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## 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.

### **Structure and function**

This group explains the structure and function of each component. It serves not only to give an understanding of the structure, but also serves as reference material for troubleshooting.

### **Operational checks and troubleshooting**

This group explains the system operational checks and troubleshooting charts correlating problem to remedy.

### **Tests and adjustments**

This group explains checks to be made before and after performing repairs, as well as adjustments to be made at completion of the checks and repairs.

### **Disassembly and assembly**

This section explains the order to be followed when removing, installing, disassembling or assembling each component, as well as precautions to be taken for these operations.

The specifications contained in this shop 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

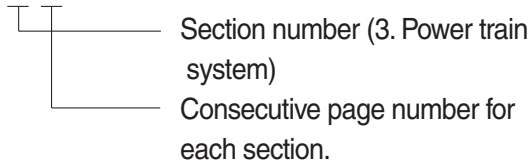
1. See the page number on the bottom of the page.

File the pages in correct order.

2. Following examples shows how to read the page number.

Example 1

3 - 3



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

10 - 5

Added pages

### Revised edition mark (①②③...)

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

### Revisions

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

### Symbols

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

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



### 3. CONVERSION TABLE

Method of using the Conversion Table

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

#### Example

##### 1. Method of using the Conversion Table to convert from millimeters to inches

Convert 55 mm into inches.

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

##### 2. Convert 550 mm into inches.

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

#### Millimeters to inches

(b)

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
(a) 50	1.969	2.008	2.047	2.087	2.126	(c) 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
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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**
 $1 \ell = 0.2642 \text{ U.S. Gal}$ 

	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	6.076	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**
 $1 \ell = 0.21997 \text{ U.K. Gal}$ 

	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	7.699	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

1 kgf · m = 7.233 lbf · 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	296.6	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<sup>2</sup> to lbf/in<sup>2</sup>**1 kgf / cm<sup>2</sup> = 14.2233 lbf / in<sup>2</sup>

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

## TEMPERATURE

Fahrenheit-Centigrade Conversion.

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

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

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

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

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

## SECTION 1 GENERAL

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## SECTION 1 GENERAL

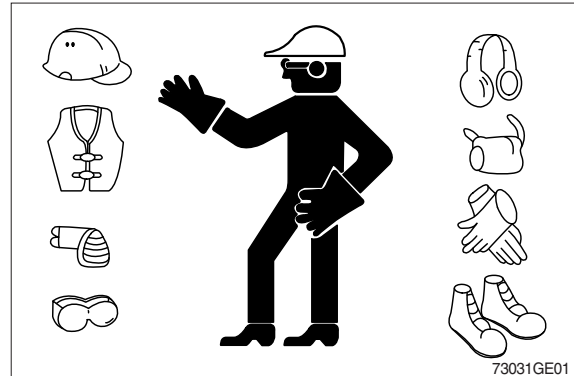
### GROUP 1 SAFETY HINTS

#### FOLLOW SAFE PROCEDURE

Unsafe work practices are dangerous. Understand service procedure before doing work; Do not attempt shortcuts.

#### WEAR PROTECTIVE CLOTHING

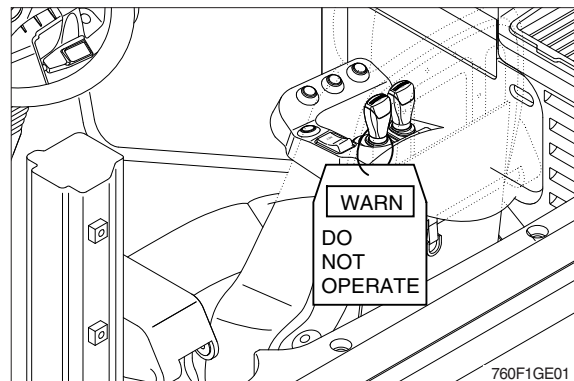
Wear close fitting clothing and safety equipment appropriate to the job.



#### WARN OTHERS OF SERVICE WORK

Unexpected machine movement can cause serious injury.

Before performing any work on the wheel loader, attach a 「Do Not Operate」 tag on the right side controller lever.



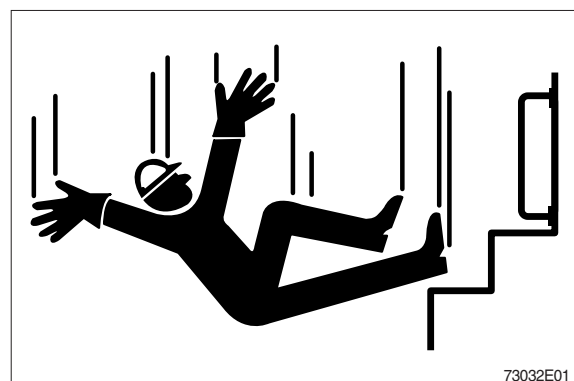
#### USE HANDHOLDS AND STEPS

Falling is one of the major causes of personal injury.

When you get on and off the machine, always maintain a three point contact with the steps and handrails and face the machine. Do not use any controls as handholds.

Never jump on or off the machine. Never mount or dismount a moving machine.

Be careful of slippery conditions on platforms, steps, and handrails when leaving the machine.



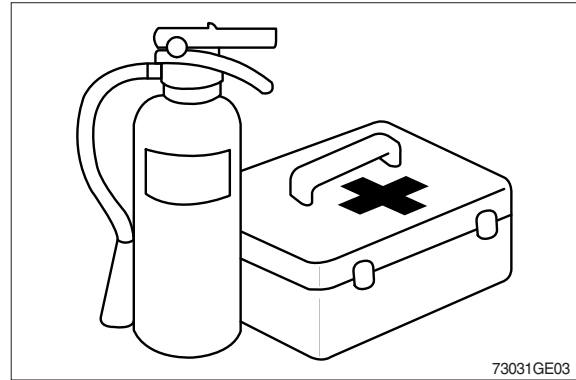


## PREPARE FOR EMERGENCIES

Be prepared if a fire starts.

Keep a first aid kit and fire extinguisher handy.

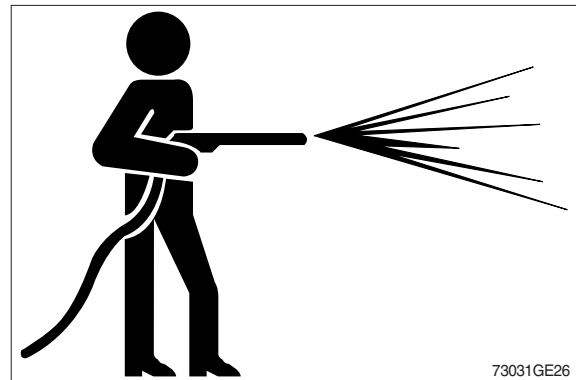
Keep emergency numbers for doctors, ambulance service, hospital, and fire department near your telephone.



## WORK IN CLEAN AREA

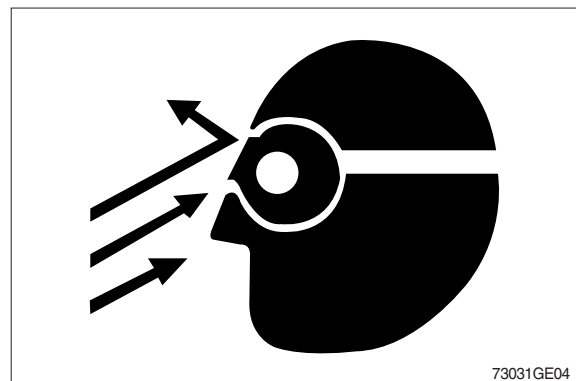
Before starting a job :

- Clean work area and machine.
- Make sure you have all necessary tools to do your job.
- Have the right parts on hand.
- Read all instructions thoroughly; Do not attempt shortcuts.



## PROTECT AGAINST FLYING DEBRIS

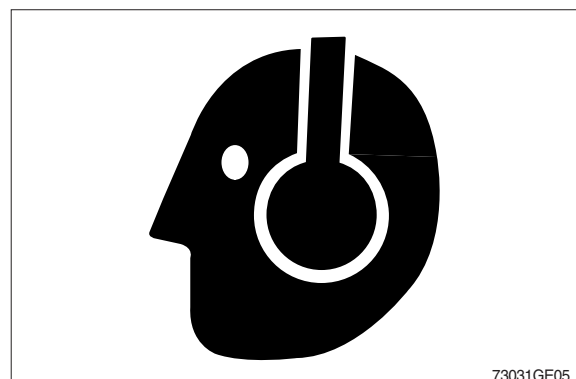
Guard against injury from flying pieces of metal or debris; Wear goggles or safety glasses.



## PROTECT AGAINST NOISE

Prolonged exposure to loud noise can cause impairment or loss of hearing.

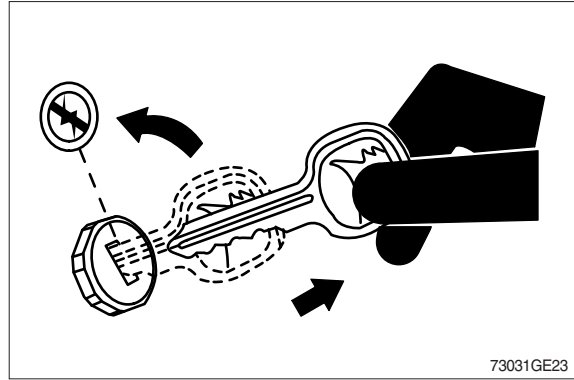
Wear a suitable hearing protective device such as earmuffs or earplugs to protect against objectionable or uncomfortable loud noises.



## PARK MACHINE SAFELY

Before working on the machine:

- Park machine on a level surface.
- Lower bucket to the ground.
- Turn key switch to OFF to stop engine. Remove key from switch.
- Move pilot control shutoff lever to locked position.
- Allow engine to cool.

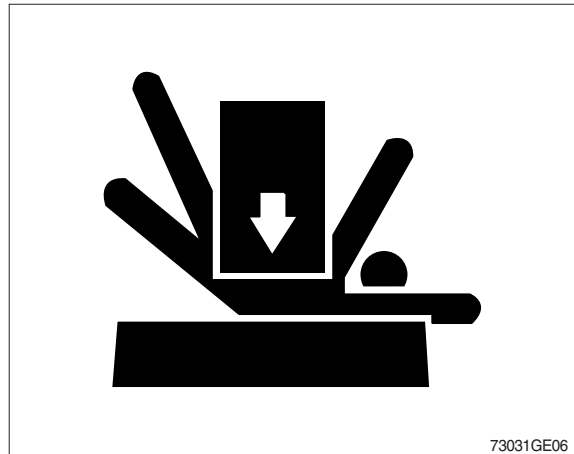


## SUPPORT MACHINE PROPERLY

Always lower the attachment or implement to the ground before you work on the machine. If you must work on a lifted machine or attachment, securely support the machine or attachment.

Do not support the machine on cinder blocks, hollow tiles, or props that may crumble under continuous load.

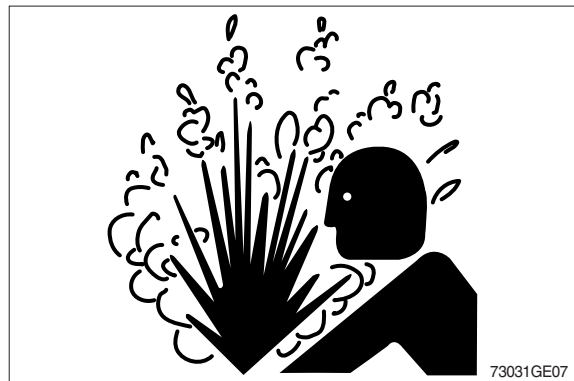
Do not work under a machine that is supported solely by a jack. Follow recommended procedures in this manual.



## SERVICE COOLING SYSTEM SAFELY

Explosive release of fluids from pressurized cooling system can cause serious burns.

Shut off engine. Only remove filler cap when cool enough to touch with bare hands.



## HANDLE FLUIDS SAFELY-AVOID FIRES

Handle fuel with care; It is highly flammable. Do not refuel the machine while smoking or when near open flame or sparks. Always stop engine before refueling machine. Fill fuel tank outdoors.



Store flammable fluids away from fire hazards.  
Do not incinerate or puncture pressurized containers.

Make sure machine is clean of trash, grease, and debris.

Do not store oily rags ; They can ignite and burn spontaneously.



### **BEWARE OF EXHAUST FUMES**

Prevent asphyxiation. Engine exhaust fumes can cause sickness or death.

If you must operate in a building, be positive there is adequate ventilation. Either use an exhaust pipe extension to remove the exhaust fumes or open doors and windows to bring enough outside air into the area.

### **REMOVE PAINT BEFORE WELDING OR HEATING**

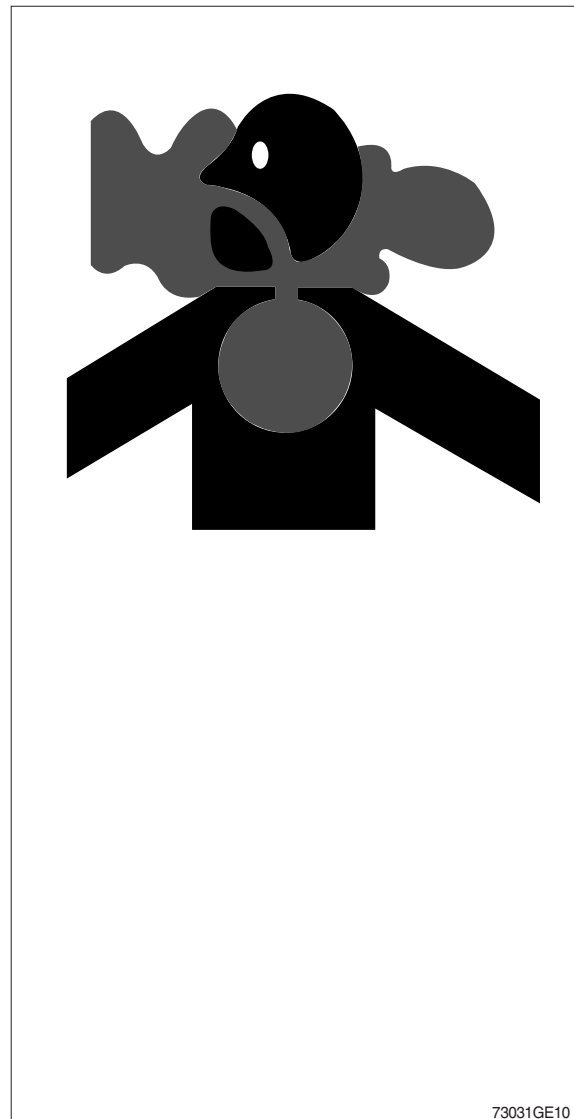
Avoid potentially toxic fumes and dust.

Hazardous fumes can be generated when paint is heated by welding, soldering, or using a torch.

Do all work outside or in a well ventilated area.  
Dispose of paint and solvent properly.

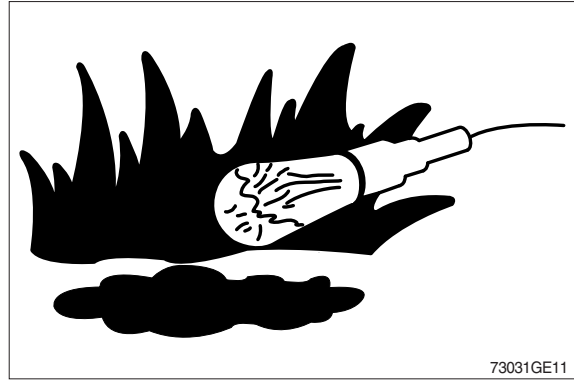
Remove paint before welding or heating:

- If you sand or grind paint, avoid breathing the dust. Wear an approved respirator.
- If you use solvent or paint stripper, remove stripper with soap and water before welding. Remove solvent or paint stripper containers and other flammable material from area. Allow fumes to disperse at least 15 minutes before welding or heating.



### ILLUMINATE WORK AREA SAFELY

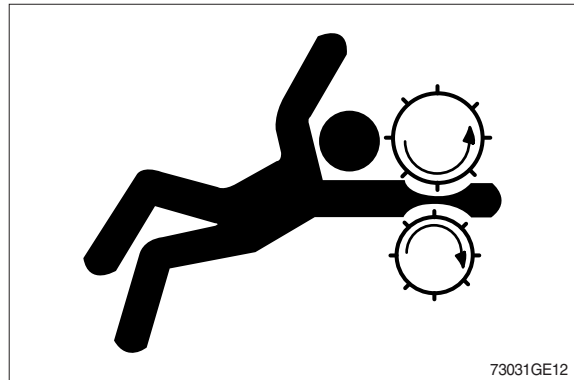
Illuminate your work area adequately but safely. Use a portable safety light for working inside or under the machine. Make sure the bulb is enclosed by a wire cage. The hot filament of an accidentally broken bulb can ignite spilled fuel or oil.



### SERVICE MACHINE SAFELY

Tie long hair behind your head. Do not wear a necktie, scarf, loose clothing or necklace when you work near machine tools or moving parts. If these items were to get caught, severe injury could result.

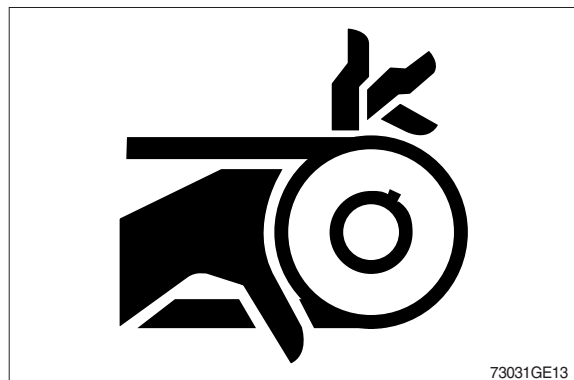
Remove rings and other jewelry to prevent electrical shorts and entanglement in moving parts.



### STAY CLEAR OF MOVING PARTS

Entanglements in moving parts can cause serious injury.

To prevent accidents, use care when working around rotating parts.



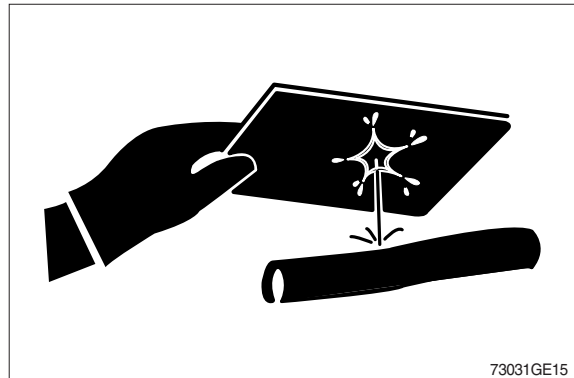
## AVOID HIGH PRESSURE FLUIDS

Escaping fluid under pressure can penetrate the skin causing serious injury.

Avoid the hazard by relieving pressure before disconnecting hydraulic or other lines. Tighten all connections before applying pressure.

Search for leaks with a piece of cardboard. Protect hands and body from high pressure fluids.

If an accident occurs, see a doctor immediately. Any fluid injected into the skin must be surgically removed within a few hours or gangrene may result.



## AVOID HEATING NEAR PRESSURIZED FLUID LINES

Flammable spray can be generated by heating near pressurized fluid lines, resulting in severe burns to yourself and bystanders. Do not heat by welding, soldering, or using a torch near pressurized fluid lines or other flammable materials.

Pressurized lines can be accidentally cut when heat goes beyond the immediate flame area. Install fire resisting guards to protect hoses or other materials.



## PREVENT BATTERY EXPLOSIONS

Keep sparks, lighted matches, and flame away from the top of battery. Battery gas can explode.

Never check battery charge by placing a metal object across the posts. Use a volt-meter or hydrometer.

Do not charge a frozen battery; It may explode. Warm battery to 16°C (60°F).

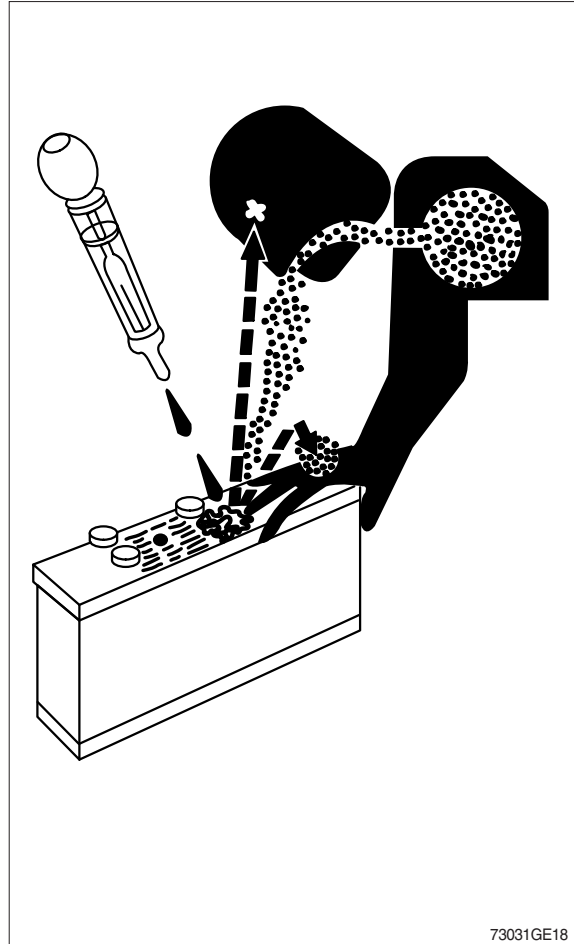


## PREVENT ACID BURNS

Sulfuric acid in battery electrolyte is poisonous. It is strong enough to burn skin, eat holes in clothing, and cause blindness if splashed into eyes.

Avoid the hazard by:

1. Filling batteries in a well-ventilated area.
  2. Wearing eye protection and rubber gloves.
  3. Avoiding breathing fumes when electrolyte is added.
  4. Avoiding spilling or dripping electrolyte.
  5. Use proper jump start procedure.
1. If you spill acid on yourself:
    2. Flush your skin with water.  
Apply baking soda or lime to help neutralize the acid.
  3. Flush your eyes with water for 10-15 minutes.  
Get medical attention immediately.
1. If acid is swallowed:
    2. Drink large amounts of water or milk.  
Then drink milk of magnesia, beaten eggs, or vegetable oil.
  3. Get medical attention immediately.



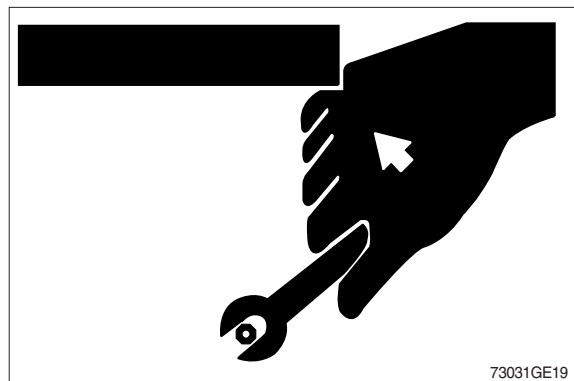
## USE TOOLS PROPERLY

Use tools appropriate to the work. Makeshift tools, parts, and procedures can create safety hazards.

Use power tools only to loosen threaded tools and fasteners.

For loosening and tightening hardware, use the correct size tools. Avoid bodily injury caused by slipping wrenches.

Use only recommended replacement parts.  
(See Parts catalogue.)



## SERVICE TIRES SAFELY

Explosive separation of a tire and rim parts can cause serious injury or death.

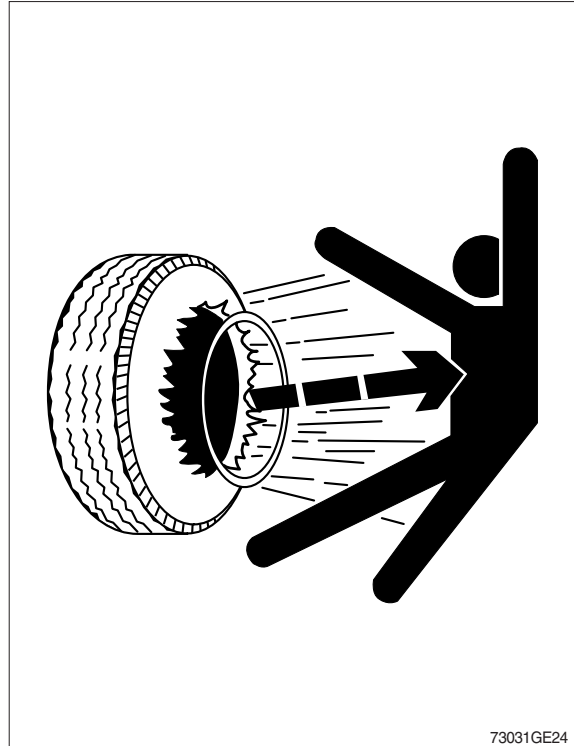
Do not attempt to mount a tire unless you have the proper equipment and experience to perform the job.

Always maintain the correct tire pressure. Do not inflate the tires above the recommended pressure. Never weld or heat a wheel and tire assembly. The heat can cause an increase in air pressure resulting in a tire explosion.

Welding can structurally weaken or deform the wheel.

When inflating tires, use a clip-on chuck and extension hose long enough to allow you to stand to one side and not in front of or over the tire assembly. Use a safety cage if available.

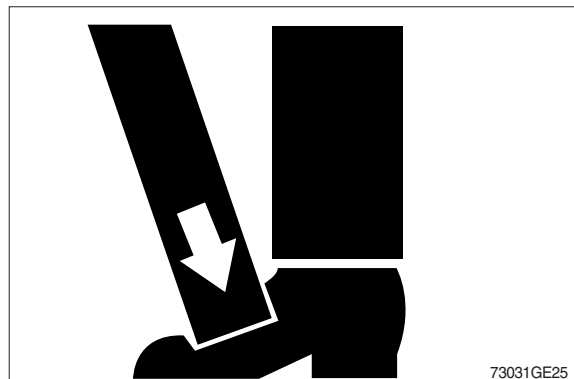
Check wheels for low pressure, cuts, bubbles, damaged rims or missing lug bolts and nuts.



## USE PROPER LIFTING EQUIPMENT

Lifting heavy components incorrectly can cause severe injury or machine damage.

Follow recommended procedure for removal and installation of components in the manual.

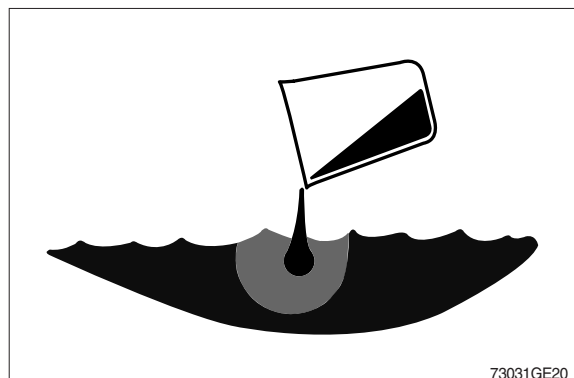


## DISPOSE OF FLUIDS PROPERLY

Improperly disposing of fluids can harm the environment and ecology. Before draining any fluids, find out the proper way to dispose of waste from your local environmental agency.

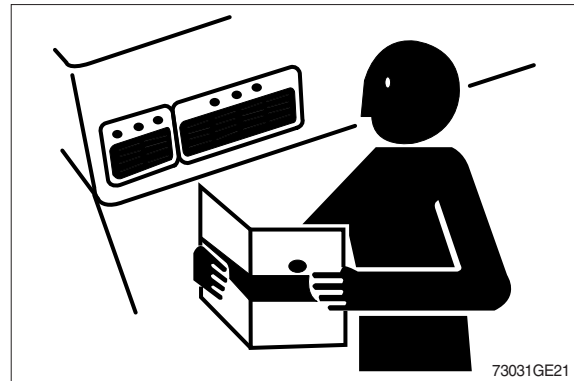
Use proper containers when draining fluids. Do not use food or beverage containers that may mislead someone into drinking from them.

DO NOT pour oil into the ground, down a drain, or into a stream, pond, or lake. Observe relevant environmental protection regulations when disposing of oil, fuel, coolant, brake fluid, filters, batteries, and other harmful waste.



## REPLACE SAFETY SIGNS

Replace missing or damaged safety signs. See the machine operator's manual for correct safety sign placement.



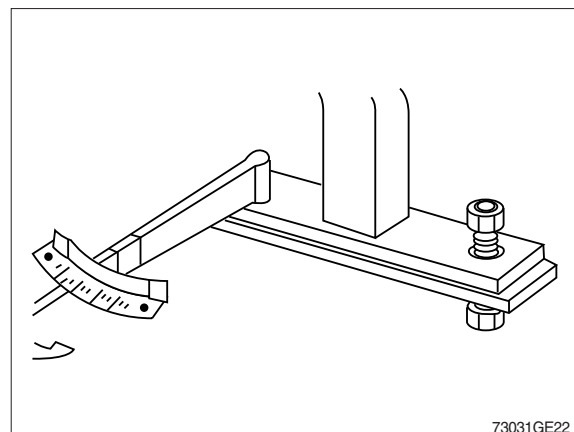
## LIVE WITH SAFETY

Before returning machine to customer, make sure machine is functioning properly, especially the safety systems. Install all guards and shields.

## KEEP ROPS INSTALLED PROPERLY

Make certain all parts are reinstalled correctly if the roll-over protective structure (ROPS) is loosened or removed for any reason. Tighten mounting bolts to proper torque.

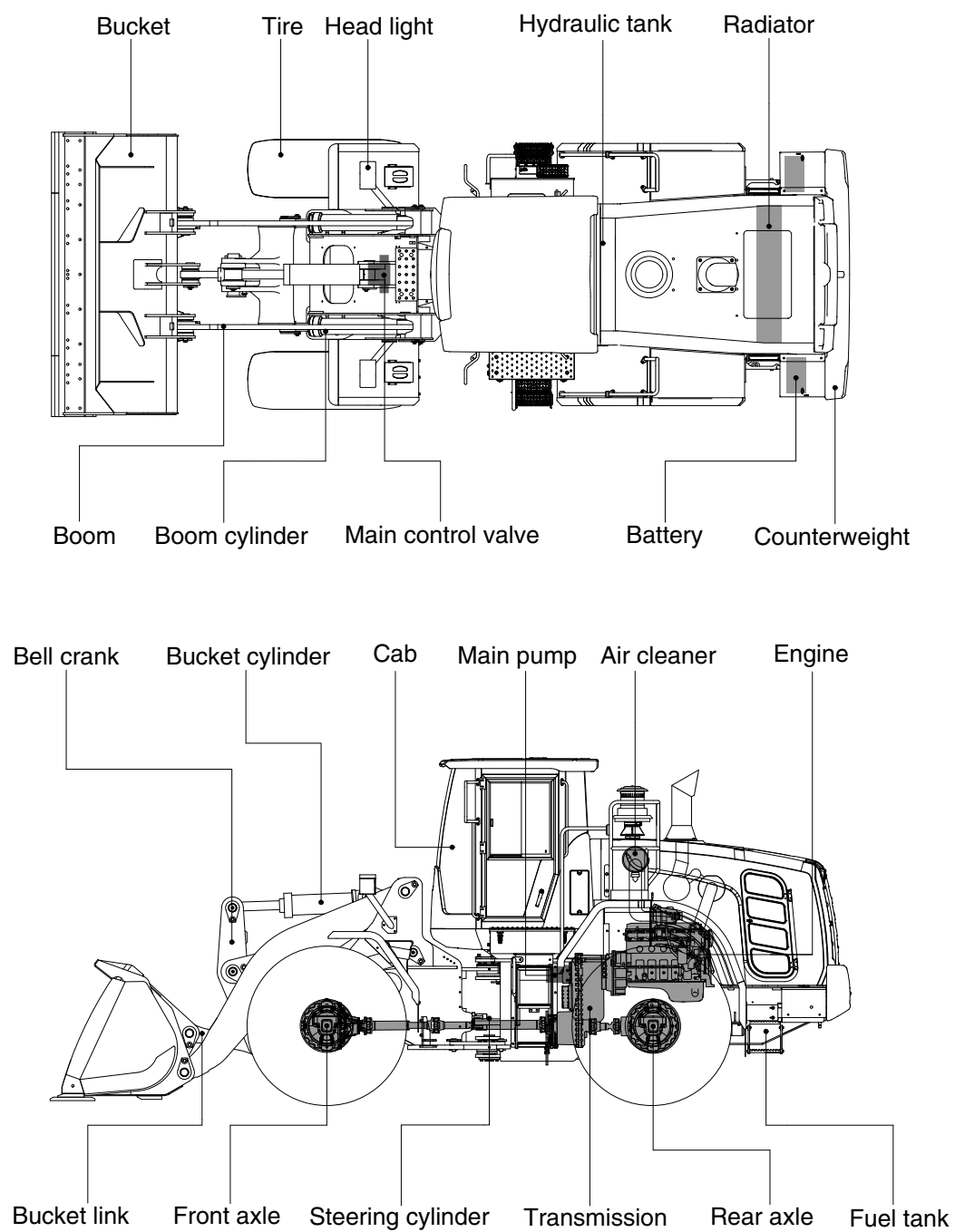
The protection offered by ROPS will be impaired if ROPS is subjected to structural damage, is involved in an overturn incident, or is in any way altered by welding, bending, drilling, or cutting. A damaged ROPS should be replaced, not reused.





## GROUP 2 SPECIFICATIONS

### 1. MAJOR COMPONENT



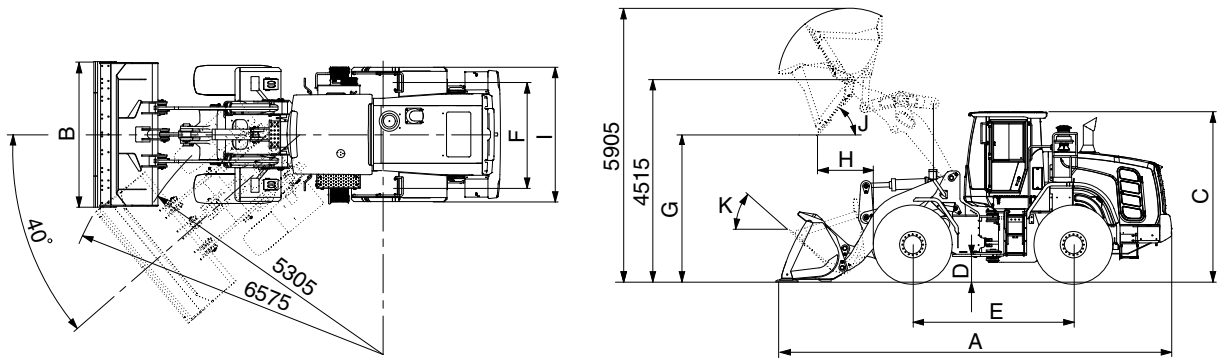
955SA2SE01

**1) WITH BOLT-ON CUTTING EDGE TYPE BUCKET (HL955 T3)**



1-11

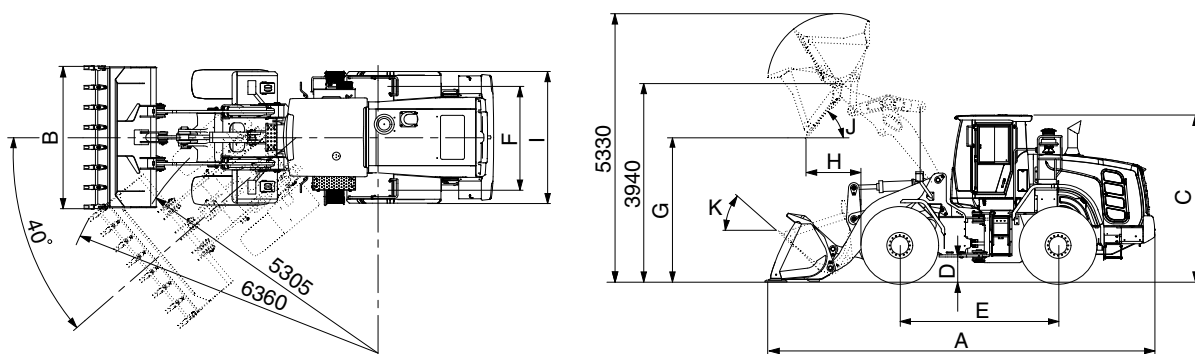
## WITH BOLT-ON CUTTING EDGE TYPE BUCKET (HL955XT T3)



757F2SE03-1

Description			Unit	Specification
Operating weight			kg (lb)	16340 (36025)
Bucket capacity	Struck		m³ (yd³)	2.4 (3.1)
	Heaped			2.8 (3.7)
Overall length	A		mm (ft-in)	8310 (27' 3")
Overall width	B			2740 ( 9' 0")
Overall height	C			3390 (11' 1")
Ground clearance	D			410 ( 1' 4")
Wheelbase	E			3050 ( 10' 0")
Tread	F			2010 ( 6' 7")
Dump clearance at 45°	G			3360 (11' 0")
Dump reach (full lift)	H			1220 ( 4' 0")
Width over tires	I			2530 ( 8' 4")
Dump angle	J			degree (°)
Rollback angle (carry position)	K		47	
Cycle time	Lift (with load)		sec	5.5
	Dump (with load)			1.6
	Lower (empty)			3.7
Maximum travel speed			km/hr (mph)	37.3 (23.2)
Braking distance			m (ft-in)	11.8 (38' 9")
Minimum turning radius (center of outside tire)				5.3 (17' 5")
Gradeability			degree (°)	30
Breakout force			kg (lb)	14540 (32055)
Travel speed	Forward	First gear	km/hr (mph)	6.8 (4.2)
		Second gear		11.2 (7.0)
		Third gear		22.6 (14.0)
		Fourth gear		37.3 (23.2)
	Reverse	First gear		7.1 (4.4)
		Second gear		11.8 (7.3)
		Third gear		23.8 (14.8)

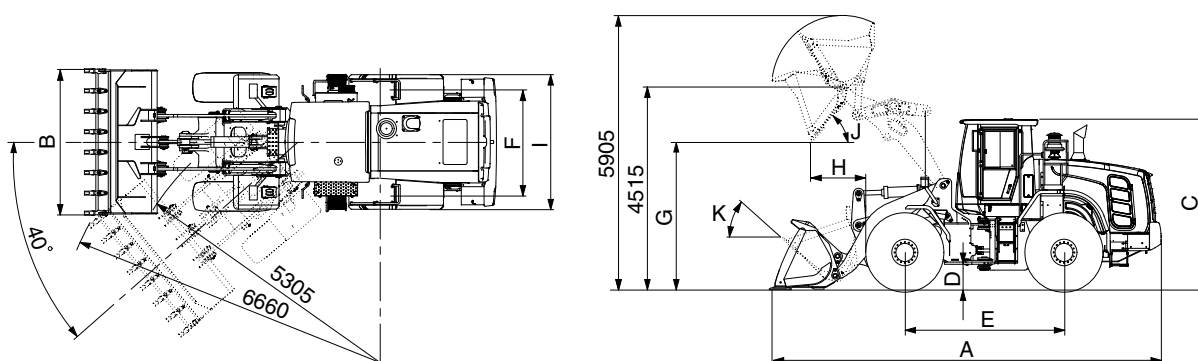
## 2) WITH 2-TOOTH TYPE BUCKET (HL955 T3)



757F2SE02

Description			Unit	Specification
Operating weight			kg (lb)	15705 (34950)
Bucket capacity	Struck		m³ (yd³)	2.4 (3.1)
	Heaped			2.8 (3.7)
Overall length	A		mm (ft-in)	7870 (25' 10")
Overall width	B			2810 ( 9' 3")
Overall height	C			3390 (11' 1")
Ground clearance	D			410 ( 1' 4")
Wheelbase	E			3050 ( 10' 0")
Tread	F			2010 ( 6' 7")
Dump clearance at 45°	G			2660 ( 8' 9")
Dump reach (full lift)	H			1275 ( 4' 2")
Width over tires	I			2530 ( 8' 4")
Dump angle	J			degree (°)
Rollback angle (carry position)	K		46	
Cycle time	Lift (with load)		sec	5.5
	Dump (with load)			1.8
	Lower (empty)			3.7
Maximum travel speed			km/hr (mph)	37.3 (23.2)
Braking distance			m (ft-in)	11.8 (38' 9")
Minimum turning radius (center of outside tire)				5.3 (17' 5")
Gradeability			degree (°)	30
Breakout force			kg (lb)	14370 (31680)
Travel speed	Forward	First gear	km/hr (mph)	6.8 (4.2)
		Second gear		11.2 (7.0)
		Third gear		22.6 (14.0)
		Fourth gear		37.3 (23.2)
	Reverse	First gear		7.1 (4.4)
		Second gear		11.8 (7.3)
		Third gear		23.8 (14.8)

# WITH 2-TOOTH TYPE BUCKET (HL955XT T3)



757F2SE02-2

Description			Unit	Specification
Operating weight			kg (lb)	16395 (36145)
Bucket capacity	Struck		m³ (yd³)	2.4 (3.1)
	Heaped			2.8 (3.7)
Overall length	A		mm (ft-in)	8465 (18662)
Overall width	B			2810 ( 9' 3")
Overall height	C			3390 (11' 1")
Ground clearance	D			410 ( 1' 4")
Wheelbase	E			3050 ( 10' 0")
Tread	F			2010 ( 6' 7")
Dump clearance at 45°	G			3235 ( 10' 7")
Dump reach (full lift)	H			1315 ( 4' 4")
Width over tires	I			2530 ( 8' 4")
Dump angle	J			degree (°)
Rollback angle (carry position)	K		47	
Cycle time	Lift (with load)		sec	5.5
	Dump (with load)			1.6
	Lower (empty)			3.7
Maximum travel speed			km/hr (mph)	37.3 (23.2)
Braking distance			m (ft-in)	11.8 (38' 9")
Minimum turning radius (center of outside tire)				5.3 (17' 5")
Gradeability			degree (°)	30
Breakout force			kg (lb)	14540 (32055)
Travel speed	Forward	First gear	km/hr (mph)	6.8 (4.2)
		Second gear		11.2 (7.0)
		Third gear		22.6 (14.0)
		Fourth gear		37.3 (23.2)
	Reverse	First gear		7.1 (4.4)
		Second gear		11.8 (7.3)
		Third gear		23.8 (14.8)

### 3. WEIGHT

Item		kg	lb
Front frame assembly		1150	2540
Rear frame assembly		1681	3710
Front fender (LH/RH)		29/29	65/65
Rear fender (LH/RH)		48/47	105/105
Counterweight	HL955 T3	500	1105
	HL955XT T3	800	1765
Cab assembly		837	1850
Engine assembly		552	1220
Transmission assembly		450	995
Driveshaft (front)		34	75
Driveshaft (center)		23	55
Driveshaft (rear)		12	30
Front axle (include differential)		1,020	2,250
Rear axle (include differential)		1,020	2,250
Tire (20.5 R25, ★★, L3), 1EA		350	775
Hydraulic tank assembly		183	405
Fuel tank assembly		287	635
Main pump assembly		53	120
Fan & brake pump assembly		14	35
Main control valve (2-spool/3-spool)		90/106	200/235
Steering valve (Priority valve)		5	15
Boom assembly	HL955 T3	976	2155
	HL955XT T3	1327	2930
Bell crank assembly		293	650
Bucket link		47	105
Quick coupler assembly (ISO type)		390	860
2.8 m³ bucket, with bolt on cutting edge		1250	2760
2.8 m³ bucket, with 2-tooth		1305	2880
Boom cylinder assembly (LH/RH)		111/111	245/245
Bucket cylinder assembly (HL955 T3/HL955XT T3)		123/152	275/335
Steering cylinder assembly (LH/RH)		26/26	60/60
Seat (Including suspension and arm rest)		66	150
Battery (1EA)		40	90
Under guard kit		61	140
Engine hood assembly		302	670
Mud guard assembly (LH/RH)		23/23	100/100

## 4. SPECIFICATION FOR MAJOR COMPONENTS

### 1) ENGINE

Item	Specification
Model	HYUNDAI HE6.7
Type	4-cycle turbocharged, charge air cooled diesel engine
Control type	Electronic control
Cooling method	Water cooled
Number of cylinders and arrangement	6 cylinders, in-line
Firing order	1-5-3-6-2-4
Combustion chamber type	Direct injection type
Cylinder bore × stroke	107 × 124 mm (4.2" × 4.9")
Piston displacement	6700 cc (409 cu in)
Compression ratio	17.2 : 1
Gross power	173 hp (129 kW) at 2100 rpm
Net power	170 hp (127 kW) at 2100 rpm
Maximum power	173 hp (129 kW) at 2100 rpm
Peak gross torque	82.9 kgf · m (600 lbf · ft) at 1400 rpm
Engine oil quantity	18 ℓ (4.8 U.S. gal)
Wet weight	552 kg (1217 lb)
Starting motor	24 V - 4.8 kW
Alternator	24 V - 70 Amp
Battery	2 × 12 V × 150 Ah

## 2) MAIN PUMP

Item	Specification
Type	Variable piston pump
Capacity	100 cc/rev
Maximum operating pressure	280 kgf/cm <sup>2</sup> (3980 psi)
Rated oil quantity (at 2200 rpm)	211 ℓ /min (55.7 U.S.gpm / 48.4 U.K.gpm)
Maximum speed	2230 rpm

## 3) FAN AND BRAKE PUMP

Item	Specification
Type	Variable piston pump
Capacity	28 cc/rev
Maximum operating pressure	250 kgf/cm <sup>2</sup> (3560 psi)
Rated oil quantity (at 2200 rpm)	62 ℓ /min (16.3 U.S.gpm)
Maximum speed	2230 rpm

## 4) MAIN CONTROL VALVE

Item	Specification
Type	2 spool & 3spool
Operating method	Hydraulic pilot assist
System pressure	280 kgf/cm <sup>2</sup> (3980 psi)
Overload relief valve pressure	340 kgf/cm <sup>2</sup> (4840 psi) / *300 kgf/cm <sup>2</sup> (4270 psi)

\* : Bucket dump

## 5) REMOTE CONTROL VALVE (EH TYPE)

Item	Specification
Type	Fingertip
Axle	Single axle for boom, bucket, auxiliary
Operating voltage	4.5~5.5 V
Output signal	0.5~4.5 V (neutral 2.5 V)



## 2) MAIN PUMP

Item	Specification
Type	Variable piston pump
Capacity	100 cc/rev
Maximum operating pressure	280 kgf/cm <sup>2</sup> (3980 psi)
Rated oil quantity (at 2200 rpm)	211 ℓ /min (55.7 U.S.gpm / 48.4 U.K.gpm)
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## 5) REMOTE CONTROL VALVE (EH TYPE)

Item	Specification
Type	Fingertip
Axle	Single axle for boom, bucket, auxiliary
Operating voltage	4.5~5.5 V
Output signal	0.5~4.5 V (neutral 2.5 V)

## 6) CYLINDER

Item		Specification
Boom cylinder	Bore dia × Rod dia × Stroke	Ø 125 × Ø 70 × 745 mm
Bucket cylinder (HL955 T3)	Bore dia × Rod dia × Stroke	Ø 140 × Ø 75 × 560 mm
Bucket cylinder (HL955XT T3)	Bore dia × Rod dia × Stroke	Ø 140 × Ø 75 × 585 mm
Steering cylinder	Bore dia × Rod dia × Stroke	Ø 70 × Ø 45 × 418 mm

## 7) DYNAMIC POWER TRANSMISSION DEVICES

Item			Specification
Transmission	Model		ZF 4WG 190
	Type	Converter	Single-stage, single-phase
		Transmission	Full-automatic power shift
	Gear shift		Forward fourth gear, reverse third gear
	Control		Electrical single lever type, kick-down system
	Travel speed		See the page 2-2.
Axle	Drive devices		4-wheel drive
	Front		Front fixed location
	Rear		Oscillation $\pm 12^\circ$ of center pin-loaded
Wheels	Tires		20.5 R25, ★★, L3
Brakes	Travel		Four-wheel, wet-disc type, full hydraulic
	Parking		Spring applied, hydraulic released brake on transmission
Steering	Type		Full hydraulic, articulated
	Steering angle		40° to both right and left angle, respectively
	Relief pressure		210 kgf/cm <sup>2</sup> (2990 psi)

## 5. TIGHTENING TORQUE

Use following table for unspecified torque.

### 1) BOLT AND NUT

#### (1) Coarse thread

Bolt size	8.8T		10.9T		12.9T	
	kgf·m	lbf·ft	kgf·m	lbf·ft	kgf·m	lbf·ft
M 6 × 1.0	0.8 ~ 1.2	5.8 ~ 8.6	1.2 ~ 1.8	8.7 ~ 13.0	1.5 ~ 2.1	10.9 ~ 15.1
M 8 × 1.25	2.0 ~ 3.0	14.5 ~ 21.6	2.8 ~ 4.2	20.3 ~ 30.4	3.4 ~ 5.0	24.6 ~ 36.1
M10 × 1.5	4.0 ~ 6.0	29.0 ~ 43.3	5.6 ~ 8.4	40.5 ~ 60.8	6.8 ~ 10.0	49.2 ~ 72.3
M12 × 1.75	6.8 ~ 10.2	50.0 ~ 73.7	9.6 ~ 14.4	69.5 ~ 104	12.3 ~ 16.5	89.0 ~ 119
M14 × 2.0	10.9 ~ 16.3	78.9 ~ 117	16.3 ~ 21.9	118 ~ 158	19.5 ~ 26.3	141 ~ 190
M16 × 2.0	17.9 ~ 24.1	130 ~ 174	25.1 ~ 33.9	182 ~ 245	30.2 ~ 40.8	141 ~ 295
M18 × 2.5	24.8 ~ 33.4	180 ~ 241	34.8 ~ 47.0	252 ~ 340	41.8 ~ 56.4	302 ~ 407
M20 × 2.5	34.9 ~ 47.1	253 ~ 340	49.1 ~ 66.3	355 ~ 479	58.9 ~ 79.5	426 ~ 575
M22 × 2.5	46.8 ~ 63.2	339 ~ 457	65.8 ~ 88.8	476 ~ 642	78.9 ~ 106	570 ~ 766
M24 × 3.0	60.2 ~ 81.4	436 ~ 588	84.6 ~ 114	612 ~ 824	102 ~ 137	738 ~ 991
M30 × 3.5	120 ~ 161	868 ~ 1164	168 ~ 227	1216 ~ 1641	202 ~ 272	1461 ~ 1967

#### (2) Fine thread

Bolt size	8.8T		10.9T		12.9T	
	kgf · m	lbf · ft	kgf · m	lbf · ft	kgf · m	lbf · ft
M 8 × 1.0	2.1 ~ 3.1	15.2 ~ 22.4	3.0 ~ 4.4	21.7 ~ 31.8	3.6 ~ 5.4	26.1 ~ 39.0
M10 × 1.25	4.2 ~ 6.2	30.4 ~ 44.9	5.9 ~ 8.7	42.7 ~ 62.9	7.0 ~ 10.4	50.1 ~ 75.2
M12 × 1.25	7.3 ~ 10.9	52.8 ~ 78.8	10.3 ~ 15.3	74.5 ~ 110	13.1 ~ 17.7	94.8 ~ 128
M14 × 1.5	12.4 ~ 16.6	89.7 ~ 120	17.4 ~ 23.4	126 ~ 169	20.8 ~ 28.0	151 ~ 202
M16 × 1.5	18.7 ~ 25.3	136 ~ 182	26.3 ~ 35.5	191 ~ 256	31.6 ~ 42.6	229 ~ 308
M18 × 1.5	27.1 ~ 36.5	196 ~ 264	38.0 ~ 51.4	275 ~ 371	45.7 ~ 61.7	331 ~ 446
M20 × 1.5	37.7 ~ 50.9	273 ~ 368	53.1 ~ 71.7	384 ~ 518	63.6 ~ 86.0	460 ~ 622
M22 × 1.5	51.2 ~ 69.2	370 ~ 500	72.0 ~ 97.2	521 ~ 703	86.4 ~ 116	625 ~ 839
M24 × 2.0	64.1 ~ 86.5	464 ~ 625	90.1 ~ 121	652 ~ 875	108 ~ 146	782 ~ 1056
M30 × 2.0	129 ~ 174	933 ~ 1258	181 ~ 245	1310 ~ 1772	217 ~ 294	1570 ~ 2126

**2) PIPE AND HOSE (FLARE type)**

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

**3) PIPE AND HOSE (ORFS type)**

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

**4) FITTING**

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

## 5) TIGHTENING TORQUE OF MAJOR COMPONENT

No.	Descriptions		Bolt size	Torque	
				kgf · m	lbf · ft
1	Engine	Engine mounting bolt, nut (rubber, 2EA)	M20×2.5	57.9 ± 8.7	419 ± 63
2		Engine mounting bolt (bracket, 8EA)	M12×1.75	11.7 ± 1.8	84.6 ± 13.0
3		Engine mounting bolt (T/C housing, 4EA)	M10×1.5	6.9 ± 1.4	50 ± 10.1
4		Engine mounting bolt (flywheel-adapter, 4EA)	M10×1.5	6.9 ± 1.4	50 ± 10.1
5		Fan motor mounting bolt	M12×1.75	12.8 ± 3.0	92.6 ± 21.7
6		Radiator mounting bolt	M16×2.0	29.7 ± 5.9	215 ± 42.7
7		Fuel tank mounting bolt, nut	M16×2.0	29.7 ± 4.5	215 ± 32.5
8	Hydraulic system	Main pump housing mounting bolt	M16×2.0	29.7 ± 4.5	215 ± 32.5
9		Fan & brake pump housing mounting bolt	M10×1.5	6.9 ± 1.4	50 ± 10.1
10		Main control valve mounting bolt	M12×1.75	12.8 ± 3.0	92.6 ± 21.7
11		Steering unit mounting bolt	M10×1.5	6.9 ± 1.4	50 ± 10.1
12		Steering valve (EHPS) mounting bolt	M8×1.25	2.5 ± 0.5	18.1 ± 3.6
13		Brake valve mounting bolt	M8×1.25	2.5 ± 0.5	18.1 ± 3.6
14		Cut-off valve mounting bolt	M8×1.25	2.5 ± 0.5	18.1 ± 3.6
15		EH control block mounting bolt	M8×1.25	2.5 ± 0.5	18.1 ± 3.6
16		Safety valve	M10×1.5	6.9 ± 1.4	50 ± 10.1
17		Hydraulic oil tank mounting bolt	M16×2.0	29.7 ± 4.5	215 ± 32.5
18	Power train system	Transmission mounting bolt, nut (rubber, 4EA)	M24×3.0	100 ± 15	723 ± 108
19		Transmission mounting bolt (bracket, 8EA)	M12×1.75	11.7 ± 1.8	84.6 ± 13.0
20		Front axle mounting bolt, nut	M33×2.0	225 ± 20	1627 ± 145
21		Rear axle support mounting bolt, nut	M36×3.0	280 ± 30	2025 ± 217
22		Rear axle shaft, cover mounting bolt	M16×2.0	29.7 ± 4.5	215 ± 32.5
23		Tire mounting nut	M22×1.5	79 ± 2.5	571 ± 18.1
24		Drive shaft joint mounting bolt	1/2-20UNF	15 ± 2.0	108 ± 14.5
25	Others	Counterweight mounting bolt	M30×3.5	199 ± 30	1439 ± 216
			M24×3.0	100 ± 15	723 ± 108
26		Operator's seat mounting bolt	M8×1.25	3.4 ± 0.8	24.6 ± 5
27		ROPS Cab mounting bolt (4EA)	M30×3.5	199 ± 29.9	1440 ± 216
		ROPS Cab mounting nut (4EA)	M16×2.0	20.5 ± 4.7	148± 34

## 6. SPECIFICATION OF FUEL, COOLANT AND LUBRICANTS

### 1) NEW MACHINE

New machine used and filled with following lubricants.

Description	Specification
Engine oil (API CH-4)	SAE 15W-40, <sup>★2</sup> SAE 5W-40
Hydraulic oil	Hyundai genuine long life hydraulic oil (ISO VG 46, VG 68 only) Conventional hydraulic oil (ISO VG15 <sup>★2</sup> )
Transmission oil	SAE 15W-40
Axle oil	<sup>★</sup> Refer to below list
Grease	Lithium base grease NLGI No. 2
Fuel	ASTM D975-No. 2
Coolant	ASTM D6210 Mixture of 50% ethylene glycol base antifreeze and 50% water Mixture of 60% ethylene glycol base antifreeze and 40% water <sup>★2</sup>

**SAE** : Society of Automotive Engineers

**API** : American Petroleum Institute

**ISO** : International Organization for Standardization

**NLGI** : National Lubricating Grease Institute

**ASTM** : American Society of Testing and Material

<sup>★</sup> Recommended oil list

- BP TERRAC SUPER TRANSMISSION 10W-30

- CASTROL AGRI TRANS PLUS 10W-30

- MOBILFLUID 426

- SHELL DONAX TD 10W-30

- TOTAL DYNATRANS MPV

<sup>★2</sup> Cold region

### 2) RECOMMENDED OILS

HYUNDAI genuine lubricating oils have been developed to offer the best performance and service life for your equipment. These oils have been tested according to the specifications of HYUNDAI and, therefore, will meet the highest safety and quality requirements.

We recommend that you use only HYUNDAI genuine lubricating oils and grease officially approved by HYUNDAI.

- ※ Using any lubricating oils other than HYUNDAI genuine products may lead to a deterioration of performance and cause damage to major components.
- ※ Do not mix HYUNDAI genuine oil with any other lubricating oil as it may result in damage to the systems of major components.
- ※ Do not use any engine oil other than that specified above, as it may clog the diesel particulate filter(DPF).
- ※ For HYUNDAI genuine lubricating oils and grease for use in regions with extremely low temperatures, please contact HYUNDAI dealers.

Service point	Kind of fluid	Capacity ℓ (U.S. gal)	Ambient temperature °C(°F)									
			-50 (-58)	-30 (-22)	-20 (-4)	-10 (14)	0 (32)	10 (50)	20 (68)	30 (86)	40 (104)	
Engine oil pan	Engine oil	18 (4.8)										
					SAE 15W-40							
					★ <sup>2</sup> SAE 5W-40							
			SAE 0W-40									
Transmission	Engine oil	44 (11.6)										
				SAE 10W-30								
					SAE 15W-40							
Axle ★ <sup>4</sup>	UTTO	FR : 35 (9.2) RR : 35 (9.2)	★ Refer to below list									
Hydraulic tank	Hydraulic oil	Tank: 110 (29.1) System: 190 (50.2)	★ <sup>2</sup> ISO VG 15									
						ISO VG 46						
						ISO VG 68						
Fuel tank	Diesel fuel	230 (60.8)	★ <sup>2</sup> ASTM D975 NO.1									
						ASTM D975 NO.2						
Fitting (grease nipple)	Grease	As required	★ <sup>2</sup> NLGI NO.1									
						NLGI NO.2						
Radiator (reservoir tank)	Mixture of antifreeze and soft water★ <sup>3</sup>	42.5 (11.2)		Ethylene glycol base permanent type (50 : 50)								
			★ <sup>2</sup> Ethylene glycol base permanent type (60 : 40)									

**SAE** : Society of Automotive Engineers

**API** : American Petroleum Institute

**ISO** : International Organization for Standardization

**NLGI** : National Lubricating Grease Institute

**ASTM** : American Society of Testing and Material

**UTTO** : Universal Tractor Transmission Oil

★ Recommended oil list

- BP TERRAC SUPER TRANSMISSION 10W-30

- CASTROL AGRI TRANS PLUS 10W-30

- MOBILFLUID 426

- SHELL DONAX TD 10W-30

- TOTAL DYNATRANS MPV

★<sup>2</sup> Cold region

★<sup>3</sup> Soft water : City water or distilled water

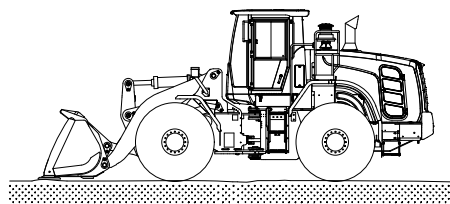
★<sup>4</sup> If the machine is equipped with axle oil cooler, refer to page 6-38.

## GROUP 3 OPERATIONAL CHECKOUT RECORD SHEET

- Owner :
- Date :
- Hours :
- Serial No. :
- Technician :

※ Use this sheet to record operational checkout results.

Perform the operational check before installing any test equipment.



760F1GE02

Item	OK	NOT OK	Comments
------	----	-----------	----------

### 1. Monitor indicator and gauge checks (engine OFF)

- Hourmeter and gauge check ☐ ☐ \_\_\_\_\_
- Battery check ☐ ☐ \_\_\_\_\_
- Monitor indicator circuit check ☐ ☐ \_\_\_\_\_
- Cluster turn signals and warning indicator check ☐ ☐ \_\_\_\_\_

### 2. Transmission, axle and engine, neutral start switch and reverse warning alarm switch checks

- Transmission control lever and neutral ☐ ☐ \_\_\_\_\_
- Neutral start and reverse warning ☐ ☐ \_\_\_\_\_
- Alarm circuit checks ☐ ☐ \_\_\_\_\_

### 3. Monitor indicator and gauge checks (engine running)

- Monitor display and alternator output checks ☐ ☐ \_\_\_\_\_
- Monitor bypass circuit and seat belt indicator check ☐ ☐ \_\_\_\_\_
- Monitor primary and secondary level check ☐ ☐ \_\_\_\_\_
- Transmission oil warm up procedure ☐ ☐ \_\_\_\_\_
- Transmission temperature gauge check ☐ ☐ \_\_\_\_\_



#### 4. Brake system and clutch cut off checks

· Park brake capacity check	<input type="checkbox"/>	<input type="checkbox"/>	_____
· Park brake transmission lockout check	<input type="checkbox"/>	<input type="checkbox"/>	_____
· Service brake pump flow check	<input type="checkbox"/>	<input type="checkbox"/>	_____
· Service brake capacity check	<input type="checkbox"/>	<input type="checkbox"/>	_____
· Brake accumulator precharge check	<input type="checkbox"/>	<input type="checkbox"/>	_____
· Brake system leakage check	<input type="checkbox"/>	<input type="checkbox"/>	_____
· Service brake pedal check	<input type="checkbox"/>	<input type="checkbox"/>	_____
· Service and park brake system drag check	<input type="checkbox"/>	<input type="checkbox"/>	_____
· Clutch cut off check	<input type="checkbox"/>	<input type="checkbox"/>	_____

#### 5. Driving checks

· Transmission oil warm up procedure	<input type="checkbox"/>	<input type="checkbox"/>	_____
· Transmission noise check	<input type="checkbox"/>	<input type="checkbox"/>	_____
· Speedometer check	<input type="checkbox"/>	<input type="checkbox"/>	_____
· Transmission kick down system check	<input type="checkbox"/>	<input type="checkbox"/>	_____
· 1st, 2nd, 3rd and 4th speed clutch pack drag check	<input type="checkbox"/>	<input type="checkbox"/>	_____
· Transmission pressure, pump flow and leakage check	<input type="checkbox"/>	<input type="checkbox"/>	_____
· Transmission shift modulation check	<input type="checkbox"/>	<input type="checkbox"/>	_____
· Torque converter check	<input type="checkbox"/>	<input type="checkbox"/>	_____
· Engine power check	<input type="checkbox"/>	<input type="checkbox"/>	_____

#### 6. Hydraulic system checks

· Hydraulic system warm up procedure	<input type="checkbox"/>	<input type="checkbox"/>	_____
· Hydraulic pump performance check	<input type="checkbox"/>	<input type="checkbox"/>	_____
· Pilot control valve boom float check	<input type="checkbox"/>	<input type="checkbox"/>	_____
· Boom down solenoid valve check	<input type="checkbox"/>	<input type="checkbox"/>	_____
· Control valve lift check	<input type="checkbox"/>	<input type="checkbox"/>	_____
· Bucket rollback circuit relief valve check	<input type="checkbox"/>	<input type="checkbox"/>	_____
· Bucket dump circuit relief			
Low pressure check	<input type="checkbox"/>	<input type="checkbox"/>	_____
High pressure check	<input type="checkbox"/>	<input type="checkbox"/>	_____
· Boom and bucket cylinder drift check	<input type="checkbox"/>	<input type="checkbox"/>	_____
· Boom down solenoid valve leakage check	<input type="checkbox"/>	<input type="checkbox"/>	_____
· Pilot controller check	<input type="checkbox"/>	<input type="checkbox"/>	_____
· Return to dig check	<input type="checkbox"/>	<input type="checkbox"/>	_____
· Boom height kickout check-if equipped	<input type="checkbox"/>	<input type="checkbox"/>	_____

## 7. Steering system checks

· Steering unit check	<input type="checkbox"/>	<input type="checkbox"/>	_____
· Steering system leakage check	<input type="checkbox"/>	<input type="checkbox"/>	_____
· Steering valve (EHPS)			
Low check pressure	<input type="checkbox"/>	<input type="checkbox"/>	_____
High check pressure	<input type="checkbox"/>	<input type="checkbox"/>	_____

## 8. Accessory checks

· Operating lights check	<input type="checkbox"/>	<input type="checkbox"/>	_____
· Work light check	<input type="checkbox"/>	<input type="checkbox"/>	_____
· Brake light check	<input type="checkbox"/>	<input type="checkbox"/>	_____
· Cab light check	<input type="checkbox"/>	<input type="checkbox"/>	_____
· Horn circuit check	<input type="checkbox"/>	<input type="checkbox"/>	_____
· Windshield washer and wiper check	<input type="checkbox"/>	<input type="checkbox"/>	_____
· Defroster blower check	<input type="checkbox"/>	<input type="checkbox"/>	_____
· Heater/Air conditioner blower check	<input type="checkbox"/>	<input type="checkbox"/>	_____
· Heater functional check	<input type="checkbox"/>	<input type="checkbox"/>	_____
· Air conditioner functional check	<input type="checkbox"/>	<input type="checkbox"/>	_____
· Start aid system check	<input type="checkbox"/>	<input type="checkbox"/>	_____

## 9. Cab components and vandal protection checks

· Cab door latch check	<input type="checkbox"/>	<input type="checkbox"/>	_____
· Cab door hold open latch check	<input type="checkbox"/>	<input type="checkbox"/>	_____
· Cab door release button check	<input type="checkbox"/>	<input type="checkbox"/>	_____
· Cab door lock check	<input type="checkbox"/>	<input type="checkbox"/>	_____
· Cab door window check	<input type="checkbox"/>	<input type="checkbox"/>	_____
· Cab window latch check	<input type="checkbox"/>	<input type="checkbox"/>	_____
· Steering column adjustment check	<input type="checkbox"/>	<input type="checkbox"/>	_____
· Seat and seat belt check	<input type="checkbox"/>	<input type="checkbox"/>	_____
· Air intake filter door check	<input type="checkbox"/>	<input type="checkbox"/>	_____
· Engine side panels check	<input type="checkbox"/>	<input type="checkbox"/>	_____
· Radiator cap access door check	<input type="checkbox"/>	<input type="checkbox"/>	_____
· Frame locking bar check	<input type="checkbox"/>	<input type="checkbox"/>	_____
· Boom lock check	<input type="checkbox"/>	<input type="checkbox"/>	_____
· Service decal check	<input type="checkbox"/>	<input type="checkbox"/>	_____

# SECTION 2 ENGINE



Group 1 Structure and Function ..... 2-1

Group 2 Engine speed and Stall rpm ..... 2-6

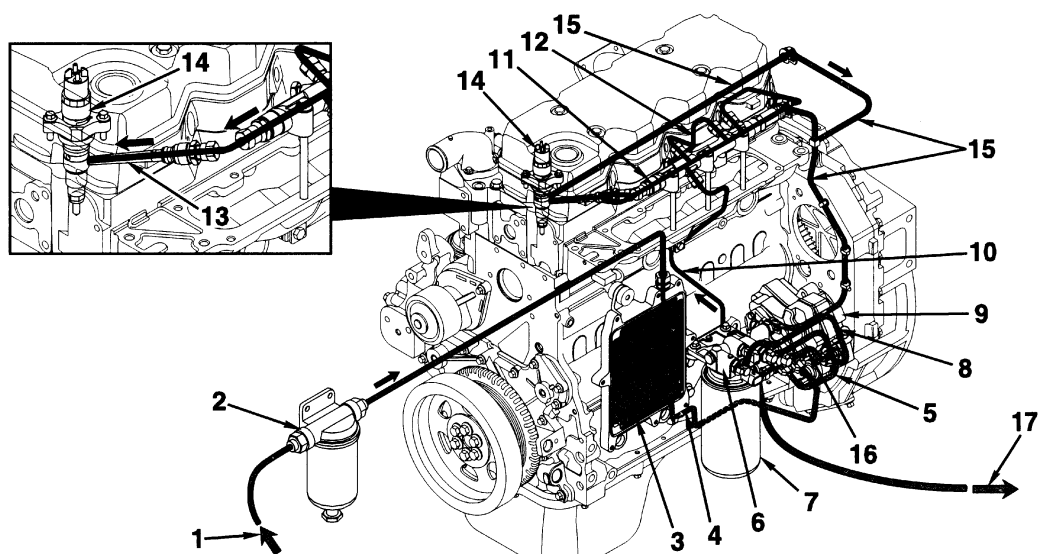
## SECTION 2 ENGINE

### GROUP 1 STRUCTURE AND FUNCTION

#### 1. SYSTEM DIAGRAMS

The following drawings show the flow through the engine systems.

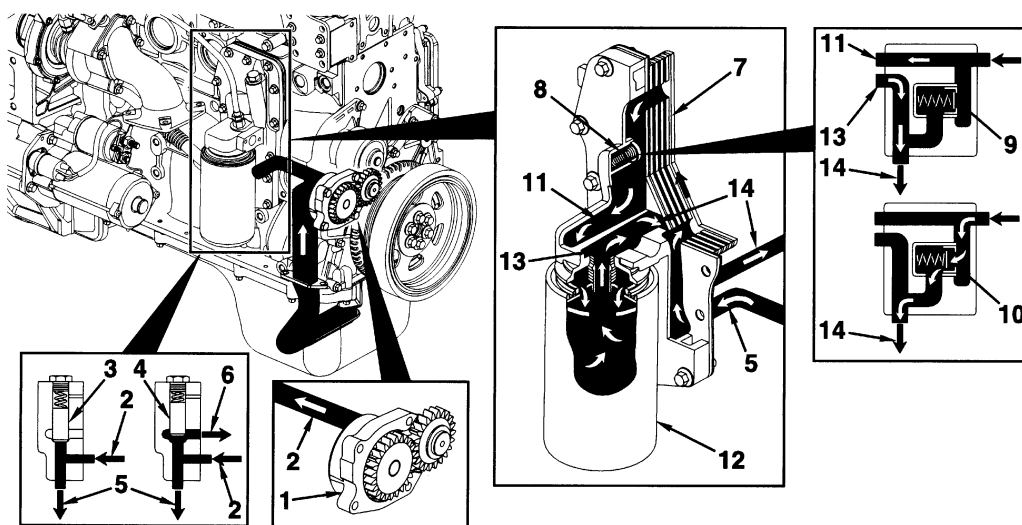
##### 1) FUEL SYSTEM



7607AEG02

- |    |  |    |  |
|----|--|----|--|
| 1  | From fuel tank                               | 11 | Fuel rail  |
| 2  | Water/fuel separator (not mounted on engine) | 12 | To injectors   |
| 3  | ECM cooling plate                            | 13 | High-pressure connector                                      |
| 4  | To fuel gear pump                            | 14 | Injector   |
| 5  | To fuel filter                               | 15 | Fuel return from injectors and fuel rail to fuel filter head |
| 6  | Fuel filter head                             | 16 | Fuel return from high-pressure pump to fuel filter head      |
| 7  | Fuel filter                                  | 17 | To fuel tank   |
| 8  | To high-pressure pump                        |    |  |
| 9  | High-pressure pump                           |    |  |
| 10 | To fuel rail                                 |    |  |

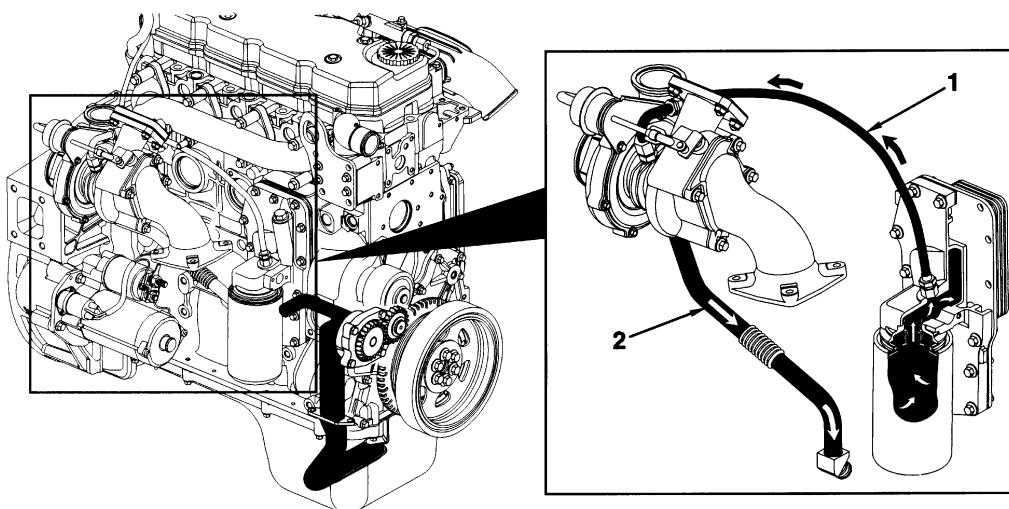
## 2) LUBRICATING OIL SYSTEM



7607AEG03

- |                                    |                                     |
|------------------------------------|-------------------------------------|
| 1 Gerotor lubricating oil pump     | 8 Filter bypass valve               |
| 2 From lubricating oil pump        | 9 Filter bypass valve closed        |
| 3 Pressure regulating valve closed | 10 Filter bypass valve open         |
| 4 Pressure regulating valve open   | 11 To lubricating oil filter        |
| 5 To lubricating oil cooler        | 12 Full-flow lubricating oil filter |
| 6 To lubricating oil pump supply   | 13 From lubricating oil filter      |
| 7 Lubricating oil cooler           | 14 Main lubricating oil rifle       |

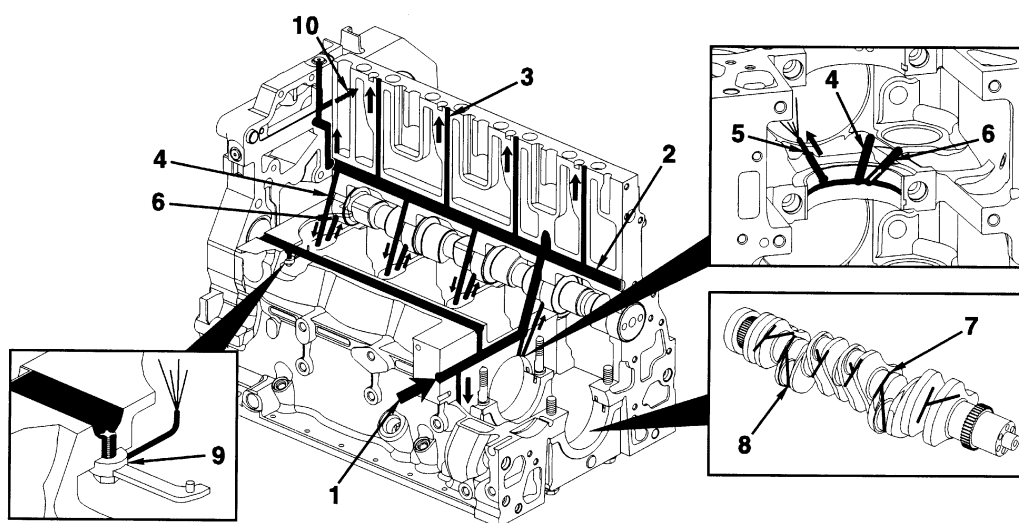
### (1) Lubrication for the turbocharger



7607AEG04

- |                                       |                                      |
|---------------------------------------|--------------------------------------|
| 1 Turbocharger lubricating oil supply | 2 Turbocharger lubricating oil drain |
|---------------------------------------|--------------------------------------|

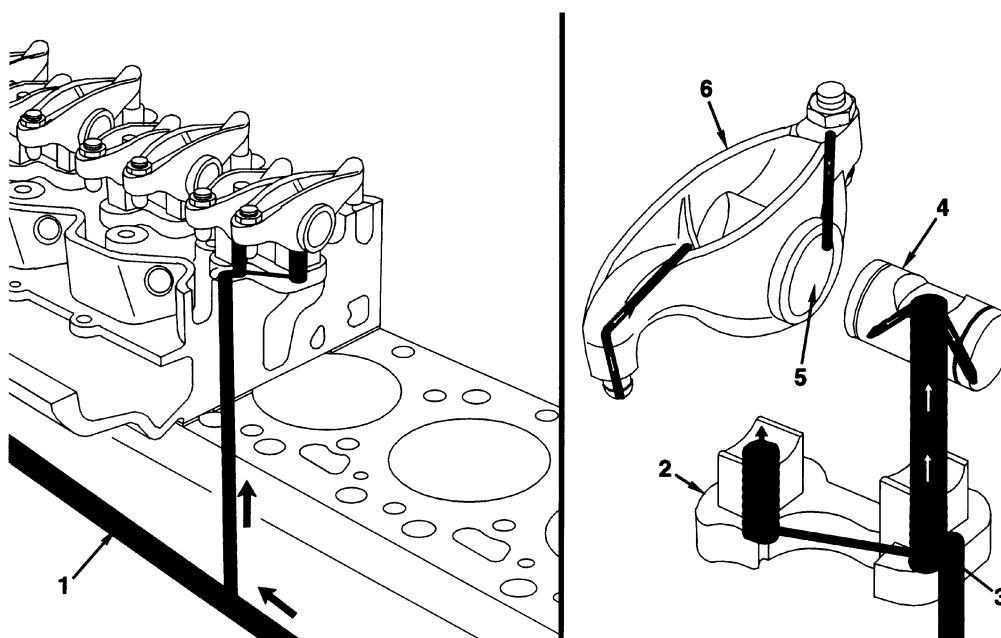
## (2) Lubrication for the power components



7607AEG05

- |   |                                 |    |   |
|---|---------------------------------|----|---|
| 1 | From lubricating oil cooler     | 6  | To camshaft                               |
| 2 | Main lubricating oil rifle      | 7  | Crankshaft main journal                   |
| 3 | To valve train                  | 8  | Oil supply to rod bearings                |
| 4 | From main lubricating oil rifle | 9  | Directed piston-cooling nozzle            |
| 5 | To piston-cooling nozzle        | 10 | To internal lubrication of air compressor |

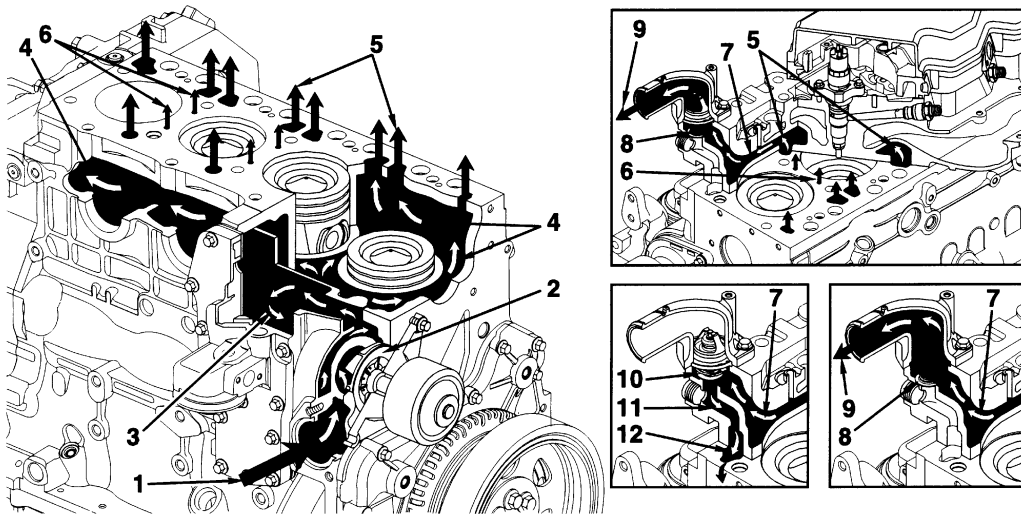
## (3) Lubrication for the overhead



7607AEG06

- |   |                            |   |                    |
|---|----------------------------|---|--------------------|
| 1 | Main lubricating oil rifle | 4 | Rocker lever shaft |
| 2 | Rocker lever support       | 5 | Rocker lever bore  |
| 3 | Transfer slot              | 6 | Rocker lever       |

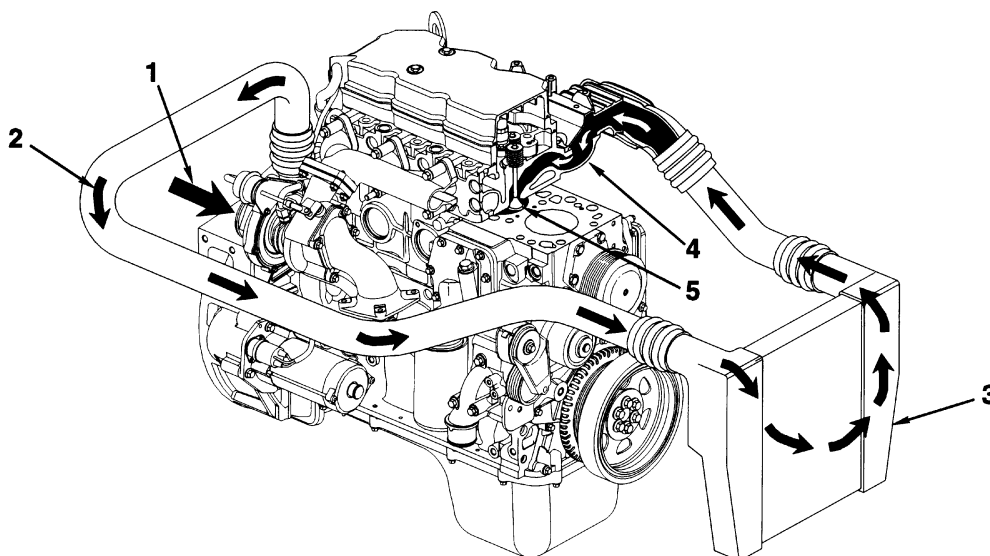
### 3) COOLING SYSTEM



7607AEG07

- |   |                                      |
|---|--------------------------------------|
| 1 Coolant inlet                                     | 7 Coolant flow to thermostat housing |
| 2 Pump Impeller                                     | 8 Coolant bypass passage             |
| 3 Coolant flow past lubricating oil cooler          | 9 Coolant flow back to radiator      |
| 4 Coolant flow past cylinders                       | 10 Bypass closed                     |
| 5 Coolant flow from cylinder block to cylinder head | 11 Coolant bypass in cylinder head   |
| 6 Coolant flow between cylinders                    | 12 Coolant flow to water pump inlet  |

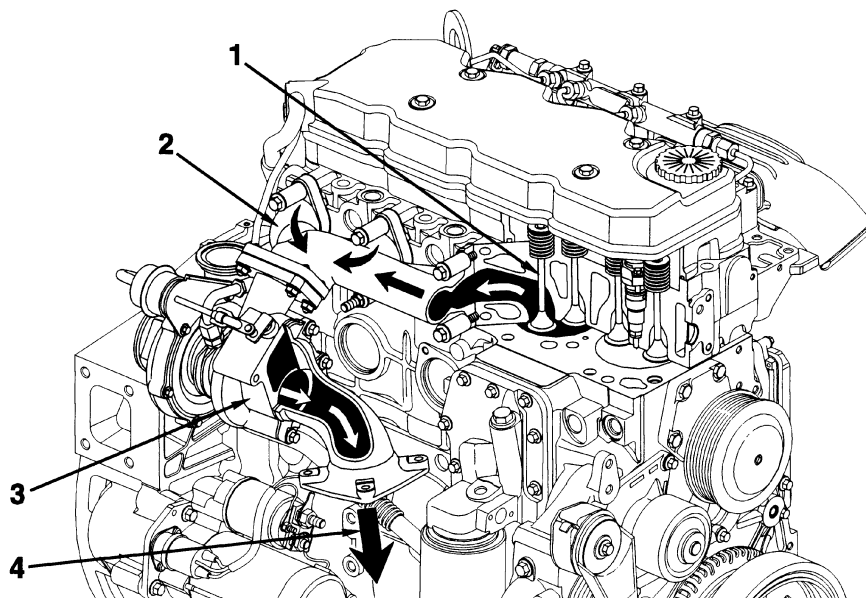
### 4) AIR INTAKE SYSTEM



7607AEG08

- |   |                                  |
|---|----------------------------------|
| 1 Intake air inlet to turbocharger      | 4 Intake manifold                |
| 2 Turbocharger air to charge air cooler | (Integral part of cylinder head) |
| 3 Charge air cooler                     | 5 Intake valve                   |

## 5) EXHAUST SYSTEM



7607AEG09

1 Exhaust valve

2 Exhaust manifold

3 Turbocharger

4 Turbocharger exhaust outlet



## GROUP 2 ENGINE SPEED & STALL RPM

### 1. TEST CONDITION

- 1) Normal temperature of the whole system
  - Coolant : Approx 80°C (176°F)
  - Hydraulic oil : 45 ± 5°C (113 ± 10°F)
  - Transmission oil : 75 ± 5°C (167 ± 10°F)
- 2) Normal operating pressure : See page 6-51.

### 2. SPECIFICATION

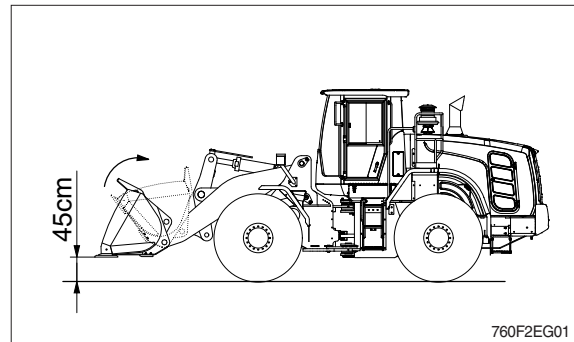
Engine speed, rpm (P mode)						Remark
Low idle	High idle	Pump stall	Converter stall	Full stall	Fan motor	
800 ± 25	2150 ± 50	2150 ± 70	1860 ± 70	1840 ± 100	950 ± 50	

### 3. ENGINE RPM CHECK

Remark : If the checked data is not normal, it indicates that the related system is not working properly. Therefore, it is required to check the related system pressure : See page 6-49.

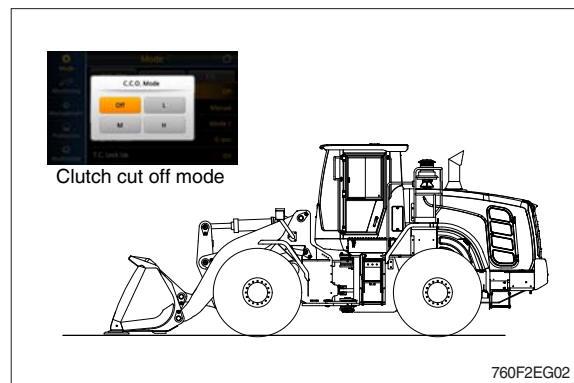
#### 1) Pump stall rpm

- Start the engine and raise the bucket approx 45 cm (1.5 ft) as the figure.
- Press the accelerator pedal fully and operate the bucket control lever to the retract position fully.
- Check the engine rpm at the above condition.



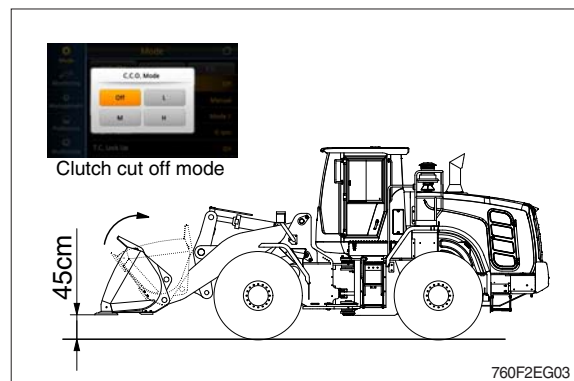
#### 2) Converter stall rpm

- Start the engine and lower the bucket on the ground as the figure.
- Set the clutch cut off mode at the OFF position.
- Press the brake pedal and accelerator pedal fully.
- Shift the transmission lever to the 4th forward position.
- Check the engine rpm at the above condition.



#### 3) Full stall rpm

- Start the engine and raise the bucket approx 45 cm (1.5 ft) as the figure.
- Set the clutch cut off mode at the OFF position.
- Press the brake pedal and accelerator pedal fully .
- Shift the transmission lever to the 4th forward position and operate the bucket lever to the retract position fully.
- Check the engine rpm at the above condition.



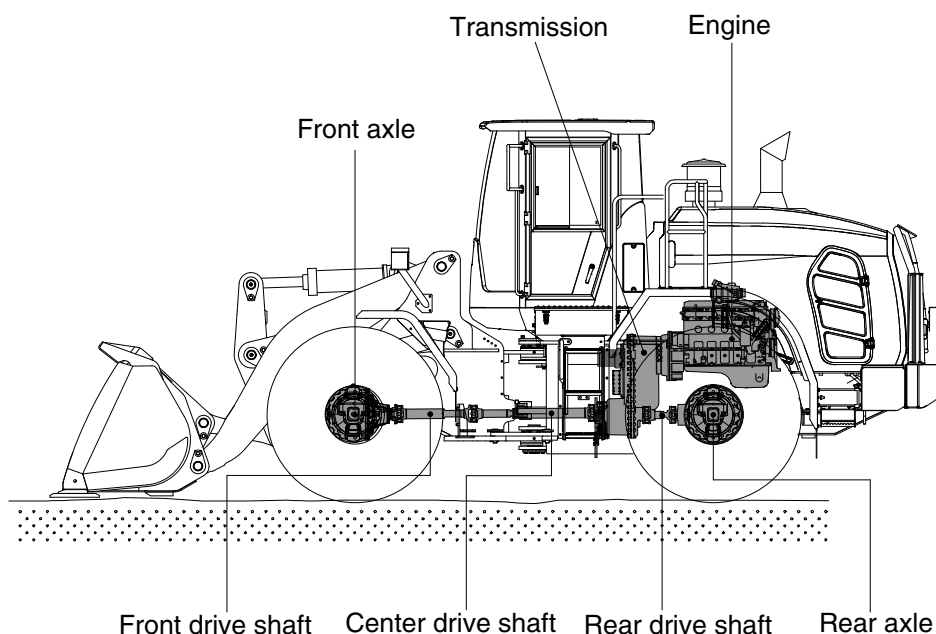
## SECTION 3 POWER TRAIN SYSTEM

Group 1	Structure and Function (fault code) .....	3-1
Group 2	Operational Checks and Troubleshooting .....	3-78
Group 3	Test and Adjustments .....	3-90
Group 4	Disassembly and Assembly .....	3-92

## SECTION 3 POWER TRAIN SYSTEM

### GROUP 1 STRUCTURE AND FUNCTION

#### 1. POWER TRAIN COMPONENT OVERVIEW



960A3PT01

The power train consists of the following components:

- Transmission
- Front, center and rear drive shafts
- Front and rear axles

Engine power is transmitted to the transmission through the torque converter.

The transmission is a hydraulically engaged four speed forward, three speed reverse countershaft type power shift transmission. A calliper-disc type parking brake is located on the transmission.

The transmission outputs through universal joints to three drive shaft assemblies. The front drive shaft is a telescoping shaft which drives the front axle. The front axle is mounted directly to the loader frame.

The front axle is equipped with limited slip differential as standard (option : Hyd lock differential).

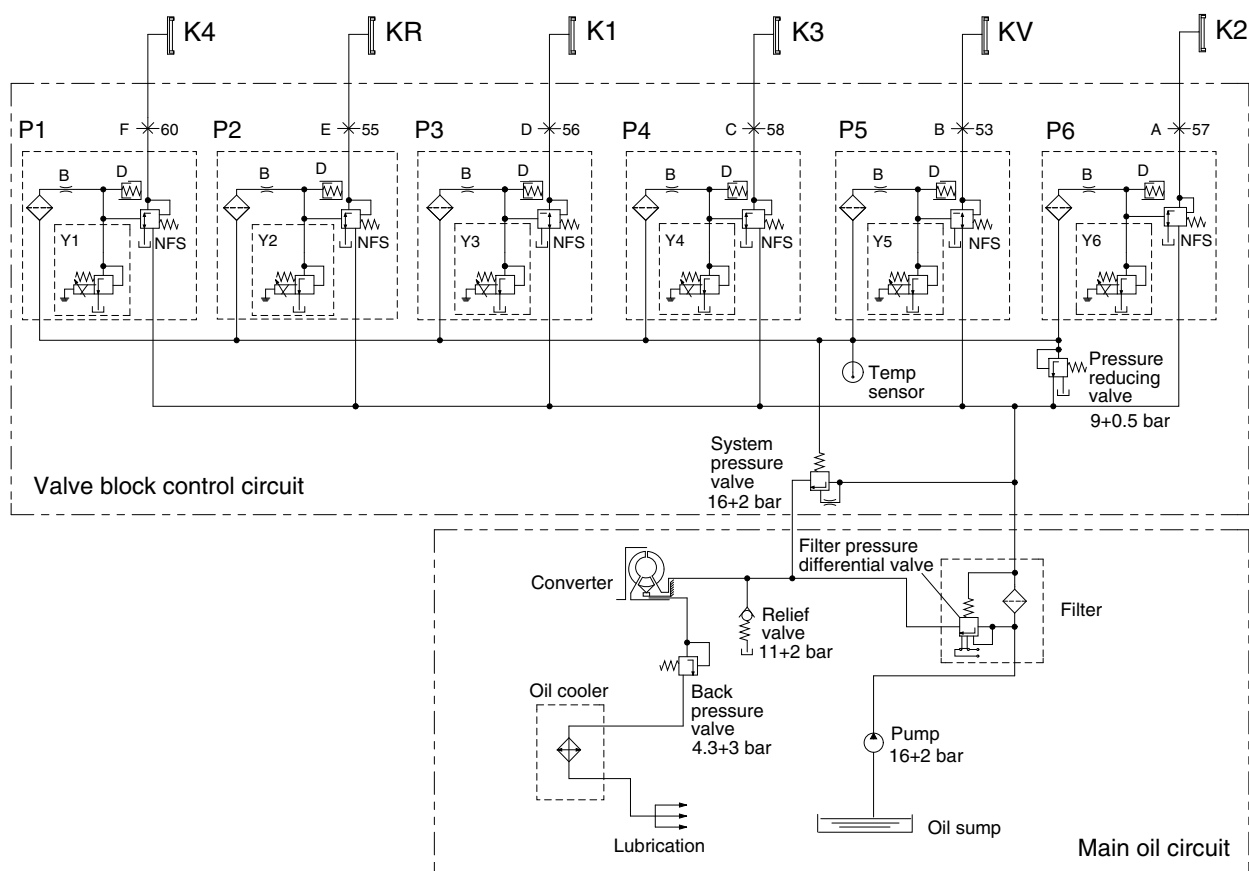
The rear axle is equipped with limited slip differential as standard (option : conventional differential)

The rear axle is mounted on an oscillating pivot.

The power transmitted to front axle and rear axle is reduced by the pinion gear and ring gear of differential. It then passes from the differential to the sun gear shaft (axle shaft) of final drive.

The power of the sun gear is reduced by a planetary mechanism and is transmitted through the planetary hub to the wheel.

## HYDRAULIC CIRCUIT



7607APT18-1

NFS Follow-on slide  
 D Vibration damper  
 B Orifice  
 P1 Proportional valve clutch K4  
 P2 Proportional valve clutch KR

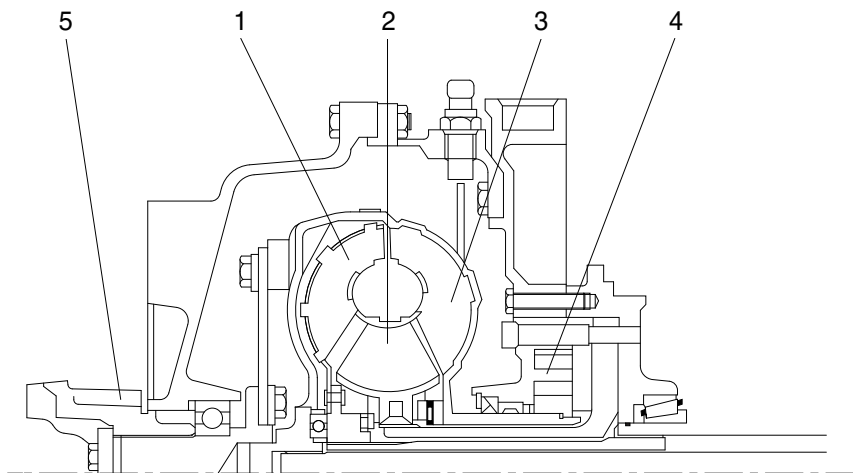
P3 Proportional valve clutch K1  
 P4 Proportional valve clutch K3  
 P5 Proportional valve clutch KV  
 P6 Proportional valve clutch K2  
 Y1~Y6 Pressure regulator

Speed	Forward				Reverse			Neutral	Engaged clutch	Positions on the valve block	Current No. of the measuring points
	1	2	3	4	1	2	3				
Y1				X					K4	F	60
Y2					X	X	X		KR	E	55
Y3	X				X				K1	D	56
Y4			X	X			X		K3	C	58
Y5	X	X	X						KV	B	53
Y6		X				X			K2	A	57
Engaged clutch	K1,KV	KV,K2	K3,KV	K4,K3	KR,K1	KR,K2	KR, K3		-	-	-

X : Pressure regulator under voltage

## 2. TORQUE CONVERTER

### 1) FUNCTION



73033TM00

- |   |         |   |                   |   |              |
|---|---------|---|-------------------|---|--------------|
| 1 | Turbine | 3 | Pump              | 5 | Input flange |
| 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 is designed according to the engine power so that the most favorable operating conditions are obtained for each installation case.

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 from the transmission pump is constantly streaming 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 via the escaping oil.

The oil which is streaming out of the pump wheel, enters the turbine wheel and is there inversed in the direction of flow.

According to the rate of reversion, the turbine wheel and with it also the output shaft is receiving a more or less high reaction torque. The stator (reaction member), following the turbine, has the task to reverse the oil streaming out of the turbine once more and to deliver it under the suitable discharge direction to the pump wheel.

Due to the reversion, the stator receiving a reaction torque.

The relation turbine torque/pump torque is called torque multiplication. This is the higher, the greater the speed difference of pump wheel and turbine wheel will be.

Therefore, the maximum torque multiplication is created at stationary turbine wheel.

With increasing output speed, the torque multiplication is decreasing. The adaption of the output speed to a certain required output torque will be infinitely variable and automatically achieved by the torque converter.

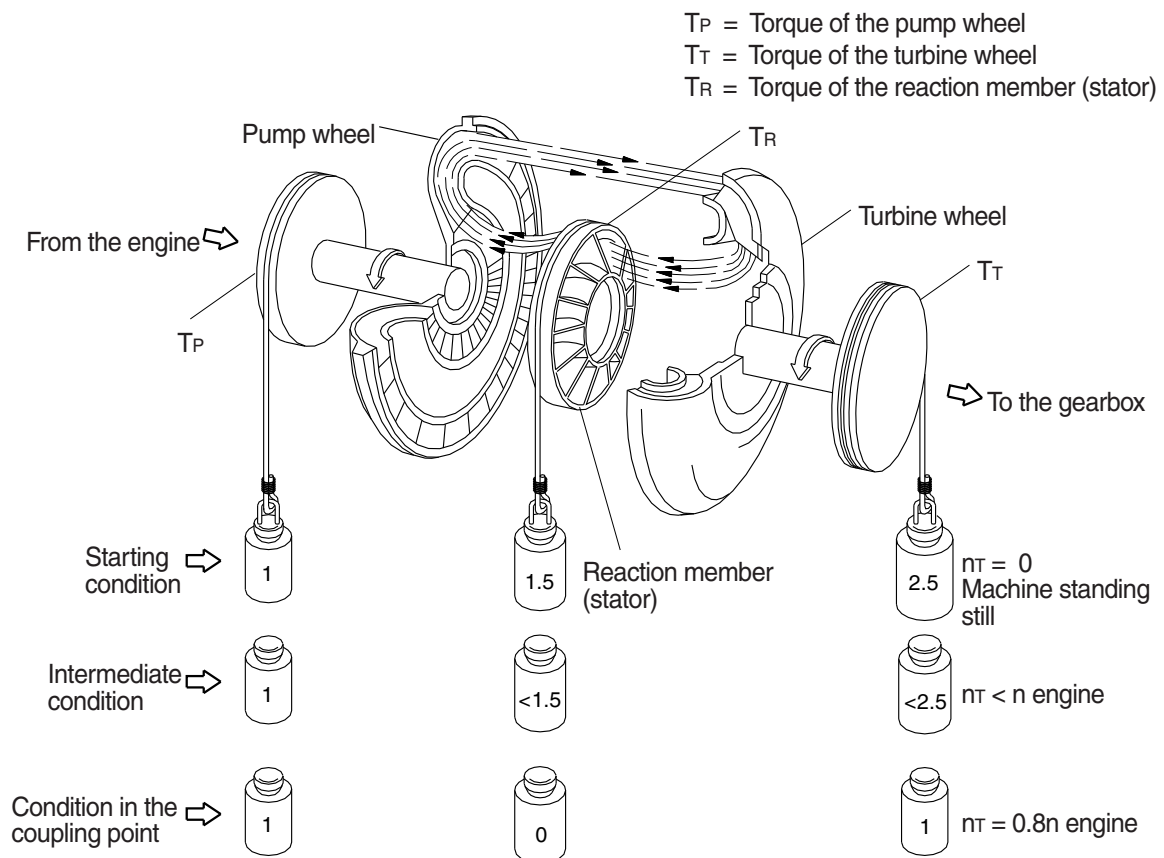
When the turbine speed is reaching about 80% of the pump speed, the torque multiplication becomes 1.0 i.e. the turbine torque becomes equal to that of the pump torque.

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, in the torque multiplication range it is backing-up the torque upon the housing, and is released in the clutch range.

In this way, the stator can rotate freely.

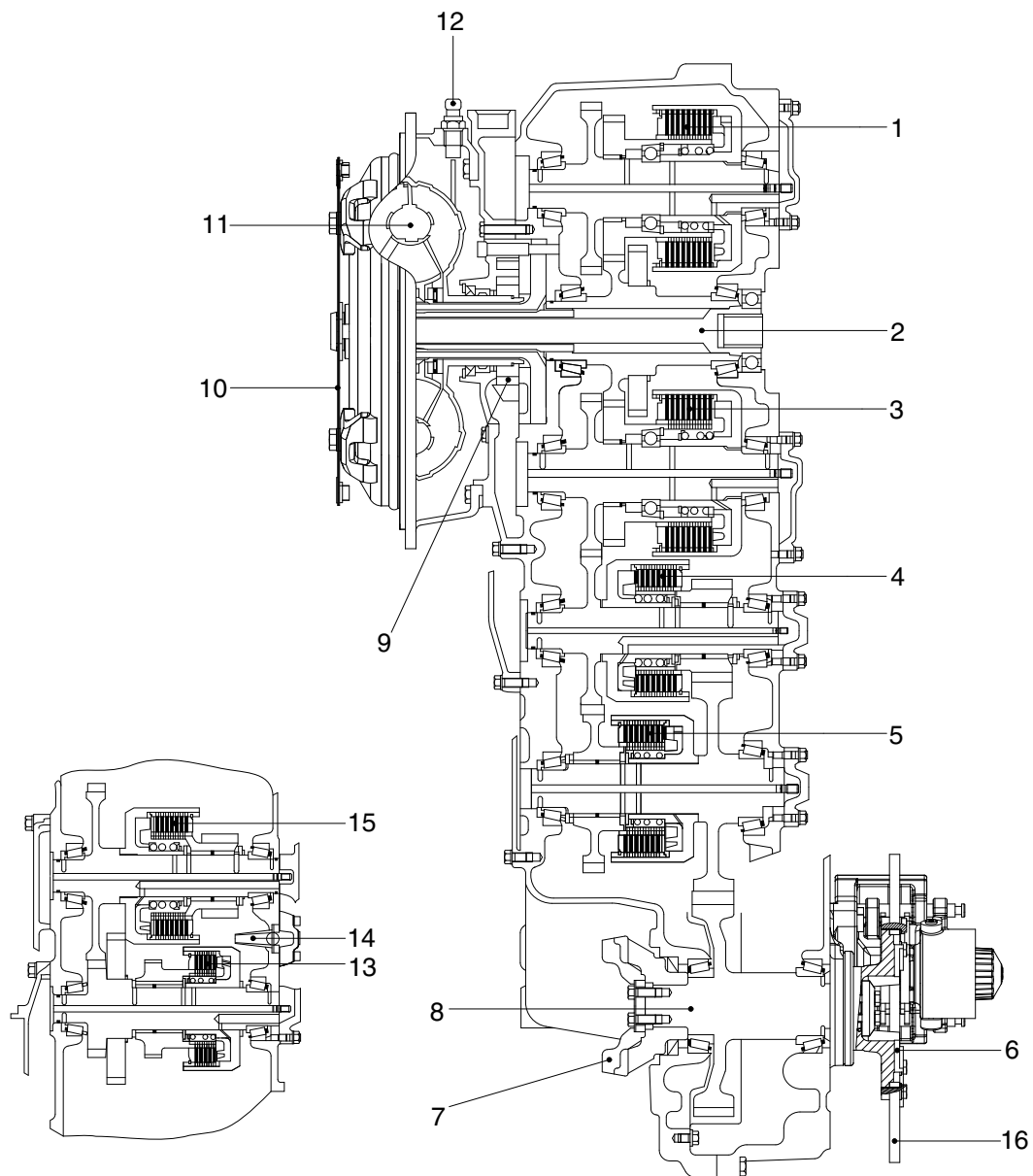
Function of a hydrodynamic torque converter (schematic view)



7577APT100

### 3. TRANSMISSION

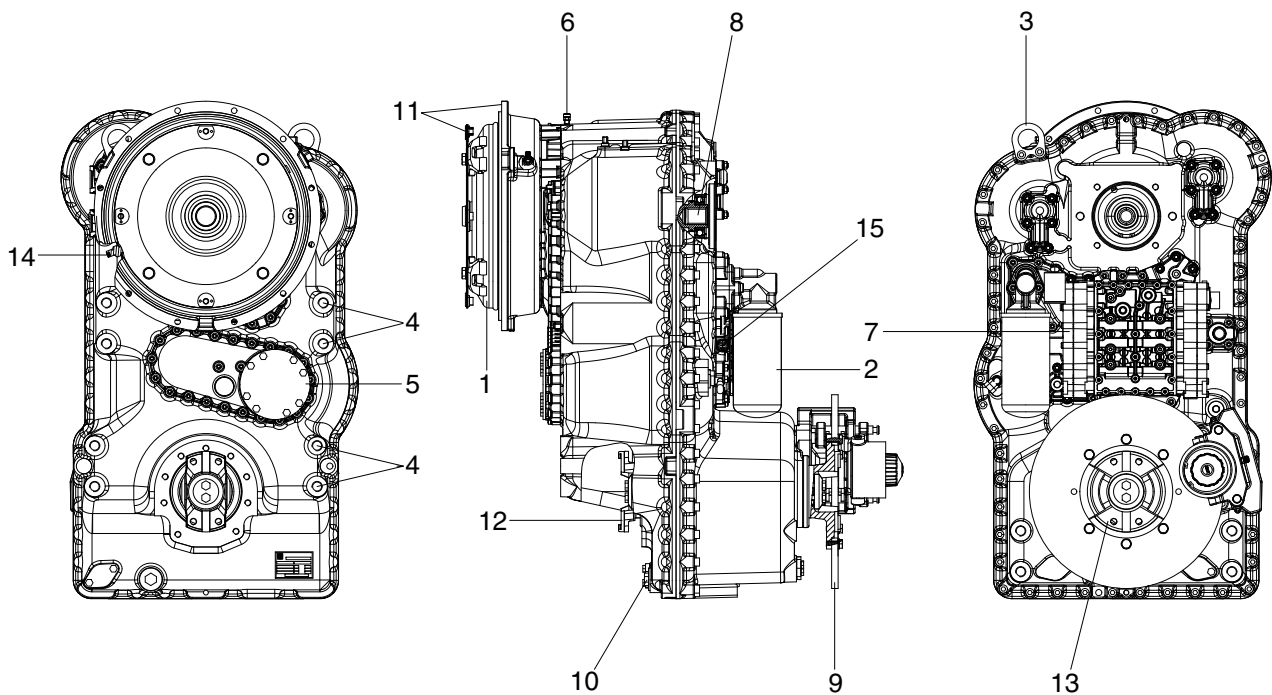
#### 1) LAYOUT



7577APT03

- |                                   |                                |   |
|-----------------------------------|--------------------------------|---|
| 1 Reverse clutch (KR)             | 7 Converter side output flange | 12 Inductive transmitter for engine speed |
| 2 Engine-dependent power take-off | 8 Output shaft                 | 13 4th clutch (K4)                        |
| 3 Forward clutch (KV)             | 9 Transmission pump            | 14 Converter relief valve                 |
| 4 2nd clutch (K2)                 | 10 Connection to engine        | 15 1st clutch (K1)                        |
| 5 3rd clutch (K3)                 | 11 Converter                   | 16 Parking brake                          |
| 6 Rear output flange              |                                |   |

## 2) INSTALLATION VIEW



955SA3PT02

- |   |  |    |   |
|---|--|----|---|
| 1 | Converter                                    | 9  | Parking brake   |
| 2 | Full flow filter                             | 10 | Oil drain plug  |
| 3 | Transportation eye                           | 11 | Connection to engine                                    |
| 4 | Gearbox mounting pads                        | 12 | Output flange-Converter side                            |
| 5 | Mounting possibility emergency steering pump | 13 | Output flange-Rear side                                 |
| 6 | Breather                                     | 14 | Temperature switch for oil temperature behind converter |
| 7 | Electrical hydraulic transmission control    | 15 | Difference pressure switch for pressure filter          |
| 8 | Power take-off; Coaxial; Engine dependent    |    |   |



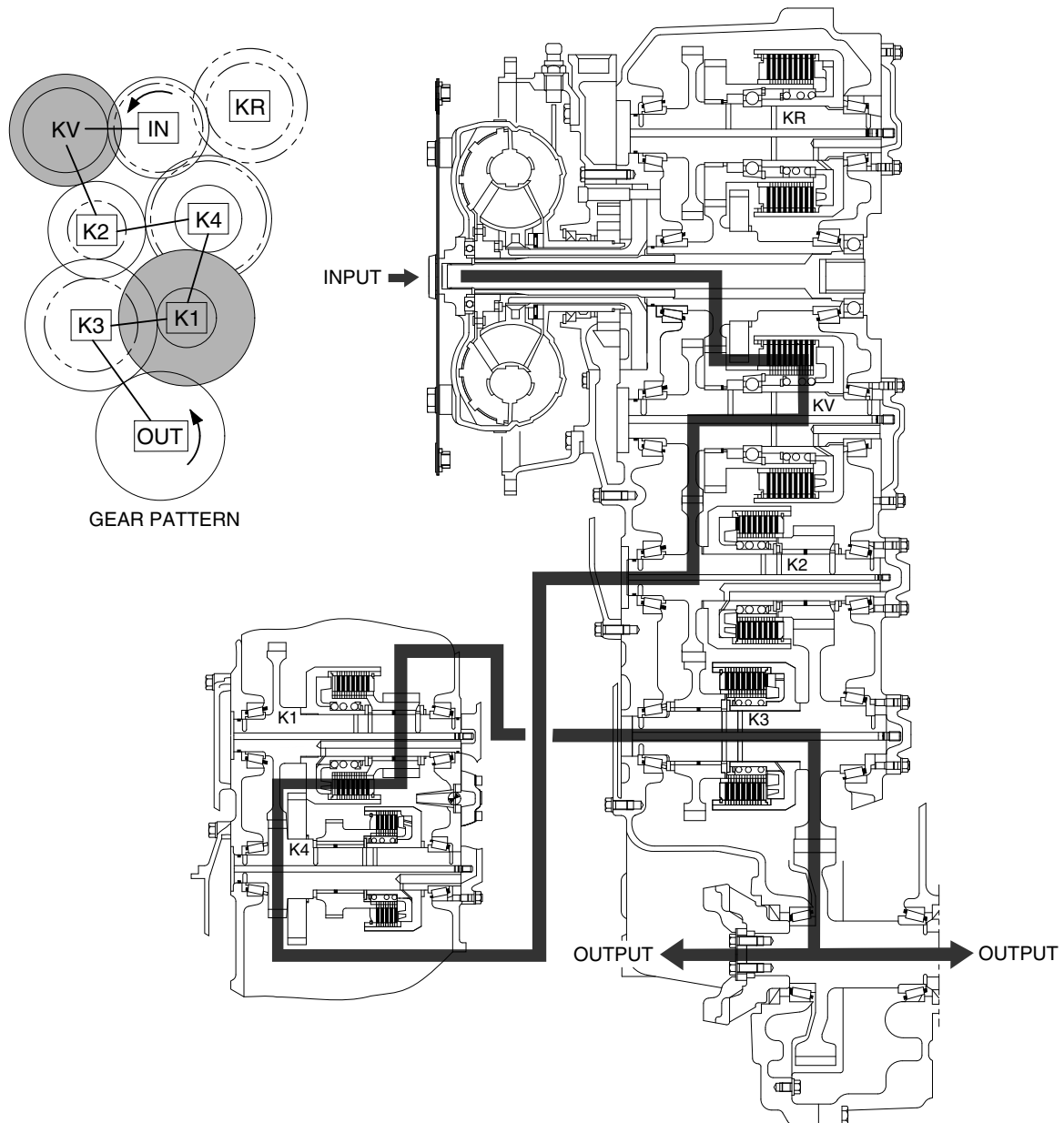
### 3) OPERATION OF TRANSMISSION

#### (1) Forward

##### ① Forward 1st

In 1st forward, forward clutch (KV) and 1st clutch (K1) are engaged.

Forward clutch and 1st clutch are actuated by the hydraulic pressure applied to the clutch piston.

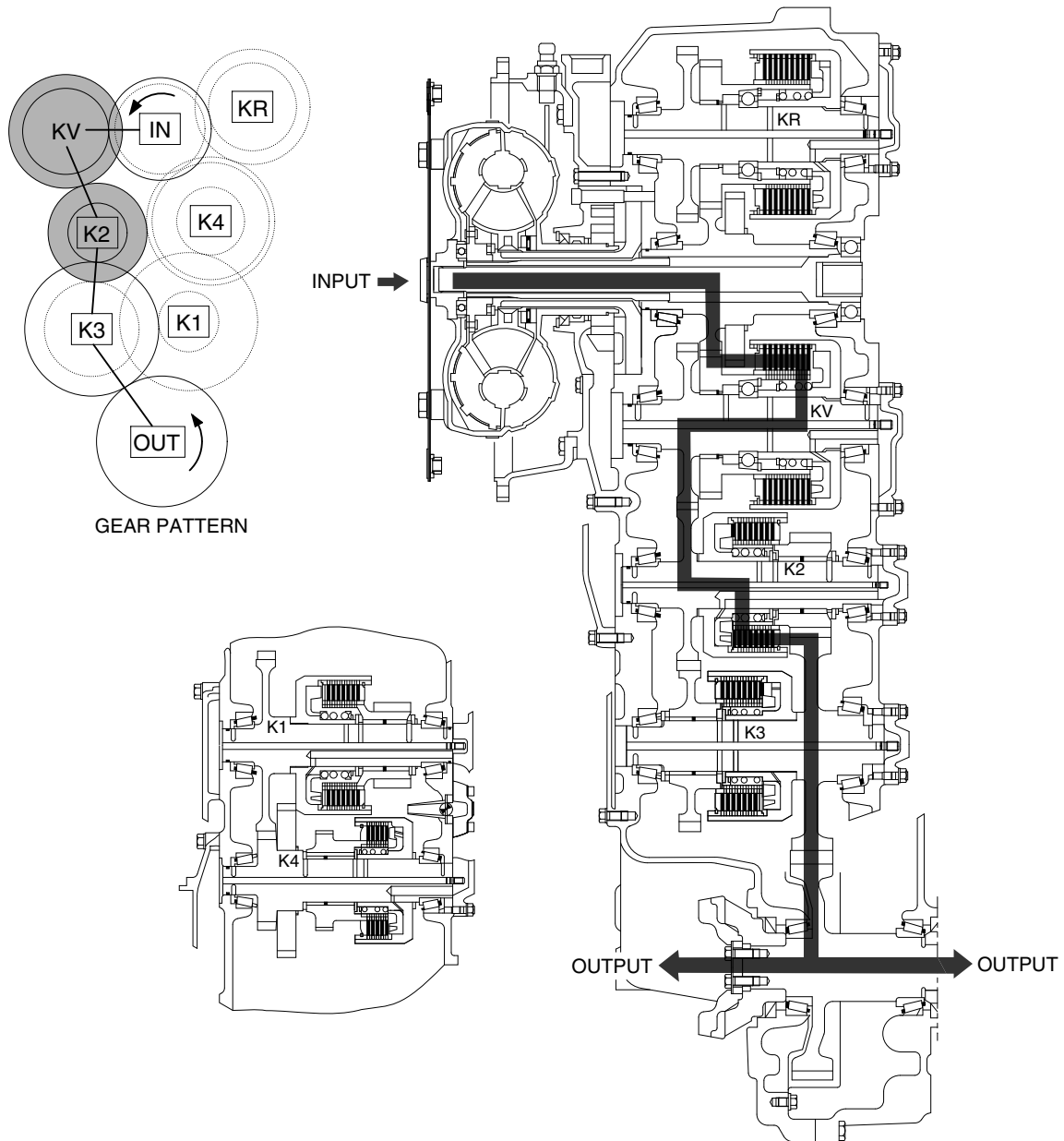


7577APT04 F1

## ② Forward 2nd

In 2nd forward, forward clutch (KV) and 2nd clutch (K2) are engaged.

Forward clutch and 2nd clutch are actuated by the hydraulic pressure applied to the clutch piston.

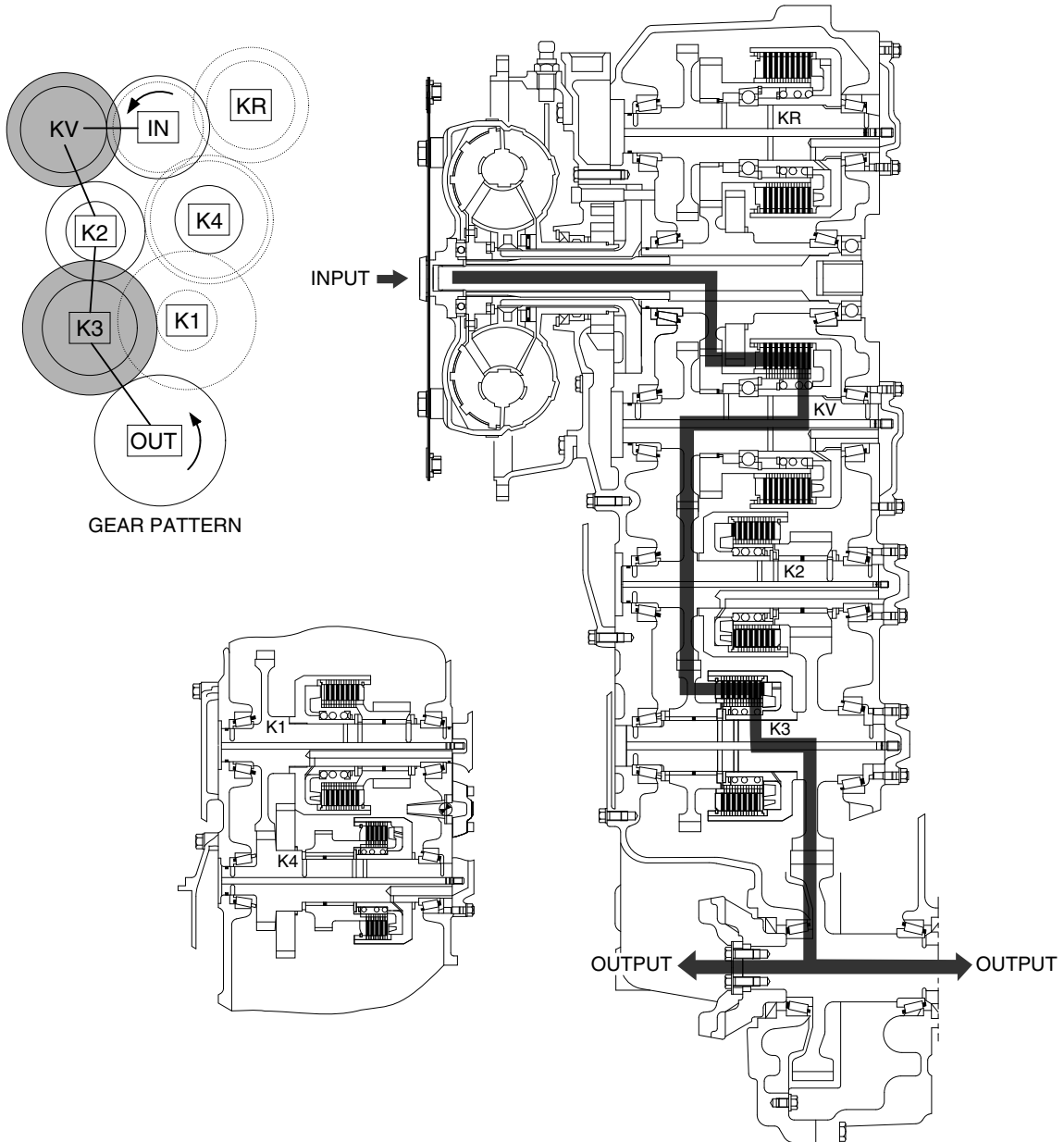


7577APT05 F2

### ③ Forward 3rd

In 3rd forward, forward clutch (KV) and 3rd clutch (K3) are engaged.

Forward clutch and 3rd clutch are actuated by the hydraulic pressure applied to the clutch piston.

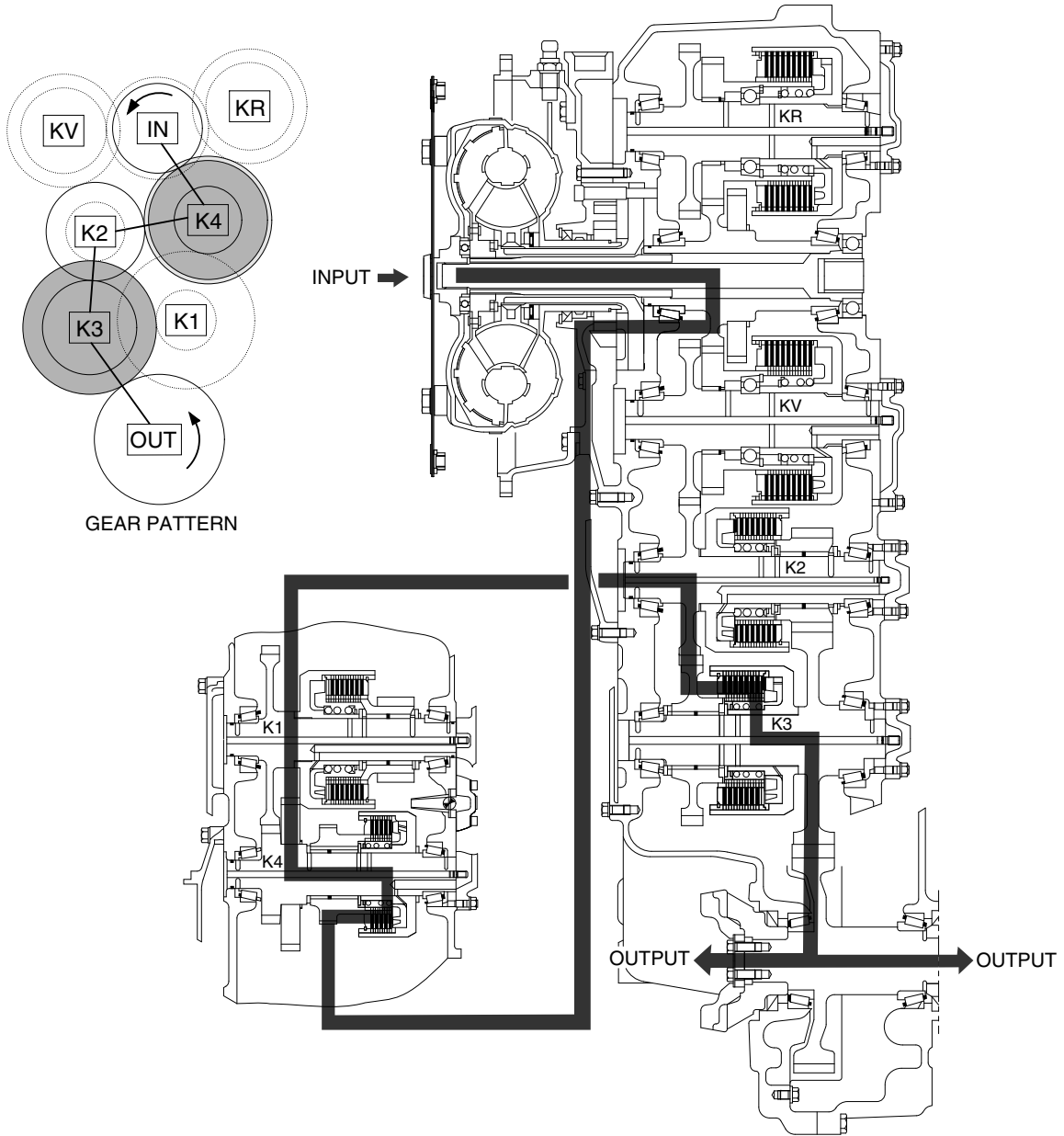


7577APT06 F3

#### ④ Forward 4th

In 4th forward, 4th clutch (K4) and 3rd clutch (K3) are engaged.

4th clutch and 3rd clutch are actuated by the hydraulic pressure applied to the clutch piston.



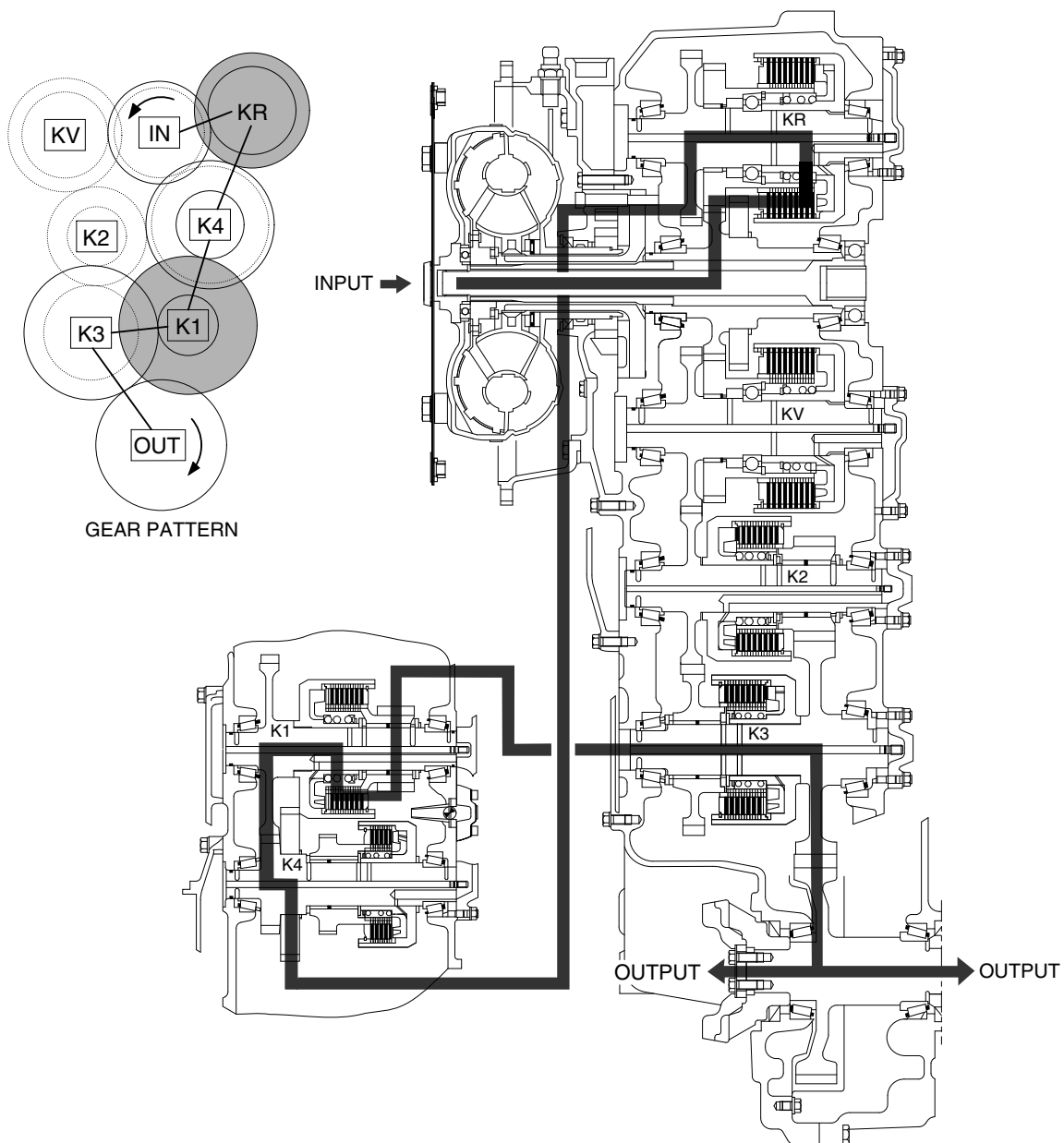
7577APT07 F4

## (2) Reverse

### ① Reverse 1st

In 1st reverse, reverse clutch (KR) and 1st clutch (K1) are engaged.

Reverse clutch and 1st clutch are actuated by the hydraulic pressure applied to the clutch piston.

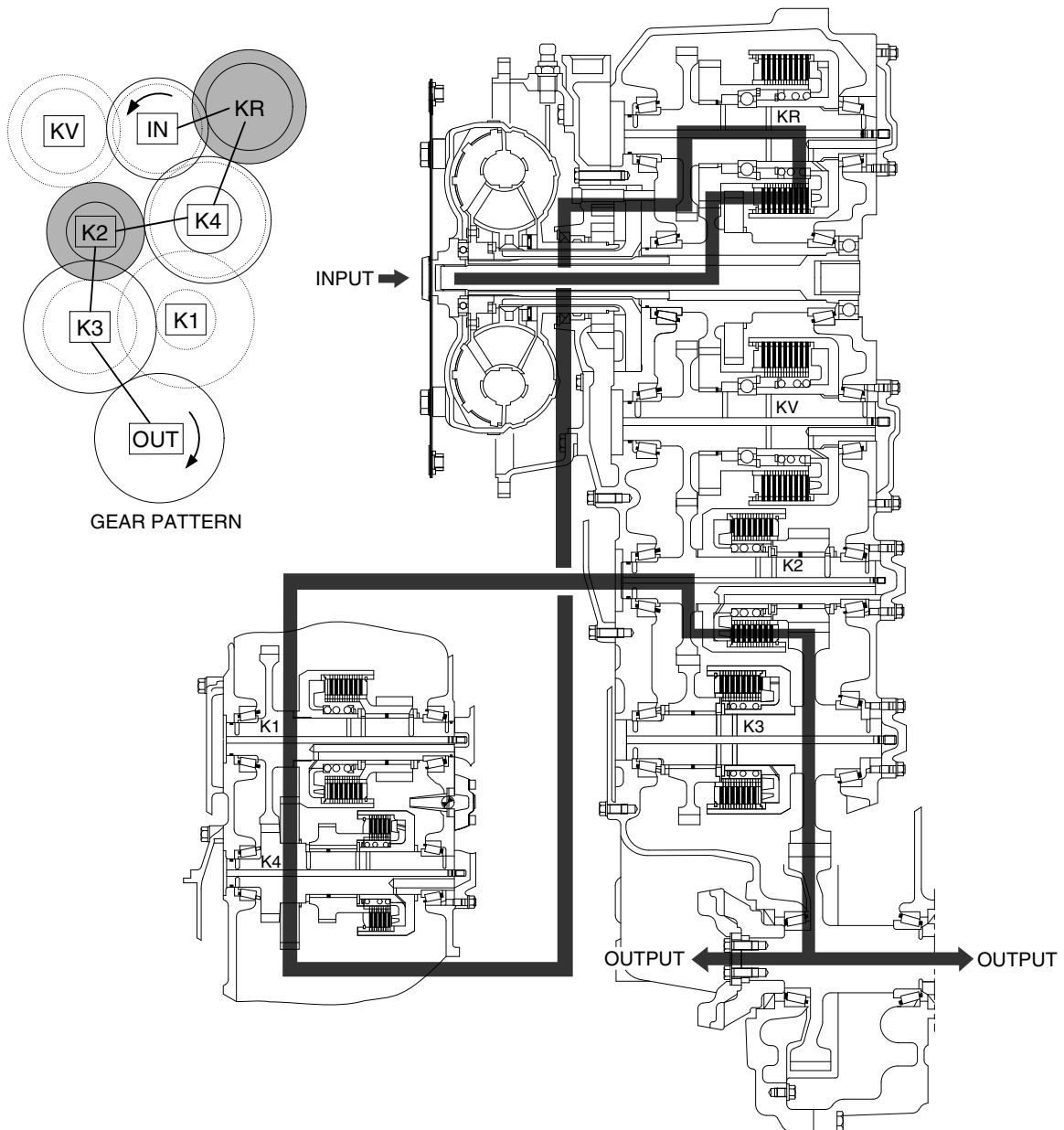


7577APT08 R1

## ② Reverse 2nd

In 2nd reverse, reverse clutch (KR) and 2nd clutch (K2) are engaged.

Reverse clutch and 2nd clutch are actuated by the hydraulic pressure applied to the clutch piston.

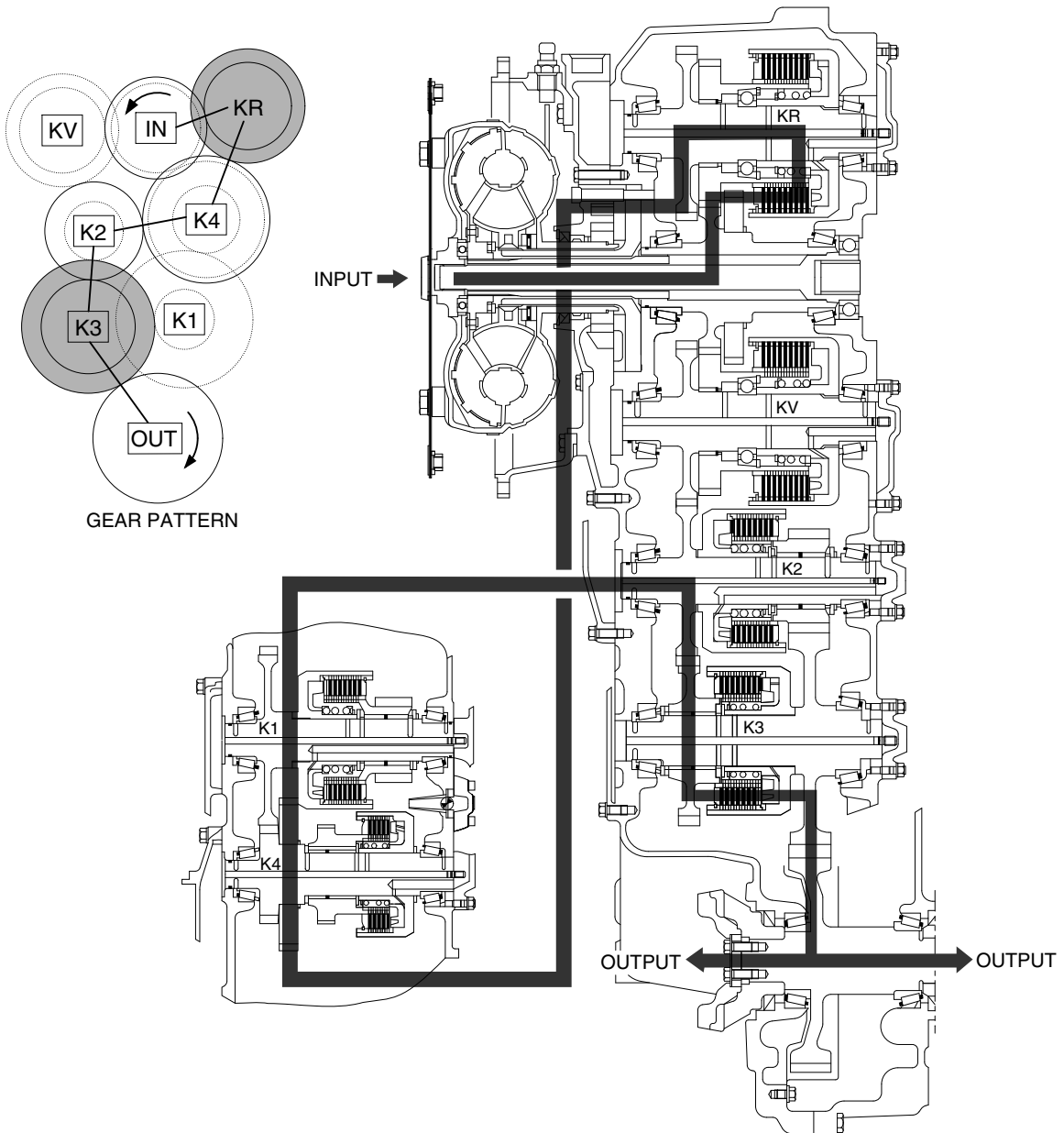


7577APT09 R2

### ③ Reverse 3rd

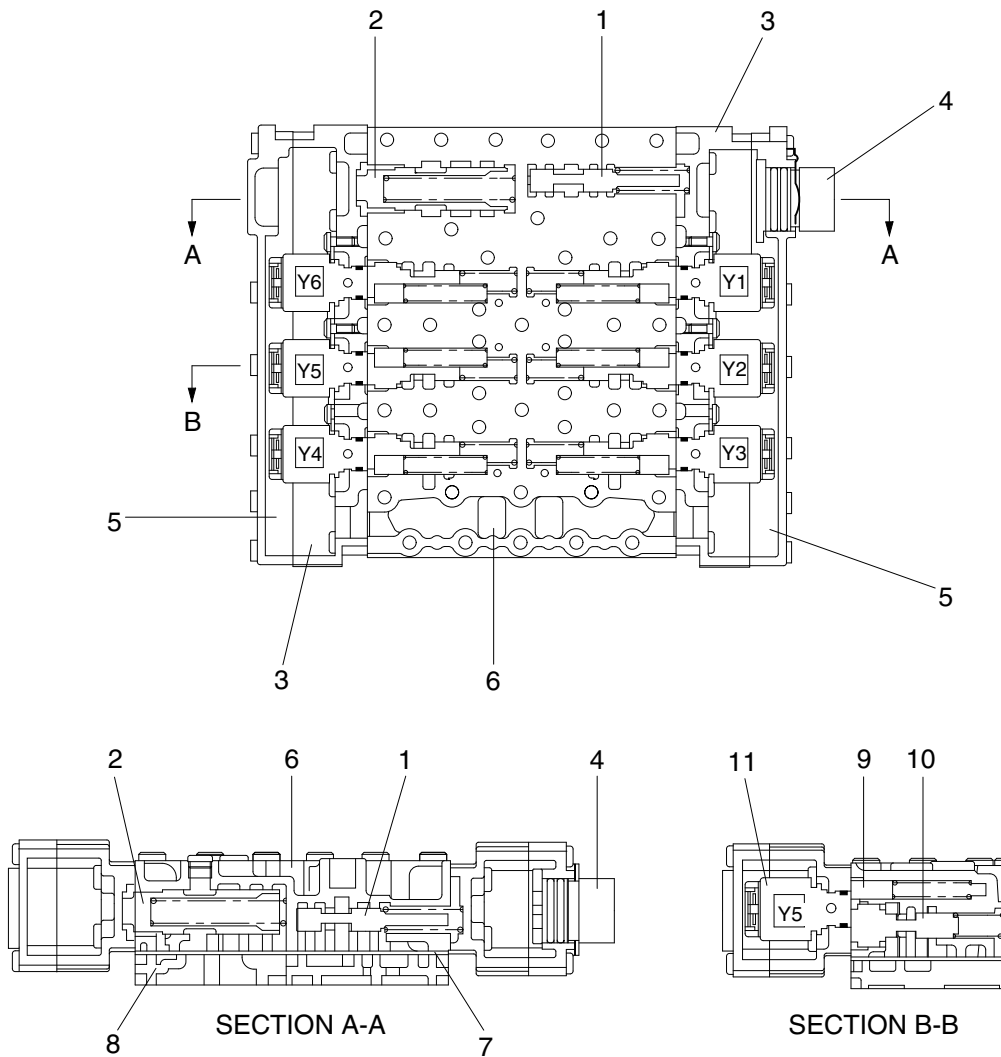
In 3rd reverse, reverse clutch (KR) and 3rd clutch (K3) are engaged.

Reverse clutch and 3rd clutch are actuated by the hydraulic pressure applied to the clutch piston.



7577APT10 R3

#### 4) ELECTRO-HYDRAULIC SHIFT CONTROL WITH PROPORTIONAL VALVE



73033CV01

- |                                       |                       |
|---------------------------------------|-----------------------|
| 1 Pressure reducing valve (9+0.5 bar) | 7 Intermediate sheet  |
| 2 System pressure valve (16+2 bar)    | 8 Duct plate          |
| 3 Housing                             | 9 Oscillation damper  |
| 4 Cable harness                       | 10 Follow-on slide    |
| 5 Cover                               | 11 Pressure regulator |
| 6 Valve block                         |                       |

Transmission control, see schedule of hydraulic circuit, electro-hydraulic control unit and measuring points at page 3-2, 3-14 and 3-90.

The six clutches of the transmission are selected via the 6 proportional valves P1 to P6. The proportional valve (pressure regulator unit) is composed of pressure regulator (e.g. Y1), follow-on slide and vibration damper.

The control pressure of 9 bar for the actuation of the follow-on slides is created by the pressure reducing valve. The pressure oil (16+2 bar) 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 pressures 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 are 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 maximum control pressure to 16+2 bar and releases the main stream to the converter and lubricating circuit.

In the inlet to the converter, a converter safety valve is installed which protects the converter from high internal pressures (opening pressure 11+2 bar).

Within the converter, the oil serves to transmit the power according to the well-known hydrodynamic principle (see torque converter, page 3-3).

To avoid cavitation, the converter must be always completely filled with oil.

This is achieved by a converter back pressure back-up valve, rear-mounted to the converter, with an opening pressure of at least 4.3bar.

The oil, escaping out of the converter, is directed to a oil cooler.

The oil is directed from the oil cooler to the transmission and from there to the lubricating oil circuit, so that all lubricating points are supplied with cooled oil.

In the electro-hydraulic control unit are 6 pressure regulators installed.

## 5) GEAR SELECTOR (DW-3)

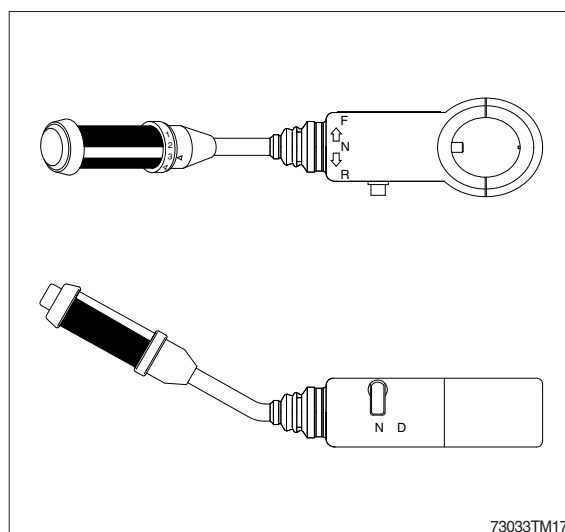
The gear selector is designed for the mounting on the left side of the steering column. The positions (speeds) 1 to 4 are selected by a rotary motion, the driving direction Forward (F)-Neutral (N)-Reverse (R) by tilting the gear selector lever.

The gear selector is also available with integrated kickdown push button.

For the protection from unintended start off, a neutral interlock is installed.

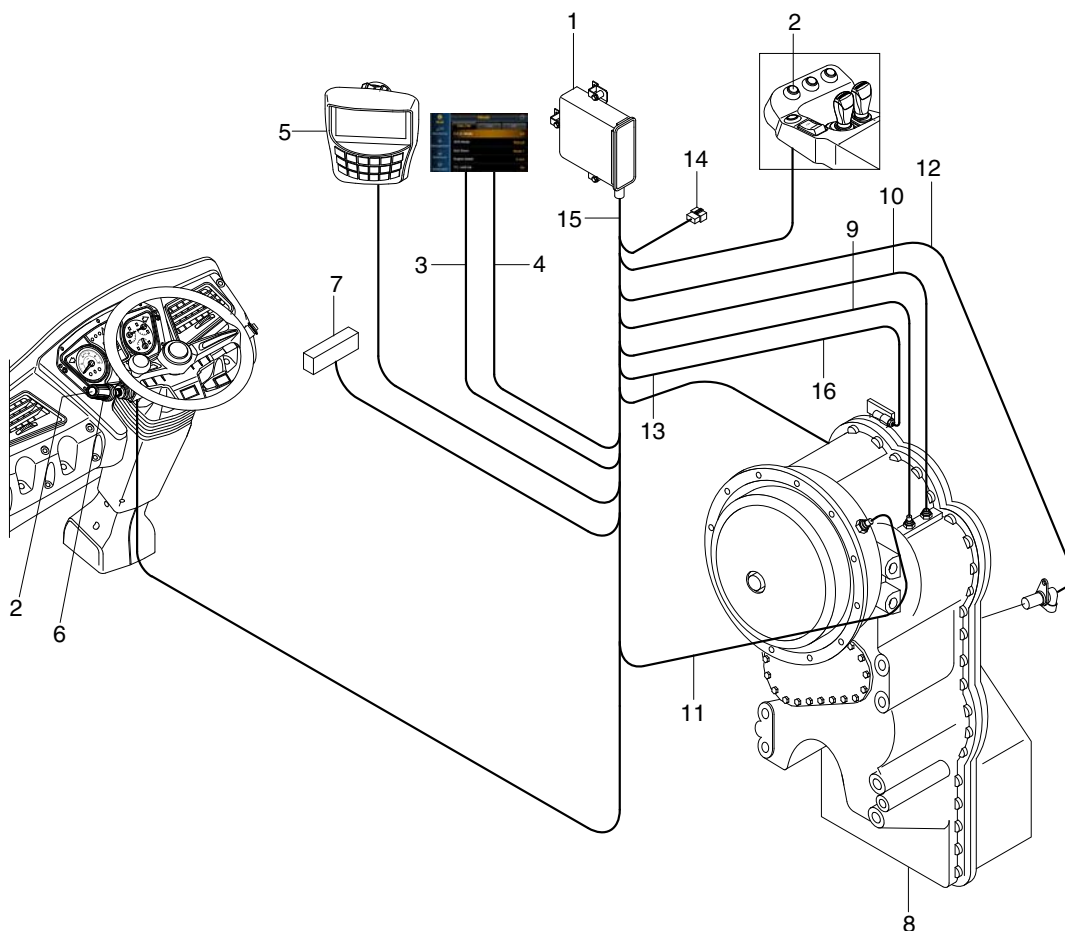
Position N - Gear selector lever blocked in this position.

Position D - Driving.



## 6) ELECTRIC CONTROL UNIT

### (1) Complete system



760F3PT37

- 1 Transmission control unit (EST-37A)
- 2 Kickdown switch
- 3 Clutch cut off mode
- 4 Transmission shift mode
- 5 Monitor
- 6 Gear selector (DW-3) with integrated kickdown switch
- 7 Power supply connection
- 8 Transmission
- 9 Cable to inductive transmitter - speed central gear train
- 10 Cable to inductive transmitter - speed turbine
- 11 Cable to inductive transmitter - speed engine
- 12 Cable to speed sensor output and speedometer
- 13 Cable to plug connection on the electro - hydraulic control unit
- 14 CAN-Connection
- 15 Wiring
- 16 Cable to lock-up clutch valve (not used)

### (2) Description of the basic functions

The powershift transmissions is equipped is electronic transmission control unit (EST-37A), developed for it.

The system is processing the desire of the driver according to the following criteria.

- Gear determination depending on controller position, driving speed and load condition.

- Protection from operating errors as far as necessary, is possible via electronic protection (programming).
- Protection from over-speeds (On the basis of engine and turbine speed).
- Automatic reversing (Driving speed-dependent).
- Pressure cut-off possible (disconnecting of the drive train for maximum power on the power take-off).
- Change-over possibility for Auto-/Manual mode.
- Kick down functions possible.

### **(3) Driving and shifting**

#### **- Neutral position :**

Neutral position will be selected via the controller.

After the ignition is switched on, the electronics remains in the waiting state. By the position NEUTRAL of the controller, resp. by pressing the pushbutton NEUTRAL, the EST-37A becomes ready for operation.

Now, a gear can be engaged.

#### **- Starting :**

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

For safety reasons it is to recommend to brake the machine 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 machine 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 machine can still accelerate by it.

#### **- Downshifting under load**

Downshifting under load will be 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 machine on a downgrade should not be further increased.

#### **- Downshifting in overrunning condition**

Downshiftings in overrunning mode will be then carried out if the machine should be retarded.

If the machine 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 machine begins to crawl, because the engine is creating at idling speed a slight drag torque via the converter.

It is convenient to brake the machine at every 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 machine speeds (above stepping speed) is not admissible.

Either a suitable gear is to be shifted immediately, or the machine must be stopped at once.

#### **(4) Independent calibration of the shifting elements (AEB)**

The AEB has the task to compensate tolerances (plate clearance and pressure level) which are influencing the filling procedure of the clutches. For each clutch, the correct filling parameters are determined in one test cycle for :

- Period of the quick-filling time
- Level of the filling compensating pressure

The filling parameters are stored, together with the AEB-program and the driving program in the transmission electronics. Because the electronics will be separately supplied, the AEB-cycle must be started only after the installation of both components in the machine, thus ensuring the correct mating (Transmission and electronics).

※ It is imperative, to respect the following test conditions :

- Shifting position neutral
- Engine in idling speed
- Parking brake actuated
- Transmission in operating temperature

※ After a replacement of the transmission, the electrohydraulic control or the TCU in the machine, the AEB-cycle must be as well carried out again.

The AEB-cycle continues for about 3 to 4 minutes. The determined filling parameters are stored in the EEPROM of the electronics. In this way, the error message F6 shown on the display will be cancelled also at non-performed AEB.

#### **(5) Pressure cut-off**

In order to provide the full engine power for the hydraulic system, the control can be enlarged for the function of a pressure cut-off in the 1st and 2nd speed. In this way, the pressure in the powershift clutches will be cut-off, and the torque transmission in the drive train will be eliminated by it. This function will be released at the actuation of a switch, arranged on the brake pedal.

For a soft restart, the pressure will be build-up via a freely programmable characteristic line.

#### 4. FAULT CODE

### 1-1) MACHINE FAULT CODE

DTC		Diagnostic Criteria	Application		
HCESPN	FMI		G	C	S
101	3	10 seconds continuous, Hydraulic Oil Temp. Measurement Voltage > 3.95 V	●		
	4	10 seconds continuous, Hydraulic Oil Temp. Measurement Voltage < 0.3 V	●		
	(Results / Symptoms)				
	1. Monitor – Hydraulic Oil temperature display failure 2. Control Function – No warming up operation, No fuel warmer function operation, High hydraulic oil temperature warning failure  (Checking list) 1. CN-58B (#23) – CD-01 (#2) Checking Open/Short 2. CN-58B (#25) – CD-01 (#1) Checking Open/Short				
202	0	10 seconds continuous, Steering main pump pressure Measurement Voltage > 5.3 V	●		
	4	10 seconds continuous, Steering main pump pressure Measurement Voltage < 0.3 V	●		
	(Results / Symptoms)				
	1. Monitor – Steering main pump press. Display failure 2. Control Function – No automatic Emergency steering operation, ECO gauge display failure 3. RMS – Working hours accumulation failure  (Checking list) 1. CN-58B (#35) – CD-39 (B) Checking Open/Short 2. CN-58A (#11) – CD-39 (A) Checking Open/Short 3. CN-58B (#25) – CD-39 (C) Checking Open/Short				
204	0	10 seconds continuous, Boom cylinder ‘head’ pressure Measurement Voltage > 5.3 V	●		
	4	10 seconds continuous, Boom cylinder ‘head’ pressure Measurement Voltage < 0.3 V	●		
	(Results / Symptoms)				
	1. Monitor – Boom cylinder ‘head’ press. display failure 2. Control Function – No Boom pressure calibration function operation, workload measurement sys. operation failure  (Checking list) 1. CN-58B (#29) – CD-80 (B) Checking Open/Short 2. CN-58A (#11) – CD-80 (A) Checking Open/Short 3. CN-58B (#25) – CD-80 (C) Checking Open/Short				

G : General      C : Cummins Engine application equipment      S : Scania Engine application equipment

DTC		Diagnostic Criteria	Application		
HCESPN	FMI		G	C	S
205	0	10 seconds continuous, Boom cylinder 'rod' pressure Measurement Voltage > 5.3V	●		
	4	10 seconds continuous, Boom cylinder 'rod' pressure Measurement Voltage < 0.3V	●		
	(Results / Symptoms) 1. Monitor – Boom cylinder 'rod' press. display failure 2. Control Function – No Boom pressure calibration function operation, workload measurement sys. operation failure  (Checking list) 1. CN-58B(#36) – CD-81(B) Checking Open/Short 2. CN-58A(#11) – CD-81(A) Checking Open/Short 3. CN-58B(#25) – CD-81(C) Checking Open/Short				
301	3	10 seconds continuous, Fuel level Measurement Voltage > 3.8V	●		
	4	10 seconds continuous, Fuel level Measurement Voltage < 0.3V	●		
	(Results / Symptoms) 1. Monitor – Fuel level display failure 2. Control Function – Fuel level low warning operation failure  (Checking list) 1. CN-58B (#22) – CD-02 (#2) Checking Open/Short 2. CN-58B (#25) – CD-02 (#1) Checking Open/Short				
318	8	(In the startup conditions) 30 seconds continuous, Fan speed < 10 rpm in the Remote cooling fan EPPR current reference value is in X Ma(differ by model)	●		
	(Results / Symptoms) 1. Monitor – Cooling Fan revolutions display failure  (Checking list) 1. CN-58A (#15) – CD-73 (#1) Checking Open/Short 2. CN-58A (#18) – CD-73 (#2) Checking Open/Short				
339	3	10 seconds continuous, Accel pedal position 1 voltage Measurement Voltage > 5.0 V			●
	4	10 seconds continuous, Accel pedal position 1 voltage Measurement Voltage < 0.2 V			●
	(Results / Symptoms) 1. Monitor – Accel pedal position 1 voltage display failure 2. Control Function – Engine rpm control failure  (Checking list) 1. CN-58B(#39) – CN-162(#2) Checking Open/Short 2. CN-58A(#6) – CN-162(#3) Checking Open/Short 3. CN-58A(#8) – CN-162(#1) Checking Open/Short				

G : General    C : Cummins Engine application equipment    S : Scania Engine application equipment

DTC		Diagnostic Criteria	Application		
HCESPN	FMI		G	C	S
343	3	10 seconds continuous, Accel pedal position 2 voltage Measurement Voltage > 5.0 V			●
	4	10 seconds continuous, Accel pedal position 2 voltage Measurement Voltage < 0.2 V			●
	(Results / Symptoms) 1. Monitor – Accel pedal position 2 voltage display failure 2. Control Function – Engine rpm control failure (Checking list) 1. CN-58B (#40) – CN-162 (#5) Checking Open/Short 2. CN-58A (#7) – CN-162 (#6) Checking Open/Short 3. CN-58A (#9) – CN-162 (#4) Checking Open/Short				
503	0	10 seconds continuous, Brake oil pressure Measurement Voltage > 5.3V	●		
	4	10 seconds continuous, Brake oil pressure Measurement Voltage < 0.3V	●		
	(Results / Symptoms) 1. Monitor – Brake oil press. display failure 2. Control Function – Brake oil pressure low warning display failure (Checking list) 1. CN-58B (#27) – CD-03 (B) Checking Open/Short 2. CN-58A (#11) – CD-03 (A) Checking Open/Short 3. CN-58B (#25) – CD-03 (C) Checking Open/Short				
507	0	10 seconds continuous, Parking oil pressure Measurement Voltage > 5.3V	●		
	4	10 seconds continuous, Parking oil pressure Measurement Voltage < 0.3V	●		
	(Results / Symptoms) 1. Monitor – Parking oil Press. display failure 2. Control Function – No judgment Parking status (Checking list) 1. CN-58B (#34) – CD-26 (B) Checking Open/Short 2. CN-58A (#11) – CD-26 (A) Checking Open/Short 3. CN-58B (#25) – CD-26 (C) Checking Open/Short				
557	0	10 seconds continuous, Brake oil charging priority pressure Measurement Voltage > 5.3V	●		
	4	10 seconds continuous, Brake oil charging priority pressure Measurement Voltage < 0.3V	●		
	(Results / Symptoms) 1. Monitor – Brake oil charging priority press. display failure 2. Control Function – Cooling fan revolutions control failure, Brake oil(Accumulator) charging failure (Checking list) 1. CN-58B (#38) – CD-31 (B) Checking Open/Short 2. CN-58A (#11) – CD-31 (A) Checking Open/Short 3. CN-58B (#25) – CD-31 (C) Checking Open/Short				

G : General    C : Cummins Engine application equipment    S : Scania Engine application equipment

DTC		Diagnostic Criteria	Application		
HCESPN	FMI		G	C	S
705	0	10 seconds continuous, Battery input Voltage > 35V	●		
	1	10 seconds continuous, Battery input Voltage < 18V	●		
		(Results / Symptoms) 1. Control Function – Disabled startup (Checking list) 1. Checking battery voltage 2. CN-58A (#1) – CN-36 (07 fuse) Checking Open/Short 3. CN-58A (#2) – CN-36 (07 fuse) Checking Open/Short			
707	1	(In the 500rpm or more) 10 seconds continuous, Alternator Node I Measurement Voltage < 18V	●		
		(Results / Symptoms) 1. Control Function – Battery charging circuit failure (Checking list) 1. CN-58B (#33) – CN-04 (#18) Checking Open/Short 2. CN-04 (#18) – CN-74 (#2) Checking Open/Short			
728	3	10 seconds continuous, Boom position sensor signal voltage Measurement Voltage > 5.0V	●		
	4	10 seconds continuous, Boom position sensor signal voltage Measurement Voltage < 0.3V	●		
		(Results / Symptoms) 1. Monitor – Boom position sensor signal voltage display failure 2. Control Function – No calibration angle sensor, No calibration boom pressure , Boom Detent operation failure, Soft end stop(Boom) operation failure, Lock-up clutch operation failure (Checking list) 1. CN-58B (#37) – CN-100 (B) Checking Open/Short 2. CN-58A (#5) – CN-100 (C) Checking Open/Short 3. CN-58B (#25) – CN-100 (A) Checking Open/Short			
729	3	10 seconds continuous, Bucket position sensor signal voltage Measurement Voltage > 5.0V	●		
	4	10 seconds continuous, Bucket position sensor signal voltage Measurement Voltage < 0.3V	●		
		(Results /Symptoms) 1. Monitor – Bucket position sensor signal voltage display failure 2. Control Function – No calibration angle sensor, Bucket Detent operation failure, Soft end stop(Bucket) operation failure (Checking list) 1. CN-58B(#30) – CN-101(B) Checking Open/Short 2. CN-58A(#5) – CN-101(C) Checking Open/Short 3. CN-58B(#25) – CN-101(A) Checking Open/Short			

G : General    C : Cummins Engine application equipment    S : Scania Engine application equipment



DTC		Diagnostic Criteria	Application		
HCESPN	FMI		G	C	S
831	2	(When mounting the A/C Controller) 10 seconds continuous, A/C controller Communication Data Error	●		
		(Results / Symptoms) 1. Control Function – A/C Controller malfunction			
841	2	10 seconds continuous, ECM Communication Data Error	●		
		(Results / Symptoms) 1. Control Function – ECM operation failure			
842	2	10 seconds continuous, TCU Communication Data Error	●		
		(Results / Symptoms) 1. Control Function – TCU operation failure			
844	2	10 seconds continuous, Monitor Communication Data Error	●		
		(Results / Symptoms) 1. Control Function – Monitor operation failure			
850	2	(When mounting the RMCU) 90 seconds continuous, RMCU Communication Data Error	●		
		(Results / Symptoms) 1. Control Function – RMCU operation failure			
861	2	(When mounting the EHCU) 10 seconds continuous, EHCU Communication Data Error	●		
		(Results / Symptoms) 1. Control Function – EHCU operation failure			
869	2	(When mounting the BKCU) 10 seconds continuous, BKCU Communication Data Error	●		
		(Results / Symptoms) 1. Control Function – BKCU operation failure			

G : General    C : Cummins Engine application equipment    S : Scania Engine application equipment

## 1-2) EHCU FAULT CODE

HCESPN	FMI	Description
2333	9	Communication timeout between EHCU and TCU
2331	9	Communication timeout between EHCU and MCU
2332	9	Communication timeout between EHCU and working joystick
2317	9	Communication timeout between EHCU and steering joystick
2319	2	Steering joystick position signal error
2320	2	Steering joystick - FNR enable switch error
2321	2	Steering joystick - forward switch error
2322	2	Steering joystick - neutral switch error
2323	2	Steering joystick - reverse switch error
2324	2	Steering joystick - kick down switch error
2325	2	Steering joystick - steering on switch error
2326	5	PVE coil power current below normal or open circuit
2326	6	PVE coil power current above normal or grounded circuit
2327	0	PVE coil PWM duty cycle input value above normal operation range
2327	1	PVE coil PWM duty cycle input value below normal operation range
2327	5	PVE coil PWM duty cycle current below normal or open circuit
2327	6	PVE coil PWM duty cycle current above normal or grounded circuit
2327	14	PVE coil PWM duty cycle control block parameter invalid
2311	2	Boom joystick position signal error
2311	0	Boom joystick position input value above normal operation range
2311	1	Boom joystick position input value below normal operation range
2311	3	Boom joystick position input voltage above normal or shorted to high source
2311	4	Boom joystick position input voltage below normal or shorted to low source
2311	13	Boom joystick position control block out of calibration
2311	14	Boom joystick position control block parameter invalid
2311	31	Boom joystick position signal redundancy lost
2313	2	Bucket joystick position signal error
2313	0	Bucket joystick position input value above normal operation range
2313	1	Bucket joystick position input value below normal operation range
2313	3	Bucket joystick position input voltage above normal or shorted to high source
2313	4	Bucket joystick position input voltage below normal or shorted to low source
2313	13	Bucket joystick position control block out of calibration
2313	14	Bucket joystick position control block parameter invalid
2313	31	Bucket joystick position signal redundancy lost
2315	2	Aux joystick position signal error
2315	0	Aux joystick position input value above normal operation range
2315	1	Aux joystick position input value below normal operation range

HCESPN	FMI	Description
2315	3	Aux joystick position input voltage above normal or shorted to high source
2315	4	Aux joystick position input voltage below normal or shorted to low source
2315	13	Aux joystick position control block out of calibration
2315	14	Aux joystick position control block parameter invalid
2315	31	Aux joystick position signal redundancy lost
2304	0	Boom up EPPR valve input value above normal operation range
2304	1	Boom up EPPR valve input value below normal operation range
2304	5	Boom up EPPR valve input current below normal or open circuit
2304	6	Boom up EPPR valve input current above normal or grounded circuit
2304	14	Boom up EPPR valve block parameter invalid
2305	0	Boom down EPPR valve input value above normal operation range
2305	1	Boom down EPPR valve input value below normal operation range
2305	5	Boom down EPPR valve input current below normal or open circuit
2305	6	Boom down EPPR valve input current above normal or grounded circuit
2305	14	Boom down EPPR valve block parameter invalid
2306	0	Bucket in EPPR valve input value above normal operation range
2306	1	Bucket in EPPR valve input value below normal operation range
2306	5	Bucket in EPPR valve input current below normal or open circuit
2306	6	Bucket in EPPR valve input current above normal or grounded circuit
2306	14	Bucket in EPPR valve block parameter invalid
2307	0	Bucket dump EPPR valve input value above normal operation range
2307	1	Bucket dump EPPR valve input value below normal operation range
2307	5	Bucket dump EPPR valve input current below normal or open circuit
2307	6	Bucket dump EPPR valve input current above normal or grounded circuit
2307	14	Bucket dump EPPR valve block parameter invalid
2308	0	Aux. Up EPPR valve input value above normal operation range
2308	1	Aux. Up EPPR valve input value below normal operation range
2308	5	Aux. Up EPPR valve input current below normal or open circuit
2308	6	Aux. Up EPPR valve input current above normal or grounded circuit
2308	14	Aux. Up EPPR valve block parameter invalid
2309	0	Aux. Down EPPR valve input data above normal operation range
2309	1	Aux. Down EPPR valve input data below normal operation range
2309	5	Aux. Down EPPR valve input current below normal or open circuit
2309	6	Aux. Down EPPR valve input current above normal or grounded circuit
2309	14	Aux. Down EPPR valve block parameter invalid
2328	0	EHCUSensor power voltage high
2328	1	EHCUSensor power voltage low
2328	3	EHCUSensor power voltage above normal or shorted to high source

HCESPN	FMI	Description
2328	4	EHCUC sensor power voltage below normal or shorted to low source
2329	0	EHCUC power voltage high
2329	1	EHCUC power voltage low
2329	11	EHCUC safety cpu error
739	2	Armrest switch signal error
2334	0	Steering pilot pressure sensor data above normal range
2334	1	Steering pilot pressure sensor data below normal range
2335	2	Steering proportional valve moving position error
2335	14	Steering proportional valve start position error

### 1-3)AAVM FAULT CODE

Fault Code	Description
A01	AAVM Communication Error -AAVM
A02	AAVM Communication Error -Front Camera
A03	AAVM Communication Error -Rear Camera
A04	AAVM Communication Error -Left Camera
A05	AAVM Communication Error -Right Camera
A06	Manual Setting Fail
A07	No MCU CID
A08	MCU CID Format Error
A09	AAVM Hardware Error -AAVM
A10	AAVM Hardware Error -Front Camera
A11	AAVM Hardware Error -Rear Camera
A12	AAVM Hardware Error -Left Camera
A13	AAVM Hardware Error -Right Camera
A14	MCU CID Model is not registered
A15	MCU CID Model can't be applied

## 2) ENGINE FAULT CODE

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
111 629 12	Engine control module critical internal failure - Bad intelligent device or component. Error internal to the ECM related to memory hardware failures or internal ECM voltage supply circuits.	Possible no noticeable performance effects, engine dying, or hard starting.
115 612 2	Engine magnetic crankshaft speed/position lost both of two signals - Data erratic, intermittent, or incorrect. The ECM has detected the primary and backup speed sensor signals are connected backwards.	The engine will shut down or will not start.
122 102 3	Intake manifold 1 pressure sensor circuit - Voltage above normal, or shorted to high source. High signal voltage detected at the intake manifold pressure circuit.	Engine power derate.
123 102 4	Intake manifold 1 pressure sensor circuit - Voltage below normal, or shorted to low Source. Low signal voltage or open circuit detected at the intake manifold pressure circuit.	Engine power derate.
124 102 16	Intake manifold 1 pressure - Data valid but above normal operational range - Moderately severe level. Intake manifold pressure is above the maximum operating limit.	Engine power derate.
125 102 18	Intake Manifold 1 Pressure - Data valid but below normal operating range - Moderately severe level. Intake manifold pressure is below the minimum operating limit.	Engine power derate.
131 91 3	Accelerator pedal or lever position sensor 1 circuit - Voltage above normal, or shorted to high source. High voltage detected at accelerator pedal position number 1 circuit.	The engine will operate in limp home mode.
132 91 4	Accelerator pedal or lever position sensor 1 circuit - Voltage below normal, or shorted to low source. Low voltage detected at accelerator pedal position number 1 signal circuit.	The engine will operate in limp home mode.
133 974 3	Remote accelerator pedal or lever position sensor 1 circuit - Voltage above normal, or shorted to high source. High voltage detected at remote accelerator pedal position signal circuit.	Remote accelerator will not operate.
134 974 4	Remote accelerator pedal or lever position sensor 1 circuit - Voltage below normal, or shorted to low source. Low voltage detected at remote accelerator pedal position signal circuit.	Remote accelerator will not operate.
143 100 18	Engine oil rifle pressure - Data valid but below normal operational range - Moderately severe level. Engine oil pressure signal indicates engine oil pressure is below the engine protection warning limit.	Engine power derate.

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
144 110 3	Engine coolant temperature 1 sensor circuit - Voltage above normal, or shorted to high source. High signal voltage or open circuit detected at engine coolant temperature circuit.	Fan will stay ON if controlled by ECM.
145 110 4	Engine coolant temperature 1 sensor circuit - Voltage below normal, or shorted to low source. Low signal voltage detected at engine coolant temperature circuit.	Fan will stay ON if controlled by ECM.
146 110 16	Engine coolant temperature - Data valid but above normal operational range - Moderately severe level. Engine coolant temperature is above engine protection warning limit.	Progressive power and/or speed derate increasing in severity from time of alert. If the engine protection shutdown feature is enabled, the engine will shut down 30 seconds after the red stop lamp starts flashing.
151 110 0	Engine coolant temperature - Data valid but above normal operational range - Most severe level. Engine coolant temperature signal indicates engine coolant temperature above engine protection critical limit.	Progressive power and/or speed derate increasing in severity from time of alert. If the engine protection shutdown feature is enabled, the engine will shut down 30 seconds after the red stop lamp starts flashing.
153 105 3	Intake manifold 1 temperature sensor circuit - Voltage above normal, or shorted to high source. High signal voltage detected at intake manifold air temperature circuit.	Fan will stay ON if controlled by ECM.
154 105 4	Intake manifold 1 temperature sensor circuit - Voltage below normal, or shorted to low source. Low signal voltage detected at intake manifold air temperature circuit.	Fan will stay ON if controlled by ECM.
155 105 0	Intake manifold 1 temperature - Data valid but above normal operational range - Most severe level. Intake manifold air temperature signal indicates intake manifold air temperature above engine protection critical limit.	Progressive power and/or speed derate increasing in severity from time of alert. If the engine protection shutdown feature is enabled, the engine will shut down 30 seconds after the red stop lamp starts flashing.
175 3464 3	Electronic throttle control actuator driver circuit - Voltage above normal, or shorted to high source. A short circuit to battery or open circuit has been detected in the engine intake air throttle actuator signal circuit.	Possible reduced engine performance.
176 3464 4	Electronic throttle control actuator driver circuit - Voltage below normal, or shorted to low source. A short circuit to ground has been detected in the engine intake air throttle actuator signal circuit.	Possible reduced engine performance.
177 3464 7	Electronic throttle control actuator - Mechanical system not responding or out of adjustment. The engine intake air throttle actuator has failed the auto zero span check.	Possible reduced engine performance.
187 3510 4	Sensor supply 2 circuit - Voltage below normal, or shorted to low source. Low voltage detected at the sensor supply number 2 circuit.	Engine power derate.
195 111 3	Coolant level sensor 1 circuit - Voltage above normal, or shorted to high source. High signal voltage detected at engine coolant level circuit.	None on performance.

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
196 111 4	Coolant level sensor 1 circuit - Voltage below normal, or shorted to low source. Low signal voltage detected at engine coolant level circuit.	None on performance.
197 111 18	Coolant level - Data valid but below normal operational range - Moderately severe level. Low coolant level has been detected.	Engine power derate.
221 108 3	Barometric pressure sensor circuit - Voltage above normal, or shorted to high source. High signal voltage detected at barometric pressure circuit.	Engine power derate.
222 108 4	Barometric pressure sensor circuit - Voltage below normal, or shorted to low source. Low signal voltage detected at barometric pressure circuit.	Engine power derate.
227 3510 3	Sensor supply 2 circuit - Voltage above normal, or shorted to high source. High voltage detected at sensor supply number 2 circuit.	Engine power derate.
234 190 0	Engine crankshaft speed/position - Data valid but above normal operational range - Most severe level. Engine speed signal indicates engine speed above engine protection limit.	Engine power derate.
238 3511 4	Sensor supply 3 circuit - Voltage below normal, or shorted to low source. Low voltage detected on the +5 volt sensor supply circuit to the engine speed sensor.	Engine may run rough, may stop running, may not start, or may be difficult to start.
239 3511 3	Sensor supply 3 circuit - Voltage above normal or shorted to high source. High voltage detected on the 5 volt sensor supply circuit to the engine speed sensor.	Engine may run rough, may stop running, may not start, or may be difficult to start.
241 84 2	Wheel-based vehicle speed - Data erratic, intermittent, or incorrect. The ECM lost the vehicle speed signal or is reading an erratic value.	Engine speed limited to ,maximum engine speed without VSS parameter value. Cruise control, gear-down protection, and road speed governor will not work.
245 647 4	Fan control circuit - Voltage below normal, or shorted to low source. Low signal voltage detected at the fan control circuit when commanded on.	The fan may stay on continuously or not run at all.
249 171 3	Ambient air temperature sensor 1 circuit - Voltage above normal or shorted to high source. High signal voltage detected at ambient air temperature circuit.	Possible reduced engine performance.
256 171 4	Ambient air temperature sensor 1 circuit - Voltage below normal or shorted to low source. Low voltage detected at ambient air temperature circuit.	Possible reduced engine performance.
271 1347 4	Fuel pump pressurizing assembly 1 circuit - Voltage below normal, or shorted to low source. Low signal voltage detected at the fuel pump actuator circuit.	Engine power derate.

