CONTENTS

SECTION 8 MAST

1. STRUCTURE

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

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

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

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

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

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

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

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

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

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

2. HOW TO READ THE SERVICE MANUAL

Distribution and updating

Any additions, amendments or other changes will be sent to HYUNDAI distributors.

Get the most up-to-date information before you start any work.

Filing method

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

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

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

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

Revised edition mark(①②③…)

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

Revisions

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

Symbols

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

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

3. CONVERSION TABLE

Method of using the Conversion Table

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

Example

1. Method of using the Conversion Table to convert from millimeters to inches
   Convert 55mm into inches.
   (1) Locate the number 50in the vertical column at the left side, take this as ⓐ, then draw a horizontal line from ⓐ.
   (2) Locate the number 5in the row across the top, take this as ⓑ, then draw a perpendicular line down from ⓑ.
   (3) Take the point where the two lines cross as ⓒ. This point ⓒ gives the value when converting from millimeters to inches. Therefore, 55mm = 2.165 inches.

2. Convert 550mm into inches.
   (1) The number 550 does not appear in the table, so divide by 10(Move the decimal point one place to the left) to convert it to 55mm.
   (2) Carry out the same procedure as above to convert 55mm to 2.165 inches.
   (3) The original value(550mm) was divided by 10, so multiply 2.165 inches by 10(Move the decimal point one place to the right) to return to the original value.
   This gives 550mm = 21.65 inches.

Millimeters to inches

1mm = 0.03937 in

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

Millimeters to inches

1mm = 0.03937in

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

Kilogram to Pound

1kg = 2.2046lb

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

Liter to U.S. Gallon

1 l = 0.2642 U.S.Gal

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

Liter to U.K. Gallon

1 l = 0.21997 U.K.Gal

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

kgf · m to lbf · ft

1kgf · m = 7.233lbf · ft

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

kgf/cm^2 to lbf/in^2

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

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

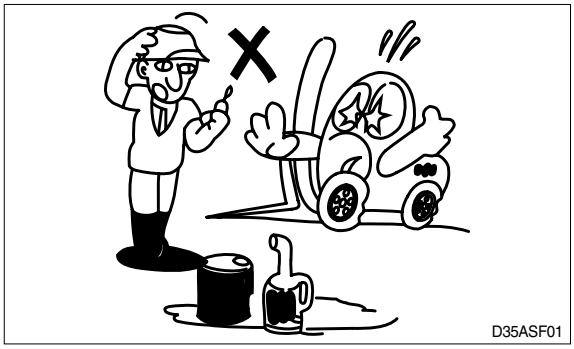
°C		°F	°C		°F	°C		°F	°C		°F
-40.4	-40	-40.0	-11.7	11	51.8	7.8	46	114.8	27.2	81	117.8
-37.2	-35	-31.0	-11.1	12	53.6	8.3	47	116.6	27.8	82	179.6
-34.4	-30	-22.0	-10.6	13	55.4	8.9	48	118.4	28.3	83	181.4
-31.7	-25	-13.0	-10.0	14	57.2	9.4	49	120.2	28.9	84	183.2
-28.9	-20	-4.0	-9.4	15	59.0	10.0	50	122.0	29.4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

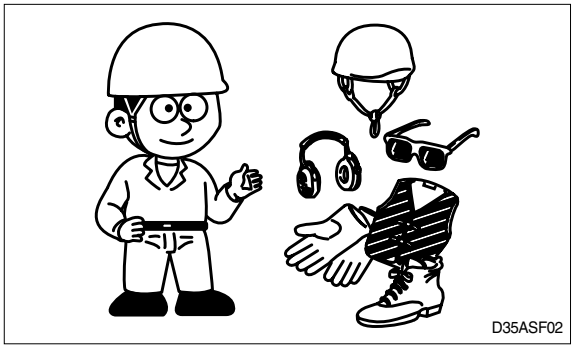
GROUP 1 SAFETY HINTS

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

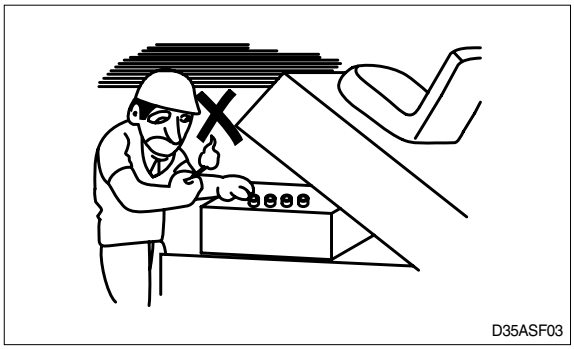
- Oil is a dangerous substance. Never handle oil, grease or oily clothes in places where there is any fire of flame.
  As preparation in case of fire, always know the location and directions for use of fire extinguishers and other fire fighting equipment.


D35ASF01

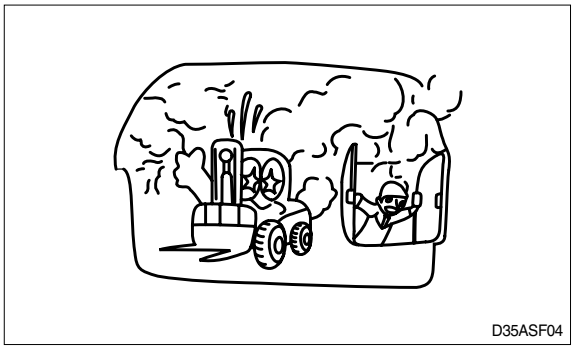
- Wear well-fitting helmet, safety shoes and working clothes. When drilling, grinding or hammering, always wear protective goggles.
  Always do up safety clothes properly so that they do not catch on protruding parts of machines. Do not wear oily clothes.
  When checking, always release battery plug.


D35ASF02

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

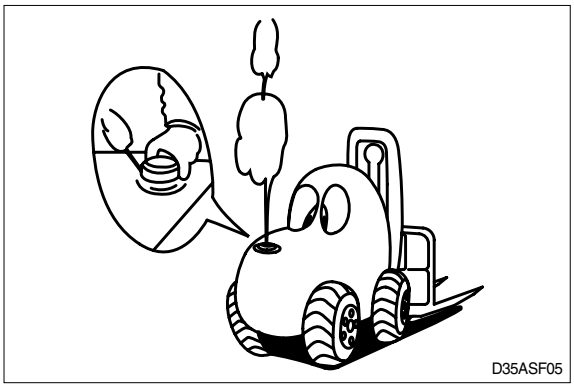

D35ASF03

- 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.

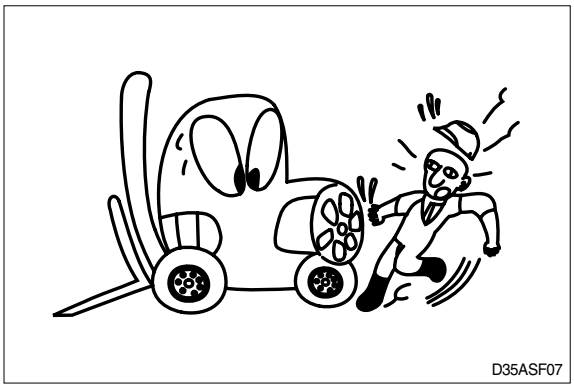

D35ASF05

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


D35ASF06

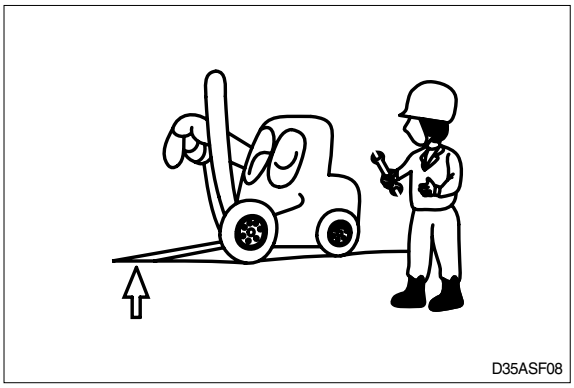
· Hand a caution sign in the operator's compartment (For example **Do not start** or **Maintenance in progress**).
This will prevent anyone from starting or moving the machine by mistake.

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

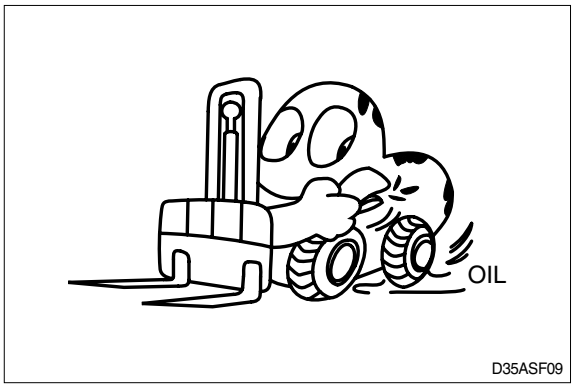

D35ASF07

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.

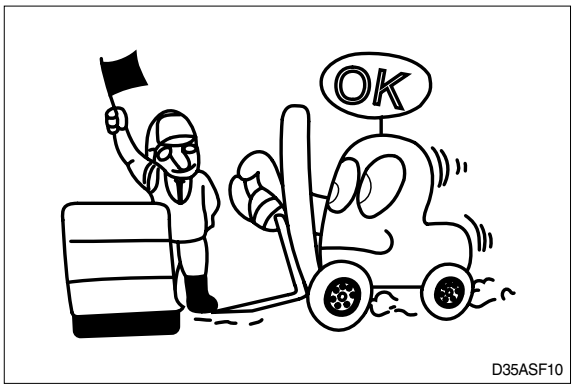
· Park the machine on firm, flat ground.
Lower the fork to the ground and stop the engine.
Return each lever to **NEUTRAL** and apply the brake lock.


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.

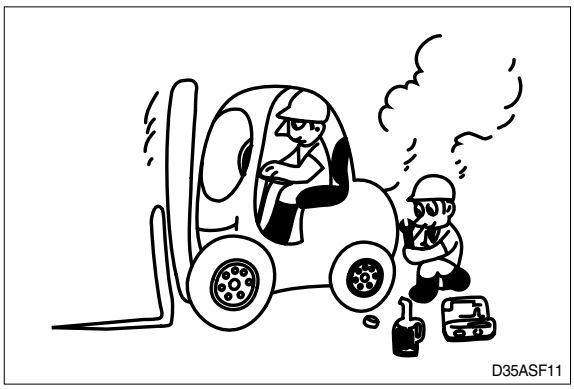


- When working with others, choose a group leader and work according to his instructions. Do not perform any maintenance beyond the agreed work.



- 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.

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

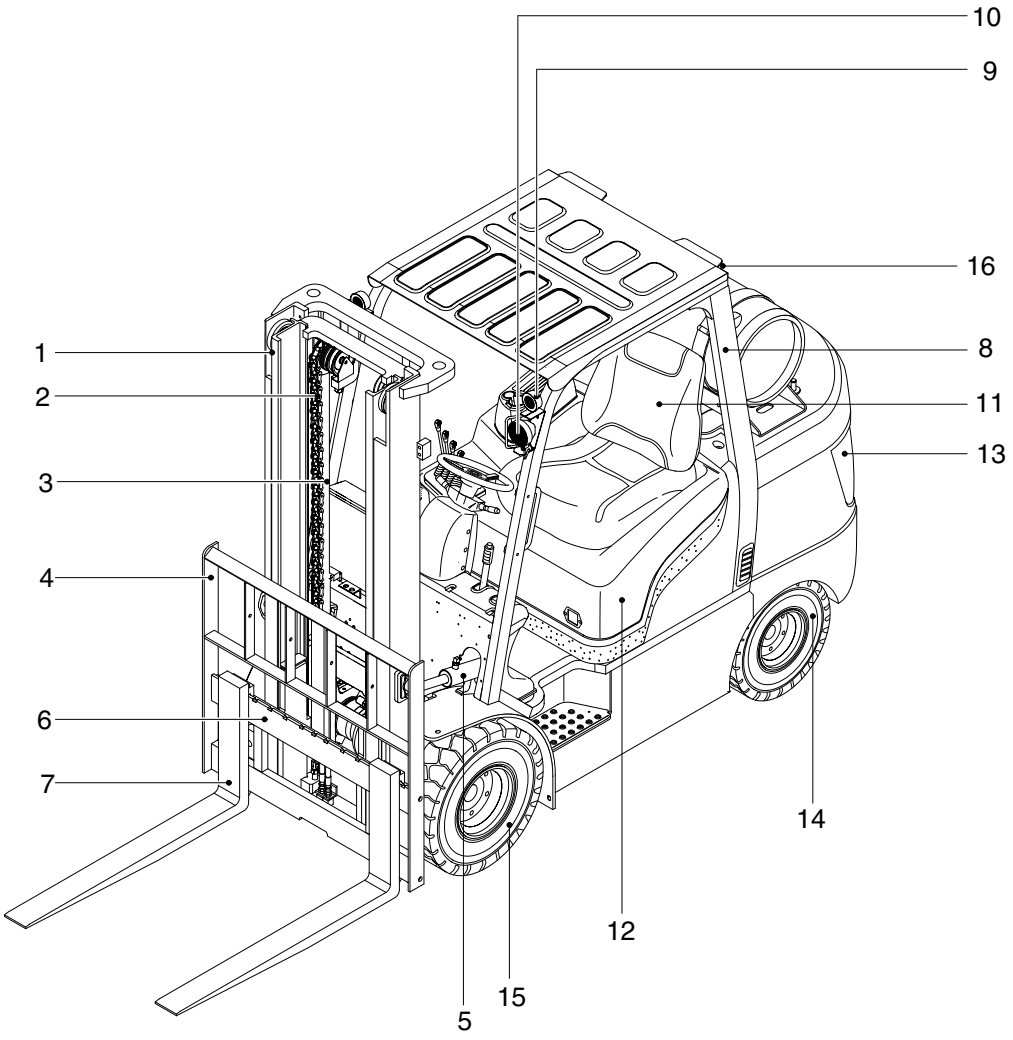


- Thoroughly clean the machine. In particular, be careful to clean the filler caps, grease fittings and the area around the dipsticks. Be careful not to let any dirt or dust into the system.
- Always use HYUNDAI Forklift genuine parts for replacement.
- Always use the grades of grease and oil recommended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

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

GROUP 2 SPECIFICATIONS

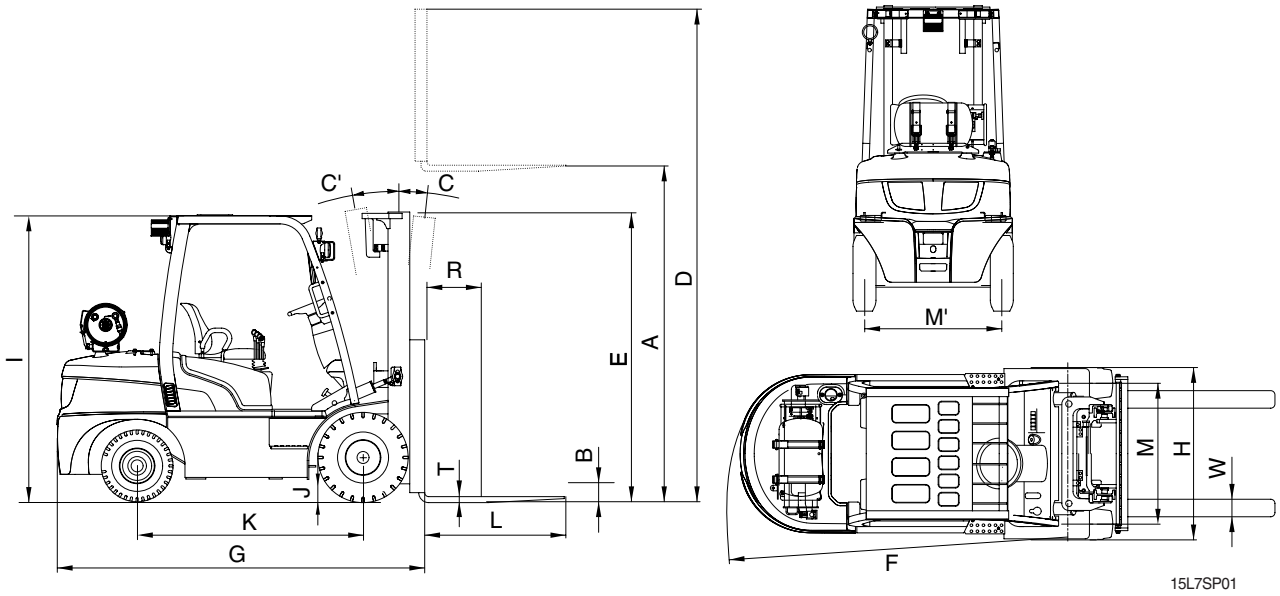
1. GENERAL LOCATIONS



15L7GE01

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

2. SPECIFICATIONS



Description			Unit	15L-7,15G-7	18L-7, 18G-7	20LA-7, 20GA-7
Capacity			kg	1500	1750	2000
Load center		R	mm	500	←	←
Weight(Unloaded)			kg	2818	2992	3139
Fork	Lifting height	A	mm	3325	←	←
	Free lift	B	mm	145	←	150
	Lifting speed(Unload/Load)		mm/sec	680/650	←	←
	Lowering speed(Unload/Load)		mm/sec	450/500	←	←
	L × W × T	L,W,T	mm	900 × 100 × 35	←	900 × 100 × 40
Mast	Tilt angle (forward/backward)	C/C'	degree	6/10	←	←
	Max height	D	mm	4332	←	←
	Min height	E	mm	2155	←	←
Body	Travel speed		km/h	20.7	←	←
	Gradeability		degree	37	33.1	31
	Min turning radius(Outside)	F	mm	1985	2015	2050
ETC	Max hydraulic pressure		kgf/cm^2	190	←	←
	Hydraulic oil tank		ℓ	30	←	←
	Fuel tank		ℓ	44	←	←
Overall length		G	mm	2233	2263	2303
Overall width		H	mm	1070	←	←
Overhead guard height		I	mm	2110	←	←
Ground clearance(Load)		J	mm	120	←	←
Wheel base		K	mm	1410	←	←
Wheel tread front/rear		M, M'	mm	890/910	←	←

3. SPECIFICATION FOR MAJOR COMPONENTS

1) ENGINE

ITEM	UNIT	SPECIFICATION
Model	-	HYUNDAI beta
Type	-	4-cycle, Vertical
Cooling Method	-	Water cooled
Number of cylinders and arrangement	-	4 cylinders, In line
Firing order	-	1-3-4-2
Cylinder bore X stroke	mm(in)	82×93.5(3.2×3.7)
Piston displacement	cc(cu in)	1975(120.5)
Compression ratio	-	9.4
Rated gross horse power	ps/rpm	50/2450
Maximum gross torque at rpm	kgf · m/rpm	16.3/1600
Engine oil quantity	ℓ (U.S.gal)	4(1.06)
Dry weight	kg(lb)	150(331)
High idling speed	rpm	2700
Low idling speed	rpm	800
Rated fuel consumption	g/ps.hr	-
Starting motor	V-kW	12-1.7
Alternator	V-A	13.5-90
Battery	V-AH	12-60
Fan belt deflection	mm(in)	10~15 (0.4~0.6)

2) MAIN PUMP

ITEM	UNIT	SPECIFICATION
Type	-	Gear
Capacity	cc/rev	26
Maximum operating pressure	bar	210
Rated speed (Max/Min)	rpm	3000/500

3) MAIN CONTROL VALVE

ITEM	UNIT	SPECIFICATION
Type	-	Sectional
Operating method	-	Mechanical
Relief valve pressure(Main/Aux)	bar	190/150
Flow capacity	lpm	80

4) POWER TRAIN DEVICES

Item			Specification
Torque converter	Model		ZF 280 27 613 / G7
	Type		3 Element, 1 stage, 2 phase
	Stall ratio		2.8 : 1
Transmission	Type		Full auto, Power shift
	Gear shift(FR/RR)		1/1
	Control		Electrical single lever type, kick-down system
	Overhaul ratio	FR	2.137 : 1
		RR	2.214 : 1
Axle	Type		Front-wheel drive type, fixed location
	Gear ratio		6.5 : 1
	Gear		Ring & pinion gear type
Wheels	Quantity(FR/RR)		2/2
	Front(drive)		6.50-10-12PR
	Rear(steer)		5.00-8-10PR
Brakes	Travel		Front wheel, Wet disc brake
	Parking		Ratchet, band brake type
Steering	Type		Hydro static, power steering
	Steering angle		81° to both right and left angle, respectively

4. TIGHTENING TORQUE OF MAJOR COMPONENTS

NO	ITEMS		SIZE	kgf · m	lbf · ft
1	Engine	Engine mounting bolt, nut	M12×1.25	12.3±2.4	89±17.4
2		Radiator mounting bolt, nut	M 8×1.25	2.5±0.5	18.1±3.6
3		Torque converter mounting bolt	M10×1.25	6.9±1.4	50±10
4	Hydraulic system	MCV mounting bolt, nut	M10×1.5	6.9±1.4	50±10
5		Steering unit mounting bolt	M10×1.5	4.0±0.5	29±3.6
6	Power train system	Transmission mounting bolt, nut	M16×2.0	7.5	54
7		Drive axle mounting bolt, nut	M20×1.5	62.5±9.5	452±69
8		Steering axle mounting bolt, nut	M20×2.5	58±8.5	420±61
9		Front wheel mounting nut	M14×1.5	17.5±1.5	127±10.8
10		Rear wheel mounting nut	M12×1.5	10±1	72±7.2
11	Others	Counterweight mounting bolt	M30×3.5	60±5	434±36
12		Operator's seat mounting nut	M 8×1.25	2.5±0.5	18.1±3.6
13		Head guard mounting bolt	M12×1.75	6.2	44.8

5. TORQUE CHART

Use following table for unspecified torque.

1) BOLT AND NUT

(1) Coarse thread

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

(2) Fine thread

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

2) PIPE AND HOSE(FLARE TYPE)

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

3) PIPE AND HOSE(ORFS TYPE)

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

4) FITTING

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

6. RECOMMENDED LUBRICANTS

Use only oils listed below or equivalent.

Do not mix different brand oil.

Service point	Kind of fluid	Capacity ℓ (U.S.gal)	Ambient temperature °C (°F)
		1.5~2.0ton	-20 (-4) / -10 (14) / 0 (32) / 10 (50) / 20 (68) / 30 (86) / 40 (104)
Engine oil pan	Engine oil	3.9 (1.0)	SAE 10W-30 (API SL class or better)
Torque converter transmission	ATF Engine oil	8.5 (2.2)	ATF DEXRON III
Axle	Gear oil	3.5 (0.9)	Mobil Fluid 424
Hydraulic tank	Hydraulic oil	STD : 24.5 (6.5) OPT : 30 (8.0)	ISO VG32 / ISO VG46 / ISO VG68
Fuel tank	LPG	-	LPG
	Gasoline	38.7 (10.2)	Gasoline*
Fitting (Grease nipple)	Grease	-	NLGI No.1 / NLGI No.2
Brake reservoir tank	Brake oil	0.5 (0.13)	Azolla ZS10 (Hydraulic oil ISO VG10)
Radiator	Antifreeze:Water 50:50	17.0 (4.5)	Ethylene glycol base permanent type

* : 15G/18G/20GA-7

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.

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 degrees 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).

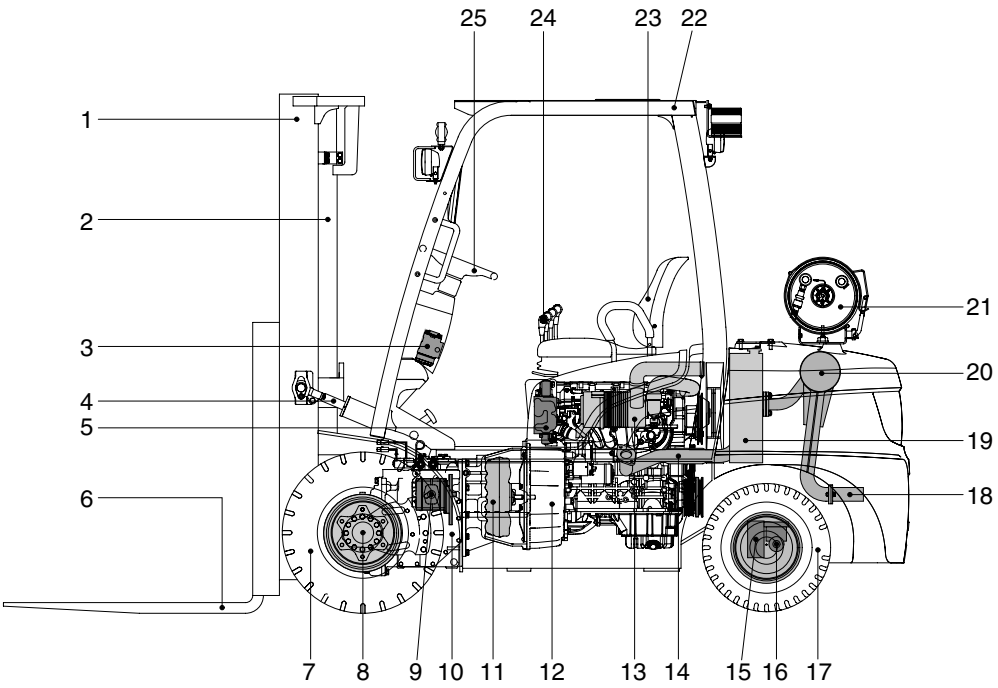
※ **Replacement of consumable service parts in not covered under warranty.**

No	Description	Period of replacement
1	Master cylinder and wheel cylinder caps, dust seals	Every 1 year
2	Brake hose or tube	Every 1 or 2 years
3	Brake reservoir tank and tube	Every 2 to 4 years
4	Power steering hose	Every 2 years
5	Stop lamp switch(oil pressure type)	Every 2 years
6	Fuel hose	Every 2 to 4 years
7	Rubber parts of power steering	Every 2 to 4 years
8	Lift chain	Every 2 to 4 years
9	Hose of load handling	Every 1 or 2 years

SECTION 2 REMOVAL AND INSTALLATION OF UNIT

SECTION 2 REMOVAL & INSTALLATION OF UNIT

GROUP 1 STRUCTURE



15L7RE01

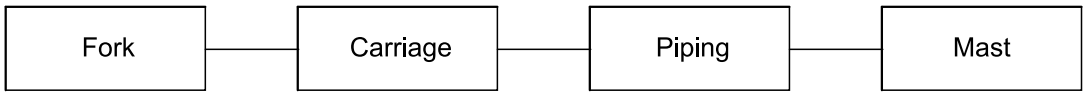
1	Mast	10	Transmission	19	Radiator
2	Lift cylinder	11	Torque converter	20	Muffler
3	Steering unit	12	Engine	21	LPG tank
4	Tilt cylinder	13	Air cleaner	22	Overhead guard
5	Main control valve	14	Exhaust pipe	23	Seat
6	Fork	15	Steering axle	24	Control lever
7	Front wheel	16	Steering cylinder	25	Steering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

GROUP 2 REMOVAL AND INSTALLATION OF UNIT

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

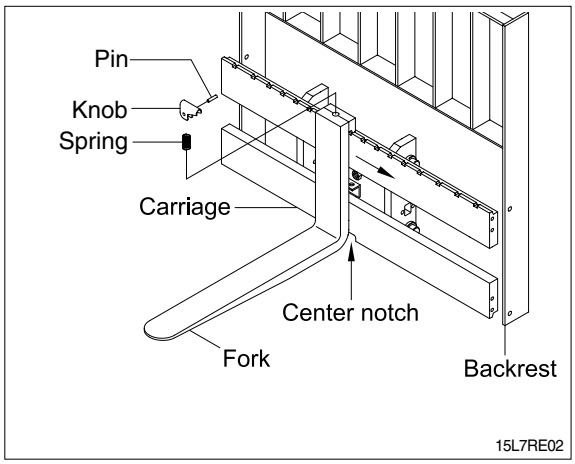
1. MAST

1) REMOVAL



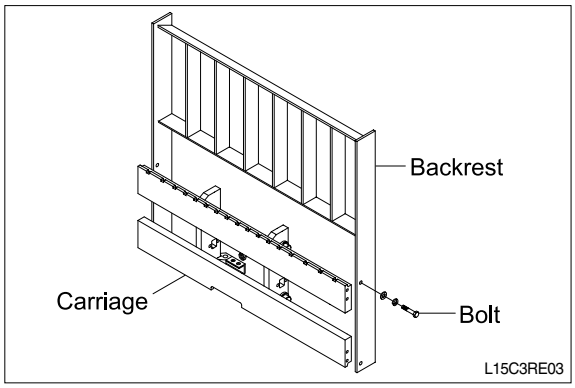
(1) Forks

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



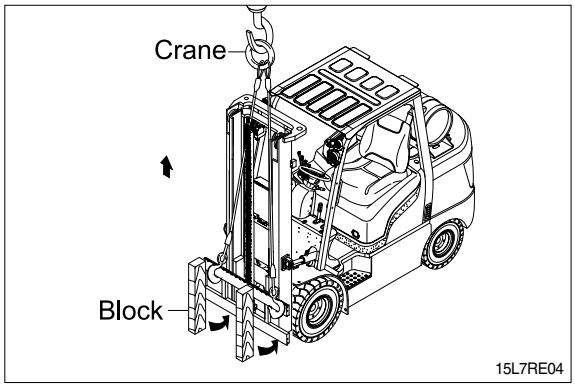
(2) Backrest(If necessary)

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

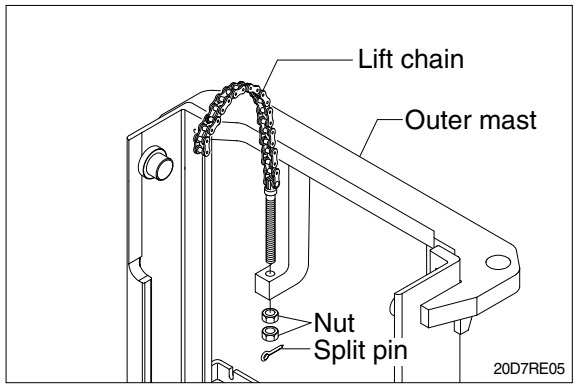


(3) Carriage

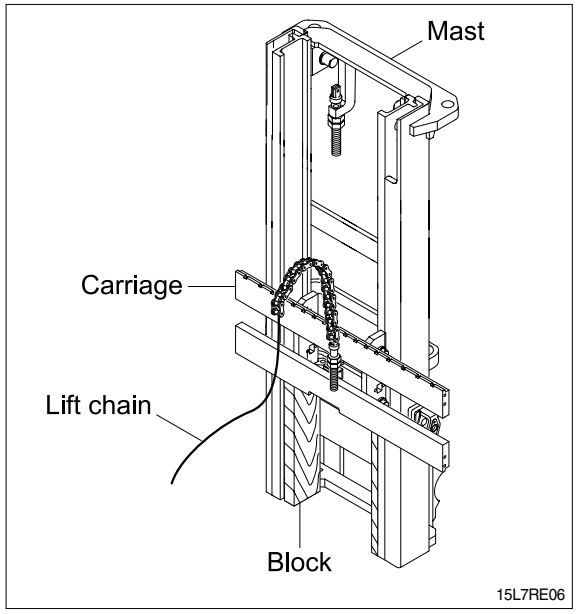
① With the mast vertical, raise the carriage high enough to place blocks under the load forks. This is done to create slack in the load chains when the carriage is lowered. Lower the carriage all the way down to the floor. Make sure the carriage is level, this will prevent any binding when the mast is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



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



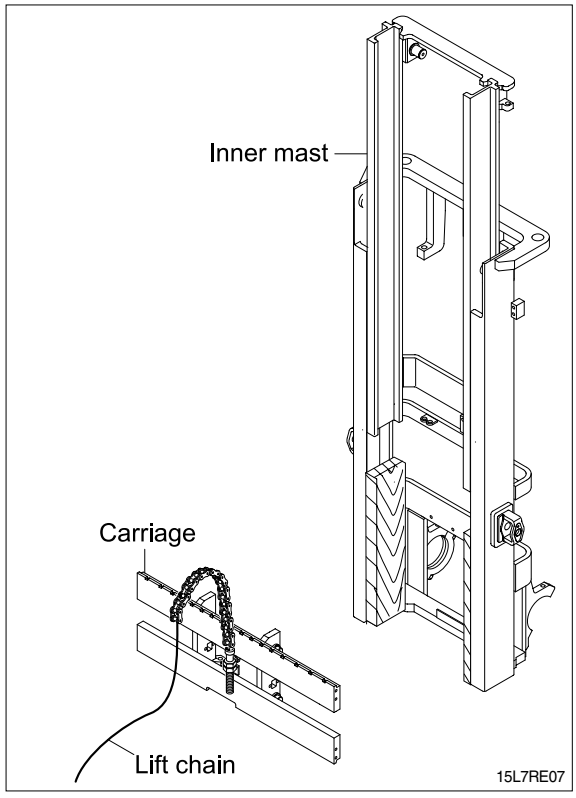
③ Pull the chains out of the sheaves and drape them over the front of the carriage.



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

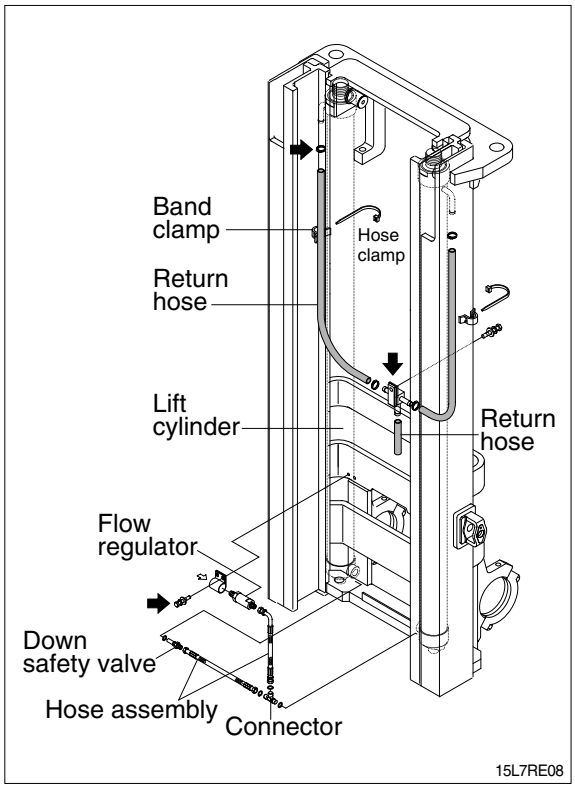
⚠ **Make sure that carriage remains on floor and does not bind while mast is being raised.**

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



(4) Piping

① Remove the return hoses and clamps attached to the cylinder.
② Remove the return hoses from the connector.
③ Remove hose assembly, connector, down safety valve from the lift cylinder.
④ Disconnect hose assembly from the flow regulator.

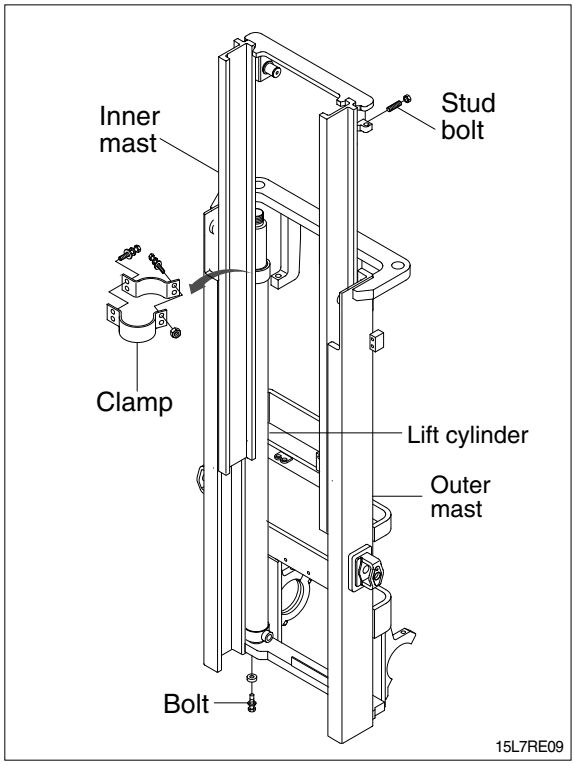


(5) Lift cylinder

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.

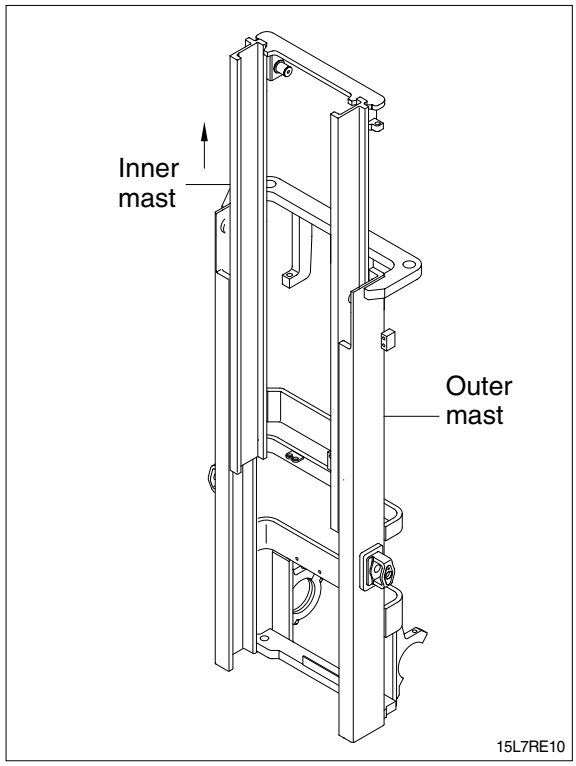
③ Loosen and remove hexagon nuts and cylinder band securing cylinder to outer mast.
④ Using an overhead hoist, slowly raise the inner mast high enough to clear lift cylinder.
⑤ Using an overhead hoist, draw out lift cylinder carefully and put down on the work floor.



(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.**



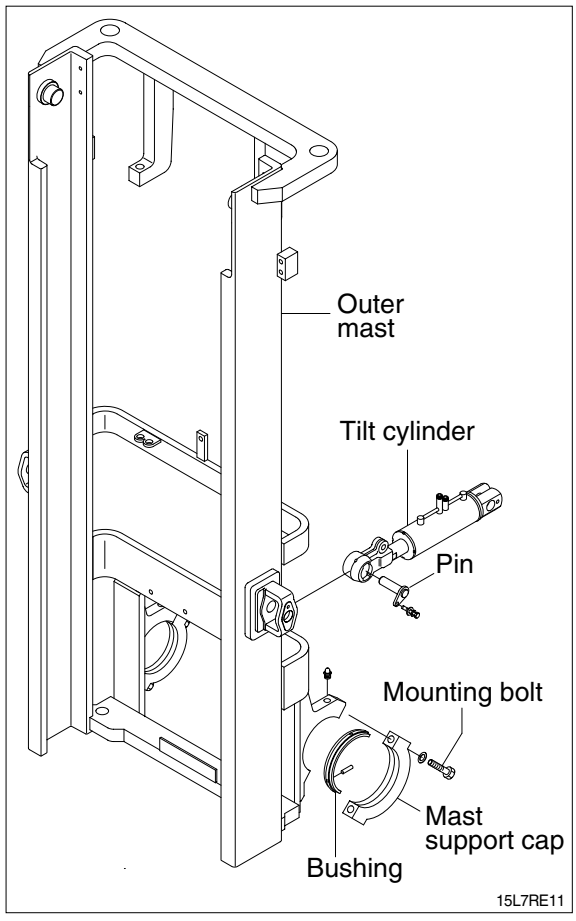
(7) Tilt cylinder pin

(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 on 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.

· Tightening torque : 19.9~26.9kgf · m(144~195lbf · ft)

(2) Tilt cylinder pin

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

(3) Lift cylinder installation and adjustment

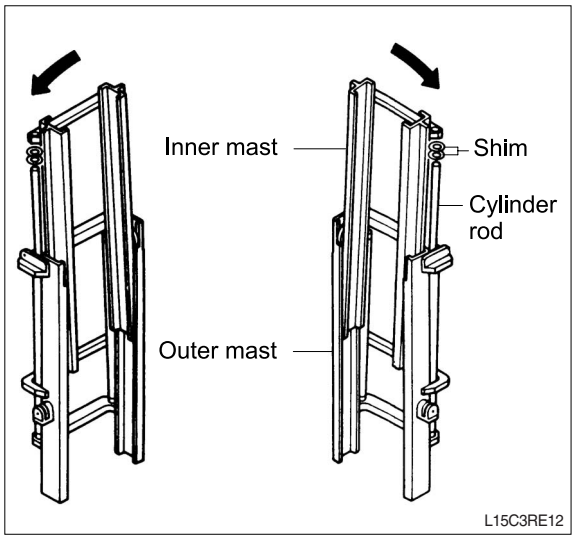
① Assemble the lift cylinder inside the outer mast, then tighten the stopper bolt. If the cylinder assembly has been replaced, adjust as follows so that the left and right cylinders are synchronized at the maximum lifting height.

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

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

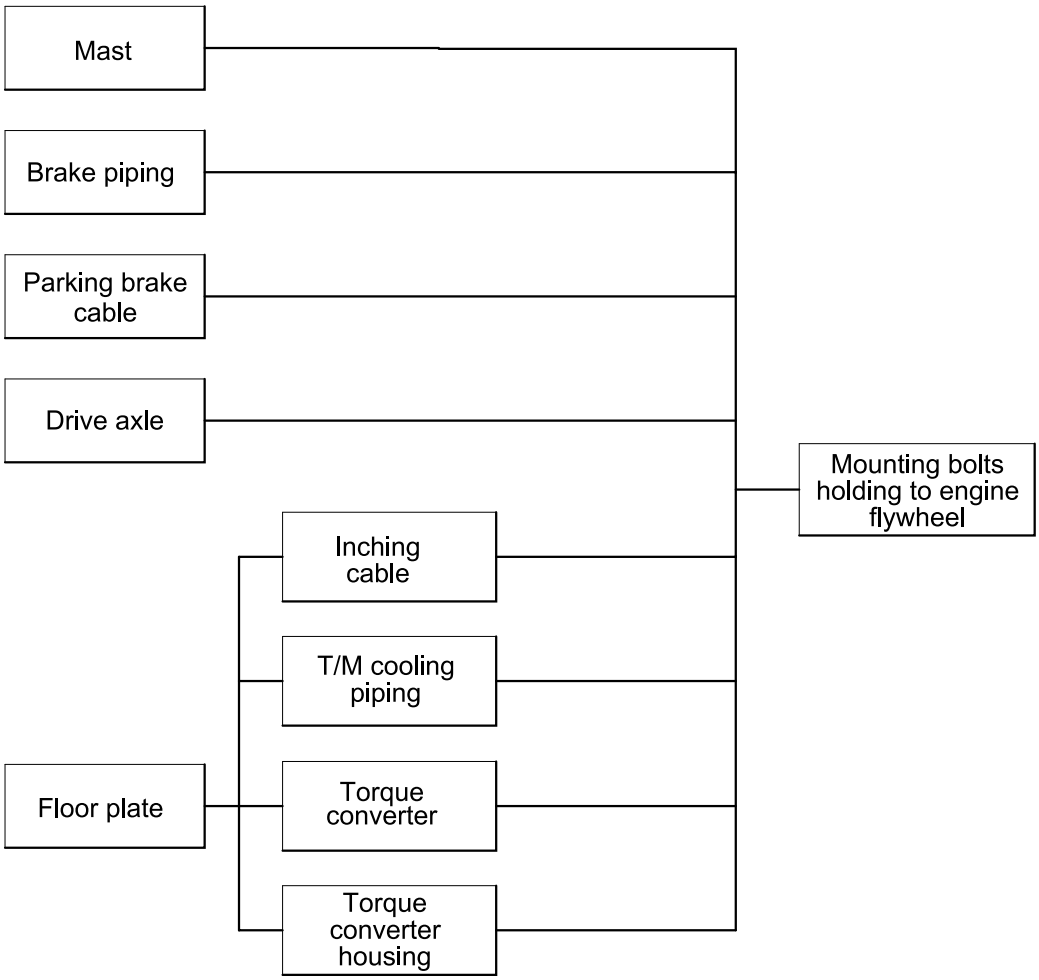
※ If play is to RIGHT, install adjustment shim to RIGHT cylinder.

· Shim thickness : 1.0mm(0.04in)



2. POWER TRAIN ASSEMBLY

1) REMOVAL



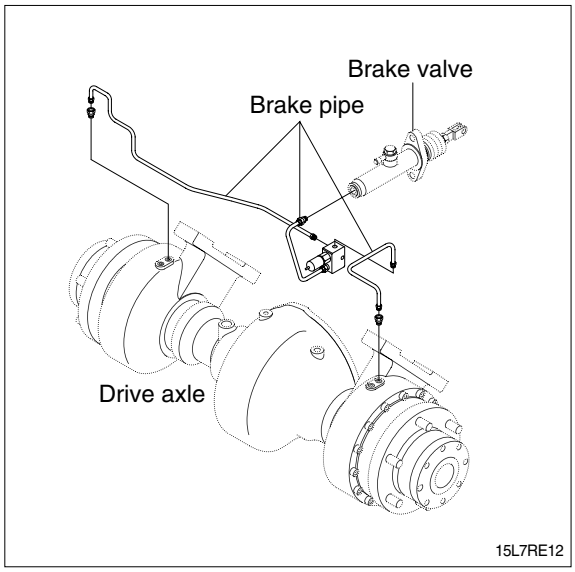
D503RE04

(1) Mast

Refer to section on mast (Page 2-2)

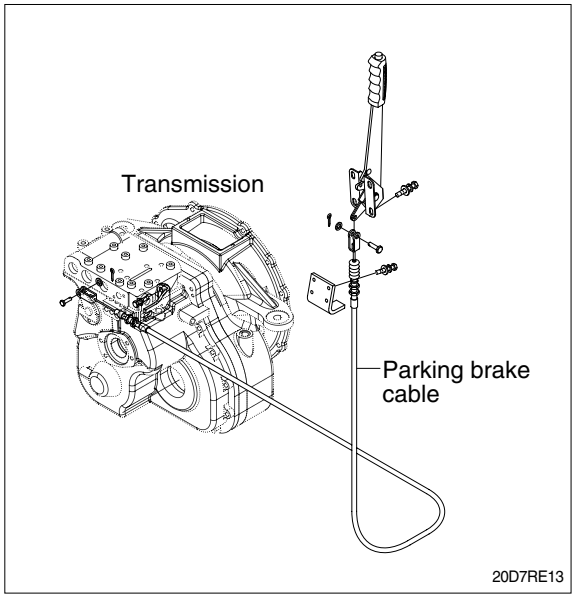
(2) Brake piping

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



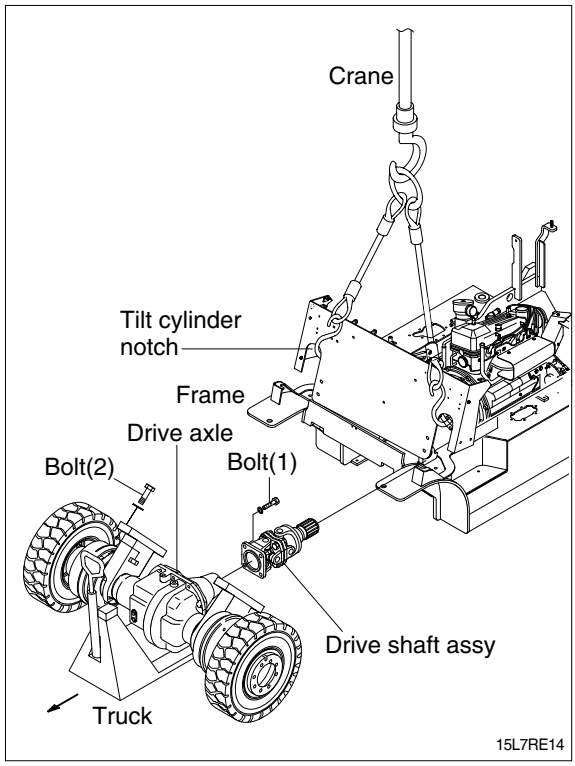
(3) Parking brake cable

Disconnect parking brake cable from the transmission.



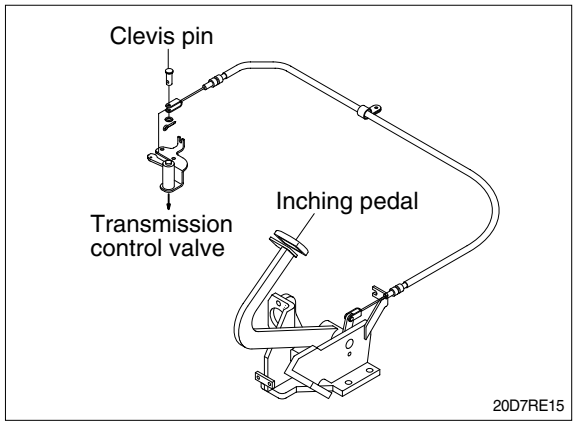
(4) Drive axle

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.



(5) Inching linkage

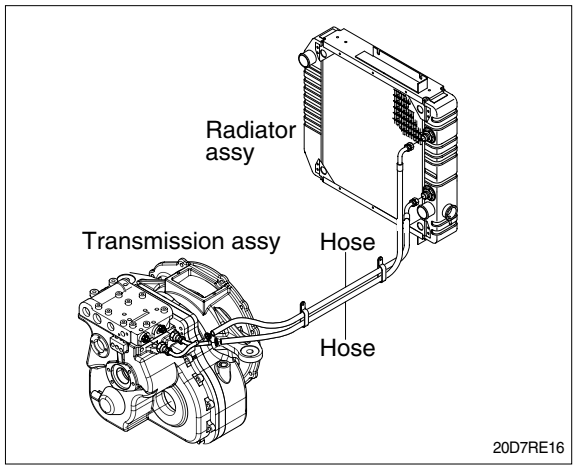
Remove the clevis pin from the transmission control valve.



(6) Transmission cooling piping

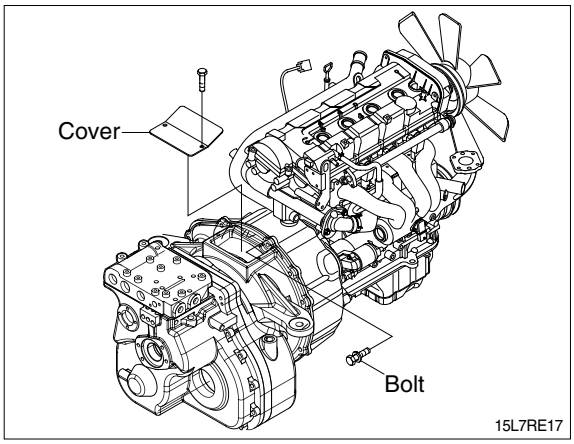
① Disconnect cooling hose from the transmission.

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



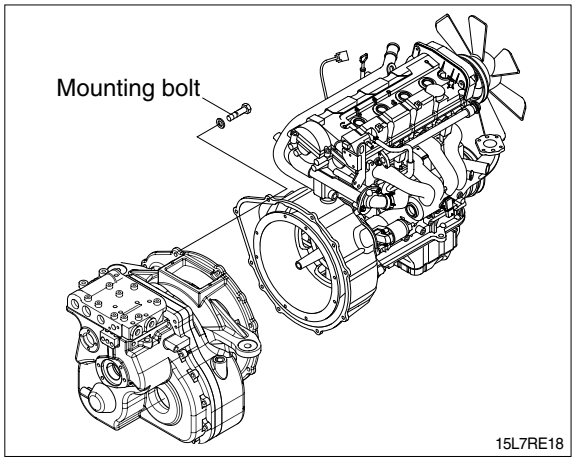
(7) Torque converter

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.

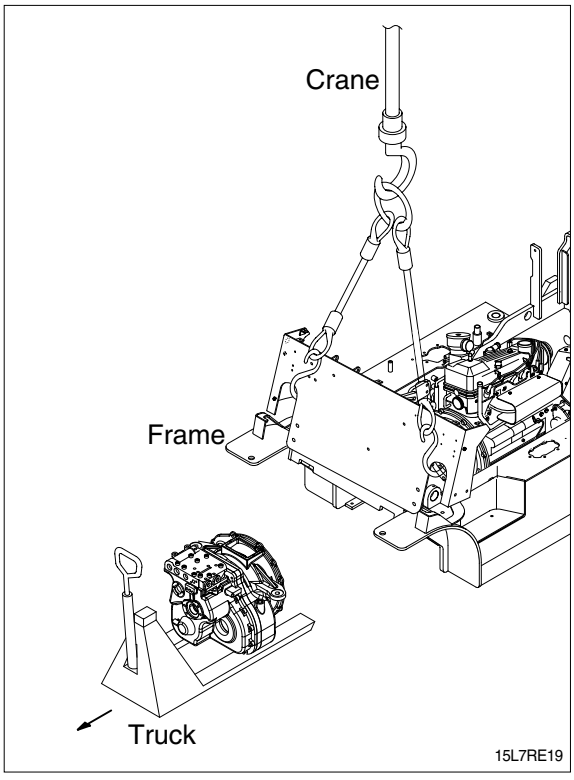


(8) Mounting bolts holding to flywheel housing

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.

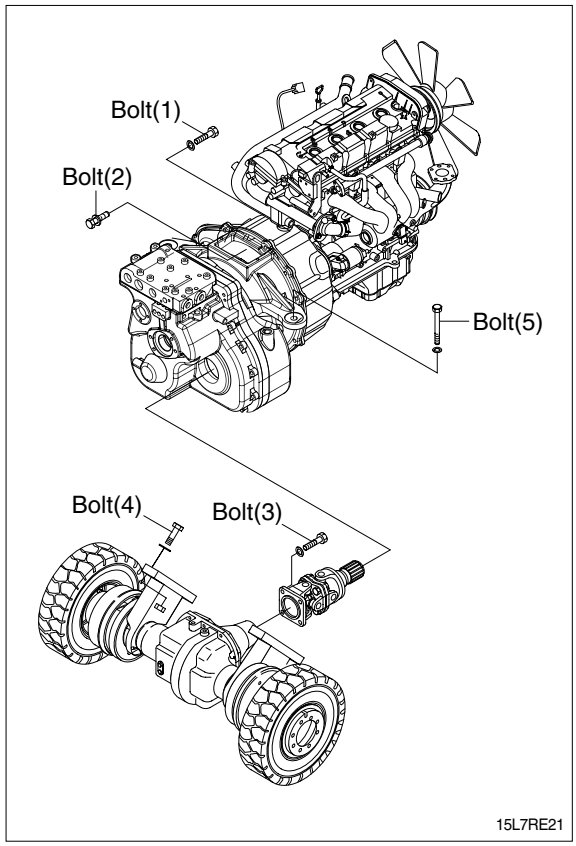


2) INSTALLATION

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

(2) Tightening torque

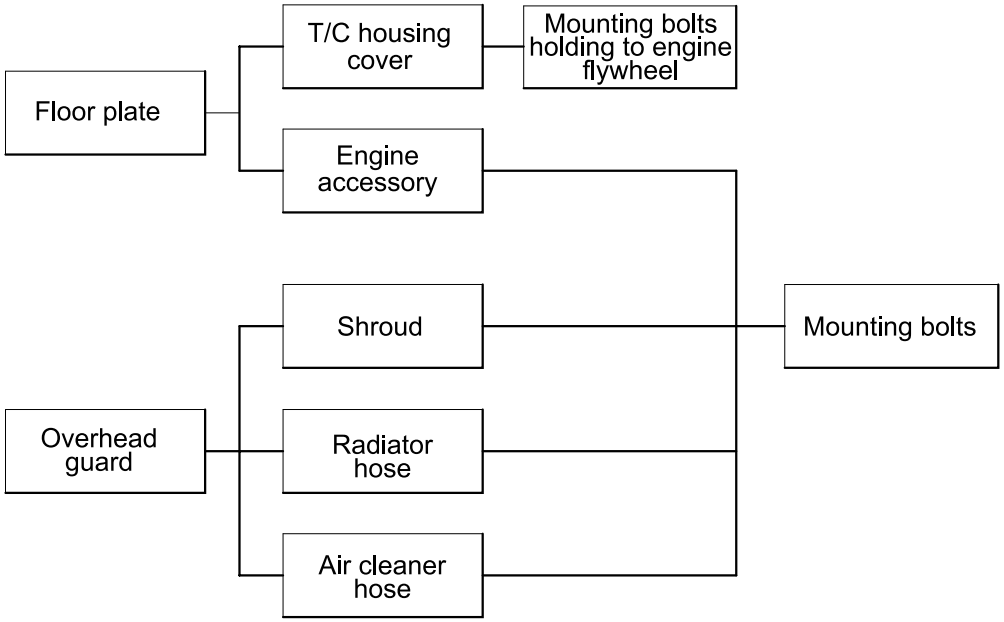
- Bolt (1) : 5.5~8.3kgf · m (39.8~60lbf · ft)
- Bolt (2) : 2.7~4.1kgf · m (19.5~29.7lbf · ft)
- Bolt (3) : 5.5~8.3kgf · m (39.8~60lbf · ft)
- Bolt (4) : 57~72kgf · m (412~521lbf · ft)
- Bolt (5) : 7.5kgf · m (54.2lbf · ft)



3. ENGINE

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

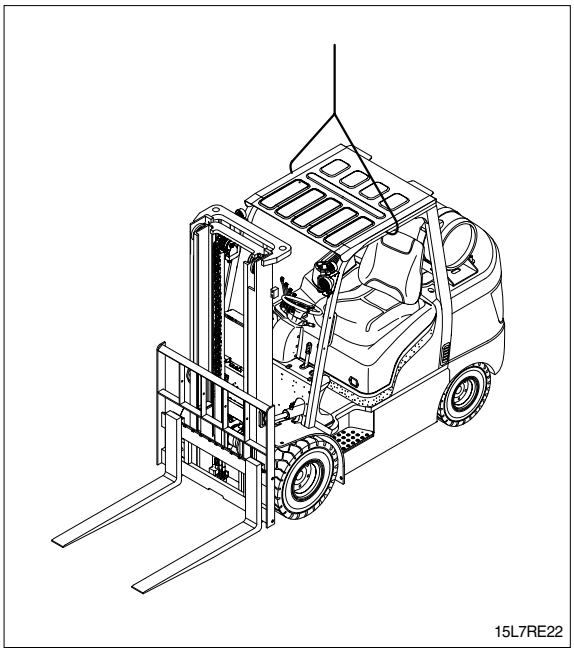
1) REMOVAL



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.



15L7RE22

(2) Remove the torque converter housing cover, mounting bolts installed to flywheel housing.
For details, see page 2-10.

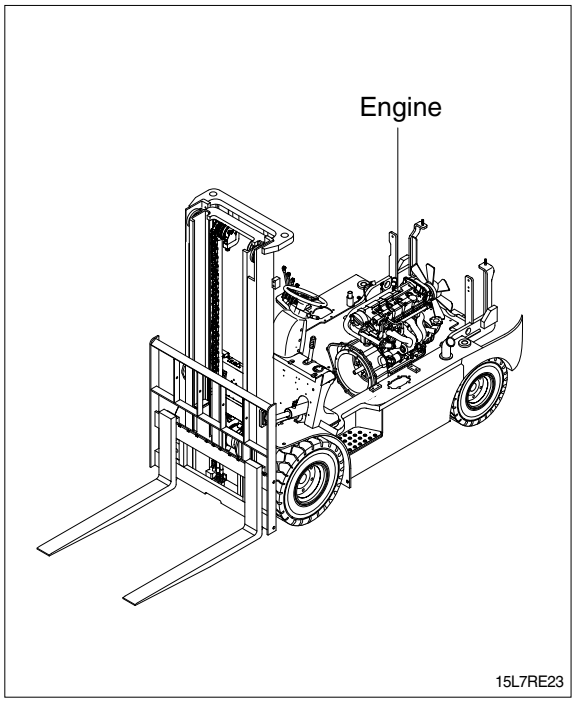
(3) Engine accessory

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 Hoses to fuel tank and air cleaner.
④ Exhaust pipe.

(4) Radiator hose

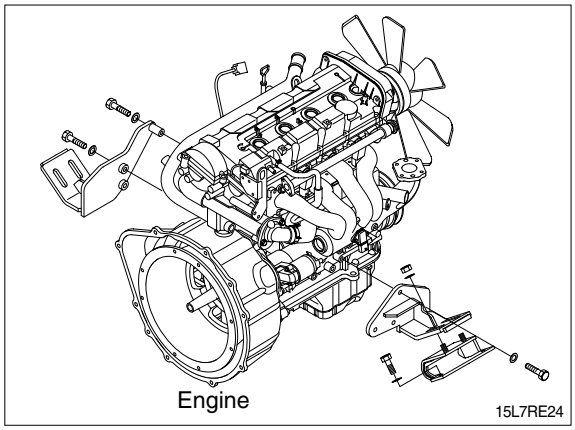
Open the drain valve of the radiator and drain the cooling water, then remove the radiator hose.



(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.

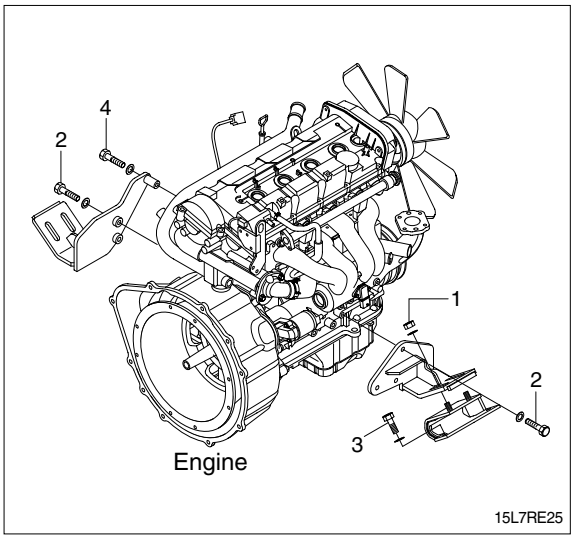
(2) Tighten the engine mounting bracket bolts.

※ 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

· Bolt(1) : 11~16kgf · m (79.6~115.8lbf · ft)
(2) : 5.5~8.3kgf · m (39.8~60lbf · ft)
(3) : 10~15kgf · m (72~108.5lbf · ft)
(4) : 2.7~4.1kgf · m (19.5~29.7lbf · ft)



(4) Radiator hoses

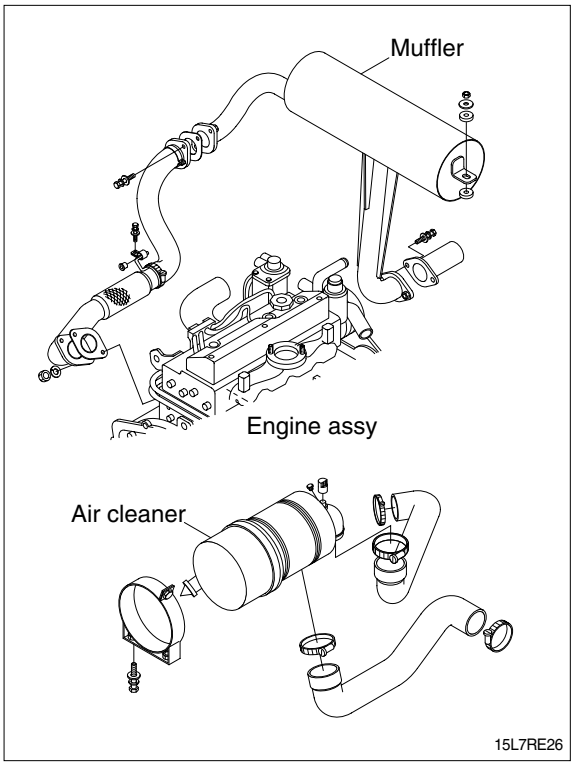
· Distance to insert hose : 35mm (1.4in)

(5) Air cleaner hose

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

② **Distance to insert hose**

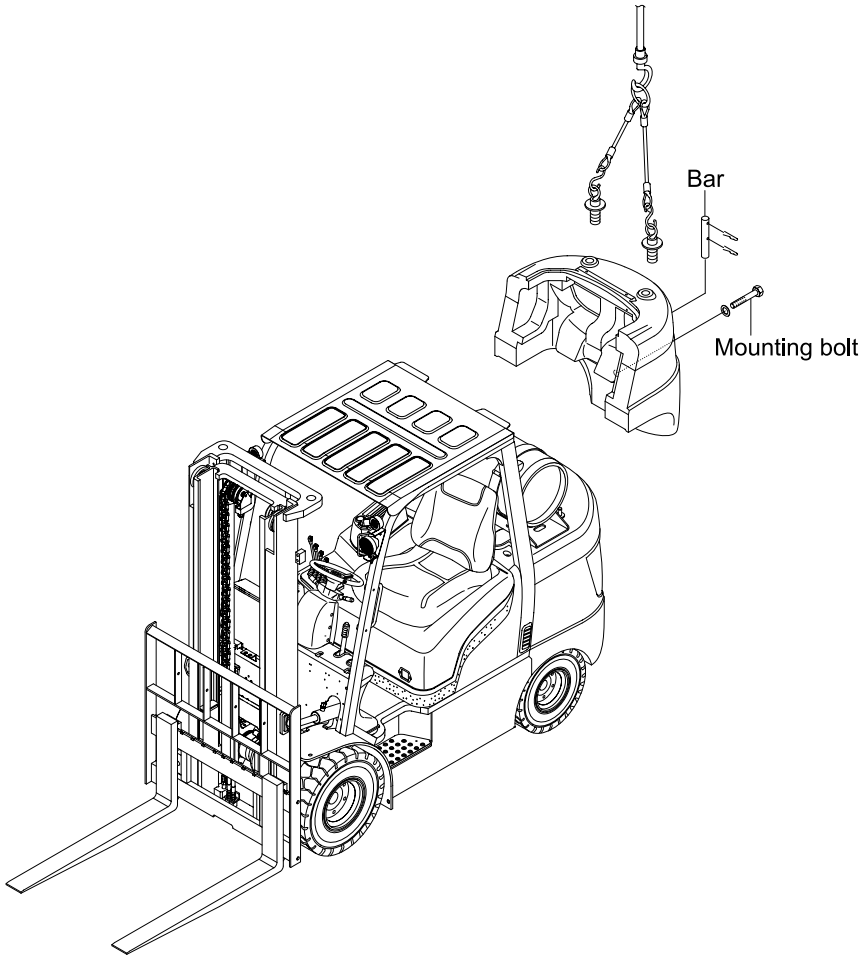
· Air cleaner hose : 35mm (1.4in)
· Engine end : 25mm (1in)



4. STEERING AXLE

1) REMOVAL

Counterweight — Rear wheel — Hose — Mounting bolt



15L7RE27

(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)

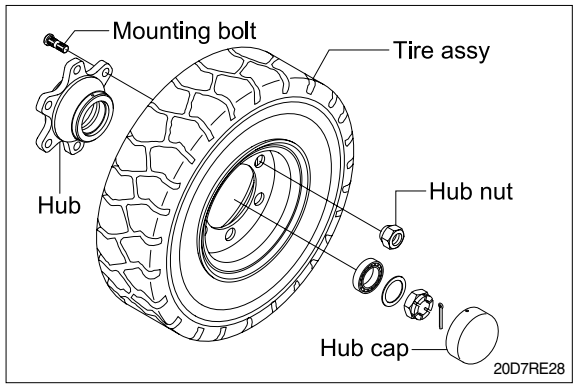
15L-7, 15G-7 : 735kg(1620lb)

18L-7, 18G-7 : 900kg(1980lb)

20LA-7, 20GA-7 : 1035kg(2280lb)

(2) Rear wheel

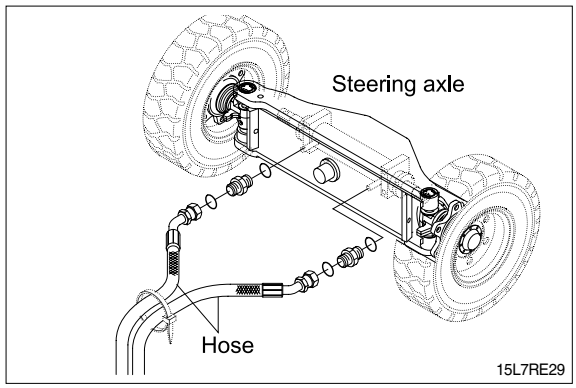
Remove mounting bolt and hub nut with socket wrench and then carefully take out the tire assembly.



(3) Hose

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

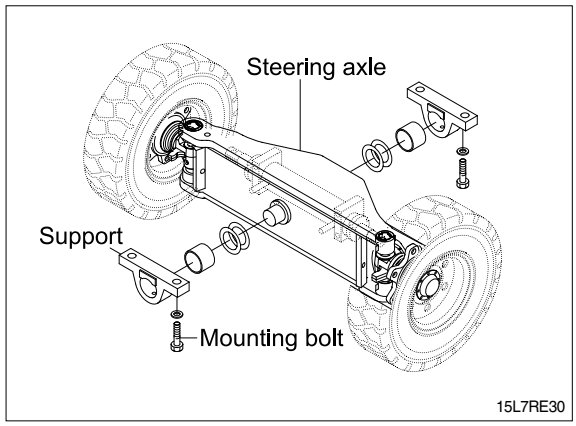
Loosen connector and then disconnect the hoses.



