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.

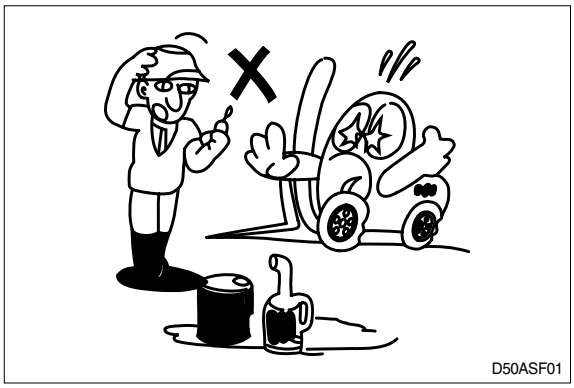
°C		°F	°C		°F	°C		°F	°C		°F
-40.4	-40	-40.0	-11.7	11	51.8	7.8	46	114.8	27.2	81	117.8
-37.2	-35	-31.0	-11.1	12	53.6	8.3	47	116.6	27.8	82	179.6
-34.4	-30	-22.0	-10.6	13	55.4	8.9	48	118.4	28.3	83	181.4
-31.7	-25	-13.0	-10.0	14	57.2	9.4	49	120.2	28.9	84	183.2
-28.9	-20	-4.0	-9.4	15	59.0	10.0	50	122.0	29.4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

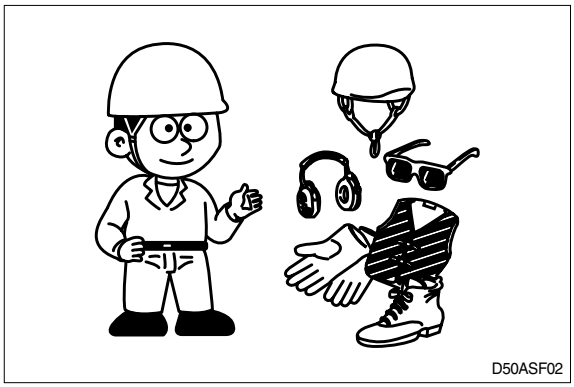
GROUP 1 SAFETY HINTS

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

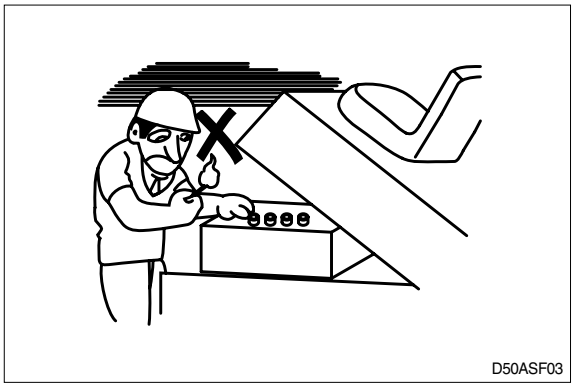
- Oil is a dangerous substance. Never handle oil, grease or oily clothes in places where there is any fire of flame.
  As preparation in case of fire, always know the location and directions for use of fire extinguishers and other fire fighting equipment.


D50ASF01

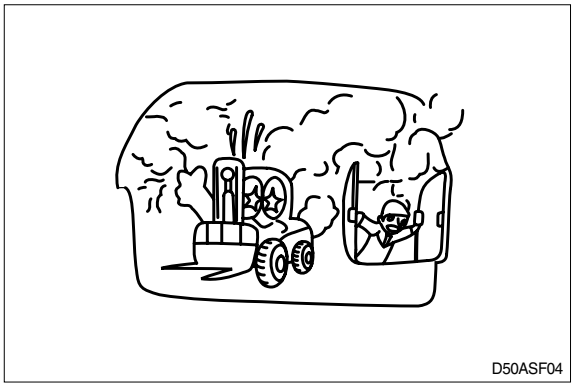
- Wear well-fitting helmet, safety shoes and working clothes. When drilling, grinding or hammering, always wear protective goggles.
  Always do up safety clothes properly so that they do not catch on protruding parts of machines. Do not wear oily clothes.
  When checking, always release battery plug.


D50ASF02

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

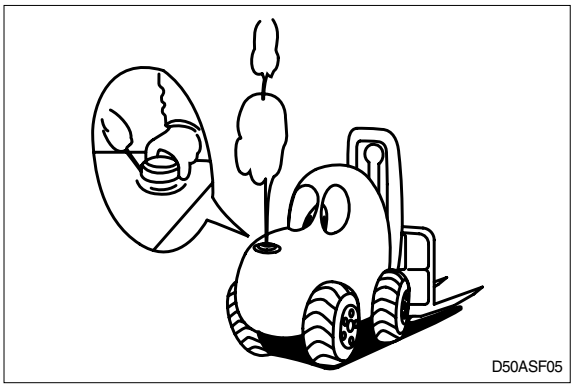

D50ASF03

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

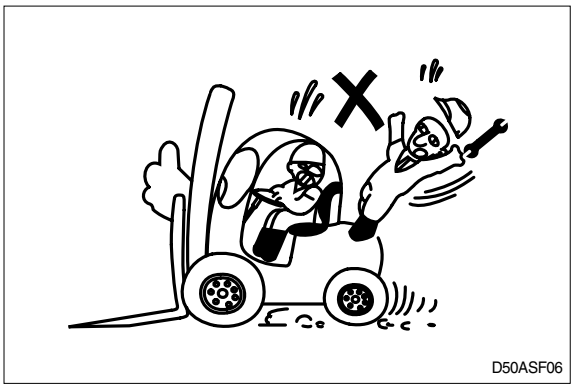

D50ASF04

⚠ 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.

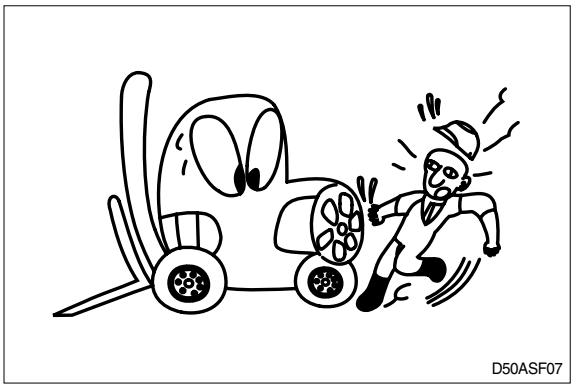

D50ASF05

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


D50ASF06

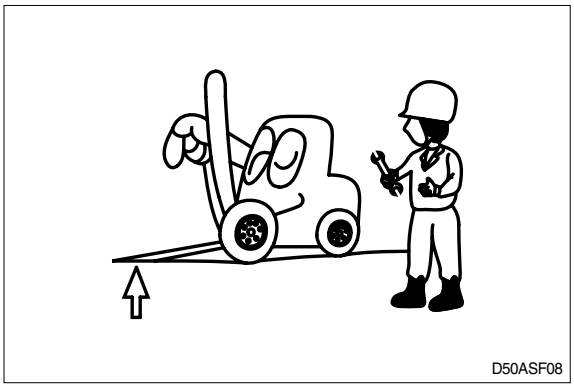
- Hand a caution sign in the operator's compartment (For example **Do not start** or **Maintenance in progress**).
  This will prevent anyone from starting or moving the machine by mistake.

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

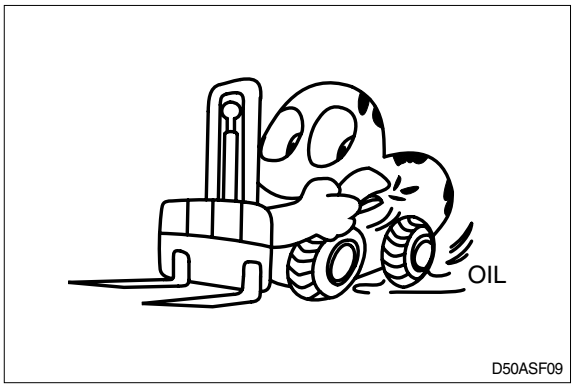

D50ASF07

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.

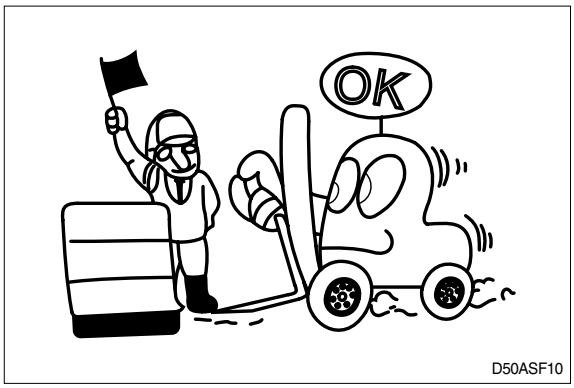
- Park the machine on firm, flat ground.
  Lower the fork to the ground and stop the engine.
  Return each lever to **NEUTRAL** and apply the brake lock.


D50ASF08

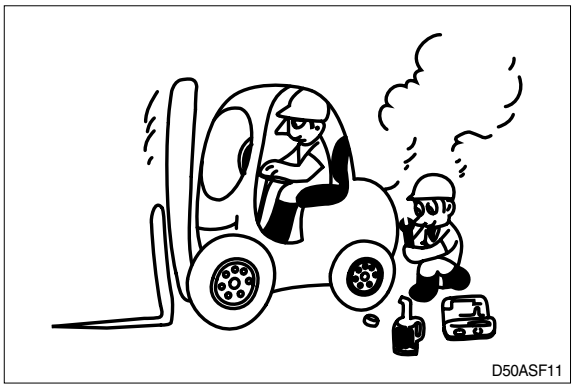
- Immediately remove any oil or grease on the floor of the operator's compartment, or on the handrail. It is very dangerous if someone slips while on the machine.



- 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.



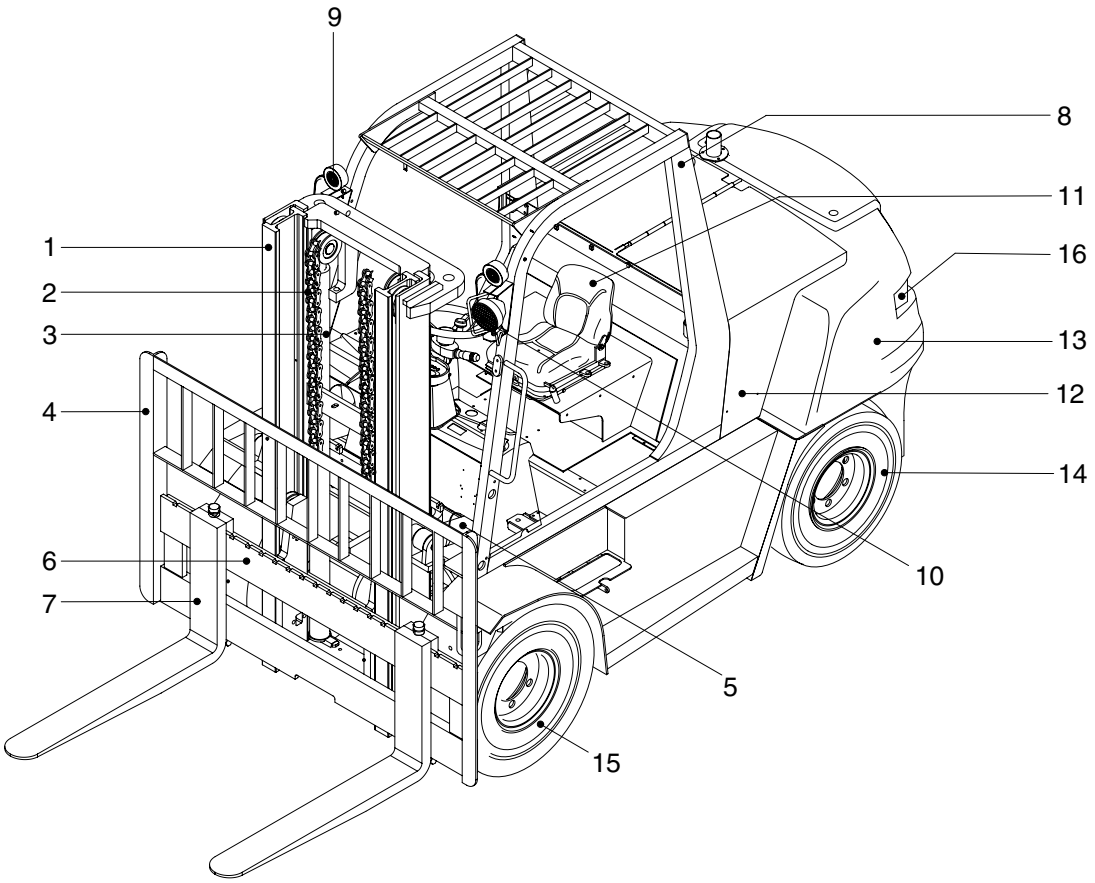
- Unless you have special instructions to the contrary, maintenance should always be carried out with the engine stopped. If maintenance is carried out with the engine running, there must be two men present : one sitting in the operator's seat and the other one performing the maintenance. In such a case, 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

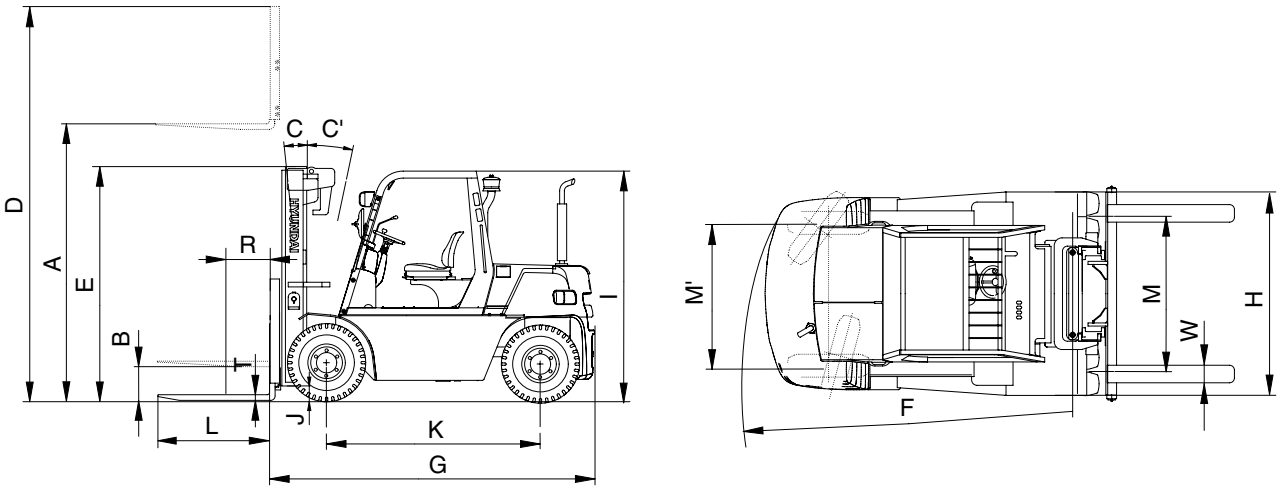
1. MAJOR COMPONENTS



80D7OM54

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

2. SPECIFICATIONS



D507SP01

Model			Unit	Specification
Capacity			kg	8000
Load center		R	mm	600
Weight(Unloaded)			kg	11140
Fork	Lifting height	A	mm	3040
	Free lift	B	mm	150
	Lifting speed(Unload/Load)		mm/sec	500/410
	Lowering speed(Unload/Load)		mm/sec	500/500
	L × W × T	L,W,T	mm	1200 × 180 × 70
Mast	Tilt angle (forward/backward)	C/C'	degree	15/10
	Max height	D	mm	4375
	Min height	E	mm	2675
Body	Travel speed		km/h	32.7
	Gradeability		degree(%)	19.3(28.4)
	Min turning radius(Outside)	F	mm	3520
ETC	Max hydraulic pressure		kgf/cm^2	210
	Hydraulic oil tank		ℓ	105
	Fuel tank		ℓ	150
Overall length		G	mm	3800
Overall width		H	mm	2277
Overhead guard height		I	mm	2603
Ground clearance		J	mm	250
Wheel base		K	mm	2400
Wheel tread front/rear		M, M'	mm	1632/1700

3. SPECIFICATION FOR MAJOR COMPONENTS

1) ENGINE

Item	Unit	Specification
Model	-	MITSUBISHI S6S-DT
Type	-	4-cycle, in-line, Vertical OHV
Cooling Method	-	Water cooling
Number of cylinders and arrangement	-	6 cylinders, in line
Firing order	-	1-5-3-6-2-4
Combustion chamber type	-	Direct injection
Cylinder bore X stroke	mm(in)	94 × 120(3.7 × 4.7)
Piston displacement	cc(cu in)	4996(305)
Compression ratio	-	19.5
Rated gross horse power	ps/rpm	88/2200
Maximum gross torque at rpm	kgf · m/rpm	34.8/1400
Engine oil quantity	ℓ (U.S.gal)	17.5(4.6)
Dry weight	kg(lb)	350(772)
High idling speed	rpm	2400 ± 50
Low idling speed	rpm	875 ± 50
Rated fuel consumption	g/ps.hr	180
Starting motor	V-kW	24-5.0
Alternator	V-A	24-50
Battery	V-AH	12-80 × 2
Fan belt deflection	mm(in)	10~12(0.4~0.5)

2) MAIN PUMP

Item	Unit	Specification
Type	-	Fixed displacement gear pump
Capacity	cc/rev	34+34+9
Maximum operating pressure	bar	250
Rated speed (Max/Min)	rpm	3000/600

3) MAIN CONTROL VALVE

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

4) POWER TRAIN DEVICES

Item			Specification
Torque converter	Model		F&S 300*16/4/-1(ZF SACH)
	Type		3 Element, 1 stage, 2 phase
	Stall ratio		2.5 : 1
Transmission	Type		Full auto, Power shift
	Gear shift(FR/RR)		3/3
	Adjustment		Electrical single lever type
	Overhaul ratio	FR	1 : 4.578 2 : 2.396 3 : 0.994
		RR	1 : 4.593 2 : 2.404 3 : 0.996
Axle	Gear ratio	Differential	3.1
		Planetary	4
		Total	12.4
	Oil		MOBILFLUID #424
	Oil quantity		12.5L
Wheels	Q'ty(FR/RR)		4/2
	Front(drive)		9.00-20-14 PR
	Rear(steer)		9.00-20-14 PR
Brakes	Type		Front wheel, wet disc type
	Oil		Hydraulic oil SAE10W (AZOLA-ZS10)
	Parking		Toggle, internal pushing mechanical type
Steering	Type		Full hydraulic, power steering
	Steering angle		75.04° 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	M12×1.75	12.8±3.0	93±22
5		Steering unit mounting bolt	M10×1.5	6.9±1.4	50±10
6	Power train system	Transmission mounting bolt, nut	M16×2.0	7.5	54
7		Drive axle mounting bolt, nut	M24×3.0	100±15	723±108
8		Steering axle mounting bolt, nut	M18×2.5	41.3±6.2	300±45
9		Front wheel mounting nut	M22×1.5	61.2±9.2	448±67
10		Rear wheel mounting nut	M22×1.5	61.2±9.2	448±67
11	Others	Counterweight mounting bolt	M30×3.5	120±15	1555±239
12		Operator's seat mounting nut	M 8×1.25	2.5±0.5	18.1±3.6
13		Head guard mounting bolt	M12×1.75	12.8±3.0	93±22

5. TORQUE CHART

Use following table for unspecified torque.

1) BOLT AND NUT - Coarse thread

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

(1) Fine thread

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

2) PIPE AND HOSE(FLARE TYPE)

Thread size(PF)	Width across flat(mm)	kgf · m	lbf · ft
1/4"	19	4	28.9
3/8"	22	5	36.2
1/2"	27	9.5	68.7
3/4"	36	18	130.2
1"	41	21	151.9
1-1/4"	50	35	253.2

3) PIPE AND HOSE(ORFS TYPE)

Thread size(UNF)	Width across flat(mm)	kgf · m	lbf · ft
9/16-18	19	4	28.9
11/16-16	22	5	36.2
13/16-16	27	9.5	68.7
1-3/16-12	36	18	130.2
1-7/16-12	41	21	151.9
1-11/16-12	50	35	253.2

4) FITTING

Thread size(PF)	Width across flat(mm)	kgf · m	lbf · ft
1/4"	19	4	28.9
3/8"	22	5	36.2
1/2"	27	9.5	68.7
3/4"	36	18	130.2
1"	41	21	151.9
1-1/4"	50	35	253.2

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)
		80D-7	-20 (-4) / -10 (14) / 0 (32) / 10 (50) / 20 (68) / 30 (86) / 40 (104)
Engine oil pan	Engine oil	17.5 (4.6)	SAE 30 SAE 10W SAE 10W-30 SAE 15W-40
Torque converter transmission	T/M oil*1 Engine oil*2	22(5.7)*1 25(6.4)*2	ATF DEXRON III*1, SAE 10W-30*2
Axle	Gear oil	12.5 (3.3)	MOBILFLUID 424
Hydraulic tank	Hydraulic oil	105 (27.7)	ISO VG32 ISO VG46 ISO VG68
Fuel tank	Diesel fuel	150 (39.6)	ASTM D975 No.1 ASTM D975 No.2
Fitting (Grease nipple)	Grease	-	NLGI No.1 NLGI No.2
Brake reservoir tank	Hyd oil	-	Hydraulic oil ISO VG10 (AZOLLA ZS10)
Radiator	Antifreeze:Water 50:50	17 (4.5)	Ethylene glycol base permanent type

*1 : #0008-

*2 : -#0007

NOTES :

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

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

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

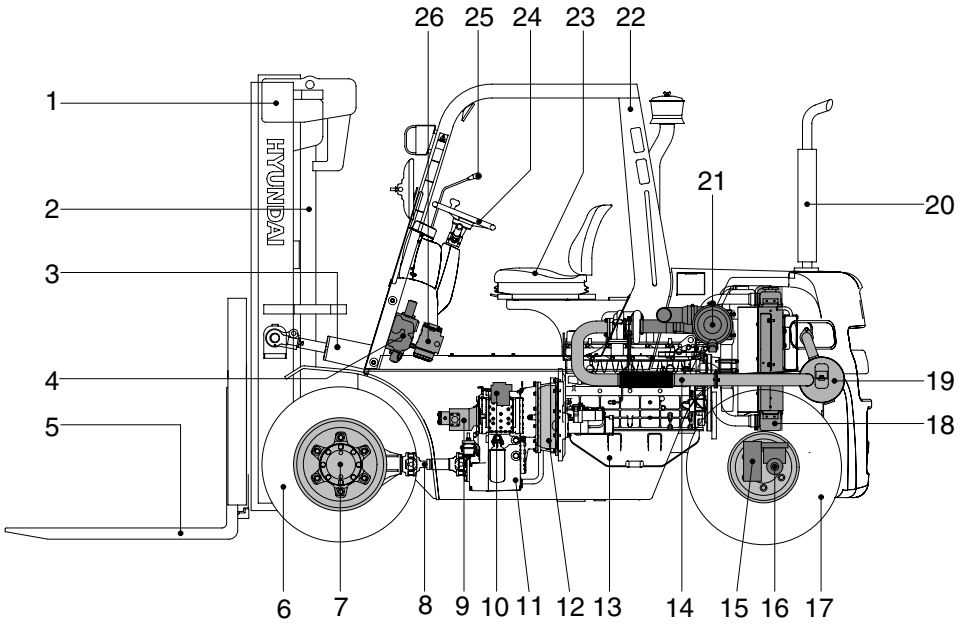
GROUP 3 PERIODIC REPLACEMENT

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

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

SECTION 2 REMOVAL & INSTALLATION OF UNIT

GROUP 1 STRUCTURE



D507OM21

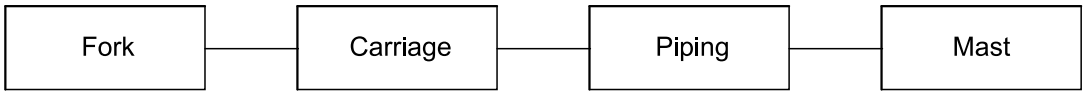
1	Mast	10	Priority valve	19	Muffler
2	Lift cylinder	11	Transmission	20	Silencer
3	Tilt cylinder	12	Torque converter	21	Air cleaner
4	Control valve	13	Engine	22	Overhead guard
5	Fork	14	Exhaust pipe	23	Seat
6	Front wheel	15	Steering axle	24	Steering wheel
7	Drive axle	16	Steering cylinder	25	Control lever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

GROUP 2 REMOVAL AND INSTALLATION OF UNIT

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

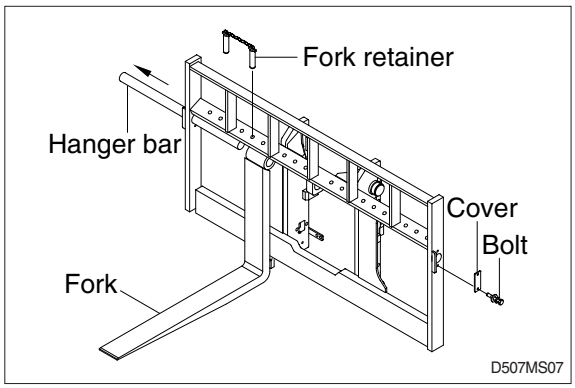
1. MAST

1) REMOVAL



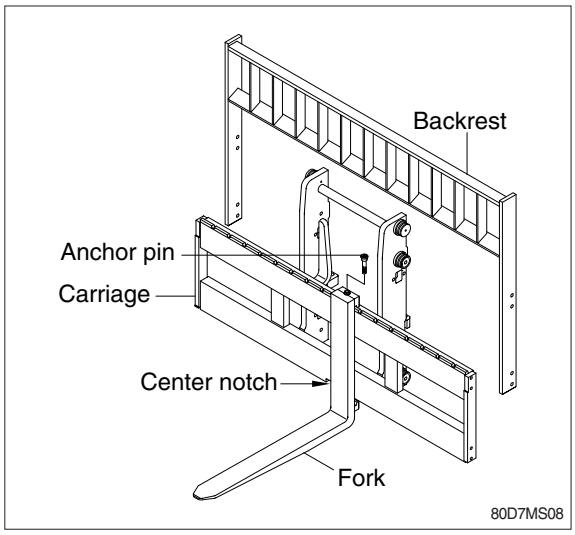
(1) SHAFT TYPE FORKS

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



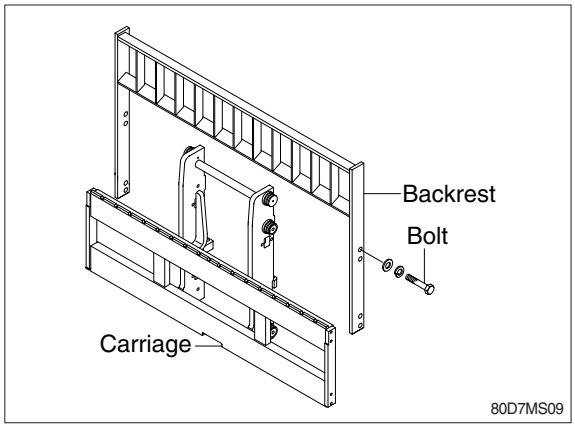
(2) HOOK ON TYPE FORKS(OPTION)

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



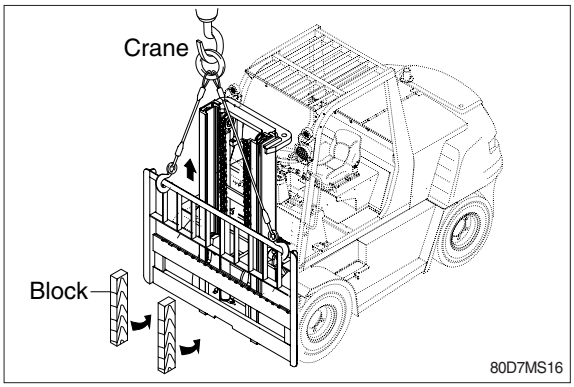
(3) BACKREST(HOOK ON TYPE)

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

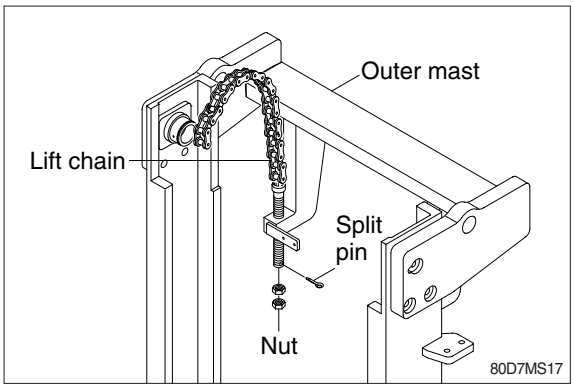


(4) CARRIAGE

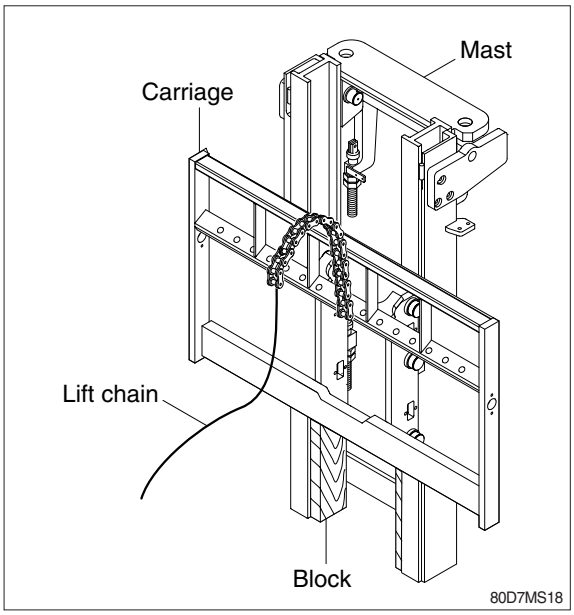
① With the mast vertical, raise the carriage high enough to place blocks under the load forks. This is done to create slack in the load chains when the carriage is lowered. Lower the carriage all the way down to the floor. Make sure the carriage is level, this will prevent any binding when the mast is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



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



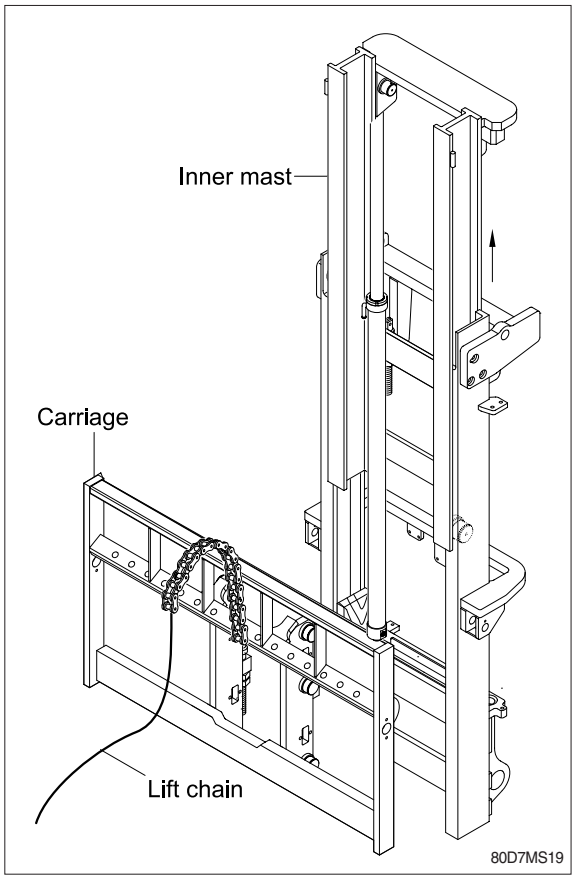
③ Pull the chains out of the sheaves and drape them over the front of the carriage.



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

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

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

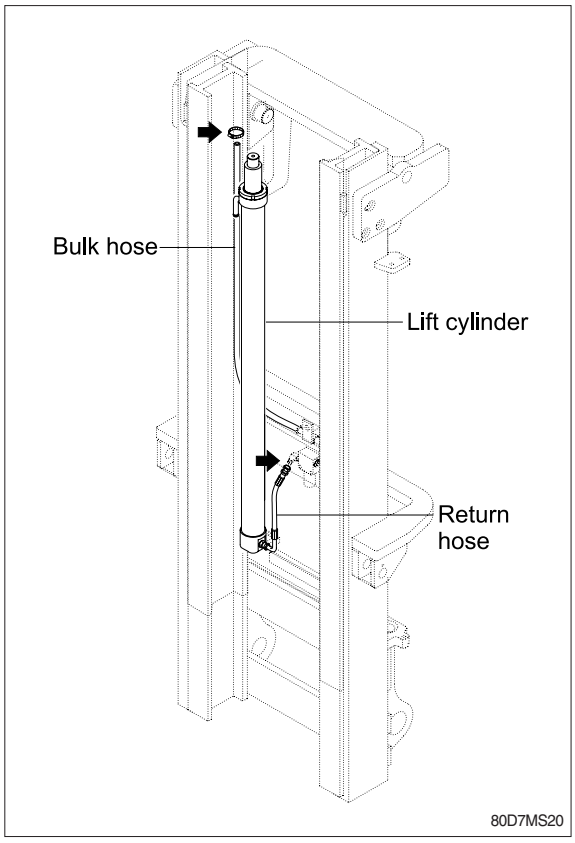


(5) PIPING

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

② Remove the return hose from the down control valve.

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

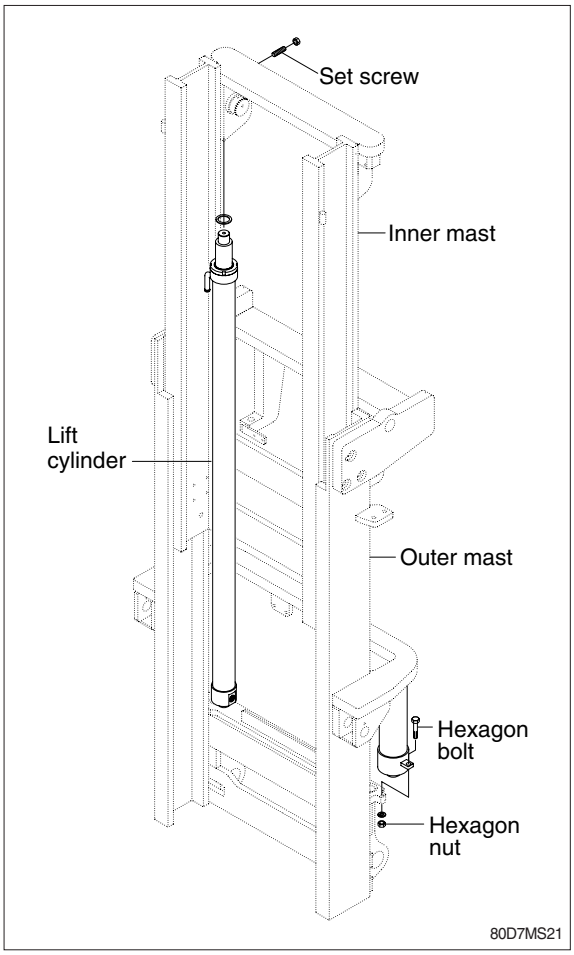


(6) LIFT CYLINDER

① Loosen and remove set screws and nuts 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.

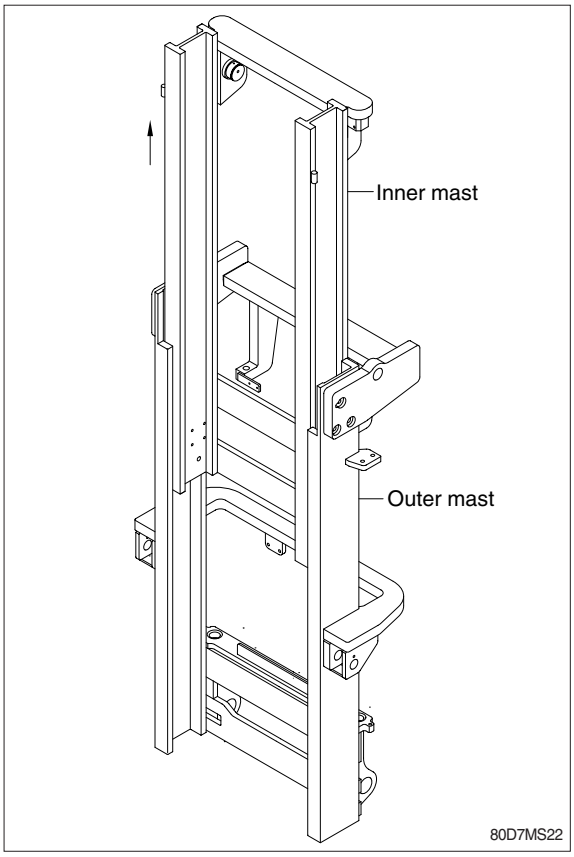
③ Loosen and remove set screws and nuts securing lift cylinders to outer mast.
④ Using an overhead hoist, slowly raise the inner mast high enough to clear lift cylinder.
⑤ Using an overhead hoist, draw out lift cylinder carefully and put down on the work floor.



(7) INNER MAST

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

⚠ Be careful the mast not to swing or fall.



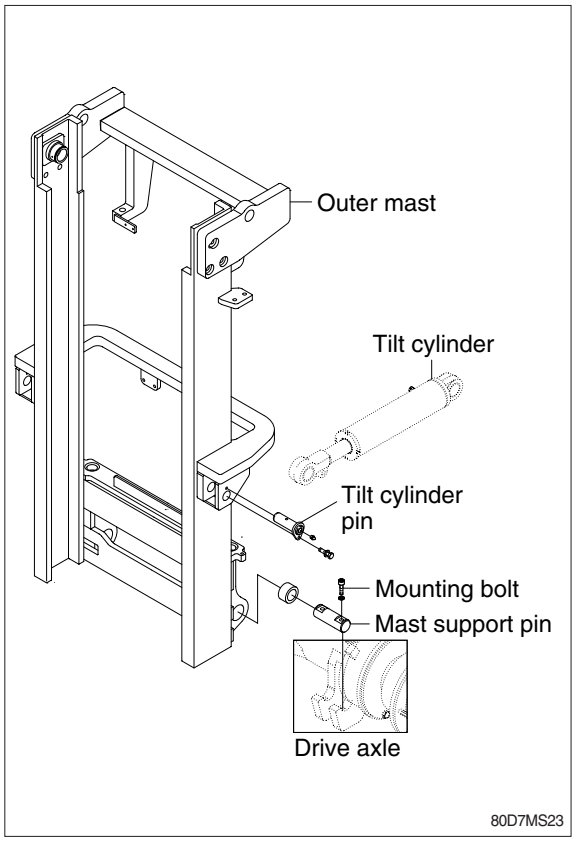
(8) TILT CYLINDER PIN

(9) MAST SUPPORT PIN

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

Remove the mounting bolts and pins from drive axle, then slowly raise outer mast.

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



2) INSTALLATION

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

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

(1) MAST SUPPORT PIN

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

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

③ Tighten mounting socket bolts to drive axle unit.

· Tightening torque : 57.7±8.5kgf · m(417±61.4lbf · ft)

※ TILT CYLINDER PIN

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

※ LIFT CYLINDER INSTALLATION AND ADJUSTMENT

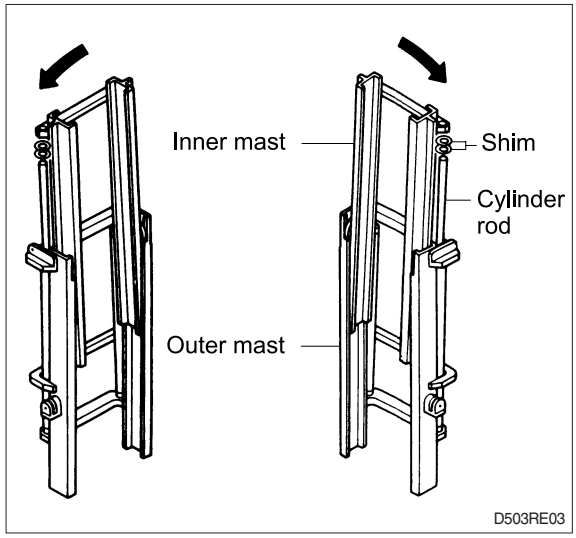
① Assemble the lift cylinder inside the outer mast, then tighten the stopper bolt. If the cylinder assembly has been replaced, adjust as follows so that the left and right cylinders are synchronized at the maximum lifting height.

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

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

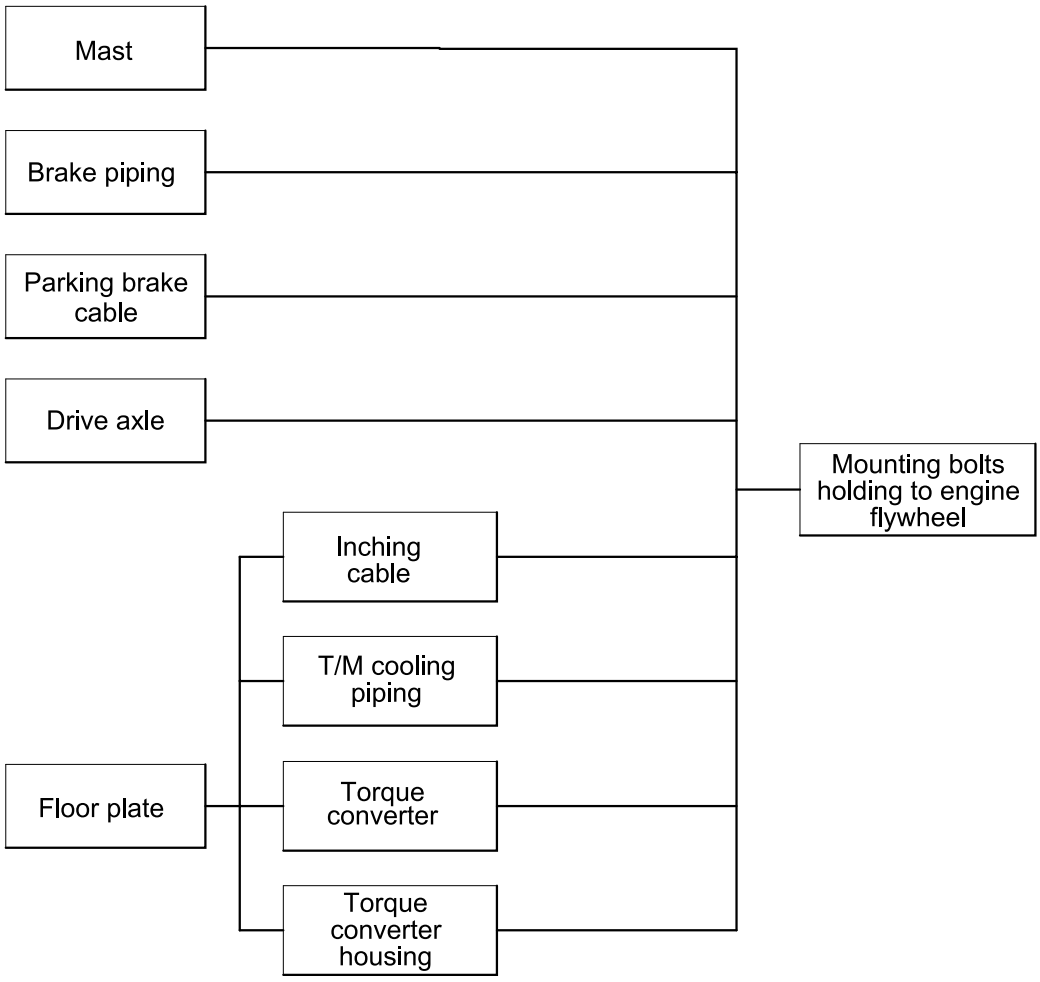
※ If play is to RIGHT, install adjustment shim to RIGHT cylinder.

· Shim thickness : 1.0㎜(0.04in)



2. POWER TRAIN ASSEMBLY

1) REMOVAL



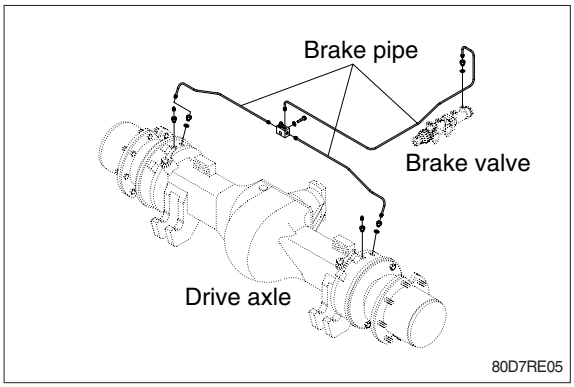
D503RE04

(1) Mast

Refer to section on mast(Page 2-2)

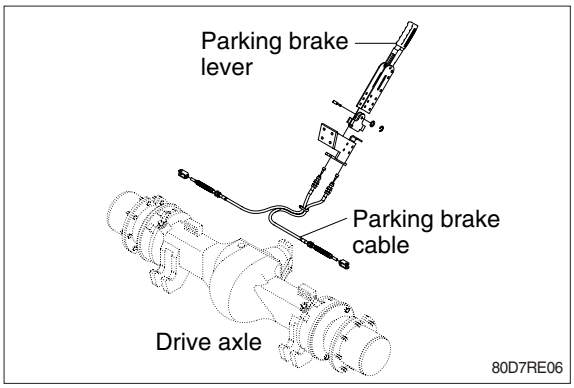
(2) Brake piping

Disconnect the brake piping from the wheel cylinder end.



(3) Parking brake cable

Disconnect parking brake cable from the wheel brake assembly.



(4) Drive axle

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

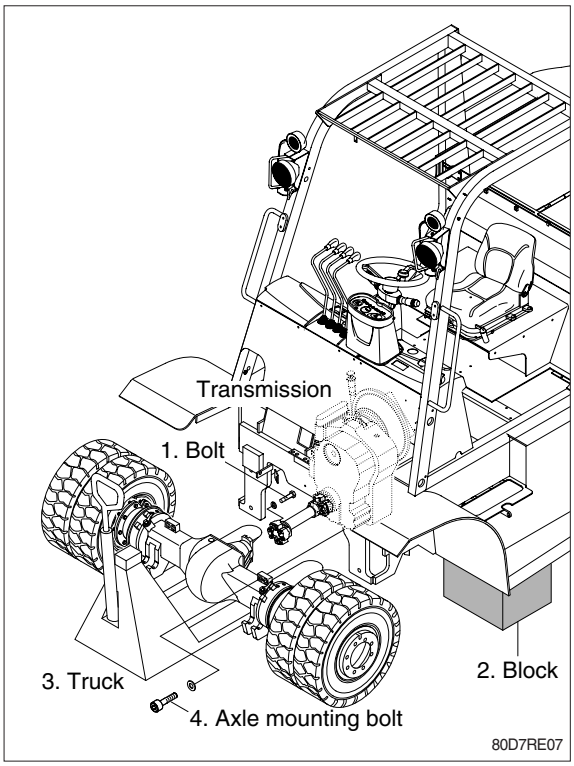
① Loosen hexagon bolts connecting drive axle to propeller shaft.

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

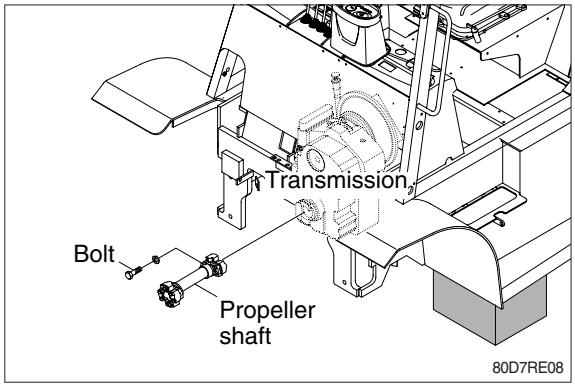
② Jack up the machine and then put the block under the frame.

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

④ Remove axle mounting bolt and then carefully draw the truck out of the vehicle with the drive axle unit.

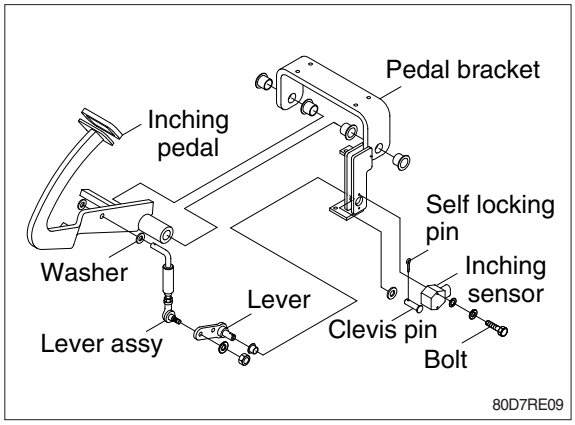


⑤ Remove propeller shaft from the transmission by loosening the mounting bolts.



(5) Inching linkage

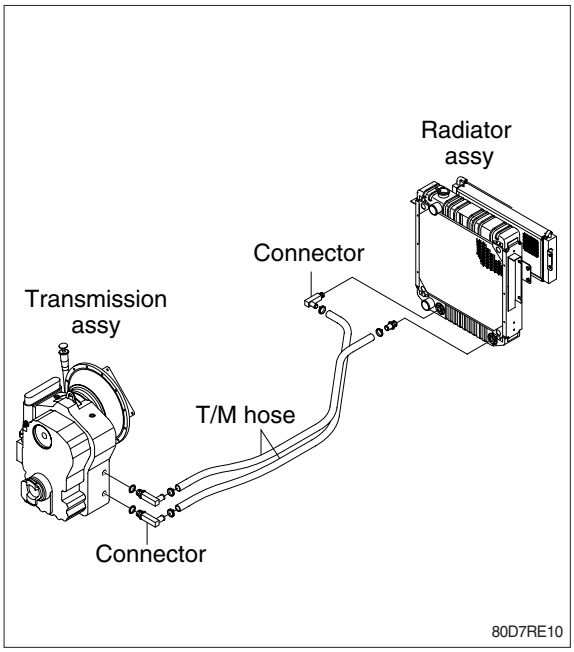
Remove the clevis pins and self locking pin.



(6) Transmission cooling piping

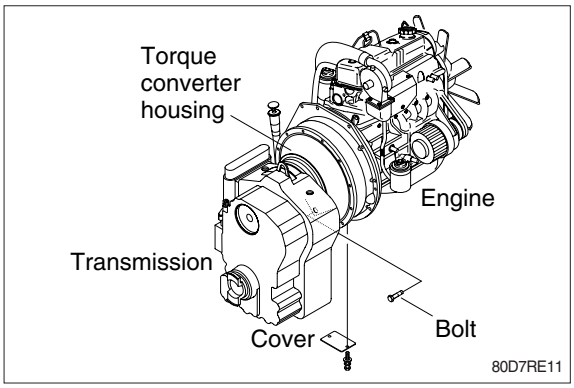
① Disconnect cooling hose and connector from the transmission.

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



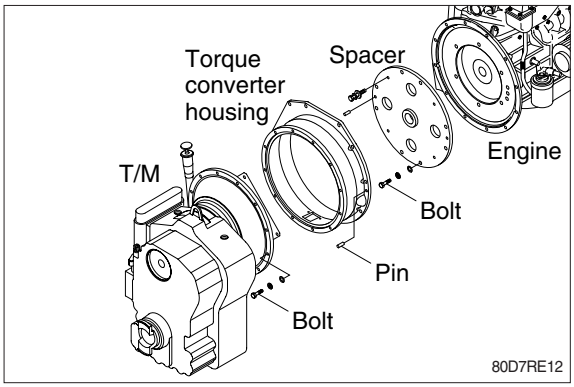
(7) Torque converter

① Remove the cover on 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.

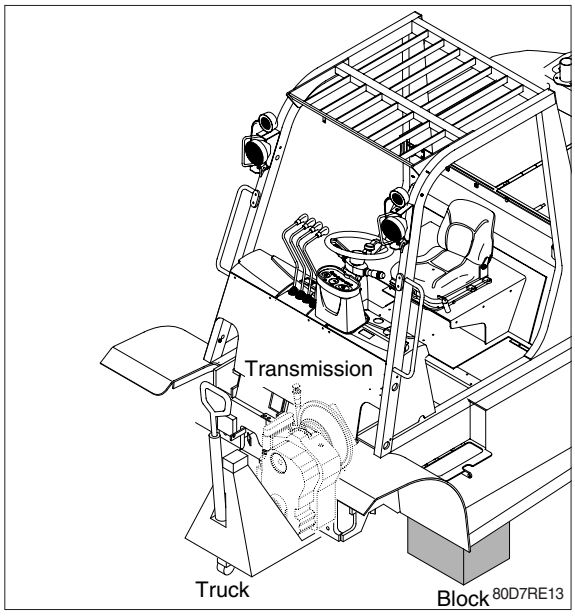


(8) Mounting bolts holding to flywheel housing

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



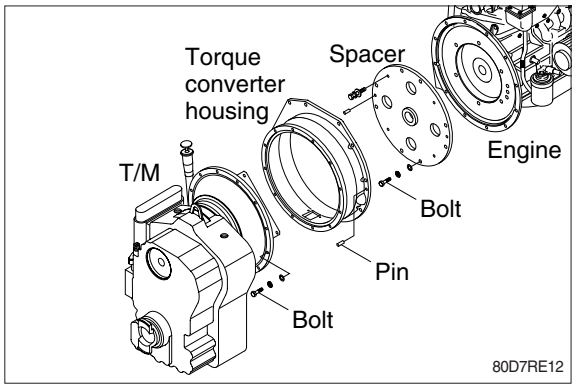
② Using a moving truck slowly pull out transmission assembly to the front.



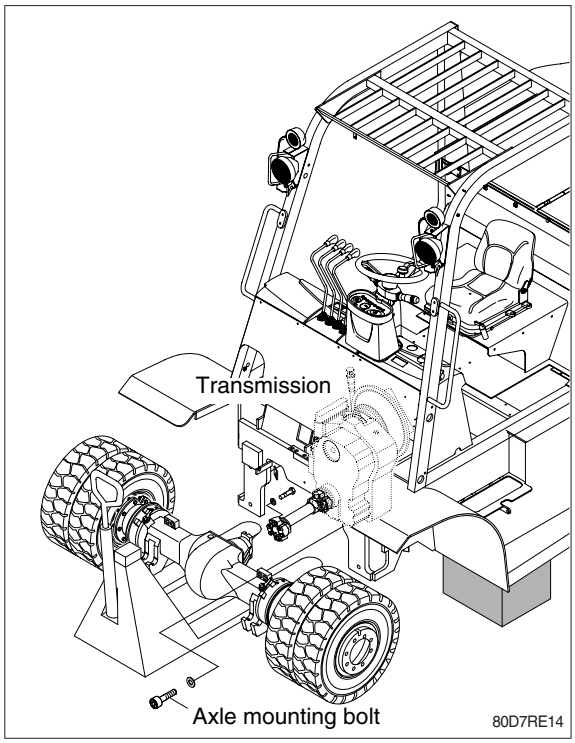
2) INSTALLATION

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

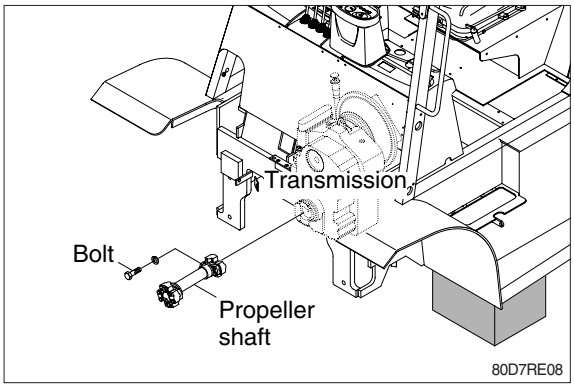
(1) Tightening torque of mounting bolt for torque converter housing.
· 6.0~8.9kgf · m(43~64lbf · ft)



(2) Tightening torque of mounting bolt for drive axle.
· 100±15kgf · m(723±108.5lbf · ft)



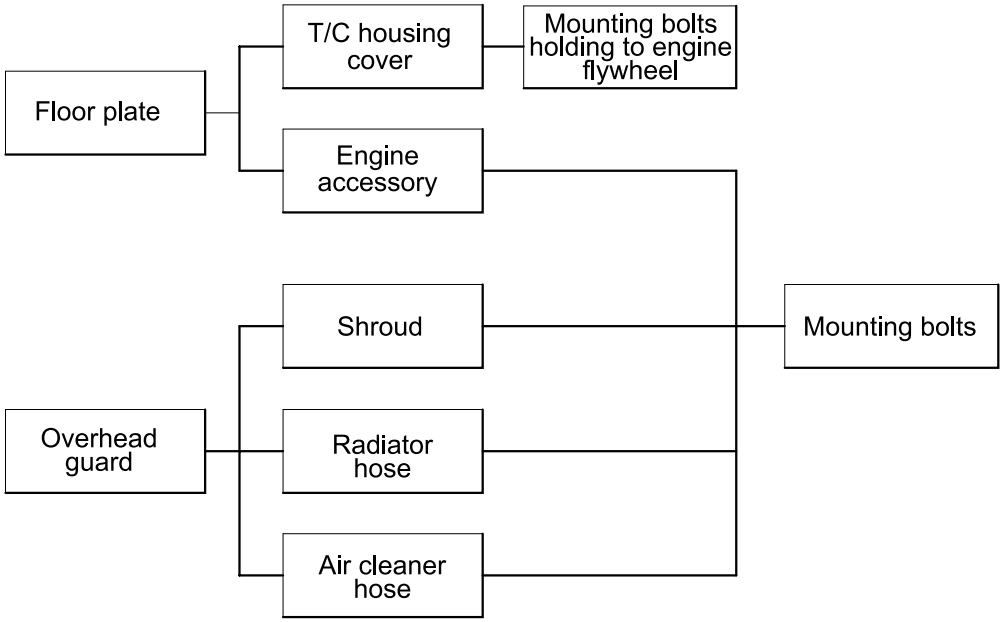
(3) Tightening torque of mounting bolt for transmission and propeller shaft.
  · 7±0.7kgf · m(50.6±5lbf · ft)



3. ENGINE

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

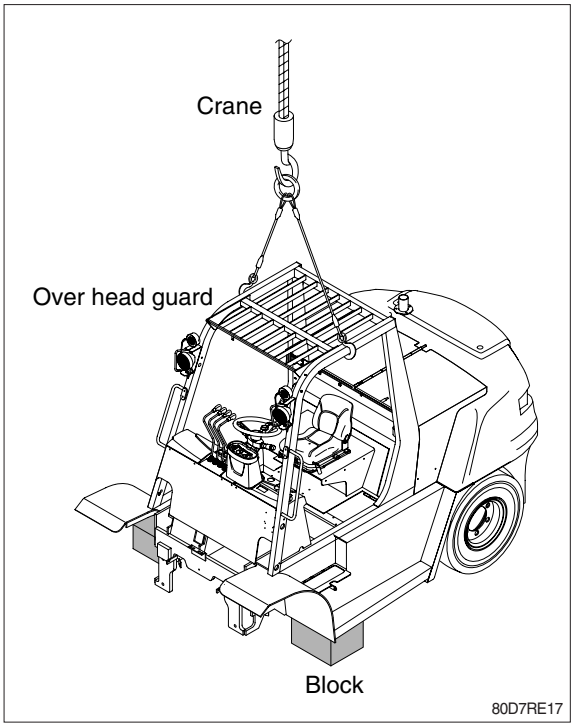
1) REMOVAL



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.



80D7RE17

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

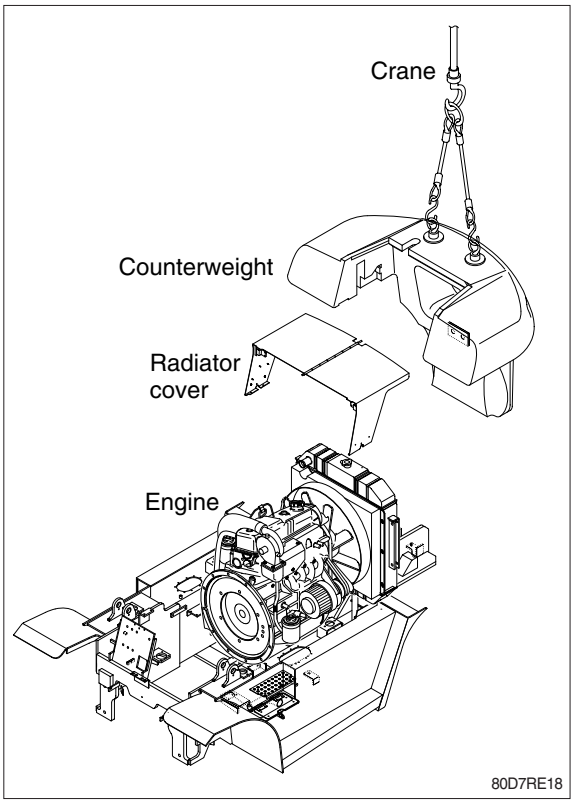
(3) Engine accessory

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

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

(4) Radiator hose

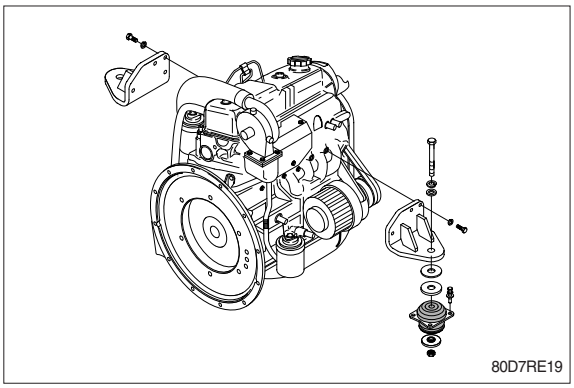
Open the drain valve of the radiator and drain the cooling water, then remove the radiator hose.



(5) Mounting bolt

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

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



2) INSTALLATION

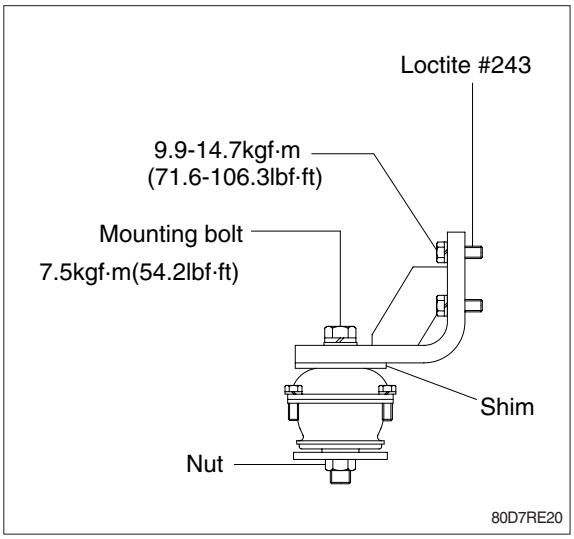
Installation is the reverse order of removal, but be careful of the following points.

(1) Tighten the engine mounting bolts and nuts.

(2) Tighten the engine mounting bracket bolts.

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

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



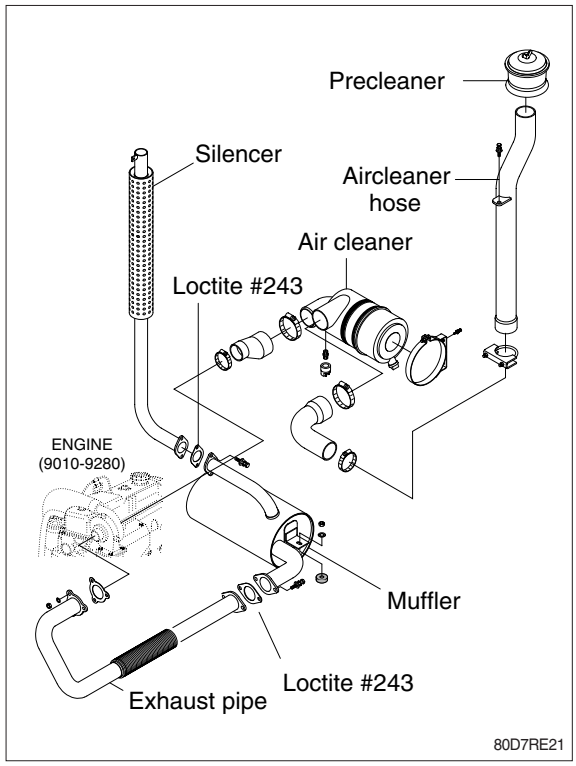
(3) Tightening torque of mounting bolt installing to torque converter housing.
· 6.0~8.9kgf · m(43~64lbf · ft)

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

(5) Air cleaner hose
Insert the air cleaner hose securely and fit a clamp.

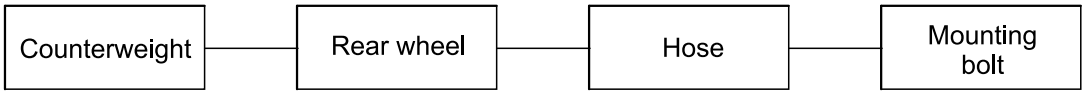
Distance to insert hose

· Air cleaner hose : 89mm(3.5in)
· Engine end : 60mm(2.36in)

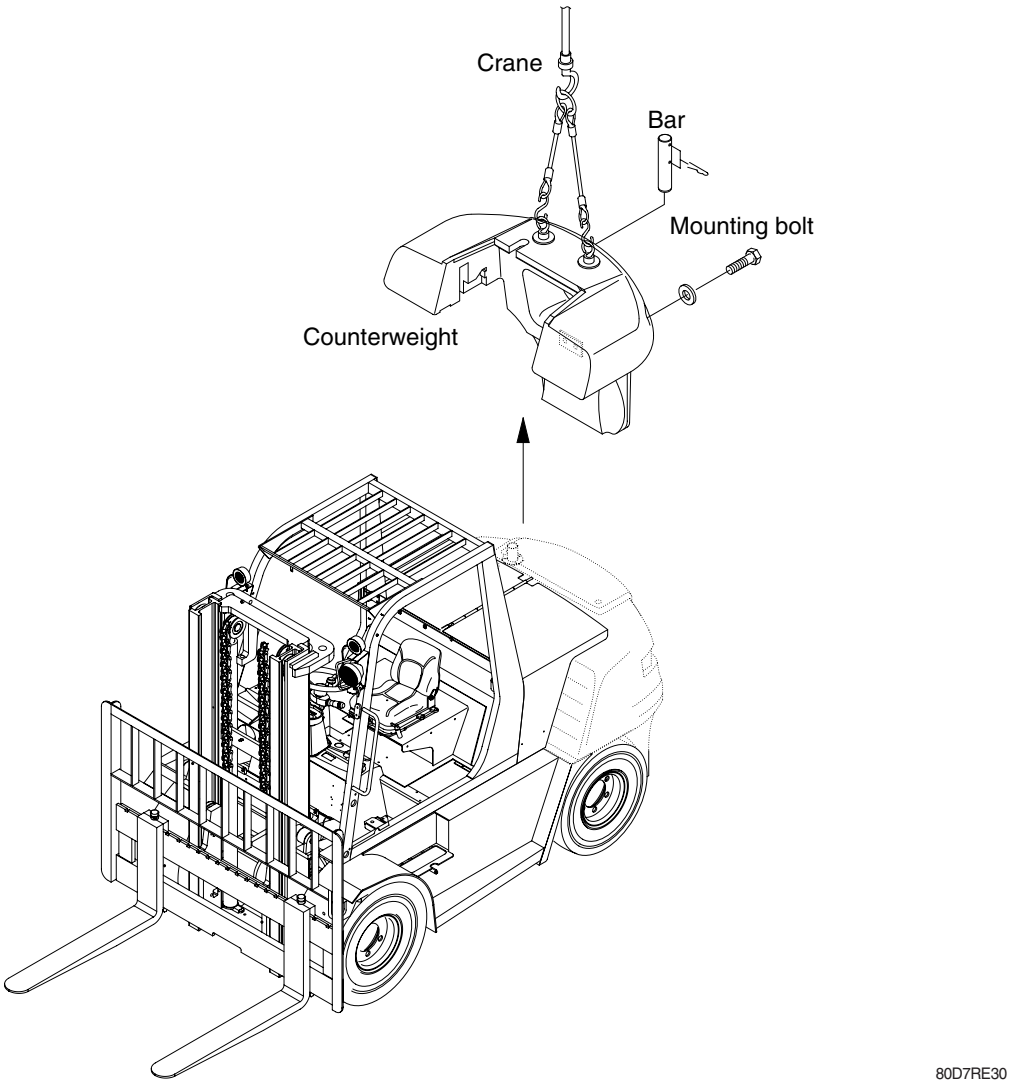


4. STEERING AXLE

1) REMOVAL



D503RE35



80D7RE30

(1) Counterweight

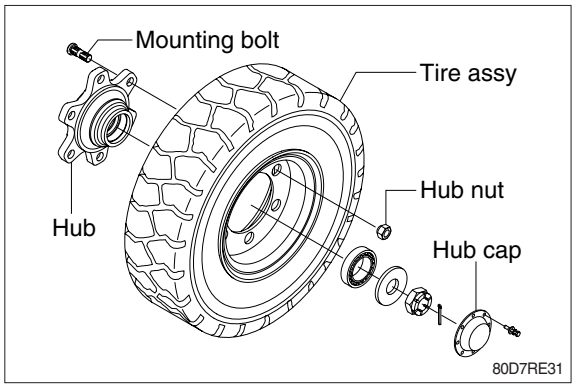
Hold the counterweight with hoist bars, and raise it with a crane.

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

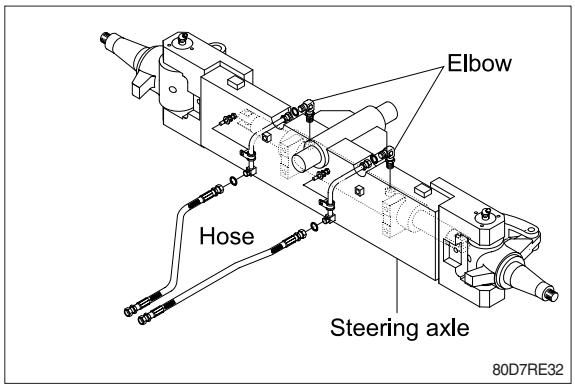
· Weight of counterweight(standard) : 3,920kg(8,640lb)

(2) Rear wheel

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



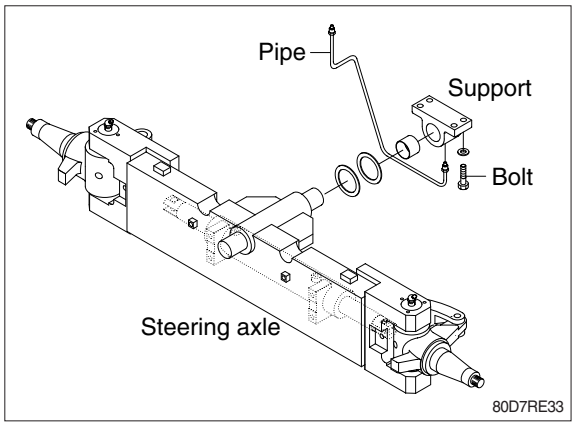
(3) Hose



(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.

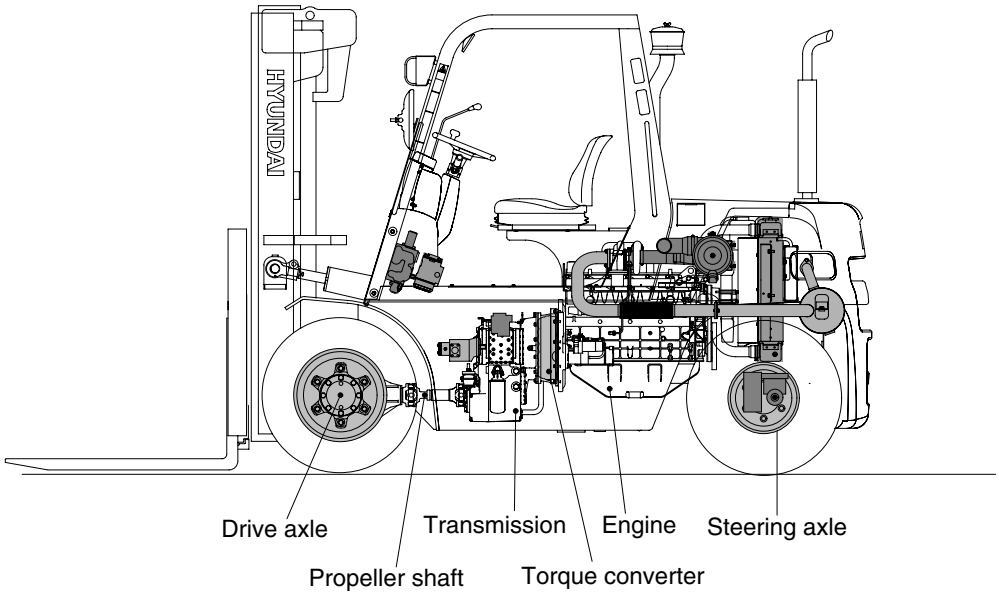


SECTION 3 POWER TRAIN SYSTEM

SECTION 3 POWER TRAIN SYSTEM

GROUP 1 STRUCTURE AND OPERATION

1. POWER TRAIN COMPONENT OVERVIEW



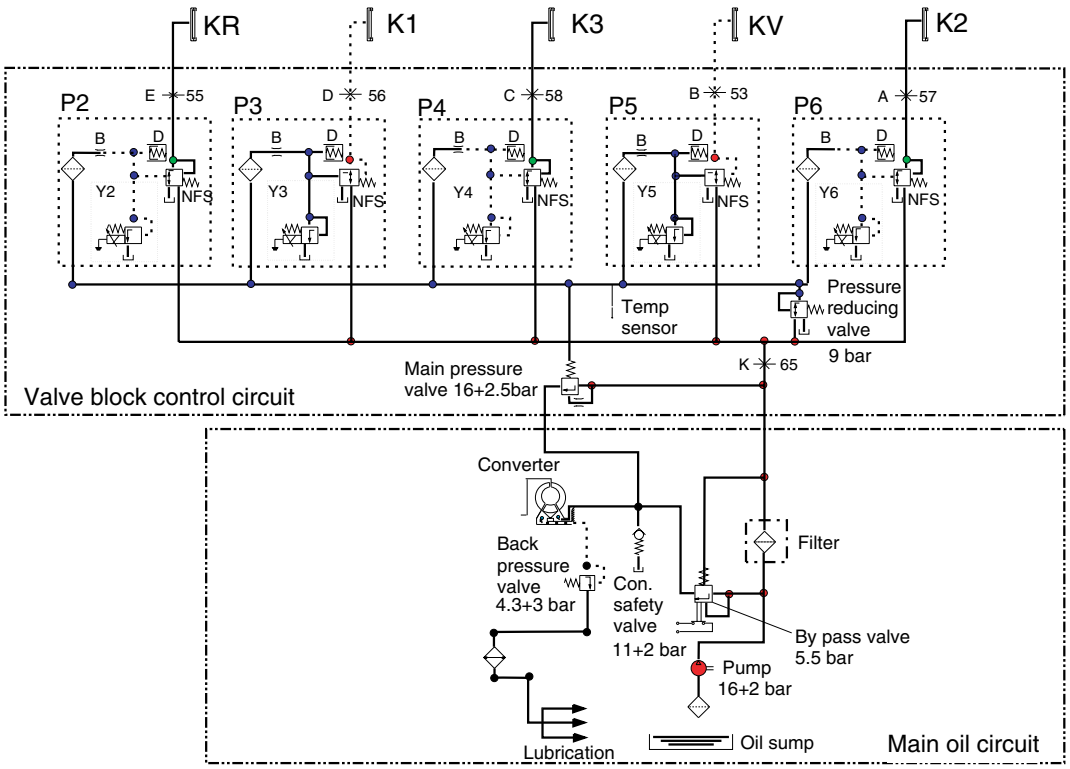
80D7PT01

The power train consists of the following components :

- Torque converter
- Transmission
- Propeller shaft
- Drive axle

Engine power is transmitted to the transmission through the torque converter.
The transmission is a hydraulically engaged three speed forward, three speed reverse power shift type transmission.
The transmission outputs through universal joints to drive axle assembly.
The power transmitted to front axle drives front wheels.

· Hydraulic circuit

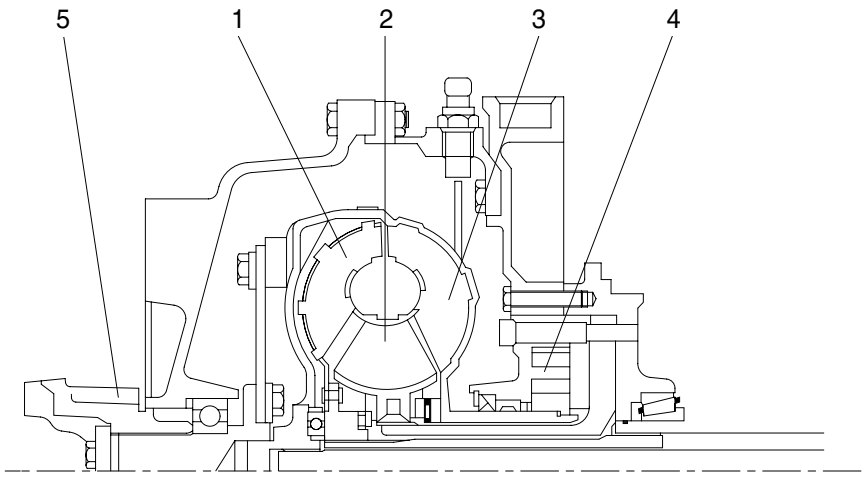


80D7PT31

Speed	Forward			Reverse			Neutral	Positions on the valve block	No. of measuring points
	F1	F2	F3	R1	R2	R3			
Y2				●	●	●	-	E	55
Y3	●			●			-	D	56
Y4			●			●	-	C	58
Y5	●	●	●				-	B	53
Y6		●			●		-	A	57
Clutch engaged	KV, K1	KV, K2	KV, K3	KR, K1	KR, K2	KR, K3	-	-	-

NFS Follow-on slide
D Vibration damper
B Orifice
P2 Proportional valve KR
P3 Proportional valve K1
P4 Proportional valve K3
P5 Proportional valve KV
P6 Proportional valve K2
Y2~Y6 Pressure regulators

2. TORQUE CONVERTER



D503TM01

1	Turbine	3	Pump	5	Input shaft
2	Stator	4	Transmission pump		

The converter is working according to the Trilok-system, i.e. it assumes at high turbine speed the characteristics, and with it the favorable efficiency of a fluid 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-shape system that the fluid is streaming through the circuit components in the indicated order.

Pressure oil is constantly streaming 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 dissipated through the escaping oil.
The oil, escaping out of the pump wheel, enters the turbine wheel and is there inversed in the direction of flow.

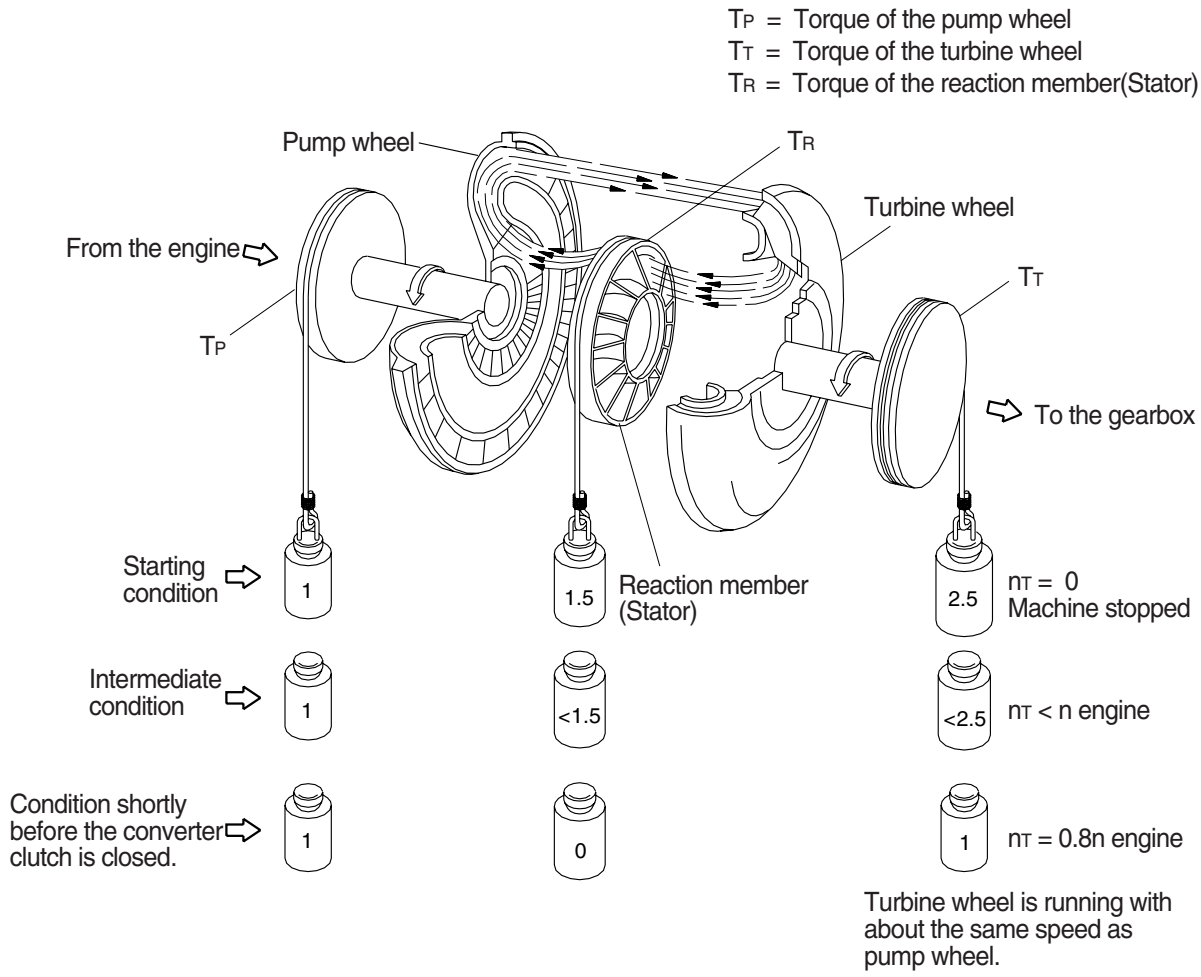
According to the rate of inversion, the turbine wheel and with it also the output shaft, receive a more or less high reaction moment. The stator(Reaction member), following the turbine, has the task to inverse again the oil which is escaping out of the turbine and to delivery it under the suitable discharge direction to the pump wheel.
Due to the inversion, the stator receives a reaction moment.
The relation turbine moment/pump moment is called torque conversion. This is the higher the greater the speed difference of pump wheel and turbine wheel will be.

Therefore, the maximum conversion is created at standing 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.

If the turbine speed is reaching about 80% of the pump speed, the conversion becomes 1.0 i.e. the turbine moment becomes equal to that of the pump moment.
From this point on, the converter is working similar to a fluid clutch.

A stator freewheel serves to improve the efficiency in the upper driving range, it is backing up in the conversion range the moment upon the housing, and is released in the coupling range.
In this way, the stator can rotate freely.

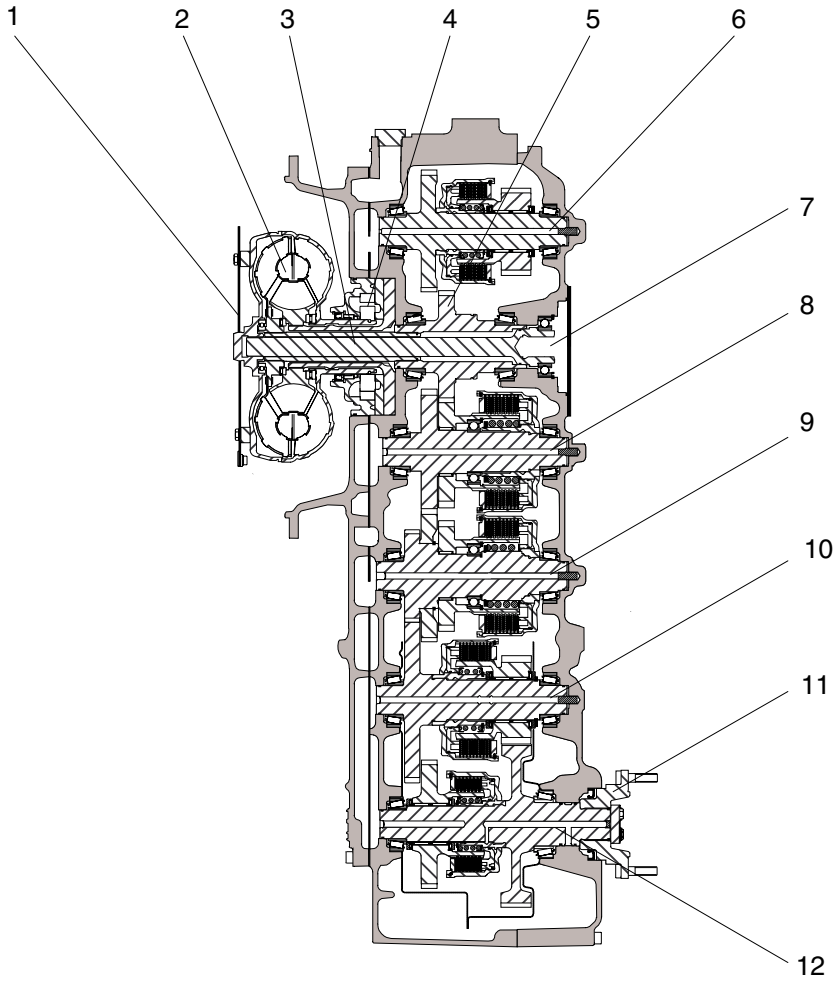
Function of a hydrodynamic torque converter(Schematic view)



D503TM02

3. TRANSMISSION

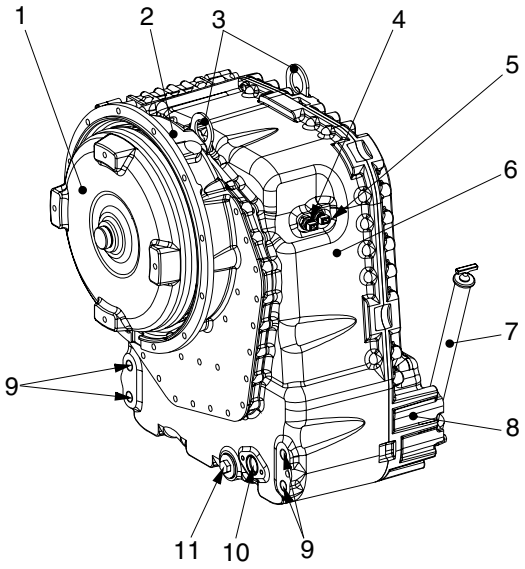
1) LAYOUT



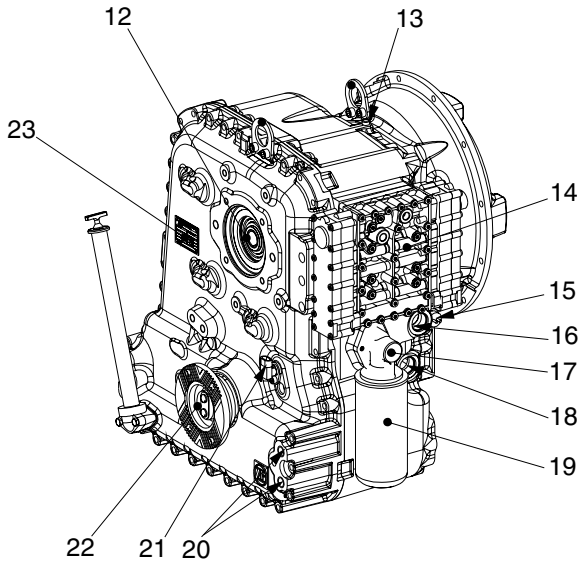
D507TM03

1	Engine connection	5	Input gear	9	Clutch shaft(KR)
2	Converter	6	Clutch shaft	10	Clutch shaft(K1)
3	Input shaft	7	Power take-off	11	Output flange
4	Transmission pump	8	Clutch shaft(KV)	12	Clutch shaft(K3/output)

2) INSTALLATION VIEW



FRONT VIEW



REAR VIEW

D507PT26

1	Converter	13	Breather
2	Converter bell	14	Electro - hydraulic control
3	Lifting lugs	15	Temperature sensor behind the converter
4	Inductive transmitter n central gear train	16	Connection to the oil cooler
5	Inductive transmitter n turbine	17	Filter head
6	Gearbox housing - Front section	18	Connection from the oil cooler
7	Oil level tube with oil dipstick	19	Exchange filter
8	Gearbox housing - Rear section	20	Transmission suspension holes M20
9	Transmission suspension holes M20	21	Speed sensor n output
10	Attachment possibility oil level tube with oil dipstick	22	Output flange
11	Oil drain plug M38 × 1.5	23	Type plate
12	Power take - off		

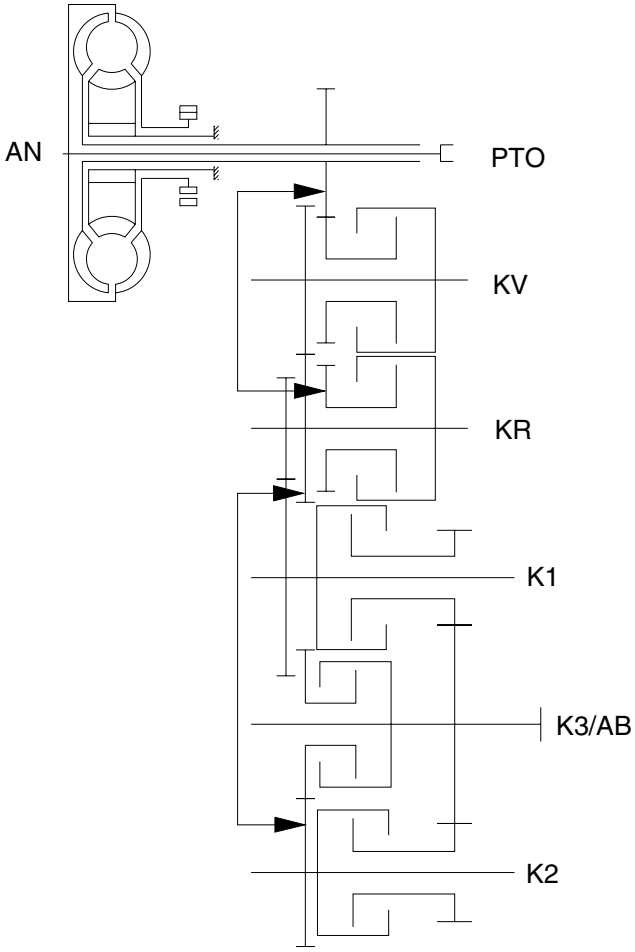
3) OPERATION OF TRANSMISSION

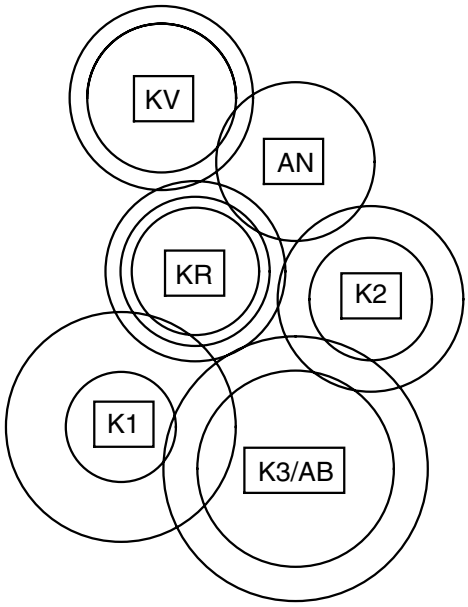
(1) Gearbox diagram

The multi-speed reversing transmission in countershaft design is power shiftable by hydraulically actuated multi-disk clutches.