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
272 1347 3	Fuel pump pressurizing assembly 1 circuit - Voltage above normal, or shorted to high source. High signal voltage or open circuit detected at the fuel pump actuator circuit.	Engine may run rough, may stop running, may not start, or may be difficult to start.
285 639 9	SAE J1939 multiplexing PGN timeout error - Abnormal update rate. The ECM expected information from a multiplexed device but did not receive it soon enough or did not receive it at all.	At least one multiplexed device will not operate properly.
286 639 13	SAE J1939 multiplexing configuration error - Out of calibration. The ECM expected information from a multiplexed device but only received a portion of the necessary information.	At least one multiplexed device will not operate properly.
288 974 19	Sae J1939 multiplexing remote accelerator pedal or lever position sensor circuit - Received network data in error. The oem vehicle electronic control unit (VECM) detected a fault with the remote accelerator.	Remote accelerator will not operate.
295 108 2	Barometric pressure - Data erratic, intermittent, or incorrect. An error in the barometric pressure sensor signal was detected by the ECM.	Engine power derate.
322 651 5	Injector solenoid driver cylinder 1 circuit - Current below normal, or open circuit. Current detected at injector 1 when voltage is turned OFF.	Engine power derate.
323 655 5	Injector solenoid driver cylinder 5 circuit - Current below normal, or open circuit. Current detected at injector 5 when voltage is turned OFF.	The current to the injector is shut OFF. Engine power derate.
324 653 5	Injector solenoid driver cylinder 3 circuit - Current below normal, or open circuit. Current detected at injector 3 when voltage is turned OFF.	The current to the injector is shut OFF. Engine power derate.
325 656 5	Injector solenoid driver cylinder 6 circuit - Current below normal, or open circuit. Current detected at injector 6 when voltage is turned OFF.	The current to the injector is shut OFF. Engine power derate.
331 652 5	Injector solenoid driver cylinder 2 circuit - Current below normal, or open circuit. Current detected at injector 2 when voltage is turned OFF.	The current to the injector is shut OFF. Engine power derate.
332 654 5	Injector solenoid driver cylinder 4 circuit - Current below normal, or open circuit. Current detected at injector 4 when voltage is turned OFF.	The current to the injector is shut OFF. Engine power derate.
334 110 2	Engine coolant temperature - Data erratic, intermittent, or incorrect. The engine coolant temperature sensor is reading an erratic value at initial key ON.	None on performance.

※ Some fault codes are not applied to this machine.



Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
338 1267 3	Idle shutdown vehicle accessories relay driver circuit - Voltage above normal, or shorted to high source. Open circuit or short to voltage source detected at the idle shutdown vehicle accessory/ignition bus relay circuit.	Vehicle accessories or ignition bus loads controlled by the idle shutdown relay will not power up.
339 1267 4	Idle shutdown vehicle accessories relay driver circuit - Voltage below normal, or shorted to low source. Low voltage detected at the idle shutdown vehicle accessory or ignition bus relay circuit when commanded ON.	Vehicle accessories or ignition bus loads controlled by the idle shutdown relay will not power up.
343 629 12	Engine control module warning internal hardware failure - Bad intelligent device or component. ECM power supply errors have been detected.	Engine power derate.
346 630 12	Engine control module calibration memory software - Bad intelligent device or component. Invalid switch configuration adjustable parameter setting have been detected by the engine control module (ECM).	Various optional switch inputs to the ECM may not operate correctly.
351 627 12	Injector power supply - Bad intelligent device or component. The ECM measured injector boost voltage is low.	Engine power derate.
352 3509 4	Sensor supply 1 circuit - Voltage below normal, or shorted to low source. Low voltage detected at sensor supply number 1 circuit.	Engine power derate.
383 729 5	Engine intake air heater 1 circuit - Current below normal or open circuit. A malfunctioning engine intake air heater circuit has been detected.	Engine may not start or may be difficult to start.
386 3509 3	Sensor supply 1 circuit - Voltage above normal, or shorted to high source. High voltage detected at sensor supply number 1 circuit.	Engine power derate.
415 100 1	Engine oil rifle pressure - Data valid but below normal operational range - Most severe level. Oil pressure signal indicates oil pressure below the engine protection critical limit.	Progressive power and/or speed derate increasing in severity from time of alert. If engine protection shutdown feature is enabled, engine will shut down 30 seconds after red stop lamp starts flashing.
418 97 15	Water in fuel indicator - Data valid but above normal operational range - Least severe level. water has been detected in the fuel filter.	None on performance.
427 639 9	J1939 data link - Abnormal update rate. Communication between the engine control module (ECM) and another device on the SAE J1939 data link has been lost.	Engine will only idle.
428 97 3	Water in fuel indicator sensor circuit - Voltage above normal, or shorted to high source. High voltage detected at the water in fuel circuit.	None on performance. No water in fuel warning available.
435 100 2	Engine oil rifle pressure - Data erratic, intermittent, or incorrect. The engine oil pressure sensor is reading an erratic value.	None on performance.

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
436 105 2	Intake manifold 1 temperature - Data erratic, intermittent, or incorrect. The intake manifold temperature sensor is reading an erratic value at initial key on or while the engine is running.	Possible reduced engine performance.
441 168 18	Battery 1 voltage - Data valid but below normal operational range - Moderately severe level. ECM supply voltage is below the minimum system voltage level.	Engine may run rough, may stop running, may not start, or may be difficult to start.
442 168 16	Battery 1 Voltage - Data valid but above normal operational range - Moderately severe level. ECM supply voltage is above the maximum system voltage level.	None on performance.
451 157 3	Injector metering rail 1 pressure sensor circuit - Voltage above normal, or shorted to high source. High signal voltage detected at the rail fuel pressure sensor circuit.	Power and/or speed derate.
452 157 4	Injector metering rail 1 pressure sensor circuit - Voltage below normal, or shorted to low source. Low signal voltage detected at the rail fuel pressure sensor circuit.	Power and/or speed derate.
483 1349 3	Injector metering rail 2 pressure sensor circuit - Voltage above normal or shorted to high source. High signal voltage detected at the fuel rail 2 pressure sensor circuit.	Possible reduced engine performance.
484 1349 4	Injector metering rail 2 pressure sensor circuit - Voltage below normal or shorted to low source. Low signal voltage detected at the fuel rail 2 pressure sensor circuit.	Possible reduced engine performance.
515 3514 3	Sensor supply 6 circuit - Voltage above normal or shorted to high source. High voltage detected on the +5 volt sensor supply circuit to the fuel rail pressure sensor.	Engine power derate.
516 3514 4	Sensor supply 6 circuit - Voltage below normal or shorted to low source. Low voltage detected on the +5 volt sensor supply circuit to the fuel rail pressure sensor.	Engine power derate.
553 157 16	Injector metering rail 1 pressure - Data valid but above normal operational range - Moderately severe level. The ECM has detected that fuel pressure is higher than commanded pressure.	Possible reduced engine performance.
555 101 16	Crankcase pressure - Data valid but above normal operational range - Moderately severe level. The crankcase breather filter requires maintenance.	None on performance.
556 101 0	Crankcase pressure - Data valid but above normal operational range - Most severe level. The crankcase breather filter requires maintenance.	None on performance.

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
559 157 18	Injector metering rail 1 pressure - Data valid but below normal operational range - Moderately severe level. The ecm has detected that fuel pressure is lower than commanded pressure.	Possibly hard to start or low power. Engine could possibly <b>not</b> start.
584 677 3	Starter relay driver circuit - Voltage above normal, or shorted to high source. Open circuit or high voltage detected at starter lockout circuit.	Either the engine will not start or the engine will not have starter lockout protection.
585 677 4	Starter relay driver circuit - Voltage below normal, or shorted to low source. Low voltage detected at starter lockout circuit.	Either the engine will not start or the engine will not have starter lockout protection.
595 103 16	Turbocharger 1 speed - Data valid but above normal operating range - Moderately severe level. High turbocharger speed has been detected by the ecm.	Engine power derate.
596 167 16	Electrical charging system voltage - Data valid but above normal operational range - Moderately severe level. High battery voltage detected by the battery voltage monitor feature.	None on performance.
597 167 18	Electrical charging system voltage - Data valid but below normal operational range - Moderately severe level. Low battery voltage detected by the battery voltage monitor feature.	None on performance.
649 1378 31	Engine oil change interval - Condition exists. Change engine oil and filter.	None on performance.
687 103 18	Turbocharger 1 speed - Data valid but below normal operational range - Moderately severe level. Low turbocharger speed detected by the ECM.	Engine power derate. The ECM uses an estimated turbocharger speed.
689 190 2	Engine crankshaft speed/position - Data erratic, intermittent, or incorrect. The ECM has detected an error in the engine speed signal.	Possible reduced engine performance.
691 1172 3	Turbocharger 1 compressor inlet temperature sensor circuit - Voltage above normal, or shorted to high source. High signal voltage detected at turbocharger compressor inlet air temperature circuit.	Engine power derate.
692 1172 4	Turbocharger 1 compressor inlet temperature circuit - Voltage below normal, or shorted to low source. Low signal voltage detected at turbocharger compressor inlet air temperature circuit.	Engine power derate.
693 1172 2	Turbocharger 1 compressor intake temperature - Data erratic, intermittent, or incorrect. A temperature too high or low for the operating conditions has been detected by the turbocharger compressor intake temperature sensor.	Possible reduced engine performance.

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
731 723 7	Engine speed / position camshaft and crankshaft misalignment - Mechanical system not responding properly or out of adjustment. Engine position signal from the crankshaft position sensor and camshaft position sensor do not match.	Engine power derate.
755 157 7	Injector metering rail 1 pressure - Mechanical system not responding or out of adjustment. The ecm has detected a difference in the 2 fuel rail pressure signals.	Possible reduced engine performance.
778 723 2	Engine camshaft speed / position sensor - Data erratic, intermittent, or incorrect. The ECM has detected an error in the camshaft position sensor signal.	Possible reduced engine performance.
784 1590 2	Adaptive cruise control mode - Data erratic, intermittent, or incorrect. Loss of communication with adaptive cruise control.	Adaptive cruise control will not operate. Standard cruise control may not operate.
1117 627 2	Power supply lost with ignition on - Data erratic, intermittent, or incorrect. Supply voltage to the ECM fell below 6.2 volts momentarily, or the ECM was not allowed to power down correctly (retain battery voltage for 30 seconds after key OFF).	Possible no noticeable performance.
1139 651 7	Injector solenoid driver cylinder 1 - Mechanical system not responding or out of adjustment. The ECM has detected an error with the injection timing or quantity.	Possible reduced engine performance.
1141 652 7	Injector solenoid driver cylinder 2 - Mechanical system not responding or out of adjustment. The ECM has detected an error with the injection timing or quantity.	Possible reduced engine performance.
1142 653 7	Injector solenoid driver cylinder 3 - Mechanical system not responding or out of adjustment. The ECM has detected an error with the injection timing or quantity.	Possible reduced engine performance.
1143 654 7	Injector solenoid driver cylinder 4 - Mechanical system not responding or out of adjustment. The ECM has detected an error with the injection timing or quantity.	Possible reduced engine performance.
1144 655 7	Injector solenoid driver cylinder 5 - Mechanical system not responding or out of adjustment. The ECM has detected an error with the injection timing or quantity.	Possible reduced engine performance.
1145 656 7	Injector solenoid driver cylinder 6 - Mechanical system not responding or out of adjustment. The ECM has detected an error with the injection timing or quantity.	Possible reduced engine performance.
1228 27 2	Egr valve position - Data erratic, intermittent, or Incorrect. The EGR valve is unable to meet commanded position.	Possible reduced engine performance.

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
1239 2623 3	Accelerator pedal or lever position sensor 2 circuit - Voltage above normal or shorted to high source. High voltage detected at accelerator pedal position number 2 signal circuit.	The engine will operate in limp home mode.
1241 2623 4	Accelerator pedal or lever position sensor 2 circuit - Voltage below normal or shorted to low source. Low voltage detected at accelerator pedal position number 2 signal circuit.	The engine will operate in limp home mode.
1242 91 2	Accelerator pedal or lever position sensor 1 and 2 - Data erratic, intermittent, or incorrect. Accelerator position sensor number 1 and number 2 are reading different values.	The engine will only idle.
1515 91 19	Sae J1939 multiplexed accelerator pedal or lever sensor system - Received network data in error. The J1939 multiplexing controller has indicated a malfunction of the multiplexed accelerator pedal.	The engine will only idle.
1654 1323 31	Engine misfire cylinder 1- Condition exists. Engine misfire has been detected in cylinder number 1.	Possible reduced engine performance.
1655 1324 31	Engine misfire cylinder 2 - Condition exists. Engine misfire has been detected in cylinder number 2.	Possible reduced engine performance.
1656 1325 31	Engine misfire cylinder 3 - Condition exists. Engine misfire has been detected in cylinder number 3.	Possible reduced engine performance.
1657 1326 31	Engine misfire cylinder 4 - Condition exists. Engine misfire has been detected in cylinder number 4.	Possible reduced engine performance.
1658 1327 31	Engine misfire cylinder 5 - Condition exists. Engine misfire has been detected in cylinder number 5.	Possible reduced engine performance.
1659 1328 31	Engine misfire cylinder 6 - Condition exists. Engine misfire has been detected in cylinder number 6.	Possible reduced engine performance.
1668 1761 4	Aftertreatment diesel exhaust fluid tank level sensor circuit - Voltage below normal or shorted to low source. Low signal voltage detected at the aftertreatment diesel exhaust fluid tank level sensor circuit.	Possible reduced engine performance.
1669 1761 3	Aftertreatment diesel exhaust fluid tank level sensor circuit - Voltage above normal or shorted to high source. High signal voltage detected at the catalyst tank level sensor circuit.	Possible reduced engine performance.
1673 1761 1	Aftertreatment diesel exhaust fluid tank level - Data valid but below normal operating range - Most severe level. The aftertreatment diesel exhaust fluid tank level has fallen below the critical warning level.	Possible reduced engine performance.

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
1677 3031 4	Aftertreatment diesel exhaust fluid tank temperature sensor - Voltage below normal or shorted to low source. Low signal voltage detected at the diesel exhaust fluid tank temperature sensor circuit.	Possible reduced engine performance.
1678 3031 3	Aftertreatment diesel exhaust fluid tank temperature sensor - Voltage above normal or shorted to high source. High signal voltage or open circuit detected at the diesel exhaust fluid tank temperature sensor circuit.	Possible reduced engine performance.
1679 3031 2	Aftertreatment diesel exhaust fluid tank temperature - Data erratic, intermittent, or incorrect. The diesel exhaust fluid tank temperature sensor has indicated a tank temperature too high or too low for the ambient conditions.	Possible reduced engine performance.
1682 3362 31	Aftertreatment diesel exhaust fluid dosing unit input lines - Condition exists. The aftertreatment diesel exhaust fluid dosing unit is unable to prime.	Possible reduced engine performance.
1683 3363 3	Aftertreatment diesel exhaust fluid tank heater - Voltage above normal or shorted to high source. High signal voltage detected at the aftertreatment diesel exhaust fluid tank heater circuit.	Possible reduced engine performance.
1684 3363 4	Aftertreatment diesel exhaust fluid tank heater - Voltage below normal, or shorted to low source. Low signal voltage detected at the aftertreatment diesel exhaust fluid tank heater circuit.	Possible reduced engine performance.
1691 100 18	Aftertreatment diesel oxidation catalyst conversion efficiency - Data valid but below normal operating range - Moderately severe level. The temperature increase across the aftertreatment catalyst is lower than expected.	Possible frequent need for aftertreatment regeneration.
1695 3513 3	Sensor supply 5 - Voltage above normal or shorted to high source. High voltage detected at sensor supply 5 circuit in the oem harness.	the engine will operate in limp home mode.
1696 3513 4	Sensor supply 5 - Voltage below normal or shorted to low source. Low voltage detected at sensor supply number 5 circuit in the oem harness.	the engine will operate in limp home mode.
1712 3363 18	Aftertreatment diesel exhaust fluid tank heater - Data valid but below normal operating range - Moderately severe level. The aftertreatment diesel exhaust fluid tank heater is unable to thaw the frozen diesel exhaust fluid.	Possible reduced engine performance.

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
1713 3363 16	Aftertreatment diesel exhaust fluid tank heater - Data valid but above normal operating range - Moderately severe level. The diesel exhaust fluid tank heater is continuously in the on position.	None on performance.
1718 1322 31	Engine misfire for multiple cylinders - Condition exists. Engine misfire has been detected in multiple cylinder numbers.	Possible reduced engine performance.
1776 2634 3	Power relay driver circuit - Voltage above normal or shorted to high source. High voltage detected at power relay driver circuit.	Possible reduced engine performance.
1777 2634 4	Power relay driver circuit - Voltage below normal or shorted to low source. An open circuit or low voltage has been detected at the power relay circuit.	Possible reduced engine performance.
1843 101 3	Crankcase pressure circuit - Voltage above normal or shorted to high source. High signal voltage detected at the crankcase pressure circuit.	None on performance.
1844 101 4	Crankcase pressure circuit - Voltage below normal or shorted to low source. Low signal voltage detected at the crankcase pressure circuit.	None on performance.
1866 411 2	Exhaust gas recirculation valve delta pressure - Data erratic, intermittent, or incorrect. An error in the egr delta pressure signal was detected at initial key on or the sensor failed the autozero test.	possible reduced engine performance.
1867 412 2	Engine gas recirculation temperature - Data erratic, intermittent, or incorrect. Engine misfire has been detected in multiple cylinder numbers.	Possible reduced engine performance.
1879 3251 3	Aftertreatment diesel particulate filter differential pressure sensor circuit - Voltage above normal or shorted to high source. High signal voltage detected at the aftertreatment differential pressure sensor circuit.	possible reduced engine performance.
1881 3251 4	Aftertreatment diesel particulate filter differential pressure sensor circuit - Voltage below normal or shorted to low source. Low signal voltage or open circuit detected at the aftertreatment differential pressure sensor circuit.	possible reduced engine performance.
1883 3251 2	Aftertreatment diesel particulate filter differential pressure sensor - Data erratic, intermittent, or incorrect. The aftertreatment diesel particulate filter differential pressure sensor is reading an erratic value at initial key on or during engine operation.	possible reduced engine performance.

※ Some fault codes are not applied to this machine.



Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
1885 3216 4	Aftertreatment intake NOx sensor circuit - Voltage below normal or shorted to low source. An internal circuit error has been detected by the aftertreatment intake NOx sensor.	Possible reduced engine performance.
1887 3226 4	Aftertreatment outlet NOx sensor circuit - Voltage below normal or shorted to low source. An internal circuit error has been detected by the aftertreatment outlet NOx sensor.	Possible reduced engine performance.
1896 2791 13	EGR valve controller - Out of calibration. The EGR valve has failed the automatic calibration procedure at initial key ON.	Possible reduced engine performance.
1921 3251 0	Aftertreatment diesel particulate filter differential pressure - Data valid but above normal operating range - Moderately severe level. The soot load of the aftertreatment diesel particulate filter has exceeded the recommended limits.	Possible reduced engine performance.
1922 3251 0	Aftertreatment diesel particulate filter differential pressure - Data valid but above normal operating range - Most severe level. The soot load of the aftertreatment diesel particulate filter has exceeded the recommended limits. Engine protection derate is enabled.	Possible reduced engine performance.
1938 3597 1	Ecu power output supply voltage 1 - Data valid but below normal operational range - Moderately severe level. Low battery voltage detected by the VGT actuator.	Possible reduced engine performance.
1942 101 2	Crankcase pressure - Data erratic, intermittent, or incorrect. The ECM has detected that the crankcase pressure signal is reading an erratic value at initial key ON or during engine operation.	None on performance.
1961 2791 0	EGR valve control circuit calculated over temperature - Data valid but above normal operational range - Least severe level. High EGR valve driver temperature has been detected.	Possible reduced engine performance.
1962 641 0	VGT Actuator driver over temperature (calculated) - Data valid but above normal operating range - Least severe level. High internal VGT actuator temperature has been detected.	None on performance.
1974 101 16	Crankcase pressure - Data valid but above normal operating range - Moderately severe level. The crankcase breather filter requires maintenance.	None on performance.

※ Some fault codes are not applied to this machine.



Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
1993 4795 31	Aftertreatment diesel particulate filter missing - Condition exists. The aftertreatment diesel particulate filter in the exhaust system is not present.	Active aftertreatment diesel particulate filter regeneration will be disabled.
2185 3512 3	Sensor supply 4 circuit - Voltage above normal, or shorted to high source. High voltage detected at 5 VDC sensor supply circuit to the accelerator pedal position sensor.	Engine will only idle.
2186 3512 4	Sensor supply 4 circuit - Voltage below normal, or shorted to low source. Low voltage detected at 5 VDC sensor supply circuit to the accelerator pedal position sensor.	Engine will only idle.
2198 641 11	VGT Actuator driver circuit - Root cause not known. Intermittent communication between the smart VGT controller and the ECM has been detected. The VGT controller is not interpreting the J1939 message from the ECM correctly.	Possible reduced engine performance.
2272 27 4	EGR Valve position circuit - Voltage below normal or shorted to low source. Low signal voltage has been detected at the EGR valve position sensor circuit	Possible reduced engine performance.
2273 411 3	Exhaust gas recirculation valve delta pressure sensor circuit - Voltage above normal or shorted to high source. High signal voltage detected at the EGR differential pressure sensor circuit.	Possible reduced engine performance.
2274 411 4	Exhaust gas recirculation valve delta pressure sensor circuit - Voltage below normal or shorted to low source. Low signal voltage detected at the EGR differential pressure sensor circuit.	Possible reduced engine performance.
2288 103 15	Turbocharger 1 speed - Data valid but above normal operating range - Least severe level. High turbocharger speed has been detected by the ECM.	Possible reduced engine performance.
2311 633 31	Electronic fuel injection control valve circuit - Condition exists. Fuel pump actuator circuit resistance too high or too low, or an intermittent connection has been detected.	Possible reduced engine performance.
2322 723 2	Engine camshaft speed / position sensor - Data erratic, intermittent, or incorrect. Camshaft engine speed sensor intermittent synchronization.	None on performance.
2349 2791 5	EGR Valve control circuit - Current below normal or open circuit. Motor terminal or motor coil open circuit has been detected by the ECM.	Possible reduced engine performance.

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
2353 2791 6	EGR Valve control circuit - Current above normal or grounded circuit. A short circuit to ground has been detected in the EGR valve motor circuit.	Possible reduced engine performance.
2372 95 16	Fuel filter differential pressure - Data valid but above normal operational range - Moderately severe level. Excessive fuel flow restriction to the high pressure fuel pump has been detected.	Possible reduced engine performance.
2373 1209 3	Exhaust gas pressure sensor circuit - Voltage above normal or shorted to high source. High signal voltage detected at the exhaust gas pressure circuit.	Possible reduced engine performance.
2374 1209 4	Exhaust gas pressure sensor circuit - Voltage below normal or shorted to low source. Low signal voltage detected at the exhaust gas pressure circuit.	Possible reduced engine performance.
2375 412 3	Exhaust gas recirculation temperature sensor circuit - Voltage above normal or shorted to high source. High signal voltage detected at EGR temperature circuit.	Possible reduced engine performance.
2376 412 4	Exhaust gas recirculation temperature sensor circuit - Voltage below normal or shorted to low source. Low signal voltage detected at EGR temperature circuit.	Possible reduced engine performance.
2377 647 3	Fan control circuit - Voltage above normal, or shorted to high source. Open circuit or high voltage detected at the fan control circuit.	The fan can stay on continuously or <b>not</b> run at all.
2387 641 7	VGT Actuator driver circuit (motor) - Mechanical system not responding or out of adjustment. The smart VGT controller has detected incorrect stop limits, or the VGT is unable to move to the closed position.	Possible reduced engine performance.
2398 171 2	Ambient air temperature - Data erratic, intermittent, or incorrect. The ambient air temperature sensor is reading an erratic value.	Possible reduced engine performance.
2448 111 17	Coolant level - Data valid but below normal operational range - Least severe level. Low engine coolant level detected.	none on performance.
2449 641 13	Vgt actuator controller - Out of calibration. The VGT actuator has been installed incorrectly.	Possible reduced engine performance.
2468 102 3	Engine crankshaft speed/position - Data valid but above normal operating range - Moderately severe level. The engine speed has exceeded a critical limit.	Engine will be shut down.
2554 1209 2	Exhaust gas pressure - Data erratic, intermittent or incorrect. The exhaust gas pressure sensor is reading an erratic value.	possible reduced engine performance.

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
2555 729 3	Intake air heater 1 circuit - Voltage above normal, or shorted to high source. High voltage detected at the intake air heater signal circuit.	The intake air heaters may be ON or OFF all the time.
2556 729 4	Intake air heater 1 circuit - Voltage below normal, or shorted to low source. Low voltage detected at the intake air heater signal circuit.	The intake air heaters may be ON or OFF all the time.
2634 641 12	VGT Actuator controller - Bad intelligent device or component. An internal error has been detected by the smart VGT controller.	Possible reduced engine performance.
2636 641 9	VGT Actuator driver circuit - abnormal update rate. No communications on the J1939 data link between the engine ECM and the smart VGT controller.	Possible reduced engine performance.
2638 5298 17	Aftertreatment diesel oxidation catalyst conversion efficiency - Data valid but below normal operating range - Least severe level. The temperature increase across the aftertreatment diesel oxidation catalyst is lower than expected.	Possible frequent need for aftertreatment regeneration.
2639 3251 15	Aftertreatment diesel particulate filter differential pressure - Data valid but above normal operating range - Least severe level. The soot load of the aftertreatment diesel particulate filter has exceeded the recommended limits.	Possible reduced engine performance.
2646 110 32	Engine coolant temperature - Condition exists. The EGR valve was closed to reduce engine coolant temperature.	Possible reduced engine performance.
2718 520325 31	Brake switch and accelerator pedal position incompatible - Condition exists. The ECM has detected the brake pedal and accelerator pedal were depressed simultaneously.	The engine will operate in limp home mode.
2771 3226 9	Aftertreatment outlet NOx sensor - Abnormal update rate. No communications or an invalid data transfer rate detected on the J1939 data link between the ECM and the aftertreatment outlet NOx sensor.	Possible reduced engine performance.
2777 3703 31	Particulate trap active regeneration inhibited due to inhibit switch - Condition exists. Regeneration of the diesel particulate filter has been prevented due to the permit switch being disabled.	Possible frequent need for aftertreatment regeneration.
2961 412 15	Exhaust gas recirculation temperature - Data valid but above normal operational range - Least severe level. EGR temperature has exceeded the engine protection limit.	Possible reduced engine performance.
2962 412 16	Exhaust gas recirculation temperature - Data valid but above normal operational range - Moderately severe level. EGR temperature has exceeded the engine protection limit.	Possible reduced engine performance.

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
2963 110 15	Engine coolant temperature - Data valid but above normal operational range - Least severe level. Engine coolant temperature is above the engine protection warning limit.	Progressive power and/or speed derate increasing in severity from time of alert. If the Engine protection shutdown feature is enabled, the engine will shut down 30 seconds after the red STOP lamps starts flashing.
2964 105 15	Intake manifold 1 temperature - Data valid but above normal operational range - Least severe level. Intake manifold air temperature signal indicates intake manifold air temperature is above engine protection warning limit.	Progressive power and/or speed derate increasing in severity from time of alert. If the Engine protection shutdown feature is enabled, the engine will shut down 30 seconds after the red STOP lamps starts flashing.
2973 102 2	Intake manifold 1 pressure - Data erratic, intermittent, or incorrect. The intake manifold pressure sensor is reading an erratic value.	Possible reduced engine performance.
2976 3361 2	Aftertreatment diesel exhaust fluid dosing unit temperature - Data erratic, intermittent, or incorrect. An internal error has been detected in the aftertreatment diesel exhaust fluid dosing unit.	Possible reduced engine performance.
3133 3610 3	Aftertreatment diesel particulate filter outlet pressure sensor circuit - Voltage above normal, or shorted to high source. High signal voltage detected at the aftertreatment diesel particulate filter outlet pressure sensor circuit.	Possible reduced engine performance.
3134 3610 4	Aftertreatment diesel particulate filter outlet pressure sensor circuit - Voltage below normal, or shorted to low source. Low signal voltage detected at the aftertreatment diesel particulate filter outlet pressure sensor circuit.	Possible reduced engine performance.
3135 3610 2	Aftertreatment diesel particulate filter outlet pressure - Data erratic, intermittent or incorrect. The aftertreatment diesel particulate filter outlet pressure sensor is reading an erratic value at initial key ON or during engine operation.	Possible reduced engine performance.
3146 4363 3	Aftertreatment SCR outlet temperature sensor circuit - Voltage above normal or shorted to high source. High signal voltage detected at the SCR outlet temperature sensor circuit.	Possible reduced engine performance.
3147 4363 4	Aftertreatment SCR outlet temperature sensor circuit - Voltage below normal or shorted to low source. Low signal voltage detected at the SCR outlet temperature sensor circuit.	Possible reduced engine performance.
3148 4363 2	Aftertreatment SCR outlet temperature sensor - Data erratic, intermittent, or incorrect. The SCR outlet temperature sensor is not changing with engine operating conditions.	Possible reduced engine performance.
3151 4794 31	Aftertreatment SCR catalyst system missing - Condition exists. The aftertreatment SCR catalyst in the exhaust system is not present.	Possible reduced engine performance.

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
3165 4363 0	Aftertreatment SCR outlet temperature - Data valid but above normal operational range - Most severe level. The SCR outlet temperature sensor reading has exceeded the maximum engine protection temperature limit.	Possible reduced engine performance.
3168 3936 16	Aftertreatment diesel particulate filter system - Data valid but above normal operating range - Moderately severe level. The system has detected a malfunction in the filtering capability of the aftertreatment diesel particulate filter.	None on performance.
3186 1623 9	Tachograph output shaft speed - Abnormal update rate. No communication or an invalid data transfer rate has been detected on the J1939 data link between the ECM and the tachograph output shaft speed sensor.	None on performance.
3213 1623 19	Tachograph output shaft speed - Received network data in error. The J1939 multiplexing controller has indicated a malfunction of the tachograph output shaft speed sensor.	None on performance.
3228 3216 2	Aftertreatment Intake NOx sensor - Data erratic, intermittent, or incorrect. An incorrect NOx sensor reading has been detected by the aftertreatment intake NOx sensor.	Possible reduced engine performance.
3232 3216 9	Aftertreatment Intake NOx sensor - Abnormal update rate. No communication or an invalid data transfer rate has been detected on the J1939 data link between the ECM and the aftertreatment intake NOx sensor.	Possible reduced engine performance.
3235 4363 16	Aftertreatment SCR outlet temperature - Data valid but above normal operating range - Moderately severe level. The SCR outlet temperature sensor reading has exceeded the maximum temperature limit.	Possible reduced engine performance.
3237 4340 3	Aftertreatment diesel exhaust fluid line heater 1 circuit - Voltage above normal or shorted to high source. High signal voltage detected at the diesel exhaust fluid line heater 1 circuit.	Possible reduced engine performance.
3238 4340 4	Aftertreatment diesel exhaust fluid line heater 1 circuit - Voltage below normal, or shorted to low source. Low signal voltage detected at the diesel exhaust fluid line heater 1 circuit.	Possible reduced engine performance.
3239 4342 3	Aftertreatment diesel exhaust fluid line heater 2 circuit - Voltage above normal or shorted to high source. High signal voltage detected at the diesel exhaust fluid line heater 2 circuit.	Possible reduced engine performance.
3241 4342 4	Aftertreatment diesel exhaust fluid line heater 2 circuit - Voltage below normal, or shorted to low source. Low signal voltage detected at the diesel exhaust fluid line heater 2 circuit.	Possible reduced engine performance.

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
3242 3363 7	Aftertreatment diesel exhaust fluid tank heater - Mechanical system not responding or out of adjustment. The aftertreatment diesel exhaust fluid temperature did not increase when the aftertreatment diesel exhaust fluid tank heater was commanded ON.	Possible reduced engine performance.
3243 3060 18	Engine cooling system monitor - Data valid but below normal operating range - Moderately severe level. The engine is not warming up as expected.	None on performance.
3251 4765 16	Aftertreatment diesel oxidation catalyst intake temperature - Data valid but above normal operating range - Moderately severe level. The diesel oxidation catalyst intake temperature sensor reading has exceeded the maximum temperature limit.	Progressive power and/or speed derate increasing in severity from time of alert. If the Engine protection shutdown feature is enabled, the engine will shut down 30 seconds after the red STOP lamps starts flashing.
3253 3242 16	Aftertreatment diesel particulate filter intake temperature - Data valid but above normal operating range - Moderately severe level. The aftertreatment diesel particulate filter intake temperature sensor reading has exceeded the maximum engine protection temperature limit.	Progressive power and/or speed derate increasing in severity from time of alert. If the Engine protection shutdown feature is enabled, the engine will shut down 30 seconds after the red STOP lamps starts flashing.
3254 3242 15	Aftertreatment diesel particulate filter intake temperature - Data valid but above normal operating range - Least severe level. The aftertreatment diesel particulate filter intake temperature sensor reading has exceeded the maximum engine protection temperature limit.	Possible reduced engine performance.
3255 3246 16	Aftertreatment diesel particulate filter outlet temperature - Data valid but above normal operating range - Moderately severe level. The aftertreatment diesel particulate filter outlet temperature sensor reading has exceeded the maximum engine protection temperature limit.	Progressive power and/or speed derate increasing in severity from time of alert. If the engine protection shutdown feature is enabled, the engine will shut down 30 seconds after the red STOP lamps starts flashing.
3256 3246 15	Aftertreatment diesel particulate filter outlet temperature - Data valid but above normal operating range - Least severe level. The aftertreatment diesel particulate filter outlet temperature sensor reading has exceeded the maximum engine protection temperature limit.	Possible reduced engine performance.
3258 4340 5	Aftertreatment diesel exhaust fluid line heater 1 circuit - Current below normal or open circuit. Open circuit detected in the diesel exhaust fluid line heater 1.	Possible reduced engine performance.
3261 4342 5	Aftertreatment diesel exhaust fluid line heater 2 circuit - Current below normal or open circuit. Open circuit detected in the diesel exhaust fluid line heater 2.	Possible reduced engine performance.

※ Some fault codes are not applied to this machine.



Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
3311 3242 0	Aftertreatment diesel particulate filter intake temperature - Data valid but above normal operating range - Most severe level. The aftertreatment diesel particulate filter intake temperature sensor reading has exceeded the maximum engine protection temperature limit.	Progressive power and/or speed derate increasing in severity from time of alert. If the engine protection shutdown feature is enabled, the engine will shut down 30 seconds after the red STOP lamps starts flashing.
3312 3246 0	Aftertreatment diesel particulate filter outlet temperature - Data valid but above normal operating range - Most severe level. The aftertreatment diesel particulate filter outlet temperature sensor reading has exceeded the maximum engine protection temperature limit.	Progressive power and/or speed derate increasing in severity from time of alert. If the engine protection shutdown feature is enabled, the engine will shut down 30 seconds after the red STOP lamps starts flashing.
3313 4765 4	Aftertreatment diesel oxidation catalyst intake temperature sensor circuit - Voltage below normal or shorted to low source. Low signal voltage detected at the catalyst intake sensor circuit.	Possible reduced engine performance.
3314 4765 3	Aftertreatment diesel oxidation catalyst intake temperature sensor circuit - Voltage above normal or shorted to high source. High signal voltage detected at the catalyst intake temperature sensor circuit.	Possible reduced engine performance.
3315 4765 2	Aftertreatment diesel oxidation catalyst intake temperature - Data erratic, intermittent, or incorrect. The aftertreatment diesel oxidation catalyst intake temperature sensor is not changing with engine operating conditions.	Possible reduced engine performance.
3316 3242 4	Aftertreatment diesel particulate filter intake temperature sensor circuit - Voltage below normal or shorted to low source. Low signal voltage detected at the aftertreatment diesel particulate filter intake temperature sensor circuit.	Possible reduced engine performance.
3317 3242 3	Aftertreatment diesel particulate filter intake temperature sensor circuit - Voltage above normal or shorted to high source. High signal voltage or open circuit detected at the aftertreatment diesel particulate filter intake temperature sensor circuit.	Possible reduced engine performance.
3318 3242 2	Aftertreatment diesel particulate filter intake temperature - Data erratic, intermittent, or incorrect. The aftertreatment diesel particulate filter intake temperature is not changing with engine operating conditions.	Possible reduced engine performance.
3319 3246 3	Aftertreatment diesel particulate filter outlet temperature sensor circuit - Voltage above normal or shorted to high source. High signal voltage or open circuit detected at the aftertreatment diesel particulate filter outlet temperature sensor circuit.	Possible reduced engine performance.

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
3321 3246 4	Aftertreatment diesel particulate filter outlet temperature sensor circuit - Voltage below normal or shorted to low source. Low signal voltage detected at the aftertreatment diesel particulate filter outlet temperature sensor circuit.	Possible reduced engine performance.
3322 3246 2	Aftertreatment diesel particulate filter outlet temperature - Data erratic, intermittent, or incorrect. The aftertreatment diesel particulate filter outlet temperature is not changing with engine operating conditions.	Possible reduced engine performance.
3326 91 9	SAE J1939 Multiplexed accelerator pedal or lever sensor system - Abnormal update rate. The ECM expected information from a multiplexed accelerator pedal or lever sensor but did not receive it soon enough or did not receive it at all.	Engine will only idle.
3328 191 9	Transmission output shaft speed - Abnormal update rate. No communication or an invalid data transfer rate has been detected on the J1939 data link between the ECM and the transmission output shaft speed sensor.	None on performance.
3342 4752 18	Engine exhaust gas recirculation cooler efficiency - Data valid but below normal operating range - Moderately severe level. The EGR cooler is not cooling the recirculated exhaust gas sufficiently.	None on performance.
3343 5285 18	Engine charge-air cooler efficiency - Data valid but below normal operating range - Moderately severe level. The engine charge air cooler is not cooling the intake air flow sufficiently.	None on performance.
3361 102 10	Intake manifold 1 pressure - Abnormal rate of change. The VGT position reading is stuck.	Possible reduced engine performance.
3366 111 18	Coolant level - Data valid but below normal operating range - Moderately severe level. Very low engine coolant level detected.	None on performance.
3374 1818 31	Roll over protection brake control active - Condition exists. The ECM received a message from the anti-lock braking (ABS) controller, inhibiting cruise control operation.	Cruise control could possibly not operate.
3375 5397 31	Aftertreatment diesel particulate filter regeneration too frequent - Condition exists. The system has detected the need for an active regeneration has occurred too soon following the last active regeneration.	None on performance.
3376 5319 31	Aftertreatment diesel particulate filter incomplete regeneration - Condition exists. The system has detected that the aftertreatment diesel particulate filter differential pressure is too high following an active regeneration.	Possible frequent need for aftertreatment regeneration.

※ Some fault codes are not applied to this machine.



Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
3382 3058 18	Engine exhaust gas recirculation (EGR) system - Data valid but below normal operating range - Moderately severe level. Measured egr flow is lower than commanded.	Possible reduced engine performance.
3383 3058 16	Engine exhaust gas recirculation (EGR) system - Data valid but above normal operating range - Moderately severe Level. Measured EGR flow is higher than commanded.	Possible reduced engine performance.
3394 4766 18	Aftertreatment 1 diesel oxidation catalyst outlet gas temperature - Data valid but below normal operating range - Moderately severe level. The diesel oxidation catalyst outlet Temperature is below the operating limit	Possible frequent need for aftertreatment regeneration.
3396 3750 31	Diesel particulate filter 1 conditions not met for active regeneration - Condition exists. The aftertreatment temperatures are not warm enough for aftertreatment injection.	Possible frequent need for aftertreatment regeneration.
3418 191 19	Transmission output shaft speed - Received network data in error. The J1939 multiplexing controller has indicated a malfunction of the transmission output shaft speed sensor.	None on performance.
3422 4344 3	Aftertreatment diesel exhaust fluid line heater 3 circuit - Voltage above normal or shorted to high source. High signal voltage detected at the diesel exhaust fluid line heater 3 circuit.	Possible reduced engine performance.
3423 4344 4	Aftertreatment diesel exhaust fluid line heater 3 circuit - Voltage below normal, or shorted to low source. Low signal voltage detected at the diesel exhaust fluid line heater 3 circuit.	Possible reduced engine performance.
3425 4344 5	Aftertreatment diesel exhaust fluid line heater 3 circuit - Current below normal or open circuit. Open circuit detected in the diesel exhaust fluid line heater 3.	Possible reduced engine performance.
3488 563 9	Anti-lock braking (ABS) controller - Abnormal update rate. No communication or an invalid data transfer rate has been detected on the J1939 data link between the ECM and the anti-lock braking (ABS) controller.	None on performance.
3492 251 10	Real time clock - Abnormal rate of change. The real time clock indicates a stuck engine off timer.	None on performance.
3494 1081 7	Engine wait to start lamp - Mechanical system not responding or out of adjustment. Wait to Start lamp has malfunction.	None on performance.
3497 1761 17	Aftertreatment diesel exhaust fluid tank level - Data valid but below normal operating range - Least severe level. The aftertreatment diesel exhaust fluid tank level is low.	None on performance.

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
3498 1761 18	Aftertreatment diesel exhaust fluid tank level - Data valid but below normal operating range - Moderately severe level. The aftertreatment diesel exhaust fluid tank level is very low.	None on performance.
3525 84 19	Wheel-based vehicle speed - Received network data in error. The J1939 multiplexing controller has indicated a malfunction of the wheel-based vehicle speed sensor.	Engine speed limited to maximum engine speed without VSS parameter value. Cruise control, gear-down protection, and road speed governor will not work.
3526 84 9	Wheel-Based vehicle speed - Abnormal update rate. No communication or an invalid data transfer rate has been detected on the J1939 data link between the ECM and the wheel-based vehicle speed sensor.	Engine speed limited to maximum engine speed without VSS parameter value. Cruise control, gear-down protection, and road speed governor will not work.
3527 558 19	Accelerator pedal or lever idle validation switch - Received network data in error. The J1939 multiplexing controller has indicated a malfunction of the accelerator pedal or lever idle validation switch.	The engine will only idle.
3528 558 9	Accelerator pedal or lever idle validation switch - Abnormal update rate. No communication or an invalid data transfer rate has been detected on the J1939 data link between the ECM and the accelerator pedal or lever idle validation switch.	Engine will only idle.
3531 171 9	Ambient air temperature - Abnormal update rate. No communication or an invalid data transfer rate has been detected on the J1939 data link between the ECM and the ambient air temperature sensor.	Possible reduced engine performance.
3532 171 19	Ambient air temperature - Received network data in error. The J1939 multiplexing controller has indicated a malfunction of the ambient air temperature sensor.	Possible reduced engine performance.
3539 51 3	Engine intake throttle actuator position sensor circuit - Voltage above normal, or shorted to high source. High signal voltage detected at the engine intake air throttle position sensor circuit.	Possible reduced engine performance.
3541 51 4	Engine intake throttle actuator position sensor circuit - Voltage below normal, or shorted to low source. Low signal voltage detected at the engine intake air throttle position sensor circuit.	Possible reduced engine performance.
3542 51 2	Engine intake throttle actuator position sensor - Data erratic, intermittent or incorrect. The engine intake air throttle position feedback is erratic or incorrect.	Possible reduced engine performance.
3545 3226 10	Aftertreatment outlet NOx sensor circuit - Abnormal rate of change. The aftertreatment outlet NOx sensor reading is not valid.	None on performance.

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
3547 4096 31	Aftertreatment diesel exhaust fluid tank empty - Condition exists. The diesel exhaust fluid tank is empty.	Possible reduced engine performance.
3555 1081 9	Engine wait to start lamp - Abnormal update rate. A loss of communication has been detected.	None on performance.
3556 1081 19	Engine wait to start lamp - Received network data in error. The ECM received an invalid signal on the SAE J1939 datalink.	None on performance.
3558 3361 3	Aftertreatment diesel exhaust fluid dosing unit - Voltage above normal or shorted to high source. High signal voltage detected at the aftertreatment diesel exhaust fluid dosing unit.	Possible reduced engine performance.
3559 3361 4	Aftertreatment diesel exhaust fluid dosing unit - Voltage below normal or shorted to low source. Low signal voltage detected at the aftertreatment diesel exhaust fluid dosing unit.	Possible reduced engine performance.
3562 5491 3	Aftertreatment diesel exhaust fluid line heater relay - Voltage above normal or shorted to high source. High signal voltage detected at the diesel exhaust fluid line heater relay.	Possible reduced engine performance.
3563 5491 4	Aftertreatment diesel exhaust fluid line heater relay - Voltage below normal or shorted to low source. Low signal voltage detected at the diesel exhaust fluid line heater relay.	Possible reduced engine performance.
3567 5394 5	Aftertreatment diesel exhaust fluid dosing valve - Current below normal or open circuit. A circuit error has been detected in the aftertreatment diesel exhaust fluid dosing valve circuit.	Possible reduced engine performance.
3568 5394 7	Aftertreatment diesel exhaust fluid (DEF) Dosing valve - Mechanical system not responding or out of adjustment. A mechanical malfunction has been detected in the DEF dosing valve.	Possible reduced engine performance.
3571 4334 3	Aftertreatment diesel exhaust fluid pressure sensor - Voltage above normal or shorted to high source. High signal voltage detected at the aftertreatment diesel exhaust fluid pressure sensor circuit.	Possible reduced engine performance.
3572 4334 4	Aftertreatment diesel exhaust fluid pressure sensor - Voltage below normal or shorted to low source. Low signal voltage detected at the diesel exhaust fluid pressure sensor circuit.	Possible reduced engine performance.
3574 4334 18	Aftertreatment diesel exhaust fluid pressure sensor - Data valid but below normal operating range - Moderately severe level. Low diesel exhaust fluid pressure has been detected in the dosing unit.	Possible reduced engine performance.

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
3575 4334 16	Aftertreatment diesel exhaust fluid pressure sensor - Data valid but above normal operating range - Moderately severe level. The diesel exhaust fluid dosing unit has detected a blockage in the diesel exhaust fluid return flow.	Possible reduced engine performance.
3577 4376 3	Aftertreatment diesel exhaust fluid return valve - Voltage above normal or shorted to high source. High signal voltage detected at the aftertreatment diesel exhaust fluid return valve.	Possible reduced engine performance.
3578 4376 4	Aftertreatment diesel exhaust fluid return valve - Voltage below normal, or shorted to low source. Low signal voltage detected at the diesel exhaust fluid return valve.	Possible reduced engine performance.
3582 4364 18	Aftertreatment SCR catalyst conversion efficiency - Data valid but below normal operating range - Moderately severe level. NOx conversion across the SCR catalyst is too low.	Possible reduced engine performance.
3583 5031 10	Aftertreatment outlet NOx sensor heater - Abnormal rate of change. The aftertreatment outlet NOx sensor heater is unable to maintain its normal operating temperature.	None on performance.
3596 4334 2	Aftertreatment diesel exhaust fluid pressure sensor - Data erratic, intermittent, or incorrect. The diesel exhaust fluid pressure sensor has reported a reading too high or low for the operating conditions.	Possible reduced engine performance.
3649 5024 10	Aftertreatment Intake NOx sensor heater - Abnormal rate of change. The aftertreatment intake NOx sensor heater is unable to maintain its normal operating temperature.	None on performance.
3681 3228 2	Aftertreatment outlet NOx sensor power supply - Data erratic, intermittent, or incorrect. The aftertreatment outlet NOx sensor indicates that the power supply to the sensor is incorrect.	None on performance.
3682 3218 2	Aftertreatment Intake NOx sensor power supply - Data erratic, intermittent or incorrect. The aftertreatment intake NOx sensor indicates that the power supply to the sensor is incorrect.	None on performance.
3697 630 12	Engine control module calibration memory - Bad intelligent device or component. Error internal to the ECM related to engine software failures.	Engine may not start or may be difficult to start.
3712 5246 0	Aftertreatment SCR operator inducement - Data valid but above normal operational range - Most severe level. Critical SCR related fault codes have been active for an extended period of time and require immediate attention.	Vehicle speed will be limited to 8 km [5 miles] per hour.

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
3714 1569 31	Engine protection torque derate - Condition exists. Critical fault codes related to engine operation are active.	Possible reduced engine performance.
3715 188 16	Engine speed at idle - Data valid but below normal operating range - Moderately severe level. The engine speed at idle has exceeded the governed idle speed.	Possible reduced engine performance.
3716 188 18	Engine speed at idle - Data valid but below normal operational range - Moderately severe level. Engine is not maintaining the governed idle speed.	None on performance.
3717 3226 13	Aftertreatment outlet NOx sensor - Out of calibration. A calibration mismatch between the aftertreatment outlet NOx sensor and the ECM has been detected.	None on performance.
3718 3216 13	Aftertreatment intake NOx - Out of calibration. A calibration mismatch between the aftertreatment intake NOx sensor and the ECM has been detected.	None on performance.
3724 168 17	Battery 1 voltage - Data valid but below normal operating range - Least severe level. Low voltage to the EGR valve device driver has been detected.	Possible reduced engine performance.
3725 3216 10	Aftertreatment Intake NOx sensor - Abnormal rate of change. The aftertreatment intake NOx sensor reading is not valid.	None on performance.
3727 5571 7	High pressure common rail fuel pressure relief valve - Mechanical system not responding or out of adjustment. The fuel rail high-pressure relief valve has opened at a lower than expected pressure.	Possible reduced engine performance.
3737 1675 31	Engine starter mode overcrank protection - Condition exists. The starter motor has been temporarily disabled in order to prevent starter damage.	Starter operation is prohibited until the starter motor has adequately cooled.
3741 5571 0	High pressure common rail fuel pressure relief valve - Data valid but above normal operational range - Most severe level. The fuel rail pressure relief valve has opened due to high fuel rail pressure.	Engine may run rough, may stop running, may not start, or may be difficult to start.
3749 3226 20	Aftertreatment outlet NOx sensor - Data not rational - Drifted high. An offset in the outlet NOx sensor reading has been detected.	None on performance.
3838 2978 9	Estimated engine parasitic losses - Percent torque - Abnormal update rate. A loss of communication has been detected.	None on performance.
3843 5603 9	Cruise control disable command - Abnormal update rate. No communication or an invalid data transfer rate has been detected on the J1939 data link between the ECM and the cruise control.	None on performance.

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
3844 5605 31	Cruise control pause command - Condition exists. The adaptive cruise control has dropped out and must be manually engaged.	Cruise control could possibly not operate.
3845 5603 31	Cruise control disable command - Condition exists. The adaptive cruise control has dropped out and must be manually engaged.	Cruise control could possibly not operate.
3899 5848 4	Aftertreatment 1 SCR Intermediate NH3 sensor - Voltage below normal, or shorted to low source. A circuit error has been detected in the NH3 sensor.	None on performance.
3911 5848 9	Aftertreatment SCR Intermediate NH3 sensor - Abnormal update rate. Loss of communication with the aftertreatment SCR intermediate NH3 sensor.	Possible reduced engine performance.
3912 5853 10	Aftertreatment SCR Intermediate NH3 sensor heater - Abnormal rate of change. A malfunction of the aftertreatment SCR intermediate NH3 sensor heater has been detected.	Possible reduced engine performance.
3932 5851 16	Aftertreatment SCR Intermediate NH3 gas sensor power supply - Data valid but above normal operating range - Moderately severe level. High battery voltage supply detected at the aftertreatment SCR intermediate NH3 sensor.	Possible reduced engine performance.
3933 5851 18	Aftertreatment SCR Intermediate NH3 gas sensor power supply - Data valid but below normal operating range - Moderately severe level. Low battery voltage supply detected at the aftertreatment SCR intermediate NH3 sensor.	Possible reduced engine performance.
3934 5851 2	Aftertreatment SCR Intermediate NH3 gas sensor power supply - Data erratic, intermittent or incorrect. Intermittent battery voltage supply detected at the aftertreatment SCR intermediate NH3 sensor.	Possible reduced engine performance.
3935 5848 13	Aftertreatment SCR Intermediate NH3 sensor - Out of calibration. Incorrect trim resistance has been detected in the aftertreatment SCR intermediate NH3 sensor.	Possible reduced engine performance.
3936 5848 12	Aftertreatment SCR Intermediate NH3 sensor - Bad intelligent device or component. An internal error of the aftertreatment SCR intermediate NH3 sensor has been detected.	Possible reduced engine performance.
3937 5848 10	Aftertreatment 1 SCR Intermediate NH3 sensor - Abnormal rate of change. The aftertreatment SCR intermediate NH3 sensor reading is NOT valid.	Possible reduced engine performance.

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
4149 2623 8	Accelerator pedal or lever position sensor 2 circuit frequency - Abnormal frequency or pulse width or period. The accelerator pedal position sensor reading is out of range.	The engine will operate in Limp Home mode.
4151 5742 9	Aftertreatment diesel particulate filter temperature sensor module - Abnormal update rate. No communications on the J1939 data link between the ECM and the aftertreatment diesel particulate filter temperature sensor module.	Possible reduced engine performance.
4152 5743 9	Aftertreatment selective catalytic reduction temperature sensor module - Abnormal update rate. No communications on the J1939 data link between the ECM and the aftertreatment SCR temperature sensor module.	Possible reduced engine performance.
4155 5746 3	Aftertreatment 1 diesel exhaust fluid dosing unit heater relay - Voltage above normal, or shorted to high source. High signal voltage detected at the aftertreatment diesel exhaust fluid dosing unit heater relay circuit.	Possible reduced engine performance.
4156 5746 4	Aftertreatment 1 diesel exhaust fluid dosing unit heater relay - Voltage below normal, or shorted to low source. Low signal voltage detected at the aftertreatment diesel exhaust fluid dosing unit heater relay circuit.	Possible reduced engine performance.
4157 4376 7	Aftertreatment diesel exhaust fluid return valve - Mechanical system not responding or out of adjustment. A stuck aftertreatment diesel exhaust fluid return valve has been detected.	None on performance.
4158 5742 12	Aftertreatment diesel particulate filter temperature sensor module - Bad intelligent device or component. An internal error has been detected in the aftertreatment diesel particulate filter temperature sensor module.	Possible reduced engine performance.
4159 5743 12	Aftertreatment selective catalytic reduction temperature sensor module - Bad intelligent device or component. An internal error has been detected in the aftertreatment SCR temperature sensor module.	Possible reduced engine performance.
4161 5742 3	Aftertreatment diesel particulate filter temperature sensor module - Voltage above normal, or shorted to high source. High battery supply voltage detected at the aftertreatment diesel particulate filter temperature sensor module.	Possible reduced engine performance.
4162 5742 4	Aftertreatment diesel particulate filter temperature sensor module - Voltage below normal, or shorted to low source. Low battery supply voltage detected at the aftertreatment diesel particulate filter temperature sensor module.	Possible reduced engine performance.

※ Some fault codes are not applied to this machine.



Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
4163 5742 16	Aftertreatment diesel particulate filter temperature sensor module- Data valid but above normal operating range - Moderately severe level. High internal temperature detected in the aftertreatment diesel particulate filter temperature sensor module.	Possible reduced engine performance.
4164 5743 3	Aftertreatment selective catalytic reduction temperature sensor module - Voltage above normal, or shorted to high source. High battery supply voltage detected at the aftertreatment SCR temperature sensor module.	Possible reduced engine performance.
4165 5743 4	Aftertreatment selective catalytic reduction temperature sensor module - Voltage below normal, or shorted to low source. Low battery supply voltage detected at the aftertreatment SCR temperature sensor module.	Possible reduced engine performance.
4166 5743 16	Aftertreatment selective catalytic reduction temperature sensor module - Data valid but above normal operating range - Moderately severe level. High internal temperature detected in the aftertreatment SCR temperature sensor module.	Possible reduced engine performance.
4168 5745 3	Aftertreatment diesel exhaust fluid dosing unit heater - Voltage above normal, or shorted to high source. The aftertreatment diesel exhaust fluid dosing unit heater is detected to be stuck on.	None on performance.
4169 5745 5	Aftertreatment diesel exhaust fluid dosing unit heater - Voltage below normal, or shorted to low source. The aftertreatment diesel exhaust fluid dosing unit heater is detected to be stuck off.	Possible reduced engine performance.
4171 5745 18	Aftertreatment diesel exhaust fluid dosing unit heater - Data valid but below normal operating range - Moderately severe level. The aftertreatment diesel exhaust fluid dosing unit failed to thaw.	Possible reduced engine performance.
4213 3695 2	Aftertreatment diesel particulate filter regeneration inhibit switch - Data erratic, intermittent or incorrect. The diesel particulate filter regeneration permit switch is stuck in the OFF or INHIBIT position.	Possible frequent need for aftertreatment regeneration.
4215 563 31	Anti-lock braking (ABS) Active - Condition exists. Cruise control was paused due to an anti-wheel slip message from the ABS controller.	Adaptive cruise control will not operate. Standard cruise control may not operate.
4244 4337 2	Aftertreatment diesel exhaust fluid dosing temperature - Data erratic, intermittent or incorrect. The aftertreatment diesel exhaust fluid dosing temperature is irrational.	None on performance.

※ Some fault codes are not applied to this machine.



Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
4245 5798 2	Aftertreatment diesel exhaust fluid dosing unit heater temperature - Data erratic, intermittent or incorrect. The aftertreatment diesel exhaust fluid dosing unit heater temperature is irrational.	None on performance.
4249 4337 10	Aftertreatment diesel exhaust fluid dosing temperature - Abnormal rate of change. The aftertreatment diesel exhaust fluid dosing unit temperature is stuck.	None on performance.
4251 5798 10	Aftertreatment 1 diesel exhaust fluid dosing unit heater temperature - Abnormal rate of change. The aftertreatment diesel exhaust fluid dosing unit heater temperature sensor reading is stuck.	None on performance.
4252 1081 31	Engine wait to start lamp - Condition exists. The received signal does not match the commanded signal.	None on performance.
4259 5742 11	Aftertreatment diesel particulate filter temperature sensor module - Root cause not known. Intermittent battery voltage supply detected at the aftertreatment diesel particulate filter temperature sensor module.	Possible reduced engine performance.
4261 5743 11	Aftertreatment selective catalytic reduction temperature sensor module - Root cause not known. Intermittent battery voltage supply detected at the aftertreatment SCR temperature sensor module.	Possible reduced engine performance.
4279 5848 21	Aftertreatment 1 SCR Intermediate NH3 - Data not rational - Drifted low. An in range low failure has been detected.	Possible reduced engine performance.
4281 5848 2	Aftertreatment SCR Intermediate NH3 - Data erratic, intermittent or incorrect. The aftertreatment SCR intermediate NH3 sensor reading is stuck.	None on performance.
4284 5793 9	Desired engine fueling state - Abnormal update rate. A valid message from the transmission ECU has NOT been received.	Engine may not start or may be difficult to start.
4289 91 8	Accelerator pedal or lever position sensor 1 circuit frequency - Abnormal frequency or pulse width or period. The accelerator pedal position sensor reading is out of range.	The engine will operate in limp home mode.
4452 520668 31	Aftertreatment outlet NOx sensor closed loop operation - Condition exists. The maximum dosing adjustment has been reached.	Possible reduced engine performance.
4453 520669 31	Aftertreatment intermediate NH3 sensor closed loop operation - Condition exists. The maximum dosing adjustment has been reached.	None on performance.
4517 237 13	Vehicle Identification number - Out of calibration. The vehicle identification number has not been programmed into the ECM.	None on performance.

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
4518 5862 3	Aftertreatment SCR Intermediate gas temperature sensor circuit - Voltage above normal, or shorted to high source. High signal voltage detected at the aftertreatment SCR intermediate temperature sensor circuit.	Possible reduced engine performance.
4519 5862 4	Aftertreatment SCR Intermediate gas temperature sensor circuit - Voltage below normal, or shorted to low source. Low signal voltage detected at the aftertreatment SCR intermediate temperature sensor circuit.	Possible reduced engine performance.
4521 5862 2	Aftertreatment SCR Intermediate gas temperature sensor - Data erratic, intermittent or incorrect. The aftertreatment SCR intermediate temperature sensor reading is irrational.	Possible reduced engine performance.
4524 5862 0	Aftertreatment SCR intermediate gas temperature - Data valid but above normal operational range - Most severe level. The aftertreatment SCR intermediate temperature sensor reading is above the engine protection limit.	Progressive power and/or speed derate increasing in severity from time of alert. If the engine protection shutdown feature is enabled, the engine will shut down 30 seconds after the red STOP lamps starts flashing.
4525 5862 16	Aftertreatment 1 SCR intermediate gas temperature - Data valid but above normal operating range - Moderately severe level. High SCR Intermediate temperature detected.	Progressive power and/or speed derate increasing in severity from time of alert. If the engine protection shutdown feature is enabled, the engine will shut down 30 seconds after the red STOP lamps starts flashing.
4526 521 2	Brake pedal position - Data erratic, intermittent or incorrect. The values of the 2 brake switch signals do not match.	None on performance.
4572 3031 9	Aftertreatment diesel exhaust fluid tank temperature - Abnormal update rate. The ECM lost communication with the aftertreatment diesel exhaust fluid tank temperature sensor.	Possible reduced engine performance.
4584 3936 14	Aftertreatment diesel particulate filter system - Special instructions. The incorrect aftertreatment diesel particulate filter system has been installed with the engine.	Engine will be shut down.
4585 4792 14	Aftertreatment 1 SCR catalyst system - Special instructions. The incorrect SCR system has been Installed.	Engine will be shut down.
4612 520701 31	Engine intake manifold pressure system monitor - Condition exists. The engine is unable to meet the air handling system commands.	Possible reduced engine performance.
4658 4331 18	Aftertreatment SCR actual dosing reagent quantity - Data valid but below normal operating range - Moderately severe level. Low aftertreatment diesel exhaust fluid flow detected.	Possible reduced engine performance.

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
4691 5585 18	Engine injector metering rail 1 cranking pressure - Data valid but below normal operating range - Moderately severe level. The fuel rail pressure during cranking is too low for the engine to start.	Engine may not start or may be difficult to start.
4713 5357 31	Engine fuel injection quantity error for multiple cylinders - Condition exists. A malfunction of all fuel injectors has been detected.	Engine may run rough, may stop running, may not start, or may be difficult to start.
4726 1239 16	Engine fuel leakage - Data valid but above normal operating range - Moderately severe level. Fuel rail pressure decay has been detected.	Engine may run rough, may stop running, may not start, or may be difficult to start.
4727 157 15	Injector metering rail 1 pressure - Data valid but above normal operating range - Least severe level. A self pumping condition has been detected in the fuel system.	Possible reduced engine performance.
4731 3031 13	Aftertreatment diesel exhaust fluid tank temperature sensor - Out of calibration. The received datalink message was not valid.	Possible reduced engine performance.
4732 1761 13	Aftertreatment diesel exhaust fluid tank level sensor - Out of calibration. The received datalink message was not valid.	None on performance.
4739 1761 11	Aftertreatment 1 diesel exhaust fluid tank level sensor - Root cause not known. An unknown error has been detected with the aftertreatment diesel exhaust fluid tank level sensor.	Possible reduced engine performance.
4769 1761 10	Aftertreatment 1 diesel exhaust fluid tank level sensor - Abnormal rate of change. A valid diesel exhaust fluid tank level reading has NOT been received.	Possible reduced engine performance.
4865 6303 3	Engine coolant level 2 sensor circuit - Voltage above normal, or shorted to high source. High signal voltage detected at the engine coolant level 2 circuit.	None on performance.
4866 6303 4	Engine coolant level 2 sensor circuit - Voltage below normal, or shorted to low source. Low signal voltage detected at the engine coolant level 2 circuit.	None on performance.
4956 520750 13	Engine variable geometry turbo (VGT) software - Out of calibration. VGT software does not match application.	Possible reduced engine performance.
4957 520750 31	Engine variable geometry turbo (VGT) software - Condition exists. The VGT actuator and ECM software is not compatible.	Possible reduced engine performance.

※ Some fault codes are not applied to this machine.

### 3) DEFINITION OF OPERATING MODES

#### (1) Normal

There's no failure detected in the transmission system or the failure has no or slight effects on transmission control. TCU will work without or in special cases with little limitations. (See following table)

#### (2) Substitute clutch control

TCU can't change the gears or the direction under the control of the normal clutch modulation.

TCU uses the substitute strategy for clutch control. All modulations are only time controlled. (Comparable with EST 25)

#### (3) Limp-home

The detected failure in the system has strong limitations to transmission control. TCU can engage only one gear in each direction. In some cases only one direction will be possible.

TCU will shift the transmission into neutral at the first occurrence of the failure. First, the operator must shift the gear selector into neutral position.

If output speed is less than a threshold for neutral to gear and the operator shifts the gear selector into forward or reverse, the TCU will select the limp-home gear.

If output speed is less than a threshold for reversal speed and TCU has changed into the limp-home gear and the operator selects a shuttle shift, TCU will shift immediately into the limp-home gear of the selected direction.

If output speed is greater than the threshold, TCU will shift the transmission into neutral. The operator has to slow down the vehicle and must shift the gear selector into neutral position.

#### (4) Transmission-shutdown

TCU has detected a severe failure that disables control of the transmission.

TCU will shut off the solenoid valves for the clutches and also the common power supply (VPS1).

Transmission shifts to neutral. The park brake will operate normally, also the other functions which use ADM1 to ADM8.

The operator has to slow down the vehicle. The transmission will stay in neutral.

#### (5) TCU-shutdown

TCU has detected a severe failure that disables control of system.

TCU will shut off all solenoid valves and also both common power supplies (VPS1, VPS2). The park brake will engage, also functions are disabled which use ADM 1 to ADM 8.

The transmission will stay in neutral.

#### ※ Abbreviations

OC : Open circuit

SC : Short circuit

OP mode : Operating mode

TCU : Transmission control unit

EEC : Electronic engine controller

PTO : Power take off

#### 4) TRANSMISSION FAULT CODES

Fault code (Hex)	Meaning of the fault code possible reason for fault detection	Reaction of the TCU	Possible steps to repair
10	Logical error at direction select signal 3rd shift lever TCU detected a wrong signal combination for the direction · Cable from shift lever 3 to TCU is broken · Cable is defective and is contacted to battery voltage or vehicle ground · Shift lever is defective	TCU shifts transmission to neutral if selector active OP mode : Transmission shutdown if selector active	<ul style="list-style-type: none"> <li>· Check the cables from TCU to shift lever 3</li> <li>· Check signal combinations of shift lever positions F-N-R</li> <li>· If shift lever is a CAN shift lever check CAN cable/shifter/device</li> </ul> ※ Fault is cleared if TCU detects a valid neutral signal for the direction at the shift lever
11	Logical error at gear range signal TCU detected a wrong signal combination for the gear range · Cable from shift lever to TCU is broken · Cable is defective and is contacted to battery voltage or vehicle ground · Shift lever is defective	TCU shifts transmission to neutral OP mode : Transmission shutdown	<ul style="list-style-type: none"> <li>· Check the cables from TCU to shift lever</li> <li>· Check signal combinations of shift lever positions for gear range</li> </ul> ※ Failure cannot be detected in systems with DW2/DW3 shift lever. Fault is taken back if TCU detects a valid signal for the position
12	Logical error at direction select signal TCU detected a wrong signal combination for the direction · Cable from shift lever to TCU is broken · Cable is defective and is contacted to battery voltage or vehicle ground · Shift lever is defective	TCU shifts transmission to neutral OP mode : Transmission shutdown	<ul style="list-style-type: none"> <li>· Check the cables from TCU to shift lever</li> <li>· Check signal combinations of shift lever positions F-N-R</li> </ul> ※ Fault is taken back if TCU detects a valid signal for the direction at the shift lever
13	Logical error at engine derating device TCU detected no reaction of engine while derating device active	After selecting neutral, TCU change to OP mode limp home	<ul style="list-style-type: none"> <li>· Check engine derating device</li> </ul> ※ This fault is reset after power up of TCU
15	Logical error at direction select signal 2 shift lever TCU detected a wrong signal combination for the direction · Cable from shift lever 2 to TCU is broken · Cable is defective and is contacted to battery voltage or vehicle ground · Shift lever is defective	TCU shifts transmission to neutral if selector active OP mode : Transmission shutdown if selector active	<ul style="list-style-type: none"> <li>· Check the cables from TCU to shift lever 2</li> <li>· Check signal combinations of shift lever positions F-N-R</li> </ul> ※ Fault is taken back if TCU detects a valid neutral signal for the direction at the shift lever
17	S.C. to ground at customer specific function No. 1 (ride control) TCU detected a wrong voltage at the output pin, that looks like a S.C. to vehicle ground · Cable is defective and is contacted to vehicle ground · Customer specific function No. 1 device has an internal defect · Connector pin is contacted to vehicle ground	Customer specific	<ul style="list-style-type: none"> <li>· Check the cable from TCU to customer specific function No. 1 device</li> <li>· Check the connectors from customer specific function No. 1 to TCU</li> <li>· Check the resistance of customer specific function No. 1 device</li> </ul>

※ Some fault codes are not applied to this machine.

Fault code (Hex)	Meaning of the fault code possible reason for fault detection	Reaction of the TCU	Possible steps to repair
18	S.C. to battery voltage at customer specific function No. 1 (ride control) TCU detected a wrong voltage at the output pin, that looks like a S.C. to battery voltage <ul style="list-style-type: none"> <li>· Cable is defective and is contacted to battery voltage</li> <li>· Customer specific function No. 1 device has an internal defect</li> <li>· Connector pin is contacted to battery voltage</li> </ul>	Customer specific	<ul style="list-style-type: none"> <li>· Check the cable from TCU to customer specific function No. 1 device</li> <li>· Check the connectors from customer specific function No. 1 to TCU</li> <li>· Check the resistance of customer specific function No. 1 device</li> </ul>
19	O.C. at customer specific function No. 1 (ride control) TCU detected a wrong voltage at the output pin, that looks like a O.C. for this output pin <ul style="list-style-type: none"> <li>· Cable is defective and has no connection to TCU</li> <li>· Customer specific function No. 1 device has an internal defect</li> <li>· Connector has no connection to TCU</li> </ul>	Customer specific	<ul style="list-style-type: none"> <li>· Check the cable from TCU to customer specific function No. 1 device</li> <li>· Check the connectors from customer specific function No. 1 device to TCU</li> <li>· Check the resistance of customer specific function No. 1 device</li> </ul>
21	S.C. to battery voltage at clutch cut off input The measured voltage is too high: <ul style="list-style-type: none"> <li>· Cable is defective and is contacted to battery voltage</li> <li>· Clutch cut off sensor has an internal defect</li> <li>· Connector pin is contacted to battery voltage</li> </ul>	Clutch cut off function is disabled OP mode : Normal	<ul style="list-style-type: none"> <li>· Check the cable from TCU to the sensor</li> <li>· Check the connectors</li> <li>· Check the clutch cut off sensor</li> </ul>
22	S.C. to ground or O.C. at clutch cut off input The measured voltage is too low: <ul style="list-style-type: none"> <li>· Cable is defective and is contacted to vehicle ground</li> <li>· Cable has no connection to TCU</li> <li>· Clutch cut off sensor has an internal defect</li> <li>· Connector pin is contacted to vehicle ground or is broken</li> </ul>	Clutch cut off function is disabled OP mode : Normal	<ul style="list-style-type: none"> <li>· Check the cable from TCU to the sensor</li> <li>· Check the connectors</li> <li>· Check the clutch cut off sensor</li> </ul>
25	S.C. to battery voltage or O.C. at transmission sump temperature sensor input The measured voltage is too high: <ul style="list-style-type: none"> <li>· Cable is defective and is contacted to battery voltage</li> <li>· Cable has no connection to TCU</li> <li>· Temperature sensor has an internal defect</li> <li>· Connector pin is contacted to battery voltage or is broken</li> </ul>	No reaction, TCU use default temperature OP mode : Normal	<ul style="list-style-type: none"> <li>· Check the cable from TCU to the sensor</li> <li>· Check the connectors</li> <li>· Check the temperature sensor</li> </ul>

※ Some fault codes are not applied to this machine.

Fault code (Hex)	Meaning of the fault code possible reason for fault detection	Reaction of the TCU	Possible steps to repair
26	S.C. to battery voltage or O.C. at transmission sump temperature sensor input The measured voltage is too low: · Cable is defective and is contacted to vehicle ground · Temperature sensor has an internal defect · Connector pin is contacted to vehicle ground	No reaction, TCU uses default temperature OP mode : Normal	· Check the cable from TCU to the sensor · Check the connectors · Check the temperature sensor
27	S.C. to battery voltage or O.C. at retarder temperature sensor input The measured voltage is too high: · Cable is defective and is contacted to battery voltage · Cable has no connection to TCU · Temperature sensor has an internal defect · Connector pin is contacted to battery voltage or is broken	No reaction, TCU uses default temperature OP mode : Normal	· Check the cable from TCU to the sensor · Check the connectors · Check the temperature sensor
28	S.C. to ground at retarder temperature sensor input The measured voltage is too low: · Cable is defective and is contacted to vehicle ground · Temperature sensor has an internal defect · Connector pin is contacted to vehicle ground	No reaction, TCU uses default temperature OP mode : Normal	· Check the cable from TCU to the sensor · Check the connectors · Check the temperature sensor
31	S.C. to battery voltage or O.C. at engine speed input TCU measures a voltage higher than 7.00V at speed input pin · Cable is defective and is contacted to battery voltage · Cable has no connection to TCU · Speed sensor has an internal defect · Connector pin is contacted to battery voltage or has no contact	OP mode : Substitute clutch control	· Check the cable from TCU to the sensor · Check the connectors · Check the speed sensor
32	S.C. to ground at engine speed input TCU measures a voltage less than 0.45V at speed input pin · Cable/connector is defective and is contacted to vehicle ground · Speed sensor has an internal defect	OP mode : Substitute clutch control	· Check the cable from TCU to the sensor · Check the connectors · Check the speed sensor
33	Logical error at engine speed input TCU measures a engine speed over a threshold and the next moment the measured speed is zero · Cable/connector is defective and has bad contact · Speed sensor has an internal defect · Sensor gap has the wrong size	OP mode : Substitute clutch control	· Check the cable from TCU to the sensor · Check the connectors · Check the speed sensor · Check the sensor gap ※ This fault is reset after power up of TCU

※ Some fault codes are not applied to this machine.



Fault code (Hex)	Meaning of the fault code possible reason for fault detection	Reaction of the TCU	Possible steps to repair
34	S.C. to battery voltage or O.C. at turbine speed input TCU measures a voltage higher than 7.00V at speed input pin · Cable is defective and is contacted to vehicle battery voltage · Cable has no connection to TCU · Speed sensor has an internal defect · Connector pin is contacted to battery voltage or has no contact	OP mode : Substitute clutch control If a failure is existing at output speed, TCU shifts to neutral OP mode : Limp home	· Check the cable from TCU to the sensor · Check the connectors · Check the speed sensor
35	S.C. to ground at turbine speed input TCU measures a voltage less than 0.45V at speed input pin · Cable/connector is defective and is contacted to vehicle ground · Speed sensor has an internal defect	OP mode : Substitute clutch control If a failure is existing at output speed, TCU shifts to neutral OP mode : Limp home	· Check the cable from TCU to the sensor · Check the connectors · Check the speed sensor ※ This fault is reset after power up of TCU
36	Logical error at turbine speed input TCU measures a turbine speed over a threshold and at the next moment the measured speed is zero · Cable/connector is defective and has bad contact · Speed sensor has an internal defect · Sensor gap has the wrong size	OP mode : Substitute clutch control If a failure is existing at output speed, TCU shifts to neutral OP mode : Limp home	· Check the cable from TCU to the sensor · Check the connectors · Check the speed sensor · Check the sensor gap
37	S.C. to battery voltage or O.C. at internal speed input TCU measures a voltage higher than 7.00V at speed input pin · Cable is defective and is contacted to vehicle battery voltage · Cable has no connection to TCU · Speed sensor has an internal defect · Connector pin is contacted to battery voltage or has no contact	OP mode : Substitute clutch control	· Check the cable from TCU to the sensor · Check the connectors · Check the speed sensor
38	S.C. to ground at turbine speed input TCU measures a voltage less than 0.45V at speed input pin · Cable/connector is defective and is contacted to vehicle ground · Speed sensor has an internal defect	OP mode : Substitute clutch control	· Check the cable from TCU to the sensor · Check the connectors · Check the speed sensor
39	Logical error at internal speed input TCU measures a internal speed over a threshold and at the next moment the measured speed is zero · Cable/connector is defective and has bad contact · Speed sensor has an internal defect · Sensor gap has the wrong size	OP mode : Substitute clutch control	· Check the cable from TCU to the sensor · Check the connectors · Check the speed sensor · Check the sensor gap ※ This fault is reset after power up of TCU
3A	S.C. to battery voltage or O.C. at output speed input TCU measures a voltage higher than 12.5V at speed input pin · Cable is defective and is contacted to battery voltage · Cable has no connection to TCU · Speed sensor has an internal defect · Connector pin is contacted to battery voltage or has no contact	Special mode for gear selection OP mode : Substitute clutch control If a failure is existing at turbine speed, TCU shifts to neutral OP mode : Limp home	· Check the cable from TCU to the sensor · Check the connectors · Check the speed sensor

※ Some fault codes are not applied to this machine.



Fault code (Hex)	Meaning of the fault code possible reason for fault detection	Reaction of the TCU	Possible steps to repair
3B	S.C. to ground at output speed input TCU measures a voltage less than 1.00V at speed input pin · Cable/connector is defective and is contacted to vehicle ground · Speed sensor has an internal defect	Special mode for gear selection OP mode : Substitute clutch control If a failure is existing at turbine speed, TCU shifts to neutral OP mode : Limp home	· Check the cable from TCU to the sensor · Check the connectors · Check the speed sensor
3C	Logical error at output speed input TCU measures a turbine speed over a threshold and at the next moment the measured speed is zero · Cable/connector is defective and has bad contact · Speed sensor has an internal defect · Sensor gap has the wrong size	Special mode for gear selection OP mode : Substitute clutch control If a failure is existing at turbine speed, TCU shifts to neutral OP mode : Limp home	· Check the cable from TCU to the sensor · Check the connectors · Check the speed sensor · Check the sensor gap ※ This fault is reset after power up of TCU
3D	Turbine speed zero doesn't fit to other speed signals	-	· Not used
3E	Output speed zero doesn't fit to other speed signals If transmission is not neutral and the shifting has finished, TCU measures output speed zero and turbine speed or internal speed not equal to zero. · Speed sensor has an internal defect · Sensor gap has the wrong size	Special mode for gear selection OP mode : Substitute clutch control If a failure is existing at turbine speed, TCU shifts to neutral OP mode : Limp home	· Check the sensor signal of output speed sensor · Check the sensor gap of output speed sensor · Check the cable from TCU to the sensor ※ This fault is reset after power up of TCU
54	DCT1 timeout Timeout of CAN-message DCT1 from display computer · Interference on CAN-Bus · CAN wire/connector is broken · CAN wire/connector is defective and has contact to vehicle ground or battery voltage	OP mode : Normal	· Check display computer · Check wire of CAN-Bus · Check cable to display computer
55	JSS timeout Timeout of CAN-message JSS from joystick steering controller · Interference on CAN-Bus · CAN wire/connector is broken · CAN wire/connector is defective and has contact to vehicle ground or battery voltage	TCU shifts to neutral while joystick steering is active OP mode : Normal	· Check joystick steering controller · Check wire of CAN-Bus · Check cable to joystick steering controller
56	Engine CONF timeout Timeout of CAN-message engine CONF from engine controller · Interference on CAN-Bus · CAN wire/connector is broken · CAN wire/connector is defective and has contact to vehicle ground or battery voltage	OP mode : Substitute clutch control	· Check engine controller · Check wire of CAN-Bus · Check cable to engine controller

※ Some fault codes are not applied to this machine.

Fault code (Hex)	Meaning of the fault code possible reason for fault detection	Reaction of the TCU	Possible steps to repair
57	EEC1 timeout Timeout of CAN-message EEC1 from EEC controller · Interference on CAN-Bus · CAN wire/connector is broken · CAN wire/connector is defective and has contact to vehicle ground or battery voltage	OP mode : Substitute clutch control	· Check EEC controller · Check wire of CAN-Bus · Check cable to EEC controller
58	EEC3 timeout Timeout of CAN-message EEC3 from EEC controller · Interference on CAN-Bus · CAN wire/connector is broken · CAN wire/connector is defective an has contact to vehicle ground or battery voltage	OP mode : Substitute clutch control	· Check EEC controller · Check wire of CAN-Bus · Check cable to EEC controller
5C	Auto downshift signal CAN signal for automatic downshift is defective · Cluster controller is defective · Interference on CAN-Bus	No reaction	· Check cluster controller · Check wire of CAN-Bus · Check cable to cluster controller
5D	Manual downshift signal CAN signal for manual downshift is defective · Cluster controller is defective · Interference on CAN-Bus	No reaction	· Check cluster controller · Check wire of CAN-Bus · Check cable to controller
5E	CCO request signal CAN signal for CCO request is defective · Cluster controller is defective · Interference on CAN-Bus	No reaction	· Check cluster controller · Check wire of CAN-Bus · Check cable to controller
61	AEB request signal CAN signal for AEB request is defective · I/O controller is defective · Interference on CAN-Bus	No reaction OP mode : Normal	· Check I/O controller, Omron master · Check wire of CAN-Bus · Check cable to I/O controller, Omron master
64	Sarting gear signal CAN signal for starting gear is defective · I/O controller is defective (illegal starting gear) · Interference on CAN-Bus	No reaction. TCU uses default starting gear OP mode : Normal	· Check I/O controller · Check wire of CAN-Bus · Check cable to I/O controller
65	Engine torque signal CAN signal for engine torque is defective · Engine controller is defective · Interference on CAN-Bus	OP mode : Substitute clutch control	· Check engine controller · Check wire of CAN-Bus · Check cable to engine controller
69	Reference engine torque signal CAN signal for reference of engine torque is defective · Engine controller is defective · Interference on CAN-Bus	OP mode : Substitute clutch control	· Check engine controller · Check wire of CAN-Bus · Check cable to engine controller
6A	Actual engine torque signal CAN signal for actual engine torque is defective · Engine controller is defective · Interference on CAN-Bus	OP mode : Substitute clutch control	· Check engine controller · Check wire of CAN-Bus · Check cable to engine controller

※ Some fault codes are not applied to this machine.

Fault code (Hex)	Meaning of the fault code possible reason for fault detection	Reaction of the TCU	Possible steps to repair
6E	EEC2 timeout Timeout of CAN-message EEC2 from EEC controller · Interference on CAN-Bus · CAN wire/connector is broken · CAN wire/connector is defective and has contact to vehicle ground or battery voltage	No reaction, TCU uses default signal accelerator pedal in idle position OP mode : Normal	· Check EEC controller · Check wire of CAN-Bus · Check cable to EEC controller
71	S.C. to battery voltage at clutch K1 The measured resistance value of the valve is out of limit, the voltage at K1 valve is too high · Cable/connector is defective and has contact to battery voltage · Cable/connector is defective and has contact to another regulator output of the TCU · Regulator has an internal defect	TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown	· Check the cable from TCU to the gearbox · Check the connectors from TCU to the gearbox · Check the regulator resistance* · Check internal wire harness of the gearbox * See page 3-74
72	S.C. to ground at clutch K1 The measured resistance value of the valve is out of limit, the voltage at K1 valve is too low · Cable/connector is defective and has contact to vehicle ground · Regulator has an internal defect	TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown	· Check the cable from TCU to the gearbox · Check the connectors from gearbox to TCU · Check the regulator resistance* · Check internal wire harness of the gearbox * See page 3-74
73	O.C. at clutch K1 The measured resistance value of the valve is out of limit · Cable/connector is defective and has no contact to TCU · Regulator has an internal defect	TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown	· Check the cable from TCU to the gearbox · Check the connectors from gearbox to TCU · Check the regulator resistance* · Check internal wire harness of the gearbox * See page 3-74
74	S.C. to battery voltage at clutch K2 The measured resistance value of the valve is out of limit, the voltage at K2 valve is too high · Cable/connector is defective and has contact to battery voltage · Cable/connector is defective and has contact to another regulator output of the TCU · Regulator has an internal defect	TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown	· Check the cable from TCU to the gearbox · Check the connectors from gearbox to TCU · Check the regulator resistance* · Check internal wire harness of the gearbox * See page 3-74
75	S.C. to ground at clutch K2 The measured resistance value of the valve is out of limit, the voltage at K2 valve is too low · Cable/connector is defective and has contact to vehicle ground · Regulator has an internal defect	TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown	· Check the cable from TCU to the gearbox · Check the connectors from gearbox to TCU · Check the regulator resistance* · Check internal wire harness of the gearbox * See page 3-74

※ Some fault codes are not applied to this machine.

Fault code (Hex)	Meaning of the fault code possible reason for fault detection	Reaction of the TCU	Possible steps to repair
76	O.C. at clutch K2 The measured resistance value of the valve is out of limit · Cable/connector is defective and has no contact to TCU · Regulator has an internal defect	TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown	· Check the cable from TCU to the gearbox · Check the connectors from gearbox to TCU · Check the regulator resistance* · Check internal wire harness of the gearbox * See page 3-74
77	S.C. to battery voltage at clutch K3 The measured resistance value of the valve is out of limit, the voltage at K3 valve is too high · Cable/connector is defective and has contact to battery voltage · Cable/connector is defective and has contact to another regulator output of the TCU · Regulator has an internal defect	TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown	· Check the cable from TCU to the gearbox · Check the connectors from gearbox to TCU · Check the regulator resistance* · Check internal wire harness of the gearbox * See page 3-74
78	S.C. to ground at clutch K3 The measured resistance value of the valve is out of limit, the voltage at K3 valve is too low · Cable/connector is defective and has contact to vehicle ground · Regulator has an internal defect	TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown	· Check the cable from TCU to the gearbox · Check the connectors from gearbox to TCU · Check the regulator resistance* · Check internal wire harness of the gearbox * See page 3-74
79	O.C. at clutch K3 The measured resistance value of the valve is out of limit · Cable/connector is defective and has no contact to TCU · Regulator has an internal defect	TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown	· Check the cable from TCU to the gearbox · Check the connectors from gearbox to TCU · Check the regulator resistance* · Check internal wire harness of the gearbox * See page 3-74
7D	S.C. ground at engine derating device · Cable is defective and is contacted to vehicle ground · Engine derating device has an internal defect · Connector pin is contacted to vehicle ground	Engine derating will be on until TCU power down even if fault vanishes (Loose connection) OP mode : Normal	· Check the cable from TCU to the engine derating device · Check the connectors from engine derating device to TCU · Check the resistance* of engine derating device ※ Not used * See page 3-74
7E	S.C. battery voltage at engine derating device · Cable/connector is defective and is contacted to battery voltage · Engine derating device has an internal defect	No reaction OP mode : Normal	· Check the cable from TCU to the engine derating device · Check the connectors from backup alarm device to TCU · Check the resistance* of backup alarm device * See page 3-74

※ Some fault codes are not applied to this machine.

Fault code (Hex)	Meaning of the fault code possible reason for fault detection	Reaction of the TCU	Possible steps to repair
7F	O.C. at engine derating device TCU detected a wrong voltage at the output pin, that looks like a O.C. for this output pin · Cable is defective and has no connection to TCU · Engine derating device has an internal defect · Connector has no connection to TCU	No reaction OP mode : Normal	· Check the cable from TCU to the engine derating device · Check the connectors from engine derating device to TCU · Check the resistance* of engine derating device * See page 3-74
81	S.C. to battery voltage at clutch K4 The measured resistance value of the valve is out of limit, the voltage at K4 valve is too high · Cable/connector is defective and has contact to battery voltage · Cable/connector is defective and has contact to another regulator output of the TCU · Regulator has an internal defect	TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown	· Check the cable from TCU to the gearbox · Check the connectors from gearbox to TCU · Check the regulator resistance* · Check internal wire harness of the gearbox * See page 3-74
82	S.C. to ground at clutch K4 The measured resistance value of the valve is out of limit, the voltage at K4 valve is too low · Cable/connector is defective and has contact to vehicle ground · Regulator has an internal defect	TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown	· Check the cable from TCU to the engine derating device · Check the connectors from gearbox to TCU · Check the regulator resistance* · Check internal wire harness of the gearbox * See page 3-74
83	O.C. at clutch K4 The measured resistance value of the valve is out of limit · Cable/connector is defective and has contact to TCU · Regulator has an internal defect	TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown	· Check the cable from TCU to the gearbox · Check the connectors from gearbox to TCU · Check the regulator resistance* · Check internal wire harness of the gearbox * See page 3-74
84	S.C. to battery voltage at clutch KV The measured resistance value of the valve is out of limit, the voltage at KV valve is too high · Cable/connector is defective and has contact to battery voltage · Cable/connector is defective and has contact to another regulator output of the TCU · Regulator has an internal defect	TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown	· Check the cable from TCU to the gearbox · Check the connectors from gearbox to TCU · Check the regulator resistance* · Check internal wire harness of the gearbox * See page 3-74
85	S.C. to ground at clutch KV The measured resistance value of the valve is out of limit, the voltage at KV valve is too low · Cable/connector is defective and has contact to vehicle ground · Regulator has an internal defect	TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown	· Check the cable from TCU to the gearbox · Check the connectors from gearbox to TCU · Check the regulator resistance* · Check internal wire harness of the gearbox * See page 3-74

※ Some fault codes are not applied to this machine.

Fault code (Hex)	Meaning of the fault code possible reason for fault detection	Reaction of the TCU	Possible steps to repair
86	O.C. at clutch KV The measured resistance value of the valve is out of limit · Cable/connector is defective and has contact to TCU · Regulator has an internal defect	TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown	· Check the cable from TCU to the gearbox · Check the connectors from gearbox to TCU · Check the regulator resistance* · Check internal wire harness of the gearbox * See page 3-74
87	S.C. to battery voltage at clutch KR The measured resistance value of the valve is out of limit, the voltage at KR valve is too high · Cable/connector is defective and has contact to battery voltage · Cable/connector is defective and has contact to another regulator output of the TCU · Regulator has an internal defect	TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown	· Check the cable from TCU to the gearbox · Check the connectors from gearbox to TCU · Check the regulator resistance* · Check internal wire harness of the gearbox * See page 3-74
88	S.C. to ground at clutch KR The measured resistance value of the valve is out of limit, the voltage at KR valve is too low · Cable/connector is defective and has contact to vehicle ground · Regulator has an internal defect	TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown	· Check the cable from TCU to the gearbox · Check the connectors from gearbox to TCU · Check the regulator resistance* · Check internal wire harness of the gearbox * See page 3-74
89	O.C. at clutch KR The measured resistance value of the valve is out of limit · Cable/connector is defective and has no contact to TCU · Regulator has an internal defect	TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown	· Check the cable from TCU to the gearbox · Check the connectors from gearbox to TCU · Check the regulator resistance* · Check internal wire harness of the gearbox * See page 3-74
91	S.C. to ground at relay reverse warning alarm TCU detected a wrong voltage at the output pin, that looks like a S.C. to vehicle ground · Cable is defective and is contact to vehicle ground · Backup alarm device has an internal defect · Connector pin is contacted to vehicle ground	Backup alarm will be on until TCU power down even if fault vanishes (Loose connection) OP mode : Normal	· Check the cable from TCU to the backup alarm device · Check the connectors from backup alarm device to TCU · Check the resistance* of backup alarm device * See page 3-74
92	S.C. to battery voltage at relay reverse warning alarm TCU detected a wrong voltage at the output pin, that looks like a S.C. to battery voltage · Cable is defective and is contacted to battery voltage · Backup alarm device has an internal defect · Connector pin is contacted to battery voltage	No reaction OP mode : Normal	· Check the cable from TCU to the backup alarm device · Check the connectors from backup alarm device to TCU · Check the resistance* of backup alarm device * See page 3-74

※ Some fault codes are not applied to this machine.



Fault code (Hex)	Meaning of the fault code possible reason for fault detection	Reaction of the TCU	Possible steps to repair
93	O.C. at relay reverse warning alarm TCU detected a wrong voltage at the output pin, that looks like a O.C. for this output pin · Cable is defective and has no connection to TCU · Backup alarm device has an internal defect · Connector has no connection to TCU	No reaction OP mode : Normal	· Check the cable from TCU to the backup alarm device · Check the connectors from backup alarm device to TCU · Check the resistance* of backup alarm device * See page 3-74
94	S.C. to ground at relay starter interlock TCU detected a wrong voltage at the output pin, that looks like a S.C. to vehicle ground · Cable is defective and is connection to vehicle ground · Starter interlock relay has an internal defect · Connector pin is contacted to vehicle ground	No reaction OP mode : Normal	· Check the cable from TCU to the stater interlock relay · Check the connectors from starter interlock relay to TCU · Check the resistance* of starter interlock relay * See page 3-74
95	S.C. to battery voltage at relay starter interlock TCU detected a wrong voltage at the output pin, that looks like a S.C. to battery voltage · Cable is defective and has no connection to battery voltage · Starter interlock relay has an internal defect · Connector pin is contacted to battery voltage	No reaction OP mode : Normal	· Check the cable from TCU to the starter interlock relay · Check the connectors from starter interlock relay to TCU · Check the resistance* of starter interlock relay * See page 3-74
96	O.C. at relay starter interlock TCU detected a wrong voltage at the output pin, that looks like a O.C. for this output pin · Cable is defective and has no connection to TCU · Starter interlock relay has an internal defect · Connector has no connection to TCU	No reaction OP mode : Normal	· Check the cable from TCU to the starter interlock relay · Check the connectors from starter interlock relay to TCU · Check the resistance* of starter interlock relay * See page 3-74
9A	S.C. to ground at converter lock up clutch solenoid TCU detected a wrong voltage at the output pin, that looks like a S.C. to vehicle ground · Cable is defective and is contacted to vehicle ground · Converter clutch solenoid has an internal defect · Connector pin is contacted to vehicle ground	No reaction OP mode : Normal	· Check the cable from TCU to the converter clutch solenoid · Check the connectors from converter clutch solenoid to TCU · Check the resistance* of converter clutch solenoid * See page 3-74

※ Some fault codes are not applied to this machine.

Fault code (Hex)	Meaning of the fault code possible reason for fault detection	Reaction of the TCU	Possible steps to repair
9B	O.C. at converter lock up clutch solenoid TCU detected a wrong voltage at the output pin, that looks like a O.C. for this output pin · Cable is defective and has no connection to TCU · Converter clutch solenoid has an internal defect · Connector has no connection to TCU	Converter clutch always open, retarder not available OP mode : Normal	· Check the cable from TCU to the converter clutch solenoid · Check the connectors from converter clutch solenoid to TCU · Check the resistance* of converter clutch solenoid * See page 3-74
9C	S.C. to battery voltage at converter lock up clutch solenoid TCU detected a wrong voltage at the output pin, that looks like a S.C. to battery voltage · Cable is defective and has no contacted to battery voltage · Converter clutch solenoid has an internal defect · Connector pin is contacted to battery voltage	No reaction OP mode : Normal	· Check the cable from TCU to the converter clutch solenoid · Check the connectors from converter clutch solenoid to TCU · Check the resistance* of converter clutch solenoid * See page 3-74
A1	S.C. to ground at difflock or axle connection solenoid TCU detected a wrong voltage at the output pin, that looks like a S.C. to vehicle ground · Cable is defective and is contacted to vehicle ground · Difflock solenoid has an internal defect · Connector pin is contacted to vehicle ground	No reaction OP mode : Normal	· Check the cable from TCU to the difflock solenoid · Check the connectors from difflock solenoid to TCU · Check the resistance* of difflock solenoid * See page 3-74
A2	S.C. to battery voltage at difflock or axle connection solenoid TCU detected a wrong voltage at the output pin, that looks like a S.C. to battery voltage · Cable is defective and has no connection to battery voltage · Difflock solenoid has an internal defect · Connector pin is contacted to battery voltage	No reaction OP mode : Normal	· Check the cable from TCU to the difflock solenoid · Check the connectors from difflock solenoid to TCU · Check the resistance* of difflock solenoid * See page 3-74
A3	O.C. at difflock or axle connection solenoid TCU detected a wrong voltage at the output pin, that looks like a O.C. for this output pin · Cable is defective and has no connection to TCU · Difflock solenoid has an internal defect · Connector has no connection to TCU	No reaction OP mode : Normal	· Check the cable from TCU to the difflock solenoid · Check the connectors from difflock solenoid to TCU · Check the resistance* of difflock solenoid * See page 3-74

※ Some fault codes are not applied to this machine.



Fault code (Hex)	Meaning of the fault code possible reason for fault detection	Reaction of the TCU	Possible steps to repair
A4	S.C. to ground at warning signal output TCU detected a wrong voltage at the output pin, that looks like a S.C. to vehicle ground · Cable is defective and is contacted to vehicle ground · Warning device has an internal defect · Connector pin is contacted to vehicle ground	No reaction OP mode : Normal	· Check the cable from TCU to the warning device · Check the connectors from warning device to TCU · Check the resistance* of warning device * See page 3-74
A5	O.C. voltage at warning signal output TCU detected a wrong voltage at the output pin, that looks like a O.C. for this output pin · Cable is defective and has no connection to TCU · Warning device has an internal defect · Connector has no connection to TCU	No reaction OP mode : Normal	· Check the cable from TCU to the warning device · Check the connectors from warning device to TCU · Check the resistance* of warning device * See page 3-74
A6	S.C. to battery voltage at warning signal output TCU detected a wrong voltage at the output pin, that looks like a S.C. to battery voltage · Cable is defective and has is contacted to battery voltage · Warning device has an internal defect · Connector pin is contacted to battery voltage	No reaction OP mode : Normal	· Check the cable from TCU to the warning device · Check the connectors from warning device to TCU · Check the resistance* of warning device * See page 3-74
B1	Slippage at clutch K1 TCU calculates a differential speed at closed clutch K1. If this calculated value is out of range, TCU interprets this as slipping clutch · Low pressure at clutch K1 · Low main pressure · Wrong signal at internal speed sensor · Wrong signal at output speed sensor · Wrong size of the sensor gap · Clutch is defective	TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown	· Check pressure at clutch K1 · Check main pressure in the system · Check sensor gap at internal speed sensor · Check sensor gap at output speed sensor · Check signal at internal speed sensor · Check signal at output speed sensor · Replace clutch
B2	Slippage at clutch K2 TCU calculates a differential speed at closed clutch K2. If this calculated value is out of range, TCU interprets this as slipping clutch · Low pressure at clutch K2 · Low main pressure · Wrong signal at internal speed sensor · Wrong signal at output speed sensor · Wrong size of the sensor gap · Clutch is defective	TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown	· Check pressure at clutch K2 · Check main pressure in the system · Check sensor gap at internal speed sensor · Check sensor gap at output speed sensor · Check signal at internal speed sensor · Check signal at output speed sensor · Replace clutch

※ Some fault codes are not applied to this machine.

Fault code (Hex)	Meaning of the fault code possible reason for fault detection	Reaction of the TCU	Possible steps to repair
B3	Slippage at clutch K3 TCU calculates a differential speed at closed clutch K3. If this calculated value is out of range, TCU interprets this as slipping clutch <ul style="list-style-type: none"> <li>· Low pressure at clutch K3</li> <li>· Low main pressure</li> <li>· Wrong signal at internal speed sensor</li> <li>· Wrong signal at output speed sensor</li> <li>· Wrong size of the sensor gap</li> <li>· Clutch is defective</li> </ul>	TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown	<ul style="list-style-type: none"> <li>· Check pressure at clutch K3</li> <li>· Check main pressure in the system</li> <li>· Check sensor gap at internal speed sensor</li> <li>· Check sensor gap at output speed sensor</li> <li>· Check signal at internal speed sensor</li> <li>· Check signal at output speed sensor</li> </ul> Replace clutch
B4	Slippage at clutch K4 TCU calculates a differential speed at closed clutch K4. If this calculated value is out of range, TCU interprets this as slipping clutch <ul style="list-style-type: none"> <li>· Low pressure at clutch K4</li> <li>· Low main pressure</li> <li>· Wrong signal at internal speed sensor</li> <li>· Wrong signal at turbine speed sensor</li> <li>· Wrong size of the sensor gap</li> <li>· Clutch is defective</li> </ul>	TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown	<ul style="list-style-type: none"> <li>· Check pressure at clutch K4</li> <li>· Check main pressure in the system</li> <li>· Check sensor gap at internal speed sensor</li> <li>· Check sensor gap at turbine speed sensor</li> <li>· Check signal at internal speed sensor</li> <li>· Check signal at turbine speed sensor</li> </ul> Replace clutch
B5	Slippage at clutch KV TCU calculates a differential speed at closed clutch KV. If this calculated value is out of range, TCU interprets this as slipping clutch <ul style="list-style-type: none"> <li>· Low pressure at clutch KV</li> <li>· Low main pressure</li> <li>· Wrong signal at internal speed sensor</li> <li>· Wrong signal at turbine speed sensor</li> <li>· Wrong size of the sensor gap</li> <li>· Clutch is defective</li> </ul>	TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown	<ul style="list-style-type: none"> <li>· Check pressure at clutch KV</li> <li>· Check main pressure in the system</li> <li>· Check sensor gap at internal speed sensor</li> <li>· Check sensor gap at turbine speed sensor</li> <li>· Check signal at internal speed sensor</li> <li>· Check signal at turbine speed sensor</li> </ul> Replace clutch
B6	Slippage at clutch KR TCU calculates a differential speed at closed clutch KR. If this calculated value is out of range, TCU interprets this as slipping clutch <ul style="list-style-type: none"> <li>· Low pressure at clutch KR</li> <li>· Low main pressure</li> <li>· Wrong signal at internal speed sensor</li> <li>· Wrong signal at turbine speed sensor</li> <li>· Wrong size of the sensor gap</li> <li>· Clutch is defective</li> </ul>	TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown	<ul style="list-style-type: none"> <li>· Check pressure at clutch KR</li> <li>· Check main pressure in the system</li> <li>· Check sensor gap at internal speed sensor</li> <li>· Check sensor gap at turbine speed sensor</li> <li>· Check signal at internal speed sensor</li> <li>· Check signal at turbine speed sensor</li> </ul> Replace clutch
B7	Overtemp sump TCU measured a temperature in the oil sump that is over the allowed threshold.	No reaction OP mode : Normal	<ul style="list-style-type: none"> <li>· Cool down machine</li> <li>· Check oil level</li> <li>· Check temperature sensor</li> </ul>
B9	Overspend engine	Retarder applies OP mode : Normal	-
BA	Differential pressure oil filter TCU measured a voltage at differential pressure switch out of the allowed range <ul style="list-style-type: none"> <li>· Oil filter is polluted</li> <li>· Cable/connector is broken or cable/connector is contacted to battery voltage or vehicle ground</li> <li>· Differential pressure switch is defective</li> </ul>	No reaction OP mode : Normal	<ul style="list-style-type: none"> <li>· Check oil filter</li> <li>· Check wiring from TCU to differential pressure switch</li> <li>· Check differential pressure switch(Measure resistance)</li> </ul>

※ Some fault codes are not applied to this machine.

Fault code (Hex)	Meaning of the fault code possible reason for fault detection	Reaction of the TCU	Possible steps to repair
BB	Slippage at converter lockup clutch TCU calculates a differential speed at closed converter lockup clutch. If this calculated value is out of range, TCU interprets this as slipping clutch <ul style="list-style-type: none"> <li>· Low pressure at converter lockup clutch</li> <li>· Low main pressure</li> <li>· Wrong signal at engine speed sensor</li> <li>· Wrong signal at turbine speed sensor</li> <li>· Wrong size of the sensor gap</li> <li>· Clutch is defective</li> </ul>	No reaction OP mode : Normal	<ul style="list-style-type: none"> <li>· Check pressure at converter lockup clutch</li> <li>· Check main pressure in the system</li> <li>· Check sensor gap at engine speed sensor</li> <li>· Check sensor gap at turbine speed sensor</li> <li>· Check signal at engine speed sensor</li> <li>· Check signal at turbine speed sensor</li> <li>· Replace clutch</li> </ul>
C0	Engine torque or engine power overload TCU calculates an engine torque or engine power above the defined thresholds	OP mode : Normal	
C1	Transmission output torque overload TCU calculates an transmission output torque above the defined threshold	OP mode : Normal	
C2	Transmission input torque overload TCU calculates an transmission input torque above the defined threshold	programmable : No reaction or shift to neutral OP mode : Normal	
C3	Overtemp converter output TCU measured a oil temperature at the converter output that is the allowed threshold	No reaction OP mode : Normal	<ul style="list-style-type: none"> <li>· Cool down machine</li> <li>· Check oil level</li> <li>· Check temperature sensor</li> </ul>
C4	S.C. to ground at joystick status indicator TCU detected a wrong voltage at the output pin, that looks like a S.C. to vehicle ground <ul style="list-style-type: none"> <li>· Cable is defective and is contacted to vehicle ground</li> <li>· Joystick status indicator has an internal defect</li> <li>· Connector pin is contacted to vehicle ground</li> </ul>	No reaction OP mode : Normal	<ul style="list-style-type: none"> <li>· Check the cable from TCU to joystick status indicator</li> <li>· Check the connectors from joystick status indicator to TCU</li> <li>· Check the resistance* of joystick status indicator</li> </ul> <p>* See page 3-74</p>
C5	S.C. to battery voltage at joystick status indicator TCU detected a wrong voltage at the output pin, that looks like a S.C. to battery voltage <ul style="list-style-type: none"> <li>· Cable is defective and is contacted to battery voltage</li> <li>· Joystick status indicator has an internal defect</li> <li>· Connector pin is contacted to battery voltage</li> </ul>	No reaction OP mode : Normal	<ul style="list-style-type: none"> <li>· Check the cable from TCU to joystick status indicator</li> <li>· Check the connectors from joystick status indicator to TCU</li> <li>· Check the resistance* of joystick status indicator</li> </ul> <p>* See page 3-74</p>

※ Some fault codes are not applied to this machine.

Fault code (Hex)	Meaning of the fault code possible reason for fault detection	Reaction of the TCU	Possible steps to repair
C6	O.C. at joystick status indicator TCU detected a wrong voltage at the output pin, that looks like a O.C. for this output pin · Cable is defective and has no connection to TCU · Joystick status indicator has an internal defect · Connector pin has no connection to TCU	No reaction OP mode : Normal	· Check the cable from TCU to joystick status indicator · Check the connectors from joystick status indicator to TCU · Check the resistance* of joystick status indicator * See page 3-74
D1	S.C. to battery voltage at power supply for sensors TCU measures more than 6V at the pin AU1 (5V sensor supply)	See fault codes No.21 to 2C	· Check cables and connectors to sensors, which are supplied from AU1 · Check the power supply at the pin AU1(Should be appx. 5V) · Fault codes No.21 to No.2C may be reaction of this fault
D2	S.C. to ground at power supply for sensors TCU measures less than 4V at the pin AU1 (5V sensor supply)	See fault codes No.21 to 2C	· Check cables and connectors to sensors, which are supplied from AU1 · Check the power supply at the pin AU1(Should be appx. 5V) · Fault codes No.21 to No.2C may be reaction of this fault
D3	Low voltage at battery Measured voltage at power supply is lower than 18V(24V device)	Shift to neutral OP mode : TCU shutdown	· Check power supply battery · Check cables from batteries to TCU · Check connectors from batteries to TCU
D4	High voltage at battery Measured voltage at power supply is higher than 32.5V(24V device)	Shift to neutral OP mode : TCU shutdown	· Check power supply battery · Check cables from batteries to TCU · Check connectors from batteries to TCU
D5	Error at valve power supply VPS1 TCU switched on VPS1 and measured VPS1 is off or TCU switched off VPS1 and measured VPS1 is still on · Cable or connectors are defect and are contacted to battery voltage · Cable or connectors are defect and are contacted to vehicle ground · Permanent power supply KL30 missing · TCU has an internal defect	Shift to neutral OP mode : TCU shutdown	· Check fuse · Check cables from gearbox to TCU · Check connectors from gearbox to TCU · Replace TCU
D6	Error at valve power supply VPS2 TCU switched on VPS2 and measured VPS2 is off or TCU switched off VPS2 and measured VPS2 is still on · Cable or connectors are defect and are contacted to battery voltage · Cable or connectors are defect and are contacted to vehicle ground · Permanent power supply KL30 missing · TCU has an internal defect	Shift to neutral OP mode : TCU shutdown	· Check fuse · Check cables from gearbox to TCU · Check connectors from gearbox to TCU · Replace TCU

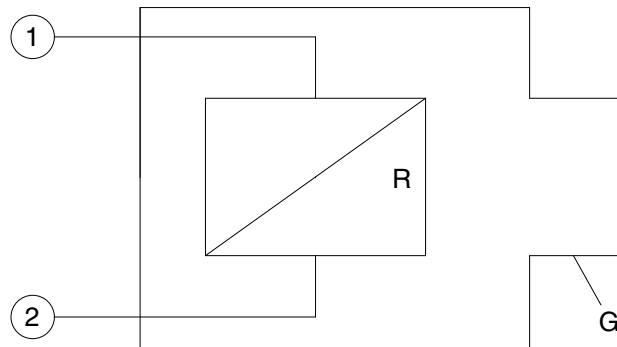
※ Some fault codes are not applied to this machine.

Fault code (Hex)	Meaning of the fault code possible reason for fault detection	Reaction of the TCU	Possible steps to repair
E3	S.C. to battery voltage at display output TCU sends data to the display and measures always a high voltage level on the connector · Cable or connectors are defective and are contacted to battery voltage · Display has an internal defect	No reaction OP mode : Normal	· Check the cable from TCU to the display · Check the connectors at the display · Change display
E4	S.C. to ground at display output TCU sends data to the display and measures always a high voltage level on the connector · Cable or connectors are defective and are contacted to battery voltage · Display has an internal defect	No reaction OP mode : Normal	· Check the cable from TCU to the display · Check the connectors at the display · Change display
E5	Communication failure on DeviceNet	Shift to neutral OP mode : TCU shutdown	· Check Omron master · Check wire of DeviceNet-Bus · Check cable to Omron master
F1	General EEPROM fault TCU can't read non volatile memory · TCU is defective	No reaction OP mode : Normal	· Replace TCU ※ Often shown together with fault code F2
F2	Configuration lost TCU has lost the correct configuration and can't control the transmission · Interference during saving data on non volatile memory · TCU is brand new or from another vehicle	Transmission stay neutral OP mode : TCU shutdown	· Reprogram the correct configuration for the vehicle (e.g. with cluster controller,...)
F3	Application error Something of this application is wrong	Transmission stay neutral OP mode : TCU shutdown	· Replace TCU ※ This fault occurs only if an test engineer did something wrong in the application of the vehicle
F5	Clutch failure AEB was not able to adjust clutch filling parameters · One of the AEB-Values is out of limit	Transmission stay neutral OP mode : TCU shutdown	· Check clutch ※ TCU shows also the affected clutch on the display
F6	Clutch adjustment data lost TCU was not able to read correct clutch adjustment parameters · Interference during saving data on non volatile memory · TCU is brand new	No reaction, Default values : 0 for AEB Offsets used OP mode : Normal	· Execute AEB and brake sensor calibration
F7	Substitute clutch control · Transmission input torque wrong · Engine retarder torque wrong · Speed signal (s) defective	OP mode : Substitute clutch control	· Check engine retarder torque · Check speed sensors

※ Some fault codes are not applied to this machine.

## 5) MEASURING OF RESISTANCE AT ACTUATOR/SENSOR AND CABLE

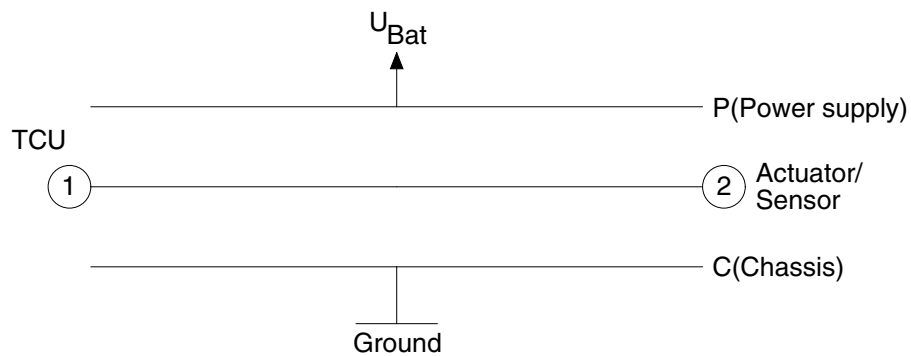
### (1) Actuator



76043PT19

- Open circuit  $R_{12} = R_{1G} = R_{2G} = \infty$
- Short cut to ground  $R_{12} = R$ ;  $R_{1G} = 0$ ,  $R_{2G} = R$  or  $R_{1G} = R$ ,  $R_{2G} = 0$   
(For S.C. to ground, G is connected to vehicle ground)
- Short cut to battery  $R_{12} = R$ ;  $R_{1G} = 0$ ,  $R_{2G} = R$  or  $R_{1G} = R$ ,  $R_{2G} = 0$   
(For S.C. to battery, G is connected to battery voltage)

### (2) Cable



76043PT20

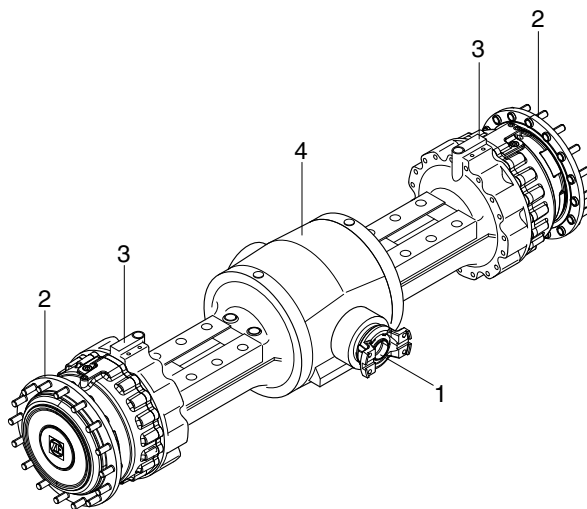
- Open circuit  $R_{12} = R_{1P} = R_{1C} = R_{2P} = R_{2C} = \infty$
- Short cut to ground  $R_{12} = 0$ ;  $R_{1C} = R_{2C} = 0$ ,  $R_{1P} = R_{2P} = \infty$
- Short cut to battery  $R_{12} = 0$ ;  $R_{1C} = R_{2C} = 0$ ,  $R_{1P} = R_{2P} = 0$

## 5. AXLE

### 1) OPERATION

- The power from the engine passes through torque converter, transmission and drive shafts, and is then sent to the front and rear axles.
- Inside the axles, the power passes from the bevel pinion to the bevel gear and is sent at right angles. At the same time, the speed is reduced and passes through the both differentials to the axle shafts. The power of the axle shafts is further reduced by planetary-gear-type final drives and is sent to the wheels.

#### (1) Front axle



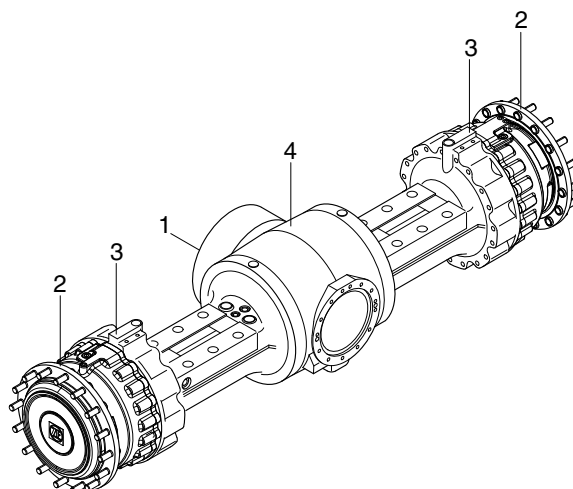
- 1 Input  
4 Axle housing

2 Output

3 Brake

7579A3PT15

#### (2) Rear axle



- 1 Input  
4 Axle housing

2 Output

3 Brake

7579A3PT16



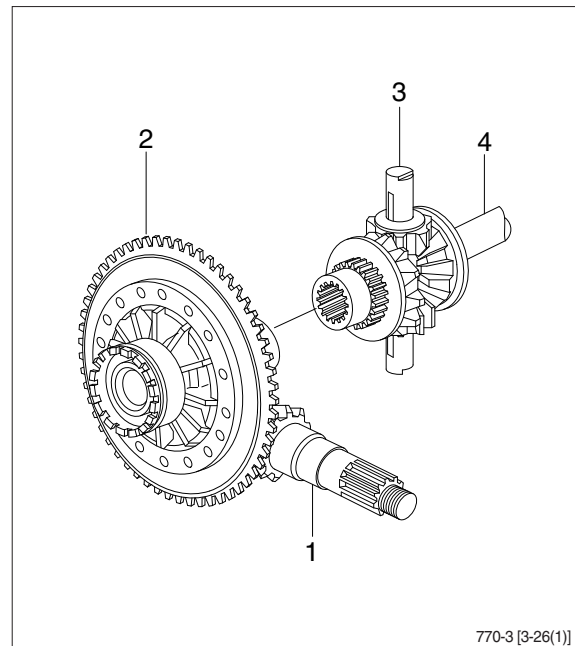
## 2) DIFFERENTIAL

### (1) Description

When the machine makes a turn, the outside wheel must rotate faster than the inside wheel. A differential is a device which continuously transmits power to the right and left wheels while allowing them to turn at different speeds, during a turn.

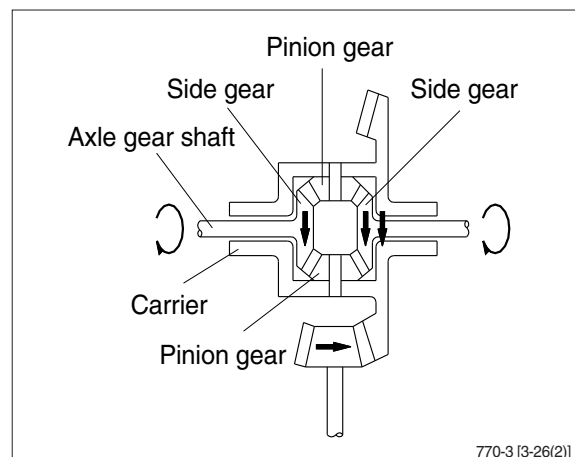
The power from the drive shaft passes through bevel pinion (1) and is transmitted to the bevel gear (2). The bevel gear changes the direction of the motive force by 90 degree, and at the same time reduces the speed.

It then transmits the motive force through the differential (3) to the axle gear shaft (4).



### (2) When driving straight forward

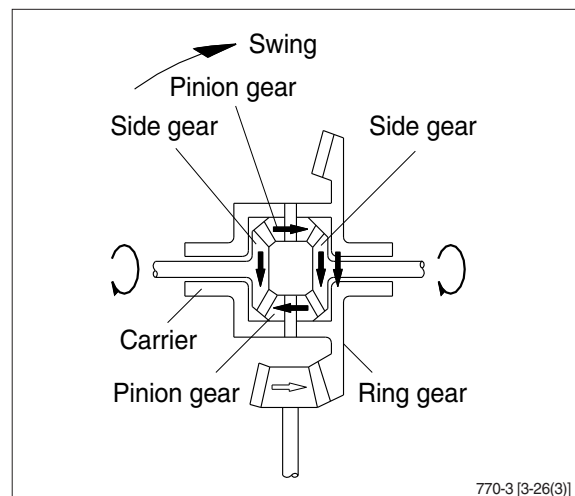
When the machine is being driven straight forward and the right and left wheels are rotating at the same speed, so the pinion gear inside the differential assembly do not rotate. The motive force of the carrier is sent through the pinion gear and the side gear, therefore the power is equally transmitted to the left and right axle gear shaft.



### (3) When turning

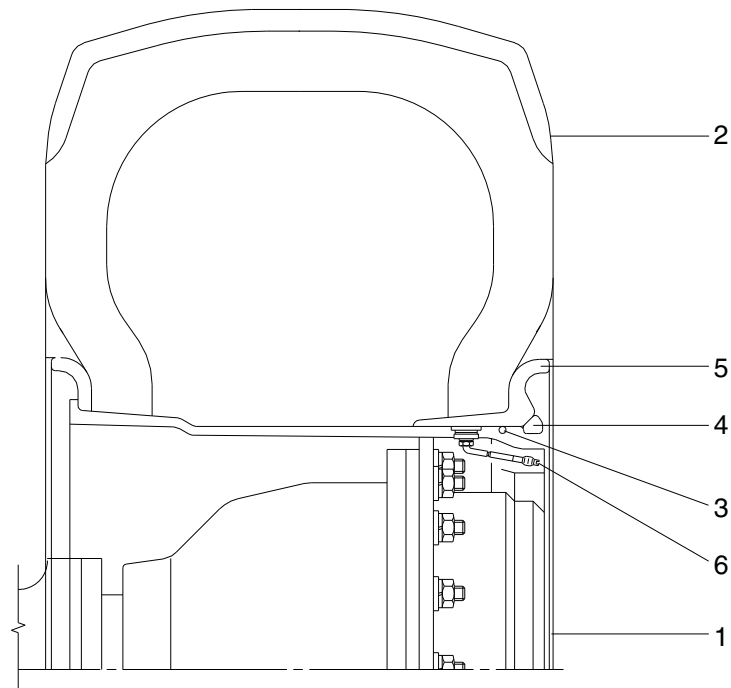
When turning, the rotating speed of the left and right wheels is different, so the pinion gear and side gear inside the differential assembly rotate in accordance with the difference between the rotating speed of the left and right wheels.

The power of the carrier is then transmitted to the axle gear shafts.





## 6. TIRE AND WHEEL



7407APT10

- |   |           |   |           |   |                |
|---|-----------|---|-----------|---|----------------|
| 1 | Wheel rim | 3 | O-ring    | 5 | Side ring      |
| 2 | Tire      | 4 | Lock ring | 6 | Valve assembly |

- 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 and bucket capacity.

## GROUP 2 OPERATIONAL CHECKS AND TROUBLESHOOTING

### 1. POWER TRAIN OPERATIONAL CHECKS

This procedure is designed so that the mechanic can make a quick check of the system using a minimum amount of diagnostic equipment. If you need additional information, read Structure and function, Group 1.

A location will be required which is level and has adequate space to complete the checks.

The engine and all other major components must be at operating temperature for some checks.

Locate system check in the left column and read completely, following the sequence from left to right. Read each check completely before performing.





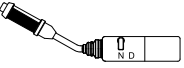



At the end of each check, if no problem is found(OK), that check is complete or an additional check is needed. If problem is indicated(NOT OK), you will be given repair required and group location.

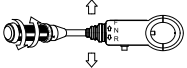
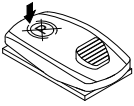


If verification is needed, you will be given next best source of information :

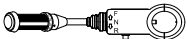

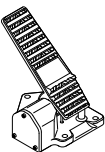
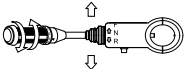
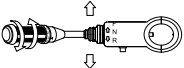
Chapter 2 : Troubleshooting

Group 3 : Tests and adjustments

※ Transmission oil must be at operating temperature for these checks.

Item	Description	Service action
Transmission oil warm-up procedure	 <p>Start engine. Apply service brakes and release parking brake.</p> <p>Select T/M shift mode to MANUAL mode.</p> <p>Move gear selector lever to 3rd speed.</p> <p>Move gear selector lever to forward "F" position.</p>  <p>Increase engine speed to high idle for 30 seconds.</p> <p>Move gear selector lever to neutral "N" position and run for 15 seconds.</p>  <p>Repeat procedure until transmission temperature gauge arrow points to bar above dial.</p>	<p><b>OK</b> Check completed.</p>
Gear selector lever and neutral lock latch checks Engine OFF.	 <p>Move gear selector lever to each position.</p> <p><b>NOTE</b> : Gear selector lever position changes slightly as steering column is tilted.</p> <p><b>FEEL</b> : Lever must move freely through all positions.</p>  <p>Engage neutral lock.</p> <p>Apply slight effort to move lever into forward (F) and reverse (R).</p> <p><b>LOOK</b> : Neutral lock must stay engaged.</p>	<p><b>OK</b> Check completed.</p> <p><b>NOT OK</b> Repair lock or replace switch.</p>
Automatic shifting check	 <p>Start engine.</p> <p>Move gear selector lever to 4th speed.</p> <p>Select T/M shift mode to AL (auto light) mode.</p>  <p><b>LOOK</b> : Automatic sign on cluster.</p> <p>Move gear selector lever to forward or reverse position.</p> <p>Increase engine rpm.</p>  <p><b>LOOK</b> : Speed on cluster must vary with machine speed.</p>	<p><b>OK</b> Check completed.</p> <p><b>NOT OK</b> Go to transmission fault code group at page 3-59~3-73. Repair or replace the monitor or harness.</p>

Item	Description	Service action
<b>Transmission noise check</b> Engine running.	 <p>Run engine at approximately 1600 rpm.</p> <p>Drive unit with transmission in each forward and reverse speed.</p> <p><b>LISTEN</b> : Transmission must not make excessive noise in any range.</p> <p>Engine rpm must not "lug down" as unit is shifted between gears.</p>	<p><b>OK</b> Check completed.</p> <p><b>NOT OK</b> Go to transmission makes excessive noise, chapter 2 in this group.</p>
<b>Transmission "quick shift" check</b> Engine running.	<p>Release</p>  <p>MANUAL mode</p>  <p>LOOK/FEEL : Transmission must shift to and remain in 1st gear.</p> <p>Press gear selector lever kick down switch once.</p> <p><b>LOOK/FEEL</b> : Transmission must shift back to 2nd gear.</p> <p>Shift to (3rd or 4th) gear and press gear selector lever kick down switch once.</p> <p><b>LOOK/FEEL</b> : Transmission must not shift down.</p> <p>AL mode</p>  <p>Select T/M shift mode to AL (auto light) mode.</p> <p>Drive machine at approximately 90% speed of max speed in each gear (2nd or 3rd or 4th).</p> <p>Shift to (2nd or 3rd or 4th) gear in each forward and reverse speed and press gear selector kick down lever switch or RCV lever switch once.</p> <p><b>LOOK/FEEL</b> :</p> <p>If shift down quickly from current gear to one step lower speed and recover to original speed quickly when push the switch one more time. (mode 1)</p> <p>If shifts down from current gear to one step lower speed when push the switch everytime and recover when push the switch in 1st gear. (mode 2)</p>	<p><b>OK</b> Check completed.</p> <p><b>NOT OK</b> Check connector at base of control valve.</p> <p><b>IF OK</b> Go to transmission controller circuit in group 1.</p>

Item	Description	Service action
<b>Forward, reverse and 4th speed clutch pack drag check</b> ※ Transmission must be warmed up for this check. Engine running.	   <p>Park unit on level surface.</p> <p>Apply service brakes.</p> <p>Move gear selector lever to neutral.</p> <p>Move gear selector lever to 1st.</p> <p>Release parking brake and service brakes.</p> <p>Run engine at low idle.</p> <p><b>LOOK</b> : Unit must not move in either direction.</p> <p><b>NOTE</b> : If unit moves forward, either the forward pack or the 4th speed pack is dragging.</p>	<p><b>OK</b> Check completed.</p> <p><b>NOT OK</b> If unit moves, repair transmission.</p>
<b>Transmission shift modulation check</b> Engine running.	 <p>Run engine at approximately 1300 rpm.</p> <p>Put transmission in 1st forward, shift several times from forward to reverse and reverse to forward. Repeat check in 2nd gear.</p> <p><b>LOOK</b> : Unit must slow down and change direction smoothly.</p>	<p><b>OK</b> Check completed.</p> <p><b>NOT OK</b> Go to unit shifts too fast, chapter 2 in this group.</p>
<b>Torque converter check</b>	 <p>Start engine. Apply service brakes and release parking brake.</p> <p>Move gear selector lever to 3rd speed.</p> <p>Move gear selector control lever to forward "F" position.</p> <p>Increase engine speed to high idle.</p> <p><b>LOOK</b> : Torque converter stall rpm must be within the following range. Stall rpm : <math>1860 \pm 70</math> rpm</p> <p>Move gear selector control lever to neutral "N" position and run for 15 seconds.</p>	<p><b>OK</b> Check completed.</p> <p><b>NOT OK</b> If stall rpm are too low or too high, problem may be engine power or torque converter.</p> <p><b>IF OK</b> Replace transmission torque converter.</p>

## 2. TROUBLESHOOTING

### 1) TRANSMISSION

※ Diagnose malfunction charts are arranged from most probable and simplest to verify, to least likely, more difficult to verify. Remember the following steps when troubleshooting a problem :

Step 1. Operational check out procedure (See group 3 in section 1.)

Step 2. Operational checks (In this group.)

Step 3. Troubleshooting

Step 4. Tests and/or adjustments (See group 3.)

Problem	Cause	Remedy
Transmission slippage	Low oil level.	Add oil.
	Wrong oil grade.	Change oil.
	Restricted transmission pump suction screen.	Remove and clean screen.
	Leak in transmission control valve or gasket.	Remove valve and inspect gaskets.
	Low transmission pump flow due to worn pump.	Do transmission pump flow test.
	Weak or broken pressure regulating valve spring.	Do transmission system pressure test.
Error code on display	Something wrong in transmission.	Go to transmission fault code group at page 3-59~3-73.

Problem	Cause	Remedy
Machine will not move	<p>Low oil level.</p> <p>Applied park brake.</p> <p>No power to transmission controller.</p> <p>Malfunctioning parking brake solenoid valve.</p> <p>Restricted orifice of PPC valve.</p> <p>Excessive leakage in transmission element.</p> <p>Worn clutch disks.</p> <p>Low or no transmission pressure.</p> <p>Service brake will not release.</p> <p>Failed torque converter.</p> <p>Broken shafts or gears.</p> <p>Broken drive shafts.</p> <p>Broken ring or pinion gear.</p>	<p>Add oil.</p> <p>Check parking brake fuse. Check continuity to parking brake switch.</p> <p>Check transmission controller fuse.</p> <p>Remove and inspect parking brake solenoid valve. Check for power to solenoid valve.</p> <p>Remove orifice and check for contamination and/or plugging. (Do not remove valve housing for this purpose.)</p> <p>Do transmission element leakage test using system pressure.</p> <p>Repair transmission.</p> <p>See transmission pressure is low in this group.</p> <p>Do brake pedal operational check. Do service and park system drag checks.</p> <p>Do torque converter stall test. If engine pulldown in normal, torque converter is good.</p> <p>Drain transmission to determine if large pieces of metal contamination are present.</p> <p>Inspect drive shafts and universal joints for external damage. Repair.</p> <p>If drive shaft rotate with transmission in gear but machine does not move, a differential failure is indicated. Repair.</p>
Machine does not engage in low gear	<p>Malfunctioning transmission control solenoid valve.</p> <p>Stuck spool in transmission control valve.</p> <p>Stuck PPC valve.</p> <p>Malfunctioning transmission speed sensor.</p>	<p>Check solenoid valve.</p> <p>Remove and inspect transmission control valve spools.</p> <p>Remove end cover to inspect PPC valve. Replace if necessary.</p> <p>Check speed sensor.</p>

Problem	Cause	Remedy
Transmission pressure is low (all gears)	Low oil level.	Check transmission oil level and refill if necessary.
	Failed transmission pressure switch.	Verify transmission system pressure. Do transmission system pressure test.
	Plugged suction strainer.	Transmission pump may be noisy if transmission suction screen is clogged. Drain transmission. Remove and clean suction screen. Also, check condition of transmission filter.
	Stuck transmission pressure regulating valve or broken spring.	Remove transmission pressure regulating valve. Inspect for damage (See transmission control valve).
	Failed control valve gasket.	Inspect transmission control valve for external leakage. Remove control valve. Inspect or replace gasket.
	Stuck PPC valve.	Remove end cover to inspect modulation spool and check torque on cap screws retaining control valve to transmission.
Transmission system pressure is low (one or two gears)	Failed transmission pump.	Do pump flow test.
	Failed transmission control valve gasket.	Inspect transmission control valve for external leakage. Remove control valve. Inspect or replace gasket.
	Leakage in clutch piston or seal ring.	Disassemble and repair.
Transmission shifts too low	Low oil level (aeration of oil).	Add oil.
	Low transmission pressure.	Do transmission system pressure test.
	Restricted transmission pump suction screen.	Remove and clean screen.
	Low transmission pump flow.	Do transmission pump flow test.
	Excessive transmission element leakage.	Do transmission element leakage test using system pressure.
	Stuck PPC valve.	Remove end cover to inspect modulation spool. Replace if necessary.
	Restricted PPC valve orifice.	Remove orifice and inspect for contamination and /or plugging.
	Restricted oil passages between control valve and transmission elements.	Remove control valve and inspect oil passage.
	Incorrect transmission oil.	Change oil (SAE 10W-30/15W-40)



Problem	Cause	Remedy
Transmission shifts too fast	<p>Wrong transmission controller.</p> <p>System pressure too high.</p> <p>Stuck PPC valve.</p> <p>Stuck or missing check valves.</p> <p>Missing O-ring from end of modulation orifice.</p> <p>Broken piston return spring.</p> <p>Incorrect transmission oil.</p>	<p>Check if transmission controller has been changed</p> <p>Do transmission system pressure test.</p> <p>Remove and inspect PPC valve. Replace if necessary. Also remove end cover to inspect PPC valve and control valve housing. Replace if necessary.</p> <p>Inspect transmission control valve.</p> <p>Remove orifice and inspect port for O-ring.</p> <p>Disassemble and inspect clutch.</p> <p>Change oil (SAE 10W-30/15W-40).</p>
Machine "creeps" in neutral	Warped disks and plates in transmission.	Check transmission.
Transmission hydraulic system overheats	<p>High oil level.</p> <p>Low oil level.</p> <p>Wrong oil grade.</p> <p>Park brake dragging.</p> <p>Pinched, restricted or leaking lube lines.</p> <p>Machine operated in too high gear range.</p> <p>Malfunction in temperature gauge or sensor.</p> <p>Restricted air flow through oil cooler or radiator.</p> <p>Failed oil cooler bypass valve (In thermal bypass valve).</p> <p>Failed thermal bypass valve.</p> <p>Internally restricted oil cooler.</p> <p>Leakage in transmission hydraulic system.</p> <p>Malfunction in converter relief valve.</p> <p>Low transmission pump output.</p>	<p>Transmission overfilled or hydraulic pump seal leaking.</p> <p>Add oil.</p> <p>Change oil.</p> <p>Check for heat in park brake area.</p> <p>Check cooler lines.</p> <p>Operate machine in correct gear range.</p> <p>Install temperature sensor the verify temperature. Do tachometer/temperature reader installation procedure.</p> <p>Do radiator air flow test.</p> <p>Disassemble and inspect.</p> <p>Remove thermal bypass valve and check to see if machine still overheats. Do transmission oil cooler thermal bypass valve test.</p> <p>Do oil cooler restriction test.</p> <p>Do transmission system pressure, element leakage test.</p> <p>Do converter out pressure test.</p> <p>Do transmission pump flow test.</p>

Problem	Cause	Remedy
Excessive transmission noise (Under load or no load)	Too low engine low idle. Worn parts or damaged in transmission. Warped drive line between engine and torque converter. Low or no lube.	Check engine low idle speed. Remove transmission suction screen. Inspect for metal particles. Repair as necessary. Inspect drive line. Do converter-out and lube pressure test. Do transmission pump flow test.
Foaming oil	Incorrect type of oil. High oil level. Low oil level. Air leak on suction side of pump.	Change oil. Transmission overfilled or hydraulic pump seal leaking. Add oil. Check oil pickup tube on side of transmission.
Oil ejected from dipstick	Plugged breather.	Inspect breather on top of transmission. Replace.
Machine vibrates	Aerated oil. Low engine speed. Failed universal joints on transmission drive shaft or differential drive shafts.	Add oil. Check engine speed. Check universal joints.
Machine lacks power and acceleration	Engine high idle speed set too low. Incorrect transmission oil. Aerated oil. Low transmission pressure. Warped transmission clutch. Torn transmission control valve gasket. Brake drag. Failed torque converter. Low engine power.	Check high idle adjustment. Change oil. Add oil. Do transmission system pressure test. Do transmission clutch drag checks. Inspect gasket. Do brake drag check. Do torque converter stall speed test. Do engine power test.
Torque converter stall RPM too high	Aerated oil. Stuck open converter relief valve. Leakage in torque converter seal. Torque converter not transferring power (Bent fins, broken starter).	Put clear hose on thermal bypass outlet port. Run machine to check for bubbles in oil. Do converter-out pressure test. Do converter-out pressure test. Replace torque converter.

Problem	Cause	Remedy
Torque converter stall RPM too low	Low engine power. Mechanical malfunction.	Do engine power test. Remove and inspect torque converter.
Transmission pressure light comes ON when shifting from forward to reverse (all other gears OK)	Low oil level. Cold oil. Leak in reverse pack.	Add oil. Warm oil to specification. Do transmission pressure, pump flow, and leakage check.
Transmission pressure light comes ON for each shift	Cold oil. No time delay in monitor. Restriction in modulation orifice.  Stuck PPC valve. Low transmission pressure circuit.  Leak in transmission pressure circuit. Failed transmission pump. Clogged filter.	Warm oil to specification. Do monitor check. Remove orifice and inspect for restriction and/or plugging. Remove and inspect. Do transmission system pressure test.  Do converter out pressure test.  Do transmission pump flow test. Inspect filter. Replace.

## 2) DIFFERENTIAL / AXLE

Problem	Cause	Remedy
Differential low on oil	External leakage.	Inspect axle and differential for leaks.
Excessive differential and/or axle noise	Low oil level in differential.	Check oil. Remove drain plug and inspect for metal particles in differential case. Disassemble and determine cause.
	Incorrect type of oil.	Change oil
	Dragging brakes.	Do brake check.
	Failed pinion bearing.	Remove and inspect pinion. Check to ensure pinion housing was indexed.
	Incorrect gear mesh pattern between ring and pinion gear.	Remove pinion gear housing and inspect ring and pinion gear.
	Failed differential pinion gears and/or cross shafts.	Remove differential housing drain plug and inspect for metal particles. Disassemble and inspect.
	Failed axle bearing.	Do axle bearing adjustment check.
Oil seeping from outer axle seal	Mechanical failure in axle planetary.	Remove differential. Inspect, repair.
	Excessive end play in axle.	Do axle bearing adjustment check.
	Worn outer bearing and/or cup.	Disassemble and inspect outer axle bearing, cup, spacer, and seal. Replace, if necessary.
Axle overheats	Overfilled differential.	Check differential oil return system for excessive internal restriction.
	Low differential oil.	Add oil.
	Overfilled differential.	See differential overfills with oil in this group.
	Brake drag.	See brakes drag in this group.

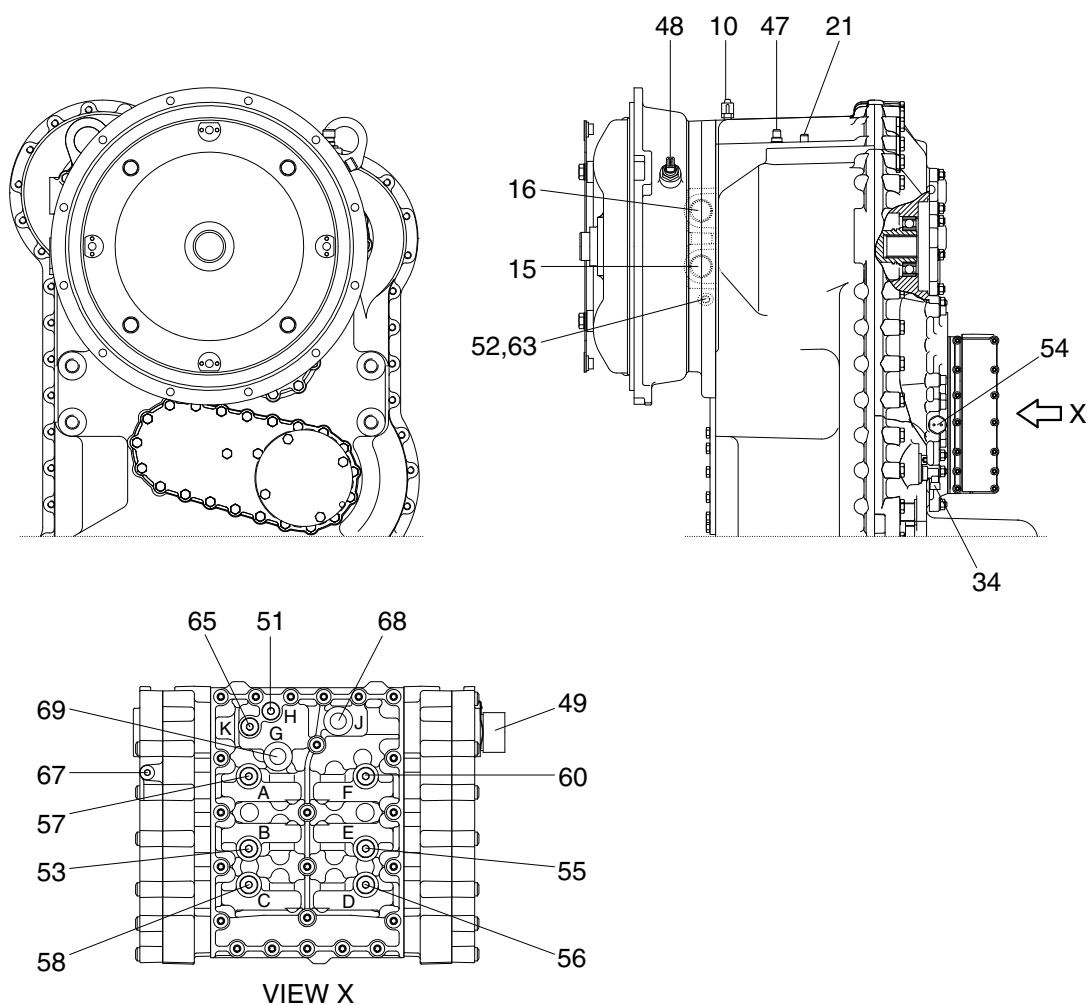
### 3) DRIVE LINE

Problem	Cause	Remedy
Excessive drive line vibration or noise	Yokes not in line on drive shafts.	Inspect. Align drive shaft yokes.
	Worn front drive line support bearing.	Inspect, repair.
	Bent drive shaft.	Inspect all drive shafts. Replace.
	Loose yoke retaining nuts (drive shafts wobble at high speed).	Inspect. Replace.
	Rear axle oscillating support.	Inspect, repair.
	Lack of lubrication.	Lubricate with proper grade of grease.

## GROUP 3 TESTS AND ADJUSTMENTS

### 1. TRANSMISSION MEASURING POINTS AND CONNECTIONS

The measurements have to be carried out at hot transmission (about 80~95°C).



955SA3PT14

#### 1) OIL PRESSURE AND TEMPERATURE

Port	Description	Size
51	Converter inlet-opening pressure (11+2 bar) H	M10×1.0
52	Converter outlet-opening pressure (4.3+3 bar)	M14×1.5
53	Forward clutch (16+2 bar) KV B	M10×1.0
55	Reverse clutch (16+2 bar) KR E	M10×1.0
56	1st clutch (16+2 bar) K1 D	M10×1.0
57	2nd clutch (16+2 bar) K2 A	M10×1.0
58	3rd clutch (16+2 bar) K3 C	M10×1.0
60	4th clutch (16+2 bar) K4 F	M10×1.0
63	Converter outlet temperature 100°C, short-time 120°C	M14×1.5
65	System pressure (16+2 bar) K	M10×1.0

## 2) DELIVERY RATES

Port	Description	Size
15	Connection to the oil cooler	1 5/6" -12UNF-2B
16	Connection from the oil cooler	1 5/6" -12UNF-2B

## 3) INDUCTIVE TRANSMITTER AND SPEED SENSOR

Port	Description	Size
21	Inductive transmitter          n turbine	M18 × 1.5
34	Speed sensor                      n output and speedometer	-
47	Inductive transmitter          n central gear train	M18 × 1.5
48	Inductive transmitter          n engine	M18 × 1.5
54	Filter contamination switch	M14 × 1.5

## 4) CONNECTIONS

Port	Description	Size
10	Breather	M10 × 1.0
49	Plug connection on the hydraulic control unit	-
68	Pilot pressure (option)                      J	M16 × 1.5
69	System pressure (option)                    G	M16 × 1.5

## GROUP 4 DISASSEMBLY AND ASSEMBLY

### 1. TRANSMISSION

#### 1) DISASSEMBLY

##### Electro-hydraulic control and fine filter

※ Attach transmission to assembly truck.

Assembly truck                      5870 350 000

Holding fixtures                    5870 350 063

Clamping angles                   5870 350 090

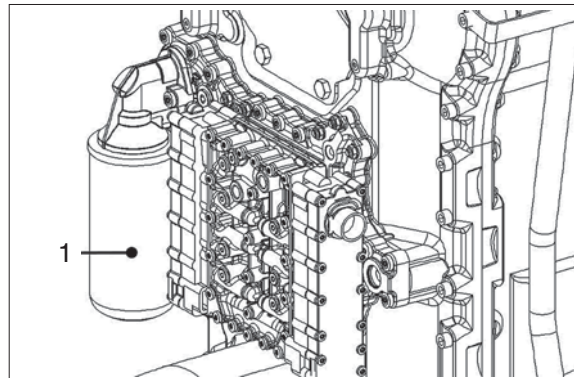
※ Drain oil prior to starting disassembly.

※ Disposal of oil according to legal requirements.

#### (1) Removal of filter

- ① Separate fine filter (1) from filter head by means of belt wrench.

Belt wrench                          5870 105 005

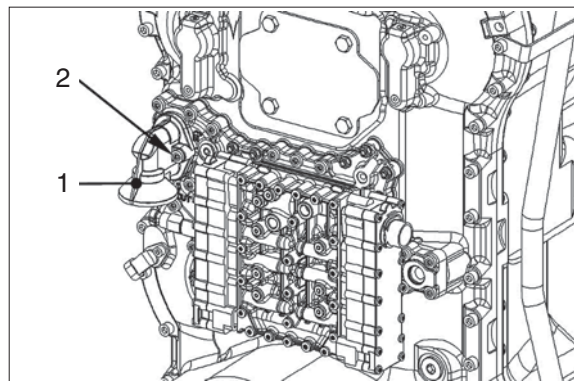


7609ATM002

- ② Loosen Torx screws (2) and separate filter head (1) from transmission housing.

※ Remove O-rings.

Socket wrench TX 40              5873 042 004



7609ATM003

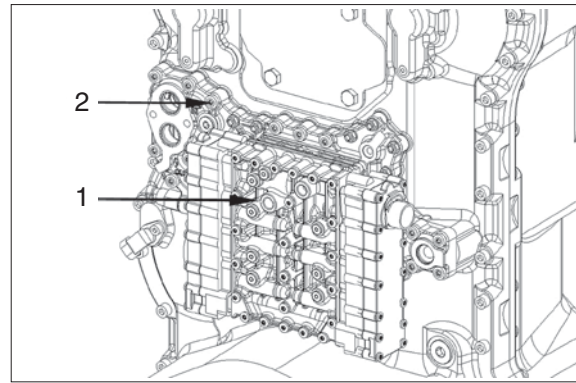


## (2) Removal of electric gear-shift control

- ① Remove gear-shift control (1).

Loosen Torx screws (2) and separate gear-shift control housing from intermediate plate.

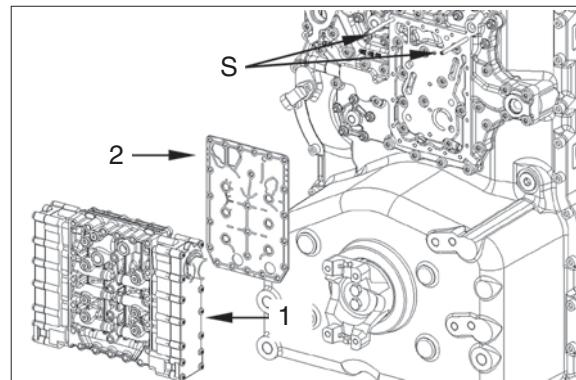
Socket wrench TX-27      5873 042 002  
Adjusting screws M6      5870 204 063



7609ATM004

- ② Remove gear-shift control assy (1) and sealing plate (2).

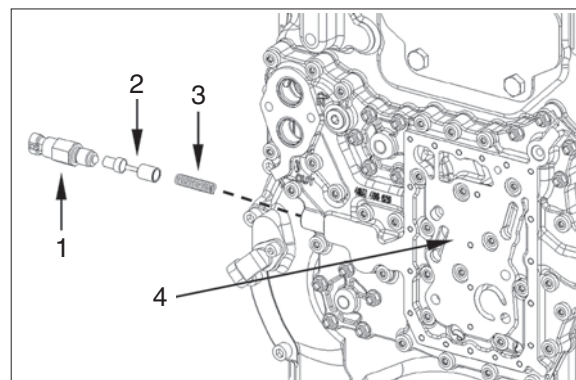
Adjusting screws M6      5870 204 063



7609ATM005

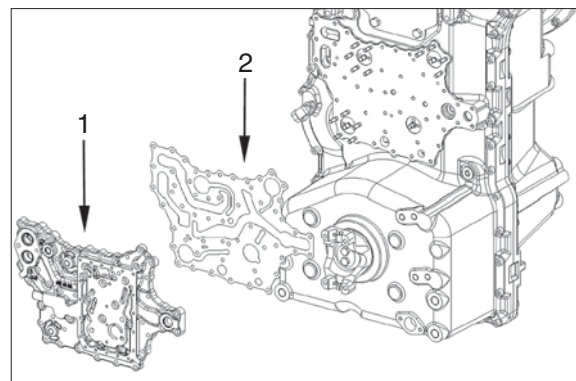
- ③ Remove differential pressure switch for fine filter from duct plate (4).

- 1 Switch with O-ring
- 2 Piston
- 3 Compression spring



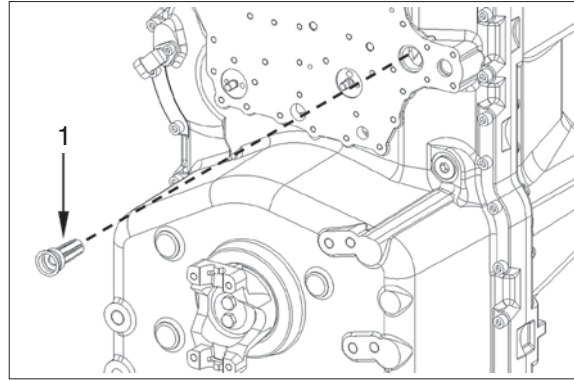
7609ATM006

- ④ Loosen hexagon nuts and Torx screws and separate duct plate (1) and seal (2) from housing rear part.



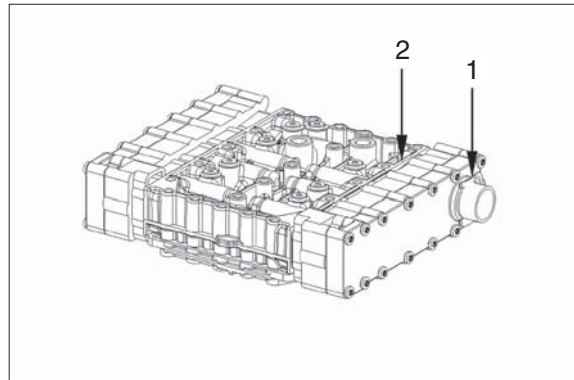
7609ATM007

- ⑤ Pull converter safety valve (1) out of housing hole.



7609ATM008

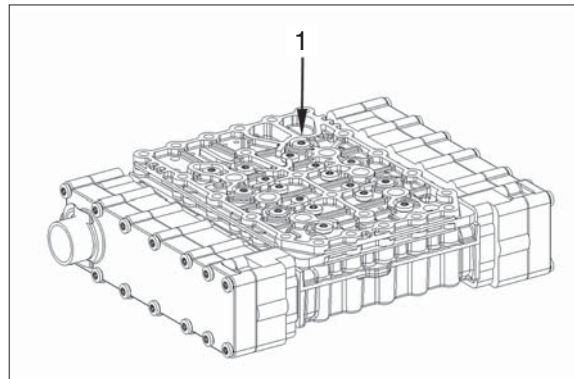
- ⑥ Mark installation position of wiring harness (1) towards valve block (2).



7609ATM009

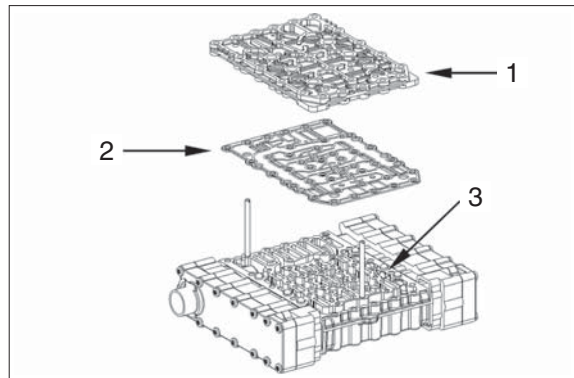
- ⑦ Loosen Torx screws (1).

Socket wrench TX-27      5873 042 002



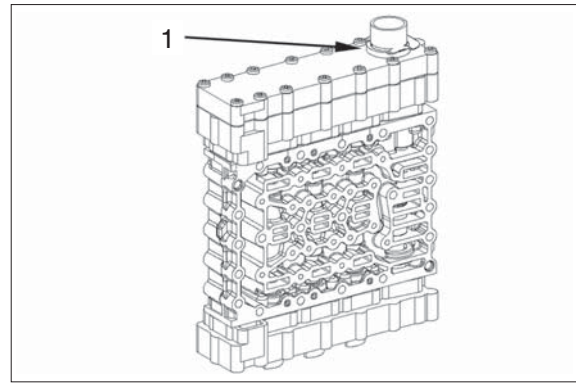
7609ATM010

- ⑧ Separate duct plate (1) and sealing plate (2) from valve block (3).



7609ATM011

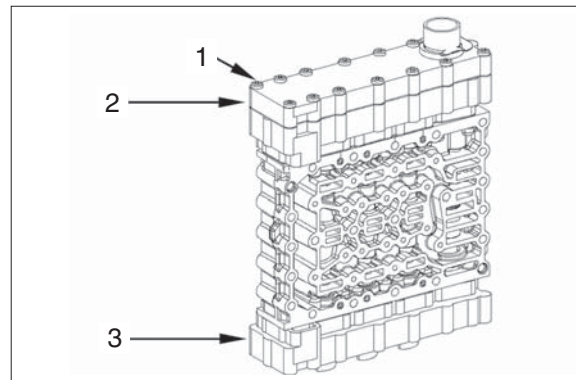
- ⑨ Remove retaining clamp (1).



7609ATM012

- ⑩ Loosen Torx screws (1) and remove cover (2).  
Remove opposite cover (3) in the same way.

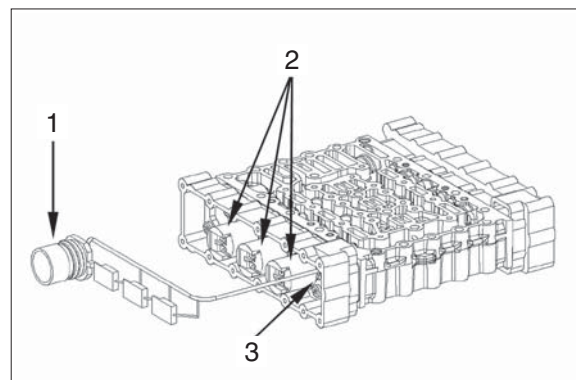
Socket wrench TX-27      5873 042 002



7609ATM013

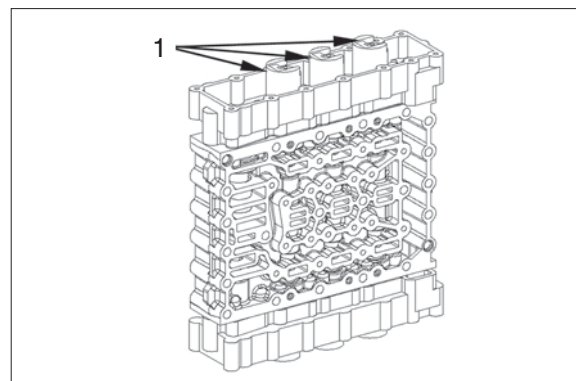
- ⑪ Remove wiring harness (1).

Loosen cylindrical screws (3), remove fixing plates and remove pressure controllers (2).



7609ATM014

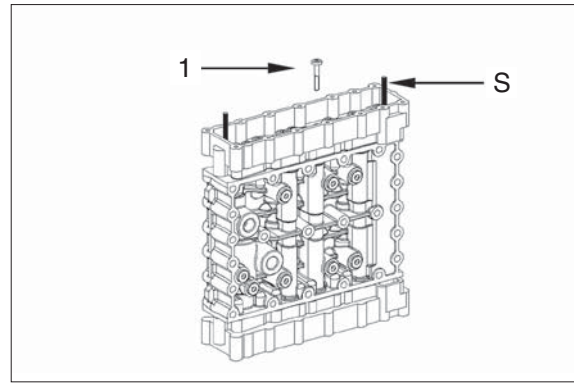
- ⑫ Loosen cylindrical screws, remove fixing plates and remove pressure controllers (1) on opposite side.



7609ATM015

- ⑬ Loosen two Torx screws (1) and preliminarily fix housing by means adjusting screws. (Housing is spring-loaded) Then loosen remaining Torx screws.

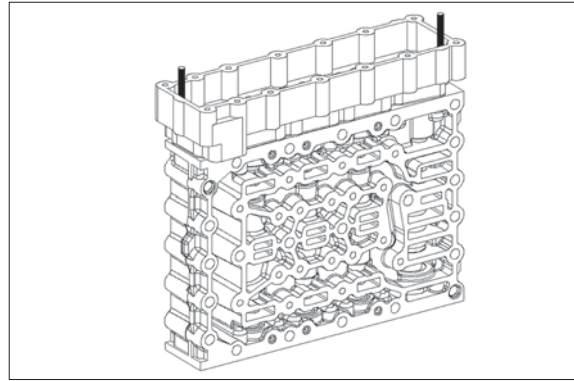
Adjusting screws (s)      5870 204 036



7609ATM016

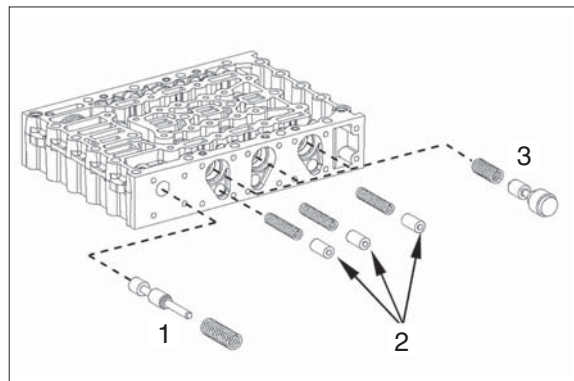
- ⑭ Separate housing from valve housing by loosening the adjusting screws equally.

Adjusting screws      5870 204 036



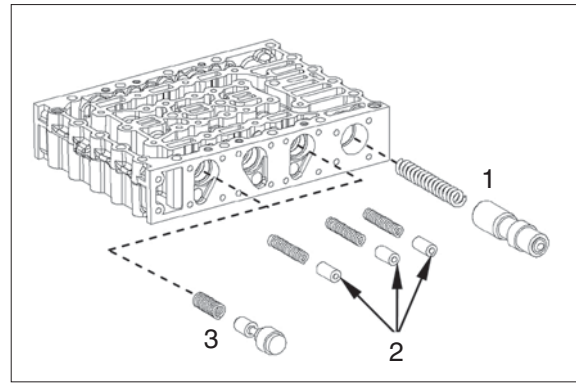
7609ATM017

- ⑮ Remove individual parts :
- 1 Pressure reducing valve
  - 2 Vibration dampers
  - 3 Follow-on slide



7609ATM018

- ⑩ Remove individual parts of opposite side analogously :
- 1 Main pressure valve
  - 2 Vibration dampers
  - 3 Follow-on slide



7609ATM019

## 2) DISASSEMBLY

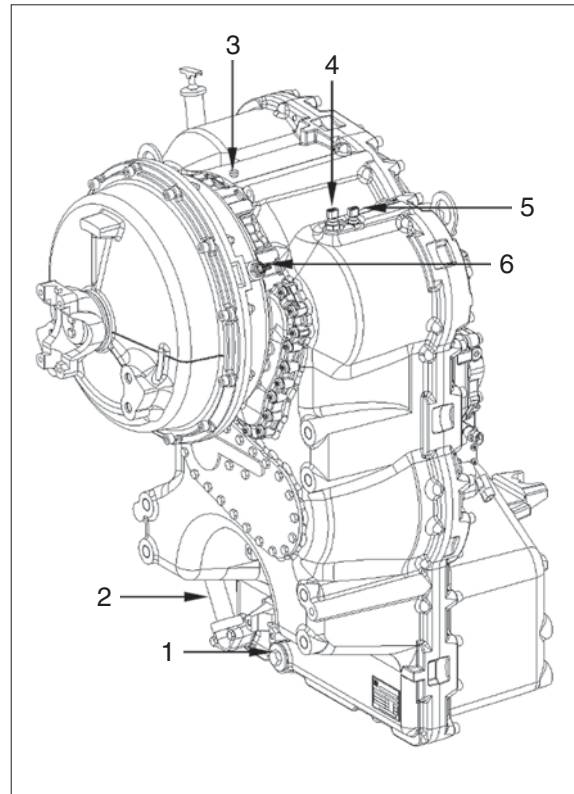
**Inductive sensor, hall sensor, breather, oil filler and oil drain plug.**

(1) Attach transmission to assembly truck.

Assembly truck	5870 350 000
Holding fixtures	5870 350 063
Clamping angles	5870 350 090

(2) Remove positioned parts.

- 1 Screw plug (oil drain hole)
- 2 Oil filler tube with oil dipstick
- 3 Breather
- 4 Inductive sensor - n central gear chain
- 5 Inductive sensor - n turbine
- 6 Inductive sensor - n engine

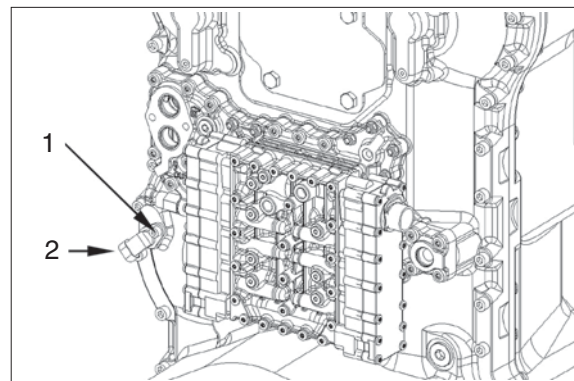


7609ATM021

(3) Loosen cylindrical screw (1) and remove speed sensor (hall sensor).

※ Remove O-ring.

- 2 Speed sensor - n output



7609ATM022

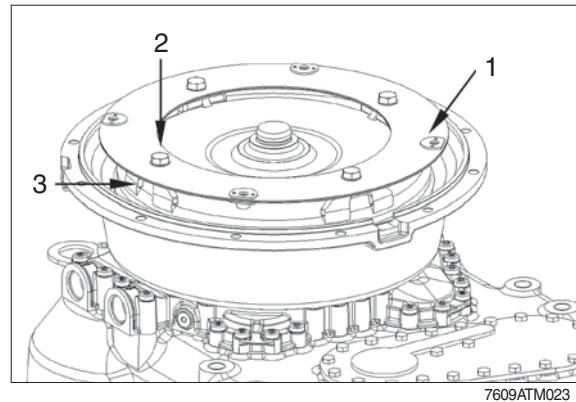


### 3) DISASSEMBLY

Engine connection, oil pressure pump, converter back-pressure valve and temperature sensor (measuring point "63" after the converter).

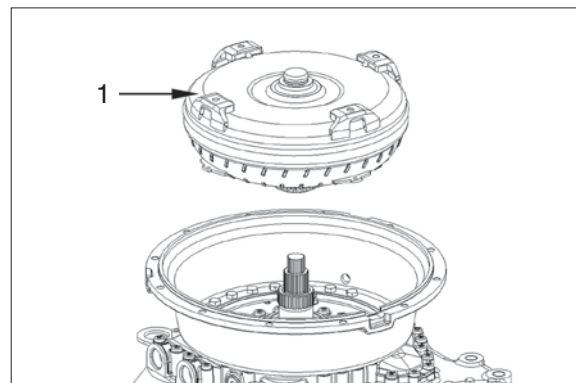
#### (1) Engine connection

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



7609ATM023

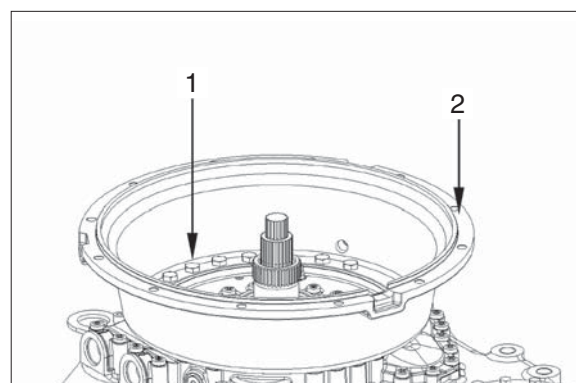
- ② Separate converter (1) from transmission by means of lifting device.



7609ATM024

#### (2) Oil pressure pump

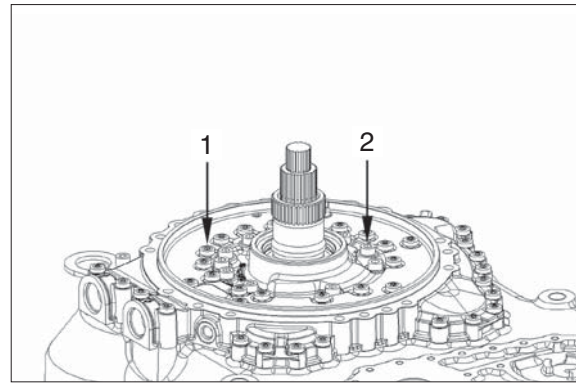
- ① Loosen bolted connection (1) converter bell housing/oil feed housing and remove converter bell housing (2).



7609ATM025

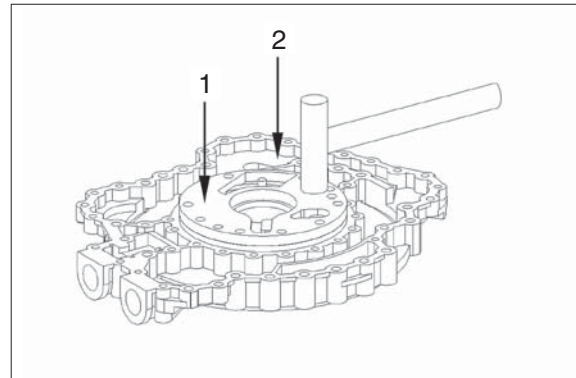
- ② Loosen bolted connection (1) oil feed housing/transmission housing front part with torx screws and bolted connection (2) oil pressure pump/transmission housing front part with cylindrical screws.

※ Separate oil feed housing together with oil pressure pump from transmission housing front part.



7609ATM026

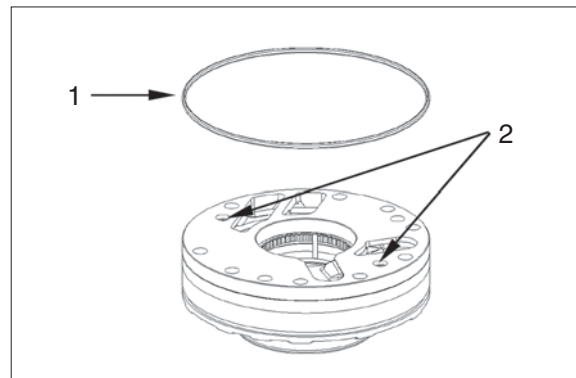
- ③ Separate oil pressure pump (1) from oil feed housing (2).



7609ATM027

- ④ Remove O-ring (1).

※ Loosen cylindrical screws (2).

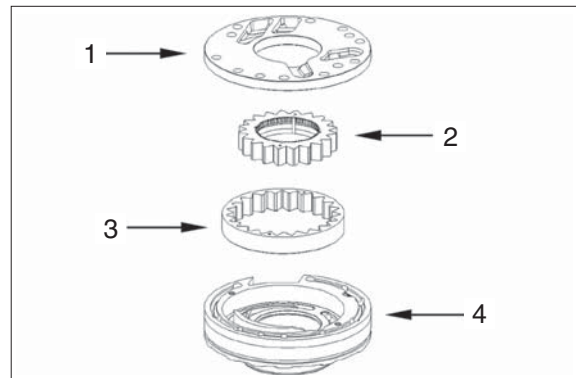


7609ATM028

※ Check oil gear pump :

In case of wear marks in the pump housing, cover or on the inner and outer rotor, the complete oil pressure pump is to be replaced.

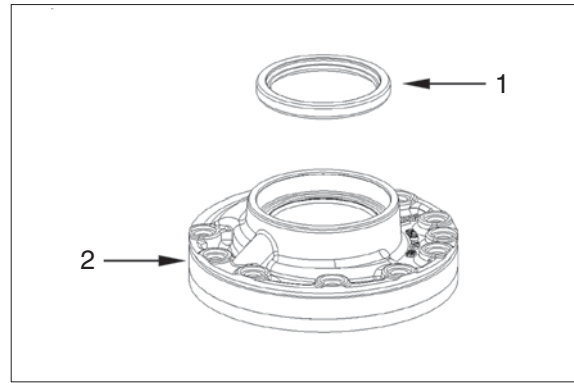
- 1 Cover
- 2 Inner rotor
- 3 Outer rotor
- 4 Pump housing



7609ATM029



- ⑤ Remove shaft seal (1) from the pump housing (2).

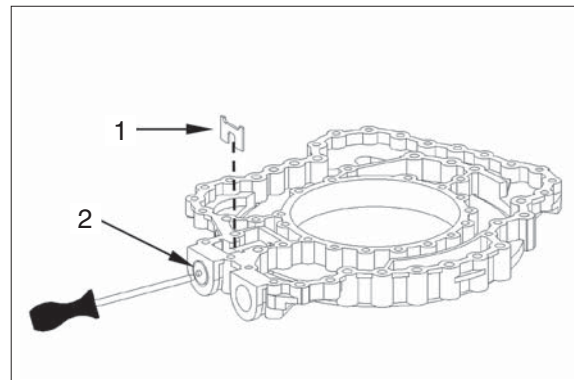


7609ATM030

### (3) Converter back-pressure valve

- ① Preload converter safety valve (1) by means of screw driver or assembly aid and remove locking plate (2).

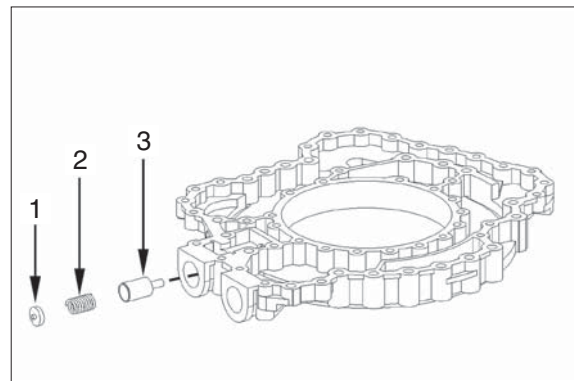
Assembly aid 5870 345 107



7609ATM031

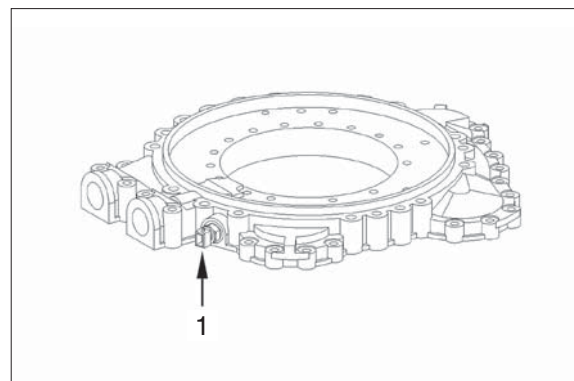
- ② Remove individual parts of converter safety valve which are getting released.