(4) Mounting bolt

Put a block under the steering axle, support on a truck, and 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.



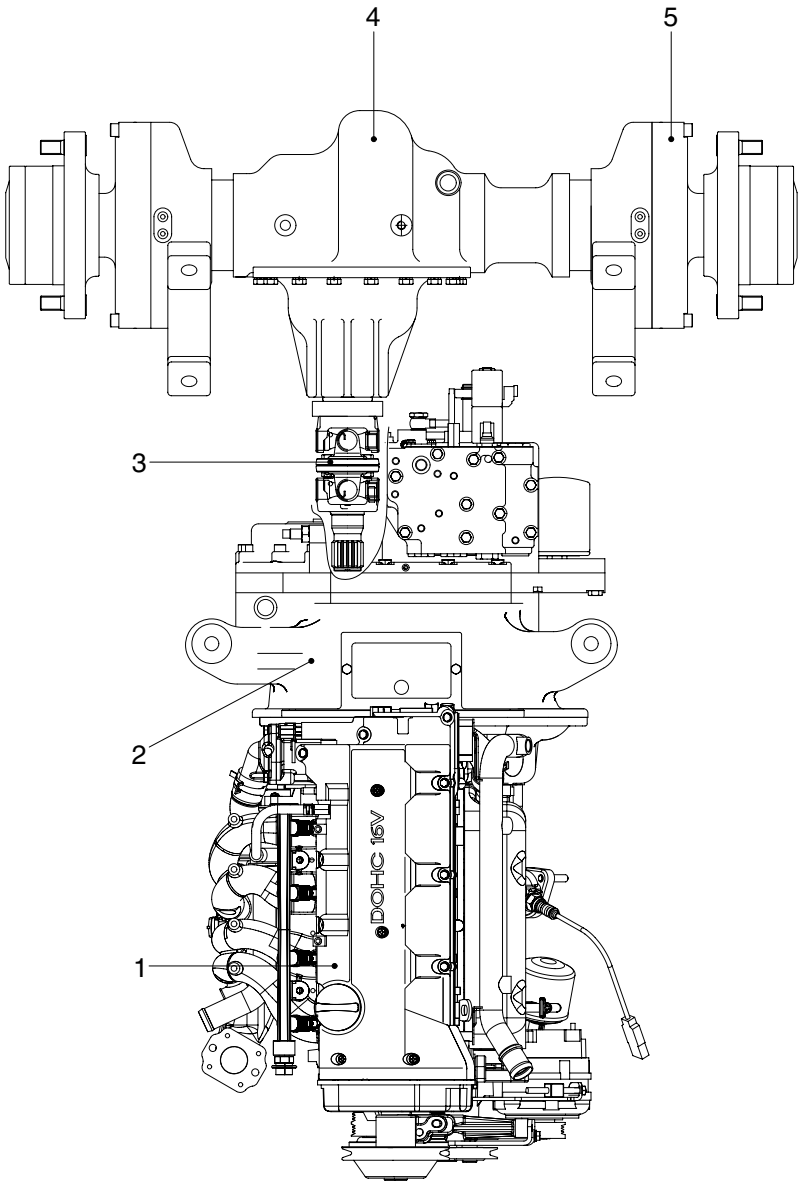
SECTION 3 POWER TRAIN SYSTEM

SECTION 3 POWER TRAIN SYSTEM

GROUP 1 STRUCTURE AND OPERATION

1. POWER TRAIN DIAGRAM

1) STRUCTURE



20L7PT26

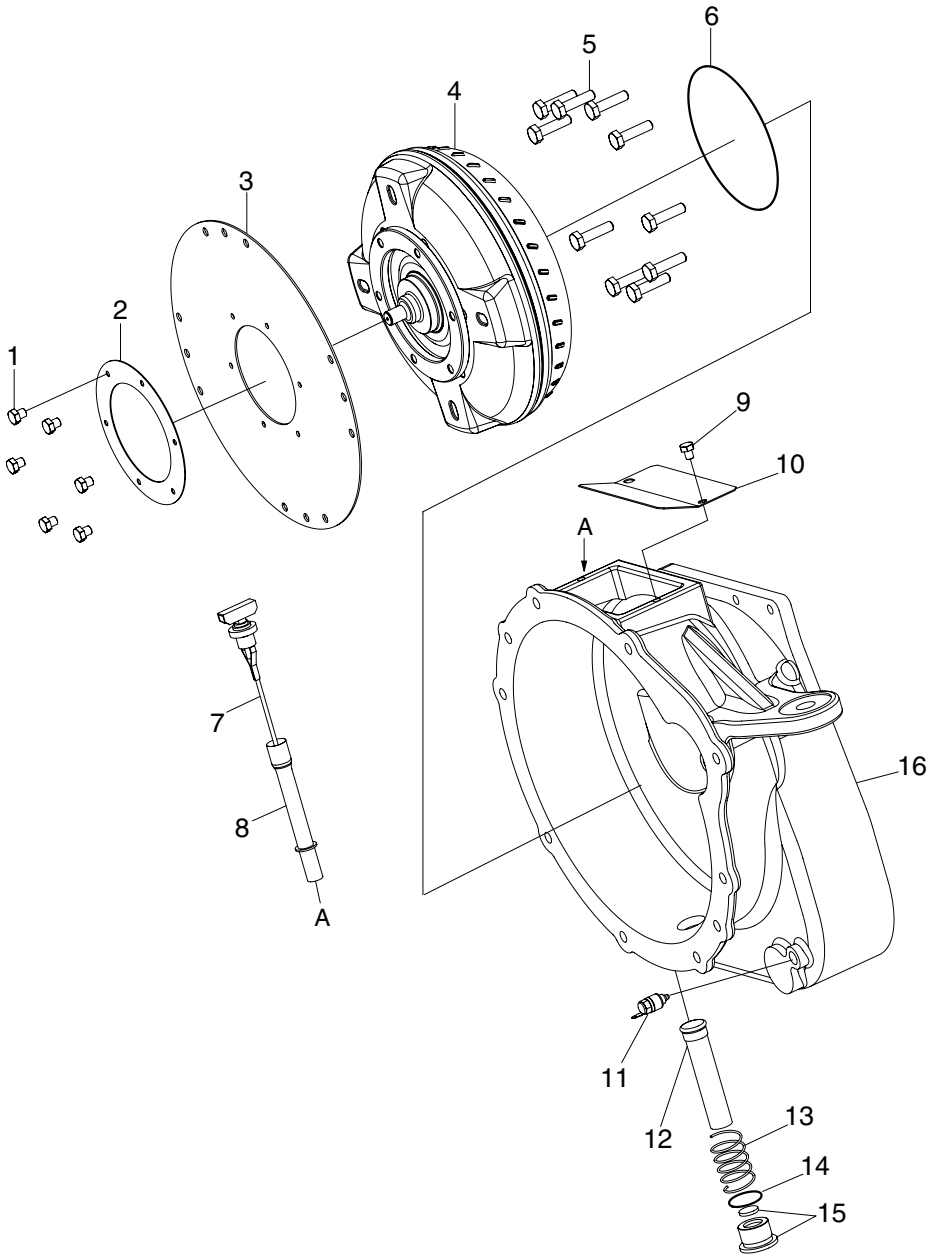
1	Engine	3	Drive shaft	5	Brake
2	Transmission	4	Drive axle		

2) SPECIFICATION

Item			Specification
Torque converter	Model		ZF 280 27 613 / G7
	Type		3 Element, 1 stage, 2 phase
	Stall ratio		2.8 : 1
Transmission	Type		Full auto, power shift
	Gear shift(FR/RR)		1/1
	Control		Electrical single lever type, kick-down system
	Overhaul ratio	FR	2.137 : 1
		RR	2.214 : 1
Axle	Type		Front-wheel drive type, fixed location
	Gear ratio		6.5 : 1
	Gear		Ring & pinion gear type
Wheels	Quantity(FR/RR)		2/2
	Front(drive)		6.50-10-12PR
	Rear(steer)		5.00-8-10PR
Brakes	Travel		Front wheel, Wet disc brake
	Parking		Ratchet, band brake type
Steering	Type		Hydro static, power steering
	Steering angle		81° to both right and left angle, respectively

2. TORQUE CONVERTER

1) STRUCTURE



20D7PT03

1	Bolt	9	Bolt
2	Plate	10	Torque converter housing cover
3	Flexible plate	11	Temperature sensor
4	Torque converter assembly	12	Inner oil strainer
5	Bolt	13	Oil strainer spring
6	O-ring	14	O-ring
7	Oil level gauge	15	Oil strainer plug
8	Oil level gauge guide	16	Torque converter housing

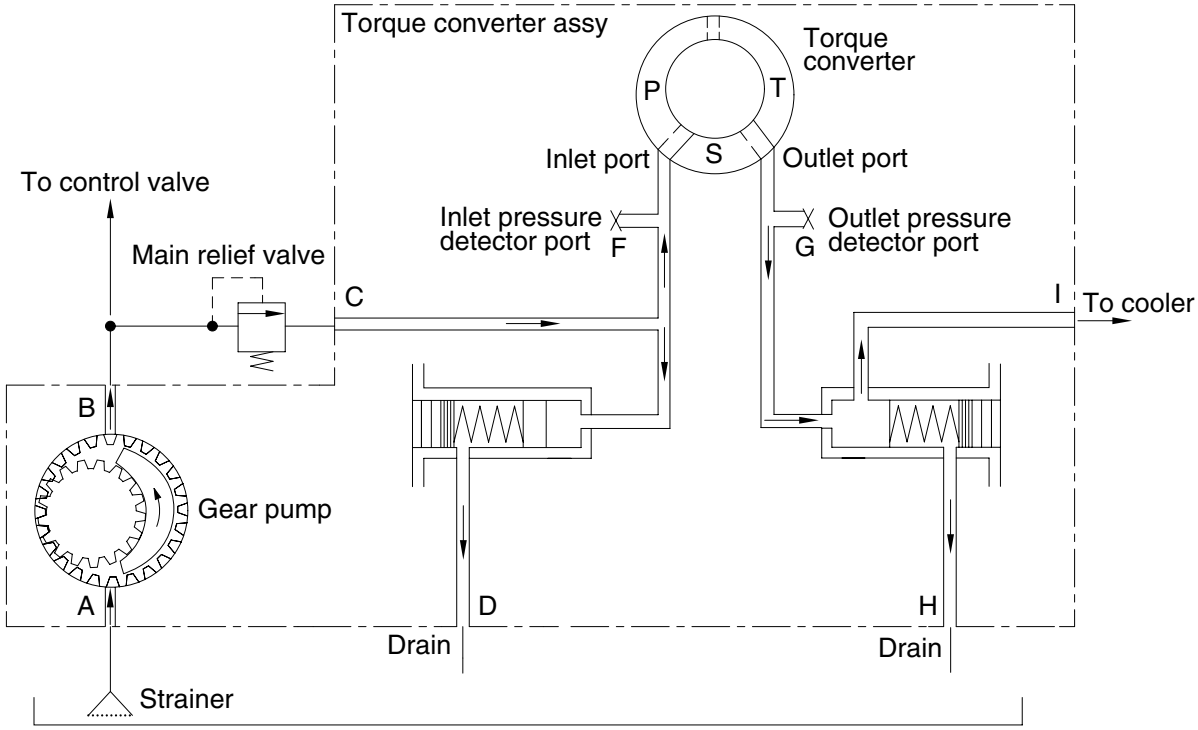
2) OPERATION

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.

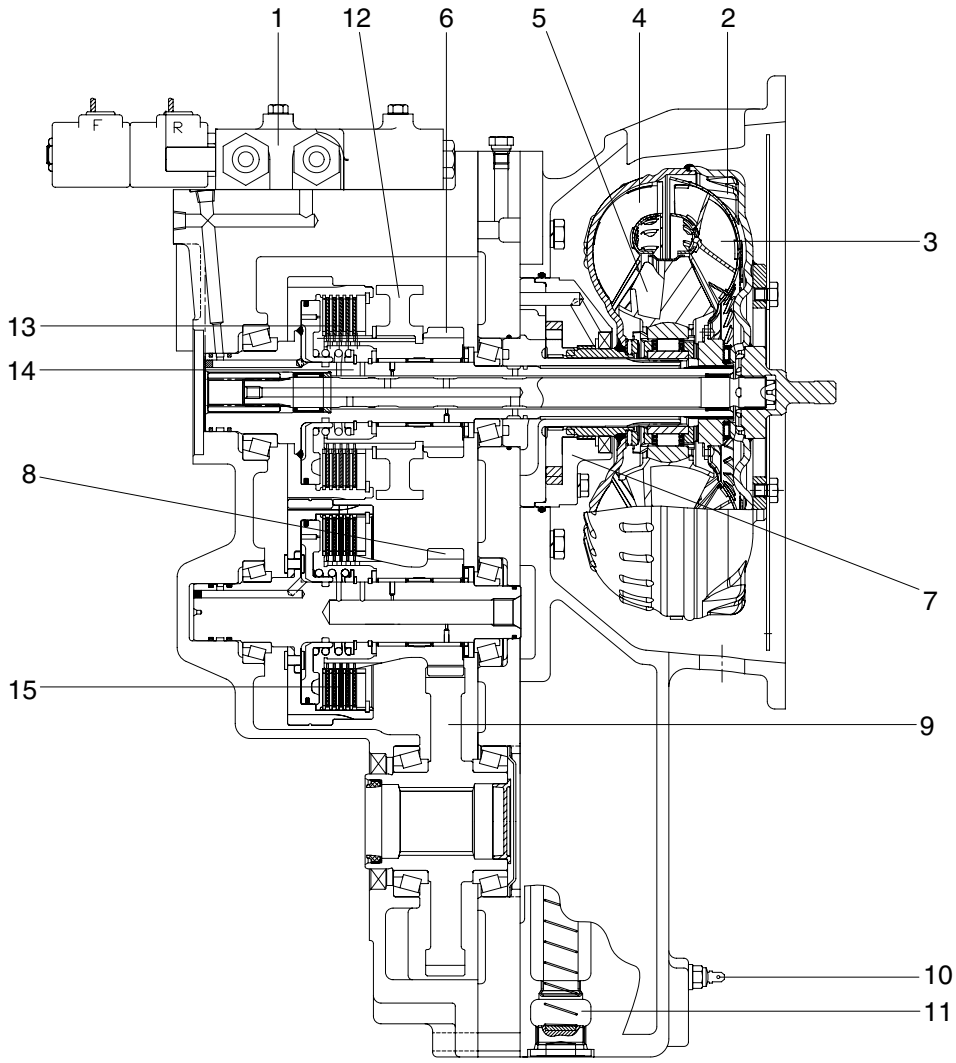
3) TORQUE CONVERTER HYDRAULIC CIRCUIT



20D7PT04

3. TRANSMISSION

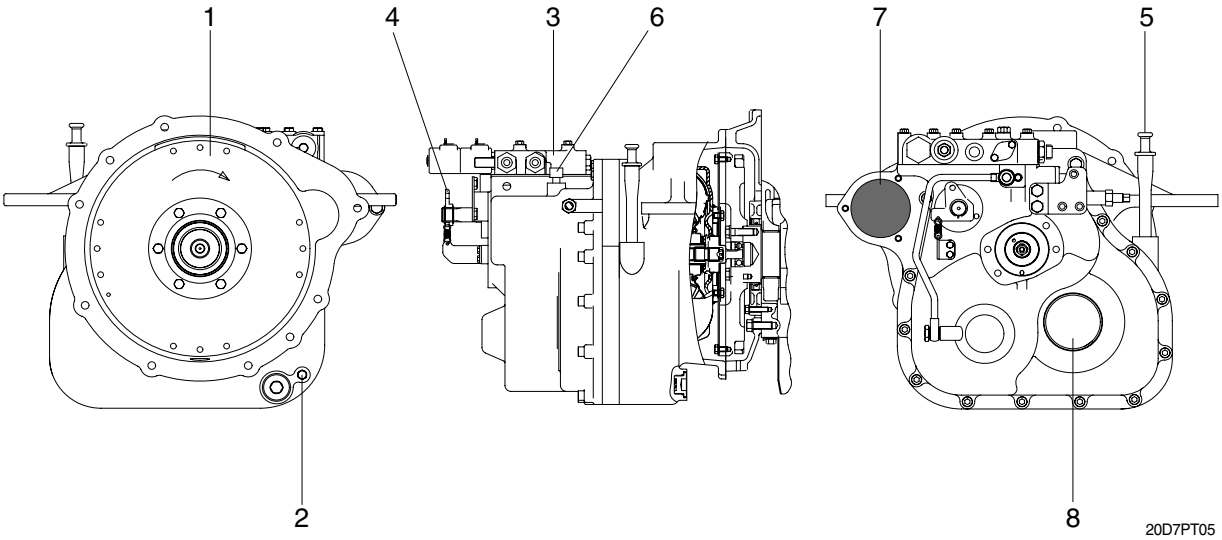
1) STRUCTURE



20D7PT28

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

2) INSTALLATION VIEW



1 Torque converter
2 Temperature sensor
3 Control valve
4 Parking brake link lever
5 Oil level pipe and dipstick
6 Air breather
7 Transmission oil filter
8 Transmission output (Universal joint link part)

3) OPERATION

The flywheel of engine transmits a power to torque converter through flexible plate.

The torque converter consists of an impeller wheel connected to the input side, a turbine connected to the output side and a stator wheel.

The power delivered from engine make the impeller wheel of the torque converter revolve, an impeller blade generate a fluid energy through being full of fluid in torque converter, this energy give torque to turbine wheel.

Flow of the fluid flowing through revolving turbine wheel is changed by stator, this course causes opposite torque at stator and it is added to the turbine.

As the result of this, the output torque brings torque increase within the compass of stall capability.

When the truck starts running or goes to the uphill, a torque converter transmits a torque increased against engine torque to power transmission system of the transport.

When the truck runs at regular speed without increase speed, high torque is not required and output torque is gradually reduced.

Since the engine and transmission are connected through the fluid, return vibrations and shocks from the drive axle is absorbed, safety of the transmission is secured.

Whether or not the truck travels, the engine continually operates and torque is converted automatically according to load.

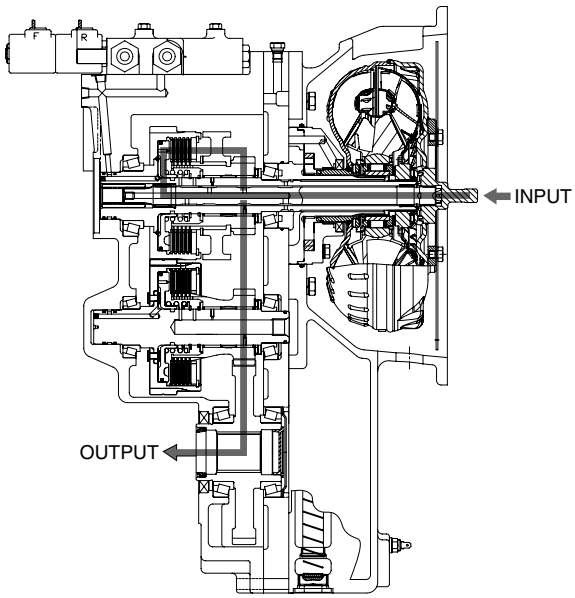
This system makes the drive operation much easier and work can be performed much more efficiently.

Output power of the torque converter is transmitted to the input shaft, forward clutch or a reverse clutch works according to gear choice of a driver.

The clutch power chosen at this time is connected to the output gear through the clutch gear.

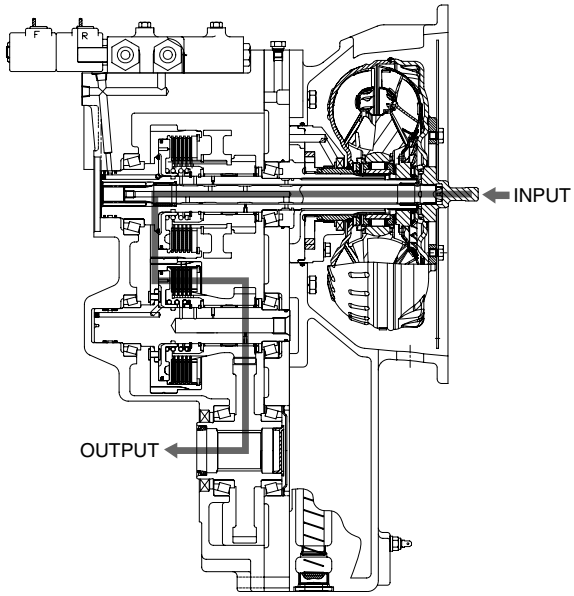
4) OPERATING MODES

(1) Forward



20D7PT29

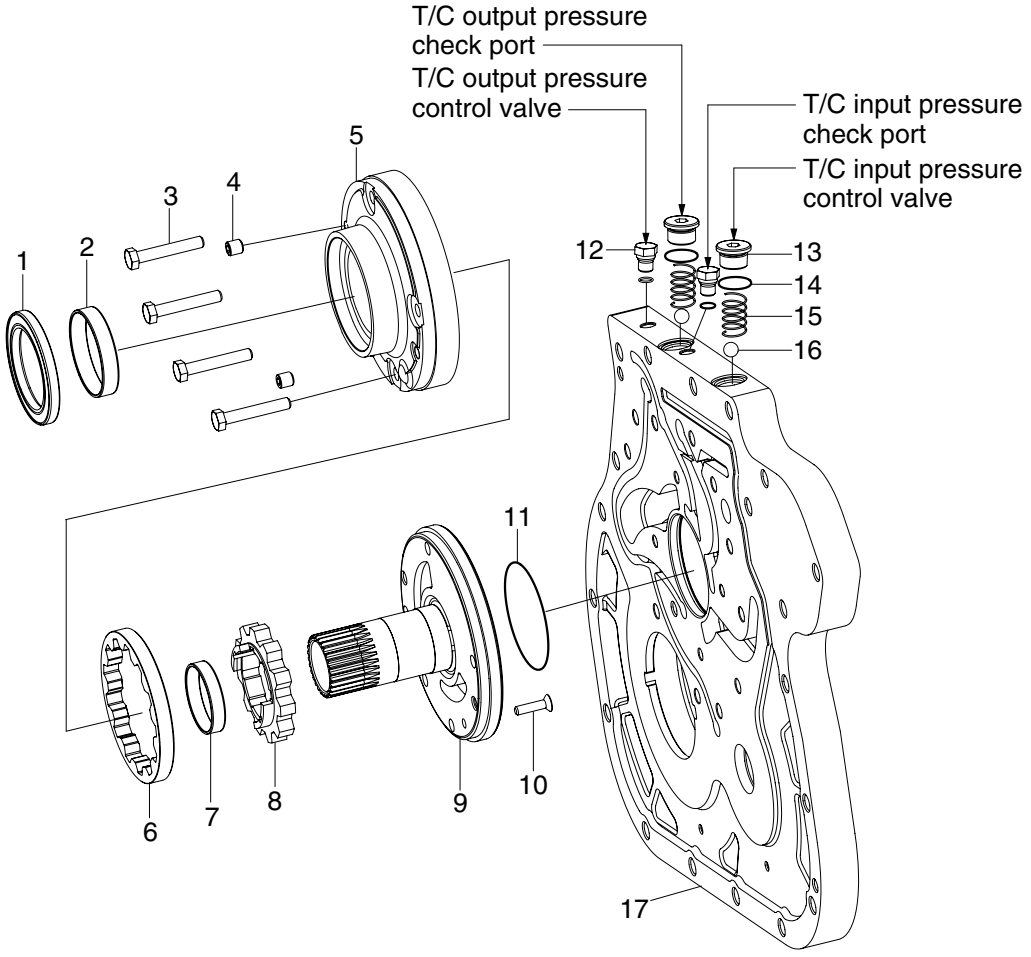
(2) Reverse



20D7PT30

5) OIL PUMP AND SPACER

(1) Structure



20D7PT06

1	Oil seal	10	Lock bolt
2	Oil pump case bush	11	O-ring
3	Bolt	12	Bolt
4	Plug	13	Plug
5	Oil pump case	14	O-ring
6	Driven gear	15	Spring
7	Drive gear bush	16	Ball
8	Drive gear	17	Spacer
9	Stator shaft		

(2) Operation

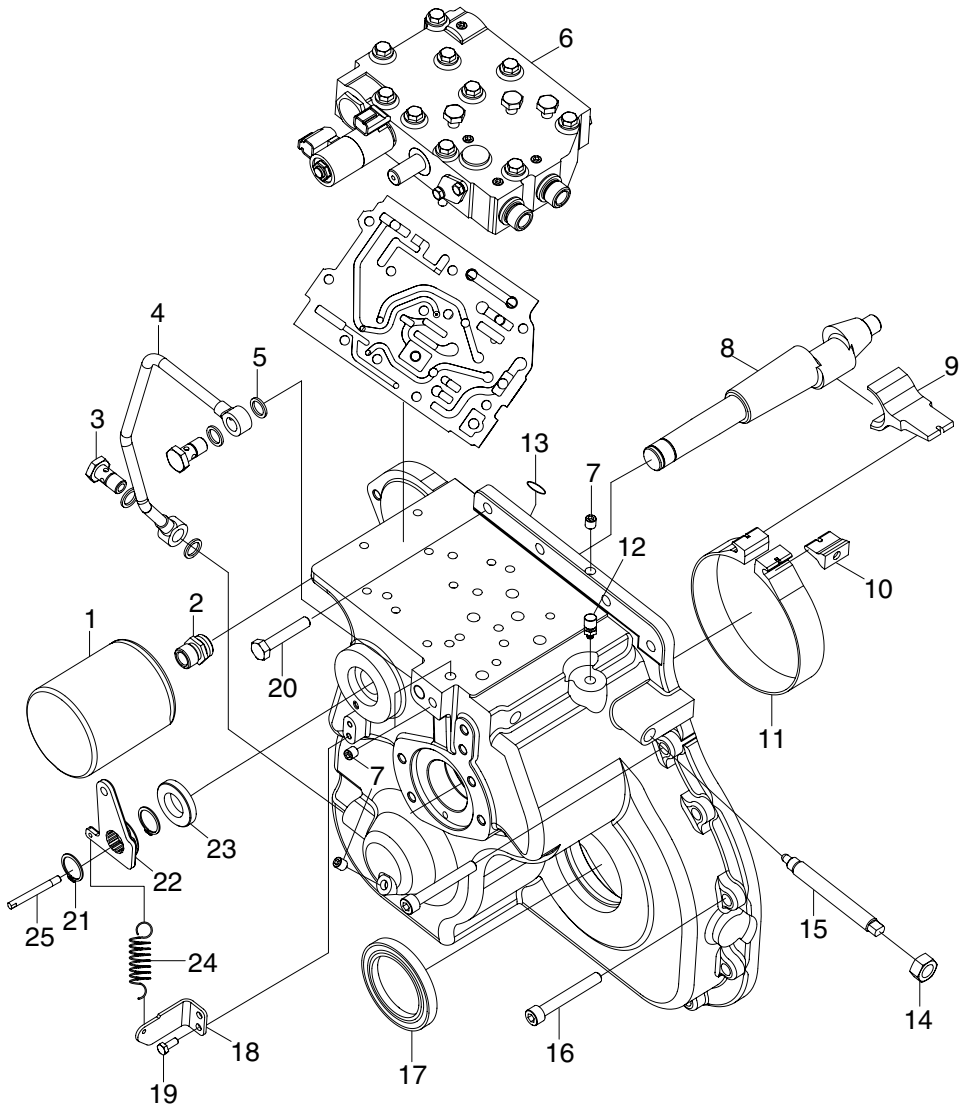
The oil pump is located on the spacer side. It is in charge of the function of clutching internal oil of the transmission through control valve and the function of sucking oil for oil supply of the torque converter and lubrication function of a clutch.

Oil pump choose gear pump, supplies oil in control valve and torque converter through the oil path between a spacer and a transmission case.

The relief valve located on the top of a spacer can maintain regularly input oil pressure and output oil pressure.

6) TRANSMISSION CASE, CONTROL VALVE, OIL PUMP AND PARKING BRAKE

(1) Structure



20D7PT07

1	Oil filter	10	Parking brake connector (Small)	18	Parking bracket
2	Oil filter bolt	11	Band brake	19	Bolt
3	Bolt	12	Air breather	20	Bolt
4	Pipe	13	O-ring	21	Snap ring
5	Washer	14	Nut	22	Parking lever
6	Control valve	15	Parking brake control shaft	23	Oil seal
7	Plug	16	Bolt	24	Parking return spring
8	Cam shaft	17	Oil seal	25	Stoper pin
9	Parking brake connector (Large)				

(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.

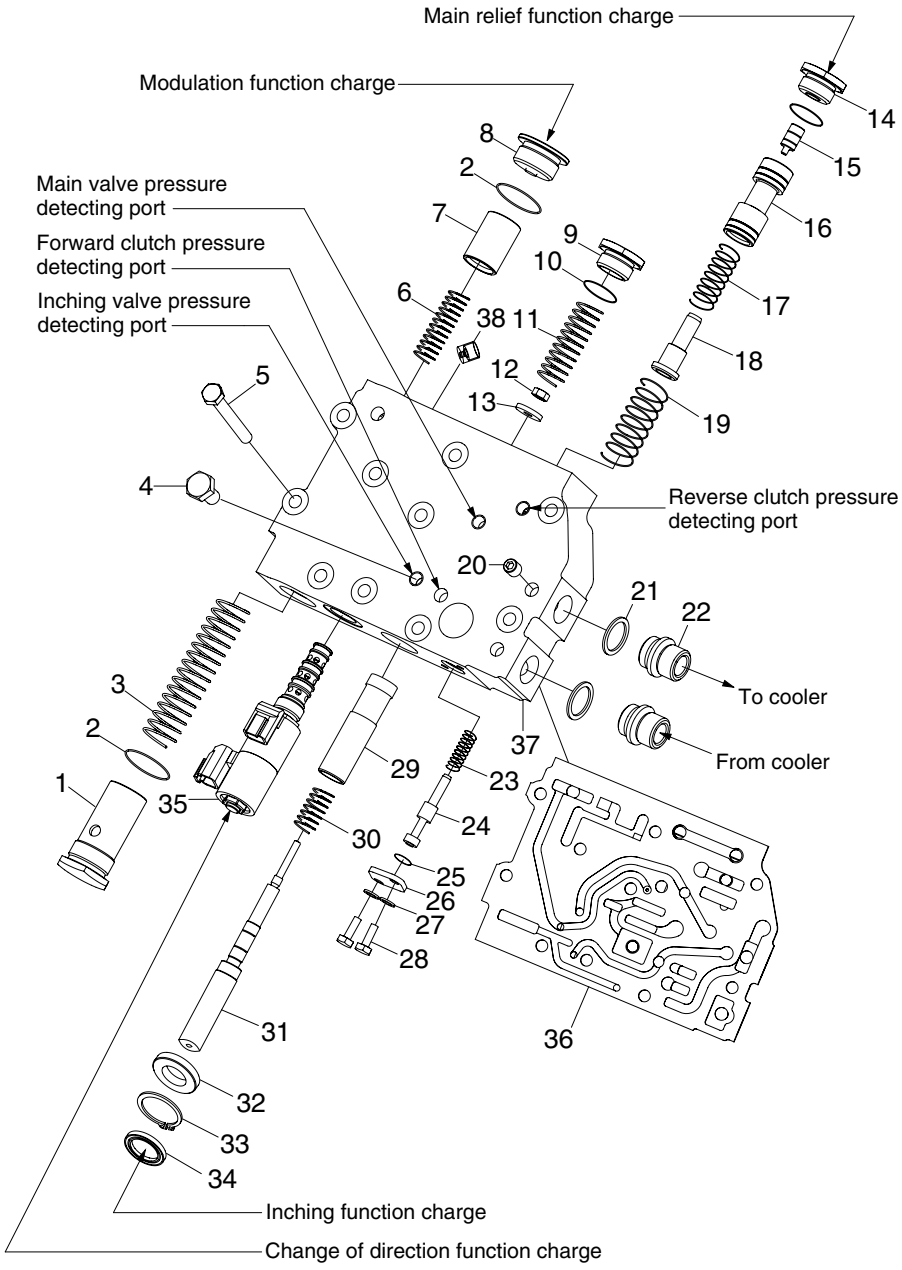
At this time, the solenoid valve is in charge of the important function of transmitting oil pressure for forward and reverse through an electric signal by the forward and reverse selection lever of the truck.

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.

7) CONTROL VALVE

(1) Structure



20D7PT08

1	Stoper	10	O-ring	20	Plug	29	Valve
2	O-ring	11	Spring	21	Washer	30	Spring
3	Spring	12	Nut	22	Nipple	31	Spool
4	Plug	13	Stoper	23	Spring	32	Plate
5	Bolt	14	Plug	24	Valve	33	Snap ring
6	Spring	15	Piston	25	O-ring	34	Oil seal
7	Piston	16	Valve	26	Plate	35	Solenoid valve
8	Plug	17	Spring	27	Washer	36	Gasket
9	Plug	18	Stoper	28	Bolt	37	Body
						38	Orifice

(2) Operation

The control valve mainly consists of the main relief valve, inching valve, accumulator valve and directional valve.

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

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 spacer and transmission case, the pipe of transmission outside and reverse clutch.

The remaining oil appropriating clutch pressure flows into the torque converter through the input pressure control valve in torque converter of the top of space.

At this time, the oil pressure input to the torque converter is adjusted 4~7kgf/cm^2 (57~100psi), the oil pressure output from the torque converter is adjusted below 7kgf/cm^2 (100psi).

The oil in charge of increasing torque in the torque converter flows from the torque converter, enters the radiator, after refrigerated, it is in charge of clutch lubrication through the lubrication oil path of the clutch shaft.

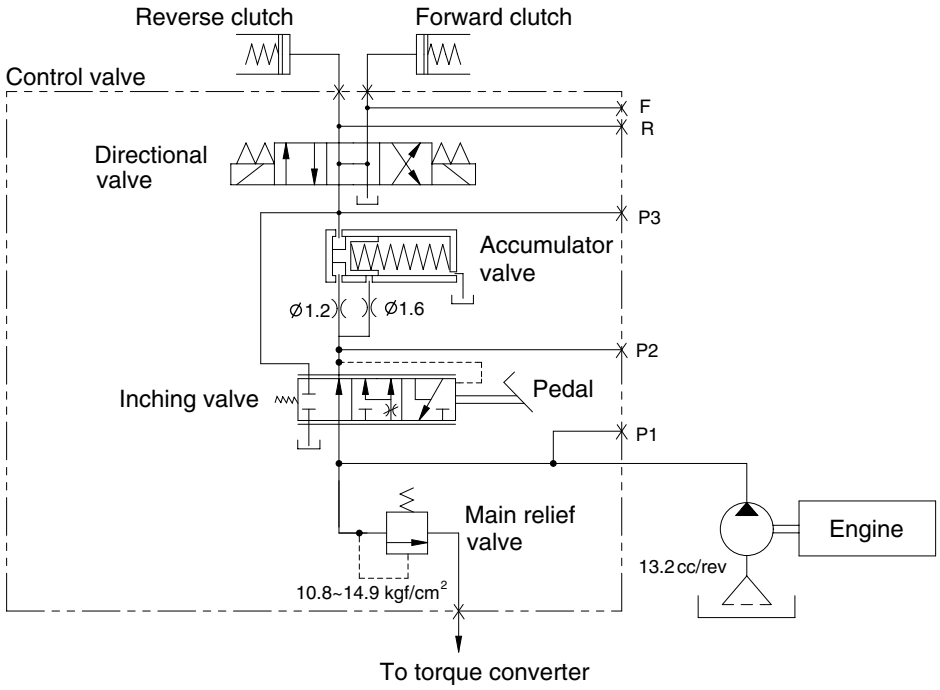
The pressure detecting valve and built in accumulator provide a soft plugging when changing gears.

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

When full pressure builds up, the pressure detecting valve shuts the accumulator 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.

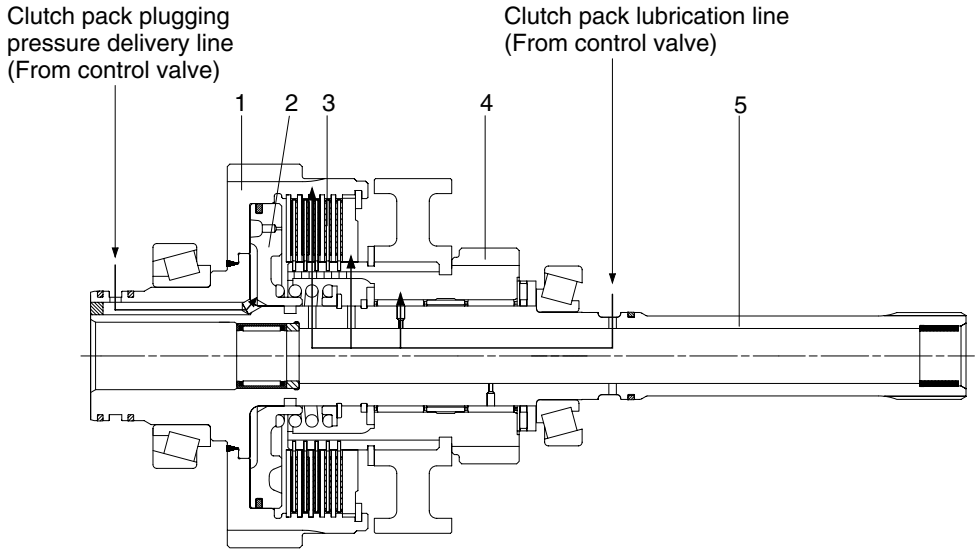
(3) Oil pressure circuit diagram



20D7PT09

8) FORWARD CLUTCH

(1) Operation



20D7PT31

1	Drum gear	3	Friction plate and plate	5	Forward shaft
2	Clutch piston	4	Clutch gear		

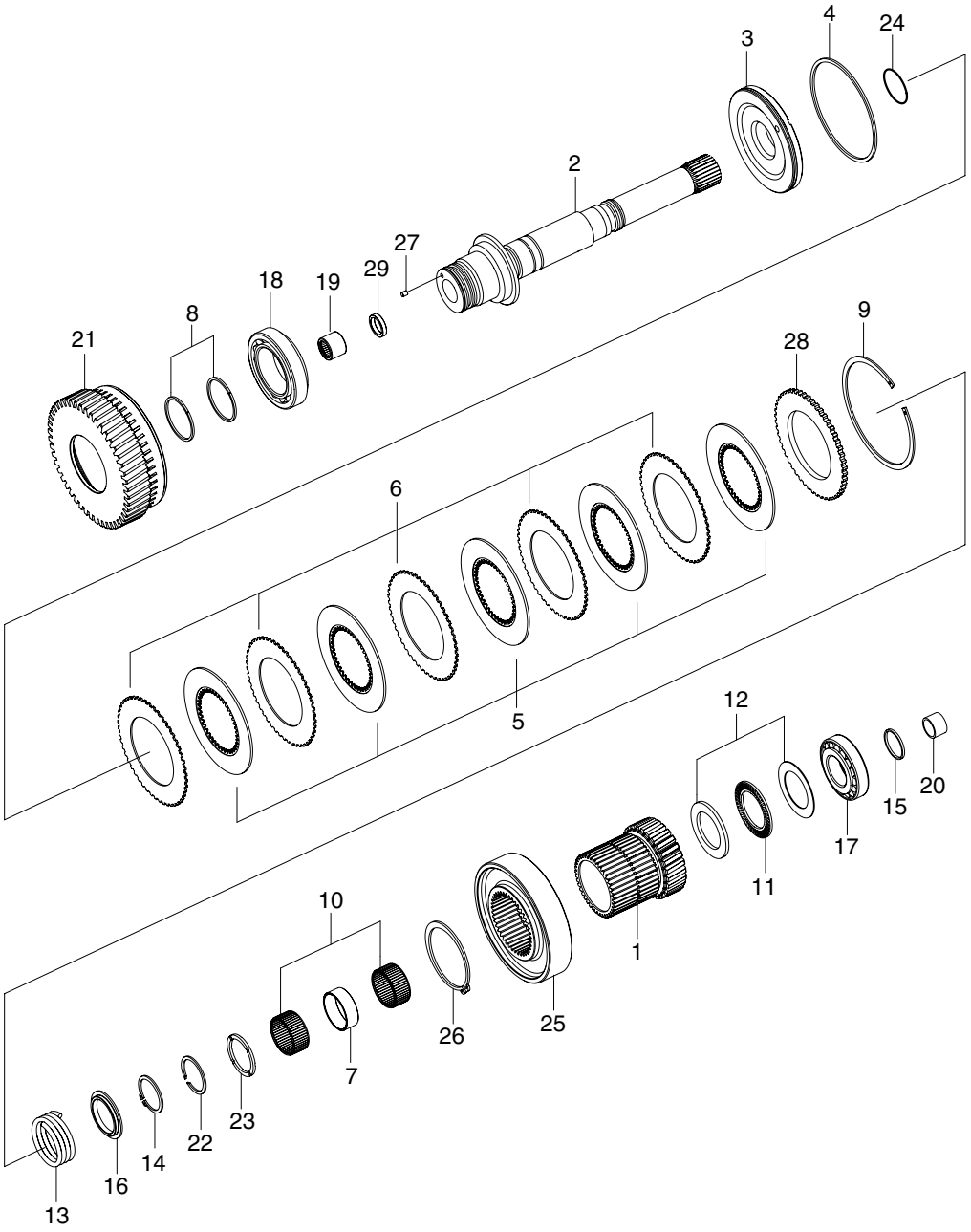
When forward mode is selected through the solenoid valve of control valve, the flux flowed by the oil pump flows into forward clutch pack in 9~14.2kgf/cm^2 (128~202psi) of pressure through the oil path of transmission inside.

This oil make plugging of clutch pack by giving pressure at the piston of clutch pack.

At this time, the drum gear of clutch pack is always revolving while connected with the turbine shaft of torque converter.

According to be plugging, the clutch gear is connected and revolved with drum gear, this power is delivered with linking output gear in touch with clutch gear.

(2) Structure

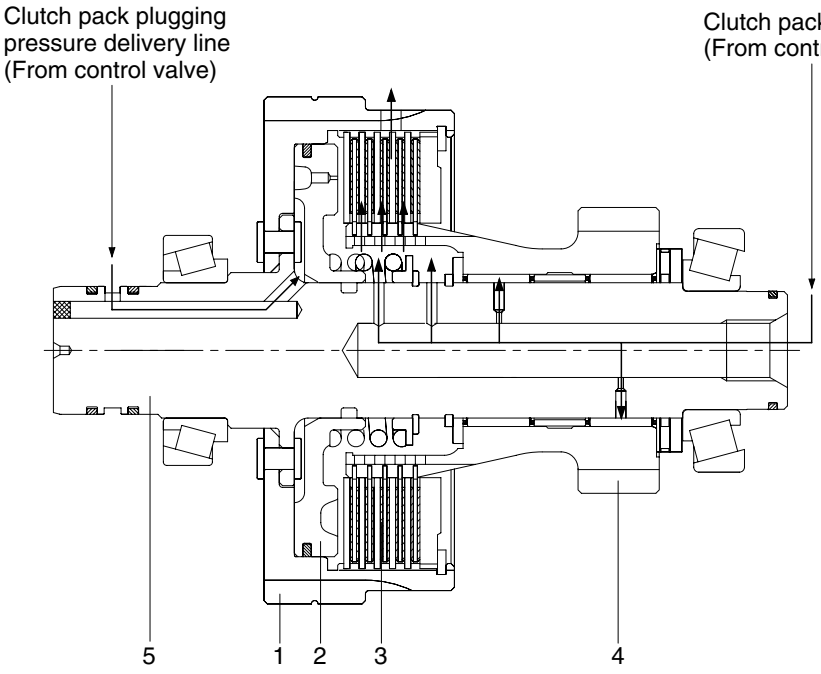


20D7PT11

1	Forward clutch gear	11	Thrust needle bearing	21	Forward drum gear
2	Forward shaft	12	Thrust washer	22	Snap ring
3	Piston	13	Spring	23	Thrust washer
4	Piston ring	14	Snap ring	24	O-ring
5	Friction plate	15	Seal ring	25	Parking drum
6	Plate	16	Spring cover	26	Snap ring
7	Spacer	17	Taper roller bearing	27	AV-Seal
8	Seal ring	18	Taper roller bearing	28	Side plate
9	Snap ring	19	Needle bearing	29	Ring
10	Needle bearing	20	Bush		

9) REVERSE CLUTCH

(1) Operation



1	Reverse drum gear	3	Friction plate and plate	5	Reverse shaft
2	Clutch piston	4	Clutch gear		

When reverse mode is selected through the solenoid valve of control valve, the flux flowed by the oil pump flows into the oil path of reverse shaft in 9~14.2kgf/cm^2 (128~202psi) of pressure through the oil path of transmission outside.

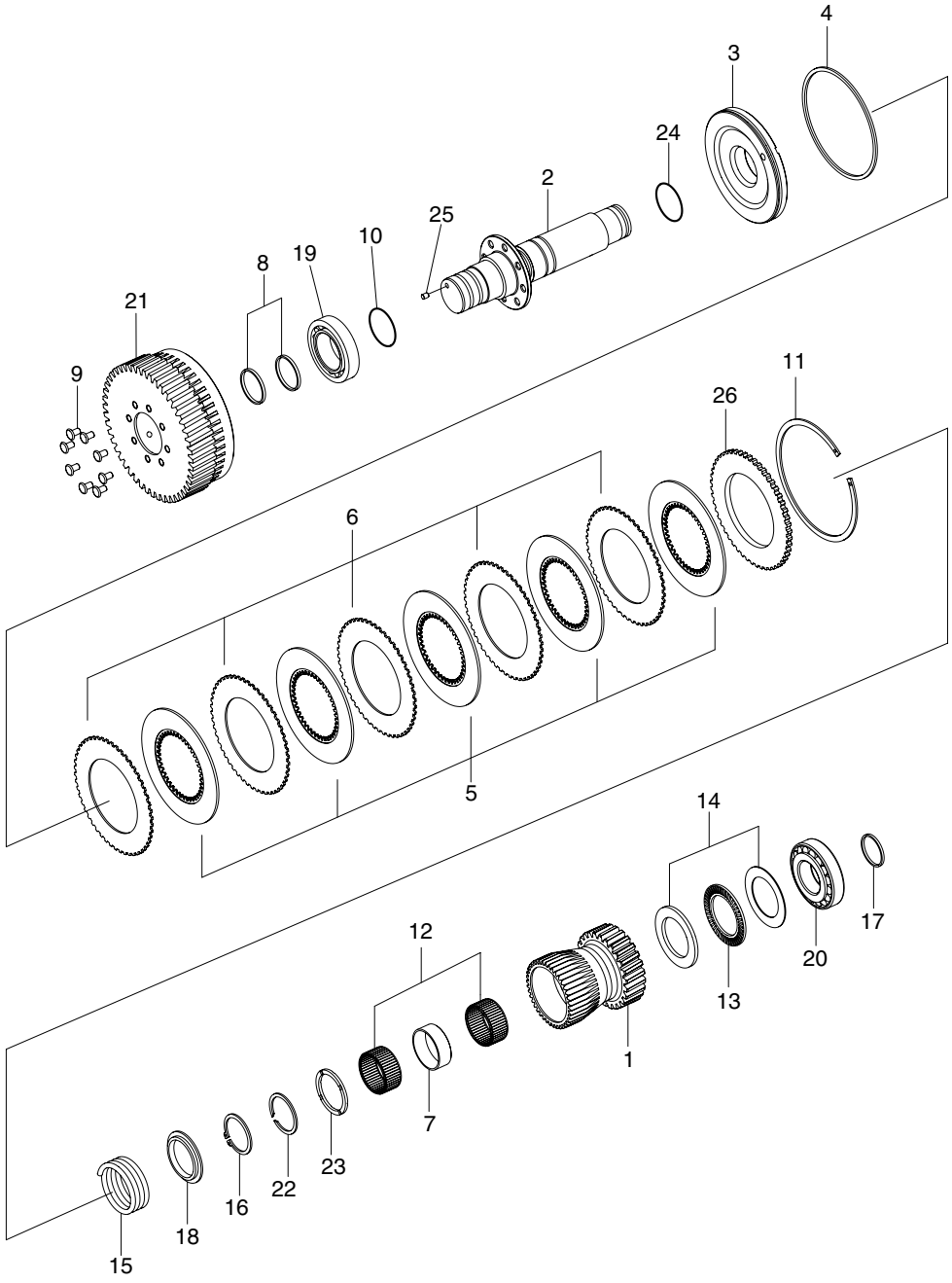
This oil make plugging of reverse clutch pack by giving pressure at the piston of clutch pack.

At this time, the reverse drum gear is revolving against forward drum gear with engaging forward drum gear.

According as the clutch is plugging, the reverse clutch gear revolves.

The reverse clutch gear is connected with output gear, the power transferred from engine is delivered to output of the transmission.

(2) Structure



20D7PT13

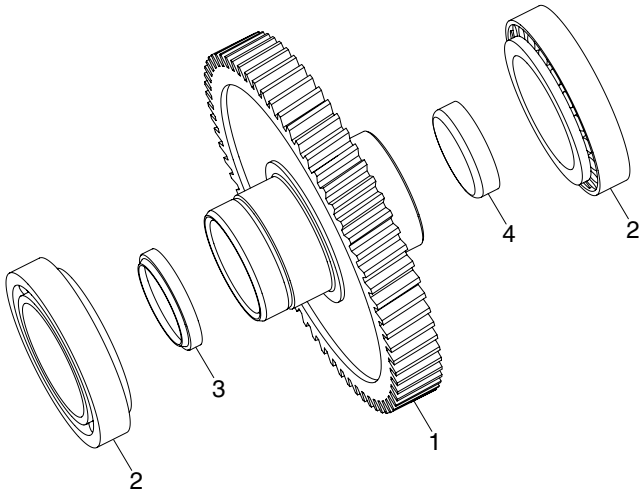
1	Reverse clutch gear	10	O-ring	19	Taper roller bearing
2	Reverse shaft	11	Snap ring	20	Taper roller bearing
3	Piston	12	Needle bearing	21	Reverse drum gear
4	Piston ring	13	Thrust needle bearing	22	Snap ring
5	Friction plate	14	Thrust washer	23	Thrust washer
6	Plate	15	Clutch spring	24	O-ring
7	Spacer	16	Snap ring	25	AV-Seal
8	Seal ring	17	Seal ring	26	Side plate
9	Rivet	18	Spring cover		

10) 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

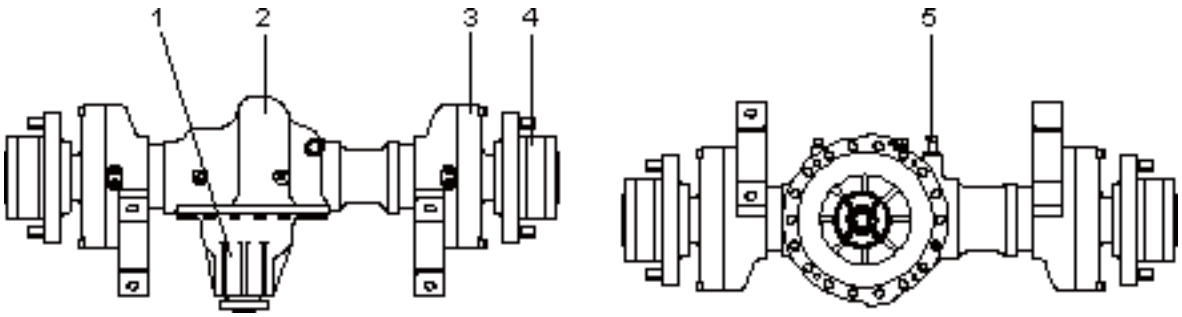


20D7PT14

1 Output gear
2 Taper roller bearing
3 Oil seal
4 Output gear cover

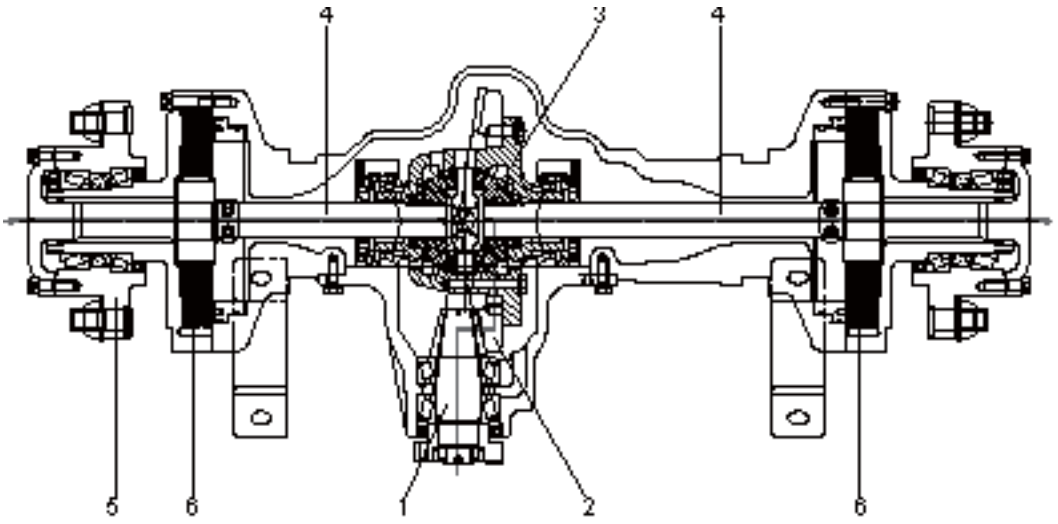
4. DRIVE AXLE

1) INSTALLATION VIEW



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

2) STRUCTURE



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

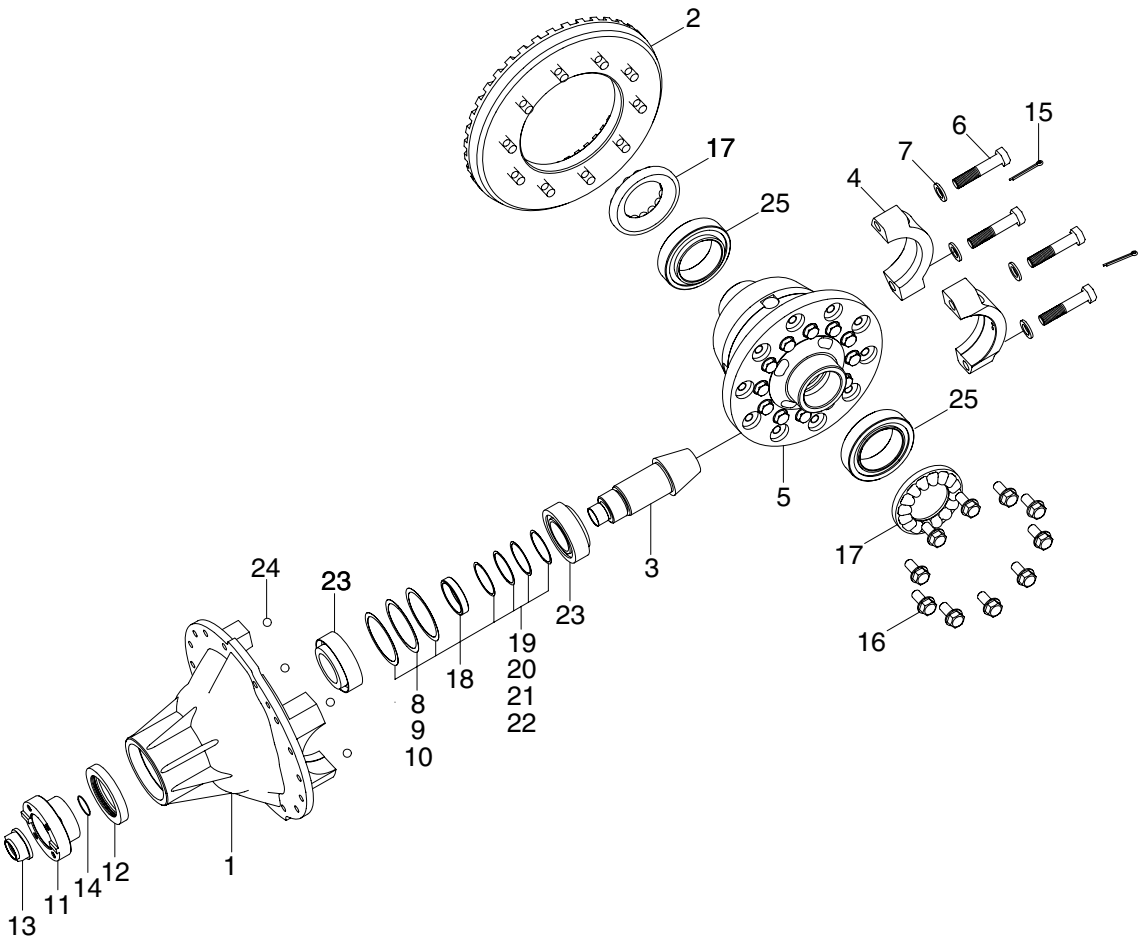
The drive axle is connected with the transmission output gear and universal joint.
The power transferred by the universal joint is connected to the pinion shaft of drive axle, the pinion shaft delivers the power to the differential device through the ring gear.
The power transferred to the differential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

3) CARRIER ASSEMBLY

(1) Operation

The pinion shaft is supported by the taper roller bearing in the carrier case and the bolt at the end of a pinion shaft and transfers the power which is delivered from the universal joint to the ring gear assembled from bolts at a differential device.
This power makes the differential device run.
Since the differential device is connected with an axle shaft and a spline, the power transferred to differential device is delivered to final drive through the axle shaft.

(2) Structure



20D7PT18

1	Carrier case	9	Shim	17	Bearing control ring bolt
2	Spiral ring gear	10	Shim	18	Spacer
3	Pinion shaft	11	Universal joint flange	19	Shim
4	Carrier cap	12	Oil seal	20	Shim
5	Differential device	13	Nut	21	Shim
6	Cap bolt	14	O-ring	22	Shim
7	Washer	15	Cotter pin	23	Taper roller bearing
8	Shim	16	Bolt	24	Ball
				25	Bearing

4) DIFFERENTIAL DEVICE

(1) Operation

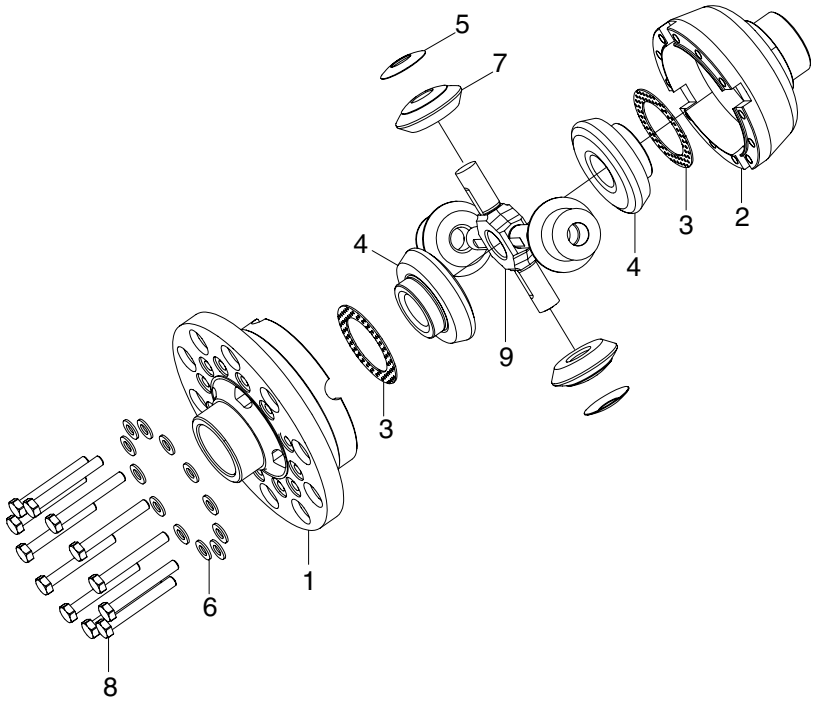
Since the ring gear is linked with the right of the differential case and the bolt, the power transferred to the ring gear makes the differential device revolve.

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



20D7PT19

1	Differential case (Left)	4	Differential gear	7	Pinion
2	Differential case (Right)	5	Thrust washer	8	Bolt
3	Thrust washer	6	Washer	9	Spider

Trouble symptom	Probable cause	Remedy
1. Excessive oil temperature rise		
1) Torque converter	· Improper oil level.	· Check oil level. Add or drain oil as necessary.
	· Impeller interfering with surroundings.	· After draining oil from oil tank and transmission, check and replace interfering parts.
	· Stator and free wheel malfunctioning.	· Check engine (stalling) speed. If necessary, replace.
	· Air sucked in.	· Check the inlet side joint or pipe. If necessary, retighten joint or replace gasket.
	· Water intruding into transmission case.	· Check drained oil. If necessary, change oil.
	· Bearing worn or seizing.	· Disassemble, inspect, repair or replace.
	· Gauge malfunctioning.	· Check and, if necessary, replace.
2) Transmission	· Clutch dragging.	· Check to see whether or not machine moves even when transmission is placed in neutral position. If so, replace clutch plate.
	· Bearing worn or seized.	· Disassemble, check and replace.
2. Noise operation		
1) Torque converter	· Cavitation produced.	· Change oil, replace parts leaking air.
	· Flexible plate damaged.	· Listen to rotating sound at lowspeed operation. If necessary, replace flexible plate.
	· Bearing damaged or worn.	· Disassemble, check and replace.
	· Gear damaged.	· Disassemble, check and replace.
	· Impeller interfering with surroundings.	· Check impeller or check drained oil for mixing of foreign matter. If necessary, change oil.
	· Bolt loosening.	· Disassemble and check. If necessary, retighten or replace.
	· Spline worn.	· Disassemble, check and replace.
	· Noise gear pump operation.	· Disassemble, check and replace.
2) Transmission	· Dragging caused by seizing clutch.	· Check to see whether or not machine moves even when transmission is in neutral position. If so, replace clutch plate.
	· Bearing worn or seizing.	· Disassemble, check and replace.
	· Gear damaged.	· Disassemble, check and replace.
	· Bolt loosening.	· Disassemble, check and retighten or replace.
	· Spline worn.	· Disassemble, check and replace.

Trouble symptom	Probable cause	Remedy
3. Low output power		
1) Torque converter	· Insufficient hydraulic pressure :	
	- Low oil level.	- Check oil level and add oil.
	- Air sucked in.	- Check joints and pipes. If necessary, retighten joint or replace packing.
	- Oil filter clogging.	- Check and replace.
	- Oil pump worn. (Low delivery flow)	- Check oil pressure. If necessary replace pump.
	- Regulator valve coil spring fatigued.	- Check spring tension. If necessary, replace.
	- Control valve spool malfunctioning.	- Disassemble, check and repair or replace.
	- Piston or O-ring worn.	- Disassemble, check measure and replace.
	· Stator free wheel cam damaged.	- Check stalling speed. (Increased engine load will cause excessive drop of stalling speed.)
		- Check oil temperature rise. If any, replace free wheel.
2) Transmission	· Flexile plate deformed	· Replace flexible plate.
	· Stator free wheel seizing.	- Check temperature plate. (No-load will cause temperature rise)
		- Replace free wheel if a drop of starting output is found.
	· Impeller damaged for interfering with the surroundings.	- Check drained oil for foreign matter. If any, change oil.
	· Use of poor quality of oil or arising of air bubbles.	- Check and change oil.
	- Air sucked in from inlet side.	- Check joints and pipes. If necessary, retighten joint or replace packing.
	- Low torque converter oil pressure accelerates generation of air bubbles.	- Check oil pressure.
	- Oil mixing with water.	- Check drained oil and change oil.
	- Inching rod out of adjustment.	- Check and adjust.
	· Clutch slipping	
	- Lowering of weight.	- Check oil pressure.
	- Piston ring or O-ring worn.	- Disassemble, check, measure and replace.
	- Clutch piston damaged.	- Disassemble, check and replace.
	- Clutch plate seizing or dragging.	- Check to see whether or not machine moves even when transmission is in neutral position. If so, replace.

Trouble symptom	Probable cause	Remedy
4. Unusual oil pressure		
1) Oil pressure is high	· Control valve malfunctioning.	(1)Check for spool operation. If necessary, replace valve. (2)Check for clogging of small hole in valve body. If necessary, clean or repair.
	· Cold weather. (high oil viscosity)	· When atmospheric temp is below freezing point (when normal oil pressure is recovered if heated to 60 ~ 80℃), change oil.
2) Oil pressure is low	· Use of improper oil.	· Check and change oil.
	· Gear pump malfunctioning(worn).	· Disassemble, check and replace.
	· Oil leaks excessively : (1)Control valve oil spring defective.	· Check spring tension (see spring specification). If necessary replace.
	(2)Control valve spool defective.	· Disassemble, check, and repair or replace valve.
	· Air sucked in.	· Check joints and pipes. If necessary, retighten joint or replace packing.
	· Low oil level.	· Check oil level and add oil.
	· Oil filter clogging.	· Check and replace.
3) Transmission	· Oil leaks excessively.	· Disassemble, check (piston ring and O-ring for wear and other defects), and replace.
5. Power is not transmitted		
1) Torque converter	· Clutch plate damaged.	· Check for damage by listening to abnormal sounds at a low converter speed and replace.
	· Low oil level.	· Check oil level and add oil.
	· Oil pump driving system faulty.	· Disassemble and check for wear of pump gear, shaft and spline. Replace defective parts.
	· Shaft broken.	· Check and replace.
	· Lack of oil pressure.	· Check oil pump gear for wear and for oil suction force. If necessary, replace pump.
2) Transmission	· Low oil level.	· Check oil level and add oil.
	· Inching valve and link lever improperly positioned.	· Check measure and adjust.
	· Forward/reverse spool and link lever improperly positioned.	· Check and adjust.
	· Clutch fails to disengage : (1)Clutch case piston ring defective.	· Disassemble, check and replace.
	(2)Main shaft plug slipping out.	· Disassemble, check and repair or replace.
	· Clutch seizing.	· Check to see whether or not machine moves even then transmission is in neutral position. If so, replace.
	· Shaft broken off.	· Disassemble, check(main shaft, etc.), and replace.
	· Clutch drum damaged (spring groove).	· Disassemble, check and replace.
	· Clutch snap ring broken.	· Disassemble, check and repair or replace.

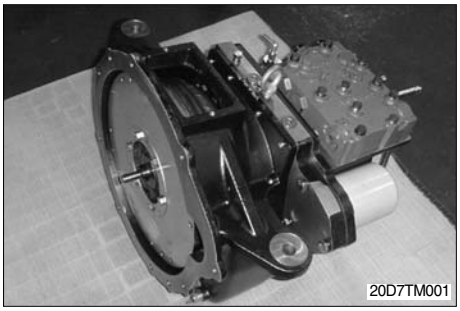
Trouble symptom	Probable cause	Remedy
6. Power is not transmitted (Continue)	· Foreign matter intruding into oil passage to clutch. · Shaft spline worn.	· Disassemble, check and repair or replace. · Disassemble, check and replace.
7. Oil leakage (Transmission and torque converter)	· Oil leaks from oil seal.	· Disassemble and check for wear of seal lips and mating sliding surfaces (pump boss, coupling etc.) Replace oil seal, pump boss, coupling, etc.
	· Oil leaks from case joining surfaces.	· Check and retighten or replace packing.
	· Oil leaks from joint or pipe.	· Check and repair or replace gasket.
	· Oil leaks from drain plug.	· Check and retighten or gasket.
	· Oil leaks from a crack.	· Check and replace cracked part.

GROUP 3 DISASSEMBLY AND ASSEMBLY

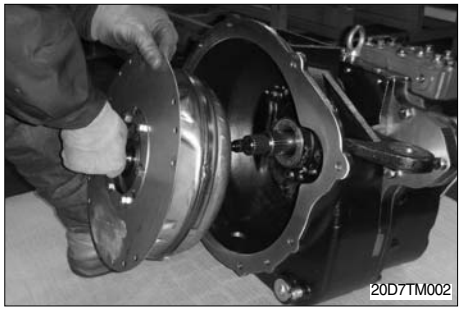
1.TRANSMISSION

1) DISASSEMBLY

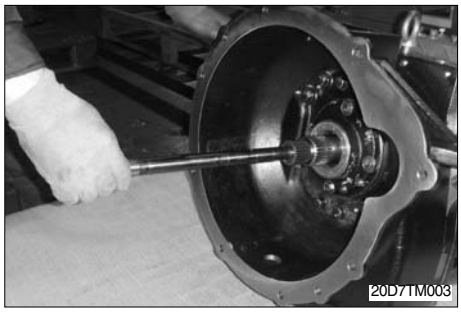
① Transmission assembly set.



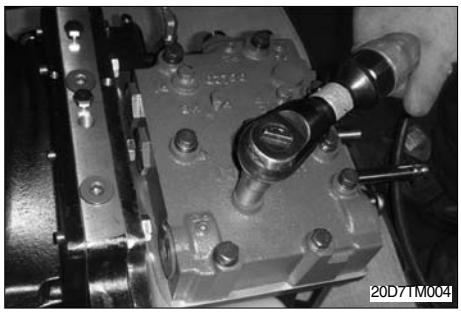
② Disconnect torque converter.



