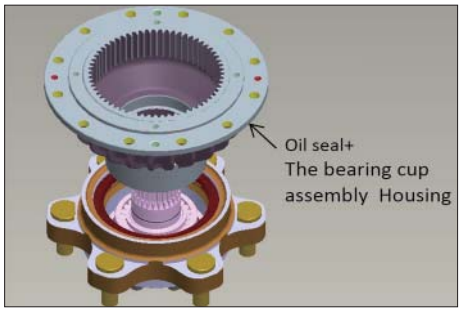
22D9TDA118

⑩ Hub + wheel shaft assemble in grease charge.
·Charge amount :
Grease outer ring of wealth space 60~80%.
※Recommended Grease : Shell Retinax 0419



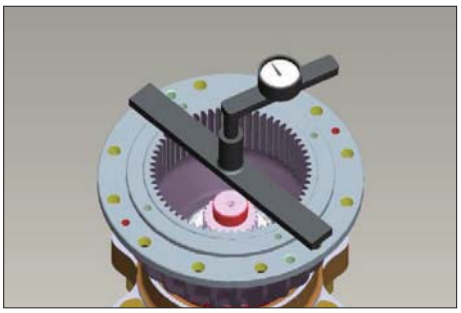
22D9TDA118A

⑪ Assemble the carrier housing on flange hub and wheel shaft.



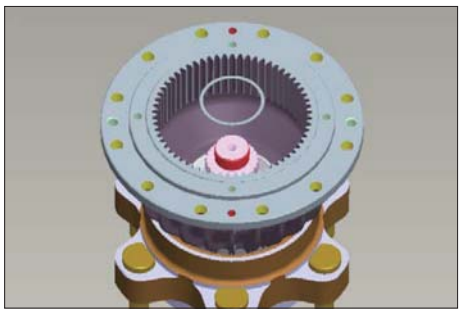
22D9TDA119

⑫ Adjust preload for fix shim.
·Preload : 40~50 kgf·cm

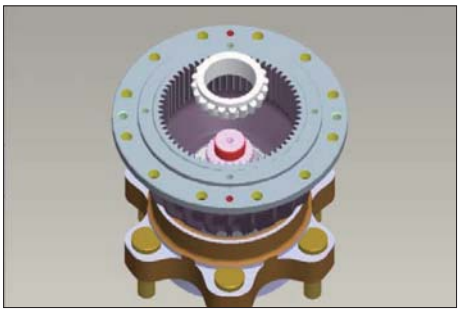

22D9TDA120

⑬ Put into shim. (Basic shim : 0.65 mm)

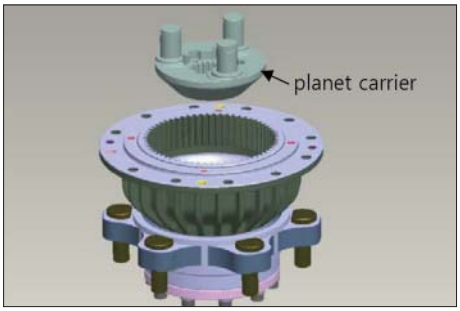
※ Sort of shim : 0.1, 0.12, 0.15, 0.25, 0.5 (mm)


22D9TDA121

⑭ Pressurize bearing cone.
Before assembling, paste axle oil on roller of bearing cone.


22D9TDA122

⑮ Assemble planet carrier.

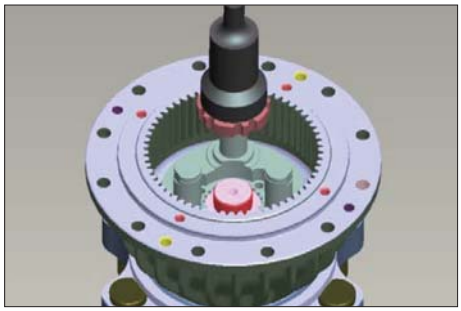


22D9TDA123

⑯ Assemble the locknut to confirm the bearing preload. Use designated jig or brass drift punch.
Loosen and tighten repeatedly 2~3 time with 35~38 kgf · m

※ If there is no parts replacement from bearing, shaft, housing and spacer, initially assembled shims can be re-used.

※ When brass drift punch is used, assemble the locknut in accordance with its initially marked position.


22D9TDA124

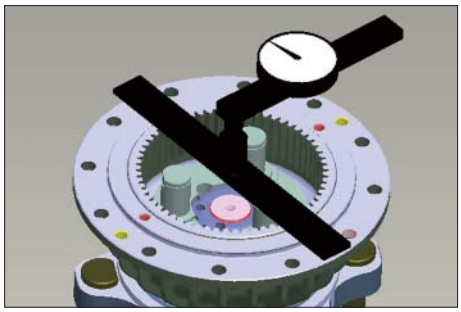
⑰ Preload check.

※ Preload setting price = Oil seal resistance price + Bearing preload

⑫ Process check price ± 40~50 kgf · cm

※ If measurements are not satisfied with the preloaded.
Decomposition ⑫ to ⑭ and proceeds to step, measured value is greater than the preload thickness of shim set to increase.
Measured value is less than the preload is set to decrease thickness of shim.

After the completion of the assembly ⑪ to ⑯ proceeds the process again.


22D9TDA124A

※ If hub bearing preload is wrong.
It should cause damage to the shaft.
In order to prevent major accent, should be sure the preload.

⑱ Fasten lock nut.

Spread the Loctite #277 on screw.

・Confirm torque : 3.5~3.8 kgf・m

Mate lock nut slot and planet carrier's hole.

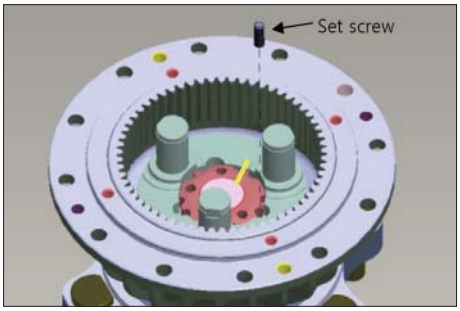
・Preload : 40~50 kgf・cm

22D9TDA124B

⑲ Fasten set screw.

Spread the Loctite #277.

・Confirm torque : 105~150 kgf・cm



22D9TDA124C

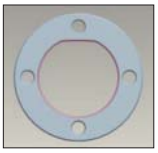
⑳ Assemble in order of washer → needle bearing → planet gear → washer .

Before assembling washer, paste oil, spread grease on needle bearing.

※ Needle roller quantity check : 19 EA/1 gear

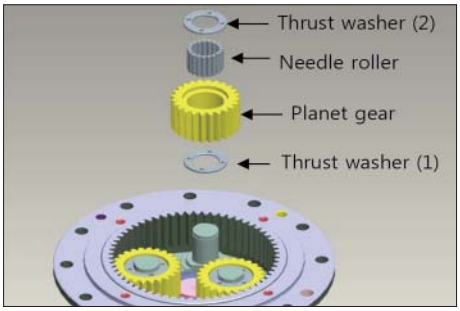
22D9TDA011-1

Thrust washer (1)



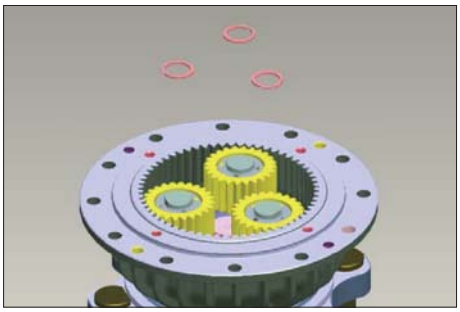
22D9TDA011-2

Thrust washer (2)



22D9TDA125

㉑ Fix snap ring.

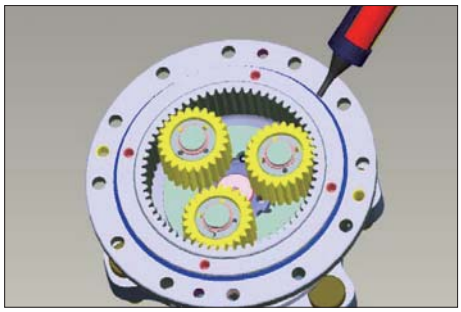


22D9TDA126

(5) Assemble of hub sub assembly

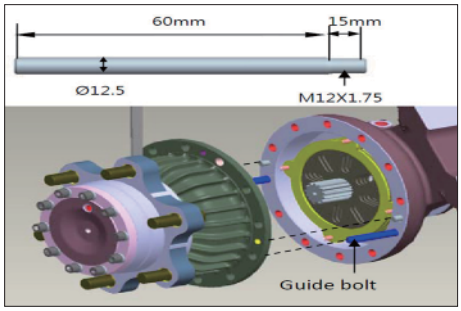
① Paste loctite #5127 on axle housing.

※ About 3 mm wide circle around the front of the application.



22D9TDA127

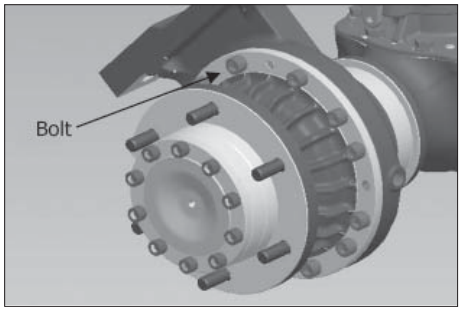
② Assemble the hub assembly on the axle housing.
Lifting device or the guide bolts.
Field, using the following guide bolt.
Can be easily assembled.



22D9TDA127A

③ Assemble hub sub assembly.
Bolt : Assemble after spread loctite #277.
Confirm torque : 11.7~13.1 kgf · m
Plug : Assemble after spread loctite #577
Confirm torque : 1.0~1.5 kgf · m

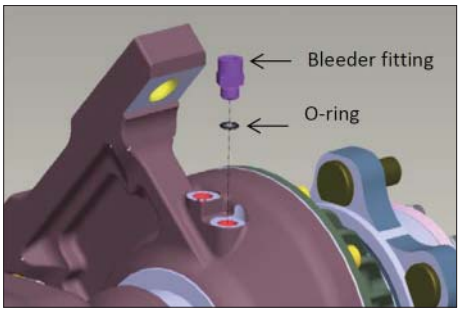
※ Assemble hub sub assembly after support it by lifting device as like the same way of disassembling.



15L7ADA128

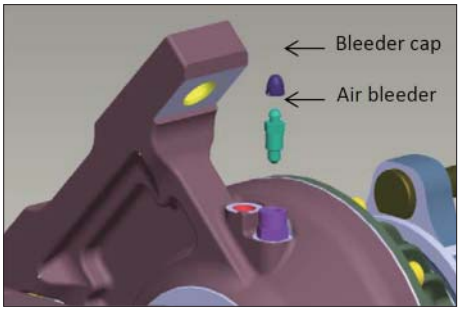
(6) The rest part assembly

① Assemble O-ring and fitting bleeder for LH and RH.
· Confirm torque : 3.8~4.2 kgf · m



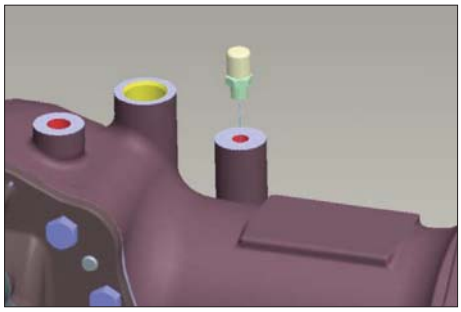
22D9TDA129

② Assemble bleeder and cap.
Screw : Assemble after spread loctite #577.
Confirm torque : 1.5~2.0 kgf · m

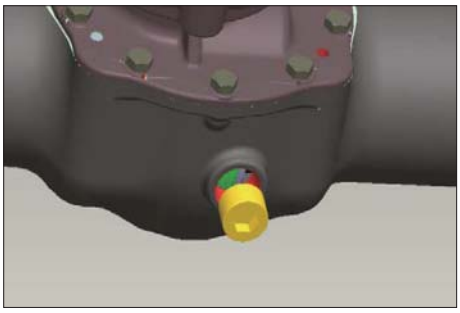


22D9TDA130

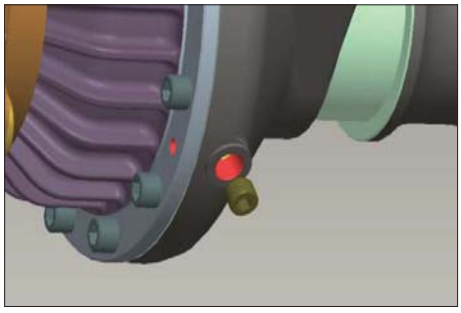
③ Assemble air breather.
Screw : Assemble after spread loctite #577.
Confirm torque : 0.5~0.7 kgf · m


22D9TDA131

④ Assemble drain plug (magnetic).
Screw : Assemble after spread loctite #577.
Confirm torque : 7.0~9.0 kgf · m

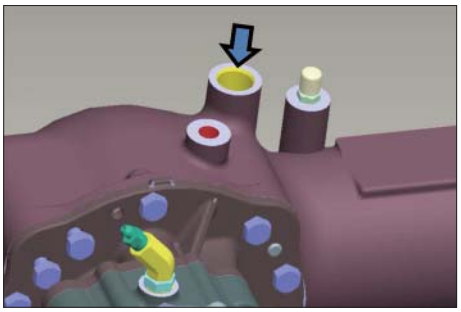

22D9TDA132

⑤ Assemble drain plug (magnetic).
Screw : Assemble after spread loctite #577.
Confirm torque : 3.0~4.1 kgf · m

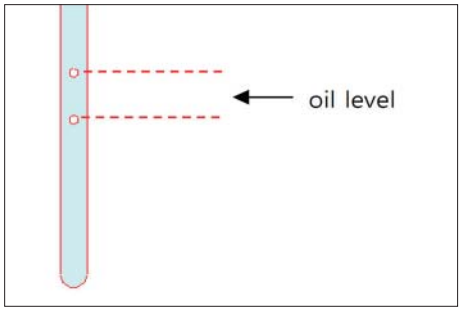

22D9TDA133

⑥ Put in dipstick.

※ Fill axle oil as much as standard.
Standard between the upper limit and the lowest limit.

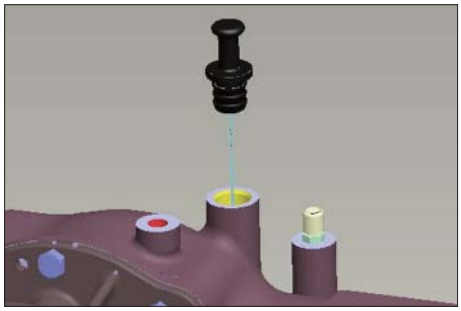


22D9TDA135



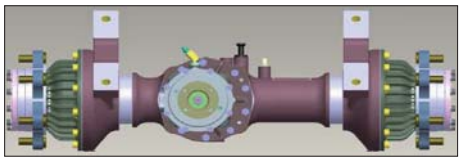
22D9TDA134

⑦ Assemble dipstick gauge.



22D9TDA136

⑧ Finish drive axle assembly.



22D9TDA137

(7) Functional test of hydraulic apply brake

※ The following procedure describes how to test the hydraulic apply brake system only.
To perform this test, use a device that allows you to observe possible leaks through oil seals and that also allows you to verify that the piston return system works correctly . For an accurate evaluation, the device must allow piston displacement of 0.4~0.6 ㎜.

① Brake bleeder valve while supplying hydraulic oil to the pressure inlet. Pump oil through the brake until oil coming out of the bleeder does not contain air bubbles.
Close the brake bleeder valve.

② Actuate the piston at least five times with 60 bar. Check for leaks and free movement of piston.

③ If you find a leak : Disassemble the hub sub assembly. Determine the cause of the leak and correct the problem. Check the seal surfaces for sharp edges, nicks and burrs.

④ Wait five minutes. Apply 60 bar to the piston and lock pressure on. Pressure must not drop after one minute.

⑤ If pressure drops off : Disassemble the hub sub assembly. Determine the cause of the leak and correct the problem. Repeat step ① - ⑤.

※ You must check that the brake completely releases after you apply the brake.
Do not operate the brake system with the brake partially released. Damage to brake components can result.

SECTION 4 BRAKE SYSTEM

SECTION 4 BRAKE SYSTEM

GROUP 1 STRUCTURE AND FUNCTION

1. OUTLINE

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

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

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

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

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

2. SPECIFICATION

1) DISK BRAKE

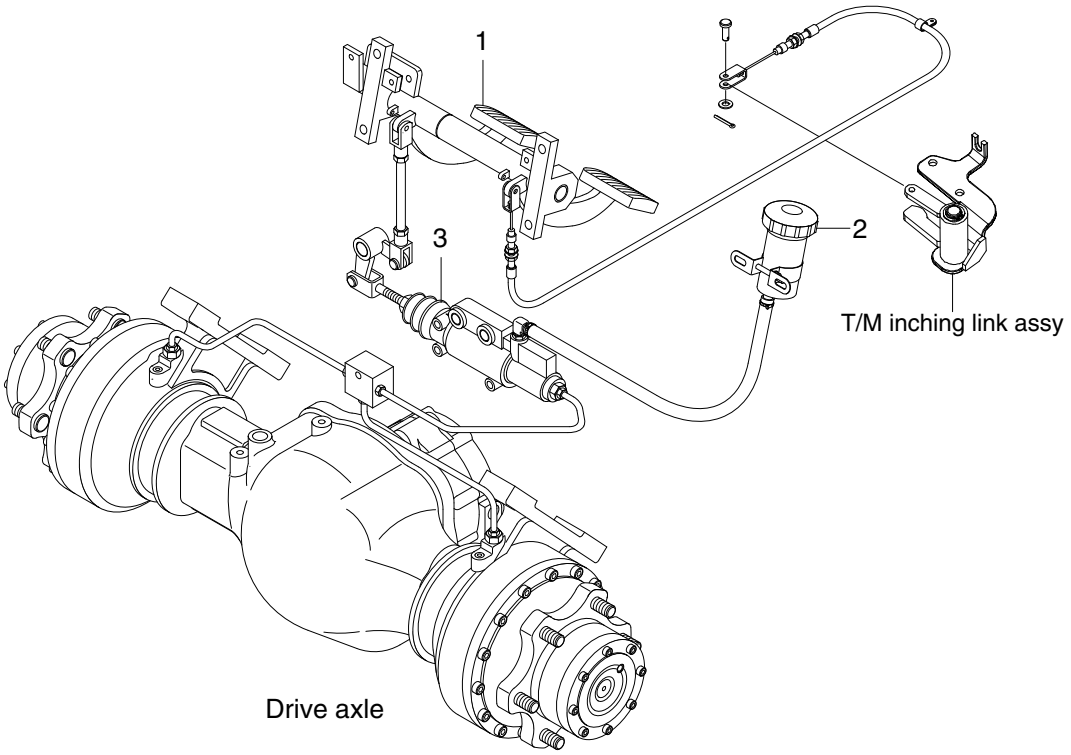
Item		Specification
Type		Wet disk brake
Master cylinder bore diameter		33 mm (1.3 in)
Pedal adjustment	Pedal height	119 mm
	Play	2~4 mm
Brake oil		Azolla ZS32 (ISO VG32 hydraulic oil)

2) PARKING BRAKE

Item	Specification
Type	Wet disk brake (Negative)
Switch location	Steering column
Disc location	Axle carrier assy

3. BRAKE PEDAL AND PIPING

1) STRUCTURE

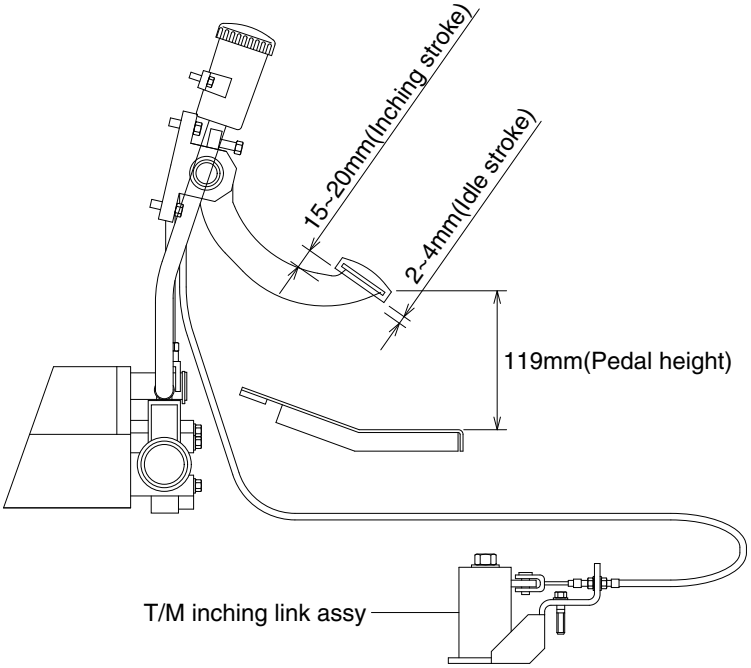


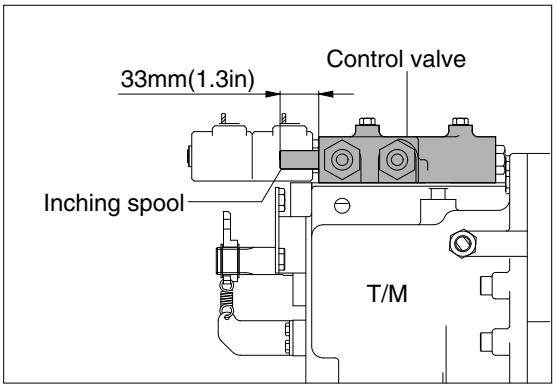
22D9SBS01

1 Brake pedal
2 Reservoir tank assembly
3 Brake master cylinder

4. INCHING PEDAL AND LINKAGE

The brake pedal serves to actuate the hydraulic brakes on the drive 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.

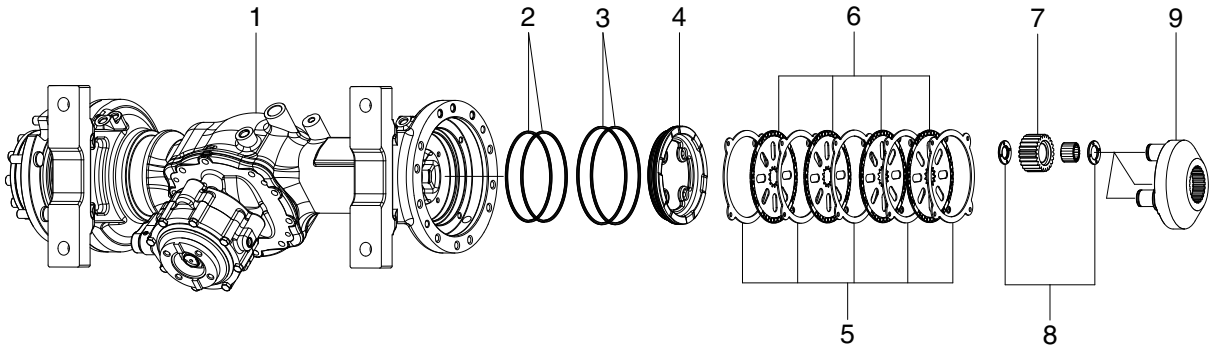




22D9TBS02

5. WET DISK BRAKE

1) STRUCTURE



22D9SPT20

1	Drive axle housing	4	Piston brake	7	Planet gear
2	Square ring	5	Plate	8	Snap ring
3	Square ring	6	Friction plate	9	Planet shaft

2) OPERATION

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

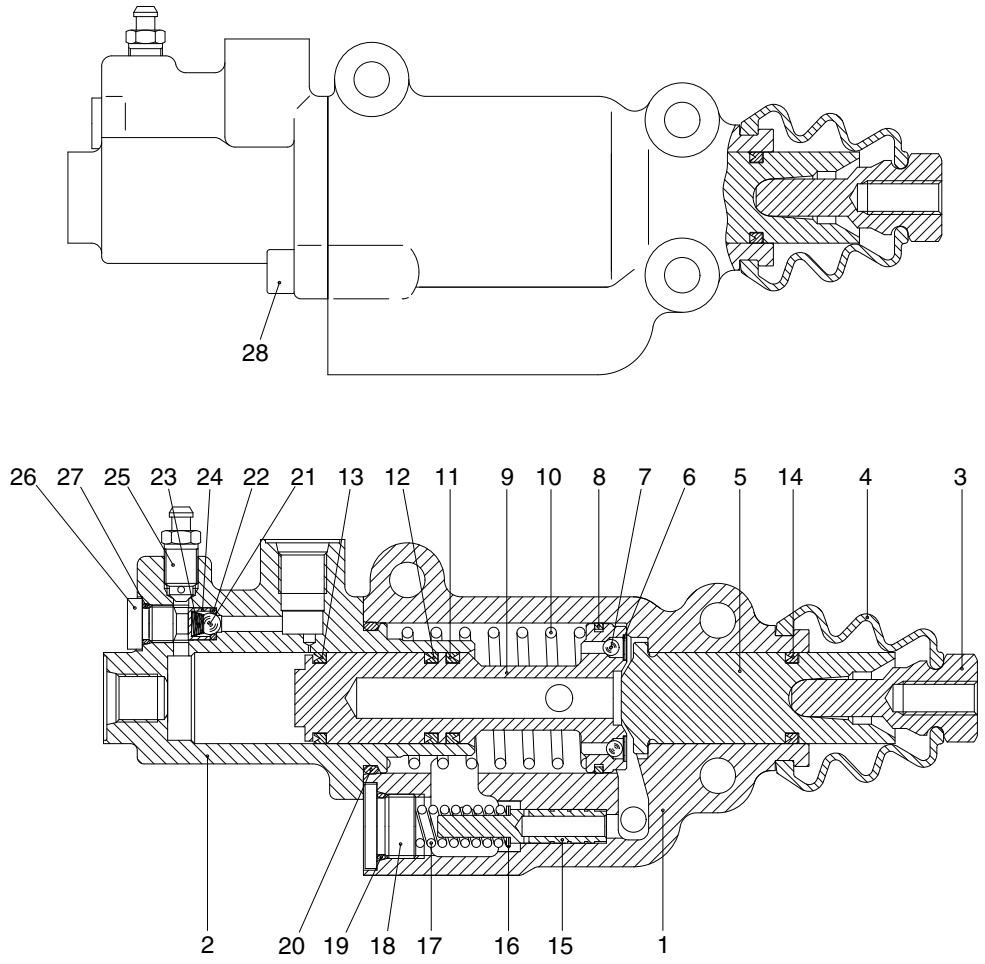
Because it is possible to use the brake semi-permanently, there is no need to replace or change the lining as drum type brake do.

Major components are 6 plates (5), 5 friction plates (6), piston brake (4), and brake housing.

Braking force is applied by restricting the drive force from drive shaft and spline collar.

6. BRAKE VALVE (BOOSTER BRAKE)

1) STRUCTURE

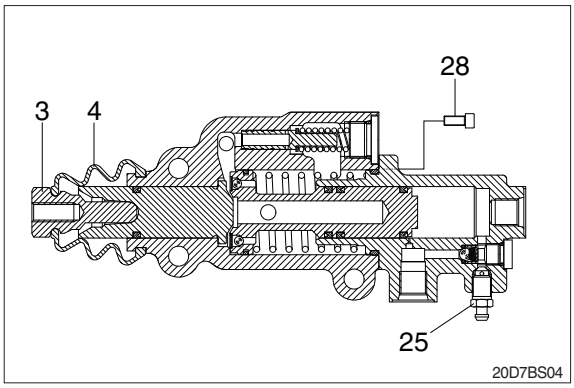


20D7BS03

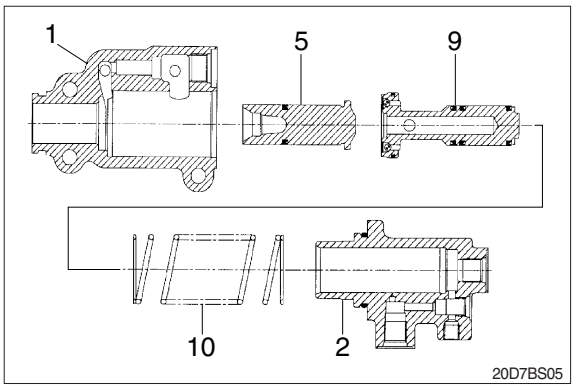
1	Front housing	11	Seal	20	O-ring
2	Rear housing	12	Seal	21	Check ball
3	Push rod	13	Seal	22	O-ring
4	Bellows	14	Seal	23	Check spring
5	Master piston	15	Relief piston	24	Cage
6	Lock washer	16	Shim	25	Air bent
7	Piston ball	17	Relief spring	26	Check plug
8	Piston ring	18	Relief plug	27	O-ring
9	Servo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

2) DISASSEMBLY

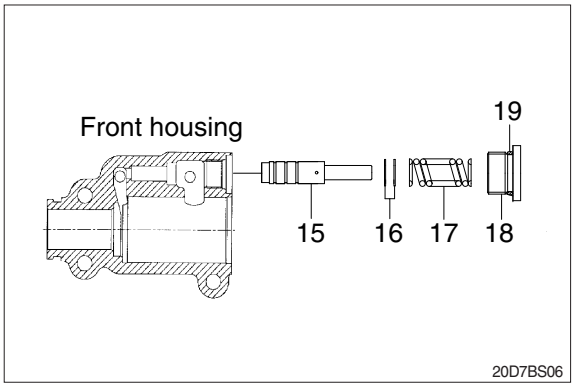
(1) Remove push rod (3), bellows (4), air vent (25) and bolt (28).



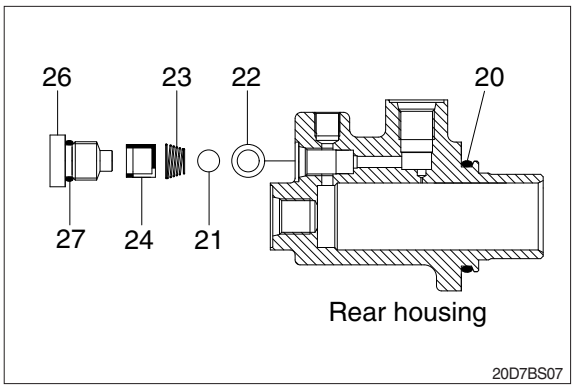
(2) Remove front housing (1), rear housing (2), servo spring (10), servo piston (9) and master piston (5).



(3) Remove relief plug (18) with O-ring (19), relief spring (17), shim (16) and relief piston (15).



(4) Remove O-ring (20), check plug (26) with O-ring (27), cage (24), check spring (23), check ball (21) and O-ring (22).



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) GENERAL INFORMATION

Brake system generate small metal wear particles at a fairly steady rate, especially during the break-in period.
If these fine, but hard particles are allowed to circulate in the lubricant, along with external moisture and dirt, internal components will wear at a much faster rate than normal.

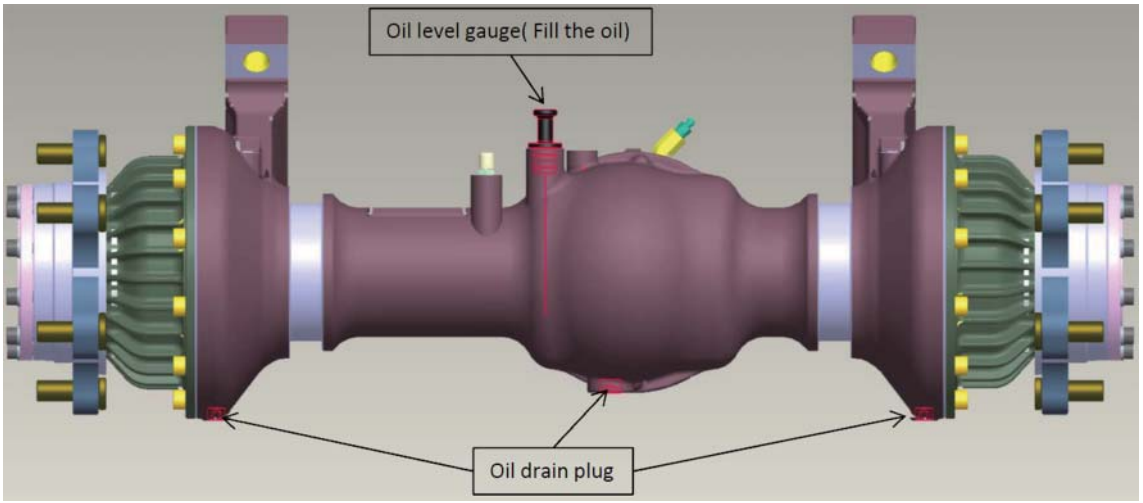
2) BRAKE PIPING

(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.

3) OIL LEVEL

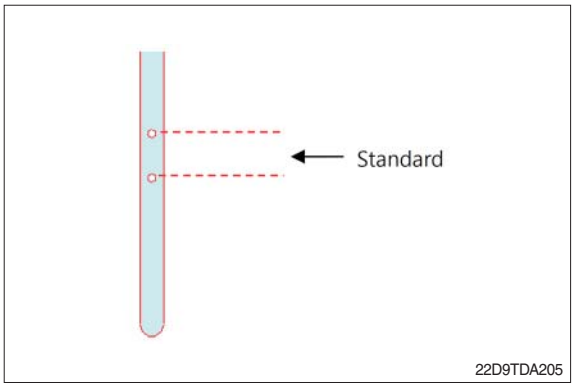
(1) Check and adjust oil

Axle housing has oil level gauge and drain plug.



22D9TDA204

① Make sure the vehicle is on a level surface.
② Pull out oil level gauge from axle, then check the height of oil.
③ If the height of oil of level gauge is higher than the upper limit, take oil out by loosening drain plug and keep the standard refer to (2), page 4-9, if the height of oil is lower than the lowest limit, pour oil in to level gauge and keep the standard.



22D9TDA205

(2) Oil change

⚠ Park the vehicle on a level surface. Block the wheels to prevent the vehicle from moving. Support the vehicle with safety stands. Do not work under a vehicle supported only jacks. Jacks can slip and fall over. Serious personal injury can result.

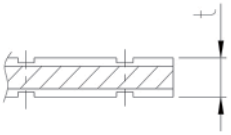
① Make sure the vehicle is on level surface.
② Raise lift of vehicle and drain oil by loosening drain plug.
③ After drain all oil, faster the plug cleaned.
④ Fill oil with checking the height of oil by level gauge at the front of vehicle.

(3) Oil capacity and using oil

① Oil volume is approximately 5.6 liters. Actual volume will vary by axle model and configuration.
② Using Hyundai Genune axle oil (If use incorrect axle oil, the product has noise and burn-out at component).

4) MAINTENANCE

(1) Period of check drive axle : 1,000 hrs
(2) O-ring, oil seal, rubber, gasket : Change all parts at every disassembling, if as necessary.
(3) Check internal leakage of brake system (Brake seal) : Replace as necessary or every 1,000 hrs
(4) Friction plate (disk), reaction (steel) plate : Change the part that exceeds the wear limits.

Item		Part no.	Standard	Limit
Friction plate (Disk)		21DA-10071	t=3.5	t=3.05
		21DA-20940	t=2.2	t=1.80
Plate (Steel plate)		21DA-10051	t=2.5	t=2.35
		21DA-20950	t=1.5	t=1.40

(5) Bearing : If in doubt about the wear or lack of lubrication, replace the bearing and oil
Check the release bearing the see if it rotates unfreely, use matel cleaner and then recheck.
If it is unfreely again, replace the part
(6) Spring : Measure free length of spring, If it has deform ±10% over then free length, replace the part
(7) Gear, shaft : If it is abnormal or change the cross sectional area, you have to change.
(8) Axle oil change

Recommended initial oil change	100 hrs
Check oil level	Every 250 operating hours
Periodic oil change	Evey 1,000 operating hours

2. TROUBLESHOOTING

1) BRAKE SYSTEM

Problem	Cause	Remedy
1. 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.
2. 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.
3. 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.
4. Brake chirps	· Brake trailing. · Piston fails to return. · Disk worn. · Disk surface roughened.	· See above. Brake trailing. · Replace. · Replace. · Repair by polishing or replace.
5. Brake squeaks	· Disk surface roughened. · Disk worn. · Excessively large friction between disk plate.	· Repair by polishing or replace. · Replace. · Clean and apply brake grease.
6. 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.
7. Pedal dragging.	· Twisted push rod caused by improperly fitted brake valve. · Brake valve seal faulty.	· Adjust. · Replace.

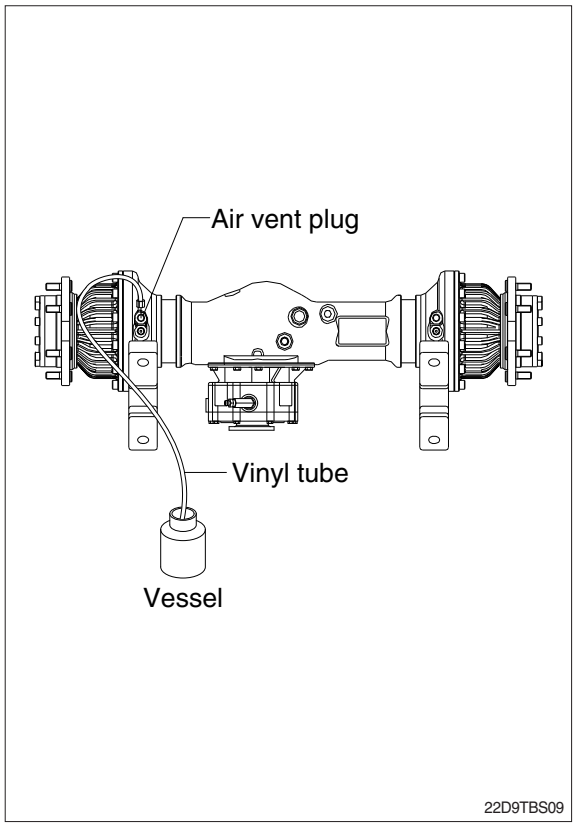
2) BRAKE SYSTEM OF THE DRIVE AXLE

Trouble symptom	Probable cause	Remedy
1. Inoperation of brake		
1) Service brake	· Non-inject or lack of brake oil	· Check oil level, set correct oil volume
	· Damage of brake seal	· Replace piston seal.
	· Wrong assemble brake seal	· After disassembly and adjust or replace part
	· Detect of slide on seal (Axle housing, pistion)	· Replace related part
	· Mix particle of slide on seal	· Wash slide part or replace piston seal
	· Damage of friction plate and plate	· After disassembly and adjust or replace part
	· Defect of material (or oil line)	· After disassembly and replace the part
2) Parking brake	· Damage of parking spring	· After disassembly and replace the part
	· Wrong assembly of parkgin spring	· After disassembly and adjust or replace part
	· Damage of friction plate and plate	· After disassembly and adjust or replace part
2. Impossible release of brake		
1) Service brake	· Failure of return at service brake piston	· After disassembly and adjust or replace part
	· Damage of friction plate and plate	· After disassembly and adjust or replace part
2) Leakage of parking brake	· Damage of brake seal	· After disassembly and replace the part
	· Wrong assemble brake seal	· After disassembly and adjust or replace part
	· Detect of slide on seal (Axle housing, Pistion)	· Replace related part
	· Mix particle of slide on seal	· Wash slide part or replace piston seal
	· Defect of material (or oil line)	· After disassembly and replace the part
3. Deterioration of brake	· Inadequate actuation fluid supply to brake	· Supply standard oil, replace seal of brake system
	· Inadequate pressure to apply brakes	· Check or replace of brake seal and brake oil line
	· Worn or damaged discs	· After disassembly and adjust or replace part
	· Air enter into brake system	· Remove air by air breather
	· Deform parking spring	· After disassembly and replace the part

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.



2. ADJUSTMENT OF PEDAL

1) BRAKE PEDAL

(1) Pedal height from floor plate

Adjust with stopper bolt.

· Pedal height : 119 mm (4.7 in)

(2) Idle stroke

Adjust with rod of master cylinder

· Play : 2~4 mm

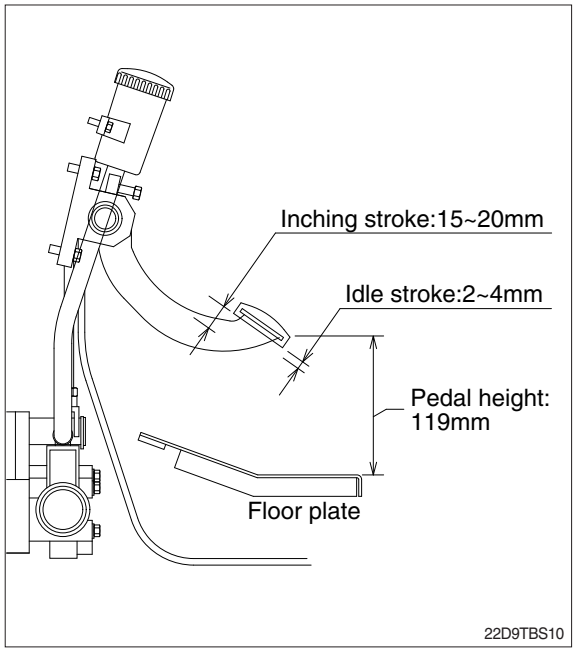
2) INCHING PEDAL

(1) Pedal height from floor plate

Adjust with stopper bolt.

· Pedal height : 119 mm (4.7 in)

(2) Adjust bolt so that brake pedal interconnects with inching pedal at inching pedal stroke 15~20 mm (0.6~0.8 in).

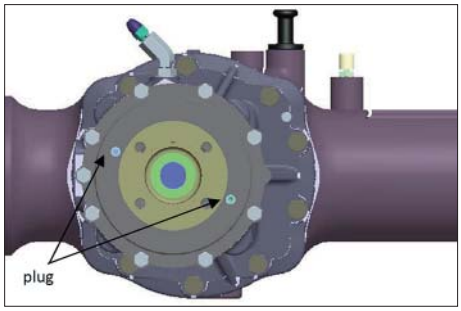


3. PARKING BRAKE RELEASE

In case of malfunction of transmission, it's hard to supply pressure at parking brake.
Using function of parking force release at carrier sub assembly of drive axle, it is possible to tow the truck.

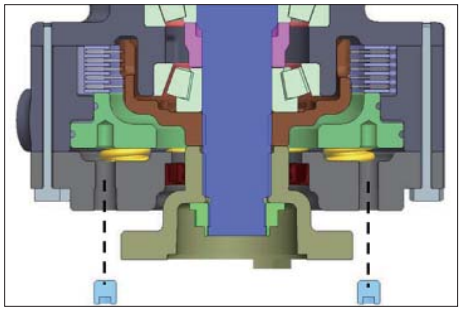
1) DISASSEMBLE PLUG

Must wash surrounding plug before disassembly
Tool : Use 5 mm six-angular lench or bitsocket



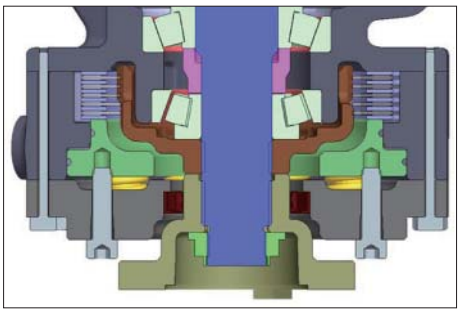
22D9TDA208

※ Correspond with hole of assembly and tap hole of piston by guide pin.