- 1 Pressure plate
- 2 Compression spring
- 3 Piston



7609ATM032

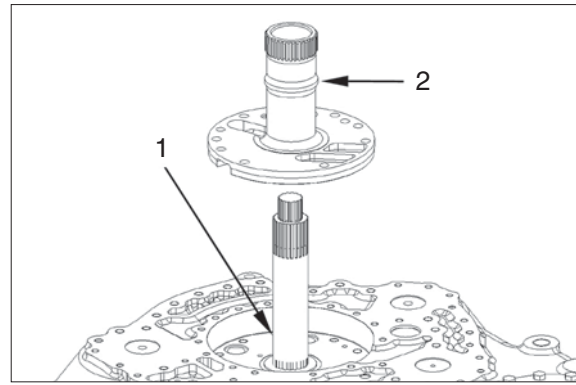
- ③ Remove temperature sensor (1).



7609ATM033

④ Remove stator shaft (1).

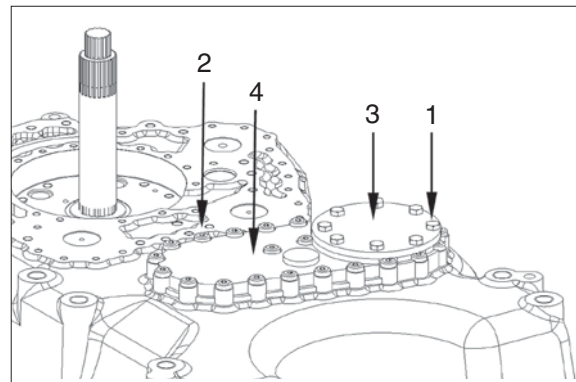
Pull pressure relief valve (2) out of the housing hole.



4) DISASSEMBLY

**Without emergency steering pump**

Loosen bolted connection cover (1) and cover front part (2) and remove cover (3 and 4) and seal.

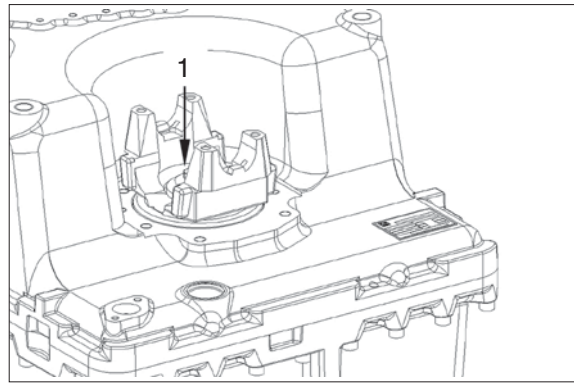


## 5) DISASSEMBLY

### Outputs flange

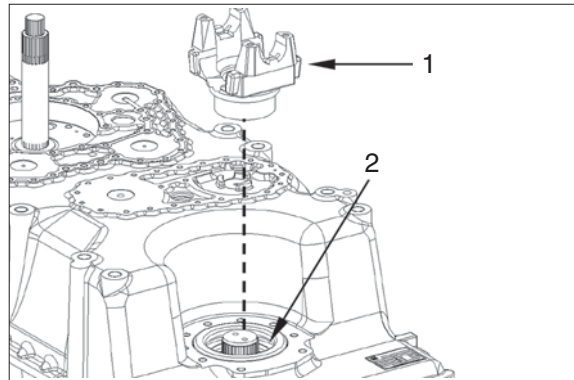
#### (1) Output flange on converter side

- ① Loosen hexagon screws (1), remove washer and O-ring.



7609ATM036

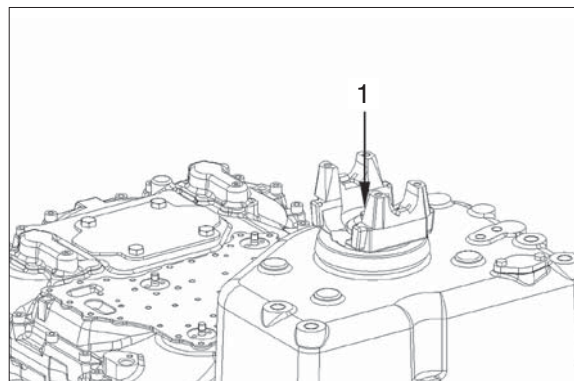
- ② Pull off output flange (1) and remove shaft seal (2).



7609ATM037

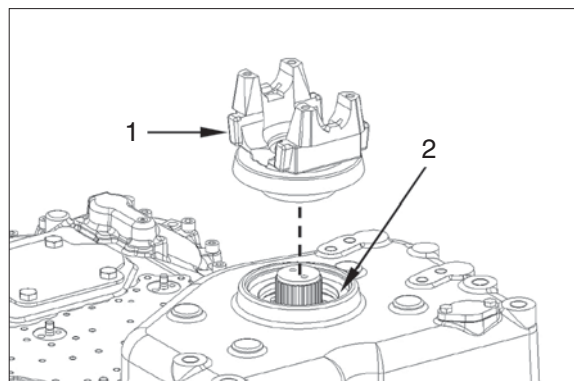
#### (2) Output flange on output side

- ① Loosen hexagon screws (1), remove washer and O-ring.



7609ATM038

- ② Pull off output flange (1) and remove shaft seal (2).

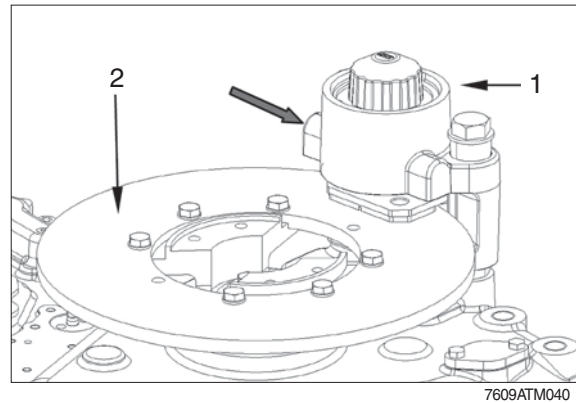


7609ATM039

**(3) Output flange on output side with parking brake**

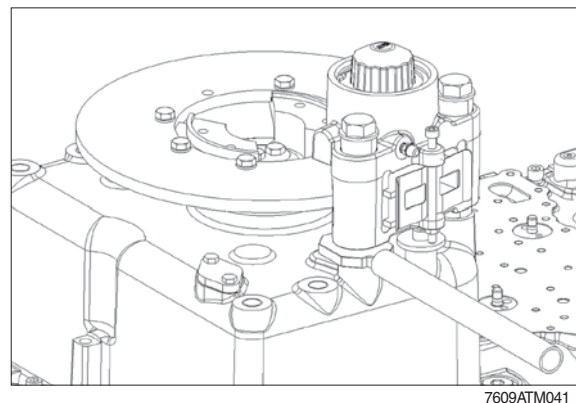
- ① Connect HP pump at port (see arrow) and apply approx. 80 bar pressure to the hydraulically actuated parking brake (1) until the brake disc (2) can be rotated by hand.

HP hand-operated pump 5870 287 007  
MINIMESS coupling (M12 × 1.5)  
5870 950 101

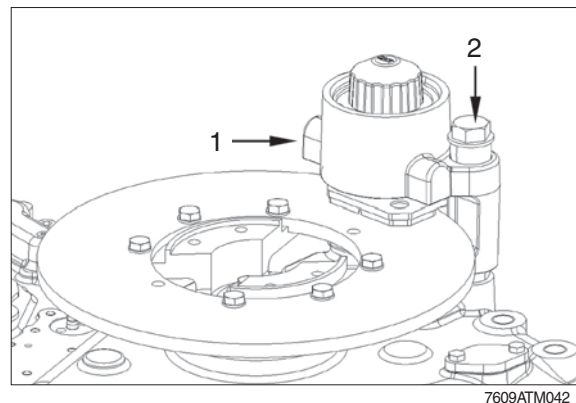


- ② Loosen hexagon nut with open end wrench insert.

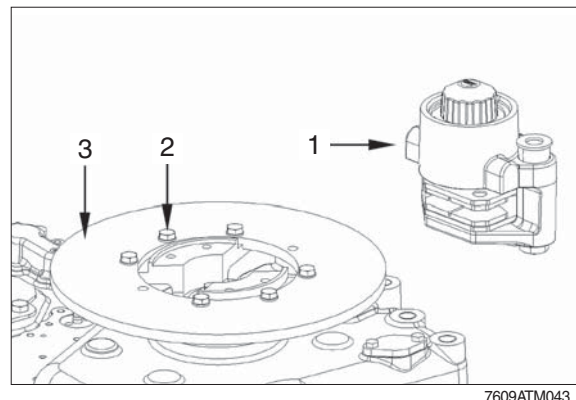
Open end wrench insert AA00 244 432



- ③ Loosen hexagon screws (2) and remove parking brake (1) (see figure TM043).



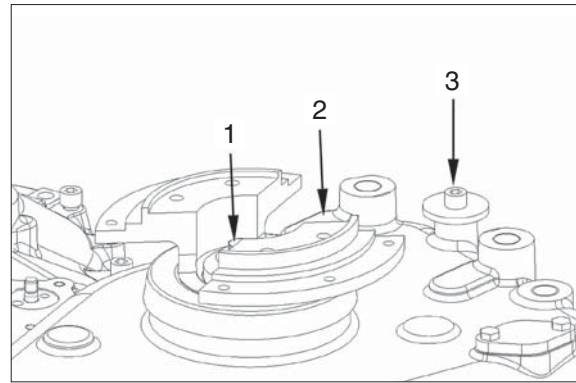
- ④ Loosen hexagon screws (2) of bolted brake disk/output flange connection and remove brake disk (3).



- ⑤ Loosen hexagon screws (1), remove washer and O-ring.

Pull-off output flange (2) and remove shaft seal.

Remove cylindrical screw with washer (3).

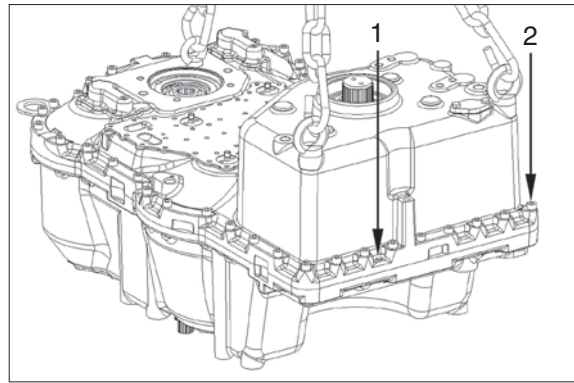


7609ATM044

## 6) REMOVAL OF INPUT SHAFT, OUTPUT SHAFT, PUMP SHAFT (PTO-SHAFT) AND CLUTCHES

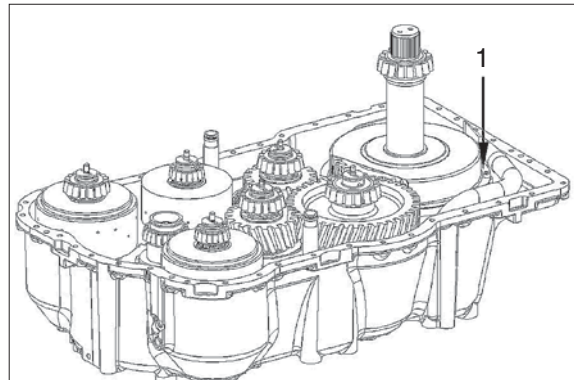
(1) Force out both cylindrical pins (1).

Loosen bolted connection (2) between housing front and rear part and separate housing rear part by means of lifting device.



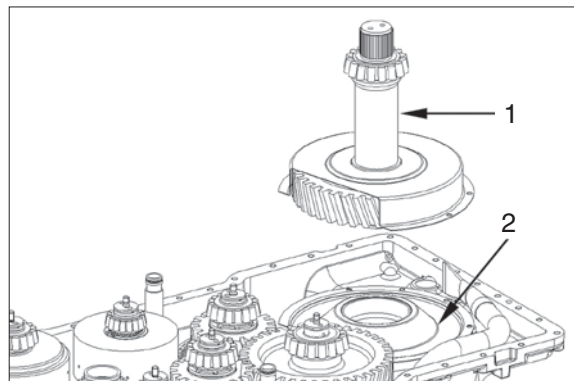
7609ATM045

(2) Loosen bolted connection (1) of oil screen sheets.



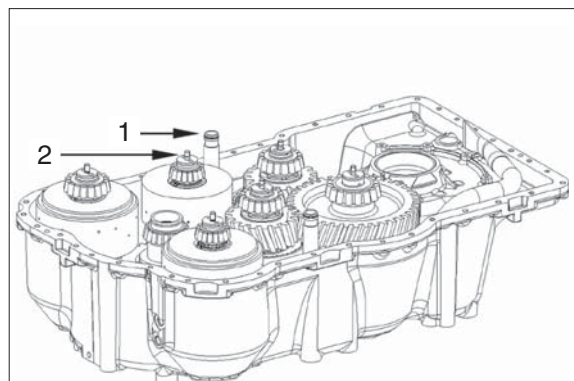
7609ATM046

(3) Remove output shaft (1) and lower oil screen sheet (2) from housing.



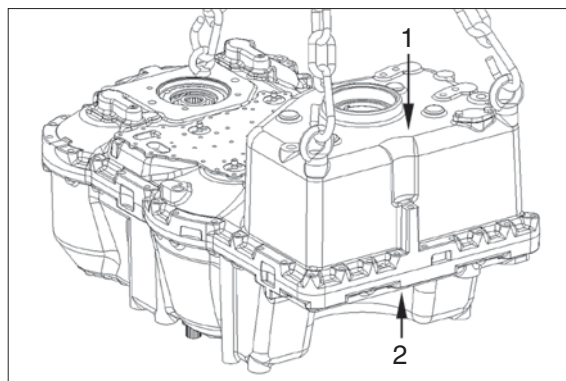
7609ATM047

(4) Remove all rectangular rings (1) from the clutches and all O-rings (2) from the oil tubes.



7609ATM048

- (5) Use lifting device to bring housing rear part (1) into contact position with housing front part (2) again.



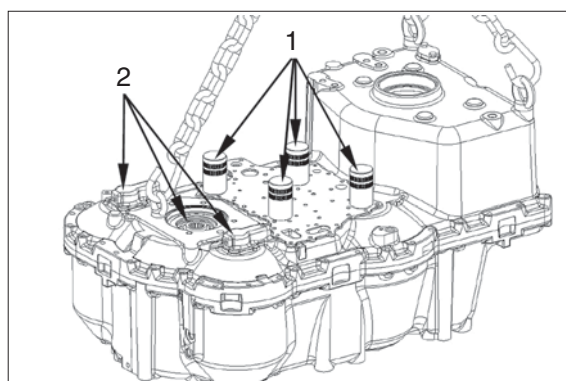
7609ATM049

- ※ Due to the installation conditions, the removal of single clutches without using the special tool is not possible.

- (6) Fix all clutches K1, K2, K3 and K4 by means of handle (1).

Handle 5870 260 010

- ※ Clutches KV, KR and input shaft (2) are only fixed by the gear chain.



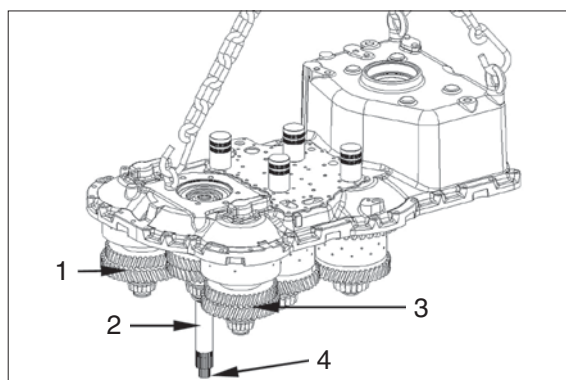
7609ATM050

- (7) Separate housing rear part incl. clutches from housing front part by means of the lifting device and attaches it to the assembly truck.

- 1 Clutch KV
- 2 Input shaft
- 3 Clutch KR
- 4 Pump shaft

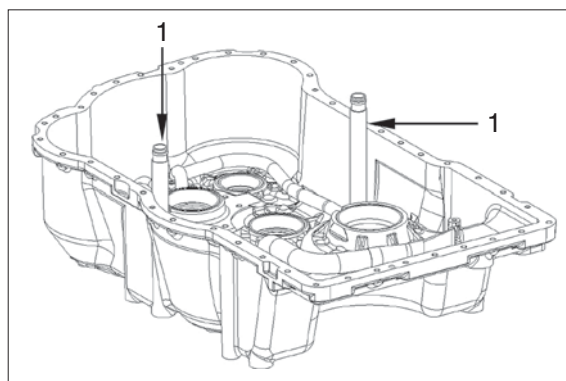
- ※ Clutches KV, KR and input shaft are only fixed by the gear chain.

Attention must be paid that the non-fixed components of the gear chain do not get loose.



7609ATM051

- (8) Loosen cylindrical screws of oil tubes (1) in the housing front part and remove them.



7609ATM052

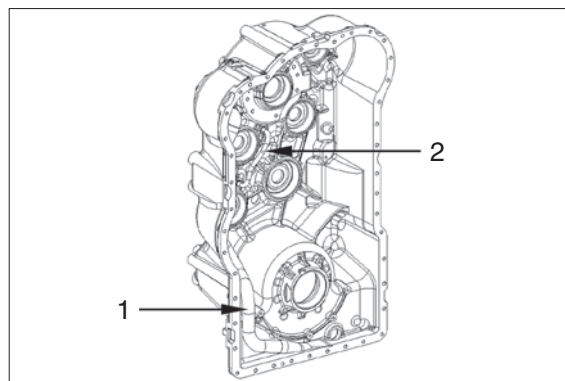


※ The suction tube (1) and the lubrication lines (2) are rolled in and are highly difficult to remove.

In case of damage, use of the appropriate special tool is imperative for fitting or replacing these components.

Rolling tool

5870 600 003

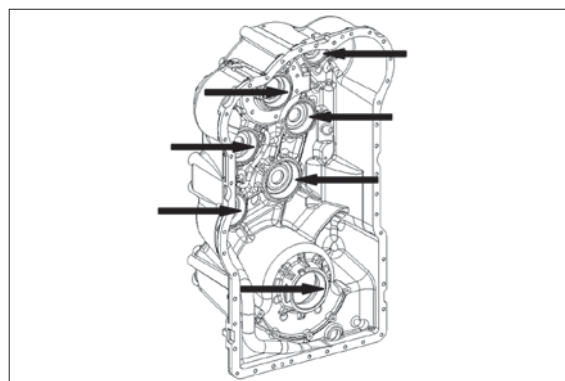


7609ATM053

(9) Remove bearing outer rings (arrows) from the housing front part.

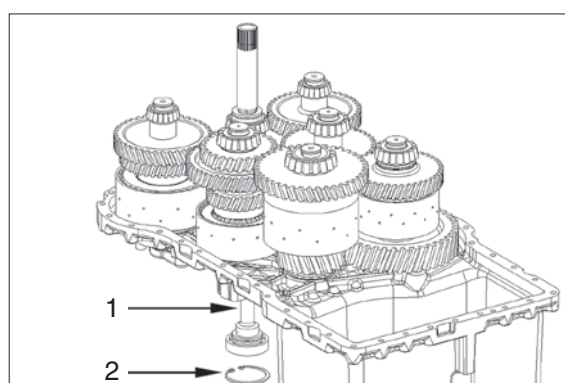
※ If, contrary to the recommendation, the tapered roller bearings of clutches, input and output are not replaced, it is imperative to ensure the previous pairing (bearing outer ring/ bearing inner ring).

Bearing outer ring and bearing inner ring must be marked.



7609ATM054

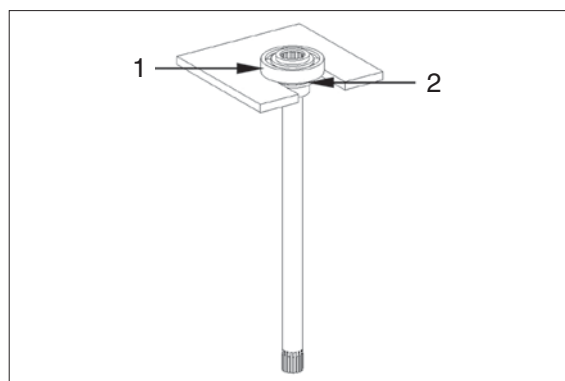
(10) Disengage retaining ring (1) and remove pump shafts (2).



7609ATM055

(11) Press ball bearing (1) off the pump shaft.

Snap out rectangular ring (2).

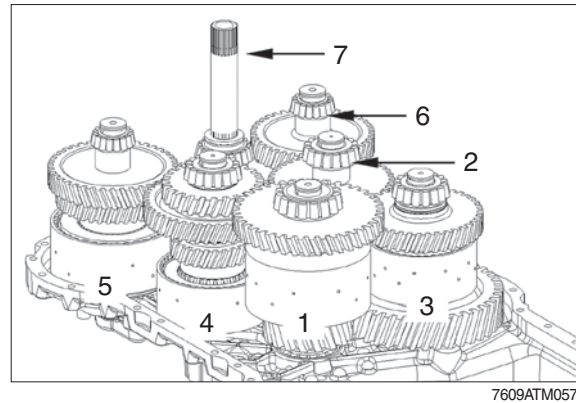


7609ATM056



(12) Lift the clutches out of the housing in numerical order as described in the legend.

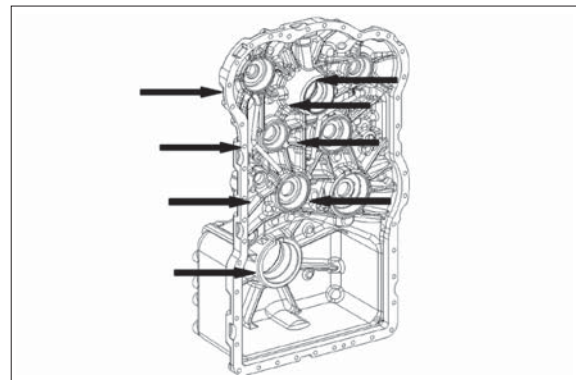
- 1 K1 clutch
- 2 K2 clutch
- 3 K3 clutch
- 4 K4 clutch
- 5 KR clutch
- 6 KV clutch
- 7 input shaft



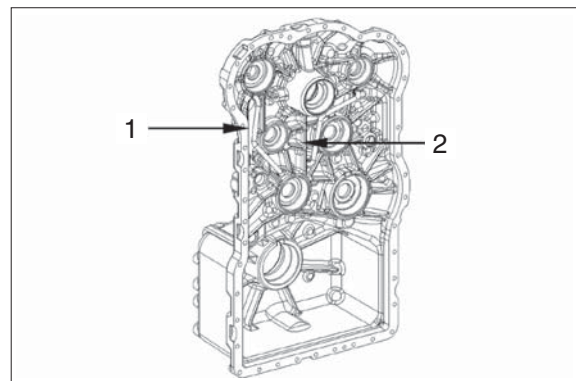
(13) Remove bearing outer rings (arrows) from the housing rear part.

※ If, contrary to the recommendation, the tapered roller bearings of clutches, input and output are not replaced, it is imperative to ensure the previous pairing (bearing outer ring/ bearing inner ring).

Bearing outer ring and bearing inner ring must be marked.



※ The lubrication lines are rolled in (1 and 2) and are highly difficult to remove. In case of damage, use of the appropriate special tool is imperative for fitting or replacing these components.

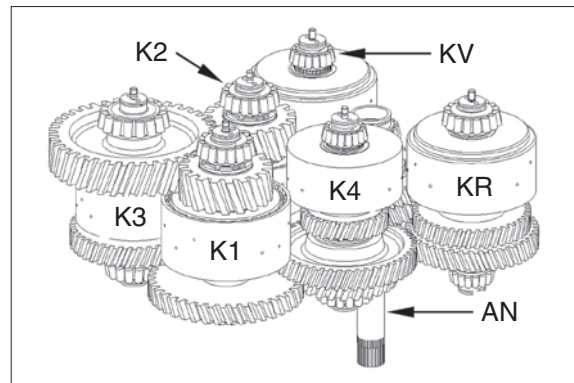


## 7) DISASSEMBLY

### Clutches KV / KR / K1 / K2 / K3 / K4 input and output shaft

See opposite picture.

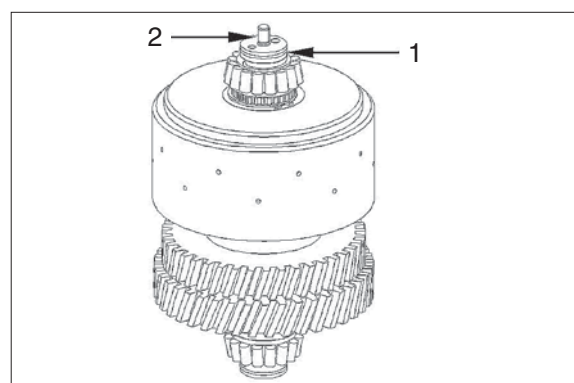
- K1 clutch
- K2 clutch
- K3 clutch
- K4 clutch
- KR clutch
- KV clutch
- AN input shaft



7609ATM060

### (1) KV clutch

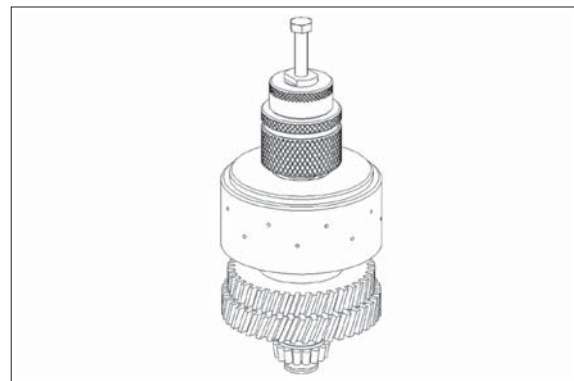
- ① Remove stud bolt (1) and snap out piston ring (2).



7609ATM061

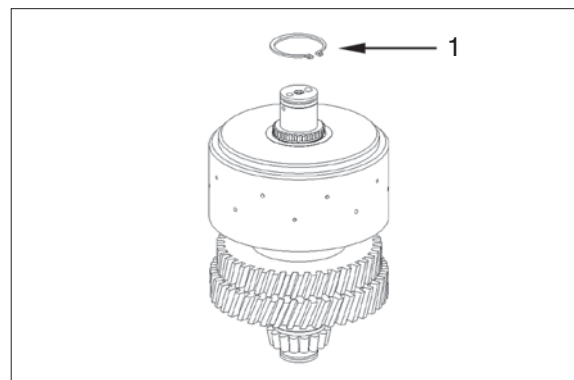
- ② Pull tapered roller bearing (inner ring) off the shaft.

Forcing device	5870 026 100
Grab sleeve	5873 001 057
or	
Rapid grip	5873 011 011



7609ATM062

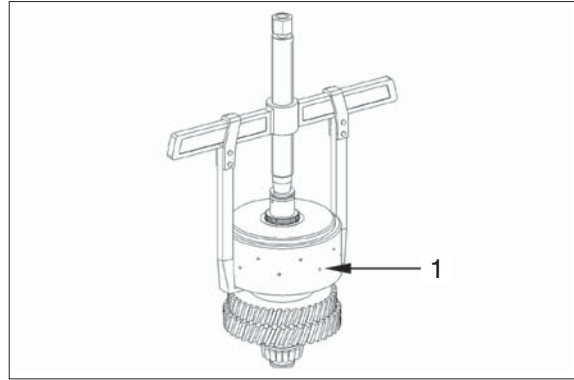
- ③ Snap out retaining ring (1).



7609ATM063

④ Pull clutch (1) off the shaft.

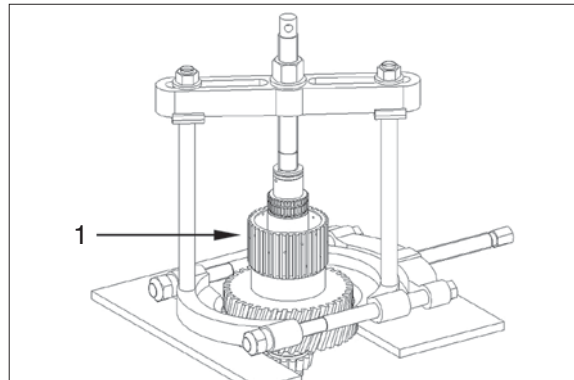
※ Disassembly clutch (1) see figure TM070~TM075.



7609ATM064

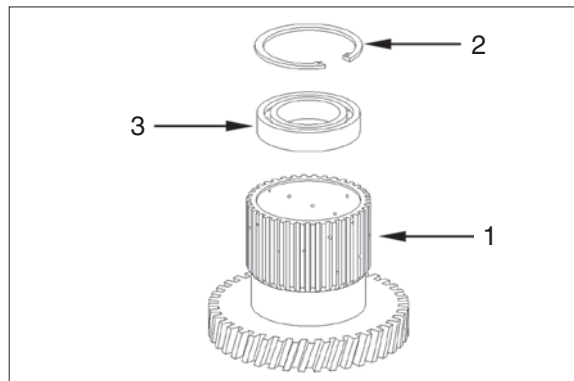
⑤ Fix idler gear (1) by means of cut-off device and pull it off the clutch shaft.

Cut-off device	5870 300 024
Puller	5870 300 033



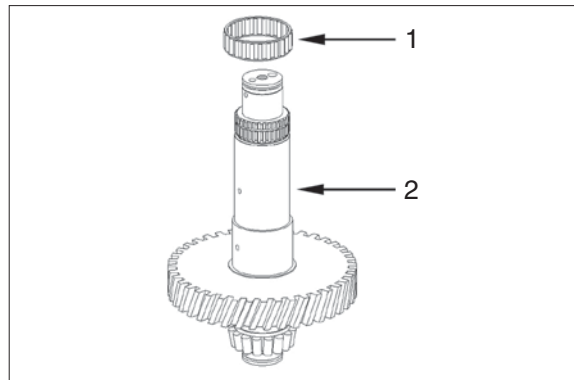
7609ATM065

⑥ Snap retaining ring (2) out of the idler gear (1) and remove ball bearing (3).



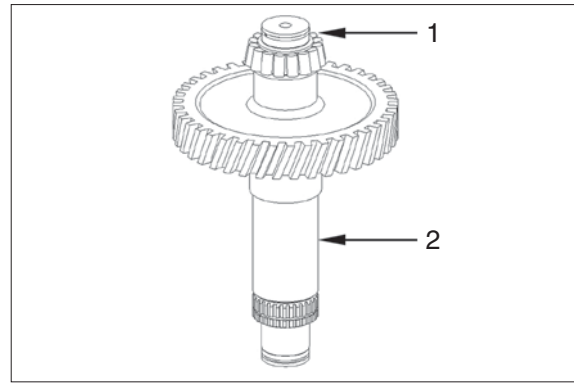
7609ATM066

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



7609ATM067

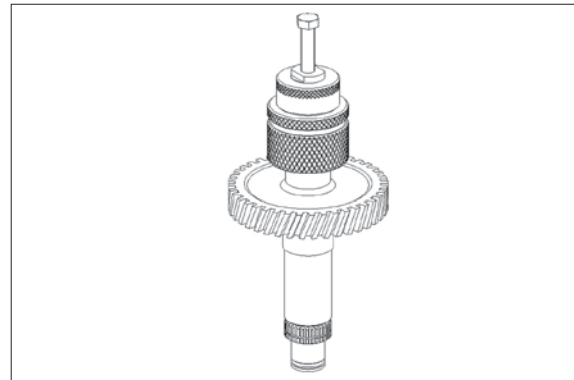
- ⑧ Turn shaft (2) by 180° and snap out piston ring (1).



7609ATM068

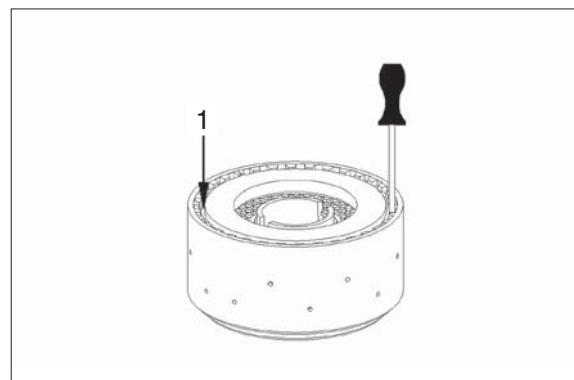
- ⑨ Pull tapered roller bearing (inner ring) off the shaft.

Forcing device	5870 026 100
Grab sleeve	5873 001 057
or	
Rapid grip	5873 011 011



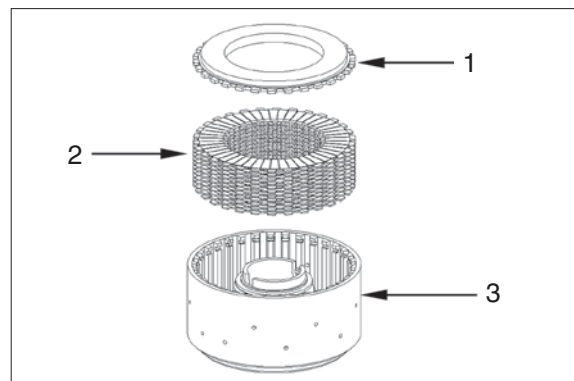
7609ATM069

- ⑩ Unsnap snap ring (1).



7609ATM070

- ⑪ Remove end shim (1) and disc set (2) out the disc carrier (3).

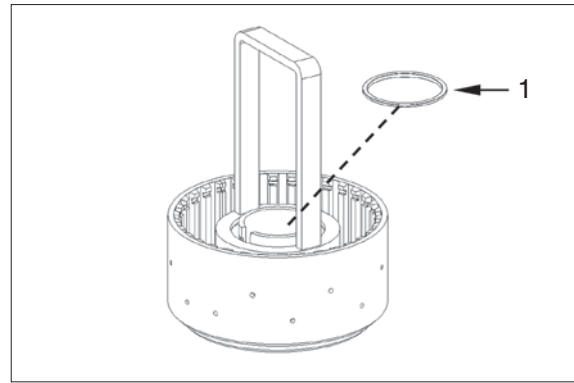


7609ATM071

- ⑫ Preload compression spring (1) unsnap L-ring.

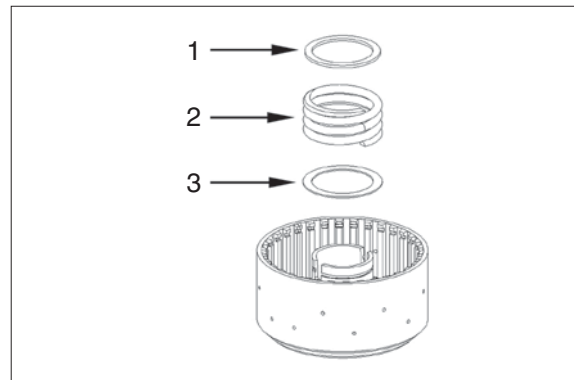
Assembly aid

5870 345 088



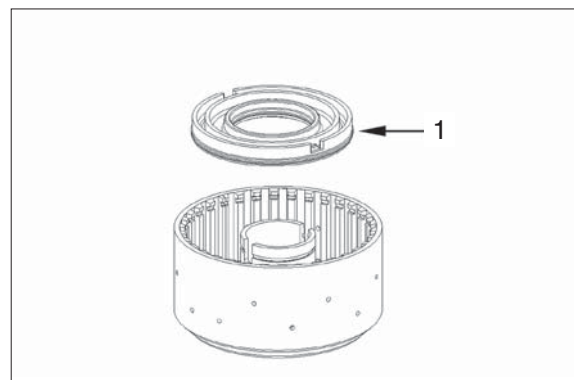
7609ATM072

- ⑬ Remove support shim (1), compression spring (2) and washer (3).



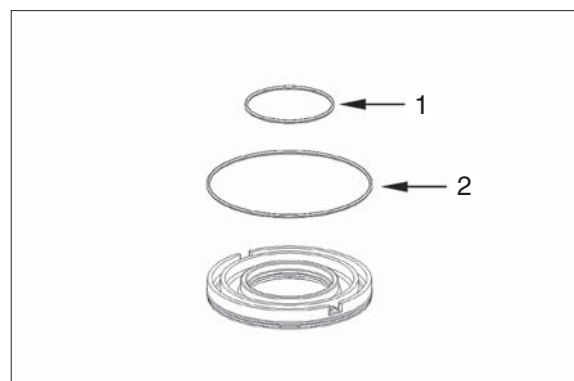
7609ATM073

- ⑭ Lift piston (1) by means of compressed air out of the cylinder bore and remove it.



7609ATM074

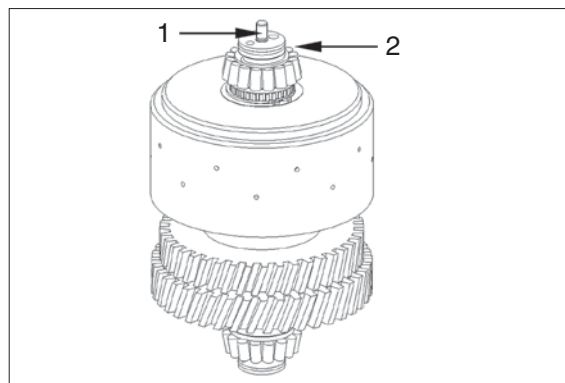
- ⑮ Remove both O-rings (1 and 2).



7609ATM075

## (2) KR clutch

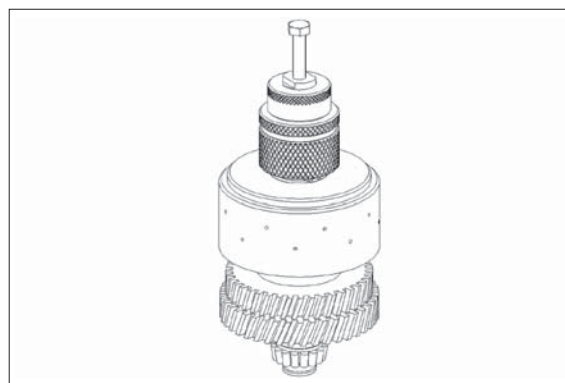
- ① Remove stud bolt (1) and snap out piston ring (2).



7609ATM076

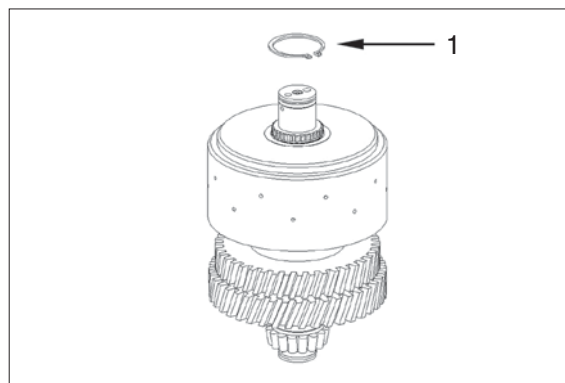
- ② Pull tapered roller bearing (inner ring) off the shaft.

Forcing device	5870 026 100
Grab sleeve	5873 001 059



7609ATM077

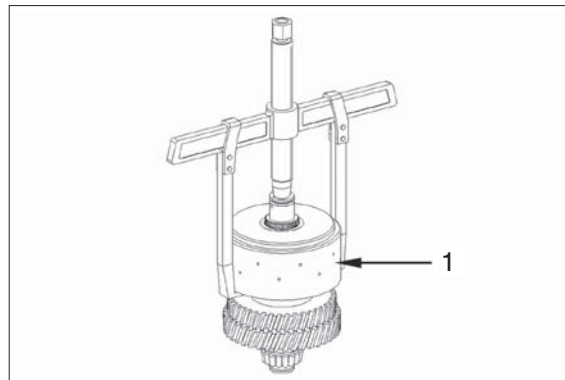
- ③ Snap out retaining ring (1).



7609ATM078

- ④ Pull clutch (1) off the shaft.

※ Disassembly clutch (1) see figure TM085~TM090.

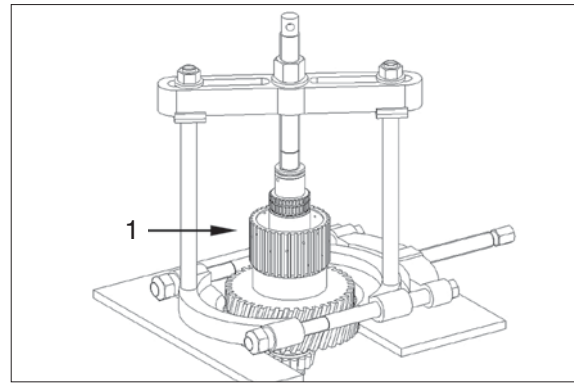


7609ATM079

- ⑤ Fix idler gear (1) by means of cut-off device and pull it off the clutch shaft.

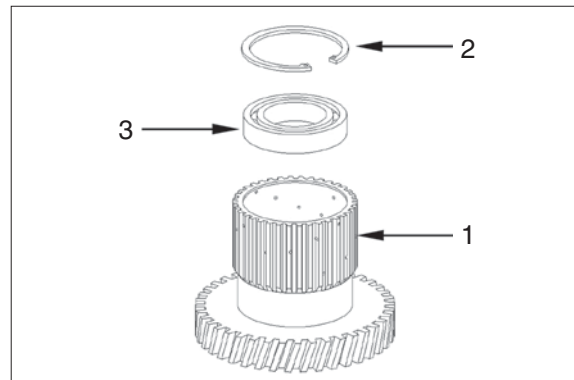
Cut-off device 5870 300 024

Puller 5870 300 033



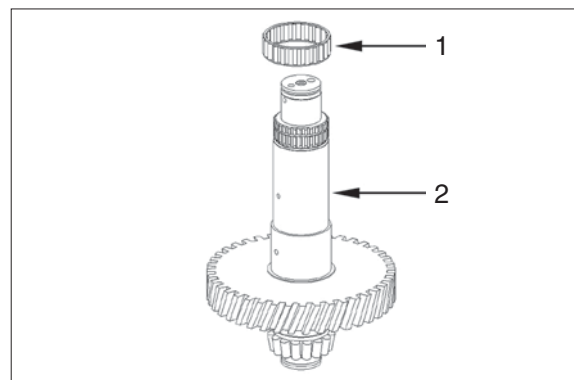
7609ATM080

- ⑥ Snap retaining ring (2) out of the idler gear (1) and remove ball bearing (3).



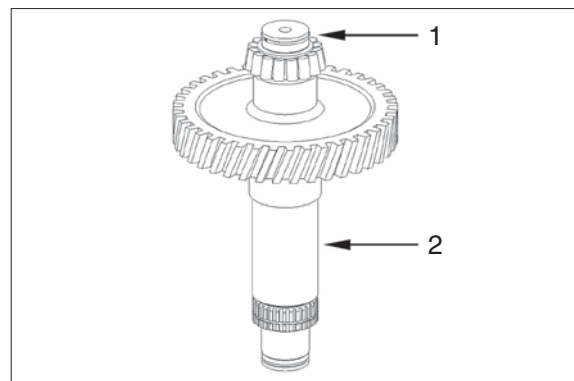
7609ATM081

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



7609ATM082

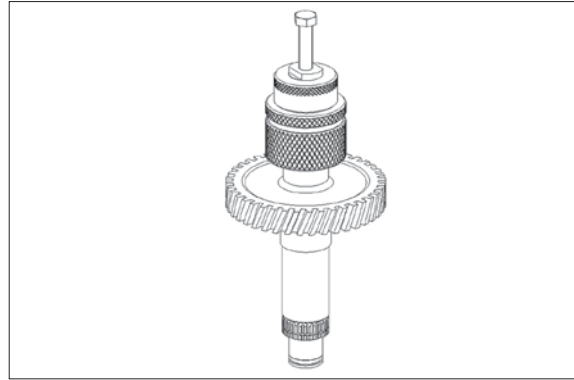
- ⑧ Turn shaft (2) by 180° and snap out piston ring (1).



7609ATM083

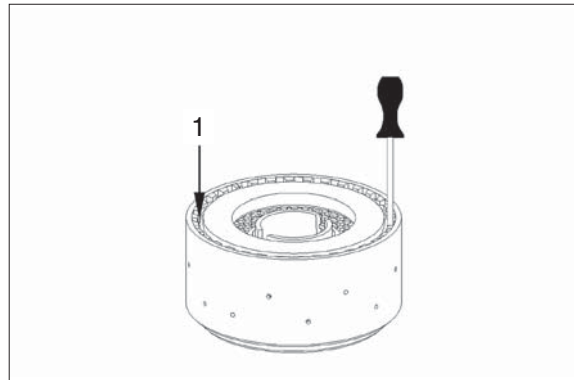
- ⑨ Pull tapered roller bearing (inner ring) off the shaft.

Forcing device	5870 026 100
Grab sleeve	5873 001 057
or	
Rapid grip	5873 011 011



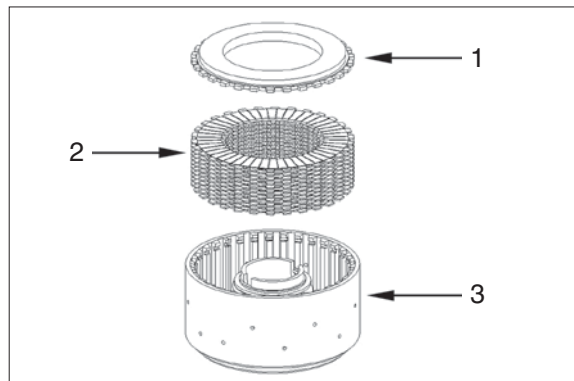
7609ATM084

- ⑩ Unsnap snap ring (1).



7609ATM085

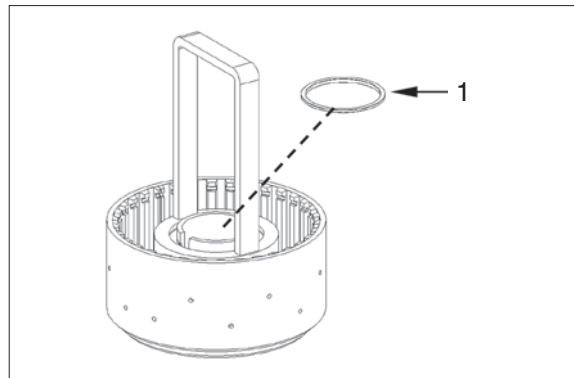
- ⑪ Remove end shim (1) and disc set (2) out the disc carrier (3).



7609ATM086

- ⑫ Preload compression spring (1) unsnap L-ring.

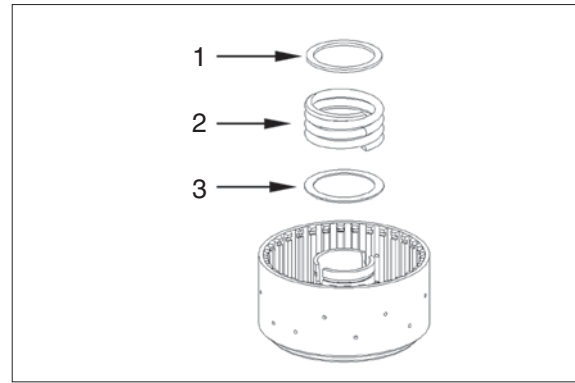
Assembly aid	5870 345 088
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7609ATM087

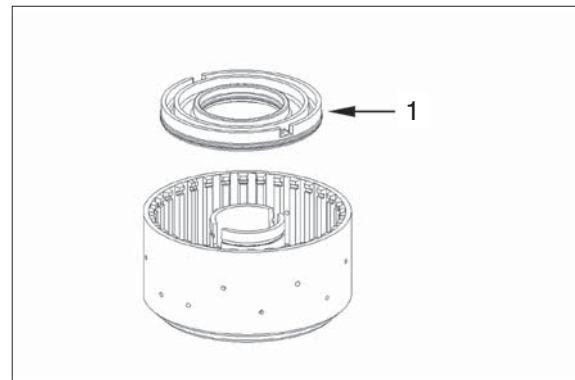


- ⑬ Remove support shim (1), compression spring (2) and washer (3).



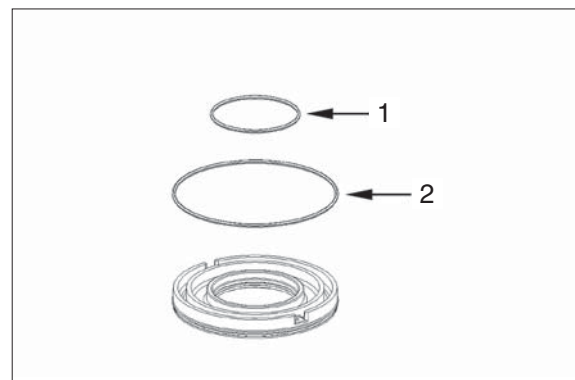
7609ATM088

- ⑭ Lift piston (1) by means of compressed air out of the cylinder bore and remove it.



7609ATM089

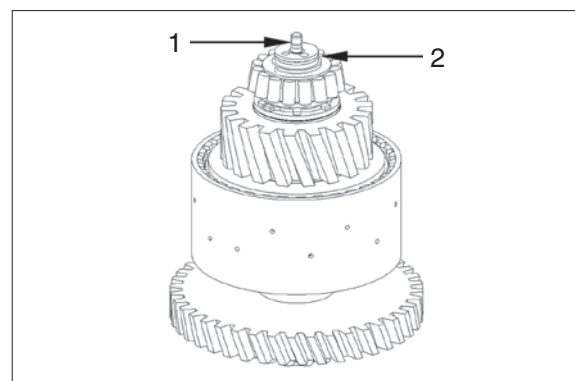
- ⑮ Remove both O-rings (1 and 2).



7609ATM090

### (3) K1 clutch

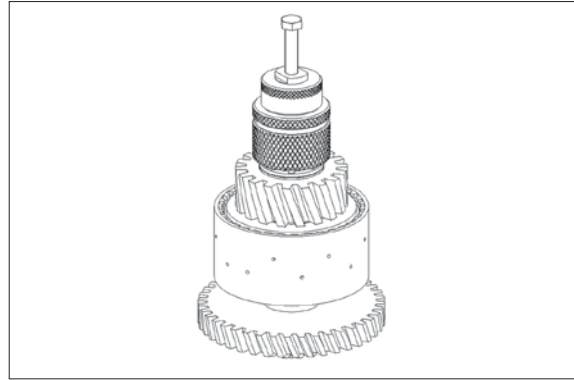
- ① Remove stud bolt (1) and snap out piston ring (2).



7609ATM091

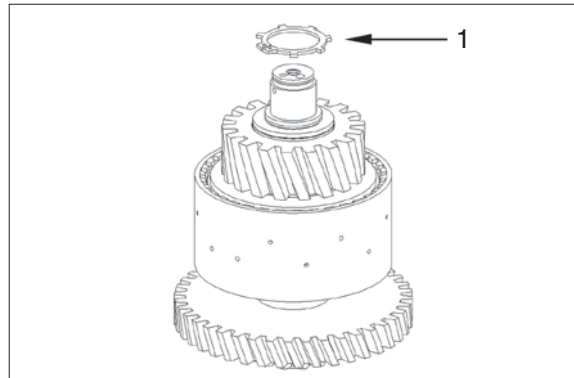
- ② Pull tapered roller bearing (inner ring) off the shaft.

Forcing device	5870 026 100
Grab sleeve	5873 001 059



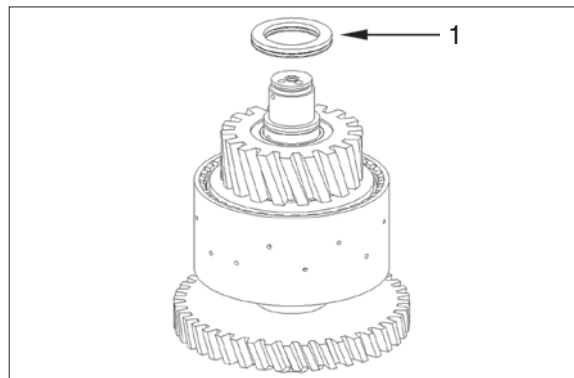
7609ATM092

- ③ Snap out retaining ring (1).



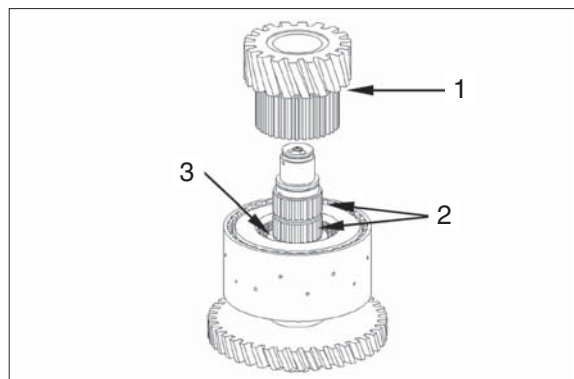
7609ATM093

- ④ Remove axial bearing assy (1).



7609ATM094

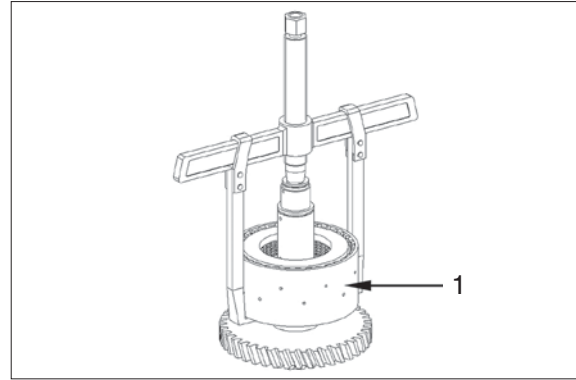
- ⑤ Take off idler gear (1), remove needle cage (2) and axial bearing assy (3).



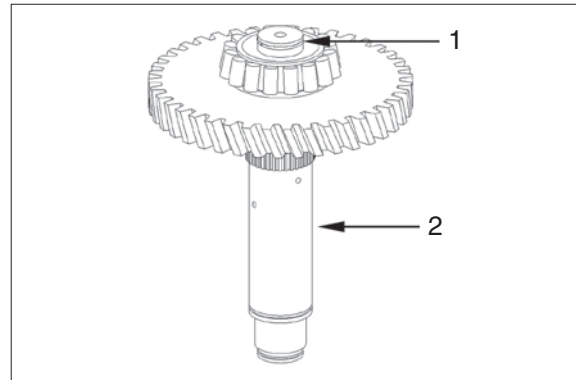
7609ATM095

⑥ Pull clutch (1) off the shaft.

※ Disassembly clutch (1) see figure TM099~TM104.

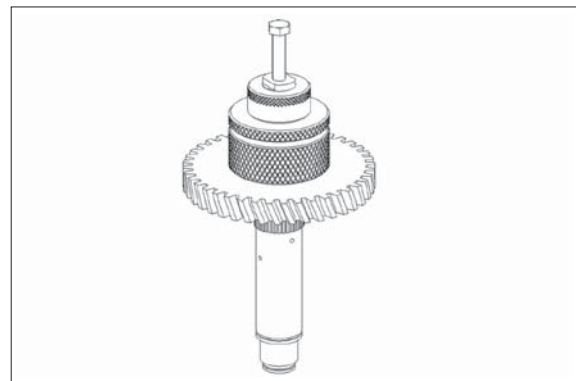


⑦ Turn shaft (2) by 180° and snap out piston ring (1).

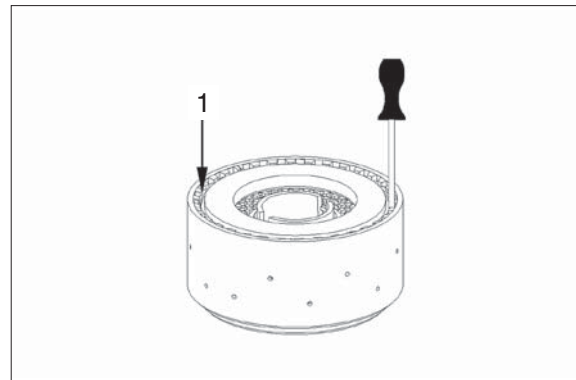


⑧ Pull tapered roller bearing (inner ring) off the shaft.

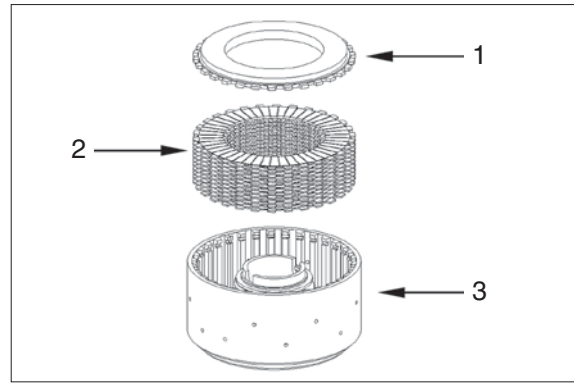
Basic tool	5873 002 001
Grab sleeve	5873 002 038



⑨ Unsnap snap ring (1).

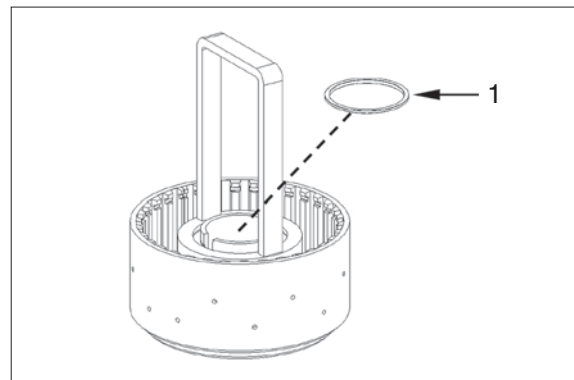


- ⑩ Remove end shim (1) and disc set (2) out the disc carrier (3).



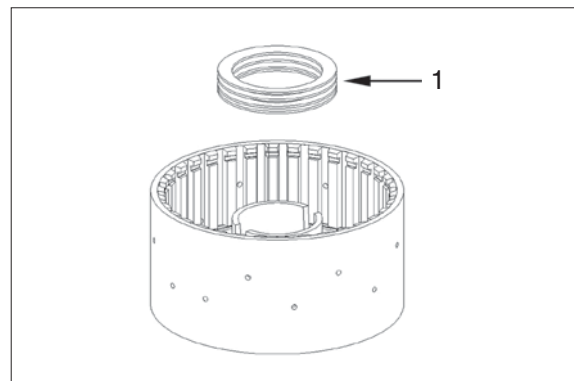
7609ATM100

- ⑪ Preload cup springs unsnap L-ring (1).  
Assembly aid 5870 345 088



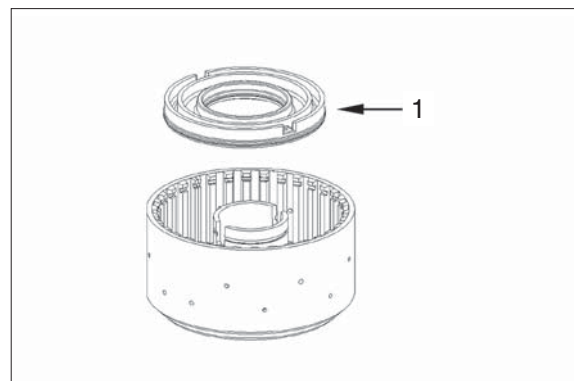
7609ATM101

- ⑫ Remove cup spring package (1).



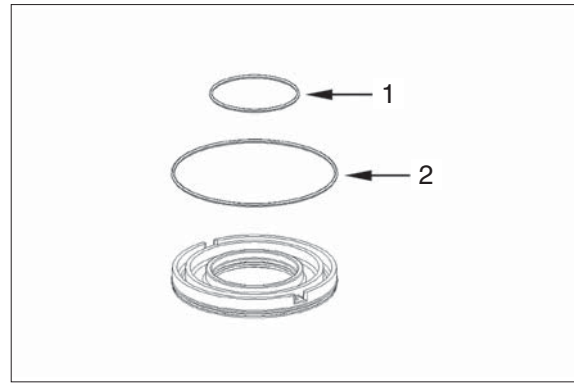
7609ATM102

- ⑬ Lift piston (1) by means of compressed air out of the cylinder bore and remove it.



7609ATM103

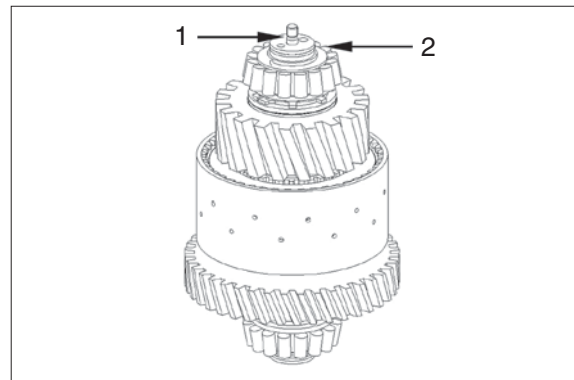
- ⑭ Remove both O-rings (1 and 2).



7609ATM104

#### (4) K2 clutch

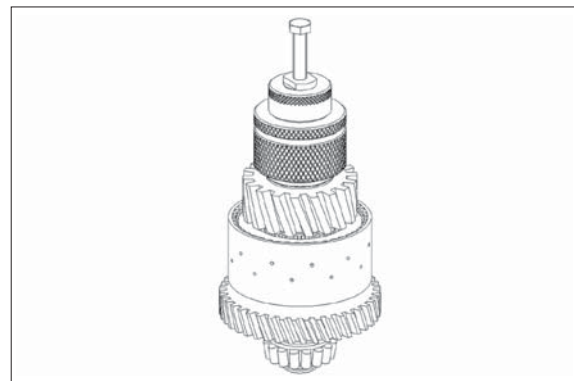
- ① Remove stud bolt (1) and snap out piston ring (2).



7609ATM105

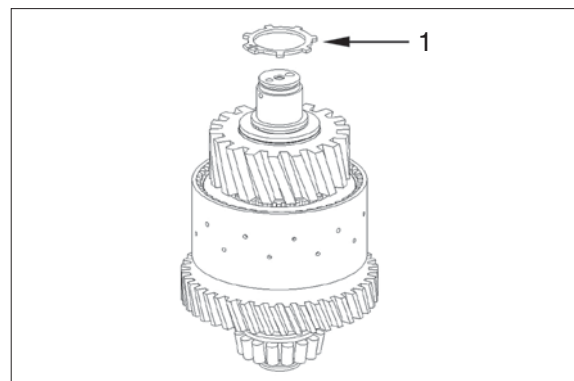
- ② Pull tapered roller bearing (inner ring) off the shaft.

Forcing device	5870 026 100
Grab sleeve	5873 001 059



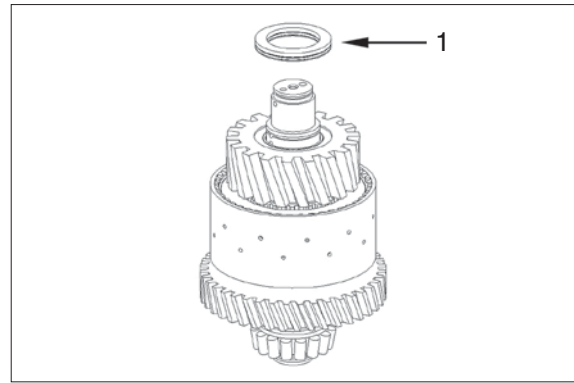
7609ATM106

- ③ Snap out retaining ring (1).



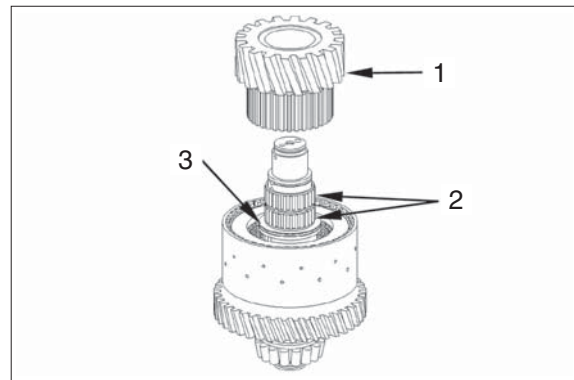
7609ATM107

- ④ Remove axial bearing assy (1).



7609ATM108

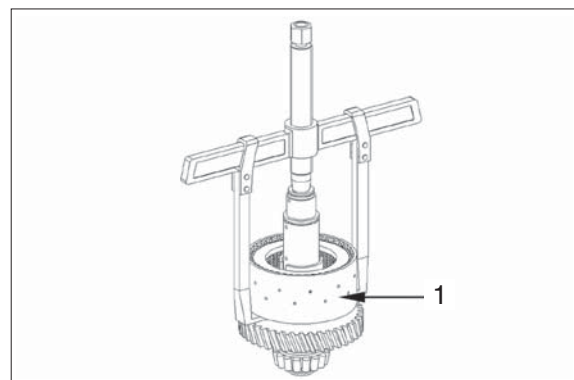
- ⑤ Take off idler gear (1), remove needle cage (2) and axial bearing assy (3).



7609ATM109

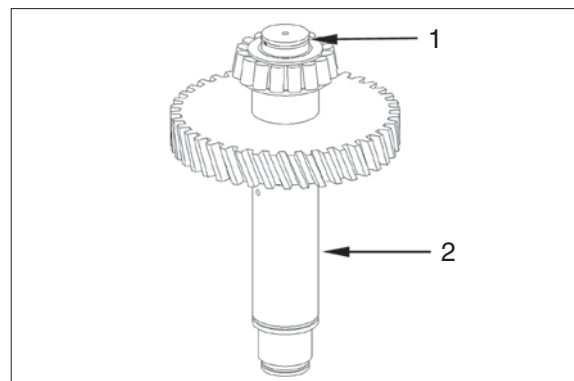
- ⑥ Pull clutch (1) off the shaft.

※ Disassembly clutch (1) see figure TM113~TM118.



7609ATM110

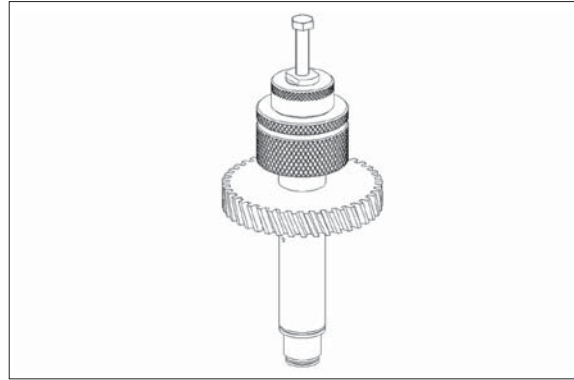
- ⑦ Turn shaft (2) by 180° and snap out piston ring (1).



7609ATM111

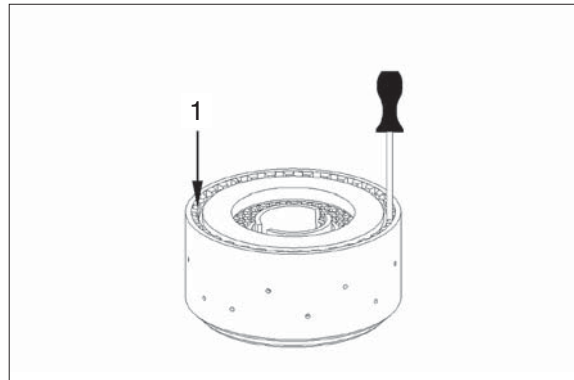
- ⑧ Pull tapered roller bearing (inner ring) off the shaft.

Forcing device	5870 026 100
Grab sleeve	5873 001 059



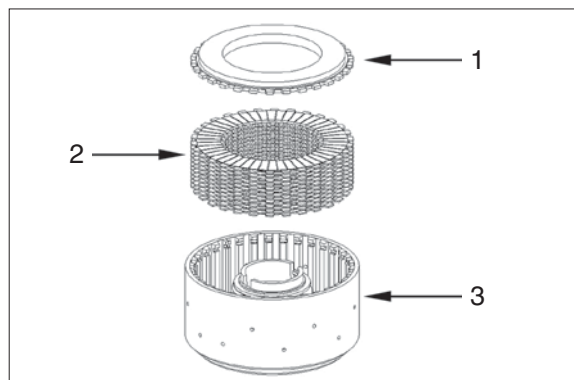
7609ATM112

- ⑨ Unsnap snap ring (1).



7609ATM113

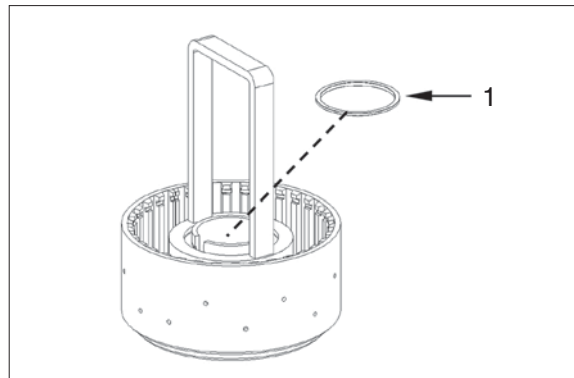
- ⑩ Remove end shim (1) and disc set (2) out the disc carrier (3).



7609ATM114

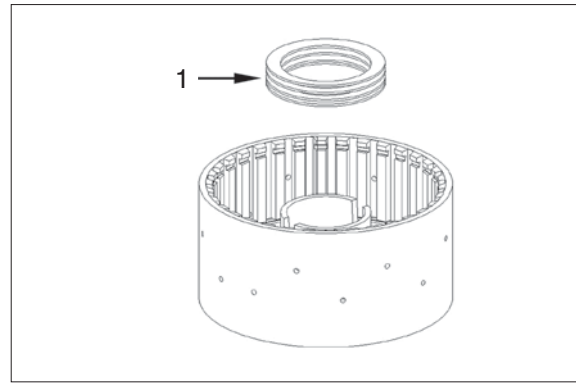
- ⑪ Preload cup springs unsnap L-ring (1).

Assembly aid	5870 345 088
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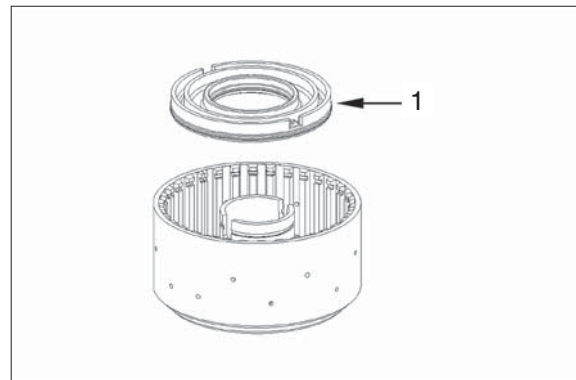
7609ATM115

- ⑫ Remove cup spring package (1).



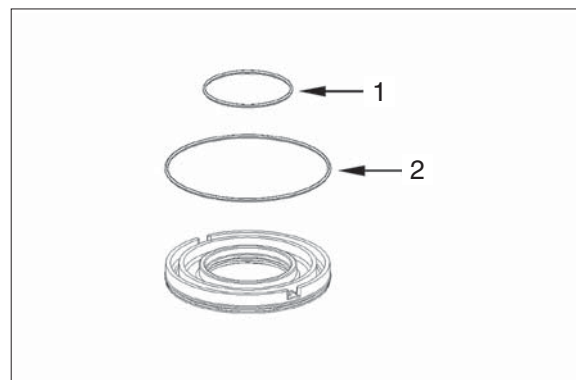
7609ATM116

- ⑬ Lift piston (1) by means of compressed air out of the cylinder bore and remove it.



7609ATM117

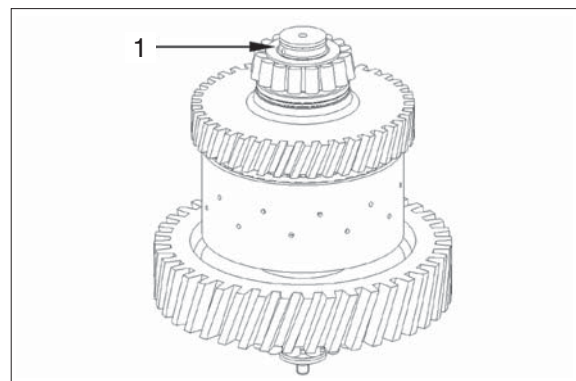
- ⑭ Remove both O-rings (1 and 2).



7609ATM118

## (5) K3 clutch

- ① Snap out piston ring (1).

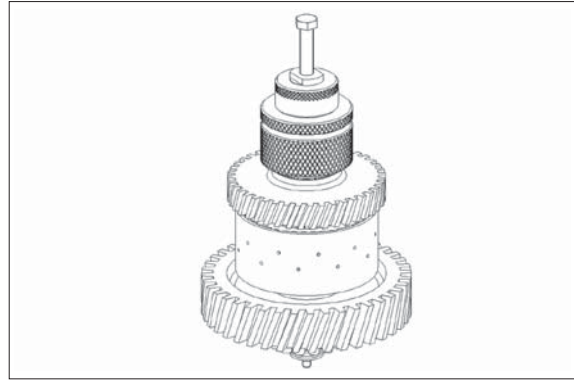


7609ATM119



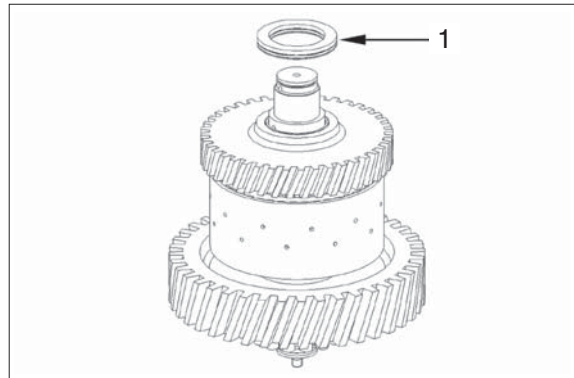
- ② Pull tapered roller bearing (inner ring) off the shaft.

Forcing device	5870 026 100
Grab sleeve	5873 001 059



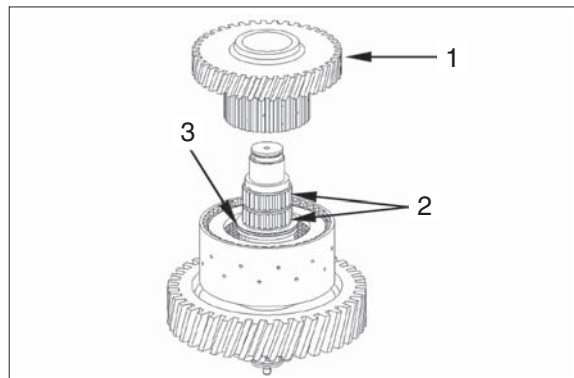
7609ATM120

- ③ Remove axial bearing assy (1).



7609ATM121

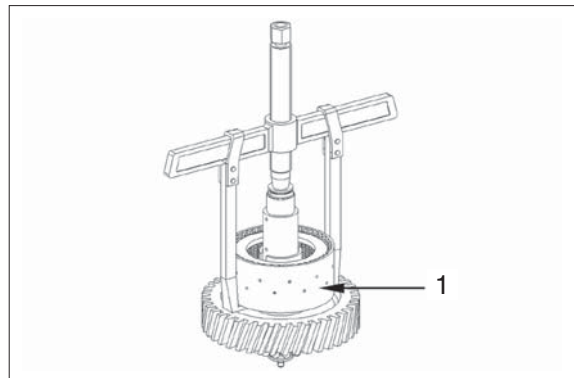
- ④ Take off idler gear (1), remove needle cage (2) and axial bearing assy (3).



7609ATM122

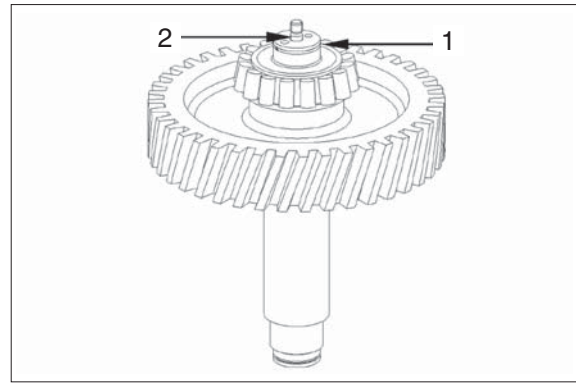
- ⑤ Pull clutch (1) off the shaft.

※ Disassembly clutch (1) see figure TM126~TM131.



7609ATM123

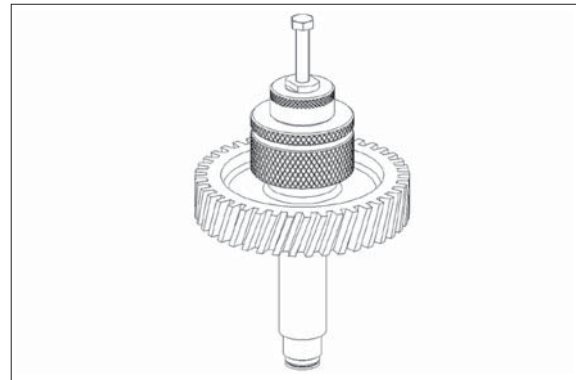
- ⑥ Remove stud bolt (1) and snap out piston ring (2).



7609ATM124

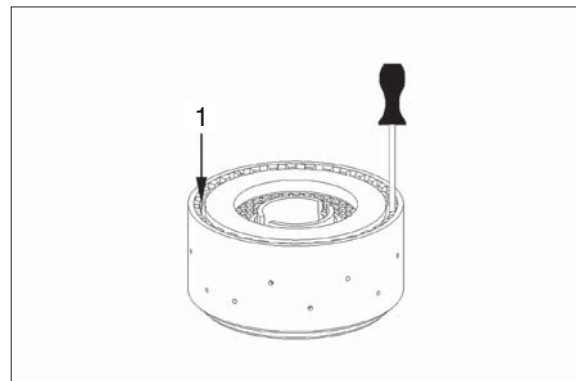
- ⑦ Pull tapered roller bearing (inner ring) off the shaft.

Basic tool 5873 002 001  
Grab sleeve 5873 002 038



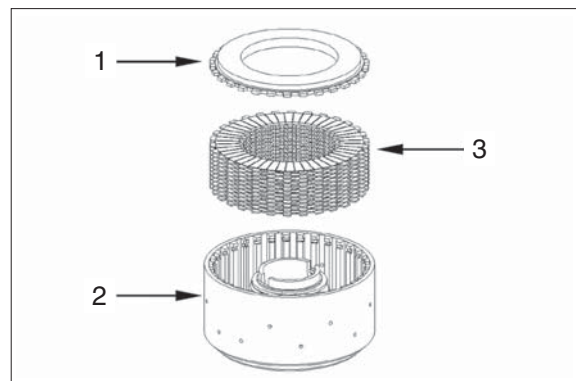
7609ATM125

- ⑧ Unsnap snap ring (1).



7609ATM126

- ⑨ Remove end shim (1) and disc set (2) out the disc carrier (3).

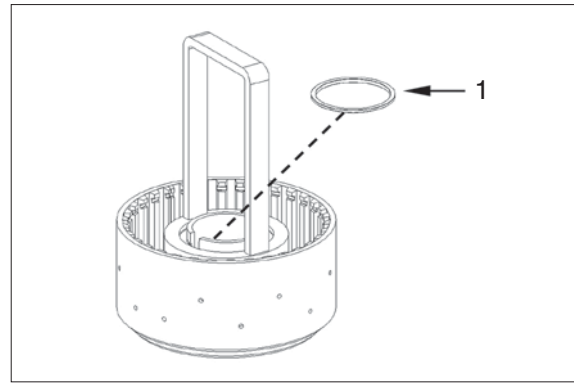


7609ATM127

- ⑩ Preload cup springs unsnap L-ring (1).

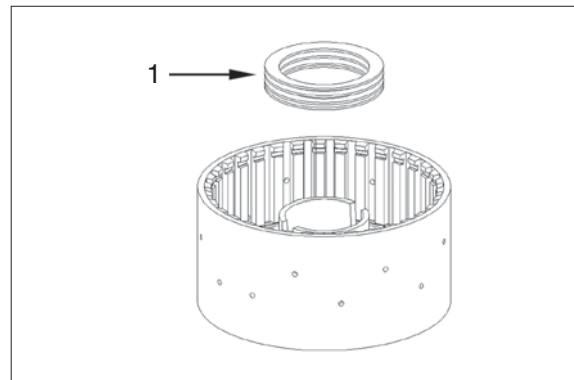
Assembly aid

5870 345 088



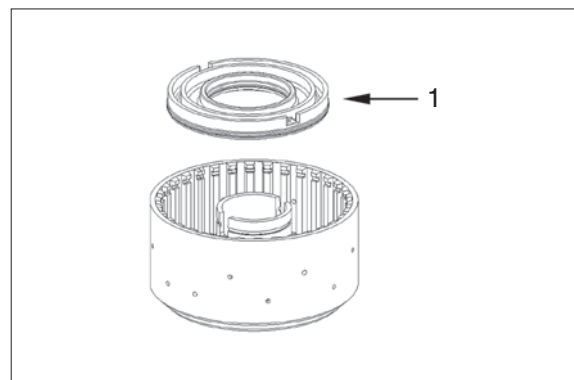
7609ATM128

- ⑪ Remove cup spring package (1).



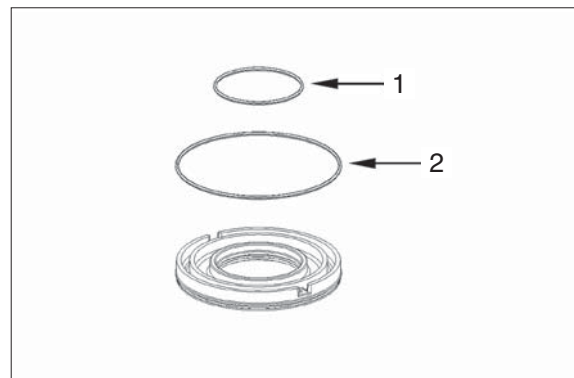
7609ATM129

- ⑫ Lift piston (1) by means of compressed air out of the cylinder bore and remove it.



7609ATM130

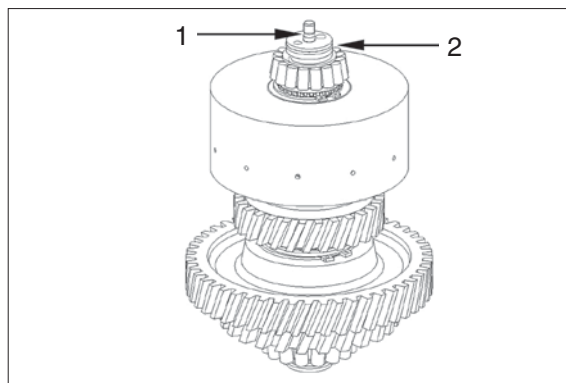
- ⑬ Remove both O-rings (1 and 2).



7609ATM131

## (6) K4 clutch

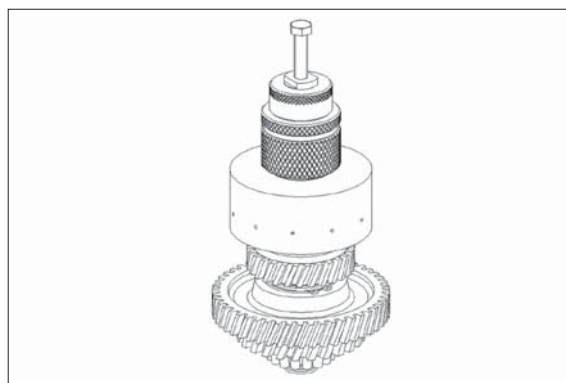
- ① Remove stud bolt (1) and snap out piston ring (2).



7609ATM132

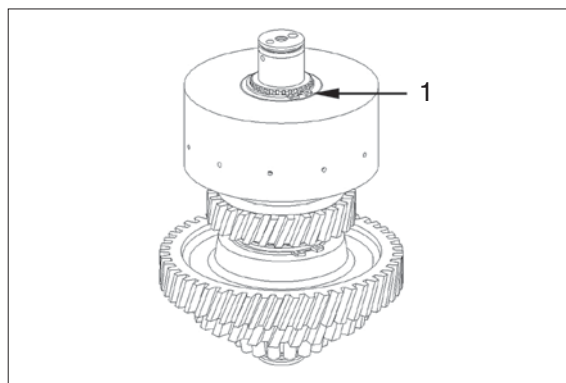
- ② Pull tapered roller bearing (inner ring) off the shaft.

Forcing device	5870 026 100
Grab sleeve	5873 001 057
or	
Rapid grip	5873 011 011



7609ATM133

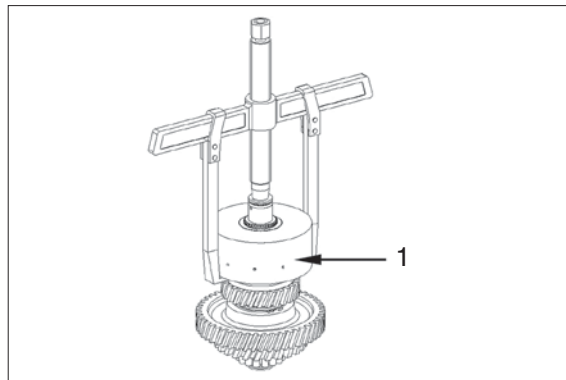
- ③ Snap out (1) retaining ring.



7609ATM134

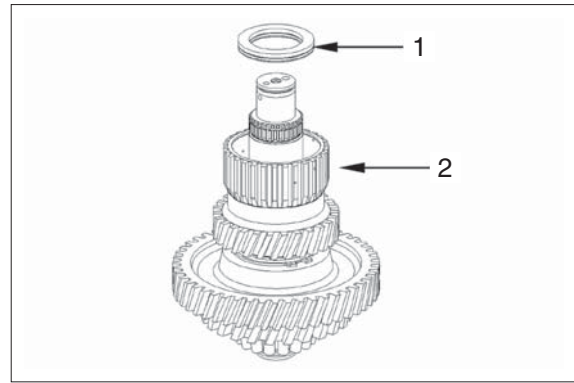
- ④ Pull clutch (1) off the shaft.

※ Disassembly clutch (1) see figure TM140~TM145.



7609ATM135

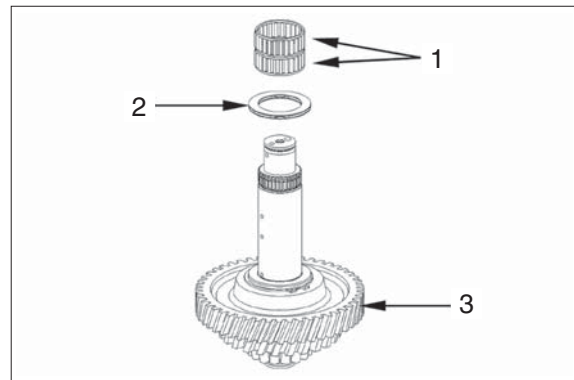
- ⑤ Remove axial bearing assy (1) and idler gear (2).



7609ATM136

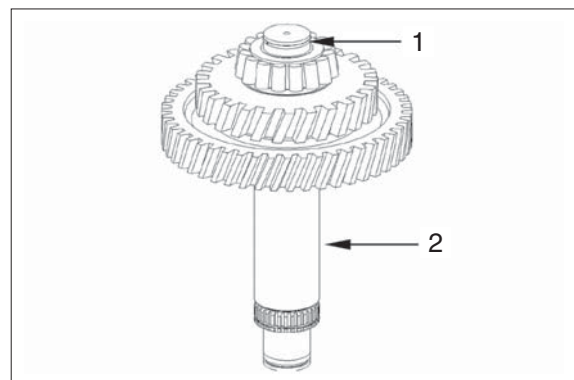
- ⑥ Remove needle cage (1) and axial bearing assy (2).

※ The gear (3) cannot be removed (shrink fit).



7609ATM137

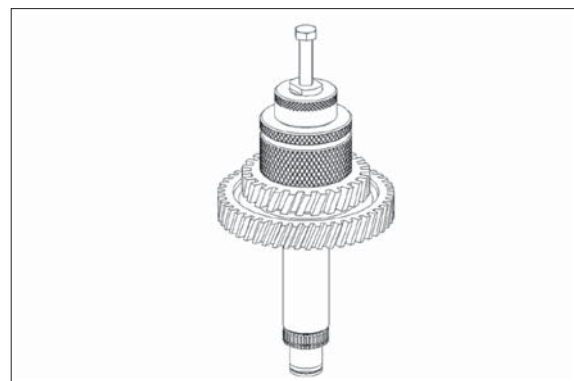
- ⑦ Turn shaft (2) by 180° and snap out piston ring (1).



7609ATM138

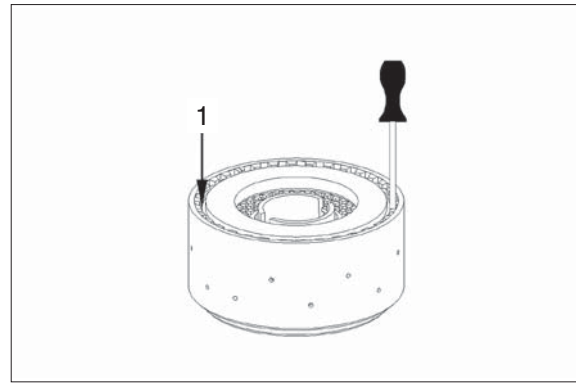
- ⑧ Pull tapered roller bearing (inner ring) off the shaft.

Forcing device	5870 026 100
Grab sleeve	5873 001 059



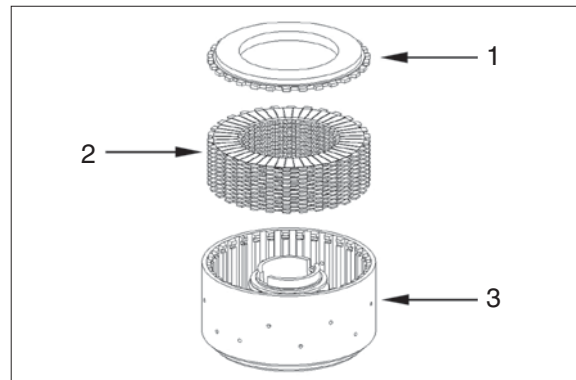
7609ATM139

- ⑨ Unsnap snap ring (1).



7609ATM140

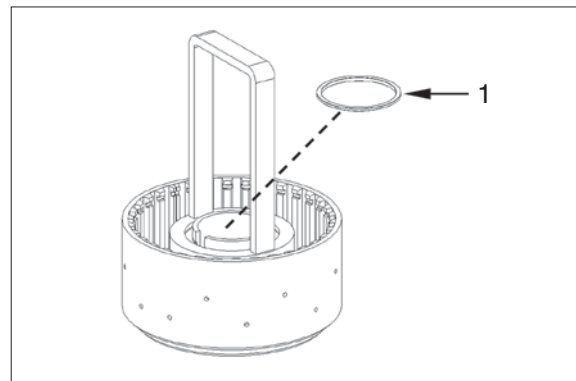
- ⑩ Remove end shim (1) and disc set (2) out the disc carrier (3).



7609ATM141

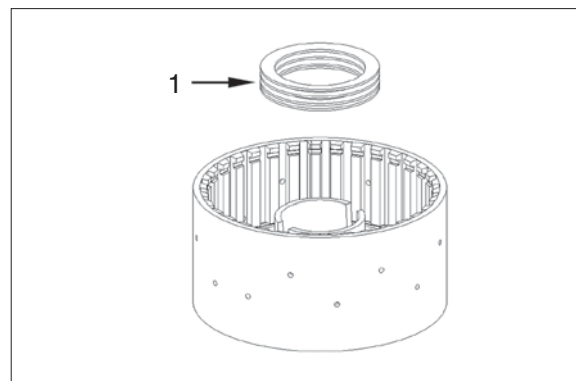
- ⑪ Preload cup springs unsnap L-ring (1).

Assembly aid 5870 345 088



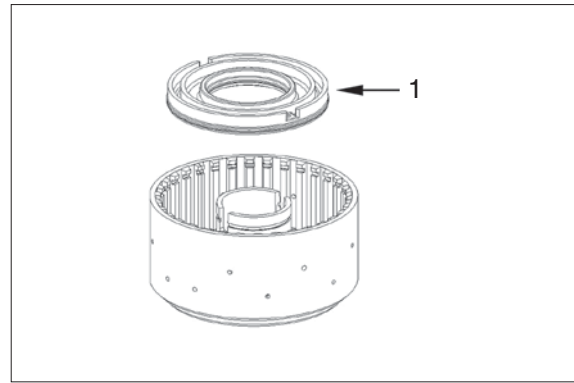
7609ATM142

- ⑫ Remove cup spring package (1).



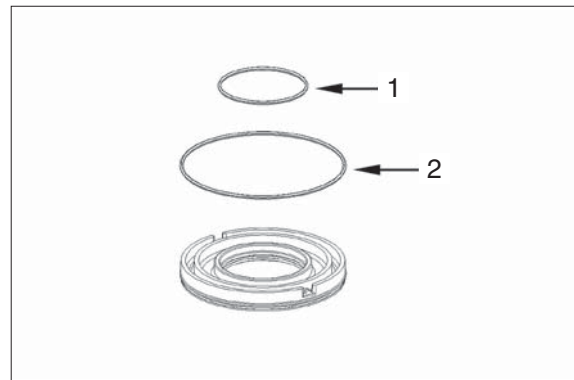
7609ATM143

- ⑬ Lift piston (1) by means of compressed air out of the cylinder bore and remove it.



7609ATM144

- ⑭ Remove both O-rings (1 and 2).



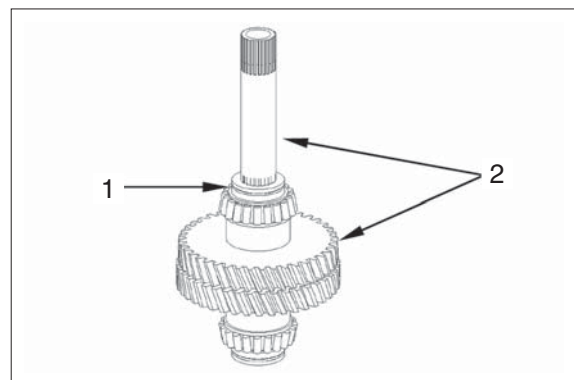
7609ATM145

## (7) Input shaft

- ① Snap out piston ring (1).

Turbine wheel shaft and drive gear (2) are fixed by a snap ring.

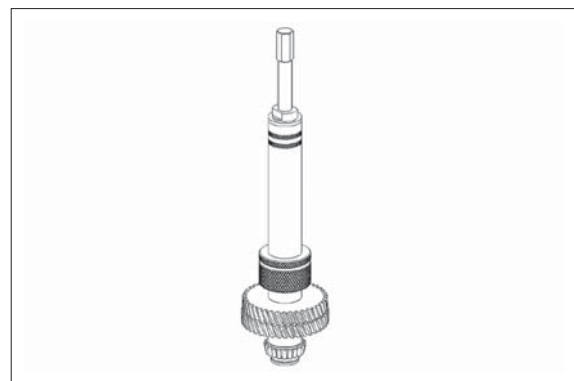
- ※ When separated, the components will be destroyed.



7609ATM146

- ② Pull tapered roller bearing (inner ring) off the drive gear.

Basic tool	5873 001 000
Grab sleeve	5873 001 058
or	
Rapid grip	5873 011 014



7609ATM147

- ③ Pull tapered roller bearing (inner ring) off the drive gear.

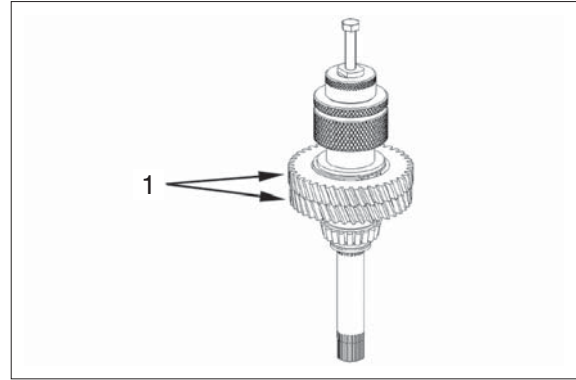
Grab sleeve 5873 001 058

Forcing device 5870 026 100

or

Rapid grip 5873 011 014

It is not possible to separate input shaft and gear (1) -shrink fit-.



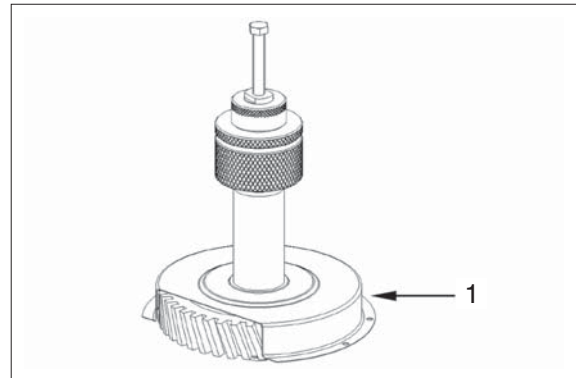
7609ATM148

## (8) Output shaft

- ① Pull tapered roller bearing (inner ring) off the output shaft and remove oil screen sheet (1).

Basic tool 5873 002 001

Grab sleeve 5873 002 038

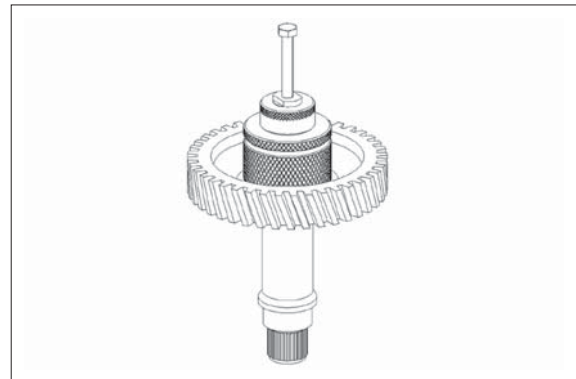


7609ATM149

- ② Turn output shaft by 180° and pull off tapered roller bearing (inner ring).

Basic tool 5873 002 001

Grab sleeve 5873 002 038



7609ATM150

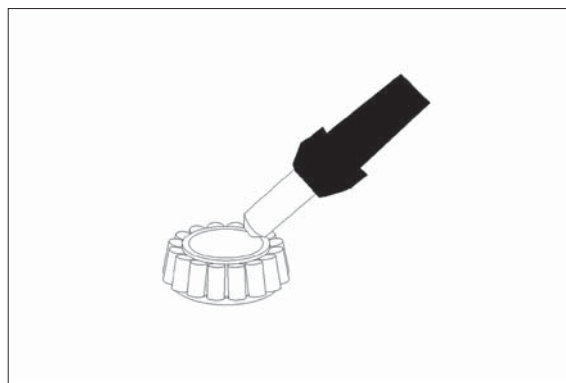


## 8) REASSEMBLY

Clutches KV / KR / K1 / K2 / K3 / K4  
input and output shaft

### (1) KV Clutch

- ① Heat up bearing inner ring (approx.  
120°C)

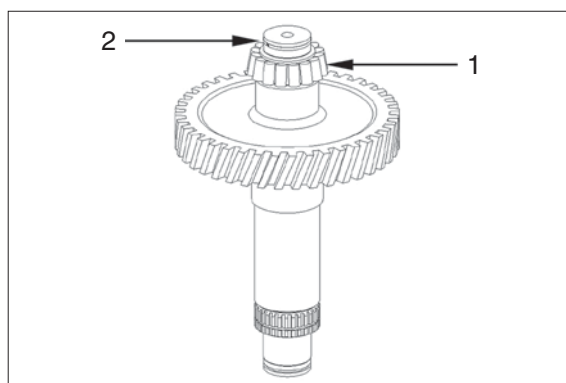


7609ATM151

- ② Mount bearing inner ring (1) until contact is obtained.

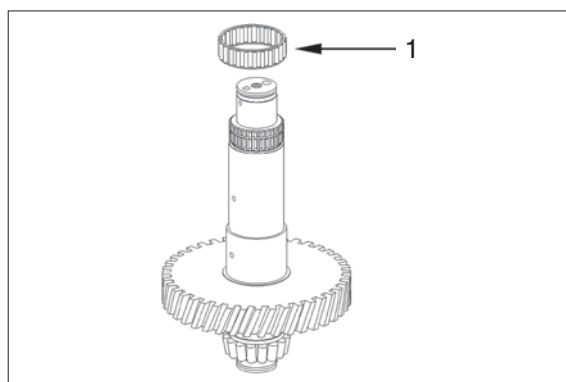
Fit rectangular ring 40×2.5 (2).

- ※ Wear protective gloves.
- ※ Adjust bearing inner ring after cooling-down.



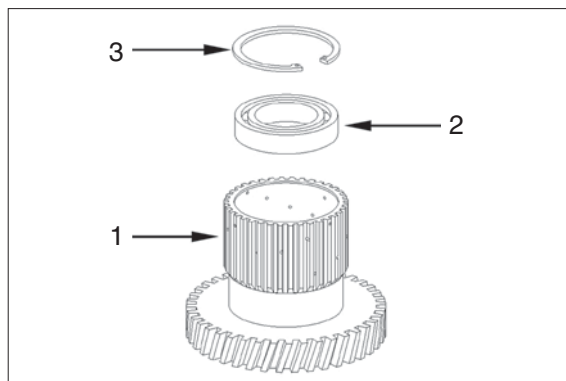
7609ATM152

- ③ Mount needle cage 60×68×20 (1) onto the shaft and oil it.



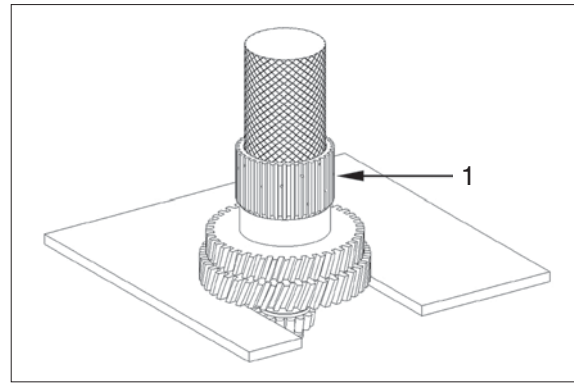
7609ATM153

- ④ Install ball bearing 50×90×18 (2) into the idler gear (1) until contact is obtained and fix it by means of retaining ring 90×3 (3).



7609ATM154

- ⑤ Press in preassembled idler gear (1) onto the shaft until contact is obtained.



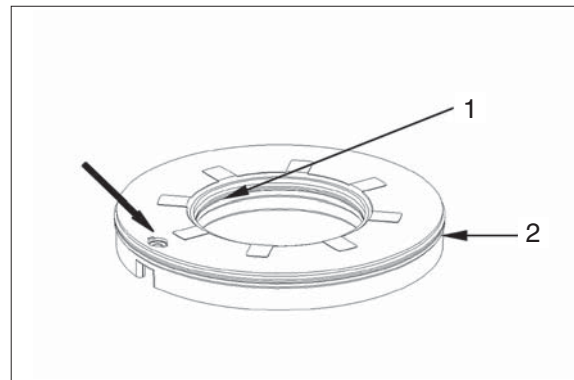
7609ATM155

- ⑥ Place both O-rings (1 and 2) into the piston grooves and oil them.

1 75×3

2 142×3

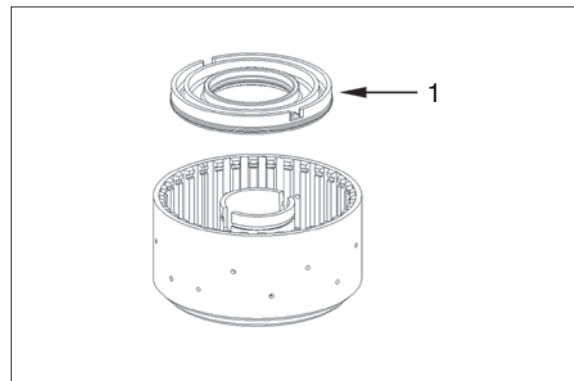
- ※ Check function of the drain valve (see arrow) - There must be no jamming of the ball.



7609ATM156

- ⑦ Place piston (1) into the disk carrier.

- ※ Observe installation position, see figure.

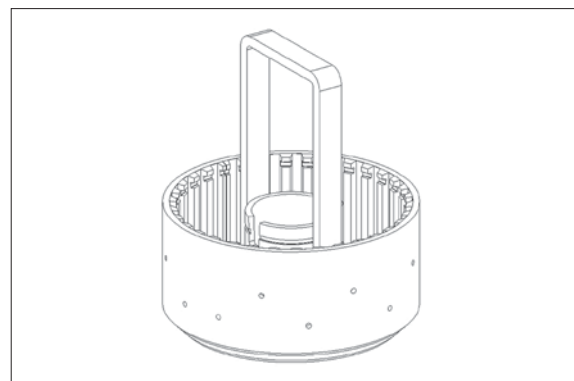


7609ATM157

- ⑧ Use a hand-operated press to place piston into the disk carrier by means of the assembly aid.

Assembly aid

5870 345 088



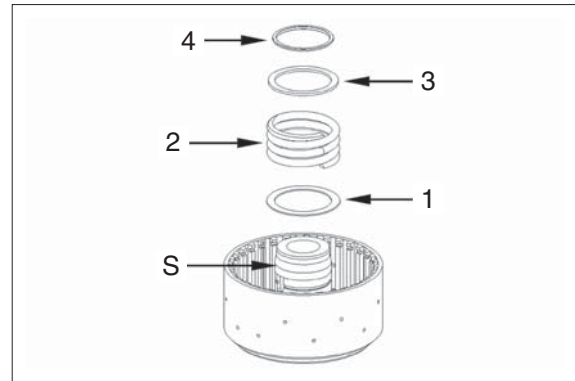
7609ATM158

- ⑨ Mount inner installer (S) onto the disk carrier.

Install disk (1), compression spring (2), support shim (3) and L-ring (4).

- ※ Installation position support shim and L-ring see TM161.

Inner installer : see figure TM160



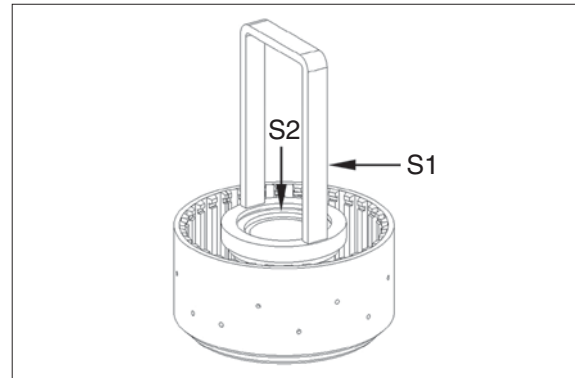
7609ATM159

- ⑩ Preload compression spring by means of assembly aid (S1) and pressure piece (S2), until L-ring has engaged into the annular groove.

Assembly aid (S1) 5870 345 088

Assembly fixture (S + S2) 5870 345 124  
(Inner installer and pressure piece)

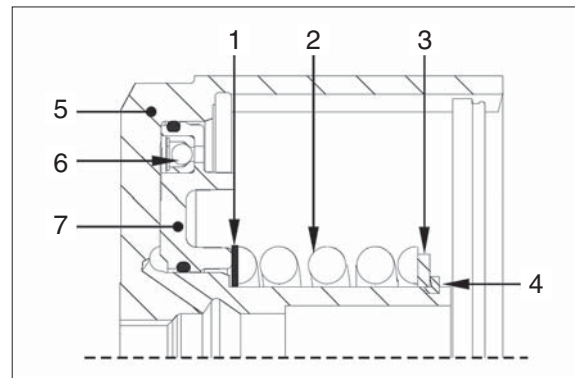
- ※ It is always necessary to mount a new L-ring.



7609ATM160

Disk carrier with piston retraction :

- 1 Washer
- 2 Compression spring
- 3 Support shim
- 4 L-ring
- 5 Disk carrier
- 6 Drain valve (piston)
- 7 Piston with O-rings



7609ATM161

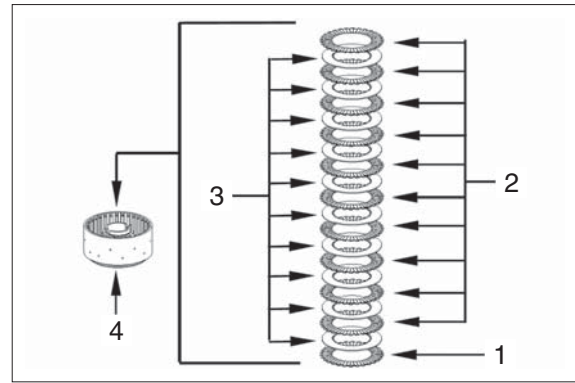
- ※ Different clutches (disc arrangements with relevant disc clearance) can be installed, depending on the parts manual.
- ※ The actually installed clutch and disc arrangement must be taken from the corresponding parts manual.
- ※ Figure no. : TM162 and TM163 illustrates the different disc arrangements.

- ⑪ Install outer and inner disks alternately into the disk carrier (4) as personated in figure TM162.

- 1 Friction disk-coated on one side (1 pcs)
- 2 Outer disks (10 pcs)
- 3 Inner disks (10 pcs)

- ※ Take care that the uncoated (blank) side of the friction disk (1) is showing towards the piston.

Number of friction surfaces : 20



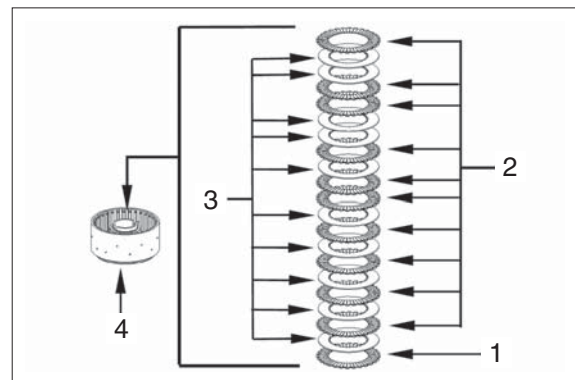
7609ATM162

- ⑫ Install outer and inner disks alternately into the disk carrier (4) as personated in TM163.

- 1 Friction disk-coated on one side (1 pcs)
- 2 Outer disks (10 pcs)
- 3 Inner disks (10 pcs)

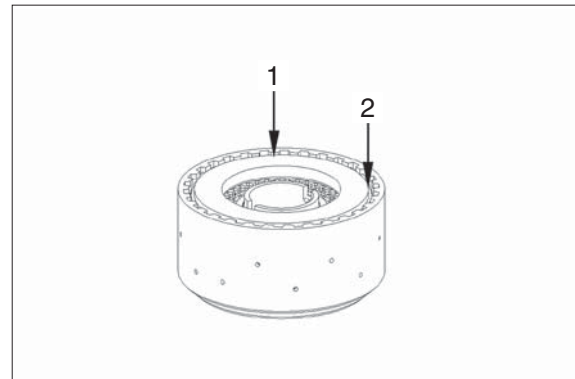
- ※ Take care that the uncoated (blank) side of the friction disk (1) is showing towards the piston.

Number of friction surfaces : 16



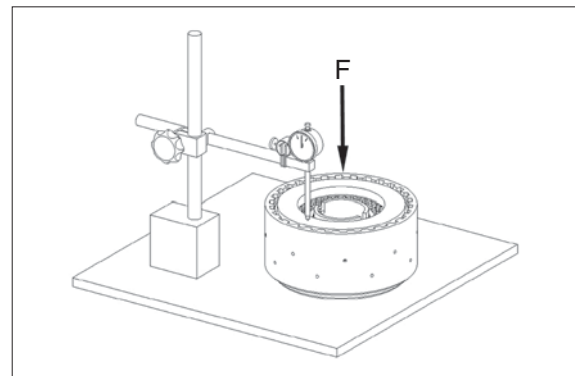
7609ATM163

- ⑬ Mount end plate (1) and fix disk package by means of snap ring (2) (e.g. thickness = 2.65 mm / recommended value).



7609ATM164

- ⑭ Press on end plate with F (approx. 100 N = 10 kg) and set dial indicator to "zero".

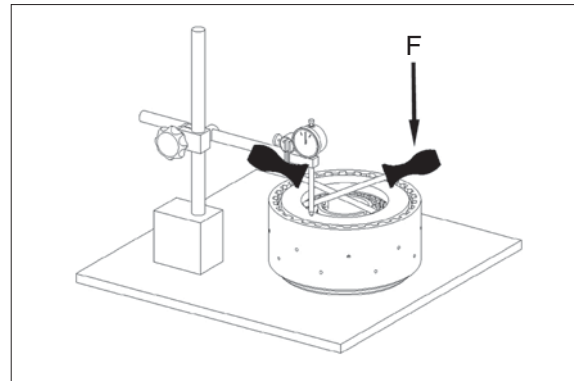


7609ATM165

- ⑮ Then press end plate against the snap ring (upwards) and read disk clearance.

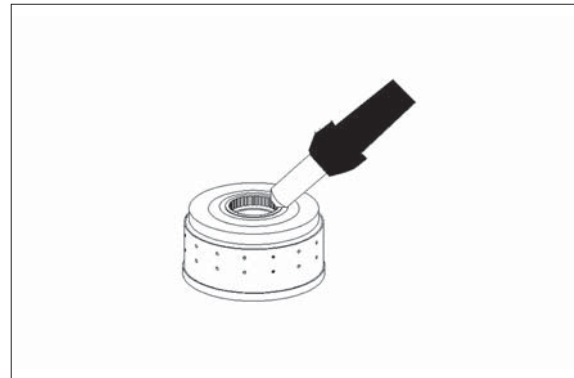
※ Disk clearance : 2.65~2.95 mm

- ※ In case of deviations, the disk clearance must be corrected with an appropriate snap ring (optional thicknesses = 2.1~4.2 mm).



7609ATM166

- ⑯ Heat up clutch inner diameter (approx. 120°C).

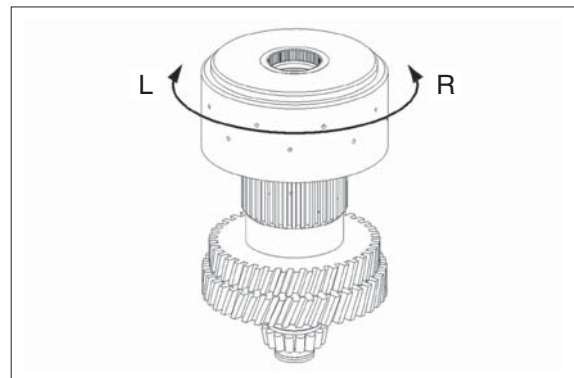


7609ATM167

- ⑰ Install clutch until contact is obtained.

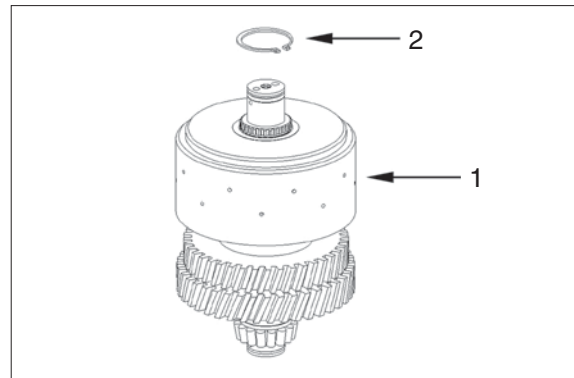
Mount inner disks onto the inner disk carrier by means of short left/right rotations.

- ※ Wear protective gloves.



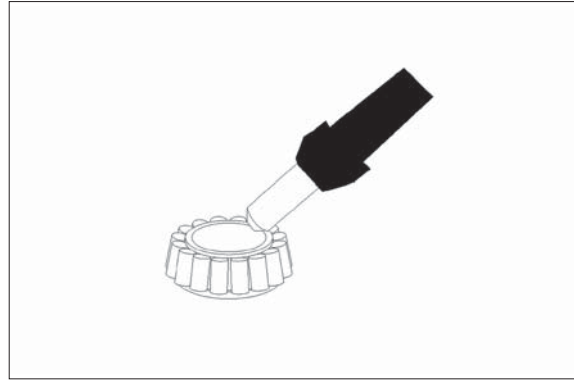
7609ATM168

- ⑱ Fix clutch (1) by means of retaining ring 55×2 (2).



7609ATM169

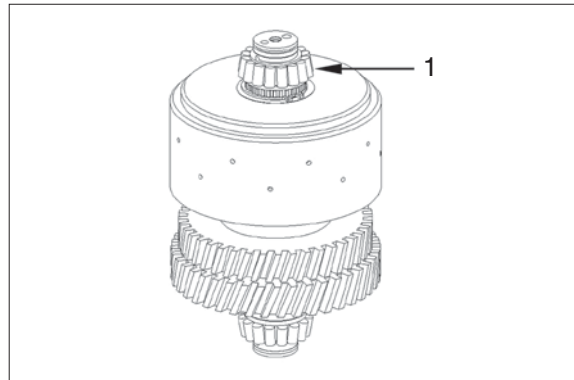
- ①⑨ Heat up bearing inner ring (approx. 120°C).



7609ATM170

- ②⑩ Mount bearing inner ring (1) until contact is obtained.

- ※ Wear protective gloves.
- ※ Adjust bearing inner ring after cooling-down.

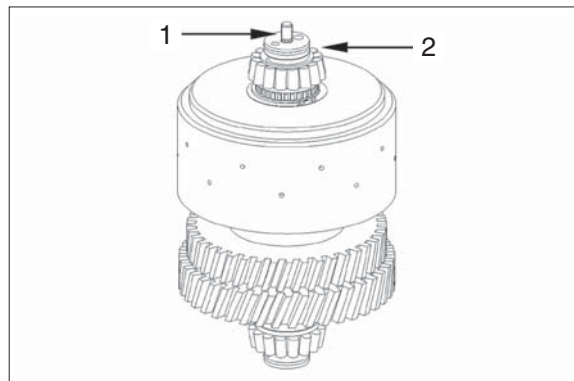


7609ATM171

- ②⑪ Mount stud bolt (1).

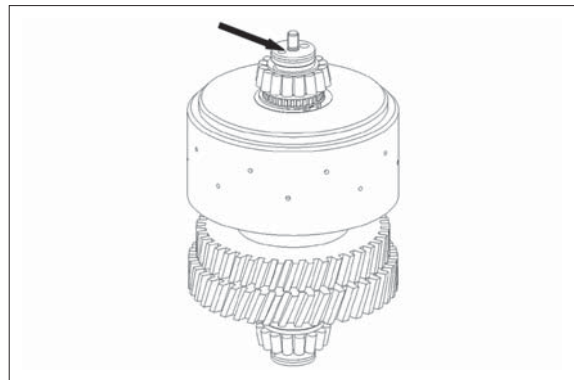
- Tightening torque (M10/8.8×16) :  
1.73 kgf · m (12.5 lbf · ft)

Fit rectangular ring 40×2.5 (2).



7609ATM172

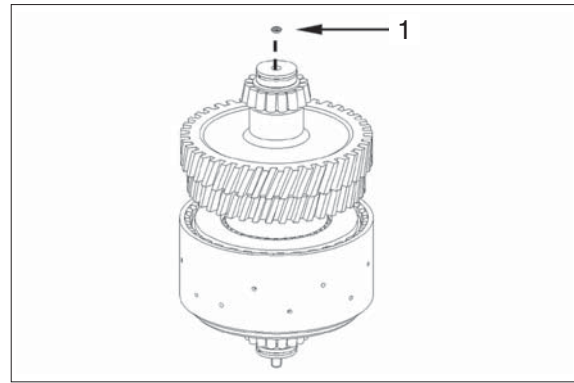
- ※ Check closing and opening of the clutch by means of compressed air at the hole (see arrow).  
Closing and opening of the clutch must be clearly audible.



7609ATM173

② Install sealing cap orifice (1).

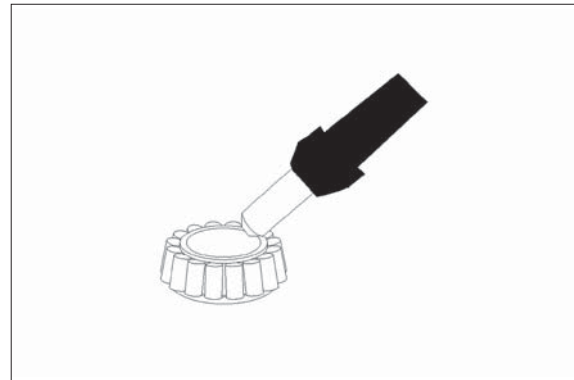
※ Wet contact surface with loctite (Type No. 262).



7609ATM174

## (2) KR Clutch

① Heat up bearing inner ring (approx. 120°C)



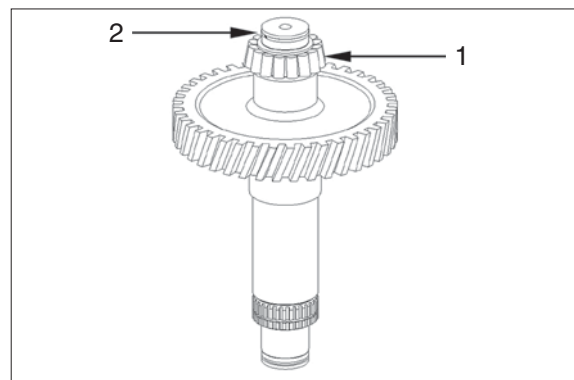
7609ATM175

② Mount bearing inner ring (1) until contact is obtained.

Fit rectangular ring 40 × 2.5 (2).

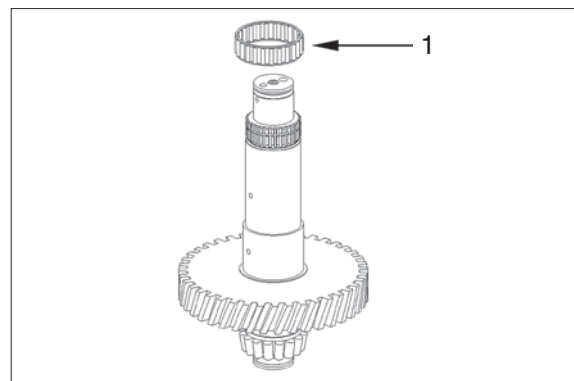
※ Wear protective gloves.

※ Adjust bearing inner ring after cooling-down.



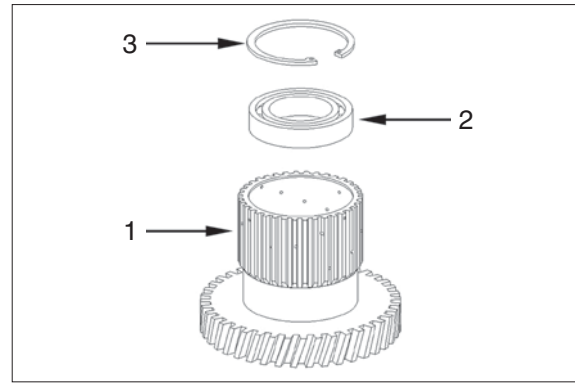
7609ATM176

③ Mount needle cage 60 × 68 × 20 (1) onto the shaft and oil it.



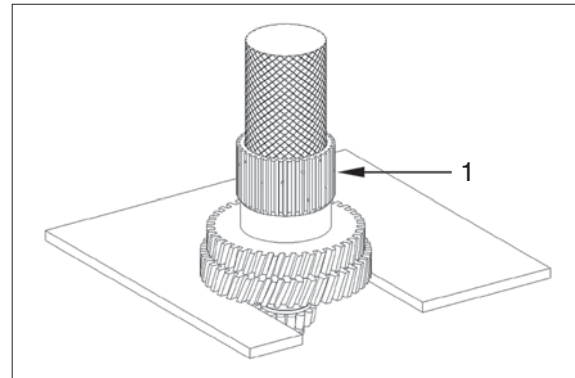
7609ATM177

- ④ Install ball bearing 50×90×18 (2) into the idler gear (1) until contact is obtained and fix it by means of retaining ring 90×3 (3).



7609ATM178

- ⑤ Press in preassembled idler gear (1) onto the shaft until contact is obtained.

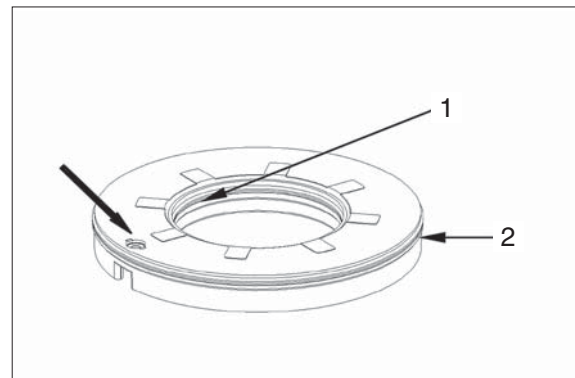


7609ATM179

- ⑥ Place both O-rings (1 and 2) into the piston grooves and oil them.

- 1 75×3  
2 142×3

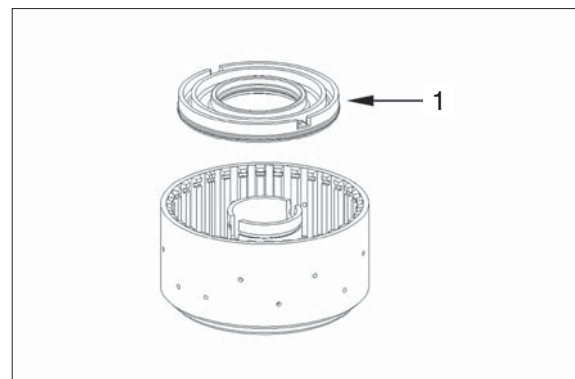
- ※ Check function of the drain valve (see arrow) - There must be no jamming of the ball.



7609ATM180

- ⑦ Place piston (1) into the disk carrier.

- ※ Observe installation position, see figure.



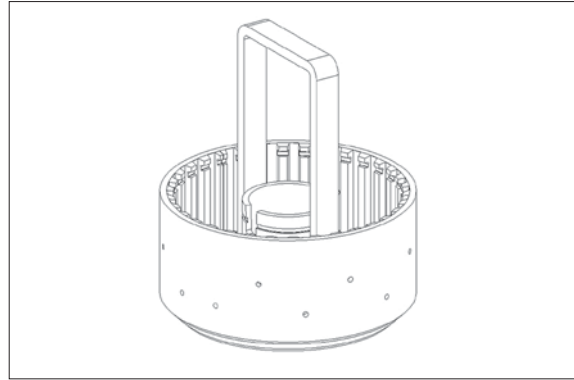
7609ATM181



- ⑧ Use a hand-operated press to place piston into the disk carrier by means of the assembly aid.

Assembly aid

5870 345 088



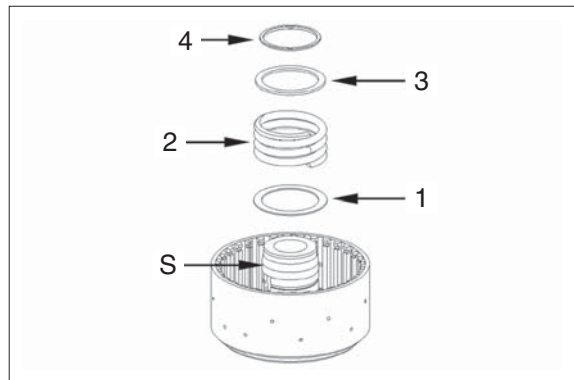
7609ATM182

- ⑨ Mount inner installer (S) onto the disk carrier.

Install disk (1), compression spring (2), support shim (3) and L-ring (4).

- ※ Installation position support shim and L-ring see figure TM185.

Inner installer : see figure TM184



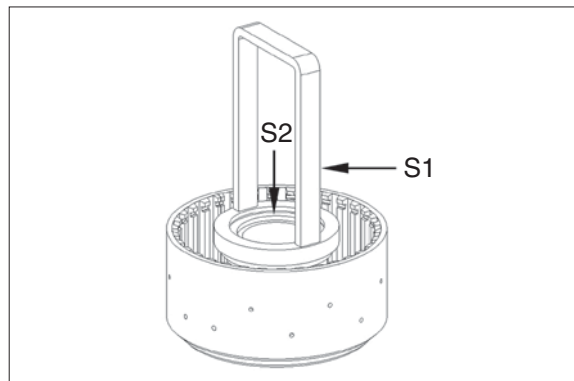
7609ATM183

- ⑩ Preload compression spring by means of assembly aid (S1) and pressure piece (S2), until L-ring has engaged into the annular groove.

Assembly aid (S1) 5870 345 088

Assembly fixture (S + S2) 5870 345 124  
(Inner installer and pressure piece)

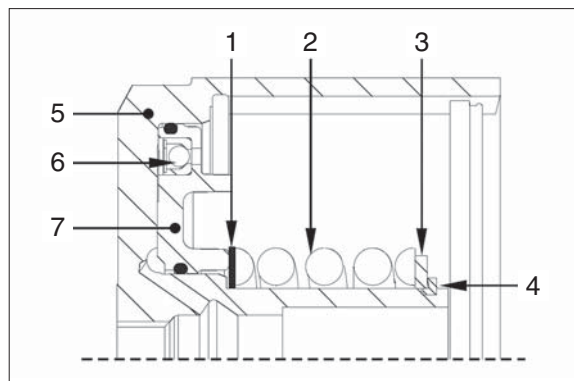
- ※ It is always necessary to mount a new L-ring.



7609ATM184

Disk carrier with piston retraction :

- 1 Washer
- 2 Compression spring
- 3 Support shim
- 4 L-ring
- 5 Disk carrier
- 6 Drain valve (piston)
- 7 Piston with O-rings



7609ATM185

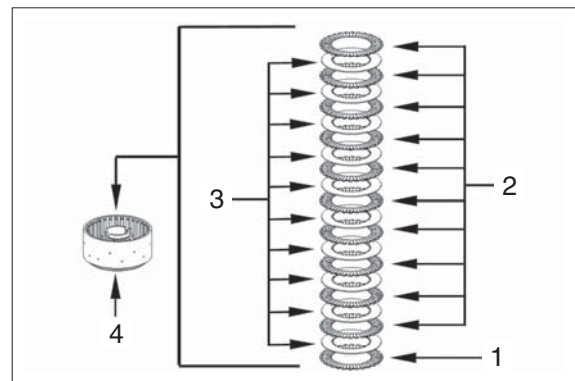
- ※ Different clutches (disc arrangements with relevant disc clearance) can be installed, depending on the parts manual.
- ※ The actually installed clutch and disc arrangement must be taken from the corresponding parts manual.
- ※ Figure no. : TM186 and TM187 illustrates the different disc arrangements.

- ⑪ Install outer and inner disks alternately into the disk carrier (4) as personated in figure TM186.

- 1 Friction disk-coated on one side (1 pcs)
- 2 Outer disks (10 pcs)
- 3 Inner disks (10 pcs)

- ※ Take care that the uncoated (blank) side of the friction disk (1) is showing towards the piston.

Number of friction surfaces : 20



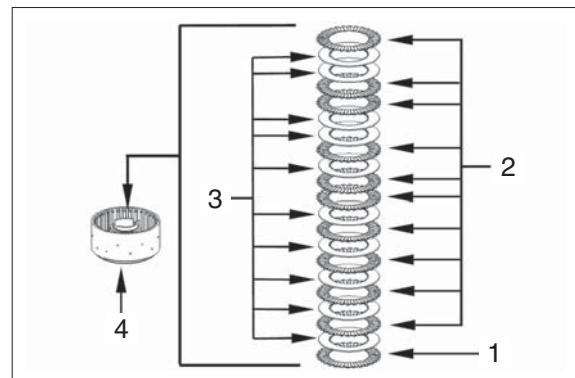
7609ATM186

- ⑫ Install outer and inner disks alternately into the disk carrier (4) as personated in figure TM187.

- 1 Friction disk-coated on one side (1 pcs)
- 2 Outer disks (10 pcs)
- 3 Inner disks (10 pcs)

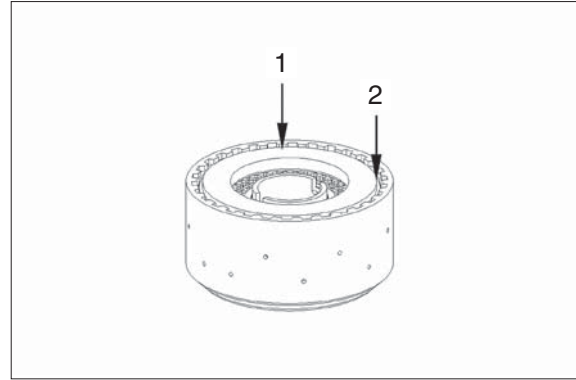
- ※ Take care that the uncoated (blank) side of the friction disk (1) is showing towards the piston.

Number of friction surfaces : 16



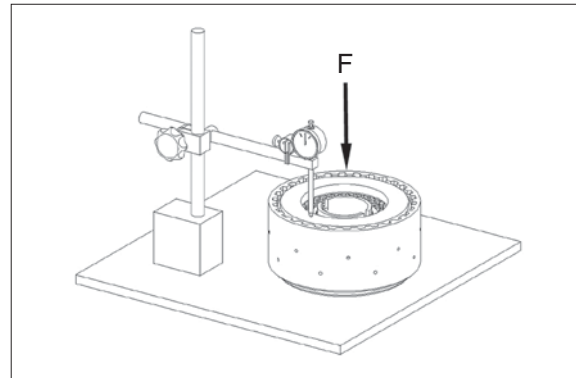
7609ATM187

- ⑬ Mount end plate (1) and fix disk package by means of snap ring (2) (e.g. thickness = 2.65 mm / recommended value).



7609ATM188

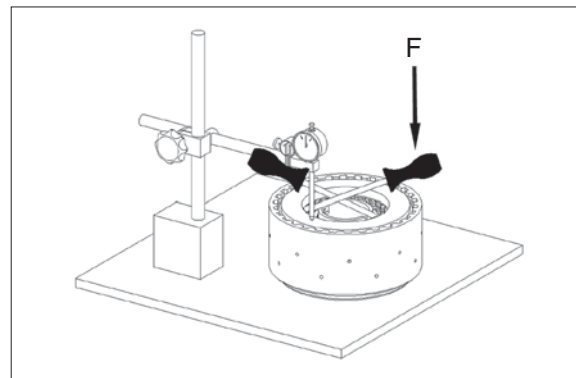
- ⑭ Press on end plate with F (approx. 100 N = 10 kg) and set dial indicator to "zero".



7609ATM189

- ⑮ Then press end plate against the snap ring (upwards) and read disk clearance.

- ※ Disk clearance : 2.65~2.95 mm
- ※ In case of deviations, the disk clearance must be corrected with an appropriate snap ring (optional thicknesses = 2.1~4.2 mm).



7609ATM190

- ⑯ Heat up clutch inner diameter (approx. 120°C).

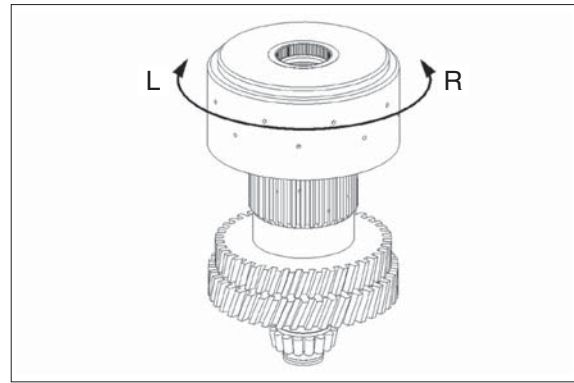


7609ATM191

- ⑰ Install clutch until contact is obtained.

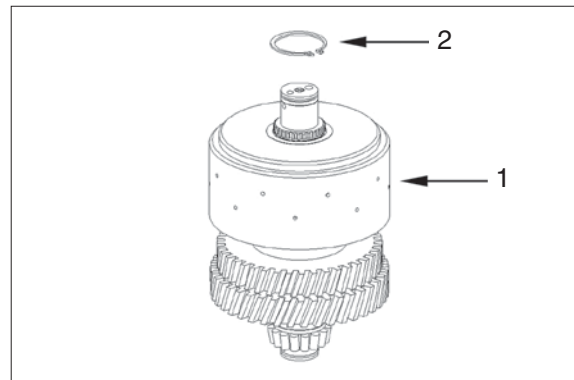
Mount inner disks onto the inner disk carrier by means of short left/right rotations.

※ Wear protective gloves.



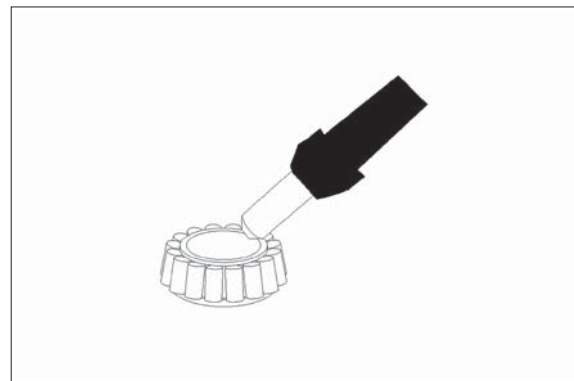
7609ATM192

- ⑱ Fix clutch (1) by means of retaining ring 55×2 (2).



7609ATM193

- ⑲ Heat up bearing inner ring (approx. 120°C).

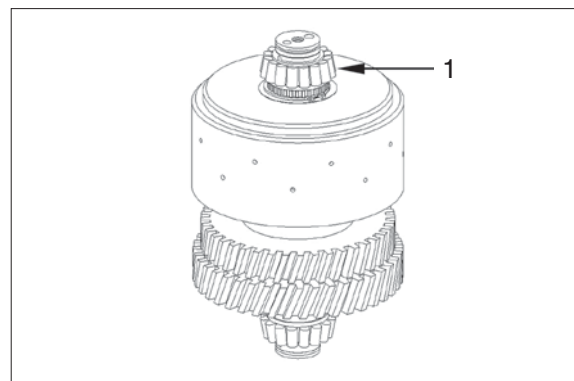


7609ATM194

- ⑳ Mount bearing inner ring (1) until contact is obtained.

※ Wear protective gloves.

※ Adjust bearing inner ring after cooling-down.

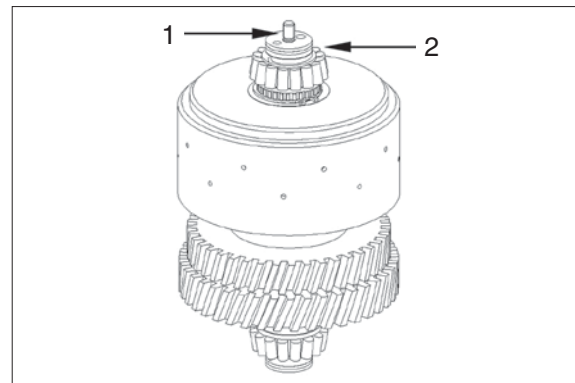


7609ATM195

②① Mount stud bolt (1).

- Tightening torque (M10/8.8×16) :  
1.73 kgf · m (12.5 lbf · ft)

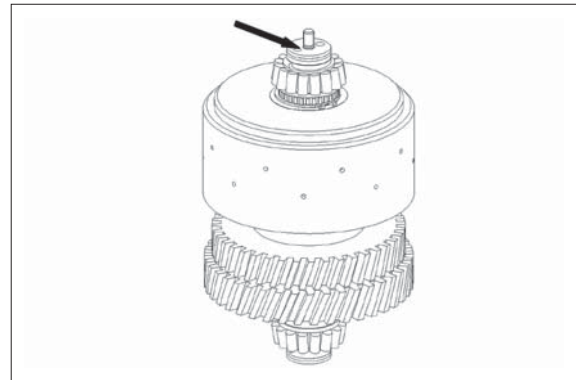
Fit rectangular ring 40×2.5 (2).



7609ATM196

※ Check closing and opening of the clutch by means of compressed air at the hole (see arrow).

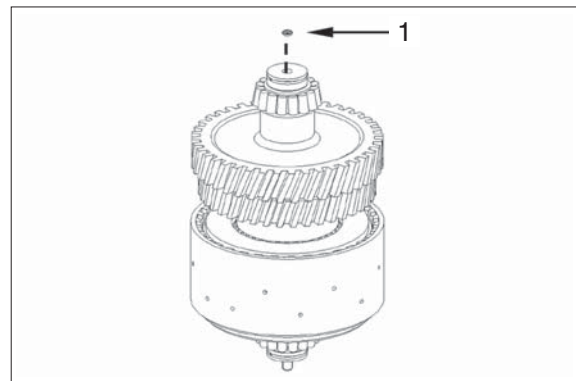
Closing and opening of the clutch must be clearly audible.



7609ATM197

②② Install sealing cap -orifice- (1).

※ Wet contact surface with loctite (Type No. 262).



7609ATM198

### (3) Clutch K1

① Heat up bearing inner ring (approx. 120°C)

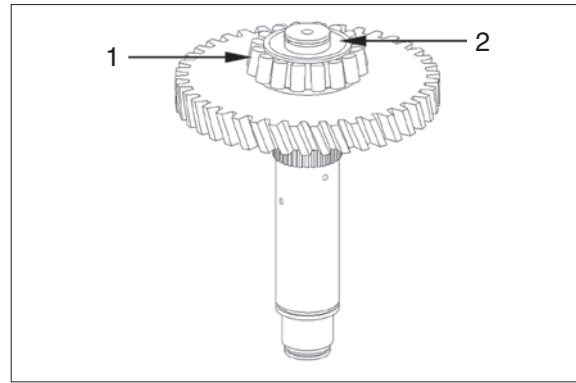


7609ATM199

- ② Mount bearing inner ring (1) until contact is obtained.

Fit rectangular ring  $40 \times 2.5$  (2).

- ※ Wear protective gloves.
- ※ Adjust bearing inner ring after cooling-down.



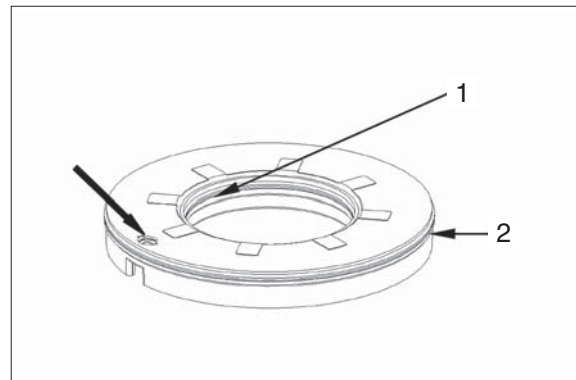
7609ATM200

- ③ Place both O-rings (1 and 2) into the piston grooves and oil them.

1  $75 \times 3$

2  $158 \times 3$

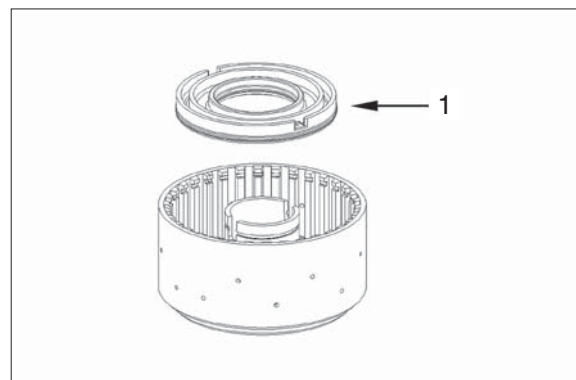
- ※ Check function of the drain valve (see arrow) - There must be no jamming of the ball.



7609ATM201

- ④ Place piston (1) into the disk carrier.

- ※ Observe installation position, see figure.

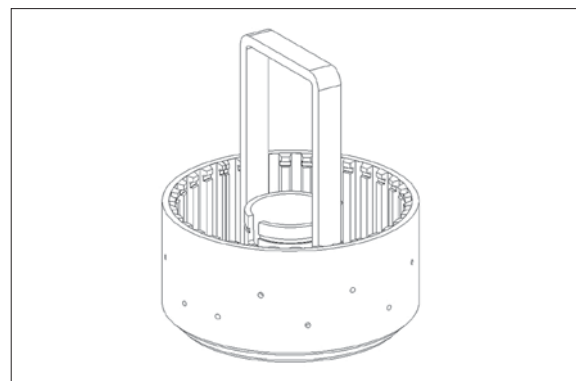


7609ATM202

- ⑤ Use a hand-operated press to place piston into the disk carrier by means of the assembly aid.

Assembly aid

5870 345 088



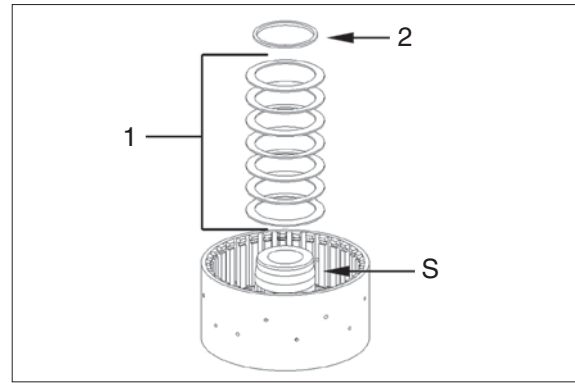
7609ATM203

- ⑥ Mount inner installer (S) onto the disk carrier.

Install cup spring package (1) and L-ring (2).

- ※ Installation position cup spring package and L-ring see figure TM206.

Inner installer see figure TM205



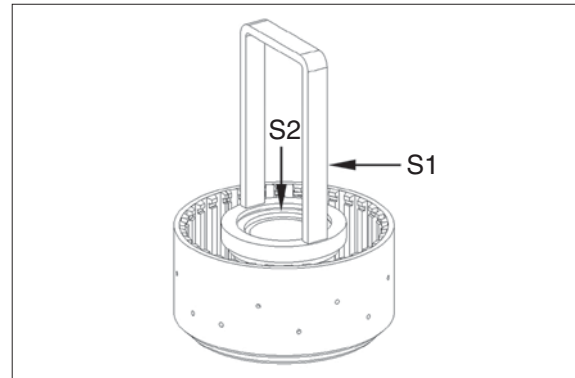
7609ATM204

- ⑦ Preload cup spring package by means of assembly aid (S1) and pressure piece (S2), until L-ring has engaged into the annular groove.

Assembly aid (S1) 5870 345 088

Assembly fixture (S + S2) 5870 345 124  
(Inner installer and pressure piece)

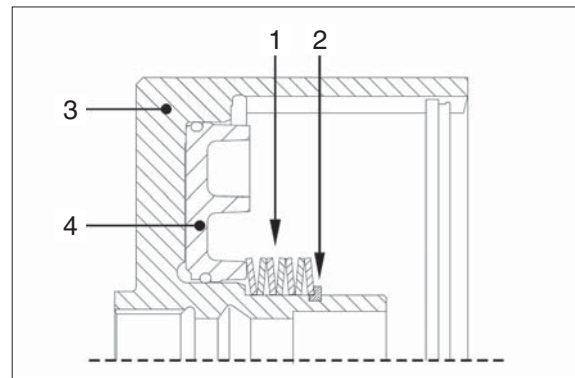
- ※ It is always necessary to mount a new L-ring.



7609ATM205

Disk carrier with piston retraction :

- 1 Cup spring package
- 2 L-ring
- 3 Disk carrier
- 4 Piston with O-rings



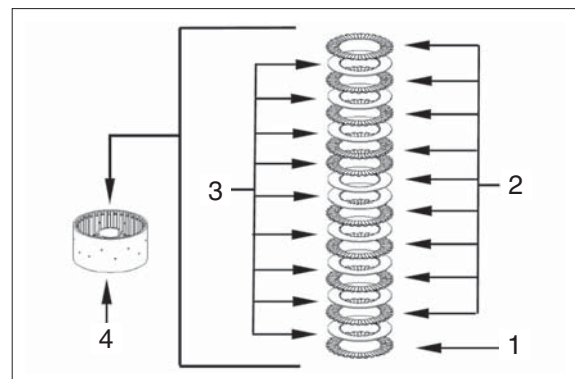
7609ATM206

- ⑧ Install outer and inner disks alternately into the disk carrier (4) as personated in figure TM207.

- 1 Friction disk-coated on one side (1 pcs)
- 2 Outer disks (9 pcs)
- 3 Inner disks (9 pcs)

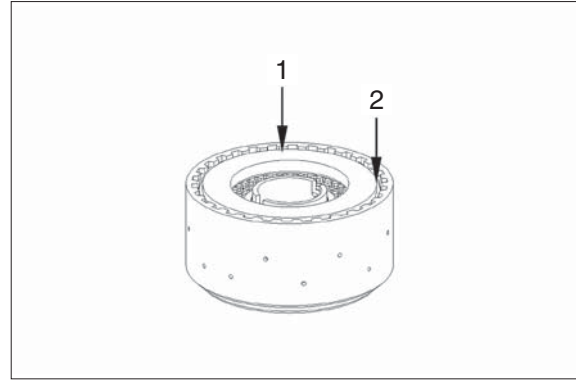
- ※ Take care that the uncoated (blank) side of the friction disk (1) is showing towards the piston.

Number of friction surfaces : 18



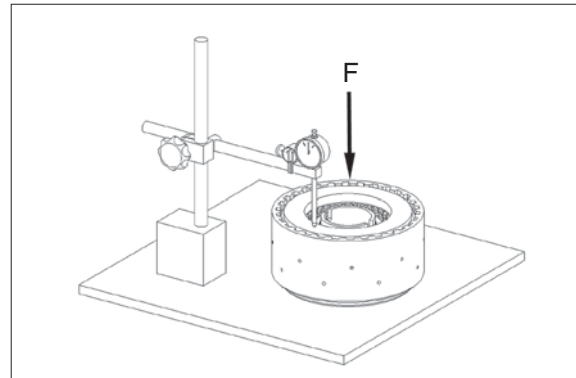
7609ATM207

- ⑨ Mount end plate (1) and fix disk package by means of snap ring (2) (e.g. thickness = 2.65 mm / recommended value).



7609ATM208

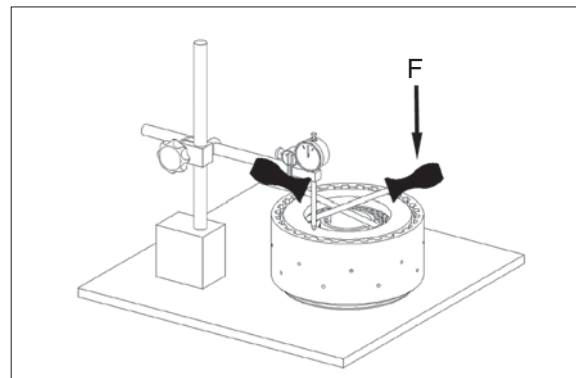
- ⑩ Press on end plate with F (approx. 100 N = 10 kg) and set dial indicator to "zero".



7609ATM209

- ⑪ Then press end plate against the snap ring (upwards) and read disk clearance.

- ※ Disk clearance : 2.35~2.65 mm
- ※ In case of deviations, the disk clearance must be corrected with an appropriate snap ring (optional thicknesses = 2.1~4.2 mm).



7609ATM210

- ⑫ Heat up clutch inner diameter (approx. 120°C).

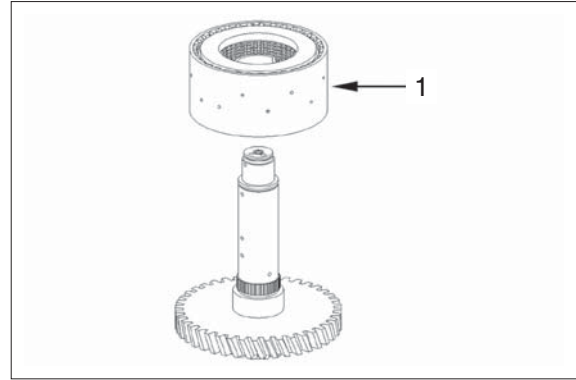


7609ATM211



⑬ Mount clutch (1) until contact is obtained.

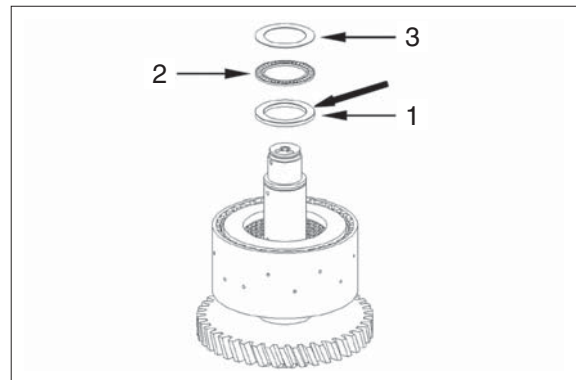
※ Wear protective gloves.



7609ATM212

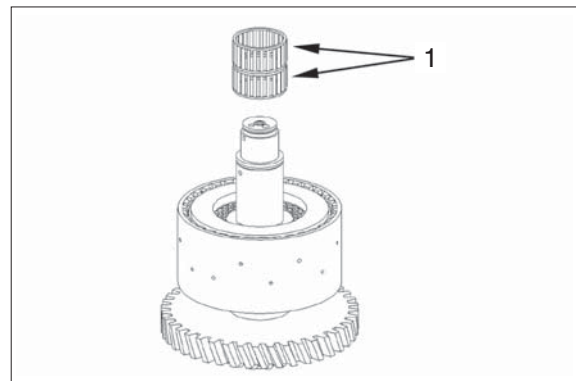
⑭ Mount running disk  $55 \times 78 \times 5$  (1), axial cage  $55 \times 78 \times 3$  (2) and axial washer  $55 \times 78 \times 1$  (3) and oil it.

※ Install chamfer (see arrow) of running disk (1) showing towards the axial cage.



7609ATM213

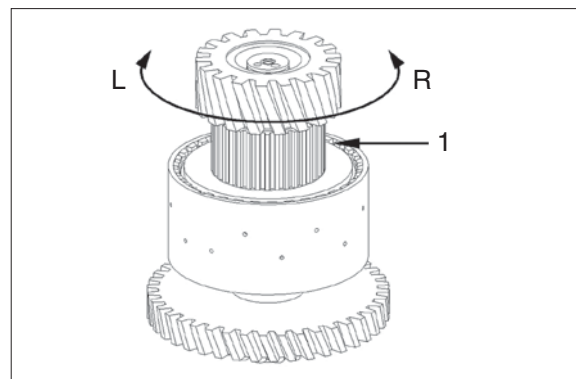
⑮ Mount needle cage  $55 \times 63 \times 64$  (1) and oil it.



7609ATM214

⑯ Install (1) idler.

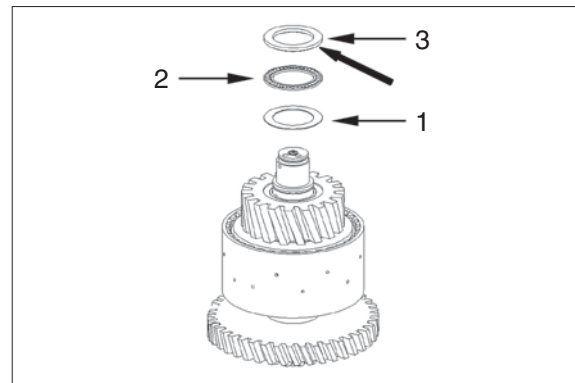
Mount inner disks onto the inner disk carrier (idler) by means of short left/right rotations.



7609ATM215

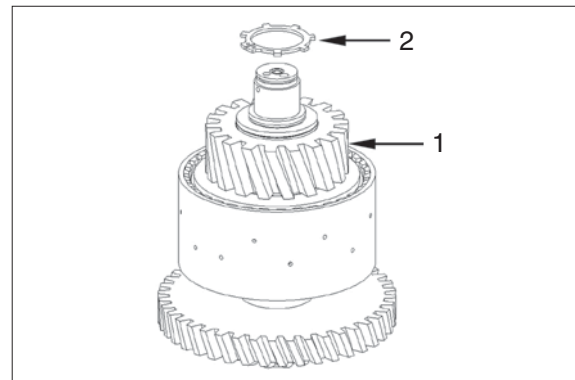
- ⑰ Mount axial washer 55×78×1 (1), axial cage 55×78×3 (2) and running disk 55×78×5 (3) and oil it.

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



7609ATM216

- ⑱ Fix idler gear (1) and single parts by means of retaining ring (2).



7609ATM217

- ⑲ Heat up bearing inner ring (approx. 120°C).

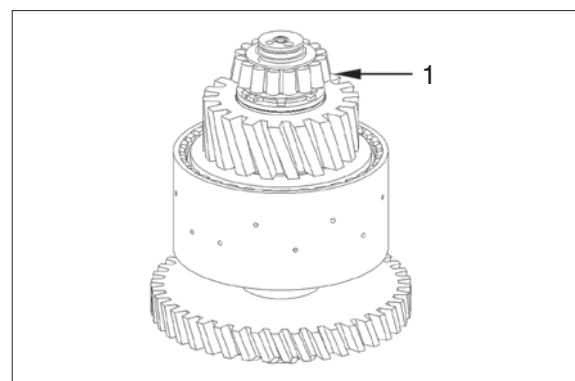


7609ATM218

- ⑳ Mount bearing inner ring (1) until contact is obtained.

※ Wear protective gloves.

※ Adjust bearing inner ring after cooling-down.

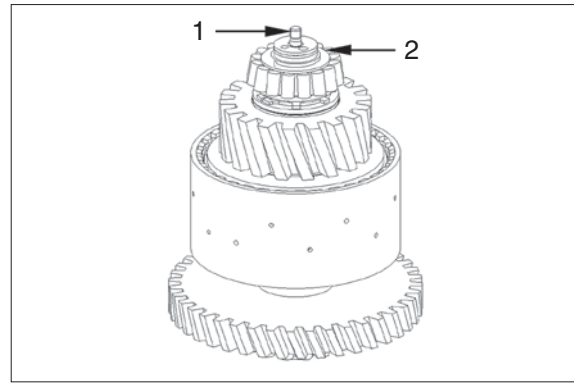


7609ATM219

② Mount stud bolt (1).

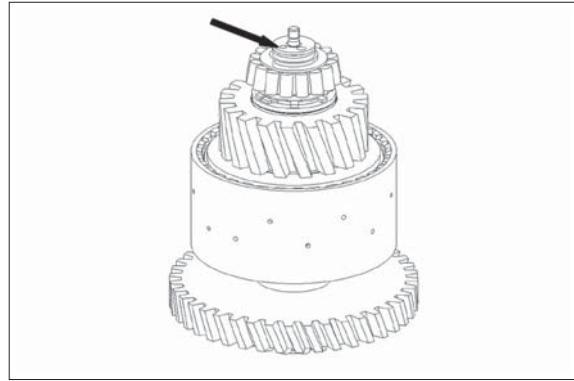
- Tightening torque (M10/8.8×16) :  
1.73 kgf · m (12.5 lbf · ft)

Fit rectangular ring 40×2.5 (2).



7609ATM220

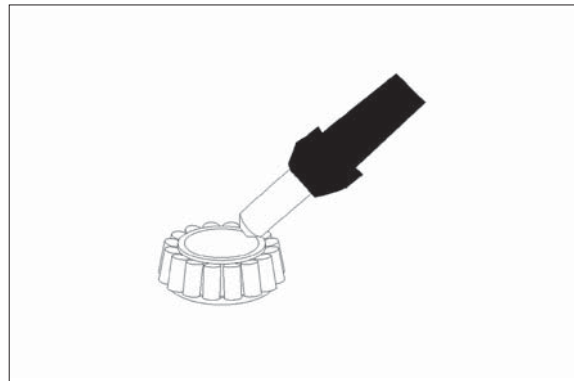
- ※ Check closing and opening of the clutch by means of compressed air at the hole (see arrow).  
Closing and opening of the clutch must be clearly audible.



7609ATM221

(4) Clutch K2

① Heat up bearing inner ring (approx. 120°C)

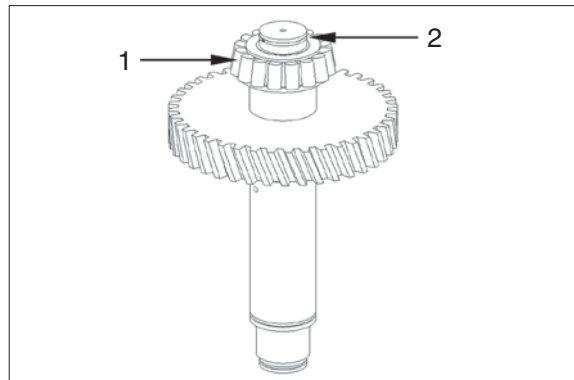


7609ATM222

② Mount bearing inner ring (1) until contact is obtained.

Fit rectangular ring 40×2.5 (2).

- ※ Wear protective gloves.
- ※ Adjust bearing inner ring after cooling-down.



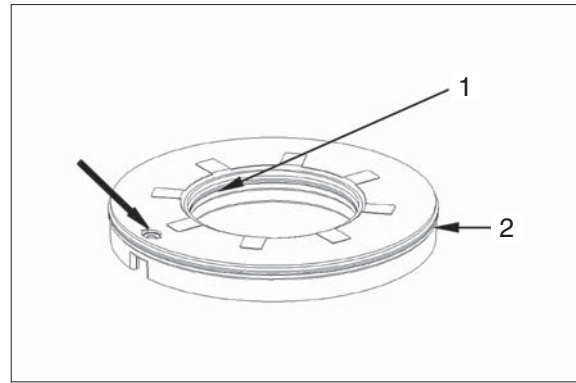
7609ATM223

- ③ Place both O-rings (1 and 2) into the piston grooves and oil them.

1 75×3

2 142×3

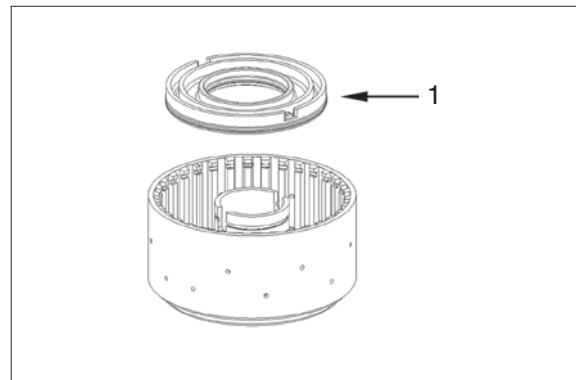
- ※ Check function of the drain valve (see arrow) - There must be no jamming of the ball.



7609ATM224

- ④ Place piston (1) into the disk carrier.

- ※ Observe installation position, see figure.

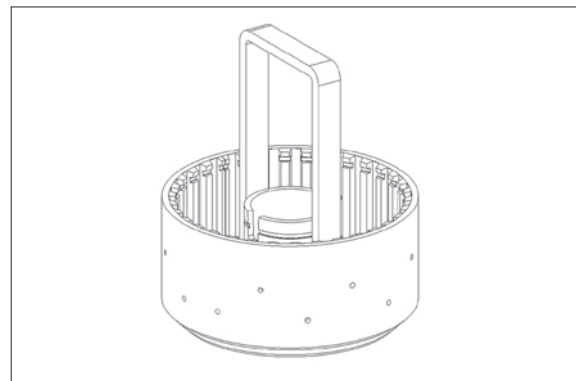


7609ATM225

- ⑤ Use a hand-operated press to place piston into the disk carrier by means of the assembly aid.

Assembly aid

5870 345 088



7609ATM226

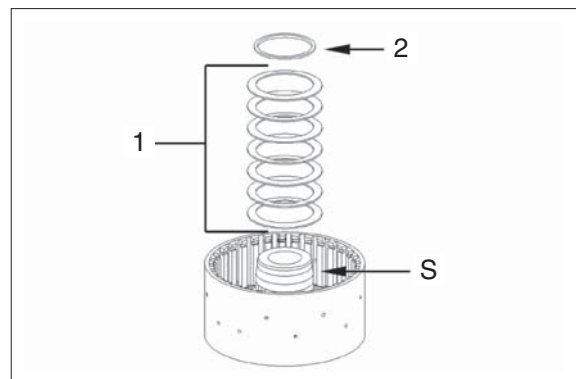
- ⑥ Mount inner installer (S) onto the disk carrier.

Install cup spring package (1) and L-ring (2).

- ※ Installation position cup spring package and L-ring see figure TM229.

Inner installer

see figure TM228



7609ATM227

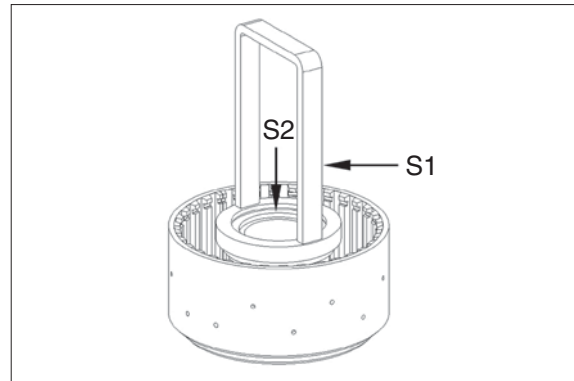
- ⑦ Preload cup spring package by means of assembly aid (S1) and pressure piece (S2), until L-ring has engaged into the annular groove.

Assembly aid (S1) 5870 345 088

Assembly fixture (S + S2) 5870 345 124

(Inner installer and pressure piece)

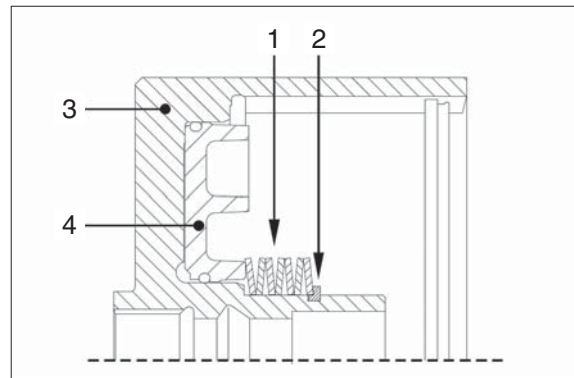
- ※ It is always necessary to mount a new L-ring.



7609ATM228

Disk carrier with piston retraction :

- 1 Cup spring package
- 2 L-ring
- 3 Disk carrier
- 4 Piston with O-rings



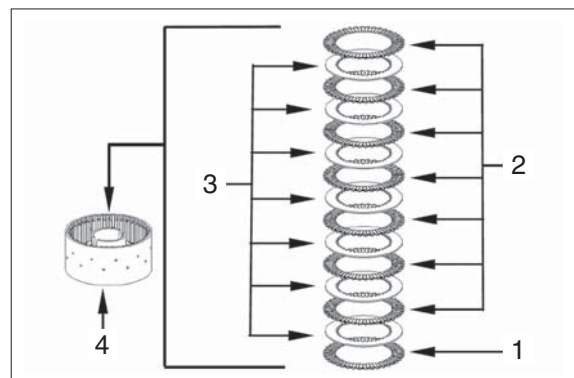
7609ATM229

- ⑧ Install outer and inner disks alternately into the disk carrier (4) as personated in figure TM230.

- 1 Friction disk-coated on one side (1 pcs)
- 2 Outer disks (7 pcs)
- 3 Inner disks (7 pcs)

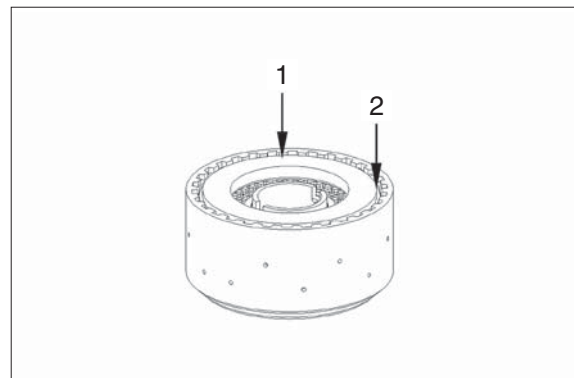
- ※ Take care that the uncoated (blank) side of the friction disk (1) is showing towards the piston.

Number of friction surfaces : 14



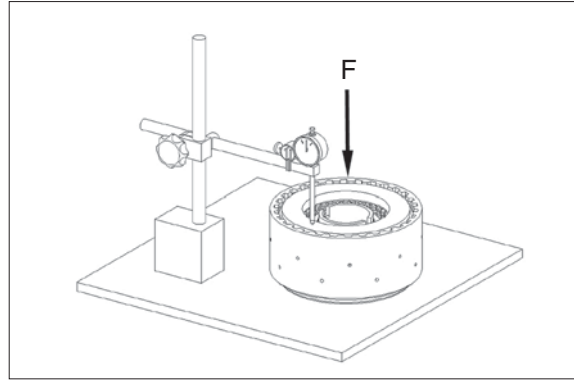
7609ATM230

- ⑨ Mount end plate (1) and fix disk package by means of snap ring (2) (e.g. thickness = 2.65 mm / recommended value).



7609ATM231

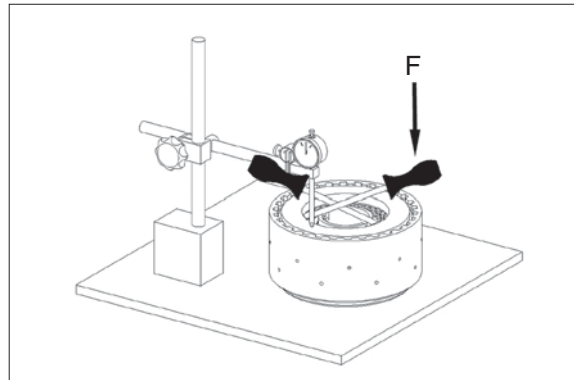
- ⑩ Press on end plate with F (approx. 100 N = 10 kg) and set dial indicator to "zero".



7609ATM232

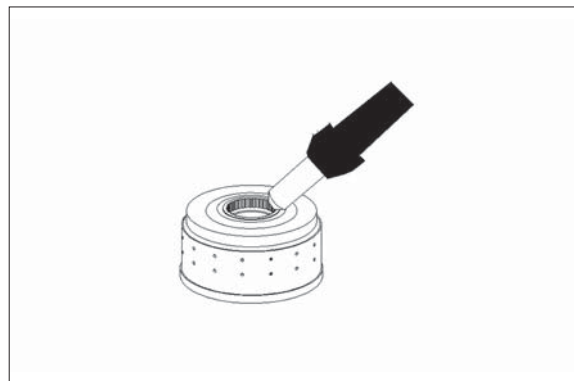
- ⑪ Then press end plate against the snap ring (upwards) and read disk clearance.

- ※ Disk clearance : 1.75~2.05 mm  
(see figure TM230)
- ※ In case of deviations, the disk clearance must be corrected with an appropriate snap ring (optional thicknesses = 2.1~4.2 mm).



7609ATM233

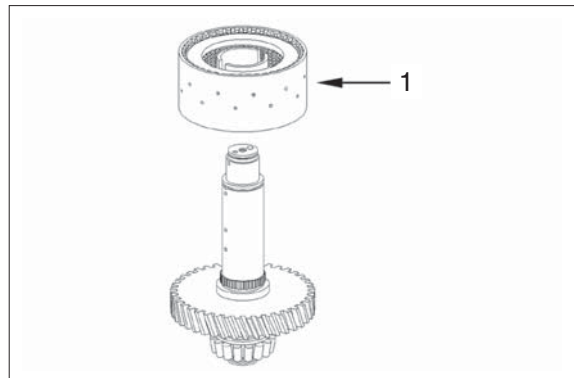
- ⑫ Heat up clutch inner diameter (approx. 120°C).



7609ATM234

- ⑬ Mount clutch (1) until contact is obtained.

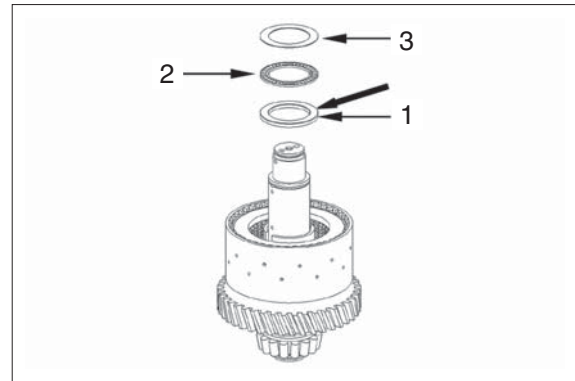
- ※ Wear protective gloves.



7609ATM235

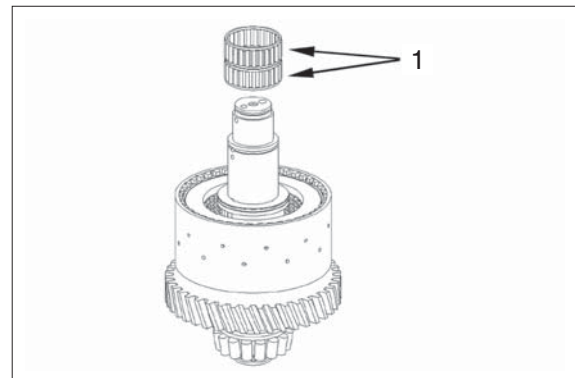
- ⑭ Mount running disk  $55 \times 78 \times 5$  (1), axial cage  $55 \times 78 \times 3$  (2) and axial washer  $55 \times 78 \times 1$  (3) and oil it.

※ Install chamfer (see arrow) of running disk (1) showing towards the axial cage.



7609ATM236

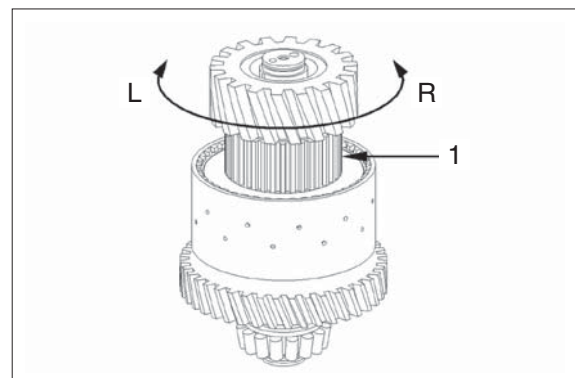
- ⑮ Mount needle cage  $55 \times 63 \times 50$  (1) and oil it.