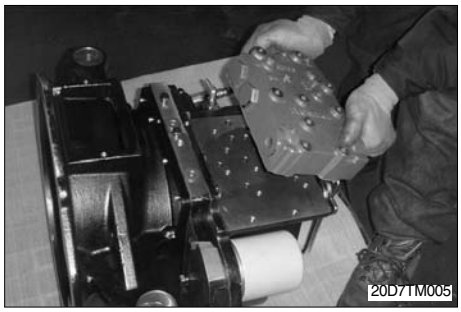
③ Extract PTO shaft.

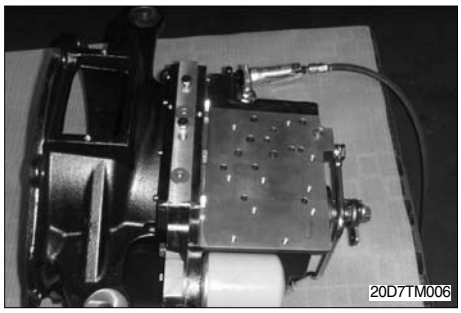


④ Remove control valve bolt.

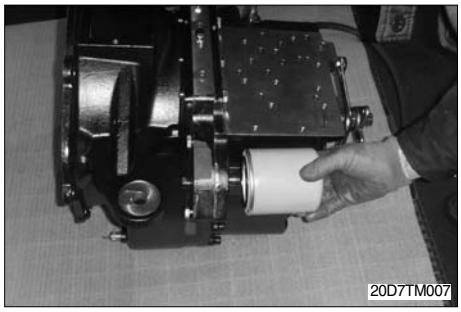


⑤ Extract control valve.

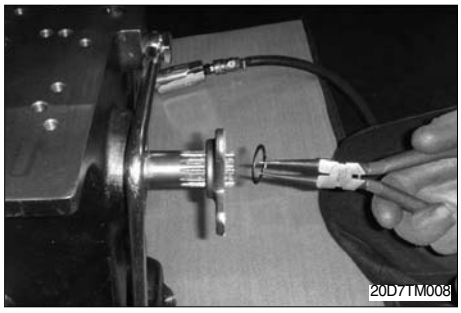




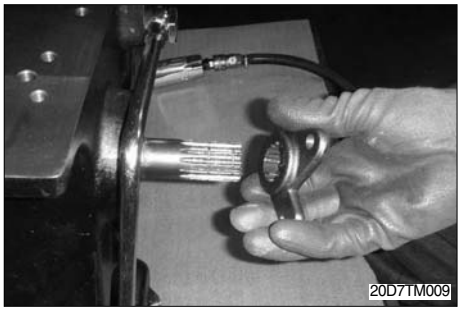
⑥ Extract oil filter.



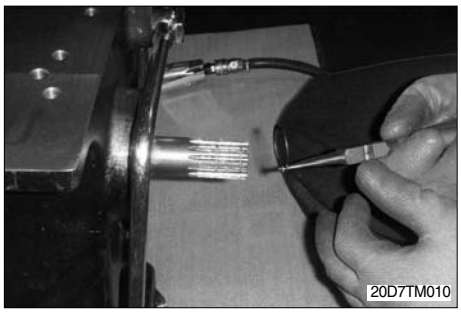
⑦ Remove snap ring.



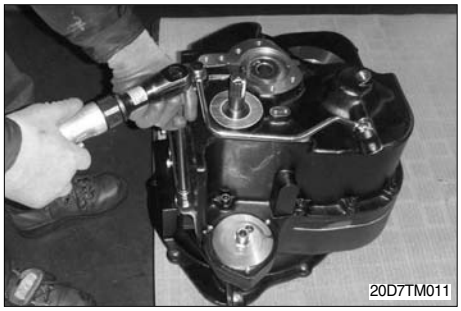
⑧ Remove parking lever.



⑨ Remove snap ring.

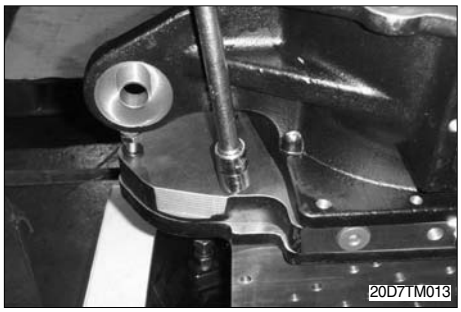


⑩ Remove bolt.

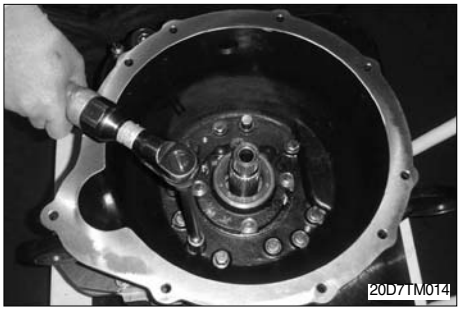


⑪ Remove out wheel bolt.

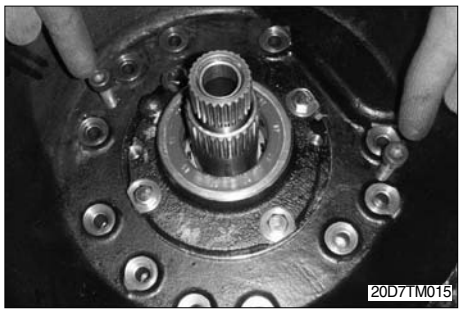
⑫ Remove bolt on the back side of filter.



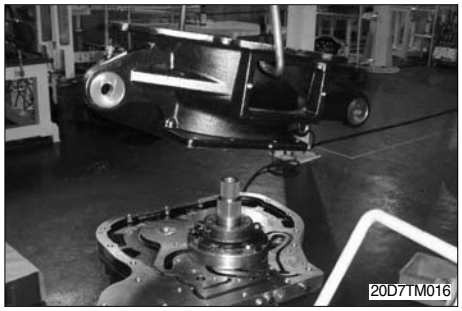
⑬ Remove bolt.



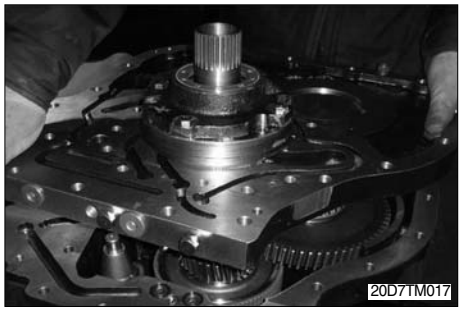
⑭ Connect disassembly bolt.



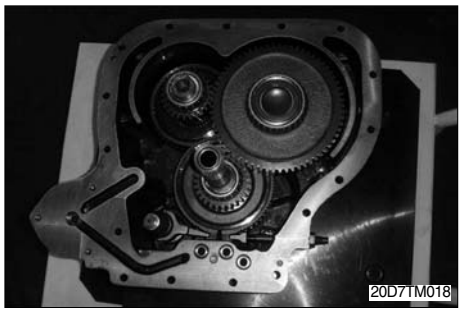
⑮ Disassemble torque converter housing.



§ Disassemble spacer.

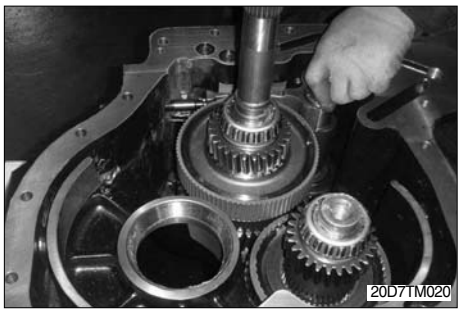


§æAfter disassemble.

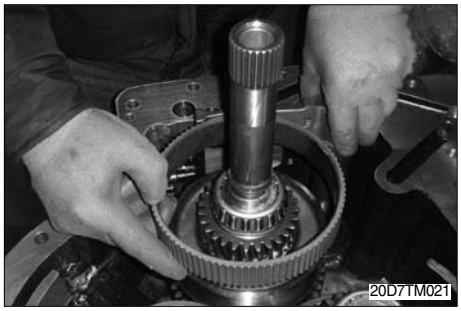


§ Disassemble output gear assembly set.

§ Disassemble connection.

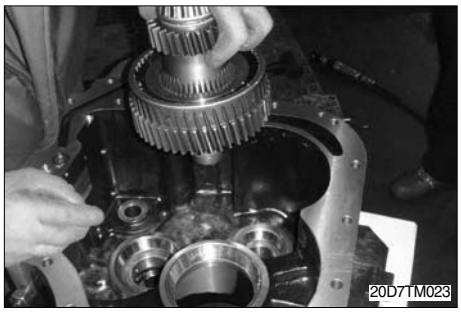


§ Extract band brake.



§ 1 Disassemble forward clutch gear.

§ Disassemble reverse clutch gear.



§ After disassemble.

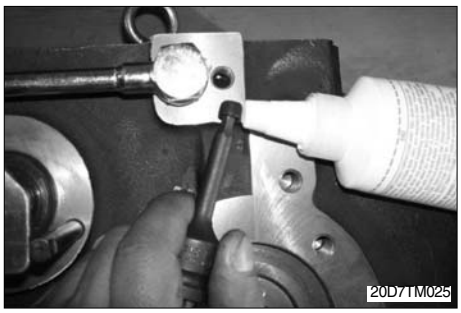
2) ASSEMBLY

(1) Assembly of transmission case outside part

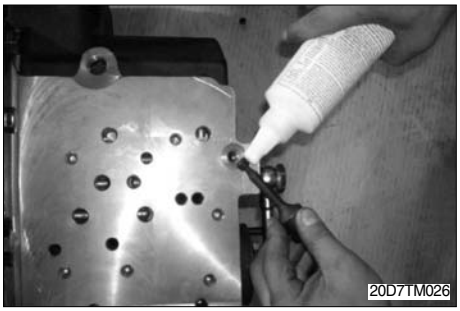
Plug assembly

※ Before assemble taper plug, spread loctite #577.

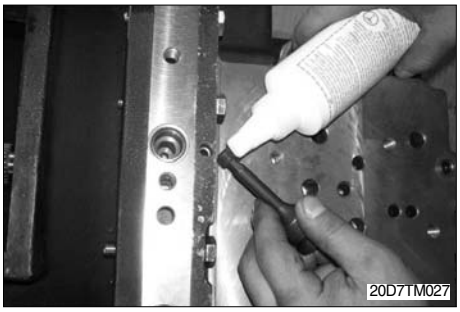
① Assemble the upper part taper plug of hydraulic pipe.



② Assemble installation part taper plug of control valve.



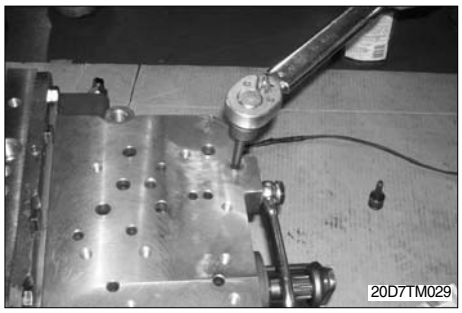
③ Assemble space installation part.



④ Assemble the left taper plug.

⑤ Confirm torque.

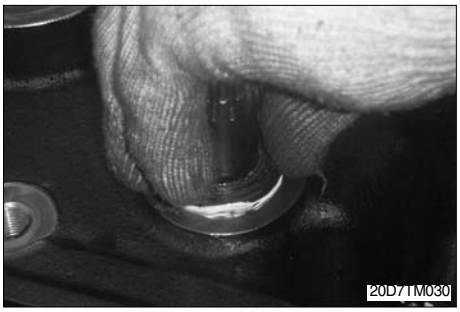
· Tightening torque : 3.5~4.5 kgf · m
(25~33 lbf · ft)



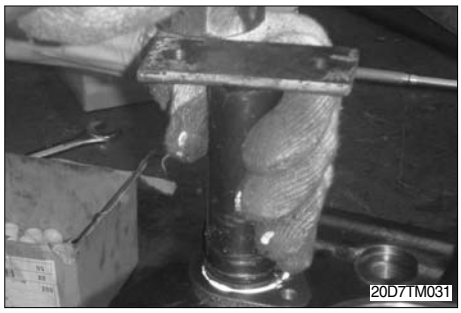
Oil seal pressurizer of cam shaft

① Spread sealant on oil seal.

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



② Pressurize oil seal.



Assembly of filter assembly bolt

① Spread sealant on oil seal.

※ Spread loctite #277 on filter assembly bolt.

② Confirm assembly and torque.

· Tightening torque : 3.5~4.5 kgf · m
(25~33 lbf · ft)

(2) Assembly of transmission case inside

Assembly of bearing and parking control shaft

① Pressurize R part of bearing out wheel.

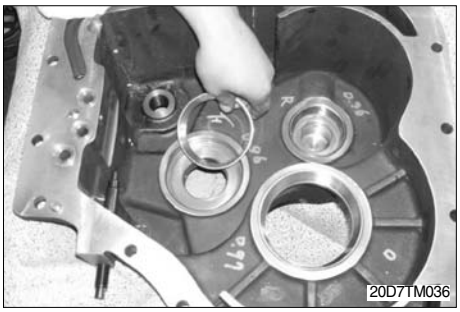
※ R part : Installation part of reverse clutch gear.

② Pressurize O part of bearing out wheel.

※ O part : Installation part of output gear assembly.

③ Pressurize F part of bearing out wheel.

※ F part : Installation part of forward clutch gear.



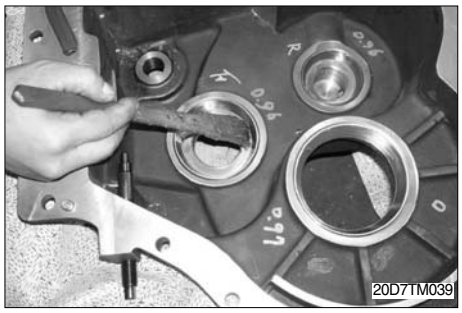
④ Assemble adjustment shaft.

⑤ Assemble nut.

⑥ Spread grease on bearing out wheel.

※ When installing taper roller bearing, make sure whether or not it is close.

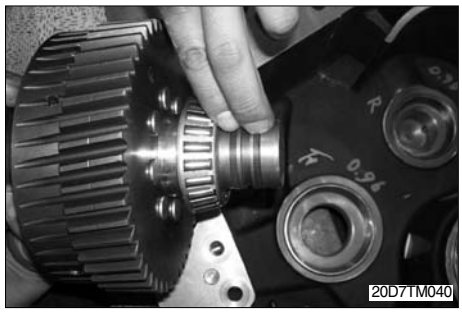
※ Spread grease in taper roller bearing.



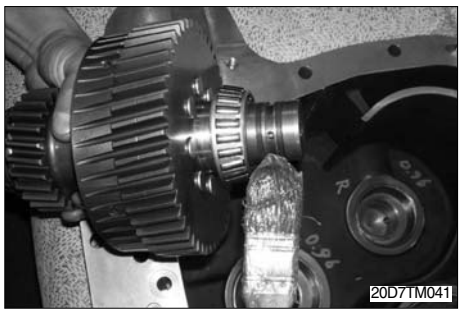
Assembly of forward / reverse clutch pack

① Confirm seal ring of reverse clutch.

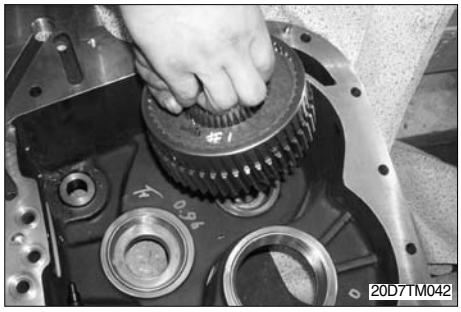
※ Spread grease on seal ring of clutch pack.



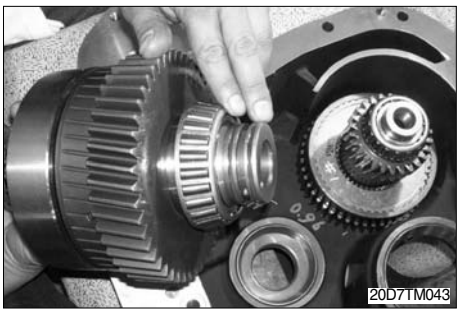
② Spread oil on seal ring of reverse clutch.



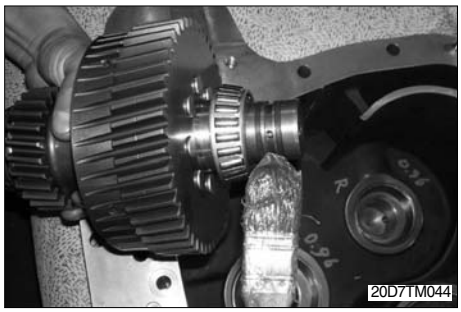
③ Assemble reverse clutch at transmission.



④ Confirm seal ring of forward clutch.

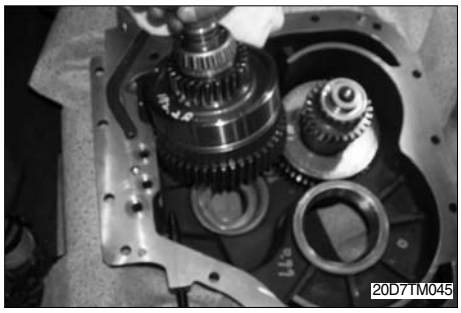


⑤ Spread oil on seal ring of forward clutch.



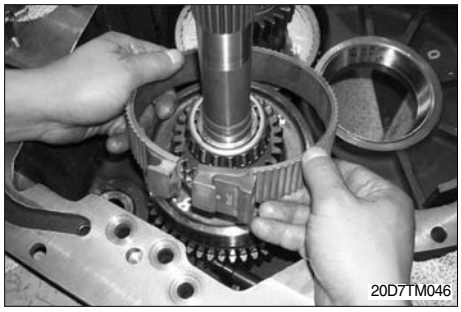
⑥ Assemble forward clutch at transmission.

※ After finishing assembly, make sure whether or not revolution of forward/reverse clutch pack is good.

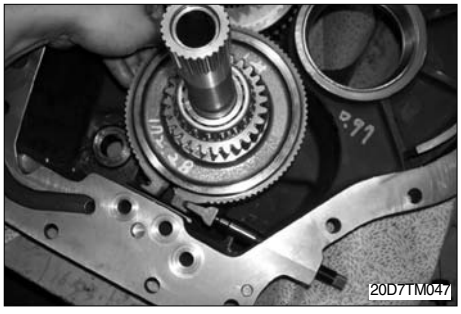


Assembly of parking brake system

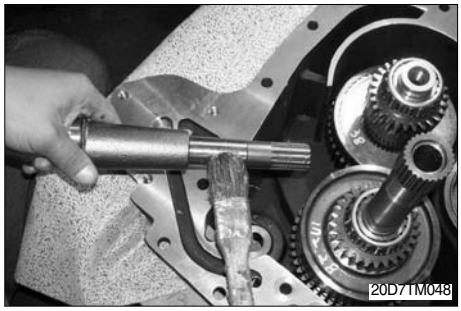
① Fix small connection in PBB.



② Set in parking drum.

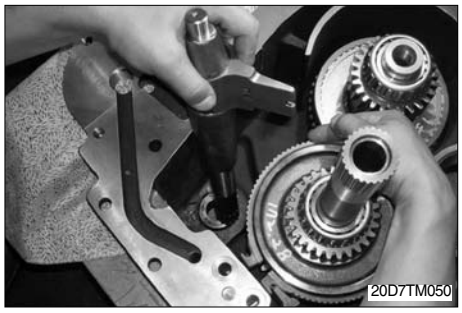


③ Spread grease on cam shaft.

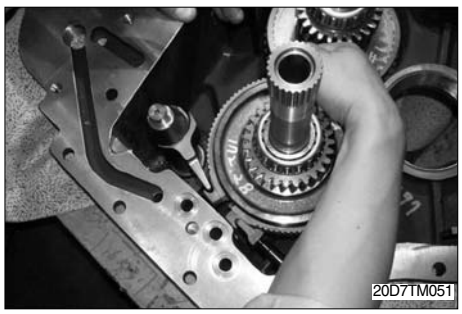


④ Fix large connection in cam shaft.

⑤ Fit large connection in PBB.



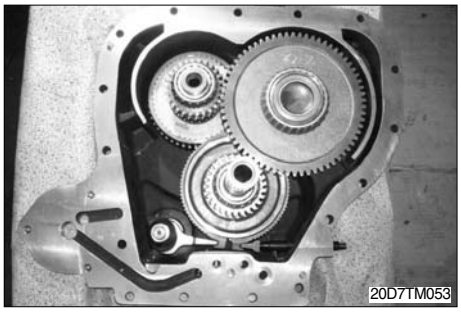
⑥ Assemble an eccentric shaft in PBB.



Assembly of output gear assembly

① Assembly output gear.

② Confirm gear revolution condition.



(3) Assembly of spacer sub assembly

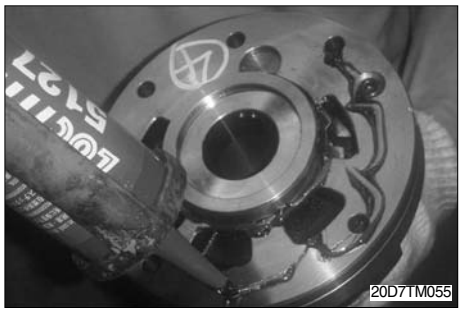
Assembly of oil pump

① Assemble O-ring of charging pump.

※ Spread grease at O-ring surface.

② Spread sealant on charging pump.

※ Spread loctite #5127 at stator shaft lower in oil pump.

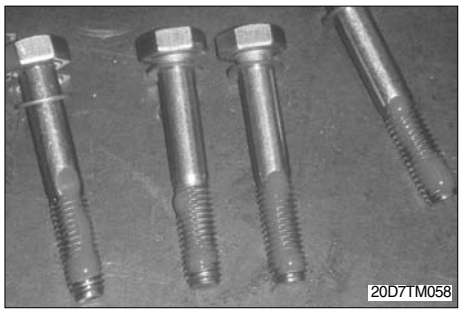


③ Spread sealant on the whole surface.

④ Fix charging pump in spacer.

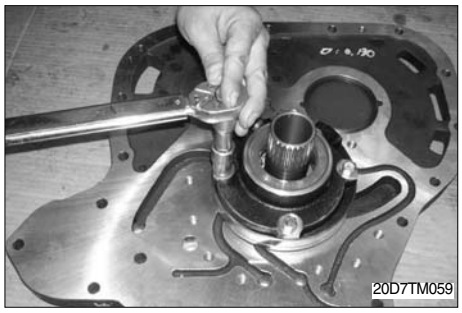
⑤ Spread sealant on hexagon bolt.

※ Spread loctite #242 at bolt.



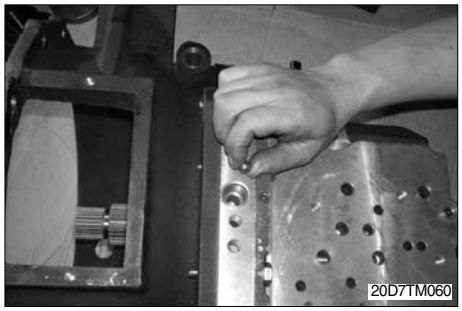
⑥ Confirm assembly and torque.

· Tightening torque : 3.5~4.0 kgf · m
(25~29 lbf · ft)

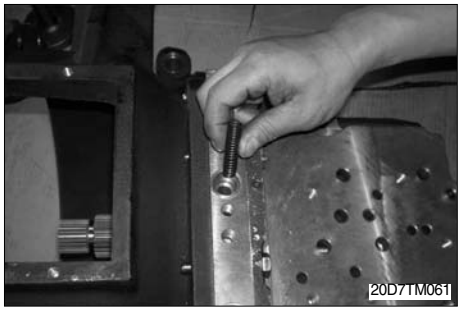


Assembly of inlet and outlet of pressure adjustment valve in torque converter and pressure checking port

① Fix steel ball in spacer.

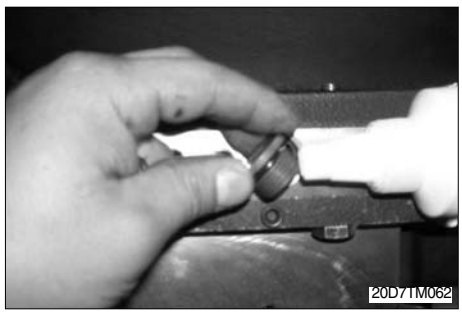


② Fix spring.



③ Spread sealant on plug and O-ring.

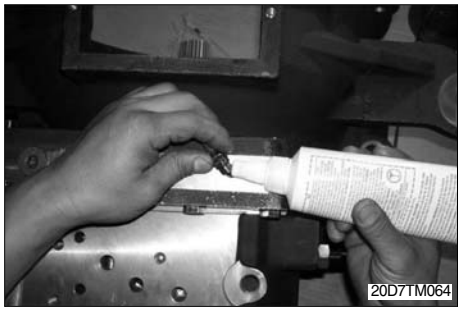
※ Spread loctite #277 at plug and bolt.



④ Confirm torque.

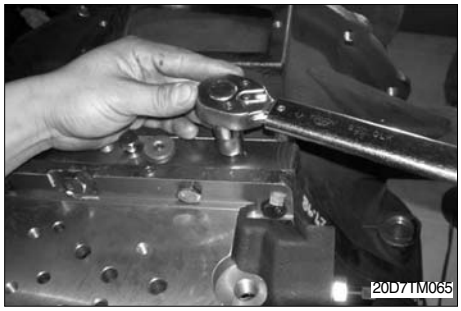
· Tightening torque : 3.5~4.5 kgf · m
(25~33 lbf · ft)

⑤ Spread sealant on hex bolt.



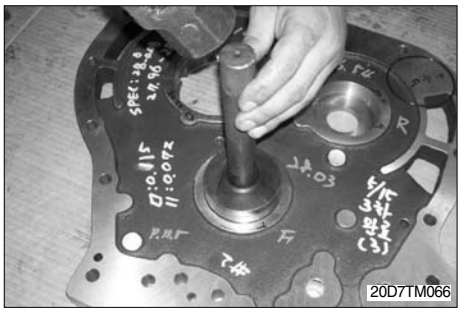
⑥ Confirm torque.

· Tightening torque : 3.5~4.5 kgf · m
(25~33 lbf · ft)



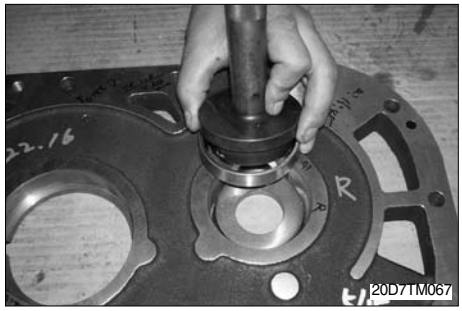
Assembly of bearing cup

※ After measuring the transmission case, spacer and each clutch pack and estimating a proper amount of shim.
Insert a proper amount of shim before assembling bearing cup.
Make sure whether or not it is close with the lower of bearing cup.



① Pressurize F part of bearing out wheel.

② Pressurize R part of bearing out wheel.



③ Pressurize O part of bearing out wheel.

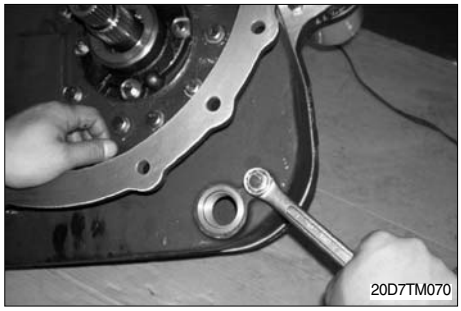
(4) Assembly of torque converter housing sub assembly

Assembly of temperature sensor and O-ring

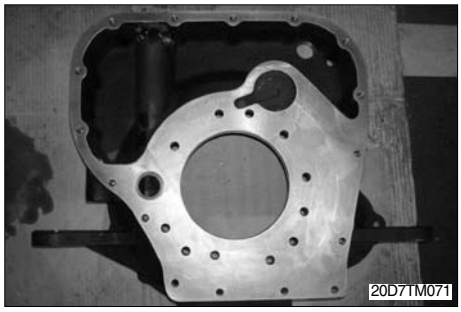
① Spread loctite #577 on temperature sensor.

② Confirm assembly and torque.

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



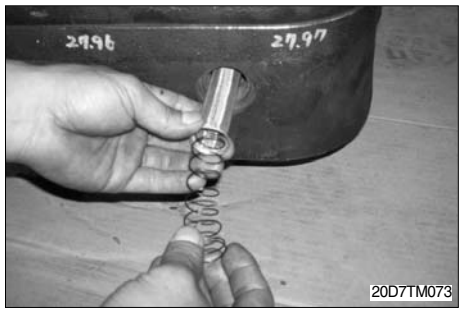
③ Assemble O-ring and spread grease.



Oil strainer assembly

① Fix spring in strainer.

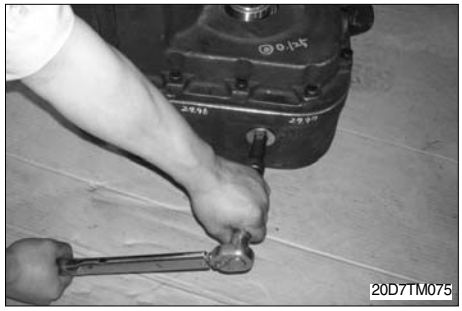
② Fix strainer in torque converter housing.



③ Temporarily assemble plug.

④ Confirm torque.

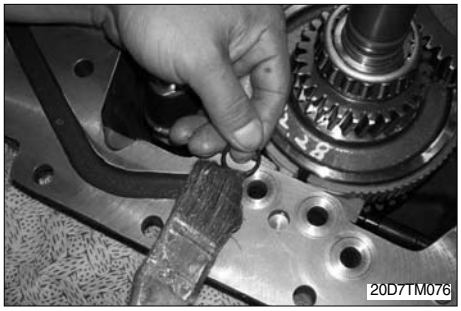
· Tightening torque : 8~10 kgf · m
(58~72 lbf · ft)



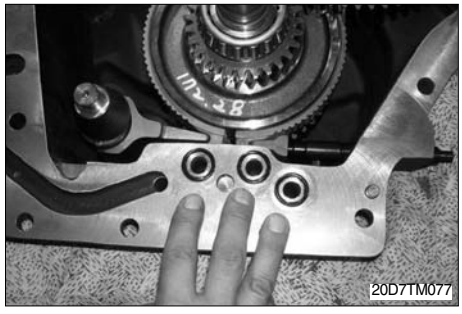
(5) Assembly of sub assembly

Assembly of transmission case and spacer sub assembly

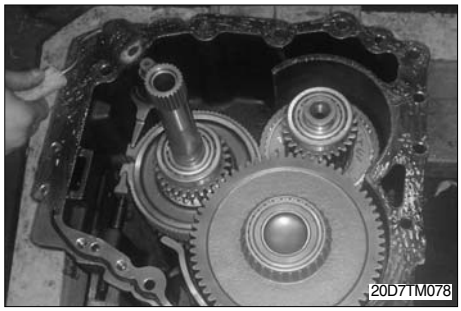
① Spread oil.



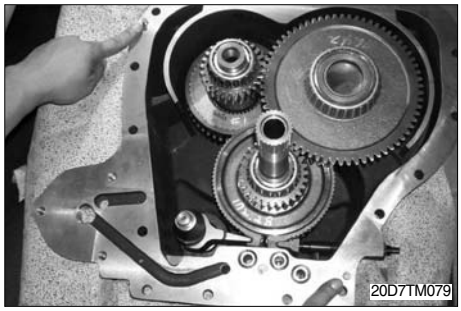
② Fix O-ring.



③ Spread loctite #5127 on transmission case.

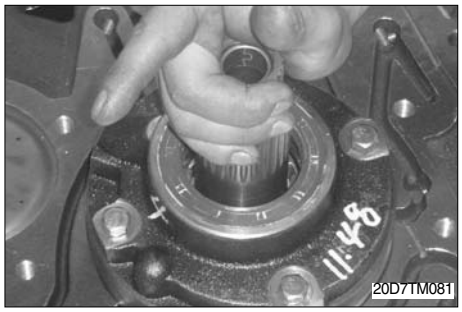


④ Pressurize lock pin.



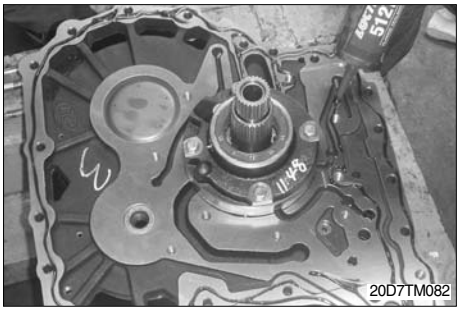
⑤ Assemble space.

⑥ Confirm gear revolution condition.



Torque converter assembly

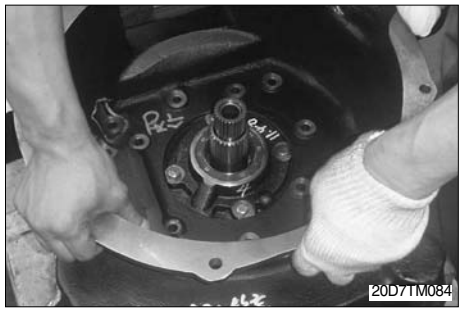
① Spread loctite #5127 on space.



② Work roller.

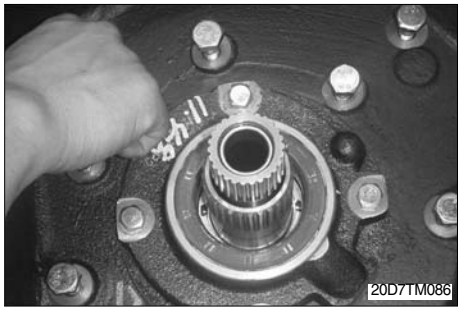
※ Pay attention to tear O-ring of torque converter and oil pump.

③ Fit torque converter housing in space.



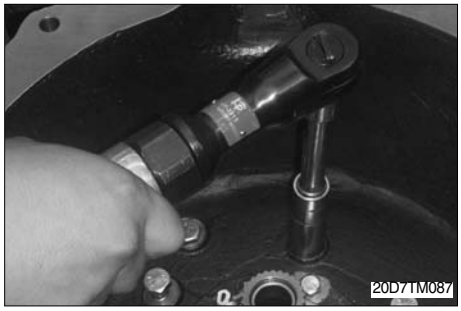
④ Spread loctite #277 on bolt.

⑤ Temporarily assemble bolt.



⑥ Confirm torque.

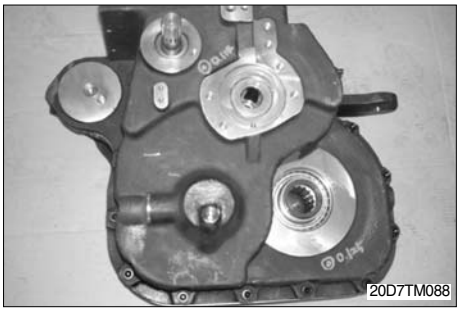
· Tightening torque : 5.5~6.5 kgf · m
(40~47 lbf · ft)



(6) Transmission outside assembly

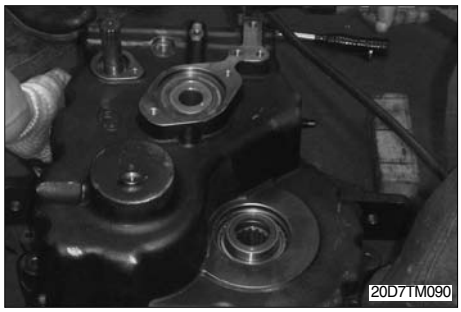
Fastening of transmission case bolt

① Revolve 90 ¡.£



② Spread sealant on socket bolt.

③ Temporarily assemble at transmission case.



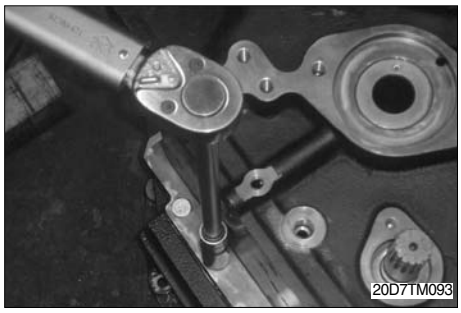
④ Confirm torque.

⑤ Spread sealant on hexagon bolt.

※ Spread loctite #277 on bolt.

⑥ Confirm torque.

· Tightening torque : 5.5~6.5 kgf · m
(40~47 lbf · ft)



Oil filter assembly

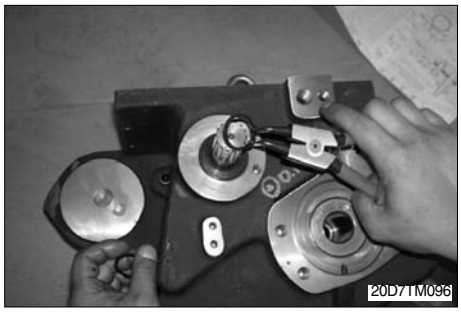
① Temporarily assemble filter.

② Confirm fastening.

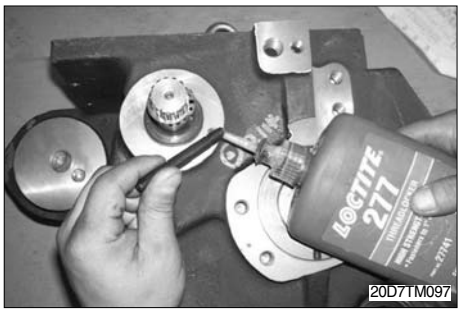
· Tightening torque : 0.8~1.2 kgf · m
(5.8~8.7 lbf · ft)

Parking brake part assembly

① Assemble snap ring.



② Spread loctite #277 on support pin.

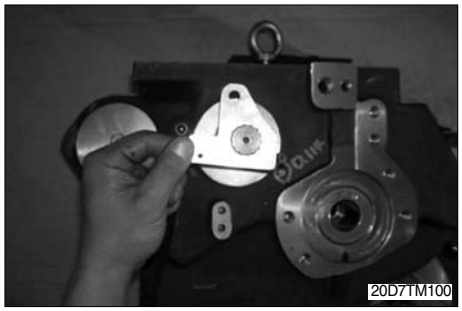


③ Temporarily assemble support pin.

④ Confirm torque.

· Tightening torque : 2.0~3.0 kgf · m
(14~22 lbf · ft)

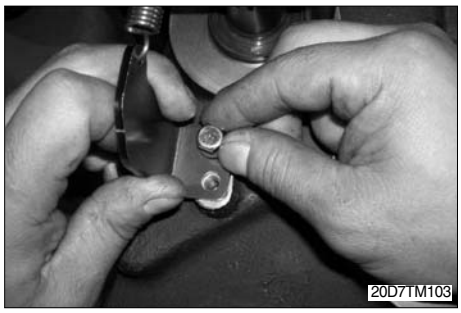
⑤ Fix parking lever.



⑥ Assemble snap ring.

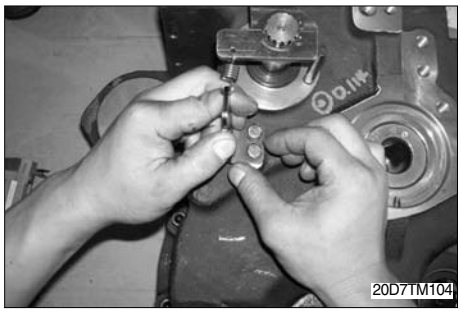
⑦ Fix spring and spread loctite #277 on bolt.

⑧ Temporarily assemble parking bracket.



⑨ Confirm torque.

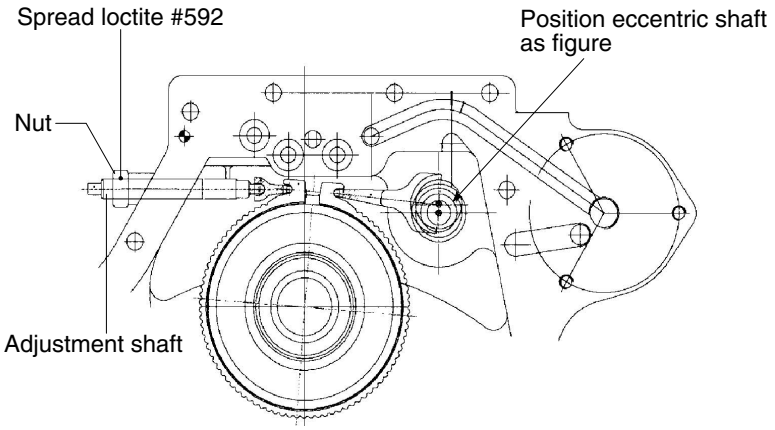
· Tightening torque : 0.6~0.8 kgf · m
(4.3~5.8 lbf · ft)



The way to adjusting parking brake

① Tighten the adjustment shaft and loosen the shaft a 3/4 revolution.
· Tightening torque : 0.65kgf · m (4.7lbf · ft)

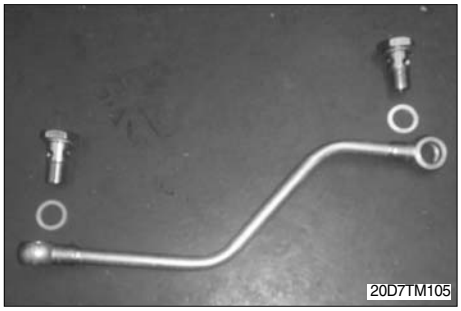
② Tighten the nut.
· Tightening torque : 3kgf · m (221lbf · ft)



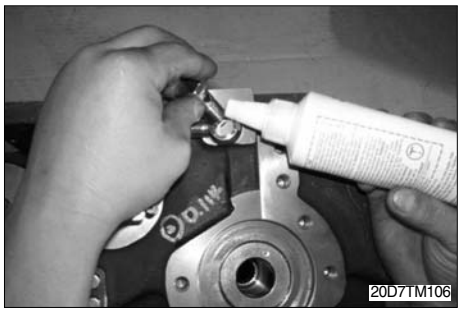
20D7PT33

Pipe offering oil path of reverse clutch assembly

① Prepare reverse pipe.

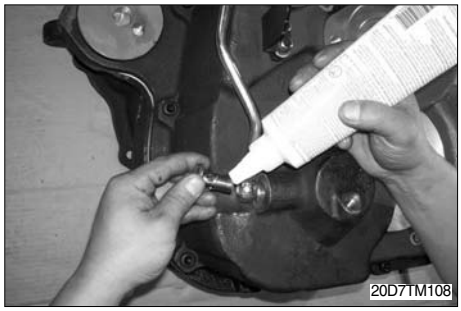


② Spread loctite #577 on nipple plug.



③ Temporarily assemble oil pressure pipe and seal washer at the same time.

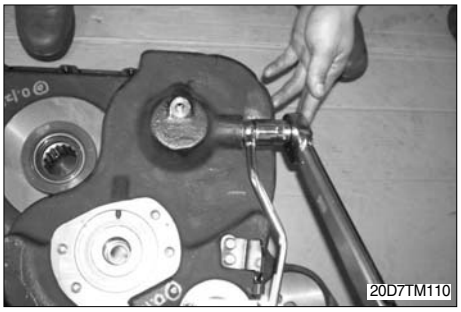
④ Spread sealant on nipple plug.



⑤ Temporarily assemble oil pressure pipe and seal washer at the same time.

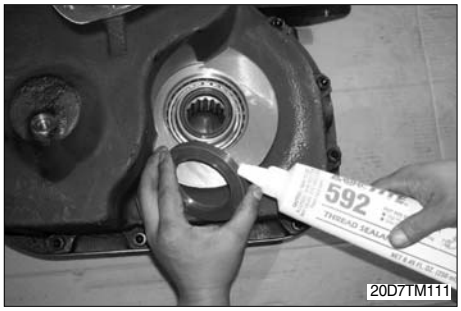
⑥ Confirm torque.

· Tightening torque : 3.5~4.0 kgf · m
(25~29 lbf · ft)

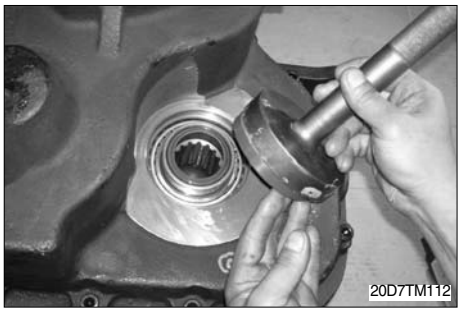


Oil seal output gear assembly

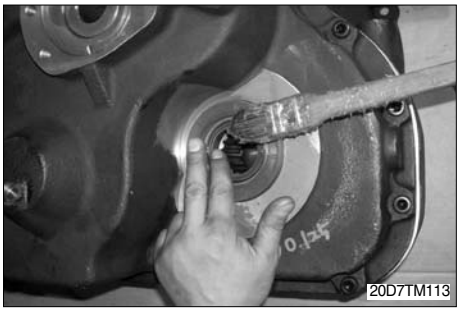
① Spread loctite #592 on the out wheel of oil seal.



② Pressurize oil seal.



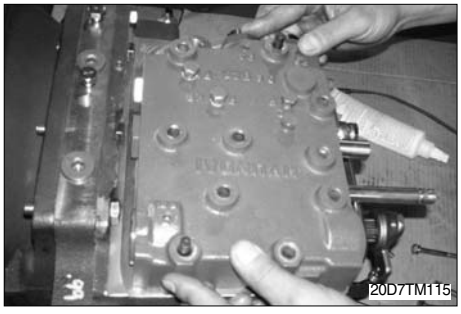
③ Spread grease on inside wheel of oil seal.



Control valve assembly

① As assembling, use guide pin at two spot.
Fix guide pin.

② Assemble control valve assembly.



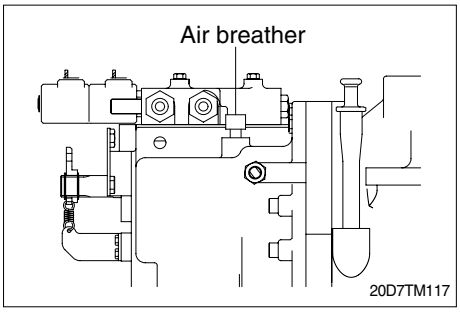
③ Assemble hex bolt and confirm torque.

· Tightening torque : 3~4 kgf · m
(22~29 lbf · ft)

Air breather and oil level gauge guide pipe assembly

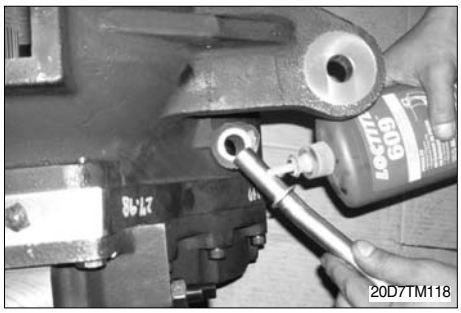
① Assemble air breather.

※ Spread loctite #577 on air breather.

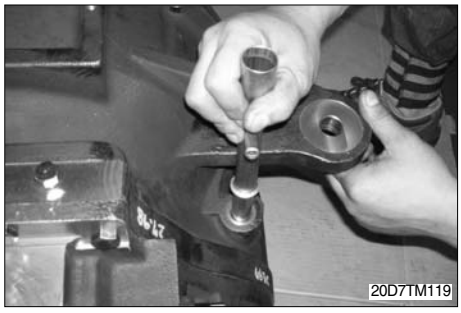


② Spread sealant on oil level gauge guide.

※ Spread loctite #608 on pipe.



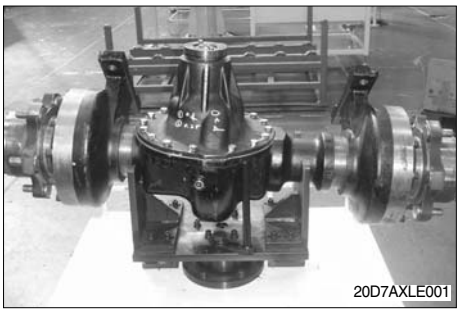
③ Pressurize guide.



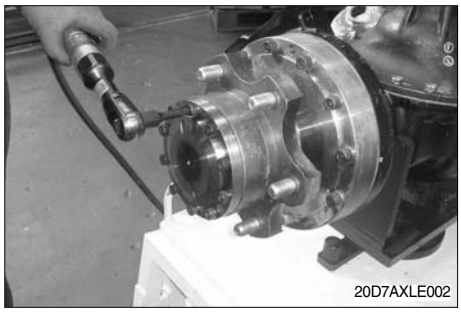
2. DRIVE AXLE

1) DISASSEMBLY

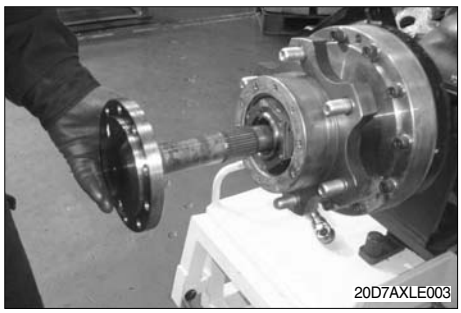
① Drive axle.



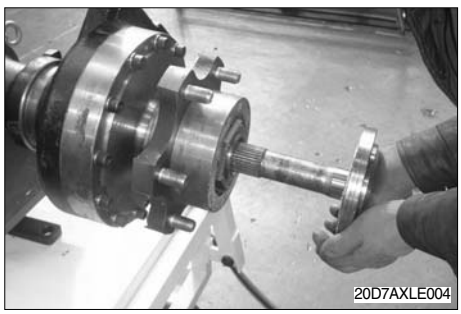
② Remove the bolt of axle shaft.



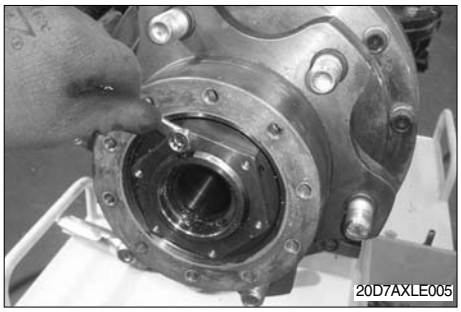
③ Extract the left axle shaft.



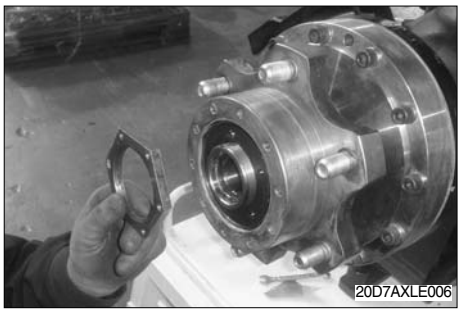
④ Extract the right axle shaft.



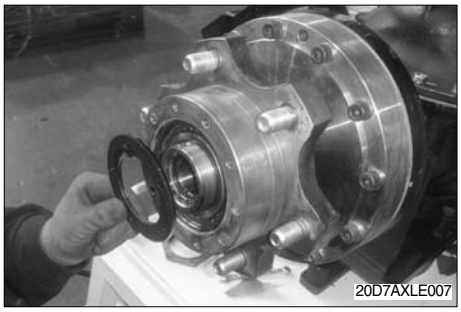
⑤ Remove the bolt of plate / nut.



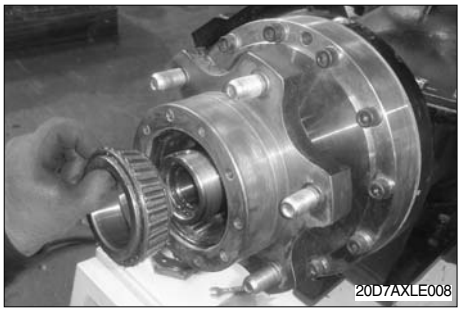
⑥ Extract the nut.



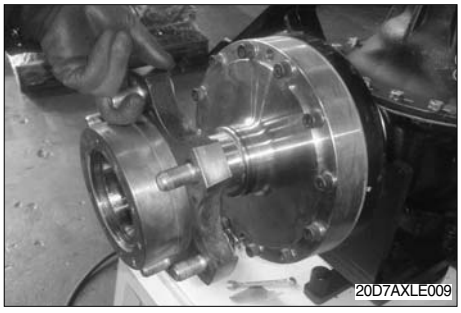
⑦ Extract the plate.



⑧ Extract the hub bearing.

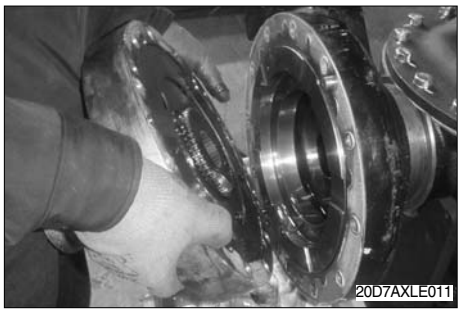


⑨ Extract the hub.

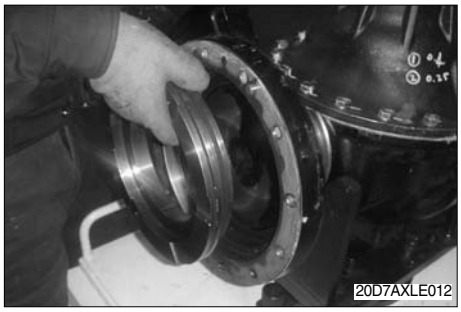


⑩ Remove the bolt of flange shaft.

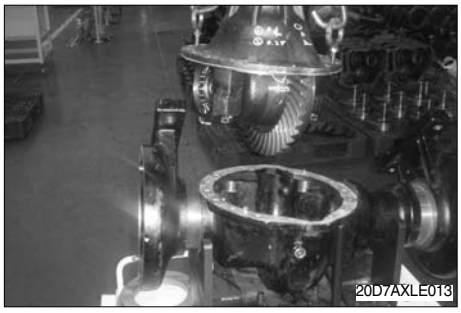
⑪ Extract the flange shaft.



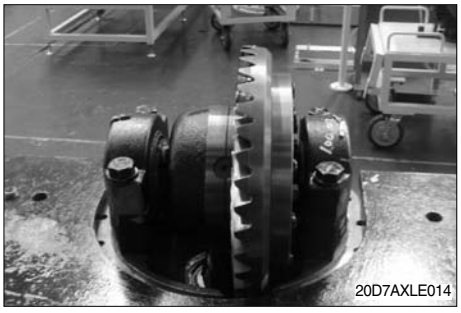
⑫ Disassemble the piston brake.



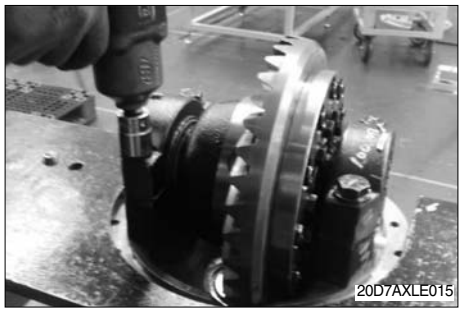
⑬ Disassemble the carrier assembly.



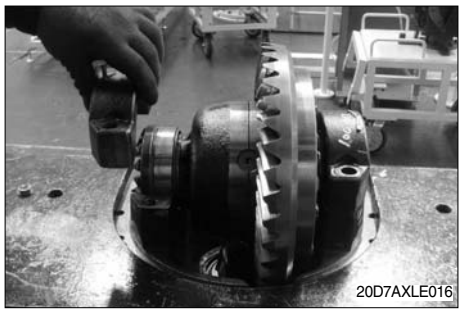
⑭ Fix the carrier assembly.



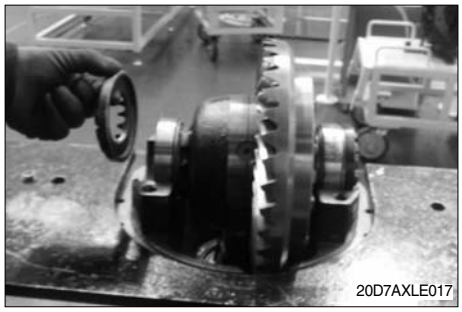
⑮ Remove the bolt of carrier cap.



§ Extract the carrier cap.

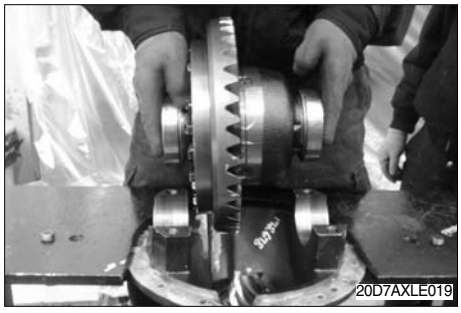


§æRemove the left adjusting cap of bearing cup.

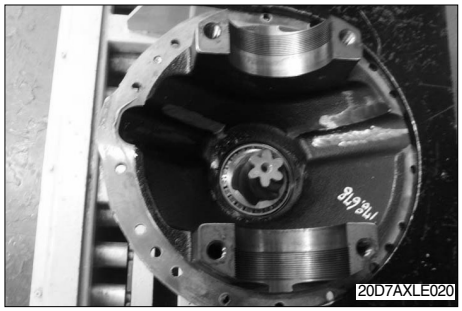


§ Remove the right adjusting cap of bearing cup.

§ Disassemble the differential assembly.



§ After disassemble the carrier.

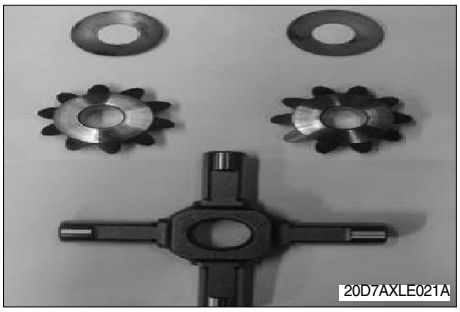


2) ASSEMBLY

(1) Assembly of carrier assembly

Differential device assembly

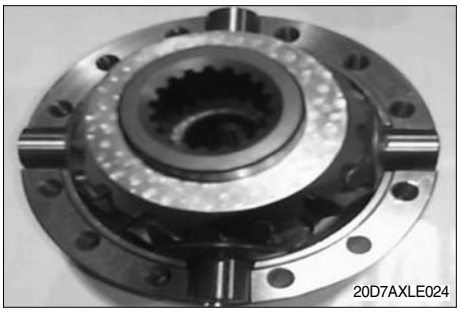
① Assemble spider and the differential pinion.



② Assemble the washer and the differential gear.

③ Assemble the spider and the differential.

④ Assemble the washer and the differential gear.



⑤ Assemble the differential case.

⑥ Fix the bolt.

⑦ Confirm the differential gear backlash.

※ Adjust backlash of differential gear within 0.015㎜.

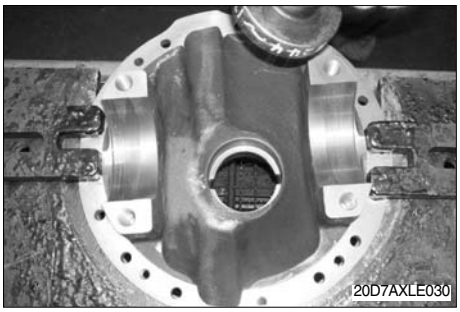
⑧ Assemble the ring gear.

⑨ Assemble the bearing of differential.

(2) Assembly of carrier sub assembly

Adjusting shim and pinion shaft assembly

① Fix the carrier case.



② Measure a gap(A) for deciding an amount of shim with feeler gauge.

¡ Determine shim X.

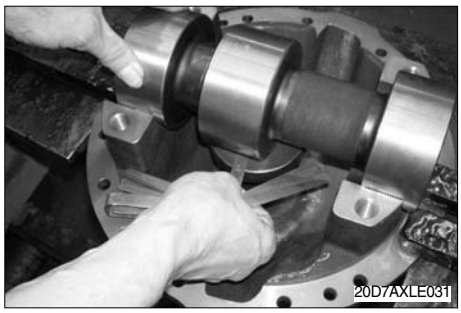
· X = A ± Mounting distance (MD) of pinion gear

Ex 1) A = 0.5, MD value = - 0.2

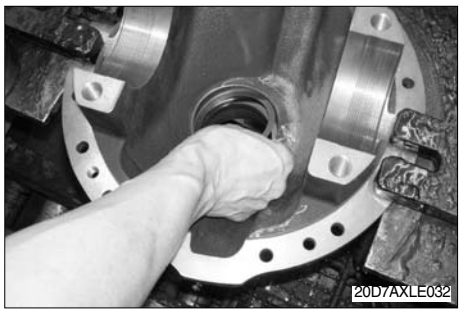
X = 0.5 + 0.2 = 0.7㎜

Ex 2) A = 0.5, MD value = + 0.2

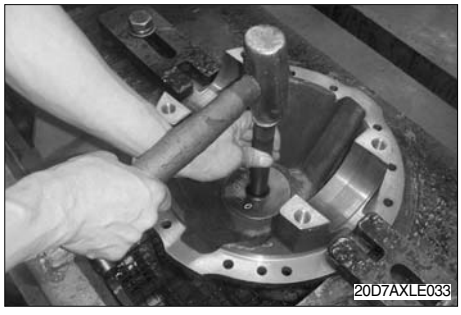
X = 0.5 - 0.2 = 0.3㎜



③ Select the shim and assemble.

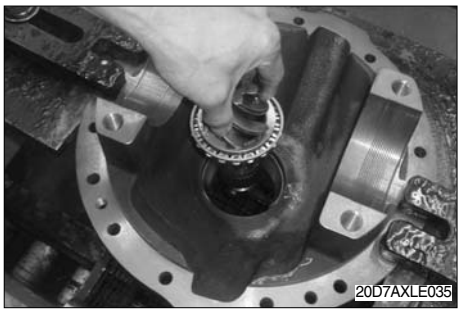


④ Pressurize the bearing cup.

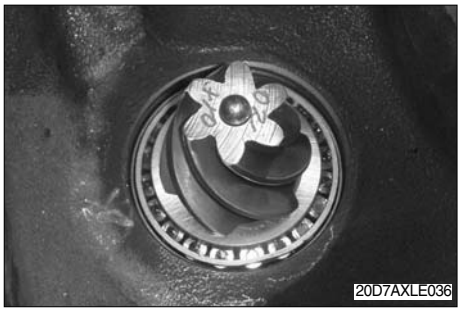


⑤ Pressurize the bearing cone into the pinion shaft.

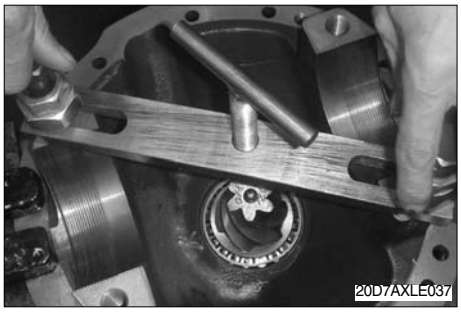
⑥ Fix the pinion shaft.



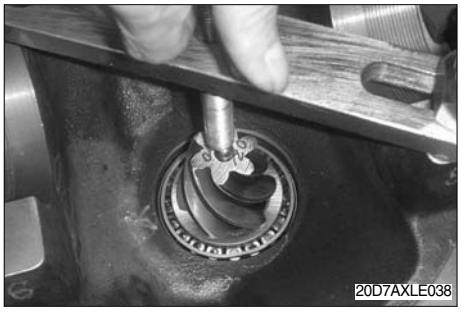
⑦ Set the ball.



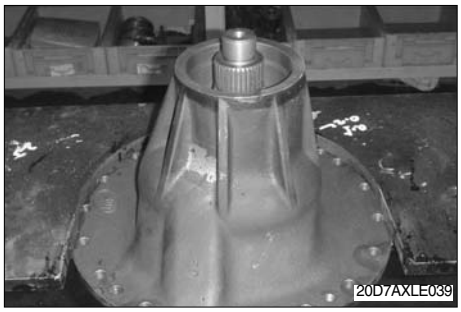
⑧ Fix the fixing jig.



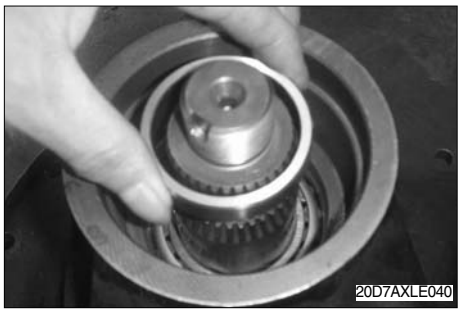
⑨ Fix the ball.



⑩ Revolve the carrier case in 180¡£



⑪ Fix the spacer.



⑫ Shim measuring gauge 1 insert.

⑬ Shim measuring gauge 2 insert.

⑭ Put the shim measuring block.

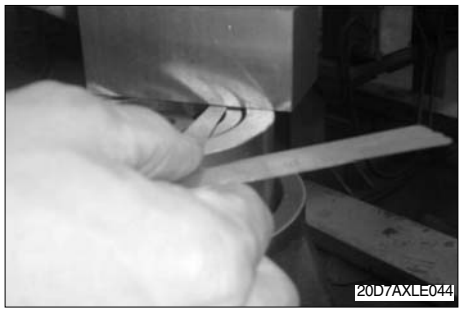
⑮ Measure a gap (B).

¡ Determine shim X.

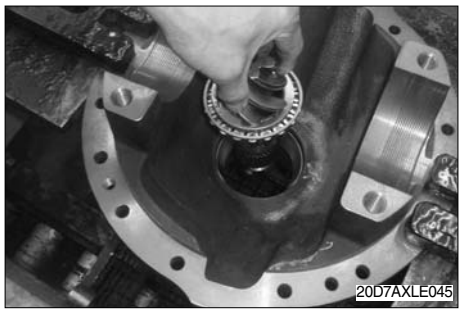
· X = B - End play (0.03~0.06)

Ex 1) B = 0.5,

X = 0.5 - (0.03~0.06) = 0.47~0.44㎜

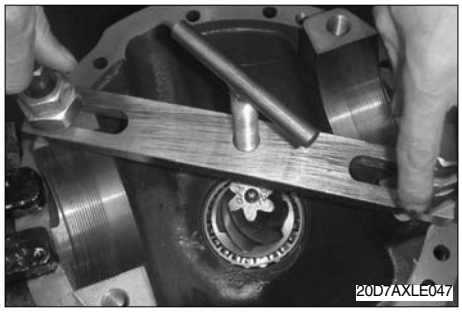


§ Remove the pinion shaft.

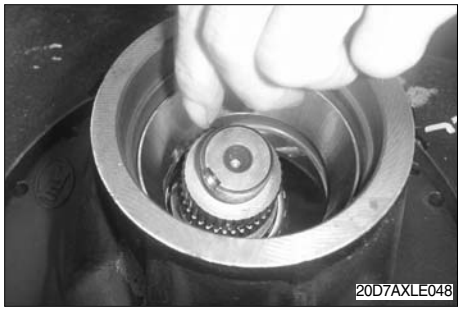


§æAssemble the bearing cup.

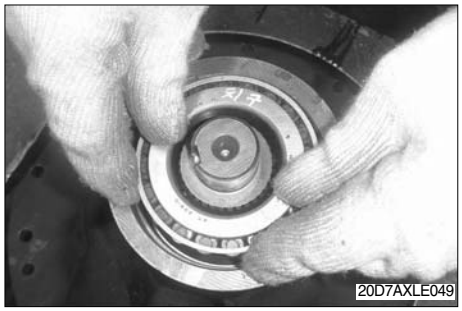
§ Assemble and fit the pinion.



§ Assemble the shim.

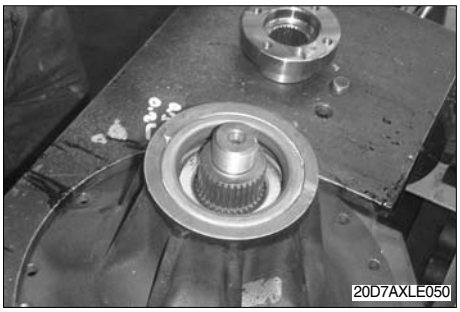


§ Fix the bearing cone.



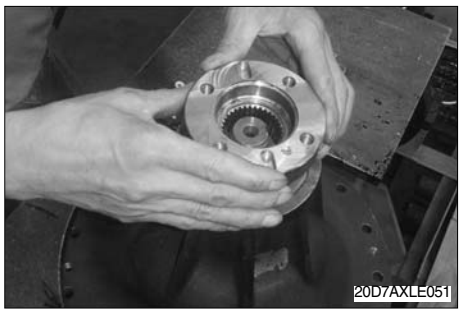
Assembly of carrier sub assembly

① Pressurize the oil seal.

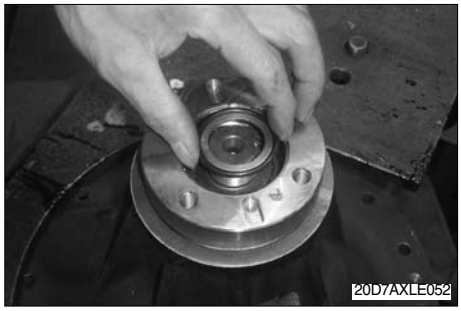


② Fix the U-joint flange.