All gears are constantly meshing and carried on antifriction bearings.
The gear wheels, bearings and clutches are cooled and lubricated with oil.
The 3-speed reversing transmission is equipped with 5 multi-disk clutches.
At the shifting, the actual plate pack is compressed by a piston, movable in axial direction, which is pressurized by pressure oil.

A compression spring takes over the pushing bask of the piston, thus the release of the plate pack. As to the layout of the transmission as well as the specifications of the closed clutches in the single speeds.





Legend:

AN = Input
KV = Clutch forward
KR = Clutch reverse
K1 = Clutch 1st speed
K2 = Clutch 2nd speed
K3 = Clutch 3rd speed/output
PTO = Power take-off

Diagram Clutches

Driving direction	Speed	Clutch
Forward	1	KV/K1
	2	KV/K2
	3	KV/K3
Reverse	1	KR/K1
	2	KR/K2
	3	KR/K3

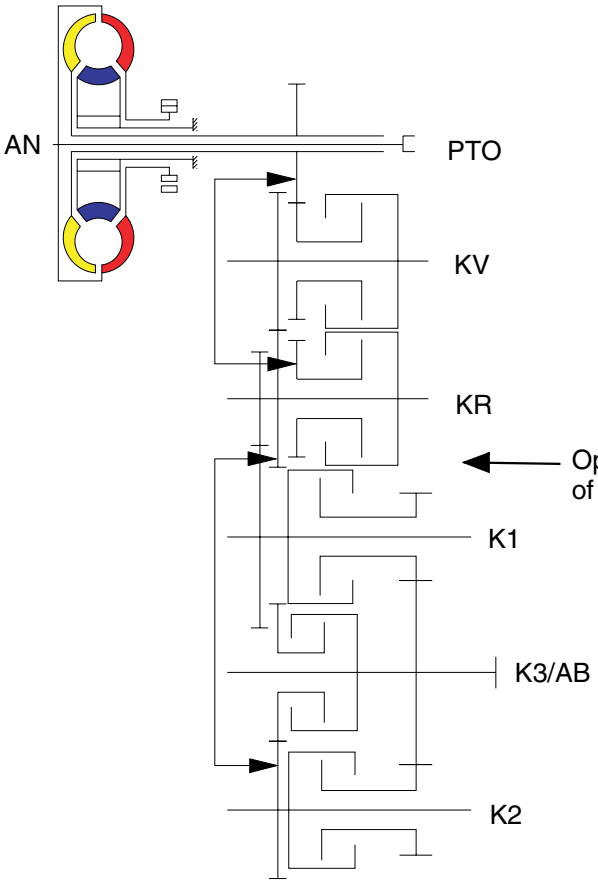
D507PT32

(2) Forward

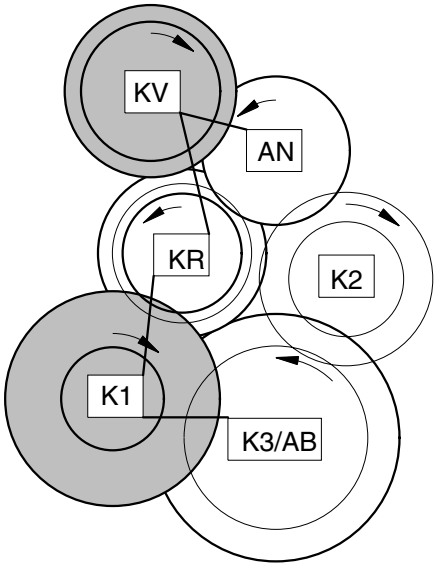
In forward, forward clutch and 1st, 2nd, 3rd clutch are engaged.

Forward clutch and 1st, 2nd, 3rd clutch are actuated by the hydraulic pressure applied to the clutch piston.

Transmission diagram



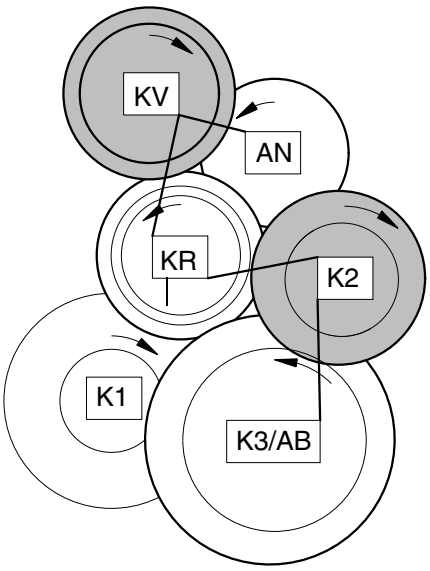
1st speed-forward



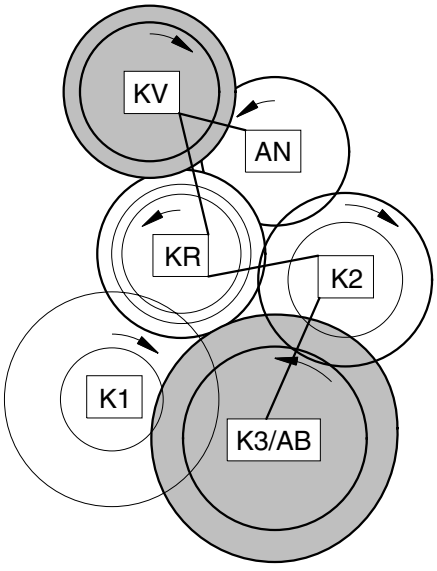
Legend:

AN = Input
KV = Clutch forward
KR = Clutch reverse
K1 = Clutch 1st speed
K2 = Clutch 2nd speed
K3/AB = Clutch 3rd speed/output
PTO = Power take-off

2nd speed-forward



3rd speed-forward



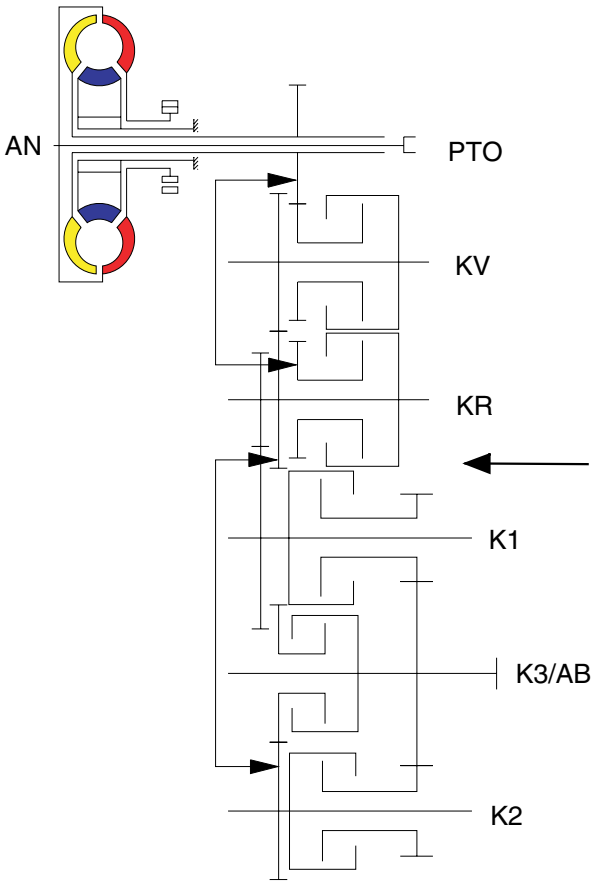
D503PT33

(3) Reverse

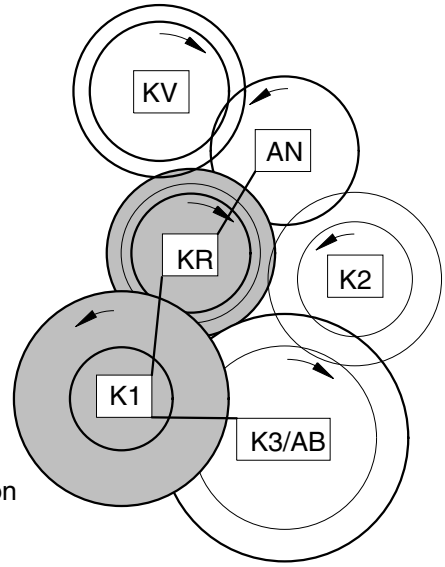
In reverse, reverse clutch and 1st, 2nd, 3rd clutch are engaged.

Reverse clutch and 1st, 2nd, 3rd are actuated by the hydraulic pressure applied to the clutch piston.

Transmission diagram



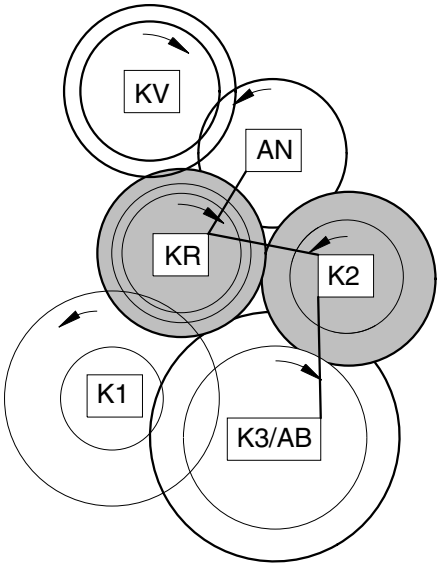
1st speed-reverse



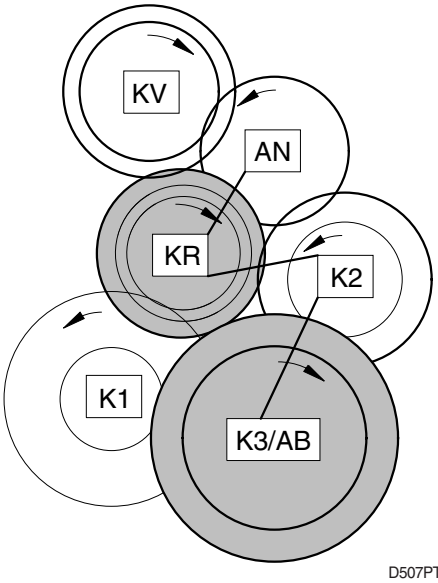
Legend:

AN = Input
KV = Clutch forward
KR = Clutch reverse
K1 = Clutch 1st speed
K2 = Clutch 2nd speed
K3/AB = Clutch 3rd speed/output
PTO = Power take-off

2nd speed-reverse

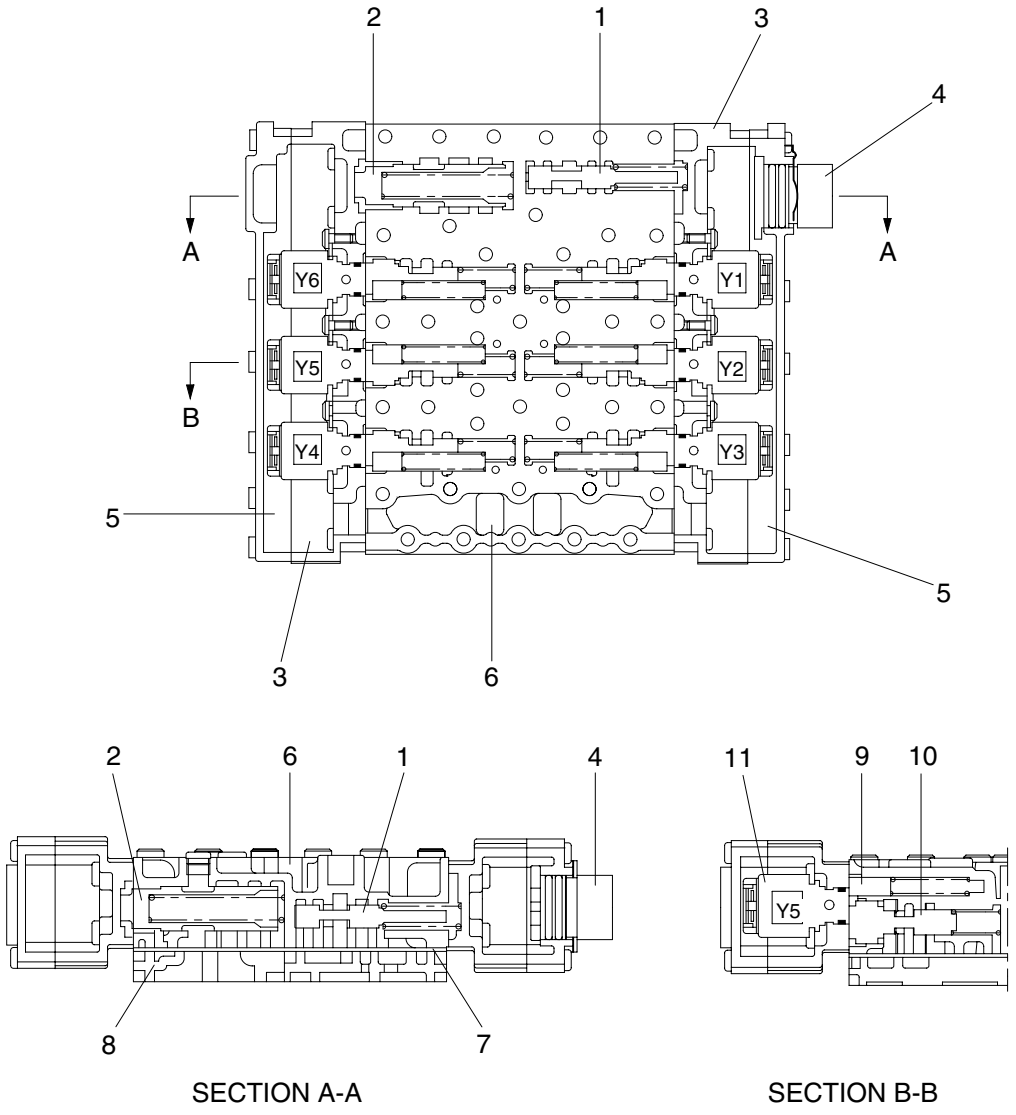


3rd speed-reverse



D507PT34

4) ELECTRO-HYDRAULIC SHIFT CONTROL WITH PROPORTIONAL VALVE



SECTION A-A

SECTION B-B

D507PT03

1 Pressure reducing valve(9bar)
2 Main pressure valve (16 + 2bar)
3 Housing
4 Plug(cable harness)
5 Cover
6 Valve block
7 Intermediate plate
8 Duct plate
9 Vibration damper
10 Follow - on slide
11 Pressure regulator

Transmission control, see schedule of measuring points, Oil circuit diagram and Electro-hydraulic control unit see page 3-2, 3-10.

The transmission pump, necessary for the oil supply of the converter, and for the transmission control, is sitting in the transmission on the engine-dependent input shaft.

The feed rate of the pump is
Q = 85 l /min, at n_{Motor} = 2000 min^{-1}
This pump is sucking the oil via the coarse filter out of the oil sump and delivers it via the fine filter - the filter can also be fitted externally from the transmission - to the main pressure valve.

If because of contamination, resp. damage, the through-flow through the fine filter is not ensured, the oil will be directly conducted via a filter differential pressure valve(bypass valve ¡ p = 5.5+3bar) to the lubrication.
In this case, an error indication is shown on the display.

The five clutches of the transmission are selected via the 6 proportional valves P1 to P6(P1 will not be under current at the 3-speed version, i.e. without function).
The proportional valve(pressure regulator unit) is composed of pressure regulator(e.g. Y6), follow-on slide and vibration damper.

The control pressure of 9 bar for the actuation of the follow-on slides is created by pressure reducing valve. The pressure oil(16+2bar) is directed via the follow-on slide to the respective clutch.

Due to the direct proportional selection with separated pressure modulation for each clutch, the pressure to the clutches, which are engaged in the gear change, will be controlled. In this way, a hydraulic intersection of the clutches to be engaged and disengaged becomes possible.
This is creating spontaneous shiftings without traction force interruption.

At the shifting, the following criteria will be considered :
- Speed of engine, turbine, central gear train and output.
- Transmission temperature.
- Shifting mode(up-,down-, reverse shifting and speed engagement out of Neutral).
- Load condition(full and part load, traction, overrun inclusive consideration of load cycles during the shifting).

The main pressure valve is limiting the max. control pressure to 16+2.5bar and releases the main stream to the converter and lubrication circuit.
In the inlet to the converter, a converter safety valve is installed which protects the converter from high internal pressures(opening pressure 11+2bar).
Within the converter, the oil serves to transmit the power according to the well-known hydrodynamic principle(see Chapter torque converter page 3-3).
To avoid cavitation, the converter must be always completely filled with oil.

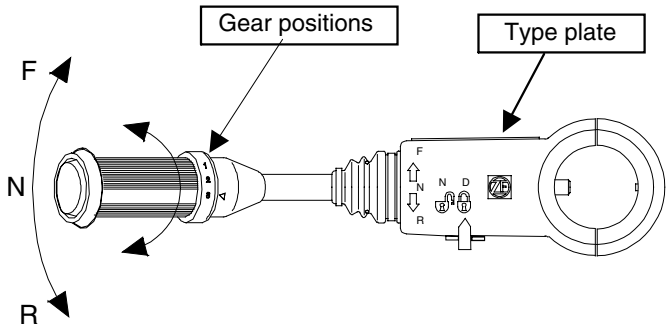
This is achieved by converter pressure back-up valve, rear-mounted to the converter, with an opening pressure of at least 4.3+3bar.
The oil, escaping out of the converter, is directed to the oil cooler.

From the oil cooler, the oil is directed to the transmission and there to the lubricating oil circuit, so that all lubricating points are supplied with cooled oil.
In the electrohydraulic control unit are 6 pressure regulators installed.

5) GEAR SELECTOR(DW-3)

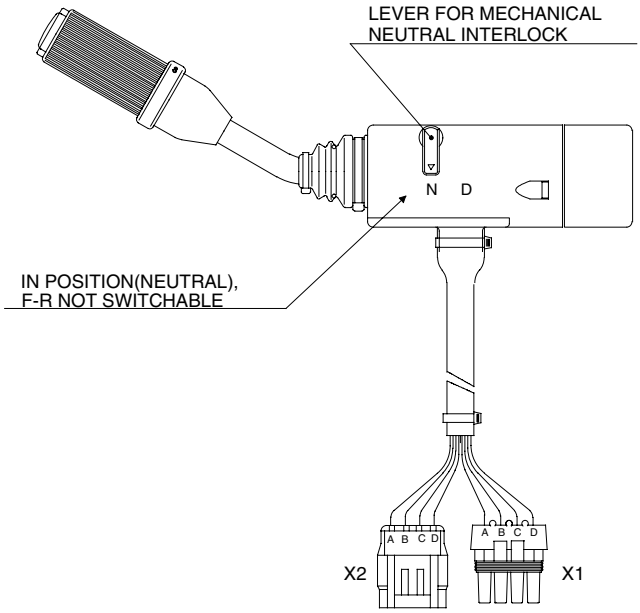
The gear selector is designed for the mounting on the steering column left side. By a rotative motion, the positions(speeds) 1 to 3 are selected by tilting the lever, the driving direction(Forward (F) - Neutral(N) - Reverse(R)).

For the protection from unintended start off, a neutral interlock is installed :
Position "N" - Controller lever blocked in this position
Position "D" - Driving



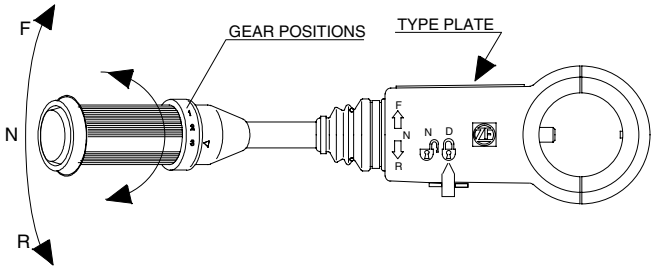
D507PT12

Gear selector(DW-3)



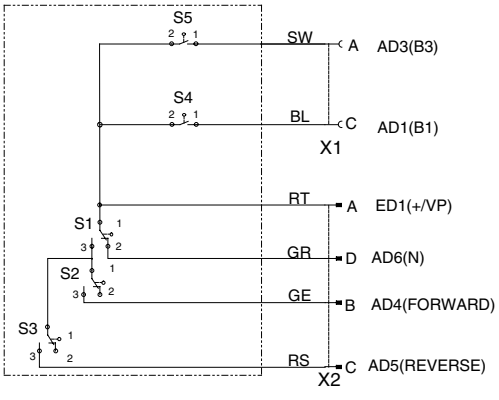
CODING GEAR SELECTOR

		OUTPUT								
SPEED		FORWARD			REVERSE			NEUTRAL		
		1	2	3	1	2	3	1	2	3
AD1	B1	●			●			●		
AD2	B2									
AD3	B3	●	●		●	●		●	●	
AD4	V	●	●	●						
AD5	R				●	●	●			
AD6	N							●	●	●

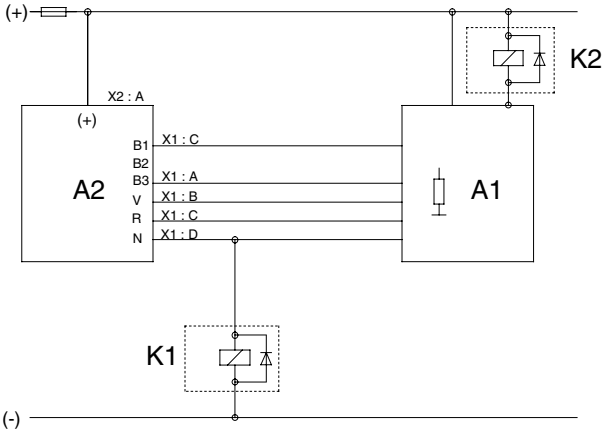


F = FORWARD
N = NEUTRAL
R = REVERSE
D = MECANICAL NEUTRAL INTERLOCK
1 = 1st SPEED
2 = 2nd SPEED
3 = 3rd SPEED

CIRCUIT DIAGRAM SELECTOR



CONNECTION DIAGRAM SELECTOR



K1 = RELAY STARTER INTERLOCK
K2 = RELAY REVERSE LIGHTS
A1 = TCU(Transmission Control Unit)
A2 = CONTROLLER

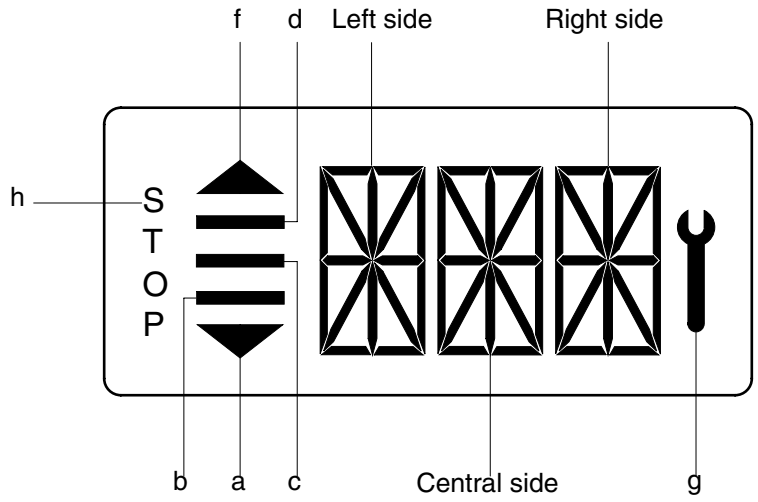
D507PT38

6) TRANSMISSION ERROR DISPLAY

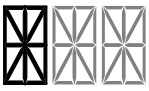
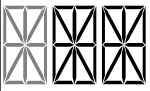
(1) Function

The display can be used with the gear selector. It indicates speed and driving direction as well as the activated inching.

When driving in the automatic mode, a bar indicator gives additionally also information about the selected driving range; The automatic range is symbolized by arrows above and below the bar indicator. In case of possible errors in the system, a wrench appears on the display, combined with indication of the error number. Also sporadically occurring errors can be indicated.



D507CD33

1	Bars	a, f	Automatic range(up and down shifting)
		b, c, d,	Preselected gear
2	Left side		For the moment still without function
3	Central and Right side		On the two alphanumeric 16-segment display, the electric control unit issues the actual state of gear and driving direction. Besides, a two digit error code will be indicated via these two segment
4	Spanner	g	Electronic control unit recognized an error, is flashing
5	Letters **STOP**	h	Immediate stop is required(At the moment not activated)

(2) Abbreviations

OC : Open circuit
SC : Short circuit
OP mode : Operating mode
TCU : Transmission control unit
EEC : Electronic engine controller
PTO : Power take off

(3) Display during operation

Symbol	Meaning	Remarks
F, N, R 1, 2, 3	Actual gear and direction Central side shows actual gear Right side shows actual direction	
NN (Central and right side)	Not neutral, waiting for neutral after power up or a reverse fault	To engage a gear, first move shift selector to neutral position and again to F to R position
1 bar	Manual mode lst gear	
2 bar	Manual mode 2nd gear	
3 bar	Manual mode 3nd gear	
3bars and 2 arrows	Automatic mode	a, f
□ □	Transmission neutral	Cold start phase
Spanner flashing	At least on fault active	Select neutral to get fault code displayed
WT	Warning torque converter temperature	Changes between actual gear/direction while driving, in neutral only displayed if no fault is detected(spanner)
WS	Warning sump temperature	Changes between actual gear/direction while driving, in neutral only displayed if no fault is detected(spanner)
WE	Warning high engine speed	Changes between actual gear/direction while driving, in neutral only displayed if no fault is detected(spanner)
PN	Direction F or R selected while parking brake engaged	Transmission in neutral until parking brake is released. ※ Machine starts to move after release of parking brake.
F or R flashing	Direction F or R selected while turbine speed is to high	※ Gear will engage when turbine speed drops
EE flashing (central and right side)	No communication with display	

(4) Definition of the error codes

① Introduction

The error codes consists of two hexadecimal numbers.

The first number shows the type of signal, the second number shows signal and the type of the error.

② Description of error codes

First No.	Meaning of number
1 hex	Digital input signals
2 hex	Analog input signals
3 hex	Speed signals
4 hex	Speed signals
7 hex	Analog current output signals
8 hex	Analog current output signals
9 hex	Digital output signals
A hex	Digital output signals
B hex	Clutch errors
D hex	Power supply
E hex	High speed signals
F hex	General errors

③ List of error codes

Number	Meaning of error code	
11 hex	Logical error at gear range signal	
12 hex	Logical error at direction select signal	
21 hex	Short circuit to battery voltage at clutch cutoff input	
22 hex	Short circuit to ground or open circuit at clutch cutoff input	
23 hex	Short circuit to battery voltage at load sensor input	not used
24 hex	Short circuit to ground or open circuit at load sensor input	not used
25 hex	Short circuit to battery voltage or open circuit at temperature sensor input	
26 hex	Short circuit to ground at temperature sensor input	
31 hex	Short circuit to battery voltage at engine speed input	
32 hex	Short circuit to ground or open circuit at engine speed input	
33 hex	Logical error at engine speed input	
34 hex	Short circuit to battery voltage at turbine speed input	
35 hex	Short circuit to ground or open circuit at turbine speed input	
36 hex	Logical error at turbine speed input	
37 hex	Short circuit to battery voltage at internal speed input	
38 hex	Short circuit to ground or open circuit at internal speed input	
39 hex	Logical error at internal speed input	

Number	Meaning of error code	
3A hex	Short circuit to battery voltage or open circuit at output speed input	
3B hex	Short circuit to ground or open circuit at output speed input	
3C hex	Logical error at output speed input	
71 hex	Short circuit to battery voltage at clutch K1	
72 hex	Short circuit to ground at clutch K1	
73 hex	Open circuit at clutch K1	
74 hex	Short circuit to battery voltage at clutch K2	
75 hex	Short circuit to ground at clutch K2	
76 hex	Open circuit at clutch K2	
77 hex	Short circuit to battery voltage at clutch K3	
78 hex	Short circuit to ground at clutch K3	
79 hex	Open circuit at clutch K3	
7A hex	Short circuit to battery voltage at converter clutch	not used
7B hex	Short circuit to ground at converter clutch	not used
7C hex	Open circuit at converter clutch	not used
81 hex	Short circuit to battery voltage at clutch K4	
82 hex	Short circuit to ground at clutch K4	
83 hex	Open circuit at clutch K4	
84 hex	Short circuit to battery voltage at clutch KV	
85 hex	Short circuit to ground at clutch KV	
86 hex	Open circuit at clutch KV	
87 hex	Short circuit to battery voltage at clutch KR	
88 hex	Short circuit to ground at clutch KR	
89 hex	Open circuit at clutch KR	
91 hex	Short circuit to ground at relay reverse warning alarm	
92 hex	Short circuit to battery voltage at relay reverse warning alarm	
93 hex	Open circuit at relay reverse warning alarm	
94 hex	Short circuit to ground at relay starter interlock	
95 hex	Short circuit to battery voltage at relay starter interlock	
96 hex	Open circuit at relay starter interlock	
97 hex	Short circuit to ground at park brake solenoid	
98 hex	Short circuit to battery voltage at park brake solenoid	
99 hex	Open circuit at park brake solenoid	

Number	Meaning of error code	
B1 hex	Slippage at clutch K1	
B2 hex	Slippage at clutch K2	
B3 hex	Slippage at clutch K3	
B4 hex	Slippage at clutch K4	
B5 hex	Slippage at clutch KV	
B6 hex	Slippage at clutch KR	
D1 hex	Short circuit to battery voltage at power supply for sensors	
D2 hex	Short circuit to ground at power supply for sensors	
D3 hex	Low voltage at battery	
D4 hex	High voltage at battery	
D5 hex	Error at valve power supply 1	
D6 hex	Error at valve power supply 2	
E1 hex	Short circuit to battery voltage at speedometer output	not used
E2 hex	Short circuit to ground or open circuit at speedometer output	not used
E3 hex	Short circuit to battery voltage at display output	not used
E4 hex	Short circuit to ground at display output	not used
E5 hex	Communication failure on devicenet	
F1 hex	General EEPROM fault	
F2 hex	Configuration lost	
F3 hex	Application error	

7) ELECTRONIC CONTROL FOR POWER TRANSMISSION

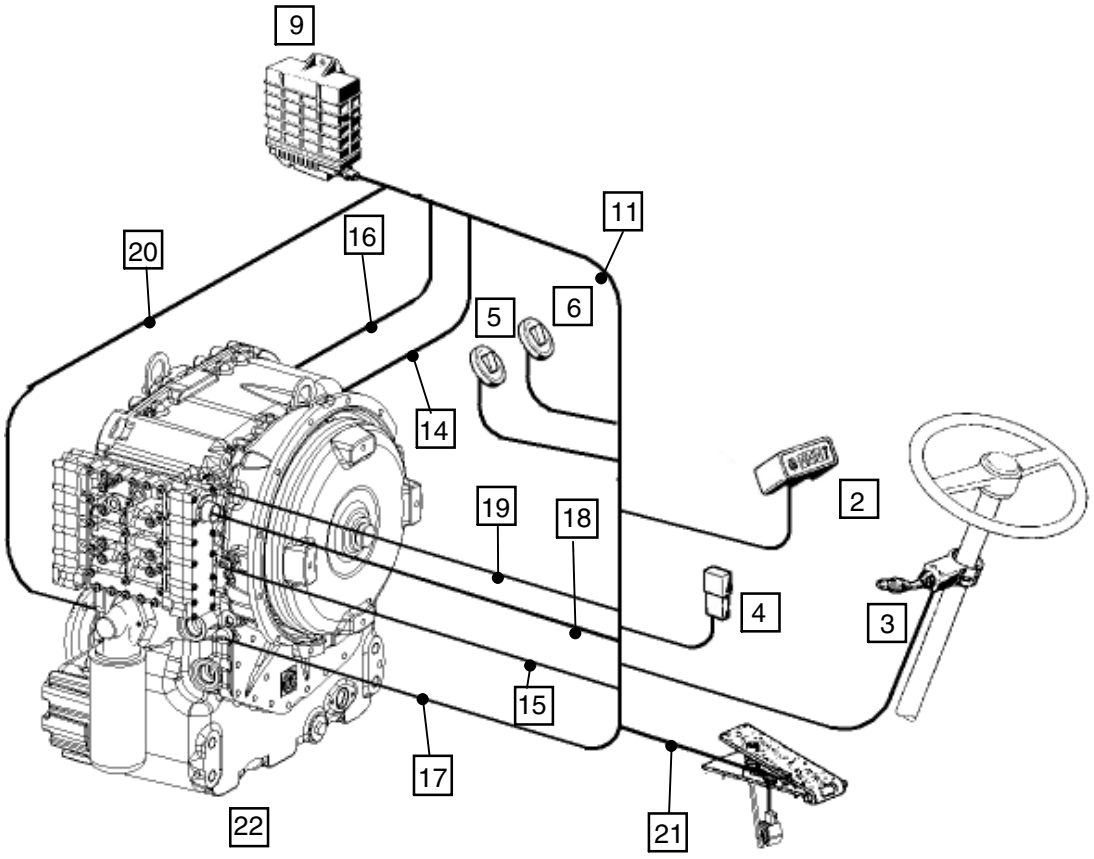
(1) Description of the basic functions

The powershift transmission is equipped with TCU.

- The system is processing the desire of the driver according to the following criteria :
- Gear determination depending on gear selector position, driving speed and load condition.
- Protection from operating error as far as necessary, is possible via electronic protection(programming).
- Protection from over-speeds(on the base of engine and turbine speed).
- Electronic inching.

Legend

2 = Display
3 = Gear selector DW - 3
4 = Power supply connection
5 = Switch for enable inched(Option)
6 = Switch for driving program manual/Auto 1/Auto 2
9 = TCU(EST-37A)
11 = Wiring
14 = Cable to inductive transmitter speed central gear train
15 = Cable to inductive speed engine
16 = Cable to inductive transmitter speed turbine
17 = Cable to temperature measuring point behind the converter
18 = Cable to plug connection on the electrohydraulic control unit
19 = Cable to filter contamination switch
20 = Cable to speed sensor output
21 = Cable from angle sensor/inch-sensor
22 = Transmission



D507PT17

(2) Inching device

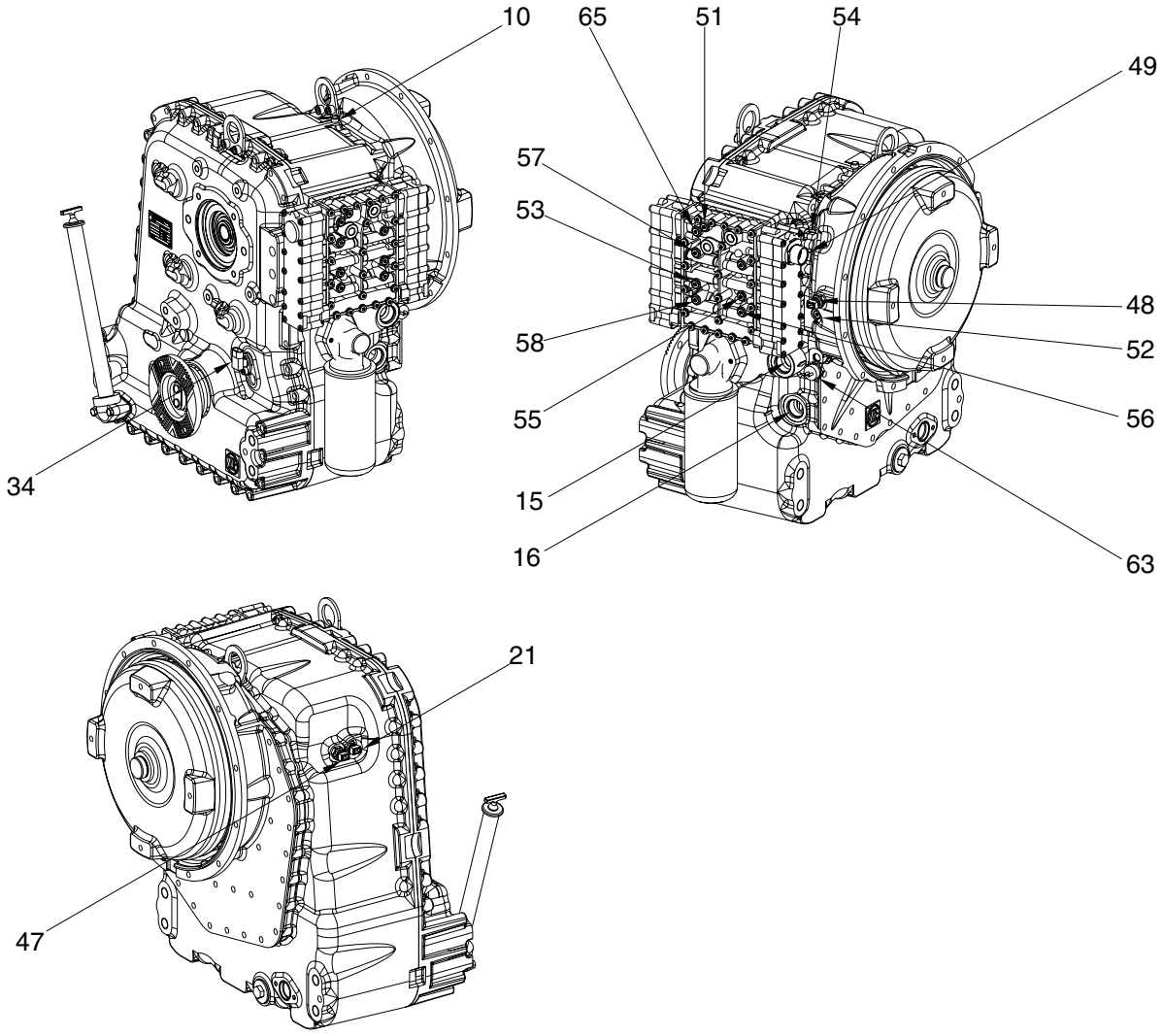
This function is especially suitable for lift trucks. It allows to reduce the driving speed infinitely variable without modification of the engine speed in such a way that driving with a very low speed will be possible. In his way, the driver can move the vehicle very exactly to a determined position. At the same time and important part of the engine power for the output of the hydraulic system is at disposal by the high engine speed.

Operation is carried out by a separate inching pedal, where an angle of rotation sensor is mounted.

By means of the proportional valve technology the TCU regulates the pressure in the driving direction clutch in such a way that the driving speed is adjusted in accordance with the inch rotating angle sensor position. Clutch overloading is avoided thanks to the electronic protection.

4. TRANSMISSION MEASURING POINTS AND CONNECTIONS

The measurement have to be carried out with hot transmission(about 80~95° C)



D50TM04

1) OIL PRESSURE AND TEMPERATURE

Port	Description			Size
51	In front of converter - Opening pressure 11+2 bar			M10x1
52	Behind converter - Opening pressure 4.3 + 3 bar			M14x1.5
53	Clutch Forward	16 + 2 bar	KV	M10x1
55	Clutch reverse	16 + 2 bar	KR	M10x1
56	Clutch	16 + 2 bar	K1	M10x1
57	Clutch	16 + 2 bar	K2	M10x1
58	Clutch	16 + 2 bar	K3	M10x1
63	Temperature sensor behind the converter			M14x1.5
65	System pressure	16 + 2.5 bar		M10x1

2) FLOW RATES

Port	Description	Size
15	Connection from oil cooler	$1\ ^{5}/_{16}$" - 12UN-2B
16	Connection to oil cooler	$1\ ^{5}/_{16}$" - 12UN-2B

3) TRANSMITTERS AND SWITCHES

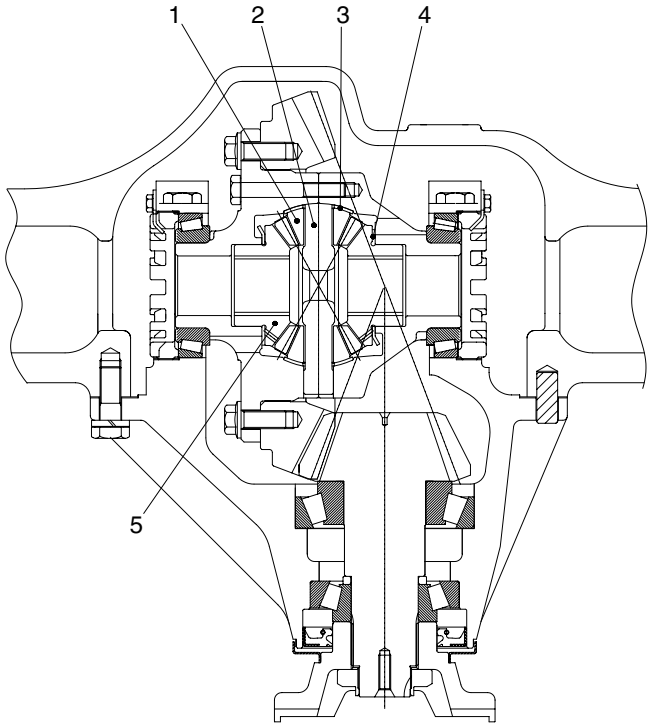
Port	Description		Size
21	Inductive transmitter	n Turbine	M18x1.5
34	Speed transmitter	n Output	-
47	Inductive transmitter	n Internal speed input	M18x1.5
48	Inductive transmitter	n Engine	M18x1.5
54	Differential pressure switch for pressure filter		M14x1.5

4) CONNECTIONS

Port	Description	Size
10	Breather	M10x1
49	Plug connection on electro-hydraulic control unit	

5. DIFFERENTIAL CARRIER ASSEMBLY

1) STRUCTURE



80D7AX02

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

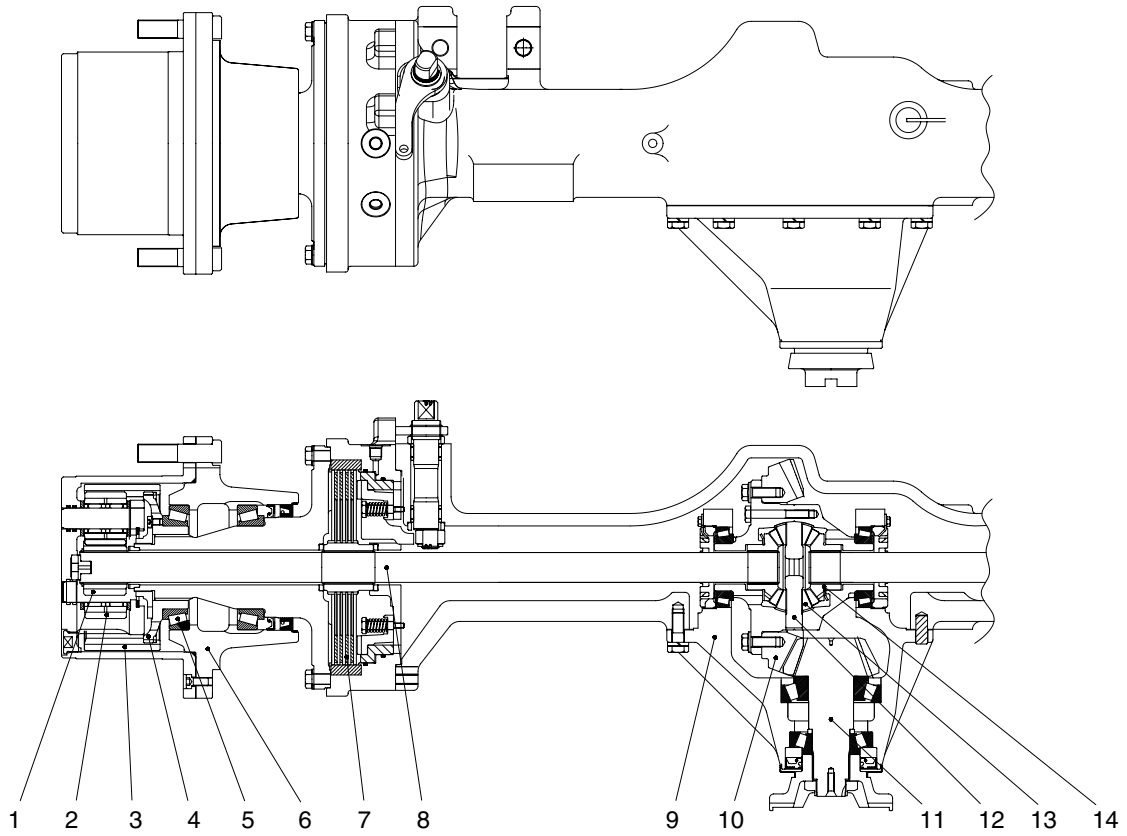
Differential transmits the power from the transmission to drive wheel.

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.

6. DRIVE AXLE

1) STRUCTURE



80D7AX03

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 with spline.

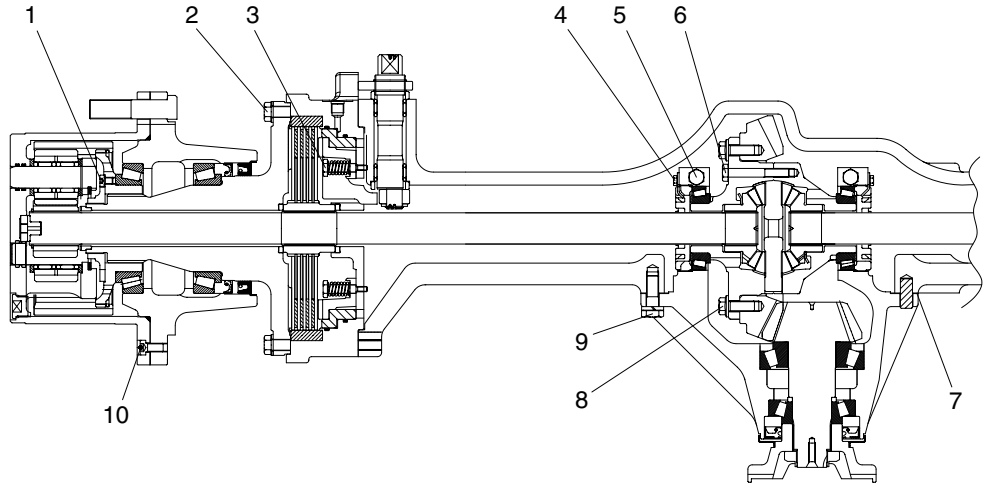
The power of transmission is transmitted to differential which consists of pinion shaft(11) and ring gear(10) and the differential rotates the drive shaft(8).

The differential transmits the drive force from transmission to wheels.

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

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

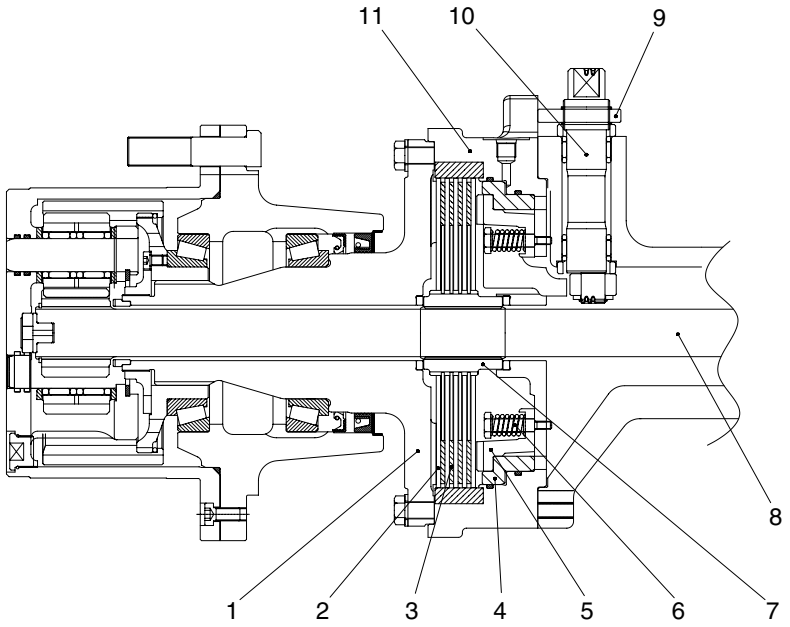
3) DRIVE AXLE TIGHTENING TORQUE



80D7AX04

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 (116±3.6lbf · ft)
6	Differential case	6±0.5kgf · m (43.4±3.6lbf · ft)
7	Connection between differential carrier and drive axle	Gasket
8	Ring gear	13.5±0.5kgf · m (97.6±3.6lbf · ft)
9	Differential carrier assembly	18.0±0.5kgf · m (130±3.6lbf · ft)
10	Wheel hub	3.0±0.3kgf · m (21.7±2.2lbf · ft)

4) DISK BRAKE

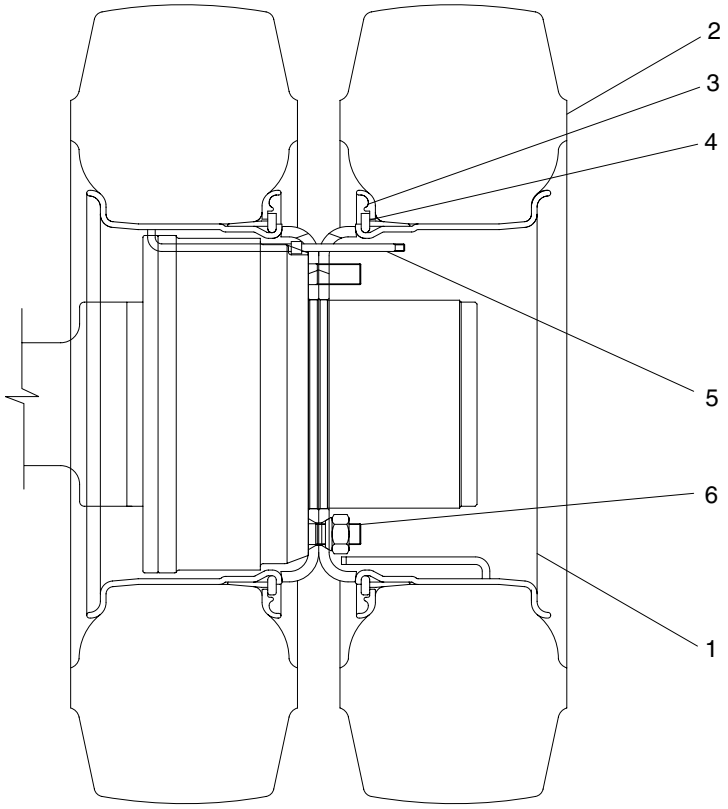


80D7AX05

1	Spindle	5	Parking 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	Service 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 4 disk plates(3), 5 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).

7. TIRE AND WHEEL



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

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

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

GROUP 2 OPERATION AND MAINTENANCE

1. OPERATION

1) DRIVING PREPARATION AND MAINTENANCE

Prior to the commissioning of the transmission, take care that the prescribed oil grade will be filled in with the correct quantity. At the initial filling of the transmission has to be considered that the oil cooler, the pressure filters as well as the pipes must get filled with oil.

According to these cavities, the quantity of oil to be filled in, is greater than at the later oil fillings in the course of the usual maintenance service.

※ Because the converter and the oil cooler, installed in the vehicle, as well as the pipes can empty at standstill into the transmission, the **oil level check must be carried out at engine idling speed and operation temperature of the transmission.**

⚠ **At the oil level check, the vehicle has to be secured against rolling by blocks, articulated vehicles additionally against unintended turning-in.**

2) DRIVING AND SHIFTING

(1) Neutral position

Neutral position will be selected via the gear selector.

After the ignition is switched on, the electronics remains in the waiting state. By the position NEUTRAL of the gear selector, the TCU becomes ready for operation.

A gear can be engaged.

(2) Starting

The starting of the engine has always to be carried out in the NEUTRAL POSITION of the gear selector.

For safety reasons it is to recommend to brake the vehicle securely in position with the parking brake prior to start the engine.

After the starting of the engine and the preselection of the driving direction and the gear, the vehicle can be set in motion by acceleration.

At the start off, the converter takes over the function of a master clutch.

On a level road it is possible to start off also in higher gears.

- **Upshifting under load.**
  Upshifting under load will be then realized if the vehicle can continue to accelerate by it.
- **Downshifting under load.**
  Downshifting under load will be then realized if more traction force is needed.

- Upshifting in overrunning condition.
  In the overrunning mode, the upshifting will be suppressed by accelerator pedal idling position, if the speed of the vehicle on a downgrade should not be further increased.
- Downshifting in overrunning condition.
  Downshifting in overrunning mode will be then carried out if the vehicle should be related.

If the vehicle will be stopped and is standing with running engine and engaged transmission, the engine cannot be stalled. On a level and horizontal roadway it is possible that the vehicle begins to crawl, because the engine is creating at idling speed a slight drag torque via the converter.
It is convenient to brake the vehicle at very stop securely in position with the parking brake. At longer stops, the controller has to be shifted to the NEUTRAL POSITION.

At the start off, the parking brake has to be released. We know from experience that at a converter transmission it might not immediately be noted to have forgotten this quite normal operating step because a converter, due to its high ratio, can easily overcome the braking torque of the parking brake.
Temperature increases in the converter oil as well as overheated brakes will be the consequences to be find out later.
Neutral position of the selector switch at higher vehicle speed(above stepping speed) is not admissible.
Either a suitable gear is to be shifted immediately, or vehicle must be stopped at once.

3) COLD START

At an oil temperature in the shifting circuit < -12° C, the transmission must be warmed-up for some minutes.
This must be carried out in neutral with an increased engine speed(about 1500min^{-1}).
Until this oil temperature is reached, the electronics remains in neutral, and the symbol of the cold start phase will be indicated on the display.

Indication on the display:

After the indication on the display is extinguished, the full driving program can be utilized out of "NEUTRAL".

4) OIL TEMPERATURE

The oil temperature in the transmission sump is in the electrohydraulic control unit.

The service temperature in the sump of 60-90° C must not be exceeded.
By overstepping results by 105° C notice "WS" on the display.

At a trouble-free unit and an adequate driving mode, a higher temperature will not occur.
The notice "WS" results at the display, the vehicle has to be stopped and controlled for external oil loss and the engine must run with a speed of 1200-1500min^{-1} at NEUTRAL POSITION of the transmission.

Now, the temperature must drop quickly(in about 2-3minutes) to normal values. If this is not the case, there is a trouble pending, which must be eliminated prior to continue working.

The monitoring of the oil temperature(behind the converter) is additionally on the temperature gauge which is located on the dashboard.

Operating temperature behind the converter at least 65°C and 100°C in continuous operation, a short-time increase up to max. 120°C is permitted.

The temperature is measured on the measuring point "63" (see schedule of measuring points-3-25)

2. MAINTENANCE

1) TRANSMISSION

(1) Oil level check

⚠ At the oil level check, the vehicle has to be secured against rolling with blocks.

The oil level check must be carried out as follows :

- Oil level check(weekly)
- At horizontally standing vehicle
- Transmission in neutral position "N"
- In the cold start phase, the engine must be running about 2-3minutes at idling speed, and the marking on the oil dipstick must then be lying above the cold start mark "COLD"
- At operating temperature of the transmission(about 80°-90°C)
- At engine idling speed
- Loosen oil dipstick by counterclock rotation, remove and clean it
- Insert oil dipstick slowly into the oil level tube until contact is obtained, and pull it out again.
- On the oil dipstick, the oil level must be lying in the zone "HOT"
- Insert the oil dipstick again, and tighten it by clockwise rotation

If the oil level has dropped in operating temperature condition below the "HOT" zone, it is absolutely necessary to replenish oil.
An oil level above the "HOT" marking, is leading to a too high oil temperature.

(2) Oil change and filter replacement intervals

※ **First oil change after 100operating hours in service.**
Every further oil change after 1000operating hours in service, however at least once a year.
At every oil change, the fine filter has to be replaced.

① Oil change and oil filling capacity

The oil change has to be carried out as follows. At operating temperature of the transmission, horizontally standing vehicle open the oil drain plug and drain the used oil.

- Clean oil drain plug with magnetic insert and surface on the housing and install again along with O-ring.
- Fill in oil(about 20 liters).
  (Sump capacity, external oil capacities e. g. in the heat exchanger, in the lines etc. are depended on the vehicle).
  The indicated value is a guide value.

※ **It is imperative to pay attention to absolute cleanliness of oil and filter.**
Binding is in any case the making on the oil dipstick.

- Start the engine-idling speed
- Transmission in neutral position "N"
- Top up oil up to the marking "COLD"
- Brake the vehicle securely in position and warm up the transmission
- Shift all controller positions through
- Check the oil level once more and top up oil once more if necessary
- On the oil dipstick, the oil level must be lying in the zone "HOT"
- Insert the oil dipstick again and tighten it by clockwise rotation

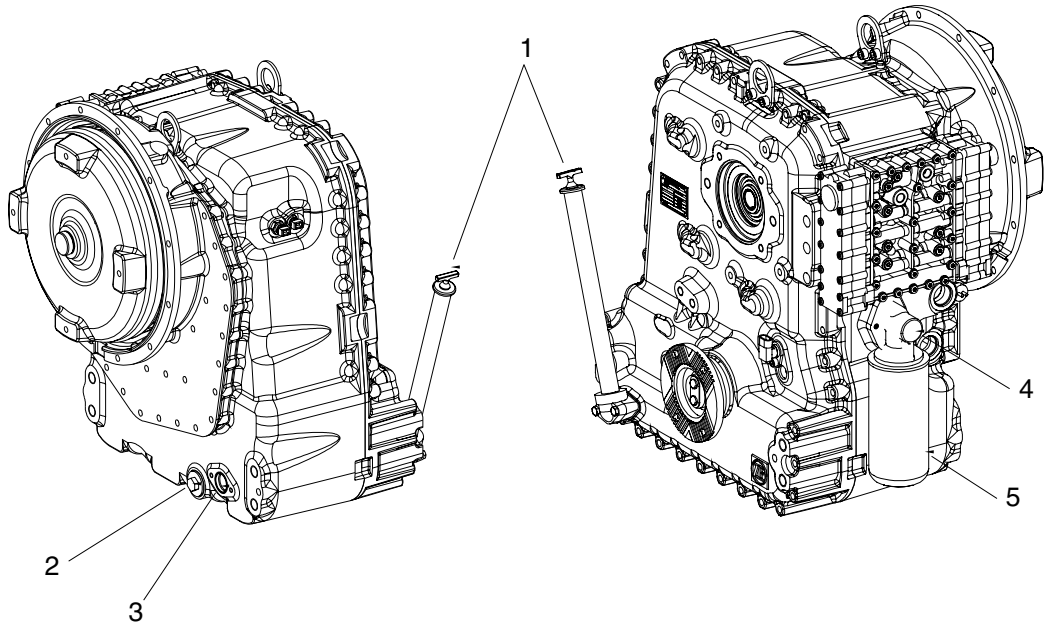
※ At the initial filling of the transmission has to be considered that the heat exchanger, the pressure filter as well as the pipes must get filled with oil.
According to these cavities, the oil capacity to be filled in is greater than at the later oil fillings in the course of the usual maintenance service.

② Filter replacement

At the replacement of the filter in the main oil steam, pay attention that no dirt or oil sludge can penetrate into the circuit.
At the mounting of the filter, any exertion of force has to be avoided.

※ Treat the filter carefully at the installation, the transport and the storage.
Damaged filters must no more be installed.
The mounting of the filter must be carried out as follows:

- Cover the gasket with a small amount of oil.
- Screw the filter in until contact with the sealing surface is obtained and tighten it now by hand about 1/3 to 1/2 turn.



D507PT19

Legend:

1 = Oil filter tube with oil dipstick

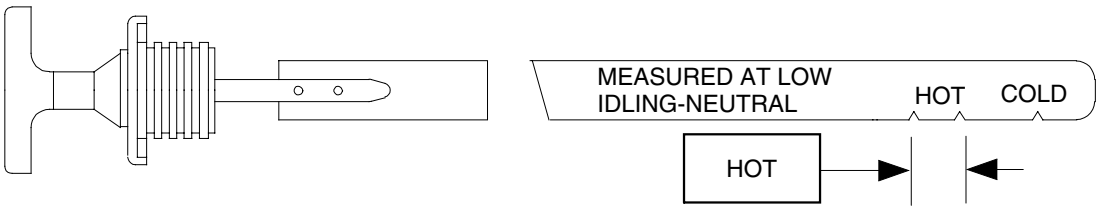
2 = Oil drain plug M38 × 1.5

3 = Attachment possibility oil level tube with oil dipstick(converter side)

4 = Filter head

5 = Fine filter

Oil dipstick



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2) DRIVE AXLE

(1) General information

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

(2) Magnets and magnetic drain plugs

Planetary axles are equipped with magnetic drain plus that have a minimum pick-up capacity of 0.57 kilograms(20 ounces) of low carbon steel. The drain plug must be checked for metal particles at every oil change interval.

※ Hyundai recommends replacing the magnetic drain plug each time the oil is changed.
Use the correct part. Pipe plugs will leak if used as a drain plug.
The magnetic drain plug can be reused if, after cleaning, the plug has a minimum pick-up capacity of 0.57kilograms(20 ounces) of low carbon steel.

(3) Breather

⚠ Cover the breather when steam cleaning the housing. If the breather is not covered, water can enter the housing and contaminate the oil.

Breathers release pressure and vacuum condensation to minimize premature oil and component failure.

(4) Oil level

⚠ Check and adjust oil

⚠ To prevent serious eye injury, always wear safe eye protection when you perform vehicle maintenance or service.

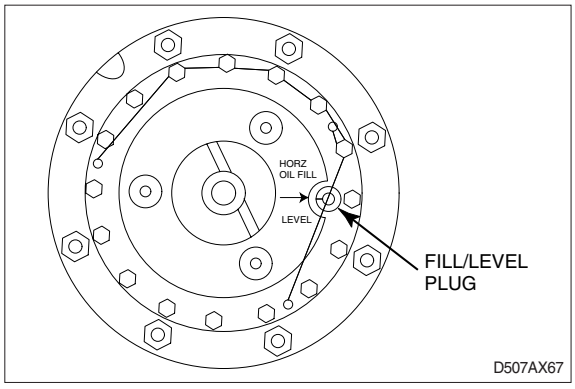
※ Fill and drain plugs are located in both brake housing and the main housing.

① Make sure the vehicle is on a level surface.

※ For axles with a common oil level that have drain and fill plugs only in the axle assembly, proceed to step ③.

② Rotate the wheels so that the "Oil level lines" on the wheel ends are parallel to the ground.

③ Clean the area around the fill/level plug.
Remove the fill/level plug from the wheel ends and the axle housing bowl. The oil level must be even with the bottom of the hole of the fill/level plug.



④ **If oil flows from the hole when you loosen the plug** : The oil level is high. Let the oil drain to the correct level.

※ Do not fill only through the axle housing bowl.

⑤ **If the oil level is below the bottom of the hole of the fill/level plug** : Fill the axle at each wheel end and the axle housing bowl to the bottom of the fill plug hole with the specified oil. Wait and allow the oil to flow through the axle.
Check the oil level again and fill to the specified level if necessary.

⑥ Install the fill/level plugs. Apply thread compound and tighten. Refer to the "Torque table".

(5) Oil change

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

① Make sure the vehicle is on a level surface.
Put large containers under the axle and wheel ends.

② Raise the vehicle so that the wheels are off the ground. Support the vehicle with safety stands.

③ Rotate the wheels so that the "fill/level" plugs in the wheel ends are toward the ground.

④ Remove the drain plugs from both brake housing and the main housing. Drain and discard the oil properly. Clean the plug.

⑤ Install the drain plugs in both brake housings and the main housing. Apply thread compound and tighten. Refer to the "torque table".

⑥ Rotate the wheels so that the " oil level lines" on the wheel ends are parallel to the ground.
Lower the vehicle.

⑦ Clean the area around the fill/level plug.
Remove the fill/level plug from the wheel ends and the axle housing bowl.

※ Do not fill only through the axle housing bowl.

⑧ Fill the axle at each each wheel end and the axle housing bowl to the bottom of the fill plugs hole with the specified oil. Wait and allow the oil to flow through the axle. Check the oil level again and fill to the specified level of necessary.

⑨ Install the fill/level plugs. Apply thread compound and tighten. Refer to the "torque table".

(6) Oil change intervals and specifications

Off-highway operation intervals*				Oil specification	Remarks
Recommended initial oil change	Check oil level	Petroleum oil change	Synthetic oil change	Mobile fluid424	Initial use or refill
100 operating hours	250 operating hours*	1,500 operating hours or twice a year(whichever comes first)	-	Transmission MP	OK to use only for refill

* The checking interval depends on individual operating conditions, speeds and loads, severe operating conditions may require more frequent checks.

3. TROUBLESHOOTING

1) DRIVE AXLE

(1) BRAKE LEAKS ACTUATION FLUID

Condition	Possible cause	Correction
Internal leak : Fluid bypasses seals into axle and fills axle with fluid and blows out breather or empties brake fluid reservoir.	1. Worn or damaged piston seal. 2. Melted or extruded piston seals. 3. Corrosion, pitting, wear or other damage, marks, scratches to piston and/or brake housing bore in area of seal/sealing lips.	1. Replace piston seals. 2. Correct cause of overheating and replace seals. 3. Clean, smooth, rework or replace affected parts.
External leak	1. Loose bleeder screw. 2. Loose inlet fitting or plugs. 3. Damaged inlet fitting or plugs or damaged seats.	1. Tighten bleeder screw to 2.0~2.7kgf·m(15-20lb-ft) 2. Tighten inlet fitting to 3.4~4.8kgf·m(25-35 lb-ft) 3. Replace inlet fitting or plug and O-ring if used.

(2) BRAKE NOISE AND VIBRATION

Condition	Possible cause	Correction
Brakes product noise, chatter, vibration.	Incorrect axle fluid and/or friction material used.	1. Use only meritor specified or approved materials. 2. Drain and flush fluid from axle. Replace with approved fluid. 3. Replace all friction discs. Thoroughly clean or replace stationary discs.

(3) BRAKE OVERHEATS

Condition	Possible cause	Correction
Overheating due to excessive duty cycle.	Inadequate coolant flow or heat exchange.	1. Install brake cooling system if not already installed on vehicle. 2. Re-analyze and re-size brake cooling system if necessary.
Inadequate coolant flow	Low pump output, blocked filter or coolant lines.	Check pump output at different operating modes. Replace filter and check lines.
Low or no coolant.	1. Improper fill or leaks. 2. Leaking face seal. 3. Loose or damaged plugs. 4. Deteriorated or inadequate sealant used at joint.	1. Check for proper fill level. 2. Replace or reinstall face seal assembly. 3. Tighten drain, fill or forced cooling plug. Replace if damaged. 4. Dissemble, clean, re-seal and re-assemble brake housing joint.
Brake drags.	1. More than 1.4bar(20psi) pressure applies when brakes released. 2. Damaged piston return spring assembly. 3. Piston not returning. 4. Wrong cooling and/or actuation fluid used. 5. Tight or damaged splines(eg. friction disc-to-hub driver).	1. Repair hydraulic system so pressure is less than 1.4bar(20psi) when brakes released and while machine is operating in any mode. 2. Repair or replace piston return spring assembly. 3. Check piston seals and seal separator. 4. Check piston seals and seal separator for swelling or damaged. Replace as necessary. Purge system and use correct fluid. 5. Repair or replace parts.

(4) BRAKE DOES NOT APPLY

Condition	Possible cause	Correction
Low or no pressure to brake	1. Empty fluid reservoir. 2. Damaged hydraulic system. 3. Leaked of brake actuation fluid. 4. Parking brake not adjusted properly.	1. Fill reservoir to correct level with specified fluid. 2. Repair hydraulic system. 3. Refer to "Brake leaks actuation fluid" in this section. 4. Adjust parking brake lever as described in assembly of this manual.

(5) BRAKE DOES NOT RELEASE

Condition	Possible cause	Correction
Vehicle does not move	Damaged hydraulic system.	Repair hydraulic system.
Brakes dragging	1. More than 1.4bar(20psi) pressure applied when brakes released.	1. Repair hydraulic system so pressure is less than 1.4bar(20psi) when brakes released and while machine is operating in any mode.
	2. Damaged piston return spring assembly.	2. Repair or replace piston return spring assembly.
	3. Piston not returning.	3. Check piston seals for swelling or damage. Replace as necessary.
	4. Wrong cooling and/or actuation fluid used.	4. Check piston seals for swelling or damage. Purge system and use specified fluid.
	5. Parking brake not adjusted properly.	5. Adjust parking brake lever as described in assembly of this manual.

(6) BRAKING PERFORMANCE

Condition	Possible cause	Correction
Noticeable change or decrease in stopping performance.	1. Inadequate actuation fluid supply to brakes.	1. Replenish fluid in brake system. Check for leakage and correct cause.
	2. Inadequate pressure to apply brakes.	2. Check brakes apply system. Check for leakage in brake system or brakes, and correct cause.
	3. Worn or damaged discs.	3. Inspect and replace discs if necessary. ※As disc wear occurs, make sure brake system can supply adequate fluid to fully apply brakes.
	4. Overheated seals and/or discs.	4. Inspect and replace discs and seals if necessary.
	5. Dirty or contaminated cooling fluid.	5. Drain and flush cooling fluid from brakes and entire brake system. Replace with approved fluid. In some cases, it may necessary to replace discs. Clean or replace filter.
Brake does not fully apply.	1. Empty fluid reservoir.	1. Fill reservoir to correct level with specified fluid.
	2. Damaged hydraulic system.	2. Repair hydraulic system.
	3. Leakage of brake actuation fluid.	3. Refer to "Brake leaks actuation fluid" in this section.
Brakes fell spongy/soft.	Brakes or brake system not properly bled.	Bleed brakes and brake system.

(7) 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.

2) TRANSMISSION

(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.

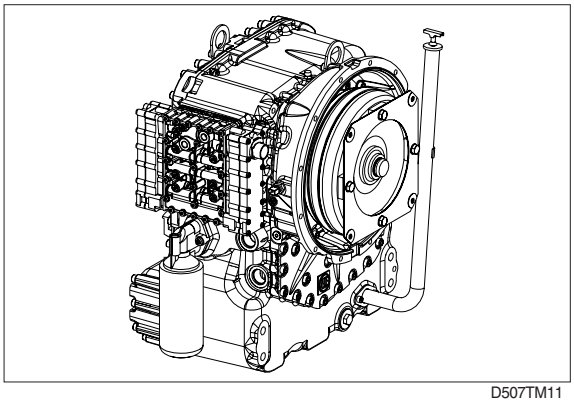
1. TRANSMISSION DISASSEMBLY

1) Electro-hydraulic control and filter (exchange filter)

① Mount the transmission to the assembly truck.

(S)Assembly truck 5870 350 000
(S)Holding fixture 5870 350 124

※ **Prior to start the disassembly, drain the oil**

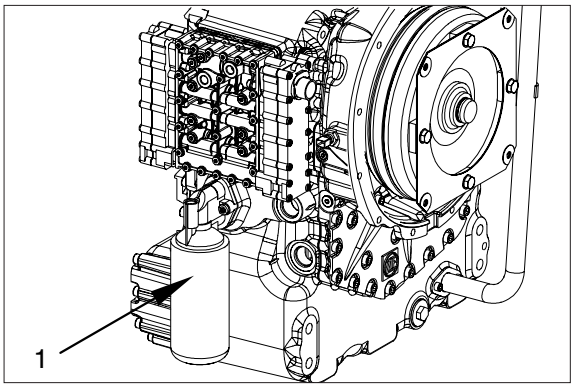


D507TM11

(1) Removal of the filter

① By means of the strap wrench separate the filter(1) from the filter head.

(S)Strap wrench 5870 105 005

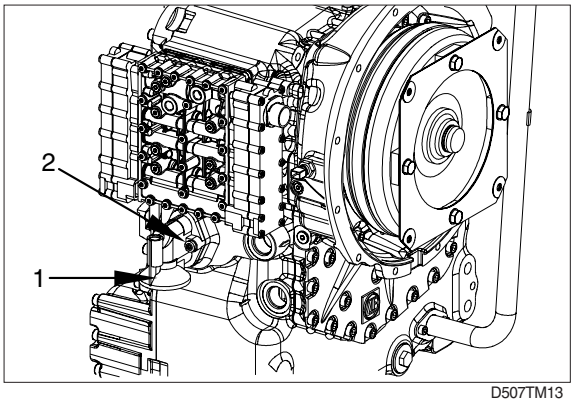


D507TM12

② Loosen the cap screws(2) and separate the filter head(1) from the transmission housing.

※ Remove the O-ring

(S) Socket spanner 5873 042 004

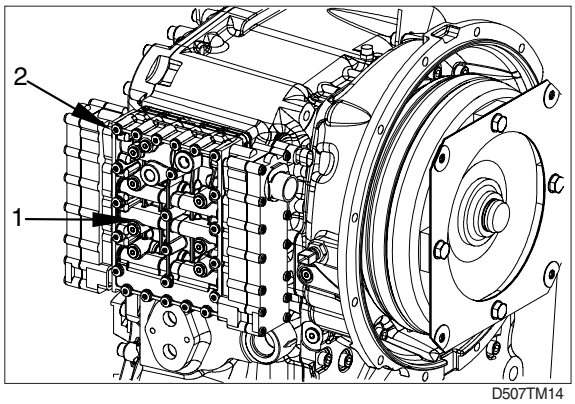


D507TM13

(2) Removal of the electric shift system

① Remove the shift system(1).
Loosen the Torx screws(2) and separate the gearshift housing from the intermediate sheet.

(S)Socket spanner TX-27 5873 042 002
(S)Adjusting screw M6 5870 204 063



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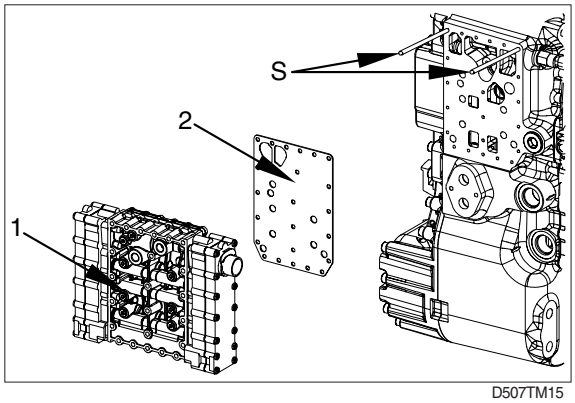
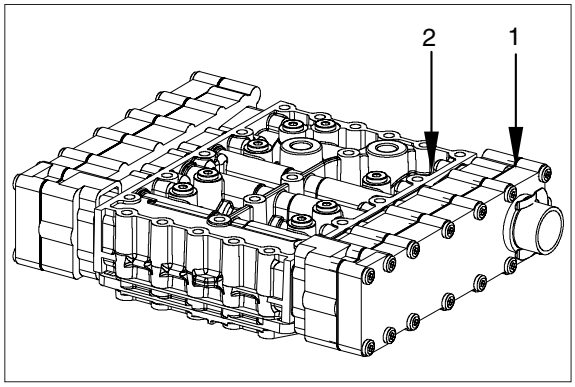
② Remove the complete shift system(1) and the intermediate shaft(2).

(S)Adjusting screw M6 5870 204 063



D507TM15

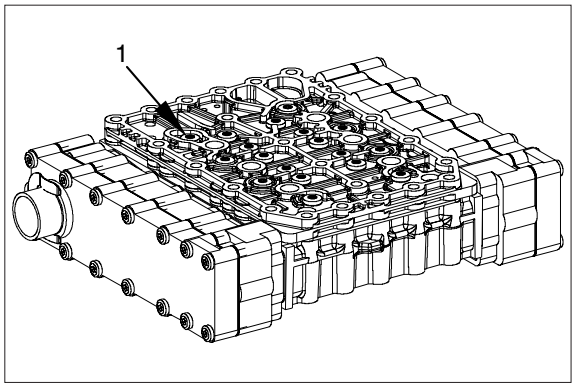
③ Mark the installation position of the cover(1) to the valve block(2).



D507TM16

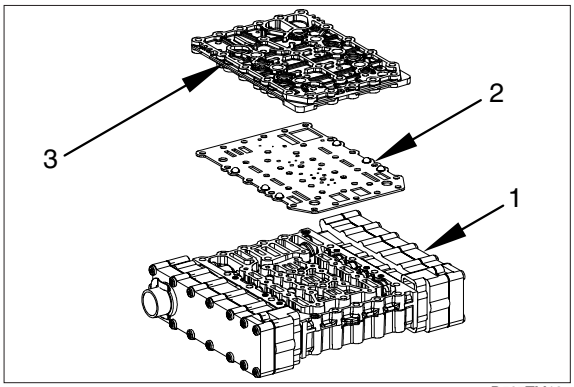
④ Loosen the Torx screws(1).

(S)Socket spanner TX-27 5873 042 002



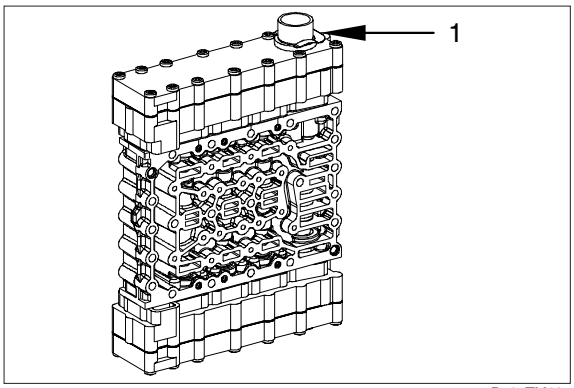
D507TM17

⑤ Separate the duct plate(3), and intermediate sheet(2) from the valve block(1).



D507TM18

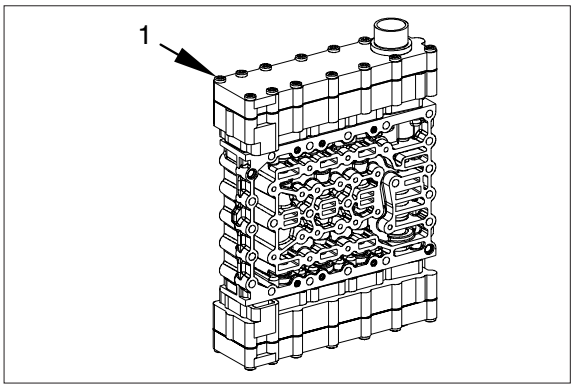
⑥ Remove the retaining clamp(1).



D507TM19

⑦ Loosen the cap screws(1) and remove the cover.
Remove the opposite cover.

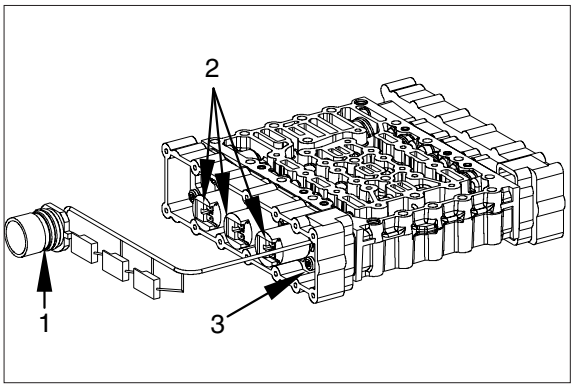
(S)Socket spanner TX-27 5873 042 002



D507TM20

⑧ Remove the wiring harness(1).
Loosen the cap screws(3), remove the fixing plates and the pressure regulators(2).

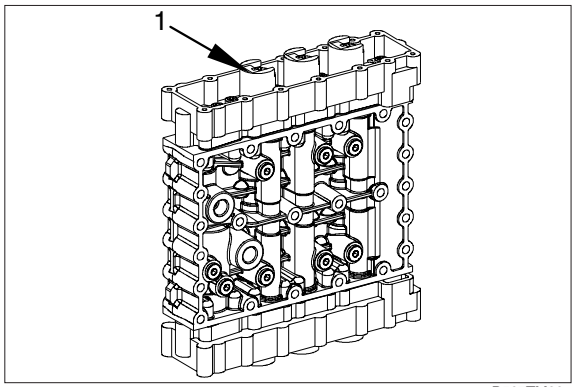
(S)Socket spanner TX-27 5873 042 002



D507TM21

⑨ Loosen the cap screws, remove the fixing plates and the pressure regulators(1).

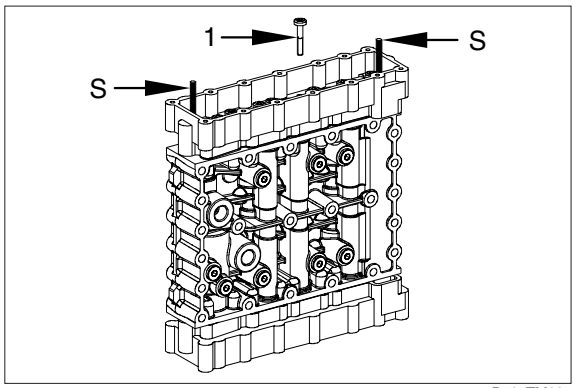
(S)Socket spanner TX-27 5873 042 002



D507TM22

⑩ Loosen two cap screws(1) and fasten the adjusting screws(S) preliminarily (housing is spring-loaded). Following to this loosen the remaining cap screws.

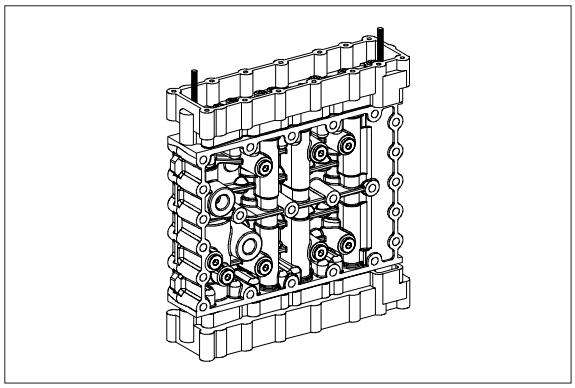
(S)Adjusting screws 5870 204 036
(S)Socket spanner 5873 042 002



D507TM23

⑪ Separate the housing from the valve housing by loosening the adjusting screws equally.

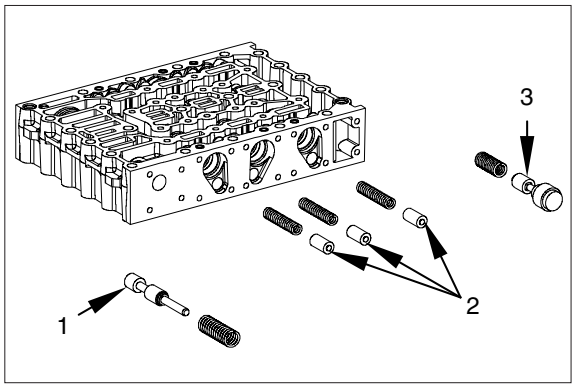
(S)Adjusting screws 5870 204 036



D507TM24

⑫ Remove the single parts:

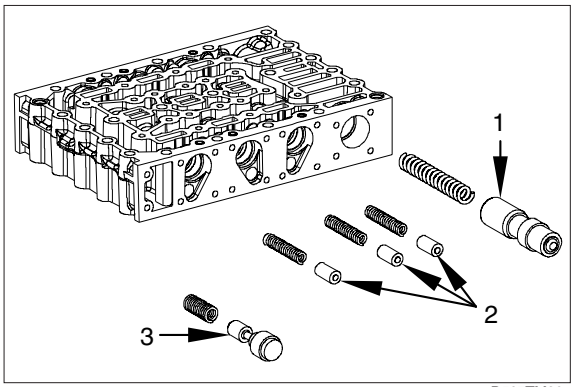
1 = Pressure reducing valve
2 = Vibration damper
3 = Follow-on slide



D507TM25

⑬ Remove the single parts on the opposite side analogously:

1 = Main pressure valve
2 = Vibration damper
3 = Follow-on slide

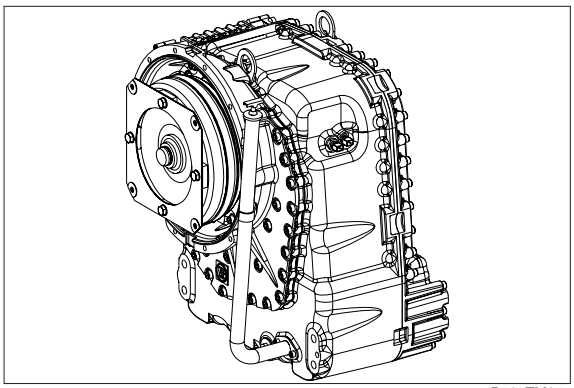


D507TM26

2) Inductive transmitters, valves, oil filter and oil drain plug, screw plugs

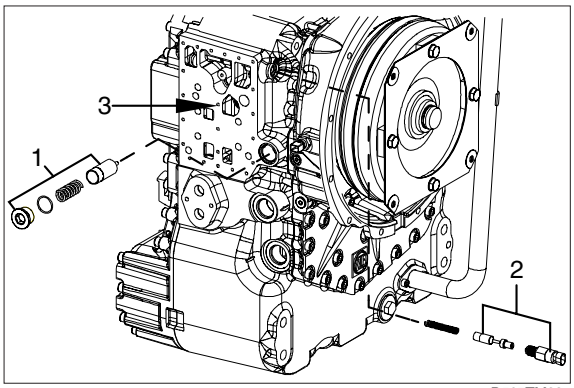
① Mount the transmission to the assembly truck.