7609ATM237

- ⑯ Install (1) idler.

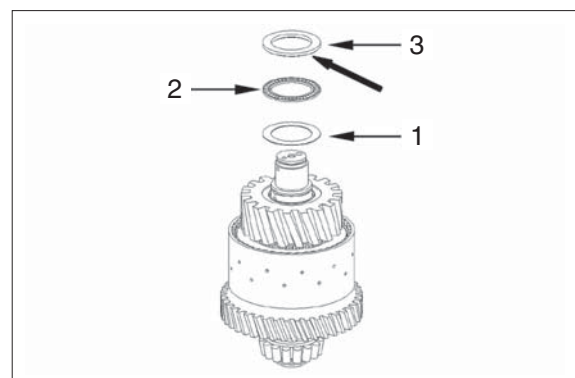
Mount inner disks onto the inner disk carrier (idler) by means of short left/right rotations.



7609ATM238

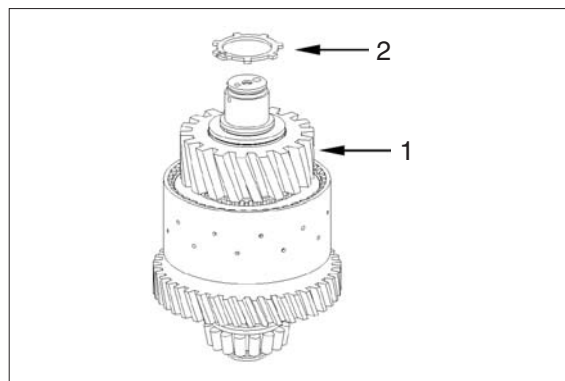
- ⑰ Mount axial washer  $55 \times 78 \times 1$  (1), axial cage  $55 \times 78 \times 3$  (2) and running disk  $55 \times 78 \times 5$  (3) and oil it.

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



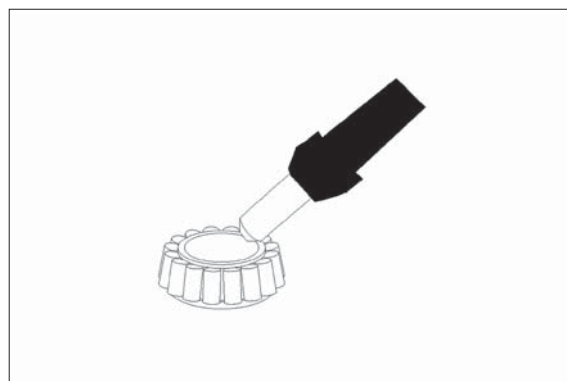
7609ATM239

- ⑱ Fix idler gear (1) and single parts by means of retaining ring (2).



7609ATM240

- ⑲ Heat up bearing inner ring (approx. 120°C).

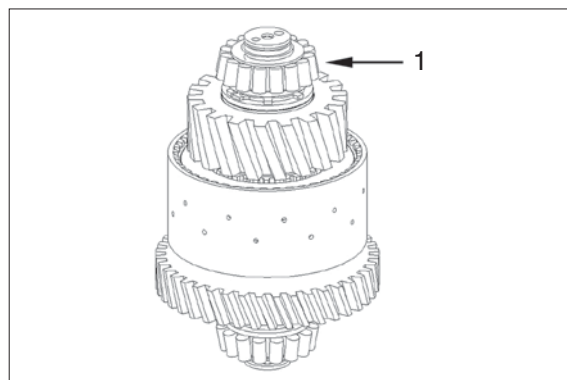


7609ATM241

- ⑳ Mount bearing inner ring (1) until contact is obtained.

※ Wear protective gloves.

※ Adjust bearing inner ring after cooling-down.

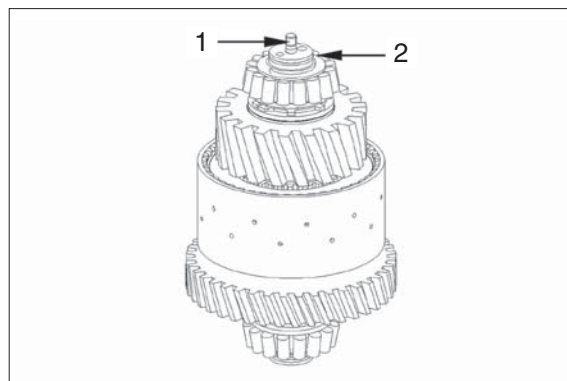


7609ATM242

- ㉑ Mount stud bolt (1).

· Tightening torque (M10/8.8×16) :  
1.73 kgf · m (12.5 lbf · ft)

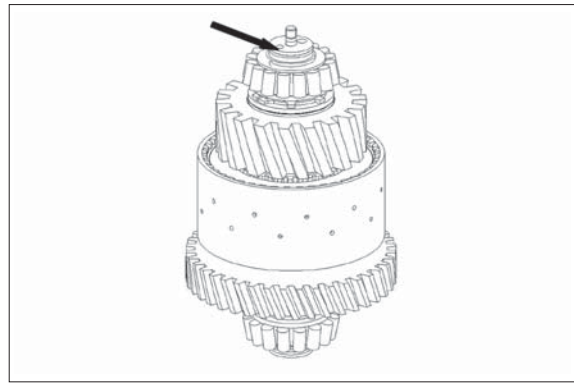
Fit rectangular ring 40×2.5 (2).



7609ATM243



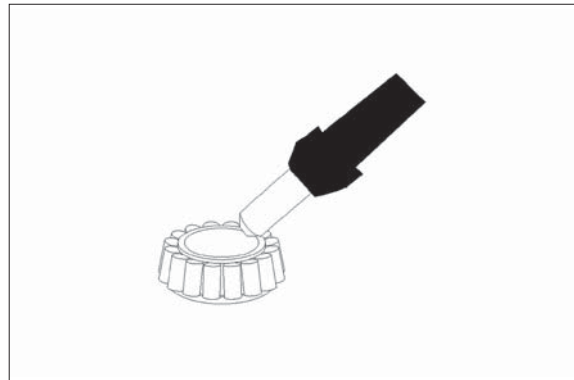
- ※ Check closing and opening of the clutch by means of compressed air at the hole (see arrow).  
Closing and opening of the clutch must be clearly audible.



7609ATM244

## (5) Clutch K3

- ① Heat up bearing inner ring (approx. 120°C)



7609ATM245

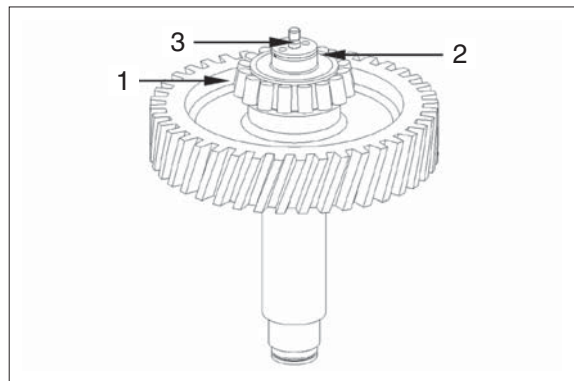
- ② Mount bearing inner ring (1) until contact is obtained.

Fit rectangular ring 40×2.5 (2).

- ※ Wear protective gloves.
- ※ Adjust bearing inner ring after cooling-down.

Mount stud bolt (3).

- Tightening torque (M10/8.8×16) :  
1.73 kgf · m (12.5 lbf · ft)



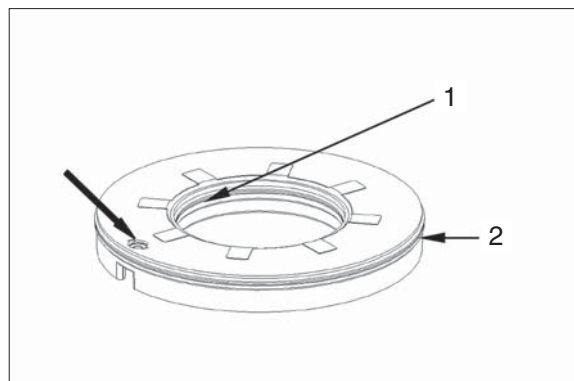
7609ATM246

- ③ Place both O-rings (1 and 2) into the piston grooves and oil them.

1 75×3

2 142×3

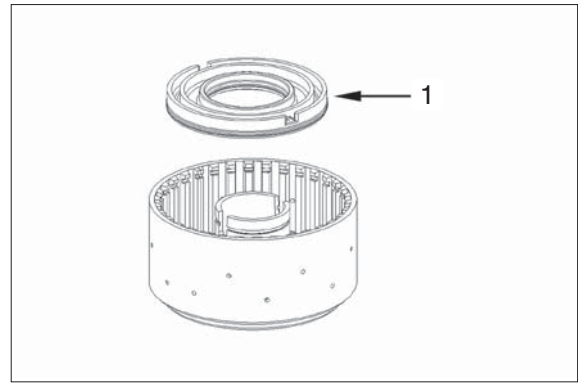
- ※ Check function of the drain valve (see arrow) - There must be no jamming of the ball.



7609ATM247

④ Place piston (1) into the disk carrier.

※ Observe installation position, see figure.

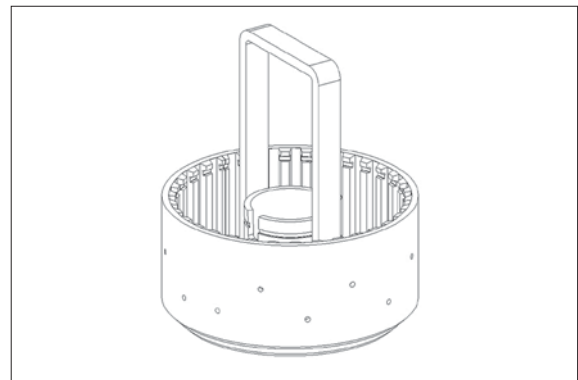


7609ATM248

⑤ Use a hand-operated press to place piston into the disk carrier by means of the assembly aid.

Assembly aid

5870 345 088



7609ATM249

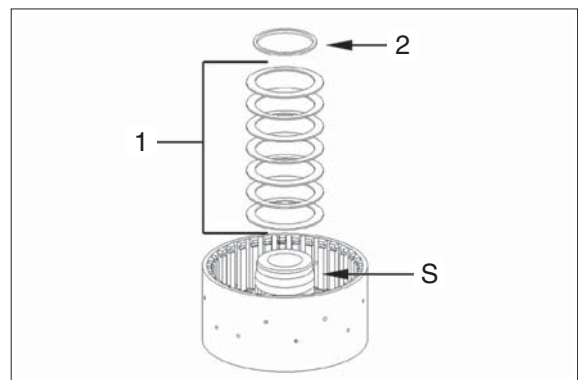
⑥ Mount inner installer (S) onto the disk carrier.

Install cup spring package (1) and L-ring (2).

※ Installation position cup spring package and L-ring see figure TM252.

Inner installer

see TM251



7609ATM250

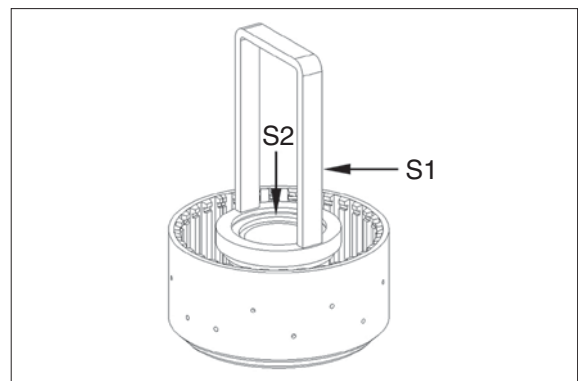
⑦ Preload cup spring package by means of assembly aid (S1) and pressure piece (S2), until L-ring has engaged into the annular groove.

Assembly aid (S1)

5870 345 088

Assembly fixture (S + S2) 5870 345 124  
(Inner installer and pressure piece)

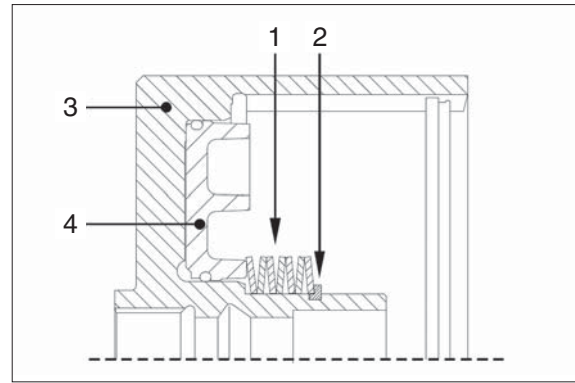
※ It is always necessary to mount a new L-ring.



7609ATM251

Disk carrier with piston retraction :

- 1 Cup spring package
- 2 L-ring
- 3 Disk carrier
- 4 Piston with O-rings



7609ATM252

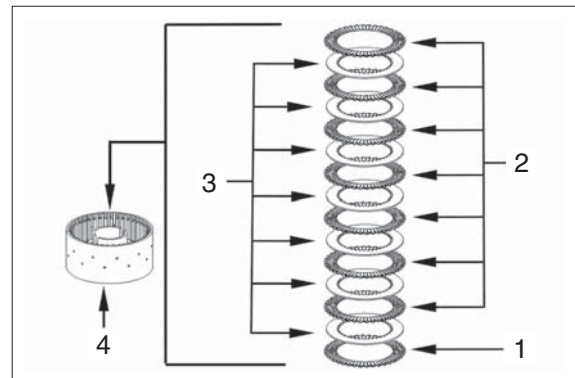
- ※ Different clutches (disc arrangements with relevant disc clearance) can be installed, depending on the parts manual.
- ※ The actually installed clutch and disc arrangement must be taken from the corresponding parts manual.
- ※ Figure no. : TM253 and TM254 illustrates the different disc arrangements.

- ⑧ Install outer and inner disks alternately into the disk carrier (4) as personated in figure TM253.

- 1 Friction disk-coated on one side (1 pcs)
- 2 Outer disks (7 pcs)
- 3 Inner disks (7 pcs)

- ※ Take care that the uncoated (blank) side of the friction disk (1) is showing towards the piston.

Number of friction surfaces : 14



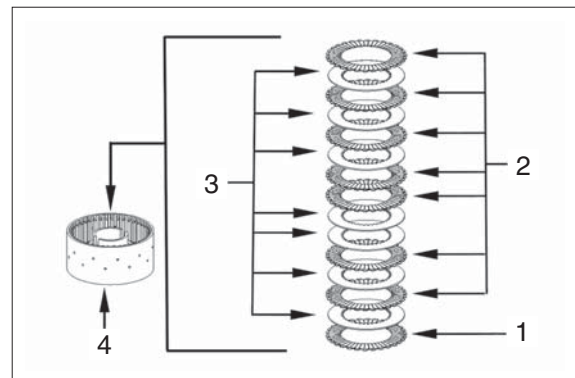
7609ATM253

- ⑨ Install outer and inner disks alternately into the disk carrier (4) as personated in figure TM254.

- 1 Friction disk-coated on one side (1 pcs)
- 2 Outer disks (7 pcs)
- 3 Inner disks (7 pcs)

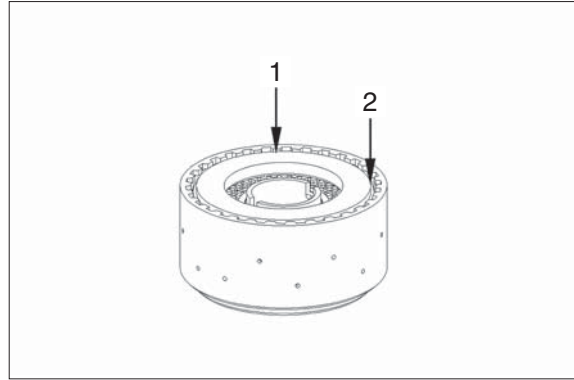
Take care that the uncoated (blank) side of the friction disk (1) is showing towards the piston.

Number of friction surfaces : 12



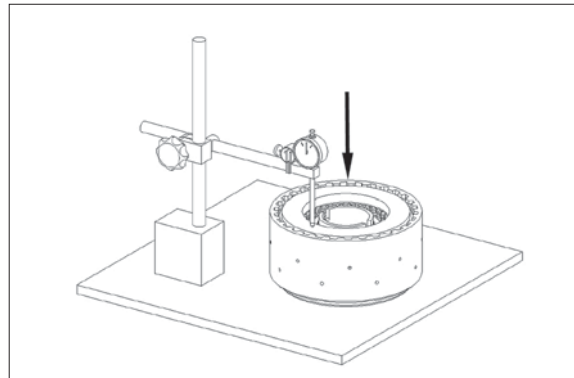
7609ATM254

- ⑩ Mount end plate (1) and fix disk package by means of snap ring (2) (e.g. thickness = 2.65 mm / recommended value).



7609ATM255

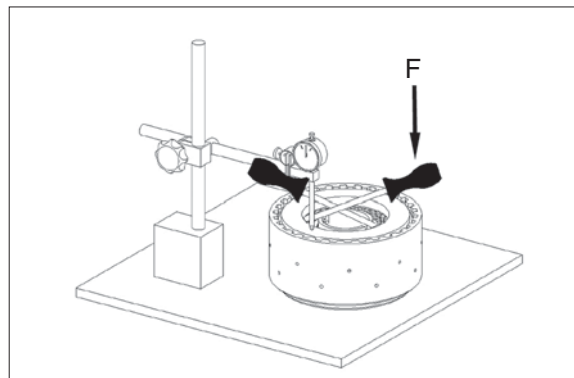
- ⑪ Press on end plate with F (approx. 100 N = 10 kg) and set dial indicator to "zero".



7609ATM256

- ⑫ Then press end plate against the snap ring (upwards) and read disk clearance.

- ※ Disk clearance : 1.75~2.05 mm
- ※ In case of deviations, the disk clearance must be corrected with an appropriate snap ring (optional thicknesses = 2.1~4.2 mm).



7609ATM257

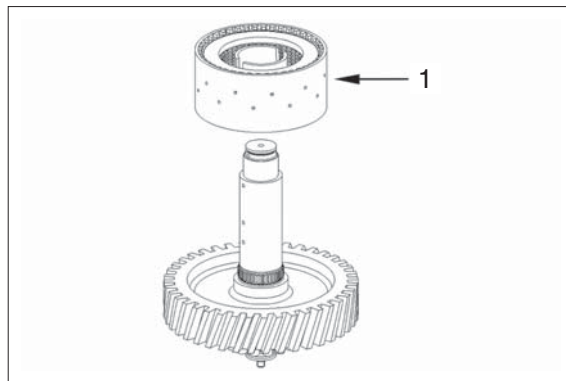
- ⑬ Heat up clutch inner diameter (approx. 120°C)



7609ATM258

⑭ Mount clutch (1) until contact is obtained.

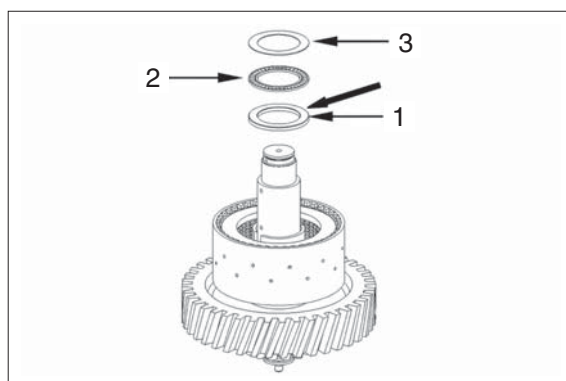
※ Wear protective gloves.



7609ATM259

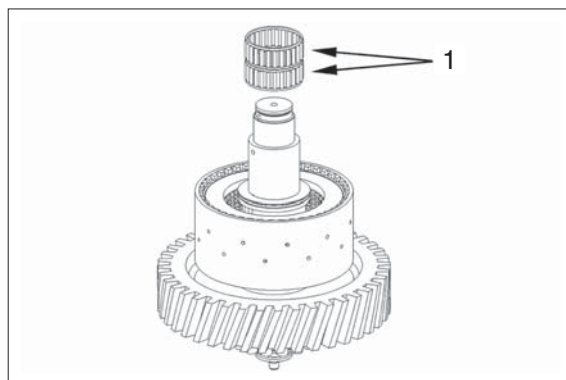
⑮ Mount running disk  $55 \times 78 \times 5$  (1), axial cage  $55 \times 78 \times 3$  (2) and axial washer  $55 \times 78 \times 1$  (3) and oil it.

※ Install chamfer (see arrow) of running disk (1) showing towards the axial cage.



7609ATM260

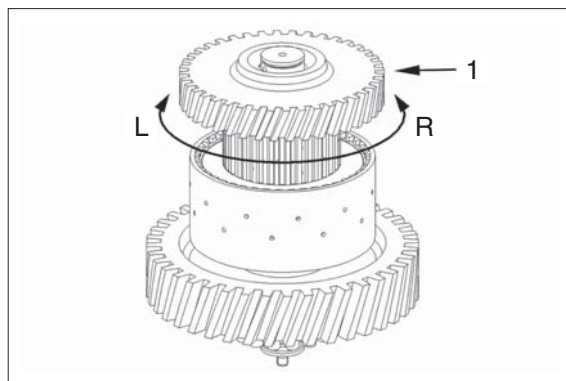
⑯ Mount needle cage  $55 \times 63 \times 50$  (1) and oil it.



7609ATM261

⑰ Install (1) idler.

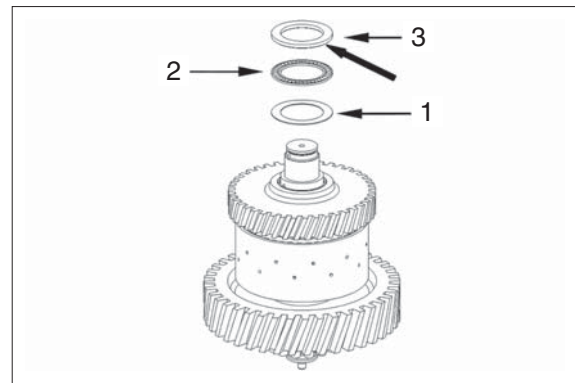
Mount inner disks onto the inner disk carrier (idler) by means of short left/right rotations.



7609ATM262

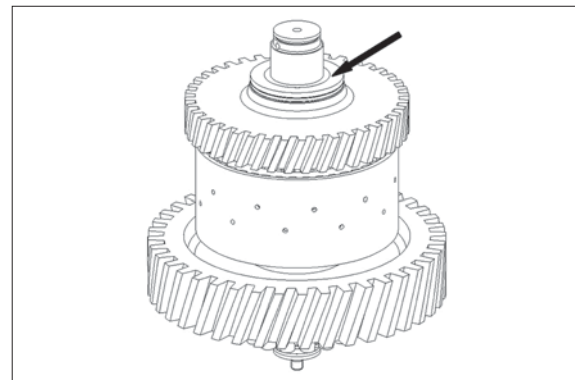
- ⑮ Mount axial washer  $55 \times 78 \times 1$  (1), axial cage  $55 \times 78 \times 3$  (2) and running disk  $55 \times 78 \times 5$  (3) and oil it.

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



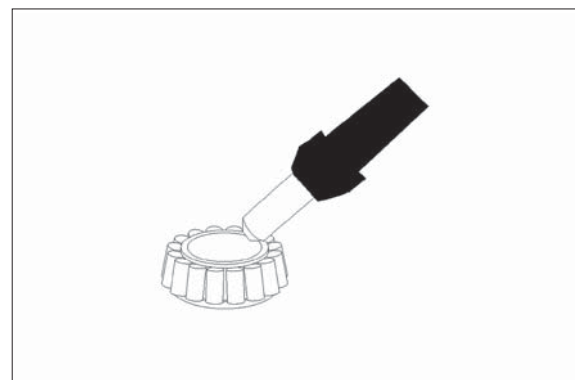
7609ATM263

※ Pay attention that the running disk is flush with the shaft (see arrow) collar to ensure that all inner disks are mounted on the idler gear teeth.



7609ATM264

- ⑯ Heat up bearing inner ring (approx.  $120^{\circ}\text{C}$ ).



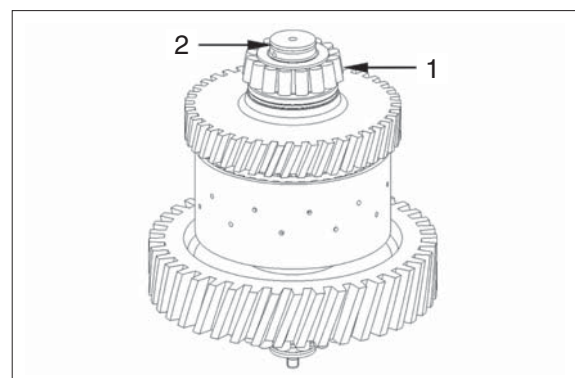
7609ATM265

- ⑰ Mount bearing inner ring (1) until contact is obtained.

Fit rectangular ring  $40 \times 2.5$  (2).

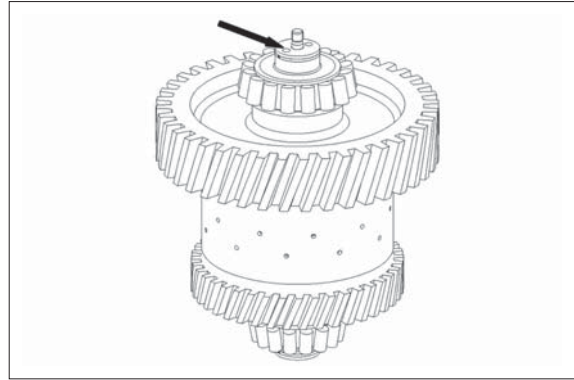
※ Wear protective gloves.

※ Adjust bearing inner ring after cooling-down.



7609ATM266

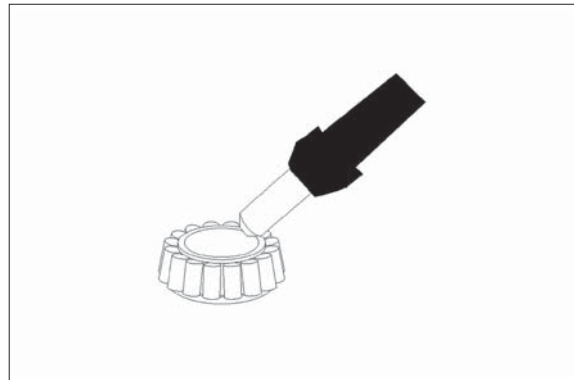
- ※ Check closing and opening of the clutch by means of compressed air at the hole (see arrow).  
Closing and opening of the clutch must be clearly audible.



7609ATM267

## (6) K4 Clutch

- ① Heat up bearing inner ring (approx. 120°C)

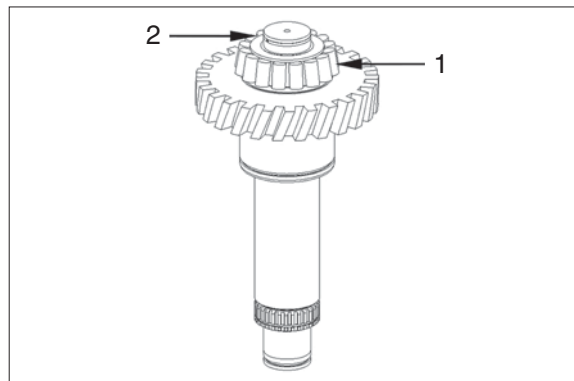


7609ATM268

- ② Mount bearing inner ring (1) until contact is obtained.

Fit rectangular ring 40 × 2.5 (2).

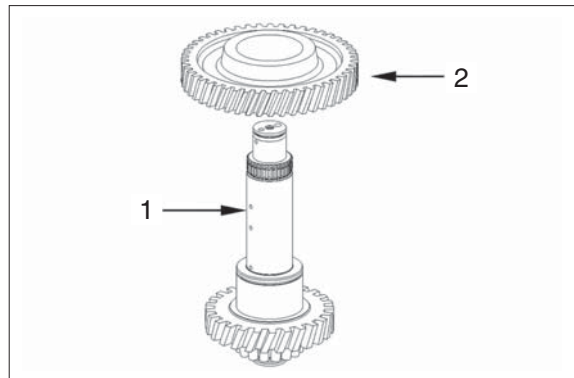
- ※ Wear protective gloves.
- ※ Adjust bearing inner ring after cooling-down.



7609ATM269

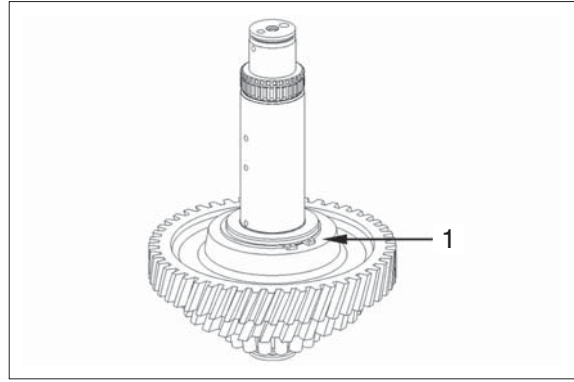
- ③ Undercool shaft (1) (approx. -80°C), heat up gear (2) (approx. +120°C) and mount until contact is obtained.

- ※ Wear protective gloves.



7609ATM270

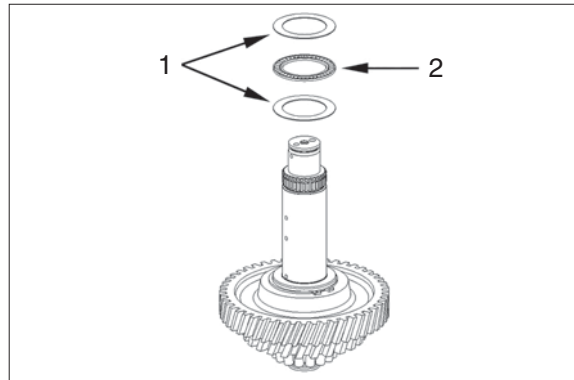
- ④ Secure gear by means of retaining ring  $80 \times 2.5$  (1).



7609ATM271

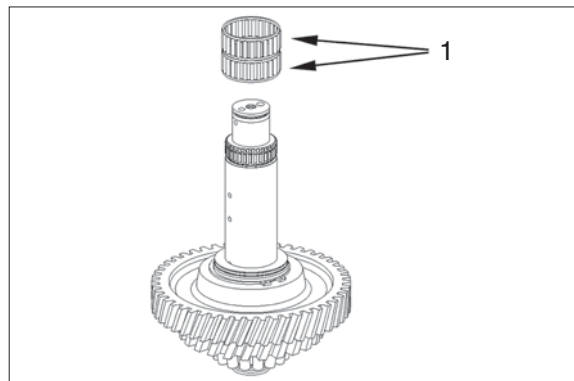
- ⑤ Mount lower axial washer  $55 \times 78 \times 1$  (1), axial needle cage  $55 \times 78 \times 3$  (2) and upper axial washer  $55 \times 78 \times 1$  (1) and oil it.

※ Upper and lower axial washer are identical.



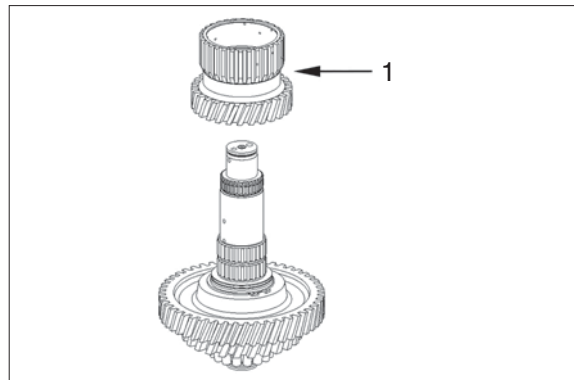
7609ATM272

- ⑥ Mount needle cage  $55 \times 63 \times 50$  (1) and oil it.



7609ATM273

- ⑦ Mount idler gear (1).

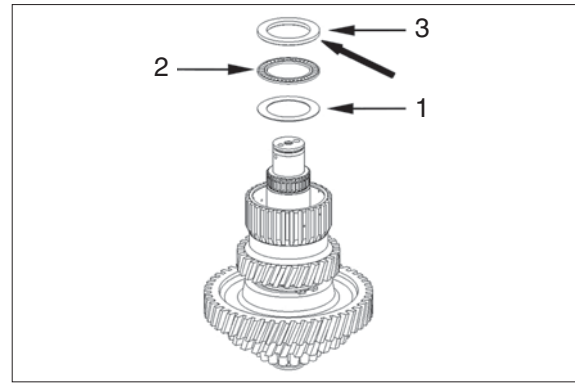


7609ATM274



- ⑧ Mount axial washer 55×78×1 (1), axial needle 55×78×3 cage (2) and running disk 55×78×5 (3) and oil it.

※ Mount running disk (3) with the chamfer (see arrow) showing to the needle cage.



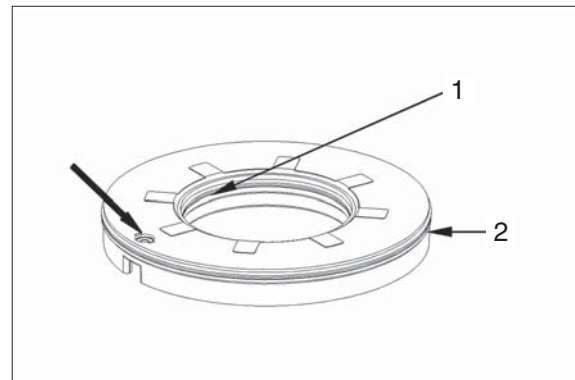
7609ATM275

- ⑨ Place both O-rings (1 and 2) into the piston grooves and oil them.

1 75×3

2 142×3

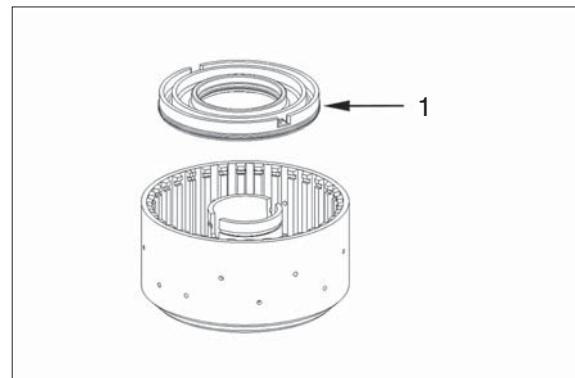
※ Check function of the drain valve (see arrow) - There must be no jamming of the ball.



7609ATM276

- ⑩ Place piston (1) into the disk carrier.

※ Observe installation position, see figure.

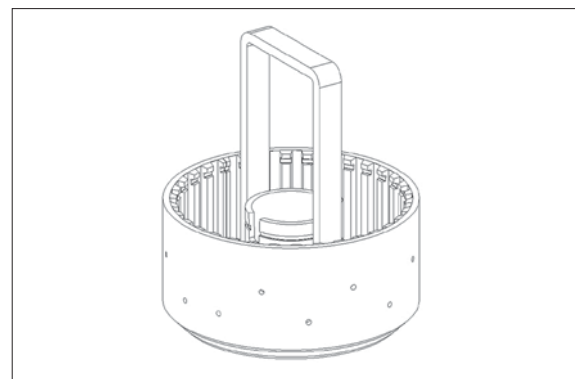


7609ATM277

- ⑪ Use a hand-operated press to place piston into the disk carrier by means of the assembly aid.

Assembly aid

5870 345 088



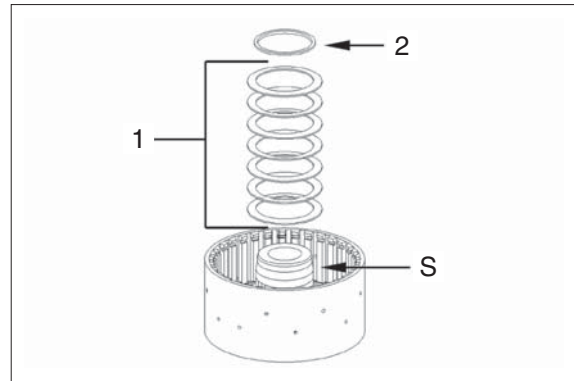
7609ATM278

- ⑫ Mount inner installer (S) onto the disk carrier.

Install cup spring package (1) and L-ring (2).

- ※ Installation position cup spring package and L-ring see figure TM281.

Inner installer see figure TM280



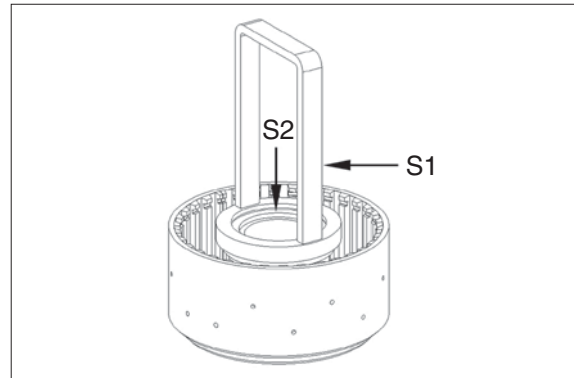
7609ATM279

- ⑬ Preload cup spring package by means of assembly aid (S1) and pressure piece (S2), until L-ring has engaged into the annular groove.

Assembly aid (S1) 5870 345 088

Assembly fixture (S + S2) 5870 345 124  
(Inner installer and pressure piece)

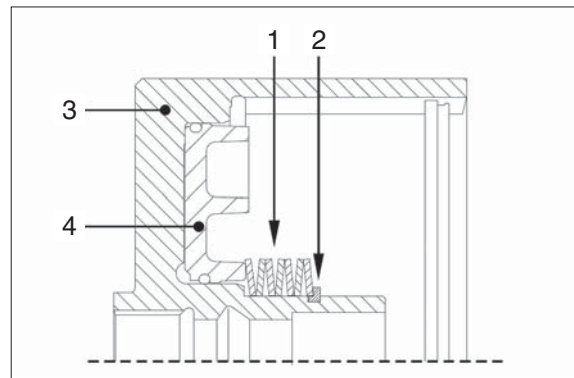
- ※ It is always necessary to mount a new L-ring.



7609ATM280

Disk carrier with piston retraction :

- 1 Cup spring package
- 2 L-ring
- 3 Disk carrier
- 4 Piston with O-rings



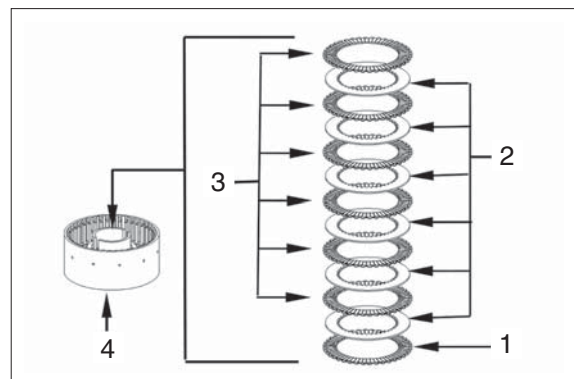
7609ATM281

- ⑭ Install outer and inner disks alternately into the disk carrier (4) as personated in figure TM282.

- 1 Friction disk -coated on one side (1 pcs)
- 2 Outer disks (6 pcs)
- 3 Inner disks (6 pcs)

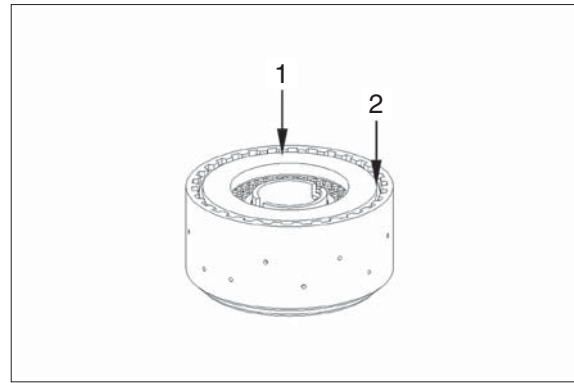
- ※ Take care that the uncoated (blank) side of the friction disk (1) is showing towards the piston.

Number of friction surfaces : 12



7609ATM282

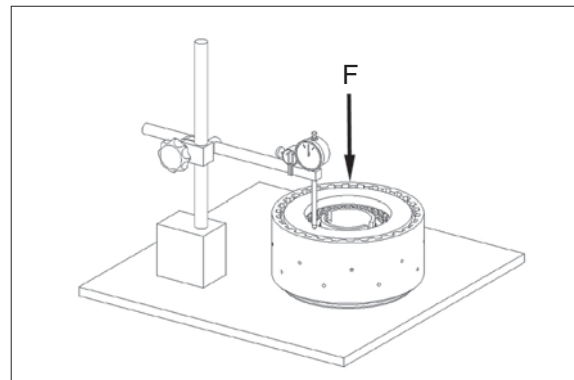
- ⑮ Mount end plate (1) and fix disk package by means of snap ring (2) (e.g. thickness = 2.65 mm / recommended value).



7609ATM283

- ⑯ Press on end plate with F (approx. 100 N = 10 kg) and set dial indicator to "zero".

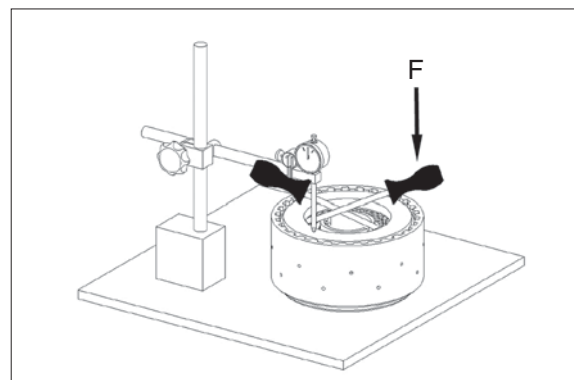
Magnetic stand                      5870 200 055  
Dial indicator                        5870 200 057



7609ATM284

- ⑰ Then press end plate against the snap ring (upwards) and read disk clearance.

- ※ Disk clearance : 1.35~1.65 mm  
(see figure TM282)
- ※ In case of deviations, the disk clearance must be corrected with an appropriate snap ring (optional thicknesses = 2.1~4.2 mm).



7609ATM285

- ⑱ Heat up bearing inner ring (approx. 120°C)

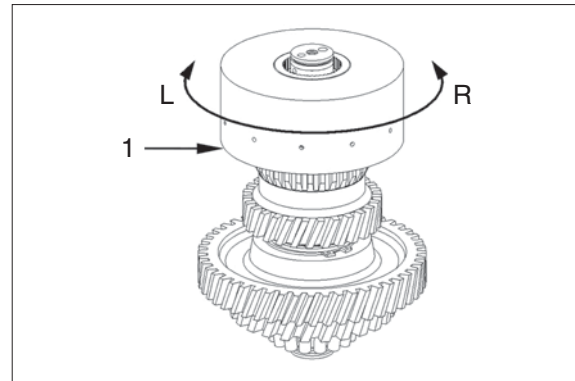


7609ATM286

- ⑲ Mount clutch (1) until contact is obtained.

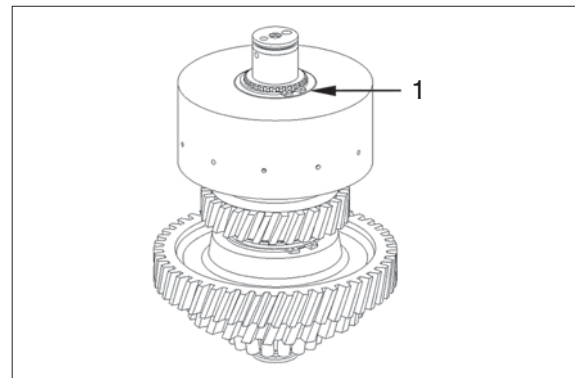
Mount inner disks onto the inner disk carrier by means of short left/right rotations.

※ Wear protective gloves.



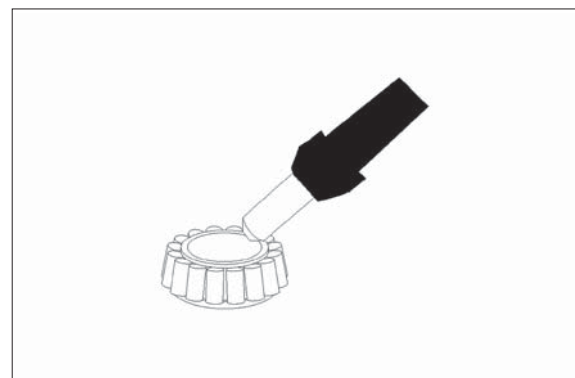
7609ATM287

- ⑳ Secure clutch by means of retaining ring 55×2 (1).



7609ATM288

- ㉑ Heat up bearing inner ring (approx. 120°C)



7609ATM289

- ㉒ Mount bearing inner ring (1) until contact is obtained.

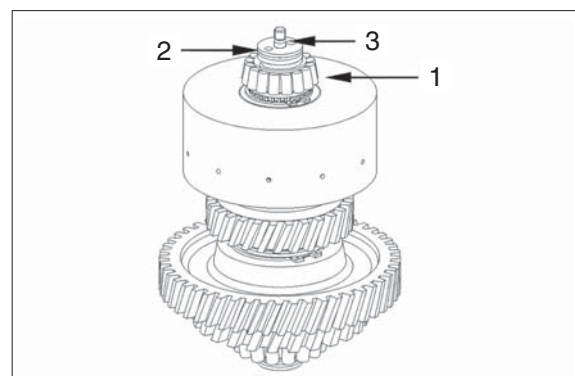
※ Wear protective gloves.

※ Adjust bearing inner ring after cooling-down.

Fit rectangular ring 40×2.5 (2).

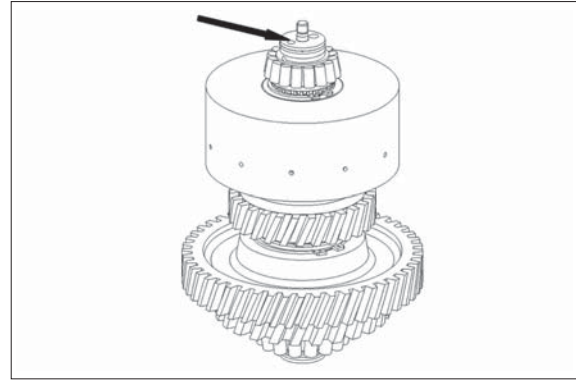
Mount stud bolt (3).

· Tightening torque (M10/8.8×16) :  
1.73 kgf · m (12.5 lbf · ft)



7609ATM290

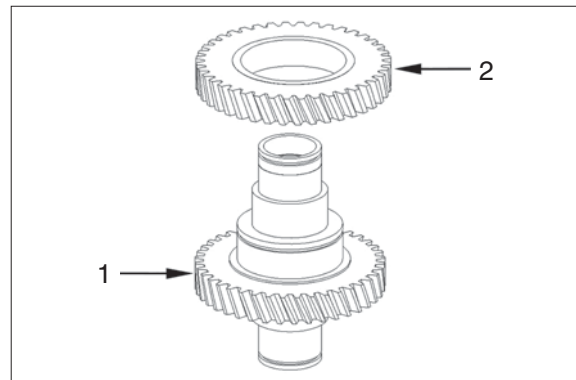
- ※ Check closing and opening of the clutch by means of compressed air at the hole (see arrow).  
Closing and opening of the clutch must be clearly audible.



7609ATM291

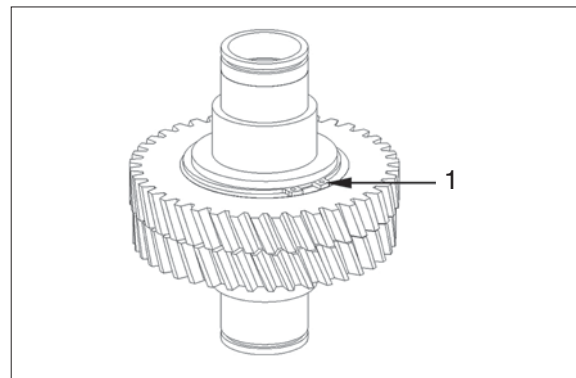
## (7) Input shaft

- ① Undercool input shaft (1) (approx.  $-80^{\circ}\text{C}$ ), heat up drive gear (2) (approx.  $+120^{\circ}\text{C}$ ) and mount until contact is obtained.
- ※ Wear protective gloves.



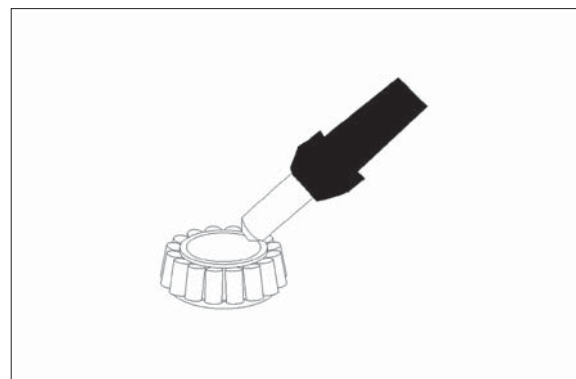
7609ATM292

- ② Secure drive gear by means of retaining ring 100×3 (1).



7609ATM293

- ③ Heat up bearing inner ring (approx.  $120^{\circ}\text{C}$ )

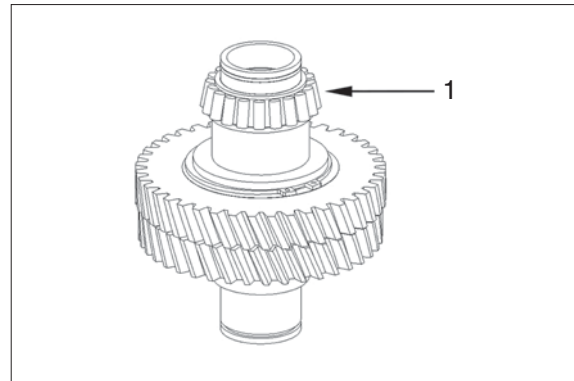


7609ATM294

- ④ Mount bearing inner ring (1) until contact is obtained.

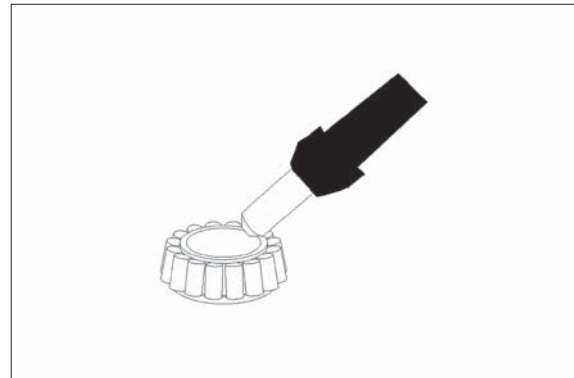
※ Wear protective gloves.

※ Adjust bearing inner ring after cooling-down.



7609ATM295

- ⑤ Heat up bearing inner ring (approx. 120° C)

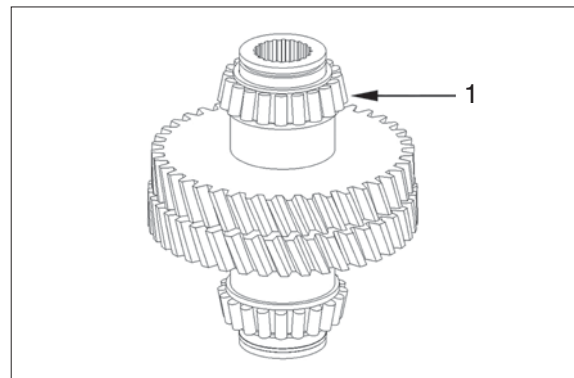


7609ATM296

- ⑥ Mount bearing inner ring (1) until contact is obtained.

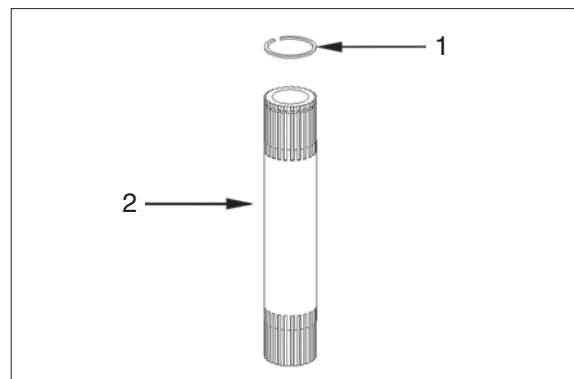
※ Wear protective gloves.

※ Adjust bearing inner ring after cooling-down.



7609ATM297

- ⑦ Install snap ring (1) into the annular groove (2) of the turbine shaft.

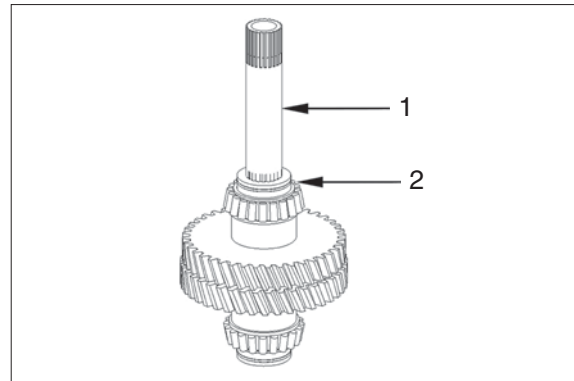


7609ATM298

- ⑧ Mount turbine shaft (1) until the snap ring engages into the input shaft groove.

※ Turbine shaft is axially fixed.

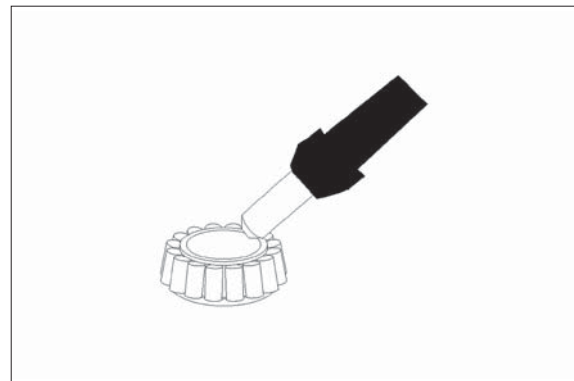
Snap in and interlock rectangular ring 60 × 3 (2).



7609ATM299

### (8) Output shaft

- ① Heat up bearing inner ring (approx. 120°C)

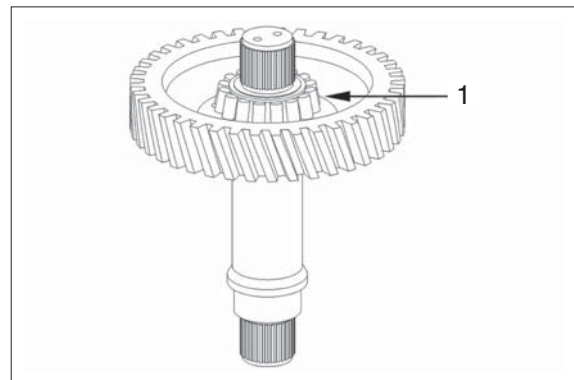


7609ATM301

- ② Mount bearing inner ring (1) until contact is obtained.

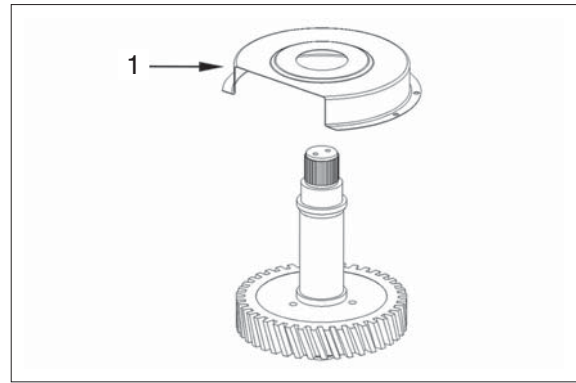
※ Wear protective gloves.

※ Adjust bearing inner ring after cooling-down.



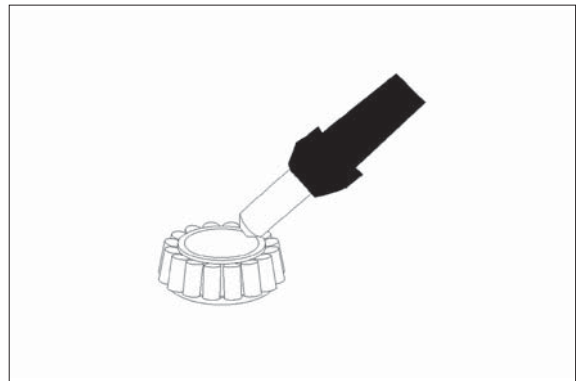
7609ATM302

③ Mount screen sheet (1).



7609ATM303

④ Heat up bearing inner ring (approx. 120°C)

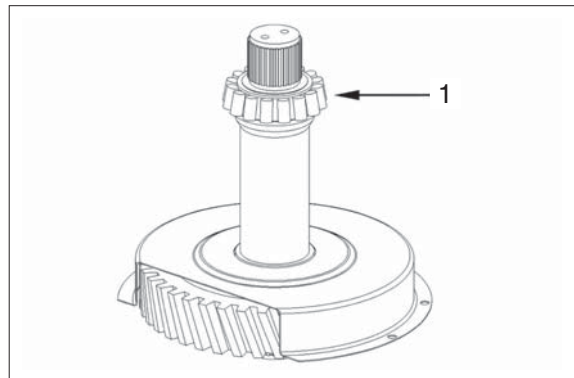


7609ATM304

⑤ Mount bearing inner ring (1) until contact is obtained.

※ Wear protective gloves.

※ Adjust bearing inner ring after cooling-down.



7609ATM305



## 9) INSTALLATION OF INPUT SHAFT, OUTPUT SHAFT, PUMP SHAFT (POWER-TAKE OFF SHAFT) AND CLUTCHES

- (1) If the suction tube (1) in the housing front part is to be replaced, it is imperative to use the special tool (rolling tool) for assembly. Then fix the tube with cylindrical screw (2). (Oil cylindrical screw)
- ※ It is always necessary to use new cylindrical screws.

· Tightening torque (M8/8.8×12) :

2.34 kgf · m (17.0 lbf · ft)

Rolling tool 5870 600 003

Lubricant 5870 451 006

- ※ The spare parts service supplies the lubricating oil tube (1) only as a complete package with the housing front part.

- ※ Single parts delivery upon request only.

- ※ Assembly is only possible with the special tool.

Rolling tool 5870 600 005

Lubricant 5870 451 006

- (2) Mount O-rings 22×3 into the annular groove of the oil tubes (1 and 2) and oil them.

Then insert tubes into the housing front part, oil cylindrical screws (3 and 4) and fix them.

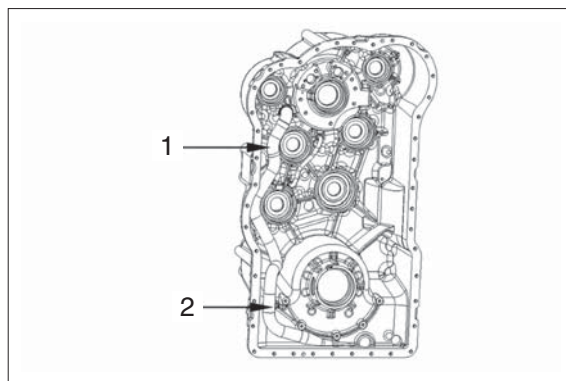
- ※ It is always necessary to use new cylindrical screws.

· Tightening torque (M8/8.8×12) :

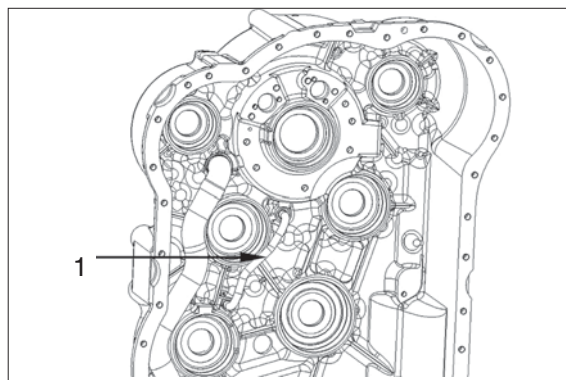
2.34 kgf · m (17.0 lbf · ft)

· Tightening torque (M8/8.8×50) :

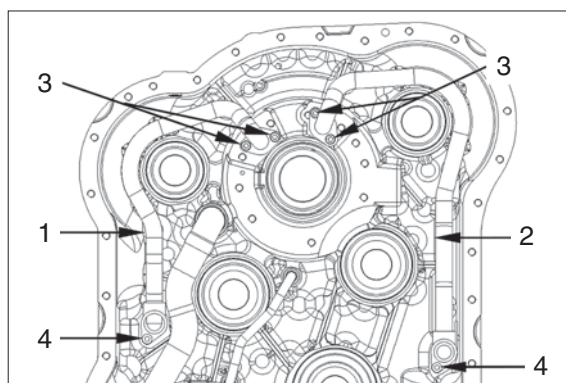
2.34 kgf · m (17.0 lbf · ft)



7609ATM306



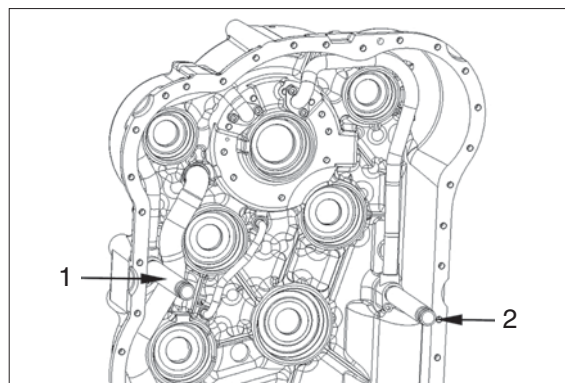
7609ATM307



7609ATM308

- (3) Mount O-rings 22×3 into the annular groove of the oil tubes (1 and 2) and oil them.

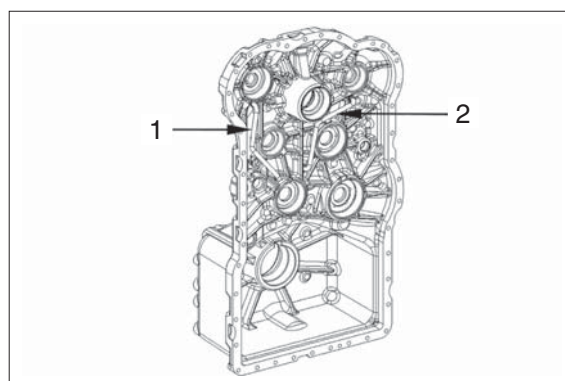
Then insert tubes into the housing front part.



7609ATM309

- ※ The spare parts service supplies the lubricating oil tubes (1 and 2) only as a complete package with the housing rear part.
- ※ Single parts delivery upon request only.
- ※ Assembly is only possible with the special tool.

Rolling tool	5870 600 006
Lubricant	5870 451 006

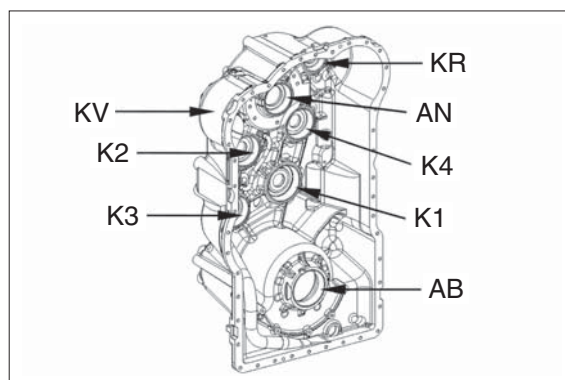


7609ATM310

- (4) Insert all bearing outer rings into the bearing holes of both housing parts.

Housing front part :

AN	Input
AB	Output
KV	Forward clutch
KR	Reverse clutch
K1	1st gear clutch
K2	2nd gear clutch
K3	3rd gear clutch
K4	4th gear clutch



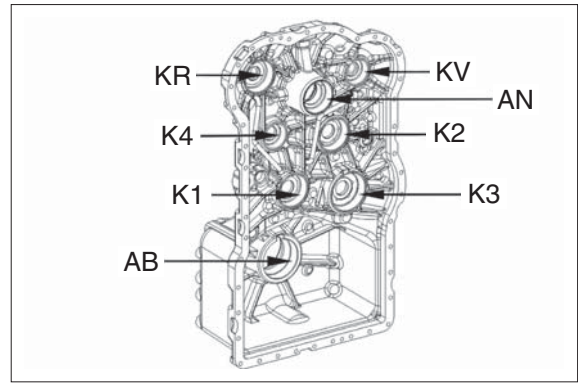
7609ATM311

- ※ Installation position see figure TM311 and TM312.

### Housing rear part :

(5) Legend see figure TM311.

- ※ Place bearing outer rings into the bearing holes using assembly grease.
- ※ If, contrary to the recommendation, the tapered roller bearings of clutches, input and output are not replaced, it is imperative to ensure the previous pairing (bearing inner ring/bearing outer ring).  
See figure TM054 and TM055.



7609ATM312

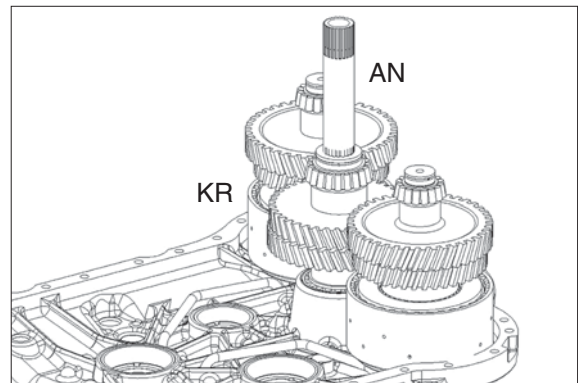
- ※ Due to the installation conditions, the installation of single clutches without using the special tool is not possible.

#### ▲ Risk of injury.

(6) Install clutches by means of housing rear part (figure TM320 to TM321).

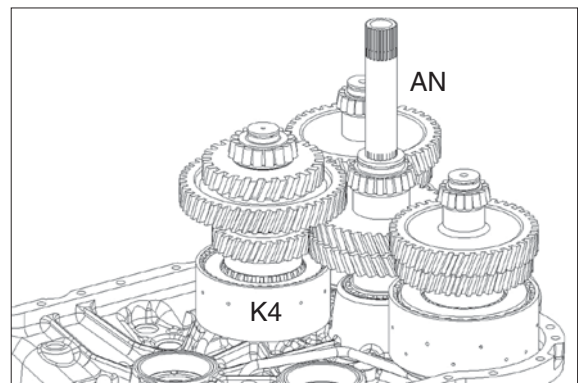
- ※ Housing rear part will be removed again later.

Place KR clutch, AN input shaft and KV clutch into the housing rear part at the same time.



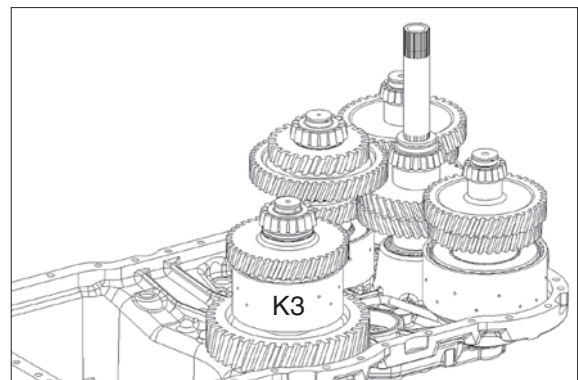
7609ATM313

(7) Slightly lift drive gear and position K4 clutch.



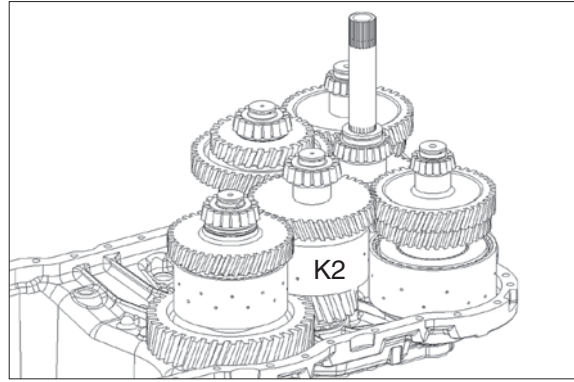
7609ATM314

(8) Mount K3 clutch.



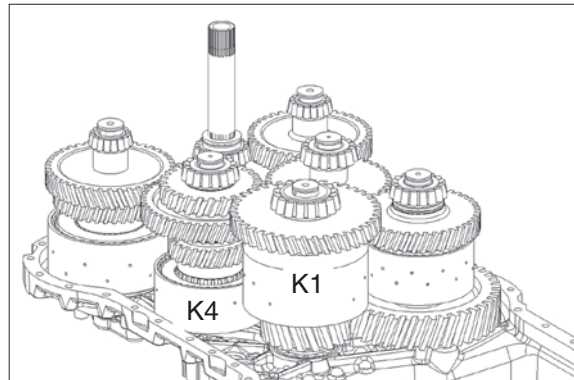
7609ATM315

(9) Position K2 clutch.



7609ATM316

(10) Slightly lift K4 clutch and position K1 clutch.

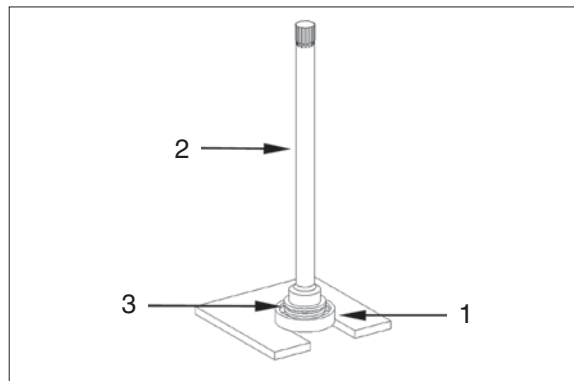


7609ATM317

(11) Press ball bearing 45×85×19 (1) onto the pump shaft (2) until contact is obtained.

Mount rectangular ring 60×3 (3).

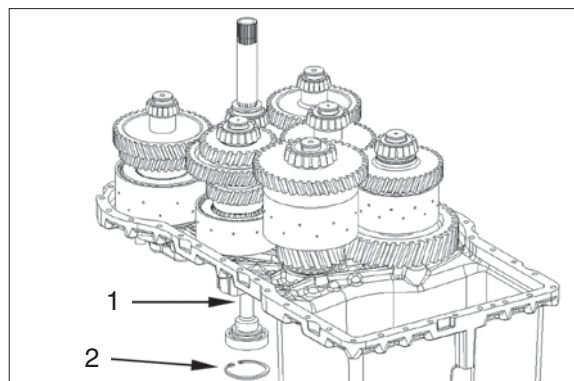
Grease and centrally align rectangular ring.



7609ATM318

(12) Mount pump shaft (1) until contact is obtained.

Fix pump shaft by means of retaining ring 85×3 (2).



7609ATM319

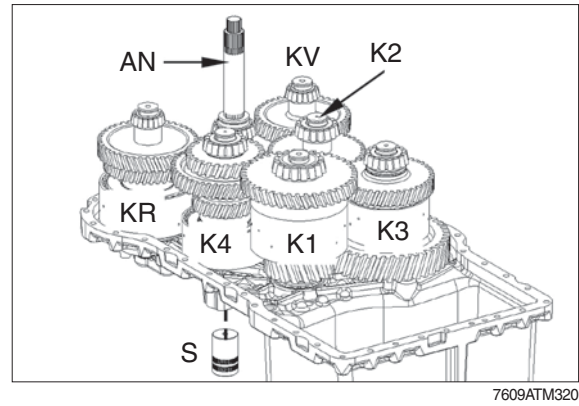
※ The figure left shows the installation position of the individual clutches in the housing rear part one more time.

(13) Fix clutches K1, K2, K3 and K4 by using a handle.

Handle 5870 260 010

※ Clutches KV, KR and input shaft (2) are only fixed by the gear chain.

Check all rectangular rings, grease and align them centrally.

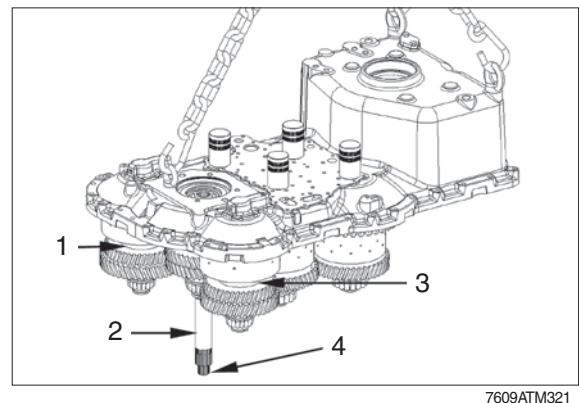


(14) Pivot housing rear part 180° by using a lifting device.

- 1 Clutch KV
- 2 Input shaft
- 3 Clutch KR
- 4 Pump shaft

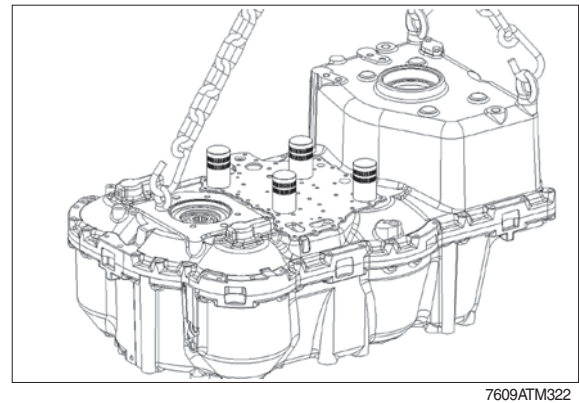
※ Clutch KV, KR and input shaft are only fixed by the gear chain.

Attention must be paid that the non-fixed components of the gear chain do not get loose.

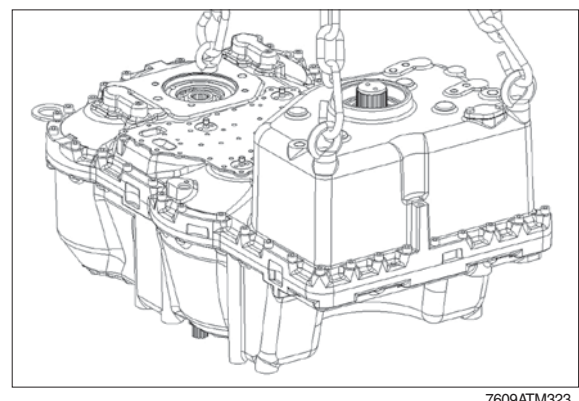


(15) Use the lifting device to bring the housing rear part into contact position with the housing front part, by cautiously assembling the clutches.

Then remove handles.



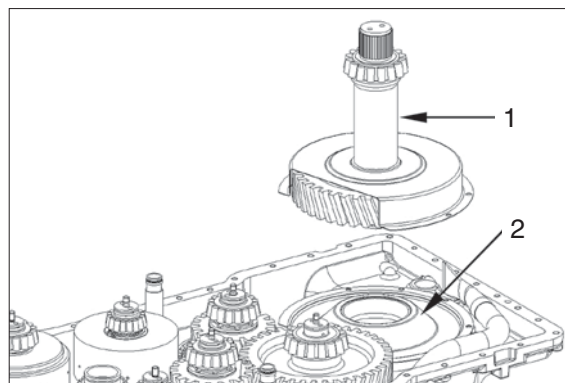
(16) Remove housing rear part again.





(17) Put on screen sheet (1).

Install preassembled output shaft (2).



(18) Oil cylindrical screws (1) and use them to fix screen sheet .

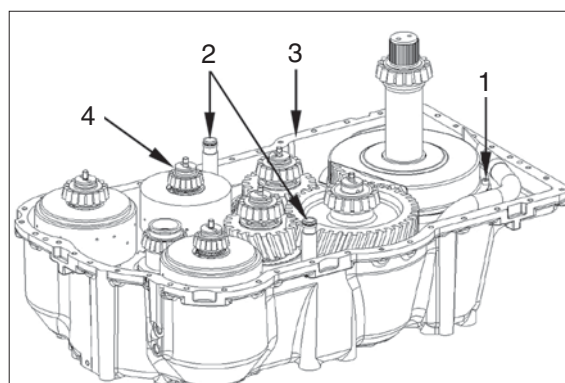
Tightening torque (M8/8.8×12) :  
2.35 kgf · m (17.0 lbf · ft)

※ It is always necessary to use new cylindrical screws.

Mount O-rings 22×3 (2) into the annular groove of the oil tubes and oil them.

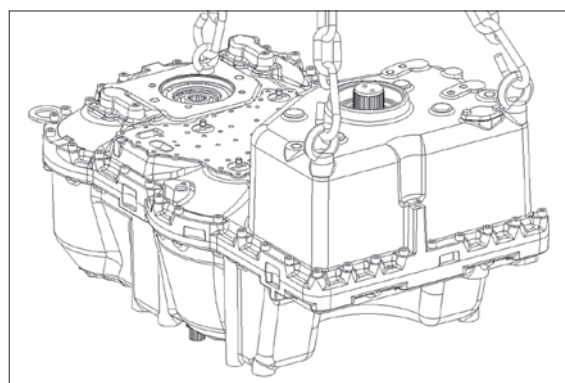
Mount all rectangular rings (4), grease and align them centrally.

Wet mounting face (3) with sealing agent loctite (type No. 574).

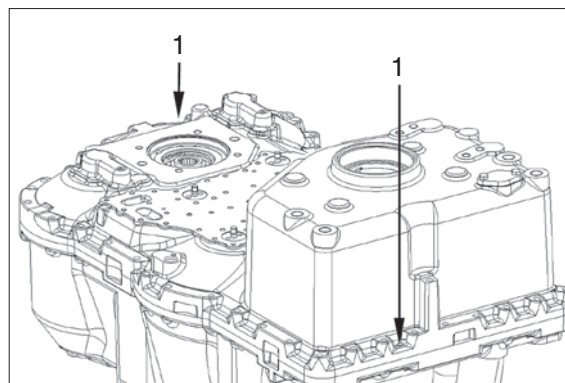


(19) Carefully bring the housing front part into contact position with the housing rear part by using the lifting device.

※ Pay attention that both oil tubes are aligned with the holes in the housing rear part.



- (20) Fit both cylindrical pins  $10 \times 24$  (1) centrally to the mounting face.



7609ATM327

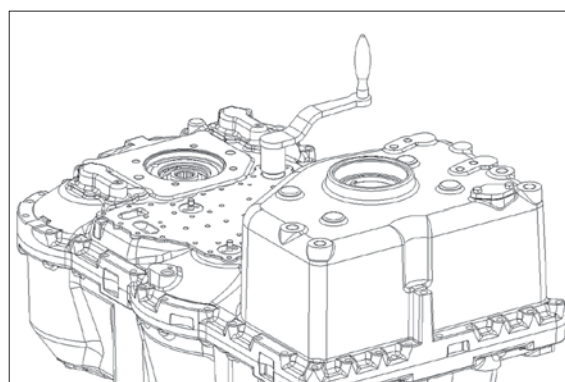
### Checking of clearance of the gear drive train

- (21) Position driving element and rotate KV clutch shaft.

※ If you notice an interference of the movable parts (e.g. on the screen sheet or on the oil tubes), you must correct this fault.

Do this step on all clutch shafts.

Driving element	5870 345 089
Crank handle	5870 280 007



7609ATM328

- (22) Fix housing front and rear part by means of cylindrical screws (1).

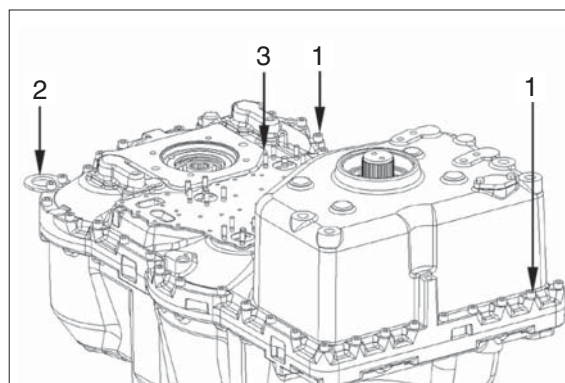
· Tightening torque (M10/8.8  $\times$  50) :  
4.69 kgf · m (33.9 lbf · ft)

Mount fixing plate (2).

Mount stud bolts (3).

※ Wet screw-in thread with loctite (type No. 243).

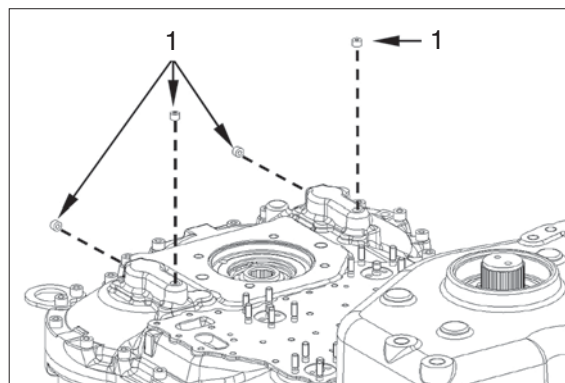
· Tightening torque (M8/10.9  $\times$  25) :  
1.53 kgf · m (11.1 lbf · ft)



7609ATM329

- (23) The screw plugs (1) must be mounted with a hydraulic pneumatic pressing tool.

※ In case of damage the premounted transmission housing rear part should/ must be fully replaced.



7609ATM330

## 10) ASSEMBLY

### Outputs flange

#### (1) Output flange on output side

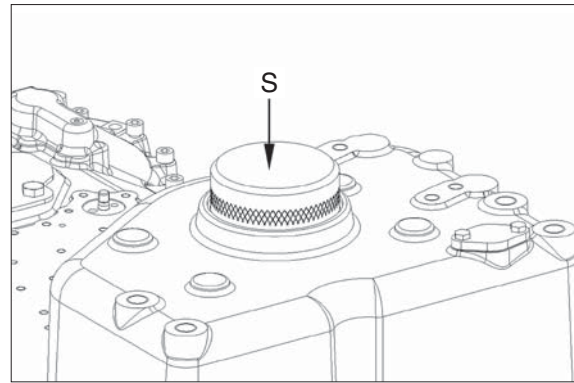
- ① Use driver (S) to mount shaft seal  $90 \times 120 \times 13$ , with the sealing lip showing to the oil sump.

Driver 5870 048 237

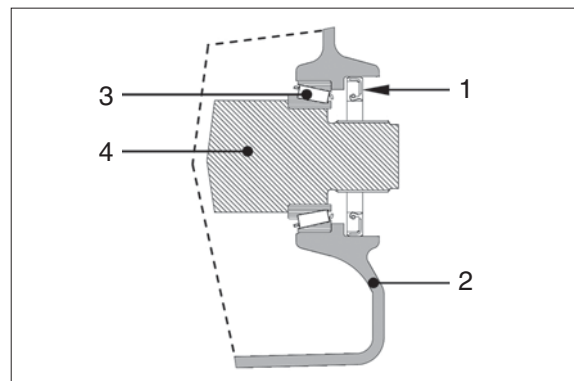
- ※ Use of the specified driver (S) ensures the exact installation position.
- ※ Fill space between sealing lip and dust lip with grease.  
Wet outer diameter (rubber-coated) with spirit.

- ※ Installation position shaft seal see figure TM332.

- 1 Shaft seal  $90 \times 120 \times 13$
- 2 Gearbox housing - rear section
- 3 Roller bearing
- 4 Output shaft

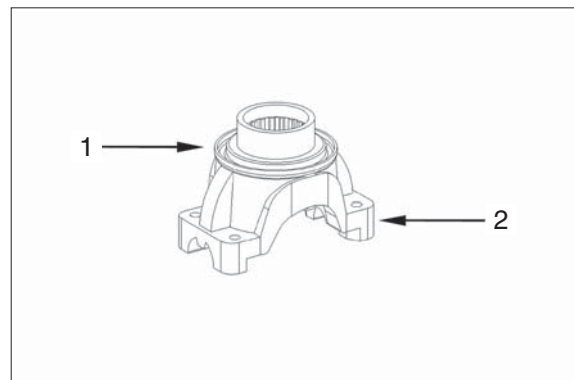


7609ATM331



7609ATM332

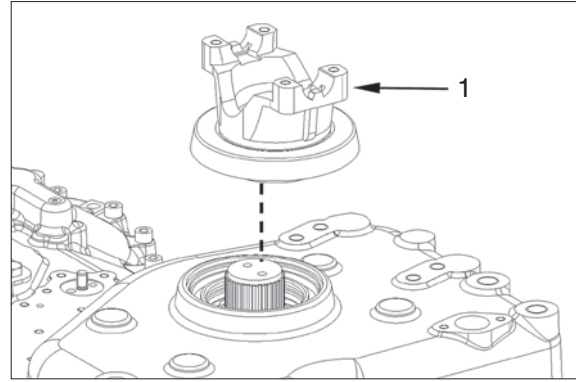
- ② Press screen sheet (1) onto the input flange (2).



7609ATM333



- ③ Mount output flange (1) until contact is obtained.



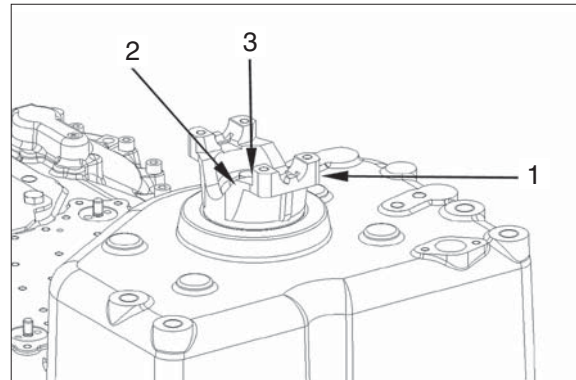
- ④ Insert O-ring  $48 \times 4$  into the space between output flange and shaft.

Fix output flange (1) by means of washer (2) and hexagon screws (3).

Oil hexagon screws before the assembly.

- Tightening torque (M10/8.  $\times$  30) :  
4.69 kgf  $\cdot$  m (33.9 lbf  $\cdot$  ft)

- ※ It is always necessary to use new hexagon screws.

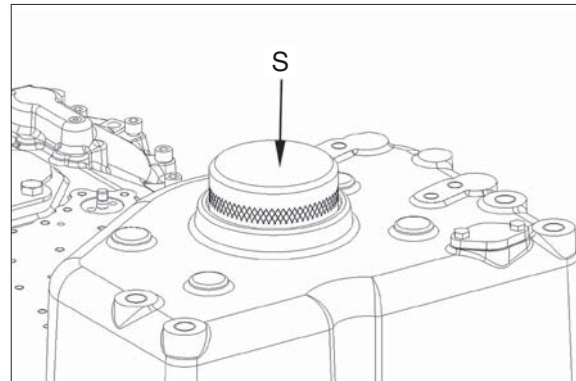


## (2) Output flange output side with parking brake

- ① Use driver (S) to mount shaft seal  $90 \times 120 \times 13$ , with the sealing lip showing to the oil sump.

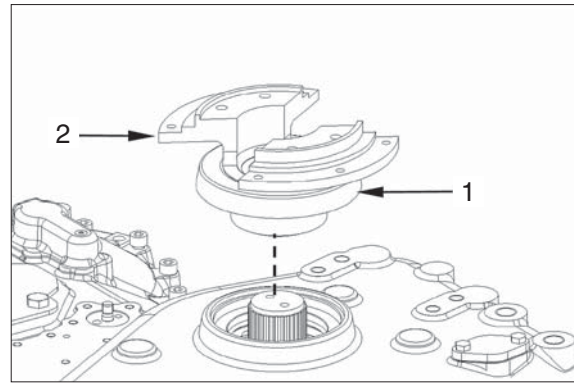
Driver 5870 048 237

- ※ Use of the specified driver (S) ensures the exact installation position.
- ※ Fill space between sealing lip and dust lip with grease.
- ※ Wet outer diameter (rubber-coated) with spirit.
- ※ Installation position shaft seal see figure TM332.



- ② Press screen sheet (1) onto the input flange (2).

Mount output flange (2) until contact is obtained.



7609ATM337

- ③ Insert O-ring 48×4 into the space between output flange and shaft.

- ※ Fix output flange (1) by means of washer (2) and hexagon screws.

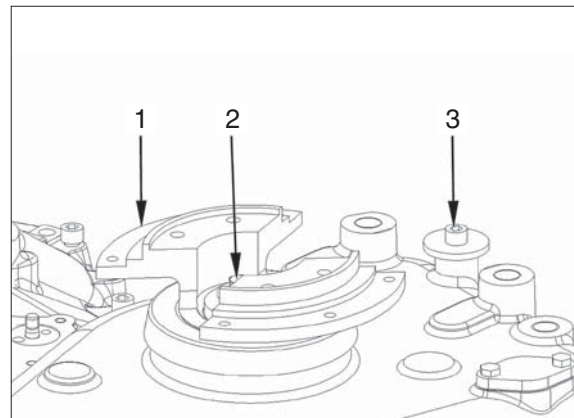
Oil hexagon screws before the assembly.

- Tightening torque (M10/10.9×30) :  
6.93 kgf · m (50.2 lbf · ft)

- ※ It is always necessary to use new hexagon screws.

Mount cylindrical screw with washer (3) for stop of the parking brake setting screw.

- Tightening torque (M10/8.8×16) :  
4.89 kgf · m (35.4 lbf · ft)

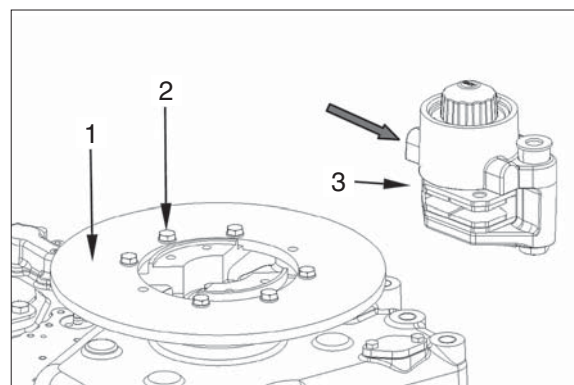


7609ATM338

- ④ Fix brake disk (1) at output flange by means of hexagon screws (2) and washers.

- Tightening torque (M10/10.9×25) :  
6.93 kgf · m (50.2 lbf · ft)

Connect HP pump on port (see arrow) and apply approx. 80 bar pressure to parking brake (3) and bring it in contact position.

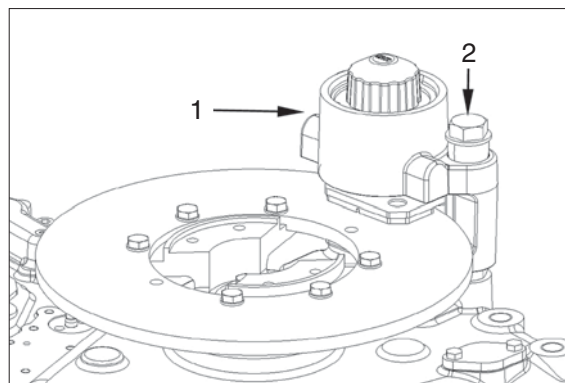


7609ATM339

HP hand-operated pump 5870 287 007  
MINIMESS coupling 5870 950 101

- ⑤ Fix parking brake (1) on transmission housing using the hexagon screw - guide pin (2).

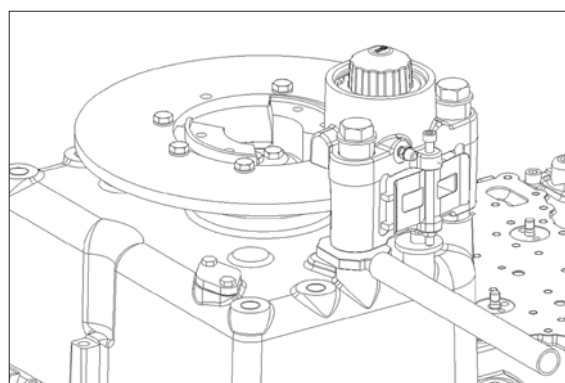
· Tightening torque (M20×1.5) :  
4.69 kgf · m (33.9 lbf · ft)



7609ATM340

- ⑥ Fix hexagon nut on brake caliper using the open end wrench insert.

· Tightening torque (M20×1.5) :  
23.5 kgf · m (170 lbf · ft)

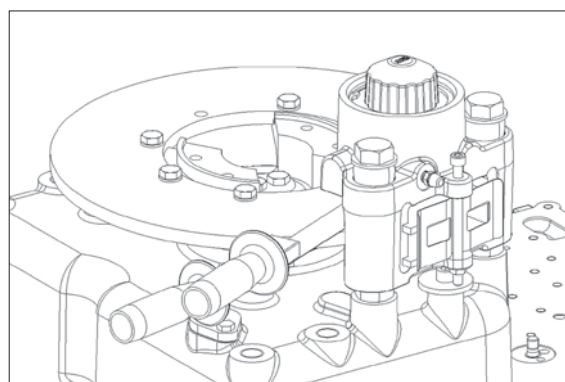


7609ATM341

- ⑦ Insert setting gauge on both sides between base disk and brake disk and hold in its position.

※ All installation, fitting and maintenance instructions, functional characteristics and setting specifications for the parking brake see page 4-22, "PARKING BRAKE SYSTEM".

Clearance : 0.5 - 1.5 mm  
Nom. clearance : 1.0 mm



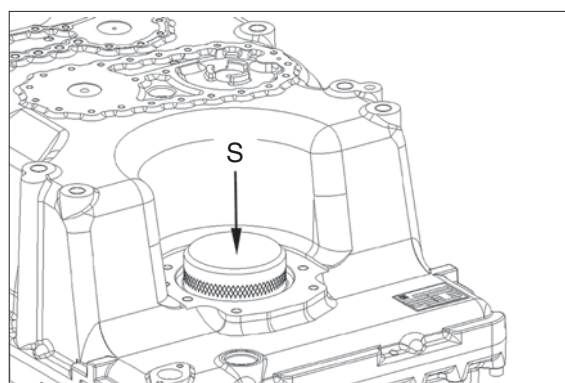
7609ATM342

### (3) Output flange on converter side

- ① Use driver (S) to mount shaft seal 90×120×13, with the sealing lip showing to the oil sump.

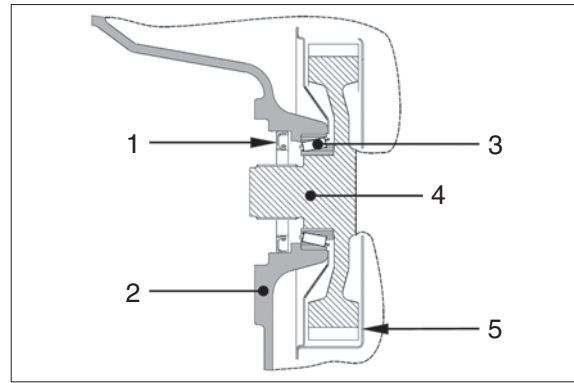
Driver 5870 048 237

- ※ Use of the specified driver (S) ensures the exact installation position.  
※ Fill space between sealing lip and dust lip with grease.  
※ Installation position shaft seal see figure TM344.



7609ATM343

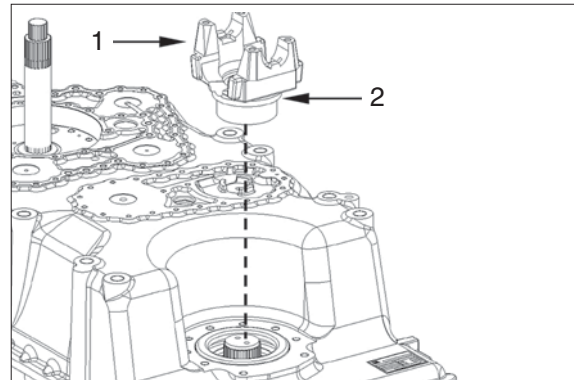
- 1 Shaft seal  $90 \times 120 \times 13$
- 2 Gearbox housing - rear section
- 3 Roller bearing
- 4 Output shaft
- 5 Screen sheet



7609ATM344

- ② Press screen sheet (1) onto the input flange (2).

Mount output flange (2) until contact is obtained.



7609ATM345

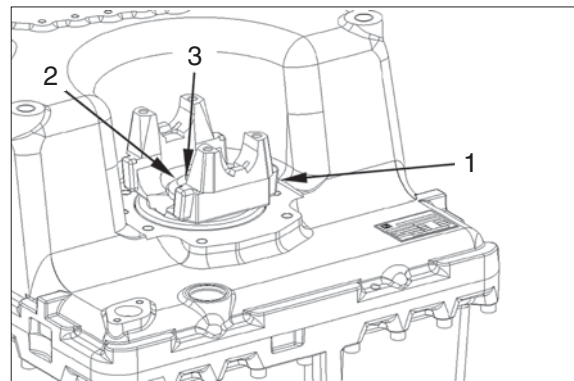
- ③ Insert O-ring  $48 \times 4$  into the space between output flange and shaft.

Fix output flange (1) by means of washer (2) and hexagon screws (3).

Oil hexagon screws before the assembly.

- Tightening torque (M10/8.8  $\times$  30) :  
4.69 kgf  $\cdot$  m (33.9 lbf  $\cdot$  ft)

- ※ It is always necessary to use new hexagon screws.



7609ATM346

## 11) REASSEMBLY

Engine connection, oil pressure pump, converter back-pressure valve and temperature sensor (measuring point "63" after the converter).

### (1) Converter back-pressure valve

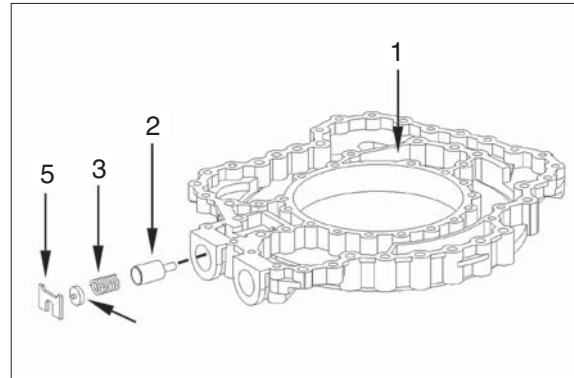
- ① The figure shows the single parts of the converter back-pressure valve.

- 1 Oil feed housing
- 2 Piston
- 3 Compression spring
- 4 Pressure plate
- 5 Locking plate

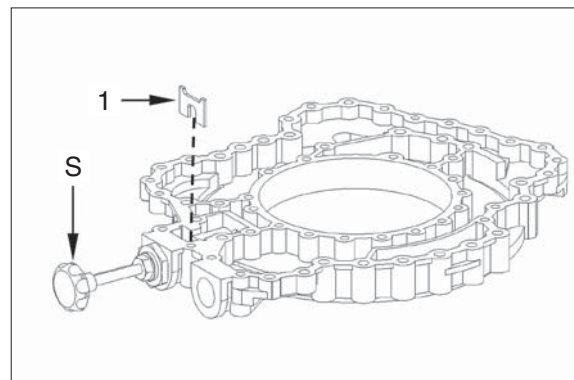
※ Install pressure plate (4), with the pin ( $\varnothing 6$  mm) showing to the locking plate (5).

- ② Assemble single parts, preload them with assembly aid (S) and fix them by means of locking plate (1).

Assembly aid                      5870 345 107



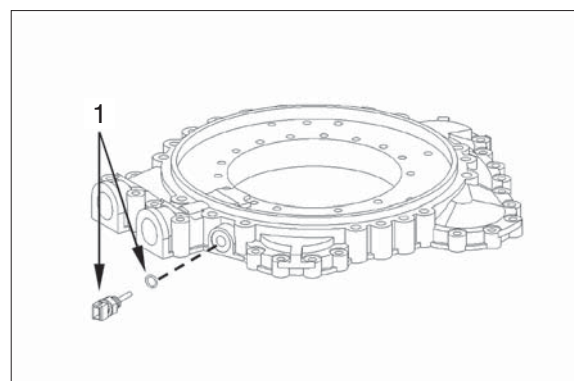
7609ATM347



7609ATM348

- ③ Mount temperature sensor (1) with O-ring 11×2.

· Tightening torque :  
2.55 kgf · m (18.4 lbf · ft)



7609ATM349

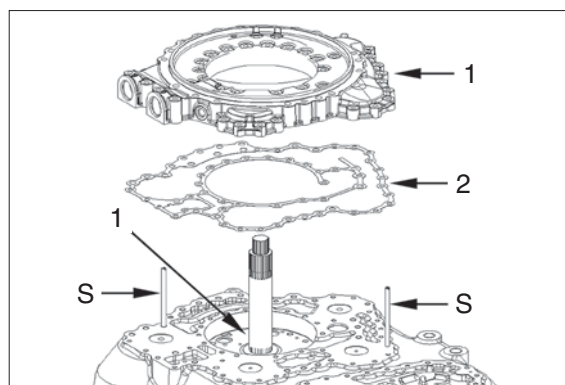
## (2) Oil pressure pump

- ① Insert pressure relief valve (1) into the housing hole until contact is obtained.

Mount two adjusting screws (S) and place gasket (2) and oil feed housing (3).

※ Use assembly grease.

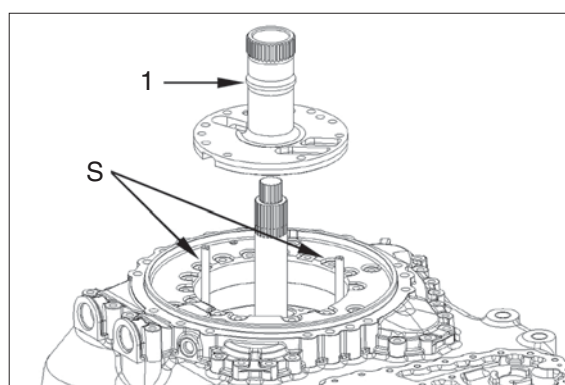
Adjusting screws (M8) 5870 204 011



- ② Install two adjusting screws (S) and mount stator shaft (1).

※ Pay attention to radial installation position.

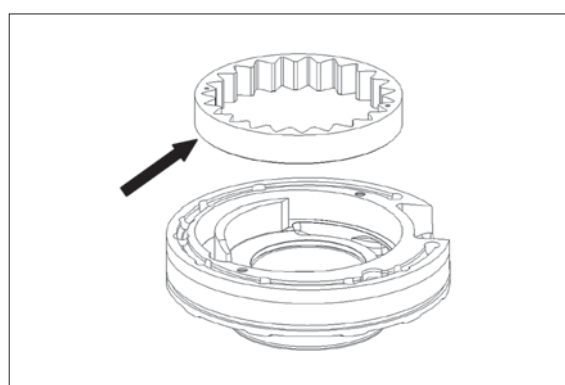
Adjusting screws (M10) 5870 204 007



※ In case of wear marks in the pump housing or on the control disk, the pump assy must be replaced.

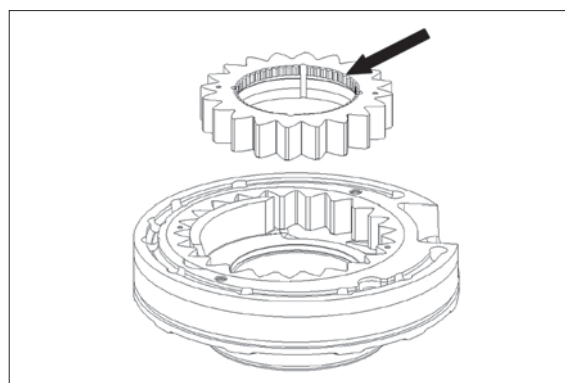
- ③ Install outer rotor.

※ Chamfer (see arrow) to show downwards.



- ④ Install inner rotor.

※ Teeth (see arrow) to show upwards.

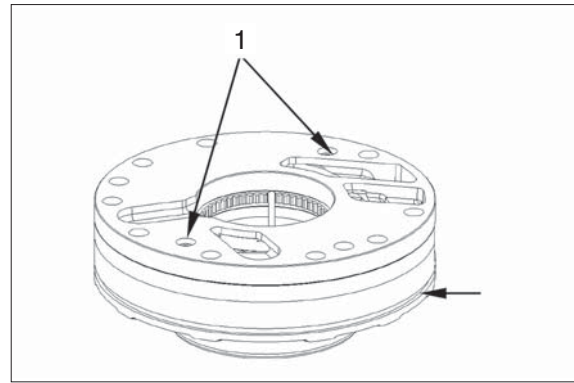




- ⑤ Place control disk and fix it radially by means of two cylindrical screws M6×12 (1).

- ※ Do not tighten the cylindrical screws - just turn them in until contact is obtained and then turn them back by approx. 1/2 rotation.
- ※ Pay attention to the installation position of the control disk, see figure.

Place O-ring 182×3 (2) into the annular groove and oil it.

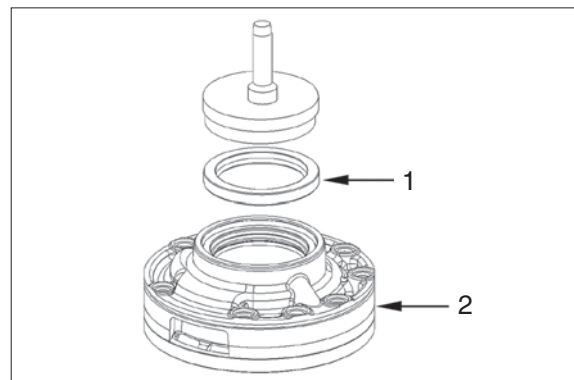


7609ATM354

- ⑥ With the sealing lip showing downwards, carefully insert the shaft seal 75×905×10 (1) into the pump housing (2) until contact is obtained.

- ※ Wet outer diameter of shaft seal with spirit.

Driver	5870 055 070
Handle	5870 260 002



7609ATM355

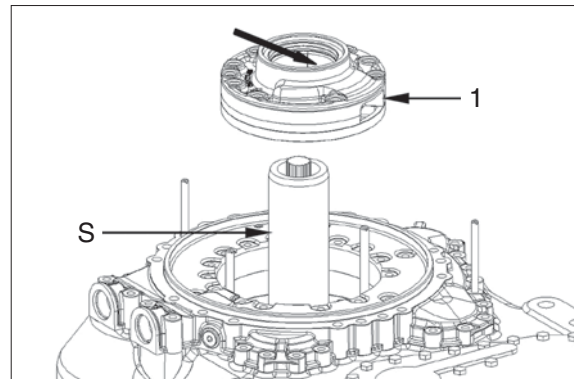
- ※ Oil sliding bearing (see arrow) before the assembly.

- ⑦ Mount inner installer (S) onto the stator shaft.

Mount preassembled transmission pump (1).

- ※ Pay attention to radial installation position.

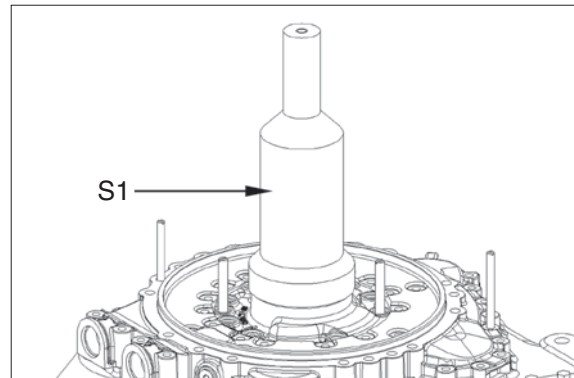
Inner installer                      see figure TM357



7609ATM356

- ⑧ Mount preassembled pump with driver (S1) until contact is obtained.

Assembly fixture (S + S1) 5870 345 126  
(Inner installer and driver)



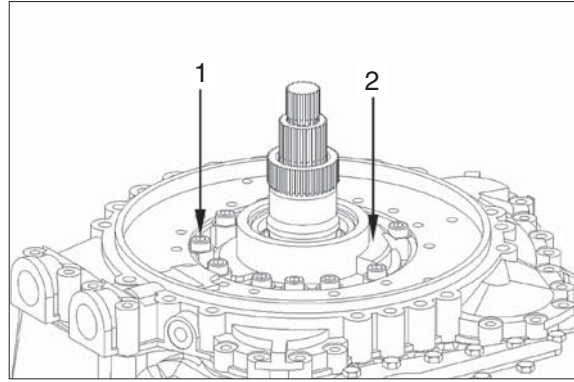
7609ATM357

- ⑨ Fit O-rings  $9.5 \times 1.6$  to the cylindrical screws  $10 \times 75$ .

※ Grease O-rings.

Fix transmission pump (2) by means of cylindrical screws (1).

- Tightening torque ( $10/8.8 \times 75$ ) :  
4.69 kgf · m (33.9 lbf · ft)



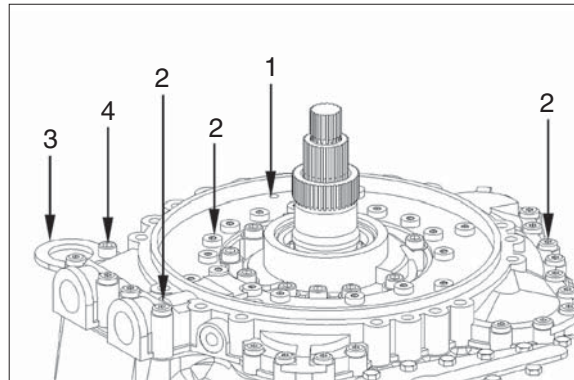
7609ATM358

- ⑩ Fix oil feed housing (1) equally by means of Torx screws (2).

- Tightening torque ( $M8/10.9 \times 30$ ) :  
2.35 kgf · m (17.0 lbf · ft)
- Tightening torque ( $M8/10.9 \times 45$ ) :  
2.35 kgf · m (17.0 lbf · ft)
- Tightening torque ( $M8/10.9 \times 60$ ) :  
2.35 kgf · m (17.0 lbf · ft)

Fasten fixing plate (3) by means of cylindrical screws (4).

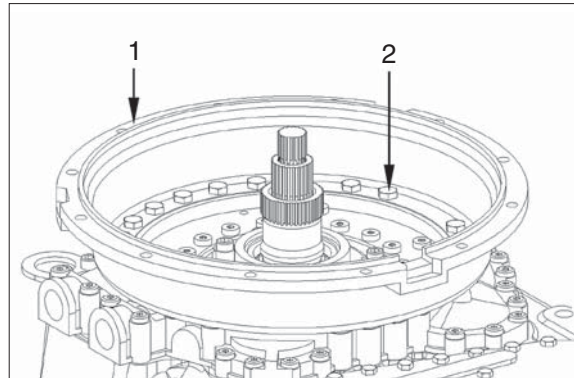
- Tightening torque ( $M8/8.8 \times 40$ ) :  
3.47 kgf · m (25.1 lbf · ft)



7609ATM359

- ⑪ Fix converter bell housing (1) by means of hexagon screws (2).

- Tightening torque ( $M10/10.9 \times 65$ ) :  
6.63 kgf · m (47.9 lbf · ft)

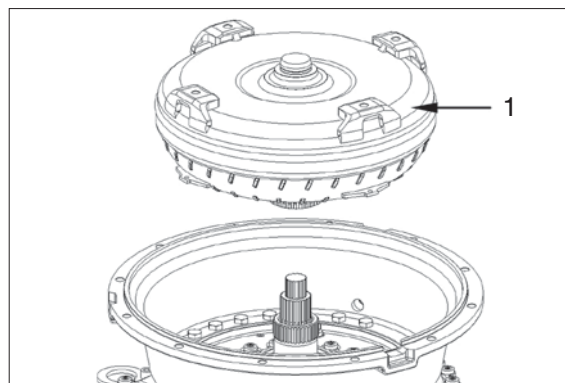


7609ATM360



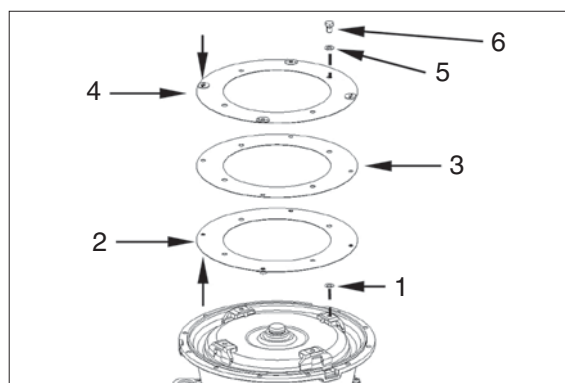
### (3) Engine connection (direct mount)

- ① Position converter (1) by means of lifting device until contact is obtained.



7609ATM361

- ② Position 1 washer/each / thickness = 1.0 mm (4EA) (1) onto the flex plate mounting webs (4EA).  
Place flex plates (2, 3 and 4).



7609ATM362

- ※ Pay attention to the installation position.
- Spot-welded reinforcing rings with thread of the flex plate (2) to be arranged towards the outside - see arrows.
  - Spot-welded reinforcing disks of the flex plate (3) to be arranged towards the outside - see arrows.

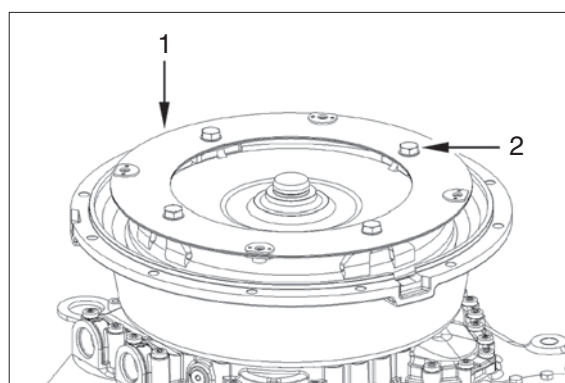
Mount washer (5) onto the hexagon screw M12×18 (6) and fix flex plate.

- ※ Wet threads of hexagon screws with loctite (type No. 262).

- ③ Fix flex plate (1) by means of hexagon screws (2).

- ※ Secure hexagon screws with loctite (type No. 262).

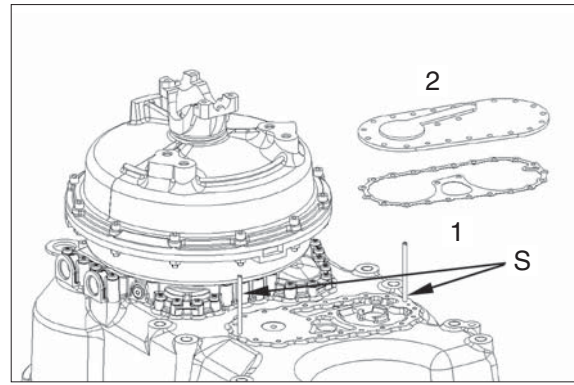
- Tightening torque (M12/10.9×18) :  
11.7 kgf · m (84.8 lbf · ft)



7609ATM363

## 12) REASSEMBLY - without emergency steering

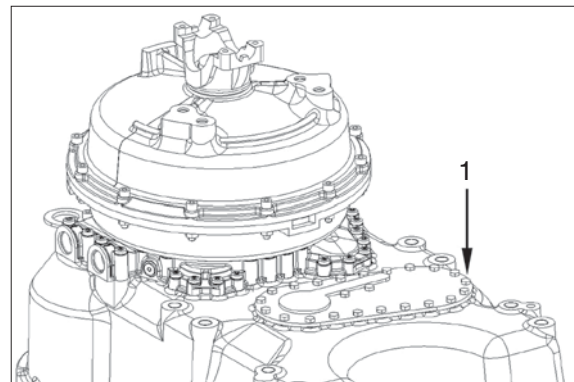
- (1) Fit adjusting screws (S) and assemble seal (1) and cover (2).



7609ATM364

- (2) Fix cover by means of hexagon screws (1).

- Tightening torque (M8/8.8×18) :  
2.35 kgf · m (17.0 lbf · ft)



7609ATM365

### 13) REASSEMBLY

#### Inductive sensor, Hall sensor, breather, oil filler and oil drain plug

- (1) Mount inductive sensors (1, 2 and 3) with O-rings 15×2.

- 1 Inductive sensor - turbine speed
- 2 Inductive sensor - speed/central gear chain
- 3 Inductive sensor - engine speed

· Tightening torque :  
3.06 kgf · m (22.1 lbf · ft)

Mount breather (4).

· Tightening torque :  
1.22 kgf · m (8.85 lbf · ft)

Mount speed sensor (5) with O-ring 15.54 × 2.62 and fix it by means of cylindrical screw (6).

- 1 speed sensor (hall sensor) -  
output speed

· Tightening torque (M8/8.8×16) :  
2.35 kgf · m (17.0 lbf · ft)

Mount screw plug M26×1.5 (7) with O-ring 23×2.

· Tightening torque (M8/8.8×16) :  
8.16 kgf · m (59.0 lbf · ft)

Bring cover (8) with seal into contact position with the housing front part and fix it by means of hexagon screws (9).

· Tightening torque (M8/8.8×18) :  
2.35 kgf · m (17.0 lbf · ft)

- (2) Mount oil drain plug with O-ring 35×2 (1).

· Tightening torque (M38×1.5) :  
8.16 kgf · m (59.0 lbf · ft)

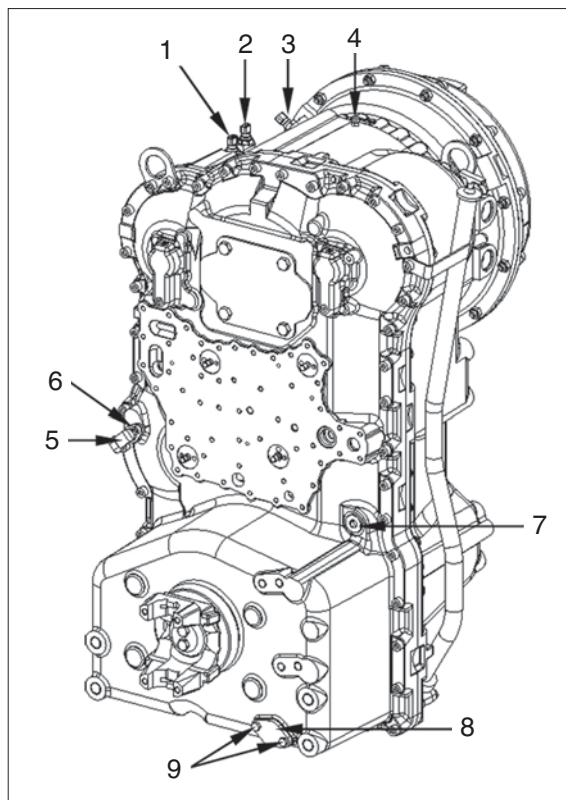
Bring oil level tube (2) with seal into contact position with the housing front part and fix it by means of hexagon screws (3).

· Tightening torque (M8/8.8×50) :  
3.47 kgf · m (25.1 lbf · ft)

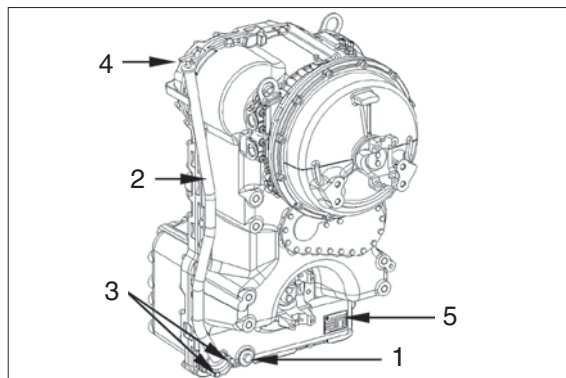
Fasten dipstick (4) in oil level tube.

Fix identification plate (5) to the housing front part.

※ Use loctite (type No. MS 9360).



7609ATM366

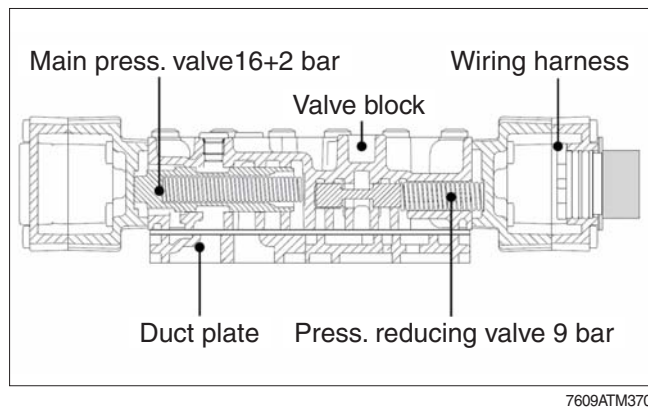
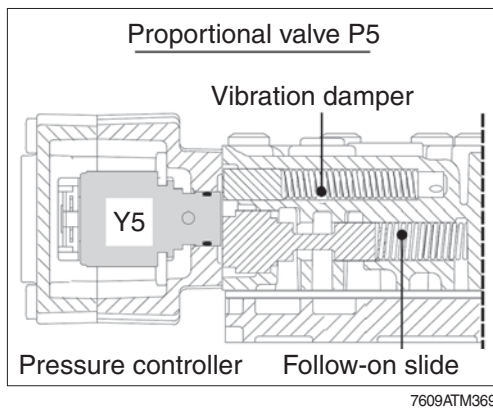
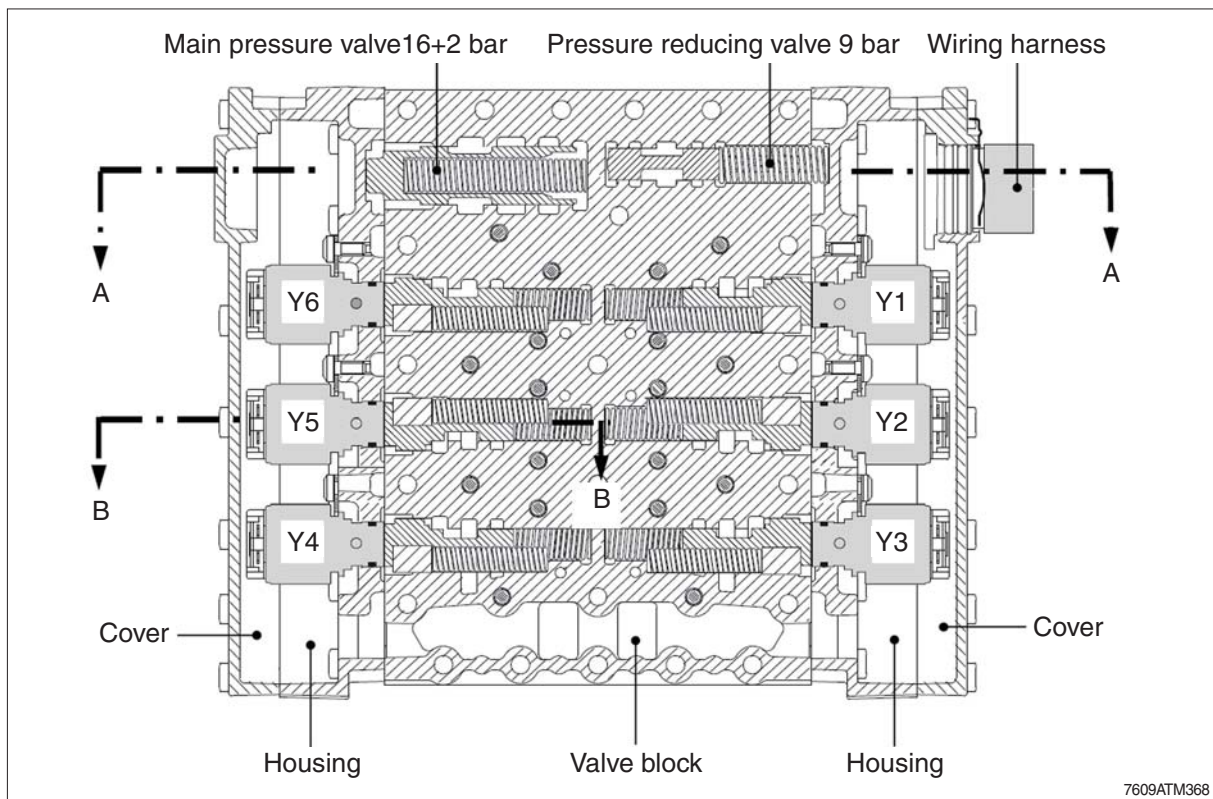


7609ATM367

## 14) REASSEMBLY

### Electro-hydraulic control with proportional valves :

※ The following sketches show the sectional views of the electro-hydraulic control.

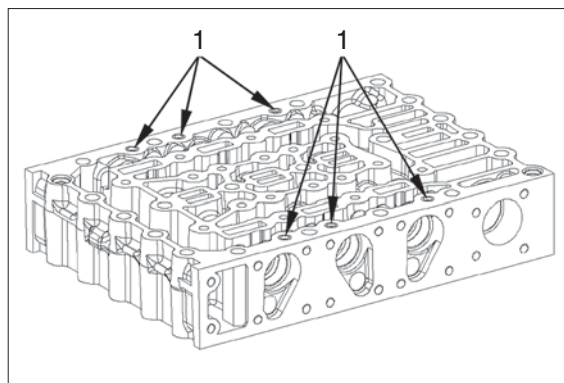


## (1) Fitting of electric control

- ※ All single parts are to be checked for damage and replaced, if required.  
Ensure free travel of the moving parts in the valve block prior to installation.  
Pistons can be exchanged individually.  
Prior to the installation, oil single parts.

① With the concave side showing upwards, insert orifice (1) until contact is obtained.

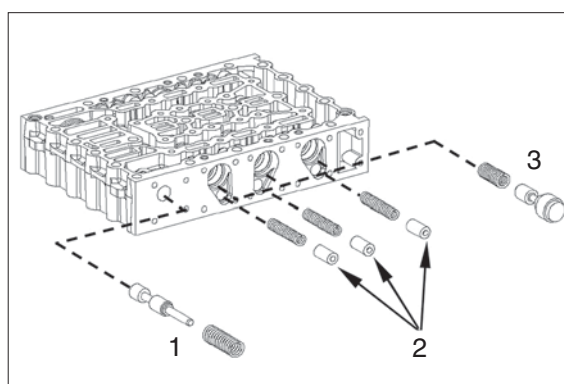
- ※ See arrows for installation position.



7609ATM371

② The opposite figure shows the following single parts :

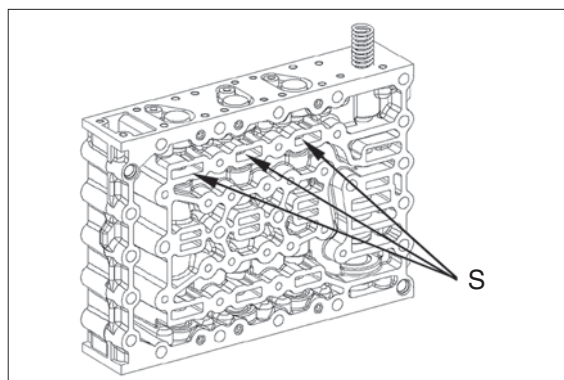
- 1 Pressure reducing valve  
(1EA, piston and compr. spring)
- 2 Vibration damper  
(3EA, piston and compr. spring)
- 3 Follow-on slide  
(3EA, piston and compr. spring)



7609ATM372

③ Install the single parts according to figure TM372.

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

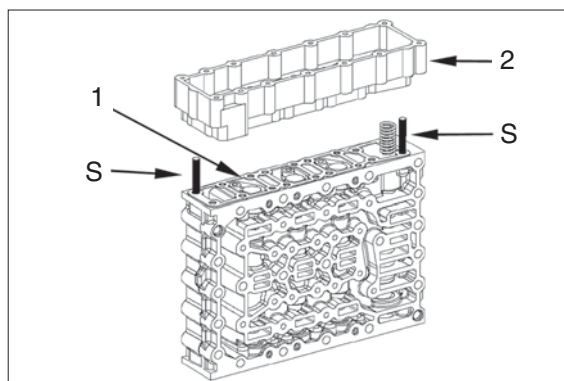


7609ATM373

④ Fit two adjusting screws.

Mount seal (1) and housing (2).  
Then position housing equally by means of adjusting screws until contact is obtained.

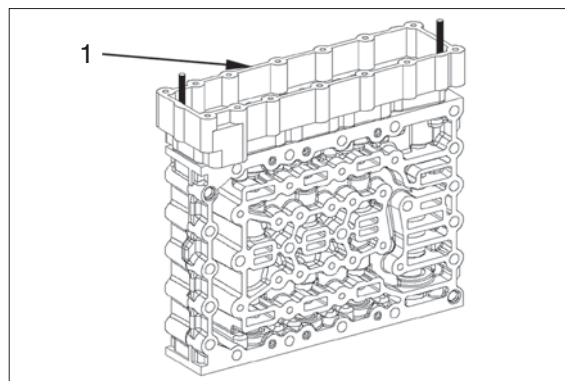
Adjusting screws 5870 204 036



7609ATM374



- ⑤ Bring housing (1) into contact position by means of the Torx screws. This will preload the pistons, and you can remove the cylindrical pins (assembly aid).

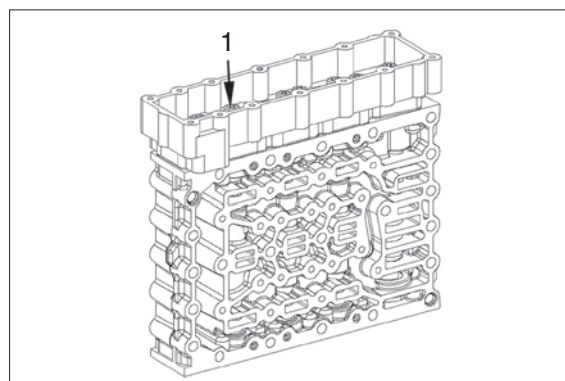


7609ATM375

- ⑥ Fix housing by means of Torx screws (1).

· Tightening torque (M5/10.9 × 30) :  
0.56 kgf · m (4.06 lbf · ft)

Reducing adapter                    5870 656 056  
Socket wrench TX-27            5873 042 002



7609ATM376

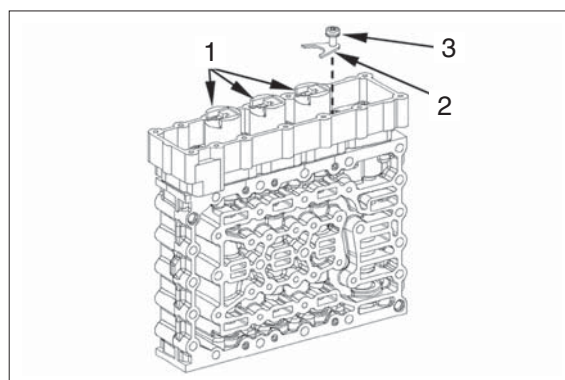
- ⑦ Mount pressure controllers with O-ring 13.5 × 2 (1) and fasten them by means of fixing plates (2) and Torx screws (3).

※ Install fixing plate, with the claw showing downwards.

Pay attention to the radial installation position of pressure controllers, see figure.

· Tightening torque (M5/8.8 × 12) :  
0.56 kgf · m (4.06 lbf · ft)

Reducing adapter                    5870 656 056  
Socket wrench TX-27            5873 042 002

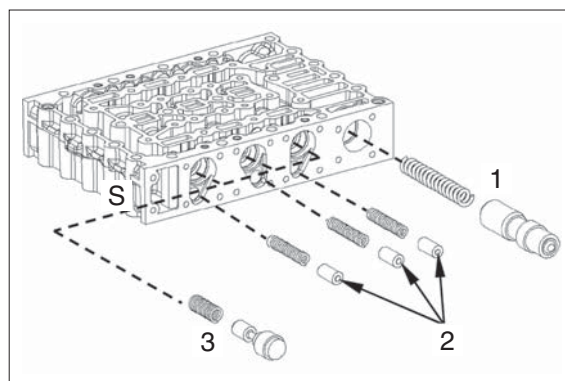


7609ATM377

### Preassemble the opposite side

- ⑧ The figure on the right shows the following single parts :

- 1 Main pressure valve  
(1EA, Piston a. compr.spring)
- 2 Vibration damper  
(3EA, Piston a. compr.spring)
- 3 Follow-on slide  
(3EA, Piston a. compr.spring)



7609ATM378

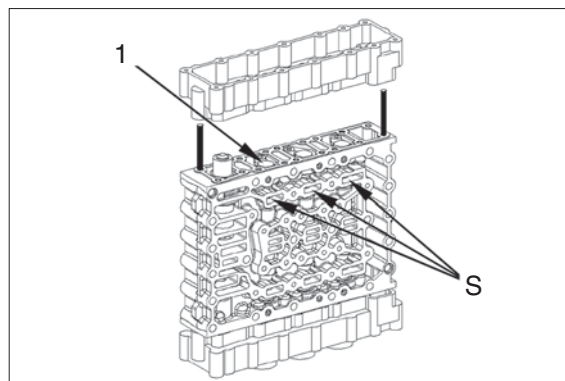
- ⑨ Install the single parts according to figure TM378.

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

Install two adjusting screws.

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.



7609ATM379

- ⑩ Preload the pistons with Torx screws and remove the cyl. pins (assembly aid) again.

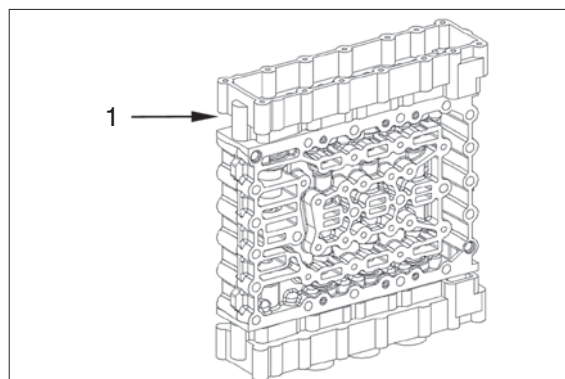
Then fasten the housing cover by means of Torx screws (1).

· Tightening torque (M5/10.9  $\times$  30) :  
0.56 kgf  $\cdot$  m (4.06 lbf  $\cdot$  ft)

Adjusting screws      5870 204 036

Reducer      5870 656 056

Socket spanner TX-27      5873 042 002



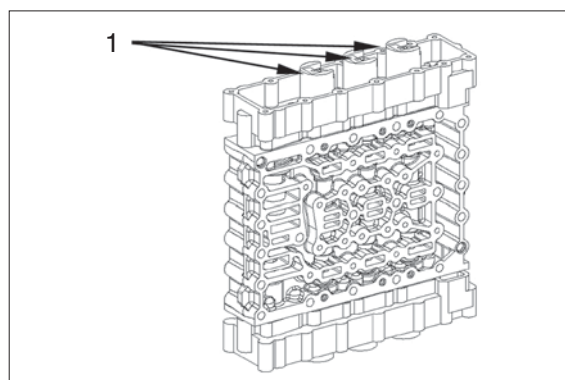
7609ATM380

- ⑪ Mount the pressure regulators with O-ring 13.5  $\times$  2 (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, see figure.

· Tightening torque (M5/8.8  $\times$  12) :  
0.56 kgf  $\cdot$  m (4.06 lbf  $\cdot$  ft)

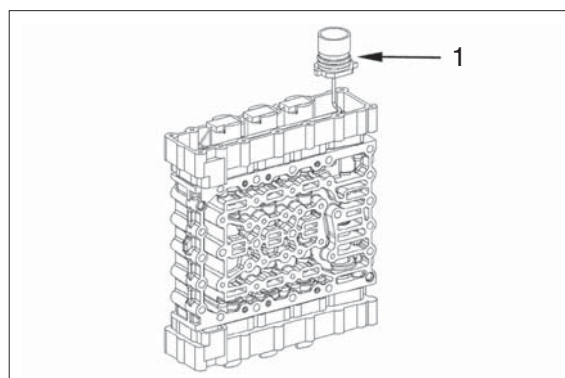


7609ATM381

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

※ See figure TM368 for installation position of pressure regulators.

※ Pay attention to the installation position of the wiring harness, also see markings (figure TM009).



7609ATM382

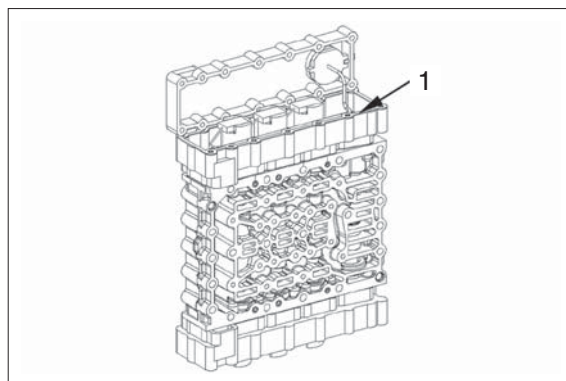
⑬ Put on the flat gasket (1).

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 (M5/10.9×30) :  
0.56 kgf · m (4.06 lbf · ft)

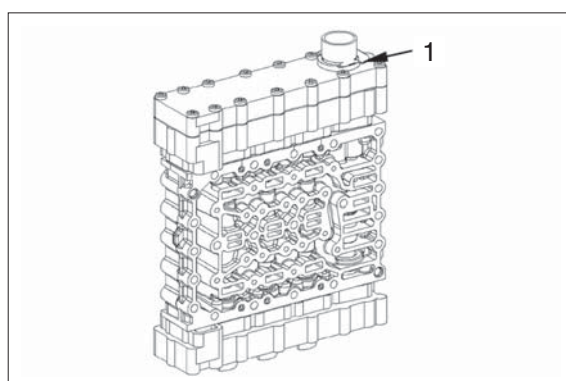
Reducer 5870 656 056  
Socket spanner TX-27 5873 042 002



7609ATM383

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

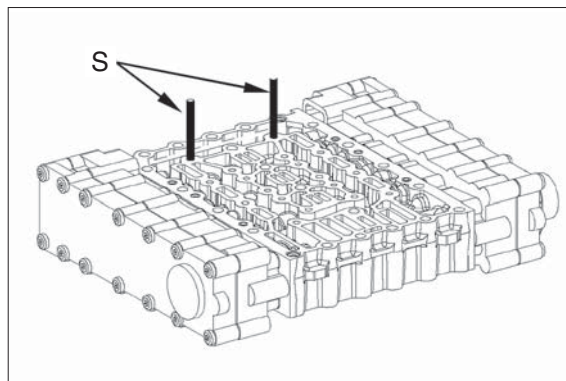
- ※ Install the opposite cover.
- ※ Lock-up clutch solenoid valve, see figure TM396~TM397 (5-speed T/M).



7609ATM384

⑮ Install two adjusting screws.

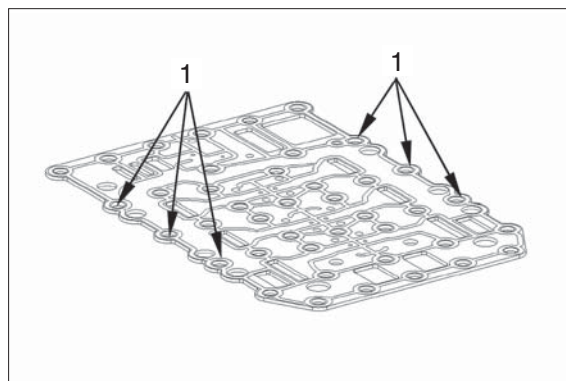
Adjusting screws 5870 204 063



7609ATM385

⑯ Flush-mount screens (1) into the holes of the sealing plate, see arrows.

- ※ Pay attention to the installation position - screens to show upwards (towards the duct plate).



7609ATM386

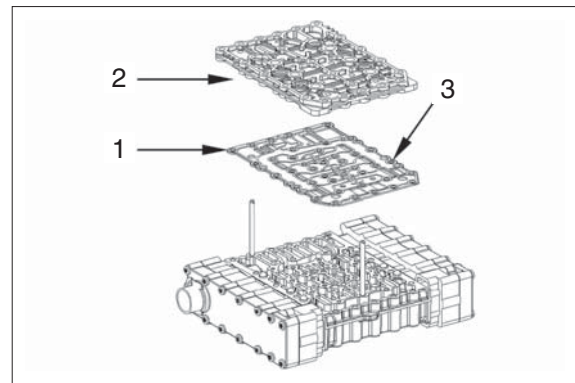


- ⑰ Put on sealing plate (1) and duct plate (2).

※ Screens (3) to show upwards.

※ It is not permitted to reassemble the seal plate after opening the threaded joint shift unit/duct plate.

In case of repair it is always necessary to mount a new seal plate.

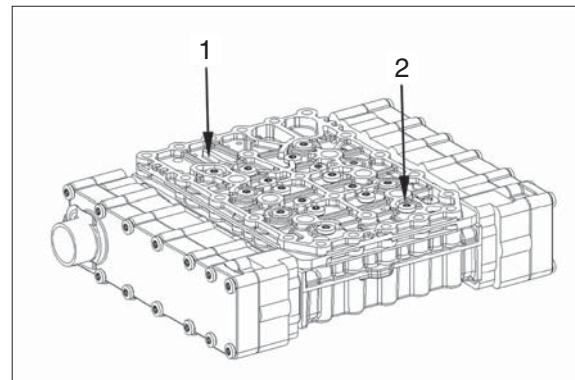


7609ATM387

- ⑱ Place duct plate (1) and fix it equally by means of Torx screws (2).

· Tightening torque (M6/10.9×23) :  
1.07 kgf · m (7.74 lbf · ft)

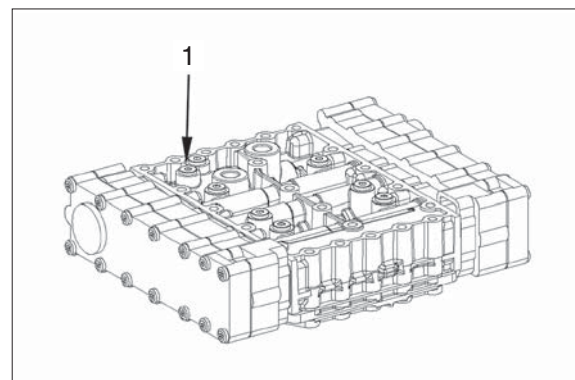
Socket wrench TX-27      5873 042 002



7609ATM388

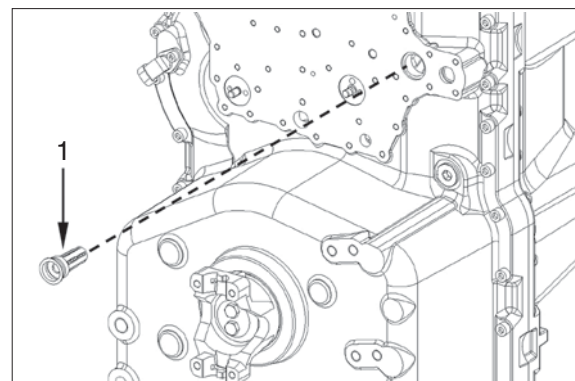
- ⑲ Provide the screw plugs M10×1 with O-rings 8×1.5 (1) and install them.

· Tightening torque :  
0.61 kgf · m (4.43 lbf · ft)



7609ATM389

- ⑳ Insert converter safety valve (1) into the housing hole until contact is obtained.



7609ATM390

㉑ Mount stud bolts (1).

※ Wet screw-in thread with loctite (type No. 243).

· Tightening torque (M8/10.9×25) :  
1.53 kgf · m (11.1 lbf · ft)

Place seal (2) and duct plate (3) at the housing rear part until contact is obtained.

※ Use assembly grease.

㉒ Fix duct plate (1) by means of Torx screws (2) and hexagon nuts (3).

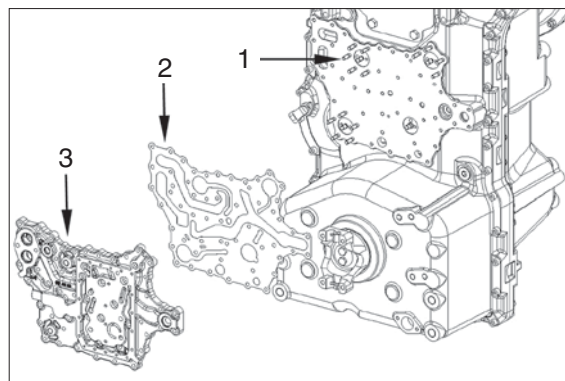
· Tightening torque (M8/10.9×30) :  
2.35 kgf · m (17.0 lbf · ft)

· Tightening torque (M8) :  
2.35 kgf · m (17.0 lbf · ft)

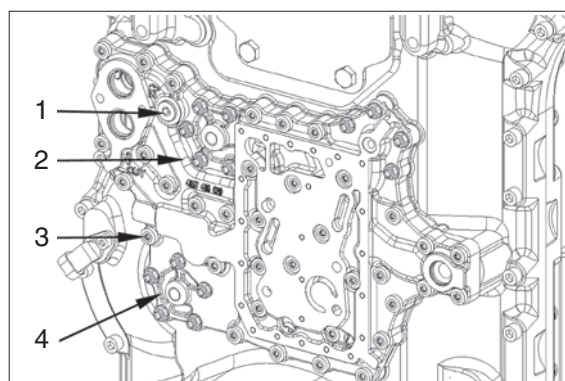
Mount screw plug (4) with new O-ring 13×2.

· Tightening torque (M16×1.5) :  
3.06 kgf · m (22.1 lbf · ft)

Socket wrench TX-40      5873 042 004



7609ATM391

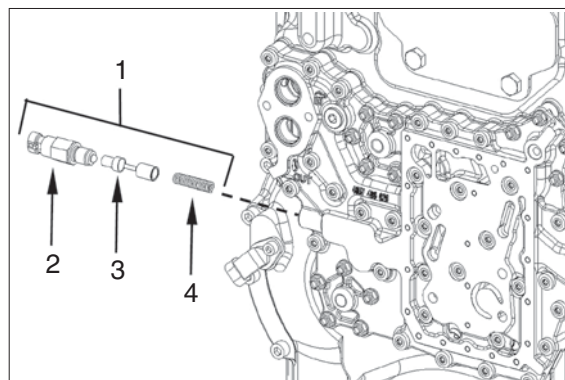


7609ATM392

㉓ Mount compression spring (4), piston (3) and switch (2) with new O-ring 13×2.

- 1 Filter differential pressure valve
- 2 Switch with O-ring
- 3 Piston
- 4 Compression spring

· Tightening torque :  
3.06 kgf · m (22.1 lbf · ft)



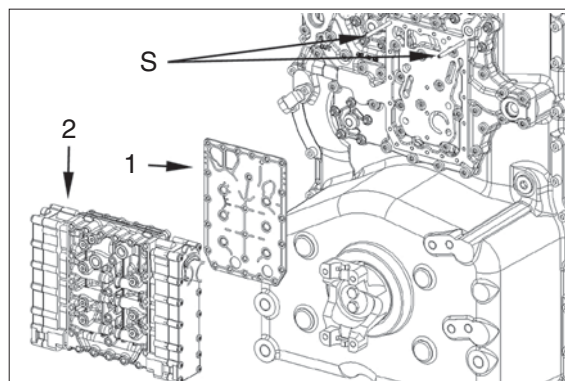
7609ATM393

㉔ Fit two adjusting screws.

Adjusting screws      5870 204 063

Mount sealing plate (1) and electro-hydraulic control unit (2).

※ It is not permitted to reassemble the seal plate after opening the threaded joint shift unit/gearbox housing.  
In case of repair it is always necessary to mount a new seal plate.



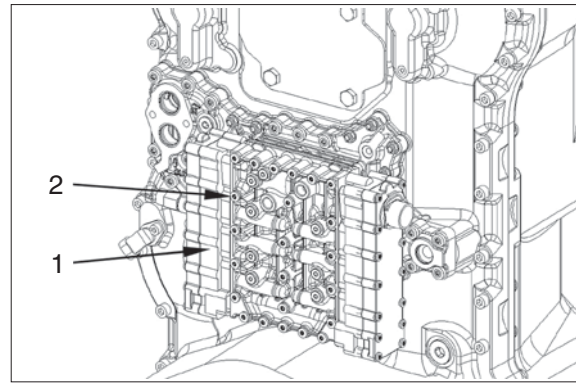
7609ATM394

- ②⑤ Fix electro-hydraulic control unit (1)  
equally by means of Torx screws (2).

· Tightening torque (M6/10.9×76) :  
3.06 kgf · m (22.1 lbf · ft)

Socket wrench TX-27      5873 042 002

Reducing adapter      5870 656 056



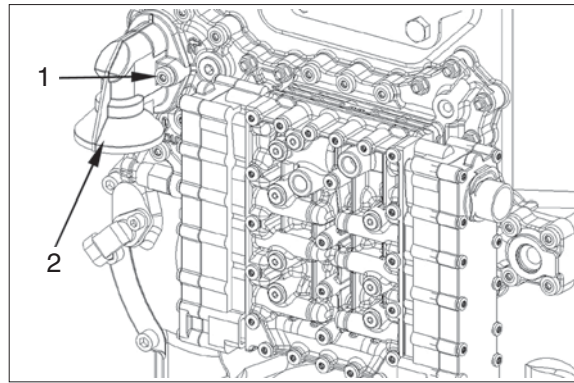
7609ATM395

### (3) Fitting of fine filter (pressure filter)

- ① Fix filter head (1) with new O-rings  $34.2 \times 3$  to the housing rear part by means of Torx screws (2).

· Tightening torque (M8/10.9  $\times$  60) :  
3.47 kgf  $\cdot$  m (25.1 lbf  $\cdot$  ft)

Socket wrench TX-40      5870 042 004

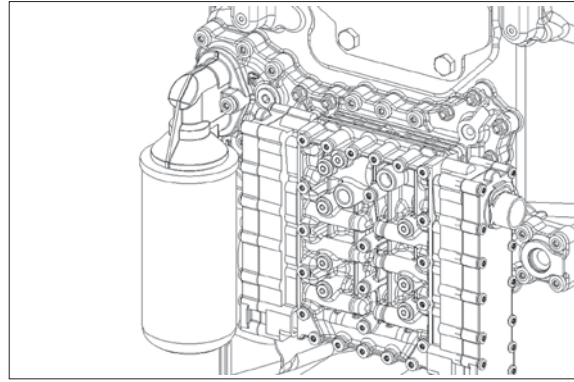


7609ATM400

※ The opposite figure shows the following single parts :

- Slightly oil the seal
- Turn in the filter until contact with the sealing surface is obtained, and then tighten it by hand with approx. 1/3 to 1/2 rotation.

※ Before putting the transmission into operation, fill it with oil according to operation manual.



7609ATM401

## 2. AXLE (FRONT AND REAR)

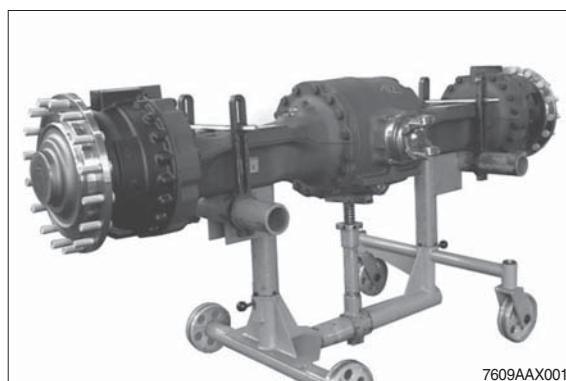
### 1) DISASSEMBLY

#### (1) Disassembly output and brake

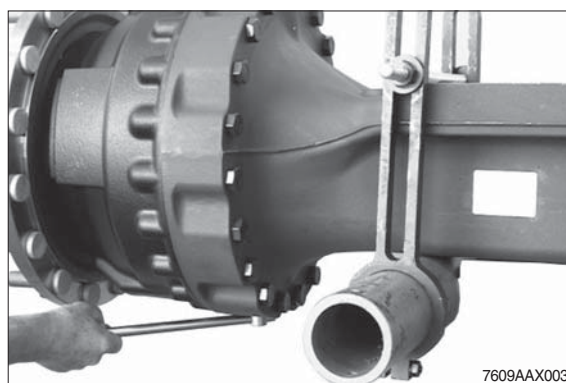
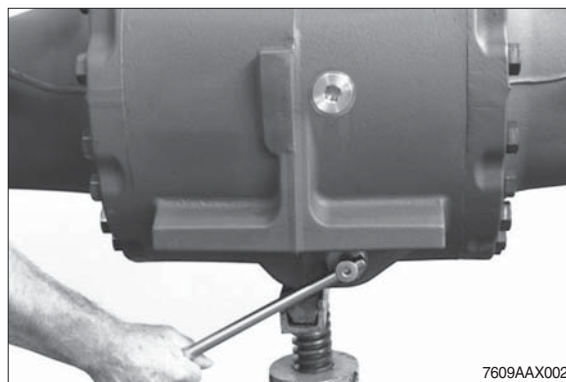
- ① Fix axle to assembly truck.

Assembly truck	5870 350 000
Fixtures	5870 350 077
Clamping brackets	5870 350 075
Support	5870 350 125

- ※ Before clamping the axle fully turn in the support. Position axle first onto the two fixtures, secure with clamping brackets and then unbolt the support until contact with the axle is obtained.



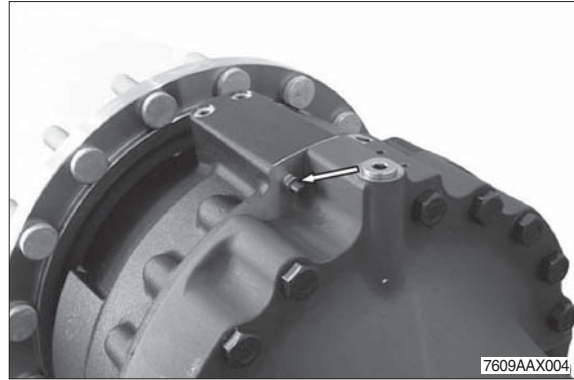
- ② Loosen screw plugs (3EA, see AX002 and AX003) and drain oil from the axle.





③ Remove the breather valve (see arrow).

※ To avoid any damage, the breather valve must be removed when separating the output.

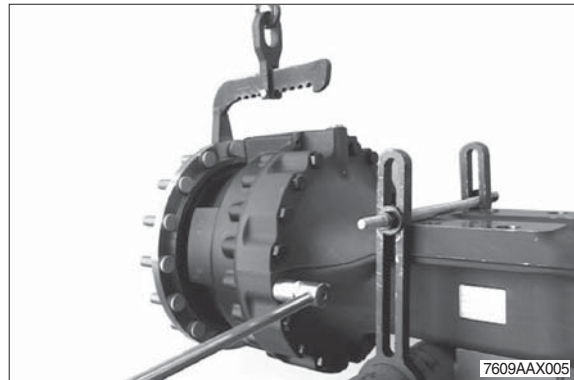


④ Secure the output with the lifting device and loosen hexagon screws.

Then separate the output assy from the axle housing.

Load carrying device      5870 281 043

※ Fix the load carrying device with a wheel nut.



⑤ Pull stub shaft and sun gear shaft.

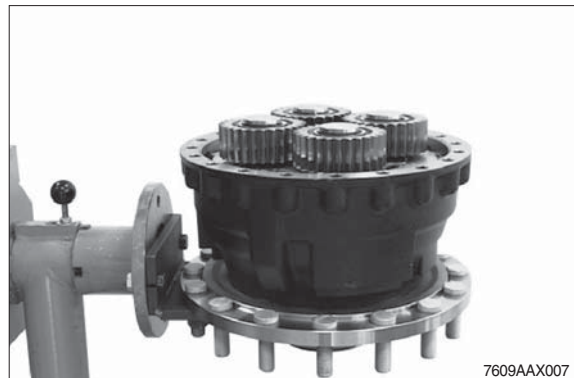
※ Pay attention to potentially releasing shim.



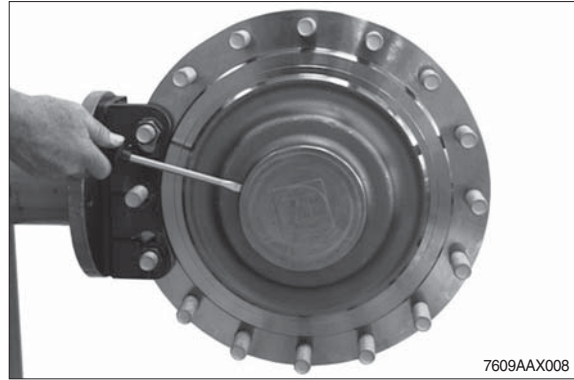
⑥ Fix output to assembly truck.

Assembly truck      5870 350 000

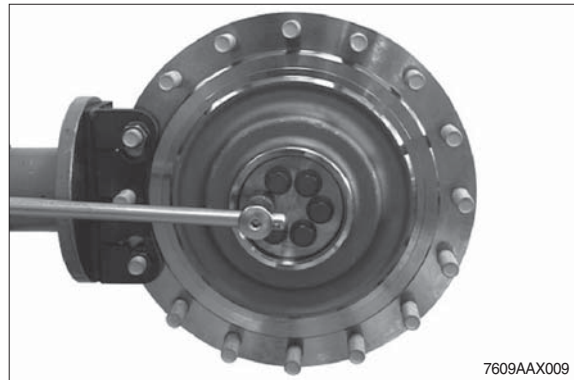
Fixture      5870 350 113



- ⑦ Use a lever to remove the cover from the output shaft.



- ⑧ Loosen locking screws and remove the releasing cover.



- ⑨ Press planetary carrier with a two-armed puller out of the profile of the output shaft.



- ⑩ Lift the planetary carrier out of the brake housing by means of the lifting device.

Rear axle

(planetary carrier with 3 planetary gears)

Inner extractor 5870 300 019

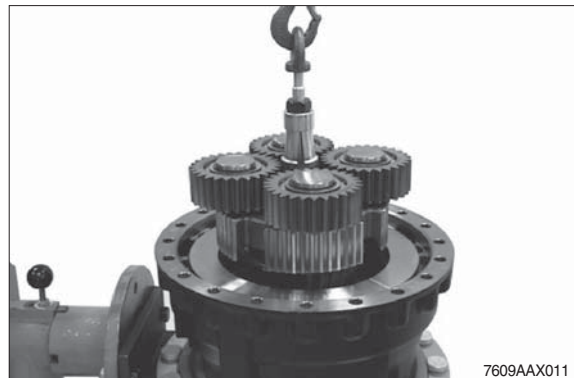
Eye bolt 5870 204 073

Front axle

(planetary carrier with 4 planetary gears)

Inner extractor 5870 300 017

Eye nut 5870 204 076





- ⑪ Pull the tapered roller bearing from the planetary carrier.

Rapid grip	5873 014 016
Basic tool	5873 004 001



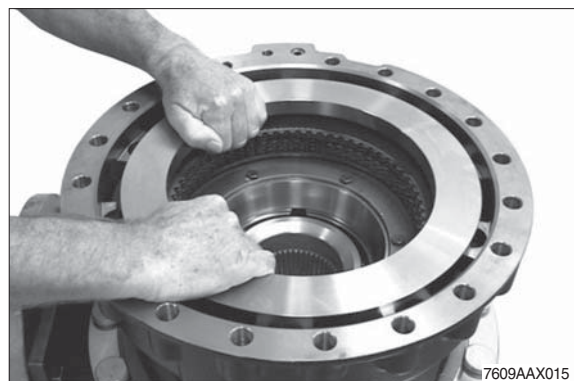
- ⑫ Disengage retaining ring.



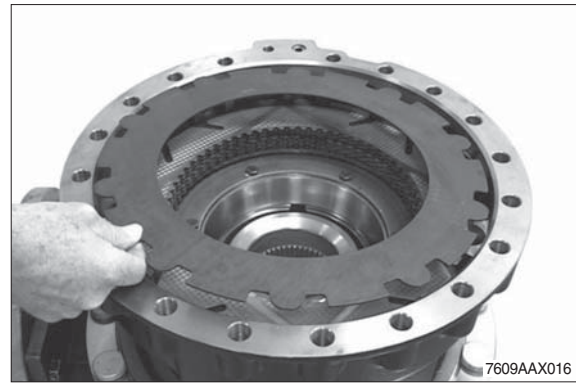
- ⑬ Pull off planetary gear.



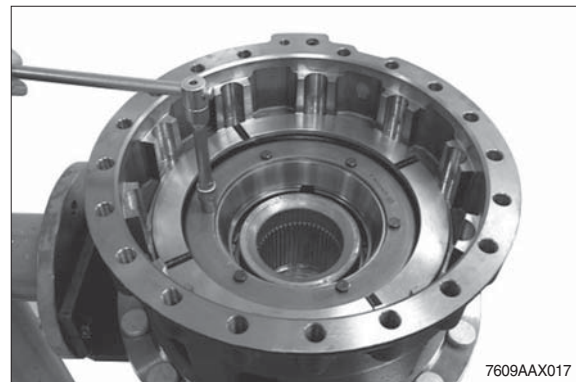
- ⑭ Lift the end plate out of the brake housing.



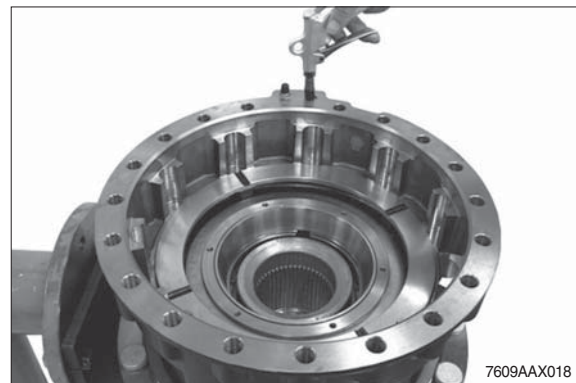
- ⑮ Lift the disk package out of the brake housing.



- ⑯ Loosen hexagon screws, remove releasing cover and cup spring.

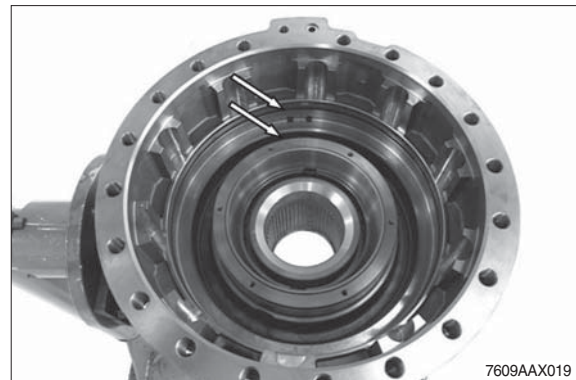


- ⑰ Mount breather valve and press piston out of the brake housing by means of compressed air.

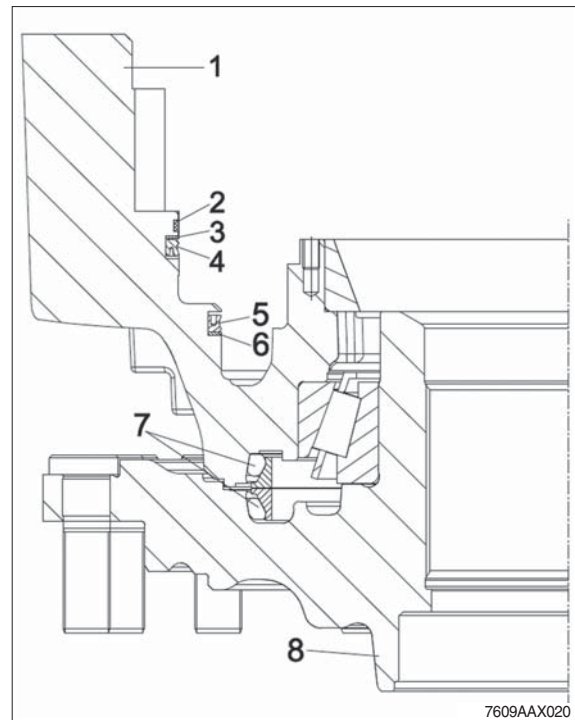


- ⑱ If necessary, remove guide ring, back-up rings and grooved rings out of the annular grooves of the brake housing (see arrows).

※ For the installation position of the single parts please also refer to the following sketch.



- 1 Brake housing
- 2 Guide ring
- 3 Back-up ring
- 4 Grooved ring
- 5 Grooved ring
- 6 Back-up ring
- 7 Slide ring seal
- 8 Output shaft



- ①⑨ Lift the brake housing from the output shaft by means of the lifting device.



- ②⑩ Use a lever to remove the slide ring seal from the brake housing.

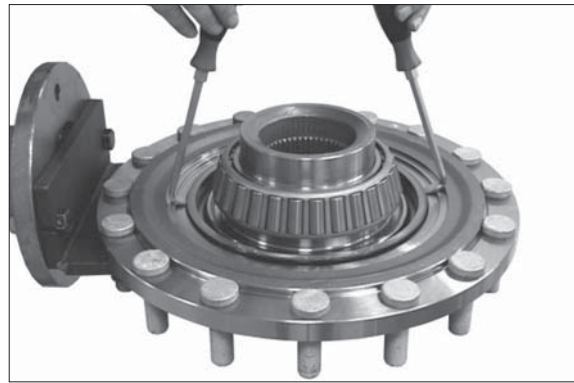
If necessary, force out both bearing outer rings.

Resetting device                      5870 400 001



- ② Use a lever to remove the slide ring seal from the output shaft.

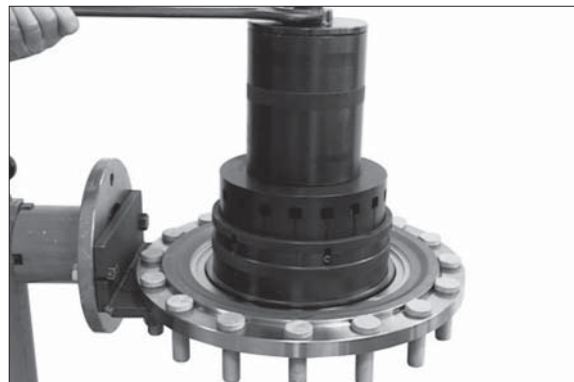
Resetting device                      5870 400 001



7609AAX023

- ② Pull the tapered roller bearing from the output shaft.

Rapid grip                              5873 014 013  
Basic tool                                5873 004 001



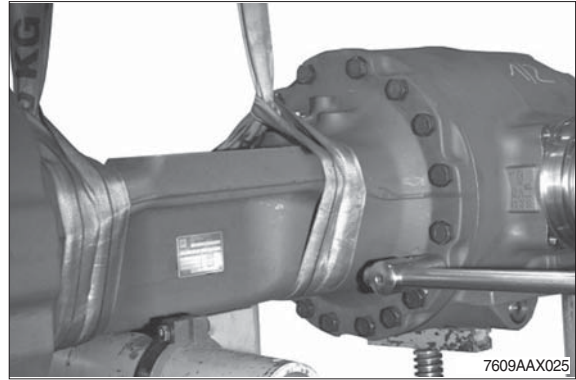
7609AAX024

## (2) Disassembly axle housing

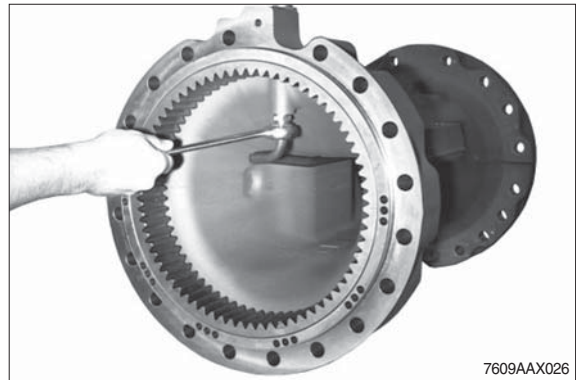
- ① Secure axle housing with the lifting device and loosen the hexagon screws.

Then separate the axle housing from the axle drive housing.

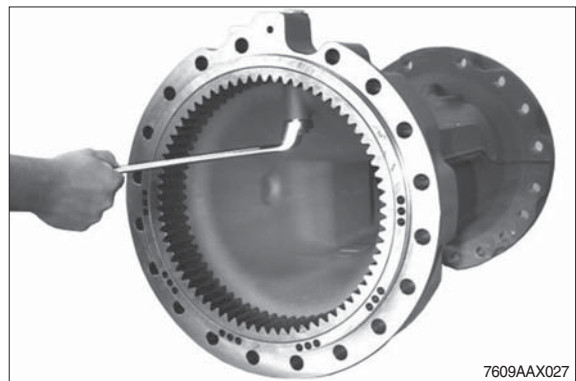
※ Pay attention to releasing differential.



- ② Loosen the threaded connections and remove the releasing brake tube.

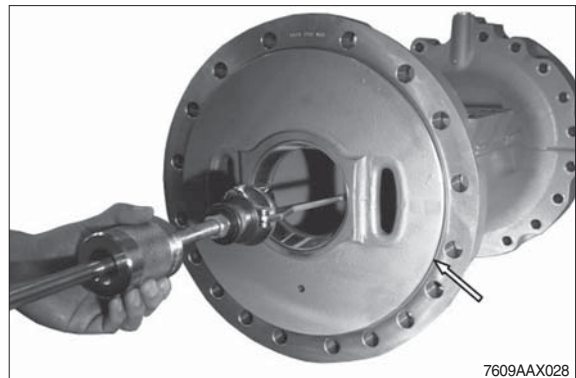


- ③ Loosen screw neck.



- ④ Pull the bearing outer ring out of the bearing hole and remove the shim behind.

Then remove the O-ring (see arrow).



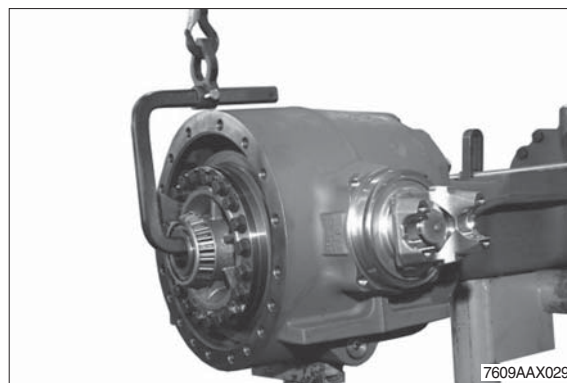


### (3) Disassembly input

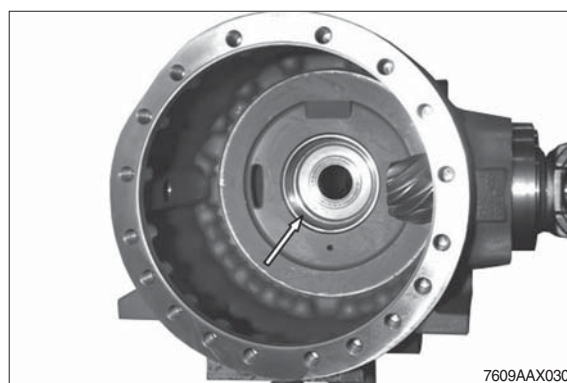
- ① Use the lifting device to lift the differential out of the axle drive housing.

Load carrying fixture      5870 281 083

- ※ Disassembly of the differential is described as of page 3-213.

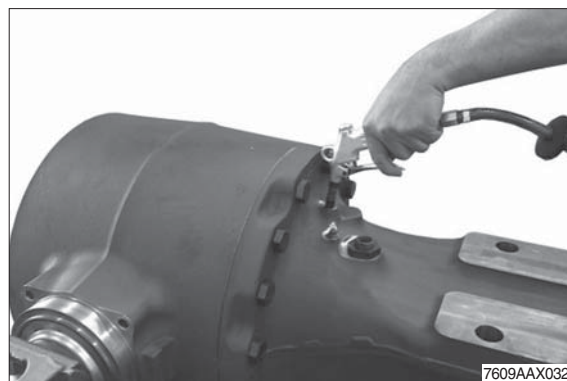
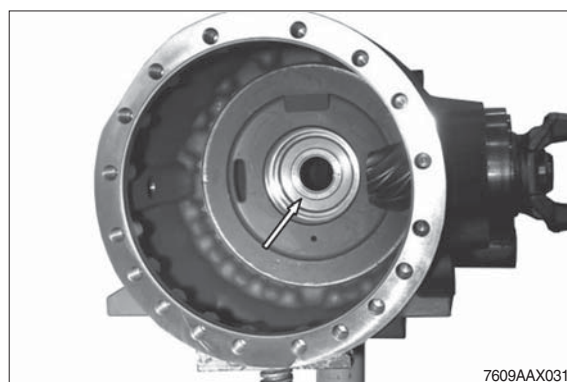


- ② Pull the bearing outer ring (see arrow) out of the housing hole and remove the shim behind.



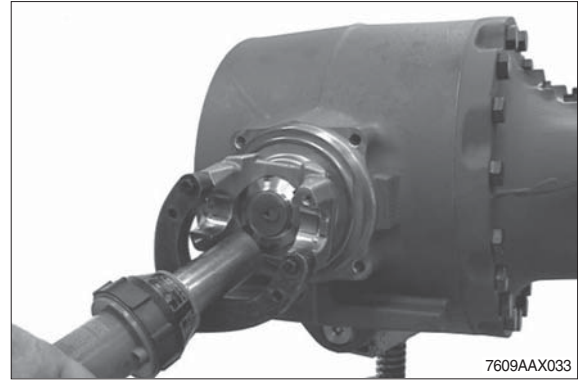
- ③ Press piston (see arrow) out of the axle housing (see subsequent figure) by means of compressed air.

- ※ This operation is only necessary for the hydraulic lock differential (option).



