CONTENTS

SECTION 8 MAST

1. STRUCTURE

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

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

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

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

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

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

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

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

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

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

2. HOW TO READ THE SERVICE MANUAL

Distribution and updating

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

Filing method

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

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

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

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

Revised edition mark(①②③…)

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

Revisions

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

Symbols

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

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

3. CONVERSION TABLE

Method of using the Conversion Table

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

Example

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

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

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

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

2. Convert 550mm into inches.

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

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

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

Millimeters to inches

1mm = 0.03937 in

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

Millimeters to inches

1mm = 0.03937in

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

Kilogram to Pound

1kg = 2.2046lb

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

Liter to U.S. Gallon

1 l = 0.2642 U.S.Gal

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

Liter to U.K. Gallon

1 l = 0.21997 U.K.Gal

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

kgf · m to lbf · ft

1kgf · m = 7.233lbf · ft

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

kgf/cm^2 to lbf/in^2

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

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

TEMPERATURE

Fahrenheit-Centigrade Conversion.

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

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

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

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

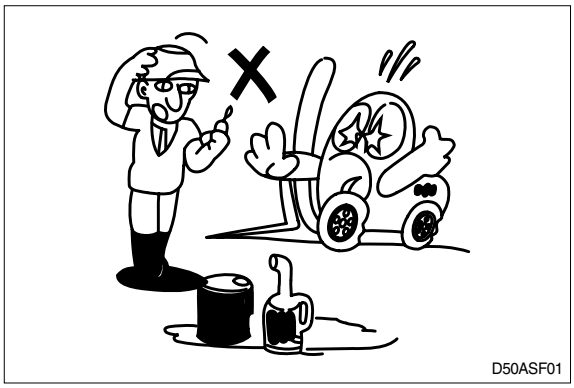
°C		°F	°C		°F	°C		°F	°C		°F
-40.4	-40	-40.0	-11.7	11	51.8	7.8	46	114.8	27.2	81	117.8
-37.2	-35	-31.0	-11.1	12	53.6	8.3	47	116.6	27.8	82	179.6
-34.4	-30	-22.0	-10.6	13	55.4	8.9	48	118.4	28.3	83	181.4
-31.7	-25	-13.0	-10.0	14	57.2	9.4	49	120.2	28.9	84	183.2
-28.9	-20	-4.0	-9.4	15	59.0	10.0	50	122.0	29.4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

SECTION 1 GENERAL

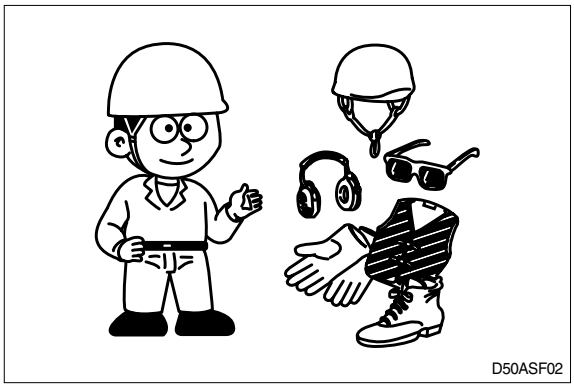
GROUP 1 SAFETY HINTS

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

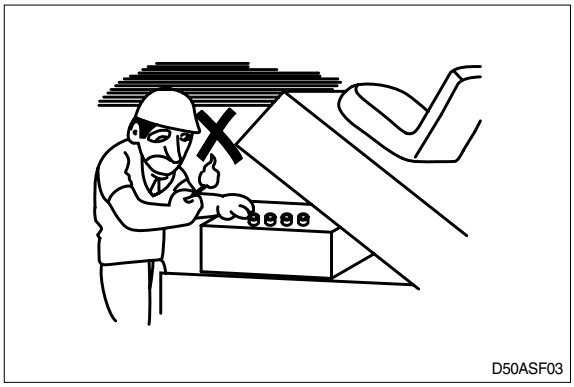
- Oil is a dangerous substance. Never handle oil, grease or oily clothes in places where there is any fire of flame.
  As preparation in case of fire, always know the location and directions for use of fire extinguishers and other fire fighting equipment.


D50ASF01

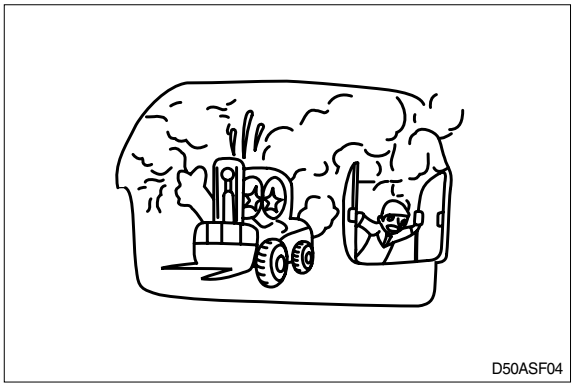
- Wear well-fitting helmet, safety shoes and working clothes. When drilling, grinding or hammering, always wear protective goggles.
  Always do up safety clothes properly so that they do not catch on protruding parts of machines. Do not wear oily clothes.
  When checking, always release battery plug.


D50ASF02

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

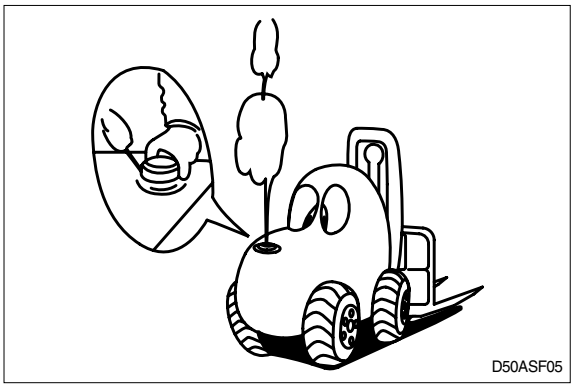

D50ASF03

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

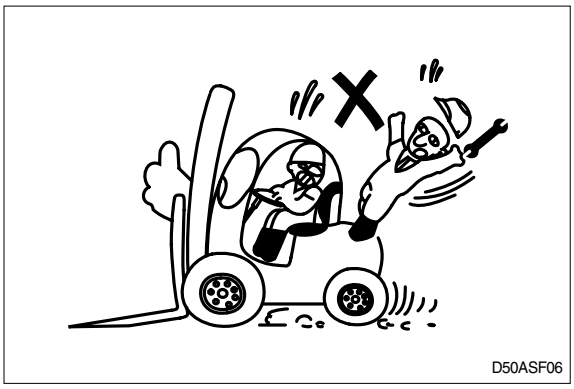

D50ASF04

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

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

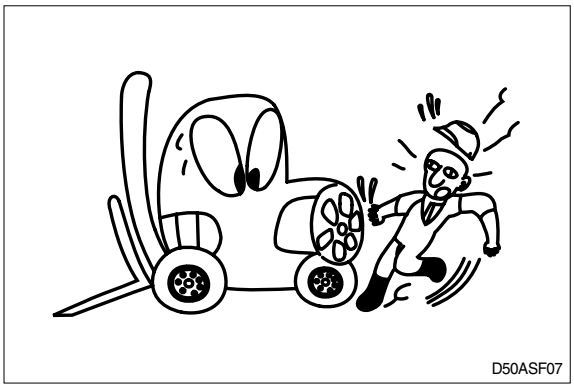

D50ASF05

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


D50ASF06

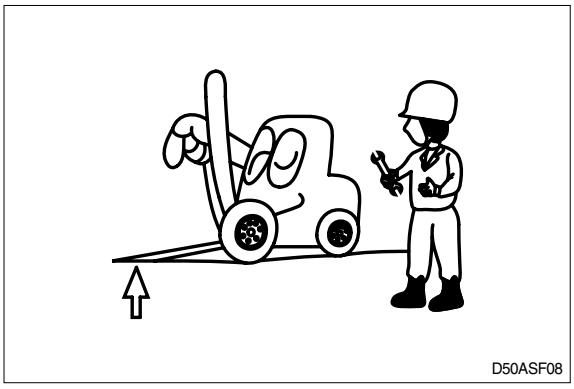
· Hand a caution sign in the operator's compartment (For example **Do not start** or **Maintenance in progress**).
This will prevent anyone from starting or moving the machine by mistake.

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

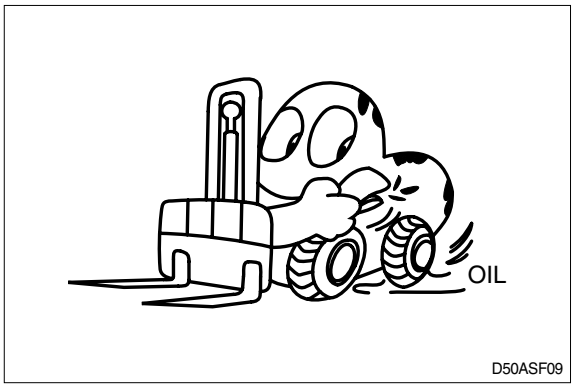

D50ASF07

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

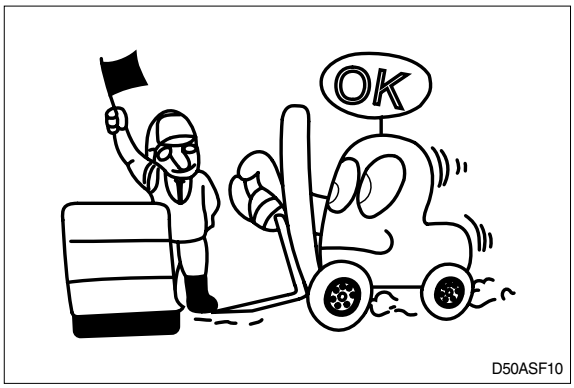
· Park the machine on firm, flat ground.
Lower the fork to the ground and stop the engine.
Return each lever to **NEUTRAL** and apply the brake lock.


D50ASF08

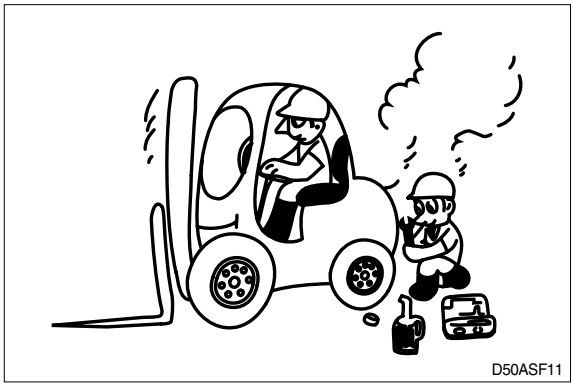
- Immediately remove any oil or grease on the floor of the operator's compartment, or on the handrail. It is very dangerous if someone slips while on the machine.



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



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



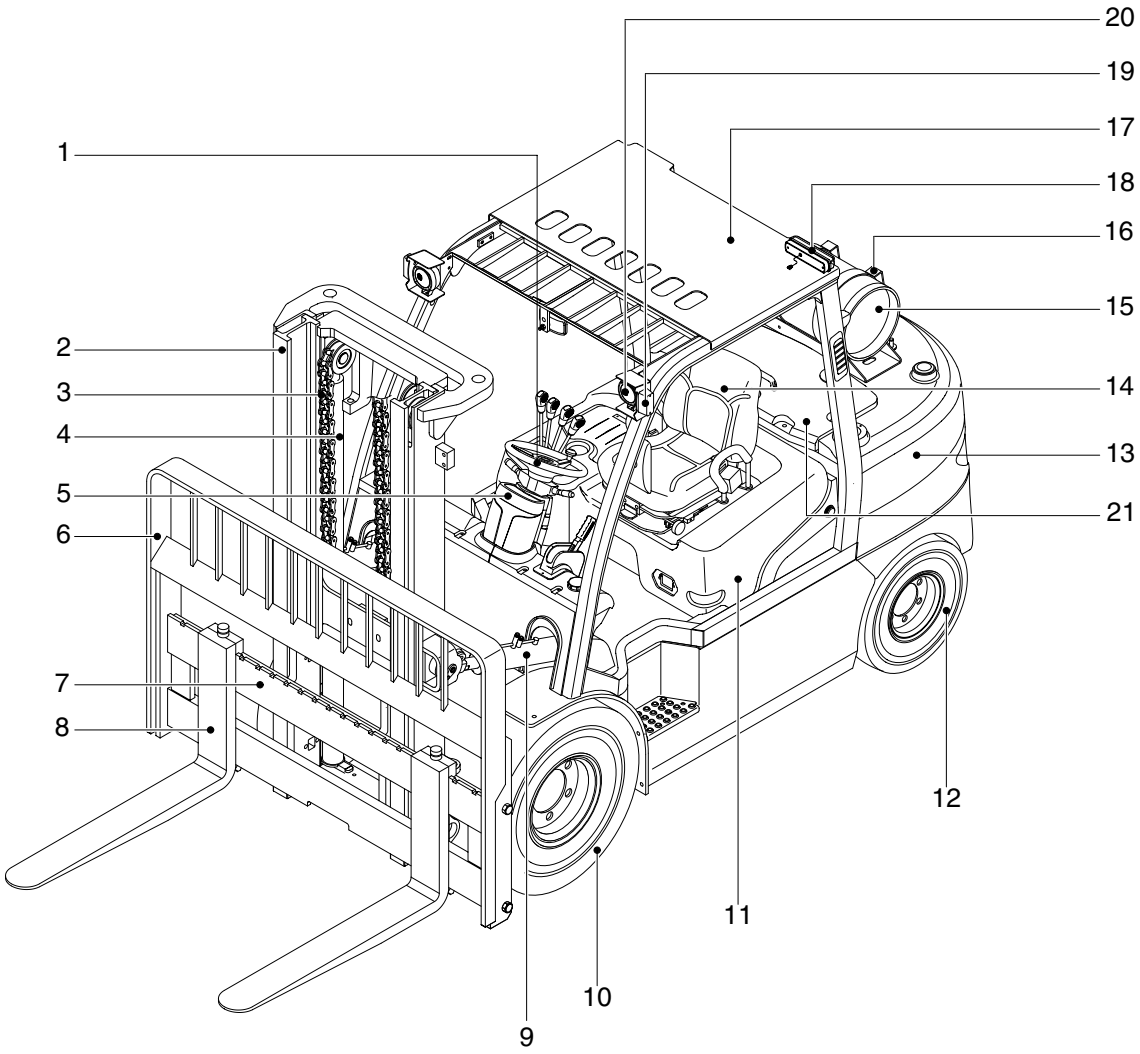
- Unless you have special instructions to the contrary, maintenance should always be carried out with the engine stopped. If maintenance is carried out with the engine running, there must be two men present : one sitting in the operator's seat and the other one performing the maintenance. In such a case,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

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

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

GROUP 2 SPECIFICATIONS

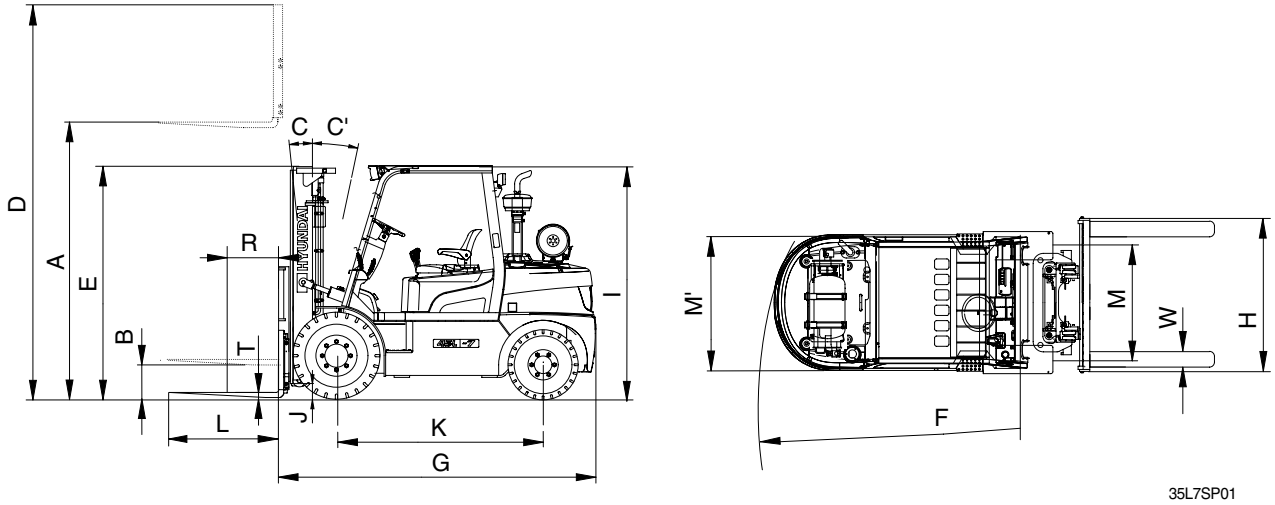
1. MAJOR COMPONENTS



35L7OM57

1	Steering wheel	8	Forks	15	LPG tank
2	Mast	9	Tilt cylinder	16	Clamp
3	Lift chain	10	Front wheel	17	Overhead guard
4	Lift cylinder	11	Bonnet	18	Rear combination lamp
5	Cluster	12	Rear wheel	19	Turn signal lamp
6	Backrest	13	Counterweight	20	Head lamp
7	Carriage	14	Seat	21	Sub bonnet

2. SPECIFICATIONS



Model			Unit	35L-7	40L-7	45L-7
Capacity			kg	3500	4000	4500
Load center		R	mm	600	←	←
Weight(Unloaded)			kg	5671	6241	6663
Fork	Lifting height	A	mm	3000	←	←
	Free lift	B	mm	120	←	←
	Lifting speed(Unload/Load)		mm/sec	530/510	←	←
	Lowering speed(Unload/Load)		mm/sec	450/500	←	←
	L × W × T	L,W,T	mm	1070 × 122 × 50	1070 × 150 × 50	1220 × 150 × 50
Mast	Tilt angle (forward/backward)	C/C'	degree	8/10	←	←
	Max height	D	mm	4236	←	4246
	Min height	E	mm	2235	2220	←
Body	Travel speed		km/h	24.6	23.2	←
	Gradeability		degree	22.3	21.6	19.8
	Min turning radius(Outside)	F	mm	2770	2830	2890
ETC	Max hydraulic pressure		kgf/cm²	210	←	←
	Hydraulic oil tank		ℓ	66	←	←
	Fuel tank		ℓ	100	←	←
Overall length		G	mm	3070	3125	3185
Overall width		H	mm	1400	1776	←
Overhead guard height		I	mm	2240	←	←
Ground clearance		J	mm	170	155	←
Wheel base		K	mm	2000	←	←
Wheel tread front/rear		M, M'	mm	1162/1140	1312/1140	←

3. SPECIFICATION FOR MAJOR COMPONENTS

1) ENGINE

Item	Unit	Specification
Model	-	GM, 4.3L
Type	-	4-cycle, in-line, Vertical OHV
Cooling Method	-	Water cooling
Number of cylinders and arrangement	-	6 cylinders, V6
Valve configuration	-	Push rod actuated overhead valve
Cylinder bore X stroke	mm(in)	101.6×88.39(4×3.48)
Piston displacement	cc(cu in)	4294(262)
Compression ratio	-	9.4
Rated gross horse power	ps/rpm	92/2300
Maximum gross torque at rpm	kgf · m/rpm	32/1400
Engine oil quantity	ℓ (U.S.gal)	6(1.6)
Dry weight	kg(lb)	220(485)
High idling speed	rpm	2400
Low idling speed	rpm	750
Rated fuel consumption	g/ps.hr	-
Starting motor	V-kW	12-1.7
Alternator	V-A	12-70A
Battery	V-AH	12-80
Fan belt deflection	mm(in)	10~15(0.4~0.6)

(2) MAIN PUMP

Item	Unit	Specification
Type	-	Fixed displacement gear pump
Capacity	cc/rev	46+7
Maximum operating pressure	bar	250
Rated speed (Max/Min)	rpm	3000/600

(3) MAIN CONTROL VALVE

Item	Unit	Specification
Type	-	Sectional
Operating method	-	Mechanical
Main relief valve pressure	bar	210/150
Flow capacity	lpm	130

(4) POWER TRAIN DEVICES

Item			Specification	
Torque converter	Model		DE 280 (KAPEC)	
	Type		3 Element, 1 stage, 2 phase	
	Stall ratio		2.25 : 1	
Transmission	Type		Power shift	
	Gear shift(FR/RR)		2/2	
	Control		Electrical single lever type	
	Overhaul ratio	FR	1 : 2.550	2 : 1.29
		RR	1 : 2.550	2 : 1.29
Axle	Type		Front-wheel drive type, fixed location	
	Gear ratio		11.692	
Wheels	Q'ty(FR/RR)		Single : 2/2	Double : 4/2
	Front(drive)	Single	3.5 ton : 8.25-15-14 PR	4.0/4.5 ton : 300-15-18 PR
		Double	7.5-16-12 PR	
	Rear(steer)		7.0-12-12 PR	
Brakes	Travel		Front wheel, wet disc brake	
	Parking		Toggle, internal expanding mechanical type	
Steering	Type		Full hydraulic, power steering	
	Steering angle		74.8° to both right and left angle, respectively	

4. TIGHTENING TORQUE FOR MAJOR COMPONENTS

NO	Item		Size	kgf · m	lbf · ft
1	Engine	Engine mounting bolt, nut	M16×2.0	7.5	54
2		Radiator mounting bolt, nut	M10×1.5	6.9±1.4	50±10
3		Torque converter mounting bolt	M10×1.5	6.9±1.4	50±10
4	Hydraulic system	MCV mounting bolt, nut	M14×2.0	19.6±2.9	142±21
5		Steering unit mounting bolt	M10×1.5	6.9±1.4	50±10
6	Power train system	Drive axle mounting bolt, nut	M22×2.5	77.4±11.6	560±84
7		Steering axle mounting bolt, nut	M14×2.0	19.6±2.9	142±21
8		Front wheel mounting nut	M22×1.5	61.2±9.2	448±67
9		Rear wheel mounting nut	M20×1.5	60.0±5.0	434±36
10	Others	Counterweight mounting bolt	M30×3.5	120±15	1555±239
11		Operator's seat mounting nut	M 8×1.25	2.5±0.5	18.1±3.6
12		Head guard mounting bolt	M12×1.75	12.8±3.0	93±22

5. TORQUE CHART

Use following table for unspecified torque.

1) BOLT AND NUT

(1) Coarse thread

Bolt size	8T		10T	
	kgf · m	lbf · ft	kgf · m	lbf · ft
M 6 × 1.0	0.85 ~ 1.25	6.15 ~ 9.04	1.14 ~ 1.74	8.2 ~ 12.6
M 8 × 1.25	2.0 ~ 3.0	14.5 ~ 21.7	2.73 ~ 4.12	19.7 ~ 29.8
M10 × 1.5	4.0 ~ 6.0	28.9 ~ 43.4	5.5 ~ 8.3	39.8 ~ 60
M12 × 1.75	7.4 ~ 11.2	53.5 ~ 79.5	9.8 ~ 15.8	71 ~ 114
M14 × 2.0	12.2 ~ 16.6	88.2 ~ 120	16.7 ~ 22.5	121 ~ 167
M16 × 2.0	18.6 ~ 25.2	135 ~ 182	25.2 ~ 34.2	182 ~ 247
M18 × 2.5	25.8 ~ 35.0	187 ~ 253	35.1 ~ 47.5	254 ~ 343
M20 × 2.5	36.2 ~ 49.0	262 ~ 354	49.2 ~ 66.6	356 ~ 482
M22 × 2.5	48.3 ~ 63.3	350 ~ 457	65.8 ~ 98.0	476 ~ 709
M24 × 3.0	62.5 ~ 84.5	452 ~ 611	85.0 ~ 115	615 ~ 832
M30 × 3.5	124 ~ 168	898 ~ 1214	169 ~ 229	1223 ~ 1655
M36 × 4.0	174 ~ 236	1261 ~ 1703	250 ~ 310	1808 ~ 2242

(2) Fine thread

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

2) PIPE AND HOSE(FLARE TYPE)

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

3) PIPE AND HOSE(ORFS TYPE)

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

4) FITTING

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

6. RECOMMENDED LUBRICANTS

Use only oils listed below or equivalent.

Do not mix different brand oil.

Service point	Kind of fluid	Capacity ℓ (U.S.gal)	Ambient temperature °C (°F) -20 (-4) / -10 (14) / 0 (32) / 10 (50) / 20 (68) / 30 (86) / 40 (104)
Engine oil pan	Engine oil	4.3 (1.1)	SAE 10W-30(API SL class or better)
Torque converter transmission	ATF Engine oil	12 ℓ (3.2)	ATF DEXRON III
Axle	Gear oil	10.5 ℓ (2.8)	Mobil Fluid 424
Hydraulic tank	Hydraulic oil	66 (17.4)	ISO VG32 ISO VG46 ISO VG68
Fuel tank	LPG	20	LPG
Fitting (Grease nipple)	Grease	-	NLGI No.1 NLGI No.2
Brake reservoir tank	Brake oil	0.25 (0.06)	Azolla ZS10(Hydraulic oil ISO VG10)
Radiator	Antifreeze:Water 50:50	21.5 (5.7)	Ethylene glycol base permanent type

NOTES :

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

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

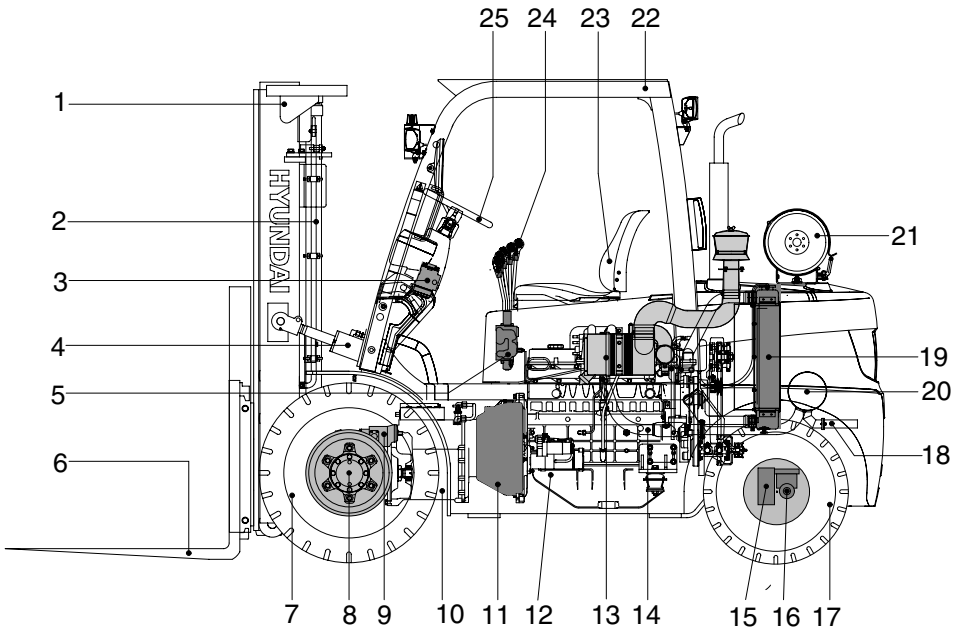
GROUP 3 PERIODIC REPLACEMENT

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

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

SECTION 2 REMOVAL & INSTALLATION OF UNIT

GROUP 1 STRUCTURE



35L7OM23

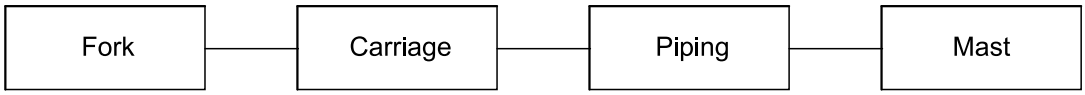
1	Mast	10	Transmission	19	Radiator
2	Lift cylinder	11	Torque converter	20	Muffler
3	Steering unit	12	Engine	21	LPG tank
4	Tilt cylinder	13	Air cleaner	22	Overhead guard
5	Control valve	14	Exhaust pipe	23	Seat
6	Fork	15	Steering axle	24	Control lever
7	Front wheel	16	Steering cylinder	25	Steering wheel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

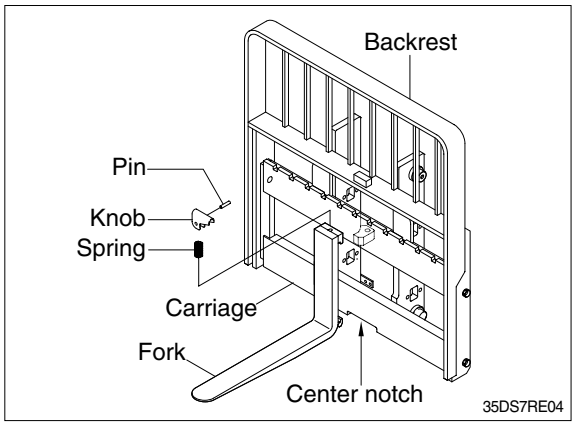
1. MAST

1) REMOVAL



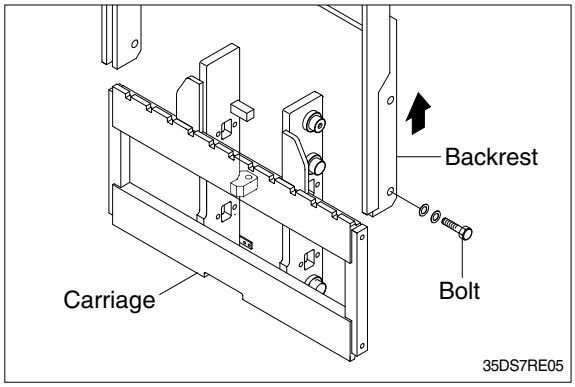
(1) Forks

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



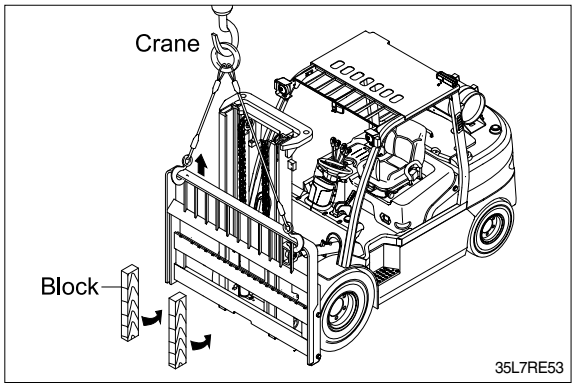
(2) Backrest(If necessary)

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

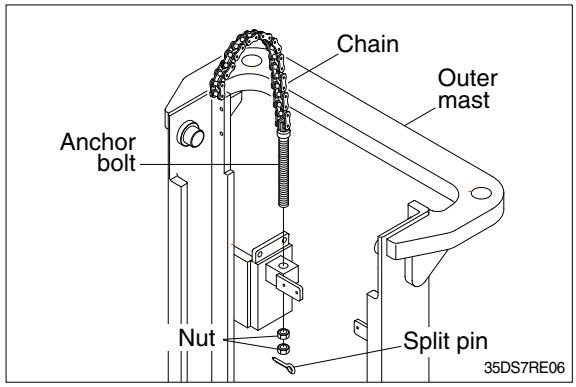


(3) Carriage

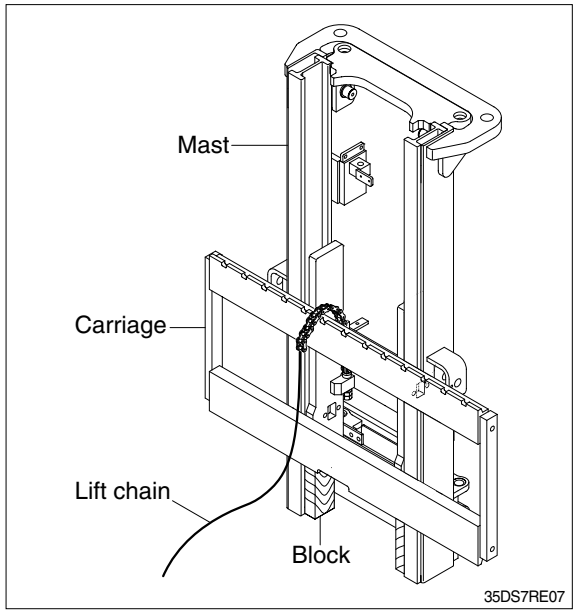
① With the mast vertical, raise the carriage high enough to place blocks under the load forks. This is done to create slack in the load chains when the carriage is lowered. Lower the carriage all the way down to the floor. Make sure the carriage is level, this will prevent any binding when the mast is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



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



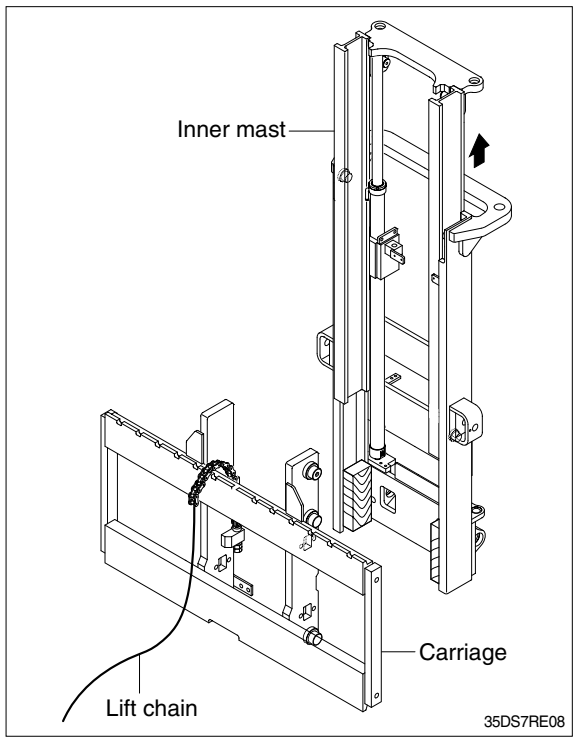
③ Pull the chains out of the sheaves and drape them over the front of the carriage.



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

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

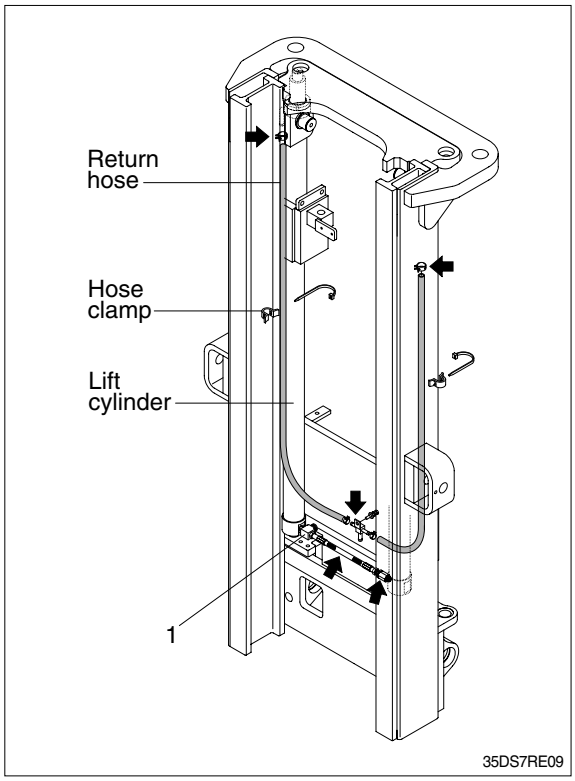
※ Inspect all parts for wear or damage. Replace all worn or damaged parts.



(4) Piping

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

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

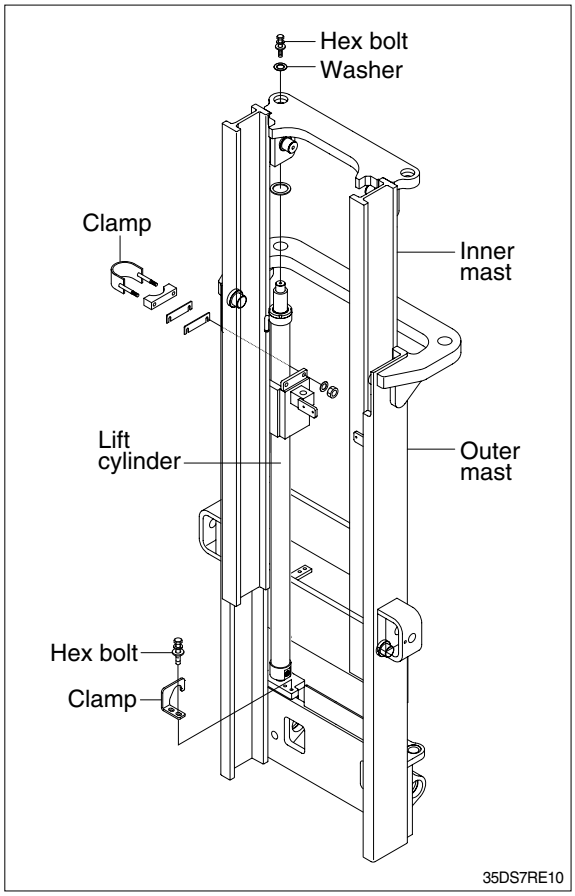


(5) Lift cylinder

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

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

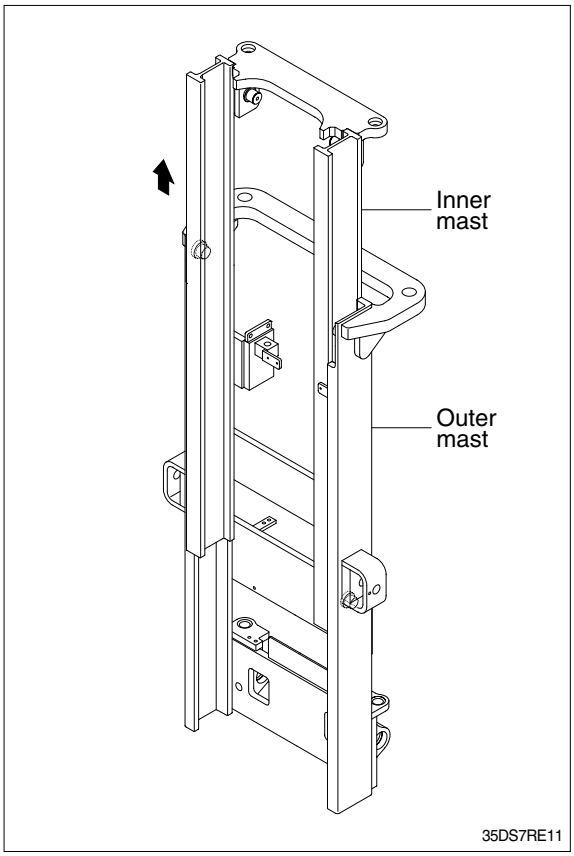
③ Loosen and remove hexagon bolts, nuts and clamp securing lift cylinders to outer mast.
④ Using an overhead hoist, slowly raise the inner mast high enough to clear lift cylinder.
⑤ Using an overhead hoist, draw out lift cylinder carefully and put down on the work floor.



(6) Inner mast

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

⚠ Be careful the mast not to swing or fall.



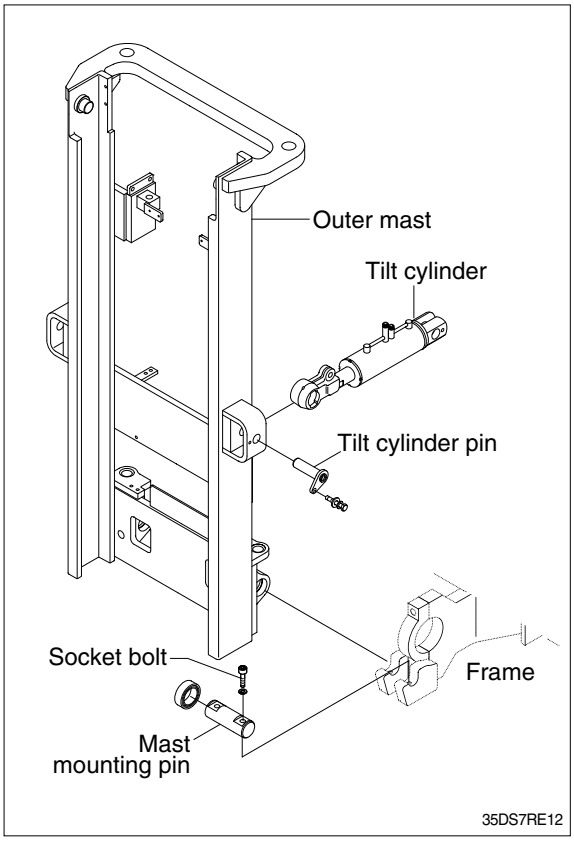
(7) Tilt cylinder pin

(8) Mast mounting pin

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

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

② Loosen the mounting socket bolts and remove the mast mounting pins.
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 mounting pin

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

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

③ Tighten mounting socket bolts to frame.

· Tightening torque : 35.1~47.5kgf · m(254~344lbf · ft)

(2) Tilt cylinder pin

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

(3) Lift cylinder installation and adjustment

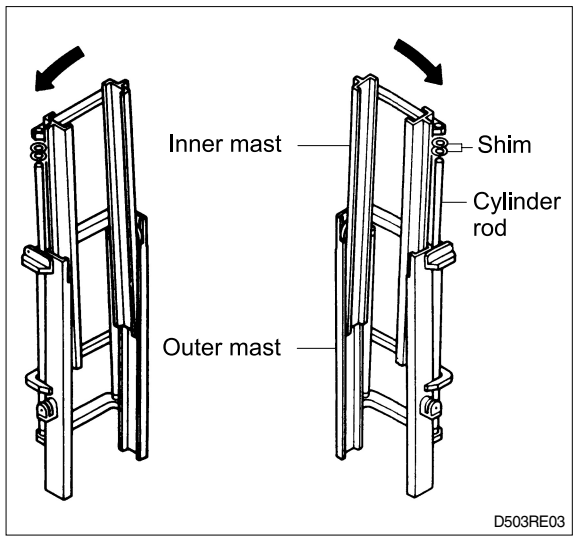
① Assemble the lift cylinder inside the outer mast, then tighten the stopper bolt. If the cylinder assembly has been replaced, adjust as follows so that the left and right cylinders are synchronized at the maximum lifting height.

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

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

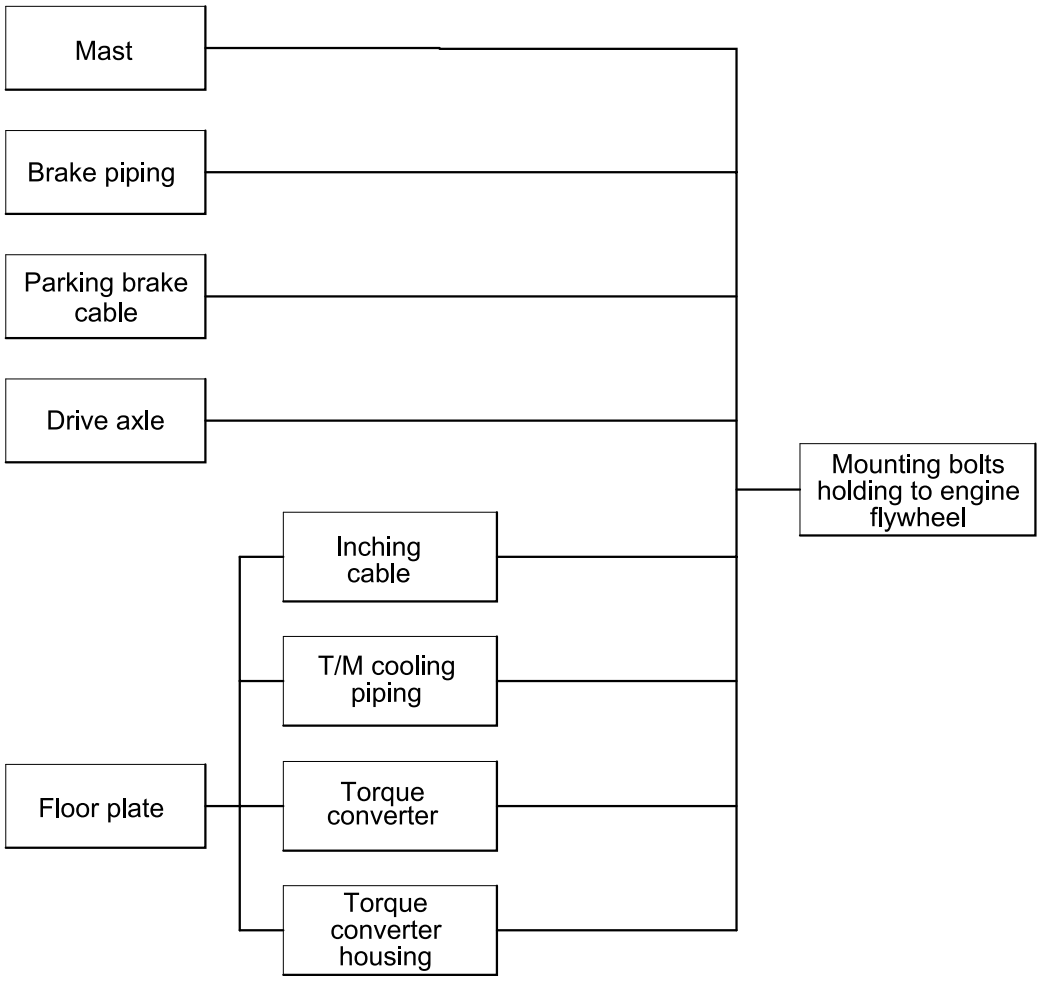
※ If play is to RIGHT, install adjustment shim to RIGHT cylinder.

· Shim thickness : 1.0mm(0.04in)



2. POWER TRAIN ASSEMBLY

1) REMOVAL

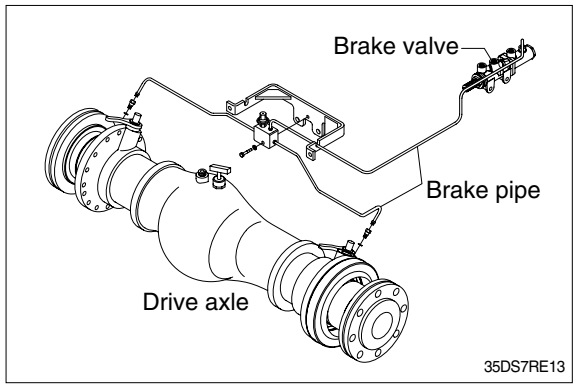


(1) Mast

Refer to section on mast(Page 2-2)

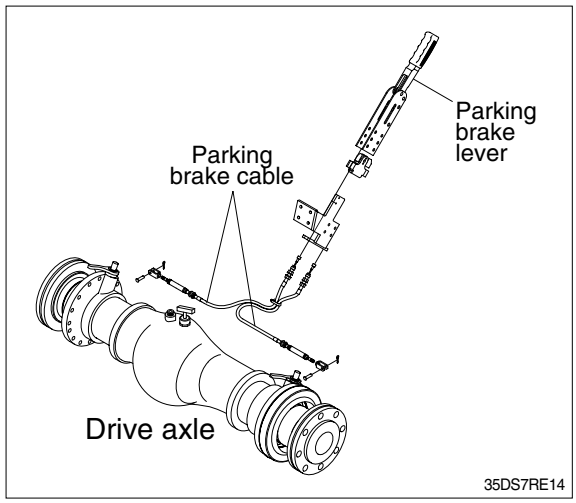
(2) Brake piping

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



(3) Parking brake cable

Disconnect parking brake cable from the brake housing of drive axle unit.



(4) Drive axle

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

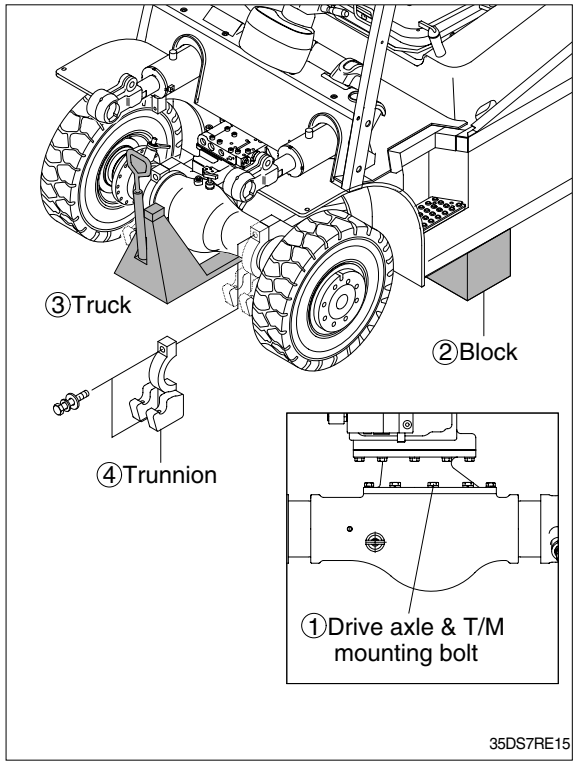
① Loosen hexagonal bolts connecting drive axle to the transmission.

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

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

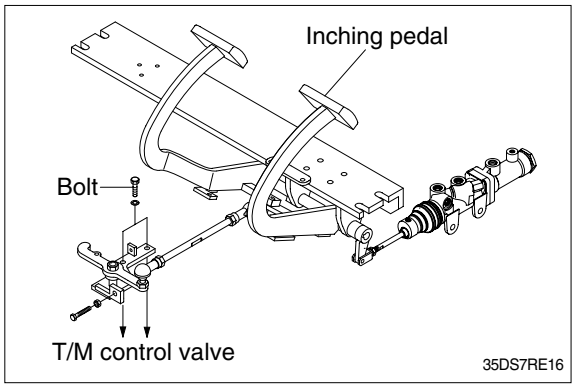
③ Prepare the truck under the drive axle unit to support it.

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



(5) Inching linkage

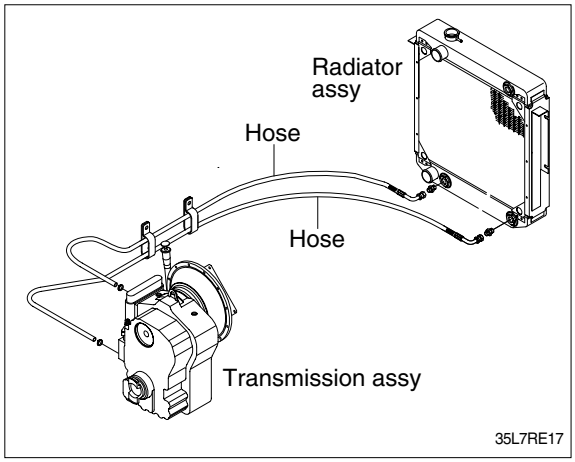
Remove the bolt fixing the linkage assembly to T/M control valve.



(6) Transmission cooling piping

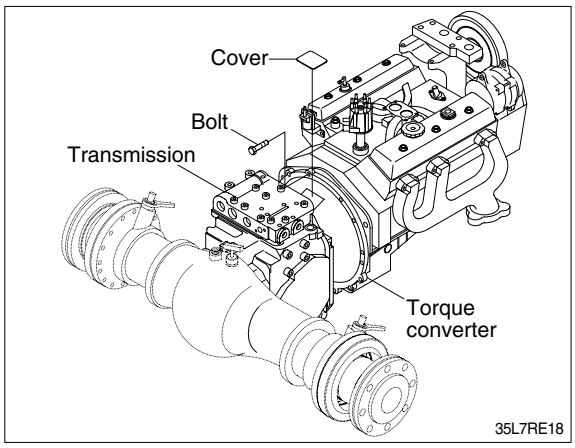
① Disconnect cooling hose and connector from the transmission.

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



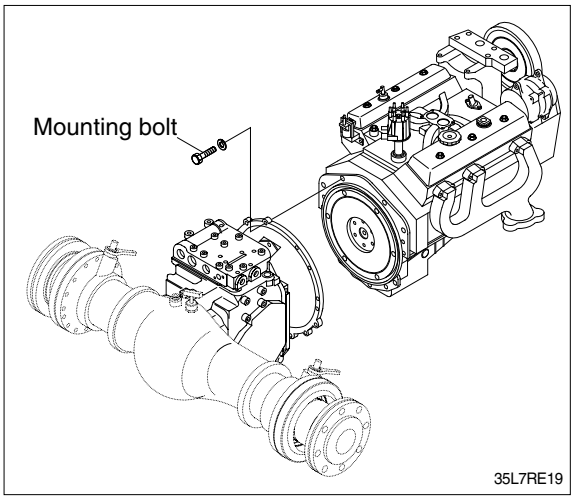
(7) Torque converter

① Remove the cover on top face of the torque converter housing then remove the 4 mounting bolts installed on the engine flywheel. To rotate the flywheel, remove 1 mounting bolt, then insert a turning tool in the mounting hole. One man must turn the engine fan by hand while the other turns the flywheel.

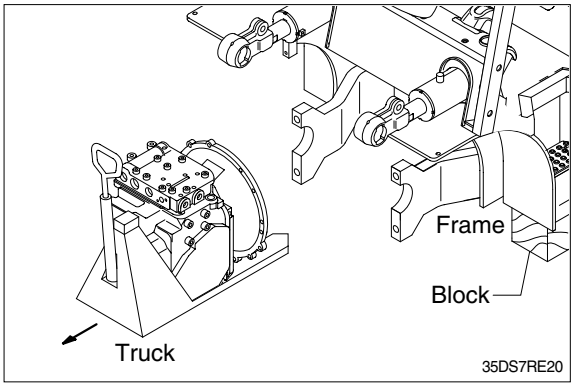


(8) Mounting bolts holding to flywheel housing

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



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

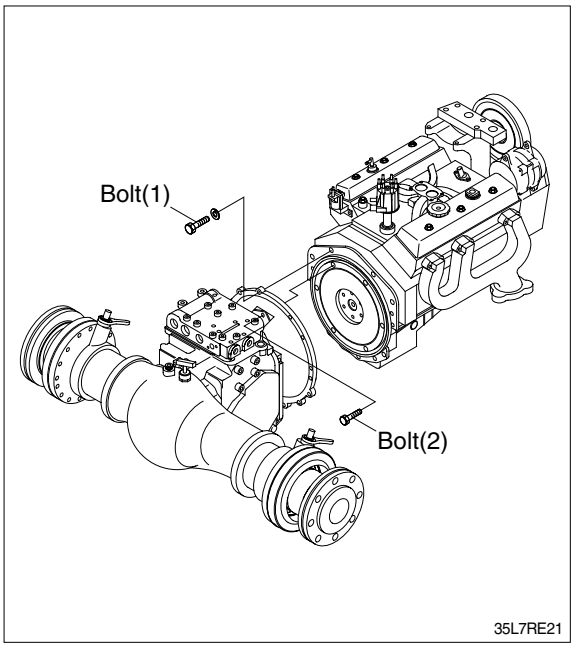


2) INSTALLATION

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

(2) Tightening torque

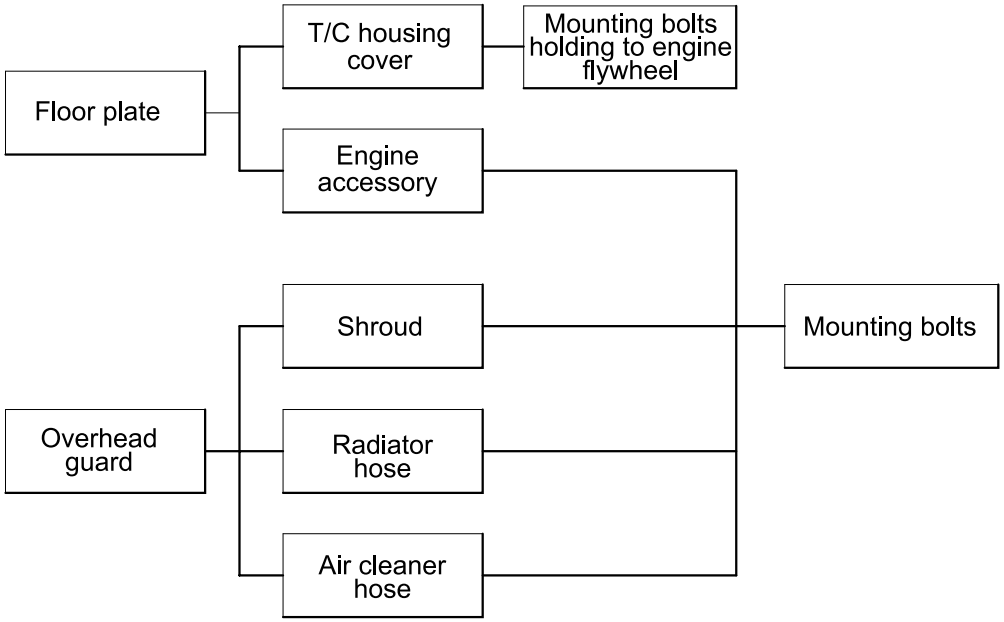
- Bolt(1) : 3.5~4.2kgf · m(25.2~30.3lbf · ft)
- Bolt(2) : 5.5~8.3kgf · m(39.7~60.0lbf · ft)



3. ENGINE

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

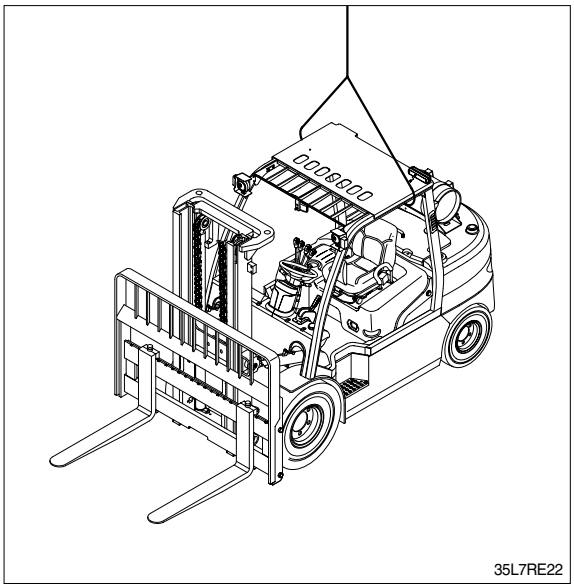
1) REMOVAL



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.