(S)Assembly truck	5870 350 000
(S)Holding fixture	5870 350 124


D507TM27

② Remove the converter pressure back-up valve(1) and differential pressure switch(3) for the filter(2).

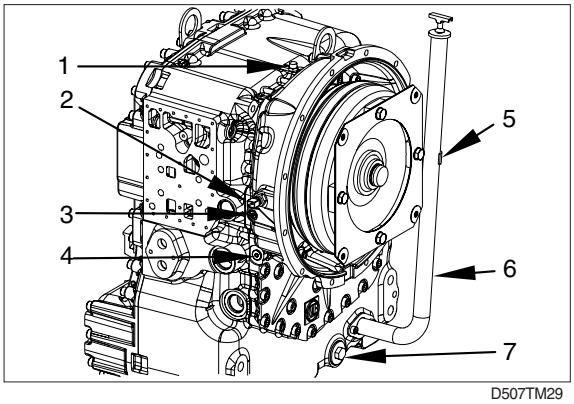
※ **Do not remove the pressure relief valve.**



D507TM28

③ Remove the positioned parts.

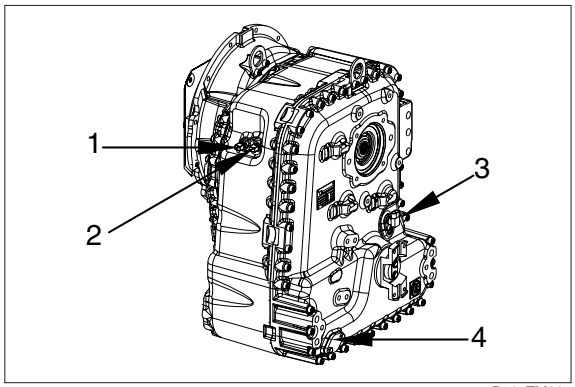
1 = Breather
2 = Inductive transmitter-n engine
3 =Screw plug(measuring point after converter)
4 =Screw plug(option for temperature sensor)
5 = Fixing strap oil filter tube
6 = Oil filter tube with oil dipstick
7 = Screw plug(Oil drain bore)



D507TM29

④ Remove the positioned parts.

1 = Inductive transmitter n - Internal speed input
2 = Inductive transmitter n - Turbine
3 = Speed transmitter n - Output
4 = Cover(mounting possibility for oil filler tube)



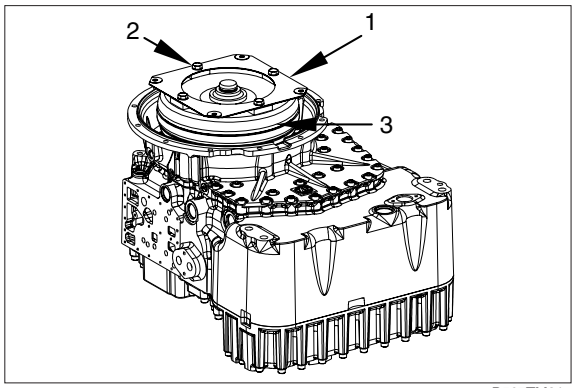
D507TM30

3) Engine connection, pressure oil pump and removal of the clutches

① Mount the transmission to the assembly truck.

(S)Assembly truck 5870 350 000
(S)Holding fixture 5870 350 124

Loosen the hexagon screw(2) and separate the flexplate(1) from the converter(3).

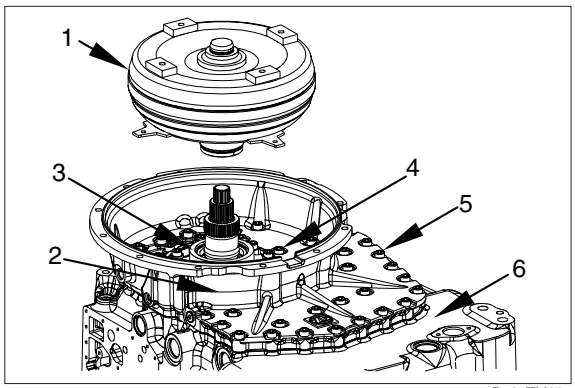


D507TM31

② By means of the lifting equipment separate the converter(1) from the transmission. Loosen the bolted connection(4) and (5).

1 = Converter
2 = Converter bell
3 = Pressure oil pump
4 = Bolted connection converter bell/transmission housing rear section
5 = Bolted connect. pressure oil pump/transmission housing rear section
6 = Transmission housing rear section

(S)Eyebolts assortment 5870 204 002
(S)Lifting chain 5870 281 047

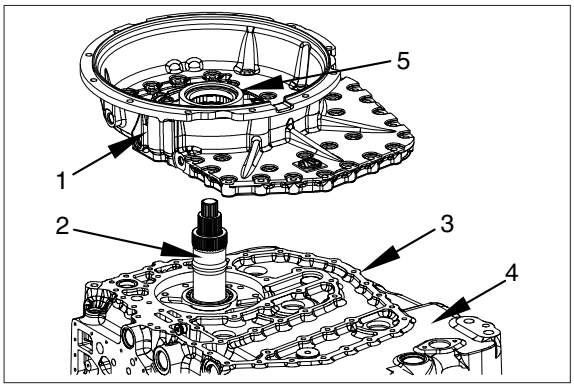


D507TM32

③ By means of the lifting equipment the converter bell(1) with pressure oil pump(5) are commonly to be separated from the transmission housing rear section(4).

Remove the intermediate sheet(3) and the stator hollow shaft(2).

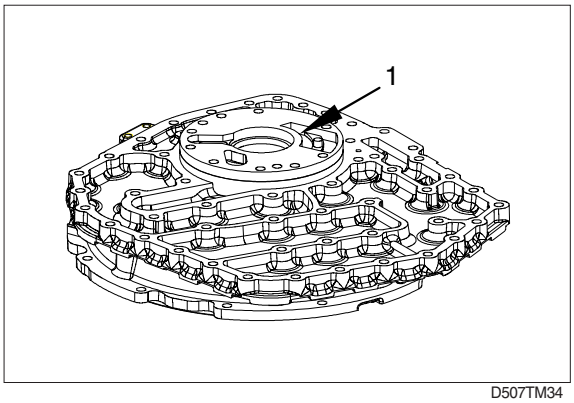
(S)Eyebolts assortment	5870 204 002
(S)Lifting chain	5870 281 047



D507TM33

④ Separate the pressure oil pump(1) from the converter bell.

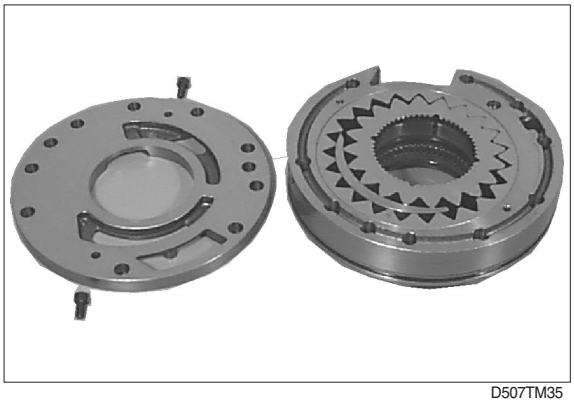
(S)Hammer	5870 280 004



D507TM34

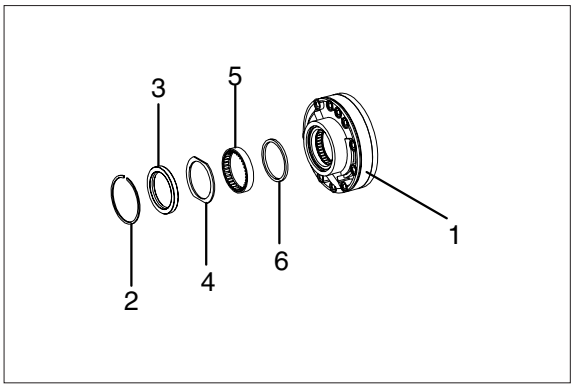
⑤ Loosen both cap screws and remove the cam disc.

※ **If running-in marks should be found in the pump housing or on the cam disc, the complete pump has to be replaced.**


D507TM35

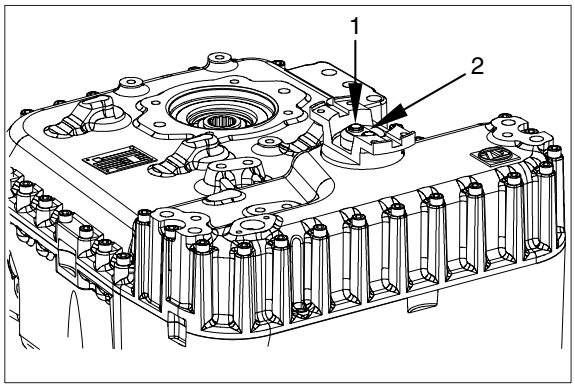
⑥ Squeeze out the snap ring(1) and remove the single parts.

1 = Pump housing with rotor
2 = Snap ring
3 = Shaft seal
4 = Support shim
5 = Needle bearing
6 = Ring



D507TM36

⑦ Remove the tab washer(2) and loosen the hexagon screws(1).

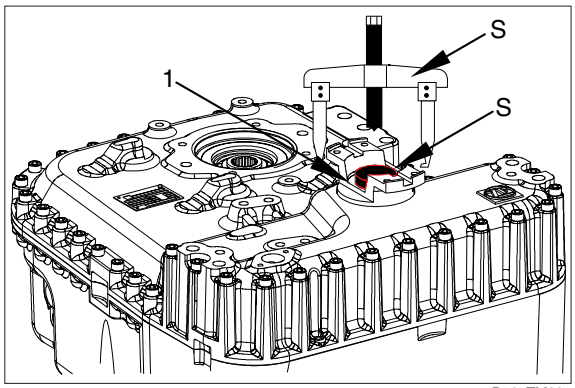


D507TM37

⑧ Pull off the input shaft(1).

Remove the shaft seal.

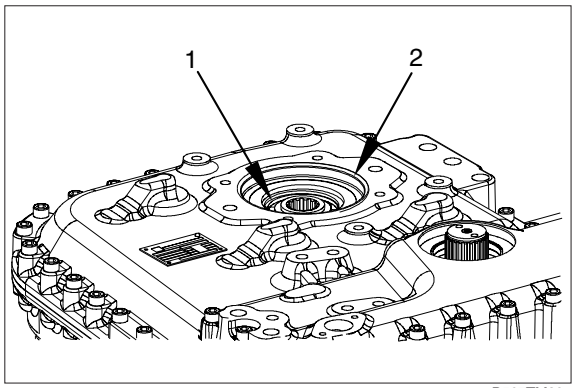
(S)Two-armed puller 5870 970 003



D507TM38

⑨ Unsnap the retaining ring(1) from the power take-off and remove the O-ring(2).

(S)Set of internal pliers 5870 900 013



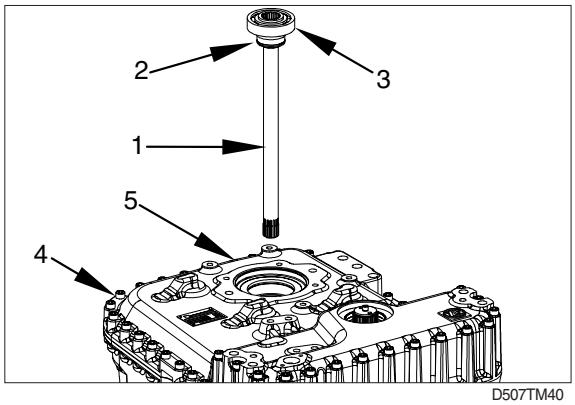
D507TM39

⑩ Pull the pump shaft (1) out of the housing bore.

Unsnap the rectangular ring(2).

Press off the ball bearing(3) from the shaft.

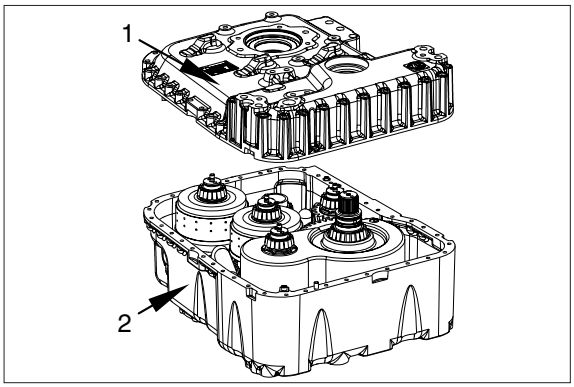
Loosen the bolted connection(4) transmission housing rear section/transmission housing front section.



D507TM40

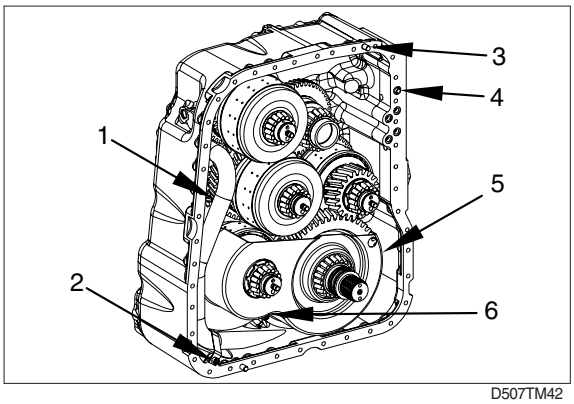
⑪ By means of the lifting equipment separate the transmission housing rear section(1) from the transmission housing front section(2).

(S)Eyebolts 2x(M20)	0636 804 003
(S)Ring nut(M12)	0664 462 774
(S)Lifting chain	5870 281 047



D507TM41

⑫ Loosen the cap screws(2) and remove the suction tube(1).
Remove the O-ring from the suction tube.
Loosen the cap screws(6) and remove the screen sheet(5).
Remove the pipes(4) with O-rings.

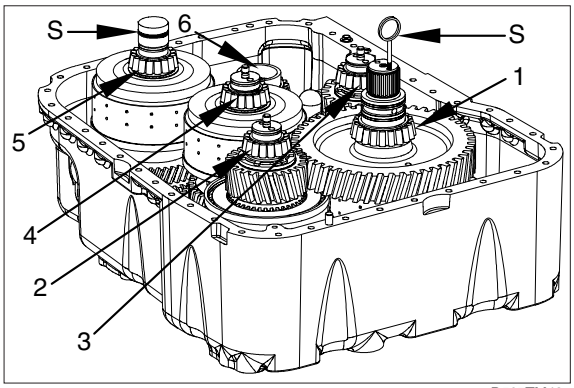


D507TM42

⑬ The clutch is to be removed from the transmission housing according to the sequence of numbers as described in the legend.

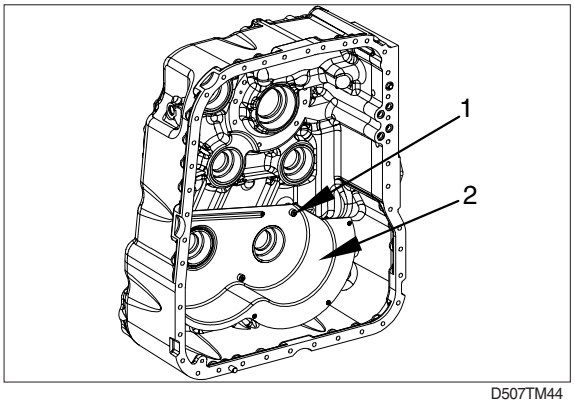
1 = Clutch K3
2 = Clutch K1
3 = Clutch K2
4 = Clutch KR
5 = Clutch KV
6 = Input shaft

(S)Handle 5870 260 014 (K1/K2/KV/KR)
(S)Eyebolt 5870 204 002 (K3)



D507TM43

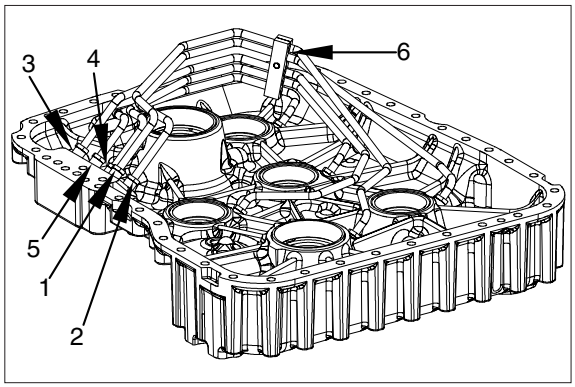
⑭ Loosen the cap screws(1) and remove the screen sheet(2).



D507TM44

⑮ Remove the pipes(system pressure from the electro-hydraulic control to the respective clutch).
Remove the holding segment(6).
The pipes are to disassembled in the following sequence:

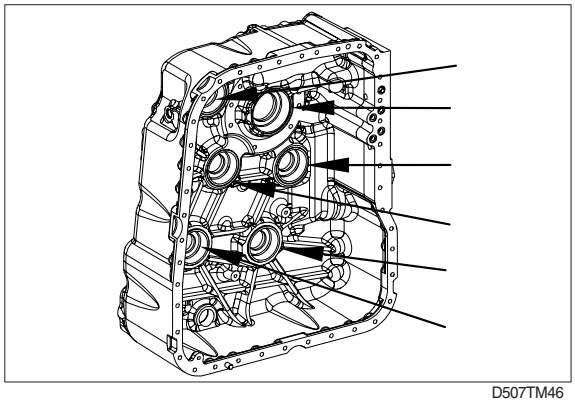
1 = Pipe	k3
2 = Pipe	k1
3 = Pipe	k2
4 = Pipe	kR
5= Pipe	kV



D507TM45

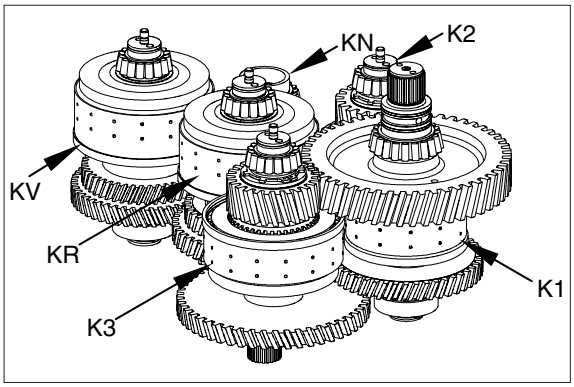
Remove all bearing outer rings(see arrows).

※ **Should contrary to the recommendations the taper roller bearings of the clutches as well as of the input not be replaced the assignment(bearing inner and outer ring) has to be kept at least. Mark the bearing inner and bearing outer rings to each other accordingly.**


D507TM46

4) Clutches KV/KR/K1/K2/K3 and Input

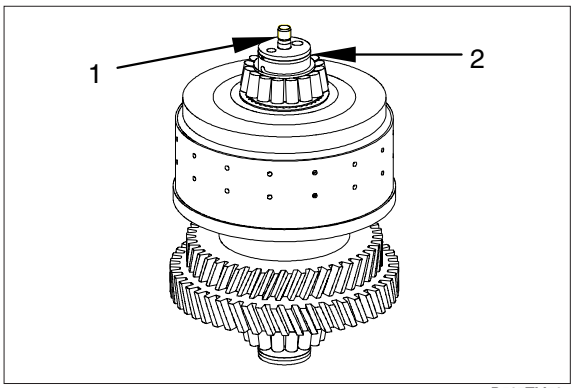
See figure on the right.



D507TM51

(1) Clutch KV

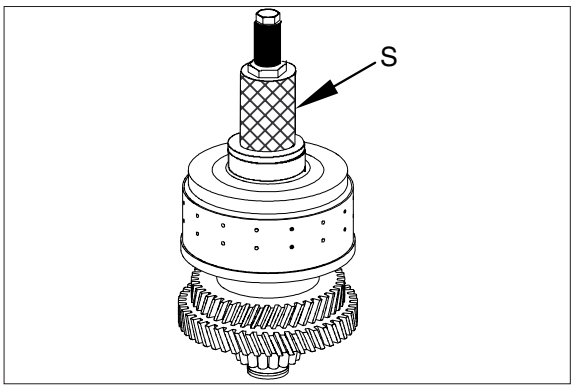
① Remove the stud(1) and unsnap the piston ring(2).



D507TM52

② Pull the taper roller bearing(inner ring) from the shaft.

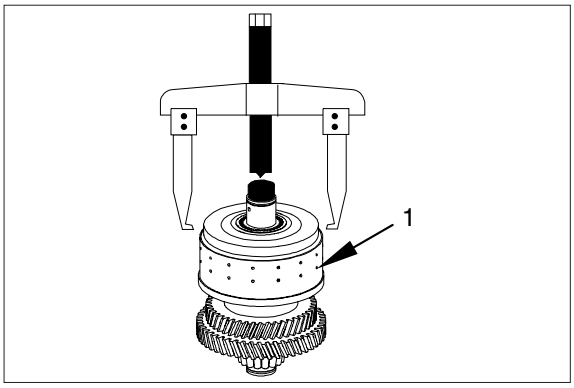
(S)Gripping insert	5873 001 057
(S)Back-off insert	5870 026 100
or	
(S)Rapid grip	5873 001 011



D507TM53

③ Pull the clutch(1) from the shaft.

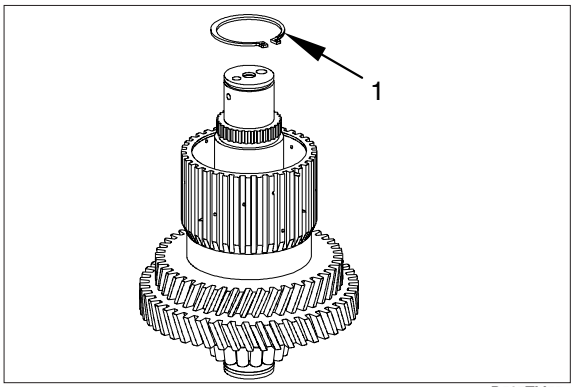
(S)Two-armed puller	5870 970 003



D507TM54

④ Unsnap the retaining ring(1).

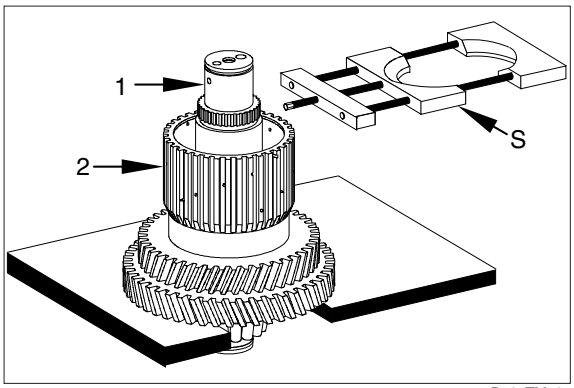
(S)Set of external pliers 5870 900 015



D507TM55

⑤ Press the clutch shaft(1) out of the idler(2).

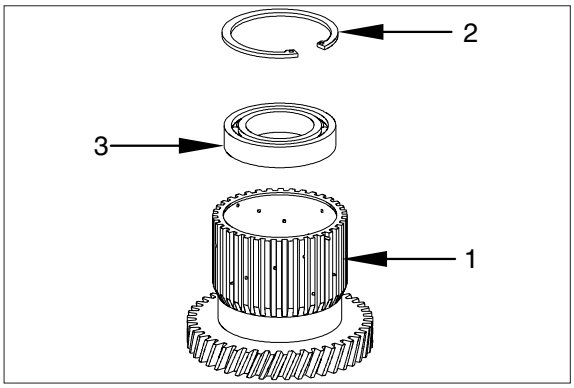
(S)Parting tool 5870 300 028



D507TM56

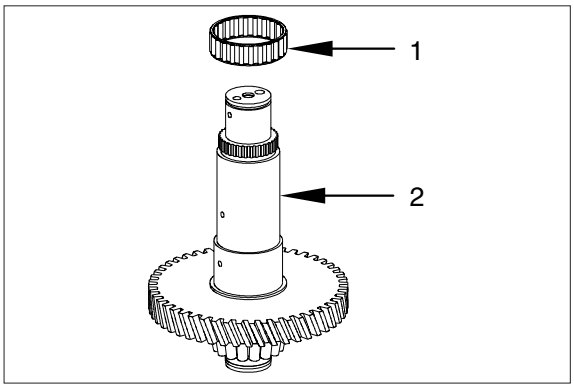
⑥ Unsnap the retaining ring(2) from the idler(1) and remove the ball bearing(3).

(S)Set of internal pliers 5870 900 013



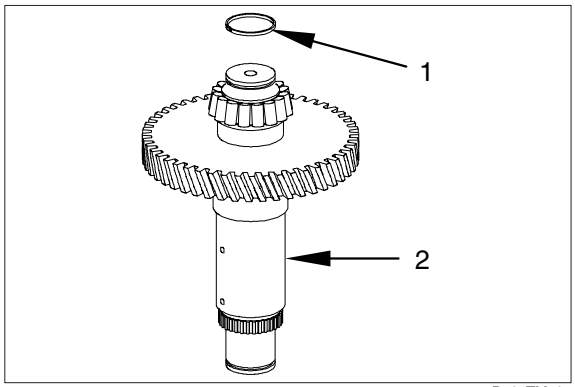
D507TM57

⑦ Remove the needle cage(1) from the shaft(2).



D507TM58

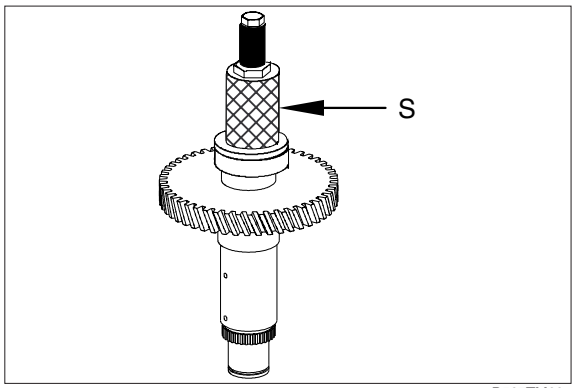
⑧ Rotate the shaft(2) by 180° and unsnap the piston ring(1).



D507TM59

⑨ Pull the taper roller bearing(inner ring) from the shaft.

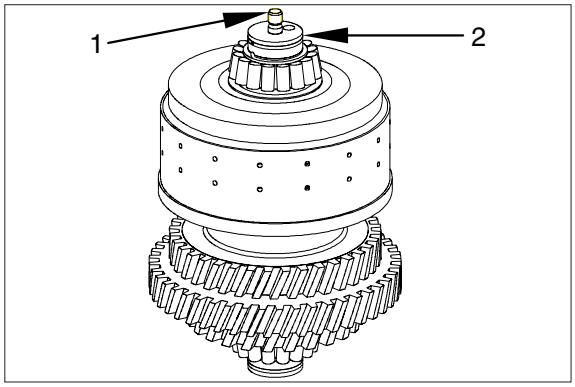
(S)Gripping insert	5873 001 057
(S)Back-off insert	5870 026 100
or	
(S)Rapid grip	5873 011 011



D507TM60

(2) Clutch KR

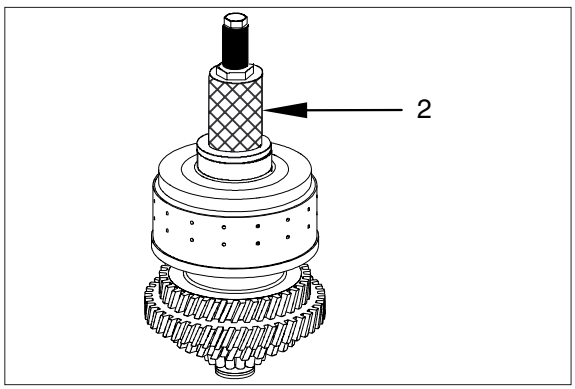
① Remove the stud(1) and unsnap the piston ring(2).



D507TM61

② Pull the taper roller bearing(inner ring)(2) from the shaft.

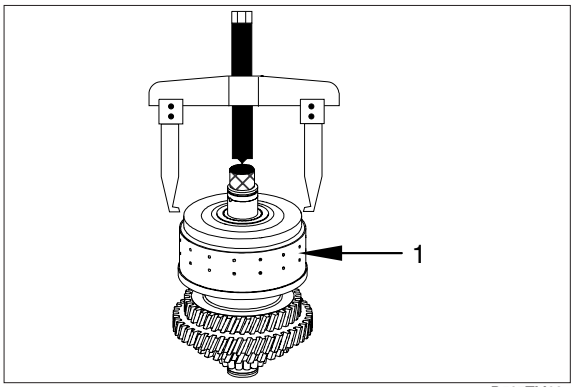
(S)Gripping insert	5873 001 057
(S)Bush	5870 026 016



D507TM62

③ Pull the clutch(1) from the shaft.

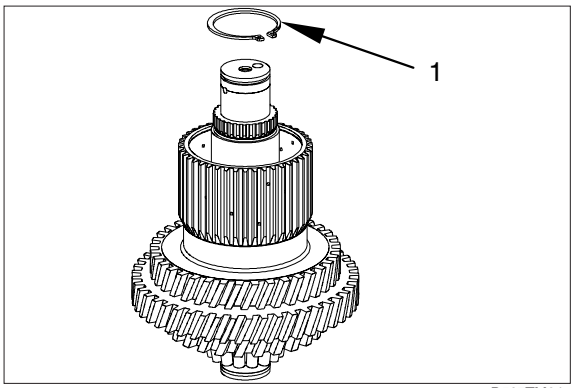
(S)Two-armed puller 5870 970 003



D507TM63

④ Unsnap the retaining ring(1).

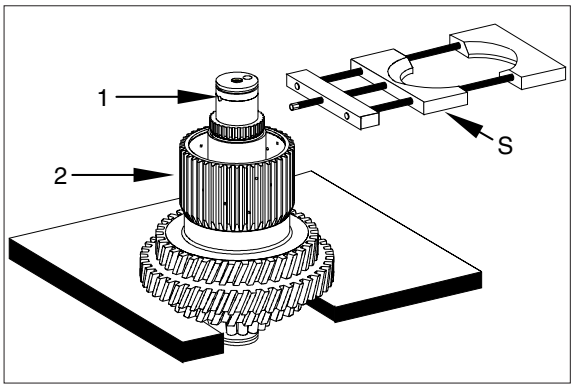
(S)Set of external pliers 5870 900 015



D507TM64

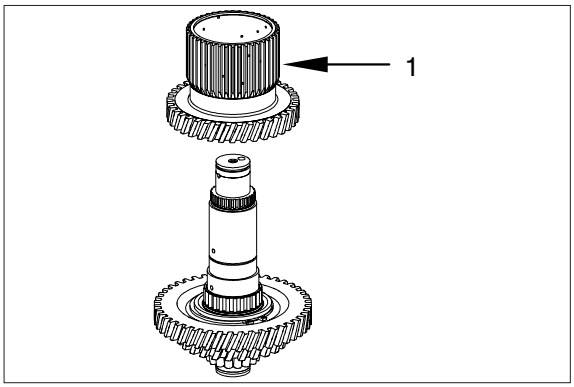
⑤ Press the clutch shaft(1) out of the idler(2).

(S)Parting tool 5870 300 028



D507TM65

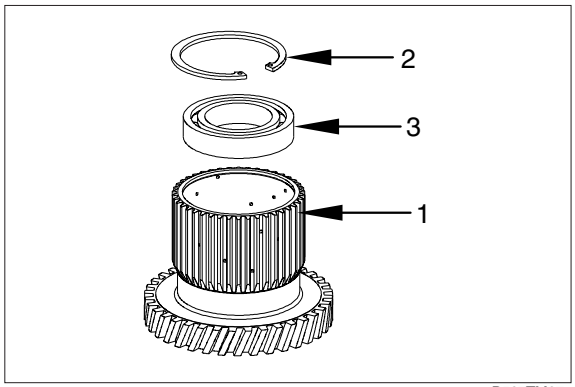
⑥ Disassemble the idler(1).



D507TM66

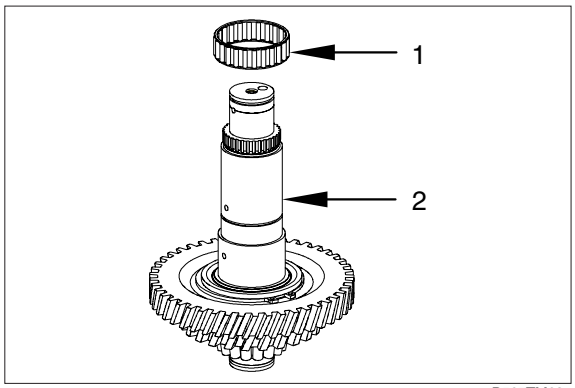
⑦ Unsnap the retaining ring(2) from the idler(1) and remove the ball bearing.

(S)Set of internal pliers 5870 900 013



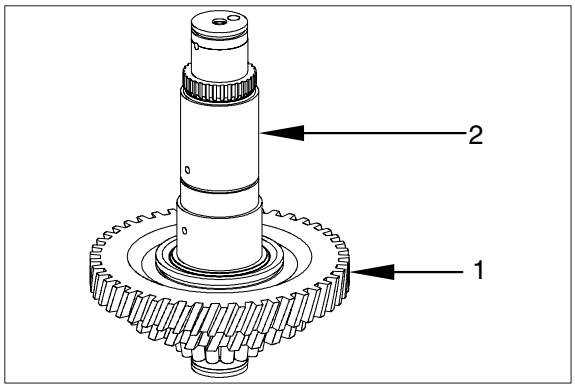
D507TM67

⑧ Remove the needle cage(1) from the shaft(2).



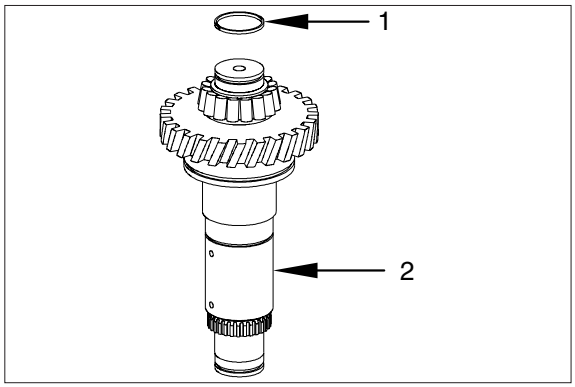
D507TM68

Shaft(2) and gear(1) cannot be separated(shrink fit).



D507TM69

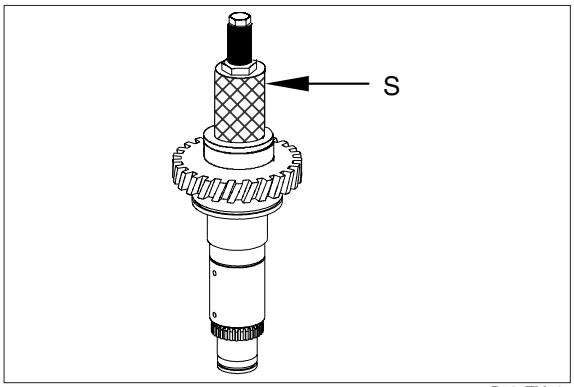
⑨ Rotated the shaft(2) by 180° and unsnap the piston ring(1).



D507TM70

⑩ Pull the taper roller bearing(inner ring) from the shaft.

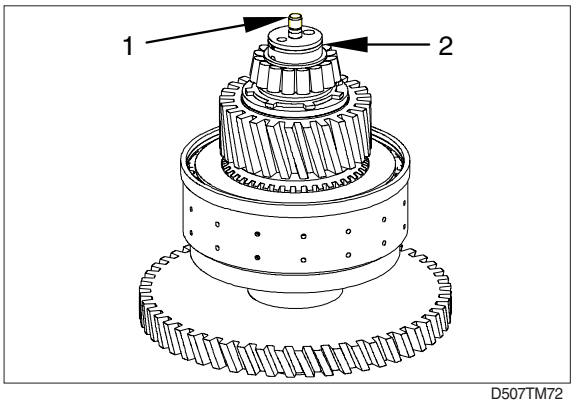
(S)Gripping insert 5873 001 057
(S)Back-off insert 5870 026 100
or
(S)Rapid grip 5873 011 011



D507TM71

(3) Clutch K1

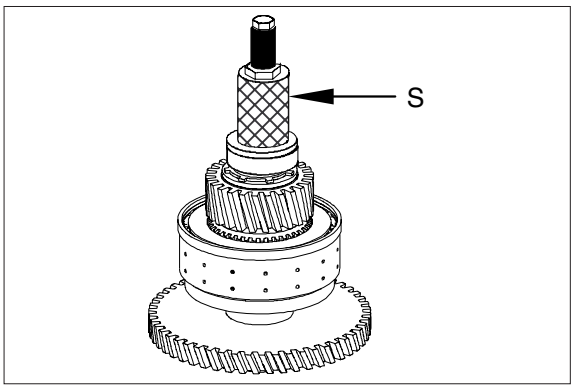
① Remove the stud(1) and unsnap the piston ring(2).



D507TM72

② Pull the taper roller bearing(inner ring) from the shaft.

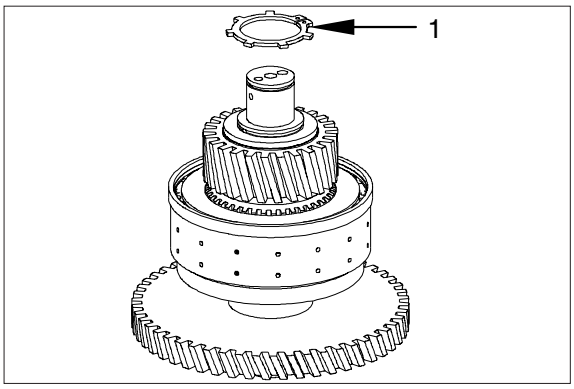
(S)Gripping insert 5873 001 057
(S)Back-off insert 5870 026 100
or
(S)Rapid grip 5873 011 011



D507TM73

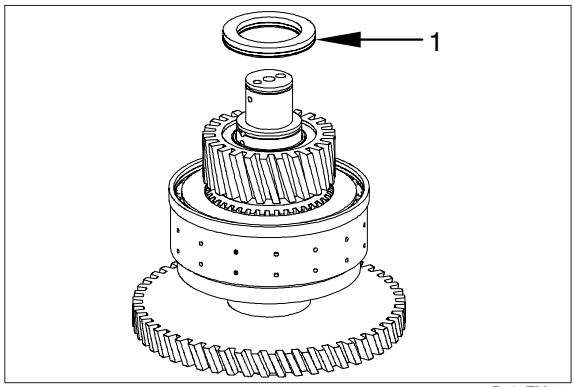
③ Unsnap the retaining ring(1).

(S)Set of internal pliers 5870 900 013



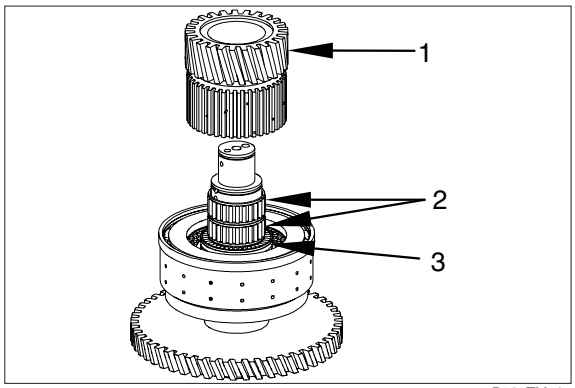
D507TM74

④ Remove the complete axial bearing(1).



D507TM75

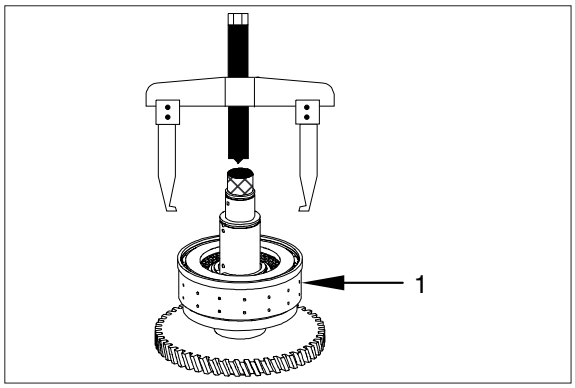
⑤ Take off idler(1), remove the needle cage(2) and the complete axial bearing(3).



D507TM76

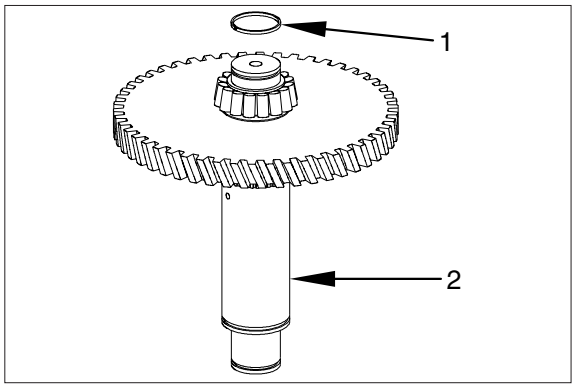
⑥ Pull the clutch(1) from the shaft.

(S)Two-armed puller 5870 970 003



D507TM77

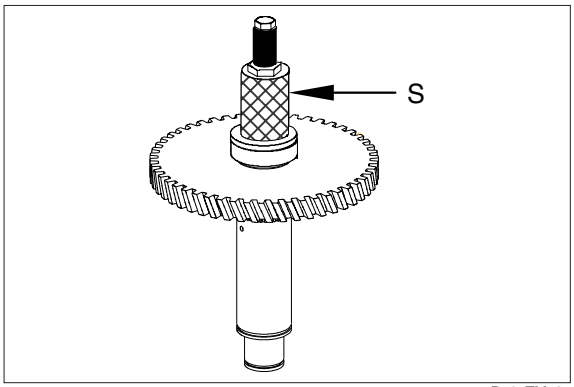
⑦ Rotated the shaft(2) by 180° and unsnap the piston ring(1).



D507TM78

⑧ Pull the taper roller bearing(inner ring) from the shaft.

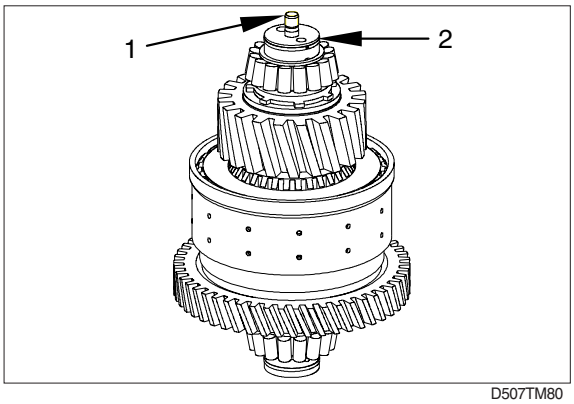
(S)Gripping insert	5873 001 057
(S)Back-off insert	5870 026 100
or	
(S)Rapid grip	5873 011 011



D507TM79

(4) Clutch K1

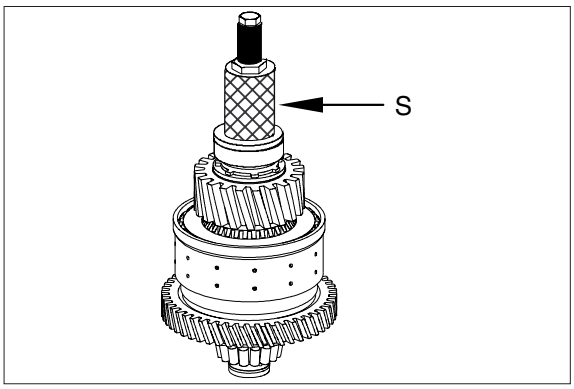
① Remove the stud(1) and unsnap the piston ring(2).



D507TM80

② Pull the taper roller bearing(inner ring) from the shaft.

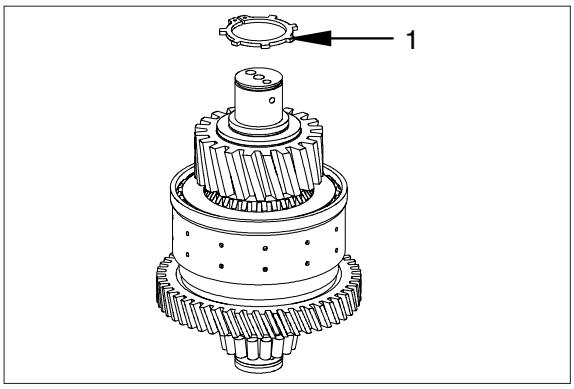
(S)Gripping insert	5873 001 057
(S)Back-off insert	5870 026 100
or	
(S)Rapid grip	5873 011 011



D507TM81

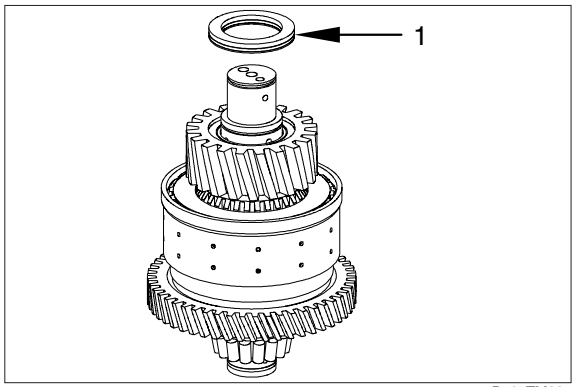
③ Unsnap the retaining ring(1).

(S)Set of internal pliers 5870 900 015



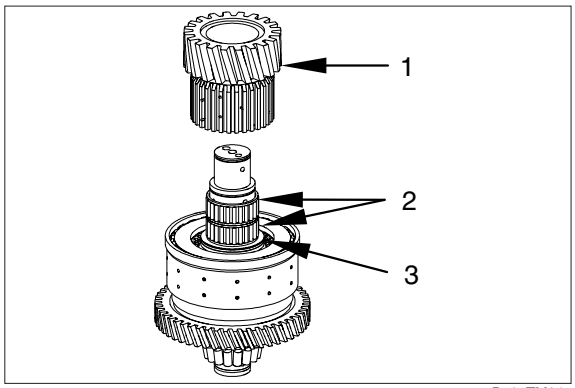
D507TM82

④ Remove the complete axial bearing(1).



D507TM83

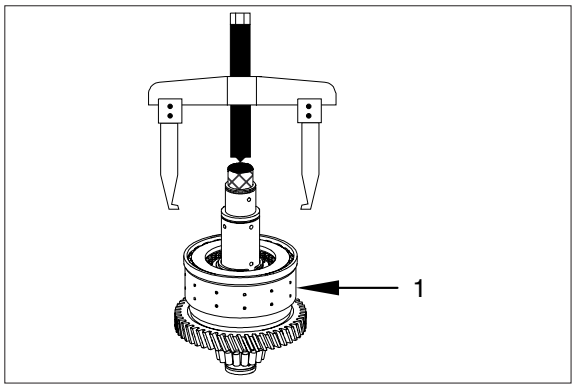
⑤ Take off idler(1), remove the needle cage(2) and the complete axial bearing(3).



D507TM84

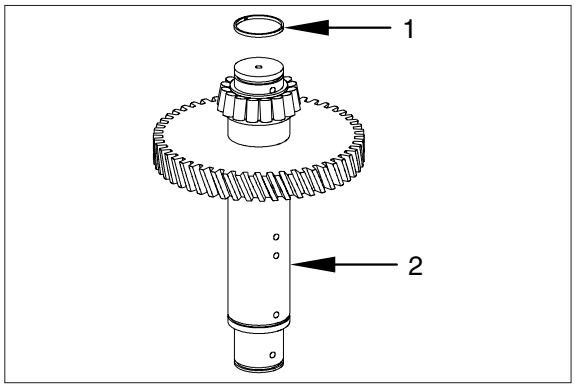
⑥ Pull the clutch(1), front the shaft.

(S)Two-armed puller 5870 970 003



D507TM85

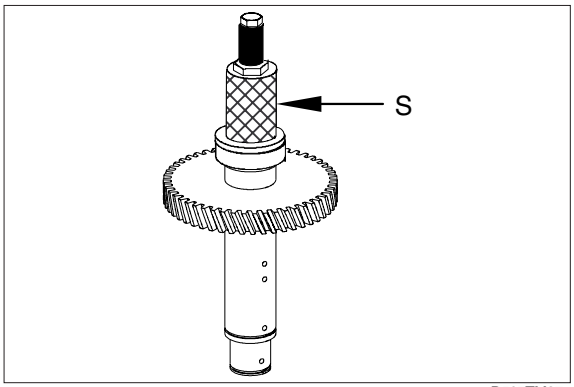
⑦ Rotated the shaft(2) by 180° and unsnap the piston ring(1).



D507TM86

⑧ Pull the taper roller bearing(inner ring) from the shaft.

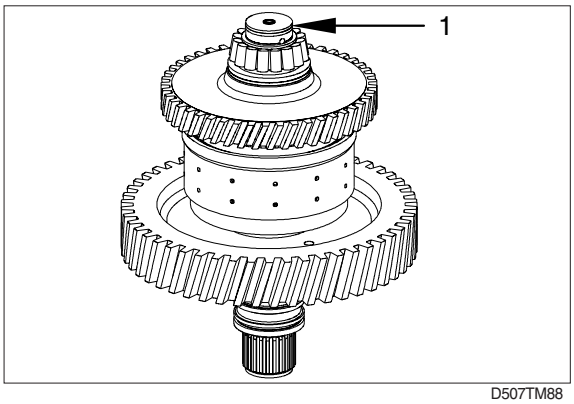
(S)Gripping insert	5873 001 057
(S)Back-off insert	5870 026 100
or	
(S)Rapid grip	5873 011 011



D507TM87

(5) Clutch K3

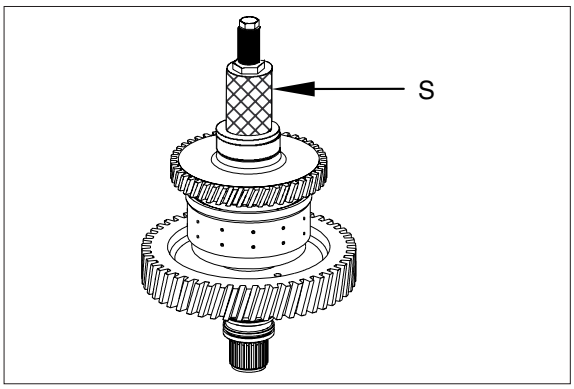
① Unsnap the piston ring(1).



D507TM88

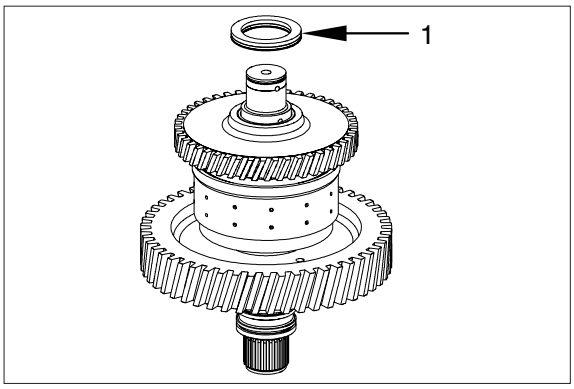
② Pull the taper roller bearing(inner ring) from the shaft.

(S)Gripping insert	5873 001 057
(S)Back-off insert	5870 026 100
or	
(S)Rapid grip	5873 011 011



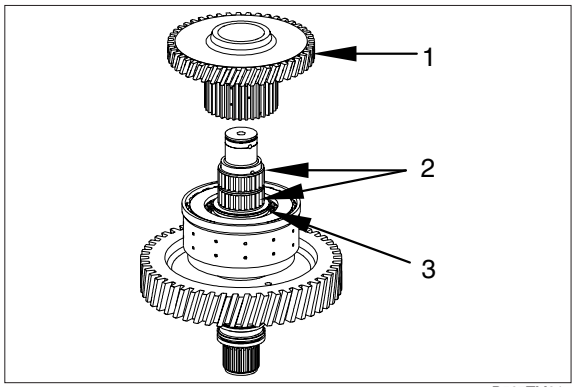
D507TM89

③ Remove the complete axial bearing(1).



D507TM90

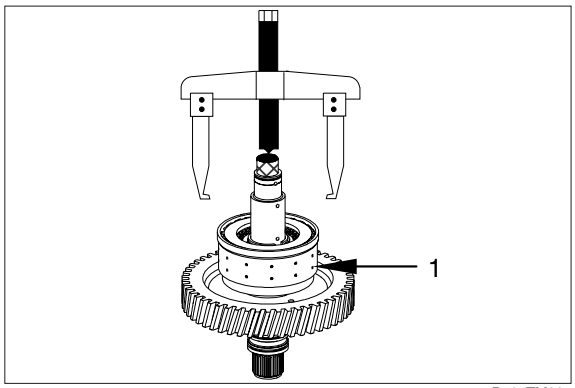
④ Take off idler(1), remove the needle cage(2) and the complete axial bearing(3).



D507TM91

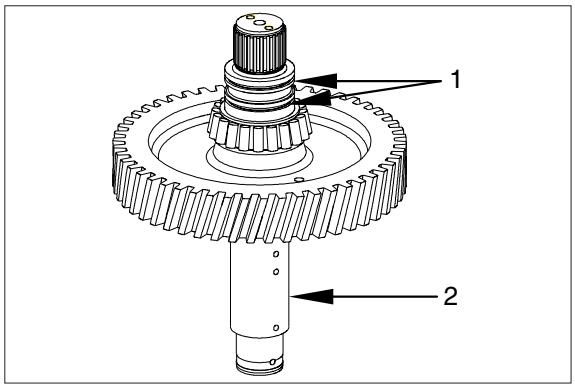
⑤ Pull the clutch(1) from the shaft.

(S)Two-armed puller 5870 970 003



D507TM92

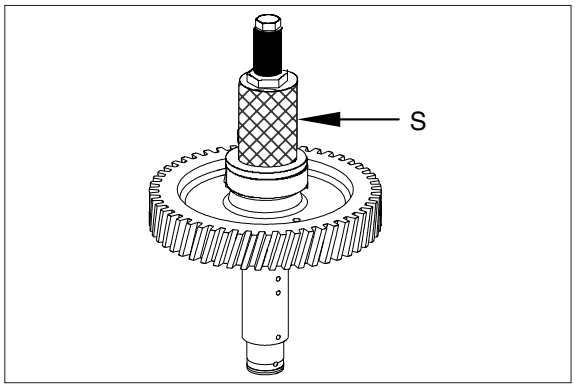
⑥ Rotated the shaft(2) by 180° and unsnap the piston ring(1).



D507TM93

⑦ Pull the taper roller bearing(inner ring) from the shaft.

(S)Gripping insert 5873 001 058
(S)Back-off insert 5870 026 100
or
(S)Rapid grip 5873 011 014

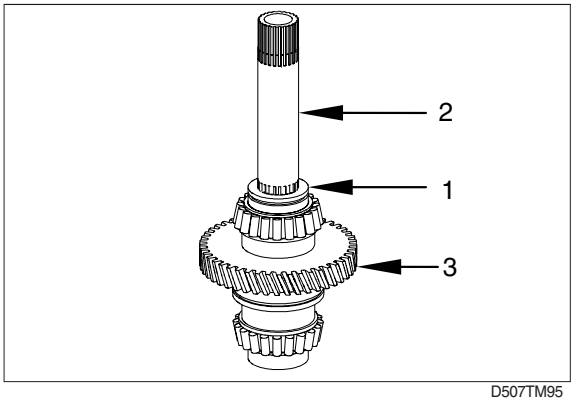


D507TM94

(6) Input

① Unsnap the piston ring(1).
The turbine wheel shaft(2) and the input gear(3) are attached with a snap ring.

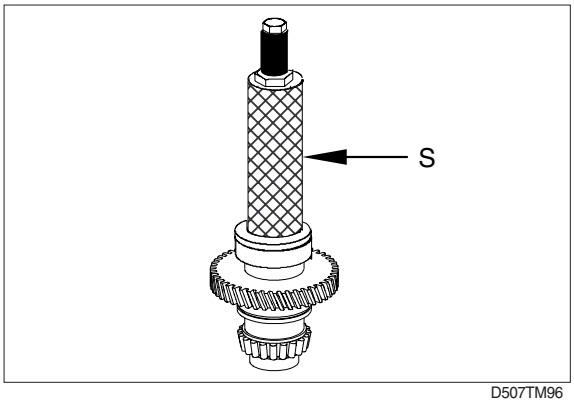
※ The components are destroyed at separation.



D507TM95

② Pull the taper roller bearing(inner ring) from the input gear.

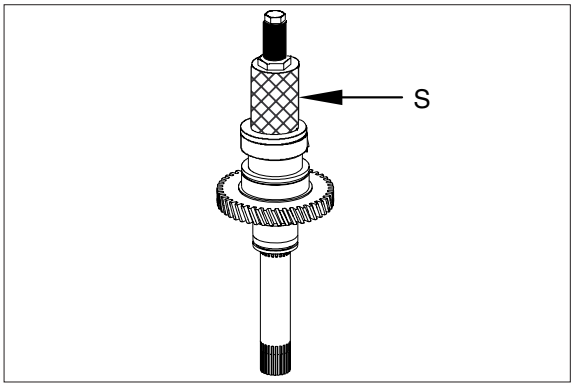
(S)Gripping insert	5873 001 058
(S)Back-off insert	5870 026 100
or	
(S)Rapid grip	5873 011 014



D507TM96

③ Pull the taper roller bearing(inner ring) from the input gear.

(S)Gripping insert	5873 001 058
(S)Back-off insert	5870 026 100
or	
(S)Rapid grip	5873 011 011



D507TM97

2. TRANSMISSION ASSEMBLY

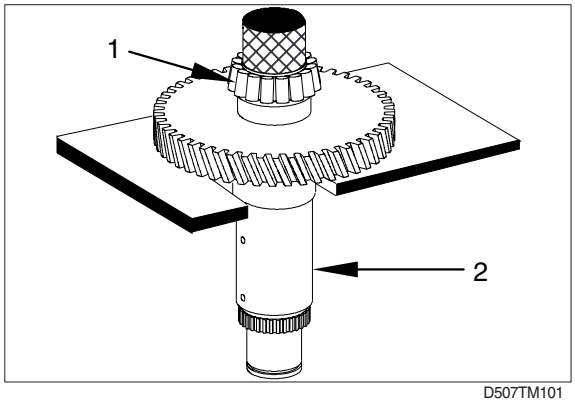
1) Clutches KV/KR/K1/K2/K3 and input

※ In the EST-37A(electronic transmission control)the gear change(filling times and pressure level) are controlled via the drive program of the transmission electronics. Additionally, the EST-37A monitors the disc clearance(clearance) of the clutches and if exceeded, a fault message is given in the transmission error display.

To ensure the shifting quality continuously, no repairs are allowed to be made on the clutches KV/KR/K1/K2/K3, which means that only the complete clutch is allowed to be replaced.

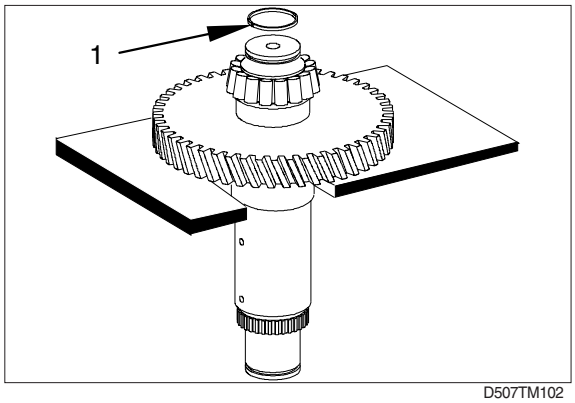
(1) Clutch KV

① Press the taper roller bearing(inner ring)(1) onto the shaft(2) until contact is obtained.



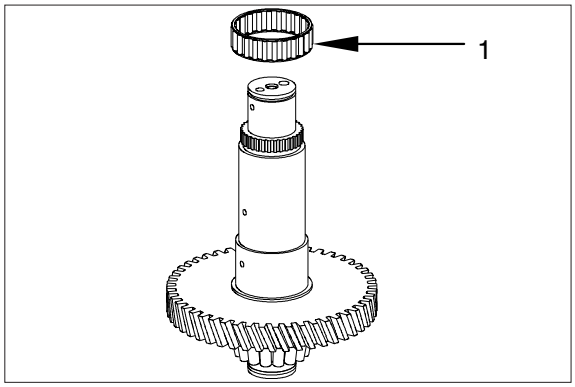
D507TM101

② Install the piston ring(1).



D507TM102

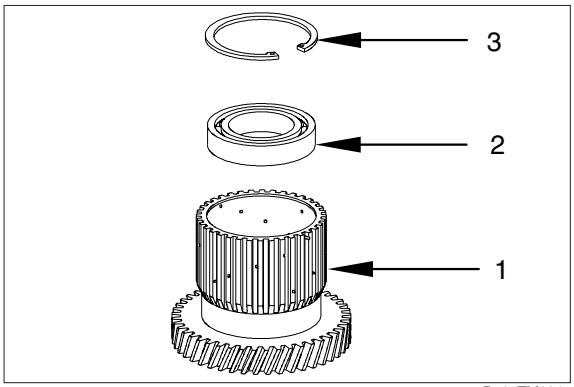
③ Mount the needle bearing(1) onto the shaft.



D507TM103

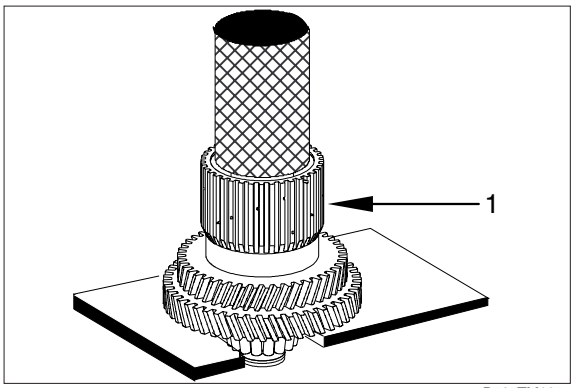
④ Put the ball bearing(2) into the idler(1) until contact is obtained and fasten it by means of retaining ring(3).

(S)Set of internal pliers



D507TM104

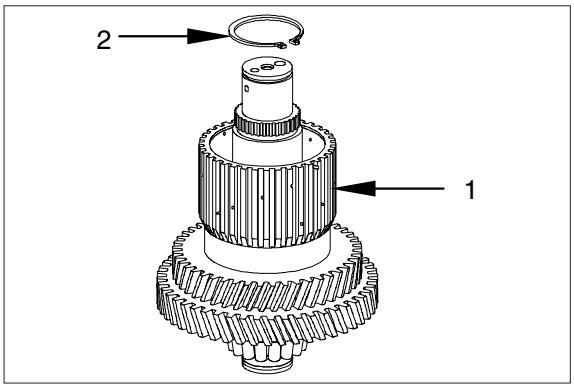
⑤ Press in preassembled idler(1) until contact.



D507TM105

⑥ Fasten the idler(1) by means of retaining ring(2).

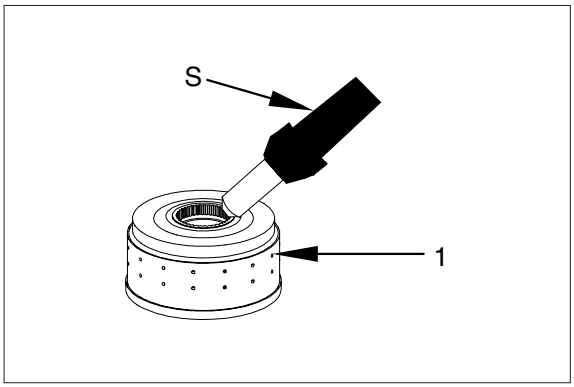
(S)Set of external pliers 5870 900 015



D507TM106

⑦ Heat up the inner diameter of the clutch(1)(approx. 120˚C).

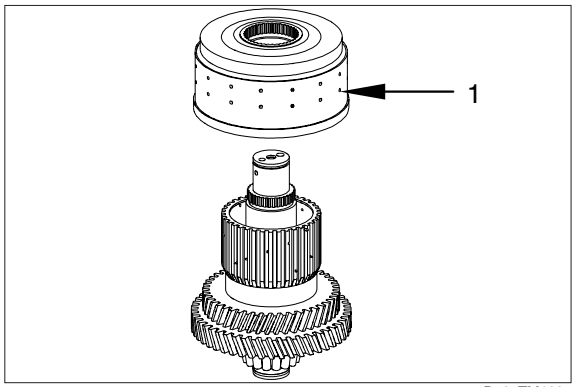
(S)Hot- air blower 220V 5870 221 500
(S)Hot- air blower 110V 5870 221 501



D507TM107

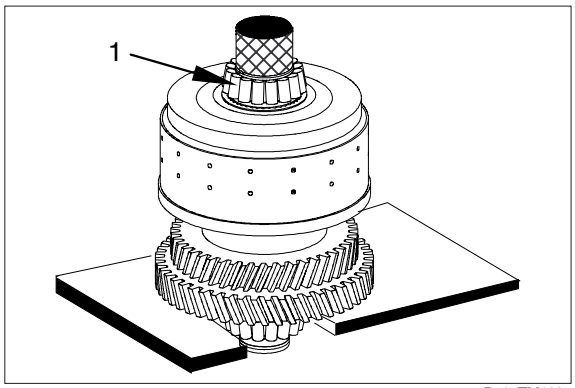
⑧ Mount the clutch(1) until contact is obtained.

⚠ **Wear safety gloves.**



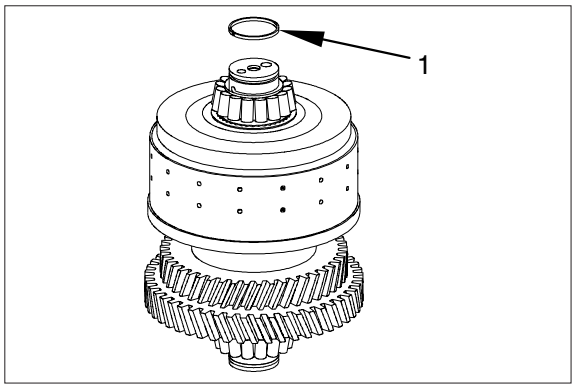
D507TM108

⑨ Press the taper roller bearing(inner ring)(1) until contact is obtained.



D507TM109

⑩ Install the piston ring(1).

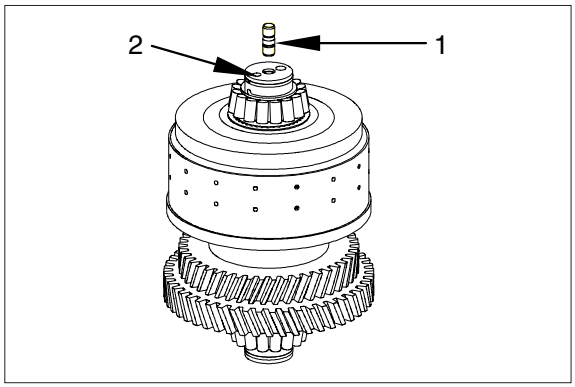


D507TM110

⑪ Install the stud(1).

Tightening torque ····· M_A=1.7kg·m

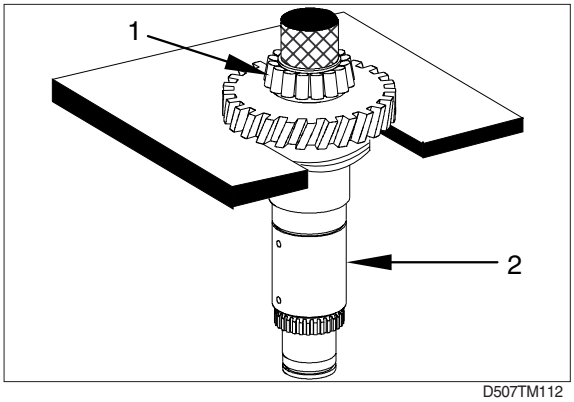
※ Check closing resp. opening of the clutch by means of compressed air at the bore(2).
Closing resp. opening of the clutch must be clearly audible.



D507TM111

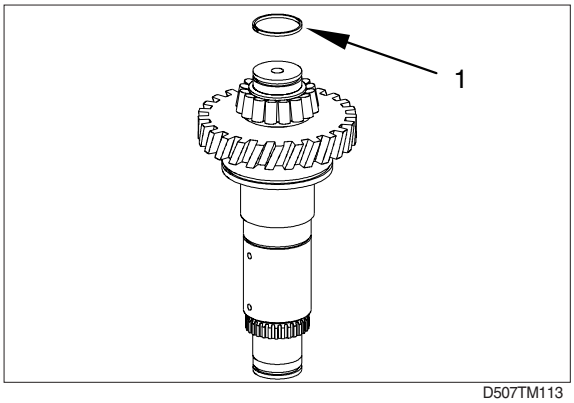
(2) Clutch KR

① Press the taper roller bearing(inner ring)(1) onto the shaft(2) until contact is obtained.



D507TM112

② Install the piston ring(1).

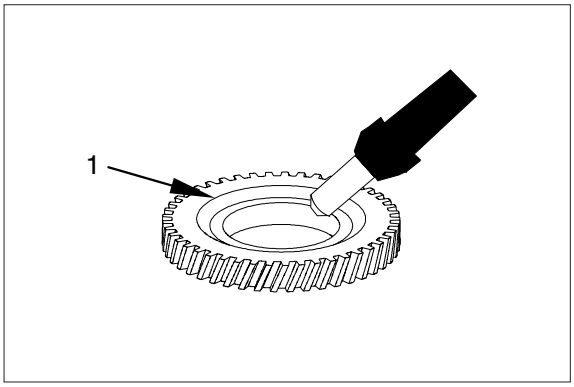


D507TM113

③ Heat up the inner diameter of the gear(1)(approx. 120˚C).

(S)Hot- air blower 220V 5870 221 500
(S)Hot- air blower 110V 5870 221 501

⚠ Wear safety gloves.

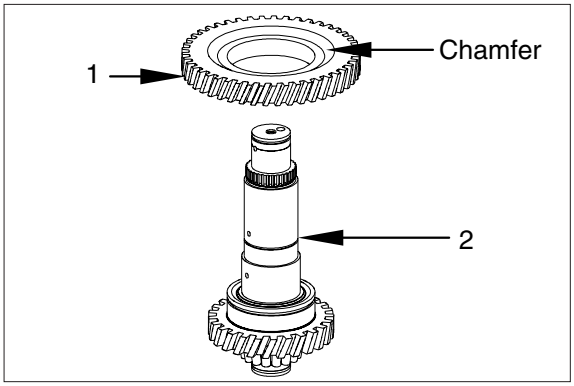


D507TM114

④ Undercool the shaft(2)(approx. 80˚C). Mount the gear until contact is obtained.

※ Install the chamfer of the gear(see arrow) showing upwards.
※ Observe the radial installation position.

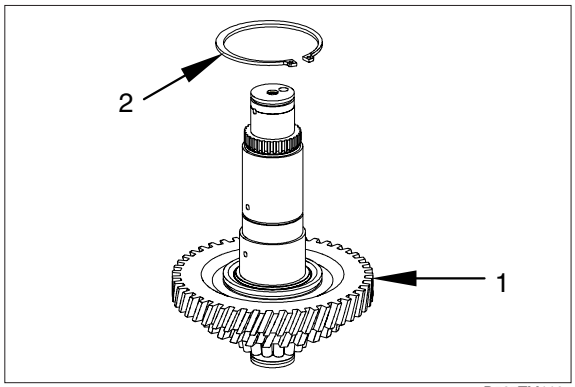
⚠ Wear safety gloves.



D507TM115

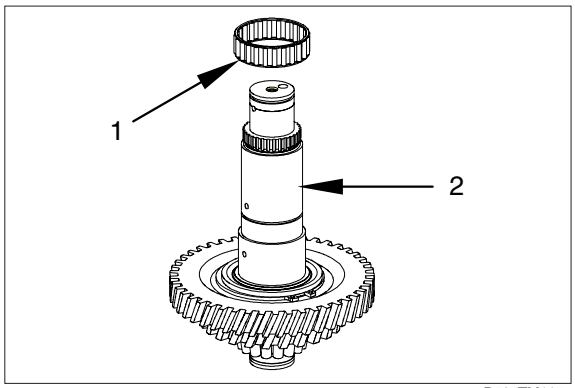
⑤ Fasten the gear(1) by means of retaining ring(2).

(S)Set of internal pliers 5870 900 015



D507TM116

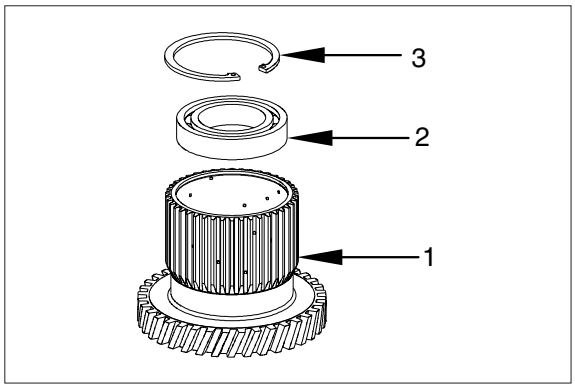
⑥ Mount the needle bearing(1) onto the shaft(2).



D507TM117

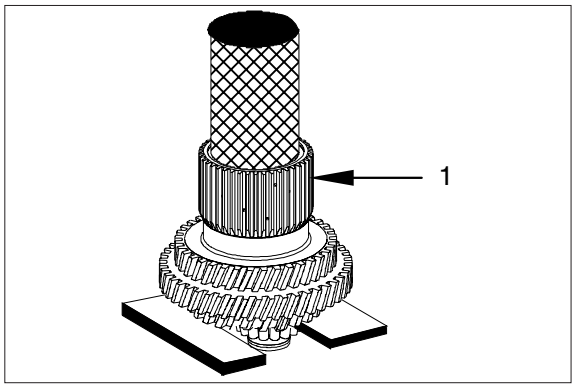
⑦ Put the ball bearing(2) into the idler(1) until contact is obtained and fasten it by means of retaining ring(3).

(S)Set of internal pliers 5870 900 013



D507TM118

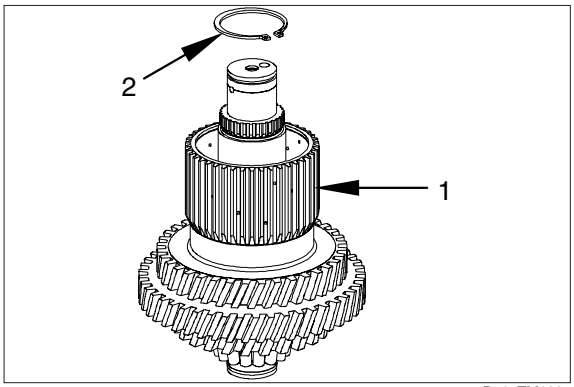
⑧ Press in the preassembled idler(1) until contact.



D507TM119

⑨ Fasten the idler(1) by means of retaining ring(2).

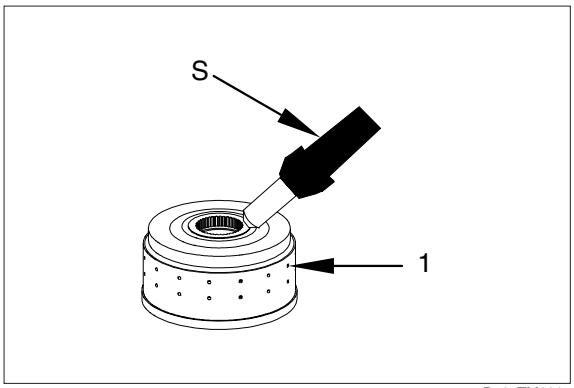
(S)Set of internal pliers 5870 900 015



D507TM120

⑩ Heat up the inner diameter of the clutch(1)(approx. 120˚C).

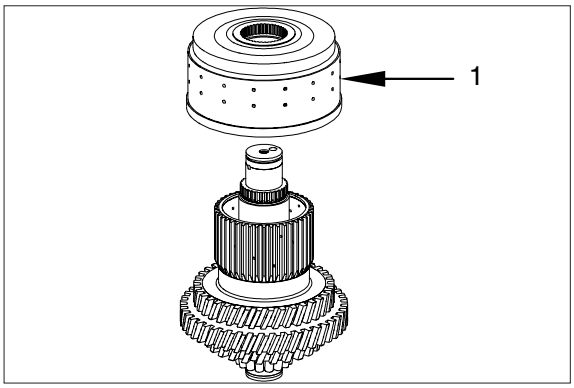
(S)Hot- air blower 220V 5870 221 500
(S)Hot- air blower 110V 5870 221 501



D507TM121

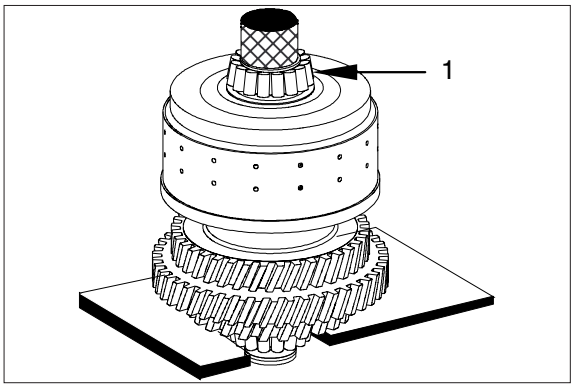
⑪ Mount the clutch(1) and press it until contact is obtained.

⚠ Wear safety gloves.



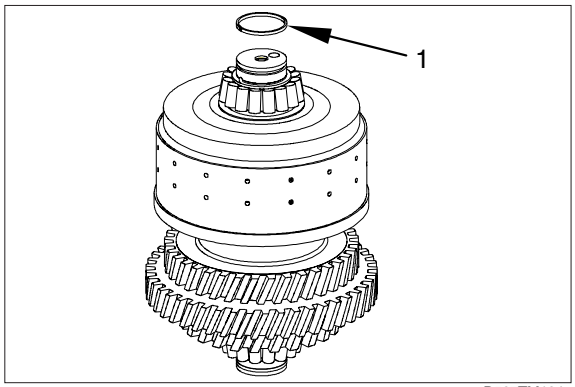
D507TM122

⑫ Press the taper roller bearing(inner ring)(1) until contact is obtained.



D507TM123

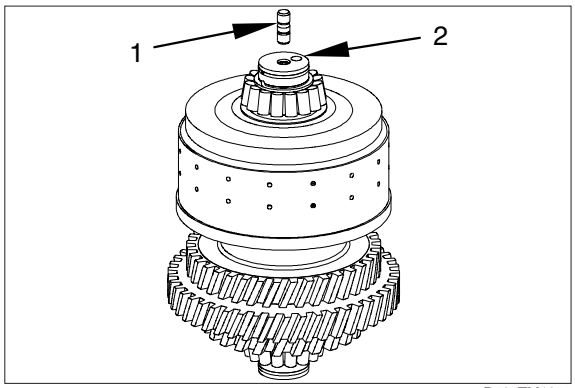
⑬ Install the piston ring(1).



D507TM124

⑭ Install the stud(1).
Tightening torque ····· M_A=1.7kg·m

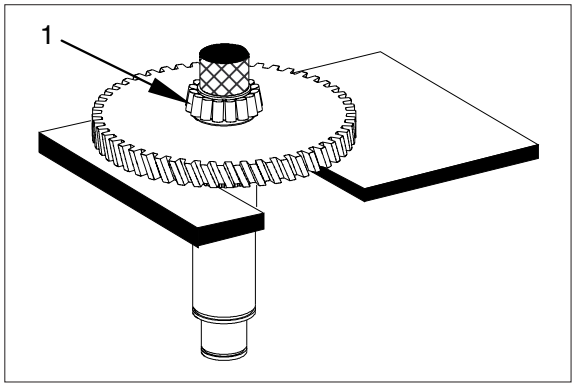
※ Check closing resp. opening of the clutch by means of compressed air at the bore(2).
Closing resp. opening of the clutch must be clearly audible.



D507TM125

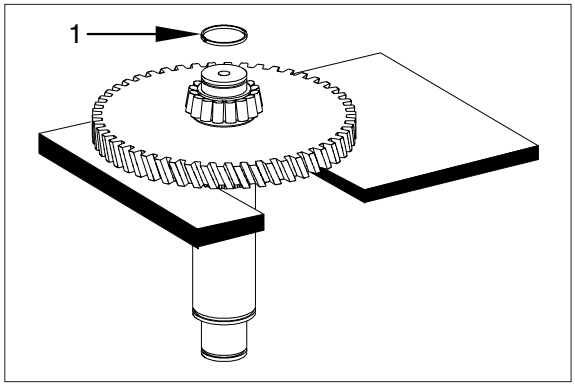
(3) Clutch K1

① Press the taper roller bearing(inner ring)(1) onto the shaft until contact.



D507TM126

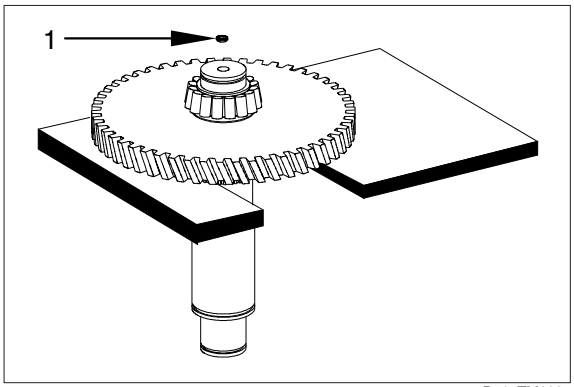
② Install the piston ring(1).



D507TM127

③ Install the sealing cap(1).

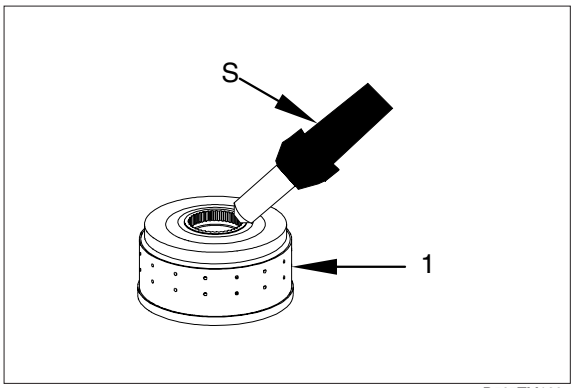
※ Wet the contact surface with(Loctite Type No. 262).



D507TM128

④ Heat up the inner diameter of the clutch(1)(approx. 120˚C).

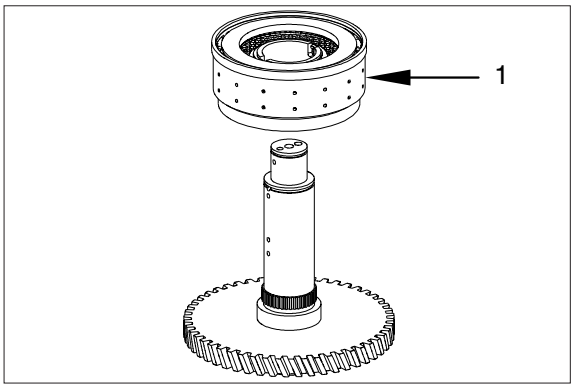
(S)Hot- air blower 220V 5870 221 500
(S)Hot- air blower 110V 5870 221 501



D507TM129

⑤ Mount the clutch(1) and press it until contact is obtained.

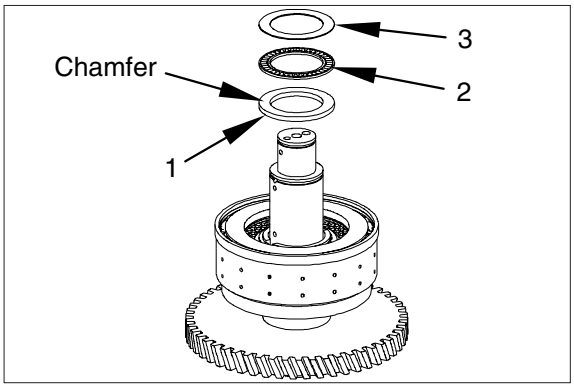
⚠ Wear safety gloves.



D507TM130

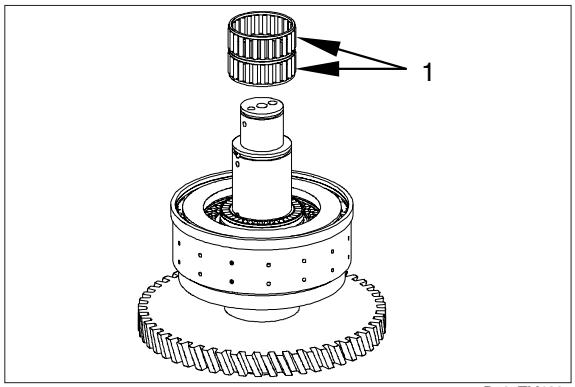
⑥ Mount the running disc(1), axial cage(2) and axial washer(3).

※ Install chamfer(see arrow) of the running disc(2) showing towards the axial cage.



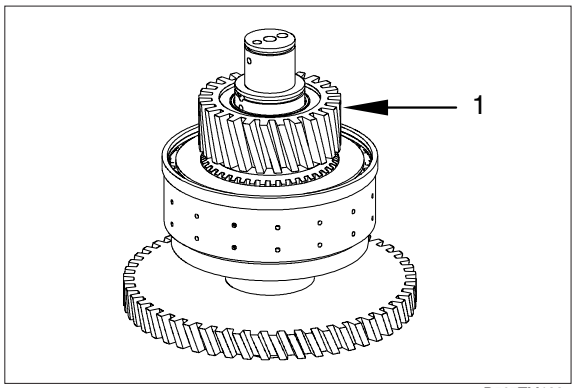
D507TM131

⑦ Mount the needle cage(1).



D507TM132

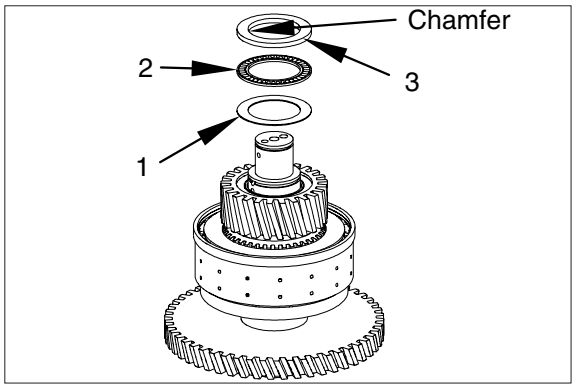
⑧ Install the idler(1).



D507TM133

⑨ Mount the axial washer(1), axial cage(2) and running disc(3).

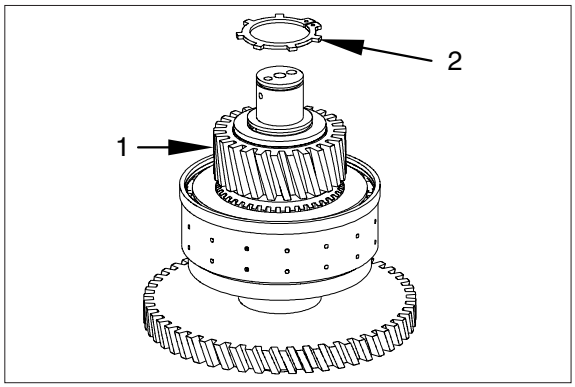
※ Install chamfer(see arrow) of the running disc(3) showing towards the axial cage



D507TM134

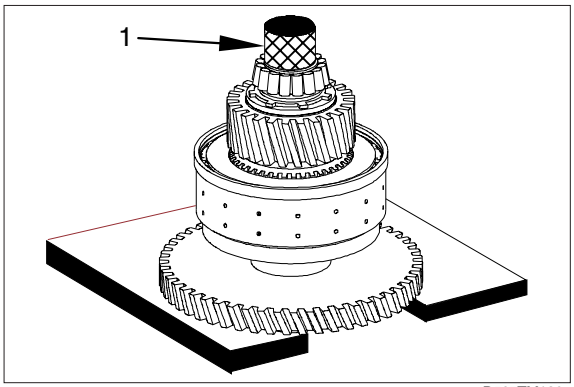
⑩ Fasten the idler(1) and the single parts by means of the retaining ring(2).