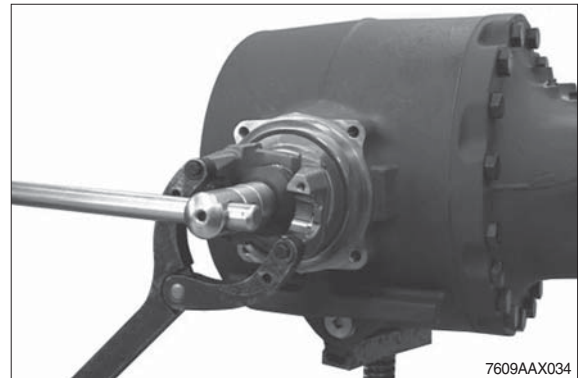
- ④ Heat slotted nut by means of hot air blower.

※ Slotted nut is secured with loctite (type No. : 262).

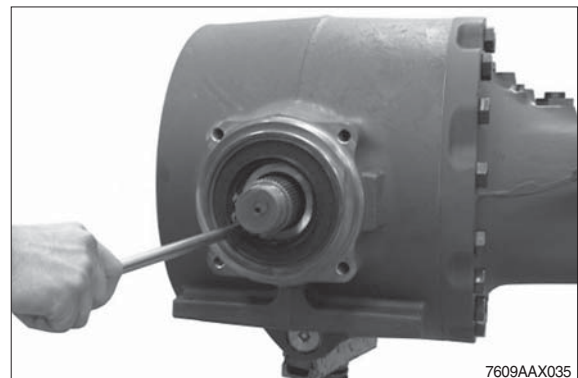


- ⑤ Loosen slotted nut and remove the shim behind.

Slotted nut wrench	5870 401 139
Clamping device	5870 240 002



- ⑥ Pull the input flange from the input pinion and use a lever to remove the shaft seal behind from the axle drive housing.



- ⑦ Press input pinion from the axle drive housing and remove the releasing tapered roller bearing.

Extractor	5870 000 065
Hexagon screw (2EA)	AA00 331 360

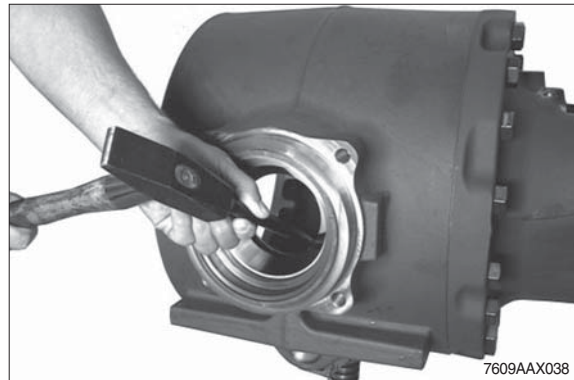


- ⑧ Remove spacer ring and pull the tapered roller bearing from the input pinion.

Gripping device	AA00 684 425
Basic tool	5873 002 000



- ⑨ If necessary, force both bearing outer rings out of the axle drive housing.





#### (4) Disassembly differentials

##### Disassembly hydraulic lock differential (option)

- ① Remove axial roller cage (arrow).



- ② Pull both tapered roller bearings from the differential.

##### **Crown wheel side**

Grab sleeve 5873 012 016

Basic tool 5873 002 001

##### **Opposite side**

Grab sleeve 5873 003 029

Basic tool 5873 002 001

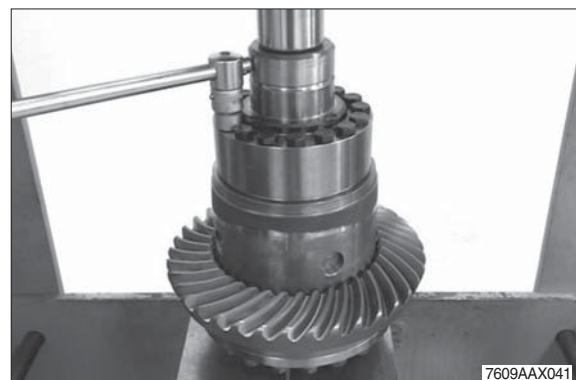
Reduction 5873 003 011

Pressure piece 5870 100 075



- ③ Preload the differential by means of the press, loosen the hexagon screws and remove the releasing housing cover.

Pressure piece 5870 100 075



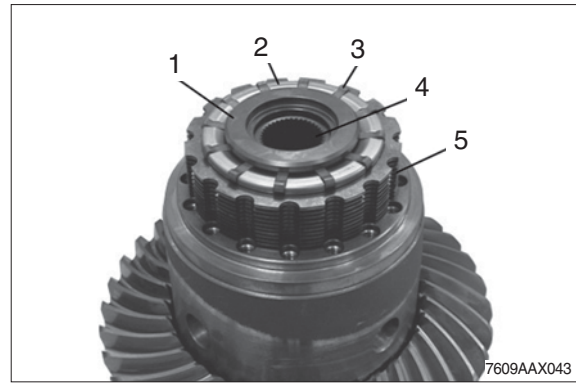
- ④ Preload the housing cover/compression spring by means of the press and disengage the retaining ring.

Then remove sliding sleeve and compression spring from the housing cover.

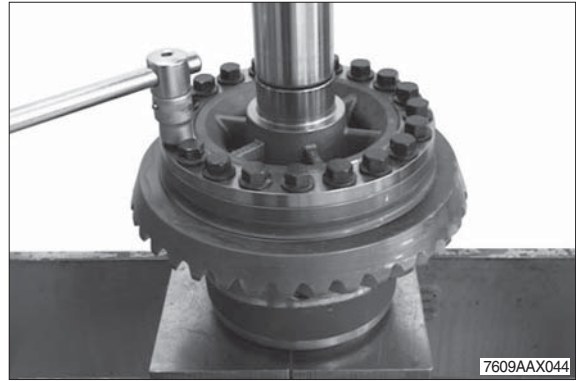


⑤ Remove single parts.

- 1 Pressure piece
- 2 Cage
- 3 Lever (12EA)
- 4 Disk carrier
- 5 Disk package



⑥ Preload differential by means of the press, loosen locking screws and housing cover.



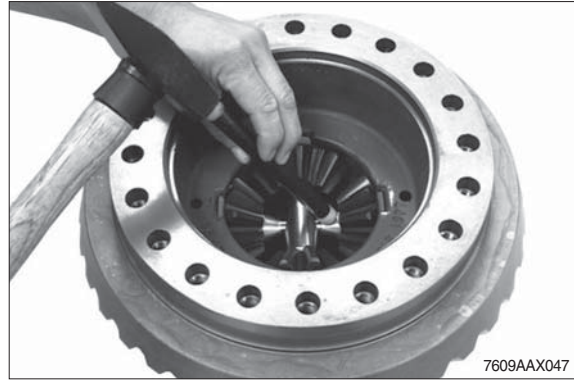
⑦ Remove axle bevel gear with thrust washers from the differential housing.



⑧ Force out both slotted pins.



- ⑨ Force out both differential axles (short) and remove the releasing spider gears with thrust washers from the differential housing.



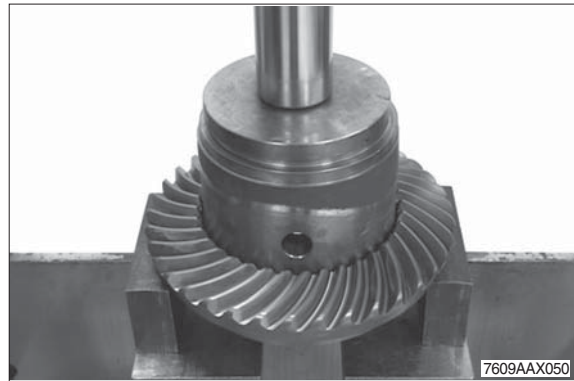
- ⑩ Pull the differential axle (long) and remove the releasing spider gears with thrust washers from the differential housing.



- ⑪ Remove the axle bevel gear and the shim behind.



- ⑫ Press crown wheel from the differential carrier.



### Disassembly conventional differential (if equipped)

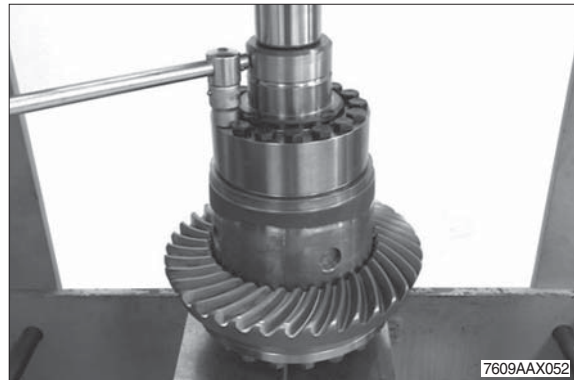
- ① Pull both tapered roller bearings from the differential.

Grab sleeve 5873 012 016

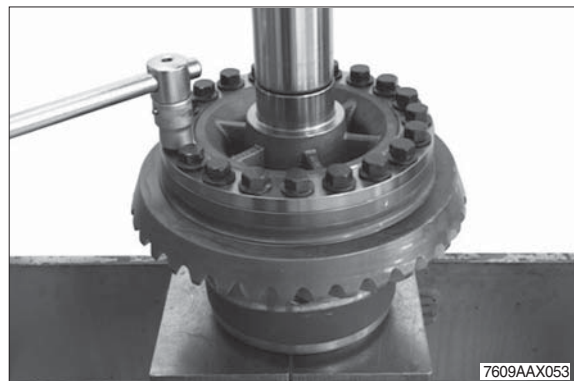
Basic tool 5873 002 001



- ② Preload the differential by means of the press, loosen the hexagon screws and remove the releasing housing cover.



- ③ Preload the differential by means of the press, loosen locking screws and housing cover.



- ④ Remove axle bevel gear with thrust washers from the differential housing.



- ⑤ Force out both slotted pins.



- ⑥ Force out both differential axles (short) and remove the releasing spider gears with thrust washers from the differential housing.



- ⑦ Pull the differential axle (long) and remove the releasing spider gears with thrust washers from the differential housing.

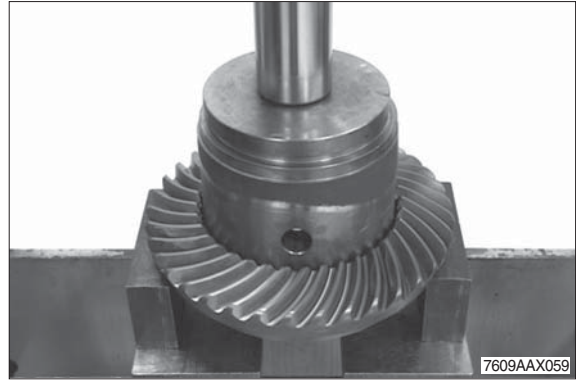


- ⑧ Remove the axle bevel gear and the shim behind.





- ⑨ Press crown wheel from the differential carrier.



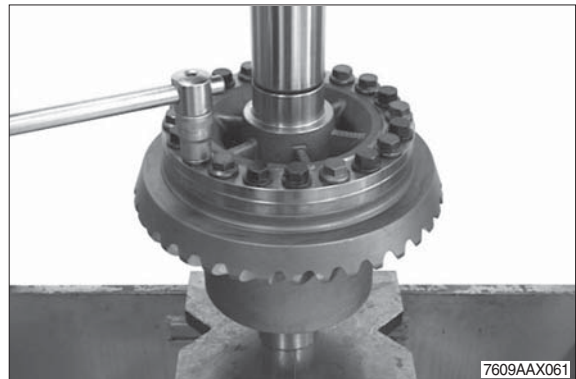
### Disassembly limited slip differential (standard)

- ① Pull both tapered roller bearings from the differential.

Grab sleeve	5873 012 016
Basic tool	5873 002 001



- ② Preload the differential by means of the press, loosen locking screws and housing cover.



- ③ Lift the axle bevel gear with pressure ring, disk package and thrust washers out of the differential housing.



- ④ Remove spider shafts and axle bevel gears (see figure) out of the differential housing.



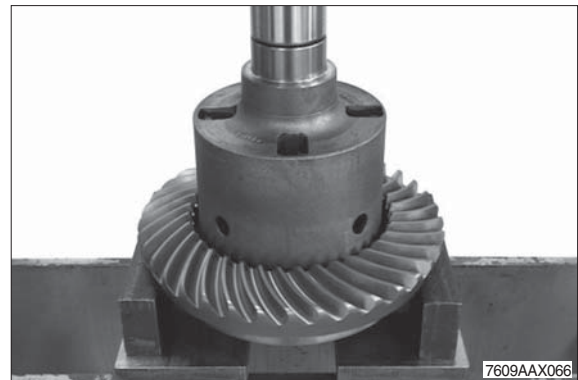
- ⑤ Remove the second axle bevel gear.



- ⑥ Lift the pressure ring out of the differential housing and remove the disk package and thrust washers behind.



- ⑦ Press crown wheel from the differential carrier.

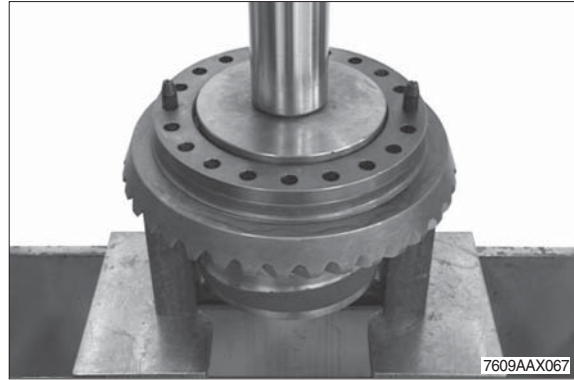


## (5) Reassembly differentials

### Reassembly hydraulic lock differential (option)

- ① Mount two locating pins and press the heated crown wheel onto the differential housing until contact is obtained.

Locating pins                      5870 204 040



- ② Insert thrust washer into the differential housing.



- ③ Insert axle bevel gear.



- ④ Insert spider gears with thrust washers into the differential housing and fix them with the spider shaft (long).

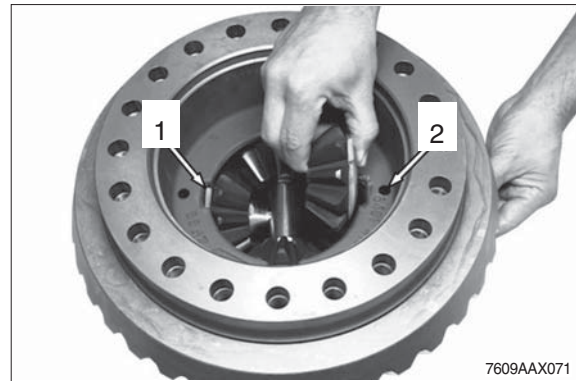
※ Thrust washers must be positioned with the tabs (see arrow) being located in the recesses of the differential housing.





- ⑤ Insert spider gears with thrust washers into the differential housing and fix them with the two spider shafts (short).

- ※ Thrust washers must be positioned with the tabs (see arrow 1) being located in the recesses of the differential housing.
- ※ Pay attention to radial installation position of the spider shafts (fixing holes, arrow 2).



- ⑥ Fix spider shafts (short) with slotted pins.

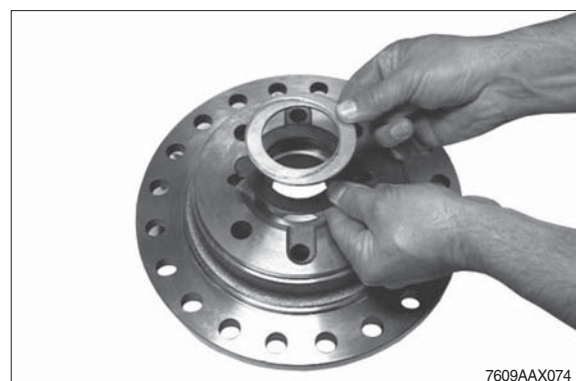
- ※ Flush mount slotted pins.



- ⑦ Mount second axle bevel gear.



- ⑧ Fix the thrust washers into the housing cover by means of grease.

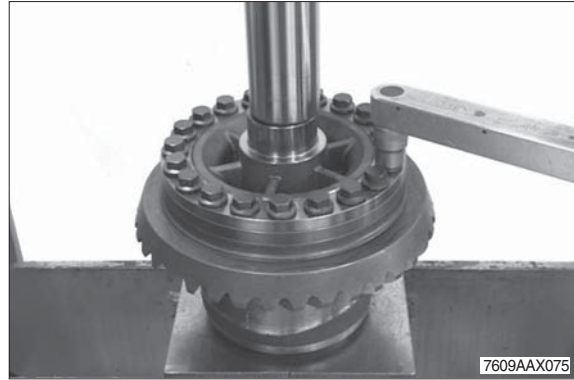


- ⑨ Mount two adjusting screws and insert the housing cover until contact with the differential housing is obtained.

Locating pins 5870 204 040

Preload the differential by means of the press and bolt with new locking screws.

- Tightening torque (M16/12.9) :  
40.8 kgf · m (295 lbf · ft)



- ⑩ Install compression spring onto the sliding sleeve.



- ⑪ Insert the premounted sliding sleeve into the housing cover.

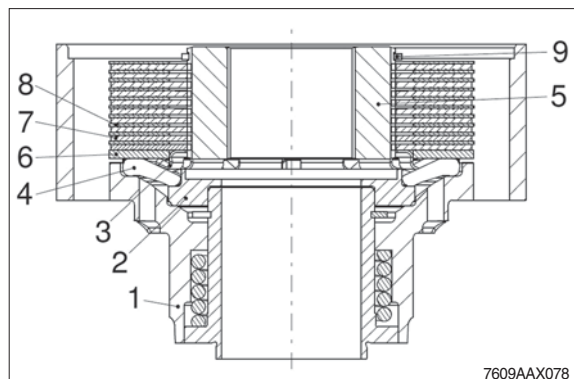
Preload the compression spring by means of the press and engage the retaining ring into the annular groove of the sliding sleeve.



### Setting of disk package

- ⑫ Premount single parts according to the adjacent sketch.

- 1 Housing cover
- 2 Pressure piece
- 3 Cage
- 4 Lever (12EA)
- 5 Disk carrier
- 6 Pressure ring
- 7 Inner disks
- 8 Outer disks (optional)
- 9 Snap ring



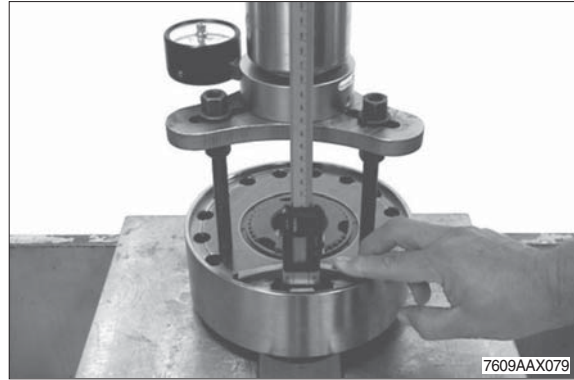
- ※ For the number of disks and the disk arrangement please refer to the relating parts manual.

- ⑬ Preload disk package with an axial force of  $F = 50^{+30}$  kN.

Then check the setting dimension "A" =  $1.05 \pm 0.1$  mm from the collar of the differential cover to the plane face of the outer disk (see also below sketch).

Pressure piece                      5870 100 069  
Load cell                              5870 700 004

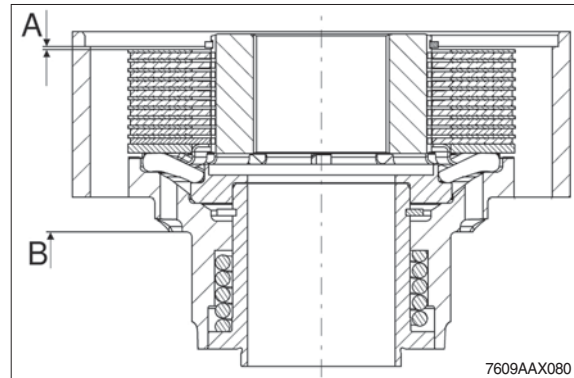
- ※ Any deviation from the specified setting dimension must be corrected with a corresponding outer disk.



A = Setting dimension =  $1.05 \pm 0.1$  mm

B = Contact face

- ⑭ To obtain a correct measuring result :  
The housing cover may only be supported on the contact face (B).  
Ensure that the assembly fixture is only supported on the disk package and not on the disk carrier (5).



- ⑮ Position housing cover onto pressure piece (see arrow).  
Insert two hexagon screws into the housing cover to radially fix the disk package.

Pressure piece                      5870 100 075



- ⑯ Position the premounted differential with the lifting device onto the housing cover and preliminarily fix with hexagon screws.

Lifting device                      AA00 331 446

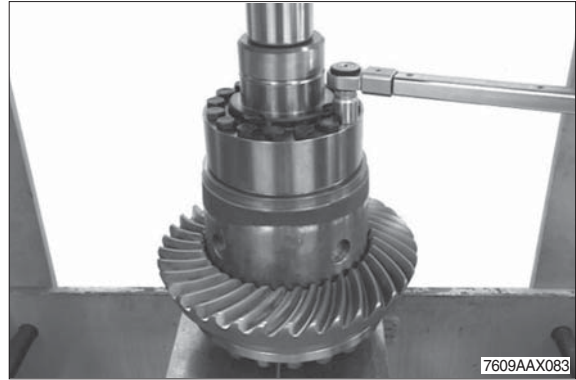


- ⑰ Preload the differential by means of the press and the pressure piece.

Then finally tighten the housing cover with hexagon screws.

· Tightening torque (M14/10.9) :  
18.9 kgf · m (136 lbf · ft)

Pressure piece 5870 100 075



- ⑱ Heat both tapered roller bearings and insert until contact is obtained.

※ Adjust tapered roller bearing after cooling down.



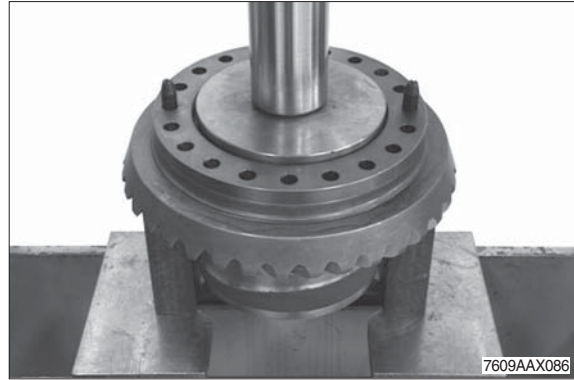
- ⑲ Fix axial roller cage (see arrow) to the sliding sleeve by means of grease.



**Reassembly conventional differential (if equipped)**

- ① Mount two locating pins and press the heated crown wheel onto the differential housing until contact is obtained.

Locating pins                      5870 204 040



- ② Insert thrust washer into the differential housing.



- ③ Insert axle bevel gear.



- ④ Insert spider gears with thrust washers into the differential housing and fix them with the spider shaft (long).

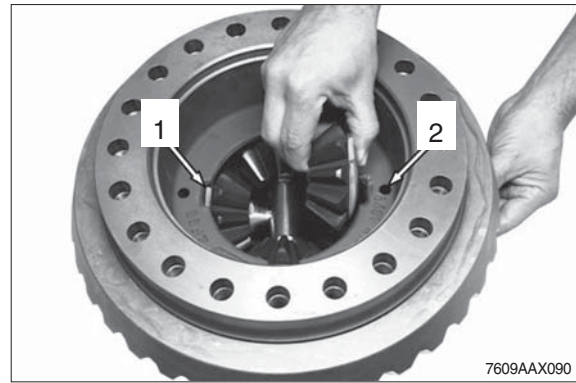
※ Thrust washers must be positioned with the tabs (see arrow) being located in the recesses of the differential housing.





- ⑤ Insert spider gears with thrust washers into the differential housing and fix them with the two spider shafts (short).

- ※ Thrust washers must be positioned with the tabs (see arrow 1) being located in the recesses of the differential housing.
- ※ Pay attention to radial installation position of the spider shafts (fixing holes, arrow 2).

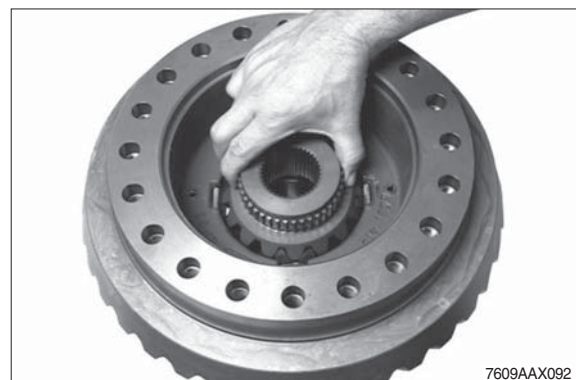


- ⑥ Fix spider shafts (short) with slotted pins.

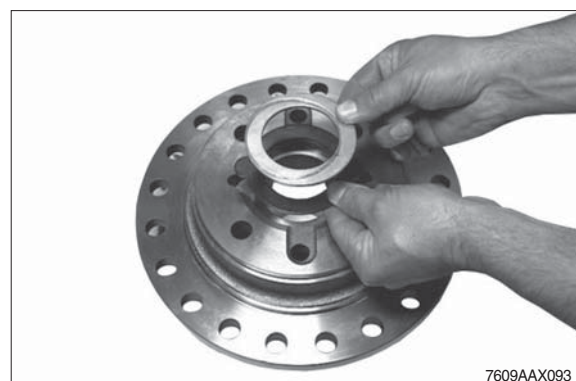
- ※ Flush mount slotted pins.



- ⑦ Mount second axle bevel gear.



- ⑧ Fix the thrust washers into the housing cover by means of grease.

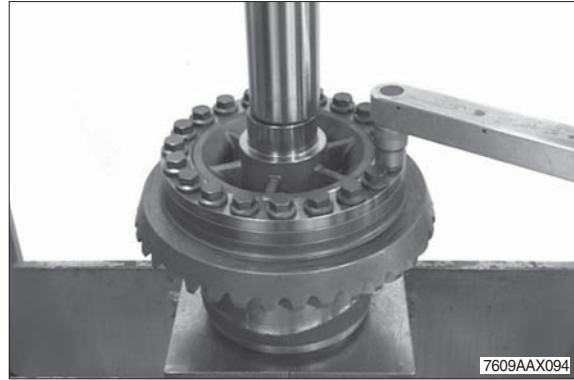


- ⑨ Mount two adjusting screws and insert the housing cover until contact with the differential housing is obtained.

Locating pins 5870 204 040

Preload the differential by means of the press and bolt with new locking screws.

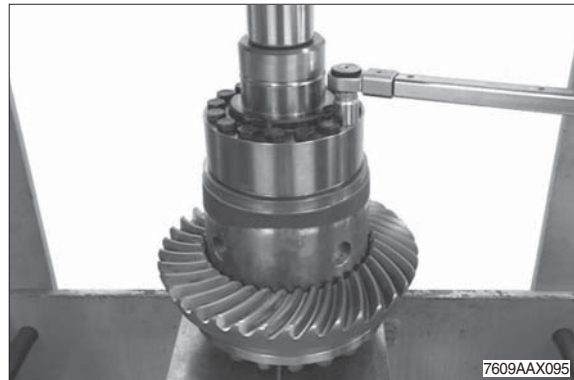
- Tightening torque (M16/12.9) :  
40.8 kgf · m (295 lbf · ft)



- ⑩ Attach the housing cover and preload the differential with the press.

Then fix the housing cover with hexagon screws.

- Tightening torque (M14/10.9) :  
18.9 kgf · m (136 lbf · ft)



- ⑪ Heat both tapered roller bearings and insert until contact is obtained.

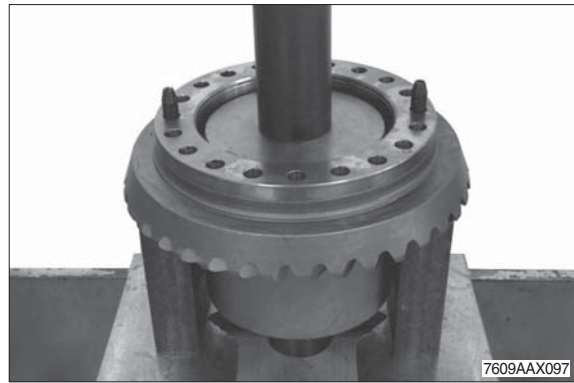
- ※ Adjust tapered roller bearing after cooling down.



### Reassembly limited slip differential (standard)

- ① Mount two locating pins and press the heated crown wheel onto the differential housing until contact is obtained.

Locating pins                      5870 204 040



- ② Insert thrust washer into the differential housing.



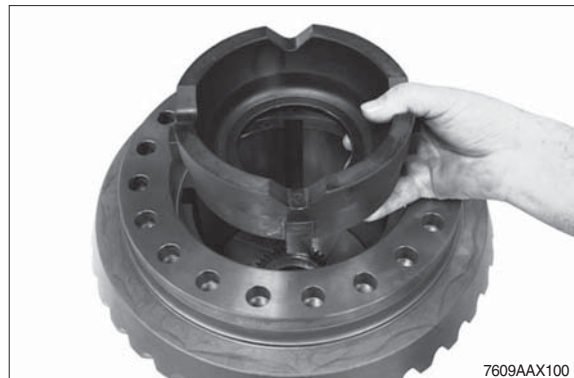
- ③ Mount outer and inner disks in alternating order, starting with an outer disk.

※ The installation clearance of the internal parts is corrected by mounting outer disks with different thicknesses.

▲ The difference in thickness between the left and the right disk package must only be 0.1 mm at maximum.

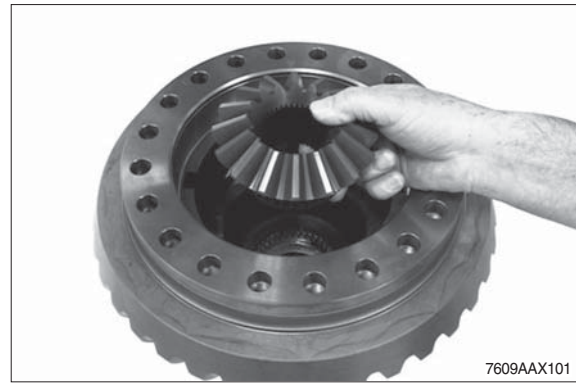


- ④ Place the pressure ring.





- ⑤ Insert the axle bevel gear until contact is obtained and install the inner disks with the teeth.



- ⑥ Preassemble the differential spider and insert it into the differential housing/into the pressure ring.



- ⑦ Mount second axle bevel gear.



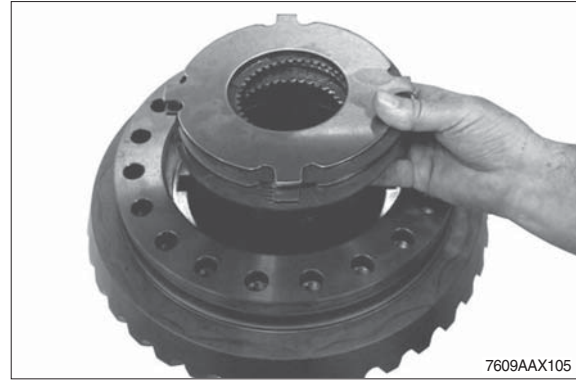
- ⑧ Insert the second pressure ring into the differential housing.



- ⑨ Mount outer and inner disks in alternating order, starting with an inner disk.

The installation clearance of the internal parts is corrected by mounting outer disks with different thicknesses.

- ▲ The difference in thickness between the left and the right disk package must only be 0.1 mm at maximum.



### Determine the installation clearance 0.2~0.7 mm

- ⑩ Measure dimension I, from the mounting face of the differential housing to the plane face of the outer disk.

Dimension I e.g. .... 44.30 mm



- ⑪ Measure dimension II, from the contact face of the outer disk to the mounting face on the housing cover.

Dimension II e.g. .... 43.95 mm

### CALCULATION EXAMPLE :

Dimension I ..... 44.30 mm

Dimension II ..... - 43.95 mm

**Difference = disk clearance = 0.35 mm**



- ※ Any deviation from the required installation clearance is to be corrected with corresponding outer disks (s = 2.7, s = 2.9, s = 3.0, s = 3.1, s = 3.2, s = 3.3 or s = 3.5 mm), taking care that the difference in thickness between the left and the right disk package must only be 0.1 mm at maximum.

- ⑫ Fix the thrust washers into the housing cover by means of grease.

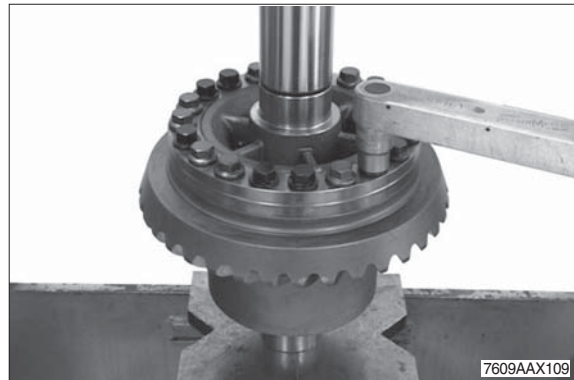


- ⑬ Mount two adjusting screws and insert the housing cover until contact with the differential housing is obtained.

Locating pins 5870 204 040

Preload the differential by means of the press and bolt with new locking screws.

- Tightening torque (M16/12.9) :  
40.8 kgf · m (295 lbf · ft)



- ⑭ Heat both tapered roller bearings and insert until contact is obtained.

- ※ Adjust tapered roller bearing after cooling down.



## (6) Reassembly input

- ※ If crown wheel or input pinion are damaged, both parts must be jointly replaced.

In case of a new installation of a complete bevel gear set pay attention to an identical mating number of input pinion and crown wheel.

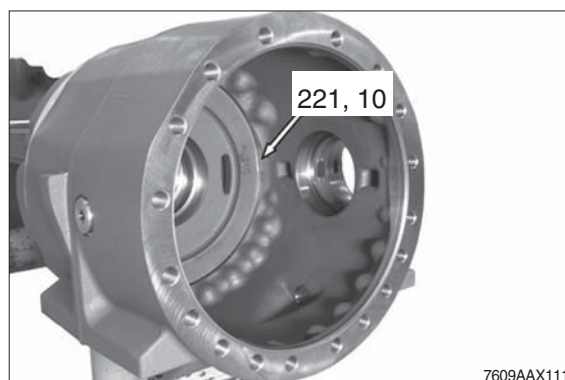
### Determination of shim thickness to obtain a correct contact pattern

- ※ The following measuring procedures must be carried out with utmost accuracy.

Inaccurate measurements lead to an incorrect contact pattern requiring an additional disassembly and reassembly of input pinion and differential.

- ① Read dimension I from the axle drive housing.

Dimension I e.g. .... 221.10 mm



- ② Read dimension II (pinion dimension).

Dimension II e.g. .... 181.00 mm



- ③ Determine dimension III (bearing width).

Dimension III e.g. .... 39.10 mm

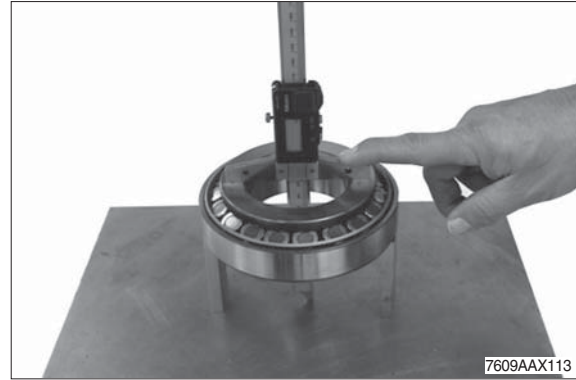
CALCULATION EXAMPLE "A<sub>1</sub>":

Dimension I ..... 221.10 mm

Dimension II ..... - 181.00 mm

Dimension III ..... - 39.10 mm

**Difference = shim                      s = 1.00 mm**

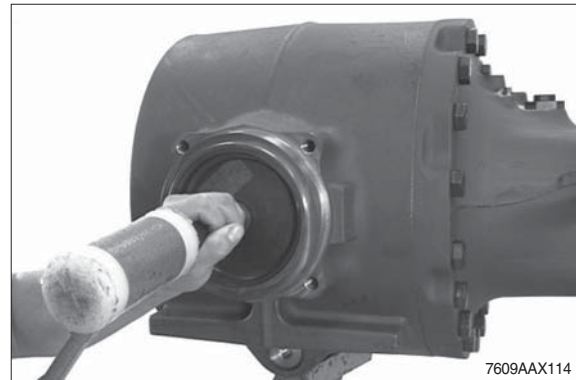


### Reassembly of input pinion

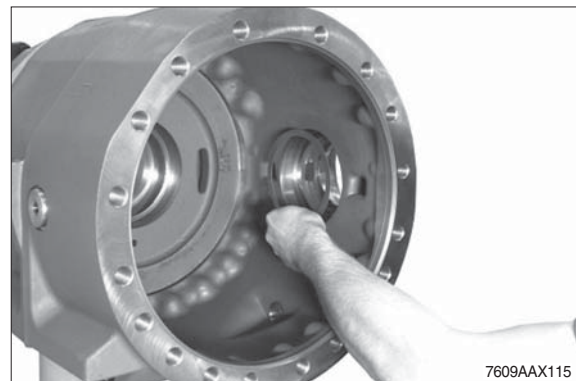
- ④ Undercool the external bearing outer ring and insert it into the axle drive housing until contact is obtained.

Driver tool                      5870 058 079

Handle                          5870 260 004



- ⑤ Insert the determined shim e.g. s = 1.00 mm into the housing hole.



- ⑥ Undercool the internal bearing outer ring and bring it into contact position in the housing hole by using the assembly fixture.

Assembly fixture                      5870 345 080



- ⑦ Heat the tapered roller bearing and insert it into the input pinion until contact is obtained.



**Setting of rolling torque of input pinion bearing 0.15~0.41 kgf · m (1.11~2.95 lbf · ft) (without shaft seal)**

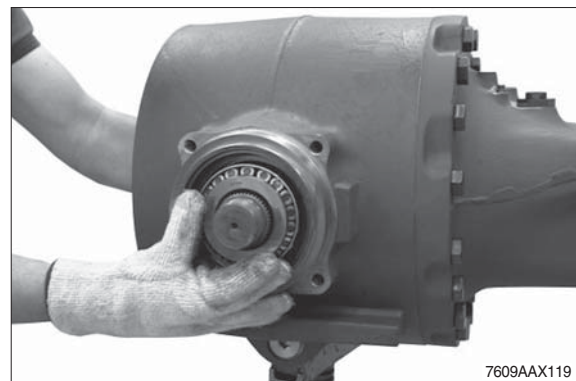
- ⑧ Insert spacer (e.g.  $s = 8.18$  mm).

※ According to our experience the necessary rolling torque is obtained when reusing the spacer which has been removed during disassembly (e.g.  $s = 8.18$  mm).

A later check of the rolling torque, however, is absolutely necessary.

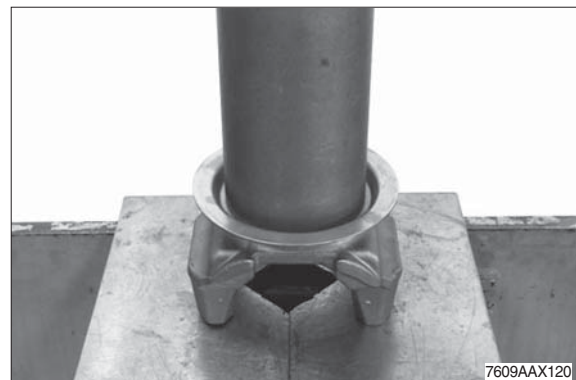


- ⑨ Insert the preassembled input pinion into the axle drive housing and insert the heated tapered roller bearing until contact is obtained.



- ⑩ Press the protection plate onto the input flange (see arrow) until contact is obtained.

※ Do not fit the shaft seal until the contact pattern has been checked.





- ⑪ Insert input flange and fix it by means of disk and slotted nut.

· Tightening torque :

122 kgf · m (885 lbf · ft)

Slotted nut wrench                    5870 401 139

Clamping device                        5870 240 002

- ※ Preliminarily mount slotted nut without loctite.

**▲ While tightening rotate the input pinion several times in both directions.**

- ⑫ Check rolling torque (0.15~0.41 kgf · m without shaft seal).

- ※ When installing new bearings try to achieve the upper value of the rolling torque.

**▲ In case of deviations from the necessary rolling torque correct with a corresponding spacer (AX118, page 3-234) as specified below.**

Insufficient rolling torque

install thinner spacer ring

Excessive rolling torque

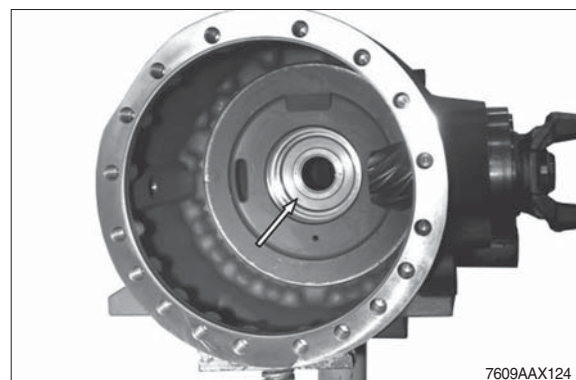
install thicker spacer ring

- ⑬ Grease O-rings (2EA, see arrows) and insert them into the annular grooves of the piston.

- ※ Operation figure AX123 and AX124 is only necessary for hydraulic lock differential (option).



- ⑭ Insert piston (see arrow) into the bearing housing until contact is obtained.



## Determination of shims for setting of bearing rolling torque (differential housing) and backlash (bevel gear set)

- ※ Determine the required shims on the basis of the read value (deviation/test dimension) and the corresponding specifications of the table below :

(KRS – SET – RIGHT)

(KRS = bevel gear set)



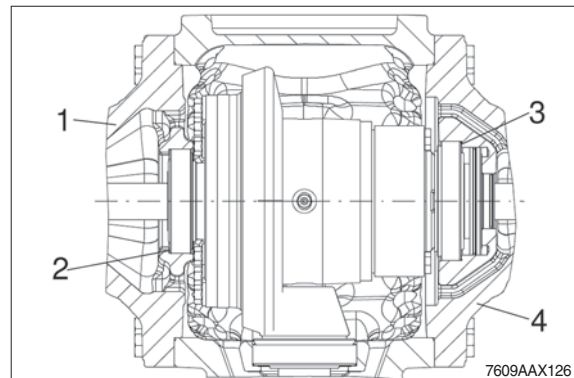
### ⑮ Deviation see crown wheel rear side.

- ※ The test dimension “101,, is stamped into the crown wheel rear side. If no + or – deviation is indicated, this value corresponds to the actual value “0” in the table below.

According to this value, the required shims are allocated in the table below.

Any + or – deviation of the test dimension caused by production is also marked on the crown wheel rear side (e.g. - 20 or - 10 or 10 or 20).

In accordance with this deviation, the required shims are allocated in the table below.

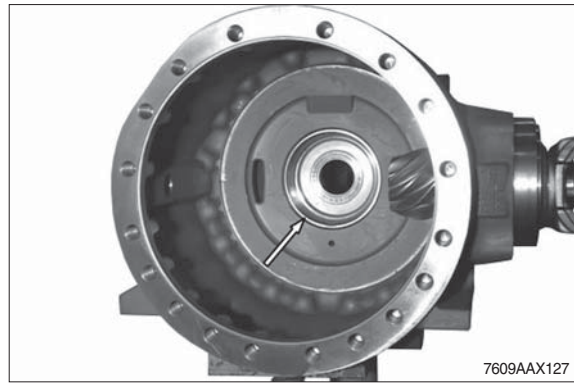


- 1 Axle housing
- 2 Shim (crown wheel side)
- 3 Shim (differential carrier side)
- 4 Axle housing

Shims for differential				
Crown wheel marking	- 20	- 10	-	10
Deviation	- 0.2	- 0.1	0	0.1
<b>Shim</b> <b>Differential cage side</b> Shim thickness	<b>0.7</b>	<b>0.8</b>	<b>0.9</b>	<b>1.0</b>
Shim Hydraulic lock differential	ZGAQ-04367	ZGAQ-04167	ZGAQ-04168	ZGAQ-04169
Shim Conventional, L/slip differential	ZGAQ-04368	ZGAQ-03896	ZGAQ-03897	ZGAQ-03898
<b>Shim</b> <b>Crown wheel side</b> Shim thickness	<b>1.3</b>	<b>1.2</b>	<b>1.1</b>	<b>1.0</b>
Shim	ZGAQ-04369	ZGAQ-03900	ZGAQ-03899	ZGAQ-03898

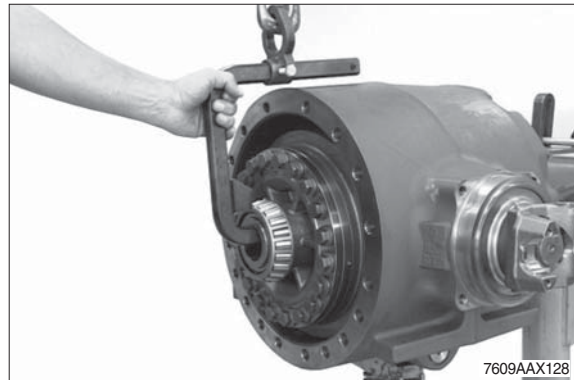


- ⑩ Insert the determined shim (e.g.  $s = 0.9 \text{ mm}$ ) into the hole of the axle housing and adjust the bearing outer ring (see arrow) until contact is obtained.

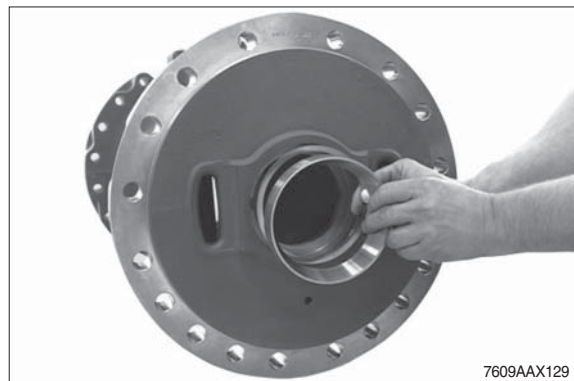


- ⑪ Cover some drive and coast flanks of the crown wheel with marking ink.
- Then insert the premounted differential into the axle drive housing.

Load carrying device      5870 281 083



- ⑫ Insert the determined shim (e.g.  $s = 1.1 \text{ mm}$ ) into the hole of the axle housing and adjust the bearing outer ring (see arrow) until contact is obtained.

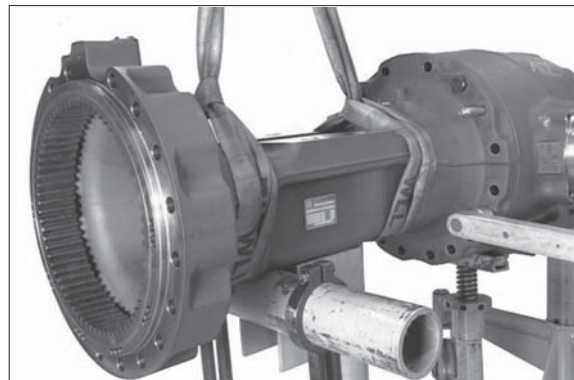


- ⑬ Mount two locating pins and bring the axle housing into contact position with the axle drive housing by means of the lifting device.

Locating pins      5870 204 024

Then preliminarily fix the axle housing with 4 hexagon screws.

- Tightening torque (M20/10.9) :  
 $57.1 \text{ kgf} \cdot \text{m}$  ( $413 \text{ lbf} \cdot \text{ft}$ )



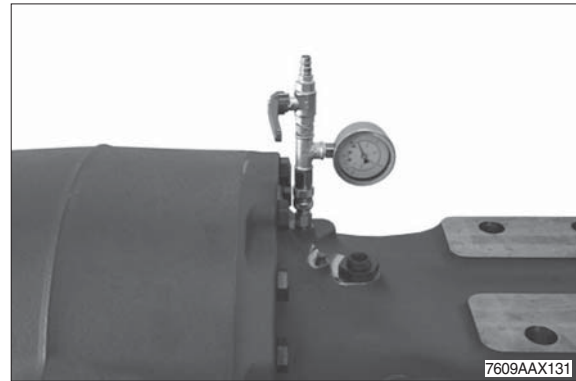
- ※ Preliminarily mount the axle housing without O-ring.

### Leakage test of lock

- ②① Pressurize the lock ( $p = 1 \text{ bar}$ ), close shut-off valve and remove air line.

**▲ No noticeable pressure loss is allowed to occur within 10 sec.**

※ This operation is only necessary for hydraulic lock differential (option).

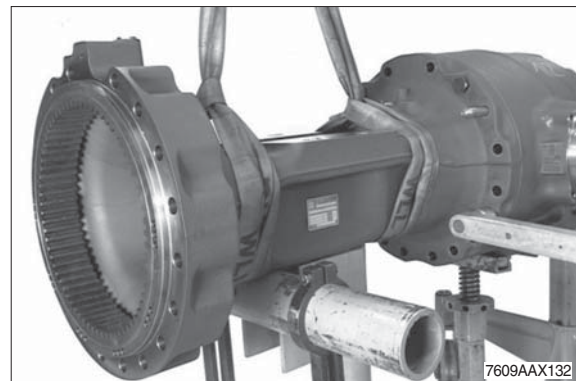


- ②① By rotating the input flange, roll crown wheel over the input pinion in both directions several times.

Then remove the axle housing again and lift the differential out of the axle drive housing.

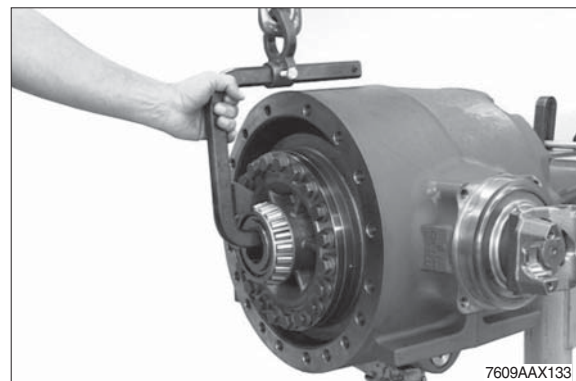
Compare the obtained contact pattern.

**▲ In case of any contact pattern deviation, a measuring error was made when determining the shim (AX115, page 3-233), which must be corrected by all means.**



- ②② After the contact pattern check insert the differential again into the axle drive housing.

Load carrying device      5870 281 083

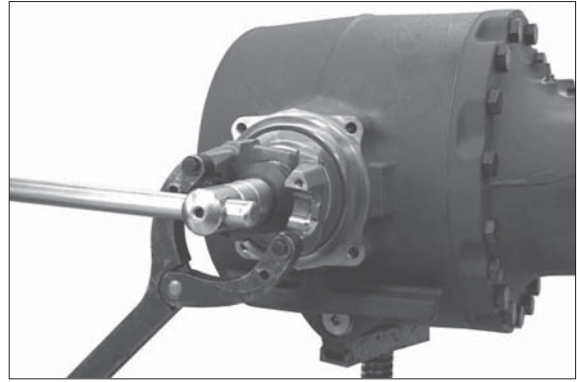


### Reassembly of shaft seal (figure AX134~136)

- ②③ Loosen the slotted nut and pull the input flange from the input pinion.

Slotted nut wrench                      5870 401 139

Clamping device                        5870 240 002

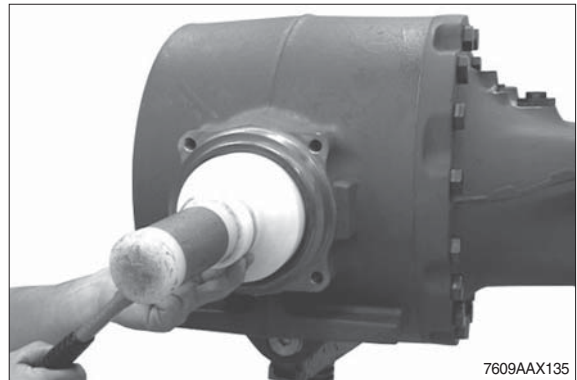


7609AAX134

- ②④ Mount the shaft seal with the seal lip showing to the oil chamber.

Driver tool                                5870 048 233

- ※ The exact installation position of the shaft seal is obtained when using the specified driver tool.
- ※ Wet the outer diameter of the shaft seal with spirit directly before installation and fill the space between seal and dust lip with grease.



7609AAX135

- ②⑤ Insert input flange and finally tighten by means of disk and slotted nut.

· Tightening torque :

122 kgf · m (885 lbf · ft)

Slotted nut wrench                      5870 401 139

Clamping device                        5870 240 002

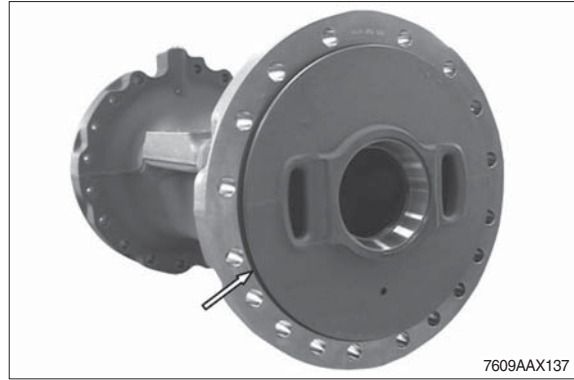
- ※ Cover the thread of the slotted nut with loctite (type no. : 262).



7609AAX136

## (7) Reassembly axle housing

- ① Grease O-ring (see arrow) and insert it into the axle housing.

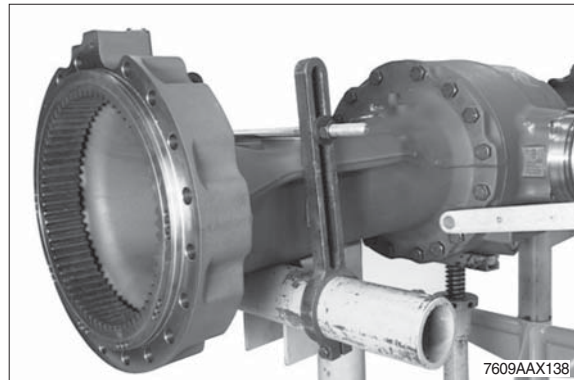


- ② Mount two locating pins and bring the axle housing into contact position with the axle drive housing by using the lifting device.

Then fix the axle housing by means of hexagon screws.

- Tightening torque (M20/10.9) :  
57.1 kgf · m (413 lbf · ft)

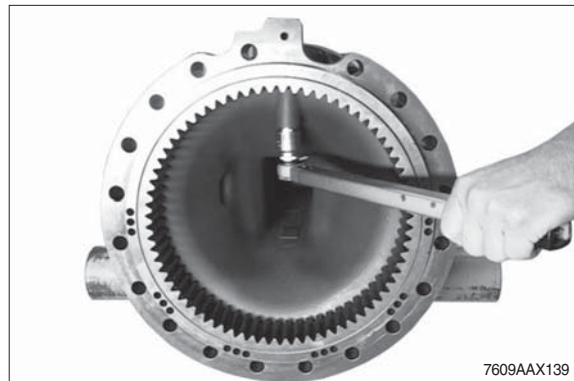
Locating pins 5870 204 024



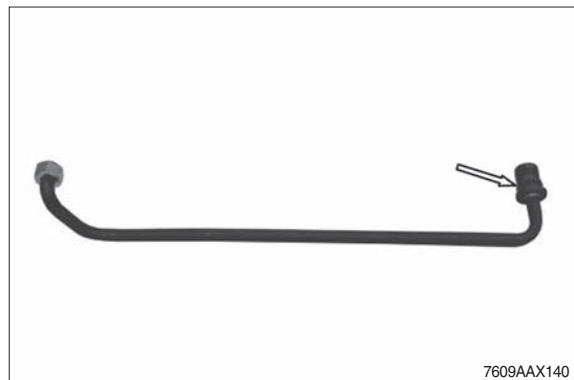
- ※ After assembling the axle housing secure the axle with clamping brackets.

- ③ Mount fitting.

- Tightening torque :  
3.67 kgf · m (26.6 lbf · ft)

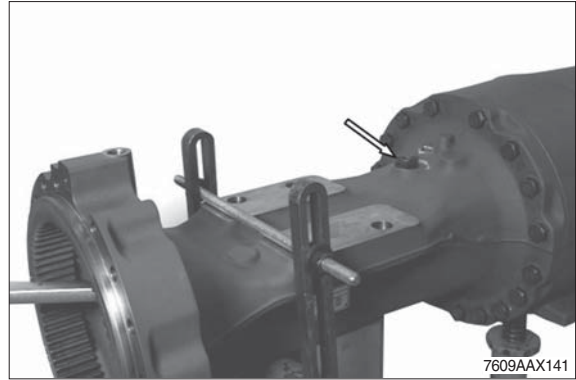


- ④ Grease O-ring and insert it into the annular groove of the brake tube (see arrow).



- ⑤ Mount brake tube with threaded connection and hexagon nut (see arrow).

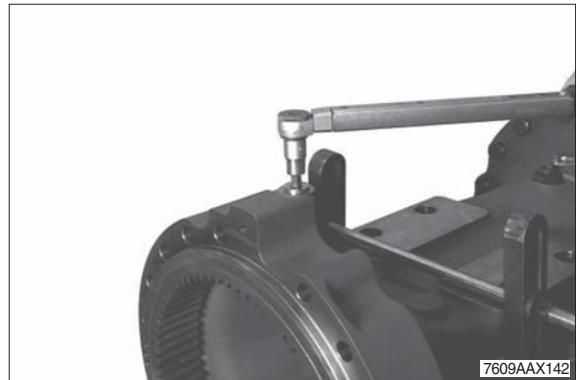
· Tightening torque :  
10.2 kgf · m (73.8 lbf · ft)



- ⑥ Provide screw plug with a new O-ring and fit it.

Flush mount slotted pins.

· Tightening torque :  
5.1 kgf · m (36.9 lbf · ft)





## (8) Reassembly output and brake

- ① Pull in wheel stud into the output shaft until contact is obtained.

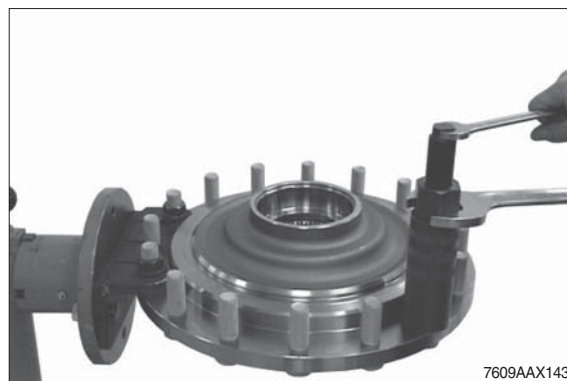
Wheel stud puller-basic tool

5870 610 001

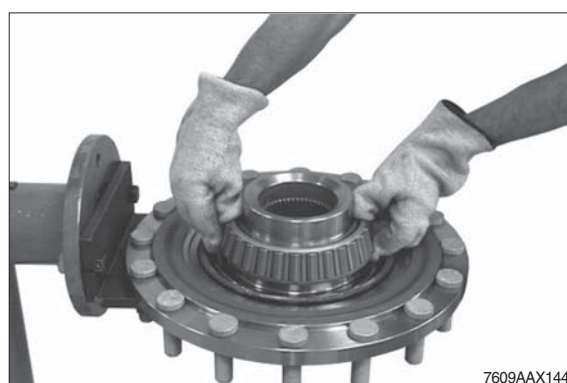
Insert (M22 × 1.5)

5870 610 002

Special tool may only be used for repair solution when exchanging individual wheel studs with mounted output shaft. When using a new output shaft, mount the wheel studs with the press.



- ② Heat tapered roller bearing and insert it into the output shaft until contact is obtained.

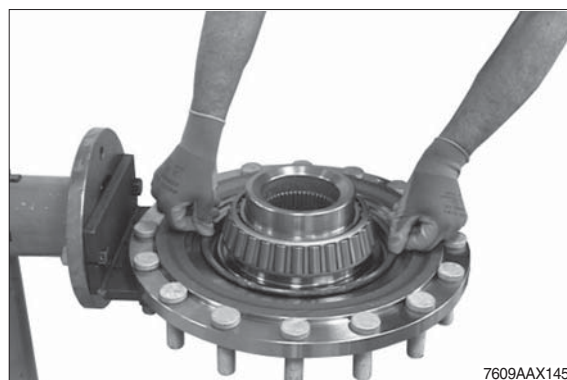


- ③ Wet O-ring of slide ring seal and locating hole with spirit.

Snap **new** slide ring seal (part 1) into the output shaft.

Then mount **new** slide ring seal (part 2) accordingly into the brake housing.

※ For the installation position of the seal please also refer to sketch, page 3-244.



※ The surface of the slide ring seal may not have any grooves, scratches or other types of damage.

Take care that the sealing surface is parallel to the housing face.

The O-rings must be mounted evenly into the locating hole and must not bulge out of the hole.

▲ **Risk of injury-Metal rings have extremely sharp edges.**  
**Wear protective gloves.**



- ④ Insert both bearing outer rings (see arrows) into the brake housing until contact is obtained.



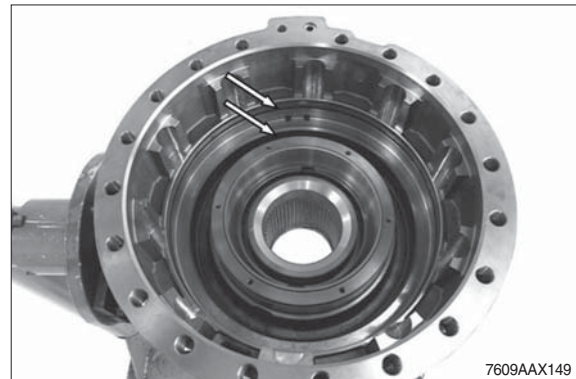
- ⑤ Insert the premounted brake housing by means of the lifting device over the output shaft until contact is obtained.

※ Before clamping the seal rings (slide ring seal) to installation dimension, clean the sliding surfaces and apply an oil film.  
We recommend to use a leather cloth soaked with oil.



- ⑥ Insert back-up rings and grooved rings into the annular grooves of the brake housing (see arrows).

※ Pay attention to the installation position; please also refer to sketch, page 3-244.



- ⑦ Clean the annular groove of the brake housing with spirit.

Then insert the guide ring into the annular groove (see also the following sketch) and fix it with loctite (type No. : 415) at its extremities (see arrows).

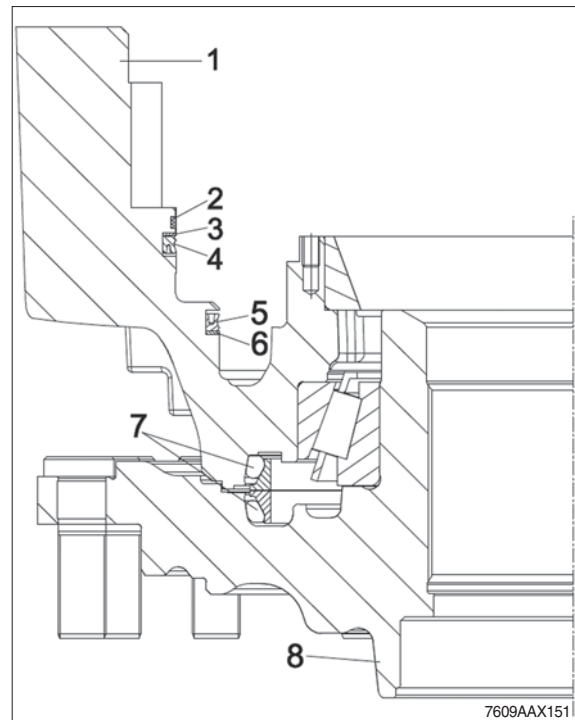
※ The full circumference of the guide ring must be in an exact contact position.

※ Upon installation the orifice of the guide ring must show upwards (12 o'clock).





- 1 Brake housing
- 2 Guide ring
- 3 Back-up ring
- 4 Grooved ring
- 5 Grooved ring
- 6 Back-up ring
- 7 Slide ring seal
- 8 Output shaft



7609AAX151

- ⑧ Flush-mount the slotted pins (6EA) into the holes of the piston.

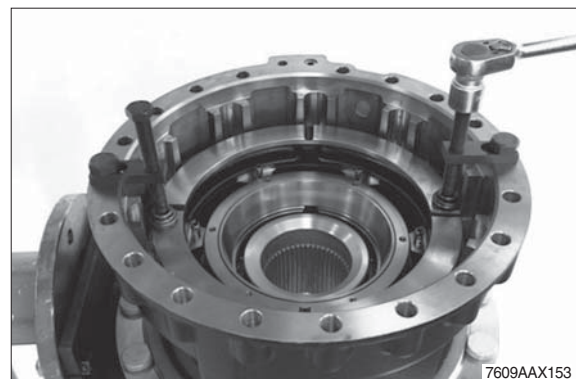


7609AAX152

- ⑨ Insert the piston into the brake housing and carefully install with the fixing device until contact is obtained.

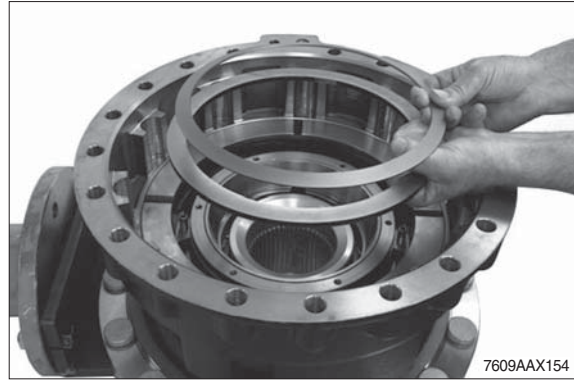
Fixing device AA00 680 530

- ※ Sufficiently oil seal surface of piston/back-up rings, grooved rings and guide ring.



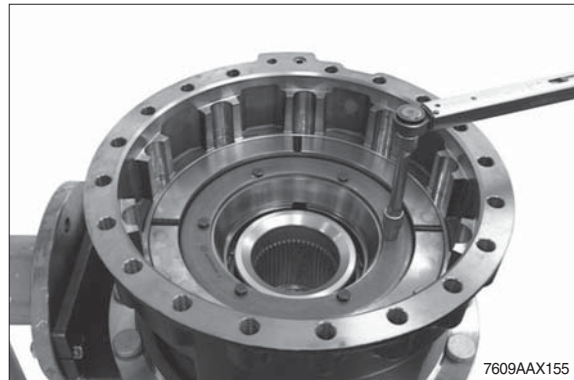
7609AAX153

- ⑩ Insert disk and cup spring with the convex side showing upwards into the piston.



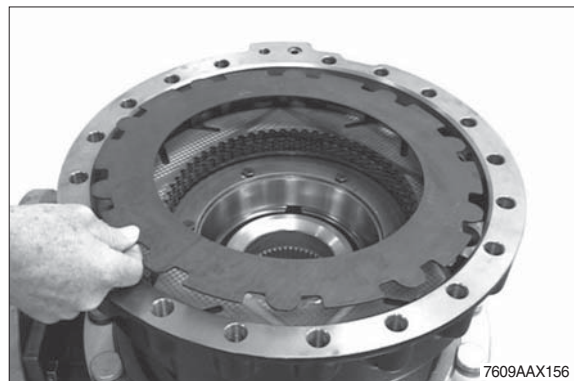
- ⑪ Insert cover and fix it by means of hexagon screws.

· Tightening torque (M8/10.9) :  
3.47 kgf · m (25.1 lbf · ft)

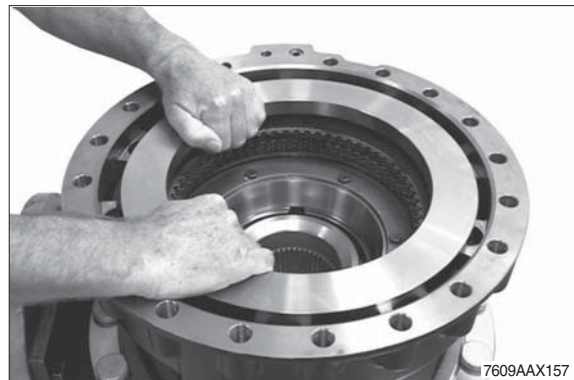


- ⑫ Mount outer and inner disks.

※ For the number of disks and the disk arrangement please refer to the relating parts manual.

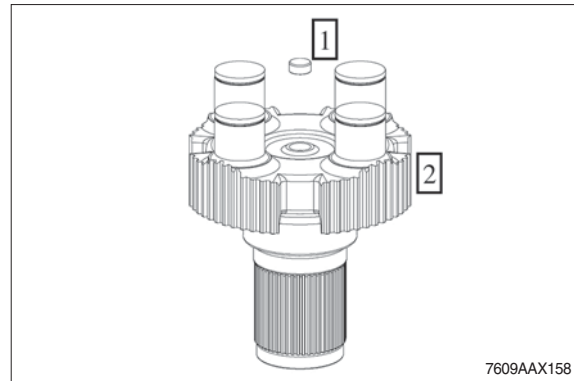


- ⑬ Insert end plate.



- ⑭ Press stop bolt into the planetary carrier until contact is obtained.

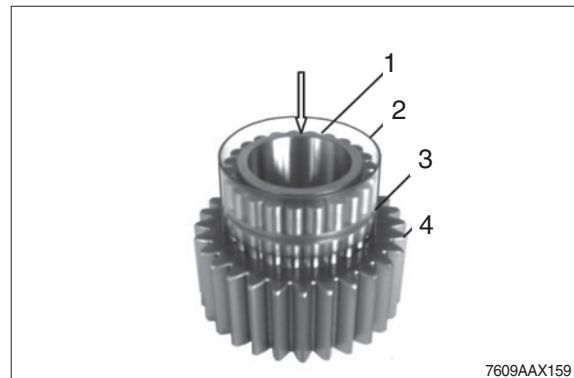
- 1 Stop bolt
- 2 Planetary carrier



- ⑮ Insert the cylindrical roller bearing into the planetary gear – for this purpose press the cylindrical roller bearing through the packaging sleeve until the snap ring engages into the annular groove of the planetary gear.

※ Use packaging sleeve to facilitate assembly.

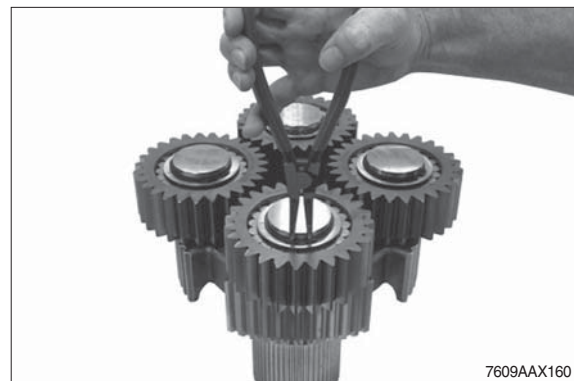
- 1 Cylindrical roller bearing
- 2 Packaging sleeve
- 3 Snap ring
- 4 Planetary gear



- ⑯ Heat bearing inner rings and insert the premounted planetary gears with large radius facing the planetary carrier (downwards) until contact is obtained.

※ Adjust bearing inner rings after cooling down.

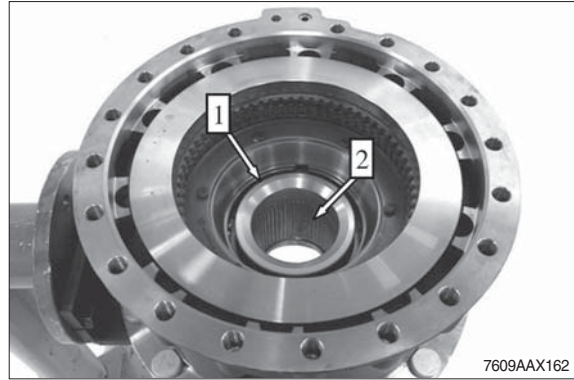
Then fix planetary gears by means of retaining rings.



- ⑰ Heat tapered roller bearing and install it to the planetary carrier until contact is obtained.



- ⑮ Wet front face (contact face bearing inner ring, arrow 1) and profile (teeth, arrow 2) in the output shaft with anti-corrosive agent.



- ⑯ Align disk package centrally and radially.

Then insert the planetary carrier by means of the lifting device into the teeth of the output shaft.

Rear axle

(planetary carrier with 3 planetary gears)

Inner extractor 5870 300 019

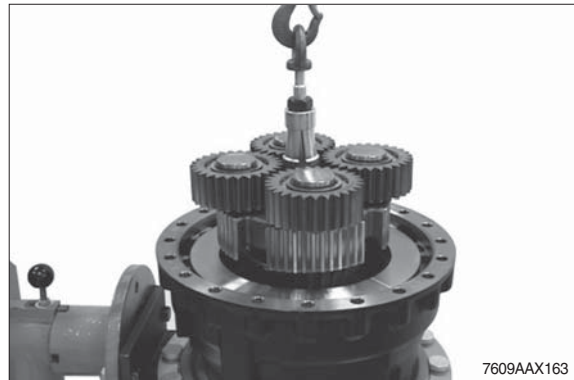
Eye bolt 5870 204 073

Front axle

(planetary carrier with 4 planetary gears)

Inner extractor 5870 300 017

Eye nut 5870 204 076



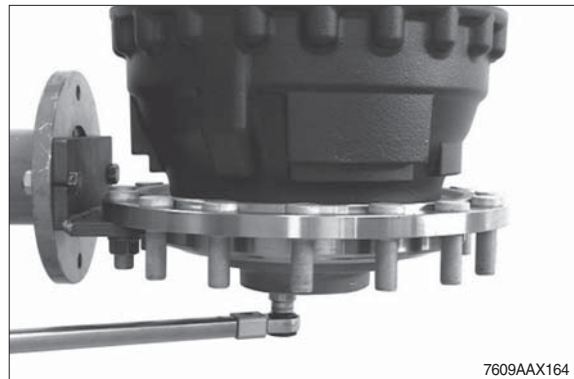
### Setting of gap width output shaft / planetary carrier

- ⑰ Bring planetary carrier with measuring disk and three old locking screws, which were removed during disassembly, into contact position.

· Tightening torque :

20.4 kgf · m (148 lbf · ft)

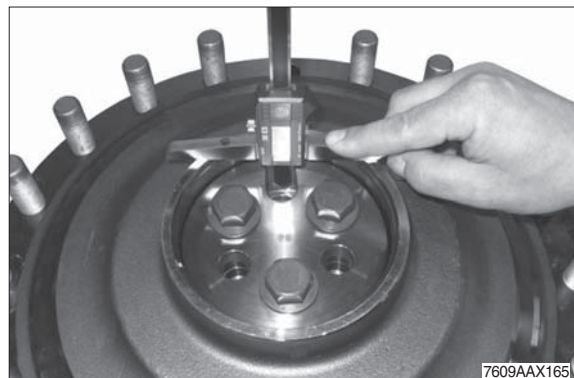
Measuring disk AA00 360 730



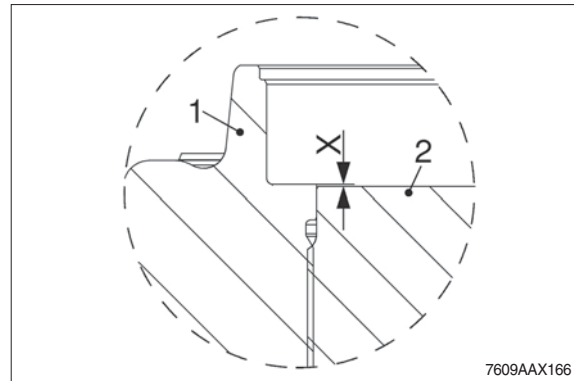
- ⑱ Pivot output 180° and measure gap width from the output shaft to the planetary carrier (see also subsequent sketch).

Gap width e.g. .... 0.21 mm

Then remove the locking screws and the measuring disk again.



- 1 Planetary carrier
- 2 Output shaft
- X Gap width

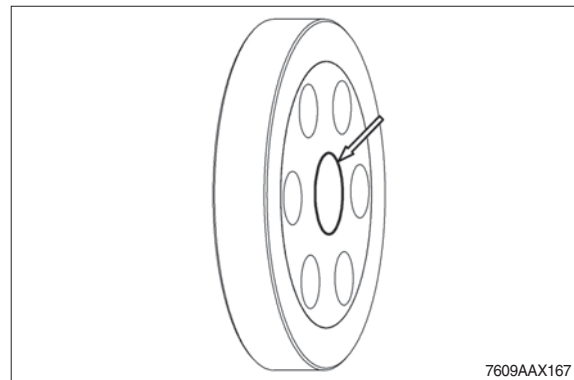


② Select the cover (optional) on the basis of the following table.

Determined gap width (Delta)	Offset to be used on the cover	P/No.
0.30~0.24 mm	$0.13 \pm 0.01$ mm	ZGAQ-04137
0.239~0.18 mm	$0.07 \pm 0.01$ mm	ZGAQ-04370
0.179~0.10 mm	0.0 mm	ZGAQ-03909

※ Cover (ZGAQ-04370) has an offset of 0.07 mm on one side and an offset of 0.13 mm on the other side.

※ Offset 0.13 mm is visually marked with an annular groove (see arrow).

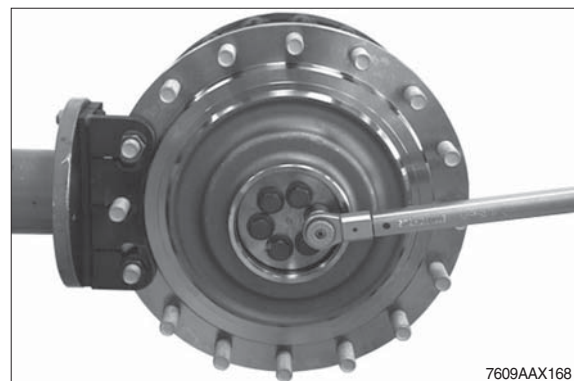


③ Insert the cover with the offset e.g. 0.07 mm showing to the planetary carrier and tighten with **new** locking screws.

※ When using the cover with offset 0.07 mm, the groove (figure AX167) must be visible when the cover is installed.

※ Tighten locking screws successively with a tightening torque of 20.4 kgf · m (148 lbf · ft).

Then retighten the locking screws successively with a tightening torque of 51 kgf · m (369 lbf · ft).



④ Install O-ring (see arrow 1) to the cover.

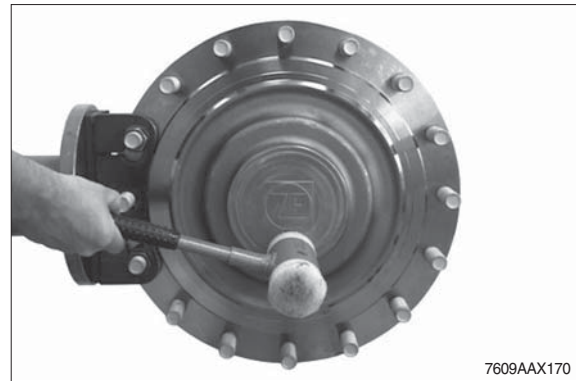
Then wet contact face (arrow 2).

※ Use new cover and O-ring.





- ②⑤ Insert the cover into the output shaft until contact is obtained.

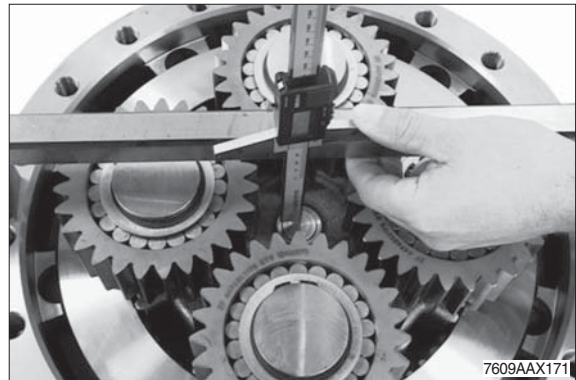


**Set the axial play of the sun gear shaft  
0.5~2.0 mm**

- ②⑥ Determine dimension I, from the mounting face of the brake housing to the front face of the stop bolt.

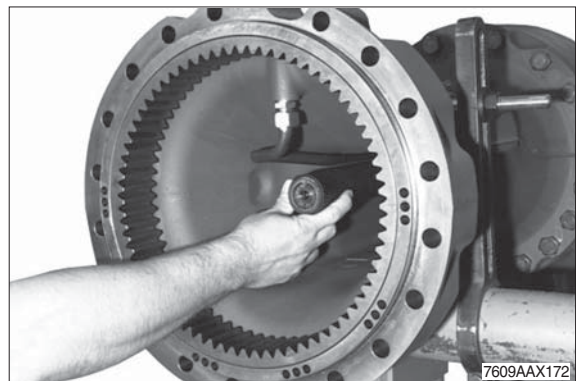
Dimension I e.g. .... 19.75 mm

Gauge blocks	5870 200 066
Straightedge	5870 200 022

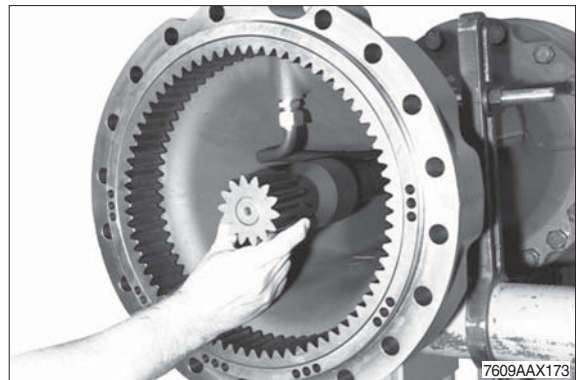


- ②⑦ Insert stub shaft into the teeth of the axle bevel gear until contact is obtained.

※ Pay attention to the installation position ;  
mount the stub shaft with the long teeth  
showing to the differential.



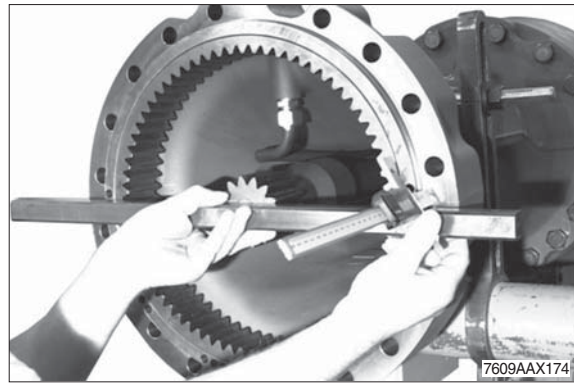
- ②⑧ Insert the sun gear shaft until contact is obtained.



- ②⑨ Measure dimension II, from the front face of the sun gear shaft to the mounting surface of the axle housing.

Dimension II e.g. .... 17.15 mm

Straightedge 5870 200 022



**CALCULATION EXAMPLE :**

Dimension I ..... 19.75 mm

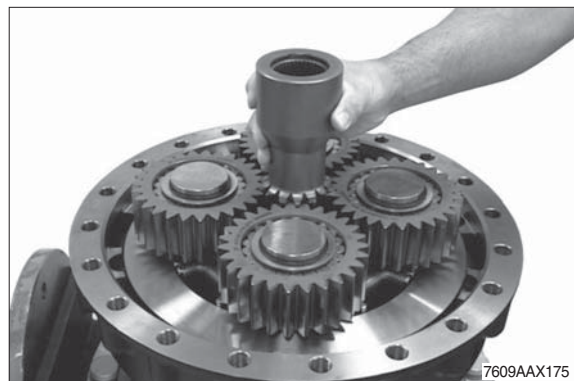
Dimension II ..... - 17.15 mm

Difference ..... 2.60 mm

Required axial play e.g. .... - 1.00 mm

**Difference = shim e.g. s = 1.60 mm**

- ③⑩ Insert sun gear shaft into the planetary carrier.

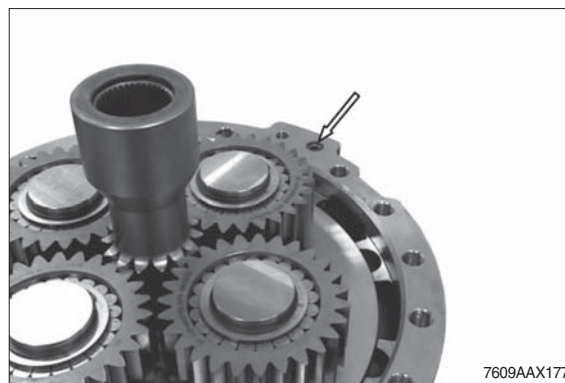


- ③⑪ Fix determined shim (s) e.g. s = 1.60 mm with grease into the sun gear shaft.

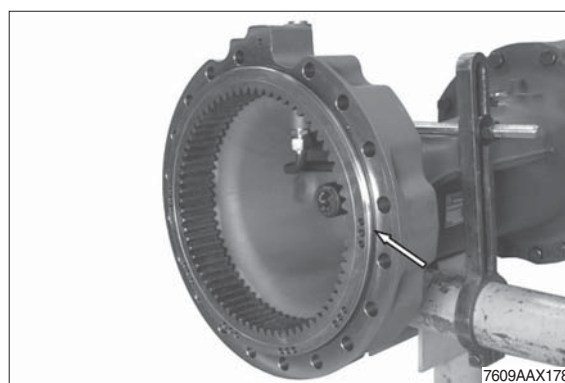




- ③② Fix O-ring (see arrow) with grease into the countersink of the brake housing.



- ③③ Grease O-ring (see arrow) and install it to the axle housing.



- ③④ Mount two adjusting screws and use the lifting device to bring the output into contact position with the axle housing.

Then fix the output by means of hexagon screws.

· Tightening torque (M18/10.9) :  
39.8 kgf · m (288 lbf · ft)

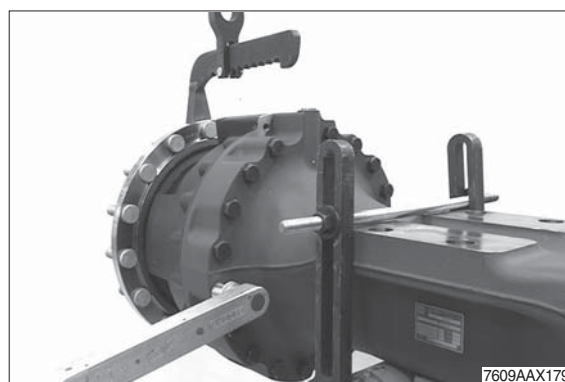
Adjusting screws (M18 × 15)

5870 204 029

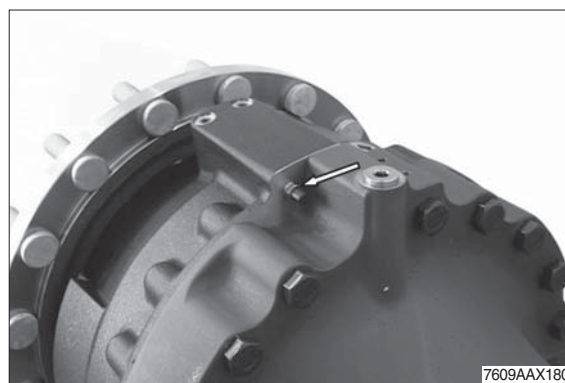
Load carrying device

5870 281 043

※ Fix load carrying device with wheel stud.



- ③⑤ Mount breather (see arrow).



### Check brake hydraulics for leakages

- ※ Before starting the test, completely breathe the brake hydraulics.

Then pressurize the brake temporarily (5EA) with  $p = 100$  bar max.

#### High-pressure test :

Build up test pressure  $p = 100-10$  bar max and close connection to HP pump via shut-off valve.

A pressure drop of max 2 % (2 bar) is permissible during a 5-minute testing time.

#### Low-pressure test :

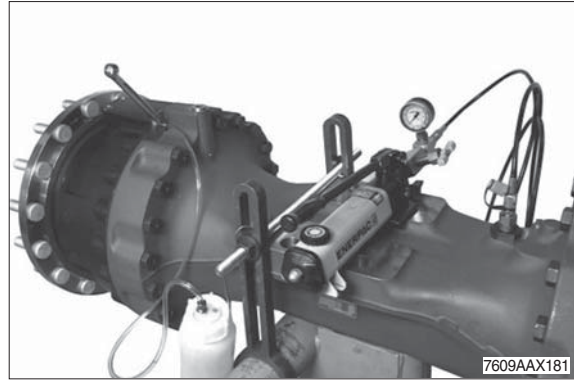
Reduce test pressure  $p = 5$  bar and close shut-off valve.

No pressure drop is allowed during a 5-minute testing time.

#### Test media :

Engine oil SAE 10W

HP pump	5870 287 007
Clutch	0501 207 939
Reduction (M18 × 1.5)	5870 950 161
Oil collector bottle	5870 286 072



### Check operability of hydraulic lock differential (opt)

Build up pressure  $p = 20$  bar max and close connection to HP pump via shut-off valve.

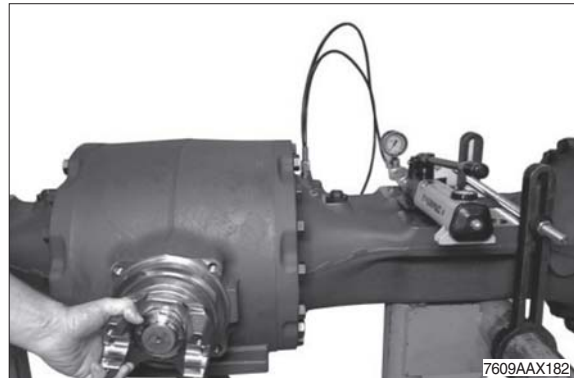
#### Lock on :

When rotating the input flange, both outputs must have the same direction of rotation.

#### Lock off :

When rotating the input flange, one side has no movement or has the opposite direction of rotation.

Prior to putting the axle into operation, fill it with oil according to the related lubrication and maintenance instructions.



## SECTION 4 BRAKE AND FAN SYSTEM

Group 1	Structure and Function .....	4-1
Group 2	Operational Checks and Troubleshooting .....	4-32
Group 3	Tests and Adjustments .....	4-39
Group 4	Disassembly and Assembly .....	4-41

# SECTION 4 BRAKE AND FAN SYSTEM

## GROUP 1 STRUCTURE AND FUNCTION

### 1. OUTLINE

The variable displacement piston pump supplies the hydraulic oil that is required in order to operate the brake and the hydraulic fan system. Oil flows from pump to the cut-off valve.

The cut-off valve controls the flow of oil from the pump to the brake accumulators and also controls the flow of oil to the hydraulic fan motor.

The cut-off valve contains a priority valve. The brake system has priority. The oil flows to the brake accumulators while the accumulators are charged. After the accumulators are fully charged, the oil then flows to the hydraulic fan system.

The accumulator has pre-charged gas and an inlet check valve to maintain a pressurized volume of oil for reserving brake system.

The oil through the accumulator flows to the brake valves. The brake valve is a closed center design, dual circuit operated by a pedal.

The front and rear brakes will operate simultaneously with only one brake pedal depressed.

The hydraulic fan system is used to meet the cooling requirements. The hydraulic fan system controls the fan speed through the pump output pressure. The desired pressure level can be set by varying the solenoid current.

The hydraulic fan system contains directional valve that reverses the direction of fan.

The brake and hydraulic fan system contains the following components :

- Fan & brake pump
- Cut-off valve
- Brake valve
- Accumulators
- Pressure sensors and switch
- Fan motor
- Directional valve

## FULL POWER HYDRAULIC BRAKE SYSTEM

**ADVANTAGES** - The full power hydraulic brake system has several advantages over traditional brake actuation systems. These systems are capable of supplying fluid to a range of very small and large volume service brakes with actuation that is faster than air brake systems. Figure represents a time comparison between a typical air/hydraulic and full power hydraulic brake actuation system.

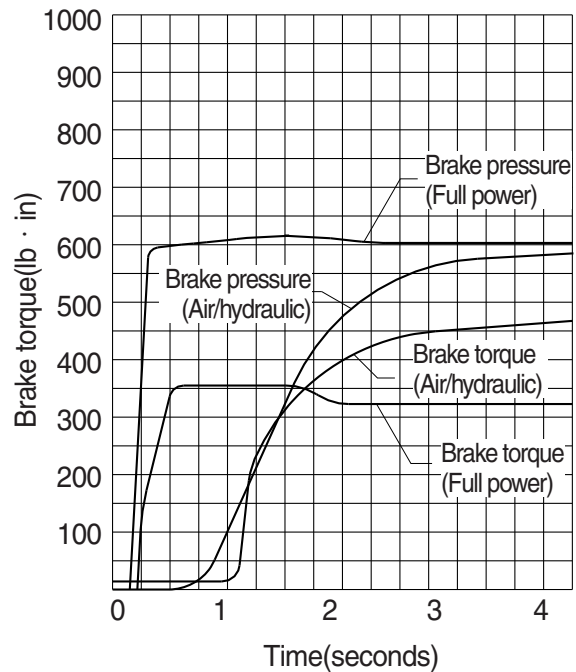
Full power systems can supply significantly higher brake pressures with relatively low reactive pedal forces. The reactive pedal force felt by the operator will be proportional to the brake line pressure being generated. This is referred to as brake pressure modulation.

Another key design feature of full power systems is the ability to control maximum brake line pressure. In addition, because these systems operate with hydraulic oil, filtration can be utilized to provide long component life and low maintenance operation.

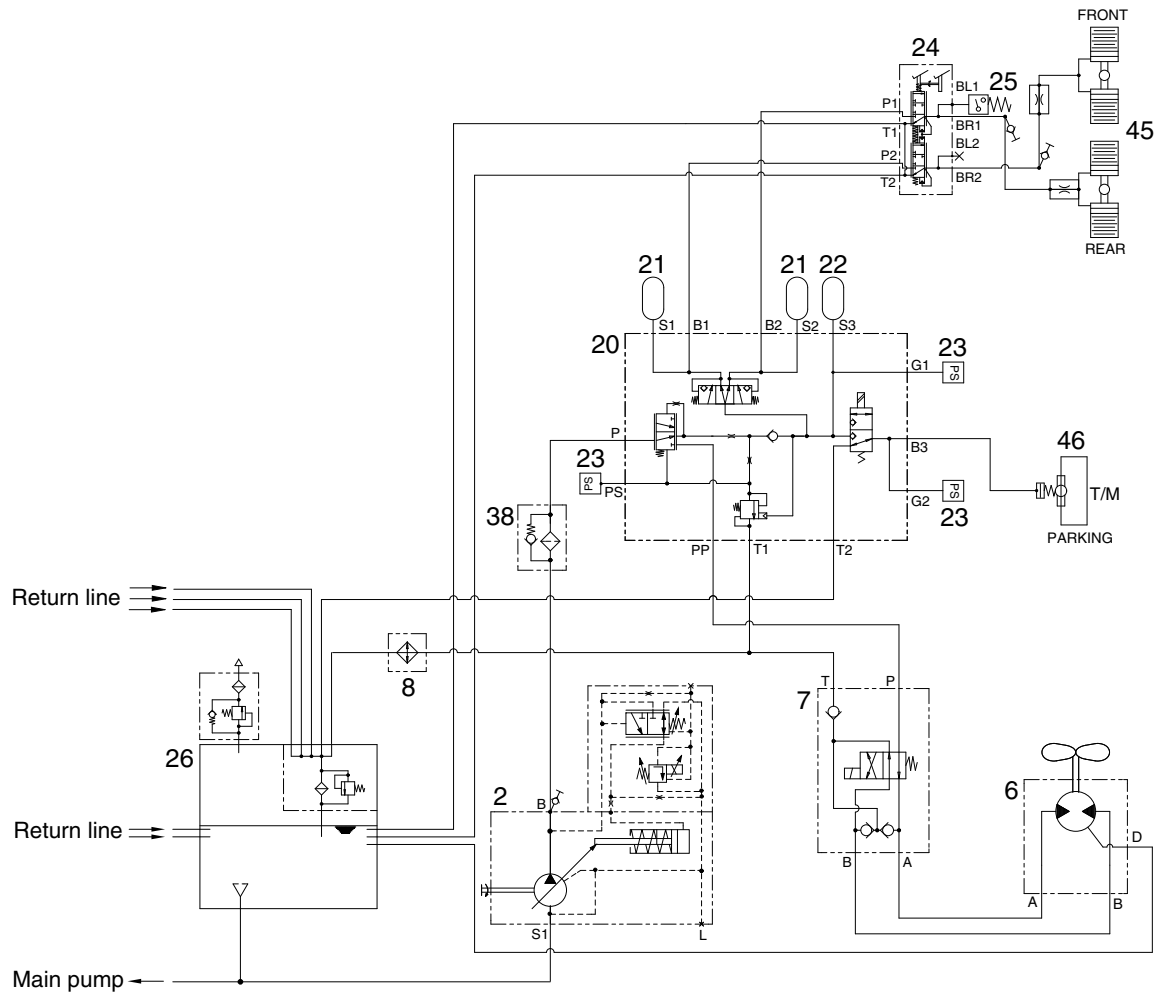
Because these systems are closed center, by using a properly sized accumulator, emergency power-off braking that is identical to power-on braking can be achieved. These systems can be either dedicated, where the brake system pump supplies only the demands of the brake system or non-dedicated, where the pump supplies the demands of the brake system as well as some secondary down stream hydraulic device.

Another important note is that all seals within these system must be compatible with the fluid medium being used.

**Response time**  
**Full power brake actuation VS**  
**Air/Hydraulic brake actuation**



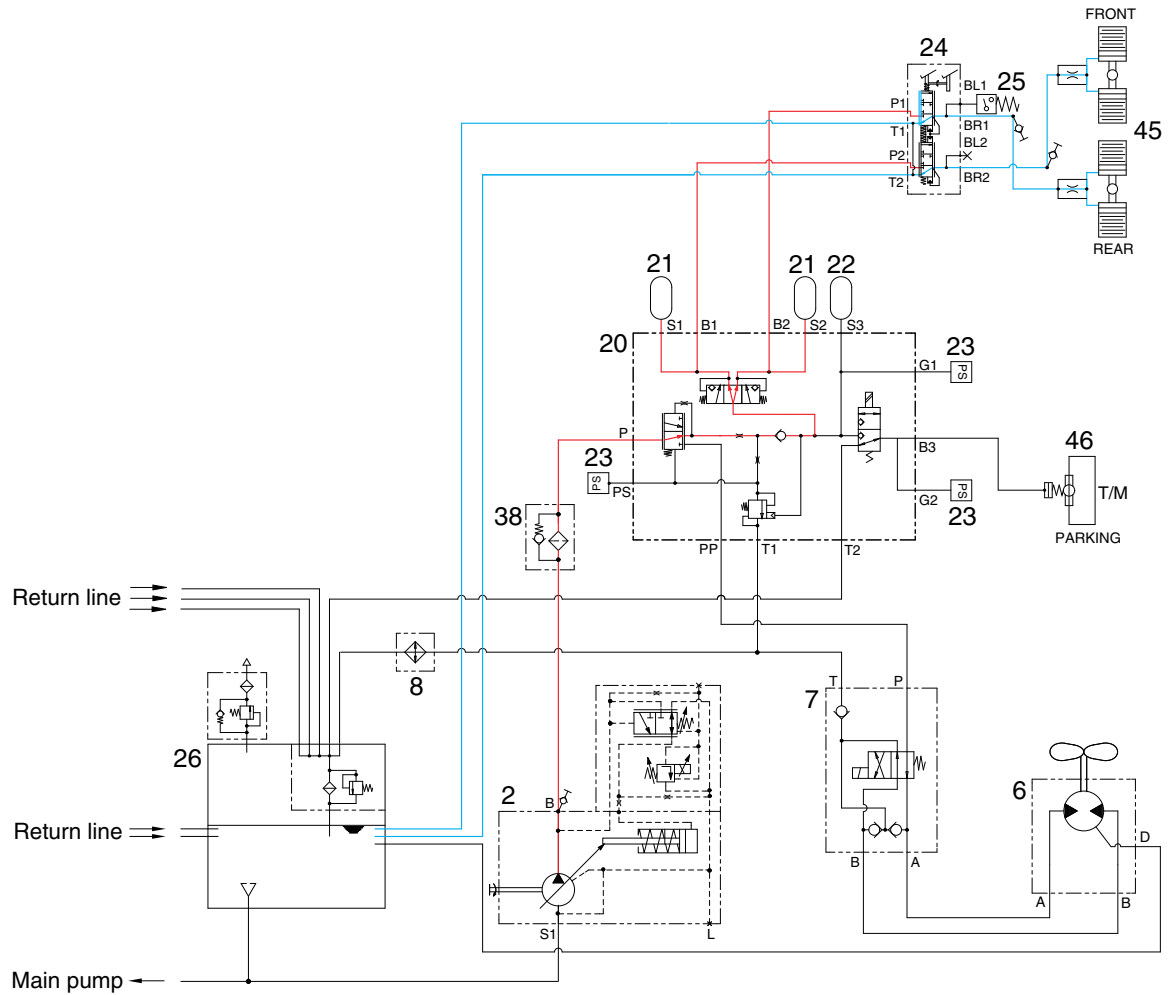
## 2. HYDRAULIC CIRCUIT



955SA4BS01

- |    |                   |    |                 |    |                      |
|----|-------------------|----|-----------------|----|----------------------|
| 2  | Fan & brake pump  | 21 | Accumulator     | 26 | Hydraulic tank       |
| 6  | Fan motor         | 22 | Accumulator     | 38 | Filter assy          |
| 7  | Directional valve | 23 | Pressure sensor | 45 | Axle                 |
| 8  | Oil cooler        | 24 | Brake valve     | 46 | Parking brake at T/M |
| 20 | Cut-off valve     | 25 | Pressure sensor |    |                      |

## 1) SERVICE BRAKE RELEASED



955SA4BS02

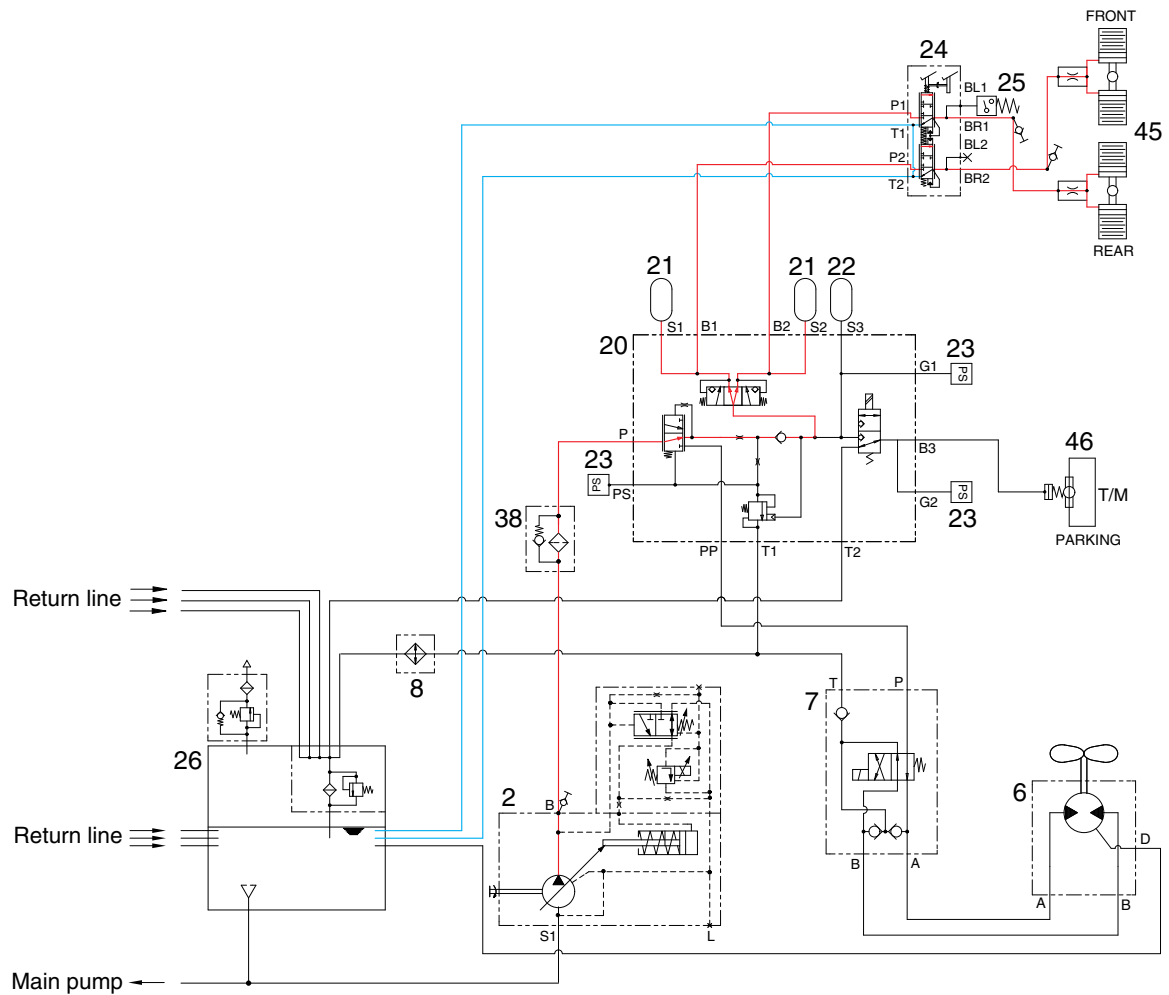
When the pedal of brake valve (24) is released, the operating force is eliminated by the force of the spring, and the spool is returned.

When the spool removes up, the drain port is opened and the hydraulic oil in the piston of axles return to the tank (26).

Therefore, the service brake is kept released.



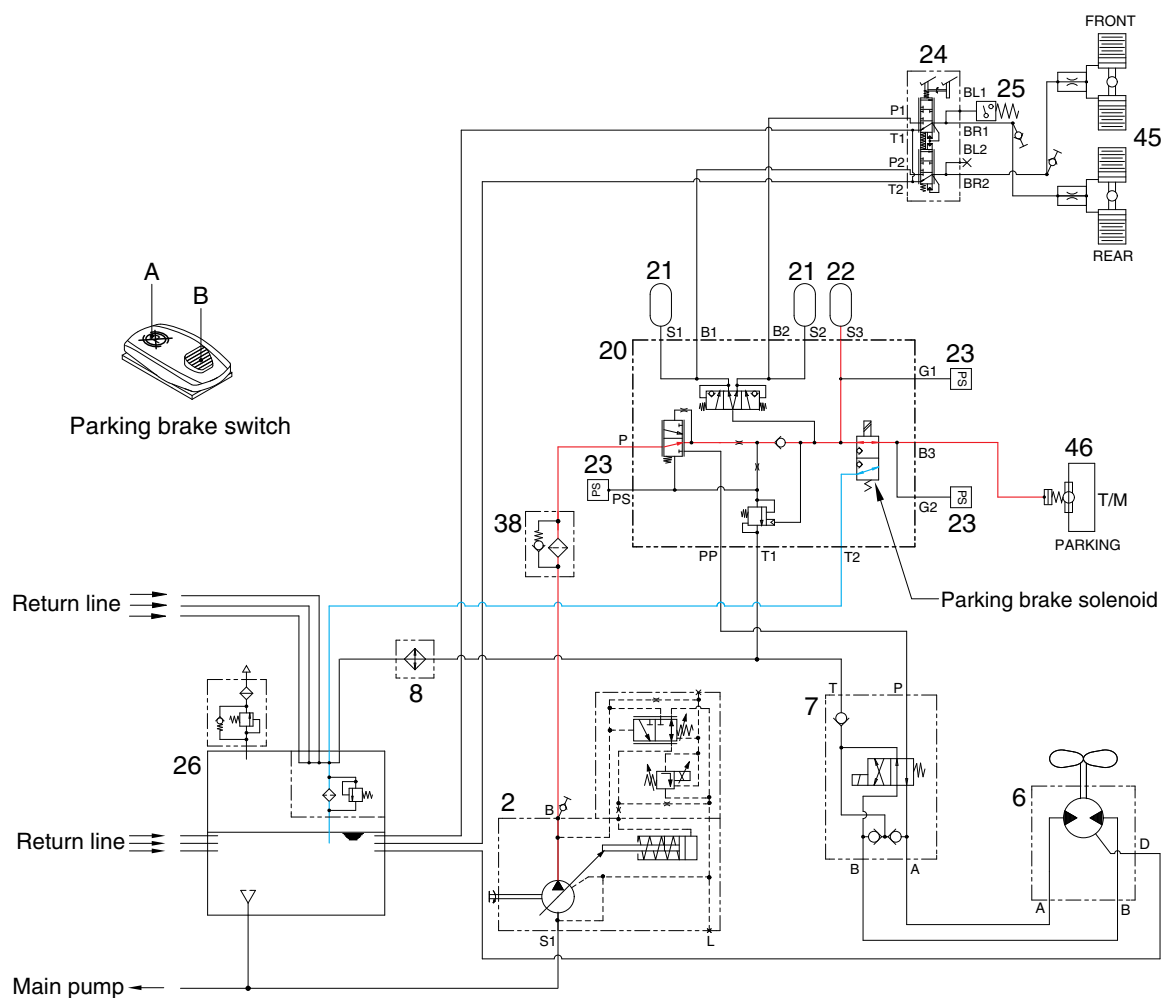
## 2) SERVICE BRAKE OPERATED



955SA4BS03

When the pedal of brake valve (24) is depressed, the operating force overcomes the force of the spring, and is transmitted to the spool. When the spool moves down, the inlet port is opened, and at the same time the hydraulic oil controlled the pressure level by the cut-off valve (20) enters the piston in the front and rear axles. Therefore, the service brake is applied.

### 3) PARKING BRAKE RELEASED

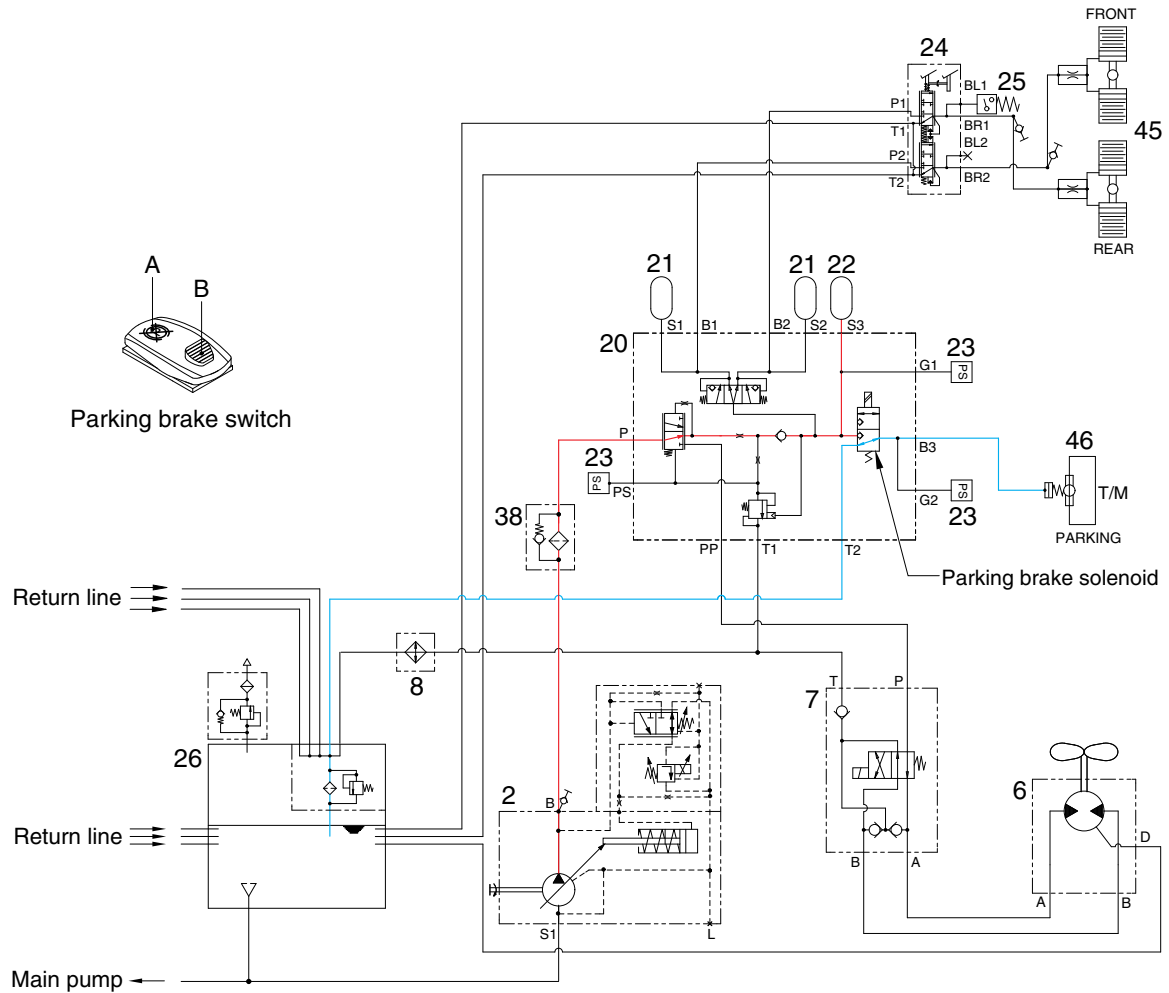


955SA4BS04

When the parking brake switch is pressed A position, the solenoid valve is energized and the hydraulic oil controlled the pressure level by the cut-off valve enters the parking brake. It overcomes the force of the spring and pushes the piston rod. This releases the brake.

Therefore, the hydraulic oil pressure is applied to the parking brake piston through the solenoid valve and the parking brake is kept released.

#### 4) PARKING BRAKE OPERATED

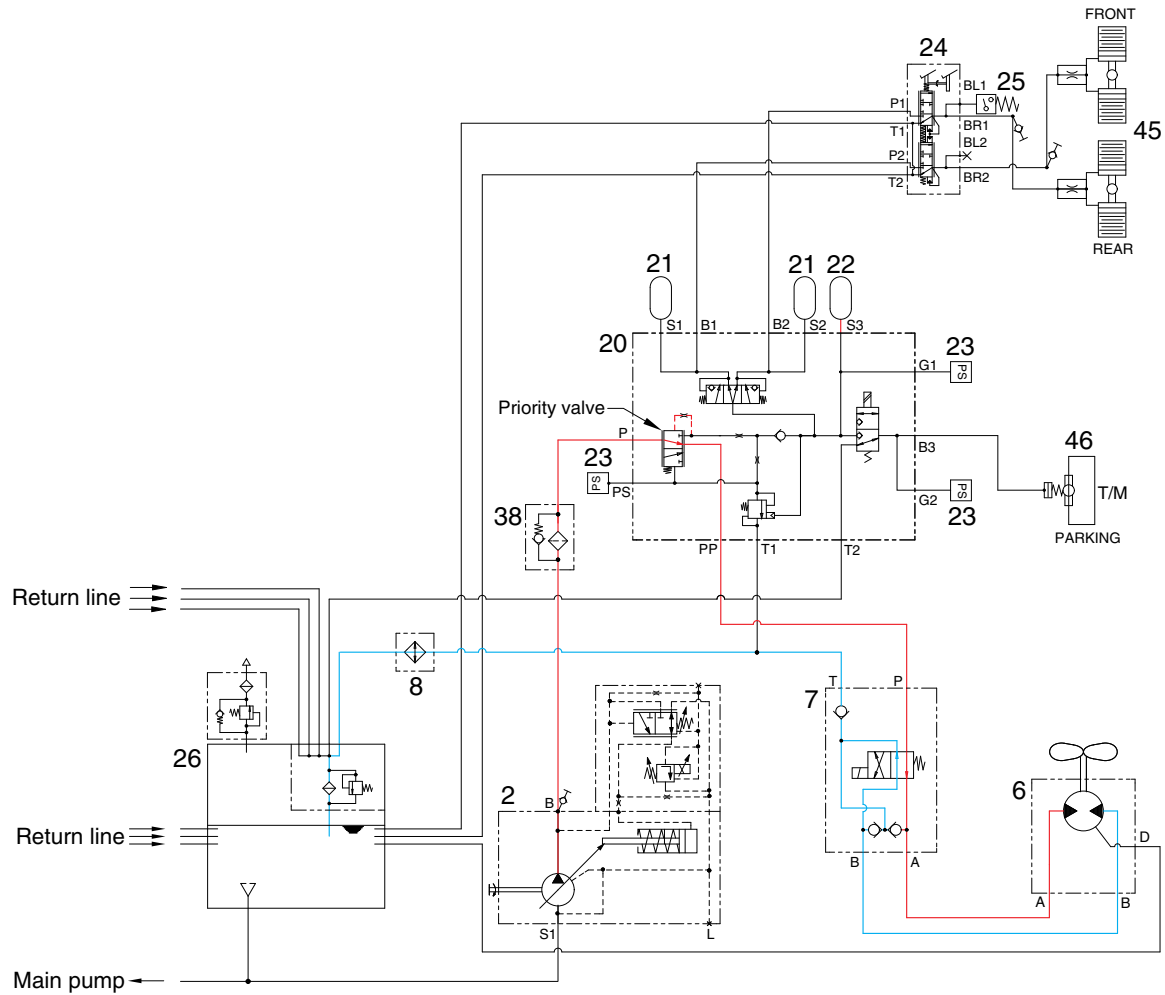


955SA4BS05

When the parking brake switch is pressed B position, the solenoid valve is deenergized and the valve open the drain port.

At the same time, the hydraulic oil in the parking brake return to the tank through the solenoid valve. When the piston rod is returned by the force of the spring, the parking brake is applied.

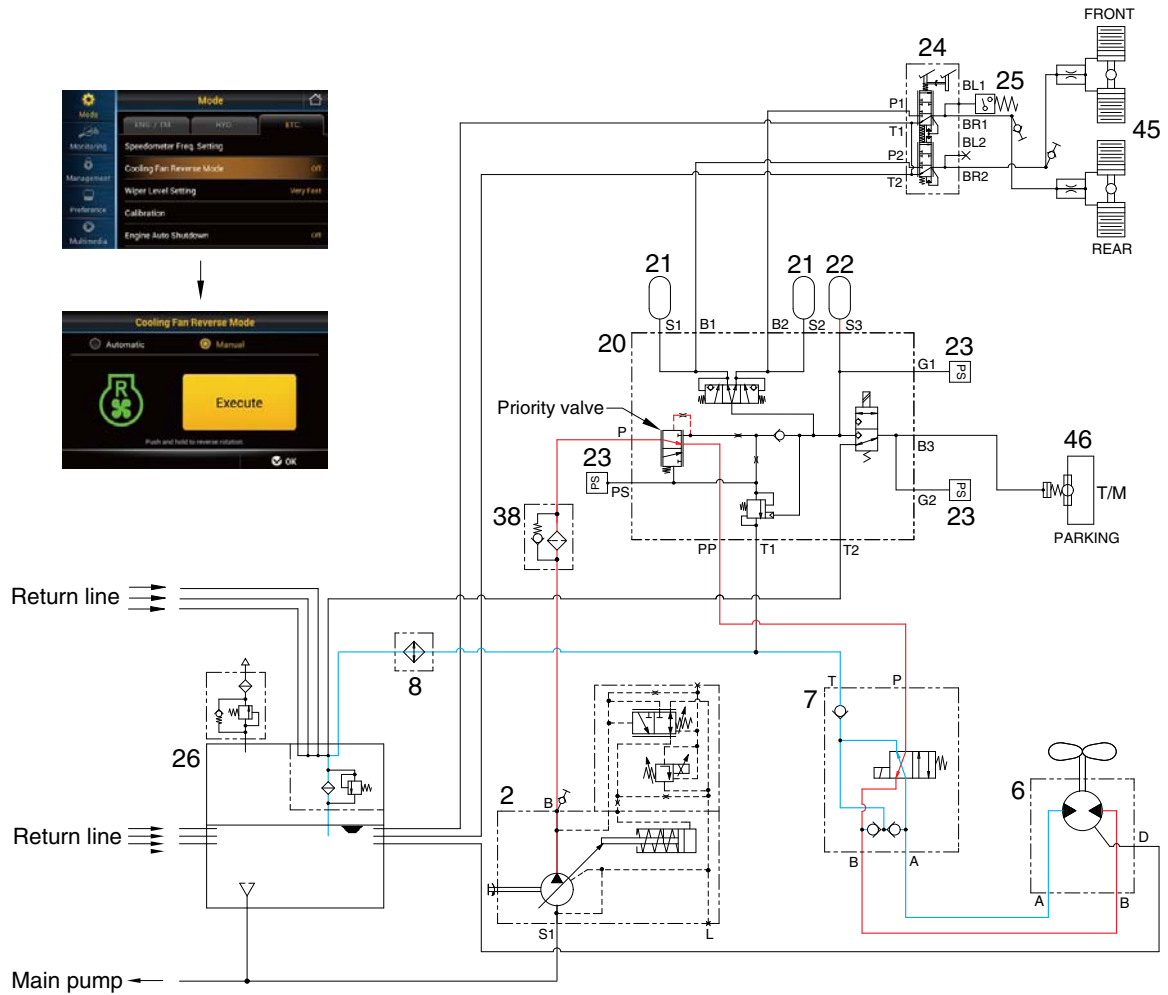
## 5) FAN MOTOR OPERATED



955SA4BS06

When the brake accumulators are fully charged, the priority valve switches position and the oil is directed to hydraulic fan motor through directional valve (30). The flow of the oil causes fan motor (29) to rotate the fan blade. The rotation of the fan forces cool air to flow through the cooler.

## 6) DIRECTIONAL VALVE OPERATED

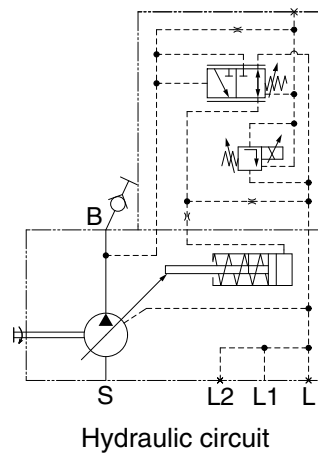
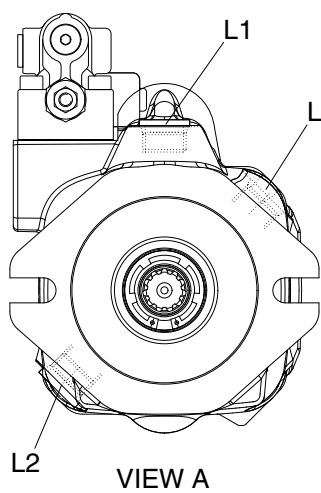
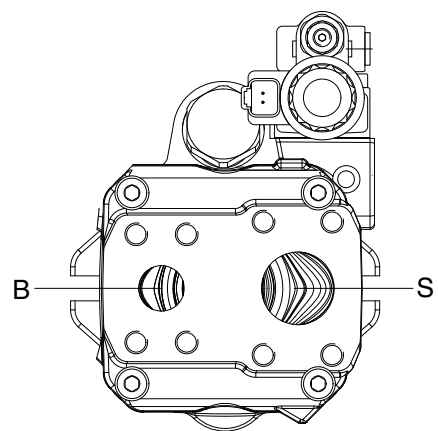
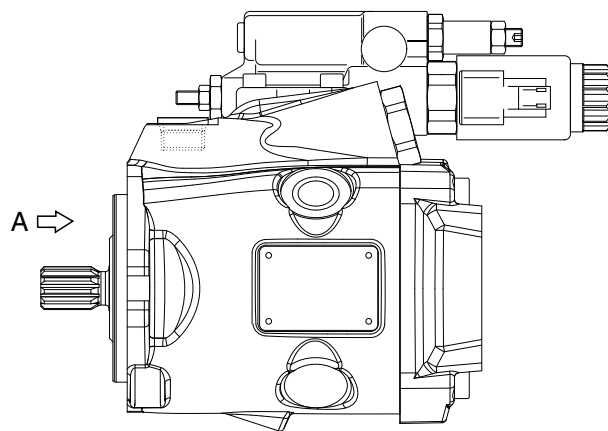


955SA4BS07

When the cooling fan reverse mode is selected manual or automatic mode, the solenoid valve in the directional valve (7) is energized and the flow of the oil is changed. The rotation of the fan is reversed to clear the radiators.

### 3. FAN AND BRAKE PUMP

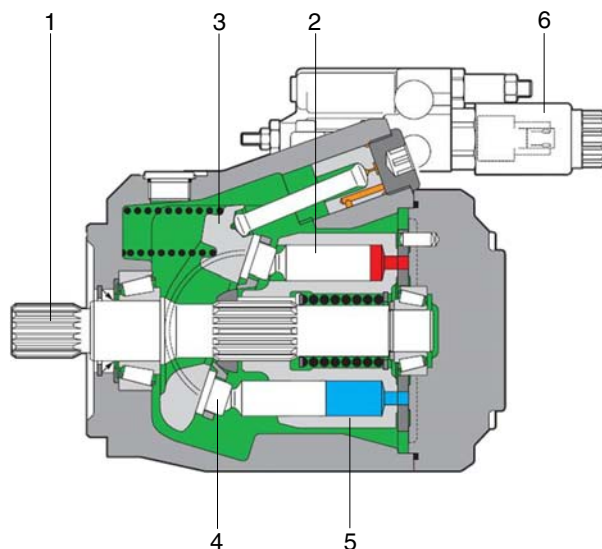
#### 1) STRUCTURE



Port	Port name	Port size
B	Delivery port	SAE 3/4"
S	Suction port	SAE 1 1/4"
L, L1, L2	Drain port	3/4-16UNF-2B

7609A4BS30

## 2) OPERATION



7609A4BS31

The pump is a variable displacement piston pump. This pump has a maximum delivery pressure of 250 kgf/cm<sup>2</sup>. The axial piston type pump is used to supply oil flow to the cut off valve. The oil is pressurized by the movement of rotary group in the pump.

When the engine is in operation, the drive shaft (1) is driven by the gears in the engine with rotary group. There are nine piston assemblies (2) in rotary group.

Each piston inside cylinder (5) is held against swashplate (3) by piston shoe (4). Swashplate can be any angle between the maximum angle and the neutral angle. The angle of swashplate determines the amount of oil that is pushed out of each cylinder.

The neutral angle is perpendicular with drive shaft (1). When swashplate(3) is at the neutral angle, pistons (2) do not move in and out of rotating cylinder. Therefore, no oil is drawn into the pump and no oil is pushed out of the pump. The pump has zero displacement and zero flow.

When swashplate (3) is at the maximum angle, pistons (2) move in and out of cylinder. The movement of the pistons allows the maximum amount of oil to be drawn into the cylinder. The pump will produce the maximum displacement.

The swashplate (3) angle is controlled by command current signal to control valve solenoid (6). The pump output pressure level can be set by the solenoid current. When the solenoid current signal drops toward a zero value, the pump output pressure level is the maximum.

### ※ FAN SYSTEM OPERATION

When the brake system pressure is below minimum pressure ( $125 \pm 5$  bar), it has the high priority than the fan system. Pump flow to the fan motor is blocked while brake system is charged.

However, The fan system has controlled pump when the brake system pressure is charged.

The fan speed solenoid valve (6) controls the pressure (fan speed) of pump when the brake system is fully charged.

The fan speed solenoid valve (6) is a proportional solenoid. As current to the fan speed solenoid increases, pump output pressure decreased, therefore, the fan motor rotates slower.

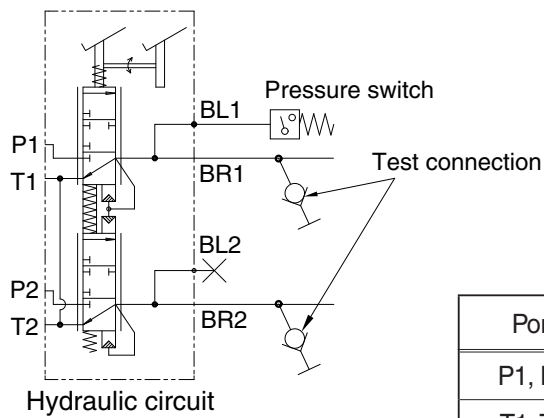
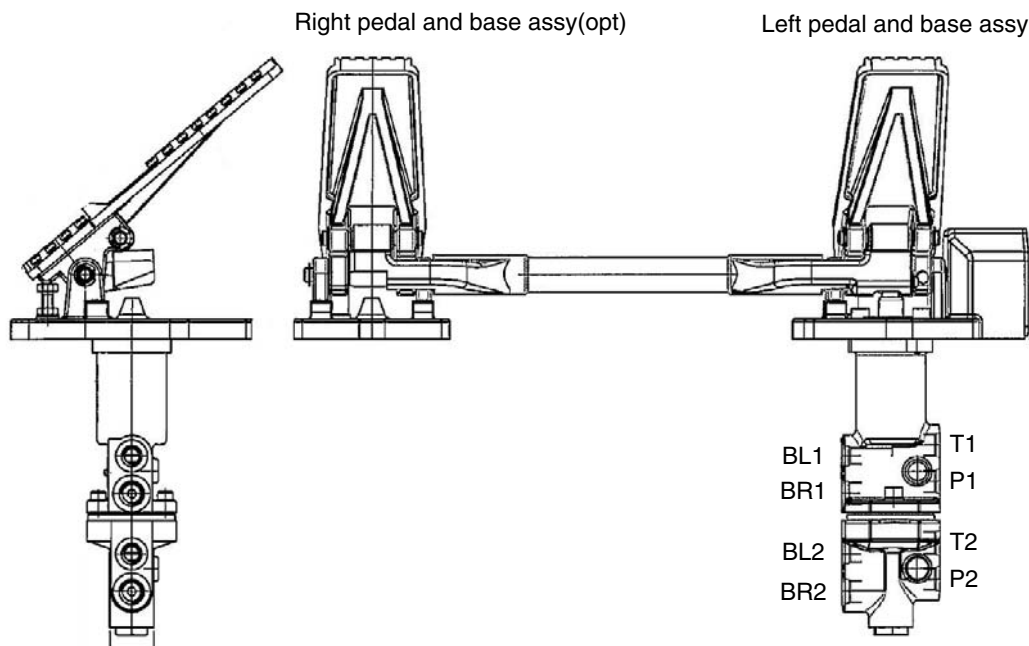
When the current of the fan speed solenoid valve (6) is reduced, the output pressure is increased.

The pump will be stroked and the pump will send maximum flow to the fan motor, thus, the fan motor is turning faster.



## 4. BRAKE VALVE

### 1) STRUCTURE



970A4BS08

Port	Port name	Port size
P1, P2	Pressure port	PF 3/8
T1, T2	Return port	PF 3/8
BR1, BR2	Brake cylinder port	PF 3/8
BL1, BL2	Pressure switch port	PF 1/4

- Brake pressure specification :  $80 \pm 5$  bar ( $1160 \pm 70$  psi)

## **2) OPERATION**

### **(1) Purpose**

The purpose of the brake valve is to sensitively increase and decrease the braking pressure when the brake pedal is actuated.

### **(2) Ready position**

When the braking system is ready for operation, its accumulator pressure acts directly on ports (P1, P2) of the brake valve. A connection is established between ports (BR1, BR2) and ports (T1, T2) so that the wheel brake ports (BR1, BR2) are pressureless via the returns ports (T1, T2).

### **(3) Partial braking**

When the brake valve is actuated, an amount of hydraulic pressure is output as a ratio of the foot force applied.

The spring assembly beneath base is designed in such a way that the braking pressure changes depending on the angle. In the lower braking pressure range, the machine can be slowed sensitively.

When the braking process is commenced, the upper spool is mechanically actuated via spring assembly, and the lower spool is actuated hydraulically by spool. As spools move downward, they will first close returns (T1, T2) via the control edges, thus establishing a connection between accumulator ports (P1, P2) and ports (BR1, BR2) for the wheel brake cylinders. The foot force applied now determines the output braking pressure. The control spools are held in the control position by the force applied (Spring assembly above the spools and the hydraulic pressure below the spool (Balance of forces).

After output of the braking pressure, spools are in a partial braking position, causing ports (P1, P2) and ports (T1, T2) to close and holding the pressure in ports (BR1, BR2).

### **(4) Full braking position**

When pedal is fully actuated, end position of the brakes is reached and a connection established between accumulator ports (P1, P2) and brake cylinder ports (BR1, BR2). Returns (T1, T2) are closed at this point.

When the braking process is ended, a connection is once again established between brake cylinder ports (BR1, BR2) and return ports (T1, T2), closing accumulator ports (P1, P2).

The arrangement of spools in the valve ensures that even if one braking circuit fails the other remains fully operational. This is achieved by means of the mechanical actuation of both spools and requires slightly more pedal travel.

### **(5) Failure of a circuit**

In the event of the lower circuit failing, the upper circuit will remain operational. Spring assembly will mechanically actuate spool.

In the event of the upper circuit failing, the lower circuit will remain operational since the lower spool is mechanically actuated by spring assembly and spool.

### **(6) Installation requirements**

Return lines (T1, T2) must be connected directly to the tank.

The connecting lines must be installed in such a way as to permit proper bleeding.

#### **(7) Maintenance of the brake valve**

No special maintenance beyond the legal requirements is necessary.

When using high-pressure cleaners on the machine, please make sure that the water jet is not aimed directly at the brake valve (to prevent damaging the bellows).

- △ **For safety reasons the whole of the brake valve must be replaced if parts other than those listed above are damaged.**

#### **(8) Repair work**

- △ When working on the braking system, always make sure that there is absolutely no pressure in the system. Even when the engine is switched off there will be some residual pressure in the system.
- ※ When doing repair work, make sure your environment is very clean.  
Immediately close all open ports on the components and on pipes using plugs.

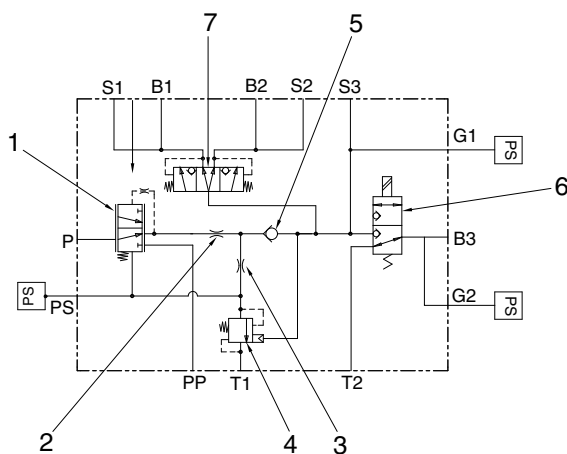
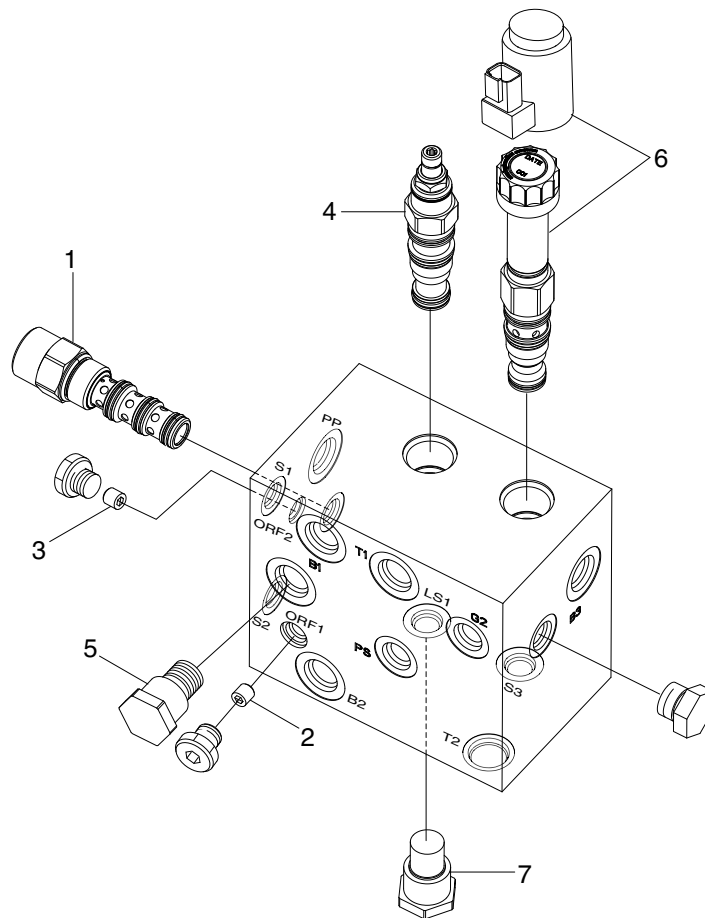
#### **(9) Replacing the complete actuating mechanism**

Carefully clamp the unit vertically in a fixture. The actuating mechanism can be removed by taking out the three bolts. Make sure that spring assembly does not fall out. When installing the new actuating mechanism, make sure that spring assembly is fitted in the right order.

Tighten the three bolts.

## 5. CUT-OFF VALVE

### 1) STRUCTURE



Hydraulic circuit

970A4BS32

- 1 Priority valve
- 2 Orifice
- 3 Orifice
- 4 Pressure control valve
- 5 Check valve
- 6 Coil, Solenoid valve
- 7 Directional valve

## 2) OPERATION

The pressure control valve (4) controls the minimum and maximum pressure of the braking system. When the service brake pressure is below the maximum pressure ( $125 \pm 5$  bar), the pressure control valve (4) is blocked and PS pilot pressure (brake priority pressure) increases.

As soon as PS pilot pressure raises up above 15 bar, pump controller current is reduced by MCU (pressure sensor detects brake priority pressure, and pump supply flow and pressure in order to meet the brake system).

The pressure sensor at PS port detect whether brake system needs to be charged.

Priority valve spring and pilot pressure (brake priority pressure) pushed priority spool to the upward.

Therefore, full pump flow directly goes to the brake system in order to satisfy the demand of the brake system.

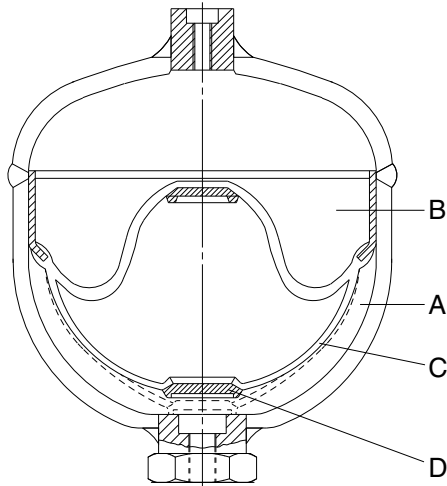
Pump flow goes through the following components : orifice (2), check valve (5), directional valve (7). Brake failure pressure sensor at G1 port detects pressure in the brake accumulators.

When the pressure is lower than 100 bar, the sensor activates warning lamp on the cluster in order to check brake system.

When brake system pressure reaches the maximum brake system pressure ( $150 \text{ bar} \pm 5 \text{ bar}$ ), pressure control valve (4) opens, pilot pressure (brake priority pressure) of priority valve is low by draining the spring side of priority valve (1) to hydraulic tank through valve (4).

## 6. BRAKE ACCUMULATOR

### 1) STRUCTURE



Item	31LL-40020 (item22)	31AC-10030 (item21)
Diameter	167 mm	136 mm
Mounting height	219 mm	159 mm
Norminal volume	2.0 ℓ	1.0 ℓ
Priming pressure	50 kgf/cm <sup>2</sup>	50 kgf/cm <sup>2</sup>
Operating medium	Oil	Oil
Operating pressure	Max 210 kgf/cm <sup>2</sup>	Max 200 kgf/cm <sup>2</sup>
Thread	M22 × 1.5	M22 × 1.5
Priming gas	Nitrogen	Nitrogen

A Fluid portion

B Gas portion

C Diaphragm

D Valve disk

★ : Cold region

75794BS09

### 2) OPERATION

#### (1) Purpose

Fluids are practically incompressible and are thus incapable of accumulating pressure energy. In hydropneumatic accumulators, the compressibility of a gas is utilized to accumulate fluid. The compressible medium used in the accumulators is nitrogen.

In braking systems, the purpose of the accumulators is to store the energy supplied by the hydraulic pump. They are also used as an energy reserve when the pump is not working, as a compensator for any losses through leakage, and as oscillation dampers.

#### (2) Operation

The accumulator consists of a fluid portion (A) and a gas portion (B) with a diaphragm (C) as a gas-tight dividing element. The fluid portion (A) is connected to the hydraulic circuit, causing the diaphragm accumulator to be filled and the gas volume to be compressed as the pressure rises.

When the pressure falls, the compressed gas volume will expand, thus displacing the accumulated pressure fluid into the circuit.

The diaphragm bottom contains a valve disk (D) which, if the diaphragm accumulator is completely empty, closes the hydraulic outlet, thus preventing damage to the diaphragm.

#### (3) Installation requirements

The accumulators can be fitted in the hydraulic circuit, directly on a component or in blocks on suitable consoles.

They should be fitted in as cool a location as possible.

Installation can be in any position.

#### (4) Maintenance of the accumulator

No special maintenance beyond the legal requirements is necessary.

The accumulator should be checked annually. It should be replaced if the initial gas pressure has fallen by more than 30% (please refer to Performance testing and checking of the accumulator).

#### (5) Disposal of the accumulator

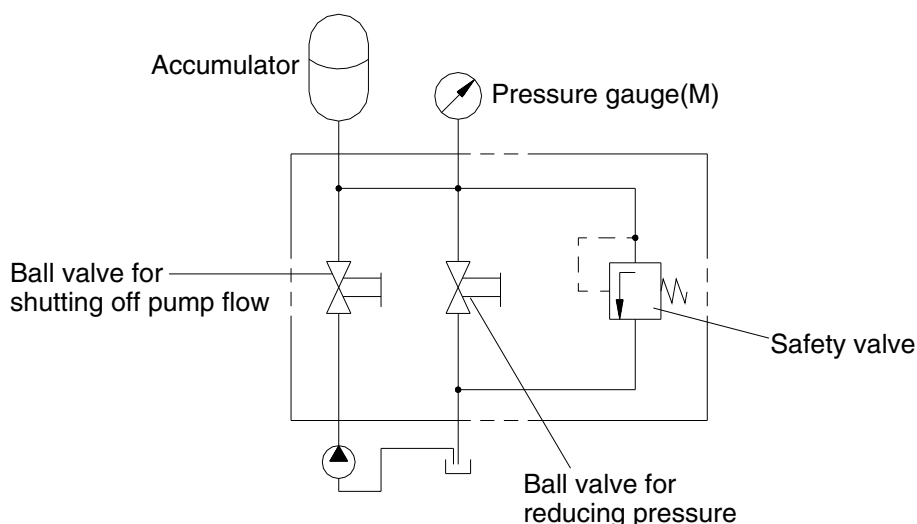
Before the accumulator is scrapped, its gas filling pressure must be reduced. For this purpose, drill a hole through gas chamber (B) using a drill approx. 3mm in diameter. The gas chamber is located on the side opposite the threaded port above the welding seam around the center of the accumulator.

※ Wear safety goggles when doing this job.

#### (6) Performance testing and checking of the accumulator

The accumulator is gradually pressurized via the test pump; until the initial gas pressure is reached, the hydraulic pressure in the accumulator will rise abruptly. This is apparent from gauge **M**. If the initial gas pressure is more than 30% below the prescribed value, the accumulator needs to be replaced. If the measuring process needs to be repeated, wait for intervals of 3 minutes between the individual tests. Any accumulator whose initial gas pressure is insufficient must be scrapped following the instructions under **Disposal of the accumulator**.

The amount of initial gas pressure can also be checked from the vehicle. Start the vehicle's engine. The pump will now supply oil to the accumulators. Until the initial gas pressure is reached, the hydraulic pressure in the accumulator will rise abruptly. This is apparent from the gauge in the cab. If the initial gas pressure is more than 30% below the prescribed value, that initial pressure lies outside the permissible range for **at least one** of the accumulators fitted in the vehicle. This accumulator can be traced only by using the method described above, i.e. all accumulators have to be individually tested. The accumulator whose initial gas pressure is insufficient must be replaced and scrapped following the instruction under **Disposal of the accumulator**.



75794BS10

#### (7) Repair work

△ When working on the braking system, always make sure that there is absolutely no pressure in the system. Even when the engine is switched off there will be some residual pressure in the system.

※ When doing repair work, make sure your environment is very clean.

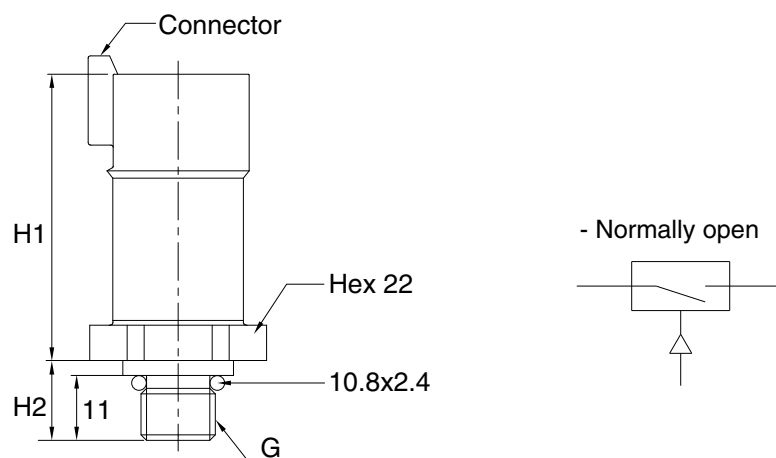
Immediately close all open ports on the components and on pipes using plugs.

△ For safety reasons the accumulators need to be replaced as a whole if damaged.



## 7. PRESSURE SENSOR AND SWITCH

### 1) STRUCTURE



7609A4BS12

### 2) TECHNICAL DATA

Item	Type	Medium	G	H1 mm	H2 mm	Adjusting range kgf/cm <sup>2</sup>	Actuating pressure kgf/cm <sup>2</sup>	Voltage V
Parking pressure sensor	-	Oil	PF 1/4"	45	12.5	0 ~ 200	100 ± 5	Max 30
Charging pressure sensor	-	Oil	PF 1/4"	45	12.5	0 ~ 200	100 ± 5	Max 30
Brake priority pressure sensor	-	Oil	PF 1/4"	45	12.5	0 ~ 200	100 ± 5	Max 30
Brake stop pressure switch	NO	Oil	PF 1/4"	45	12.5	1 ~ 10	5 ± 1	Max 32

NO : Normally open

3) Tightening torque : 3.5 kgf · m (25.3 lbf · ft)

## **2) OPERATION**

### **(1) Purpose**

The pressure switches are used to visually or audibly warn the driver of the pressure within the system.

### **(2) Make contact / circuit closer**

The pressure switch can be fitted in the braking system or directly on one of its components.

The system pressure acts on an absorption area within the switch, making an electrical contact as the pressure on that area is increased. The resulting current is used to activate a warning facility, for instance.

### **(3) Break contact / circuit breaker**

The pressure switch can be fitted in the braking system or directly on one of its components.

The system pressure acts on a absorption area within the switch, breaking an electrical contact as the pressure on that area is increased. The current is now broken, e.g. to deactivate a warning facility.

### **(4) Installation requirements**

No special measures need to be taken.

### **(5) Maintenance of the pressure switch**

No special maintenance beyond the legal requirements is necessary.

When using high-pressure cleaners on the vehicle, please make sure that the water jet is not directed at the pressure switch (corrosion of contacts).

### **(6) Repair work**

△ When working on the braking system, always make sure that there is absolutely no pressure in the system. Even when the engine is switched off there will be some residual pressure in the system.

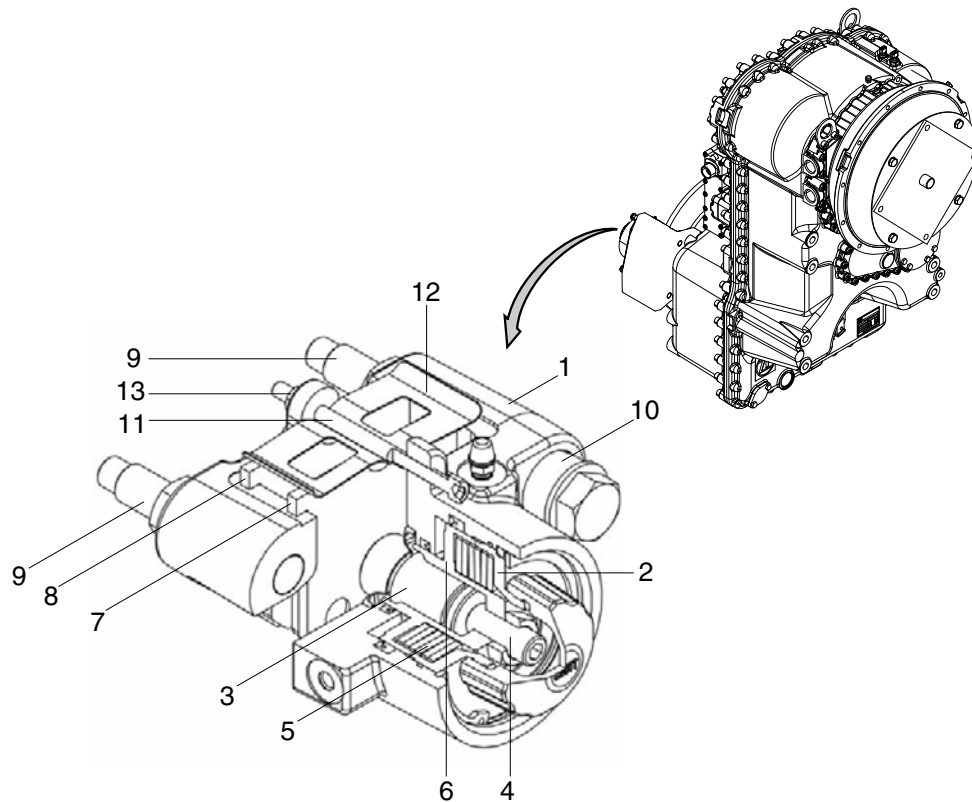
※ When doing repair work, make sure your environment is very clean.

Immediately close all open ports on the components and on pipes using plugs.

※ For safety reasons the pressure switch needs to be replaced as a whole if damaged.

## 8. PARKING BRAKE SYSTEM

### 1) STRUCTURE



7609A4BS21

- |   |                   |    |               |    |                 |
|---|-------------------|----|---------------|----|-----------------|
| 1 | Housing           | 6  | Piston        | 11 | Adjusting screw |
| 2 | Pressure ring     | 7  | Lining pad    | 12 | Lining spring   |
| 3 | Pressure bolt     | 8  | Lining pad    | 13 | Counter nut     |
| 4 | Setting screw     | 9  | Guiding pin   |    |                 |
| 5 | Plate spring pack | 10 | Rubber buffer |    |                 |

## 2) OPERATION

The two identical lining pads (7, 8) slide on the guide surfaces on the top of the housing and are held in position by a lining spring (12). The brake itself is directly fixed on the gearbox with the two guide pins (9).

The brake is positioned axially using the rubber buffers (10) between the brake housing (1) and the guide pins (9), and the setting screw (11).

When the brake is actuated (= closed) a clamping force is created on the lining pads (7, 8) which is transmitted to the brake disc. Under the force of the plate spring pack (5), the piston (6), together with the adjusting screw (4), the pressure bolt (3) and the lining pad (7) are moved towards the brake disc. When the lining pad (7) comes into contact with the brake disc, the reaction force displaces the brake on the guide pins (9), against the spring force of the rubber buffers (10), until the second lining pad (8) is also pressed against the brake disc.

The braking effect (braking torque) is dependent upon the frictional values of the brake linings.

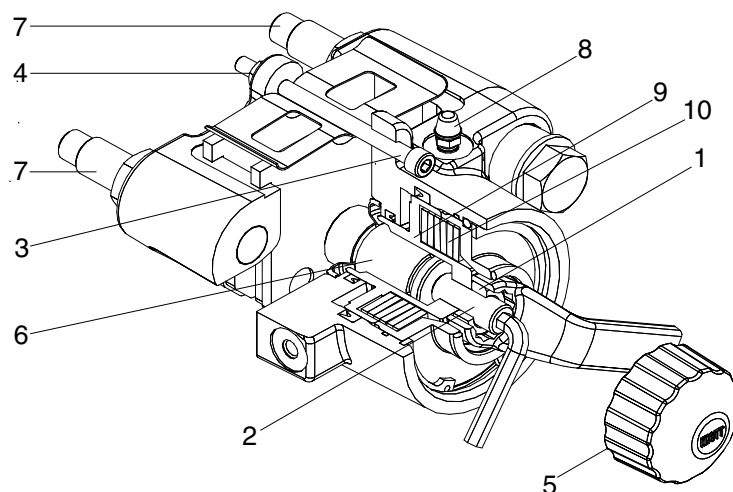
The brake is released by complete pretensioning of the plate spring pack (5). The piston (6) is moved back by the required minimum release pressure to the stop on the pressure ring (2).

During this process the brake positions itself, depending upon the setting, by the two rubber buffers (10) up to contact with the setting screw (11). An equal air gap must be guaranteed on both sides of the brake disc when set correctly.

The clamping force is reduced by wear of the lining pads (7, 8) and the brake disc.

The brake must then be readjusted.

### 3) FITTING AND SETTING INSTRUCTIONS



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- |   |                 |   |                |    |             |
|---|-----------------|---|----------------|----|-------------|
| 1 | Lock nut        | 5 | Screw cap      | 9  | Piston      |
| 2 | Setting screw   | 6 | Pressure bolt  | 10 | Spring pack |
| 3 | Adjusting screw | 7 | Guiding bolt   |    |             |
| 4 | Counter nut     | 8 | Bleeding screw |    |             |

※ The fitting or adjusting must always be carried out when the brake is cold.

#### (1) Fitting the brake

- ① Rotate the screw cap (5) in a counter-clockwise direction and unscrew it.
- ② Release the lock nut (1) and turn the adjusting screw (2) counter-clockwise until the pressure bolt (6) contacts the piston (9) with the flat surface.
- ③ Slide the brake over the brake disc in this condition.
- ④ Screw the two guide pins (7) into the gearbox in accordance with the fitting instructions. Refer to page 3-181.
- ⑤ Connect the pressure.
- ⑥ Apply the required release pressure (min. 130 bar) to the brake in order to pre-tension the plate spring pack (10) completely, up to the stop.
- ⑦ Carry out bleeding of the brake using the bleed valve (8) .

## (2) Clearance adjusting

- ① Insert a setting gauge on both sides between the brake lining carrier and brake disc and hold them in position.

※ The thickness of the setting gauge must be adjusted to the desired air gap.

Clearance		Setting gauge
Min.	0.5 mm	0.25 mm
Nominal clearance	1.0 mm	0.50 mm
Max.	1.5 mm	0.75 mm

- ② Turn the adjusting screw (2) in a clockwise direction until the two setting gauges are clamped between the brake lining carriers and the brake disc.

- ③ Hold the adjusting screw (2) in position and lock using the lock nut (1).

※ The application pressure for clamping the setting gauges must be selected so that both gauges can be removed using a small amount of force after locking in position.

- ④ Release the counter nut (4) and then turn the setting screw (3) in a clockwise direction until the end surface of the setting screw (3) is in contact with the surface provided for setting.

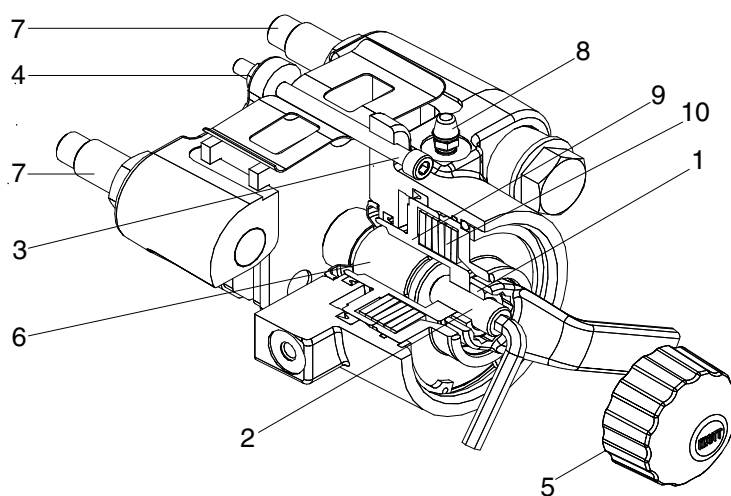
- ⑤ Hold the setting screw (3) in position and lock using the counter nut (4).

- ⑥ Remove the setting gauges from both sides of the brake disc.

※ The fitting procedure for the brake and the setting of the desired air gap is now complete.  
The brake is ready for use.

- ⑦ Turn the screw cap (5) in a clockwise direction and tighten hand-tight.

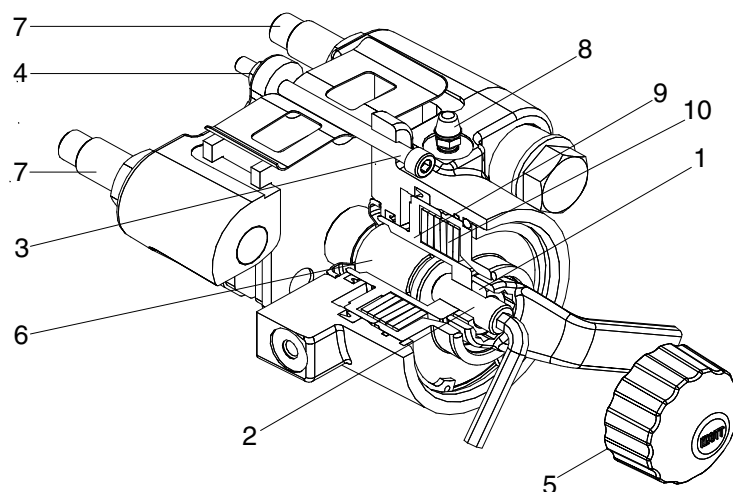
※ The brake should be actuated and released several times to check that it is functioning properly.



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### (3) Adjusting instructions

- ① Place the machine on flat ground and secure against rolling away.
- ② Release the parking brake by application of the required release pressure (min. 130 bar).
- ③ Rotate the screw cap (5) in a counter-clockwise direction and unscrew it.
- ④ Release the lock nut (1) of the setting screw (2).
- ⑤ Insert a setting gauge on both sides between the brake lining carrier and brake disc and hold them in position.
- ※ **The setting gauge must be selected in accordance with the table under (2) "Clearance adjusting".**
- ⑥ Turn the setting screw (2) in a clockwise direction until the two setting gauges are clamped between the brake lining carriers and the brake disc.
- ⑦ Apply the lock nut (1) to the setting screw (2).
- ※ **The application pressure for clamping the setting gauges must be selected so that both gauges can be removed using a small amount of force after locking in position.**
- ⑧ Release the counter nut (4) and then turn the adjusting screw (3) in a clockwise direction until the end surface of the adjusting screw (3) is in contact with the surface provided for setting.
- ⑨ Hold the adjusting screw (3) in position and lock using the counter nut (4).
- ⑩ Remove the setting gauge from both sides of the brake disc.
- ※ **The adjustment of the desired air gap is now complete. The brake is ready for use.**
- ⑪ Turn the screw cap (5) in a clockwise direction and tighten hand-tight.
- ※ **Actuate the brake valve several times and check the holding effect of the parking brake on a suitable incline or a suitable gradient.**

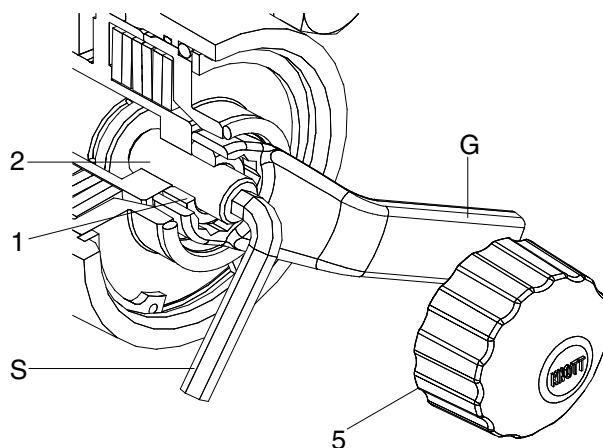


7609A4BS22



#### 4) EMERGENCY RELEASE OF THE PARKING BRAKE

In the event of a failure in pressure supply the parking brake can be released mechanically in the following way :



7609A4BS23

- 1 Lock nut
- 2 Setting screw
- 5 Screw cap

- S Peg spanner
- G Ring spanner

- (1) Secure the machine against rolling away.
  - (2) Rotate the screw cap (5) in a counter-clockwise direction and unscrew it.
  - (3) Release the lock nut (1) and unscrew it back to the end of the setting screw (2).
  - (4) Rotate the setting screw (2) in a clockwise direction until the brake disc is completely free.
- ※ For emergency release a torque of min 7.1 kgf·m (51.6 lbf·ft) is required on the setting screw (2).
- (5) Screw on the lock nut (1) up to contact with the piston and apply a slight locking force to the setting screw (2).
  - (6) Screw on the screw cap (5) in a clockwise direction by a few threads. (dirt ingress protection)
- ※ In this condition the machine has no parking brake facility and thus must be protected from rolling away by different means. The brake must be adjusted before recommissioning.

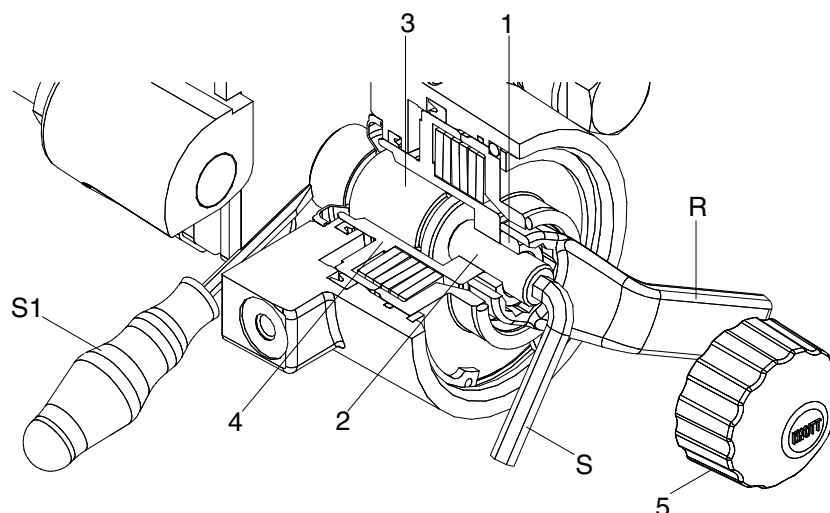
## 5) MAINTENANCE AND REPAIR WORK

### (1) Maintenance and replacement of the lining pads

The brake, particularly the brake lining carriers, must be visually inspected at regular intervals.

If the remaining lining thickness is too thin, these intervals must be reduced accordingly to prevent extensive damage to the brake or the brake disc.

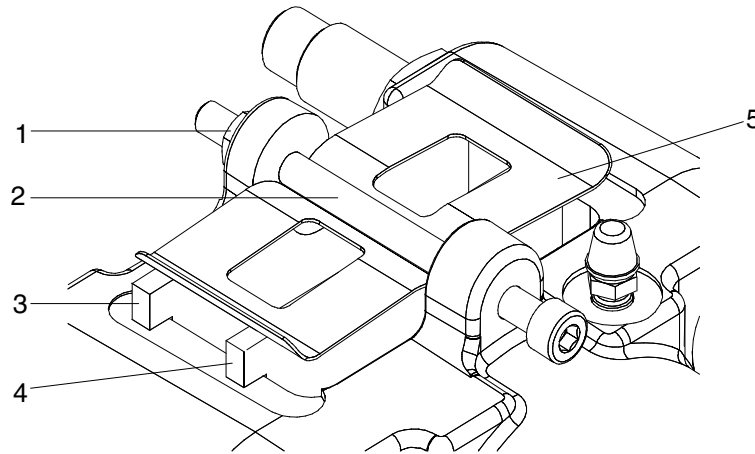
Once the minimum remaining lining thickness of 1.0 ~ 1.5 mm per brake lining carrier is reached, the brake lining carrier must be replaced in accordance with the following instructions :



7609A4BS24

- |   |               |    |              |
|---|---------------|----|--------------|
| 1 | Lock nut      | 5  | Screw cap    |
| 2 | Setting screw | S  | Peg spanner  |
| 3 | Pressure bolt | S1 | Screwdriver  |
| 4 | Piston        | R  | Ring spanner |

- ① Place the machine on flat ground and secure against rolling away.
- ② Release the parking brake by application of the required release pressure (min. 130 bar).
- ③ Rotate the screw cap (5) in a counter-clockwise direction and unscrew it.
- ④ Release the lock nut (1) of the setting screw (2).
- ⑤ Rotate the setting screw (2) in an counter-clockwise direction until the pressure bolt (3) can be pushed completely into the piston (4) .
- ⑥ Unscrew (lever) the pressure bolt (3) with a suitable screwdriver until it contacts the piston (4).



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- |   |                 |   |               |
|---|-----------------|---|---------------|
| 1 | Counter nut     | 4 | Lining pad    |
| 2 | Adjusting screw | 5 | Lining spring |
| 3 | Lining pad      |   |               |

⑦ Release the counter nut (1) and unscrew the adjusting screw (2) from the brake housing.

※ **The lining spring (5) is pre-tensioned. The lining spring (5) must be held in position with a suitable tool whilst removing the adjusting screw (2).**

⑧ Remove the lining spring (5).

⑨ Remove the two lining pads (3, 4) from the lining compartment in the brake housing.

※ **If there is no possibility of changing the brake lining carriers (3, 4) as described above (not enough space), the brake must be removed completely. The procedure for removing the brake from the gearbox can be taken from the fitting instructions. Refer to page 3-93.**

※ **Check the pressure line. A pressure line which is too short must be unscrewed in order to permit removal of the brake.**

**An emergency release of the parking brake must be carried out before releasing the pressure line.**

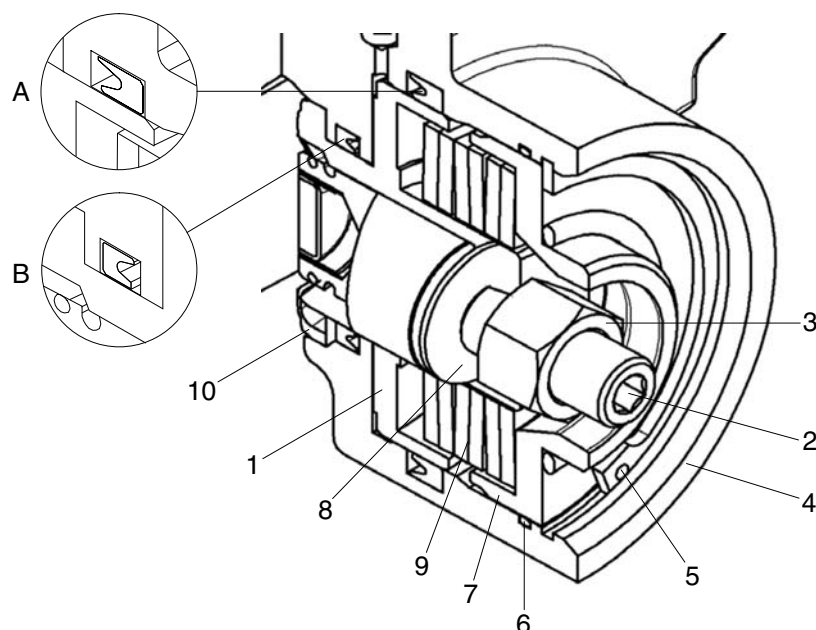
⑩ Replace the lining pads (3, 4).

⑪ The lining spring (5) must be pushed in position with a suitable tool whilst screwing in the adjusting screw (2).

※ **If you removed the brake completely because of a lack of space you must carry out fitting of the brake in accordance with the fitting instructions. Refer to page 3-181.**

※ **After changing the lining pads (3, 4), or repair to them, the brake must be adjusted in accordance with 3) FITTING AND SETTING INSTRUCTION.**

## (2) Replacing the seals



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1	Piston	5	Circlip	9	Plate spring pack
2	Setting screw	6	Sealring	10	Dust protection cap
3	Lock nut	7	Pressure ring	A	Detail sealing
4	Housing	8	Pressure bolt	B	Detail sealing

Leaking seals must be replaced in accordance with the following instructions :

- ① Place the machine on flat ground and secure against rolling away.
- ② Release the parking brake by application of the required release pressure (min. 130 bar).
- ※ **If the brake cannot be pressurised with the required release pressure (min. 130 bar) because of excessive leaks, the parking brake MUST be released using the emergency procedure. See 4) Emergency release of the parking brake.**
- ③ Rotate the screw cap in a counter-clockwise direction and unscrew it.
- ④ Release the lock nut (3) of the setting screw (2).
- ⑤ Rotate the setting screw (2) in an counter-clockwise direction until the pressure bolt (8) can be pushed completely into the piston (1).
- ⑥ Unscrew (lever) the pressure bolt (8) with a suitable screwdriver until it contacts the piston (1).
- ⑦ Actuate the brake valve and dissipate the existing release pressure down to 0 bar.
- ※ **The plate spring pack (9) is now fully de-tensioned.**
- ⑧ Unscrew the pressure line and remove the brake completely.
- ⑨ Remove the circlip (5) and remove the pressure ring (7) from the housing (4).
- ⑩ Remove the plate spring pack (9) and the piston (1).
- ⑪ Always replace both the seals (A, B).

- ※ Observe the fitting direction of the grooved rings and use a suitable fitting needle with rounded edges to fit the new grooved rings. Take care - there is a danger of injury.
- ※ Carry out re-fitting of the individual parts into the brake in reverse order. Apply a light coat of fitting fluid lubricant to the sliding and sealing surfaces of the piston when fitting.

⑫ If necessary, also replace the dust protection cap (10).

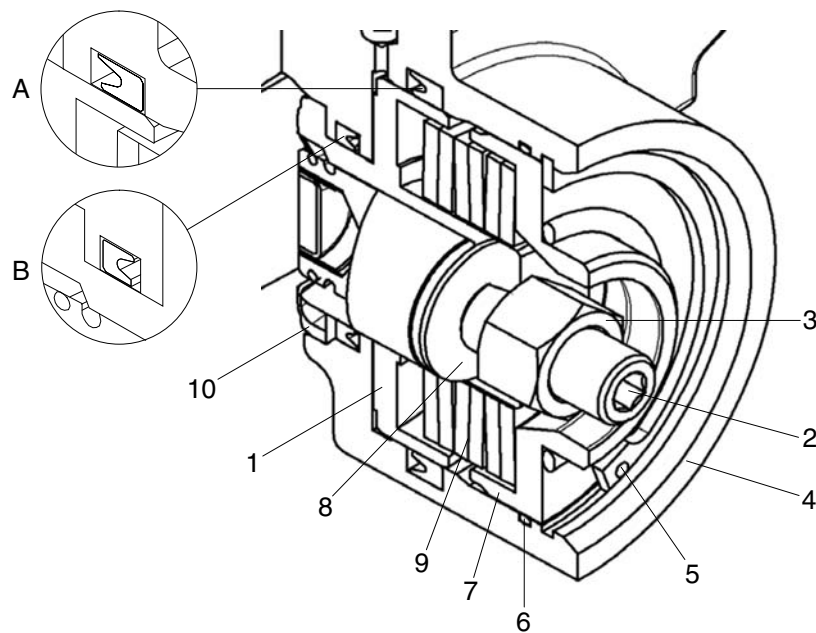
- ※ The dust protection cap (10) has a vulcanised-in steel ring which is used to press it into the opening in the brake housing (4).

In order to replace this you will need to "lever it out" with a suitable tool and then replace with a fitting fixture by pressing it into the housing (4).

⑬ Fit the brake onto gearbox in accordance with the fitting instructions. **Refer to page 3-181.**

### (3) General instructions

Any faults or damage detected on parts not listed here must, of course, be rectified or replaced by genuine parts.



7609A4BS26

## MEMORANDUM

## GROUP 2 OPERATIONAL CHECKS AND TROUBLESHOOTING

### 1. OPERATIONAL CHECKS

This procedure is designed so the mechanic can make a quick check of the system using a minimum amount of diagnostic equipment. If you need additional information, read **structure and function**, Group 1.

A location will be required which is level and has adequate space to complete the checks.

The engine and all other major components must be at operating temperature for some checks.

Locate system check in the left column and read completely, following the sequence from left to right. Read each check completely before performing.

At the end of each check, if no problem is found (OK), that check is complete or an additional check is needed. If problem is indicated (NOT OK), you will be given repair required and group location.

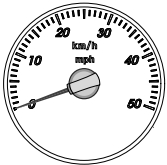
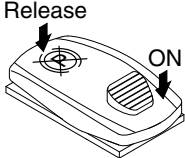
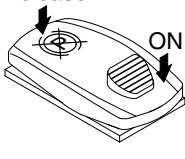
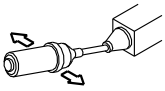
If verification is needed, you will be given next best source of information:

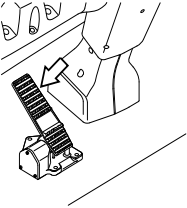


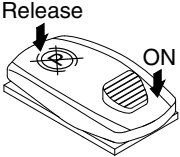
Chapter 2 : Troubleshooting




Group 3 : Tests and adjustments

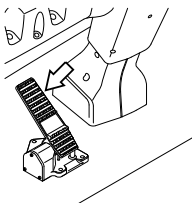

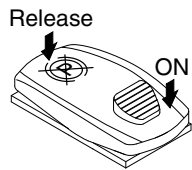

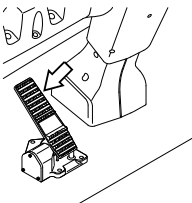


※Hydraulic oil must be at operating temperature for these checks (refer to page 6-49).