35L7RE22

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

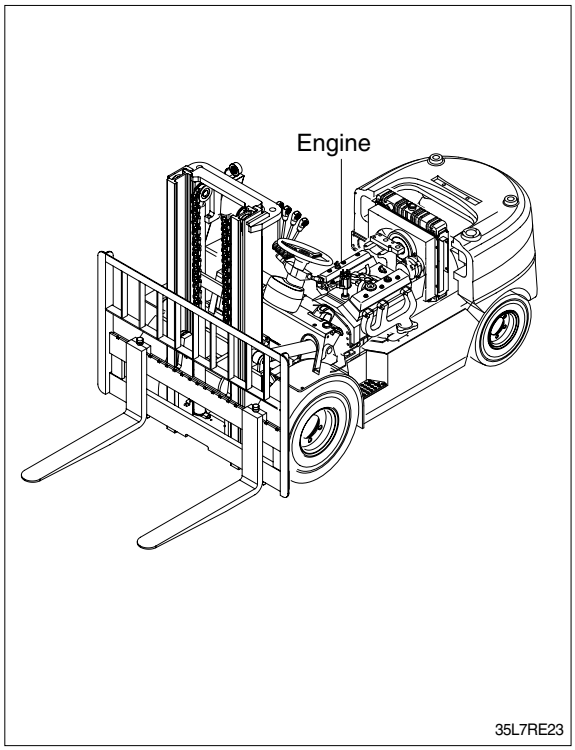
(3) Engine accessory

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

① Wiring harness to alternator and starter.
② Wiring harness for oil pressure and engine water temperature gauges.
③ Cables for meters, buttons and accelerator pedal.
④ Hoses to fuel tank and air cleaner.
⑤ Exhaust pipe.

(4) Radiator hose

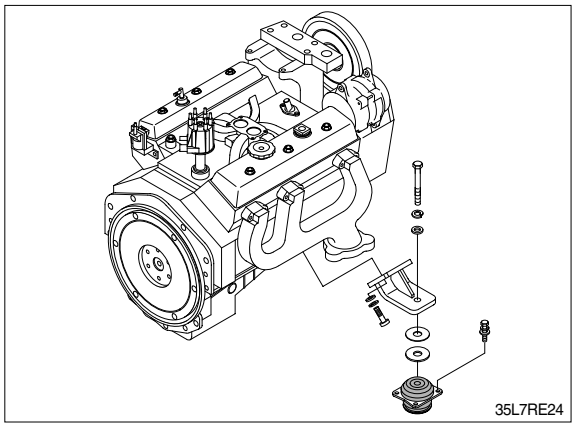
Open the drain valve of the radiator and drain the cooling water, then remove the radiator hose.



(5) Mounting bolt

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

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



2) INSTALLATION

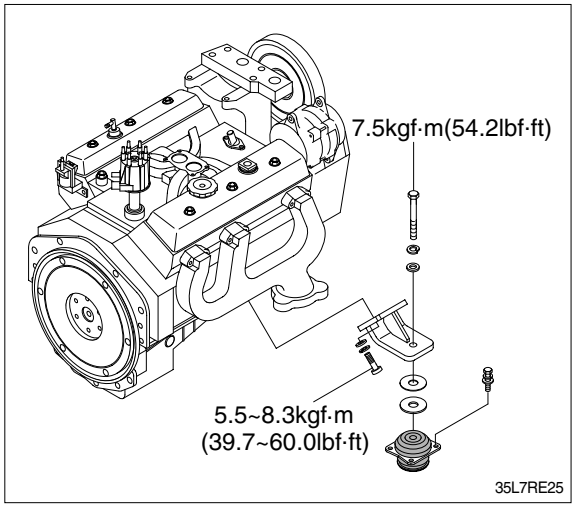
Installation is the reverse order of removal, but be careful of the following points.

(1) Tighten the engine mounting bolts and nuts.

(2) Tighten the engine mounting bracket bolts.

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

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



(3) Radiator hoses

· Distance to insert hose : 42㎜(1.65in)

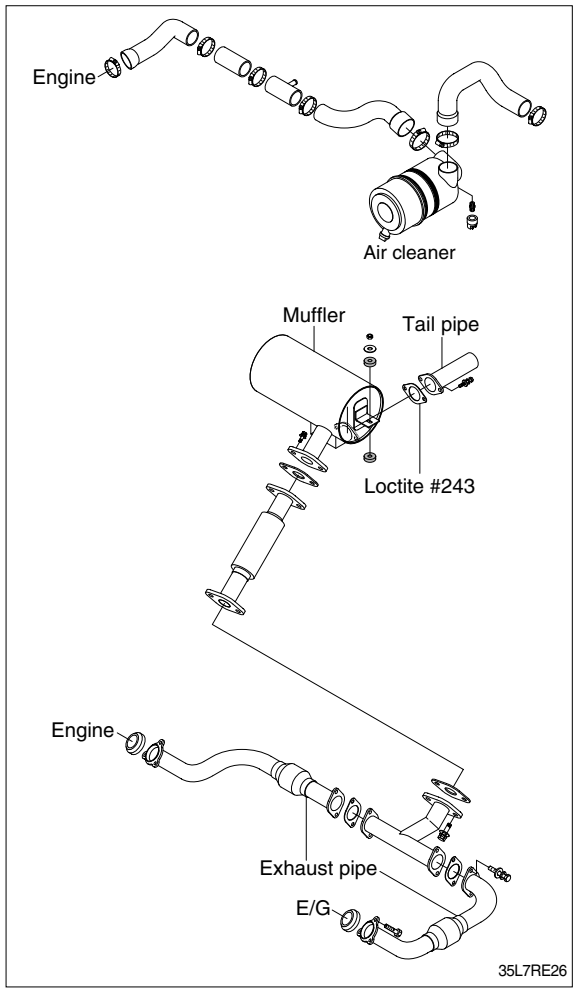
(4) Air cleaner hose

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

② **Distance to insert hose**

· Air cleaner hose : 89㎜(3.5in)

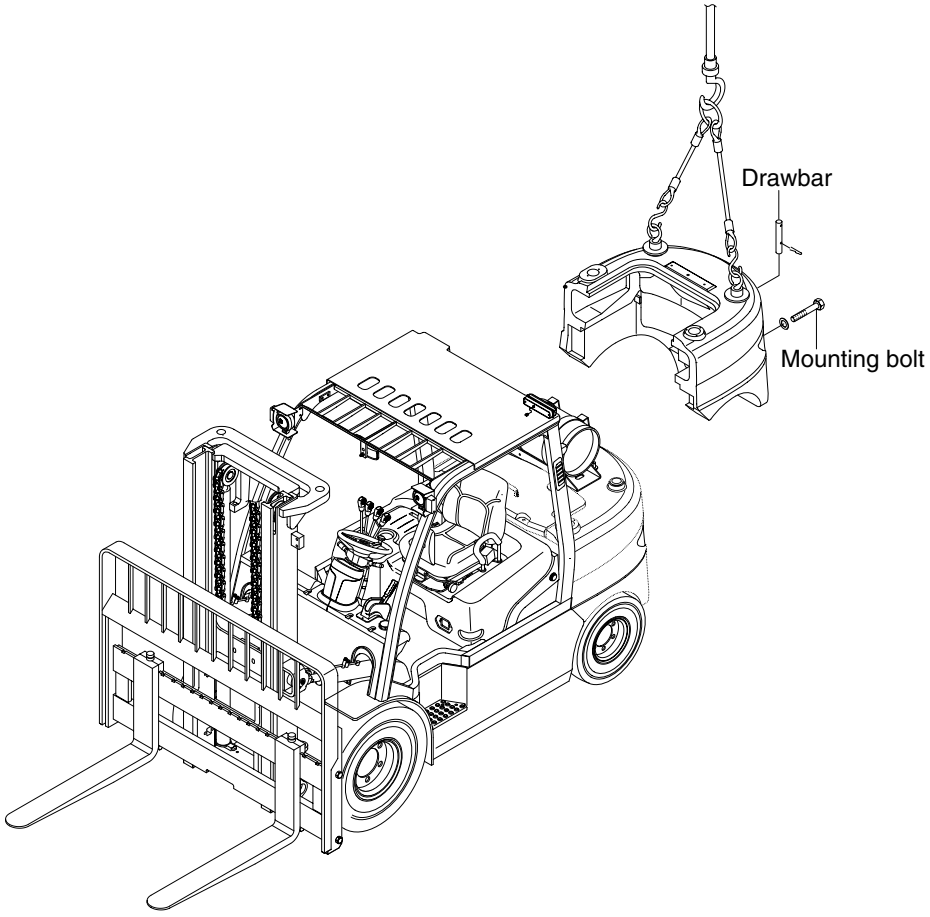
· Engine end : 60㎜(2.36in)



5. STEERING AXLE

1) REMOVAL

Counterweight — Rear wheel — Hose — Mounting bolt



35L7RE27

(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.

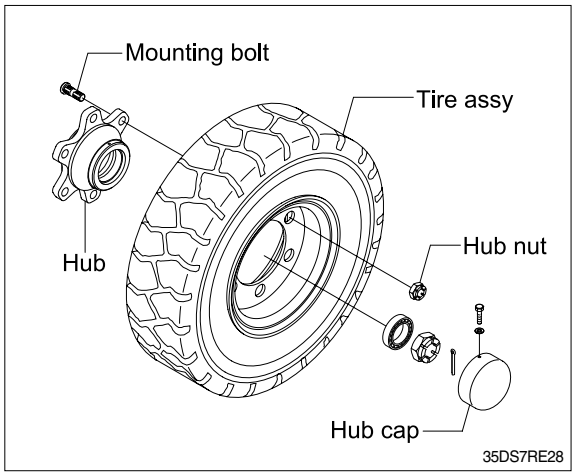
· Weight of counterweight(standard)

35L-7	1820kg (4010lb)
40L-7	2200kg (4850lb)
45L-7	2550kg (5620lb)

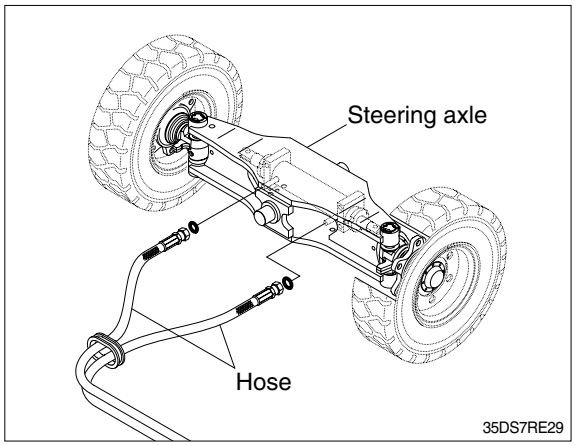
· Tightening torque : 199±29.9 kgf · m (1440±216lbf · ft)

(2) Rear wheel

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



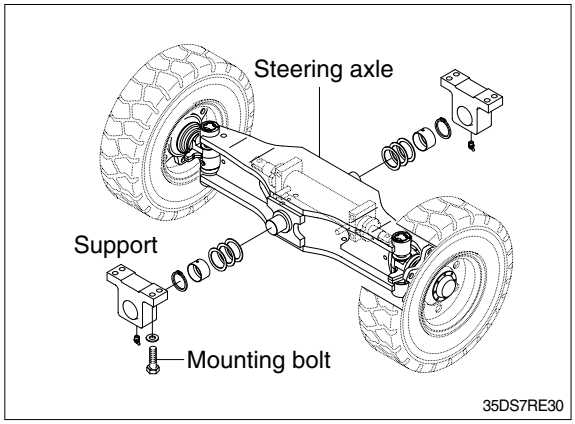
(3) Hose



(4) Mounting bolt

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

There are shims between the support and steering axle to prevent play.

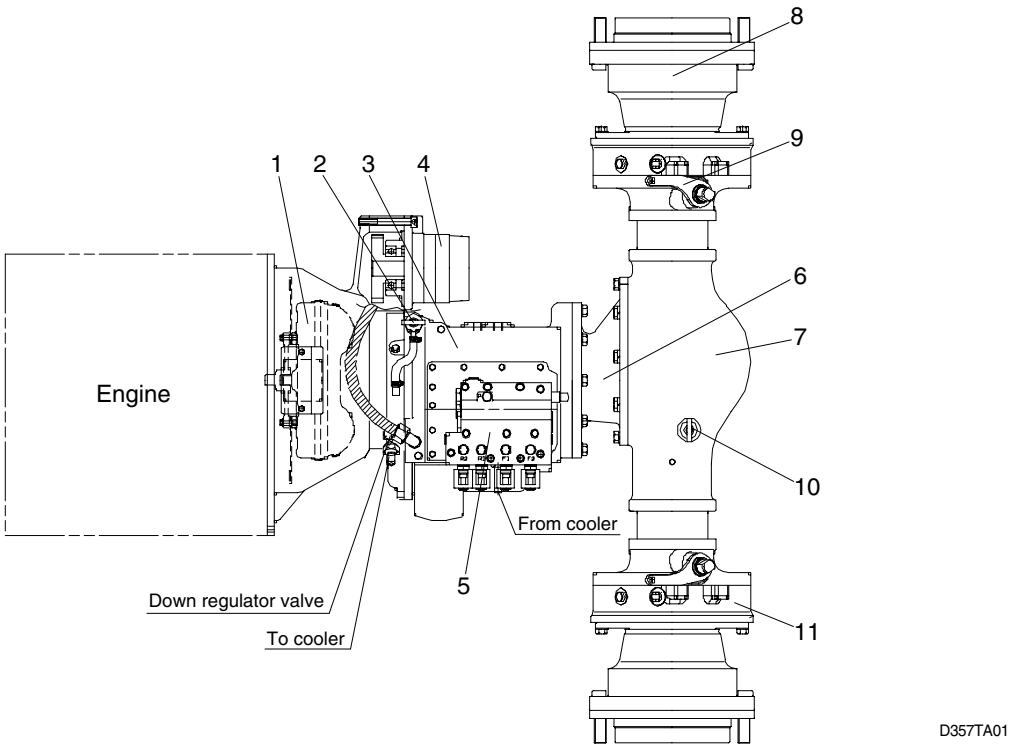


SECTION 3 POWER TRAIN SYSTEM

GROUP 1 STRUCTURE AND OPERATION

1. POWER TRAIN COMPONENT OVERVIEW

1) STRUCTURE



1	Torque converter	5	T/M control valve	9	Parking lever
2	T/M oil level gauge	6	Differential	10	Drive axle oil level gauge
3	Transmission	7	Drive axle	11	Disk brake
4	T/M oil pump	8	Drive wheel		

2) OPERATION

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

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

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

Clutch piston is released by tension of spring.

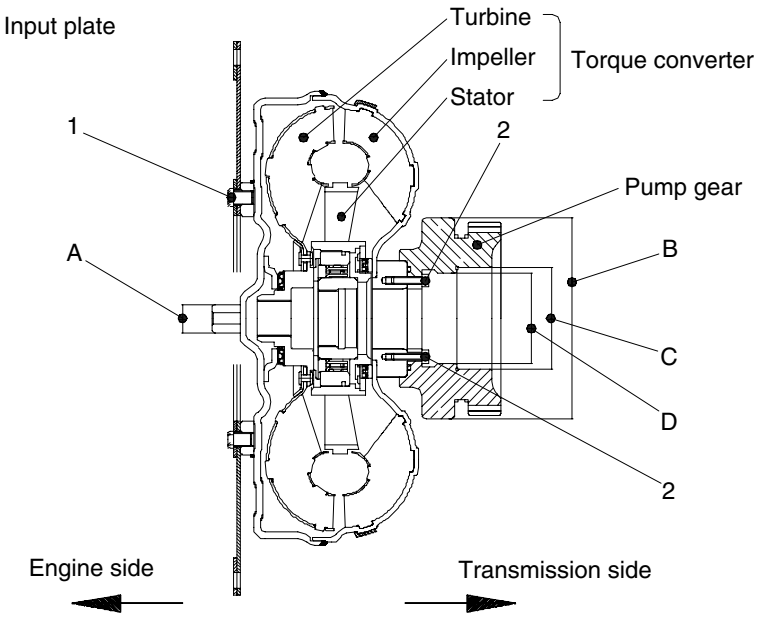
The power is transmitted to spiral gear and bevel gear set of differential through the output gear and then goes to the drive wheel via drive axle.

2. SPECIFICATION

Item			Unit	Specification
Torque converter	Type		-	3 elements 2 phase 1 stage
	Power transmit		-	Torque converter
Transmission	Type/Gear shift		-	POWER SHIFT / F2 : R2
	Gear ratio	FR/RR 1 stage	-	2.550
		FR/RR 2 stage	-	1.29
	P.T.O system		-	Included
	T/M oil		-	DEXRON 3
	Oil quantity		ℓ	12
T/M valve	Type		-	Electric
Charging pump	Displacement		cc/rev	20.6
Drive axle	Gear ratio	Differential	-	2.923
		Planetary	-	4
		Total	-	11.692
	Axle oil		-	MOBILFLUID 424
	Oil quantity		ℓ	10.5
	Brake type		-	WET DISC BRAKE (Include parking brake)
Differential	Gear type		-	Spiral bevel gear
	Differential type		-	4 pinions
Total gear ratio	FR.RR 1 stage		-	29.815
	FR.RR 2 stage		-	15.087

2. TORQUE CONVERTER

1) STRUCTURE



D357TA02

No	Item	Specification
1	Torque converter input plate	4.5±0.3kg · m (32.5±2.2lbf · ft)
2	Torque converter pump gear	2.0±0.3kg · m (14.5±2.2lbf · ft)
A	Pilot boss outer diameter	19.959 - 19.980mm(0.786 - 0.787in)
B	Oil seal outer diameter	134.9 - 135.0mm(5.311 - 5.315in)
C	Needle bearing outer diameter	68.000 - 68.019mm(2.677 - 2.678in)
D	Seal ring inner diameter	60.333 - 60.363mm(2.375 - 2.376in)

2) OPERATION

The torque converter is working according to the Trilok-system, i.e. it assumes at high turbine speed the characteristics, and therefore the favorable efficiency of a hydraulic clutch.

The converter will be defined according to the engine power so that the most favorable operating conditions for each installation case are given.

The Torque converter is composed of 3 main components :

Pump wheel - turbine wheel - stator(Reaction member)

These 3 impeller wheels are arranged in such a ring-shaped system that the fluid passes through the circulating components in the indicated order.

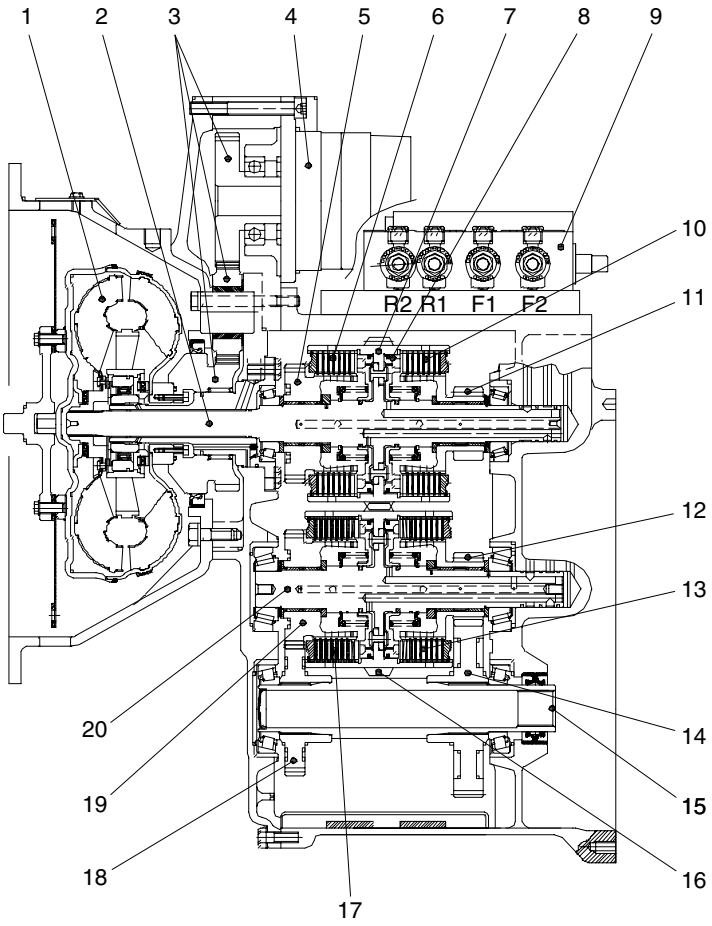
Pressure oil is constantly pressing out of the transmission pump through the converter. In this way, the converter can fulfill its task to multiply the torque of the engine, and at the same time, the heat created in the converter is absorbed through the escaping oil.

The oil, escaping out of the pump wheel, enters the turbine wheel and where the direction of flow is inversed.

According to the rate of inversion, the turbine wheel and with it also the output shaft, receives a more or less high reaction moment. The stator(Reaction member), following the turbine, has the task to inverse again the oil which is escaping out of the turbine and to delivery it under the suitable discharge direction to the pump wheel.
The stator receives a reaction moment, due to the inversion.
The relation between turbine and pump moment is called torque conversion. The conversion is increasing in correspondence with the speed difference of the pump and the turbine wheel.
Finally the maximum conversion will be broken down at turbine wheel.
With increasing output speed, the torque conversion is decreasing. The adoption of the output speed to a certain required output moment is infinitely variable and automatically achieved by the torque converter.

3. TRANSMISSION

1) STRUCTURE



D357TA03

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

2) OPERATION

Transmission enables to a power transmission and a gearshift by the operation of hydraulic friction clutch pack which is controlled through the torque converter.

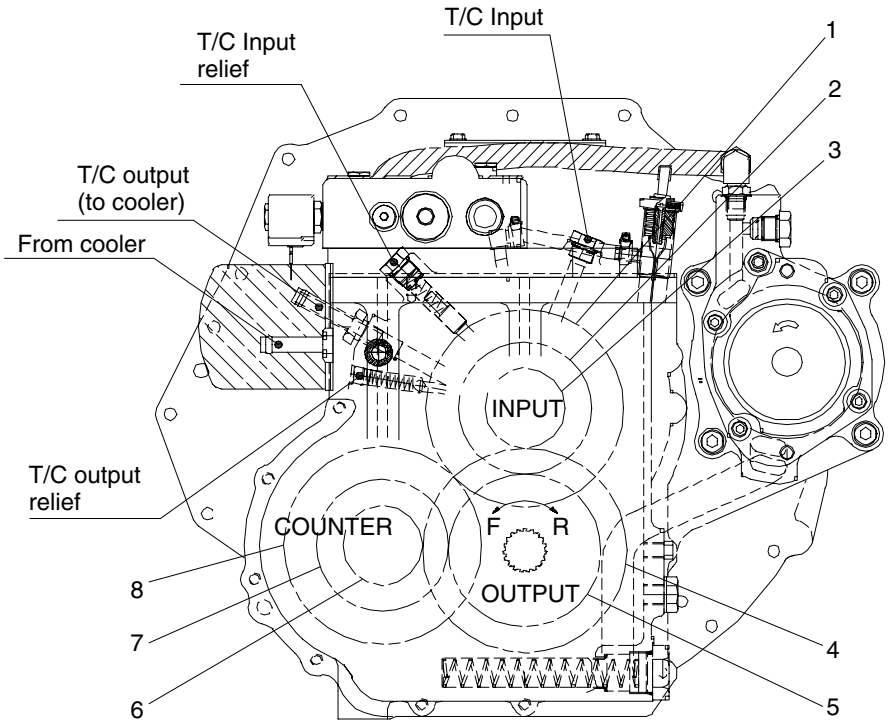
In accordance with the drive speed of vehicle, transmission shifts the gear to the optimal stage for a stable drive.

T/M transmits the power to drive axle by 2 stage each of forward and reverse gear selections.

T/M consists of 4 hydraulic clutches and it is released by spring tension.

Direction and gear stage are electrically changed. The power from the transmission is transmitted to all of the powertrain components.

3) TRANSMISSION GEAR ARRAY

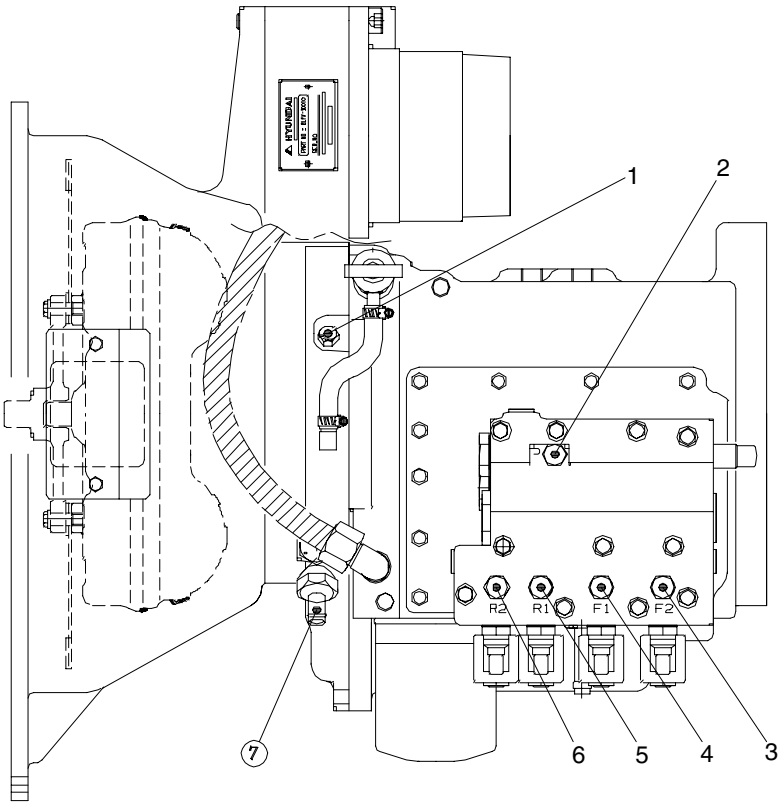


D357TA04

1	Cylinder clutch (RR)	4	Gear(Output, 1st stage)	7	Gear(FR, 2nd stage)
2	Gear(RR, 2nd stage)	5	Gear(Output, 2nd stage)	8	Gear clutch(FR)
3	Gear(RR, 1st stage)	6	Gear(FR, 1st stage)		

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

4) TRANSMISSION INPUT PORT



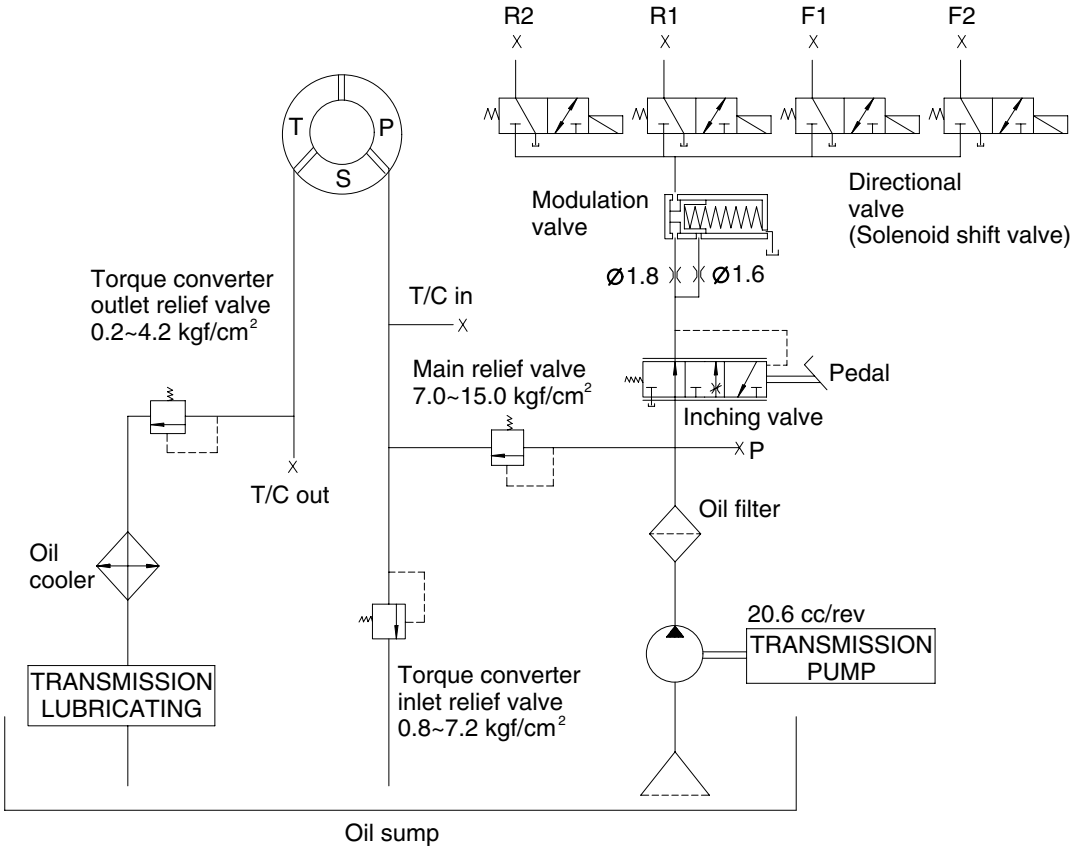
D357TA05

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

· Transmission pressure

Engine rpm	Unit	Main line (Neutral)	T/C input port (Neutral)	T/C output port (Neutral)	FR 1,2 stage clutch	RR 1,2 stage clutch
Idle	kgf/cm^2 (psi)	7.0~13.2 (99.6~187.7)	0.8~4.2 (11.4~59.7)	0.2~1.2 (2.8~17.1)	7.0~13.2 (99.6~187.7)	7.0~13.2 (99.6~187.7)
1300	kgf/cm^2 (psi)	7.5~14.5 (106.7~206.2)	2.5~6.1 (35.6~86.8)	0.7~2.5 (10.0~35.6)	7.5~14.5 (106.7~206.2)	7.5~14.5 (106.7~206.2)
2400	kgf/cm^2 (psi)	7.5~15.0 (106.7~213.4)	4.2~7.2 (59.7~102.4)	1.0~4.2 (14.2~59.7)	7.5~15.0 (106.7~213.4)	7.5~15.0 (106.7~213.4)

3. TRANSMISSION HYDRAULIC CIRCUIT



D357TA06

(1) Specification

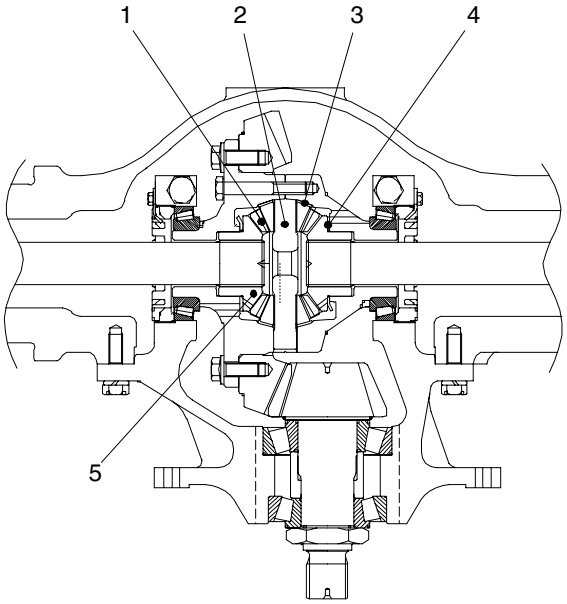
Item	Unit	Specification
Rated flow	ℓ /rpm	37.4 / 2200
Main relief pressure	kgf/cm²(psi)	7.0 ~ 15.0(99.6~213.4)
T/C relief pressure	kgf/cm²(psi)	0.8 ~ 7.2(11.4~102.4)
Clutch pressure	kgf/cm²(psi)	7.0 ~ 15.0(99.6~213.4)
Residual pressure (Clutch release condition)	kgf/cm²(psi)	Max. 0.3(4.3)

(2) Electric input data

Item	Unit	Specification
Initial coil current at 20°C	A / VDC	0.7/24
Resistance at 20°C	Ω	39.3
Shifting time	sec	1.0 ~ 1.6
Connector	-	DR/D Models With Diode

4. DIFFERENTIAL CARRIER ASSEMBLY

1) STRUCTURE



D357TA07

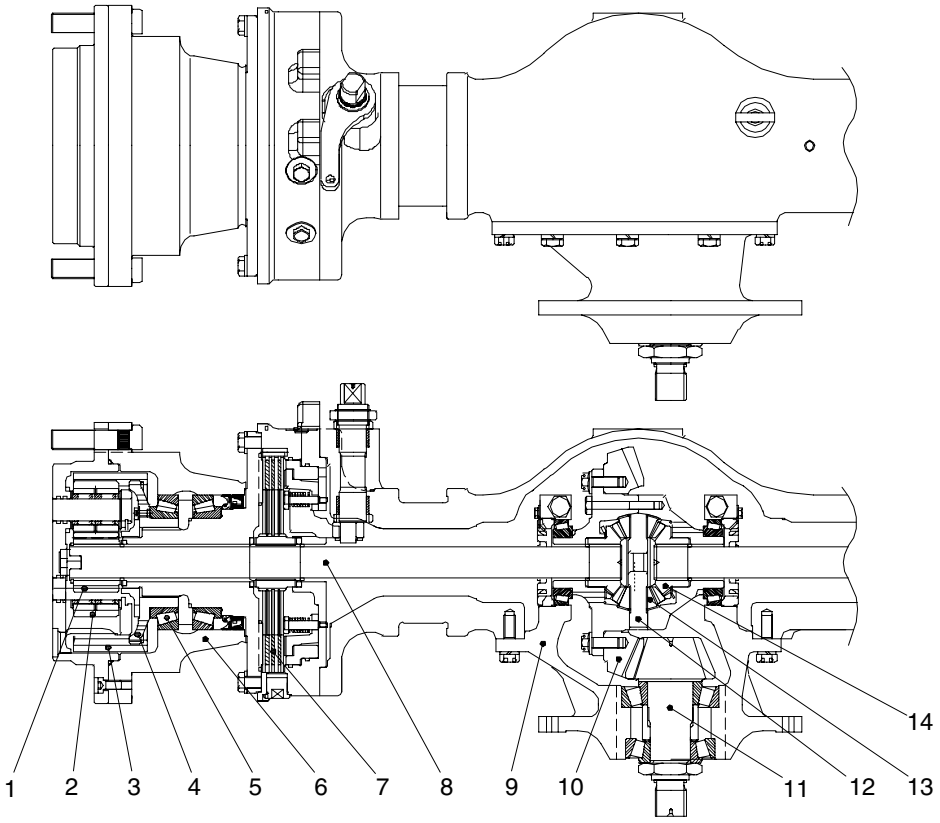
No	Item	Unit	Specification
1	Differential pinion gear inner diameter	mm(in)	20.000 - 20.021(0.787~0.788)
2	Spider outer diameter	mm(in)	19.959 - 19.980(0.786~0.787)
3	Pinion gear washer	mm(in)	1.92 - 2.08(0.076~0.082)
4	Side gear washer	mm(in)	1.95 - 2.05(0.077~0.081)
5	Side gear	-	-

2) OPERATION

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

5. DRIVE AXLE

1) STRUCTURE



D357TA08

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

2) OPERATION

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

Pinion shaft(11) is connected to transmission output shaft and spline.

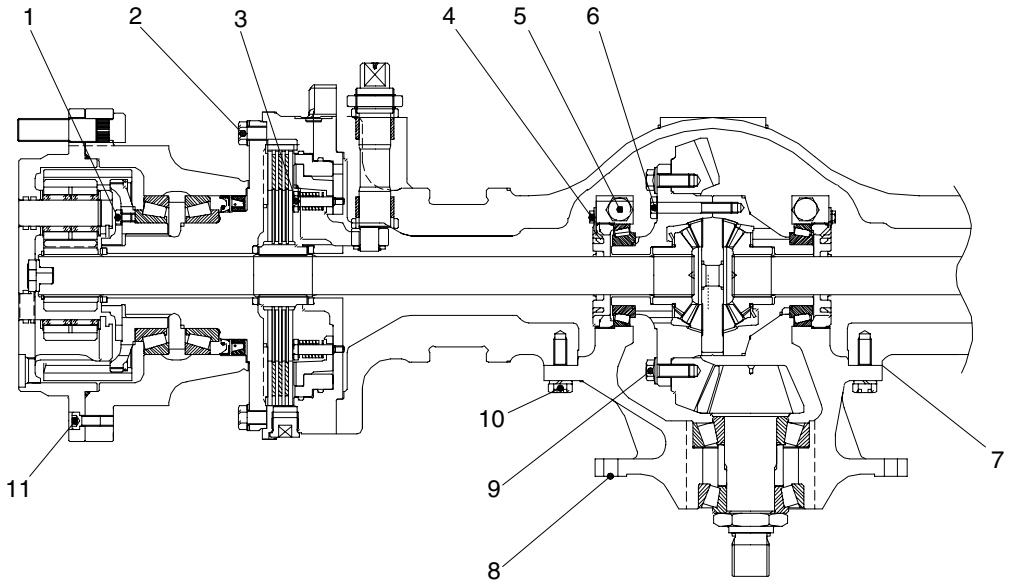
The power of transmission is transmitted to differential which consists of pinion shaft(11) and ring gear(10) and the differential rotates the drive shaft.

The differential transmits the drive force from transmission to wheels and one wheel's rotation speed is differ from the other.

The differential consists of 4 pinions(13) , 2 side gears(14) and spider and the engagement between 4 pinions(13) and side gear(14) makes a right angle.

Side gear(14) and drive shaft(8) are connected with spline and the drive shaft(8) consists of planetary gear(2), inner gear(3), wheel hub(6) and drive wheels.

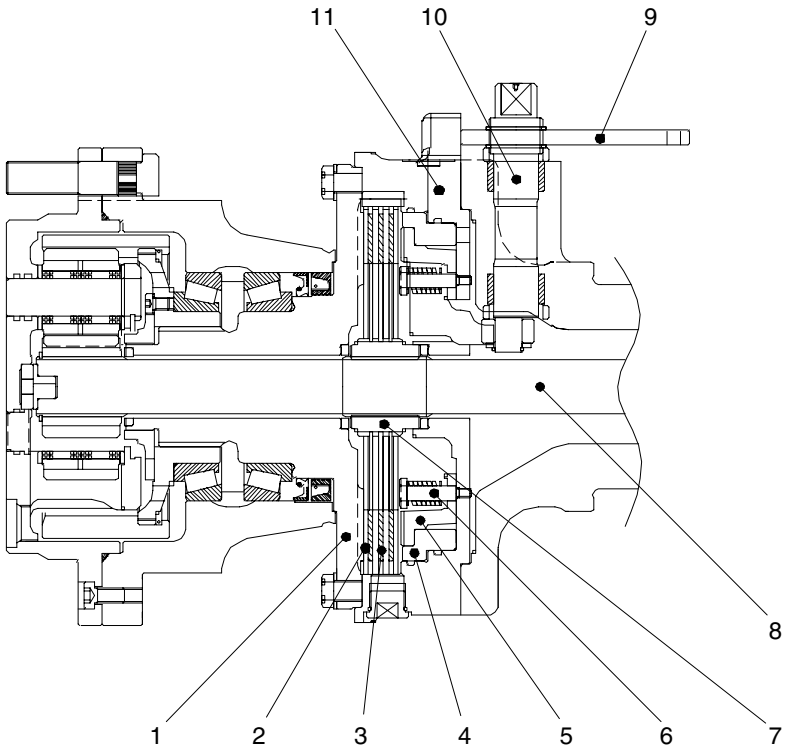
3) DRIVE AXLE TIGHTENING TORQUE



D357TA09

No	Item	Specification
1	Inner carrier	2.2±0.3kgf · m (15.9±2.2lbf · ft)
2	Spindle	12±0.5kgf · m (86.8±3.6lbf · ft)
3	Parking piston	1.5±0.1kgf · m (10.8±0.7lbf · ft)
4	Adjuster nut	1.0±0.2kgf · m (7.2±1.4lbf · ft)
5	Differential cap	16±0.5kgf · m (115.7±3.6lbf · ft)
6	Differential case	6±0.5kgf · m (43.4±3.6lbf · ft)
7	Connection between differential carrier and drive axle	LOCTITE #5127
8	Connection between differential carrier and T/M	LOCTITE #17430
9	Ring gear	13.5±0.5kgf · m (97.6±3.6lbf · ft)
10	Differential carrier assembly	11.5±0.5kgf · m (83.2±3.6lbf · ft)
11	Wheel hub	3.0±0.3kgf · m (21.7±2.2lbf · ft)

4) DISK BRAKE



D357TA10

1	Spindle	5	Service piston	9	Parking lever
2	Steel plate	6	Parking piston mounting bolt	10	Parking lever shaft
3	Disk plate	7	Spline collar	11	Brake housing
4	Parking piston	8	Drive shaft		

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.

Parking brake's lever system is the serration type, so it is possible to adjust the play.

Because it is easy to maintain the gap of both brakes, high brake efficiency and minimum disproportional braking deviation is acquired.

Major components are 3 disk plates(3), 4 steel plates(2), service piston(4), parking piston(5), parking lever(9) and brake housing(11).

Braking force is applied by restricting the driving force from drive shaft(8) and spline collar(7).

GROUP 2 INSPECTION AND TROUBLESHOOTING

1. INSPECTION

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

1) VISUAL CHECK

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

2) DRIVE CHECK

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

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

2. TROUBLESHOOTING

1) GENERAL INSPECTION WHILE DRIVING

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

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

2) ABNORMAL NOISE CHECK LIST

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

3) PRESSURE TEST CHECK LIST

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

4) DIFFERENTIAL

No	Problem	Cause
1	Regular noise	1. Lubricating oil shortage. 2. Incorrect oil specification. 3. Wheel bearing adjustment failure or defect. 4. Drive gear and pinion adjustment failure. 5. Drive gear or pinion gear damage or wear. 6. Large or small gear backlash. 7. Pinion bearing wear or loosening. 8. Side bearing wear or loosening.
2	Irregular noise	1. Irregular rotation of ring gear. 1) Loosened drive gear fixing bolt. 2) Drive gear defect. 2. Differential bearing damage.
3	Noise only at the rotation	1. Differential drive gear and pinion shaft or spider are tightly meshed. 2. Side gear and differential case are tightly meshed. 3. Differential pinion and side gear defect. 4. Thrust washer wear or damage. 5. Too large backlash (between side gear and pinion)
4	Lubricating oil leakage	1. Oil leakage at the axle hub carrier side. 1) Too high oil level. 2) Incorrect oil specification. 3) Clogged axle housing breather. 2. Pinion axle leakage. 1) Too high oil level. 2) Incorrect oil specification. 3) Clogged breather. 4) Wear or incorrect assembly of oil seal.
5	Drive wheel stopping	1. Axle shaft damaged. 1) Wheel bearing loosening. 2) Short length of shaft. 3) Stud and nut loosening. 2. Drive gear teeth damaged. 3. Pinion gear of differential side gear is damaged. 4. Spider of differential pinion is damaged.

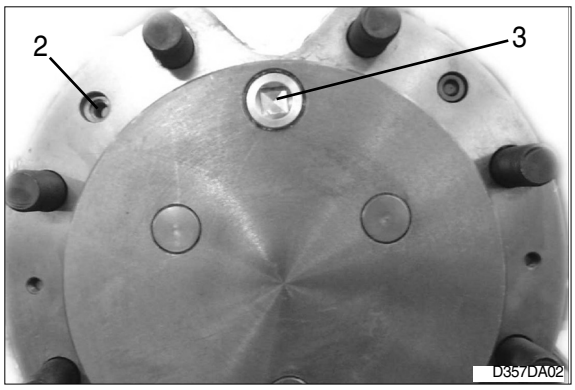
GROUP 3 DISASSEMBLY AND ASSEMBLY

1. DISASSEMBLY OF DRIVE AXLE

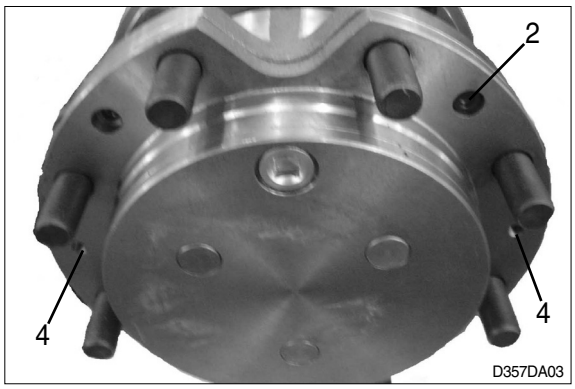
1) REMOVAL AND DISASSEMBLY OF WHEEL HUB

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

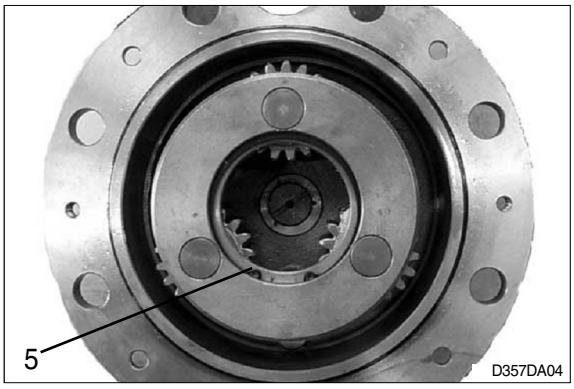
(2) Loosen 4 socket head bolts(2) and a plug(3) from the housing of planetary.



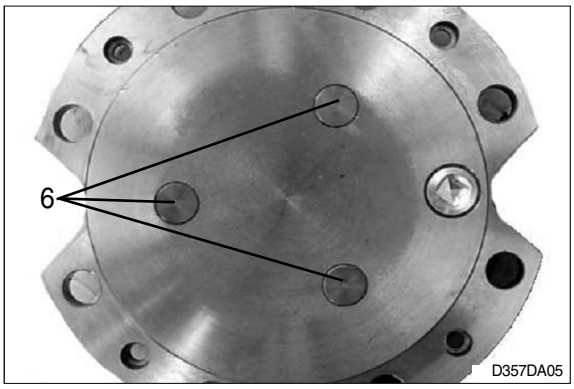
(3) Fit socket head bolt(2) into the 2 tap holes(4) and remove housing of planetary.



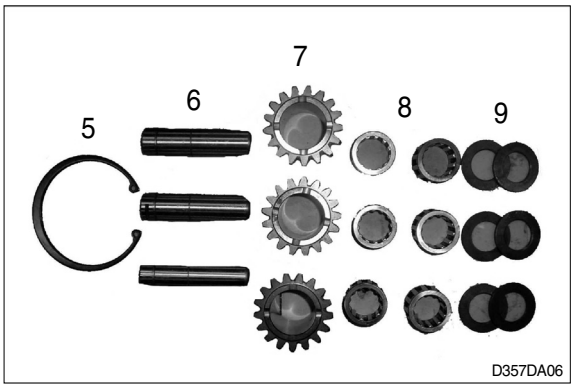
(4) Remove snap ring(5) from the housing of planetary.



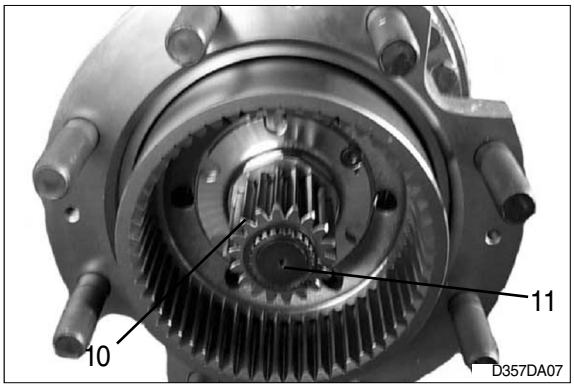
(5) Remove 3 pins(6) with a plastic hammer.



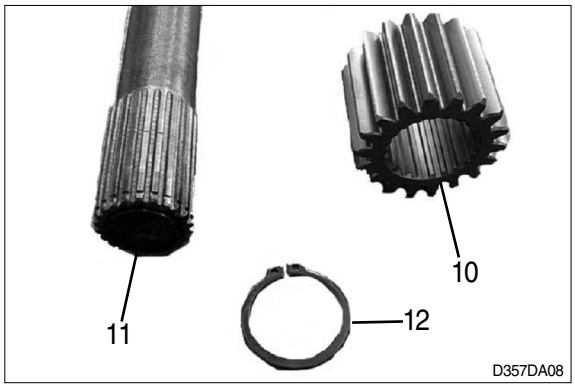
(6) Remove needle bearing(8), planet gear(7) and thrust washer(9).



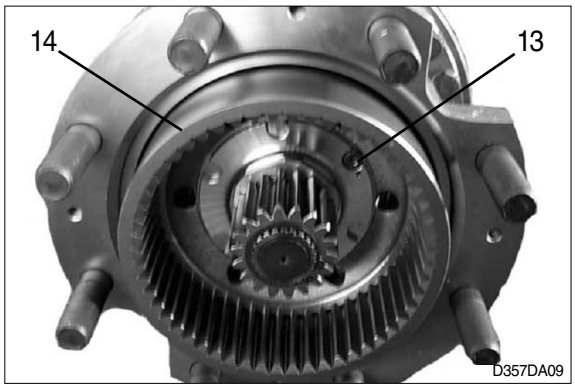
(7) Remove sun gear(10) and drive shaft(11).



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

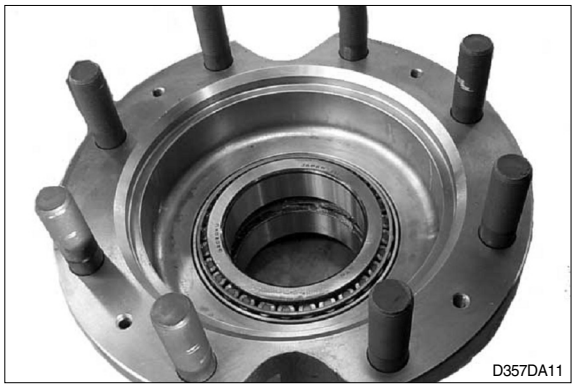


(9) After removing bolt(13), remove ring gear(14) and torque plate assembly from the axle tube.



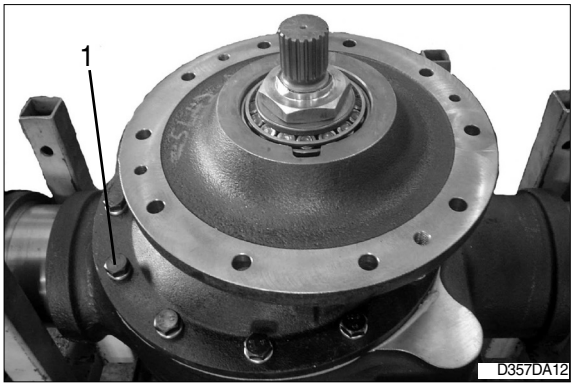
(10) Remove snap ring from the ring gear(14) and disassemble internal gear carrier.

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

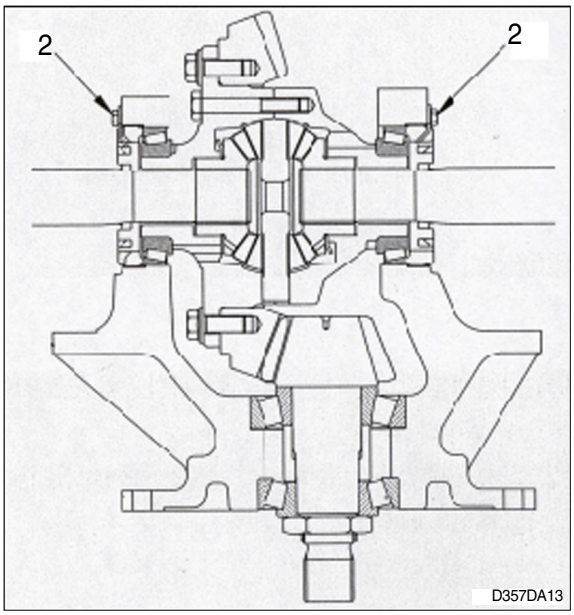


2) REMOVAL AND DISASSEMBLY OF AXLE HOUSING

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

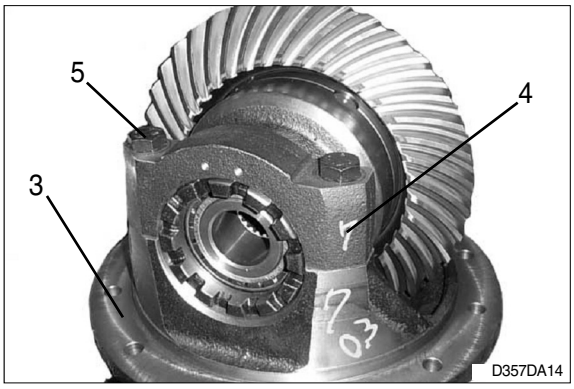


(2) For the reassembly, check rolling resistance and record it. Remove backing plate(2).

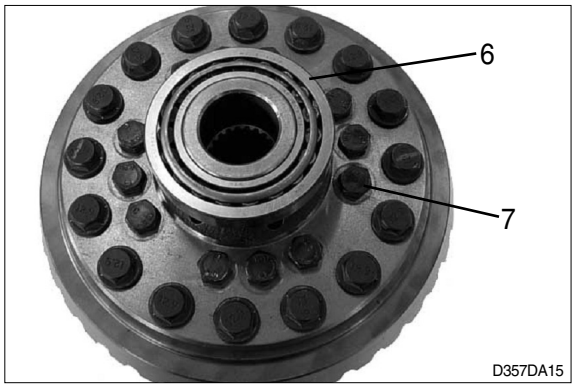


(3) Before removing differential assembly from carrier(3), check the location of cap(4) and mark it for reassembly.

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

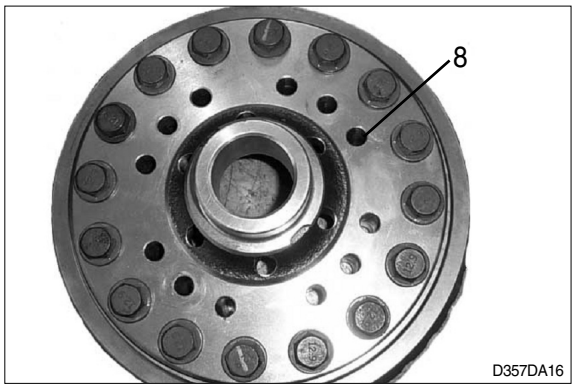


(5) Disassemble bearing(6) from the differential housing and remove 12 bolts (7).



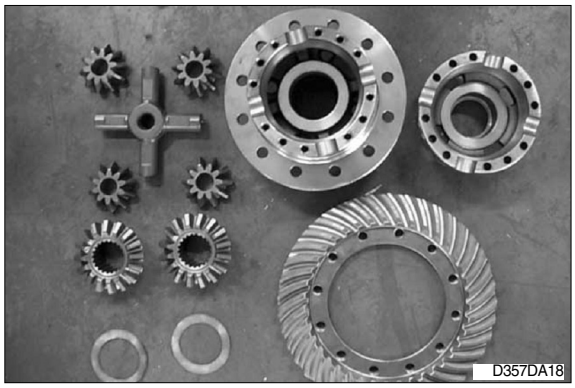
(6) Remove differential assembly from the carrier.

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



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

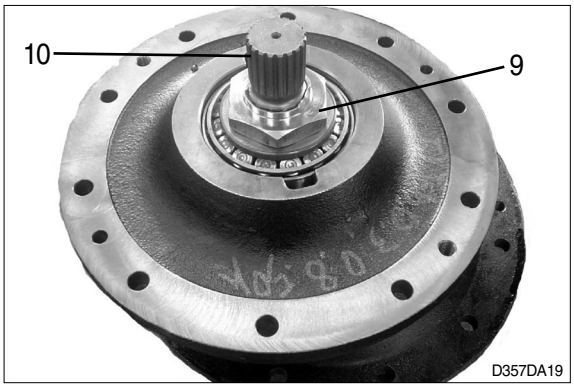
(9) Remove thrust washer, side gear, pinion gear and spider and then place them on the clean bench.



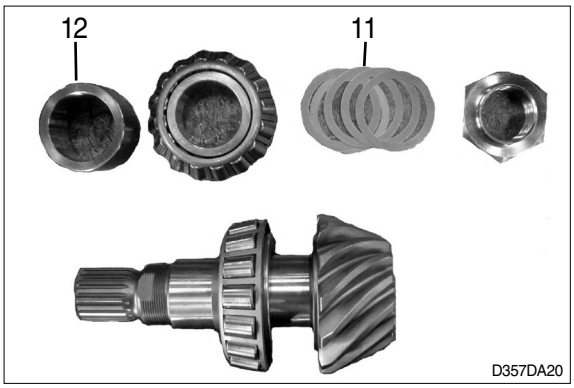
(10) Remove lock nut(9).

(11) Remove drive bevel pinion shaft (10) by using a plastic hammer.

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



(12) Remove shim(11) and spacer(12) from pinion shaft.
Using a bearing puller, disassemble inner race of taper roller bearing from the pinion shaft.



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

※ **Do not reuse damaged shims.**

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

2. REASSEMBLY OF DRIVE AXLE

Clean all of the parts with cleaner and then remove remained loctite.

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

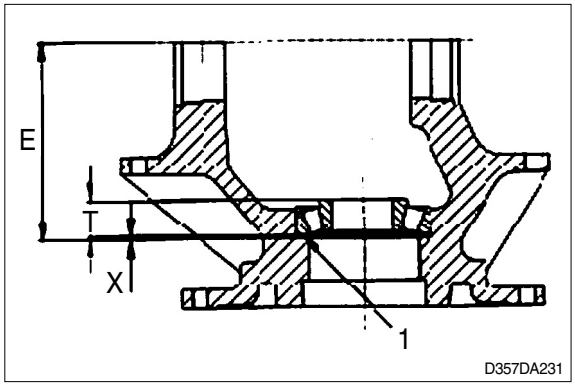
- Check wear, damage or crack for all the parts and replace if needed.
- If the teeth of gear are damaged, replace it as a set.
- Replace damaged tapered roller bearing.
- Do not reuse deformed shims or worn thrust washers.
- Rasp off the seal contacted surface.

1) ADJUSTMENT OF BEVEL PINION SHAFT

Adjusting shim of bevel pinion shaft.

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

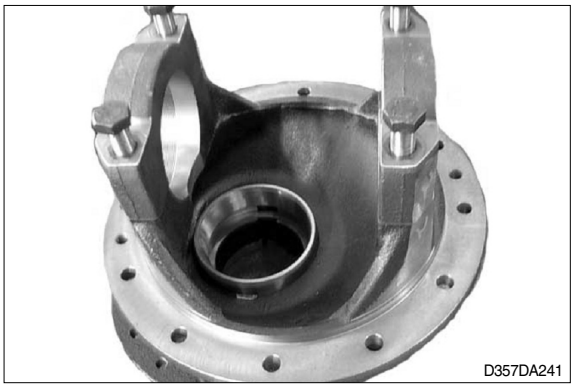
B : Mounting dimension of bevel pinion shaft , 133.20mm (5.2 in)
T : Height of bearing.
C : Dimension of carved seal on the pinion. If there's no carved seal **C**=0.