(S)Set of external pliers 5870 900 015



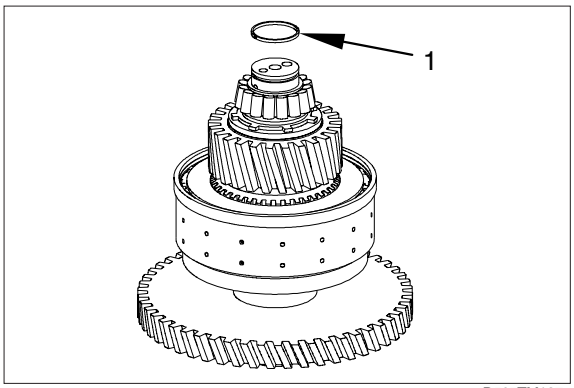
D507TM135

⑪ Press the taper roller bearing(inner ring)(1) until contact is obtained.



D507TM136

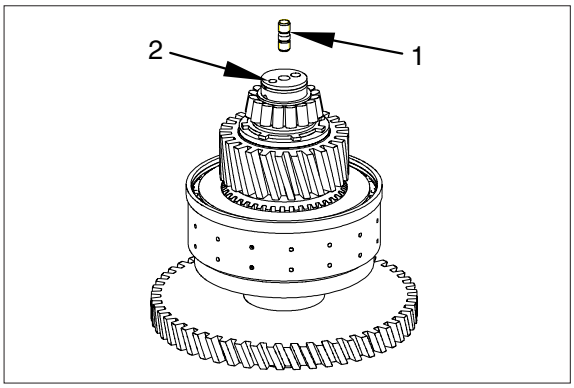
⑫ Install the piston ring(1).



D507TM137

⑬ Install the stud(1).
Tightening torque ····· M_A=1.7kg·m

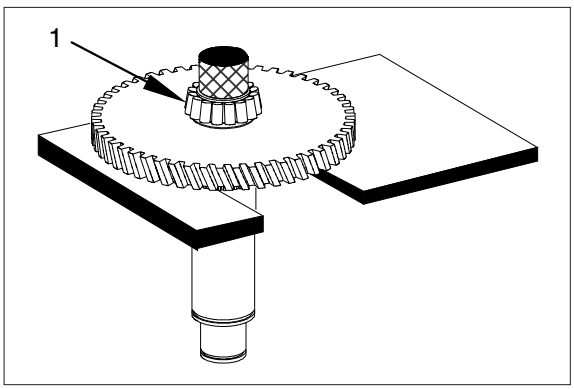
※ Check closing resp. opening of the clutch by means of compressed air at the bore(2).
Closing resp. opening of the clutch must be clearly audible.



D507TM138

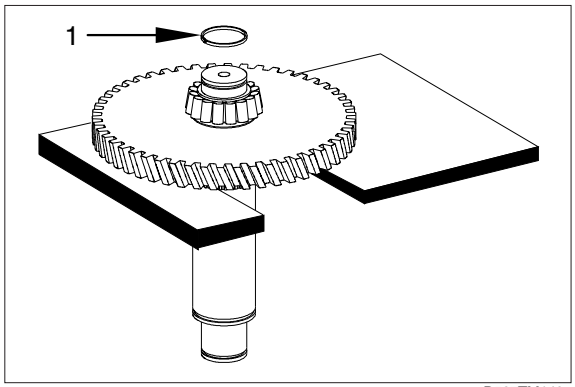
(4) Clutch K2

① Press the taper roller bearing(inner ring)(1) onto the shaft until contact.



D507TM139

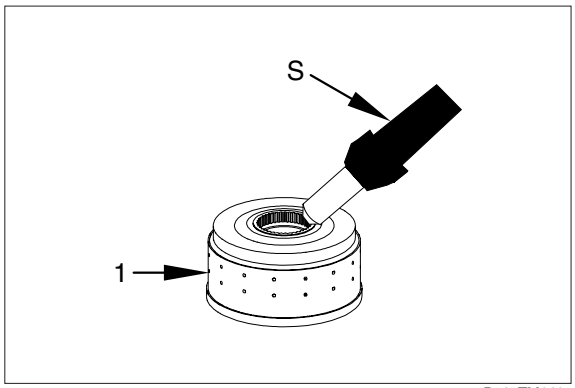
② Install the piston ring(1).



D507TM140

③ Heat up the inner diameter of the clutch(1)(approx. 120˚C).

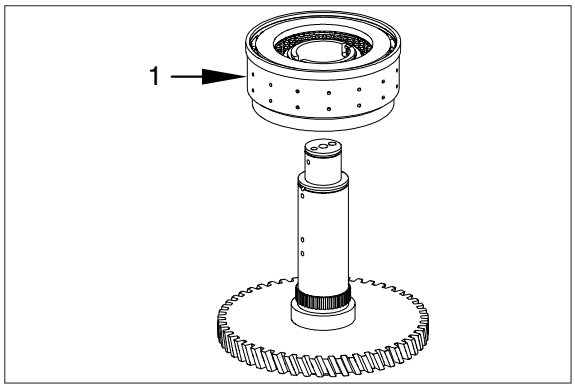
(S)Hot- air blower 220V 5870 221 500
(S)Hot- air blower 110V 5870 221 501



D507TM141

④ Mount the clutch(1) until contact is obtained.

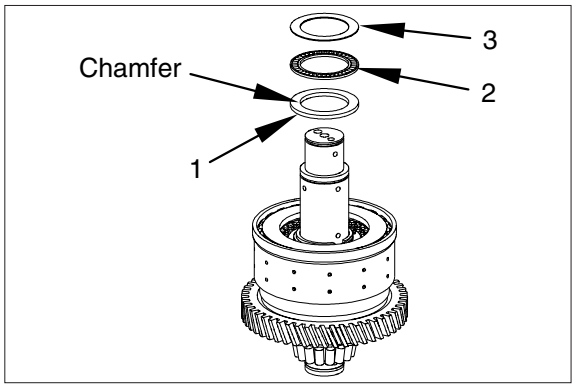
⚠ Wear safety gloves.



D507TM142

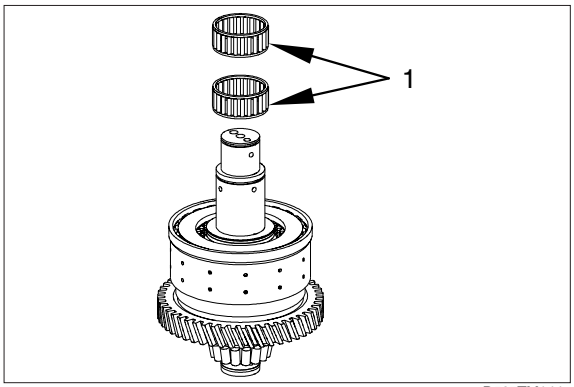
⑤ Mount the running disc(1), axial cage(2) and axial washer(3).

※ Install chamfer(see arrow) of the running disc(2) showing towards the axial cage.



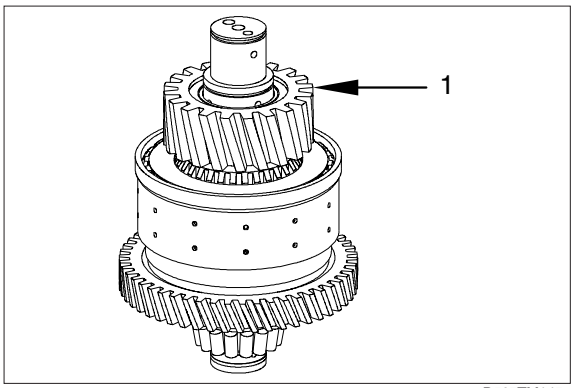
D507TM143

⑥ Mount the needle cage(1).



D507TM144

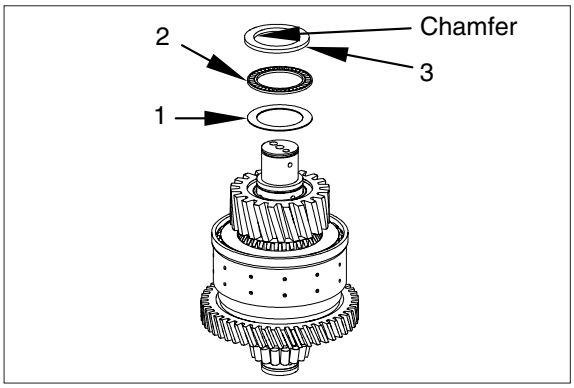
⑦ Install the idler(1).



D507TM145

⑧ Mount the axial washer(1), axial cage(2) and running disc(3).

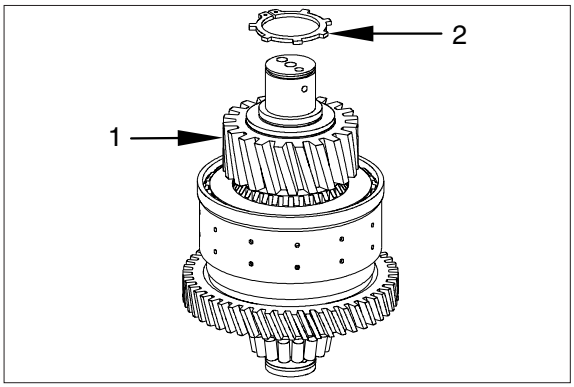
※ Install chamfer(see arrow) of the running disc(3) showing towards the axial cage.



D507TM146

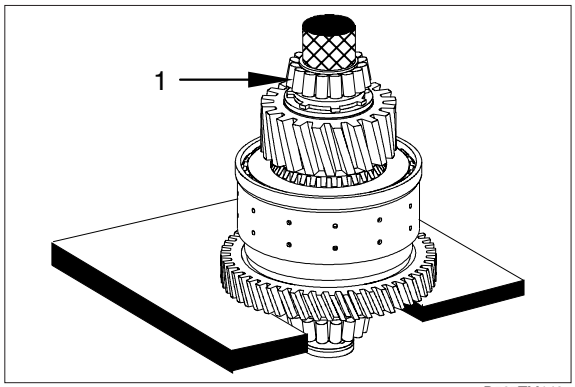
⑨ Fasten the idler(1) and the single parts by means of the retaining ring(2).

(S)Set of external pliers 5870 900 015



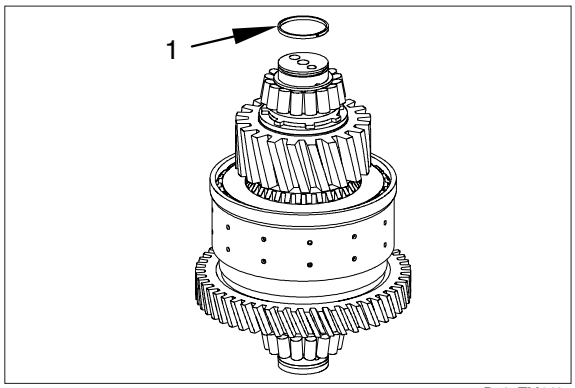
D507TM147

⑩ Press the taper roller bearing(inner ring)(1) until contact is obtained.



D507TM148

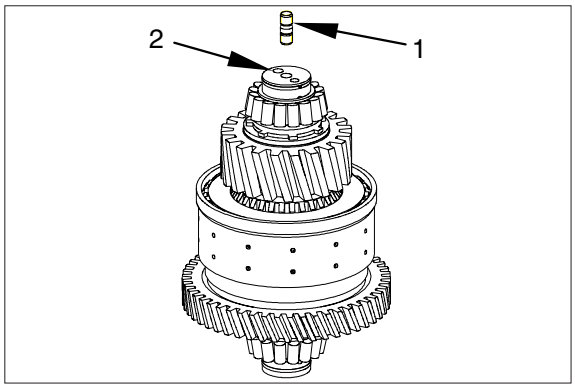
⑪ Install the piston ring(1).



D507TM149

⑫ Install the stud(1).
Tightening torque ····· M_A=1.7kg·m

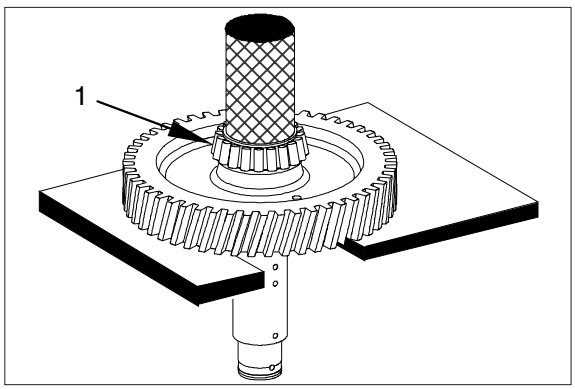
※ Check closing resp. opening of the clutch by means of compressed air the bore(2). Closing resp. opening of the clutch must be clearly audible.



D507TM150

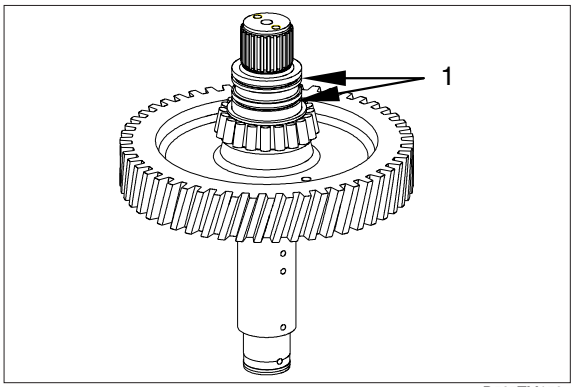
(5) Clutch K3

① Press the taper roller bearing(inner ring)(1) onto the shaft until contact.



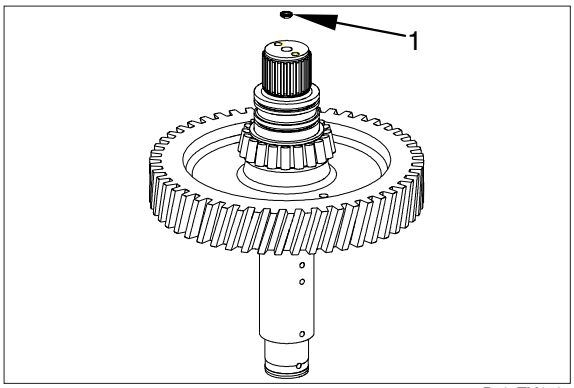
D507TM151

② Install the piston ring(1).



D507TM152

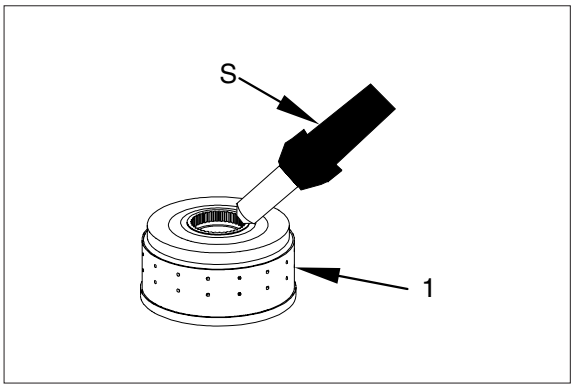
③ Install the sealing cap(1).
Wet the contact surface with loctite type No.262.



D507TM153

④ Heat up the inner diameter of the clutch(1)(approx. 120˚C).

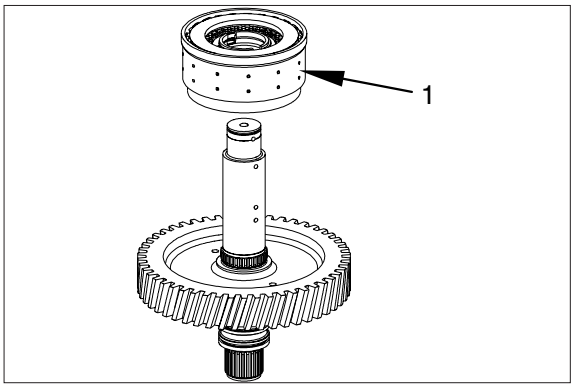
(S)Hot- air blower 220V 5870 221 500
(S)Hot- air blower 110V 5870 221 501



D507TM154

⑤ Mount the clutch(1) until contact is obtained.

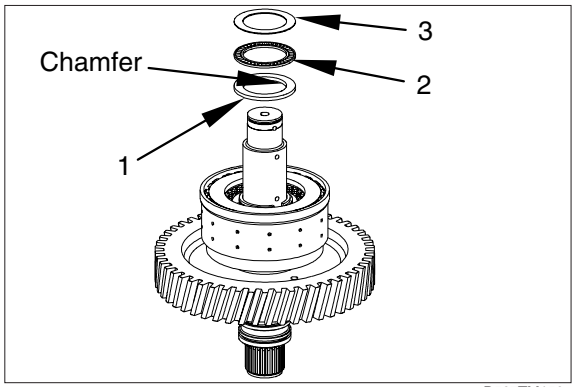
⚠ Wear safety gloves.



D507TM155

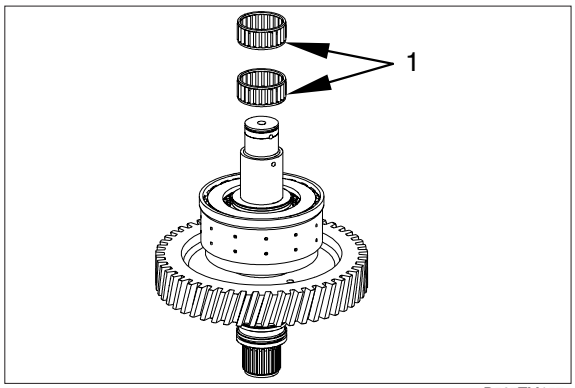
⑥ Mount the running disc(1), axial cage(2) and axial washer(3).

※ Install chamfer(see arrow) of the running disc(3) showing toward the axial cage.



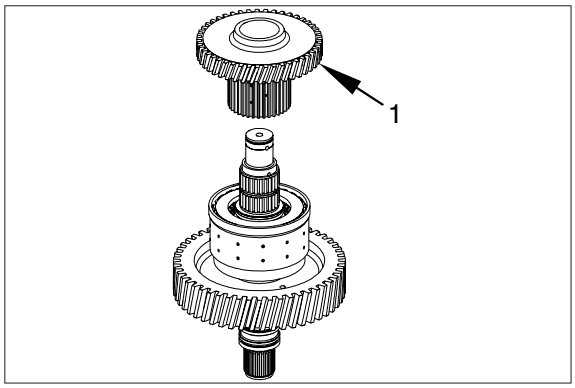
D507TM156

⑦ Mount the needle cage(1).



D507TM157

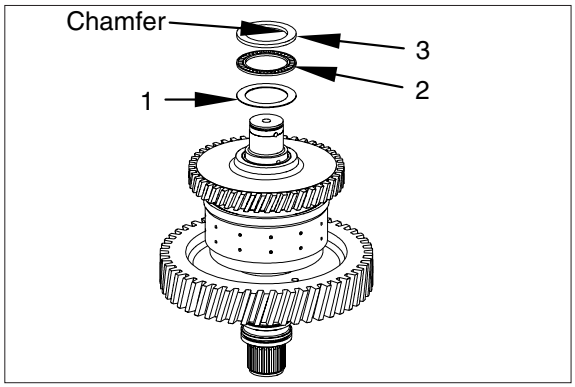
⑧ Install the idler(1).



D507TM158

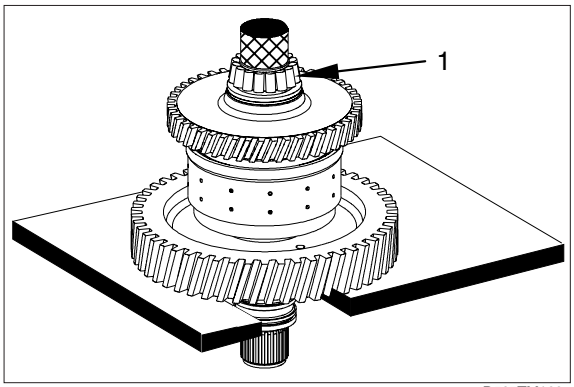
⑨ Mount the axial washer(1), axial cage(2) and running disc(3).

※ Install chamfer(see arrow) of the running disc(3) showing towards the axial cage.



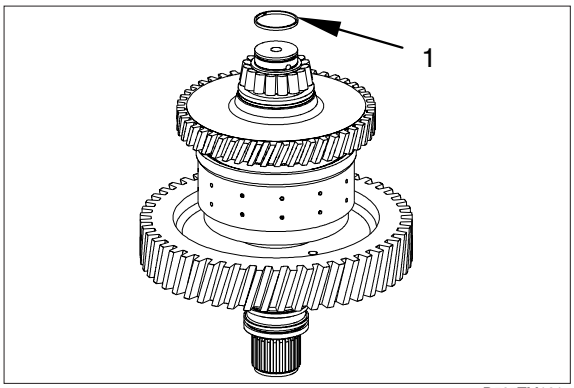
D507TM159

⑩ Press the taper roller bearing(inner ring)(1) until contact is obtained.



D507TM160

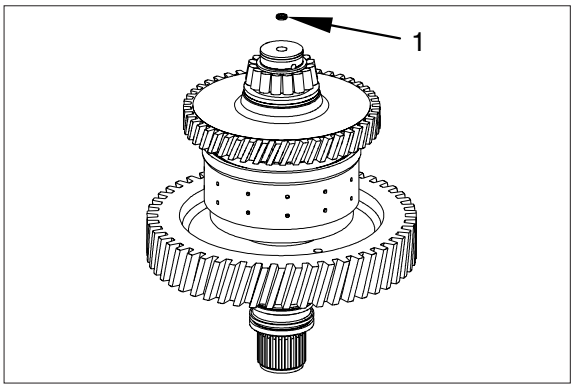
⑪ Install the piston ring(1).



D507TM161

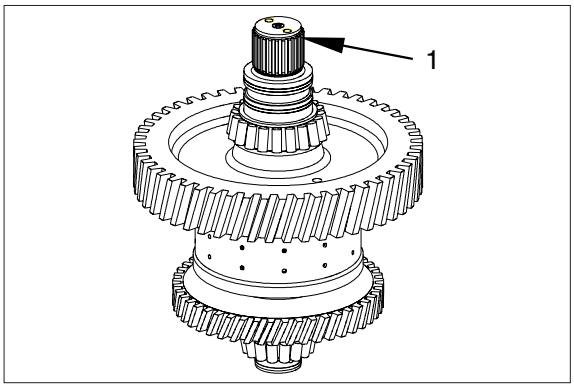
⑫ Install the screw plug(1).

(S)Lever riveting tongs 5870 320 016



D507TM162

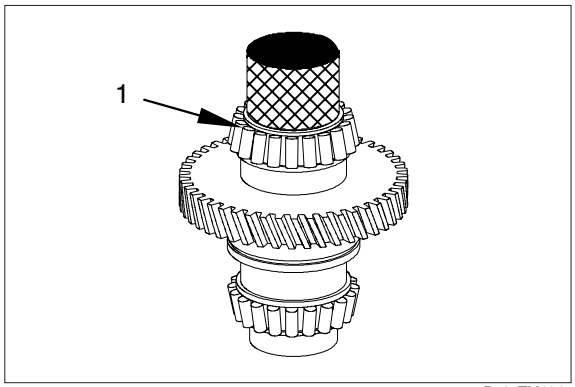
※ Check closing resp. opening of the clutch by means of compressed air at the bore(1).
Closing resp. opening of the clutch must be clearly audible.



D507TM163

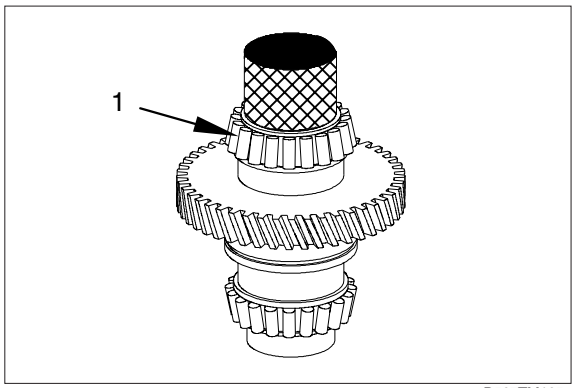
(6) Input

① Press the taper roller bearing(inner ring)(1) until contact is obtained.



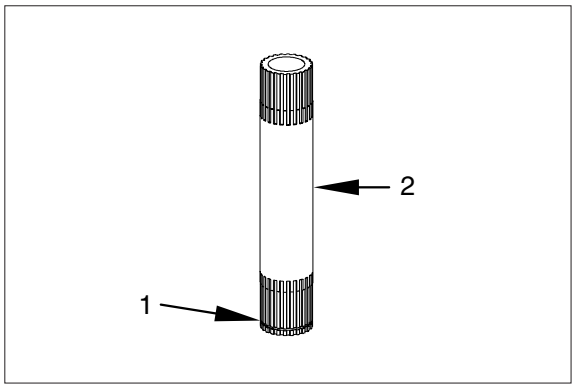
D507TM164

② Press the taper roller bearing(inner ring)(1) until contact is obtained.



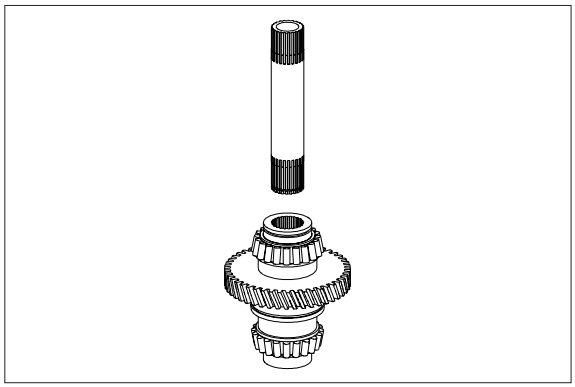
D507TM165

③ Have the snap ring(1) engaged into the annular groove of the turbine wheel shaft(2).



D507TM166

④ Mount the turbine wheel shaft until the snap ring engages into the recess of the input gear-turbine wheel shaft is axially fixed.



D507TM167

2) ENGINE CONNECTION, PRESSURE OIL PUMP AND INSTALLATION OF THE CLUTCHES

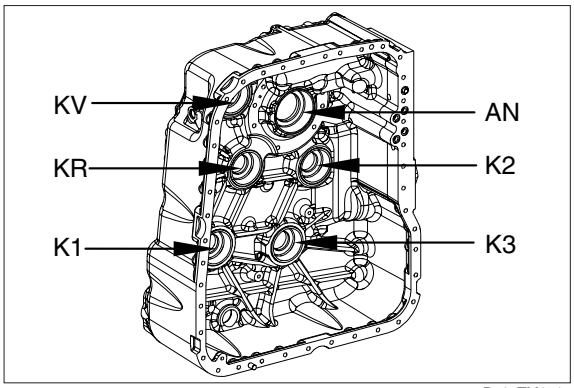
Install all bearing outer rings into the bearing bores of both transmission housing sections.

※ **Should contrary to the recommendations the taper roller bearing of the clutches as well as of the input not be replaced, the assignment(bearing inner and outer rings) has to be kept at least .**

Mark the bearing inner and bearing outer rings to each other accordingly.

(1) Transmission housing front section

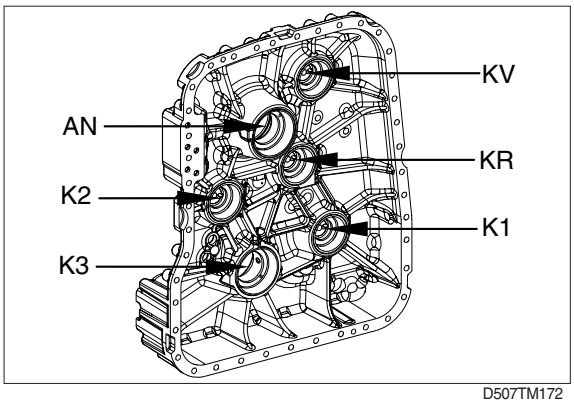
AN = Input
KV = Clutch - Forward
KR = Clutch - Reverse
K1 = Clutch - 1st gear
K2 = Clutch - 2nd gear
K3 = Clutch - 3rd gear



D507TM171

(2) Transmission housing rear section

※ Put the bearing outer rings with assembly grease into the bearing bores

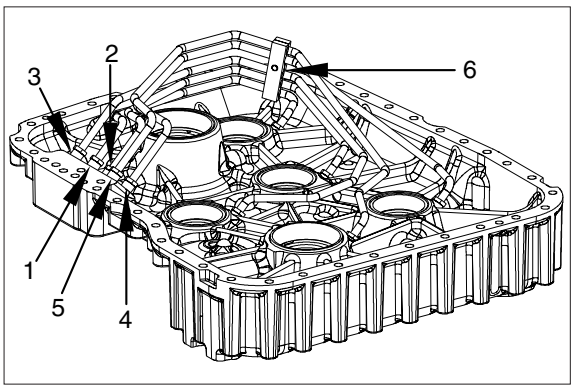


D507TM172

① Install the pipe(system pressure from the electro-hydraulic control to the respective clutch).
The pipes are to be installed in the following sequence:

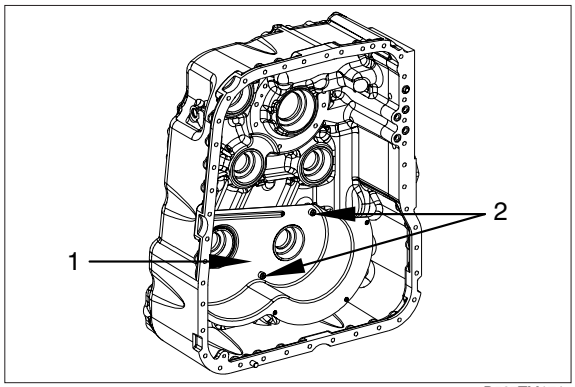
1 = Pipe	KV
2 = Pipe	KR
3 = Pipe	K2
4 = Pipe	K1
5 = Pipe	K3

Tightening torque ····· M_A =4.3kg·m
Install the holding segment(6)
Tightening torque(M8/8.8) ·· M_A =2.3kg·m



D507TM173

② Fasten the screen sheet(1) by means of cap screws(2).
Tightening torque(M8/8.8) ··· M_A=2.3kg·m

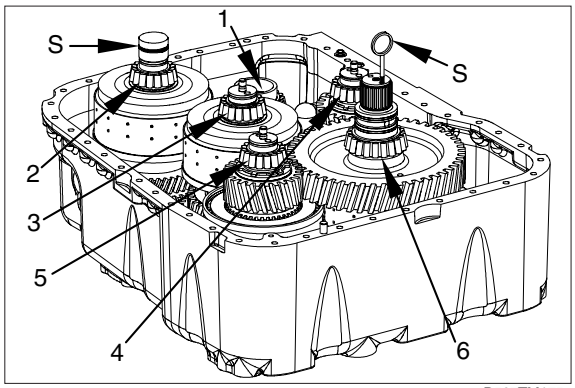


D507TM174

③ The clutch is to be put into the transmission housing front section as described in the legend.

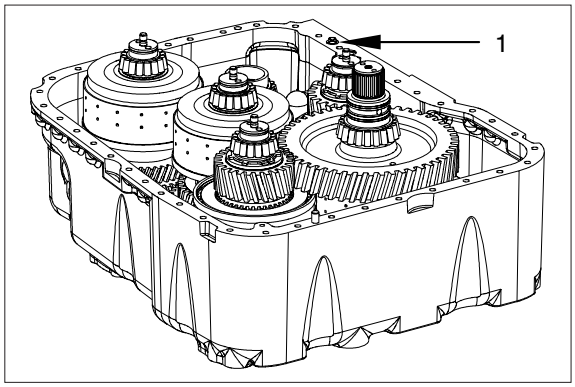
1 = Input shaft
2 = Clutch KV
3 = Clutch KR
4 = Clutch K2
5 = Clutch K1
6 = Clutch K3

(S)Handle 5870 260 010 (K1/K2/KV/KR)
(S)Eyebolt 5870 204 002



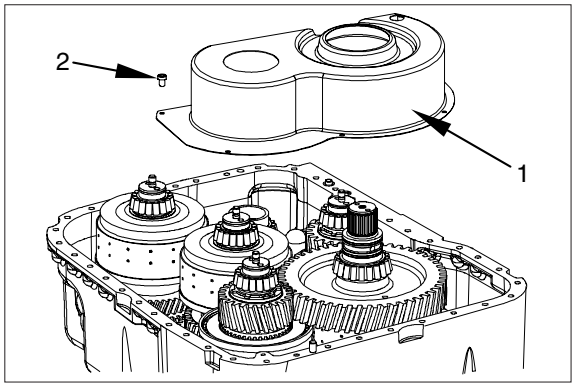
D507TM175

④ Put the pipes and O-rings into the bores and grease them.



D507TM176

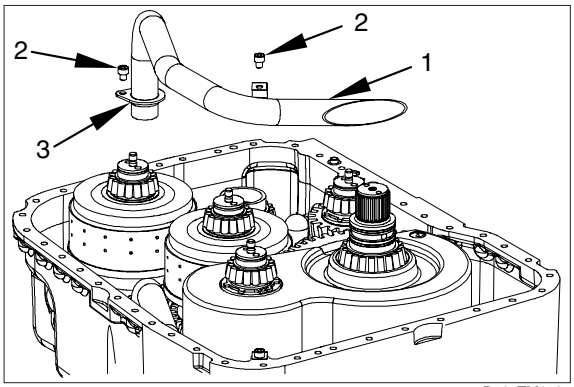
⑤ Fasten the screen sheet(1) by means of cap screws(2).
Tightening torque(M6/8.8) ··M_A=0.97kg·m



D507TM177

⑥ Install the O-rings(3) and fasten the suction pipe(1) by means of cap screws(2).

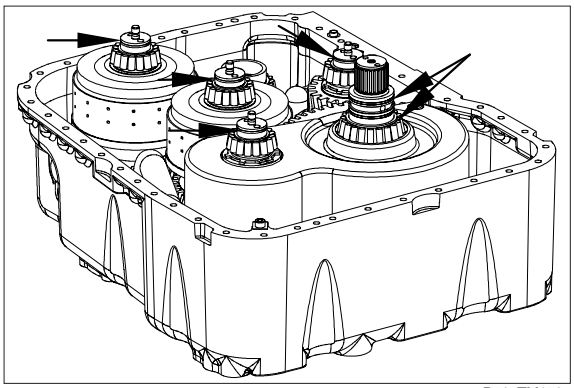
Tightening torque(M8/8.8) ··· M_A=2.3kg·m



D507TM178

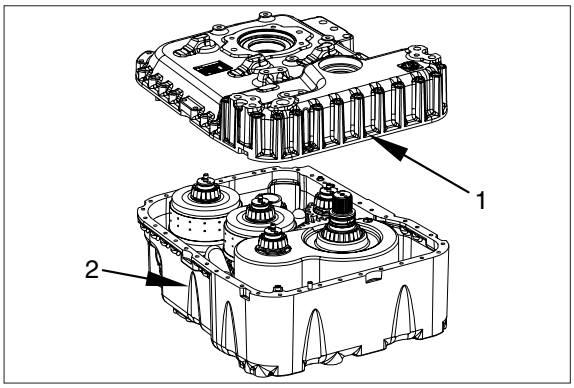
⑦ Grease the rectangular rings(see arrows) and align them, centrically.

※ Wet the mounting face with sealing compound loctite(Type No.574)


D507TM179

⑧ Cautiously place the transmission housing rear section(1) by means of the lifting equipment to the transmission housing front section(2) until contact is obtained.

(S)Eyebolts 2x(M20)	0636 804 003
(S)Ring nut(M12)	0664 462 774
(S)Lifting chain	5870 281 047



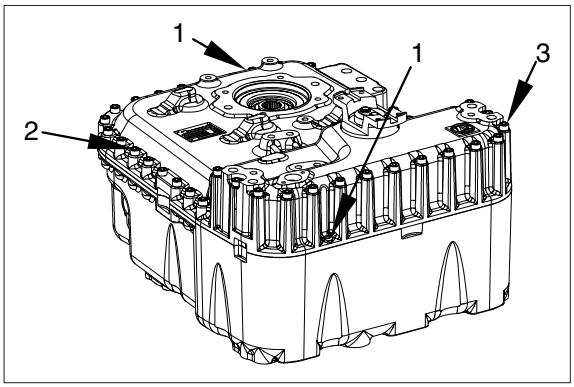
D507TM180

⑨ Install both cyl. pins(1) centrally to the mounting face.

By means of cap screws(2 and 3) fasten the transmission housing rear section to the transmission housing front section.

※ Cap screws with different lengths.

Tightening torque(M8/8) ····· M_A=4.7kg·m



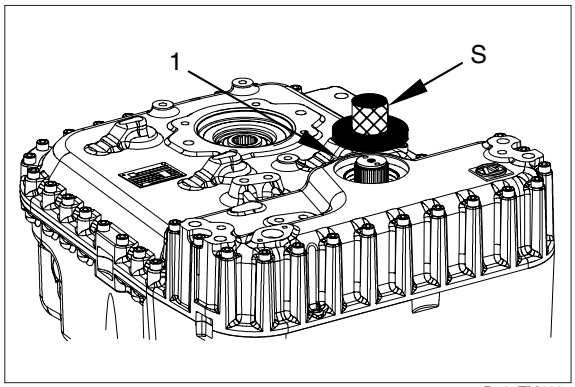
D507TM181

⑩ Install the shaft seal(1) with the sealing lip showing to the oil sump.

※ The exact installation position is obtained by using the specified mounting tool(S).

※ Fill the shaft seal between dust lip and sealing lip with grease.
Wet the outer diameter with spirit.

(S)Mounting tool 5870 048 057

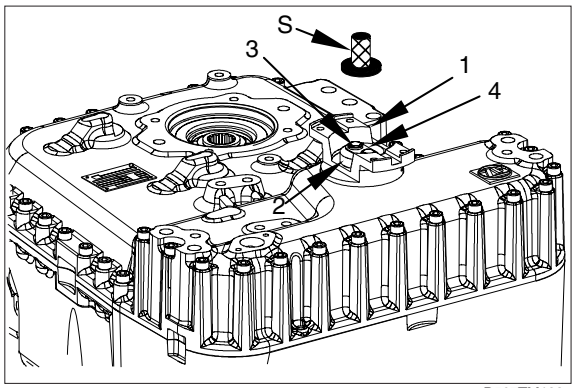


D507TM182

⑪ Insert the input flange(1) until contact and put in the O-ring. Fix the input flange(1) by means of washer(2) and hexagon screws(3).
Then fix the hexagon screws(3) with the tab washer(4) by means of the mounting tool(S).

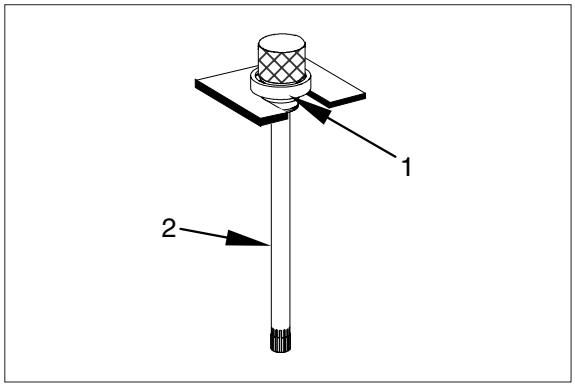
Tightening torque(M8/8.8) ··· M_A=3.5kg·m

(S)Mounting tool 5870 057 011
(S)Handle 5870 260 002



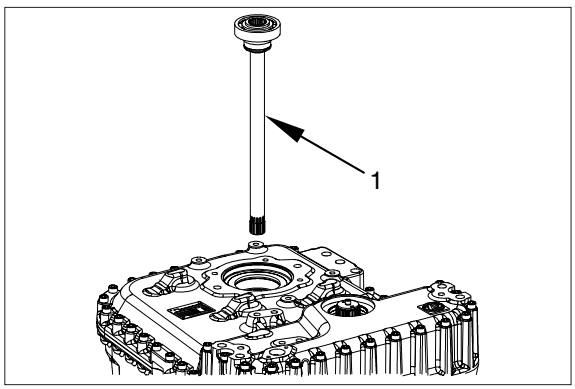
D507TM183

⑫ Press the ball bearing(1) onto the pump shaft(2) until contact is obtained.



D507TM184

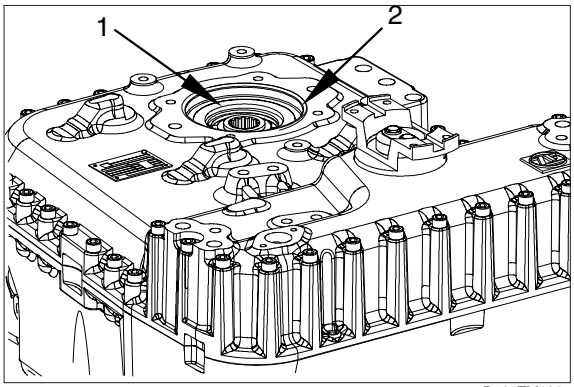
⑬ Install the pump shaft(1) until contact is obtained.



D507TM185

¤ Install the retaining ring(1) and the O-ring(2).

¡ Grease the O-ring

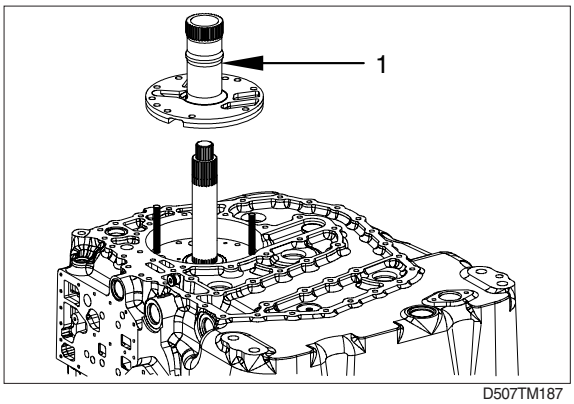


D507TM186

¤1 Install two adjusting screws and mount the stator hollw shaft(1).

¡ Observe the radial installation position.

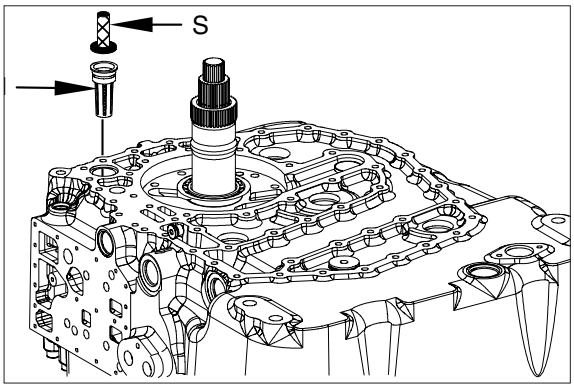
(S)Adjusting screws 5870 204 007



D507TM187

§ Install the converter safety valve(1) until contact.

(S)Drive mandrel 5870 705 012

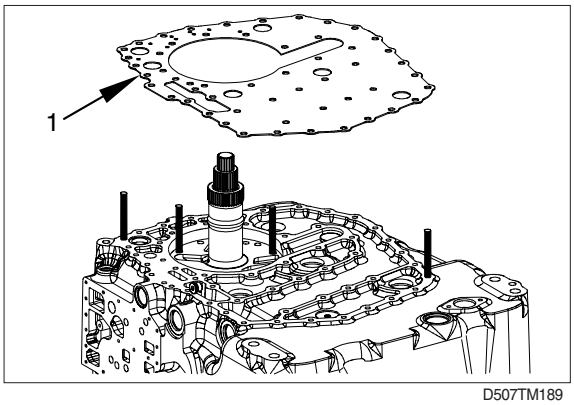


D507TM188

§æ Install two adjusting screws and mount the intermediate sheet(1).

¡ The intermediate sheet has always to be replaced.

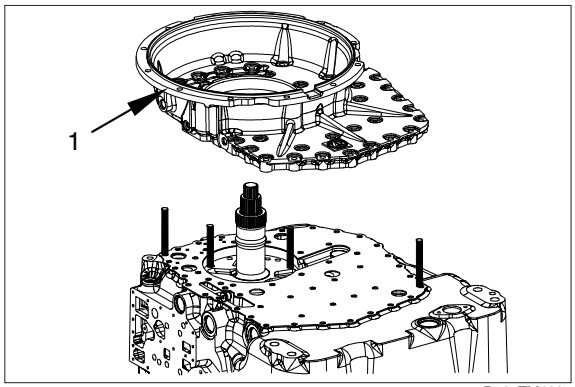
(S)Adjusting screws 5870 204 007



D507TM189

§ Cautiously place the converter bell(1) by means of the lifting equipment to the transmission until contact is obtained.

(S)Eyebolts assortment 5870 204 002
(S)Lifting chain 5870 281 047

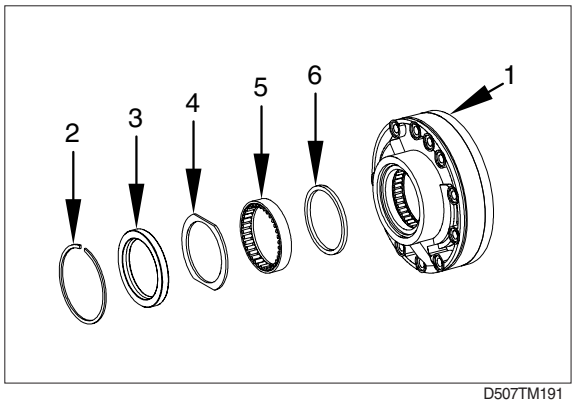


D507TM190

(3) Pressure oil pump

¡ **If running-in marks should be found in the pump housing or on the cam disc, the complete pump has to be replaced.**
¡ **Item 1-6 are allowed to be replaced.**

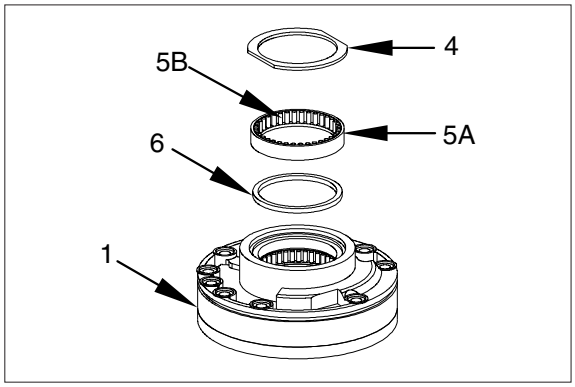
1 = Pump housing with rotor
2 = Snap ring
3 = Shaft seal
4 = Support shim
5 = Needle bearing cpl.(bearing outer ring and needle bearing)
6 = Ring



D507TM191

¤ Install the following parts into the pump housing(1).

6 = Ring
5A = Bearing outer ring
5B = Needle cage
4 = Support shim

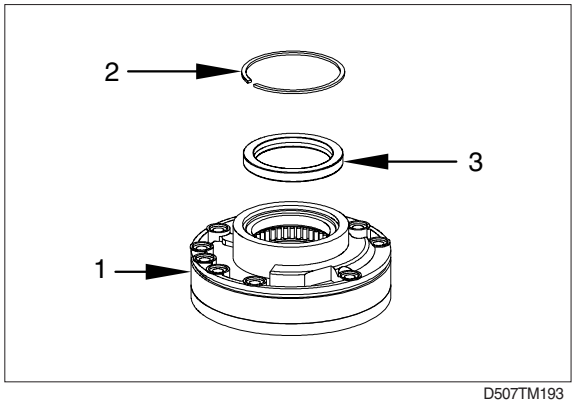


D507TM192

¤£ Cautiously put the shaft seal(3) with the sealing lip showing downwards into the pump housing(1) until contact and fasten it by means of the snap spring(2).

¡ Wet the outer diameter of the shaft seal with spirits.

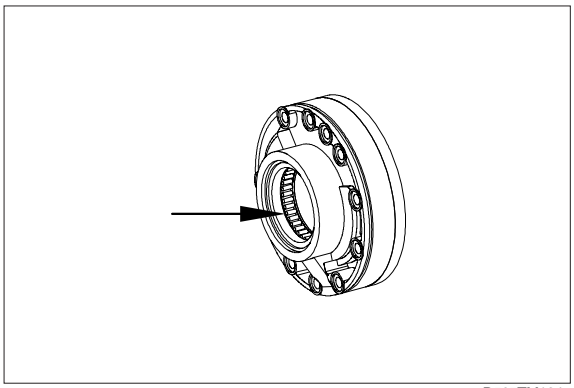
(S)Mounting tool 5870 055 070
(S)Handle 5870 260 002



D507TM193

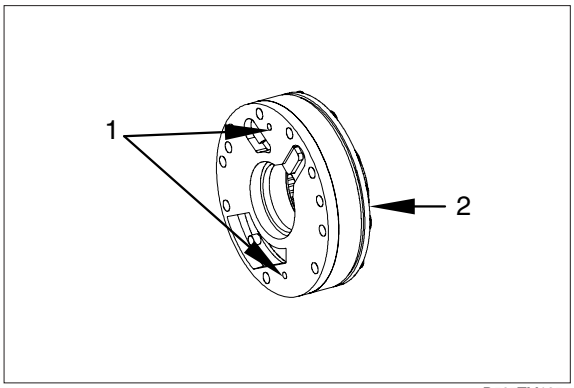
(4) Installation of the external and internal rotor

※ Install the external rotor.
Chamfer shows to the pump base (cannot be seen in the picture).
※ Install the internal rotor.
Gearing(arrow) shows downwards.



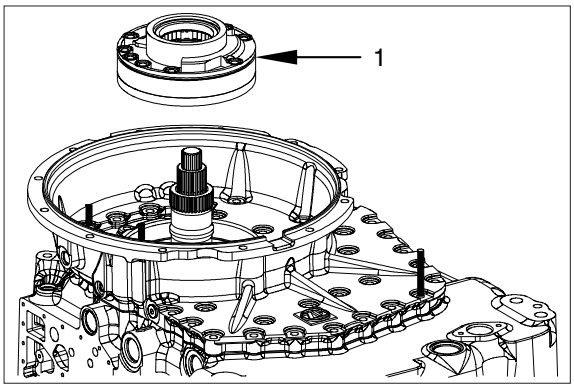
D507TM194

① Put on the cam disc and by means of two cap screws(1) fasten it radially.
※ Do not tighten the cap screws - just turn then in until contact is obtained and then make approx. 1/2 rotation back.
Observe the installation position of the cam disc.
Put the O-ring(2) into the annular groove and oil it.



D507TM195

② Mount the preassembled pressure oil pump(1) and with the cap screws(3pcs.) first place it equally until contact is obtained.
※ Observe the radial installation position.
Then remove the cap screws again.



D507TM196

③ Fasten the converter bell, pressure oil pump and stator hollow shaft together by means of cap screws.

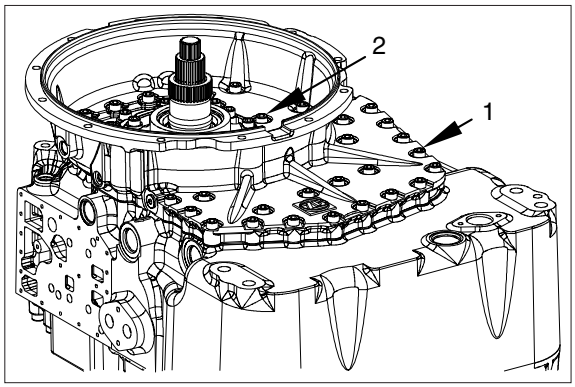
※ **Different bolted connections**.

1 = Bolted connection converter bell/transmission housing rear section.

Tightening torque(M10/8.8) ·· M_A=4.7kg·m

2 = Bolted connect. pressure oil pump/ stator hollow shaft transmission housing rear section.

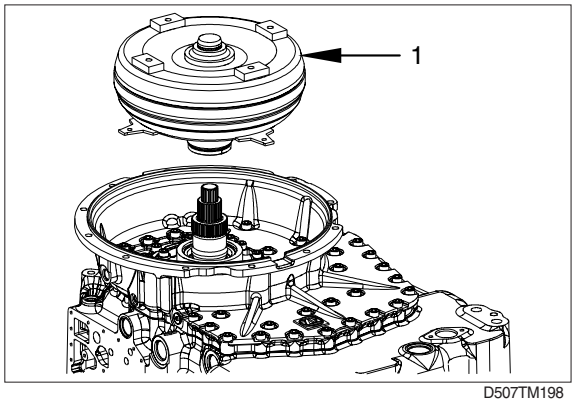
※ **Cap screws with O-rings.**
Grease the O-rings.



D507TM197

④ Mount the converter(1) by means of lifting equipment until contact is obtained.

(S)Eyebolts assortment 5870 204 002
(S)Lifting chain 5870 281 047



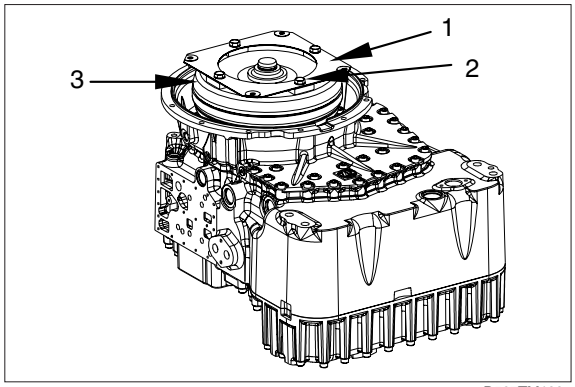
D507TM198

⑤ Fasten the flexplate(1) by means of hexagon screws(2).

※ Install washers between converter(3) and flexplate(1) under the hexagon screws.

※ Lock the hexagon screws with loctite (Type No.262).

Tightening torque(M12/10.9)··· M_A=11.7kg·m

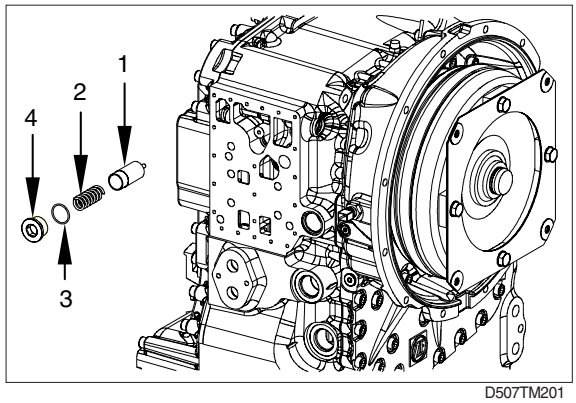


D507TM199

3) Inductive transmitters, valves, oil filters and oil drain plug, screw plugs

① Install the converter pressure back-up valve.
1 = Piston
2 = Compression spring
3 = O-ring(27x2)
4 = Screw plug(30x1.5)

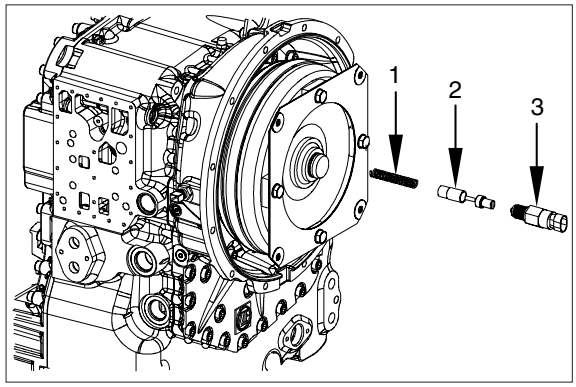
※ Tightening torque ····· M_A=10.2kg·m



D507TM201

② Install the differential pressure switch for the pressure filter.
1 = Compression spring
2 = Piston
3 = Tappet switch

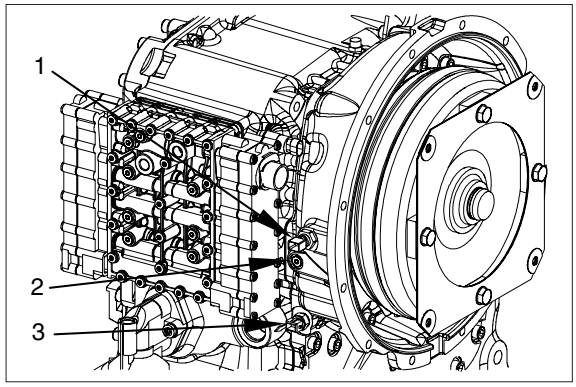
※ Tightening torque ····· M_A=3.1kg·m



D507TM202

③ Installation of:
1 = Inductive transmitter - n Engine
2 = Screw plug M10x1.0
(measuring point pressure after converter)
3 = Temperature transmitter M14x1.5
(measuring point temperature after converter)

※ Tightening torque(1) ····· M_A=3.1kg·m
Tightening torque(2) ····· M_A=0.97kg·m
Tightening torque(3) ····· M_A=2.6kg·m



D507TM203

④ Installation of:

1 = Inductive transmitter - n Internal speed input

2 = Inductive transmitter - n Turbine

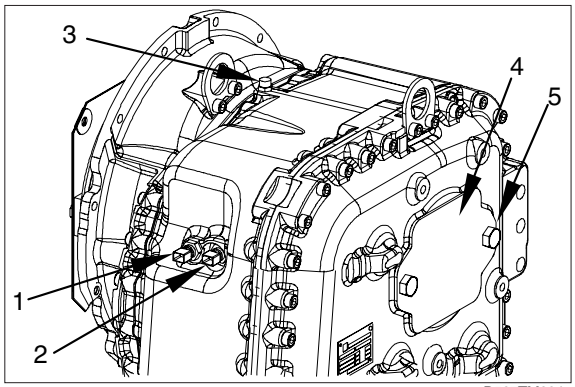
3 = Breather

※ Tightening torque(1 and 2) ·· M_A=3.1kg·m

Tightening torque(3) ····· M_A=1.2kg·m

Fasten the coverplate(4) by means of hexagon screws(5).

Tightening torque(M16/8.8) · M_A=2.6kg·m



D507TM204

⑤ Installation of :

1 = Speed transmitter

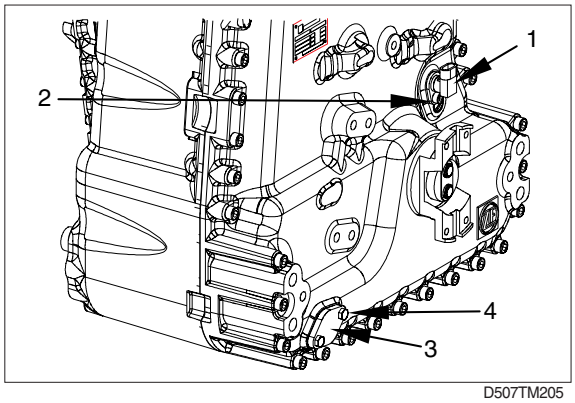
2 = Cap screw

※ Tightening torque(2)(M8/8.8) ·· M_A=2.4kg·m

3 = Install the coverplate(3) with gasket.

4 = Hexagon screw

※ Tightening torque(2)(M8/8.8) ·· M_A=2.4kg·m



D507TM205

⑥ Fasten the oil filler tube(1) with O-ring(2) to the transmission housing by means of the hexagon screws(3).

Turn the oil dipstick(4) into the oil filler tube.

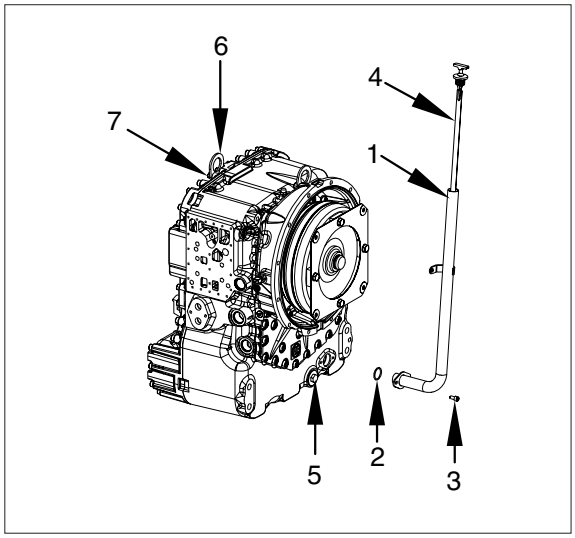
※ Tightening torque(2)(M8/8.8) ·· M_A=2.4kg·m

Install the oil drain plug(5) with the O-ring.

※ Tightening torque ····· M_A=14.3kg·m

Fasten the fixing plate(6) by means of cap screws(7)

※ Tightening torque(M10/8.8) ···· M_A=4.7kg·m

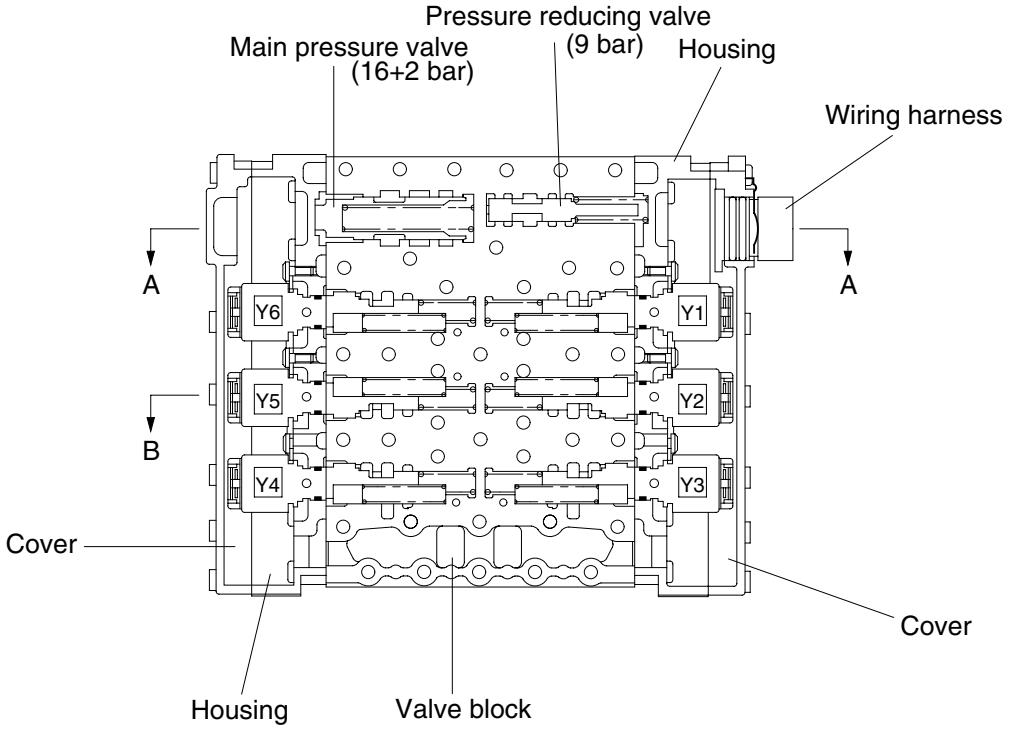


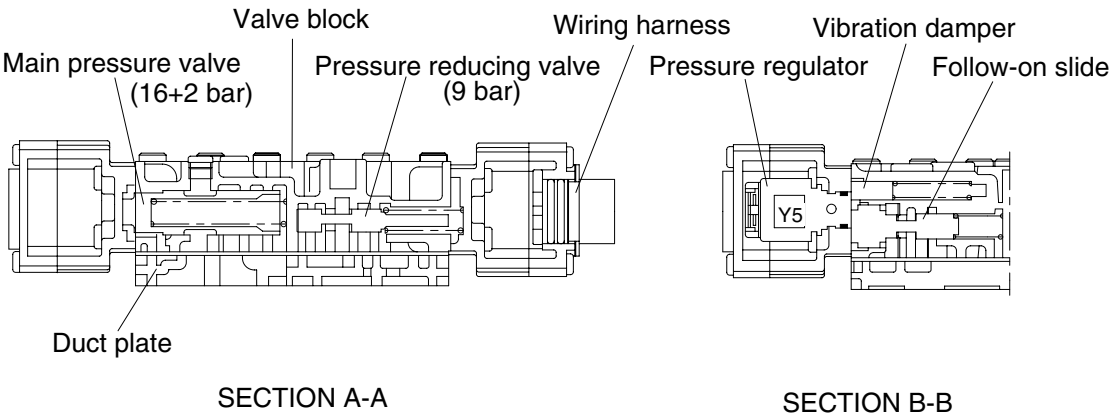
D507TM206

4) ELECTRO-HYDRAULIC CONTROL UNIT WITH PROPORTIONAL VALVES

※ **Different versions as to the positions of the wiring harness are possible.**

· The following sketches shows the sections of the electro-hydraulic control unit.





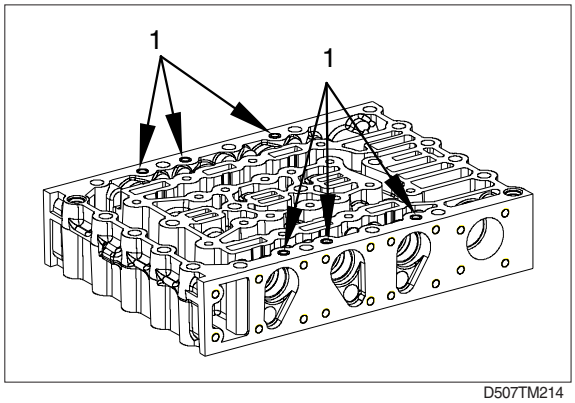
D507TM211

(1) Mounting of the electric control unit

※ All single parts are to be checked for damaged and replaced, if required.
Prior to installation check the mobile parts in the housing for functionality. Piston can be replaced individually.
Oil the single parts prior to installation acc. to the list of lubricants.

① Place the orifices(1) with the concave side showing upwards, until contact.

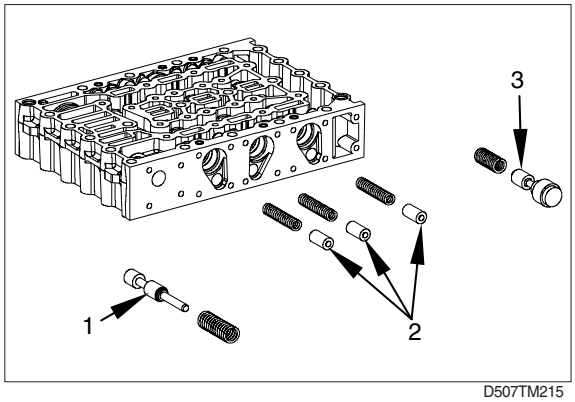
※ Installation position, see arrows.



D507TM214

② The figure on the left shows the following single parts:

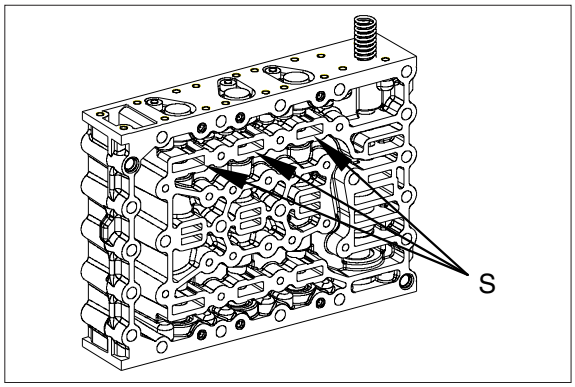
1 = Pressure reducing valve
(1x, piston a. compr. spring)
2 = Vibration damper
(3x, piston a. compr. spring)
3 = Follow-on slide
(3x, piston a. compr. spring)



D507TM215

③ Install the single parts acc to right figure.

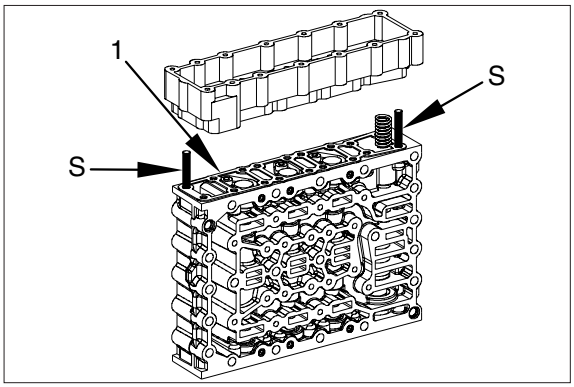
※ Preload the compression springs of the follow-on slides and fasten the piston preliminarily by means of cylindrical pins ø5.0mm(assembly aid), see arrows(s)



D507TM216

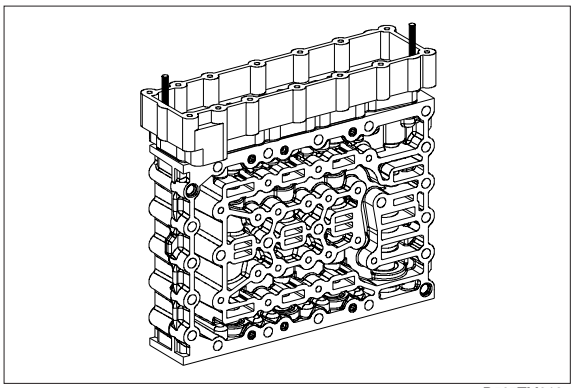
④ Install two adjusting screws.
Assembly flat gasket(1) and housing cover.
Then place the housing cover by means of adjusting screws equally until contact.

(S)Adjusting screws 5870 204 036



D507TM217

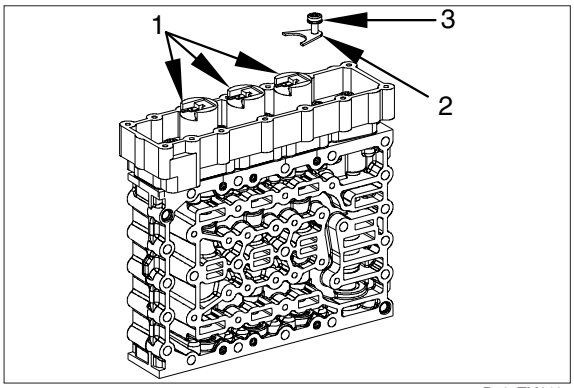
⑤ Preload the pistons with cap screws and remove the cyl. pins(assembly aid)again.


D507TM218

⑥ Fasten the housing cover by means of cap screws(1).

※ Tightening torque ····· M_A=0.56kg·m

(S)Torque spanner 5870 203 031
(S)Reducer 5870 656 056
(S)Socket spanner TX-27 5873 042 002



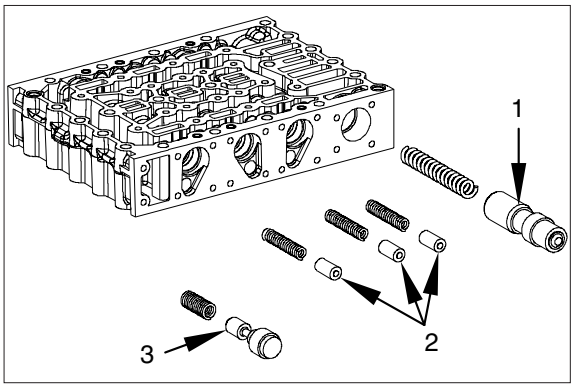
D507TM219

⑦ Mount the pressure regulators(1) and fasten them by means of fixing plates(2) and cap screws(3).

※ **Install the fixing plate with the neck showing downwards**
Observe radial installation position of the pressure regulators.

Tightening torque ····· M_A=0.56kg·m

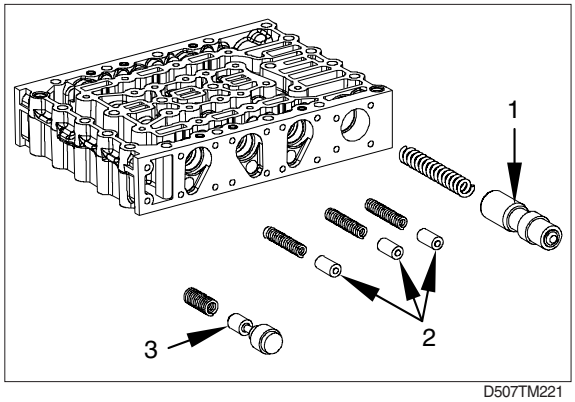
(S)Torque spanner 5870 203 031
(S)Reducer 5870 656 056
(S)Socket spanner TX-27 5873 042 002



D507TM220

· **Preassemble the opposite side**

⑧ The figure on the right shows the following single parts:
1 = Main pressure valve
(1x, piston a. compr. spring)
2 = Vibration damper
(3x, piston a. compr. spring)
3 = Follow-on slide
(3x, piston a. compr. spring)



D507TM221

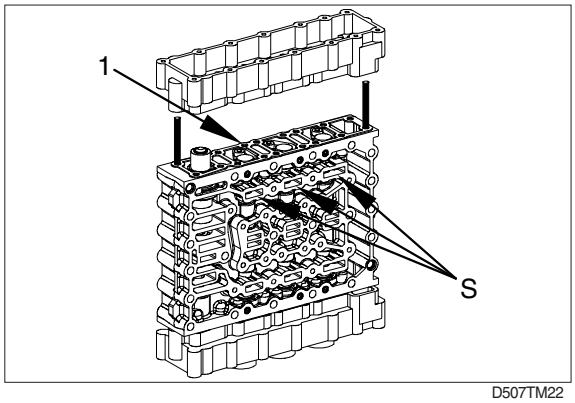
⑨ Install the single parts acc to right figure.

※ **Preload the compression springs of the follow-on slides and fasten the pistons preliminarily by means of cylindrical pins(S) ø 5.0mm(assembly aid), see arrows(S).**

Install two adjusting screws.

(S)Adjusting screws M5 5870 204 036

Assemble flat gasket(1) and housing cover. Then place the housing cover by means of adjusting screws equally until contact.

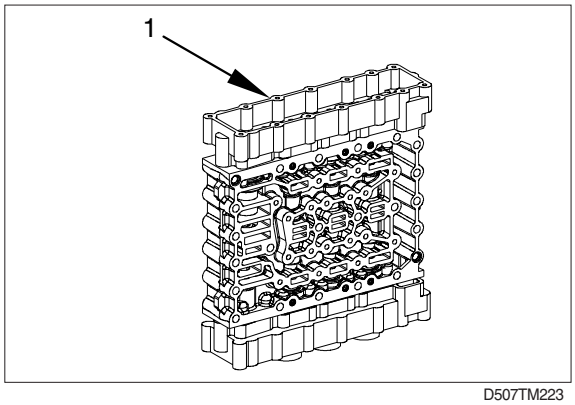


D507TM22

⑩ Preload the pistons with cap screws and remove the cyl. pins(assembly aid) again. Then fasten the housing cover by means of cap screws(1).

Tightening torque ····· M_A=0.56kg·m

(S)Adjusting screws 5870 204 036
(S)Torque spanner 5870 203 031
(S)Reducer 5870 656 056
(S)Socket spanner TX-27 5873 042 002

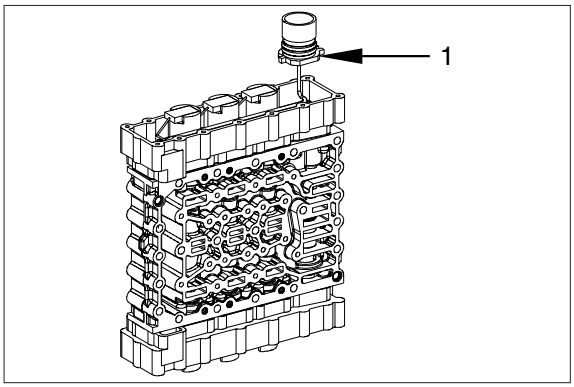


D507TM223

⑪ Mount the pressure regulators(1) and fasten them by means of fixing plates and cap screws.

※ **Install the fixing plate with the neck showing downwards**
Observe radial installation position of the pressure regulators.

Tightening torque ····· M_A=0.56kg·m

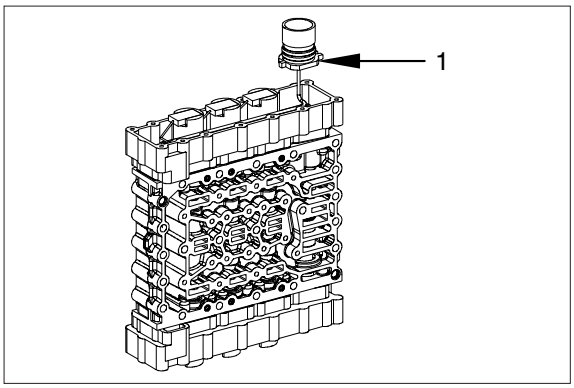


D507TM224

⑫ Assemble the wiring harness(1) and connect the pressure regulators(6x).

※ Installation position of pressure regulators.

※ Pay attention to the installation position of the wiring harness, also see markings ③ page 3-108.

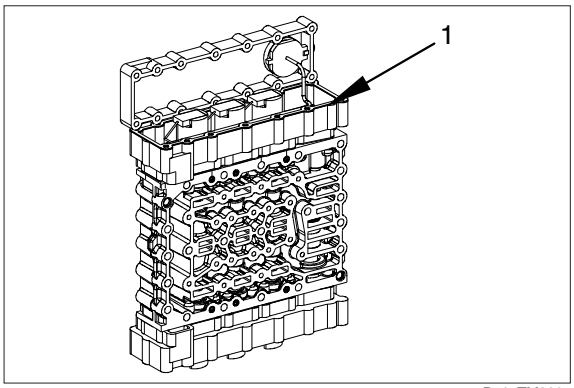


D507TM225

⑬ Put on the plate gasket(1).
Assemble the plug socket with the slot showing to the lug of the cover until contact.
Fasten the cover by means of cap screws.

Tightening torque ····· M_A=0.56kg·m

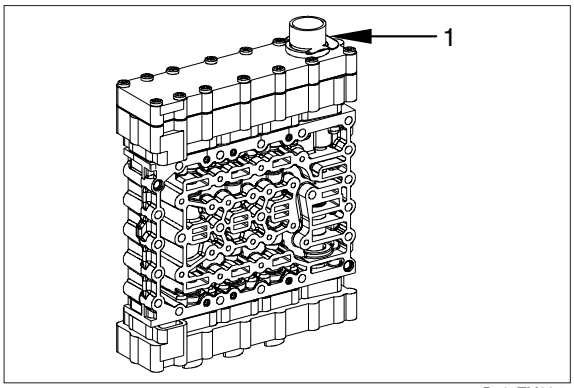
(S)Torque spanner 5870 203 031
(S)Socket spanner TX-27 5873 042 002



D507TM226

⑭ Fix the wiring harness by means of retaining clamp(1).

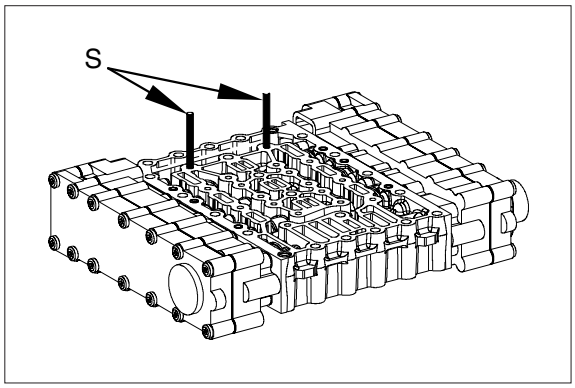
※ Install the opposite cover



D507TM227

⑮ Install two adjusting screws.

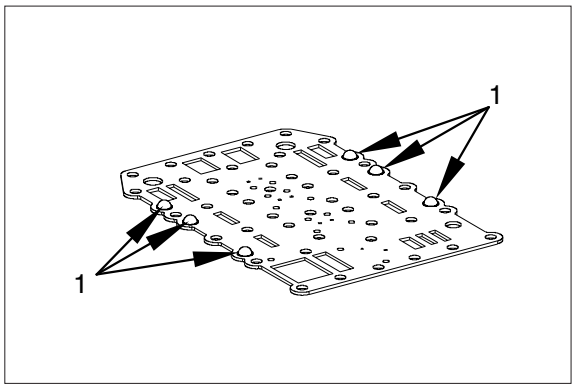
(S)Adjusting screws 5870 204 063



D507TM228

§ Screens(1) are to be flush mounted into the bores of the intermediate sheet, see arrows.

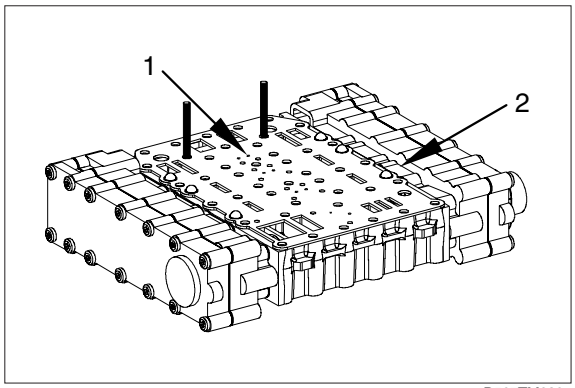
Observe the installation position-the screens are showing upwards(to the duct plate).



D507TM229

§æPut on the intermediate sheet(1)

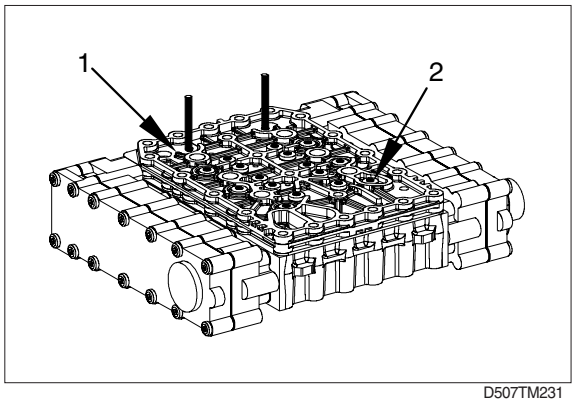
¡ Screens(2) must show upwards.



D507TM230

§ Put on the duct plate(1) and tighten it equally with torx screw(2).

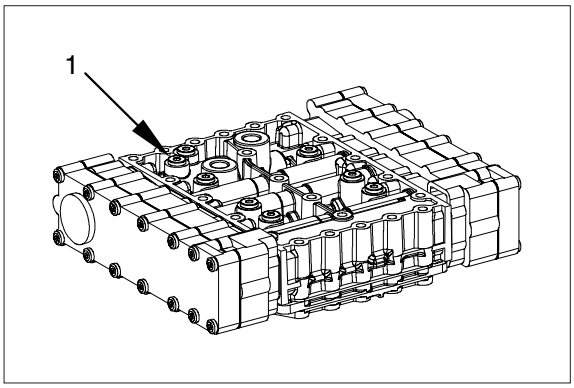
¡ Tightening torque ····· M_A=0.97kg¡ ,m
(S)Socket spanner TX-27 5873 042 002



D507TM231

§ Provide the screw plugs(1) with new O-rings and install them.

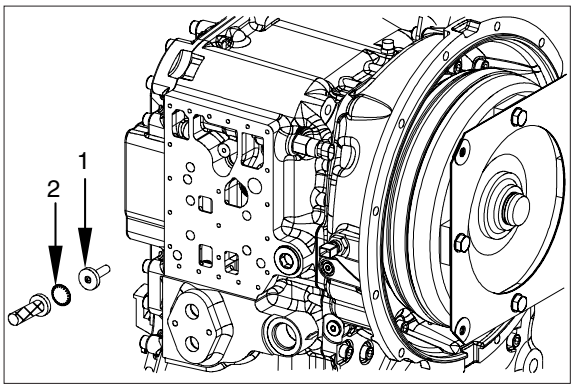
¡ Tightening torque ····· M_A=0.61kg¡ ⁄m



D507TM232

§ Insert the pressure relief valve(1) and lock it with the indented ring(2).

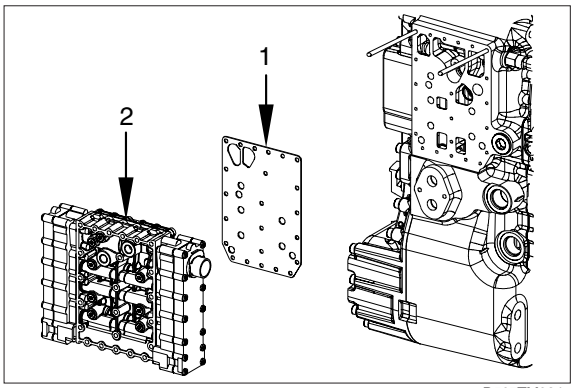
(S)Drive mandrel 5870 705 012



D507TM233

Mount the gasket(1) and the cpl. shift system(2).

(S)Adjusting screws M6 5870 204 063

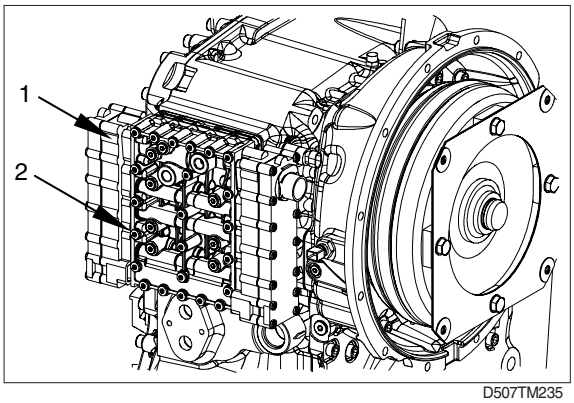


D507TM234

§ Fasten the electro-hydraulic control unit(1) equally by means of Torx screws(2).

¡ Tightening torque ····· M_A=0.56kg¡ ⁄m

(S)Torque spanner 5870 203 031
(S)Reducer 5870 656 056
(S)Socket spanner TX-27 5873 042 002



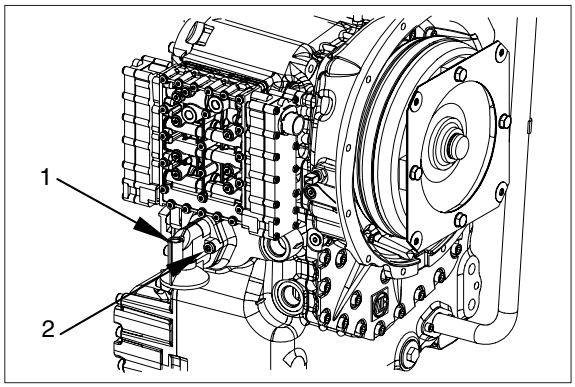
D507TM235

(2) Mounting of the filter(pressure filter)

Fasten the filter head(1) with new O-rings ① by means of cap screws(2) to the transmission housing.

Tightening torque(M8) ····· M_A=2.4kg·m

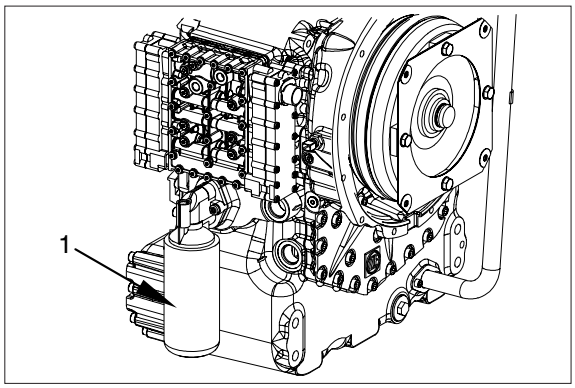
(S)Torque spanner 5870 203 034
(S)Socket spanner TX-40 5870 042 004



D507TM236

⚠ The filter is to be installed as follows:
- Oil the gasket slightly
- Turn in the filter until contact with the sealing surface is obtained and then tighten it by hand with an approx. 1/3 to 1/2 rotation.

Prior to initial operation of the transmission make the oil filling in accordance with the operating instructions.