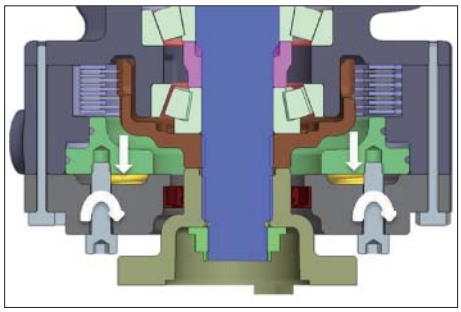

22D9TDA209

2) ASSEMBLE BOLT OF RELEASED PARKING

(1) Assemble bolt for released parking at hole of plug by disassemble.
Bolt spec : M8x1.25P × 30L
Socket-bolt, S109-080304
(2) Assemble bolt by hand to reach axle housing.


22D9TDA210

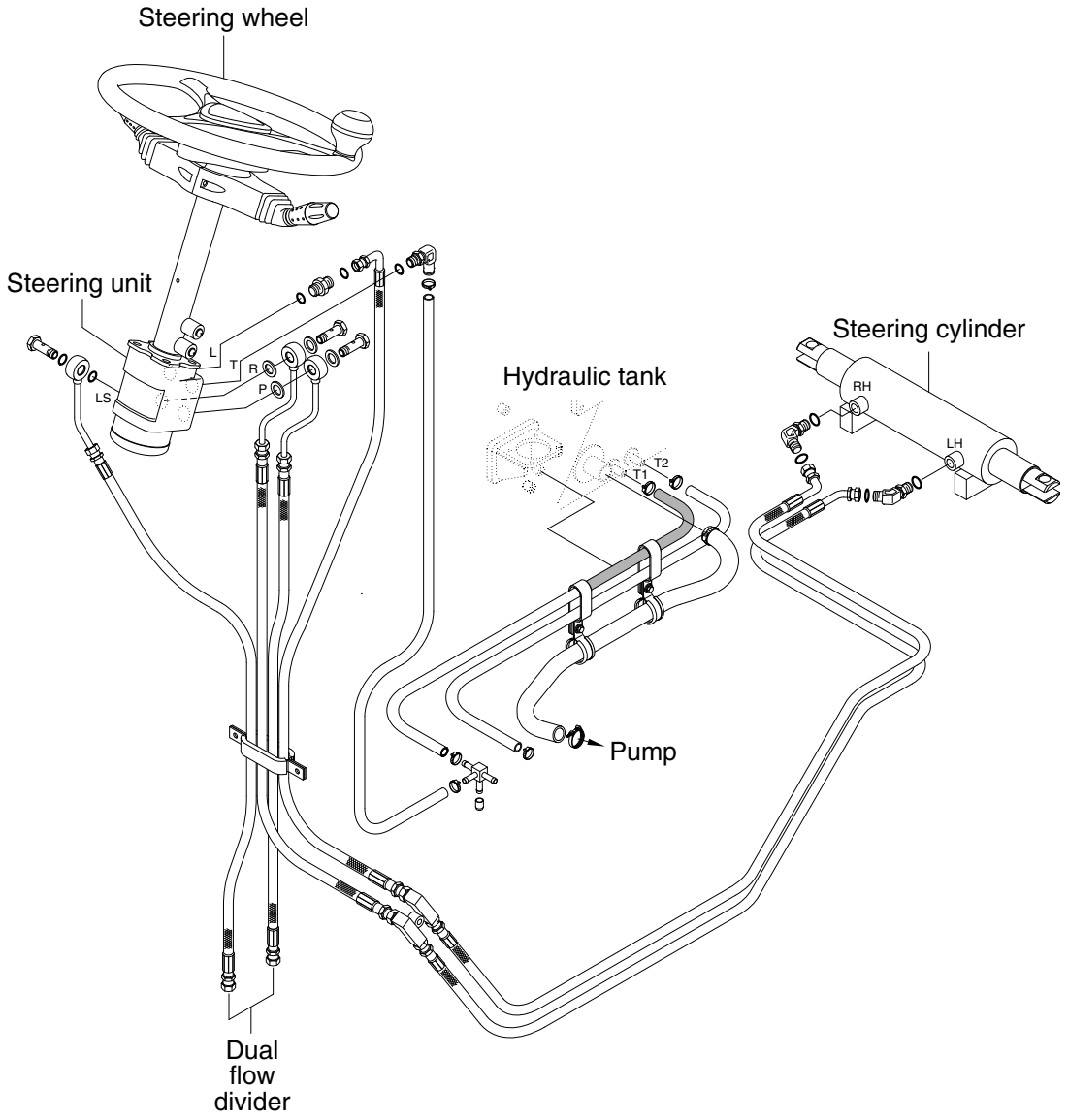
(3) Tighten two bolt like clockwise rotation.
According to the force of tighten bolt, pull piston and release parking brake.
Tool : Use 6 mm six-angluar lench or bitsocket
(4) Rotate 1.5~2 times by clockwise direction, and then release parking brake.
Do not exceed tightening torque 400 kgf-cm
(5) Check parking to rotate flange shaft by hand.


22D9TDA211

SECTION 5 STEERING SYSTEM

GROUP 1 STRUCTURE AND FUNCTION

1. OUTLINE (NON BOOSTER BRAKE)

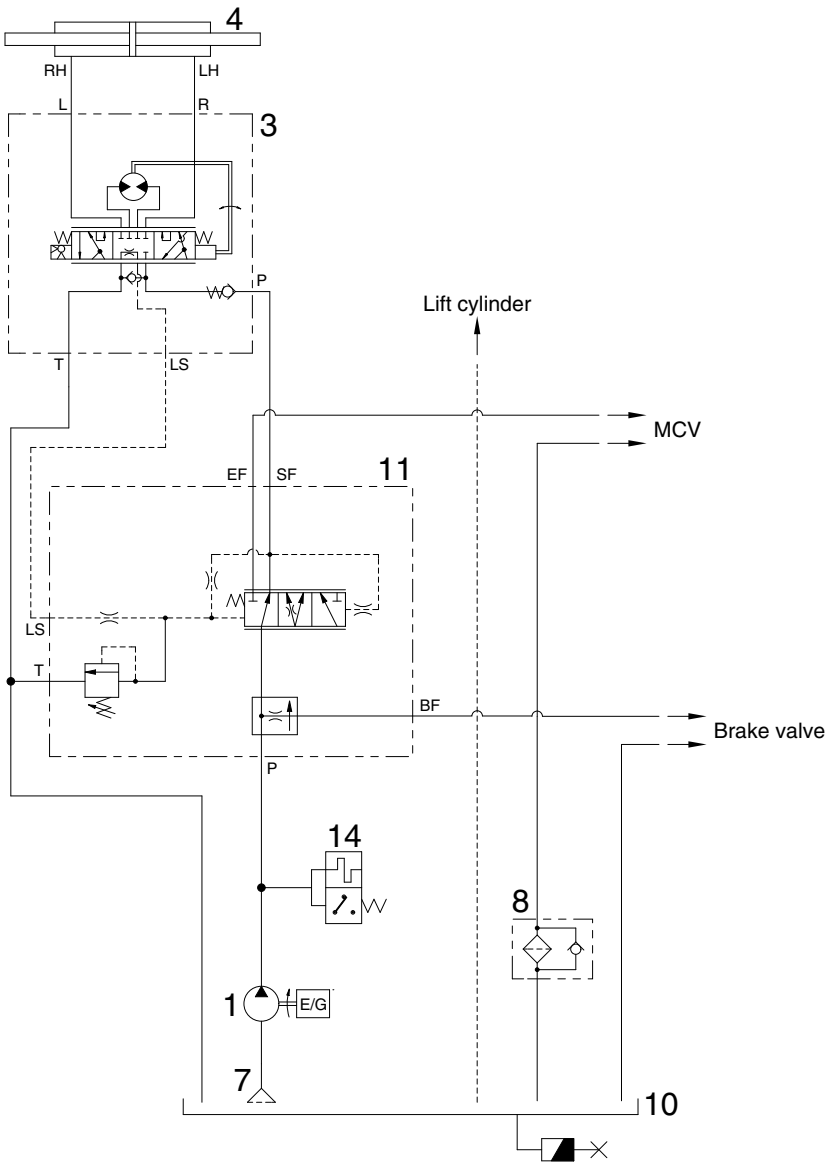


22D9TSS01

The steering system for this machine is composed of steering wheel assembly, steering unit, steering cylinder, steering axle and pipings. 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

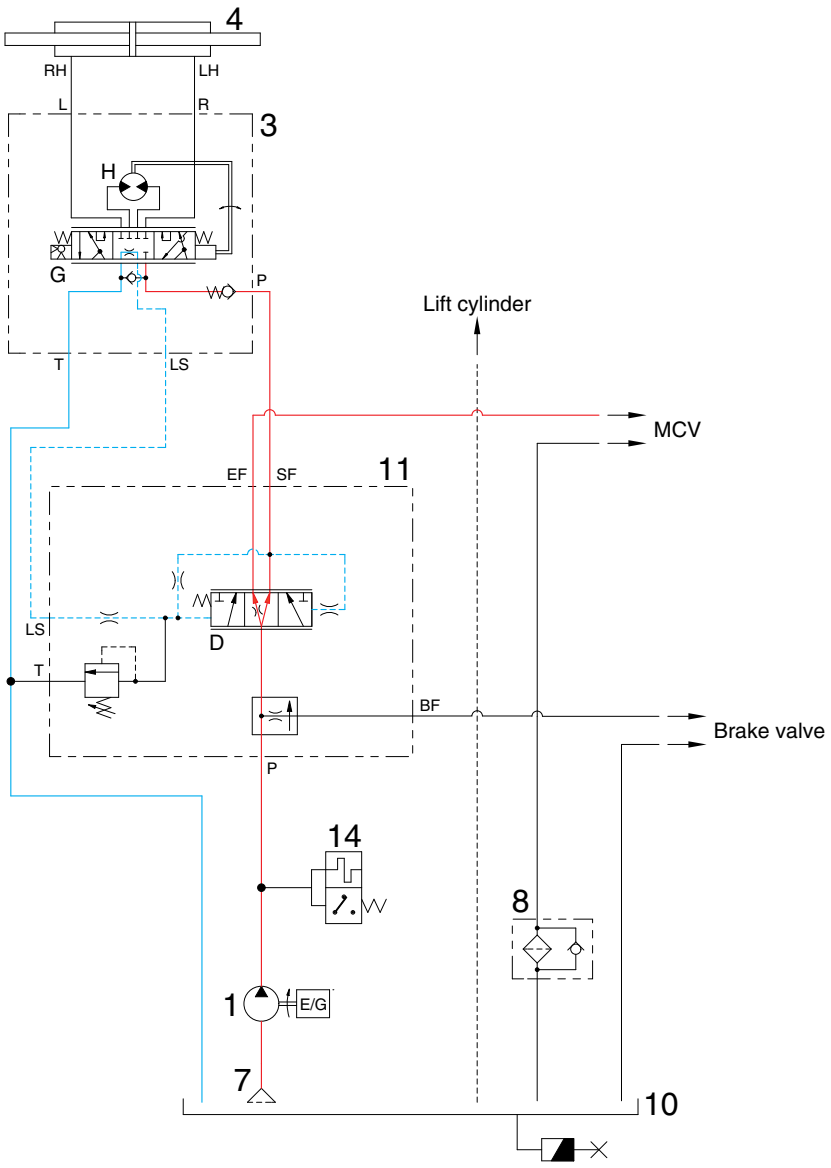


22D9TSS02

1	Hydraulic gear pump	8	Return filter
3	Steering unit (obitrol)	10	Hydraulic tank
4	Steering cylinder	11	Dual flow divider
7	Suction strainer	14	Temperature sensor

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

1) NEUTRAL

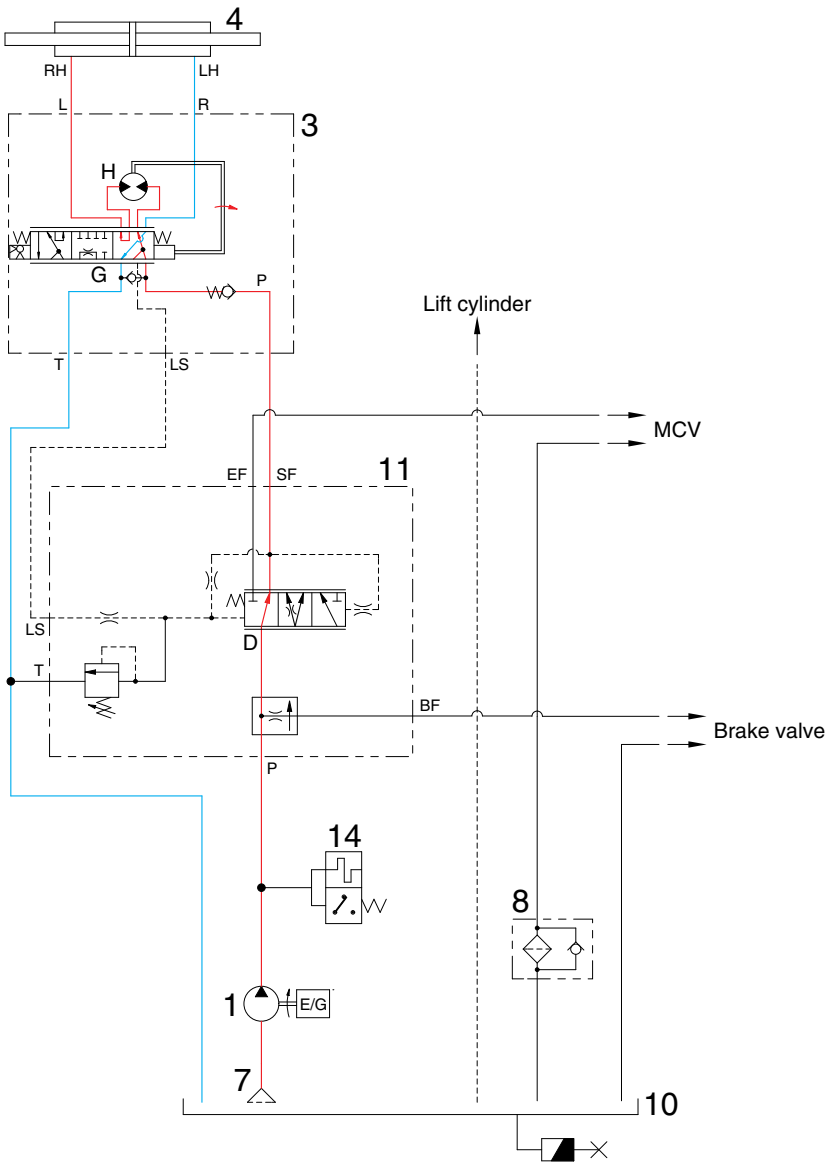


22D9TSS03

The steering wheel is not being operated so control spool (G) does not move.
The oil from hydraulic gear pump (1) enters dual flow divider (11) and the inlet pressure oil moves the spool (D) to the left.
Oil flow into LS port to the hydraulic tank (10).
So, the pump flow is routed to the main control valve.

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

2) LEFT TURN

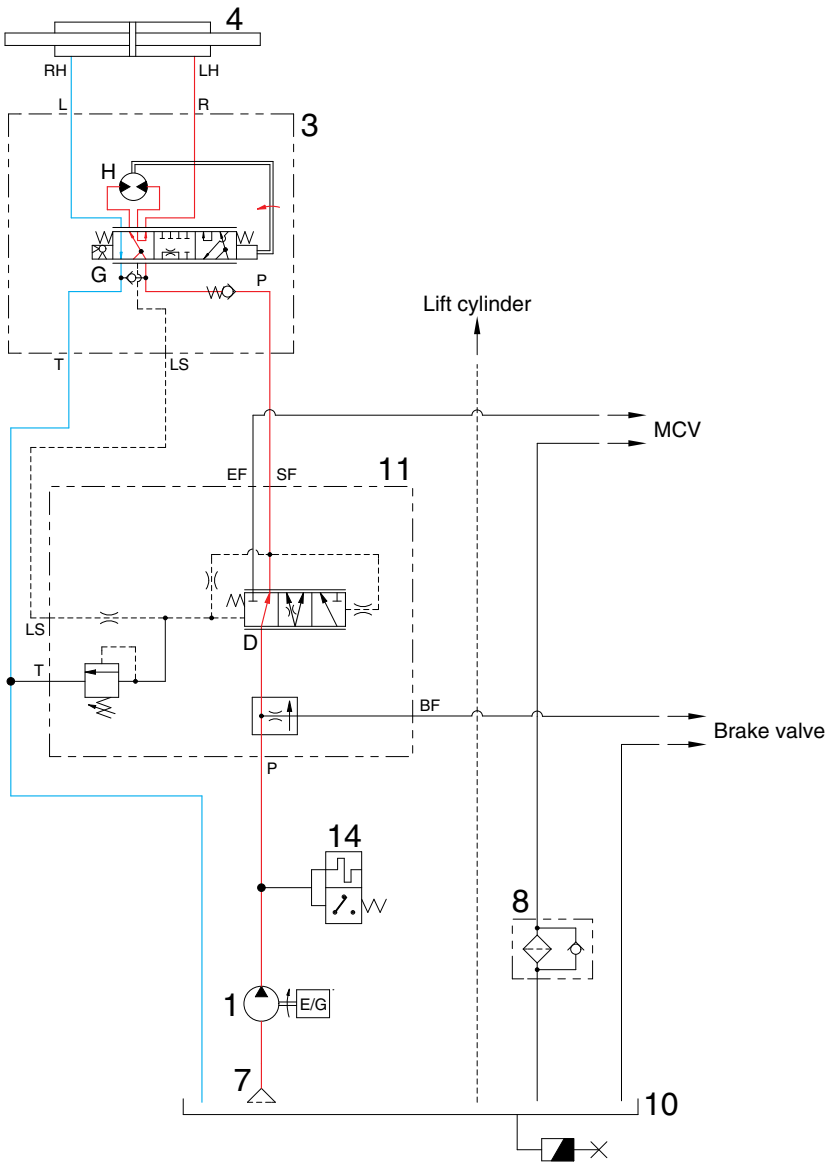


22D9TSS04

When the steering wheel is turned to the left, the spool (G) within the steering unit (3) connected with steering column turns in left hand direction.
At this time, the oil discharged from the pump flows into the spool (G) within the steering unit (3) through the spool (D) of dual flow divider (11) and flows to the gerotor (H).
Oil flow from the gerotor (H) flows back into the spool (G) where it is directed out of the left work port (L).
Oil returned from cylinder returns to hydraulic tank (10).
When the above operation is completed, the machine turns to the left.

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

3) RIGHT TURN



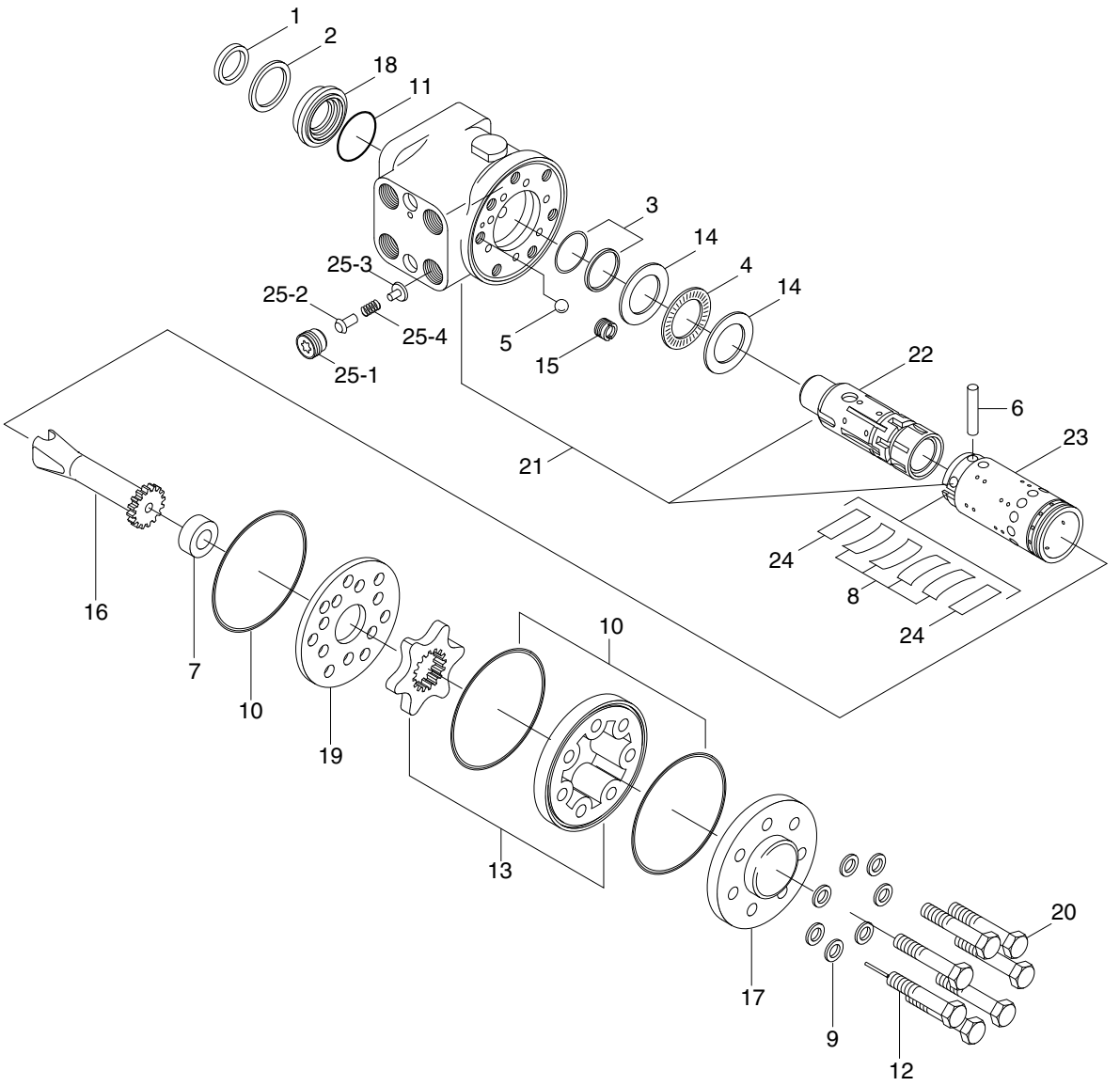
22D9TSS05

When the steering wheel is turned to the right, the spool (G) within the steering unit (3) connected with steering column turns in right hand direction.
At this time, the oil discharged from the pump flows into the spool (G) where it is directed out of the right work port (R).
Oil returned from cylinder returns to hydraulic tank (10).
When the above operation is completed, the machine turns to the right.

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

3. STEERING UNIT

1) STRUCTURE



20D7SS06

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

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.

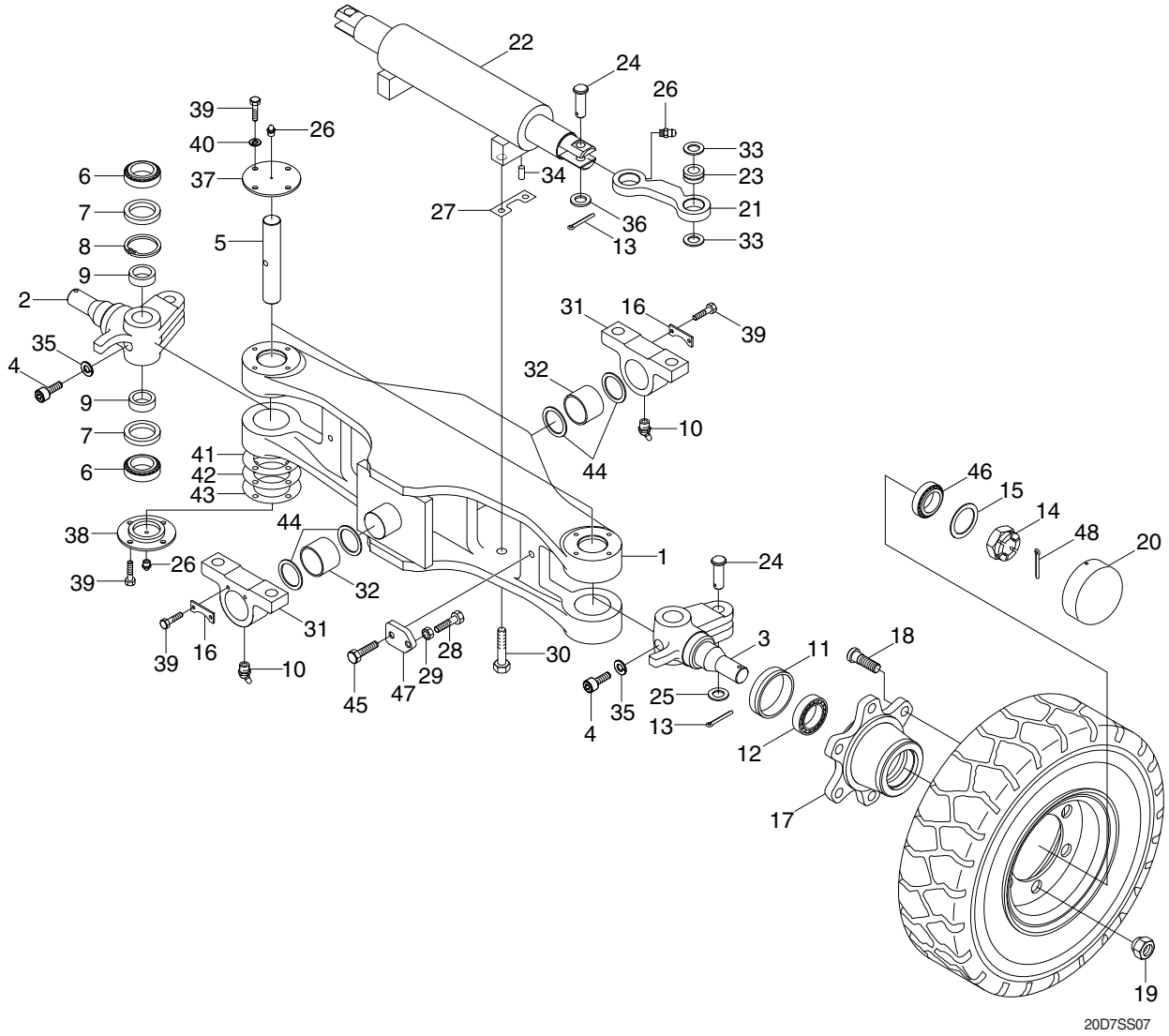
When the steering wheel is turned, the spool turns, the oil path is switched and the oil is fed into the metering device. As a result, the rotor is caused to run by oil pressure, and the sleeve is caused to run through the drive shaft and cross pin. Therefore, when the spool is turned, the spool turns 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. STEERING AXLE

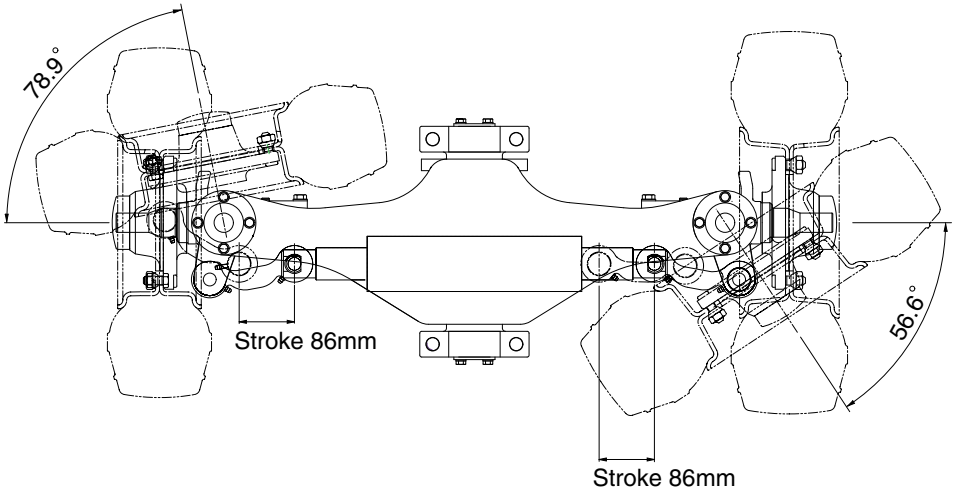
1) STRUCTURE

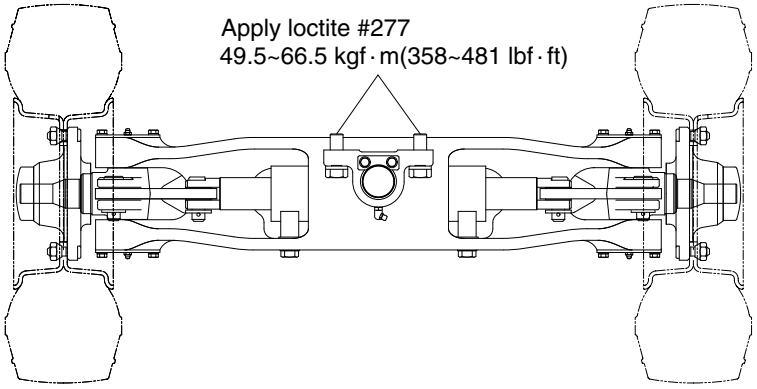


20D7SS07

1	Steering axle	17	Hub	33	Thrust washer
2	Knuckle-RH	18	Hub bolt	34	Pin
3	Knuckle-LH	19	Hub nut	35	Spring washer
4	Special bolt	20	Hub cap	36	Hardened washer
5	King pin	21	Steering link	37	Upper cover
6	Taper roller bearing	22	Steering cylinder	38	Lower cover
7	Oil seal	23	SPH plain bearing	39	Hex bolt
8	Retaining ring	24	Steer link pin	40	Spring wahser
9	Collar	25	Plain washer	41	Shim (0.1)
10	Grease nipple	26	Grease nipple	42	Shim (0.15)
11	Oil seal	27	Lock plate	43	Shim (0.3)
12	Taper roller bearing	28	Bolt	44	Spacer(0.5)
13	Split pin	29	Hex nut	45	Hex bolt
14	Nut	30	Hex bolt	46	Taper roller bearing
15	Washer	31	Trunnion block	47	Plate
16	Plate	32	Bushing	48	Split pin

2) TIGHTENING TORQUE AND SPECIFICATION



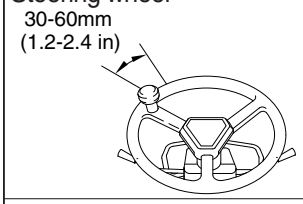


20D7SS08

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	78.9 / 56.6
Tread	mm (in)	980 (38.6)

GROUP 2 OPERATIONAL CHECKS AND TROUBLESHOOTING

1. OPERATIONAL CHECKS

<table>
<tr><th>Check item</th><th>Checking procedure</th></tr>
<tr><td>Steering wheel
 
</td><td>· Set rear wheels facing straight forward, then turn steering wheel to left and right. Measure range of steering wheel movement before rear wheel starts to move. Range should be 30~60 mm at rim 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±100 mm (±4 in)of specified value, adjust turning angle stopper bolt.
Min turning radius (Outside)
<table>
<tr><td>22D-9S</td><td>2286 mm (90 in)</td><td>30D-9S</td><td>2413 mm (95 in)</td></tr>
<tr><td>25D-9S</td><td>2342 mm (92 in)</td><td>33D-9S</td><td>2463 mm (97 in)</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 : 90 kgf/cm² (90 bar)</td></tr>
</table>

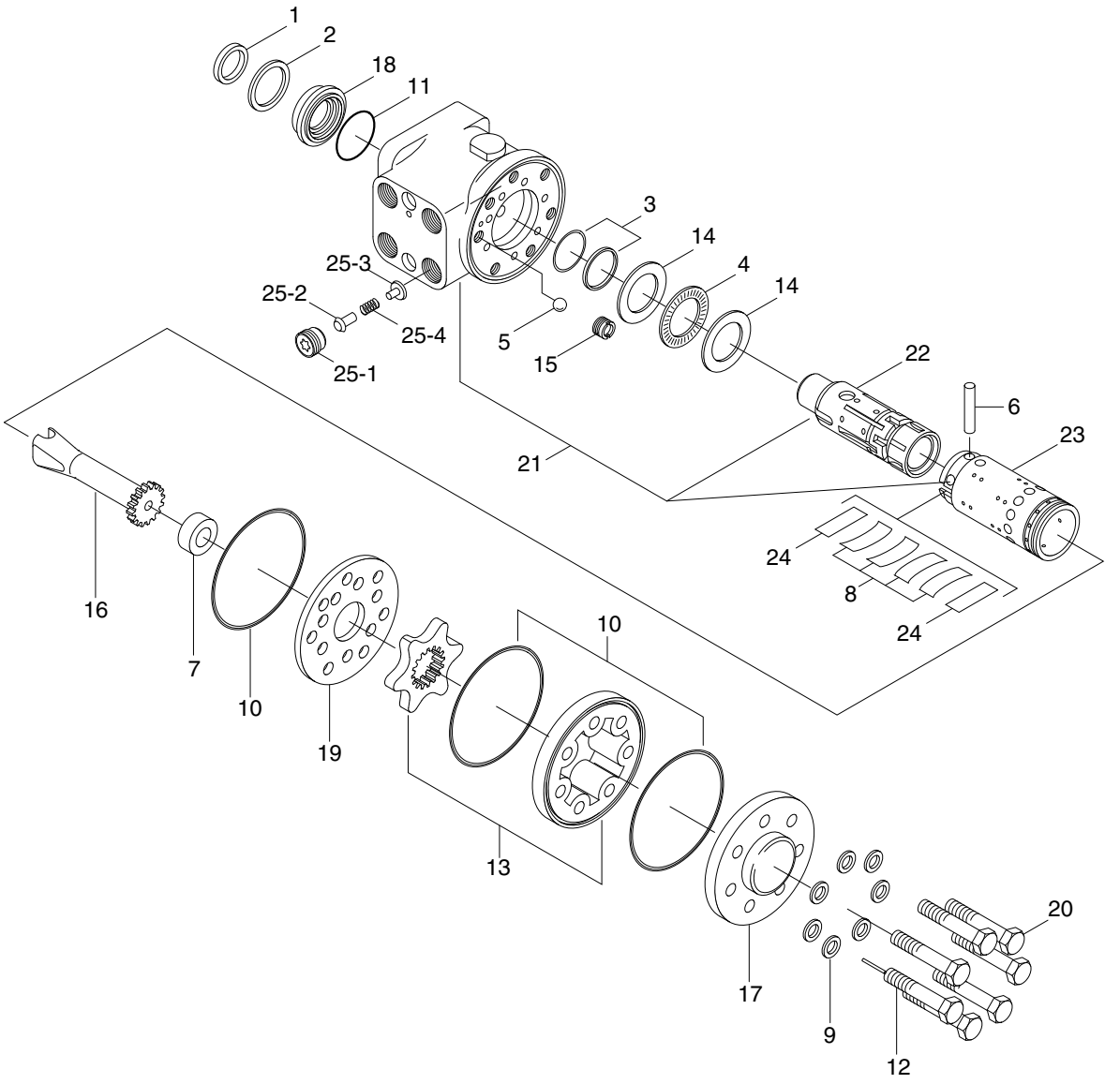
2. TROUBLESHOOTING

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.	· Lockout loosening. · Metal spring deteriorated.	· Retighten. · Replace.
Steering system makes abnormal sound or vibration.	· Gear backlash out of adjustment. · Lockout loosening. · Air in oil circuit.	· 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

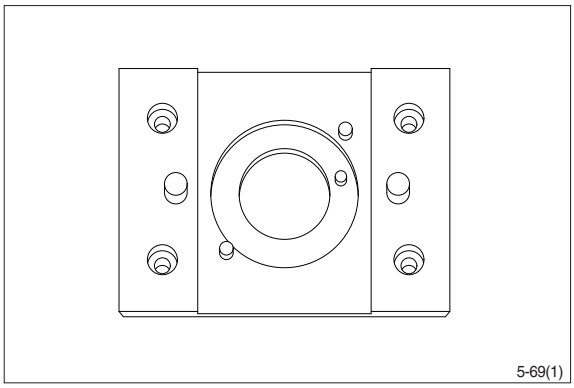


20D7SS06

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

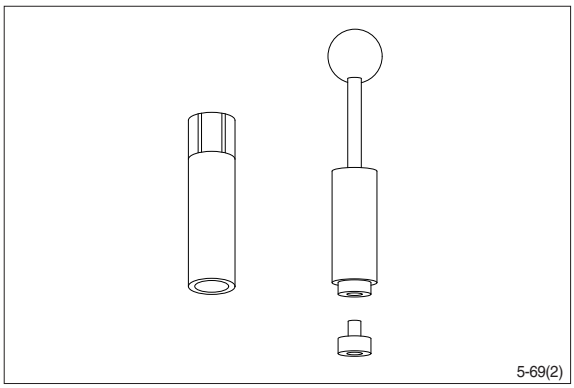
2) TOOLS

(1) Holding tool.



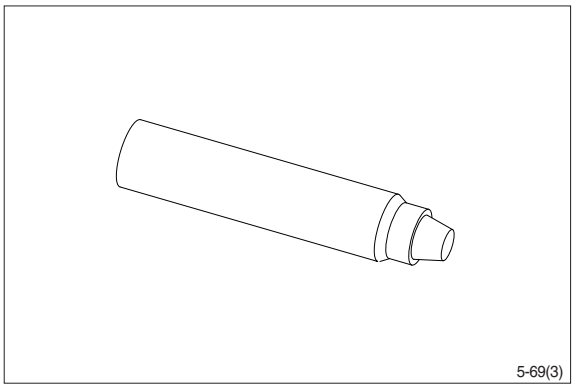
5-69(1)

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



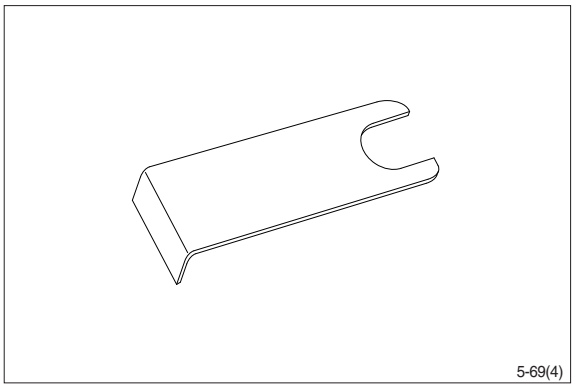
5-69(2)

(3) Assembly tool for lip seal.



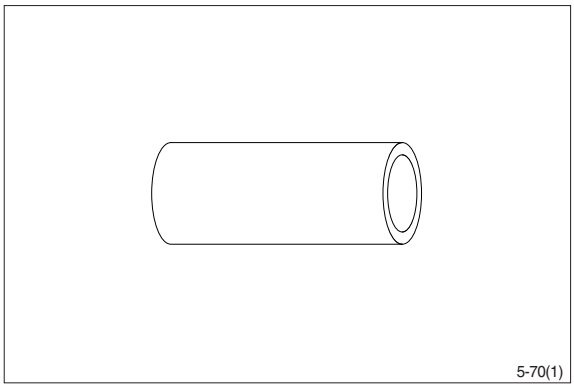
5-69(3)

(4) Assembly tool for cardan shaft.

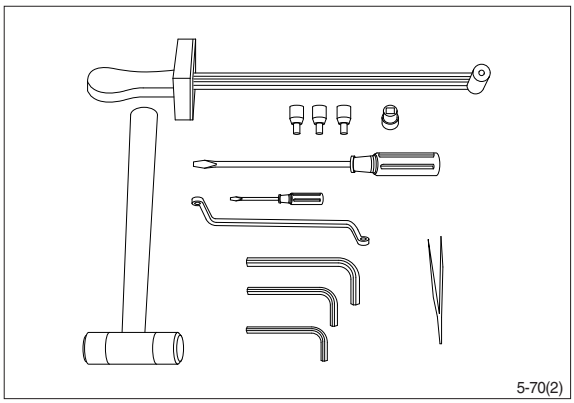


5-69(4)

(5) Assembly tool for dust seal.

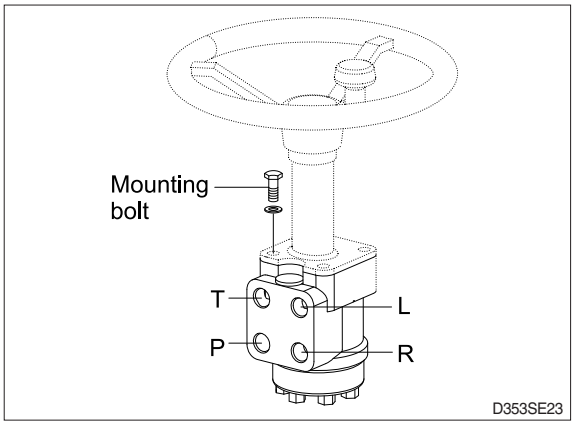


(6) Torque wrench 0~7.1kgf · m
(0~54.4lbf · ft)
13 mm socket spanner
6, 8 mm and 12 mm hexagon sockets
12 mm screwdriver
2 mm screwdriver
13 mm ring spanner
6, 8 and 12 mm hexagon socket spanners
Plastic hammer
Tweezers



3) TIGHTENING TORQUE

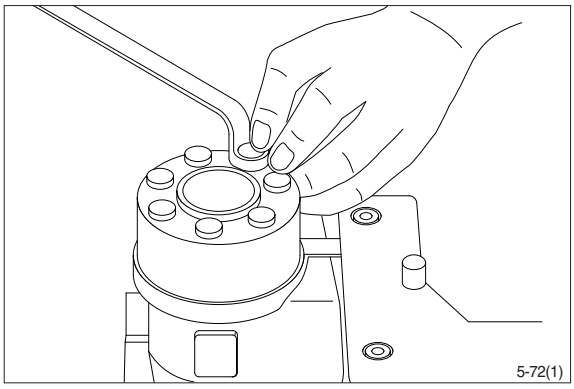
L : Left port
R : Right port
T : Tank
P : Pump



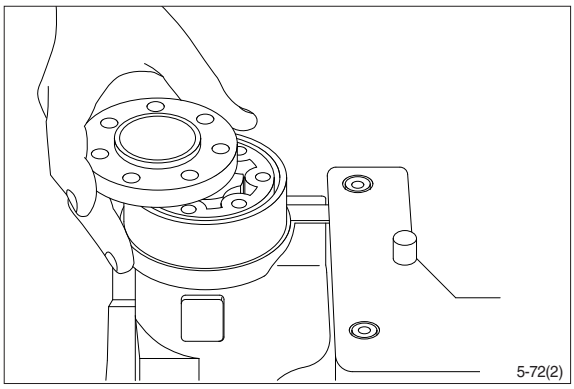
Port	Size	Torque [kgf · m (lbf · ft)]
L	3/4 UNF - 16	13 (94)
R	3/4 UNF - 16	13 (94)
T	3/4 UNF - 16	13 (94)
P	3/4 UNF - 16	13 (94)
Mounting bolt	M10×1.5	5.0±1.0 (36±7.2)

4) DISASSEMBLY

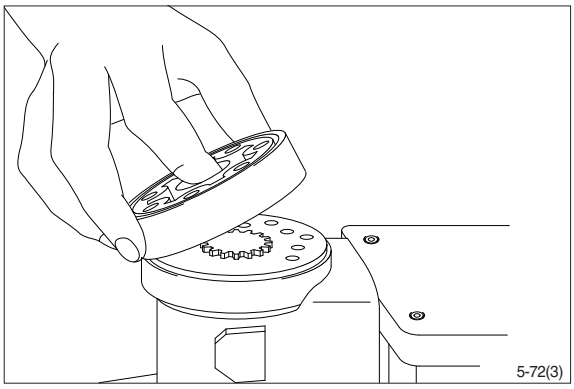
(1) Disassemble steering column from steering unit and place the steering unit in the holding tool.
Screw out the screws in the end cover (6-off plus one special screw).