EX) : From the housing
"**E**" = 162.95mm (6.4in)
B is factory dimension
"**B**" = 133.20mm (5.2in)
From the bearing
"**T**" = 29.25mm (1.2in)
Carved seal on the pinion
"**C**"= 0.05mm (0.002in)
Shim thickness :
"**X**" = 162.95 -133.20 - 29.25 + 0.05
= 0.55mm (0.022in)

※ **If teeth are damaged, replace bevel gear and shaft**

(2) Using different kinds of shims, adjust shim thickness as measured by previous equation. Place shims at the bearing place.
Using a jig, assemble drive bearing so that the outer race contact with the bearing place.


D357DA241

(3) Heat inner race of bearing to max 100°C and then assemble it to the pinion shaft.
Also inner race should contact with bearing place.

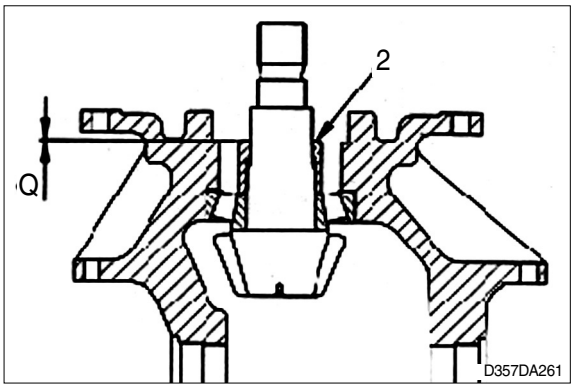

D357DA25

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

" **Z** = **P** - **Q** "

EX) : From the bearing
P = 2.25mm (0.09in)
From the housing
Q = 1.85mm (0.07in)
Required shim thickness **Z** :

Z = 2.25 - 1.85 = 0.40mm (0.02in)



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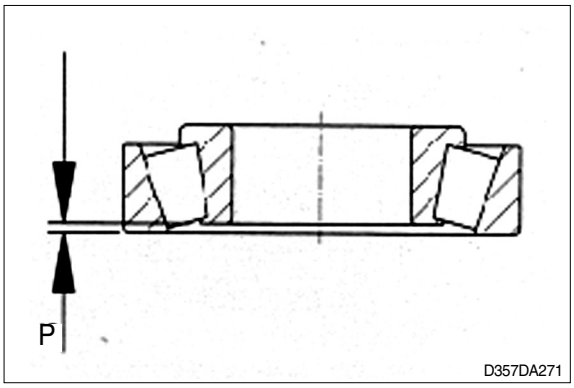
Unit : mm(in)

P	Q	Z
2.15(0.085)	1.85(0.073)	0.30(0.012)
2.20(0.087)	1.85(0.073)	0.35(0.014)
2.25(0.089)	1.85(0.073)	0.40(0.016)
2.30(0.091)	1.85(0.073)	0.45(0.018)
2.35(0.093)	1.85(0.073)	0.50(0.020)



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2) ADJUSTMENT OF PINION SHAFT

(1) Assemble bearing cup.
Assemble spacer to the pinion shaft and then install measured shims onto the spacer.


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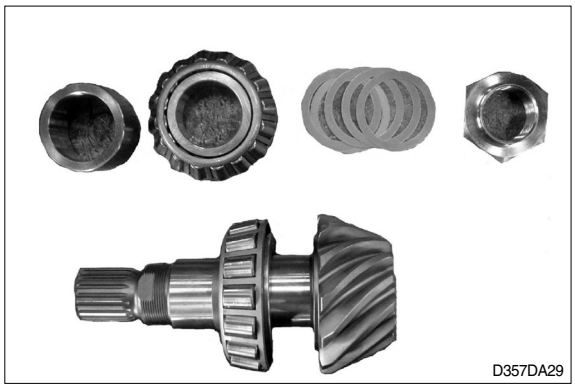
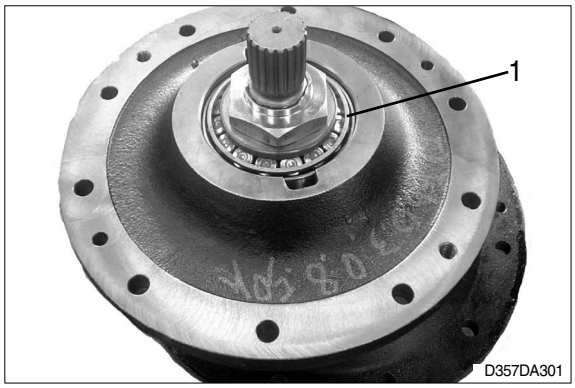

D357DA29

(2) Insert pinion shaft into the carrier.
Assemble bearing cone and lock nut.
Apply grease on the outer bearing(1).
Apply loctite #271 or #277 on the thread of pinion and then tighten lock nut.

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



D357DA301

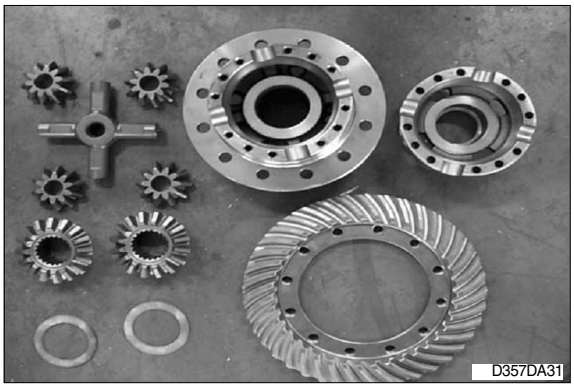
Measure rolling resistance of pinion shaft.
Adjust shim thickness.

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

Coke lock nut into the pinion shaft slot.

3) ASSEMBLY OF DIFFERENTIAL ASSEMBLY

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



(2) Assemble differential housing.

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

(3) Tighten 12 bolts(7) to the differential housing.
Apply loctite #271 or #277 on the thread of bolt.

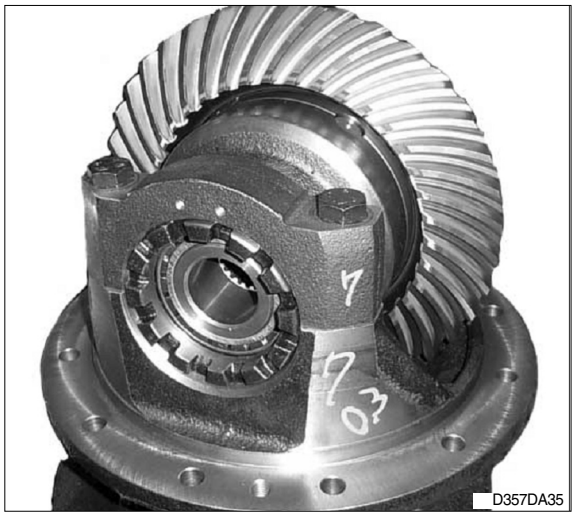
· Tightening torque : 5.5~6.5kgf · m
(40~47lbf · ft)

(4) Assemble ring gear by tightening 12 bolts(6).
Apply loctite #271 or #277 on the thread of bolt.

· Tightening torque : 13~14kgf · m
(94~101lbf · ft)

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

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



(6) Assemble bearing cap.

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

· Tightening torque : 15.5~16.5kgf · m (112~119lbf · ft)

Measure rolling resistance of tapered roller bearing.

The right table shows the relation between preload(P) of bevel pinion shaft and rolling resistance(Z) calculated at 1).

Unit : kgf · m (lbf · ft)

P	Z
0.20(1.45)	0.35~0.41(2.53~2.95)
0.25(1.81)	0.40~0.46(2.89~3.33)
0.30(2.17)	0.45~0.49(3.25~3.54)
0.35(2.53)	0.50~0.56(3.62~4.05)
0.408(2.95)	0.56~0.62(4.05~4.48)
0.50(3.62)	0.62~0.70(4.48~5.06)

(7) Confirm that the screw contacts with bearing.

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

(9) Apply loctite #271 to the thread of bearing cap bolt.
· Tightening torque : 15.5~16.5kgf · m(112~119lbf · ft).

(10) Assemble plate with hexagon bolts. Apply loctite #271 or #277 to the thread of bolt and then assemble at the tightening torque of 0.80~2.10 kgf · m(5.8~15.2lbf · ft).

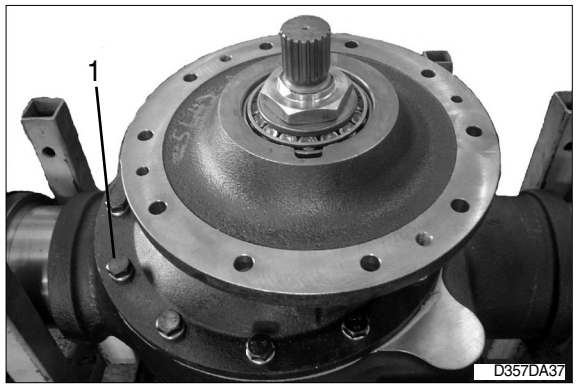
※ **Assemble opposite side with the same methods.**

(11) Apply marking liquid to 3~4 teeth of crown gear and then bring bevel pinion gear contact with the crown gear several times. Check out the contacted shape.

4) ASSEMBLY OF CARRIER

(1) Assemble carrier assembly into the axle housing.

(2) Apply loctite #271 or #277 to thread of bolt and then assemble at the tightening torque of 11~12kgf · m(79.6~86.8lbf · ft).

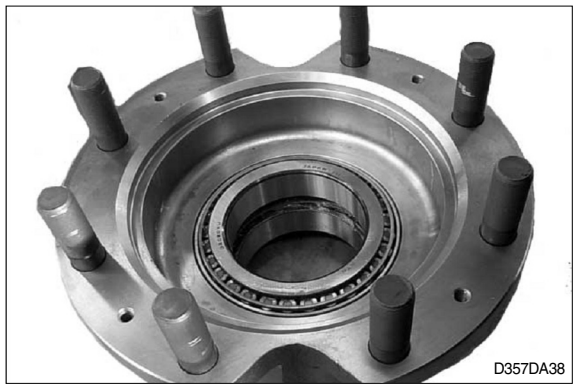


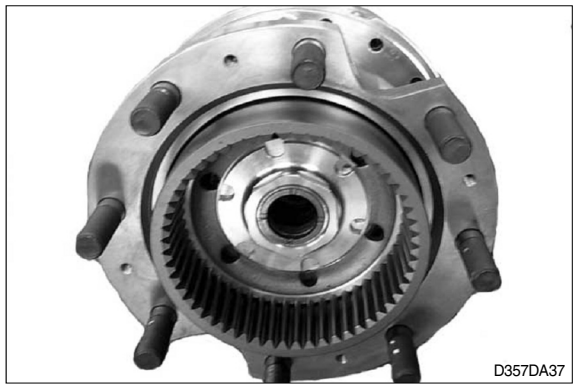
5) ASSEMBLY OF WHEEL HUB

(1) Insert bearing into wheel hub.
Confirm that the bearing and wheel hub contact completely.

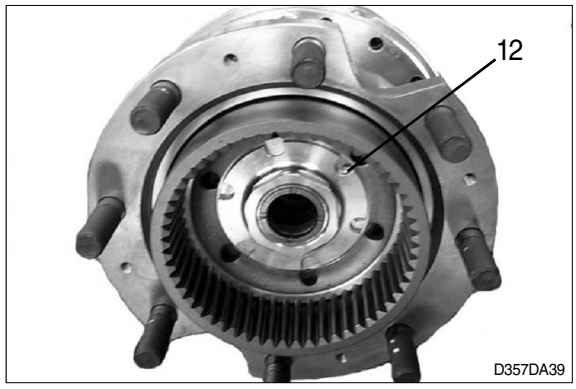
※ **Apply grease or oil to shaft seal and then assemble it from the direction of outer side of wheel hub.**

(2) Install wheel hub assembly to the tube flange of axle completely.
Install bearing cone.





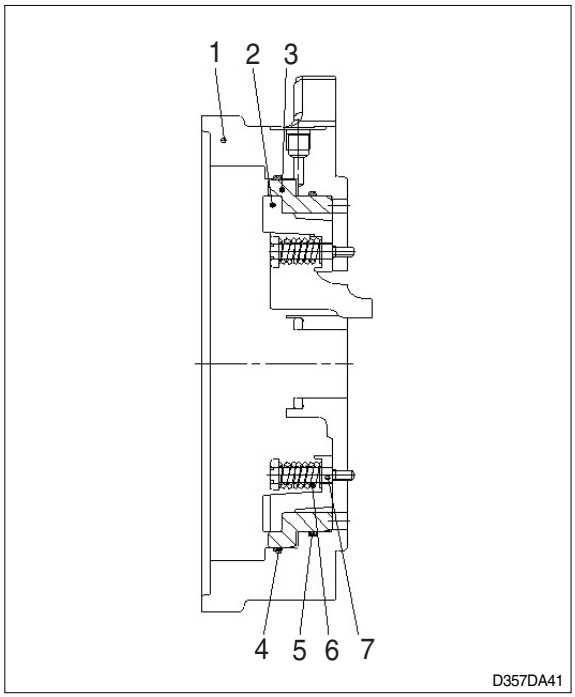
(3) Insert shim, fix the torque plate and ring gear with snap ring and assemble them to the axle tube.
Apply loctite #271 or #277.
Apply grease on the bushing.



(3) Assemble square ring(4, 5) with oil(MOBIL #424) to the brake housing.
Assemble piston(3) after applying oil sufficiently and apply loctite #271 to spring(6) and 4 bolts(4).

· Tightening torque : 1.4~1.6kgf · m
(10.1~11.6lbf · ft)

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



Assembling plate and inspection

① Assemble 4 plates(8) and 3 disks(9) into the brake housing(1).

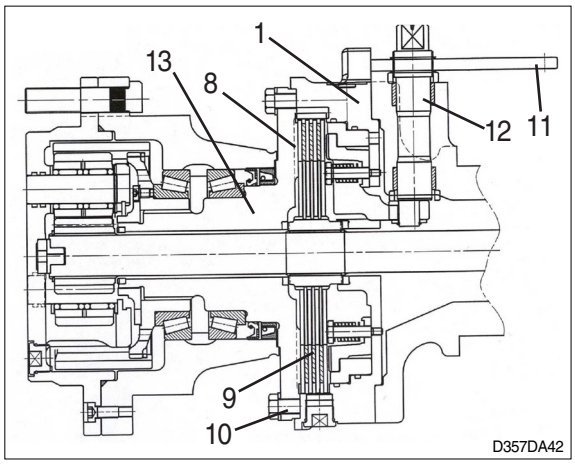
② Before assembling, clean all of the parts completely and remove burrs.

③ Disk must be assembled after 12 hours of infiltrate.(MOBIL #424)

④ After assembling plate and disk, confirm that the tolerance with brake housing surface is 1.8~2.3mm(0.07~0.09in).
(Spindle protrusion is 1mm(0.04in) and operation stroke of plate(8) and disk(9) assembly is 0.8~1.3mm(0.03~0.05in))

⑤ After tightening the bolt(10), confirm that parking lever(11) stroke is 18~28mm (0.71~1.10in) when pulling lever at the operation force of 25kgf.m(181lbf · ft).
· In case that the parking lever(11) distance is wrong, disassemble lever shaft(12) to rotate spline by 1 pitch and then reassemble it.

⑥ Apply loctite #5127 to spindle side of brake housing(1)



Unit : mm(in)

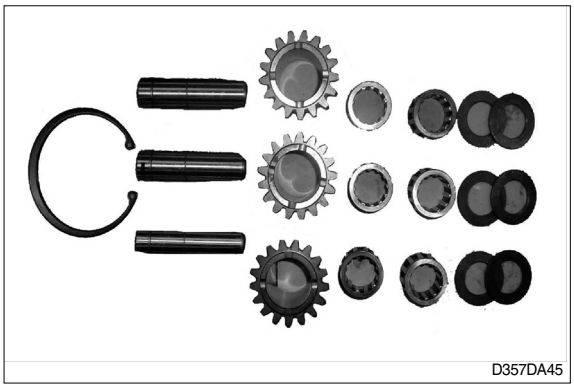
Spline	Parking lever operation distance
1 pitch	21(0.8)

(5) Assemble sun gear to axle shaft and fix it with snap ring.
Assemble axle shaft to the axle assembly.
Apply grease on the shaft where bushing contacts.
Apply grease to teeth parts of planetary gear.


D357DA43

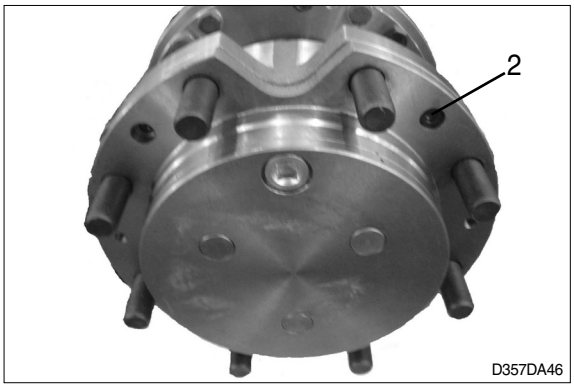
(6) Assemble internal components of planetary carrier in the reverse order to disassembly.


D357DA44


D357DA45

(7) Install planetary carrier assembly to wheel hub and tighten bolt(2).

· Tightening torque : 2.7~3.3kgf · m
(19.5~23.9lbf · ft)



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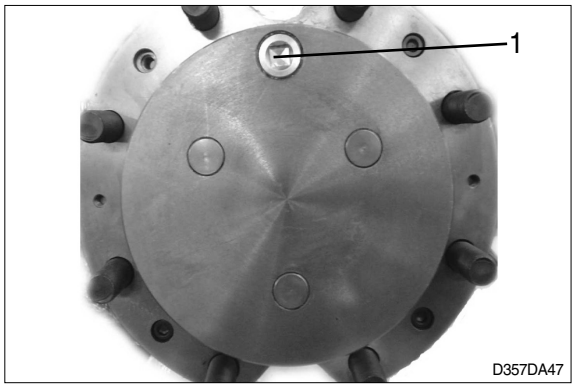
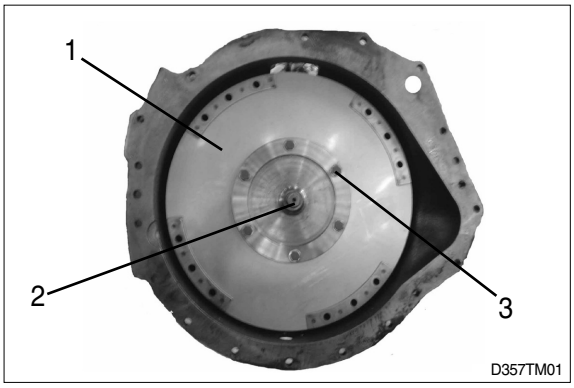
(8) Assemble wheel hub and tighten plug(1).

· Tightening torque : 4~5kgf · m
(28.9~36.1lbf · ft)

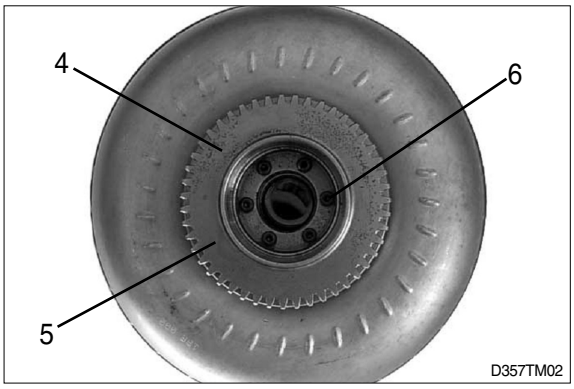


3. DISASSEMBLY OF TRANSMISSION

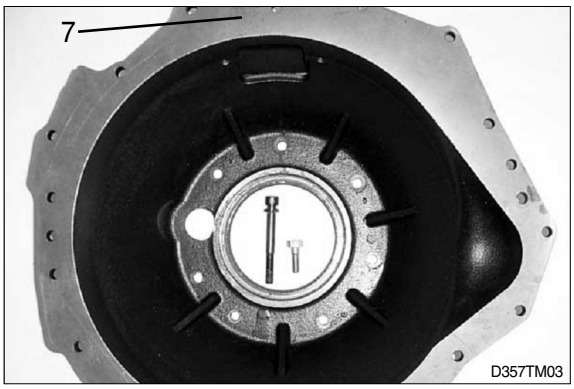
1) Remove torque converter from the housing. Loosen 6 bolt(3) from torque converter and then remove adaptor(2) and flexible plate(1).



2) Loosen 6 socket bolts(6) and remove Gear P.T.O Input(5).



3) Remove oil seal(8), 4 bolts(9, 10) and washer individually, from the housing(7).

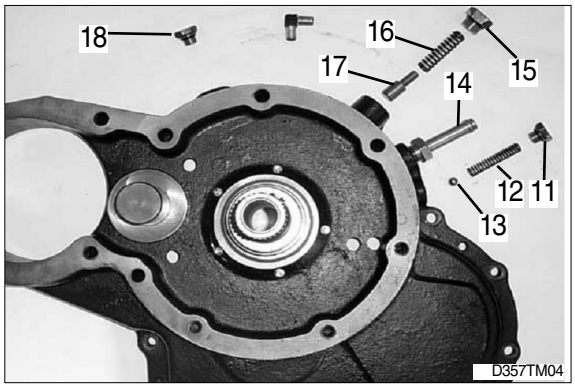


4) Remove plug(11), O-ring, spring(12) and ball(13) from cover.

5) Remove nipple(14) from the housing.

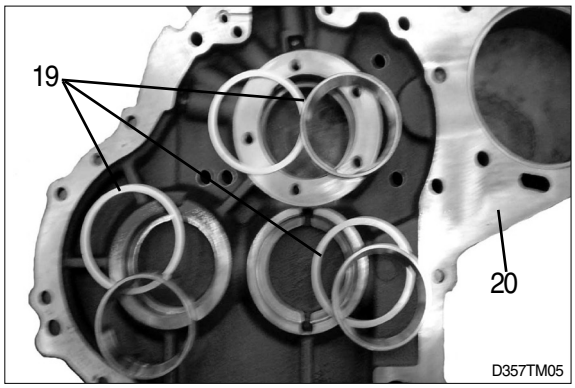
6) Remove plug(15), O-ring, spring(16) and valve(17).

7) Remove plug(18).



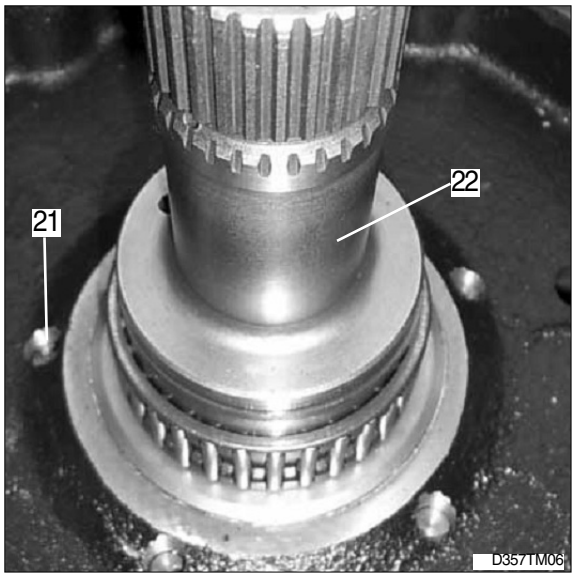
※ **Bearing cup(19) and shim(20) are located in the cover or at the shaft in the transmission case.**

※ **Mark the location of the bearing cup(19) and shim(20) on the transmission cover or shaft in the transmission case.**



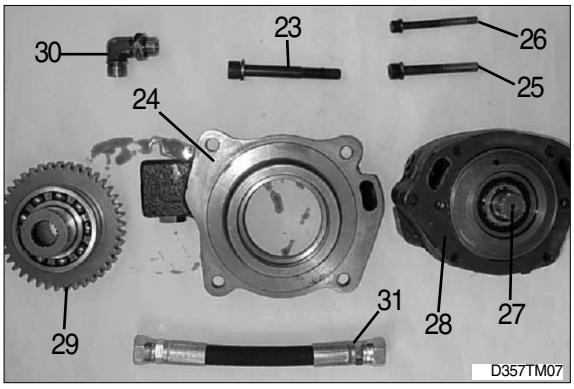
8) Loosen 5 bolts of stator hub(22) fixed at bearing plate(20) and remove stator hub(22) from bearing plate(20).

Use plastic hammer in order not to damage stator hub.

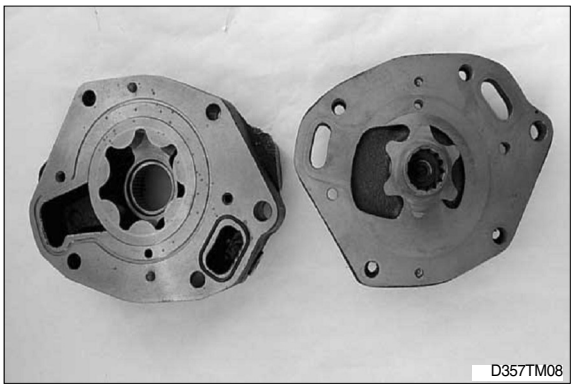


9) Remove 4 socket bolts(23) from the bearing plate(14) and disassemble flange pump(24).

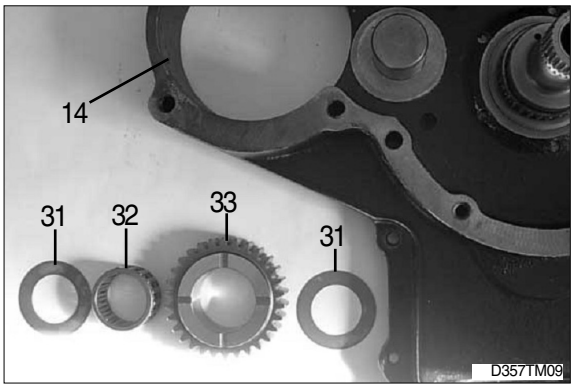
Remove 1 socket bolt(25) and 4 socket bolts(26) from the flange pump to remove charging pump(27) and pump gasket(27) and then disassemble gear P.T.O output(29) and ball bearing.
Remove elbow(30).



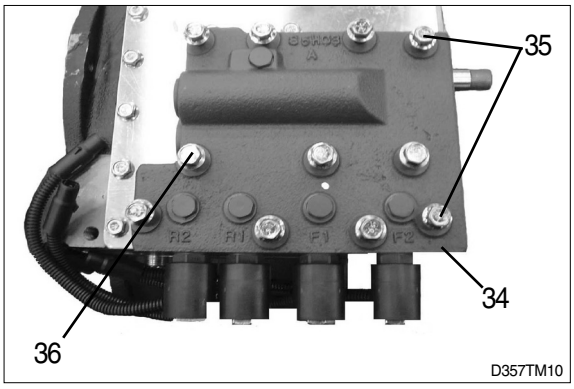
10) Loosen 2 socket bolts from charging pump(27) and then remove pump case and pump cover.



11) Remove 2 thrust washers(31), needle bearing(32) and gear P.T.O idle(33) individually from the bearing plate(14).



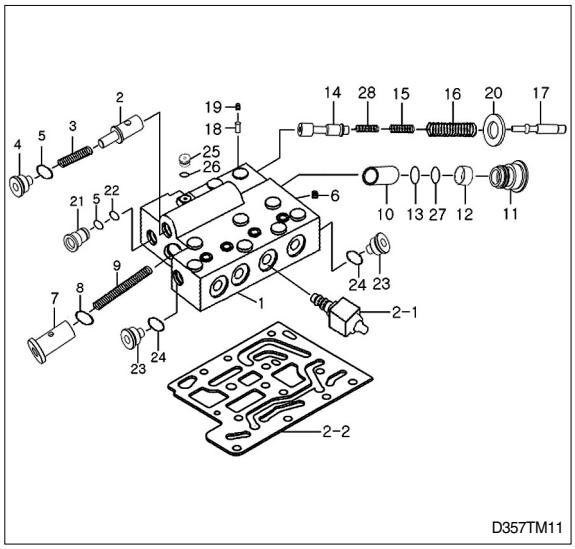
12) Remove 2 bolts(35) and 9 bolts(36) and then disassemble control valve gasket(34).



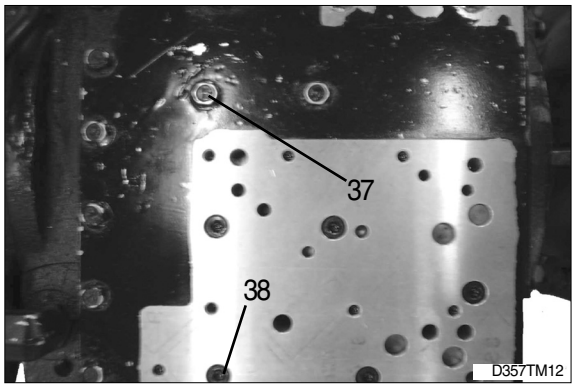
· **Disassembly of transmission control valve**

Remove transmission control valve

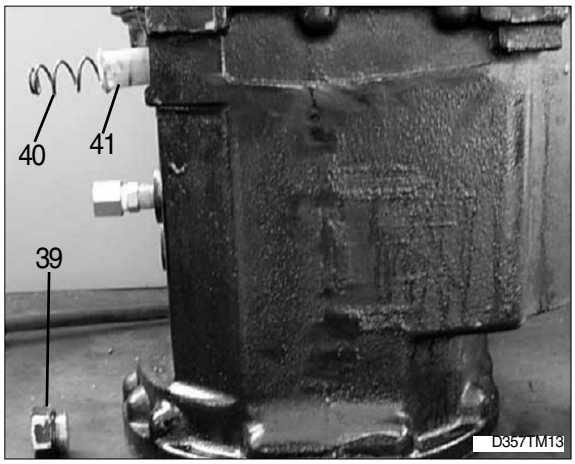
① Remove valve gasket(2-2).
② Remove stop bolt(19) and pin(18) from the valve body(1).
③ Remove spool(14), spring(18), spring (16), plunger(17), oil seal(20) and plug(21).
④ Remove plug(4), spring(3) and spool(2).
⑤ Remove plug(7), spring(9) and then remove plug(11), filter(12), O-ring(13, 27) and piston(10).
⑥ Remove both side of plug(23).



13) Remove 11 bolts(37) and 5 socket bolt(38) from transmission and remove valve plate carefully.

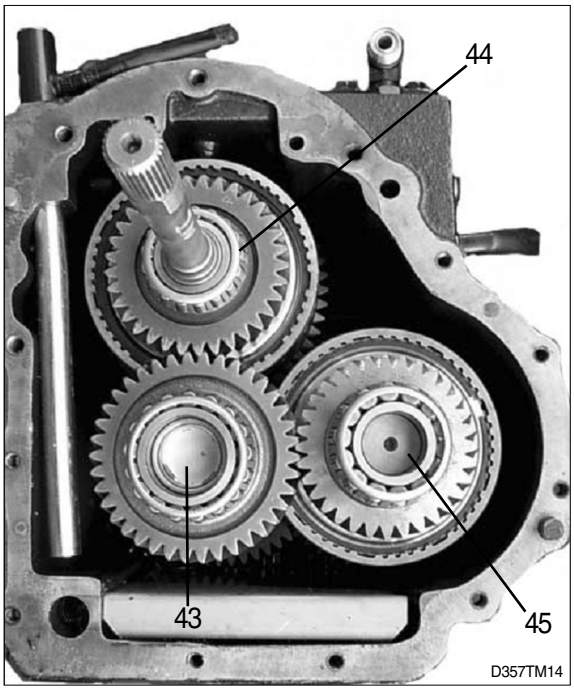


14) Remove plug(39) and O-ring and then remove spring(40) and oil screen(41) from the case.

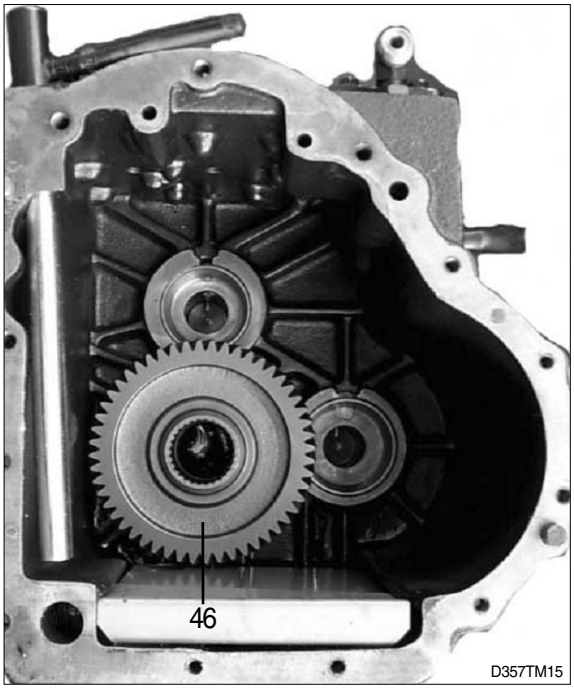


15)Using a plastic hammer push out tube(45) from transmission case.

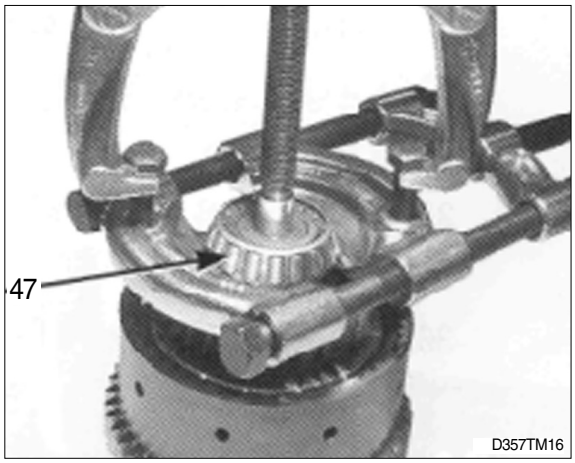
16)Remove output shaft assembly(43), input shaft assembly(44) and counter shaft assembly(45).



17)Disassemble output gear(46) from the transmission case.

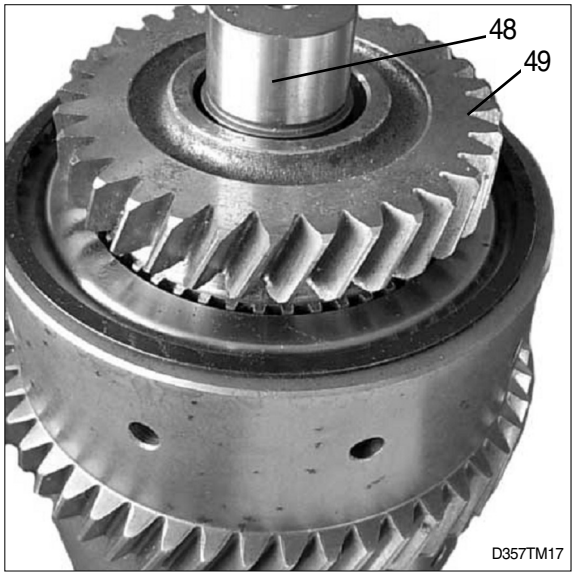


18)Disassemble bearing cone(47) for high speed which locates in front side of clutch assembly with a gear puller.

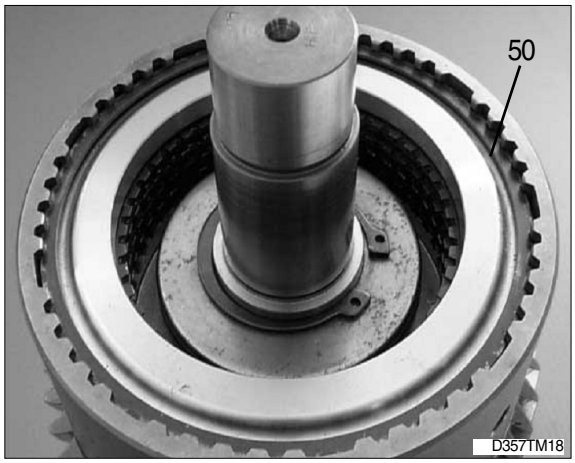


19)Remove 2 thrust washers(48) and gear(49).

20)Remove needle bearing and washer from the shaft in front side of high speed clutch.



21)Using a driver remove snap ring(50) from the cylinder.



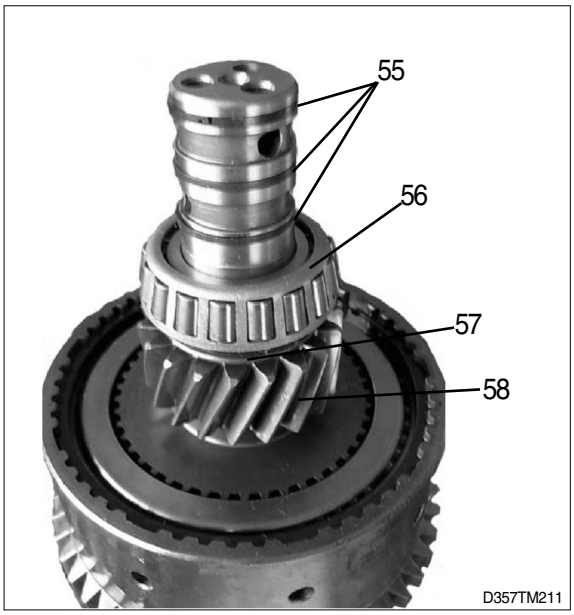
22)Remove clutch pressure plate, 7 clutch disks and 7 clutch plates(51) from the cylinder.

23)Pressing the retainer(52) downward and then remove snap ring(53) with a driver while reducing the tension of spring assembly.

24)Remove retainer(52) and spring assembly from the cylinder.

25)Remove piston(54) using pressurized air and remove O-ring from the shaft.

26)Remove seal ring from low speed forward clutch.
Remove 3 seal rings(55), bearing(56), thrust washer(57) and gear(58).
Remove needle bearing and spacer.



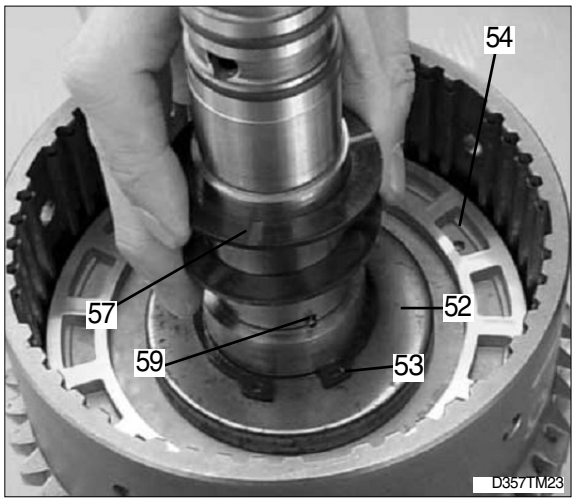
27)After removing snap ring(50) and then disassemble 7 disks and 7 plates from the cylinder.

28)Remove 2 thrust washers(57) and a pin(59).

29)By pressing the retainer(52), remove snap ring(53).
Carefully reducing tension of spring assembly, remove retainer and spring.

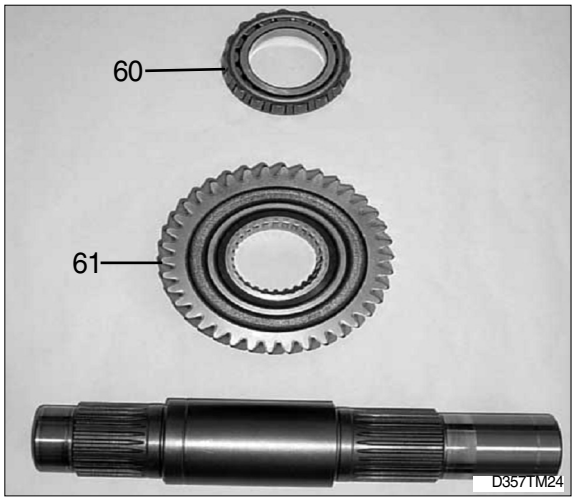
30)Using a air compressor, remove piston(54) and pull out O-ring.

※ **Disassembling procedure of Input shaft assembly is same as that of counter shaft assembly.**



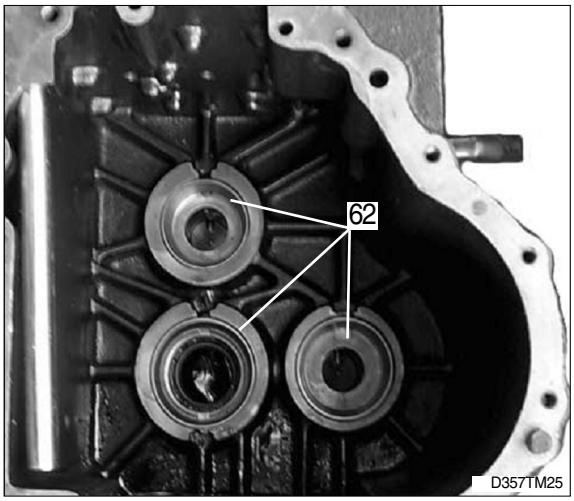
31)Disassemble input shaft assembly.

32)Remove bearing(60) and gear(61) from the output shaft assembly.

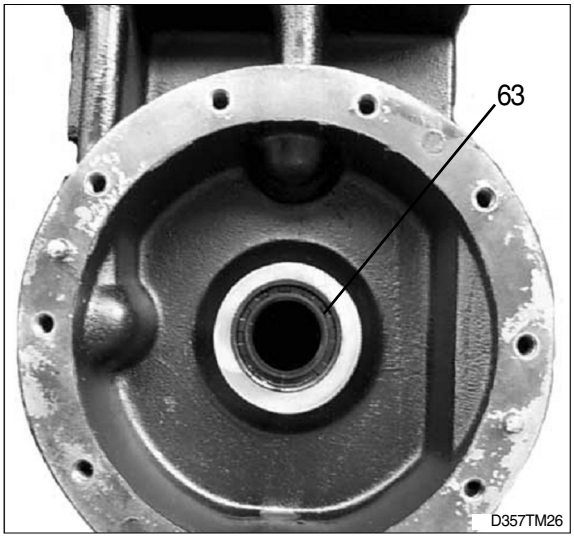


33)Remove 3 kinds of bearings(62) from the transmission case.

※ **Mark on the bearing.**



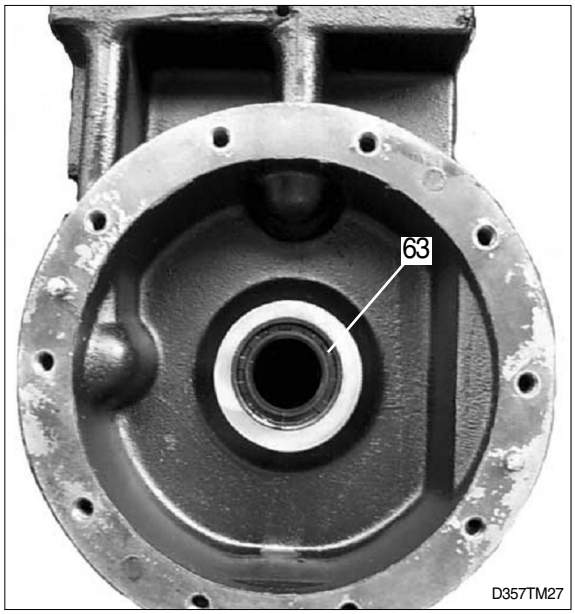
34)Remove lip shaped oil seal (63) from the transmission.



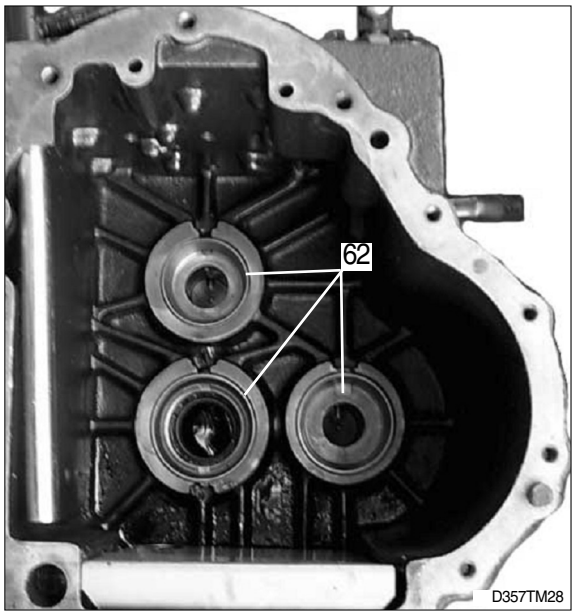
4. ASSEMBLY OF TRANSMISSION

1) After cleaning all of the parts completely, apply T/M oil.

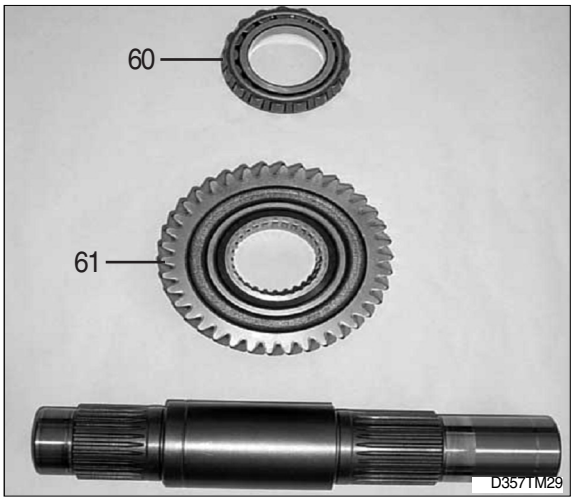
2) Install inner seal(63) in order lip side to face the inner side and outer seal to face the outer side.



3) Assemble 3 kinds of bearing cups(62) into the transmission case at their original positions.



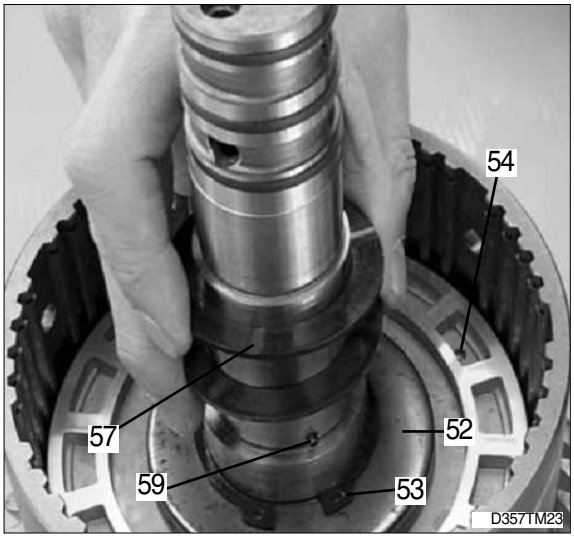
4) Assemble gear(61) and bearing(60) to the output shaft.



5) Install seal ring on the piston(54).
Apply T/M oil to seal ring.

6) Assemble seal ring and piston into the cylinder.

※ **Be careful not to damage seal ring when assembling piston.**

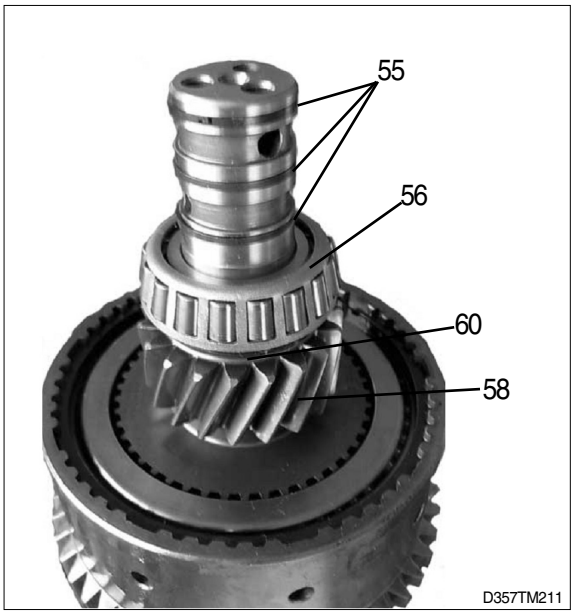


7) Install spring assembly and retainer(52) inside the cylinder.

8) Fix axle assembly in a vise and then pressurize the retainer downward to assemble snap ring with a screw driver.

9) Assemble pin(59) and 2 thrust washers(57) inside the counter shaft of low speed clutch.

10) Assemble needle bearing, spacer, gear(58), thrust washer(60) and bearing(56).



11) Apply clean T/M oil to the clutch disk and plate and then assemble 7 clutch disks and plates in the order of ;
   (1) At first, install clutch plate which has teeth on the outer race.
   (2) Install clutch disk which has teeth on the inner race.
   (3) Repeat (1) and (2) until all of the clutch plates and disks are assembled.

12) Install pressure plate inside the cylinder.

13) Assemble the pressure plate in the right position and then install snap ring(50) with a screw driver.

14) Assemble 3 seal rings(55) on the shaft.

※ **Be careful not to damage seal ring inside the counter shaft.**

15) Refer to 5) ~ 8) for assembling another side of counter shaft assy.

16) Apply clean T/M oil to the clutch disk and plate and then assemble clutch disks and plates in the order of ;
   (1) At first, install clutch plate which has teeth on the outer race.
   (2) Install clutch disk which has teeth on the inner race.
   (3) Repeat (1) and (2) until all of the clutch plates and disks are assembled.

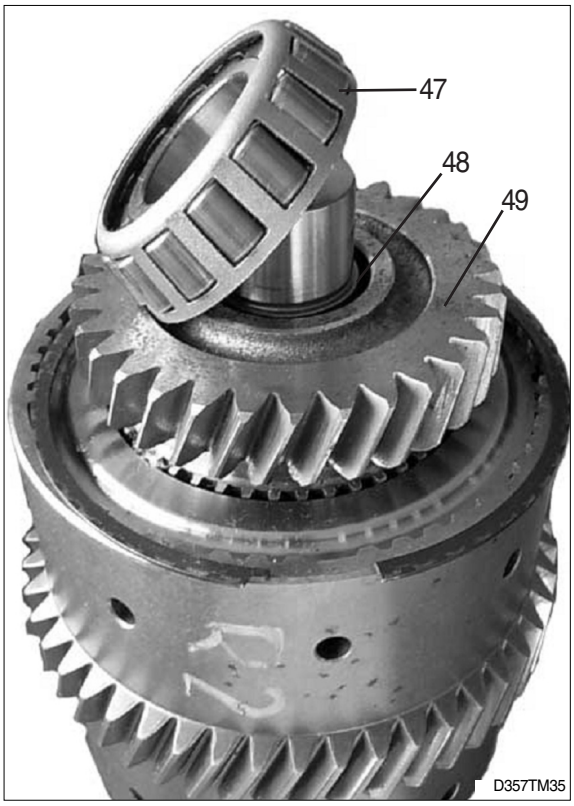
17) Install pressure plate inside the cylinder.

18) Assemble snap ring(50) fixing the pressure plate inside the cylinder with a screw driver.

19) Assemble thrust washer and needle bearing to the high speed clutch counter shaft.

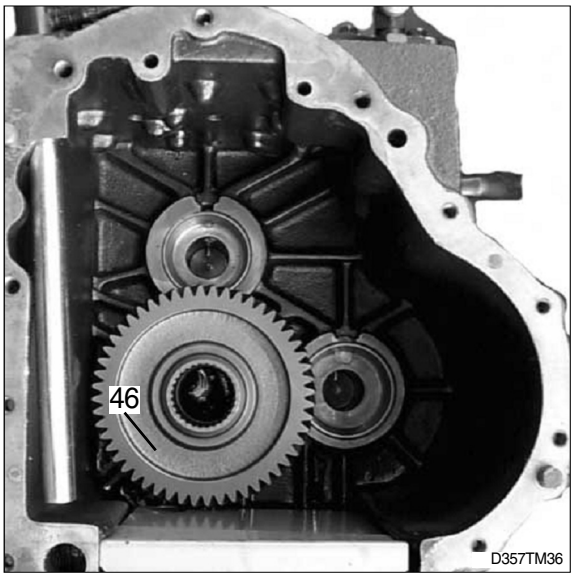
20) Assemble gear(49), thrust washer(48) and install bearing cone(47).

※ **Do not apply compulsory force when assembling gears.**
Move gear forward and backward until spline of gear and teeth side of clutch disk mesh with each other.



21)Assembly order of input shaft is the same as that of counter shaft assembly.

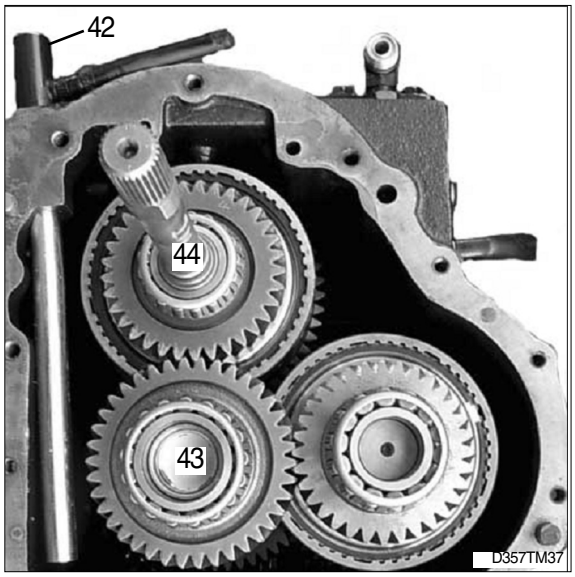
22)Install gear assembly(46) into the transmission.



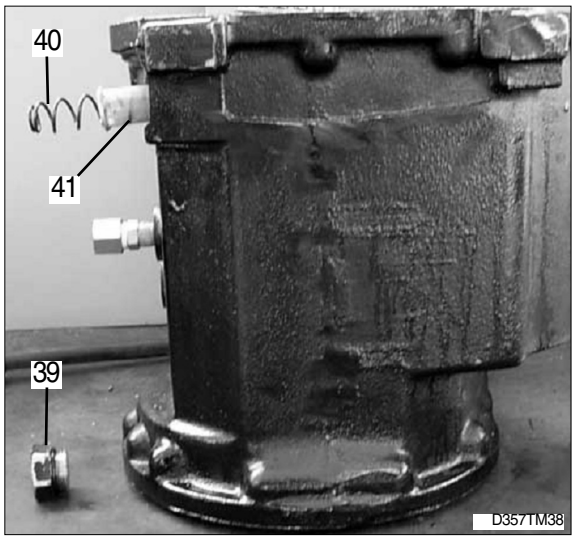
23)Place the T/M case in the right position and then install counter shaft assembly(45) carefully.

24)Install input shaft(44) carefully on its own place.
Assemble output shaft assembly(43) into the output gear assembly(46) and then rotate the gear until teeth meshed.

25)Install tube(42) into the case with a plastic hammer.

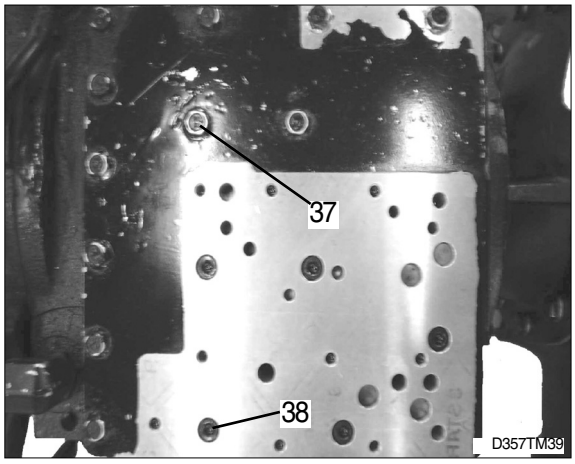


26)Assemble oil screen(41), spring(40), plug(39) and O-ring into the transmission case.



27)Apply loctite #5172 on the gasket adhering surface of case and then fix it.
Tighten bolt(37) and 5 socket bolts(38) to assemble valve plate.

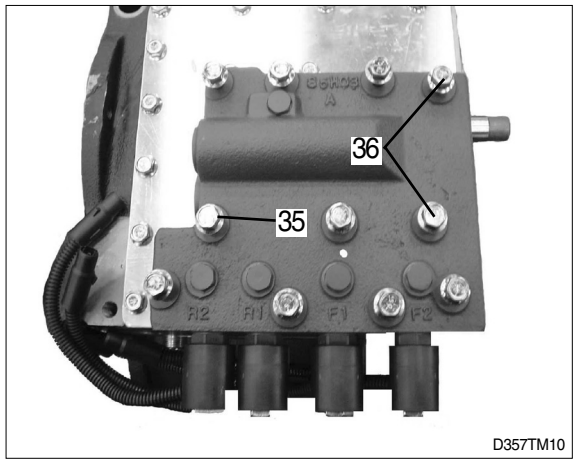
· Tightening torque (37, 38)
: 2.8kgf · m(20.3lbf · ft)



28)After adhering valve gasket(34), assemble valve plate with 9 bolts(35) and 2 bolts(36).

· Tightening torque (35) : 1.4kgf · m (10.1lbf · ft)

· Tightening torque (36) : 2.8kgf · m (20.3lbf · ft)



D357TM10

29)T/M control valve assembly

① Adhere valve gasket on the control valve body.

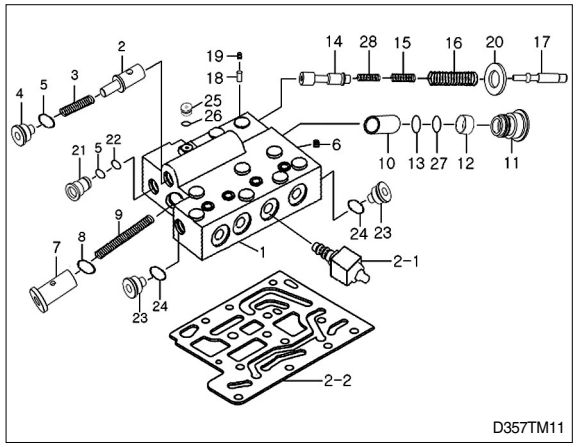
② Assemble plug(23) on the both sides.

③ After assembling spring(9) and plug(7) and then install piston(10), O-ring(13, 27), filter(12) and plug(11).

④ Assemble plug(21), spool(14), spring (28,15,16), oil seal(20) and plunger(17).