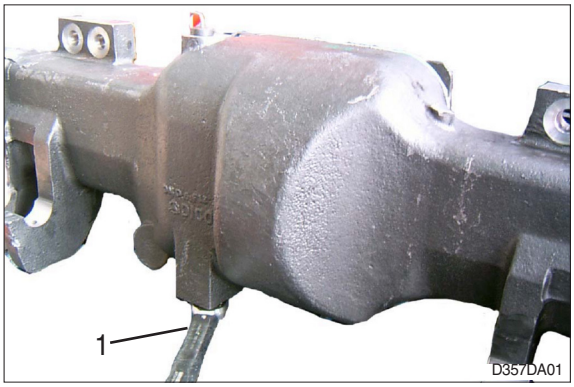


D507TM237

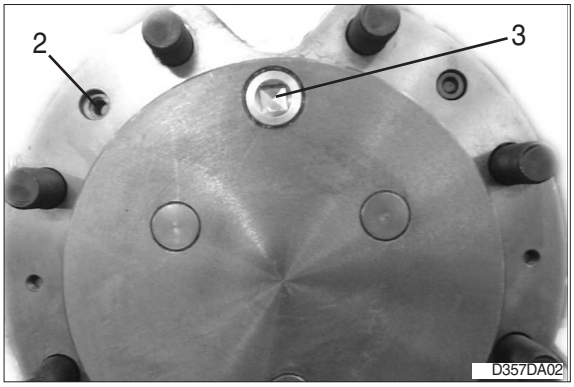
3. DISASSEMBLY OF DRIVE AXLE

1) REMOVAL AND DISASSEMBLY OF WHEEL HUB

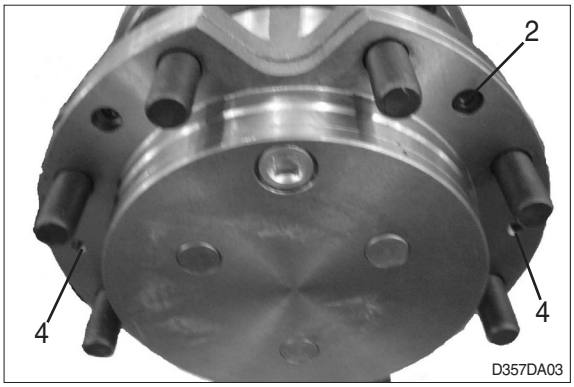
(1) Loosen drain plug with a torque wrench(1) and drain oil.



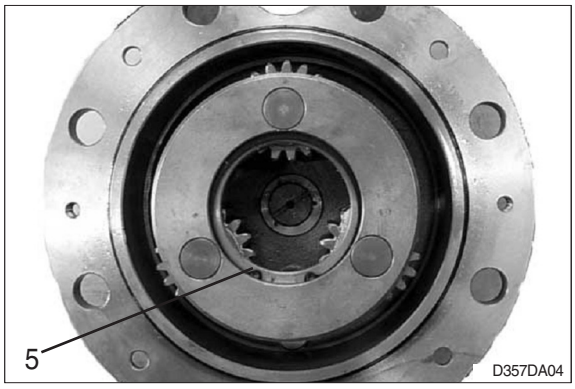
(2) Loosen 4 socket head bolts(2) and a plug(3) from the housing of planetary.



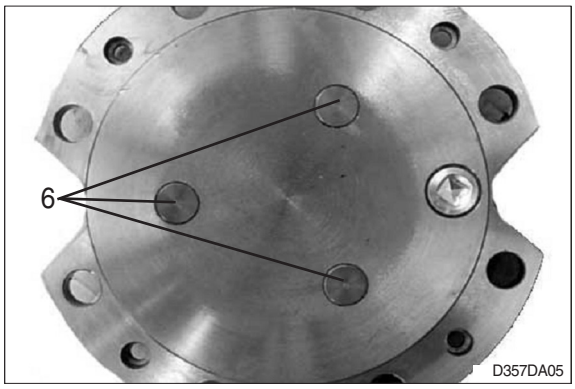
(3) Fit socket head bolt(2) into the 2 tap holes(4) and remove housing of planetary.



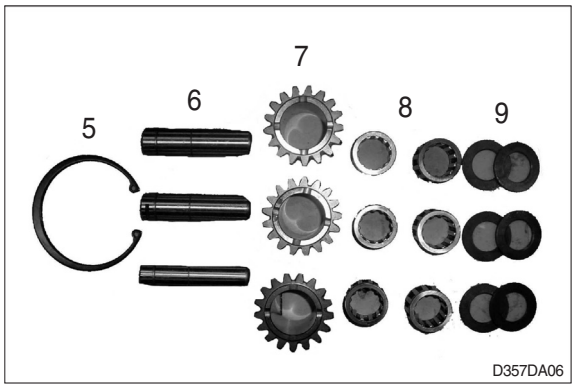
(4) Remove snap ring(5) from the housing of planetary.



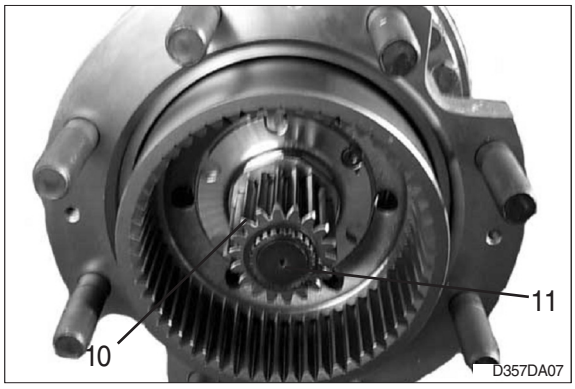
(5) Remove 3 pins(6) with a plastic hammer.



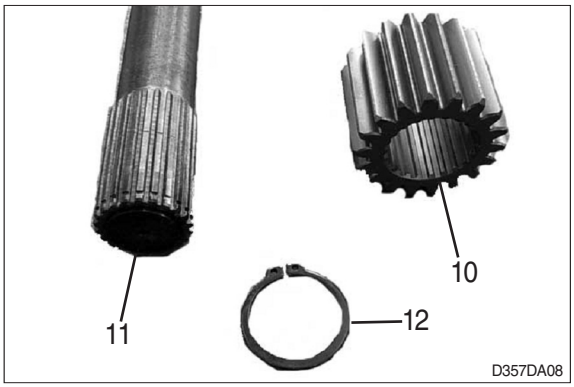
(6) Remove needle bearing(8), planet gear(7) and thrust washer(9).



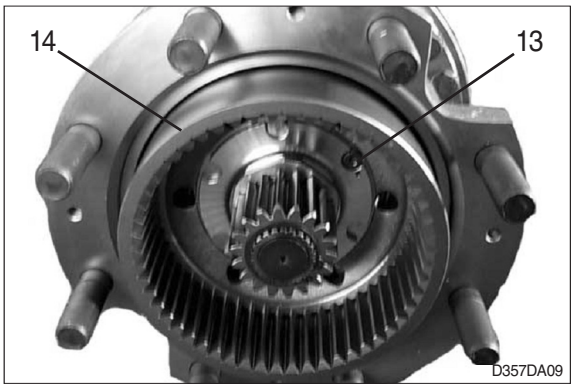
(7) Remove sun gear(10) and drive shaft(11).



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

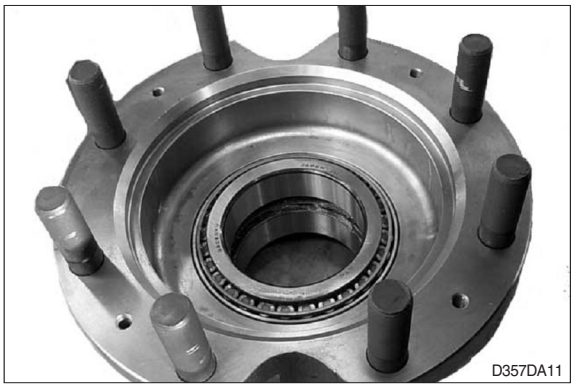


(9) After removing bolt(13), remove ring gear(14) and torque plate assembly from the axle tube.



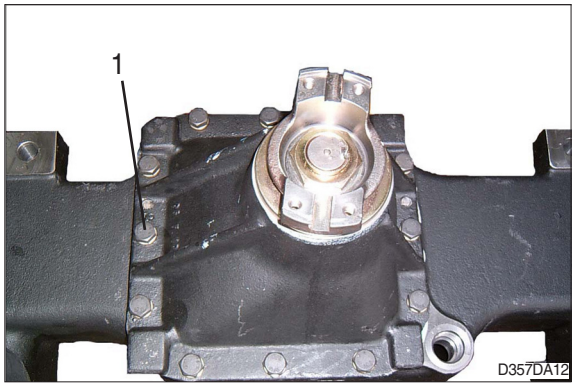
(10) Remove snap ring from the ring gear(14) and disassemble internal gear carrier.

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

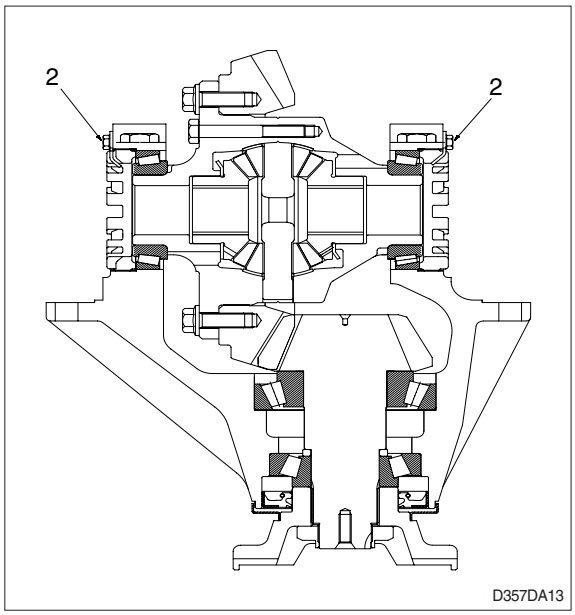


2) REMOVAL AND DISASSEMBLY OF AXLE HOUSING

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

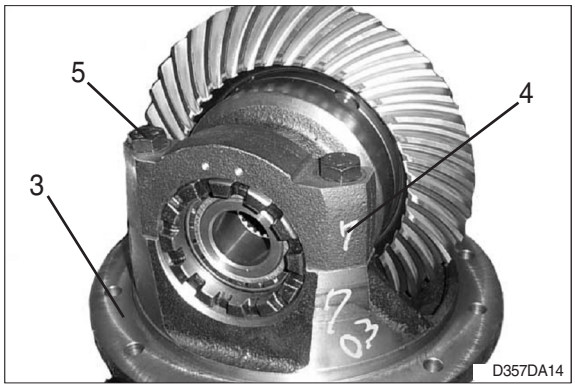


(2) For the reassembly, check rolling resistance and record it. Remove backing plate(2).

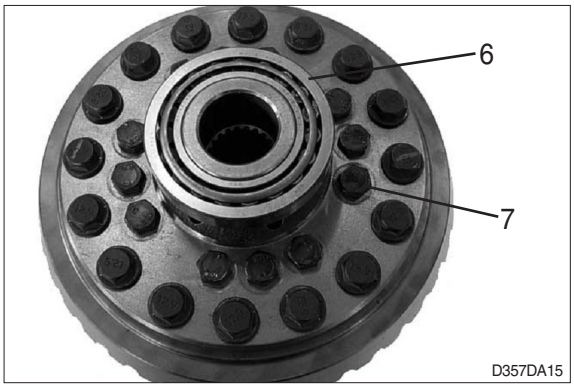


(3) Before removing differential assembly from carrier(3), check the location of cap(4) and mark it for reassembly.

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

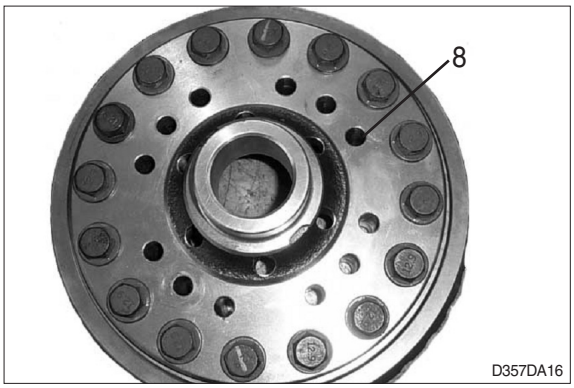


(5) Disassemble bearing(6) from the differential housing and remove 12 bolts (7).



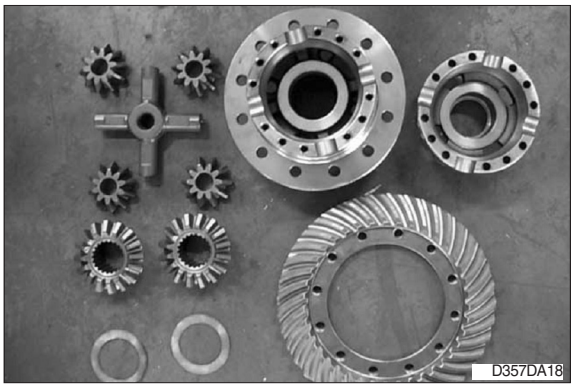
(6) Remove differential assembly from the carrier.

(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.

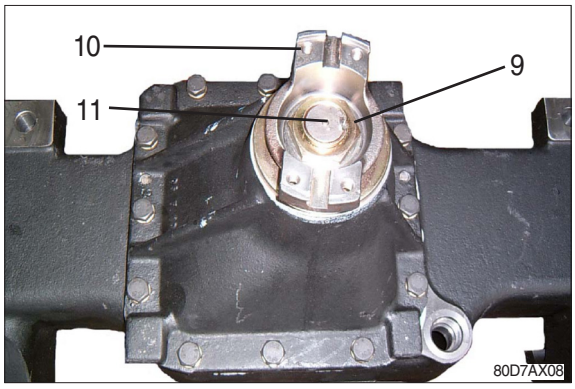
(9) Remove thrust washer, side gear, pinion gear and spider and then place them on the clean bench.



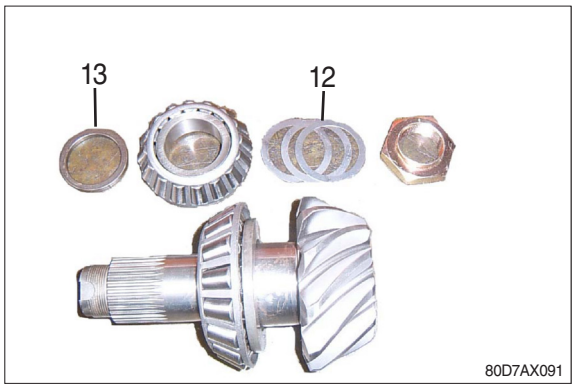
(10)After loosening lock nut(9), remove yoke(11).

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

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

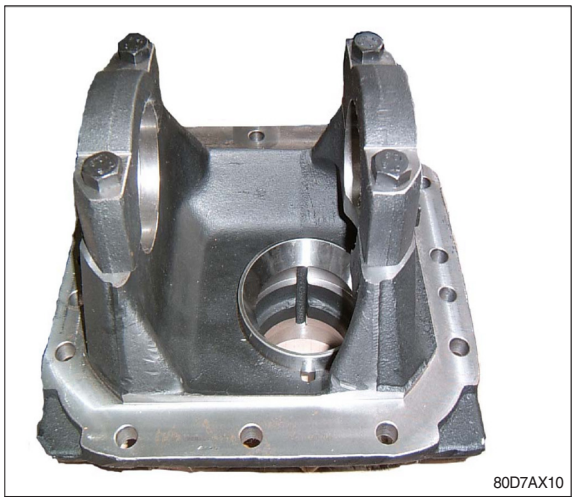


(12)Remove shim(12) and spacer(13) from pinion shaft.
Using a bearing puller, disassemble inner race of taper roller bearing from the pinion shaft.

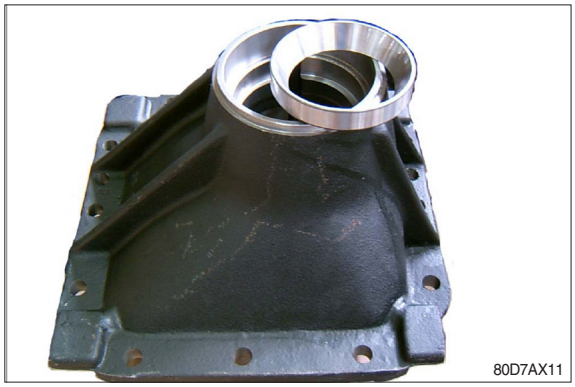


(13)Remove outer race of taper roller bearing and shim from the housing by using a jig and hammer.

※ **Do not reuse damaged shims.**



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



4. 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.

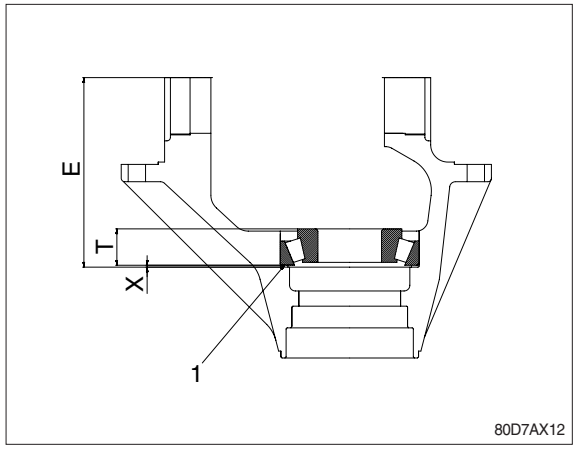
- Check wear, damage or crack for all the parts and replace if needed.
- If the teeth of gear are damaged, replace it as a set.
- Replace damaged tapered roller bearing.
- Do not reuse deformed shims or worn thrust washers.
- Rasp off the seal contacted surface.

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).

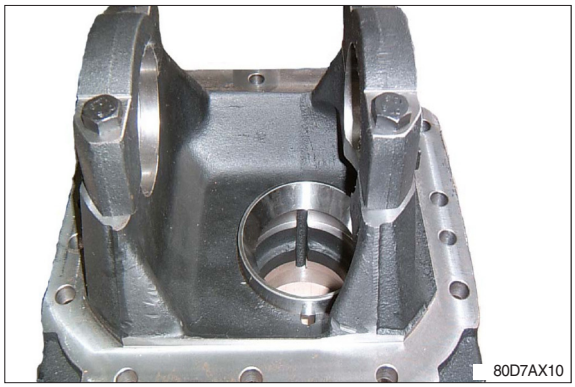
B : Mounting dimension of bevel pinion shaft , 133.20mm (5.2 in)
T : Height of bearing.
C : Dimension of carved seal on the pinion. If there's no carved seal **C**=0.



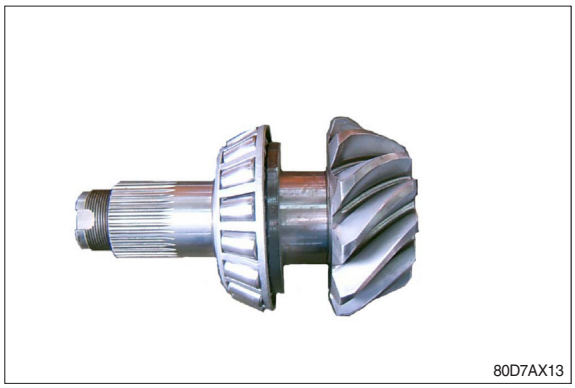
EX) : From the housing
"**E**" = 162.95mm (6.4in)
B is factory dimension
"**B**" = 133.20mm (5.2in)
From the bearing
"**T**" = 29.25mm (1.2in)
Carved seal on the pinion
"**C**"= 0.05mm (0.002in)
Shim thickness :
"**X**" = 162.95 -133.20 - 29.25 + 0.05
= 0.55mm (0.022in)

※ **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.



(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.

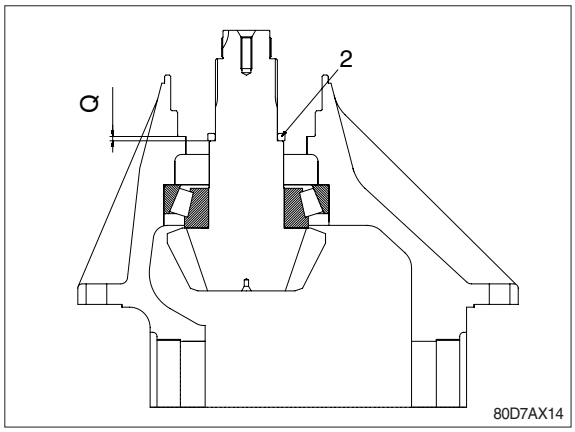


· **Measuring play of bevel pinion shaft end**
Measure shim thickness by following method.
Dimension "**Q**" : Distance from bearing outer race surface to spacer surface.
Dimension "**S**" : Distance from bearing outer race surface to inner race surface.
From the below equation, define required shim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

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

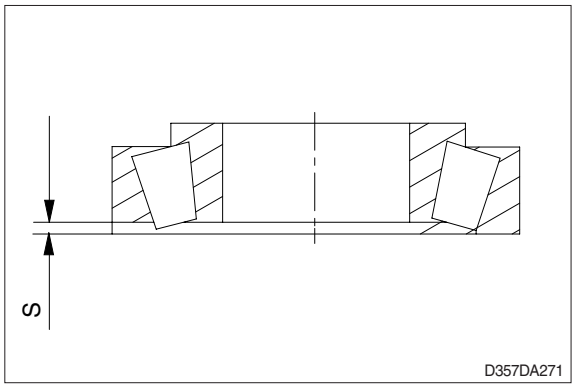
EX) : From the bearing
S = 2.25mm (0.09in)
From the housing
Q = 3.15mm (0.12in)
Required shim thickness **Z** :

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



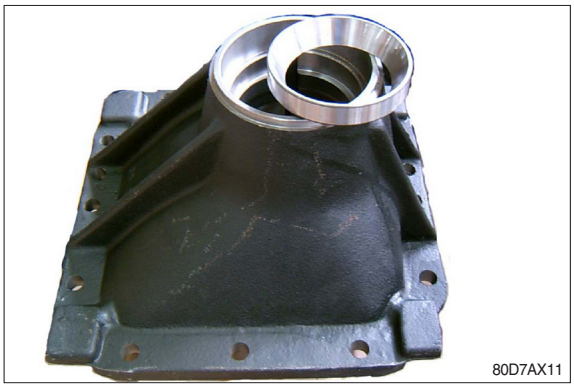
Unit : mm(in)

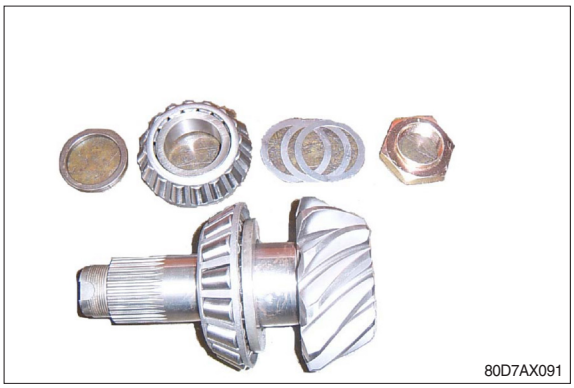
P	Q	Z
2.25(0.089)	3.15(0.124)	5.40(0.213)
2.30(0.091)	3.15(0.124)	5.45(0.215)
2.35(0.093)	3.15(0.124)	5.50(0.217)
2.40(0.094)	3.15(0.124)	5.55(0.219)
2.45(0.096)	3.15(0.124)	5.60(0.220)



2) ADJUSTMENT OF PINION SHAFT

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

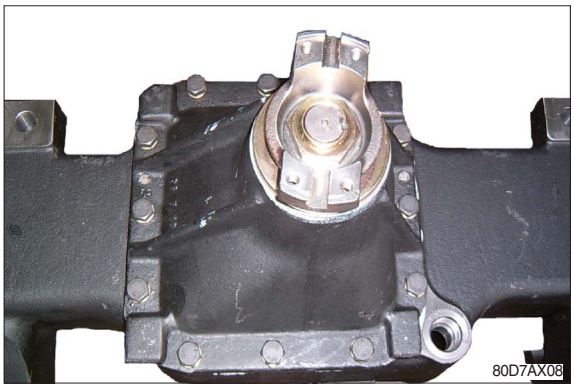




(2) Insert pinion shaft into the carrier.
Assemble bearing cone, yoke and lock nut.

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

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



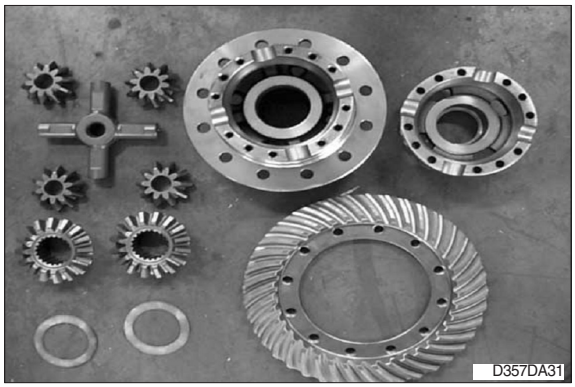
Measure rolling resistance of pinion shaft.
Adjust shim thickness.

· 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.

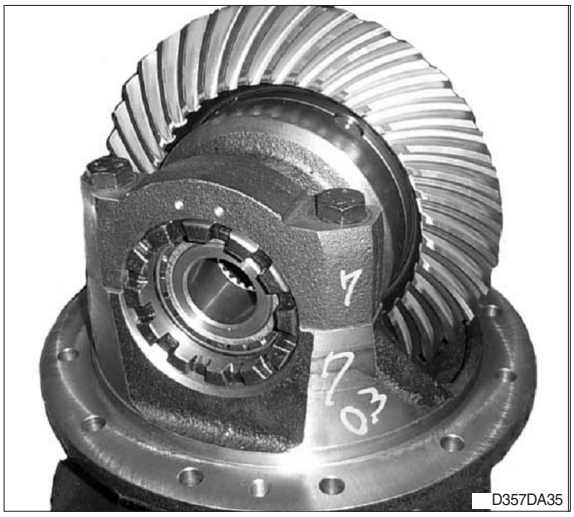
· Tightening torque : 5.0~7.5kgf · m
(36~54lbf · ft)

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

· Tightening torque : 12.5~14.5kgf · m
(90~105lbf · 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 : 15.0~17.0kgf · m (108~123lbf · 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 : 15.0~17.0kgf · m(108~123lbf · 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 0.80~1.20 kgf · m(5.8~8.7lbf · ft).

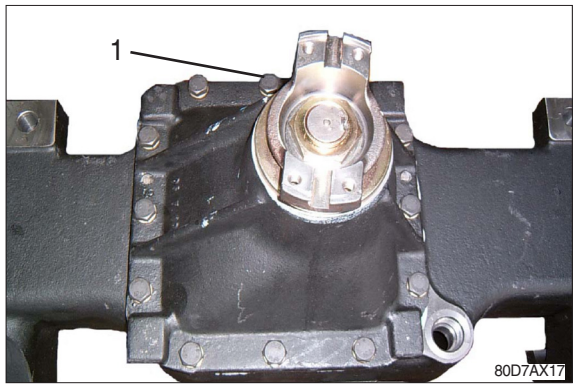
※ **Assemble opposite side with the same methods.**

(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 11~13kgf · m(79.6~94.0lbf · ft).

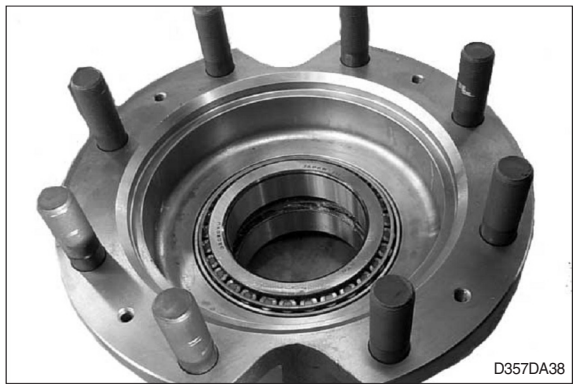


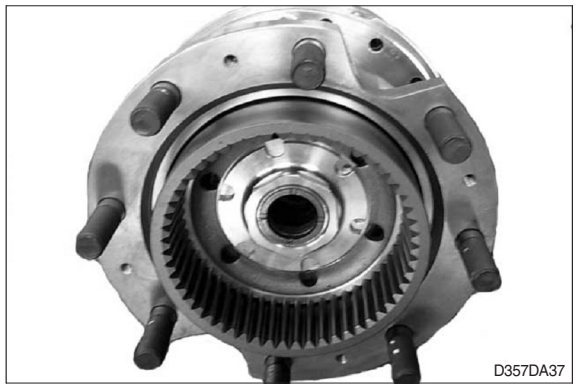
5) ASSEMBLY OF WHEEL HUB

(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.**

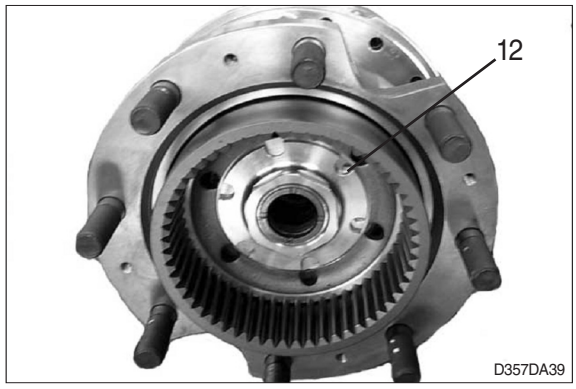
(2) Install wheel hub assembly to the tube flange of axle completely.
Install bearing cone.





(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 on the tapped side of bolt(12) and tighten at the tightening torque of 1.5~1.7kgf · m(108~123lbf · ft).

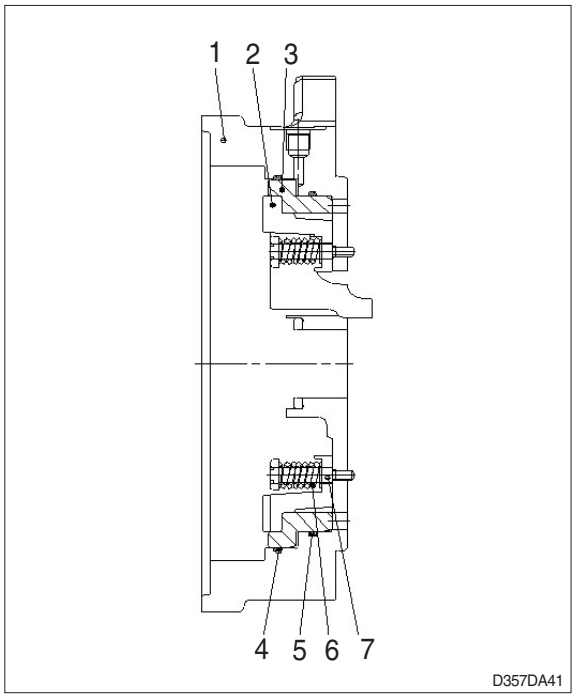
Apply grease on the bushing.



(4) 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.

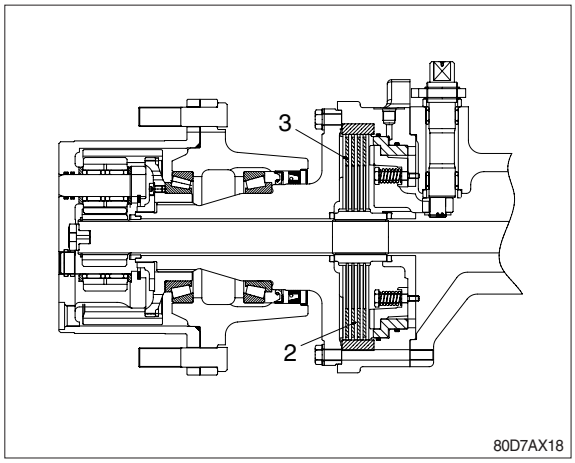
③ Disk must be assembled after 12 hours of infiltrate.(MOBILFLUID #424)

④ After assembling plate and disk, confirm that the tolerance with brake housing surface is 2.1~2.6mm(0.08~0.10in).
(Spindle protrusion is 1.4mm(0.06in) and operation stroke of plate(8) and disk(9) assembly is 1.0~1.5mm(0.04~0.06in))

⑤ After tightening the bolt(10), confirm that parking lever(11) stroke is 17~32mm (0.67~1.26in) 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)

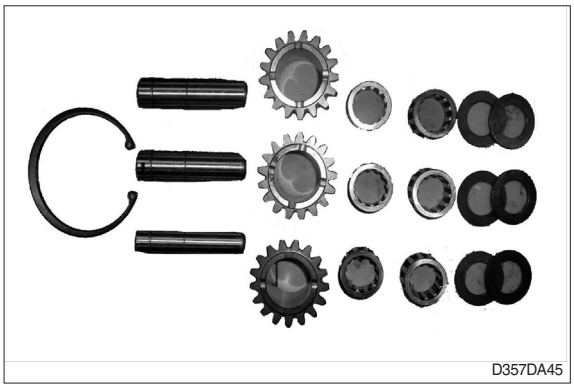
Spline	Parking lever operation distance
1 pitch	17(0.67)

(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

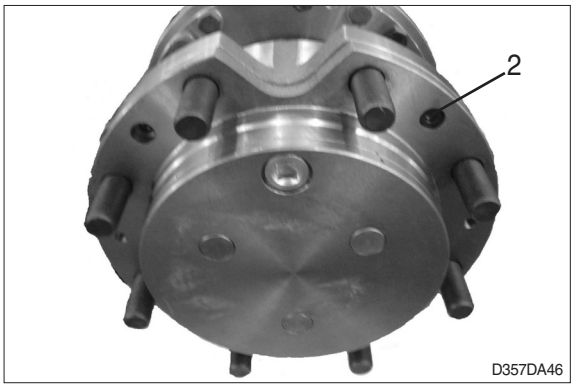
(6) Assemble internal components of planetary carrier in the reverse order to disassembly.


D357DA44


D357DA45

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

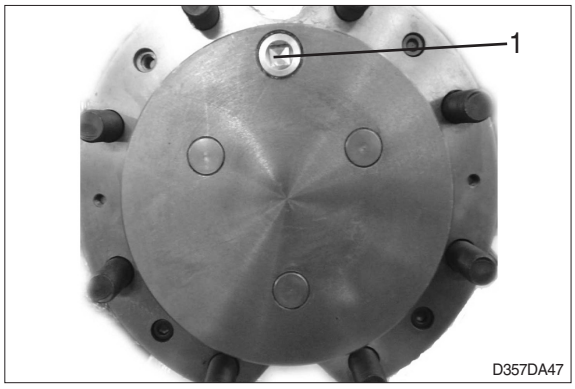
· Tightening torque : 2.5~4.0kgf · m
(18.1~28.9lbf · ft)



D357DA46

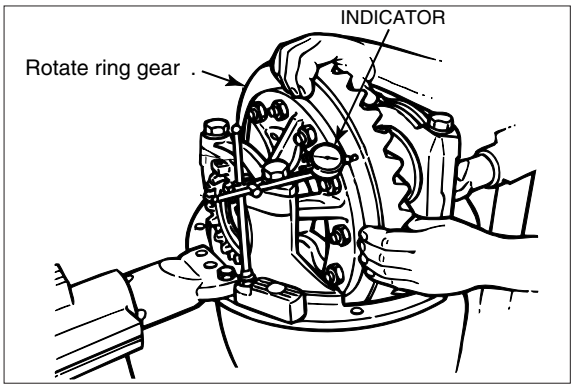
(8) Assemble wheel hub and tighten plug(1).

· Tightening torque : 3.5~6.0kgf · m
(25.3~43.4lbf · ft)



1. Checking the ring gear backface runout

Runout specification : 0.20㎜(0.008-inch) maximum



D507AX53

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

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

2. Adjusting the gearset backlash

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

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

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

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

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

3) Hold the drive pinion in position.

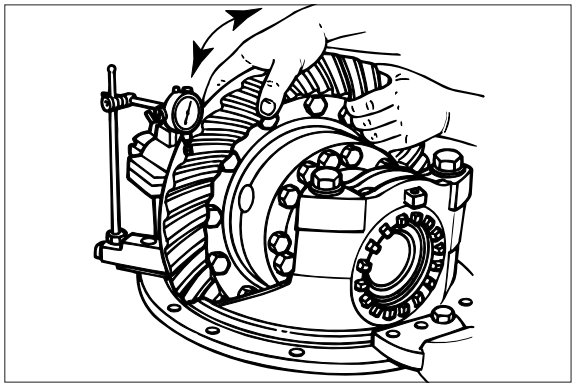
4) Read the dial indicator, while rotating the ring gear a small amount in both directions, against the drive pinion teeth.

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

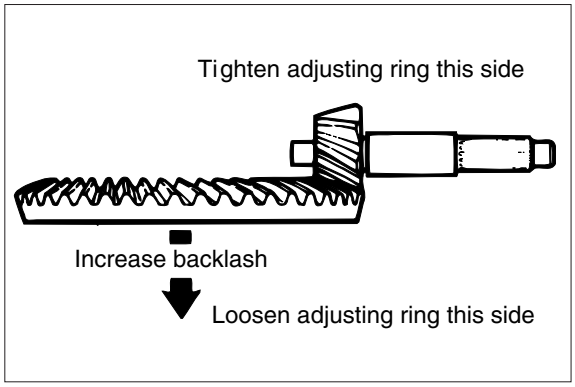
5) If the backlash reading is within specification, continue checking tooth contact patterns.
Otherwise, adjust backlash. Refer to step 6), and check, following steps 1)-4).

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

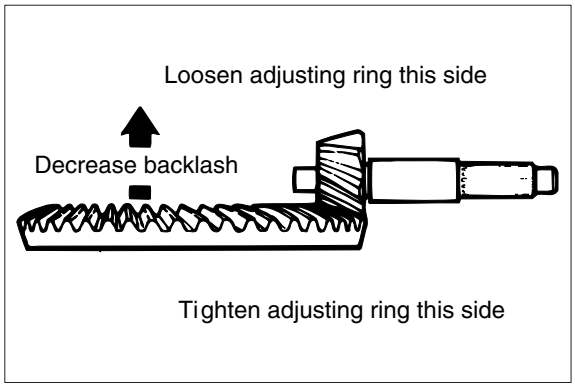
6) Loosen one bearing adjusting ring one notch, then tighten the opposite ring the same amount.



D507AX54



D507AX55

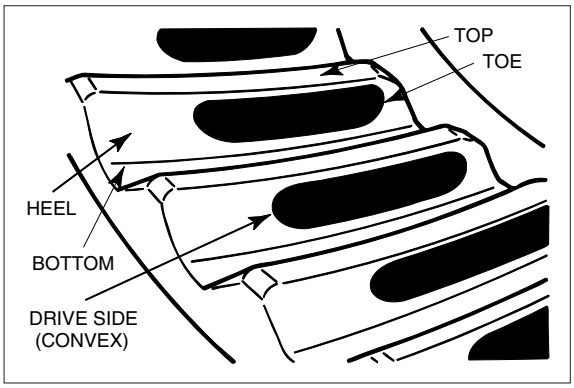


D507AX56

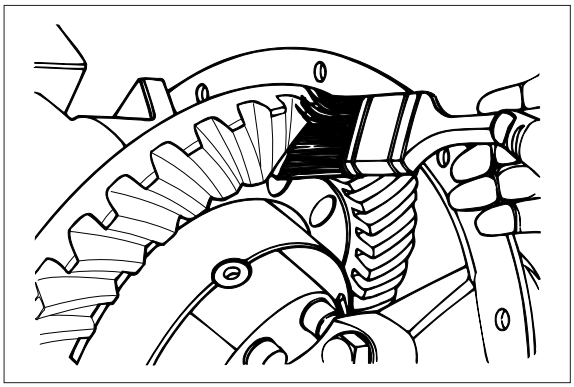
3. ADJUSTING TOOTH CONTACT PATTERN OF THE GEARSET

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

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



D507AX57



D507AX58

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

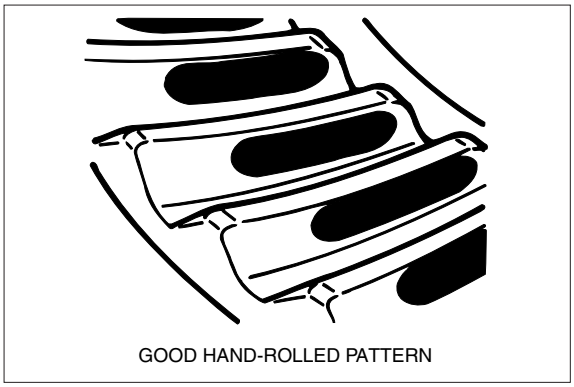
3) Compare the contact patterns.

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

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

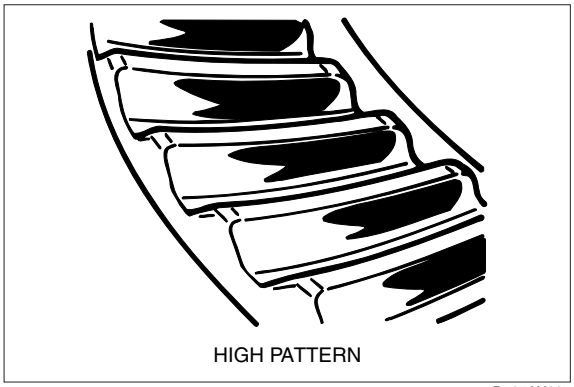
If the contact patterns require adjustment along the width of tooth(top/bottom), follow steps 4)-5).

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



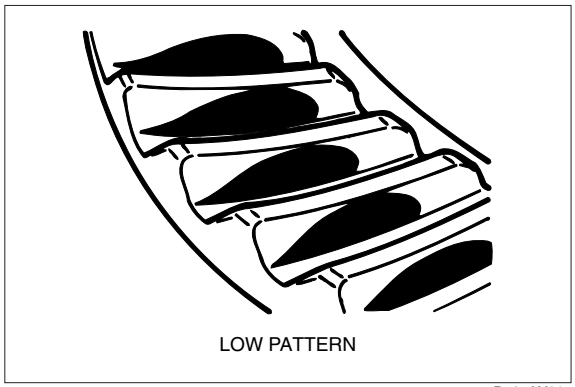
GOOD HAND-ROLLED PATTERN

D507AX59



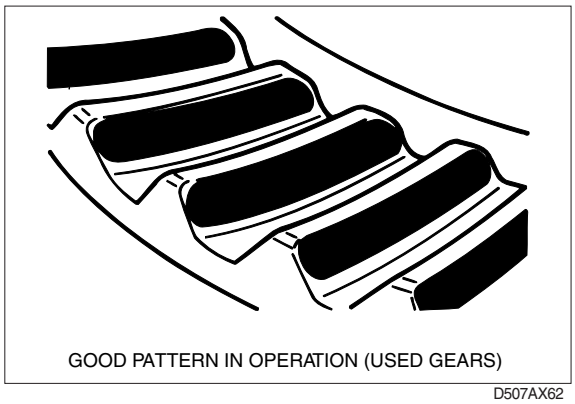
HIGH PATTERN

D507AX60



LOW PATTERN

D507AX61

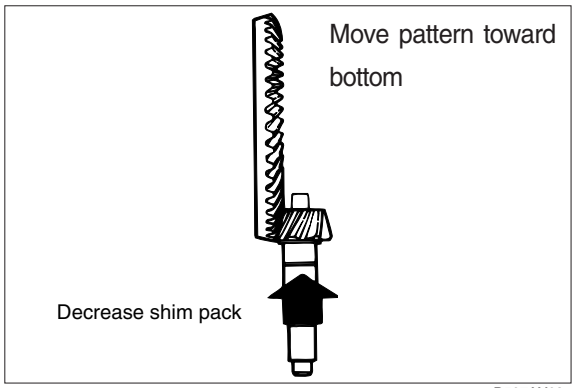


GOOD PATTERN IN OPERATION (USED GEARS)

D507AX62

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

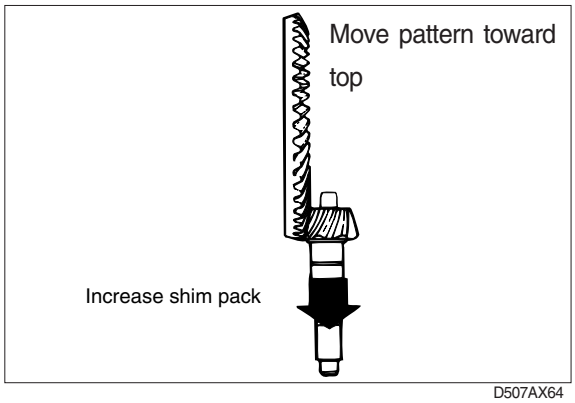
To correct, move the pinion toward the ring gear by decreasing the shim pack between pinion spigot and inner bearing cone. Refer to "Assembling the pinion bearing cage".



D507AX63

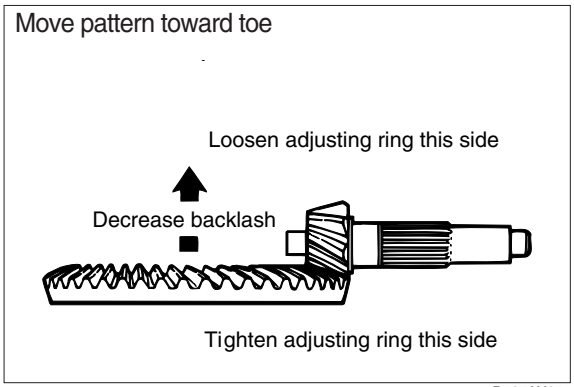
5) **Low pattern :** A low contact pattern indicates that the pinion was installed too deep into the carrier.

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



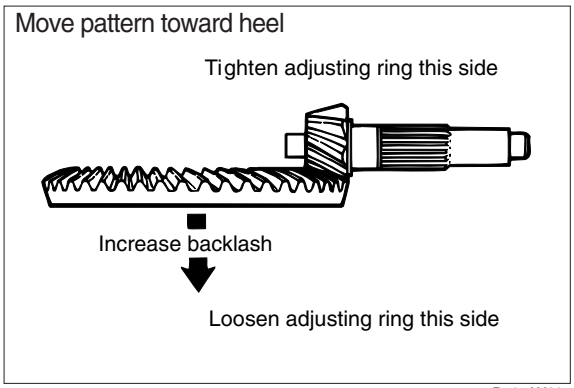
D507AX64

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



D507AX65

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



D507AX66

SECTION 4 BRAKE SYSTEM

SECTION 4 BRAKE SYSTEM

GROUP 1 STRUCTURE AND FUNCTION

1. OUTLINE

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

In the foot (wheel) 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 wheel brake assembly.

The wheel brake is the duo-servo type. With force applied to both the primary and secondary shoes, this type provides a large amount of brake force.
In addition, the brake equipped with automatic adjusters which constantly adjust the clearance between the shoe and the drum, compensation for wear due to the shoe friction and thus keeping the clearance constant.

2. SPECIFICATION

1) WET DISC BRAKE

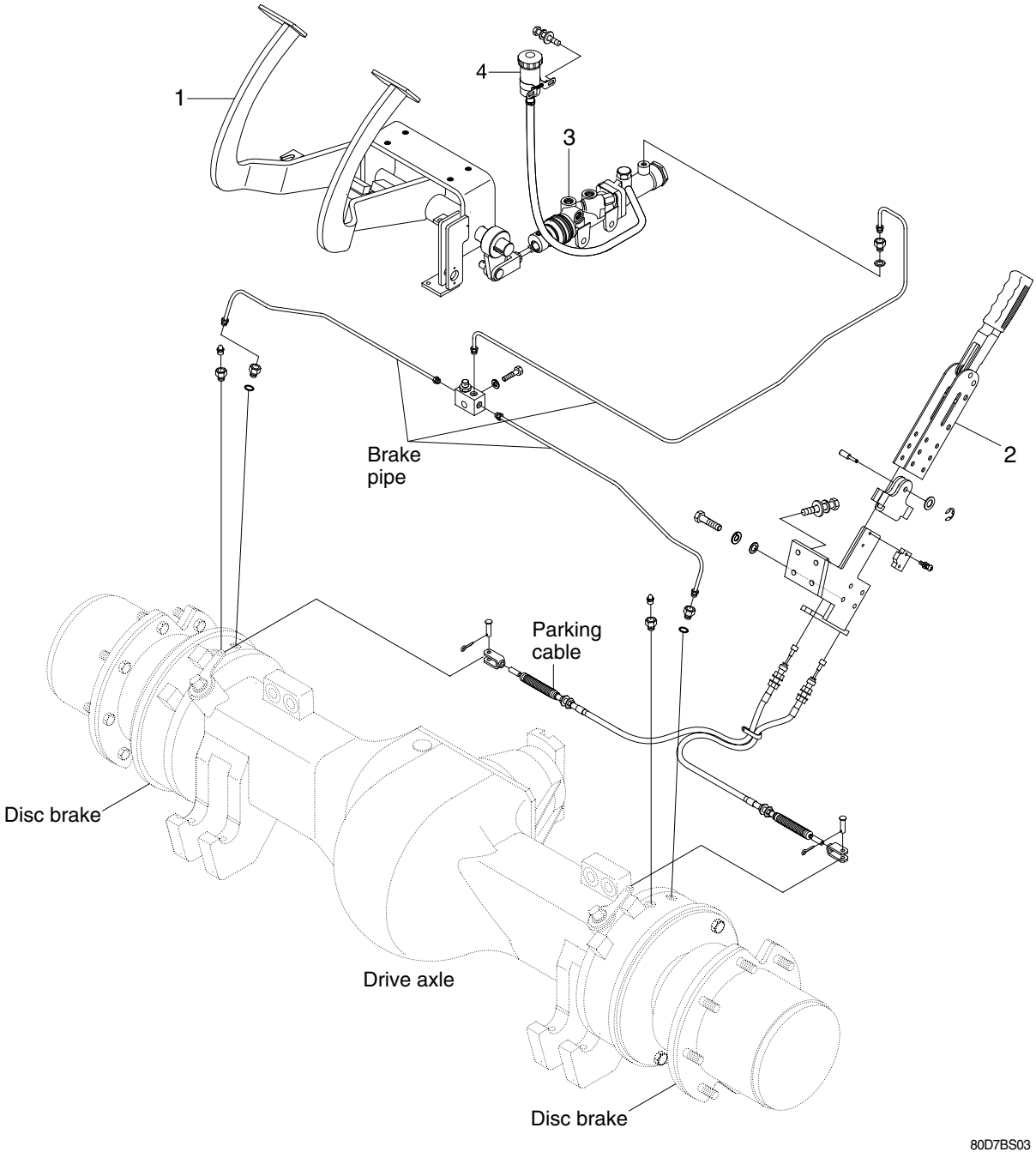
Item		Specification
Type		Wet disk brake
Master cylinder diameter		40mm (1.6in)
Pedal adjustment	Pedal height	122~128mm (4.8~5.0in)
	Idle stroke	4.0~6.5mm (0.15~0.26in)
Brake oil		AZOLA ZS10 (SAE 10W hydraulic oil)

2) PARKING BRAKE

Item	Specification
Type	Toggle, internal pushing mechanical type
Parking lever stroke	322mm
Parking cable stroke	48mm

3. BRAKE PEDAL AND PIPING

1) STRUCTURE



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

2) DO AEB WORK

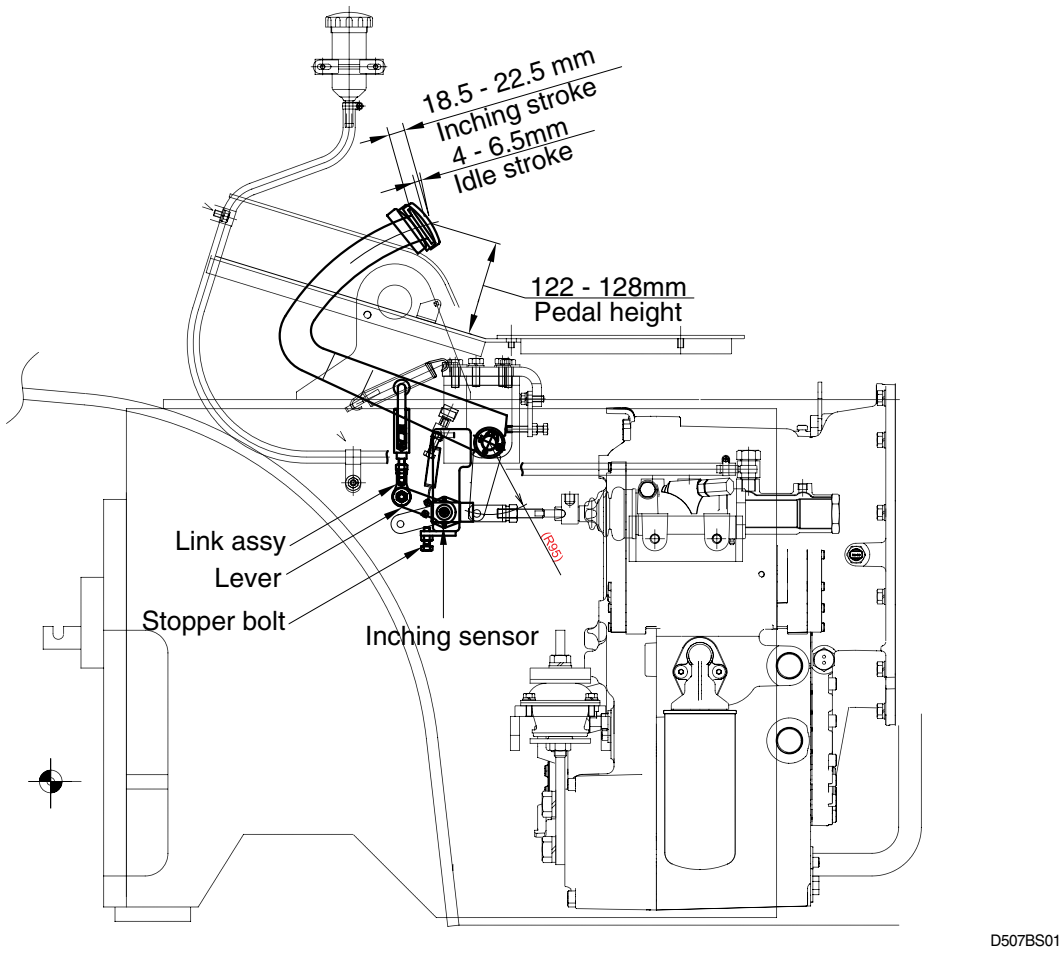
(1) Start engine after parking the machine on flat floor and blocking wheels.
(2) Release parking brake.
(3) With stepping on the service brake, operate T/M STALL(3 stage).
(To avoid defect of clutch pack, repeat 10 sec of operation and 10 sec of placing neutral)
(4) When the T/M oil temperature reaches 75~80° C, lock the parking brake and then shift gear to neutral position to keep the machine at LOW RPM.
(5) Connect the AEB STARTER to T/M controller.
(6) Push AEB STARTER over 3 seconds.
(7) Confirm the status of AEB from the DISPLAY.
- Normal operation shows "ST, KR, KV, K1, K2, K3" orderly for 3~5minutes.
- After the successful completion, it displays " OK".
- With a new controller, it may display "F6" error code before AEB, but after AEB, it will disappear.

(8) In case of abnormal running, it may display "STOP" with the appropriate error code.
(9) After troubleshooting, start the machine again to repeat above.

※ As the STALL operation has to be done, the SERVICE BRAKE must be locked perfectly to avoid the fatal accident.

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.



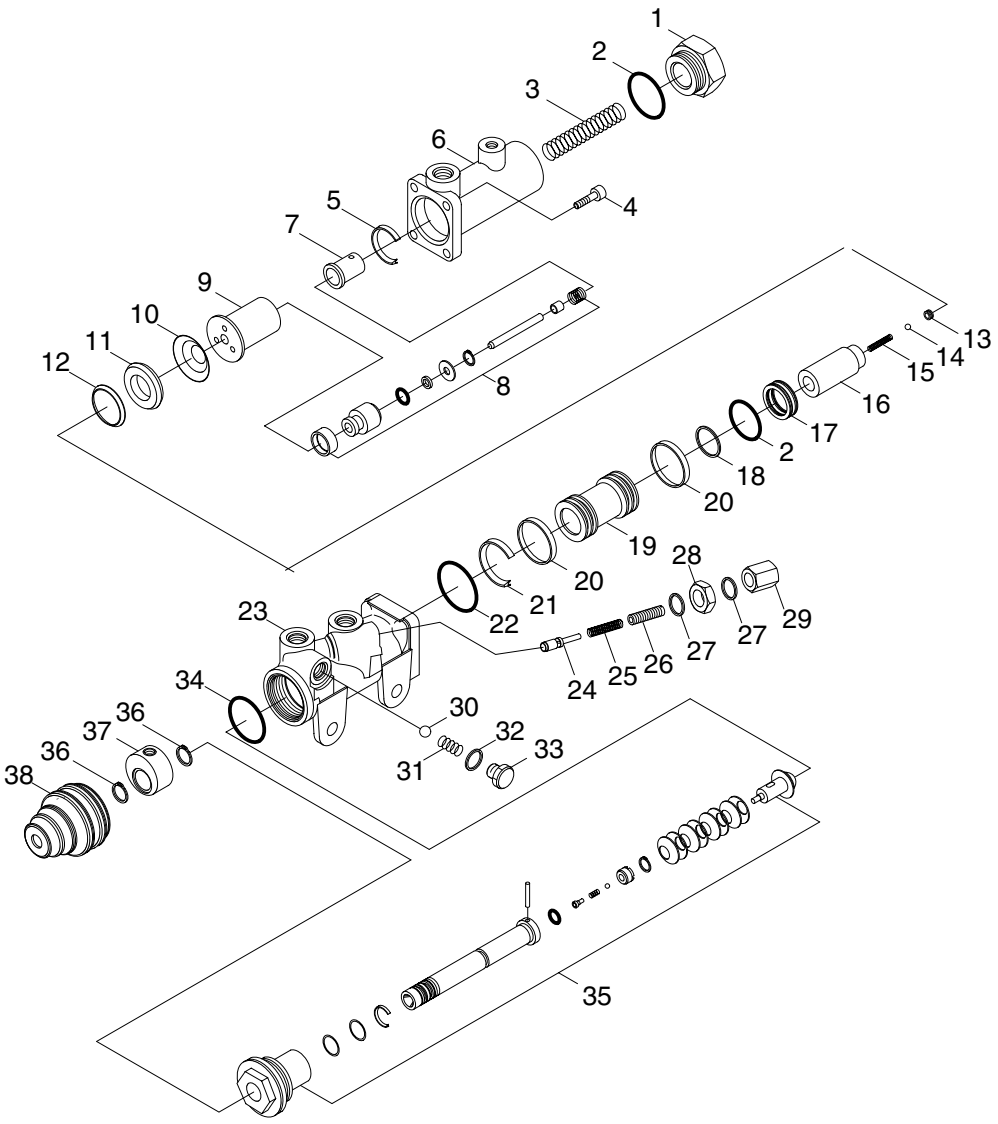
1) INITIALIZING THE INCHING SENSOR

(1) Start engine after parking the machine on flat floor and blocking wheels.
(2) Release parking brake and keep neutral gear shift.
(3) Adjust the inching sensor linkage so that the regular voltage is supplied to inching sensor when operating the pedal.
(Regular voltage ; Before pedal operation(1±0.1V),
After pedal operation(3.5±0.1V))
(4) Stop the engine and then just KEY ON.(Release parking brake, keep neutral gear)
(5) Connect the AEB STARTER to the T/M controller.
(6) Push AEB STARTER over 3 seconds.
(7) If display shows "▼IP", Step on the pedal fully.
(8) If display shows "▲IP", release "OK"
(9) After the successful completion, it displays "OK".
(10) In case of abnormal running, it may display "STOP" with the appropriate error code.
(11) After troubleshooting, start the machine again to repeat above.

※ Above works are to be done with the parking brake released, so machine's wheels must be blocked for safety.

5. BRAKE VALVE

1) STRUCTURE



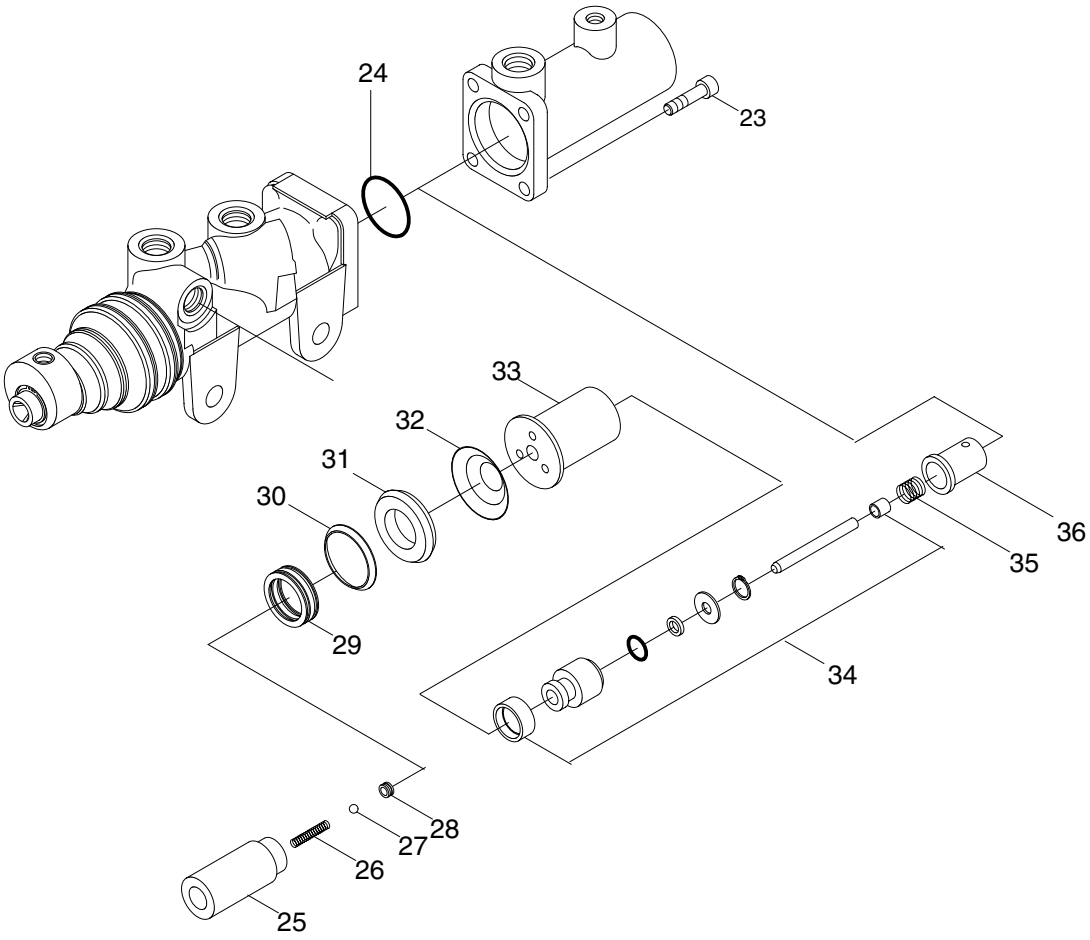
D507BS42

1	Plug	11	Seal	21	Seal	31	Spring
2	Seal	12	Ring	22	Seal	32	Seal
3	Spring	13	Seal	23	Booster housing	33	Plug
4	Screw	14	Ball	24	Relief valve body	34	Seal
5	Seal	15	Spring	25	Spring	35	Push rod
6	B/Cyl Housing	16	Auxiliary piston	26	Adjustment screw	36	Stop ring
7	Spring guide	17	Ring	27	Washer	37	Connector
8	Valve	18	Seal	28	Nut	38	Dust cover
9	Piston	19	Booster piston	29	Plug		
10	Spring	20	Sliding guide	30	Ball		

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(23), in order to separate the booster from the braking cylinder housing, separate the two parts and remove the components that are inside from(25) to(36), in order to remove spring(26) and ball(27), you should remove seal(28) from piston containing the seal(25).

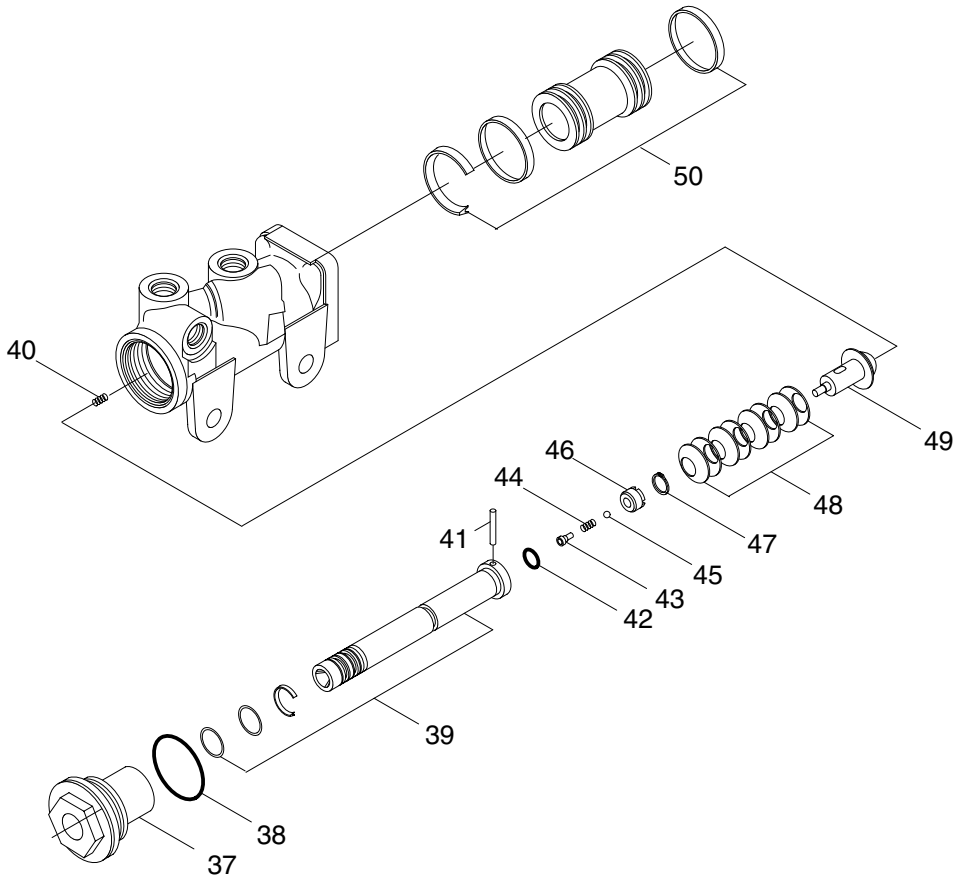


D507BS43

(2) Unscrew guide cap(37) and then remove O-ring(38), rod(39), spring(40) and the piston(50).
Once rod(39) has been removed, take out pin(41) and all the components that are inside the rod from(42) to(49).

(3) Remove the lip seal inside the brake cylinder housing by means of on L-Iron.
Remove all other seals from the disassembled components, namely drive(39), piston(50), O-ring housing(29) and valve(34).

(4) Clean all the components thoroughly and check that there is no ribbing inside the position slide cylinder(50) of the brake cylinder housing ; Smooth if necessary.
Lubricate the components, particularly the seals by mean of proper oil, or better with grease suitable for ATE(Automatic test equipment) braking systems. Take great care not to contaminate components operating on brake fluid with mineral oil and vice-versa.



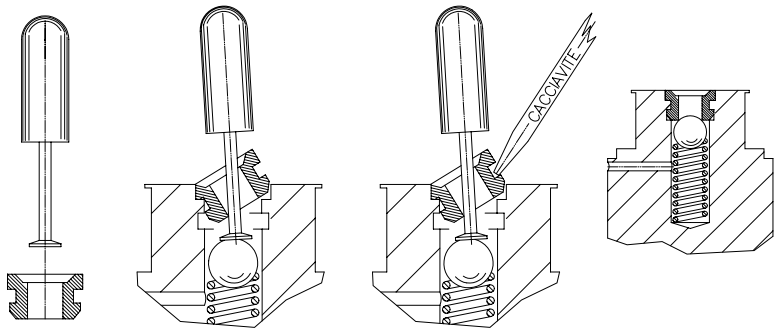
D507BS44

3) ASSEMBLY

※ **The assembly procedure must be carried out by following the sequence described before in reverse order, taking great care not to fit the new seals back to front or upside down.**

(1) In order to fit the valve inside the piston containing the seal(25) following these instructions.

Fit the seal into the appropriate tool and press ball and spring into the seat;
Fit one end of the seal (as shown in the picture) and then fit the rest of the seal with a screwdriver.
Make sure that the seal is fitted proplely by inserting the screwdriver into the hole and by checking that seal is not misshappen in any way.

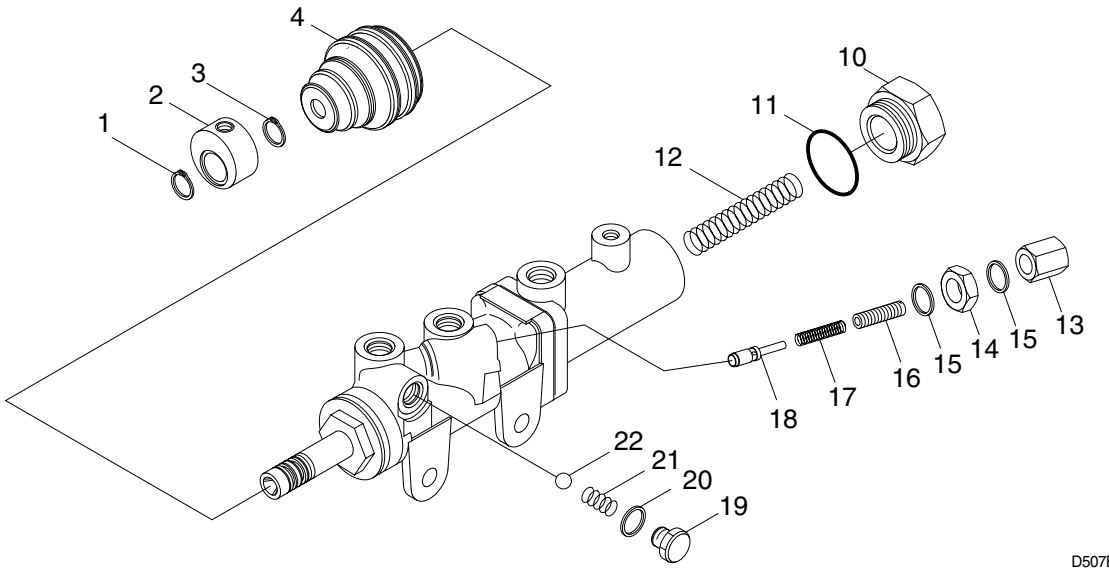


D507BS52

4) SEALS REPLACEMENT IN BRAKE CYLINDERS WITH HYDRAULIC BOOSTER

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

(1) After disassembling retaining ring(1), accumulator fitting(2) and then the second retaining ring(3), remove rubber cap(4).
Then disassemble the check valve composed of parts(19~22) and the relief valve composed of parts(13~18) only in case of failure.
Unscrew rear cap completely(10) by making sure that it's not being disconnected abruptly; remove then O-ring (11), spring (12).



D507BS45

- **SEAL KIT : ZTAX-00040**

⚠ **Use only brake fluid(SAE10W) in the compensation reservoirs.**

GROUP 2 OPERATIONAL CHECKS AND TROUBLESHOOTING

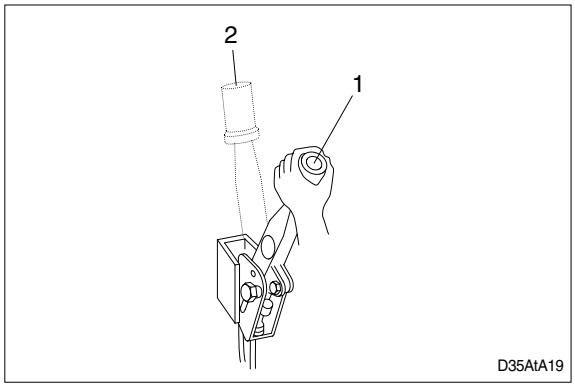
1. OPERATIONAL CHECKS

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.



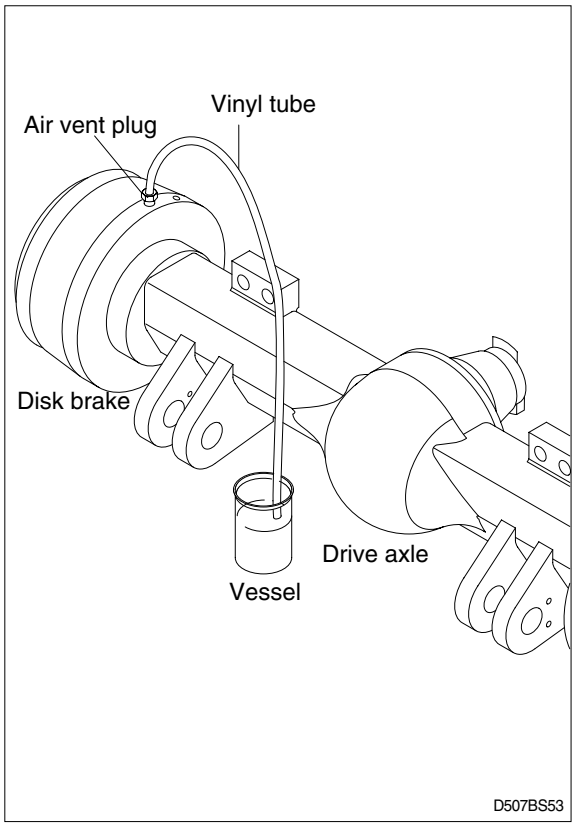
2. TROUBLESHOOTING

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.
8) Same way for the opposite side.



2. ADJUSTMENT OF PEDAL

1) BRAKE PEDAL

(1) Pedal height from floor plate

Adjust with stopper bolt.

· Pedal height : 122~128mm(4.8~5.0in)

(2) Idle stroke

Adjust with rod of master cylinder

· Play : 4~6.5mm(0.16 ~ 0.25in)

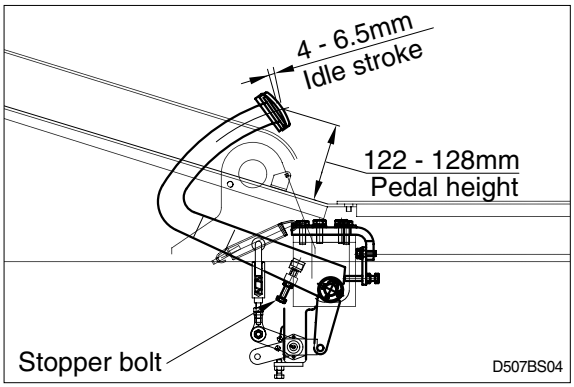
(3) Micro switch for parking brake (if equipped)

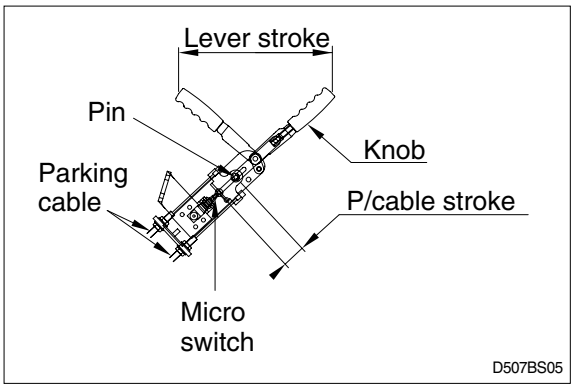
① After assembling parking brake and parking cable, put the parking brake lever released.

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)





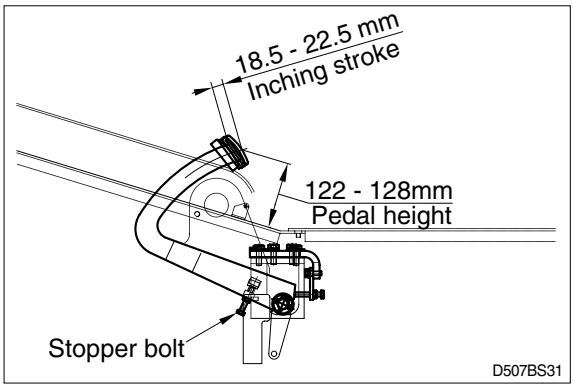
2) INCHING PEDAL

(1) Pedal height from floor plate

Adjust with stopper bolt.

· Pedal height : 122~128mm(4.8~5.0in)

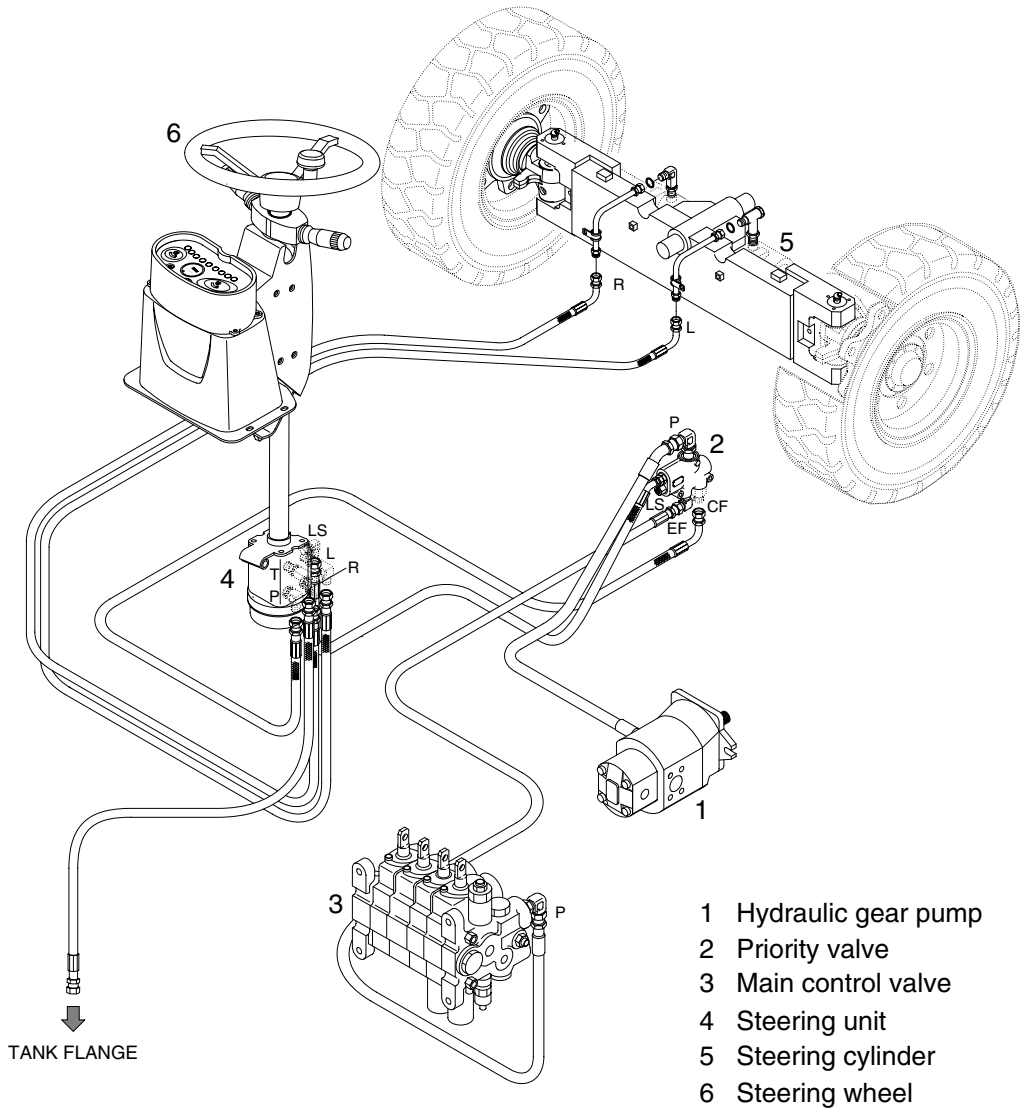
(2) Adjust bolt so that brake pedal interconnects with inching pedal at inching pedal stroke 18.5~22.5mm(0.72~0.88in).