※ Assemble U-joint flange in preload 0.01~0.19 kgf¡/m.

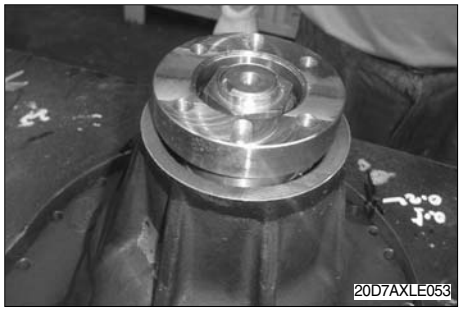


③ Fix the O-ring.



④ Temporarily assemble the nut.

※ Spread loctite #242 on nut.

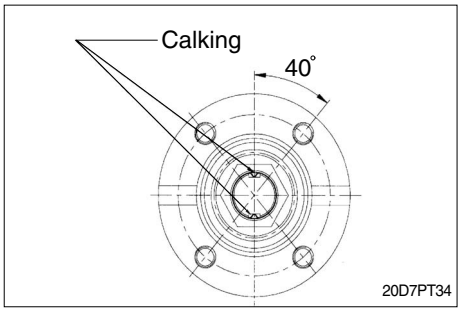


⑤ Fasten the torque.

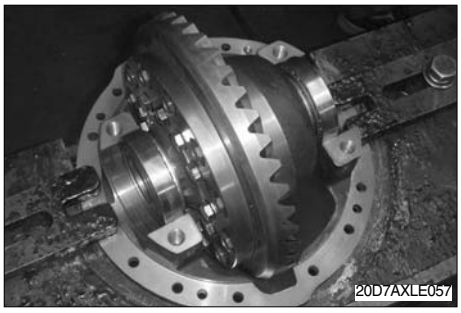
· Tightening torque : 16.2~19.1 kgf · m
(117~138 lbf · ft)

⑥ Confirm the preload.

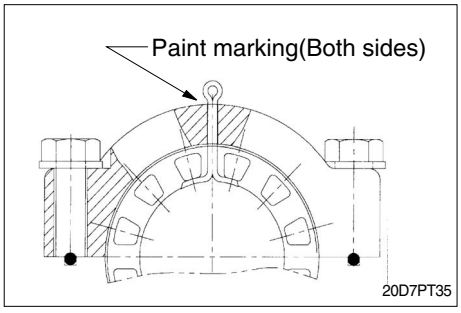
⑦ Perform the calking.



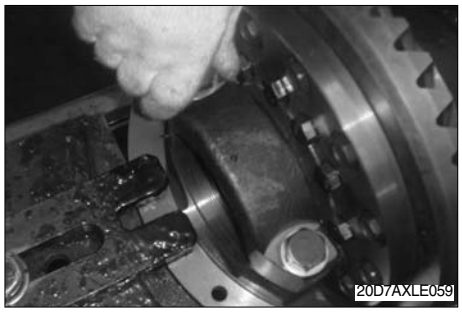
⑧ Assemble the differential sub in case.



⑨ Fix the steel ball.



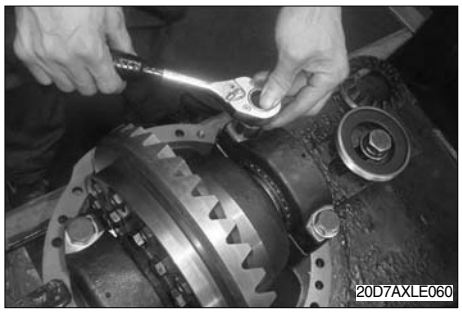
⑩ Temporarily assemble the carrier cap.



⑪ Fasten the torque.

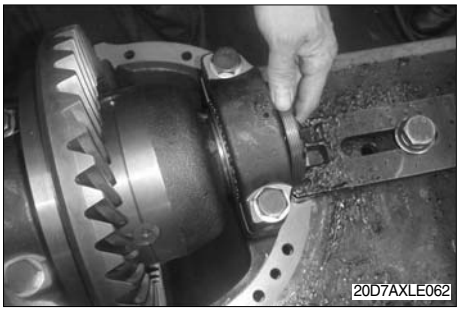
※ Spread loctite #277 on bolt.

· Tightening torque : 26.8~32 kgf · m
(194~231 lbf · ft)

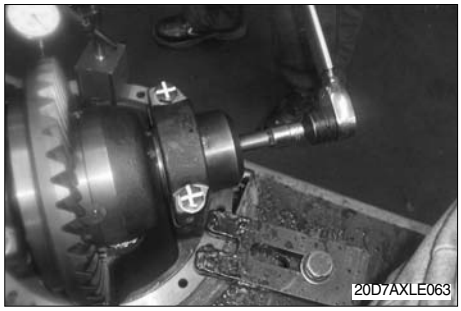


Adjust backlash

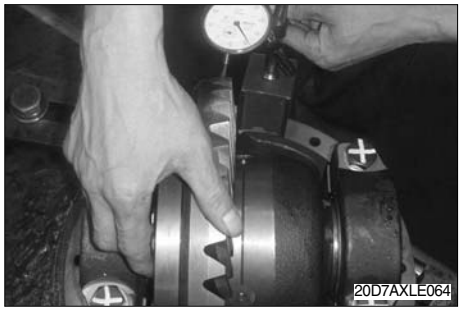
① Assemble the RING BRG ADJUST.



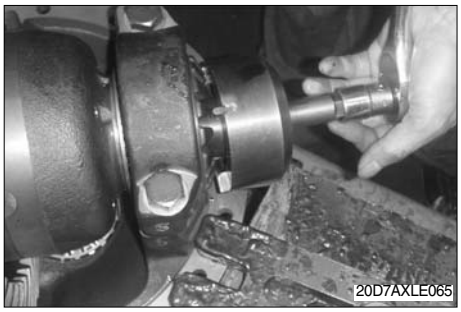
② Adjust the RING BRG ADJUST.



③ Measure backlash.



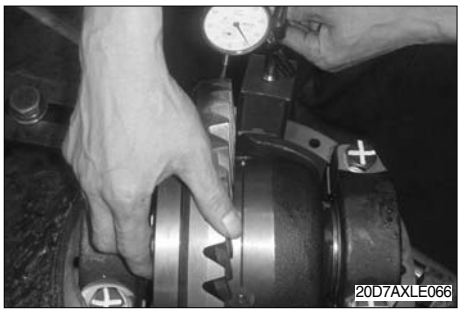
④ Fasten RING BRG ADJUST.



⑤ Measure backlash again.

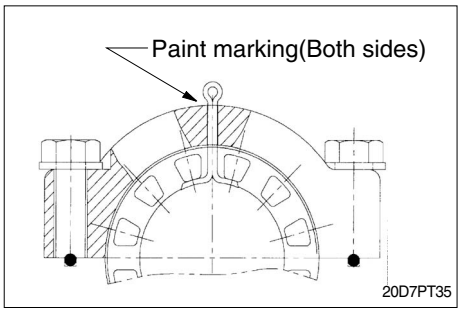
※ Backlash of pinion shaft and ring gear is 0.15~0.2mm (0.006~0.008 in)

※ If backlash is wrong, carry out adjusting work.
Adjust the left / right of RING BRG ADJUST by one and one clip.

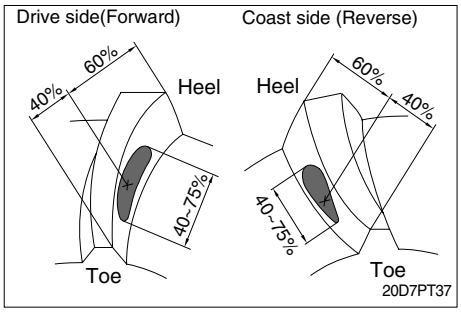


⑥ Fit position.

⑦ Assemble cotter pin.

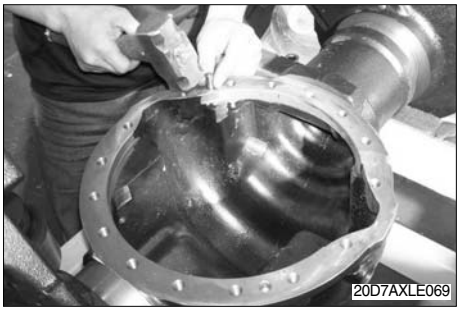


※ After assembling, adjust pattern of the gear and pinion shaft as figure.
If pattern is not adjusted, take a measure as measuring backlash again and then reassemble.

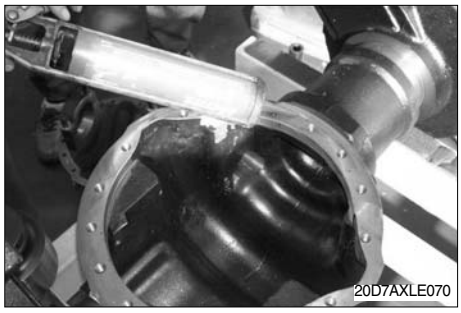


Assembly of carrier assembly

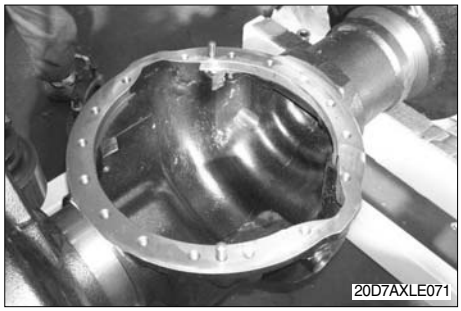
① Pressurize lock pin into drive axle.



② Spread sealant on the installation surface of carrier.



③ Fix assembly guide bar.



④ Fit carrier at drive axle housing.

※ Spread loctite #5127 on drive axle housing.

⑤ Spread loctite #277 on the spring washer bolt.

⑥ Temporarily assemble bolt and confirm torque.

· Tightening torque : 6~7 kgf · m
(43~51 lbf · ft)

(2) TRAVELING BRAKE SYSTEM ASSEMBLY

Piston assembly

① Fix large quad ring into brake.

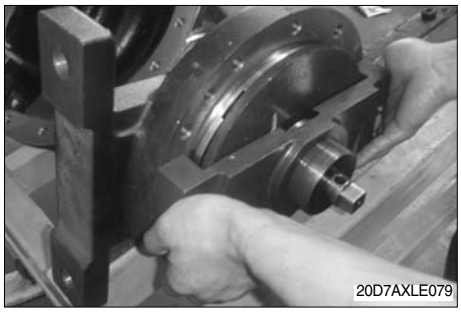
② Fix small quad ring into brake.

※ When assembling quad ring, pay attent to chopping.

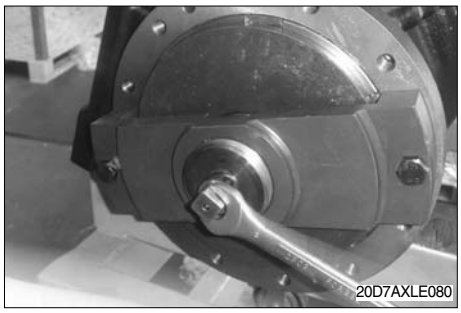
③ Spread oil on the piston.

④ Fix piston into drive axle housing.

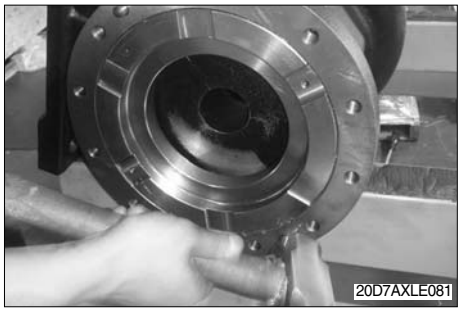
⑤ Set assembly jig.



⑥ Assemble close to drive axle housing.

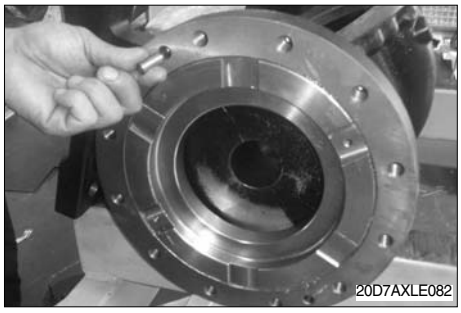


⑦ Pressurize lock pin.



⑧ Measure projection degree of piston.

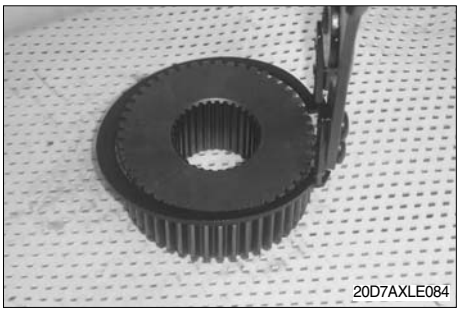
※ Manage projection degree of piston in 0.6~0.9㎜.



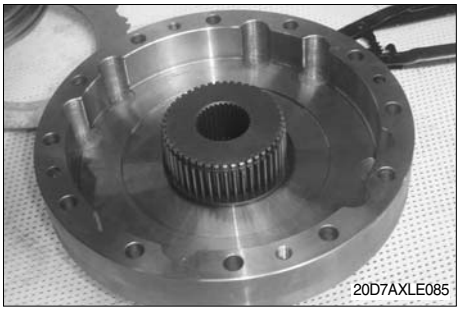
Friction plate and plate assembly

① Pressurize oil seal into flange.

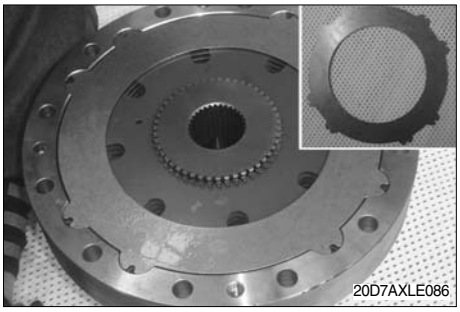
② Assemble snap ring at socket.



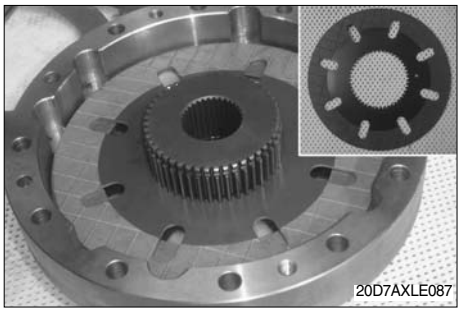
③ Fix socket gear into flange shaft.



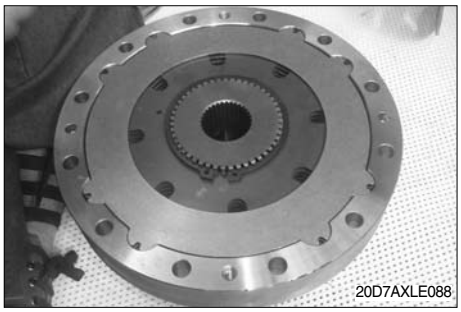
④ Fix plate into socket gear.



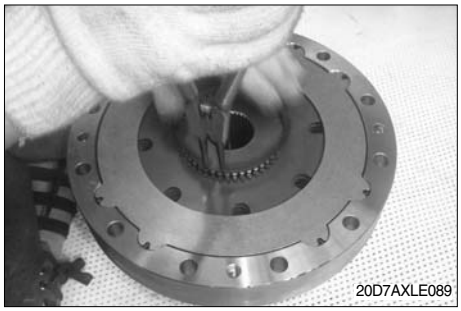
⑤ Fix friction plate into socket gear.



⑥ Fix friction plate and confirm the direction.

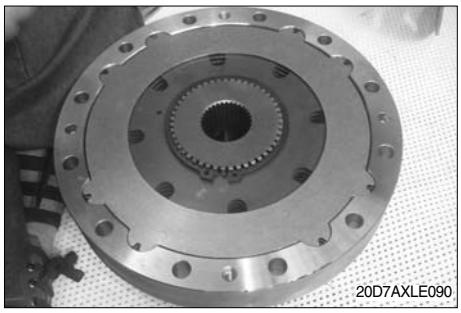


⑦ Assemble snap ring at socket.



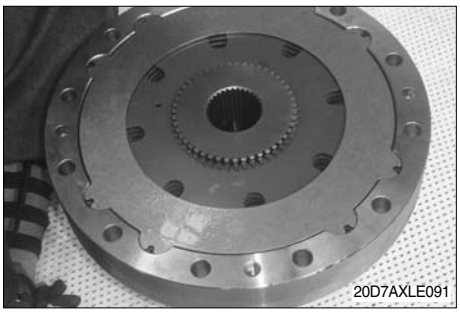
⑧ Measure stepped pulley between flange and plate and record.

※ Manage stepped pulley of flange 0.6~0.9㎜.

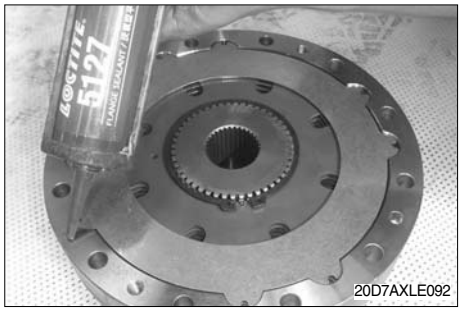


Flange shaft assembly

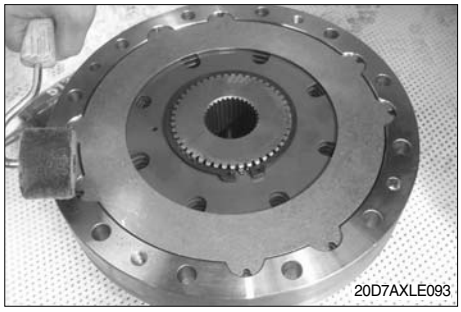
① Select flange shaft.



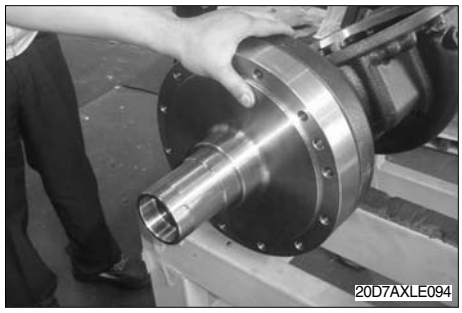
② Spread loctite # 5127.



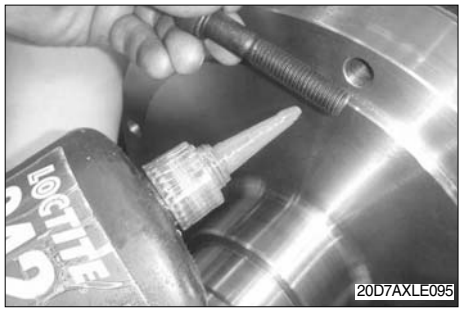
③ Spread on the whole surface of flange shaft.



④ Fit flange into drive axle housing.

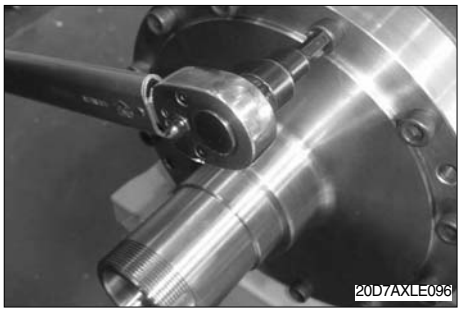


⑤ Spread loctite #242 on bolt.



⑥ Fasten bolt.

· Tightening torque : 9~11.5 kgf · m
(65~83 lbf · ft)

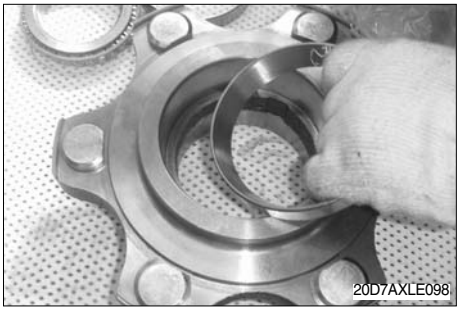


(3) Hub assembly

Hub sub assembly

① Pressurize bolt.

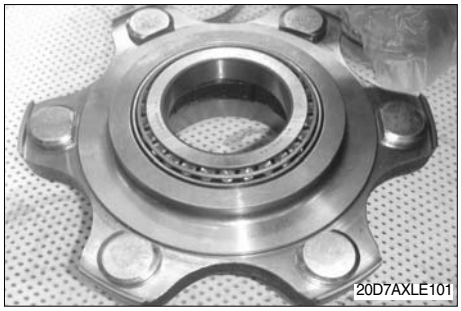
② Put a bearing cup on the upper and lower of hub.



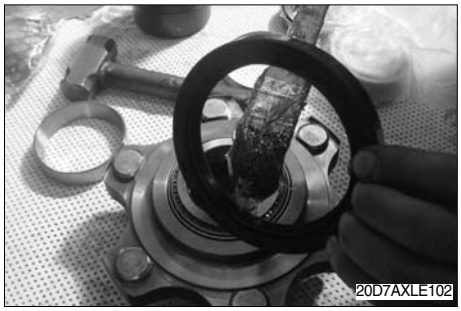
③ Pressurize bearing cup.

④ Spread grease on the bearing of flange.

⑤ Fix bearing into hub.



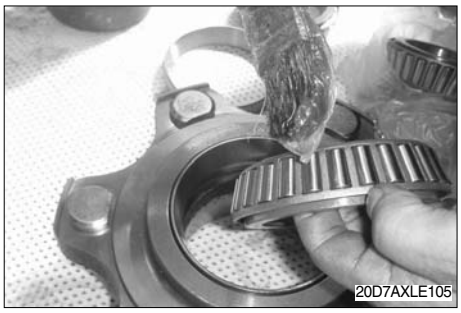
⑥ Spread grease in the oil seal.



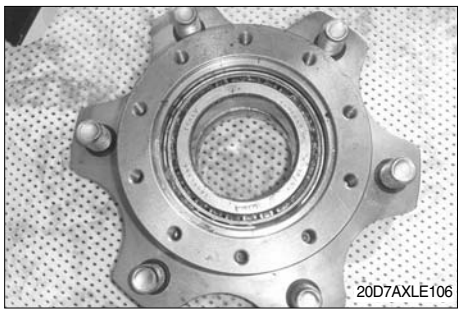
⑦ Spread sealant on the outside of oil.

⑧ Pressurize oil seal.

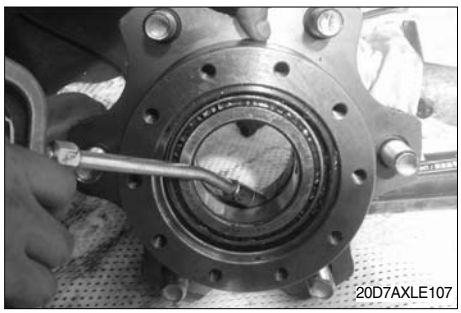
⑨ Spread grease on the bearing of axle.



⑩ Fix bearing into hub.

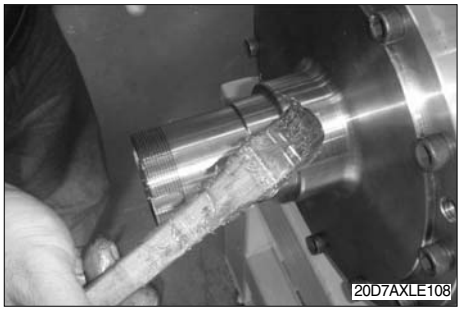


⑪ Spread grease on hub.

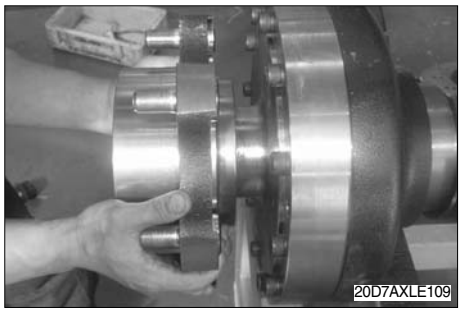


Hub assembly

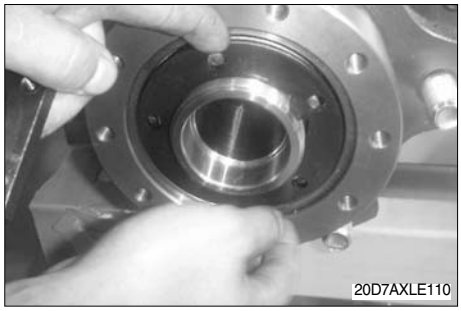
① Spread grease on the flange shaft.



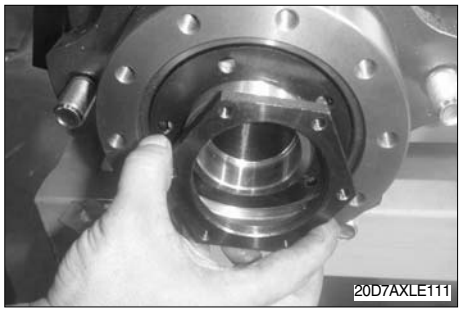
② Fix hub.



③ Fix plate.

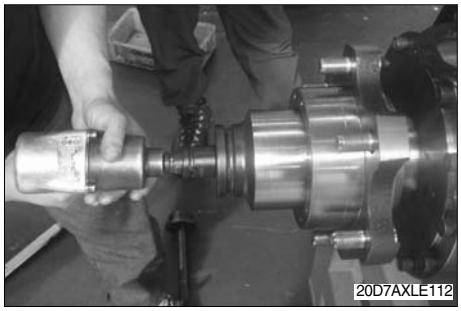


④ Fix nut.



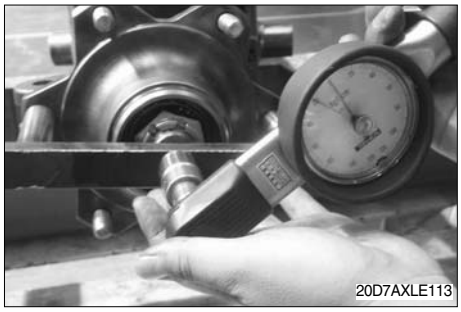
⑤ Fasten torque and loosen.

· Tightening torque : 21~25 kgf · m
(152~181 lbf · ft)

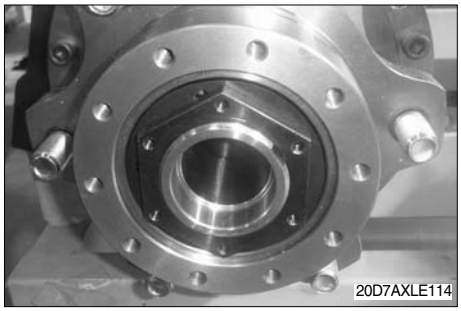


⑥ Adjust preload.

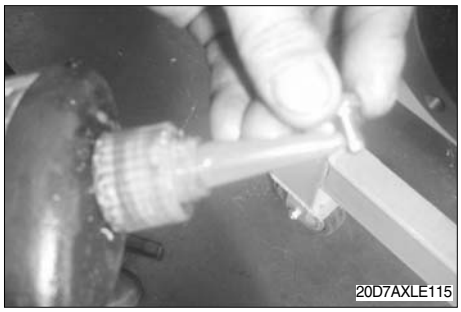
· 0.6~0.8 kgf · m



⑦ Fit the position of plate, nut and hole.

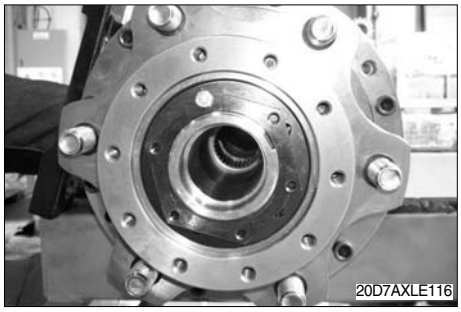


⑧ Spread loctite #277.



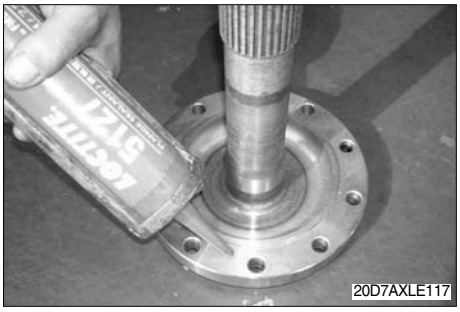
⑨ Confirm torque.

· Tightening torque : 0.8~1.2 kgf · m
(5.8~11 lbf · ft)

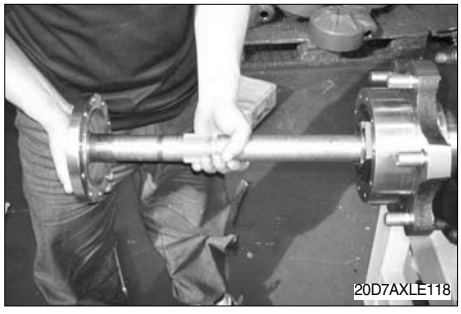


Axle shaft assembly

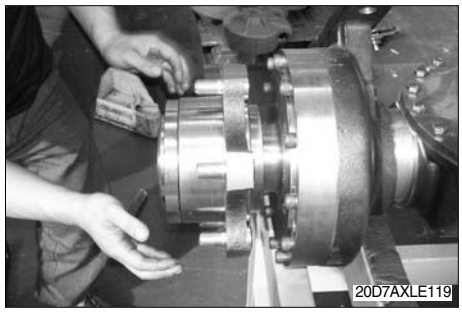
① Spread loctite #5127 on axle shaft.



② Fix into hub.



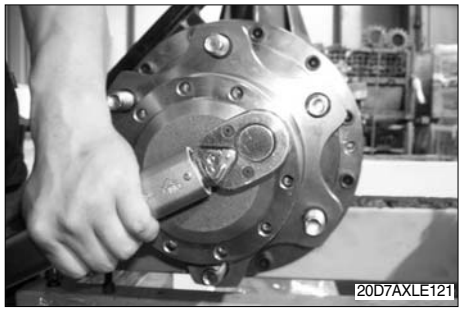
③ Close to hub.



④ Spread loctite #277 on bolt.

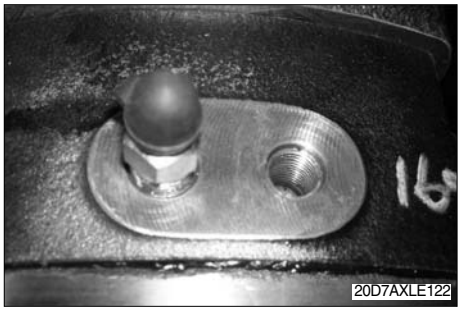
· Tightening torque : 6~7 kgf · m
(43~51 lbf · ft)

⑤ Fasten torque.



The rest part assembly

① Assemble the air breather into LH.



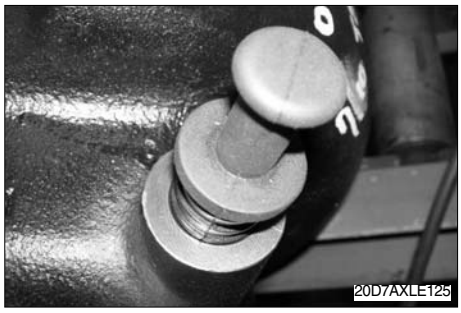
② Assemble the air breather into RH.

※ Spread loctite #577 on the air breather.

· Tightening torque (LH, RH) : 1.5~2 kgf · m
(11~14 lbf · ft)

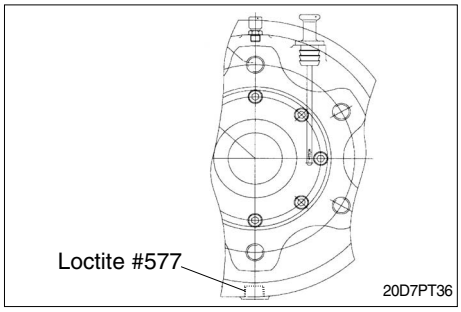
③ Assemble hanger bolt.

④ Fix dipstick.



⑤ Assemble the magnetic plug.

※ Spread loctite #577 on plug.



SECTION 4 BRAKE SYSTEM

SECTION 4 BRAKE SYSTEM

GROUP 1 STRUCTURE AND FUNCTION

1. OUTLINE

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

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

Oil pressure is generated in maximum 60kgf/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 hand brake installed on parking drum which is linked to the output shaft of the forward clutch.

2. SPECIFICATION

1) DISK BRAKE

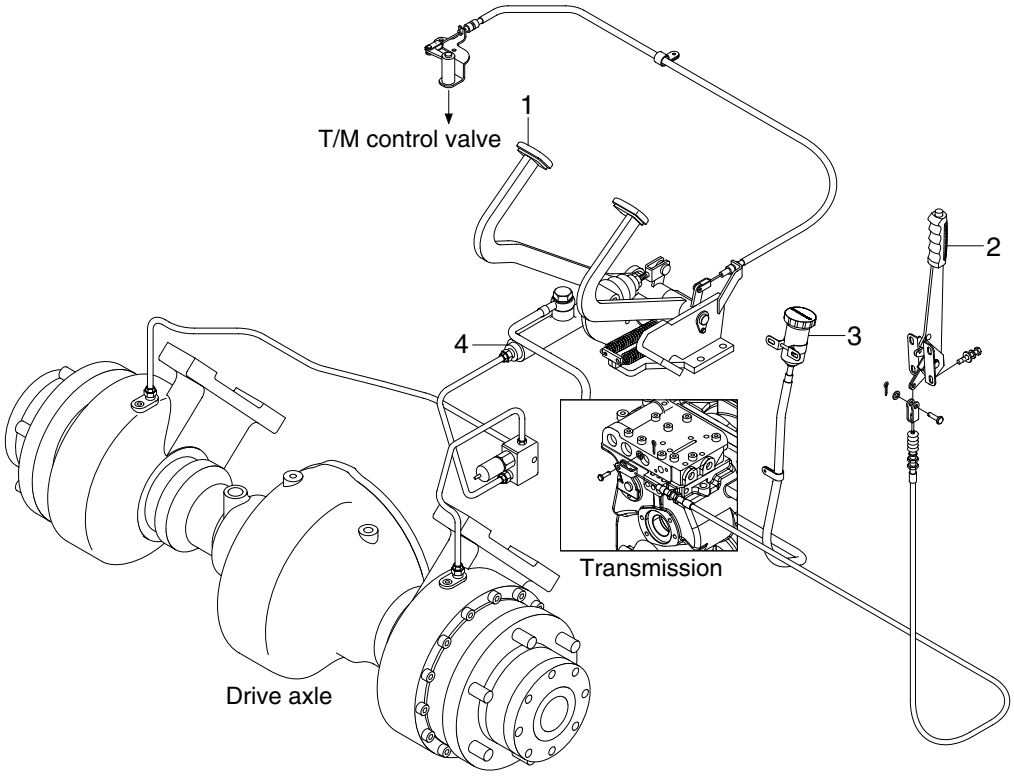
Item		Specification
Type		Wet disk brake
Master cylinder diameter (Non boosted)		33mm (1.3in)
Pedal adjustment	Pedal height	150mm
	Play	1~3mm
Brake oil		Azola ZS10 (SAE 10W hydraulic oil)

2) PARKING BRAKE

Item	Specification
Type	Ratchet, internal expanding mechanical type
Parking lever stroke / Cable stroke	12.1° / 11.5mm

3. BRAKE PEDAL AND PIPING

1) STRUCTURE

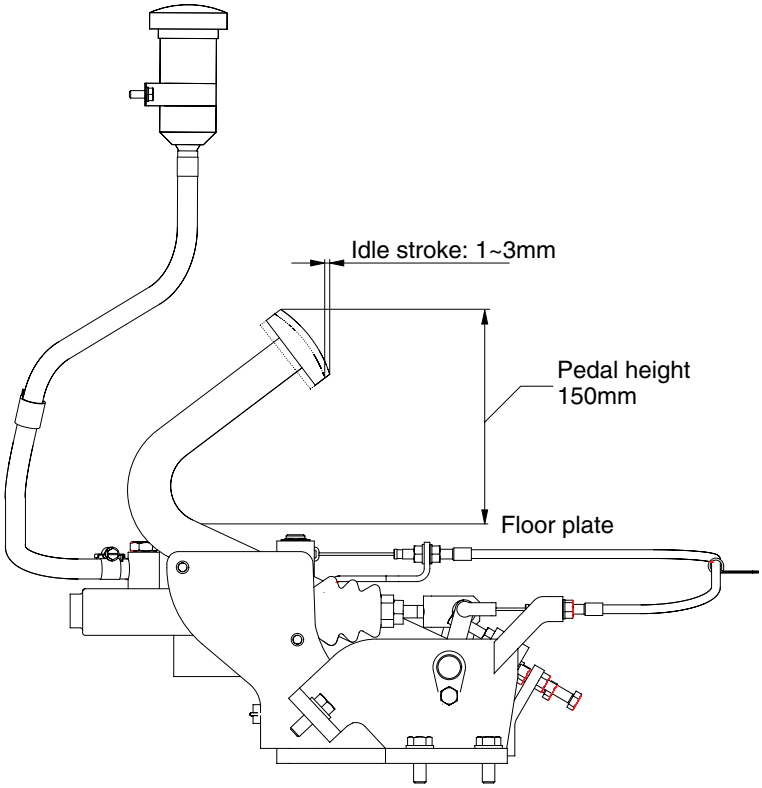


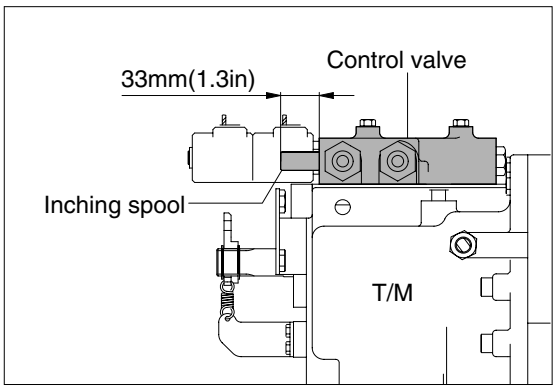
15L7BS01

1 Brake pedal
2 Parking lever assembly
3 Reservoir tank assembly
4 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.

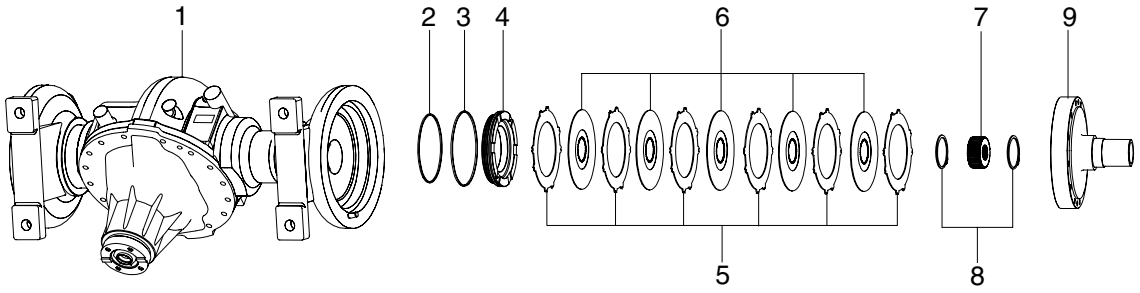




15L7BS02

5. WET DISK BRAKE

1) STRUCTURE



20D7PT20

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

2) OPERATION

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

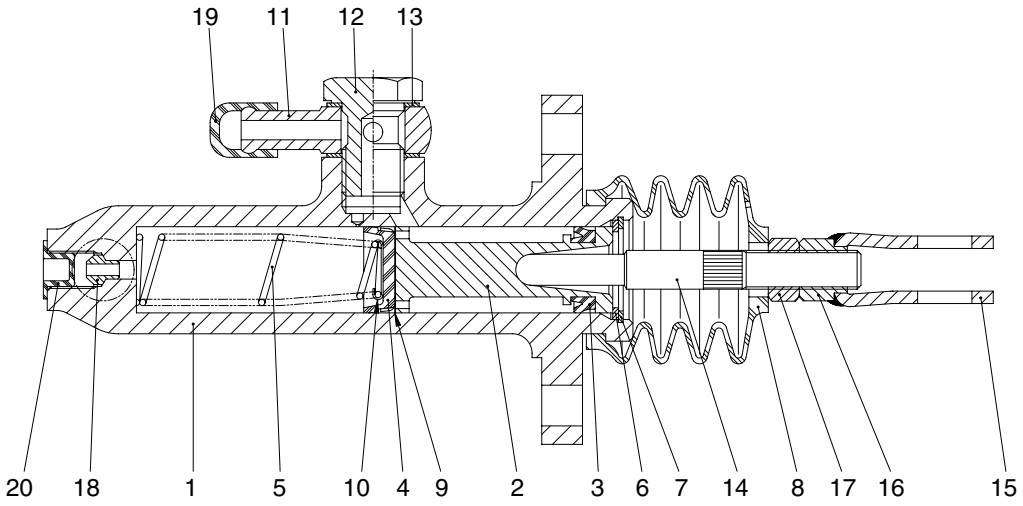
Because it is possible to use the brake semi-permanently, there is no need to replace or change the lining as drum type brake do.

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 MASTER CYLINDER

1) STRUCTURE



D205SBS04

1	Body	8	Boot	15	Head
2	Piston	9	Spacer	16	Head pin
3	Secondary cup	10	Spring seat	17	Nut
4	Primary cup	11	Union	18	Seat
5	Spring	12	Union bolt	19	Cap
6	Plate	13	Washer	20	Cap
7	Snap ring	14	Rod		

2) DISASSEMBLY

(1) Remove the master cylinder boot(8) and remove the rod(14).

(2) Remove the snap ring(7) and take out the plate(6), the piston(2), the piston primary cup(4), and piston spring(5).

(3) Specification of master cylinder.

- Cylinder bore diameter : 22.22mm
- Piston stroke : 35mm

3) INSPECTION

(1) Clean and check these components.

※ **Use isopropyl alcohol or brake fluid for washing the components. Do not use gasoline, kerosene or any other mineral oils. When using alcohol, do not leave rubber parts in the liquid for more than 30 seconds.**

(2) Inspect the inside wall of the master cylinder, and if any faults are found, replace the cylinder assembly.

(3) Replace the boot(8), the primary cup(4), piston(2), if deformation or any other defect is found.

4) ASSEMBLY

※ **Prior to assembly make sure again of no contaminant of the components. Apply a thin coat of brake oil to the components.**

- Assembly is in opposite order to disassembly.

GROUP 2 OPERATIONAL CHECKS AND TROUBLESHOOTING

1. OPERATIONAL CHECKS

1) BRAKE PIPING

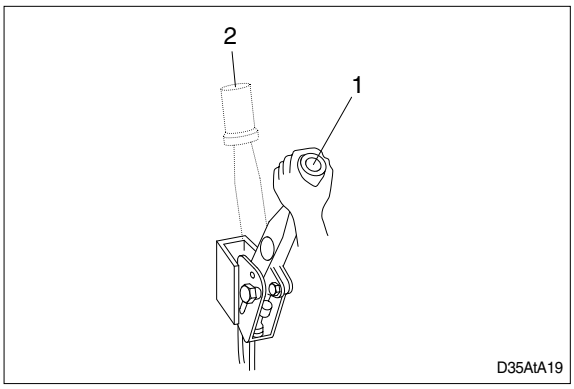
(1) Check pipes, hoses and joints for damage, oil leakage or interference.

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

2) PARKING BRAKE

(1) Operating force of parking lever is 35~40 kgf · m(253~290lbf · ft).

(2) Check that parking brake can hold machine in position when loaded on 20% slope. If there is no slope available, travel at low speed and check braking effect of parking brake.



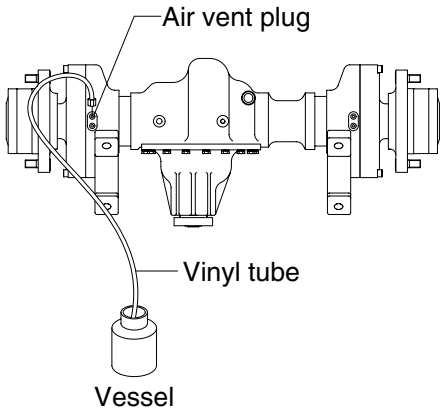
2. TROUBLESHOOTING

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

GROUP 3 TESTS AND ADJUSTMENTS

1. AIR BLEEDING OF BRAKE SYSTEM

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



20D7BS09

2. ADJUSTMENT OF PEDAL

1) BRAKE PEDAL

(1) Pedal height from floor plate

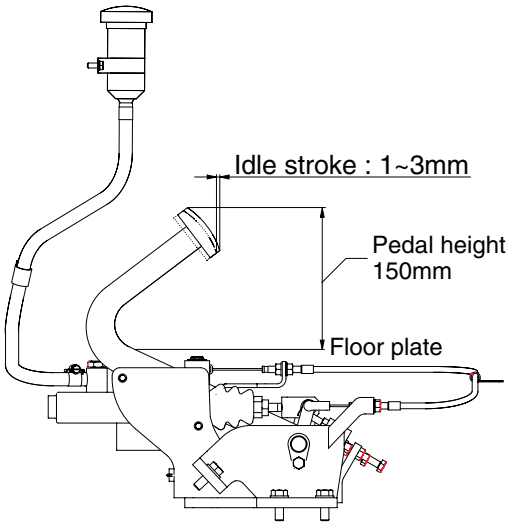
Adjust with stopper bolt.

· Pedal height : 150mm (5.9in)

(2) Play

Adjust with rod of master cylinder.

· Play : 1~3mm (0.04~0.1in)



15L7BS10

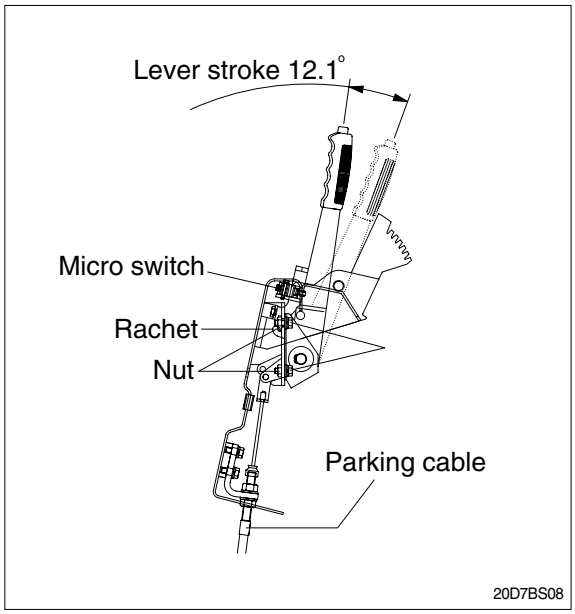
(3) Micro switch for parking brake (if equipped)

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

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

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

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



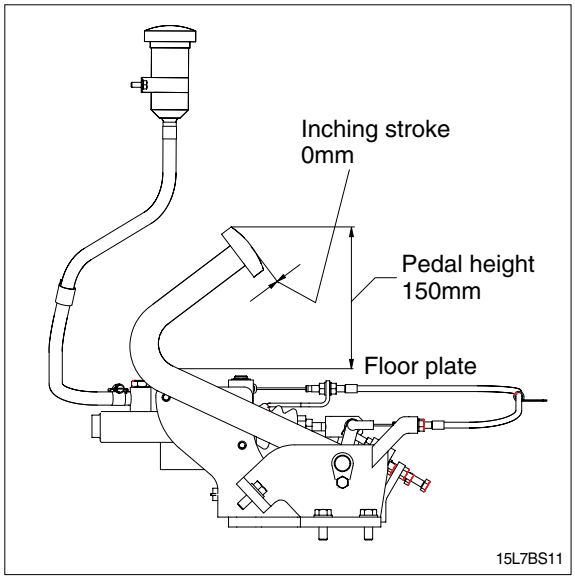
2) INCHING PEDAL

(1) Pedal height from floor plate

Adjust with stopper bolt.

- Pedal height : 150mm (5.9in)

(2) Adjust bolt so that brake pedal interconnects with inching pedal at inching pedal stroke 0mm.

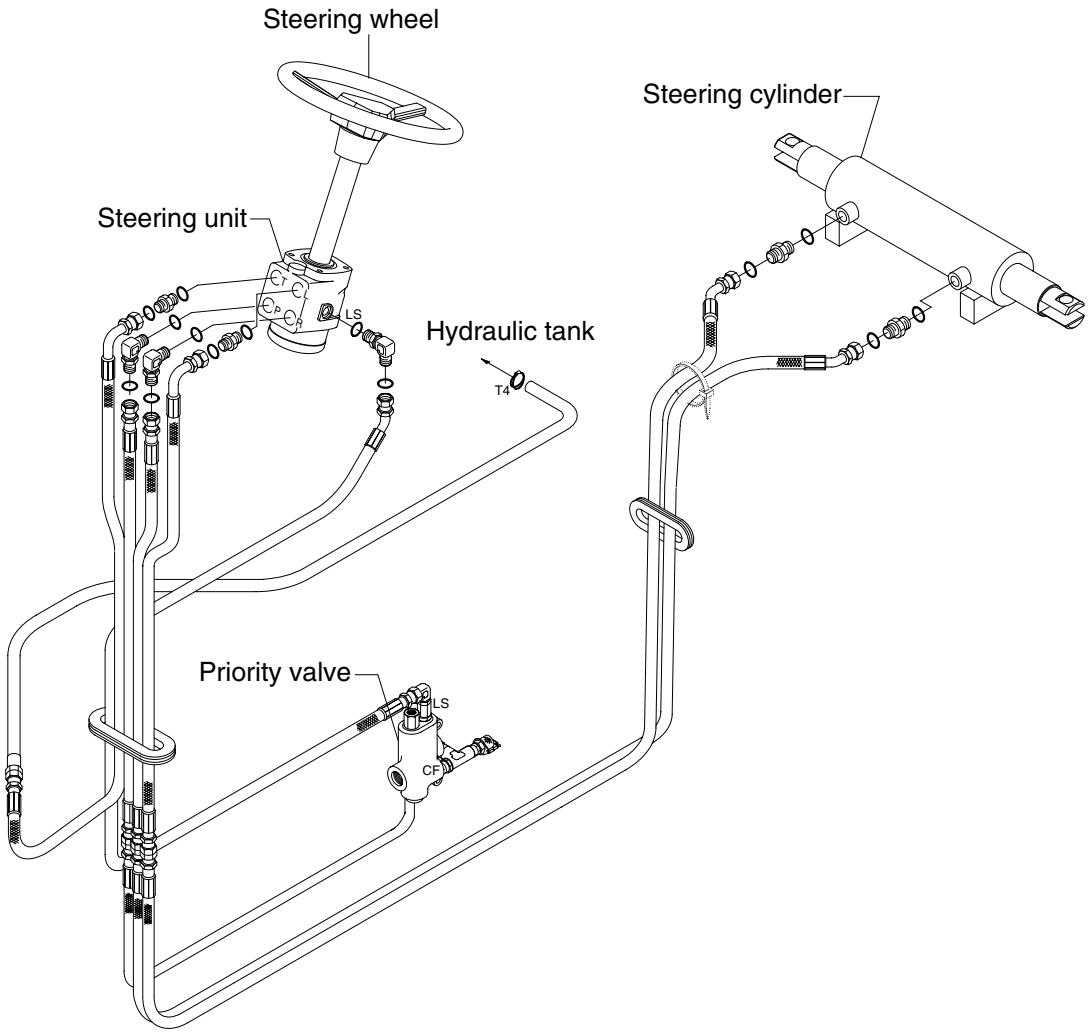


SECTION 5 STEERING SYSTEM

SECTION 5 STEERING SYSTEM

GROUP 1 STRUCTURE AND FUNCTION

1. OUTLINE

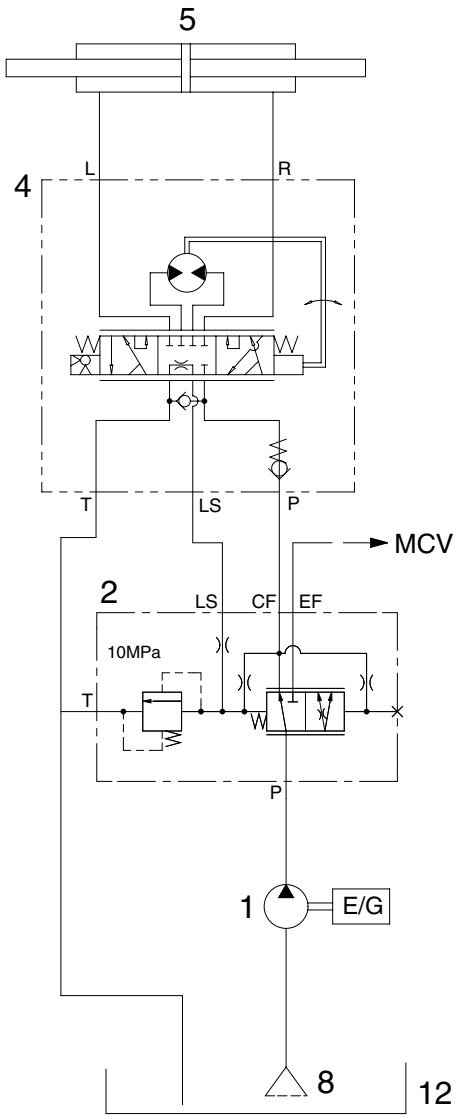


15L7SS01

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.

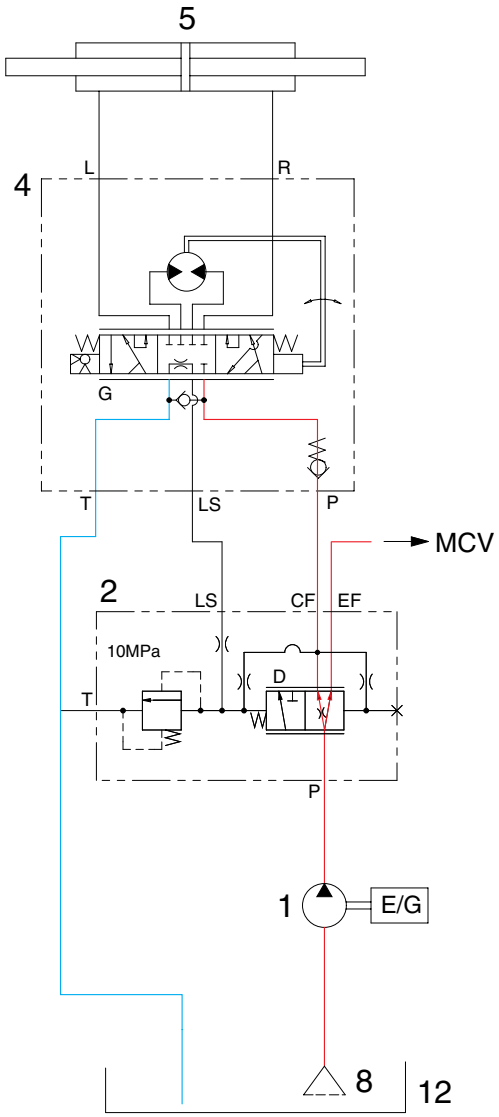
2. HYDRAULIC CIRCUIT



15L7SS02

1	Hydraulic gear pump	5	Steering cylinder
2	Priority valve	8	Suction strainer
4	Steering unit	12	Hydraulic tank

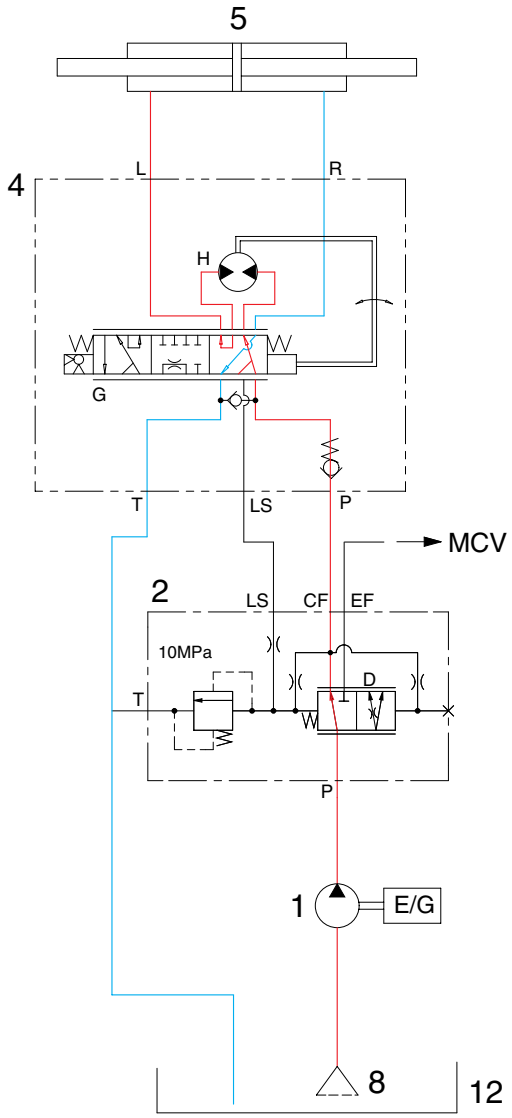
1) NEUTRAL



15L7SS03

The steering wheel is not being operated so control spool(G) does not move.
The oil from hydraulic gear pump(1) enters port P of priority valve(2) and the inlet pressure oil moves the spool(D) to the left.
Oil flow into LS port to the hydraulic tank(12).
So, the pump flow is routed to the main control valve.

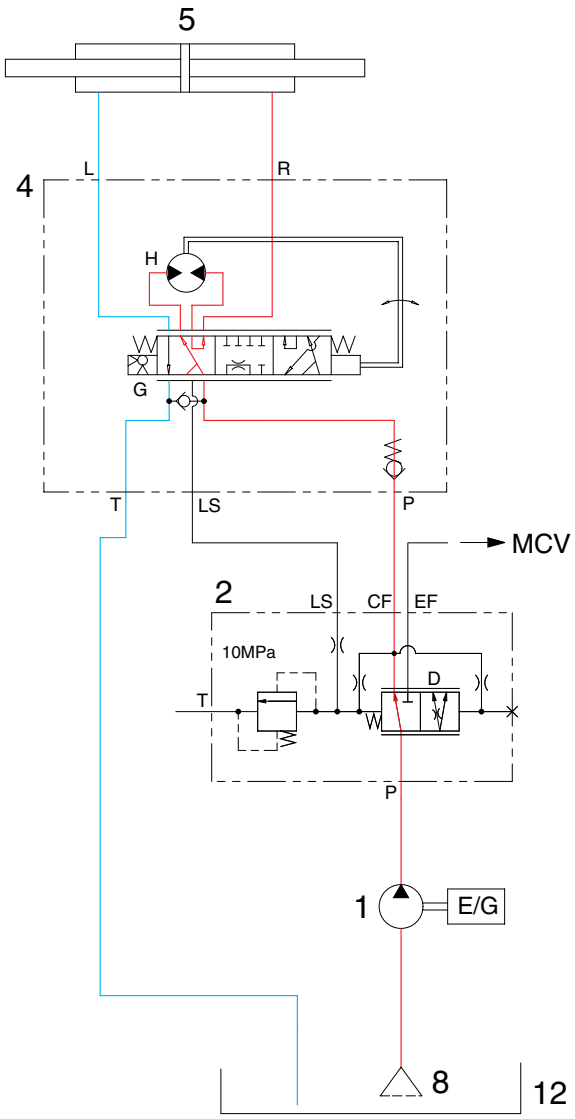
2) LEFT TURN



15L7SS04

When the steering wheel is turned to the left, the spool(G) within the steering unit(4) connected with steering column turns in left hand direction.
At this time, the oil discharged from the pump flows into the spool(G) within the steering unit(4) through the spool(D) of priority valve(2) 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(12).
When the above operation is completed, the machine turns to the left.

3) RIGHT TURN

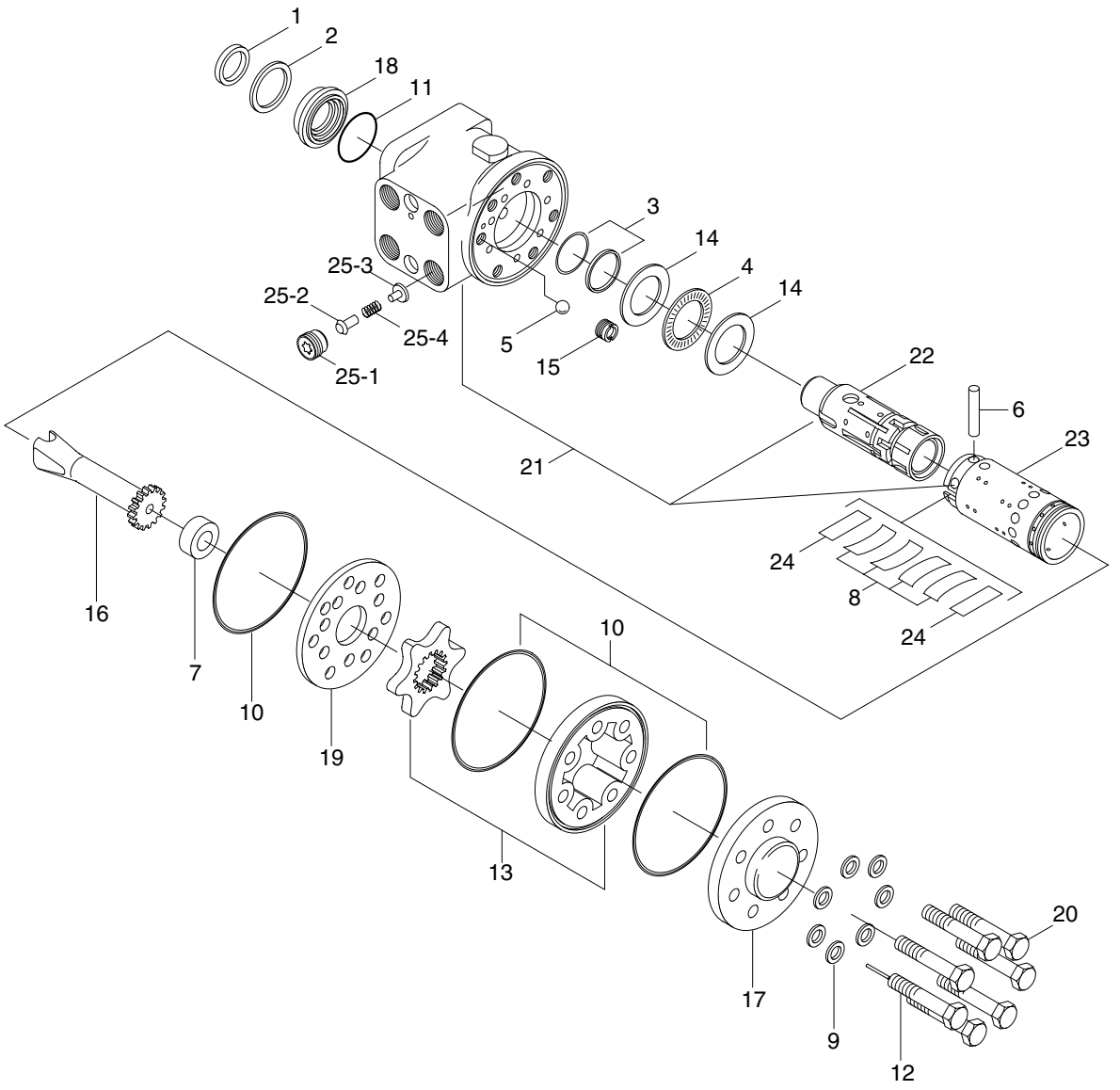


15L7SS05

When the steering wheel is turned to the right, the spool(G) within the steering unit(4) connected with steering column turns in right hand direction.
At this time, the oil discharged from the pump flows into the spool(G) within the steering unit(4) through the spool(D) of priority valve(2) 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 right work port(R).
Oil returned from cylinder returns to hydraulic tank(12).
When the above operation is completed, the machine turns to the right.

3. STEERING UNIT

1) STRUCTURE



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.