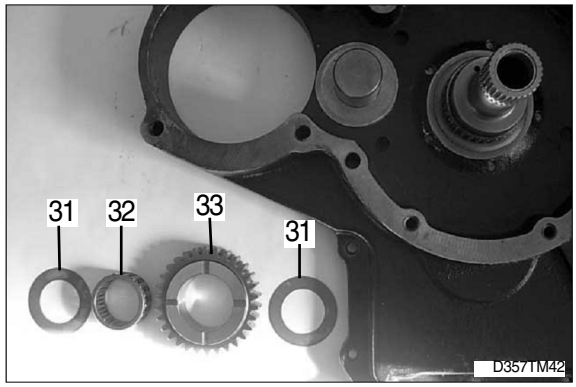
⑤ Assemble pin(18) and stop bolt(19).

⑥ Assemble spool(2), spring(3)and plug(4).



D357TM11

30)Assemble 2 thrust wasers(31), needle bearing(32), Gear-P.T.O Idle(33) to the bearing plate(14) individually.

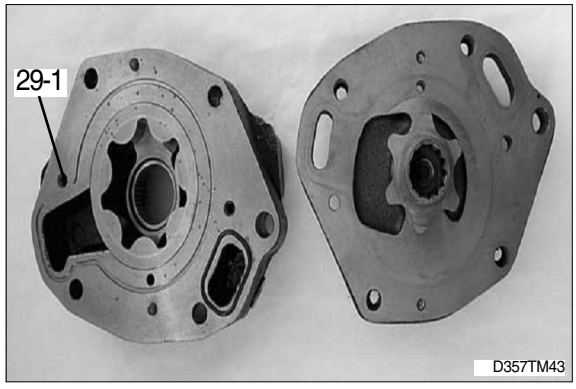


D357TM42

· Charging pump assembly

31)Assemble pump case and pump cover with 2 socket bolts (29-1).

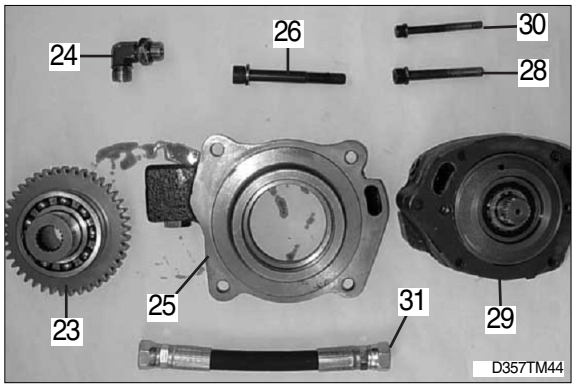
· Tightening torque (29-1) : 0.48~0.55kgf · m (3.5~4.0lbf · ft)



D357TM43

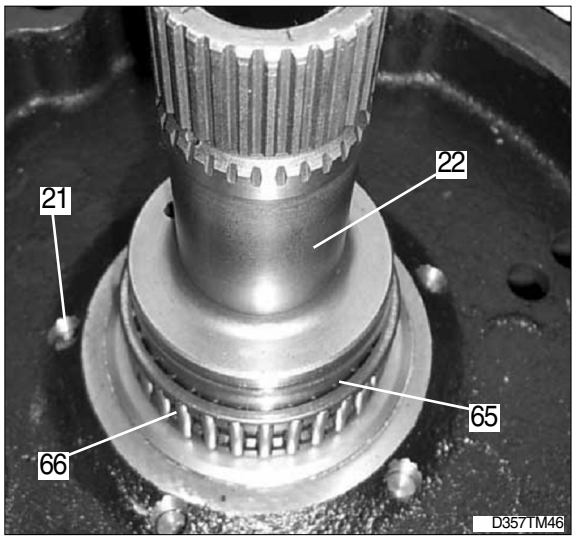
32) Assemble the gear P.T.O output(23) and 2 ball bearings to the flange pump(25) with a jig and then assemble them to bearing plate with 4 bolts(26). Install charging pump(29) and gasket (27) to the flange pump(25) with bolts(28, 30x4).
Assemble elbow(24) and then connect tube(31) to the elbow(24).

- Tightening torque(26) : 11~12kgf · m (79.6~86.8lbf · ft)
- Tightening torque(28) : 4.9~5.5kgf · m (35.4~39.8lbf · ft)
- Tightening torque(30) : 3.5~4.1kgf · m (25.3~29.7lbf · ft)



33) Assemble Stator Hub (22) with a bushing(64), a seal ring(65) and a needle bearing(66) on the bearing plate by fastening with 5 bolts(21).

- Tightening torque (21) : 6.5~7.1kgf · m (47.0~51.4lbf · ft)



34) Assemble plug(18) and O-ring into the bearing plate.

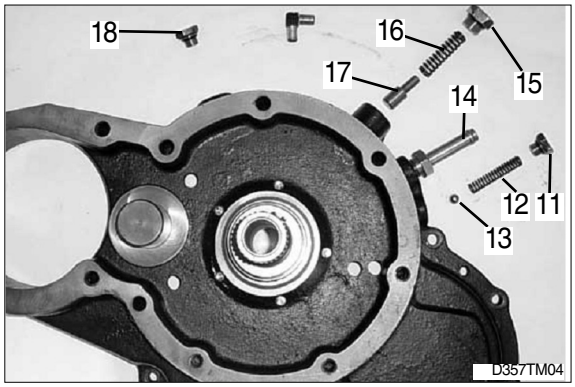
35) Assemble valve(17), spring(16), plug(15) and O-ring into the bearing plate.

36) Assemble nipple(14).

37) Fit ball(13), spring(12), plug(11) and O-ring into the bearing plate.

38) Install bearing cup and shim into the T/M cover.

※ **Install bearing cup and shim on their own position of the transmission case to align the shaft and the transmission case.**

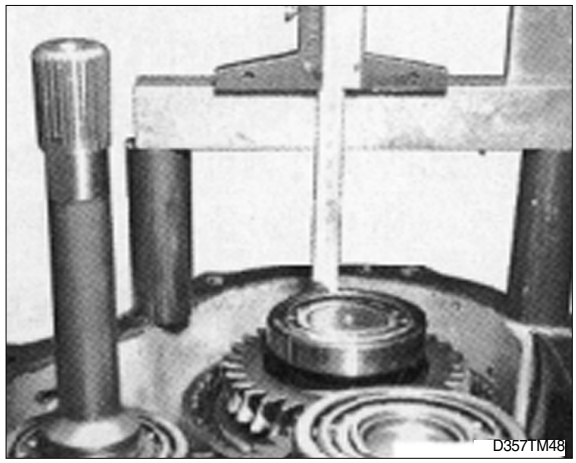


39) In case of using new items calculate the shim thickness as below.

(1) Shaft assembly. (Including tapered bearing cone and cup)
(2) Install shaft assembly into the T/M case.
(3) Measure distance from the surface of bearing cup to that of T/M case, "**X**".

※ **The height of bearing cup should be higher than the height of T/M case so that depth gauge and block gauge can be used.**

(4) Measure distance from the beneath of bore fitted with bearing cup to the transmission cover surface, "**Y**".

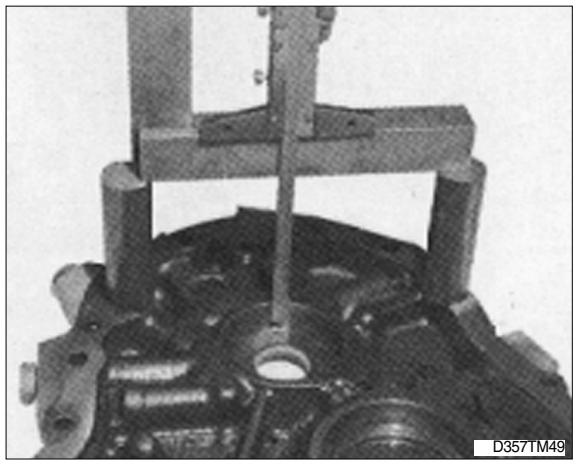


(5) Shim thickness can be acquired by ;

· **Measuring shim thickness**

T/M cover depth - Protrusion of shaft bearing.

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

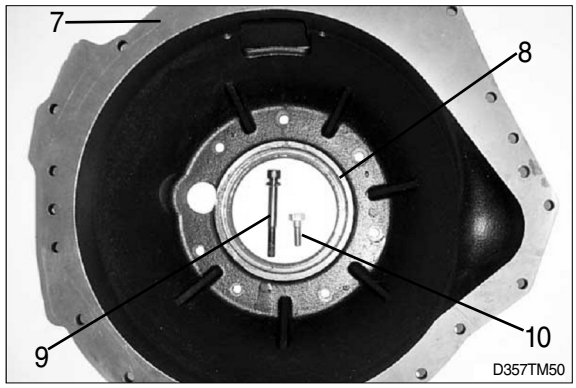


(6) Choose 0~0.5mm(0.002in) required shim.
(7) Assemble cover on the T/M case.
(8) Turn the T/M assembly vertically.
(9) Check shim adjustment
(10) In case that output shaft doesn't rotate smoothly, remove shim of 0.025~0.05mm (0.001~0.002in).

※ **Do not tilt the T/M assembly while assembling the cover.**
Seal ring of input shaft may be damaged.

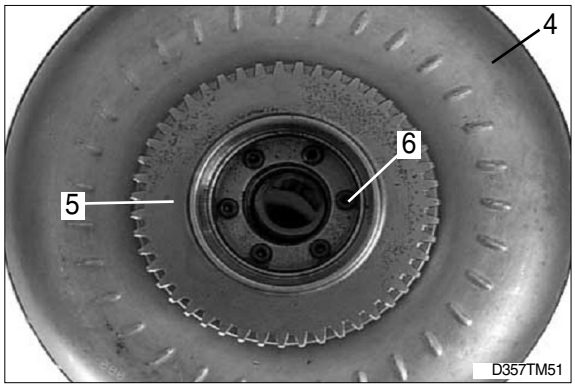
40) Assemble oil seal(8), 4 bolts(9, 10) and washers into housing.

· Tightening torque (9, 10): 6.6~7.2kgf · m (47.7~52.1lbf · ft)



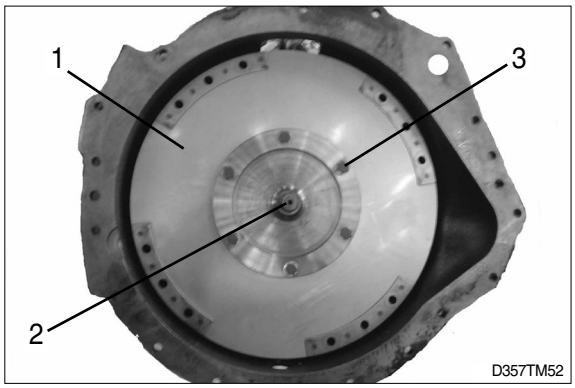
41)Install Gear P.T.O Input(5) on the torque converter(4) and fasten with 6 socket bolts(6).

· Tightening torque : 1.7~2.3kgf · m
(12.3~16.6lbf · ft)



42)With 6 bolts(3) and 6 washers, assemble adaptor(2) and flexible plate(1) into torque converter.
And then put together torque converter and housing.

· Tightening torque : 4.2~4.8kgf · m
(30.4~34.7lbf · ft)



SECTION 4 BRAKE SYSTEM

SECTION 4 BRAKE SYSTEM

GROUP 1 STRUCTURE AND FUNCTION

1. OUTLINE

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

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

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

2. SPECIFICATION

1) DISK BRAKE

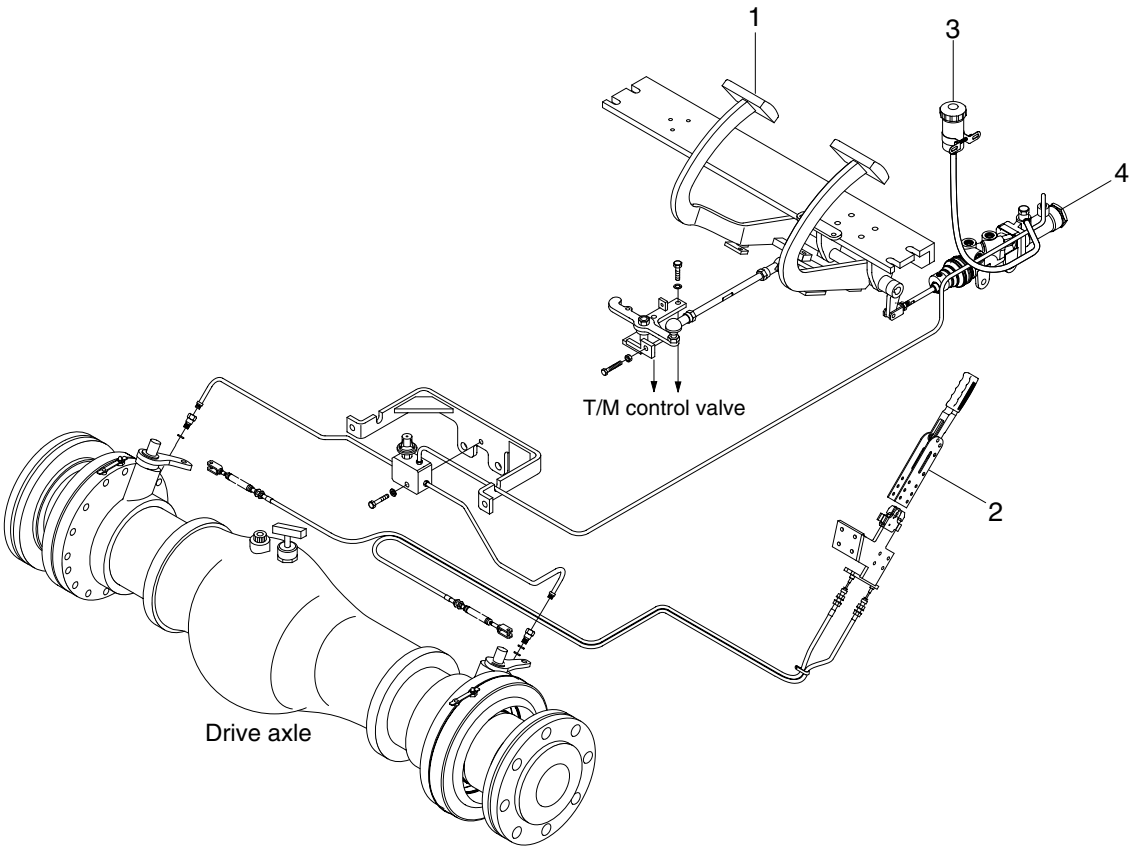
Item		Specification
Type		Wet disk brake
Brake valve step/bore piston diameter		40mm (1.6in) / 30mm (1.2in)
Pedal adjustment	Pedal height	130~140mm (5.1~5.5in)
	Play	5~8mm (0.2~0.31in)
Brake oil		Azola ZS10 (SAE 10W hydraulic oil)

2) PARKING BRAKE

Item	Specification
Type	Ratchet, internal expanding mechanical type
Parking lever stroke	295mm(11.6in)
Parking cable stroke	28mm(1.1in)

3. BRAKE PEDAL AND PIPING

1) STRUCTURE

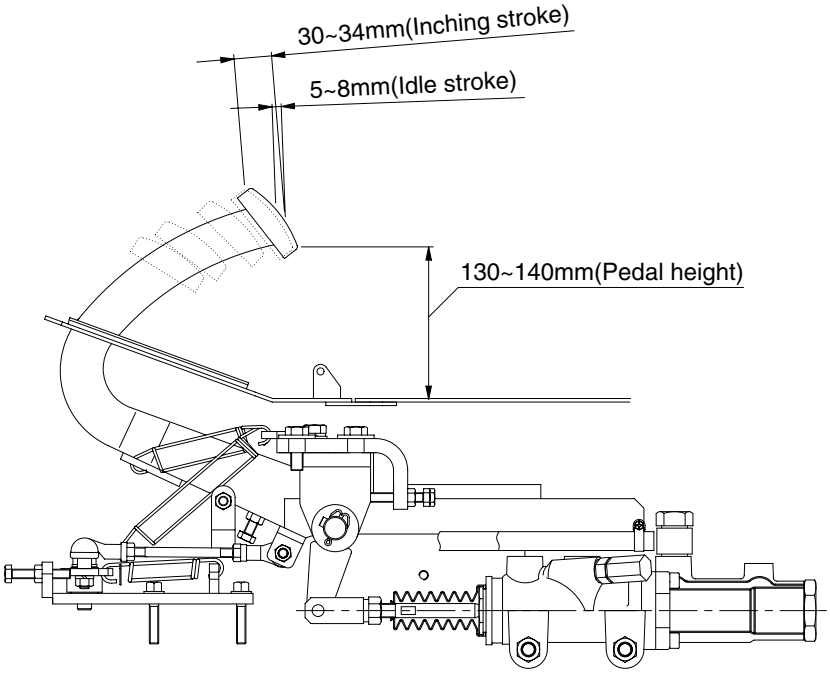


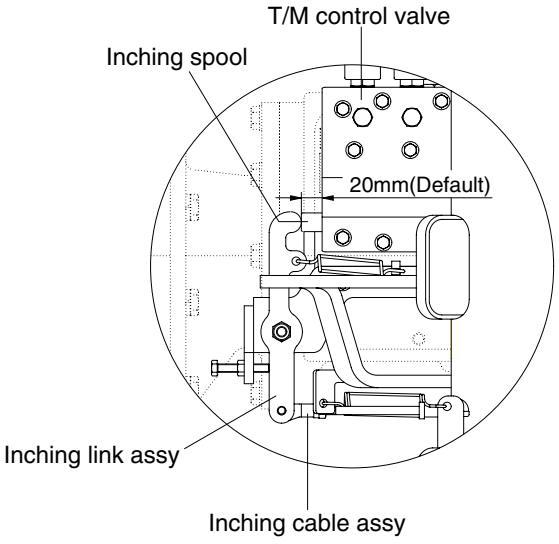
35DS7BS03

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

4. INCHING PEDAL AND LINKAGE

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

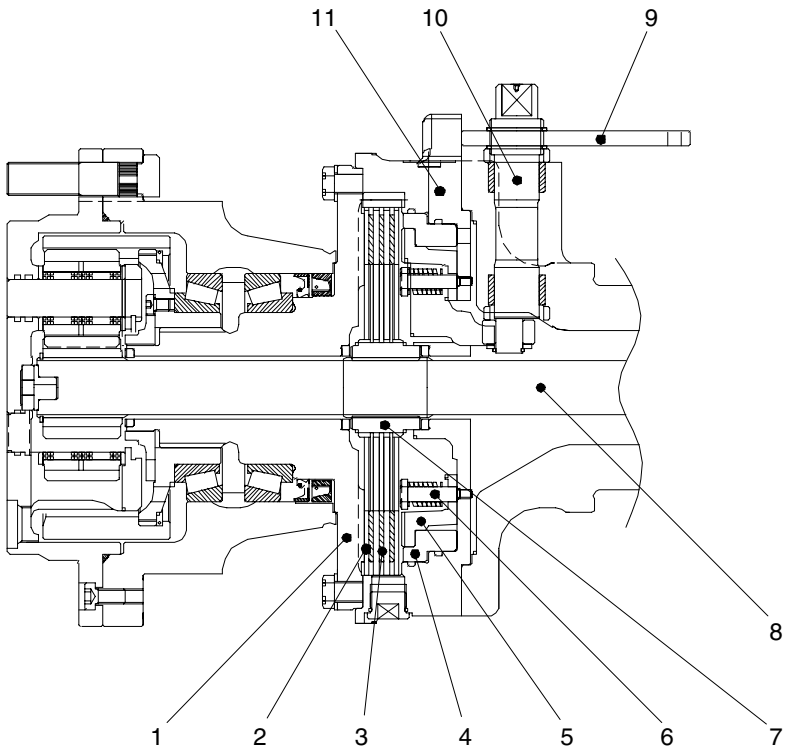




35L7BS04

5. WET DISK BRAKE

1) STRUCTURE



D357TA10

1	Spindle	5	Service piston	9	Parking lever
2	Steel plate	6	Parking piston fixing bolt	10	Parking lever shaft
3	Disk plate	7	Spline collar	11	Brake housing
4	Parking piston	8	Drive 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.

Parking brake's lever system is the serration type, so it is possible to adjust the play.

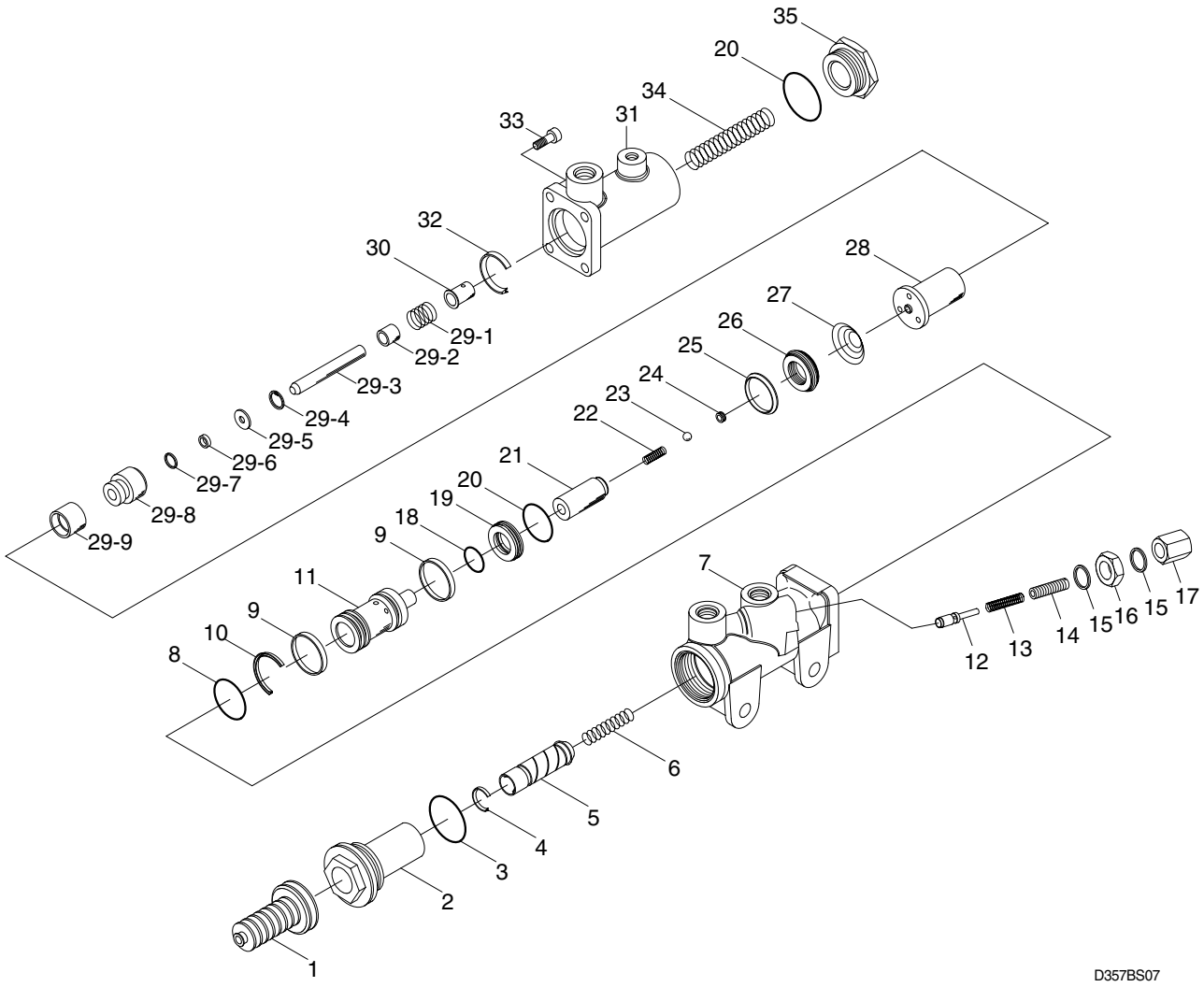
Because it is easy to maintain the gap of both brakes, high brake efficiency and minimum disproportional braking deviation is acquired.

Major components are 3 disk plates(3), 4 steel plates(2), service piston(4), parking piston(5), parking lever(9) and brake housing(11).

Braking force is applied by restricting the driving force from drive shaft(8) and spline collar(7).

6. BRAKE VALVE

1) STRUCTURE

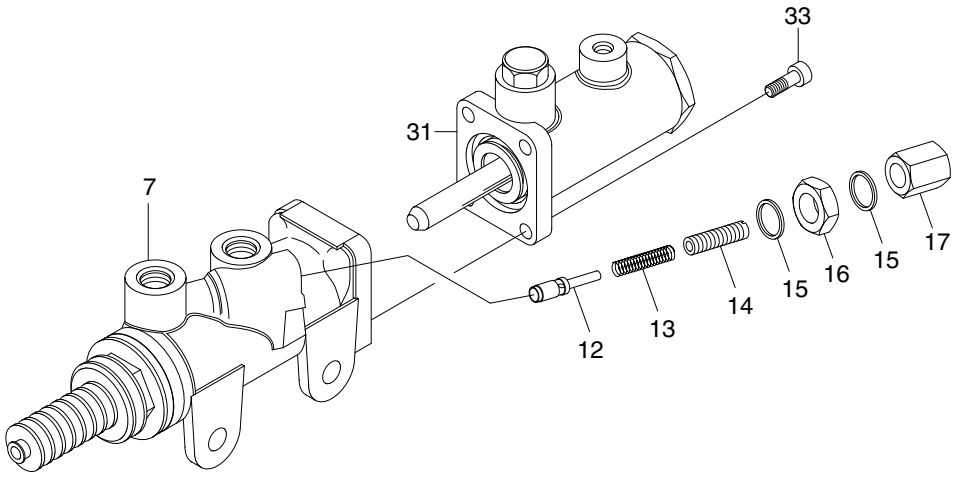


1	Dust cover	16	Nut	29-2	Spool plug
2	Guide plug	17	Plug	29-3	Spool
3	Seal	18	Seal	29-4	Stop ring
4	Seal	19	Ring	29-5	Washer
5	Push rod	20	Seal	29-6	Seal
6	Push rod spring	21	Auxiliary piston	29-7	Seal
7	Booster housing	22	Spring	29-8	Valve housing
8	Seal	23	Ball	29-9	Seal
9	Sliding guide	24	Seal	30	Spring guide
10	Seal	25	Ring	31	Brake cylinder housing
11	Booster piston	26	Seal	32	Seal
12	Relief valve body	27	Spring	33	Fixing screw
13	Spring	28	Piston	34	Spring
14	Adjusting screw	29	Valve	35	Plug
15	Washer	29-1	Spring		

2) DISASSEMBLY

⚠ All operations must be carried out with the greatest care, following the instructions carefully. The disassembly instructions are being provided in chronological.

(1) Unscrew the 4 screws(33), in order to be able to separate the front housing(7) from the rear housing(31).
Then disassemble the check valve and the limiting pressure valve composed of parts(12~17).

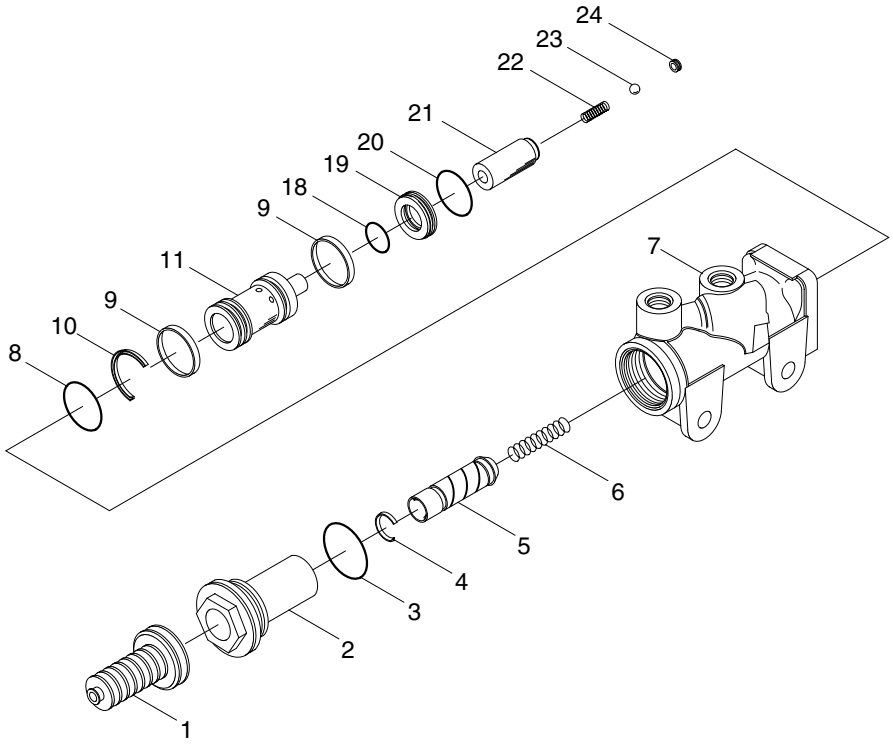


D357BS08

(2) Remove dust cover(1) and then unscrew guide plug(2) with O-ring(3).

(3) Extract push rod(5) and spring(6).
Disassemble booster piston(11) with seal(8,10) and guide sliding(9) and then remove seal(18,20) and ring(19).

(4) Extract auxiliary piston(21) with auxiliary spring(22), ball(23) and seal(24).



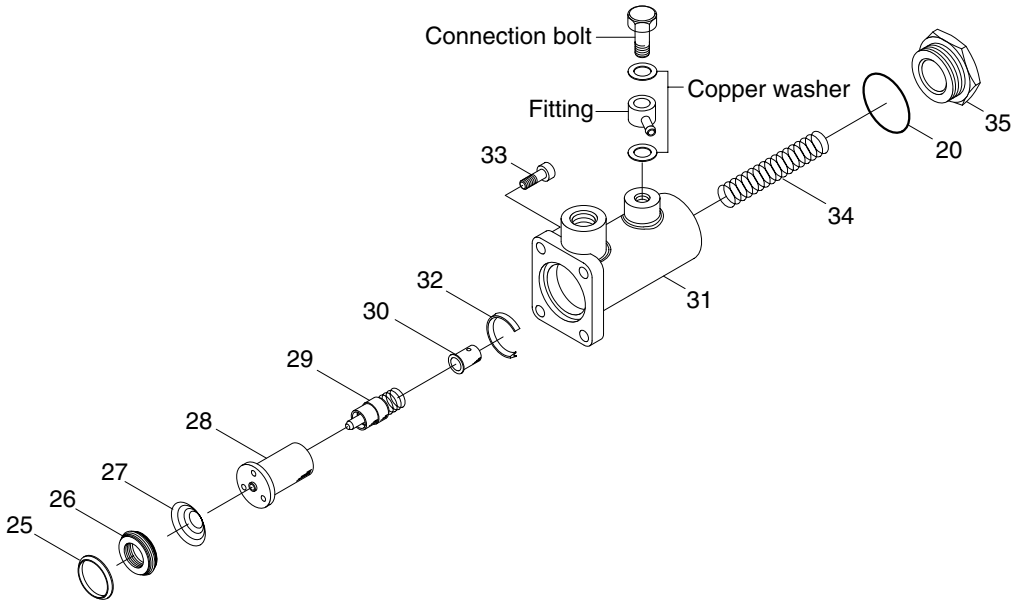
D507BS09

(5) Remove ring(25), seal(26), spring(27) and piston(28).

(6) Disassemble valve assembly(29), spring guide(30) and seal(32).

(7) Remove the O-ring and the lip seal still inside the pump body with the aid of an “L” iron.
Remove all of the other gaskets from the disassembled components, namely the push rod(5), the piston(11).

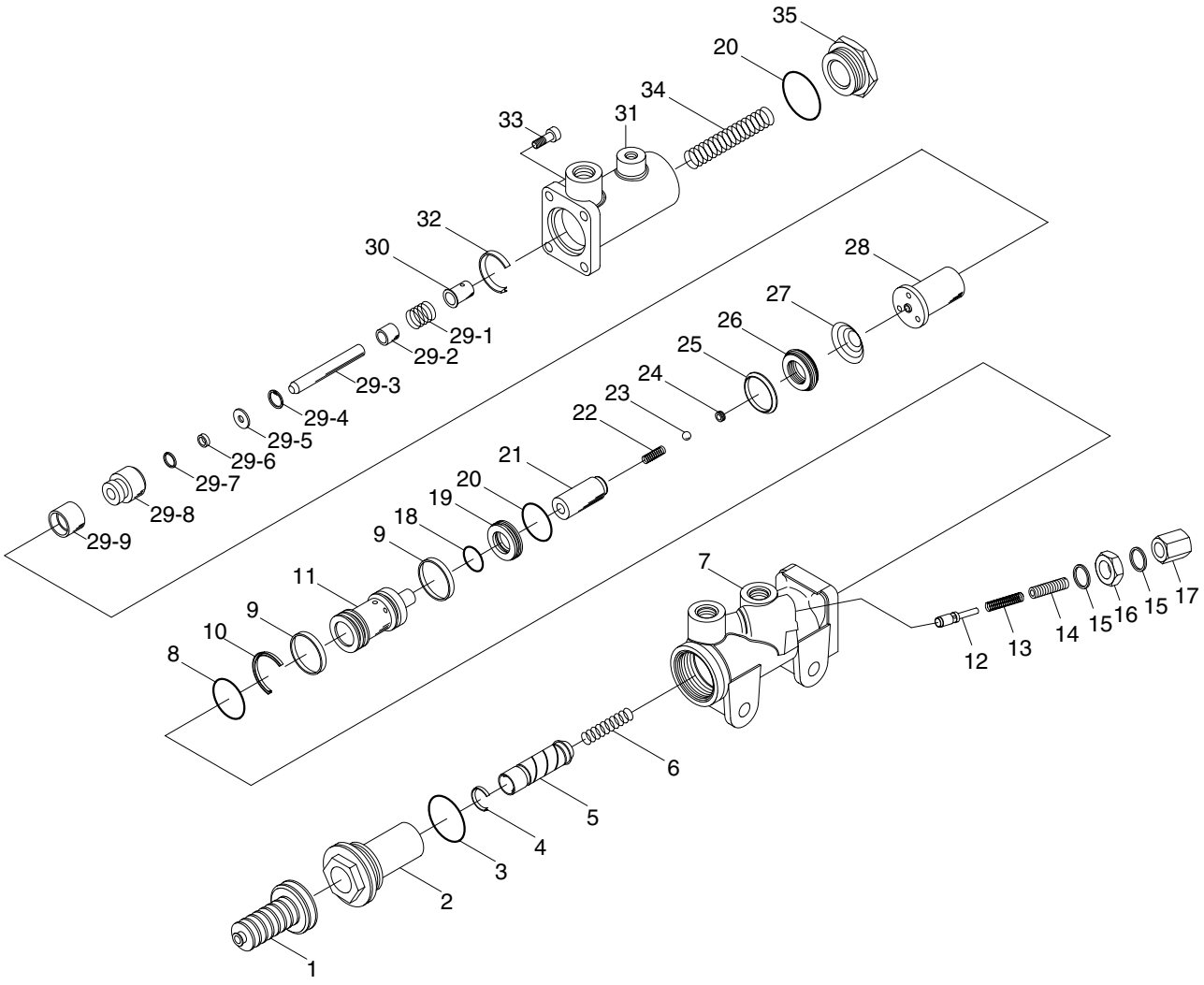
(8) Clean all the components thoroughly and check that there is no ribbing inside the piston slide cylinder(11) of the pump body; smooth if necessary.
Lubricate the components either with mineral or with hydraulic oil, according to their use destination.



D357BS10

3) ASSEMBLY

※ The assembly must be carried out by following the so far described sequence but in reverse order, taking great care not to assemble the new gaskets back to front or upside down.



D357BS07

· SEAL KIT : ZTAX-00077

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

GROUP 2 OPERATIONAL CHECKS AND TROUBLESHOOTING

1. OPERATIONAL CHECKS

1) BRAKE PIPING

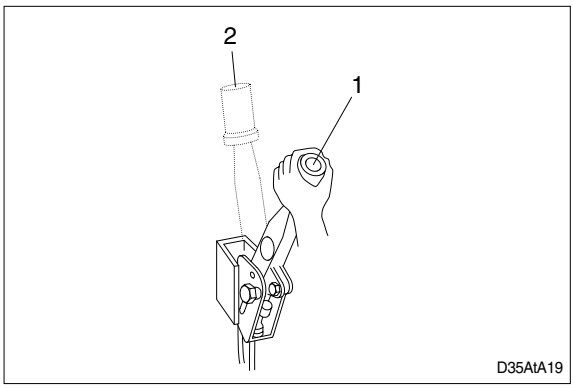
(1) Check pipes, hoses and joints for damage, oil leakage or interference.

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

2) PARKING BRAKE

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

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



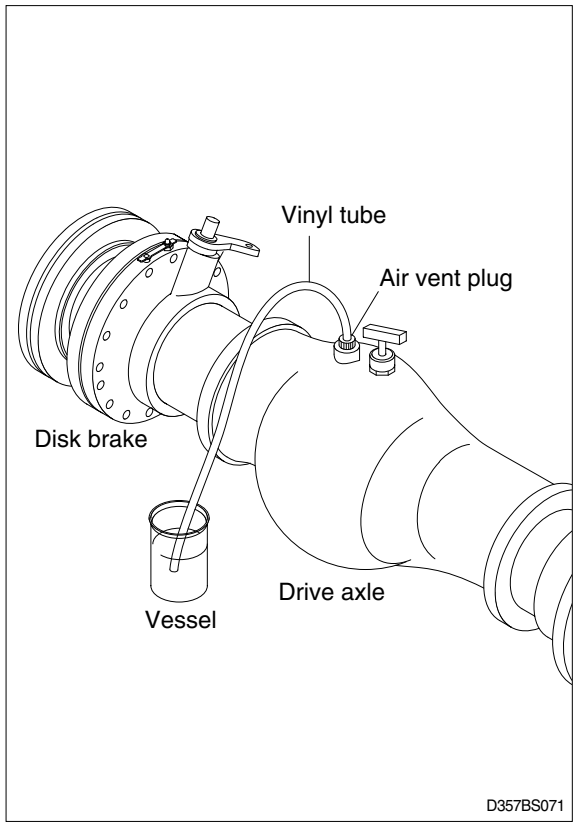
2. TROUBLESHOOTING

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.



2. ADJUSTMENT OF PEDAL

1) BRAKE PEDAL

(1) Pedal height from floor plate

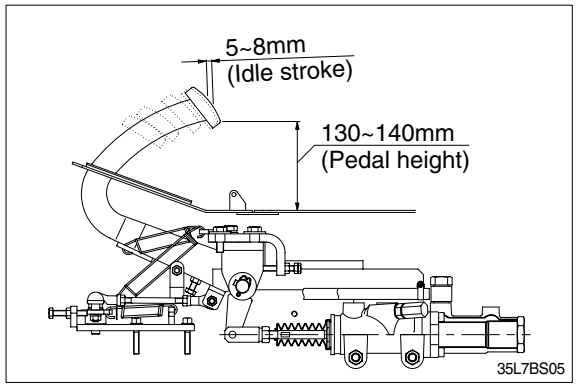
Adjust with stopper bolt.

· Pedal height : 130~140mm(5.1~5.5in)

(2) Idle stroke

Adjust with rod of brake valve

· Play : 5~8mm(0.2 ~ 0.31in)



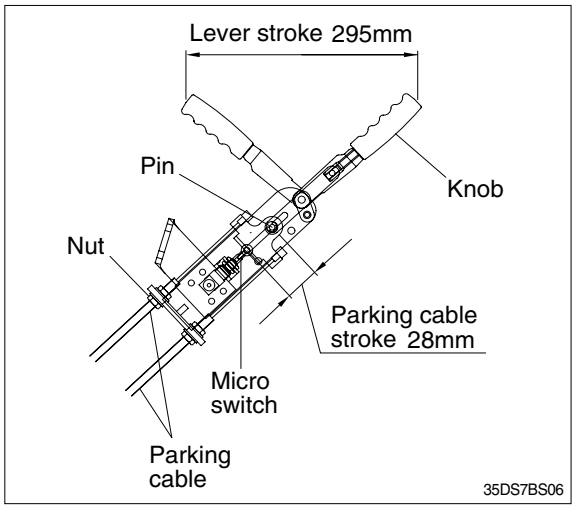
(3) Micro switch for parking brake (if equipped)

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)



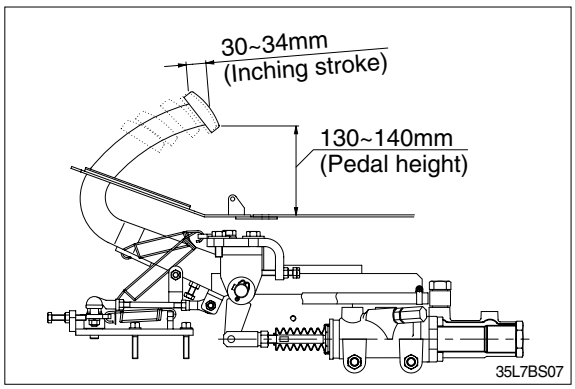
2) INCHING PEDAL

(1) Pedal height from floor plate

Adjust with stopper bolt.

· Pedal height : 130~140mm(5.1~5.5in)

(2) Adjust bolt so that brake pedal interconnects with inching pedal at inching pedal stroke 30~34mm(1.2~1.3in).

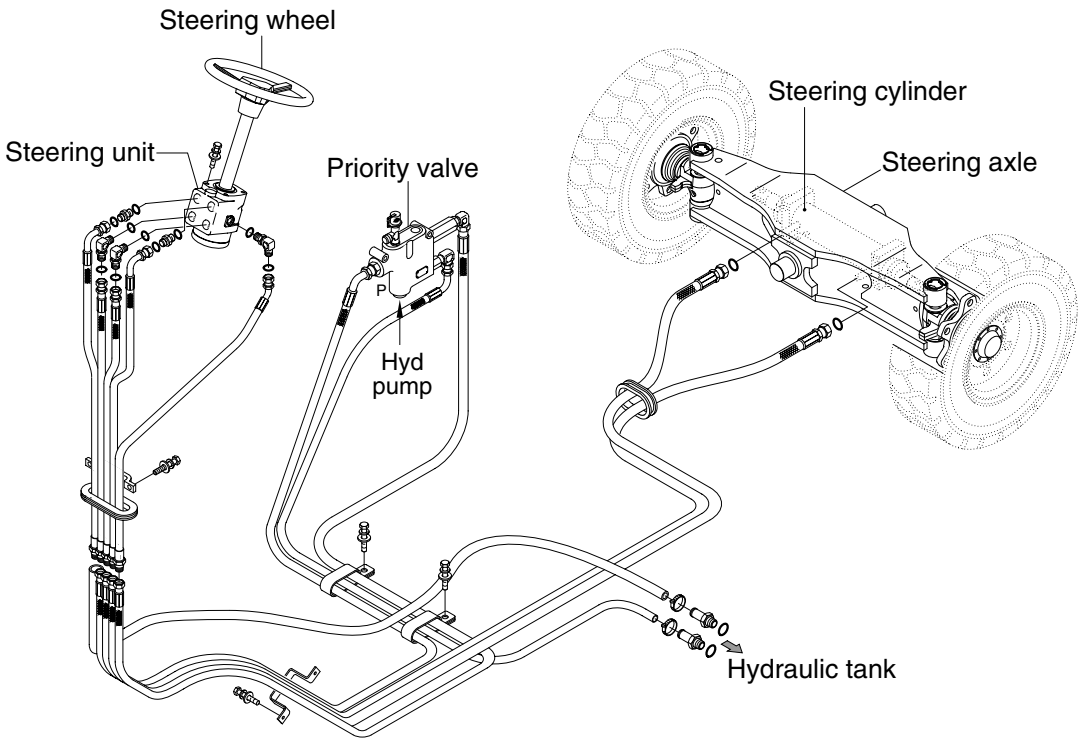


SECTION 5 STEERING SYSTEM

SECTION 5 STEERING SYSTEM

GROUP 1 STRUCTURE AND FUNCTION

1. OUTLINE

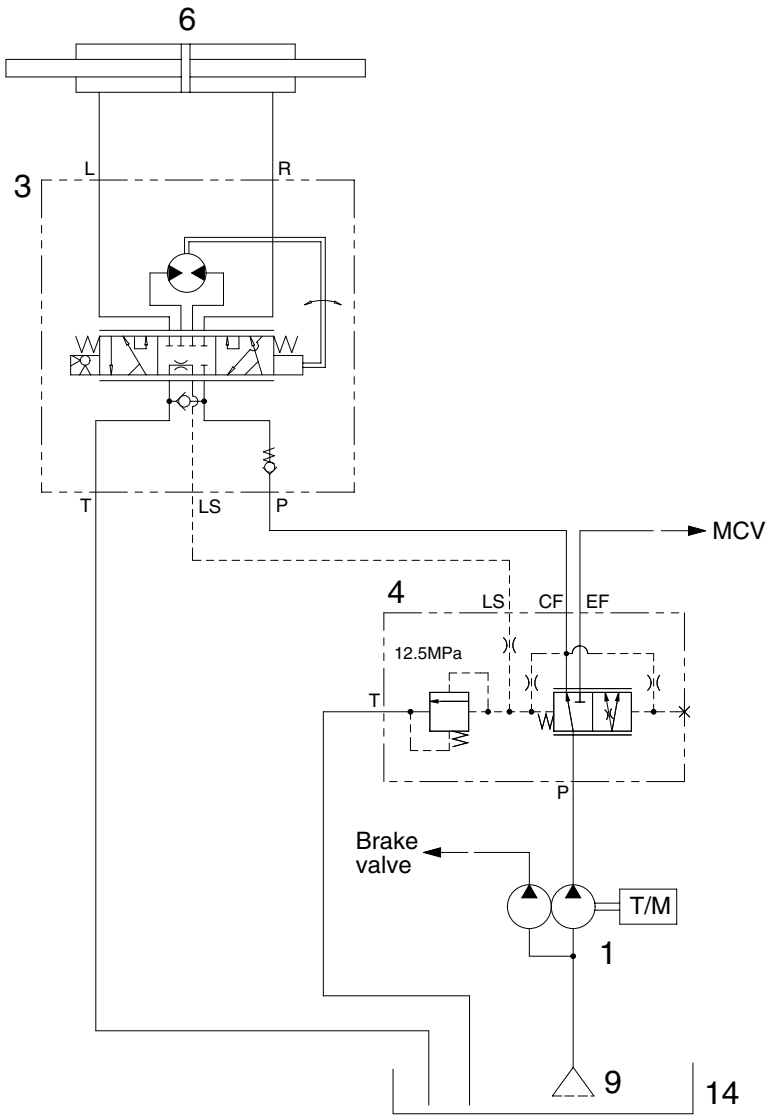


35DS7SE01

The steering system for this machine is composed of steering wheel assembly, steering unit, priority valve steering cylinder, steering axle and piping. The steering force given to the steering wheel enters the steering unit through the steering column. The required oil flow is sensed by the function of the control section of the unit, and pressurized oil delivered from the hydraulic pump is fed to the steering cylinder. The force produced by the steering cylinder moves the knuckle of steering tires through the intermediate link.

The axle body is unit structure having steering knuckles installed to its both ends by means of kingpins. Hub and wheel are mounted through bearing to spindle of knuckle.

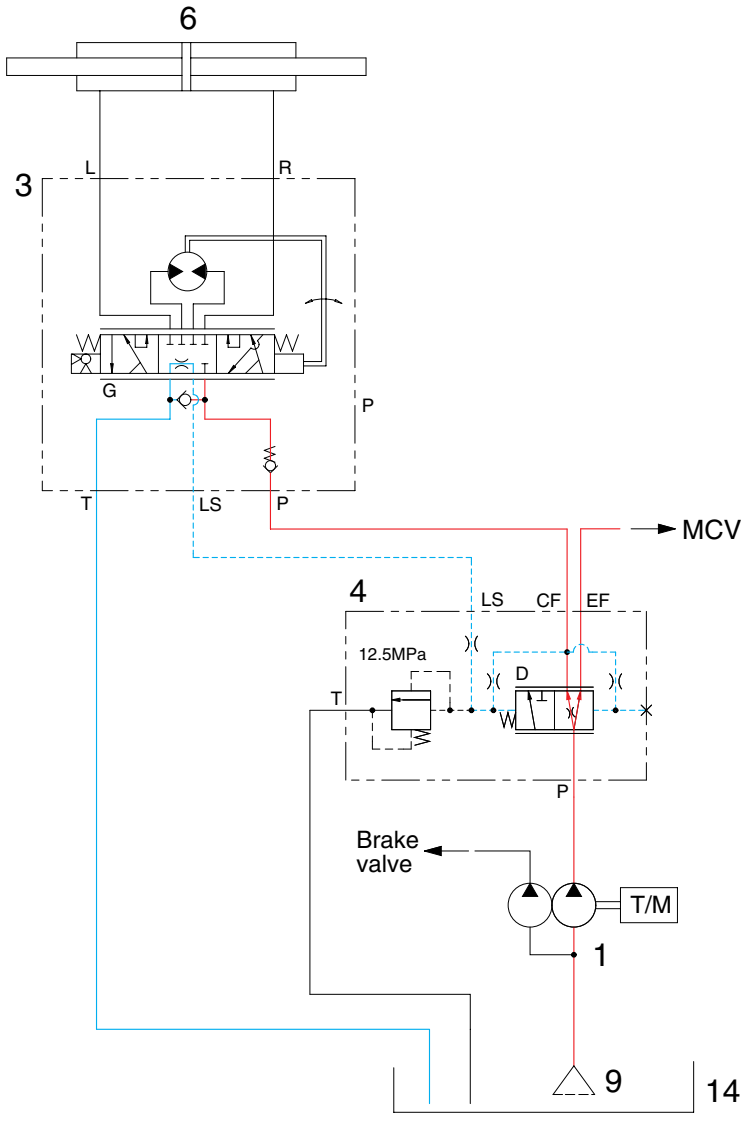
2. HYDRAULIC CIRCUIT



35DS7SE02

1	Hydraulic gear pump	6	Steering cylinder
3	Steering unit	9	Suction filter
4	Priority valve	14	Hydraulic tank

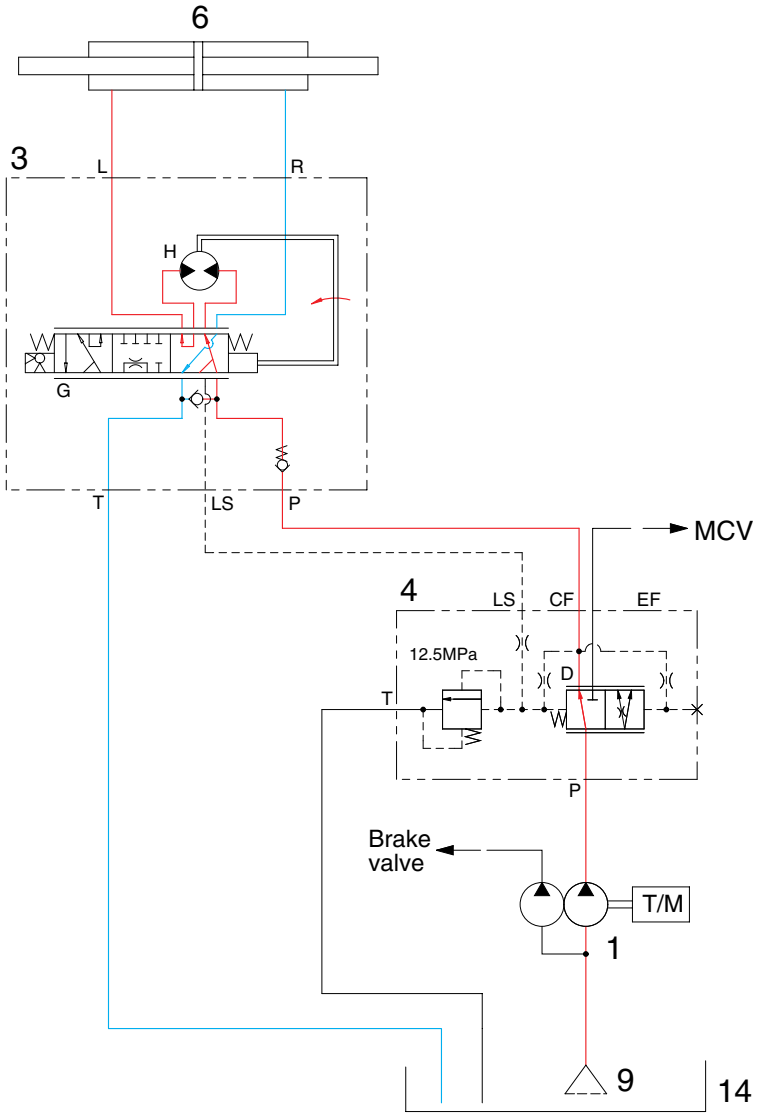
1) NEUTRAL



35DS7SE03

The steering wheel is not being operated, so control spool(G) does not move.
The oil from hydraulic gear pump(1) enters the port P of priority valve(4) and the inlet pressure oil moves the spool(D) to the left.
Oil flow into LS port to the hydraulic tank(14).
So, the pump flow is routed to the main control valve.

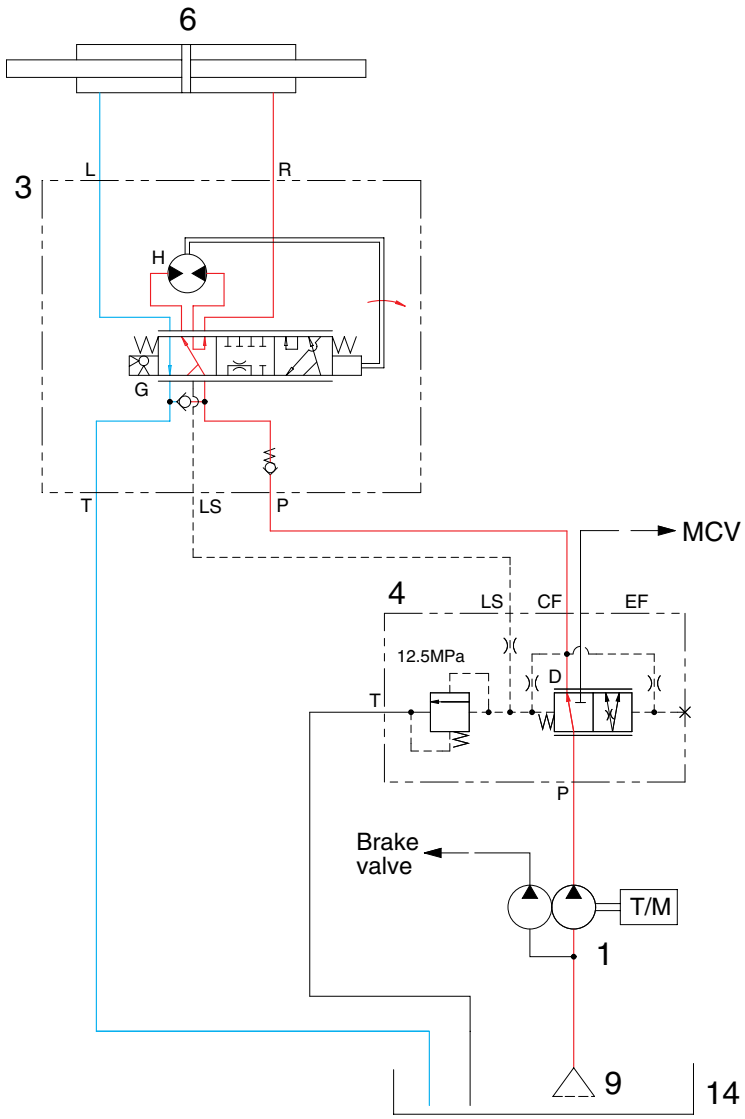
2) LEFT TURN



35DS7SE04

When the steering wheel is turned to the left, the spool(G) within the steering unit(3) connected with steering column turns in left hand direction.
At this time, the oil discharged from the pump flows into the spool(G) within the steering unit(3) through the spool(D) of priority valve(4) and flows the gerotor(H).
Oil flow from the gerotor(H) flows back into the spool(G) where it is directed out the left work port(L).
Oil returned from cylinder returns to hydraulic tank(14).
When the above operation is completed, the machine turns to the left.

3) RIGHT TURN

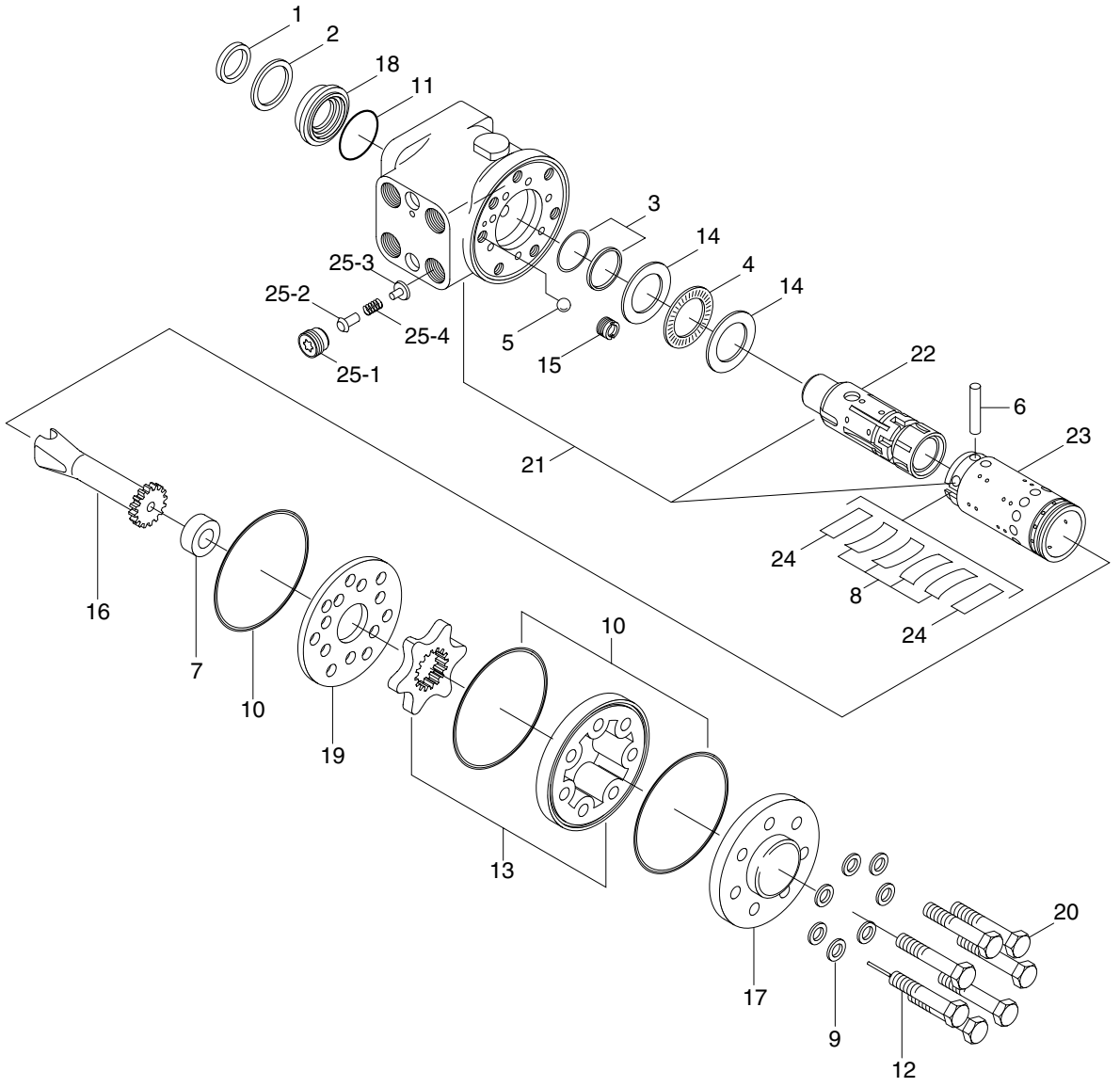


35DS7SE05

When the steering wheel is turned to the right, the spool(G) within the steering unit(3) connected with steering column turns in right hand direction.
At this time, the oil discharged from the pump flows into the spool(G) within the steering unit(3) through the spool(D) of priority valve(4) and flows the gerotor(H).
Oil flow from the gerotor(H) flows back into the spool(G) where it is directed out the right work port(R).
Oil returned from cylinder returns to hydraulic tank(14).
When the above operation is completed, the machine turns to the right.