5-72(1)

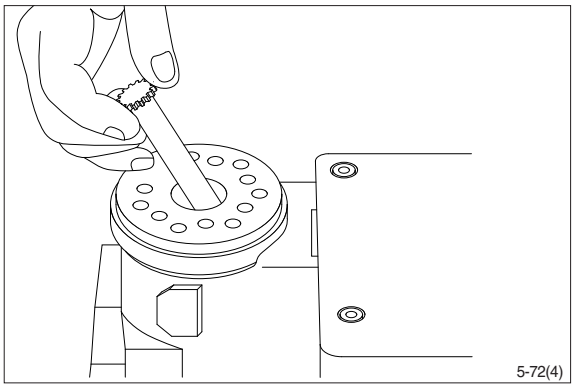
(2) Remove the end cover, sideways.


5-72(2)

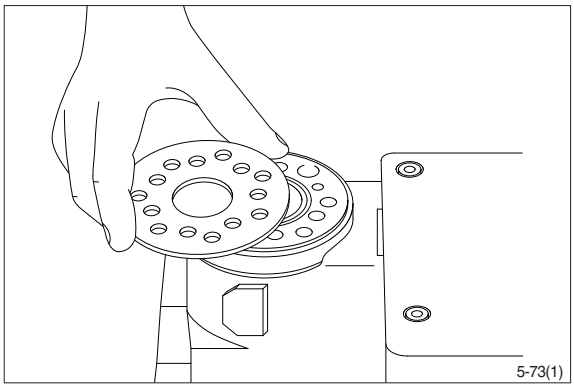
(3) Lift the gearwheel set(With spacer if fitted) off the unit.
Take out the two O-rings.


5-72(3)

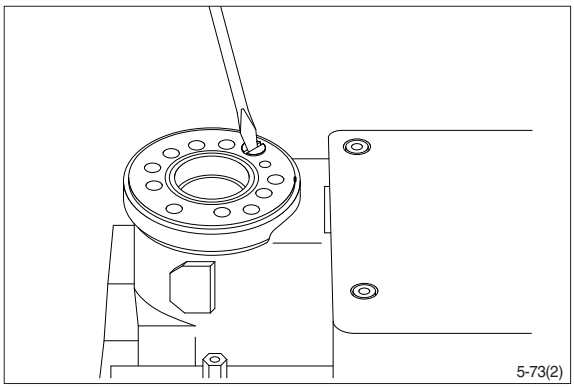
(4) Remove cardan shaft.


5-72(4)

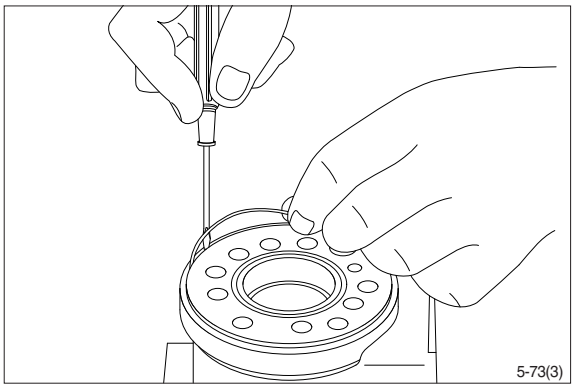
(5) Remove distributor plate.


5-73(1)

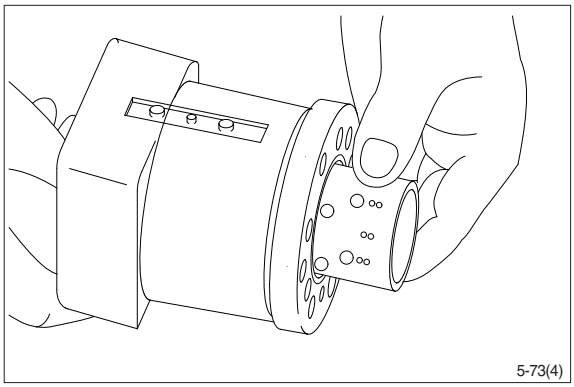
(6) Screw out the threaded bush over the check valve.


5-73(2)

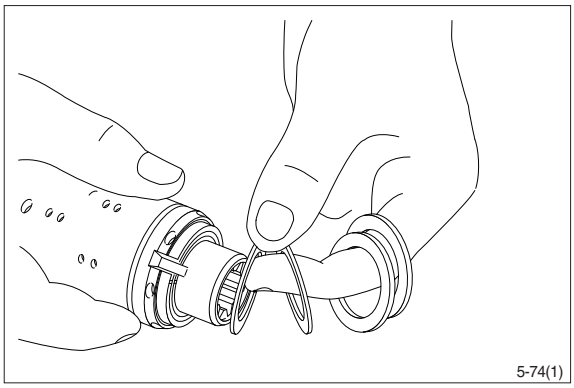
(7) Remove O-ring.


5-73(3)

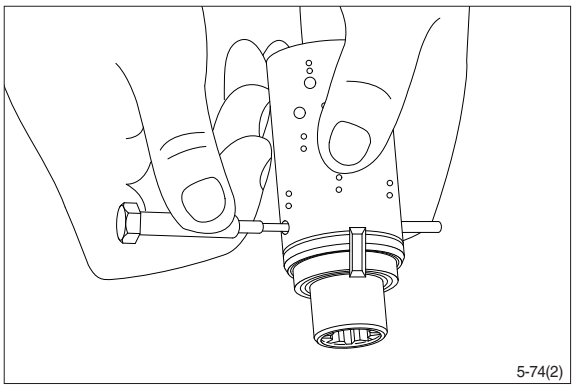
(8) Take care to keep the cross pin in the sleeve and spool horizontal. The pin can be seen through the open end of the spool. Press the spool inwards and the sleeve, ring, bearing races and thrust bearing will be pushed out of the housing together.


5-73(4)

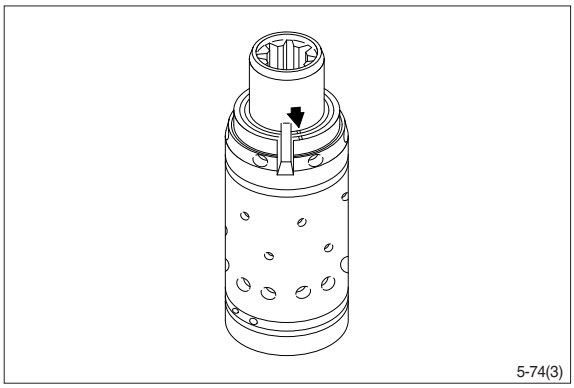
(9) Take ring, bearing races and thrust bearing from sleeve and spool. The outer (Thin) bearing race can sometimes "stick" in the housing, therefore check that it has come out.


5-74(1)

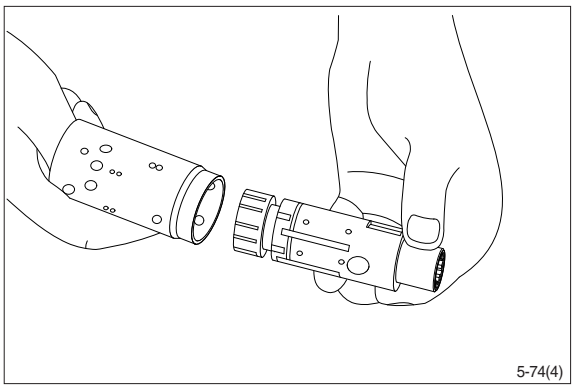
(10) Press out the cross pin. Use the special screw from the end cover.


5-74(2)

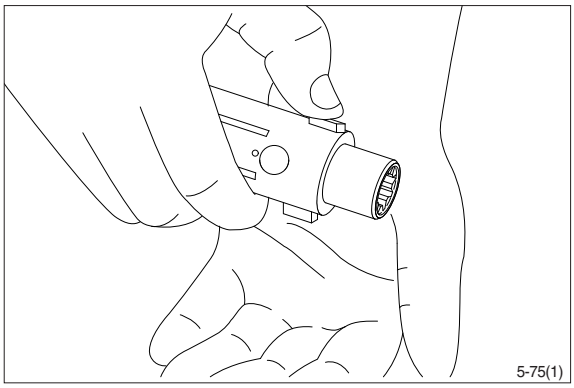
※ A small mark has been made with a pumice stone on both spool and sleeve close to one of the slots for the neutral position springs (See drawing).
If the mark is not visible, remember to leave a mark of your own on sleeve and spool before the neutral position springs are disassembled.


5-74(3)

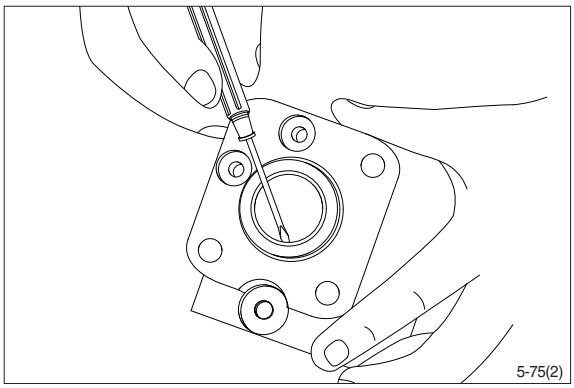
(11) Carefully press the spool out of the sleeve.


5-74(4)

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

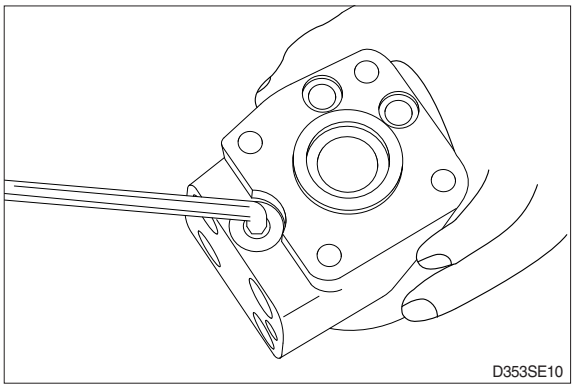


(13) Remove dust seal and O-ring.

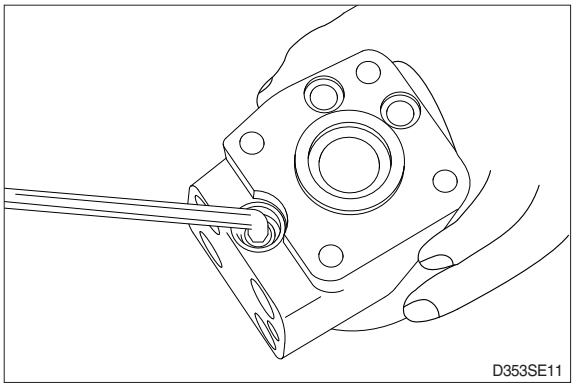


Disassembling the pressure relief valve

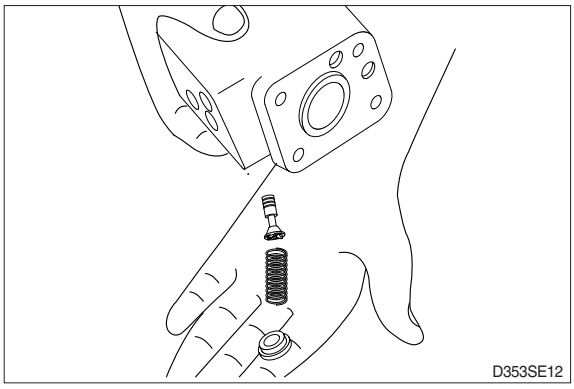
(14) Screw out the plug using an 8 mm hexagon socket spanner.
Remove seal washers.



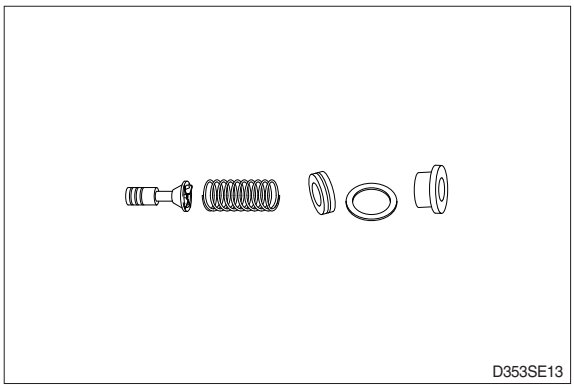
(15) Unscrew the setting screw using an 8 mm hexagon socket spanner.



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



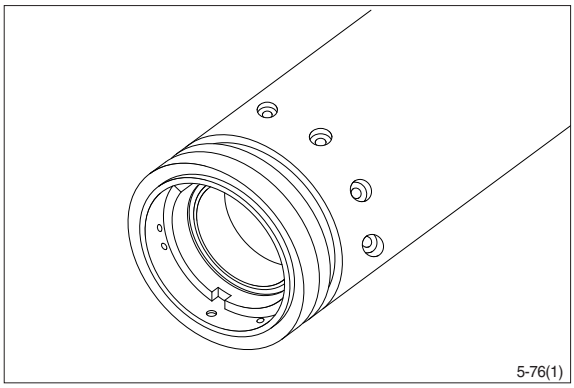
(17) The pressure relief valve is now disassem-bled.



5) ASSEMBLY

(1) Assemble spool and sleeve.

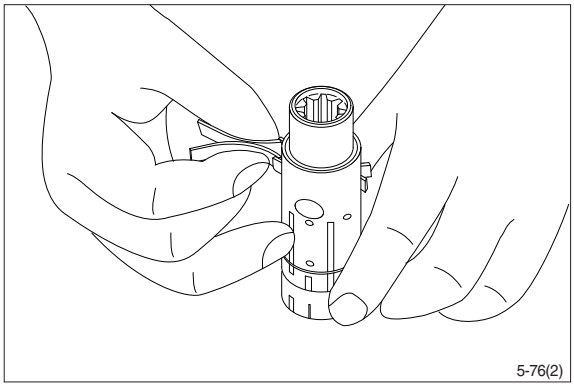
※ When assembling spool and sleeve only one of two possible ways of positioning the spring slots is correct. There are three slots in the spool and three holes in the sleeve in the end of the spool / sleeve opposite to the end with spring slots. Place the slots and holes opposite each other so that parts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



5-76(1)

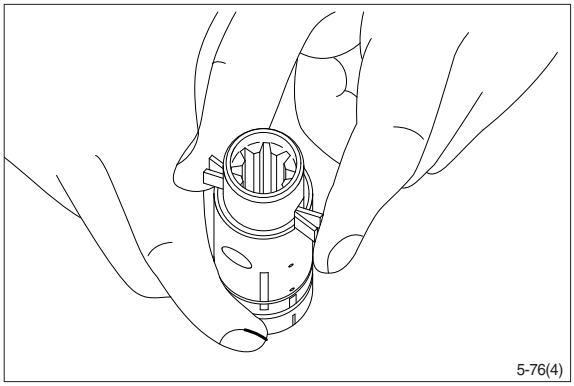
(2) Place the two flat neutral position springs in the slot.

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



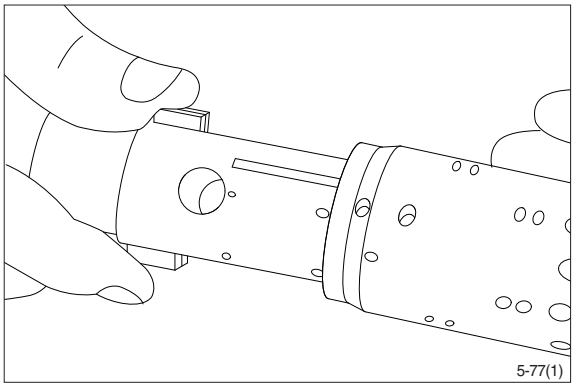
5-76(2)

(3) Line up the spring set.



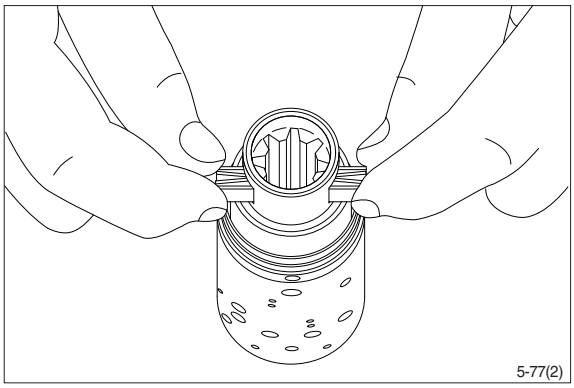
5-76(4)

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

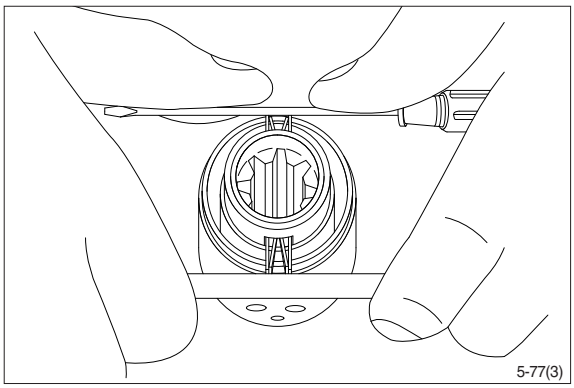


5-77(1)

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

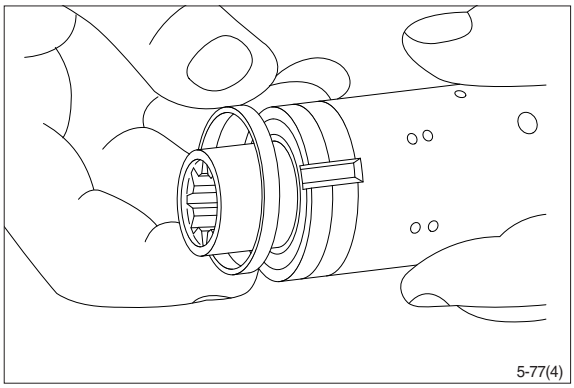

5-77(2)

(6) Line up the springs and center them.

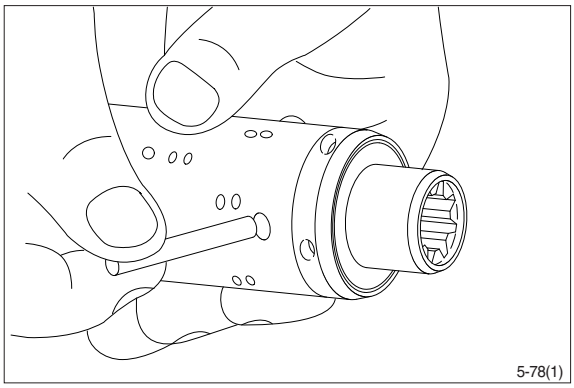

5-77(3)

(7) Guide the ring down over the sleeve.

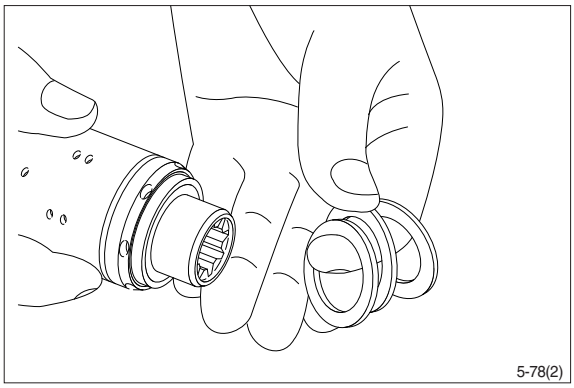
※ The ring should be able to rotate free of the springs.


5-77(4)

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

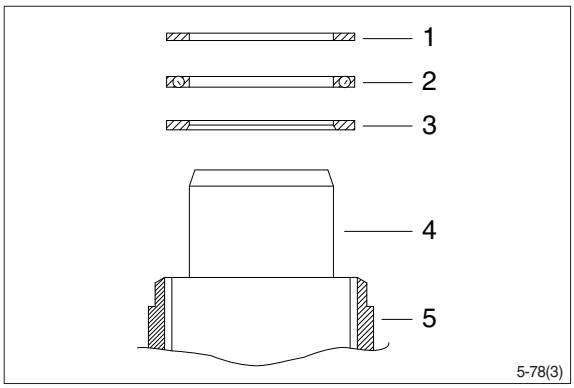

5-78(1)

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



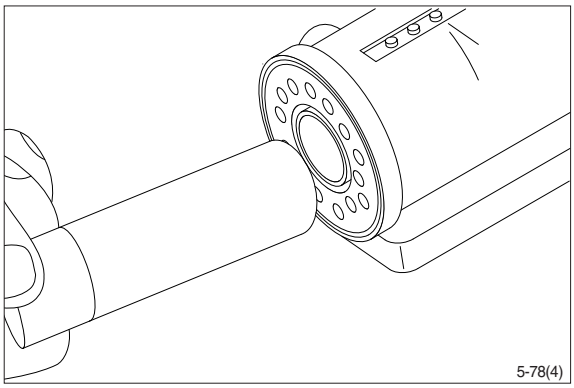
※ **Assembly pattern for standard bearings**

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

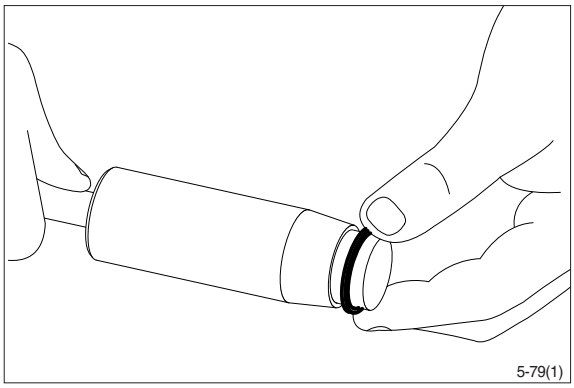


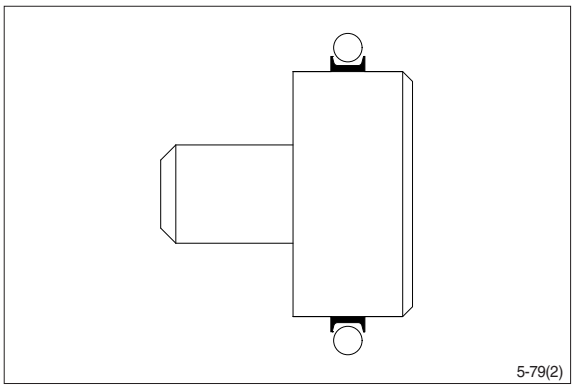
Installation instruction for O-ring

(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.

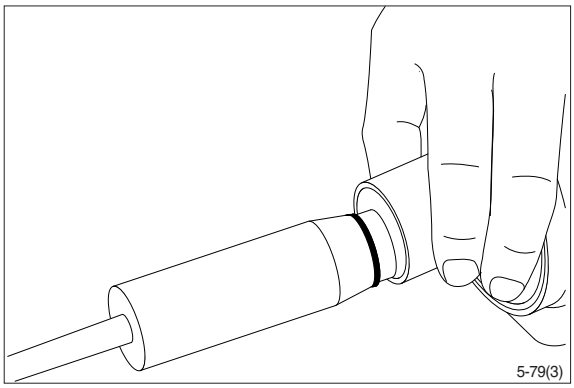


(11) Grease O-ring with hydraulic oil and place them on the tool.

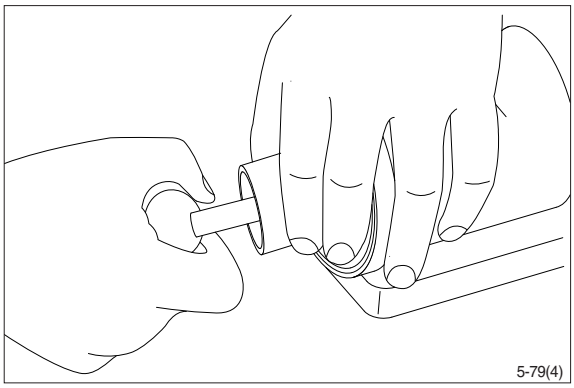

5-79(1)


5-79(2)

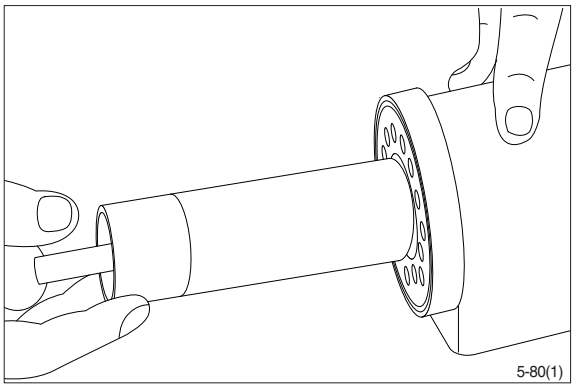
(12) Hold the outer part of the assembly tool in the bottom of the steering unit housing and guide the inner part of the tool right to the bottom.


5-79(3)

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

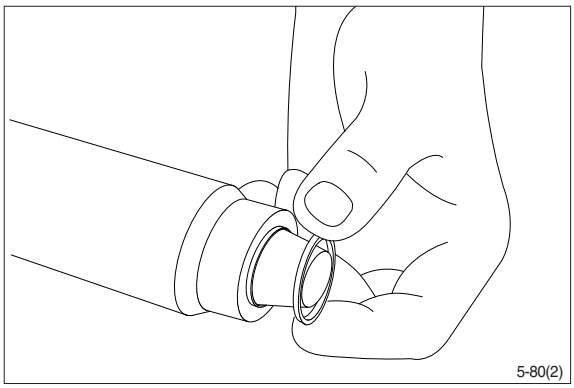

5-79(4)

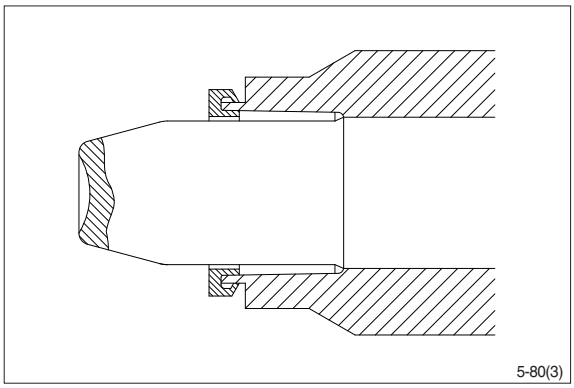
(14) Draw the inner and outer parts of the assembly tool out of the steering unit bore, leaving the guide from the inner part in the bore.



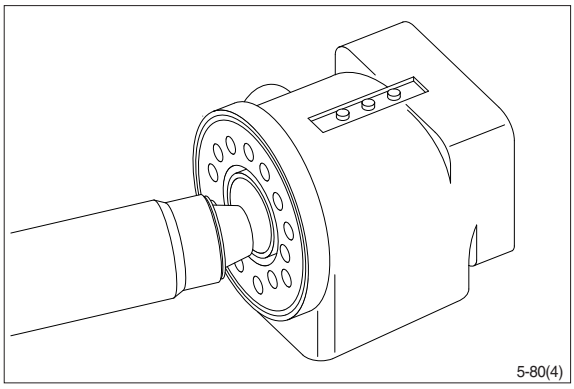
Installation instructions for lip seal

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

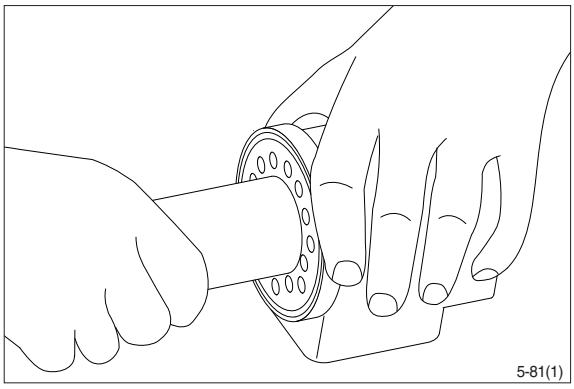




(16) Guide the assembly tool right to the bottom.

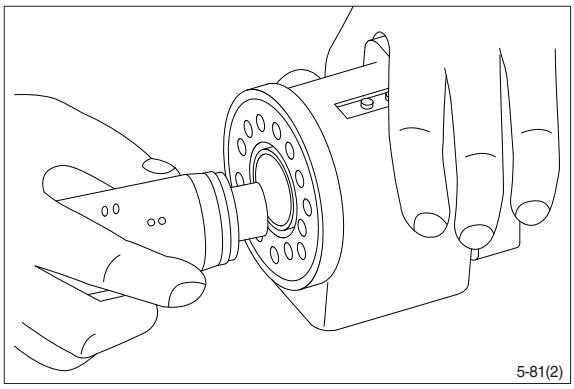


(17) Press and turn the lip seal into place in the housing.

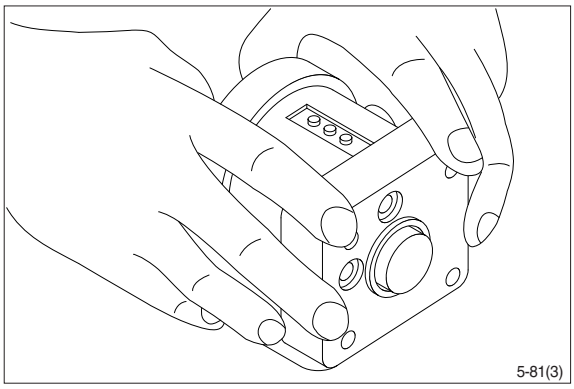


(18) With a light turning movement, guide the spool and sleeve into the bore.

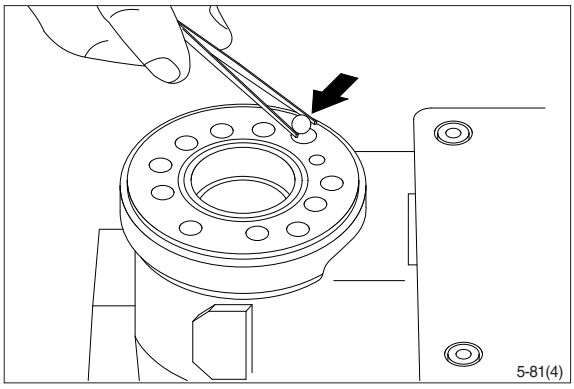
※ Fit the spool set holding the cross pin horizontal.



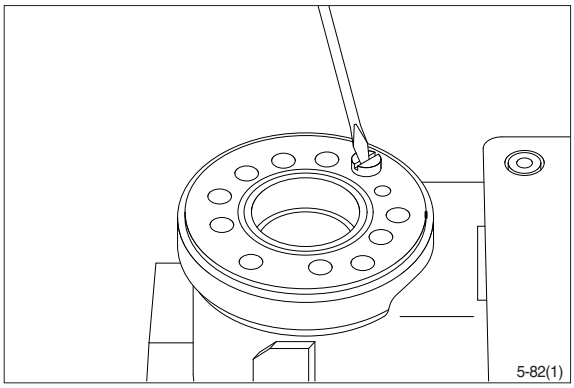
(19) The spool set will push out the assembly tool guide. The O-ring are now in position.



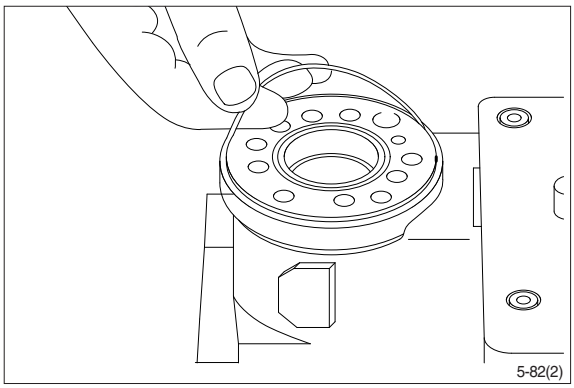
(20) Turn the steering unit until the bore is vertical again. Put the check valve ball into the hole indicated by the arrow.



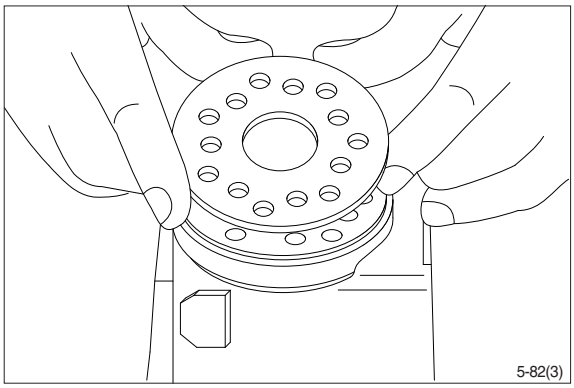
(21) Screw the threaded bush lightly into the check valve bore. The top of the bush must lie just below the surface of the housing.



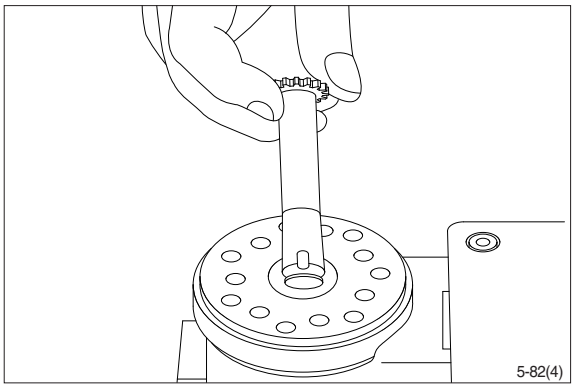
(22) Grease the O-ring with mineral oil approx. viscosity 500 cSt at 20˚C.



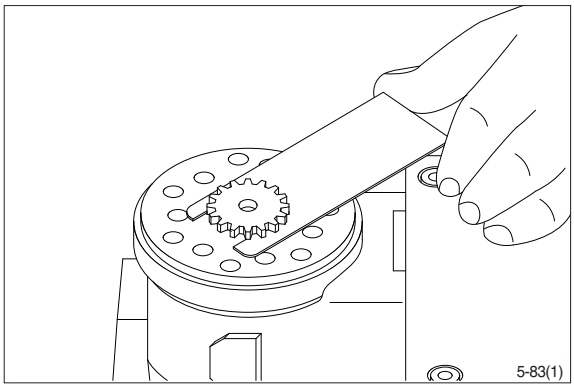
(23) Place the distributor plate so that the channel holes match the holes in the housing.



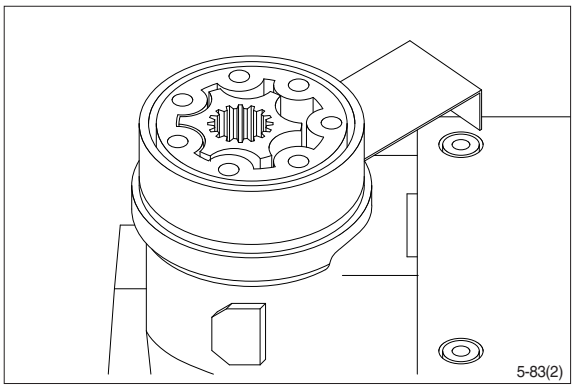
(24) Guide the cardan shaft down into the bore so that the slot is parallel with the connection flange.



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



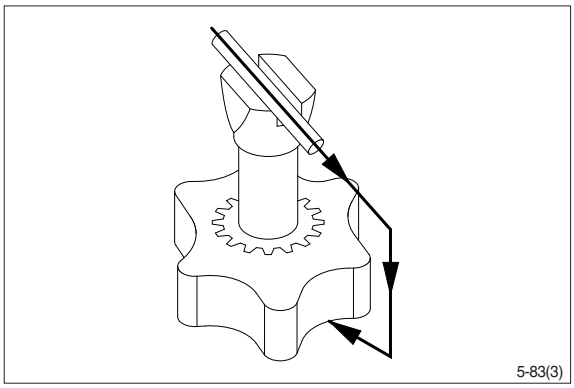
(26) Grease the two O-rings with mineral oil approx. viscosity 500 cSt at 20°C and place them in the two grooves in the gear rim. Fit the gearwheel and rim on the cardan shaft.



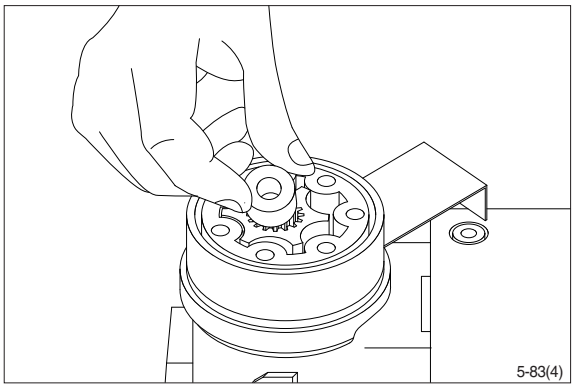
(27) Important

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.

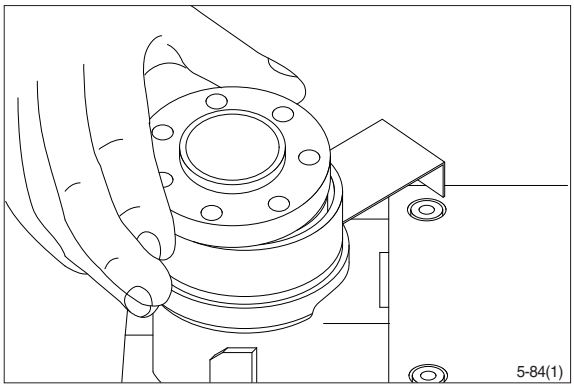
Turn the gear rim so that the seven through holes match the holes in the housing.



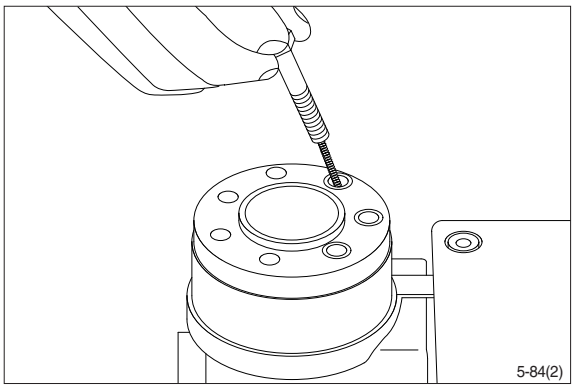
(28) Fit the spacer, if any.



(29) Place the end cover in position.

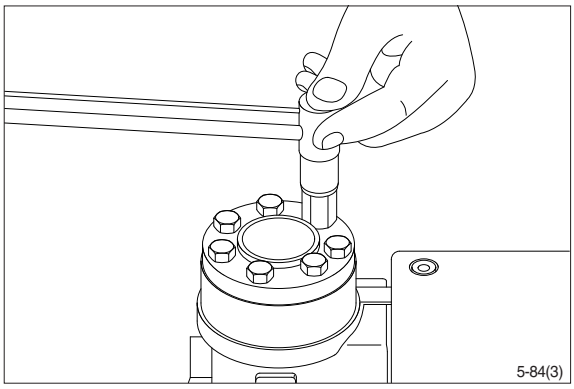

5-84(1)

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

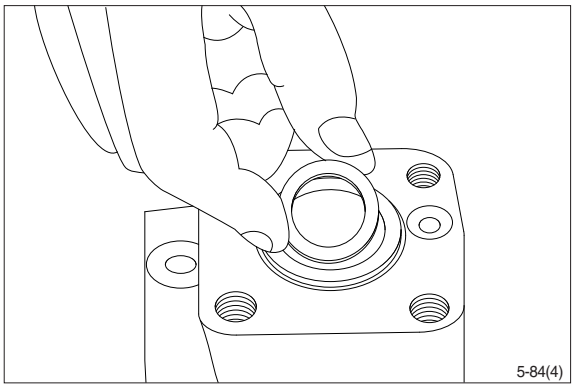

5-84(2)

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

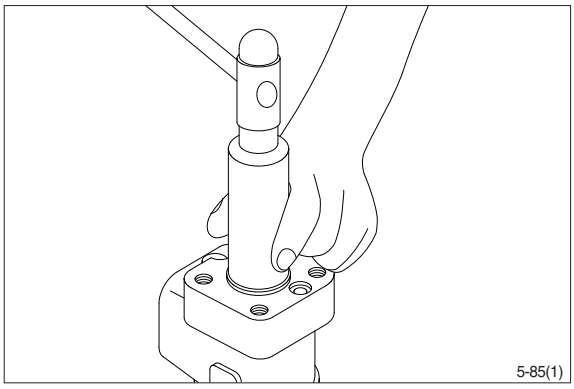
· Tightening torque : 3.0 ± 0.6kgf · m
(21.7 ± 4.3lbf · ft)


5-84(3)

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

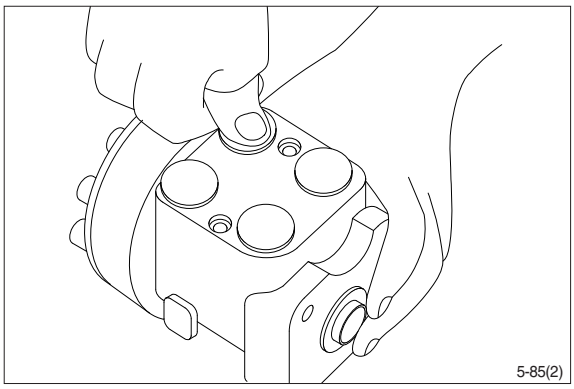

5-84(4)

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


5-85(1)

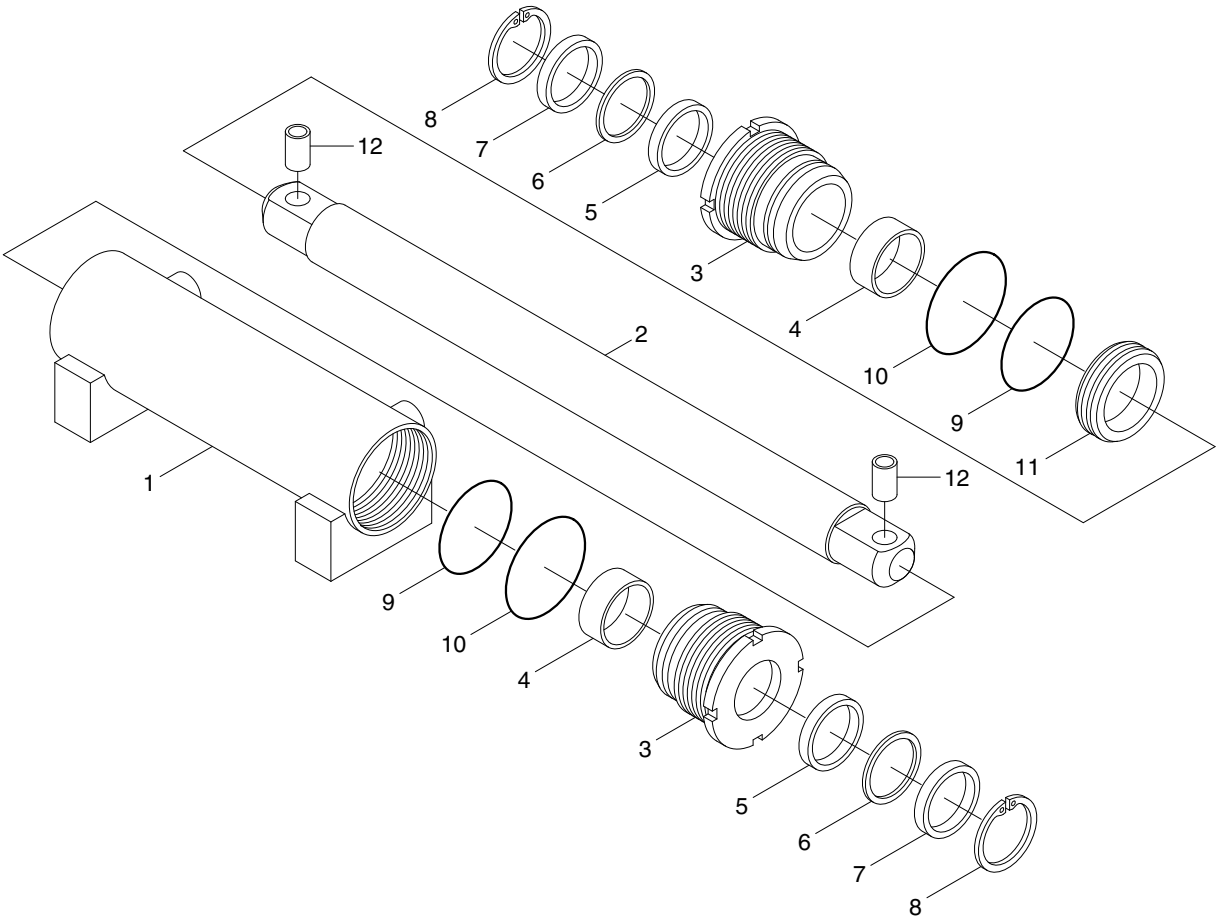
(34) Press the plastic plugs into the connection ports.