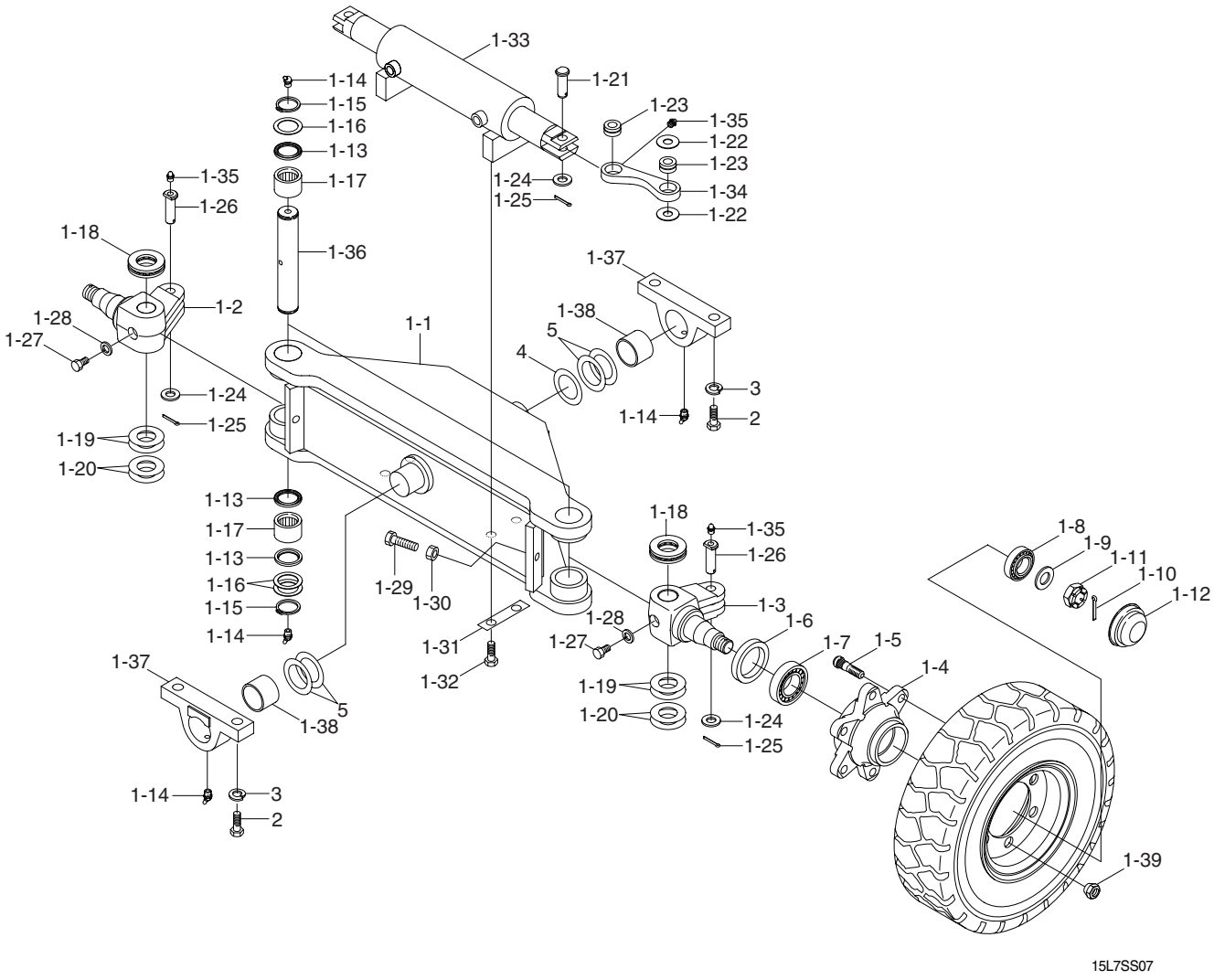
When the steering wheel is turned, the spool turns, the oil path is switched and the oil is fed into the metering device. As a result, the rotor is caused to run by oil pressure, and the sleeve is caused to run through the drive shaft and cross pin. Therefore, when the spool is turned, the spool turns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

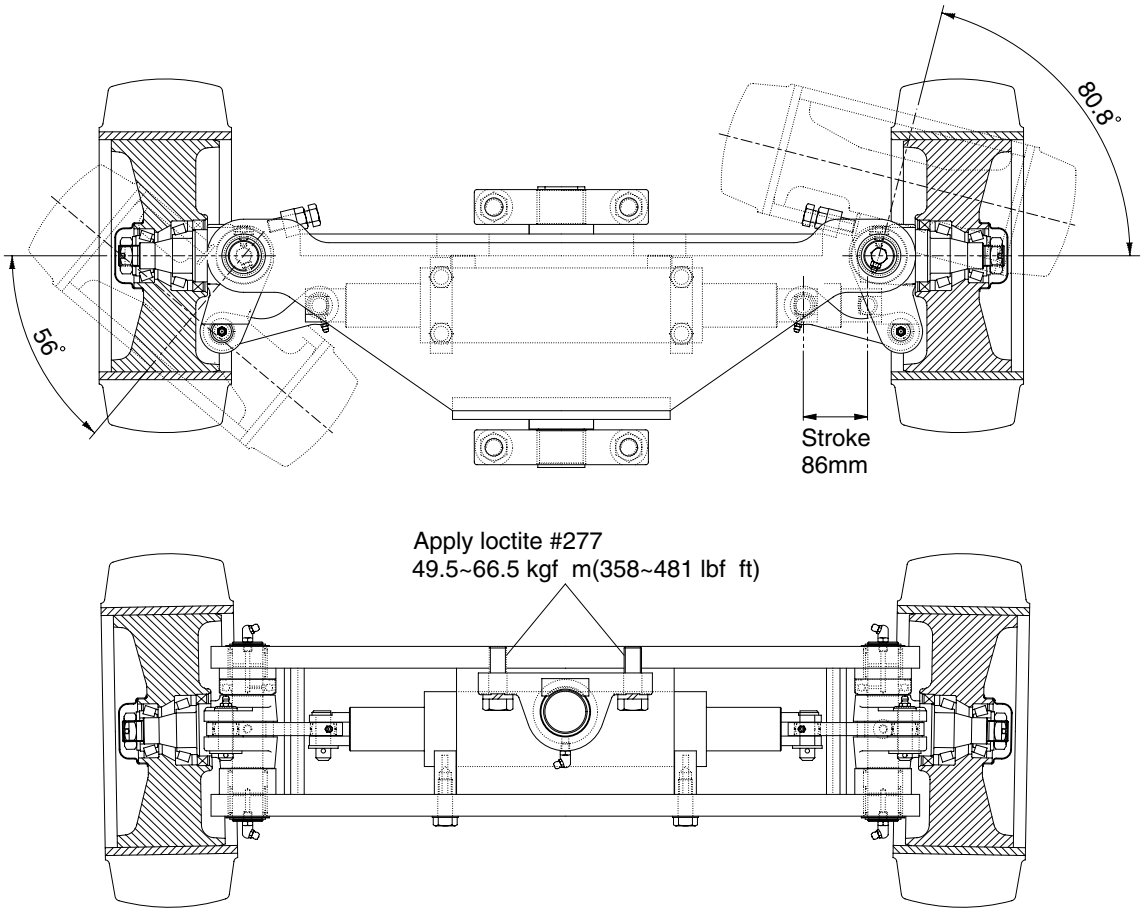
4. STEERING AXLE

1) STRUCTURE



1	Steering axle assy	1-15	Retaining ring	1-30	Hex nut
1-1	Steering axle wa	1-16	King pin washer	1-31	Lock plate
1-2	Knuckle-RH	1-17	Needle bearing	1-32	Hex bolt
1-3	Knuckle-LH	1-18	Thrust bearing	1-33	Steering cylinder
1-4	Wheel hub	1-19	Shim (0.13t)	1-34	Link
1-5	Hub bolt	1-20	Shim (0.25t)	1-35	Grease nipple
1-6	Oil seal	1-21	Clevis pin	1-36	King pin
1-7	Taper roller bearing	1-22	Thrust washer	1-37	Block
1-8	Taper roller bearing	1-23	Bearing	1-38	Bushing
1-9	Plain washer	1-24	Plain washer	1-39	Hub nut
1-10	Split pin	1-25	Split pin	2	Hex bolt
1-11	Castle nut	1-26	Clevis pin	3	Spring washer
1-12	Hub cap	1-27	Special bolt	4	Shim (1.0t)
1-13	Oil seal	1-28	Spring washer	5	Shim (0.5t)
1-14	Grease nipple	1-29	Hex bolt		

2) TIGHTENING TORQUE AND SPECIFICATION

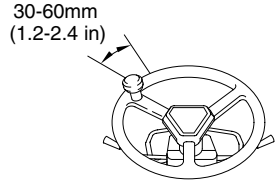


15L7SS08

Type	Unit	Center pin support single shaft
Structure of knuckle	-	Elliott type
Toe-in	degree	0
Camber	degree	1
Caster	degree	0
King pin angle	degree	0
Max steering angle of wheels(Inside/Outside)	degree	80.8 / 56
Tread	mm(in)	910 (35.8)

GROUP 2 OPERATIONAL CHECKS AND TROUBLESHOOTING

1. OPERATIONAL CHECKS

Check item	Checking procedure
Steering wheel  	· Set rear wheels facing straight forward, then turn steering wheel to left and right. Measure range of steering wheel movement before rear wheel starts to move. Range should be 30~60㎜ at rim of steering wheel. If play is too large, adjust at gear box. Test steering wheel play with engine at idling.
Knuckle	· Check knuckle visually or use crack detection method. If the knuckle is bent, the tire wear is uneven, so check tire wear.
Steering axle	· Put camber gauge in contact with hub and measure camber. If camber is not within 1±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㎜ (±4in)of specified value, adjust turning angle stopper bolt. Min turning radius(Outside) 15L-7, 15G-7 — 1985㎜ (78in) 18L-7, 18G-7 — 2015㎜ (79in) 20LA-7, 20GA-7 — 2050㎜ (81in)
Hydraulic pressure of power steering	Remove plug from outlet port of flow divider and install oil pressure gauge. Turn steering wheel fully and check oil pressure. ※ Oil pressure :100~105kgf/㎠ (1420~1490psi)

2. TROUBLESHOOTING

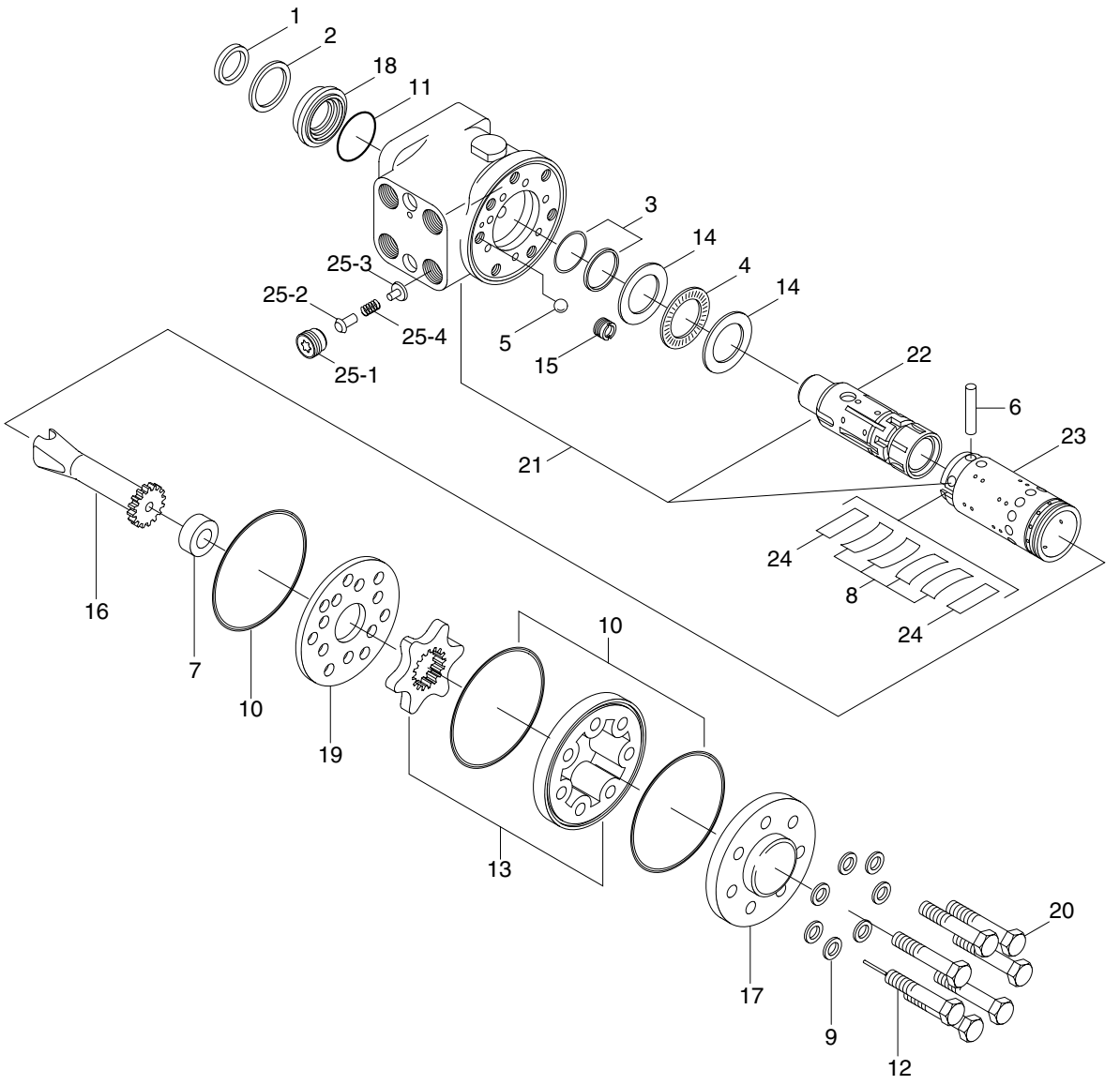
Problem	Cause	Remedy
Steering wheel drags.	· Low oil pressure. · Bearing faulty. · Spring spool faulty. · Reaction plunger faulty. · Ball-and-screw assembly faulty. · Sector shaft adjusting screw excessively tight. · Gears poorly meshing. · Flow divider coil spring fatigued.	· Check lockout. Repair.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

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

GROUP 3 DISASSEMBLY AND ASSEMBLY

1. STEERING UNIT

1) STRUCTURE

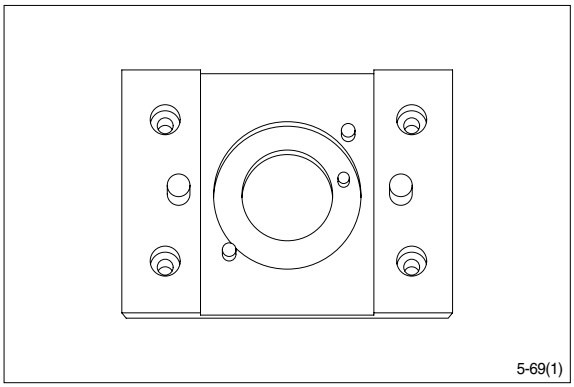


20D7SS06

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		

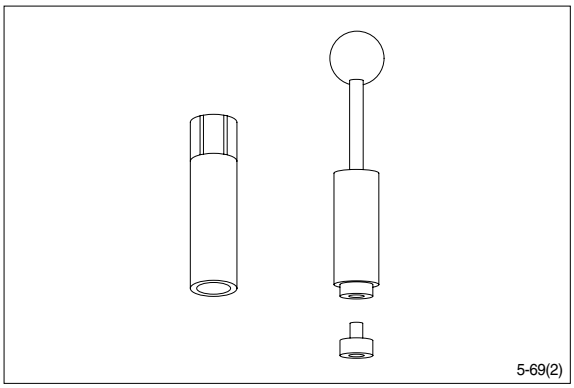
2) TOOLS

(1) Holding tool.



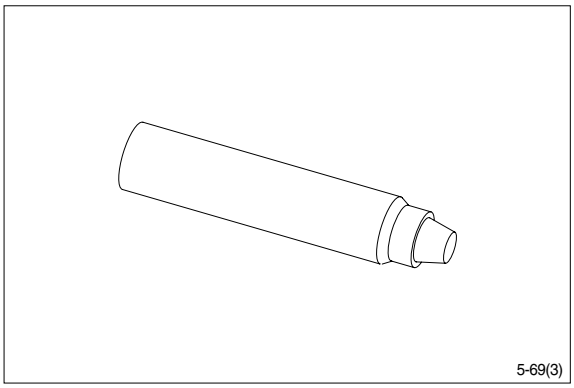
5-69(1)

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



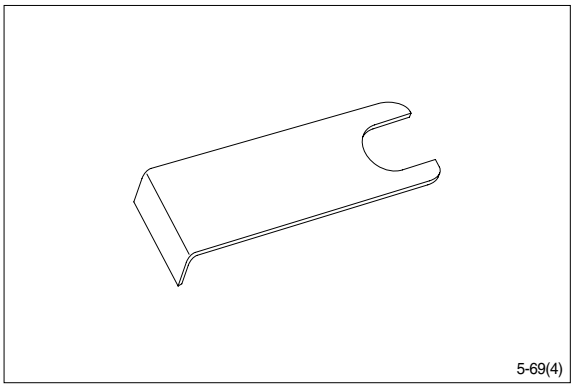
5-69(2)

(3) Assembly tool for lip seal.



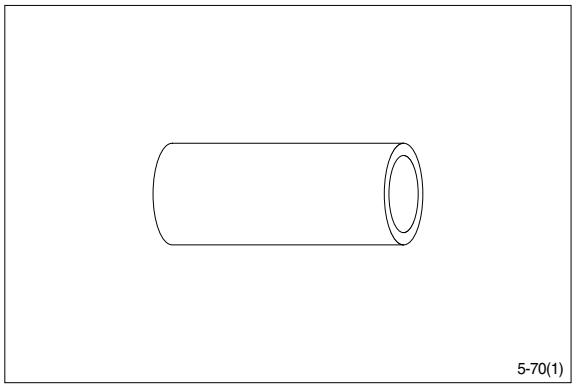
5-69(3)

(4) Assembly tool for cardan shaft.

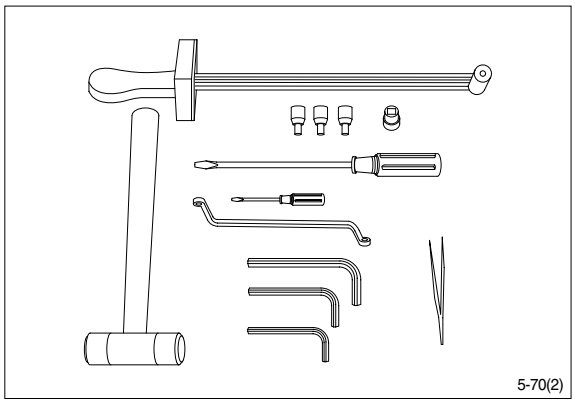


5-69(4)

(5) Assembly tool for dust seal.

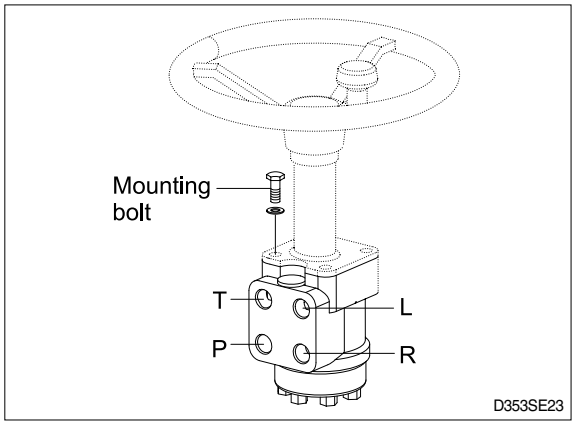


(6) Torque wrench 0~7.1kgf · m
(0~54.4lbf · ft)
13mm socket spanner
6, 8mm and 12mm hexagon sockets
12mm screwdriver
2mm screwdriver
13mm ring spanner
6, 8 and 12mm hexagon socket spanners
Plastic hammer
Tweezers



3) TIGHTENING TORQUE

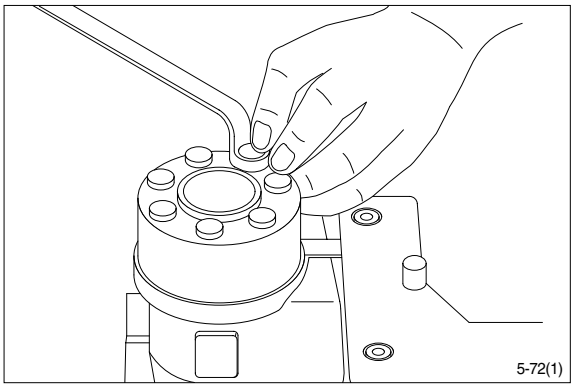
L : Left port
R : Right port
T : Tank
P : Pump



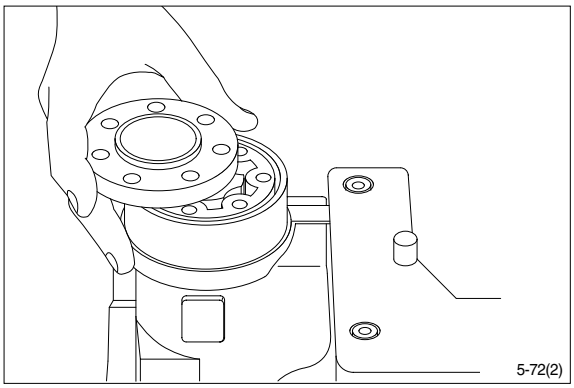
Port	Size	Torque [kgf · m(lbf · ft)]
L	3/4 UNF - 16	13 (94)
R	3/4 UNF - 16	13 (94)
T	3/4 UNF - 16	13 (94)
P	3/4 UNF - 16	13 (94)
Mounting bolt	M10×1.5	5.0 ±1.0 (36±7.2)

4) DISASSEMBLY

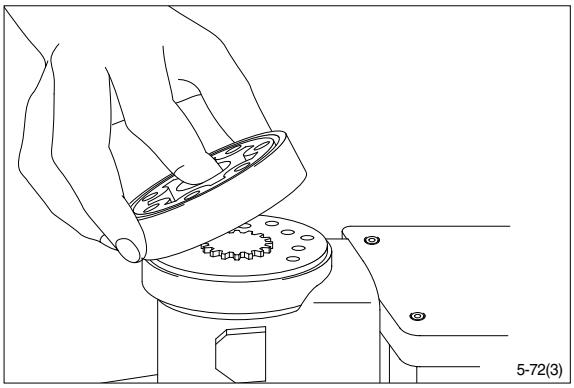
(1) Disassemble steering column from steering unit and place the steering unit in the holding tool.
Screw out the screws in the end cover(6-off plus one special screw).


5-72(1)

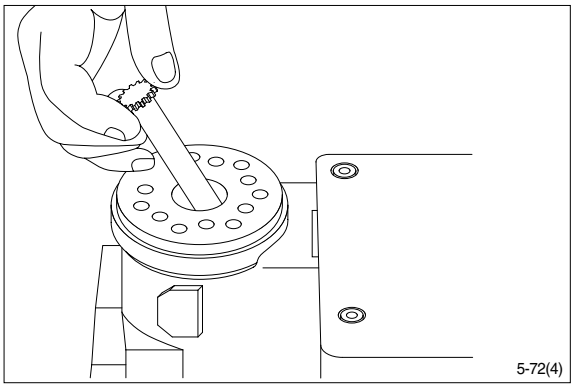
(2) Remove the end cover, sideways.


5-72(2)

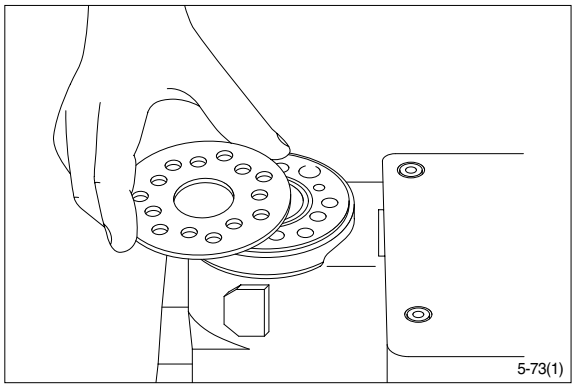
(3) Lift the gearwheel set(With spacer if fitted) off the unit.
Take out the two O-rings.


5-72(3)

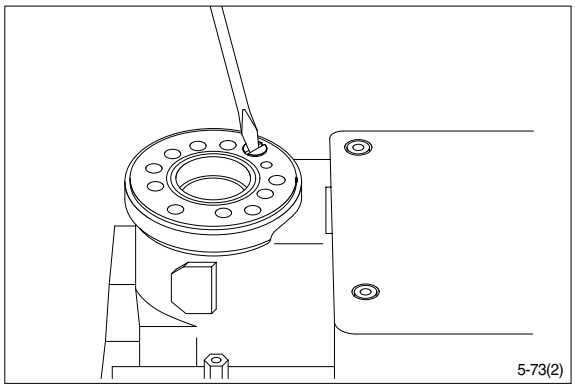
(4) Remove cardan shaft.


5-72(4)

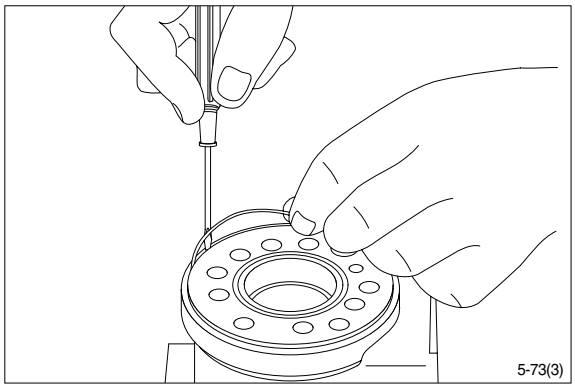
(5) Remove distributor plate.


5-73(1)

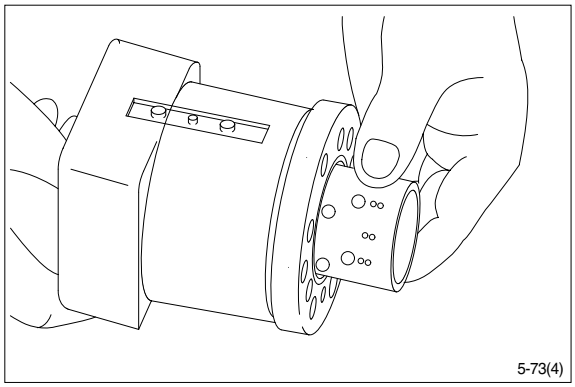
(6) Screw out the threaded bush over the check valve.


5-73(2)

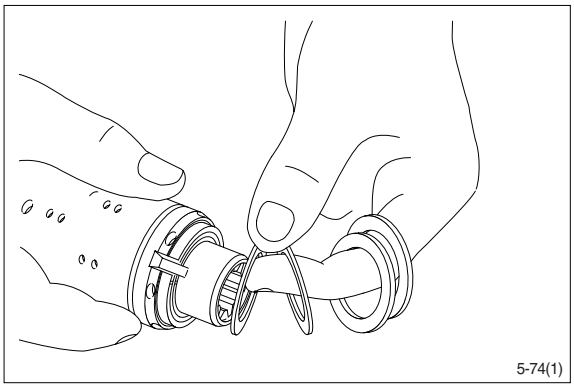
(7) Remove O-ring.


5-73(3)

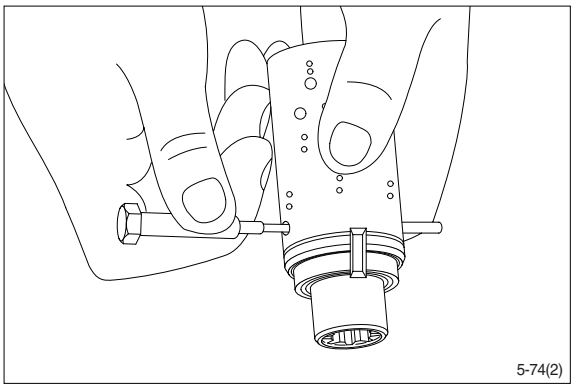
(8) Take care to keep the cross pin in the sleeve and spool horizontal. The pin can be seen through the open end of the spool. Press the spool inwards and the sleeve, ring, bearing races and thrust bearing will be pushed out of the housing together.


5-73(4)

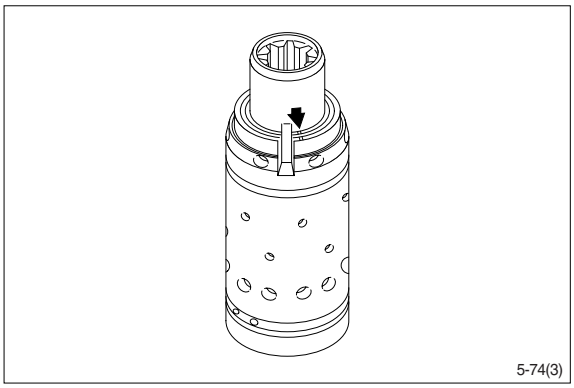
(9) Take ring, bearing races and thrust bearing from sleeve and spool. The outer (Thin) bearing race can sometimes "stick" in the housing, therefore check that it has come out.


5-74(1)

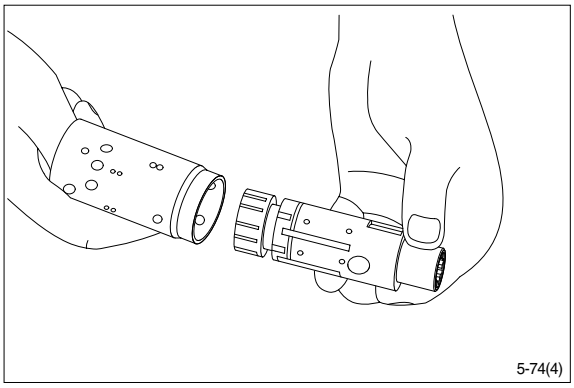
(10) Press out the cross pin. Use the special screw from the end cover.


5-74(2)

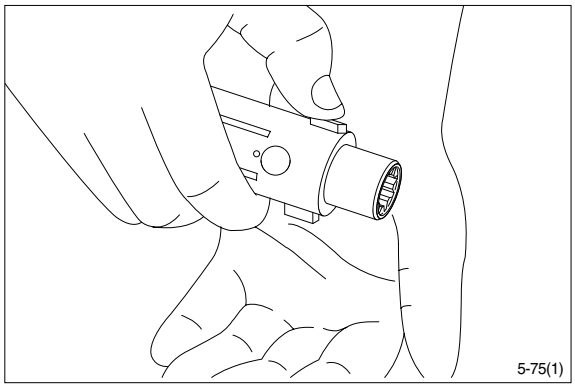
※ **A small mark has been made with a pumice stone on both spool and sleeve close to one of the slots for the neutral position springs(See drawing).**
If the mark is not visible, remember to leave a mark of your own on sleeve and spool before the neutral position springs are disassembled.


5-74(3)

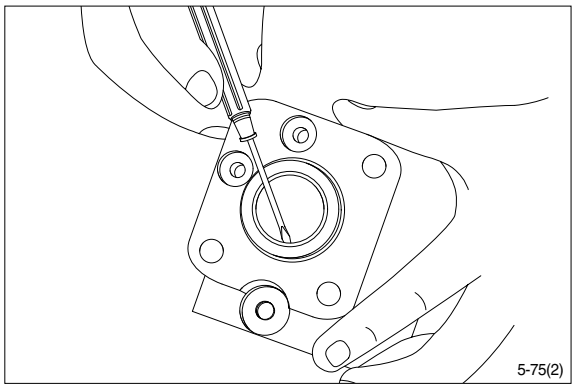
(11) Carefully press the spool out of the sleeve.


5-74(4)

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

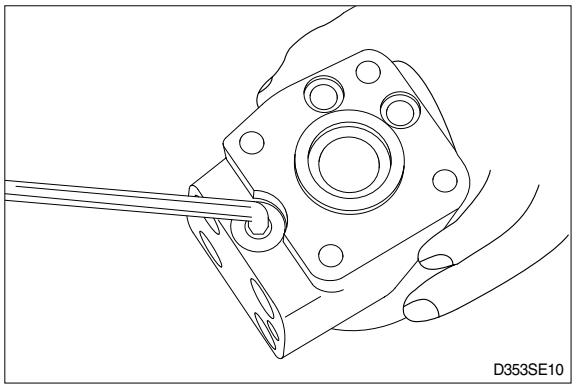


(13) Remove dust seal and O-ring.

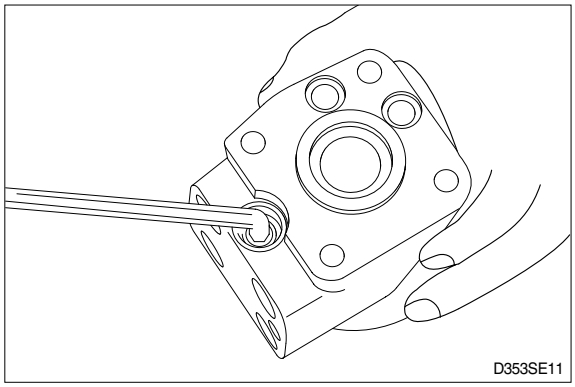


Disassembling the pressure relief valve

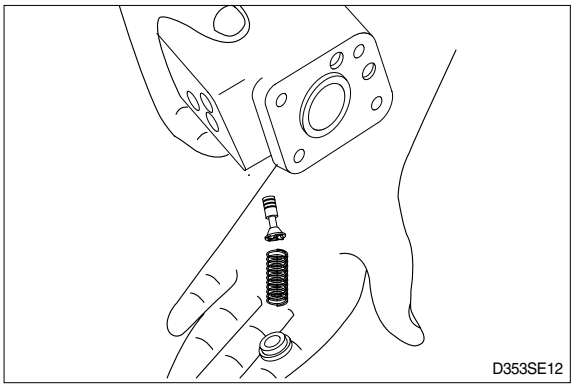
(14) Screw out the plug using an 8㎜ hexagon socket spanner.
Remove seal washers.



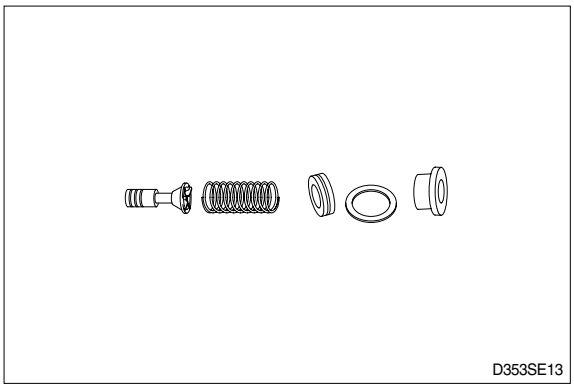
(15) Unscrew the setting screw using an 8㎜ hexagon socket spanner.



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



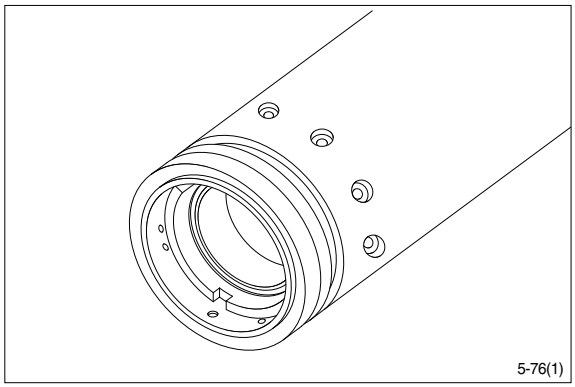
(17) The pressure relief valve is now disassembled.



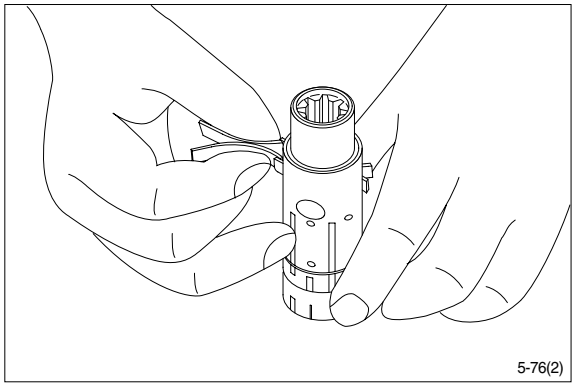
5) ASSEMBLY

(1) Assemble spool and sleeve.

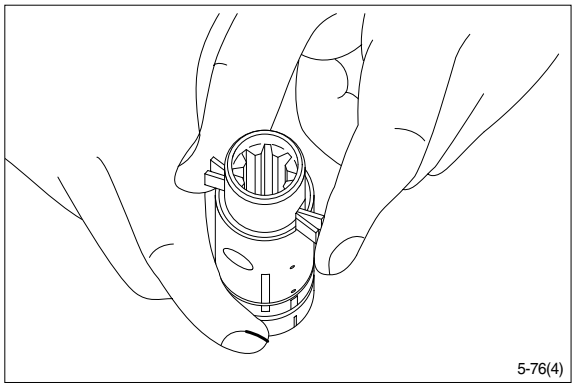
※ **When assembling spool and sleeve only one of two possible ways of positioning the spring slots is correct. There are three slots in the spool and three holes in the sleeve in the end of the spool / sleeve opposite to the end with spring slots. Place the slots and holes opposite each other so that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


5-76(1)

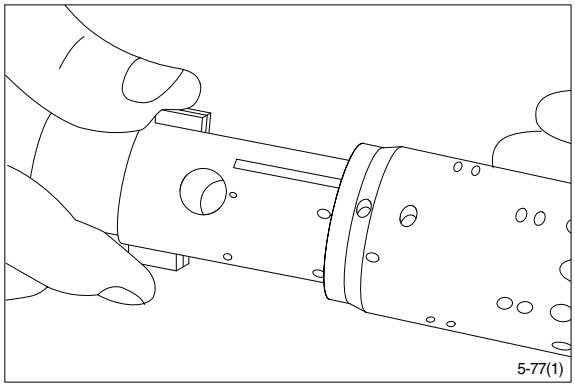
(2) Place the two flat neutral position springs in the slot.
Place the curved springs between the flat ones and press them into place (see assembly pattern).


5-76(2)

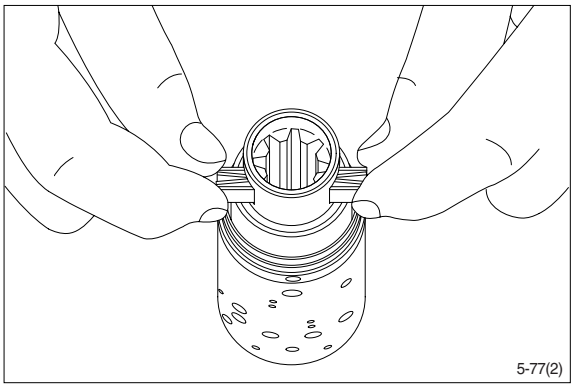
(3) Line up the spring set.


5-76(4)

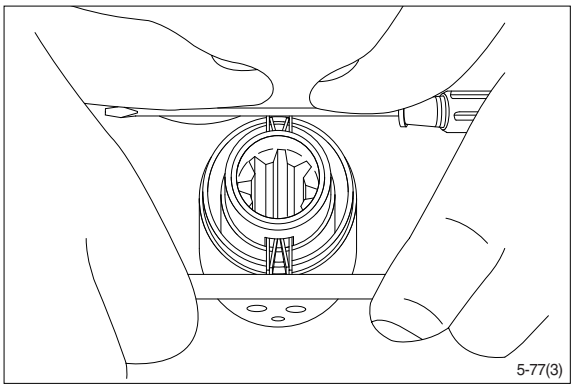
(4) Guide the spool into the sleeve. Make sure that spool and sleeve are placed correctly in relation to each other.


5-77(1)

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

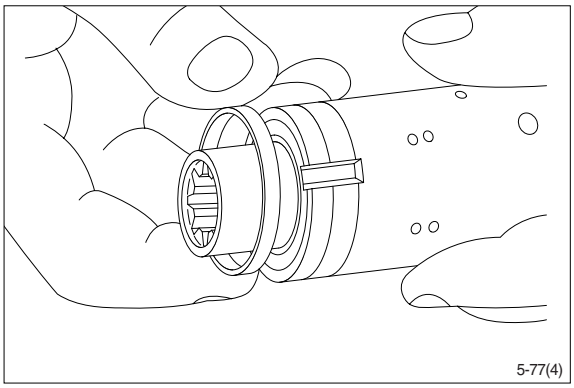

5-77(2)

(6) Line up the springs and center them.

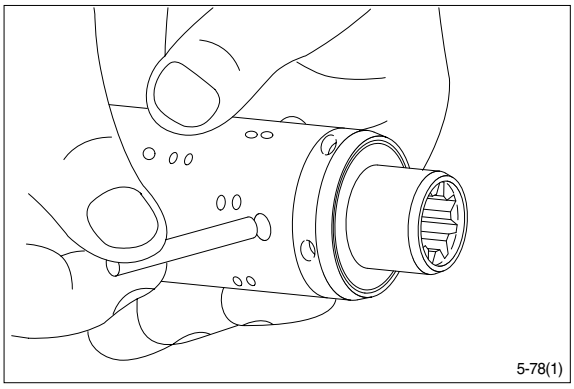

5-77(3)

(7) Guide the ring down over the sleeve.

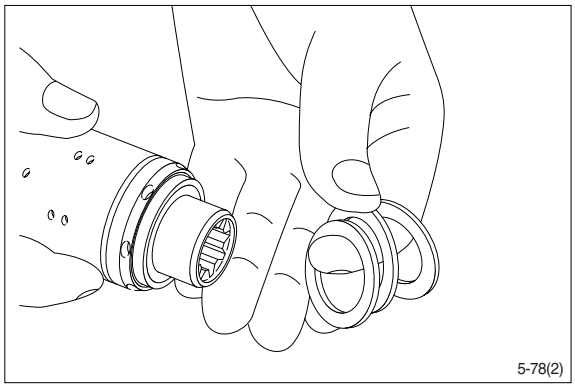
※ **The ring should be able to rotate free of the springs.**


5-77(4)

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

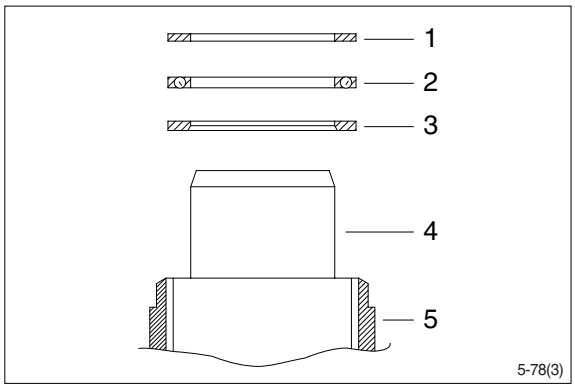

5-78(1)

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



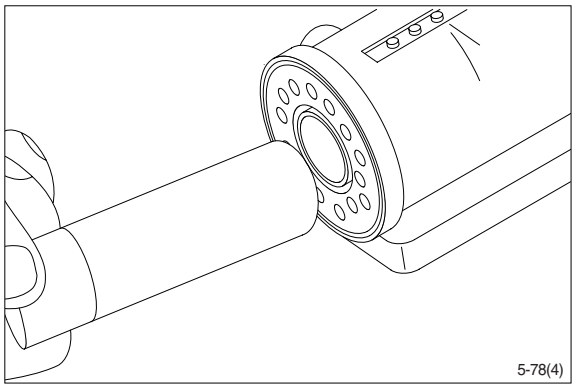
※ **Assembly pattern for standard bearings**

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

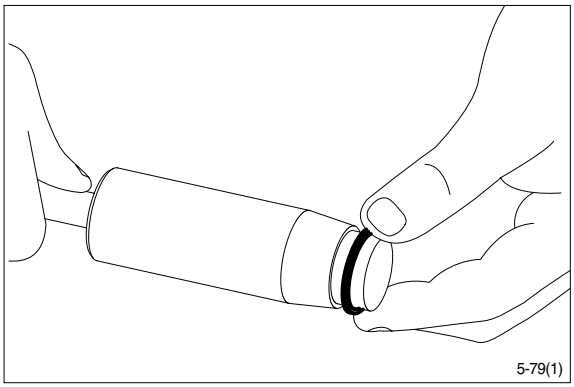


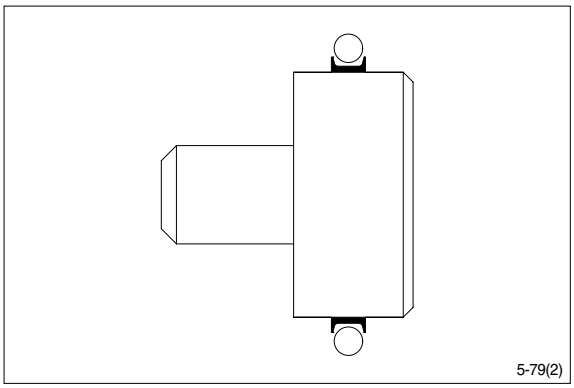
Installation instruction for O-ring

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

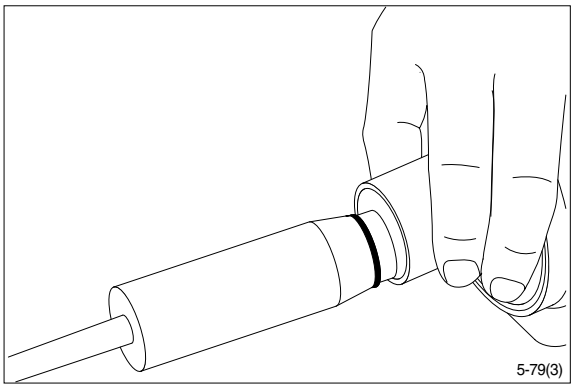


(11) Grease O-ring with hydraulic oil and place them on the tool.

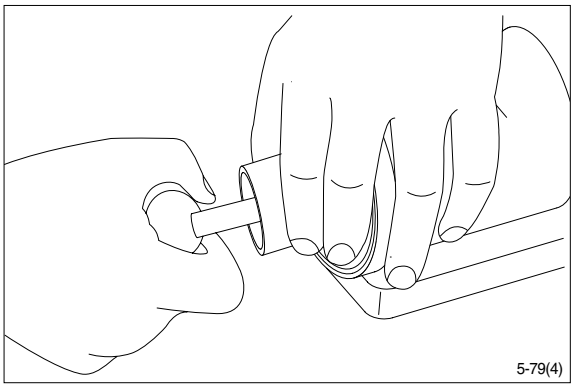

5-79(1)


5-79(2)

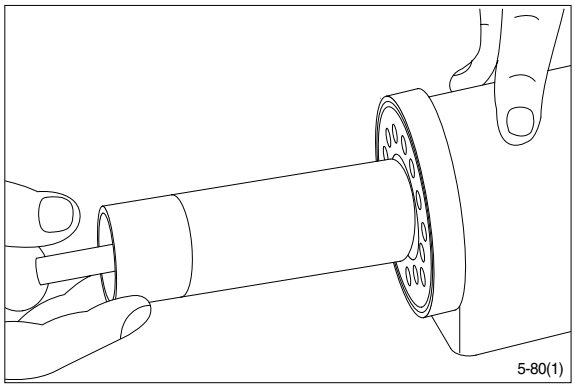
(12) Hold the outer part of the assembly tool in the bottom of the steering unit housing and guide the inner part of the tool right to the bottom.


5-79(3)

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

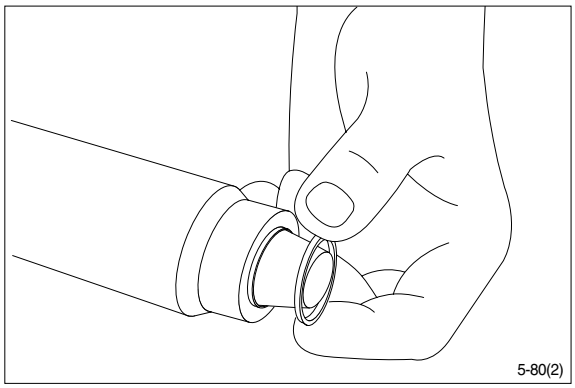

5-79(4)

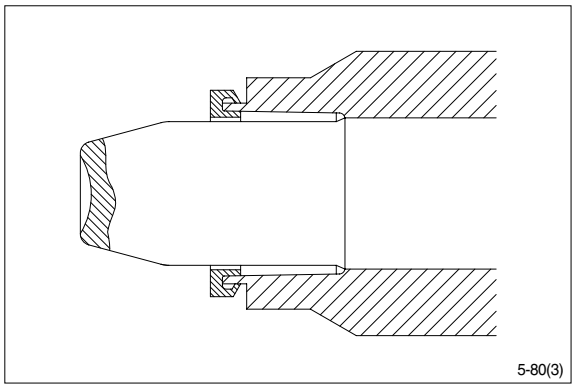
(14) Draw the inner and outer parts of the assembly tool out of the steering unit bore, leaving the guide from the inner part in the bore.



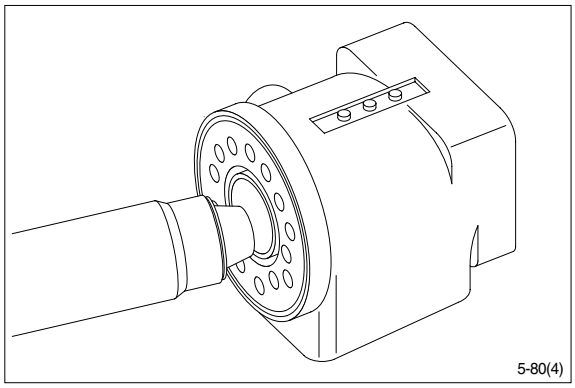
Installation instructions for lip seal

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

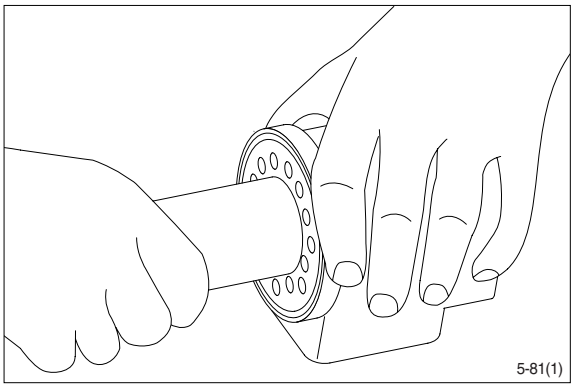




(16) Guide the assembly tool right to the bottom.

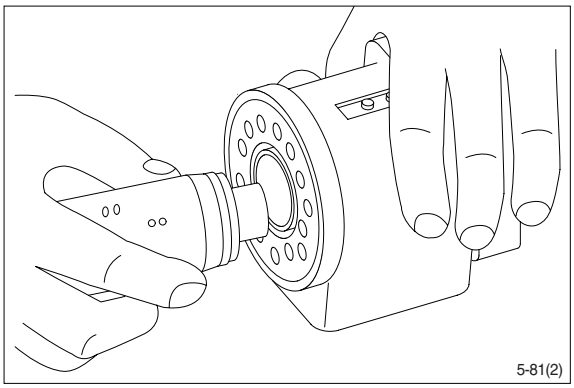


(17) Press and turn the lip seal into place in the housing.

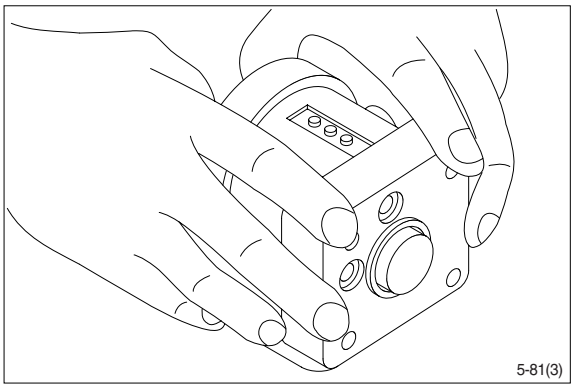


(18) With a light turning movement, guide the spool and sleeve into the bore.

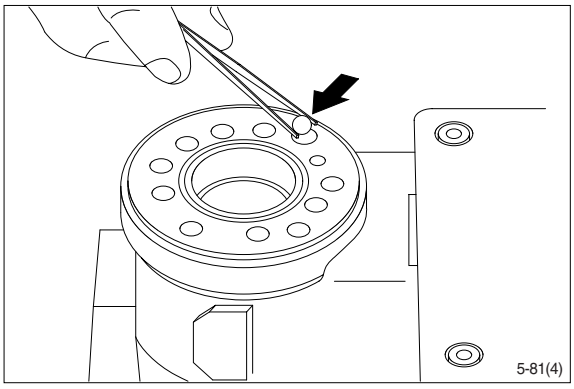
※ **Fit the spool set holding the cross pin horizontal.**



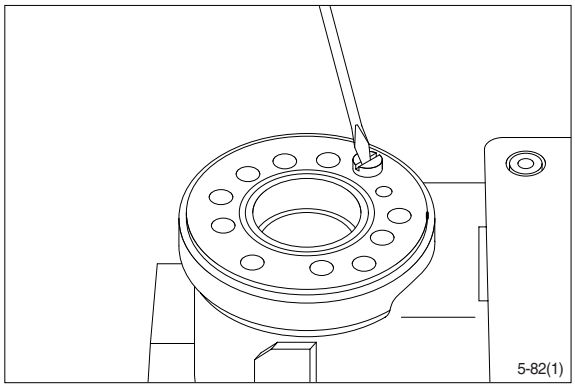
(19) The spool set will push out the assembly tool guide. The O-ring are now in position.



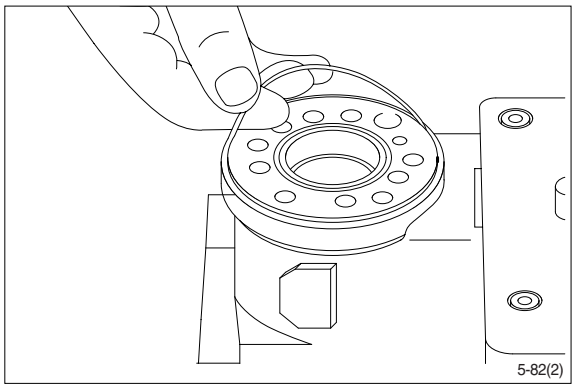
(20) Turn the steering unit until the bore is vertical again. Put the check valve ball into the hole indicated by the arrow.



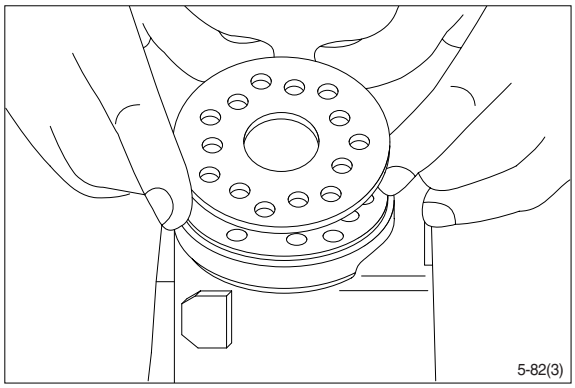
(21) Screw the threaded bush lightly into the check valve bore. The top of the bush must lie just below the surface of the housing.



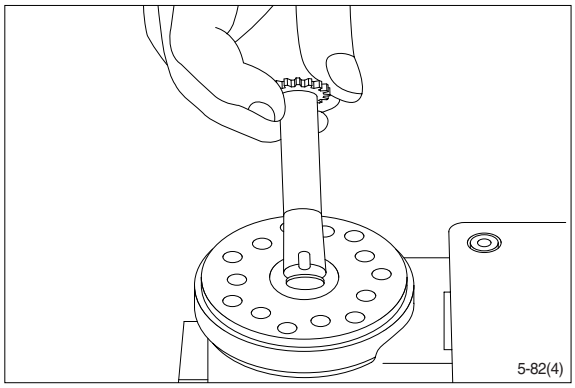
(22) Grease the O-ring with mineral oil approx. viscosity 500 cSt at 20℃.



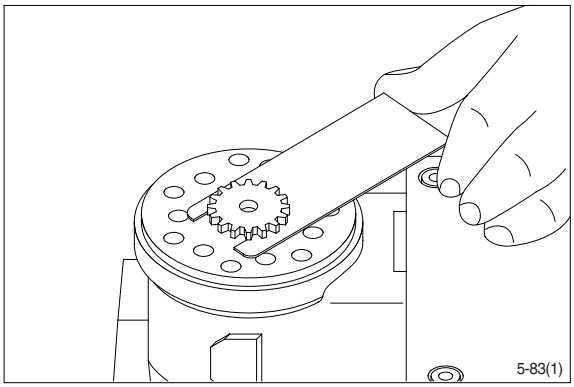
(23) Place the distributor plate so that the channel holes match the holes in the housing.



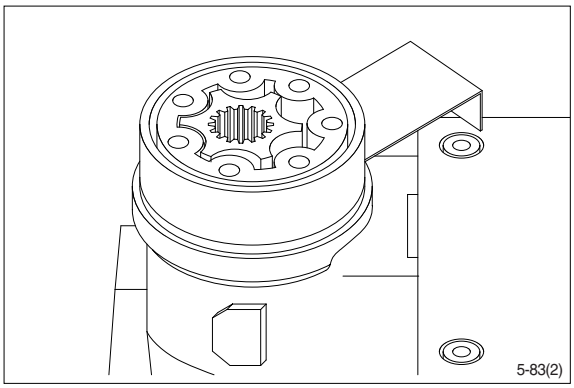
(24) Guide the cardan shaft down into the bore so that the slot is parallel with the connection flange.



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



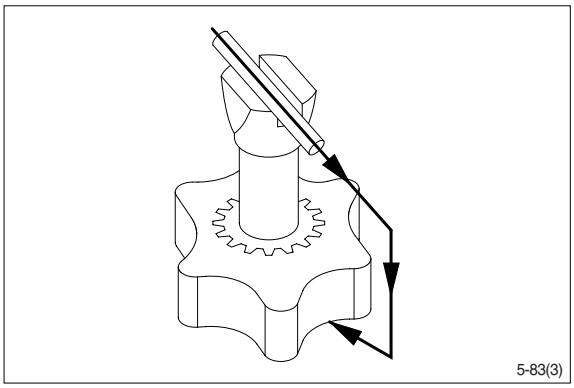
(26) Grease the two O-rings with mineral oil approx. viscosity 500 cSt at 20°C and place them in the two grooves in the gear rim. Fit the gearwheel and rim on the cardan shaft.



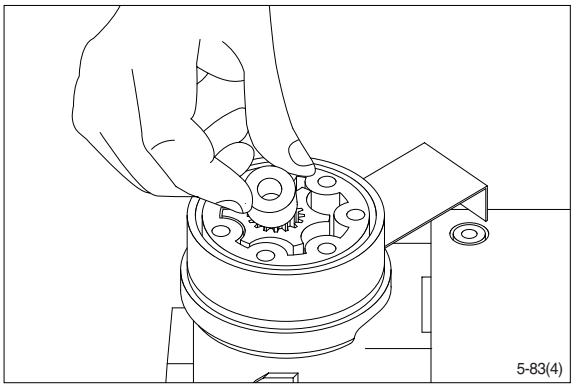
(27) Important

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

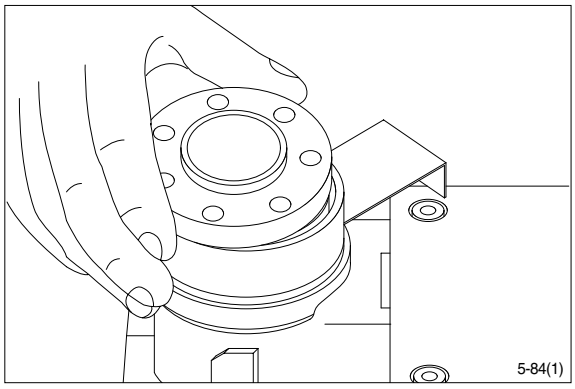
Turn the gear rim so that the seven through holes match the holes in the housing.



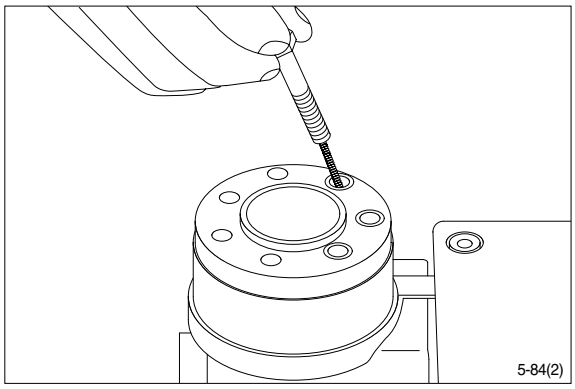
(28) Fit the spacer, if any.



(29) Place the end cover in position.

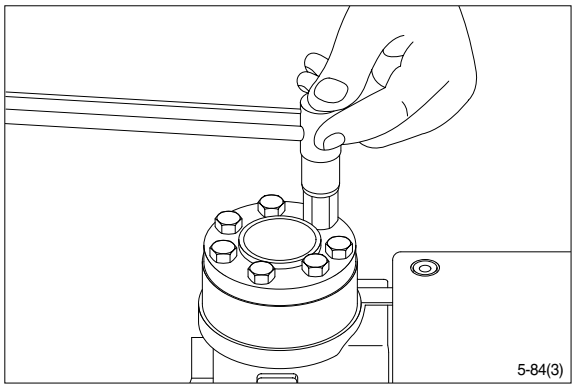


(30) Fit the special screw with washer and place it in the hole shown.

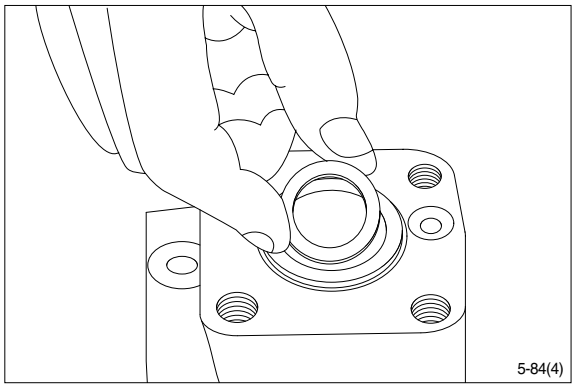


(31) Fit the six screws with washers and insert them. Cross-tighten all the screws and the rolled pin.

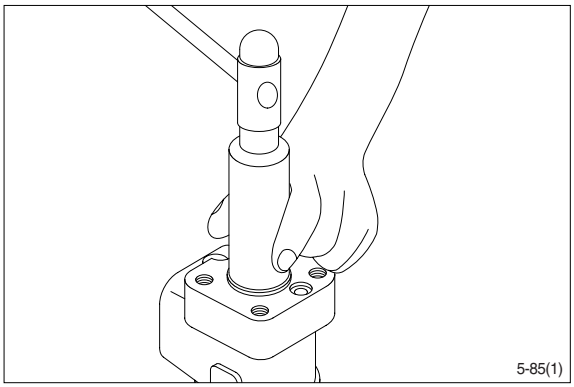
· Tightening torque : 3.0 ± 0.6kgf · m
(21.7 ± 4.3lbf · ft)



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

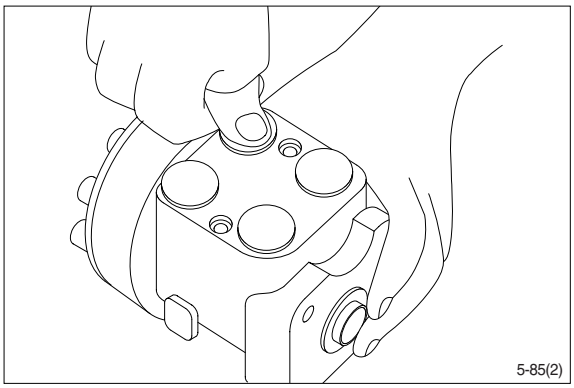


(33) Fit the dust seal ring in the housing.


5-85(1)

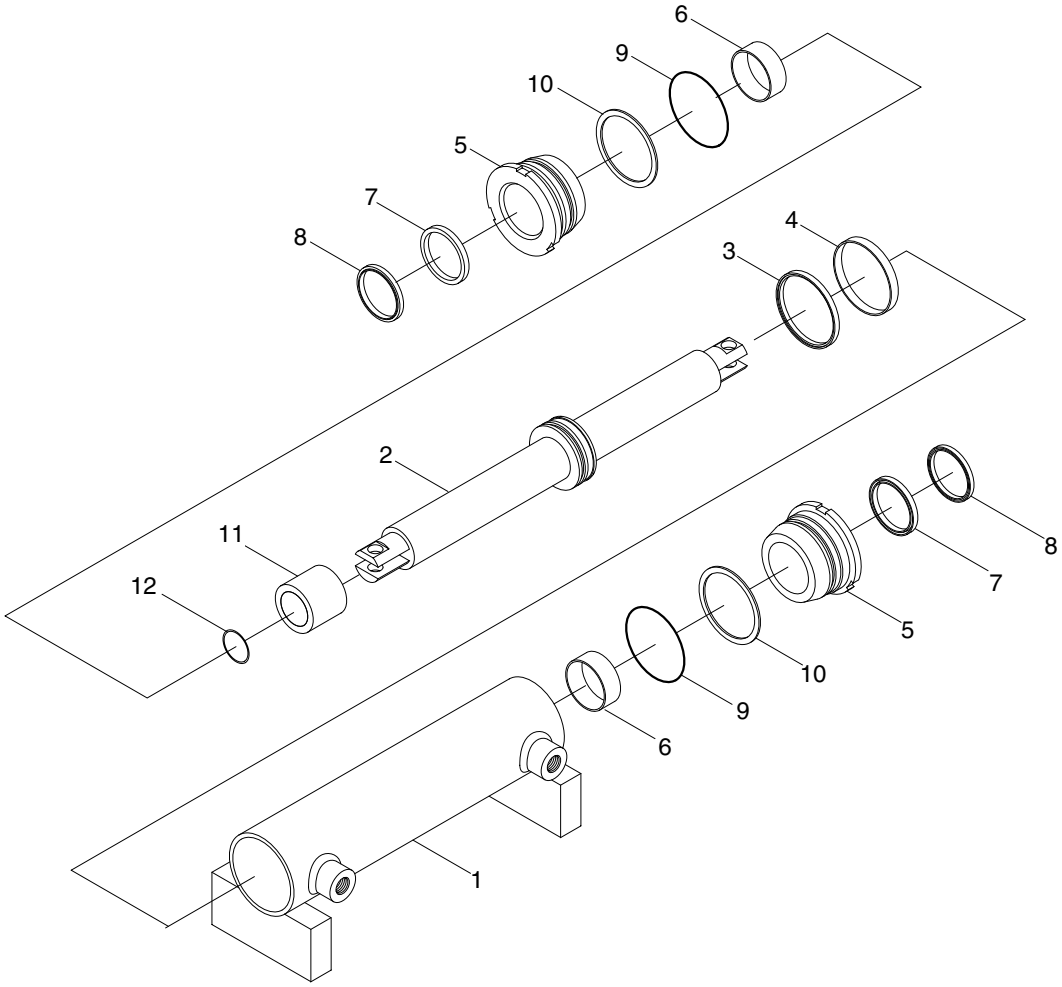
(34) Press the plastic plugs into the connection ports.

※ **Do not use a hammer!**


5-85(2)

2. STEERING CYLINDER

1) STRUCTURE



15L7SS11

1	Tube assembly	5	Gland	9	O-ring
2	Rod	6	DU bushing	10	Lock washer
3	Piston seal	7	Rod seal	11	Spacer
4	Wear ring	8	Dust wiper	12	O-ring

2) DISASSEMBLY

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

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

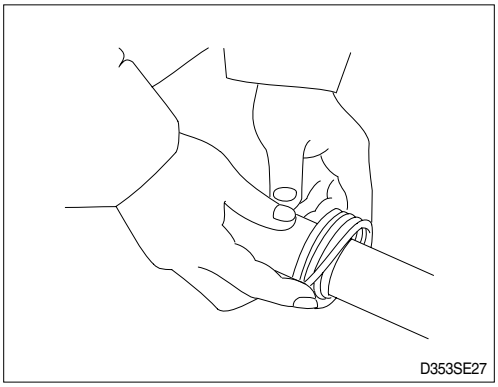
mm(in)

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

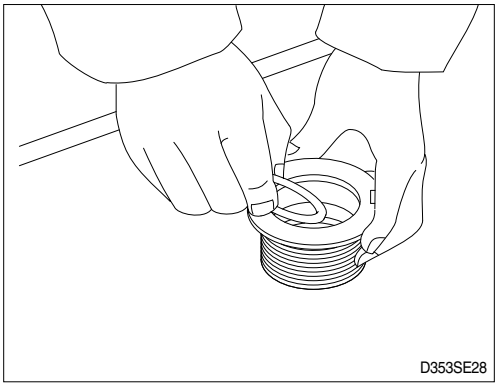
4) ASSEMBLY

(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.**

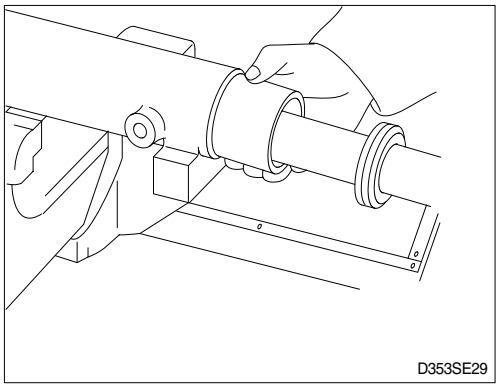


(2) Install the rod seal to the position in the gland applying a slight coat with grease prior to install.

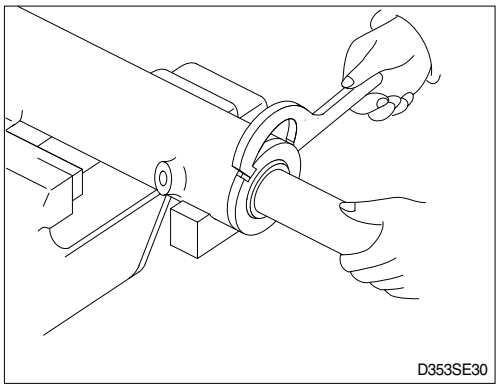


(3) Install the dust wiper to the gland using a special installing tool. Coat the dust wiper with grease slightly before installing.

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

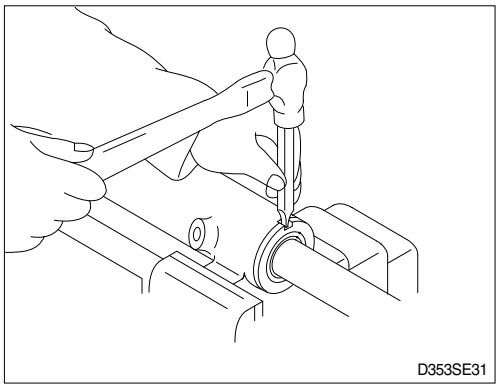

D353SE29

(5) Using a hook spanner, install the gland assembly, and tighten it with torque 45±4.5 kgf · m(325±33lbf · 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.

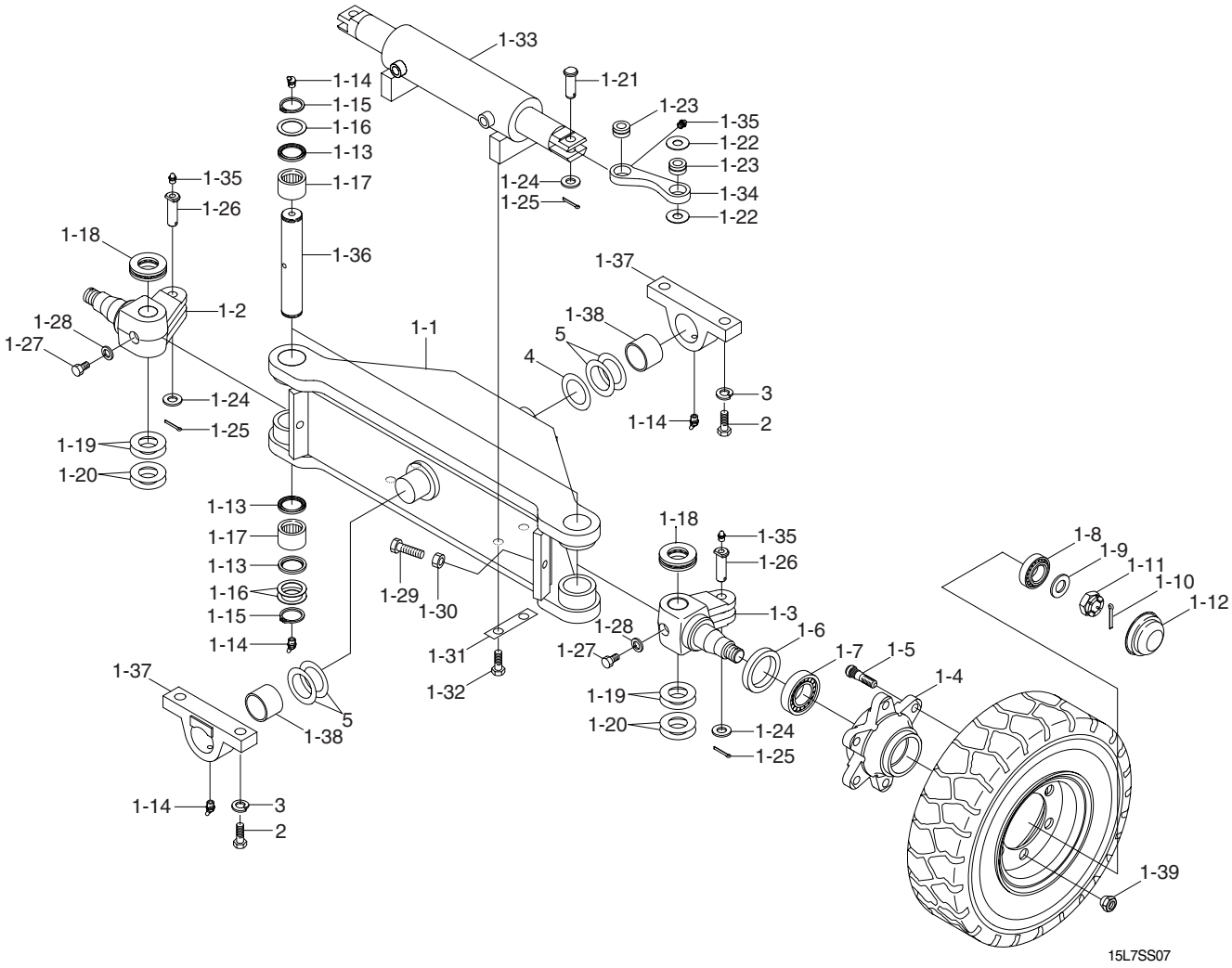
※ **Then, repeat the above operation at gradually increasing engine rpm. This releases air from the system and completes preparation for operation.**

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

3. STEERING AXLE

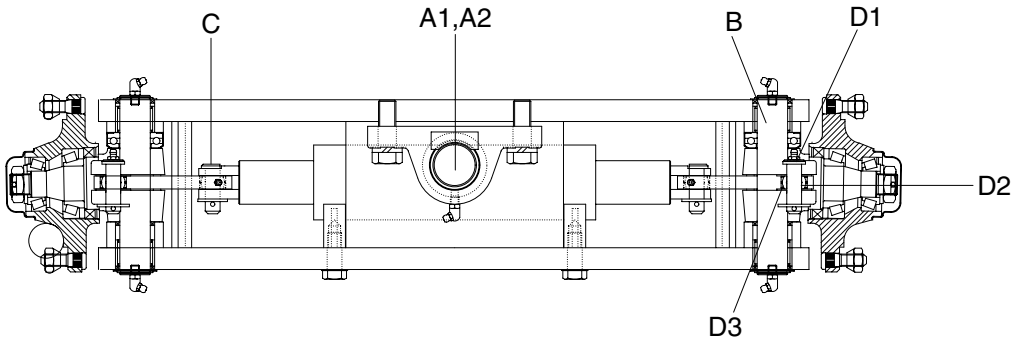
1) STRUCTURE

※ Do not remove the stopper bolt unless necessary.