Item	Description	Service action
<b>Parking brake capacity check</b> Seat belt must be worn while doing this check to prevent possible injury when machine stops suddenly.	    Start engine. Fasten seat belt. Release parking brake and put transmission in 2nd gear forward. Drive machine at 8 km/hr and switch parking brake ON. <b>LOOK/FEEL</b> : Machine must come to a stop within 2 meters (6 feet) when parking brake is engaged at 8 km/hr. Transmission must shift to neutral.	<b>OK</b> Check completed. <b>NOT OK</b> Inspect parking brake. Go to group 3.
<b>Parking brake transmission lockout check</b> Engine running.	    Turn parking brake to ON. Place transmission in 1st forward. Slowly increase engine speed to high idle. <b>LOOK</b> : Machine must not move.	<b>OK</b> Check completed. <b>NOT OK</b> Go to transmission control circuit in section 3.

Item	Description	Service action
<b>Service brake pump flow check</b> ※ Hydraulic oil must be at operating temperature for the check. Engine OFF.	 <p>Stop engine.</p> <p>Operate brake pedal approximately 20 times.</p> <p>Start engine and run at low idle.</p> <p>Record number of seconds required for low brake pressure indicator lamp to go out.</p> <p><b>LOOK</b> : Indicator lamp must go out in less than 4 seconds from time engine starts.</p> <p><b>NOTE</b> : Indicator will not come on approximately 1 second after starting engine.</p> 	<p><b>OK</b> Check completed.</p> <p><b>NOT OK</b> Check for brake circuit leakage. Go to next page.</p> <p><b>IF OK</b> Install a cap on line connected to inlet of brake valve and repeat pump flow check.</p> <p>If time does not decrease, check for worn brake pump.</p>
<b>Service brake capacity check</b> Engine running.	<p>OFF</p>  <p>Release</p>  <p>ON</p> <p>Select clutch cut-off mode to OFF.</p> <p>Apply service brakes, release park brake and put transmission in 2nd forward.</p> <p>Increase engine speed to high idle.</p> <p><b>LOOK</b> : Machine may not move or move at a very slow speed.</p> <p>Repeat check three times to ensure accurate results.</p>	<p><b>OK</b> Check completed.</p> <p><b>NOT OK</b> Check brake pressure.</p> <p><b>IF OK</b> Inspect brake disk.</p>

Item	Description	Service action
<b>Brake accumulator precharge check</b> ※ The axles and hydraulic oil must be at operating temperature for this check.	   <p>Start and run engine for 30 seconds.</p> <p>Stop engine and turn start switch to ON and wait 5 seconds.</p> <p><b>NOTE</b> : Engine oil pressure lamp will be on due to no engine oil pressure.</p> <p>Count the number of times the brake pedal can be fully depressed before the low brake pressure warning lamp comes ON.</p> <p><b>LOOK</b> : Warning lamp should not come ON in 1~5 applications.</p> <p>Start engine and operate at low idle.</p> <p>Observe cluster while applying brake pedal with maximum force.</p> <p><b>LOOK/LISTEN</b> : Brake pressure indicator must not come ON.</p>	<p><b>OK</b> Check completed.</p> <p><b>NOT OK</b> Make sure brake pedal is not binding and keeping brakes partially engaged.</p> <p>Bleed brakes in group 3.</p> <p>Check brake system pressure.</p> <p><b>NOT OK</b> If light comes ON with engine running, accumulator has lost it's charge. Inspect and recharge accumulator.</p>
<b>Brake system leakage check</b>	 <p>Start engine and wait 30 seconds.</p> <p>Stop engine.</p> <p>Wait 2 minutes.</p> <p>Turn start switch to ON and wait 5 seconds.</p> <p><b>LOOK</b> : Brake oil pressure warning lamp must not come ON within 2 minutes after stopping engine.</p>	<p><b>OK</b> Check completed.</p> <p><b>NOT OK</b> If brake leakage is indicated with brakes released, check leakage at accumulator inlet check valve and brake valve. If brake leakage is indicated with brakes applied, check for leakage at brake valve and brake pistons.</p> <p>Check individual component leakage.</p>

Item	Description	Service action
<b>Service brake pedal check</b>	 <p>Slowly depress brake pedal.</p> <p>Listen for a hissing noise that indicates oil is flowing to brake pistons.</p> <p><b>LISTEN/FEEL</b> : A hissing noise must be heard when pedal is depressed.</p>	<p><b>OK</b> Check completed.</p> <p><b>NOT OK</b> Inspect for debris under brake pedal.</p>
<b>Service and parking brake system drag checks</b> Engine running	 <p>Position machine on gradual slope.</p> <p>Lower bucket approximately 50 mm (2 in) from ground.</p> <p>Release parking and service brakes.</p>  <p><b>LOOK</b> : Machine must move or coast.</p> <p><b>NOTE</b> : If machine does not move, check brake pedals to be sure they fully release when feet are removed from pedals.</p> <p>Drive machine at high speed for about 5 minutes.</p> <p>Brake drag is indicated if brake areas in differential case are hot.</p> <p><b>NOTE</b> : Observe parking brake.</p> <p>If disk is hot, parking brake drag is indicated.</p>	<p><b>OK</b> Check completed.</p> <p><b>NOT OK</b> Adjust park brake.</p> <p><b>NOT OK</b> Check floor mat interference to pedal or debris build-up.</p> <p><b>IF OK</b> Check for brake pressure when brake is released.</p> <p>Go to brake pressure test.</p>
<b>Clutch cut-off check</b>	 <p>Select clutch cut-off mode to L mode.</p> <p>Release parking brake.</p> <p>Run engine at half speed in 1st forward.</p>  <p>Firmly depress brake pedal.</p> <p><b>FEEL</b> : Transmission must disengage when brake pedal is depressed at 30% of pedal stroke.</p> <p><b>NOTE</b> : Clutch cut-off mode can be selected to operator preference to match your loading needs.</p>	<p><b>OK</b> Check completed.</p> <p><b>NOT OK</b> Adjust clutch cut-off mode.</p>

## 2. TROUBLESHOOTING

### 1) SERVICE BRAKE

Diagnose malfunction charts are arranged from most probable and simplest to verify, to least likely, more difficult to verify. Remember the following steps when troubleshooting a problem :

Step 1. Operational check out procedure (see section 1)

Step 2. Operational checks (in this group)

Step 3. Troubleshooting

Step 4. Tests and adjustments (see group 3)

Problem	Cause	Remedy
<b>Poor or no brakes</b>	Brake accumulator charge low. Brake pump standby pressure low. Brake pressure low. Air in system. Worn brake surface material. Leakage in brake valve. Leakage in brake piston seal.	Do brake accumulator check. Do brake pump standby pressure test. Do brake valve pressure test. Bleed brakes. Inspect brake surface material. Do brake valve leakage test. Check for an over filled differential. Apply brakes and check for leakage from check plug. ※ It is normal for the oil level to be slightly above the check plug.
<b>Aggressive brakes</b>	Internal restriction in circuit. Brake valve malfunction. Low oil level.	Remove lines and components. Disassemble and inspect. Check oil level.
<b>Brakes drag</b>	Brake pedal not returning properly. Debris holding valve partially open in brake valve. Warped brake disk. Stuck brake piston.	Inspect floor mat and pedal. Do brake valve pressure test. Inspect brake disk. Repair.
<b>Brakes lock up</b>	Brake valve malfunction.	Clean or replace brake valve.

Problem	Cause	Remedy
<b>Brakes chatter</b>	Air in brake system. Worn brake surface material. Wrong oil in differential.	Do brake bleed procedure. Inspect brake surface material. Drain. Refill.
<b>Hissing noise when brake pedal is held with engine stopped</b>	Leakage in brake valve, or brake piston.	Do brake system leakage test.
<b>Brake pressure warning light will not go out or stays on excessively long after start-up</b>	Malfunction in brake low pressure warning switch. Brake accumulator pressure too low. Low brake pump standby pressure setting. Leakage in pressure reducing manifold block. Leakage in brake system. Worn brake pump. Leakage in parking brake solenoid.	Replace switch. Recharge accumulator. Do brake pump standby pressure test. Do pressure reducing valve manifold leakage test. Do brake system components leakage tests. Do brake pump flow test. Do parking brake pressure test.

## 2) PARKING BRAKE MALFUNCTIONS

Problem	Cause	Remedy
<b>Brake will not hold</b>	Pads not adjusted correctly. Malfunctioning parking brake solenoid. Worn brake disk and / or brake pads. Brake piston hangs up in bore.	Adjust parking brake. Inspect and replace. Disassemble, inspect, repair. Remove and inspect. Repair.
<b>Brake disk overheats</b>	Pads out of adjustment. Brake not released.	Adjust parking brake. Release parking brake. Disassemble, inspect brake. Repair if necessary. Inspect for loosen or broken lines between brake pressure switch and indicator on dash.
<b>Parking brake indicator in monitor does not come on when brake applied</b>	Faulty wiring or switch.	Inspect for loose or broken lines between brake pressure switch and indicator on dash. Inspect for a faulty indicator on dash. Replace if necessary.
<b>Brake will not apply</b>	Pads out of adjustment. Malfunctioning wiring, switch, or solenoid. Restriction between brake valve and brake.	Adjust parking brake. Check electric circuit. Remove hose and inspect. Replace.

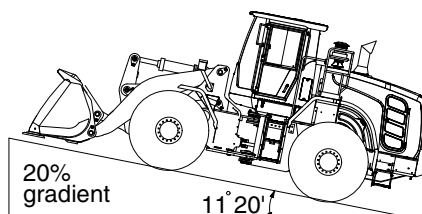
## GROUP 3 TESTS AND ADJUSTMENTS

### 1. PARKING BRAKE PERFORMANCE

#### 1) MEASUREMENT CONDITION

- (1) Tire inflation pressure : Specified pressure
- (2) Road surface : Flat, dry, paved surface with 1/5 (11°20') gradient.
- (3) Machine : In operating condition

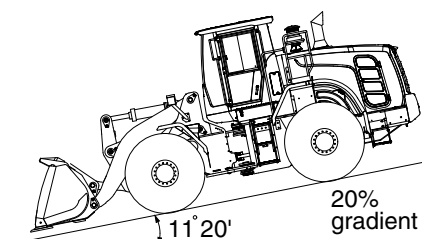
Item	Standard value
Parking brake performance	Keep machine on 20% (11°20') gradient



760F4BS17

#### 2) MEASURING PROCEDURE

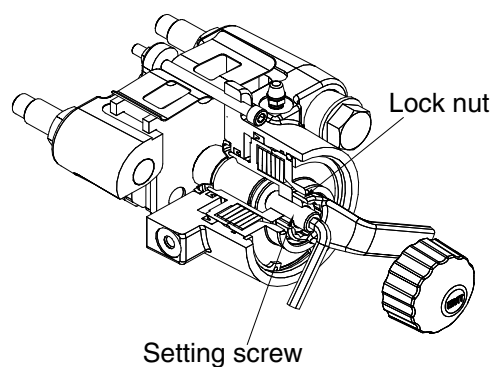
- (1) Start the engine and drive the machine straight up a 1/5 gradient with the bucket unloaded.
  - (2) Depress the service brake, place the gear selector lever in neutral, then stop the engine.
  - (3) Turn the parking brake switch ON, then slowly release the service brake pedal and the machine must be kept stopped.
- ※ The measurement must be made with the machine facing either up or down the slope.



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### 2. ADJUSTMENT OF PARKING BRAKE

- (1) External brake inspection
  - Inspect for wear of brake pad
- (2) Refer to the PARKING BRAKE SYSTEM on the page 4-21.



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### 3. HYDRAULIC BRAKE BLEEDING PROCEDURE

**⚠ Escaping fluid under pressure can penetrate the skin causing serious injury. Avoid the hazard by relieving pressure before disconnecting hydraulic or other lines. Tighten all connections before applying pressure.**

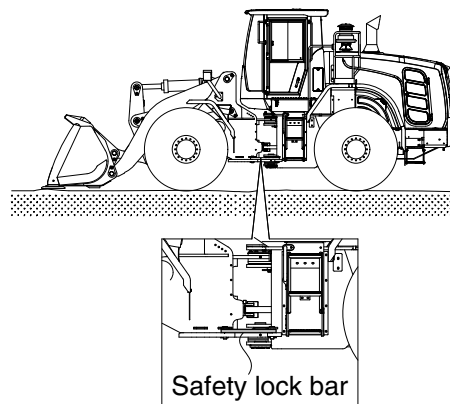
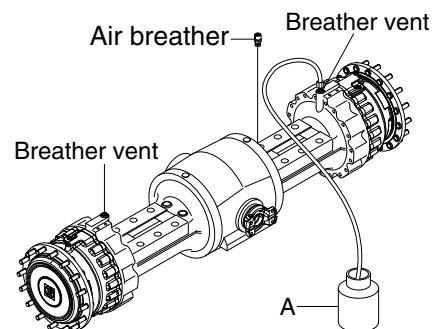
**Search for leaks with a piece of cardboard. Protect hands and body from high pressure fluids.**

※ If an accident occurs, see a doctor immediately. Any fluid injected into the skin must be surgically removed within a few hours or gangrene may result.

Doctors unfamiliar with this type of injury should reference a knowledgeable medical source.

Two people are required to bleed brake system oil, one to operate brake valve and other to open and close bleed screws.

- 1) Install frame locking bar. Engage parking brake.
- 2) Put a clear plastic tube on bleed screw to route low to hydraulic oil tank filler tube or container (A).
- 3) Start engine and run at low idle.
- 4) Push and hold brake pedal down until brake bleeding procedure is complete.
  - ※ If bubbles continue for more than 2 minutes, stop bleeding procedure. Check for and correct problem, then continue.
- 5) Open on bleed screw on differential and axle assembly until hydraulic oil starts to flow. Close bleed screw when oil is free of air. Release brake pedal.
- 6) Repeat steps 1)~5) for each bleed screw.
- 7) Push either brake pedal and hold down.
- 8) Check hydraulic oil level.

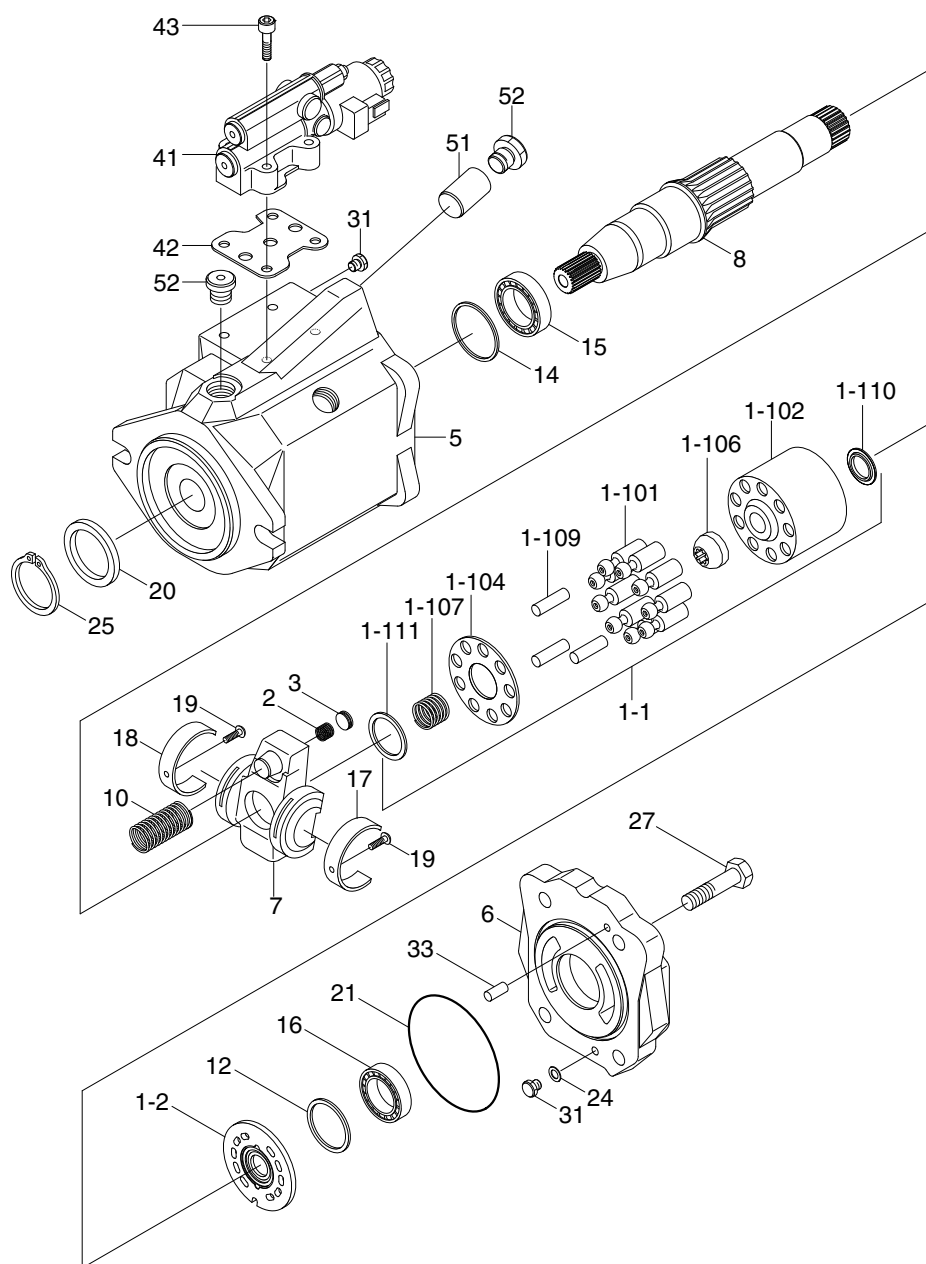


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## GROUP 4 DISASSEMBLY AND ASSEMBLY

### 1. FAN AND BRAKE PUMP

#### 1) STRUCTURE



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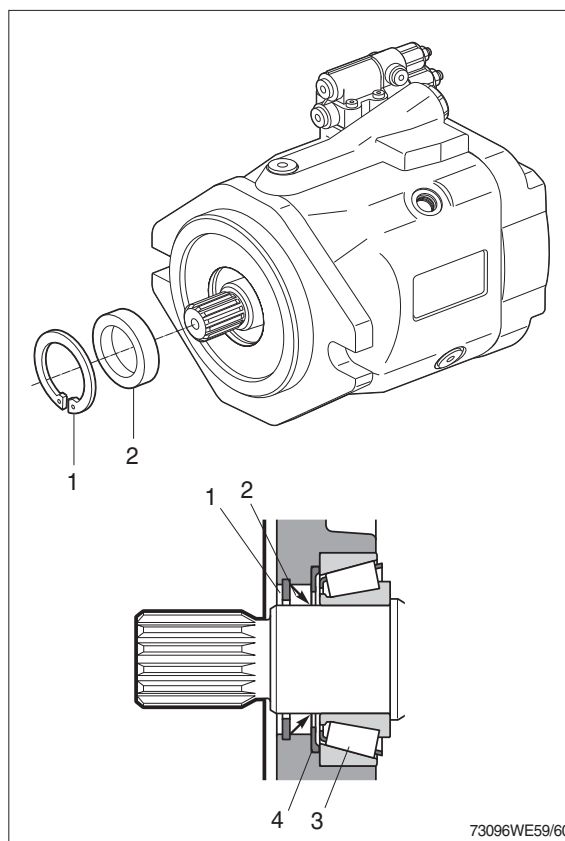
1-1	Rotary group	5	Pump housing	20	Shaft seal ring
1-101	Piston	6	Port plate	21	O-ring
1-102	Cylinder	7	Swash plate	24	Kantseal ring
1-104	Retaining plate	8	Drive shaft	25	Retaining ring
1-106	Retaining ball	10	Spring	27	Socket screw
1-107	Spring	12	Adjustment shim	31	Plug
1-109	Pressure pin	14	Stop ring	33	Cylinder pin
1-110	V-ring	15	Tapered roller bearing	41	Control valve
1-111	Back-up plate	16	Tapered roller bearing	42	Gasket
1-2	Control plate	17	Liner bearing	43	Socket screw
2	Pressure spring	18	Liner bearing	51	Control piston
3	Stop	19	Flat screw	52	Locking screw

## 2) GENERAL REPAIR GUIDELINES

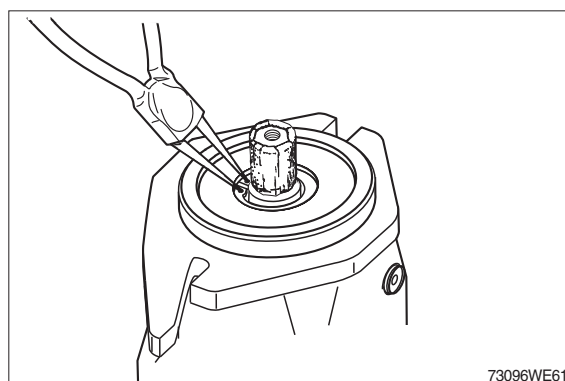
- ※ Observe the following guidelines when carrying out repairs on hydraulic pumps.
- (1) Close off all openings of the hydraulic unit.
- (2) Replace all of the seals.  
Use only original spare parts.
- (3) Check all sealing and sliding surfaces for wear.
- ※ Re-work of the sliding surfaces by using, for example abrasive paper, can damage the surface.
- (4) Fill the hydraulic pump with hydraulic oil before commissioning.

## 3) SEALING THE DRIVE SHAFT

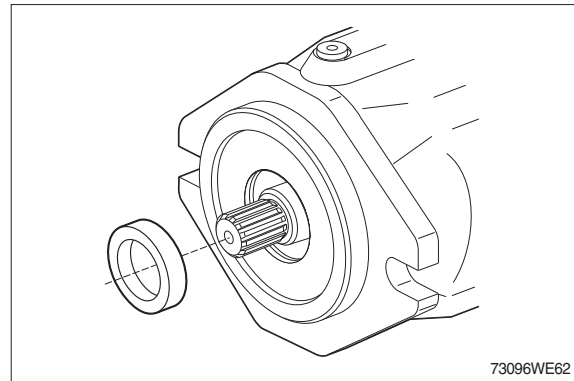
- |   |                |   |            |
|---|----------------|---|------------|
| 1 | Retaining ring | 2 | Shaft seal |
| 3 | Bearing        | 4 | Stop ring  |



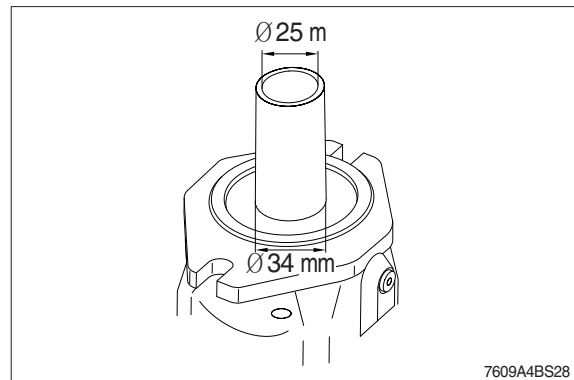
- (1) Protect the drive shaft.  
Wrap the drive shaft with tape.  
Remove the retaining ring.  
Remove shaft seal to front.



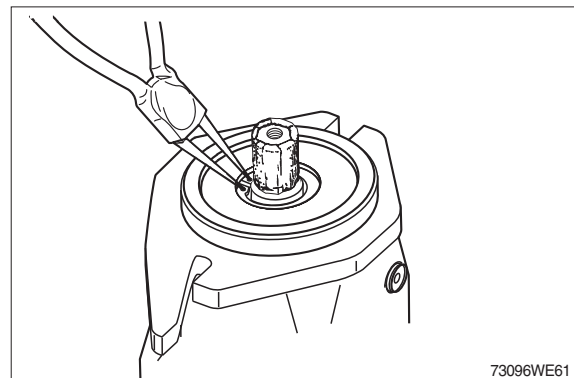
- ※ Change the shaft seal and check its sliding surface (drive shaft) and housing, grease the sealing ring.  
Visual check shaft seal and housing.



- (2) Assembling of the sealing ring carefully down to the stop ring.

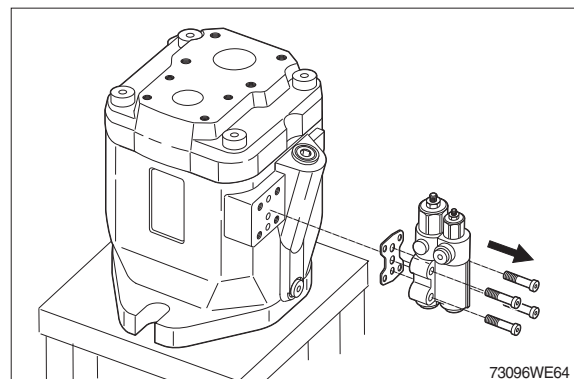


- (3) Assemble the retaining ring (circlip).
- ※ Visual check to ensure that the circlip is correctly located in the groove.

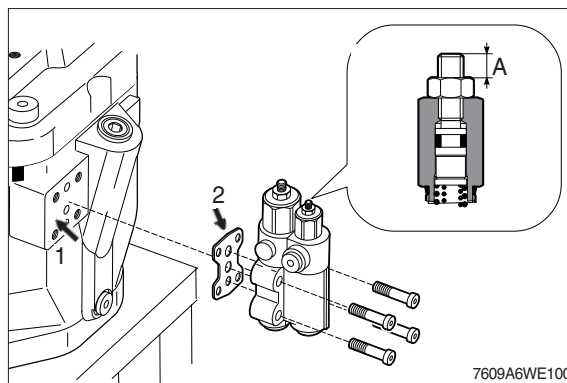


#### 4) SEALING THE CONTROL VALVE

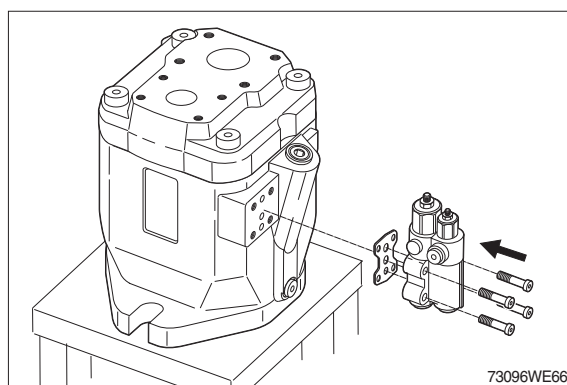
- (1) Remove the control valve.



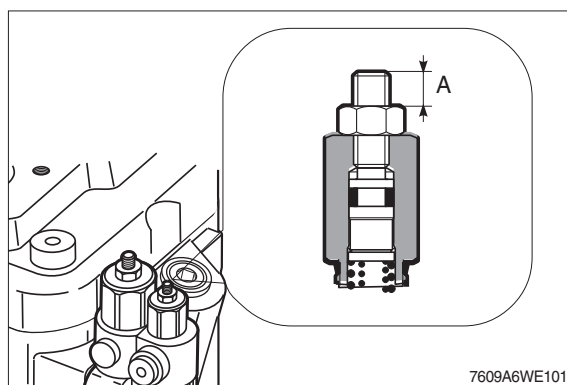
- (2) Measure dimension A and note down.  
Check sealing surface (1).  
Replace gasket (2).



- (3) Assemble control valve.  
Tighten the bolts.  
· Tightening torque : 1.58 kgf · m  
(11.4 lbf · ft)

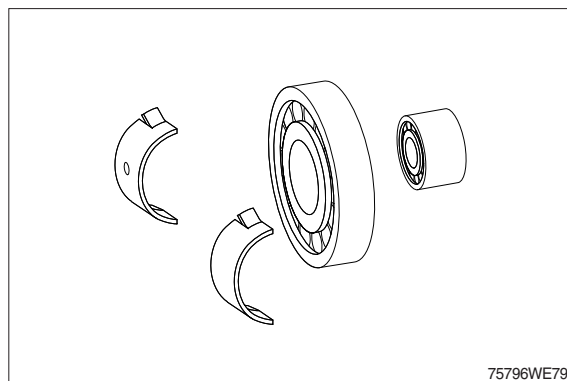


- (4) Check dimension A.



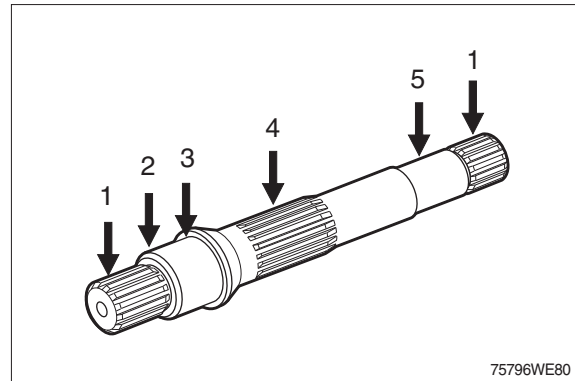
## 5) INSPECT HINTS

- (1) Renew all bearings.



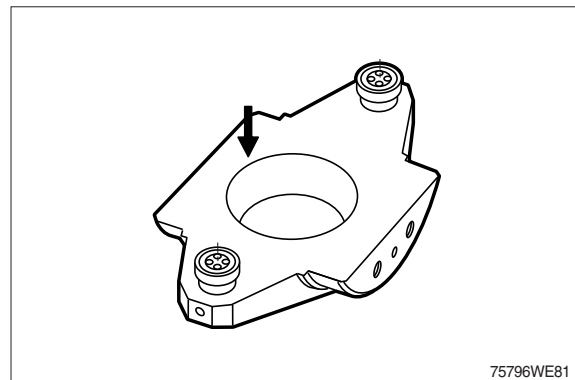
(2) Check :

- 1 Wear on splines, rust
- 2 Drive shaft seal wear grooves
- 3 Bearing seat
- 4 Splines for cylinder drive
- 5 Bearing seat



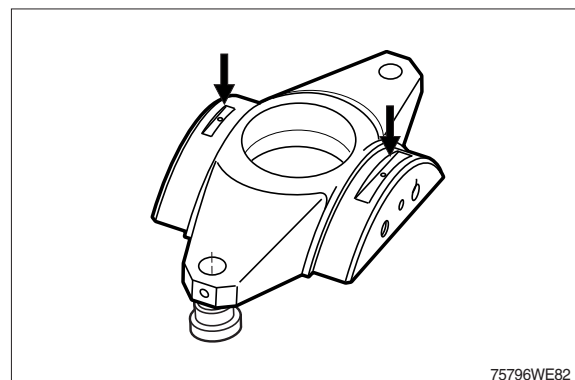
(3) Check :

Sliding surface free of grooves.



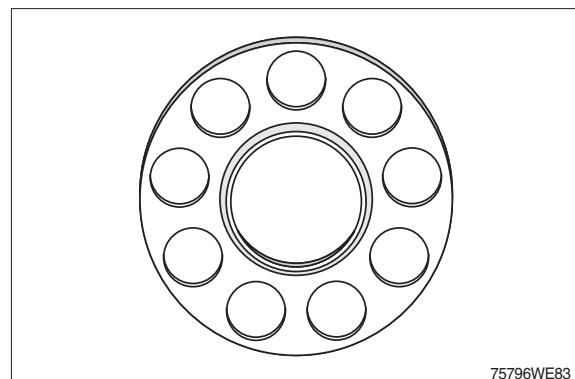
(4) Check :

Bearing surfaces.



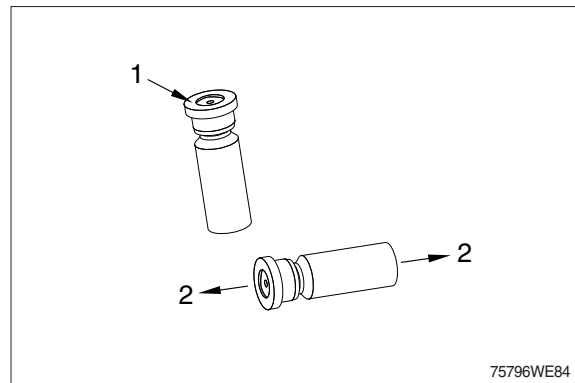
(5) Check :

That the retaining plate is free of grooves and that there is no wear in the slipper pad area.



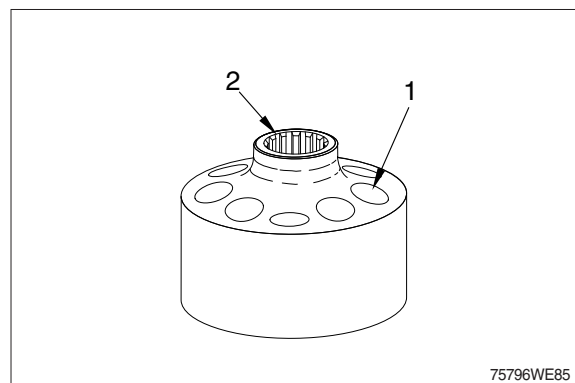
(6) Check :

Check to see that there are no scratches or metal deposits on the sliding surface (1) and that there is no axial play (2) (Pistons must only be replaced as a set).

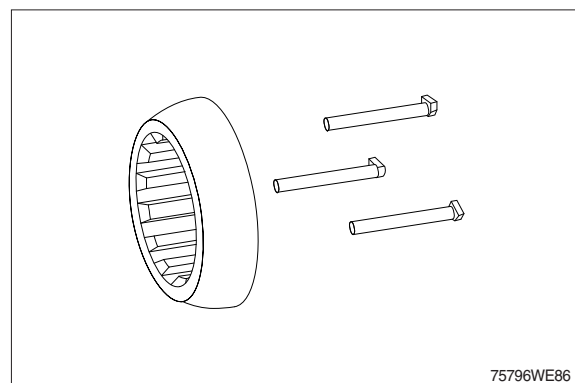


(7) Check :

- 1 Cylinder bores
- 2 Splines

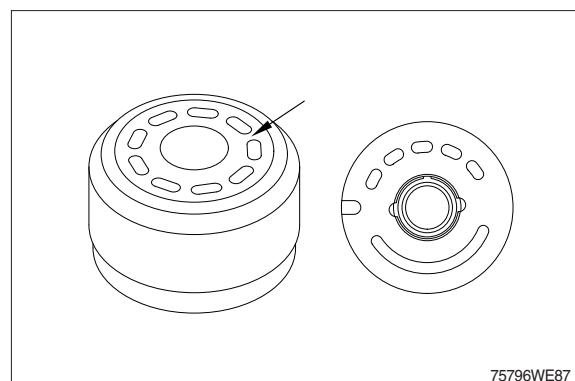


(8) Free of grooves, no signs of wear.



(9) Check :

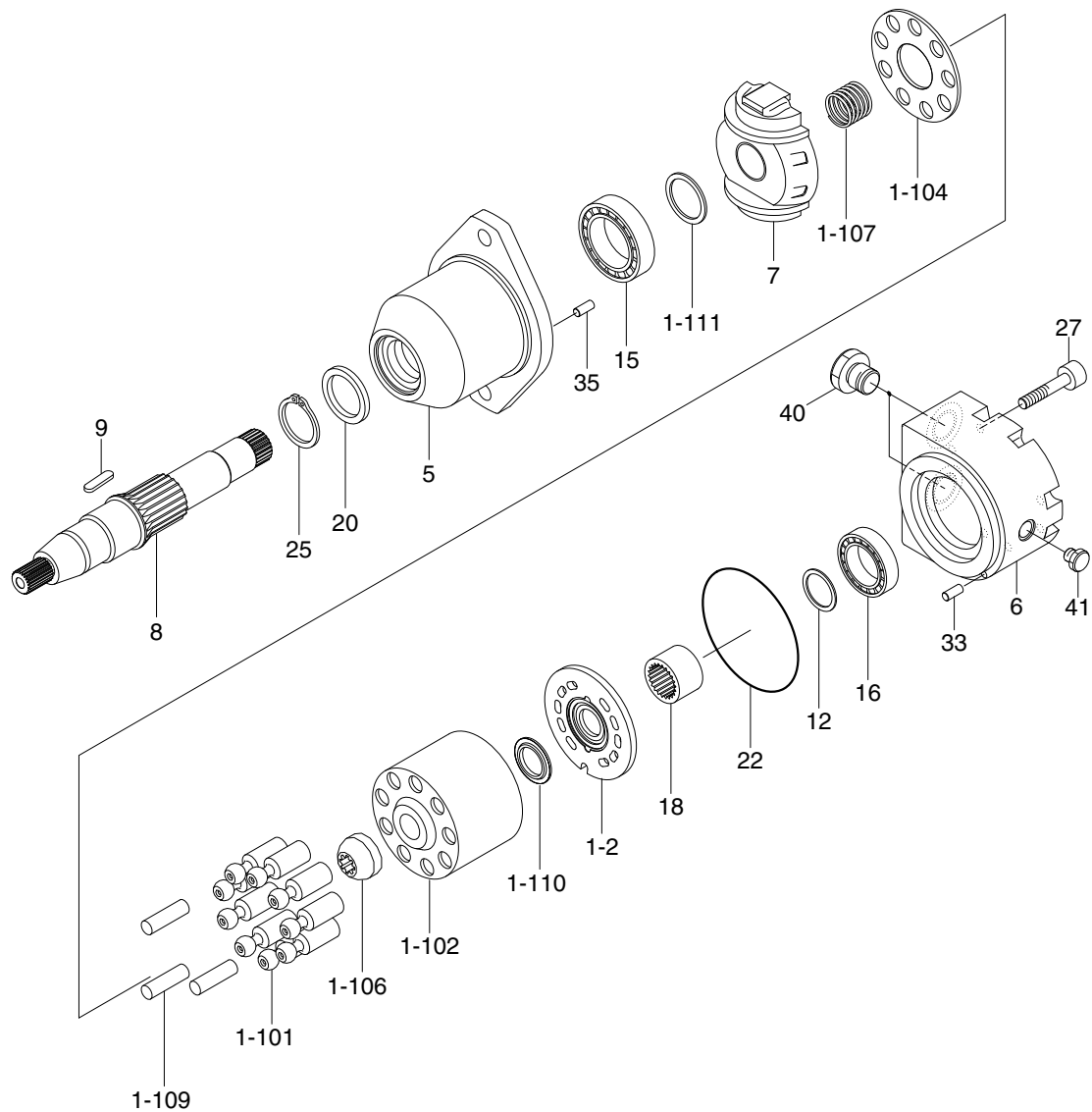
Cylinder sliding surface free of grooves, no wear, no embedded foreign particles. That there are no scratches on the control plate. (Only replace them as a set).





## 2. FAN MOTOR

### 1) STRUCTURE

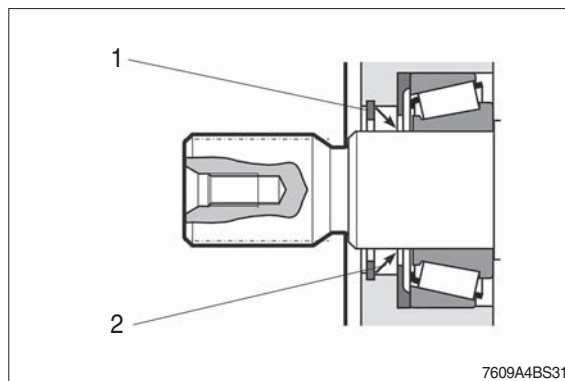


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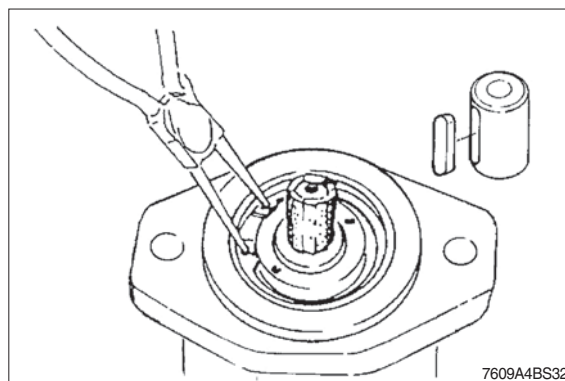
1-1 Rotary group	1-2 Control plate	18 Bearing bushing
1-101 Piston	5 Motor housing	20 Shaft seal
1-102 Cylinder	6 Port plate	22 O-ring
1-104 Retaining plate	7 Cam plate (swash plate)	25 Retaining ring (circlip)
1-106 Retaining ball	8 Drive shaft	27 Socket bolt
1-107 Spring	9 Shaft key	33 Cylinder pin
1-109 Pressure pin	12 Adjustment shim	35 Cylinder pin
1-110 V-ring	15 Tapered roller bearing	40 Screw
1-111 Back-up plate	16 Tapered roller bearing	41 Screw

## 2) SEALING THE DRIVE SHAFT

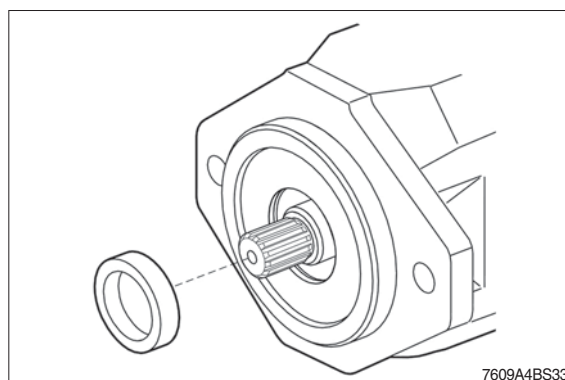
- (1) 1 Circlip
- 2 Shaft seal



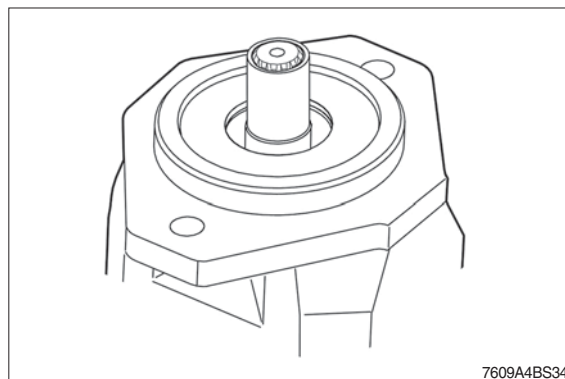
- (2) Remove key.  
Protect the drive shaft.  
Remove the circlip.



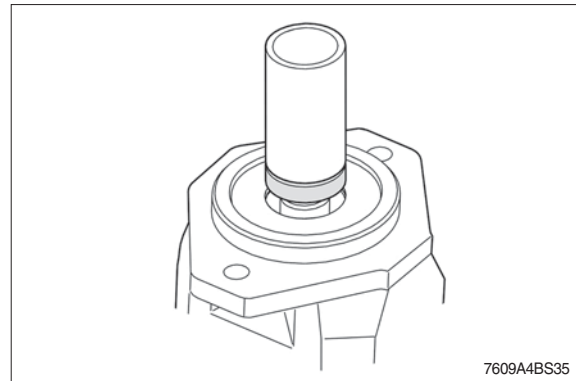
- (3) Change the shaft seal and check its sliding surface (drive shaft) and housing, grease the sealing ring.



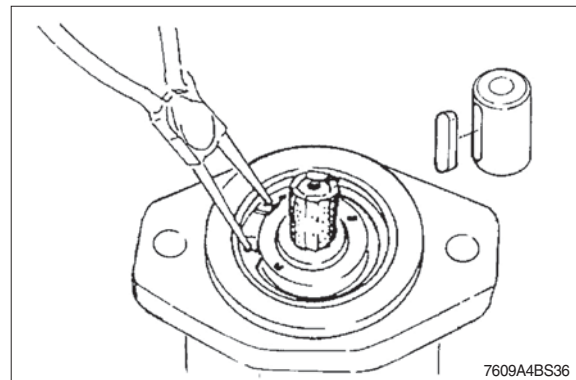
- (4) Use installation tool or plastic strip for assembling seal.



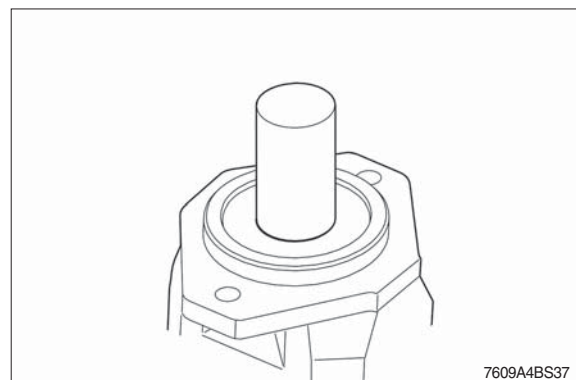
- (5) Use a suitable pipe to mount the shaft seal, but don't push it too deep. If the shaft ring touches the bearing ring you will damage the seal ring.



- (6) Assemble the circlip.



- (7) Assemble the circlip in the correct position.



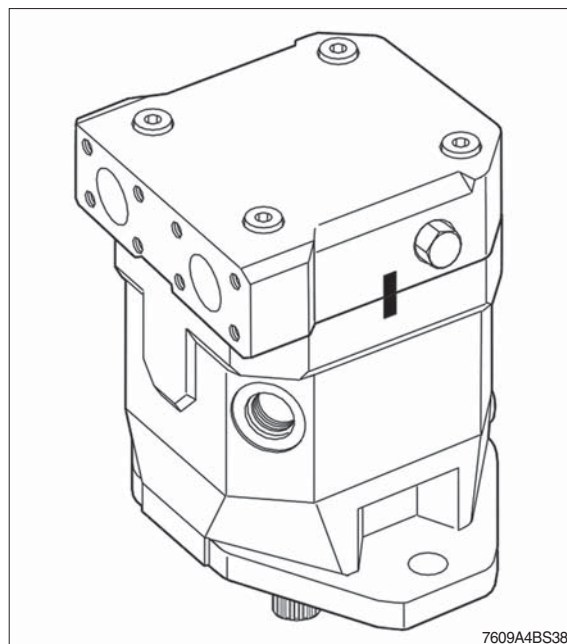
※ This discription shows how th change the drive shaft seal but it isn't the way of serial assembly.

The seal is assembled together with the taper roller bearing from inside the motor housing normally to get a secure sealing condition. If you decide to repair the motor in the shown way be very careful while handling so that the drive shaft wouldn't be damaged during disassembly of the shaft seal.

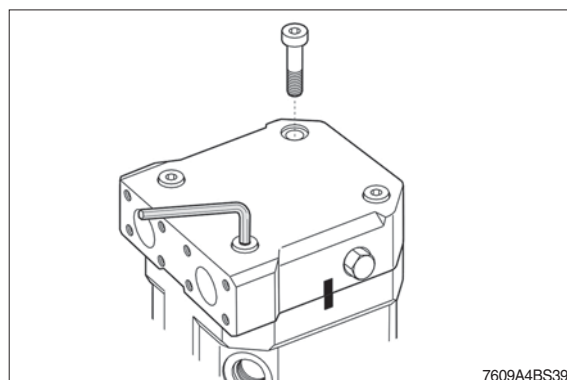
### 3) DISASSEMBLE THE MOTOR

(1) Disassembly position.

Mark the location of the port plate on the housing.

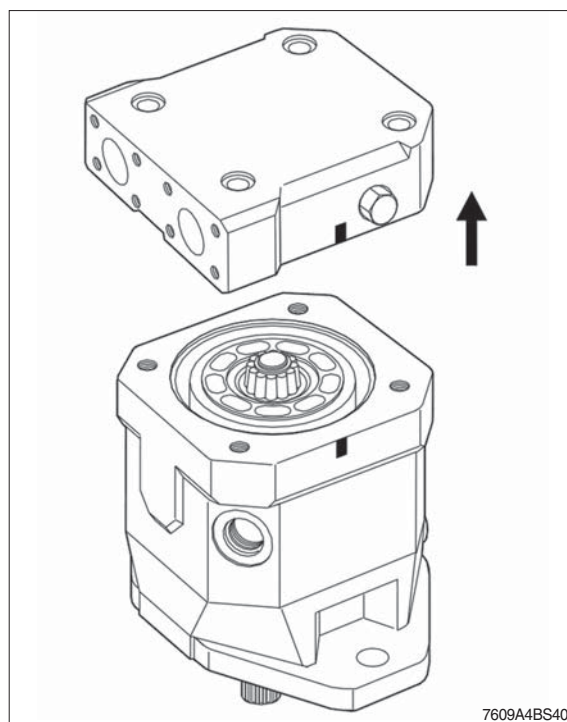


(2) Remove the port plate fixing bolts crosswise.

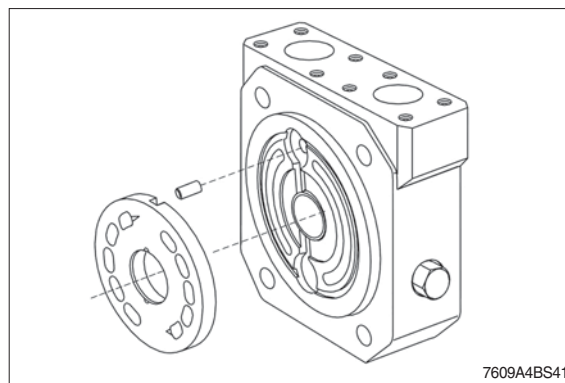


(3) Remove the port plate.

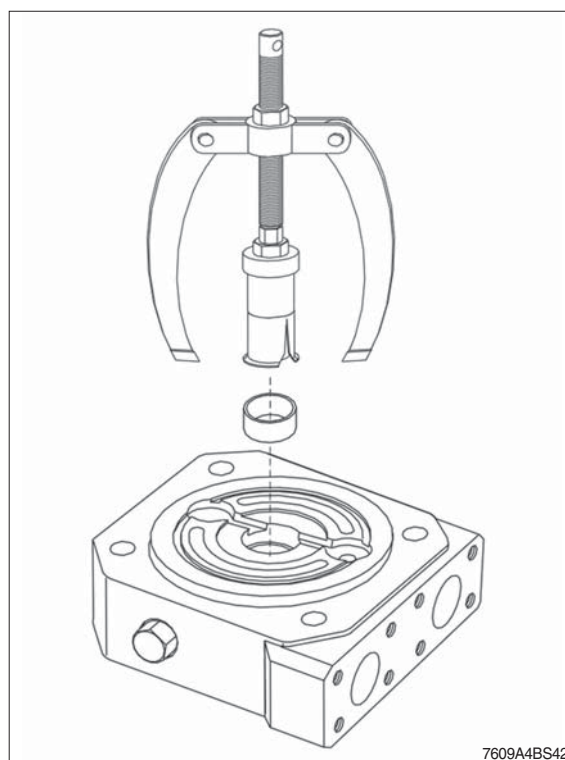
※ Control plate can drop down-hold tight.



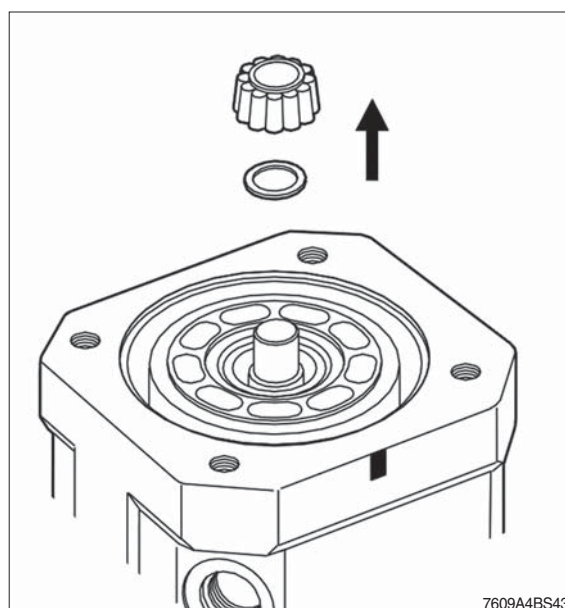
(4) Remove control plate.



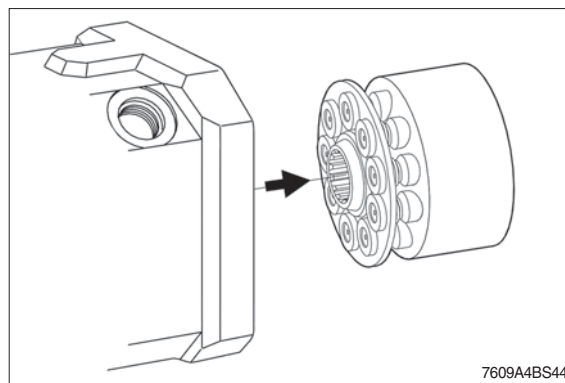
(5) Remove bearing outer ring with withdrawal tool.  
Do not damage the sealing surface.



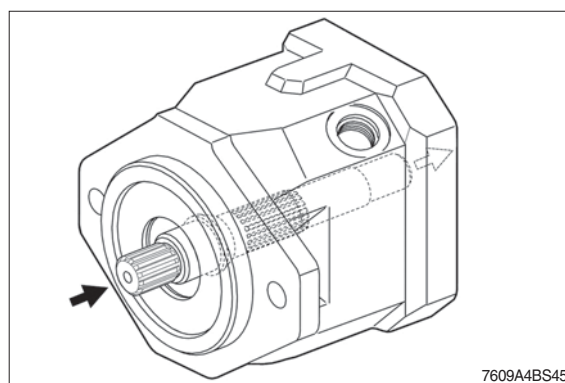
(6) Disassemble the taper roller bearing (near by port plate).  
Remove the adjustment shim.



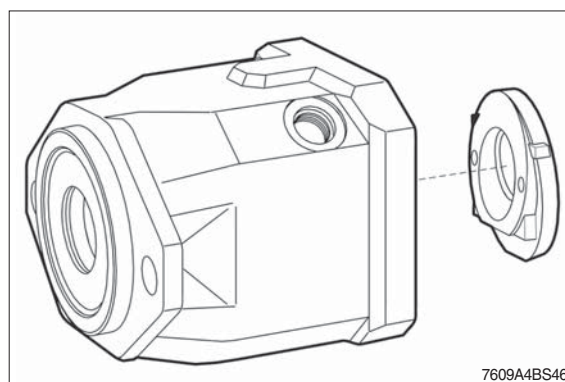
- (7) Remove the rotary group in a horizontal position.



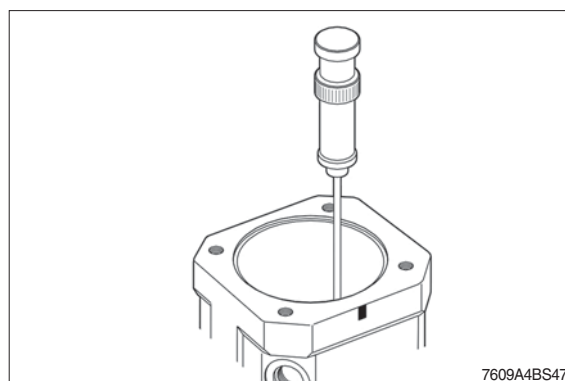
- (8) Remove the drive shaft to rear side.



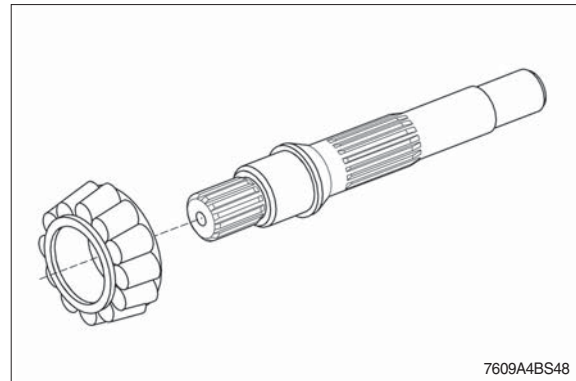
- (9) Remove swash plate with special tool (see the next figure).



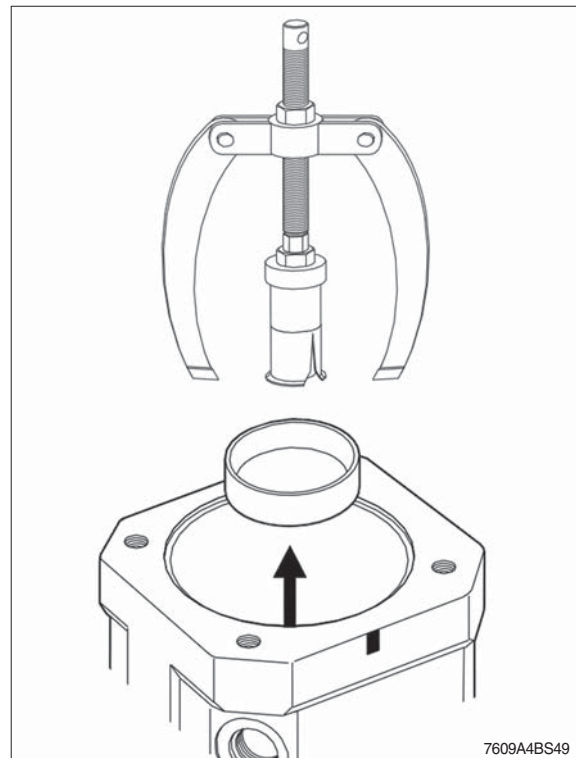
- (10) Loosen the swash plate with a slide hammer (a small hook - diameter 6 mm - catches the end of the swash plate at the bottom).



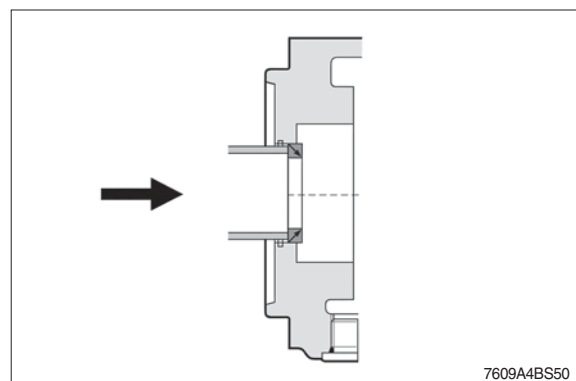
(11) Press down bearing.



(12) The external front bearing ring is pulled out of the pump housing.

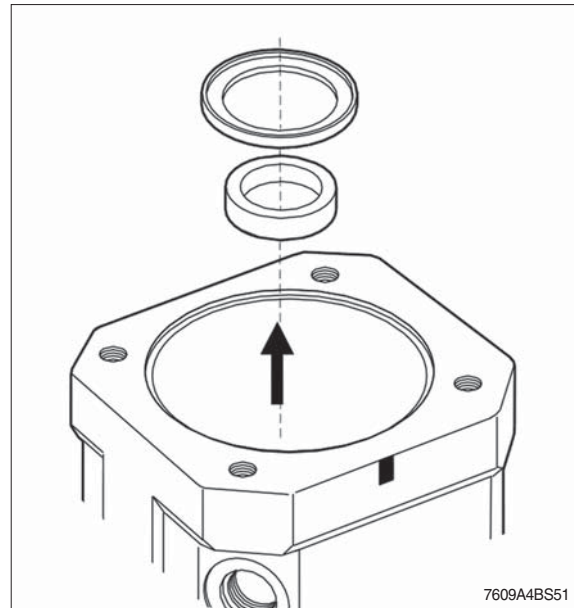


(13) Disassemble circlip and shaft seal.

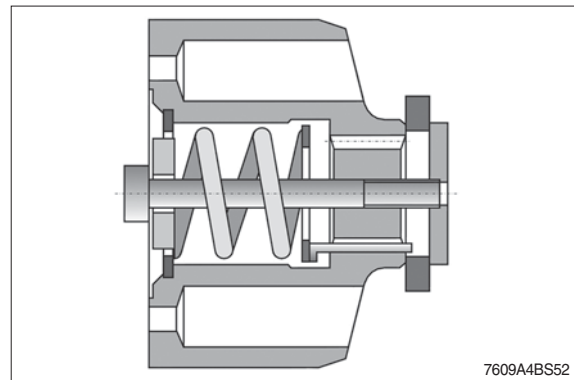




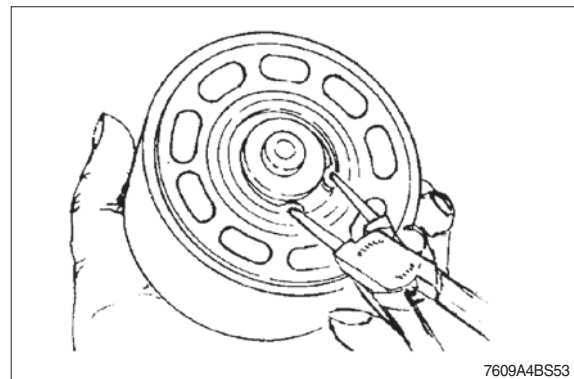
(14) Remove shaft seal and shim.



(15) Pre-tension the spring using a suitable device.

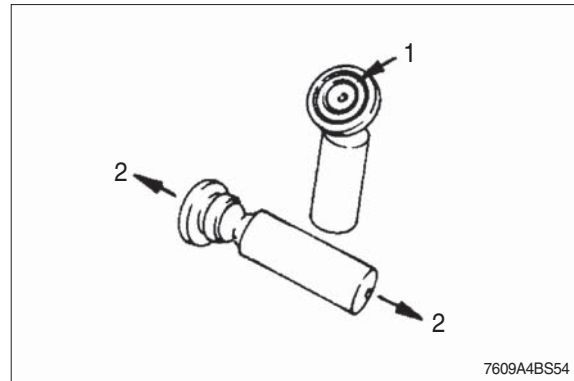


(16) Remove circlip.  
Remove spring and pressure pins.

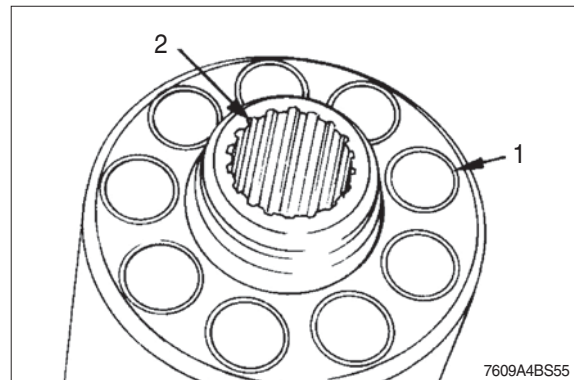


#### 4) INSPECTION HINTS

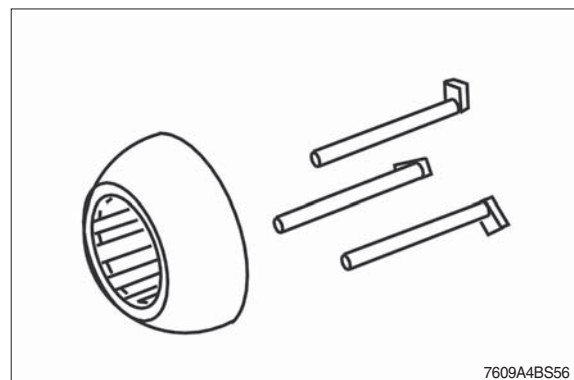
- (1) Check to see that there are no scratches or metal deposits on the sliding surface (1), and that there is no axial play (2), (pistons must only be replaced as a set).



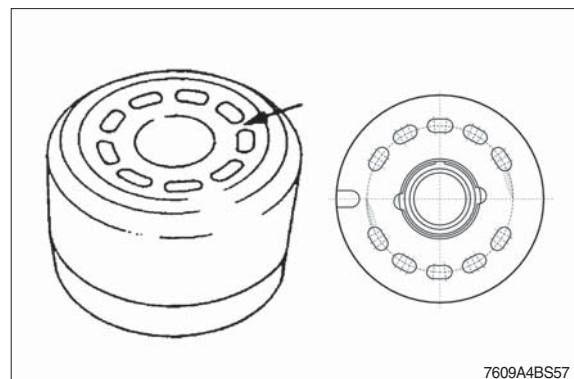
- (2) Check cylinder bores (1) and splines (2).



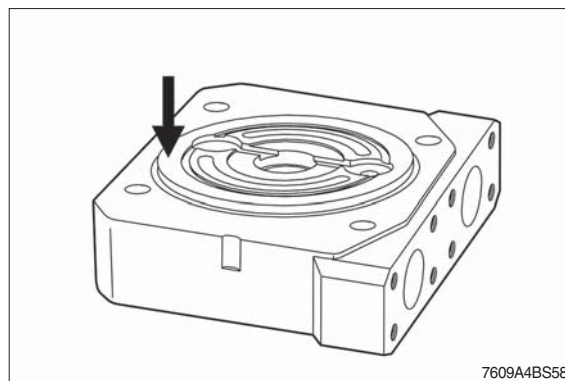
- (3) Free of grooves, no signs of wear.



- (4) Cylinder sliding surface free of grooves, no wear, no embedded foreign particles. That there are no scratches on the control plate. (Only replace them as a set).

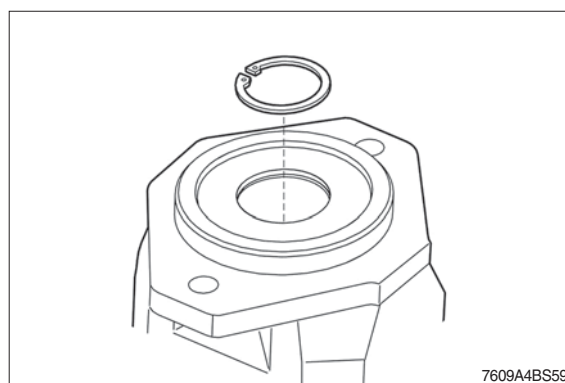


- (5) Mounting surface - control plate undamaged.

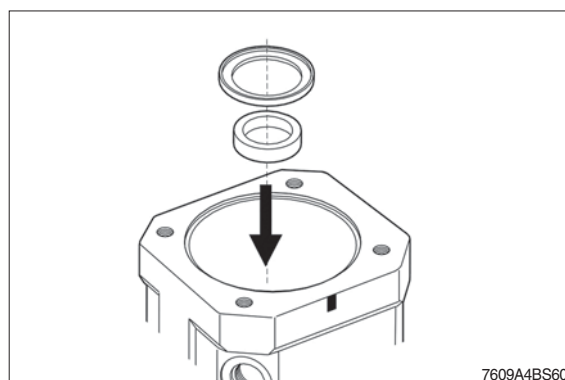


## 5) MOTOR ASSEMBLY

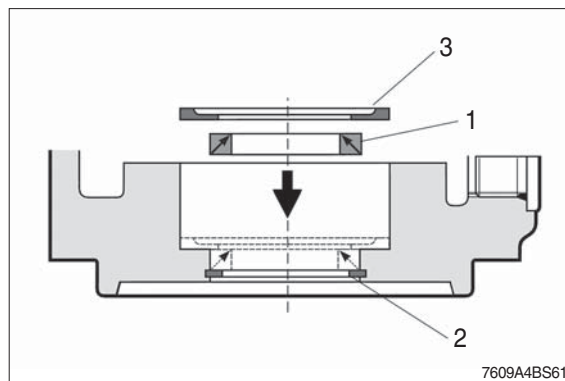
- (1) Fit the circlip into the housing.



- (2) Assemble shaft seal and shim against circlip.

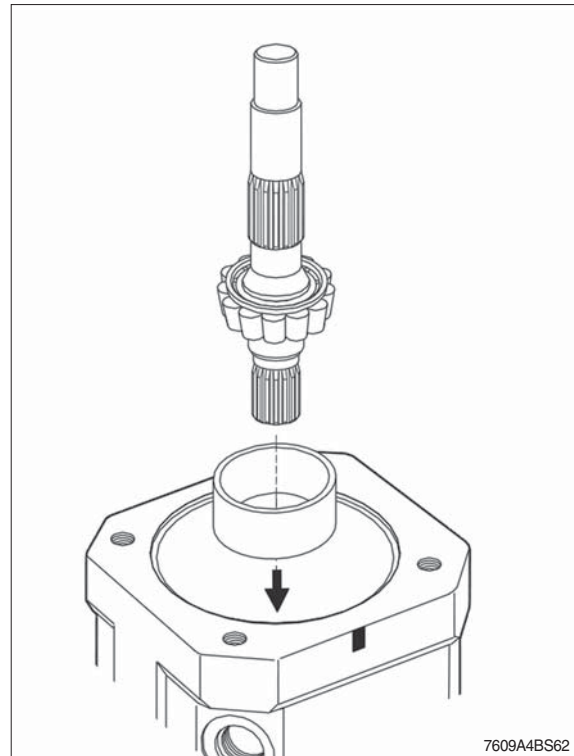


- (3) Assembly of the shaft seal (1) against the safety ring (2) back up the shim (3) down to the seal ring.

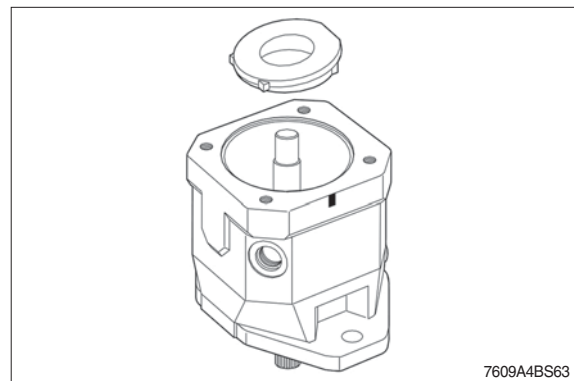


(4) Press outer bearing ring into housing.  
Shaft seal with pre-assembled bearing into housing.

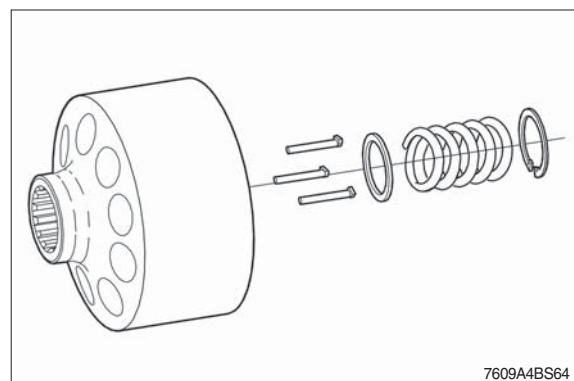
※ Protect splines of the shaft with plastic strip against damage of the seal lip.



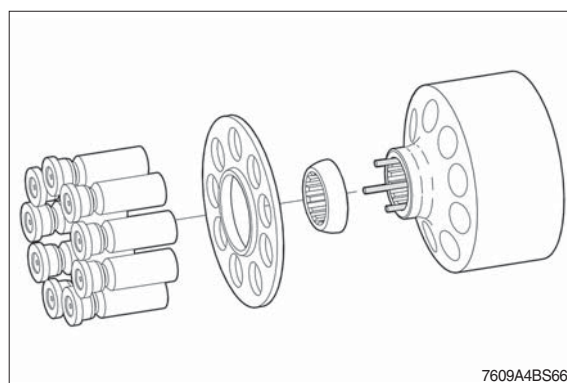
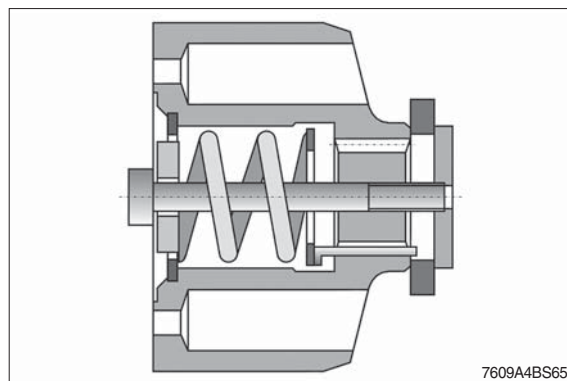
(5) Assemble swash plate.



(6) Fit pressure pins using an assembly aid.

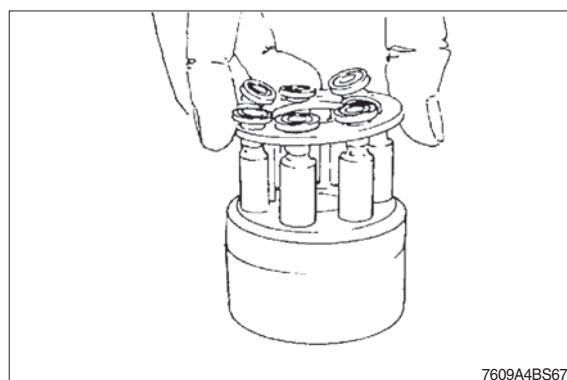


- (7) Pre-tension the spring using a suitable device.



- (8) Assemble piston with retaining plate.

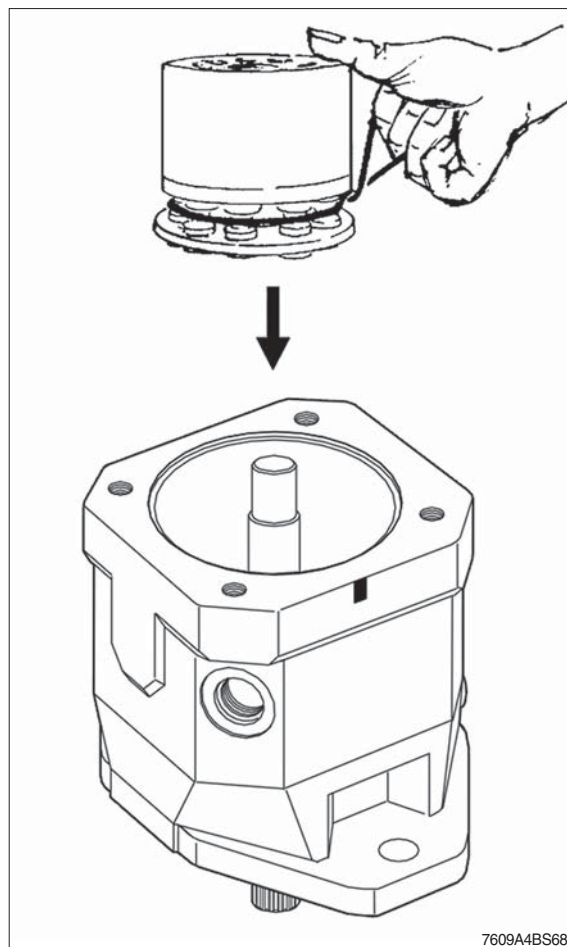
※ Oil piston and slipper pad.



(9) Fit rotary group.

※ Assembly aid :

Hold the pistons by using an O-ring.



(10) Fit bearing (1) in port plate.

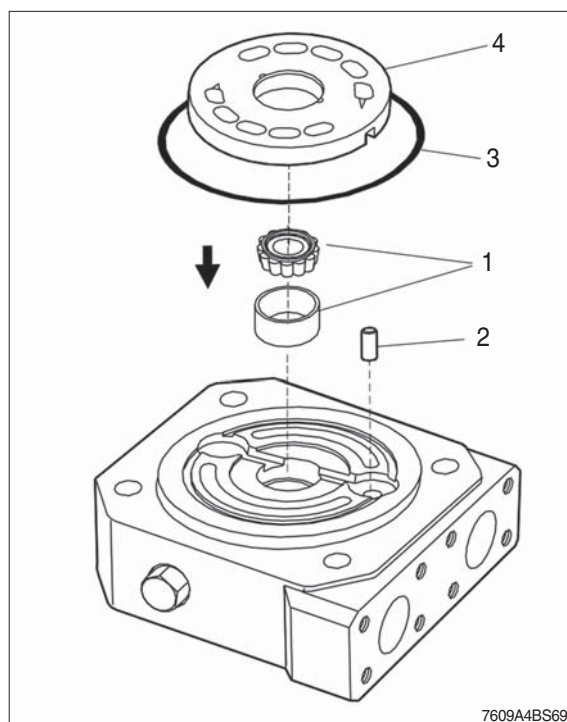
Fit cylindrical pin (2).

Fit O-ring (3).

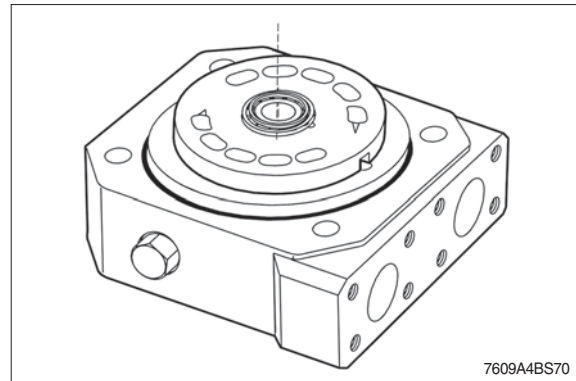
Fit control plate (4).

※ Assembly :

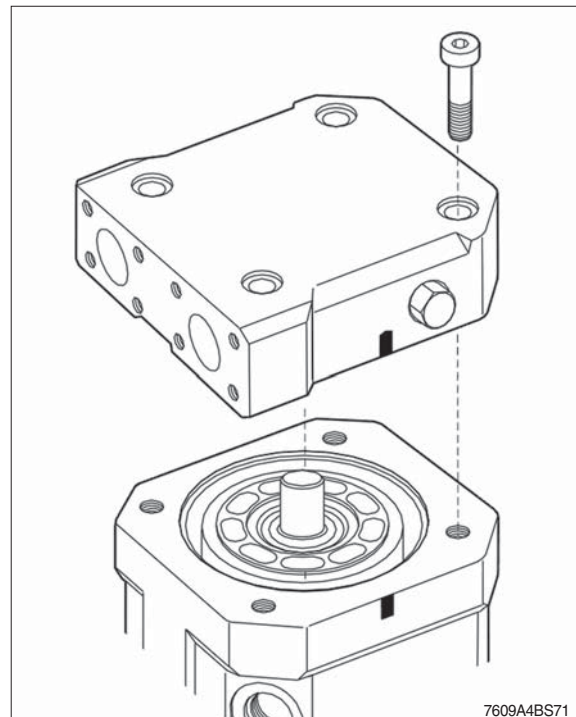
Hold the components in place with grease.



- (11) Fit control plate.  
Assembly aid : Grease



- (12) Fit the port plate and fix it with the bolts crosswise.



## SECTION 5 STEERING SYSTEM

Group 1	Structure and Function .....	5-1
Group 2	Operational Checks and Troubleshooting .....	5-8
Group 3	Tests and Adjustments .....	5-16
Group 4	Disassembly and Assembly .....	5-21



# SECTION 5 STEERING SYSTEM

## GROUP 1 STRUCTURE AND FUNCTION

### 1. OUTLINE

The steering system of this machine consists of a variable displacement piston pump supplying a load sensing steering system and an closed center loader system.

The components of the steering system are :

- Steering pump
- Priority valve
- Steering unit
- Accumulators
- Steering cylinders

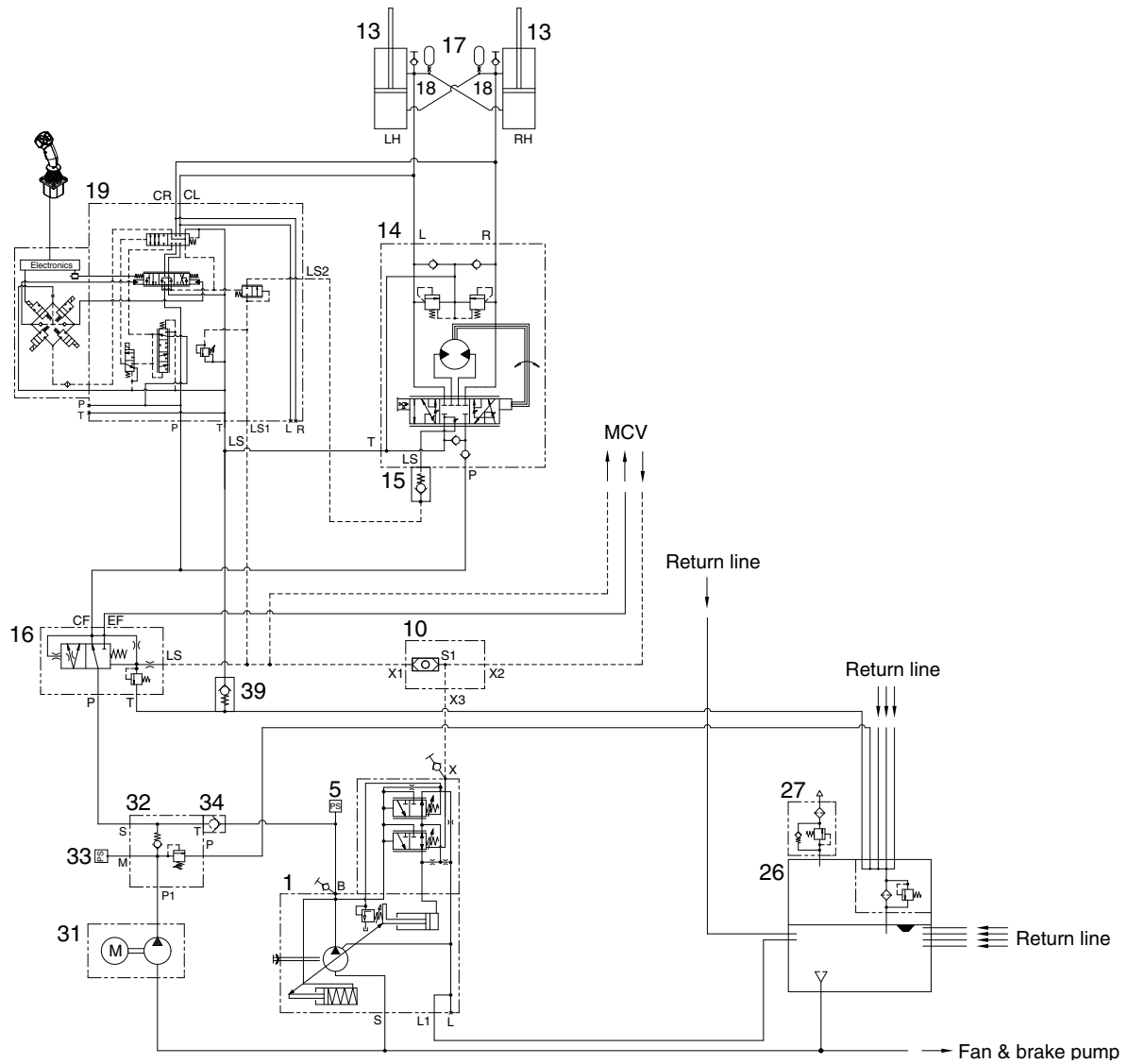
The steering pump draws hydraulic oil from the hydraulic tank.

Outlet flow from the pump flows to the priority valve. The priority valve preferentially supplies flow, on demand, to the steering unit. When the machine is steered, the steering unit routes flow to the steering cylinders to articulate the machine.

When the machine is not being steered, or if pump flow is greater than steering flow, the priority valve supplies flow to the loader system.

That is, output flow from the steering pump enters into the main control valve for the operation of the attachment.

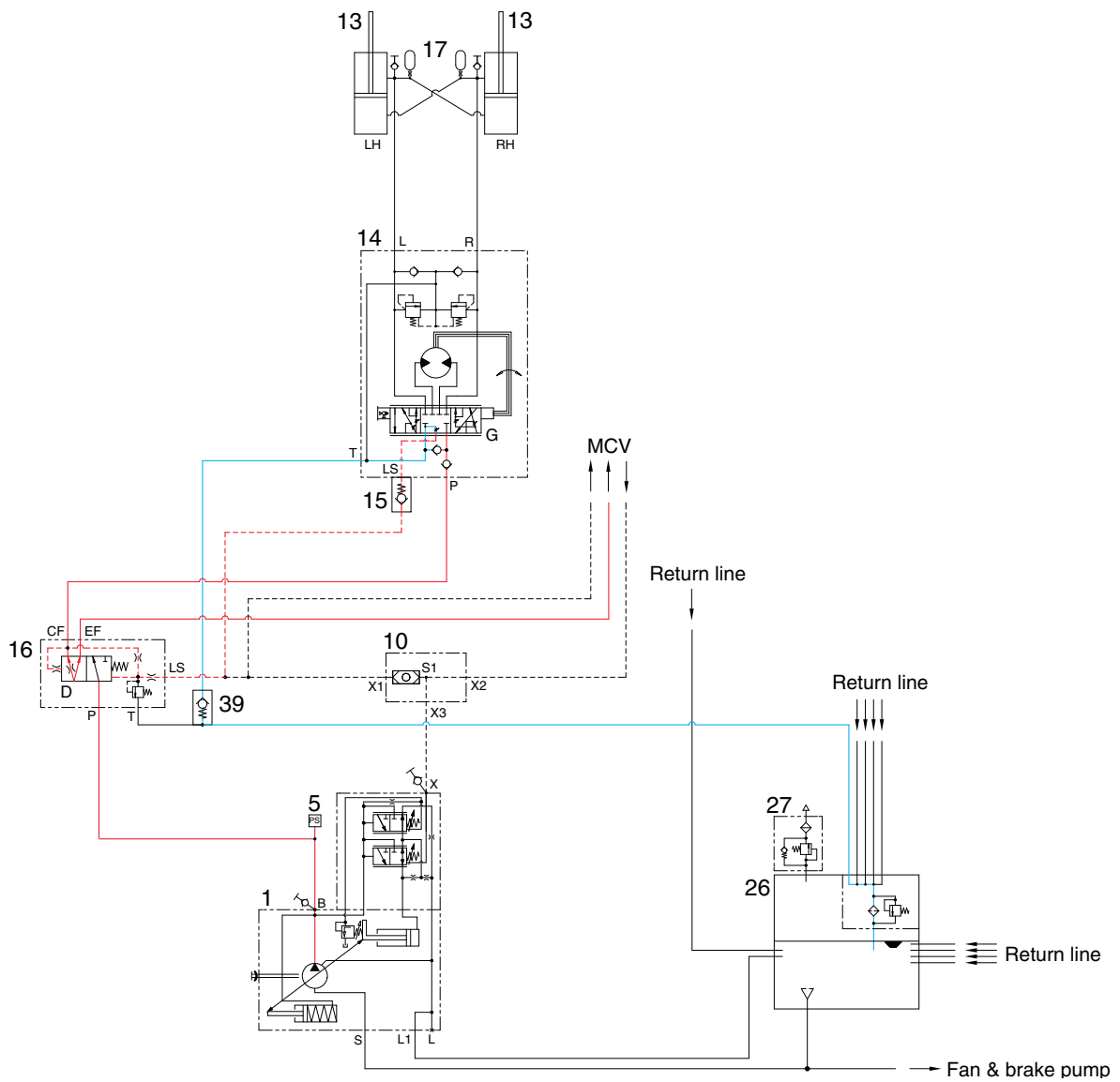
## 2. HYDRAULIC CIRCUIT



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- |                       |                                     |                             |
|-----------------------|-------------------------------------|-----------------------------|
| 1 Main(steering) pump | 17 Accumulator                      | 32 Check block (option)     |
| 10 LS check valve     | 18 Orifice                          | 33 Pressure sensor (option) |
| 13 Steering cylinder  | 19 Joystick steering valve (option) | 34 Check valve (option)     |
| 14 Steering unit      | 26 Hydraulic tank                   | 39 Check valve              |
| 15 Line check valve   | 27 Air breather                     |                             |
| 16 Priority valve     | 31 Motor pump (option)              |                             |

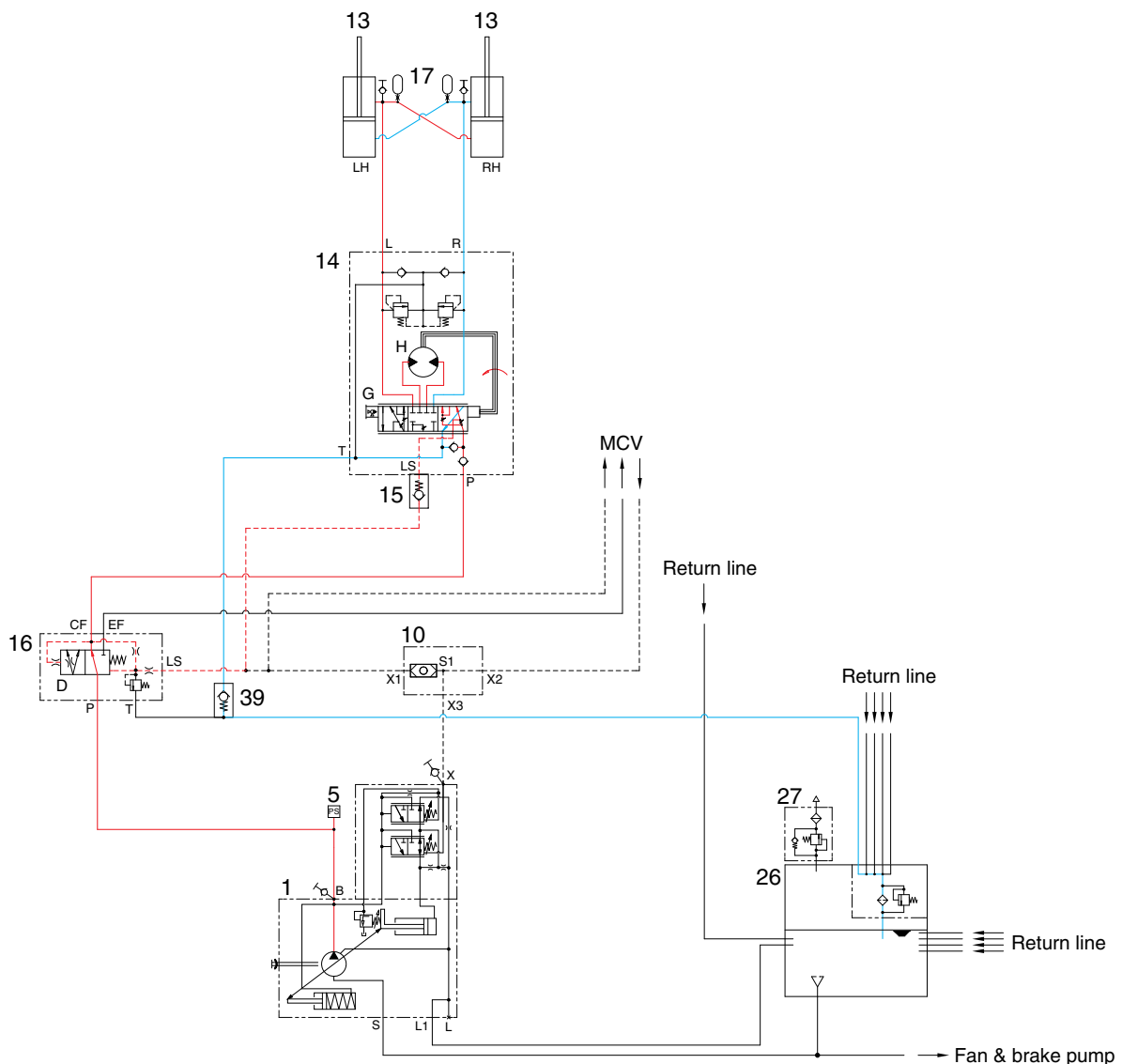
1) NEUTRAL



955SA5SE02

- The steering wheel is not being operated so control spool (G) does not move.
- The oil from the main pump enters port P of the priority valve and the inlet pressure oil moves the spool (D) to the right.
- Almost all of pump flow goes to the loader system (main control valve) through the EF port and partly flows into the hydraulic tank (26).

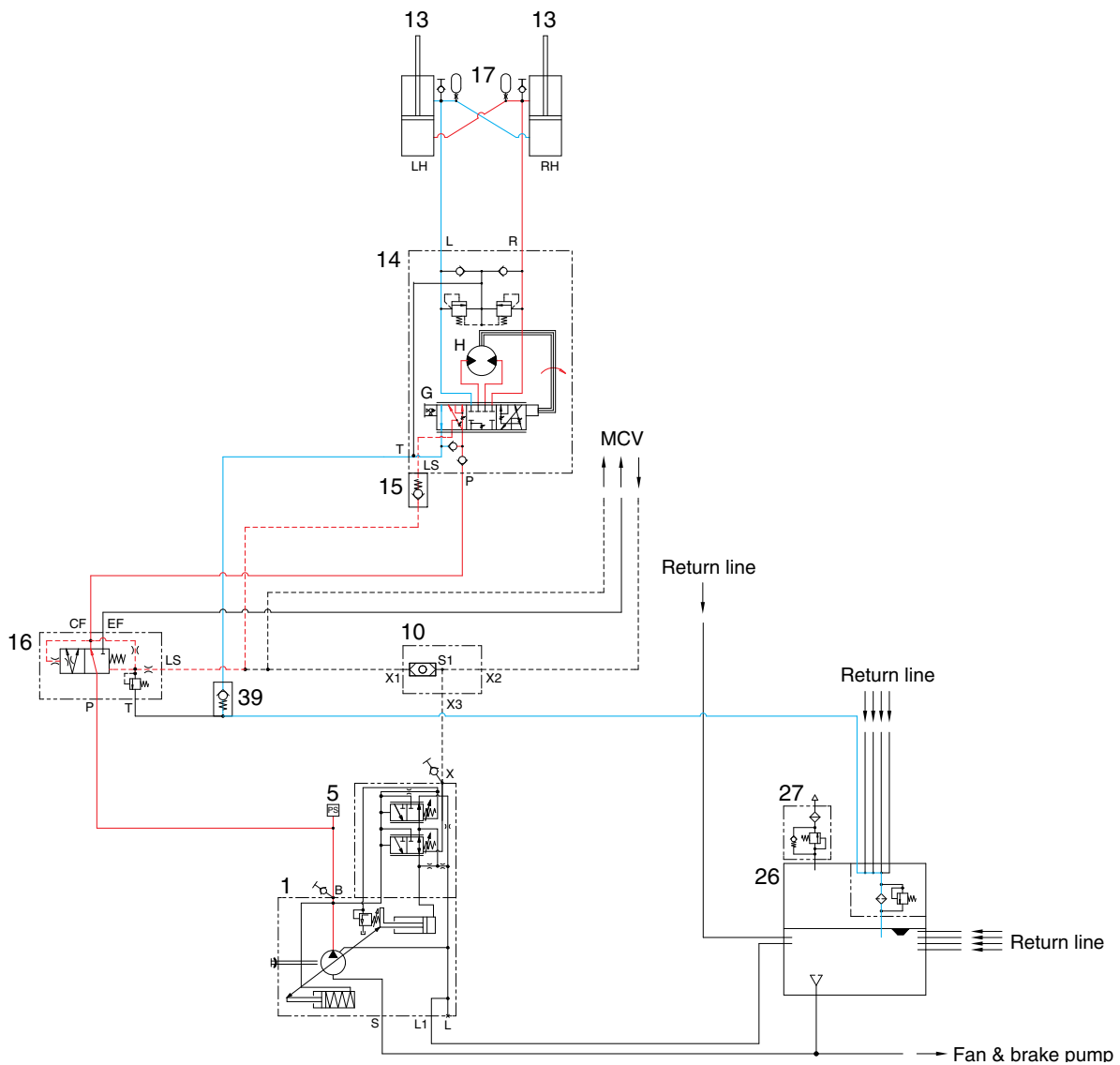
## 2) LEFT TURN



955SA5SE03

- When the steering wheel is turned to the left, the spool(G) within the steering unit(14) connected with steering column turns in the left hand direction.
- At this time, the oil discharged from the pump flows into the spool(G) of the steering unit(14) through the spool(D) of priority valve(16) and flows into the gerotor(H).
- Oil flow from the gerotor flows back into the spool(G) where it is directed out the left work port(L) to the respective chamber of the steering cylinders(13). Oil returned from left and right cylinder returns to hydraulic tank through the spool of the steering unit.
- When the above operation is completed, the machine turns to the unit.

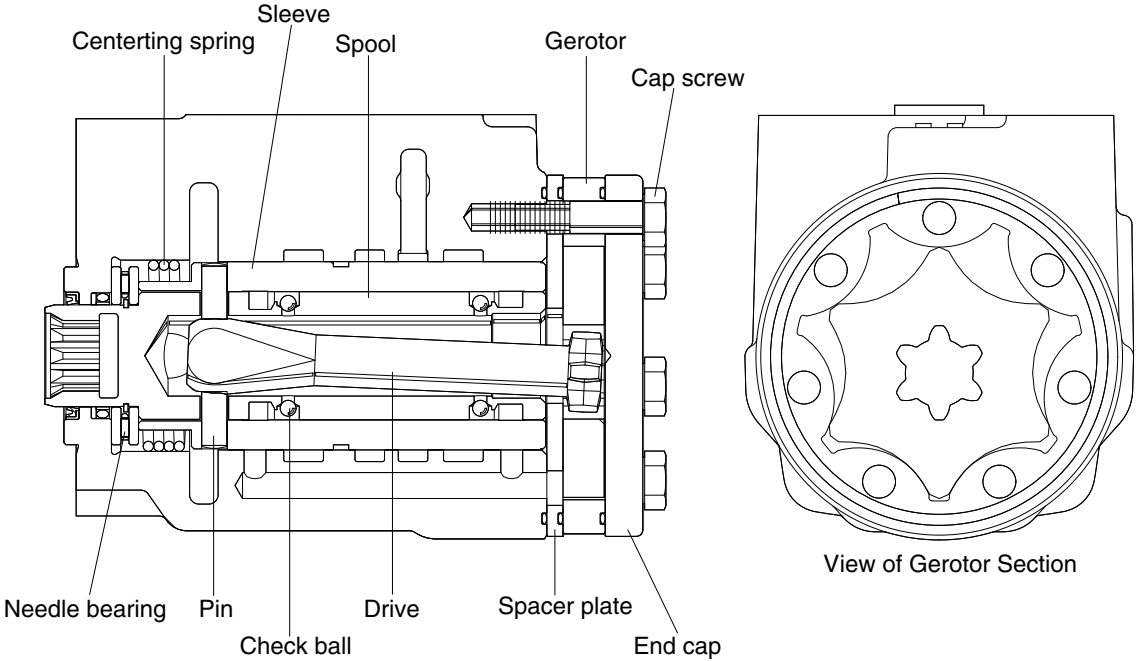
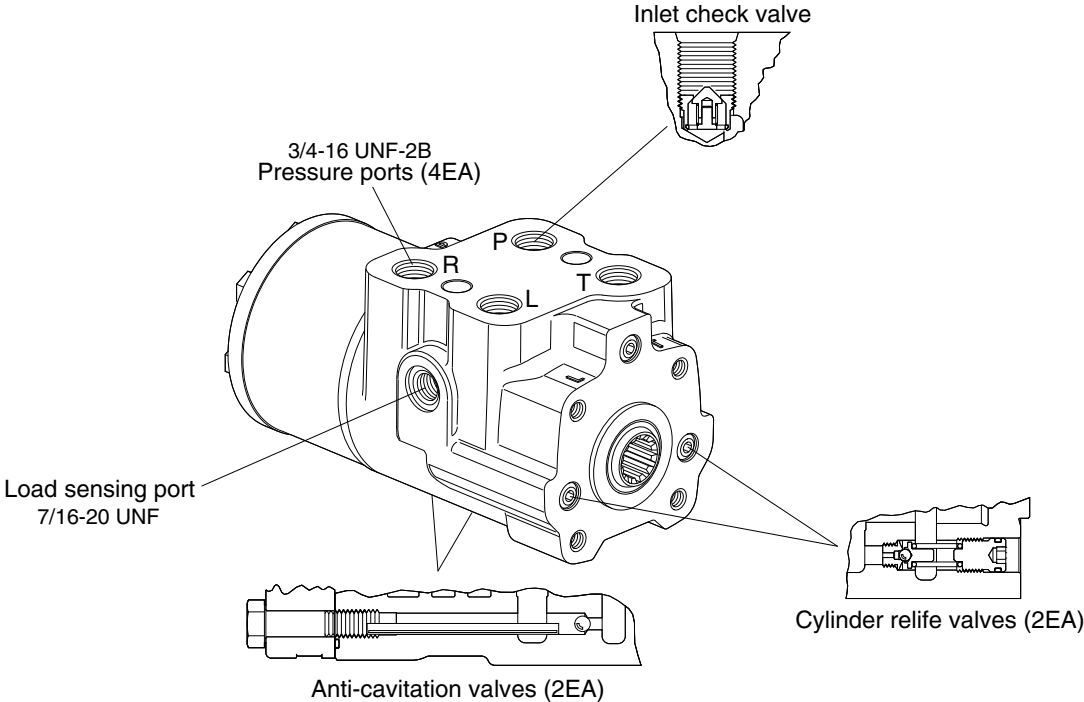
### 3) RIGHT TURN



955SA5SE04

- When the steering wheel is turned to the right, the spool(G) within the steering unit(14) connected with steering column turns in right hand direction.
- At this time, the oil discharged from the steering pump flows into the spool(G) of the steering unit(14) through the spool(D) of priority valve(16) and flows into the gerotor(H).
- Oil flow from the gerotor flows back into the spool(G) where it is directed out the right workport to the respective chamber of the steering cylinders(13). Oil returned from left and right cylinder returns to hydraulic tank through the spool of the steering unit.
- When the above operation is completed, the machine turns to the right.

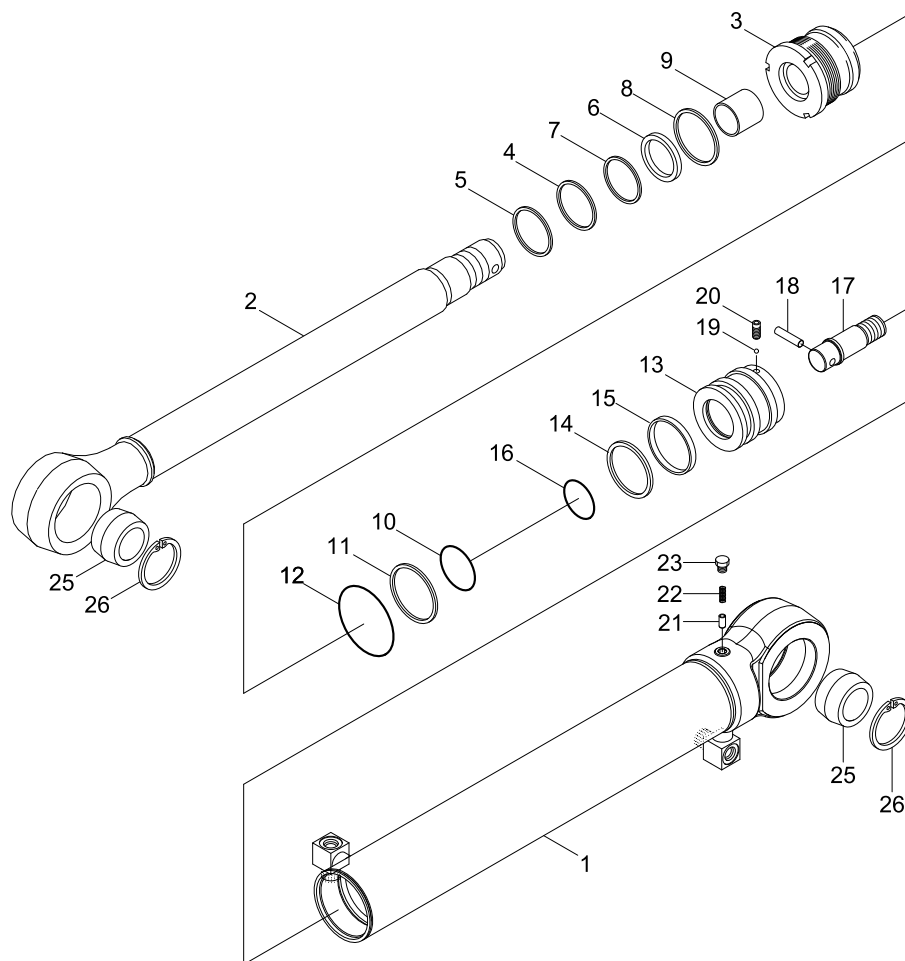
3. STEERING UNIT



960A5SE13

## 4. STEERING CYLINDER

### 1) STRUCTURE



955A5SE05

1	Tube assembly	10	O-ring	19	Steel ball
2	Rod assembly	11	Back up ring	20	Set screw
3	Gland	12	O-ring	21	Check valve
4	Dust wiper	13	Piston	22	Coil spring
5	Retaining ring	14	Piston seal	23	Hexagon socket plug
6	Rod seal	15	Wear ring	25	Spherical bearing
7	Back up ring	16	O-ring	26	Retaining ring
8	Buffer ring	17	Cushion plunger		
9	Du bushing	18	Parallel pin		

### 2) OPERATION

This machine use to cross connected cylinder for steering operation.

The steering cylinder use a gland (3) to remove piston (13) and sealed seals.

Dust wiper (4) located on the in side of the gland protects cylinder inner parts from dust.

The piston (13) is fastened to the rod (2).

The piston uses a single wear ring (15) with a piston seal to seal between the piston and tube.

The gland seals against the tube with two O-rings. The rod is sealed against the gland with a rod seal.

## GROUP 2 OPERATIONAL CHECKS AND TROUBLESHOOTING

### 1. OPERATIONAL CHECKS

This procedure is designed so the service man can make a quick check of the steering system using a minimum amount of diagnostic equipment. If you need additional information, refer to structure and function in group 1.

A location will be required which is level and has adequate space to complete the checks.

The engine and all other major components must be at operating temperature for some checks.

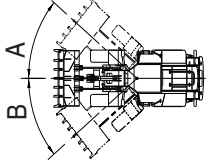
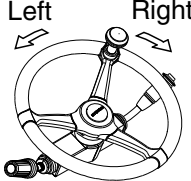
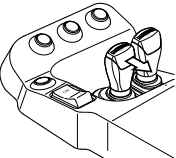
Locate system check in the left column and read completely, following this sequence from left to right. Read each check completely before performing.

At the end of each check, if no problem is found (OK), that check is complete or an additional check is needed. If problem is indicated (NOT OK), you will be give repair required and group location. If verification is needed, you will be give next best source of information :

- Chapter 2 : Troubleshooting
- Group 3 : Tests and adjustments



※ Hydraulic oil must be at operating temperature for these checks (refer to page 6-49).

Item		Description	Service action
<b>Steering unit check</b>		<p>Run engine at low idle.</p> <p>Turn steering wheel until frames are at maximum right (A) and then left (B) positions.</p> <p><b>LOOK</b> : Frames must move smoothly in both directions.</p> <p>When steering wheel is stopped, frames must stop.</p> <p><b>FEEL</b> : Excessive effort must not be required to turn steering wheel.</p> <p><b>NOTE</b> : It is normal for steering to drift from stops when steering wheel is released.</p>	<p><b>OK</b> Check completed.</p> <p><b>NOT OK</b> Go to next check.</p>
<b>Steering system leakage check</b> Heat hydraulic oil to operating temperature. Run engine at high idle.		<p>Turn steering wheel rapidly until frames are against stop.</p> <p>Hold approximately 2 kg on steering wheel.</p> <p>Count steering wheel revolutions for 1 minute.</p> <p>Repeat test in opposite direction.</p> <p><b>LOOK</b> : Steering wheel should rotate less than 7 rpm.</p> <p><b>NOTE</b> : Use good judgment;</p> <p>Excessive steering wheel rpm does not mean steering will be affected.</p>	<p><b>OK</b> Check completed.</p> <p><b>NOT OK</b> Do steering system leakage test in group 3 to isolate the leakage.</p>
<b>Priority valve low pressure check</b>		<p>Park machine on a hard surface.</p> <p>Hold brake pedal down.</p> <p>Run engine at high idle.</p> <p>Steer machine to the right and left as far as possible.</p> <p><b>LOOK</b> : Machine must turn at least half way to the right and left stops.</p>	<p><b>OK</b> Check completed.</p> <p><b>NOT OK</b> Do priority valve pressure test.</p>
<b>Priority valve high pressure check</b>  Run engine at high idle.		<p>Steer to steering stop and release steering wheel.</p> <p>Roll bucket back and hold over relief and observe engine rpm.</p> <p>Turn steering wheel to steering stop and hold, observe engine rpm.</p> <p><b>LOOK</b> : Steering stall engine rpm must be higher than hydraulic stall rpm.</p>	<p><b>OK</b> Check completed.</p> <p><b>NOT OK</b> Priority pressure is set too high. Do priority valve pressure test in group 3.</p>

## 2. TROUBLESHOOTING

※ Diagnose malfunction charts are arranged from most probable and simplest to verify, to least likely, more difficult to verify. Remember the following steps when troubleshooting a problem :

Step 1. Operational check out procedure (see group 3 in section 1)

Step 2. Operational checks (in this group)

Step 3. Troubleshooting

Step 4. Tests and adjustments (see group 3)

Problem	Cause	Remedy
<b>No steering</b>	Low oil level. Failed steering pump. Failed main pump drive. Stuck priority valve spool. Broken priority valve spring.	Add recommended oil. Remove and inspect return filter for metal pump particles. Do main pump flow test. Remove and inspect priority valve spool. Remove and inspect spring.
<b>No hydraulic functions steering normal</b>	Stuck open system relief valve. Locked safety valve. Plugged pilot line filter. Failed hydraulic pump. Low secondary pressure of RCV.	Replace relief valve. Unlock safety valve. Inspect and replace. Remove and inspect the pump. Check the pressure and replace if necessary.

Problem	Cause	Remedy
<b>Slow or hard steering</b>	Too much friction in the mechanical parts of the machine.  Cold oil.  Low priority valve pressure setting.  Worn hydraulic pump.  Sticking priority valve spool.  Broken priority valve spring.	Lubricate bearings and joints of steering column or repair if necessary. Check steering column installation.  Warm the hydraulic oil.  Do priority valve pressure test. Clean or replace cartridge in steering valve.  Do hydraulic pump performance check.  Remove and inspect.  Remove and inspect.
<b>Constant steering to maintain straight travel</b>	Air in system.  Leakage in steering system.  Worn steering unit.    Leaf spring without spring force or broken.  Spring in double shock valve broken.  Gear wheel set worn.  Cylinder seized or piston seals worn.	Check for foamy oil.  Do steering system leakage check.    Do steering system leakage check. Do steering unit neutral leakage test in group 3.  Replace leaf springs.  Replace shock valve.  Replace gear wheel set.  Replace defects parts.
<b>Slow steering wheel movement will not cause any frame movement</b>	Leakage in steering unit gerotor.  Worn steering unit gerotor.	Do steering system leakage check.  Do steering leakage check.
<b>Steering wheel can be turned with frames against steering stop</b>	Leakage in steering system.	Do steering system leakage check.
<b>Steering wheel turns with no resistance and causes no frame movement</b>	Broken steering column or splined coupling.  Lack of oil in steering unit.  Leakage in steering system.	Remove and inspect.  Start engine and check steering operation.  Do steering system leakage test in group 3.

Problem	Cause	Remedy
<b>Erratic steering</b>	Air in oil. Low oil level. Sticking priority valve spool. Loose cylinder piston. Damaged steering unit.	Check for foamy oil. Add recommended oil. Remove and inspect spool. Remove rod to inspect piston. Remove and inspect.
<b>Spongy or soft steering</b>	Air in oil. Low oil level.	Check for foamy oil. Add recommended oil.
<b>Free play at steering wheel</b>	Loose steering wheel nut. Worn or damaged splines on steering column or unit.	Tighten. Inspect.
<b>Steering unit binding or steering wheel does not immediately return to neutral when released</b>	Binding in steering column or misalignment of column. High return pressure.  Contamination in steering unit.  Large particles of contamination in steering unit.	Inspect.  Check for a pinched or damaged return line.  Inspect hydraulic filter for contamination. Repair cause of contamination. Flush hydraulic system.  Inspect hydraulic filter for contamination. Repair cause of contamination. Flush hydraulic system.
<b>Steering unit locks up</b>	Worn or damaged steering unit.	Repair or replace steering unit.
<b>Abrupt steering wheel oscillation</b>	Improperly timed gerotor gear in steering unit.	Time gerotor gear.
<b>Steering wheel turns by itself</b>	Lines connected to wrong port.	Reconnect lines.
<b>Vibration in steering system or hoses jump</b>	High priority valve setting.	Do priority valve pressure test.
<b>Neutral position of steering wheel cannot be obtained, i.e. there is a tendency towards "motoring"</b>	Steering column and steering unit out of line. Too little or no play between steering column and steering unit input shaft. Pinching between inner and outer spools.	Align the steering column with steering unit. Adjust the play and, if necessary, shorten the splines journal. Contact the nearest service shop.

Problem	Cause	Remedy
<b>"Motoring" effect. The steering wheel can turn on its own.</b>	Leaf springs are stuck or broken and have therefore reduced spring force.	Replace leaf springs.
	Inner and outer spools pinch, possibly due to dirt.	Clean steering unit or contact the nearest service shop.
	Return pressure in connection with the reaction between differential cylinder and steering unit too high.	Reduce return pressure.
	Oil is needed in the tank.	Fill with clean oil and bleed the system.
	Steering cylinder worn.	Replace or repair cylinder.
	Gear wheel set worn.	Replace gear wheel set.
	Spacer across cardan shaft forgotten.	Install spacer.

Problem	Cause	Remedy
<b>Backlash</b>	Cardan shaft fork worn or broken. Leaf springs without spring force or broken. Worn splines on the steering column.	Replace cardan shaft. Replace leaf springs. Replace steering column.
<b>"Shimmy" effect. The steered wheels vibrate. (Rough tread on tires gives vibrations)</b>	Air in the steering cylinder.  Mechanical connections or wheel bearings worn.  High priority valve setting pressure.	Bleed cylinder. Find and remove the reason for air collection.  Replace worn parts.  Set pressure as regular value.
<b>Steering wheel can be turned slowly in one or both directions without the steered wheels turning.</b>	One or both shock valves are leaky or are missing in steering valve.	Clean or replace defective or missing valves.
<b>Steering is too slow and heavy when trying to turn quickly.</b>	Insufficient oil supply to steering unit, pump defective or number of revolutions too low. Relief valve setting too low. Relief valve sticking owing to dirt. Spool in priority valve sticking owing to dirt.  Too weak spring in priority valve.	Replace pump or increase number of revolutions. Adjust valve to correct setting. Clean the valve. Clean the valve, check that spool moves easily without spring. Replace spring by a stronger.
<b>"Kick back" in steering wheel from system. Kicks from wheels.</b>	Fault in the system.	Contact authorized man or shop.

Problem	Cause	Remedy
<b>Heavy kick-back in steering wheel in both directions.</b>	Wrong setting of cardan shaft and gear-wheel set.	Correct setting as shown in this manual.
<b>Turning the steering wheel activates the steered wheels opposite.</b>	Hydraulic hoses for the steering cylinders have been switched around.	Connect lines to correct ports.
<b>Hard point when starting to turn the steering wheel</b>	Spring force in priority valve too weak. Oil is too thick (cold).	Replace spring by a stronger. Let motor run until oil is warm.
<b>Too little steering force (possibly to one side only).</b>	Pump pressure too low. Too little steering cylinder. Piston rod area of the differential cylinder too large compared with piston diameter.	Correct pump pressure. Fit a larger cylinder. Fit cylinder with thinner piston rod or 2 differential cylinders.
<b>Leakage at either input shaft, end cover, gear-wheel set, housing or top part.</b>	Shaft defective. Screws loose. Washers or O-rings defective.	Replace shaft seal. Tighten screws. Replace.

## GROUP 3 TESTS AND ADJUSTMENTS

### 1. HYDRAULIC OIL CLEAN UP PROCEDURE USING PORTABLE FILTER CADDY

- ※ Service equipment and tool.
  - Portable filter caddy
  - Two 3658 mm (12 ft) × 1" I.D. 100R1 hoses with 3/4 M NPT ends
  - Quick disconnect fittings
  - Discharge wand
  - Various size fittings and hoses
- ※ Brake system uses oil from hydraulic oil tank. Flush all lines in the steering system.  
Disassemble and clean major components for steering system.  
Steering components may fail if steering system is not cleaned after hydraulic oil tank contamination.
- 1) If hydraulic system is contaminated due to a major component failure, remove and disassemble steering cylinders to clean debris from cylinders.
- 2) Install a new return filter element. Clean filter housing before installing new element.
- ※ For a failure that creates a lot of debris, remove access cover from hydraulic oil tank. Drain and clean hydraulic oil tank of fill the specified oil to hydraulic oil tank through upper cover.
- 3) To minimize oil loss, pull a vacuum in hydraulic oil tank using a vacuum pump. Connect filter caddy suction line to drain port at bottom of hydraulic oil tank using connector. Check to be sure debris has not closed drain port.
- 4) Put filter caddy discharge line into hydraulic oil tank filter hole so end is as far away from drain port as possible to obtain a thorough cleaning of oil.



- 5) Start the filter caddy. Check to be sure oil is flowing through the filters.  
Operate filter caddy approximately 10 minutes so oil in hydraulic oil tank is circulated through filter a minimum of four times.  
※ Hydraulic oil tank capacity 110 ℓ (29.1 U.S. gal).  
Leave filter caddy operating for the next steps.
- 6) Start the engine and run it at high idle.  
※ For the most effective results, cleaning procedure must start with the smallest capacity circuit then proceed to the next largest capacity circuit.
- 7) Operate all functions, one at a time, through a complete cycle in the following order: clam, steering, bucket, and boom. Also include all auxiliary hydraulic functions.  
  
Repeat procedure until the total system capacity has circulated through filter caddy seven times, approximately 30 minutes.  
Each function must go through a minimum of three complete cycles for a thorough cleaning for oil.  
  
※ Filtering time for machines with auxiliary hydraulic functions must be increased because system capacity is larger.
- 8) Stop the engine. Remove the filter caddy.
- 9) Install a new return filter element.
- 10) Check oil level in hydraulic oil tank ; Add oil if necessary.

## 2. TEST TOOLS

### 1) CLAMP-ON ELECTRONIC TACHOMETER INSTALLATION

- Service equipment and tools

Tachometer

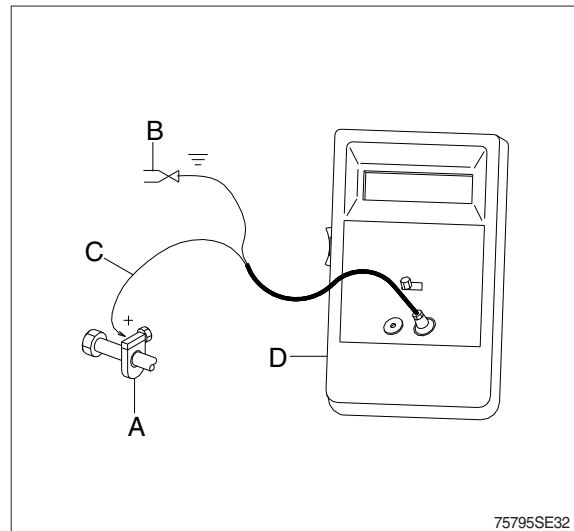
A : Clamp on tachometer.

Remove paint using emery cloth and connect to a straight section of injection line within 100 mm (4in) of pump. Finger tighten only-do not over tighten.

B : Black clip (-). Connect to main frame.

C : Red clip (+). Connect to transducer.

D : Tachometer readout. Install cable.



### 2) DIGITAL THERMOMETER INSTALLATION

- Service equipment and tools

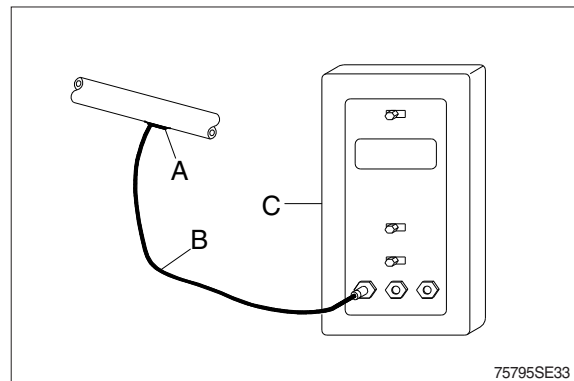
Digital thermometer

A : Temperature probe.

Fasten to a bare metal line using a tie band. Wrap with shop towel.

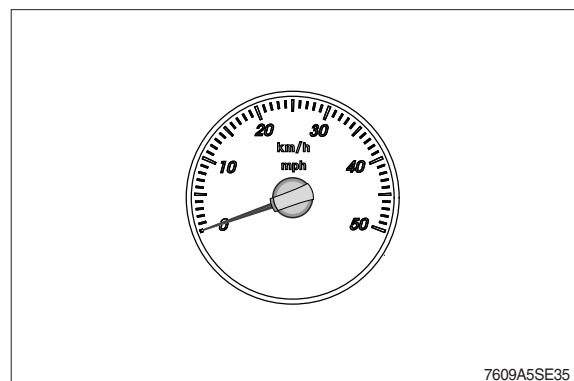
B : Cable.

C : Digital thermometer.



### 3) DISPLAY MONITOR TACHOMETER

The display monitor tachometer is accurate enough for test work.



### 3. STEERING SYSTEM RESTRICTION TEST

- **SPECIFICATION**

Oil temperature       $45 \pm 5^{\circ}\text{C}$  ( $113 \pm 9^{\circ}\text{F}$ )  
Engine speed          High idle  
Maximum pressure    210 bar (3046 psi)  
at steering unit

- **GAUGE AND TOOL**

Gauge

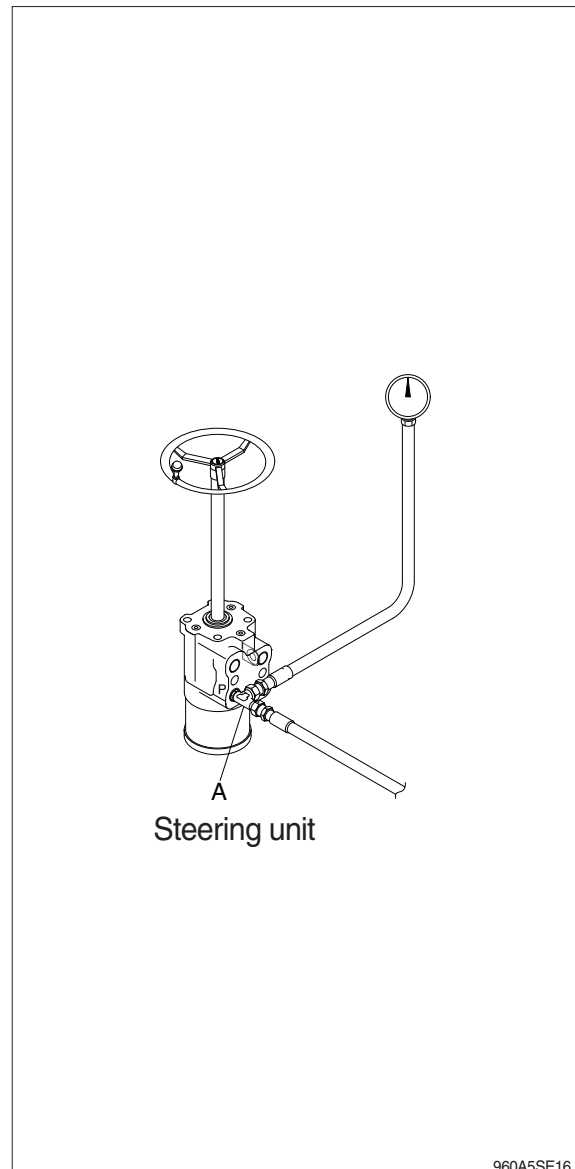
- This test will check for restrictions in the steering system which can cause overheating of hydraulic oil.

- 1) Install temperature reader.  
(see temperature reader installation procedure in this group).
- 2) Heat hydraulic oil to specifications.  
(see hydraulic oil warm up procedure at page 6-49).
- 3) Connect fitting (A) and install gauge.

**⚠ Do not operate steering or loader functions or test gauge may be damaged.**

- 4) Run engine at specification and read pressure gauges.

If pressure is more than specification at the steering unit, inspect priority valve spool for a stuck spool. Make sure orifice plugs installed in ends of priority valve spool.



#### 4. STEERING UNIT LEAKAGE TEST

- **SPECIFICATION**

Oil temperature  $45 \pm 5^{\circ}\text{C}$  ( $113 \pm 9^{\circ}\text{F}$ )

Engine speed High idle

Maximum leakage  $7.5 \text{ l/min}$  ( $2 \text{ gpm}$ )

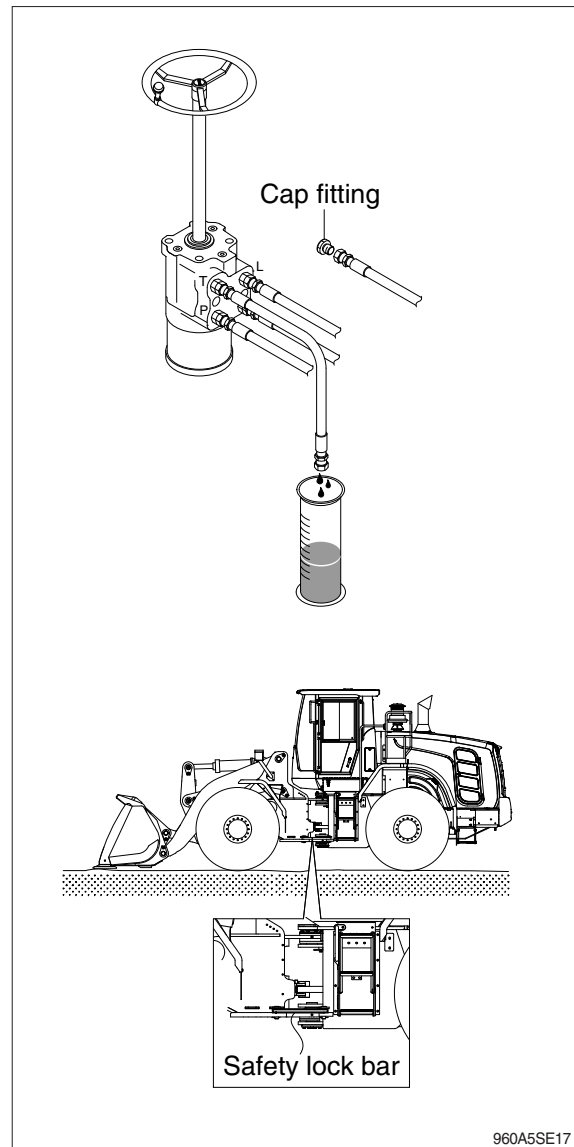
- **GAUGE AND TOOL**

Temperature reader

Measuring container (approx.  $20 \text{ l}$  )

Stop watch

- 1) Install frame locking bar to prevent machine from turning.
- 2) Install temperature reader.  
(see temperature reader installation procedure in this group).
- 3) Heat hydraulic oil to specifications.  
(see hydraulic oil warm up procedure at page 6-49).
- 4) Disconnect return hose from fitting.  
Install cap fitting.
- 5) Run engine at specifications. Rotate steering wheel against locking bar using approximately  $1.2 \text{ kgf} \cdot \text{m}$  of force.  
Measure oil flow from return hose for 1 minute.
- 6) Leakage is greater than specifications,  
repair or replace steering unit.

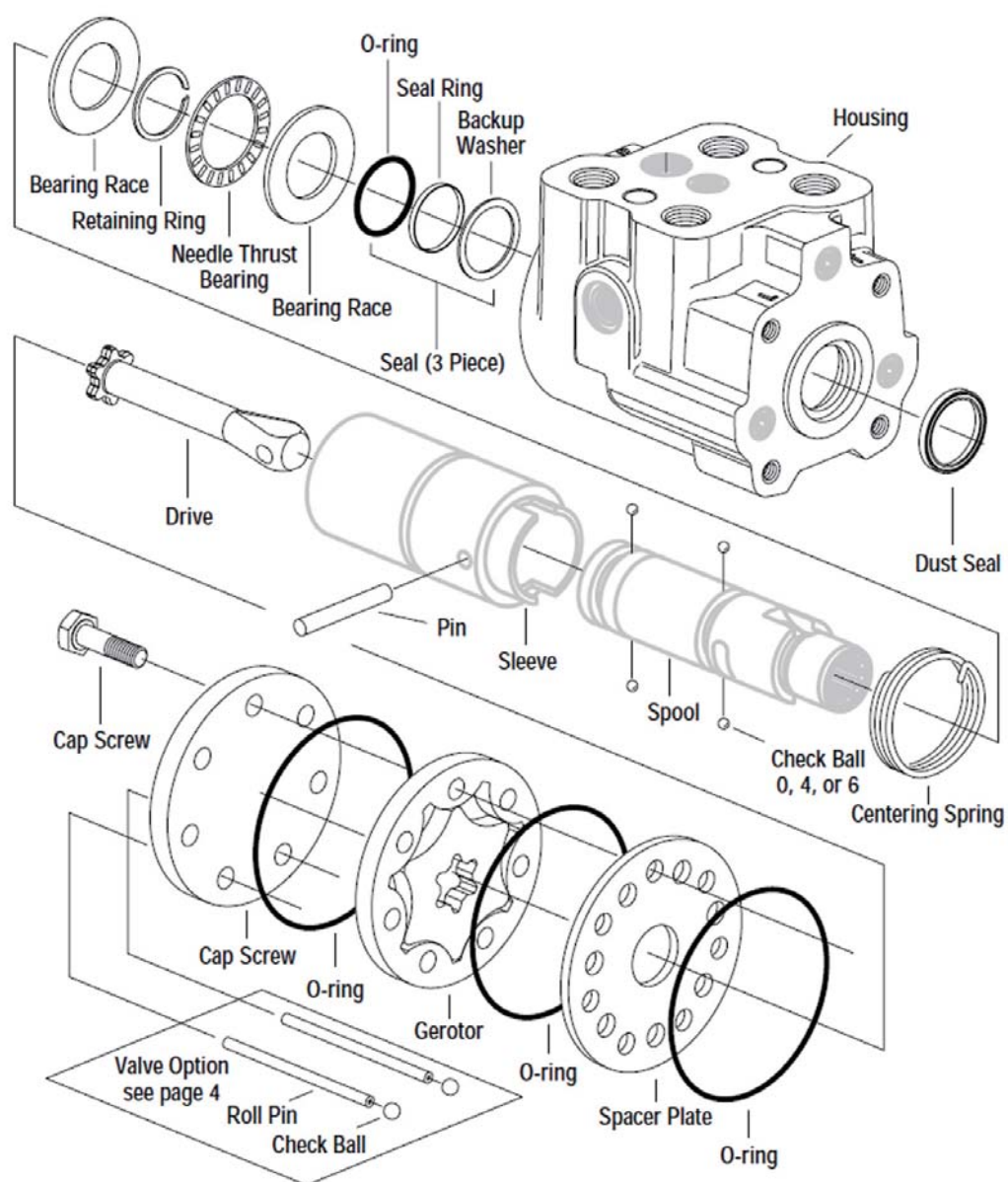


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## GROUP 4 DISASSEMBLY AND ASSEMBLY

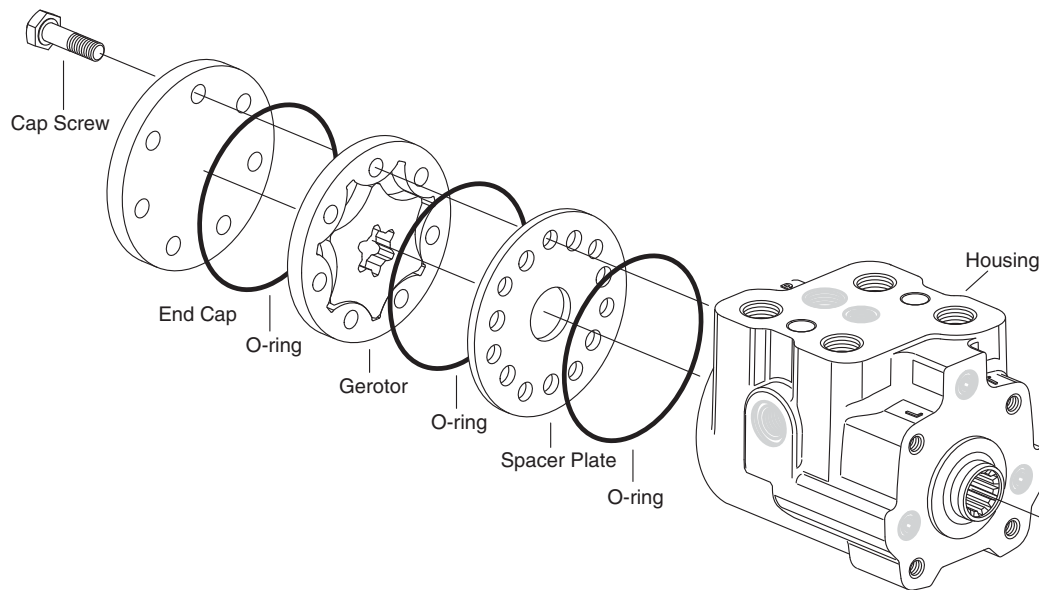
### 1. STEERING UNIT

#### 1) STRUCTURE



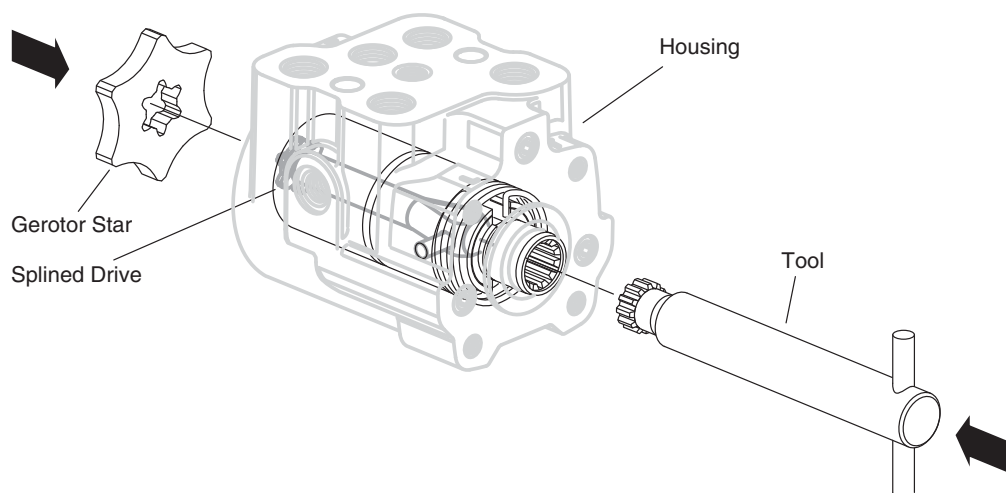
960A5SE33

## 2) DISASSEMBLY



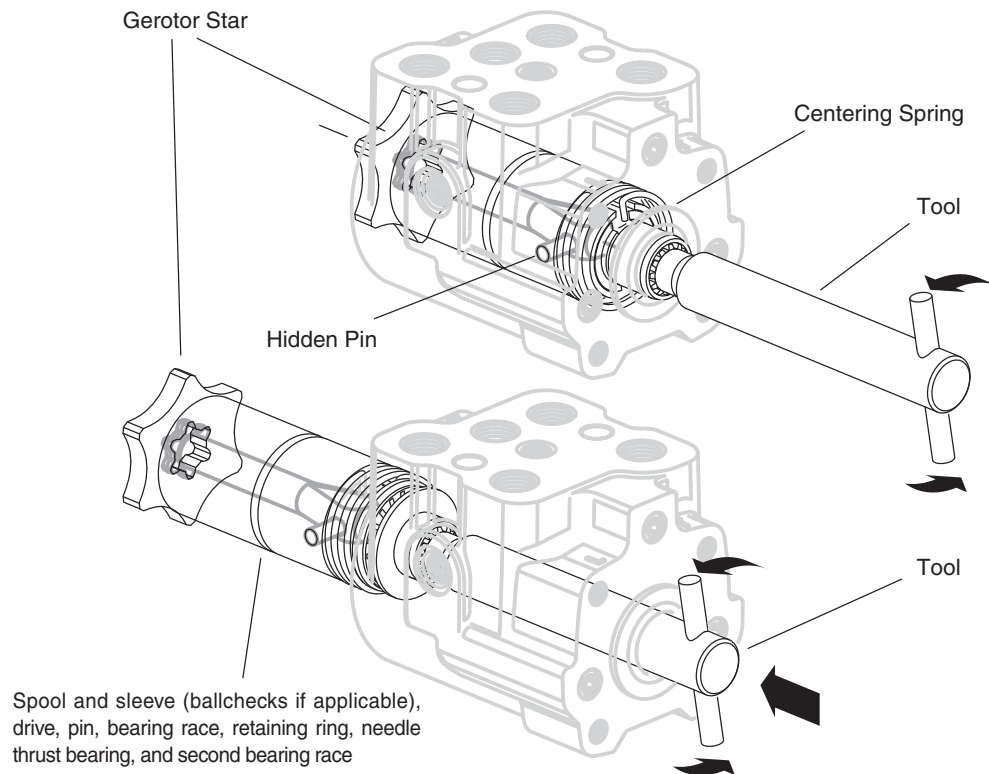
960A5SE19

- (1) Remove the seven cap screws, end cap, O-ring, gerotor, O-ring spacer plate and O-ring.



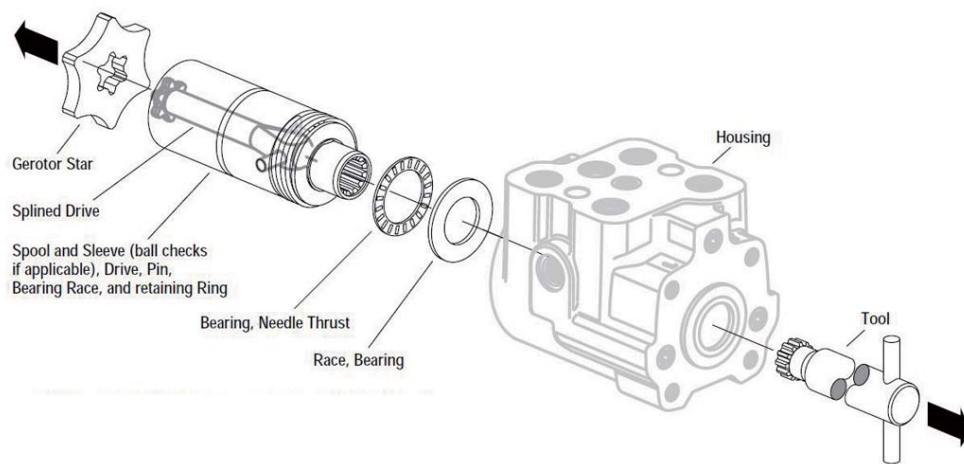
960A5SE20

- (2) Engage tool with splined end of spool.



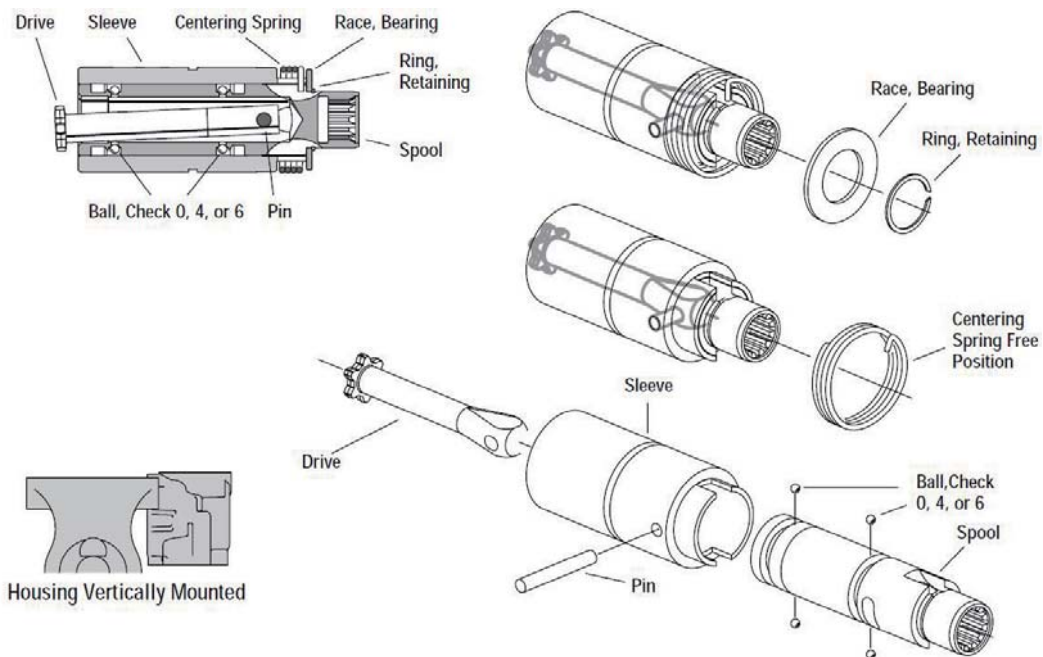
960A5SE21

- (3) Protect gerotor star and hand with shop towel, hold gerotor star and splined drive from turning.
- (4) Twist tool to compress centering spring radially CW or CCW, decreasing the coil diameter of the centering spring allowing it to be removed along with the spool and sleeve (ball checks if applicable), drive, pin, bearing race (2), retaining ring, and needle thrust bearing.  
(Bearing races, retaining ring, and needle thrust bearing, not shown on drawing (left). Centering spring shown compressed.)
- (5) With drive held stationary and centering spring compressed, carefully push these assembled parts out of housing.



960A5SE22

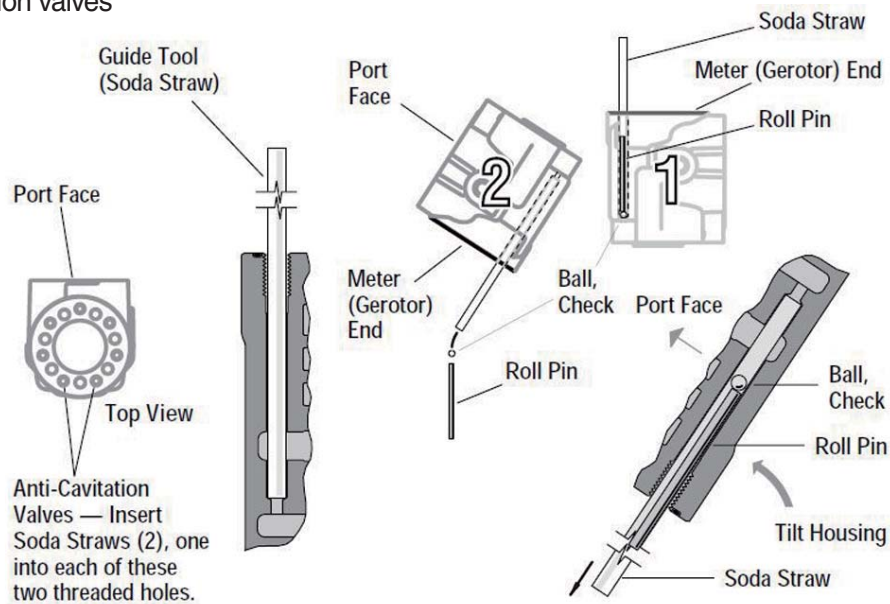
- (6) Remove the thrust bearing race and needle thrust bearing.
- (7) Remove the retaining ring (use retaining ring pliers), bearing race, centering spring, pin, drive, spool, sleeve, and ball checks if applicable.



960A5SE23



## Anti-cavitation valves



960A5SE24

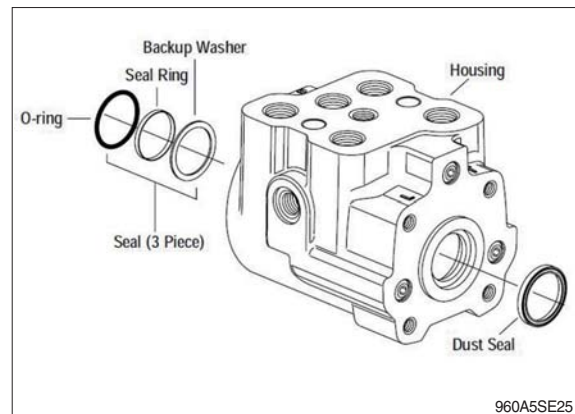
- (8) Insert two soda straws, one in each of two threaded holes, as a safety measure for removal of two small ball check valves and roll pins (correct threaded holes identified in illustration).

Remove housing from vise, tilt the housing and bring the port face upward. Continue turning the housing until the roll pins and ball checks slide through the straws from the meter (gerotor) end of the housing.

- (9) Remove the shaft seal. These three parts may or may not still be in the housing. These parts include O-ring, seal ring, and backup washer.

- (10) Using a small blade screw driver, carefully pry the dust seal from the housing.

※ Do not damage the dust seal seat.

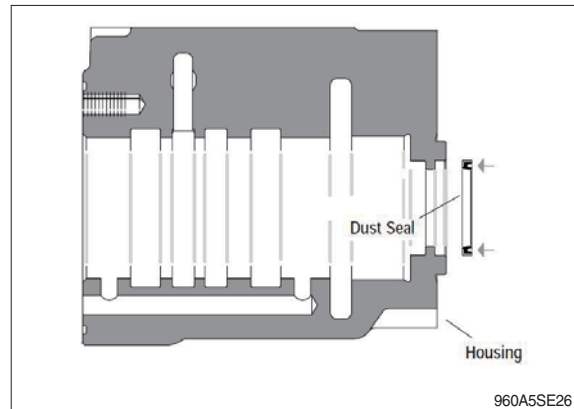


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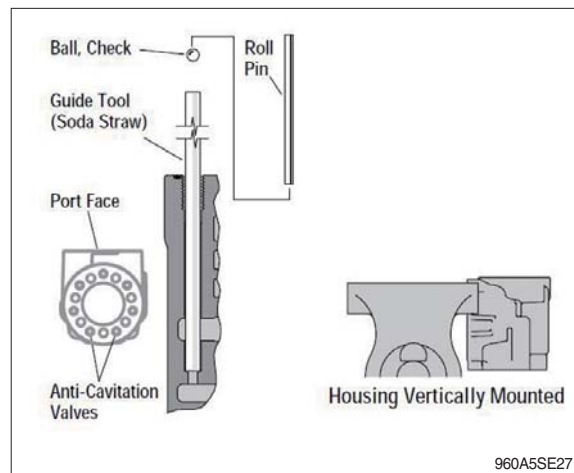
### 3) ASSEMBLY

※ During assembly lubricate the new seals with a petroleum jelly such as vaseline.  
Also lubricate machined surfaces with clean hydraulic fluid.

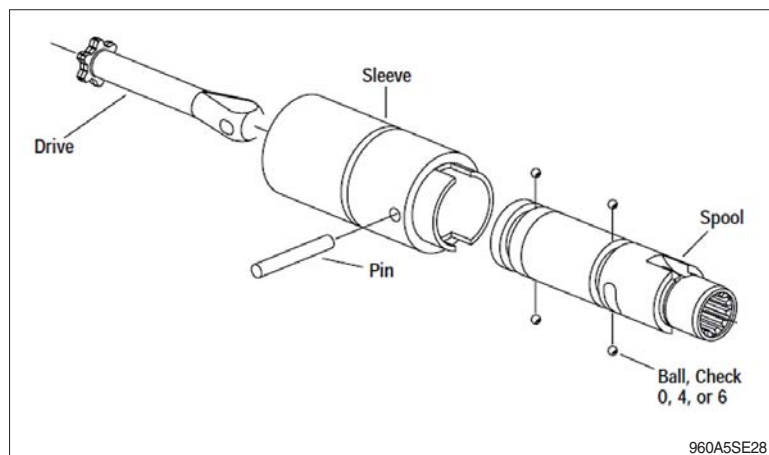
- (1) Lubricate and install the dust seal (see drawing (right) for correct seal orientation).



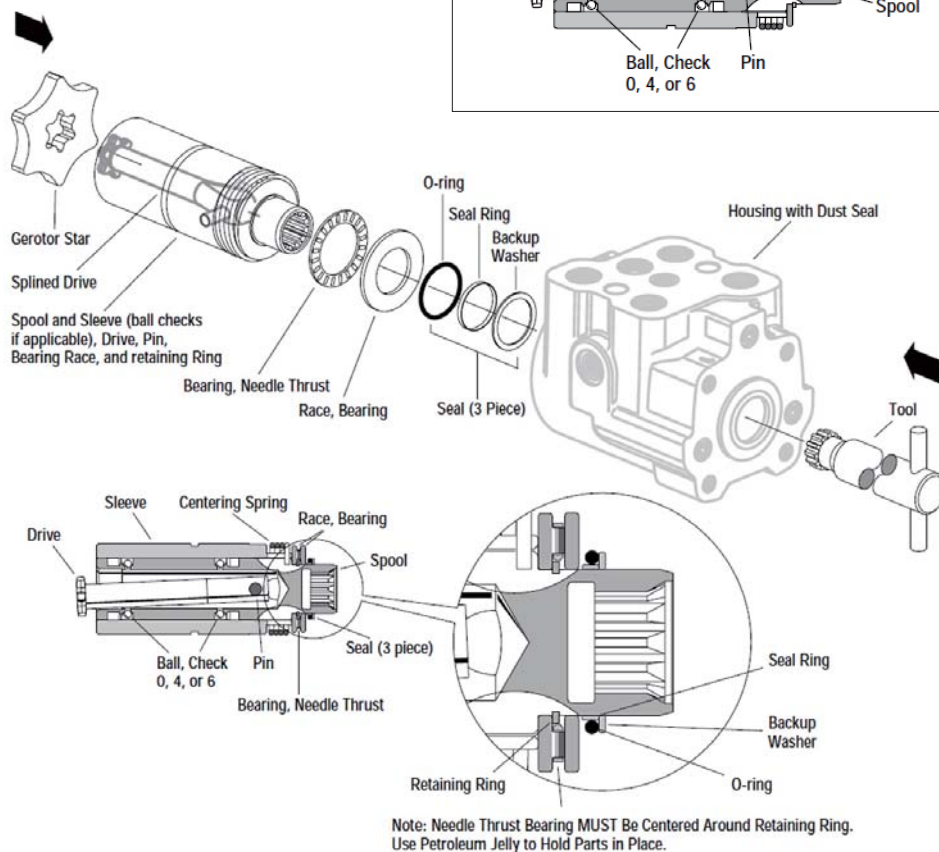
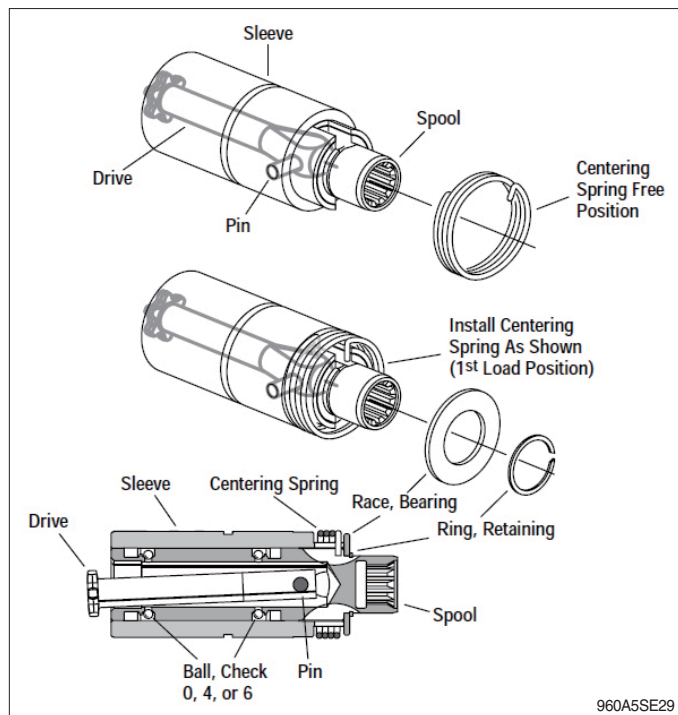
- (2) Installing the anti-cavitation ball checks seems simple enough. However, a word of caution : use a soda straw as a guide tool. Drop the straw into the hole to the bottom of bore, then drop ball through straw. Pull straw and use the same procedure in second ball seat. Check each bore with small light to make sure each ball is in the correct place. Add roll pin in each bore.



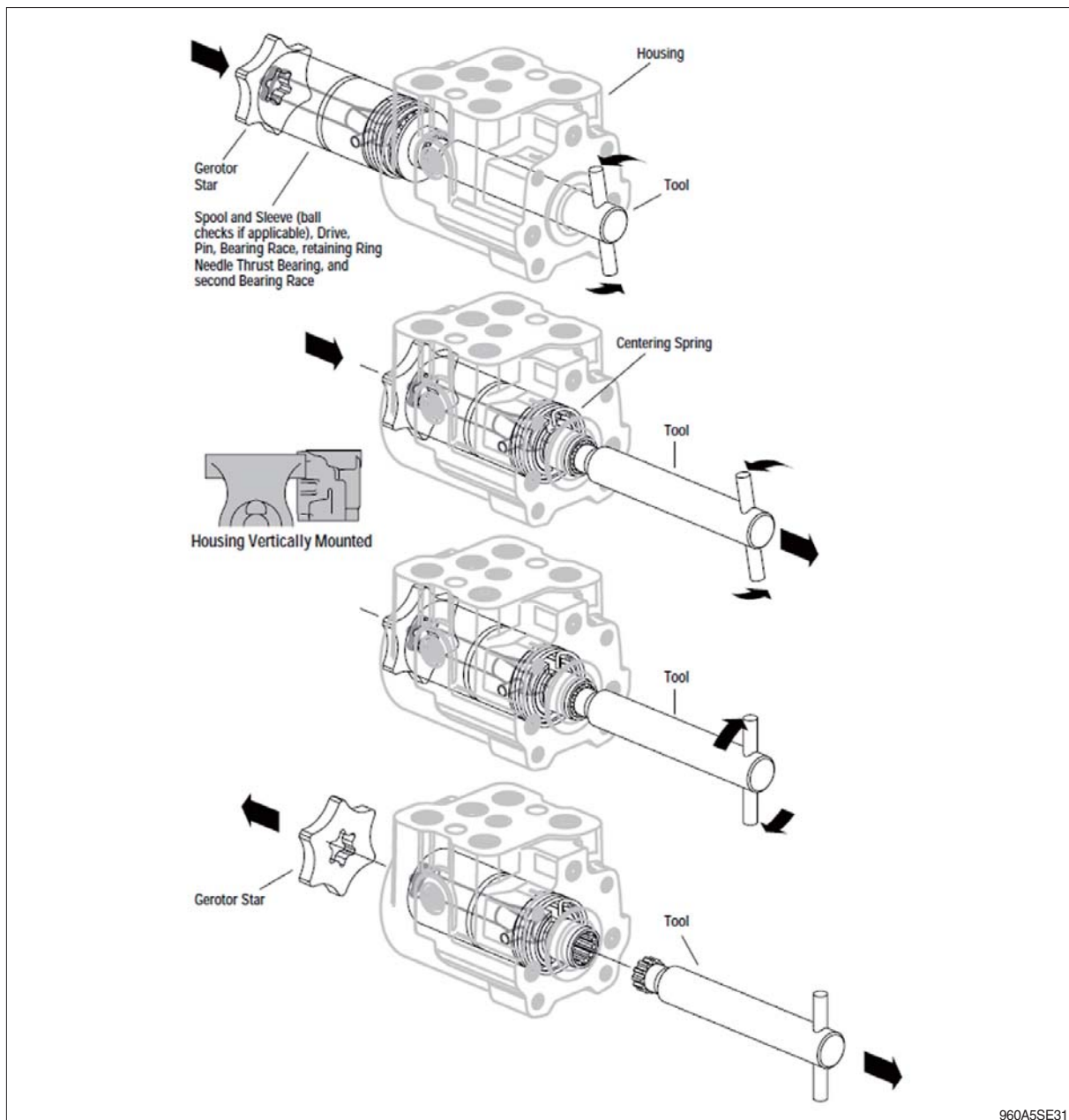
- (3) Apply a light coating of clean hydraulic fluid to the spool and slide it into the sleeve along with the ball checks if applicable.



- (4) Install the drive and pin.
- (5) Install the centering spring. Position one end of spring in slotted end of spool and sleeve, and compress the spring radially (CCW) to engage free end of spring.
- (6) Install the bearing race and retaining ring (use retaining ring pliers) onto spool.

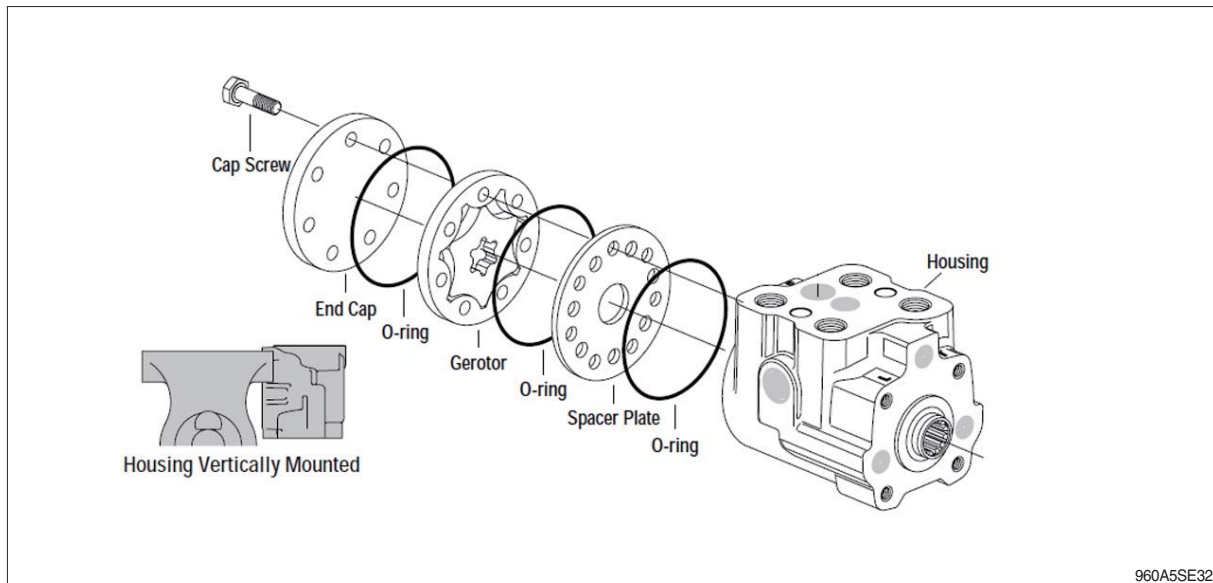


- (7) Apply a light coating of petroleum jelly to the inside diameter of the previously mounted dust seal in the housing.
  - (8) Apply a light coating of petroleum jelly to the needle thrust bearing, second bearing race, and three part shaft seal. Position each part onto the spool as shown in enlarged section drawing. The needle thrust bearing goes between the two bearing races and must be centered around retaining ring.
  - (9) Apply a light coating of clean hydraulic fluid to the spool and sleeve assembly and slide it into the housing. See steps (10)~(15).
- ※ Do not damage the dust or shaft seals.



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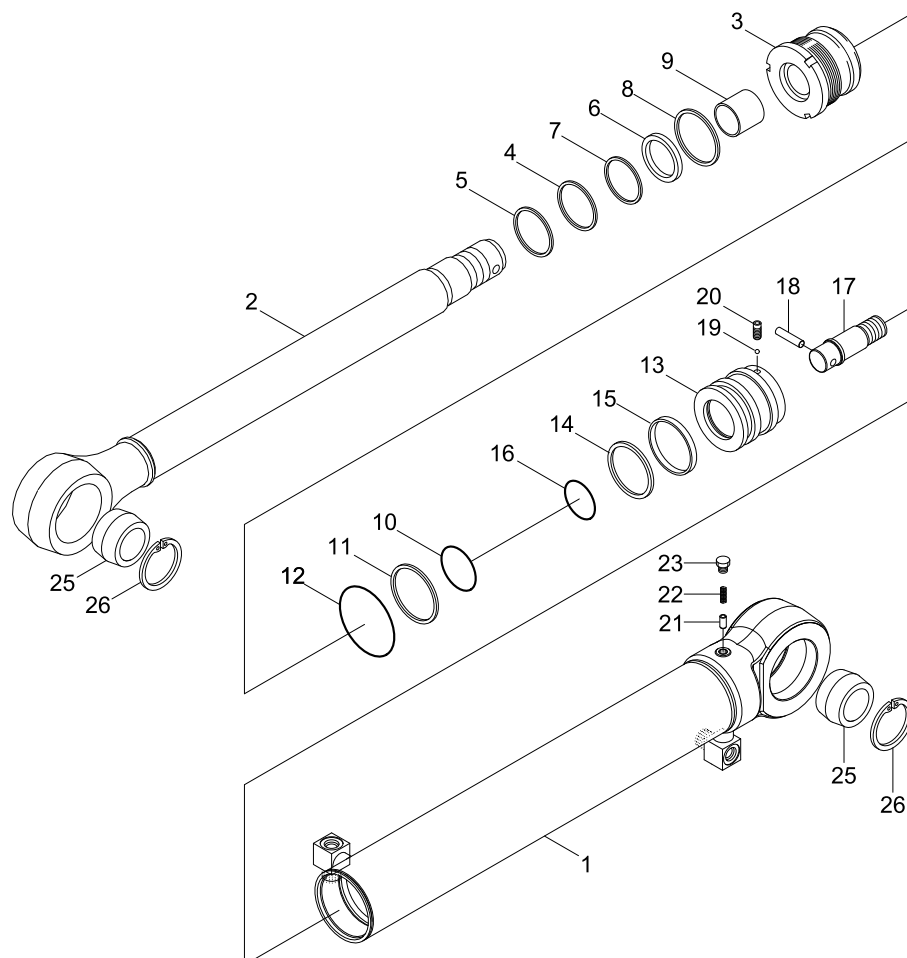
- (10) Protect gerotor star and hand with shop towel, hold gerotor star and splined end of drive to keep it from turning.
- (11) Insert tool through housing; engage with splined end of spool assembled inside of sleeve along with ball checks (if applicable), centering spring, drive, pin, bearing race, retaining ring, needle thrust bearing, second bearing race, shaft seals and backup washer. Twist tool to compress spring coils radially CW or CCW.
  - ※ If by some chance this unit is in the horizontal position keep pin nearly horizontal. If tension on this pin is released before these parts are fully engaged and the pin is not horizontal, the pin can drop and lockup can occur like a deadbolt.
- (12) Keep centering spring compressed, and carefully insert these assembled parts into housing. DO NOT FORCE. (Bearing races, retaining ring, needle thrust bearing, shaft seals and backup washer not shown on drawing. Centering spring shown compressed)
- (13) Release centering spring tension.
- (14) Remove gerotor star and tool.



- (15) Lubricate and install a new O-ring seal in the groove in the housing.
- (16) Install the wear plate O-ring groove up and align the holes in the wear plate with threaded holes in the housing.
- (17) Lubricate and install a new O-ring seal in the groove in the wear plate.
- (18) Install the gerotor and align the screw holes.
- (19) Lubricate and install a new O-ring seal in the groove in the gerotor ring.
- (20) Install the end cap and seven cap screws.
  - Pretighten the cap screws, in a crisscross pattern, to  $1.73 \text{ kgf} \cdot \text{m}$  ( $12.5 \text{ lbf} \cdot \text{ft}$ ).
  - Finally, in a crisscross pattern, tighten cap screws to  $3.46 \text{ kgf} \cdot \text{m}$  ( $25.0 \text{ lbf} \cdot \text{ft}$ ).

## 2. STEERING CYLINDER

### 1) STRUCTURE



955A5SE05

- |   |                |    |                 |    |                     |
|---|----------------|----|-----------------|----|---------------------|
| 1 | Tube assembly  | 10 | O-ring          | 19 | Steel ball          |
| 2 | Rod assembly   | 11 | Back up ring    | 20 | Set screw           |
| 3 | Gland          | 12 | O-ring          | 21 | Check valve         |
| 4 | Dust wiper     | 13 | Piston          | 22 | Coil spring         |
| 5 | Retaining ring | 14 | Piston seal     | 23 | Hexagon socket plug |
| 6 | Rod seal       | 15 | Wear ring       | 25 | Spherical bearing   |
| 7 | Back up ring   | 16 | O-ring          | 26 | Retaining ring      |
| 8 | Buffer ring    | 17 | Cushion plunger |    |                     |
| 9 | Du bushing     | 18 | Parallel pin    |    |                     |

## 2) TOOLS AND TIGHTENING TORQUE

### (1) Tools

Tool name	Remark
Wrench	For gland
(-) Driver	Small and large sizes
Torque wrench	Capable of tightening with the specified torques

### (2) Tightening torque

Part name	Item	Size	Torque	
			kgf · m	lbf · ft
Gland	3	M75×2	60±6	434±43.4
Piston	13	M36×2	90±9	651±65.1
Hex socket plug	23	PT3/8	13.8±1.4	99.8±10.1
Set screw	20	M 6×1	0.8±0.1	5.8±0.7

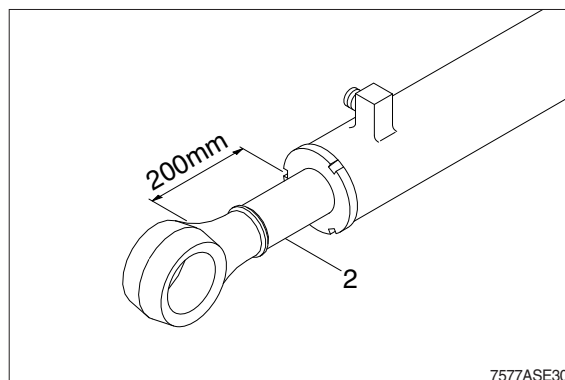
### 3) DISASSEMBLY

#### (1) Remove cylinder head and piston rod

① Hold the clevis section of the tube in a vise.

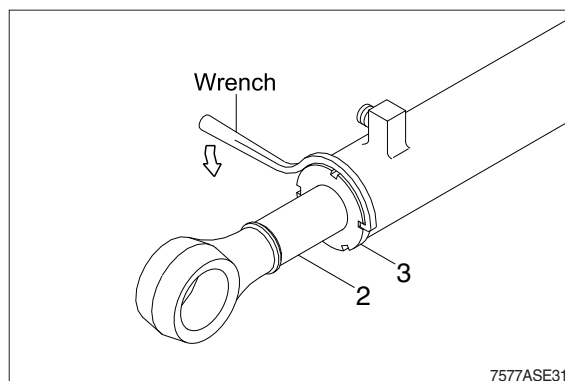
※ Use mouth pieces so as not to damage the machined surface of the cylinder tube. Do not make use of the outside piping as a locking means.

② Pull out piston rod (2) about 200 mm (7.8 in). Because the piston rod is rather heavy, finish extending it with air pressure after the oil draining operation.



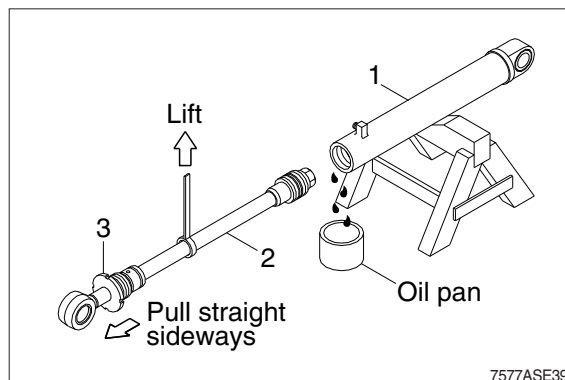
③ Loosen and remove the gland (3).

※ Cover the extracted piston rod (2) with rag to prevent it from being accidentally damaged during operation.



④ Draw out gland (3) and piston rod (2) assembly together from cylinder tube (1).

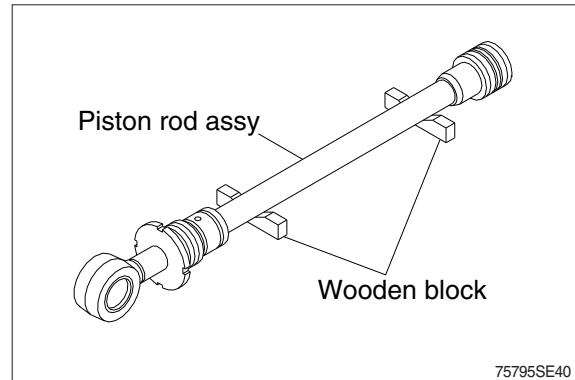
※ Since the piston rod assembly is heavy in this case, lift the tip of the piston rod (2) with a crane or some means and draw it out. However, when piston rod (2) has been drawn out to approximately two thirds of its length, lift it in its center to draw it completely.





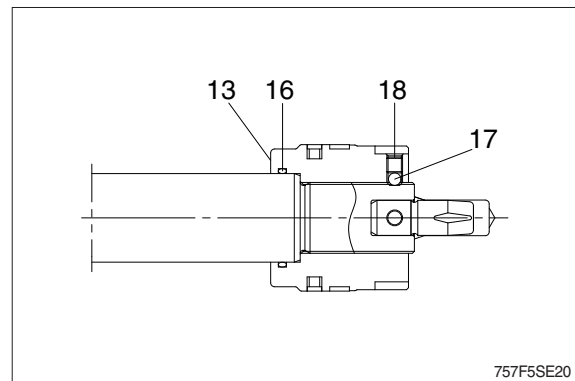
- ※ Note that the plated surface of piston rod (2) is to be lifted. For this reason, do not use a wire sling and others that may damage it, but use a strong cloth belt or a rope.

- ⑤ Place the removed piston rod assembly on a wooden V-block that is set level.
- ※ Cover a V-block with soft rag.

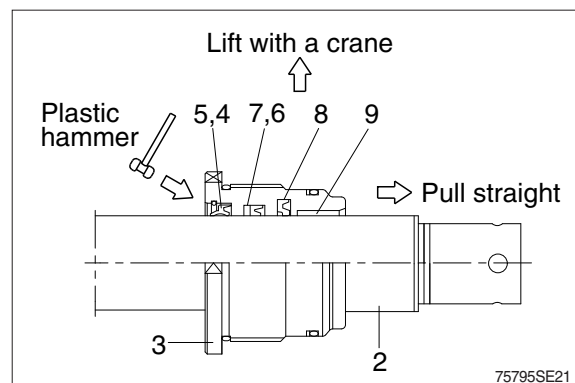


## (2) Remove piston and gland assembly

- ① Remove the set screw (18) and steel ball (17).
- ② Remove piston assembly (13) and O-ring (16).



- ③ Remove the gland (3) assembly from piston rod (2).
  - ※ If it is too heavy to move, move it by striking the flanged part of gland (3) with a plastic hammer.
  - ※ Pull it straight with gland assembly lifted with a crane.
- Exercise care so as not to damage the lip of rod bushing (9) and packing (4, 5, 6, 7, 8) by the threads of piston rod (2).

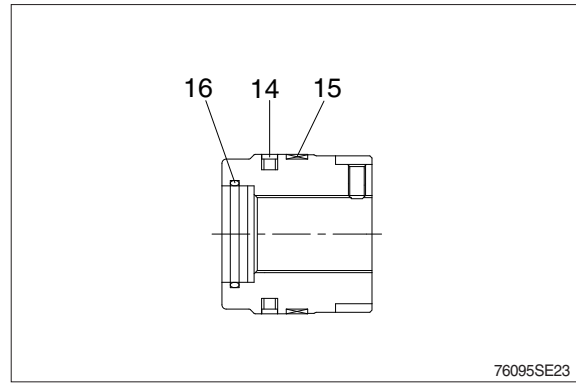


### (3) Disassemble the piston assembly

- ① Remove wear ring (15) and piston seal (14).

Remove O-ring (16).

- ※ Exercise care in this operation not to damage the grooves.



### (4) Disassemble gland assembly

- ① Remove back up ring (11), and O-ring (10).

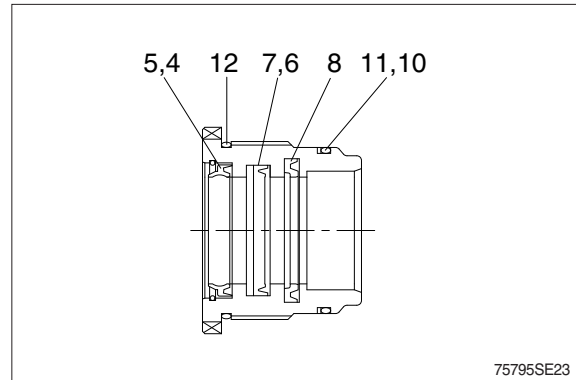
- ② Remove O-ring (12).

- ③ Remove snap ring (5) and dust wiper (4).

- ④ Remove back up ring (7), rod seal (6) and buffer ring (8).

- ※ Exercise care in this operation not to damage the grooves.

- ※ Do not remove seal and ring, if does not damaged.

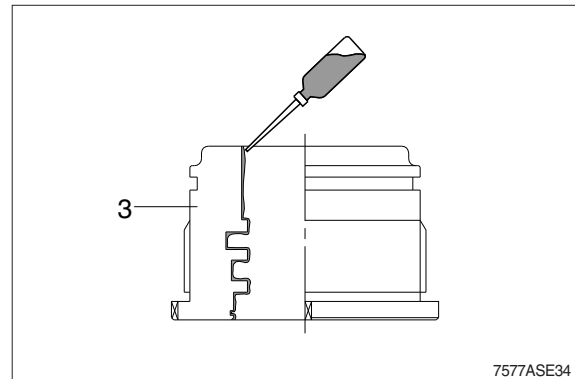


#### 4) ASSEMBLY

##### (1) Assemble gland assembly

※ Check for scratches or rough surfaces if found smooth with an oil stone.

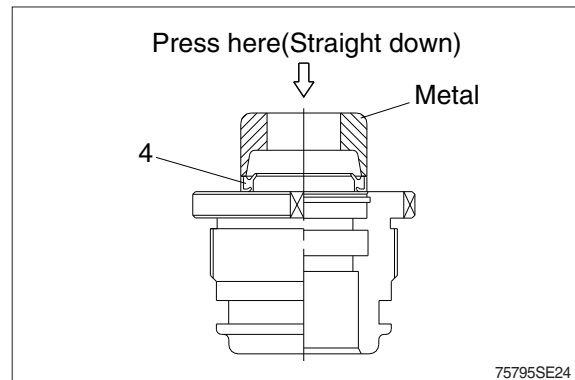
① Coat the inner face of gland (3) with hydraulic oil.