※ **Do not use a hammer!**


5-85(2)

2. STEERING CYLINDER

1) STRUCTURE



D255SS11

1	Tube assembly	5	Rod seal	9	O-ring
2	Rod	6	Back up ring	10	O-ring
3	Gland	7	Dust wiper	11	Piston seal
4	DU bushing	8	Snap ring	12	Pin bush

2) DISASSEMBLY

※ Before disassembling steering cylinder, release oil in the cylinder first.

(1) Put wooden blocks against the cylinder tube, then hold in a vice.

(2) Remove the gland 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. If there are some damage, replace with new parts.

3) CHECK AND INSPECTION

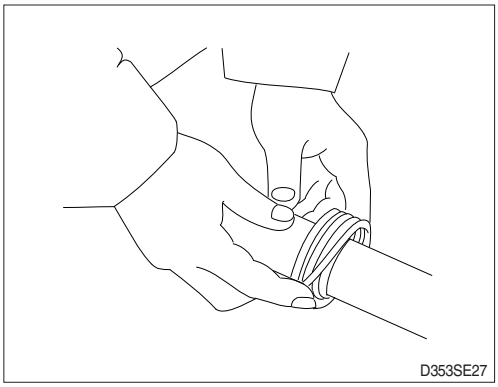
mm (in)

Check item	Criteria		Remedy
	Standard size	Repair limit	
Clearance between piston & cylinder tube	0.064~0.137 (0.0025~0.0054)	0.180 (0.0070)	Replace piston seal
Clearance between cylinder rod & bushing	0.024~0.112 (0.0009~0.0044)	0.120 (0.0049)	Replace bushing
Seals, O-ring	Damage		Replace
Cylinder rod	Dents		Replace
Cylinder tube	Biting		Replace

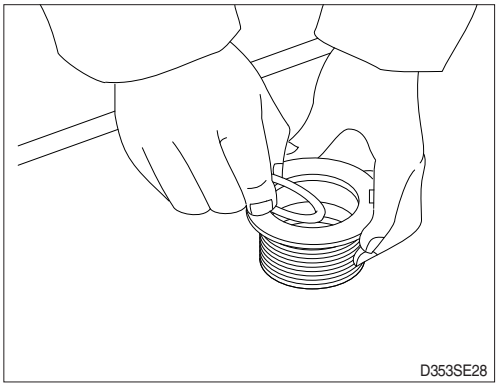
4) ASSEMBLY

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

※ Be careful not to scratch the seal too much during installation or it will not seat properly.

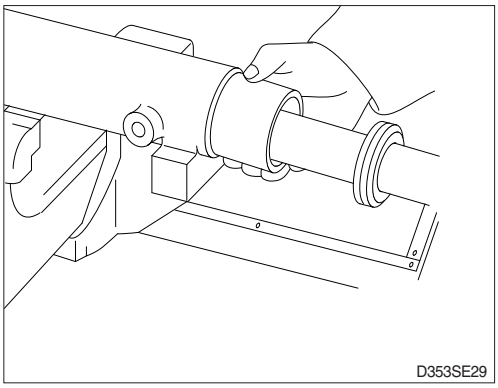

D353SE27

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

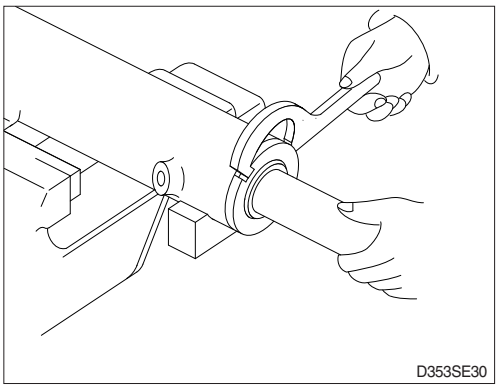

D353SE28

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

(4) Set a special tool the cylinder, gland assembly into the cylinder tube.

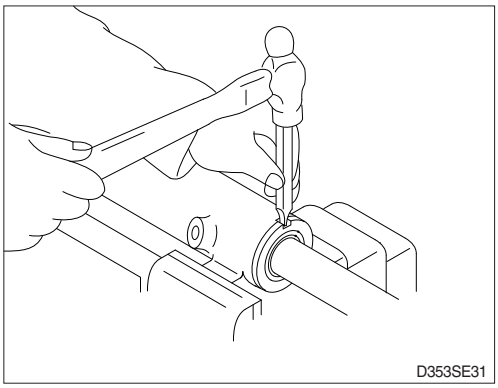

D353SE29

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


D353SE30

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

※ If it need calking again, never using previous calking position.


D353SE31

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

(8) Install cylinder into trail axle.

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

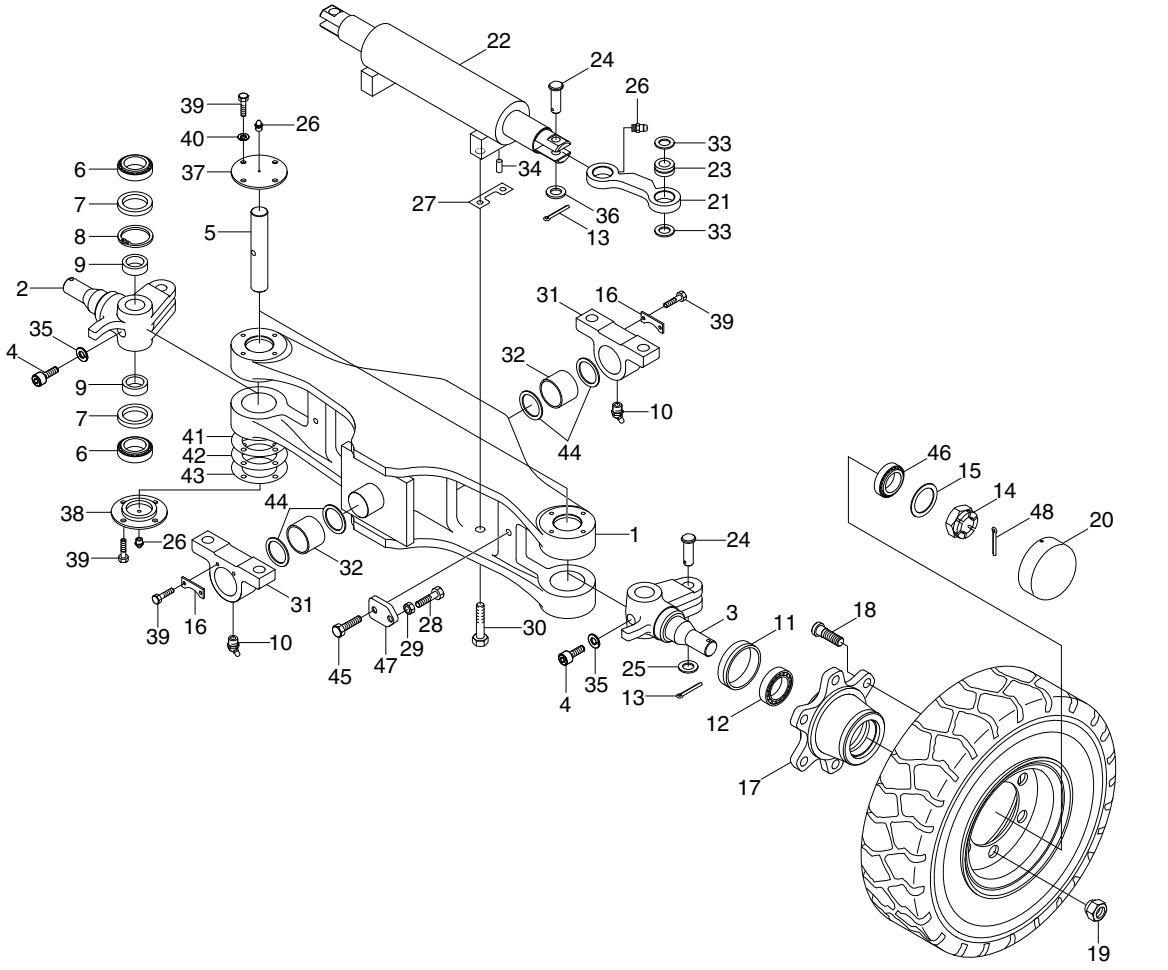
※ Then, repeat the above operation at gradually increasing engine rpm. This releases air from the system and completes preparation for operation.

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

3. TRAIL AXLE

1) STRUCTURE

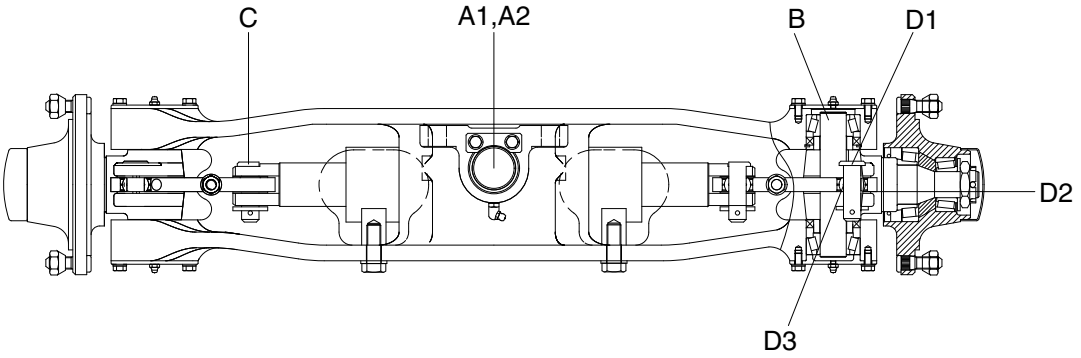
※ Do not remove the stopper bolt unless necessary.



20D7SS07

1	Steering axle	17	Hub	33	Thrust washer
2	Knuckle-RH	18	Hub bolt	34	Pin
3	Knuckle-LH	19	Hub nut	35	Spring washer
4	Special bolt	20	Hub cap	36	Hardened washer
5	King pin	21	Steering link	37	Upper cover
6	Taper roller bearing	22	Steering cylinder	38	Lower cover
7	Oil seal	23	SPH plain bearing	39	Hex bolt
8	Retaining ring	24	Steer link pin	40	Spring wahser
9	Collar	25	Plain washer	41	Shim (0.1)
10	Grease nipple	26	Grease nipple	42	Shim (0.15)
11	Oil seal	27	Lock plate	43	Shim (0.3)
12	Taper roller bearing	28	Bolt	45	Hex bolt
13	Split pin	29	Hex nut	46	Taper roller bearing
14	Nut	30	Hex bolt	47	Plate
15	Washer	31	Trunnion block	48	Split pin
16	Plate	32	Bushing		

2) CHECK AND INSPECTION



20D7SS10

unit : mm (in)

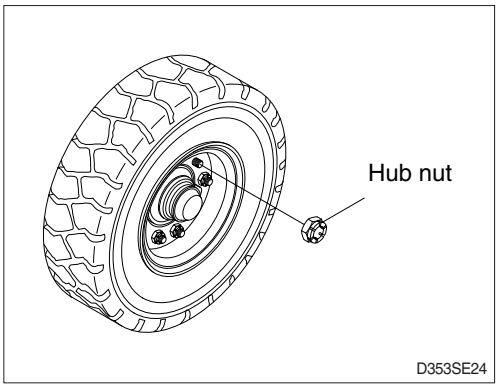
No.	Check item			Criteria		Remarks
				Standard size	Repair limit	
A	Shaft	A1	OD of shaft	55 (2.2)	54.5 (2.1)	Replace
		A2	ID of bushing	55 (2.2)	55.5 (2.2)	
B	OD of king pin			35 (1.4)	34.5 (1.4)	
C	OD of steering cylinder pin			20 (0.8)	19.5 (0.8)	
D	Knuckle	D1	OD of pin	20 (0.8)	19.5 (0.8)	
		D2	Vertical play	-	-	Adjust with shims
		D3	ID of bushing	20 (0.8)	20.5 (0.8)	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 counter 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 slotted nut.

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

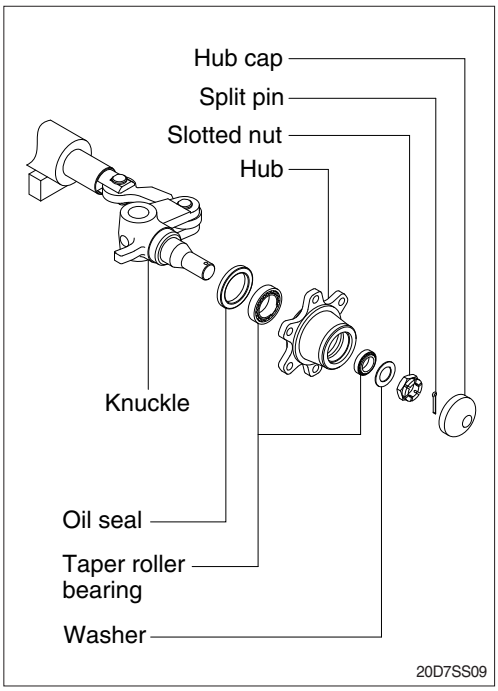
※ Be very careful because just before the hub comes off, tapered roller bearing will fall out.

(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 slotted nut in the knuckle to protect the threaded portion.



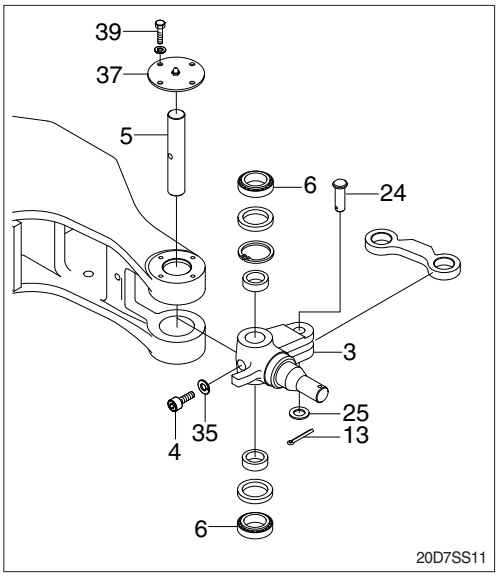
(8) Loosen special bolt (4) and spring washer (35).

(9) Remove hexagon bolt (39) and upper cover (37).

(10) Push out the king pin (5) without damaging the knuckle arm (3).

(11) If defect is observed in bearing (6), pull it out by using extractor.

(12) Remove spilt pin (13), plain washer (25) and link pin (24).



4) ASSEMBLY

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

Perform the disassembly in reverse order.

(1) Tighten the special bolt (4) and washer (35) of king pin (5).

(2) There is a notch in the middle of the king pin (5), make sure that this notch is on the special bolt side.

(3) Do not hammer to drive in bearing (6) because it will break.
Always use drive-in tool.
Be sure that the fixed ring of the bearing is placed in position facing the knuckle (3).

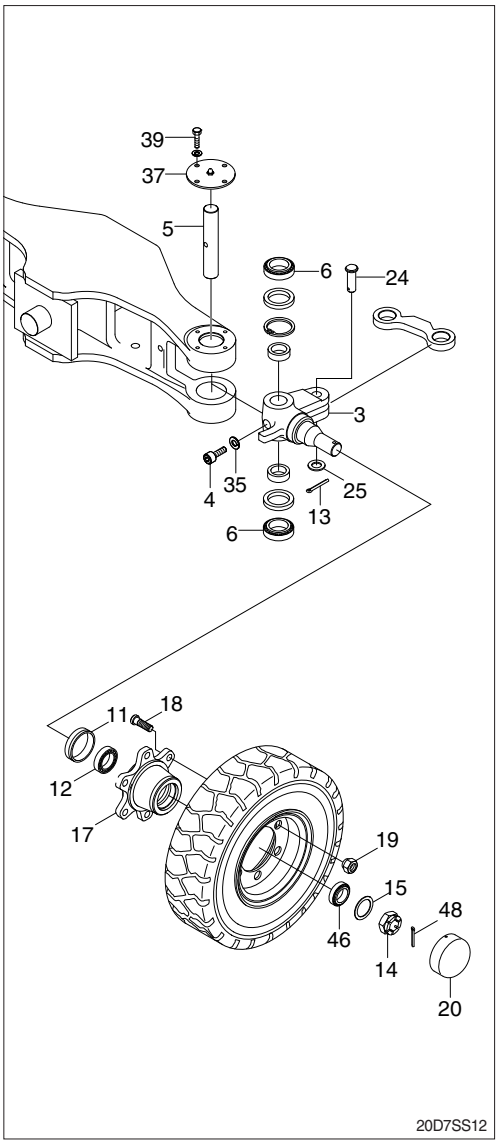
(4) Hub

① Mount oil seal (11) and inner race of tapered roller bearing (12) on the knuckle. The bearing should be well greased before assembling.

② Install the outer race of the bearing (46) in the wheel center and assemble to the knuckle.

③ Tighten nut (14) and lock with split pin (48). In locking with split pin, locate the hole for the split pin by turning the nut back 1/6 of a turn.
Adjust the preload of bearing.

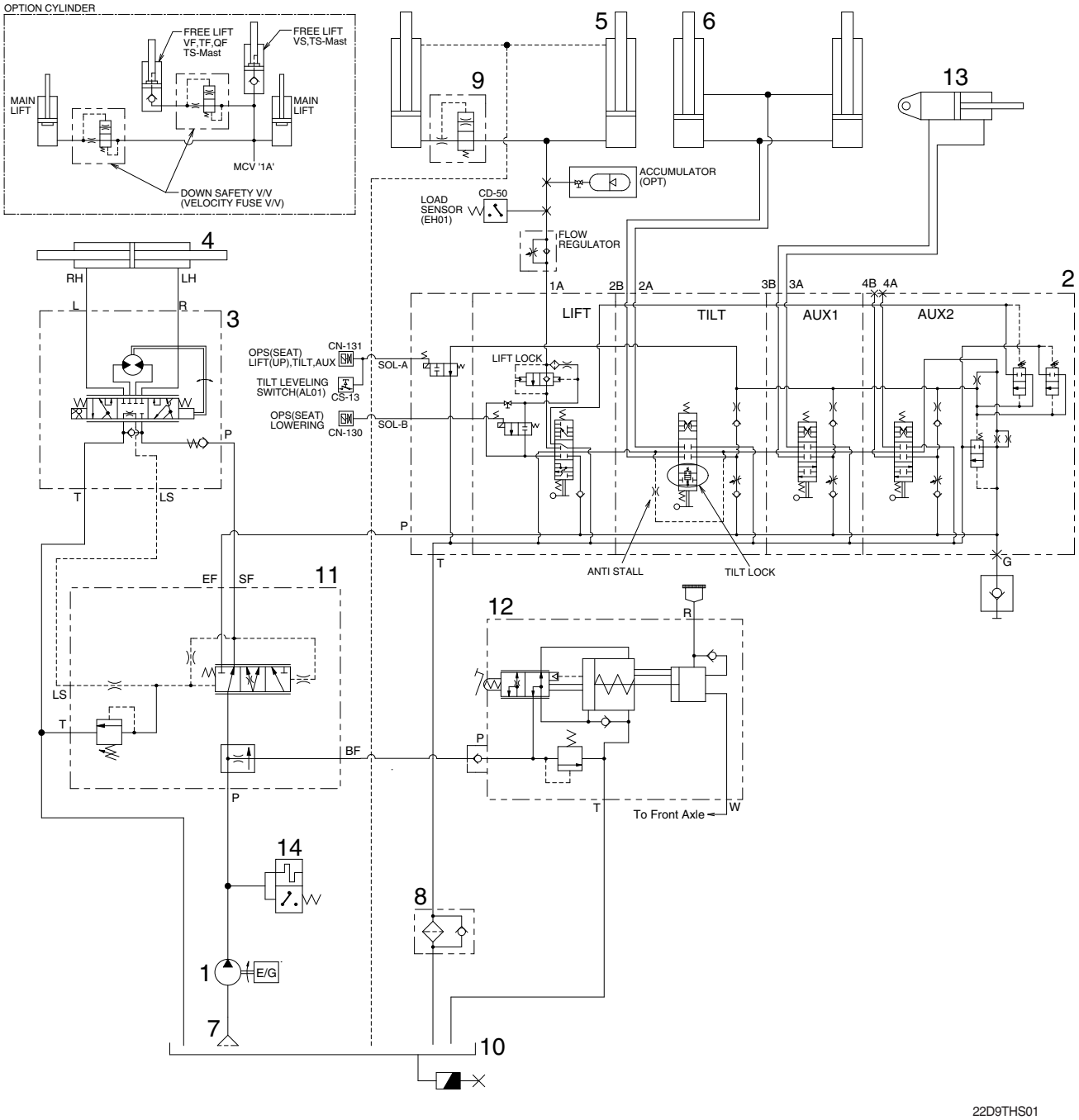
④ Mount the hub cap (20).
Bearing should be well greased before assembling.



SECTION 6 HYDRAULIC SYSTEM

GROUP 1 STRUCTURE AND FUNCTION

1. HYDRAULIC CIRCUIT

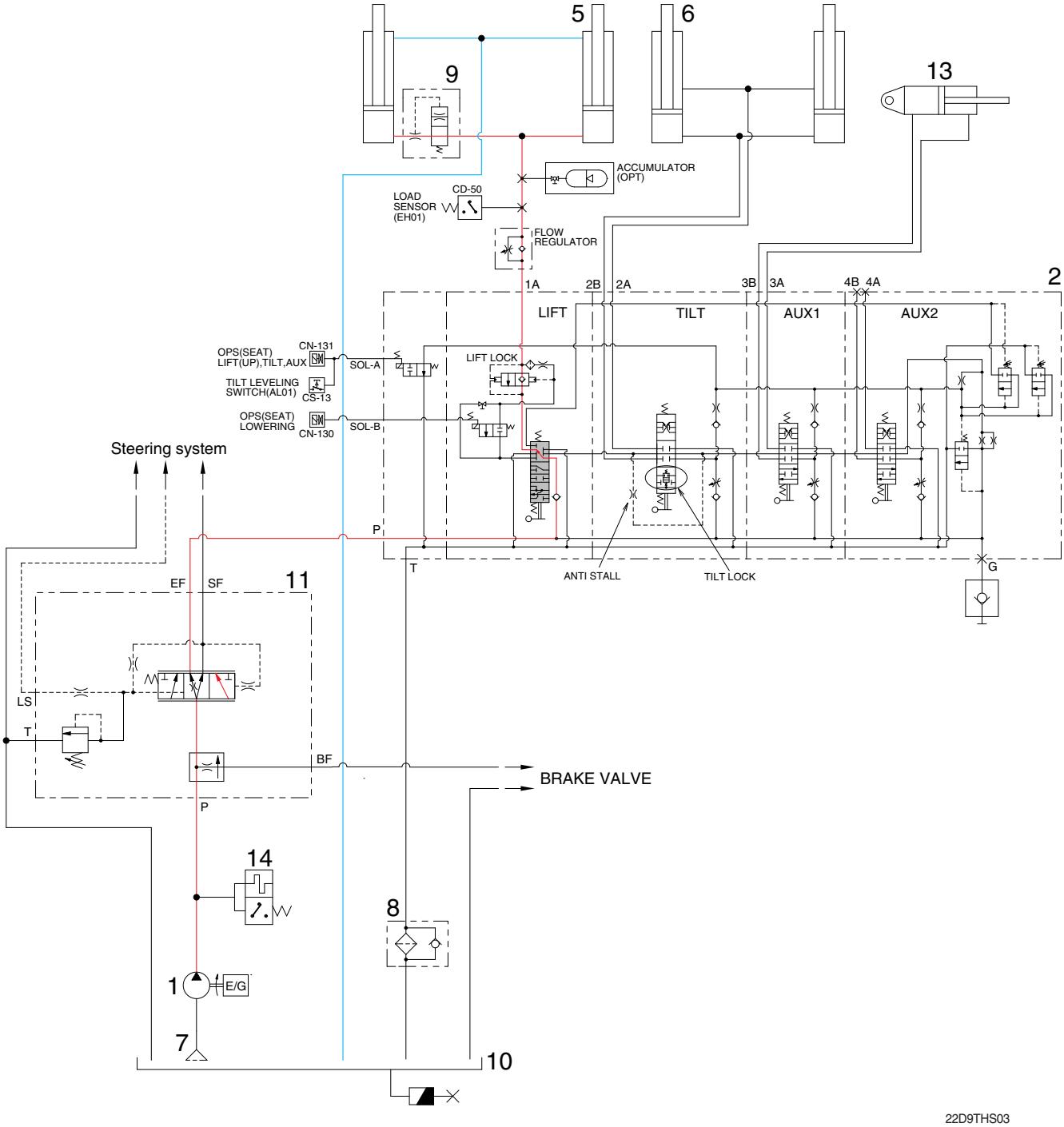


22D9THS01

1	Hydraulic gear pump	8	Return filter
2	Main control valve	9	Down safety valve
3	Steering unit	10	Hydraulic tank
4	Steering cylinder	11	Dual flow divider
5	Lift cylinder	12	Brake valve
6	Tilt cylinder	13	Side shift cylinder
7	Suction strainer	14	Temperature sensor

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

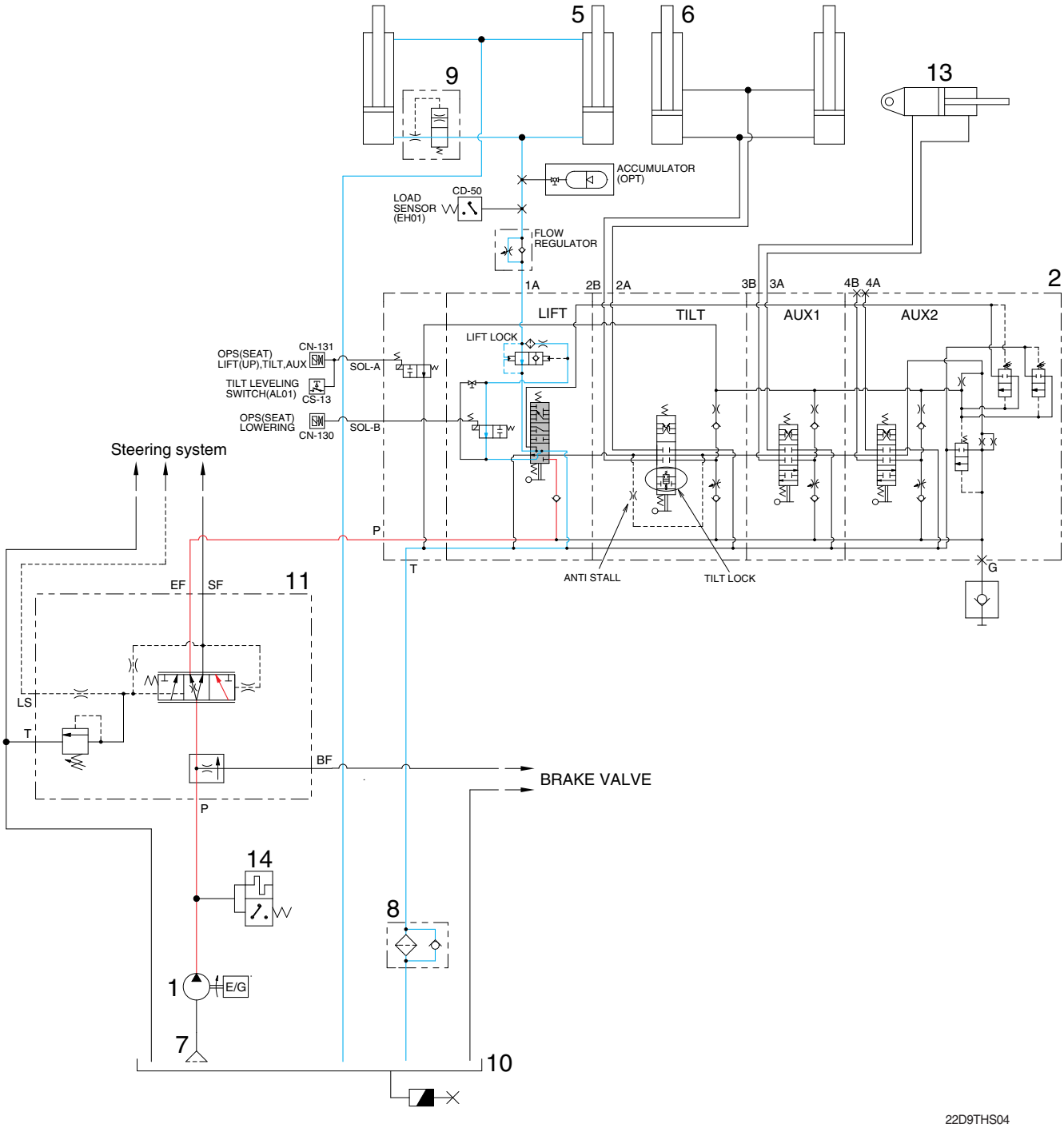
1) WHEN THE LIFT CONTROL LEVER IS IN THE LIFT POSITION



When the lift control lever is pulled back, the spool on the first block moves to lift position.
The oil from hydraulic gear pump (1) flows into main control valve (2) and then goes to the large chamber of lift cylinder (5) by pushing the load check valve of the spool.
The oil from the small chamber of lift cylinder (5) returns to hydraulic oil tank (10) at the same time.
When this happens, the fork goes up.

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

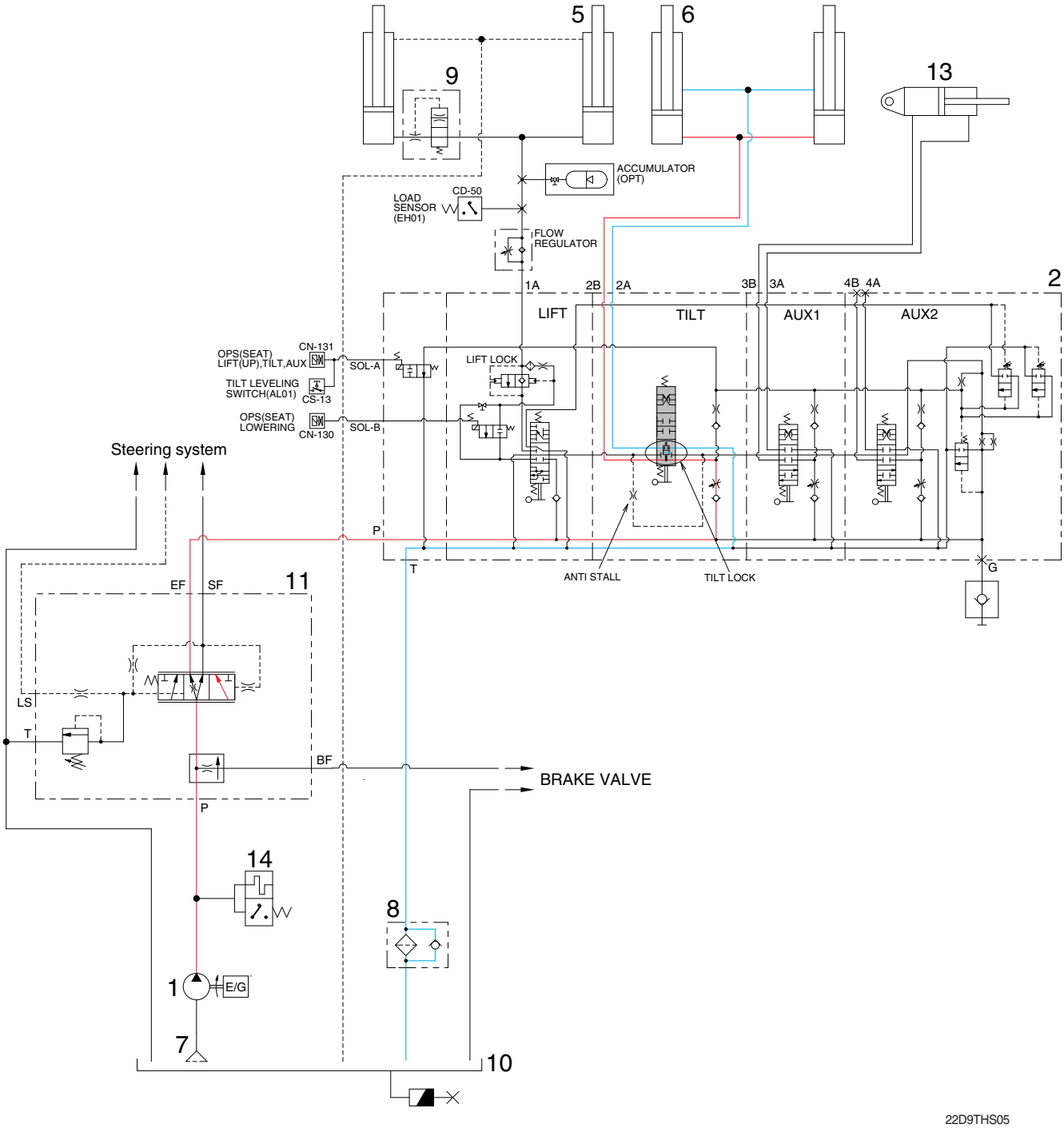
2) WHEN THE LIFT CONTROL LEVER IS IN THE LOWER POSITION



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

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

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



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

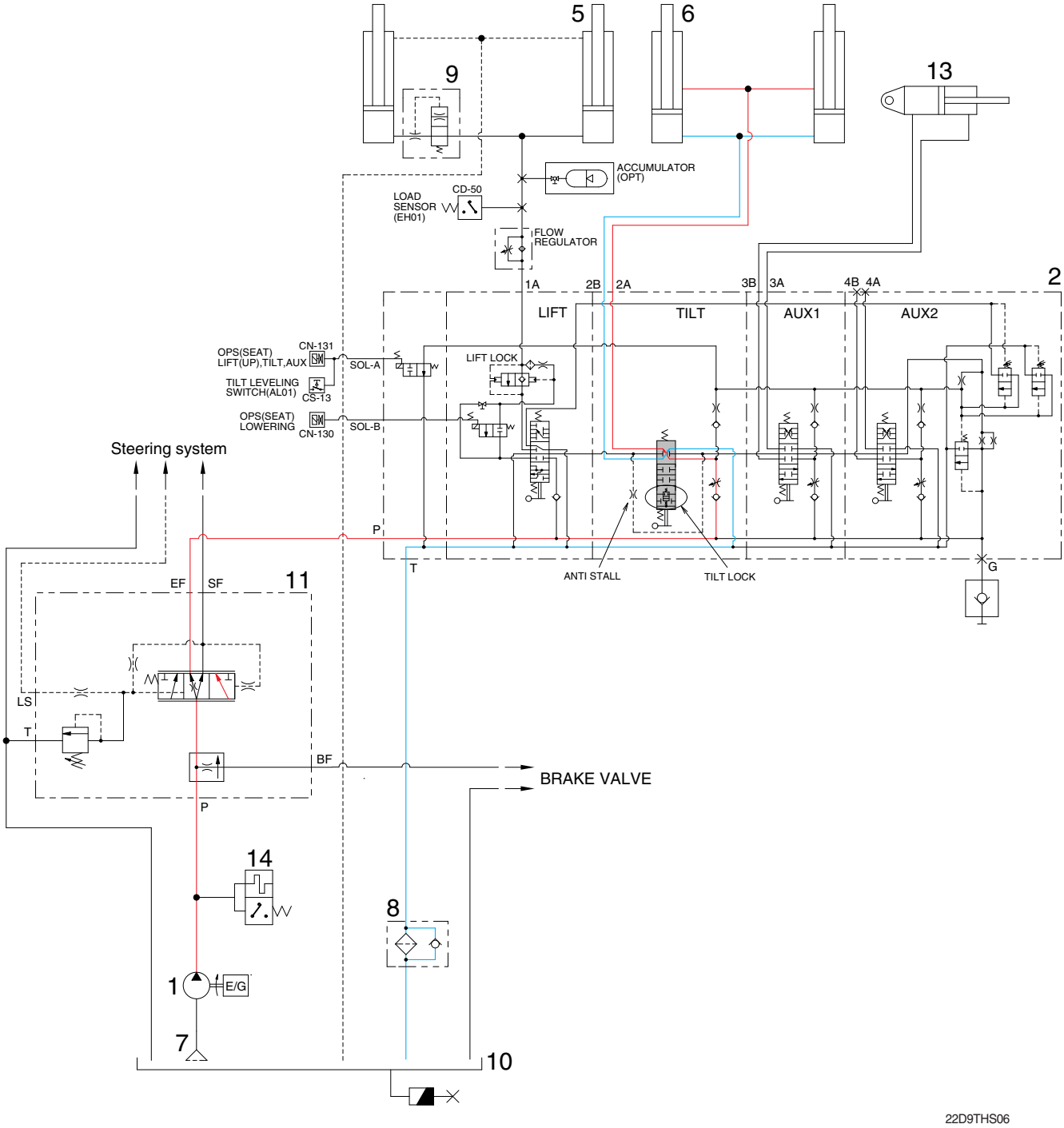
The oil from hydraulic gear pump (1) flows into main control valve (2) and then goes to the large chamber of tilt cylinder (6) by pushing the load check valve of the spool.

The oil at the small chamber of tilt cylinder (6) returns to hydraulic tank (10) at the same time.

When this happens, the mast tilt forward.

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

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



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 (2) and then goes to the small chamber of tilt cylinder (6) by pushing the load check valve of the spool.

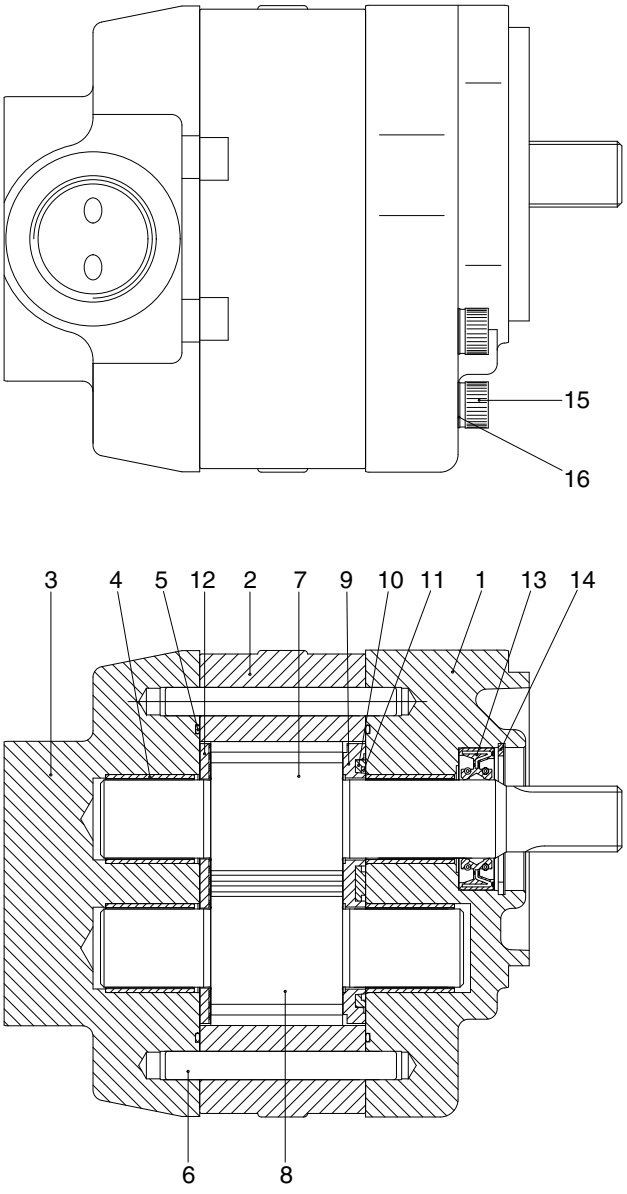
The oil at the large chamber of tilt cylinder (6) returns to hydraulic tank (10) at the same time.

When this happens, the mast tilts backward.