1	Steering axle assy	1-15	Retaining ring	1-30	Hex nut
1-1	Steering axle wa	1-16	King pin washer	1-31	Lock plate
1-2	Knuckle-RH	1-17	Needle bearing	1-32	Hex bolt
1-3	Knuckle-LH	1-18	Thrust bearing	1-33	Steering cylinder
1-4	Wheel hub	1-19	Shim (0.13t)	1-34	Link
1-5	Hub bolt	1-20	Shim (0.25t)	1-35	Grease nipple
1-6	Oil seal	1-21	Clevis pin	1-36	King pin
1-7	Taper roller bearing	1-22	Thrust washer	1-37	Block
1-8	Taper roller bearing	1-23	Bearing	1-38	Bushing
1-9	Plain washer	1-24	Plain washer	1-39	Hub nut
1-10	Split pin	1-25	Split pin	2	Hex bolt
1-11	Castle nut	1-26	Clevis pin	3	Spring washer
1-12	Hub cap	1-27	Special bolt	4	Shim (1.0t)
1-13	Oil seal	1-28	Spring washer	5	Shim (0.5t)
1-14	Grease nipple	1-29	Hex bolt		

2) CHECK AND INSPECTION



15L7SS10

unit : mm(in)

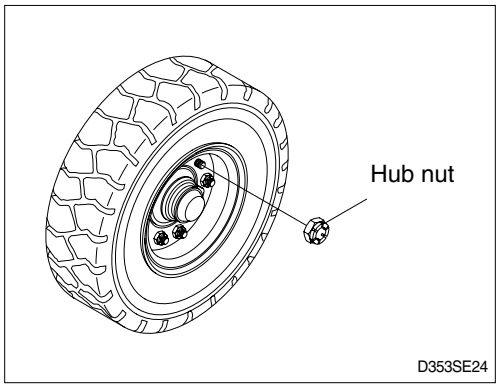
No.	Check item			Criteria		Remarks
				Standard size	Repair limit	
A	Shaft	A1	OD of shaft	50(1.9)	49.5(1.9)	Replace
		A2	ID of bushing	50(1.9)	50.5(1.9)	
B	OD of king pin			35(1.4)	34.5(1.4)	
C	OD of steering cylinder pin			17(0.6)	16.5(0.6)	
D	Knuckle	D1	OD of pin	17(0.6)	16.5(0.6)	
		D2	Vertical play	-	-	Adjust with shims
		D3	ID of bushing	17(0.6)	16.5(0.6)	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.

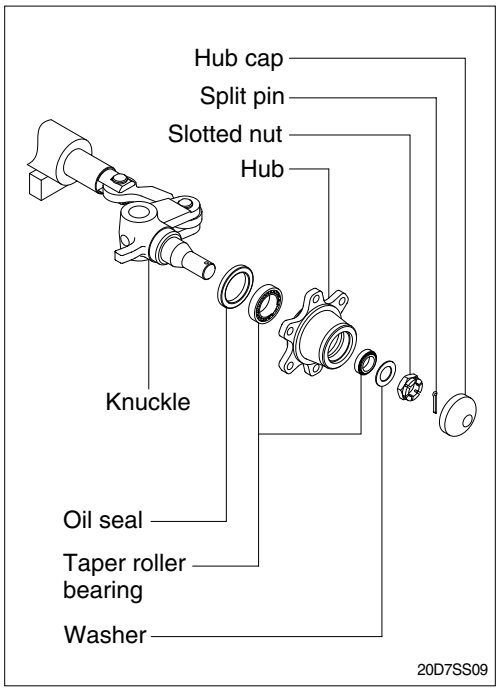
※ Be very careful because just before the hub comes off, tapered roller bearing will fall out.

(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.



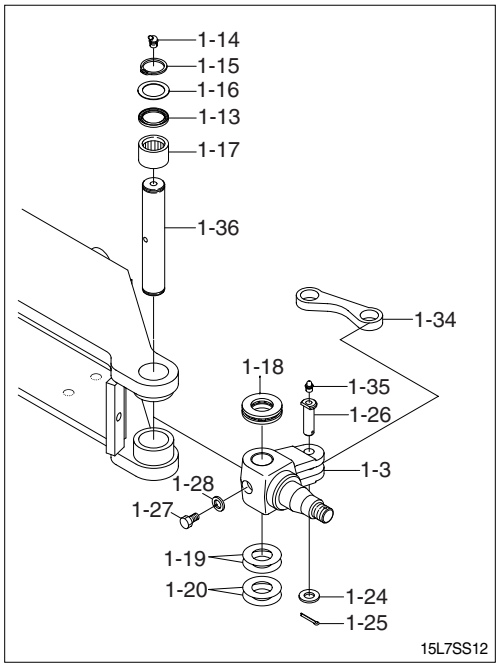
(8) Loosen special bolt (1-27) and spring washer (1-28).

(9) Pry out the retaining ring (1-15) and remove oil seal (1-13).

(10) Push out the king pin (1-36) without damaging the knuckle arm (1-3).

(11) If defect is observed in bearing (1-18), pull it out by using extractor.

(12) Remove spilt pin (1-25), plain washer(1-24) and link pin(1-26).



4) ASSEMBLY

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

Perform the disassembly in reverse order.

(1) Tighten the special bolt (1-27) and washer (1-28) of king pin (1-36).

(2) There is a notch in the middle of the king pin (1-36), make sure that this notch is on the special bolt side.

(3) Do not hammer to drive in bearing (1-18) 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 (1-3).

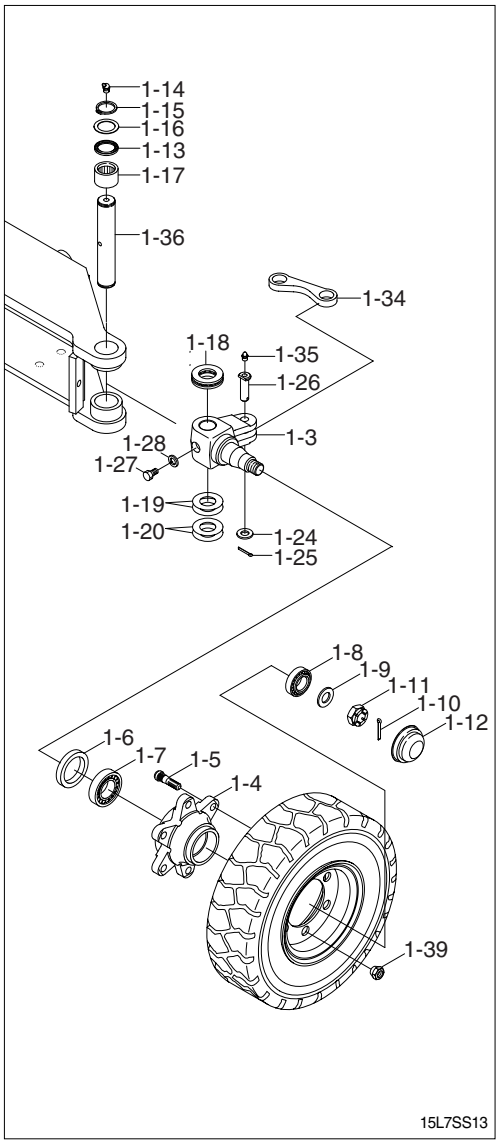
(4) Hub

① Mount oil seal(1-6) and inner race of tapered roller bearing(1-7) on the knuckle. The bearing should be well greased before assembling.

② Install the outer race of the bearing(1-8) in the wheel center and assemble to the knuckle.

③ Tighten nut(1-11) and lock with split pin(1-10). 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.

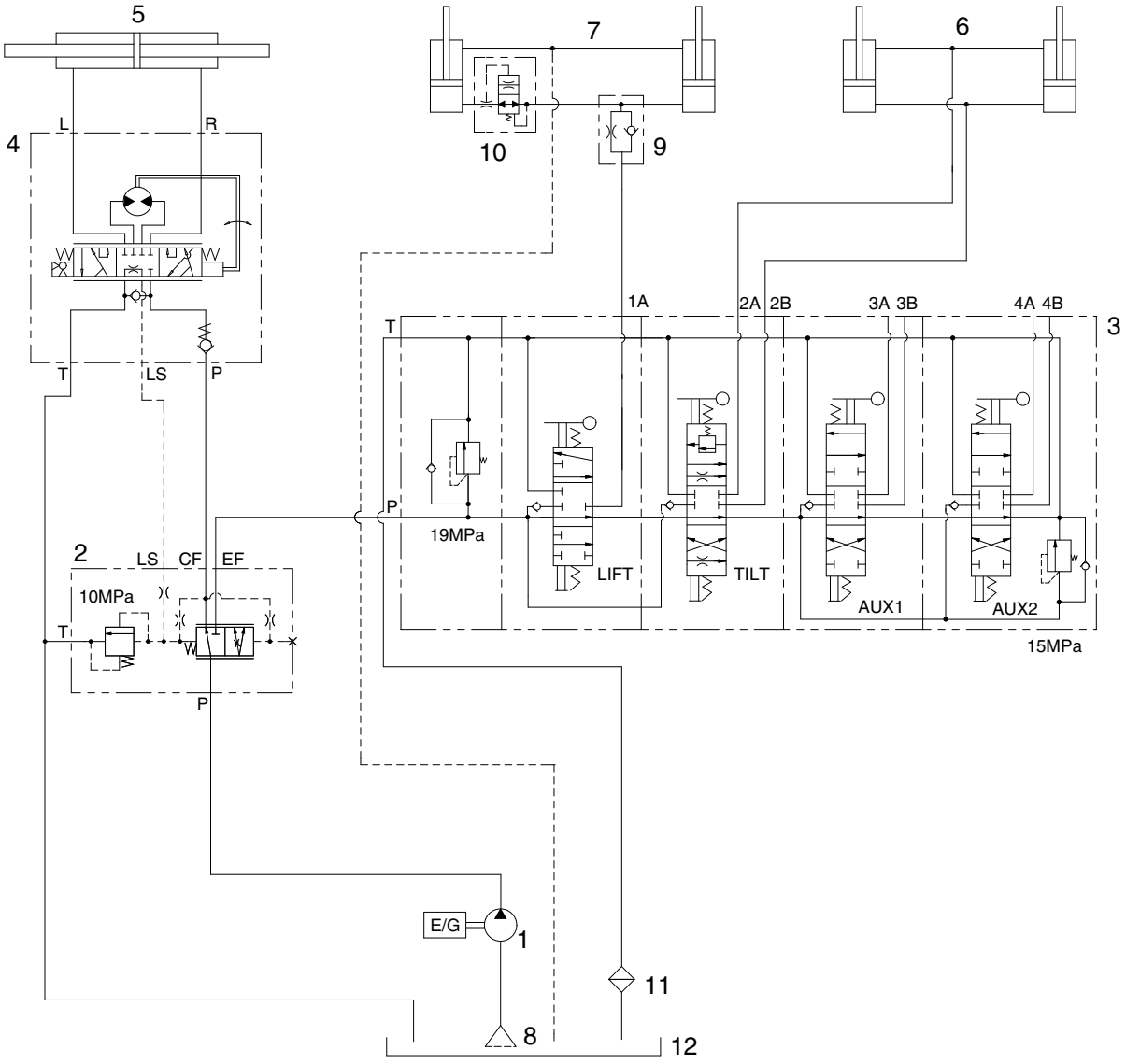
④ Mount the hub cap(1-12).
Bearing should be well greased before assembling.



SECTION 6 HYDRAULIC SYSTEM

GROUP 1 STRUCTURE AND FUNCTION

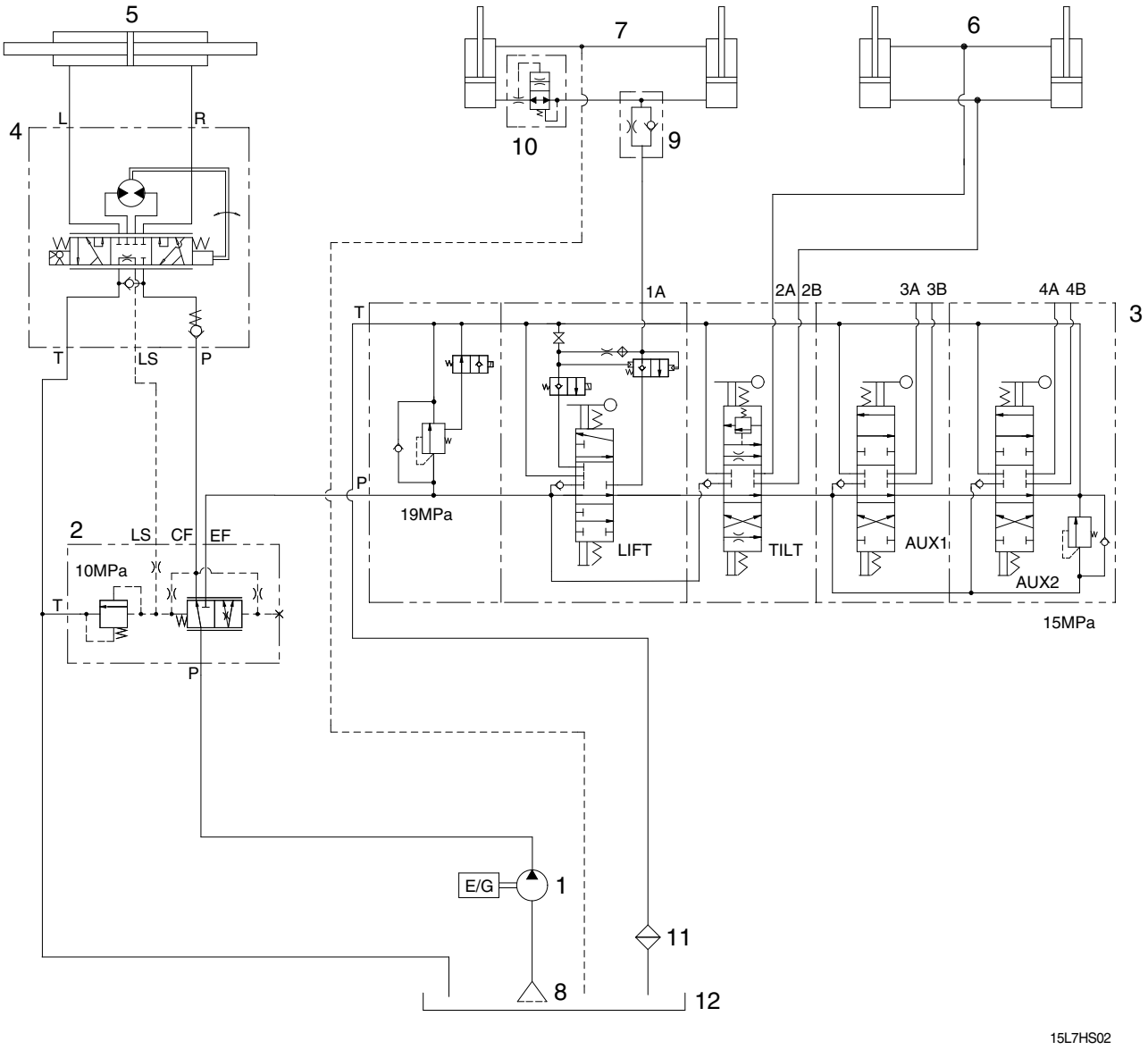
1. HYDRAULIC CIRCUIT (NON OPSS / TRAVEL OPSS)



15L7HS01

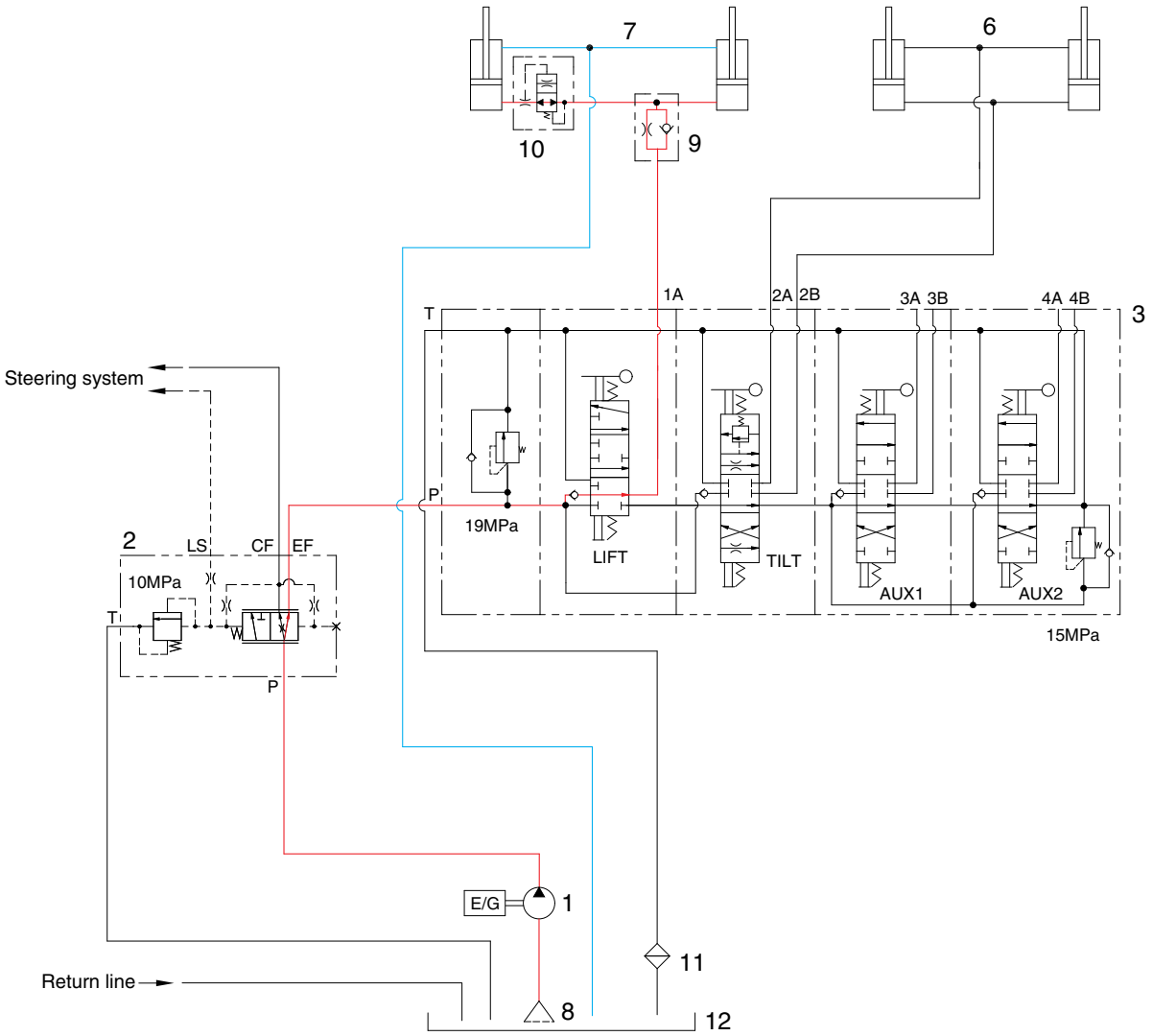
1	Hydraulic gear pump	7	Lift cylinder
2	Priority valve	8	Suction strainer
3	Main control valve	9	Down control valve
4	Steering unit	10	Down safety valve
5	Steering cylinder	11	Return filter
6	Tilt cylinder	12	Hydraulic tank

HYDRAULIC CIRCUIT (TRAVEL WITH MAST OPSS)



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

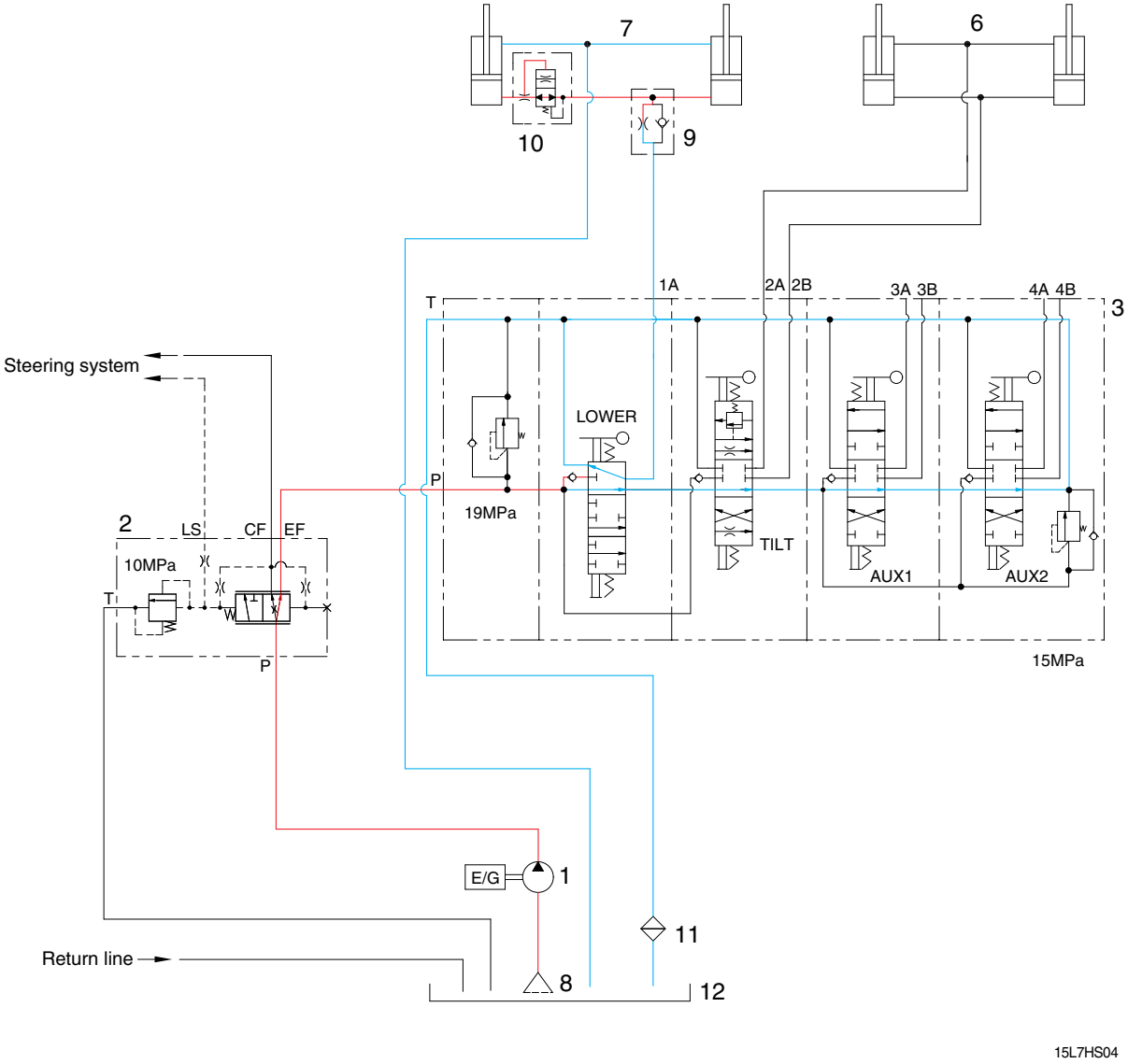
1) WHEN THE LIFT CONTROL LEVER IS IN THE LIFT POSITION



15L7HS03

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(3) through the priority valve(2) and then goes to the large chamber of lift cylinder(7) by pushing the load check valve of the spool.
The oil from the small chamber of lift cylinder(7) returns to hydraulic oil tank(12) at the same time.
When this happens, the fork goes up.

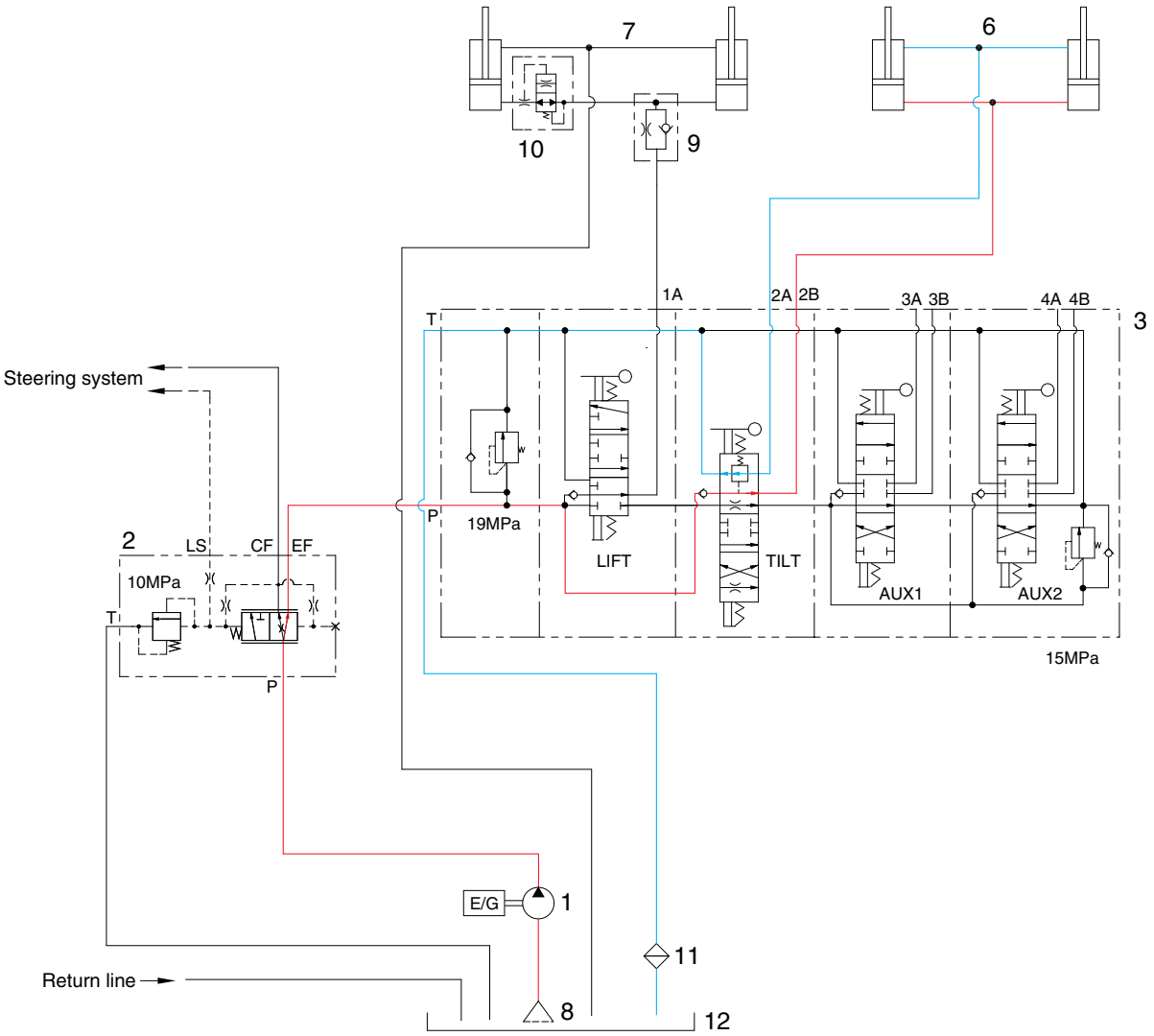
2) WHEN THE LIFT CONTROL LEVER IS IN THE LOWER POSITION



15L7HS04

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.

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



15L7HS05

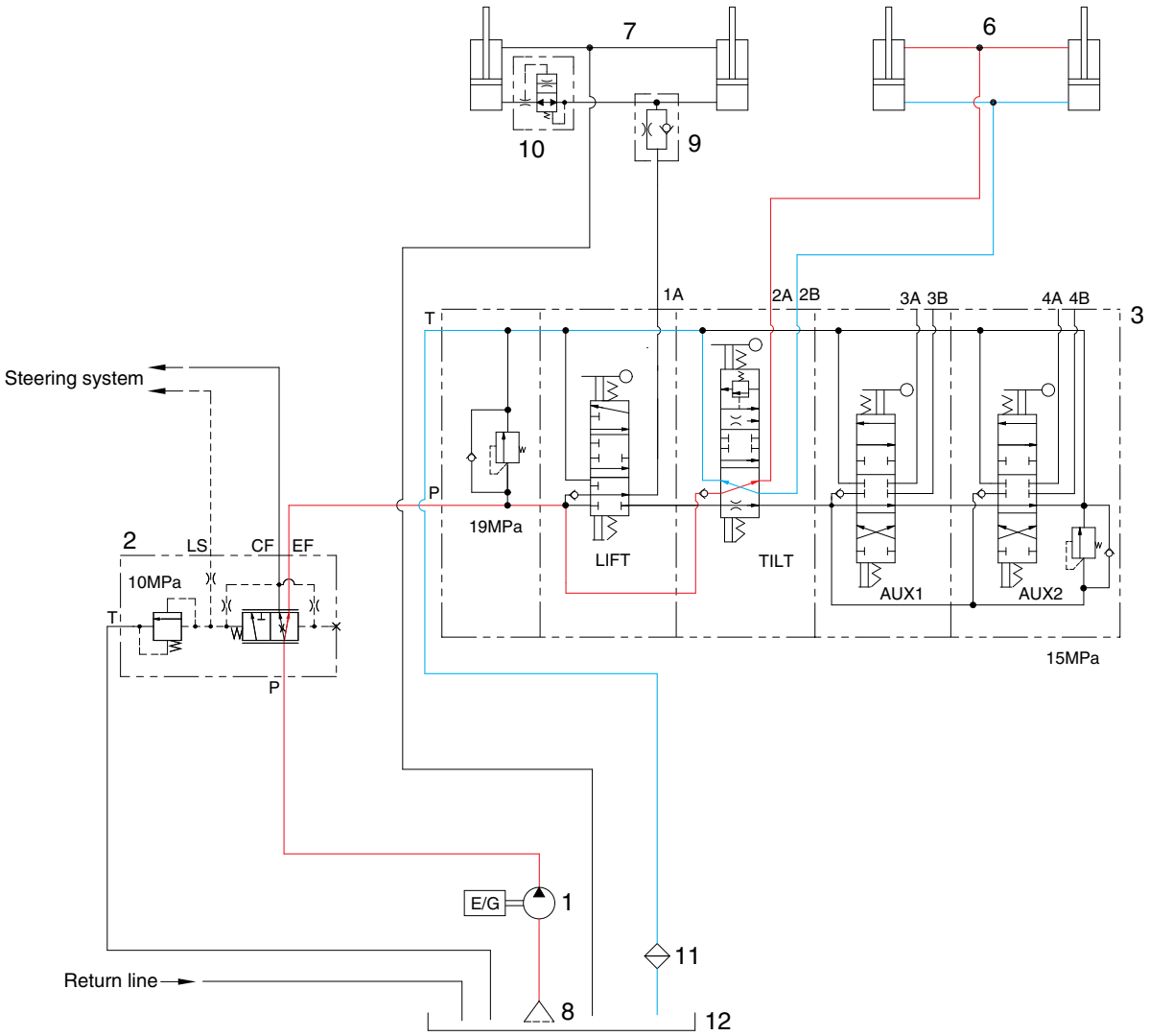
When the tilt control lever is pushed forward, the spool on the second block is moved to tilt forward position.

The oil from hydraulic gear pump(1) flows into main control valve(3) through the priority 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(12) at the same time.

When this happens, the mast tilt forward.

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



15L7HS06

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

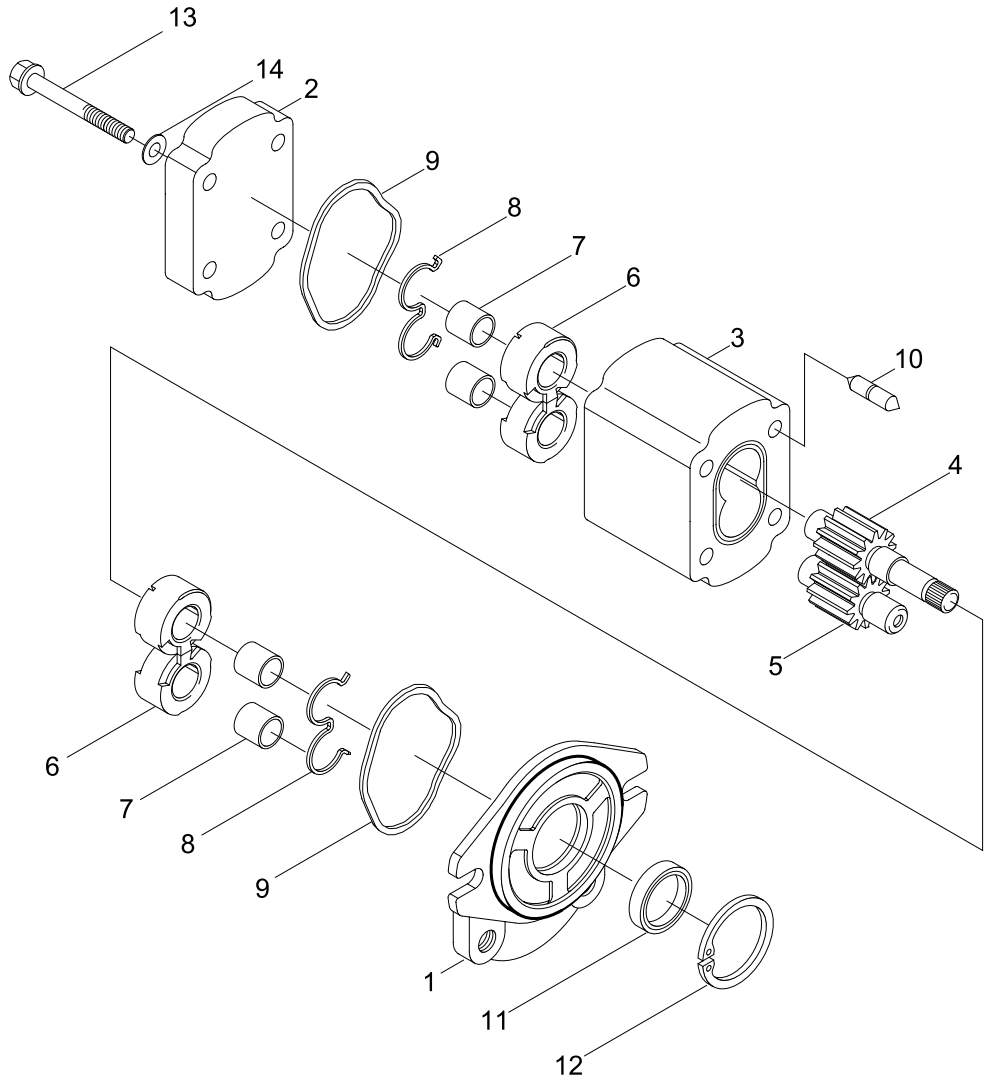
The oil from hydraulic gear pump(1) flows into main control valve(3) through the priority valve(2) and then goes to the small chamber of tilt cylinder(6) by pushing the load check valve of the spool.

The oil at the large chamber of tilt cylinder(6) returns to hydraulic tank(12) at the same time.

When this happens, the mast tilts backward.

2. HYDRAULIC GEAR PUMP

1) STRUCTURE



D155HS06

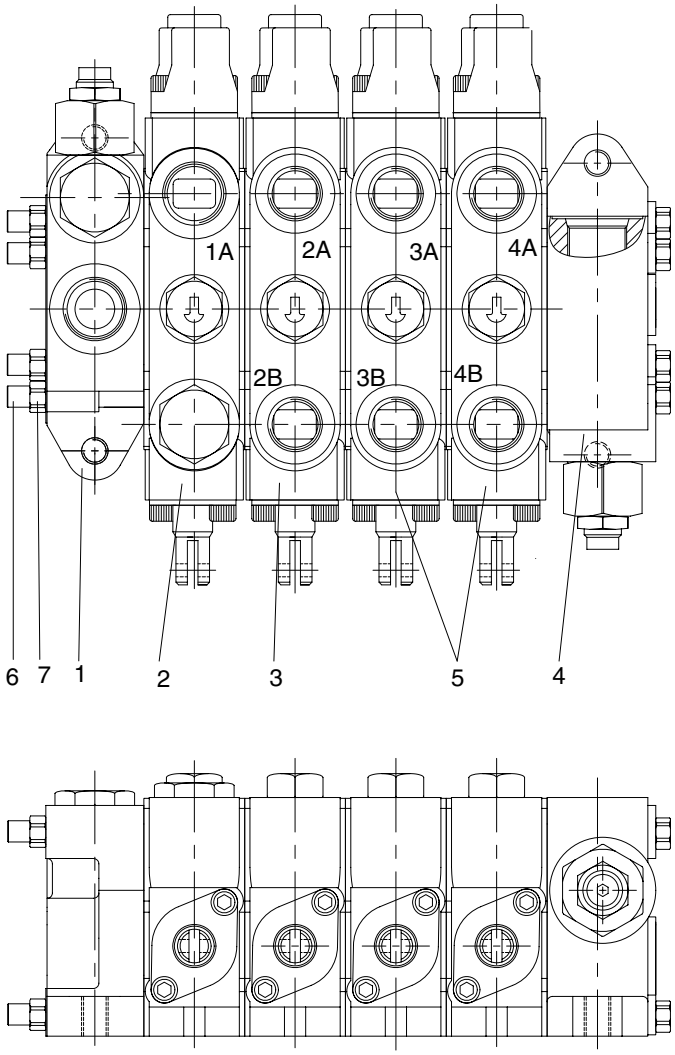
1	Front cover	6	Bushing block	11	Lip seal
2	Rear cover	7	Dry bearing	12	Snap ring
3	Gear housing	8	Channel seal	13	Socket head bolt
4	Drive shaft gear	9	Square seal	14	Plain washer
5	Driven gear	10	Dowel pin		

2) OPERATION

This pump comprises of an end cover, a body, bushings and a mounting flange bolted together. The gear journals are supported in plane bearings within pressure balanced bushings to give high volumetric and mechanical efficiencies.

3. MAIN CONTROL VALVE

1) STRUCTURE (4 Spool - NON OPSS / TRAVEL OPSS)



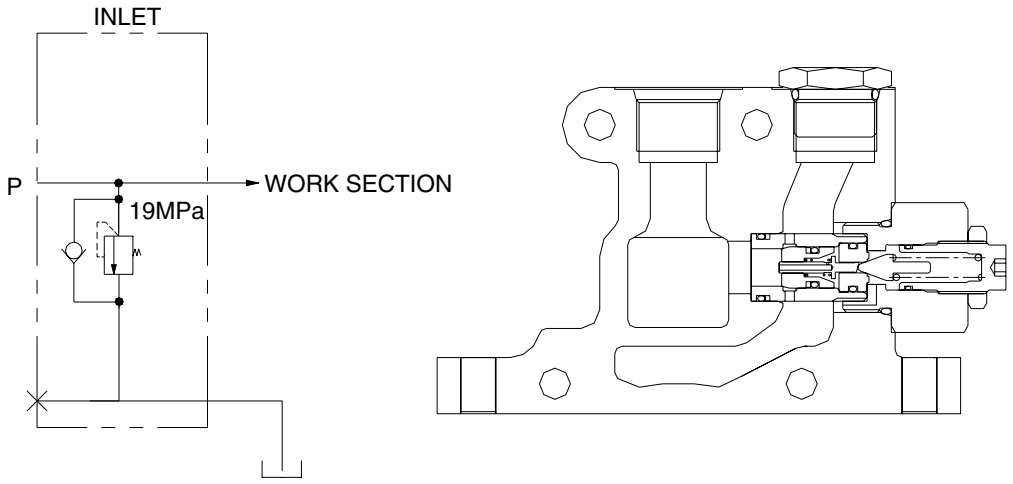
15L7HS07

Port name	Size
Inlet port	7/8-14UNF
Outlet port	7/8-14UNF
Work port	3/4-16UNF

1 Inlet block assy
2 Lift block assy
3 Tilt block assy
4 Outlet block assy
5 Auxiliary block assy
6 Long bolt
7 Nut

2) INLET SECTION OPERATION

(1) Operation

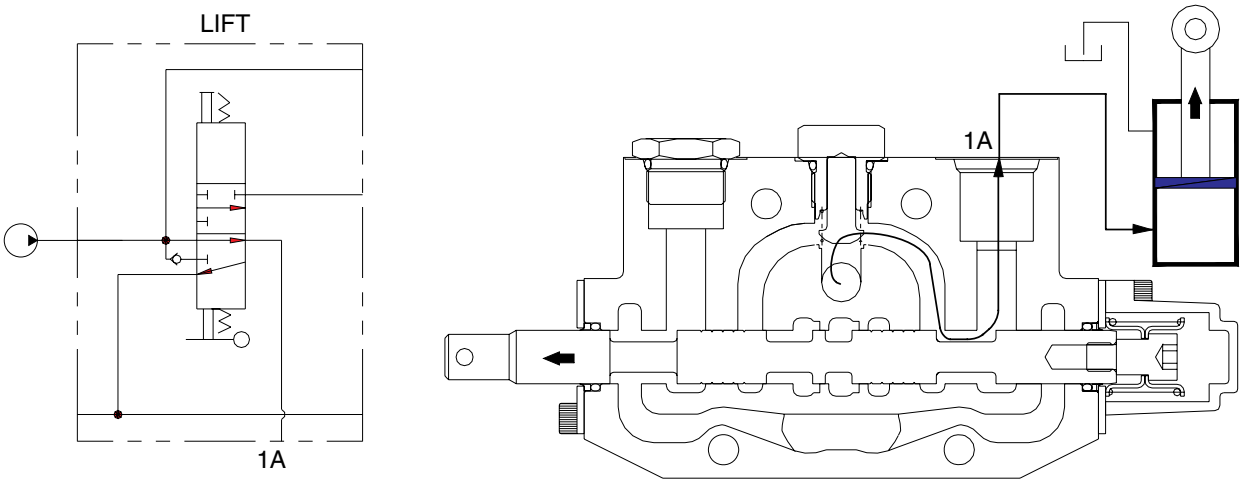


15L7HS08

The inlet section contains the pump inlet connection as well as a diagnostic inlet pressure gage port (new feature to be included).

3) LIFT SECTION OPERATION

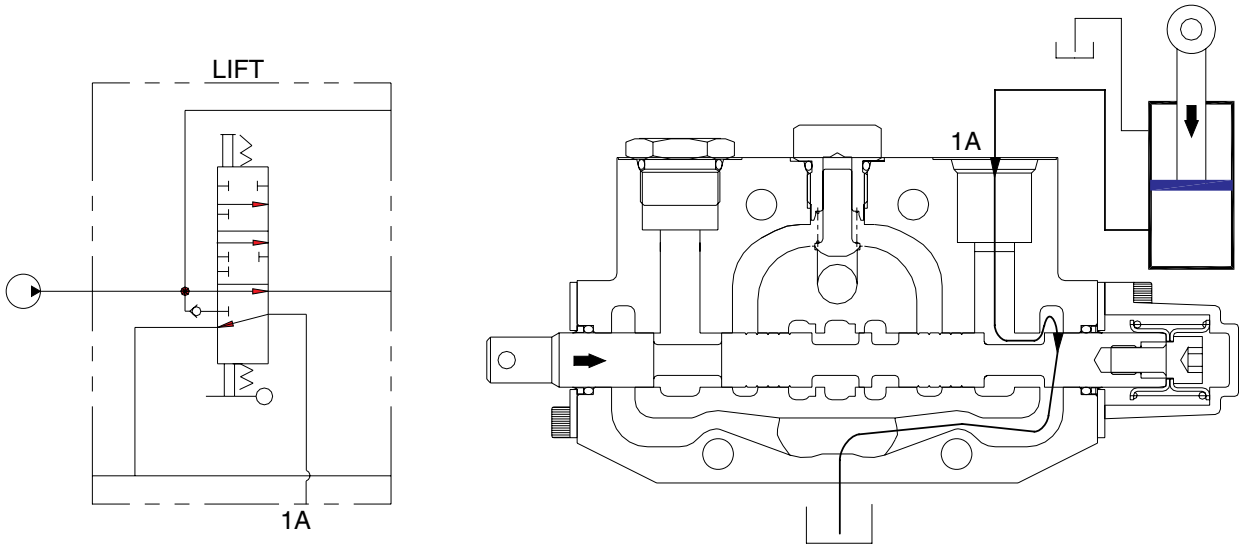
(1) Lift position



15L7HS09

When the operator shifts the lever backwards, the spool is extended out of the valve, and this opens the internal fluid passages that lift the mast. Oil flows through the high pressure parallel cavity, past the load check valve, through the spool metering notches, past the lift lock check valve, and to the head side of the lift cylinder.

(2) Lower position

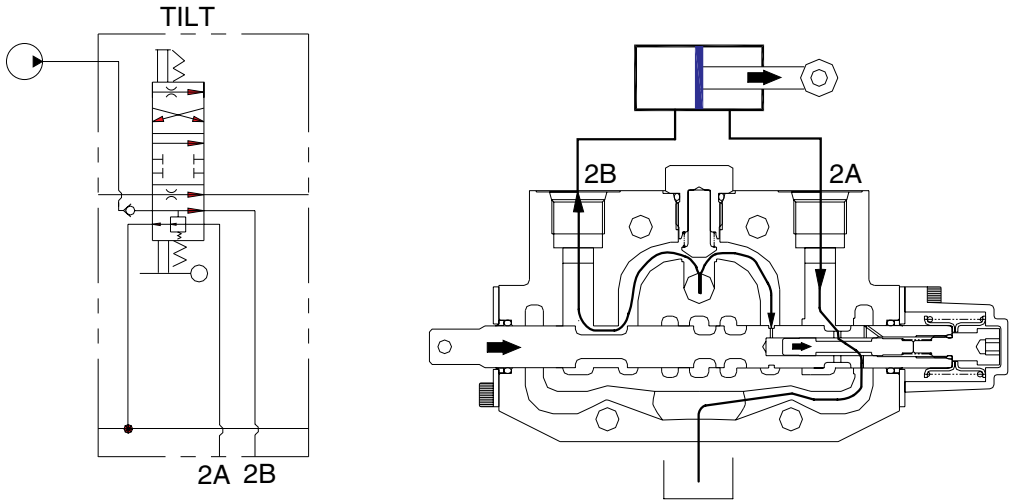


15L7HS10

When the seated operator shifts the lever forwards, the spool retracts into the valve, and the oil is directed from the cylinder, past the lift lock check valve, past the spool metering notches, and to the common tank cavity.

4) TILT SECTION OPERATION

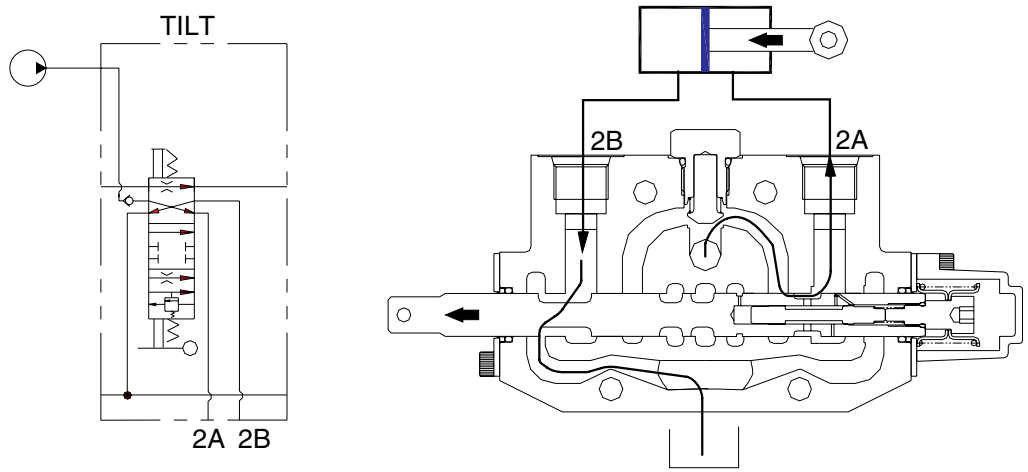
(1) Tilt forward position



15L7HS11

When the seated operator shifts the level forward, pressure is applied to the head of the tilt cylinder, and the forks tilt forward. Oil is past the spool metering notches, and towards the cylinder head. Simultaneously, the high pressure acts upon the end of the tilt lock plunger to move it towards the spring end of the spool.This plunger movement opens additional spool metering notches which control oil flow from the rod end of the cylinder to the tank return line.

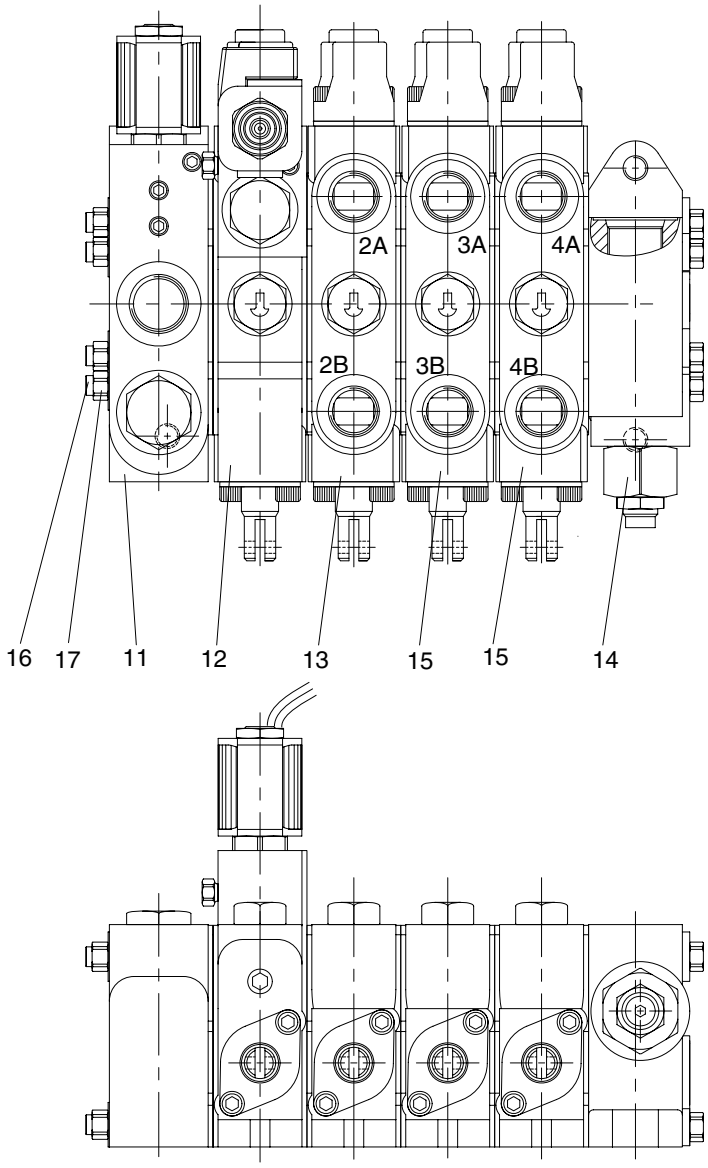
(2) Tilt backward position



15L7HS12

When the seated operator shifts the lever back, the high pressure oil from the parallel passage is directed past the load check valve, past the spool metering notches, and to the rod side of the cylinder.
Exhaust oil from the head side of the cylinder is directed past the spool metering notches to tank.

5) STRUCTURE (4 SPOOL - TRAVEL WITH MAST OPSS)



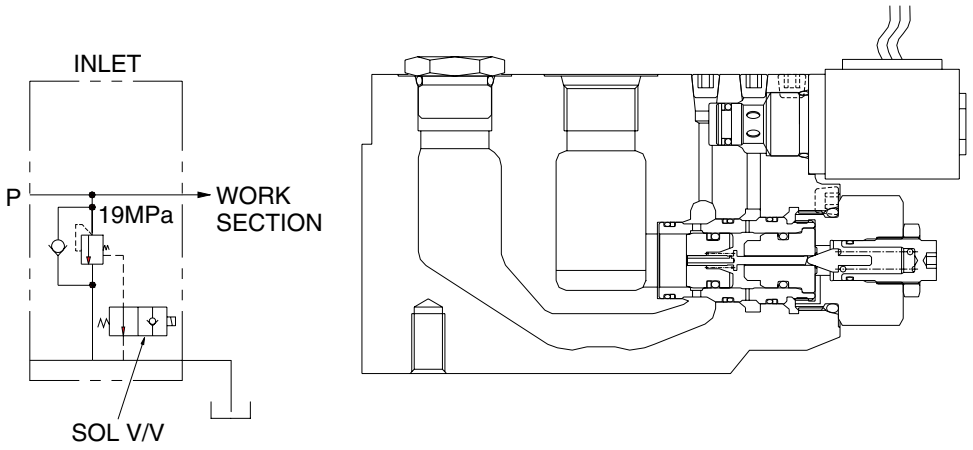
15L7HS57

Port name	Size
Inlet port	7/8-14UNF
Outlet port	7/8-14UNF
Work port	3/4-16UNF

11 Inlet block assy
12 Lift block assy
13 Tilt block assy
14 Outlet block assy
15 Auxiliary block assy
16 Long bolt
17 Nut

6) INLET SECTION OPERATION (TRAVEL WITH MAST OPSS)

(1) Operation

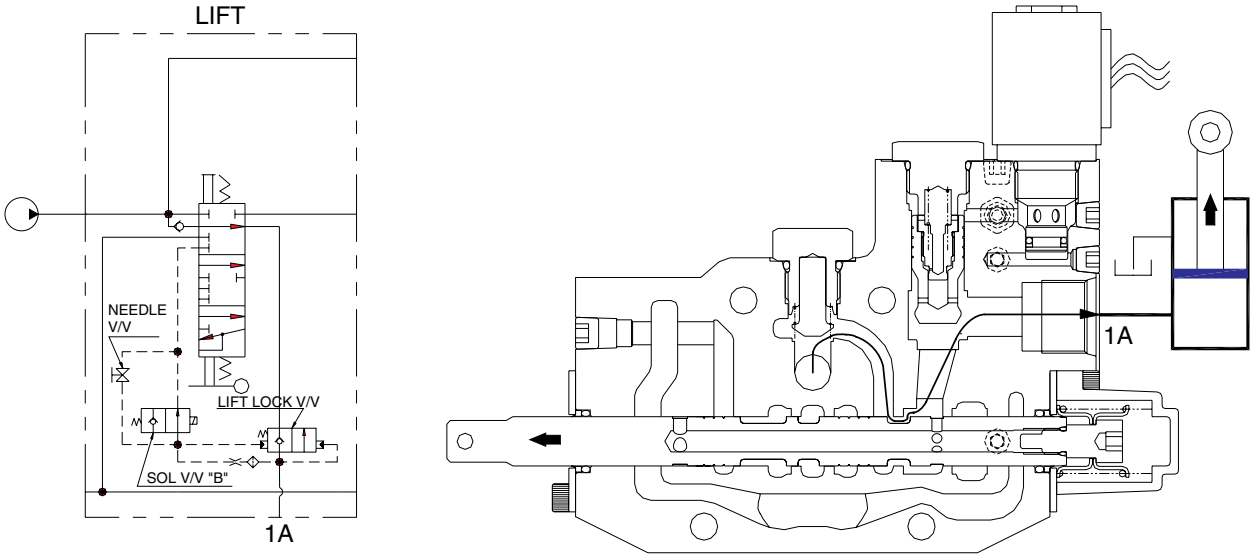


15L7HS58

When the operator is not seated, the solenoid valve is in the normally open position, which helps divert flow from the pump directly to the outlet to tank. In this manner, oil pressure and flow are not able to reach the portions of the valve which control the vehicle functions, so their operation is prevented.
Pressure is limited by the main relief valve.

7) LIFT SECTION OPERATION (TRAVEL WITH MAST OPSS)

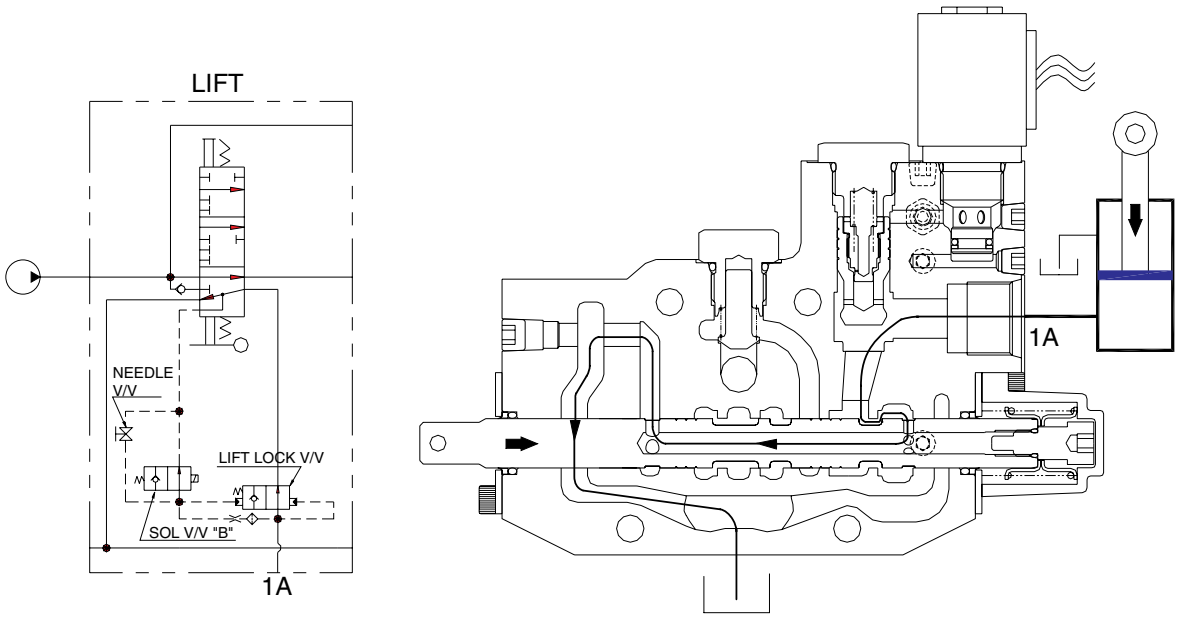
(1) Lift position



15L7HS59

When the operator shifts the lever backwards, the spool is extended out of the valve, and this opens the internal fluid passages that lift the mast. Oil flows through the high pressure parallel cavity, past the load check valve, through the spool metering notches, past the lift lock check valve, and to the head side of the lift cylinder.

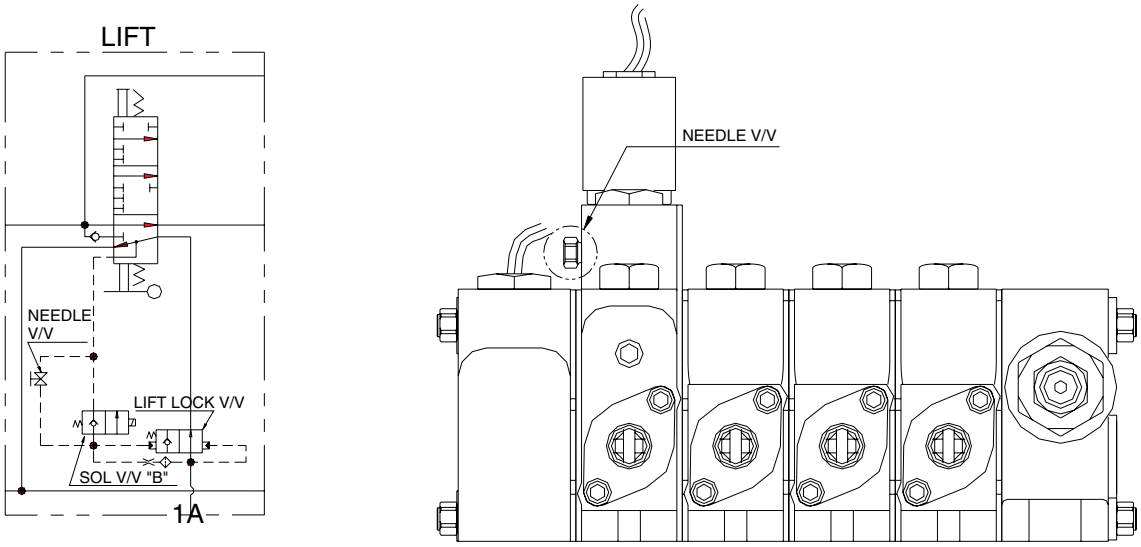
(2) Lower position



15L7HS60

When the seated operator shifts the lever forwards, the spool retracts into the valve, and the oil is directed from the cylinder, past the lift lock check valve, past the spool metering notches, and to the common tank cavity.

(3) Secondary lower position



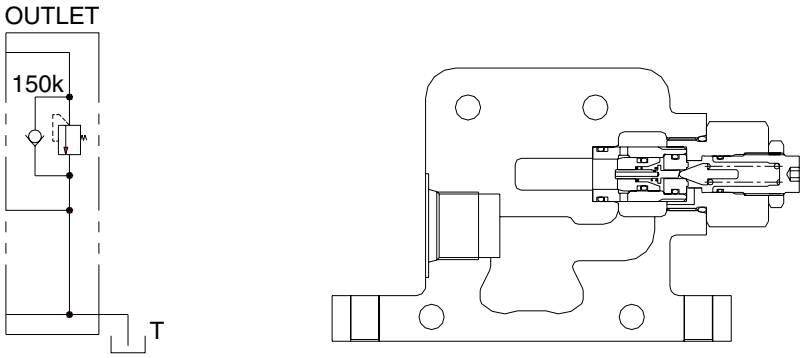
15L7HS61

Secondary lowering method : A secondary lowering method is available in the event of the loss of engine power that is needed to energize the normally closed solenoid valve.

- Important Note : Before opening the secondary needle valve, make sure personnel and equipment are safely positioned to avoid accidents. Be careful to operate this secondary valve slowly, as heavy loads may be suspended.
- A manual valve (needle valve) is located on the lift section, and it can be operated by opening the vehicle cowling and rotating the manual valve (needle valve) counterclockwise with a wrench.
  Open the manual valve (needle valve) approximately 2~3 turns (do not rotate more than 4 turns). Then shift the lift spool slowly for controlled lowering. This should be just enough for slow, controlled movement of the mast.
- Pressure is limited by the main relief valve.

8) OUTLET SECTION OPERATION

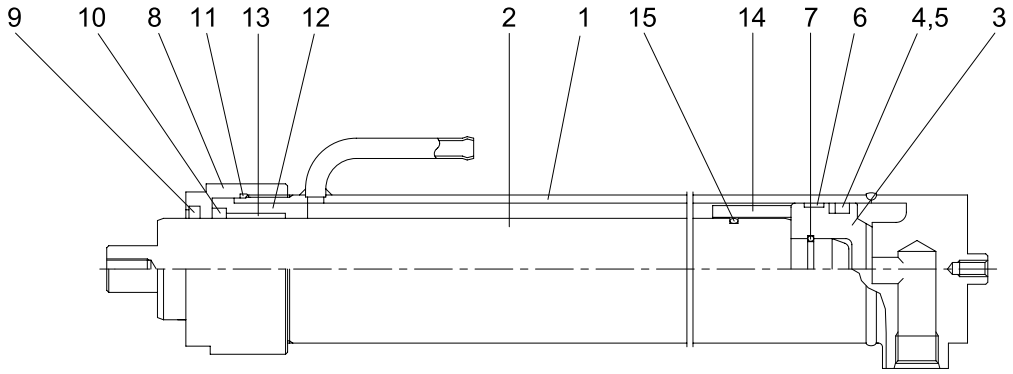
(1) Operation



15L7HS62

The outlet section contains the tank port and the secondary relief valve (with built-in anti-cavitation feature).

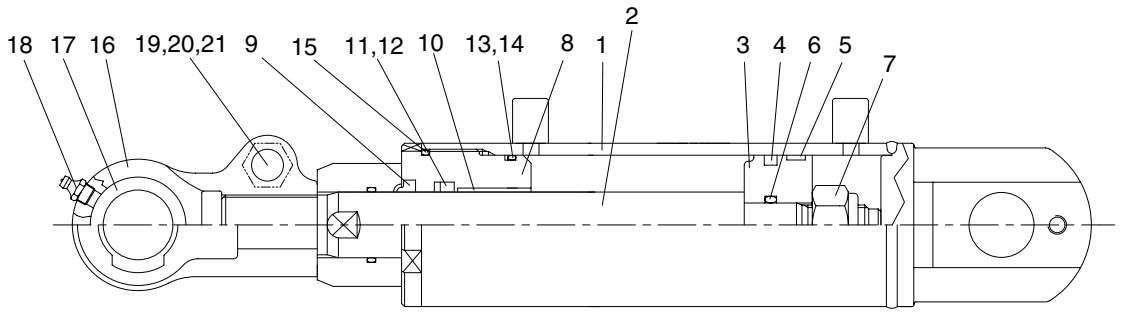
4. LIFT CYLINDER



D155HS13

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

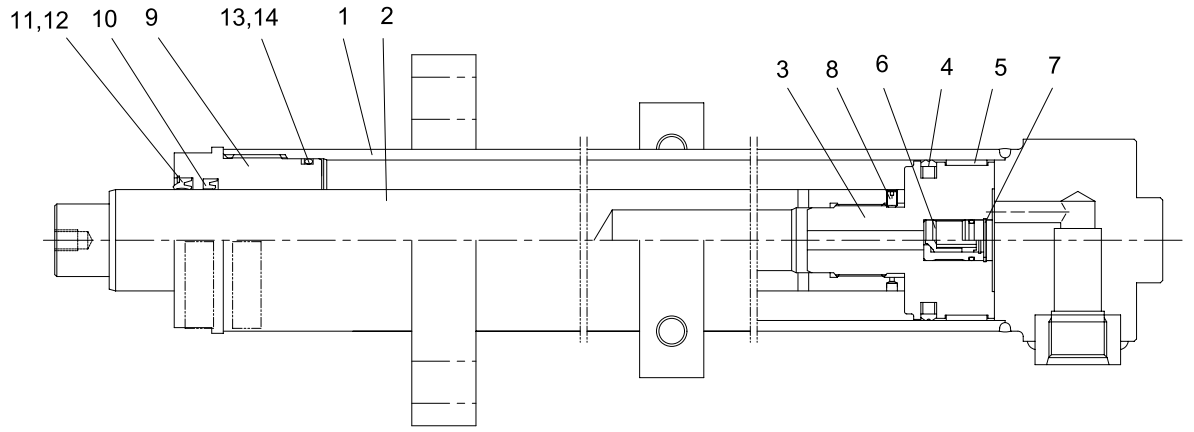
5. TILT CYLINDER



15L7HS14

1	Tube assembly	8	Gland	15	O-ring
2	Rod	9	Wiper dust	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	Hex bolt
6	O-ring	13	O-ring	20	Spring washer
7	Nylon nut	14	Back up ring	21	Hex nut

6. FREE LIFT CYLINDER



D155HS15

1	Tube assembly	6	Check valve	11	Dust wiper
2	Rod	7	Ring retaining	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.