② Coat dust wiper (4) with grease and fit dust wiper (4) to the bottom of the hole of dust wiper.

At this time, press a pad metal to the metal ring of dust seal.

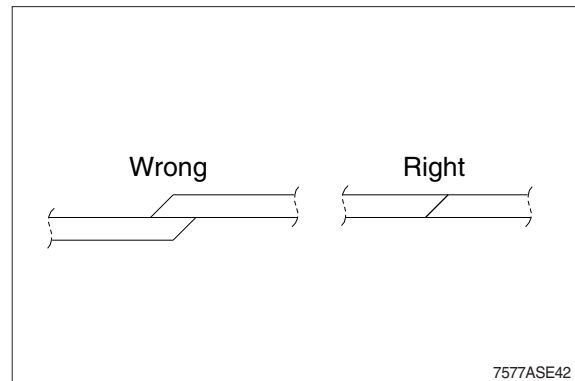
③ Fit snap ring (5) to the stop face.



④ Fit back up ring (7) and rod seal (6), and buffer ring (8) to corresponding grooves, in that order.

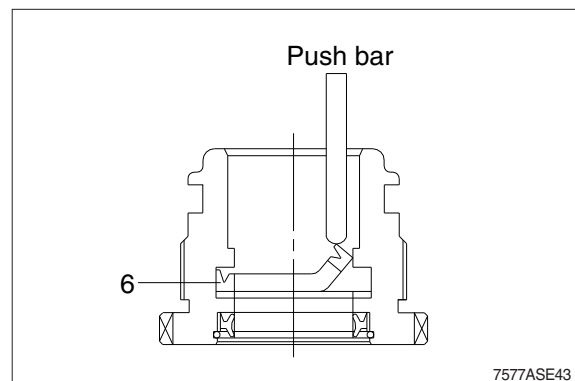
※ Coat each packing with hydraulic oil before fitting it.

※ Insert the backup ring until outside of it is inserted into groove.

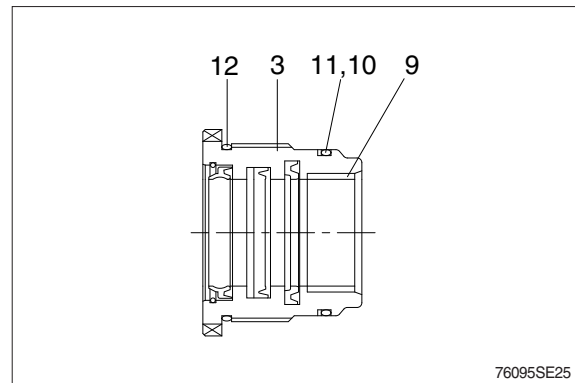


※ Rod seal (6) has its own fitting direction. Therefore, confirm it before fitting them.

※ Fitting rod seal (6) up side down may damage its lip. Therefore check the correct direction that is shown in figure.

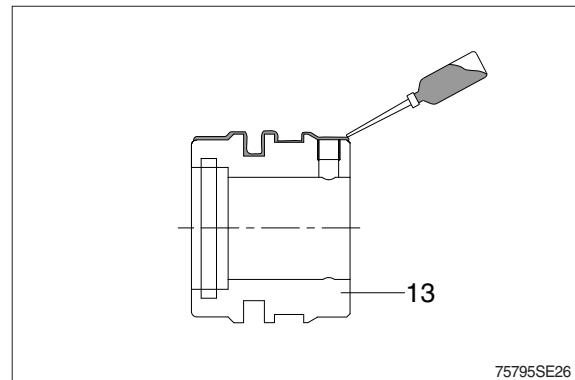


- ⑤ Fit back up ring (11) to gland (3).
- ※ Put the back up ring in the warm water of 30~50°C.
- ⑥ Fit O-ring (10, 12) to gland (3).
- ⑦ Fit bushing (9) to gland (3).

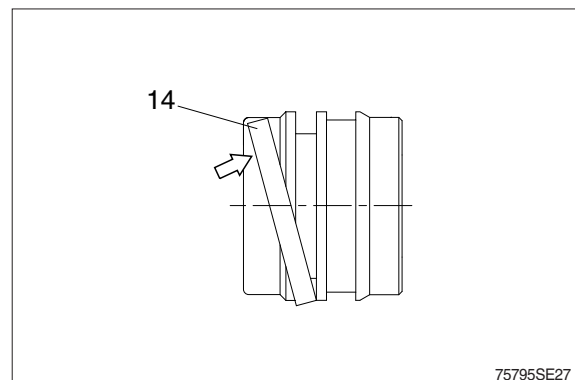


## (2) Assemble piston assembly

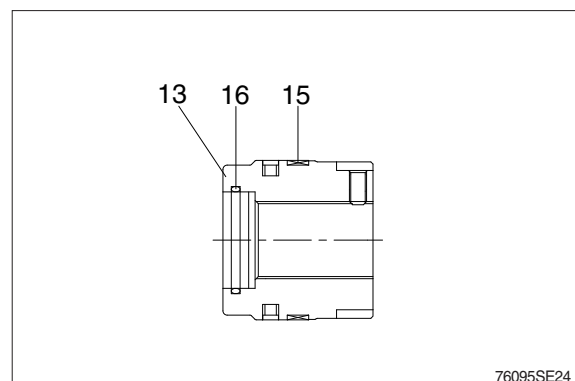
- ※ Check for scratches or rough surfaces.
- ① If found smooth with an oil stone.  
Coat the outer face of piston (13) with hydraulic oil.



- ② Fit piston seal (14) to piston.
- ※ Put the piston seal in the warm water of 60~100°C for more than 5 minutes.
- ※ After assembling the piston seal, press its outer diameter to fit in.

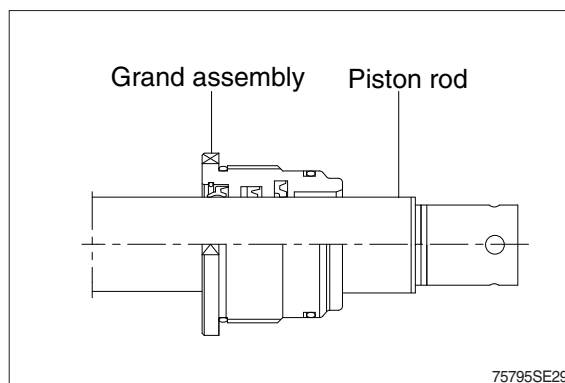


- ③ Fit wear ring (15) to piston (13).
- ④ Fit O-ring (16) to piston (13).

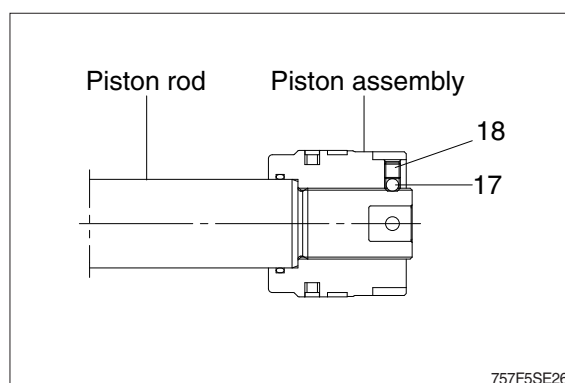


### (3) Install piston and gland assembly

- ① Fix the piston rod assembly to the work bench.
- ② Apply hydraulic oil to the outer surface of piston rod (2), the inner surface of piston and gland (3).
- ③ Insert gland assembly to piston rod (2).

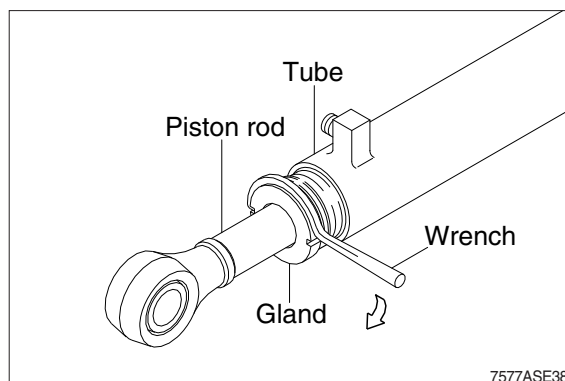
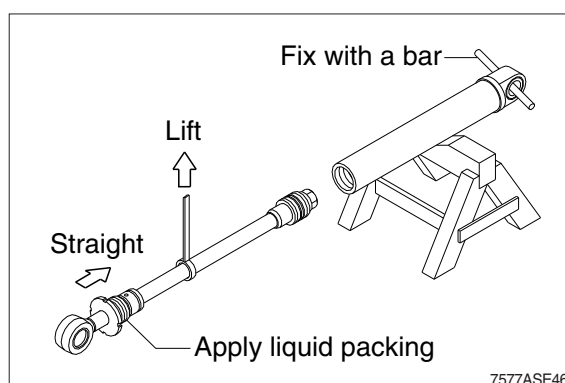


- ④ Fit piston assembly to piston rod.
  - Tightening torque :  $90 \pm 9 \text{ kgf} \cdot \text{m}$   
( $651 \pm 65.1 \text{ lbf} \cdot \text{ft}$ )
- ⑤ Insert the steel ball (17) and the set screw (18).



### (4) Overall assembly

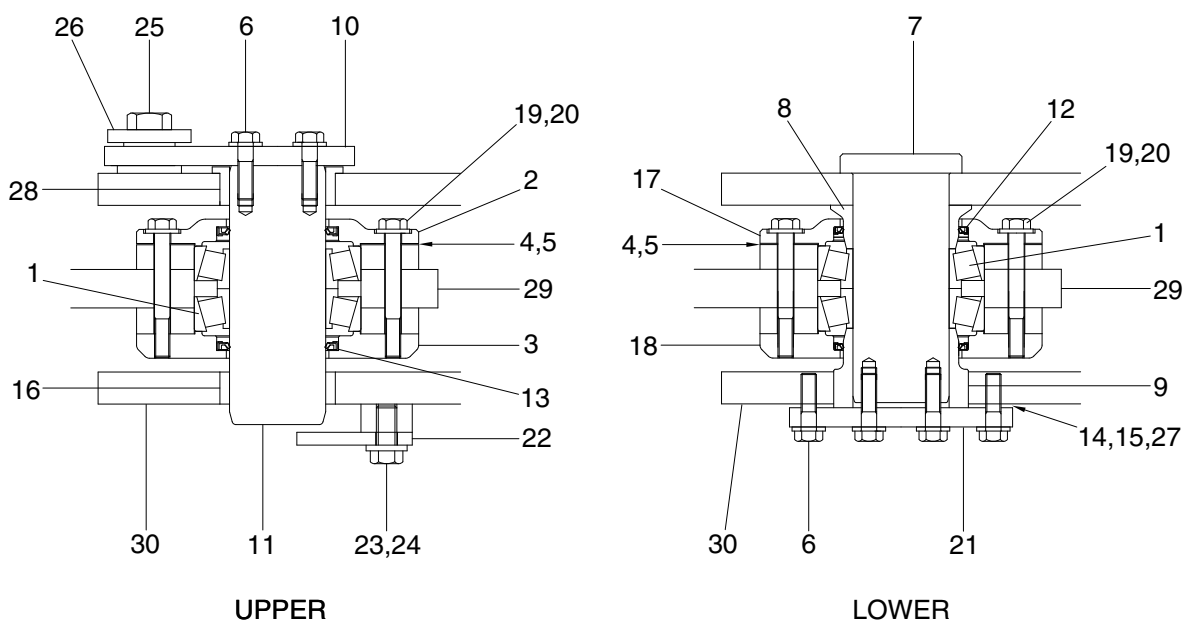
- ① Place a V-block on a rigid work bench. Mount the cylinder tube assembly on it and fix the assembly by passing a bar through the clevis pin hole to lock the assembly.
  - ② Insert the piston rod assembly in to the cylinder tube assembly, while lifting and moving the piston rod assembly with a crane.
- ※ Be careful not to damage piston seal by thread of cylinder tube.
- ③ Fit gland to the tube.
    - Tightening torque :  $60 \pm 6.0 \text{ kgf} \cdot \text{m}$   
( $434 \pm 43.4 \text{ lbf} \cdot \text{ft}$ )



### 3. CENTER PIVOT PIN

#### 1) CONSTRUCTION

Figure shows the construction of the center pivot pin assembly. This assembly serves to connect the front frame with the rear frame; two sets of assemblies are provided, one each for the upper and lower parts. The numbers in parentheses following the parts name denote the item numbers shown in the figure in the disassembly and assembly procedures.



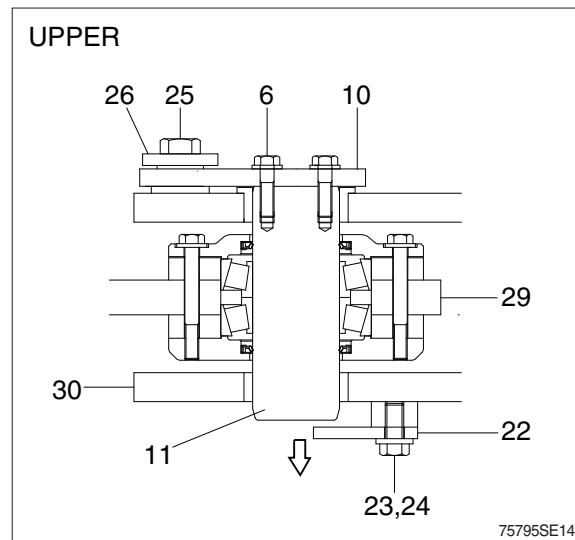
75795SE13

1	Bearing	11	Pin	21	Plate
2	Cover	12	Dust seal	22	Plate
3	Cover	13	Dust seal	23	Hexagon bolt
4	Shim (0.1 t)	14	Shim (0.1 t)	24	Hardened washer
5	Shim (0.5 t)	15	Shim (0.5 t)	25	Hexagon bolt
6	Bolt-w/washer	16	Bushing	26	Hardened washer
7	Pin	17	Cover	27	Shim (2.0 t)
8	Collar	18	Cover	28	Bushing
9	Collar	19	Hexagon bolt	29	Front frame
10	Plate	20	Hardened washer	30	Rear frame

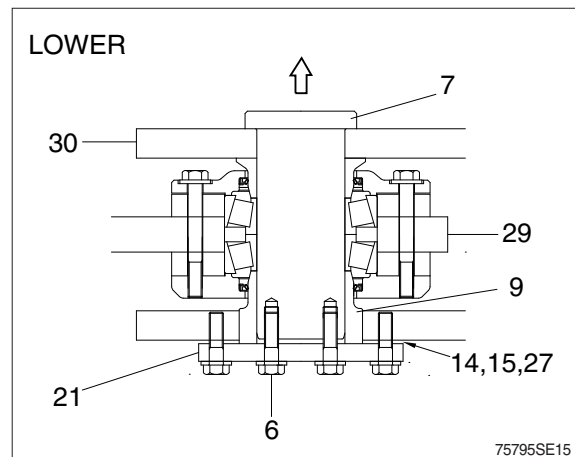
## 2) DISASSEMBLY

After supporting the front frame and the rear frame as horizontally as possible using wood blocks and jacks, disassemble as follows: In order to facilitate the disassembly/assembly of the center pivot pins, remove the drive shaft, hydraulic line and steering cylinder first.

- (1) Maintain the horizontal level of front frame (29) and rear frame (30), and then remove hexagon bolt (6, 23, 25), washer (24, 26) and plate (10, 22).
- (2) Take out upper pin (11) to the downside using a metal punch.



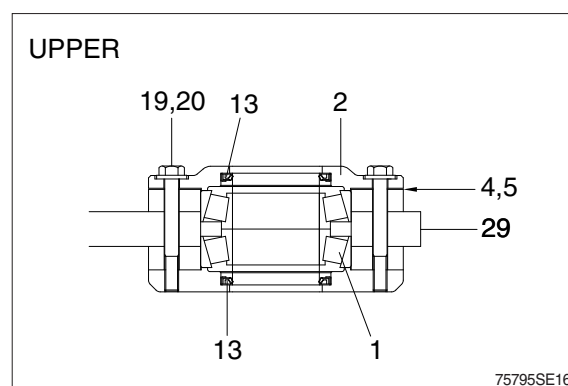
- (3) Maintain the front frame horizontal level, remove hexagon bolts (6) and then remove the plate (21) and shims (14, 15, 27).
- (4) Take out lower pin (7) to the upside using a metal punch carefully.
- (5) Jack up or lifting the front frame (29) slightly, the collar (9) protrudes over the rear frame. Remove the collar (9).
- (6) Lift the frame by passing the slinging wire rope at four positions of front frame, in order to separate it from the rear frame.
- (7) Support the front frame safely.



(8) Remove bolt (19), washer (20) and then take out cover (2) and shims (4, 5).

(9) Take out dust seal (13) from the cover (2).

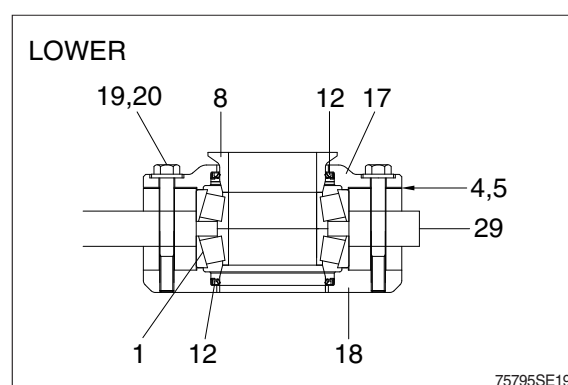
(10) Remove the bearing (1), and dust seal (13).



(11) Remove bolt (19), washer (20) and then take out cover (17, 18) and shims (4, 5).

(12) Take out the dust seal (12) from the cover (17, 18).

(13) Remove the bearing (1) and collar (8).



### 3) INSPECTION

(1) Check the bearing sliding surface for excessive wear, scorching or scratches; replace if necessary.

(2) Replace all dust seals (12,13) with new ones.

(3) Grind any pins (7, 11) dented with an oilstone or replace any pins abrasive excessively.

(4) Check inside cover (2, 3, 17, 18) and collar (8, 9) for dents or scratches; if any damage is found, correct with a grinder or replace.

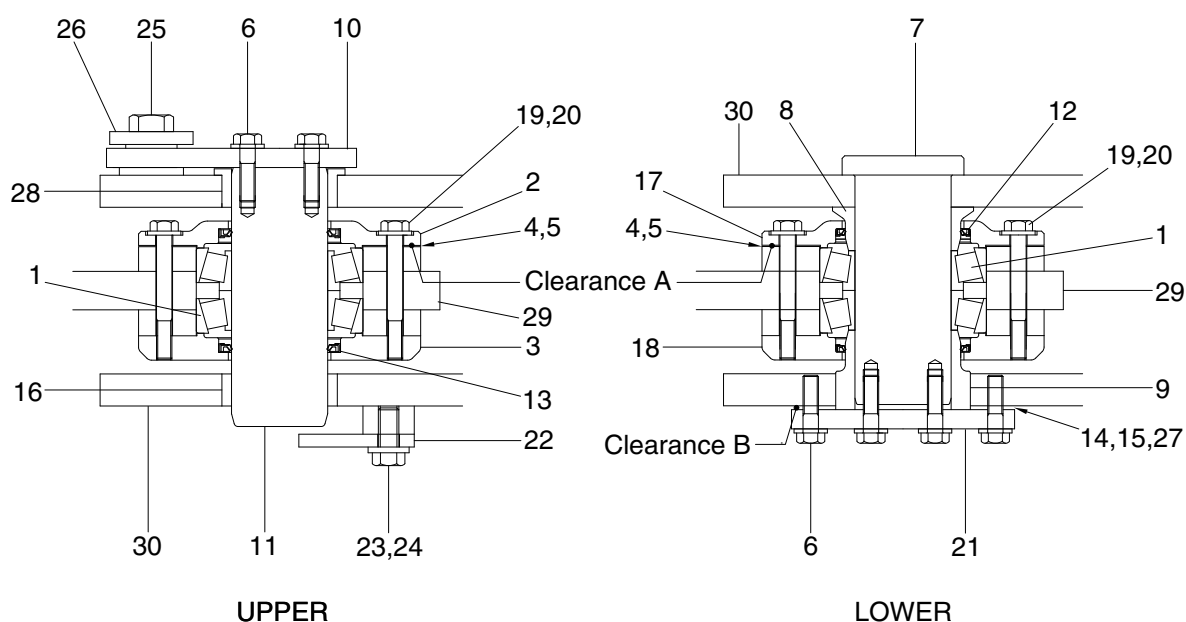
(5) The serviceable limit of pins and bushings is shown in the table below.

Unit : mm

Item No.	Name	Std dimension	Serviceable limit			Remedy
			Outer dia	Inner dia	Clearance	
7, 11	Pin	75	74.5		0.8	Replace
1	Tapered roller bearing			75.5		
8, 9	Collar			75.5		
12, 13	Dust seal	When removed				Replace



#### 4) ASSEMBLY



75795SE31

Assemble the center pivot group by reversing the order of disassembly while paying close attention to the following.

- (1) Put the dust seal (12,13) into cover (2, 3, 17, 18).
  - ※ Apply grease to the lip of the dust seal. Insert the dust seal so that the dust seal lip faces out and punch four places on the outer circumference of the seal to lock it.
- (2) Lower the temperature of the lower bearing cup to  $-75 \pm 5^{\circ}\text{C}$  ( $-103 \pm 9^{\circ}\text{F}$ ) and install it to front frame until it contacts the bottom of the frame.
- (3) Place the cover (3, 18).
- (4) Coat lightly with oil and install lower bearing in bore in front frame. Coat lightly with oil and install upper bearing in bore in upper front frame.
- (5) Place the cover (2, 17) and hold in place with bolt (19). At this time, adjust shims (4, 5) to press the shoulder of bearing (1) against retainer.
  - **Adjustment method of clearance A**
    - ① Install bearing (1) and cover (2, 17) without shim (4, 5)  
Install four of bolt (19) so that each bolt is separated by 90 degrees.
      - Tightening torque :  $0.8 \sim 1.0 \text{ kgf} \cdot \text{m}$  ( $5.8 \sim 7.2 \text{ lbf} \cdot \text{ft}$ )
    - ② Adjust shims (4, 5) in order to control the clearance A.
      - Clearance A : Below 0.1 mm
      - Shim thickness : 0.1 mm, 0.5 mm
    - ③ Measure bearing preload and confirm the value.
      - Bearing preload :  $0.6 \sim 1.0 \text{ kgf} \cdot \text{m}$  ( $4.3 \sim 7.2 \text{ lbf} \cdot \text{ft}$ )

- (5) Apply grease to lower collar (8) and insert it to the lower of roller bearing.
- (6) After setting the bearing so that its upper surface is horizontal, tighten the all the bolt (19).  
After tightening, confirm that tapered roller bearing moves lightly ; if does not move smoothly, add shims (4, 5).
- Tightening Torque : 9.8~15.8 kgf · m (70.9~114 lbf · ft)
  - Apply loctite #243.
- (7) Move the front frame and join it to the rear frame so that match the pin hole at the center.
- (8) Apply grease to pin (11), bushing (28) and insert it into tapered roller bearing (1).
- (9) Apply grease to lower collar (9) and insert it to the lower of roller bearing through rear frame (30).
- (10) Apply grease to pin (7) and insert it into tapered roller bearing (1).
- (11) Before tightening bolt (6), adjust shims (14, 15) in order to control the clearance between the plate (21) and rear frame (30).
- **Adjustment method of clearance B**
- ① Install pin (7) and plate (21) without shim (14,15, 27).  
Install four of bolt (6) so that each bolt is separated by 90 degrees.
    - Tighting torque : 0.8~1.0 kgf · m (5.8~7.2 lbf · ft)
  - ② Adjust shims in order to control the clearance B.
    - Clearance B : 0.1~0.2 mm
    - Shim thickness : 0.1 mm, 0.5 mm, 2.0 mm
- (12) Tighten the all the bolts (6).
- Tightening Torque : 9.8~15.8 kgf · m (70.9~114 lbf · ft)
  - Apply loctite #243.

## 5) TROUBLESHOOTING

Trouble	Probable cause	Remed
Shock is felt when steering	Capscrew for fixing steering valve is loose	Retighten
	Faulty center pivot pin mounting bolts	Retighten
	Center pivot pins have worn out	Readjust or replace
	Faulty hydraulic system	See hydraulic system
Shock is felt when moving backward or forward	Fault fixing of connecting capscrews	Retighten
	Center pins have worn out	Readjust or replace
	Bearings of support unit have worn out	Retighten
	Drive shaft damaged	See drive system
	Faulty transmission	See transmission system

# SECTION 6 WORK EQUIPMENT



Group 1 Structure and Function ..... 6-1

Group 2 Operational Checks and Troubleshooting ..... 6-34

Group 3 Tests and Adjustments ..... 6-45

## SECTION 6 WORK EQUIPMENT

### GROUP 1 STRUCTURE AND FUNCTION

#### 1. HYDRAULIC SYSTEM OUTLINE

The loader hydraulic system is a pilot operated, closed center system which is supplied with flow from the variable displacement piston main hydraulic pump.

The loader system components are :

- Main pump
- Main control valve
- Bucket cylinder
- Boom cylinders
- Remote control valve
- Safety valve

Flow from the main hydraulic pump not used by the steering system leaves the priority valve EF port. It flows to the inlet port plate of two section or three section block type main control valve.

The main control valve is load pressure independent flow distribution system which routes flow to the boom, bucket or auxiliary cylinders (not shown) when the respective spools are shifted.

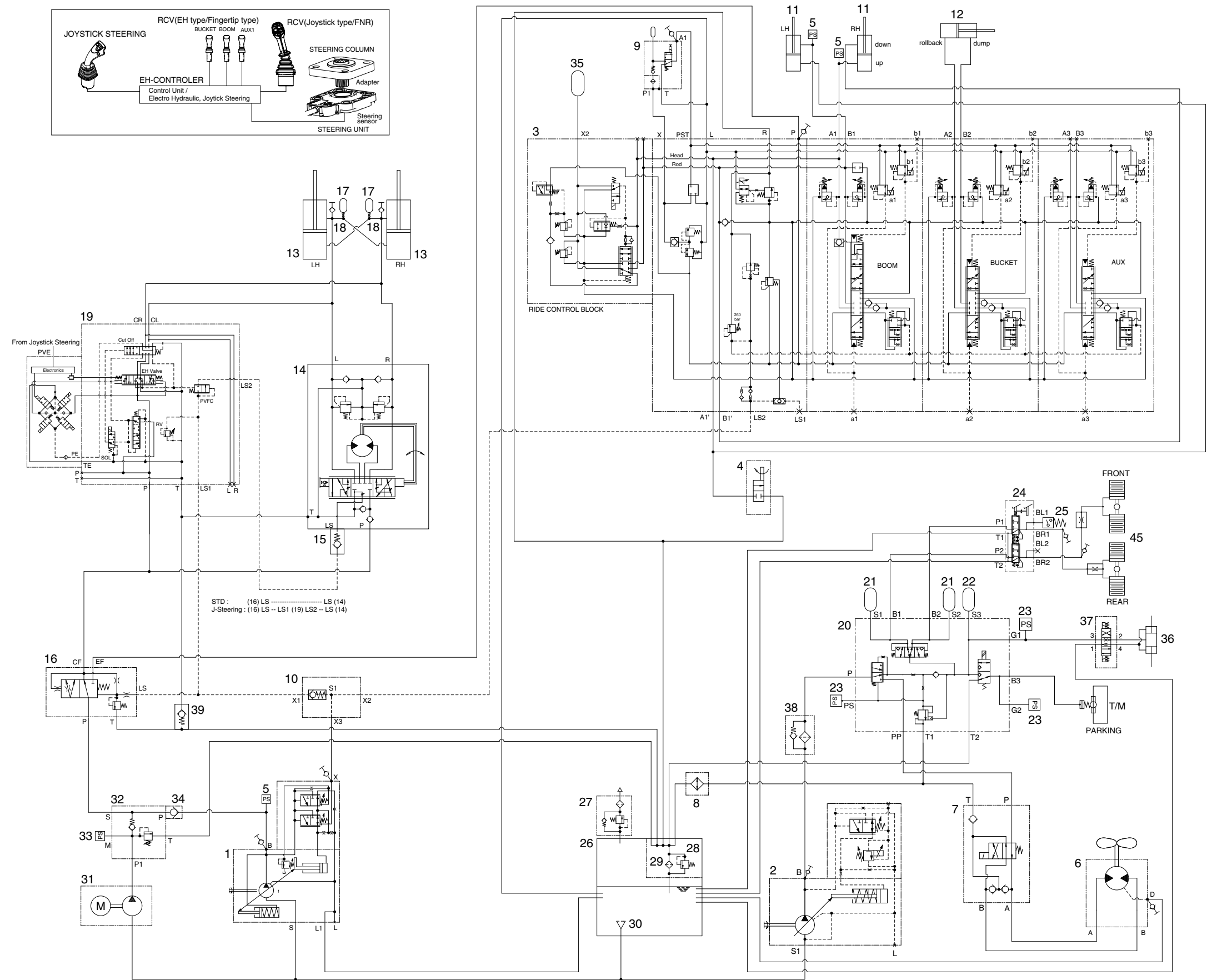
Flow from the main pump is routed to the main control valve where pump outlet pressure is reduced to pilot circuit pressure. The main control valve flow to the remote control valve.

The remote control valve routed flow to either end of each spool valve section in the main control valve to control spool stroke.

A accumulator mounted on safety valve supplies a secondary pressure source to operated remote control valve so the boom can be lowered if the engine is off.

The return circuit for the main hydraulic system have return filter inside the hydraulic tank. The return filter uses a filter element and a bypass valve. The bypass valve is located in the upside of filter.

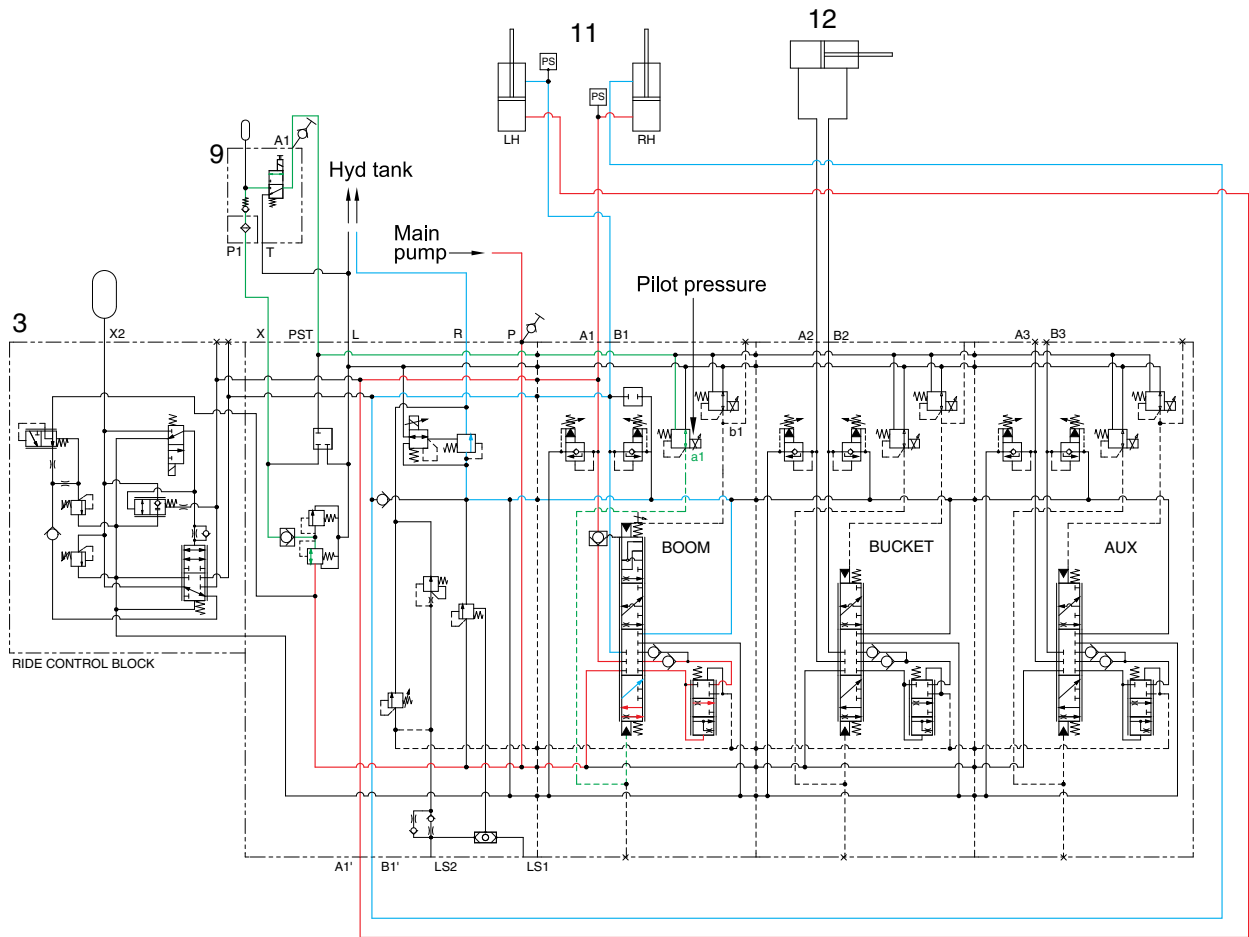
2. HYDRAULIC CIRCUIT



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### 3. WORK EQUIPMENT HYDRAULIC CIRCUIT

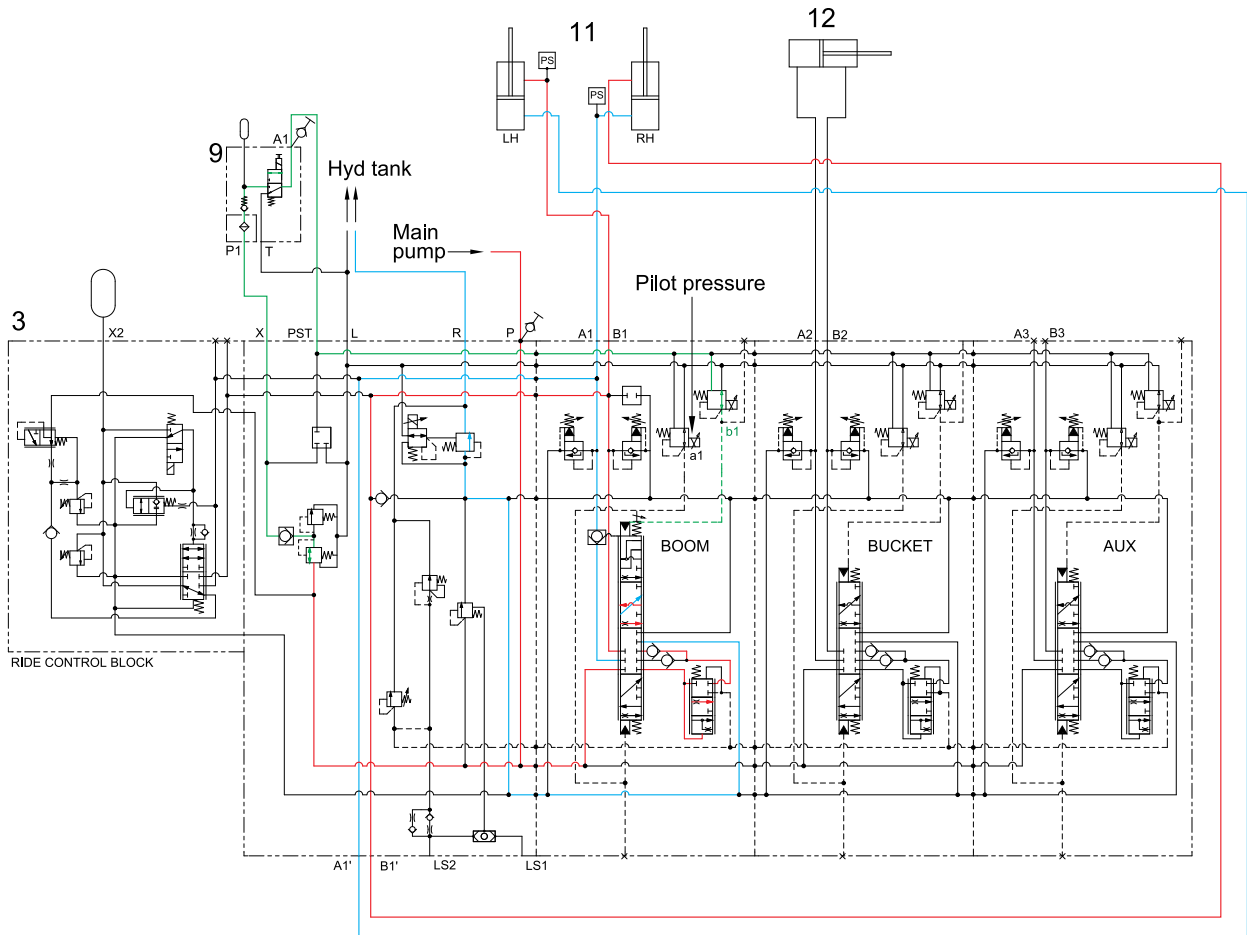
#### 1) WHEN THE RCV LEVER IS IN THE BOOM RAISE POSITION



960A6WE02

- When the RCV lever is pulled back, the boom spool is moved to raise position by pilot pressure from EPPR valve.
- The oil from main pump flows into main control valve (3) and then goes to the large chamber of boom cylinder (11).
- The oil from the small chamber of boom cylinder (11) returns to hydraulic oil tank through the boom spool at the same time.
- When this happens, the boom goes up.

## 2) WHEN THE RCV LEVER IS IN THE BOOM LOWER POSITION

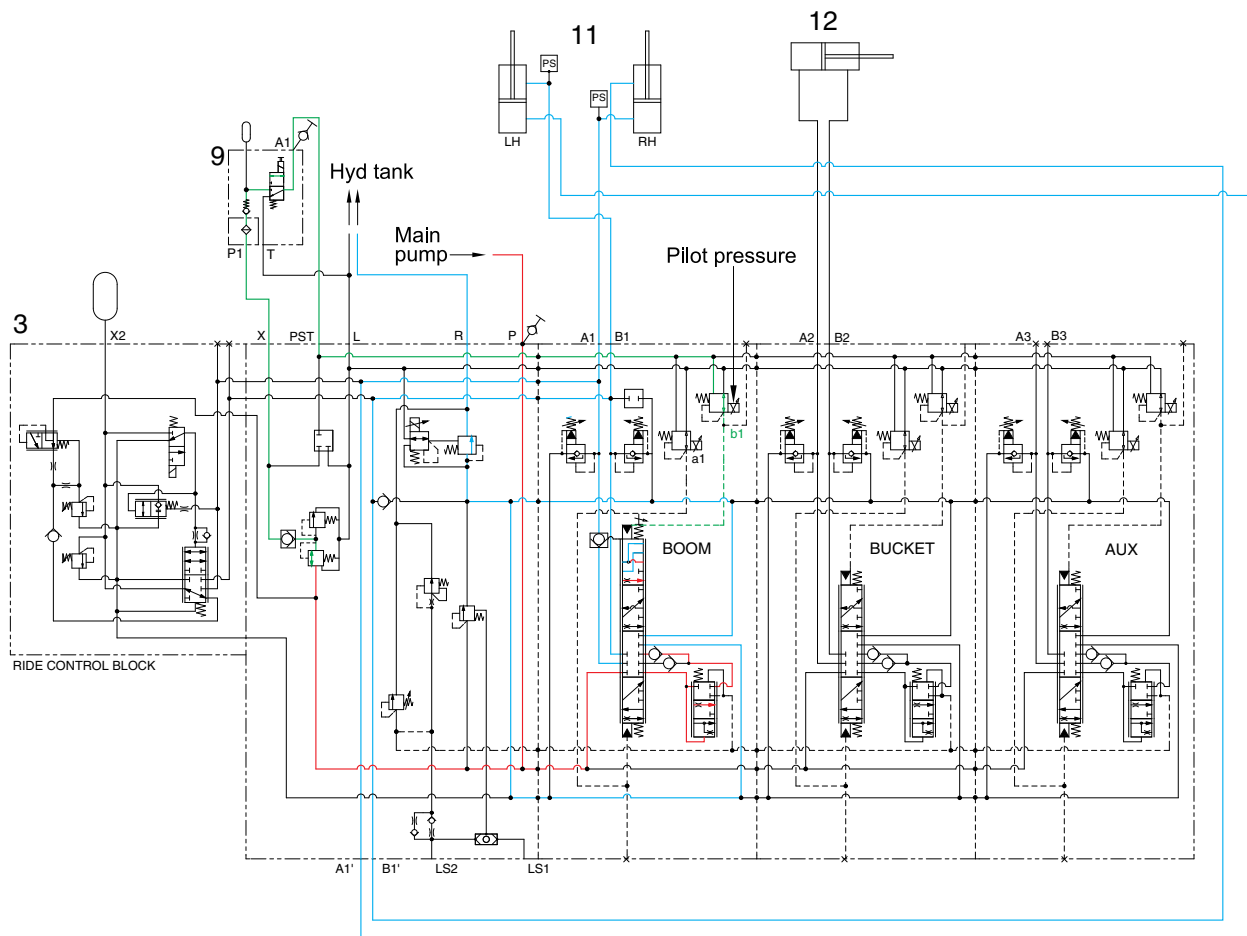


960A6WE03

- When the RCV lever is pushed forward, the boom spool is moved to lower position by pilot pressure from EPPR valve.
- The oil from main pump flows into main control valve (3) and then goes to small chamber of boom cylinder (11).
- The oil returned from large chamber of boom cylinder (11) returns to hydraulic tank through the boom spool at the same time.
- When the lowering speed of boom is faster, the return oil from the large chamber of boom cylinder combines with the oil from the pump through the regeneration check valve, and flows into the small chamber of the cylinder.

This prevents cylinder cavitation by the negative pressure when the pump flow cannot match the boom down speed.

### 3) WHEN THE RCV LEVER IS IN THE BOOM FLOAT POSITION

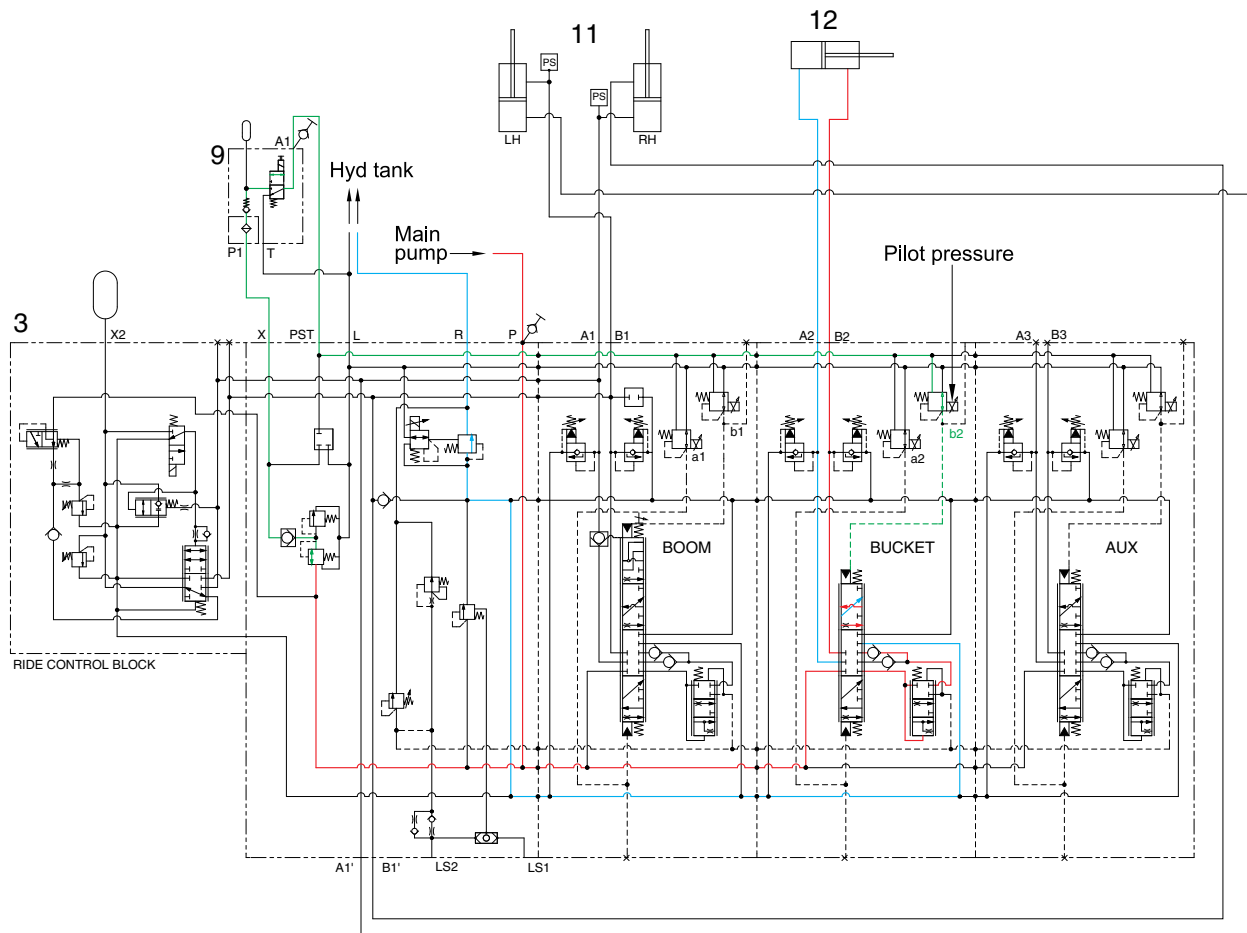


960A6WE04

- When the RCV lever is pushed further forward from the lower position, the pilot pressure reaches to 13~15 bar, then the boom spool is moved to floating position.
- The work ports (A1), (B1) and the small chamber and the large chamber are connected to the return passage, so the boom will be lowered due to it's own weight.
- In this condition, when the bucket is in contact with the ground, it can be move up and down in accordance with the shape of the ground.



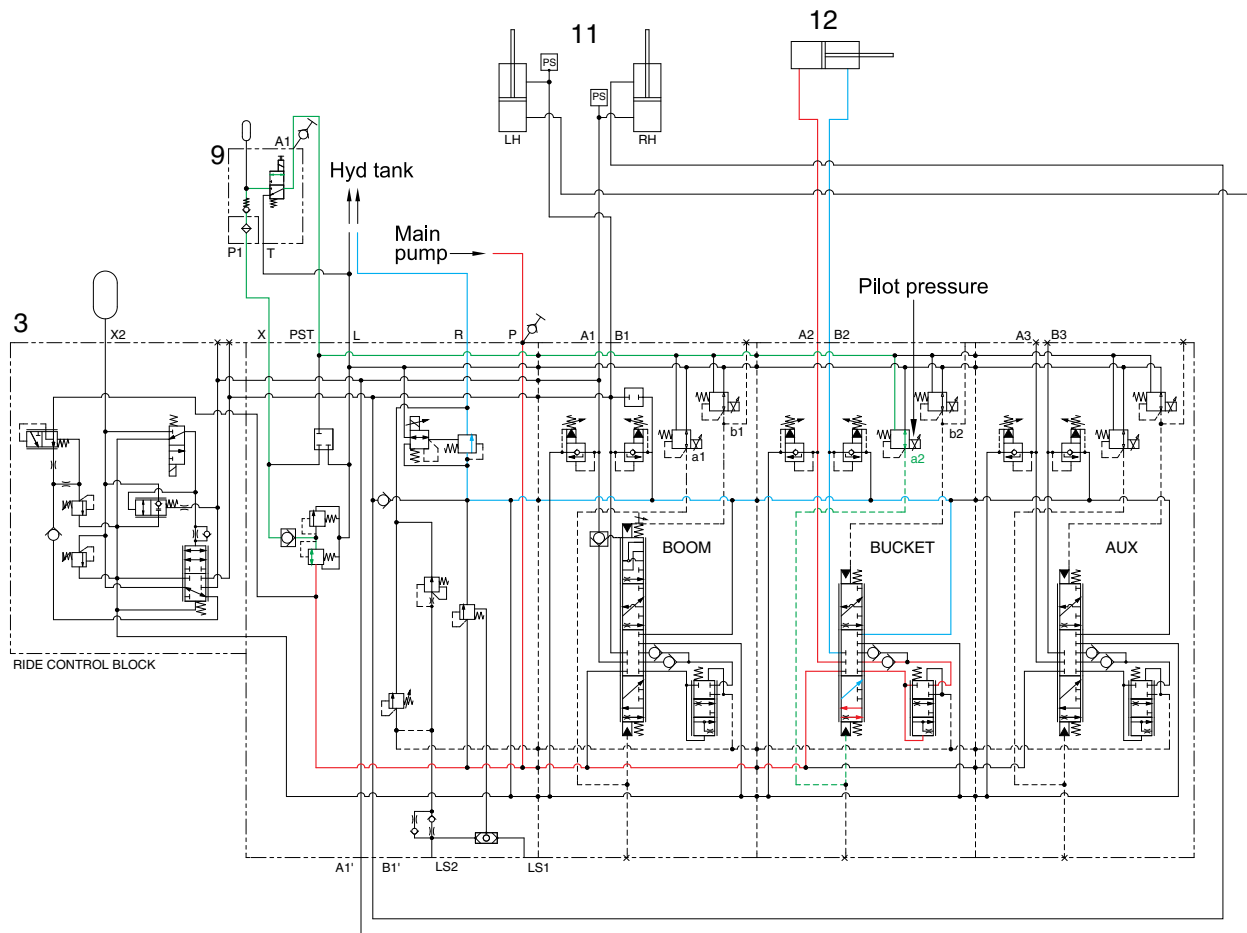
#### 4) WHEN THE RCV LEVER IS IN THE BUCKET DUMP POSITION



960A6WE05

- If the RCV lever is pushed right, the bucket spool is moved to dump position by pilot pressure from EPPR valve.
- The oil from main pump flows into main control valve (3) and then goes to the small chamber of bucket cylinder (12).
- The oil at the large chamber of bucket cylinder (12) returns to hydraulic tank.
- When this happens, the bucket is dumped.
- When the dumping speed of bucket is faster, the oil returned from the large chamber of bucket cylinder combines with the oil from the pump, and flows into the small chamber of the cylinder. This prevents cylinder cavitation by the negative pressure when the pump flow cannot match the bucket dump speed.

## 5) WHEN THE RCV LEVER IS IN THE BUCKET ROLL BACK (retract) POSITION

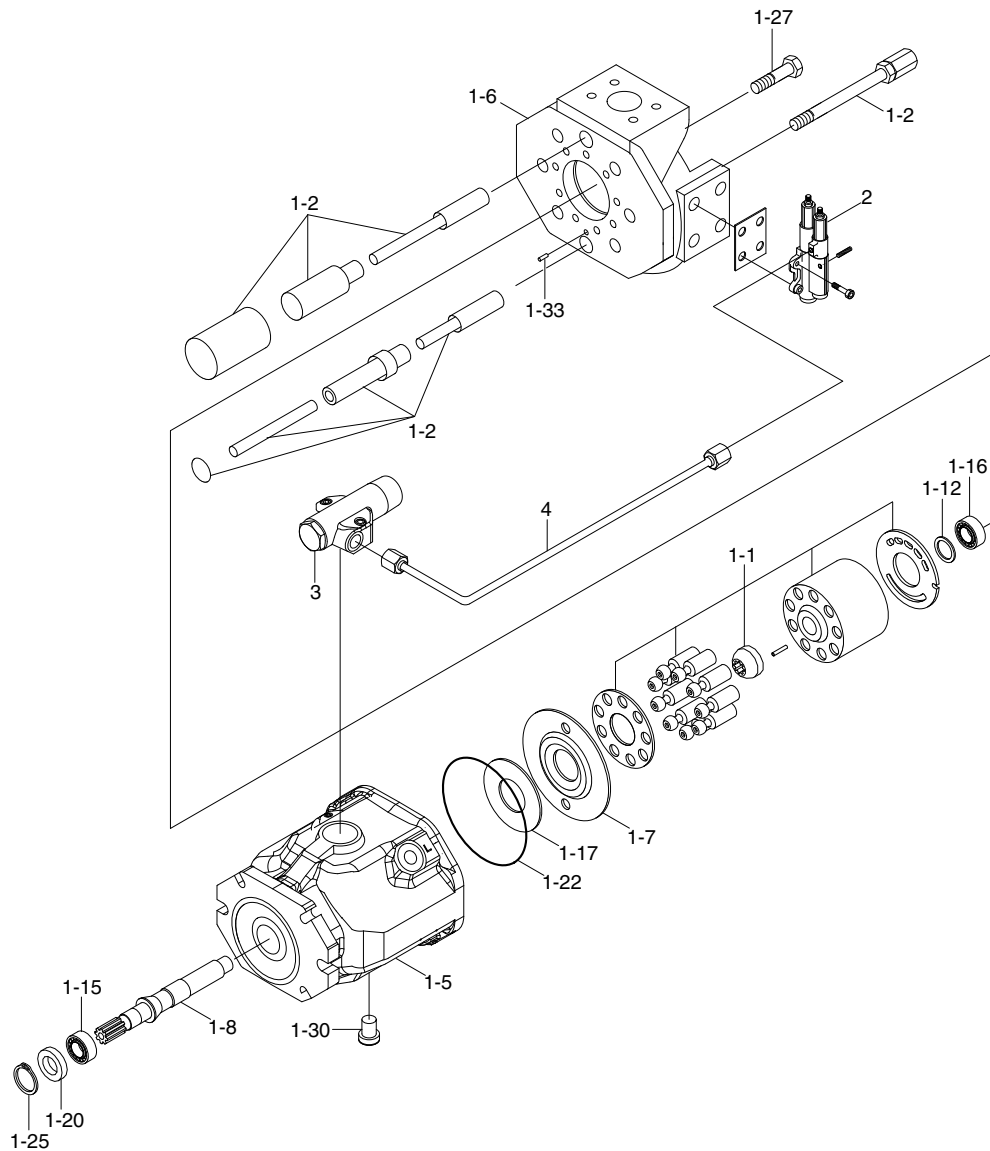


960A6WE06

- If the RCV lever is pulled left, the bucket spool is moved to roll back position by pilot oil pressure from EPPR valve.
- The oil from main pump flows into main control valve (3) and then goes to the large chamber of bucket cylinder.
- The oil at the chamber of bucket cylinder (12) returns to hydraulic tank.
- When this happens, the bucket roll back.

## 4. MAIN PUMP

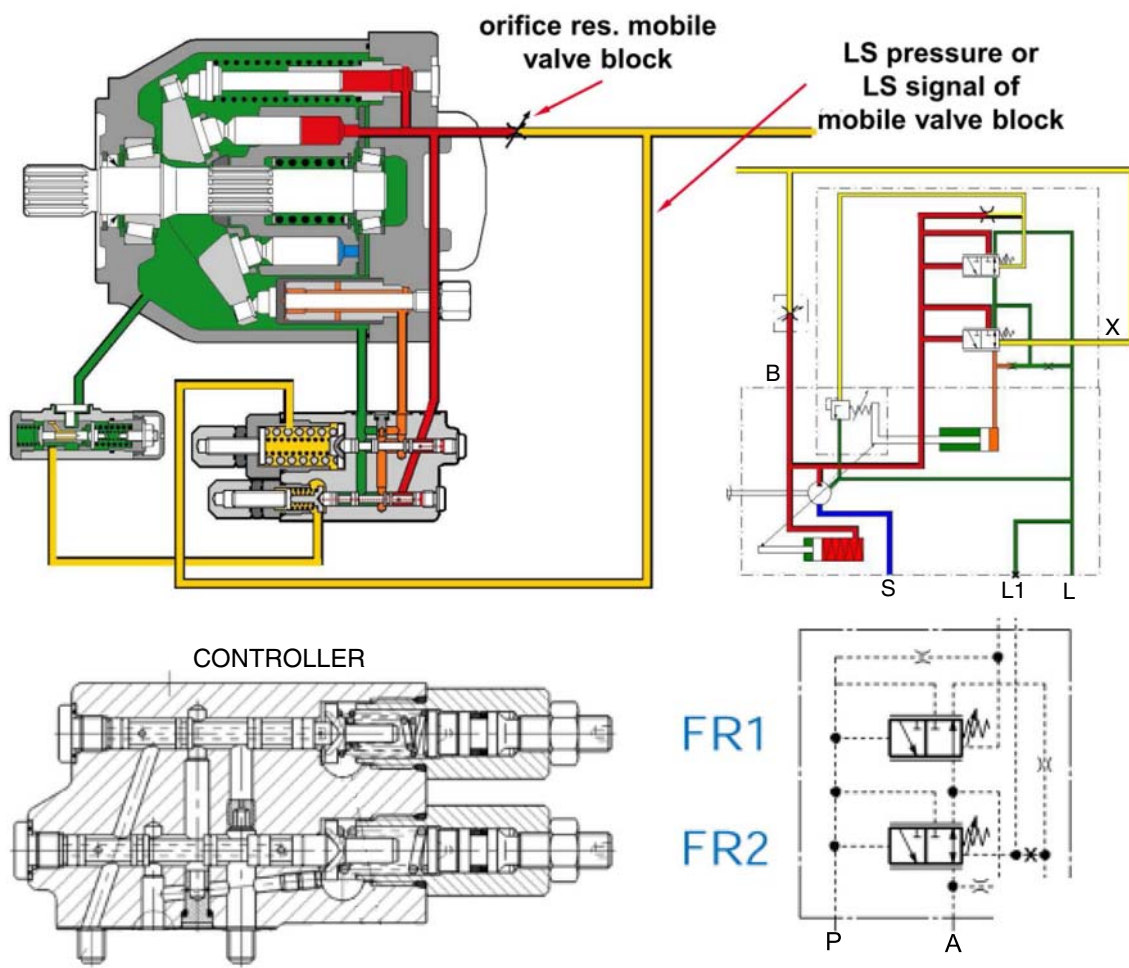
### 1) STRUCTURE



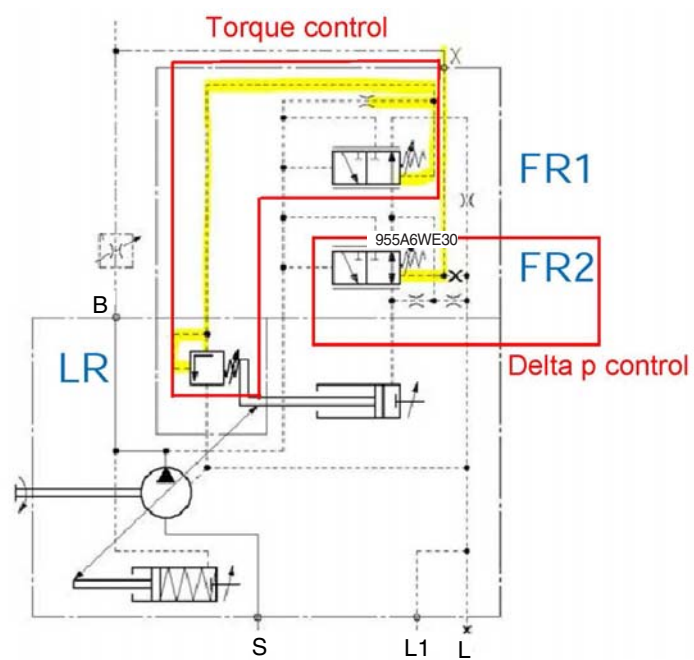
955A6WE10

- |                     |                           |                    |
|---------------------|---------------------------|--------------------|
| 1 Pump base         | 1-12 Adjustment shim      | 1-27 Socket screw  |
| 1-1 Rotary kit      | 1-15 Taper roller bearing | 1-30 Locking screw |
| 1-2 Adjusting piece | 1-16 Taper roller bearing | 1-33 Cylinder pin  |
| 1-5 Pump housing    | 1-17 Bearing liner        | 2 Control valve    |
| 1-6 Port plate      | 1-20 Shaft seal ring      | 3 Control valve    |
| 1-7 Swash plate     | 1-22 O-ring               | 4 Pipe             |
| 1-8 Drive shaft     | 1-25 Retaining ring       |                    |

## 2) FUNCTION AND CIRCUIT

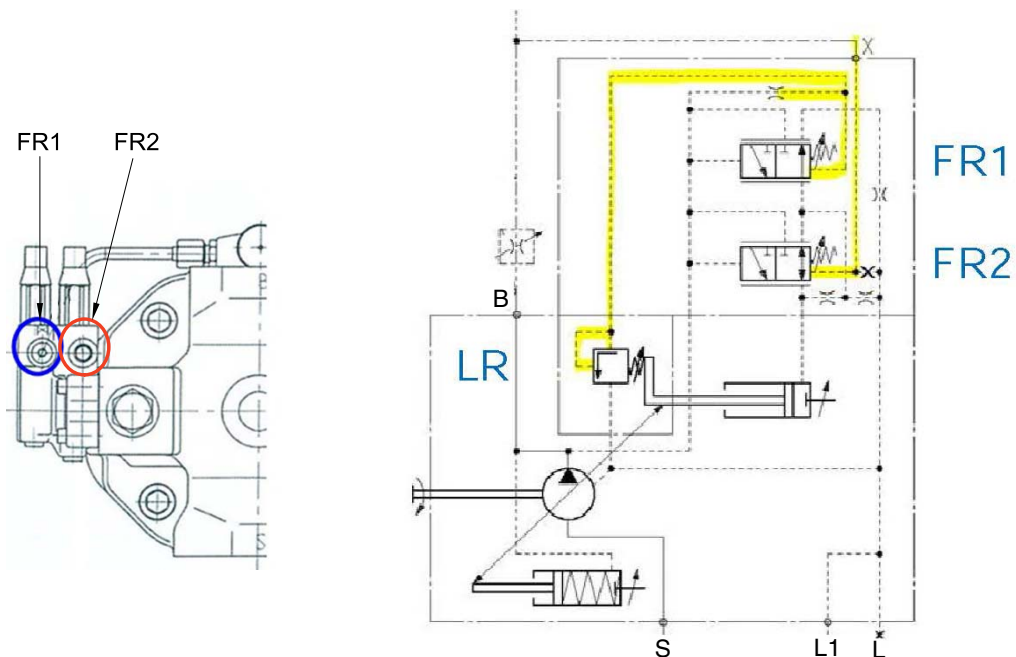


955A6WE30



955A6WE31

### 3) PUMP CONTROLLER



955A6WE32

#### (1) FR2

- LS signal from valve block is only indicated to the FR2 controller stage.
- FR2 stage can control the pump displacement.
  - . If  $(p) > \text{LS signal} + \text{FR2 spring force}$  : Pump displacement reduction
  - . If  $(p) < \text{LS signal} + \text{FR2 spring force}$  : Pump displacement increase

#### (2) FR1

- The FR and LR stages are separated.
- LR controller is directly fed by high-pressure (p) :  
The orifice is generating a delta pressure  $(p) - (p)'$
- FR1 stage is needed to reduce the pump displacement after LR controller has opened up to tank.
  - . If  $(p) > (p)' + \text{FR1 spring force}$  : Pump displacement reduction
  - . If  $(p) < (p)' + \text{FR1 spring force}$  : Pump displacement increase

#### (3) LR

- Combination of FR1 and LR realizes torque control function.
- This valve will change the relief pressure value according to swash plate of pump.  
When pump uses a large volume, pressure value is lowered.

#### (4) Adjustment of flow control

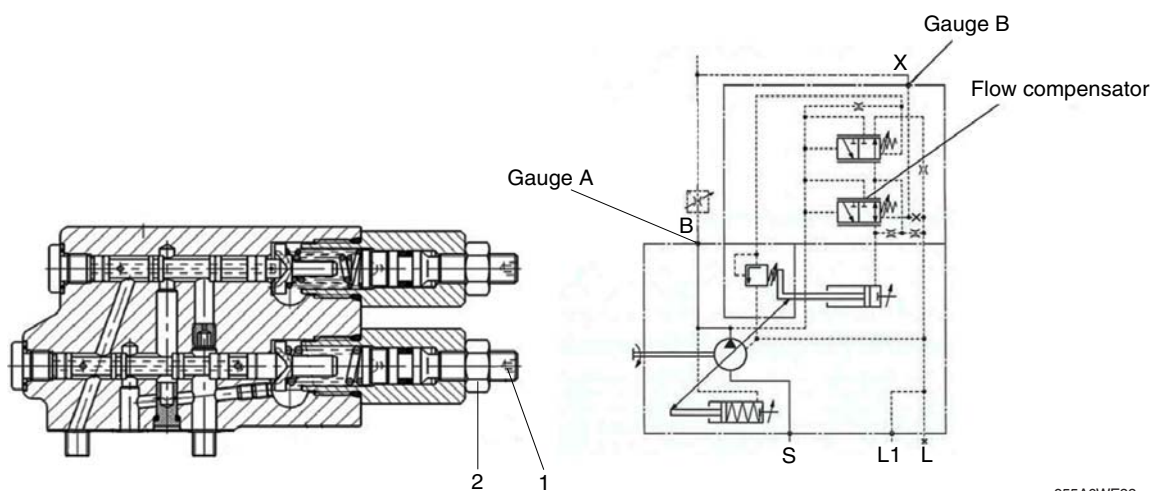
Flow compensator setting must be carried out following procedures and conditions.

##### ① Conditions

- Engine is running (at high or low idle).
- RCV is operated slowly (example : Boom up).
- Pressure gauges are installed.
- ※ Discharge pump flow should be less than max pump flow.

##### ② Procedures

- Loosening the hexagon nut (2).
- Adjusting screw (1) of flow controller by tightening or loosening the screw (1).
  - Flow setting :  $\Delta P = \text{Gauge A} - \text{Gauge B}$
  - Specification : LS setting 29 bar



955A6WE33

## (5) Adjustment of power control

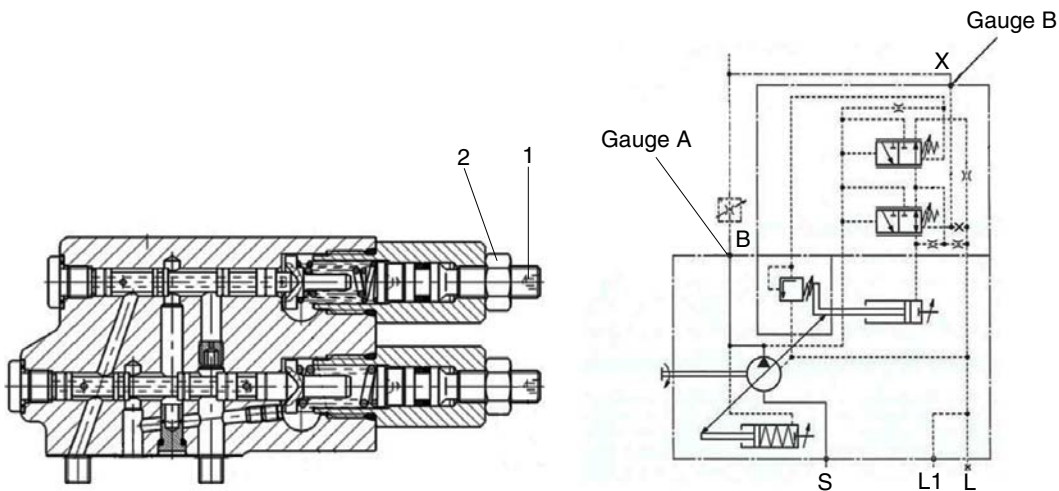
Don't touch any setting, it is impossible to adjust in field. The below content is for reference.

### ① Conditions

- Engine is running.
- System is at relief condition.

### ② Procedures

- Loosening the hexagon nut (2).
- Adjusting screw (1) of pressure controller by tightening or loosening the screw (1).
  - Setting :  $\Delta P = \text{Gauge A} - \text{Gauge B}$
  - Specification : 18 bar

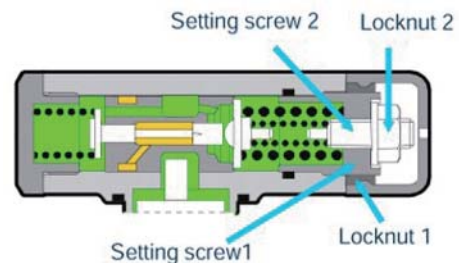


955A6WE34

## ※ SETTING INSTRUCTION.

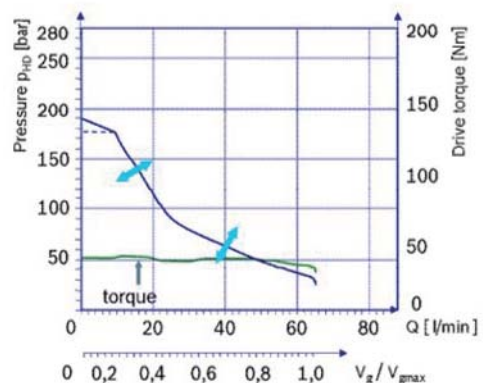
### · Start of control

- Loosen locknut 1.  
(ensure that spring 2 has clearance)
- Set start of control by turning setting screw 1 :
  - Turning screw clockwise increases power
  - Turning screw anti-clockwise reduces power
- Secure setting screw with locknut 1.



### · End of control

- Loosen 13 mm hexagon locknut.
- Set end of control by turning setting screw 2 :
  - Turning screw clockwise increases power
  - Turning screw anti-clockwise reduces power



955A6WE35

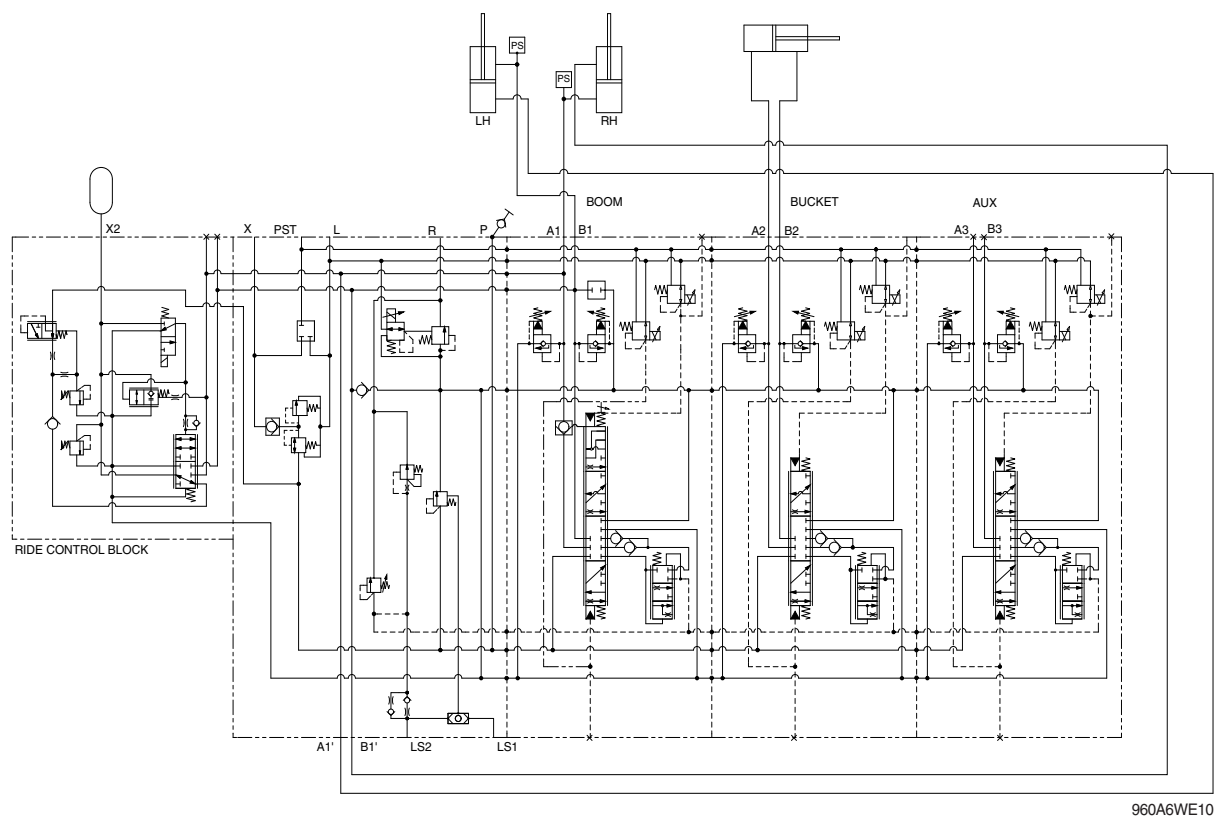
### · Requirement of field adjustment

- Measurement of speed and pressure.
- Measurement of flow (flowmeter).

- **Setting torque** : 39.8 kgf·m (288 lbf·ft).

## 5. MAIN CONTROL VALVE

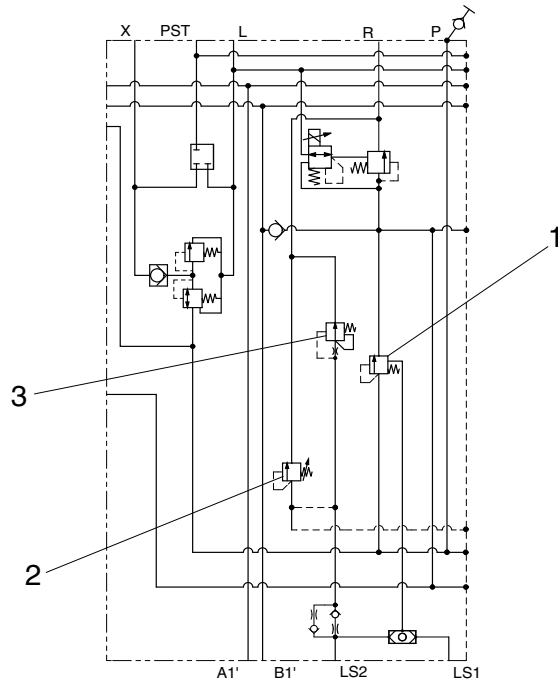
### 1) HYDRAULIC CIRCUIT





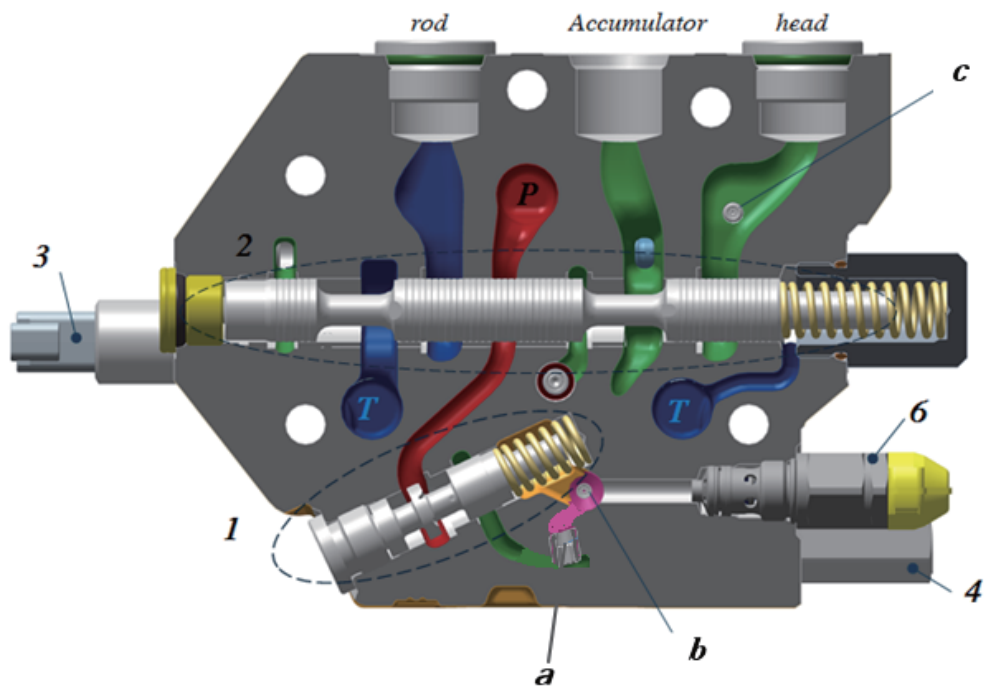
## 2) INLET ELEMENT DESCRIPTION

- (1) The inlet element moreover comprises all components necessary for the system function : One flow control valve (1) for the controlled unloading of the LS line and one LS pressure relief valve (2) to limit the maximum system pressure.
- (2) Protection of the system by means of LS pressure relief valve (2) combined with flushing valve (3).



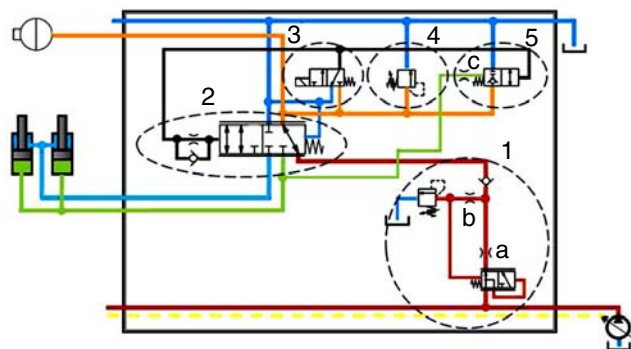
960A6WE11

### 3) RIDE CONTROL VALVE STRUCTURE



960A6WE12

- 1 Accumulator loading
- 2 Main spool
- 3 Activation of RSM
- 4 Accumulator relief valve
- 5 Accumulator balancing
- 6 Accumulator loading pressure relief valve
- a Loading flow limitation orifice
- b LS orifice
- c Balancing damping orifice



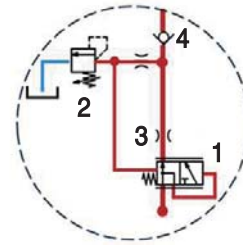
960A6WE14

#### 4) RIDE CONTROL VALVE FUNCTION

- (1) The LS compensator in the loading function is limiting the loading flow in combination with the loading orifice (3). In under saturation, the loading flow is reduced.

As soon as the pressure setting of the pressure relief valve (2) is reached (120 bar), the pressure compensator will close as the pump pressure is higher.

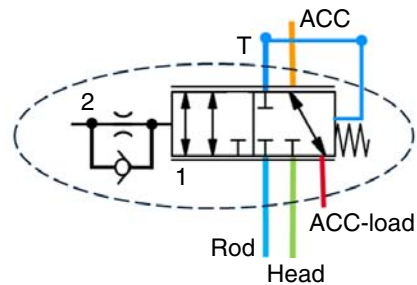
The charging stops automatically.



960A6WE15

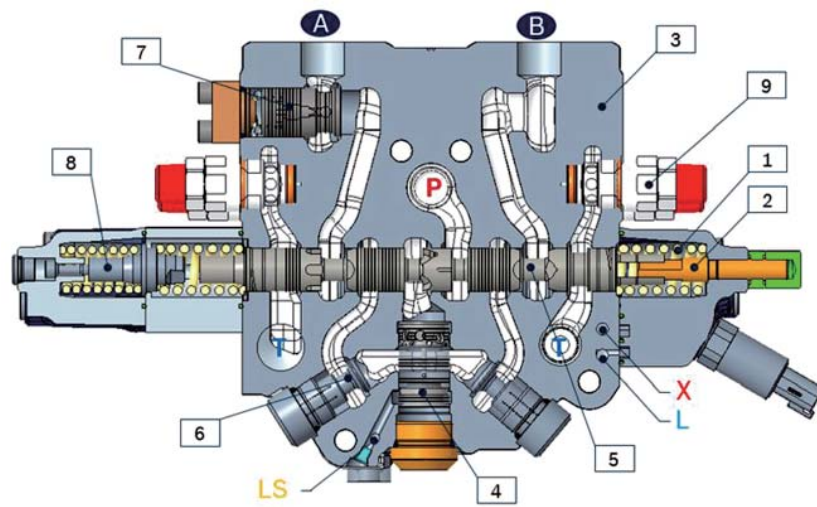
- (2) When switching on the ride control valve, the rod side of the boom cylinder is connected with the tank and the head side is connected to the accumulator. The loading of the accumulator is disconnected when ride control is activated.

The shuttle valve (2) guarantees that balancing of the accumulator pressure with the current cylinder pressure is finished before head side and accumulator are connected.



960A6WE16

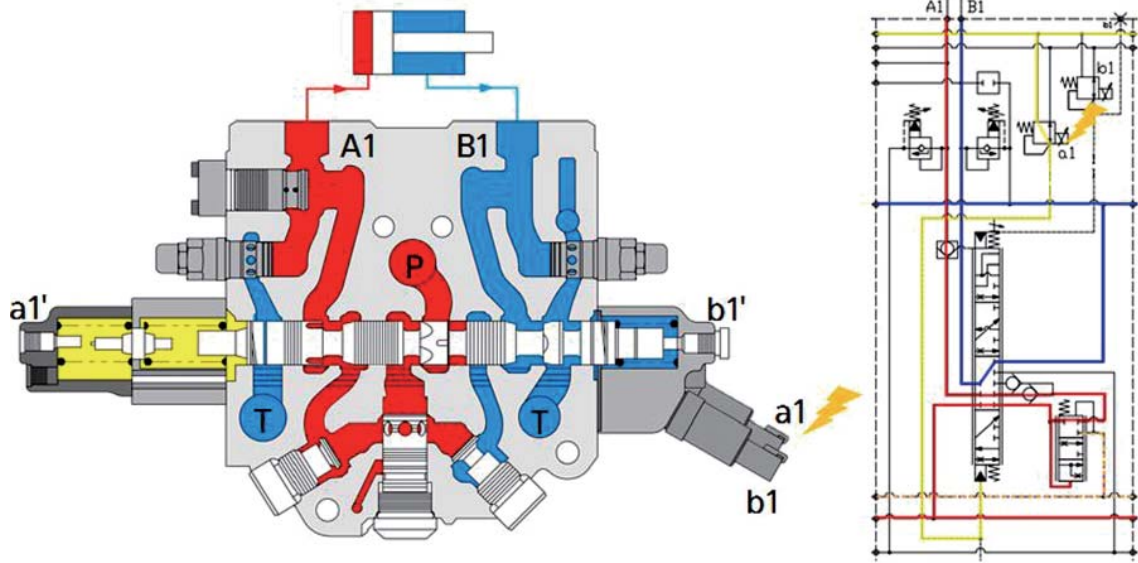
## 5) BOOM SECTION DESCRIPTION



960A6WE17

- |   |                      |   |                          |
|---|----------------------|---|--------------------------|
| 1 | Spring               | 6 | Load holding check valve |
| 2 | Anti rotation device | 7 | Anti drift poppet        |
| 3 | Housing              | 8 | 4th position device      |
| 4 | Pressure compensator | 9 | Port relief valve        |
| 5 | Spool                |   |                          |

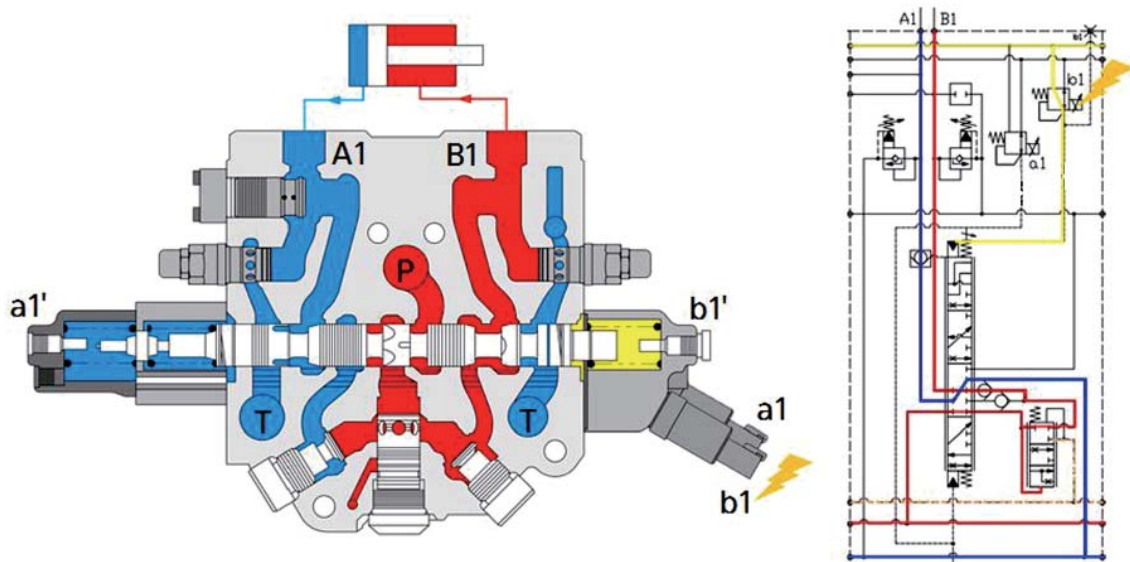
## 6) BOOM UP DESCRIPTION



960A6WE18

When the pilot pressure from EPPR valve (a1) is led to the port a1', the oil from the pump flows to the boom cylinder (LC) port A1 and oil from the boom cylinder (SC) flows into the tank through the boom cylinder (SC) port B1.

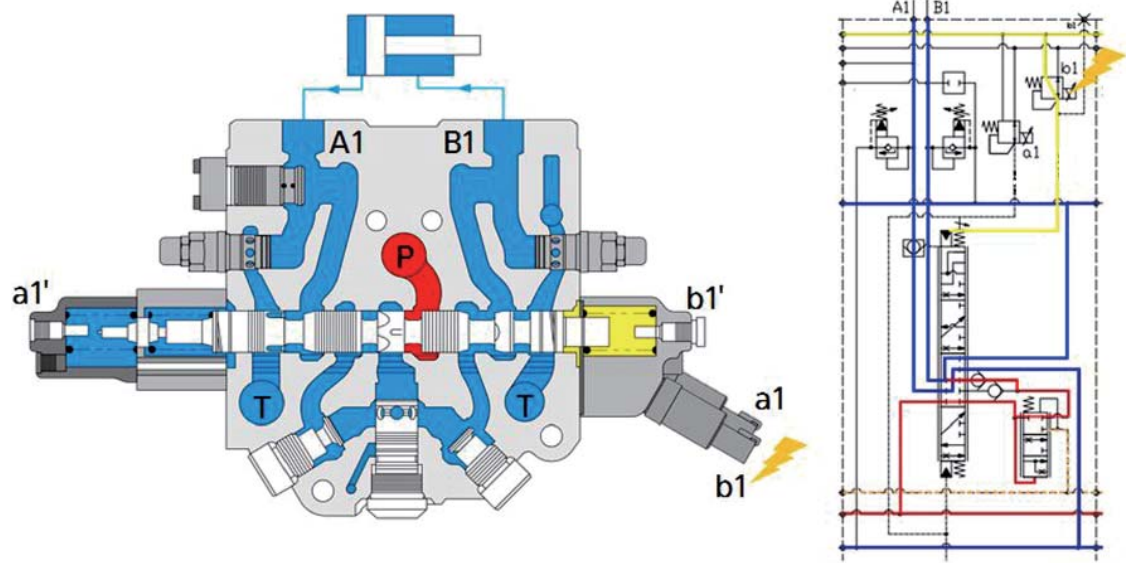
## 7) BOOM DOWN DESCRIPTION



960A6WE19

When the pilot pressure from EPPR valve (b1) is led to the port b1', the oil from the pump flows to the boom cylinder (SC) port B1 and oil from the boom cylinder (LC) flows into the tank through the boom cylinder (LC) port A1.

## 8) BOOM FLOATING DESCRIPTION

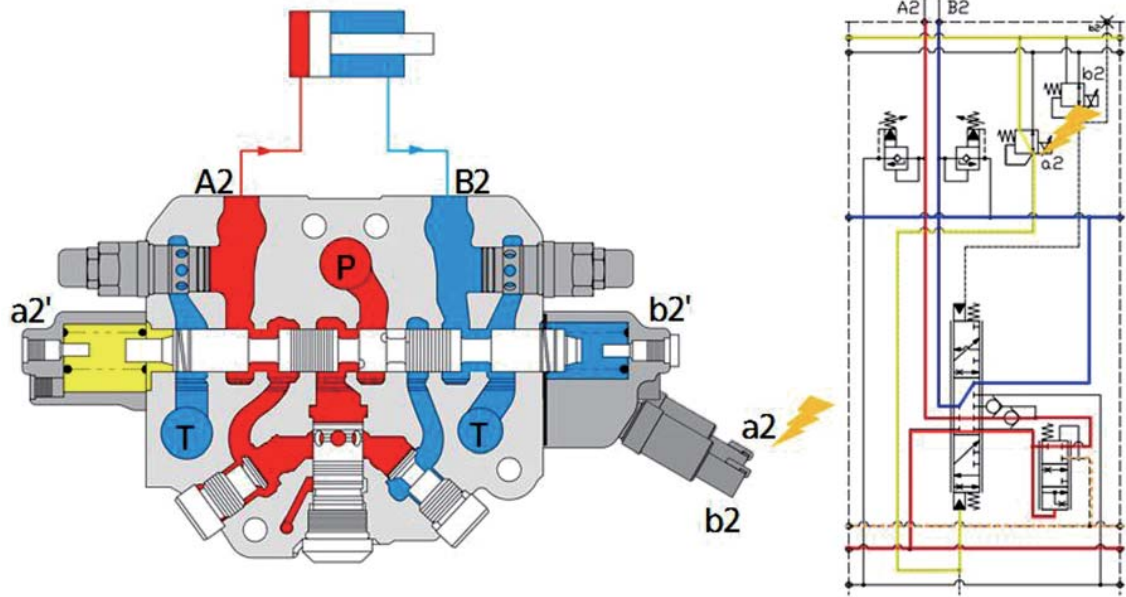


960A6WE20

When the pilot pressure from EPPR valve (b1) is led to the port b1' to maximal pressure, the spool is in the forth position. The pump is in low pressure stand-by while port A1 and B1 are connected to tank.



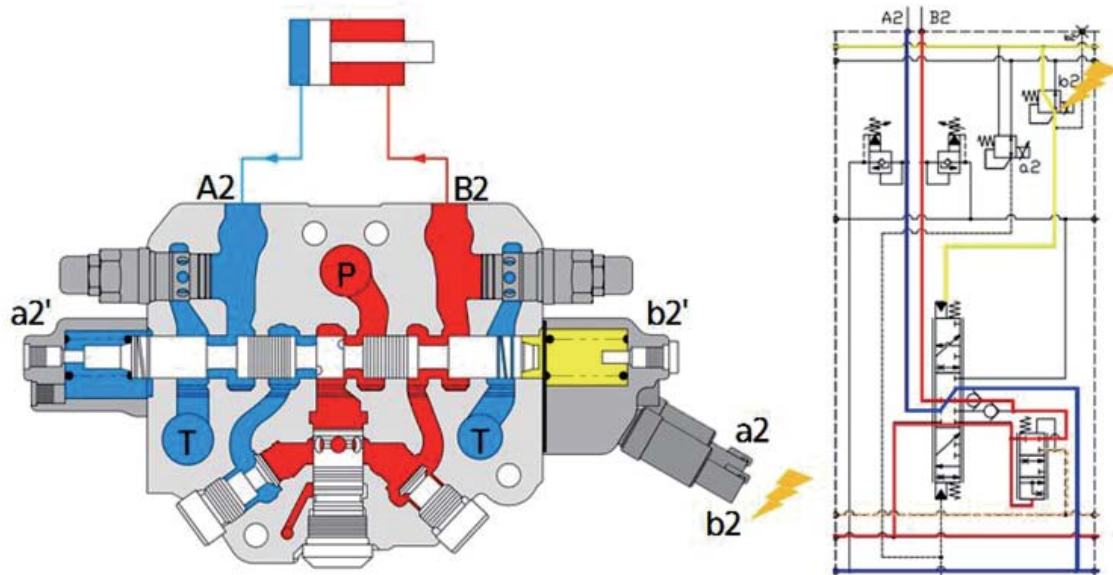
## 9) BUCKET ROLL BACK DESCRIPTION



960A6WE21

When the pilot pressure from EPPR valve (a2) is led to the port a2', the oil from the pump flows to the bucket cylinder (LC) port A2 and oil from the bucket cylinder (SC) flows into the tank through the bucket cylinder (sc) port B2.

## 10) BUCKET DUMP DESCRIPTION

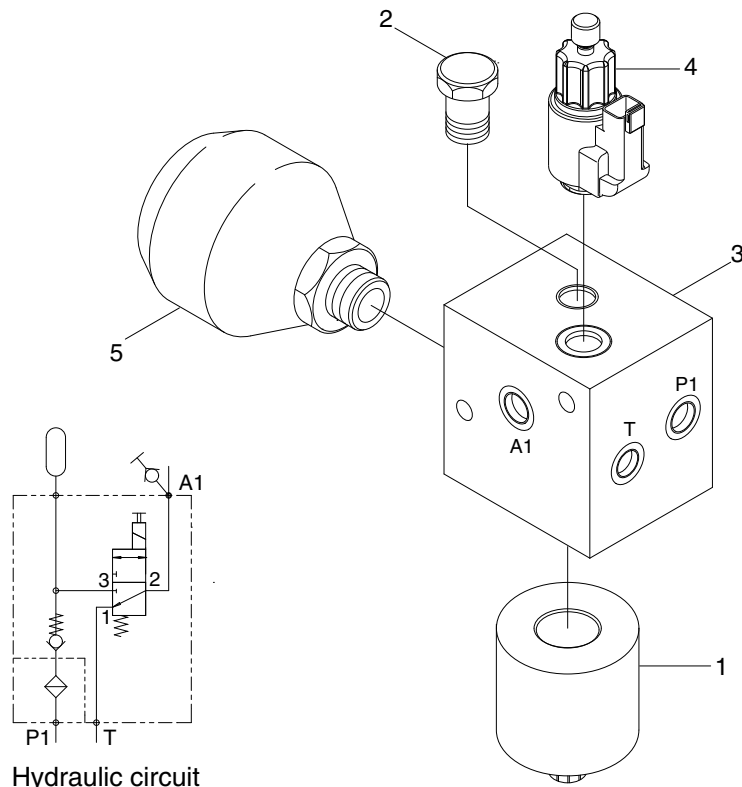


960A6WE22

When the pilot pressure from EPPR valve (b2) is led to the port b3', the oil from the pump flows to the bucket cylinder (SC) port B3 and oil from the bucket cylinder (LC) flows into the tank through the bucket cylinder (LC) port A3.

## 6. SAFETY VALVE

### 1) STRUCTURE



Port	Port name	Port size
P1	From MCU	PF 3/8"
A1	Supply to RCV lever	PF 1/4"
T	To hydraulic tank	PF 1/4"

75796WE16

- 1 Bowl and element assy
- 2 Check valve
- 3 Cartridge

- 4 Solenoid valve
- 5 Accumulator

### 2) OPERATION

This valve is used to cut off the pilot circuit.

When the pilot cut off switch in the cab is pressed to ON position, the solenoid valve is activated and then the pilot oil flow into the pilot circuit.

The accumulator satisfied short term peak power demands and is a source of emergency power in case of main circuit pressure failures.



## 7. BOOM AND BUCKET CYLINDER

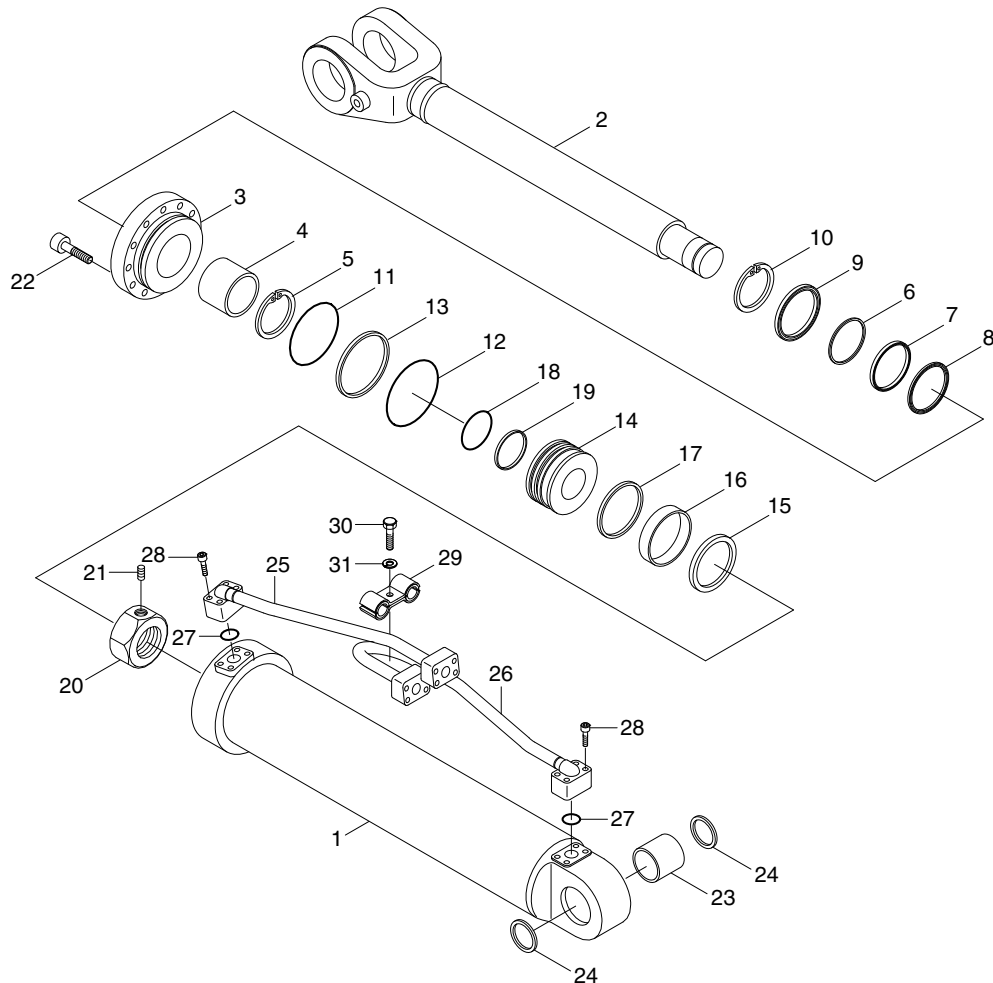
The boom cylinders are two unit and the bucket cylinder is one unit. They use a bolt on rod guide.

The piston (14) threads on to the rod (2) and is retained by a nut (20) and set screw (21).

The piston seals against the tube (1) with piston seal (15). Two wear rings (16) are located on each side of the piston seal.

The gland (3, the rod guide) seals against the tube with an O-ring (12). The cylinder thread seals against the rod with a lip type buffer ring (8) and a rod seal (5). A dust wiper (9) cleans the rod when it is retracted.

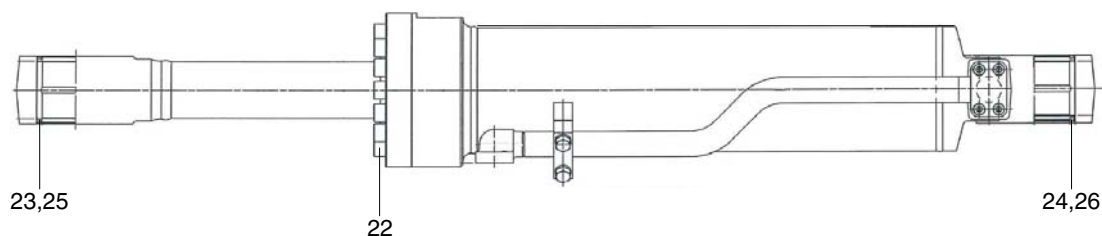
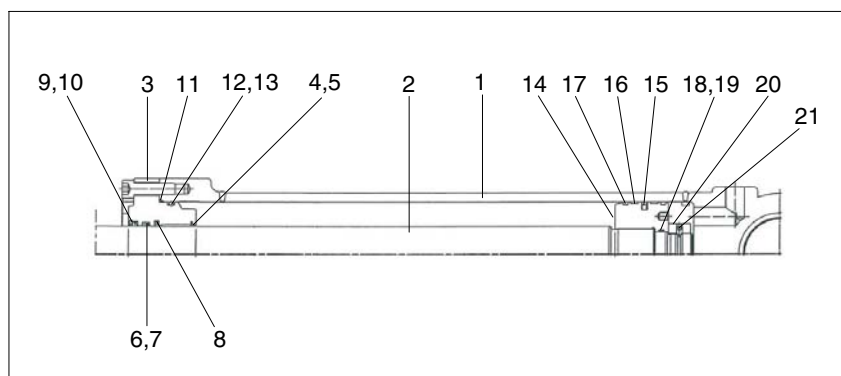
### 1) BOOM CYLINDER



757F6WE17

1	Tube assembly	12	O-ring	23	Bushing
2	Rod assembly	13	Back up ring	24	Dust seal
3	Gland	14	Piston	25	Pipe assembly
4	Bushing	15	Piston seal	26	Pipe assembly
5	Snap ring	16	Wear ring	27	O-ring
6	Rod seal	17	Dust ring	28	Bolt
7	Back up ring	18	O-ring	29	Band assembly
8	Buffer ring	19	Back up ring	30	Bolt
9	Dust wiper	20	Lock nut	31	Spring washer
10	Snap ring	21	Set screw		
11	O-ring	22	Bolt		

## 2) BUCKET CYLINDER



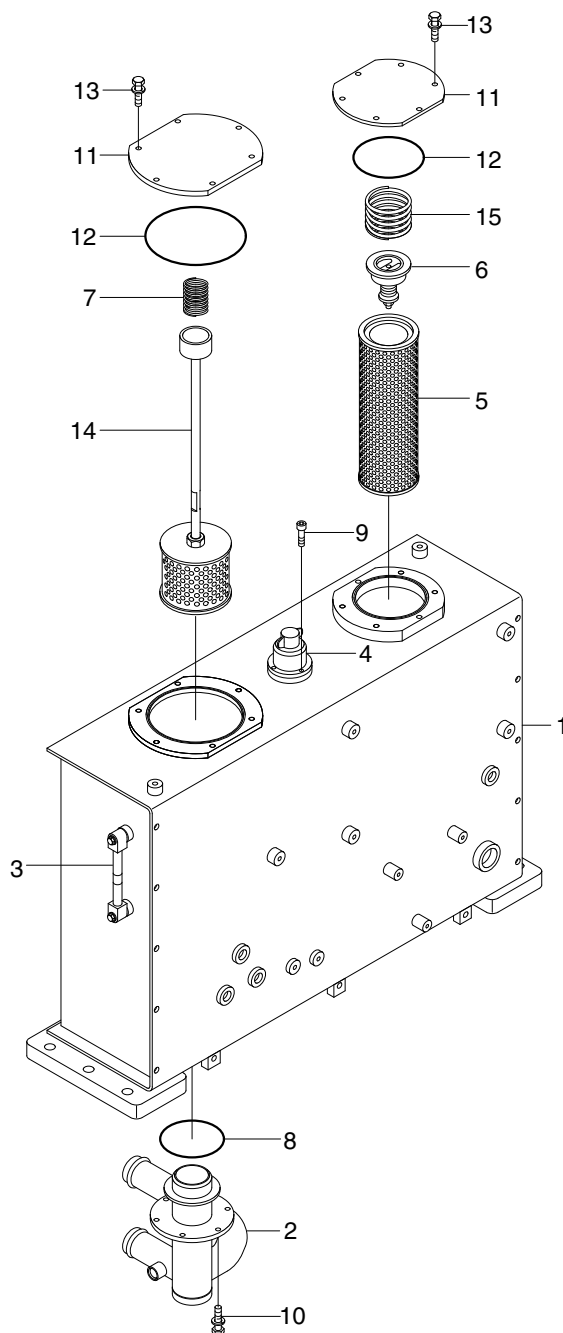
955SA6WE18

- |    |               |    |              |    |           |
|----|---------------|----|--------------|----|-----------|
| 1  | Tube assembly | 12 | O-ring       | 23 | Bushing   |
| 2  | Rod assembly  | 13 | Back up ring | 24 | Bushing   |
| 3  | Gland         | 14 | Piston       | 25 | Dust seal |
| 4  | Bushing       | 15 | Piston seal  | 26 | Dust seal |
| 5  | Snap ring     | 16 | Wear ring    |    |           |
| 6  | Rod seal      | 17 | Dust ring    |    |           |
| 7  | Back up ring  | 18 | O-ring       |    |           |
| 8  | Buffer ring   | 19 | Back up ring |    |           |
| 9  | Dust wiper    | 20 | Lock nut     |    |           |
| 10 | Snap ring     | 21 | Set screw    |    |           |
| 11 | O-ring        | 22 | Bolt         |    |           |

## 8. HYDRAULIC OIL TANK

### 1) STRUCTURE

- The oil from the hydraulic tank is sent from the pump through main control valve to the cylinders. In the return circuit, the oil from various parts merges.
- A part of oil is cooled in the oil cooler, passes through the hydraulic filter and returns to the hydraulic tank (1).
- If the hydraulic return oil filter becomes clogged, return filter bypass valve (6) acts to allow the oil to return directly to the hydraulic tank (1). This prevents damage to the hydraulic filter (5). The bypass valve (6) is also actuated when negative pressure is generated in the circuit.



- 1 Hydraulic tank wa
- 2 Pipe wa
- 3 Sight gauge
- 4 Air breather
- 5 Element assembly
- 6 Bypass valve
- 7 Spring
- 8 O-ring
- 9 Socket bolt
- 10 Bolt
- 11 Cover
- 12 O-ring
- 13 Bolt
- 14 Strainer
- 15 Spring

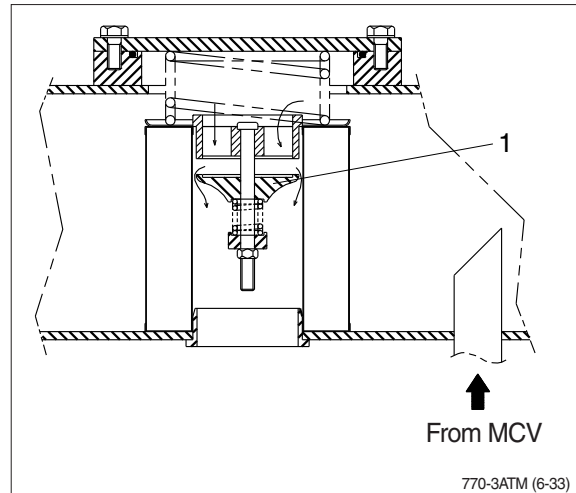
960A6WE21

## 2) RETURN OIL FILTER BYPASS VALVE

### (1) When the filter is clogged

Bypass valve (1) is opened and the oil returns directly to the tank without passing through the filter.

- Bypass valve set pressure : 1.36 kg/cm<sup>2</sup>  
(19.3 psi)



### **3) AIR BREATHER**

The air breather is equipped with the capacity to perform three functions simultaneously-as an air filter, breathing valve, and as a lubrication opening.

#### **(1) Preventing negative pressure inside the tank**

The tank is a pressurized sealed type, so negative pressure is formed inside the hydraulic tank when the oil level drops during operations. When this happens, the difference in pressure between the tank and the outside atmospheric pressure opens the poppet in the breather, and air from the outside is let into the tank or prevent negative pressure.

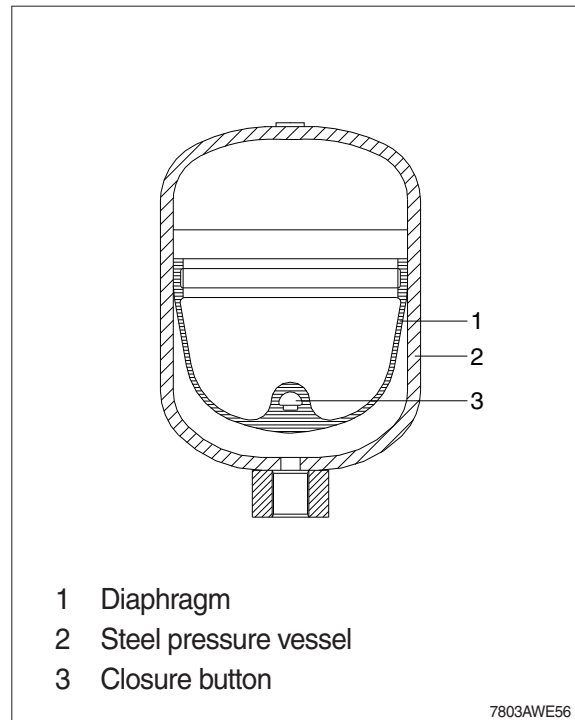
#### **(2) Preventing excessive pressure inside the tank**

When the hydraulic cylinder is being used, the oil level in the hydraulic system increases and as temperature rises. If the hydraulic pressure rises above the set pressure, breather is actuated to release the hydraulic pressure inside the tank.

## 9. ACCUMULATOR

The accumulator is installed at the safety valve. When the boom is left the raised position, and the control levers are operated with the engine stopped the pressure of the compressed nitrogen gas inside the accumulator sends pilot pressure to the control valve to actuate it and allow the boom and bucket to come down under their own weight.

Type of gas	Nitrogen gas (N <sub>2</sub> )
Volume of gas	0.75 ℓ (0.2 U.S.gal)
Charging pressure of gas	16 kg/cm <sup>2</sup> (228 psi)
Max actuating pressure	128 kg/m <sup>2</sup> (1820 psi)



## 10. RIDE CONTROL SYSTEM (option)

### 1) ACCUMULATORS

#### (1) Pre-charging

Use an inert gas such as nitrogen for pre-charging accumulator.

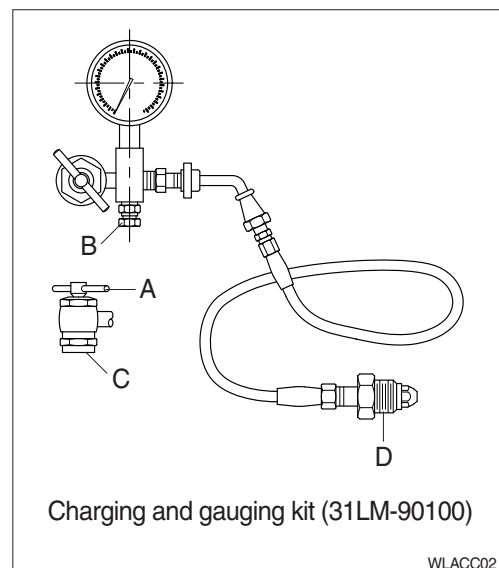
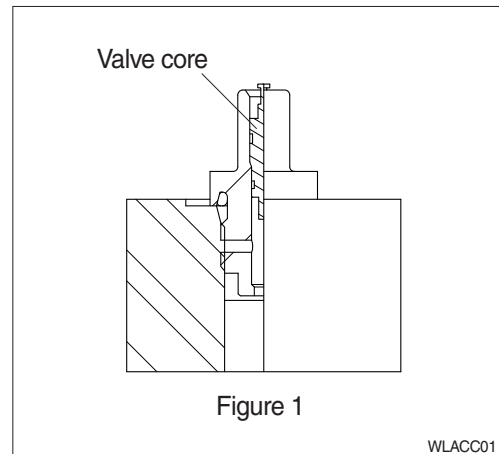
- ※ Do not use oxygen or shop air.
- ※ Nitrogen source and all components must be rated for a pressure at least as high as the nitrogen source.

#### Accumulator having gas valve as per figure 1.

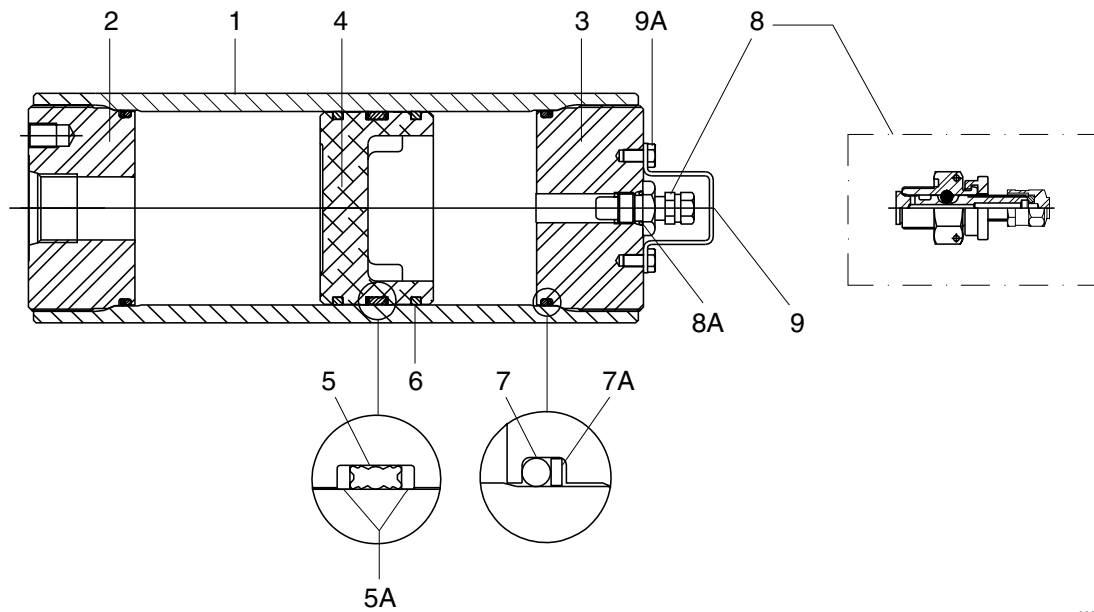
- ① Remove gas valve guard and gas valve cap.
- ② Back gas chuck "T" handle (A) all the way out (counter clockwise) before attaching charging & gauging kit to accumulator gas valve.
- ③ Close bleed valve (B).
- ④ Making sure not to loop or twist the hose, attach swivel nut (C) to gas valve and tighten 11.5~17 kgf·cm (10~15 lbf·ft).
- ⑤ Turn gas chuck "T" handle (A) until the gauge starts showing the pressure in the accumulator. Do not turn the "T" handle all the way down, as it will damage the valve core.
- ⑥ Crack open nitrogen bottle valve (D) and **slowly** fill accumulator. Shut off when gauge indicates desired pre-charge.
- ⑦ Let the pre-charge set for 10 to 15 minutes. This will allow the gas temperature to stabilize. If the desired pre-charge is exceeded, close nitrogen bottle valve (D), then slowly open bleed valve (B). Do not reduce pre-charge by depressing valve core with a foreign object. High pressure may rupture rubber valve seat.
- ⑧ When finished pre-charging accumulator, turn "T" handle (A) all the way out on gas chuck, then open bleed valve (B).
- ⑨ Hold gas valve to keep from turning, loosen swivel nut (C), remove assembly. Check for pre-charge leak using a common leak reactant.
- ⑩ Replace gas valve cap 11.5~17 kgf·cm (10~15 lbf·ft) and valve guard. (Gas valve cap serves as a secondary seal.)

#### (2) Pre-charge checking procedure

Using appropriate valve in the hydraulic system, discharge all oil from accumulator and allow piston to bottom against hydraulic end cap.



### (3) Structure



WLACC03

- |   |               |    |                          |    |                  |
|---|---------------|----|--------------------------|----|------------------|
| 1 | Body          | 5A | V-O-ring back-up washers | 8A | Gas valve O-ring |
| 2 | Hydraulic cap | 6  | Piston ring (piston)     | 9  | Gas valve guard  |
| 3 | Gas cap       | 7  | O-ring                   | 9A | Screw            |
| 4 | Piston        | 7A | O-ring back-up washer    |    |                  |
| 5 | V-O-ring      | 8  | Gas valve                |    |                  |

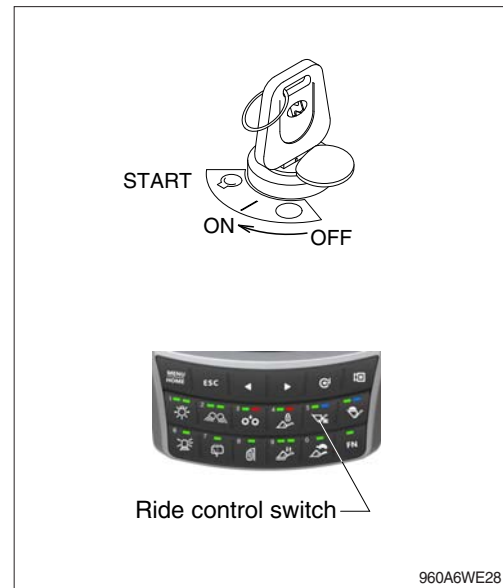


## 2) REMOVE FROM HYDRAULIC SYSTEM

### ⚠ Attention

※ Before carrying out any maintenance work the accumulators must be unloaded (zero pressure).

- 1) Bucket should be lade on the ground.
- 2) Turn the starting switch to ON position and press the ride control switch on monitor to operate ride control function.
- 3) Lower the boom to the position of down or floating to release the charged oil in accumulators.



## MEMORANDUM

## MEMORANDUM

## MEMORANDUM

## GROUP 2 OPERATIONAL CHECKS AND TROUBLESHOOTING

### 1. OPERATIONAL CHECKS

This procedure is designed so the mechanic can make a quick check of the system using a minimum amount of diagnostic equipment. If you need additional information, read structure and function, Group 1.

A location will be required which is level and has adequate space to complete the checks.

The engine and all other major components must be at operating temperature for some checks.

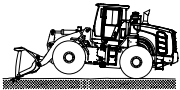
Locate system check in the left column and read completely, following the sequence from left to right. Read each check completely before performing.

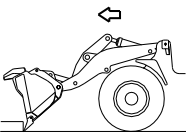
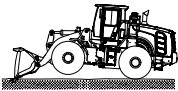
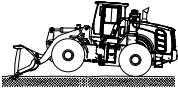
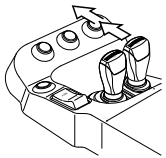
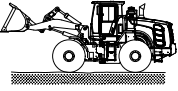
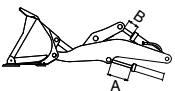
At the end of each check, if no problem is found (OK), that check is complete or an additional check is needed. If problem is indicated (NOT OK), you will be given repair required and group location.

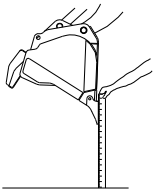
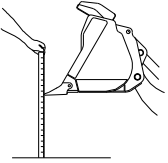
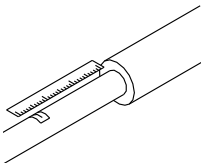
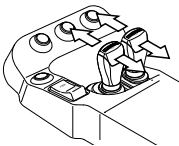
If verification is needed, you will be given next best source of information:

- Chapter 2 : Troubleshooting
- Group 3 : Tests and adjustments

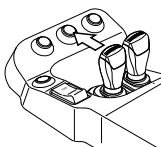
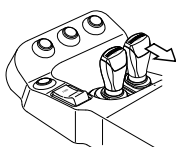
※ Hydraulic oil must be at operating temperature for these checks (refer to page 6-49).

Item	Description	Service action
<b>Hydraulic system warm-up procedure</b> Run engine at high idle. Refer to page 6-55.	Hold a hydraulic function over relief to heat oil. (don't keep relief condition over 5 seconds at a time) Periodically cycle all hydraulic functions to distribute warm oil. Repeat procedure until oil is at operating temperature. <b>FEEL</b> : Hydraulic reservoir must be uncomfortable to hold your hand against. (approximately 40 ~50°C)	<b>OK</b> Check completed.
<b>Hydraulic pump performance check</b> Heat hydraulic oil to operating temperature. Run engine at high idle.	With bucket flat on ground, actuate boom raise. Time how long it takes to raise boom to full height. <b>LOOK</b> : Boom must raise to full height in less than 7 seconds.	<b>OK</b> Check completed. <b>NOT OK</b> Do priority valve high pressure check. <b>IF OK</b> Do steering system leakage check at page 5-20. <b>IF OK</b> Do main hydraulic pump flow test at page 6-50.
<b>Control valve lift check</b> Run machine at low idle.	 With bucket partially dumped, lower boom to raise front of machine. Slowly move boom control lever (RCV lever) to boom lower position. Slowly move bucket control lever to bucket dump position. <b>LOOK</b> : Boom must not raise before moving down. Bucket must not rollback before dumping.	<b>OK</b> Check complete. <b>NOT OK</b> Repair lift checks in loader control valve.

Item	Description	Service action
<b>Bucket rollback circuit relief valve check</b>	 <p>Position bucket at a 45° angle against an immovable object.</p> <p>Engage transmission in 3rd speed forward.</p> <p><b>LOOK</b> : Bucket angle must not change.</p>	<p><b>OK</b> Check complete.</p> <p><b>NOT OK</b> Replace boom lower check valve.</p>
<b>Bucket dump circuit relief valve low pressure check</b>	 <p>Raise front of machine which bucket at 45° angle.</p> <p>Backdrag with bucket while observing bucket angle.</p> <p><b>LOOK</b> : Bucket must not rollback</p>	<p><b>OK</b> Go to next check.</p> <p><b>NOT OK</b> Do loader system and circuit relief valve test at page 6-51.</p>
<b>Pilot control valve float check</b> Run engine at low idle.	 <p>With the bucket partially dumped, lower boom to raise front of machine.</p> <p>Push control lever to the float detent position and release lever.</p>  <p><b>LOOK</b> : Front of machine lower to the ground and valve must remain in float position when lever is released.</p>	<p><b>OK</b> Check complete.</p> <p><b>NOT OK</b> Do pilot control valve pressure test.</p>
<b>Boom cylinder and bucket cylinder drift check</b> Heat hydraulic oil to operating temperature.	 <p>Set the boom and bucket horizontal, then stop the engine.</p> <p>Stop the engine, wait for 5 minutes, then start measuring.</p> <p>Measure the amount the lift and dump cylinder rods retract during 15 minutes. (unloaded bucket)</p>  <p>A : Retraction of boom cylinder rod</p> <p>B : Retraction of bucket cylinder rod</p> <p>Boom cylinder must drift less than 9 mm</p> <p>Bucket cylinder must drift less than 29 mm</p>	<p><b>OK</b> Check complete.</p> <p><b>NOT OK</b> Go to next check.</p>

Item	Description	Service action
<b>Boom cylinder leakage check</b> Heat hydraulic oil to operating temperature.	 <p>Dump bucket until teeth or cutting edge is perpendicular to the ground.</p> <p>Raise boom until cutting edge is about 1 m (3 ft) above ground.</p> <p>Stop engine. Measure drift from tooth or cutting edge to ground for 1 minute.</p> <p>Wait 10 minutes.</p> <p>Measure drift from tooth or cutting edge to ground for 1 minute.</p> <p><b>LOOK</b> : Compare the drift rate between the first measurement and the second measurement.</p>	<p><b>OK</b> Drift is approximately the same between first and second measurement.</p> <p>Repair loader control valve or circuit relief valve.</p> <p><b>NOT OK</b> If drift is considerably less on second measurement, repair cylinder.</p>
<b>Bucket cylinder leakage check</b> Heat hydraulic oil to operating temperature.	 <p>Raise bucket about 1 m (3 ft) off ground with bucket level.</p> <p>Stop engine. Place a support under boom.</p> <p>Measure drift from tooth or cutting edge to ground for 1 minute.</p> <p>Wait 10 minutes.</p> <p>Measure drift from tooth or cutting edge to ground for 1 minute.</p> <p><b>LOOK</b> : Compare the drift rates between the first measurement and the second measurement.</p>	<p><b>OK</b> Drift is approximately the same between first and second measurement.</p> <p>Repair loader control valve or circuit relief valve at page 6-51.</p> <p><b>NOT OK</b> Drift is considerably less on second measurement.</p> <p>Repair cylinder.</p>
<b>Check valve of safety valve leakage check</b> Heat hydraulic oil to operating temperature.	 <p>Put bucket level and position about 1.2 m (4 ft) above ground.</p> <p>Place a piece of tape on cylinder rod at least 51 mm (2 in) from rod guide.</p> <p>Run engine at low idle in safety-release position.</p> <p><b>LOOK</b> : Bucket must not drift up.</p>	<p><b>OK</b> Check complete.</p> <p><b>NOT OK</b> Check or replace safety valve.</p>
<b>Pilot control valve (RCV lever) check</b>	 <p>Stop engine. Turn key switch to OFF position.</p> <p>Move control lever to all positions and then release.</p> <p><b>LOOK</b> : Lever must return to neutral when released from all positions.</p>	<p><b>OK</b> Check completed.</p> <p><b>NOT OK</b> Repair pilot control valve.</p>



Item	Description		Service action
<b>Bucket leveler (positioner) check</b> Run engine at low idle.		Position bucket fully dumped just above ground level.  Move control lever to bucket leveler detent position and release.  <b>LOOK</b> : Bucket must rollback to the level position and control lever must return to neutral. If bucket is in a rolled back position when key is turned ON, control lever must be returned to neutral manually if placed in the bucket leveler detent position.  After bucket is dumped once, bucket leveler will work normally.	<b>OK</b> Check complete.  <b>NOT OK</b> Do bucket leveler checks.
<b>Boom height kickout check</b> Run engine at low idle.		Position bucket flat on ground.  Move control lever to boom raise detent position and release.  <b>LOOK</b> : Boom must raise to the set height and stop.  Control lever must return to neutral.	<b>OK</b> Check complete.  <b>NOT OK</b> Do boom height kickout check.
<b>Cycle time check</b> Heat hydraulic oil to operating temperature. Run engine at high idle.	Function Boom raise Boom lower Bucket dump Bucket rollback Steering [No. of turns]	Operating condition. Bucket flat on ground to full height. Full height to level ground. Boom at full height. Boom at full height. Frame stop to frame stop.	Maximum cycle time 5.5sec 3.7sec 1.8sec 2.2sec 3.9 turns  <b>OK</b> Check complete.  <b>NOT OK</b> Go to slow hydraulic functions in group 2.

## ※ MEASURING BOOM AND BUCKET CYCLE TIME

### 1) MEASUREMENT CONDITION

- Coolant temperature : Inside operating range
- Steering position : Neutral
- Hydraulic temperature : 40~50°C
- Bucket : Unloaded
- Engine speed : High idling

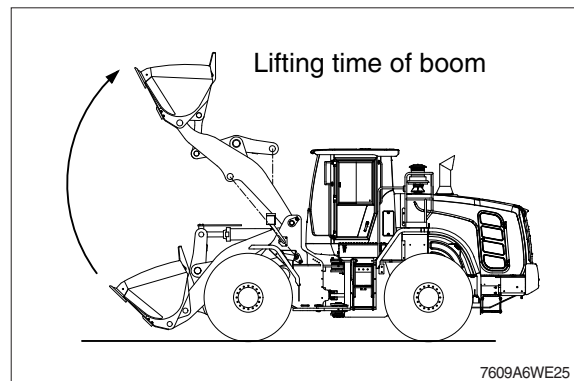
### 2) MEASURING TOOL

- Stop watch (1EA)

### 3) MEASURING PROCEDURE

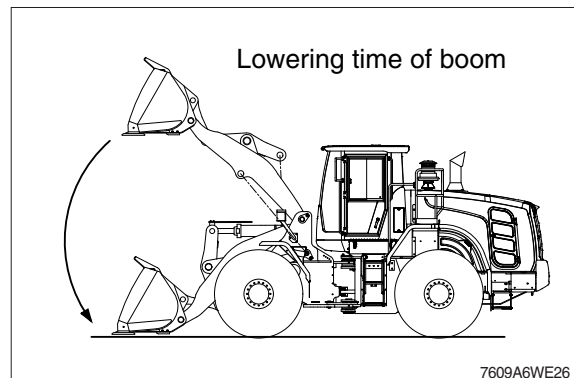
#### (1) LIFTING TIME OF BOOM

Set the bucket near the maximum tilt back position and at the lowest position on the ground. Raise the bucket and measure the time taken for bucket to reach the maximum height of the boom.



#### (2) LOWERING TIME OF BOOM

Set the bucket horizontal with the boom at the maximum height, lower the bucket and measure the time taken for the bucket to reach the lowest position on the ground.

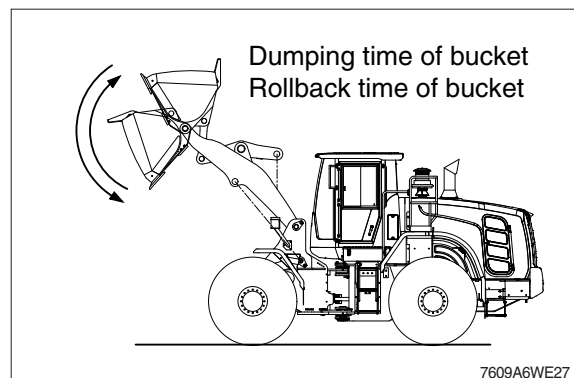


#### (3) DUMPING TIME OF BUCKET

Raise the boom to the maximum height and measure the time taken for the bucket to move from the maximum tilt back position to the maximum dump position.

#### (4) ROLL BACK TIME OF BUCKET

Raise the boom to the maximum height and measure the time taken for the bucket to reach the maximum tilt back position.



## 2. TROUBLESHOOTING

※ Diagnose malfunction charts are arranged from most probable and simplest to verify, to least likely, more difficult to verify. Remember the following steps when troubleshooting a problem :

Step 1. Operational check out procedure (see section 1)

Step 2. Operational checks (see group 2)

Step 3. Troubleshooting

Step 4. Tests and adjustments (see group 3)

Problem	Cause	Remedy
<b>Noisy hydraulic pump</b>	Low oil supply or wrong viscosity. Plugged or pinched suction line. Air in oil.  Plugged suction strainer. Loose or missing hydraulic line clamps. Hydraulic lines in contact with frame. Worn or damaged pump.	Fill reservoir with recommended oil. Clean or replace line. Check for foamy oil. Tighten connections. Replace O-rings and or lines.  Inspect and clean strainer in reservoir. Tighten or replace clamps. Inspect and repair. Do hydraulic pump performance check in group 2. Do hydraulic pump flow test in group 3.
<b>No or Slow hydraulic functions</b>	Failed or worn hydraulic pump. Cold oil. Slow engine speed.  Suction line air leak. Low oil supply. Wrong oil viscosity. Oil leaking past cylinders or control valve. Blocked or damaged line.  Binding loader control valve (MCV) spool. Faulty steering unit.	Do performance check. Warm oil up. Adjust engine speed. Check high idle speed. Check for foamy oil. Add recommended oil. Use recommended oil. Check cylinder drift in group 2.  Inspect lines. Inspect valve.  Check priority valve, orifice of steering unit specification.

Problem	Cause	Remedy
<b>No steering or hydraulic function</b>	Low oil level. Failed hydraulic pump.	Add recommended oil. Remove and inspect return filter for metal pump particles.
<b>No hydraulic functions steering normal</b>	Failed hydraulic pump.  Failed line filter. Faulty safety valve.  Stuck open port relief valve.	Remove and inspect return filter for metal pump particles, or replace the pump.  Remove and inspect line filter for RCV. Safety valve leakage test or ON, OFF function test.  Replace relief valve.
<b>Boom float function does not work</b>	Low pilot control pressure.  Faulty pilot control valve (RCV). Loader control valve (MCV) spool binding in bore.	Do pressure reducing valve pressure test in group 3.  Replace relief valve. Do pressure reducing valve pressure test in group 3.
<b>One hydraulic function does not work.</b>	Faulty pilot control valve (RCV). Stuck open port relief valve. Oil leaking past cylinder packings.  Blockage in oil lines or valve.  Loader control valve (MCV) spool stuck in bore.	Inspect and repair valve. Replace relief valve. Do boom and bucket cylinder leakage test in group 3.  Inspect lines for damage. Disconnect and inspect lines for internal blockage.  Inspect and repair valve.
<b>Low hydraulic power</b>	Leakage within work circuit. Low system relief valve (main relief valve) setting. Low port relief valve setting.  Leaking system relief valve. Worn hydraulic pump.	Do cylinder drift check in group 2. Do loader system and port relief valve pressure test in group 3. Do loader system and port relief valve pressure test in group 3.  Remove and inspect valve. Do hydraulic pump performance check in group 2.

Problem	Cause	Remedy
<b>Function drifts down</b>	Leaking cylinders. Leaking seals in circuit relief valve (port relief valve) or valve stuck open. Leaking loader control valve (MCV).	Do cylinder leakage checks in group 3. Inspect seals. Replace relief valve. Repair or replace valve section.
<b>Boom drifts up</b>	Leakage in boom down spool.	Remove and inspect boom down spool.
<b>Boom down does not work (engine off)</b>	Safety valve not operated. Stuck pilot control valve. Faulty line filter. Accumulation not operated. MCV spool stuck.	Operate valve. Inspect. Remove and inspect filter. Inspect. Inspect and repair valve.
<b>Oil overheats</b>	Low oil viscosity in hot weather. Excessive load. Holding hydraulic system over relief. Leakage in work circuit.  Plugged fins in oil cooler. Internally plugged oil cooler. Incorrect system or circuit relief valve setting. Restriction in oil lines or loader control valve (MCV). Malfunctioning steering valve.  Leaking system main relief valve.  Worn hydraulic pump (internal leakage).	Use recommended oil. Reduce load. Reduce load. Do boom and bucket cylinder leakage test in group 3. Inspect and clean oil cooler. Do hydraulic oil cooler restriction test. Do loader system and circuit relief valve pressure test in group 3. Inspect for dented or kinked lines.  Do hydraulic system restriction test in group 3. Do hydraulic system restriction test in group 3. Remove and inspect valve and seals. Do hydraulic pump performance check in group 2.
<b>Function drops before raising when valve is activated</b>	Stuck open lift check valve.	Do control valve lift check in group 2.

Problem	Cause	Remedy
<b>Hydraulic oil foams</b>	Low oil level. Wrong oil. Water in oil. Loose or faulty suction lines (air leak in system).	Add recommended oil. Change to recommended oil. Change oil. Tighten or install new lines.
<b>Remote control valve (RCV) leaking</b>	Leaking plunger seals.	Remove, inspect and replace plunger seals.

※ Followings are general precautions for the hydraulic system and equipment.

- 1) Every structure has its limit of strength and durability. The relief valve is installed to limit the pressure on the hydraulic equipment and protect various parts of the wheel loader from possible damage. Therefore, never change the preset pressure of the relief valve unless absolutely necessary.
- 2) Since the hydraulic equipment is built with precision, the presence of only the slightest amount of dust and / or other particles in the hydraulic circuit might cause wear and/or damage, resulting in unstable functions and/or damage, resulting in unstable functions and/or unexpected accidents. Therefore, always keep hydraulic oil clean. Periodically, check the filter in the return circuit and replace the element as necessary.
- 3) Extract about 200cc of hydraulic oil from the tank as a sample every 6 months. If possible, have it analyzed by a specialist to confirm that the oil can still be used. Never extract the oil for sampling until the oil temperature has become the normal operating temperature. Since the replacement period varies depending on operating conditions, refer to **Operator's Manual** and change oil.
- 4) Should the equipment get damaged due to the presence of metal particles and/or foreign matter in the circuit drain out the hydraulic oil and carry out flushing. Also, replace the filter element and clean the hydraulic tank. Change the hydraulic oil entirely.
- 5) When checking the filter, if found metal particles in the element, drain out the hydraulic oil entirely, flush the whole circuit, and then fill with new oil. The presence of metal particles may indicate internal damage to the equipment. In such a case, check carefully before flushing, and repair or replace as required.
- 6) To add and/or change the hydraulic oil, always use recommended oil. (Refer to the list of recommended oils and lubricants at page 1-22, **Recommended lubricants**.) Never mix oil of different makes of kinds.
- 7) To change the hydraulic oil, use a clean vessel and funnel for pouring it into the tank. Never use cloth because it might cause the presence of lint in the circuit.
- 8) When removing the hydraulic equipment, be sure to put plugs or caps on hoses, tube lines and ports. Also, enter mating marks for later identification.

- 9) Disassemble and/or assemble the hydraulic equipment only in a clean place free of dust. When disassembling, be careful about the interchangeability of parts, and clean the disassembled parts with pure and clean mineral cleansing oil. Clean the internal passages as well. After the parts have dried, wipe them off with a clean lint-free cloth.
- 10) When overhauling the hydraulic equipment replace all O-rings, backup rings, etc. with new ones. Assemble O-rings with grease or vaseline applied.
- 11) After installing the equipment, add more hydraulic oil to make up for that lost during disassembly.
- 12) Tighten joints correctly. Loose joints will cause the hydraulic oil to leak. If the oil leaks, the tank oil level drops and air gets sucked in, so the pump will break down. Also loose joints in suction lines will take air in and might cause abnormal noise, malfunction or damage to pumps.

## GROUP 3 TESTS AND ADJUSTMENTS

### 1. HYDRAULIC OIL CLEAN UP PROCEDURE USING PORTABLE FILTER CADDY

※ **Service equipment and tool**

- Portable filter caddy
- Two 4000 mm × 1in 100R1 Hoses
- Quick disconnect fittings.
- Discharge wand
- Various size fittings.

※ **Brake system uses oil from hydraulic oil tank. Flush all lines in the brake, pilot, steering system and cut off system.**

**Disassemble and clean major components for brake and steering system. Remove and clean pilot caps from main control valve.**

**Brake and steering components may fail if brake and steering system is not cleaned after hydraulic oil tank contamination.**

- 1) If hydraulic system is contaminated due to a major component failure, remove and disassemble steering cylinders to clean debris from cylinders.
  - 2) Install a new return filter element. Inspect filter housing before installing new element.
- ※ **For a failure that creates a lot of debris, remove access cover from hydraulic oil tank. Drain and clean hydraulic oil tank of fill the specified oil to hydraulic oil tank through upper cover.**
- 3) To minimize oil loss, pull a vacuum in hydraulic oil tank using a vacuum pump. Connect filter caddy suction line to drain port at bottom of hydraulic oil tank using connector. Check to be sure debris has not closed drain port.
  - 4) Put filter caddy discharge line into hydraulic oil tank filler hole so end is as far away from drain port as possible to obtain a thorough cleaning of oil.



- 5) Start the filter caddy. Check to be sure oil is flowing through the filters.  
Operate filter caddy approximately 10 minutes so oil in hydraulic oil tank is circulated through filter a minimum of four times.  
※ Hydraulic oil tank capacity : 110 ℓ (29.1 U.S. gal)  
Leave filter caddy operation for the next steps.
- 6) Start the engine and run it at high idle.  
※ For the most effective results, cleaning procedure must start with the smallest capacity circuit then proceed to the next largest capacity circuit.
- 7) Operate all functions, one at a time, through a complete cycle in the following order: Clam, steering, bucket, and boom. Also include all auxiliary hydraulic functions. Repeat procedure until the total system capacity has circulated through filter caddy seven times, approximately 30 minutes. Each function must go through a minimum of three complete cycles for a thorough cleaning for oil.  
※ Filtering time for machines with auxiliary hydraulic functions must be increased because system capacity is larger.
- 8) Stop the engine. Remove the filter caddy.
- 9) Install a new return filter element.
- 10) Check oil level in reservoir; Add oil if necessary.


## 2. BOOM HEIGHT KICKOUT ADJUSTMENT

The bucket can be adjusted to a height desired by using the boom kick-out device.


- ▲ Park the machine on level ground and block the tires to prevent sudden movement of the machine.
- ▲ Press the parking brake switch.
- ▲ Fix the front and rear frames by using the safety lock bar.
- ▲ Do not work underneath the work equipment.

### 1) ADJUSTMENT OF THE BOOM KICKOUT AND BUCKET LEVELER


#### (1) Lift kickout position

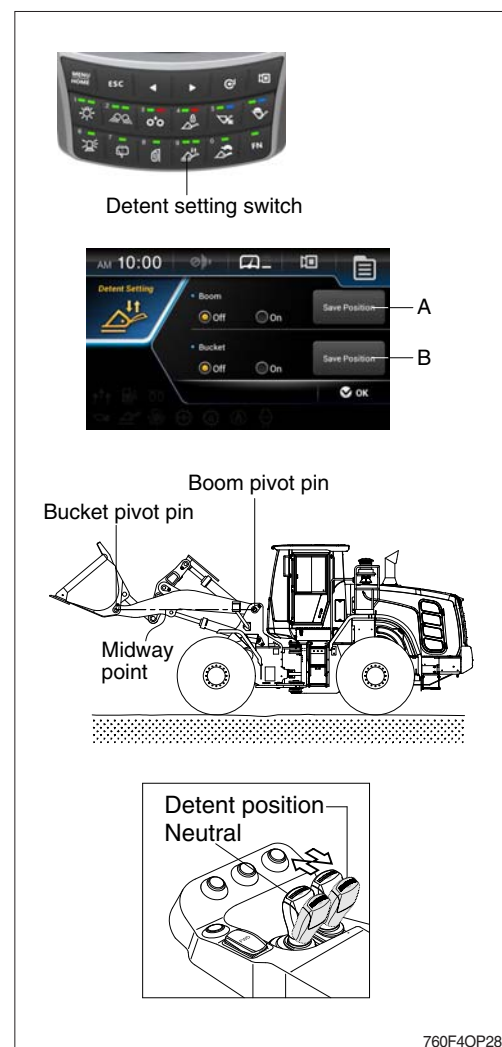
To set the lift kickout, raise the bucket to the desired position above the midway point. Then push icon (  , A) for 2~3 seconds. The boom will return to the programmed position when the raise detent is activated and the boom is below the kickout position.

#### (2) Lower kickout position

To set the lower kickout, lower the bucket to the desired position below the midway point. Then push icon (  , A) for 2~3 seconds. The boom will return to the programmed position when the float detent is activated and the boom is at least a foot above the kickout position.

#### (3) Bucket leveler position

To set the bucket leveler, roll back the bucket to the desired position. Then push icon (  , B) for 2~3 seconds. The bucket will return to the programmed position when the roll back detent is activated and the bucket is below the leveler position.



### 3. TEST TOOLS

#### 1) CLAMP-ON ELECTRONIC TACHOMETER INSTALLATION

· Service equipment and tools

Tachometer

A : Clamp on tachometer.

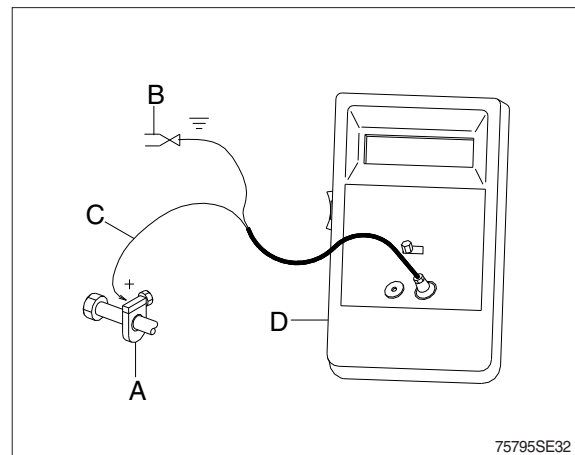
Remove paint using emery cloth and connect to a straight section of injection line within 100 mm (4 in) of pump.

Finger Tighten only-do not over tighten.

B : Black clip (-). Connect to main frame.

C : Red clip (+). Connect to transducer.

D : Tachometer readout. Install cable.



#### 2) DIGITAL THERMOMETER INSTALLATION

· Service equipment and tools

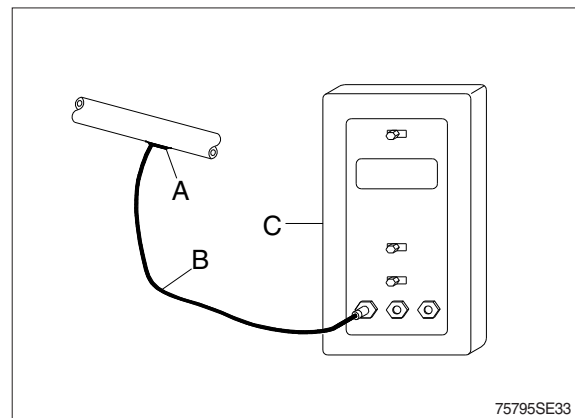
Digital thermometer

A : Temperature probe.

Fasten to a bare metal line using a tie band. Wrap with shop towel.

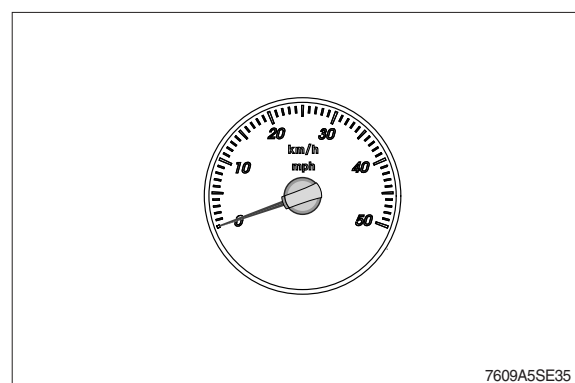
B : Cable.

C : Digital thermometer.



#### 3) DISPLAY MONITOR TACHOMETER

The display monitor tachometer is accurate enough for test work.



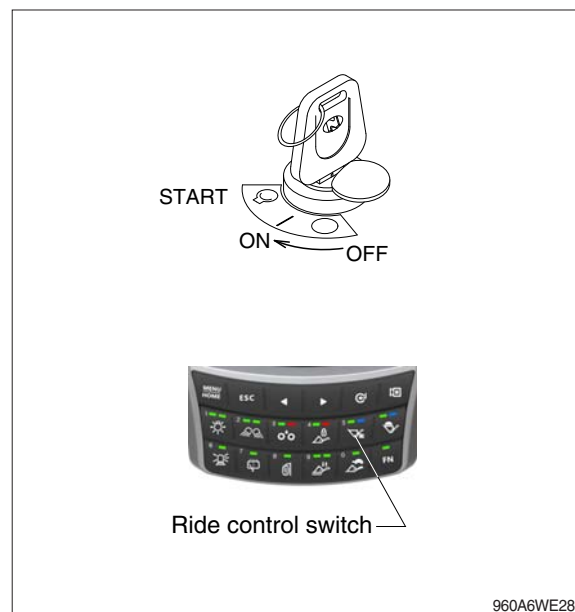
#### 4. HYDRAULIC OIL WARM UP PROCEDURE

- 1) Install temperature reader (see temperature reader installation procedure in this group).
- 2) Run engine at high idle.
- 3) Hold a hydraulic function over relief to heat the oil.
- 4) Periodically cycle all hydraulic functions to distribute warm oil.
- 5) Heat oil to test specification (approx. 45°C).

#### ※ Ride control system (option)

##### ▲ Attention

- 1) Before carrying out any maintenance work the accumulators must be unloaded (zero pressure).
- 2) Bucket should be lade on the ground.
- 3) Turn the starting switch to ON position and press the ride control switch on monitor to operate ride control function.
- 4) Lower the boom to the position of down or floating to release the charged oil in accumulators.



## 5. MAIN HYDRAULIC PUMP FLOW TEST

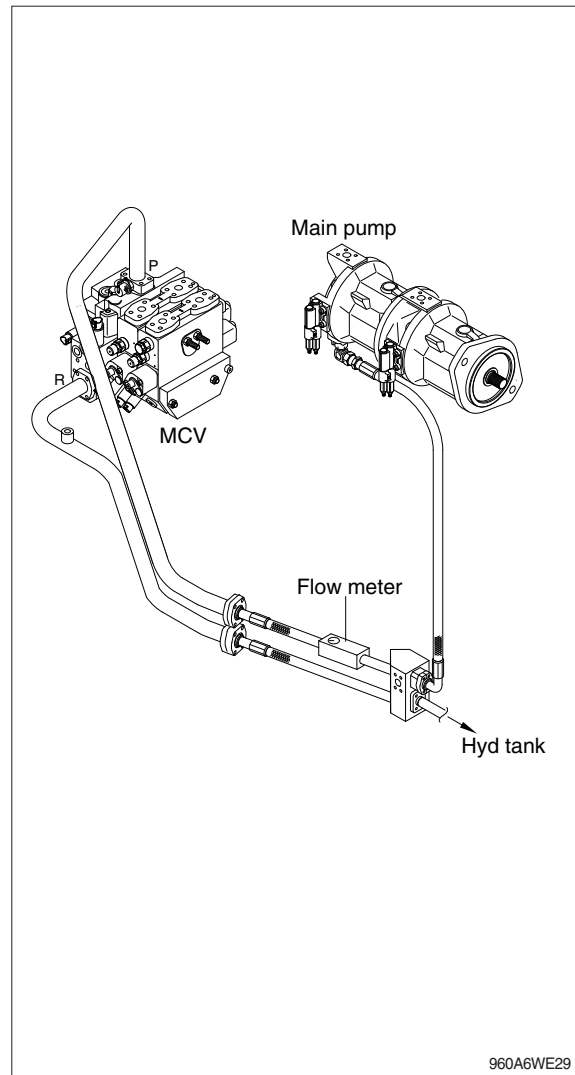
### · SPECIFICATION

Oil temperature	$45 \pm 5^{\circ}\text{C}$ ( $113 \pm 9^{\circ}\text{F}$ )
Engine speed	2230 rpm
Test pressure	$280 \pm 5$ bar (3980 psi)
Maximum pump flow	215 ℓ /min (56.8 gpm)

### · FLOW METER GAUGE AND TOOL

Gauge 0~35 MPa (0~350 bar, 0~5000 psi)  
Temperature reader

- 1) Make test connections.
- 2) Install temperature reader.  
(see temperature reader installation procedure in this group)
- 3) Heat hydraulic oil to specifications.  
(see hydraulic oil warm up procedure in this group)
- 4) Run engine at test specifications.
- 5) Close flow meter loading valve to increase pressure to test specifications.
- 6) Read flow meter.
- 7) If flow is below specifications, check suction line and suction pressure for abnormality before removing pump.



## 6. LOADER SYSTEM AND PORT RELIEF VALVE PRESSURE TEST

### · SPECIFICATION

Oil temperature (40~50°C)

Relief valve	Engine speed	Relief pressure
System (M)	High	280 ± 5 kg/cm <sup>2</sup> (3980 ± 70 psi)
Boom raise (U)	Low	340 ± 10 kg/cm <sup>2</sup> (4840 ± 140 psi)
Boom down (W)	Low	340 ± 10 kg/cm <sup>2</sup> (4840 ± 140 psi)
Bucket rollback (R)	Low	340 ± 10 kg/cm <sup>2</sup> (4840 ± 140 psi)
Bucket dump (D)	Low	340 ± 10 kg/cm <sup>2</sup> (4840 ± 140 psi)

### · Gauge and tool

Gauge 0~35 MPa (0~350 bar, 0~5000 psi)

M : System (main) relief valve

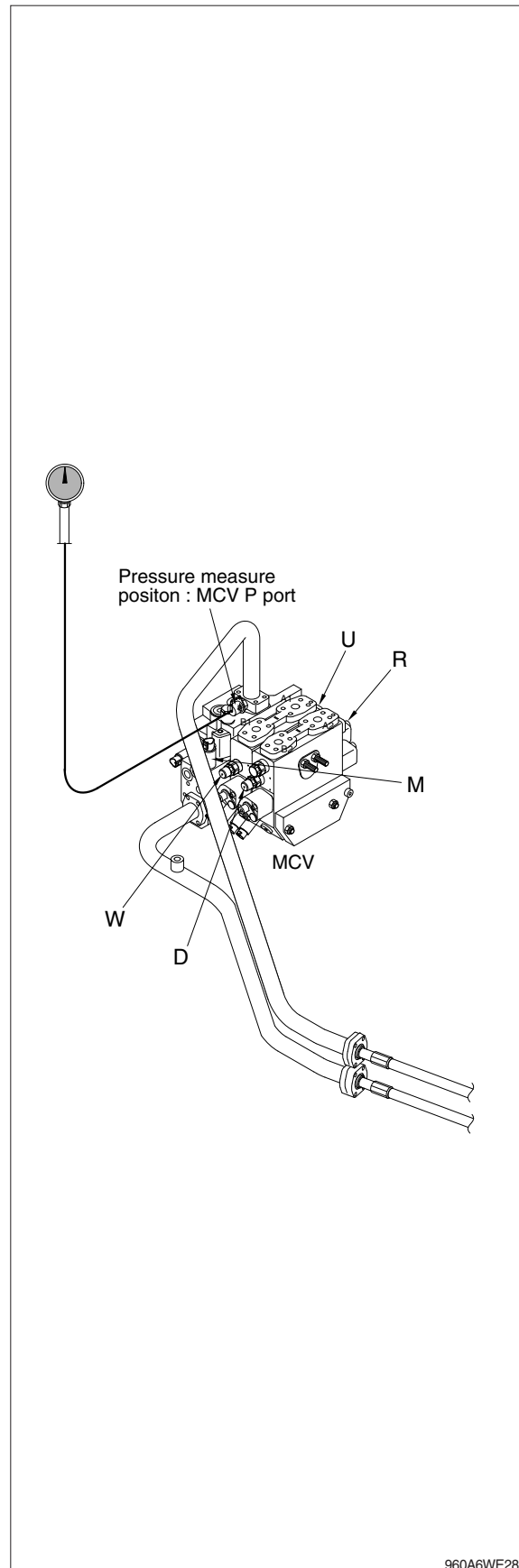
R : Bucket rollback relief

D : Bucket dump relief

U : Boom raise relief

W: Boom down relief

- 1) Install fitting and pressure gauge to test port in pump delivery line.
  - 2) Install temperature reader.  
(see temperature reader installation procedure in this group)
  - 3) Heat hydraulic oil to specifications.  
(see hydraulic oil warm up procedure in this group)
  - 4) To check the system relief (M), run engine at high idle. Lower boom to bottomed position.  
Slowly activate boom down function while watching pressure gauge. If pressure is not to specification, loosen lock nut on system relief valve (M) and adjust to specification.
- ※ Do not adjust the system relief valve above 280 kg/cm<sup>2</sup> (3980 psi). Damage to the pump will result from excessive pressure settings.



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## 7. HYDRAULIC SYSTEM RESTRICTION TEST

### · SPECIFICATION

Oil temperature  $45 \pm 5^{\circ}\text{C}$  ( $113 \pm 9^{\circ}\text{F}$ )  
Engine speed High idle  
Maximum pressure 4.5 MPa (45 bar, 640 psi) at steering unit.  
Maximum pressure at main control valve  
1 MPa (10 bar, 145 psi)

### · GAUGE AND TOOL

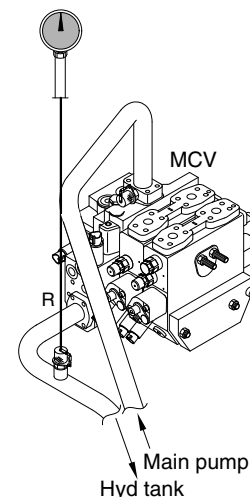
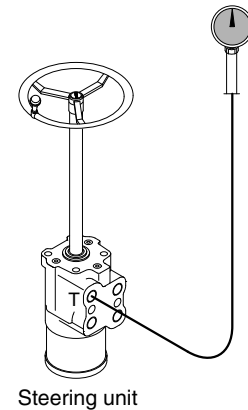
Gauge 0~7 MPa (0~70 bar, 0~1000 psi) 2EA  
This test will check for restrictions in the hydraulic system which can cause overheating of hydraulic oil.

- 1) Install temperature reader.  
(see temperature reader installation procedure in this group)
- 2) Heat hydraulic oil to specifications.  
(see hydraulic oil warm up procedure in this group)
- 3) Connect fitting and gauge to steering valve.
- 4) Connect fitting and gauge to main control valve.
- ▲ Do not operate steering or loader functions or test gauge may be damaged.
- 5) Run engine at specification and read pressure gauges.

If pressure is more than specification at the loader control valve, check for a kinked, dented or obstructed hydraulic line. Check loader control valve for a binding spool.

If pressure is more than specification at the steering unit, inspect neutral condition of the steering unit and steering valve for a stuck spool. Make sure orifice plugs are installed in ends of priority valve spool.

Check for plugged orifice in priority valve and dynamic signal orifice on steering valve body.



960A6WE39

## 8. LOADER CYLINDER DRIFT TEST

### · SPECIFICATION

Oil temperature  $45 \pm 5^{\circ}\text{C}$  ( $113 \pm 9^{\circ}\text{F}$ )

Boom horizontal

Bucket horizontal

Bucket unloaded

Item	Standard value
Retraction of boom cylinder rod	9 mm
Retraction of bucket cylinder rod	29 mm

### · GAUGE AND TOOL

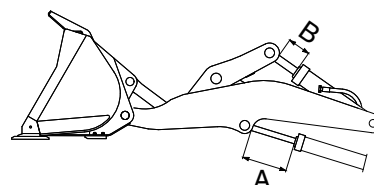
Stop watch

Temperature reader

**▲ Put the pilot cut off switch in the OFF position.**

**▲ Do not go under the work equipment.**

- 1) Set the boom and bucket horizontal, then stop the engine.
- 2) Stop the engine, wait for 5 minutes, then start measuring.
- 3) Measure the amount the boom and bucket cylinder rods retract during 15 minutes.



A : Retraction of boom cylinder rod

B : Retraction of bucket cylinder rod

7577AWE31



## 9. BOOM AND BUCKET CYLINDER LEAKAGE TEST

### · SPECIFICATION

Oil temperature      $45 \pm 5^{\circ}\text{C}$  ( $113 \pm 9^{\circ}\text{F}$ )  
Engine speed        Low idle  
Maximum leakage    15 ml/min (1/2 oz/min)

### · GAUGE AND TOOL

Temperature reader  
Stop watch  
Measuring container

1) Fasten temperature sensor to head end port of cylinder to be tested. Cover sensor with a shop towel.

2) Heat hydraulic oil to specifications (see hydraulic oil warm up procedure in this group).

**⚠ Never work under raised equipment unless it is supported with a hoist or support stands.**

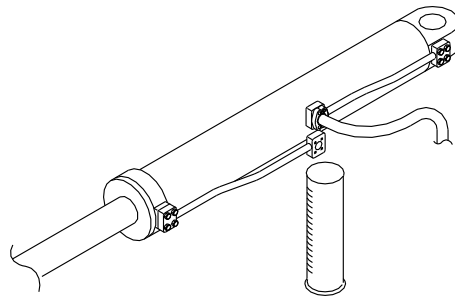
3) Full extend the cylinder to be tested. If testing the boom cylinders, restrain boom in the fully raised position using a hoist or a stand.

※ Check cylinders for leakage in the fully extended position only. In the retracted position contacts the end of the cylinder and seals off piston seal leakage.

4) Remove and plug cylinder rod end hose or line.

5) Run engine at slow idle. Activate control lever to extend cylinder for 1 minute over relief while measuring leakage for open port.

If leakage is within specification, excessive cylinder drift is caused by leakage in the loader control valve or circuit relief valve.



(770-3ATM) 6-56

## 10. CYCLE TIME TEST

### SPECIFICATION

Oil temperature —  $45 \pm 5^{\circ}\text{C}$  ( $113 \pm 9^{\circ}\text{F}$ )

Engine speed — High idle

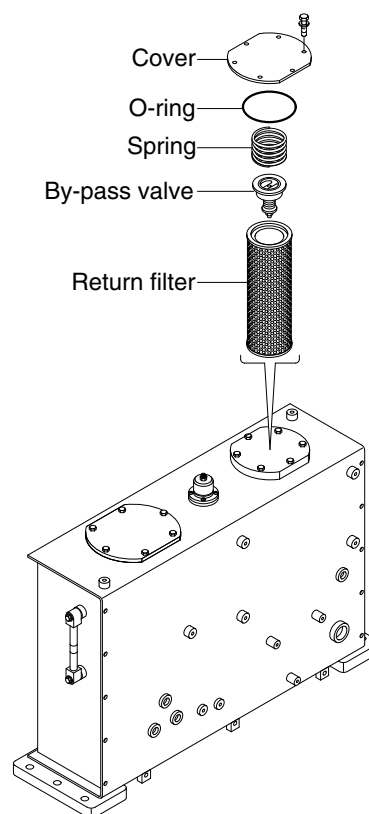
Function	Operating conditions	Maximum cycle time (seconds)
Boom raise	Bucket flat on ground to full height	5.5
Boom lower (float)	Full height to ground level	3.7
Bucket dump	Boom at full height	1.8
Bucket rollback	Boom at full height	2.2
Steering (No. of turns)	Frame stop to stop	3.9 turns

## 11. HYDRAULIC OIL FILTER INSPECTION PROCEDURE

- 1) Lower the bucket to the ground, stop the engine, move the control lever back and forth several times, and clean all over the upper surface of the hydraulic oil tank.
- 2) Remove the bolts and take out the filter case cover and O-ring.
- 3) Remove the spring and bypass valve.
- 4) Remove the filter element from the tank.
- 5) Check the element and the filter case bottom for debris. Excessive amounts of brass and steel particles can indicate a failed hydraulic pump or a pump failure in process. A rubber type of material can indicate cylinder packing or other packing failure.

※ The hydraulic oil filter in the filter case of the hydraulic oil tank should be replaced every 1000 operating hours or more often. When the filter element is replaced, please keep as follows.

- (1) Clean the inside of the filter case.
- (2) Place new element in the proper positions inside the filter case.
- (3) Install the bypass valve and spring. Make sure the element stand upright, and check for complete contact of the element bottom with the filter case bottom.
- (4) Install the O-ring and filter case covers. Tighten them with bolt. Replace the O-ring with new one if damaged.