3. STEERING UNIT

1) STRUCTURE



20D7SS06

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

2) OPERATION

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

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

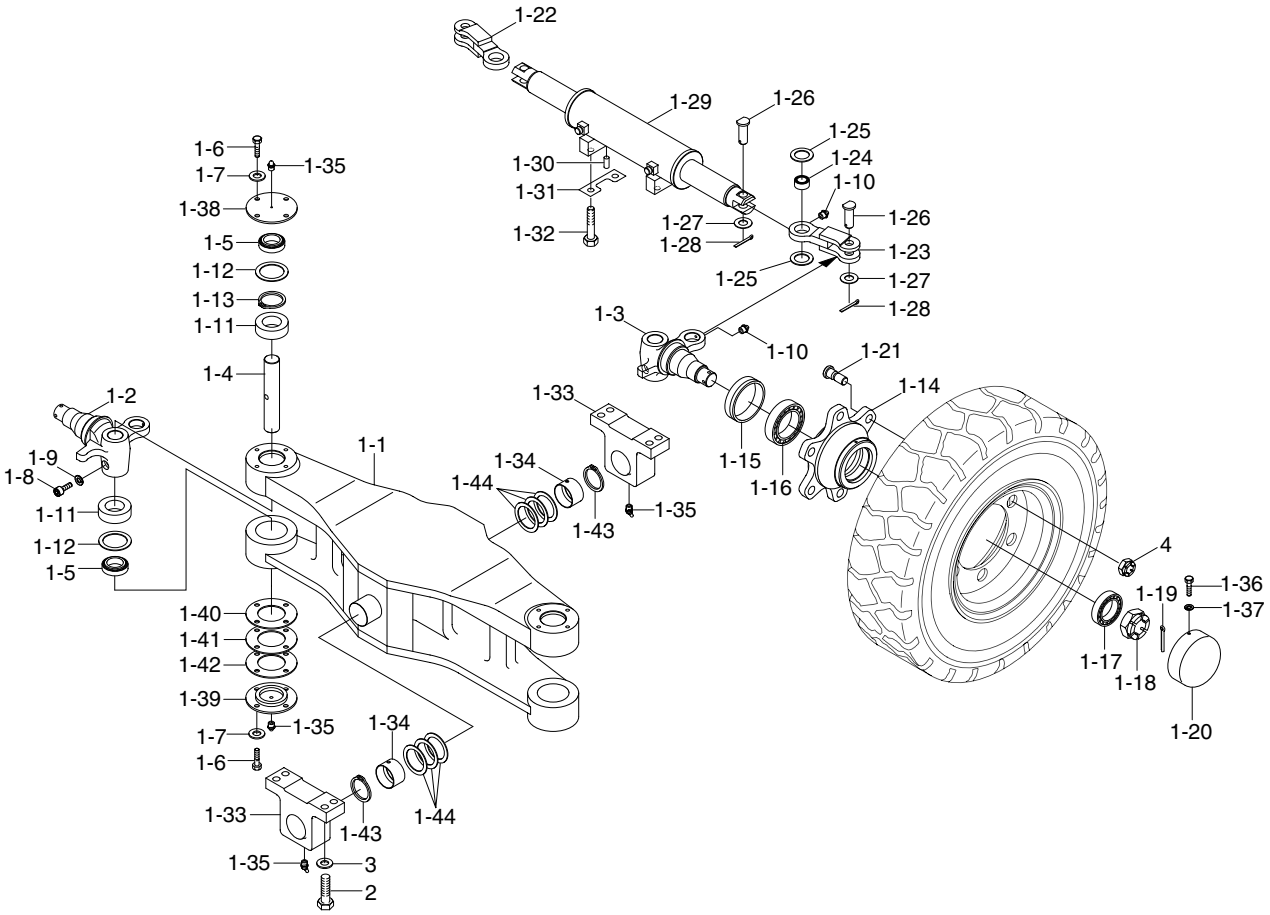
⚠ If the hoses of the steering system are incorrectly connected, the steering wheel can turn very rapidly when the engine is started. Keep clear of the steering wheel when starting the engine.

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

4. STEERING AXLE

1) STRUCTURE

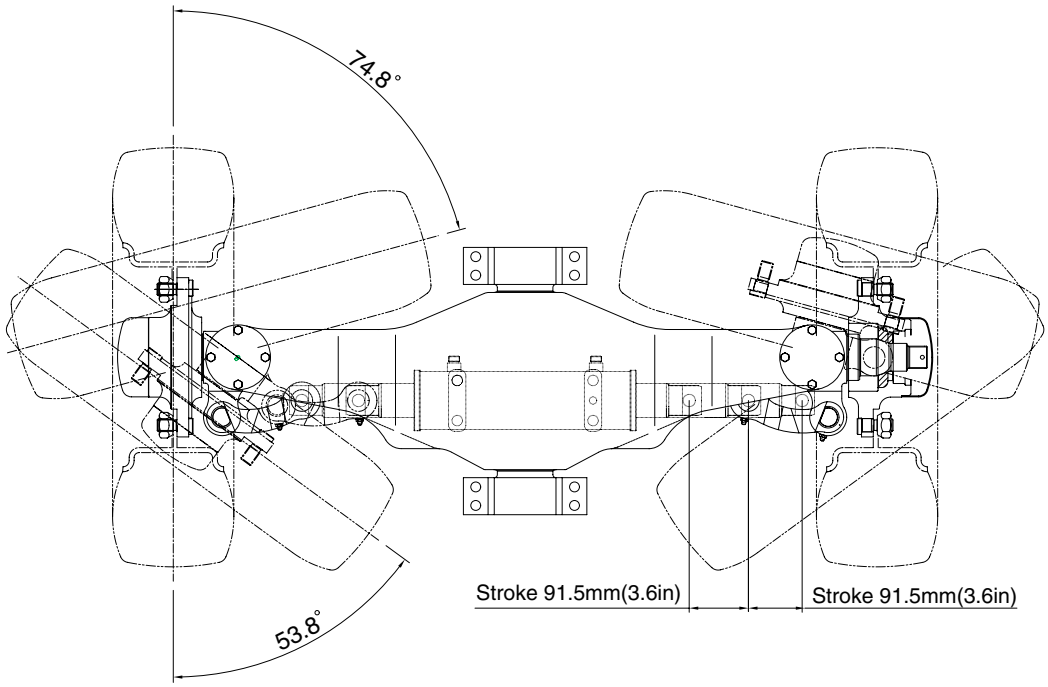
※ Do not remove the stopper bolt unless necessary.

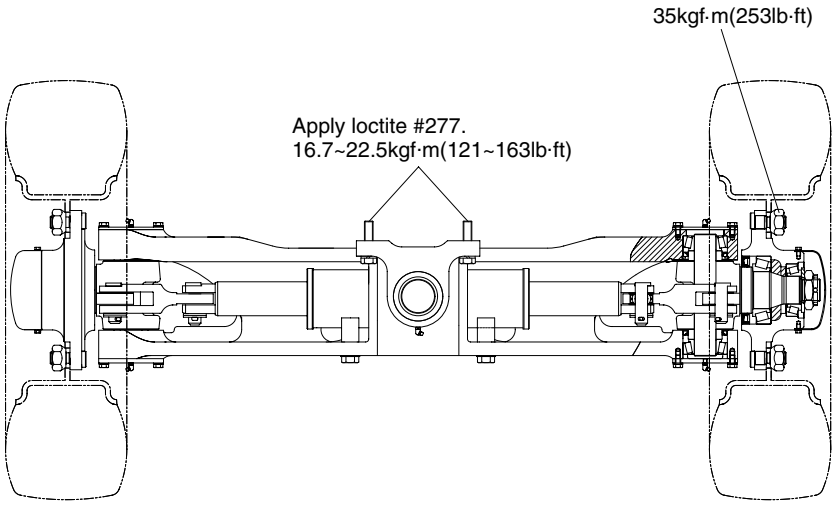


35DS7SE06

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

2) GREASING AND SPECIFICATION



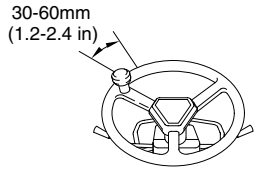


35DS7SE07

Type	Unit	Center pin support single shaft
Structure of knuckle	-	Elliott type
Toe-in	degree	0
Camber	degree	0
Caster	degree	0
King pin angle	degree	0
Max steering angle of wheels(Inside/Outside)	degree	74.8/53.8
Tread	mm(in)	1140(45)

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 rin of steering wheel. If play is too large, adjust at gear box. Test steering wheel play with engine at idling.
Knuckle	· Check knuckle visually or use crack detection method. If the knuckle is bent, the tire wear is uneven, so check tire wear.
Steering axle	· Put camber gauge in contact with hub and measure camber. If camber is not within 0±0.5° ; rear axle is bent. · Ask assistant to drive machine at minimum turning radius. · Fit bar and a piece of chalk at outside edge of counterweight to mark line of turning radius. · If minimum turning radius is not within±100㎜ (±4in)of specified value, adjust turning angle stopper bolt. Min turning radius(Outside)
Hydraulic pressure of power steering	Remove screw coupling from CF port of priority valve and install oil pressure gauge. Turn steering wheel fully and check oil pressure. ※ Oil pressure : 125kgf/cm² (1780psi)

35L-7	2770㎜(109in)
40L-7	2830㎜(111in)
45L-7	2890㎜(114in)

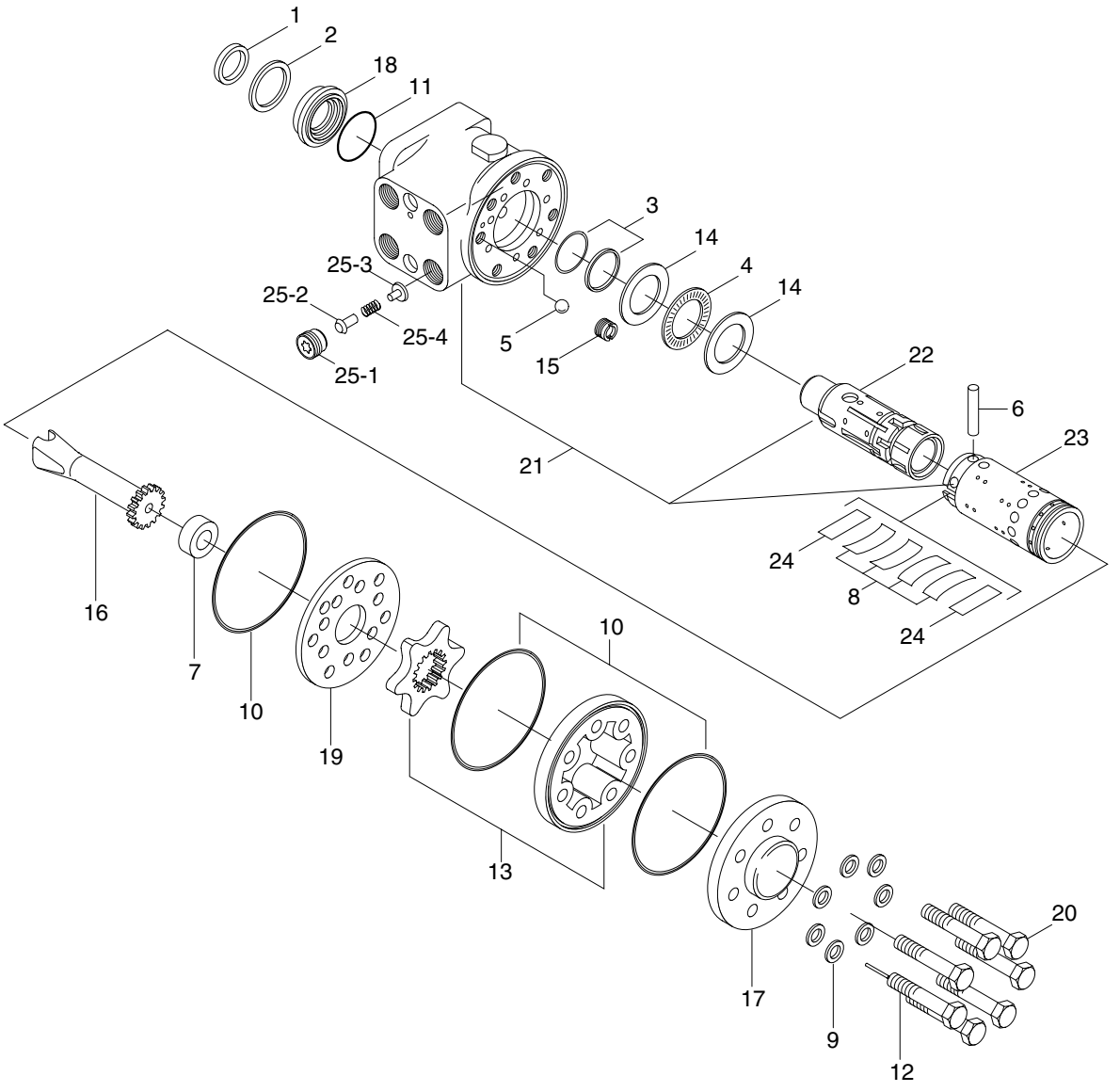
2. TROUBLESHOOTING

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 excessi-vely tight. · Gears poorly meshing. · Flow divider coil spring fatigued.	· Check lockout. Repair. · Clean or replace. · Clean or replace. · Replace. · Clean or replace. · Adjust. · Check and correct meshing. · Replace.
Steering wheel fails to return smoothly.	· Bearing faulty. · Reaction plunger faulty. · Ball-and-screw assy faulty · Gears poorly meshing.	· Clean or replace. · Replace. · Clean or replace. · Check and correct meshing.

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

1. STEERING UNIT

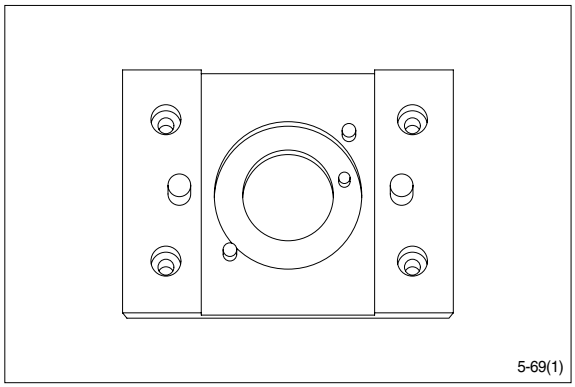
1) STRUCTURE



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		

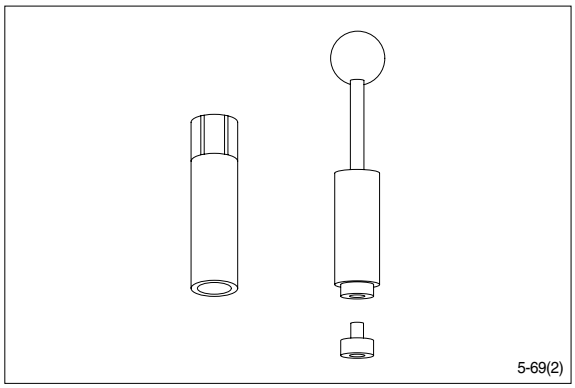
2) TOOLS

(1) Holding tool.



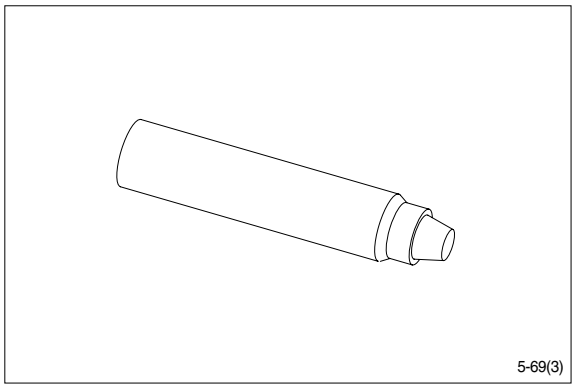
5-69(1)

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



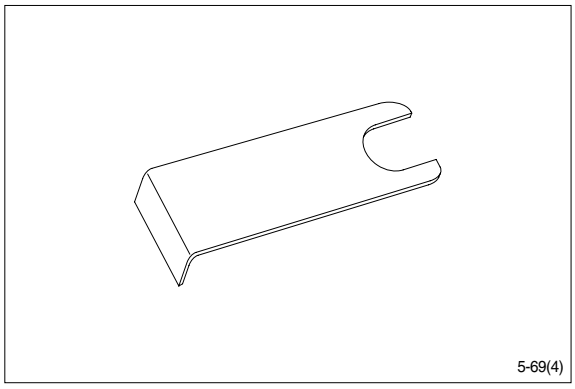
5-69(2)

(3) Assembly tool for lip seal.



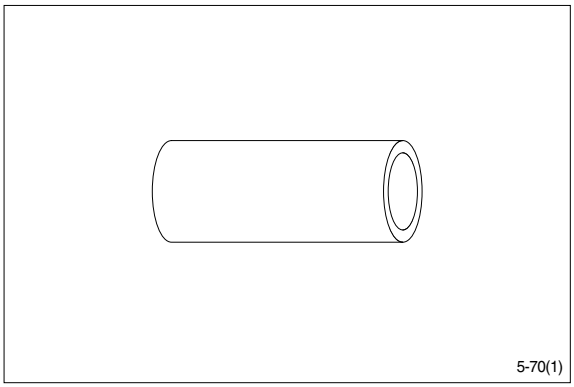
5-69(3)

(4) Assembly tool for cardan shaft.

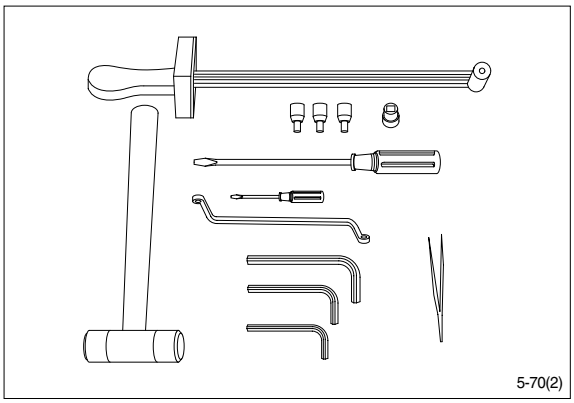


5-69(4)

(5) Assembly tool for dust seal.

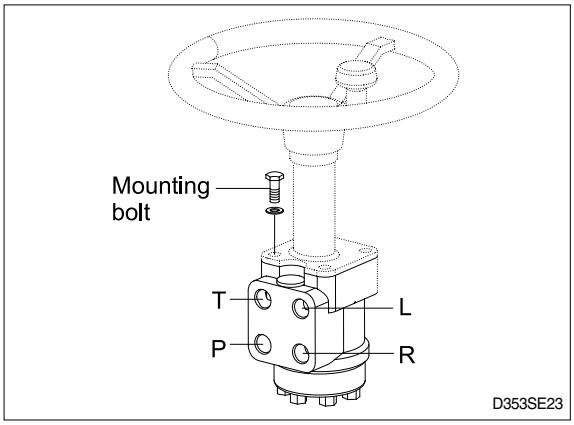


(6) Torque wrench 0~7.1kgf · m
(0~54.4lbf · ft)
13mm socket spanner
6, 8mm and 12mm hexagon sockets
12mm screwdriver
2mm screwdriver
13mm ring spanner
6, 8 and 12mm hexagon socket spanners
Plastic hammer
Tweezers



3) TIGHTENING TORQUE

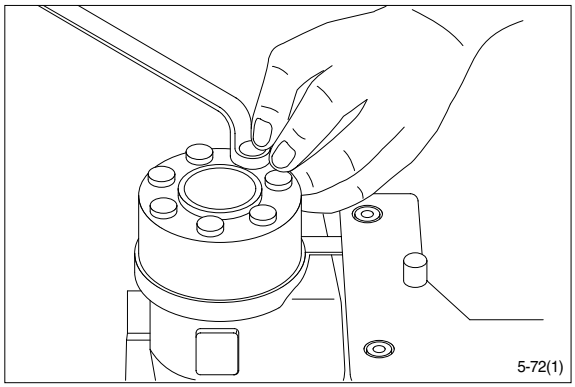
L : Left port
R : Right port
T : Tank
P : Pump



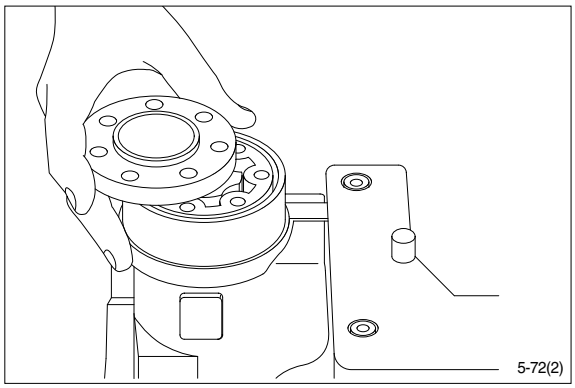
Port	Size	Torque [kgf · m(lbf · ft)]
L	3/4 - 16UNF	6.1±0.6 (44±4.3)
R	3/4 - 16UNF	6.1±0.6 (44±4.3)
T	3/4 - 16UNF	6.1±0.6 (44±4.3)
P	3/4 - 16UNF	6.1±0.6 (44±4.3)
Mounting bolt	M10×1.5	4.0 ±0.5 (29±3.6)

4) DISASSEMBLY

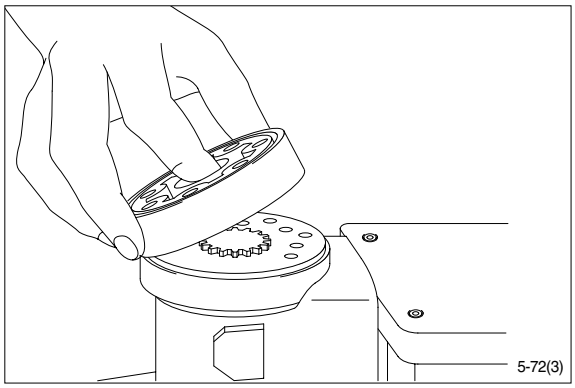
(1) Disassemble steering column from steering unit and place the steering unit in the holding tool.
Screw out the screws in the end cover(6-off plus one special screw).


5-72(1)

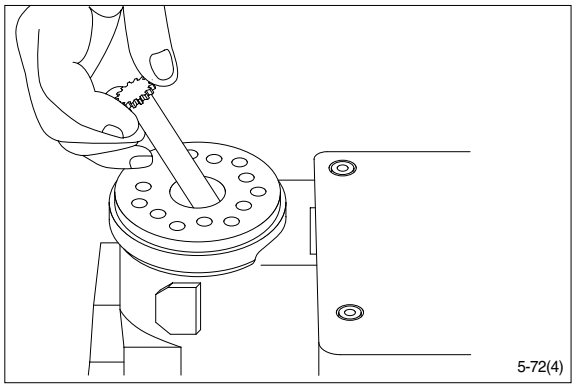
(2) Remove the end cover, sideways.


5-72(2)

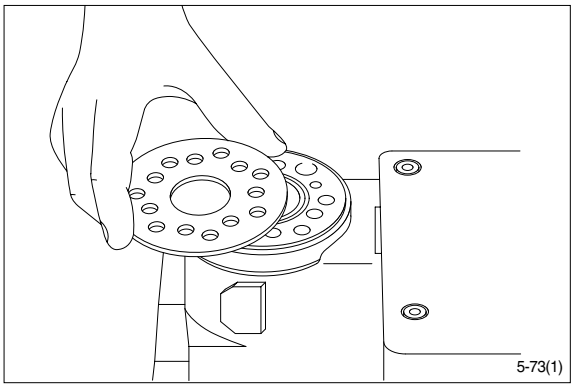
(3) Lift the gearwheel set(With spacer if fitted) off the unit.
Take out the two O-rings.


5-72(3)

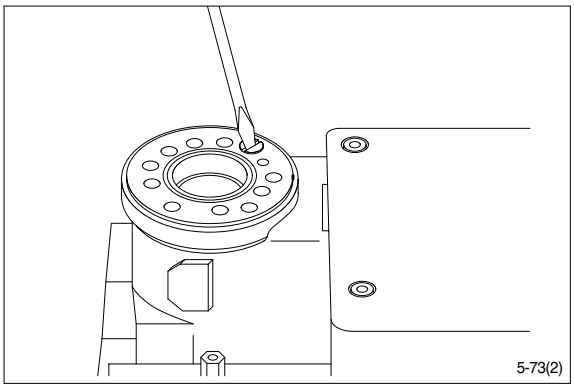
(4) Remove cardan shaft.


5-72(4)

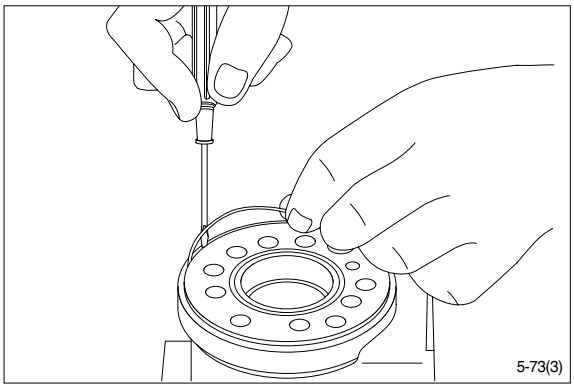
(5) Remove distributor plate.



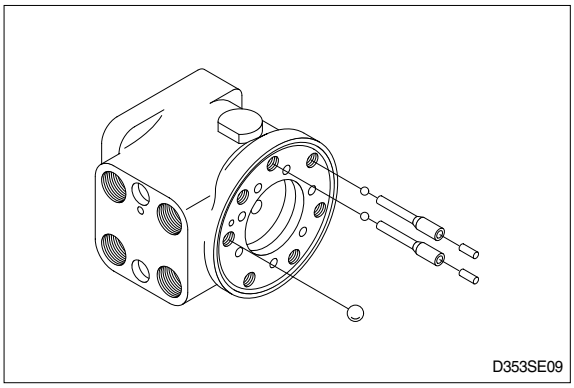
(6) Screw out the threaded bush over the check valve.



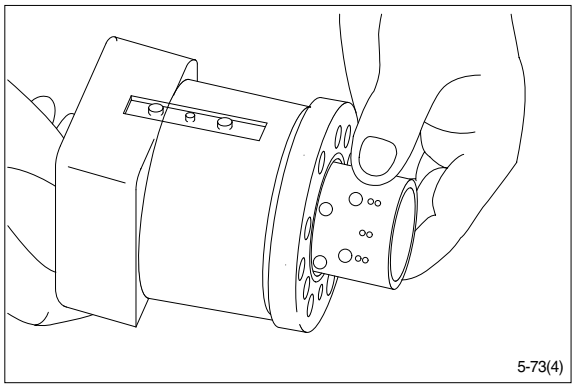
(7) Remove O-ring.



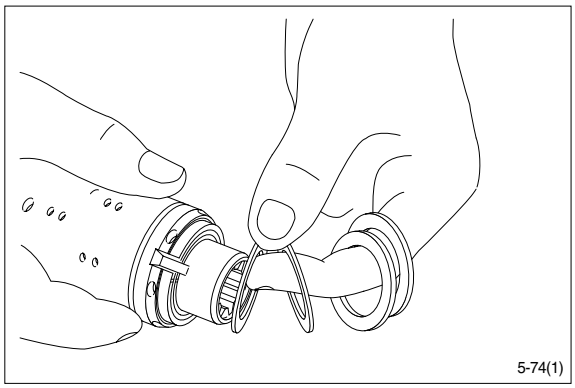
(8) Shake out the check valve ball and suction valve pins and balls.



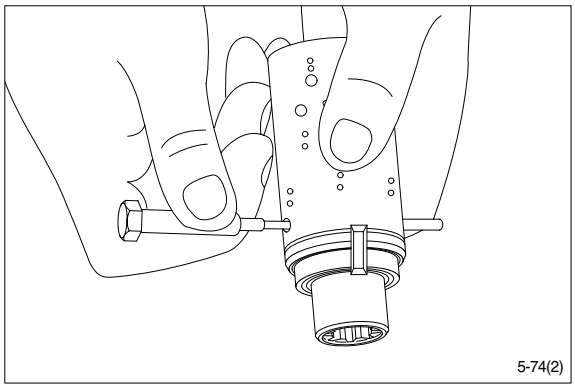
(9) Take care to keep the cross pin in the sleeve and spool horizontal. The pin can be seen through the open end of the spool. Press the spool inwards and the sleeve, ring, bearing races and thrust bearing will be pushed out of the housing together.


5-73(4)

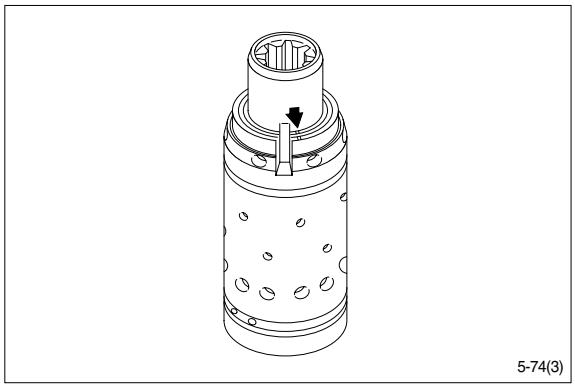
(10) Take ring, bearing races and thrust bearing from sleeve and spool. The outer (Thin) bearing race can sometimes "stick" in the housing, therefore check that it has come out.


5-74(1)

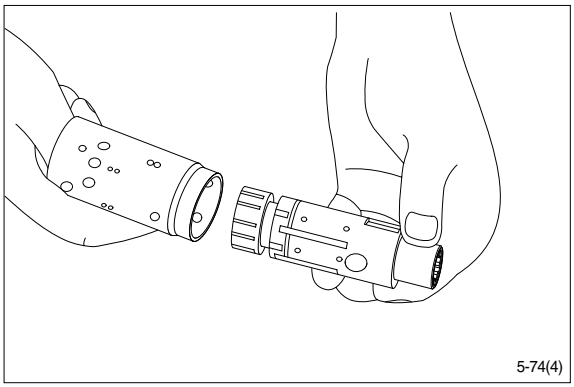
(11) Press out the cross pin. Use the special screw from the end cover.


5-74(2)

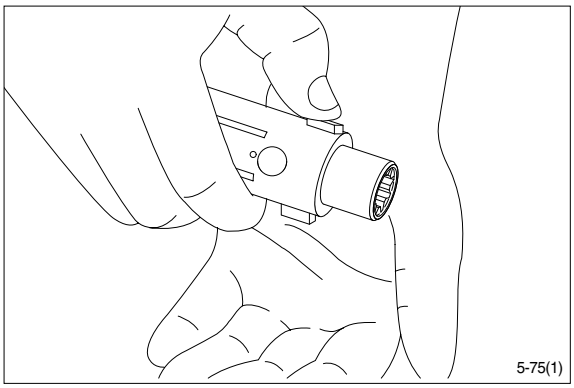
※ A small mark has been made with a pumice stone on both spool and sleeve close to one of the slots for the neutral position springs(See drawing).
If the mark is not visible, remember to leave a mark of your own on sleeve and spool before the neutral position springs are disassembled.


5-74(3)

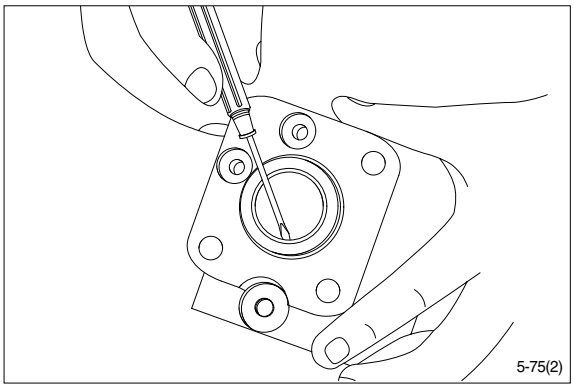
(12) Carefully press the spool out of the sleeve.



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

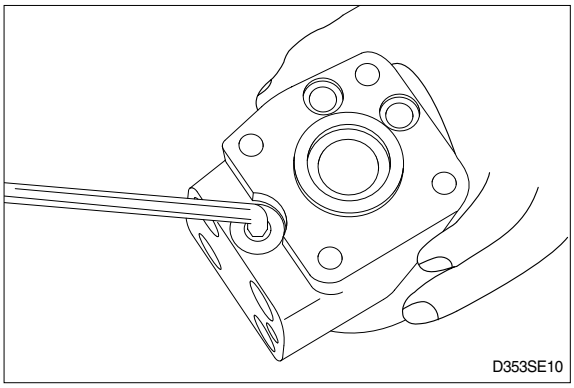


(14) Remove dust seal and O-ring.

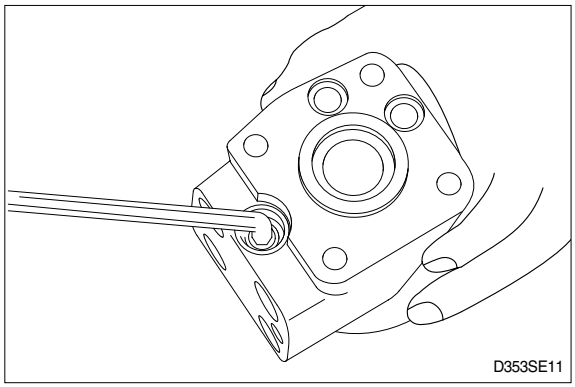


Disassembling the pressure relief valve

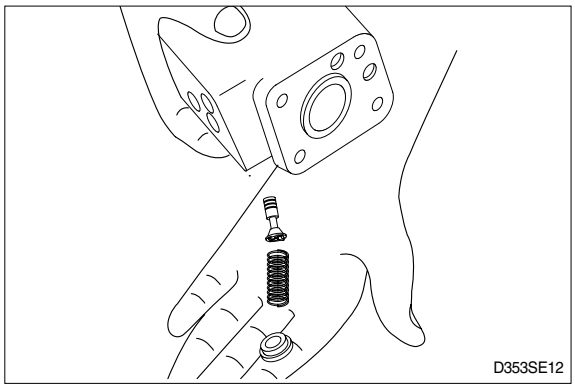
(15) Screw out the plug using an 8㎜ hexagon socket spanner.
Remove seal washers.



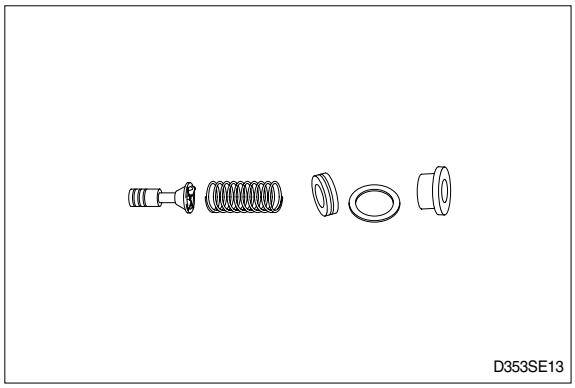
(16) Unscrew the setting screw using an 8mm hexagon socket spanner.



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



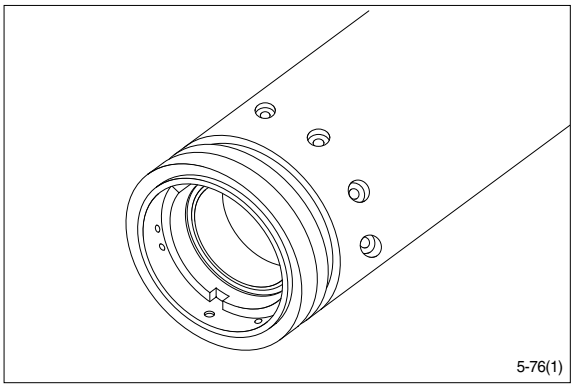
(18) The pressure relief valve is now disassembled.



5) ASSEMBLY

(1) Assemble spool and sleeve.

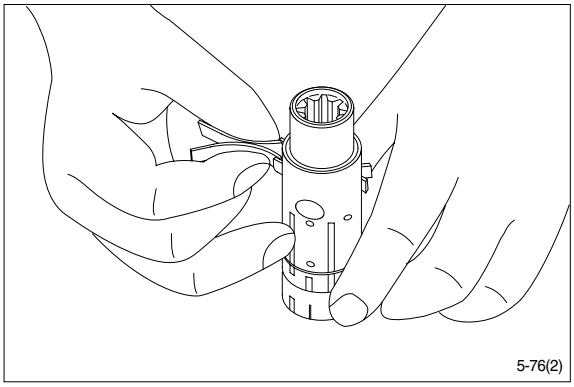
※ When assembling spool and sleeve only one of two possible ways of positioning the spring slots is correct. There are three slots in the spool and three holes in the sleeve in the end of the spool / sleeve opposite to the end with spring slots. Place the slots and holes opposite each other so that parts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



5-76(1)

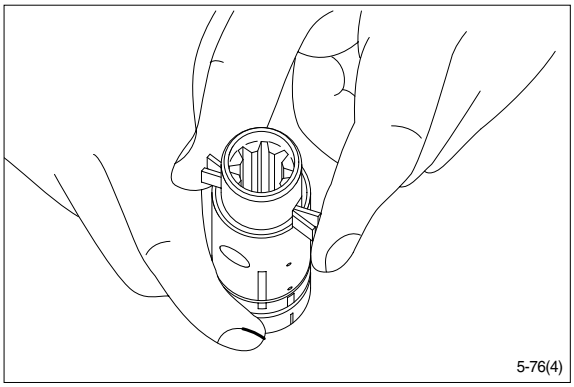
(2) Place the two flat neutral position springs in the slot.

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



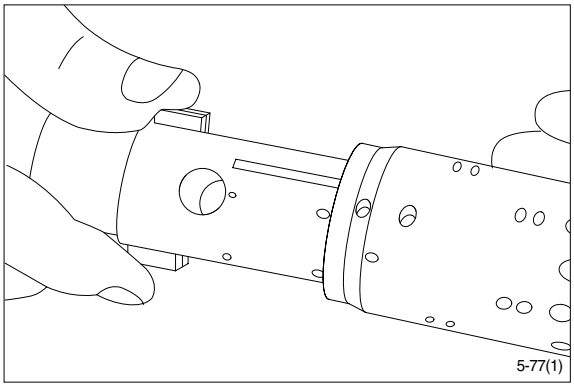
5-76(2)

(3) Line up the spring set.



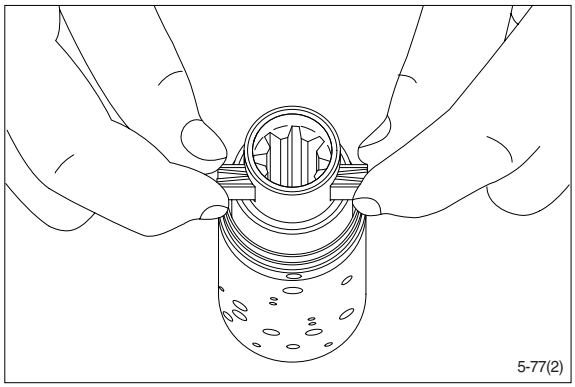
5-76(4)

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

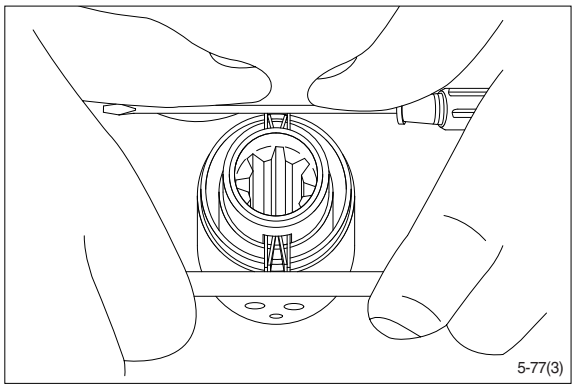


5-77(1)

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

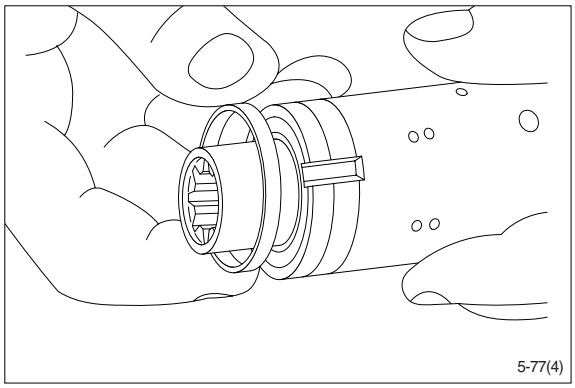

5-77(2)

(6) Line up the springs and center them.

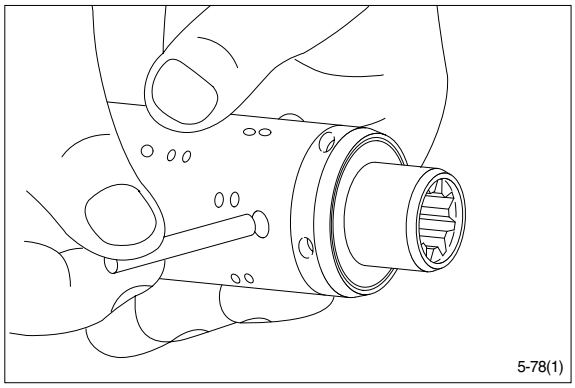

5-77(3)

(7) Guide the ring down over the sleeve.

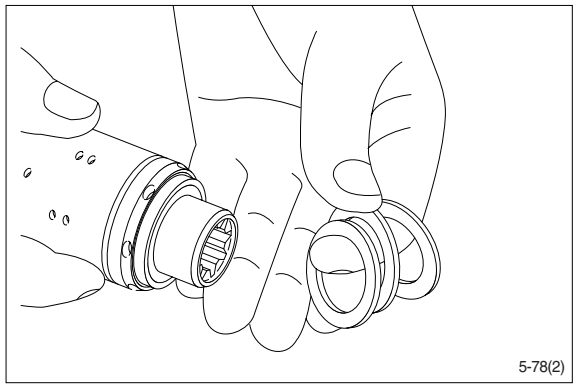
※ The ring should be able to rotate free of the springs.


5-77(4)

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

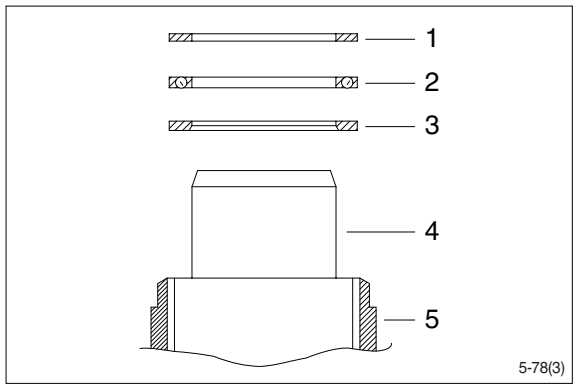

5-78(1)

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



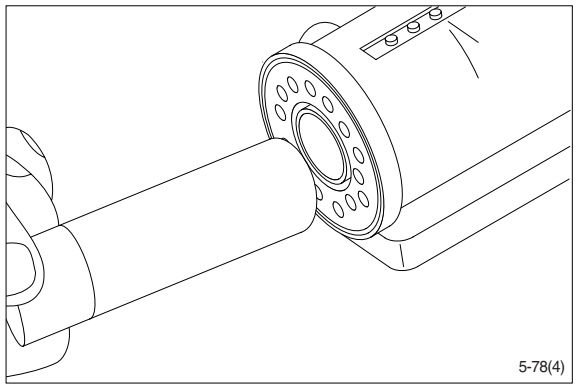
※ **Assembly pattern for standard bearings**

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

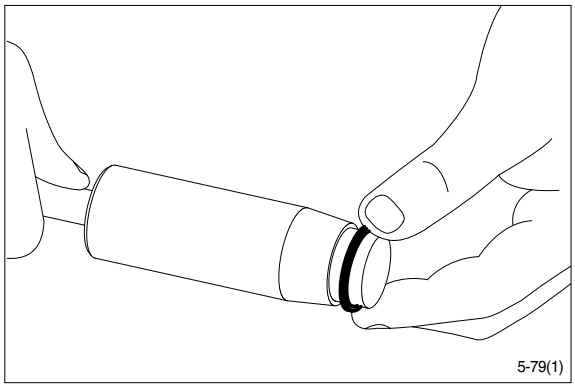


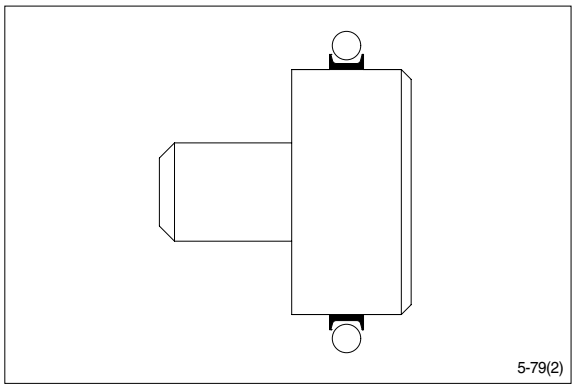
Installation instruction for O-ring

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

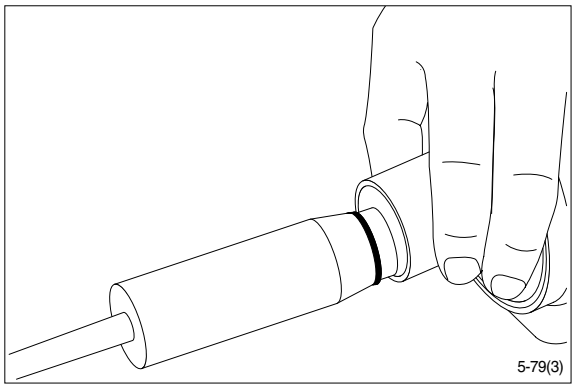


(11) Grease O-ring with hydraulic oil and place them on the tool.

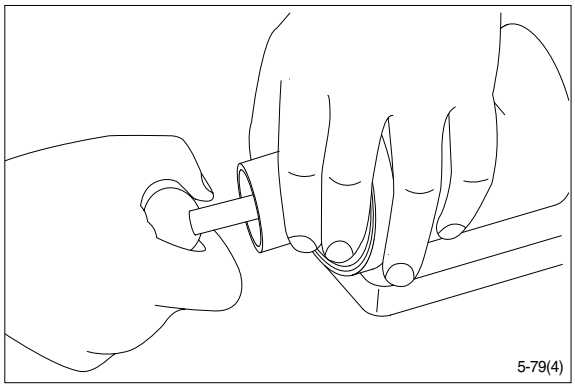

5-79(1)


5-79(2)

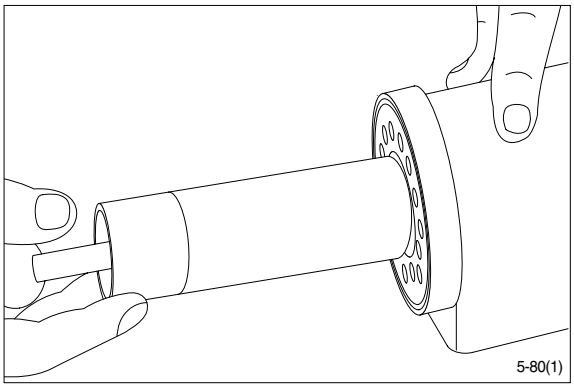
(12) Hold the outer part of the assembly tool in the bottom of the steering unit housing and guide the inner part of the tool right to the bottom.


5-79(3)

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

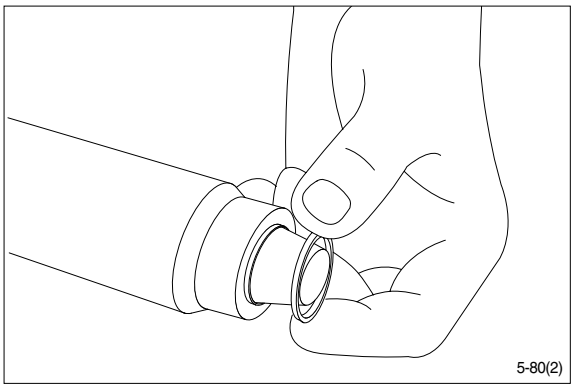

5-79(4)

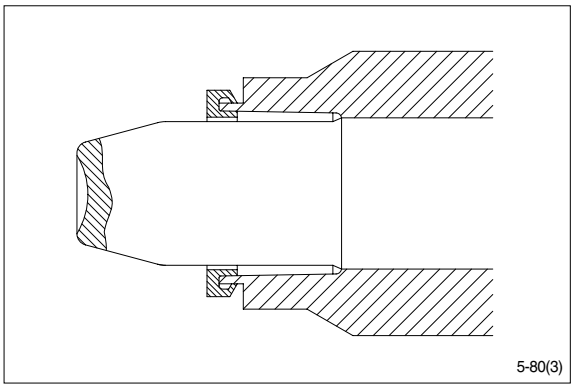
(14) Draw the inner and outer parts of the assembly tool out of the steering unit bore, leaving the guide from the inner part in the bore.



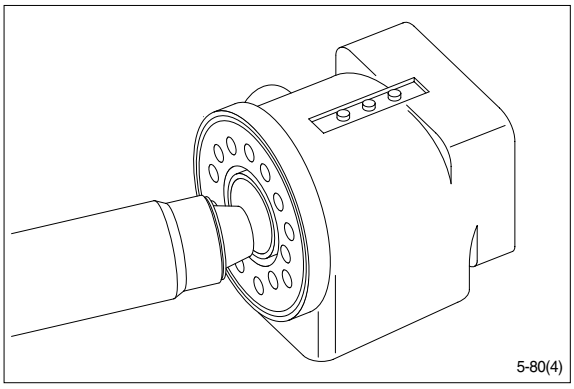
Installation instructions for lip seal

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

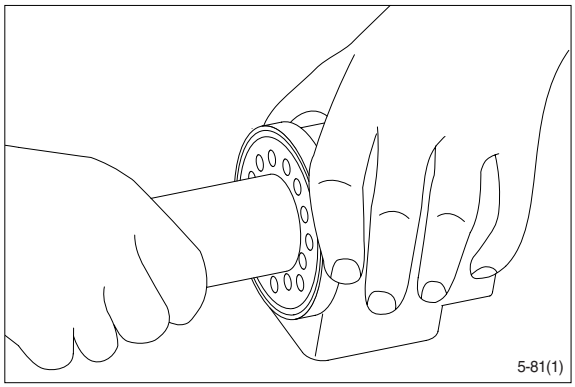




(16) Guide the assembly tool right to the bottom.

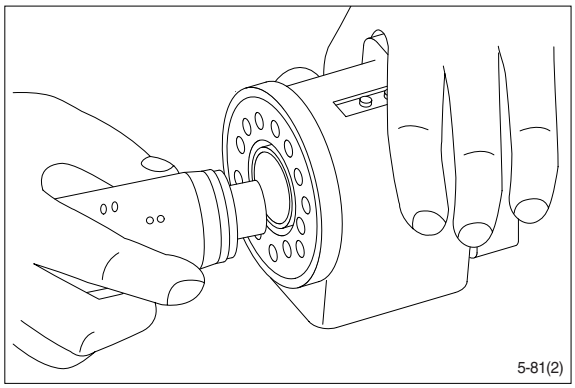


(17) Press and turn the lip seal into place in the housing.

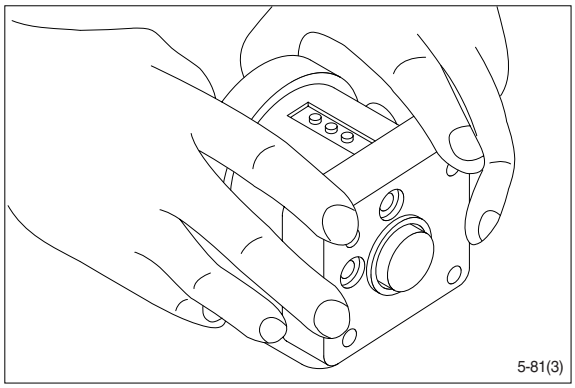


(18) With a light turning movement, guide the spool and sleeve into the bore.

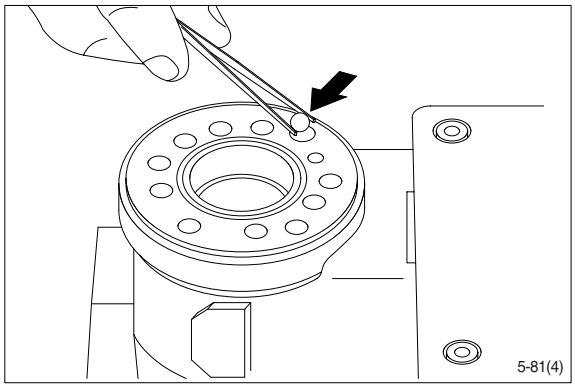
※ Fit the spool set holding the cross pin horizontal.



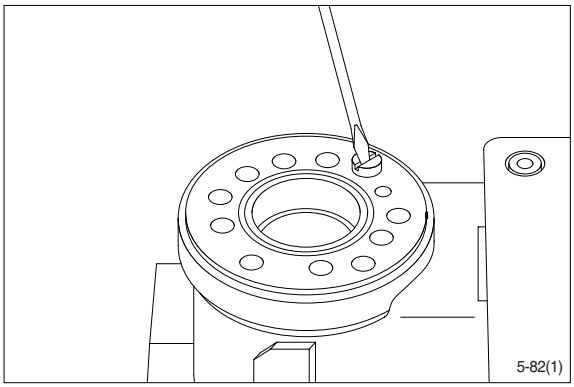
(19) The spool set will push out the assembly tool guide. The O-ring are now in position.



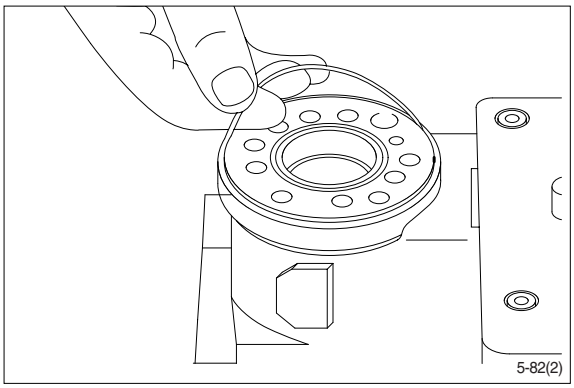
(20) Turn the steering unit until the bore is vertical again. Put the check valve ball into the hole indicated by the arrow.



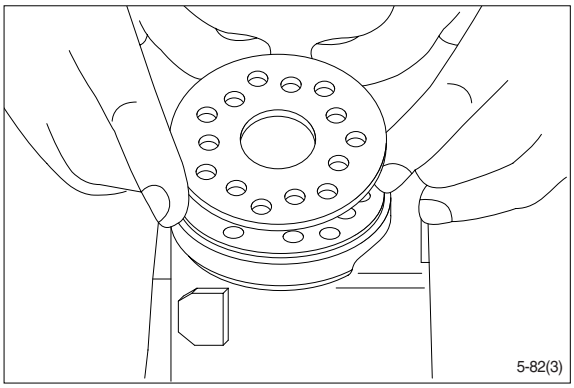
(21) Screw the threaded bush lightly into the check valve bore. The top of the bush must lie just below the surface of the housing.



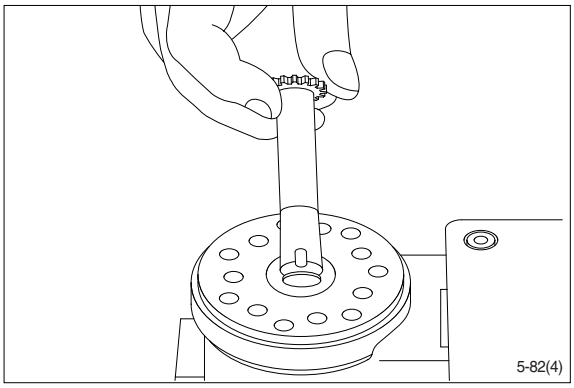
(22) Grease the O-ring with mineral oil approx. viscosity 500 cSt at 20°C.



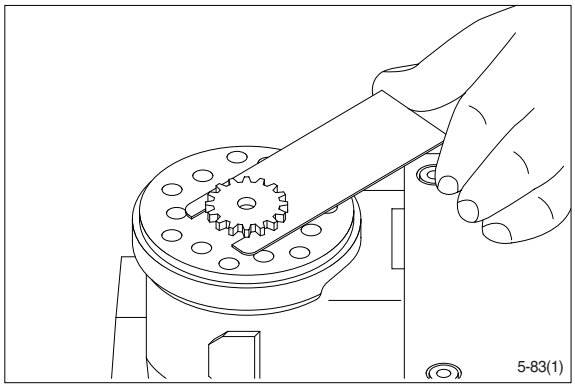
(23) Place the distributor plate so that the channel holes match the holes in the housing.