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

2. HYDRAULIC GEAR PUMP

1) STRUCTURE



20D7HS14

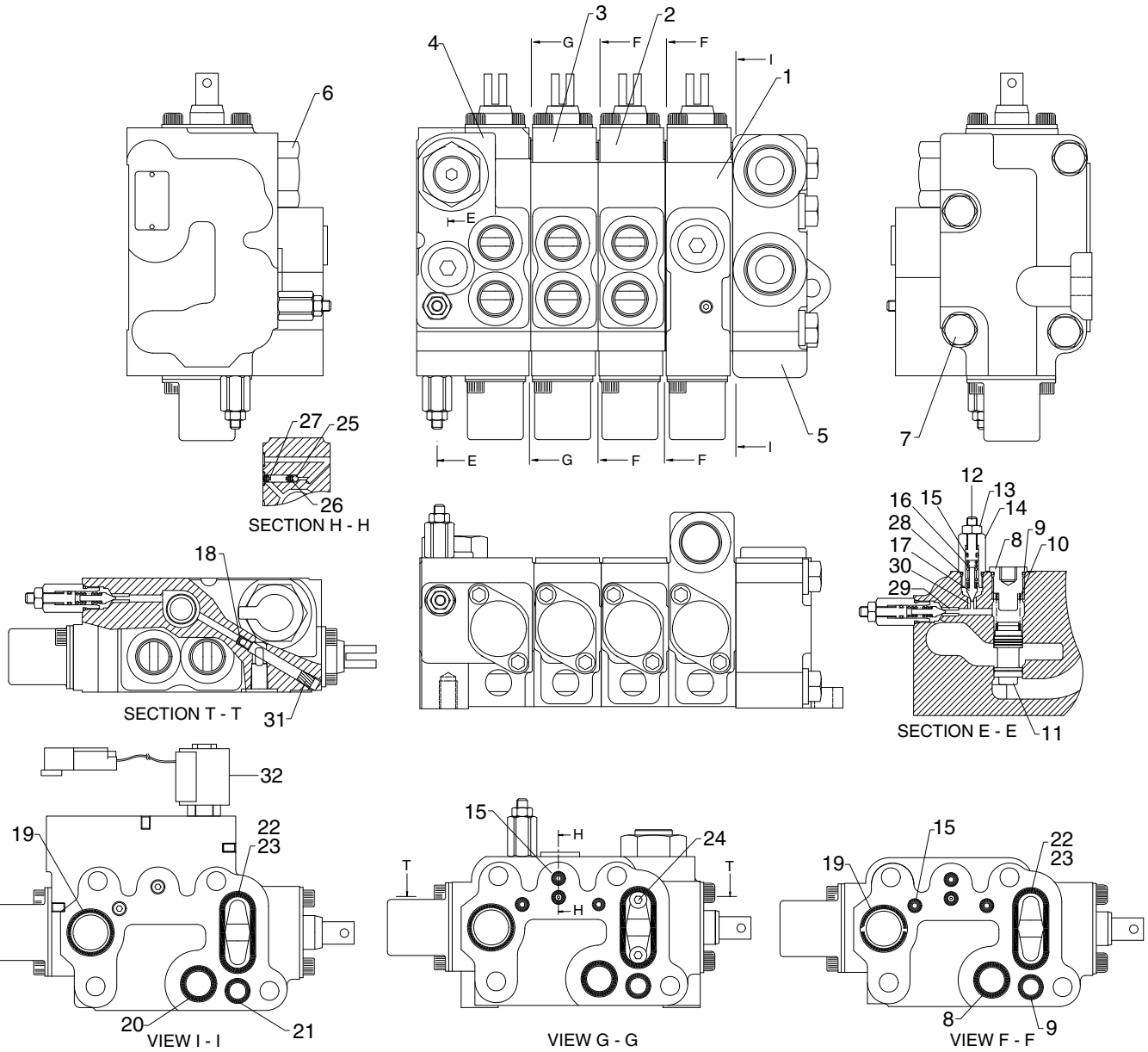
1	Housing	7	Drive gear	13	Oil seal
2	Body	8	Idle gear	14	Snap ring
3	Rear cover	9	Side plate	15	Bolt
4	Bushing	10	O-ring	16	Washer
5	O-ring	11	Back up ring		
6	Pin	12	Side plate		

2) OPERATION

This pump comprises of a rear cover, a body and a housing bolted together. The gear journals are supported by bushings (4) to give high volumetric and mechanical efficiencies.

3. MAIN CONTROL VALVE

1) STRUCTURE (4- Spool)



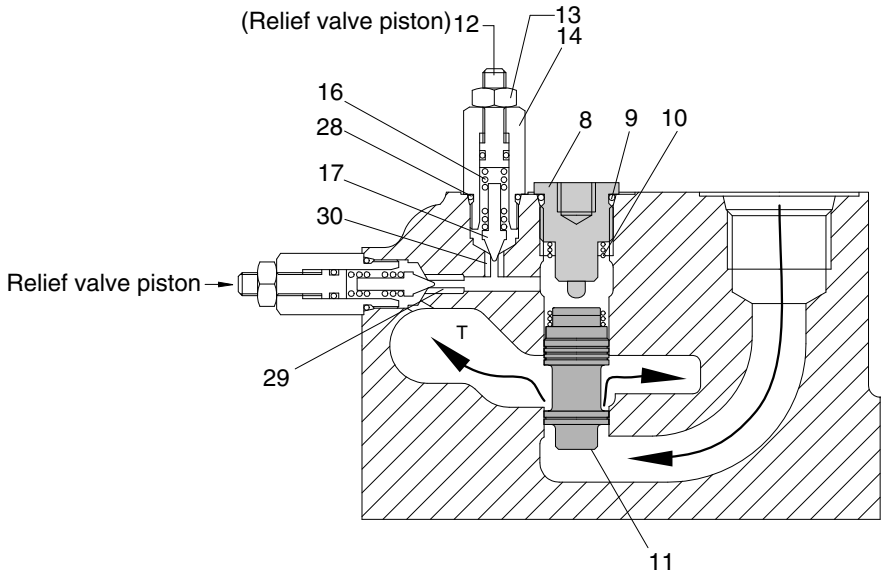
Port name	Size
Inlet port	1-1/16-12UN
Outlet port	1-1/16-12UN

20DEHS07

1	Lift block assy	12	Relief piston	22	O-ring
2	Tilt block assy	13	Nut	23	O-ring, retainer
3	Aux1 block assy	14	Relief plug	24	Plug
4	Work block assy	15	O-ring	25	Steel ball
5	PT block	16	Relief spring	26	Load sensor spring
6	Gauge plug assy	17	Pilot poppet	27	Load sensor spring
7	Long bolt	18	Plug	28	O-ring
8	Plug	19	O-ring	29	System relief seat
9	O-ring	20	O-ring	30	Secondary relief seat
10	Spring	21	O-ring	32	Solenoid valve assy
11	Spool				

2) INLET SECTION OPERATION

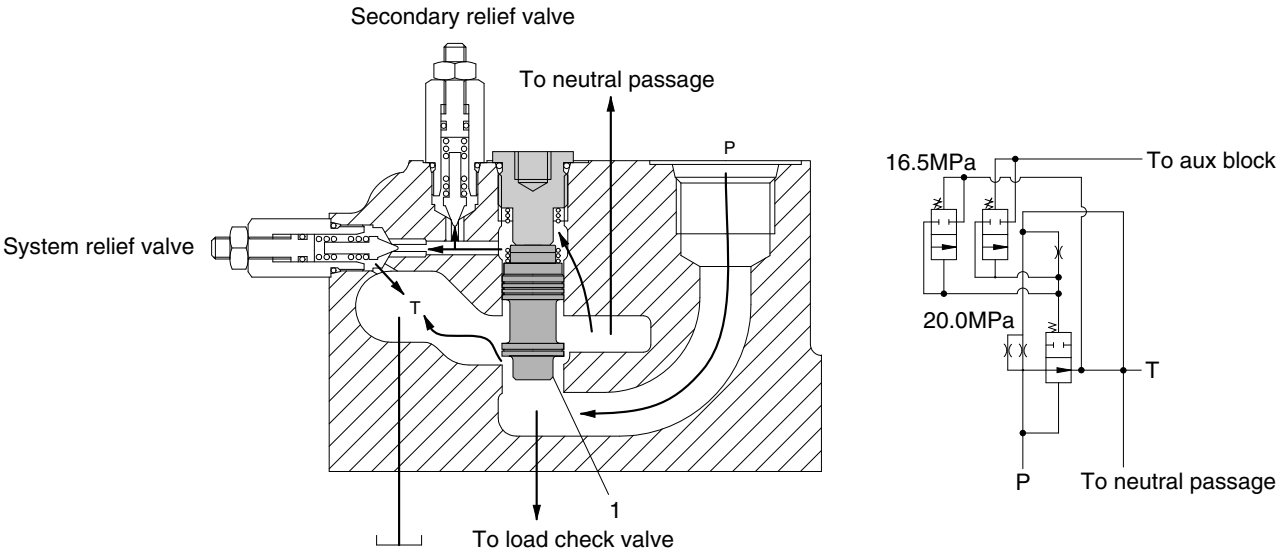
(1) Structure and description



20D7HS08

8	Plug	14	Relief plug
9	O-ring	16	Relief spring
10	Spring	17	Pilot poppet
11	Spool	28	O-ring
12	Relief piston	29	System relief seat
13	Nut	30	Secondary relief seat

(2) Operation

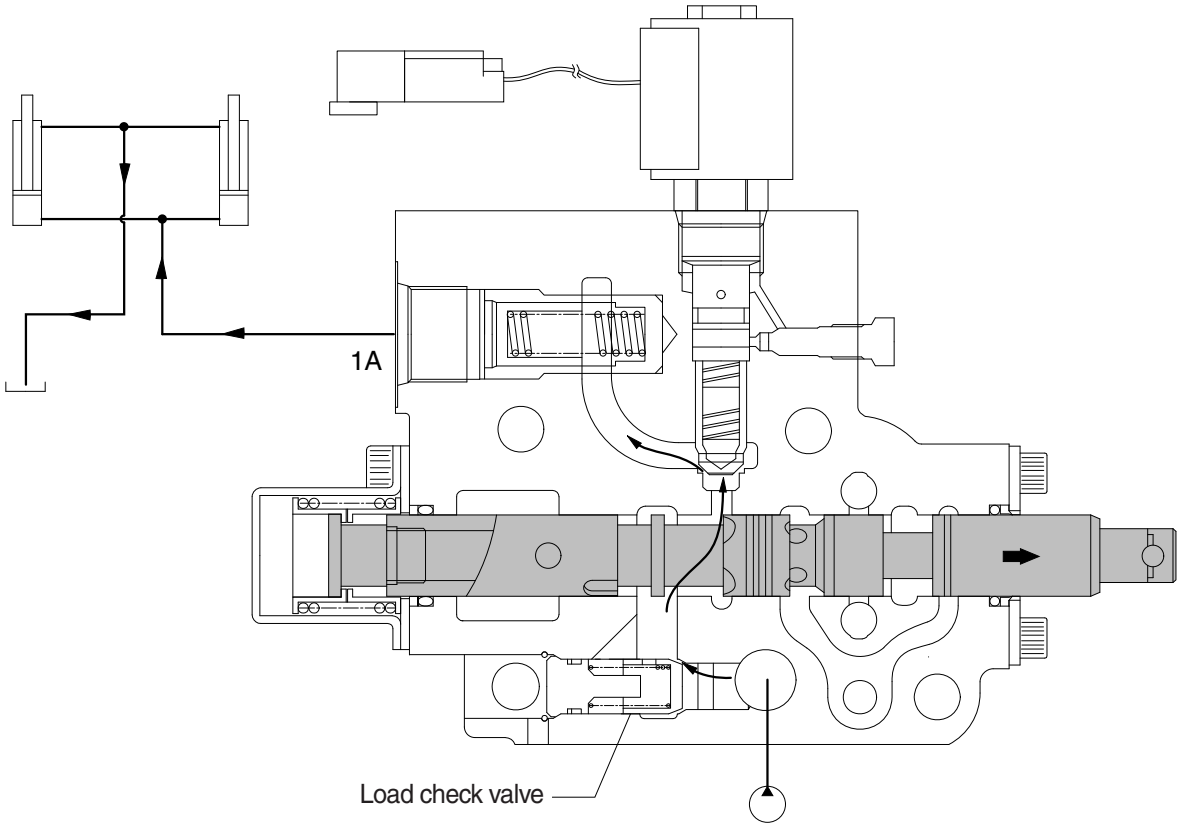


20D7HS15

Oil flows from P (pump) port to reservoir (T) by pushing hydrostat spool (1).
Before the center bypass line closed, hydrostat spool is keep opening, so pump port (P) and tank port (T) are always connected in operation to minimize heat generation.

3) LIFT SECTION OPERATION

(1) Lift position



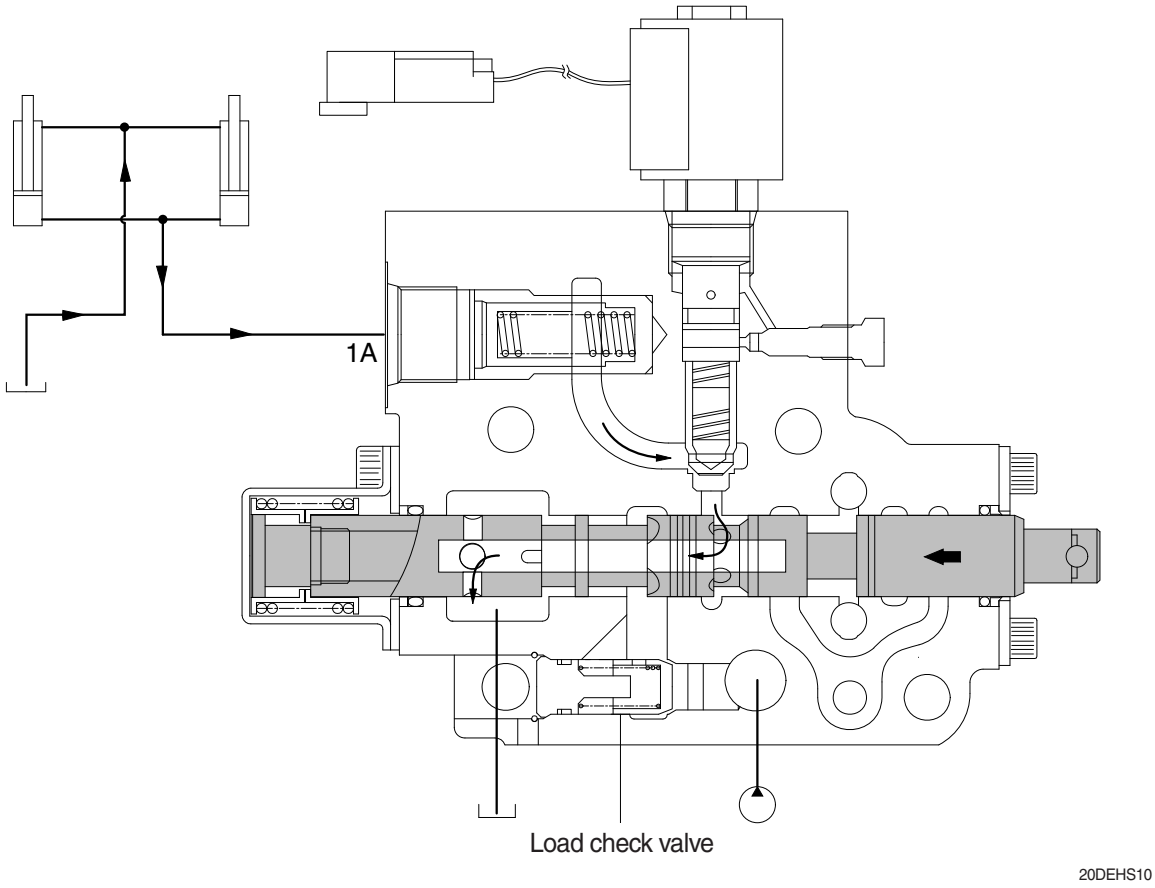
When the lift control lever is pulled back, the spool moves to the right and the neutral passage is closed.

The oil supplied from the pump pushes up the load check valve and flow into lift cylinder port (1A).

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

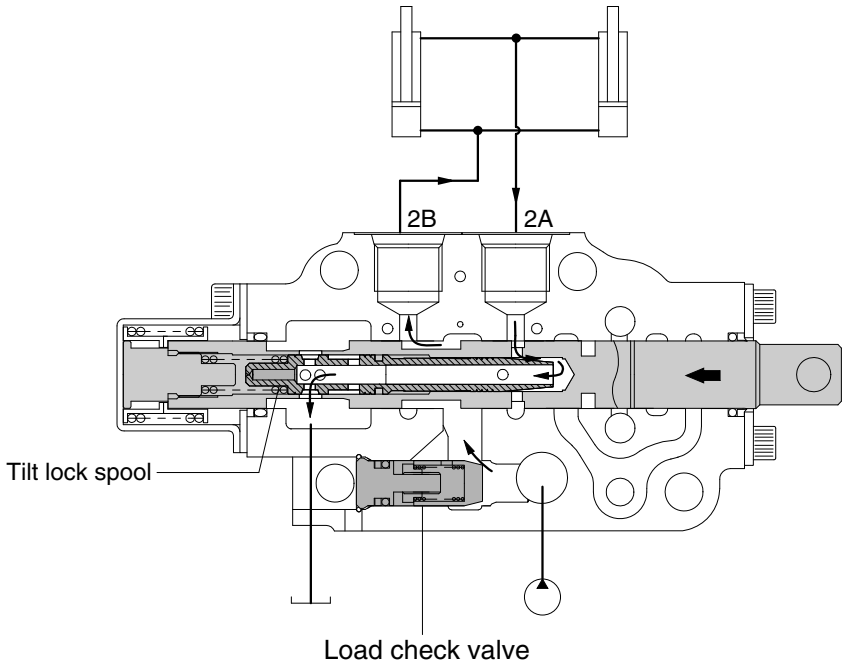


20DEHS10

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 (1A) → T.
In lift lower position the fork drops due to its own weight.

4) TILT SECTION OPERATION

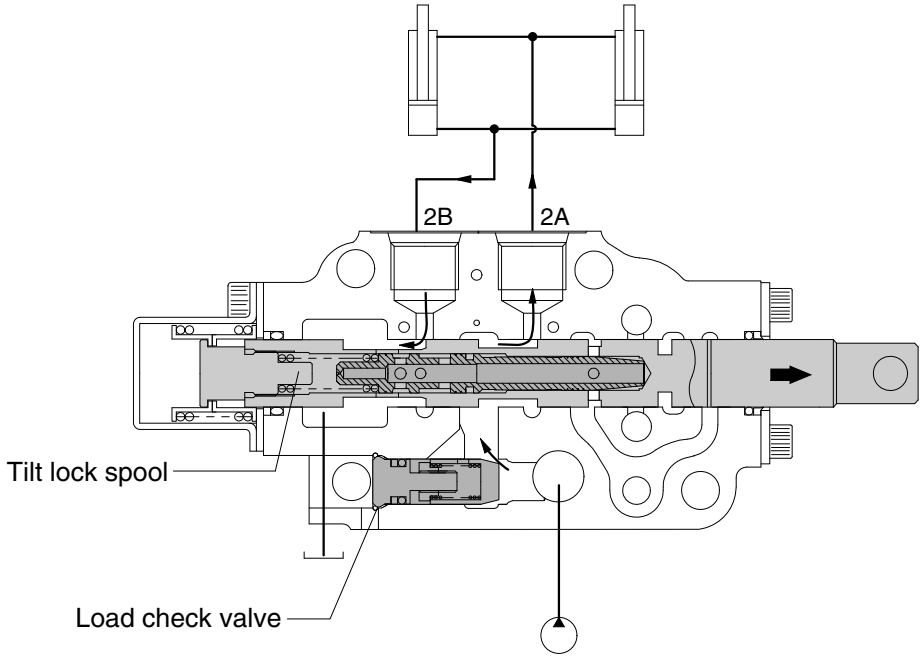
(1) Tilt forward position



20D7HS11

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 and flow into tilt cylinder port (2B).
The pump pressure reaches proportionally the load of cylinders and fine control finished by closing the neutral passage.
The return oil from cylinder port (2A) flows into the tank through the hole of the tilt lock spool.

(2) Tilt backward position



20D7HS12

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 and flows into tilt cylinder port (2A).
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 (2B) flows into the tank via the low pressure passage.

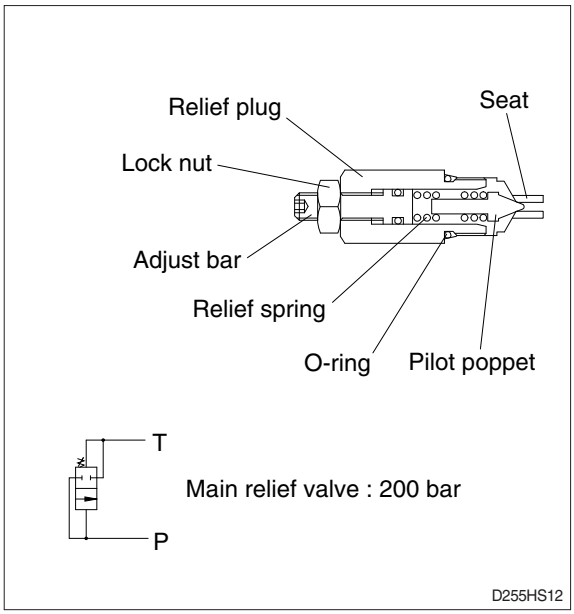
5) MAIN RELIEF VALVE

(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.

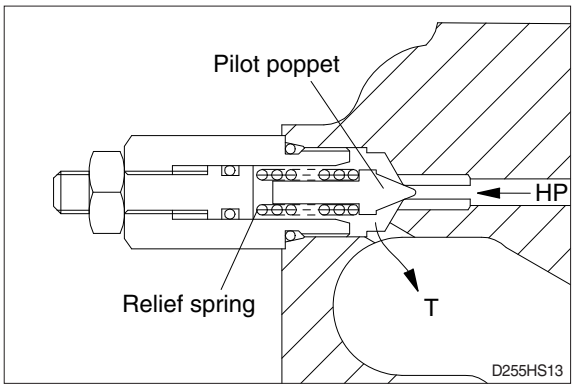
Procedure

① Loosen lock nut.
② Set adjusting bar to desired pressure setting.
③ Tighten lock nut.
④ Retest in similar manner as above.

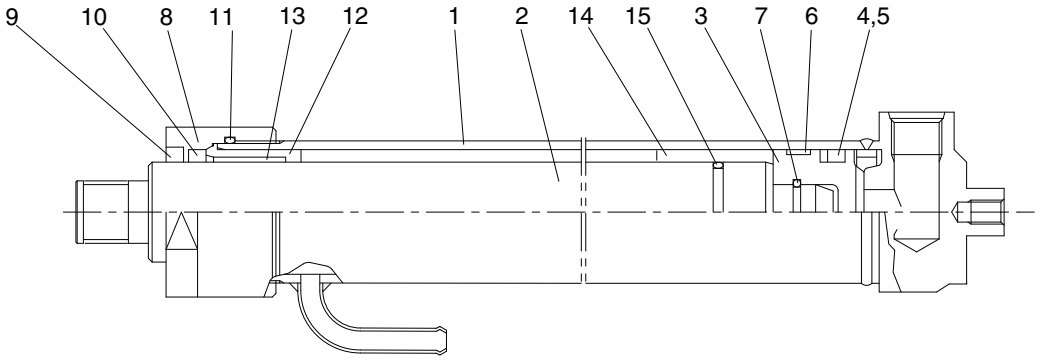


(2) Operation

Pressurized oil over the relief pressure pushes pilot poppet and flows to tank passage, therefore the system pressure keeps under the adjusted relief pressure.



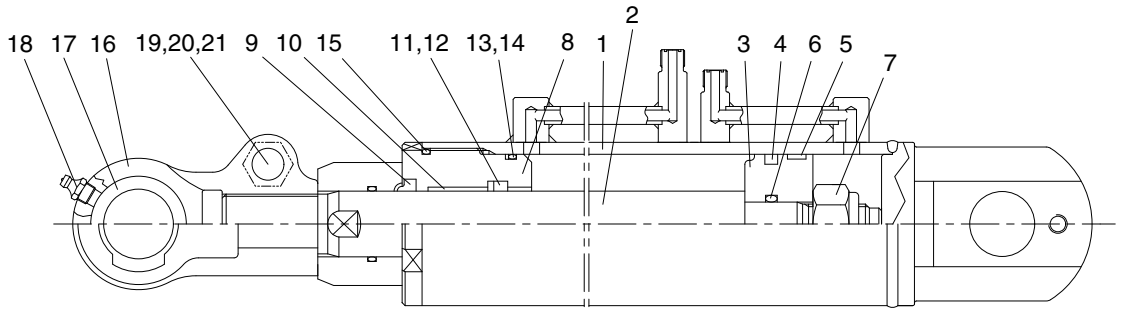
4. LIFT CYLINDER



D255HS18

1	Tube assembly	6	Wear ring	11	O-ring
2	Rod	7	Retaining ring	12	Guide
3	Piston	8	Gland	13	DU bushing
4	Piston seal	9	Dust wiper	14	Spacer
5	Back up ring	10	Rod seal	15	O-ring

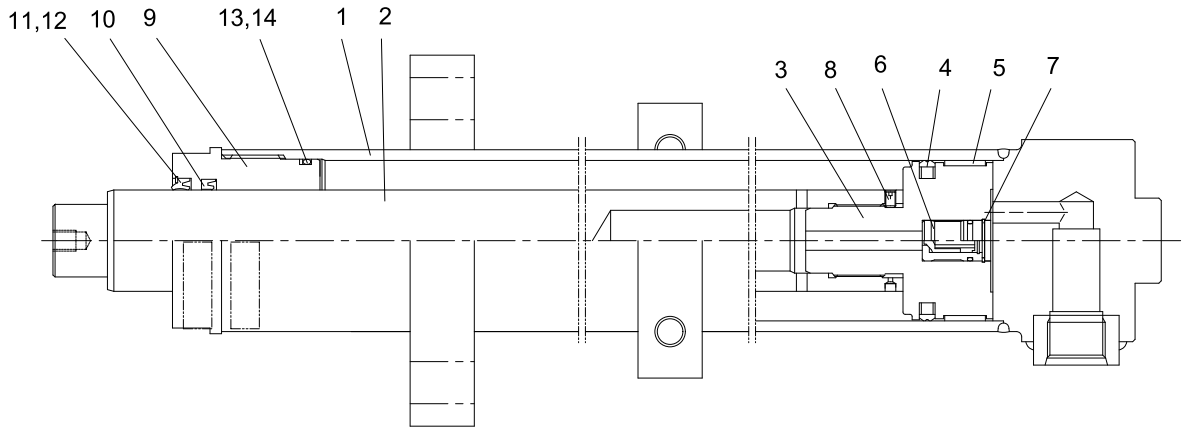
5. TILT CYLINDER



D255HS19

1	Tube assembly	8	Gland	15	O-ring
2	Rod	9	Dust wiper	16	Rod eye
3	Piston	10	Du bushing	17	Spherical bearing
4	Piston seal	11	Rod seal	18	Grease nipple
5	Wear ring	12	Back up ring	19	Hexagon bolt
6	O-ring	13	O-ring	20	Spring washer
7	Hexagon nut	14	Back up ring	21	Hexagon nut

6. FREE LIFT CYLINDER



D255HS20

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

GROUP 2 OPERATIONAL CHECKS AND TROUBLESHOOTING

1. OPERATIONAL CHECKS

1) CHECK ITEM

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

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

· Check condition

- Hydraulic oil : Normal operating temp
- Mast substantially vertical.
- Rated capacity load.

· Hydraulic drift

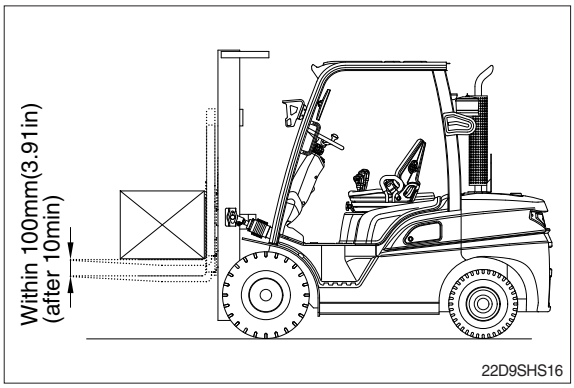
- Down (Downward movement of forks)
: Within 100 mm (3.9 in)
- Forward (Extension of tilt cylinder)
: Within 5°

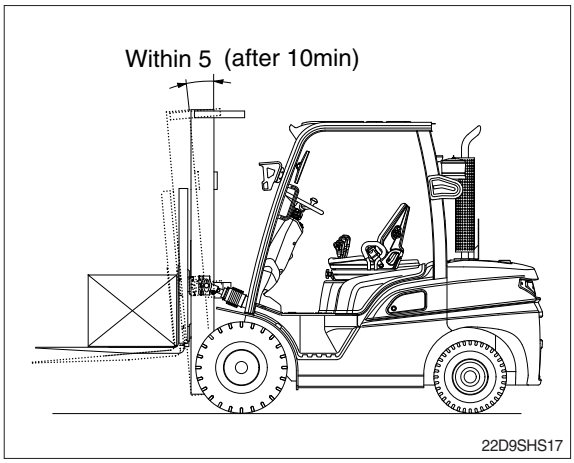
(3) If the hydraulic drift is more than the specified value, replace the control valve or cylinder packing.

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

mm (in)

Standard	Under 0.6 (0.02)

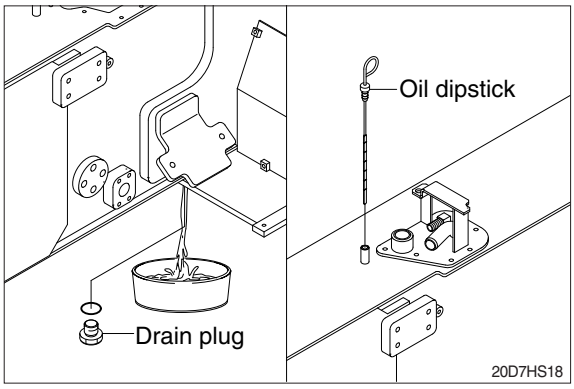




2) HYDRAULIC OIL

(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 200 kgf/cm^2.

(2845 psi)

2. TROUBLESHOOTING

1) SYSTEM

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

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 stuck open or contamination under seat.	· Check for foreign matter between poppets and their mating parts. Parts must slide freely.
Erratic pressure	· Pilot poppet seat damaged.	· Replace the relief valve. · Clean and remove surface marks for free movement.
Pressure setting not correct	· Normal wear. Lock nut & adjust screw loose.	· See page 6-14 for 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.

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 surface 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.

GROUP 3 DISASSEMBLY AND ASSEMBLY

1. HYDRAULIC GEAR PUMP

※ **Tools required**

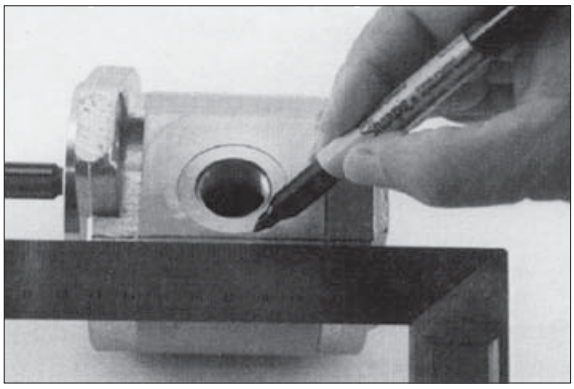
- Metric socket set
- Internal snap ring pliers
- Shaft seal sleeve
- Torque wrench

(1) It is very important to work in a clean work area when repairing hydraulic products. Plug ports and wash exterior of pump with a proper cleaning solvent before continuing.

(2) Remove port plugs and drain oil from pump.

(3) Use a permanent marker pen to mark a line across the mounting flange, gear housing and end cover. This will assure proper reassembly and rotation of pump.

(4) Remove key from drive shaft if applicable.

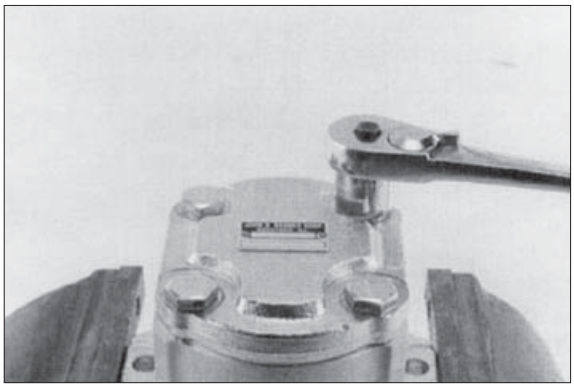


PUMP 01

(5) Clamp mounting flange in a protected jaw vise with pump shaft facing down.

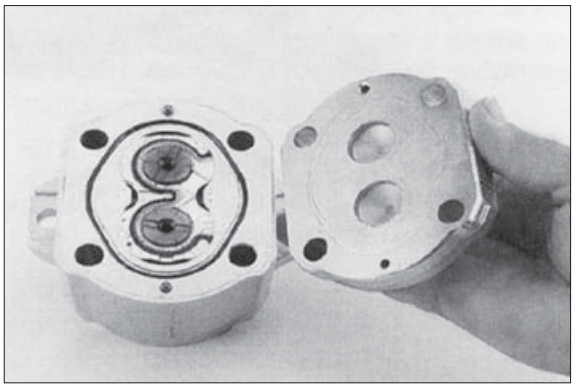
(6) Loosen the four metric hexagon head bolts.

(7) Remove pump from vise and place on clean work bench, remove the four hexagon head bolts and spacers applicable.



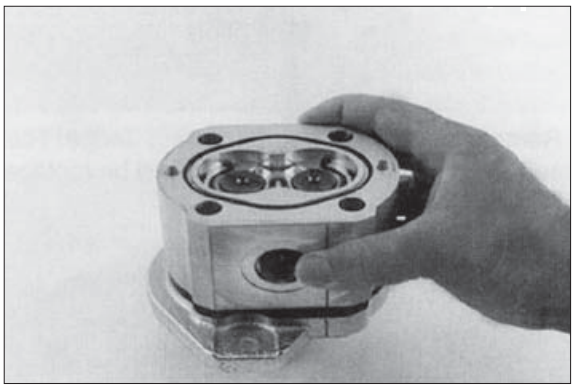
PUMP 02

(8) Lift and remove end cover.



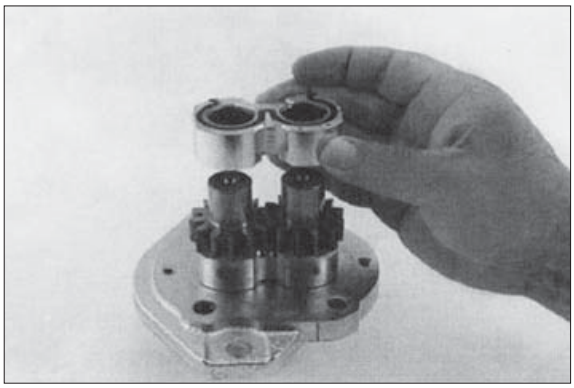
PUMP 03

(9) Carefully remove gear housing and place on work bench. Make sure the rear bearing block remains on the drive and idler shafts.



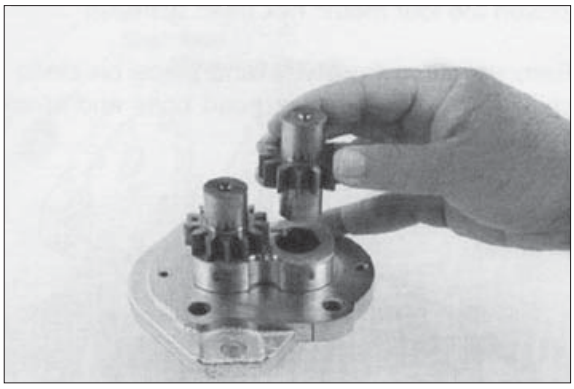
PUMP 04

(10) Remove rear bearing block from drive and idler shafts.



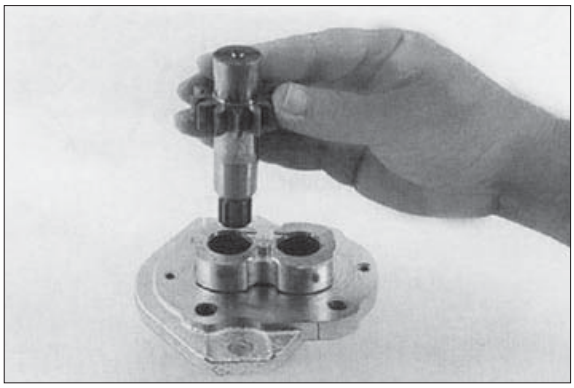
PUMP 05

(11) Remove idler shaft from bearing block.



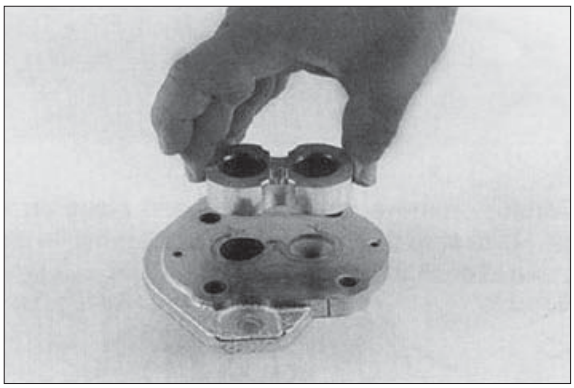
PUMP 06

(12) Remove drive shaft from mounting flange. There is no need to protect the shaft seal as it will be replaced as a new item.



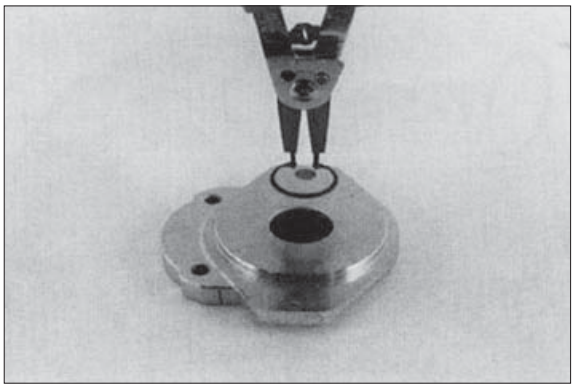
PUMP 07

(13) Remove the front bearing block.



PUMP 08

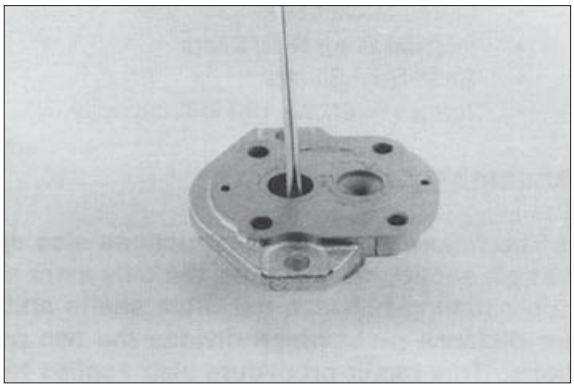
(14) Turn mounting flange over, with shaft seal up, and remove the retaining ring with proper snap ring pliers.



PUMP 09

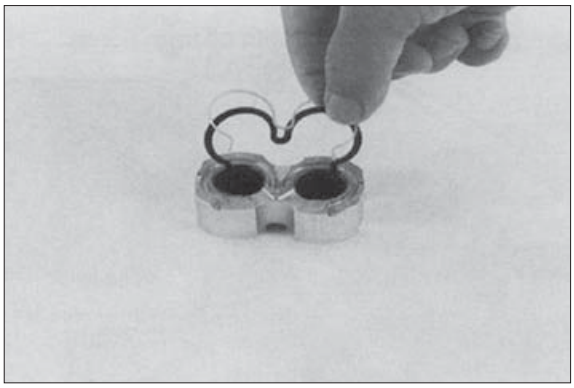
(15) Remove the oil seal from mounting flange, be careful not to mar or scratch the seal bore.

(16) Remove the dowel pins from the gear housing. Do not lose pins.



PUMP 10

(17) Remove seals from both bearing blocks and discard.



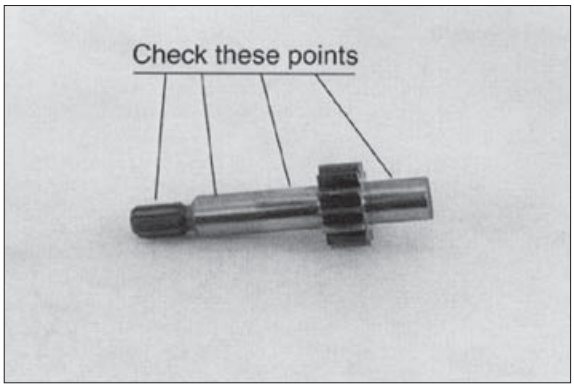
PUMP 11

2) INSPECT PARTS FOR WEAR

(1) Clean and dry all parts thoroughly prior to inspection. It is not necessary to inspect the seals as they will be replaced as new items.

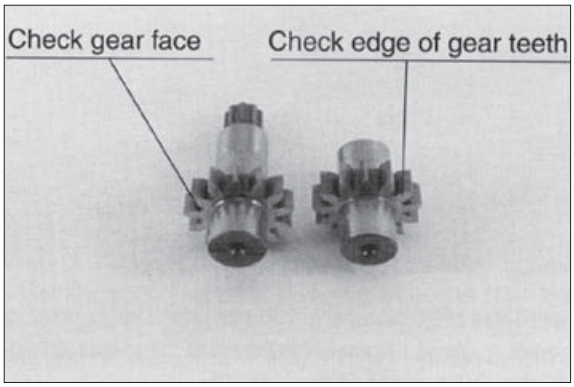
(2) Check drive shaft spline for twisted or broken teeth, check keyed drive shaft for broken or chipped keyway. No marks or grooves on shaft in seal area, some discoloration of shaft is allowable.

(3) Inspect both the drive gear shaft and idler gear shafts at the bearing points and seal area for rough surfaces and excessive wear.



PUMP 12

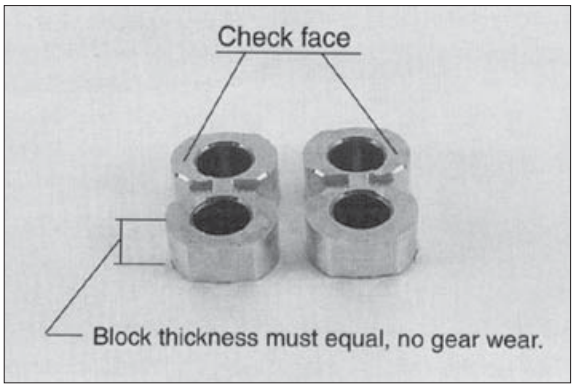
(4) Inspect gear face for scoring or excessive wear. If the face edge of gear teeth are sharp, they will mill into the bearing blocks. If wear has occurred, the parts are unusable.