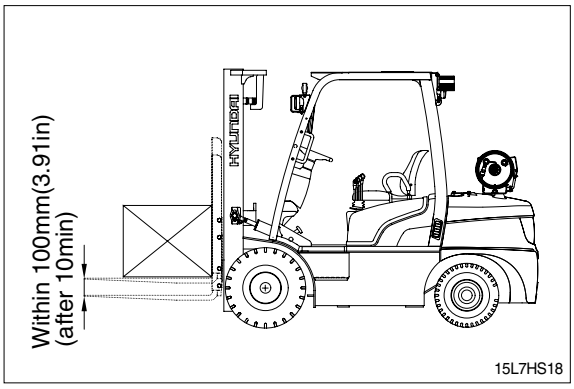
· **Hydraulic drift**

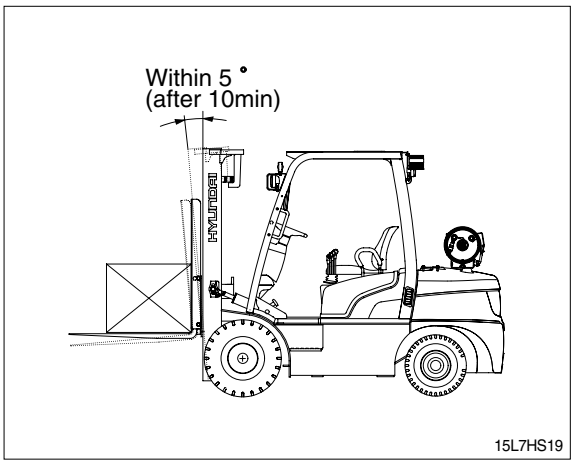
- Down(Downward movement of forks)
  : Within 100㎜ (3.9in)
- Forward(Extension of tilt cylinder)
  : Within 5°

(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)

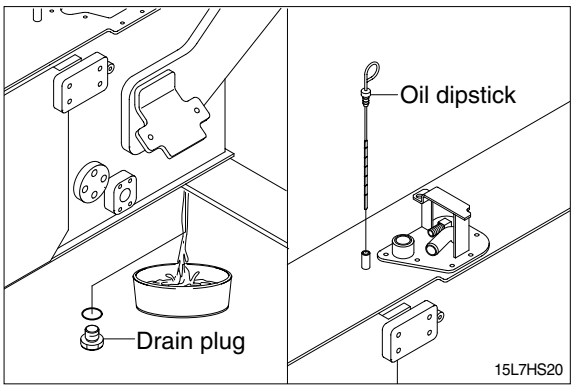




2) HYDRAULIC OIL

(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). Line filter uses paper element, so replace periodically(every 6 months or 1000 hours)



3) CONTROL VALVE

(1) Raise forks to maximum height and measure oil relief pressure.
Check that oil relief pressure is 190kgf/cm^2.
(2702psi)

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

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

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

4) LIFT CYLINDER

Problem	Cause	Remedy
Oil leaks out from gland through rod.	· Foreign matters on packing. · Unallowable score on rod. · Unusual distortion of dust seal. · Chrome plating is striped.	· Replace packing. · Smooth rod surface with an oil stone. · Replace dust seal. · Replace rod.
Oil leaks out from cylinder gland thread.	· O-ring damaged.	· Replace O-ring.
Rod spontaneously retract.	· Scores on inner surface of tube. · Unallowable score on the inner 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**

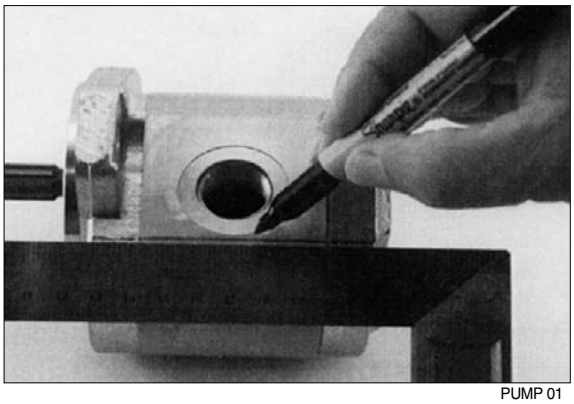
- Metric socket set
- Internal snap ring pliers
- Shaft seal sleeve
- Torque wrench

(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.

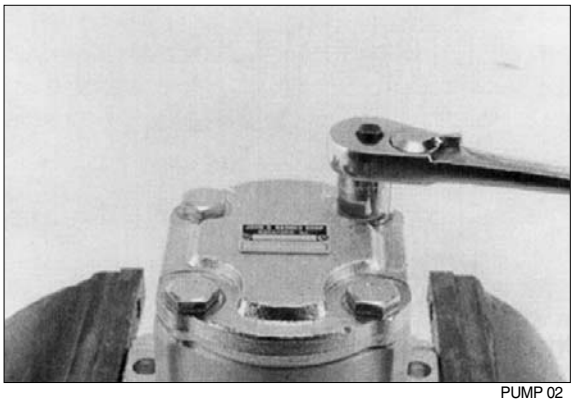


PUMP 01

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

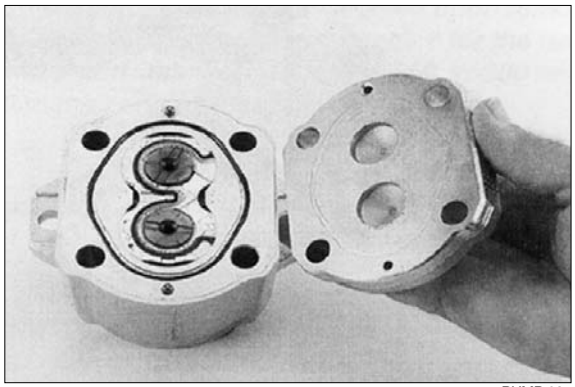
(6) Loosen the four metric hexagon head bolts.

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



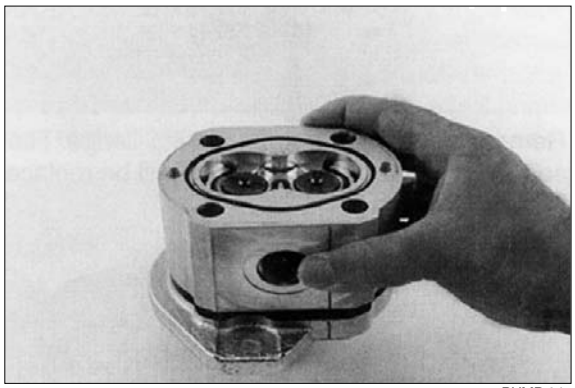
PUMP 02

(8) Lift and remove end cover.



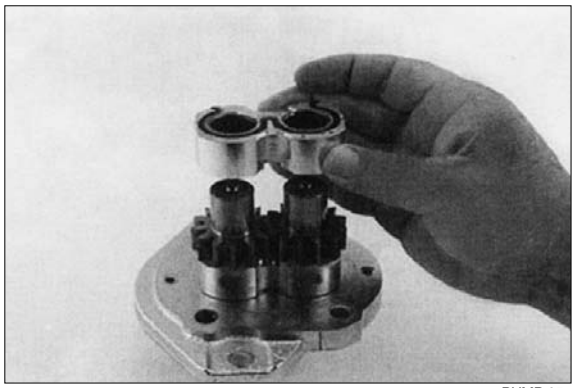
PUMP 03

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



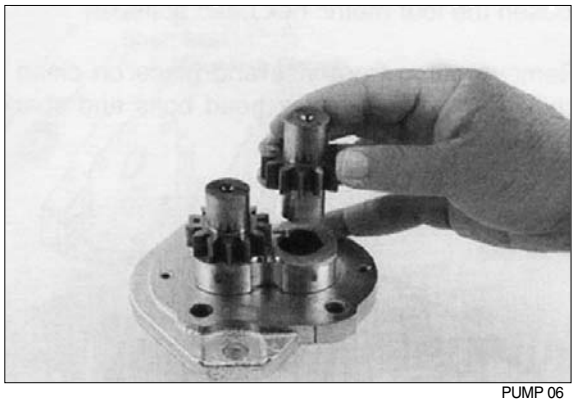
PUMP 04

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



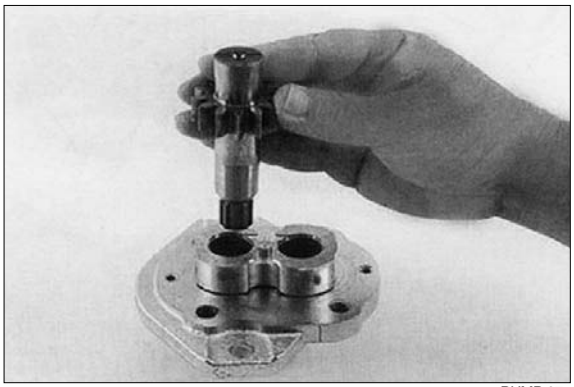
PUMP 05

(11) Remove idler shaft from bearing block.



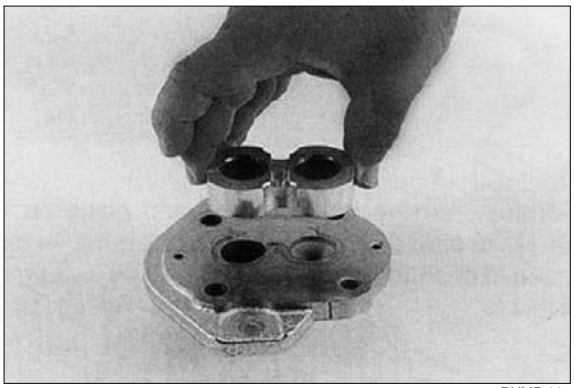
PUMP 06

(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.



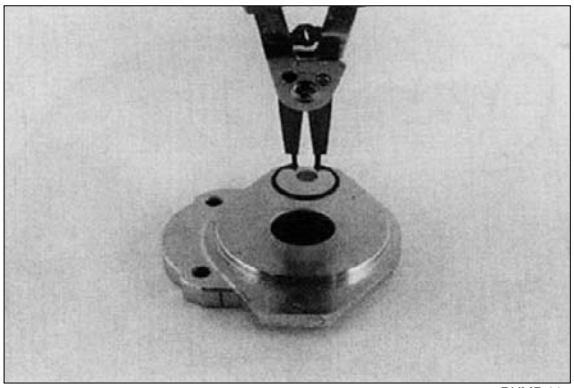
PUMP 07

(13) Remove the front bearing block.



PUMP 08

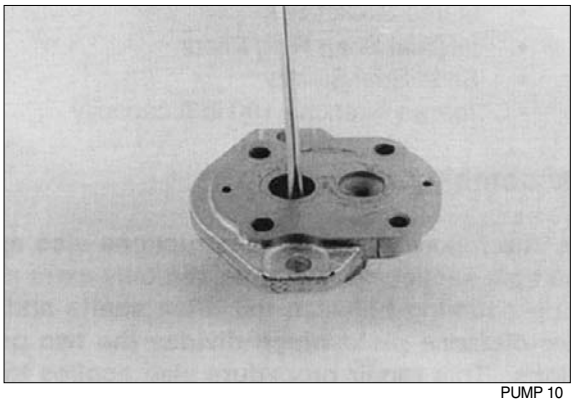
(14) Turn mounting flange over, with shaft seal up, and remove the retaining ring with proper snap ring pliers.



PUMP 09

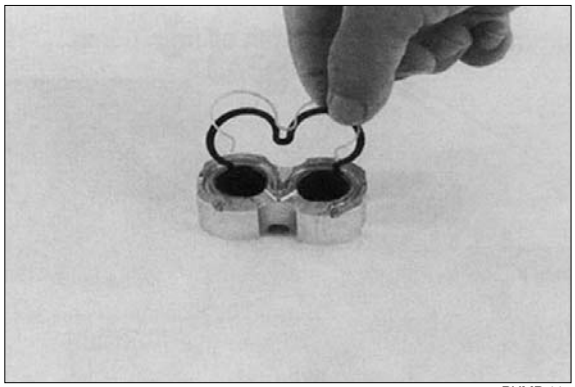
(15) Remove the oil seal from mounting flange, be careful not to mar or scratch the seal bore.

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



PUMP 10

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



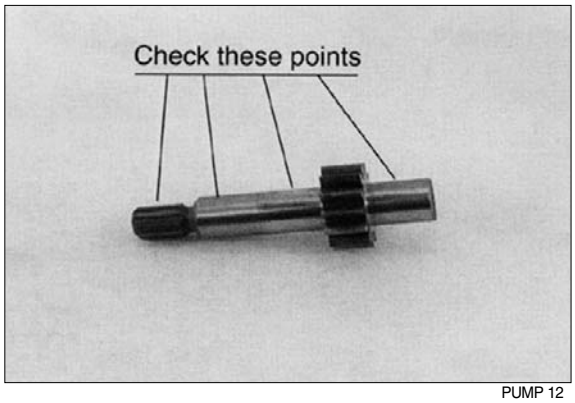
PUMP 11

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.

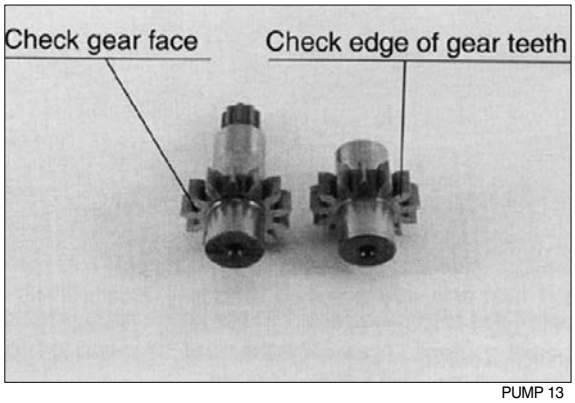
(2) Check drive shaft spline for twisted or broken teeth, check keyed drive shaft for broken or chipped keyway. No marks or grooves on shaft in seal area, some discoloration of shaft is allowable.

(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

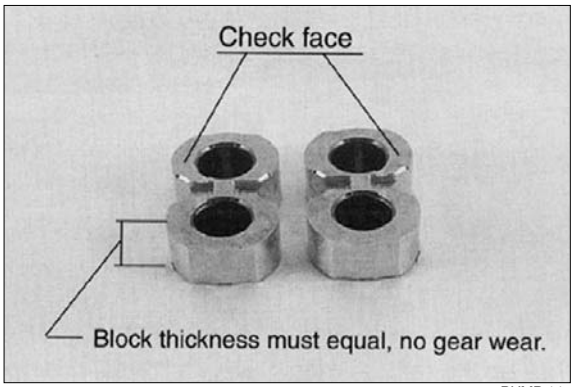
(4) Inspect gear face for scoring or excessive wear. If the face edge of gear teeth are sharp, they will mill into the bearing blocks. If wear has occurred, the parts are unusable.



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**

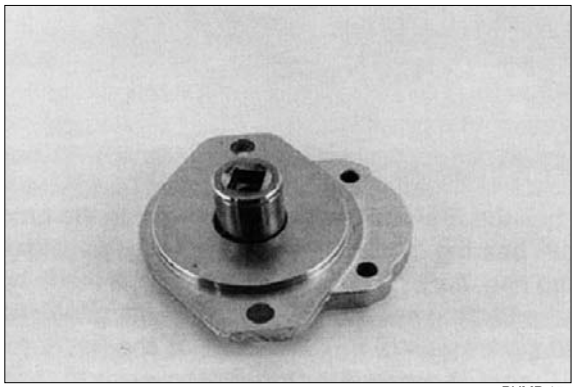
It is important that the relationship of the mounting flange, bearing blocks and gear housing is correct. Failure to properly assemble this pump will result with little or no flow at rated pressure.

※ **This pump is not bi-rotational.**

3) ASSEMBLY

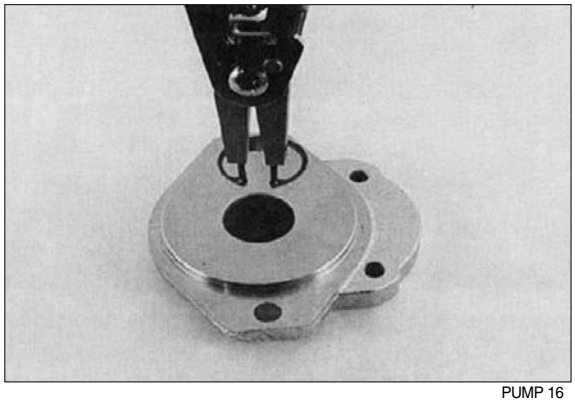
※ **New seals should be installed upon reassembly of pump.**

(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.



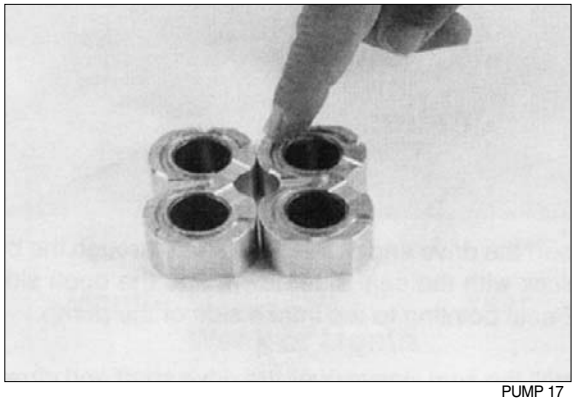
PUMP 15

(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.

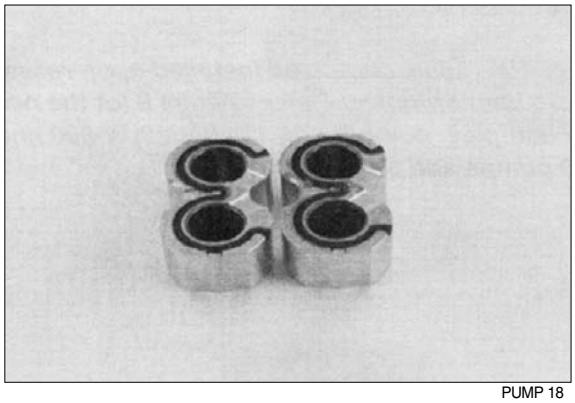


PUMP 17

(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.

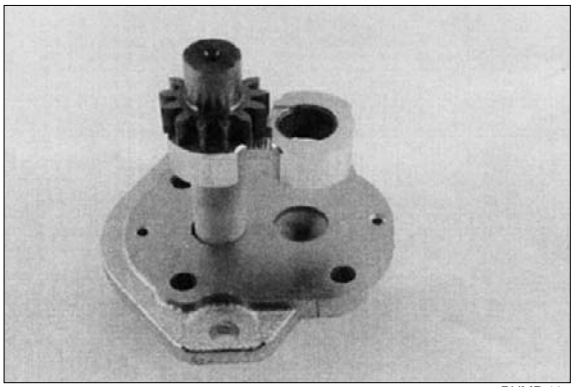
(6) Apply a light coating of petroleum jelly to the exposed face of the front bearing block.



PUMP 18

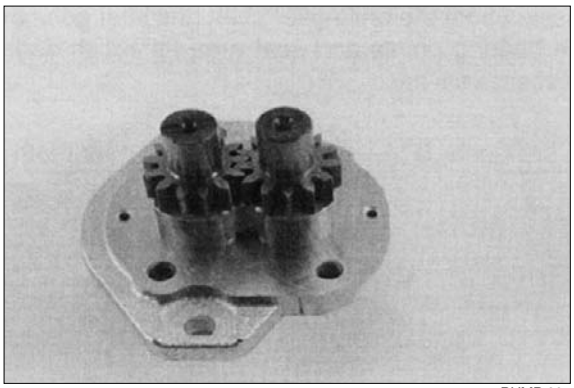
(7) Insert the drive end of the drive shaft through the bearing block with the seal side down, and the open side of the E-seal pointing to the intake side of the pump.

(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

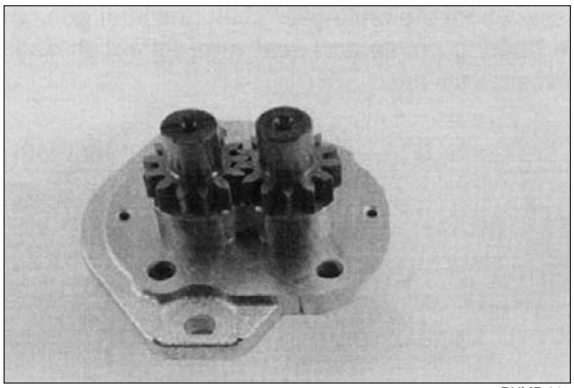
(9) Install the idler gear shaft in the remaining position in the bearing block. Apply a light coat of clean oil to the face of the drive and idler gears.



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.

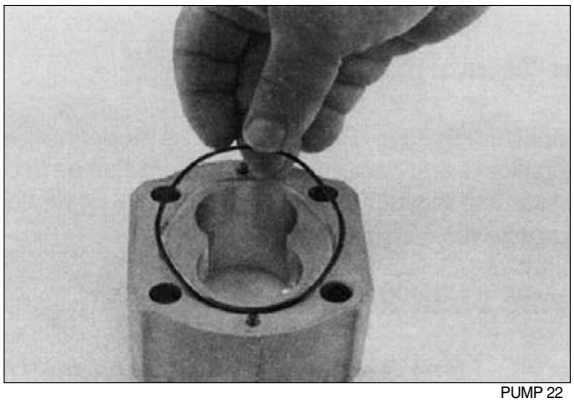
(11) Install two dowel pins in the holes in the mounting flange or two long dowel pins through gear housing if pump is a multiple section pump.



PUMP 21

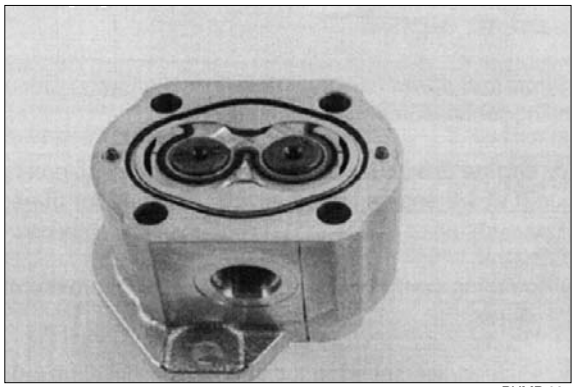
(12) To install the O-rings in the gear housing, apply a light coating of petroleum jelly in the grooves on both sides of the gear housing.

Also coat the new O-ring and install them in the grooves.



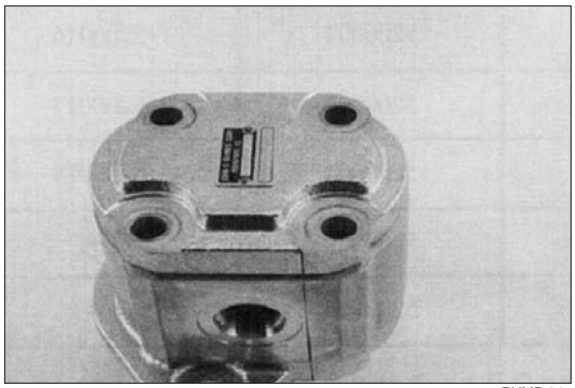
PUMP 22

(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.

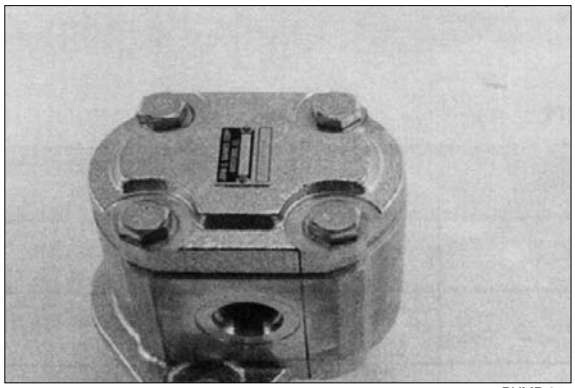

PUMP 23

(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.

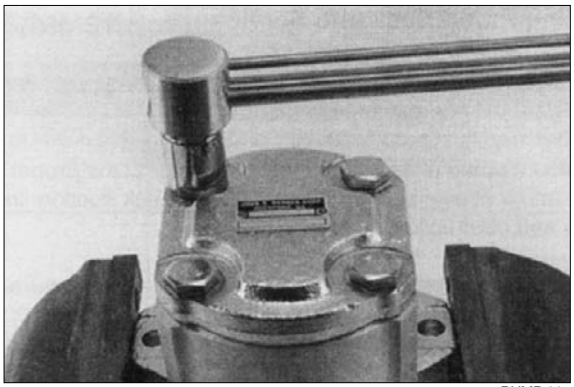

PUMP 25

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

· Tighten torque : 6~7kgf · m
(43.4~50.6lbf · 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

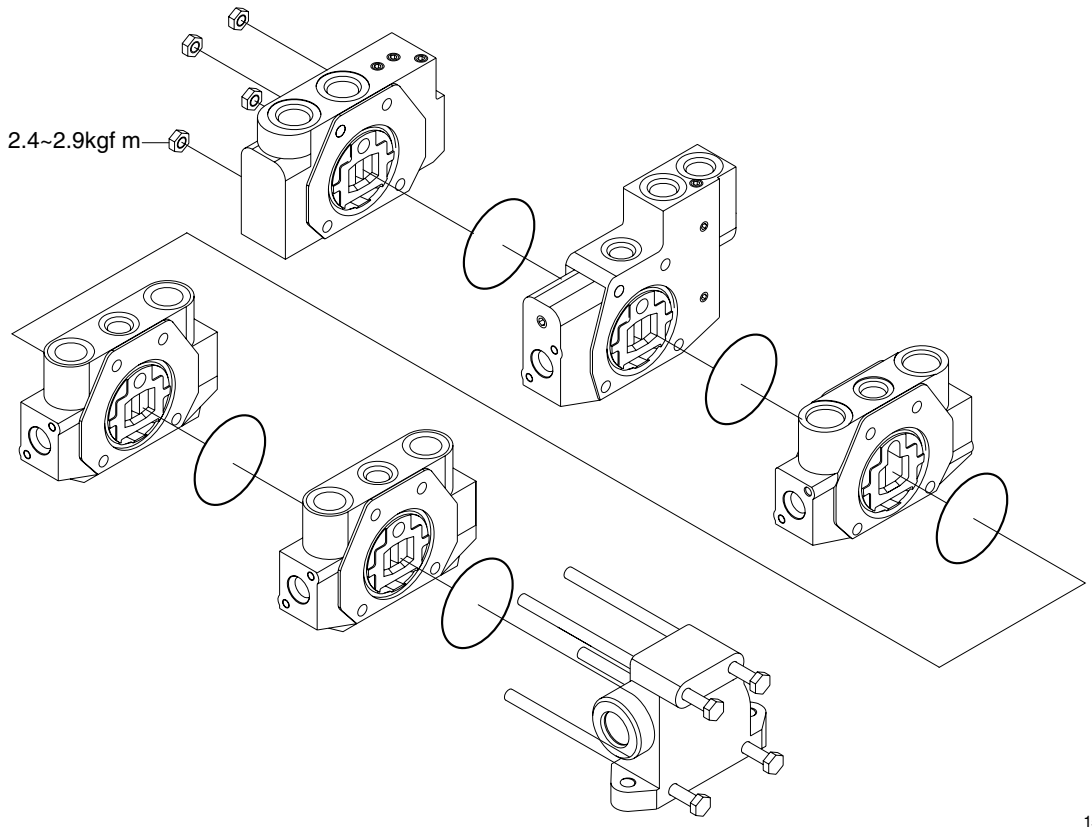
2. MAIN CONTROL VALVE

1) ASSEMBLY

(1) General

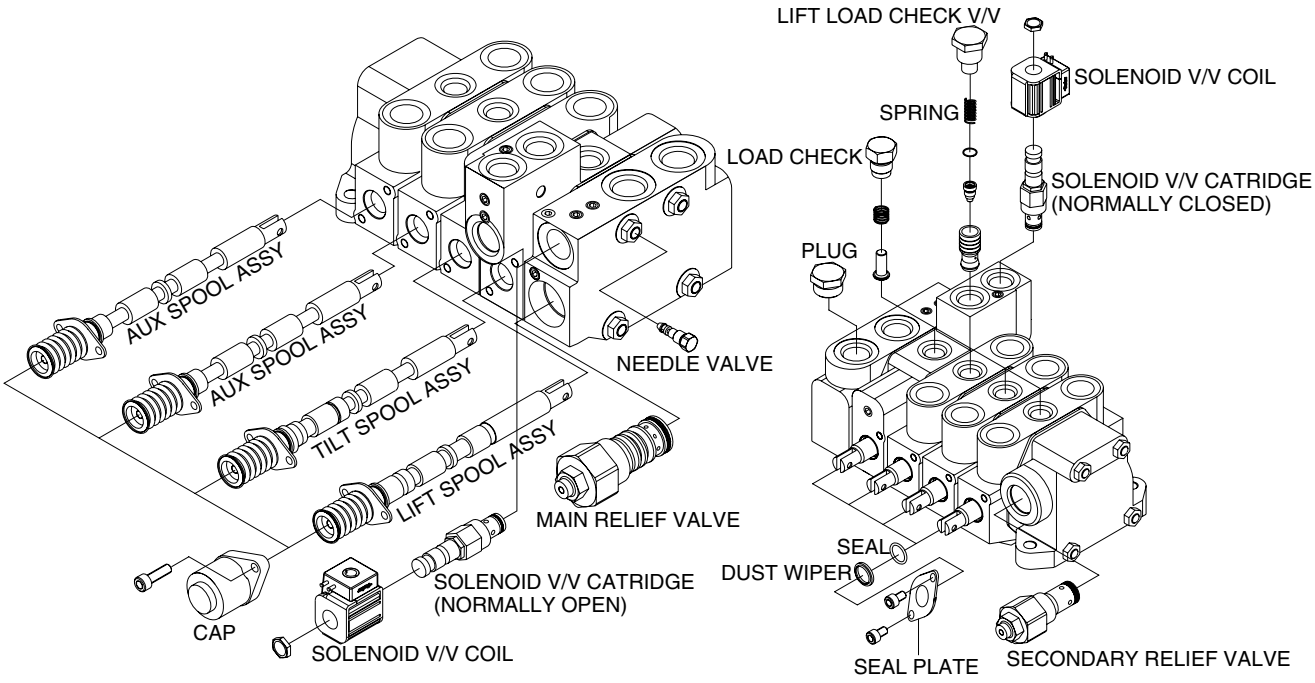
① Ensure that the assembly area will be clean and free of contamination.
② Use a flat (within 0.2mm) work surface when bolting the valve sections together.
③ Use calibrated torque wrenches and instrumentation.
④ The formal Bills of Material, descriptions, and views are found in the attached documentation.
⑤ Additional auxiliary valve sections may be added to the main control valve in a similar manner as indicated below, as approved by the Hyundai.

(2) Block subassembly



① Attach all the o-rings to the appropriate grooves between the spool sections.
② Stack the valve sections such that all the work ports are facing up, the spool ends are all in the same direction, and resting on a flat (within 0.2㎜), uniform surface.
③ Insert all the tie rods through the drilled holes in each of the housings.
④ Press the sections together, being careful not to damage sealing surfaces or seals.
⑤ Install nuts to both ends of all tie rods and progressively torque in a circular pattern until reaching a torque of 2.4~2.9 kgf · m (17.4~21.0 lbf · ft)on all tie rods. Periodically, make sure that the valve remains flat while applying torque.

(3) Inlet section



15L7HS34

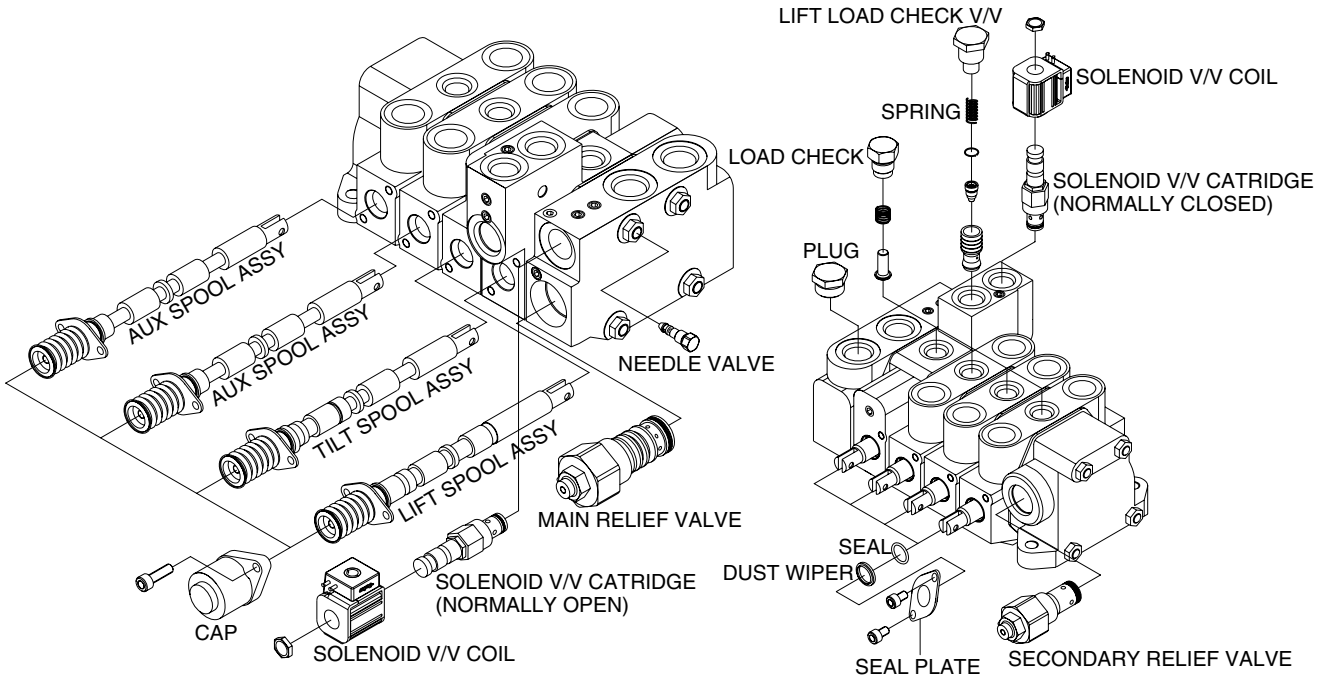
① Install the main relief valve assembly into the lower side cavity of the inlet section, as illustrated. Torque to 4.5-5.0 kgf · m (32.5~36.2 lbf · ft).

② Install the normally open solenoid valve assembly in the side cavity of the inlet directly above the main relief valve. Torque to 3.5-4.0 kgf · m (25.2~28.8 lbf · ft).

③ Install the plug assembly in the tank port of the inlet section.
Torque to 4.5-5.0 kgf · m (32.5~36.2 lbf · ft).

④ Install the plug in the pressure gage port to the inlet. Torque to 4.5-5.0 kgf · m (32.5~36.2 lbf · ft).

(4) Lift section



15L7HS34

① The spool assembly should already consist of the lift spool, the return spring, one spring seat on either end of the spring, the seal plate, a spool seal, and a dust wiper. All of these are assembled on the end of the spool opposite the clevis.

② Insert the clevis end of the spool into the right-hand side of the spool bore (the tallest end of the housing). Place the spool cap over the spool and spring assembly and connect the cap to the housing using two bolts. Torque both bolts alternatively until a torque of 1.0-1.5 kgf · m (7.2~10.8 lbf · ft) is reached on both bolts.

③ Install the second spool seal and dust wiper over the clevis end of the spool and retain with a seal plate and two bolts. Torque both bolts alternatively until a torque of 1.0-1.5 kgf · m (7.2~10.8 lbf · ft) is reached on both bolts.

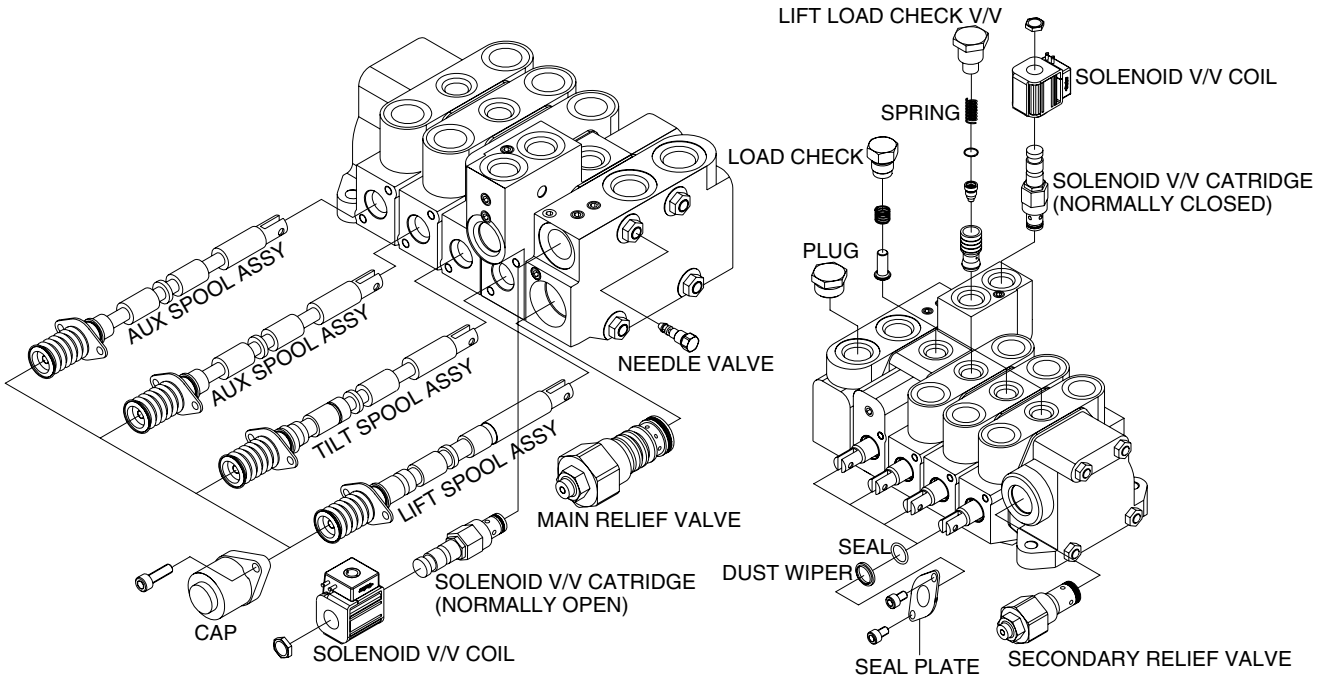
④ The load check assembly is inserted into the top center cavity.
Torque to 3.5-4.0kgf · m (25.2~28.8 lbf · ft).

⑤ The normally closed solenoid is installed in the rightmost cavity on the top of the section.
Torque to 3.5-4.0 kgf · m (25.2~28.8 lbf · ft).

⑥ Install the lift lock check valve assembly in the remaining open cavity in the top of the housing.
Torque to 4.5-5.0 kgf · m (32.5~36.2 lbf · ft).

⑦ Install the needle valve subassembly in the cavity on the inlet-facing surface of the housing.
Torque to 1.0-1.5 kgf · m (7.2~10.8 lbf · ft).

(5) Tilt section



15L7HS34

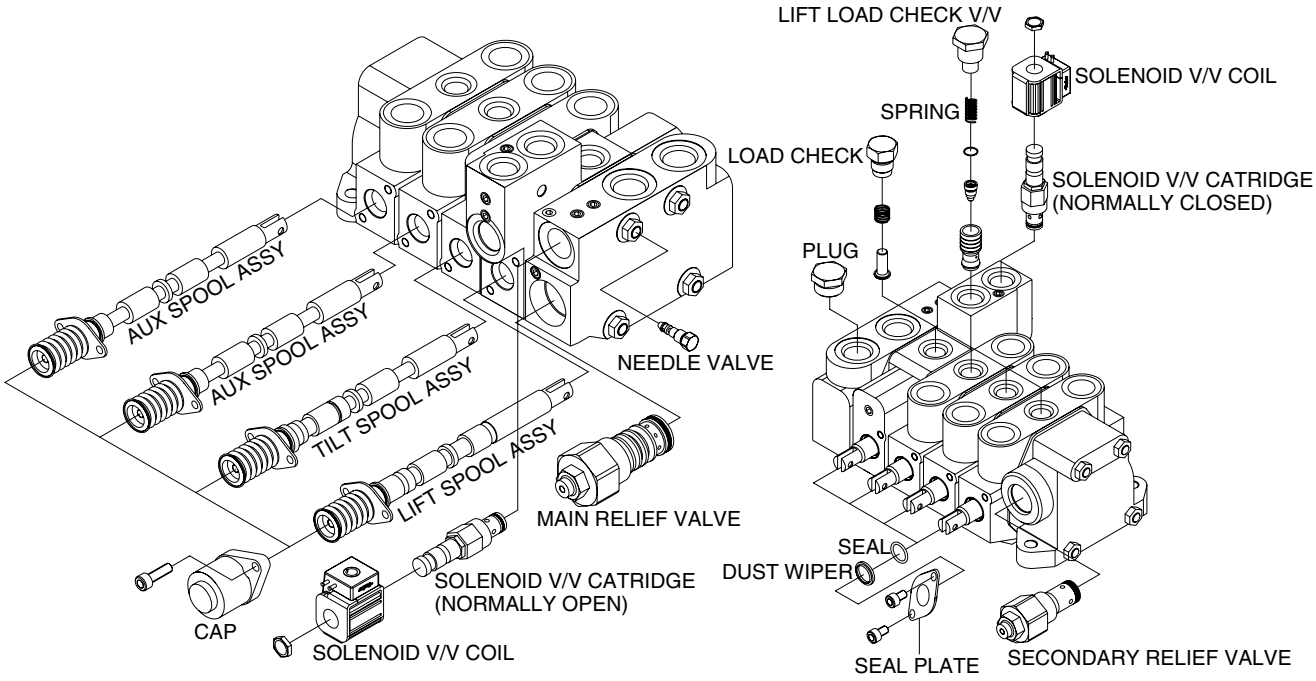
① The spool assembly should already consist of the tilt spool (with tilt plunger and spring inserted into the bore on the spring end), the return spring, one spring seat on either end of the spring, the seal plate, a spool seal, and a dust wiper. All of these are assembled on the end of the spool opposite the clevis.

② Insert the clevis end of the spool into the right-hand side of the spool bore (the tallest end of the housing). Place the spool cap over the spool and spring assembly and connect the cap to the housing using two bolts. Torque both bolts alternatively until a torque of 1.0-1.5 kgf · m (7.2~10.8 lbf · ft) is reached on both bolts.

③ Install the second spool seal and dust wiper over the clevis end of the spool and retain with a seal plate and two bolts. Torque both bolts alternatively until a torque of 1.0-1.5 kgf · m (7.2~10.8 lbf · ft) is reached on both bolts.

④ The load check assembly is inserted into the top center cavity.
Torque to 3.5-4.0 kgf · m (25.2~28.8 lbf · ft).

(6) Auxiliary sections



15L7HS34

(Same procedure for all aux sections, but spool assembly components may vary)

① The spool assembly should already consist of the proper aux spool, the return spring, one spring seat on either end of the spring, the seal plate, a spool seal, and a dust wiper. All of these are assembled on the end of the spool opposite the clevis.

② Insert the clevis end of the spool into the right-hand side of the spool bore (the tallest end of the housing). Place the spool cap over the spool and spring assembly and connect the cap to the housing using two bolts. Torque both bolts alternatively until a torque of 1.0-1.5 kgf · m (7.2~10.8 lbf · ft) is reached on both bolts.

③ Install the second spool seal and dust wiper over the clevis end of the spool and retain with a seal plate and two bolts. Torque both bolts alternatively until a torque of 1.0-1.5 kgf · m (7.2~10.8 lbf · ft) is reached on both bolts.

④ The load check assembly is inserted into the top center cavity.
Torque to 3.5-4.0kgf · m (25.2~28.8 lbf · ft) .

(7) Outlet section

① Install the secondary relief valve into the cavity on the clevis end of the housing.
Torque to 4.5-5.0 kgf · m (32.5~36.2 lbf · ft).

2) DISASSEMBLY INSTRUCTIONS

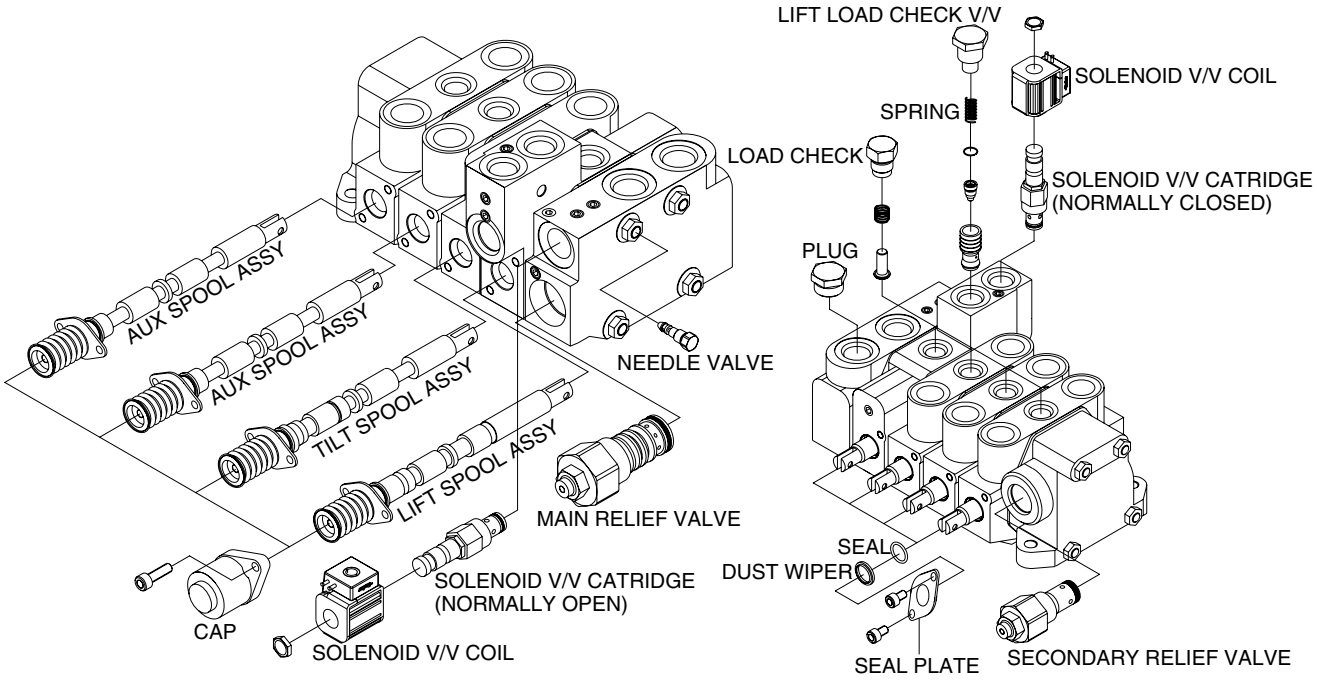
(1) General

① Subassemblies (such as relief valves, check valves, and spools) may be removed without having to loosen the tie rods and disassembling the entire valve.

② Disassemble the valve sections on a flat working surface.

③ Ensure that the disassembly area will be clean and free of contamination.

④ Keep the disassembly area neat to avoid loss or damage of parts.



15L7HS34

(2) Procedure

① Loosen the tie rod nuts and remove the tie rods from the valve sections.

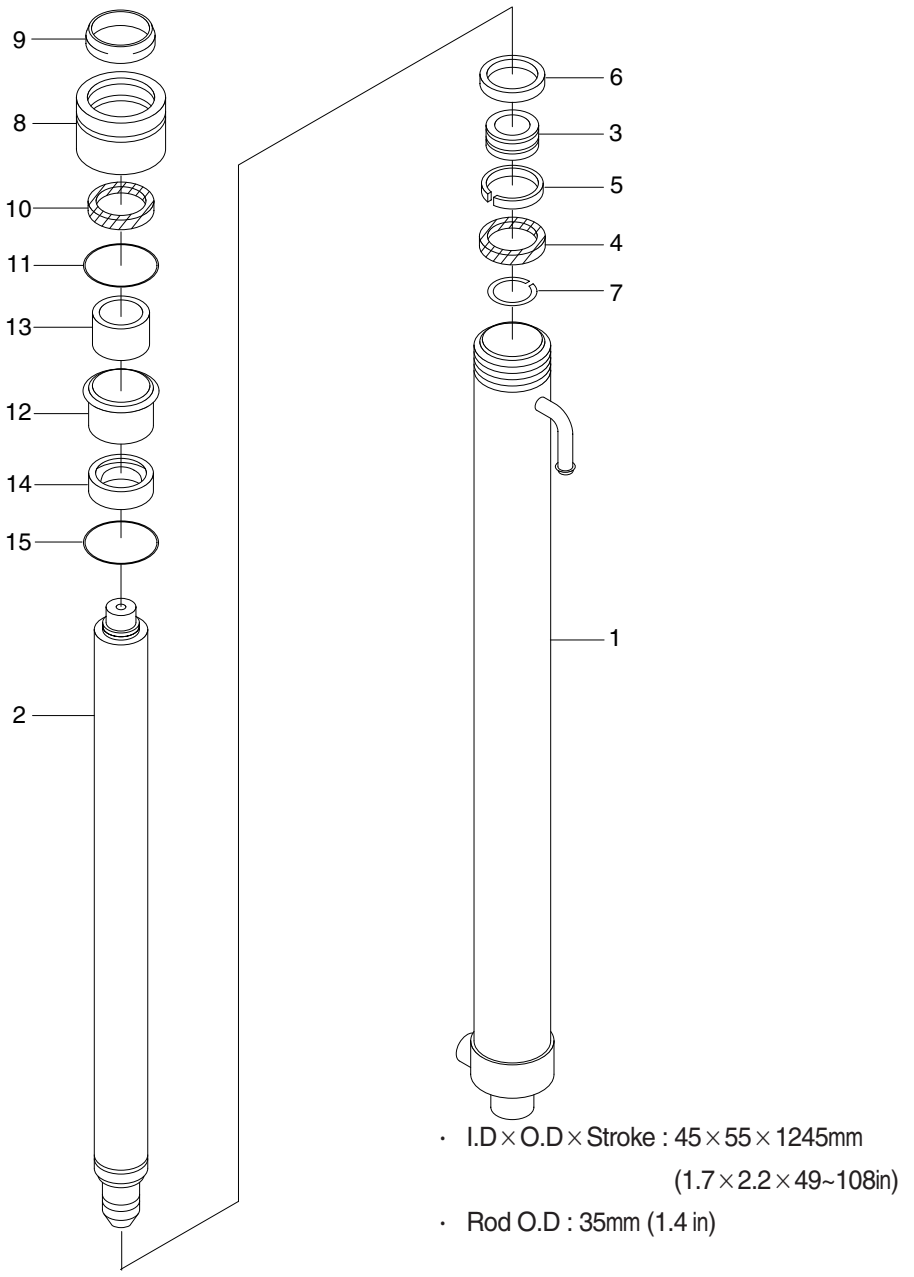
② Remove o-rings between valve sections and set aside to avoid damage.

③ Spools, relief valves, load check valves, lift lock poppets, solenoid valves, and plugs can all be removed from the valve sections. Refer to the associated assembly procedures, above, for specific torque and handling details. Inspect and repair or replace the assemblies as complete units, as may be necessary.

④ Valve components are precision items, and care must be taken when handing them to avoid damage or the introduction of contamination that could adversely affect performance.

3. LIFT CYLINDER

1) STRUCTURE



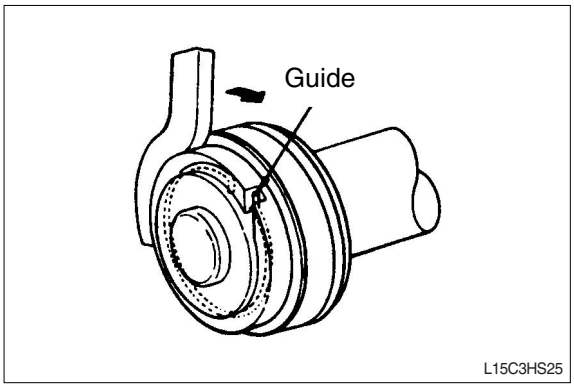
- I.D × O.D × Stroke : 45 × 55 × 1245mm
  (1.7 × 2.2 × 49~108in)
- Rod O.D : 35mm (1.4 in)

D155HS16

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.



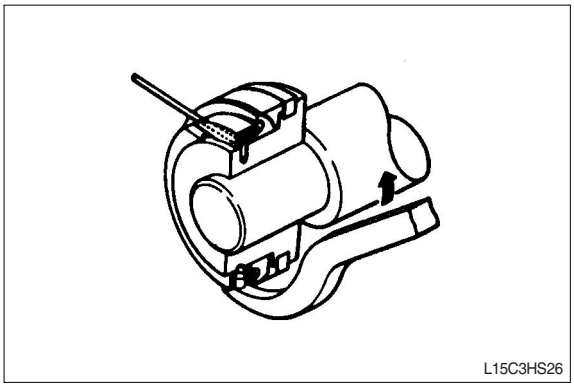
3) CHECK AND INSPECTION

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

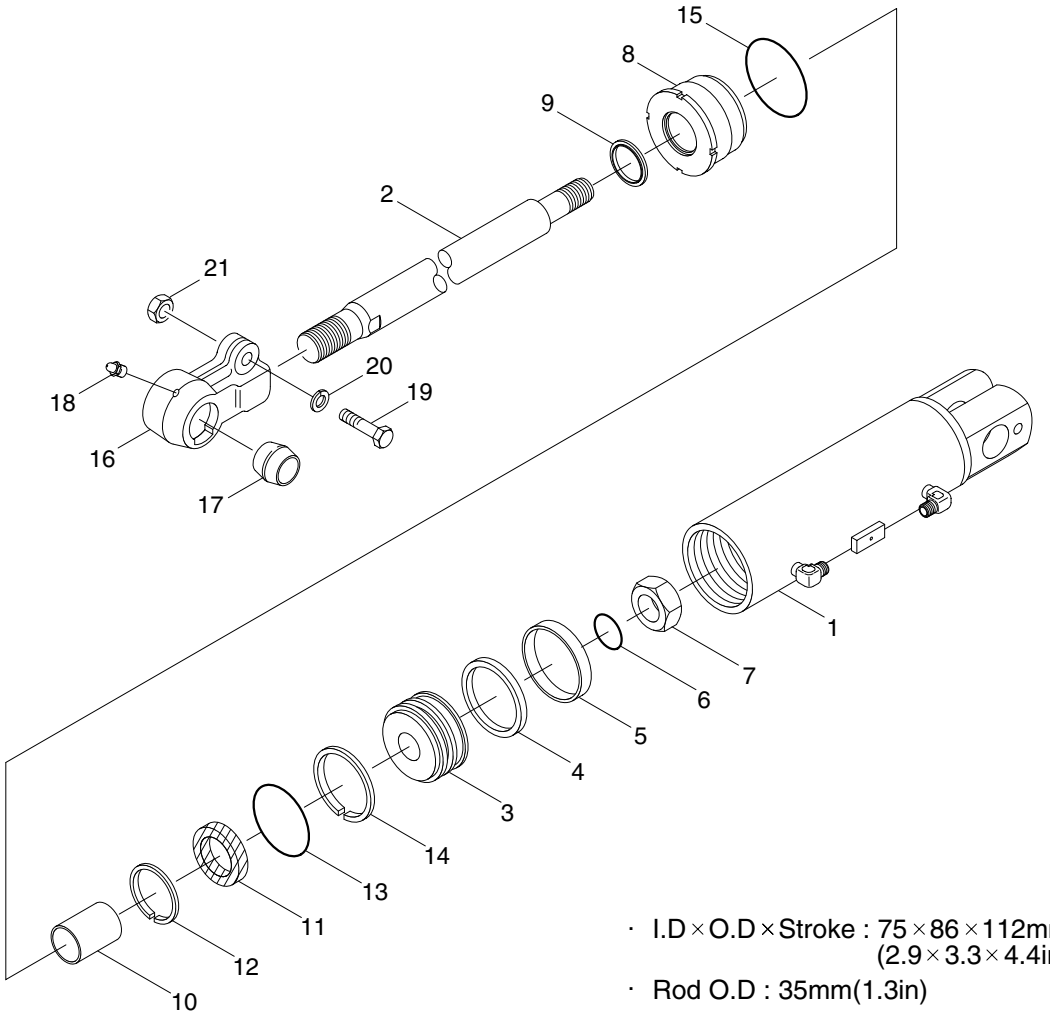
4) ASSEMBLY

(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



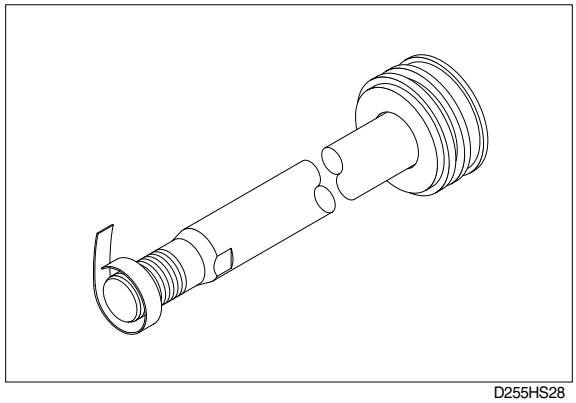
· I.D × O.D × Stroke : 75 × 86 × 112mm
(2.9 × 3.3 × 4.4in)
· Rod O.D : 35mm(1.3in)

15L7HS21

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

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.



D255HS28

3) CHECK AND INSPECTION

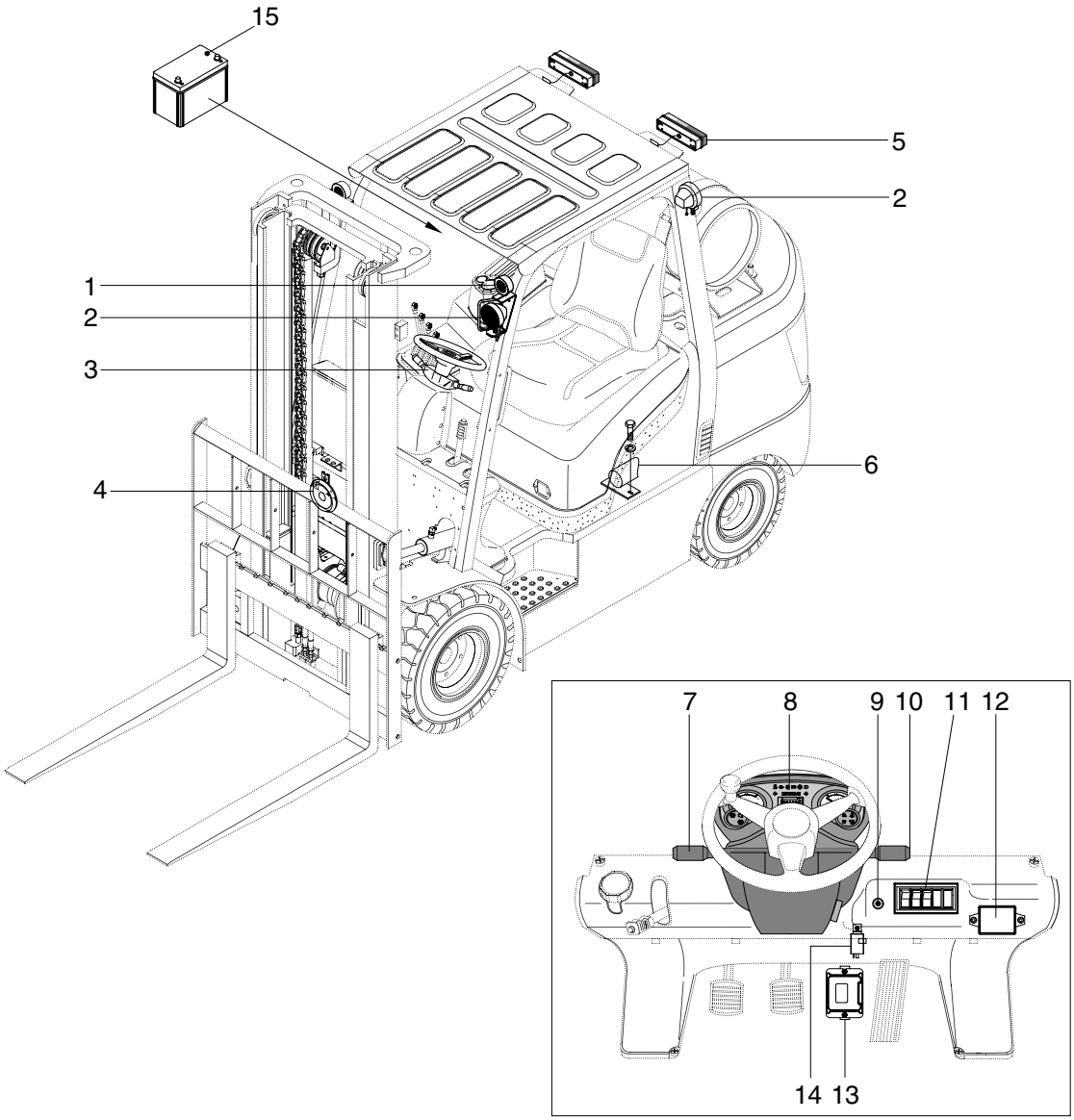
mm(in)

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

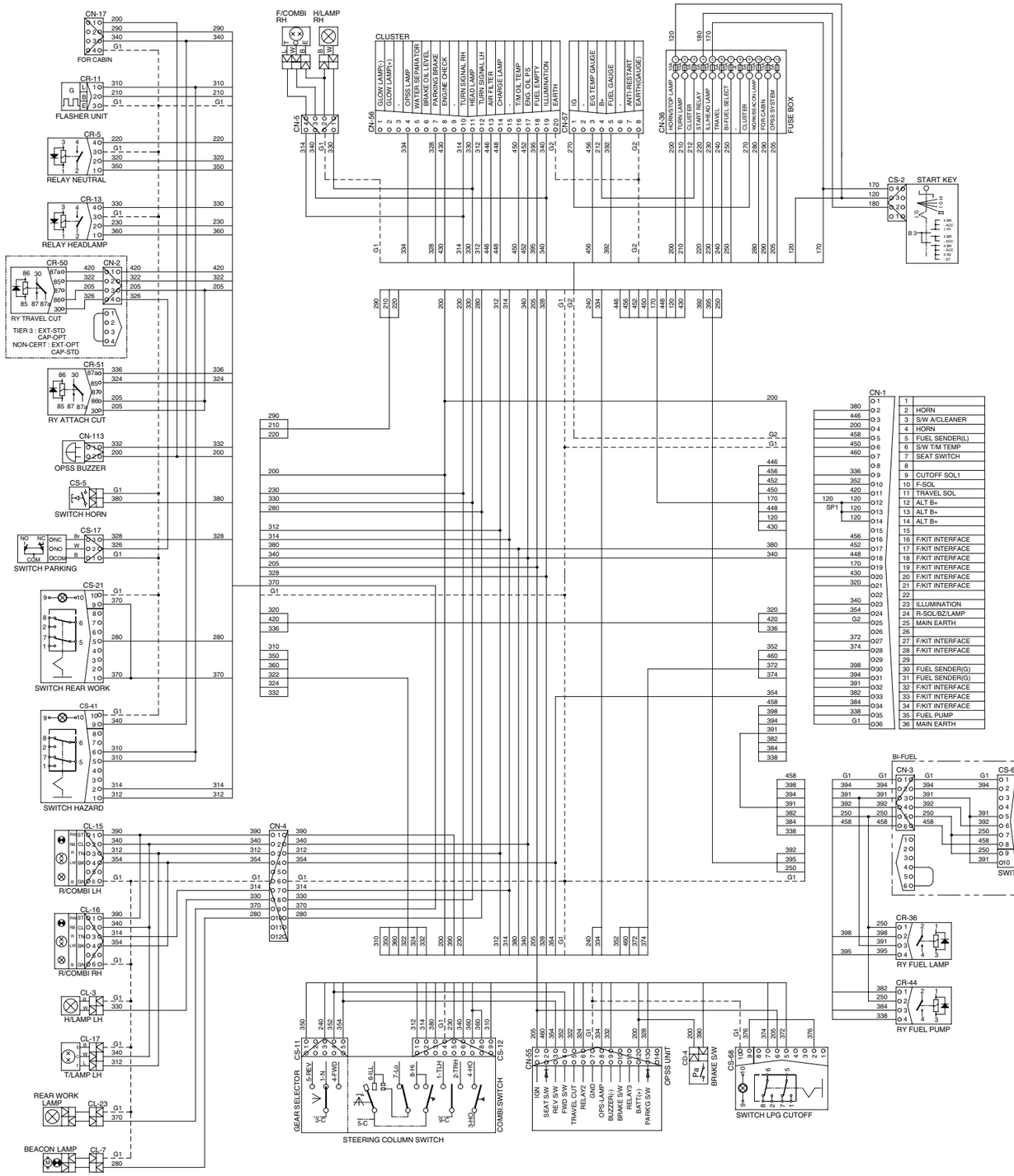
GROUP 1 COMPONENT LOCATION



15L7EL01

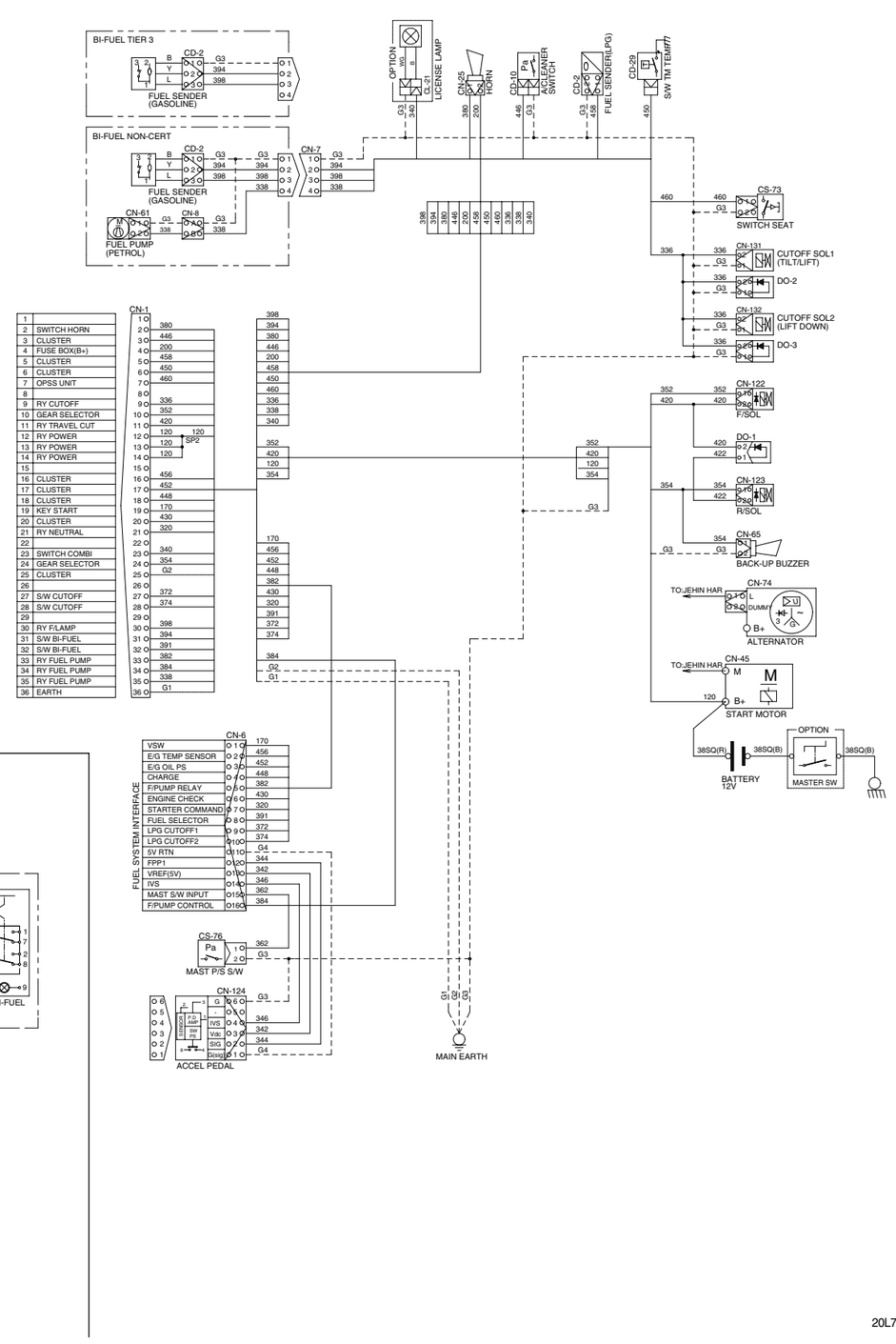
1	Flasher lamp	6	Back buzzer	11	Switch assembly
2	Work lamp	7	Forward-reverse lever	12	Fuse box
3	Combination switch	8	Operating panel	13	OPSS unit
4	Horn assembly	9	Start switch	14	Flasher unit
5	Combination lamp	10	Horn button	15	Battery