SECTION 5 STEERING SYSTEM

GROUP 1 STRUCTURE AND FUNCTION

1. OUTLINE

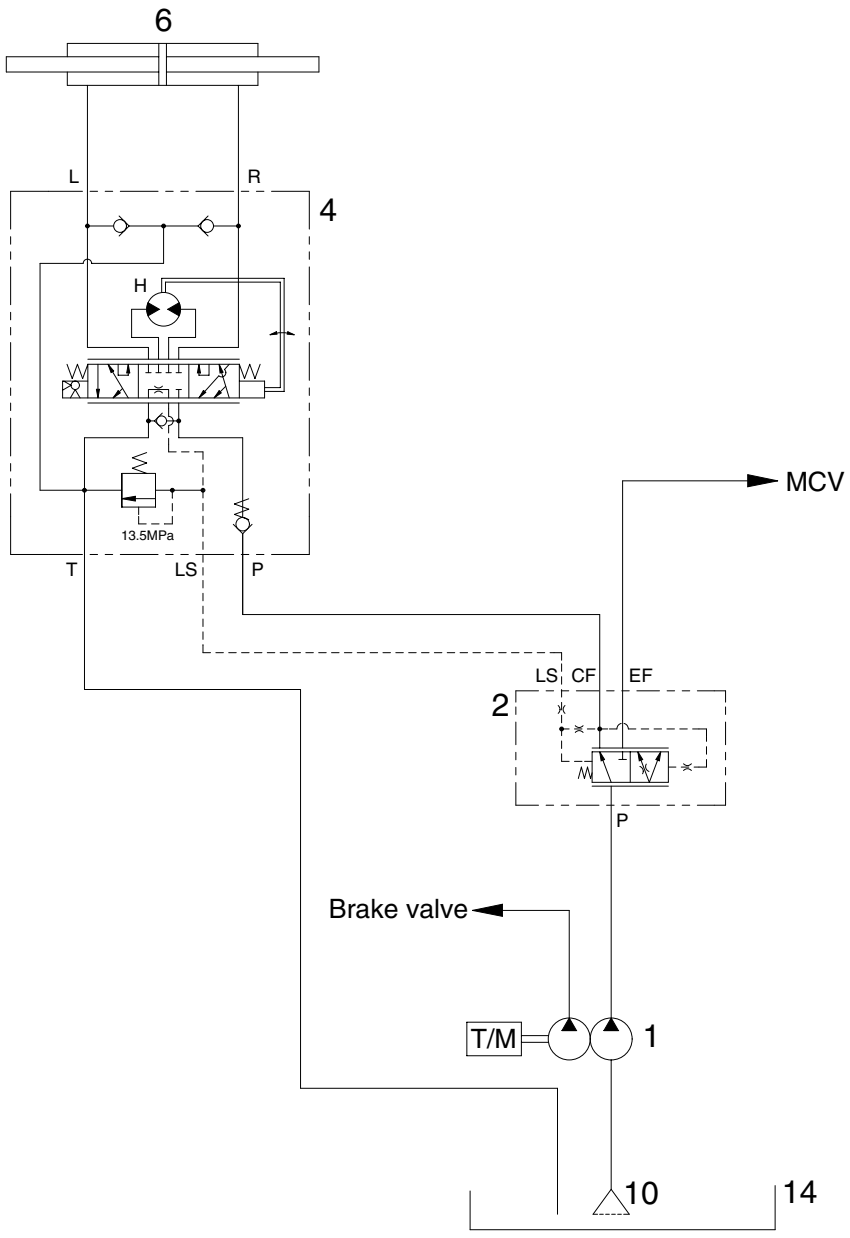


1 Hydraulic gear pump
2 Priority valve
3 Main control valve
4 Steering unit
5 Steering cylinder
6 Steering wheel

80D7SE00

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

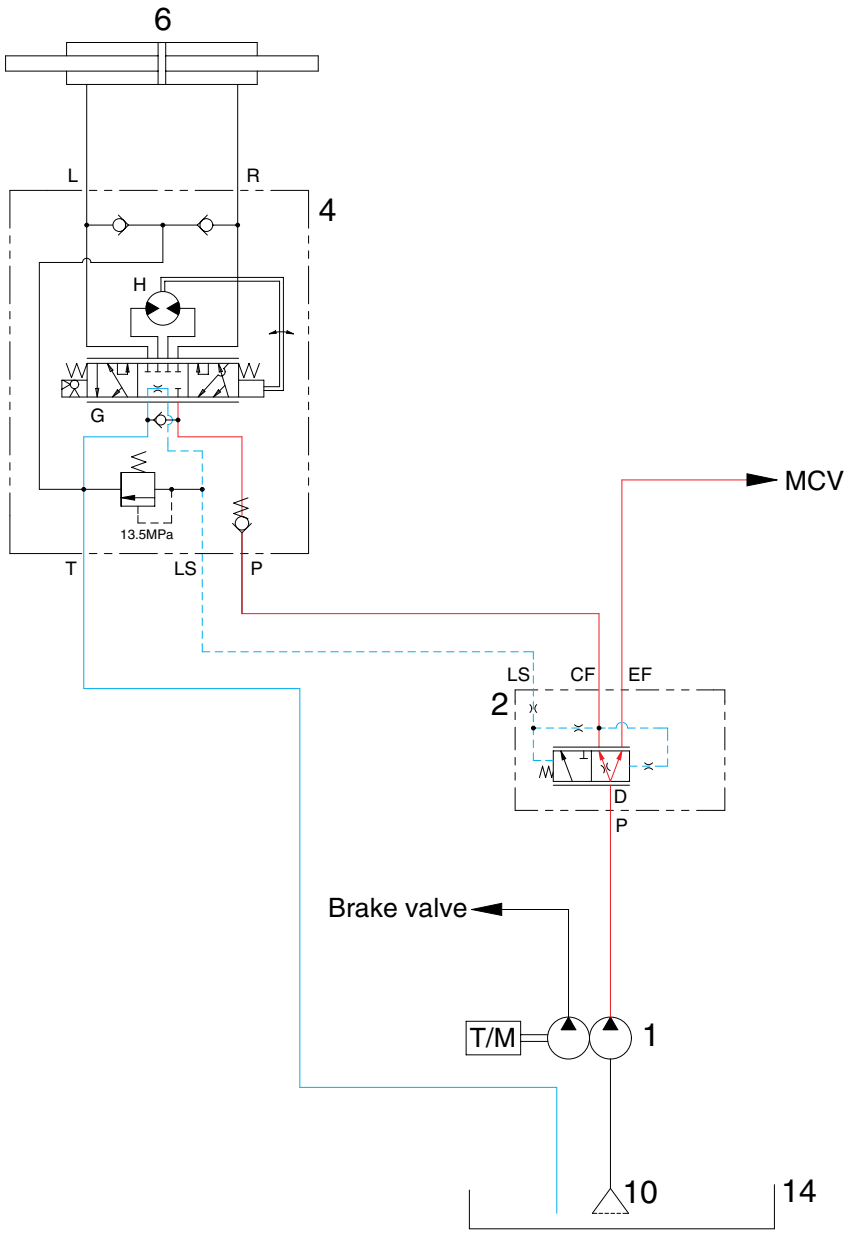
2. HYDRAULIC CIRCUIT



D507SE01

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

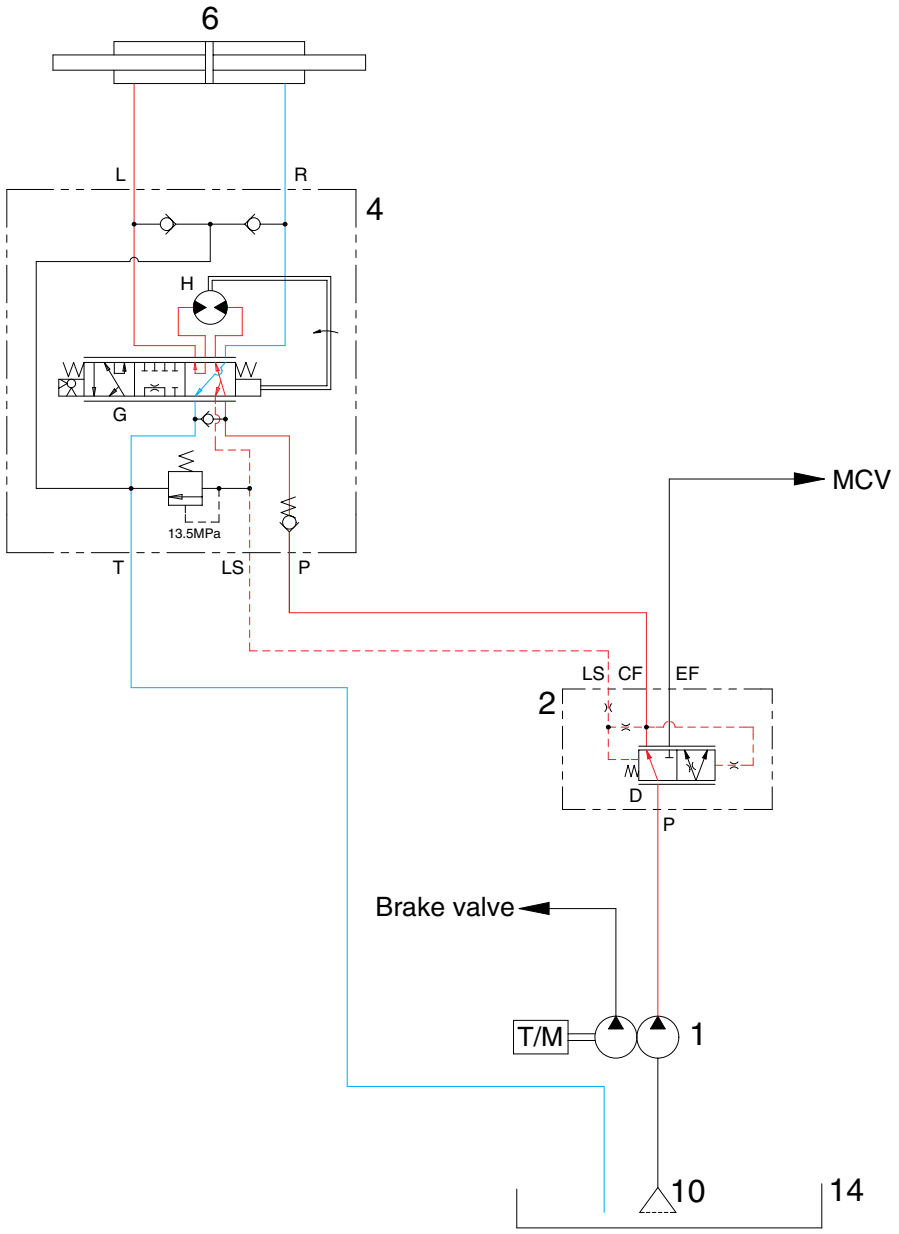
1) NEUTRAL



D507SE02

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

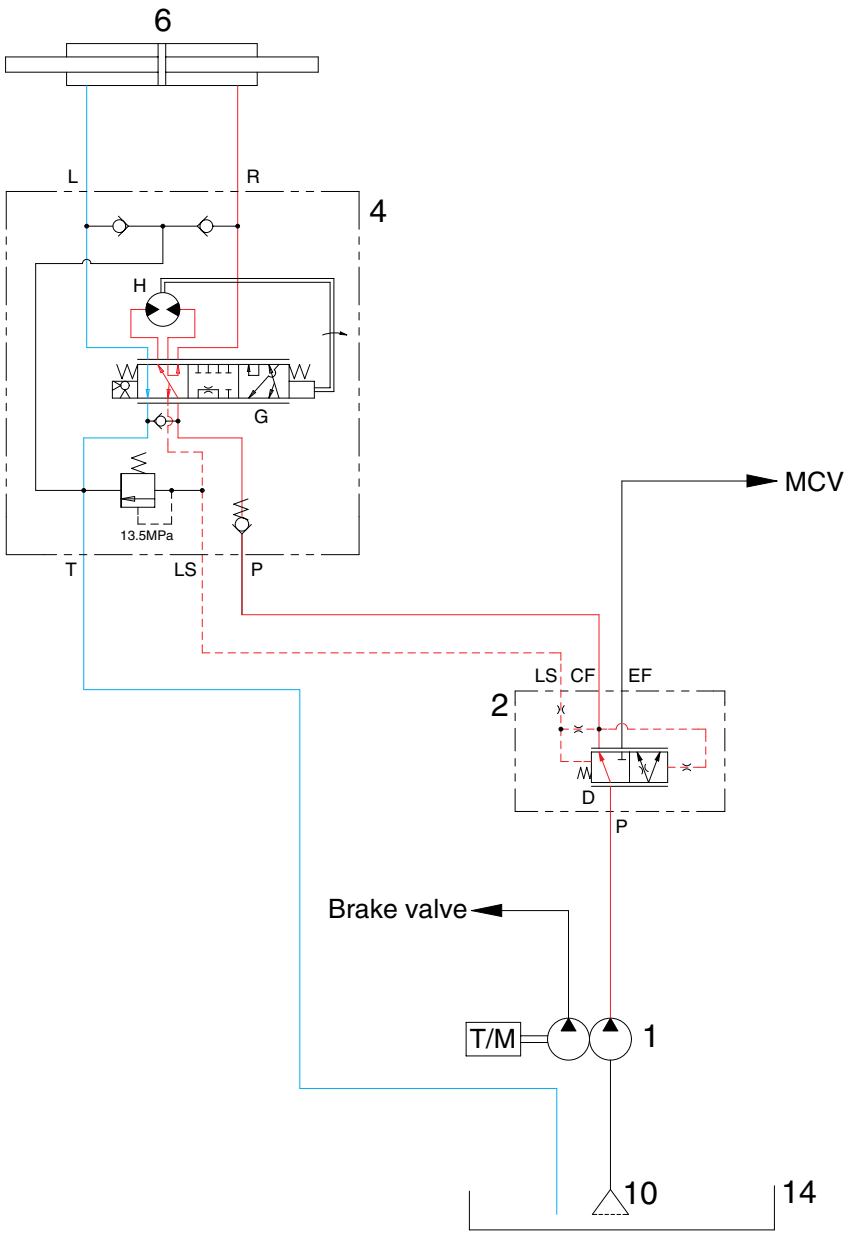
2) LEFT TURN



D507SE03

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

3) RIGHT TURN

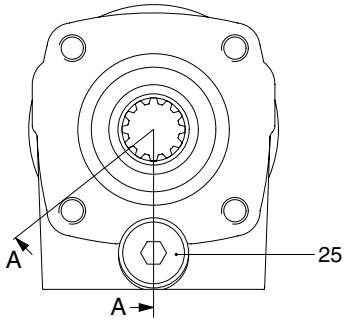


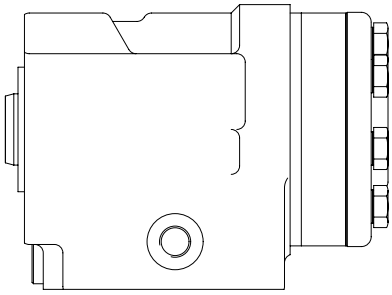
D507SE04

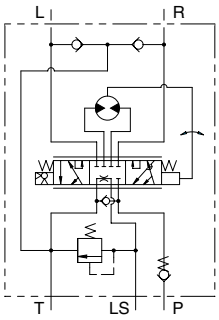
When the steering wheel is turned to the right, the spool(G) within the steering unit(4) connected with steering column turns in right hand direction.
At this time, the oil discharged from the pump flows into the spool(G) the steering unit through the spool(D) of priority valve and flows the gerotor(H).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

3. STEERING UNIT

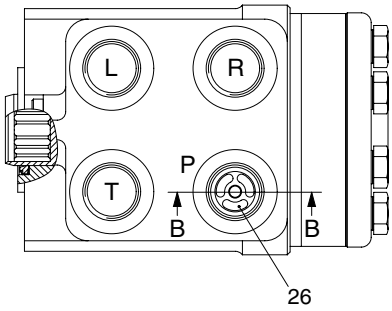
1) STRUCTURE

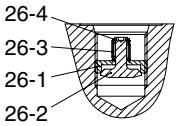




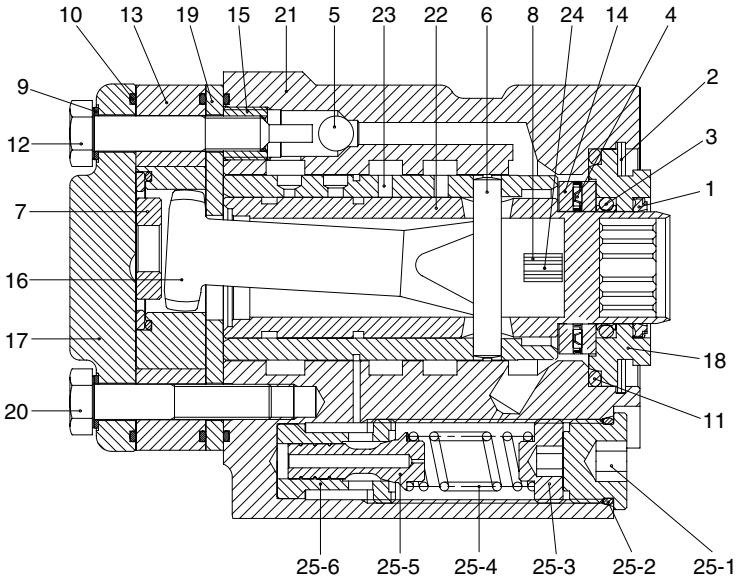


Hydraulic circuit





SECTION B-B



SECTION A - A

80D7SE32

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

2) OPERATION

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

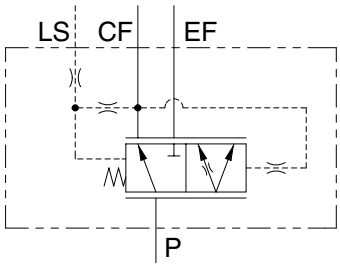
When the steering wheel is turned, the spool turns, the oil path is switched and the oil is fed into the metering device. As a result, the rotor is caused to run by oil pressure, and the sleeve is caused to run through the drive shaft and cross pin. Therefore, when the spool is turned, the spool turns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

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

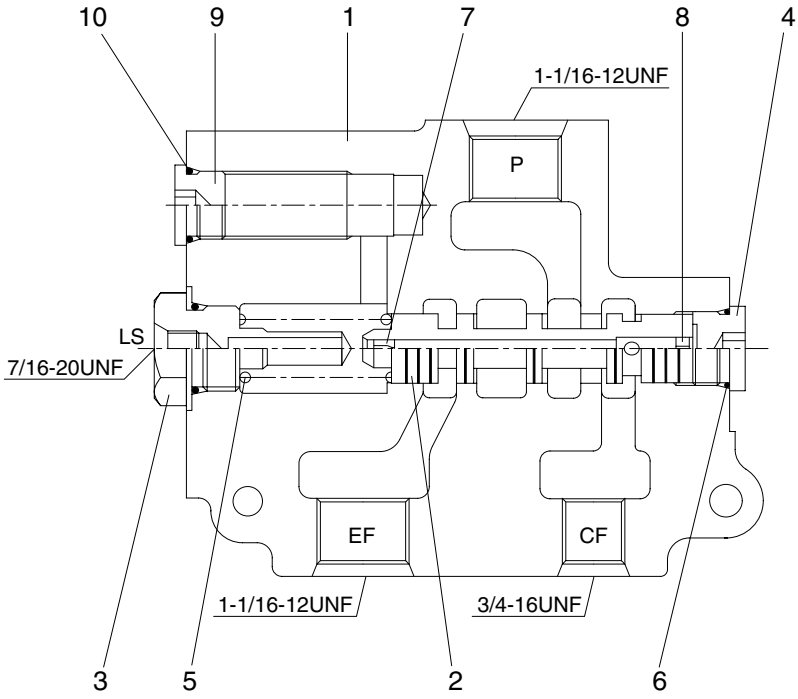
The centering spring for the spool and sleeve is provided to cause the valve to return to the neutral position. It is therefore possible to obtain a constant steering feeling, which is transmitted to the hands of the driver. Return to the center position occurs when the steering wheel is released.

4. PRIORITY VALVE

1) STRUCTURE



HYDRAULIC CIRCUIT



D353SE06

1	Body	5	Spring	9	End plug
2	Spool	6	O-ring	10	O-ring
3	Spring plug	7	Orifice		
4	End plug	8	Orifice		

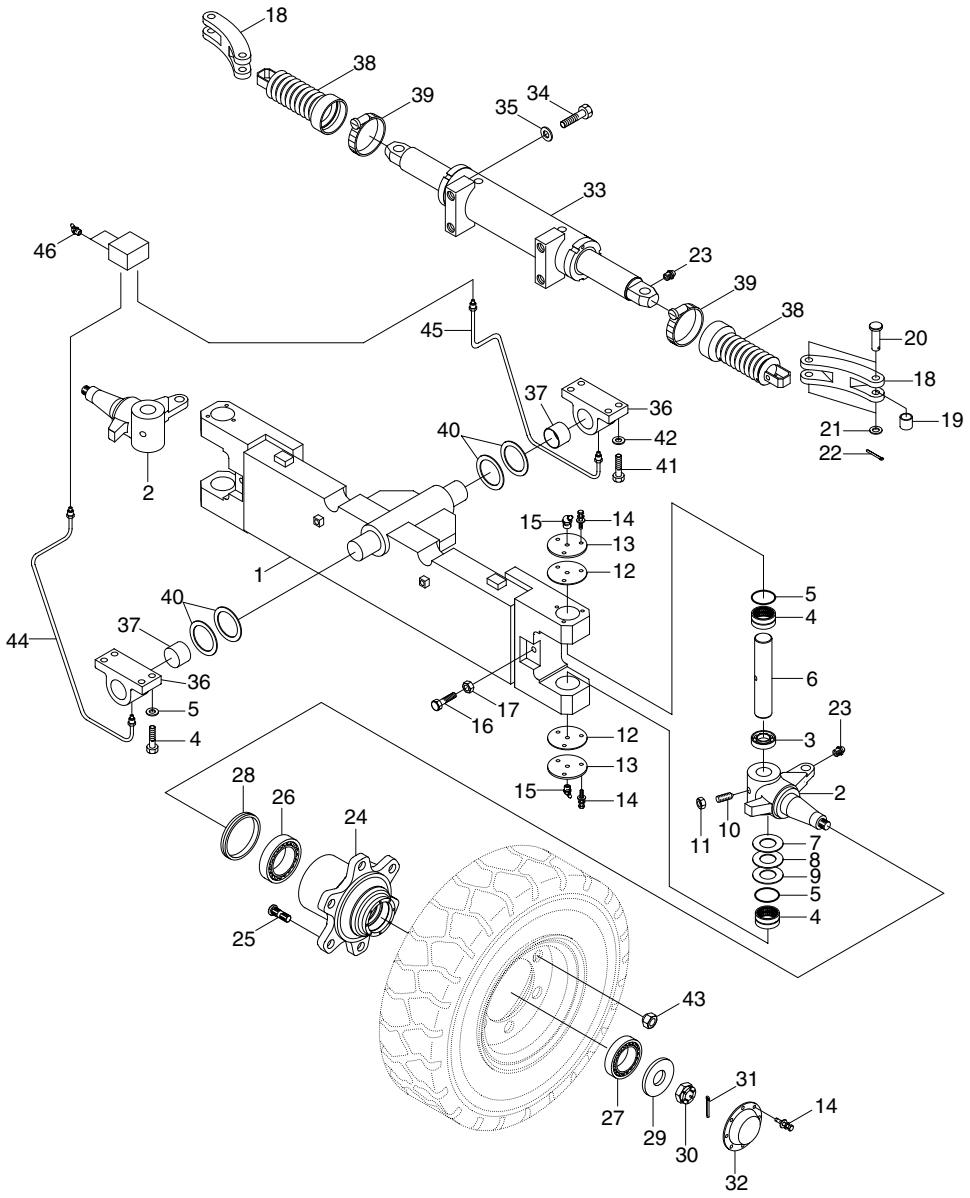
2) OPERATION

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

5. STEERING AXLE

1) STRUCTURE

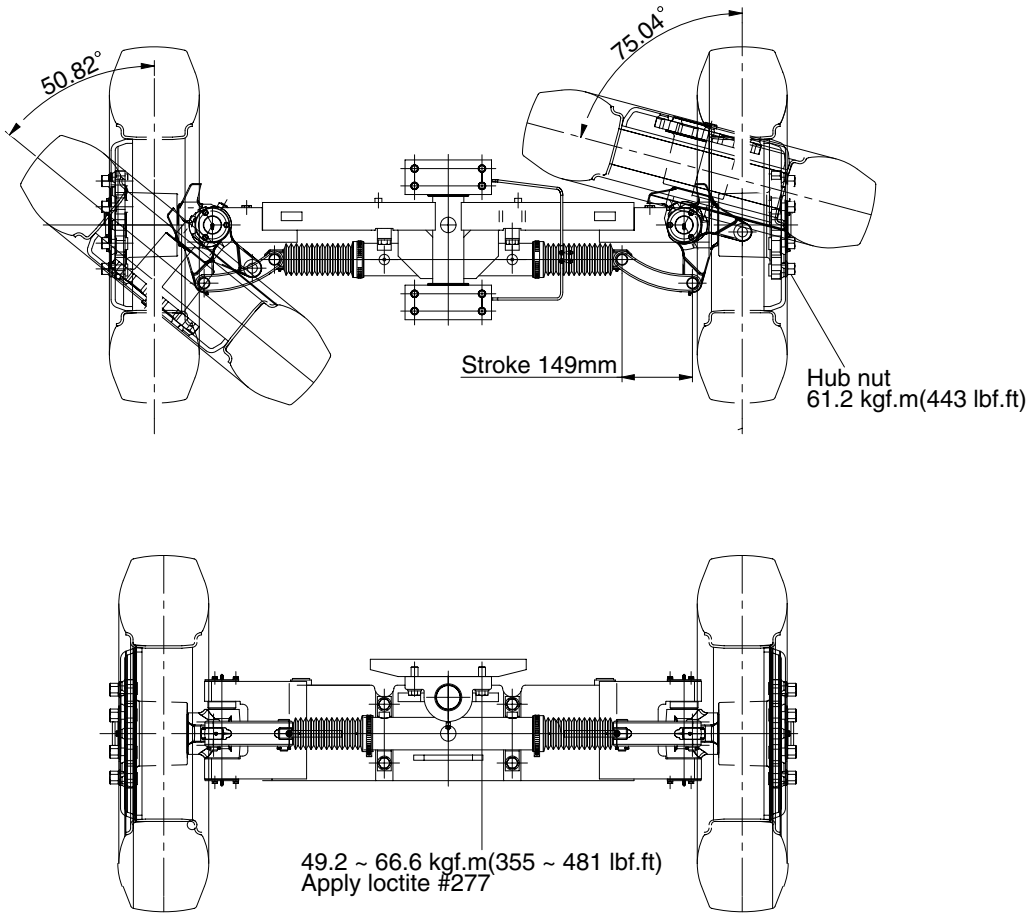
※ Do not remove the stopper bolt unless necessary.



80D7SE24

1	Steering axle	13	Cover	25	Hub bolt	37	Bushing
2	Knuckle	14	Bolt w/washer	26	Taper roller bearing	38	Steer cylinder boot
3	Thrust bearing	15	Grease nipple	27	Taper roller bearing	39	Clamp
4	Needle bearing	16	Hexagon bolt	28	Oil seal	40	Shim
5	Oil seal	17	Hexagon nut	29	Special washer	41	Hexagon bolt
6	King pin	18	Link	30	Lock nut	42	Washer
7	Thrust washer	19	Inner race bushing	31	Split pin	43	Hub nut
8	Shim washer	20	Link pin	32	Hub cap	44	Pipe
9	Shim washer	21	Special washer	33	Steering cylinder	45	Pipe
10	Set screw	22	Split pin	34	Hexagon bolt	46	Grease nipple
11	Hexagon nut	23	Grease nipple	35	Washer		
12	Gasket	24	Hub	36	Support		

2) TIGHTENING TORQUE AND SPECIFICATION

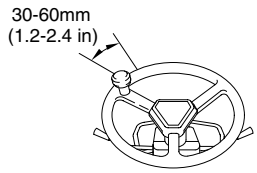


80D7SE07

Type	Unit	Center pin support single shaft
Structure of knuckle	-	Elliott type
Toe-in	degree	0
Camber	degree	0
Caster	degree	0
King pin angle	degree	0
Max steering angle of wheels(Inside/Outside)	degree	75.04 / 50.82
Tread	mm(in)	1700(66.9)

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 30~60mm 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±100mm (±4in)of specified value, adjust turning angle stopper bolt. Min turning radius(Outside) 80D-7 | 3520mm(139in)
Hydraulic pressure of power steering	Remove plug from outlet port of flow divider and install oil pressure gauge. Turn steering wheel fully and check oil pressure. ※ Oil pressure : 135 ~ 140 kgf/cm² (132 ~ 137bar)

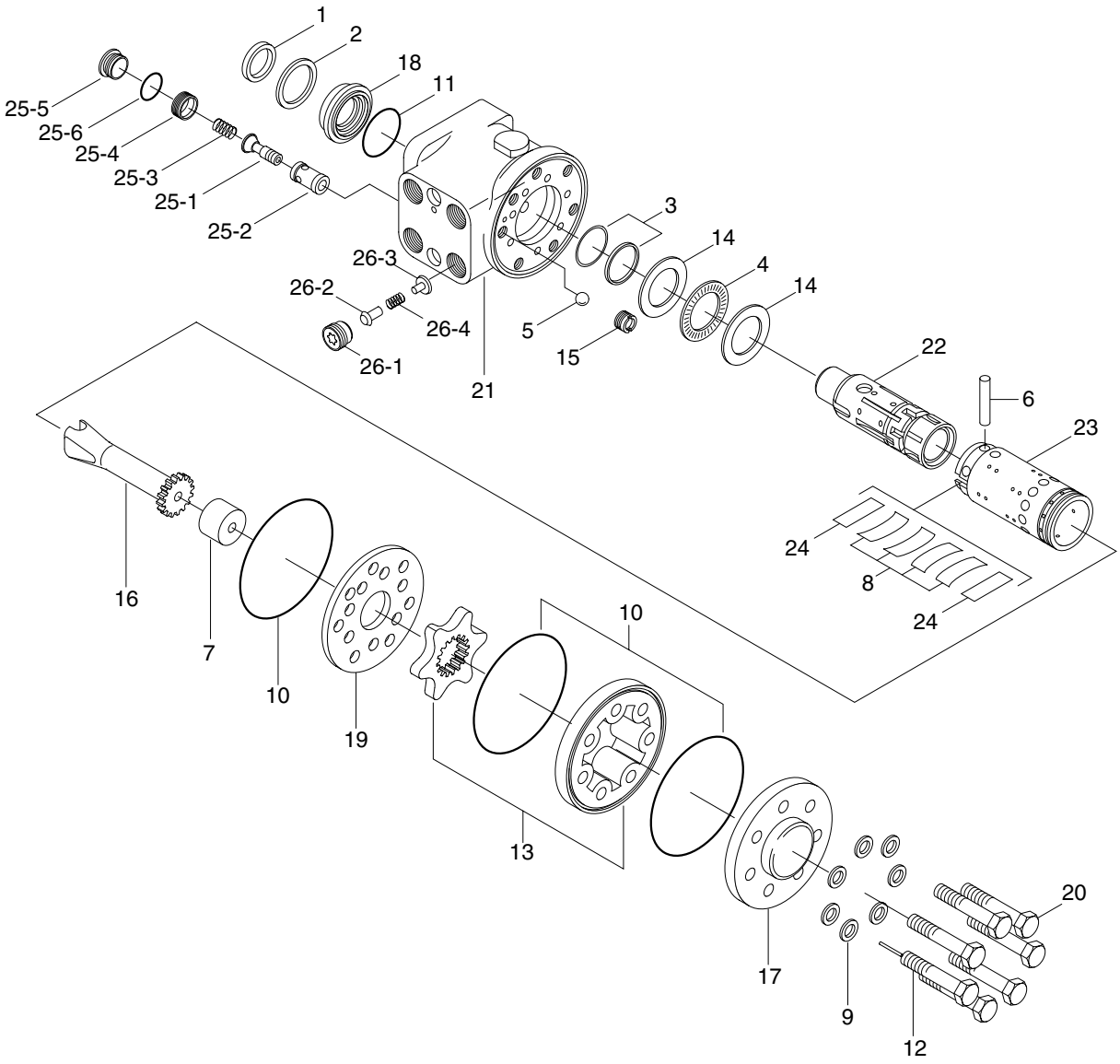
2. TROUBLESHOOTING

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

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

1. STEERING UNIT

1) STRUCTURE

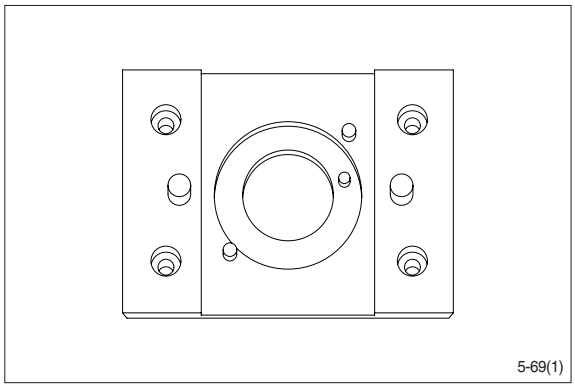


80D7SE05

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

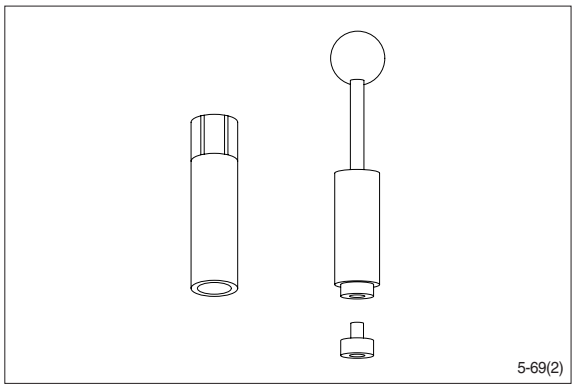
2) TOOLS

(1) Holding tool.



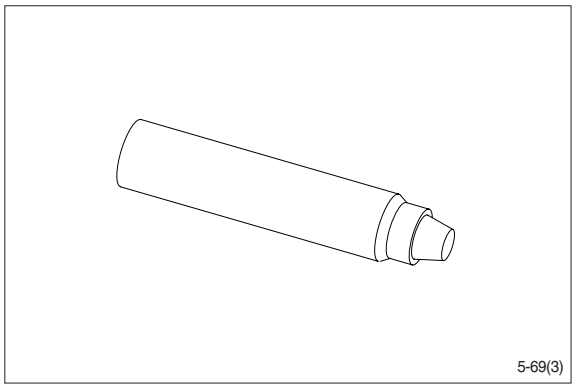
5-69(1)

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



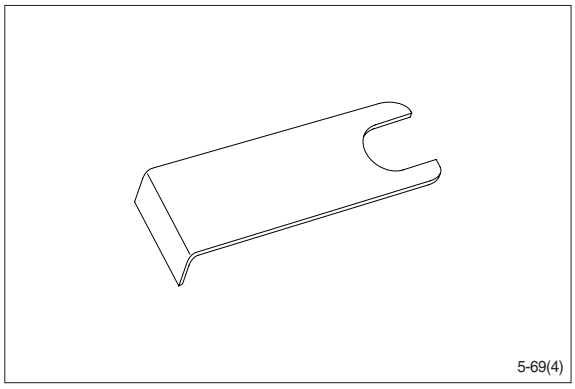
5-69(2)

(3) Assembly tool for lip seal.



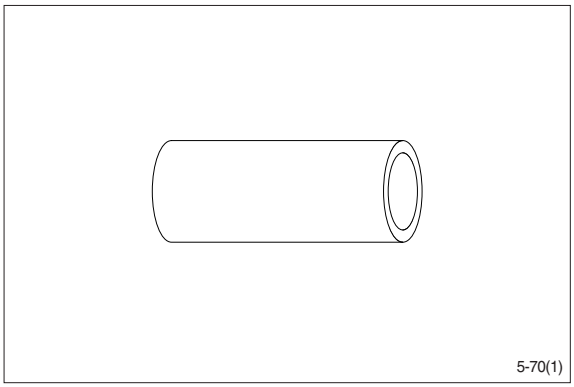
5-69(3)

(4) Assembly tool for cardan shaft.

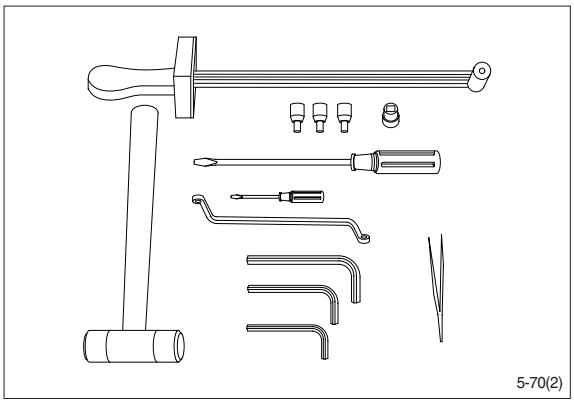


5-69(4)

(5) Assembly tool for dust seal.

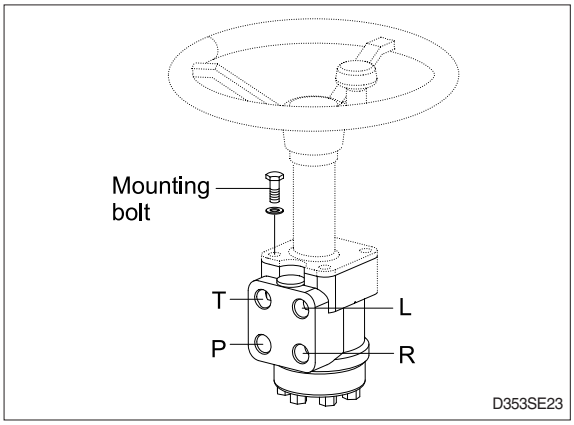


(6) Torque wrench 0~7.1kgf · m
(0~54.4lbf · ft)
13mm socket spanner
6, 8mm and 12mm hexagon sockets
12mm screwdriver
2mm screwdriver
13mm ring spanner
6, 8 and 12mm hexagon socket spanners
Plastic hammer
Tweezers



3) TIGHTENING TORQUE

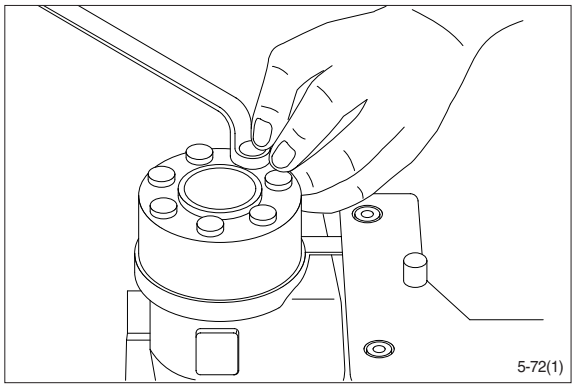
L : Left port
R : Right port
T : Tank
P : Pump



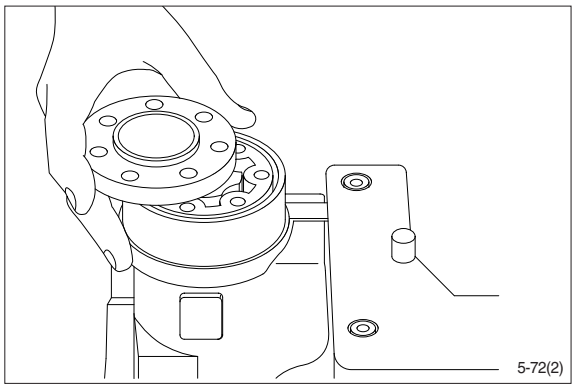
Port	Size	Torque [kgf · m(lbf · ft)]
L	3/4 - 16UNF	6.1±0.6 (44±4.3)
R	3/4 - 16UNF	6.1±0.6 (44±4.3)
T	3/4 - 16UNF	6.1±0.6 (44±4.3)
P	3/4 - 16UNF	6.1±0.6 (44±4.3)
Mounting bolt	M10×1.5	4.0 ±0.5 (29±3.6)

4) DISASSEMBLY

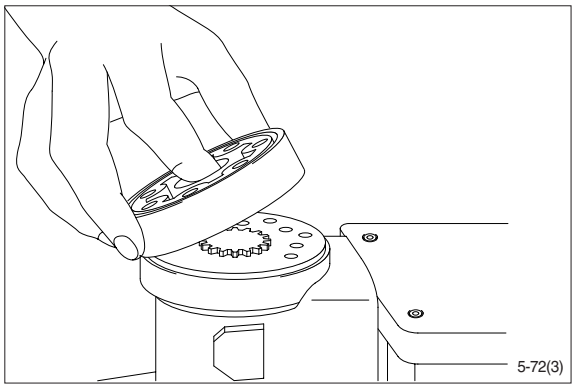
(1) Disassemble steering column from steering unit and place the steering unit in the holding tool.
Screw out the screws in the end cover(6-off plus one special screw).


5-72(1)

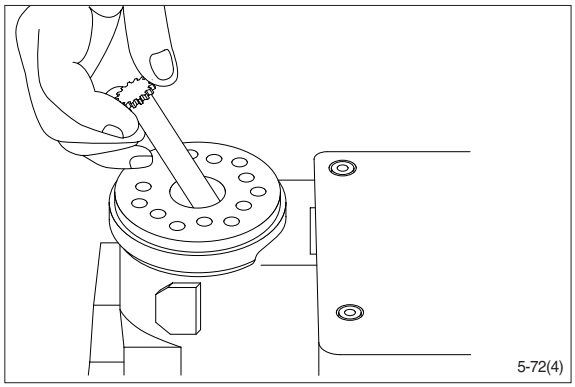
(2) Remove the end cover, sideways.


5-72(2)

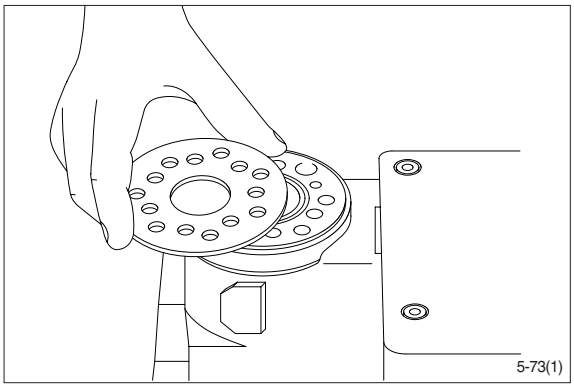
(3) Lift the gearwheel set(With spacer if fitted) off the unit.
Take out the two O-rings.


5-72(3)

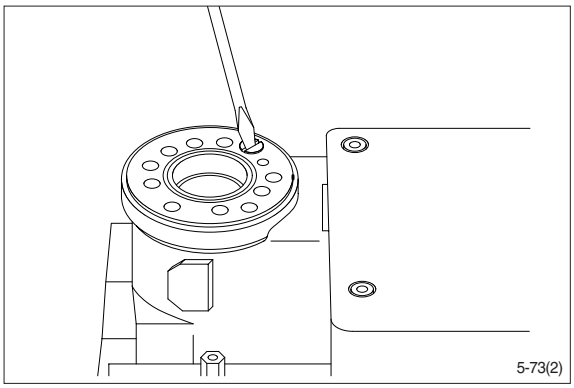
(4) Remove cardan shaft.


5-72(4)

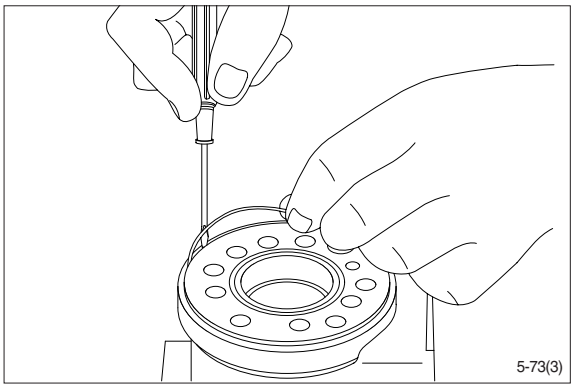
(5) Remove distributor plate.



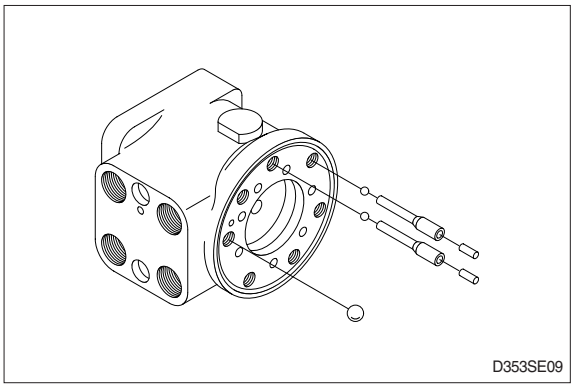
(6) Screw out the threaded bush over the check valve.



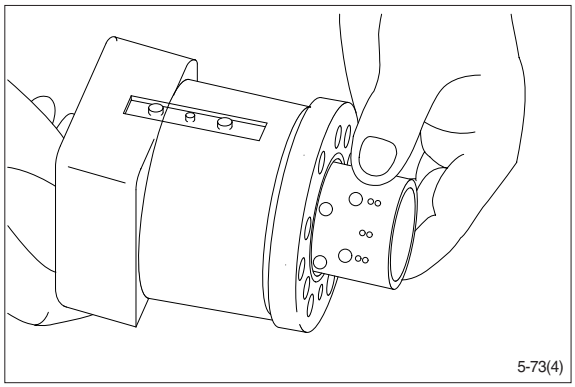
(7) Remove O-ring.



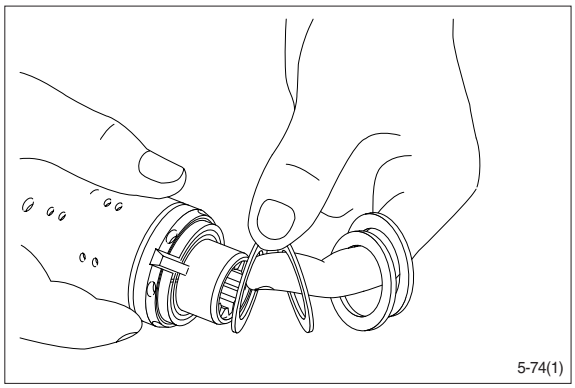
(8) Shake out the check valve ball and suction valve pins and balls.



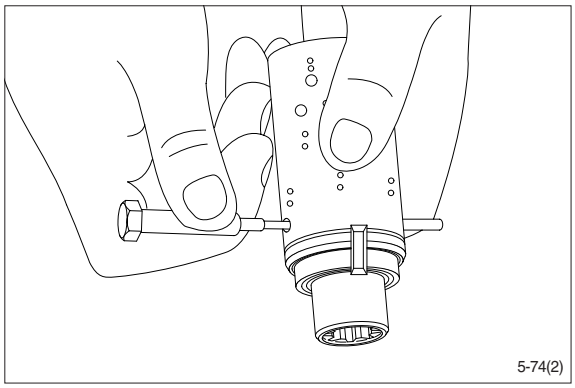
(9) Take care to keep the cross pin in the sleeve and spool horizontal. The pin can be seen through the open end of the spool. Press the spool inwards and the sleeve, ring, bearing races and thrust bearing will be pushed out of the housing together.


5-73(4)

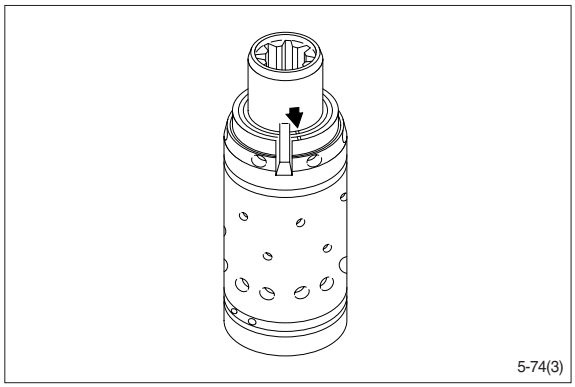
(10) Take ring, bearing races and thrust bearing from sleeve and spool. The outer (Thin) bearing race can sometimes "stick" in the housing, therefore check that it has come out.


5-74(1)

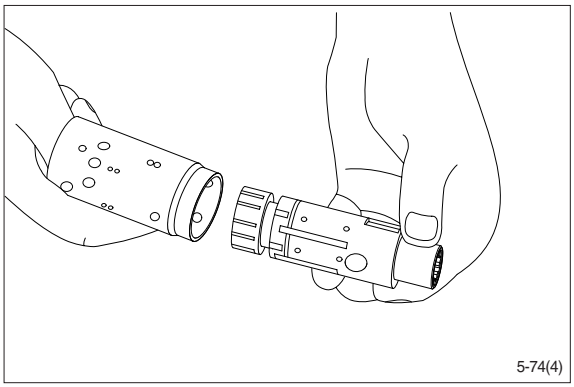
(11) Press out the cross pin. Use the special screw from the end cover.


5-74(2)

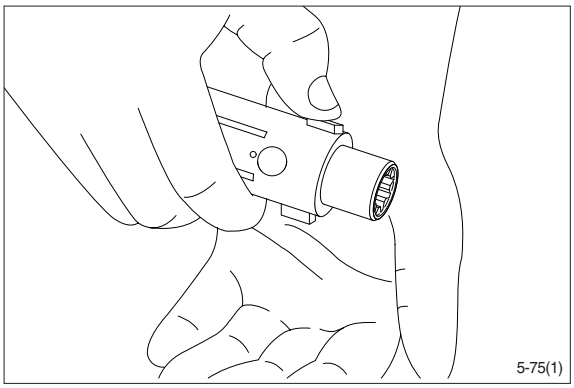
※ A small mark has been made with a pumice stone on both spool and sleeve close to one of the slots for the neutral position springs(See drawing).
If the mark is not visible, remember to leave a mark of your own on sleeve and spool before the neutral position springs are disassembled.


5-74(3)

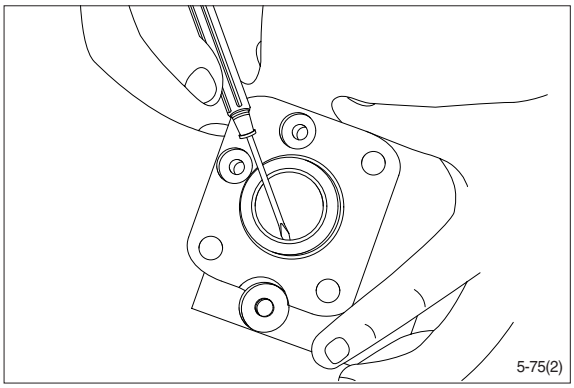
(12) Carefully press the spool out of the sleeve.



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

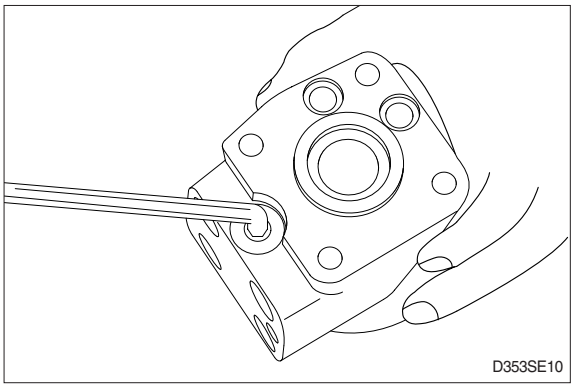


(14) Remove dust seal and O-ring.

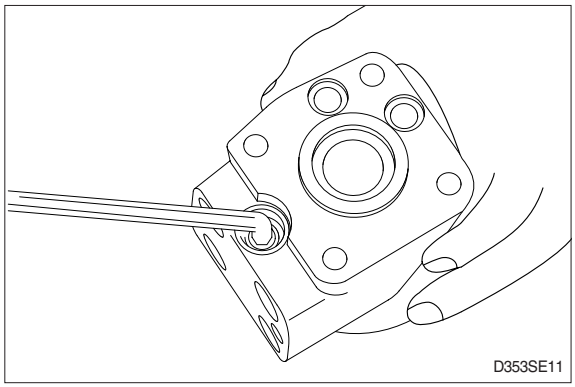


Disassembling the pressure relief valve

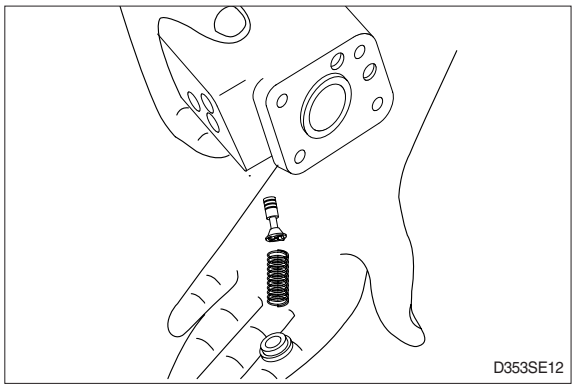
(15) Screw out the plug using an 8㎜ hexagon socket spanner.
Remove seal washers.



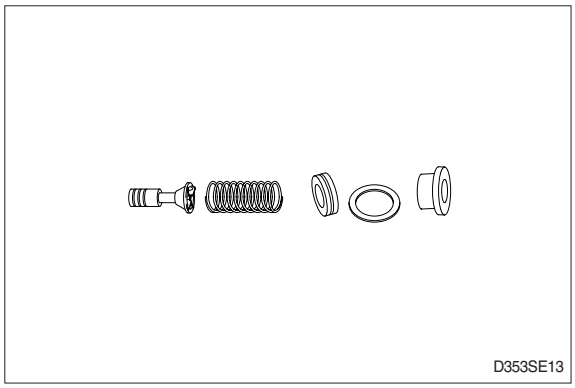
(16) Unscrew the setting screw using an 8mm hexagon socket spanner.



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



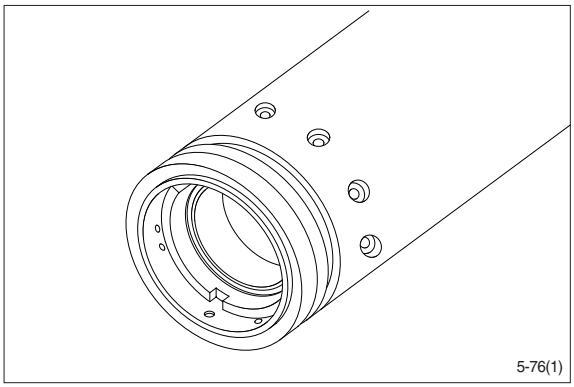
(18) The pressure relief valve is now disassembled.



5) ASSEMBLY

(1) Assemble spool and sleeve.

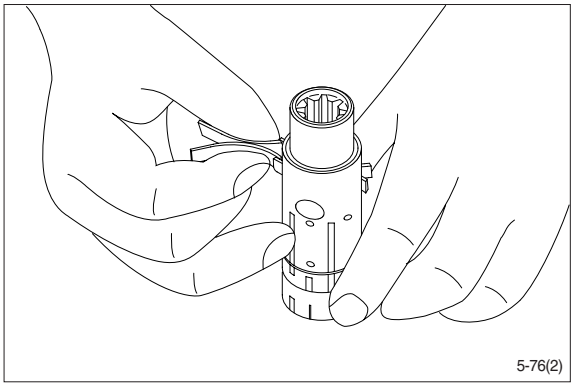
※ When assembling spool and sleeve only one of two possible ways of positioning the spring slots is correct. There are three slots in the spool and three holes in the sleeve in the end of the spool / sleeve opposite to the end with spring slots. Place the slots and holes opposite each other so that parts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



5-76(1)

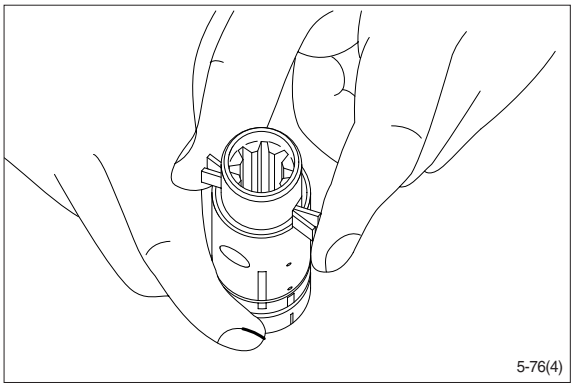
(2) Place the two flat neutral position springs in the slot.

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



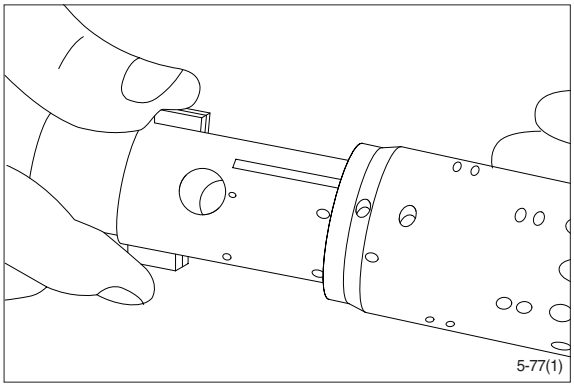
5-76(2)

(3) Line up the spring set.



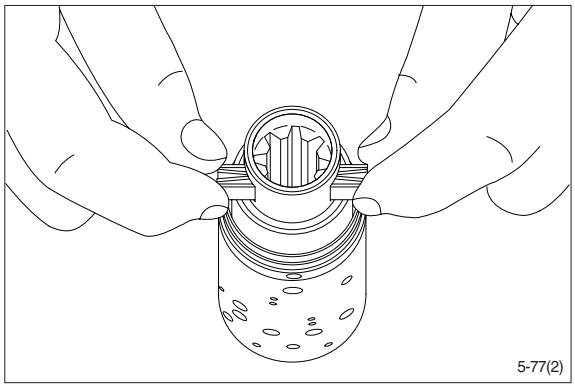
5-76(4)

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

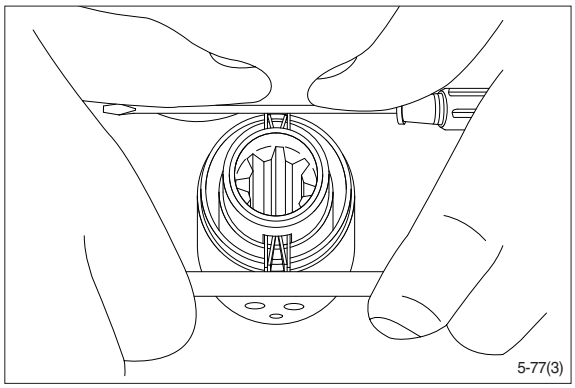


5-77(1)

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

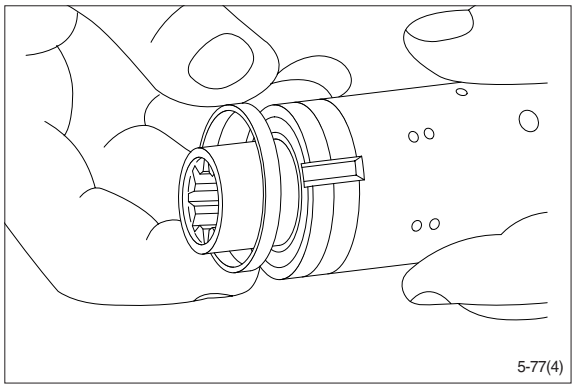

5-77(2)

(6) Line up the springs and center them.

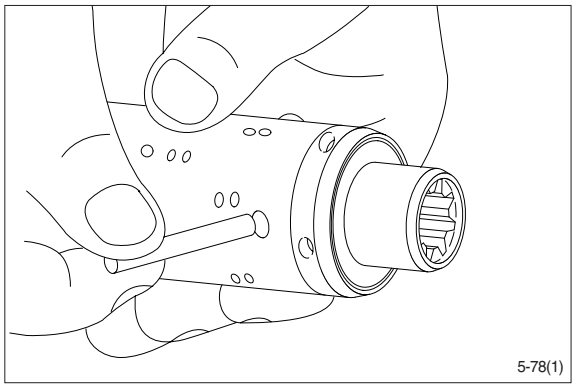

5-77(3)

(7) Guide the ring down over the sleeve.

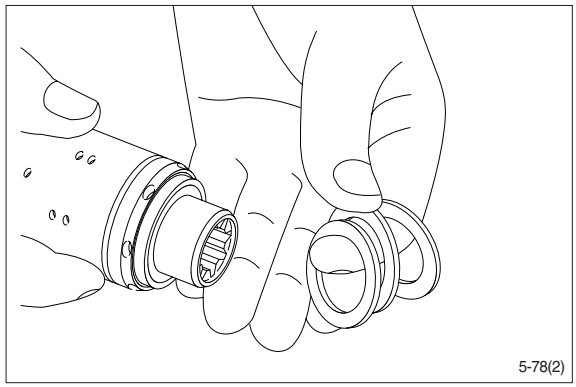
※ The ring should be able to rotate free of the springs.


5-77(4)

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

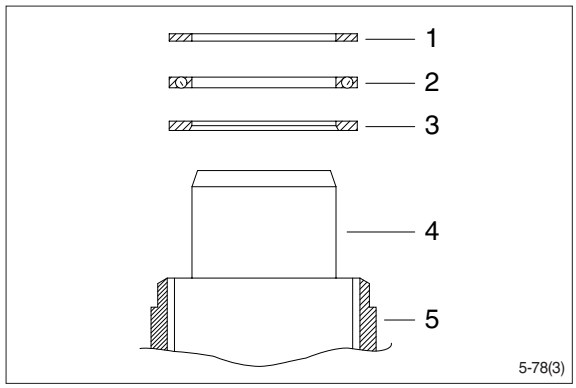

5-78(1)

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



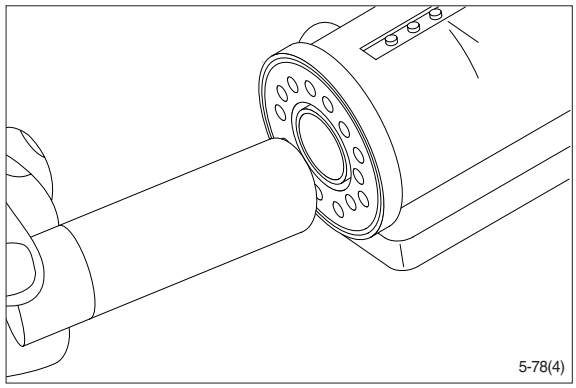
※ **Assembly pattern for standard bearings**

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

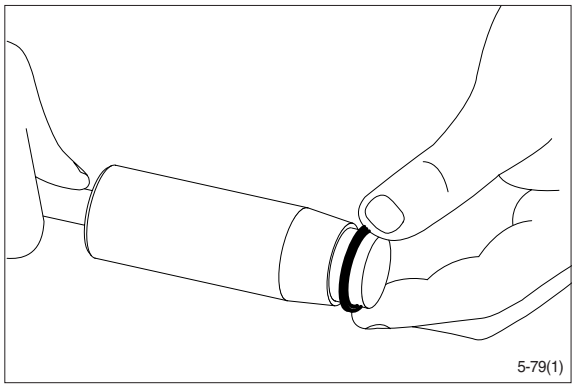


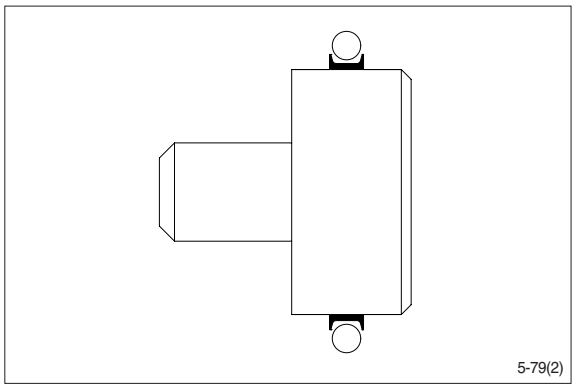
Installation instruction for O-ring

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

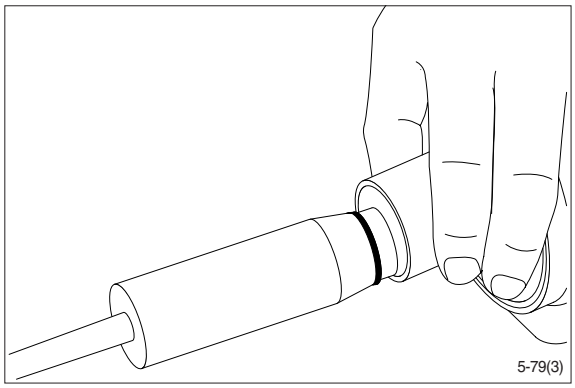


(11) Grease O-ring with hydraulic oil and place them on the tool.

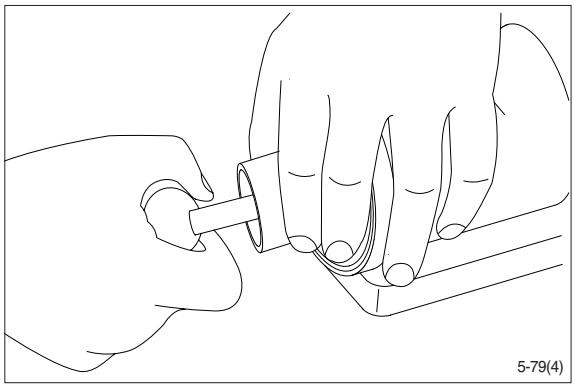

5-79(1)


5-79(2)

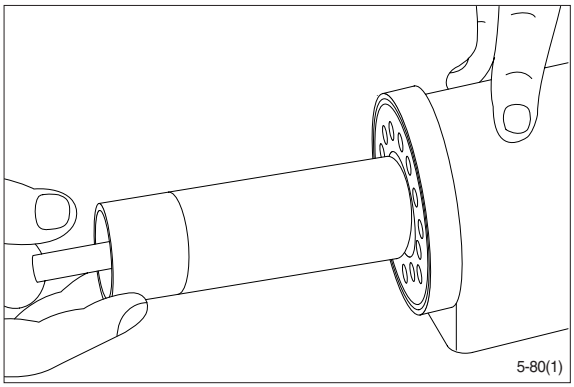
(12) Hold the outer part of the assembly tool in the bottom of the steering unit housing and guide the inner part of the tool right to the bottom.


5-79(3)

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

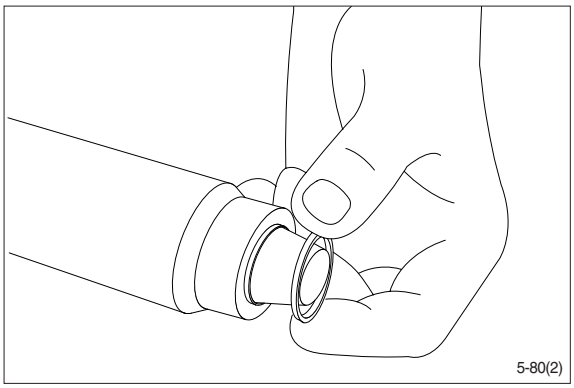

5-79(4)

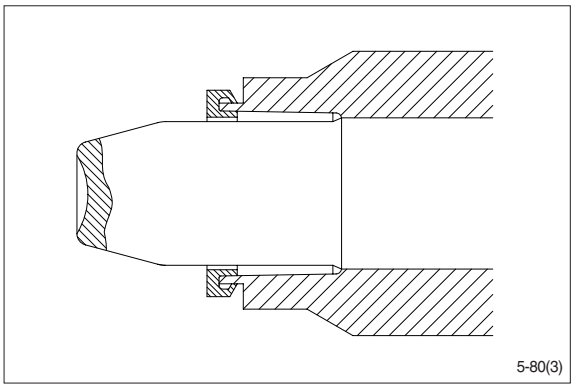
(14) Draw the inner and outer parts of the assembly tool out of the steering unit bore, leaving the guide from the inner part in the bore.



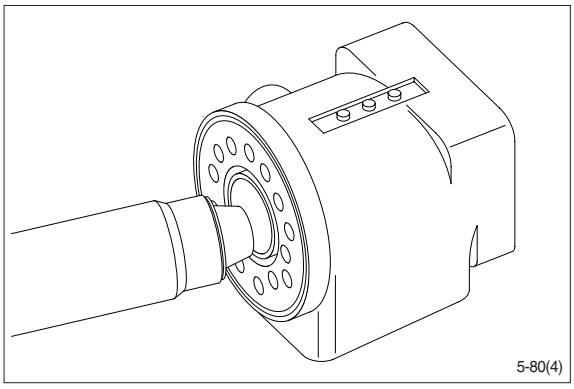
Installation instructions for lip seal

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

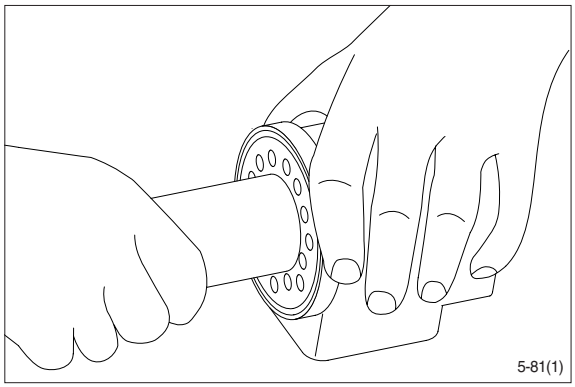




(16) Guide the assembly tool right to the bottom.

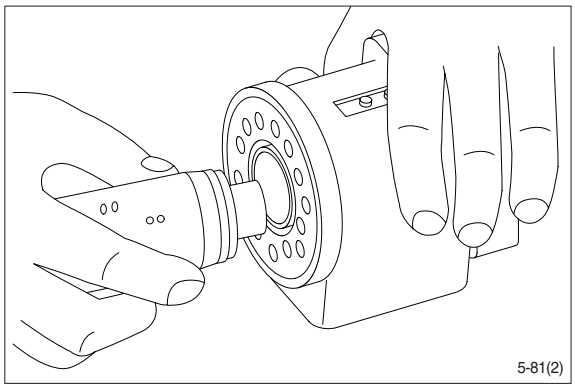


(17) Press and turn the lip seal into place in the housing.

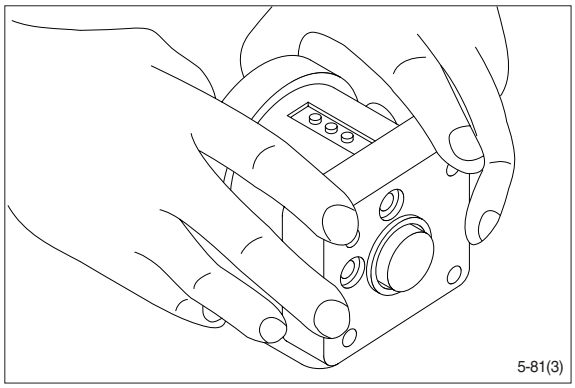


(18) With a light turning movement, guide the spool and sleeve into the bore.

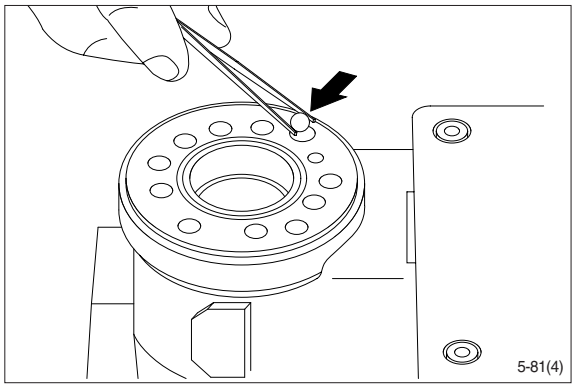
※ Fit the spool set holding the cross pin horizontal.



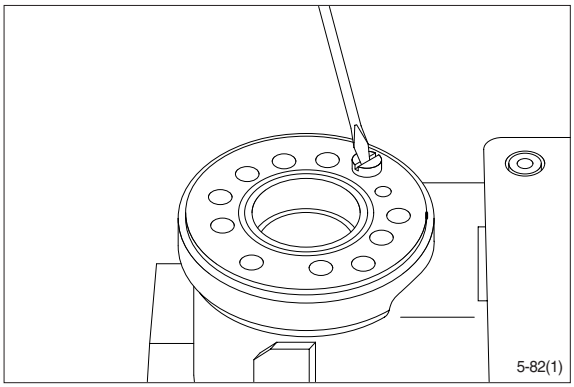
(19) The spool set will push out the assembly tool guide. The O-ring are now in position.



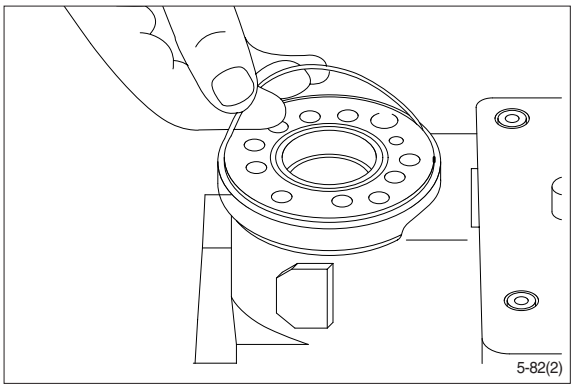
(20) Turn the steering unit until the bore is vertical again. Put the check valve ball into the hole indicated by the arrow.



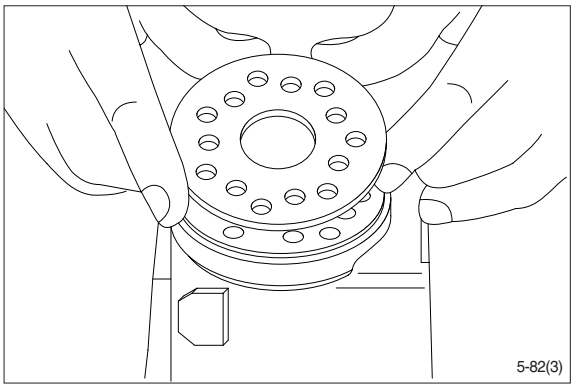
(21) Screw the threaded bush lightly into the check valve bore. The top of the bush must lie just below the surface of the housing.



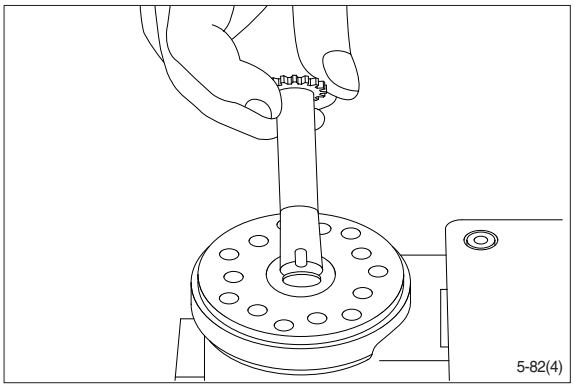
(22) Grease the O-ring with mineral oil approx. viscosity 500 cSt at 20℃.



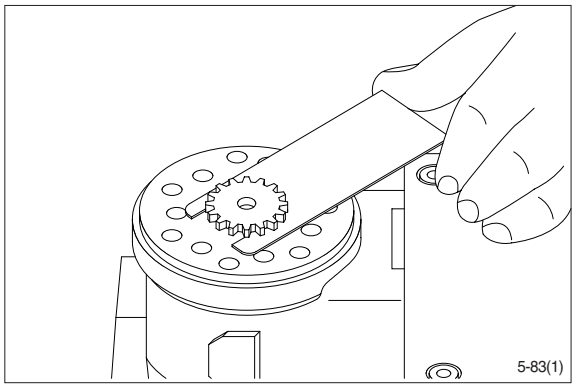
(23) Place the distributor plate so that the channel holes match the holes in the housing.



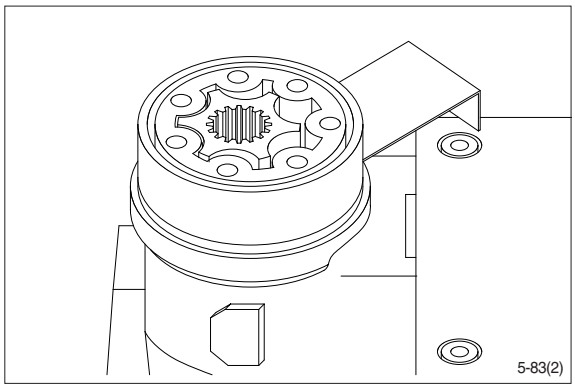
(24) Guide the cardan shaft down into the bore so that the slot is parallel with the connection flange.



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



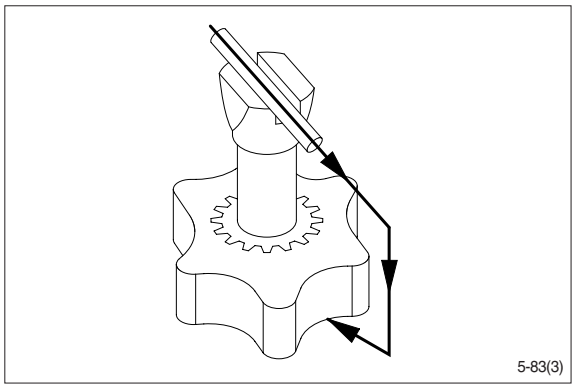
(26) Grease the two O-rings with mineral oil approx. viscosity 500 cSt at 20°C and place them in the two grooves in the gear rim. Fit the gearwheel and rim on the cardan shaft.



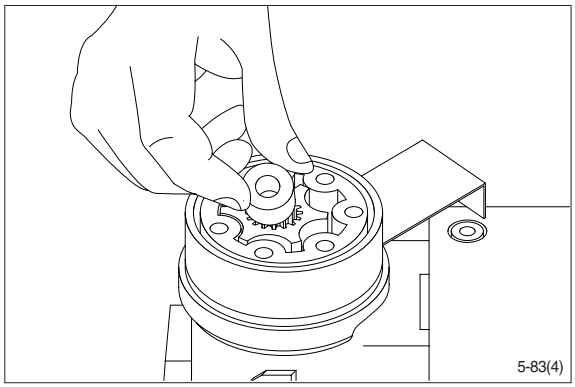
(27) Important

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

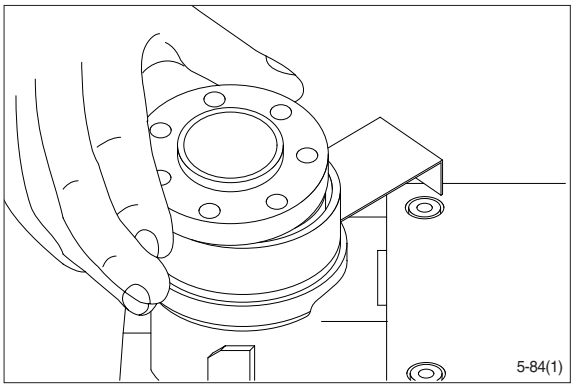
Turn the gear rim so that the seven through holes match the holes in the housing.



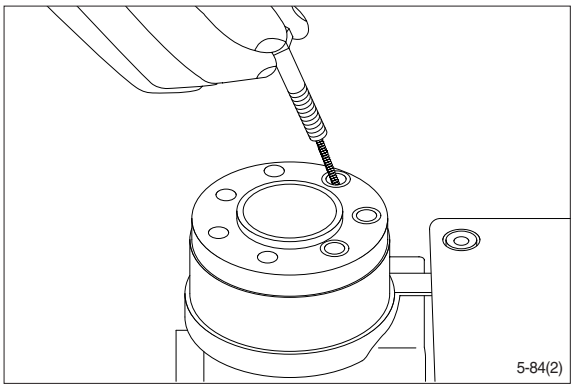
(28) Fit the spacer, if any.



(29) Place the end cover in position.

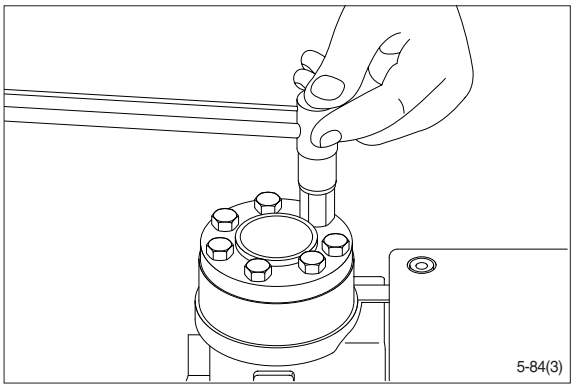

5-84(1)

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

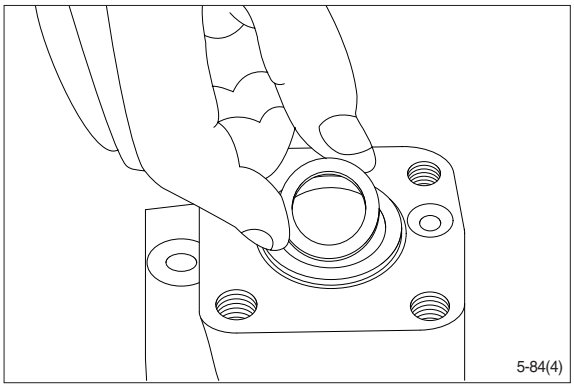

5-84(2)

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

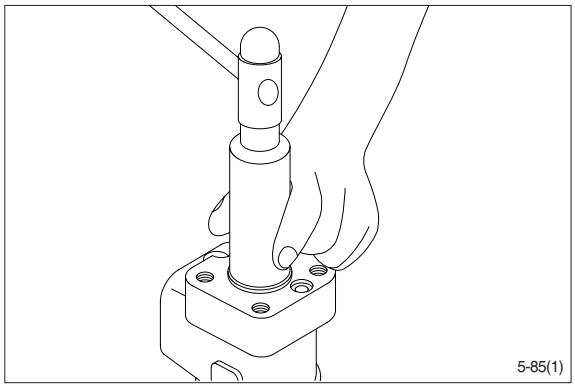
· Tightening torque : 4.0 ± 0.5kgf · m
(28.9 ± 3.6lbf · ft)


5-84(3)

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

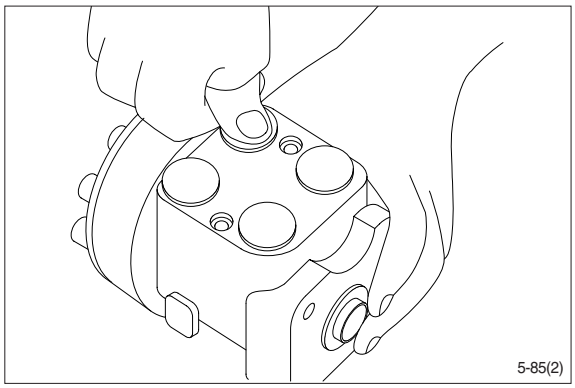

5-84(4)

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


5-85(1)

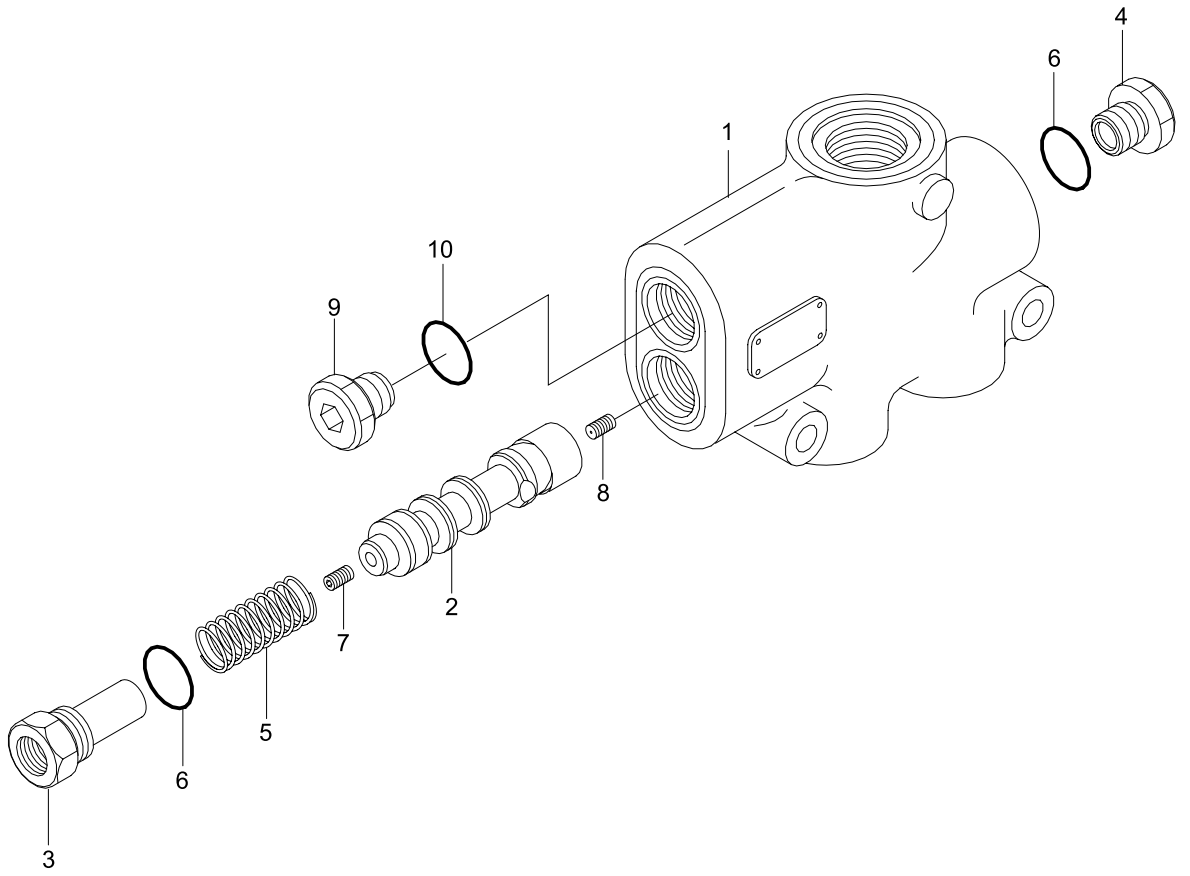
(34) Press the plastic plugs into the connection ports.

※ Do not use a hammer!


5-85(2)

2. PRIORITY VALVE

1) STRUCTURE



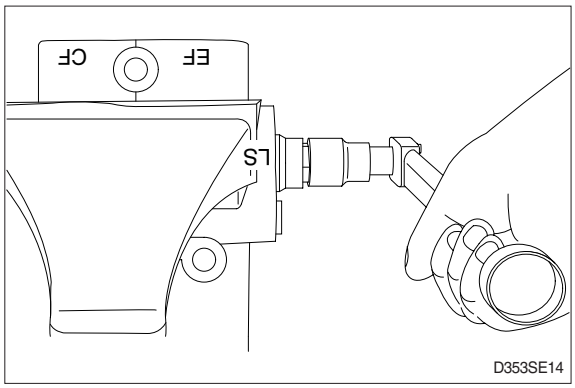
D353SE07

1	Body	5	Spring	9	End plug
2	Spool	6	O-ring	10	O-ring
3	Spring plug	7	Orifice		
4	End plug	8	Orifice		

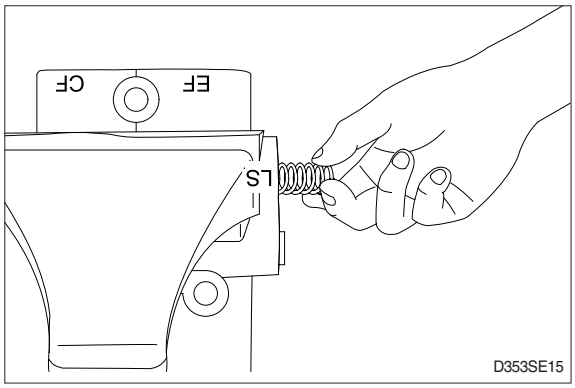
2) DISASSEMBLY

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

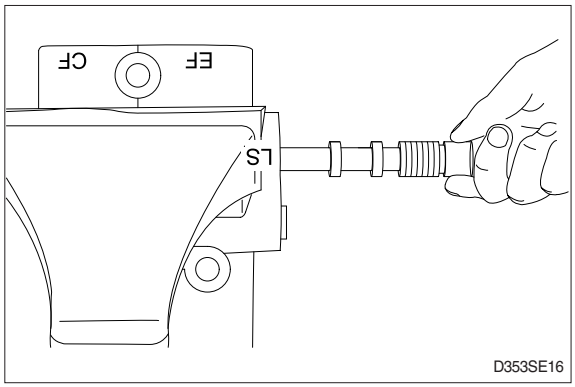
(1) Fix the body(1) in a vise with copper or lead sheets.
Do not over tighten jaws.
(2) Loosen plug(3) for LS port.



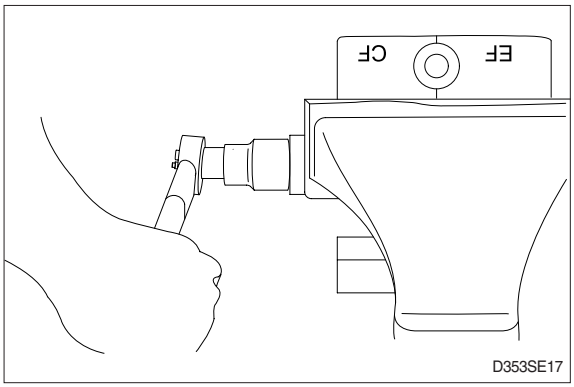
(3) Remove spring(5).



(4) Remove spool assy(2).
※ Can't remove the orifice(7) and orifice(8) from spool(2), because the orifices were locked at the spool.



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

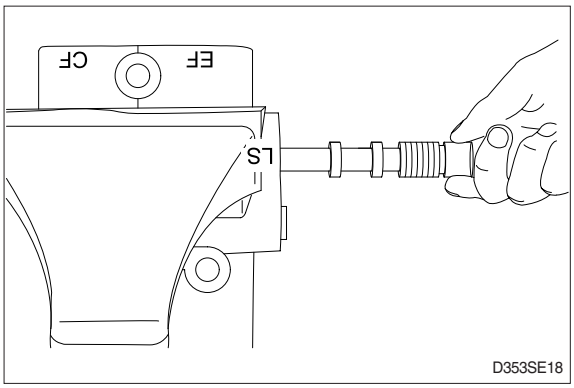


3) ASSEMBLY

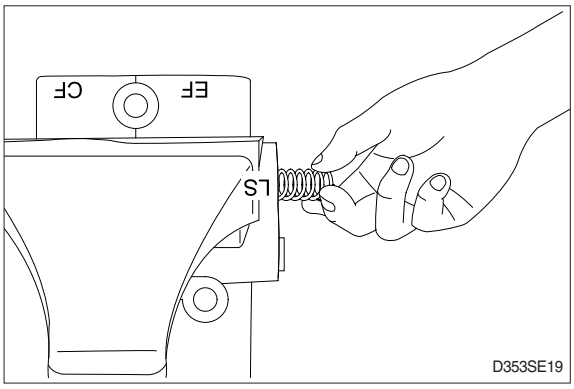
※ Clean all metal parts in clean solvent and blow dry with air and correct any damage, burrs and rust.
※ Do not wipe dry with cloth or paper towel.
※ Replace seals such as O-ring with new ones as a rule and coat with grease.

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

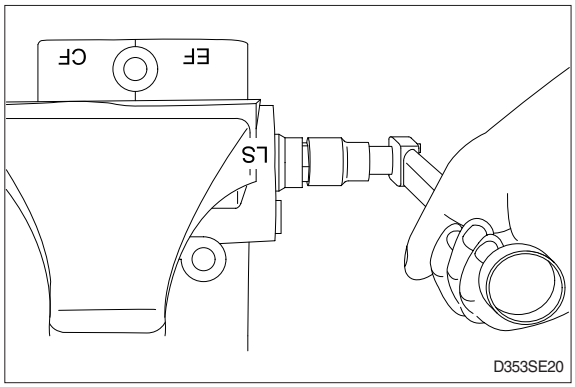
※ Secure the spool(2) remain in their correct direction.
※ Secure the spool(2) to move smoothly by finger.



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

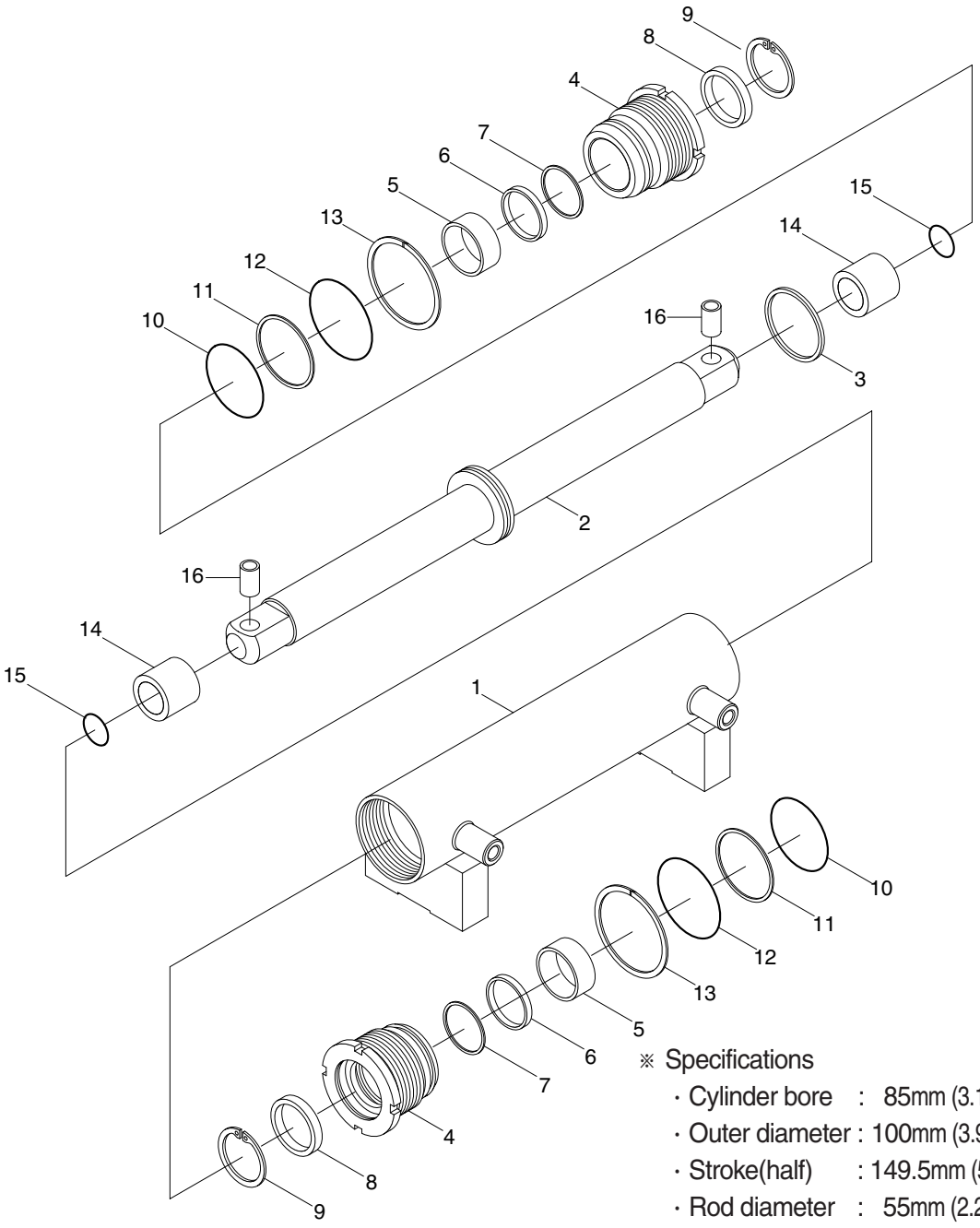


(4) Install the O-ring(6) onto plug(3, 4) and install the plug(3, 4) into the body(1).
· Tighten torque : 4.5kgf · m(32.5lbf · ft)



3. STEERING CYLINDER

1) STRUCTURE



※ Specifications
- Cylinder bore : 85mm (3.1in)
- Outer diameter : 100mm (3.9in)
- Stroke(half) : 149.5mm (5.8in)
- Rod diameter : 55mm (2.2in)

80D7SE21

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

2) DISASSEMBLY

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

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

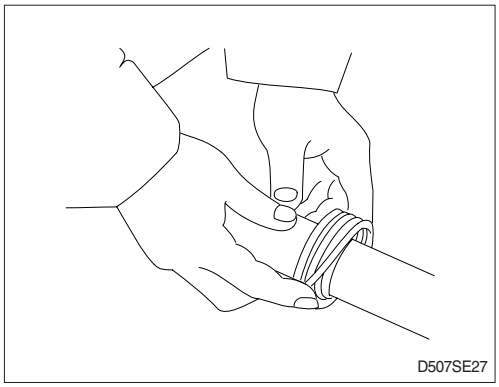
mm(in)

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

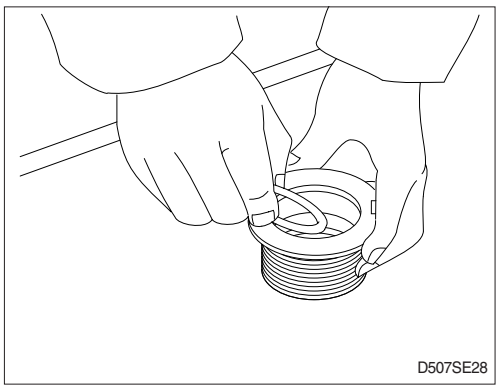
4) ASSEMBLY

(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.