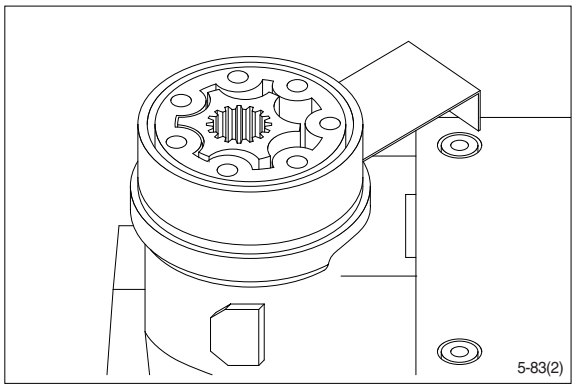
(24) Guide the cardan shaft down into the bore so that the slot is parallel with the connection flange.



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



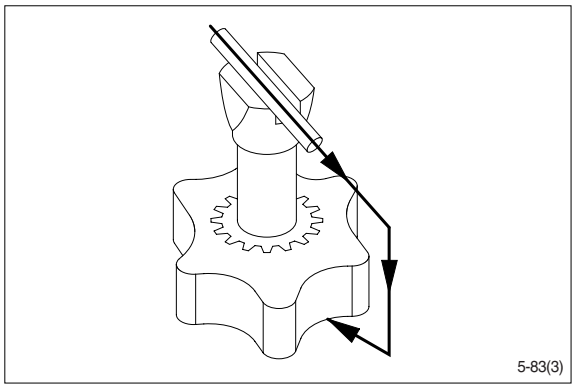
(26) Grease the two O-rings with mineral oil approx. viscosity 500 cSt at 20°C and place them in the two grooves in the gear rim. Fit the gearwheel and rim on the cardan shaft.



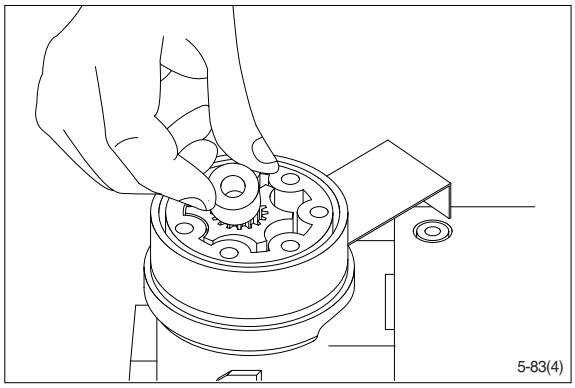
(27) Important

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

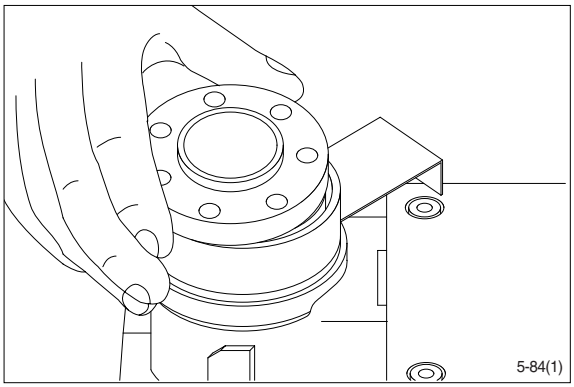
Turn the gear rim so that the seven through holes match the holes in the housing.



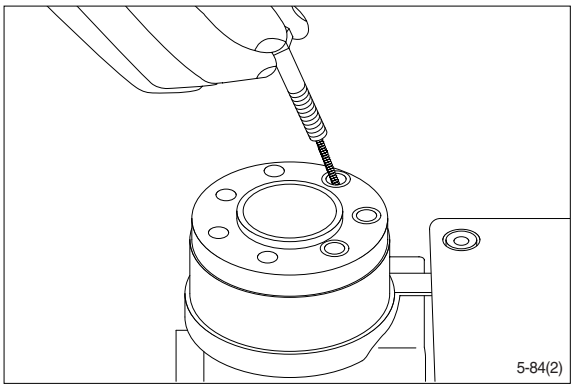
(28) Fit the spacer, if any.



(29) Place the end cover in position.

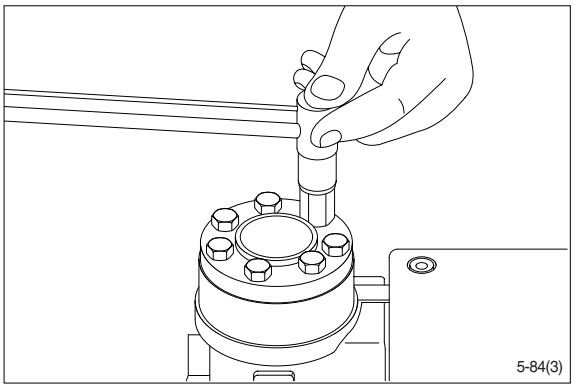

5-84(1)

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

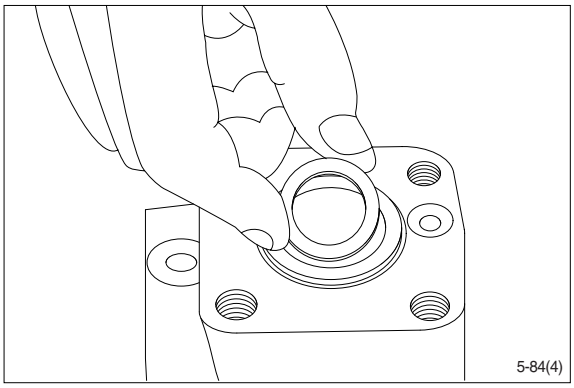

5-84(2)

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

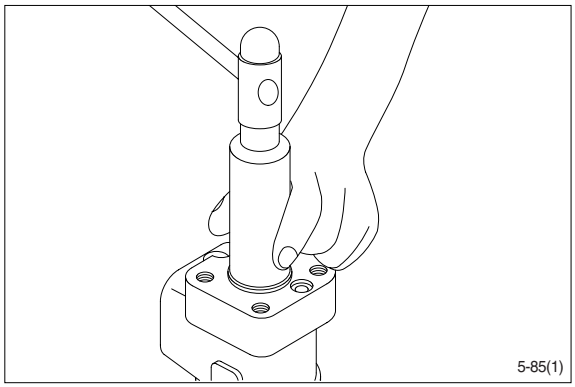
· Tightening torque : 4.0 ± 0.5kgf · m
(28.9 ± 3.6lbf · ft)


5-84(3)

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

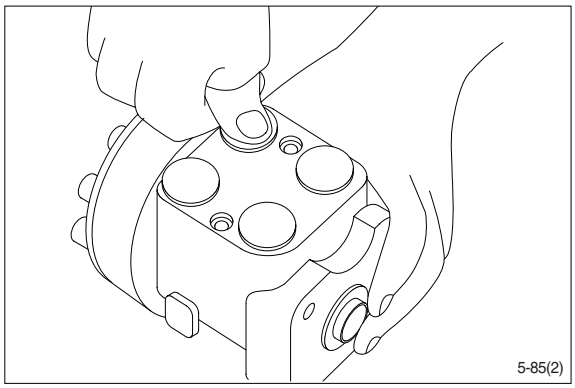

5-84(4)

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


5-85(1)

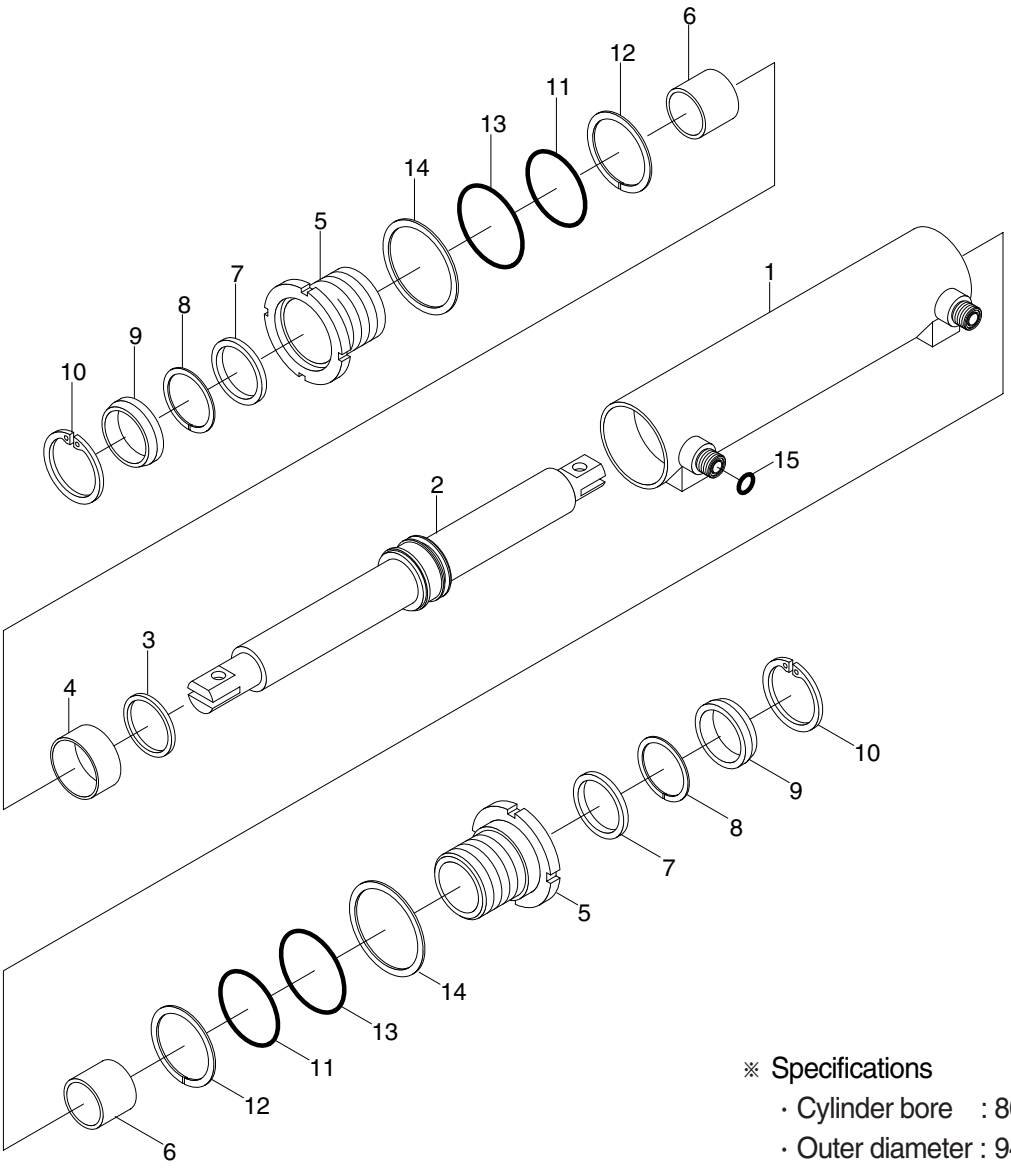
(34) Press the plastic plugs into the connection ports.

※ Do not use a hammer!


5-85(2)

2. STEERING CYLINDER

1) STRUCTURE



※ Specifications
- Cylinder bore : 80mm
- Outer diameter : 94mm
- Stroke(half) : 180mm
- Rod diameter : 55mm

D357SE21

1	Tube assy	6	DU bushing	11	O-ring
2	Rod assy	7	Rod seal	12	Back up ring
3	Piston seal	8	Back up ring	13	O-ring
4	Wear ring	9	Dust wiper	14	Lock washer
5	Gland	10	Snap ring	15	O-ring

2) DISASSEMBLY

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

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

(2) Remove the cover by hook a wrench in the notch of cylinder head and turn counter-clockwise.

(3) Remove the cylinder rod and piston from the tube.

(4) Check wear condition of the sealing parts(O-ring, oil seal, dust seal, U-packing, bush). If there are some damage, replace with new parts.

3) CHECK AND INSPECTION

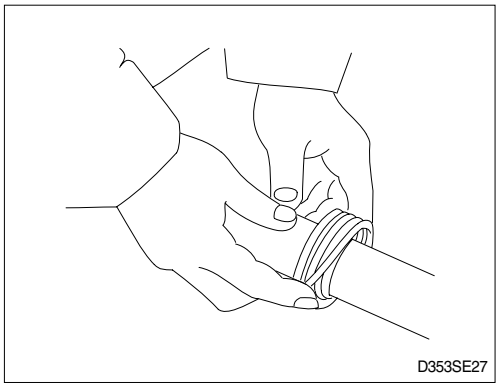
mm(in)

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

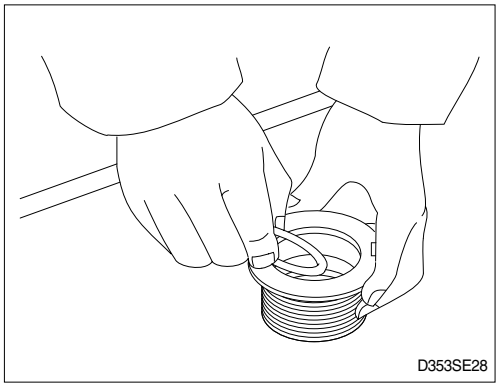
4) ASSEMBLY

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

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

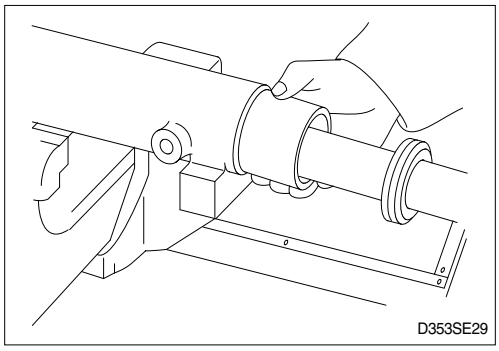

D353SE27

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

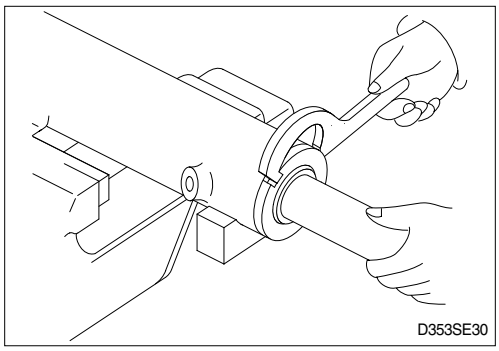

D353SE28

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

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

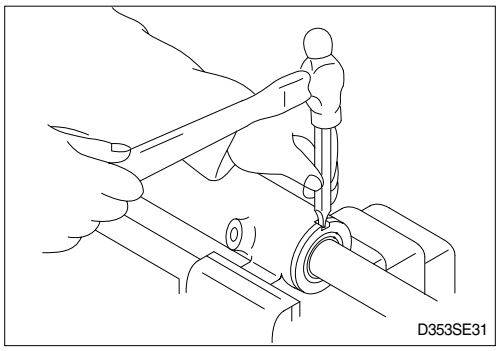


(5) Using a hook spanner, install the gland assembly, and tighten it with torque 60±6kgf · m (434±43lbf · ft).



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

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



(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.

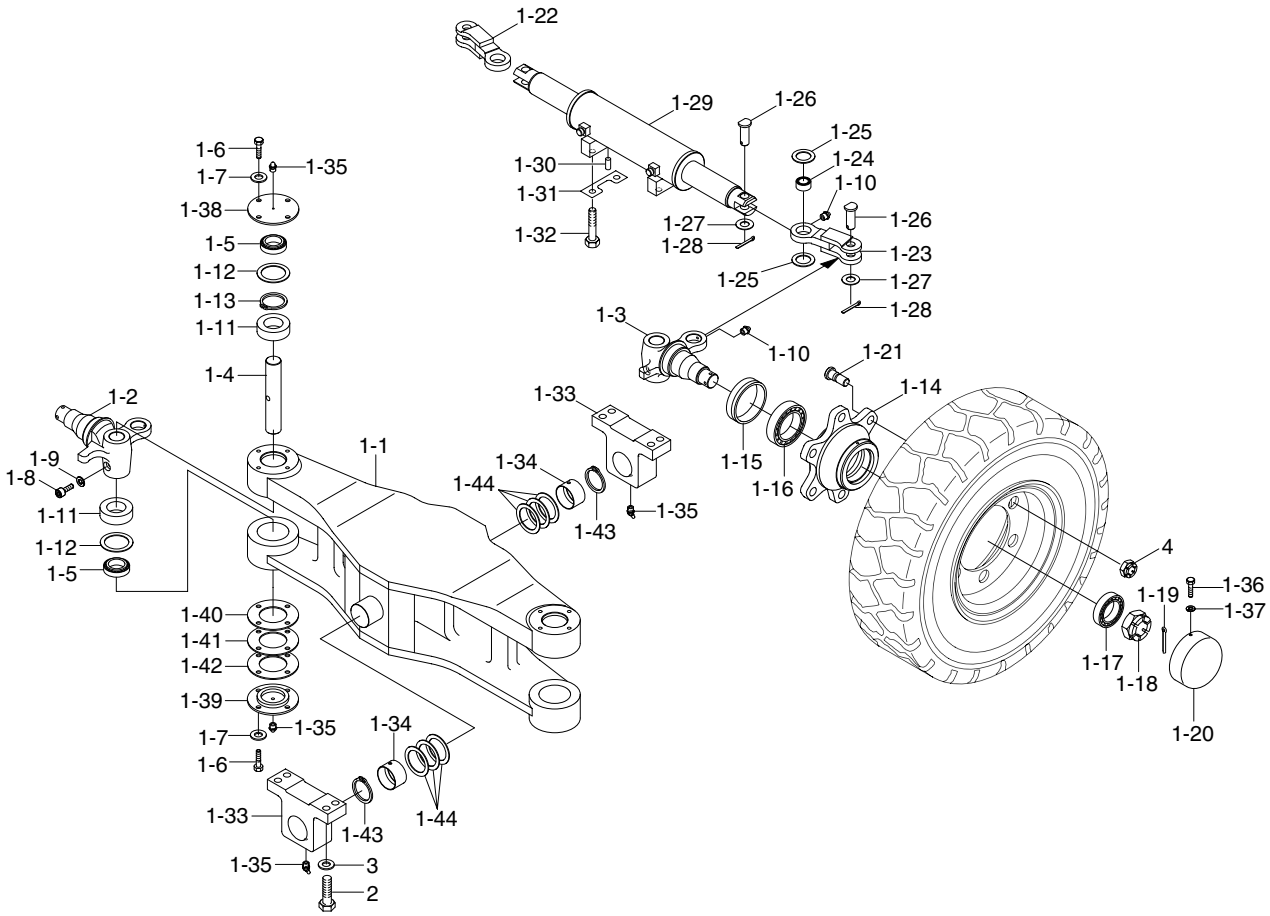
※ Then, repeat the above operation at gradually increasing engine rpm. This releases air from the system and completes preparation for operation.

(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

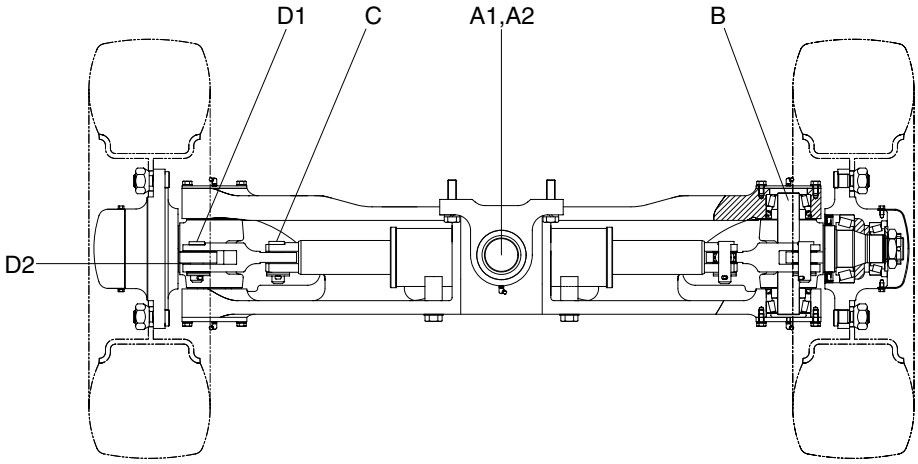
※ Do not remove the stopper bolt unless necessary.



35DS7SE06

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

2) CHECK AND INSPECTION



35DS7SE08

unit : mm(in)

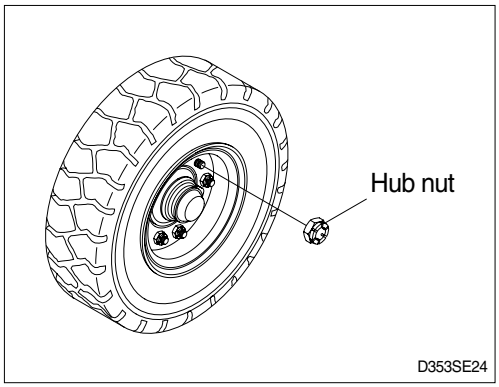
No.	Check item			Criteria		Remarks
				Standard size	Repair limit	
A	Shaft	A1	OD of shaft	55(2.2)	54.5(2.1)	Replace
		A2	ID of bushing	55(2.2)	55.5(2.2)	
B	OD of king pin			35(1.4)	34.5(1.4)	
C	OD of steering cylinder pin			20(0.8)	19.5(0.8)	
D	Knuckle	D1	OD of pin	20(0.8)	19.5(0.8)	
		D2	Vertical play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

· 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 lock nut.

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

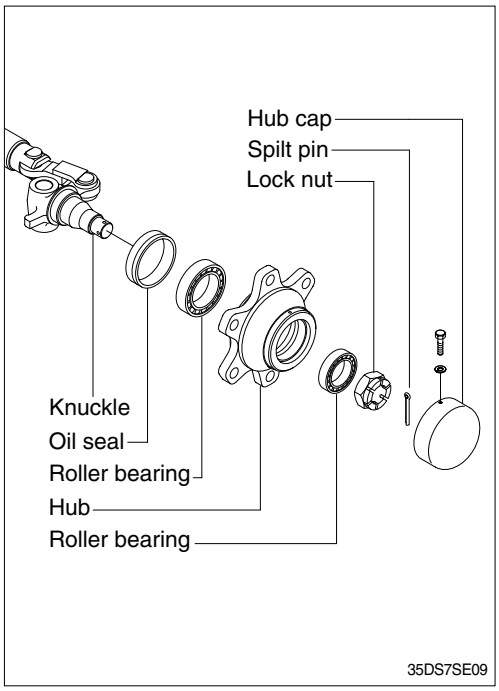
※ Be very careful because just before the hub comes off, tapered roller bearing will fall out.

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



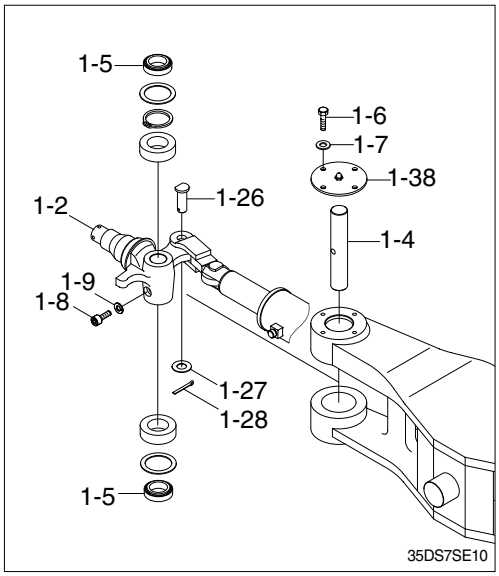
(8) Loosen special bolt(1-8) and spring washer(1-9).

(9) Remove hexagon bolt(1-6) and upper cover(1-38).

(10) Push out the king pin(1-4) without damaging the knuckle arm(1-2).

(11) If defect is observed in taper roller bearing(1-5), pull it out by using extractor.

(12) Remove spilt pin(1-28), plain washer(1-27) and clevis 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(1-8) and washer(1-9) of king pin(1-3).

(2) There is a notch in the middle of the king pin(1-4), make sure that this notch is on the special bolt side.

(3) Do not hammer to drive in taper roller bearing(1-5) because it will break.
Always use drive-in tool.
Be sure that the fixed ring of the bearing is placed in position facing the knuckle(1-3).

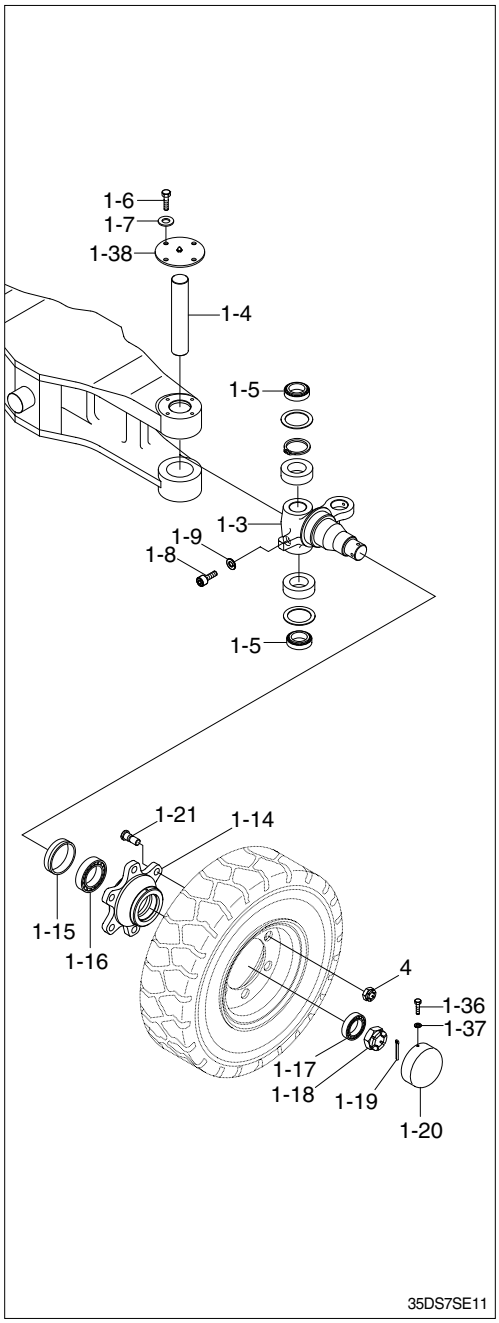
(4) Hub

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

② Install the outer race of the taper roller bearing(1-17) in the wheel center and assemble to the knuckle.

③ Tighten nut(1-18) and lock with split pin(1-19). In locking with split pin, locate the hole for the split pin by turning the nut back 1/6 of a turn. Adjust the preload of bearing.

④ Mount the hub cap(1-20) and tighten with bolt (1-36).
Bearing should be well greased before assembling.

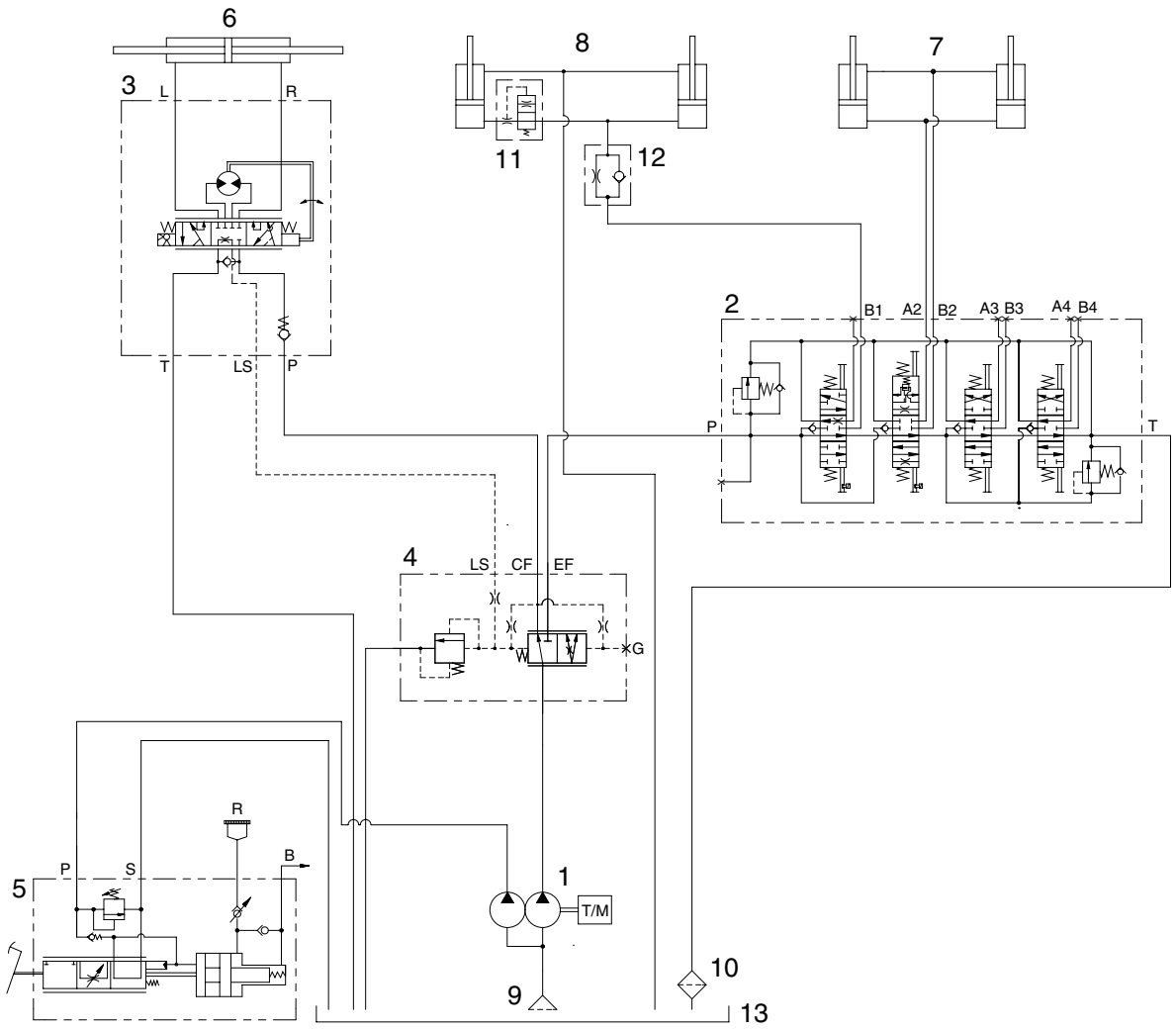


SECTION 6 HYDRAULIC SYSTEM

SECTION 6 HYDRAULIC SYSTEM

GROUP 1 STRUCTURE AND FUNCTION

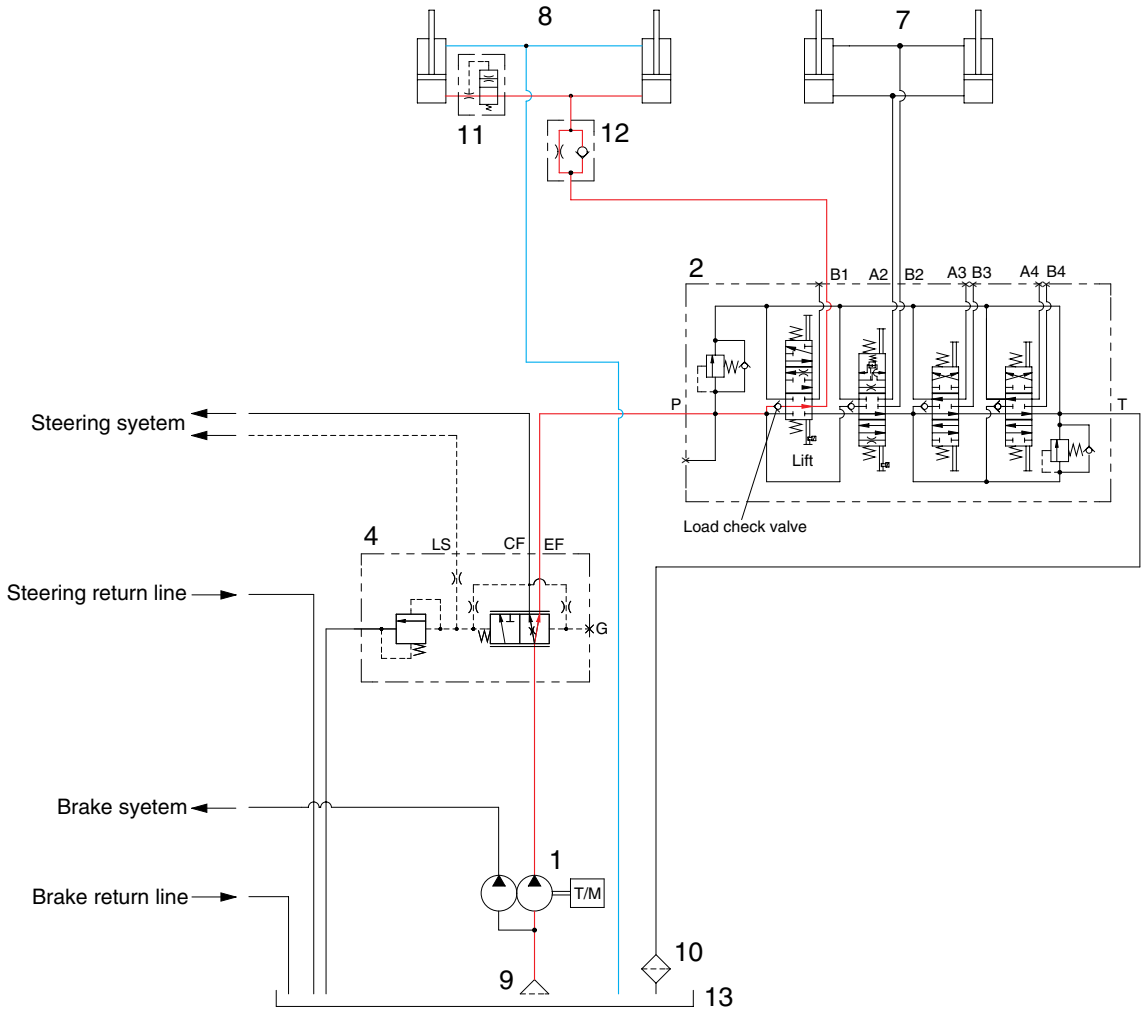
1. HYDRAULIC CIRCUIT



35DS7HS01

1	Hydraulic gear pump	8	Lift cylinder
2	Main control valve	9	Suction filter
3	Steering unit	10	Return filter
4	Priority valve	11	Down safety valve
5	Brake valve	12	Down control valve
6	Steering cylinder	13	Hydraulic oil tank
7	Tilt cylinder		

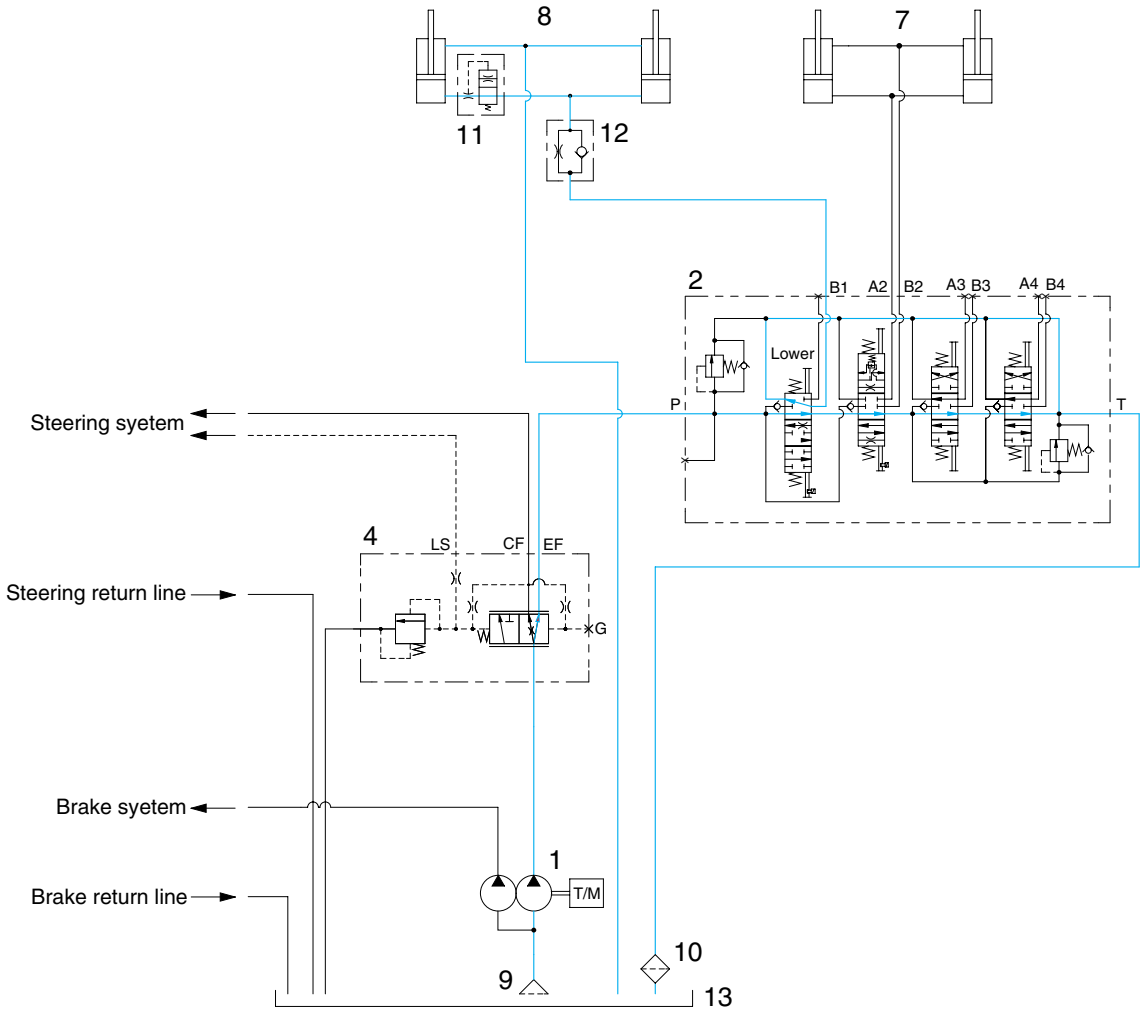
1) WHEN THE LIFT CONTROL LEVER IS IN THE LIFT POSITION



35DS7HS02

When the lift control lever is pulled back, the spool on the first block is moves to lift position.
The oil from hydraulic gear pump(1) flows into main control valve(2) through the priority valve(4) and then goes to the large chamber of lift cylinder(8) by pushing the load check valve of the spool.
The oil from the small chamber of lift cylinder(8) returns to hydraulic oil tank(13) at the same time.
When this happens, the forks go up.

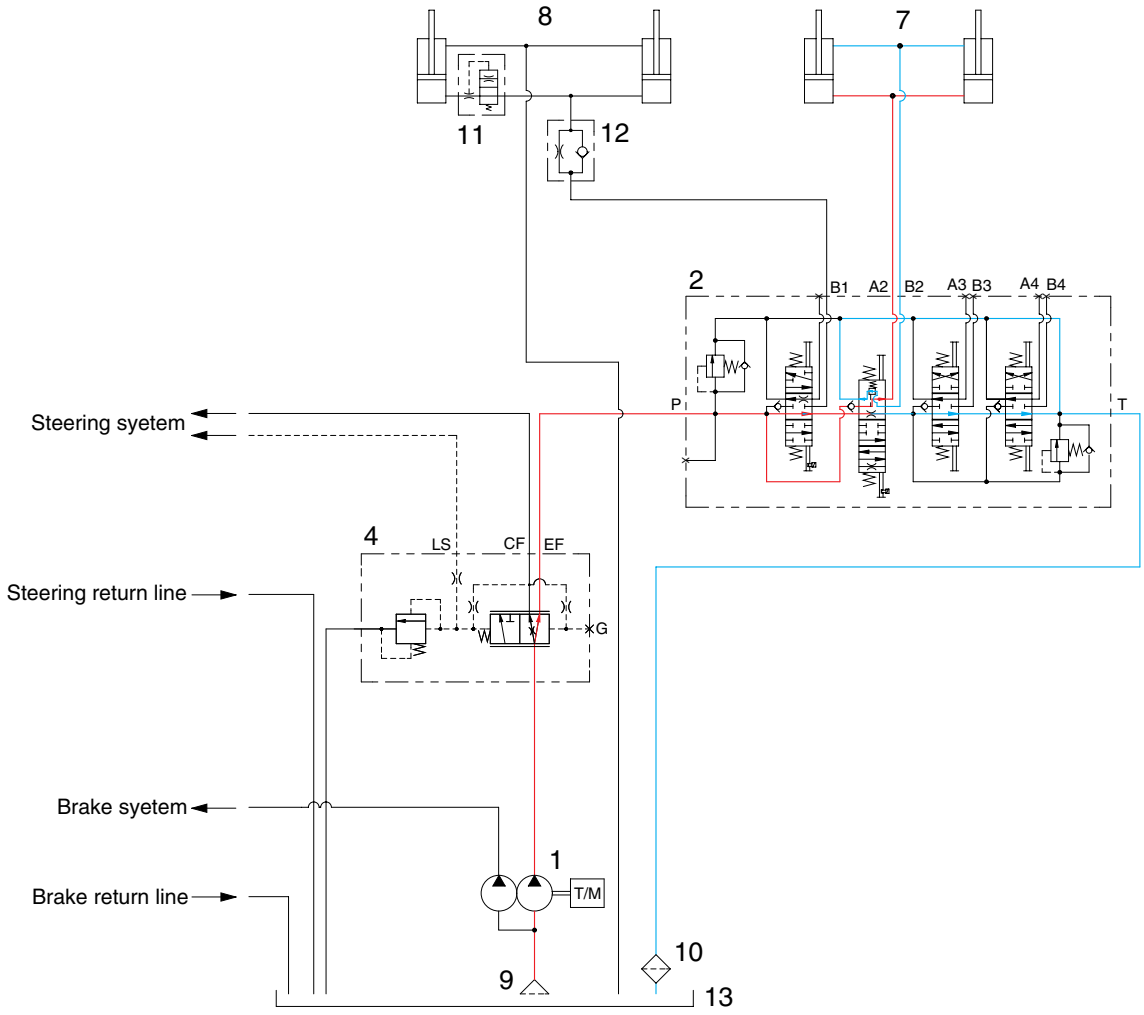
2) WHEN THE LIFT CONTROL LEVER IS IN THE LOWER POSITION



35DS7HS03

When the lift control is pushed forward, the spool on the first block is moved to lower position.
The work port(B1) and the small chamber and the large chamber are connected to the return passage, so the lift will be lowered due to its own weight.

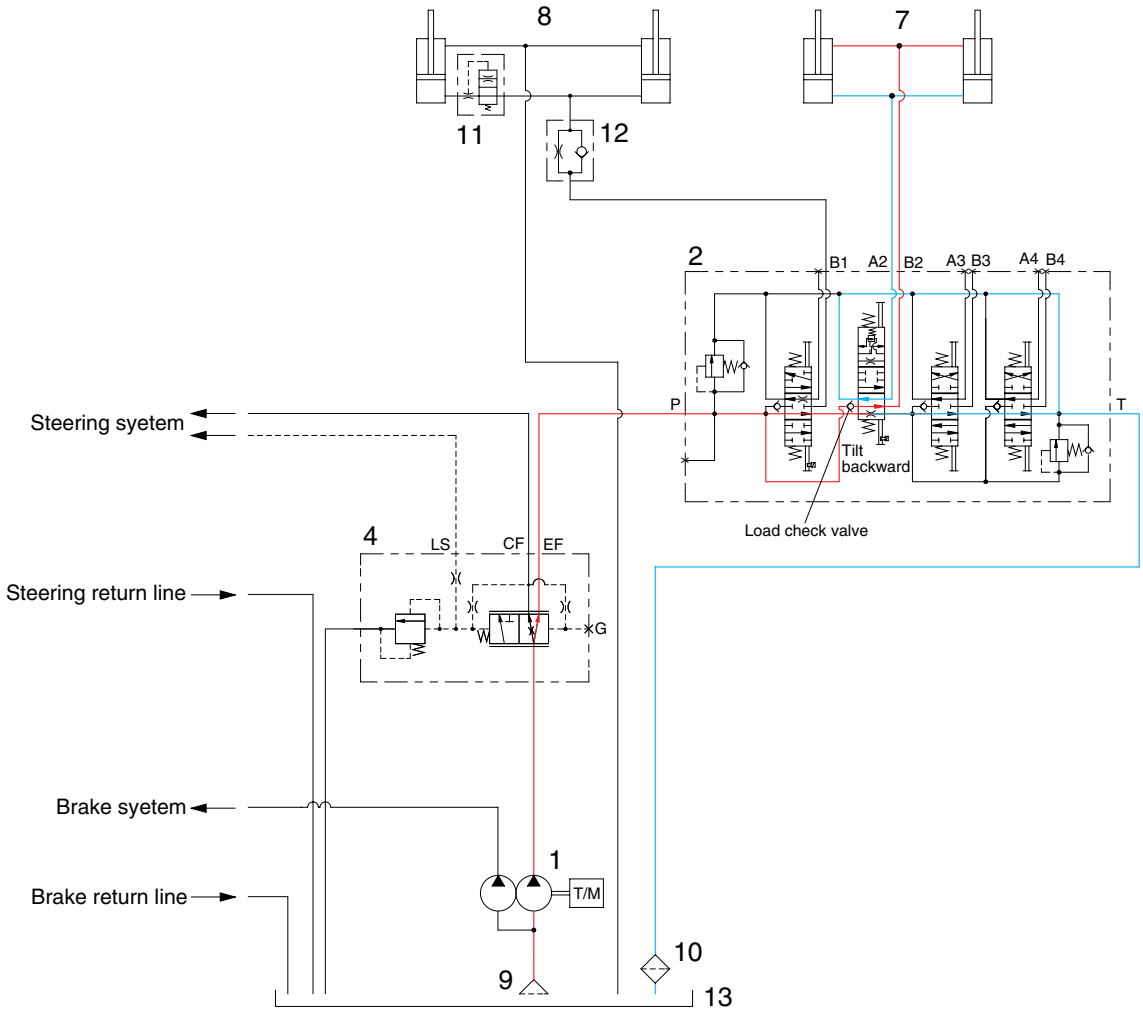
3) WHEN THE TILT CONTROL LEVER IS IN THE FORWARD POSITION



35DS7HS04

When the tilt control lever is pushed forward, the spool on the second block is moved to tilt forward position.
The oil from hydraulic gear pump(1) flows into main control valve(2) through the priority valve(4) and then goes to the large chamber of tilt cylinder(7) by pushing the load check valve of the spool.
The oil at the small chamber of tilt cylinder(7) returns to hydraulic tank(13) at the same time.
When this happens, the mast tilt forward.

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

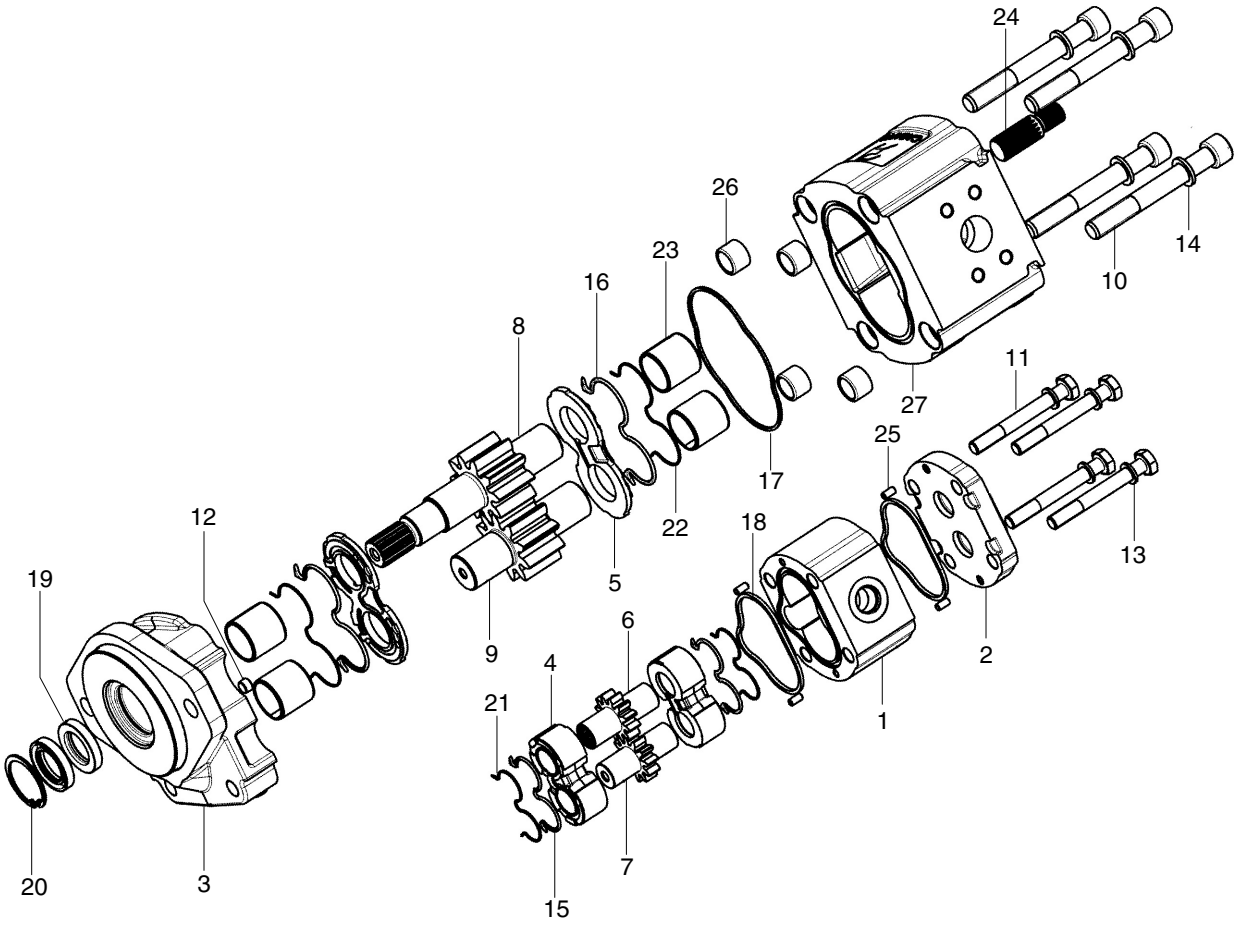


35DS7HS05

When the tilt control lever is pulled back, the spool on the second block is moved to tilt backward position.
The oil from hydraulic gear pump(1) flows into main control valve(2) through the priority valve(4) and then goes to the small chamber of tilt cylinder(7) by pushing the load check valve of spool.
The oil at the large chamber of tilt cylinder(7) returns to hydraulic tank(13) at the same time.
When this happens, the mast tilt backward.

2. HYDRAULIC GEAR PUMP

1) STRUCTURE



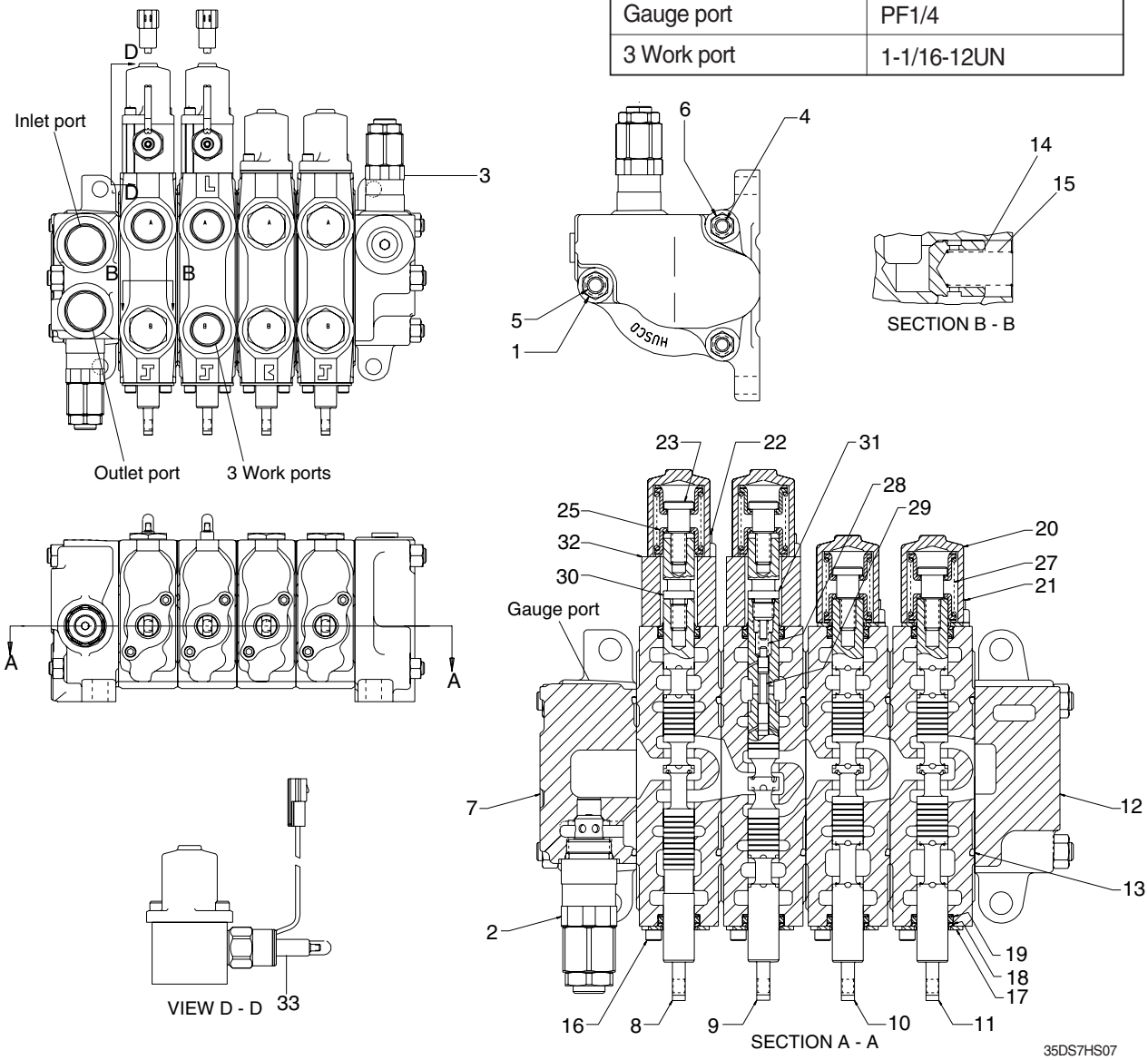
35DS7HS06

1	Body	10	Screw	19	Shaft seal
2	Rear cover	11	Screw	20	Ring
3	Front cover	12	Grub screw	21	Back-up ring
4	Thrust plate	13	Washer	22	Antiextrusion
5	Thrust plate	14	Washer	23	Sleeve bearing
6	Drive gear	15	Seal	24	Hub
7	Driven gear	16	Seal	25	Dowel pin
8	Drive shaft	17	Seal	26	Steel bushing
9	Driven gear	18	Seal	27	Body

3. MAIN CONTROL VALVE

1) STRUCTURE (2 Spool)

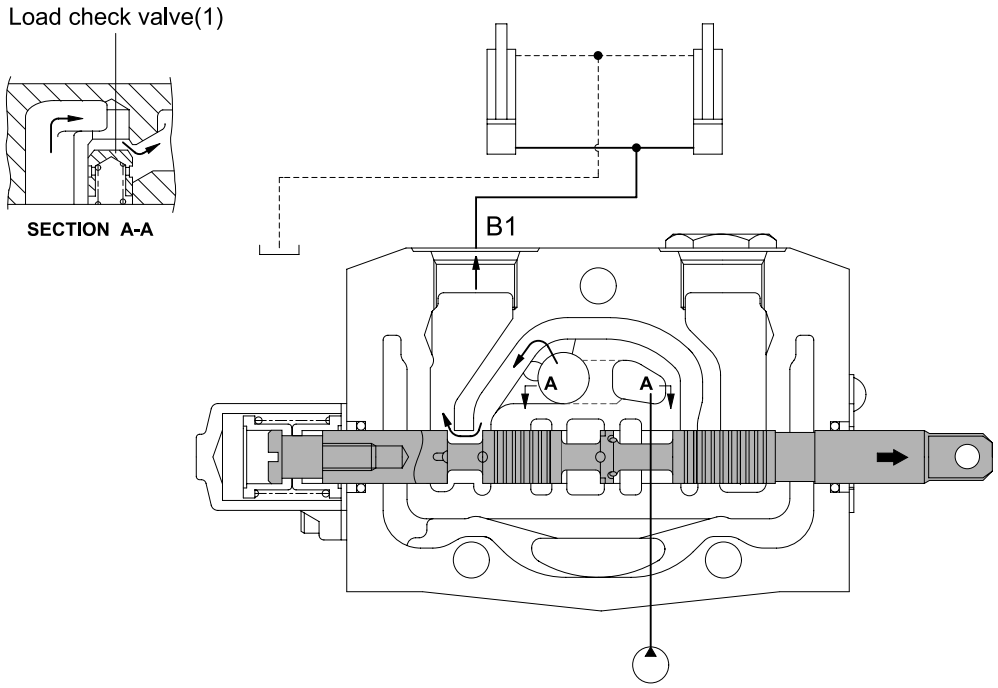
Port name	Size
Inlet port	1-5/16-12UN
Outlet port	1-5/16-12UN
Gauge port	PF1/4
3 Work port	1-1/16-12UN



1	Special nut	12	Outlet section assy	23	Spool end
2	Main relief valve	13	O-ring	25	Spring seat
3	Aux relief valve	14	Poppet	27	Spring
4	Tie rod	15	Spring	28	Spring
5	Tie rod	16	Screw	29	Piston
6	Special nut	17	Seal plate	30	Spool end
7	Inlet section assy	18	Wiper	31	Spool end
8	Spool section-lift	19	Spool seal	32	Spool cap
9	Spool section-tilt	20	Spool cap	33	Solenoid valve
10	Spool section-A1	21	Screw cap		
11	Spool section-A2	22	Screw cap		

2) LIFT SECTION OPERATION

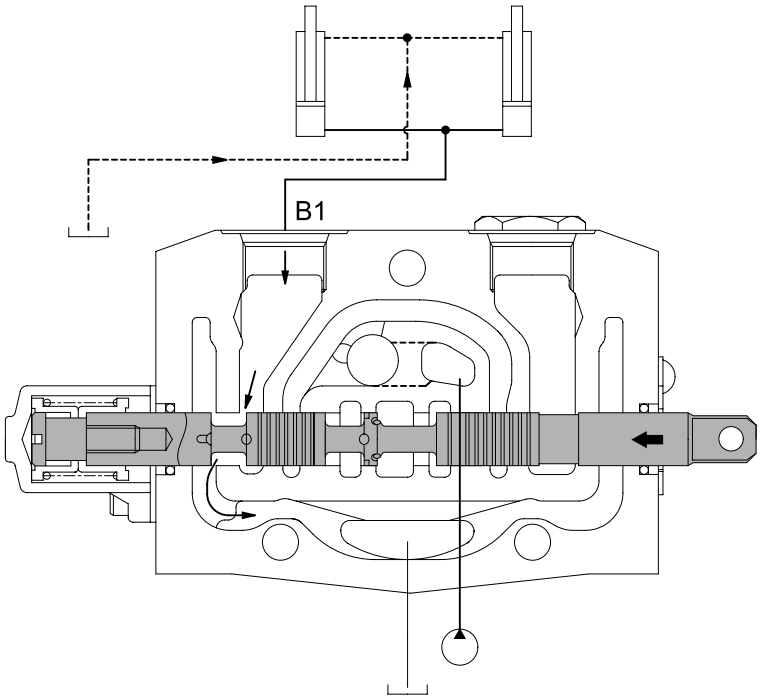
(1) Lift position



D353HS08

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

(2) Lower position

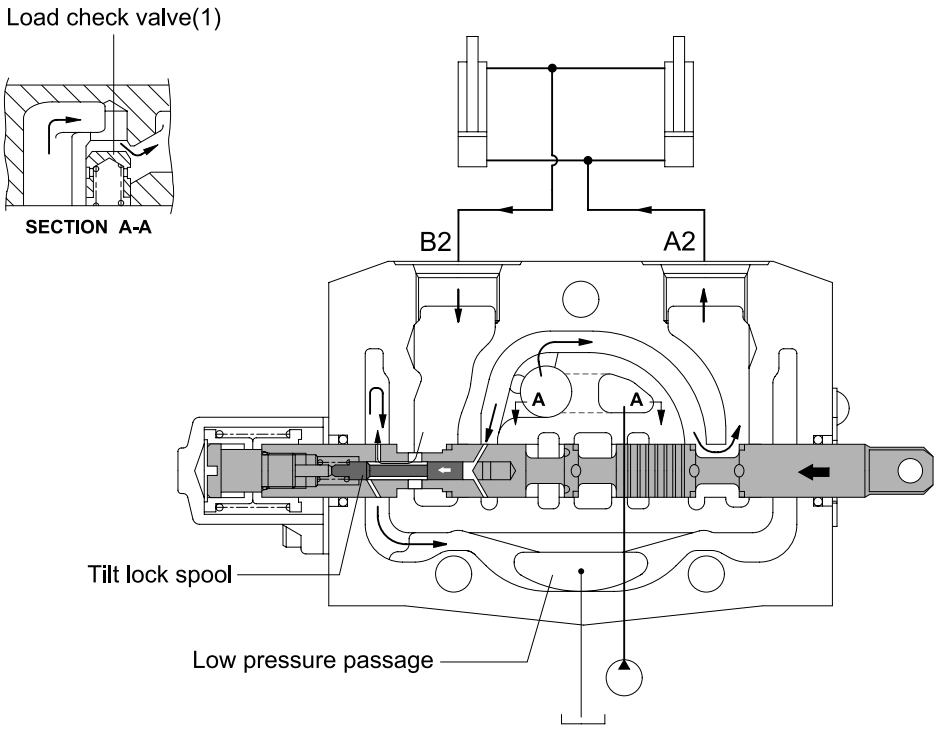


D353HS09

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

3) TILT SECTION OPERATION

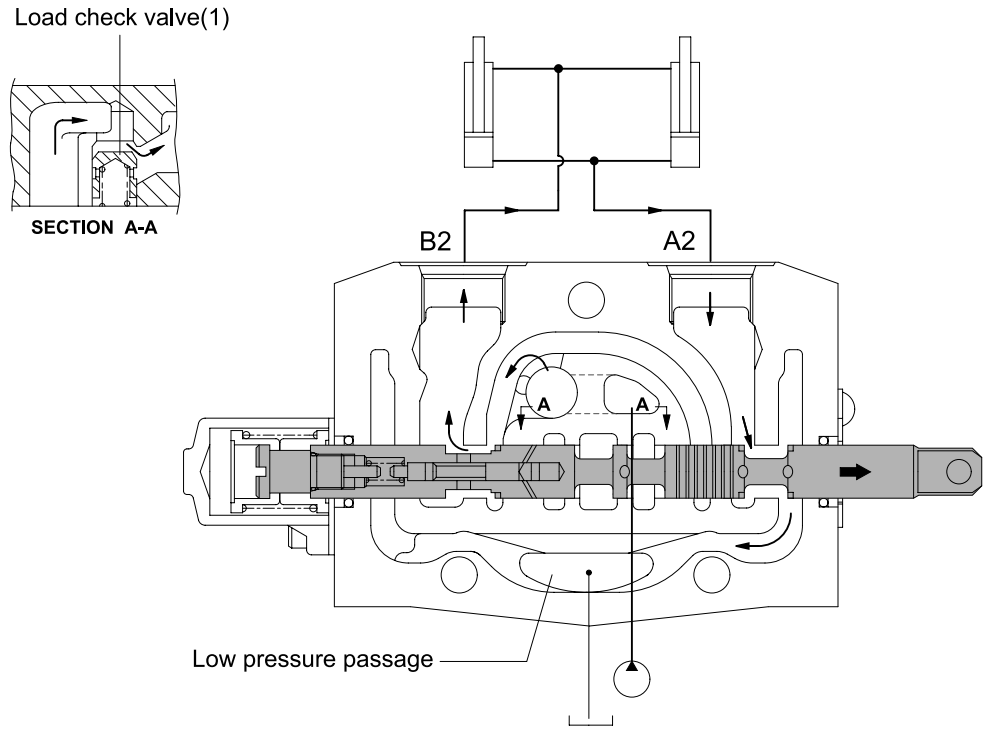
(1) Tilt forward position



D353HS10

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

(2) Tilt backward position



D353HS11

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

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

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

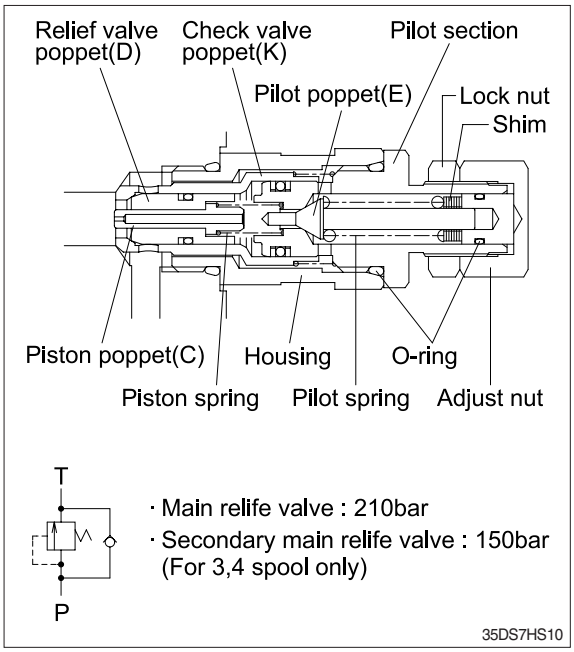
4) MAIN RELIEF VALVE

(1) Pressure setting

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

Procedure

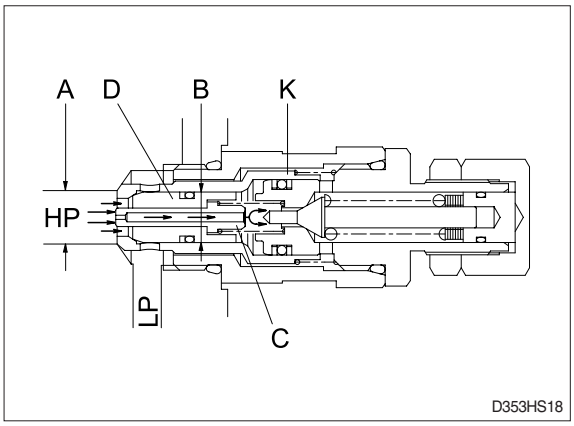
① Loosen lock nut.
② Set adjusting nut to desired pressure setting.
③ If desired pressure setting cannot be achieved, add or remove shims as required.
④ Tighten lock nut.
⑤ Retest in similar manner as above.