960A6WE24

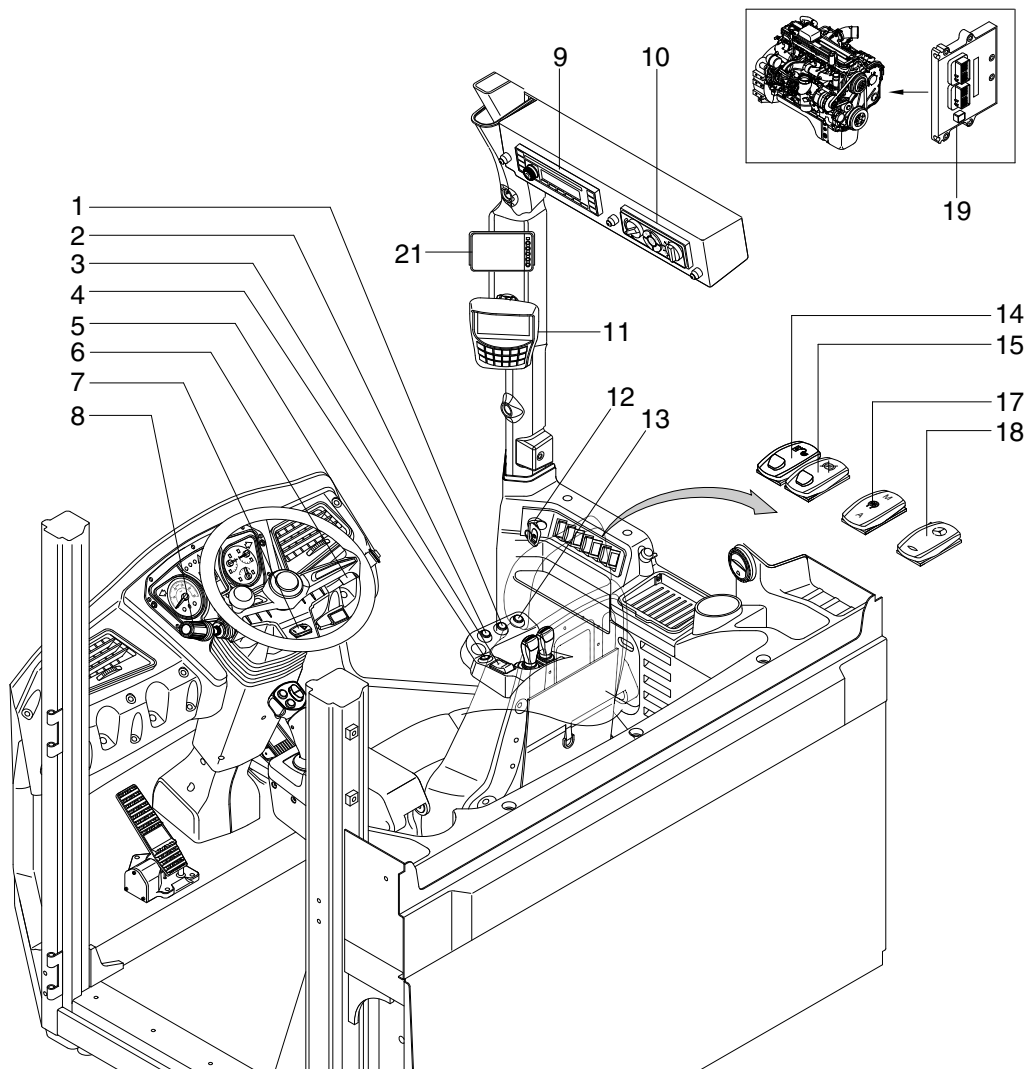
## SECTION 7 ELECTRICAL SYSTEM

Group 1 Component Location .....	7-1
Group 2 Electrical Circuit .....	7-3
Group 3 Electrical Component Specification .....	7-22
Group 4 Connectors .....	7-29
Group 5 Troubleshooting .....	7-52

# SECTION 7 ELECTRICAL SYSTEM

## GROUP 1 COMPONENT LOCATION

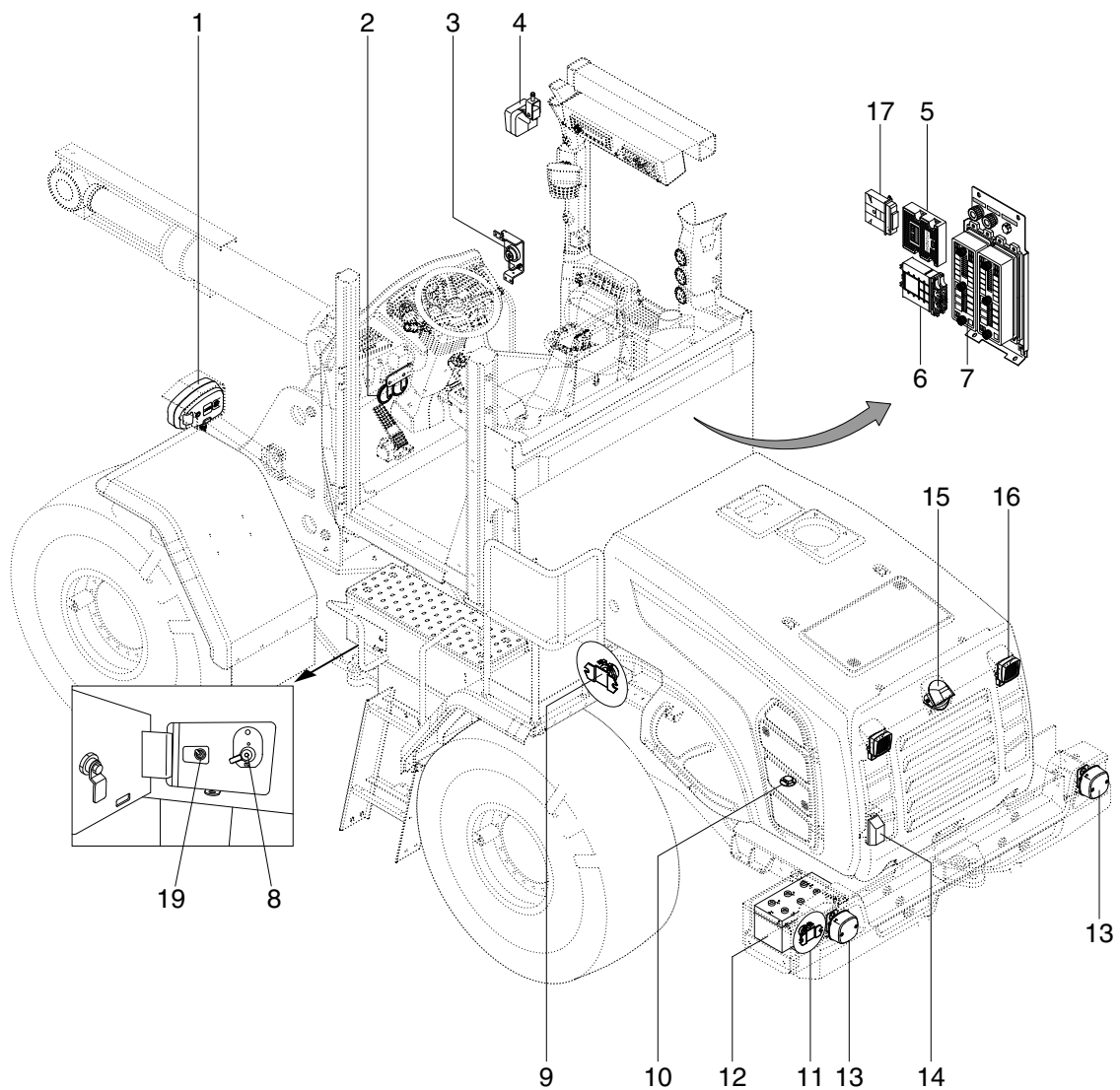
### 1. LOCATION 1



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- |                         |                           |                                   |
|-------------------------|---------------------------|-----------------------------------|
| 1 Kick down button      | 8 Gear select lever       | 14 Pilot cut off switch           |
| 2 Horn button           | 9 Radio & USB player      | 15 Parking brake switch           |
| 3 FNR switch            | 10 Aircon & heater switch | 17 Differential lock switch (opt) |
| 4 FNR select button     | 11 Monitor                | 18 Emergency test switch          |
| 5 Hone button           | 12 Starting switch        | 19 Engine control unit (ECU)      |
| 6 Multi function switch | Starting button (opt)     | 21 Camera monitor                 |
| 7 Hazard switch         | 13 Work load button       |                                   |

## 2. LOCATION 2

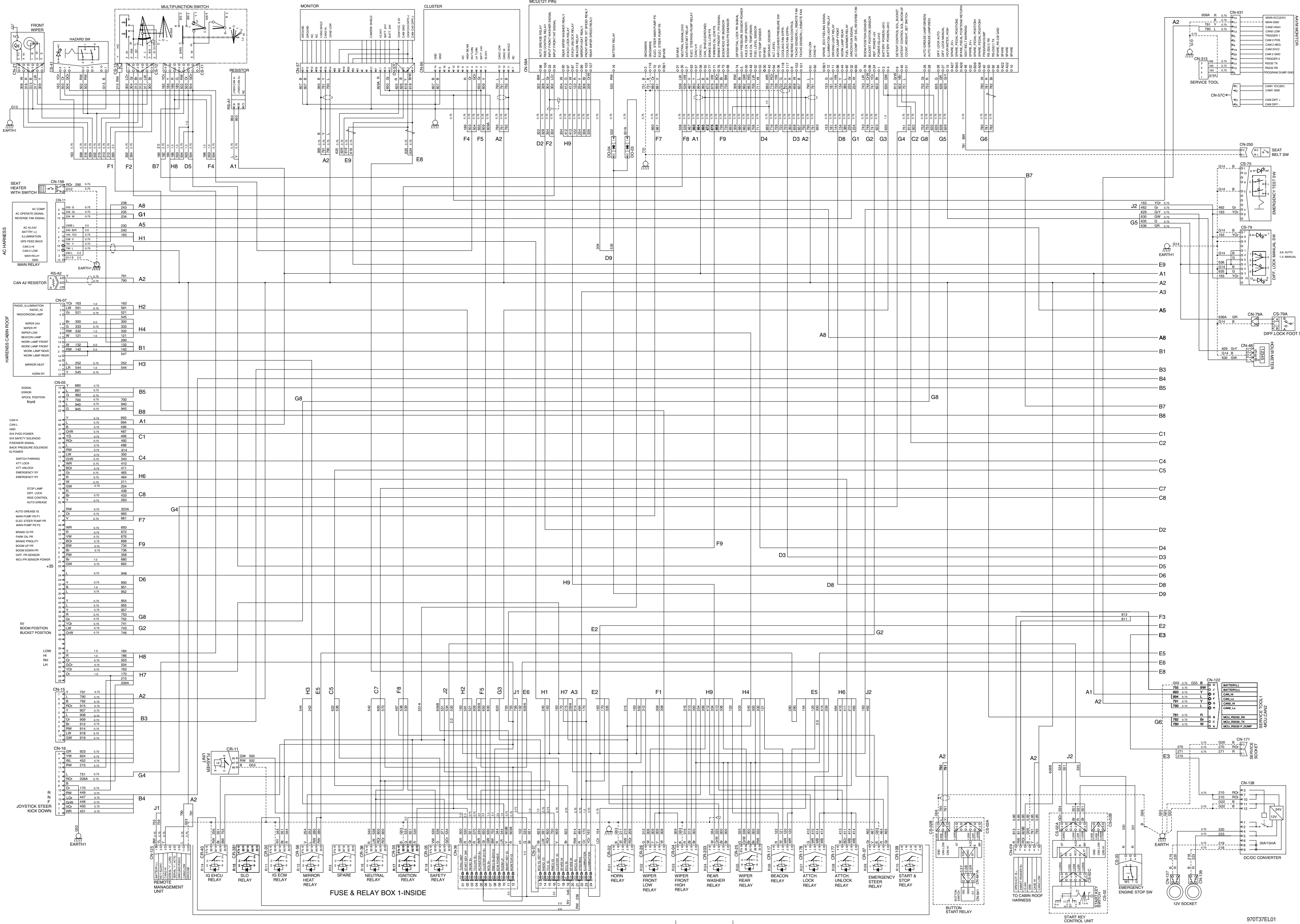


960A7EL21

- |                                   |                      |   |
|-----------------------------------|----------------------|---|
| 1 Head lamp                       | 8 Master switch      | 15 Camera (opt)   |
| 2 Horn                            | 9 Start relay        | 16 Work lamp  |
| 3 Angle sensor                    | 10 Fuel sender       | 17 Control unit (electro hydraulic & joystick steering) |
| 4 Work lamp                       | 11 Battery relay     | 19 Engine hood open switch                              |
| 5 Machine control unit (MCU)      | 12 Battery           |   |
| 6 Transmission control unit (TCU) | 13 Rear combi lamp   |   |
| 7 Fuse and relay box              | 14 Number plate lamp |   |

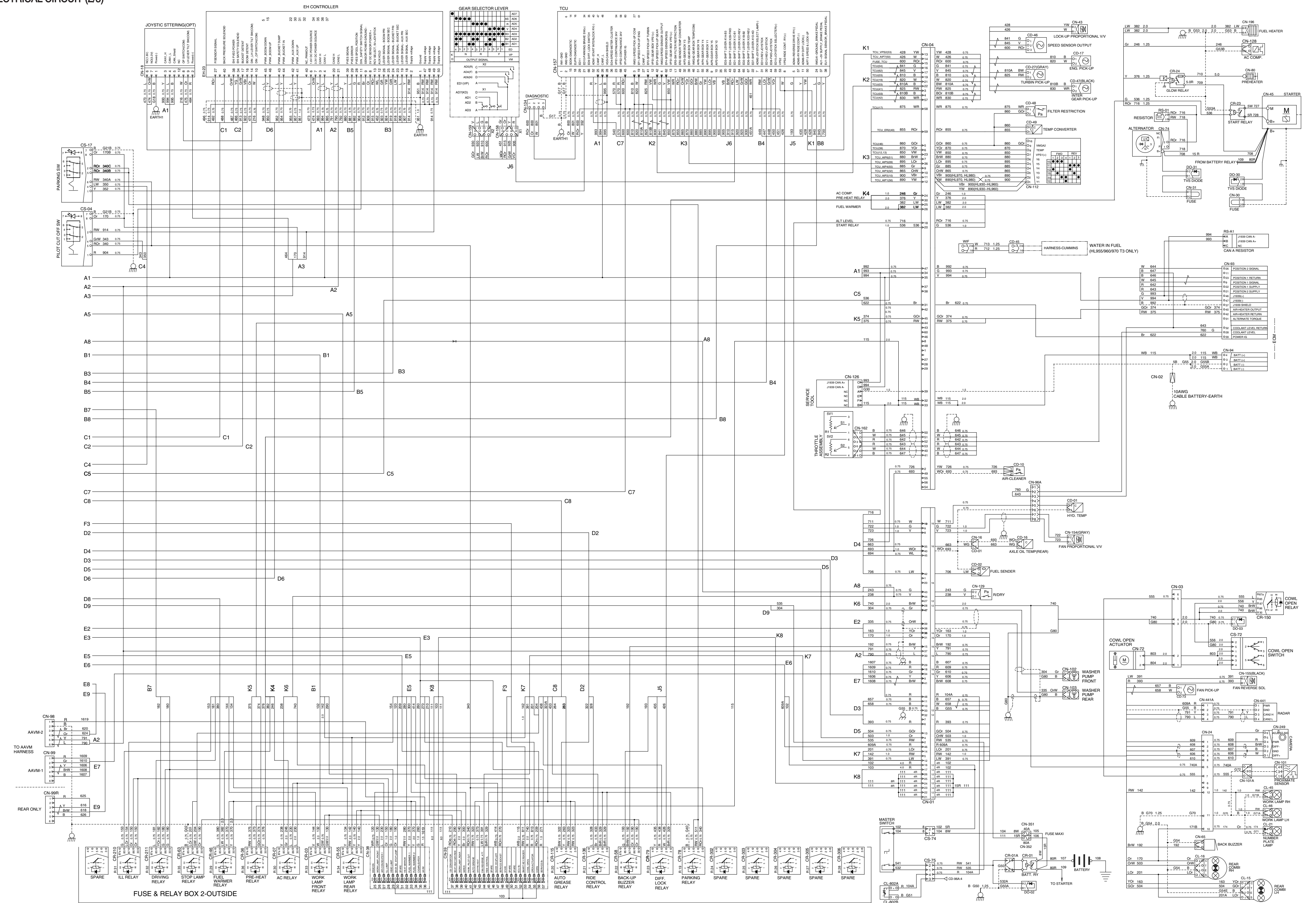
GROUP 2 ELECTRICAL CIRCUIT

- ELECTRICAL CIRCUIT (1/3)



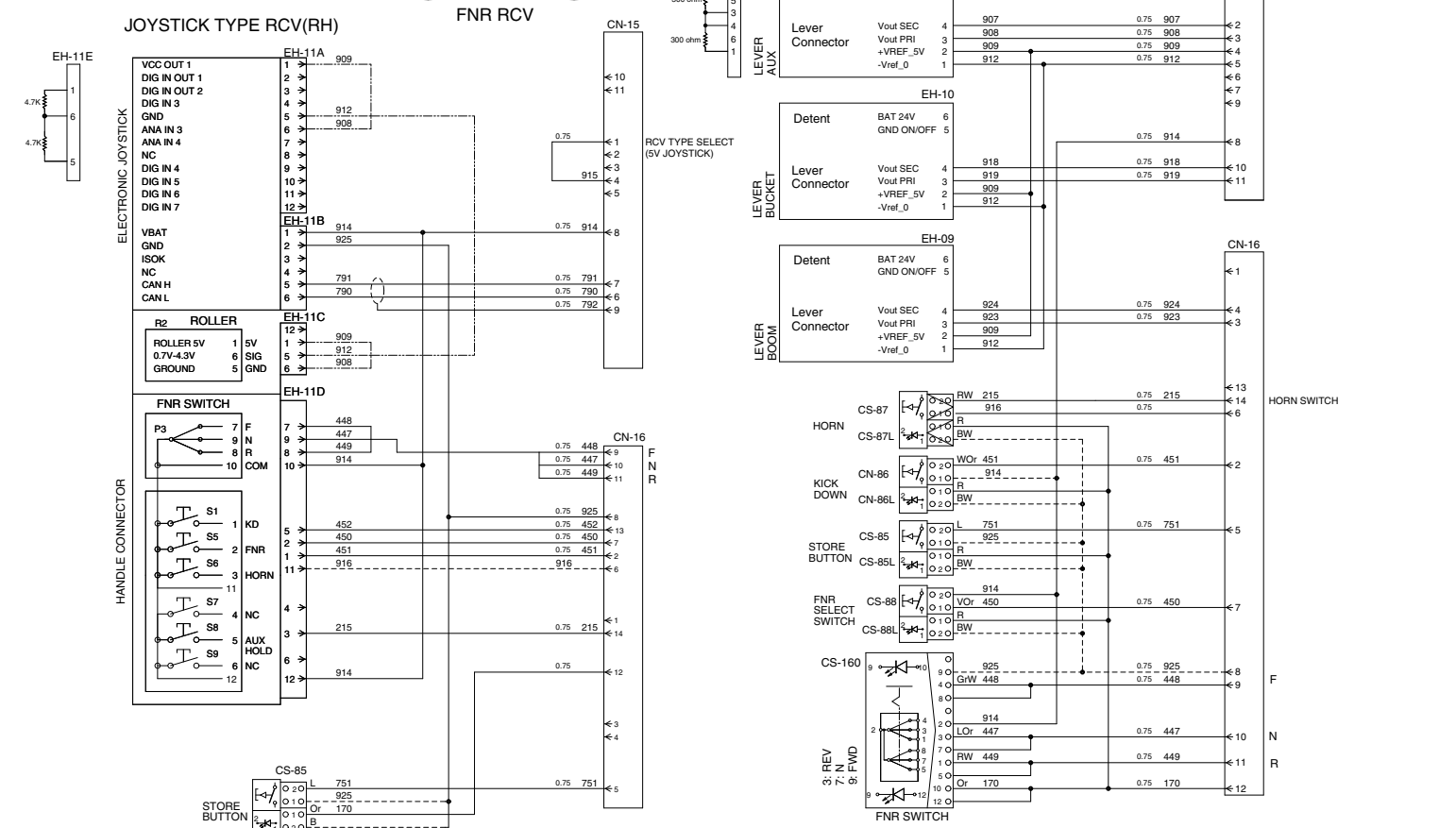
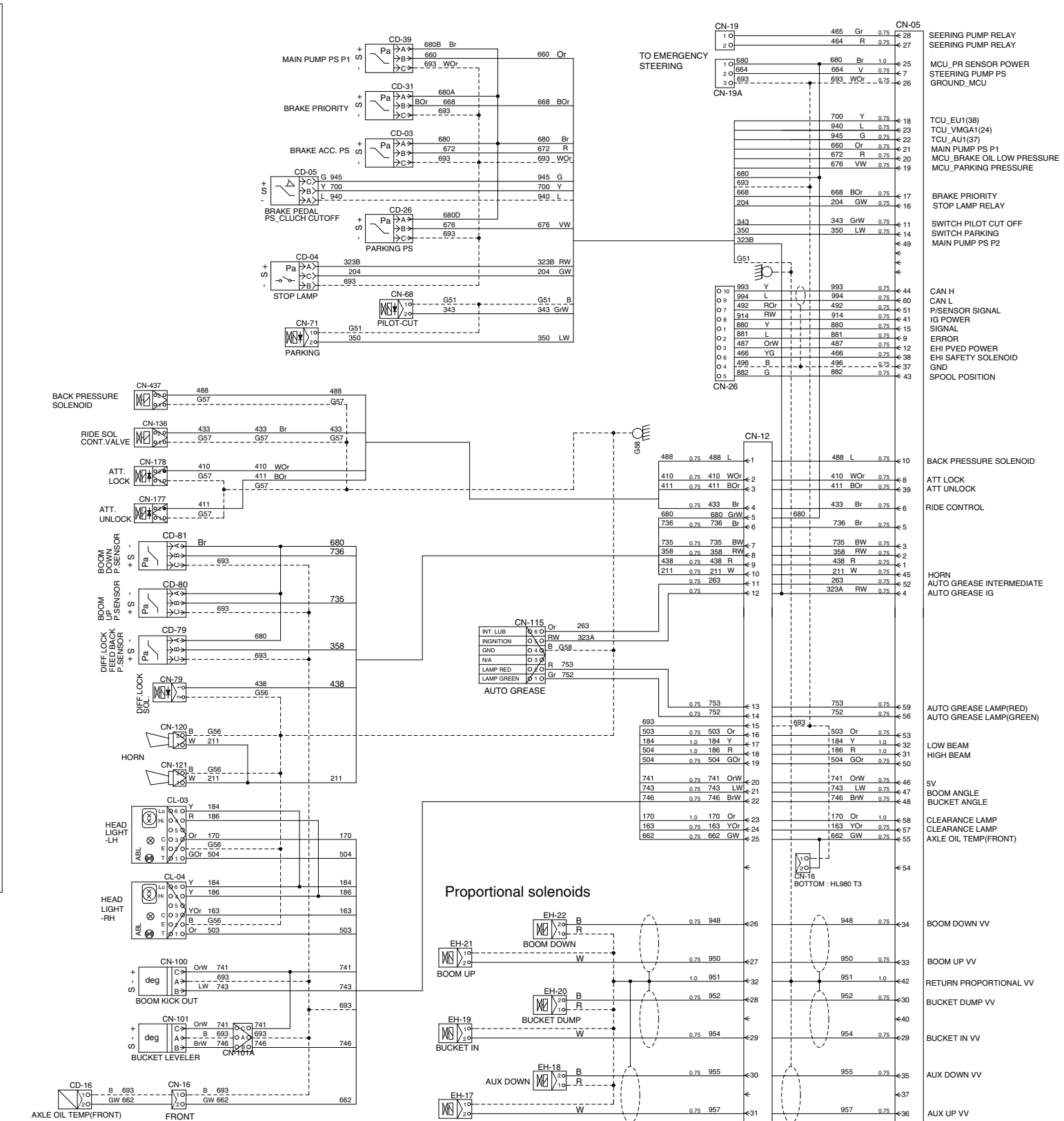
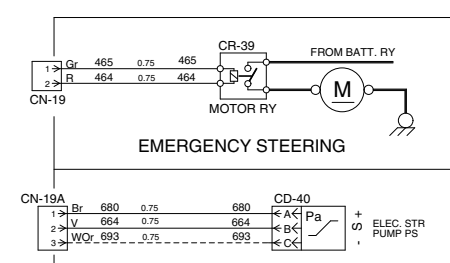
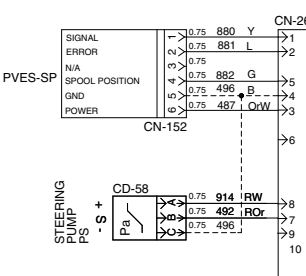
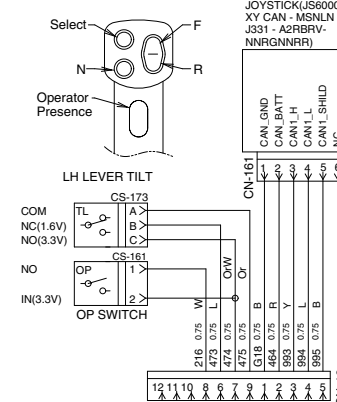
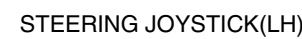
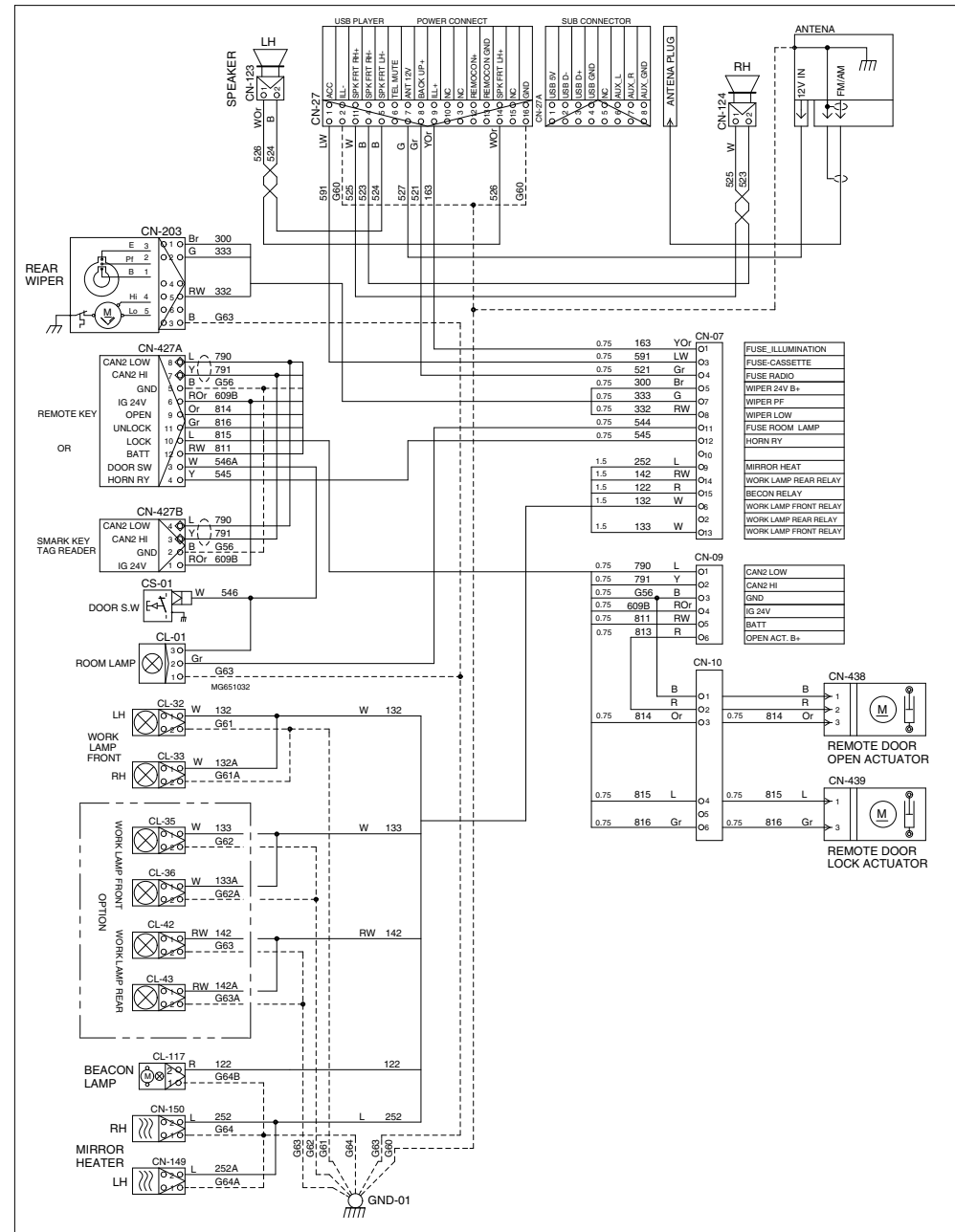
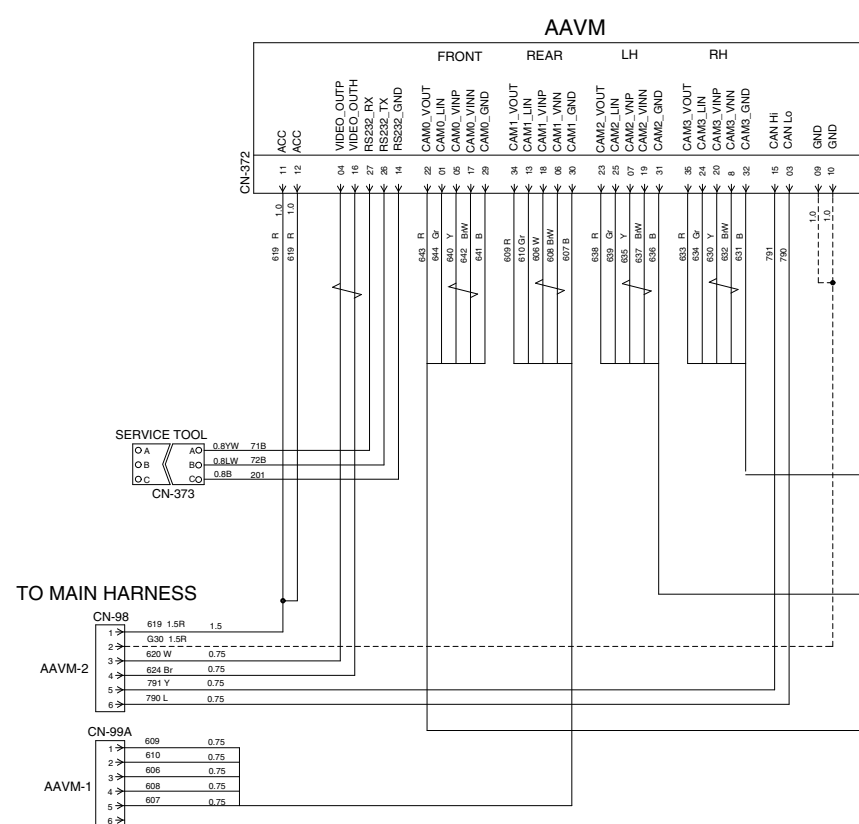
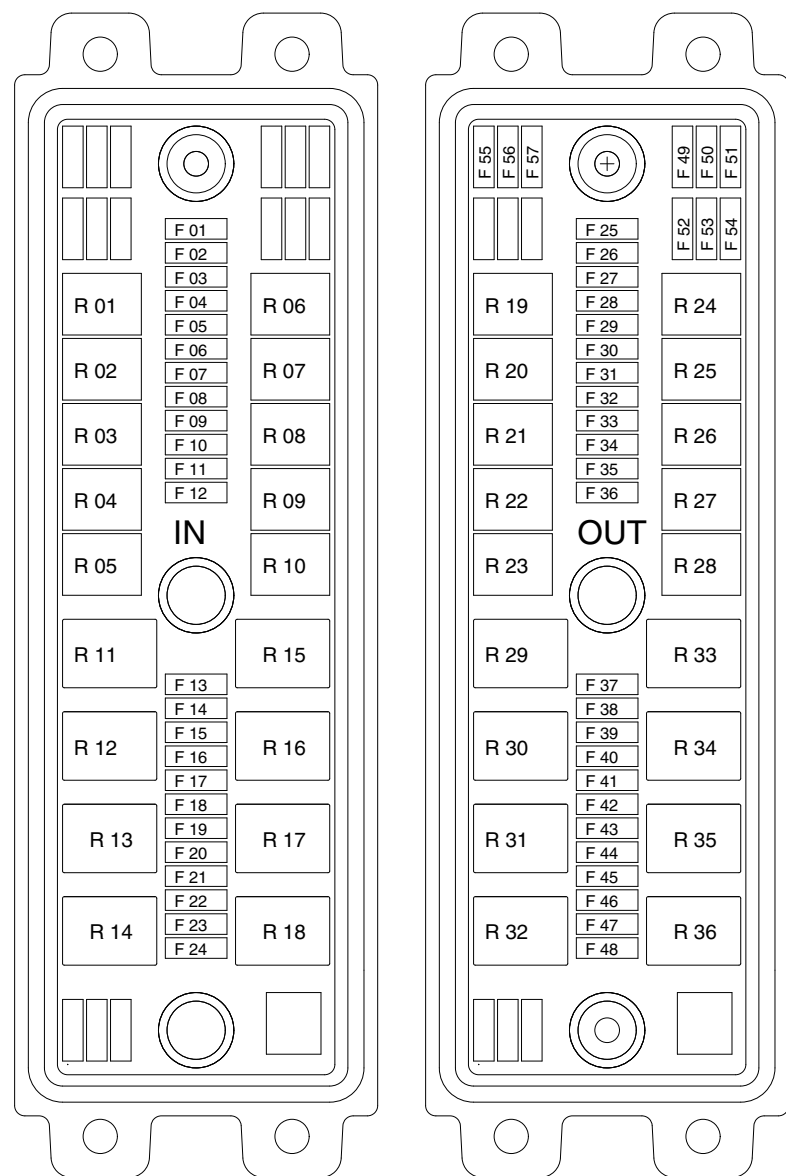
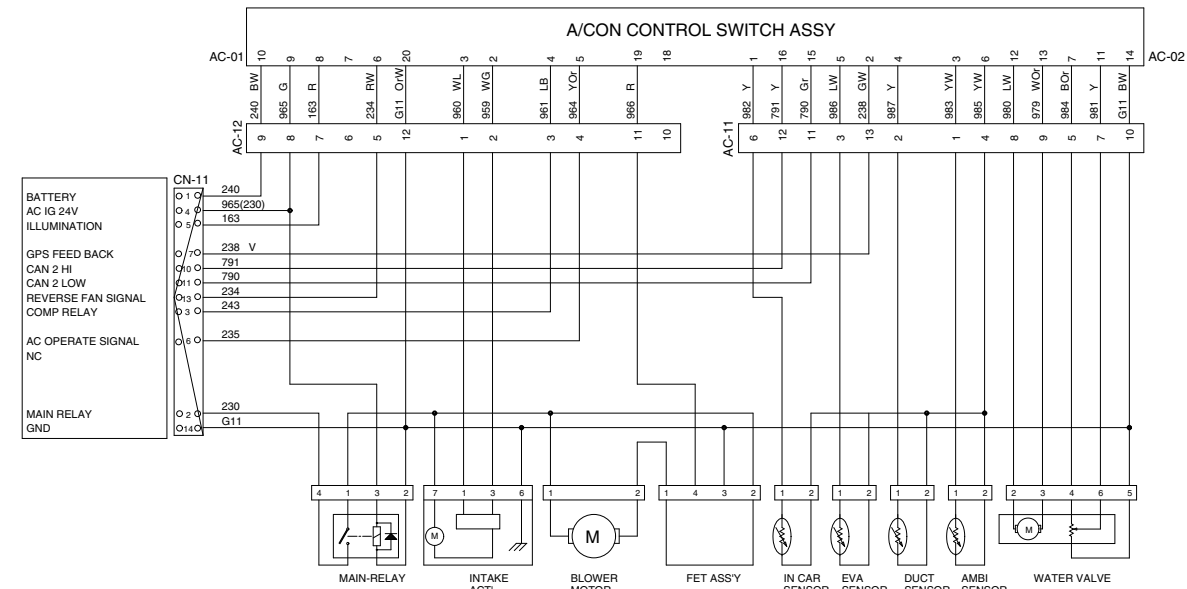


• ELECTRICAL CIRCUIT (2/3)





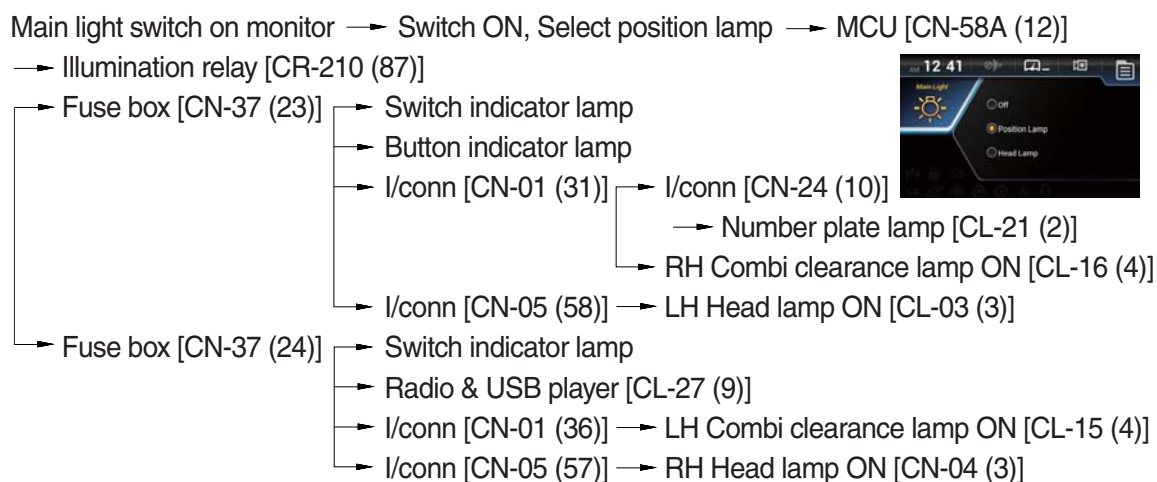
### • ELECTRICAL CIRCUIT (3/3)



## MEMORANDUM

## 1. ILLUMINATION CIRCUIT

### 1) OPERATING FLOW



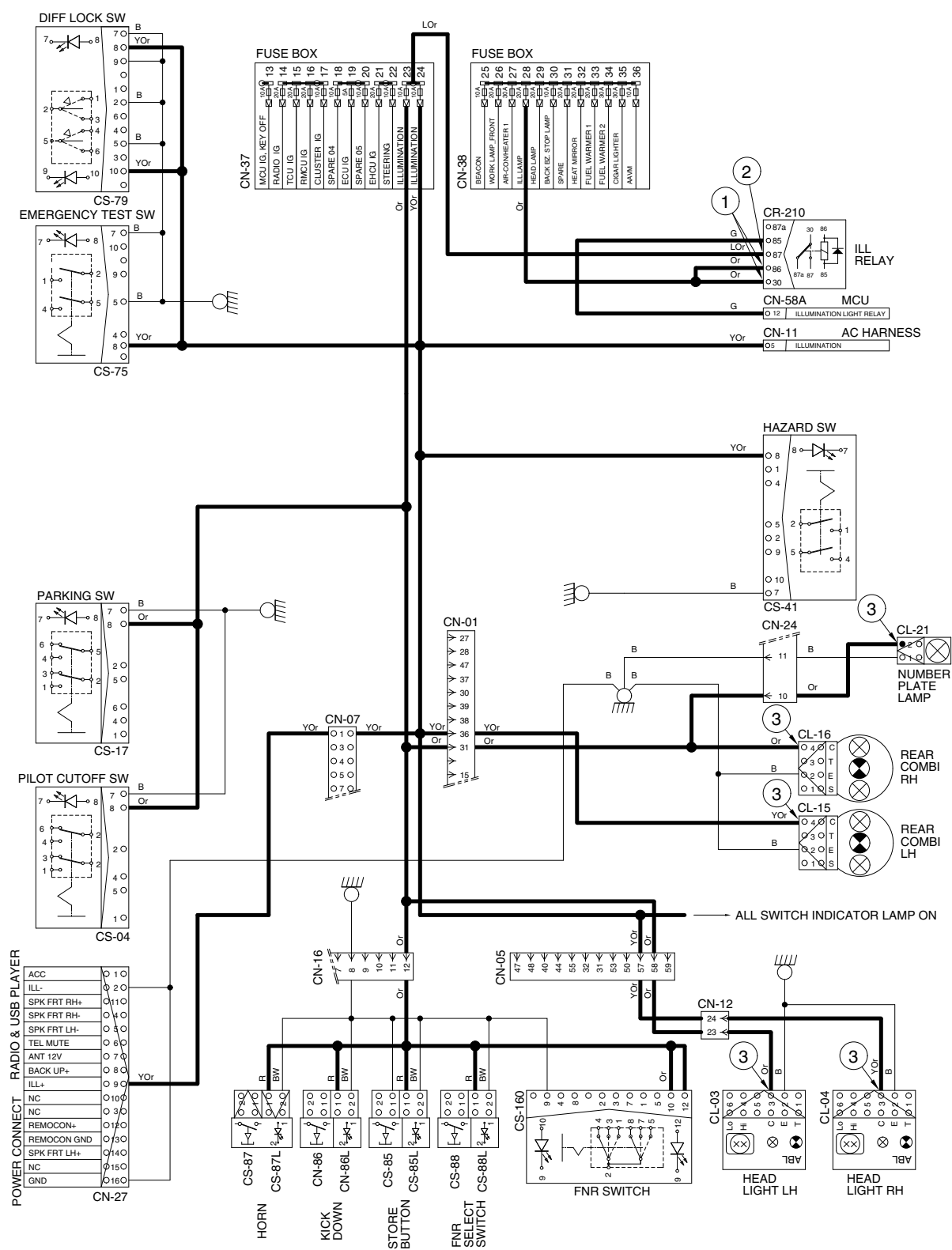
### 2) CHECK POINT

Engine	Key switch	Check point	Voltage
OFF	ON	① - GND (relay input) ② - GND (relay output) ③ - GND (to light)	20~25V

※ GND : Ground

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

# ILLUMINATION CIRCUIT

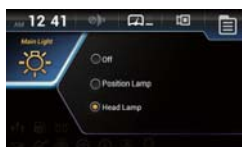
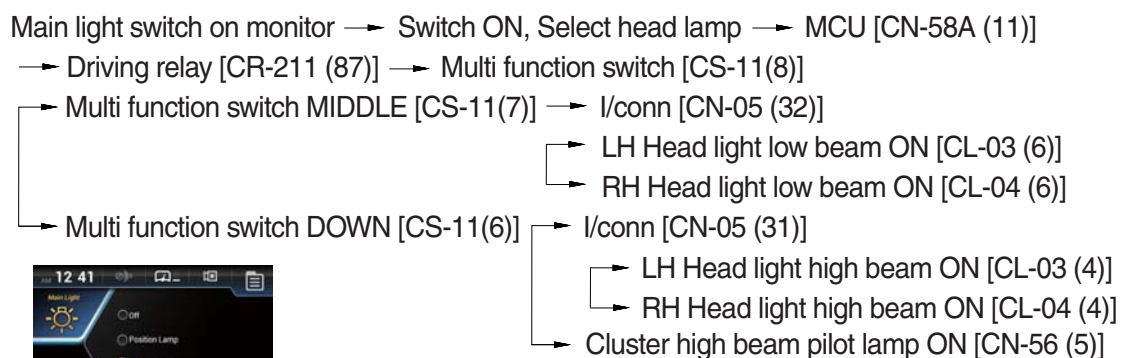


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※ The circuit diagram may differ from the equipment, so please check before a repair.

## 2. HEAD LIGHT CIRCUIT

### 1) OPERATING FLOW



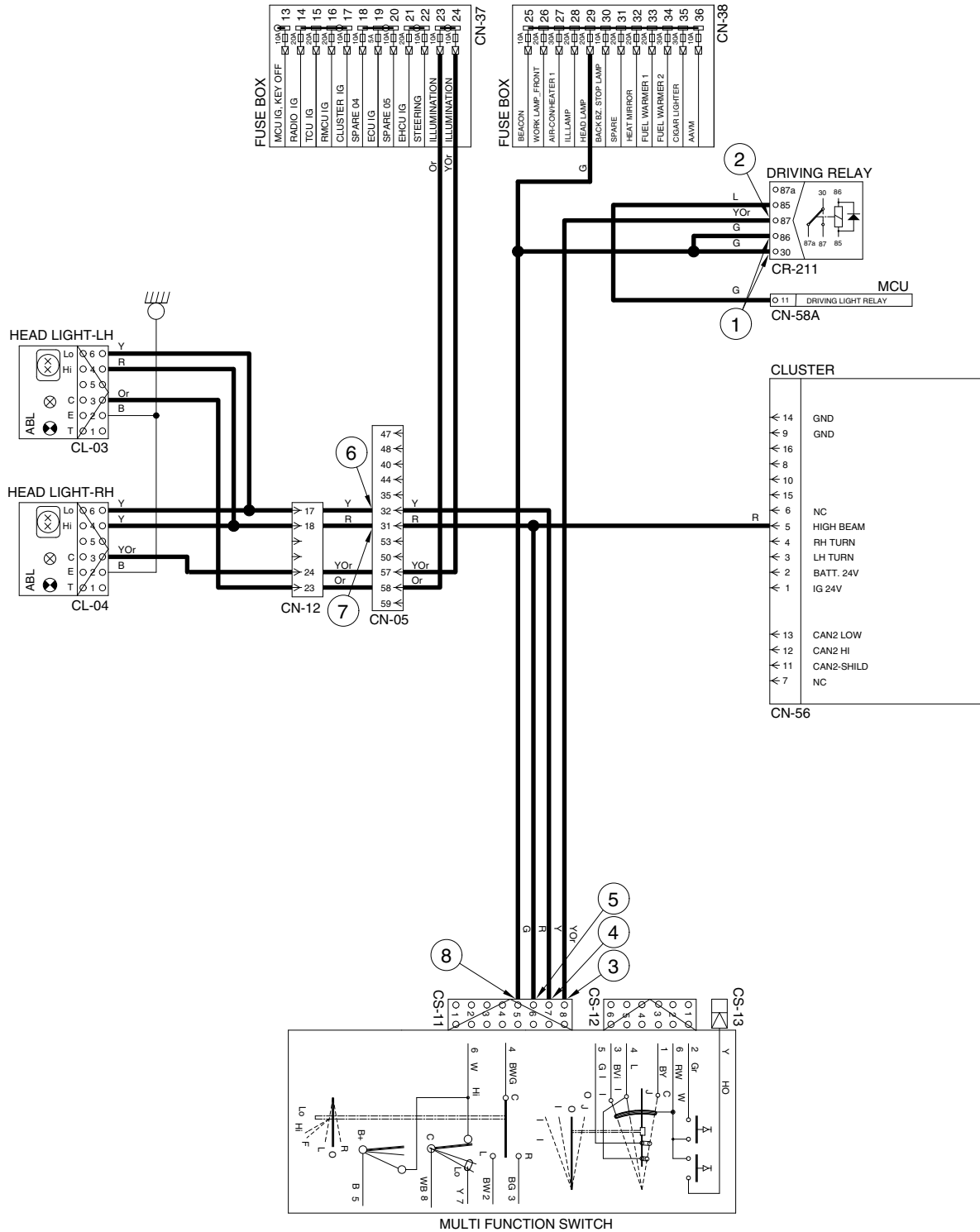
### 2) CHECK POINT

Engine	Key switch	Check point	Voltage
OFF	ON	① - GND (relay input) ② - GND (relay output) ③ - GND (multi function input) ④ - GND (multi function output) ⑤ - GND (multi function output) ⑥ - GND (low beam) ⑦ - GND (high beam) ⑧ - GND (passing B <sup>+</sup> )	20~25V

※ GND : Ground

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

## HEAD LIGHT CIRCUIT



970SA7EL05

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

### 3. WORK LIGHT SWITCH

#### 1) OPERATING FLOW

※ Main light switch on monitor : Select position lamp.

##### (1) Work lamp switch (select Front)

MCU [CN-58A (88)] → Front work lamp relay [CR-03 (87)] → I/conn [CN-07 (06)]

- LH Front work lamp ON [CL-32 (1)]
- RH Front work lamp ON [CL-33 (1)]



##### (2) Work lamp switch (select Rear)

MCU [CN-58A (44)] → Rear work lamp relay [CR-55 (87)] → I/conn [CN-01 (05)]

- I/conn [CN-24 (12)]
  - LH Rear work lamp ON [CL-46 (1)]
  - RH Rear work lamp ON [CL-45 (1)]



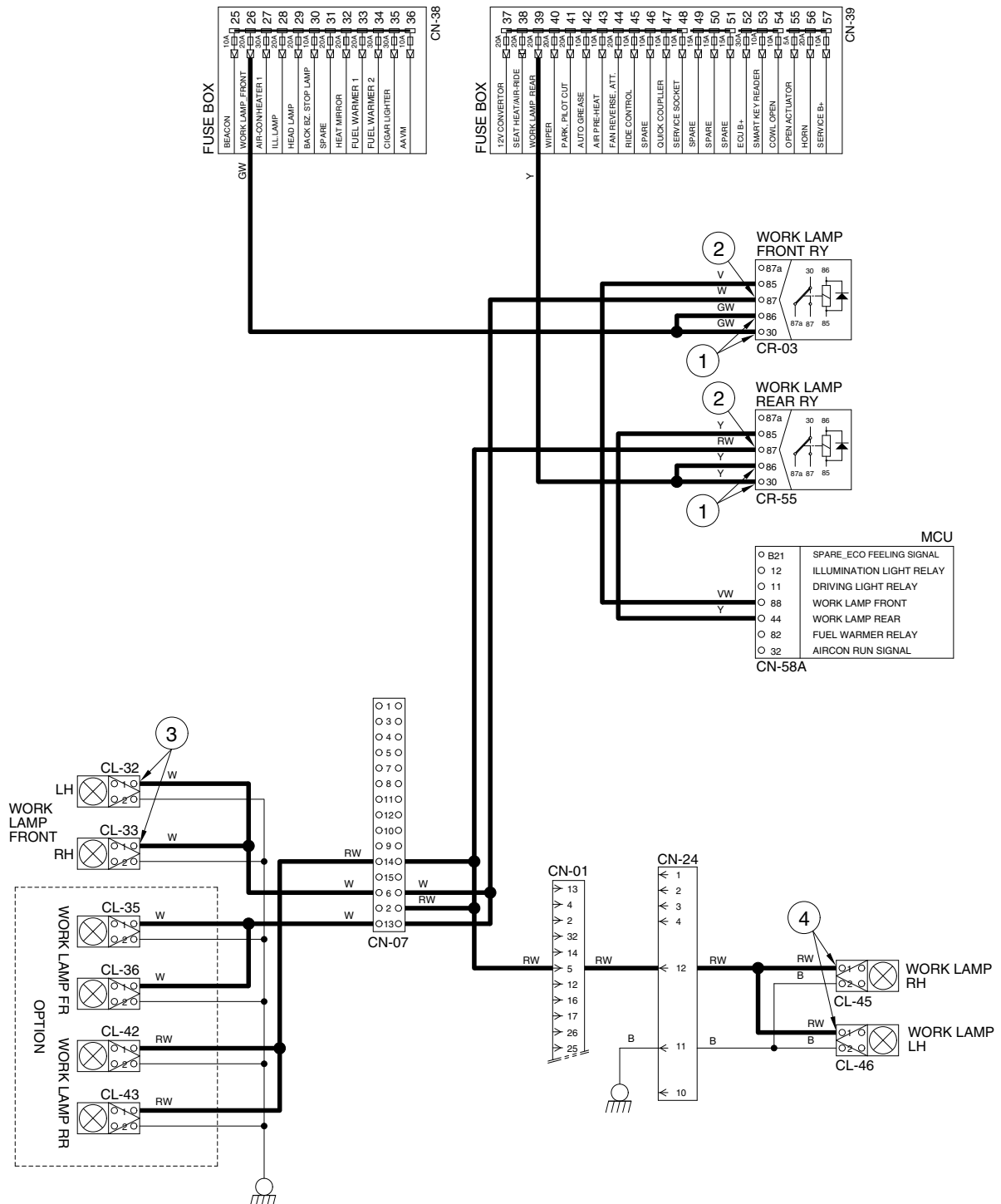
#### 2) CHECK POINT

Engine	Key switch	Check point	Voltage
OFF	ON	① - GND (work lamp power input) ② - GND (work lamp power output) ③ - GND (front work lamp) ④ - GND (rear work lamp)	20~25V

※ GND : Ground

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

# WORK LIGHT SWITCH



970SA7EL06

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



## 1) OPERATING FLOW

Battery(+) terminal → Fusible link [CN-351 (40A)] → Master switch [CS-74 (1) → (2)]  
 → I/conn [CN-01 (16, 17)] → Fuse box [CN-36] → Start switch [CS-02 (1)]  
 → ECM power relay [CR-30 (30)]  
 → Power relay [CR-35 (30)]

The gear selector has an output signal which is activated whenever the shift lever is in the neutral position. This signal can be used to control a relay and prevent engine from starting whenever the shift lever is not in the neutral position.

```

graph LR
    Start[Start switch ON [CS-02 (2, 3)]] --> IConn1[I/conn [CN-01(2)]]
    IConn1 --> Master[Master switch [CS-75 (1) → (2)]]
    IConn1 --> BatRel[Battery relay [CR-1]]
    BatRel --> BatRelOp[Battery relay operating (All power is supplied with the electric component)]
    Start --> ECMRel[ECM power relay [CR-30 (30) → (87)]]
    ECMRel --> FuseBox1[Fuse box [CN-37 (19)]]
    FuseBox1 --> IConn2[I/conn [CN-04 (31)]]
    IConn2 --> ECM[ECM [CN-93 (39)]]
    Start --> FuseBox2[Fuse box [CN-37 (13)]]
    FuseBox2 --> MCU[MCU [CN-58A (1)]]
    Start --> PowerRel[Power relay [CR-35 (30) → (87)]]
    PowerRel --> FuseBox3[Fuse box [CN-37 (15)]]
    FuseBox3 --> TCU[TCU [CN-157 (45)]]

```

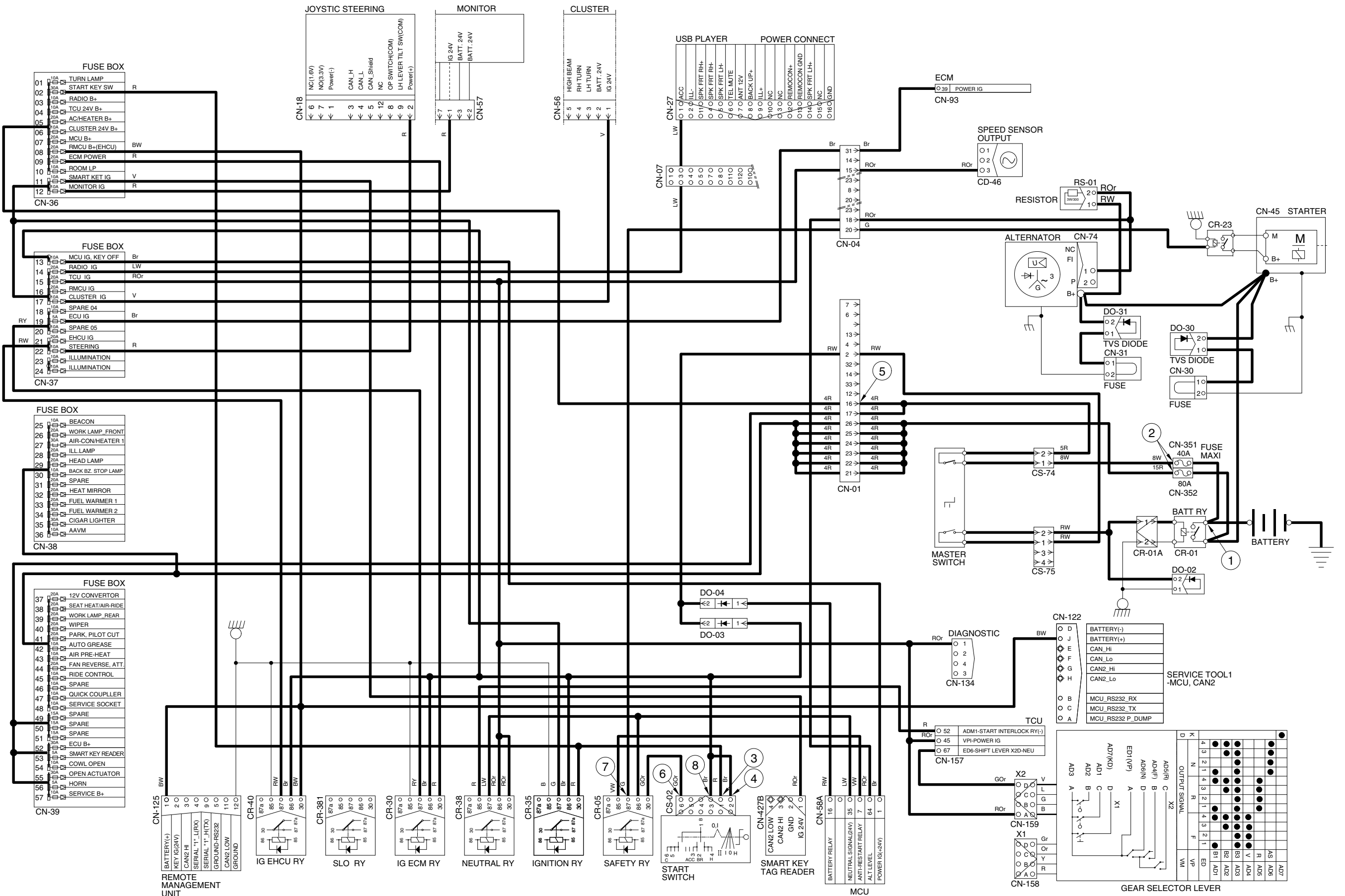
Start switch START [CS-2 (6)] → Start safety relay [CR-05 (30) → (87)] → I/conn [CN-04 (20)] → Start relay [CR-23] → Starter (terminal B<sup>+</sup> and M connector of start motor)

Engine	Key switch	Check point	Voltage
Running	ON	① - GND (battery B <sup>+</sup> ) ② - GND (fusible link) ③ - GND (start key B terminal) ④ - GND (start key BR terminal) ⑤ - GND (i/conn CN-01 (16)) ⑥ - GND (start key C terminal) ⑦ - GND (start safety relay output) ⑧ - GND (start key ACC terminal)	20~25 V

※ TCU : Transmission control unit

7-13

# STARTING CIRCUIT



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

## 5. CHARGING CIRCUIT

When the starter is activated and the engine is started, the operator releases the key switch to the ON position.

Charging current generated by operating alternator flows into the battery through the battery relay (CR-01).

The current also flows from alternator to each electrical component and controller through the fuse box.

### 1) OPERATING FLOW

#### (1) Warning flow

Alternator [CN-74 (1)] → I/conn [CN-04 (18)] → MCU [CN-58A (64)]

→ Cluster charge warning lamp ON

#### (2) Charging flow

Alternator → Starter [CN-45 (B<sup>+</sup>)] → Battery relay [CR-01]

→ Battery (+) terminal → Charging

→ Fusible link [CN-351 (40A)] → Master switch [CS-74 (1)→(2)] → I/conn [CN-01 (16, 17)]

→ Fuse box [CN-36, 39]

→ Fusible link [CN-352 (80A)] → I/conn [CN-01 (21~26)] → Fuse box [CN-38, 39]

### 2) CHECK POINT

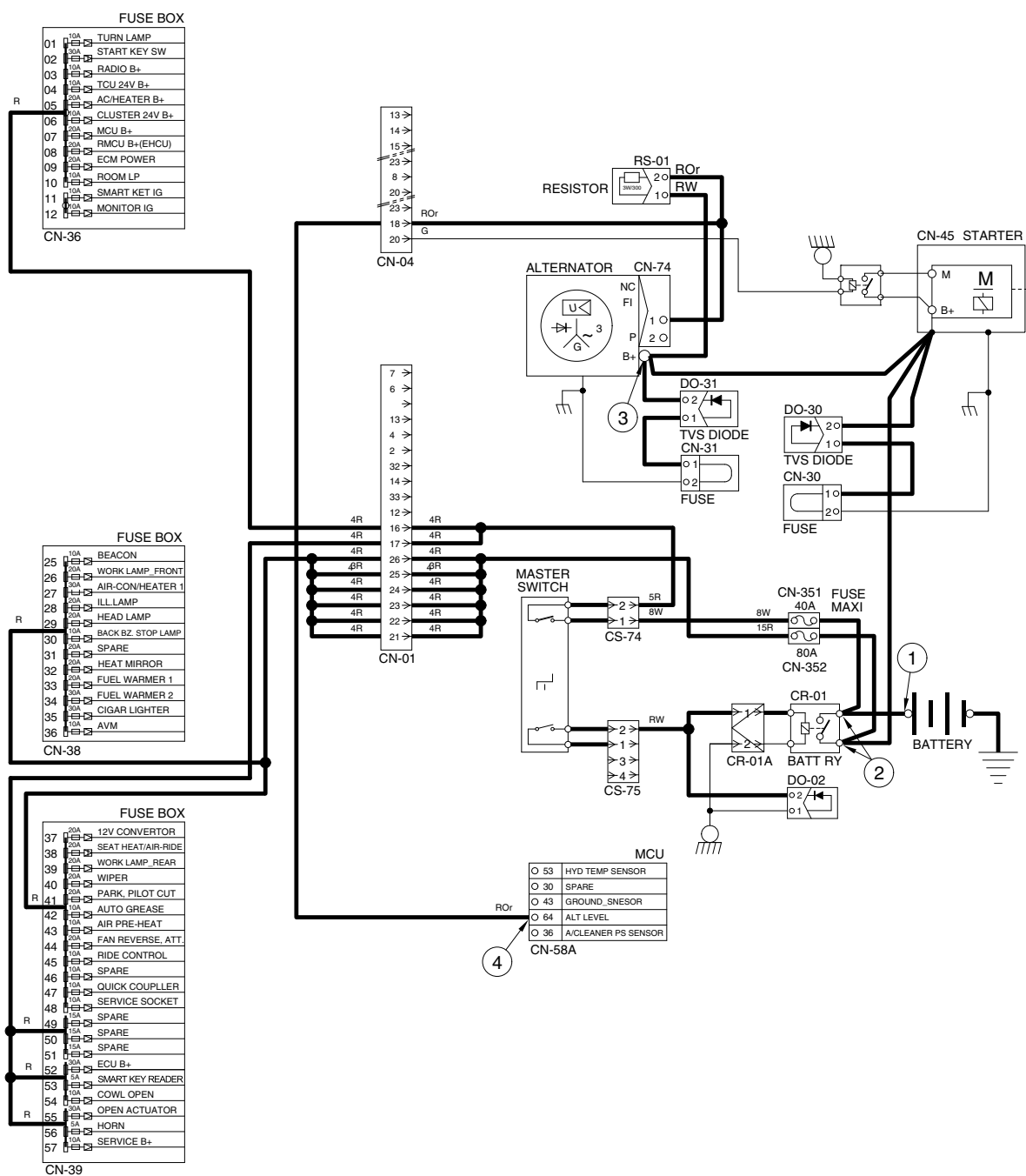
Engine	Key switch	Check point	Voltage
OFF	ON	① - GND (battery) ② - GND (battery relay) ③ - GND (alternator B <sup>+</sup> ) ④ - GND (MCU)	20~28V

※ GND : Ground

※ MCU : Machine control unit

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

# CHARGING CIRCUIT



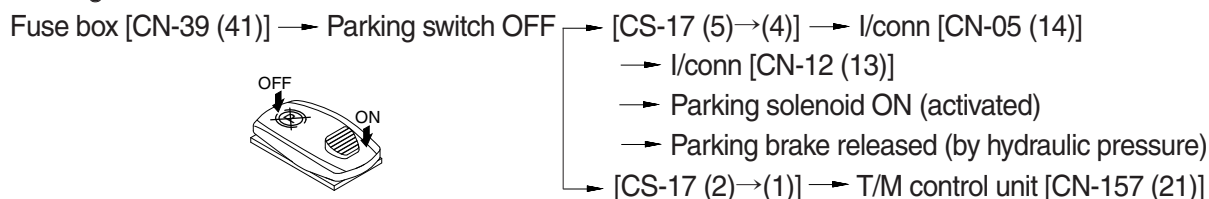
970SA7EL08

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

## 6. ELECTRIC PARKING, PILOT CUT OFF CIRCUIT

### 1) OPERATING FLOW

#### (1) Parking OFF



#### (2) Parking ON

Fuse box [CN-39 (41)] → Parking switch ON → Parking solenoid [CN-71] OFF  
 → Parking brake applied [By spring force]

#### (3) Pilot cut off ON

Fuse box [CN-39 (41)] → Pilot cut off switch ON → Pilot cut off switch [CS-4 (5) → (4)]  
 → I/conn [CN-05 (11)] → I/conn [CN-12 (12)] → Pilot cut off solenoid ON [CN-68] (activate)  
 → Pilot cut off released

#### (4) Pilot cut off OFF

Fuse box [CN-39 (41)] → Pilot cut off switch OFF → Pilot cut off solenoid [CN-68] OFF  
 → Pilot cut off applied

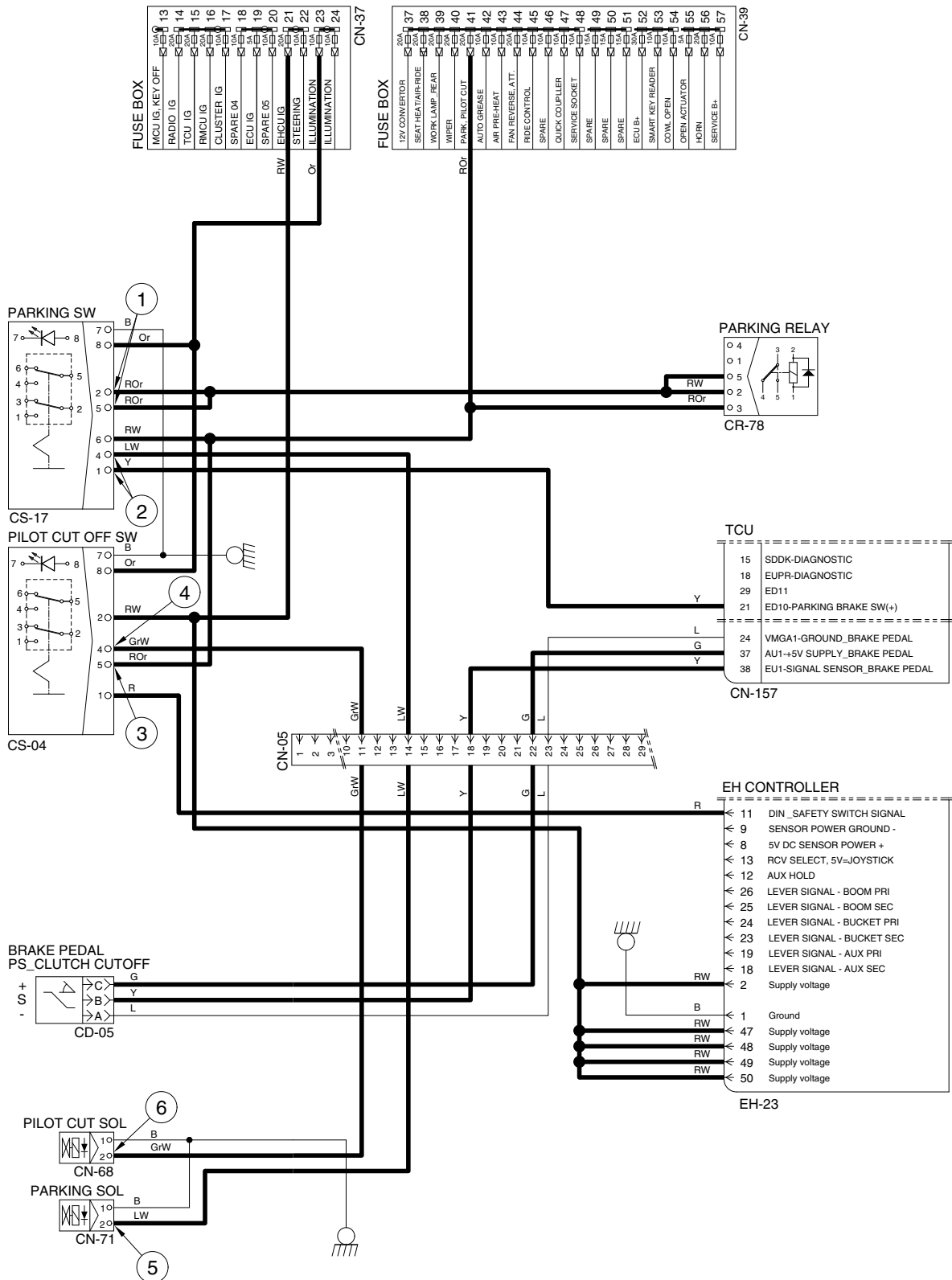
### 2) CHECK POINT

Engine	Key switch	Check point	Voltage
Running	ON	① - GND (parking switch input) ② - GND (parking switch output) ③ - GND (pilot cut off switch input) ④ - GND (pilot cut off switch output) ⑤ - GND (parking solenoid) ⑥ - GND (pilot cut off solenoid)	20~25V

※ GND : Ground

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

# ELECTRIC PARKING, PILOT CUT OFF CIRCUIT

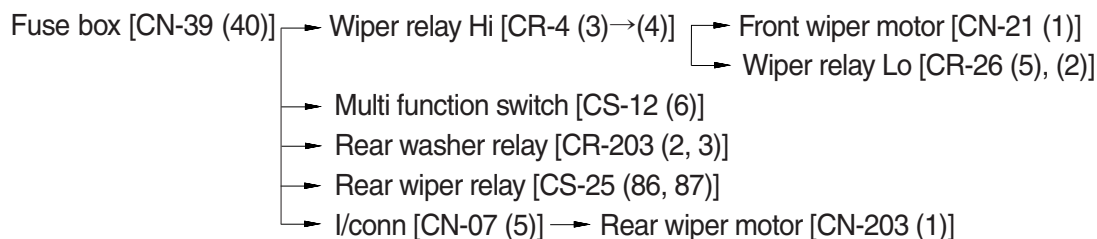


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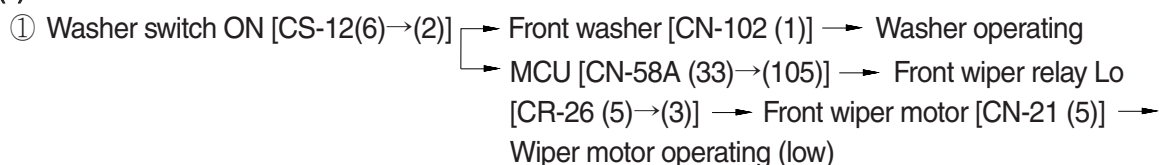
※ The circuit diagram may differ from the equipment, so please check before a repair.

## 7. WIPER AND WASHER CIRCUIT

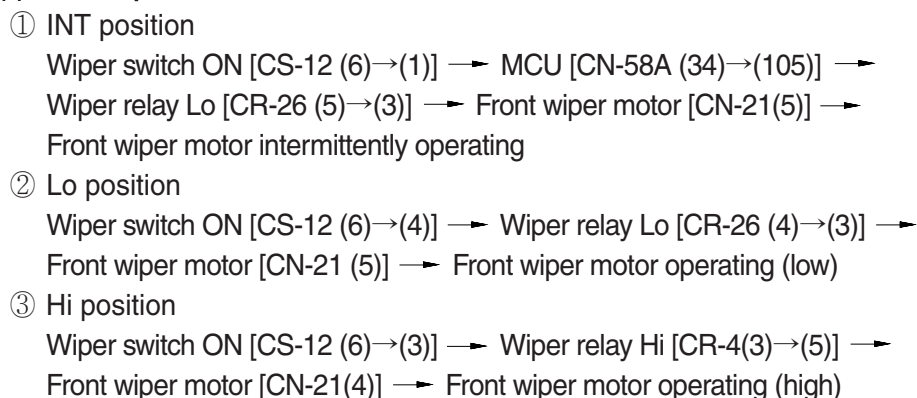
### 1) OPERATING FLOW



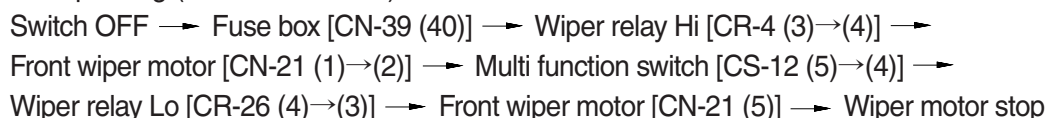
#### (1) Front washer switch ON



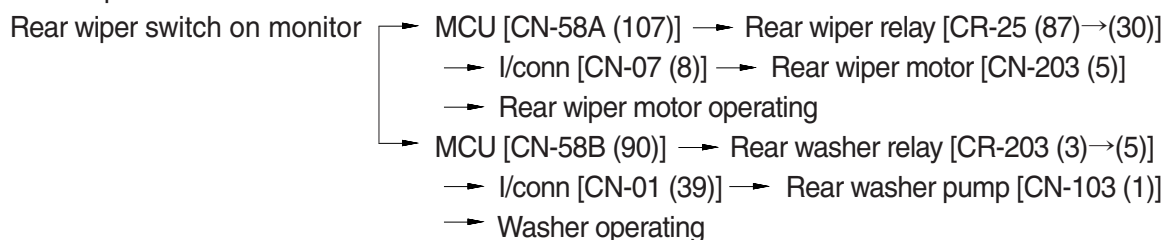
#### (2) Front wiper switch ON



#### (3) Auto-parking (when switch OFF)



#### (4) Rear wiper and washer switch



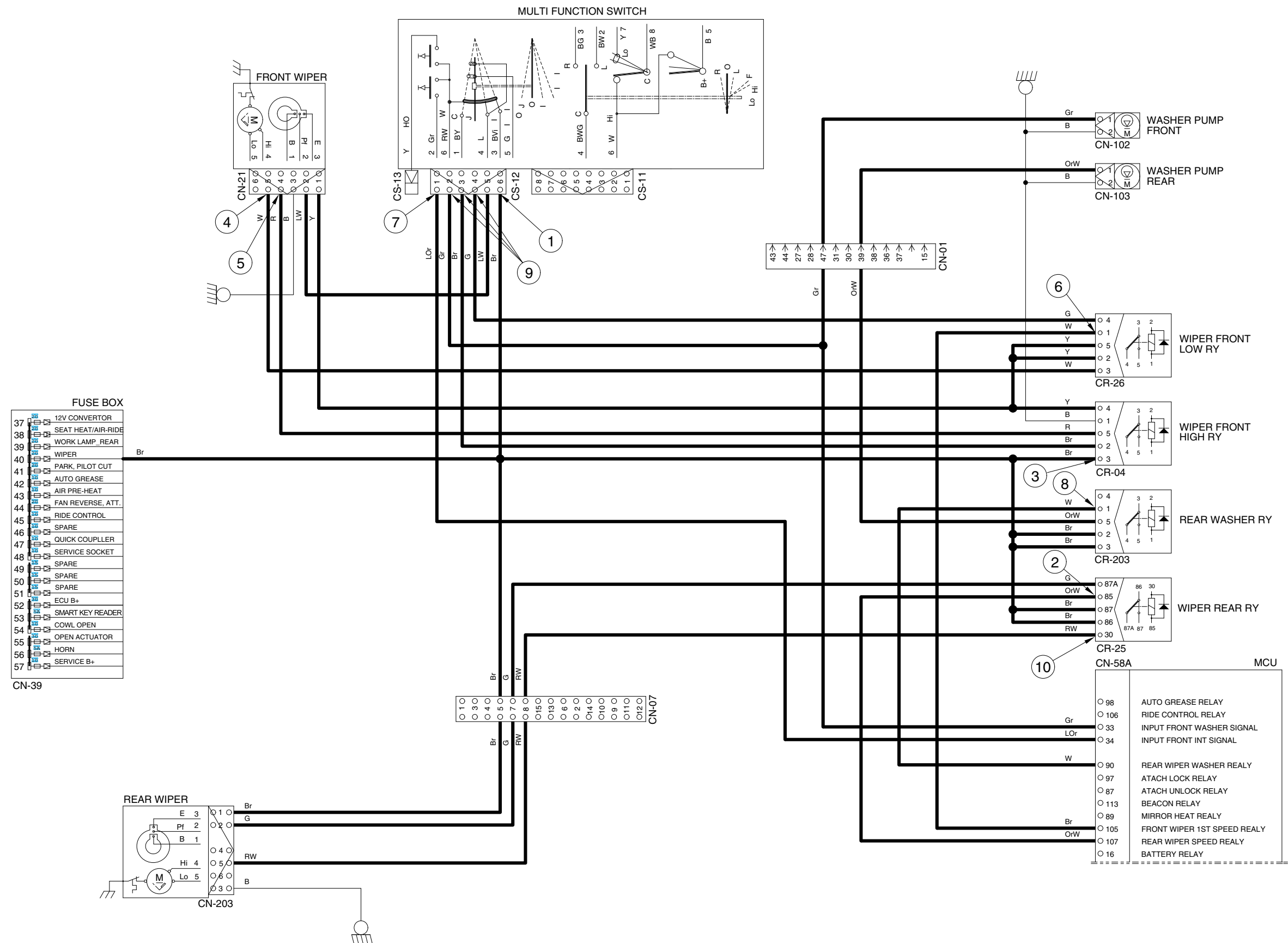
### 2) CHECK POINT

Condition	Check point	
Engine : Stop Key switch : ON Voltage : 20~25V	① - GND (front wiper switch power input)	⑥ - GND (wiper relay power input)
	② - GND (rear wiper relay power input)	⑦ - GND (front washer power output)
	③ - GND (wiper relay power input)	⑧ - GND (rear washer power output)
	④ - GND (front wiper motor Lo power input)	⑨ - GND (front wiper motor power output)
	⑤ - GND (front wiper motor High power input)	⑩ - GND (rear wiper motor power output)

※ GND : Ground

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

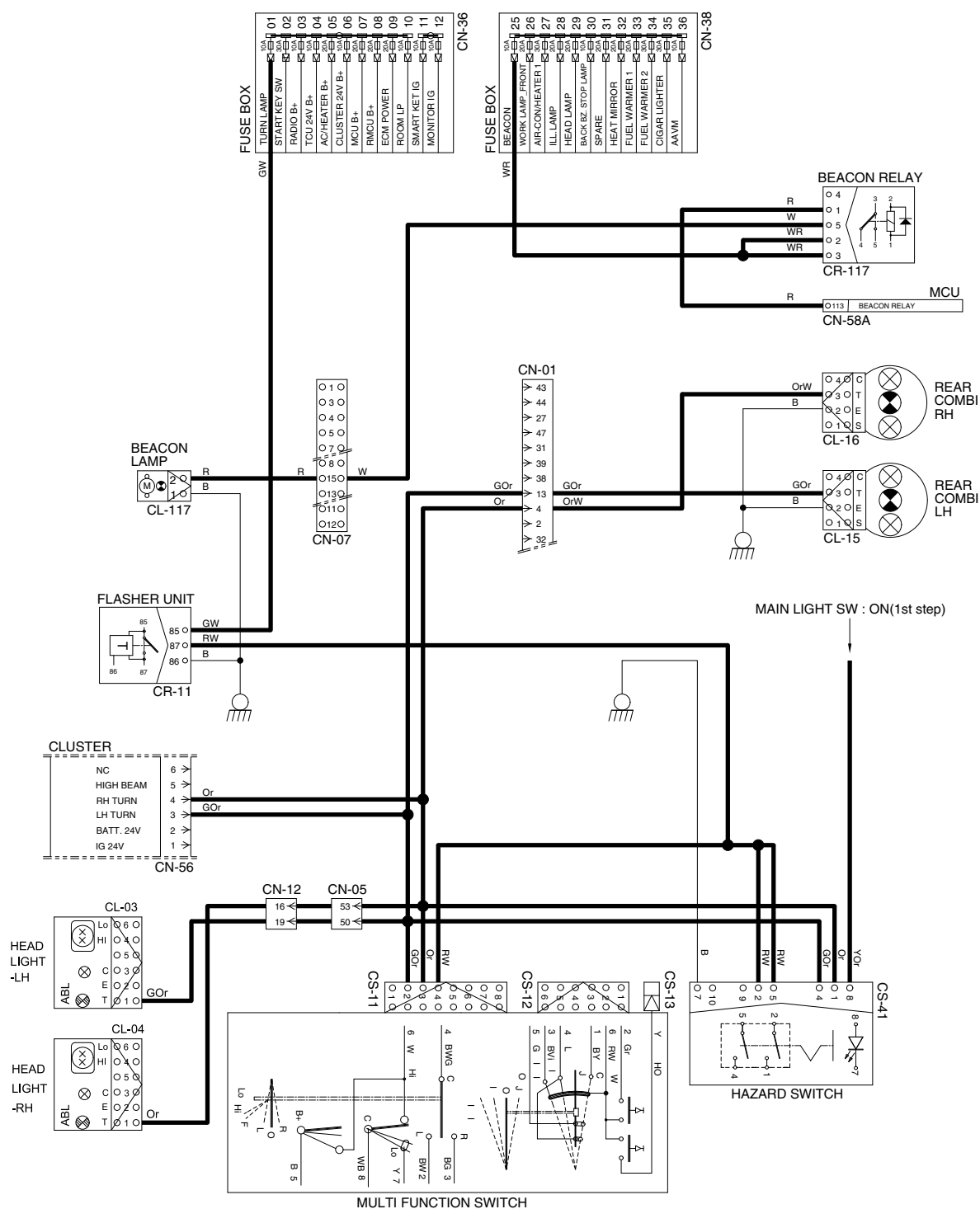
## WIPER AND WASHER CIRCUIT



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



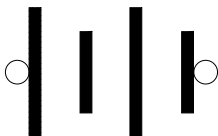
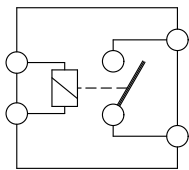
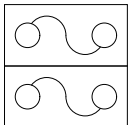
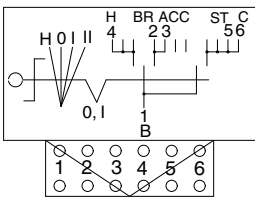
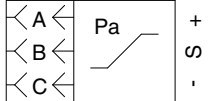
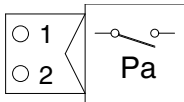
# HAZARD, TURN AND ROTARY CIRCUIT

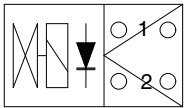
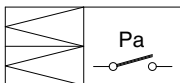
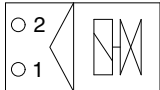
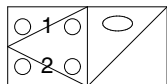
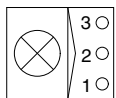
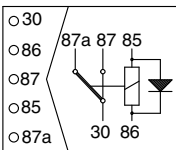


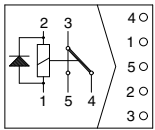
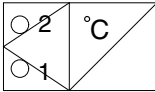
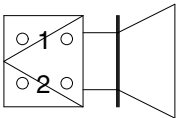
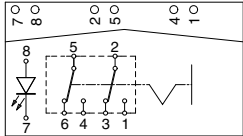
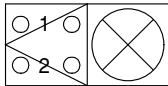
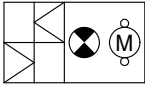
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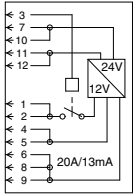
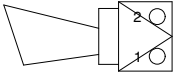
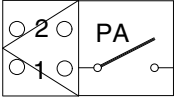
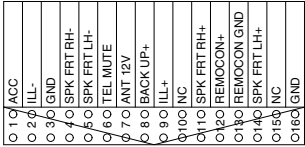
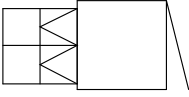
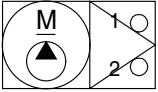
※ The circuit diagram may differ from the equipment, so please check before a repair.

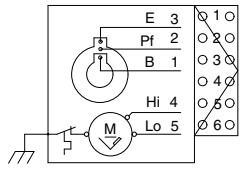
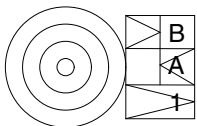
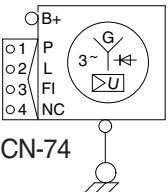
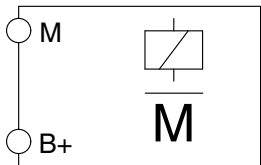
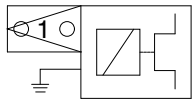
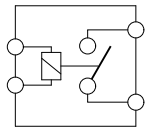
## GROUP 3 ELECTRICAL COMPONENT SPECIFICATION

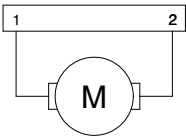
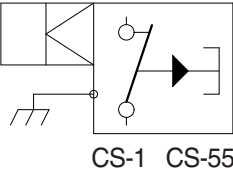
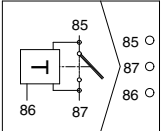
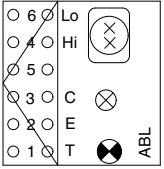
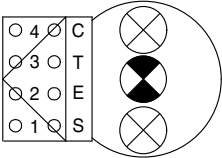
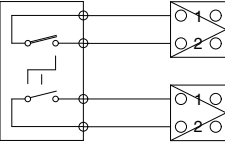
Part name	Symbol	Specifications	Check item
Battery		12V × 200Ah (2EA)	Gravity 1.280 over : over charged 1.280 ~ 1.250 : normal 1.250 below : discharged
Battery relay	 CR-1	Rated load : 24V 100A (continuity) 1000A (30seconds)	Coil resistance broken : approx 50 Ω connected : ∞ Ω
Fusible link	 CN-351 (40A), CN-352 (80A)	24V	Resistance between ring terminal and each connector pin 0 Ω : normal
Start key	 CS-2	B-BR : 24V 1A B-ACC : 24V 10A B-ST : 20V 40A	Resistance between each pin Key off : ∞ Ω (for each pin) Key on : 0 Ω (for pin 1-2 & 1-3) Start : 0 Ω (for pin 1-5)
Pressure switch	 CD-3 CD-26 CD-31 CD-39 CD-40 CD-58 CD-79 CD-80 CD-81	N.C Type	Resistance 0 Ω : normal (close)
Pressure switch	 CD-48 CD-129	N.O Type	Resistance ∞ Ω : normal (open)

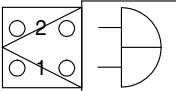
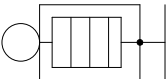
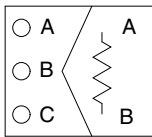
Part name	Symbol	Specifications	Check item
Pilot cut off, parking brake, diff lock, attach lock, unlock solenoid	 CN-68 CN-177 CN-71 CN-178 CN-79	24V 1A	Resistance normal : 15~25Ω
Air cleaner pressure switch	 CD-10	Max load : 6W N.O Type	Resistance ∞Ω : normal (open)
Lock-up, Ride control valve / Fan sole- noid	 CN-43 CN-136 CN-154 CN-155	24V 1.2A	※ Check LED lamp ※ Check resistance about 24Ω
Fuel sender	 CD-2	-	Resistance at fuel levels full level : 200Ω 9/12 level : 500Ω 6/12 level : 800Ω 3/12 level : 1100Ω empty : 1300Ω
Room lamp	 CL-1	24V 10W	Resistance normal : 1.2Ω
Relay (5pin)	 CR-3 CR-5 CR-7 CR-30 CR-35 CR-36 CR-38 CR-40 CR-46 CR-55 CR-56 CR-63 CR-210 CR-211 CR-381	24V 20A	Resistance normal : about 160Ω (for pin 85~86) 0Ω (for pin 30~87) ∞Ω (for pin 30~87)

Part name	Symbol	Specifications	Check item
Relay (5 pin)	 CR-2 CR-4 CR-25 CR-26 CR-37 CR-58 CR-79 CR-115 CR-117 CR-136 CR-302 CR-303	24V 20A	Resistance normal : about 160Ω (for pin 1~2) 0Ω (for pin 3~4) ∞Ω (for pin 3~5)
Hydraulic, transmission temperature	 CD-1 CD-49	—	Resistance normal : ∞Ω 105. C over : 0Ω
Speaker	 CN-123 (LH) CN-124 (RH)	4Ω 20W	Resistance normal : 4Ω
Switch (Locking type)	 CS-4 CS-17 CS-75	24V 8A	Resistance at switch off position ∞Ω between pin 1-5 and 2-6 0Ω between pin 5-7 and 6-8
Work lamp, Number plate lamp	 CL-21 CL-32 CL-33 CL-35 CL-36 CL-42 CL-43 CL-45 CL-46	Work lamp 24V 70W Number plate lamp 24V 10W	Resistance normal : 1.2Ω
Beacon lamp	 CL-117	24V 70W (H1 TYPE)	Resistance normal : 1.1Ω

Part name	Symbol	Specifications	Check item
DC/DC Converter	 CN-138	12V 3A	Resistance 8.8Ω (for pin A-B) 7.7Ω (for pin B-C)
Horn	 CN-120 CN-121	24V 2A	Operation by external power source - connect 24V power to (+) terminal - ground the (-) terminal
Receiver dryer	 CN-29	24V 2.5A	Resistance 0Ω : $2.1 \pm 0.3 \sim 27 \pm 2 \text{ kgf/cm}^2$ $\infty \Omega$ : $\sim 2.1 \pm 0.3, 27 \pm 2 \sim \text{kgf/cm}^2$
Radio & USB player	 CN-27	24V 20W+20W	Resistance Power ON : $4\Omega + 4\Omega$ (for pin 1-6, 4-8)
Back up buzzer	 CN-65	24V 0.5A 110dB	Resistance normal : $5.2\Omega$
Washer pump	 CN-102 (FR) CN-103 (RR)	24V 2.5A	Resistance normal : $26.4 \Omega$ (for pin1-2)

Part name	Symbol	Specifications	Check item
Wiper motor	 <p>CN-21 (FR) CN-102 (RR)</p>	24V 1.5A 2-speed Auto parking	-
Cigar lighter	 <p>CL-2</p>	24V 5A 1.4W	Coil resistance normal : about 1M $\Omega$
Alternator	 <p>CN-74</p>	Denso 24V 70A	Voltage normal : 24~28V
Starter	 <p>CN-45</p>	24V-7.8kW	Operating or not
Aircon compressor	 <p>CN-28</p>	24V 79W	Resistance normal : 13.4 $\Omega$
Start relay	 <p>CR-23</p>	24V 300A	Coil resistance normal : 1-2 $\Omega$ Switch connection $\infty \Omega$ at normal open position 0 $\Omega$ when engaged

Part name	Symbol	Specifications	Check item
Blower motor		24V 9.5A	Resistance at each switch position normal : 0.5-2Ω
Door switch		24V 2W	Resistance normal : about 5MΩ
Flasher unit		24V 85 ~ 190 C/M 50dB	-
Head lamp		24V 75W/70W (H4 TYPE) 24V 4W (T4W)	Resistance normal : a fewΩ
Combi lamp (rear)		24V 5W (R5W) 2 × 24V 21W (P21W)	-
Master switch		Continuous capacity : 180Amp Push in capacity : 1000Amp	-

Part name	Symbol	Specifications	Check item
Warning buzzer	 CN-26	24V 200mA $90 \pm 5\text{dB}$ ( ℓ m)	-
Preheater	 CN-80	24V 200A	Resistance 0.25~0.12Ω
Resistor	 CN-99	4W	Resistance A - B : 120Ω



## GROUP 4 CONNECTORS

### 1. CONNECTOR DESTINATION

Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CN-1	DEUTSCH	48	I/conn (Frame harness-Main harness)	DRB16-48SAE-L018	DRB12-48PAE-L018
CN-4	DEUTSCH	60	I/conn (Engine harness-Main harness)	DRB16-60SAE-L018	DRB12-60PAE-L018
CN-5	DEUTSCH	60	I/conn (Front harness-Main harness)	DRB16-60SBE-L018	DRB12-60PBE-L018
CN-7	AMP	15	I/conn (Main harness-Cab harness)	2-85262-1	368301-1
CN-9	DEUTSCH	6	I/conn (Main harness-Cab harness)	174264-2	174262-2
CN-11	AMP	15	I/conn (Main harness-Aircon harness)	2-85262-1	368301-1
CN-12	DEUTSCH	35	I/conn (Front harness-Bottom harness)	2-85262-1	HDP24-24-35PN-L015
CN-14	DEUTSCH	12	I/conn (Frame harness-Grill harness)	DT06-12S	DT04-12P
CN-15	KET	11	I/conn (RH console harness-Main harness)	MG651350	MG641353
CN-16	KET	14	I/conn (RH console harness-Main harness)	MG651110	MG641113
CN-18	DEUTSCH	12	LH seat console	DT06-12S	DT04-12P
CN-19	DEUTSCH	2	I/conn (Emer steer harness-Bottom harness)	DT06-2S	DT04-2P
CN-21	AMP	6	Front wiper motor	936257-2	-
CN-22	DEUTSCH	2	Compressor	DTP06-2S	
CN-24	DEUTSCH	12	Grill harness	DT06-12S	-
CN-26	TYCO	10	EHI unit	174655-2	174657-2
CN-26A	AMP	10	Joystick steering	-	174657-2
CN-27	MK II	16	Radio and USB player	PK145-16017	-
CN-27A	MK II	8	USB connector	174984-2	-
CN-31	DEUTSCH	3	Brake priority	DT06-3S	-
CN-36~39	-	-	Fuse box assy	21WF-17031	-
CN-43	AMP	2	Lock-up	282028	-
CN-45	Ring term	-	Starter	R14-12	ST 710246-2
CN-48	AMP	1	Hour meter	2-520193-2	-
CN-49	AMP	2	Torque converter temperature	85202-1	-
CN-56	KUM	16	Cluster	KPK145-16017	-
CN-57	AMP	20	Monitor	174047-2	-
CN-57C	DEUTSCH	4	Camera monitor	DT06-4S-EP06	-
CN-58A	AMP	81	MCU (machine control unit)	1473244-1	-
CN-58B	AMP	40	MCU (machine control unit)	1473252-1	-
CN-64	MOLEX	4	Smart key	39012040	-
CN-65	DEUTSCH	2	Back up buzzer	DT06-2S	-
CN-68	DEUTSCH	2	Pilot cut off	DT06-2S	-
CN-71	DEUTSCH	2	Parking solenoid	DT06-2S	-
CN-72	DEUTSCH	2	Cowl open activator	DT06-2S	-

Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CN-74	PACKARD	4	Alternator	1218-6568	-
CN-79	DEUTSCH	2	Differential lock solenoid	DT06-2S	-
CN-79A	DEUTSCH	2	Differential lock foot switch	DT06-2S-EP06	DT04-2P-E005
CN-93	DEUTSCH	-	ECM (engine control module)	DRC26-50S-04	-
CN-94	DEUTSCH	-	ECM power	DT06-4S-EP06	-
CN-99,99R	DEUTSCH	6	Rear camera	DT06-6S	DT04-6P
CN-100	DEUTSCH	3	Boom kick out	DT06-3S	-
CN-101	DEUTSCH	3	Bucket leveler	DT06-3S	-
CN-102	KET	2	Front washer tank	MG640605	-
CN-103	KET	2	Rear washer tank	MG640605	-
CN-112	-	16	Gear box	21L7-60290	-
CN-115	DEUTSCH	6	Auto grease	DT06-6S	DT04-6P
CN-120,121	DEUTSCH	2	Horn	DT06-2S	-
CN-122	DEUTSCH	9	Machine service tool	HD10-9-96P	-
CN-123	KET	2	Speaker (LH)	7123-1520	-
CN-124	KET	2	Speaker (RH)	7123-1520	-
CN-125	DEUTSCH	12	RMCU(remote management control unit)	DT06-12S	DT04-12P
CN-126	DEUTSCH	9	Engine service tool	HD10-9-1939P	-
CN-128	KET	1	Aircon compressor	PB625-01027	-
CN-129	KET	2	Receiver drier	MG640795	-
CN-134	AMP	6	Diagnostic (TCU)	1-480705-0	-
CN-136	DEUTSCH	2	Ride control solenoid	DT06-2S	-
CN-136A	Econoseal J	2	I/conn (Ride control harness-Front harness)	S816-002002	S816-102002
CN-137	AMP	1	12V socket	172434-2	-
CN-138	AMP	12	DC/DC Converter	1-967622-1	-
CN-139	AMP	2	12V socket	172434-2	-
CN-149	DEUTSCH	2	Mirror heat (LH)	DT06-2S	DT04-2P
CN-150	DEUTSCH	2	Mirror heat (RH)	DT06-2S	DT04-2P
CN-152	AMP	4	Proportional valve	2-967059-1	-
CN-154	DEUTSCH	2	Fan speed solenoid	DT06-2S	-
CN-155	DEUTSCH	2	Fan reverse solenoid	DT06-2S	-
CN-156	DEUTSCH	2	Seat heat (with switch)	-	DT04-2P-E005
CN-157	AMP	68	Transmission control unit	963598-1	-
CN-158	PACKARD	4	Gear shift lever	1201-0974	-
CN-159	PACKARD	4	Gear shift lever	1201-5797	-
CN-160	CARLING	12	FNR joystick lever	LC3-01	-
CN-162	AMP	6	Throttle pedal	174262-2	-
CN-163	AMP	2	ECO feeling switch	174352-2	-

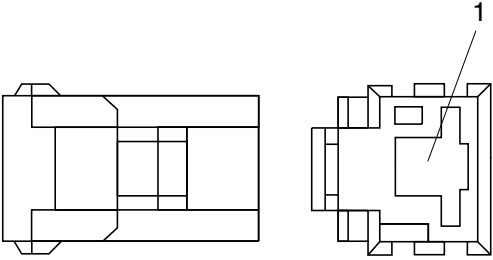
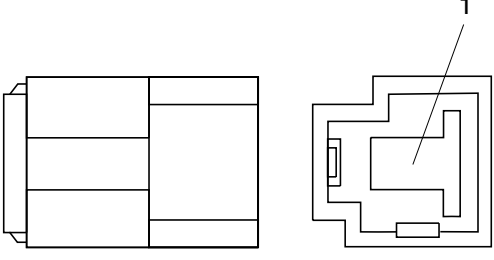
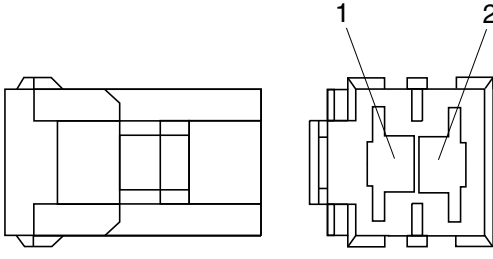
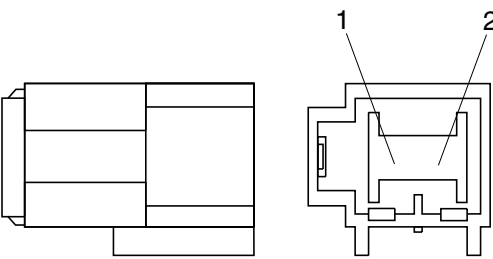
Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CN-171	DEUTSCH	3	Service socket	DT06-3S-EP06	-
CN-177	DEUTSCH	2	Quick coupler unlock solenoid	DT06-2S	-
CN-177A	Econoseal J	3	I/conn (Front harness-Quick coupler harness)	S816-003002	S816-103002
CN-178	DEUTSCH	2	Quick coupler lock solenoid	DT06-2S	-
CN-196	PACKARD	4	Fuel heater	2-967325-3	-
CN-203	AMP	6	Rear wiper motor	936257-1	-
CN-246	KET	1	PTC power	-	MG620659-5
CN-249	DEUTSCH	6	Camera	DT06-4S	DT04-6P
CN-250	DEUTSCH	2	Seat belt alarm	DT06-2S-EP06	-
CN-252	TYCO	6	Differential lock	S816-006602	S816-106602
CN-313	DEUTSCH	4	AAVM monitor service tool	DT06-4S-EP06	-
CN-399	AMP	4	DEF sensor	1-967325-1	-
CN-431	KET	20	AAVM monitor	MG635026	-
Relay					
CR-1	Ring term	-	Battery relay	S820-104002	-
CR-2	AMP	5	Horn relay	VCFM-1002	-
CR-3	AMP	5	Front work lamp relay	VCFM-1002	-
CR-4	AMP	5	Wiper relay (Hi)	VCFM-1002	-
CR-5	HELLA	5	Safety relay	8JA003526-001	-
CR-7	AMP	5	Aircon relay	VCFM-1002	-
CR-11	250	-	Flasher unit	S810-003702	-
CR-23	Ring term	-	Start relay	ST 710289-2	ST 710384-2
CR-24	Shur	1	Preheater relay	S822-014000	-
CR-25	AMP	5	Rear wiper relay	VCFM-1002	-
CR-26	AMP	5	Wiper relay (low)	VCFM-1002	-
CR-30	HELLA	5	ECM power relay	8JA003526-001	-
CR-36	AMP	5	Preheater relay	VCFM-1002	-
CR-39	-	2	Emergency steering pump relay	S820-104000	-
CR-40	KET	5	EHCU power relay	MG610047-1	-
CR-46	HELLA	5	Fuel warmer relay	8JA003526-001	-
CR-55	AMP	5	Rear work lamp relay	VCFM-1002	-
CR-56	KET	5	Mirror heat relay	MG610047-1	-
CR-58	AMP	5	Back up relay	VCFM-1002	-
CR-63	AMP	5	Stop lamp relay	VCFM-1002	-

Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
Switch					
CS-1	AMP	1	Door switch	ST730018-3	-
CS-2	KET	6	Start key switch	MG610335-5	-
CS-4	CARLING	10	Pilot cut off switch	VC2-01	-
CS-11	KET	8	Multi function switch	MG610339-5	-
CS-12	KET	6	Multi function switch	MG610339-5	-
CS-13	KET	1	Multi function switch	ST730018-3	-
CS-17	CARLING	10	Parking switch	VC2-01	-
CS-33	AMP	6	Engine stop switch	174262-2	-
CS-41	CARLING	10	Hazard switch	VC2-01	-
CS-74	-	2	Master switch	S813-030200	-
CS-75	CARLING	10	Emergency steering test switch	VC2-01	-
CS-79	CARLING	10	Differential lock switch	VC2-01	-
CS-85, 85L	KET	2	Workload switch	MG610070	MG620074
CS-86, 86L	KET	2	Kick down switch	MG610070	MG620074
CS-87, 87L	KET	2	Horn switch	MG610070	MG620074
CS-88, 88L	KET	2	FNR select switch	MG610070	MG620074
CS-105	CARLING	10	SCR switch	VC2-01	-
Light					
CL-1	KET	3	Room lamp	MG651032	-
CL-3	DEUTSCH	6	Head light (LH)	DT06-6S	-
CL-4	DEUTSCH	6	Head light (RH)	DT06-6S	-
CL-15	YAZAKI	4	Combi lamp (RR, LH)	7232-7444	-
CL-16	YAZAKI	4	Combi lamp (RR, RH)	7232-7444	-
CL-21	SWP	2	Number plate lamp	S814-002000	-
CL-22	DEUTSCH	2	Work light (LH)	DT06-2S	-
CL-23	DEUTSCH	2	Work light (RH)	DT06-2S	-
CL-32	DEUTSCH	2	Rear work light (RH)	DT06-2S	DT04-2P
CL-33	DEUTSCH	2	Rear work light (LH)	DT06-2S	DT04-2P
CL-42	DEUTSCH	2	Rear work light (opt)	DT06-2S	DT04-2P
CL-45	DEUTSCH	2	Work light (RH)	DT06-2S-EP06	-
CL-46	DEUTSCH	2	Work light (LH)	DT06-2S-EP06	-
CL-117	AMP	2	Beacon lamp	174198-2	-

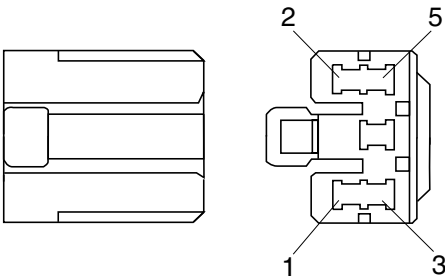
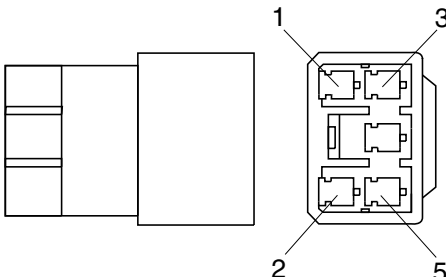
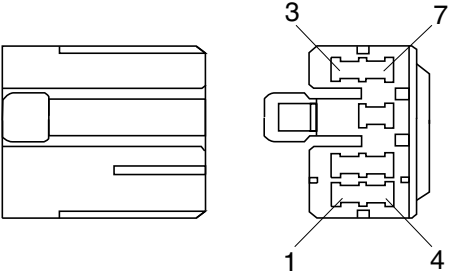
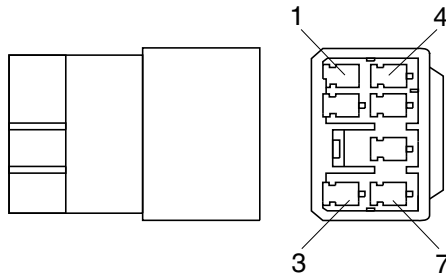
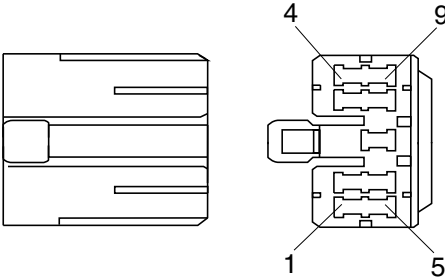
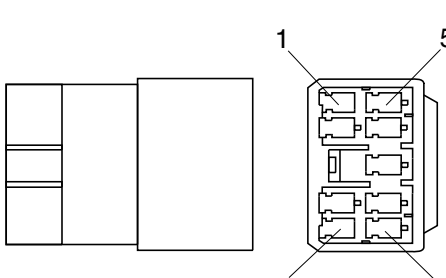
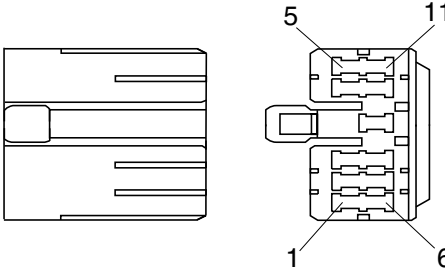
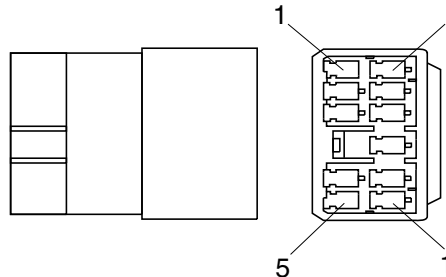
Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
Sensor, sender					
CD-1	AMP	2	Hyduaualic oil temp sendor	85202-1	-
CD-2	YAZAKI	2	Fuel sendor	7123-7424	-
CD-3	DEUTSCH	3	Brake fail pressure switch	DT06-3S	-
CD-4	DEUTSCH	3	Stop lamp pressure switch	DT06-3S	-
CD-5	PACKARD	3	Clutch cut off pressure switch	-	1215793
CD-10	AMP	2	Air cleaner switch	85202-1	-
CD-17	AMP	2	Engine pick-up sensor	85202-1	-
CD-26	DEUTSCH	3	Parking pressure switch	DT06-3S	-
CD-27	AMP	2	Turbin pick up sensor	85202-1	-
CD-31	DEUTSCH	3	Brake priority pressure switch	DT06-3S	-
CD-39	DEUTSCH	3	Main pump pressure switch	DT06-3S	-
CD-40	DEUTSCH	3	Steering pump pressure switch	DT06-3S	-
CD-43	AMP	2	Lock up proportional valve	282027	-
CD-45	DEUTSCH	2	WIF sensor	DT06-2S	-
CD-46	AMP	3	Output speed sensor	282087	-
CD-47	AMP	2	Gear chain sensor	85202-1	-
CD-48	AMP	2	Oil filter restriction sensor	282080	-
CD-49	AMP	2	Converter temp sensor	85202-1	-
CD-73	AMP	2	Speed sendor	174352-2	-
CD-79	DEUTSCH	3	Diff lock feed back sensor	DT06-3S	-
CD-80	DEUTSCH	3	Boom up positioner sensor	DT06-3S	-
CD-81	DEUTSCH	3	Boom down positioner sensor	DT06-3S	-
CD-96	PACKARD	3	Coolant level sensor	12110293	-
CD-101	SUMITOMO	4	TBAP sensor	6098-0144	-

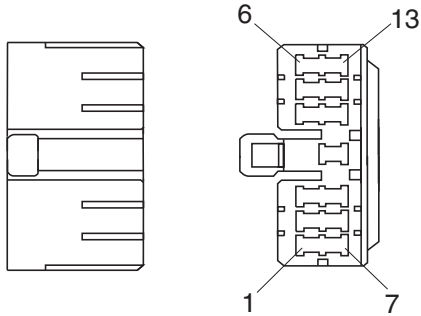
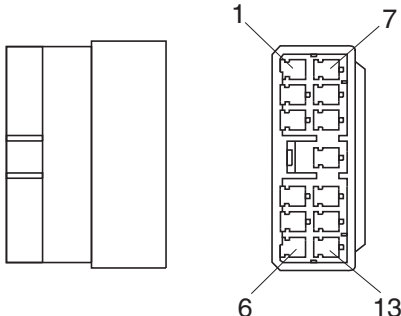
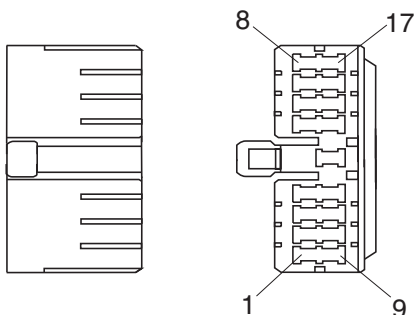
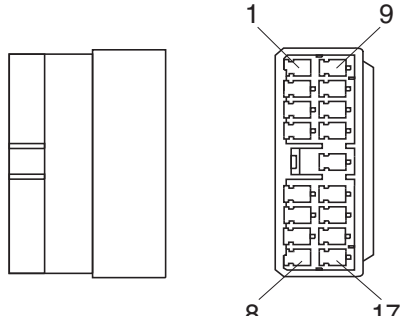
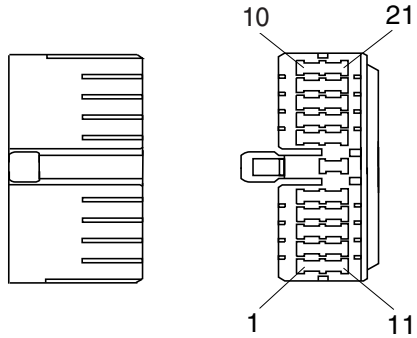
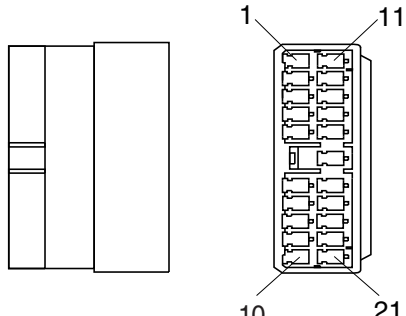
2. CONNECTION TABLE FOR CONNECTORS

1) 58-L TYPE CONNECTOR

No. of pin	Receptacle connector (female)	Plug connector (male)
1	 S813-030100	 S813-130100
2	 S813-030200	 S813-130200

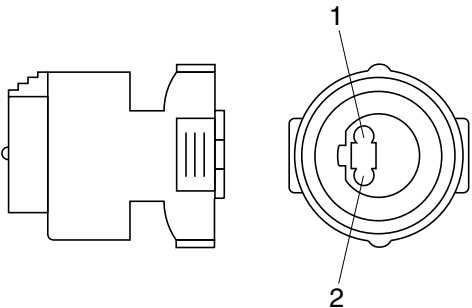
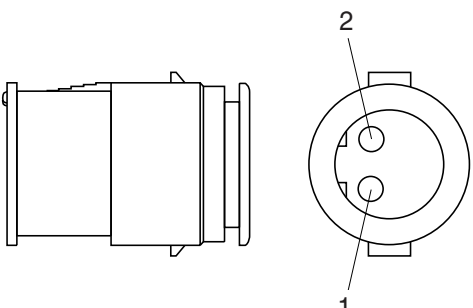
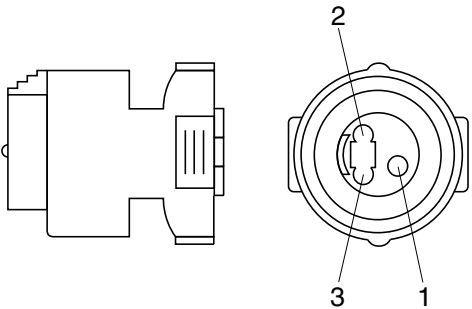
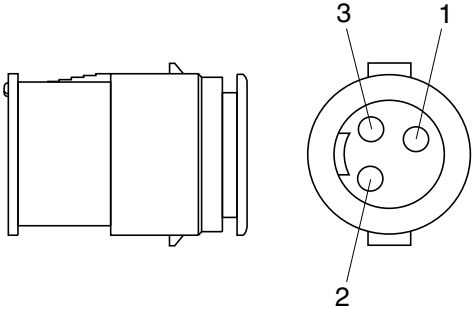
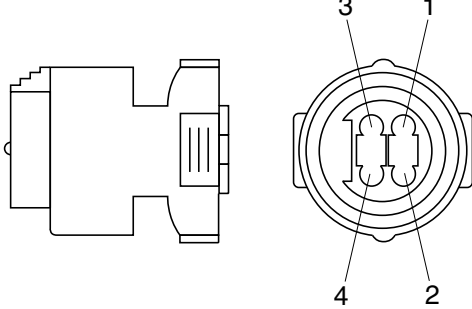
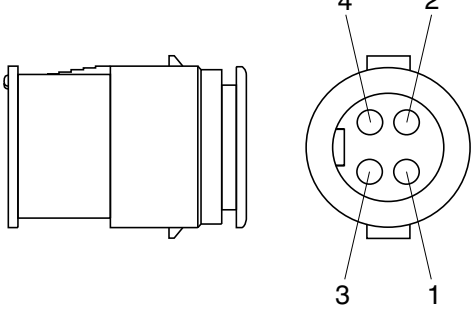
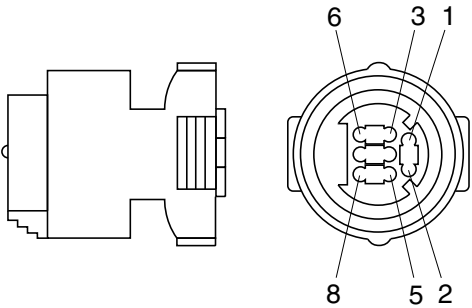
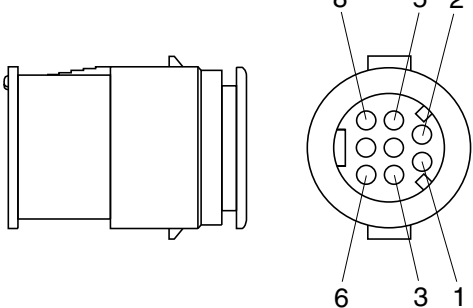
## 2) PA TYPE CONNECTOR

No. of pin	Receptacle connector (female)	Plug connector (male)
5	 <p>S811-005002</p>	 <p>S811-105002</p>
7	 <p>S811-007002</p>	 <p>S811-107002</p>
9	 <p>S811-009002</p>	 <p>S811-109002</p>
11	 <p>S811-011002</p>	 <p>S811-111002</p>

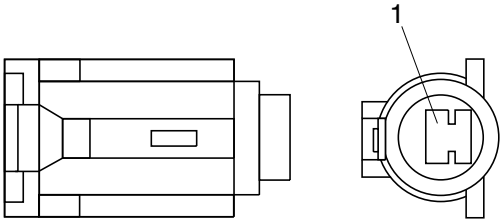
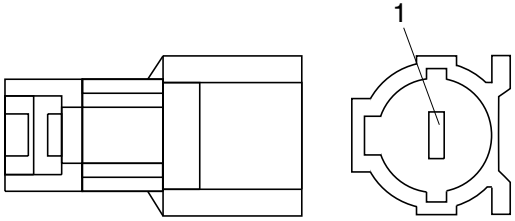
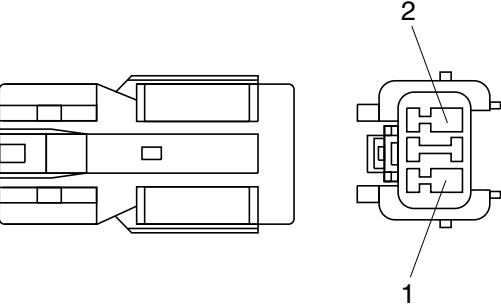
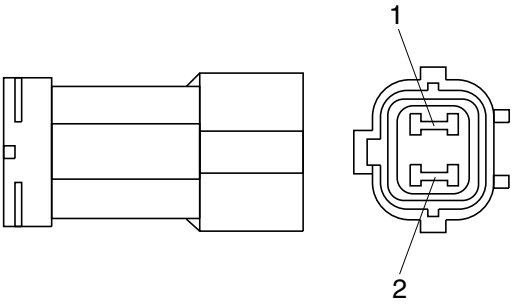
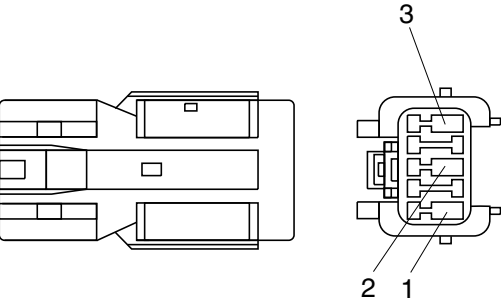
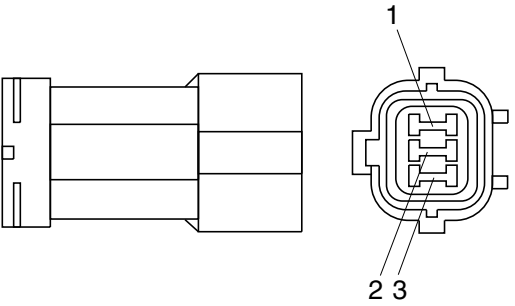
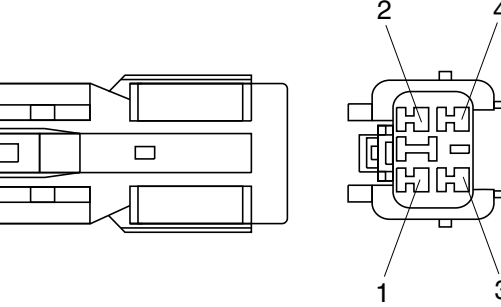
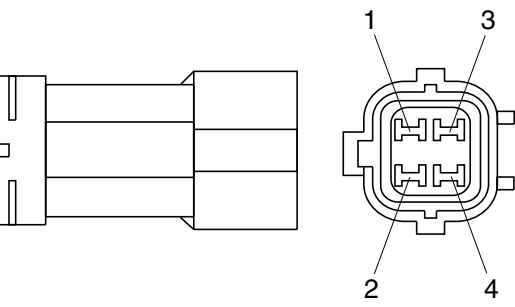
No. of pin	Receptacle connector (female)	Plug connector (male)
13	 <p>S811-013002</p>	 <p>S811-113002</p>
17	 <p>S811-017002</p>	 <p>S811-117002</p>
21	 <p>S811-021002</p>	 <p>S811-121002</p>

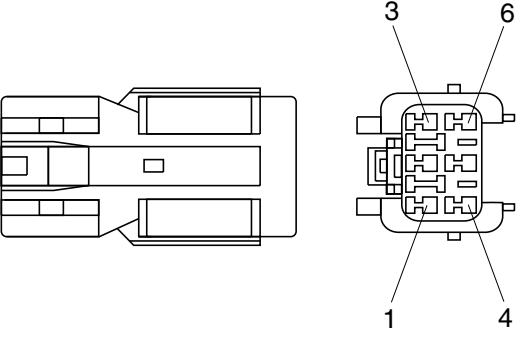
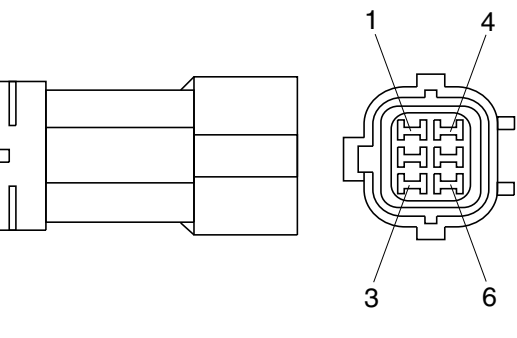
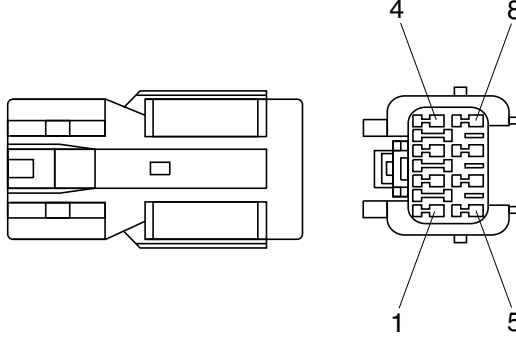
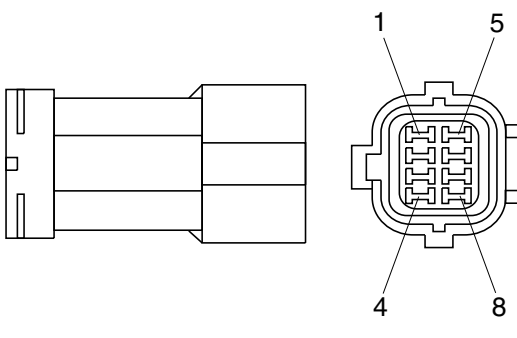
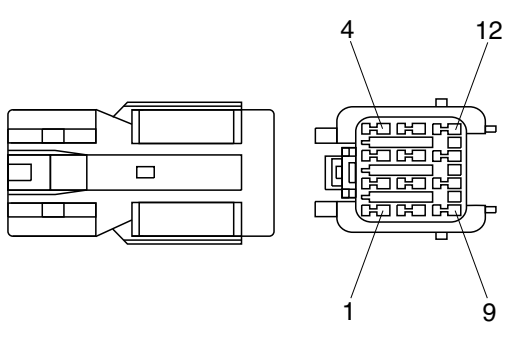
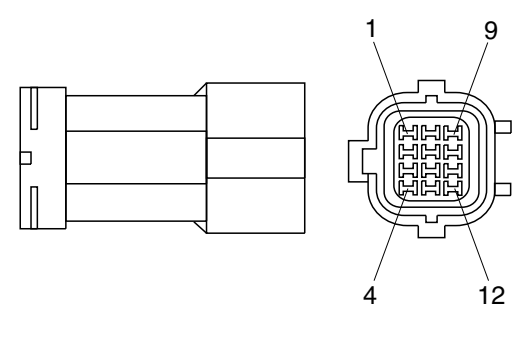
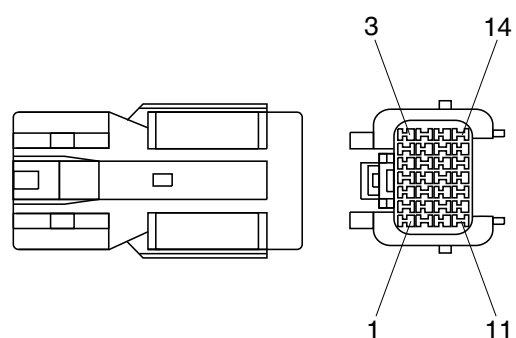
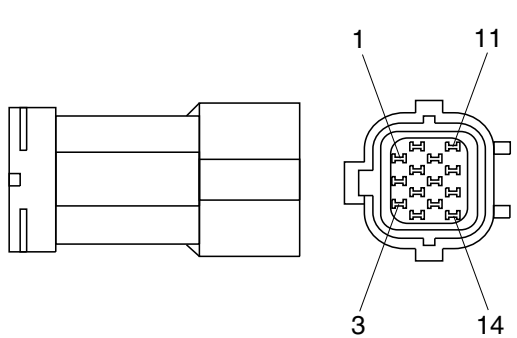


3) J TYPE CONNECTOR

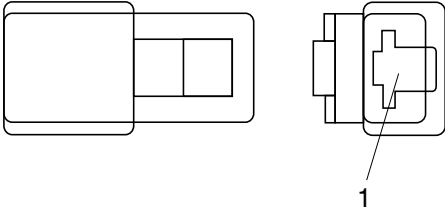
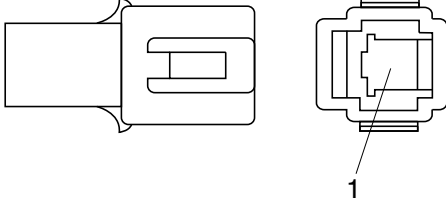
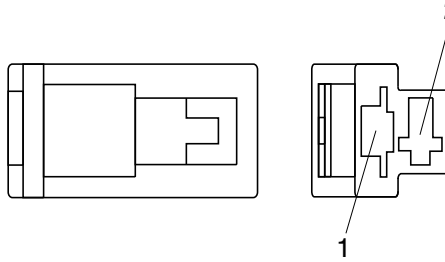
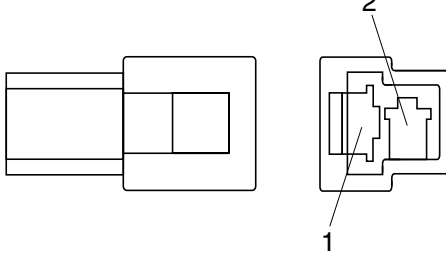
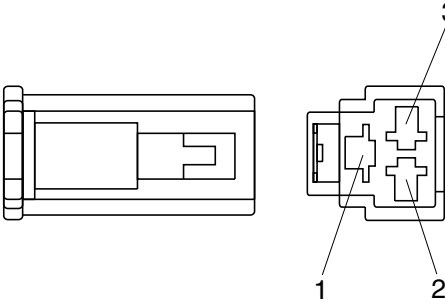
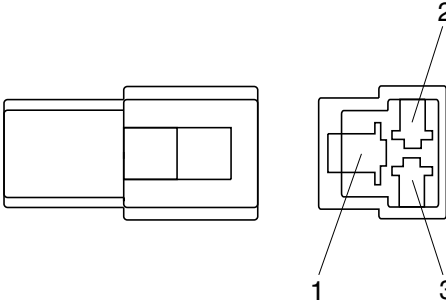
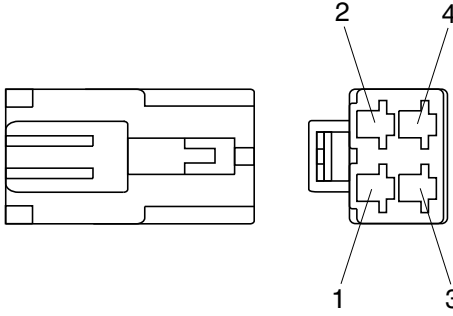
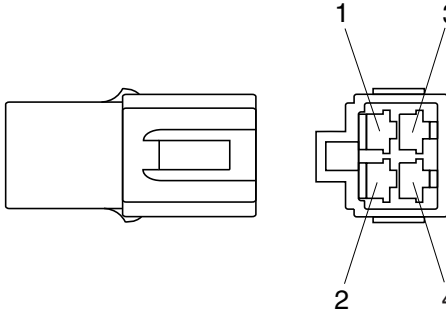
No. of pin	Receptacle connector (female)	Plug connector (male)
2	 <p>S816-002001</p>	 <p>S816-102001</p>
3	 <p>S816-003001</p>	 <p>S816-103001</p>
4	 <p>S816-004001</p>	 <p>S816-104001</p>
8	 <p>S816-008001</p>	 <p>S816-108001</p>

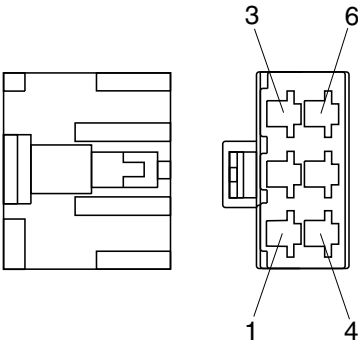
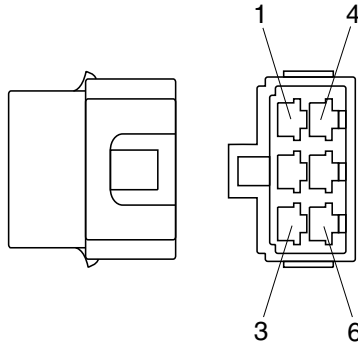
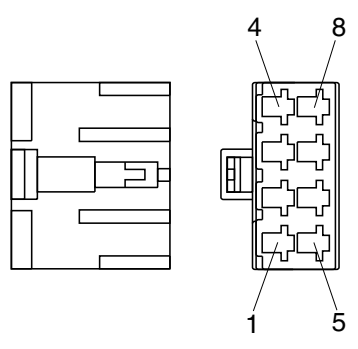
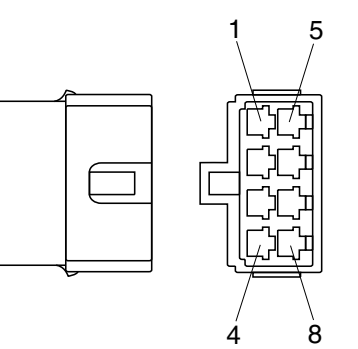
4) SWP TYPE CONNECTOR

No. of pin	Receptacle connector (Female)	Plug connector (male)
1	 S814-001000	 S814-101000
2	 S814-002000	 S814-102000
3	 S814-003000	 S814-103000
4	 S814-004000	 S814-104000

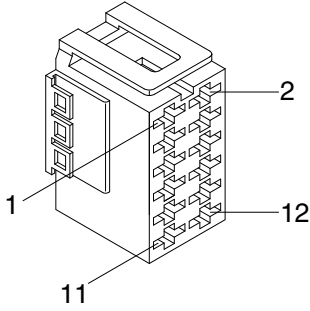
No. of pin	Receptacle connector (female)	Plug connector (male)
6	 <p data-bbox="686 627 837 660">S814-006000</p>	 <p data-bbox="1260 627 1412 660">S814-106000</p>
8	 <p data-bbox="686 1030 837 1064">S814-008000</p>	 <p data-bbox="1260 1030 1412 1064">S814-108000</p>
12	 <p data-bbox="686 1433 837 1467">S814-012000</p>	 <p data-bbox="1260 1433 1412 1467">S814-112000</p>
14	 <p data-bbox="686 1836 837 1870">S814-014000</p>	 <p data-bbox="1260 1836 1412 1870">S814-114000</p>

## 5) CN TYPE CONNECTOR

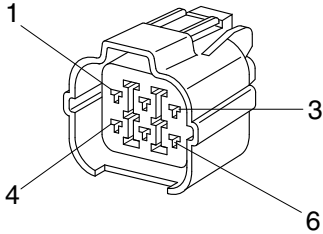
No. of pin	Receptacle connector (female)	Plug connector (male)
1	 <p>S810-001202</p>	 <p>S810-101202</p>
2	 <p>S810-002202</p>	 <p>S810-102202</p>
3	 <p>S810-003202</p>	 <p>S810-103202</p>
4	 <p>S810-004202</p>	 <p>S810-104202</p>

No. of pin	Receptacle connector (female)	Plug connector (male)
6	 <p data-bbox="686 638 837 672">S810-006202</p>	 <p data-bbox="1244 638 1396 672">S810-106202</p>
8	 <p data-bbox="686 1041 837 1075">S810-008202</p>	 <p data-bbox="1244 1041 1396 1075">S810-108202</p>

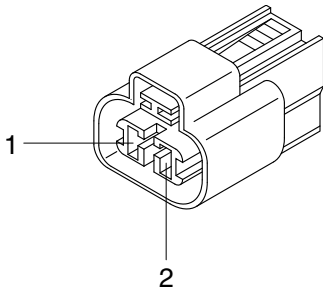
## 6) ITT SWF CONNECTOR

No. of pin	Receptacle connector (female)	Plug connector (male)
10	 <p>SWF589790</p>	

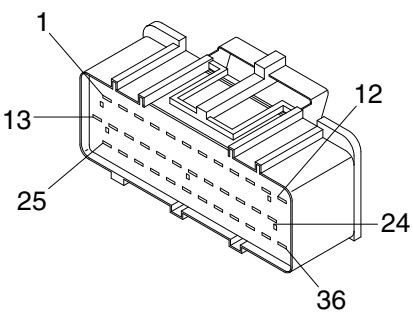
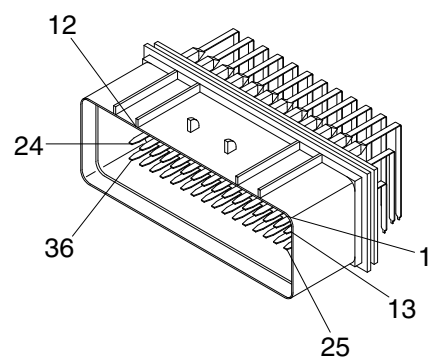
## 7) HW090 SEALED CONNECTOR

No. of pin	Receptacle connector (female)	Plug connector (male)
6	 <p>6189-0133</p>	

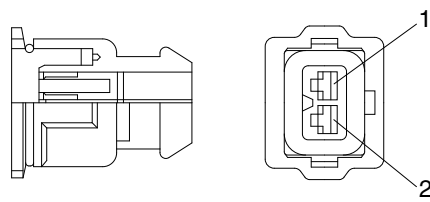
## 8) MWP02F-B CONNECTOR

No. of pin	Receptacle connector (female)	Plug connector (male)
2	 <p>PH805-02028</p>	

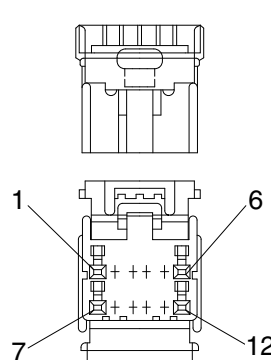
## 9) AMP ECONOSEAL CONNECTOR

No. of pin	Receptacle connector (female)	Plug connector (male)
36	 <p>344111-1</p>	 <p>344108-1</p>

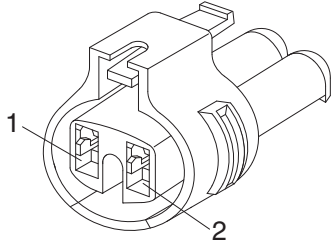
## 10) AMP TIMER CONNECTOR

No. of pin	Receptacle connector (female)	Plug connector (male)
2	 <p>85202-1</p>	

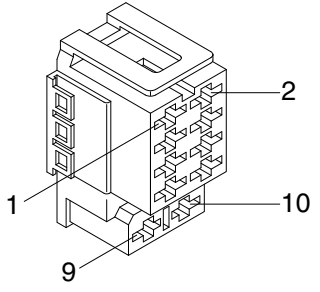
## 11) AMP 040 MULTILOCK CONNECTOR

No. of pin	Receptacle connector (female)	Plug connector (male)
12	 <p>174045-2</p>	

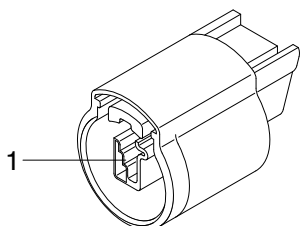
## 12) KET 090 WP CONNECTORS

No. of pin	Receptacle connector (female)	Plug connector (male)
2	 <p>MG640795</p>	

## 13) ITT SWF CONNECTOR

No. of pin	Receptacle connector (female)	Plug connector (male)
10	 <p>SWF593757</p>	

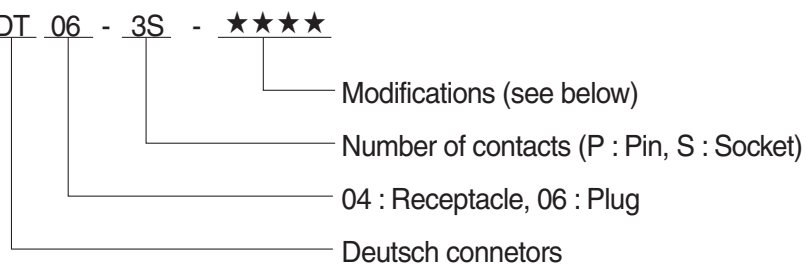
## 14) MWP NMWP CONNECTOR

No. of pin	Receptacle connector (female)	Plug connector (male)
1	 <p>NMWP01F-B</p>	



## 15) DEUTSCH DT CONNECTORS

DT 06 - 3S - ★★☆☆



### ※ Modification

E003 : Standard end cap - gray

E004 : Color of connector to be black

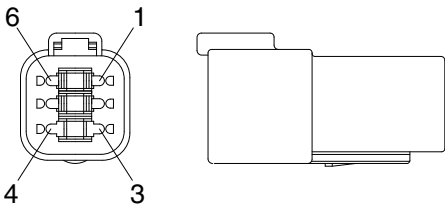
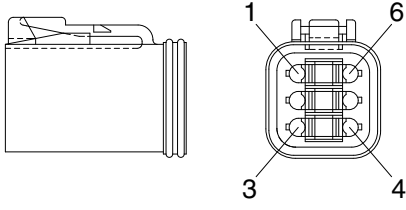
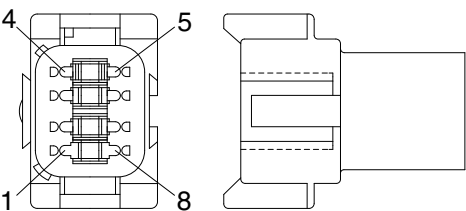
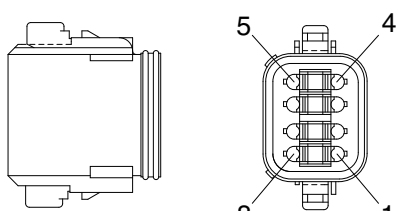
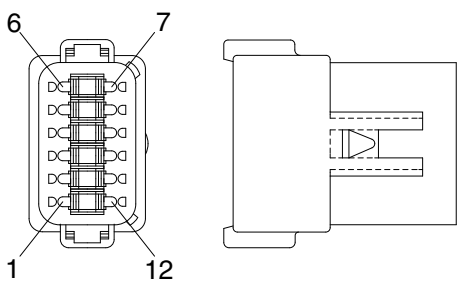
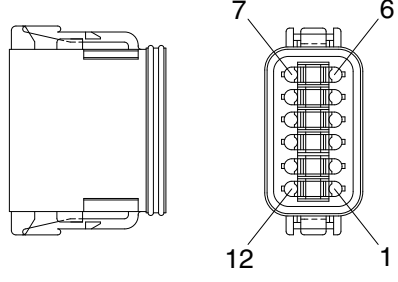
E005 : Combination - E004 & E003

EP04 : End cap

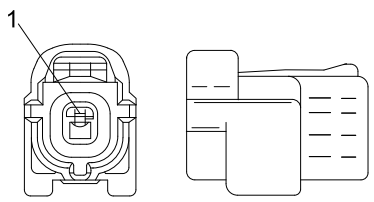
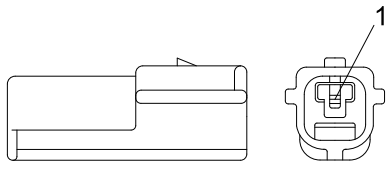
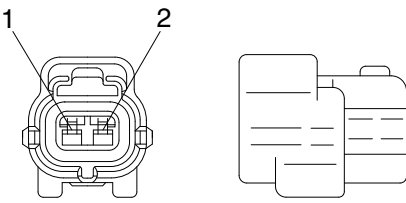
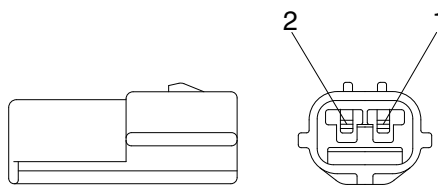
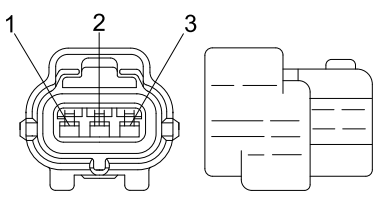
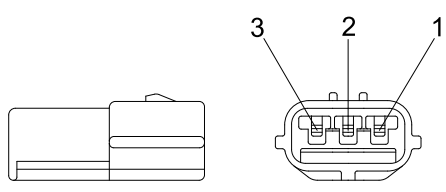
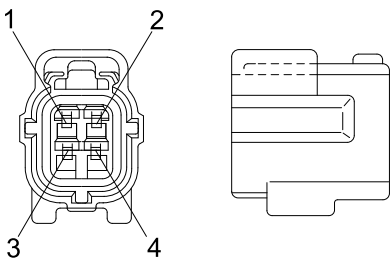
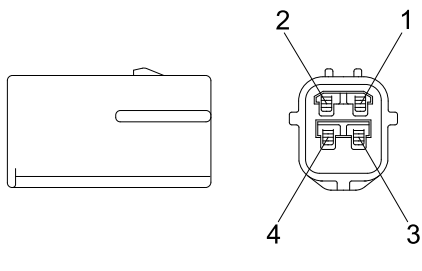
EP06 : Combination P012 & EP04

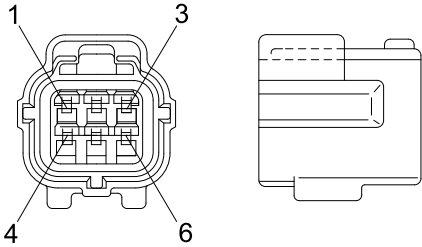
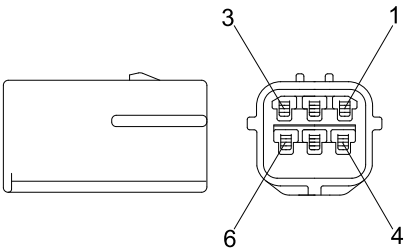
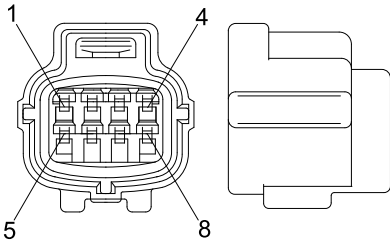
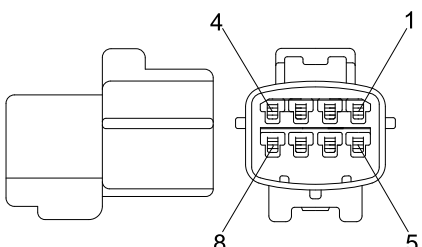
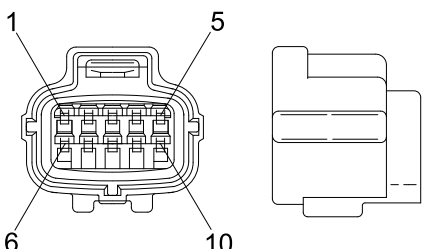
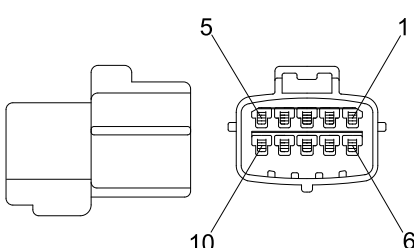
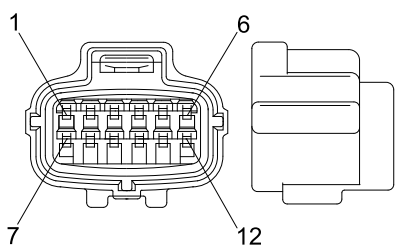
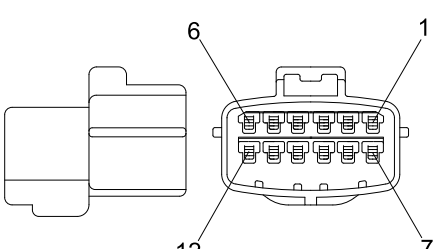
P012 : Front seal enhancement - connectors color to black for 2, 3, 4 & 6pin

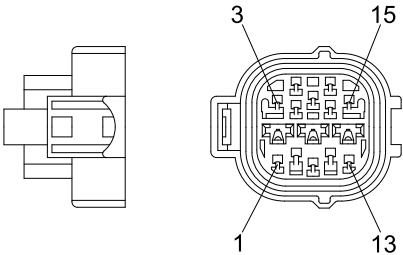
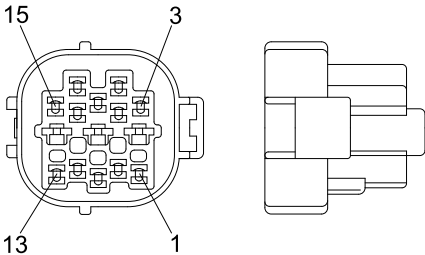
No. of pin	Receptacle connector (female)	Plug connector (male)
2		
3		
4		

No. of pin	Receptacle connector (female)	Plug connector (male)
6	 <p>DT06-6S</p>	 <p>DT04-6P</p>
8	 <p>DT06-8S</p>	 <p>DT04-8P</p>
12	 <p>DT06-12S</p>	 <p>DT04-12P</p>

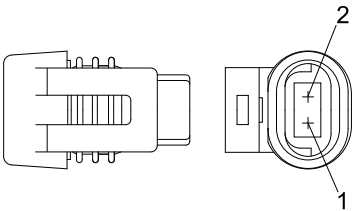
## 16) ECONOSEAL J TYPE CONNECTORS

No. of pin	Receptacle connector (female)	Plug connector (male)
1	 <p>S816-001002</p>	 <p>S816-101002</p>
2	 <p>S816-002002</p>	 <p>S816-102002</p>
3	 <p>S816-003002</p>	 <p>S816-103002</p>
4	 <p>S816-004002</p>	 <p>S816-104002</p>

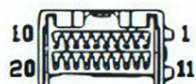
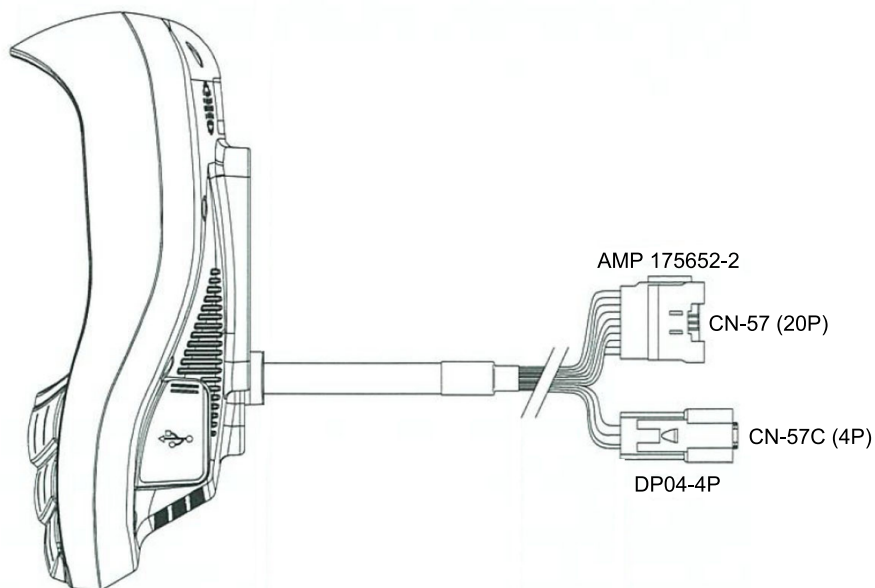
No. of pin	Receptacle connector (female)	Plug connector (male)
6	 <p>S816-006002</p>	 <p>S816-106002</p>
8	 <p>S816-008002</p>	 <p>S816-108002</p>
10	 <p>S816-010002</p>	 <p>S816-110002</p>
12	 <p>S816-012002</p>	 <p>S816-112002</p>

No. of pin	Receptacle connector (female)	Plug connector (male)
15	 <p>368301-1</p>	 <p>2-85262-1</p>

**17) METRI-PACK TYPE CONNECTOR**

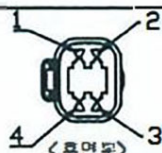
No. of pin	Receptacle connector (female)	Plug connector (male)
2	 <p>12040753</p>	

# 18) MONITOR CONNECTOR (21WD-11400)



PART NO. : AMP 175652-2

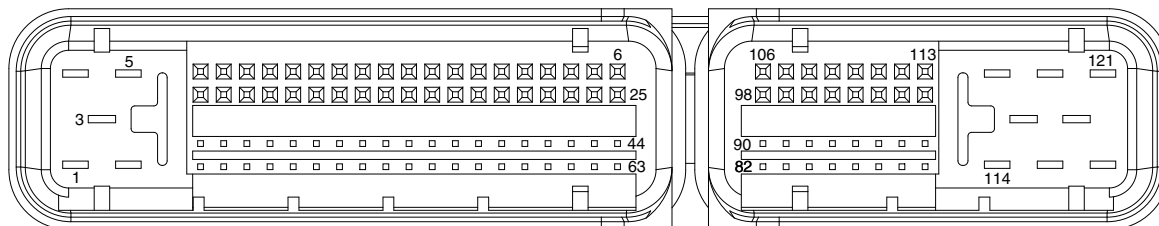
NO	PIN NAME	NO	PIN NAME
1	IG 24V	11	GND
2	BATTERY 24V	12	GND
3	BATTERY 24V	13	N.C
4	CAMERA CH1 (SINGLE)	14	CAN2 L
5	CAMERA CH3 DIFF-	15	CAN2 H
6	CAMERA VCC (8V OUTPUT)	16	CAN2 SHIELD
7	N.C	17	CAMERA SHIELD
8	N.C	18	N.C
9	CAMERA CH2 DIFF-(OPTIONAL)	19	N.C
10	CAMERA CH2 DIFF+(OPTIONAL)	20	CAMERA CH3 DIFF+



PART NO. : DT04-4P

NO	PIN NAME	NO	PIN NAME
1	CAM VCC (8V OUTPUT)	3	CAM CH3 DIFF+
2	CAM GND	4	CAM CH3 DIFF-

## 19)MCU



CN-58A

○ 13	REVERSE DRIVE RELAY	○ 61	CAN2 LOW
○ 98	AUTO GREASE RELAY	○ 60	CAN2 HI
○ 106	RIDE CONTROL RELAY	○ B21	SPARE_ECO FEELING SIGNAL
○ 33	INPUT FRONT WASHER SIGNAL	○ 12	ILLUMINATION LIGHT RELAY
○ 34	INPUT FRONT INT SIGNAL	○ 11	DRIVING LIGHT RELAY
○ 90	REAR WIPER WASHER REALY	○ 88	WORK LAMP FRONT
○ 97	ATCH LOCK RELAY	○ 44	WORK LAMP REAR
○ 87	ATCH UNLOCK RELAY	○ 82	FUEL WARMER RELAY
○ 113	BEACON RELAY	○ 32	AIRCON RUN SIGNAL
○ 89	MIRROR HEAT REALY	○ 83	AC COMP. OFF SIG_REVERSE FAN
○ 105	FRONT WIPER 1ST SPEED REALY	○	
○ 107	REAR WIPER SPEED REALY	○ 78	BOOM POSITION SENSOR
○ 16	BATTERY RELAY	○ 66	BUCKET POSITION SENSOR
○ 2	GND(MAIN)	○ 24	REF. POWER +5V
○ 116	GND(MAIN)	○ 1	POWER IG(+24V)
○ 72	ELEC. STEER MAIN PUMP PS	○ 3	BATTERY POWER(+24V)
○ 75	ELEC. STEER PUMP PS	○ 4	BATTERY POWER(+24V)
○ B21	SPARE	○ 6	DETENT CONTROL SOL_BUCKET
○ 31	SPARE	○ 45	DETENT CONTROL SOL_BOOM UP
○ 35	NEUTRAL SIGNAL(24V)	○ 51	COUNT_WEIGHT_SET SWITCH
○ 7	ANTI-RESTART RELAY	○ 29	AUTO GREASE LAMP(GREEN)
○ 63	ELEC. STEERING PUMP RELAY	○ 28	AUTO GREASE LAMP(RED)
○ 57	CAN(1)-H	○ 26	DIFF. LOCK AUTO
○ 58	CAN(1)-L	○ 27	DIFF. LOCK MANUAL
○ 55	CAN_SHIELD(GROUND)	○ 15	HOOR METER_HIGH
○ 77	BRAKE OIL LOW PS	○ A07	SPARE_5V+
○ 71	PARKING OIL LOW PS	○ B40	SPARE_PEDAL POSITION2
○ 76	BRAKE PRIORITY_PR SIGNAL	○ A09	SPARE_PEDAL POSITION2 RETURN
○ 73	BOOM ROD PR SNSENSOR	○ 48	SEAT BELT WARNING
○ 68	BOOM HEAD PR SNSENSOR	○ 22	SPARE_5V+
○ 74	DIFFERTIAL LOCK PR SIGNAL	○ B39	SPARE_PEDAL POSITION1
○ 5	+24V PRESSURE SENSOR POWER	○ A08	SPARE_PEDAL POSITION1
○ 50	AXLE OIL TEMP (FRONT)	○ 42	PROGRAM DUMP
○ 49	AXLE OIL TEMP(REAR)	○ 93	RS-232(1) RX
○ 52	FUEL LEVEL SENSOR	○ 92	RS-232(1) TX
○ 53	HYD TEMP SENDER	○ 94	SPARE_RS-232 GND
○ 30	SPARE(COOLANT LEVEL SENSOR)	○ A22	SPARE
○ 43	GROUND_SENSOR	○ A32	SPARE
○ 64	ALT LEVEL	○ 10	SPARE
○ 36	AIR CLEANER PRESSURE SW		
○ 118	COOLING FAN EPPR-		
○ 117	COOLING FAN EPPR+		
○ 8	REVERSE FAN CONTROL		
○ 102	TACHO SENSOR(+)_REMOTE FAN		
○ 101	TACHO SENSOR(-)_REMOTE FAN		

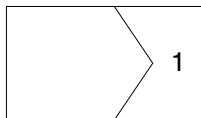
## GROUP 5 TROUBLESHOOTING

### 1. WHEN STARTING SWITCH IS TURNED ON, CLUSTER AND MONITOR LAMP DOES NOT LIGHT UP

- Before carrying out below procedure, check all the related connectors are properly inserted and the fuse No.12, 17 are not blown out and ON/OFF of bulb.
- After checking, connect the disconnected connectors again immediately unless otherwise specified.

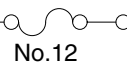
		Cause	Remedy
Check voltage between CN-56 (1), CN-57(1) and chassis	YES	Defective cluster	Replace
		Defective monitor	Replace
	NO	Disconnection in wiring harness or poor contact between CN-56 (1), CN-57 (1) and fuse No. 12, 17	Repair or replace (after clean)

#### MONITOR

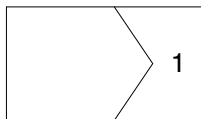


CN-57

FUSE[CN-36]

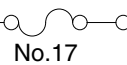


#### CLUSTER



CN-56

FUSE[CN-37]



960A7EL24

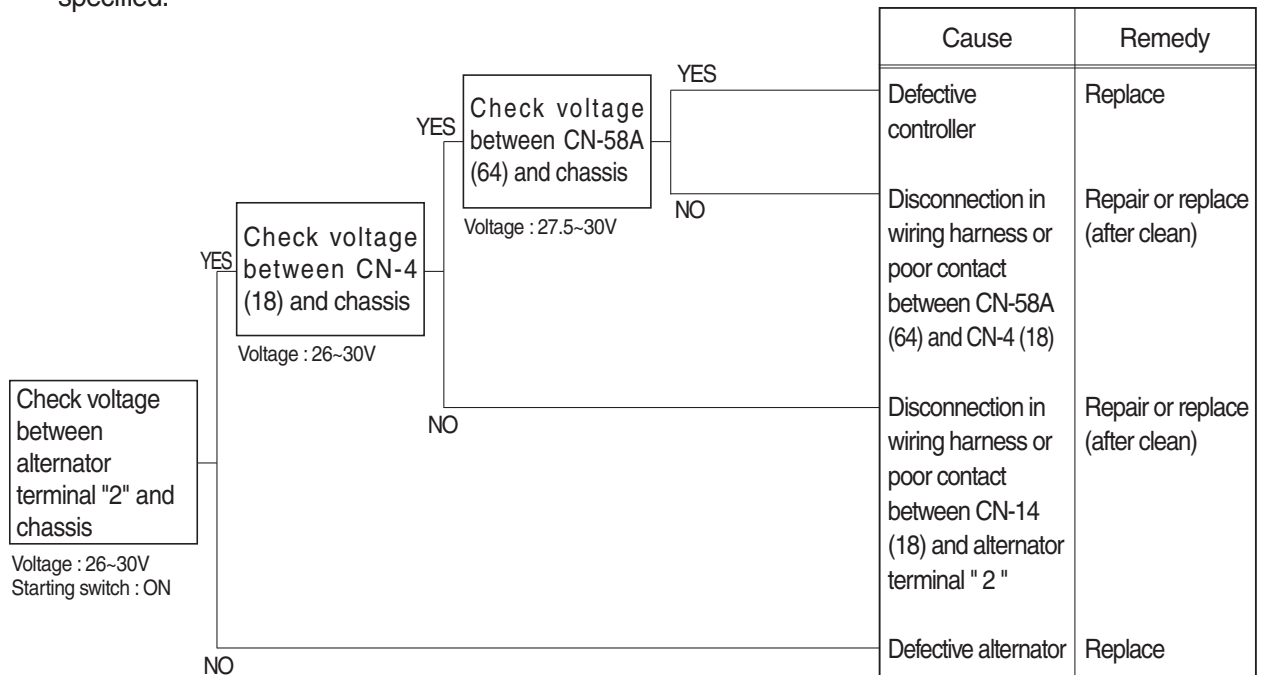
Check voltage

YES	20 ~ 30 V
NO	0 V

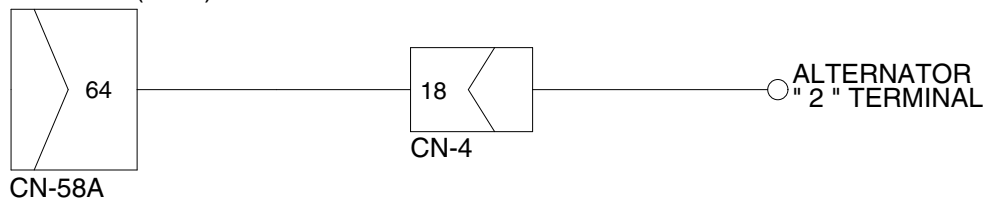


## 2. WHEN BATTERY LAMP LIGHTS UP (engine is started)

- Before carrying out below procedure, check all the related connectors are properly inserted.
- After checking, connect the disconnected connectors again immediately unless otherwise specified.



### CONTROLLER(MCU)



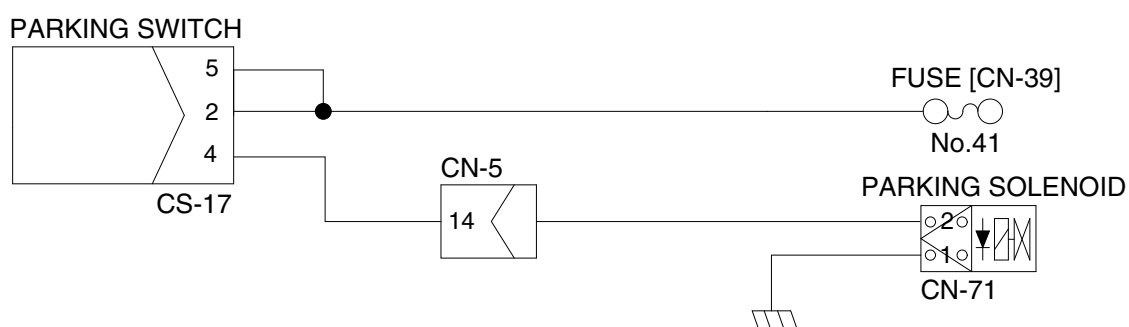
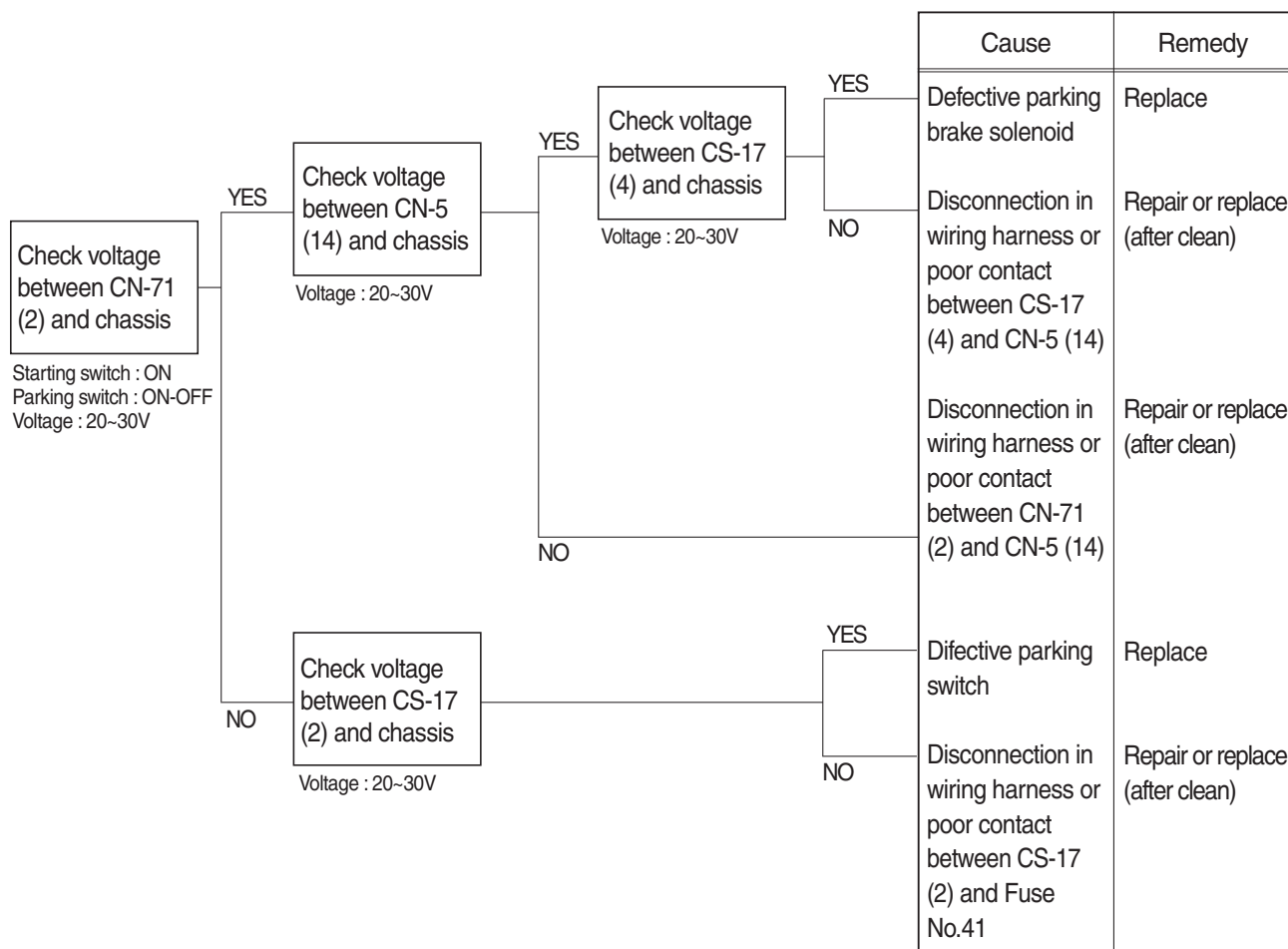
970SA7EL38

### Check valtage

YES	20 ~ 30 V
NO	0 V

### 3. WHEN PARKING SOLENOID DOES NOT WORK

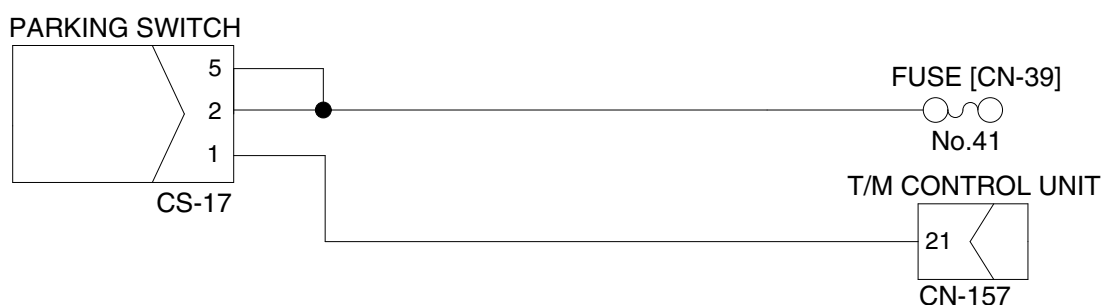
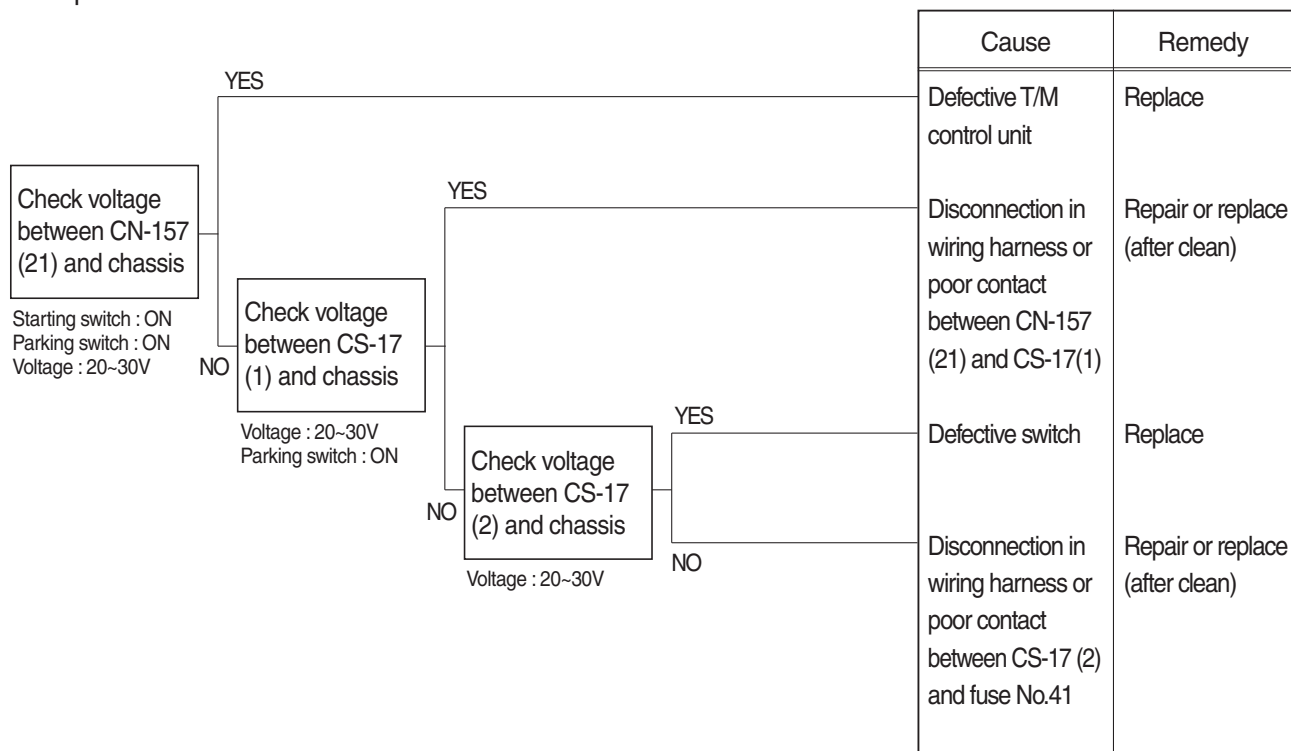
- Before carrying out below procedure, check all the related connectors are properly inserted and the fuse No.41 is not blown out.
- After checking, connect the disconnected connectors again immediately unless otherwise specified.



960A7EL39

#### 4. TRANSMISSION IS NOT RETURNED TO NEUTRAL WHEN PARKING BRAKE IS APPLIED

- Before carrying out below procedure, check all the related connectors are properly inserted and the fuse No.15 (transmission control unit) and No.41 are not blown out.
- After checking, connect the disconnected connectors again immediately unless otherwise specified.



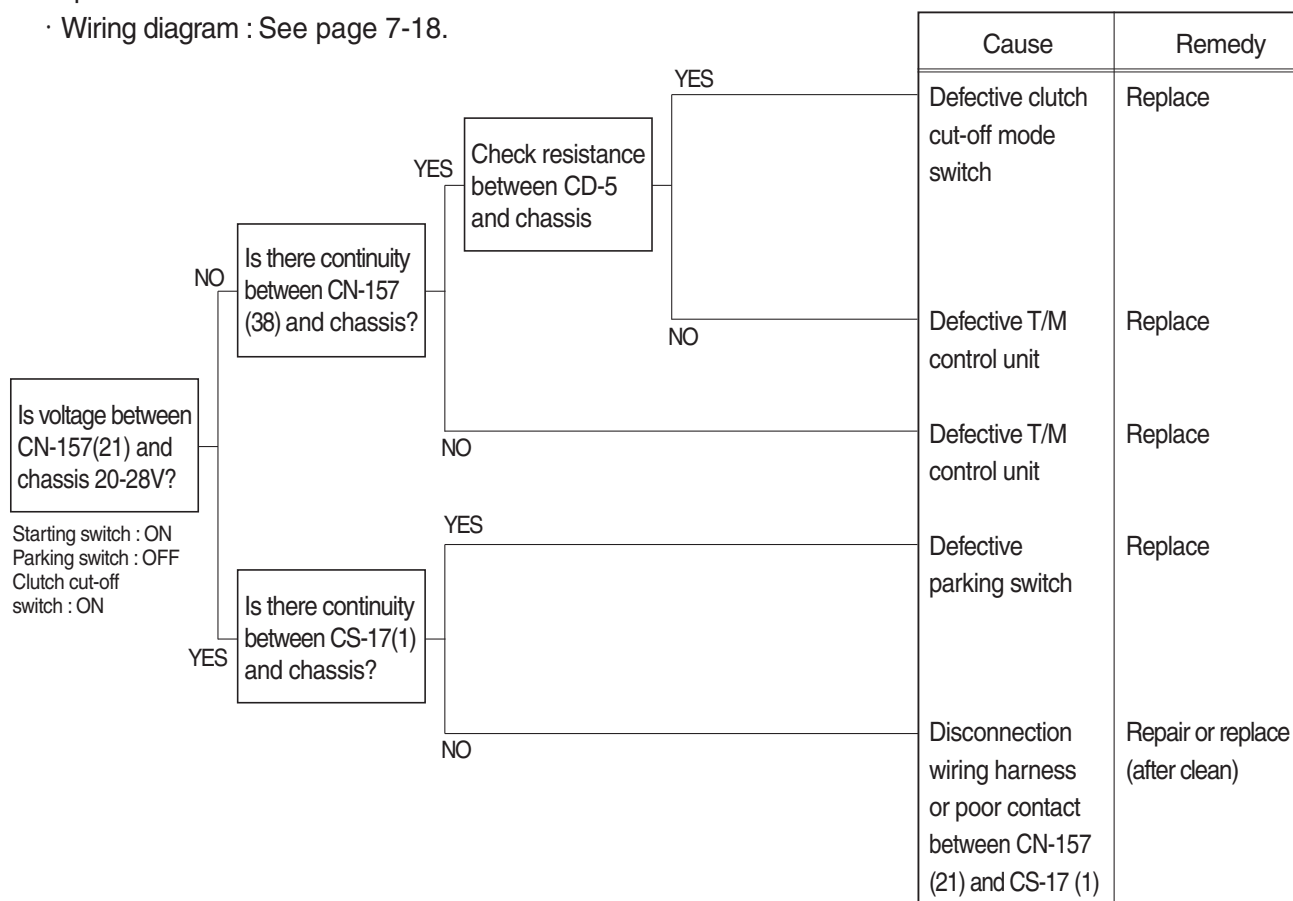
Check resistance

YES	MAX 1Ω
NO	MIN 1MΩ

760F7EL40

## 5. MACHINE DOES NOT TRAVEL

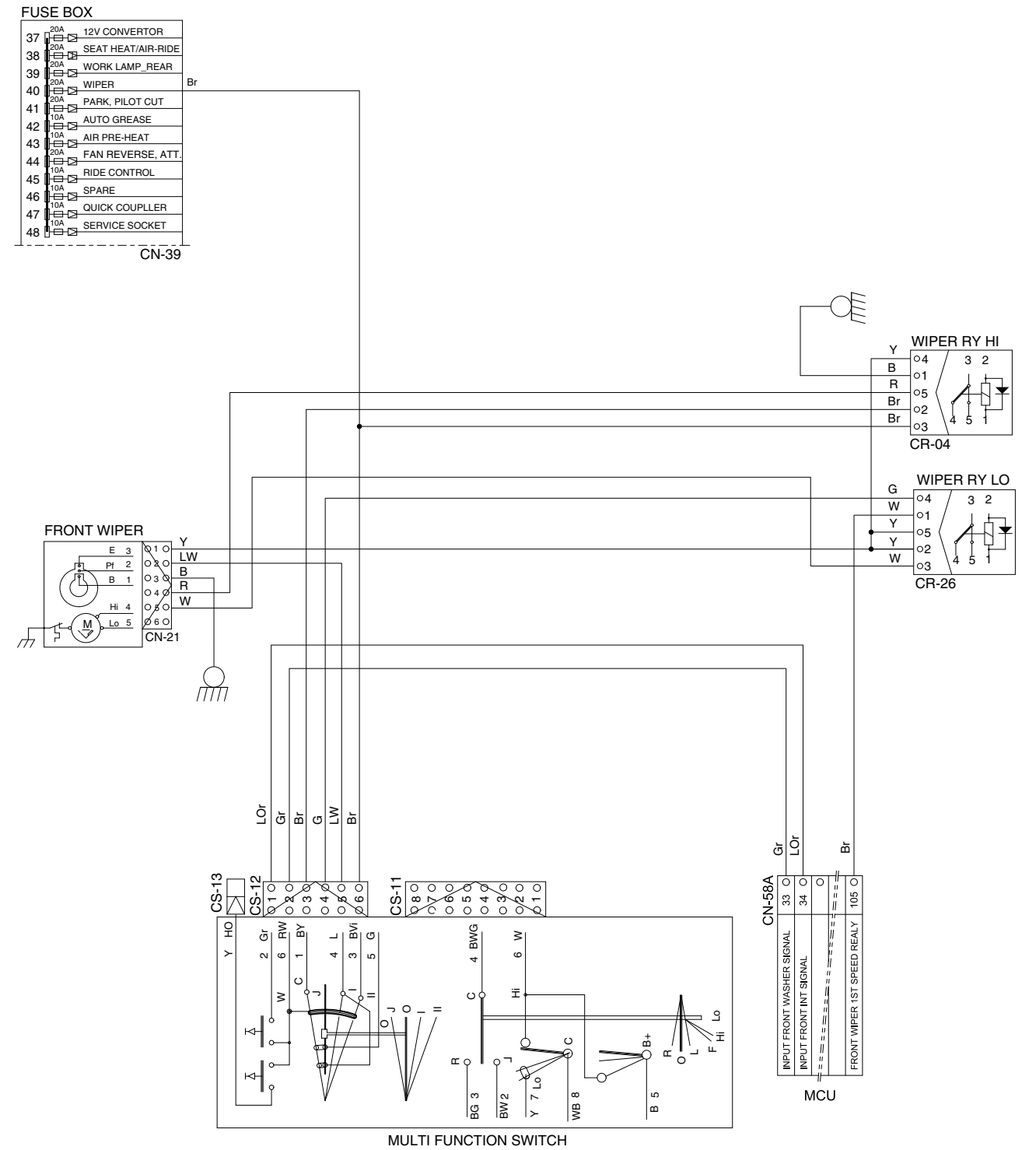
- Before carrying out below procedure, check all the related connectors are properly inserted and the fuse No.15 (transmission control unit) is not blown out.
- After checking, connect the disconnected connectors again immediately unless otherwise specified.
- Wiring diagram : See page 7-18.



### Check resistance

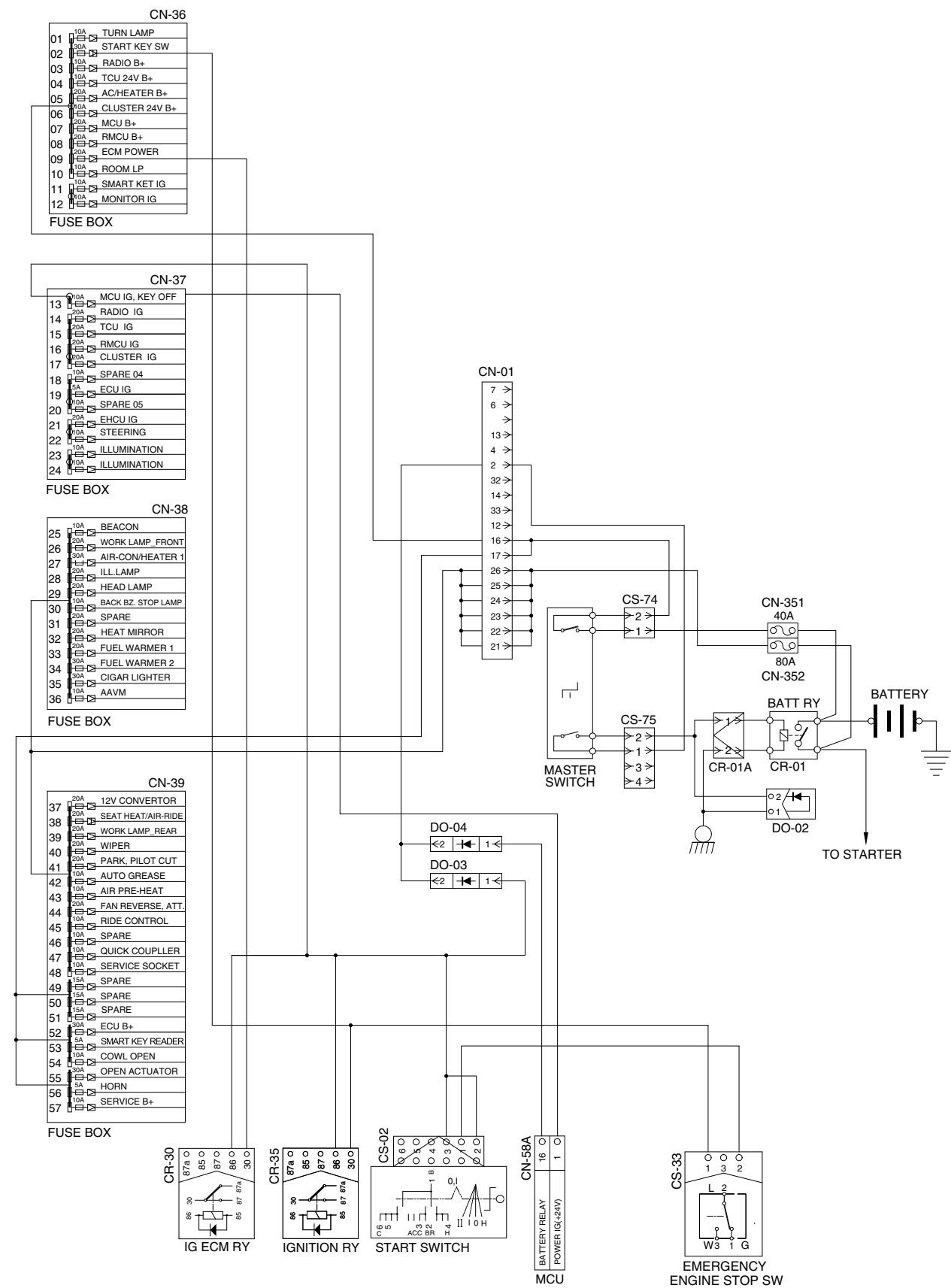
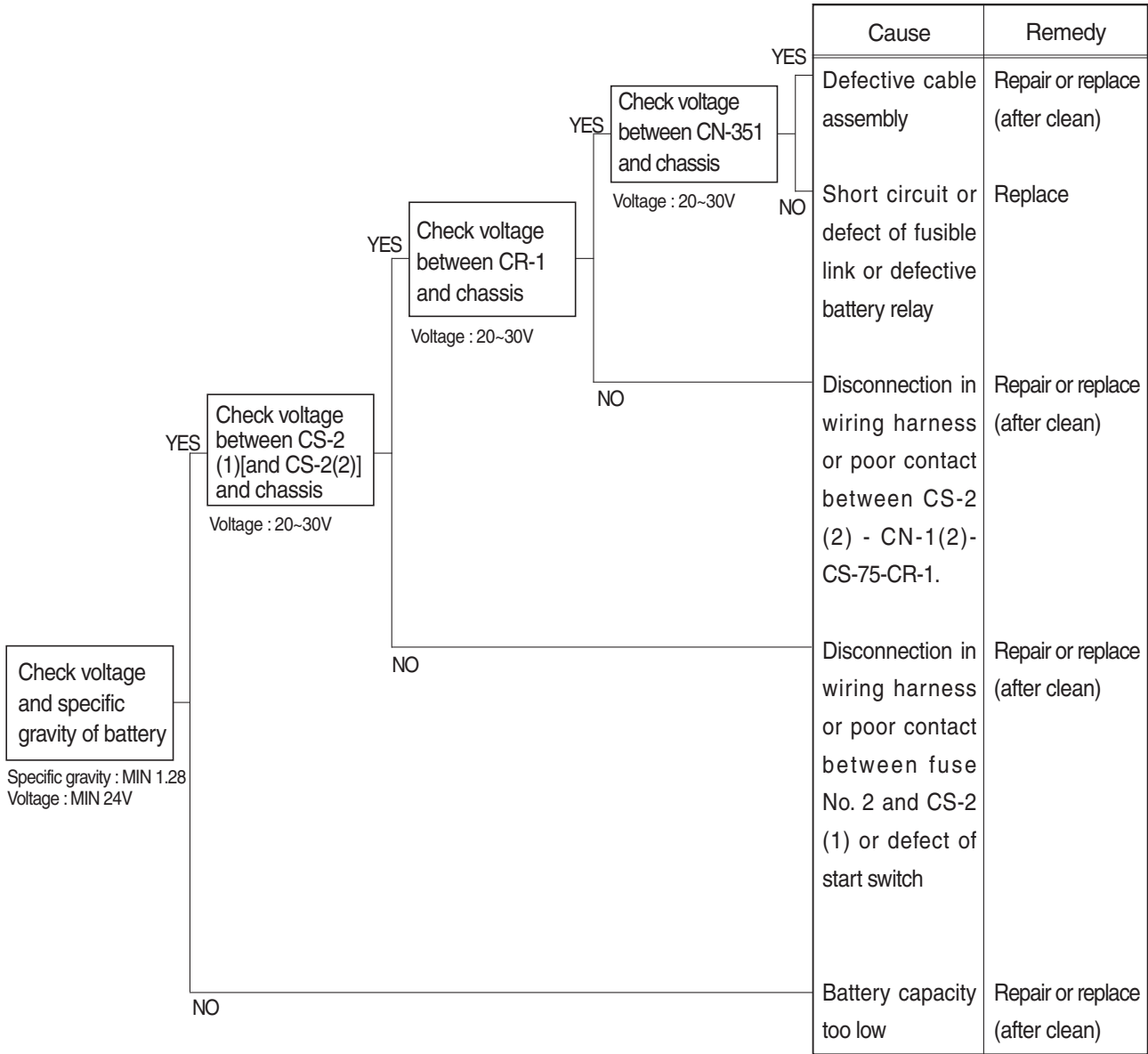
YES	MAX 1 Ω
NO	MIN 1M Ω

- Before carrying out below procedure, check all the related connectors are properly inserted and the fuse No.40 is not blown out.
- After checking, connect the disconnected connectors again immediately unless otherwise specified.



7. WHEN STARTING SWITCH "ON" DOES NOT OPERATE

- Before carrying out below procedure, check all the related connectors are properly inserted the fuse No.2 is not blown out.
- After checking, connect the disconnected connectors again immediately unless otherwise specified.



8. WHEN STARTING SWITCH IS TURNED ON, WORK LAMP DOES NOT LIGHTS UP

- Before carrying out below procedure, check all the related connectors are properly inserted, and the fuse No.26, 39 is not blown out.
- After checking, connect the disconnected connectors again immediately unless otherwise specified.