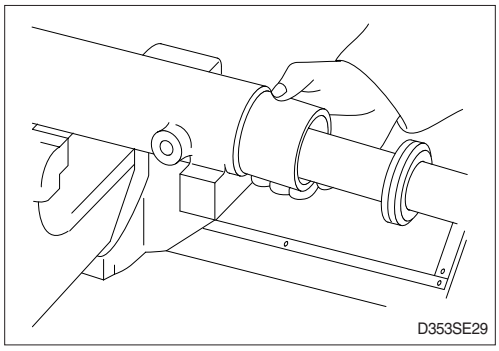

D507SE27

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

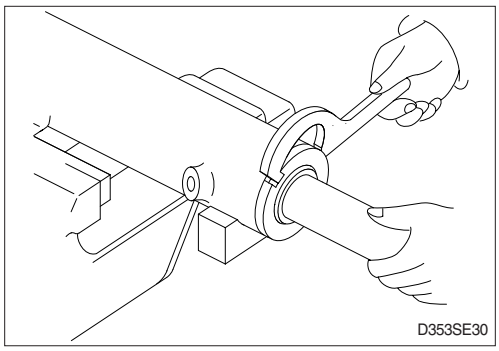

D507SE28

(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.

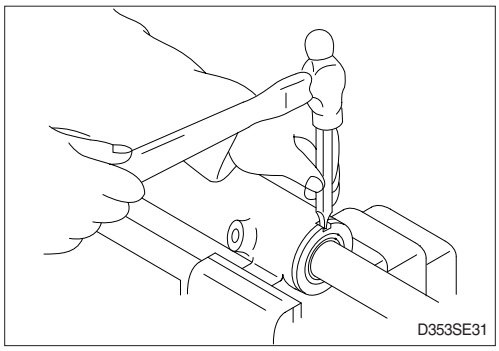


(5) Using a hook spanner, install the gland assembly, and tighten it with torque 60±6kgf · m (434±43lbf · ft).



(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 need calking again, never using previous calking position.



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

(8) Install cylinder into trail axle.

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

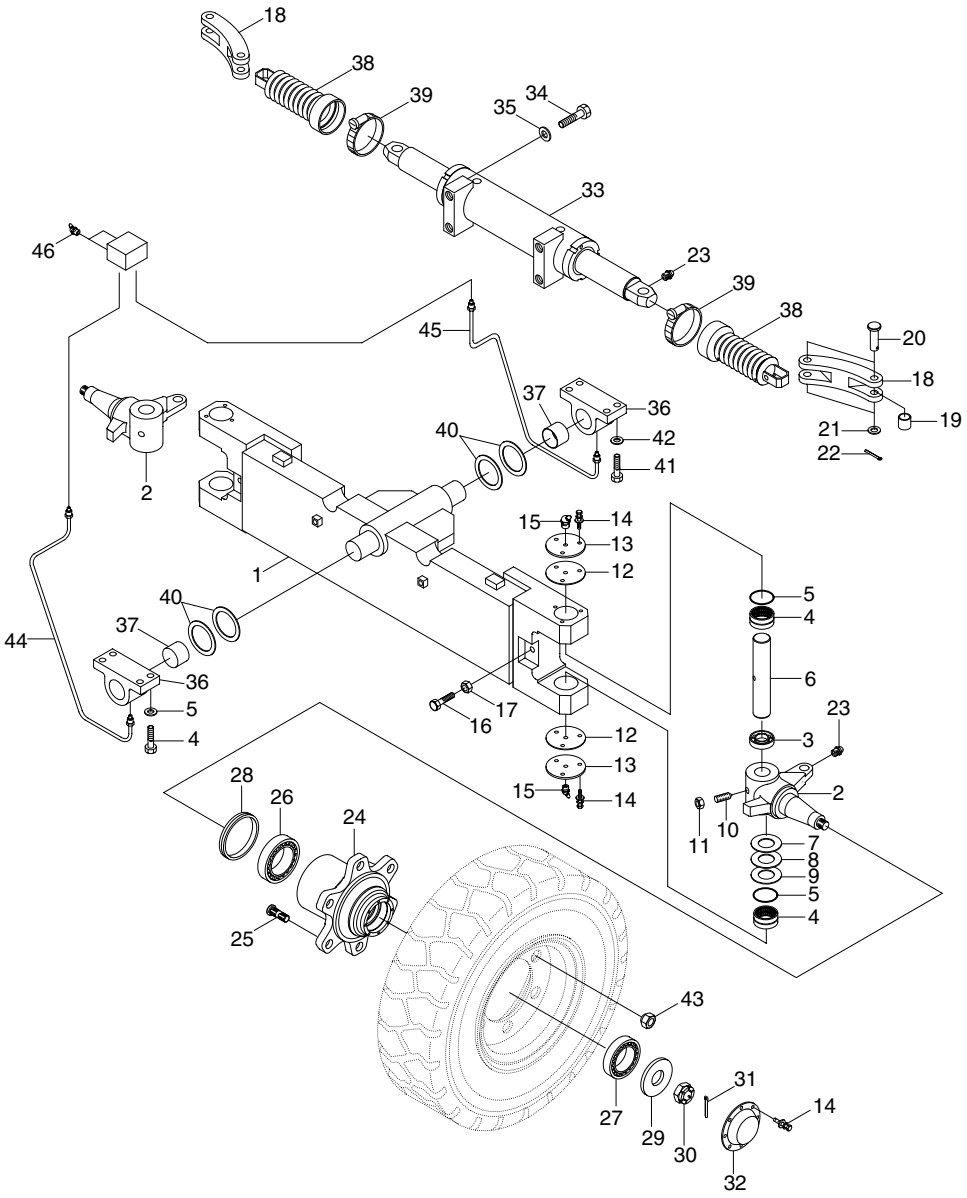
※ Then, repeat the above operation at gradually increasing engine rpm. This releases air from the system and completes preparation for operation.

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

4. STEERING AXLE

1) STRUCTURE

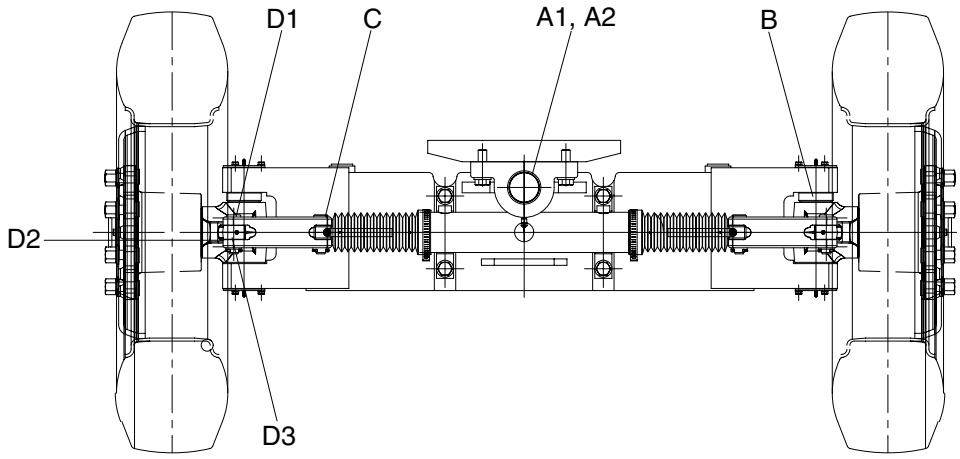
※ Do not remove the stopper bolt unless necessary.



80D7SE24

1	Steering axle	13	Cover	25	Hub bolt	37	Bushing
2	Knuckle	14	Bolt w/washer	26	Taper roller bearing	38	Steer cylinder boot
3	Thrust bearing	15	Grease nipple	27	Taper roller bearing	39	Clamp
4	Needle bearing	16	Hexagon bolt	28	Oil seal	40	Shim
5	Oil seal	17	Hexagon nut	29	Special washer	41	Hexagon bolt
6	King pin	18	Link	30	Lock nut	42	Washer
7	Thrust washer	19	Inner race bushing	31	Split pin	43	Hub nut
8	Shim washer	20	Link pin	32	Hub cap	44	Pipe
9	Shim washer	21	Special washer	33	Steering cylinder	45	Pipe
10	Set screw	22	Split pin	34	Hexagon bolt	46	Grease nipple
11	Hexagon nut	23	Grease nipple	35	Washer		
12	Gasket	24	Hub	36	Support		

2) CHECK AND INSPECTION



80D7SE25

unit : mm(in)

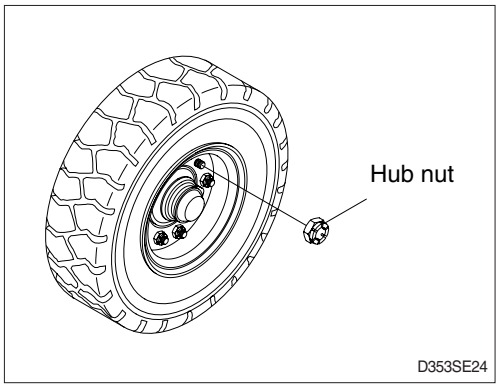
No.	Check item			Criteria		Remarks
				Standard size	Repair limit	
A	Shaft	A1	OD of shaft	70(2.8)	69.5(2.7)	Replace
		A2	ID of bushing	70(2.8)	69.5(2.7)	
B	OD of king pin			50(2.0)	49.8(2.0)	
C	OD of steering cylinder pin			22(0.9)	21.9(0.9)	
D	Knuckle	D1	OD of pin	22(0.9)	21.9(0.9)	
		D2	Vertical play	-	0.2(0.008)	Adjust shim
		D3	ID of bushing	22(0.9)	22.5(0.9)	Replace

· OD : Outer diameter
· ID : Inner diameter

3) DISASSEMBLY

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

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



(2) Remove Hub cap.

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

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

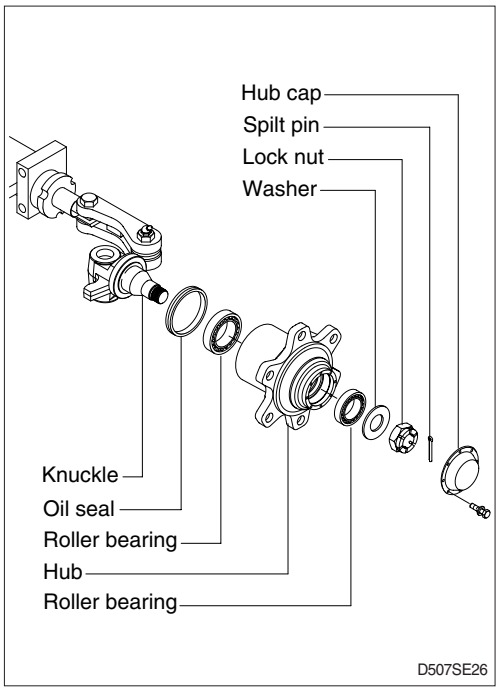
※ Be very careful because just before the hub comes off, tapered roller bearing will fall out.

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

(6) Pull out oil seal.

※ Don't use same oil seal twice.

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



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

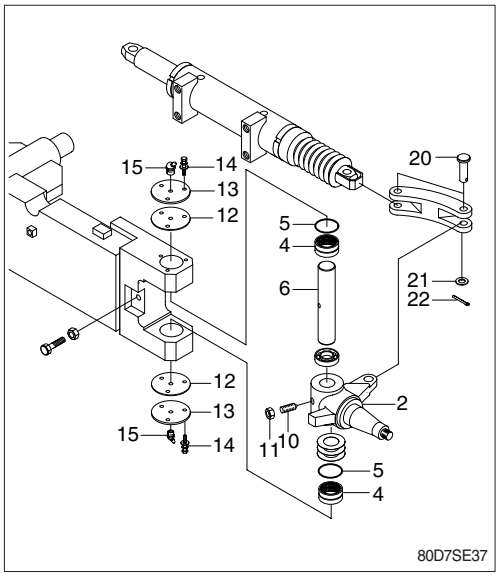
(9) Loosen with washer bolt(14) and remove cover (13), gasket(12). Remove grease nipple(15).

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

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

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

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



4) ASSEMBLY

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

Perform the disassembly in reverse order.

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

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

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

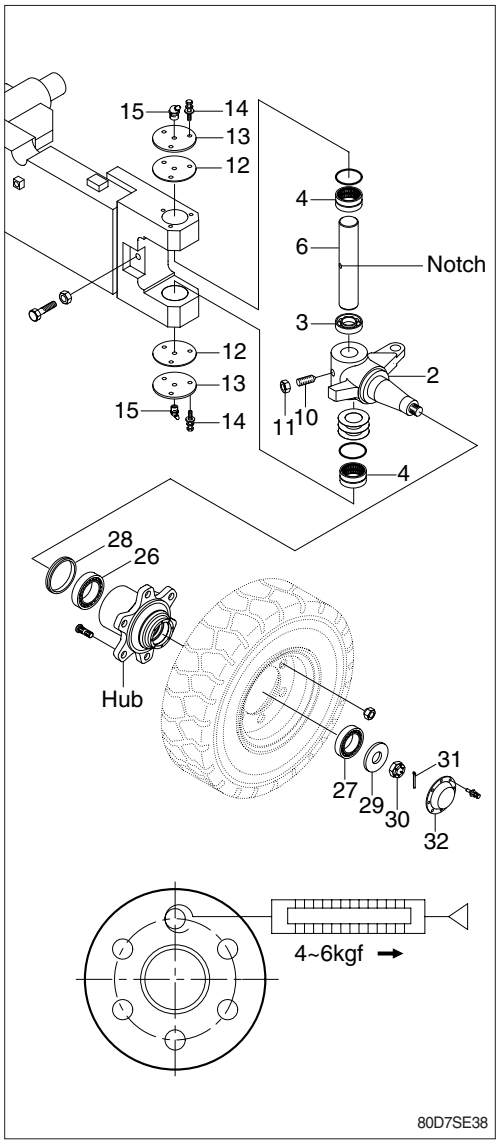
(4) Hub

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

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

③ Put washer(29) in place, tighten with nut(30) and locked with split pin(31). In locking with split pin, locate the hole for the split pin by turning the nut back 1/6 of a turn. Adjust the preload of bearing.

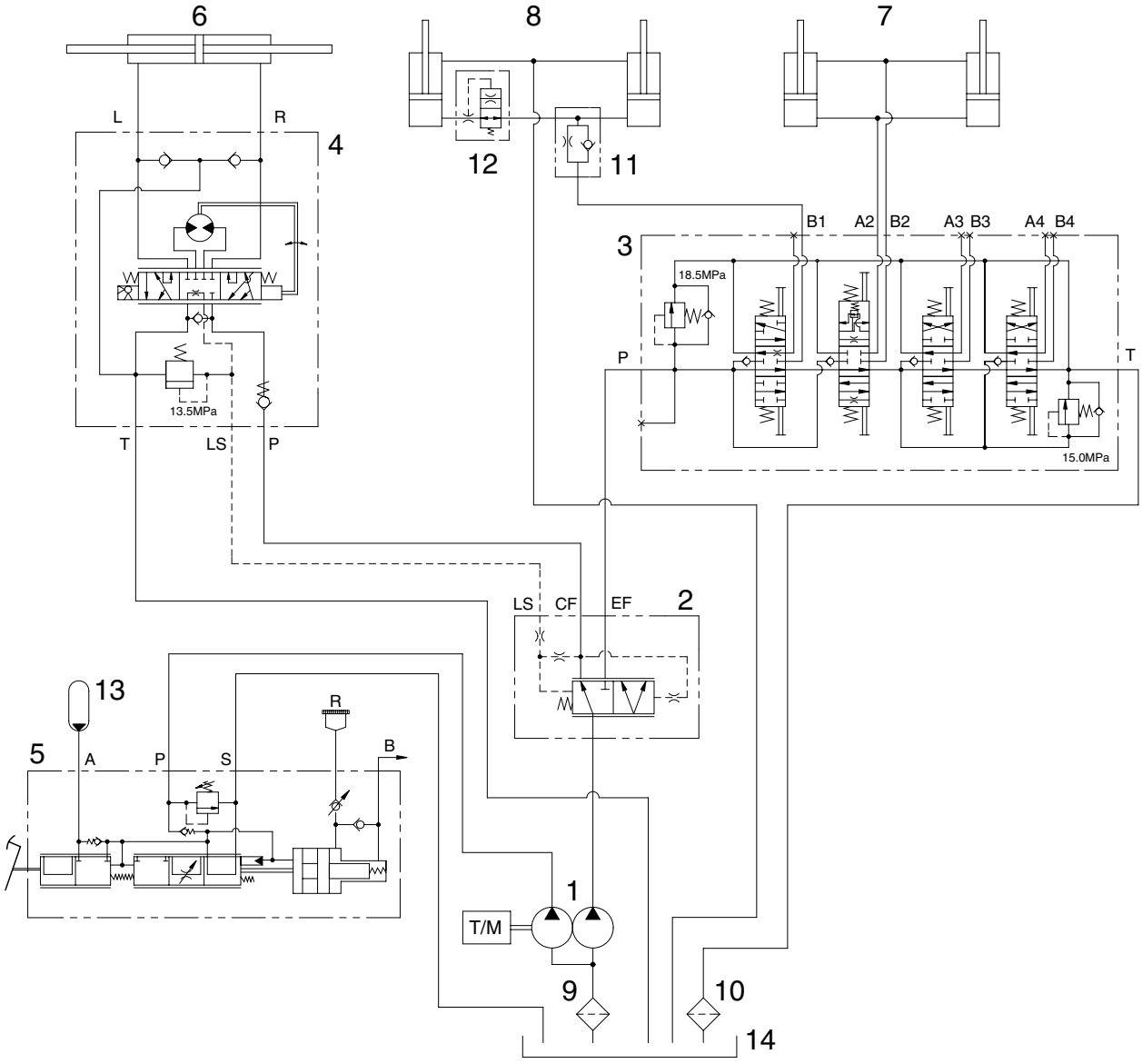
④ Mount the hub cap(32).
Bearing should be well greased before assembling.



SECTION 6 HYDRAULIC SYSTEM

GROUP 1 STRUCTURE AND FUNCTION

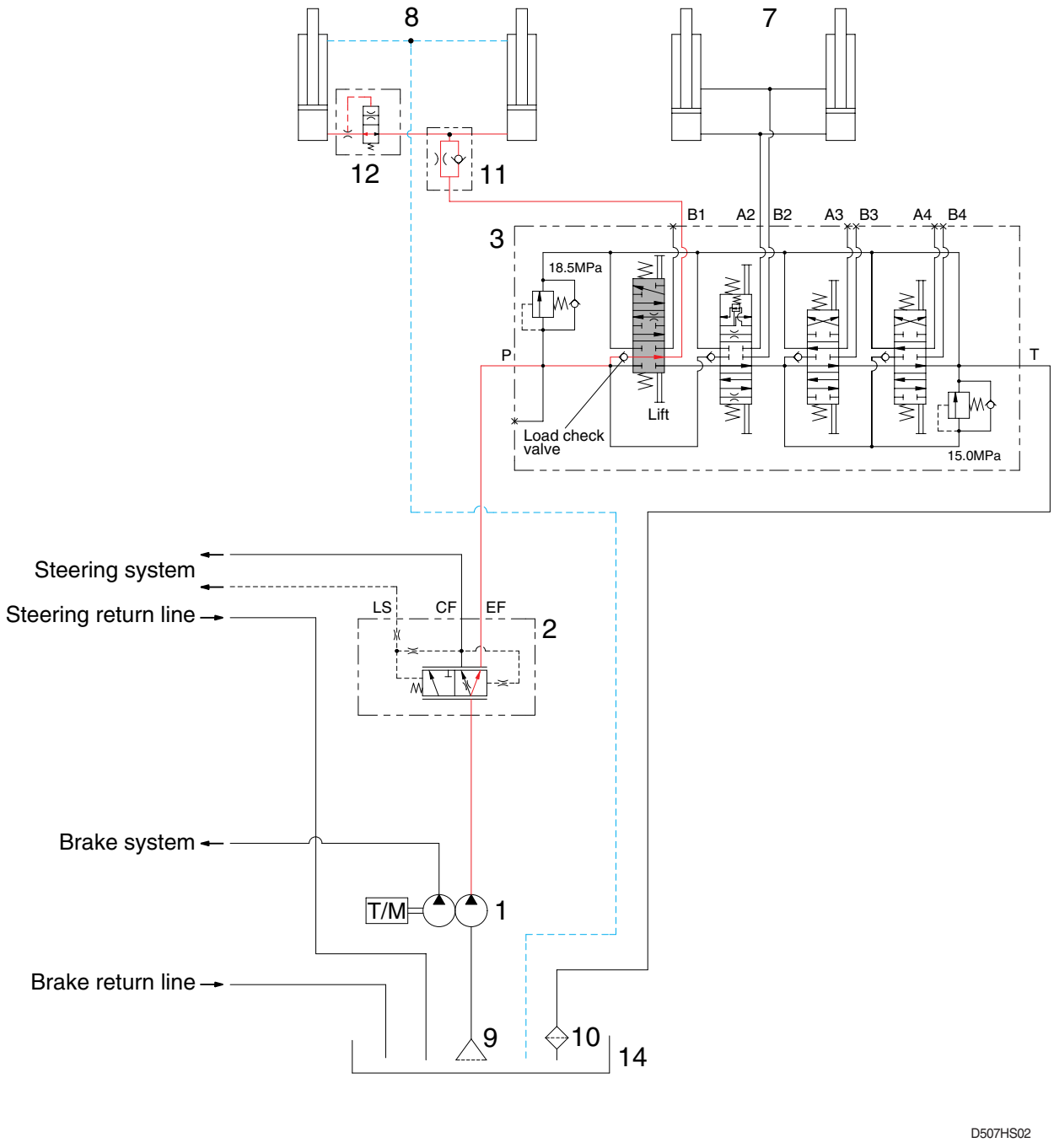
1. HYDRAULIC CIRCUIT



D507HS01

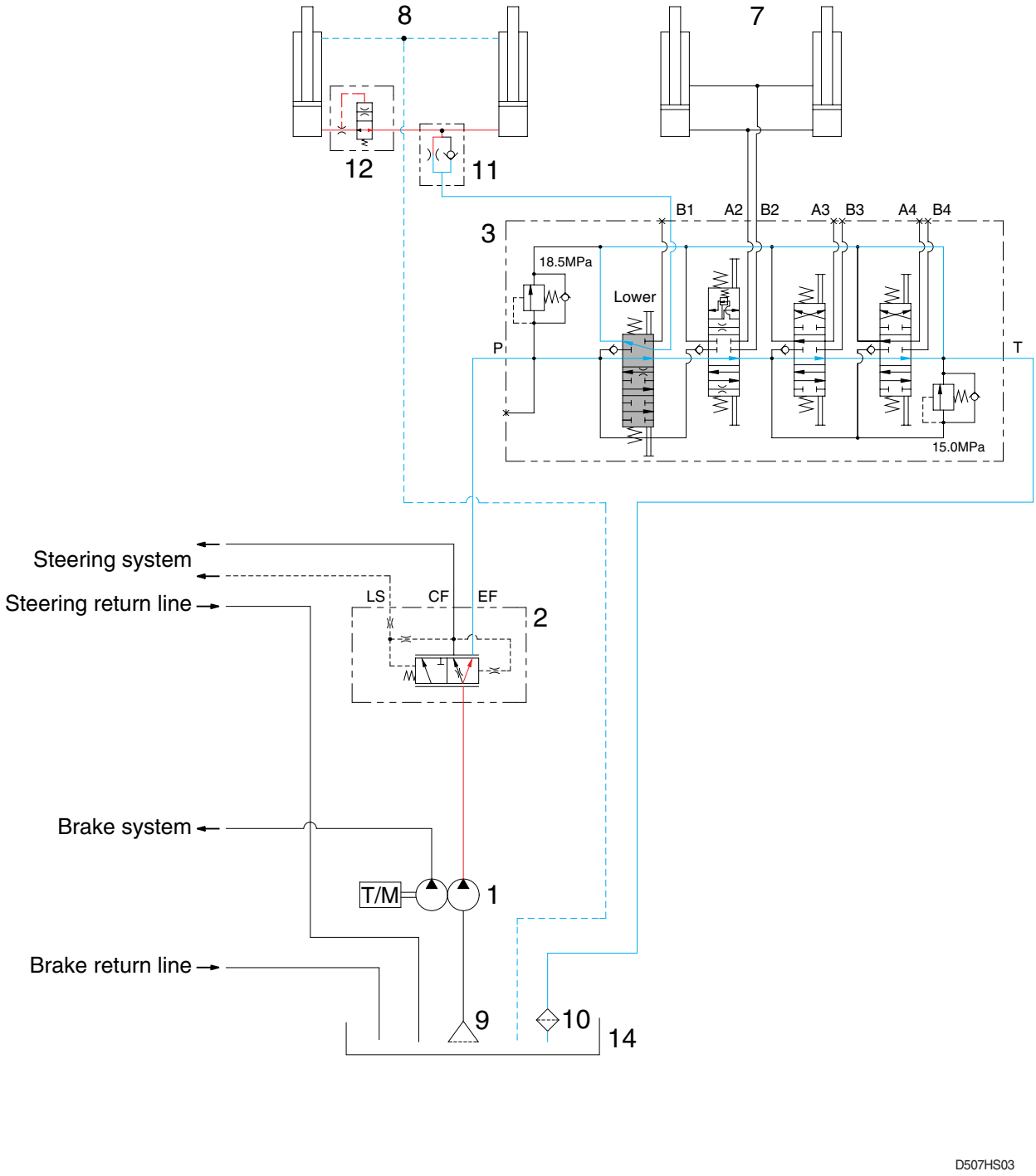
1	Hydraulic gear pump	8	Lift cylinder
2	Priority valve	9	Suction filter
3	Main control valve	10	Return filter
4	Steering unit	11	Down control valve
5	Brake valve	12	Down safety valve
6	Steering cylinder	13	Accumulator
7	Tilt cylinder	14	Hydraulic tank

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



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

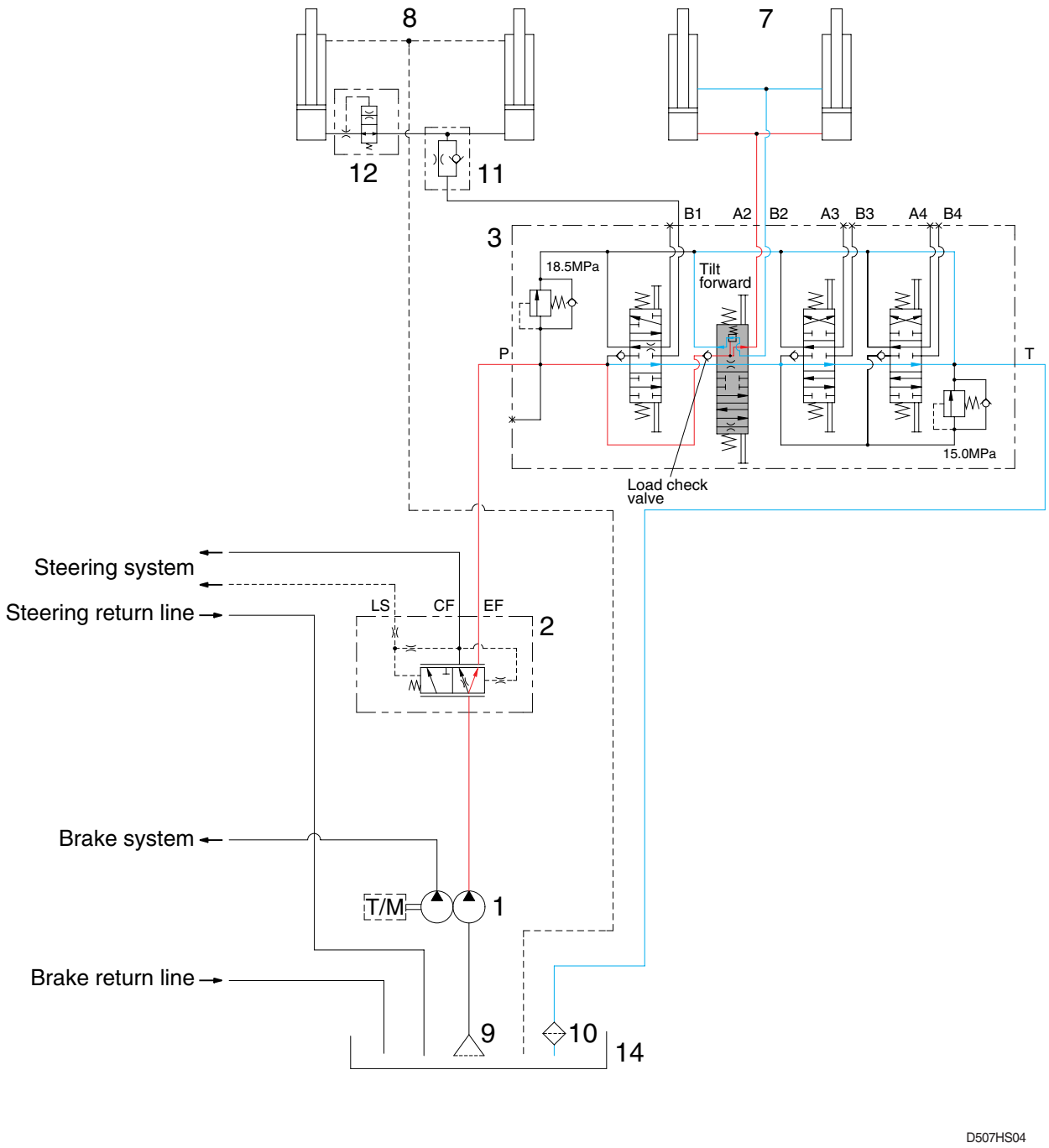
2) WHEN THE LIFT CONTROL LEVER IS IN THE LOWER POSITION



D507HS03

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



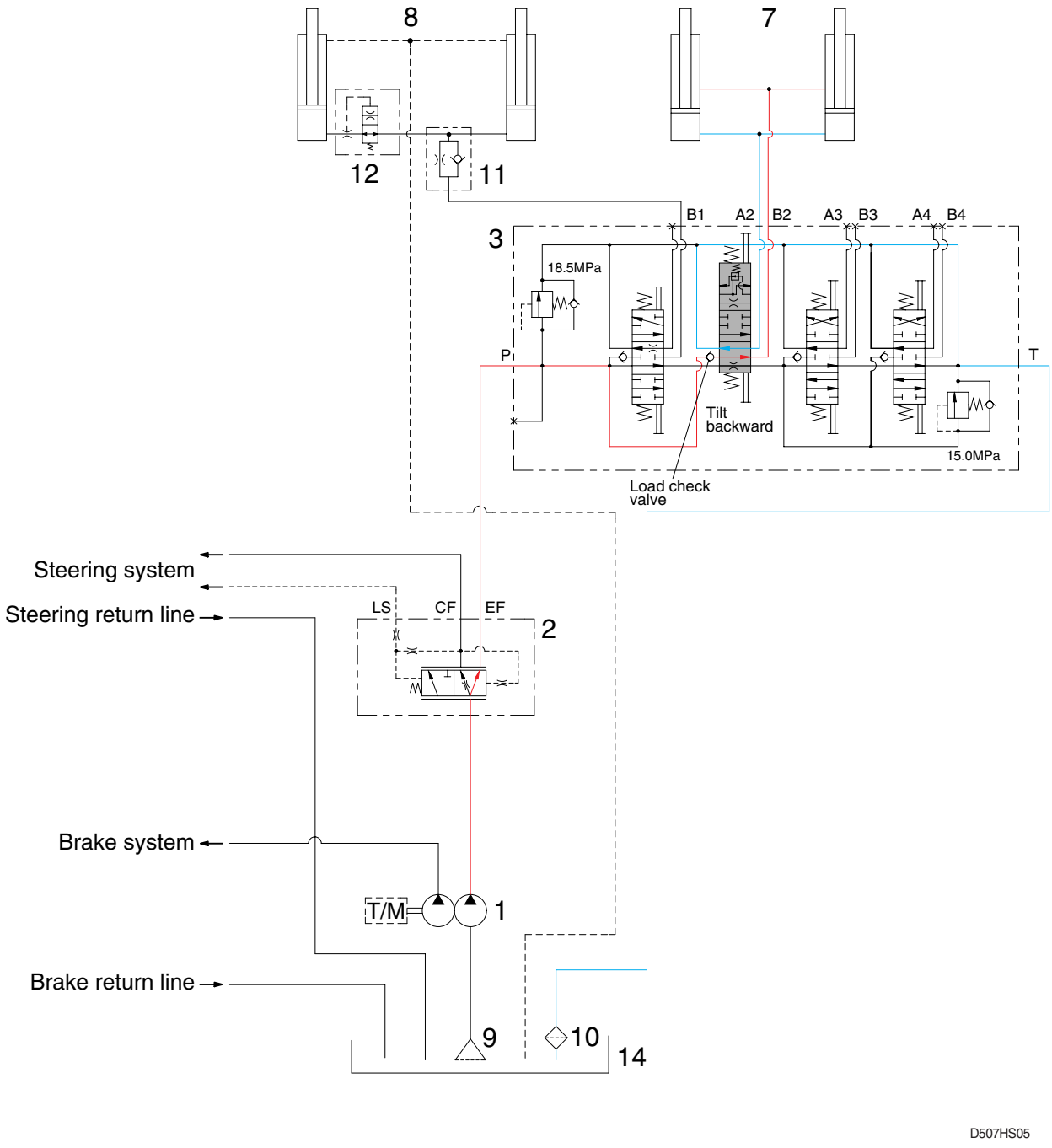
When the tilt control lever is pushed forward, the spool on the second block is moved to tilt forward position.

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

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

When this happens, the mast tilt forward.

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



D507HS05

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

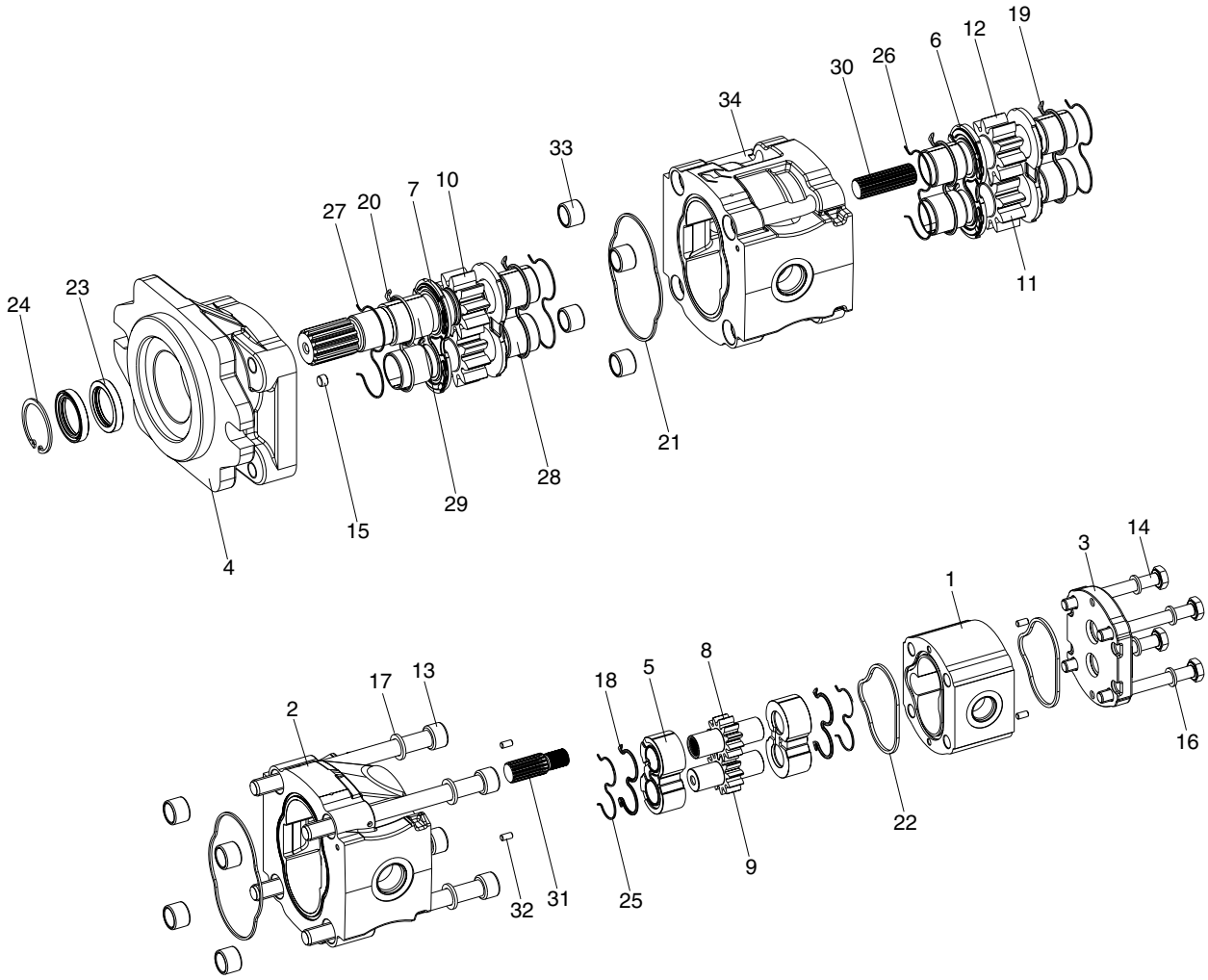
The oil from hydraulic gear pump(1) flows into main control valve(3) and then goes to the small chamber of tilt cylinder(7) by pushing the load check valve of spool.

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

When this happens, the mast tilt backward.

2. HYDRAULIC GEAR PUMP

1) STRUCTURE

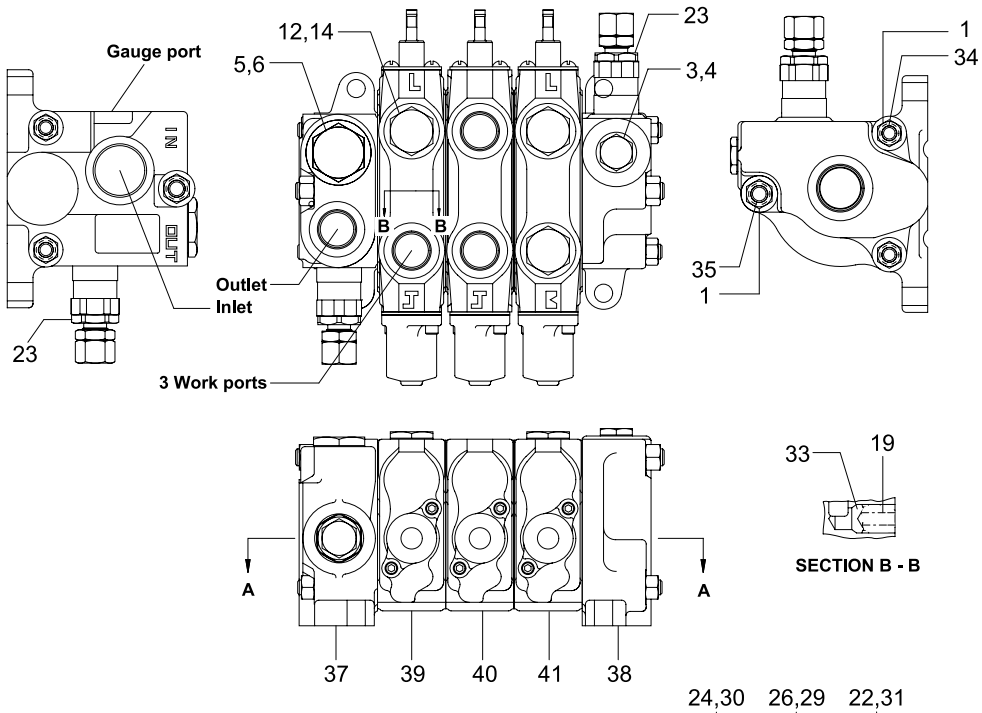


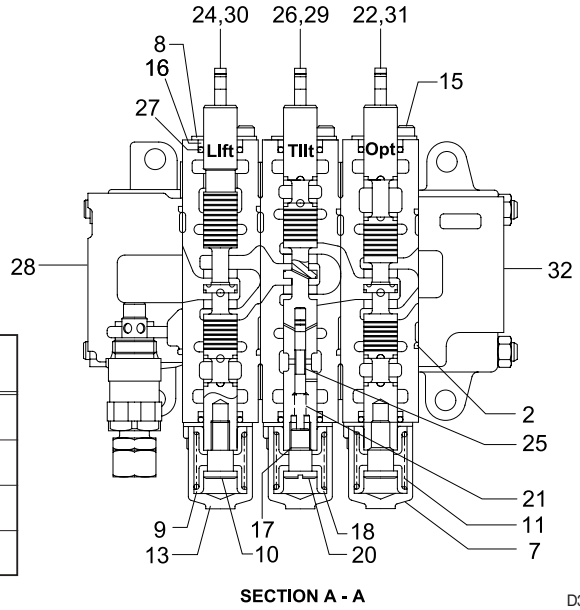
80D7HS06

1	Body	13	Screw	25	Antiextrusion
2	Body	14	Screw	26	Antiextrusion ring
3	Rear cover	15	Grub screw	27	Upper antiextrusion ring
4	Cover	16	Washer	28	Sleeve bearing
5	Thrust plate	17	Washer	29	Upper sleeve bearing
6	Thrust plate	18	Seal	30	Hub
7	Upper thrust plate	19	Seal	31	Hub
8	Drive gear	20	Upper seal	32	Dowel pin
9	Driven gear	21	Standard seal	33	Steel bushing
10	Drive shaft	22	Seal	34	G. housing
11	Driven gear	23	Shaft seal		
12	Drive shaft	24	Ring		

3. MAIN CONTROL VALVE

1) STRUCTURE (3 Spool)





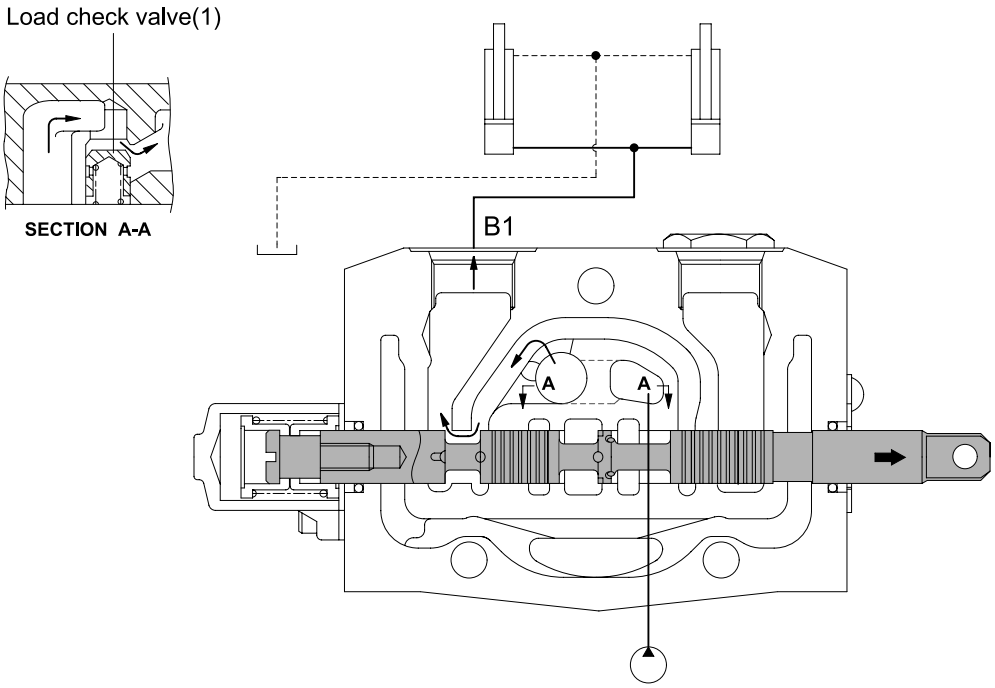
D353HS07

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

1	Special nut	15	Screw	29	Spool housing
2	O-ring	16	Wiper	30	Spool housing
3	Plug	17	O-ring	31	Spool housing
4	O-ring	18	Spring seat	32	Outlet housing
5	O-ring	19	Spring	33	Poppet
6	Plug	20	Spool end	34	Tie rod
7	Spool cap	21	Spring	35	Tie rod
8	Seal plate	22	Spool	36	Special nut
9	Spring seat	23	Main relief valve	37	Inlet section assy
10	Spool end	24	Spool	38	Outlet section assy
11	Spring	25	Piston	39	Spool section assy
12	O-ring	26	Spool	40	Spool section assy
13	Cap screw	27	O-ring	41	Spool section assy
14	Plug	28	Inlet housing		

2) LIFT SECTION OPERATION

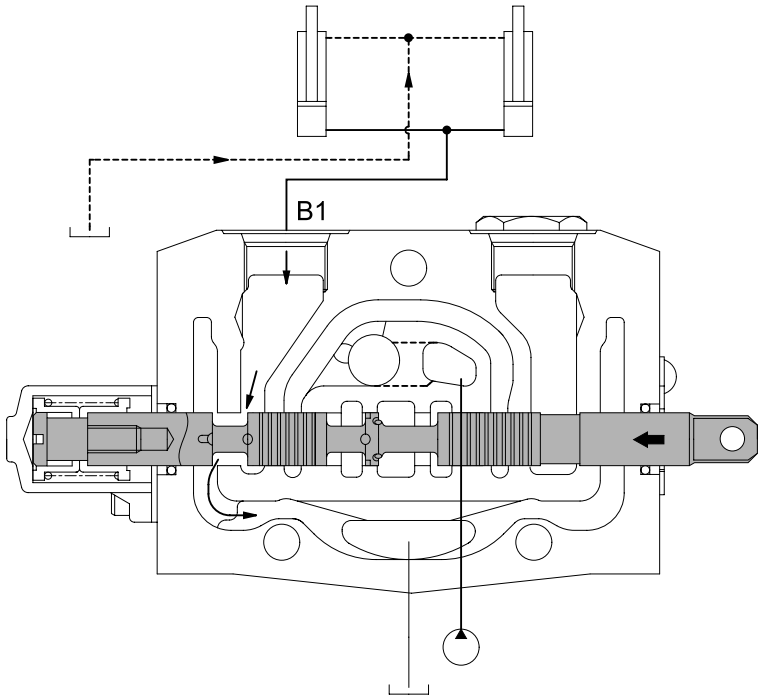
(1) Lift position



D353HS08

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

(2) Lower position

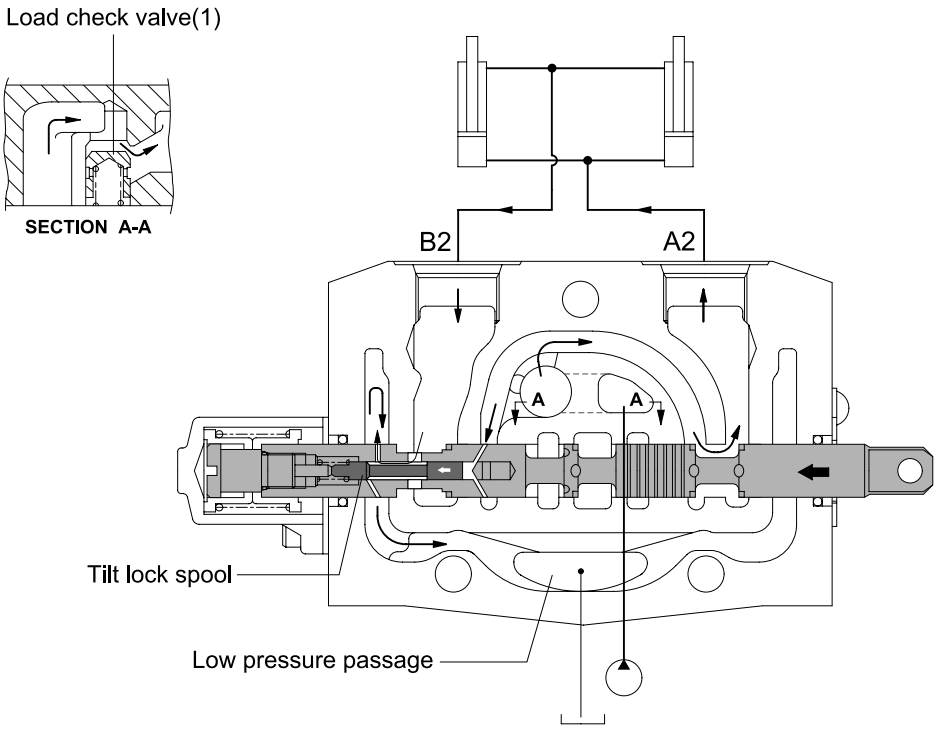


D353HS09

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

3) TILT SECTION OPERATION

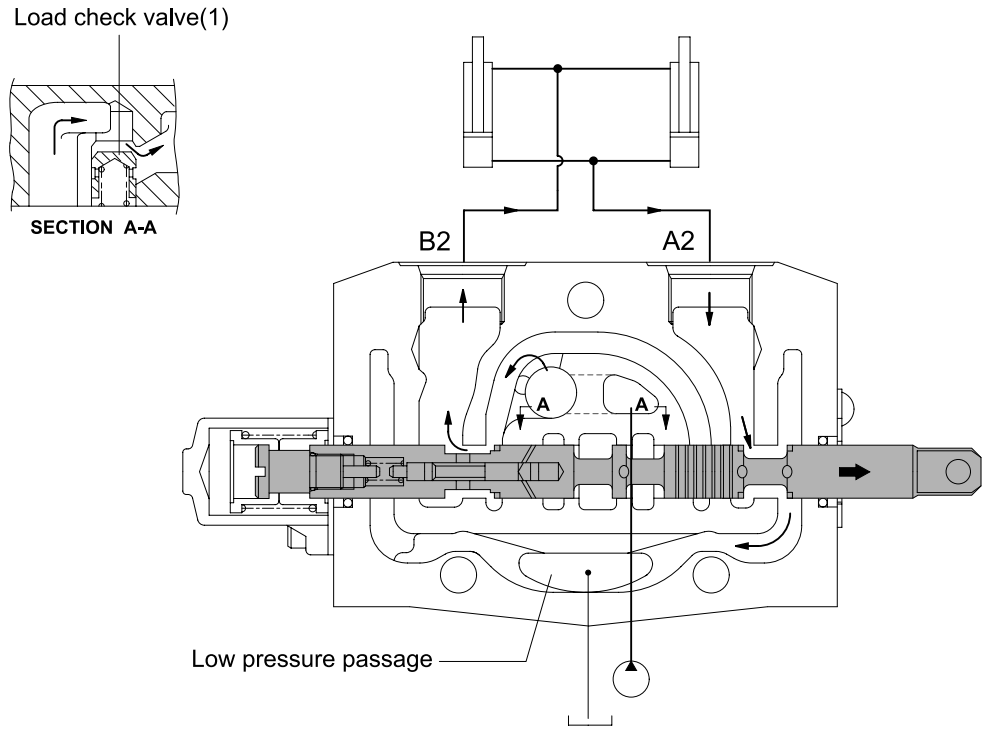
(1) Tilt forward position



D353HS10

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

(2) Tilt backward position



D353HS11

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

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

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

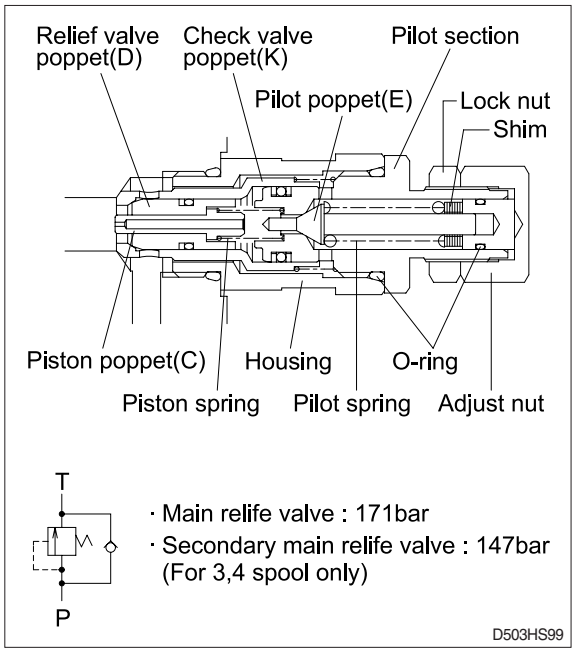
4) MAIN RELIEF VALVE

(1) Pressure setting

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

Procedure

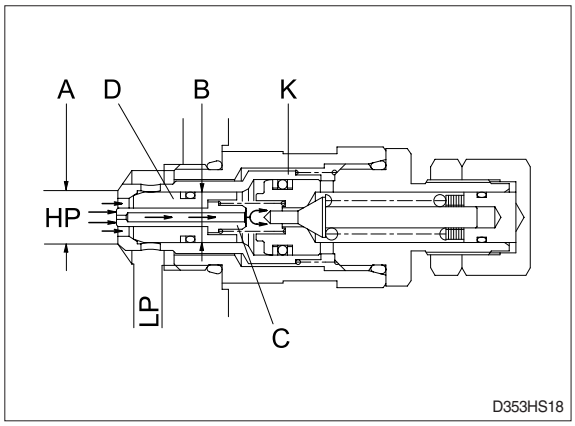
① Loosen lock nut.
② Set adjusting nut to desired pressure setting.
③ If desired pressure setting cannot be achieved, add or remove shims as required.
④ Tighten lock nut.
⑤ Retest in similar manner as above.



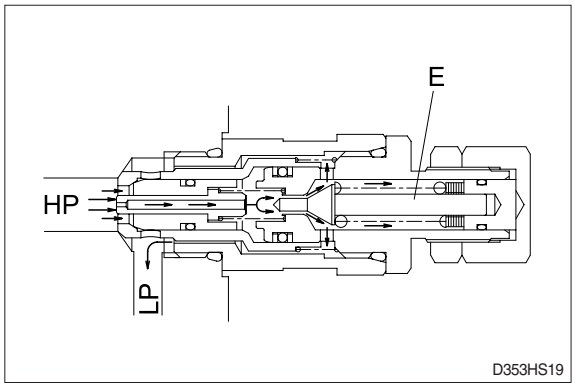
(2) Function

① As work port relief

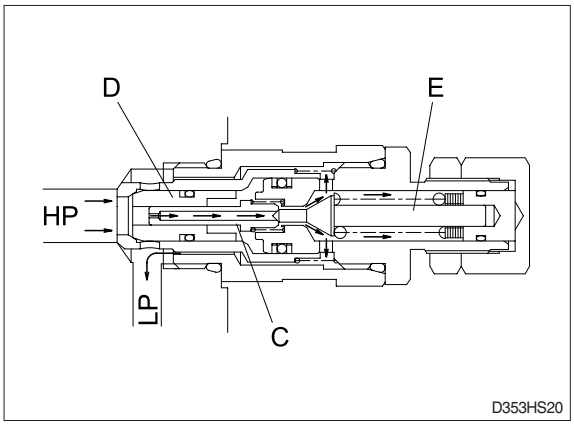
The relief valve is in communication between the high pressure port HP and low pressure LP. Oil is admitted through the hole in poppet C and because of the differential area between diameters A and B relief valve poppet D and check valve poppet K are tightly seated as shown.



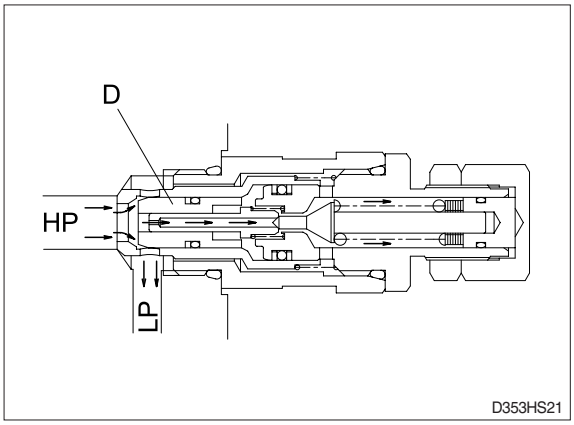
The oil pressure in the high pressure port HP has reached the setting of the pilot poppet spring force and unseats the pilot poppet E and oil flows around the poppet through the cross drilled holes and to the low pressure area LP.



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

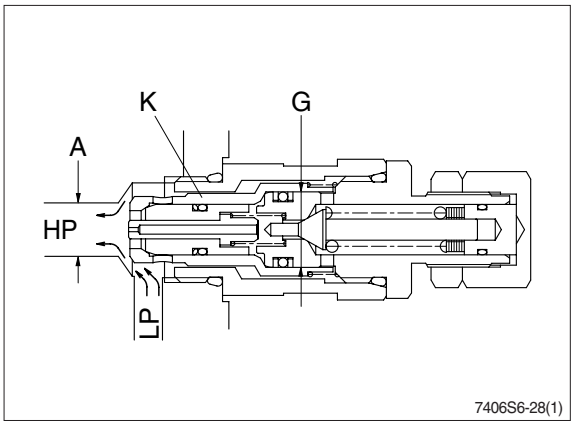


The imbalance of pressure on the inside as compared to that of the high pressure port HP, forces the relief valve poppet D to open and relieve the oil directly to the low pressure chamber LP in the valve.

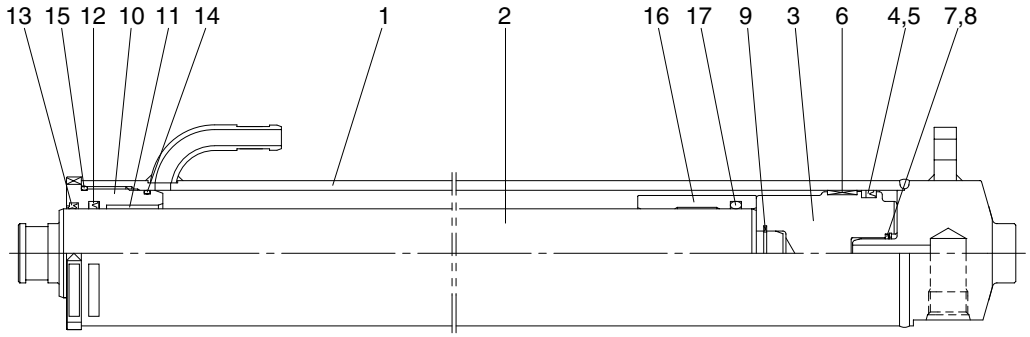


② As anti void

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



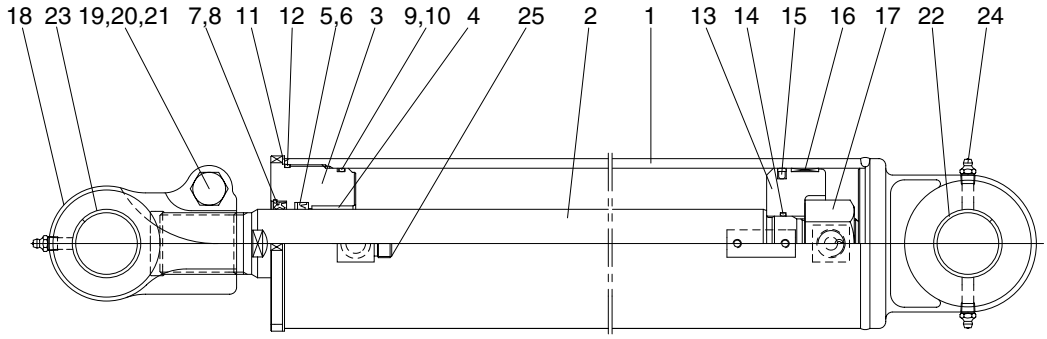
4. LIFT CYLINDER



D507HS12

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

5. TILT CYLINDER



80D7HS13

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

GROUP 2 OPERATIONAL CHECKS AND TROUBLESHOOTING

1. OPERATIONAL CHECKS

1) CHECK ITEM

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

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

· **Hydraulic drift**

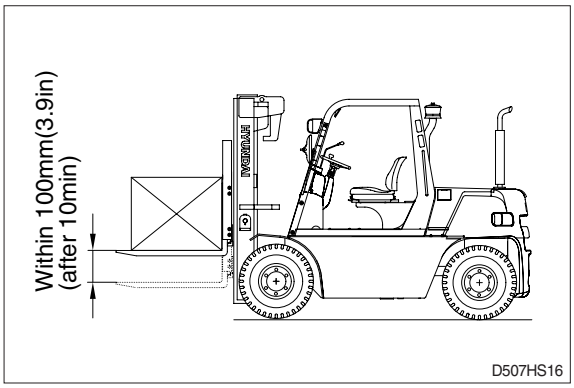
- Down(Downward movement of forks)
  : Within 100mm(3.9in)
- Forward(Extension of tilt cylinder)
  : Within 5°

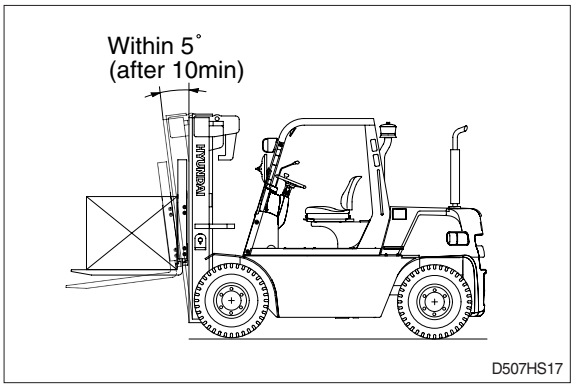
If the hydraulic drift is more than the specified value, replace the control valve or cylinder packing.

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

mm (in)

Standard	Under 0.6 (0.02)

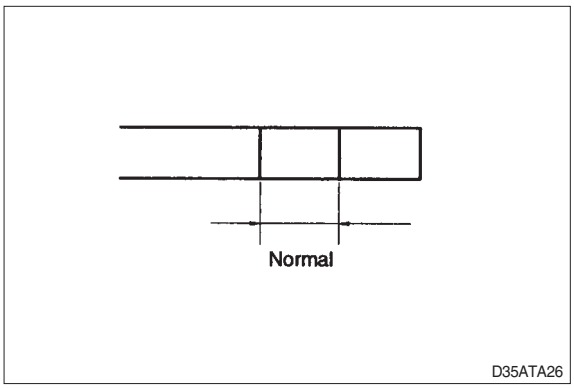




2) HYDRAULIC OIL

(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 175kgf/cm^2.
(2538psi)

2. TROUBLESHOOTING

1) SYSTEM

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

2) HYDRAULIC GEAR PUMP

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

3) MAIN RELIEF VALVE

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

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

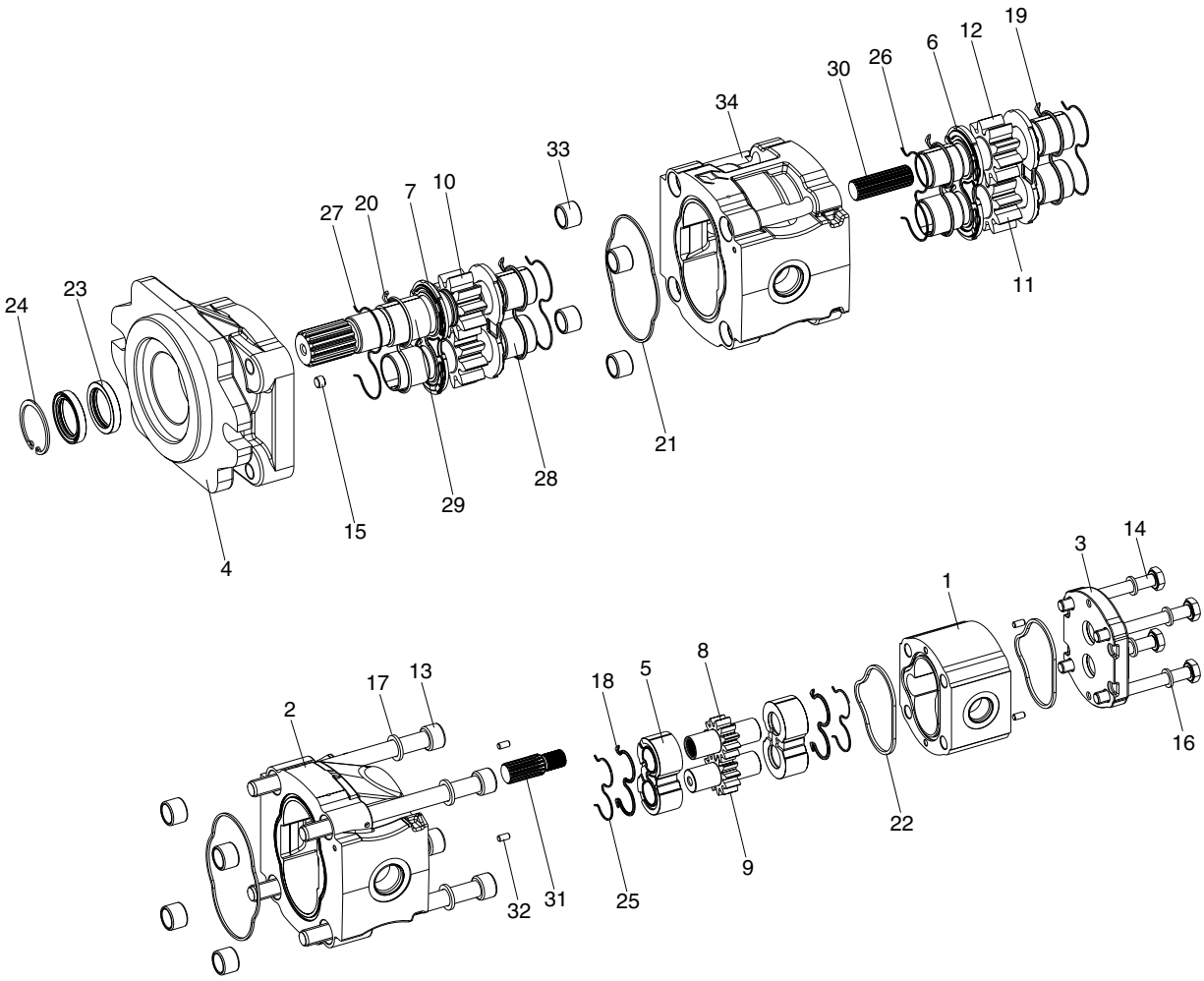
- Loosen lock nut.
- Set adjusting nut to desired pressure setting.
- If desired pressure setting cannot be achieved, add or remove shims as required.
- Tighten lock nut.
- Retest in similar manner as above.

4) LIFT CYLINDER

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

1. MAIN PUMP

1) STRUCTURE



80D7HS06

1	Body	13	Screw	25	Antiextrusion
2	Body	14	Screw	26	Antiextrusion ring
3	Rear cover	15	Grub screw	27	Upper antiextrusion ring
4	Cover	16	Washer	28	Sleeve bearing
5	Thrust plate	17	Washer	29	Upper sleeve bearing
6	Thrust plate	18	Seal	30	Hub
7	Upper thrust plate	19	Seal	31	Hub
8	Drive gear	20	Upper seal	32	Dowel pin
9	Driven gear	21	Standard seal	33	Steel bushing
10	Drive shaft	22	Seal	34	G. housing
11	Driven gear	23	Shaft seal		
12	Drive shaft	24	Ring		

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

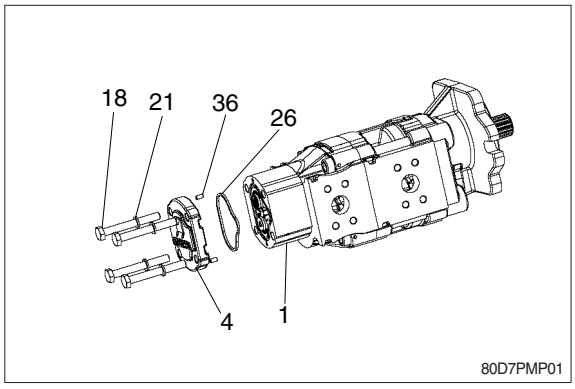
① Socket set(1/2″ drive)
② Internal snap ring pliers
③ Shaft seal sleeve or clear tape
④ Torque wrench(200lbf · ft capacity)
⑤ Plastic hammer
⑥ Torque wrench box end adapters

3) DISASSEMBLY

(1) Rear section

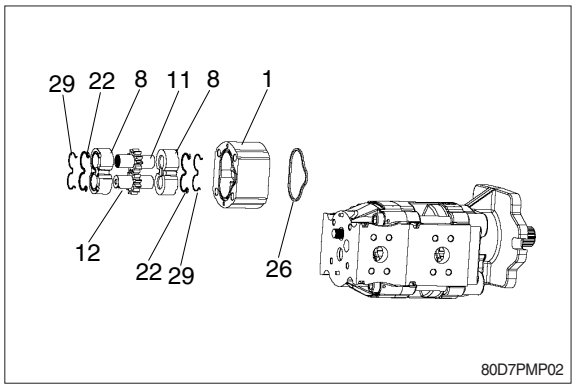
① Loosen and remove the clamp bolts(18) from rear working section(1).

※ Related parts
Washer(21), rear cover(4), dowel pin(36) and square-ring(26).



② Remove driving gear(11), driven gear(12) with thrust plate parts(8, 22, 29), keeping gear as straight as possible, and working section(1) also.

※ Related parts
Back-up ring(29), O-ring(22), thrust plate (8), working body(1) and square ring(26).

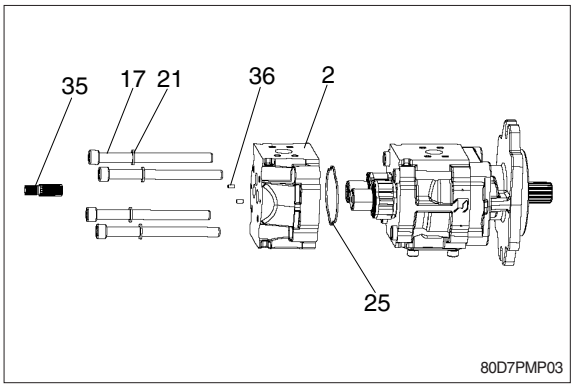


(2) Center section

① Remove through shaft(35) from driving shaft(15).

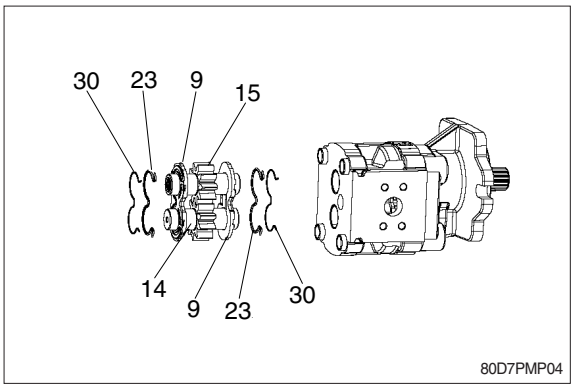
② Loosen and remove the clamp bolt(17) with washer(21), and then remove the working section(2) with dowel pin(36).

※ Related parts
Square ring(25).



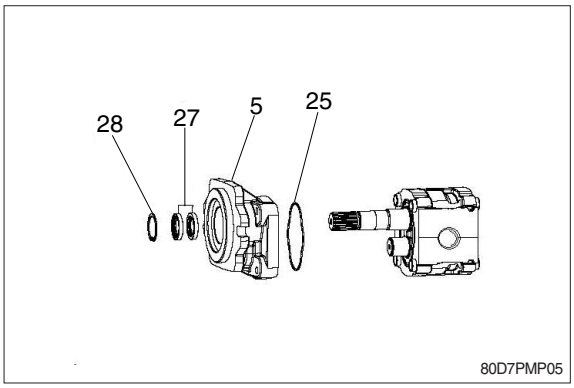
③ Remove driving gear(15), driven gear(14) with thrust plate parts (9, 23, 30), keeping gear as straight as possible, from first working body.

※ Related parts
Back-up ring(30), O-ring(23) and thrust plate (9).



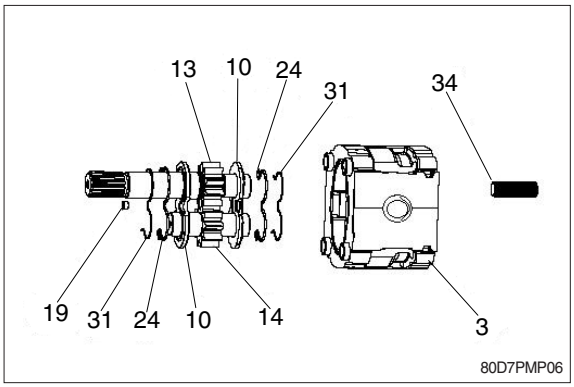
(3) Front section

① Remove the snap-ring(28) and shaft seal (27), and then remove mounting flange (5) and square ring(25) from working section(3).



② Remove driving gear(13), driven gear(14) with through shaft(34) and thrust plate parts(10,24,31) from the working body (3), keeping gear as straight as possible.

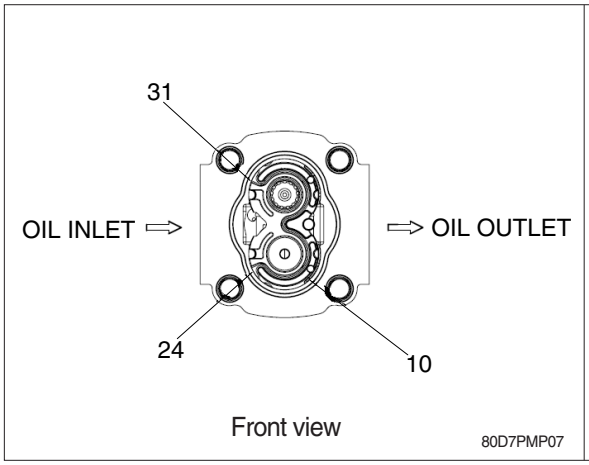
※ Related parts
Plug(19), back-up ring(31), O-ring(24) and thrust plate(10).

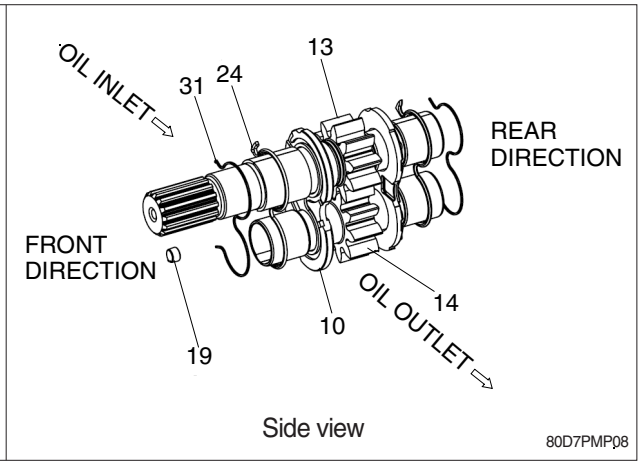


4) REASSEMBLY

※ Information for assembly way of thrust plates

It is important that all of thrust plate parts in this hydraulic pump should be assembled such as below picture during reassembly. Below figures show assembling sequence and direction.



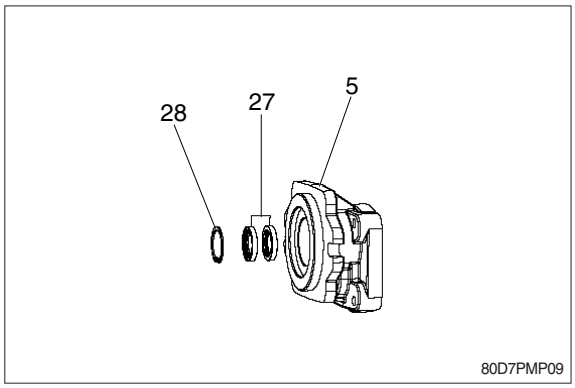


10	Thrust plate	14	Driven gear	24	O-ring
13	Driving gear	19	Plug	31	Back-up ring

(1) Front cover area

① Insert the shaft seal(27) carefully and fit it inside of mounting flange(5) with proper tool.

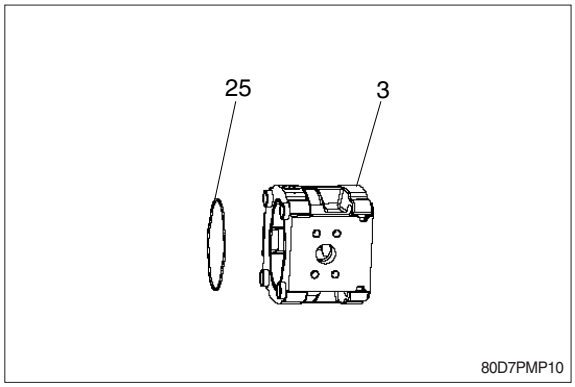
② Fit the snap-ring(28) in pre-arranged position with proper tool.



(2) Center section

① Fit the square ring(25) on the prearranged groove of the working section(3).

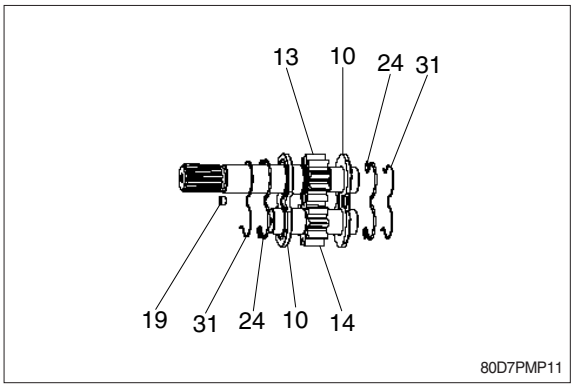
※ Smear clean grease on the square ring (25) to avoid drifting away of square ring from the working section(3).



② Locate the o-ring(24) on the groove prearranged on the thrust plate(10).

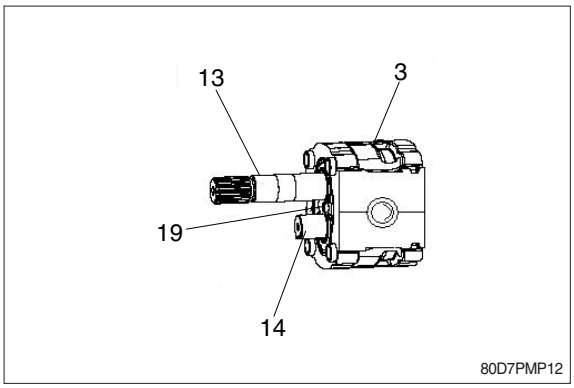
③ Then, locate back-up ring(31) on the groove pre-arranged on the seals(10, 24) with plug(19).

※ Smear clean grease on the seal(24,31). (The front and rear thrust plates and seals and back-up ring are same.)



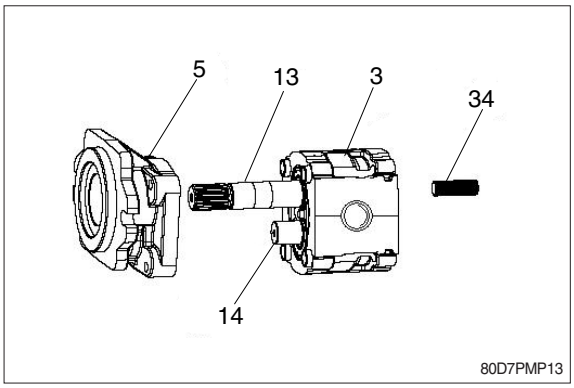
④ Insert the driving gear(13) and driven gear(14) into working section(3) while keeping the gears straight.

※ Locate thrust plate(10+24+31) with care for the direction.



⑤ Locate the completed mounting flange (5+27+28) to working section(3) while tacking care not to give any damage on the shaft seal by edge of shaft(13).

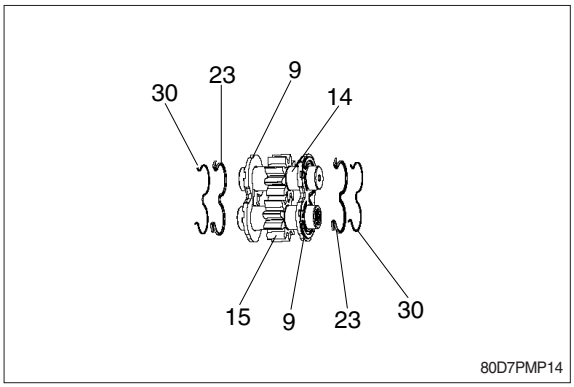
⑥ Insert the through shaft(34) to rear side of the driving shaft(13).



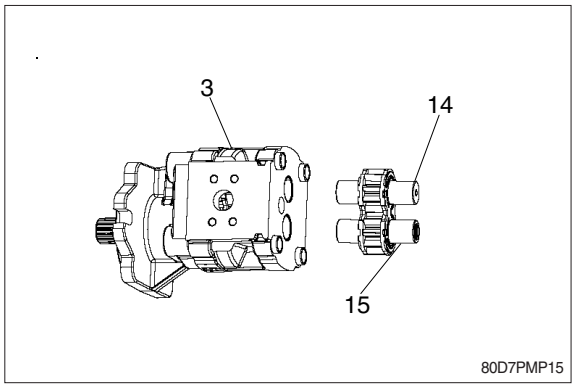
⑦ Locate the O-ring(23) on the groove prearranged on the thrust plate(9).

⑧ Then, locate back-up ring(30) on the groove pre-arranged on the seals(9, 23).

※ Smear clean grease on the seal(9,23) (The front and rear thrust plates and seals and back-up ring are same.)

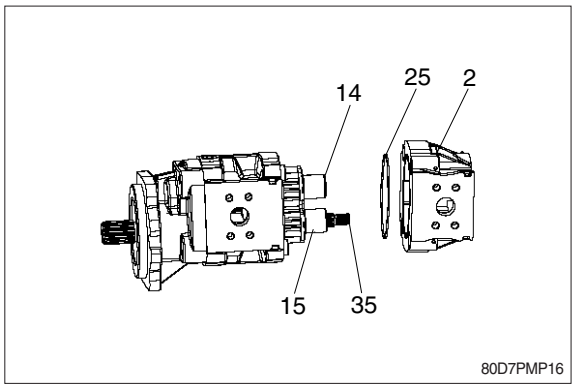


⑨ Insert the driving shaft(15) and driven gear(14) including the completed thrust plate(9+23+30) into working section(3) while keeping the plate straight.

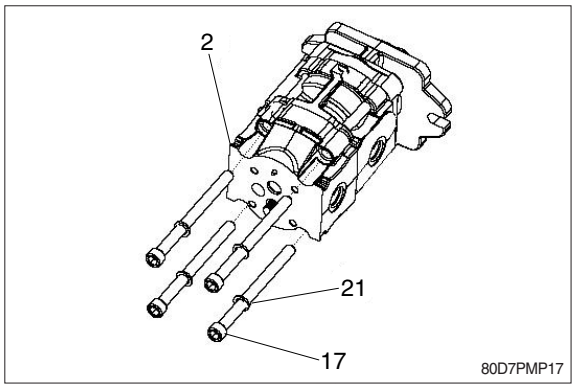


⑩ Insert the through shaft(35) into driving shaft(15), and then locate the working body(2) after inserting the squaring ring (25) to body(2).

※ Smear clean grease on the square ring (25) to avoid drifting away of square ring from the working body(2).



⑪ Tighten the bolt(17) with washer(21) in a cross pattern to torque valve of 140Nm.

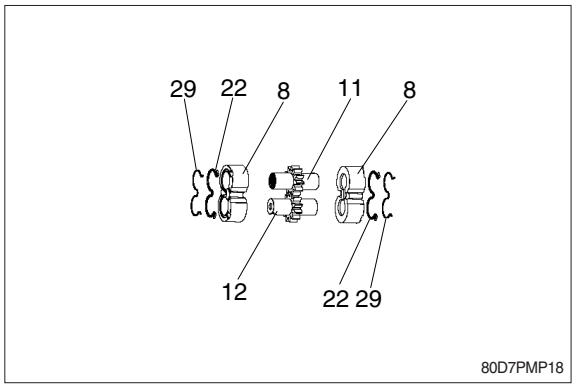


(3) Rear section

① Locate the O-ring(22) on the groove prearranged on the thrust plate(8).

② Then, locate back-up ring(29) on the groove pre-arranged on the seals(8, 22).

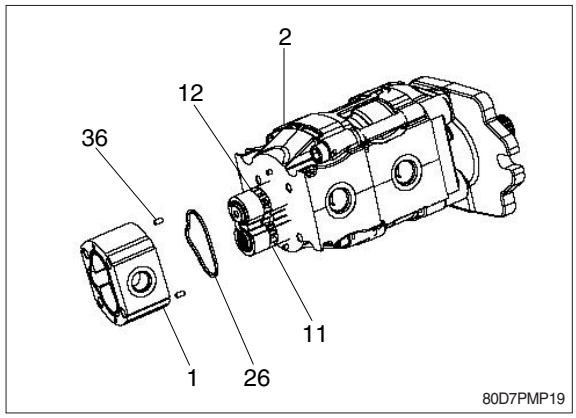
※ Smear clean grease on the seal(8,22) (The front and rear thrust plates and seals and back-up ring are same.)



③ Locate the driving gear(11) and driven gear(12) with thrust plate parts(8+22+29) into working section(2).

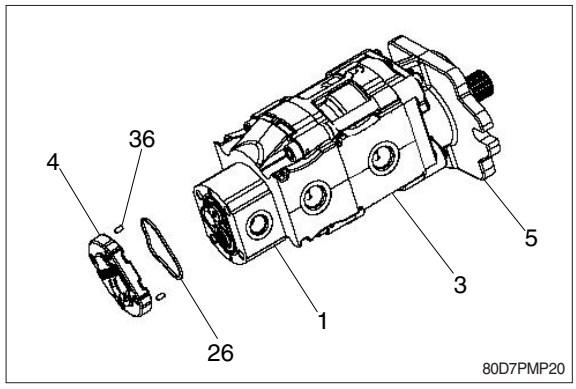
④ Insert the dowel pin into the working section(2) and then, locate the rear working section(1) to working section(2) while keeping the gear straight.

※ Smear clean grease on the square ring (26) to avoid drifting away of square ring from the rear working section(1).



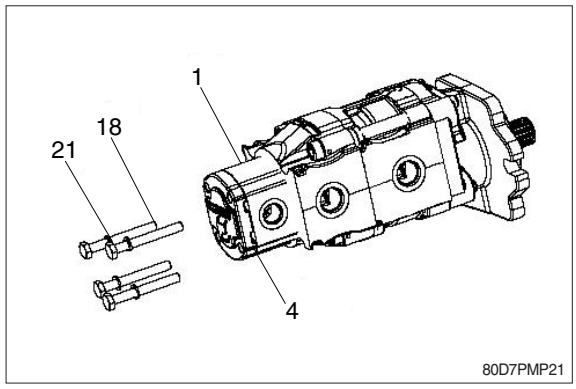
⑤ Locate the rear cover(4) after inserting the square ring(26) and the dowel pin(36) into the rear working section(1).

※ Smear clean grease on the square ring(26) to avoid drifting away of square ring(26) from the rear cover(4).