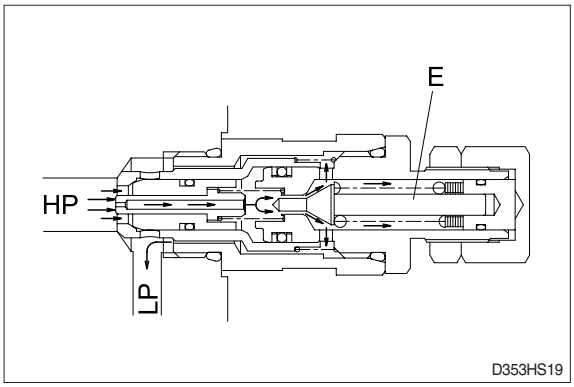
(2) Function

① As work port relief

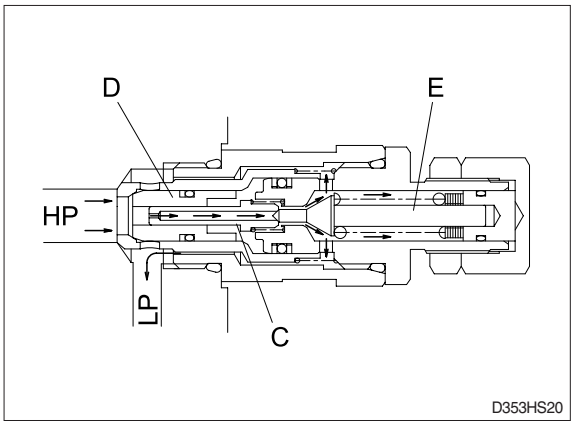
The relief valve is in communication between the high pressure port HP and low pressure LP. Oil is admitted through the hole in poppet C and because of the differential area between diameters A and B relief valve poppet D and check valve poppet K are tightly seated as shown.



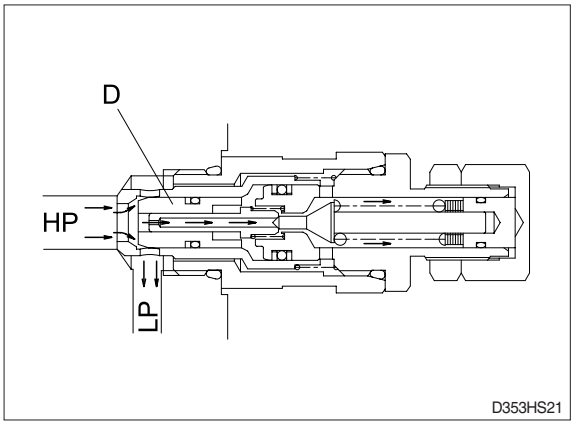
The oil pressure in the high pressure port HP has reached the setting of the pilot poppet spring force and unseats the pilot poppet E and oil flows around the poppet through the cross drilled holes and to the low pressure area LP.



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

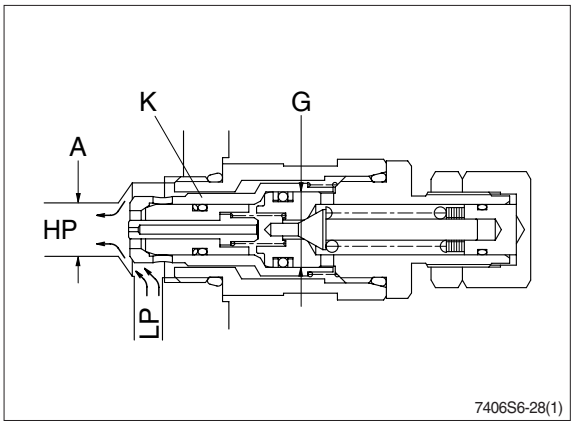


The imbalance of pressure on the inside as compared to that of the high pressure port HP, forces the relief valve poppet D to open and relieve the oil directly to the low pressure chamber LP in the valve.

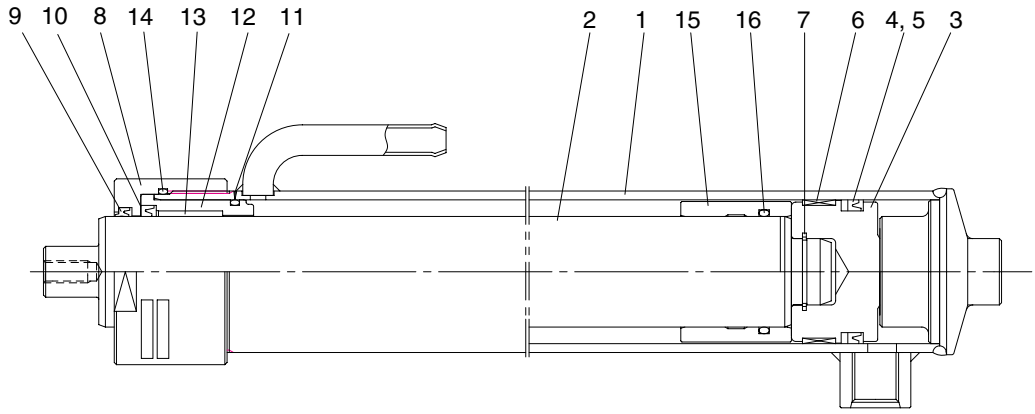


② As anti void

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



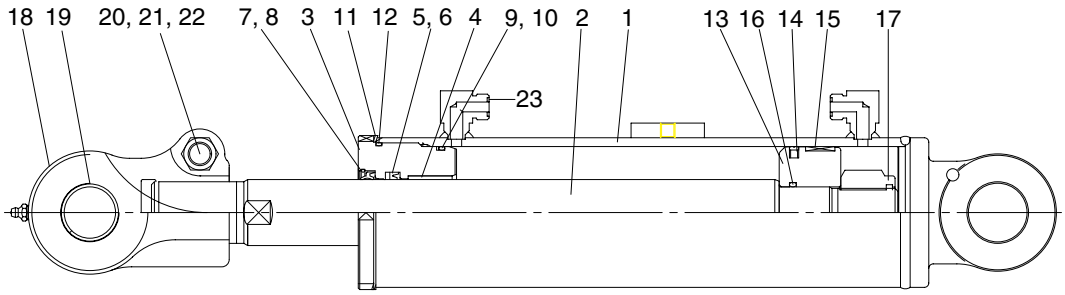
4. LIFT CYLINDER



D357HS12

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

5. TILT CYLINDER



D357HS13

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

GROUP 2 OPERATIONAL CHECKS AND TROUBLESHOOTING

1. OPERATIONAL CHECKS

1) CHECK ITEM

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

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

· **Hydraulic drift**

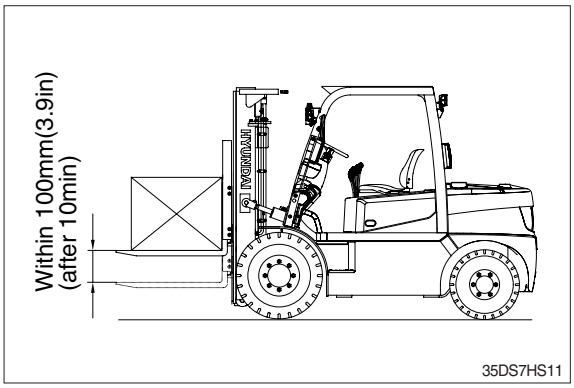
- Down(Downward movement of forks)
  : Within 100mm(3.9in)
- Forward(Extension of tilt cylinder)
  : Within 5°

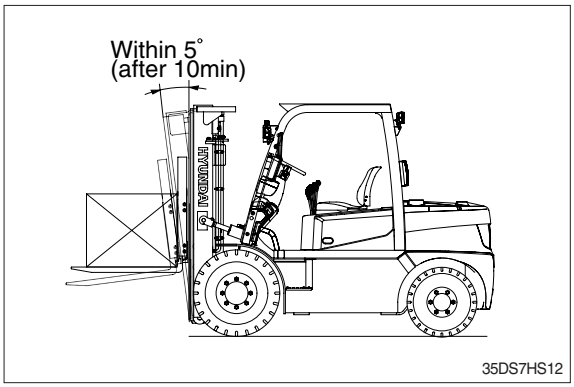
If the hydraulic drift is more than the specified value, replace the control valve or cylinder packing.

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

mm (in)

Standard	Under 0.6 (0.02)

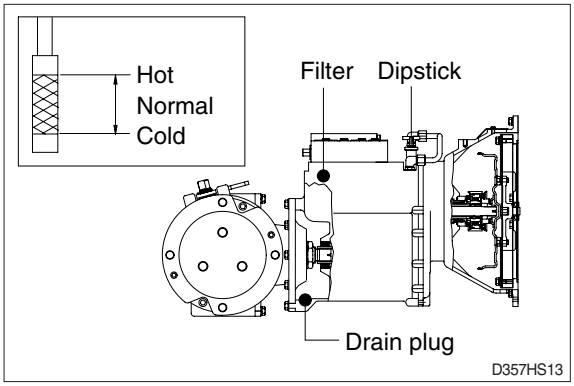




2) HYDRAULIC OIL

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

(2) When changing hydraulic oil, clean suction strainer(screwed into outlet port pipe) and line filter(screwed into inlet pipe). Line filter uses paper element, so replace periodically(every 6 months or 1200 hours)



3) CONTROL VALVE

(1) Raise forks to maximum height and measure oil pressure.

Check that oil pressure is 210kgf/cm^2.

(2990psi)

2. TROUBLESHOOTING

1) SYSTEM

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

Problem	Cause	Remedy
Actuator(cylinder or motor) works slowly or does not operate.	· Shortage of oil in oil tank. · Decrease of relief valve pressure. · Spool got stuck. · Shortage of oil flow to the valve.	· Check the oil level in the oil tank. · Install pressure gauge on the circuit, and check the pressure with it by handling the lever. · Check that manual lever moves smoothly. · Check that lever stroke is enough. · Check that oil flow of the pump is within specified rate.
Cylinder lowers considerably under normal circumstance.	· Internal leakage of cylinder happens frequently. · Excessive leakage from spool of the valve. · Spool got stuck. · Leakage in a part of the circuit.	· Fit the stop valve on the pipe between valve and cylinder, observe the internal leakage of cylinder. · Check the oil viscosity is not too low. · Check that manual lever moves smoothly. · Check the circuit. · Observe leakage from pipes.
Pressure does not increase sufficiently.	· Defect of relief valve. · Leakage in a part of the circuit.	· Check the relief valve. · Check the circuit. · Observe leakage from pipes.
Temperature rising of the hydraulic oil.	· Working with higher pressure than rated pressure. · Low viscosity of oil. · Leakage from a part of the circuit. · Oil leakage in the pump. · Insufficient suction of the pump.	· Check the flow pressure. · Check the sort of oil and viscosity. · Check if the circuit is relieved at all times. · Check if the temperature of pump surface higher 30°C than oil temperature. · Check the oil tank volume. · Check if the suction strainer is blocked.
Steering force is heavy.	· Defect of steering relief valve.	· Check the steering relief valve.

2) HYDRAULIC GEAR PUMP

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

3) MAIN RELIEF VALVE

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

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

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

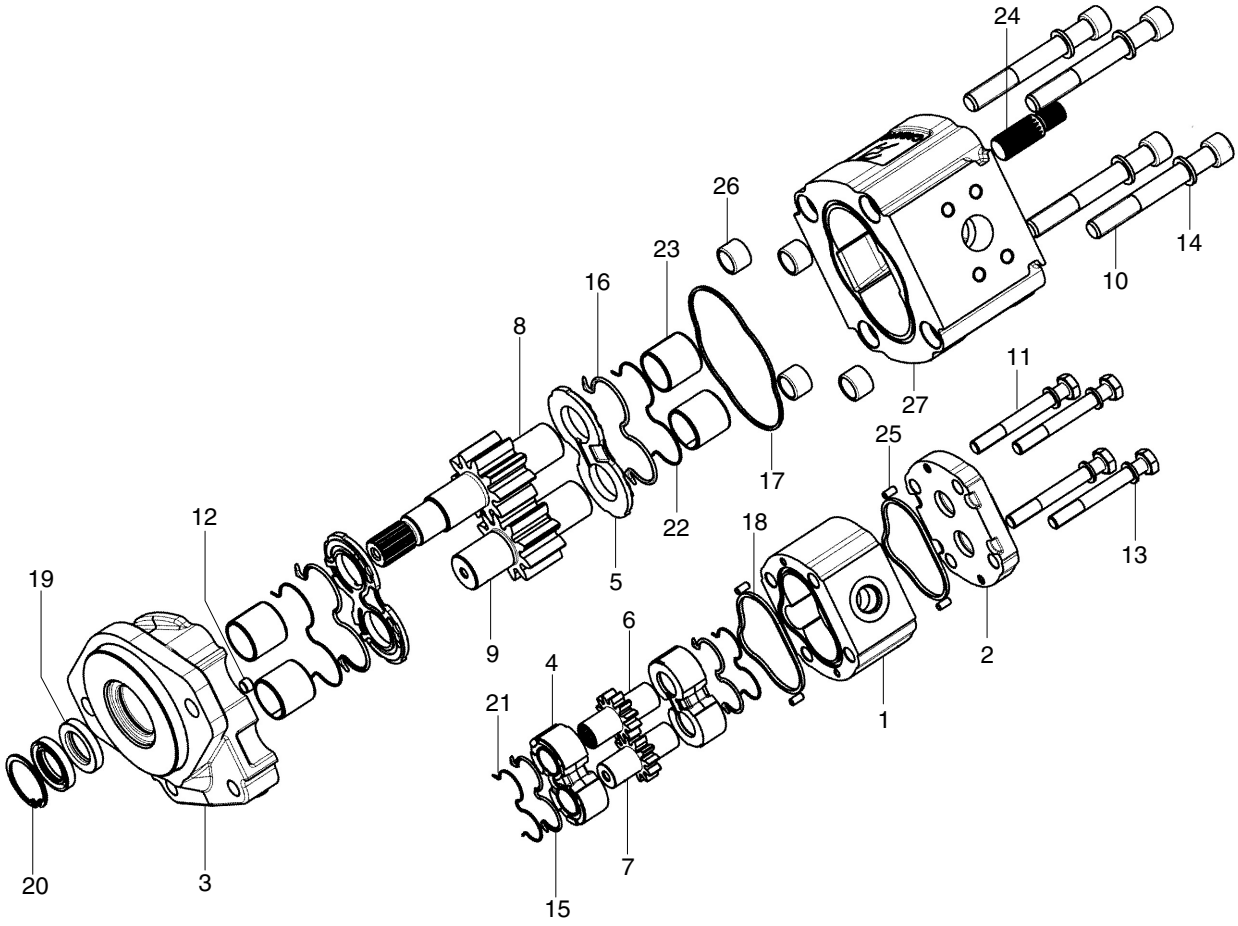
4) LIFT CYLINDER

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

1) STRUCTURE



35DS7HS06

1	Body	10	Screw	19	Shaft seal
2	Rear cover	11	Screw	20	Ring
3	Front cover	12	Grub screw	21	Back up ring
4	Thrust plate	13	Washer	22	Antiextrusion
5	Thrust plate	14	Washer	23	Sleeve bearing
6	Drive gear	15	Seal	24	Hub
7	Driven gear	16	Seal	25	Dowel pin
8	Drive shaft	17	Seal	26	Steel bushing
9	Driven gear	18	Seal	27	Body

2) GENERAL INSTRUCTION

(1) Cleanliness

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

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

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

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

(2) Lubrication of moving parts

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

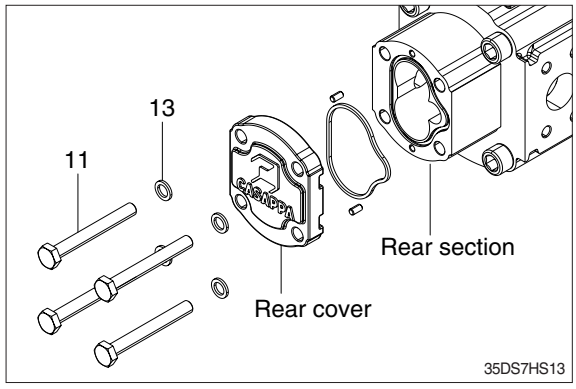
(3) Tools required for assembly

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

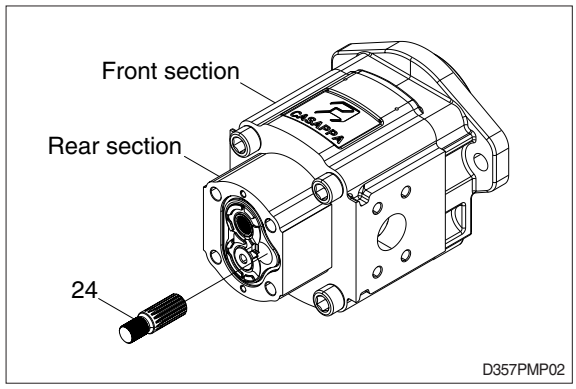
3) DISASSEMBLY

(1) Rear section

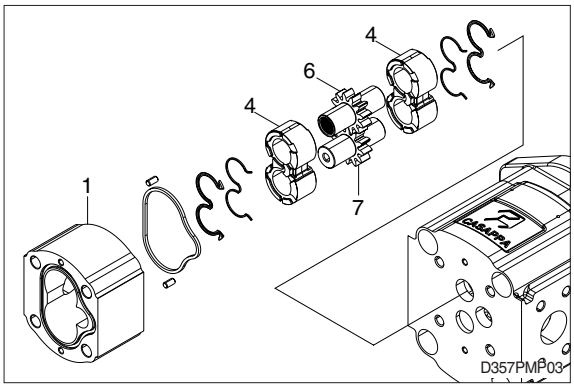
① Loosen and remove the screw(11) of second pump.



② Remove hub(24) and ease the drive gear up to facilitate removal the thrust plate.



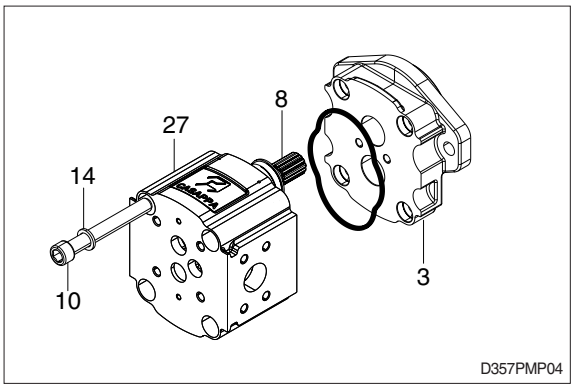
③ And remove drive gear(6), driven gear(7), thrust plate(4), keeping gears as straight as possible, and body(1) also.



(1) Front section

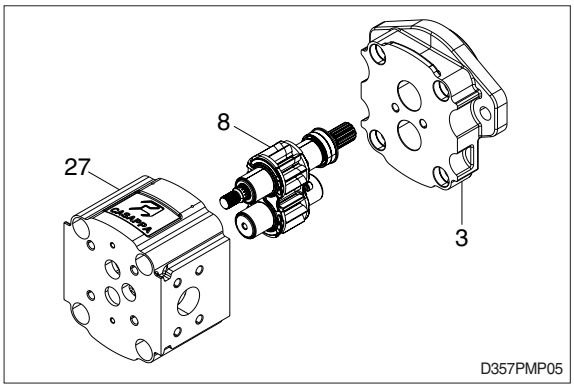
① Loosen and remove the screw(10) from the body(27).

※ Coat the sharp edges of the drive shaft (8) with adhesive tape and smear a clean grease on the shaft end extension to avoid any damaging lip of the shaft seal when removing the cover(3).



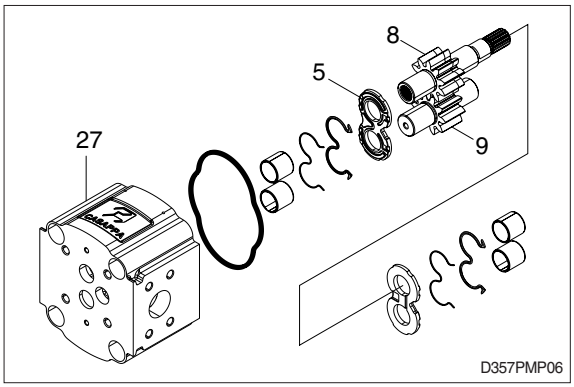
② Remove the cover(3) taking care to keep the cover as straight as possible during removal. If cover is stuck, tap around the edge with rubber mallet in order to break away from the body(27).

※ Ensure that while removing cover(3) shaft and other components remain position.



③ Ease the drive gear(8) up to facilitate removal the thrust plate(5).

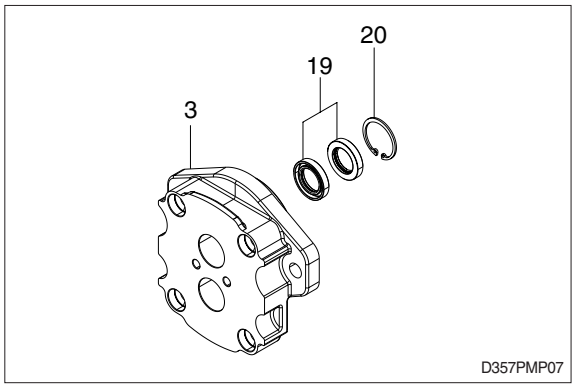
④ Remove drive gear(8), driven gear(9), thrust plate(5), keeping gears as straight as possible, and body(27) also.



(3) Cover assembly

① Remove snap ring(20) with proper tool(Only when it is needed to replace shaft seal).

② Remove the shaft seal(19) taking care not to give any damage on the surface of shaft hole(Only when it is needed to replace shaft seal).

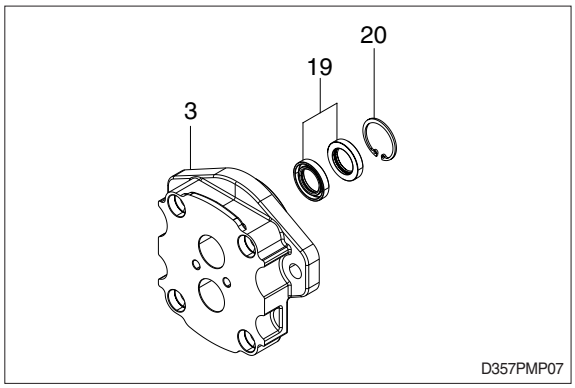


4) REASSEMBLY

(1) Cover assembly

① Insert the shaft seal(19) carefully and fit it inside of cover with proper tool.

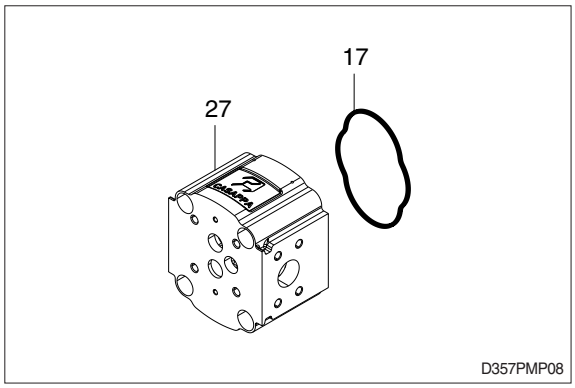
② Fit the snap ring(20) in pre-arranged position with proper tool.



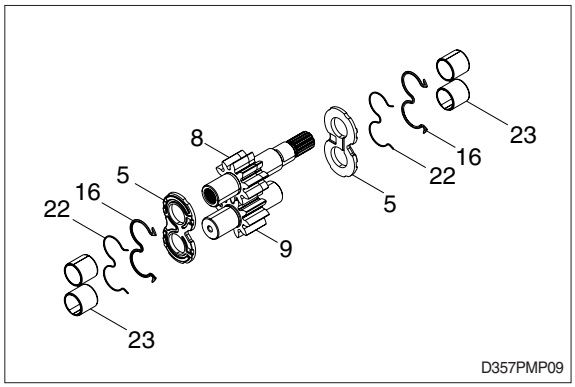
(2) Front section

① Fit the seal(17) on the pre-arrang-ed groove of the body(27).

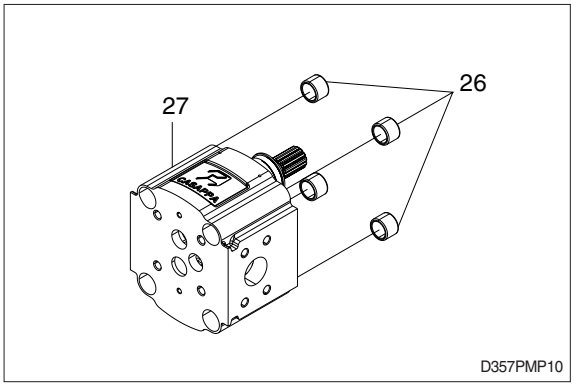
※ Smear clean grease on the parker ring to avoid drifting away of parker ring from the body.



② Locate the seals(16) on the groove pre-arranged on the thrust plate(5).
Then, locate antiextrusion(22) on the groove pre-arranged on the seals(16).
Smear clean grease on the seals(16, 22).
(The front and rear thrust plates and seals and back-up rings are same).



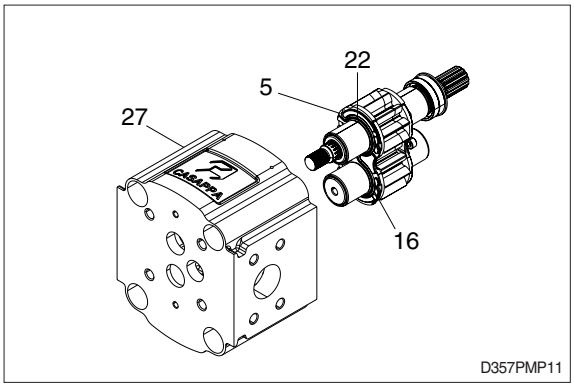
③ Insert the steel bushing(26) into body(27).



④ Insert the complete pressure plate (5+16+22) into body(27) while keeping the plate straight.

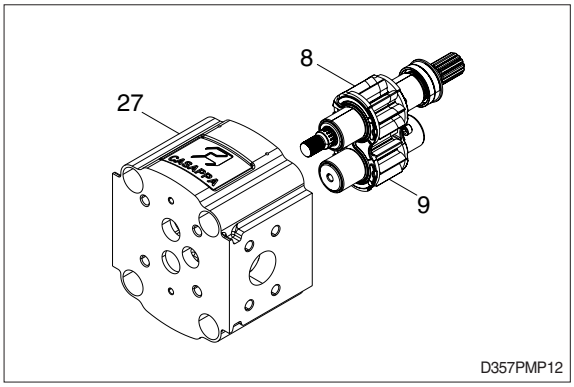
※ Seal side should face to the rear side, opposite side of gears.

※ Pay attention to the direction of seal. (opened side should face suction side always)

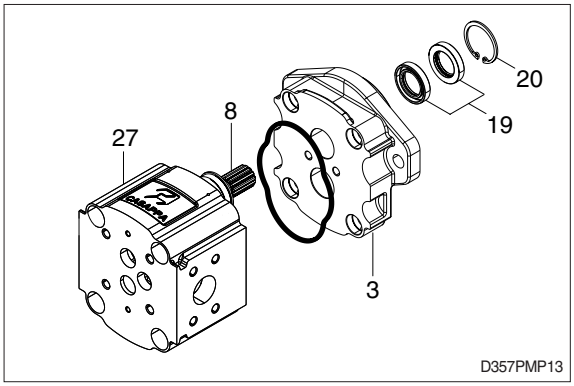


⑤ Locate driving gear(8) and driven gear(9) while keeping the gears straight.

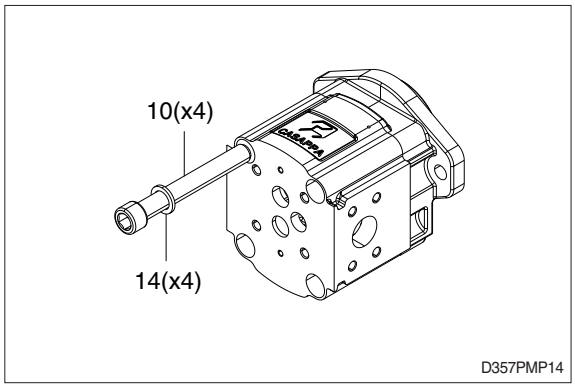
※ Locate pressure plate(5+16+22) with care for the direction.



⑥ Locate complete cover(3+19+20) while taking care not to give any damage on the shaft seal by edge of shaft.
And tap around the cover(3) with rubber mallet.

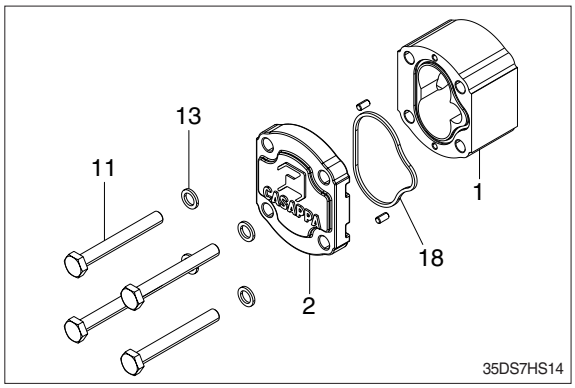


⑦ Tighten the bolts(10) with washer(14) in a crisscross pattern to torque value of 14.3kgf · m(103lbf · ft).



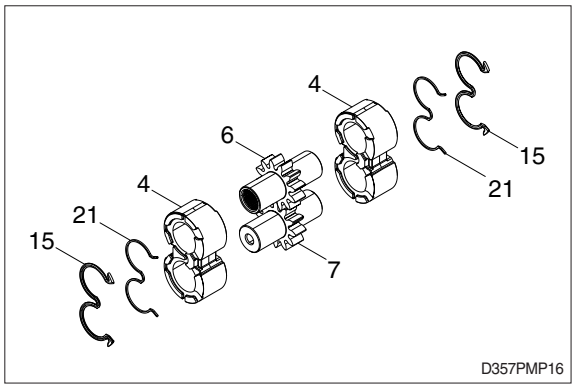
(3) Rear section

① Smear clean grease on the seal(18) to avoid drifting away of seal from the body(1) and assemble temporarily rear cover(2).



② Locate the seals(15) on the groove pre-arranged on the thrust plates(4).
Then, locate back-up ring(21) on the groove pre-arranged on the seals(15).

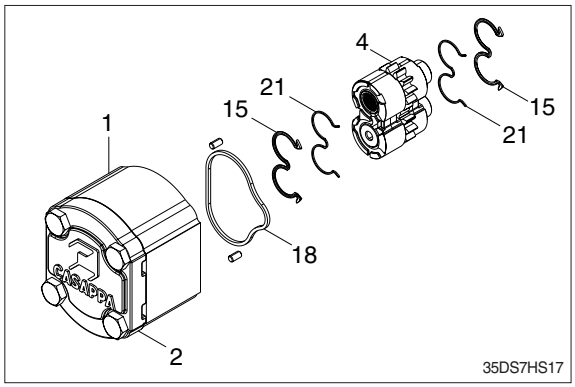
※ Smear clean grease on the seals (21+15).
(The front and rear thrust plates and seals and back-up rings are same)



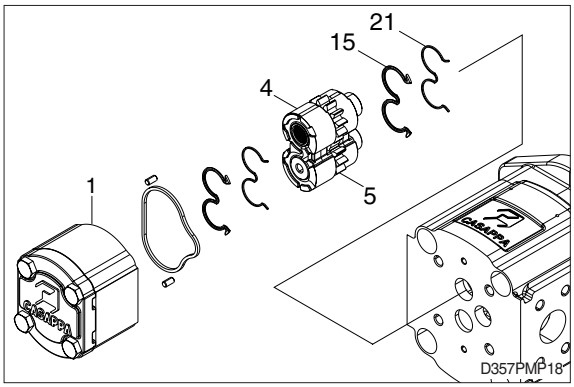
③ Insert the complete pressure plate (4+21+15) into body while keeping the plate straight.

※ Seal side should face to the rear cover (2), opposite side of gears.

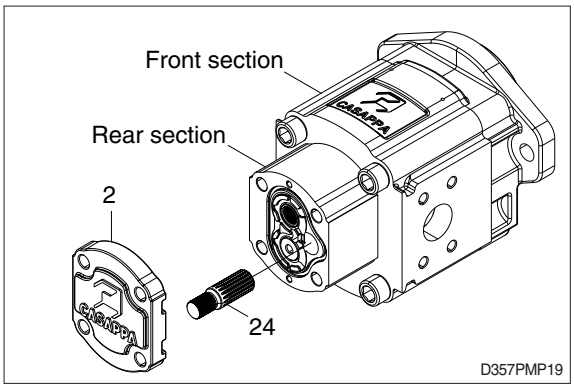
※ Pay attention to the direction of seal. (opened side should face suction side always)



④ Locate driving gear(4) and driven gear(5) while keeping the gears straight.
Locate pressure plate(4+21+15) with care for the direction.

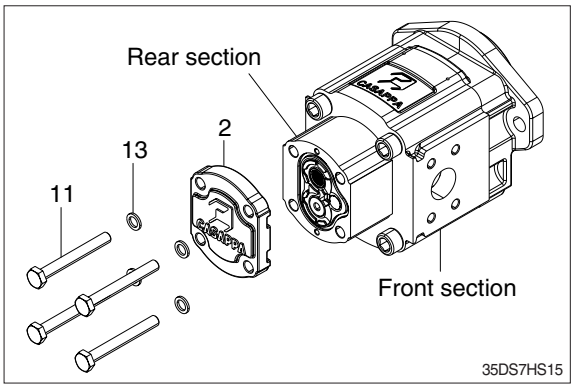


⑤ Open rear cover(2) to locate hub(24) into rear section.



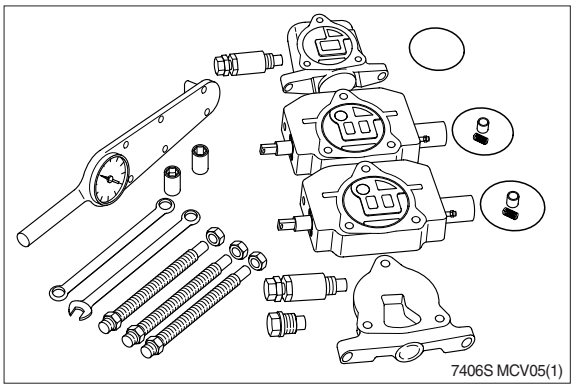
⑥ Tighten the bolts(11) with washer(13) in a crisscross pattern to torque value of 4.6kgf · m(33.3lbf · ft).

※ Check that the pump rotate freely when the drive shaft is turned by hand. If not a thrust plate seal may be pinched.



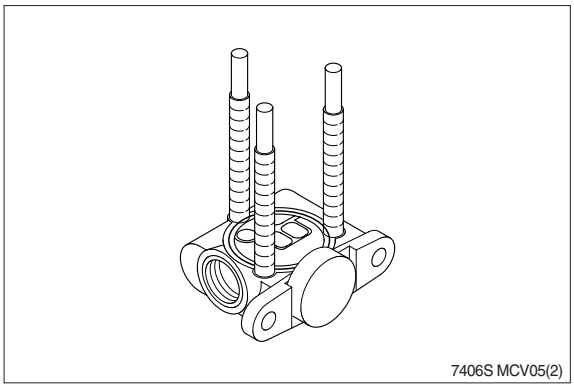
2. MAIN CONTROL VALVE

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



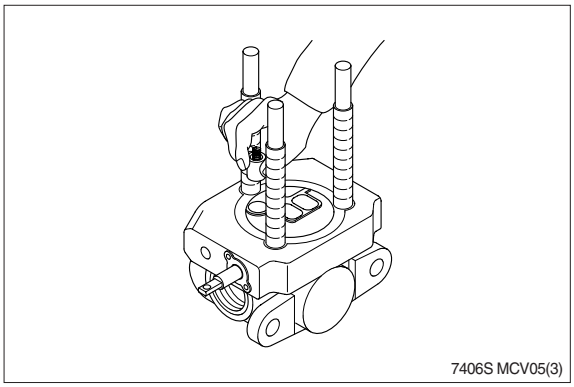
7406S MCV05(1)

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



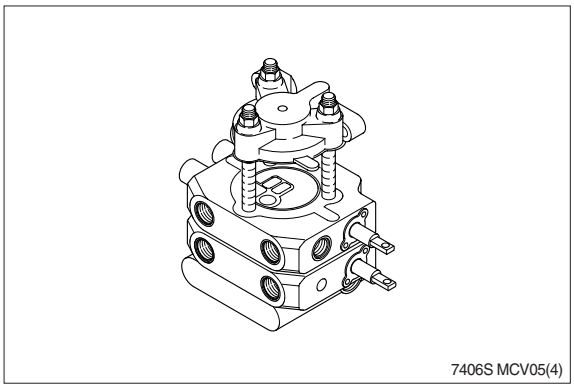
7406S MCV05(2)

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



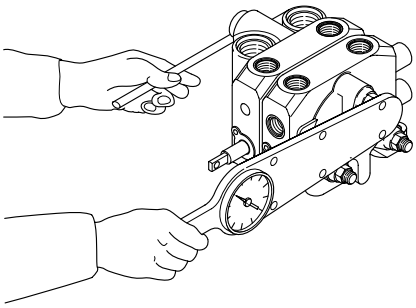
7406S MCV05(3)

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



7406S MCV05(4)

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

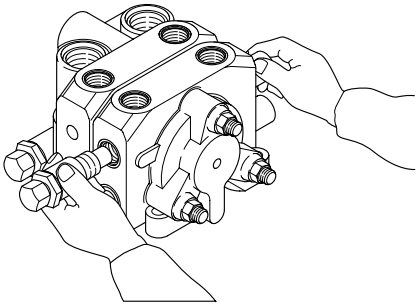

7406S MCV06(1)

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

※ **General assembly notes**:

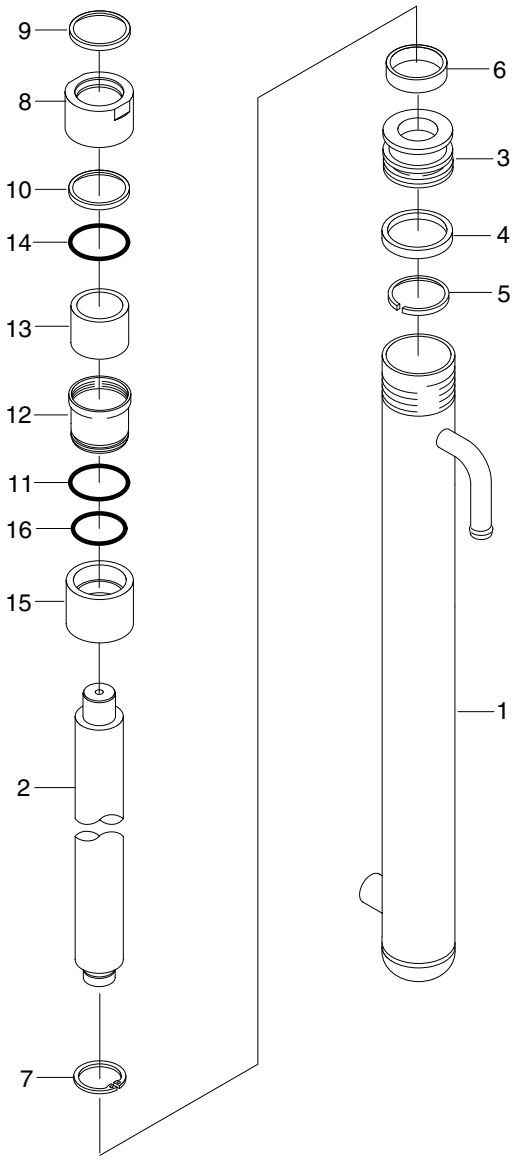
A. Lever assemblies can be installed on section before or after complete valve assembly.

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


7406S MCV06(2)

4. LIFT CYLINDER

1) STRUCTURE



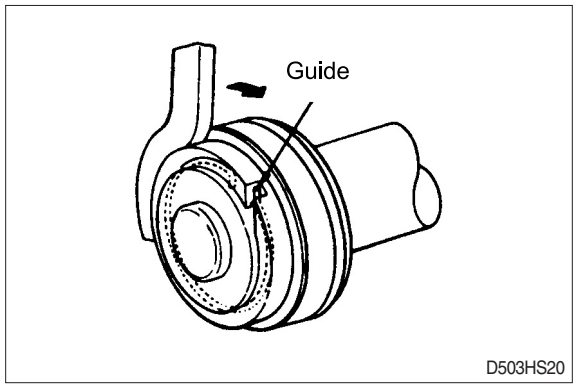
- I.D × O.D × stroke(standard)
  73 × 65 × 1335mm
  (2.9 × 2.6 × 52.6in)
- Rod O.D : 50mm(2.0in)

D357HS19

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



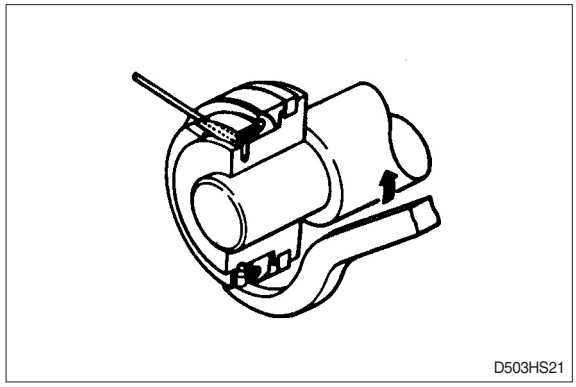
2) CHECK AND INSPECTION

mm(in)

Check item	Standard size	Repair limit	Remedy
Clearance between cylinder rod & bushing	0.05~0.25 (0.002~0.01)	0.4 (0.0015)	Replace bushing
Clearance between piston ring & tube	0.05~0.35 (0.002~0.013)	0.5 (0.02)	Replace piston ring

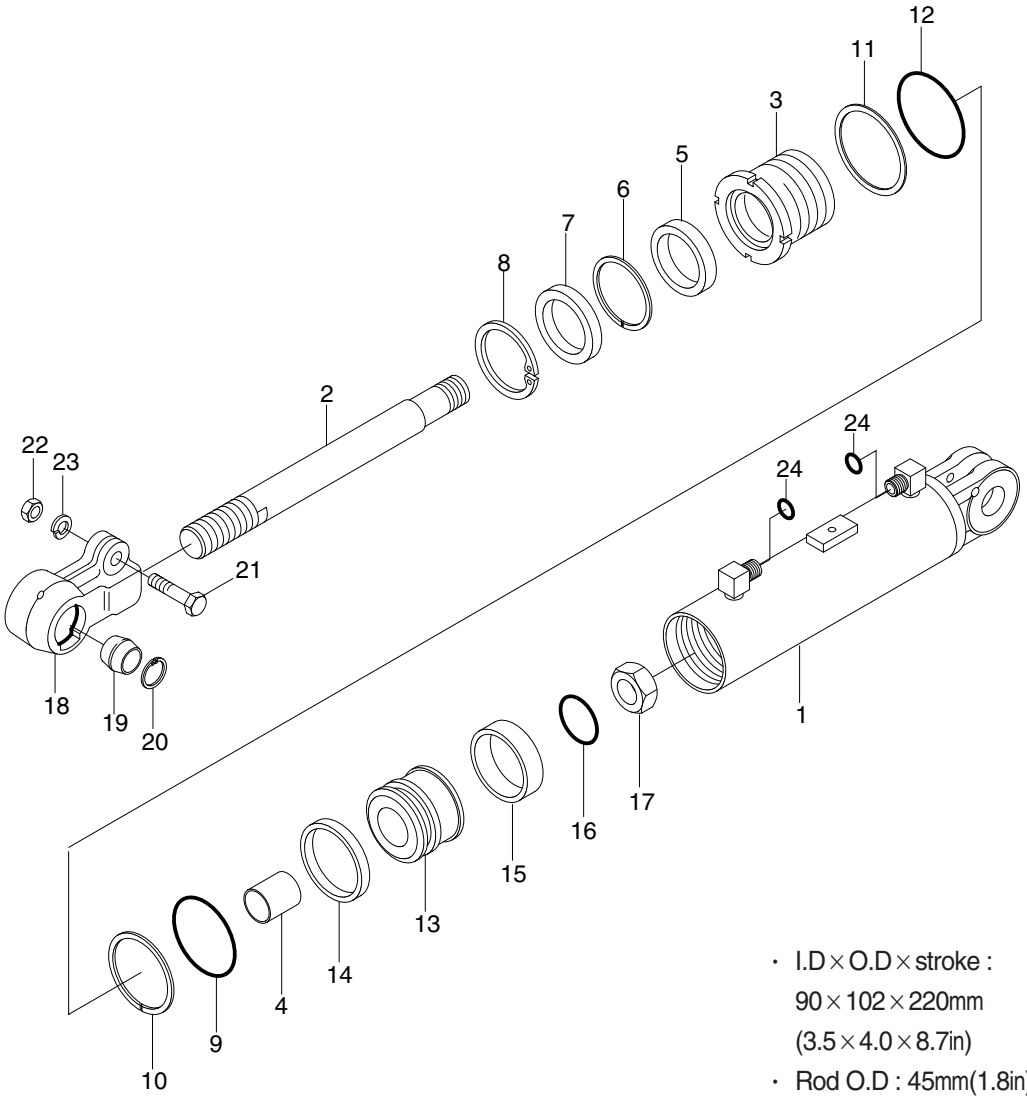
3) ASSEMBLY

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



5. TILT CYLINDER

1) STRUCTURE



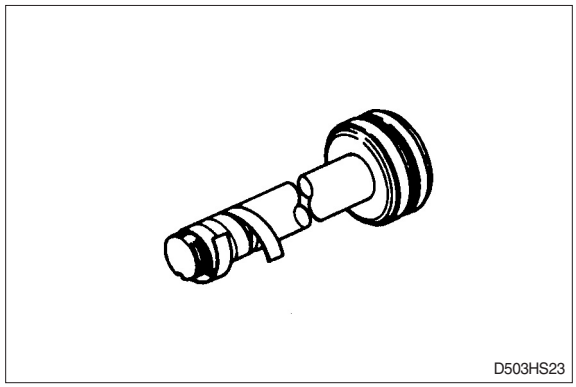
- I.D × O.D × stroke : 90 × 102 × 220mm (3.5 × 4.0 × 8.7in)
- Rod O.D : 45mm(1.8in)

35DS7HS16

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

2) DISASSEMBLY

(1) Hold the parallel parts of the cylinder tube bottom in a vice and mark the rod head end to show how much it is screwed in, then remove the rod head. Next, hook a wrench into the notch at the cylinder head and remove the cylinder head from cylinder tube.
When doing this, wind tape round the threaded part of the rod and be careful not to damage the dust seal and rod seal inside cylinder head.