PUMP 13

(5) Inspect bearing blocks for excessive wear or scoring on the surfaces which are in contact with the gears. Also inspect the bearings for excessive wear or scoring.

(6) Inspect the area inside the gear housing. It is normal for the surface inside the gear housing to show a clean "wipe" on the inside surface on the intake side. There should not be excessive wear or deep scratches and gouges.



PUMP 14

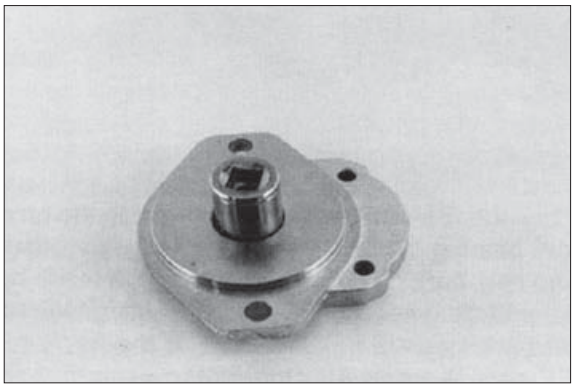
※ **General information**
It is important that the relationship of the mounting flange, bearing blocks and gear housing is correct. Failure to properly assemble this pump will result with little or no flow at rated pressure.

※ **This pump is not bi-rotational.**

3) ASSEMBLY

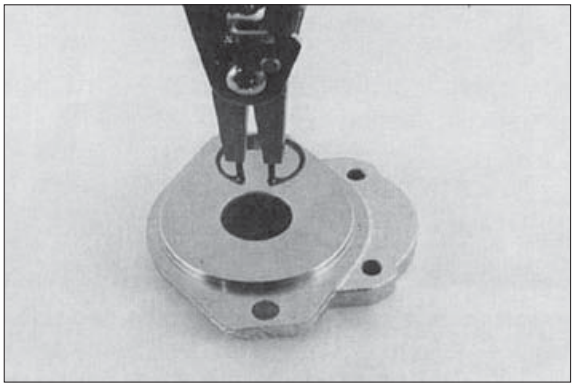
※ New seals should be installed upon reassembly of pump.

(1) Install new shaft seal in mounting flange with part number side facing outboard. Press the seal into the seal bore until the seal reaches the bottom of the bore. Uniform pressure must be used to prevent misalignment or damage to the seal.



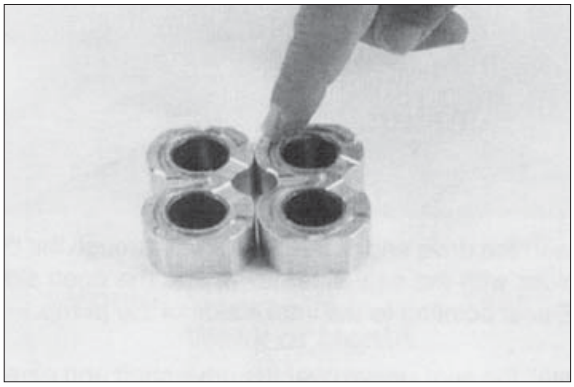
PUMP 15

(2) Install retaining ring in groove in seal bore of mounting flange.



PUMP 16

(3) Place front and back bearing blocks on a clean surface with the E-seal grooves facing up. Apply a light coating of petroleum jelly in the grooves. Also coat the E-seal and backup with the petroleum jelly, this will help keep the seals in place during assembly.

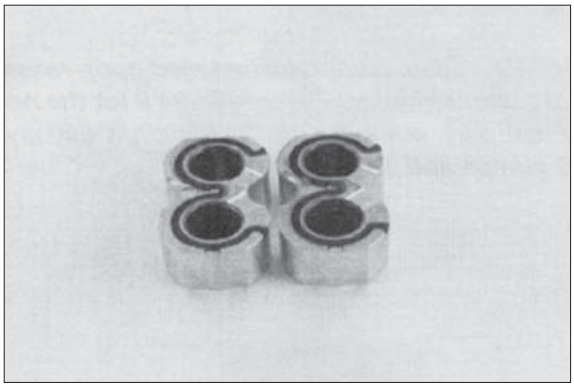


PUMP 17

(4) Place the E-seals, flat side outward, into the grooves in both bearing blocks. Follow by carefully placing the backup ring, flat side outward, in the groove made by the E-seal and the groove in the bearing block.

(5) Place mounting flange, with shaft seal side down, on a clean flat surface.

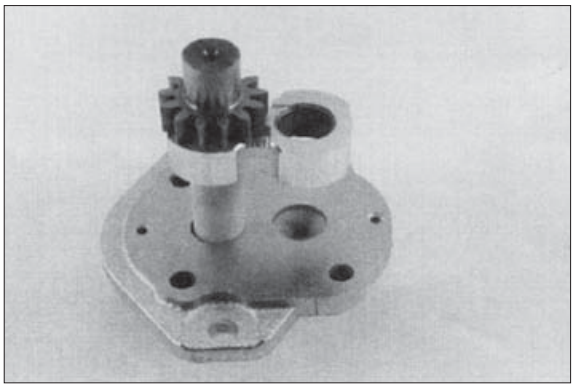
(6) Apply a light coating of petroleum jelly to the exposed face of the front bearing block.



PUMP 18

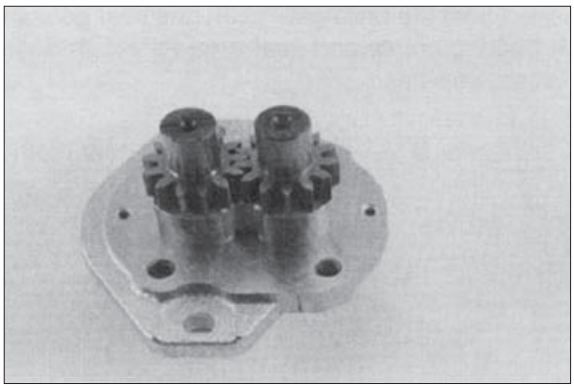
(7) Insert the drive end of the drive shaft through the bearing block with the seal side down, and the open side of the E-seal pointing to the intake side of the pump.

(8) Install the seal sleeve over the drive shaft and carefully slide the drive shaft through the shaft seal. Remove the seal sleeve from shaft.



PUMP 19

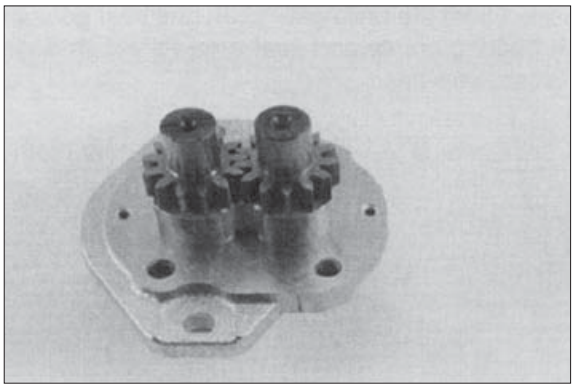
(9) Install the idler gear shaft in the remaining position in the bearing block. Apply a light coat of clean oil to the face of the drive and idler gears.



PUMP 20

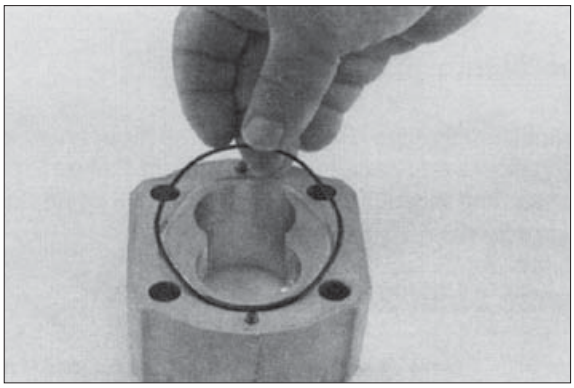
(10) Pick up the rear bearing block, with seal side up and with open end of the E-seal facing the intake side of the pump, place over the drive and idler gear shafts.

(11) Install two dowel pins in the holes in the mounting flange or two long dowel pins through gear housing if pump is a multiple section pump.



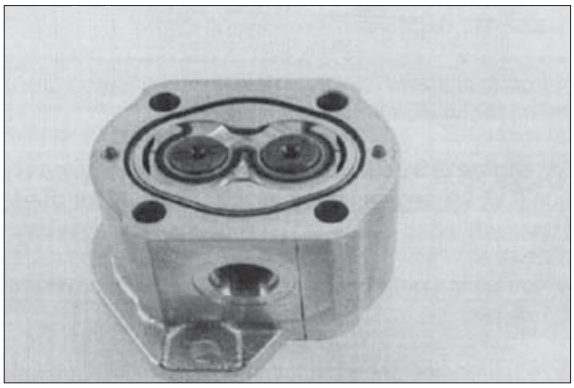
PUMP 20

(12) To install the O-rings in the gear housing, apply a light coating of petroleum jelly in the grooves on both sides of the gear housing.
Also coat the new O-ring and install them in the grooves.



PUMP 22

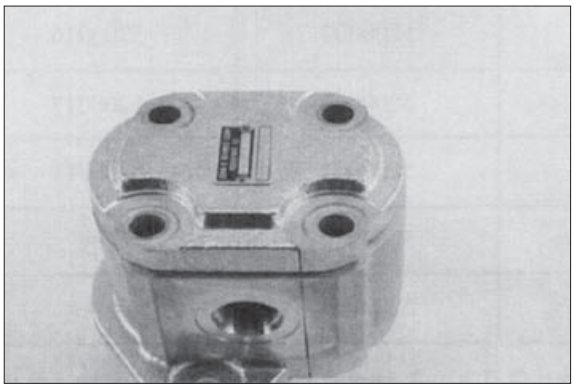
(13) Gently slide the gear housing over the rear bearing block assembly, slide housing down until the housing engages the dowel pins. Press firmly in place with hands, do not force or use any tool.
Check to make sure the intake port in the housing in on the same side as the open end of the E-seal and that the marked lines on the mounting flange and gear housing are in alignment.



PUMP 23

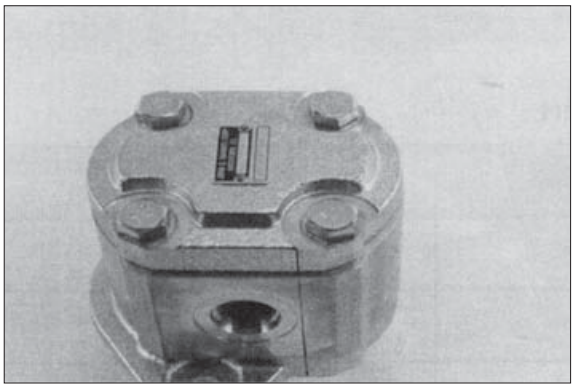
(14) The surface of the rear bearing block should be slightly below the face of the gear housing. If the bearing block sits higher then the rear face of the gear housing then the E-seal or O-ring have shifted out of the groove. If this is the case, remove the gear housing and check for proper seal installation.

(15) Install the two remaining dowel pins in the rear of the gear housing and place the end cover over the back of the pump.



PUMP 24

(16) Install the four spacers and hexagon head bolts through the bolt holes in the end cover, hand tighten.



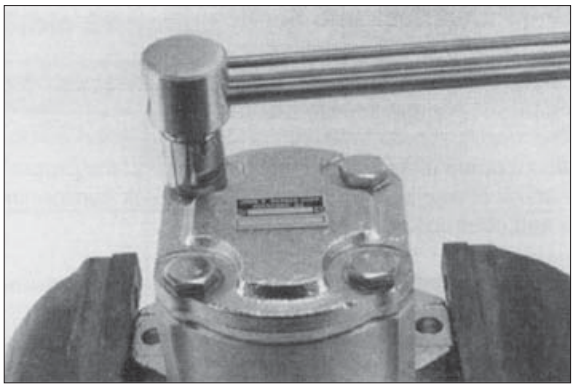
PUMP 25

(17) Place mounting flange of the pump back in the protected jawed vise and alternately torque the bolts.

· Tighten torque : 3.0~4.0 kgf · m
(22~29 lbf · ft)

(18) Remove pump from vise.

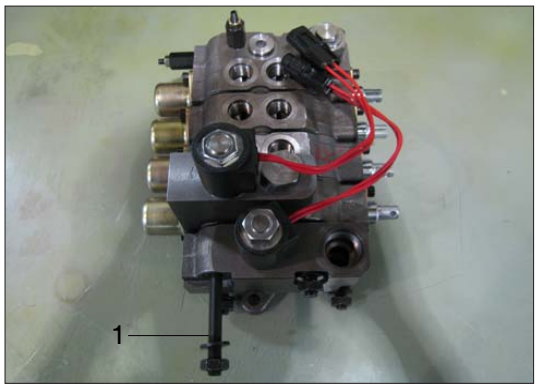
(19) Place a small amount of clean oil in the inlet of the pump and rotate the drive shaft away from the inlet one revolution. If the drive shaft binds, disassemble the pump and check for assembly problems, then reassemble the pump.



PUMP 26

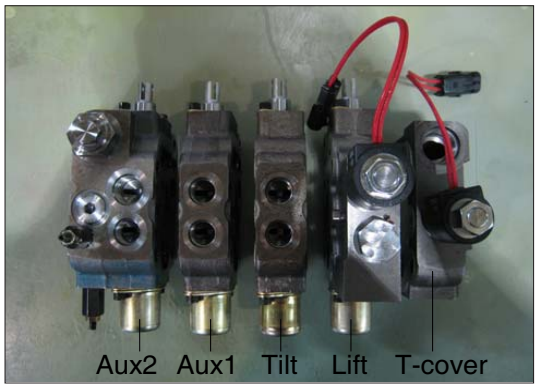
2. MAIN CONTROL VALVE

1) Remove bolt (1) to separate the valve section.
·Bolt torque (1) : 4.0 $^{+0.6}_{0}$ kgf·m



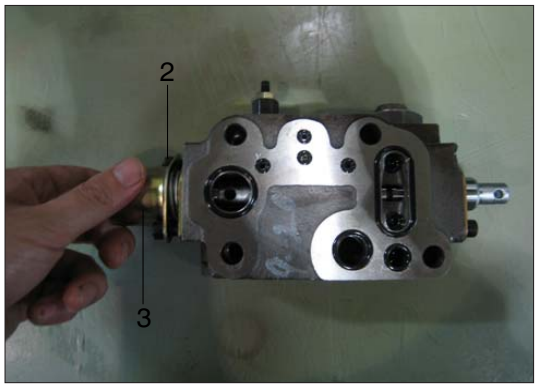
20D7MCV01

2) Divide the valve body.



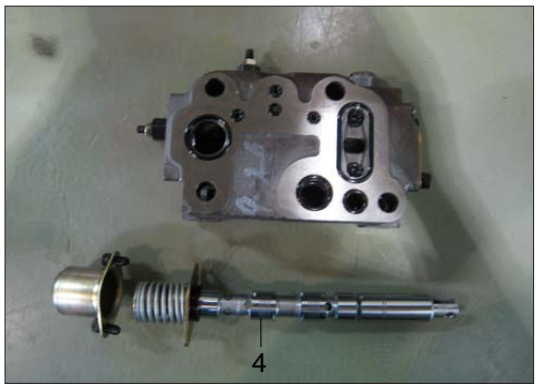
20D7MCV02

3) Remove dust cap (3) and bolt (2) from the valve body.
·Bolt torque (2) : 1.2 kgf·m



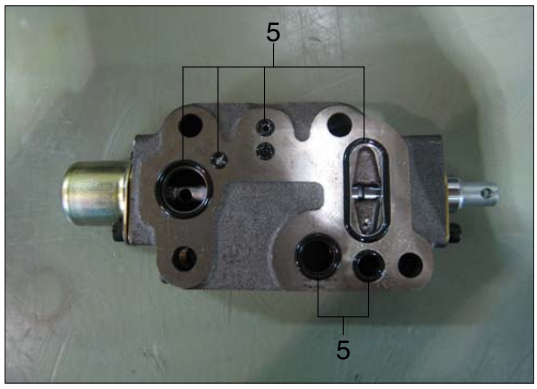
20D7MCV03

4) Remove attachment spool (4) from the valve body.



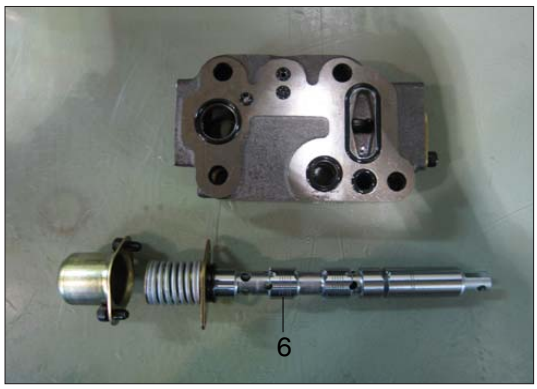
20D7MCV04

5) Remove O-ring seals (5) from the valve body.



20D7MCV05

6) Remove tilt spool (6) from the valve body.

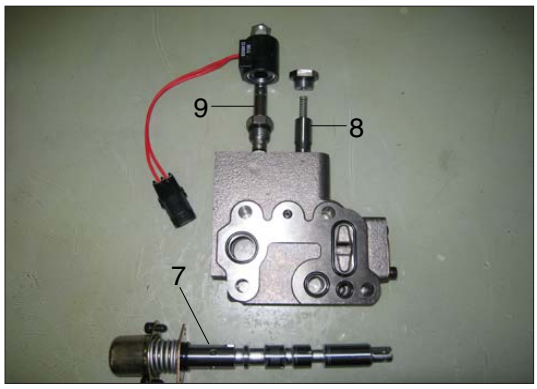


20D7MCV06

7) Remove lift spool (7) from the valve body.

8) Remove lock poppet (8) from the valve body.

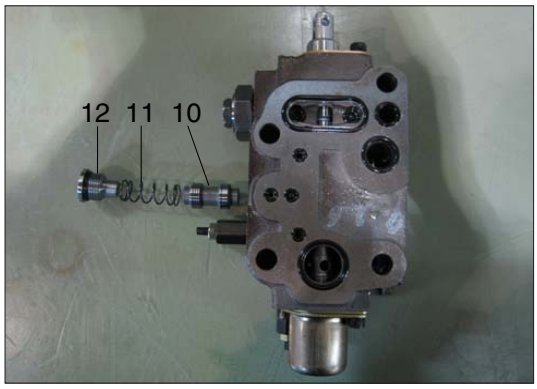
9) Remove normal close solenoid valve (9, Opt) from the valve body.



20D7MCV07

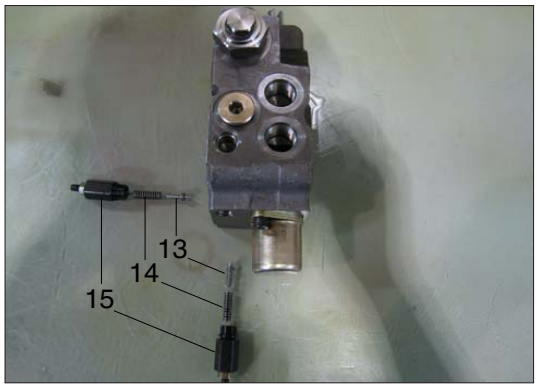
10) Remove plug (12) and spring (11).

11) Remove hydrostat (10).



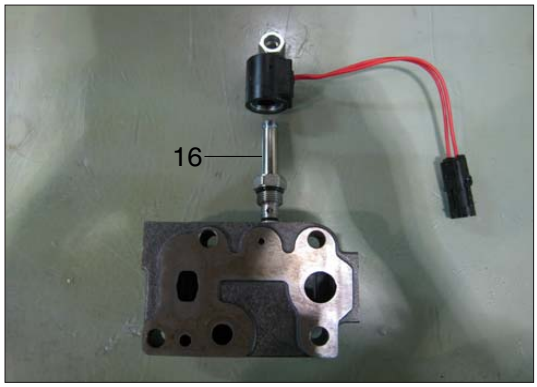
20D7MCV08

12) Remove relief plugs (15), springs (14) and poppets (13).
 · Relief plugs torque (15) : 2.5 kgf · m



20D7MCV09

13) Remove normal open solenoid valve (16, Opt) from the valve body.

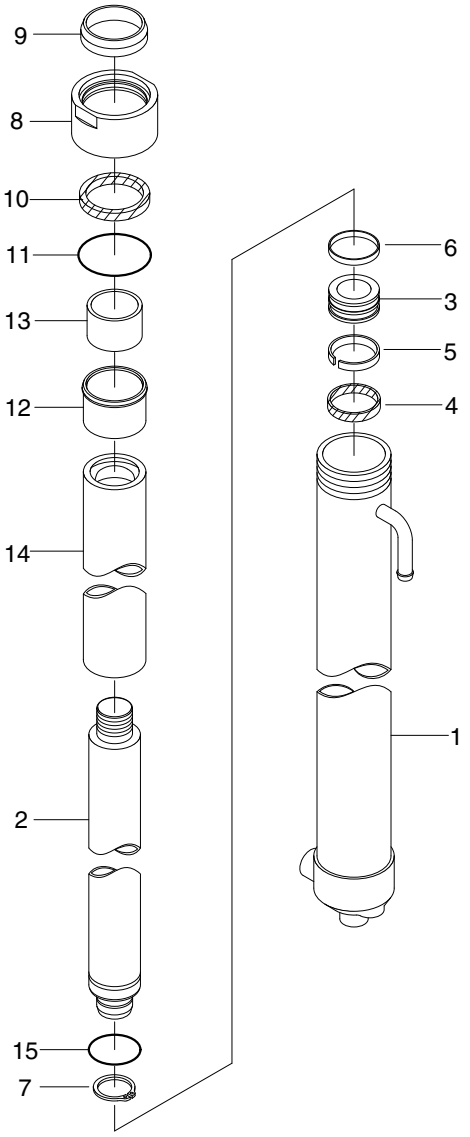


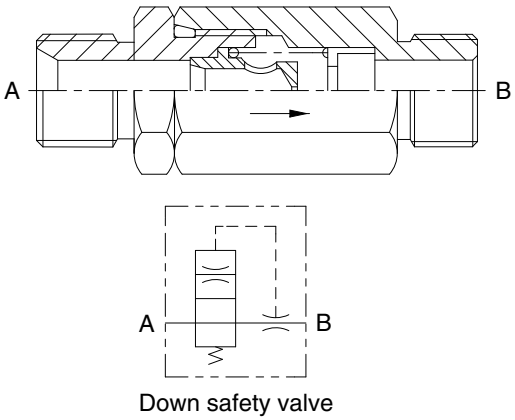
20D7MCV10

14) Assembly procedure of the main control valve is the reverse order of the removal procedure.

3. LIFT CYLINDER

1) STRUCTURE





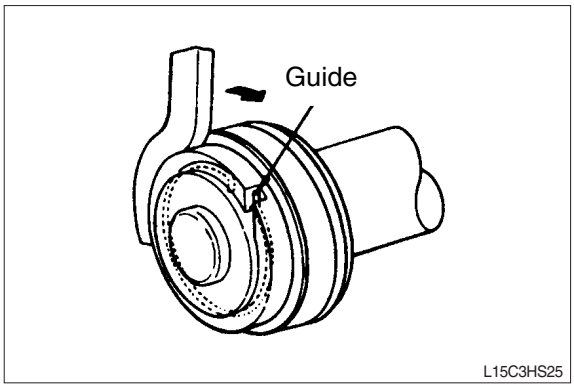
Down safety valve

20D7HS19

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



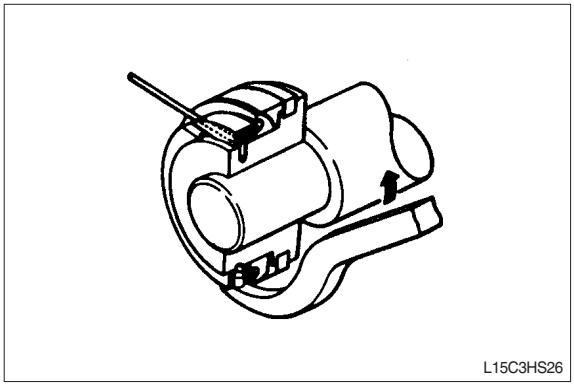
3) CHECK AND INSPECTION

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 piston ring & tube	0.05~0.030 (0.002~0.012)	0.5 (0.020)	Replace piston ring

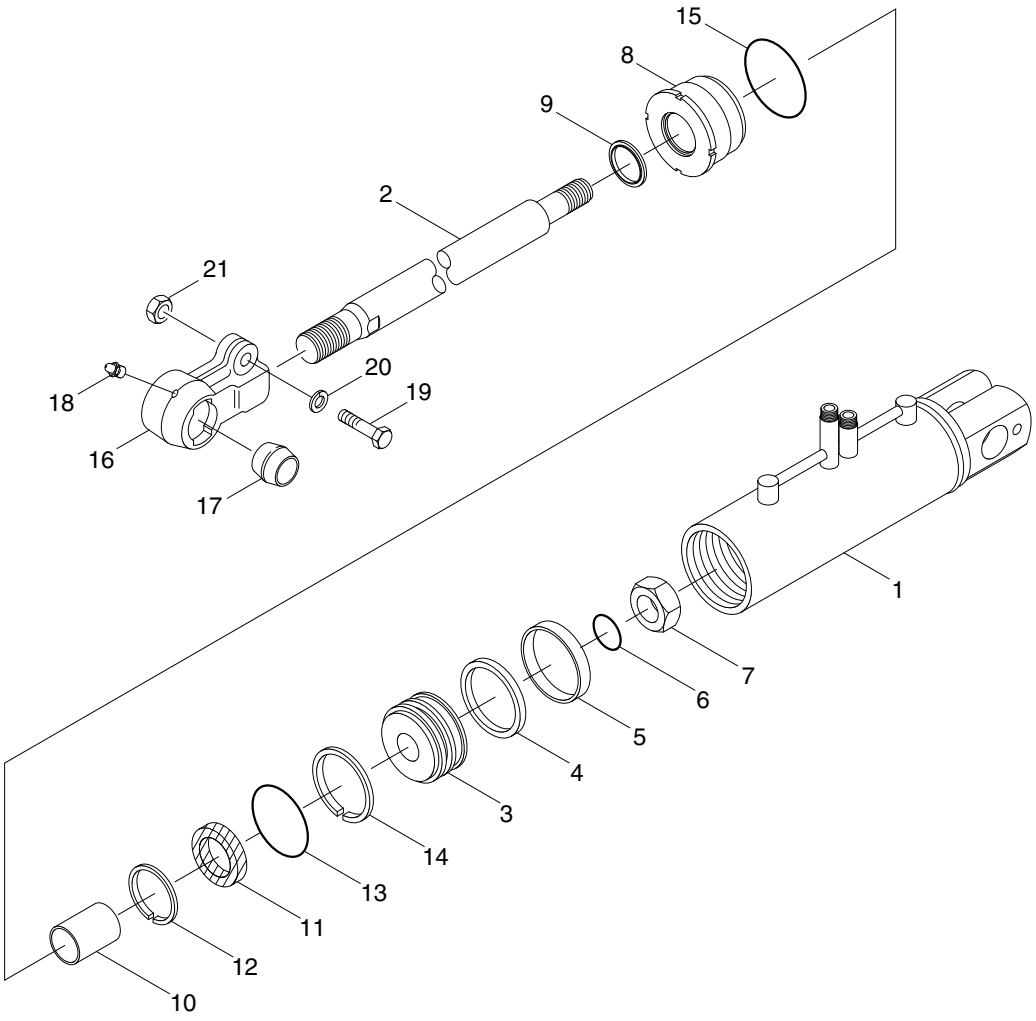
4) ASSEMBLY

(1) Soak the piston ring in hydraulic oil at a temperature of 40 to 50°C, expand the inside diameter and assemble on the piston. Install a piston seal.
Bend the edge of the guide and rotate it to install the guide completely.



4. TILT CYLINDER

1) STRUCTURE

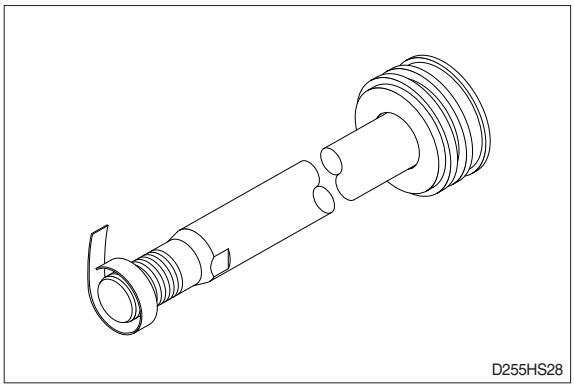


D255HS27

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

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

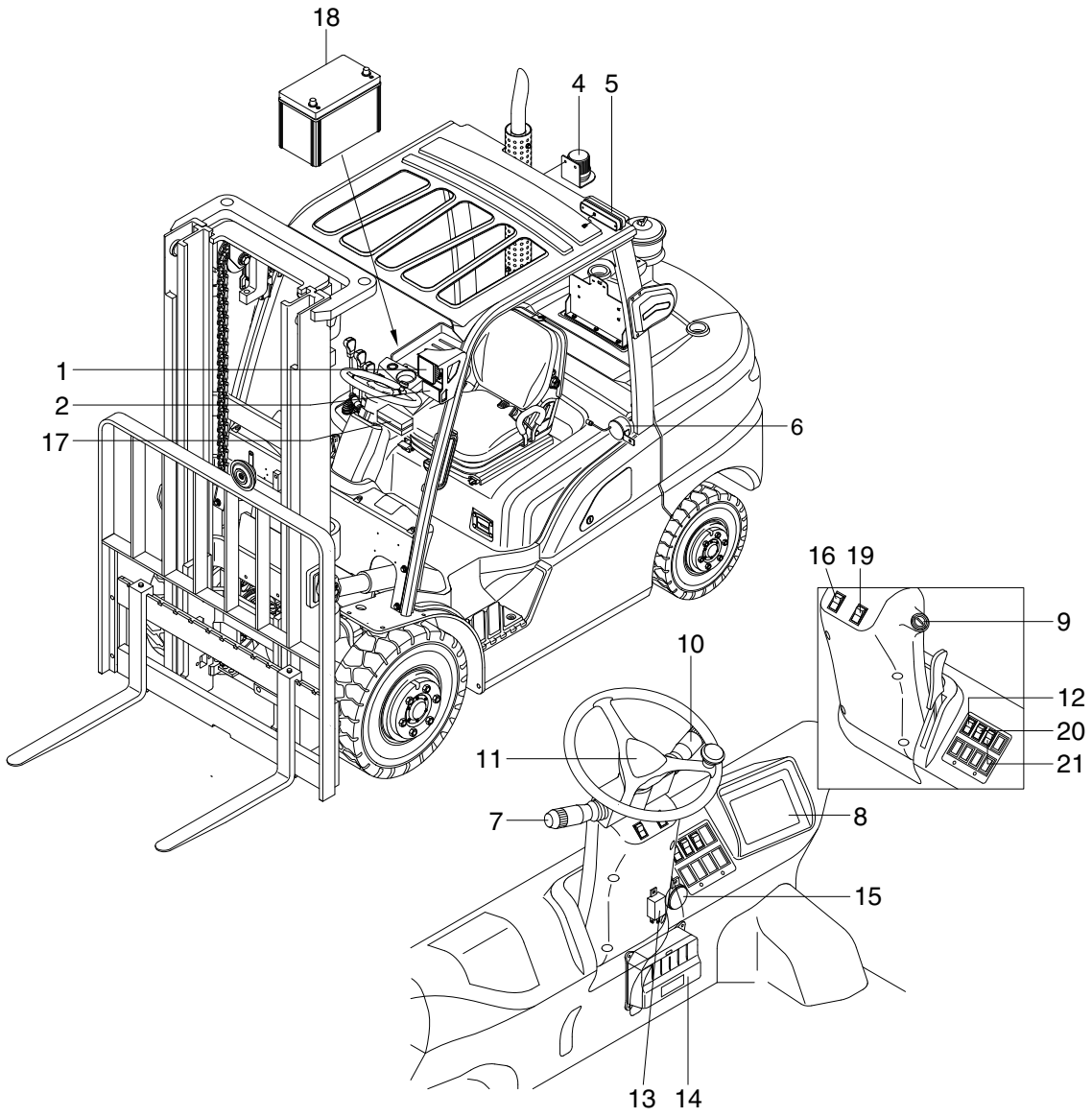
mm (in)

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

SECTION 7 ELECTRICAL SYSTEM

GROUP 1 COMPONENT LOCATION

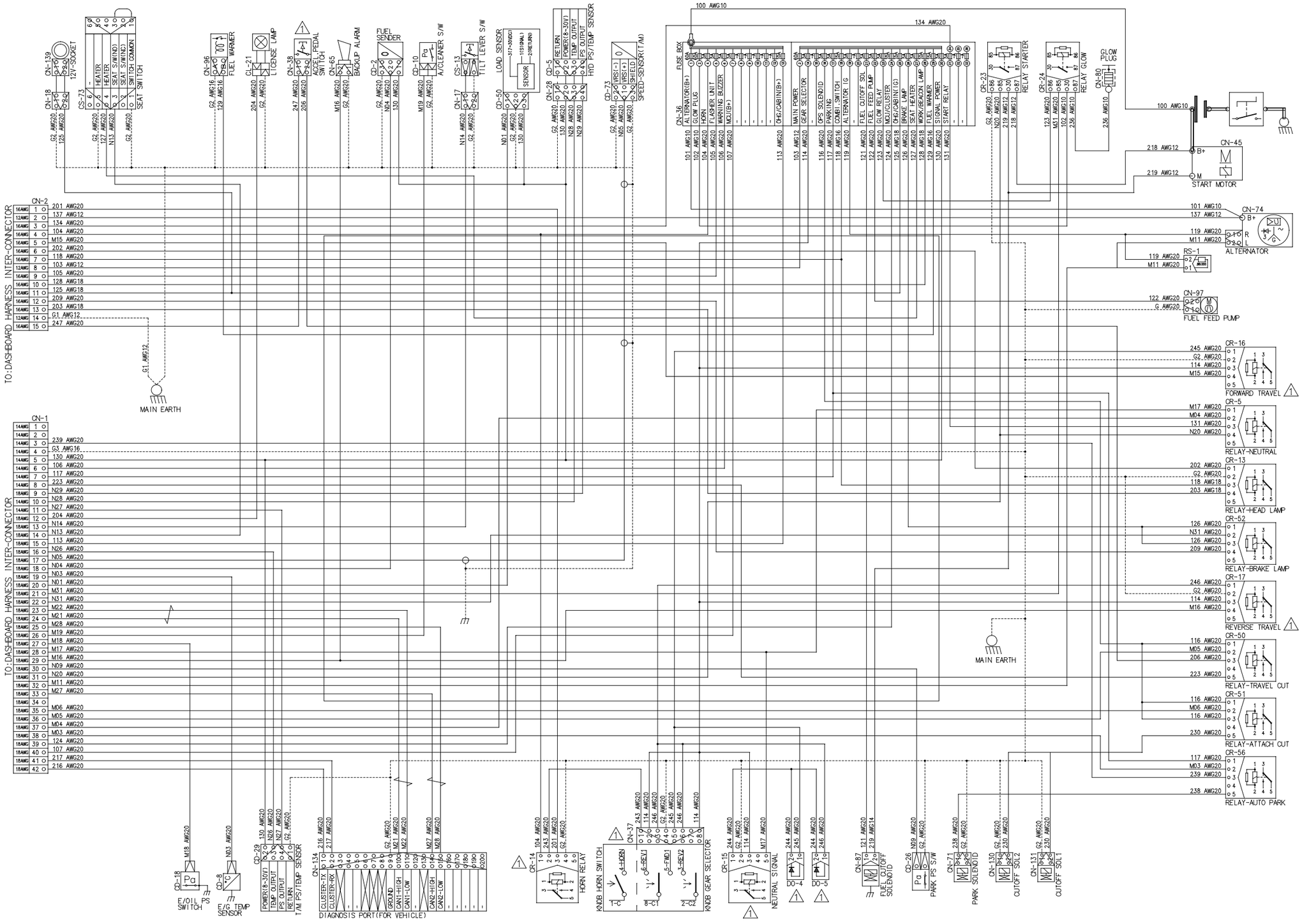


22D9TEL01

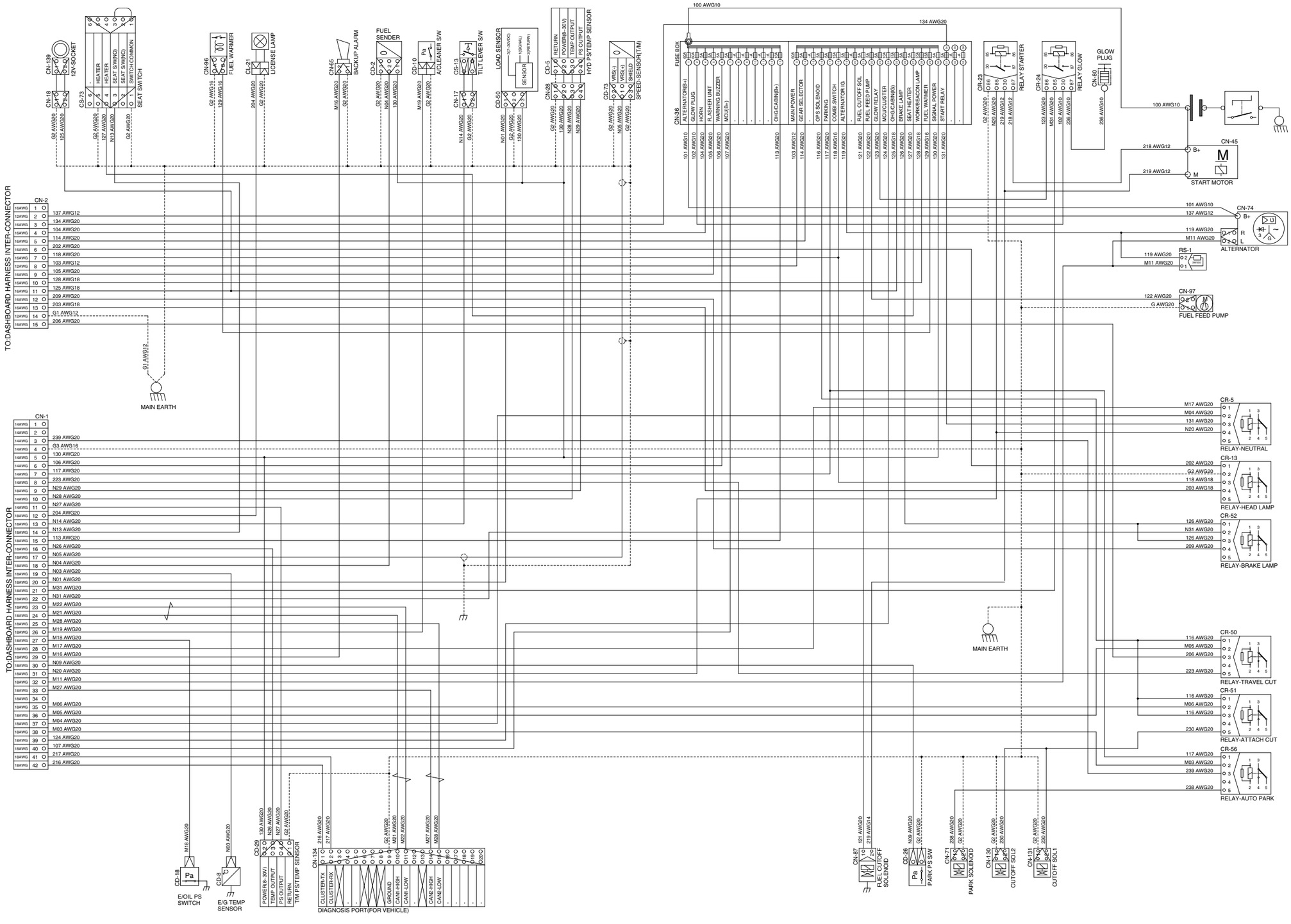
1	Head lamp	9	Start switch	15	Buzzer
2	Turn signal lamp	10	Head lamp switch	16	Hazard lamp switch (opt)
3	Horn assembly		Illumination lamp	17	Fuse box
4	Beacon lamp (opt)		Turn signal switch	18	Battery
5	Combination lamp	11	Horn button	19	Parking switch
6	Back buzzer	12	Work lamp switch (opt)	20	Beacon switch (opt)
7	Forward-reverse lever	13	Flasher unit	21	Wiper switch (opt)
8	Cluster	14	MCU		

GROUP 2 ELECTRICAL CIRCUIT

· ELECTRICAL CIRCUIT (1/4)

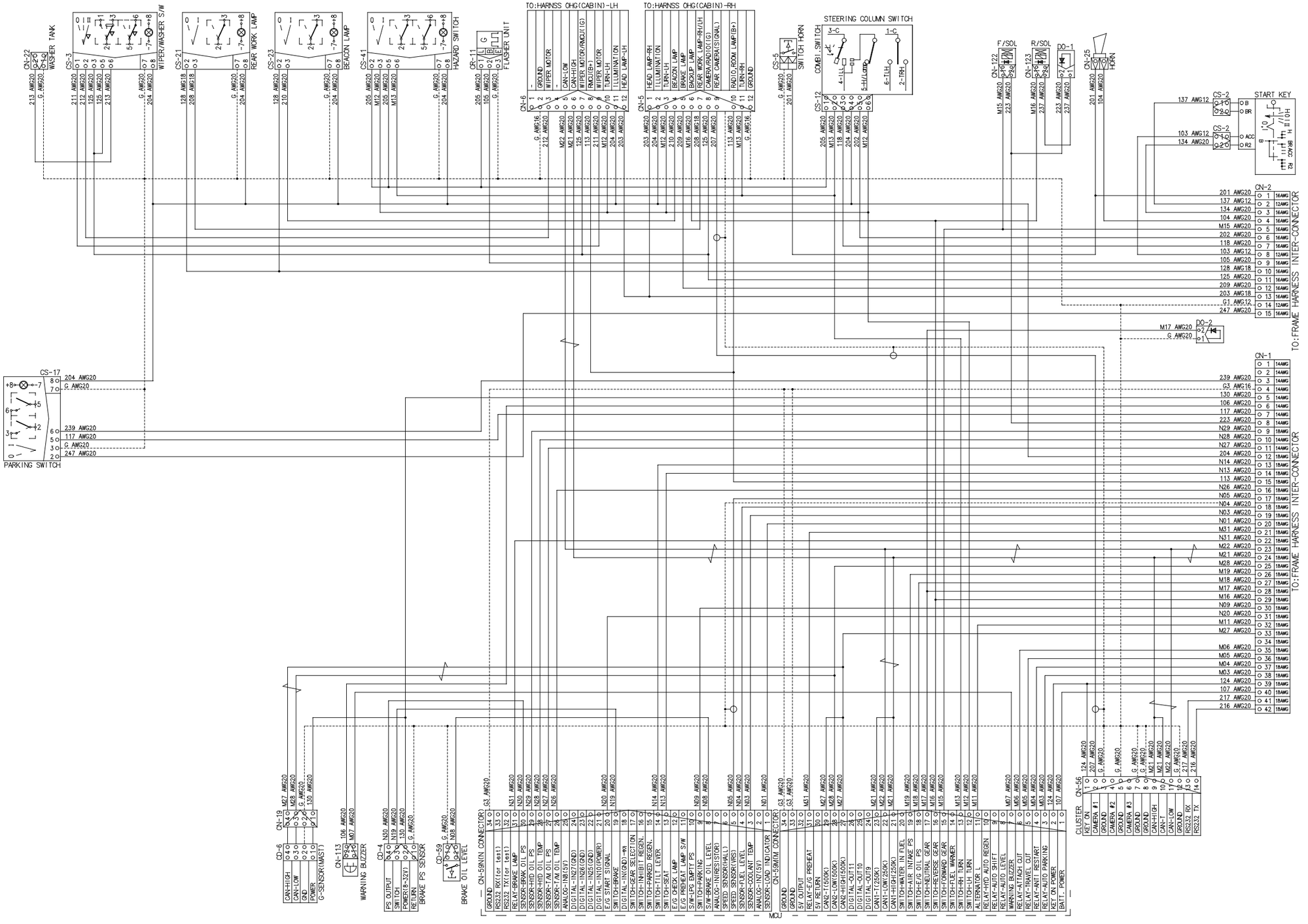


· ELECTRICAL CIRCUIT (2/4)