DASHBOARD PART

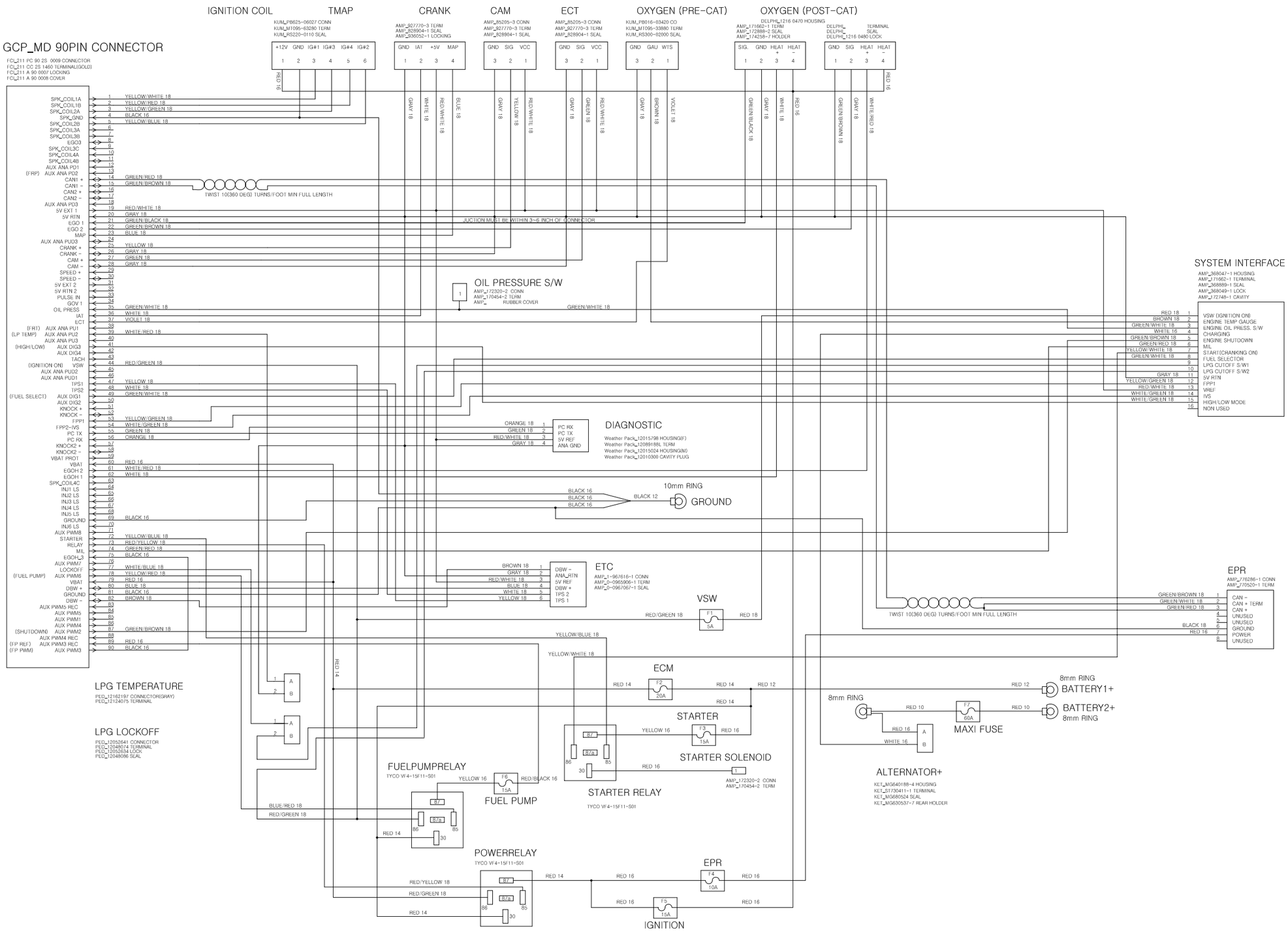


CN-1	
1	
2	HORN
3	S/W A/CLEANER
4	HORN
5	FUEL SENDER(L)
6	S/W T/M TEMP
7	SEAT SWITCH
8	
9	CUTOFF SOL1
10	F-SOL
11	TRAVEL SOL
12	ALT B+
13	ALT B+
14	ALT B+
15	
16	F/KIT INTERFACE
17	F/KIT INTERFACE
18	F/KIT INTERFACE
19	F/KIT INTERFACE
20	F/KIT INTERFACE
21	F/KIT INTERFACE
22	
23	ILLUMINATION
24	R-SOL/BZ/LAMP
25	MAIN EARTH
26	
27	F/KIT INTERFACE
28	F/KIT INTERFACE
29	
30	FUEL SENDER(G)
31	FUEL SENDER(G)
32	F/KIT INTERFACE
33	F/KIT INTERFACE
34	F/KIT INTERFACE
35	FUEL PUMP
36	MAIN EARTH

FRAME / ENGINE PART

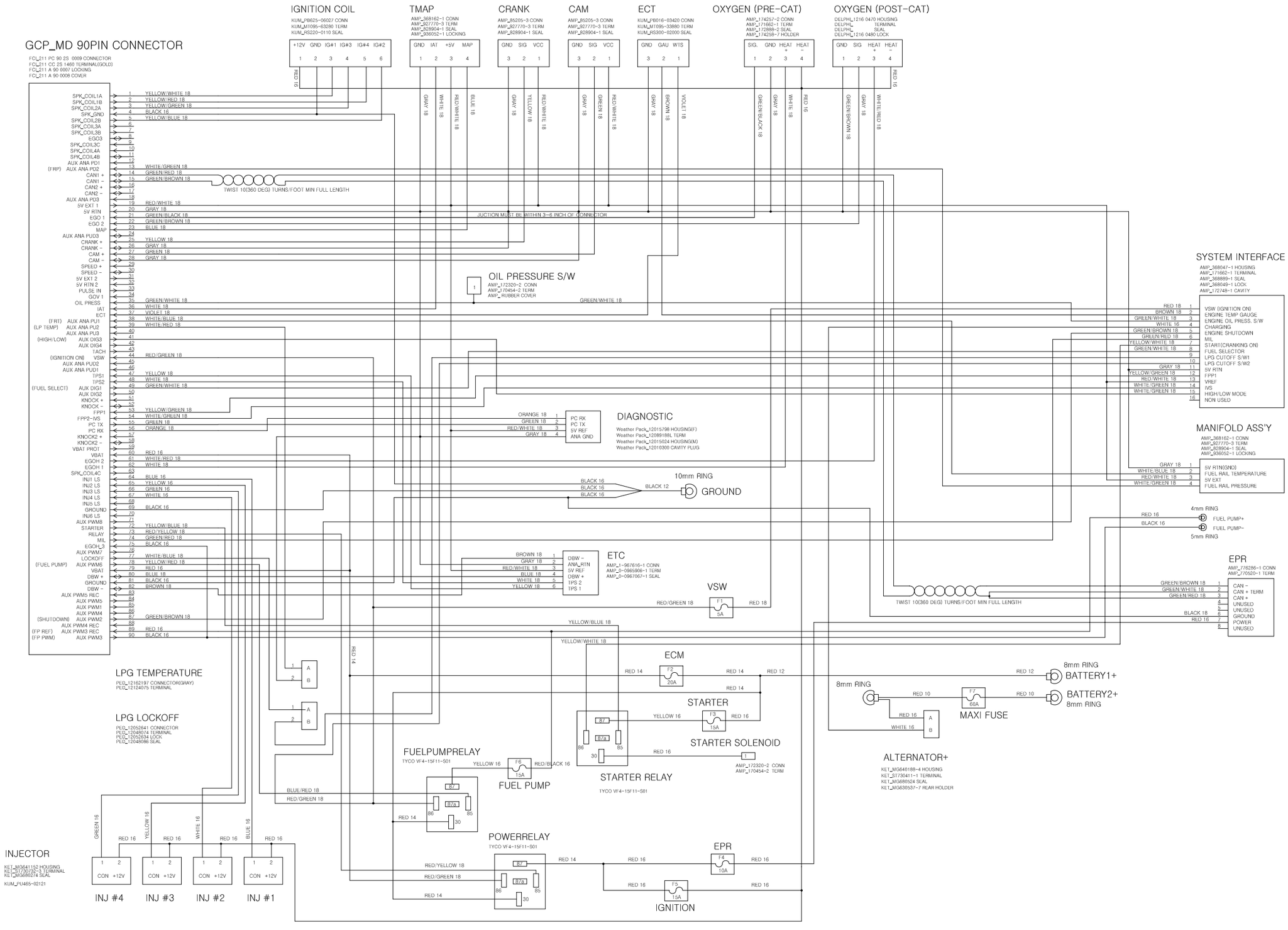


FUEL SYSTEM CIRCUIT(TIER 3, LPG)



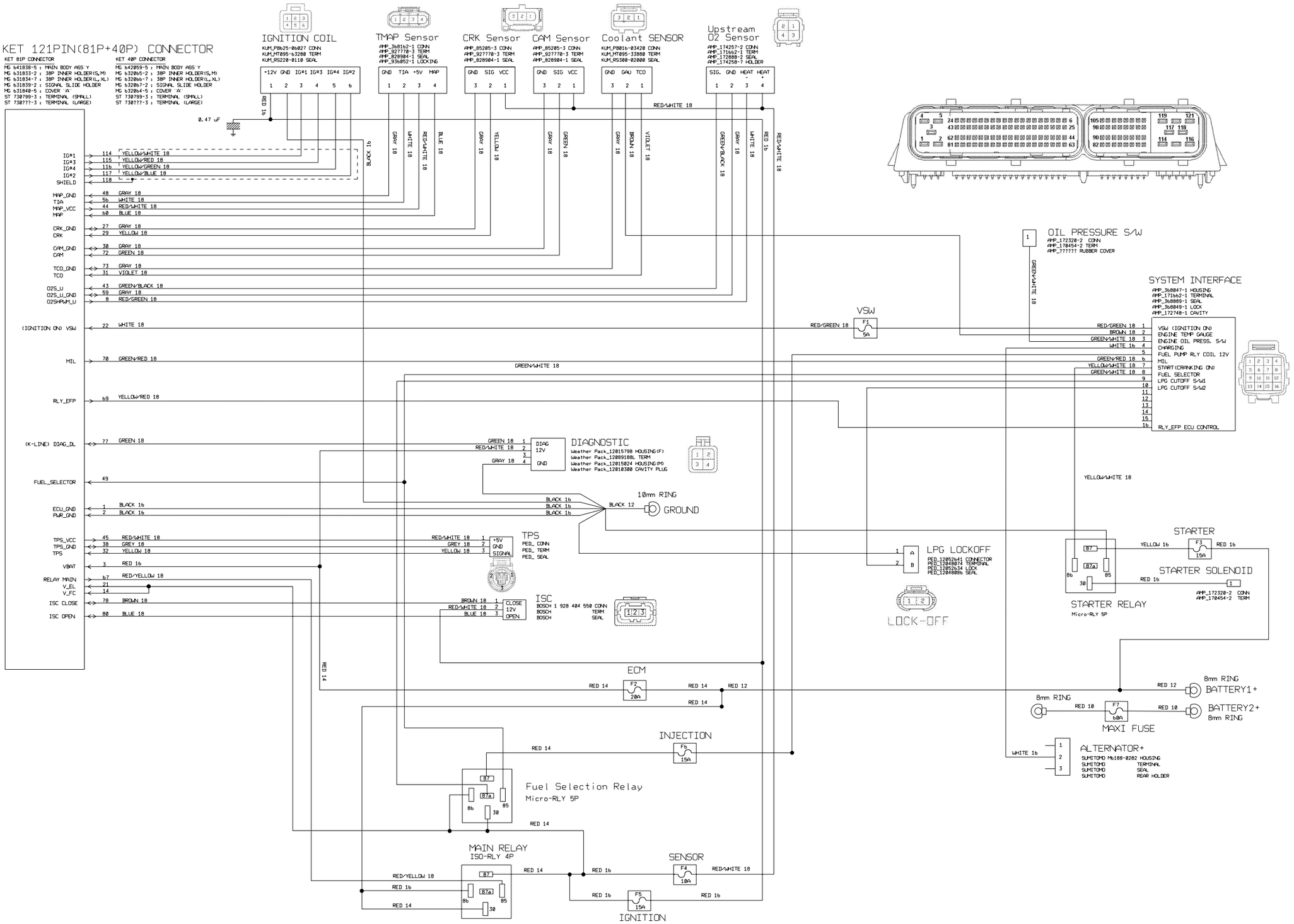
20L7EL07

FUEL SYSTEM CIRCUIT(TIER 3, BI-FUEL)

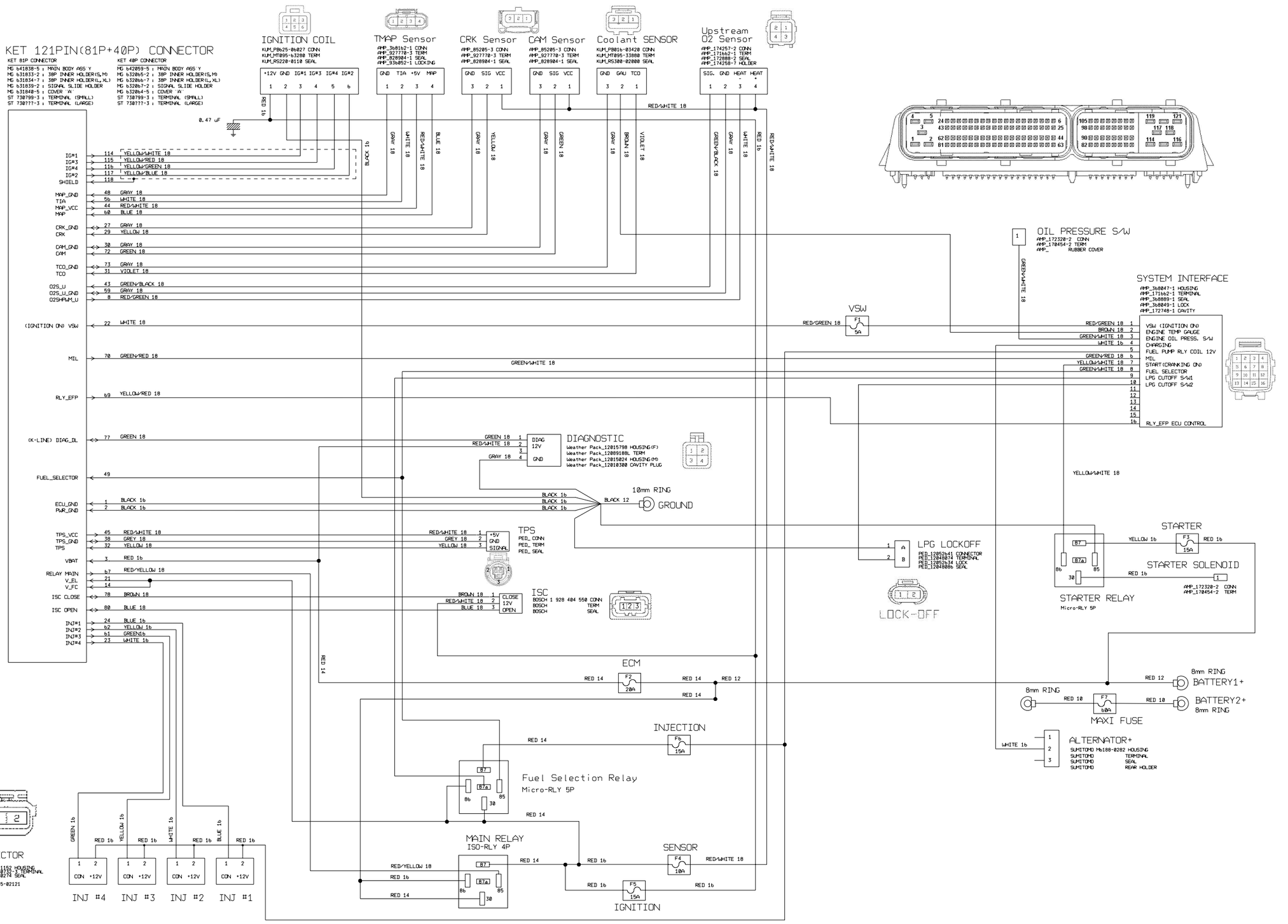


20L7EL06

FUEL SYSTEM CIRCUIT(NON-CERT, LPG)



FUEL SYSTEM CIRCUIT(NON-CERT, BI-FUEL)



MEMORANDUM


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

1. POWER CIRCUIT

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

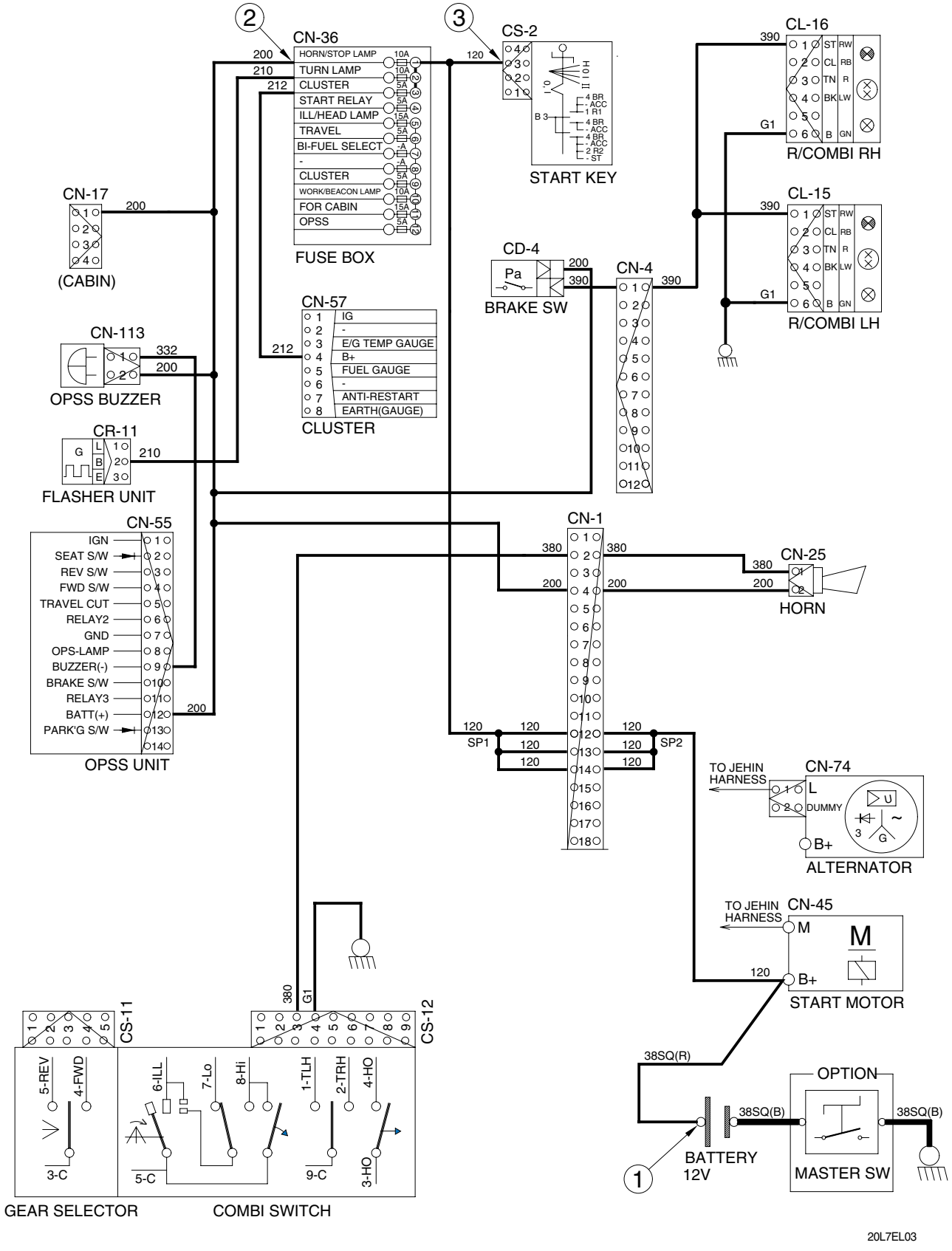
1) OPERATING FLOW

Battery(+) → Start motor[CN-45(B+)] → I/conn[CN-1(12,13,14)]
- → Start switch[CS-2(3)]
- → Fuse box[CN-36]
  - → (No.1)
    - → Cab[CN-7(1)]
    - → OPSS buzzer[CN-113(2)]
    - → OPSS unit[CN-55(12)]
    - → I/conn[CN-1(4)] → Horn[CN-25(2)]
    - → Brake switch[CD-4]
  - → (No.2) → Flasher unit[CR-11(2)]
  - → (No.3) → Cluster[CN-57(4)]

2) CHECK POINT

Engine	Key switch	Check point	Voltage
OFF	OFF	① - GND (Battery(+)) ② - GND (Fuse No.1) ③ - GND (Start key)	10 ~ 13V

POWER CIRCUIT



2. STARTING CIRCUIT

1) OPERATING FLOW

Battery(+) terminal → Start motor[CN-45(B+)] → I/conn[CN-1(12,13,14)] → Start switch[CS-2(3)]

※ 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(4)] → Fuse box[No. 5]
→ I/conn[CN-1(19)] → Fuel system interface[CN-6(1)]

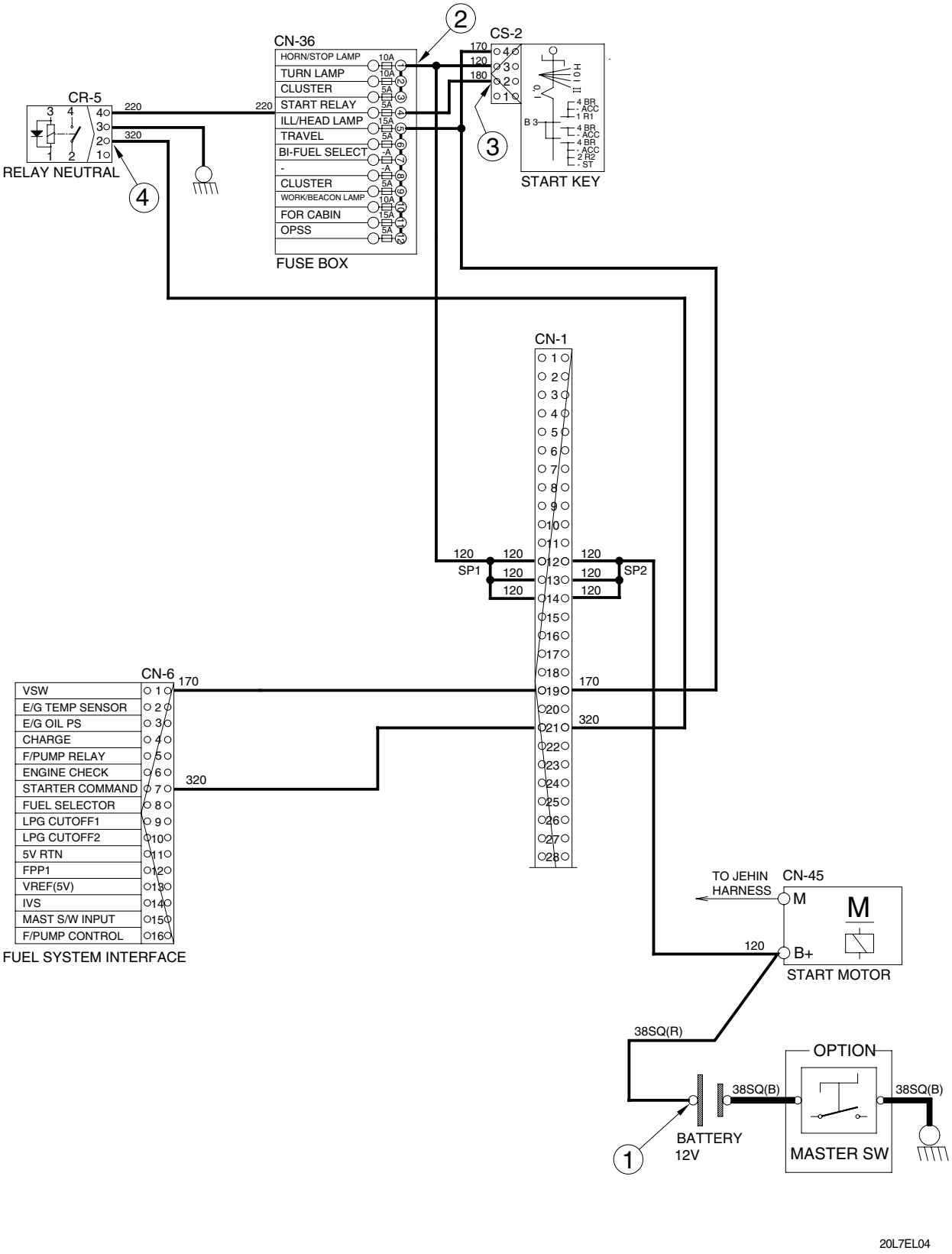
(2) When start key switch is START position

Start switch START[CS-2(2)] → Fuse box[CN-36(4)] → Neutral relay[CR-5(4→2)]
→ I/conn[CN-1(21)] → Fuel system interface[CN-6(7)]

2) CHECK POINT

Engine	Key switch	Check point	Voltage
Running	ON	① - GND (Battery B+) ② - GND (Fuse box No.5) ③ - GND (Start key) ④ - GND (Neutral relay)	10 ~ 14.5V

STARTING CIRCUIT



GROUP 3 COMPONENT SPECIFICATION

No	Part name	Qty	Specification	Remark
1	Battery	1	CCA : 550 20HR : 60AH CMF 60(223×168×220)	
2	Working lamp	1	12V, 55W	
3	License lamp	1	12V, 3.4W×2	
4	Combination lamp	2	12V, 21W(T/S) 12V, 10W(Back) 12V, 5W (Tail) 12V, 21W(Stop)	
5	Head lamp	2	12V, 55W	
6	Flasher lamp	2	85±10 C/M, (23W+23W)×2+3W×2	
7	Flasher & Relay	1	12V, 20A (Relay) 12V, (21W+21W)×2+3W(Flasher) 130W (Harzard)	
8	Back horn	1	12V, 90±5dB, 60±10C/M	
9	Horn	1	12V, MAX 3.5A, 105~120dB	
10	Master switch	1	180A	
11	Combination switch	1	12V, 16A	
12	Hazard switch	1	12V, 16A	
13	Start switch	1	12V/24V, 15~28A	
14	OPSS unit	1	12V/24V, MAX 0.5A(at 12V)	
15	Relay(4P)	2	12V, 20A	
16	Relay(5P)	2	12V, 20A	

GROUP 4 CONNECTOR DESTINATION

Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CN-1	AMP	36	I/conn(Dashboard harness-frame harness)	1743059-2	1743062-2
CN-2	KET	4	I/conn (Dashboard harness-travel ext harness)	MG610331	MG640329
CN-4	KET	12	I/conn (Dashboard harness-head guard harness)	MG640348	MG610346
CN-5	KET	4	Support harness-RH	S810-004201	-
CN-6	AMP	16	Fuel system interface connection	-	368050-1
CN-17	KET	4	Power output for cabin	S810-004201	-
CN-25	MOLEX	2	Horn	35825-0211	-
CN-36	-	-	Fuse box	21HF-10500	-
CN-45	RING TERM	-	Start motor	-	-
CN-48	KET	2	Hour meter	S822-014000	S822-114000
CN-55	KET	14	OPSS unit	S814-014100	-
CN-56	AMP	20	Cluster	368511-2	-
CN-65	KET	2	Back buzzer	MG640322	-
CN-113	KET	2	OPSS buzzer	S814-002100	-
CN-122	DEUTSCH	2	Forward solenoid	DT03-2S	-
CN-123	DEUTSCH	2	Reverse solenoid	DT03-2S	-
CN-124	AMP	6	Accel pedal	174262-2	-
Switch					-
CS-2	KET	4	Start switch	S810-004201	-
CS-11	AMP	5	Gear selector switch	172494-1	-
CS-12	AMP	9	Combination switch	S811-009002	-
CS-17	KET	3	Parking switch	S810-003201	-
CS-21	SWF	10	Rear work switch	593757	-
CS-41	SWF	10	Hazard switch	593757	-
CS-68	SWF	10	Cut off switch	593757	-
CS-73	KET	2	Seat switch	MG610043	-
Lamp					
CL-3	KET	2	Head lamp	S822-014000	S822-114000
CL-7	KET	2	Beacon lamp	S822-014000	S822-114000
CL-15	DAEDONG	6	Combination lamp-LH	110-6PR	-
CL-16	DAEDONG	6	Combination lamp-RH	110-6PR	-
CL-23	KET	2	Rear working lamp	S822-014000	S822-114000
Relay					
CR-5	KET	4	Neutral relay	S810-004201	-
CR-11	KET	3	Flasher unit	S810-003702	-
CR-13	KET	4	Head lamp relay	S810-004201	-
CR-35	AMP	4	Warning relay	S810-004202	-
CR-36	KET	4	Fuel lamp relay	S810-004201	-
CR-51	KET	5	Attach cut relay	MG640927	-

Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
Sensor and pressure switch					
CD-2	KET	2	Fuel level sensor	MG610043	-
CD-4	DEUTSCH	2	Brake switch	-	DT04-2P-E005
CD-10	KET	2	Air cleaner switch	ST730057-2	-
CD-29	AMP	1	T/M temp switch	172320-2	-

GROUP 5 TROUBLESHOOTING

Trouble symptom	Probable cause	Remedy
Lamps dimming even at maximum engine speed.	· Faulty wiring.	· Check for loose terminal and disconnected wire.
Lamps flicker during engine operation.	· Improper belt tension.	· Adjust belt tension.
Charge lamp does not light during normal engine operation.	· Charge lamp defective. · Faulty wiring.	· Replace. · Check and repair.
Alternator makes abnormal sounds.	· Alternator defective.	· Replace
Starting motor fails to run.	· Faulty wiring. · Insufficient battery voltage.	· Check and repair. · Recharge battery.
Starting motor pinion repeats going in and out.	· Insufficient battery voltage.	· Recharge battery.
Excessively low starting motor speed.	· Insufficient battery voltage. · Starting motor defective.	· Recharge battery. · Replace
Starting motor comes to a stop before engine starts up.	· Faulty wiring. · Insufficient battery voltage.	· Check and repair. · Recharge battery.
Heater signal does not become red.	· Faulty wiring. · Glow plug damaged.	· Check and repair. · Replace
Engine oil pressure caution lamp does not light when engine is stopped (with starting switch left in"ON" position).	· Caution lamp defective. · Caution lamp switch defective.	· Replace · Replace

GROUP 5 TROUBLESHOOTING

Trouble symptom	Probable cause	Remedy
Lamps dimming even at maximum engine speed.	· Faulty wiring.	· Check for loose terminal and disconnected wire.
Lamps flicker during engine operation.	· Improper belt tension.	· Adjust belt tension.
Charge lamp does not light during normal engine operation.	· Charge lamp defective. · Faulty wiring.	· Replace. · Check and repair.
Alternator makes abnormal sounds.	· Alternator defective.	· Replace
Starting motor fails to run.	· Faulty wiring. · Insufficient battery voltage.	· Check and repair. · Recharge battery.
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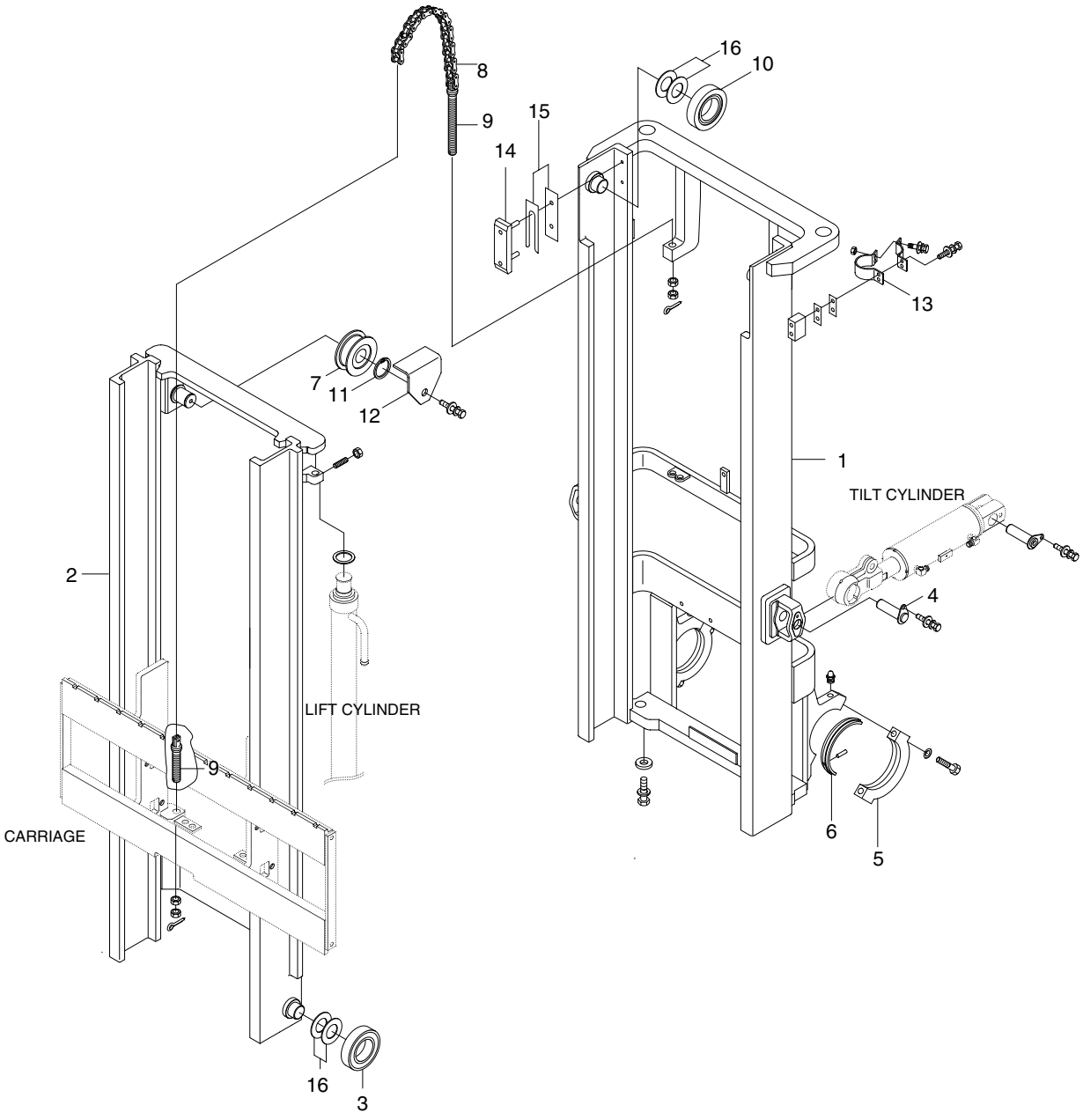
Engine oil pressure caution lamp does not light when engine is stopped (with starting switch left in"ON" position).	· Caution lamp defective. · Caution lamp switch defective.	· Replace · Replace

SECTION 8 MAST

GROUP 1 STRUCTURE

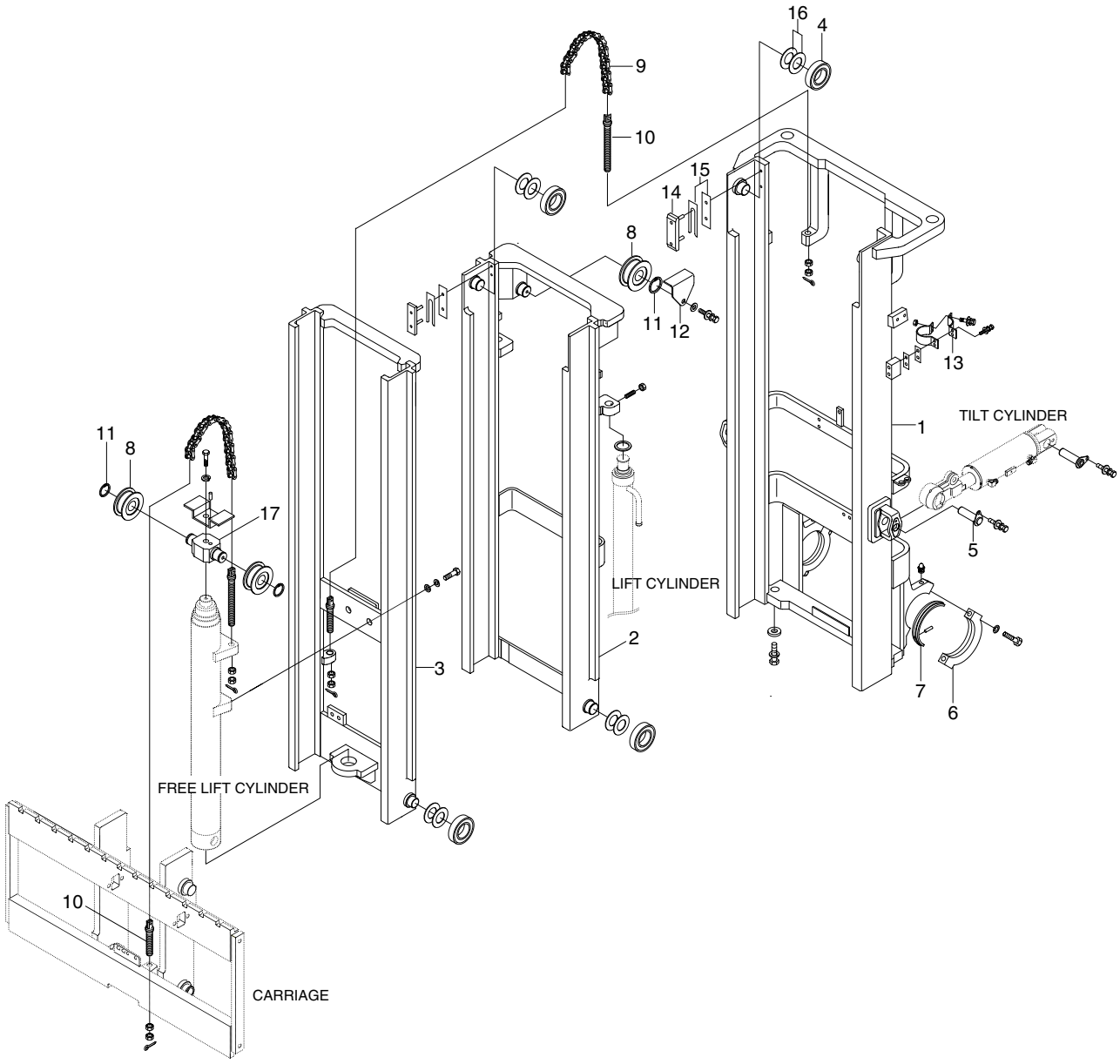
1. 2 STAGE MAST(V MAST)



15L7MS01

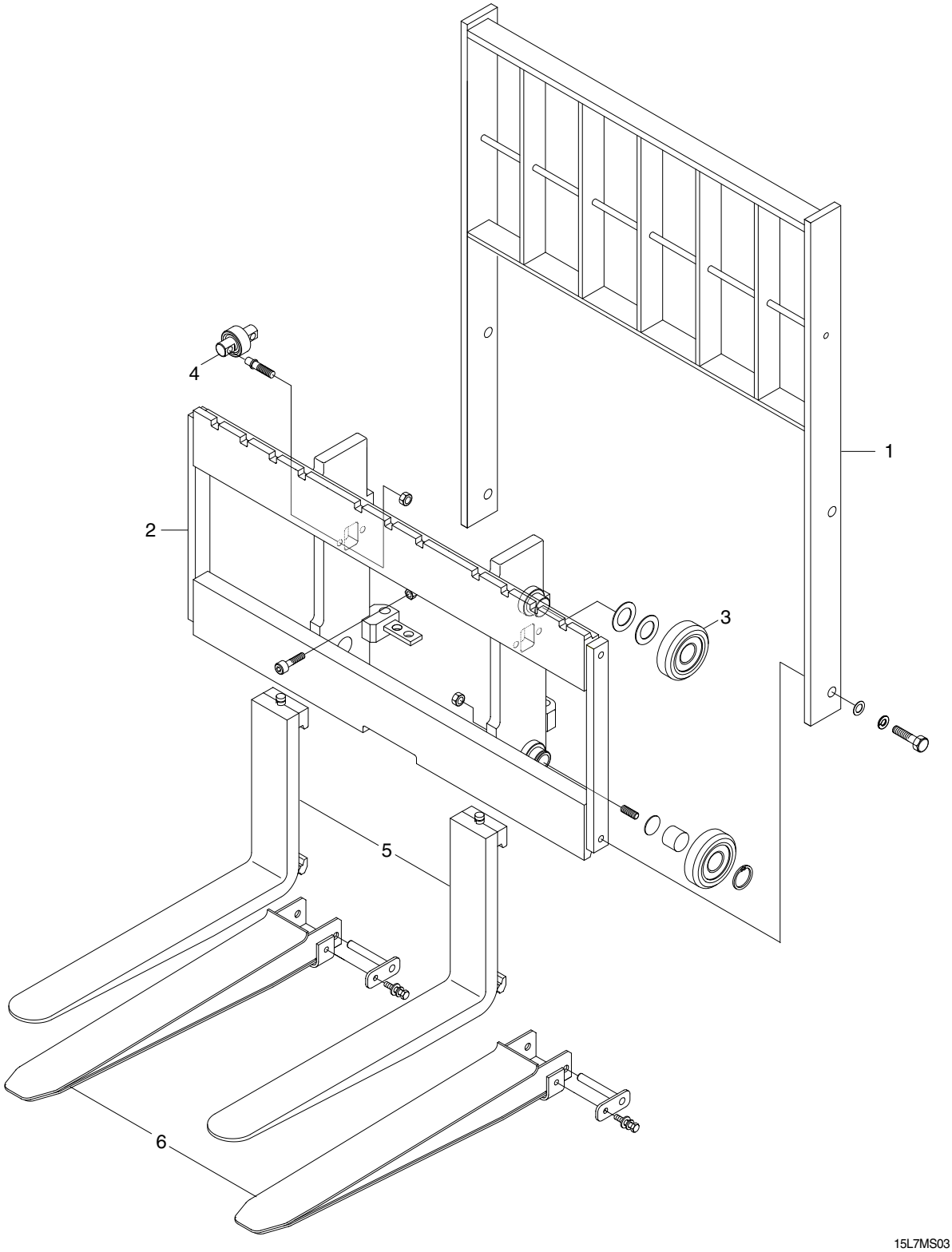
1	Outer mast	7	Chain sheave	13	Clamp
2	Inner mast	8	Chain	14	Back up liner
3	Roller	9	Anchor bolt	15	Shim(0.5, 1.0t)
4	Tilt cylinder pin	10	Roller	16	Shim(0.5, 1.0t)
5	Mast support cap	11	Retaining ring		
6	Bushing	12	Chain guard		

2. 3 STAGE MAST(TF MAST)



1	Outer mast	7	Bushing	13	Clamp
2	Middle mast	8	Chain sheave	14	Back up liner
3	Inner mast	9	Chain	15	Shim(0.5, 0.1Ton)
4	Roller	10	Anchor bolt	16	Shim(0.5, 0.1Ton)
5	Tilt cylinder pin	11	Retaining ring	17	Sheave bracket
6	Mast support cap	12	Chain guard		

3. CARRIAGE, BACKREST AND FORK



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

GROUP 2 OPERATIONAL CHECKS AND TROUBLESHOOTING

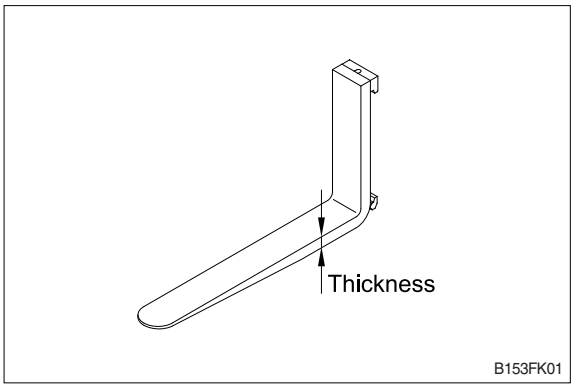
1. OPERATIONAL CHECKS

1) FORKS

(1) Measure thickness of root of forks and check that it is more than specified value.
EX : l =900mm(35.4in)

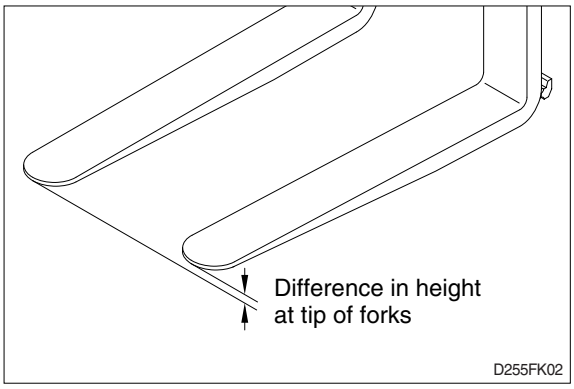
mm(in)

STD Fork assy	Applicable model	Standard	Limit
64FP-12030	15L/18L-7, 15G/18G-7	35(1.4)	32(1.3)
64FD-11010	20LA-7, 20GA-7	40(1.6)	36(1.4)



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

Model	Fork length (mm)	Height difference(mm)
15L/18L-7 15G/18G-7	below 1200	3
	above 1200	6
20LA-7, 20GA-7	below 1200	3
	above 1200	6



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

2. MAST

1) Check for cracks at mast stay, tilt cylinder bracket, guide bar, fork carriage and roller shaft weld. Check visually or use crack detection method. Repair any abnormality.
2) Set mast vertical, raise forks about 10cm from ground and check front-to-rear clearance and left-to-right clearance between inner mast and fork carriage, and between outer mast and inner mast. Use these figures to judge if there is any play at roller or rail.
   - Front-to-rear clearance : Within 2.0mm(0.08in)
   - Left-to-right clearance : Within 2.5mm (0.10in)
3) Check that there is an oil groove in bushing at mast support.
4) Set mast vertical, raise forks about 10cm from ground, and push center of lift chain with finger to check for difference in tension.
   If there is any difference in tension, adjust chain stopper bolt.
5) Check visually for abnormalities at thread of chain anchor bolt, and at contact surface between chain wheel and chain.
   Rotate chain wheel by hand and check for any play of bearing.

2. TROUBLESHOOTING

1) MAST

Problem	Cause	Remedy
Forks fail to lower.	· Deformed mast or carriage.	· Disassemble, repair or replace.
Fork fails to elevate	· Faulty hydraulic equipment.	· See troubleshooting hydraulic pump and cylinders in section 6, hydraulic system.
	· Deformed mast assembly.	· Disassemble mast and replace damaged parts or replace complete mast assembly.
Slow lifting speed and insufficient handling capacity.	· Faulty hydraulic equipment.	· See troubleshooting hydraulic pump and cylinders in section 6, hydraulic system.
	· Deformed mast assembly.	· Disassemble mast and replace damaged parts or replace complete mast assembly.
Mast fails to lift smoothly.	· Deformed masts or carriage.	· Disassembly, repair or replace.
	· Faulty hydraulic equipment.	· See Troubleshooting Hydraulic Cylinders, pump and control valve in section 6, hydraulic system.
	· Damaged load and side rollers.	· Replace.
	· Unequal chain tension between LH & RH sides.	· Adjust chains.
	· LH & RH mast inclination angles are unequal. (Mast assembly is twisted when tilted)	· Adjust tilt cylinder rods.
Abnormal noise is produced when mast is lifted and lowered.	· Broken load roller bearings.	· Replace.
	· Broken side roller bearings.	· Replace.
	· Deformed masts.	· Disassemble, repair or replace.
	· Bent lift cylinder rod.	· Replace.
	· Deformed carriage.	· Replace.
	· Broken sheave bearing.	· Replace.
Abnormal noise is produced during tilting operation.	· Insufficient lubrication of anchor pin, or worn bushing and pin.	· Lubricate or replace.
	· Bent tilt cylinder rod.	· Replace.

2) FORKS

<table>
<tr><th>Problem</th><th>Cause</th><th>Remedy</th></tr>
<tr><td>Abrasion</td><td>Long-time operations causes the fork to wear and reduces the thickness of the fork.
Inspection for thickness is needed.
· Wear limit : Must be 90% of fork thickness</td><td>If the measured value is below the wear limit, replace fork.</td></tr>
<tr><td>Distortion</td><td>Forks are bent out of shape by a number of reasons such as overloading, glancing blows against walls and objects, and picking up load unevenly.
· Difference in fork tip height
<table>
<tr><th>Fork length (mm)</th><th>Height difference(mm)</th></tr>
<tr><td>below 1200</td><td>3</td></tr>
<tr><td>above 1200</td><td>6</td></tr>
</table></td><td>If the measured value exceeds the allowance, replace fork.</td></tr>
<tr><td>Fatigue</td><td>Fatigue failure may result from the fatigue crack even though the stress to fork is below the static strength of the fork. Therefore, a daily inspection should be done.
· Crack on the fork heel.
· Crack on the fork weldments.</td><td>Repair fork by expert.
In case of excessive distortion, replace fork.</td></tr>
</table>

GROUP 3 ADJUSTMENT

1. MAST LOAD ROLLER(V MAST)

1) INNER/OUTER MAST ROLLER CLEARANCE ADJUSTMENT

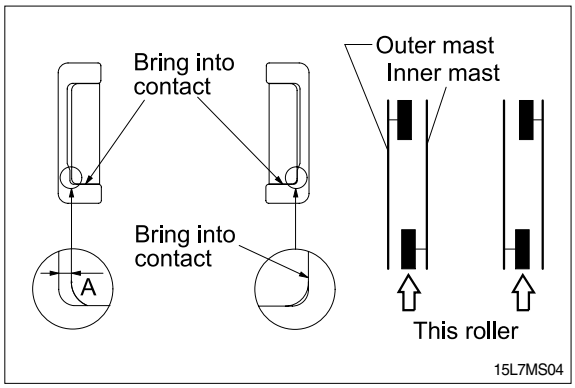
(1) Measure the clearance with the mast overlap at near 480mm.

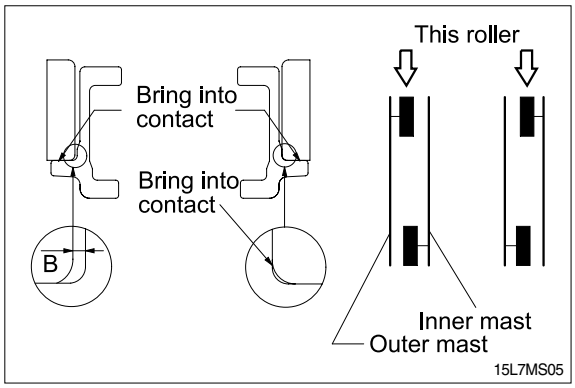
(2) Shift the inner mast to one side to bring the roller into contact with the outer mast, and adjust the clearance between the roller side face and mast at the closest position on the opposite side to the following value by inserting the inner/outer mast roller shim.

- Standard clearance A, B = 0.3 ~ 0.6mm
- Shim thickness 0.5, 1.0mm

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

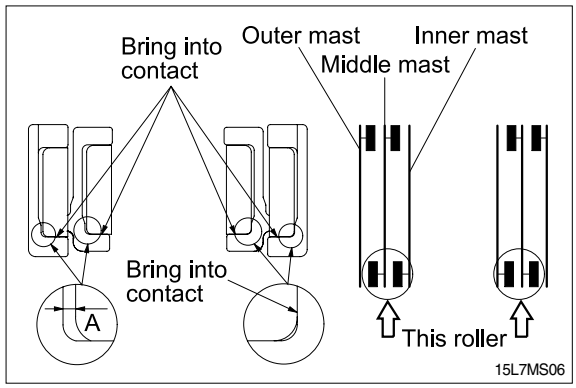
(4) After the adjustment, check that the inner mast moves smoothly in the outer mast.





2. MAST LOAD ROLLER(TF MAST)

1) INNER AND MIDDLE MAST ROLLER CLEARANCE ADJUSTMENT



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

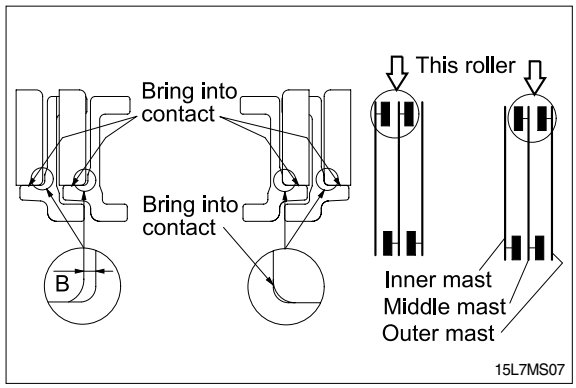
(2) Shift the inner mast to one side to bring the roller into contact with the outer mast and the middle mast, and adjust the clearance between the roller side face and mast at the closest position on the opposite side to the following value by inserting the inner and middle mast roller shim, respectively.

- Standard clearance A = 0.3~0.6mm
- Shim thickness 0.5, 1.0mm

(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 480mm.

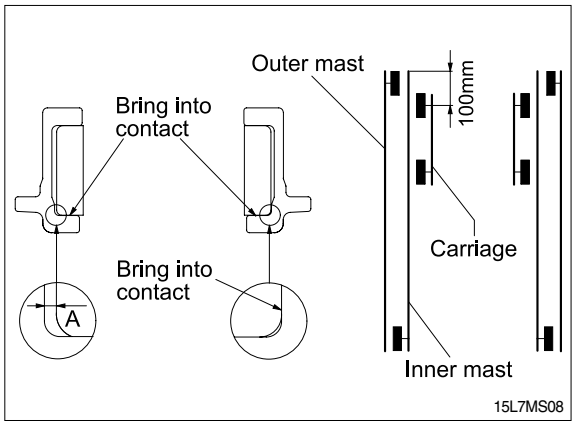
(2) Shift the inner mast to one side to bring the roller into contact with the middle mast and the inner mast, and adjust the clearance between the roller side face and mast at the closest position on the opposite side to the following value by inserting the outer and middle mast roller shim, respectively.

- Standard clearance B = 0.3~0.6mm
- Shim thickness 0.5, 1.0mm

(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㎜ from the top of the inner mast.

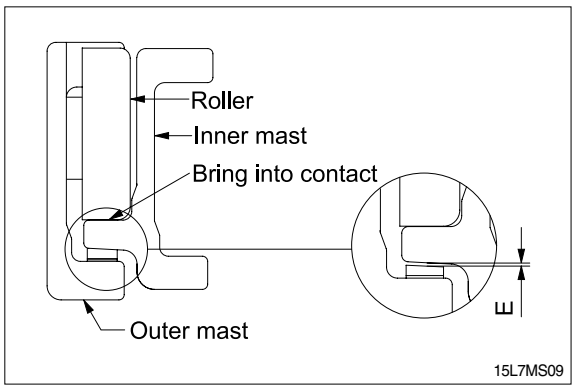
(2) Measure the clearance at upper, lower rollers after loosen the adjust screws from the side rollers. Shift the carriage to one side to bring the roller into contact with the inner mast, and measure the clearance between the roller side face and mast at the closest position on the opposite side to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

- Standard clearance C = 0.3~0.6㎜
- Shim thickness 0.5, 1.0㎜

(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 inner mast at the bottom position.

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

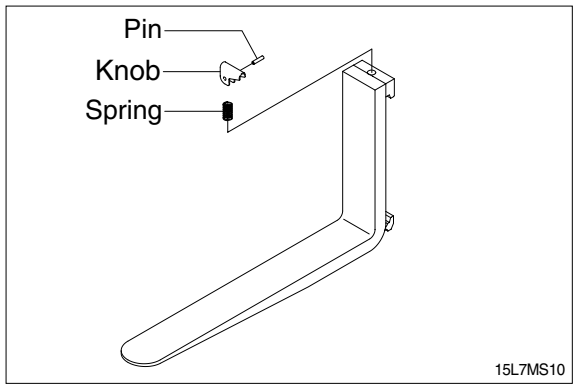
- Standard clearance E = 0.2 ~ 0.6㎜
- Shim thickness 0.5, 1.0㎜

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

GROUP 4 REMOVAL AND INSTALLATION

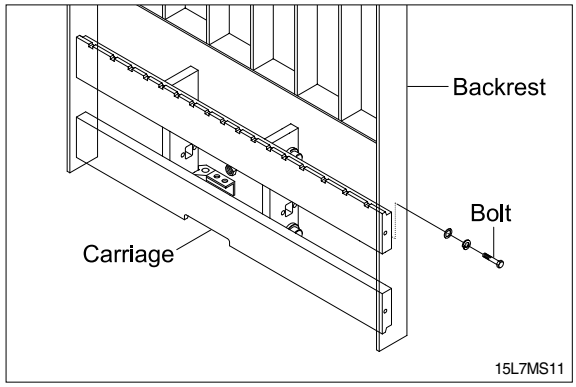
1. FORKS

1) Lower the fork carriage until the forks are approximately 25㎜(1inch) 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. Lift backrest straight up and remove from carriage.
2) Position backrest on carriage and lower in place. Install and tighten bolts.



3. CARRIAGE ASSEMBLY

1) CARRIAGE

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

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

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

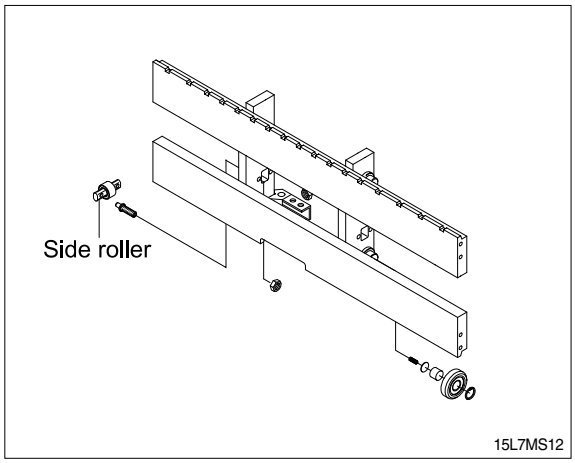
⚠ Replace the split pin of chain anchor with new one.

2) SIDE ROLLER

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

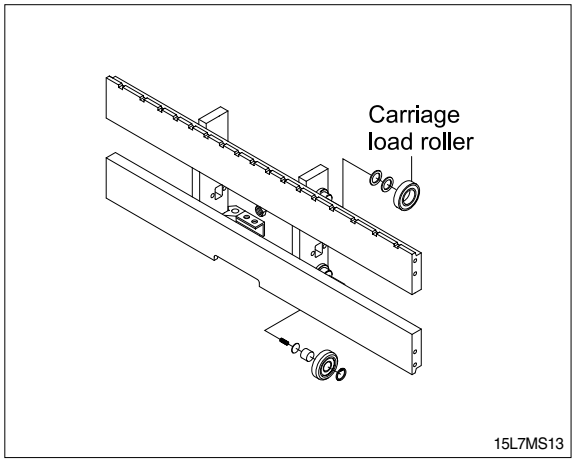
※ **Adjustment**

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



3) CARRIAGE LOAD ROLLER

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



4) MAST LOAD ROLLER AND BACK UP LINER

(1) 2 stage mast(V mast)

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

② Loosen and remove hexagon bolts and 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.

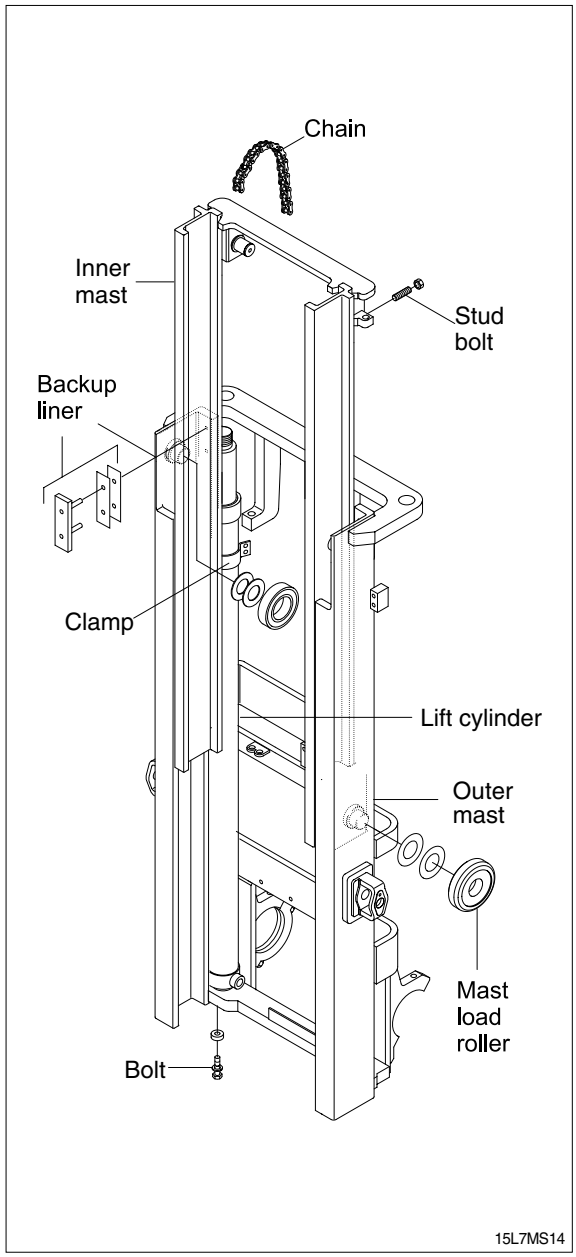
⑤ After lowering the lift cylinder rods, and disconnecting lift cylinder hose, tilt the lift cylinders LH and RH and them with ropes to the outer mast.

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) 3 stage mast(TF mast)

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

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

③ Loosen and remove hexagon bolt and special washers securing lift cylinders to middle mast. Remove the spring pin.

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.

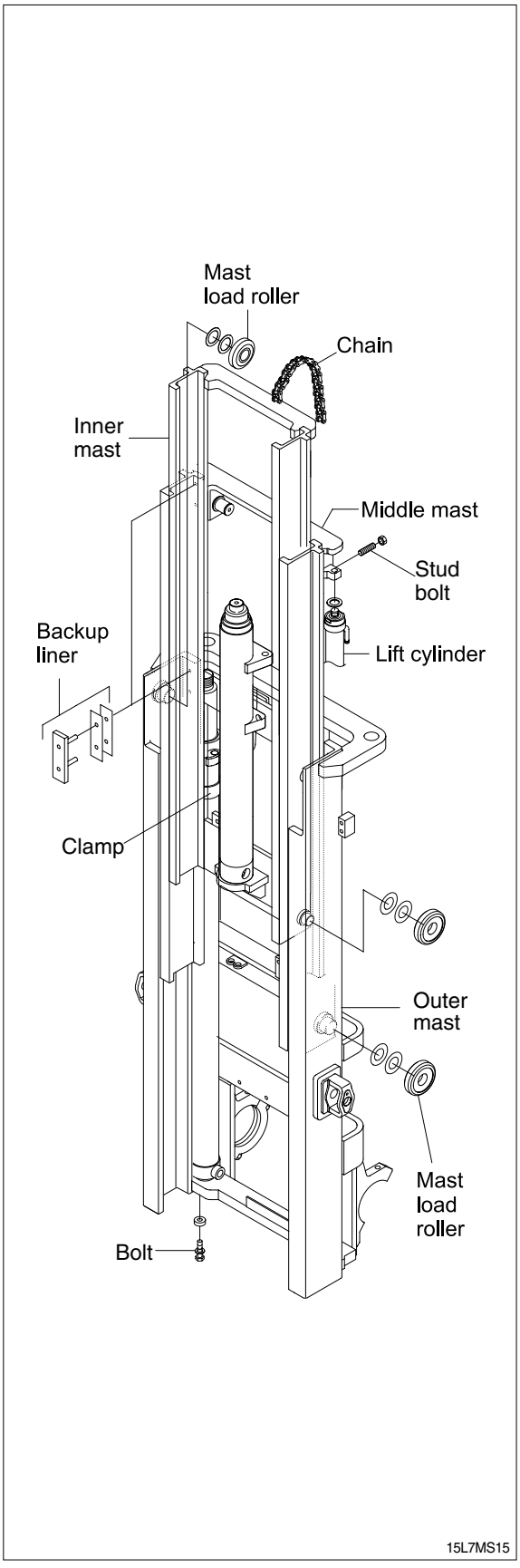
⑧ Using a player, remove load rollers from load bracket. Remove back up liners and shims.

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 pryer, 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 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 mast)

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

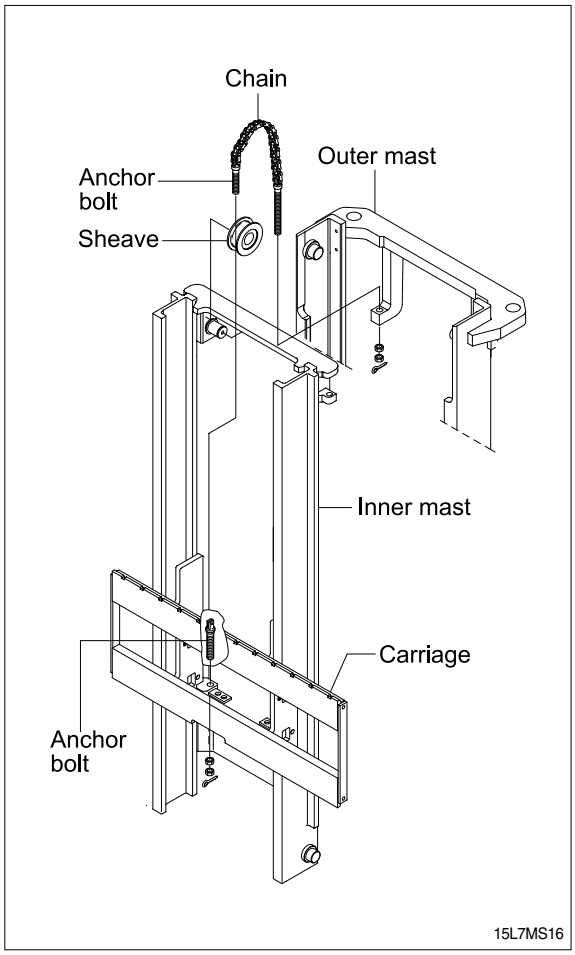
② Remove the split pin securing the chain anchor pins and discard.
While supporting the chains, remove the chain anchor pins and drape the chains over the carriage.

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

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

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

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



(2) Rear chain sheave(TF mast)

① Raise and securely block carriage and inner mast section.

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

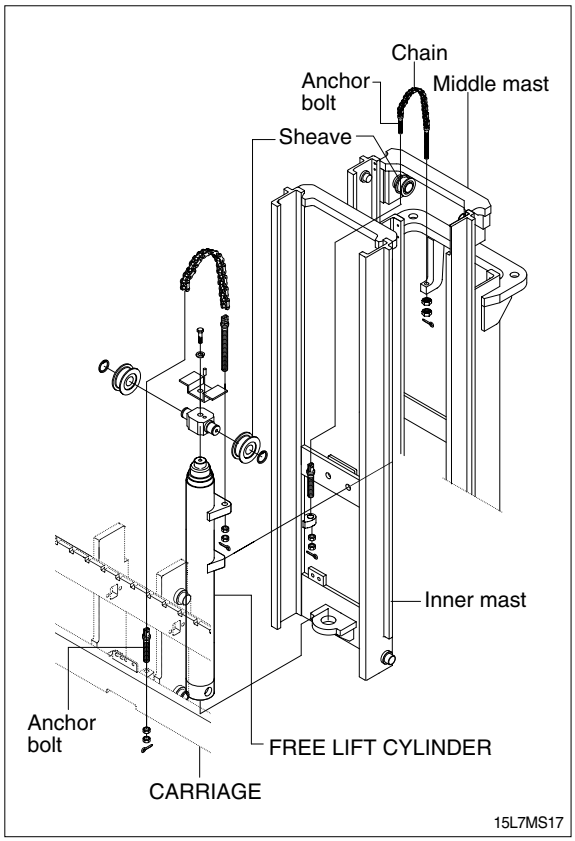
③ Remove chains.

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

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

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

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



(3) Chain wheel bearing support(TF mast)

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

(4) Rear chain(TF mast)

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

(5) Carriage chain

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

(6) Load chain inspection and maintenance

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

① Wear

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

Chain wear can be measured using a wear scale or steel tape. When chains have elongated 2%, they should be discarded. When checking chain wear, be sure to measure a segment of chain that operates over a sheave. Do not repair chains by cutting 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 phenomenon that affects most metals and many plastics. After many repeated heavy loads, the plates may crack and the chains will eventually break. Fatigue cracks are almost always found through the pitch holes perpendicular to the pitch line. Contrast this failure mode to the random failures caused by stress-corrosion cracking. If cracks are present, replace all the chain on the truck. Noise in the chain indicates that the plate is on the verge of cracking and will be failed before long.

④ Tight joints

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

Tight joints in lift chains can be caused by :

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

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

⑤ Protruding or turned pins

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

⑥ Chain side wear

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

⑦ Chain anchors and chain wheel bearings

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

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

⑧ Chain wear scale

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

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

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

(7) Load chain lubrication and adjustment

① Lubrication

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

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

⚠ Wear eye protection.

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

② Replacement

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

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

③ **Adjustment**

Chain adjustments are important for the following reasons :

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

④ **Adjustment procedure**

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