D503HS23

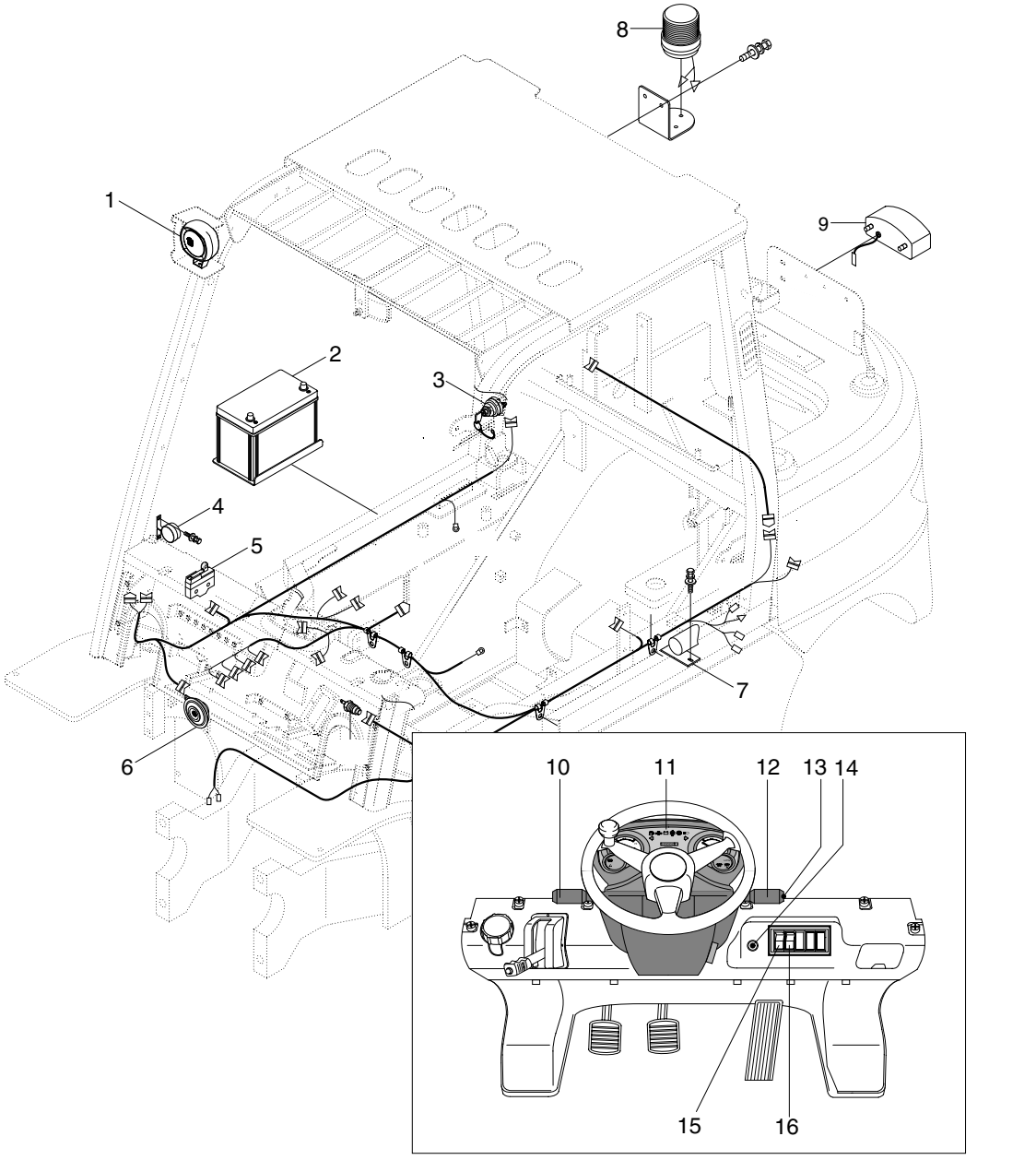
3) CHECK AND INSPECTION

mm(in)

Check item	Standard size	Repair limit	Remedy
Clearance between cylinder rod & bushing	0.072~0.288 (0.003~0.011)	0.5 (0.020)	Replace bushing
Clearance between rod head bushing & pin	0.10~0.35 (0.004~0.014)	0.6 (0.024)	Replace bushing

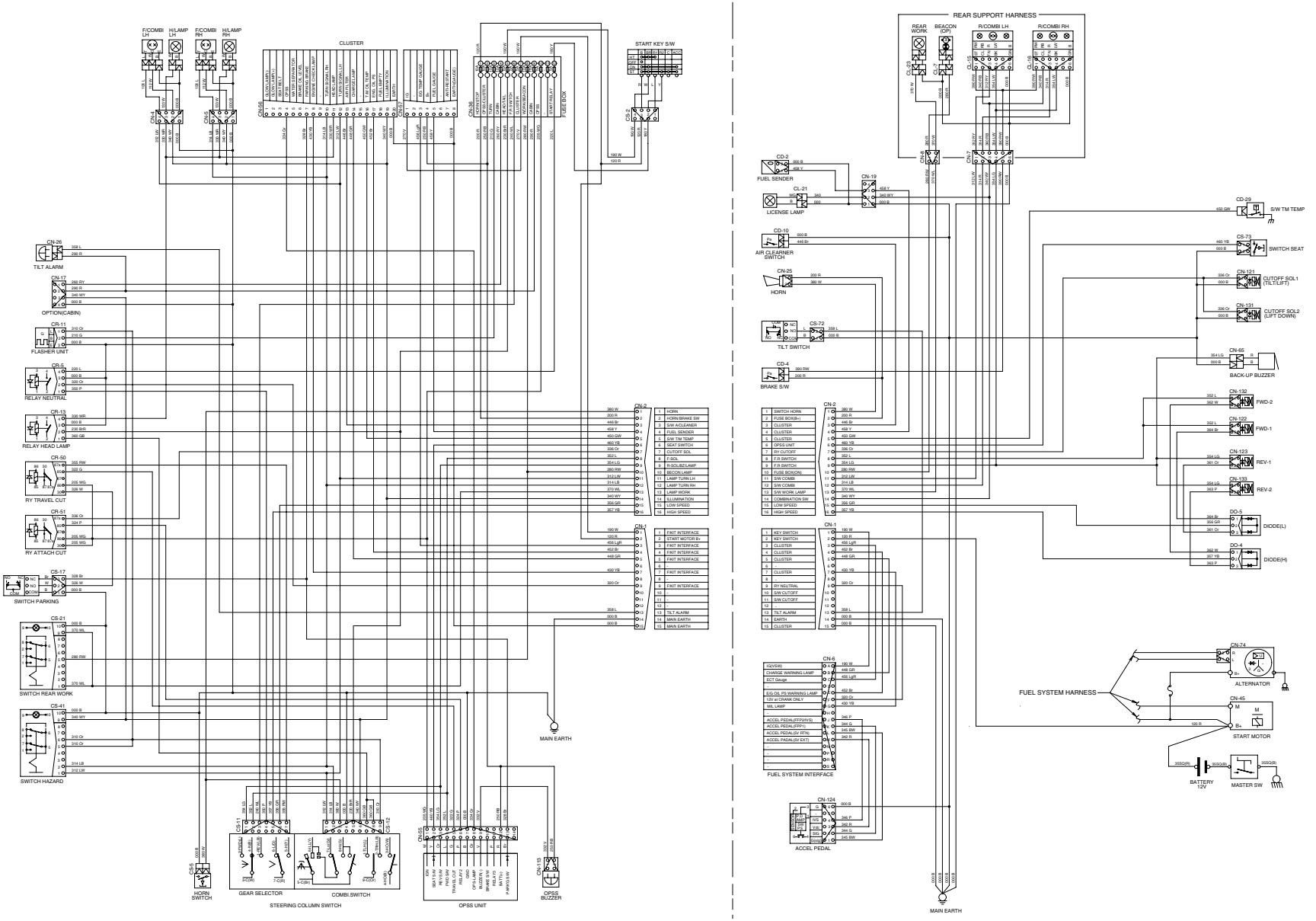
SECTION 7 ELECTRICAL SYSTEM

GROUP 1 COMPONENT LOCATION



35L7EL02

1	Work lamp	8	Beacon lamp	13	Horn button
2	Battery	9	License lamp	14	Start switch
3	Master switch	10	Forward-reverse lever	15	Work lamp switch(opt)
4	Tilt alarm	11	Operating panel	16	Hazard lamp switch(opt)
5	Micro switch	12	Head lamp switch		
6	High horn		Illumination lamp		
7	Back buzzer		Turn signal switch		


F/COMBI LH
H/LAMP LH
F/COMBI RH
H/LAMP RH
CLUSTER
START KEY S/W
F.SAFE BOX
REAR SUPPORT HARNESS
REAR WORK
BEACON (OP)
R/COMBI LH
R/COMBI RH
CD-2
FUEL SENDER
CL-21
LICENSE LAMP
CD-10
AIR CLEANER SWITCH
CN-25
HORN
CS-72
TILT SWITCH
CD-4
BRAKE S/W
CN-19
CD-29
S/W TM TEMP
CS-73
SWITCH SEAT
CN-121
CUTOFF SOL1 (TILT/LIFT)
CN-131
CUTOFF SOL2 (LIFT DOWN)
CN-65
BACK-UP BUZZER
CN-132
FWD-2
CN-122
FWD-1
CN-123
REV-1
CN-133
REV-2
DO-5
DIODE(L)
DO-4
DIODE(H)
CN-26
TILT ALARM
CN-17
OPTION(CABIN)
CR-11
FLASHER UNIT
CR-5
RELAY NEUTRAL
CR-13
RELAY HEAD LAMP
CR-50
RY TRAVEL CUT
CR-51
RY ATTACH CUT
CS-17
SWITCH PARKING
CS-21
SWITCH REAR WORK
CS-41
SWITCH HAZARD
CN-2
CN-1
CN-6
FUEL SYSTEM INTERFACE
CN-124
ACCEL PEDAL
CN-74
ALTERNATOR
CN-45
START MOTOR
FUEL SYSTEM HARNESS
BATTERY 12V
MASTER SW
MAIN EARTH
CS-54
HORN SWITCH
CS-11
GEAR SELECTOR
CS-12
COMBI.SWITCH
STEERING COLUMN SWITCH
CN-05
OPSS UNIT
CN-13
OPSS BUZZER
35L7EL01

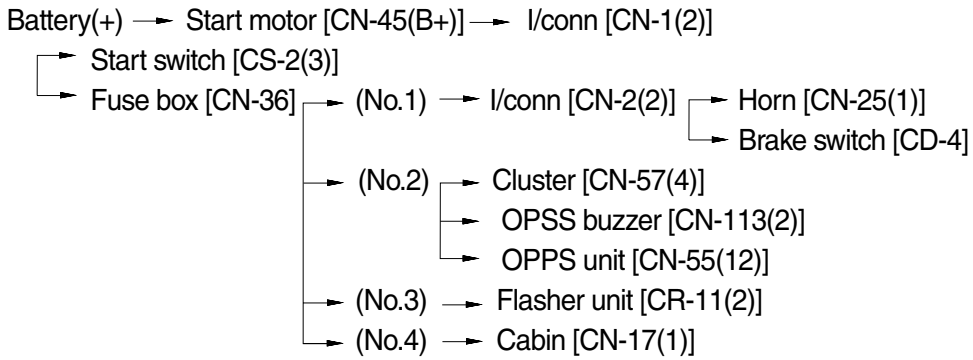
MEMORANDUM


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

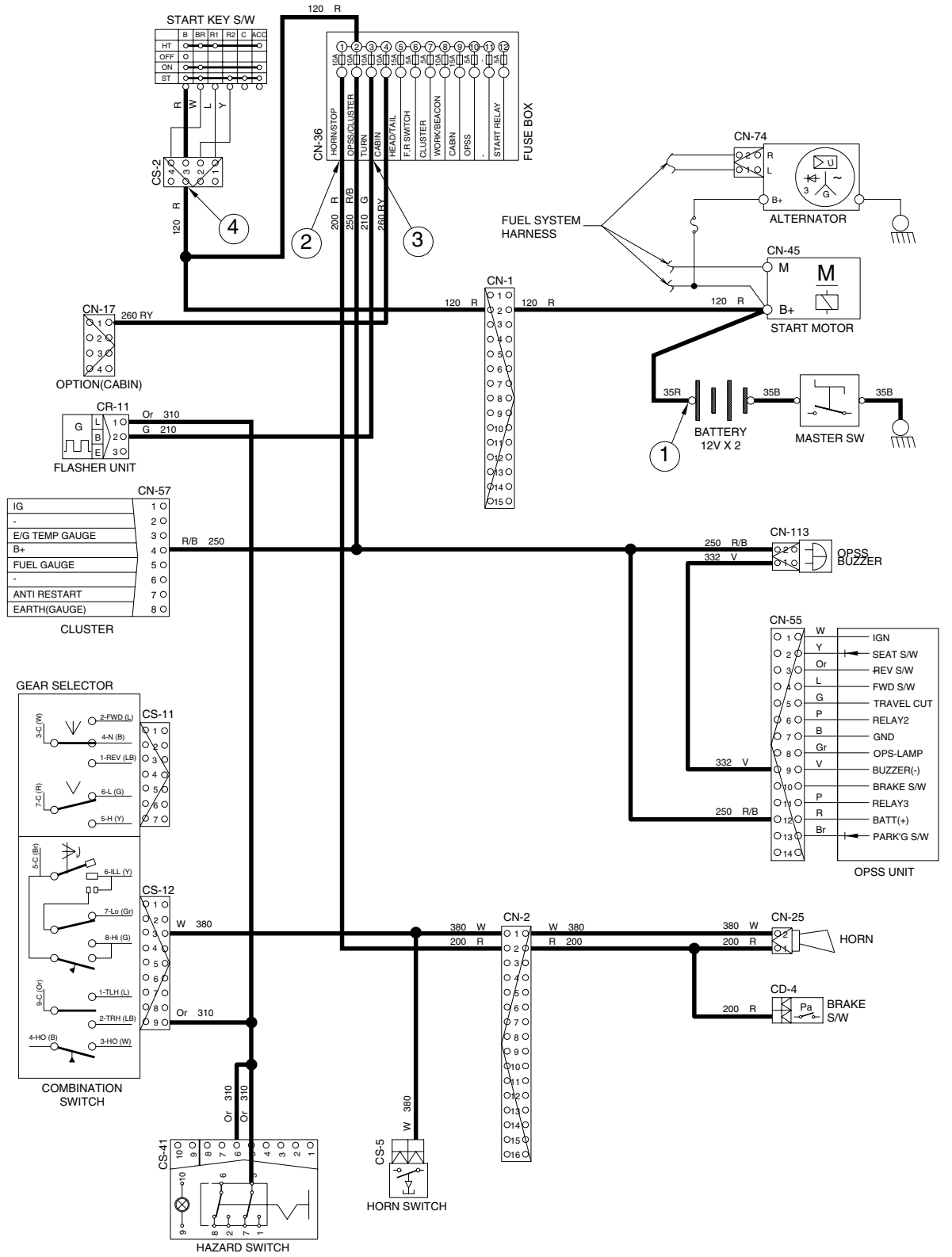


2) CHECK POINT

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

※ GND : Ground

POWER CIRCUIT



35L7EL03

2. STARTING CIRCUIT

1) OPERATING FLOW

Battery(+) terminal → Start motor [CN-45(B+)] → I/conn [CN-1(2)] → 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] → Combination switch [CS-12(5)]

(2) **When start key switch is START position**

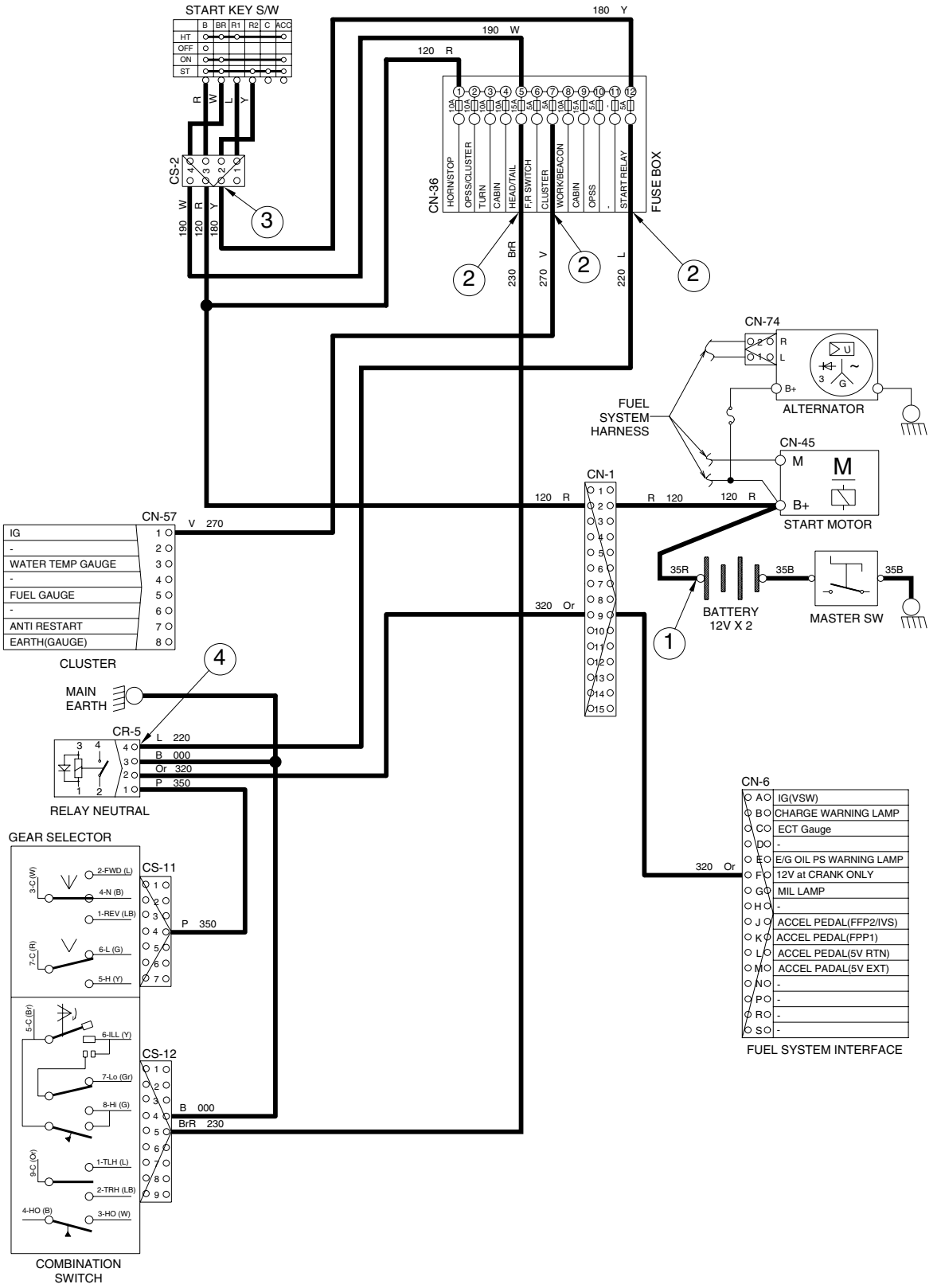
Start switch START [CS-2(2)] → Fuse box [CN-36(12)] → Neutral relay [CR-5(4 →2)]
→ I/conn [CN-1(9)] → Fuel system interface [CN-6(F)]

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)	12V

※ GND : Ground

STARTING CIRCUIT



35L7EL04

GROUP 3 COMPONENT SPECIFICATION

No	Part name	Qty	Specification	Remark
1	Battery	1	12V80AH, RC : 30min, CCA : 630	
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 unit	1	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 ~ 120 dB	
10	Master switch	1	180A	
11	Combination switch	1	Tail, Horn : 5A, F/R : 8A, Etc : 7A	
12	Hazard switch	1	12V, 16A	
13	Start switch	1	30 ~ 60A	
14	OPSS unit	1	12V/24V, MAX 0.5A(at 12V)	
15	Relay(4P)	2	12V, 20A	
16	Relay(5P)	1	12V, 20A	
17	Work lamp switch	1	12V, 16A	

GROUP 4 CONNECTOR DESTINATION

Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CN-1	AMP	15	I/conn(Frame harness-dashboard harness)	2-85262-1	368301-1
CN-2	AMP	16	I/conn(Dashboard harness-frame harness)	368047-1	368050-1
CN-4	KET	4	LH support harness	S810-004201	-
CN-5	KET	4	RH support harness	S810-004201	-
CN-7	AMP	6	I/conn(RR support harness-frame harness)	174262-2	174264-2
CN-8	AMP	2	I/conn(RR support harness-frame harness)	S816-002002	-
CN-17	KET	4	Option	S810-004201	-
CN-19	AMP	4	Option	-	S816-104002
CN-25	MOLEX	2	Horn	35825-0211	-
CN-26	KET	1	Tilt alarm	S822-014000	S822-114000
CN-36	-	-	Fuse box	21HF-10500	-
CN-45	RING TERM	2	Start motor	S820-308000	-
CN-55	KET	14	OPSS unit	S814-014100	-
CN-56	AMP	20	Cluster	368511-2	-
CN-57	AMP	8	Cluster	368540-2	-
CN-65	KET	2	Back buzzer	S822-014000	S822-114000
CN-113	KET	2	OPSS buzzer	S814-002100	-
CN-121	AMP	2	C/O SOL 1	S816-002002	-
CN-122	DEUTSCH	2	Forward solenoid 1	S812-002001	-
CN-123	DEUTSCH	2	Reverse solenoid 1	S812-002001	-
CN-124	AMP	6	Accel pedal	174262-2	-
CN-131	AMP	2	C/O SOL 2	S816-002002	-
CN-132	DEUTSCH	2	Forward solenoid 2	S812-002001	
CN-133	DEUTSCH	2	Reverse solenoid 2	S812-002001	-
Switch					
CS-2	KET	4	Start switch	S810-004201	-
CS-11	AMP	7	Gear selector switch	S811-007002	-
CS-12	AMP	9	Combination switch	S811-009002	-
CS-17	KET	3	Parking switch	S810-003201	-
CS-21	KET	10	Work lamp switch	593757	-
CS-41	KET	10	Hazard switch	593757	-
CS-72	KET	2	Tilt switch	S814-002100	-
Lamp					
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-21	KET	2	License lamp	S822-014000	S822-114000

Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CL-23	KET	2	Rear work lamp	S822-014000	S822-114000
Relay					
CR-5	KET	4	Neutral relay	S810-004201	-
CR-11	-	3	Flasher unit relay	S810-003702	-
CR-13	KET	4	Head lamp relay	S810-004201	-
CR-50	AMP	6	Travel cut relay	S810-006202	-
CR-51	AMP	6	Attach cut relay	S810-006202	-
Sensor and pressure switch					
CD-2	KET	3	Fuel sendor	S810-003201	-
CD-4	AMP	1	Brake switch	S819-010122	-
CD-10	KET	1	Air cleaner switch	ST730057-2	-
CD-29	AMP	1	T/M temperature sensor	S819-010122	-

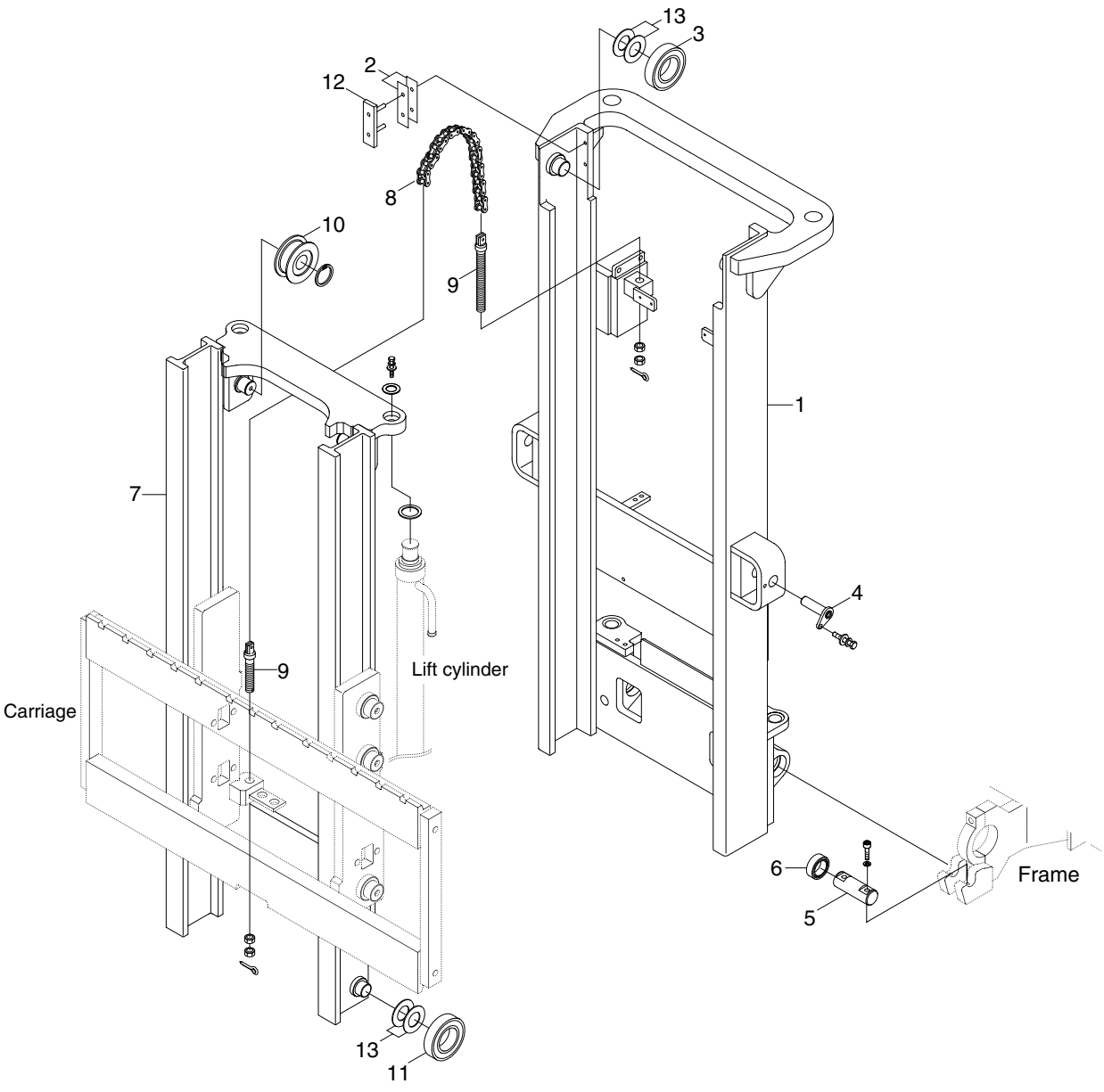
GROUP 5 TROUBLESHOOTING

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

SECTION 8 MAST

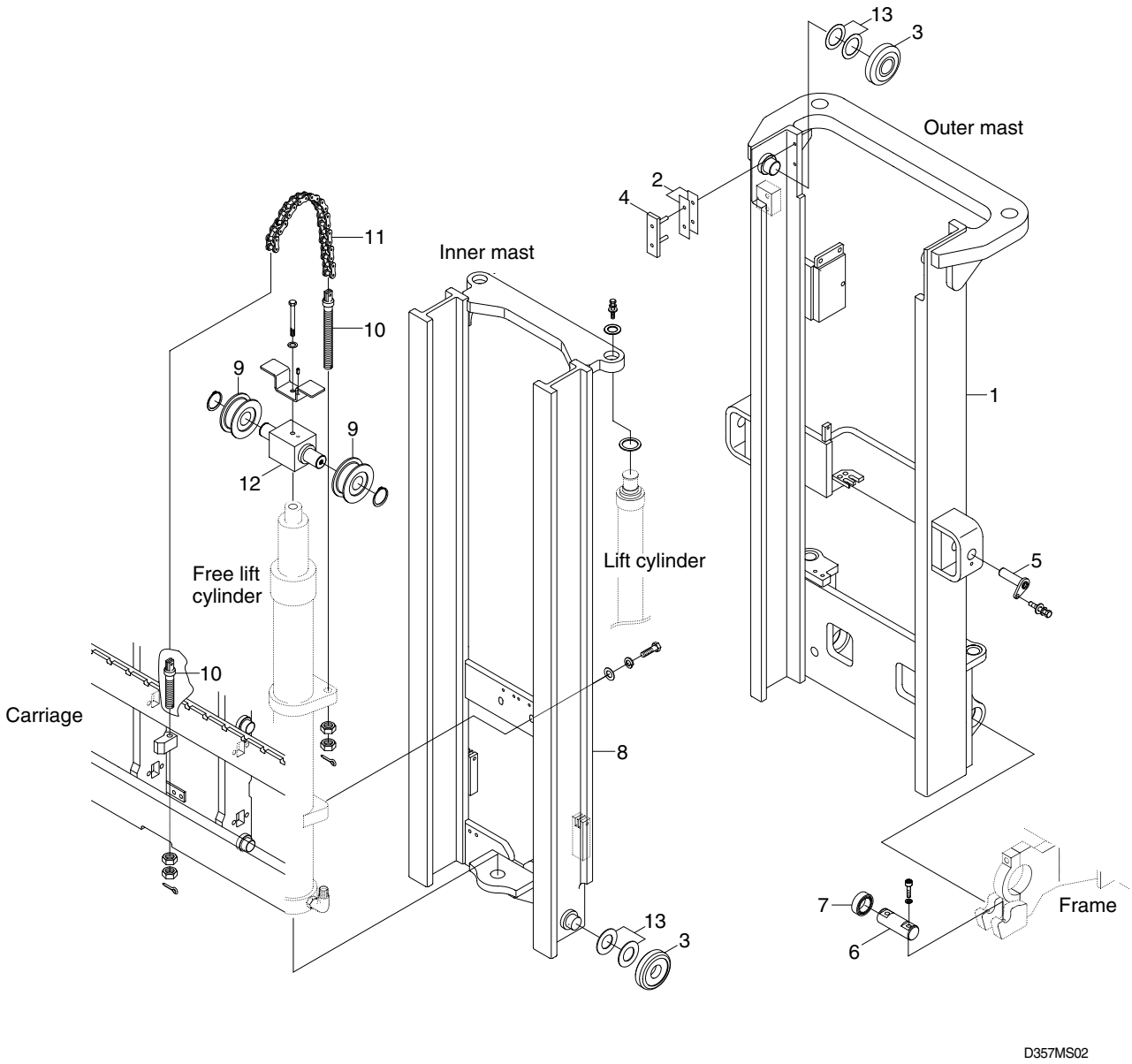
GROUP 1 STRUCTURE

1. 2 STAGE MAST(V MAST)



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

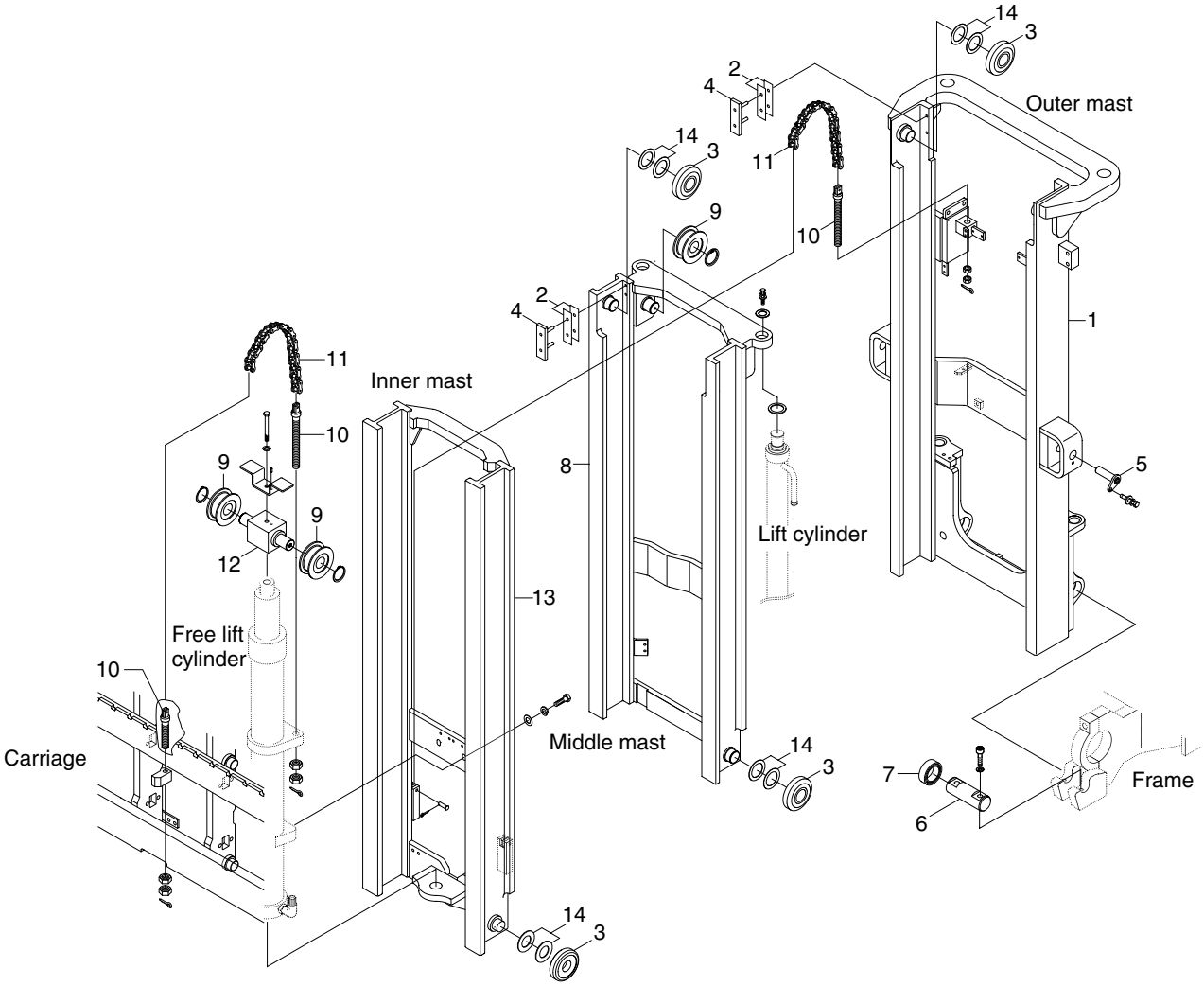
2. 2 STAGE MAST(VF MAST)



D357MS02

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

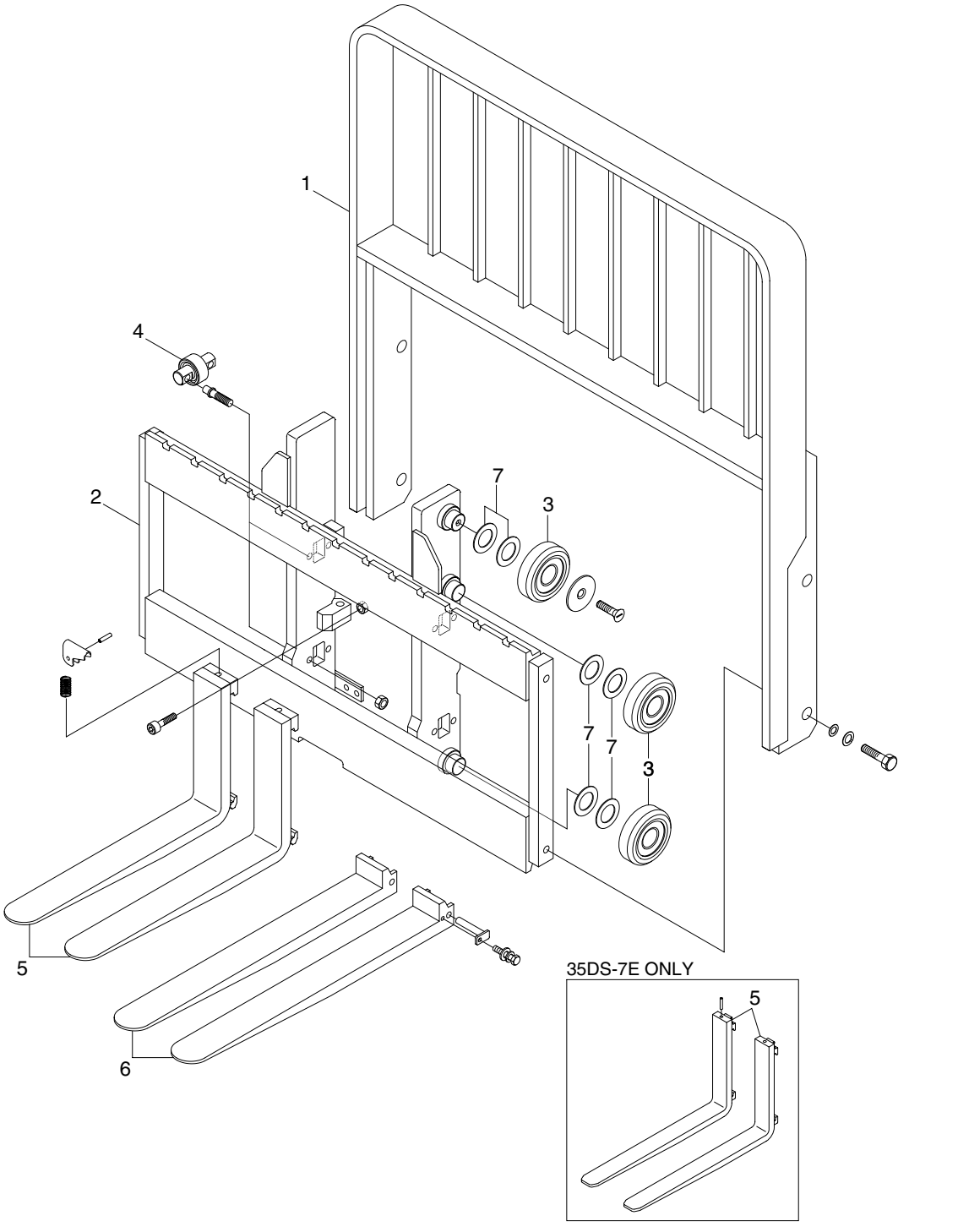
3. 3 STAGE MAST(TF MAST)



D357MS03

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

3. CARRIAGE, BACKREST AND FORK



35DS7MS04

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

GROUP 2 OPERATIONAL CHECKS AND TROUBLESHOOTING

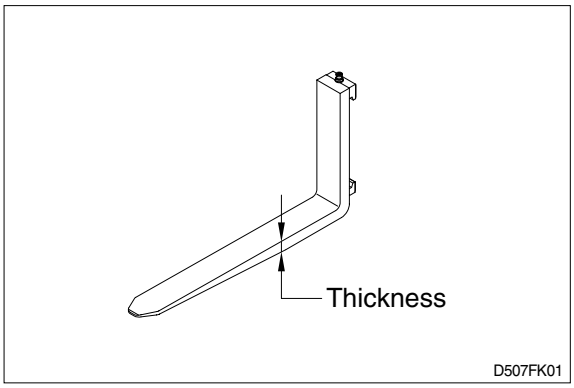
1. OPERATIONAL CHECKS

1) FORKS

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

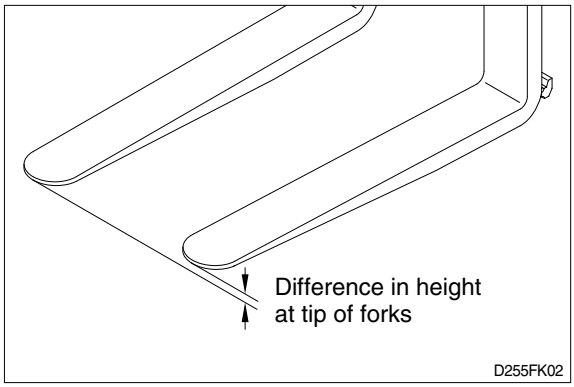
mm(in)

STD Fork assy	Applicable model	Standard	Limit
S173896-02	35L-7	50(2.0)	45(1.7)
F13710010	40L-7	50(2.0)	45(1.7)
F17393603	45L-7	50(2.0)	45(1.7)



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

Model	Fork length	Height difference
35L/40L/45L-7	1070~1970	6mm



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 height at tip of forks
<table>
<tr><th>Model</th><th>Fork length</th><th>Height difference</th></tr>
<tr><td>35L/40L/45L-7</td><td>1070~1970</td><td>6mm</td></tr>
</table></td><td>If the measured value exceeds the allowance, replace fork.</td></tr>
<tr><td>Fatigue</td><td>Fatigue failure may result from the fatigue crack even though the stress to fork is below the static strength of the fork. Therefore, a daily inspection should be done.
· Crack on the fork heel.
· Crack on the fork weldments.</td><td>Repair fork by expert.
In case of excessive distortion, replace fork.</td></tr>
</table>

GROUP 3 ADJUSTMENT

1. MAST LOAD ROLLER(V, VF MAST)

1) INNER/OUTER MAST ROLLER CLEARANCE ADJUSTMENT

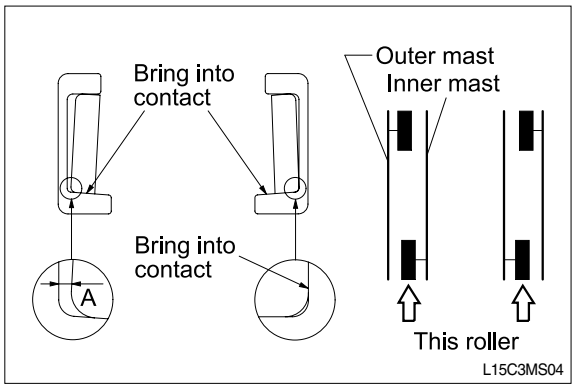
(1) Measure the clearance with the mast overlap at near 480mm.

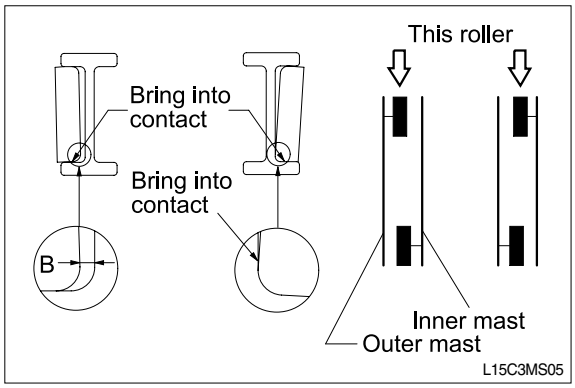
(2) Shift the inner mast to one side to bring the roller into contact with the outer mast, and adjust the clearance between the roller side face and mast at the closest position on the opposite side to the following value by inserting the inner/outer mast roller shim.

- Standard clearance A, B = 0~0.6mm
- 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.

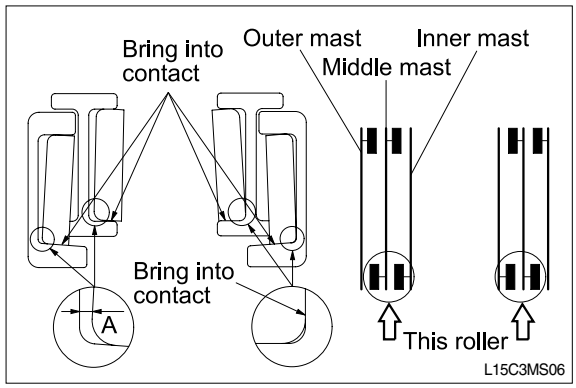
(4) After the adjustment, check that the inner mast moves smoothly in the outer mast.





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.

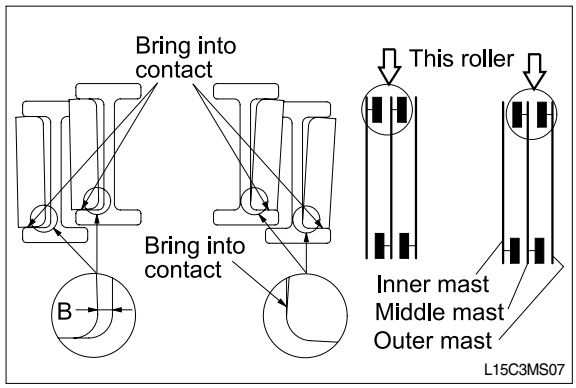
(2) Shift the inner mast to one side to bring the roller into contact with the outer mast and the middle mast, and adjust the clearance between the roller side face and mast at the closest position on the opposite side to the following value by inserting the inner and middle mast roller shim, respectively.

- Standard clearance A = 0~0.6mm
- 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.

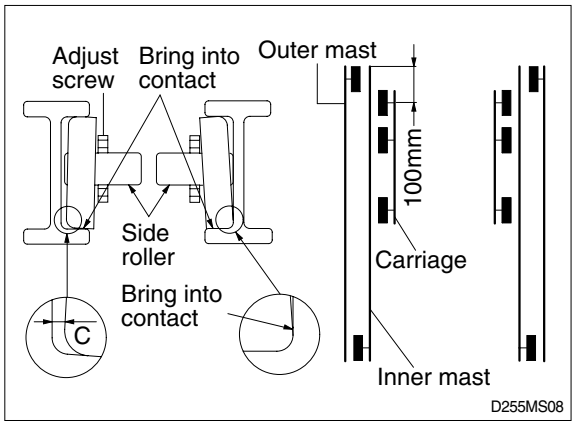
(2) Shift the inner mast to one side to bring the roller into contact with the outer mast and the middle mast, and adjust the clearance between the roller side face and mast at the closest position on the opposite side to the following value by inserting the outer and middle mast roller shim, respectively.

- Standard clearance B = 0~0.6mm
- 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.

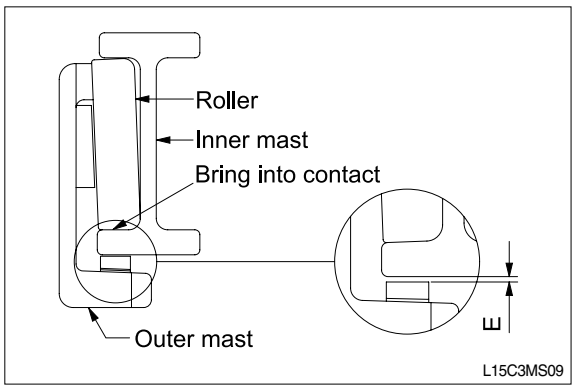
(2) Measure the clearance at upper, middle and lower rollers after loosen the adjust screws from the side rollers. Shift the carriage to one side to bring the roller into contact with the inner mast, and measure the clearance between the roller side face and mast at the closest position on the opposite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

- Standard clearance C = 0~0.6㎜
- 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 middle mast at the bottom position.

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

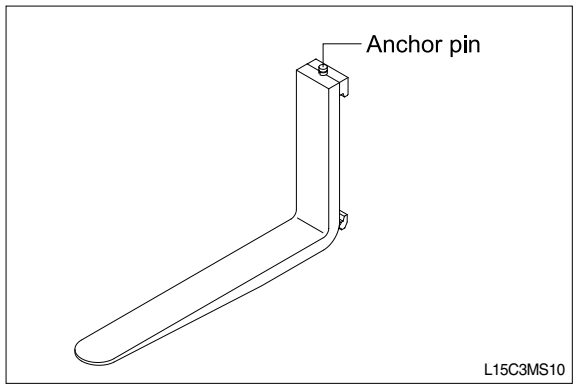
- Standard clearance E = 0.2 ~ 0.6㎜
- Shim thickness 0.5, 1.0㎜

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

GROUP 4 REMOVAL AND INSTALLATION

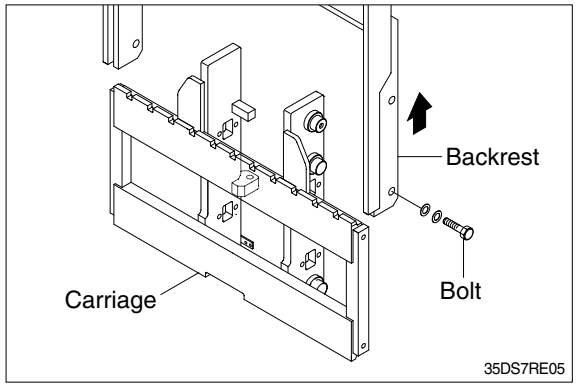
1. FORKS

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



2. BACKREST

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



3. CARRIAGE ASSEMBLY

1) CARRIAGE

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

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

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

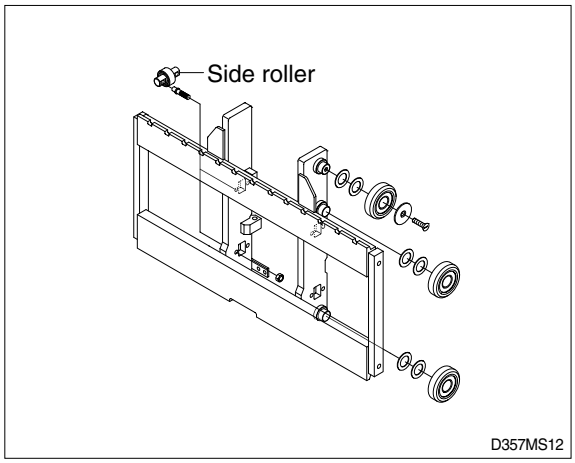
⚠ Replace the split pin of chain anchor with new one.

2) SIDE ROLLER

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

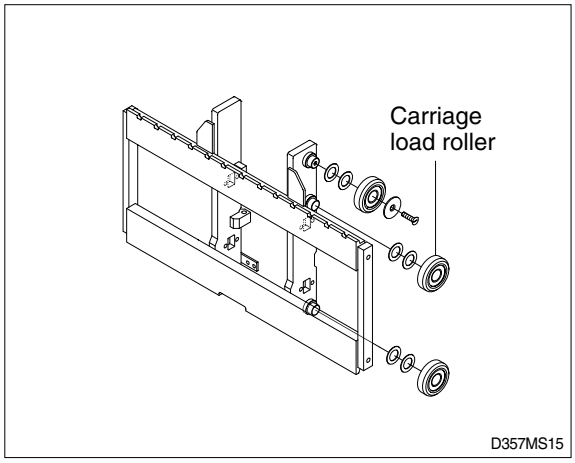
※ **Adjustment**

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



3) CARRIAGE LOAD ROLLER

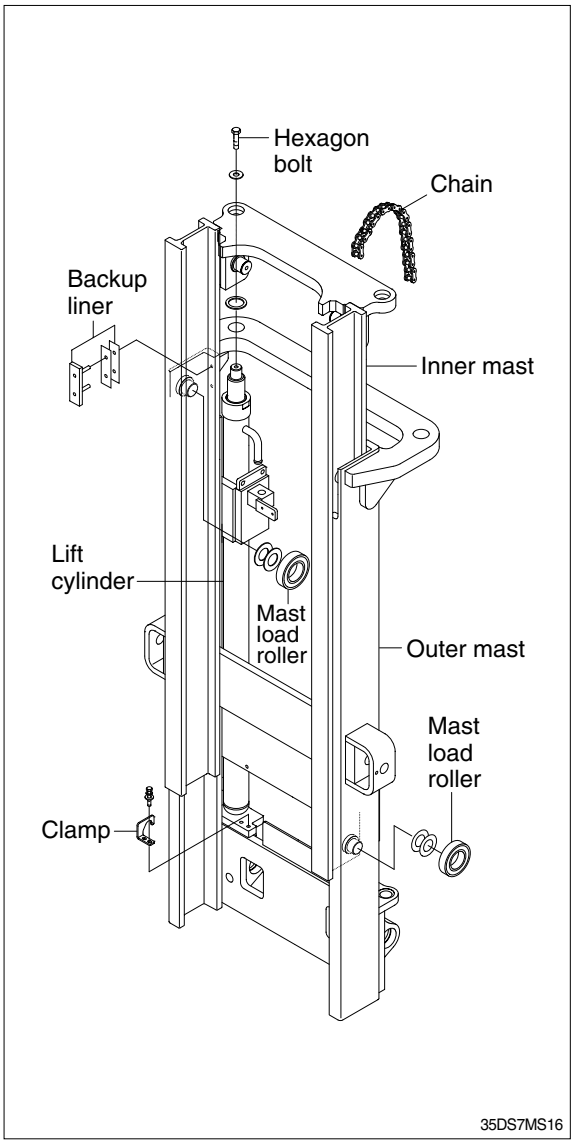
(1) Remove carriage as outlined in the carriage assembly removal paragraph.
(2) Loosen and remove flat head bolts and plain washers from top load roller bracket.
(3) Using a pryer, remove load rollers from load roller bracket.
(4) Reverse the above procedure to assemble. Refer to MAST ROLLER ADJUSTMENT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



4) MAST LOAD ROLLER AND BACK UP LINER

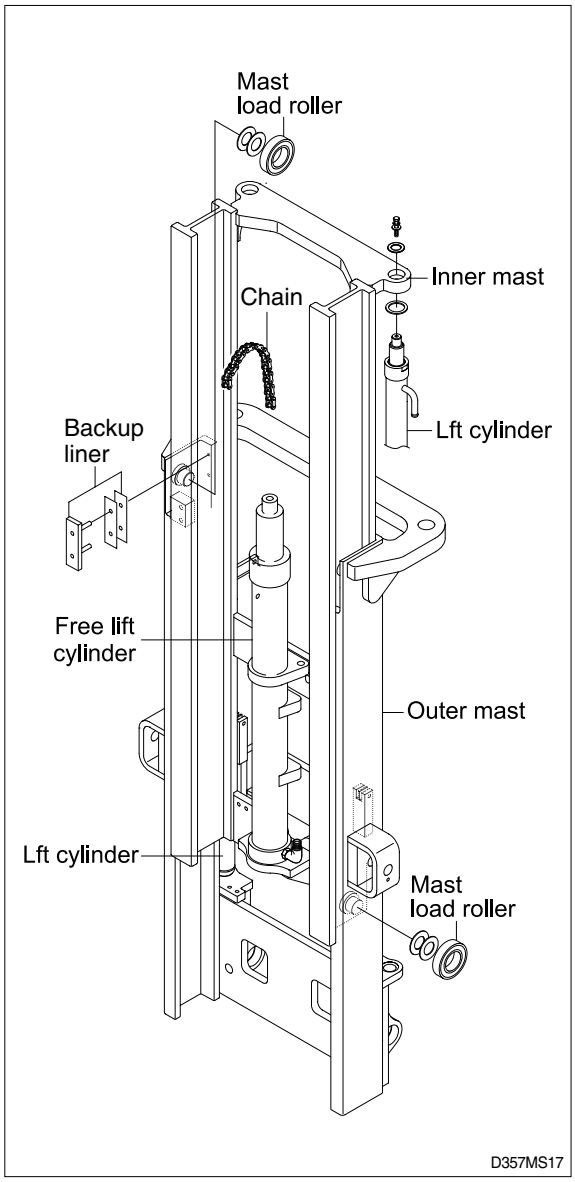
(1) 2 stage mast(V mast)

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



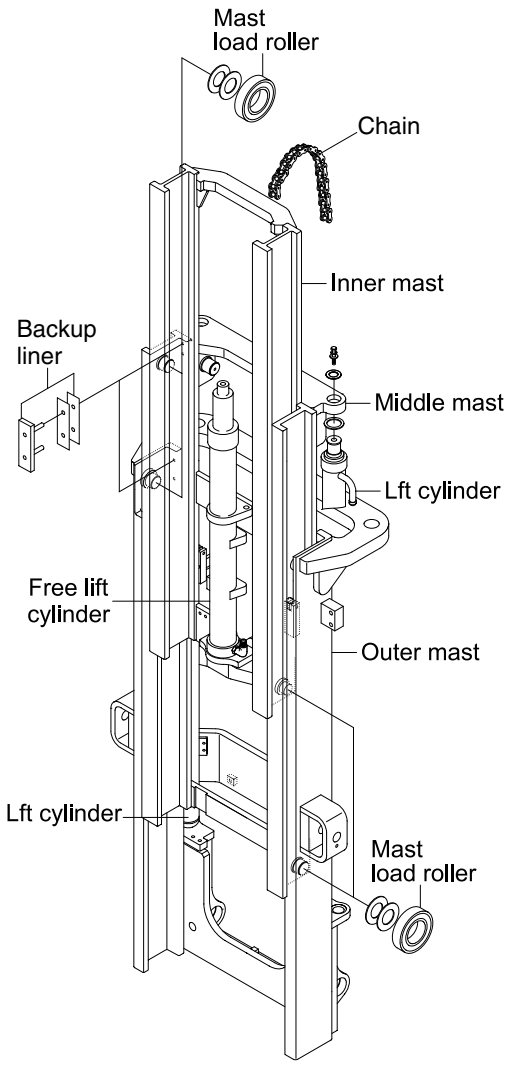
(2) 2 stage mast(VF mast)

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



(3) 3 stage mast(TF mast)

① Remove the carriage assembly and move to one side.
② Loosen and remove hexagon bolt securing bottom cylinder from outer mast.
③ Loosen and remove bolts and special washers securing lift cylinders to middle mast.
④ Attach chains or sling to the inner and middle mast section at top crossmember. Using an overhead hoist, slowly raise the uprights high enough to clear lift cylinder.
⑤ After lowering the lift cylinder rods, and disconnecting lift cylinder hose, tilt the lift cylinders LH and RH and tie them with ropes to the outer mast.
⑥ Using the overhead hoist raise inner and middle masts. Place 4 inch block of wood under the free lift cylinder bracket of the inner mast then lower mast sections (this will create slack in the chains).
⑦ Remove retaining rings securing chain sheaves to sheave support brackets. While support chains, remove chain sheaves and let chains hang free. The upper outer and lower middle mast rollers and back up liners are now exposed.
⑧ Using a pryer, remove load rollers from load bracket. Remove back up liners and shims.
⑨ Attach chains or sling to the middle mast section at top crossmember. Using an overhead hoist, slowly raise the middle mast until top and bottom rollers are exposed.
⑩ Using a player, remove load rollers from load roller bracket.
⑪ Thoroughly clean, inspect and replace all worn or damaged parts.
⑫ Reverse the above procedure to assemble. Refer to MAST LOAD ROLLER ADJUSTMENT paragraph.



5) ELEVATING MAST

(1) Inner mast (V, VF mast)

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

(2) Inner and middle mast(TF mast)

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

6) CHAIN

(1) Chain sheave(V, VF mast)

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

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

③ carriage.

Remove retaining ring securing sheaves to sheave support. Remove sheaves

④ with bearings.

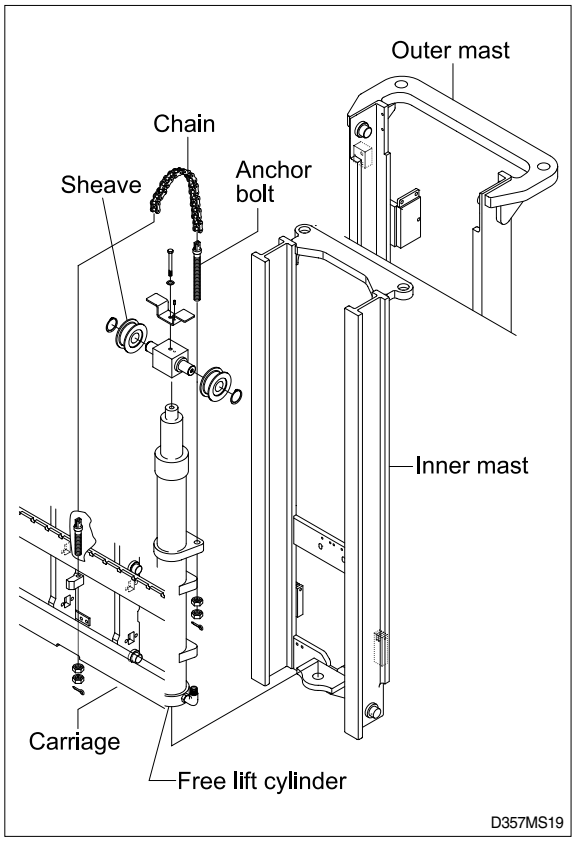
Remove bearing retaining ring from

⑤ sheave and press bearings from sheaves.

Thoroughly clean, inspect and replace all

⑥ worn or damaged parts.

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



(2) Rear chain sheave(TF mast)

① Raise and securely block carriage and inner mast section.

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

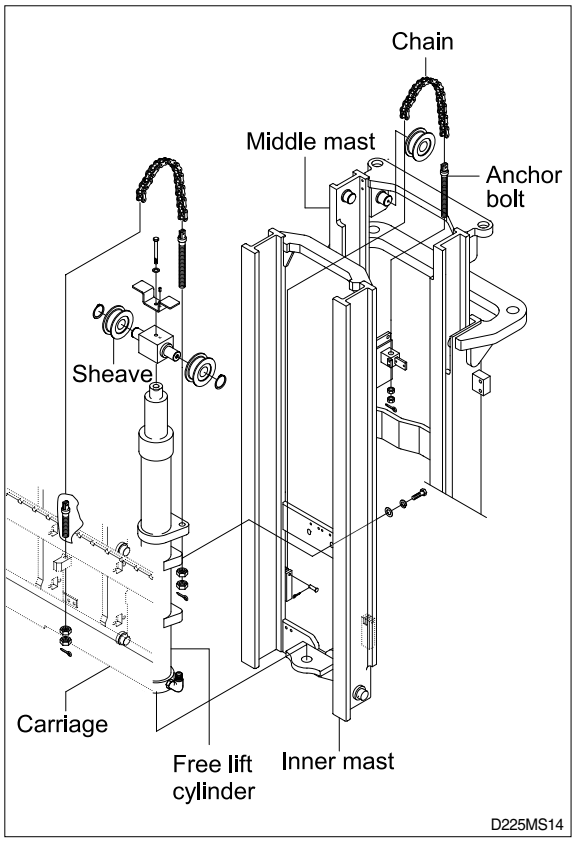
③ Remove chains.

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

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

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

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



(3) Chain wheel bearing support(TF mast)

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

(4) Rear chain(TF mast)

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

(5) Carriage chain

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

(6) Load chain inspection and maintenance

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

① Wear

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

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

② Rust and corrosion

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

③ Cracked plate

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

④ Tight joints

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

Tight joints in lift chains can be caused by :

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

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

⑤ Protruding or turned pins

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

⑥ Chain side wear

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

⑦ Chain anchors and chain wheel bearings

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

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

⑧ Chain wear scale

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

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

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

(7) Load chain lubrication and adjustment

① Lubrication

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

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

⚠ Wear eye protection.

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

② Replacement

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

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

③ **Adjustment**

Chain adjustments are important for the following reasons :

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

④ **Adjustment procedure**

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