22D9SEL02-2

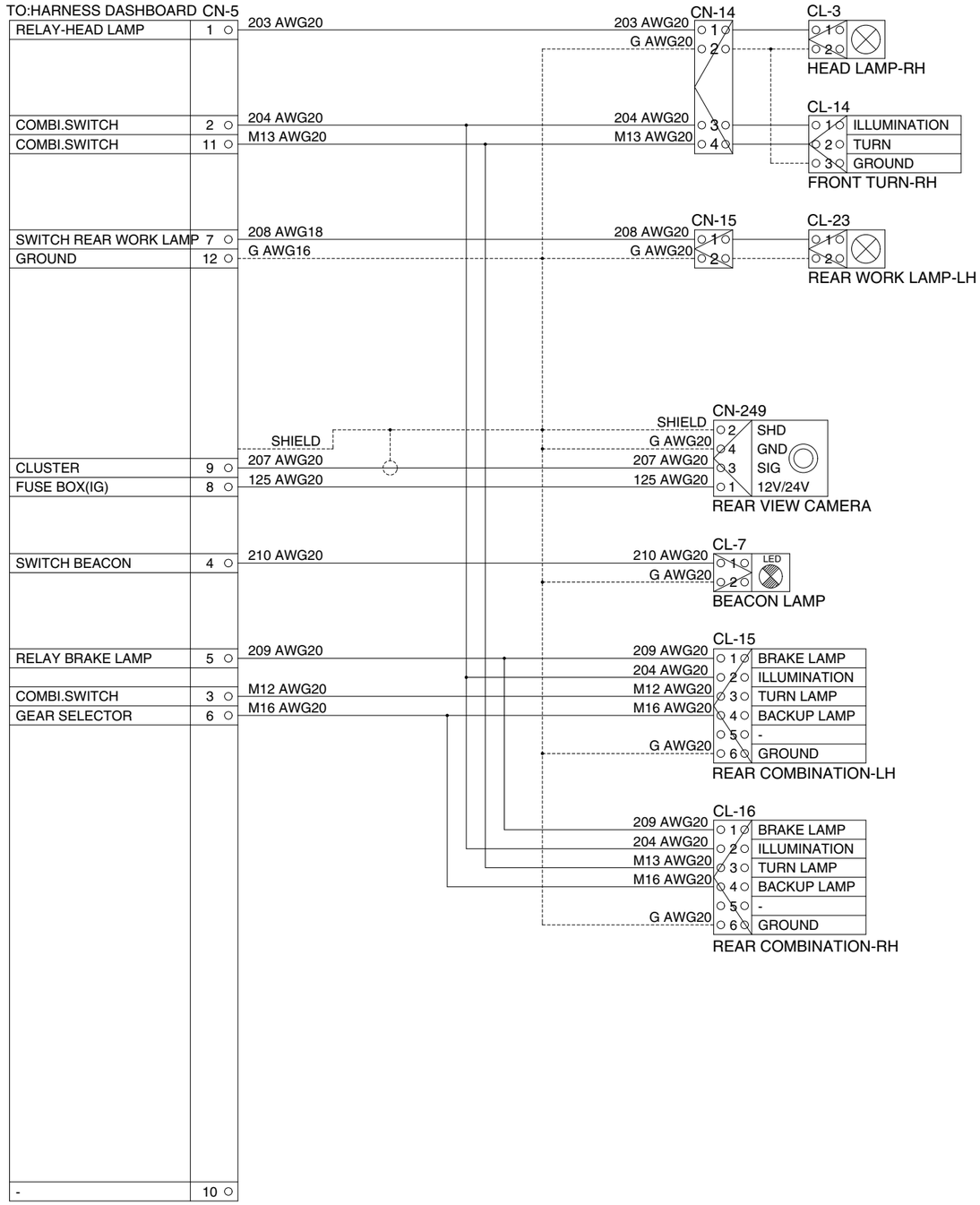
· ELECTRICAL CIRCUIT (3/4)



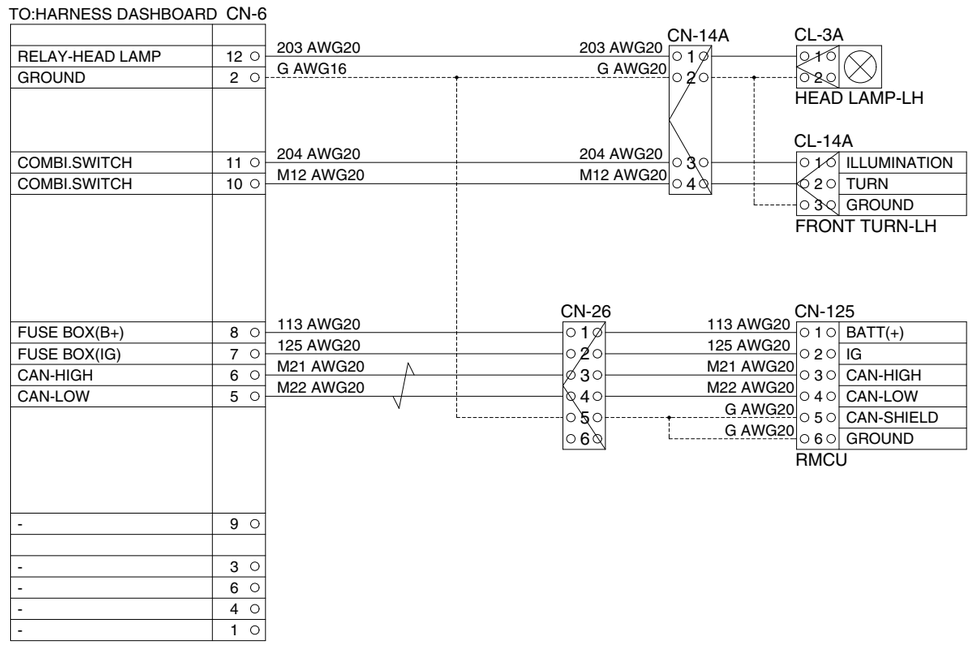
22D9SEL03

· ELECTRICAL CIRCUIT (4/4)

*ELEC.DIAGRAM OF HARNESS OHG-RH



*ELEC.DIAGRAM OF HARNESS OHG-LH



22D9SEL04

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
- → Start relay [CR-23]
- → Fuse box [CN-36 (1)] → Alternator [CN-74 (B+)] → I/conn [CN-2 (2)]
  - → I/conn [CS-2 (1)] → Start switch OFF
  - → Fuse box [No.4] → I/conn [CN-2 (4) → Horn [CN-25]
  - → Fuse box [No.5] → I/conn [CN-2 (9)] → Flasher unit [CR-11 (2) → (1)]
    - → Hazard switch [CS-41 (4, 5)]
    - → Combi switch [CS-12 (1)]

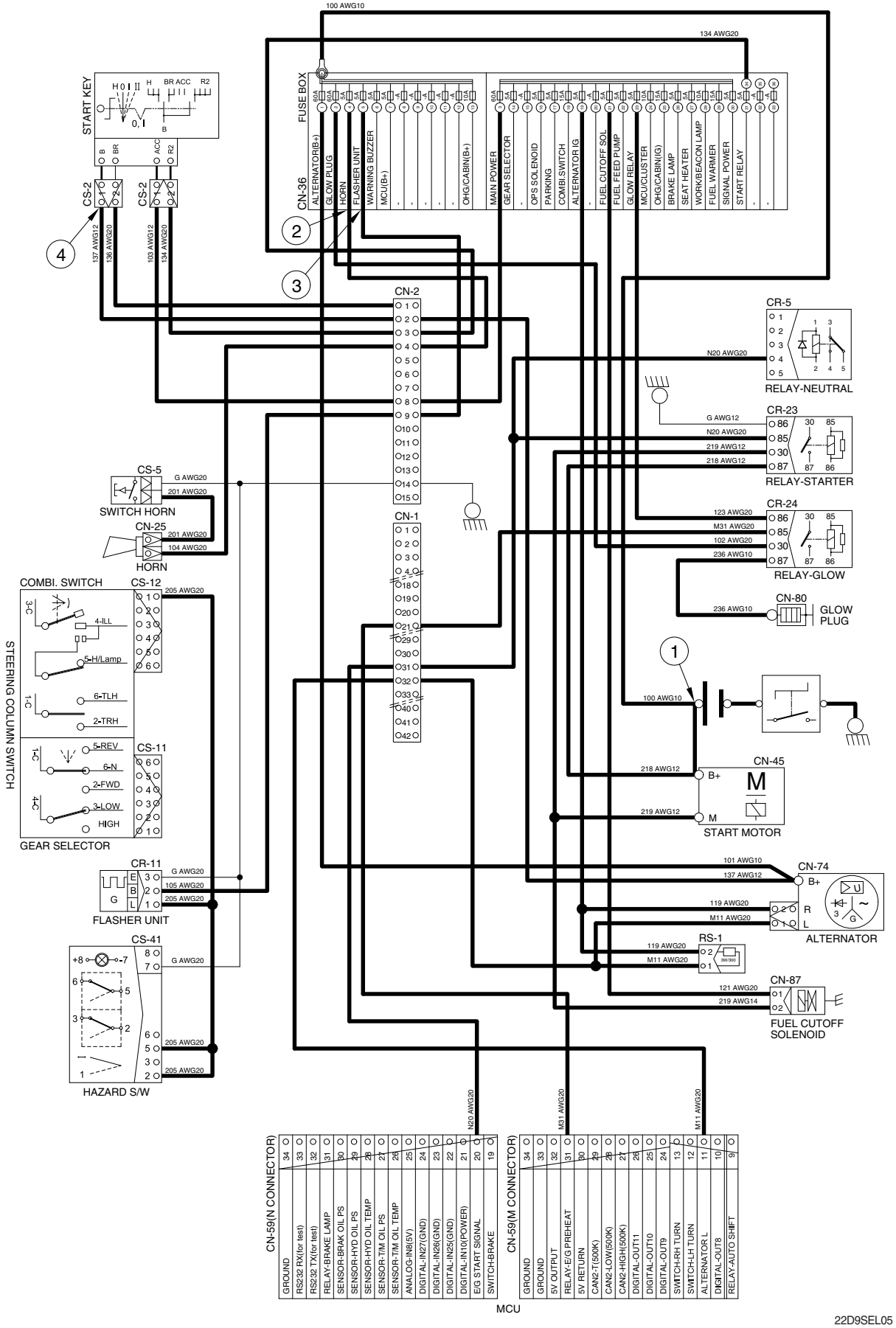
2) CHECK POINT

Engine	Key switch	Check point	Voltage
OFF	OFF	① - GND (Battery(+)) ② - GND (Fuse No.3) ③ - GND (Fuse No.4) ④ - GND (Start key)	12V

※ GND : Ground

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

POWER CIRCUIT



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

2. STARTING CIRCUIT

1) OPERATING FLOW

Battery (+) terminal → Start motor [CN-45 (B+)]
→ Fuse box [CN-36 (1)] → Alternator [CN-74 (B+)] → I/conn [CN-2 (2)] → Start switch [CS-2 (1)]
→ Start relay [CR-23]

※ The engine can be started only when the gearshift is in neutral position.

(1) When start key switch is in ON position

Start switch ON [CS-2 (2)] → I/conn[CN-2 (8)] → Fuse box [No.3] → Main power

(2) When start key switch is START position

Start switch START [CS-2 (2)] → I/conn [CN-2 (3)] → Fuse box [No. 34 →31]
→ Neutral relay [CR-5(3) → (4)] → Start relay [CR-23]
→ I/conn [CN-1 (31)] → ECU [CN-59 (20)]

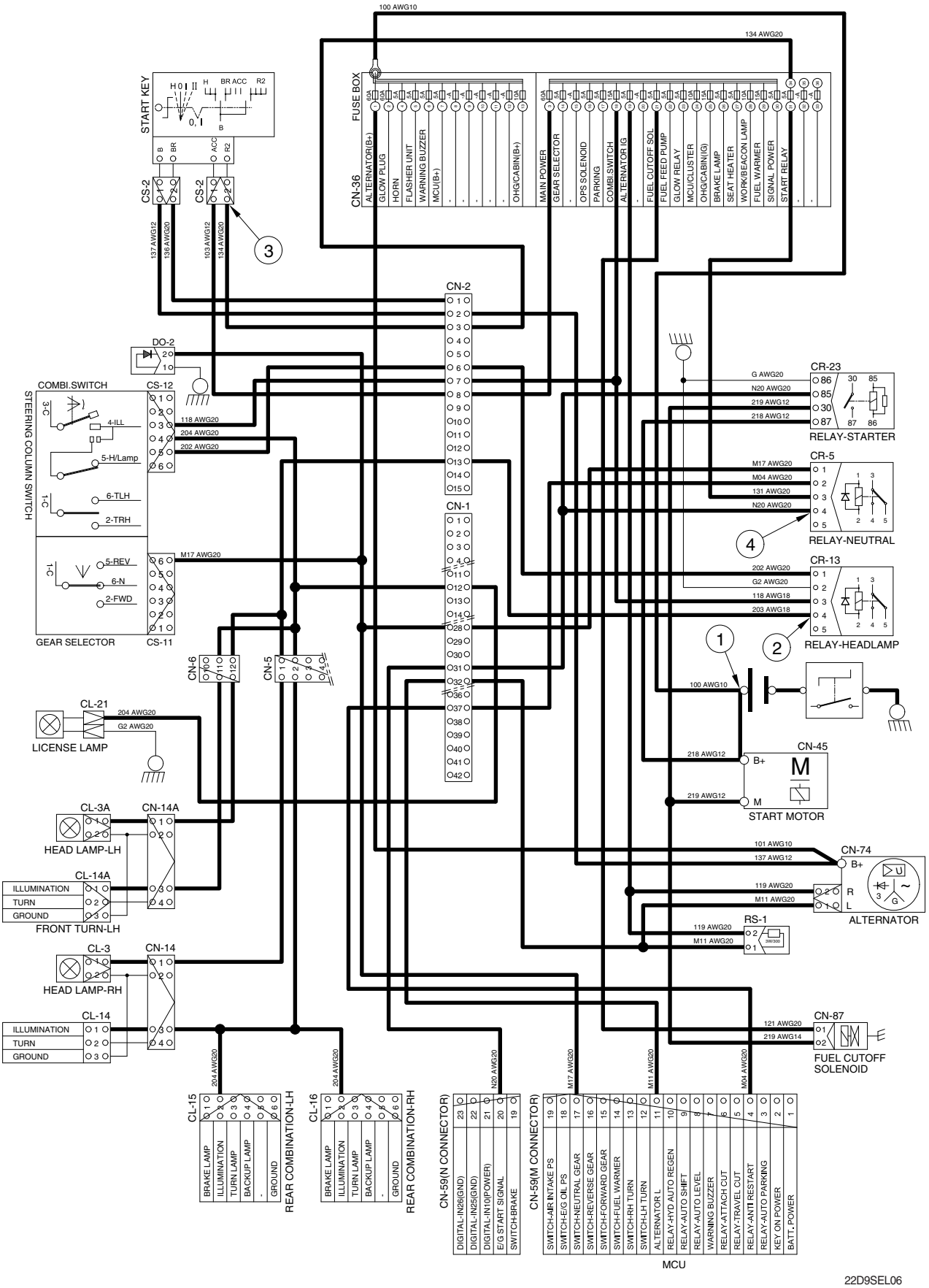
2) CHECK POINT

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

※ GND : Ground

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

STARTING CIRCUIT



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

3. CHARGING CIRCUIT

When the starter is activated and the engine is started, the operator release the start switch to the ON position. Charging current generated by operating alternator flows into the battery.
The current also flows from alternator to each electrical component through the fuse box.

1) OPERATING FLOW

(1) Warning flow
Alternator [CN-74 (L)] → I/conn [CN-1 (32)] → MCU [CN-59 (11)]

(2) Charging flow
Alternator [CN-74 (B+)] → Fuse box [CN-36 (1)] → Starter [CN-45 (B+)] → Battery (+) terminal → Charging

2) CHECK POINT

Engine	Key switch	Check point	Voltage
ON	ON	① - GND (Alternator B+) ② - GND (Start switch) ③ - GND (Cluster)	12V

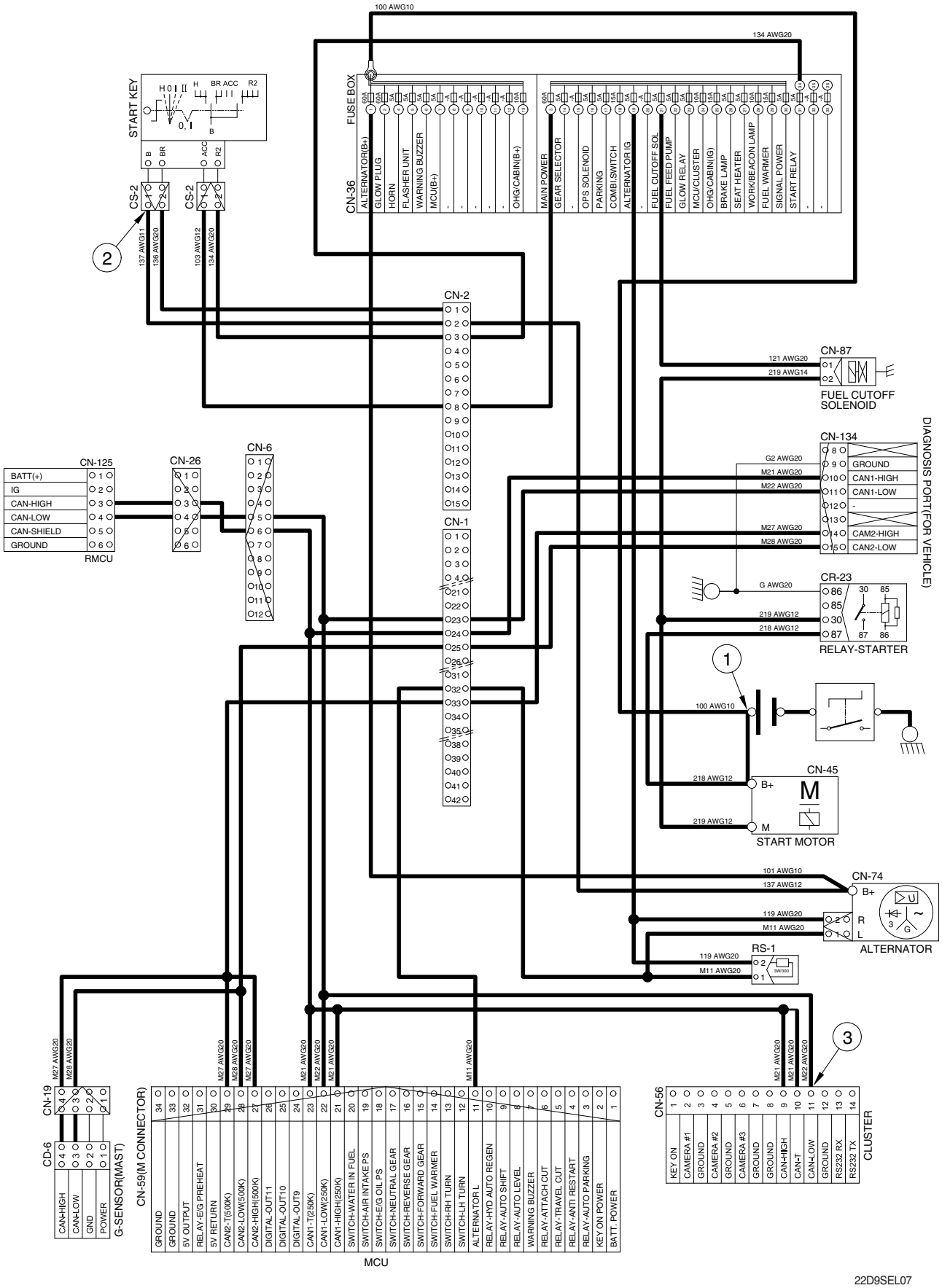
※ GND : Ground

※ Cautions

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

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

CHARGING CIRCUIT



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

4. PREHEATING CIRCUIT

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

1) OPERATING FLOW

Battery (+) terminal → Fuse box [CN-36 (1)] → Alternator [CN-74 (B+)] → I/conn [CN-2 (2)]
→ I/conn [CS-2(1)] → Start switch
→ Glow relay [CR-24]

※ 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 (2)] → I/conn [CN-2 (8)] → Fuse box [CN-36 (3)]
→ Glow relay ON [CR-24] → Glow plug operating
→ Cluster [CN-56 (1)] → Key ON
→ MCU [CN-59 (2)] → Key ON power

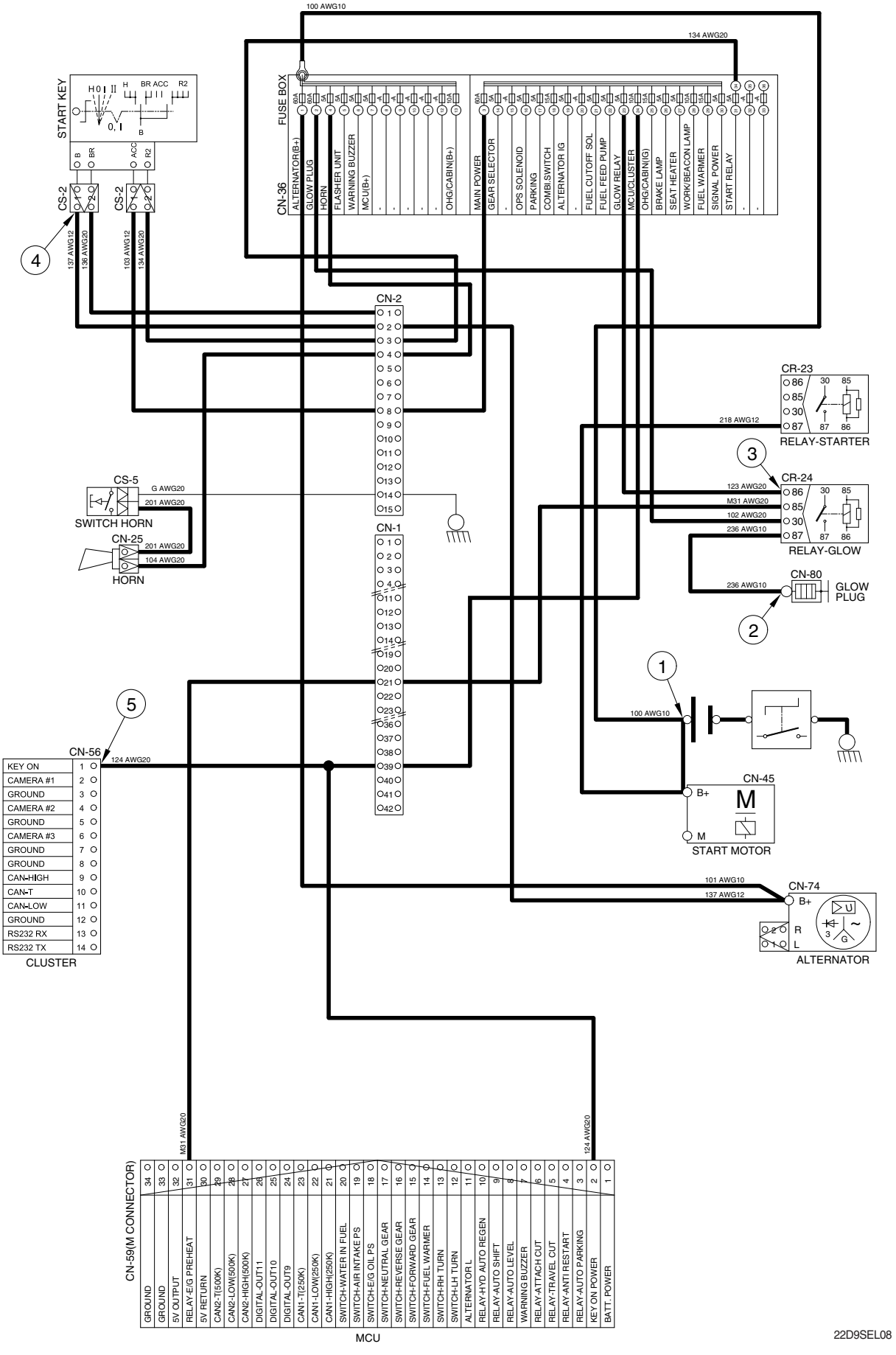
2) CHECK POINT

Engine	Key switch	Check point	Voltage
Stop	HEAT	① - GND (Battery B+) ② - GND (Glow plug) ③ - GND (Glow relay) ④ - GND (Start switch) ⑤ - GND (Cluster)	12V

※ GND : Ground

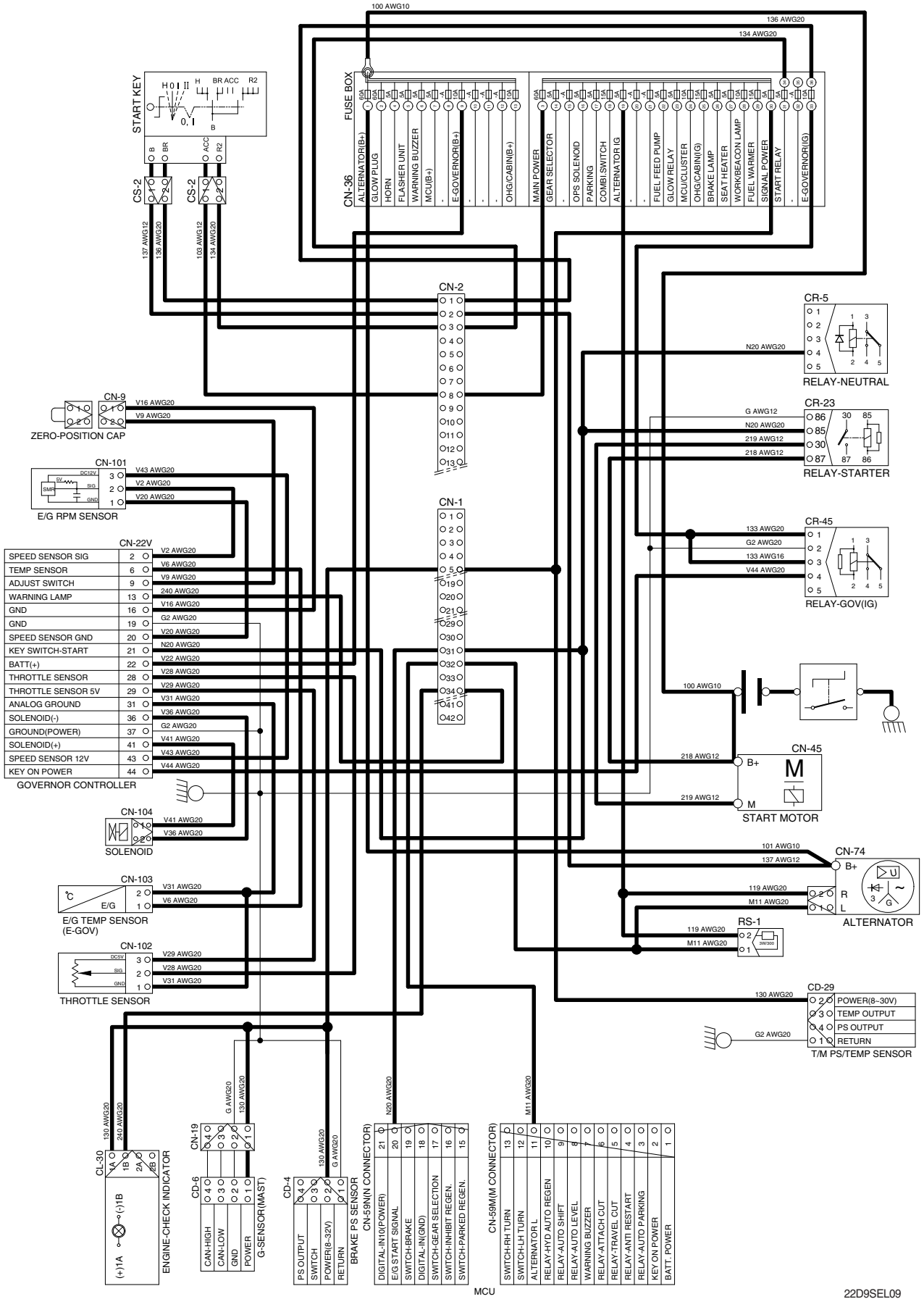
※ The circuit diagram may differ from the equipment, so please check before a repair.

PREHEATING CIRCUIT



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

GOVERNOR CONTROLLER CIRCUIT



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

GROUP 3 COMPONENT SPECIFICATION

No	Part name	Qty	Specification	Remark
1	Battery	1	12V-CMF100 RC : 190 min CCA : 850A	
2	Working lamp	1	12V, 55W	
3	License lamp	1	12V, 10W	
4	Rear combination lamp (LED)	2	12V, 1.6W (T/S) 12V, 1.1W (Back) 12V, 0.2W (Tail) 12V, 1.1W (Stop)	
5	Head lamp	2	12V, 55W	
6	Flasher lamp	2	12V (Posi : 0.5W, T/Signal : 2.2W)	
7	Beacon lamp (opt)	1	12V, Max. 1.210A	
8	Beacon lamp - LED (opt)	1	12V, Max. 0.800A	
9	Camera (opt)		12V, Max. 1.32W	
10	Flasher unit	1	12V, 85±10C/M, (23W+23W)×2+3W×2	
11	Backup alarm	1	12V, 90±5dB, 60±10C/M	
12	Horn	1	12V, MAX 3.5A, 105~120dB	
13	Fuel level sender	1	Reed switch - Magnet type Float indicate: E / 4/8 / F Resistance [Ω]: 700 / 350 / 50 Allowance [Ω]: $^{0}_{+5}$% / ±5% / $^{0}_{-5}$%	
14	Cluster	1	12V, 15W	
15	12V scoket	1	12V, 120W	
16	G-sensor	1	12V, 5W	
17	Master switch		180A	
18	Gear selector switch	1	12V, (Resistive load max 12V/3.5A)	
19	Combination switch	1	12V, Direction : Resistive load max 12V/3.5A Multi switch : Resistive load max 12V/2A	
20	Parking brake switch	1	12V, 20A	
21	Hazard switch	1	12V, 20A	
22	Start switch	1	DC 12V	
23	Rear work lamp switch (opt)	1	12V, 20A	
24	Beacon lamp switch (opt)	1	12V, 20A	
25	Front wiper/washer switch (opt)	1	12V, 20A	
26	Relay (4P)	2	12V, 20A	
27	Relay (5P)	2	12V, 20A	

GROUP 4 CONNECTOR DESTINATION

Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CN-1	AMP	42	I/conn (Dashboard harness-frame harness)	936421	936429
CN-2	AMP	15	I/conn (Dashboard harness-frame harness)	2-85262-1	369301-1
CN-5	KET	12	I/conn (Dashboard harness-OHG harness-RH)	-	MG640348
CN-6	KET	12	I/conn (Dashboard harness-OHG harness-LH)	-	MG640348
CN-9	DEUTSCH	2	Zero position	-	DT04-2P
CN-17	KET	2	Tilt lever switch	MG610320	-
CN-18	AMP	2	12V socket	174352-2	-
CN-19	AMP	4	G-sensor	174257-2	-
CN-22V	AMP	44	Engine governor controller	1376886-1	-
CN-25	AMP	1	Horn	171809-2	-
CN-28	KET	4	Hydraulic oil PS/temp sensor	MG610331	-
CN-45	AMP	1	Start motor M	171809-2	-
CN-56	AMP	14	Cluster	776273-2	-
CN-59M	AMP	34	Machine control unit	4-1437290-0	-
CN-59N	AMP	34	Machine control unit	4-1437290-1	-
CN-62	YAZAKI	6	Glow unit	7123-2262	-
CN-65	KET	2	Back buzzer	-	MG640322
CN-71	DEUTSCH	2	Parking solenoid	DT06-2S	-
CN-74	KET	2	Alternator	MG610043	-
CN-87	SUMITOMO	2	Fuel stop solenoid (MECHANIC)	6195-0003	-
CN-96	PACKARD	2	Fuel warmer	15300027	-
CN-97	YAZAKI	2	Fuel feed pump	7123-6423-30	-
CN-101	YAZAKI	3	Engine rpm sensor	7283-8732-40	-
CN-102	SUMITOMO	3	Throttle sensor	6098-0142	-
CN-103	SUMITOMO	2	Engine temp sensor (For engine governor)	6189-0552	-
CN-104	SUMITOMO	2	Solenoid	6189-0249	-
CN-113	KET	2	OPSS buzzer	MG610320	-
CN-122	DEUTSCH	2	Forward solenoid	DT06-2S	-
CN-123	DEUTSCH	2	Reverse solenoid	DT06-2S	-
CN-130	PACKARD	2	Cut off solenoid 2 (Tilt, lift)	12015792	-
CN-131	PACKARD	2	Cut off solenoid 1 (Lift, down)	12015792	-
CN-134	KET	20	Diagnosis port (Vehicle)	MG652863	-
CN-139	KET	2	12V socket	MG610043	-
CN-140	KET	3	MCU update	MG610327	-

Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
Switch					
CS-2	KET	2	Start switch	MG610281	MG620282
CS-3	CARLING	10	Wiper/washer switch	21HN-56300	-
CS-5	KET	-	Horn switch	-	MG640329
CS-11	DEUTSCH	6	Gear selector	DT06-6S	-
CS-12	DEUTSCH	6	Combination switch	DT06-6S-P012	-
CS-13	KET	1	Tilt lever switch	ST730018-3	ST750036-3
CS-17	CARLING	10	Parking switch	21HN-56300	-
CS-21	CARLING	10	Work lamp switch	21HN-56300	-
CS-23	CARLING	10	Beacon lamp switch	21HN-56300	-
CS-41	DAEDONG	10	Harzard switch	21HN-56300	-
CS-73	DEUTSCH	6	Seat switch	DT06-6S	-
Lamp					
CL-3	KET	2	Head lamp-RH	ST730018-3	ST750036-3
CL-3A	KET	2	Head lamp-LH	ST730018-3	ST750036-3
CL-7	DEUTSCH	1	Beacon lamp	DT06-2S	DT04-2P
CL-14	AMP	3	Front turn lamp-RH	936187-3	-
CL-14A	AMP	3	Front turn lamp-LH	936187-3	-
CL-15	DAEDONG	6	Combination lamp-LH	110-6PR	-
CL-16	DAEDONG	6	Combination lamp-RH	110-6PR	-
CL-21	KET	2	License lamp	ST730018-3	ST750036-3
CL-23	DAEDONG	2	Working lamp	110-2PR	-
CL-30	-	4	Engine check	21HN-56320	-
Relay					
CR-5	OMRON	5	Neutral relay	21HN-55510	-
CR-11	KET	3	Flasher unit relay	312_GIHUNG_3P	-
CR-13	OMRON	5	Head lamp relay	21HN-55510	-
CR-23	AMP	4	Starter relay	21HN-55520	-
CR-24	AMP	4	Glow relay	21HN-55520	-
CR-45	OMRON	5	Engine governor (1G)	21HN-55510	-
CR-50	OMRON	5	Travel cut relay	21HN-55510	-
CR-51	OMRON	5	Attach cut relay	21HN-55510	-
CR-52	OMRON	5	Brake lamp relay	21HN-55510	-
CR-56	OMRON	5	Auto park relay	21HN-55510	-

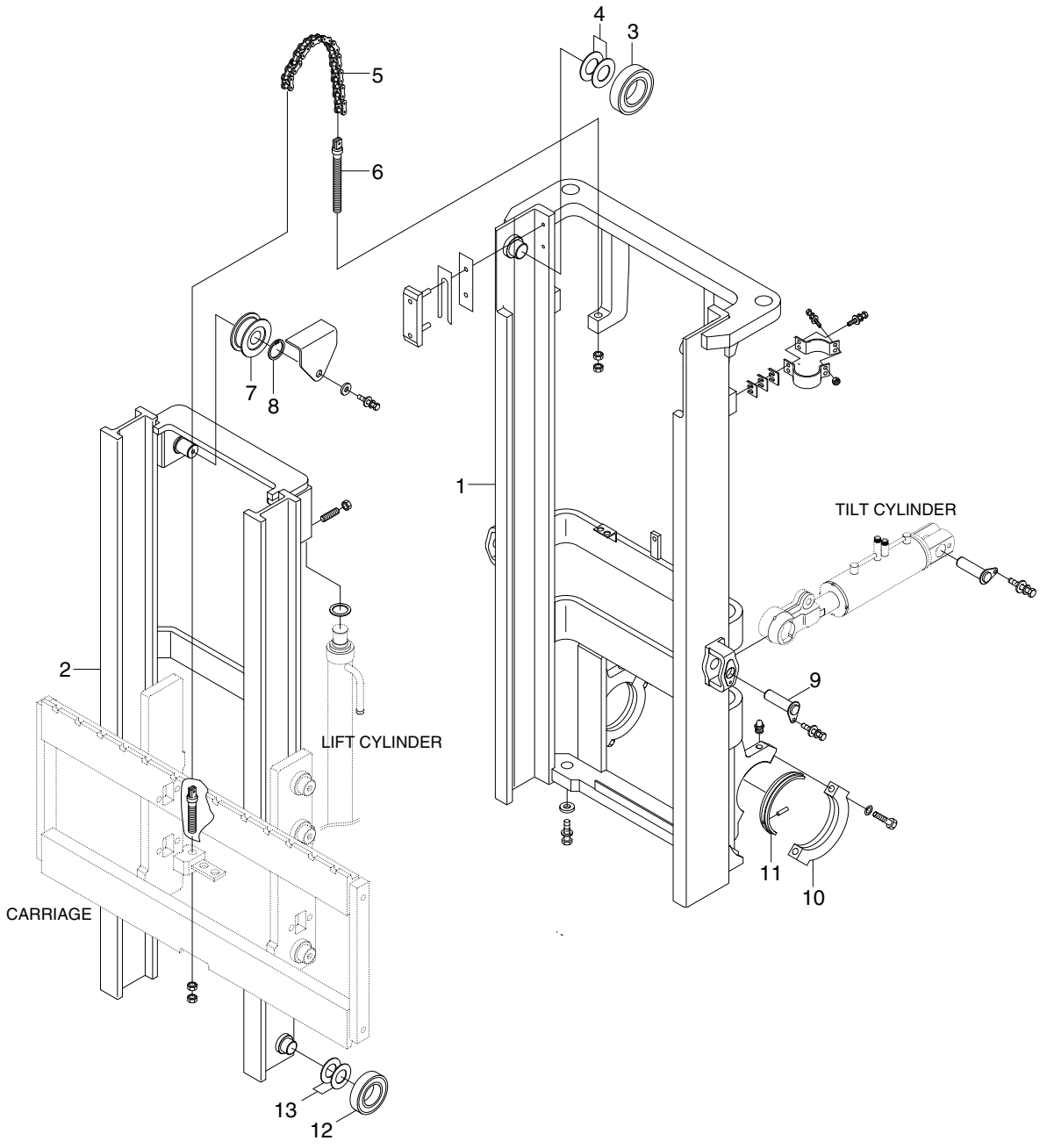
Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
Sensor and pressure switch					
CD-2	KET	3	Fuel level sensor	MG610327	-
CD-4	DEUTSCH	4	Brake oil pressure sensor	DT06-4S	-
CD-6	DEUTSCH	4	G-sensor (Mast agnle)	DT06-4S	-
CD-8	AMP	1	Temp sender (For MCU)	171809-2	-
CD-10	KET	1	Air cleaner switch	ST730057-2	-
CD-18	AMP	1	Engine oil pressure sensor	171809-2	-
CD-26	AMP	1	Parking pressure switch	171809-2	-
CD-29	DEUTSCH	4	T/M oil PS/temp sensor	DT06-4S	-
CD-50	DEUTSCH	3	Load sensor	DTM06-3S	-
CD-59	KET	2	Brake oil level	MG610320	-
CD-73	AMP	3	Speed sensor	85205-1	-
Diode					
DO-01	QPL	-	Diode	21E-50550	-
DO-02	QPL	-	Diode	21E-50550	-