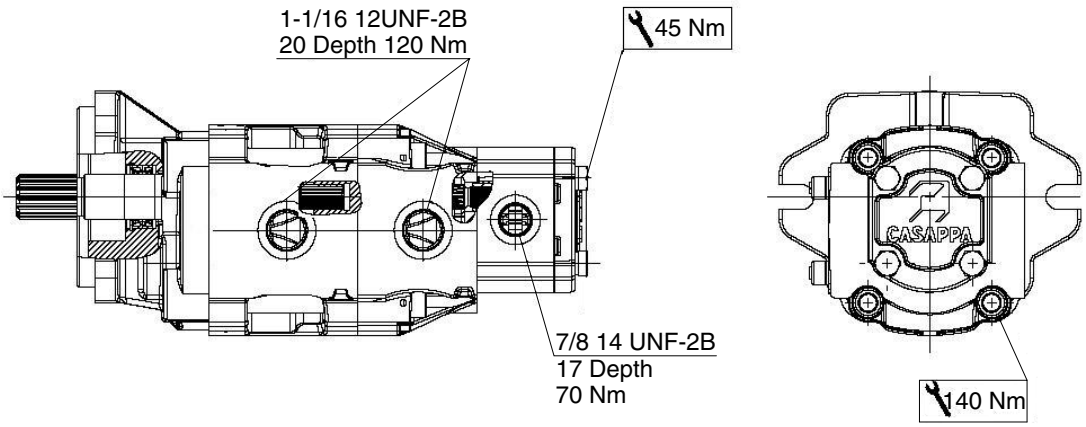


⑥ Tighten the bolt(18) with washer(21) in a cross pattern to torque valve of 45Nm.

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



(4) Reference

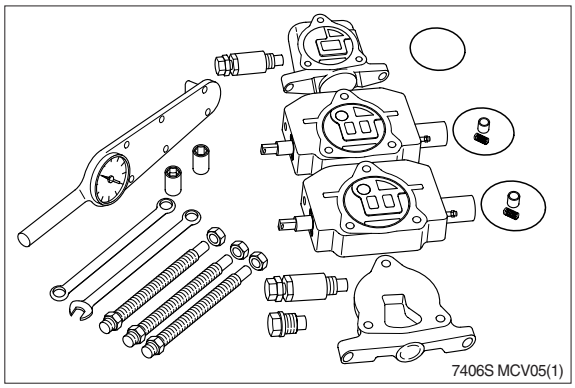


Torque configuration for hydraulic pump

80D7PMP22

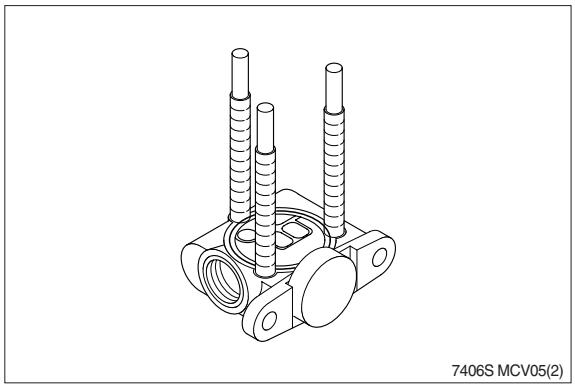
2. MAIN CONTROL VALVE

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.



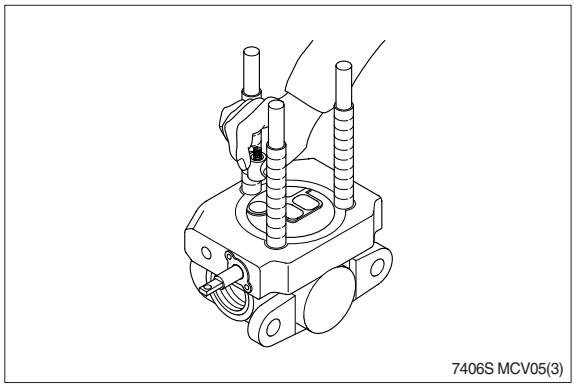
7406S MCV05(1)

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.



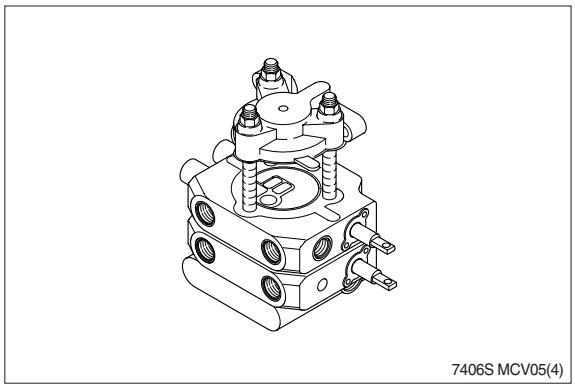
7406S MCV05(2)

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.



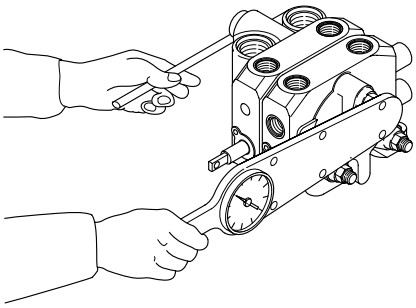
7406S MCV05(3)

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.



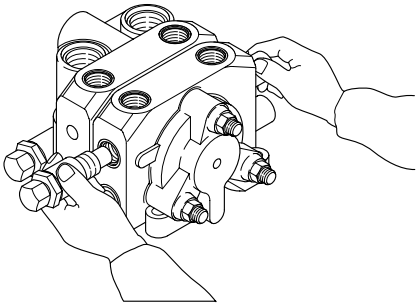
7406S MCV06(1)

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.

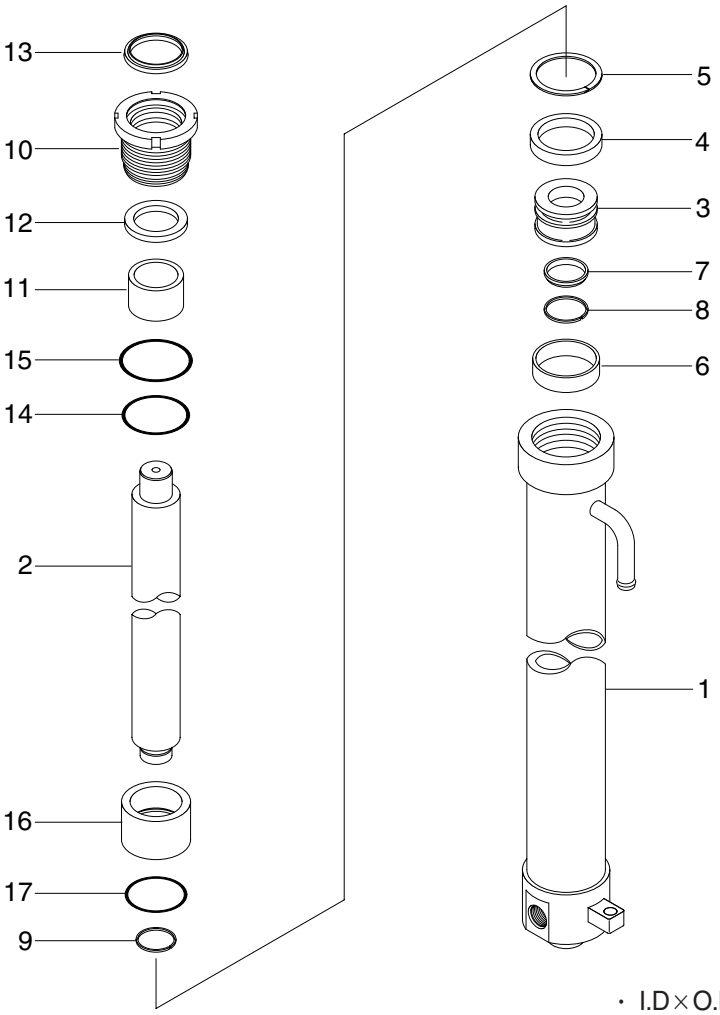
B. The load check and spring may be omitter from assembly in certain circuit conditions(i.e., motor spools).



7406S MCV06(2)

3. LIFT CYLINDER

1) STRUCTURE



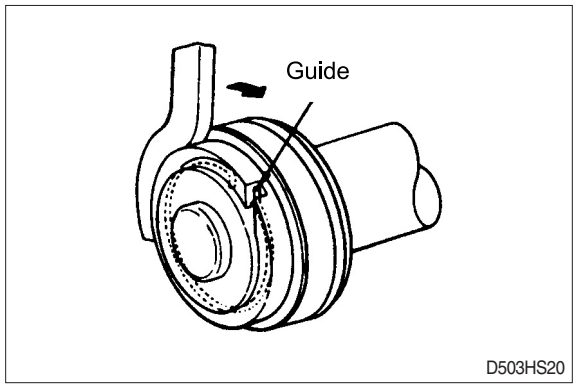
- I.D × O.D × stroke(standard)
  85 × 98 × 1335mm
  (3.3 × 3.9 × 52.6in)
- Rod O.D : 60mm(2.4in)

D507HS19

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

2) DISASSEMBLY

(1) Hold the cylinder tube in a vice, loosen the cylinder head and remove it.
Remove the spacer from the cylinder tube and knock out the bushing. Hook a wrench in the hole in the retainer at the piston end and turn. Lever up the edge of the guide, then turn the guide in again and the guide can be removed.



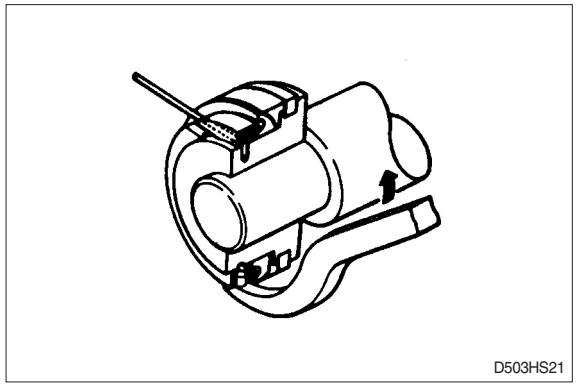
2) CHECK AND INSPECTION

mm(in)

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

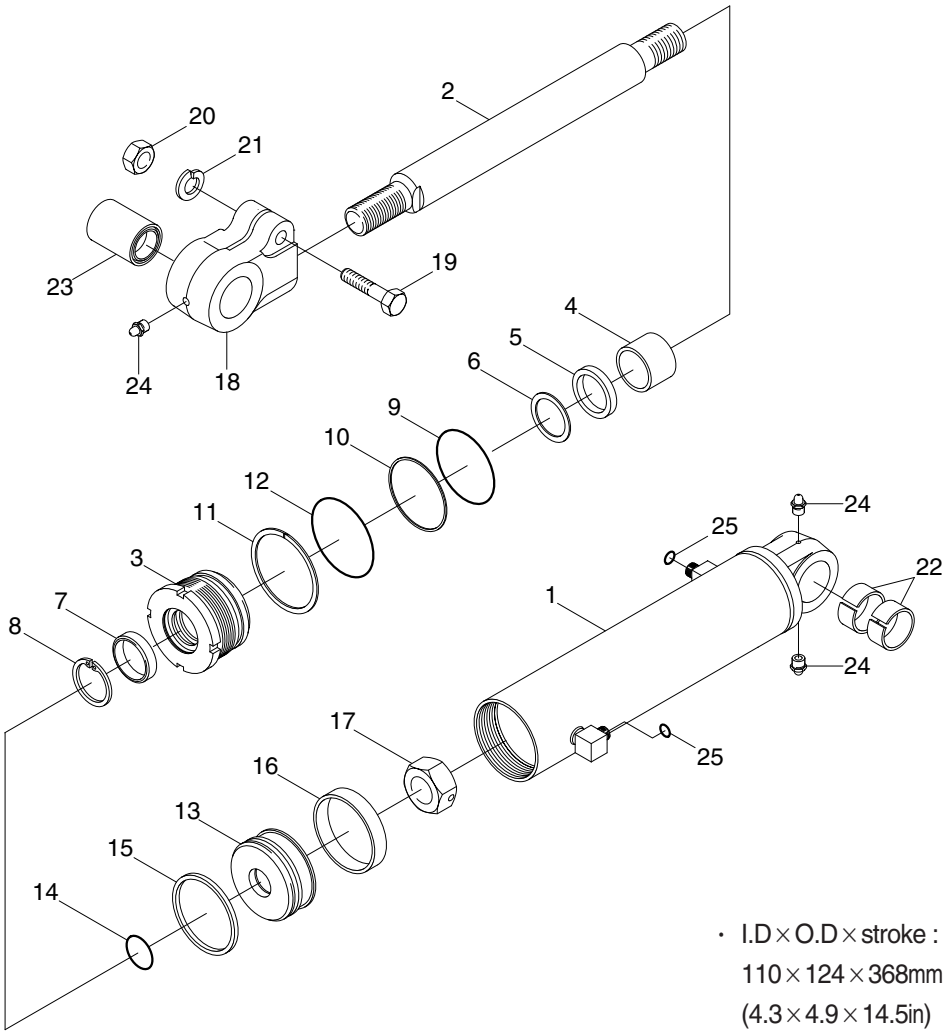
3) ASSEMBLY

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



4. TILT CYLINDER

1) STRUCTURE



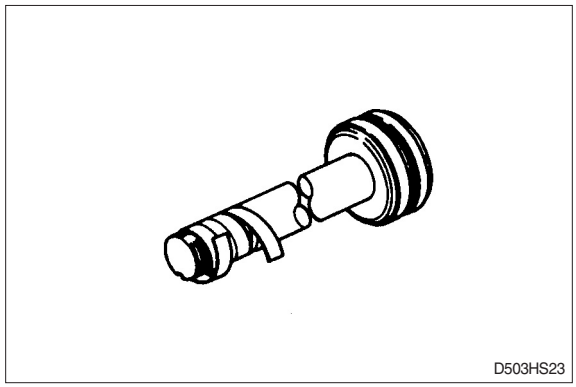
- I.D × O.D × stroke : 110 × 124 × 368mm (4.3 × 4.9 × 14.5in)
- Rod O.D : 50mm(2.0in)

80D7HS22

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

2) DISASSEMBLY

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



3) CHECK AND INSPECTION

mm(in)

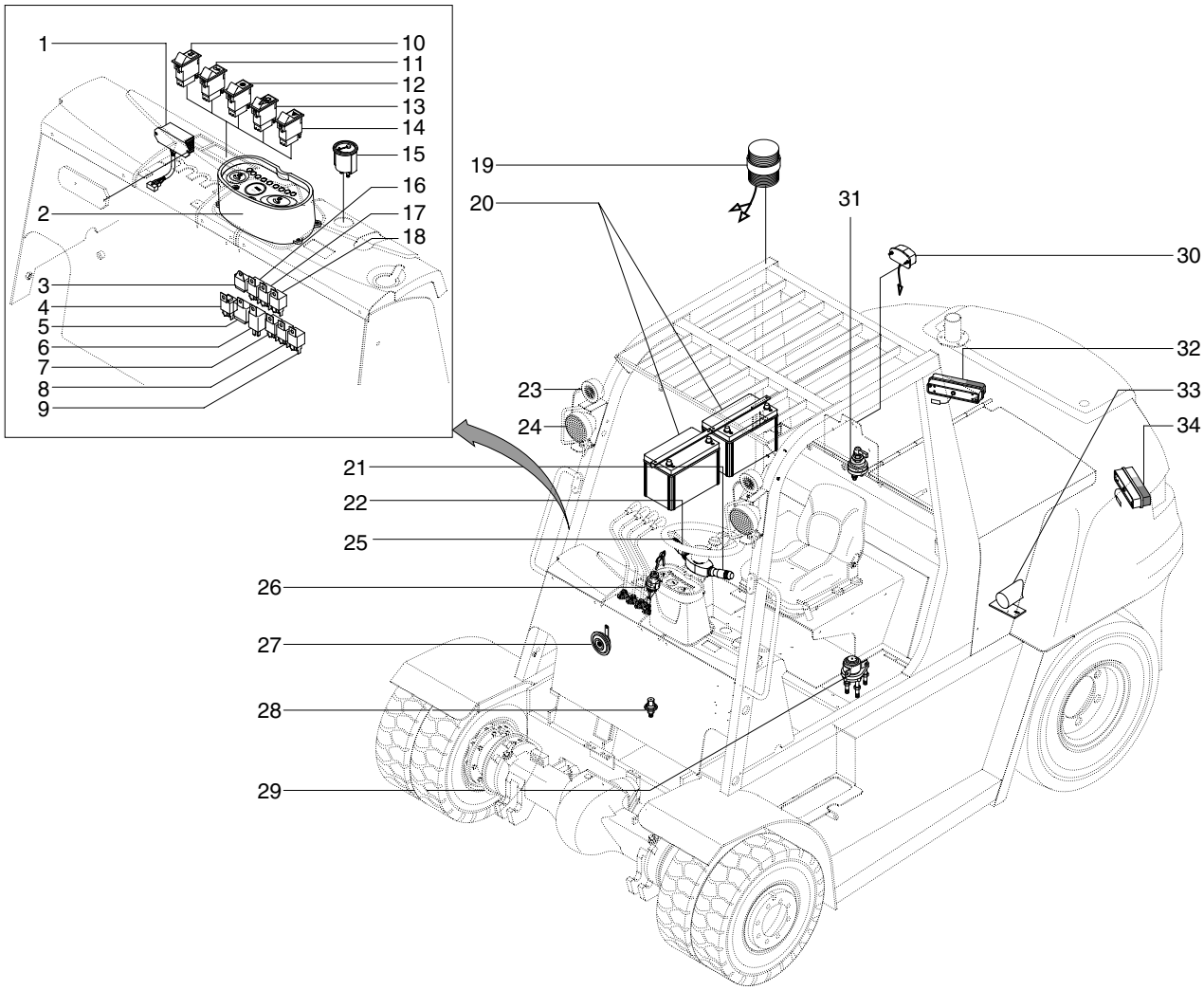
Check item	Standard size	Repair limit	Remedy
Clearance between cylinder rod & bushing	0.072~0.288 (0.003~0.011)	0.5 (0.020)	Replace bushing
Clearance between rod head bushing & pin	0.10~0.35 (0.004~0.014)	0.6 (0.024)	Replace bushing

SECTION 7 ELECTRICAL SYSTEM

SECTION 7 ELECTRICAL SYSTEM

GROUP 1 COMPONENT LOCATION

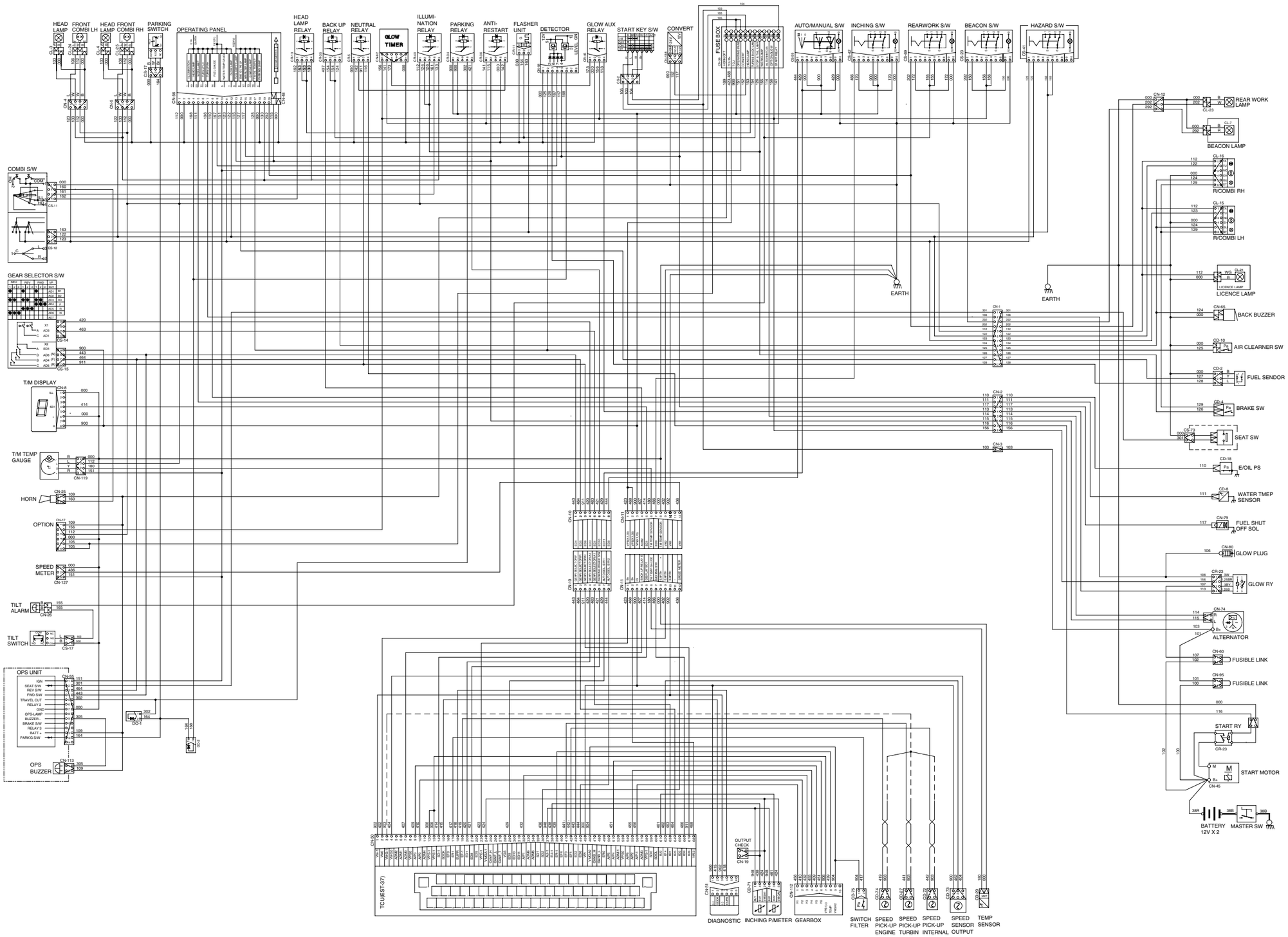
DASHBOARD SIDE



80D7EL06

1	Convert	13	Auto manual switch	25	Horn switch
2	Operating panel	14	Hazard switch	26	Start switch
3	Glow timer	15	Transmission temp gauge	27	High horn
4	Glow auxiliary	16	Neutral relay	28	Brake switch
5	Detector relay	17	Back up relay	29	Glow relay
6	Flasher unit	18	Head lamp relay	30	License lamp
7	Anti restart relay	19	Beacon lamp	31	Master switch
8	Parking relay	20	Battery	32	RH combination lamp
9	Illumination relay	21	Gear selector	33	Back horn
10	Beacon switch	22	Combination switch	34	LH combination lamp
11	Work lamp switch	23	Flasher lamp		
12	Inching switch	24	Work lamp		

GROUP 2 ELECTRICAL CIRCUIT



80D7EL01

MEMORANDUM


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

1. POWER CIRCUIT

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

1) OPERATING FLOW

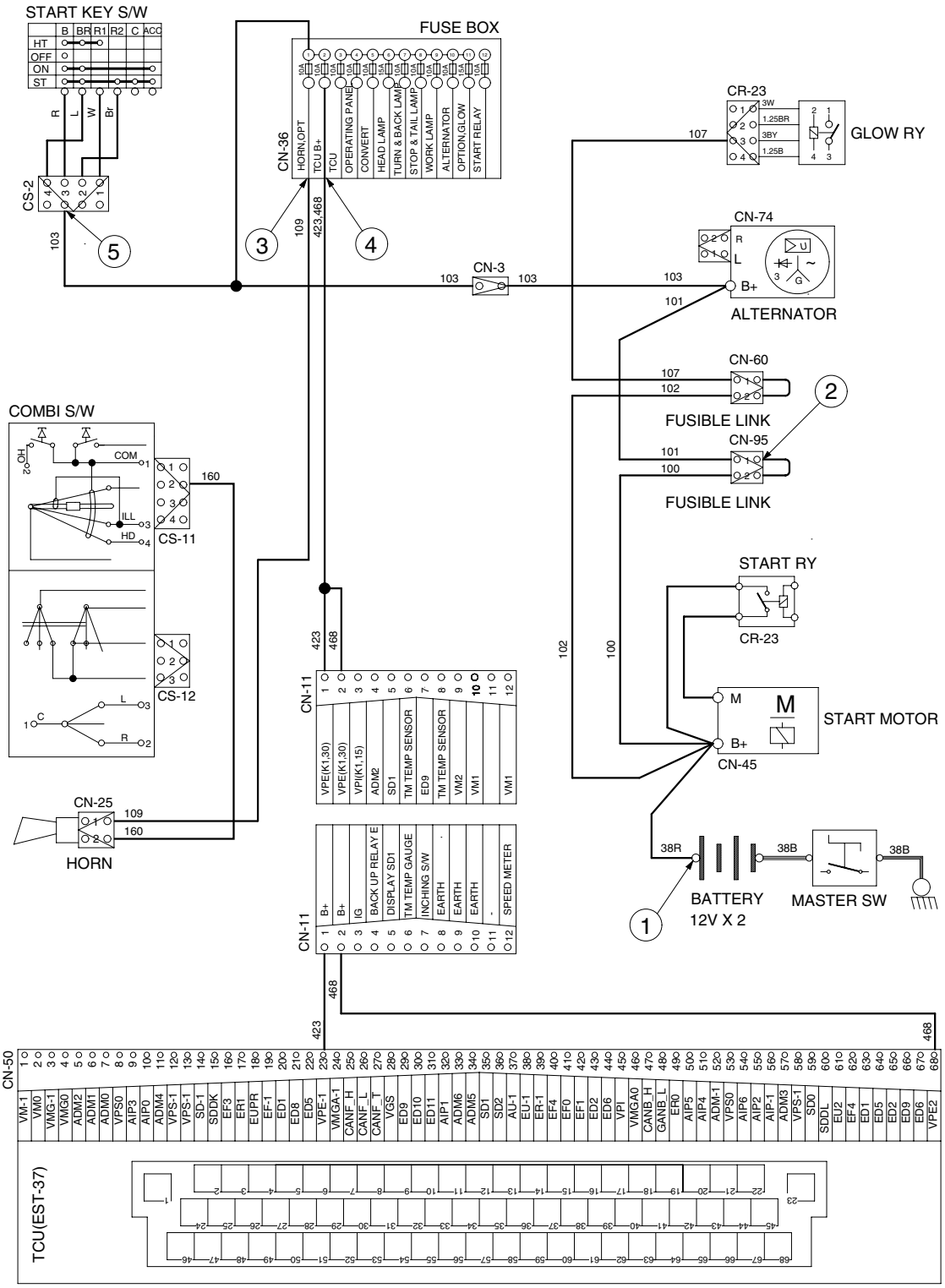
Battery(+) → Start motor[CN-45(B+)] → Fusible link[CN-60] → Glow relay[CR-24(3)]
→ Start relay[CR-23]
→ Fusible link[CN-95] → Alternator[CN-74(B+)] → [CN-3]
→ I/conn[CS-2(3)] → Start switch OFF
→ Fuse box[CN-36(1)] → Combi switch[CS-11(2)]
→ Fuse box[CN-36(2)] → I/conn[CN-11(1, 2)] → TCU[CN-50]

2) CHECK POINT

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

※ GND : Ground

POWER CIRCUIT



80D7EL02

2. STARTING CIRCUIT

1) OPERATING FLOW

Battery(+) terminal → Start motor[CN-45(B+)] → Fusible link[CN-95] → Start switch[CS-2(3)]
Start motor[CN-45(B+)] → Start relay[CR-23]

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

(1) **When start key switch is in ON position**

Start switch ON [CS-2(4)] → Fuse box[No.5 →3] → Gear selector switch[CS-15(A)]

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

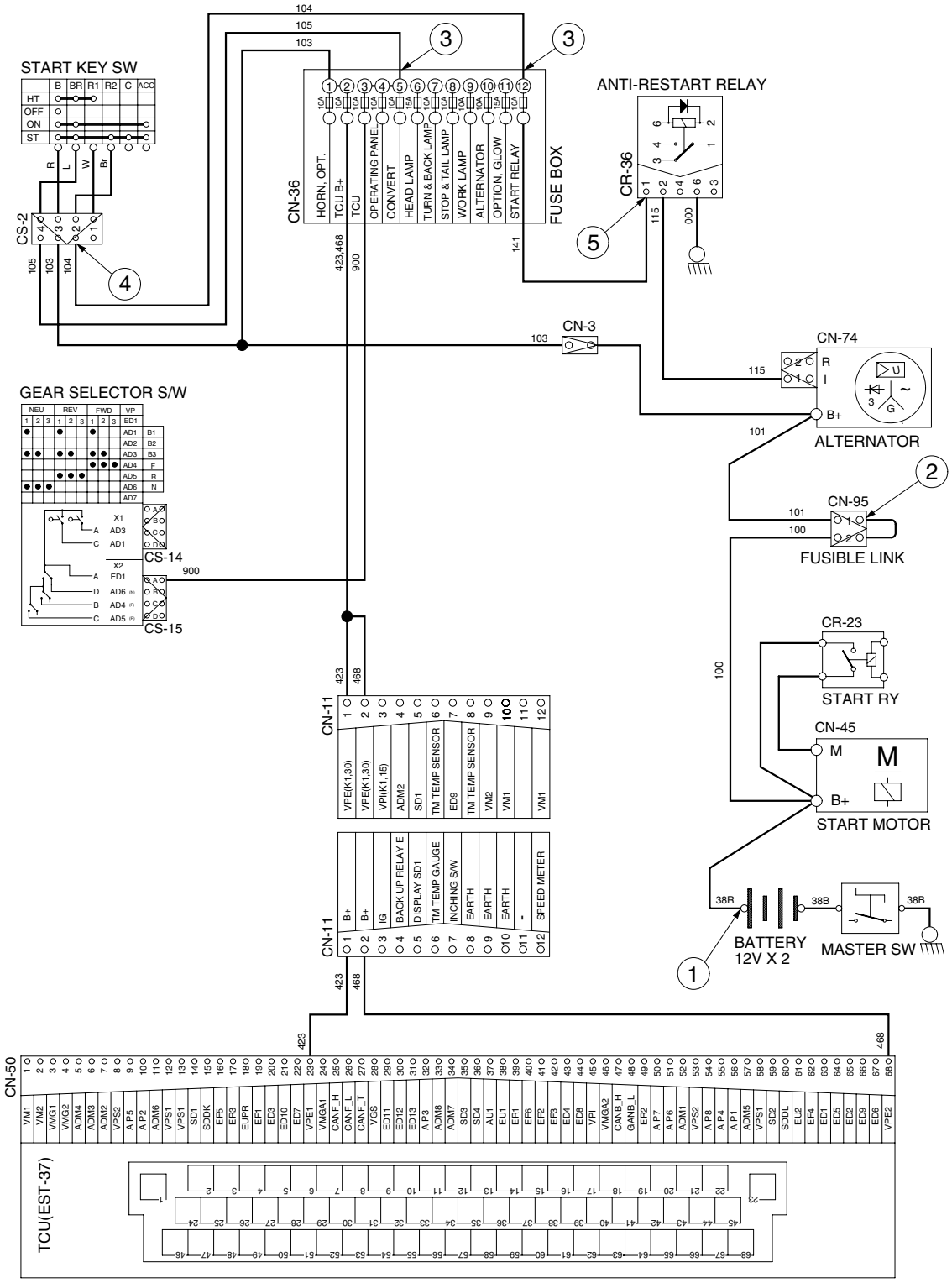
Start switch START[CS-2(2)] → Fuse box[No. 12] → Anti restart relay[CR-36(1) → (2)]

2) CHECK POINT

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

※ GND : Ground

STARTING CIRCUIT



80D7EL03

3. CHARGING CIRCUIT

When the starter is activated and the engine is started, the operator release the start switch to the ON position. Charging current generated by operating alternator flows into the battery.
The current also flows from alternator to each electrical component through the fusible link(CN-60) and the fuse box.

1) OPERATING FLOW

(1) Warning flow
Alternator[CN-74(I)] → I/conn[CN-2(6)] → Cluster charging warning lamp ON [CN-56(13)]

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

2) CHECK POINT

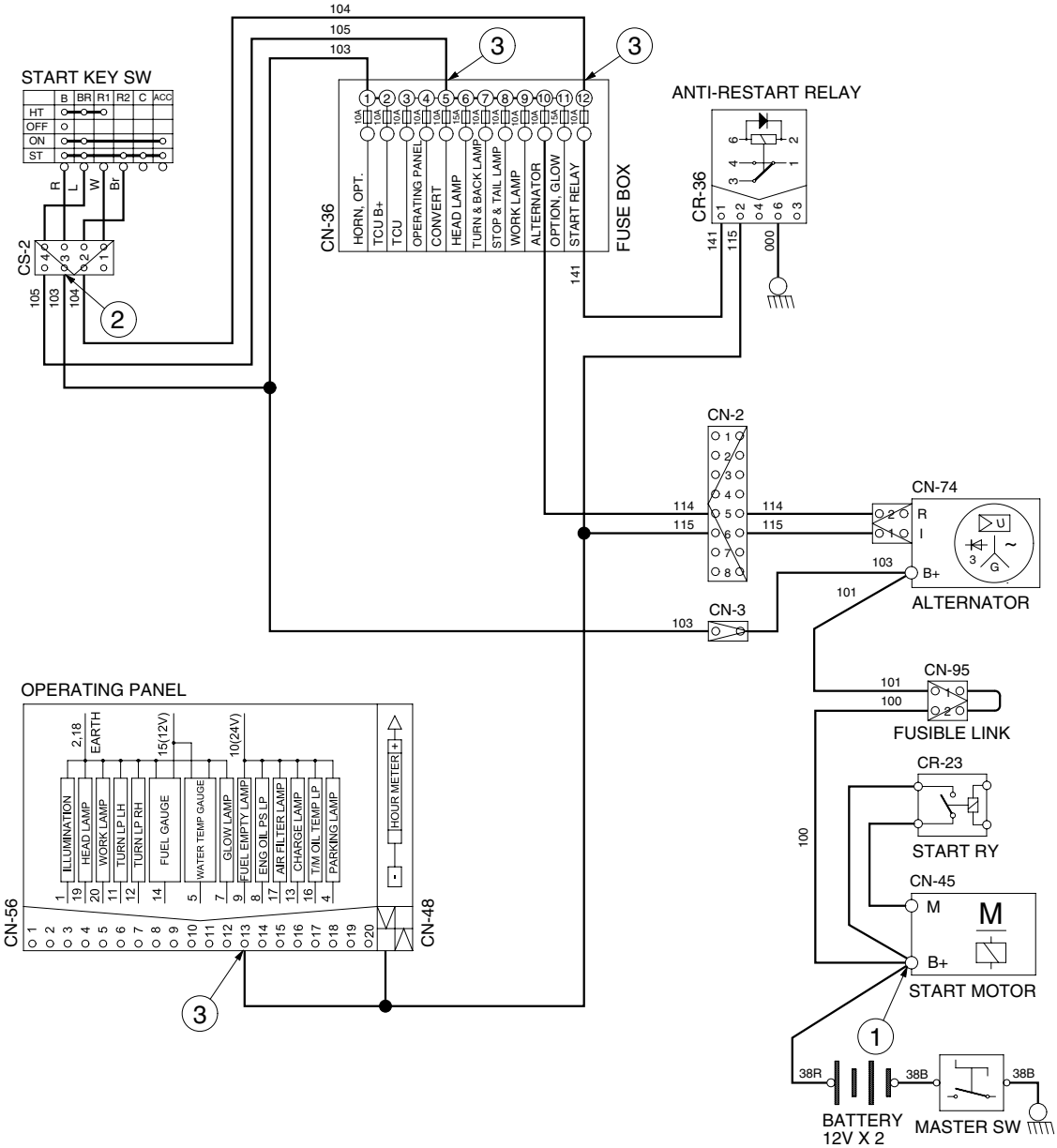
Engine	Key switch	Check point	Voltage
ON	ON	① - GND (Alternator B+) ② - GND (Start switch) ③ - GND (Cluster)	24V

※ GND : Ground

※ **Cautions**

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

CHARGING CIRCUIT



80D7EL04

4. PREHEATING CIRCUIT

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

1) OPERATING FLOW

Battery(+) terminal → Fusible link[CN-95] → I/conn[CS-2(3)] → Start switch(B)
Battery(+) terminal → Glow relay[CR-24]

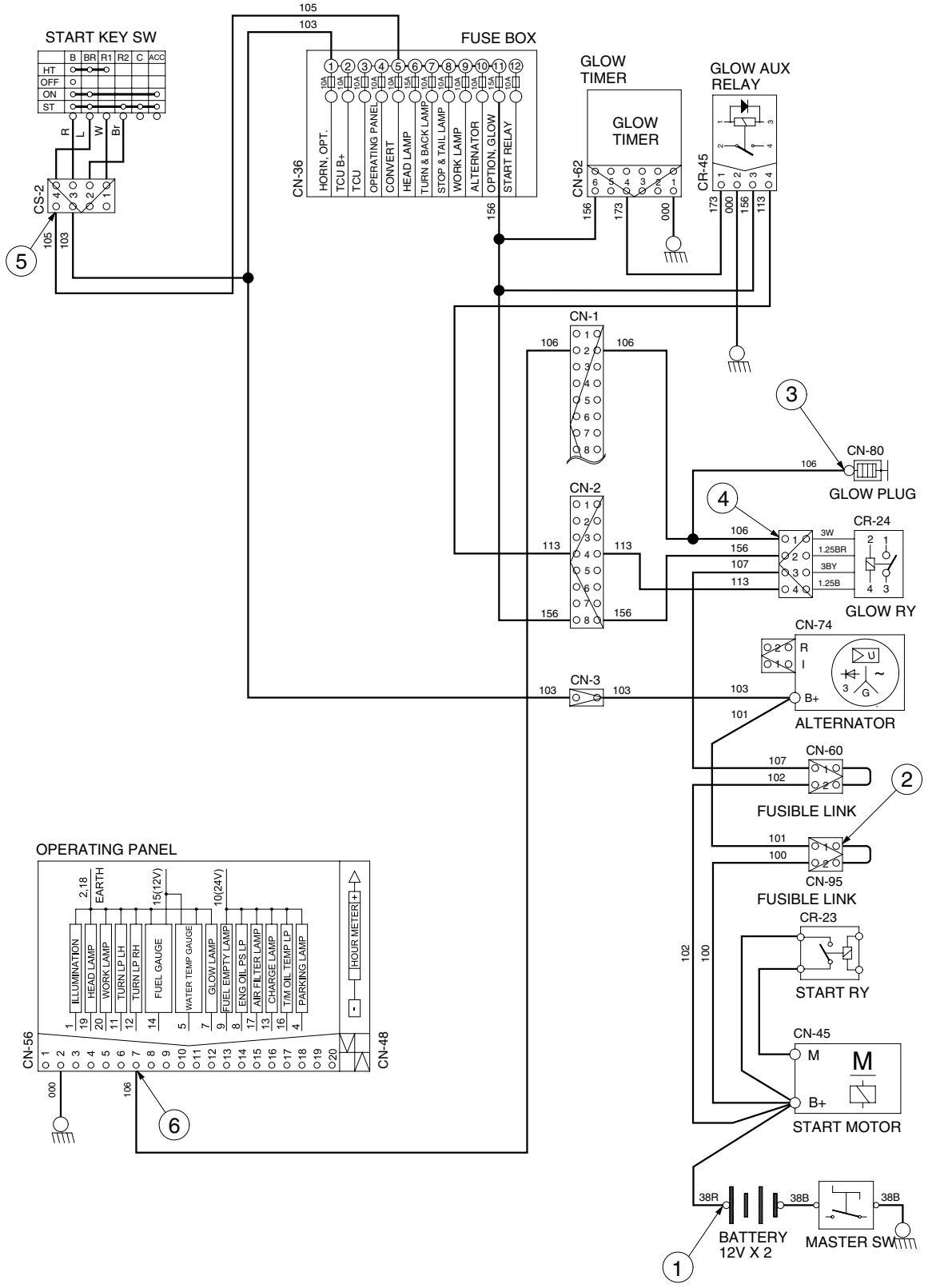
※ When you turn the start switch to the ON position, the glow relay makes the glow plugs operated and the glow lamp of the cluster turned ON.

Start switch ON [CS-2(4)] → Fuse box [No.5→11] → Glow timer[CN-62(6)→(4)] →
Glow Aux relay[CR-45(1)→(4)] → I/conn[CN-2(4)] →
Glow relay ON [CR-24]
→ Glow plug operating[CN-80]
→ I/conn[CN-1(2)] → Operating panel[CN-56(7)] → Glow lamp ON

2) CHECK POINT

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

PREHEATING CIRCUIT



80D7EL05

GROUP 3 COMPONENT SPECIFICATION

<table>
<tr><th>No</th><th>Part name</th><th>Qty</th><th>Specification</th></tr>
<tr><td>1</td><td>Battery</td><td>2</td><td>12V × 80AH
RC : 130min
CCA : 630A</td></tr>
<tr><td>2</td><td>Working lamp</td><td>1</td><td>24V, 70W</td></tr>
<tr><td>3</td><td>License lamp</td><td>1</td><td>24V, 3W x 2</td></tr>
<tr><td>4</td><td>Rear Combination lamp</td><td>2</td><td>24V, 25/10W (Stop/Tail)
24V, 25W (Turn)
24V, 25W (Back Up)</td></tr>
<tr><td>5</td><td>Head lamp</td><td>2</td><td>24V, 70W</td></tr>
<tr><td>6</td><td>Flasher lamp</td><td>2</td><td>24V, 25/10W</td></tr>
<tr><td>7</td><td>Glow relay</td><td>1</td><td>24V, 300A</td></tr>
<tr><td>8</td><td>Relay (4P)</td><td>4</td><td>24V, 20A</td></tr>
<tr><td>9</td><td>Relay (5P)</td><td>3</td><td>24V, 6A</td></tr>
<tr><td>10</td><td>Flasher Unit</td><td>1</td><td>85±10CM, (21W + 21W) x 2 + 3W x 2</td></tr>
<tr><td>11</td><td>Detector</td><td>1</td><td>12V, 2A</td></tr>
<tr><td>12</td><td>Converter</td><td>1</td><td>Input 24V, Output 12V, 10A</td></tr>
<tr><td>13</td><td>Back buzzer</td><td>1</td><td>24V, 90±5dB, 60±10C/M</td></tr>
<tr><td>14</td><td>Horn</td><td>1</td><td>24V, 1.5A, 100 ~ 115 dB</td></tr>
<tr><td>15</td><td>Fuel level sender</td><td>1</td><td>
<table>
<tr><td>Float indicate</td><td>E</td><td>1/2</td><td>F</td></tr>
<tr><td>Resistance(Ω)</td><td>105</td><td>32.5</td><td>5</td></tr>
<tr><td rowspan="2">Tolerance(Ω)</td><td>+0
−5</td><td rowspan="2">±2.5</td><td>+0.5
−0</td></tr>
</table>
</td></tr>
<tr><td>16</td><td>Master Switch</td><td>1</td><td>24V, 180A</td></tr>
<tr><td>17</td><td>Combination Switch</td><td>1</td><td>Direction 4.5A, Tail 5A
Head 6A, Horn 4A</td></tr>
<tr><td>18</td><td>Brake Switch</td><td>1</td><td>24V, 50W</td></tr>
<tr><td>19</td><td>Working Lamp Switch</td><td>1</td><td>24V, 8A</td></tr>
<tr><td>20</td><td>Hazard Switch</td><td>1</td><td>24V, 8A</td></tr>
<tr><td>21</td><td>Beacon Inching</td><td>1</td><td>24V, 8A</td></tr>
<tr><td>22</td><td>Auto manual Switch</td><td>1</td><td>24V, 8A</td></tr>
<tr><td>23</td><td>Start switch</td><td>1</td><td>24V, 30A</td></tr>
</table>

GROUP 4 CONNECTOR DESTINATION

Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CN-1	KET	12	I/conn(Dashboard harness-frame harness)	S814-012100	S814-112100
CN-2	KET	8	I/conn(Dashboard harness-frame harness)	S814-008100	S814-108100
CN-3	KET	1	I/conn(Frame harness-dashboard harness)	MG640944-5	MG650943-5
CN-4	KET	4	LH support harness	S810-004201	-
CN-5	KET	4	Support harness	S810-004201	-
CN-8	AMP	8	Transmission display	929504-3	-
CN-10	AMP	8	I/conn(Dashboard harness-T/M harness)	S816-008002	S816-108002
CN-11	AMP	12	I/conn(Dashboard harness-T/M harness)	S816-012002	S816-112002
CN-12	KET	3	Rear support harness	S810-003201	-
CN-17	KET	6	Option	MG640515-4	-
CN-18	KET	2	Inching sensor	-	S814-102100
CN-19	KET	2	Output check	S814-002100	-
CN-20	AMP	6	Cover	48074-0	
CN-25	MOLEX	2	Horn	35825-0211	-
CN-26	KET	2	Tilt alarm	S822-014000	S822-114000
CN-36	-	2	Fuse box	F12890010	-
CN-45	RING TERM	2	Start motor	S820-308000	-
CN-48	KET	2	Hour meter	S822-014000	S822-114000
CN-50	AMP	68	Transmission control unit	963598-1	-
CN-51	AMP	6	Diagnostic	-	926682-3
CN-55	KET	14	OPS unit	S814-014100	-
CN-56	MOLEX	20	Operating panel	35109-2010	-
CN-58	KET	8	Detector(Indicator)	S810-008201	-
CN-60	KET	2	Fusible link	-	S813-130201
CN-62	-	6	Glow timer	S810-006202	-
CN-65	KET	2	Back buzzer	S822-014000	S822-114000
CN-74	KET	2	Alternator	MG640188-4	-
CN-79	SUMITOMO	1	Fuel shut off solenoid	6180-1181	-
CN-80	RING TERM	1	Glow plug	S820-204000	-
CN-95	KET	2	Fusible link	-	S813-130201
CN-112	ZF	16	Gearbox	21L7-60290	-
CN-113	KET	2	OPS buzzer	S814-002000	-
CN-119	KET	4	Transmission temperature gauge	S810-004201	-
CN-127	KET	3	Speed meter	S810-003201	-
CN-138	KET	3	Regulator	S810-003201	-
Switch					
CS-2	KET	4	Start switch	S810-004201	-

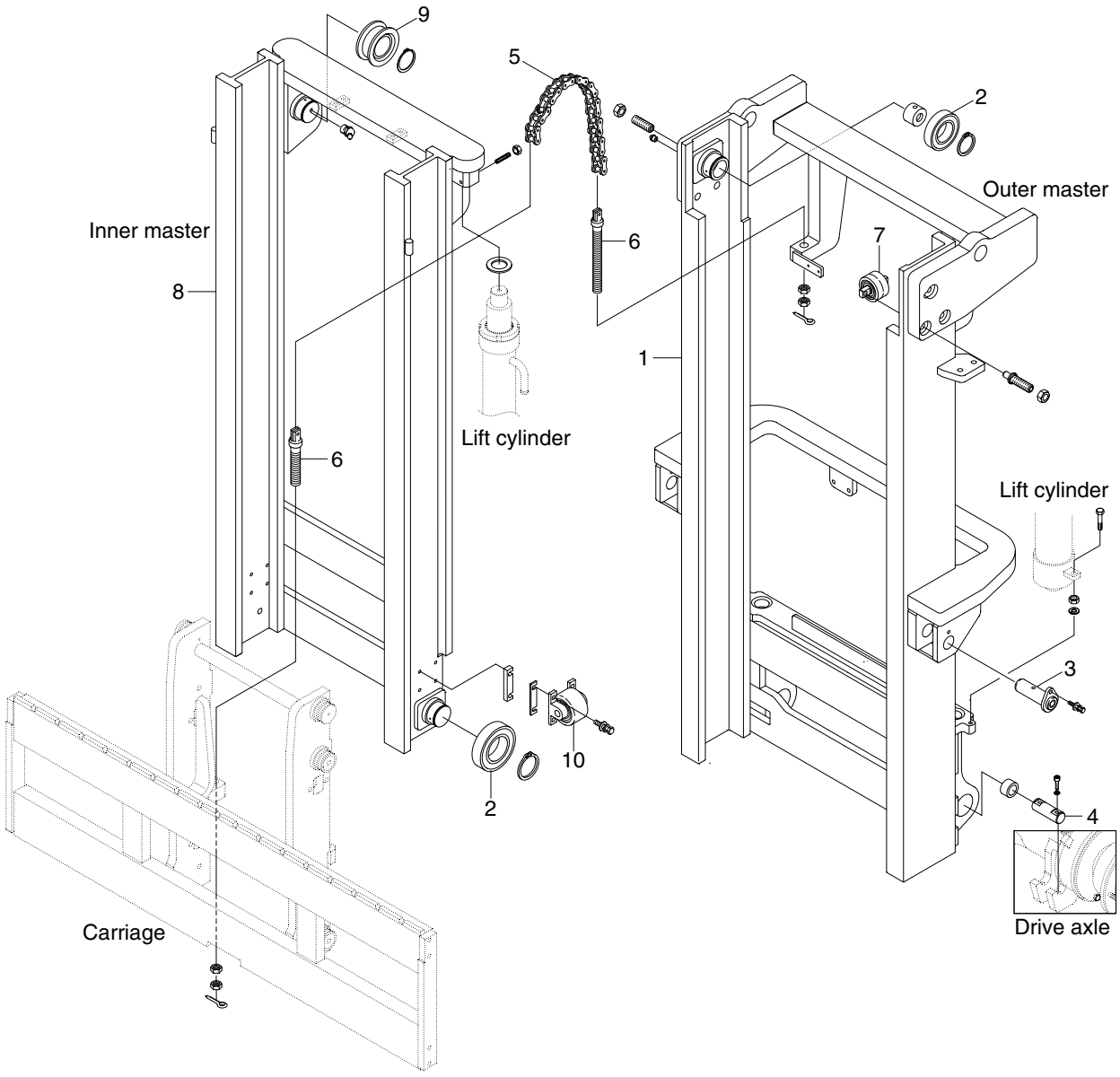
Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CS-11	KET	4	Combination switch	S810-004201	-
CS-12	KET	3	Combination switch	S810-003201	-
CS-14	PACKARD	4	Gear selector switch	-	12010974
CS-15	PACKARD	4	Gear selector switch	12015797	-
CS-17	KET	3	Parking switch	S810-003201	-
CS-23	SWF	10	Beacon lamp switch	593757	-
CS-41	SWF	10	Hazard switch	593757	-
CS-42	SWF	10	Inching switch	593757	-
CS-59	SWF	10	Auto manual switch	593757	-
CS-69	SWF	10	Rear work switch	593757	-
CS-72	KET	2	Tilt switch	S814-002000	-
CS-73	KET	2	Seat switch	S810-002201	-
Lamp					
CL-15	KET	6	Combination lamp-LH	S814-006100	-
CL-16	KET	6	Combination lamp-RH	S814-006100	-
CL-21	KET	2	License 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-23	KET	2	Start relay	S814-002100	S814-102100
CR-24	KET	4	Glow relay	S810-004201	-
CR-34	-	6	Parking relay	S810-006202	-
CR-35	KET	4	Back up relay	S810-004201	-
CR-36	-	6	Anti restart relay	S810-006202	-
CR-40	-	6	Illumination relay	S810-006202	-
Sensor and pressure switch					
CD-2	KET	3	Fuel sendor	S810-003201	-
CD-4	AMP	2	Brake switch	150656-1	-
CD-8	KET	1	Water temperature sensor	S822-014000	-
CD-10	KET	1	Air cleaner switch	ST730057-2	-
CD-18	AMP	1	Engine oil pressure switch	S819-010122	-
CD-27	AMP	2	Turbin speed sensor	963040-3	-
CD-29	ZF	2	T/M temperature sensor	21FF-10170	-
CD-71	AMP	6	Inching sensor	1-967616-1	-
CD-72	AMP	2	Gear train speed sensor	963040-3	-
CD-73	AMP	3	Output speed sensor	282087	-
CD-74	AMP	2	Engine speed sensor	963040-3	-
CD-75	AMP	2	Oil filter switch	282080	-

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

SECTION 8 MAST

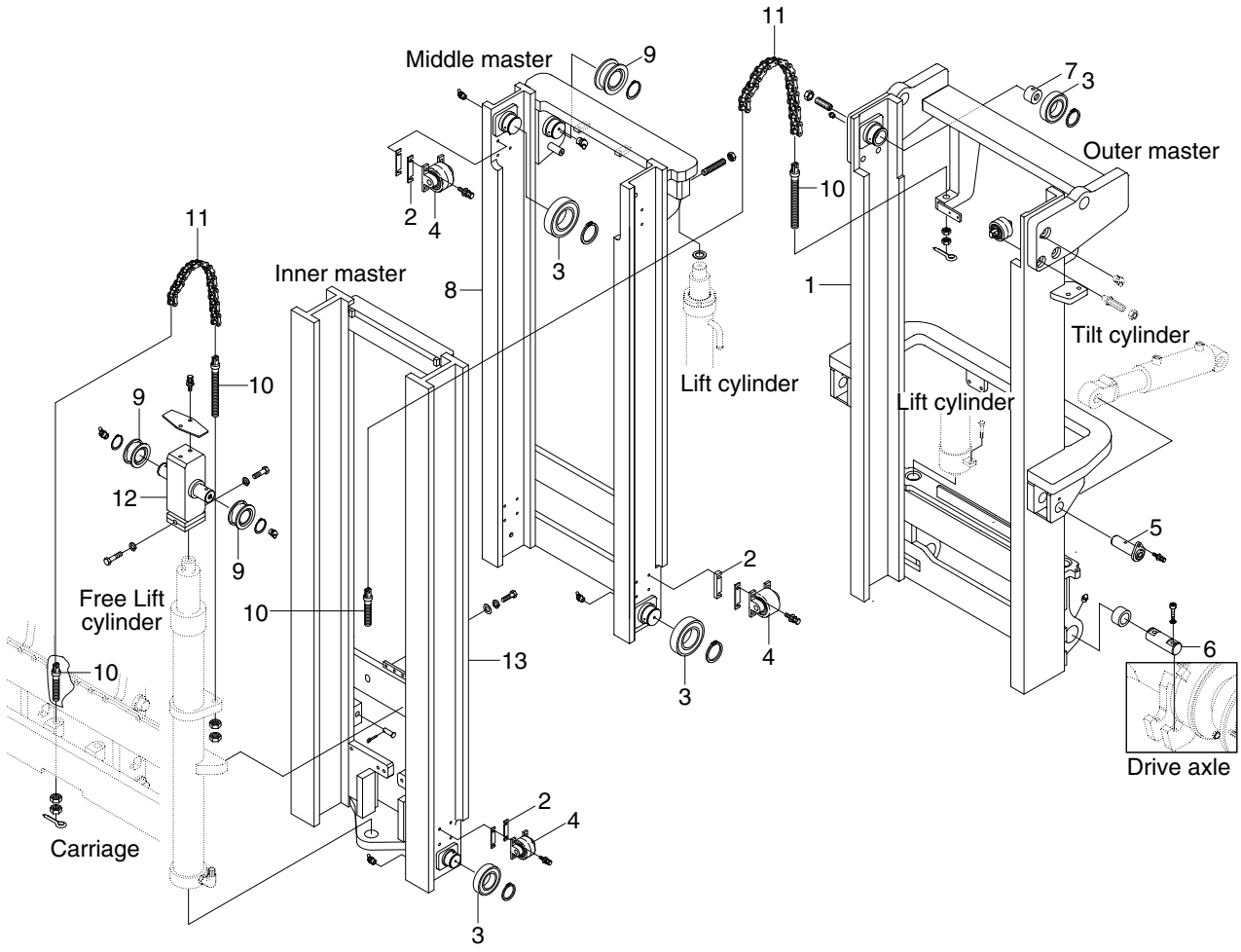
GROUP 1 STRUCTURE

1. 2 STAGE MAST(V MAST)



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

2. 3 STAGE MAST(TF MAST)

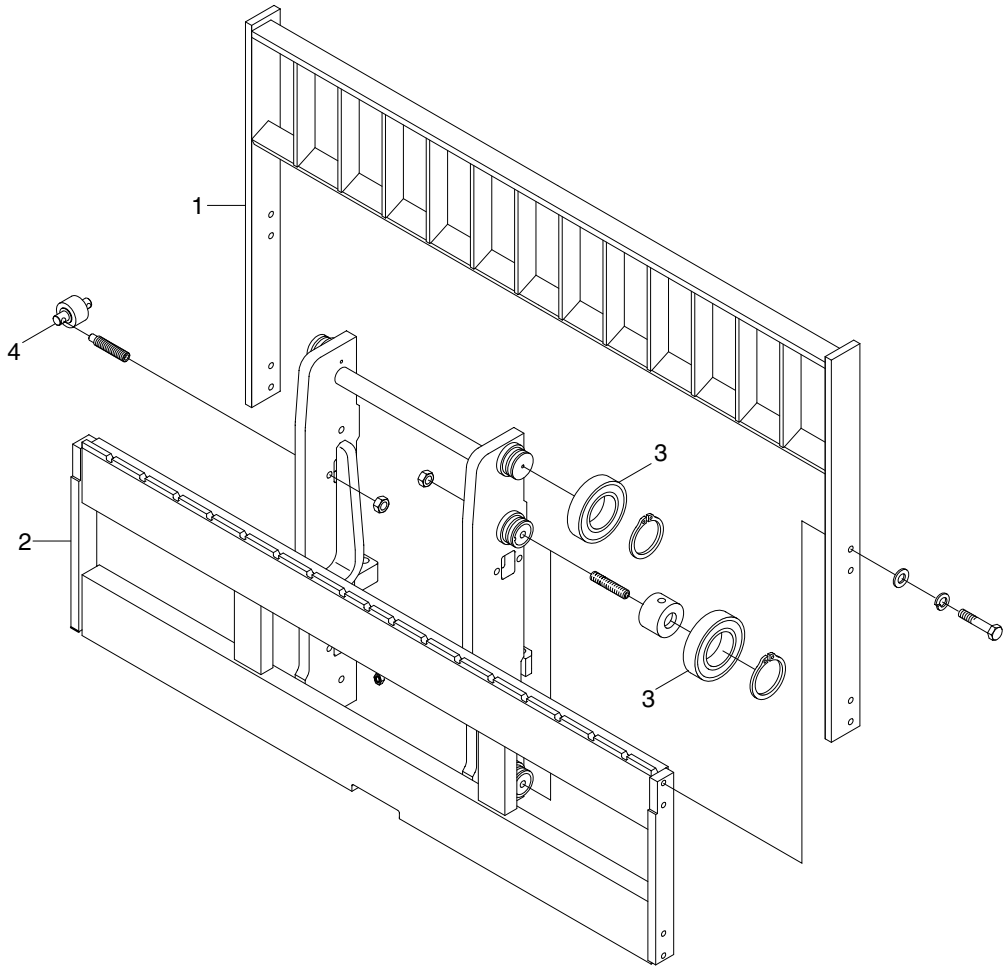


80D7MS011

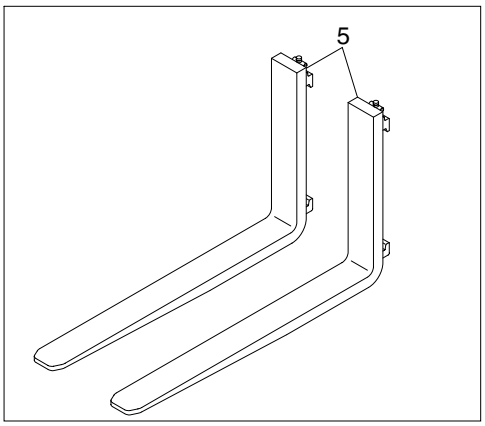
1	Outer mast	6	Mast mounting pin	11	Lift chain
2	Shim	7	Wear plug	12	Sheave bracket
3	Roller bearing	8	Middle mast	13	Inner mast
4	Side roller bearing	9	Chain sheave bearing		
5	Tilt cylinder pin	10	Anchor bolt		

3. CARRIAGE, BACKREST AND FORK

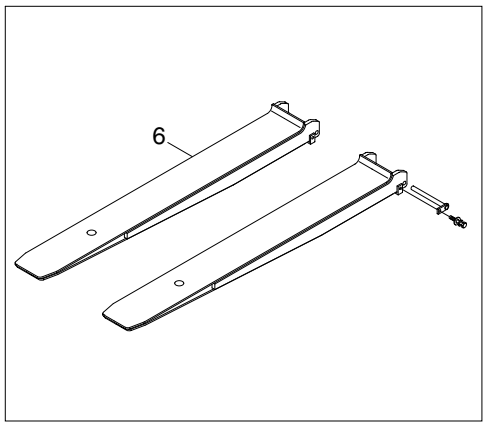
1) HOOK ON TYPE(STD)



Hook on type fork



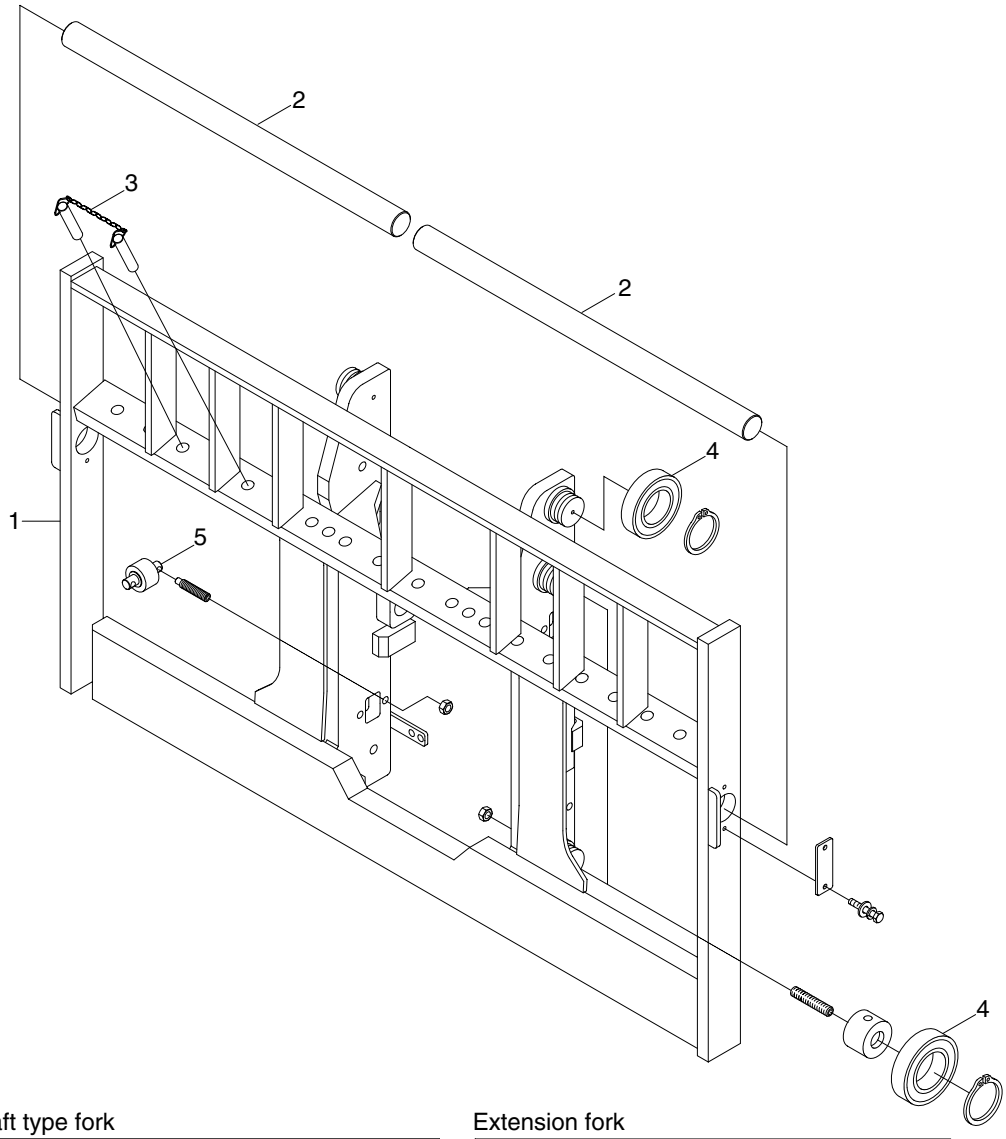
Extension fork



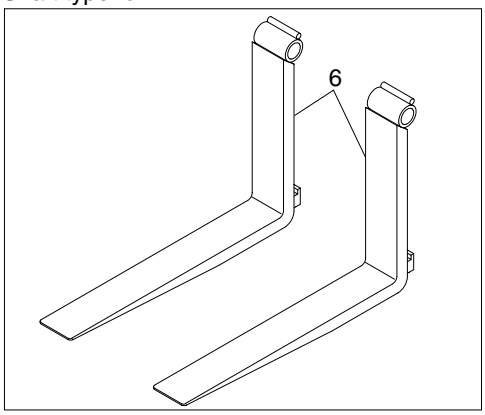
80D7MS03

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

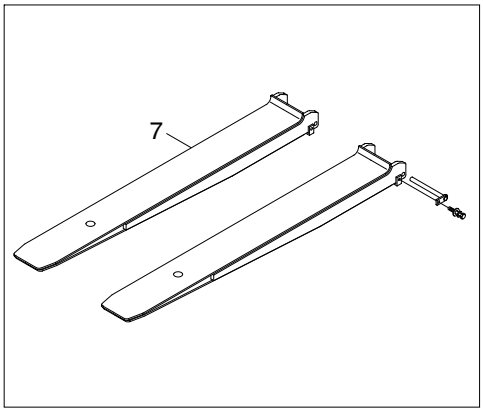
2) SHAFT TYPE(OPTION)



Shaft type fork



Extension fork



80D7MS02

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

GROUP 2 OPERATIONAL CHECKS AND TROUBLESHOOTING

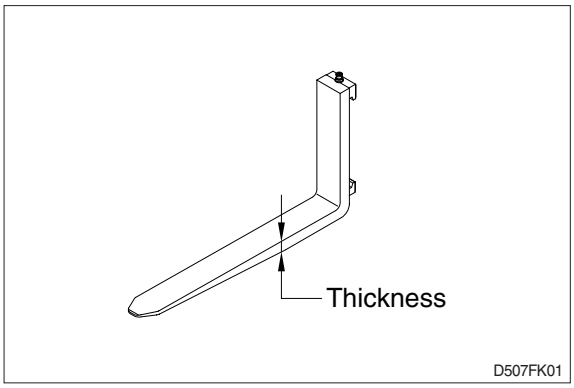
1. OPERATIONAL CHECKS

1) FORKS

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

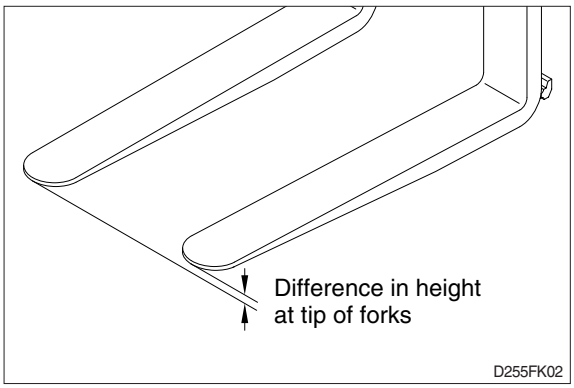
mm(in)

STD Fork assy	Applicable model	Standard	Limit
67FQ-70110	80D-7	70(2.7)	63(2.4)



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

Model	Fork length (mm)	Height difference (mm)
80D-7	below 1500	3
	above 1500	6



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

2. MAST

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

2. TROUBLESHOOTING

1) MAST

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

2) FORKS

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

GROUP 3 ADJUSTMENT

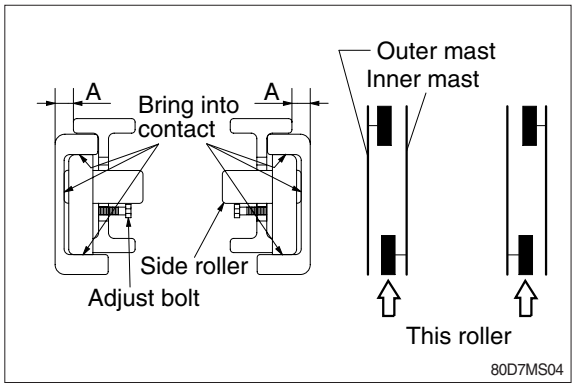
1. MAST LOAD ROLLER

1) INNER/OUTER MAST ROLLER CLEARANCE ADJUSTMENT

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

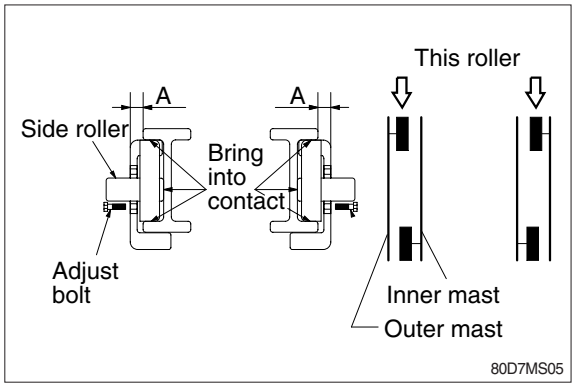
(2) Shift the inner mast to one side to bring the side roller into contact with the outer mast, and adjust the clearance between the end of inner beam and the outside of outer mast position on the opposite side to the following value by adjust bolt.

· Reference clearance A = 43.1mm



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

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



2) CARRIAGE LOAD ROLLER

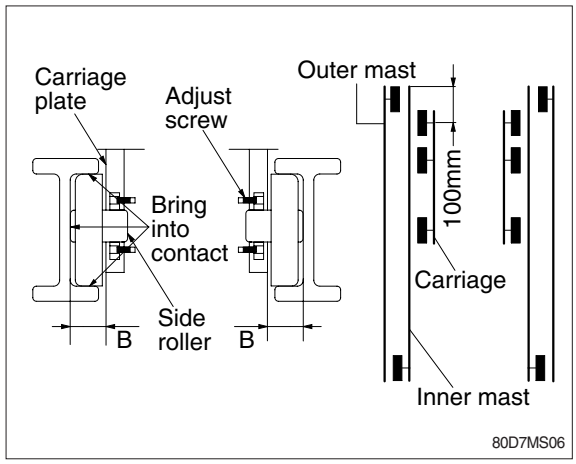
(1) Measure the clearance when the center of the carriage upper roller is 100㎜ from the top of the inner mast.

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

· Reference clearance B = 56.9㎜

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

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



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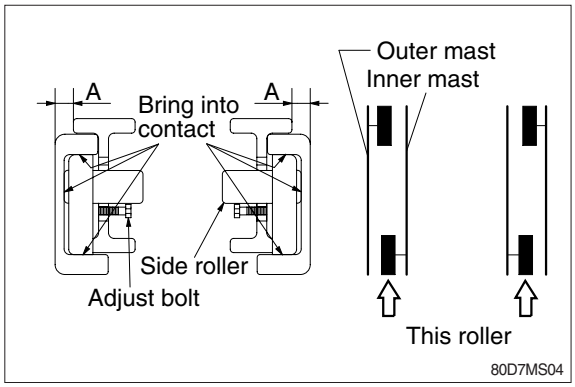

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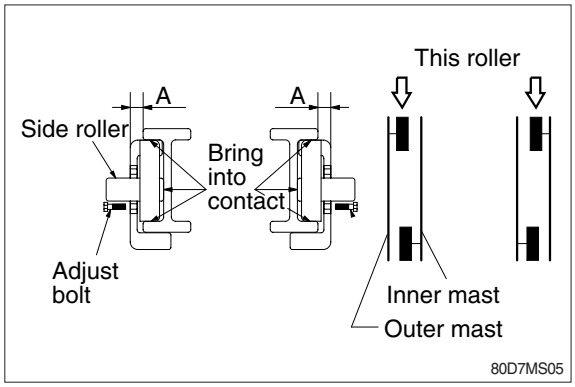

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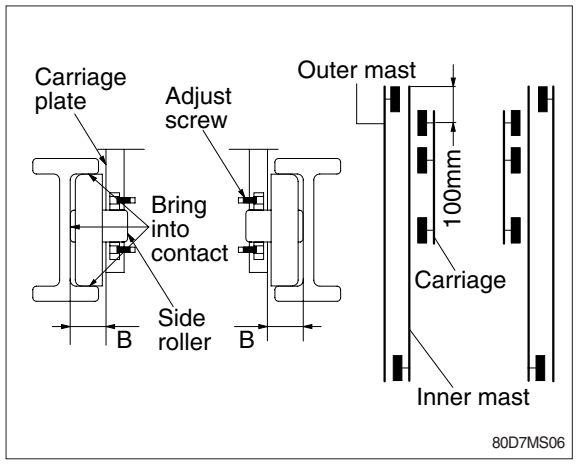
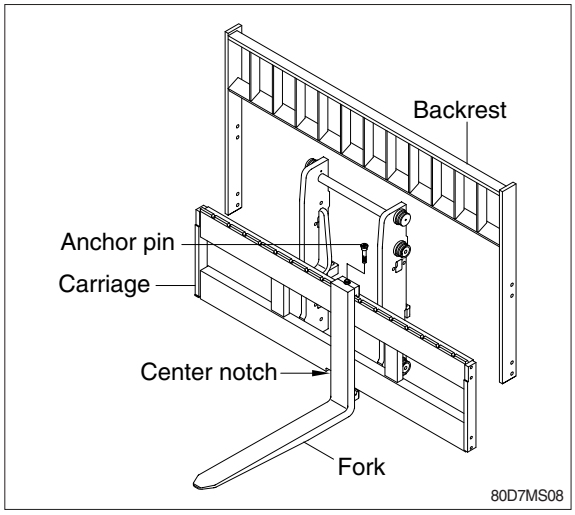


GROUP 4 REMOVAL AND INSTALLATION

1. FORKS

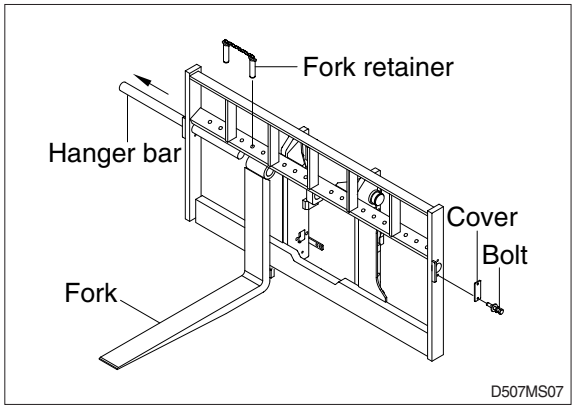
1) HOOK ON TYPE

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



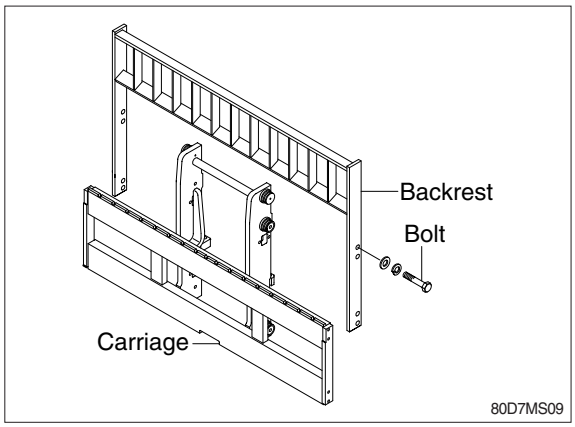
2) SHAFT TYPE(Option)

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



2. BACKREST(Hook on type)

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



3. CARRIAGE ASSEMBLY

1) CARRIAGE

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

(2) While supporting lift chains, remove the split pin and slide out chain anchor pins from the chain anchors of stationary upright.

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

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

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

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

(6) Reverse the above steps to reinstall.

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

2) SIDE ROLLER

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

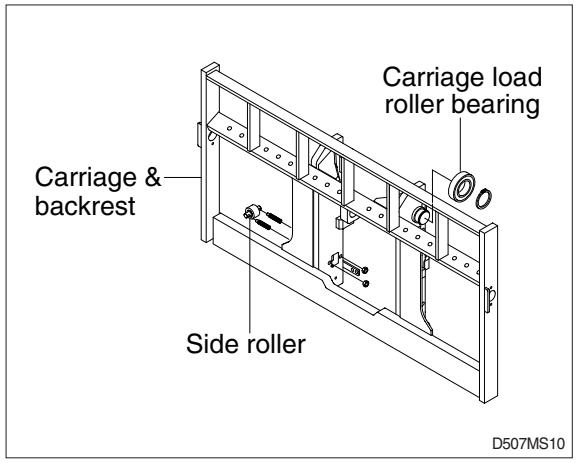
(2) Loosen and remove nuts, adjust screws and side rollers from carriage side plate.

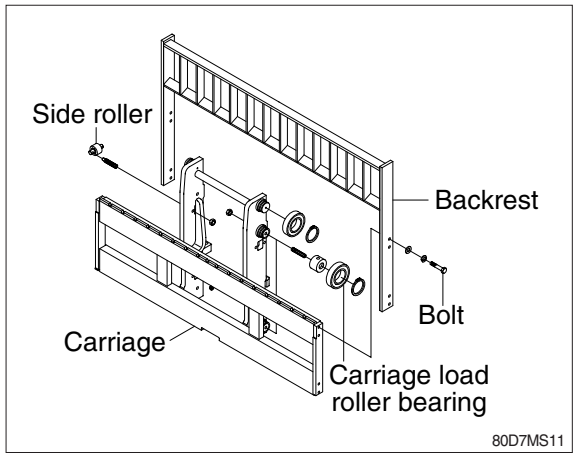
(3) Thoroughly clean, inspect and replace all worn or damaged parts.

(4) Reverse the above procedure to assembly.

※ **Adjustment**

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





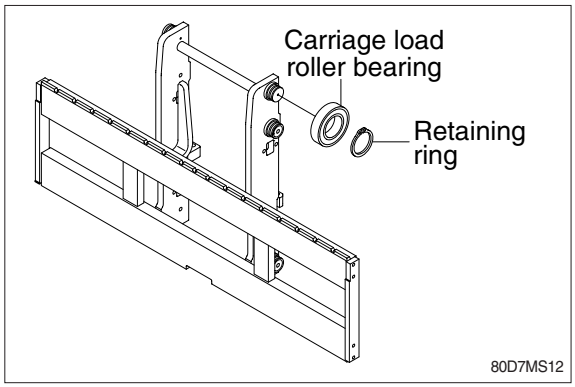
3) CARRIAGE LOAD ROLLER BEARING

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

(2) Using the plier, remove retaining rings from load roller bearing bracket.

(3) Using a plier, remove load roller bearings from load roller bearing bracket.

(4) Reverse the above procedure to assemble. Refer to MAST ROLLER ADJUSTMENT paragraph.



4. MAST LOAD ROLLER

1) 2 STAGE MAST(V MAST)

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

(2) Loosen and remove hexagon nuts and screws securing lift cylinders to inner mast.

(3) Loosen and remove hexagon bolts and nuts securing lift cylinders to outer mast.

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

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

(6) Using the overhead hoist, lower inner mast until top and bottom rollers are exposed.

(7) Using a plier, remove load rollers from load roller bracket. Remove side rollers.

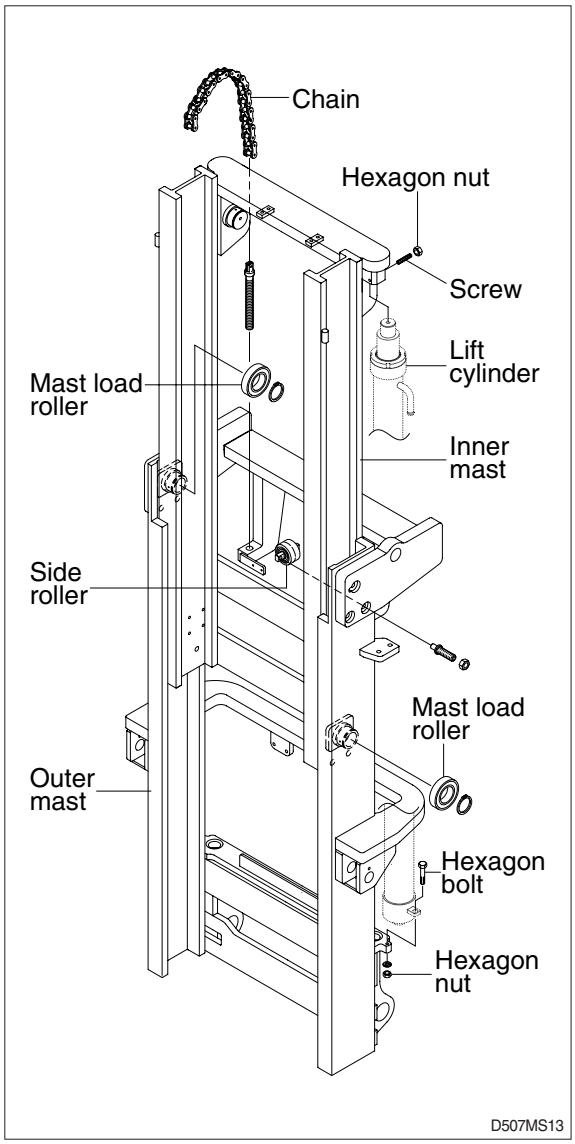
(8) Thoroughly clean, inspect and replace all worn or damaged parts.

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

(10) After completing all necessary steps for load rollers removal, use an overhead hoist to remove sling or chain around upper crossmember of the inner mast section. Lift inner mast upright straight up and out of outer mast section.

(11) Replace and reverse above procedure to install.

(12) Make all necessary measurements and adjustments.



2) 3 STAGE MAST(TF MAST)

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

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

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

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

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

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

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

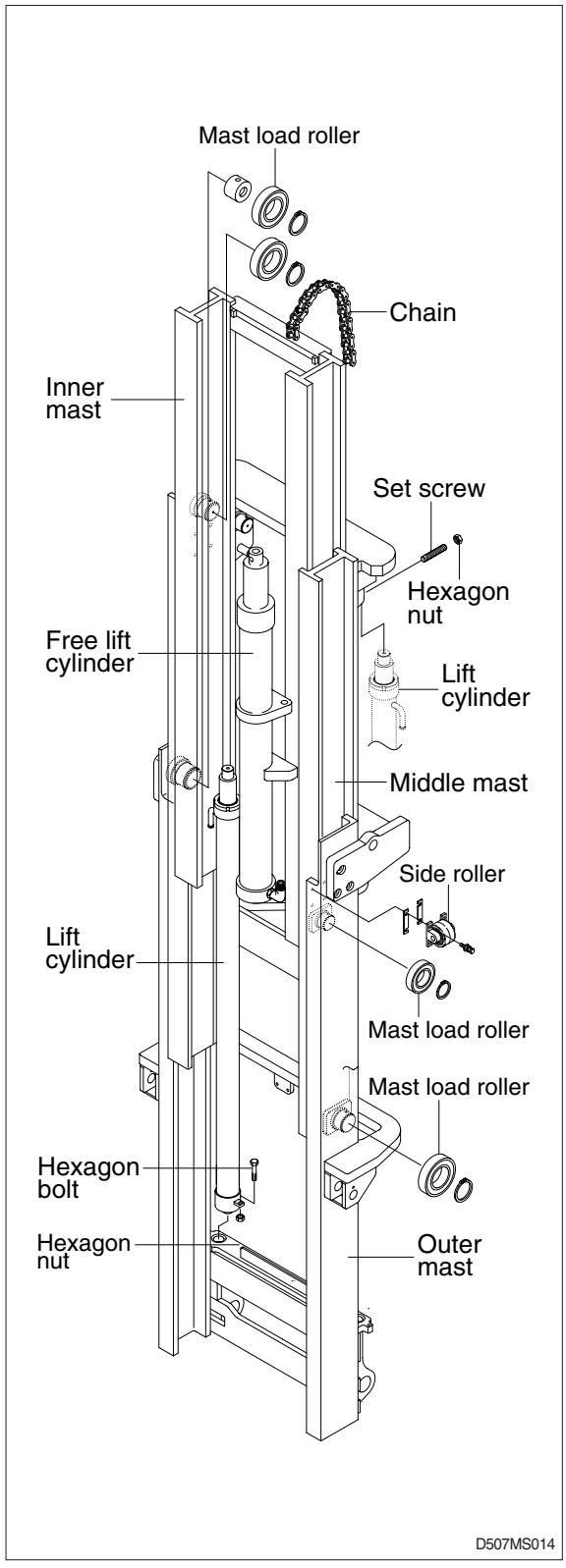
(8) Using a plier, remove load rollers from load bracket. Remove side rollers from mast.

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

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

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

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



5. CHAIN

1) CHAIN SHEAVE

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

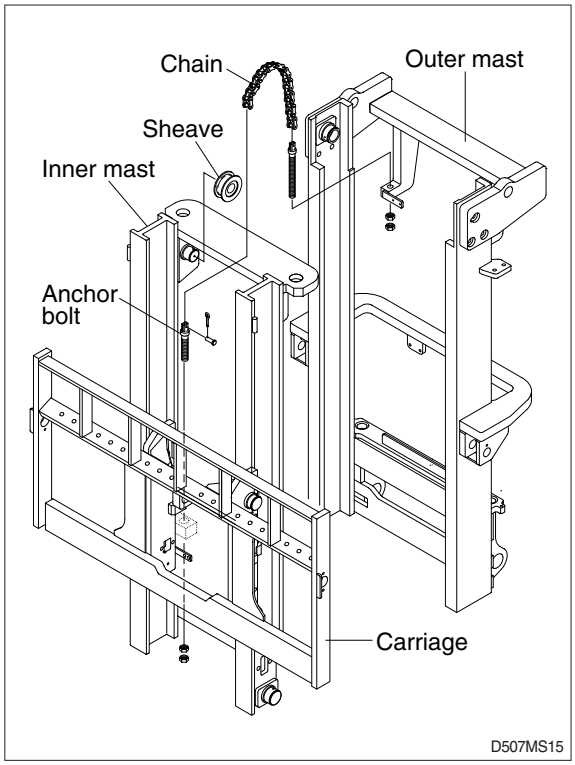
(2) Remove the split pin securing the chain anchor pins and discard. While supporting the chains, remove the chain anchor pins and drape the chain over the carriage.

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

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

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

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



2) Rear chain sheave(TF mast)

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

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

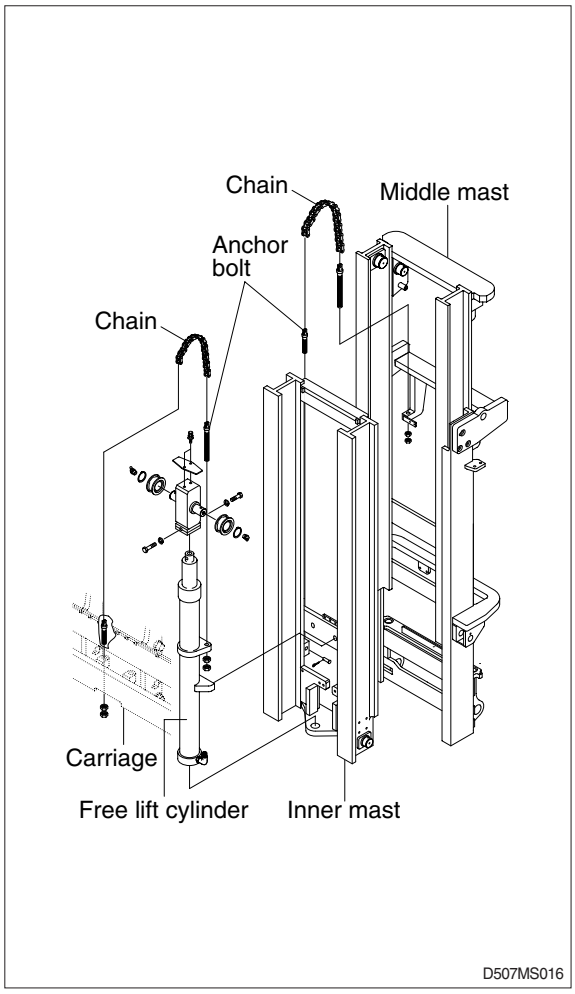
(3) Remove chains.

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

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

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

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



3) Sheave support(TF mast)

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

4) Rear chain(TF mast)

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

5) Carriage chain

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

6) Load chain inspection and maintenance

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

(1) Wear

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

(2) Rust and corrosion

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

(3) Cracked plate

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

(4) Tight joints

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

Tight joints in lift chains can be caused by :

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

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

(5) Protruding or turned pins

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

(6) Chain side wear

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

(7) Chain anchors and sheaves

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

(8) Chain wear scale

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

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

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

7) Load chain lubrication and adjustment

(1) Lubrication

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

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

⚠ Wear eye protection.

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

(2) Replacement

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

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

(3) Adjustment

Chain adjustments are important for the following reasons :

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

(4) Adjustment procedure

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