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

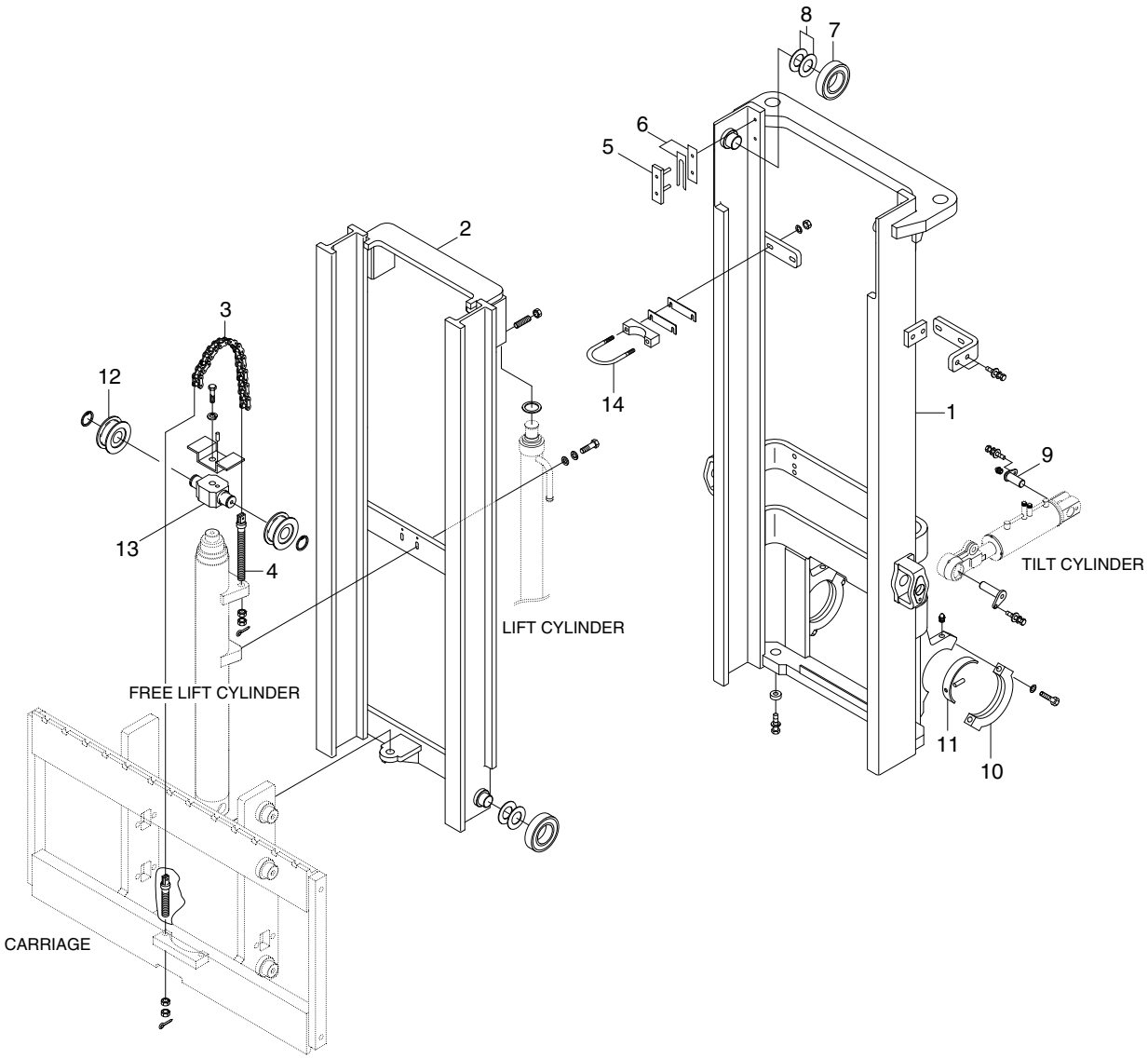
GROUP 1 STRUCTURE

1. 2 STAGE MAST (V MAST)



1	Outer mast	6	Anchor bolt	11	Bushing
2	Inner mast	7	Chain wheel bearing	12	Roller
3	Roller	8	Retaining ring	13	Shim (0.5, 1.0t)
4	Shim (0.5, 1.0t)	9	Tilt cylinder pin		
5	Chain	10	Trunnion cap		

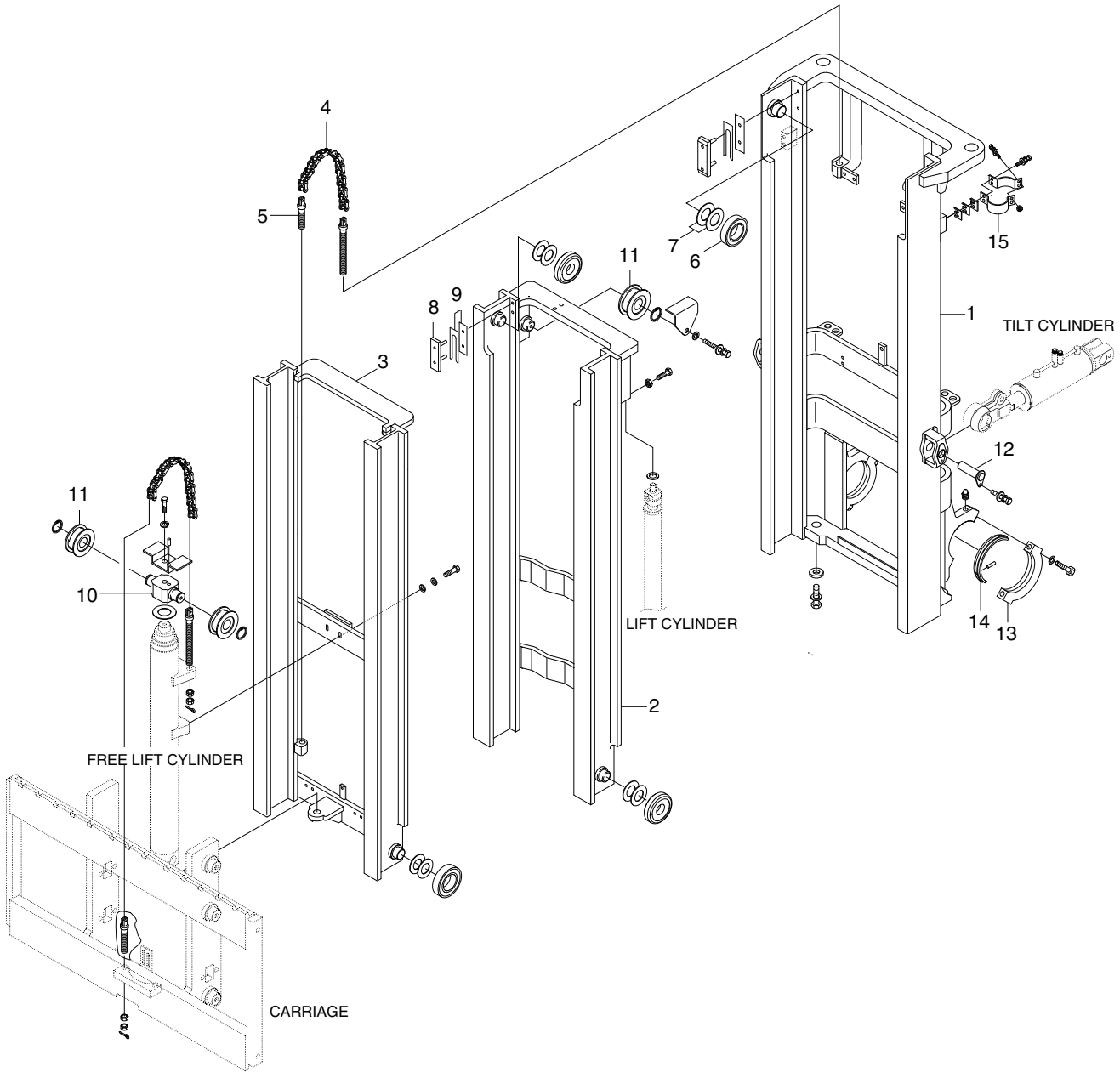
2. 2 STAGE MAST (VF MAST)



20D7MS02

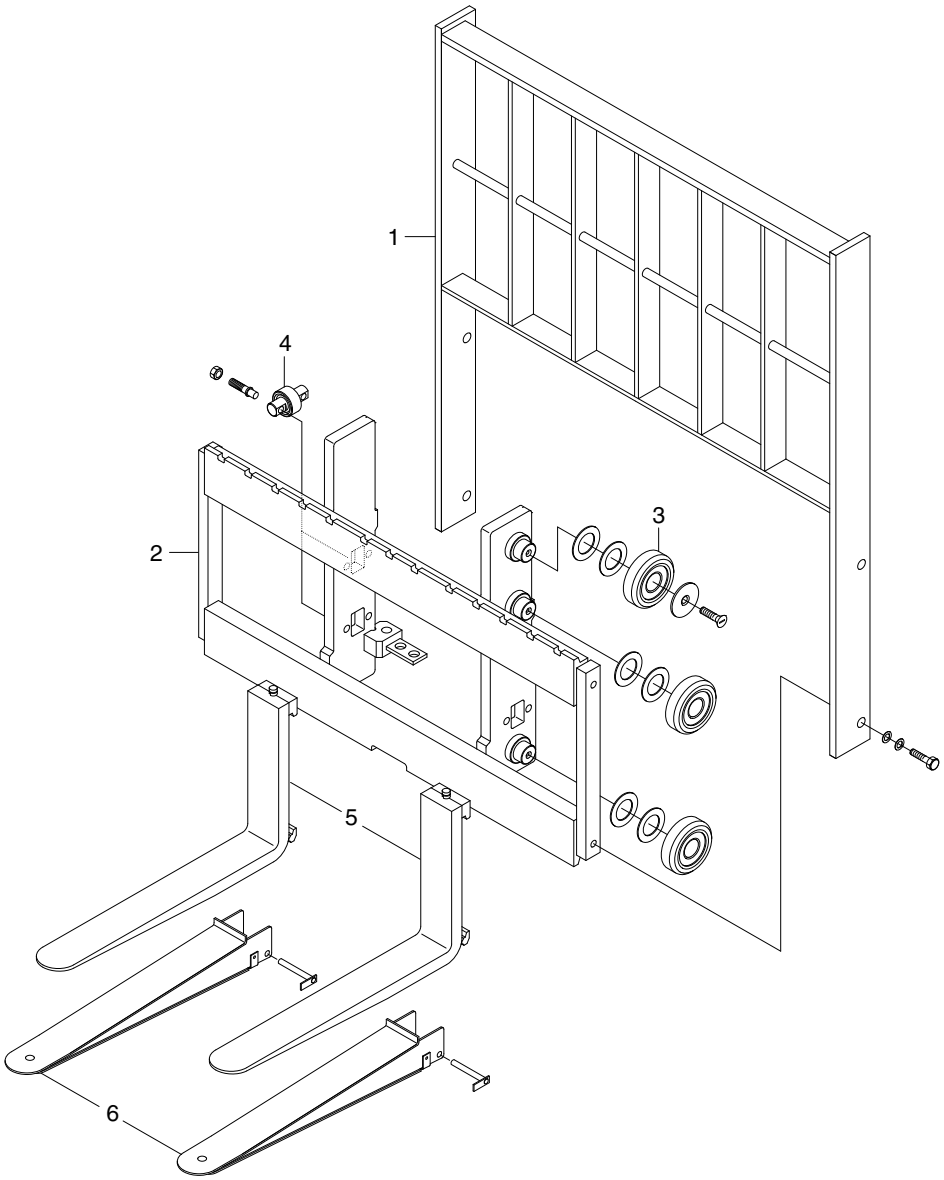
1	Outer mast	6	Shim (0.5, 1.0t)	11	Bushing
2	Inner mast	7	Roller	12	Sheave
3	Chain	8	Shim (0.5, 1.0t)	13	Sheave bracket
4	Anchor bolt	9	Tilt cylinder pin	14	U-bolt
5	Back up liner	10	Support cap		

3. 3 STAGE MAST (TF MAST)



1	Outer mast	6	Roller	11	Sheave
2	Middle mast	7	Shim (0.5, 1.0t)	12	Tilt cylinder pin
3	Inner mast	8	Back up liner	13	Support cap
4	Chain	9	Shim (0.5, 1.0t)	14	Bushing
5	Anchor bolt	10	Sheave bracket	15	Clamp

4. CARRIAGE, BACKREST AND FORK



D255MS03

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

GROUP 2 OPERATIONAL CHECKS AND TROUBLESHOOTING

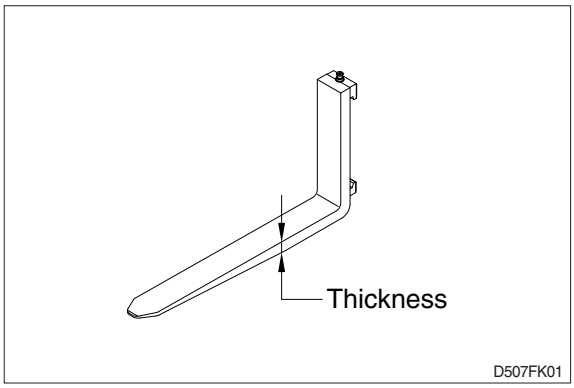
1. OPERATIONAL CHECKS

1) FORKS

(1) Measure thickness of root of forks and check that it is more than specified value.
EX : ℓ = 1050 mm (41.3 in)

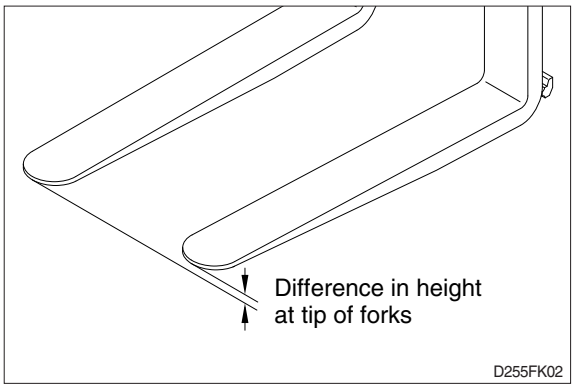
mm (in)

STD Fork assy	Applicable model	Standard	Limit
64HN-21030	22/25D-9S	45 (1.8)	40 (1.6)
64HN-31020	30/33D-9S	45 (1.8)	40 (1.6)



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

Model	Fork length (mm)	Height difference (mm)
22/25/30/ 33D-9S	equal or below 1500	3
	above 1500	4



(3) Most force is concentrated at root of fork and at hook, so use crack detection method to check cracks.

2. MAST

1) Check for cracks at mast stay, tilt cylinder bracket, guide bar, fork carriage and roller shaft weld. Check visually or use crack detection method. Repair any abnormality.
2) Set mast vertical, raise forks about 10cm from ground and check front-to-rear clearance and left-to-right clearance between inner mast and fork carriage, and between outer mast and inner mast. Use these figures to judge if there is any play at roller or rail.
   · Front-to-rear clearance : Within 2.0 mm (0.08 in)
   · Left-to-right clearance : Within 2.5 mm (0.10 in)
3) Check that there is an oil groove in bushing at mast support.
4) Set mast vertical, raise forks about 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. · Deformed mast assembly.	· See troubleshooting hydraulic pump and cylinders in section 6, hydraulic system. · Disassemble mast and replace damaged parts or replace complete mast assembly.
Slow lifting speed and insufficient handling capacity.	· Faulty hydraulic equipment. · Deformed mast assembly.	· See troubleshooting hydraulic pump and cylinders in section 6, hydraulic system. · Disassemble mast and replace damaged parts or replace complete mast assembly.
Mast fails to lift smoothly.	· Deformed masts or carriage. · Faulty hydraulic equipment. · Damaged load and side rollers. · Unequal chain tension between LH & RH sides. · LH & RH mast inclination angles are unequal. (Mast assembly is twisted when tilted)	· Disassembly, repair or replace. · See Troubleshooting Hydraulic Cylinders, pump and control valve in section 6, hydraulic system. · Replace. · Adjust chains. · Adjust tilt cylinder rods.
Abnormal noise is produced when mast is lifted and lowered.	· Broken load roller bearings. · Broken side roller bearings. · Deformed masts. · Bent lift cylinder rod. · Deformed carriage. · Broken sheave bearing.	· Replace. · Replace. · Disassemble, repair or replace. · Replace. · Replace. · Replace.
Abnormal noise is produced during tilting operation.	· Insufficient lubrication of anchor pin, or worn bushing and pin. · Bent tilt cylinder rod.	· Lubricate or replace. · Replace.

2) FORKS

<table>
<tr><th>Problem</th><th>Cause</th><th>Remedy</th></tr>
<tr><td>Abrasion</td><td>Long-time operations causes the fork to wear and reduces the thickness of the fork.
Inspection for thickness is needed.
· Wear limit : Must be 90% of fork thickness</td><td>If the measured value is below the wear limit, replace fork.</td></tr>
<tr><td>Distortion</td><td>Forks are bent out of shape by a number of reasons such as overloading, glancing blows against walls and objects, and picking up load unevenly.
· Difference in fork tip height
<table><tr><th>Fork length (mm)</th><th>Height difference (mm)</th></tr><tr><td>equal or below 1500</td><td>3</td></tr><tr><td>above 1500</td><td>4</td></tr></table></td><td>If the measured value exceeds the allowance, replace fork.</td></tr>
<tr><td>Fatigue</td><td>Fatigue failure may result from the fatigue crack even though the stress to fork is below the static strength of the fork. Therefore, a daily inspection should be done.
· Crack on the fork heel.
· Crack on the fork weldments.</td><td>Repair fork by expert.
In case of excessive distortion, replace fork.</td></tr>
</table>

1. MAST LOAD ROLLER (V, VF MAST)

1) INNER/OUTER MAST ROLLER CLEARANCE ADJUSTMENT

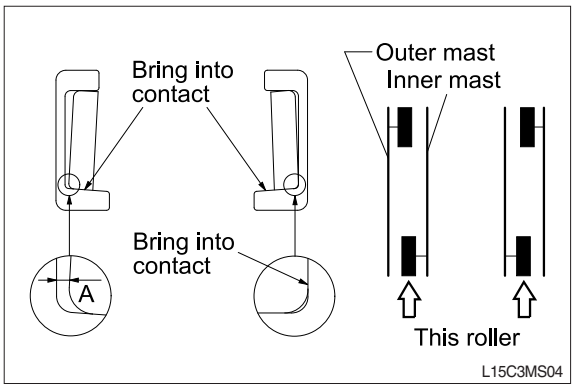
(1) Measure the clearance with the mast overlap at near 480 mm.

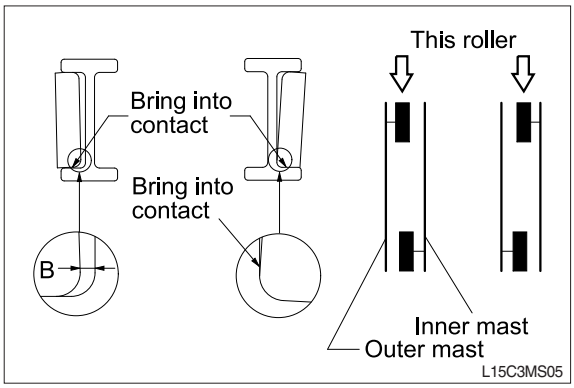
(2) Shift the inner mast to one side to bring the roller into contact with the outer mast, and adjust the clearance between the roller side face and mast at the closest position on the opposite side to the following value by inserting the inner/outer mast roller shim.

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

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

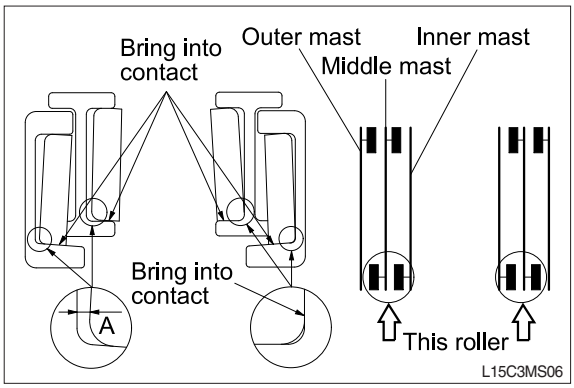
(4) After the adjustment, check that the inner mast moves smoothly in the outer mast.





2. MAST LOAD ROLLER (TF MAST)

1) INNER AND MIDDLE MAST ROLLER CLEARANCE ADJUSTMENT



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

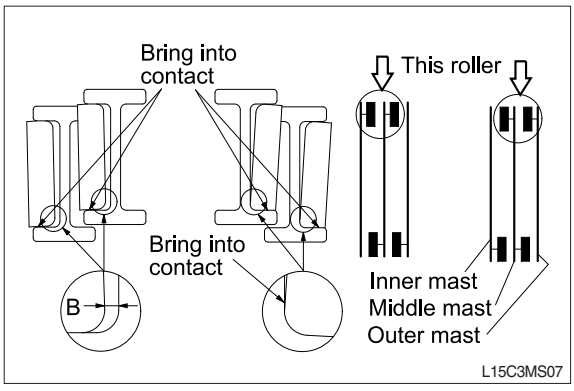
(2) Shift the inner mast to one side to bring the roller into contact with the outer mast and the middle mast, and adjust the clearance between the roller side face and mast at the closest position on the opposite side to the following value by inserting the inner and middle mast roller shim, respectively.

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

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

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

2) OUTER AND MIDDLE MAST UPPER ROLLER CLEARANCE ADJUSTMENT.



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

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

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

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

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

3) CARRIAGE LOAD ROLLER

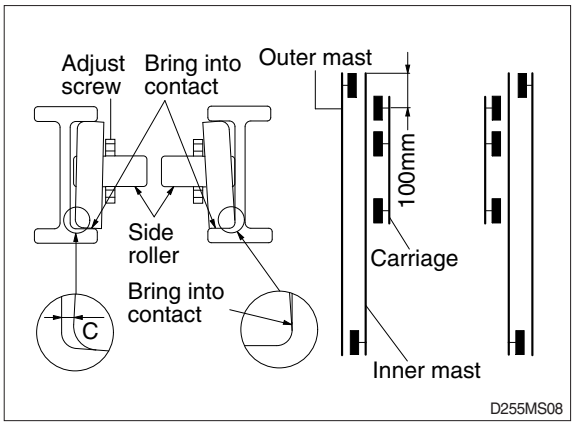
(1) Measure the clearance when the center of the carriage upper roller is 100 mm from the top of the inner mast.

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

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

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

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



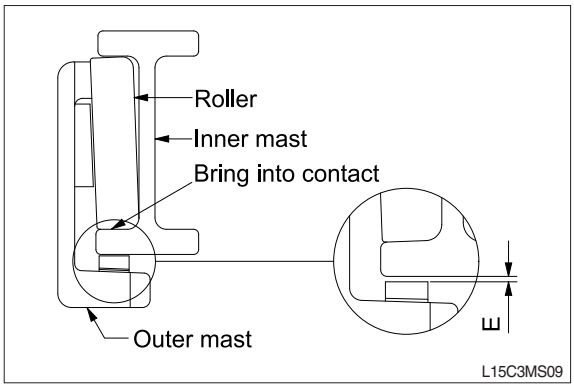
4) MAST BACK UP LINER

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

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

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

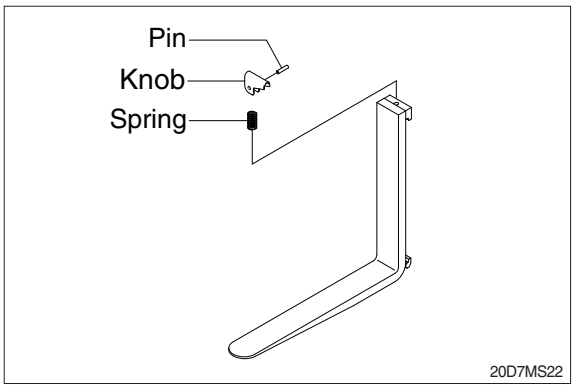
(3) After the adjustment, the mast should move smoothly.



GROUP 4 REMOVAL AND INSTALLATION

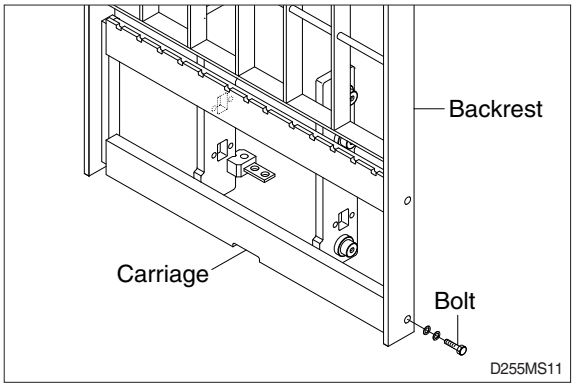
1. FORKS

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



2. BACKREST

1) Remove bolts securing backrest to fork carriage. Disassemble the backrest from the carriage.
2) Position backrest on carriage and lower in place. Install and tighten bolts.



3. CARRIAGE ASSEMBLY

1) CARRIAGE

(1) With the mast vertical, raise the carriage high enough to place blocks under the load forks. This is done to create slack in the load chains when the carriage is lowered. Lower the carriage all the way down to the floor. Make sure the carriage is level, this will prevent any binding when the mast is raised.
(2) While supporting lift chains, remove the split pin and slide out chain anchor pins from the chain anchors of stationary upright.
(3) Pull the chains out of the sheaves and drape them over the front of the carriage.
(4) Slowly raise elevating upright until mast clears top of fork carriage. Move carriage to work area and lower mast.

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

(5) Inspect all parts for wear or damage. Replace all worn or damaged pars.
(6) Reverse the above steps to reinstall.

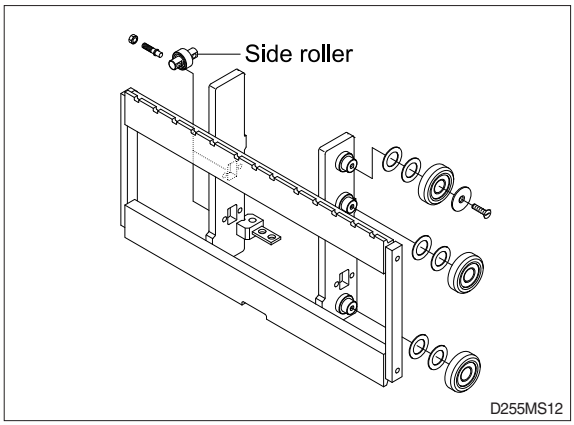
⚠ Replace the split pin of chain anchor with new one.

2) SIDE ROLLER

(1) Remove carriage as outlined in the carriage assembly and removal paragraph.
(2) Loosen and remove nuts, adjust screws and side rollers from carriage side pate.
(3) Thoroughly clean, inspect and replace all worn or damaged parts.
(4) Reverse the above procedure to assembly.

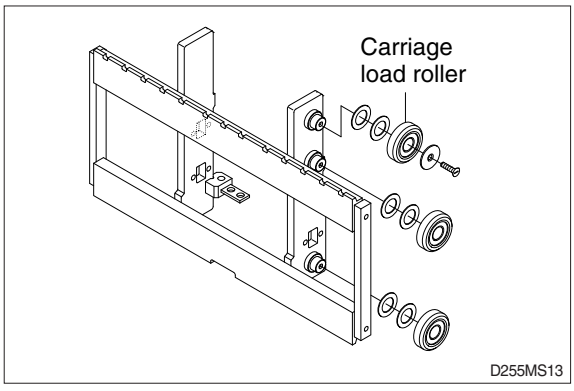
※ **Adjustment**

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



3) CARRIAGE LOAD ROLLER

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



4) MAST LOAD ROLLER AND BACK UP LINER

(1) 2 stage mast (V mast)

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

② Loosen and remove hexagon bolts and washers securing lift cylinders to inner mast.

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

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

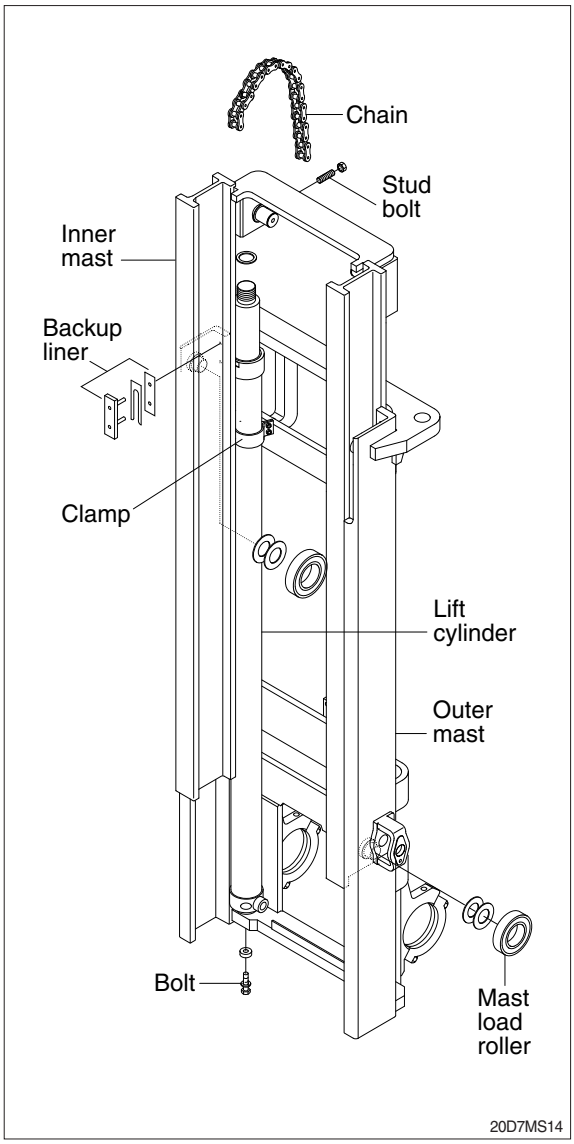
⑤ After lowering the lift cylinder rods, and disconnecting lift cylinder hose, tilt the lift cylinders LH and RH and them with ropes to the outer mast.

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

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

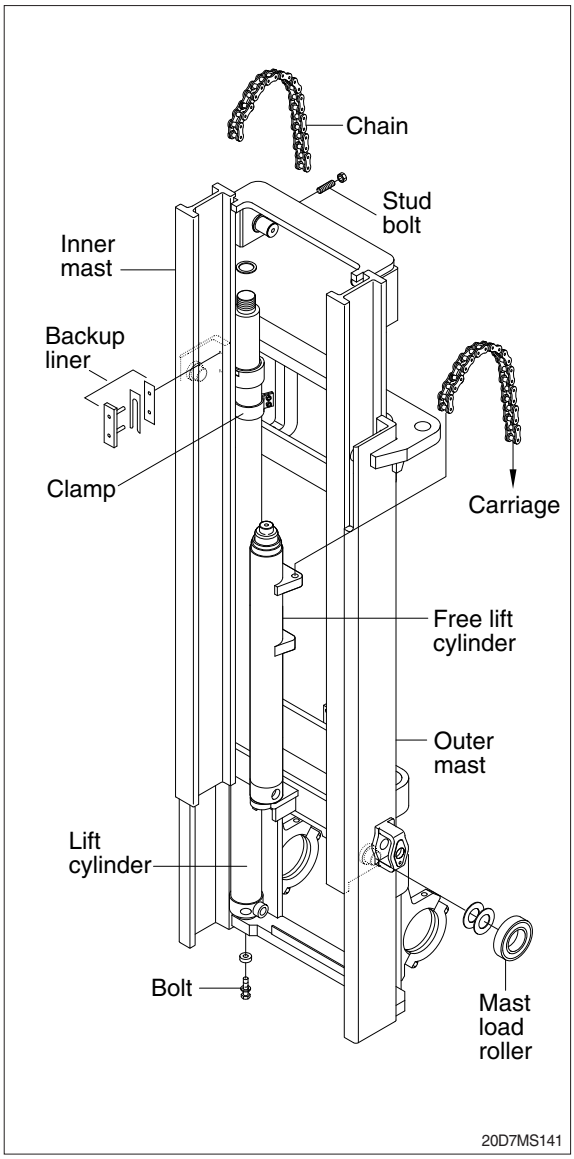
⑧ Thoroughly clean, inspect and replace all worn or damaged parts.

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



(2) 2 stage mast (TF mast)

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



(2) 3 stage mast (TF mast)

① Remove the carriage assembly and move to one side.

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

③ Loosen and remove bolts and special washers securing lift cylinders to middle mast.

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

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

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

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

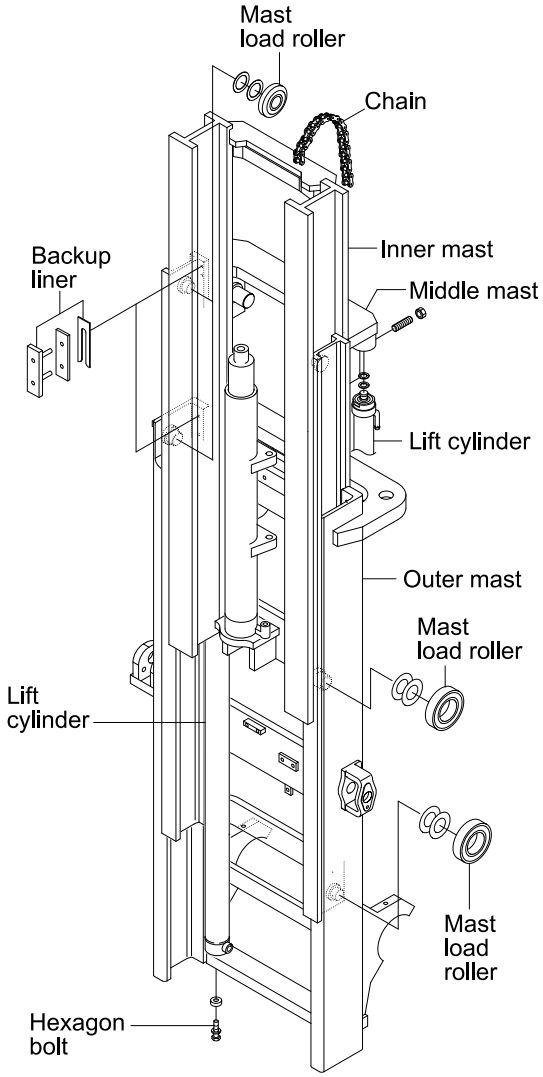
⑧ Using a pryer, remove load rollers from load bracket. Remove back up liners and shims.

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

⑩ Using a player, remove load rollers from load roller bracket.

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

⑫ Reverse the above procedure to assemble. Refer to MAST LOAD ROLLER ADJUSTMENT paragraph.



5) ELEVATING MAST

(1) Inner mast (V, VF mast)

① After completing all necessary steps for load rollers and back up liner removal use an overhead hoist and sling or chain around upper crossmember of the inner mast section.

② Lift inner mast upright straight up and out of outer mast section.

③ Replace and reverse above procedure to install. Make all necessary measurements and adjustments.

(2) Inner and middle mast (TF mast)

① After completing all necessary steps for load rollers and back up liner removal. Remove rear chains and sheave support if not already done.

② Disconnect free lift cylinder hose. Drain hose into a suitable pan or container and cap hose.

③ While supporting free lift cylinder assembly, remove bolts and washers securing cylinder to mast crossmember.

④ Place a sling around free lift cylinder and attach to an overhead hoist. Slowly raise and move cylinder to one side.

⑤ Attach chains or sling to the inner mast section at top crossmember. Using an overhead hoist slowly raise the upright straight up and out of middle mast section.

⑥ Attach chains or sling to the middle mast section at top crossmember. Using an overhead hoist slowly raise the upright straight up and out of outer mast section.

⑦ Replace upright and reverse above procedure to install. Make all necessary measurements and adjustments.

6) CHAIN

(1) Chain sheave (V, VF mast)

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

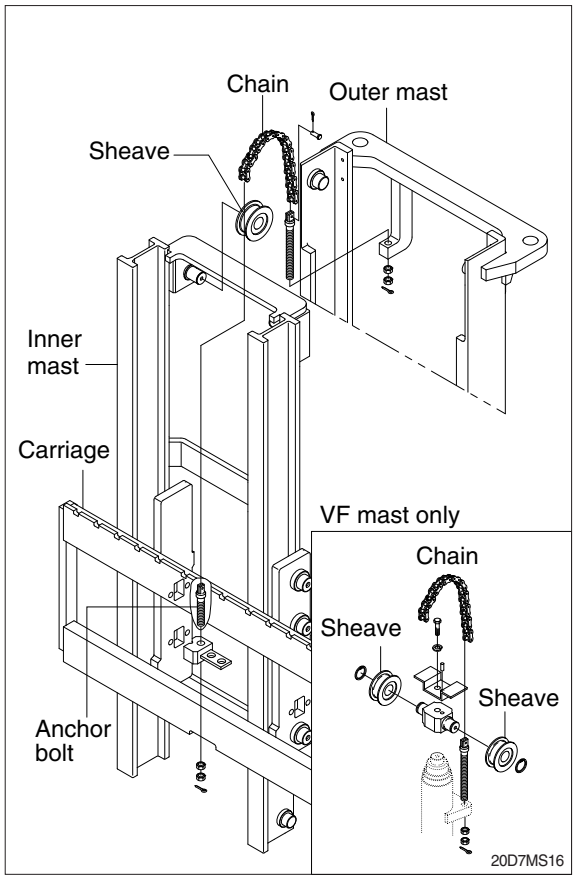
② Remove the split pin securing the chain anchor pins and discard. While supporting the chains, remove the chain anchor pins and drape the chains over the carriage.

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

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

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

⑥ Reverse the above to assemble and install.



(2) Rear chain sheave (TF mast)

① Raise and securely block carriage and inner mast section.

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

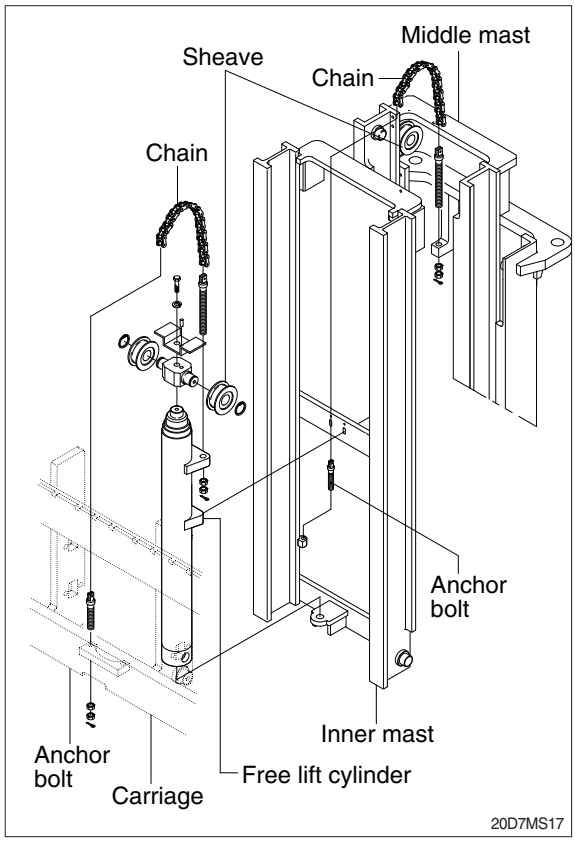
③ Remove chains.

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

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

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

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



(3) Chain wheel bearing support (TF mast)

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

(4) Rear chain (TF mast)

① Remove the carriage assembly and move to one side. Refer to carriage removal and installation.
② Raise and securely block truck approximately 6 inches from the floor.
③ Using a sling or chain around inner mast section attached to an overhead hoist, slowly raise inner mast until there is enough slack in the chains to remove them. Block inner mast section.
④ Remove split pins and chain anchor pins securing chains to chain anchor(part of inner mast).
⑤ While supporting the chains, remove split and chain anchor pins securing chains to chain anchors attached to outer mast section.
⑥ Remove chains.
⑦ Reverse the above to assemble and install. Use new split pins in chain anchor pins. Refer to this section for Load chain lubrication and adjustment.

(5) Carriage chain

① Place a sling around carriage front plate and attach to an overhead hoist. Lift and secure carriage high enough so that split and chain anchor pins on carriage can be easily be removed. Remove chain anchor pins from carriage and drape chains out over carriage.
② Place a wooden block under the carriage and lower the carriage on the block.
③ While supporting the chains, remove split pins and chain anchor pins from chain anchors.
④ Remove chains and wash them with solvent. Refer to this section for Load chain inspection and maintenance.
⑤ Reverse the above procedure to assemble and install. Use new split pins in chain anchor pins. Refer to this section for Load chain lubrication and adjustment.

(6) Load chain inspection and maintenance

After every 200 hours of truck operation, lift chains should be inspected and lubricated inspect for the following chain conditions :

① Wear

As the chain flexes on and off the chain wheel bearings, the joints very gradually wear. The stretch a chain developes in service is due to material being worn off pin outer diameter and pitch hole inner diameter on the inside plate.

Chain wear can be measured using a wear scale or steel tape. When chains have elongated 2%, they should be discarded. When checking chain wear, be sure to measure a segment of chain that operates over a sheave. Do not repair chains by cutting our the worn section and splicing in a new piece. If part of the chain is worn, replace all the chains on the truck.

② Rust and corrosion

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

③ Cracked plate

The most common cause of plate cracking is fatigue failure. Fatigue is a penomenon that affects most metals and many plastics. After many repeated heavy loads, the plates may crack and the chains will 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 chain wheel bearings

An inspection of the chain system includes a close examination of chain anchors and chain wheel bearings. Check chain anchors for wear, breakage and misalignment.

Anchors with worn or broken fingers should be replaced. Anchors should be adjusted to eliminate twisting or other misalignment in the chain. When chain is misaligned, load is not distributed uniformly between the plates. Prolonged operation will result in premature fatigue failure. Chain wheel bearings with badly worn flanges and outside diameter should be replaced.

Heavy flange wear indicates chain misalignment.

⑧ Chain wear scale

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

- Determine pitch length of chain using 6 inch scale on one side of wear scale.
- If pitch is 1/2(12.7㎜), 3/4(19.05㎜), 1(25.4㎜), 1-1/2(38.1㎜), 2(50.8㎜), use side A of scale.
- If pitch is 5/8(15.875㎜), 1-1/4(31.75㎜) or 2(50.8㎜), use side B.
- Align point A or B to center of a pin and note position of the opposite A or B point.
- If other point also lines up with a pin, the chain is worn and should be replaced.

If any of the above conditions exists(cracked plates, turned pins, stretching etc), the chains should be replaced in pairs as a complete assembly. Order chains by part number to insure the correct chain length, pitch and material specifications.

(7) Load chain lubrication and adjustment

① Lubrication

The most important consideration in field maintenance of lift chains is lubrication. Hard working, heavily loaded chains cannot be expected to give satisfactory wear life without scheduled periodic re-lubrication. Like all bearing surfaces, the precision manufactured, hardened steel, joint-wearing surfaces require a film of oil between mating parts to prevent rapid wear. Oil must penetrate the chain joint to prevent wear. Applying oil to external surfaces will prevent rust, but oil must flow into the live bearing surfaces for maximum wear life. Frequency of re-lube will vary with operating conditions and environment, the best estimate of lube period is 200 hours. Trucks parked outdoors or trucks in extremely severe service, may require more frequent re-lube to maintain an oil film on all chain surface.

- Wipe off the old oil with a clean cloth and blow out the remaining dirt with compressed air.

⚠ Wear eye protection.

- With a clean brush, apply EP-140 extreme pressure lubricant or heavy motor oil (40W).

② Replacement

Replace chains as a pair. It will be virtually impossible to maintain uniform loading between the strands if a new chain is put into service opposite an old chain. The jonts in the old chain will be greater than that on the new chain, greatly complicating the problem of maintaining equal chain tension. The new chain will wear more slowly causing it to bear the major portion of the load resulting in premature wear and fatigue failure. Don't steam clean or decrease new chains.

The manufacturer's grease is effective in reducing wear and corrosion. If the original factory lube is dried out or wiped off, soak the new chain in heavy engine oil for at 1/2 hour prior to installing on truck. After the old chains have been stripped from the mast, very carefully inspect chain anchors and chain wheel bearing. Broken, cracked or worn anchor must be replaced using the new anchor pin and split pin. Do not paint newly replaced chain after it has been installed.

③ Adjustment

Chain adjustments are important for the following reasons :

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

④ Adjustment procedure

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